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PROJECT TECHNICAL REPORT

PROGRAMMER'S GUIDE FOR THE GNAT COMPUTER PROGRAM

(NUMERICAL ANALYSIS OF STRATIFICATION IN SUPERCRITICAL OXYGEN)

MSC/TRW TASK 705-2

NAS 9 8166

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ABSTRACT

This document is the Programmer's Guide for the GNAT Computer Program developed under MSC/TRW Task 705-2, "Apollo Cyrogenic Storage System (CSS) Analysis," Subtask 2. Detailed logic flowcharts and compiled program listings are provided for all program elements.

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1.0 INTRODUCTION

The General Numerical Analysis of Transport Computer Program (GNAT) was developed to describe the thermal stratification and fluid mixing occurring in the supercritical oxygen storage system of the Apollo Command and Service Module. These phenomena are governed in two dimensions by a system of four non-linear partial differential equations which specify the conservation of mass, momentum, and energy. These equations are formulated in rectilinear Eulerian coordinates and are solved simultaneously using an explicit finite difference technique which is described in Reference 1.

2.0 PROGRAM DESCRIPTION

The two-dimensional volume is divided into a grid of cubic nodes which are individually identified by subscripts (I, J) which run in the x-and y-directions respectively. The indicies I and J must have values between 1 and 20 inclusive. The tank geometric configuration is defined by specifying the beginning (NG) and ending (NS) values of the J-subscript for each value of I such that:

$$NG(I) \leq J \leq NS(I) \; ; \; 1 \leq I \leq 20$$

The same limits apply to the I-subscript at a given value of J so that:

$$NG(J) \leq I \leq NS(J); \quad 1 \leq J \leq 20$$

The program variables were defined in a self-consistent set of engineering units so that no conversion constants were required to formulate the governing equations. All program variables are expressed in units which are combinations of one or more of the following units: lbf, slug, ft, sec, °F. Input data, expressed in the commonly used units shown in Tables 3.2 and 3.3, are converted immediately upon entry into the program. Output data is converted to the commonly used units shown in Table 3.4 for ease in interpretation. All computations performed in the program use the consistent set of units shown in Table 2.1.

The state of the fluid at any given time is specified by the density, thermal energy, and the x- and y- components of momentum at each node point I, J. From these values, the corresponding pressure, temperature, and velocities are computed.

The program is started by specifying the initial state at time t_o. This initial state may be specified by card input in which case zero velocity conditions are assumed, or it may be input from a previously generated data tape which contains the information for a developed fluid state obatined from an earlier computer run.

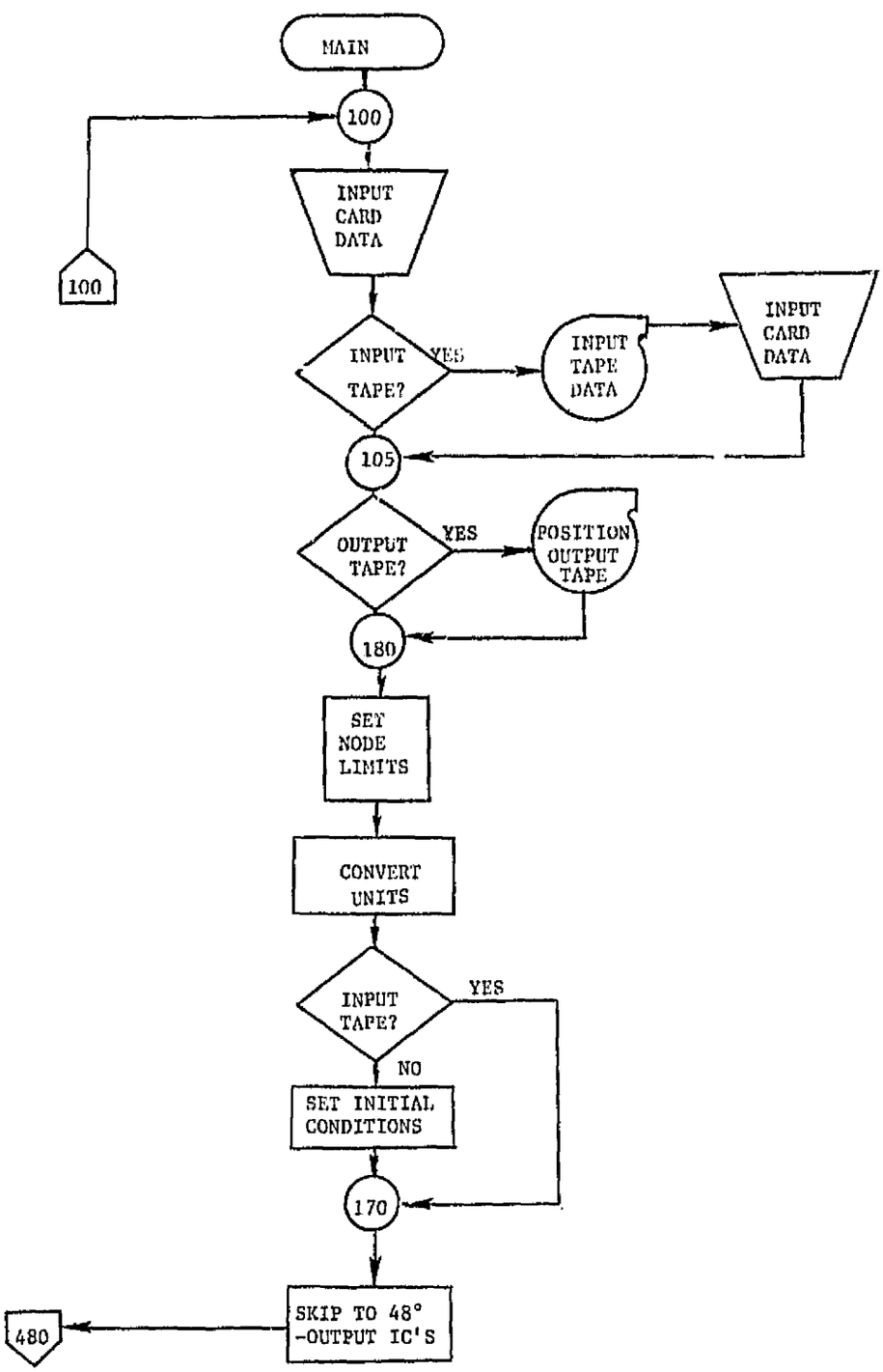
The program time is advanced in a stepwise manner from the initial time by successively integrating the four governing equations at each node (I,J) within the fluid volume. This procedure is illustrated in the logic flow chart of the main program (Figure 2.1).

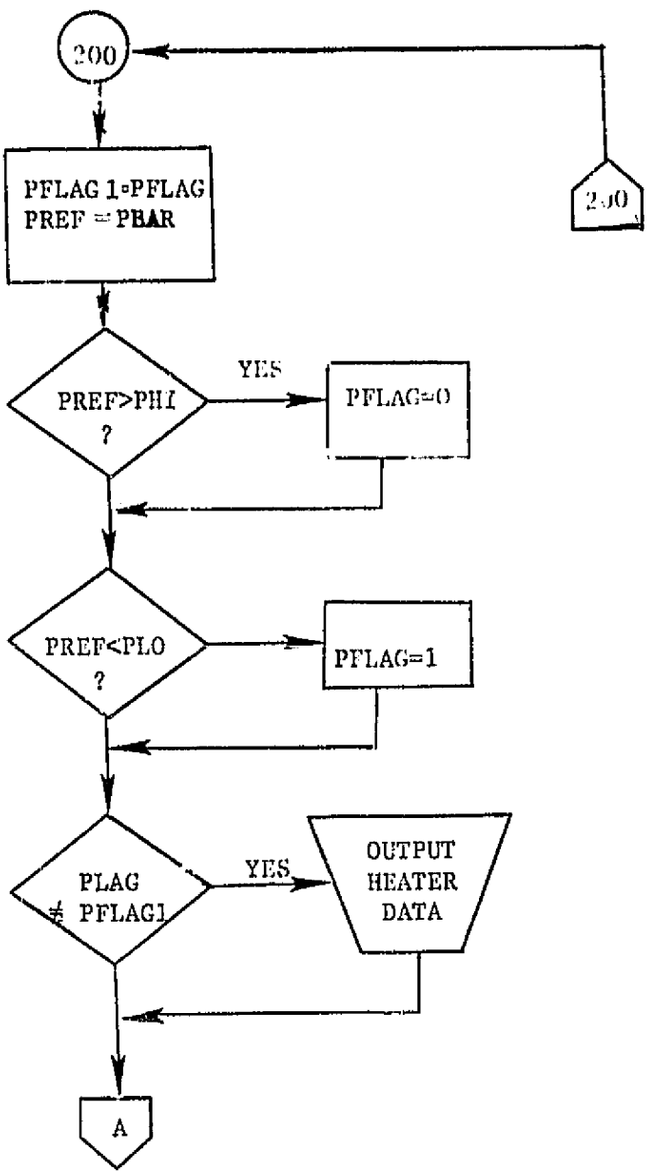
TABLE 2.1

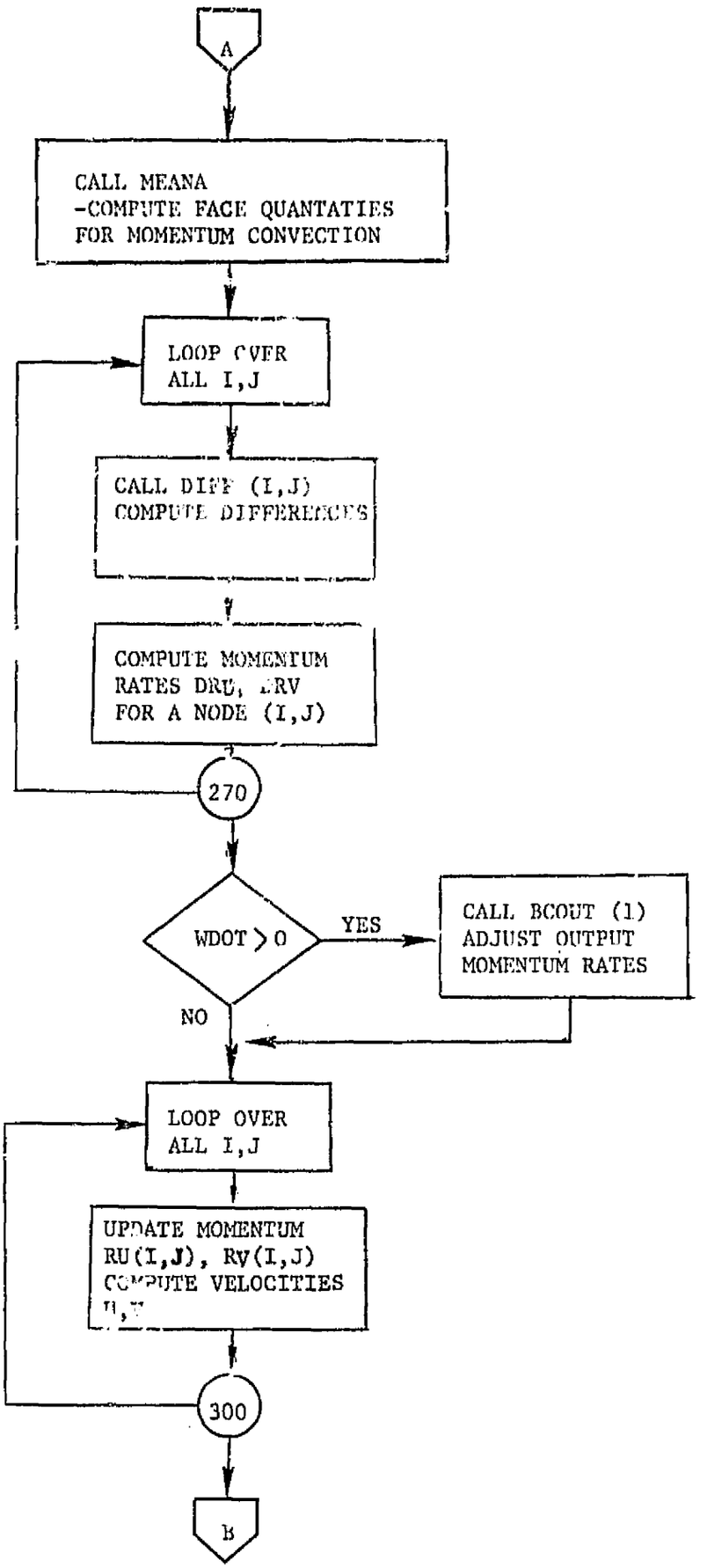
PROGRAM UNITS

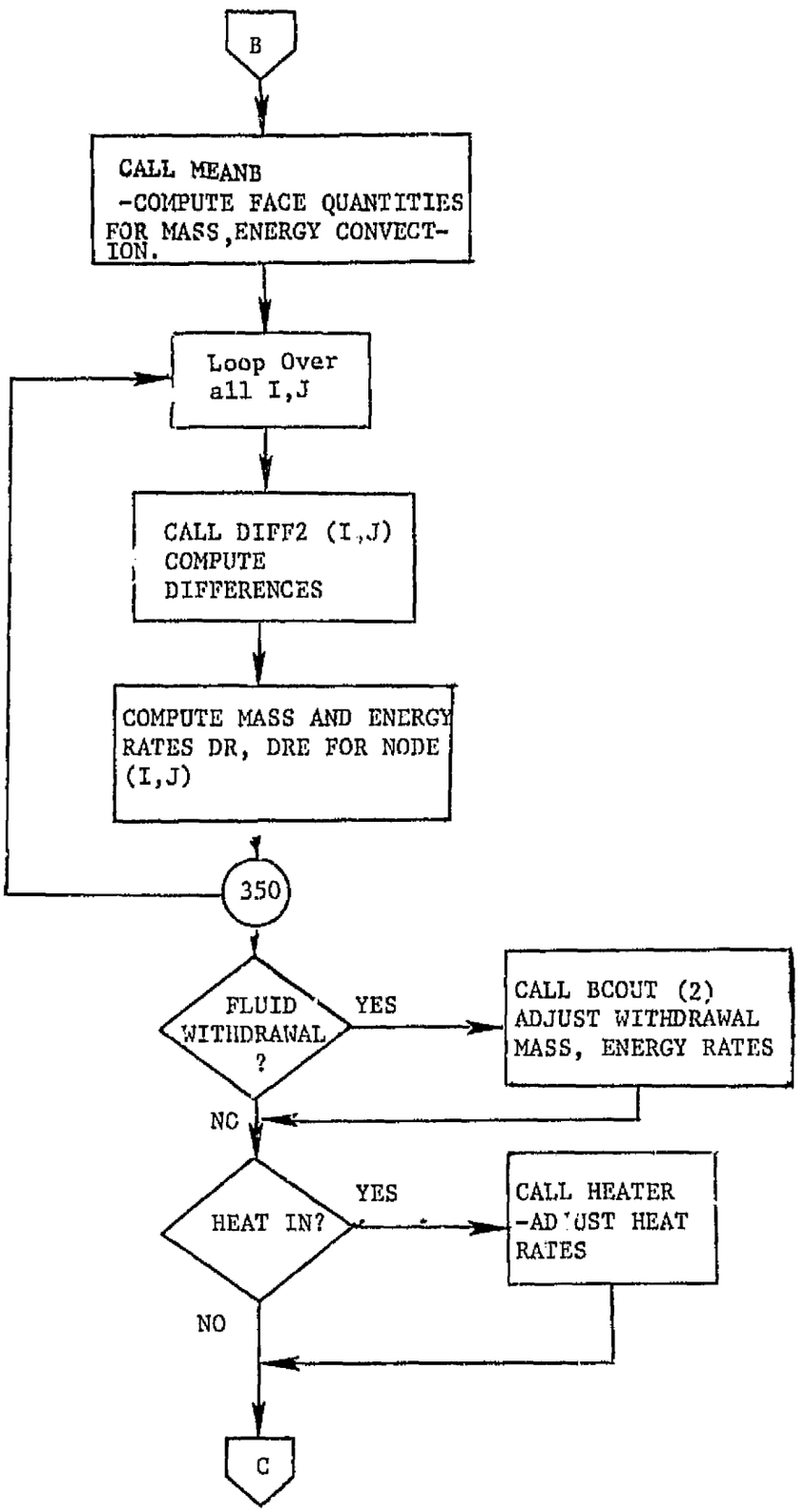
Variable	Description	Units
P	Pressure	(lb_f/ft^2)
H	Temperature, T	(°R)
R	Density, ρ	($slugs/ft^3$)
U, V	Velocity	(ft/sec)
E	Specific Internal Energy	($ft\text{-}lb_f/slug$)
RU, RV	Momentum	($slug\text{-}ft/sec/ft^3$)
RE	Internal Energy	($ft\text{-}lb_f/ft^3$)
T, DT	Time	(sec)
K	Thermal Conductivity, k	($\frac{ft\text{-}lbf}{ft\text{-}sec\text{-}°R}$)
VSC	Absolute Viscosity, μ	($lb_f\text{-}sec/ft^2$)

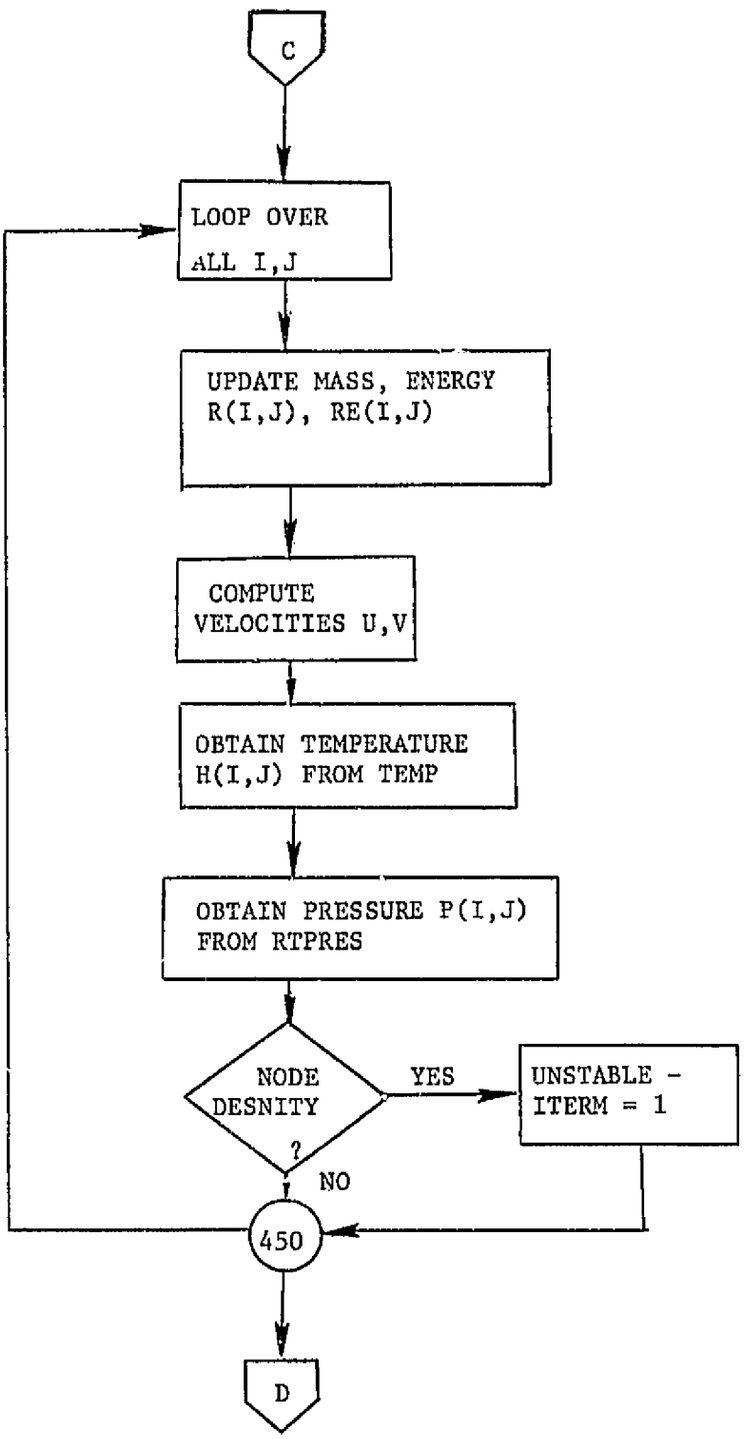
FIGURE 2.1
FLOWCHART OF MAIN PROGRAM

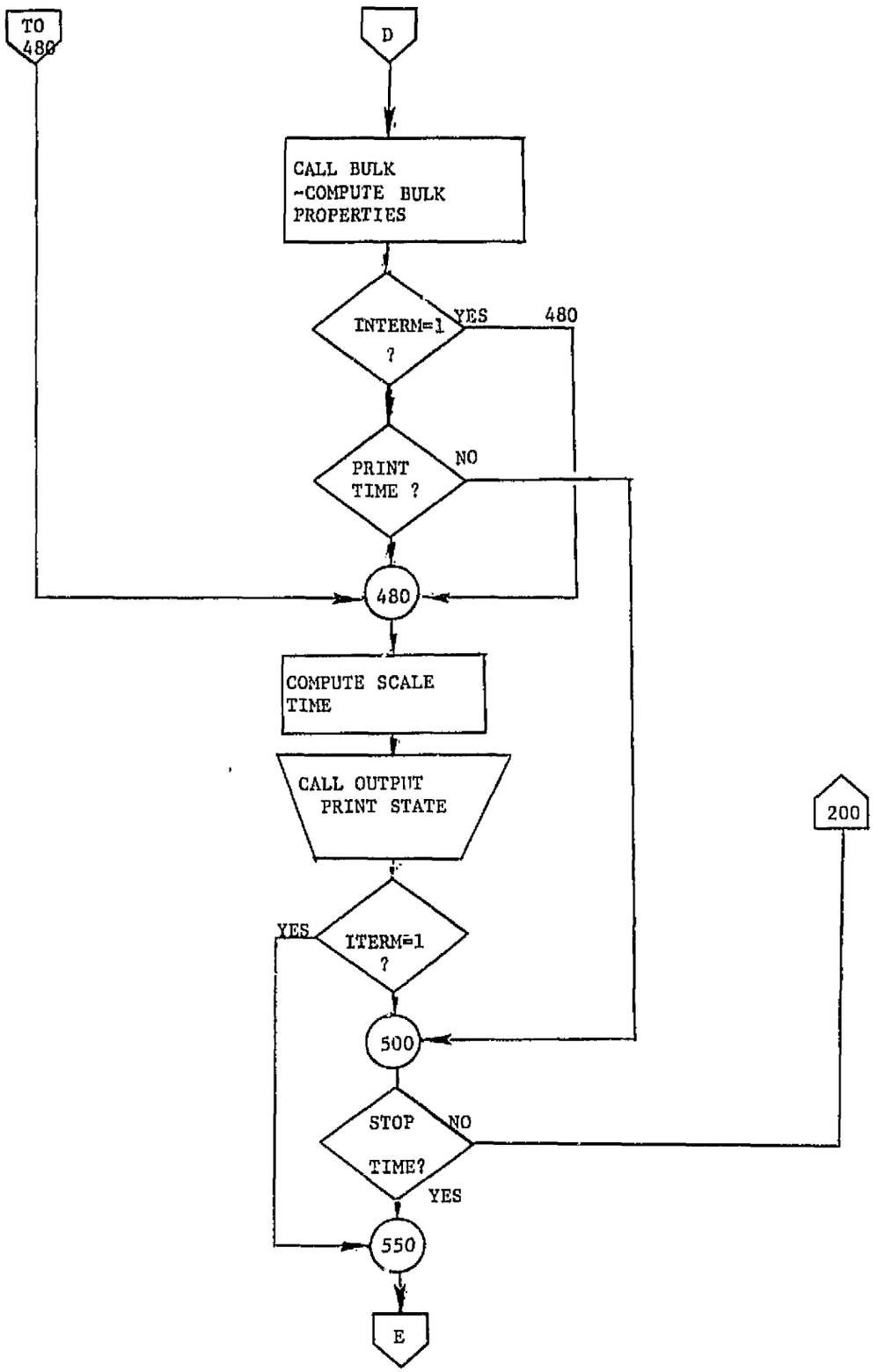


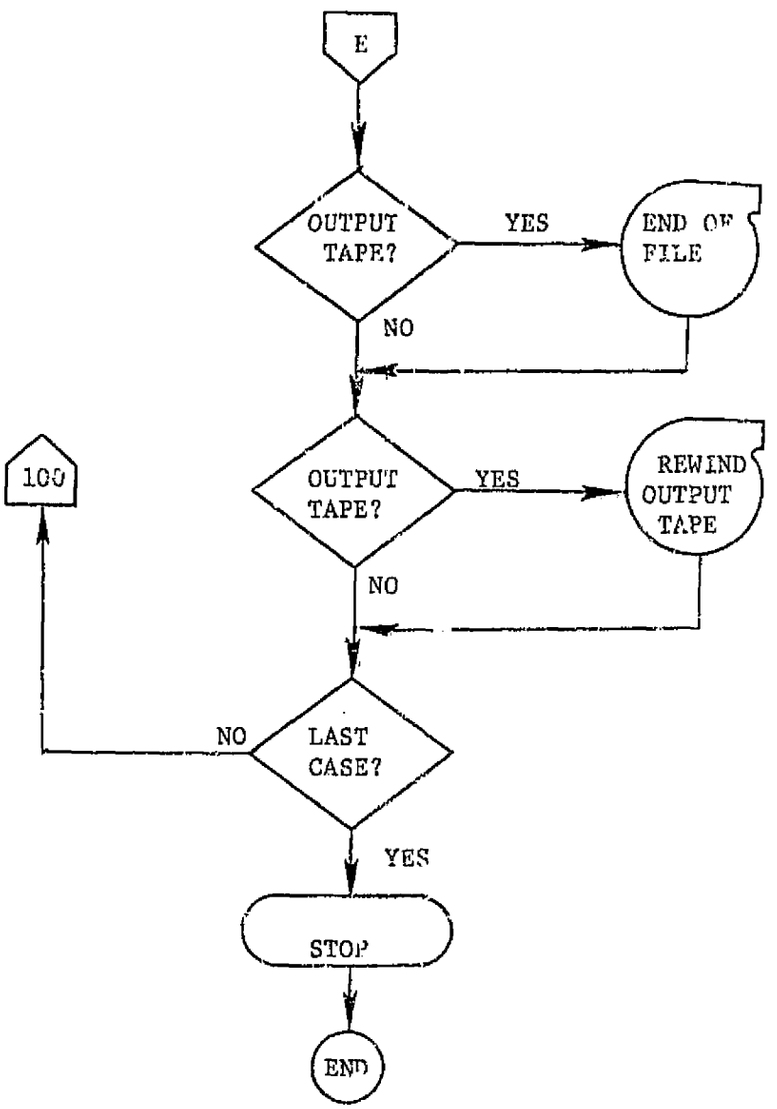

200
PFLAG 1=PFLAG
PREF = PBAR
200
PREF>PHI
?
YES
PFLAG=0
PREF<PLO
?
PFLAG=1
PLAG
≠ PFLAG1
YES
OUTPUT
HEATER
DATA
A


A
CALL MEANA
-COMPUTE FACE QUANTATIES
FOR MOMENTUM CONVECTION
LOOP OVER
ALL I,J
CALL DIFF (I,J)
COMPUTE DIFFERENCES
COMPUTE MOMENTUM
RATES DRU, DRV
FOR A NODE (I,J)
270
WDOT > 0
YES
CALL BCOUT (1)
ADJUST OUTPUT
MOMENTUM RATES
NO
LOOP OVER
ALL I,J
UPDATE MOMENTUM
RU(I,J), RV(I,J)
COMPUTE VELOCITIES
U,V
300
B


B
CALL MEANB
-COMPUTE FACE QUANTITIES FOR MASS, ENERGY CONVECTION.
Loop Over all I,J
CALL DIFF2 (I,J) COMPUTE DIFFERENCES
COMPUTE MASS AND ENERGY RATES DR, DRE FOR NODE (I,J)
350
FLUID WITHDRAWAL ?
YES
CALL BCOUT (2) ADJUST WITHDRAWAL MASS, ENERGY RATES
NO
HEAT IN?
YES
CALL HEATER -ADJUST HEAT RATES
NO
C


C
LOOP OVER
ALL I,J
UPDATE MASS, ENERGY
R(I,J), RE(I,J)
COMPUTE
VELOCITIES U,V
OBTAIN TEMPERATURE
H(I,J) FROM TEMP
OBTAIN PRESSURE P(I,J)
FROM RTPRES
NODE
DESNITY
?
YES
UNSTABLE -
ITERM = 1
NO
450
D


TO 480
D
CALL BULK -COMPUTE BULK PROPERTIES
INTERM=1 ?
YES
480
PRINT TIME ?
NO
480
COMPUTE SCALE TIME
CALL OUTPUT PRINT STATE
200
YES
ITERM=1 ?
500
STOP TIME?
NO
YES
550
E


E
OUTPUT TAPE?
YES
END OF FILE
NO
100
OUTPUT TAPE?
YES
REWIND OUTPUT TAPE
NO
NO
LAST CASE?
YES
STOP
END

3.0 STORAGE ALLOCATION

The program requires the storage of the fluid state variables for each of the possible 400 node points. All node centered variables are dimensioned 20 x 20. The values of density, energy, and x- and y-momentum at the node faces are obtained by interpolation between nodes and are stored in arrays which are dimensioned 21 x 21 and are identified by the suffix x or y. The associated subscripts (I,J) refer to the left or lower face of node I,J.

Most of the program variables are ultimately equivalenced to the master Input/Output (I/O) variable A which is dimensioned 3700 and which is placed in the COMMON block DATA. The single equivalencing variable A was defined to simplify reading and writing of the state data and other necessary control data on magnetic tape to provide a program restart capability.

The program data are combined in logical groupings depending upon their function. For example, the array CTL contains twenty locations which are used for program initiation and control. Table 3.1 shows the relationship of these data blocks to the A-array.

Tables 3.2 through 3.8 show the breakdown of the data blocks to the basic program variables. In addition to the data blocks equivalenced to the A-array, other COMMON blocks are used to transfer data between the program elements. Table 3.9 shows a cross-reference between all data blocks in COMMON storage and the program elements in which the data blocks are used.

TABLE 3.1

STORAGE ALLOCATION: A(3700)

TYPE: Real

PURPOSE: Provide a common I/O variable to which most program variables are equivalenced.

A(1) - A(20)	CTL	(Table 3.2)
A(21 - A(30)	PROP	(Table 3.3)
A(31) - A(40)	LABEL	(Table 3.4)
A(41) - A(90)	LIMITS	(Table 3.5)
A(91) - A(100)	AVE	(Table 3.6)
A(101) - A(2100)	STATE	(Table 3.7)
A(2101) - A(3700)	RATES	(Table 3.8)

TABLE 3.2

STORAGE ALLOCATION: CTL(20)

TYPE: Real

PURPOSE: Input of program control variables

I	CTL(I)	Description (Input Units)
1	TO	Program start time (sec)
2	DT	Integration time step (sec)
3	TSTOP	Program stop time (sec)
4	DTPR	Data output time interval (sec)
5	WDOT	Tank mass flowrate (lbm/hr)
6	DQHEAT	Tank heater input (B/hr)
7	DQBC(1)	Boundary heat flux-left wall (B/ft^2-hr)
8	DQBC(2)	Boundary heat flux-right wall (B/ft^2-hr)
9	DQBC(3)	Boundary heat flux-bottom wall (B/ft^2-hr)
10	DQBC(4)	Boundary heat flux-top wall (B/ft^2-hr)
11	GX	Acceleration, x-component (g's)
12	GY	Acceleration, y-component (g's)
13	SCALE	Scale factor
14	ITAPE(1)	I/O Tape control described in Table 3.2a
15	↓	
16		
17		
18		
19	ITAPE(6)	
20	STOPFG	Program stop flag. Stop if $\geq$ 1.

Equivalenced to A(1)

TABLE 3.2a

STORAGE ALLOCATION: ITAPE(6)

TYPE: Integer

PURPOSE: I/O Tape control variables.

I	ITAPE(I)	Description
1	IUNITR	Tape unit for input state data.
2	IFILER	File of input data on IUNITR
3	IRECR	Record of input data in IFILER
4	IUNITW	Tape unit to output state data.
5	IFILEW	File of output data on IUNITW
6	IRECW	Record of output data in IFILEW

ITAPE is equivalenced to CTL(14)

TABLE 3.3

STORAGE ALLOCATION: PRØP(10)

TYPE: Real

PURPOSE: Input of property data

I	PRØP(I)	Description (Input Units)
1	---	
2	---	
3	k	Thermal conductivity (B/ft-hr-^{o}R)
4	VSC	Absolute viscosity (Poise)
5	---	
6	L	Node dimension (ft)
7	---	
8	PO	Initial pressure (psi)
9	HO	Initial temperature (^{o}R)
10	PFLAG	Heater flag: 1.=on, 0.=off.

Equivalenced to A(21).

TABLE 3.4

STORAGE ALLOCATION: LABEL(10)

TYPE: Real

PURPOSE: Output array.

I	LABEL(I)	Description (Output Units)
1	T	Time (minutes)
2	DT1	Program time step (sec)
3	TSCALE	Scaled problem time (min)
4	PBAR1	Average tank pressure (psi)
5	RBAR1	Average tank density (lbm/ft^3)
6	HMIN	Minimum node temperature (^oR)
7	HBAR1	Average temperature (^oR)
8	HMAX	Maximum node temperature (^oR)
9	PCOL	Collapse pressure (psi)
10	WT	Weight of fluid contained (lbm)

Equivalenced to A(31)

TABLE 3.5

STORAGE ALLOCATION: LIMITS(50)

TYPE: Integer

PURPOSE: I, J Indexing limits for geometry definition

I	LIMITS(I)	Description
1	NG(1)	Node starting index array J1=NG(I) or I1=NG(J)
↓	↓	
20	NG(20)	
21	NS(1)	Node ending index array J2=NS(I) or I2=NS(J)
↓	↓	
40	NS(20)	
41	NO	Minimum NG
42	NF	Maximum NS
43	NODES	Total number of nodes

Equivalenced to A(41)

TABLE 3.6

STORAGE ALLOCATION: AVE(10)

TYPE: Double precision

PURPOSE: Double precision storage of average state variables.

I	AVE(I)	Description
1	PBAR	Average pressure (lbf/ft^2)
2	↓	
3	RBAR	Average density ($slugs/ft^3$)
4	↓	
5	REBAR	Average internal energy ($ft\text{-}lbf/ft^3$)
6	↓	
7	----	
8	----	
9	----	
10	----	

Equivalenced to A(91)

TABLE 3.7

STORAGE ALLOCATION: STATE(2000)

TYPE: Real

PURPOSE: Contains the state variables P, R, U, V.

I	Rates (I)	Description
1	P(1,1)	Relative pressure (lbf/ft^2)
↓	↓	
400	P(20,20)	
401	R(1,1)	Relative density ($slugs/ft^3$)
↓	↓	
800	R(20,20)	
801	U(1,1)	x-component velocity (ft/sec)
↓	↓	
1200	U(20,20)	
1201	V(1,1)	y-component velocity (ft/sec)
↓	↓	
1600	V(20,20)	

Equivalenced to A(101)

TABLE 3.8

STORAGE ALLOCATION: RATES(1600)

TYPE: Real

PURPOSE: Contains the additional state variables RE, RU, RV

I	Rates (I)	Description
1	--	
↓		
400		
401	RE(1,1)	Relative internal energy (ft-lbf/ft^3)
↓		
800	RE(20,20)	
801	RU(1,1)	x-component momentum (ft/sec/ft^3)
↓	↓	
1200	RU(20,20)	
1201	RV(1,1)	y-component momentum (ft/sec/ft^3)
↓	↓	
1600	RV(20,20)	

Equivalenced to A(2101)

TABLE 3.9 STORAGE CROSS-REFERENCE

PROGRAM ELEMENTS

DATA BLOCKS IN COMMON	MAIN	MEAN A	MEAN B	DIFF	DIFF2	HEATER	BCOUT	TEMP	BETA	PRESS	RTPRES	BULK	OUTPUT	DISPLY	CR2TAP	RDTAPE	TAPEIO
DATA/A/																	
CTL	X												X			X	
PROP	X				X		X			X		X					
AVE	X						X			X		X		X			
LABEL	X											X	X				
LIMITS	X	X	X	X	X							X		X			
STATE	X	X	X	X	X		X					X					
RATES	X	X	X		X		X					X	X				
NODWAL		X	X	X	X												
D1	X			X													
D2	X				X												
CSTS	X			X													
TRNSMT	X																
DSTATE	X					X	X										
TEFCTN								X	X								

4.0 SUBPROGRAM DESCRIPTION

All program logic and the evaluation and integration of the governing equations are performed in the main program. However, extensive use is made of subroutine subprograms to perform support and peripheral functions. A summary of these subprograms and a brief description of the function served is given in Table 4.1.

The subprograms are described in more detail in the following subsections. The operation of each subprogram is shown in the accompanying flowcharts, (Figures 4.1 through 4.16).

TABLE 4.1

SUBPROGRAM SUMMARY

Subprogram	Function
1. MEANA	Face-centered interpolation for momentum
2. MEANB	Face-centered interpolation for mass and energy
3. DIFF	Differences for momentum
4. DIFF2	Differences for mass and energy
5. HEATER	Heater input simulation
6. BCØUT	Withdrawal port boundary conditions
7. TEMP	Temperature calculation from internal energy
8. BETA	Internal energy calculation from temperature
9. PRESS	Ideal gas equation of state
10. RTPRES	Stewart's equation of state
11. BULK	Average tank quantities
12. OUTPUT	Data output control
13. DISPLY	Display of one state variable
14. CR2TAP	Input data display
15. RDTAPE	Data tape input
16. TAPEIØ	Tape input/output package
17. OPTD	Interpolation of Weber's oxygen density data

4.1 Subroutine MEANA

CALLING SEQUENCE: CALL MEANA

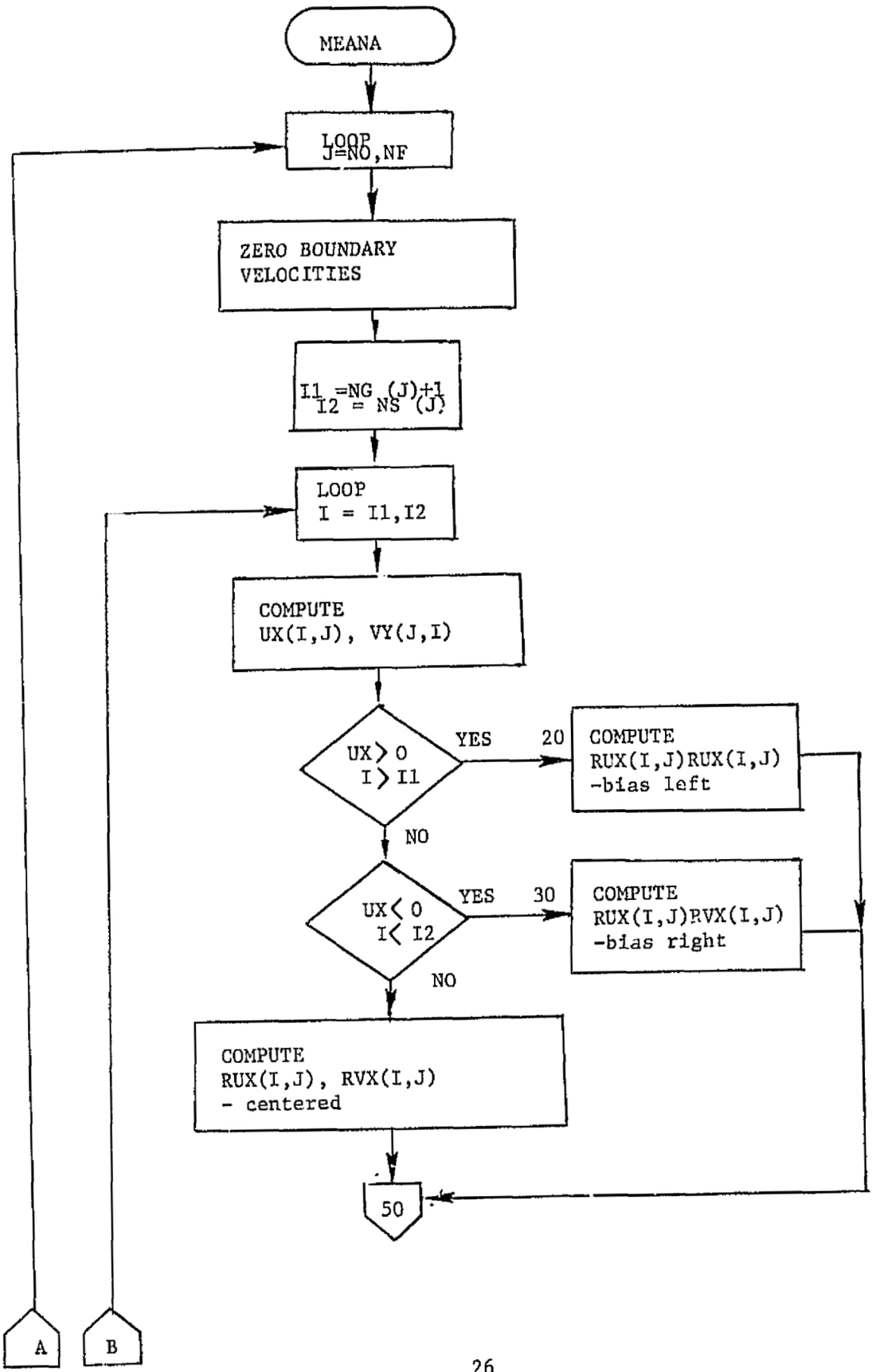
INPUT DATA: RU, RV, U, V, NO, NF, NG, NS

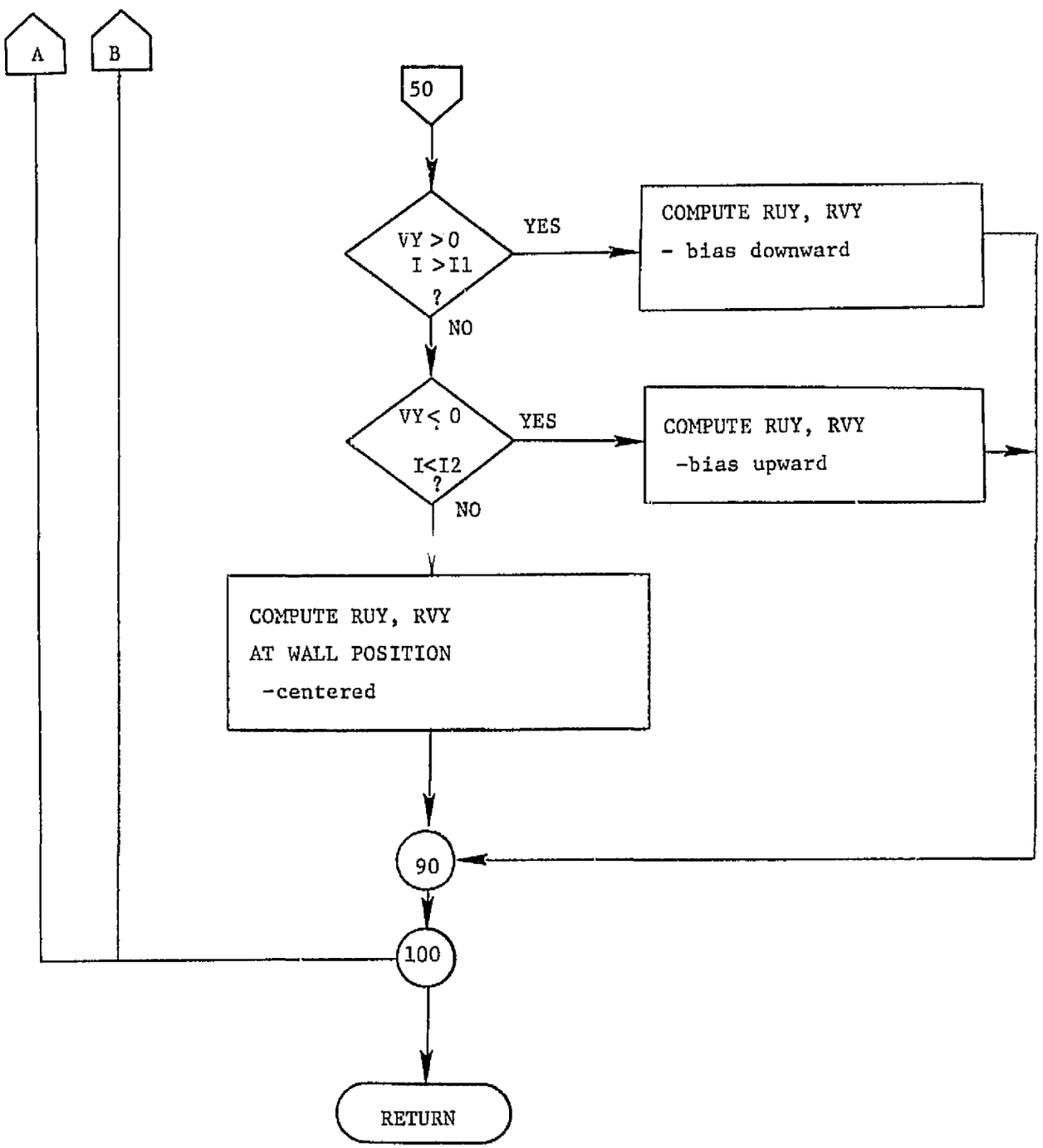
OUTPUT DATA: RUX, RUY, RVX, RVY, UX, VY

USAGE: This subroutine is called from MAIN once each program time step.

FUNCTION: Linear interpolation between node centers is used to define x- and y- components of velocity at node faces. Quadratic interpolation between three node centers is used to obtain the values of x- and y- momentum at each of the node faces. The signs of UX and VY are used to bias the interpolation in the upstream direction. A linear interpolation is used at wall nodes where a third upstream point is not available.

FIGURE 4.1 FLOWCHART OF MEANA




A
B
50
VY > 0
I > I1
?
YES
COMPUTE RUY, RVY
- bias downward
NO
VY < 0
I<I2
?
YES
COMPUTE RUY, RVY
-bias upward
NO
COMPUTE RUY, RVY
AT WALL POSITION
-centered
90
100
RETURN

4.2 Subroutine MEANB

CALLING SEQUENCE: CALL MEANB

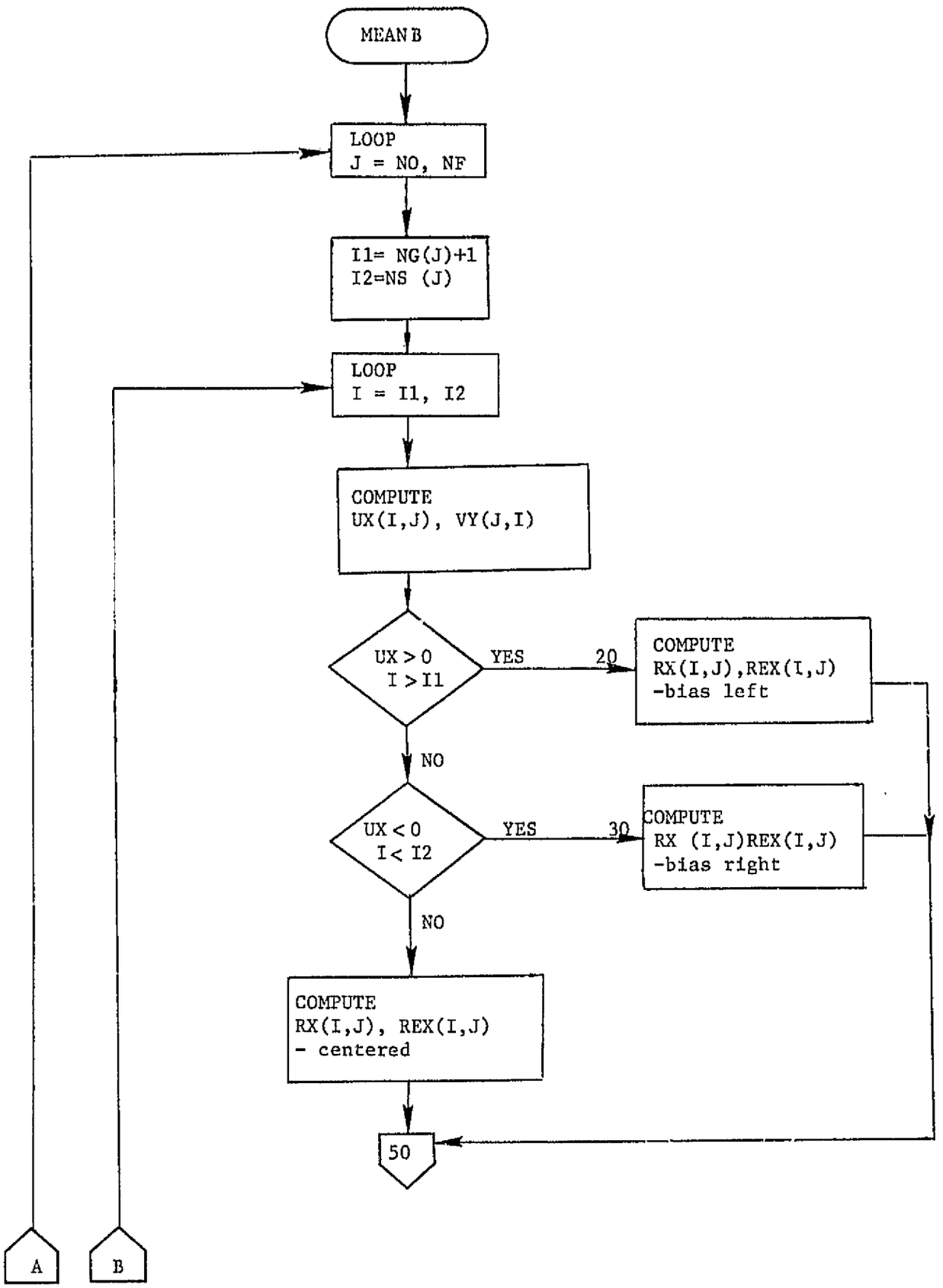
INPUT DATA: R, RE, U, V

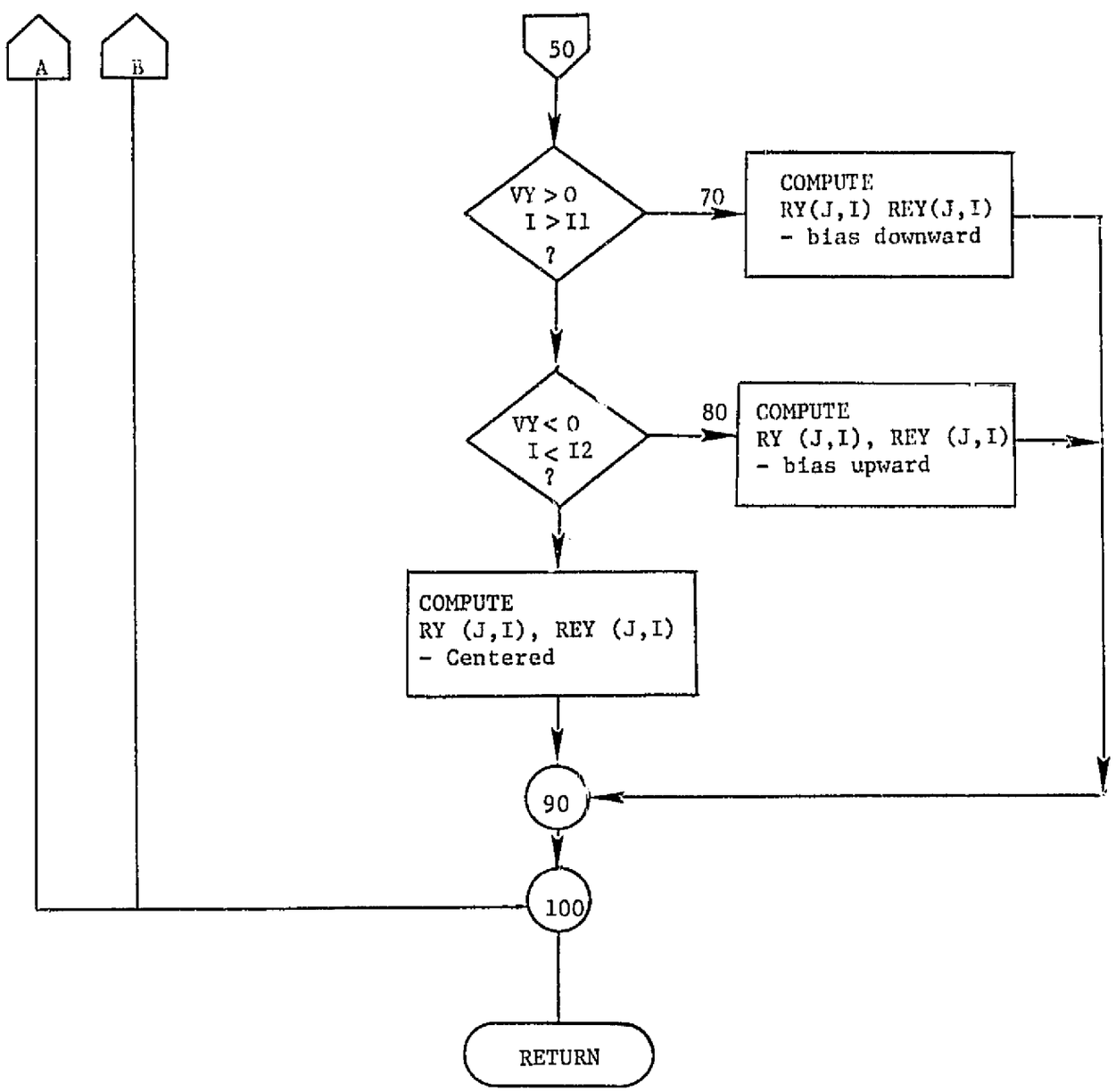
OUTPUT DATA: RX, RY, REX, REY, UX, VY

USAGE: This subroutine is called from MAIN once each program time step.

FUNCTION: Linear interpolation between node centers is used to define x- and y- components of velocity at the node faces. Quadratic interpolation between three node centers is used to obtain the values of density and internal energy at each of the node faces. The signs of UX and VY are used to bias the interpolation in the upstream direction. A linear interpolation is used at wall nodes where a third upstream point is not available.

FIGURE 4.2 FLOWCHART OF MEANB

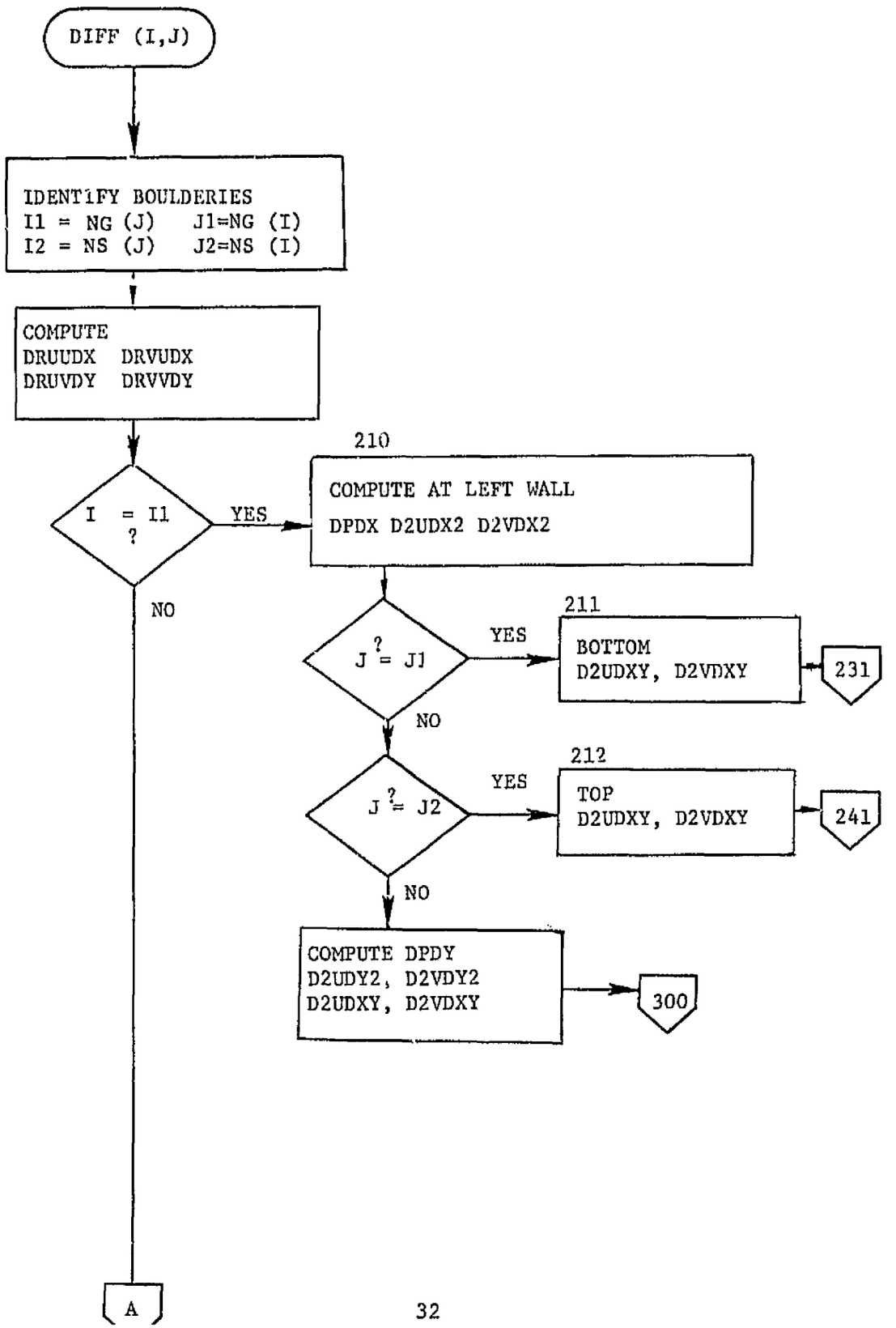


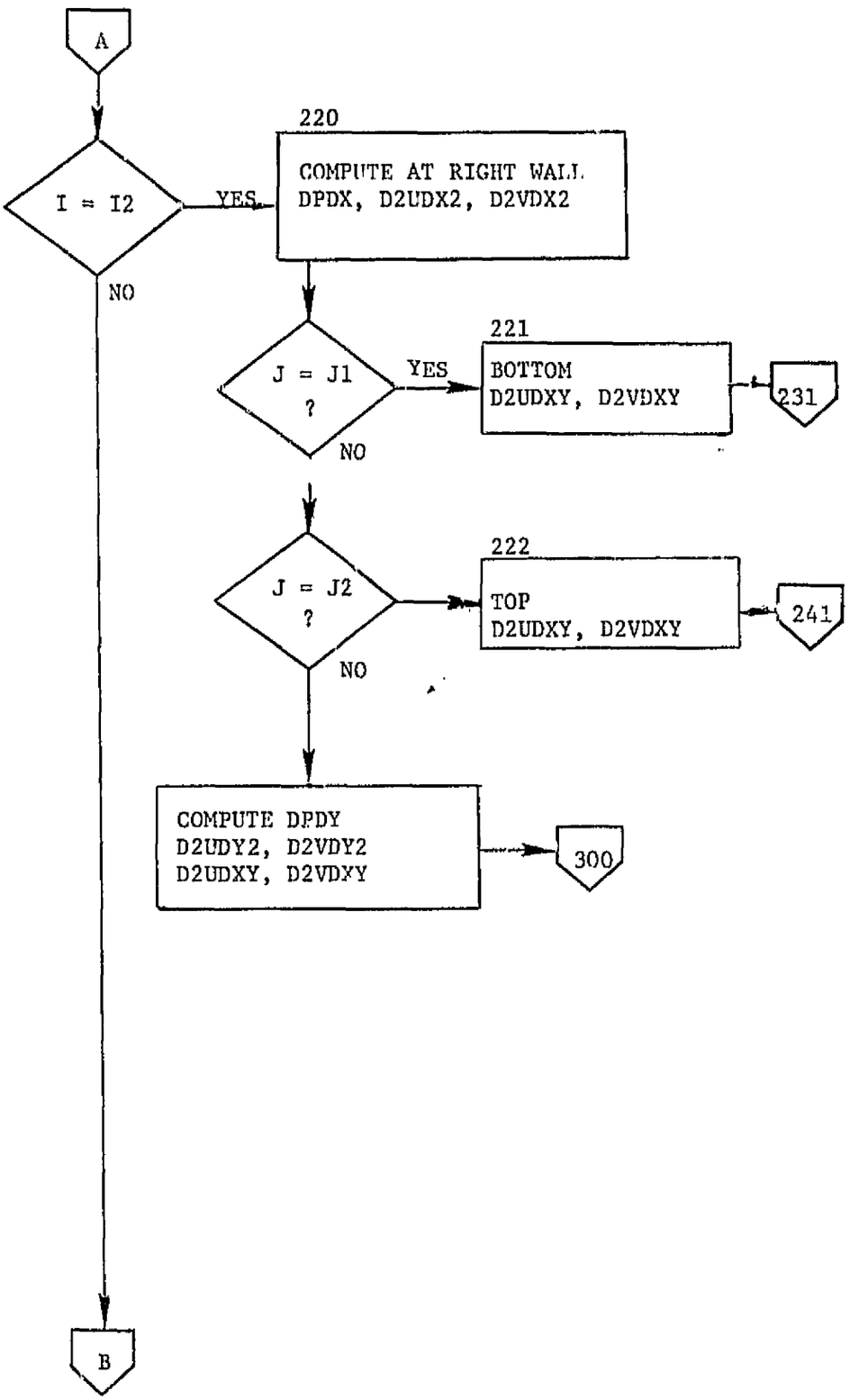

A
B
50
VY > 0
I > I1
?
70
COMPUTE
RY(J,I) REY(J,I)
- bias downward
VY < 0
I < I2
?
80
COMPUTE
RY (J,I), REY (J,I)
- bias upward
COMPUTE
RY (J,I), REY (J,I)
- Centered
90
100
RETURN

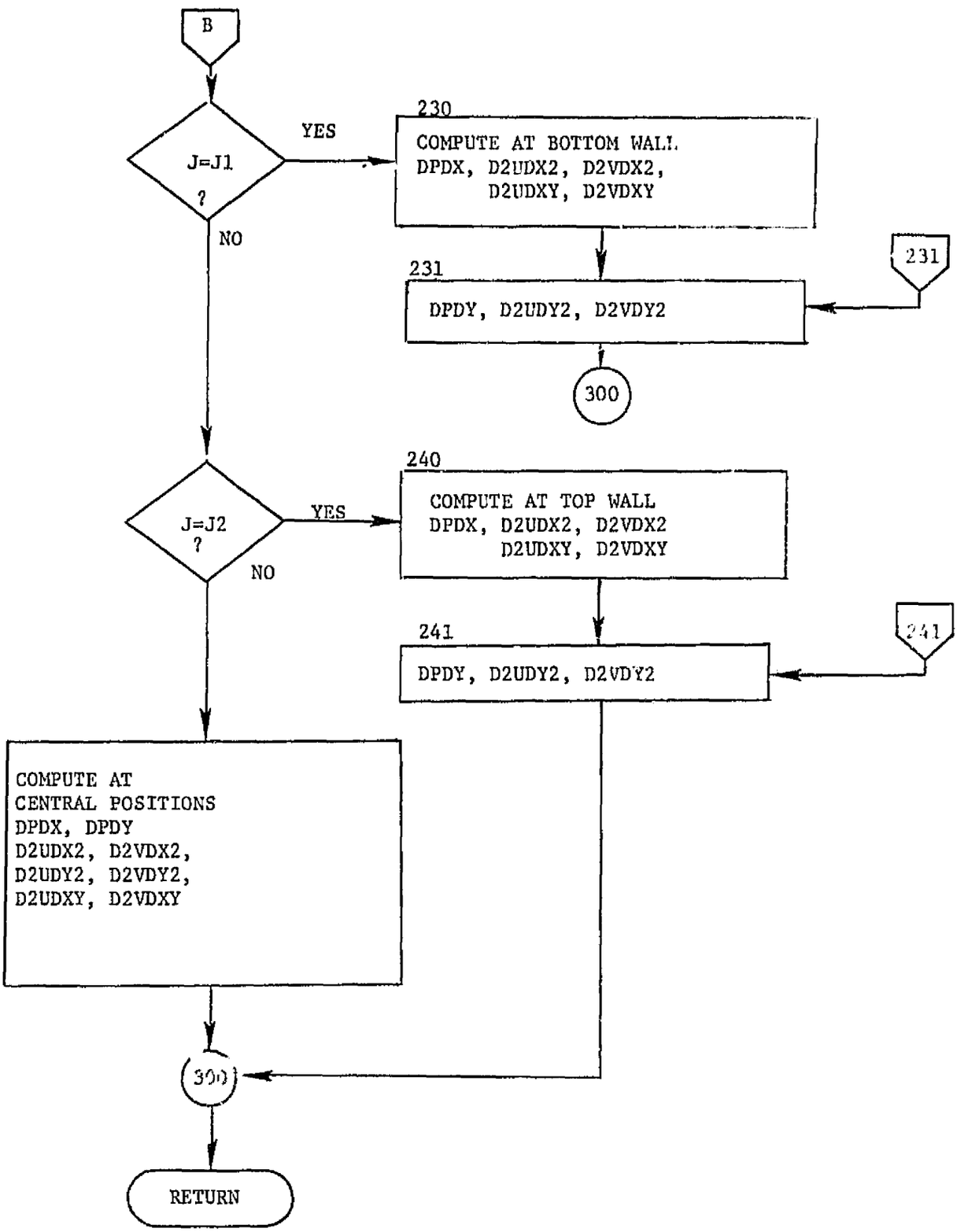
4.3 Subroutine DIFF

CALLING SEQUENCE:	CALL DIFF(I,J)
INPUT DATA:	P, U, V, RUX, RUY, RVX, RVY, UX, VY, L, I, J
OUTPUT DATA:	DRUUDX, DRVUDX, DRVDY, DRVUDY, DPDX, DPDY, D2UDX2, D2VDY2, D2UDXY, D2VDXY
USAGE:	This subroutine is called from MAIN for each node (I,J) at each program time step.
FUNCTION:	Difference terms used in the momentum equations are computed in this subroutine.

FIGURE 4.3 FLOWCHART OF DIFF




A
I = I2
YES
220
COMPUTE AT RIGHT WALL
DPDX, D2UDX2, D2VDX2
NO
J = J1
?
YES
221
BOTTOM
D2UDXY, D2VDXY
231
NO
J = J2
?
222
TOP
D2UDXY, D2VDXY
241
NO
COMPUTE DPDY
D2UDY2, D2VDY2
D2UDXY, D2VDXY
300
B


B
J=J1
?
YES
NO
230
COMPUTE AT BOTTOM WALL
DPDX, D2UDX2, D2VDX2,
D2UDXY, D2VDXY
231
231
DPDY, D2UDY2, D2VDY2
300
J=J2
?
YES
NO
240
COMPUTE AT TOP WALL
DPDX, D2UDX2, D2VDX2
D2UDXY, D2VDXY
241
241
DPDY, D2UDY2, D2VDY2
COMPUTE AT
CENTRAL POSITIONS
DPDX, DPDY
D2UDX2, D2VDX2,
D2UDY2, D2VDY2,
D2UDXY, D2VDXY
300
RETURN

4.4 Subroutine DIFF2

CALLING SEQUENCE: CALL DIFF2(I,J)

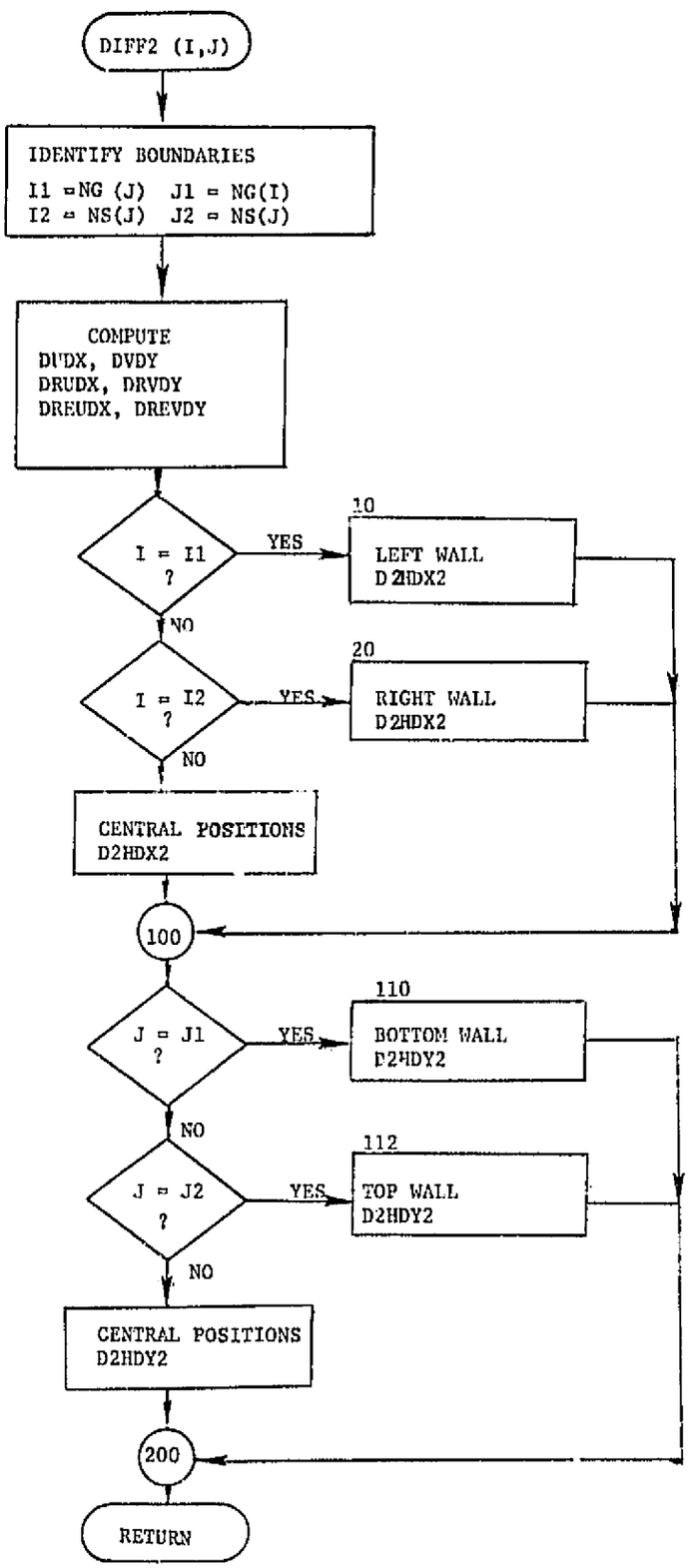
INPUT DATA: RX, RY, REX, REY, UX, VY, H, K, DQ1, DQ2, DQ3, DQ4, L, I, J

OUTPUT DATA: DUDX, DVDY, DRUDX, DRVDY, DREUDX, DREVDY, D2HDX2, D2HDY2

USAGE: This subroutine is called from MAIN for each node (I,J) at each program time step.

FUNCTION: Difference terms used in the continuity and energy equations are computed in this subroutine. Heat leak boundary conditions are imposed at exterior node faces as prescribed temperature gradients.

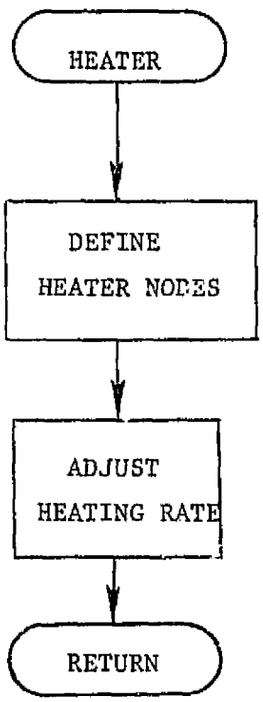
FIGURE 4.4 FLOWCHART OF DIFF2



4.5 Subroutine HEATER

CALLING SEQUENCE:	CALL HEATER (DQHEAT, L3)
INPUT DATA:	DQHEAT, L3, DRE
	Heater node location is hard-coded.
OUTPUT DATA:	DRE
USAGE:	This subroutine is called from MAIN once each program time step whenever DQHEAT > 0.
FUNCTION:	The heating rate of the specified nodes is increased to represent heater input.

FIGURE 4.5 FLOWCHART OF HEATER



4.6 Subroutine BCØUT

CALLING SEQUENCE: CALL BCØUT (N, WDØT)

INPUT DATA: N, WDØT, R, RBAR, DRU, DRV, DRE, RE, REBAR, L

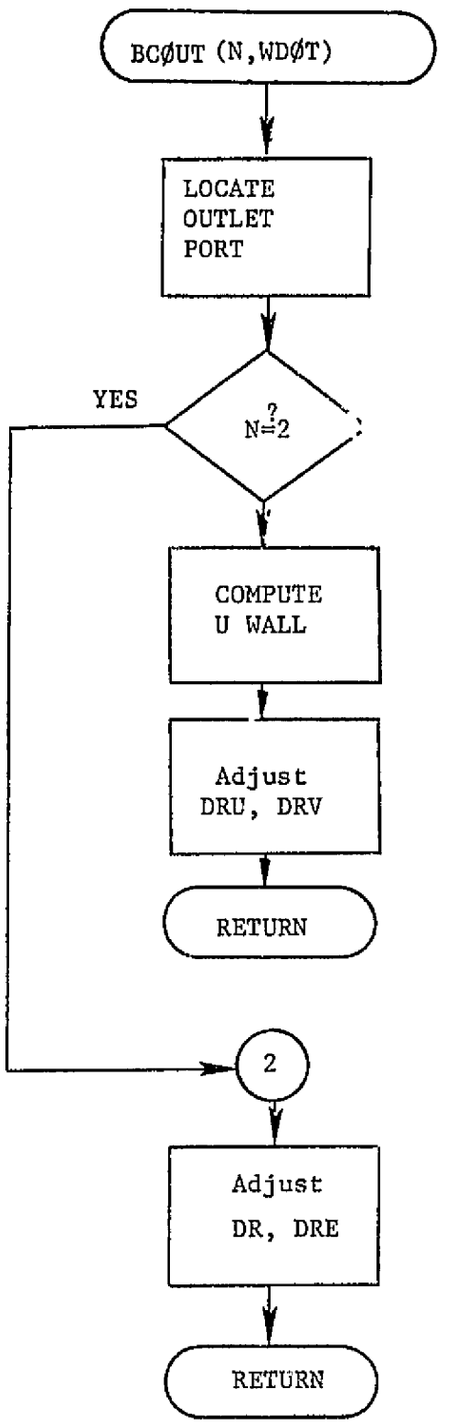
OUTPUT DATA: DRU, DRV, DR, DRE

USAGE: This subroutine is called twice from MAIN during each program time step: The first time with N=1; the second time with N=2.

FUNCTION: The outlet port location is hard-coded. During the first call, the fluid velocity at the node wall, UWALL, is computed such that the prescribed flowrate, WDØT will take place. This velocity is used to establish the convection rate of x- and y-momentum from the node.

During the second call, UWALL is used to establish the convection rate of mass and internal energy from the node.

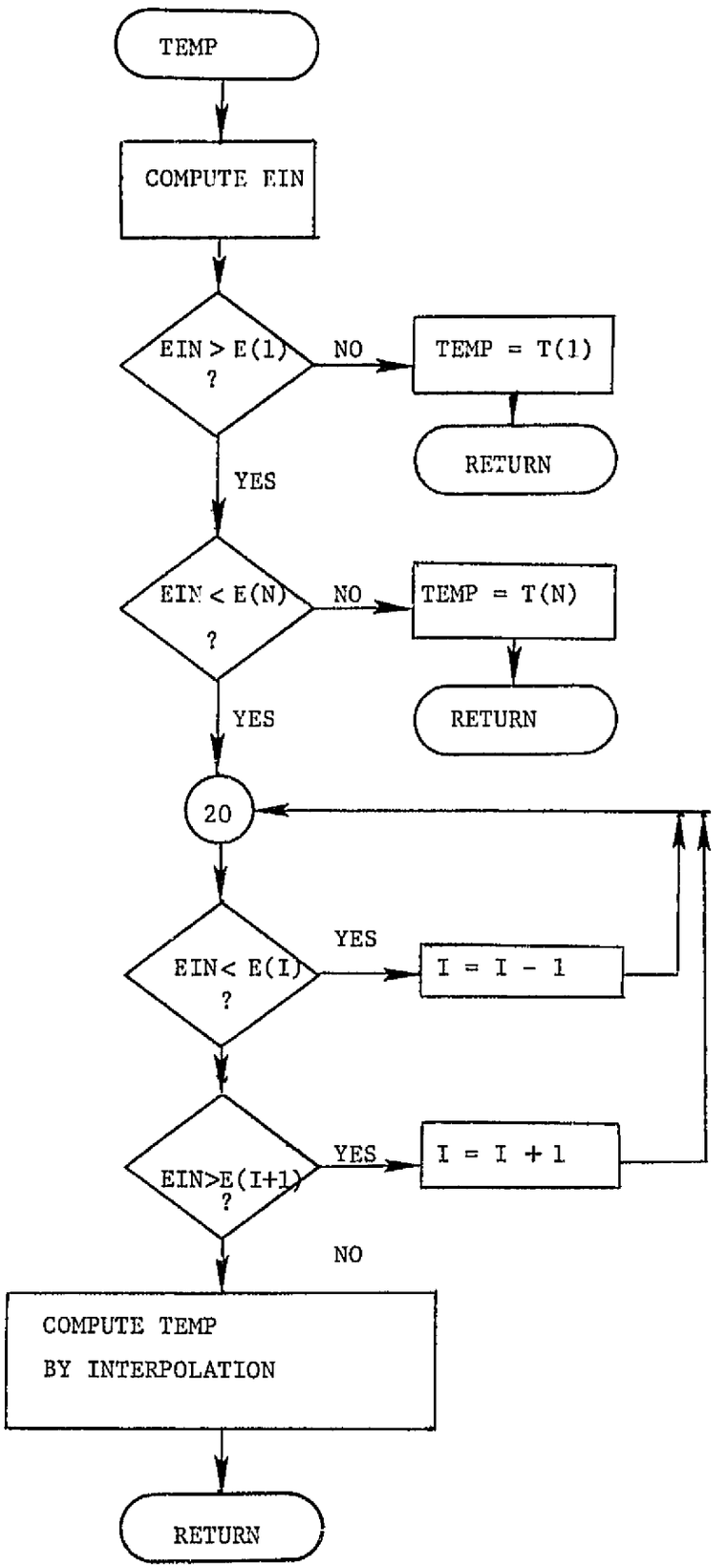
FIGURE 4.6 FLOWCHART OF BCØUT



4.7 Function TEMP

CALLING SEQUENCE:	T(I,J)=TEMP(ERHO, RHO)
INPUT DATA:	ERHO, RHO, data tables E, T
OUTPUT DATA:	TEMP
USAGE:	This function is called from MAIN for each node (I,J) at each time step.
FUNCTION:	Linear interpolation in a real-gas data table is used to compute a node temperature corresponding to the interval energy of the node.
NON-STANDARD UNITS:	E(B/lbm)
REFERENCE:	The data for these tables was taken from Reference 2 and assumes the nominal tank pressure of 60 atmospheres (882 psi).

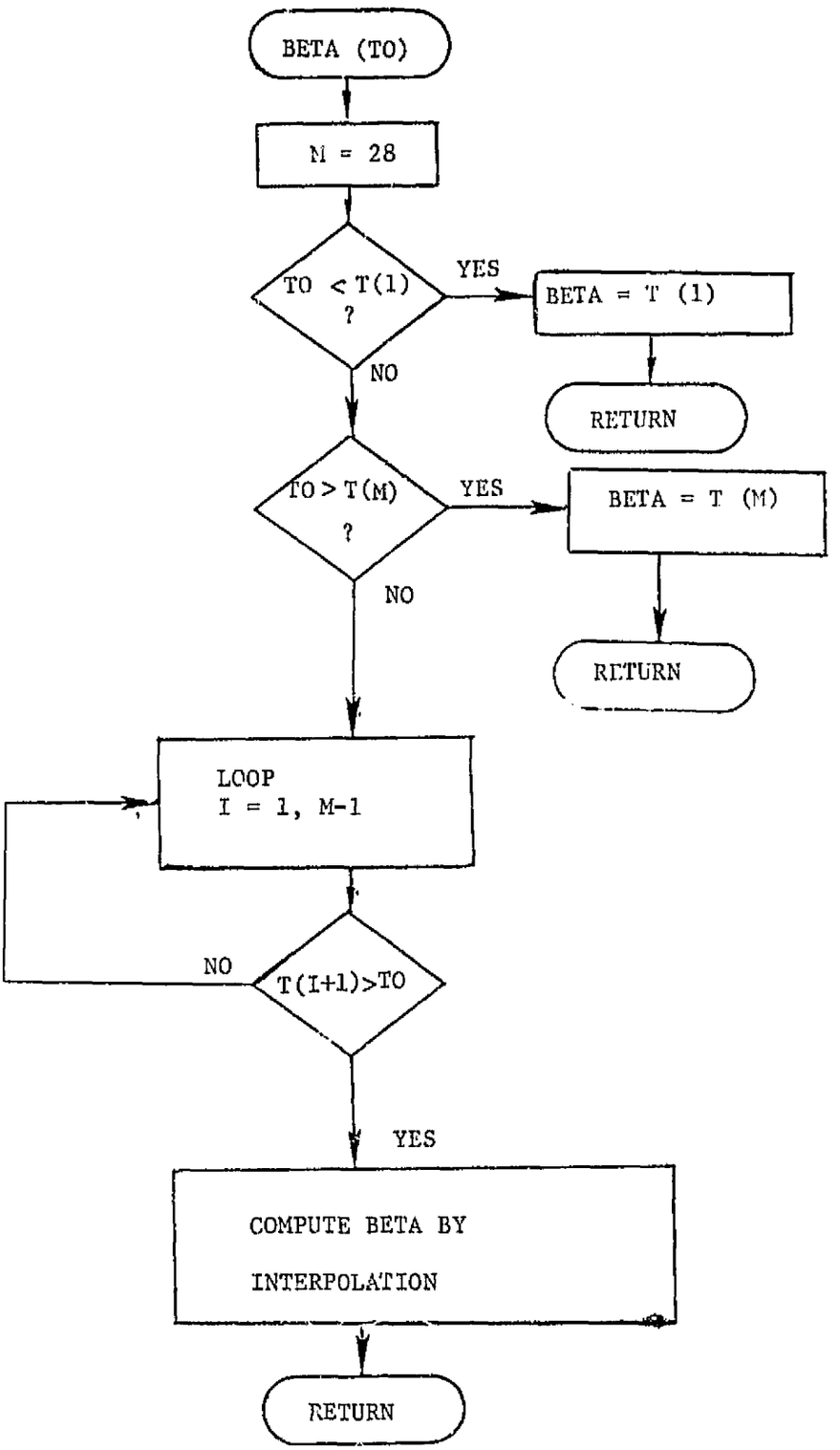
FIGURE 4.7 FLOWCHART OF TEMP



4.8 Function BETA

CALLING SEQUENCE:	EO=BETA(TO)*778.156*32.2
INPUT DATA:	TO, data tables E, T
OUTPUT DATA:	BETA
USAGE:	This function is called once at the beginning of MAIN during initialization.
FUNCTION:	Linear interpolation in the real-gas data table is used to obtain the initial specific internal energy corresponding to a given initial fluid temperature.
REFERENCE:	The data for these tables was taken from Reference 2 and assumes the nominal tank pressure of 60 atmospheres (882 psi).

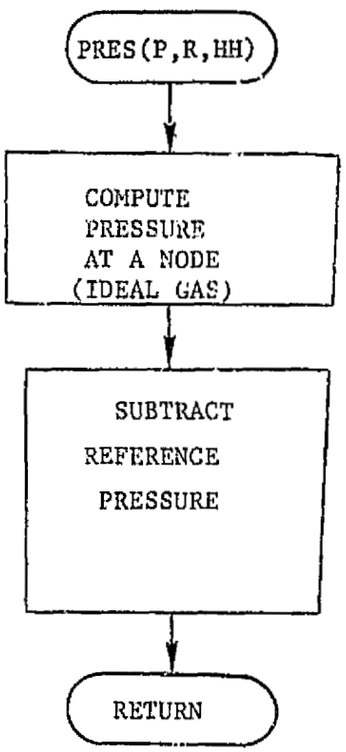
FIGURE 4.8 FLOWCHART OF BETA



4.9 Subroutine PRESS

CALLING SEQUENCE:	CALL PRESS(P, R, HH)
INPUT DATA:	R, HH, PBAR, RBAR, Z, RCONST
OUTPUT DATA:	P
USAGE:	Not used for real-gas problems
FUNCTION:	The relative pressure $(p-\bar{p})$ is computed in double precision from the ideal gas equation with a compressibility factor.

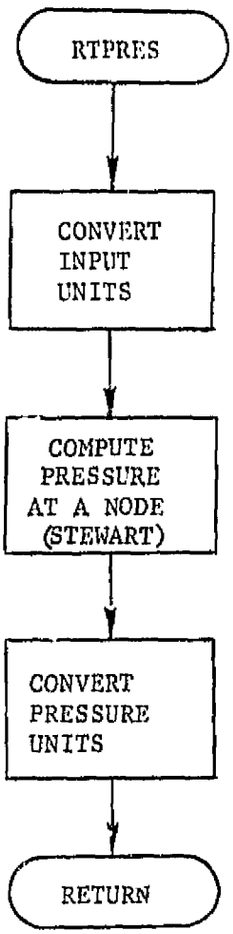
FIGURE 4.9 FLOWCHART OF PRES



4.10 Function RTPRES

CALLING SEQUENCE:	P=RTPRES(RR, TO)
INPUT DATA:	RHO, TO
OUTPUT DATA:	RTPRES
USAGE:	This function is called from MAIN once for each node (I,J) at each time step.
FUNCTION:	A node pressure is computed using Stewart's equation of state (Reference 3) given density and temperature.

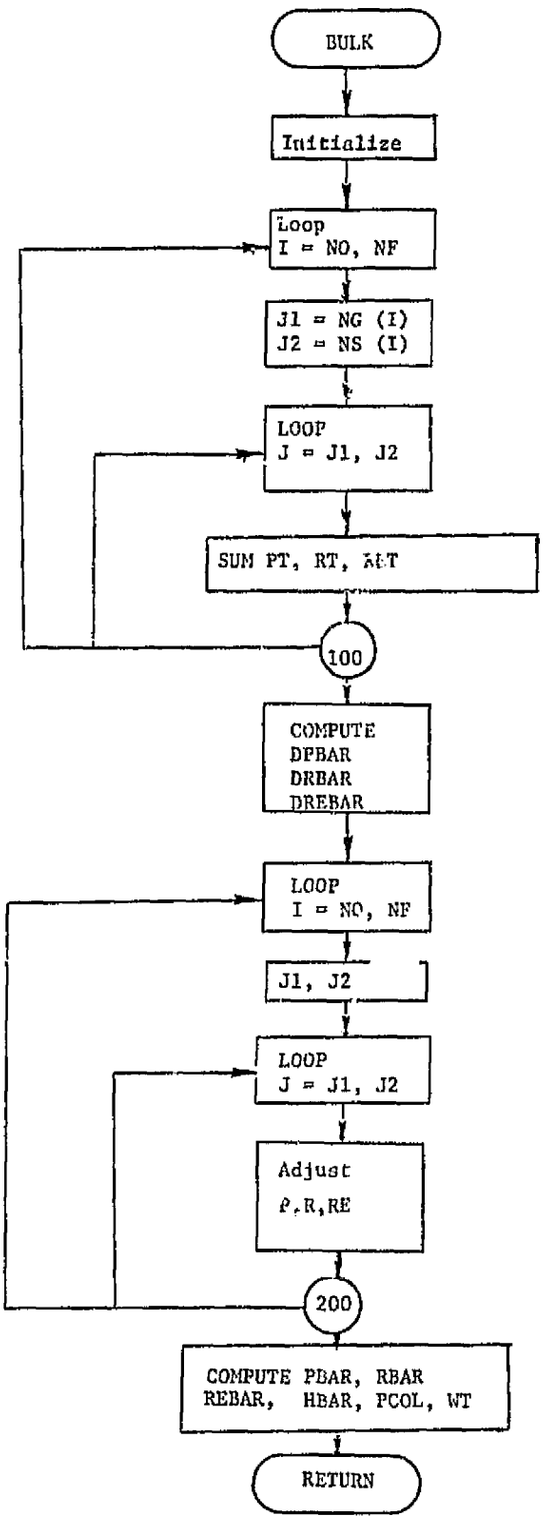
FIGURE 4.10 FLOWCHART OF RTPRES



4.11 Subroutine BULK

CALLING SEQUENCE:	CALL BULK
INPUT DATA:	P, R, RE, H, PBAR, REBAR, L, NG, NS, NO, NF, NØDES
OUTPUT DATA:	P, R, RE, PBAR, RBAR, REBAR, HMIN, HBAR1, HMAX, PCØL, WT
USAGE:	This subroutine is called periodically during the execution of MAIN, normally just prior to a call of the OUTPUT subroutine.
FUNCTION:	The average tank quantities PBAR, RBAR, and REBAR are computed in this subroutine. The relative values, P, R, RE are revised according to the change in the average values. The equilibrium temperature and the corresponding potential collapse pressure are also computed in this subroutine.
SUBPROGRAM REFERENCES:	TEMP, RTPRES

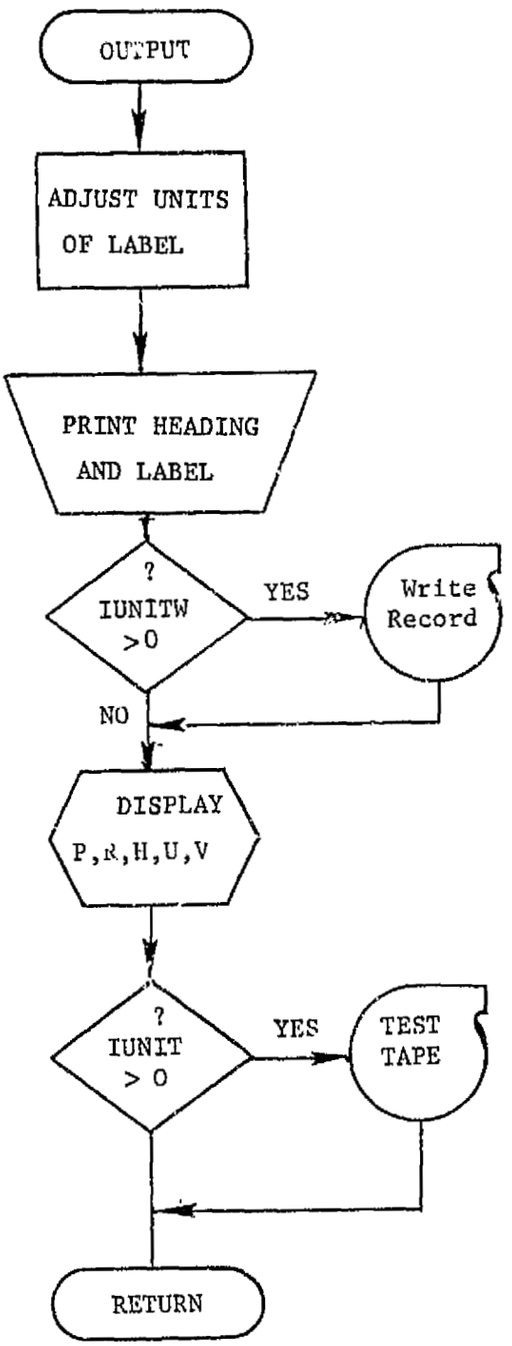
FIGURE 4.11 - FLOWCHART OF BULK



4.12 Subroutine ØUTPUT

CALLING SEQUENCE:	CALL OUTPUT (T, DT, DTCR, REF1, REF2, REF3)
INPUT DATA:	P, R, H, U, V, PBAR, RBAR, T, REF1, REF2, REF3
OUTPUT DATA:	Heading LABEL
USAGE:	This subroutine is called from MAIN every DTPR seconds.
FUNCTION:	The printing of all output data is controlled by this subroutine. The units of PBAR and RBAR are adjusted for display and the output heading and the data in array LABEL is printed. Also, the printing of P, R, H, U, and V by subroutine DISPLY is controlled. If an output tape is being generated (IUNITW > 0) this subroutine calls the tape I/O package to write a record.
SUBPROGRAM REFERENCES:	TAPEIO, DISPLY

FIGURE 4.12 FLOWCHART OF OUTPUT



4.13 Subroutine DISPLY

CALLING SEQUENCE: CALL DISPLY(X, XBAR, CONST)

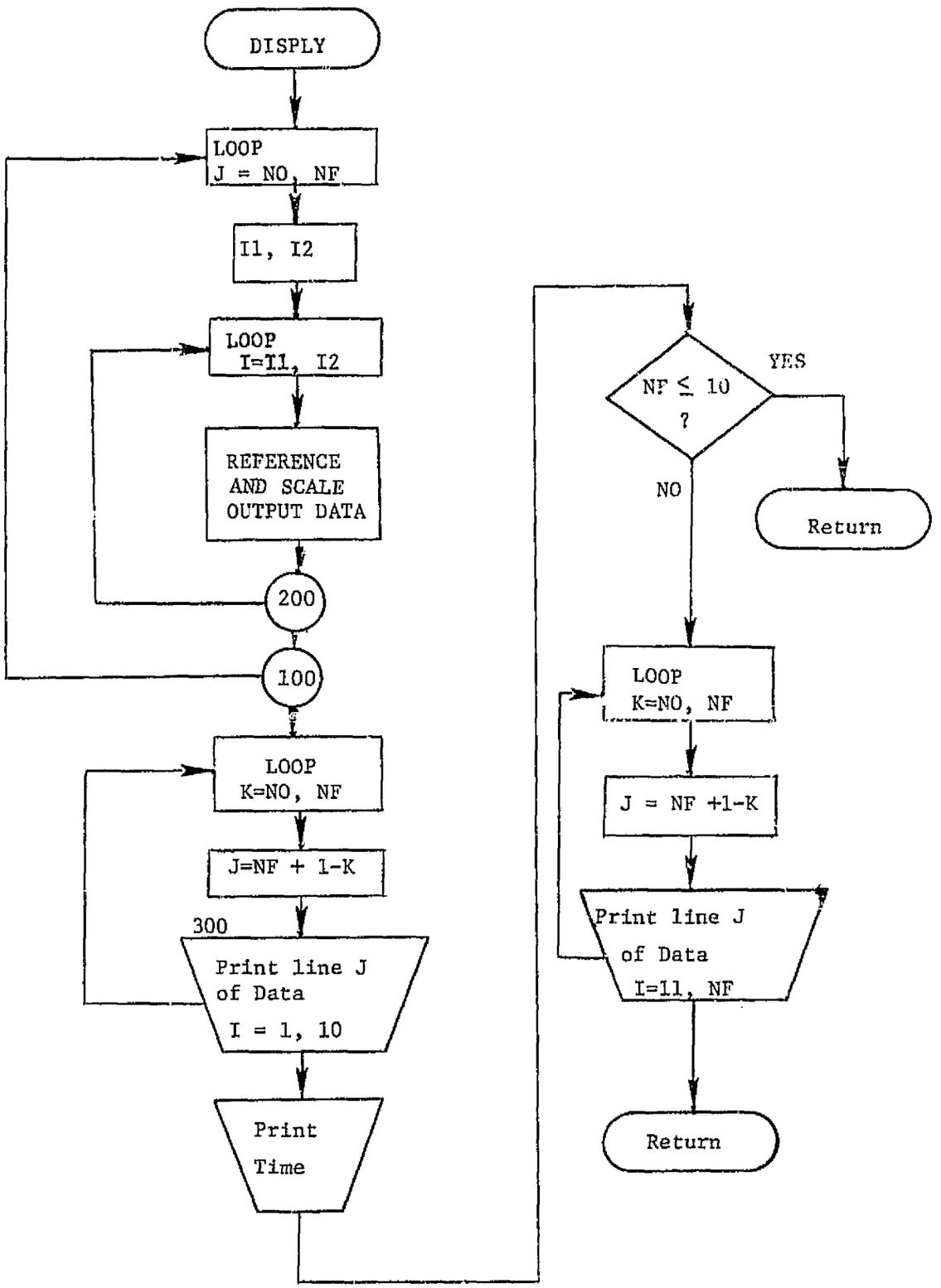
INPUT DATA: X, XBAR, CONST, NG, NS, NO, NF, TIME

OUTPUT DATA: TIME, Y

USAGE: This subroutine is called five times during the execution of a CALL to OUTPUT.

FUNCTION: The variables P, R, H, U, and V are displayed by successive calls to this subroutine from OUTPUT. Prior to printing, the reference value XBAR is subtracted from each element in X and the units are adjusted by the multiplier, CONST: Y(I,J)= (X(I,J) - XBAR)*CONST. The rows of data are displayed in inverted order to coincide with the physical description.

FIGURE 4.13


DISPLY
LOOP
J = NO, NF
I1, I2
LOOP
I=I1, I2
REFERENCE
AND SCALE
OUTPUT DATA
200
100
LOOP
K=NO, NF
J=NF + 1-K
300
Print line J
of Data
I = 1, 10
Print
Time
NF ≤ 10
?
YES
NO
Return
LOOP
K=NO, NF
J = NF +1-K
Print line J
of Data
I=I1, NF
Return

4.14 Subroutine CR2TAP

CALLING SEQUENCE: CALL CR2TAB (ENDECK, I5, LINES)

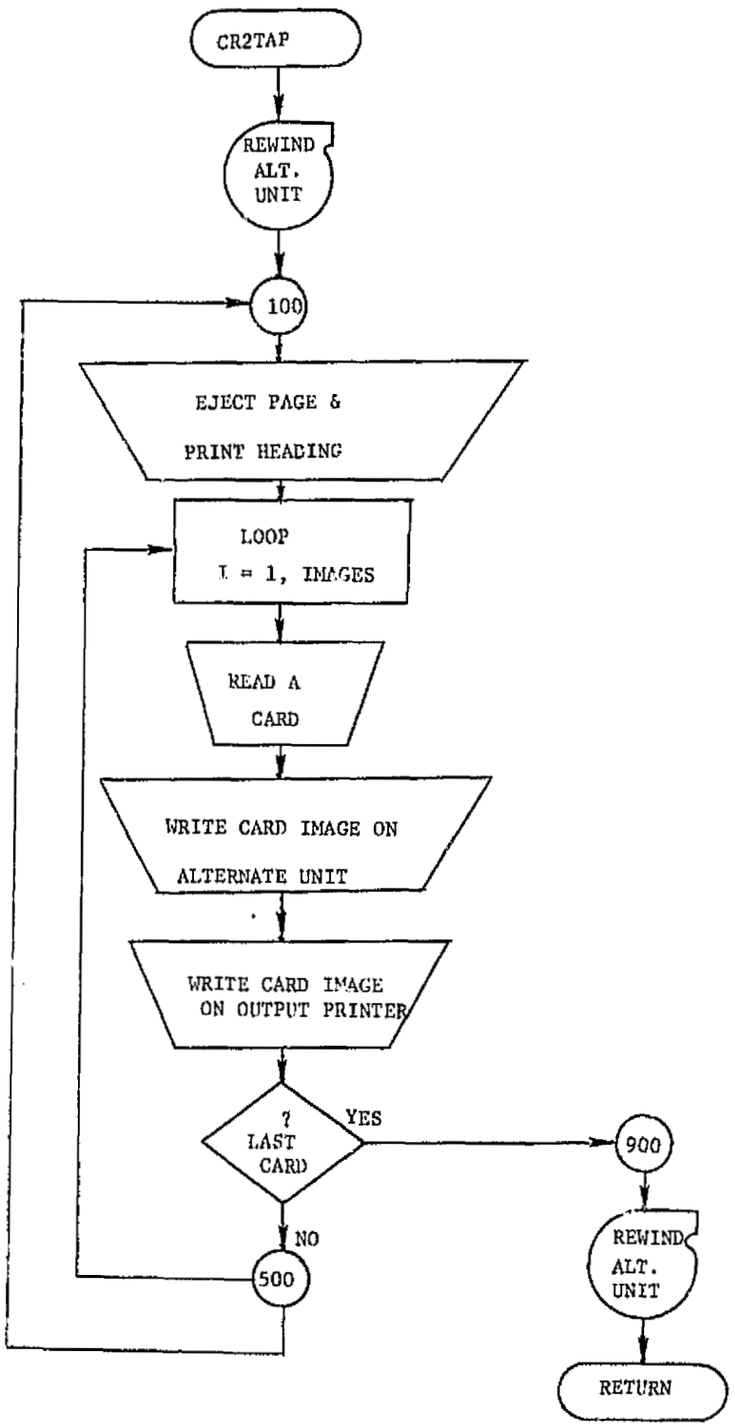
INPUT DATA: Card images, I5, LINES

OUTPUT DATA: Card images on computer internal unit (I5).

USAGE: This subroutine is called from MAIN whenever card input is expected.

FUNCTION: The purpose of this subroutine is to document all the data input to the program by card. Images of the input data cards are stored on the computer internal unit (I5) and are output on the line printer. Card reading is initiated by a CALL of this subroutine and is terminated upon reading a card beginning with the alphameric word stored in ENDECK. This word was selected to be the NAMELIST terminator word b$ENDb. Data is input through NAMELIST from the internal unit I5.

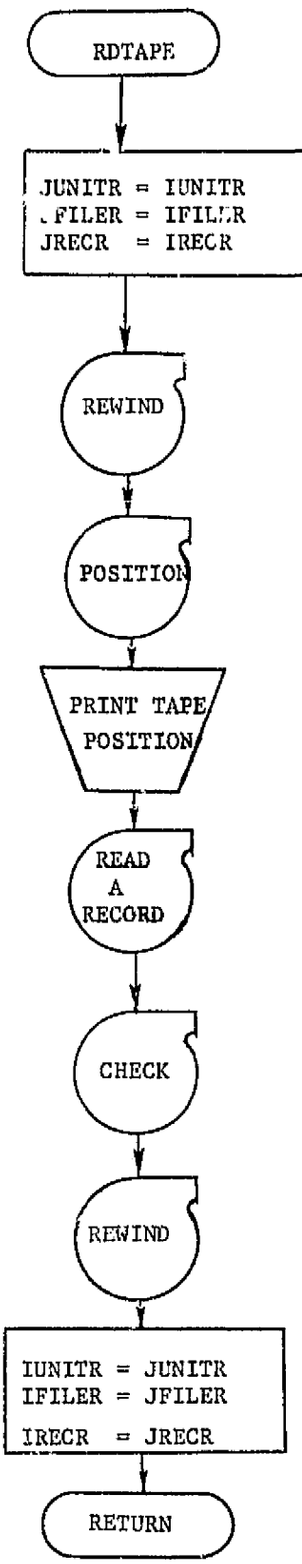
FIGURE 4.14 FLOWCHART OF CR2TAP



4.15 Subroutine RDTAPE

CALLING SEQUENCE:	CALL RDTAPE
INPUT DATA:	IUNITR, IFILER, IRECR, previously generated tape data.
OUTPUT DATA:	A-array (data from input tape).
USAGE:	This subroutine is called once at the beginning of MAIN if an input data tape is used to initialize the program.
FUNCTION:	The series of operations performed by successive calls to the TAPEIØ package is collected here. The input tape read parameters supercede those input from tape.
SUBPROGRAM REFERENCES:	TAPEIØ

FIGURE 4.15 FLOWCHART OF RDTAPE



4.J.6 SUBROUTINE TAPEIØ

IDENTIFICATION

Name/Title - TAPEIØ (Tape Input/Output)

Programmer/Date - John Prewitt, September 1970

Organization/Installation - TRW for EP5-MSC

Source Language - FORTRAN V

PURPOSE

Subroutine TAPEIØ performs unformatted tape input/output functions with either NTRAN or FORTRAN I/O packages.

USAGE

• Calling Sequence	• Function
CALL TAPEPS (ITYPE, IUNIT, IFILE, IREC)	Position tape
CALL TAPERD (ITYPE, IUNIT, IWØRDS, A, LSTAT)	Read tape
CALL TAPEWR (ITYPE, IUNIT, IWØRDS, A, LSTAT)	Write tape
CALL TAPERW (ITYPE, IUNIT)	Rewind tape
CALL TAPEØF (ITYPE, IUNIT)	Write end-of-file
CALL TAPEPR (ITYPE, IUNIT)	Print status of tape position
CALL TAPECK (JSTAT)	Check status of NTRAN read/write

Arguments:

Parameter Name	In/Out	Dimension	Type	Description
ITYPE	In	1	I	Type of data tape 0 = NTRAN 1 = FORTRAN
IUNIT	In	1	I	Physical unit for tape assignment
IFILE	In	1	I	Number of files to be skipped
IREC	In	1	I	Number of blocks or physical records to be skipped
IWØRDS	In	1	I	Number of data words to be transmitted

Parameter Name	In/Out	Dimension	Type	Description
A	In/Out	IWØRDS	I	Storage area for data words
LSTAT	Out	1	I	Status word for NTRAN read/write
				-1 = Transmission is not complete
				-2 = End-of-file for read, end-of-tape or drum-file for write
				-3 = Device error
				-4 = Transmission abort
				IWØRDS = Number of data words transmitted when transmission is complete
				Status word for FORTRAN read/write
				IWØRDS = Number of data words transmitted when transmission is complete
JSTAT	In/Out	1	I	Status word for NTRAN read/write

- Data In/Out

  None

- Error Messages

  If an error occurs subroutine KILLER is called and a walkback is generated.

- Storage

  Coding occupies 774_8 (508_{10}) locations. Internal data occupies 142_8 (98_{10}) locations.

METHOD

- Model

  The logic for each of the functions in TAPEIØ is basically the same. First the status of the tapes position is updated, next a test is made on the type of data tape (NTRAN or FORTRAN) being processed and then the appropriate function is called.

  This routine works on all tape or tape simulated I/O devices (see restrictions).

- Symbol Definition

  None

References

"UNIVAC 1108 FORTRAN V Programmer Reference Manual", UP-3569 Rev. 1.

P. N. Bertstresser, T. W. Rimkus, "Computer Systems Bulletin No. 64, File and Physical Record Skipping on the Univac 1108", TRW IØC 5513.20-37, 20 August 1969.

H. W. Bryan, "Computer Systems Bulletin No. 71, System Supplied Editing Routines", TRW IOC 5513.20-60, 2 February 1970.

RESTRICTIONS

- Analytic

  IUNIT can have any value between 1-29 except for 5, 6, and 17.

- Operational

  The tape positioning function does not work for high speed drum (FH232).

- Other subprograms required

  KILLER

  NTRAN

  QQFIL

  QQREC

ACCURACY

Not applicable

VALIDITY

A main driver was developed to check all possible combinations of tape input/output functions.

CODING INFORMATION

- Special Program Constants

  None needed

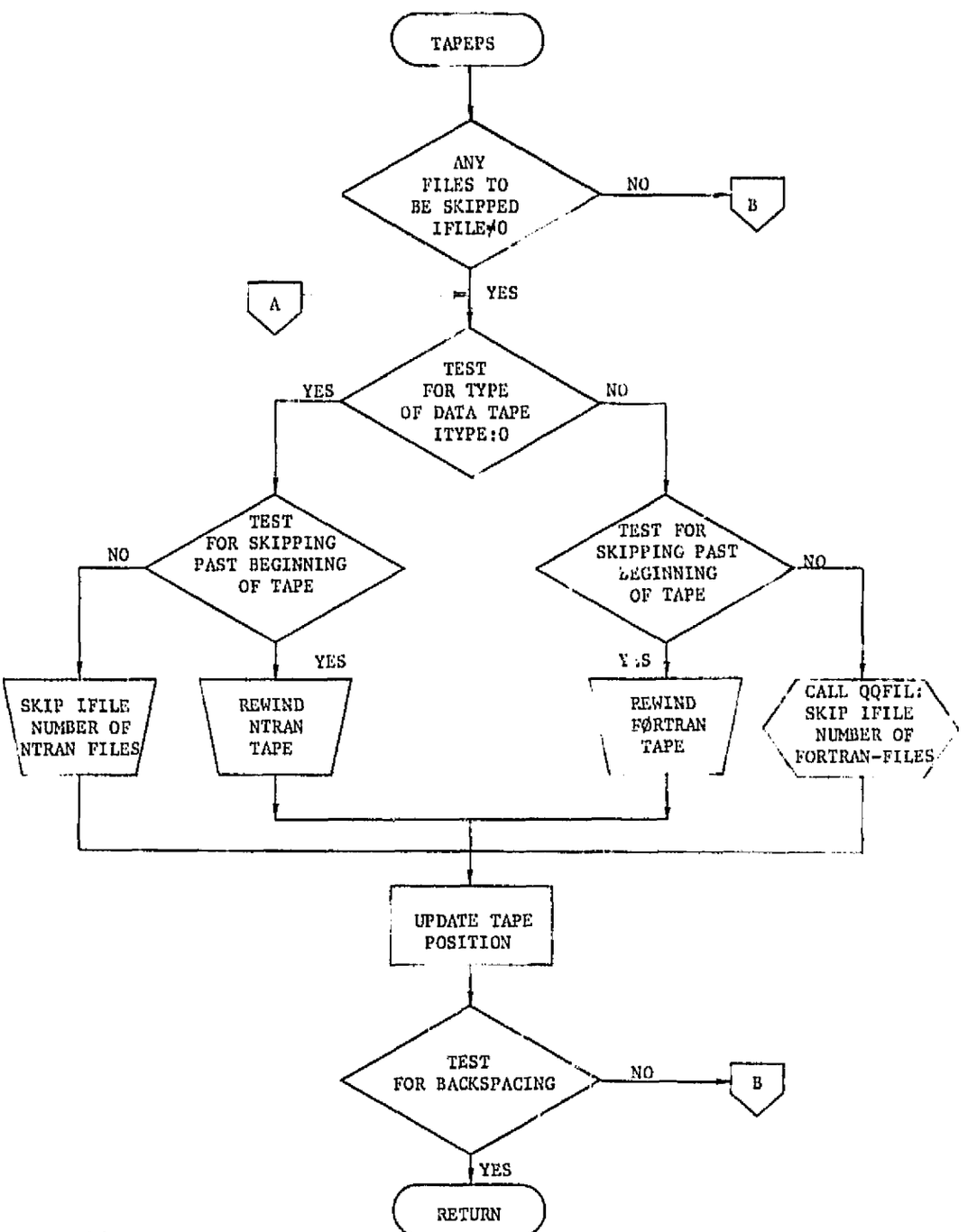
- Timing

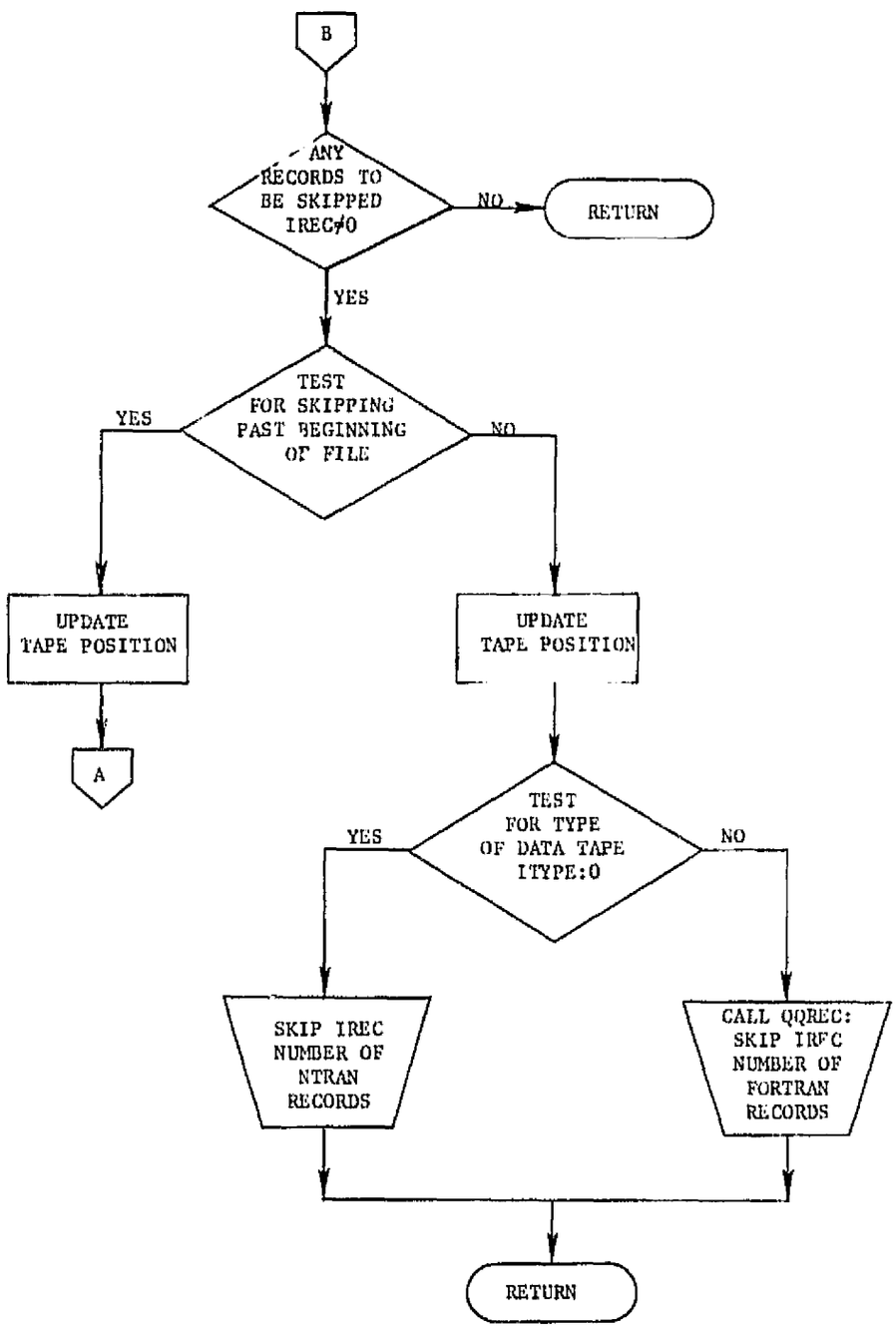
  The speed is dependent on the amount of information to be transmitted and the I/O device used.

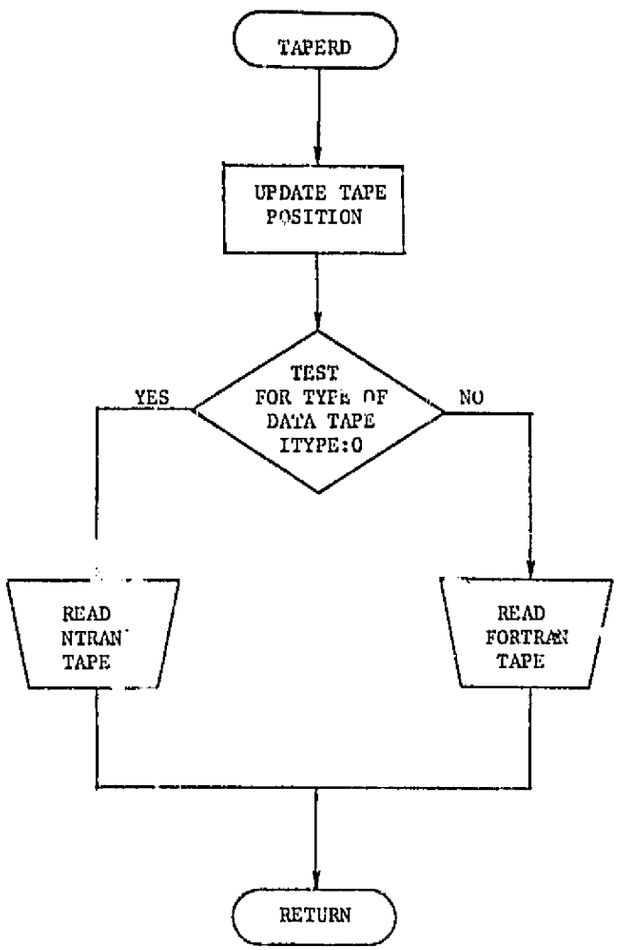
FIGURE 4.16

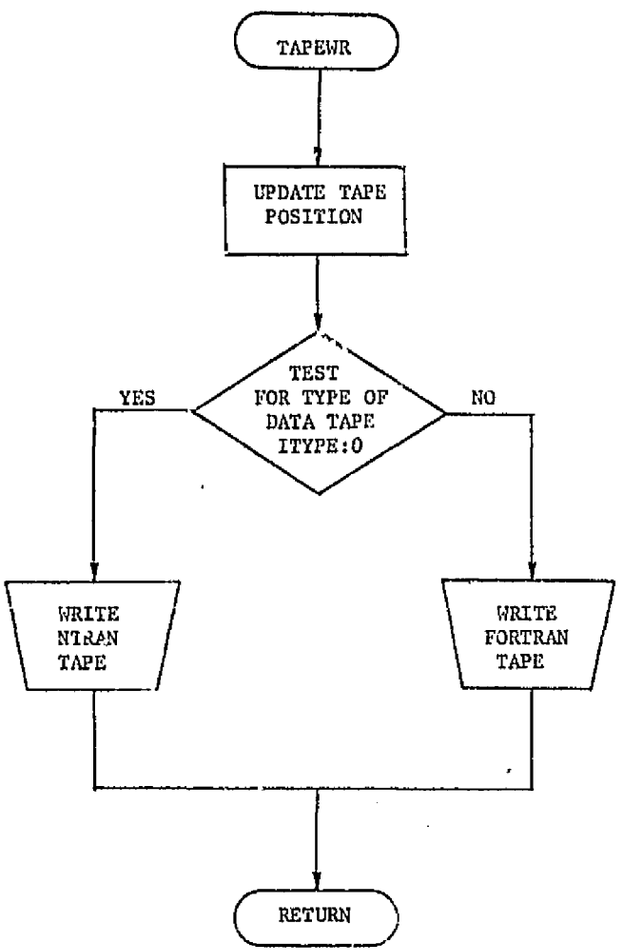
FLOWCHART OF TAPE IØ

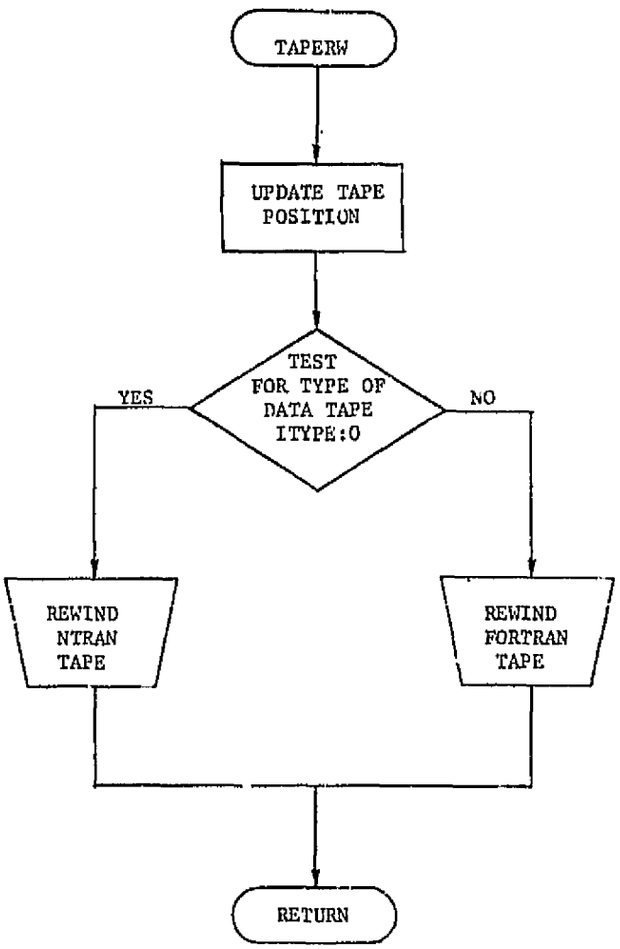
DETALLED FLOW CHART SUBRØUTINE TAPEIØ

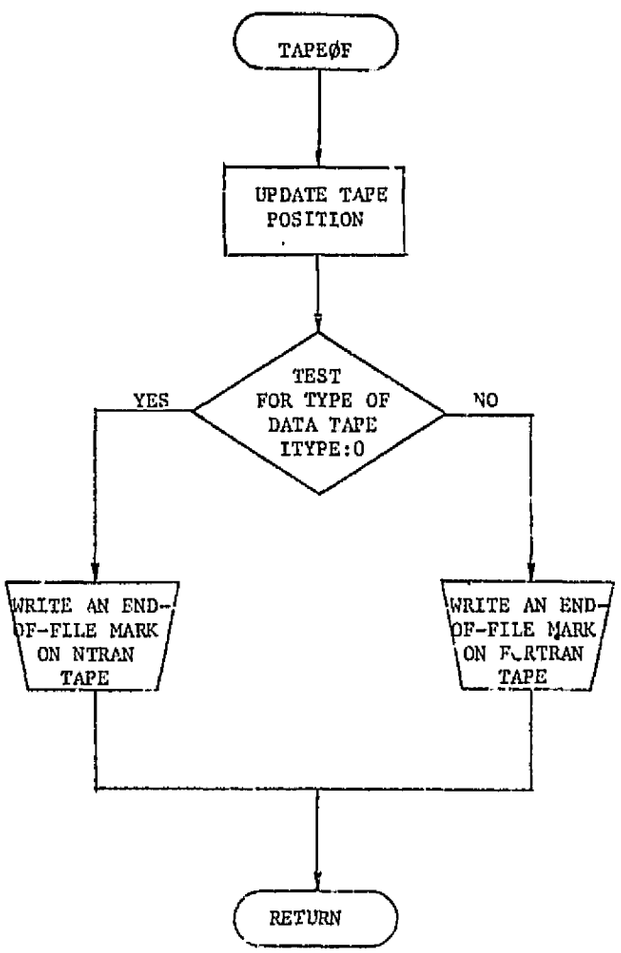


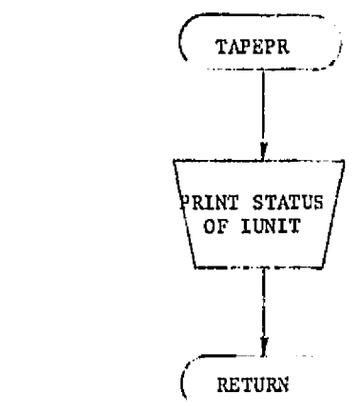

B
ANY RECORDS TO BE SKIPPED IREC≠0
NO
RETURN
YES
TEST FOR SKIPPING PAST BEGINNING OF FILE
YES
NO
UPDATE TAPE POSITION
UPDATE TAPE POSITION
A
TEST FOR TYPE OF DATA TAPE ITYPE:0
YES
NO
SKIP IREC NUMBER OF NTRAN RECORDS
CALL QQREC: SKIP IREC NUMBER OF FORTRAN RECORDS
RETURN

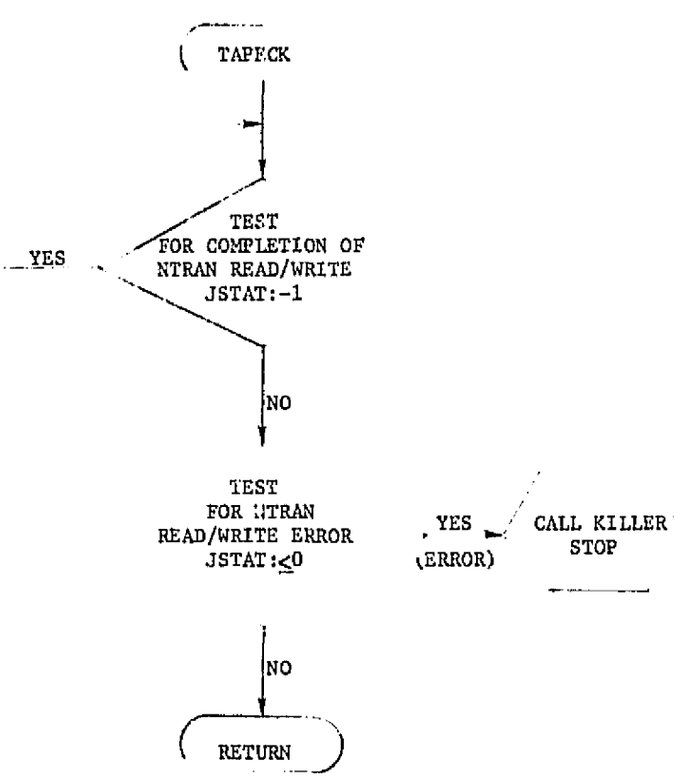

TAPERD
UPDATE TAPE POSITION
TEST FOR TYPE OF DATA TAPE ITYPE:0
YES
NO
READ NTRAN TAPE
READ FORTRAN TAPE
RETURN


TAPEWR
UPDATE TAPE POSITION
TEST FOR TYPE OF DATA TAPE ITYPE:0
YES
NO
WRITE NTRAN TAPE
WRITE FORTRAN TAPE
RETURN


TAPERW
UPDATE TAPE POSITION
TEST FOR TYPE OF DATA TAPE ITYPE:0
YES
NO
REWIND NTRAN TAPE
REWIND FORTRAN TAPE
RETURN


TAPEØF
UPDATE TAPE POSITION
TEST FOR TYPE OF DATA TAPE ITYPE:0
YES
NO
WRITE AN END-OF-FILE MARK ON NTRAN TAPE
WRITE AN END-OF-FILE MARK ON FORTRAN TAPE
RETURN


TAPEPR
PRINT STATUS
OF IUNIT
RETURN


TAPECK
TEST
FOR COMPLETION OF
NTRAN READ/WRITE
JSTAT:-1
YES
NO
TEST
FOR NTRAN
READ/WRITE ERROR
JSTAT:≤0
YES
(ERROR)
CALL KILLER
STOP
NO
RETURN

4.17 Function OPTD

CALLING SEQUENCE: RO=OPTD (P1, HO) /32.2

INPUT DATA: P1, HO

OUTPUT DATA: OPTD (oxygen density)

USAGE: When initial conditions are generated by the program, this function is called once from MAIN to establish the initial bulk density and then is also called at each node point at time t=o to establish the initial individual node densities.

FUNCTION: This subprogram employs linear interpolation of data tables obtained from Reference 2 to obtain the density of oxygen at a given pressure and temperature.

REFERENCE: Further documentation of this subprogram is contained under Subroutine THERM in Reference 4.

5.0 REFERENCES

1. "A Numerical Solution For The Prediction of Pressure Collapse in Supercritical Oxygen," P. J. Heinmiller, TRW Project Technical Report 17618-H080-RO-00, December 1970.

2. Weber, L. A., "Thermodynamic and Related Properties of Oxygen from the Triple Point to 300 K at Pressures to 330 Atmospheres Suppliment A (British Units), "National Bureau of Standards Report 9710 A, August 29, 1968.

3. Stewart, R. B., "The Thermodynamic Properties of Oxygen," PhD Thesis, University of Iowa, June 1966.

4. "Apollo Cryogenic Systems Programs Programmer's [illegible] MSC/TRW Task 705-2," Lindsey, J. G. and Prewitt, J. I., [illegible] Project Technical Report 17618-H092-RO-00, January 1971.

APPENDIX I

COMPUTER PROGRAM NOMENCLATURE

The following nomenclature list contains the program variable names appearing in the storage assignment lists generated for each program element. The x's at the right of the page designate in which program elements the variable names appeared. The following key identifies the element numbers with the names of the program elements.

Number	Name
0	MAIN
1	MEANA
2	MEANB
3	DIFF
4	DIFF2
5	HEATER
6	BCØUT
7	TEMP
8	BETA
9	PRES
10	RTPRES
11	BULK
12	OUTPUT
13	DISPLY
14	RDTAPE
15	-

N O M E N C L A T U R E

VAR	TYP	DIM	DESCRIPTION (UNITS)	PROGRAM ELEMENT 0123456789 111111 012345
A	R	3700	MASTER EQUIVALENCING ARRAY FOR TAPE I/O	XXXXX X X XXXX
AVE	R	10	ARRAY CONTAINING AVERAGE STATE VALUES	X X X X XX
BETA	R	1	RETURNED SPEC. INT. ENERGY (F) FROM FCTN BETA	X X
C	R	1	SPECIFIC HEAT, CP, (UNUSED) (FT-LBF/SLUG-R)	X
CST1L2	R	1	CONSTANT 1/L2 (FT-2)	XX
CST1L	R	1	CONSTANT 1/L (FT-1)	X XX
CS11L2	R	1	CONSTANT 1/L2(FT-2)	X X
CST2L	R	1	CONSTANT 1/2L (FT-1)	X X
CST2L2	R	1	CONSTANT 1/2L2 (FT-2)	X X
CST4L	R	1	CONSTANT 1/4L (FT-1)	X X
CST4L2	R	1	CONSTANT 1/4L2 (FT-2)	X X
CTL	R	20	PROGRAM CONTROL DATA ARRAY	X X XXX
DPBAR	R	1	CHANGE IN PBAR	X
DPDX	R	1	DERIVATIVE OF P WRT X (LBF/FT2/FT)	X X
DPDY	R	1	DERIVATIVE OF P WRT Y (LBF/FT2/FT)	X X
DQBC	R	4	HEAT LEAK BOUNDARY CONDITION INPUT ARRAY	X
DQH	R	1	INTERNAL HEAT GENERATION (FT-LBF/SEC/NODE)	X
DQHEAT	R	1	INTERNAL HEAT GENERATION (FT-LBF/SEC/NODE)	X
DQ1	R	1	HEAT FLUX - LEFT BOUNDARY (FT-LBF/FT2-SEC)	X X
DQ2	R	1	HEAT FLUX - RIGHT BOUNDARY	X X
DQ3	R	1	HEAT FLUX - BOTT. BOUNDARY	X X
DQ4	R	1	HEAT FLUX - TOP BOUNDARY	X X
DR	R	20X20	NODE DENSITY RATE (SLUG/ FT3/SEC)	X XX X
DRBAR	R	1	CHANGE IN RBAR	X
DRE	R	20X20	NODE INTERNAL ENERGY RATE (FT-LBF/FT3/SEC)	X XX
DREBAR	R	1	CHANGE IN REBAR	X
DREUDX	R	1	DERIVATIVE OF RE U WRT X (FT-LBF/FT3/SEC)	X X
DREVDY	R	1	DERIVATIVE OF RE V WRT Y (FT-LBF/FT3/SEC)	X X
DRU	R	20X20	NODE X-MOMENTUM RATE (SLUG-FT/FT3-SEC2)	X XX
DRUDX	R	1	DERIVATIVE OF RU WRT X (SLUG-FT/FT3-SEC/FT)	X X
DRUUDX	R	1	DERIVATIVE OF RU U WRT X (SLUG-FT/FT3-SEC)	X X
DRUVDY	R	1	DERIVATIVE OF RU V WRT Y (SLUG-FT/FT3-SEC2)	X X
DRV	R	20X20	NODE Y-MOMENTUM RATE (SLUG-FT/FT3-SEC2)	X XX
DRVDY	R	1	DERIVATIVE OF RV WRT Y (SLUG-FT/FT3-SEC/FT)	X X

0123456789 111111 012345

VAR	TYP	DIM	DESCRIPTION (UNITS)	PROGRAM ELEMENT 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 1 1 1 1 1 1
DRVUDX	R	1	DERIVATIVE OF PV U WRT X (SLUG-FT/FT3-SEC2)	X X
DRVVDY	R	1	DERIVATIVE OF PV V WRT Y (SLUG-FT/FT3-SEC2)	X X
DT	R	1	PROGRAM TIME STEP (SEC)	X
DTPR	R	1	PRINT TIME INTERVAL (SEC)	X
DT1	R	1	PROGRAM TIME STEP DISPLAYED (SEC)	X
DUDX	R	1	DERIVATIVE OF U WRT X (FT/SEC2)	X
DVDY	R	1	DERIVATIVE OF V WRT Y (FT/SEC2)	X
D2HDX2	R	1	2 ND DERIVATIVE OF H WRT X (R/FT2)	X X
D2HDY2	R	1	2 ND DERIVATIVE OF H WRT Y (R/FT2)	X X
D2UDXY	R	1	2 ND DERIVATIVE OF U WRT X,Y (FT/SEC/FT2)	X X
D2UDX2	R	1	2 ND DERIVATIVE OF U WRT X (FT/SEC/FT2)	X X
D2UDY2	R	1	2 ND DERIVATIVE OF U WRT Y (FT/SEC/FT2)	X X
D2VDXY	R	1	2 ND DERIVATIVE OF V WRT X,Y (FT/SEC/FT2)	X X
D2VDX2	R	1	2 ND DERIVATIVE OF V WRT X (FT/SEC/FT2)	X X
D2VDY2	R	1	2 ND DERIVATIVE OF V WRT Y (FT/SEC/FT2)	X X
E	R	30	SPECIFIC INTERNAL ENERGY TABLE (BTU/LBM)	XX
EIN	R	1	SPECIFIC INTERNAL ENERGY IN (BTU/LBM)	X
ENDECK		1	ALPHAMERIC TERMINATOR FOR CARD INPUT	X
ERHO	R	1	INTERNAL ENERGY (FT-LBF/FT3)	X
E0	R	1	INITIAL TANK SPEC. INTERNAL ENERGY (FT-LBF/SLUG)	X
GX	R	1	ACCELERATION X-COMPONENT (FT/SEC2)	X
GY	R	1	ACCELERATION Y-COMPONENT (FT/SEC2)	X
H	R	20X20	NODE TEMPERATURE (R)	X XX XX
HBAR	R	1	AVERAGE TEMPERATURE (R)	XX
HBAR1	R	1	AVERAGE TEMPERATURE FOR OUTPUT (R)	X
HH	D	1	DOUBLE PRECISION NODE TEMPERATURE (R)	X
HMAX	R	1	MAXIMUM NODE TEMPERATURE (R)	X
HMIN	R	1	MINIMUM NODE TEMPERATURE (R)	X
H0	R	1	INITIAL TANK TEMPERATURE (R)	X
I	I	1	NODE INDEX X-DIRECTION 1 TO 20	XXX XX X X
J	I	1	LAST INDEX USED IN T-E TABLES	XX
IFILER	I	1	TAPE FILE NUMBER - READING	X X
IFILEW	I	1	TAPE FILE NUMBER - WRITING	X
IRECR	I	1	TAPE RECORD NUMBER - READING	X X

0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 1 1 1 1 1 1

VAR	TYP	DIM	DESCRIPTION (UNITS)	PROGRAM ELEMENT 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5
IRECW	I	1	TAPE RECORD NUMBER - WRITING	X
ITAPE	I	6	TAPE CONTROL DATA ARRAY	X X X
ITERM	I	1	TERMINATION FLAG FOR NEGATIVE DENSITY	X
IUNITR	I	1	TAPE UNIT NUMBER - READING	X X
IUNITW	I	1	TAPE UNIT NUMBER - WRITING	X X
I1	I	1	STARTING I-INDEX AT ROW J	XXXX X
I2	I	1	STOPPING I-INDEX AT ROW J	XXXX X
I5	I	1	ALTERNATE UNIT NUMBER FOR CARD INPUT THRU CR2TAP	X
J	I	1	NODE INDEX Y-DIRECTION 1 TO 20	XXX XX X X
JFILER	I	1	TEMPORARY TAPE INPUT FILE NUMBER	X
JRECR	I	1	TEMPORARY TAPE INPUT RECORD NUMBER	X
JUNITR	I	1	TEMPORARY TAPE INPUT UNIT NUMBER	X
J1	I	1	STARTING J-INDEX AT COLUMN I	X XX X
J2	I	1	STOPPING J-INDEX AT COLUMN I	X XX X
K	R	1	THERMAL CONDUCTIVITY (FT-LBF/FT-SEC-R)	X X
K	I	1	INVERTED ROW INDEX	X
L	R	1	NODE DIMENSION (FT)	X XX X X
LABEL	R	10	OUTPUT LABEL DATA ARRAY	X XX
LIMITS	I	50	INDEX LIMITS DEFINING TANK CONFIGURATION	XXXXX X X
LINES	I	1	NUMBER OF PRINT LINES FOR CARD INPUT DISPLAY	X
LSTAT	I	1	STATUS OF TAPE OUTPUT	X X
L3	R	1	VOLUME OF NODE (FT3)	X
M	I	1	NUMBER OF ENTRIES IN T/E TABLES	X
M1	I	1	DO - LOOP INDEX	X
N	I	1	NUMBER OF ENTRIES IN T-E TABLES	X
NF	I	1	MAXIMUM INDEX OF TANK CONFIGURATION	XXX X X
NG	I	20	ARRAY CONTAINING STARTING INDICIES	XXXXX X X
NODES	R	1	TOTAL NUMBER OF NODES IN TANK CONFIGURATION	X X X
NS	I	20	ARRAY CONTAINING ENDING INDICIES	XXXXX X X
NO	I	1	MINIMUM INDEX OF TANK CONFIGURATION	XXX X X
P	R	20X20	NODE PRESSURE RELATIVE TO PBAR (LBF/FT2)	X X XX
PBAR	D	1	REFERENCE PRESSURE - UPDATED AS AVERAGE (LB/FT2)	X X XX
PBAR1	P	1	AVERAGE FLUID PRESSURE OUTPUT (LBF/IN2)	X
PCOL	R	1	POTENTIAL COLAPSE PRESSURE (LBF/IN2)	X

0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5

VAR	TYP	DIM	DESCRIPTION (UNITS)	PROGRAM ELEMENT 0123456789012345 111111
PFLAG	R	1	PRESSURE FLAG FOR HEATER CYCLE OPERATION	X
PHI	R	1	PRESSURE UPPER LIMIT FOR HEATER CYCLE (LBF/FT2)	X
PLO	R	1	PRESSURE LOWER LIMIT FOR HEATER CYCLE (LBF/FT2)	X
PP	D	1	DOUBLE PRECISION PRESSURE (LBF/FT2)	X
PREF	R	1	TANK PRESSURE FOR HEATER CYCLE (LBF/FT2)	X
PROP	R	10	FLUID PROPERTY DATA ARRAY	X X X X XX
PT	R	1	SUM OF PRESSURE VARIATIONS (LBF/FT2)	X
PO	R	1	INITIAL TANK PRESSURE (LBF/FT2)	X
P1	R	1	NODE PRESSURE FOR CALL TO OPTD (LBF/IN2)	X
R	R	20X20	NODE DENSITY RELATIVE TO RBAR (SLUG/FT3)	X X X X XX
RATES	R	1600	ARRAY CONTAING FLUID STATE DATA	XXXXX X XX
RBAR	D	1	REFERENCE DENSITY - UPDATED AS AVERAGE (SLUG/FT3)	X X X X XX
RBAR1			AVERAGE FLUID DENSITY OUTPUT (LBM/FT3)	XX
RCONST	R	1	GAS CONSTANT, P (UNUSED) (FT-LBF/SLUG-R)	X X
RE	R	20X20	NODE INT. ENERGY RELATIVE TO REBAR (FT-LBF/FT3)	X XXX X XX
REBAR	D	1	REFERENCE INTEPNAL ENERGY (FT-LBF/FT3)	X X X
REBAR1	R	1	AVERAGE INTERNAL ENERGY	X
REFG	R	1	CENTER LOCATION IN TANK FOR ACCELERATION HEAD	X
RET	R	1	SUM OF INTERNAL ENERGY VARIATIONS (FT-LBF/FT3)	X
REX	R	21X21	FACE-CENTERED VALUES OF RE IN X-DIRECTION	XXXX
REY	R	21X21	FACE-CENTERED VALUES OF RE IN Y-DIRECTION	XXXX
RHO	R	1	NODE DENSITY (SLUG/FT3)	X
RI	R	1	REAL INDEX I	X
RJ	R	1	REAL INDEX J	X
RR	D	1	DOUBLE PRECISION DENSITY (SLUG/FT3)	X
RT	R	1	SUM OF DENSITY VARIATIONS (SLUGS/FT3)	X
RTPRES	R	1	RETURNED PRESSURE FROM FUNCTION RTPRES (LBF/FT2)	X X X
RU	R	20X20	NODE MOMENTUM X-DIRECTION (SLUG-FT/FT3-SEC)	XX XX X X
RUX	R	21X21	FACE-CENTERED VALUES OF RU IN X-DIRECTION	XXXX
RUY	R	21X21	FACE-CENTERED VALUES OF RU IN Y-DIRECTION	XXXX
RV	R	20X20	NODE MOMENTUM Y-DIRECTION (SLUG-FT/FT3-SEC)	XX XX X X
RVX	R	21X21	FACE-CENTERED VALUES OF RV IN X-DIRECTION	XXXX
RVY	R	21X21	FACE-CENTERED VALUES OF RV IN Y-DIRECTION	XXXX
RX	R	21X21	FACE-CENTERED VALUES OF R IN X-DIRECTION	XXX
RY	R	21X21	FACE-CENTERED VALUES OF R IN Y-DIRECTION	XXX

0123456789012345 111111

VAR	TYP	DIM	DESCRIPTION (UNITS)	PROGRAM ELEMENT 111111 012345678901 2345
RO	R	1	INITIAL FLUID DENSITY (SLUG/FT3)	X
SCALE	R	1	SCALE FACTOR	X
STATE	R	2000	ARRAY CONTAINING FLUID STATE DATA	XX X X XX
STOPFG	R	1	END OF RUN FLAG	X
T	R	1	PROGRAM TIME (SEC)	X
T	R	30	TEMPERATURE TABLE (R) (IN ASCENDING ORDER)	XX
TEMP	R	1	RETURNED NODE TEMPERATURE FROM FUNCTION TEMP (R)	X X X
TIME	R	1	PROBLEM TIME (MINUTES)	XX
TPR	R	1	PROGRAM TIME FOR NEXT PRINTED OUTPUT (SEC)	X
TSCALE	R	1	SCALED PROBLEM TIME (MINUTES)	X
TSTOP	R	1	PROGRAM END TIME (SEC)	X
TO	R	1	PROGRAM START TIME (SEC)	X
U	R	20X20	NODE VELOCITY X-DIRECTION (FT/SEC)	XXXXX X
UWALL	R	1	WALL VELOCITY AT EXIT PORT (FT/SEC)	X
UX	R	21X21	FACE-CENTERED VALUES OF U IN X-DIRECTION	XXXX
V	R	20X20	NODE VELOCITY Y-DIRECTION (FT/SEC)	XXXXX X
VSC	R	1	FLUID ABSOLUTE VISCOSITY (LBF-SEC/FT2)	X
VY	R	21X21	FACE-CENTERED VALUES OF V IN Y-DIRECTION	XXXX
WDOT	R	1	MASS FLOWRATE FROM FLUID VOLUME (SLUG/SEC)	X
WT	R	1	SUMMED WEIGHT OF FLUID (LBM) (OUTPUT)	X
WTM	R	1	FLUID MOLECULAR WEIGHT (UNUSED) (LB/LB-MOLE)	X X
Y	R	20X20	TRANSFORMED OUTPUT DATA ARRAY	X
Z	R	1	FLUID COMPRESSIBILITY FACTOR (UNUSED)	X X X

012345678901 2345
111111

APPENDIX II

COMPUTER PROGRAM LISTING

This Appendix contains a listing of the GNAT Computer Program followed by results from a sample computer run. The input control cards show the specified initial state of the fluid and the fluid properties used. Computer output on magnetic tape was specified by the ITAPE input data. The standard computer printout is shown at initialization and at the first print time specified.

```
@Z RUN *9314,EP5,548,3198P,F206,C,2,1                    HEINMILLER P.

@N MSG     FILE REQ,  TAPE  ( FH432 )   FSTRN  )                    27 JAN 71          14:33:25.  8

@  ASG X*3887)                                                      27 JAN 71          14:33:25.  9
```

This page shows typical control cards which are necessary to execute the GNAT program on the Univac 1108 system at NASA/MSC.

```
@ XQT CUR                                                    27 JAN 71          14:33:25.112
    1.   TR# X                                                                  14:33:25.858
    2.   IN X                                                                   14:33:25.840

      END OF FILE ON UNIT X
    3.   TRT X                                                                  14:33:34.812
    4.   TOC                                                                    14:33:34.815
```

FLEMENT TABLE

BLK1		SYMBOLIC	23 DEC 70	23:05:07	0	0193667₀	14	166
BLK2		SYMBOLIC	23 DEC 70	23:05:1₀	0	01443314	14	103
CROSS		SYMBOLIC	23 DEC 70	23:05:19	0	01450316	14	48
CRZTAP		SYMBOLIC	23 DEC 70	23:05:21	0	01451554	14	100
CSSTTH		SYMBOLIC	23 DEC 70	23:05:25	0	01454346	14	409
EQTANK		SYMBOLIC	23 DEC 70	23:05:39	0	01467504	14	317
HDTPP		SYMBOLIC	23 DEC 70	23:05:50	0	01500232	14	83
HPTD		SYMBOLIC	23 DEC 70	23:05:57	0	01502444	14	275
HPDTT		SYMBOLIC	23 DEC 70	23:06:07	0	01512056	14	82
HPTCV		SYMBOLIC	23 DEC 70	23:06:10	0	01514252	14	39
HPTCP		SYMBOLIC	23 DEC 70	23:06:12	0	01515314	14	39
HPTH		SYMBOLIC	23 DEC 70	23:06:13	0	01516356	14	180
HPTPT		SYMBOLIC	23 DEC 70	23:06:20	0	01523306	14	85
HPTV		SYMBOLIC	23 DEC 70	23:06:23	0	01525554	14	266
HPTTC		SYMBOLIC	23 DEC 70	23:06:32	0	01534770	14	229
ODT		SYMBOLIC	23 DEC 70	23:06:41	0	01543176	14	198
OPTPT		SYMBOLIC	23 DEC 70	23:06:48	0	01550522	14	83
PTHLAT		SYMBOLIC	23 DEC 70	23:06:51	0	01552734	14	180
STEP		SYMBOLIC	23 DEC 70	23:06:58	0	01557664	14	44
THERM		SYMBOLIC	23 DEC 70	23:06:59	0	01561034	14	371
TPOCB1		SYMBOLIC	23 DEC 70	23:07:12	0	01573144	14	927
TPOCB2		SYMBOLIC	23 DEC 70	23:07:45	0	01624430	14	204
MAIN		SYMBOLIC	24 DEC 70	09:17:18	0	01632134	14	309
BINSER		SYMBOLIC	24 DEC 70	09:17:31	0	01642374	14	101
HFRQ		SYMBOLIC	24 DEC 70	09:17:32	0	01645202	14	106
CROSS	CODE	RELOCATABLE	20 DEC 70	11:35:17	1	01650116	24	1
					0	01650146	14	5
HPDTT	CODE	RELOCATABLE	20 DEC 70	11:35:42	1	01650236	24	1
					0	01650266	14	8
STEP	CODE	RELOCATABLE	20 DEC 70	11:35:53	1	01650446	24	1
					0	01650476	14	9
MAIN	CODE	RELOCATABLE	23 DEC 70	23:04:16	1	01650566	36	1
					0	01650632	14	70
BLK1	CODE	RELOCATABLE	23 DEC 70	23:04:18	1	01652556	24	1
					0	01652626	14	101
BLK2	CODE	RELOCATABLE	23 DEC 70	23:04:19	1	01655414	24	1
					0	01655444	14	119
CRZTAP	CODE	RELOCATABLE	23 DEC 70	23:04:21	1	01660446	24	1
					0	01660676	14	14
CSSTTH	CODE	RELOCATABLE	23 DEC 70	23:04:24	1	01661202	36	1
					0	01661246	14	64
EQTANK	CODE	RELOCATABLE	23 DEC 70	23:04:29	1	01663046	36	1
					0	01663112	14	83
HDTPP	CODE	RELOCATABLE	23 DEC 70	23:04:31	1	01665324	24	1
					0	01665354	14	8
HPTCP	CODE	RELOCATABLE	23 DEC 70	23:04:32	1	01665534	24	1
					0	01665564	14	3
HPTCV	CODE	RELOCATABLE	23 DEC 70	23:04:33	1	01665636	24	1

HPTD	CODE	RELOCATABLE	23 DEC 70	23:04:36	0 01665664	14	3
					1 01665740	24	1
HPTH	CODE	RELOCATABLE	23 DEC 70	23:04:39	0 01665770	14	141
					1 01671656	24	1
HPTPT	CODE	RELOCATABLE	23 DEC 70	23:04:40	0 01671706	14	62
					1 01673452	24	1
ODT	CODE	RELOCATABLE	23 DEC 70	23:04:43	0 01673507	14	9
					1 01673700	24	1
HPTTC	CODE	RELOCATABLE	23 DEC 70	23:04:46	0 01673730	14	48
					1 01675170	24	1
HPTV	CODE	RELOCATABLE	23 DEC 70	23:04:49	0 01675220	14	96
					1 01677720	24	1
OPTPT	CODE	RELOCATABLE	23 DEC 70	23:04:50	0 01677750	14	100
					1 01702540	24	1
PTHEAT	CODE	RELOCATABLE	23 DEC 70	23:04:53	0 01702570	14	8
					1 01702750	24	1
THERM	CODE	RELOCATABLE	23 DEC 70	23:04:56	0 01703000	14	60
					1 01704510	72	1
TPOCB1	CODE	RELOCATABLE	23 DEC 70	23:05:00	0 01704620	14	55
					1 01706222	24	1
TPOCB2	CODE	RELOCATABLE	23 DEC 70	23:05:02	0 01706252	14	283
					1 01716044	24	1
BINSER	CODE	RELOCATABLE	24 DEC 70	09:17:31	0 01716074	14	35
					1 01717046	24	1
HFWQ	CODE	RELOCATABLE	24 DEC 70	09:17:32	0 01717076	14	13
					1 01717364	24	1
					0 01717414	14	9

ENTRY POINT TABLE

BINSER	(BINSER/CODE)	1	000137	CROSS	(CROSS/CODE)	1	000036	CR2TAP	(CR2TAP/CODE)	1	000134
CSSTTM	(CSSTTM/CODE)	1	000751	EQTANK	(EQTANK/CODE)	1	001366	HDTPP	(HDTPP/CODE)	1	000071
HFWQ	(HFWQ/CODE)	1	000065	HPDTT	(HPDTT/CODE)	1	000071	HPTCP	(HPTCP/CODE)	1	000016
HPTCV	(HPTCV/CODE)	1	000016	HPTD	(HPTD/CODE)	1	000544	HPTH	(HPTH/CODE)	1	000557
HPTPT	(HPTPT/CODE)	1	000064	HPTTC	(HPTTC/CODE)	1	000504	HPTV	(HPTV/CODE)	1	000461
ODTIC	(ODT/CODE)	1	000604	ODTIT	(ODT/CODE)	1	000613	ODTP	(ODT/CODE)	1	000575
OPDCP	(THERM/CODE)	1	000703	OPDCV	(THERM/CODE)	1	000643	OPDH	(THERM/CODE)	1	000603
OPDIC	(THERM/CODE)	1	000543	OPDIT	(THERM/CODE)	1	000503	OPDT	(THERM/CODE)	1	000743
OPTCP	(THERM/CODE)	1	000723	OPTCV	(THERM/CODE)	1	000663	OPTD	(THERM/CODE)	1	000463
OPTH	(THERM/CODE)	1	000623	OPTIC	(THERM/CODE)	1	000563	OPTIT	(THERM/CODE)	1	000523
OPTPT	(OPTPT/CODE)	1	000052	OPTTC	(THERM/CODE)	1	001003	OPTV	(THERM/CODE)	1	000763
PTHEAT	(PTHEAT/CODE)	1	000617	STEP	(STEP/CODE)	1	000023				

BLOCK TABLE

BLKPTH	(BLK1/CODE)	34	BANK 2 DEPENDENT	SPHEAT	(BLK2/CODE)	34	BANK 2 DEPENDENT
TPCB	(TPOCB1/CODE)	34	BANK 2 DEPENDENT	TPCB	(TPOCB2/CODE)	34	BANK 2 DEPENDENT

COBOL LIBRARY TABLE EMPTY

PROCEDURE NAME TABLE EMPTY

END CVR LCC 1102-0038 L8

```
@ FOR MAIN, MAIN                                    GNAT0009          27 JAN 71          14:33:34.480
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:33:34

   MAIN PROGRAM

   STORAGE USED (BLOCK, NAME, LENGTH)

      0001   *CODE   001247
      0000   *DATA   000137
      0002   *BLANK  000000
      0003   DATA    007164
      0004   D1      000014
      0005   D2      000010
      0006   CSTS    000006
      0007   TRNSMT  000005
      0010   DSTATE  003100


   EXTERNAL REFERENCES (BLOCK, NAME)

      0011   CRZTAP
      0012   ROTAPE
      0013   TAPERW
      0014   TAPEPS
      0015   TAPEPR
      0016   BETA
      0017   OPTD
      0020   RTPRES
      0021   MEANA
      0022   DIFF
      0023   BCOUT
      0024   MEANB
      0025   DIFF2
      0026   HEATER
      0027   TEMP
      0030   BULK
      0031   OUTPUT
      0032   TAPEOF
      0033   NRNL$
      0034   NWDU$
      0035   NIO1$
      0036   NIO2$
      0037   NSTOP$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

   0001   000001 100L      0001   000031 105L      0001   000123 125L      0001   000493 170L      0001   000041 180L
   0001   000447 200L      0001   000071 20[illegible]      0001   000117 215G      0001   000242 246G      0001   000332 273G
   0001   000351 277G      0001   000520 3[illegible]G      0001   000534 351G      0001   000636 364G      0001   000652 3[illegible]G
   0001   000720 404G      0001   000734 411G      0001   001043 427G      0001   001055 434G      0001   001161 480L
   0001   001204 500L      0001   001216 550L      0000   000070 910F      0003 R 000000 A         0003   000132 AVE
   0016 R 000000 BETA      0000 R 000024 C         0006 R 000000 CSTIL     0006 R 000003 CSTIL2    0006 R 000001 CST2L
   0006 R 000004 CST2L2    0006 R 000032 CST4L     0006 R 000005 CST4L2    0003 R 000000 CTL       0004 R 000000 DPDX
```

```
0004 R 000001 DPDY       0000 R 000005 DRBC       0000 R 000045 DWH        0000 R 000027 DRHEAT     0007 R 000001 DQ1
0007 R 000002 DQ2        0007 R 000003 DQ3        0007 R 000004 DQ4        0010 R 000000 DR         0010 R 000420 DRE
0005 R 000002 DREUDX     0005 R 000003 DREVDY     0010 R 001440 DRU        0005 R 000000 DRUDX      0004 R 000010 DRVUDX
0004 R 000013 DRUVDY     0010 R 002280 DRV        0005 R 000001 DRVDY      0004 R 000012 DRVUDX     0004 R 000011 DRVVDY
0003 R 000001 DT         0003 R 000003 DTPR       0003 R 000037 DTI        0005 R 000004 DUDX       0005 R 000005 DVDY
0005 R 000008 D2HDX2     0005 R 000007 D2HDY2     0004 R 000006 D2UDXY     0004 R 000002 D2UDX2     0004 R 000004 D2UDY2
0004 R 000007 D2VDXY     0004 R 000003 D2VDX2     0004 R 000005 D2VDY2     0000 R 000012 ENDECK     0000 R 000046 ERHO
0000 R 000032 EO         0000 R 000030 GX         0000 R 000031 GY         0003 R 001404 H          0000 D 000001 HH
0003 R 000034 HO         0000 I 000015 I          0003   000016 IFILER     0003 I 000021 IFILEW     0003   000017 IRECR
0003 I 000022 IRECW      0003 I 0000 5 ITAPE      0000 I 000042 ITERM      0003 I 000015 IUNITR     0003 I 000020 IUNITW
0000 I 000011 IS         0000 I 000[illegible] JS 0000 I 000020 J          0000 I 000018 J1         0000 I 000017 J2
0007 R 000000 K          0003 R 000031 L          0003 R 000036 LABEL      0003   000050 LIMITS     0000 I 000014 LINES
0000 R 000000 L3         0003 I 000121 NF         0003 I 000050 NG         0003 R 000122 NODES      0003 I 000074 NS
0003 I 000120 NO         0017 R 000000 OPTO       0003 R 000144 P          0003 D 000132 PBAR       0003 R 000035 PFLAG
0000 R 000043 PFLAGI     0000 R 000022 PHI        0000 R 000023 PLO        0000 R 000044 PREF       0003 R 000024 PROP
0000 R 000021 PO         0000 R 000033 PI         0003 R 000744 R          0003   000044 RATES      0003 D 000134 RBAR
0003 R 000032 RCONST     0003 R 004704 RE         0003 D 000136 REBAR      0000 R 000035 REFG       0000 R 000040 RHO
0000 R 000038 RI         0000 R 000037 RJ         0000 D 000003 RR         0020 R 000000 RTPRES     0003 R 005524 RU
0003 R 006344 RV         0000 R 000034 RO         0003 R 000014 SCALE      0003   000144 STATE      0003 R 000023 STOPFG
0003 R 000036 T          0027 R 000000 TEMP       0000 R 000041 TPR        0003 R 000040 TSCALE     0003 R 000002 TSTOP
0003 R 000000 TO         0003 R 002424 U          0003 R 003244 V          0000 R 000025 VSC        0000 R 000026 WDOT
0003 R 000024 WTR        0003   000030 Z
```

```
00100     1*    C                                                                GNAT0010
00100     2*    C  P J HEINMILLER   T R W    M4 1121   TEL  591 3133  X 2701     GNAT0011
00100     3*    C                                                                GNAT0012
00100     4*    C                                                                GNAT0013
00101     5*          REAL L, K, NODES, LABEL, L3                                GNAT0014
00103     6*          COMMON /DATA/ A(3700)                                      GNAT0015
00104     7*          COMMON /D1/ DPDX,DPDY,D2UDX2,D2VDX2,D2UDY2,D2VDY2,         GNAT0016
00104     8*         1    D2UDXY,D2VDXY,DRUUDX,DRVVDY,DRVUDX,DRUVDY              GNAT0017
00105     9*          COMMON /D2/ DRUDX,DRVDY,DREUDX,DREVDY,DUDX,DVDY,D2HDX2,D2HDY2 GNAT0018
00106    10*          COMMON /CSTS/ CST1L,CST2L,CST4L,CST1L2,CST2L2,CST4L2       GNAT0019
00107    11*          COMMON /TRNSMT/ K,DQ1,DQ2,DQ3,DQ4                          GNAT0020
00110    12*          COMMON /DSTATE/ DR(20,20), DRE(20,20), DRU(20,20), DRV(20,20) GNAT0021
00111    13*          EQUIVALENCE                                                GNAT0022
00111    14*         1   (A(1),CTL)                                              GNAT0023
00111    15*         2,  (A(2),PROP)                                             GNAT0024
00111    16*         3,  (A(3)),LABEL)                                           GNAT0025
00111    17*         3,  (A(91),LIMITS)                                          GNAT0026
00111    18*         4,  (A(?1),AVE)                                             GNAT0027
00111    19*         5,  (A(101),STATE)                                          GNAT0028
00111    20*         6,  (A(2101),RATES)                                         GNAT0029
00112    21*          DIMENSION AVE(10), RATES(1600), STATE(2000)                GNAT0030
00113    22*          DIMENSION P(20,20),R(20,20),H(20,20),U(20,20),V(20,20)     GNAT0031
00114    23*          DIMENSION  RE(20,20), RU(20,  ), RV(20,20)                 GNAT0032
00115    24*          EQUIVALENCE                                                GNAT0033
00115    25*         1   (STATE(  1),P)                                          GNAT0034
00115    26*         2,  (STATE(401),R)                                          GNAT0035
00115    27*         3,  (STATE(801),H)                                          GNAT0036
00115    28*         4,  (STATE(1201),U)                                         GNAT0037
00115    29*         5,  (STATE(1601),V)                                         GNAT0038
00115    30*         7,  (RATES(401), RE )                                       GNAT0039
00115    31*         8,  (RATES(?01),RU )                                        GNAT0040
00115    32*         9,  (RATES(1201),RV )                                       GNAT0041
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00116    38*        DOUBLE PRECISION PBAR, RBAR, REBAR                                GNAT0042
00117    39*        DOUBLE PRECISION HH, RR                                           GNAT0043
00120    40*        EQUIVALENCE (AVE(1),PBAR), (AVE(3),RBAR), (AVE(5),REBAR)          GNAT0044
00121    41*        DIMENSION LABEL(10)                                               GNAT0045
00122    42*        EQUIVALENCE                                                       GNAT0046
00122    43*       1   (LABEL(1),T)                                                   GNAT0047
00122    44*       2,  (LABEL(2),DT1)                                                GNAT0048
00122    45*       3,  (LABEL(3),TSCALE)                                             GNAT0049
00123    46*        DIMENSION LIMITS(50)                                              GNAT0050
00124    47*        EQUIVALENCE (LIMITS(1),NG),(LIMITS(2),NS)                         GNAT0051
00124    48*       1, (LIMITS(41),NO),(LIMITS(42),NF),(LIMITS(43),NODES)              GNAT0052
00125    49*        DIMENSION  PROP(10), CTL(20), NG(20), NS(20), DQBC(4)             GNAT0053
00126    50*        EQUIVALENCE (PROP(1),WTH), (PROP(5),Z), (PROP(6),L),              GNAT0054
00126    51*       1   (PROP(7), RCONST), (PROP(9),HO)                                GNAT0055
00127    52*        EQUIVALENCE (CTL(1),TB), (CTL(2),DT), (CTL(3),TSTOP),             GNAT0056
00127    53*       1   (CTL(4),DTPR), (CTL(20),STOPPS)                               GNAT0057
00127    54*       2  , (CTL(13),SCALE)                                              GNAT0058
00130    55*        DIMENSION ITAPE(6)                                                GNAT0059
00131    56*        EQUIVALENCE (CTL(14),ITAPE(1))                                    GNAT0060
00131    57*       1,   (ITAPE(1),IUNITR), (ITAPE(2),IFILER), (ITAPE(3),IRECR)       GNAT0061
00131    58*       2,   (ITAPE(4),IUNITW), (ITAPE(5),IFILEW), (ITAPE(6),IRECW)       GNAT0062
00132    59*        EQUIVALENCE (PROP(10),PFLAG)                                      GNAT0063
00132    60*  C                                                                       GNAT0064
00133    61*        DATA PROP    / 32., .200, .08, 1.2E-3, .2, .1, 4*0. /             GNAT0065
00135    62*        DATA CTL     /  0., .001,  60., .01,   0.,   0., 0., 0., 0., 0.,  GNAT0066
00135    63*       1    0.,-1.,1., 7*0. /                                           GNAT0067
00137    64*        DATA NG / 8, 6, 4, 3, 3, 2, 2, 1, 1, 1, 1, 1, 1, 2, 2, 3, 3, 4,  GNAT0068
00137    65*       1    6, 8 /                                                      GNAT0069
00141    66*        DATA NS /13,15,17,18,18,19,19,20,20,20,20,20,20,19,19,18,18,17,   GNAT0070
00141    67*       1   16,13 /                                                      GNAT0071
00143    68*        DATA ENDECK, 15, LINES / 6H SEND , 10 ,59 /                       GNAT0072
00147    69*        DATA PFLAG /0./                                                   GNAT0073
00147    70*  C                                                                       GNAT0074
00147    71*  C  STATEMENT FUNCTIONS                                                 GNAT0075
00151    72*        FR(I,J) = R(I,J) + RBAR                                           GNAT0076
00161    73*  C                                                                       GNAT0077
00152    74*        NAMELIST /INPUT/ PROP, CTL, NG, NS, ITAPE                         GNAT0078
00152    75*  C                                                                       GNAT0079
00152    76*  C                                                                       GNAT0080
00152    77*  C  TO INPUT STATE FROM TAPE ENTER IUNITR =, IFILE =, IRECR = AND ITAPE(1)GNAT0081
00152    78*  C                                                                       GNAT0082
00153    79*        IUNITR = 0                                                        GNAT0083
00154    80*    100 CONTINUE                                                          GNAT0084
00155    81*        CALL CR2TAP ( ENDECK, 15, LINES )                                 GNAT0085
00156    82*        READ (15,INPUT)                                                   GNAT0086
00161    83*        IF (IUNITR.LE.0) GO TO 105                                        GNAT0087
00163    84*        CALL RDTAPE                                                       GNAT0088
00164    85*        CALL CR2TAP ( ENDECK, 15, LINES )                                 GNAT0089
00165    86*        READ (15,INPUT)                                                   GNAT0090
00165    87*  C                                                                       GNAT0091
00170    88*    105 CONTINUE                                                          GNAT0092
00170    89*  C  POSITION OUTPUT TAPE IF REQUIRED                                    GNAT0093
00171    90*        IF (IUNITW.LE.0) GO TO 180                                        GNAT0094
00173    91*        CALL TAPERW (0,IUNITW)                                            GNAT0095
00174    92*        CALL TAPEPS (0,IUNITW,IFILEW-1,IRECW-1)                           GNAT0096
00175    93*        CALL TAPEPR (0,IUNITW)                                            GNAT0097
00176    94*    180 CONTINUE                                                          GNAT0098
00177    95*        DT1 = DT                                                          GNAT0099
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00177    91*  C                                                              GNATO100
00200    92*       NO = 20                                                   GNATO101
00201    93*       NF = 0                                                    GNATO102
00202    94*       NODES = 0.                                                GNATO103
00203    95*       DO 125 I=1,20                                             GNATO104
00206    96*         J1 = NG(I)                                              GNATO105
00207    97*         J2 = NS(I)                                              GNATO106
00210    98*       IF (J1.LE.0) GO TO 125                                    GNATO107
00212    99*       NO = MIND (NO,J1)                                         GNATO108
00213   100*       NF = MAXO (NF,J2)                                         GNATO109
00214   101*       DO 120 J=J1,J2                                            GNATO110
00217   102*  120 NODES = NODES + 1.                                         GNATO111
00221   103*  125 CONTINUE                                                   GNATO112
00221   104*  C  SET CONSTANTS FOR DIVISION IN DIFFERENCE ROUTINES           GNATO113
00223   105*       L3 = L**3                                                 GNATO114
00224   106*       CST1L = 1. / L                                            GNATO115
00225   107*       CST2L = .5 / L                                            GNATO116
00226   108*       CST4L  = .25 / L                                          GNATO117
00227   109*       CST1L2 = 1. / L**2                                        GNATO118
00230   110*       CST2L2 = .5 /  L**2                                       GNATO119
00231   111*       CST4L2 = .25 / L**2                                       GNATO120
00231   112*  C  CONVERT UNITS                                               GNATO121
00232   113*       PO = PROP(8)* 144.                                        GNATO122
00233   114*       PHI = 900. * 144.                                         GNATO123
00234   115*       PLO = 860. * 144.                                         GNATO124
00235   116*       C   = PROP(2) * 778.156 * 32.2                            GNATO125
00236   117*       K   = PROP(3) * 778.156 / 3600. * SCALE                   GNATO126
00237   118*       VSC = PROP(4) * 2.0886E-3 * SCALE                         GNATO127
00240   119*       HDOT = CTL(5) / 32.2 / 3600. * .075 * SCALE               GNATO128
00241   120*       DQHEAT = CTL(6) * 778.156 /3600. /17. / 1. * SCALE        GNATO129
00241   121*  C  UNITS  VSC = LBF-SEC/FT**2      INPUT AS POISE              GNATO130
00242   122*       RCONST = 32.2 * 1545. / MTH                               GNATO131
00243   123*       GX = 32.2*CTL(11) * SCALE **2                             GNATO132
00244   124*       GY = 32.2*CTL(12) * SCALE **2                             GNATO133
00245   125*       DO 110 I=1,4                                              GNATO134
00250   126*       DQBC(I) = CTL(I+6) * 778.156 / 3600. * SCALE              GNATO135
00251   127*  110 CONTINUE                                                   GNATO136
00253   128*       DQ1 = DQBC(1)                                             GNATO137
00254   129*       DQ2 = DQBC(2)                                             GNATO138
00255   130*       DQ3 = DQBC(3)                                             GNATO139
00256   131*       DQ4 = DQBC(4)                                             GNATO140
00256   132*  C  SET INITIAL CONDITIONS                                      GNATO141
00257   133*       IF (IUNITS.GT.0) GO TO 170                                GNATO142
00261   134*       T = T0                                                    GNATO143
00262   135*       PBAR = PO                                                 GNATO144
00263   136*       EO = BETA (T0) * 778.156 * 32.2                           GNATO145
00263   137*  CC   RO = PO / (Z* RCONST* HO)                                 GNATO146
00264   138*       PI = PO / 144.                                            GNATO147
00265   139*       RO = OPTD( PI,HS ) /32.2                                  GNATO148
00266   140*       RBAR = RO                                                 GNATO149
00267   141*       REBAR = RO * EO                                           GNATO150
00270   142*       REFG = FLOAT (NF-NO) /2. +1.                              GNATO151
00271   143*       DO 150 I=NO,NF                                            GNATO152
00274   144*       JI = NG(I)                                                GNATO153
00275   145*       J2 = NS(I)                                                GNATO154
00276   146*       DO 150 J=J1,J2                                            GNATO155
00301   147*       RI = I                                                    GNATO156
00302   148*       RJ = J                                                    GNATO157
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00303   149*          P(I,J) =    = RO * ( GX*L* (REFG-RI) + GY*L* (REFG-RJ) )          GNAT0158
00303   150*    C     R(I,J) =  (P(I,J)+ PBAR)  / ( Z* RCONST * HO ) - RBAR             GNAT0159
00304   151*          PI = ( P(I,J)+PBAR ) / 144.                                       GNAT0160
00305   152*          R(I,J) = OPTO( PI,HO ) / 32.2 - RO                                GNAT0161
00306   153*          RU(I,J) = 0.                                                      GNAT0162
00307   154*          RV(I,J) = 0.                                                      GNAT0163
00310   155*          RE(I,J) = EO * R(I,J)                                             GNAT0164
00311   156*          H(I,J) = HO                                                       GNAT0165
00311   157*    C                                                                       GNAT0166
00312   158*          RHO = R(I,J) + RBAR                                               GNAT0167
00313   159*          P(I,J) = RTPRES( RHO, H(I,J) ) - PBAR                             GNAT0168
00313   160*    C                                                                       GNAT0169
00314   161*          U(I,J) = 0.                                                       GNAT0170
00315   162*          V(I,J) = 0.                                                       GNAT0171
00316   163*      150 CONTINUE                                                          GNAT0172
00316   164*    C                                                                       GNAT0173
00321   165*      170 CONTINUE                                                          GNAT0174
00322   166*          TPR = T                                                           GNAT0175
00323   167*          ITERM = 0                                                         GNAT0176
00324   168*          GO TO 480                                                         GNAT0177
00324   169*    C  SKIP TO 480 = OUTPUT INITIAL CONDITIONS                              GNAT0178
00324   170*    C                                                                       GNAT0179
00325   171*      200 CONTINUE                                                          GNAT0180
00325   172*    C                                                                       GNAT0181
00326   173*          PFLAG1 = PFLAG                                                    GNAT0182
00327   174*          PREF = PBAR                                                       GNAT0183
00330   175*          IF ( PREF .GT. PHI ) PFLAG = 0.                                   GNAT0184
00332   176*          IF ( PREF .LT. PLO ) PFLAG = 1.                                   GNAT0185
00334  *DIAGNOSTIC* THE TEST FOR EQUALITY BETWEEN NON-INTEGERS MAY NOT BE MEANINGFUL.
00334   177*          IF ( PFLAG .NE. PFLAG1 ) WRITE (6,910) T, PFLAG                   GNAT0186
00341   178*      910 FORMAT (1HO, E12.6, 5X, 7HPFLAG =, F3.0 / )                       GNAT0187
00341   179*    C  COMPUTE 1ST DIFFERENCES FOR VELOCITY CALCULATIONS                    GNAT0188
00342   180*          CALL MEANA                                                        GNAT0189
00343   181*          DO 270 I=NO,NF                                                    GNAT0190
00346   182*            J1 = NG(I)                                                      GNAT0191
00347   183*            J2 = NS(I)                                                      GNAT0192
00350   184*          DO 270 J=J1,J2                                                    GNAT0193
00353   185*          CALL DIFF ( I,J )                                                 GNAT0194
00353   186*    C  COMPUTE RATE OF CHANGE OF VELOCITIES                                 GNAT0195
00354   187*          DRU(I,J) = - DRUUDX - DRUVDY - DPDX + GX* FR(I,J) +               GNAT0196
00354   188*         1      VSC * (D2UDX2+D2UDY2 +(D2UDX2+D2VDXY) /3. )                GNAT0197
00355   189*          DRV(I,J) = - DRVUDX - DRVVDY - DPDY + GY* FR(I,J) +               GNAT0198
00355   190*         1      VSC * (D2VDX2+D2VDY2 +(D2VDY2+D2UDXY) /3. )                GNAT0199
00356   191*      270 CONTINUE                                                          GNAT0200
00361   192*          IF ( MDOT.GT. 0.) CALL BCOUT(1,RDOT)                              GNAT0201
00361   193*    C  UPDATE VELOCITIES                                                    GNAT0202
00363   194*          DO 300 I=NO,NF                                                    GNAT0203
00366   195*          J1 = NG(I)                                                        GNAT0204
00367   196*          J2 = NS(I)                                                        GNAT0205
00370   197*          DO 300 J=J1,J2                                                    GNAT0206
00373   198*          RU(I,J) = RU(I,J) + DT * DRU(I,J)                                 GNAT0207
00374   199*          RV(I,J) = RV(I,J) + DT * DRV(I,J)                                 GNAT0208
00375   200*           U(I,J) = RU(I,J) / FR(I,J)                                       GNAT0209
00376   201*           V(I,J) = RV(I,J) / FR(I,J)                                       GNAT0210
00377   202*      300 CONTINUE                                                          GNAT0211
00377   203*    C  COMPUTE DIFFERENCES FOR HEAT RATE EQUATION                           GNAT0212
00402   204*          CALL MEANB                                                        GNAT0213
00403   205*          DO 350 I=NO,NF                                                    GNAT0214
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00406   206*          J1 = NG(I)                                                    GNAT0215
00407   207*          J2 = NS(I)                                                    GNAT0216
00410   208*          DO 350 J=J1,J2                                                GNAT0217
00411   209*          CALL DIFF2 (I,J)                                              GNAT0218
00413   210*    C  COMPUTE DENSITY AND HEAT RATES                                   GNAT0219
00414   211*          DR(I,J) = - DRUDX * DRVDY - RBAR * (DUDX+DVDY)                GNAT0220
00415   212*          DRE(I,J) = - DREUDX - DREVDY - (PBAR + REBAR)*(DUDX + DVDY) + GNAT0221
00415   213*         1      K * (DZHDX2+DZHDY2)                                    GNAT0222
00416   214*      350 CONTINUE                                                      GNAT0223
00421   215*          IF ( WDOT.GT. 0.) CALL BCOUT(2,WDOT)                          GNAT0224
00423   216*          DQH = DQHEAT * FFLAG                                          GNAT0225
00424   217*          IF ( DQH .GT.0. ) CALL HEATER ( DQH,L3 )                      GNAT0226
00424   218*    C  UPDATE HEAT AND MASS                                             GNAT0227
00426   219*          DO 450 I=KD,NE                                                GNAT0228
00431   220*          J1 = NG(I)                                                    GNAT0229
00432   221*          J2 = NS(I)                                                    GNAT0230
00433   222*          DO 450 J=J1,J2                                                GNAT0231
00436   223*          R(I,J) = R(I,J) + DT* DR(I,J)                                 GNAT0232
00437   224*          RE(I,J) = RE(I,J) + DT * DRE(I,J)                             GNAT0233
00440   225*          RR = R(I,J) + RBAR                                            GNAT0234
00441   226*          U(I,J) = RU(I,J) / RR                                         GNAT0235
00442   227*          V(I,J) = RV(I,J) / RR                                         GNAT0236
00443   228*          ERHO = RE(I,J) + REBAR                                        GNAT0237
00444   229*          RHO = RR                                                      GNAT0238
00445   230*          H(I,J) = TEMP( ERHO, RHO )                                    GNAT0239
00446   231*          HH = H(I,J)                                                   GNAT0240
00446   232*    C     CALL PRESS ( P(I,J) , R(I,J) , HH )                           GNAT0241
00447   233*          P(I,J) = RTPRES(RHO,H(I,J)) - PBAR                            GNAT0242
00447   234*    C                                                                   GNAT0243
00450   235*          IF ( RHO .LT. 0.) ITERM = 1                                   GNAT0244
00452   236*      450 CONTINUE                                                      GNAT0245
00455   237*          CALL BULK                                                     GNAT0246
00456   238*          IF (ITERM .EQ. 1) GO TO 480                                   GNAT0247
00460   239*          IF ( T .LT. TPR+.0000I) GO TO 500                             GNAT0248
00462   240*      480 CONTINUE                                                      GNAT0249
00463   241*          TSCALE = T * SCALE / 60.                                      GNAT0250
00464   242*          CALL OUTPUT  ( T, DT, TSCALE, 0., 0., HD )                    GNAT0251
00465   243*          IF (ITERM .EQ. 1) GO TO 550                                   GNAT0252
00467   244*          TPR = TPR + DTPR                                              GNAT0253
00470   245*      500 CONTINUE                                                      GNAT0254
00471   246*          T = T + DT                                                    GNAT0255
00472   247*          IF ( T.LE. TSTOP+DT*1.E-5 ) GO TO 200                         GNAT0256
00474   248*      550 CONTINUE                                                      GNAT0257
00475   249*          IF (IUNITW.GT.0) CALL TAPEOF (0,IUNITW)                       GNAT0258
00477   250*          IF (IUNITW.GT.0) CALL TAPERW (0,IUNITW)                       GNAT0259
00501   251*          IF ( STOPFG .LT. 1. ) GO TO 100                               GNAT0260
00503   252*          STOP                                                          GNAT0261
00504   253*          END                                                           GNAT0262

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     1 *DIAGNOSTIC* MESSAGE(S)
   MAIN            SYMBOLIC                                  29 DEC 70  09:17:18   0  01632134    14    304  (DELETED)
   MAIN    CODE    RELOCATABLE                               23 DEC 70  23:04:16   1  01650564    36      1  (DELETED)
                                                                                    0  01650432    14     70
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@ FOR MEANA, MEANA                                          GNAT0263          27 JAN 71          14:33:38.435
UNIVAC 1100 FORTRAN V LEVEL   2206 0018 F5018M
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:33:38

   SUBROUTINE MEANA     ENTRY POINT 000354

   STORAGE USED (BLOCK, NAME, LENGTH)

      0001   *CODE   000373
      0000   *DATA   000047
      0002   *BLANK  000000
      0003   DATA    007164
      0004   NODMAL  010472


   EXTERNAL REFERENCES (BLOCK, NAME)

      0005   NERR3S


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

 0001   000005 113G      0001   000044 124G      0001   000145 20L       0001   000166 30L       0001   000204 50L
 0001   000257 70L       0001   000300 80L       0001   000320 90L       0003 R 000000 A         0000 I 000003 I
 0000 I 000001 II        0000 I 000002 I2        0000 I 000000 J         0003   000050 LIMITS    0003 I 000121 NF
 0003 I 000050 NG        0003 I 000074 NS        0003 I 000120 NO        0003   004064 RATES     0004 R 006710 REX
 0004 R 007601 REY       0003 R 005524 RU        0004 R 000000 RUX       0004 R 000671 RUY       0003 R 006344 RV
 0004 R 001562 RVX       0004 R 002453 RVY       0004 R 005126 RX        0004 R 004057 RY        0003   000144 STATE
 0004 R 002424 U         0004 R 003344 UX        0003 R 003244 V         0004 R 004235 VY


00101    1*         SUBROUTINE MEANA                                                    GNAT0264
00101    2*   C                                                                         GNAT0265
00101    3*   C  INTERPOLATE VALUES OF VELOCITY AND MOMENTUM AT NODE FACES              GNAT0266
00101    4*   C                                                                         GNAT0267
00103    5*         COMMON /DATA/ A(3700)                                               GNAT0268
00104    6*         COMMON /NODMAL/ RUX(21,21),RUY(21,21),RVX(21,21),RVY(21,21)         GNAT0269
00104    7*        1, UX(21,21),VY(21,21),RX(21,21),RY(21,21),REX(21,21),REY(21,21)    GNAT0270
00104    8*   C                                                                         GNAT0271
00105    9*         DIMENSION RATES(1600),STATE(2000),LIMITS(50),NG(20),NS(20)          GNAT0272
00106   10*         DIMENSION U(20,20),V(20,20),RU(20,20),RV(20,20)                     GNAT0273
00107   11*         EQUIVALENCE (A(4)),LIMITS), (A(101),STATE), (A(2101),RATES)         GNAT0274
00110   12*         EQUIVALENCE (STATE(1201),U), (STATE(1601),V)                        GNAT0275
00110   13*        1, (RATES(801),RU), (RATES(1201),RV)                                 GNAT0276
00111   14*         EQUIVALENCE (LIMITS(1),NG), (LIMITS(21),NS)                         GNAT0277
00111   15*        1, (LIMITS(41),NO), (LIMITS(42),NF)                                  GNAT0278
00111   16*   C                                                                         GNAT0279
00112   17*         DO 100 J=NO,NF                                                      GNAT0280
00115   18*           I1 = NG(J) + 1                                                    GNAT0281
00116   19*           I2 = NS(J)                                                        GNAT0282
00117   20*         UX(I1-1,J) = 0.                                                     GNAT0283
00120   21*         UX(I2+1,J) = 0.                                                     GNAT0284
00121   22*         VY(J,I1-1) = 0.                                                     GNAT0285
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00122    23*          VY(J,I2+1) = 0.                                                    GNAT0286
00123    24*          DO 100 I=I1,I2                                                     GNAT0287
00126    25*           UX(I,J) = ( U(I-1,J) +  U(I,J) )/ 2.                              GNAT0288
00127    26*           VY(J,I) = ( V(J,I-1) +  V(J,I) )/ 2.                              GNAT0289
00130    27*          IF( (UX(I,J).GT.0.).AND.(I.GT.I1) ) GO TO 20                       GNAT0290
00132    28*          IF( (UX(I,J).LT.0.).AND.(I.LT.I2) ) GO TO 30                       GNAT0291
00134    29*          RUX(I,J) = ( RU(I-1,J) + RU(I,J) )/2.                              GNAT0292
00135    30*          RVX(I,J) = ( RV(I-1,J) + RV(I,J) )/2.                              GNAT0293
00136    31*          GO TO 50                                                           GNAT0294
00137    32*       20 CONTINUE                                                           GNAT0295
00140    33*          RUX(I,J) = ( -RU(I-2,J) +6.*RU(I-1,J) +3.*RU(I,J) )/8.             GNAT0296
00141    34*          RVX(I,J) = ( -RV(I-2,J) +6.*RV(I-1,J) +3.*RV(I,J) )/8.             GNAT0297
00142    35*          GO TO 50                                                           GNAT0298
00143    36*       30 CONTINUE                                                           GNAT0299
00144    37*          RUX(I,J) = ( 3.*RU(I-1,J) +6.*RU(I,J) -RU(I+1,J) )/8.              GNAT0300
00145    38*          RVX(I,J) = ( 3.*RV(I-1,J) +6.*RV(I,J) -RV(I+1,J) )/8.              GNAT0301
00146    39*       50 CONTINUE                                                           GNAT0302
00147    40*          IF ( (VY(J,I).GT.0.).AND.(I.GT.I1) ) GO TO 70                      GNAT0303
00151    41*          IF ( (VY(J,I).LT.0.).AND.(I.LT.I2) ) GO TO 80                      GNAT0304
00153    42*          RUY(J,I) = ( RU(J,I-1) + RU(J,I) )/2.                              GNAT0305
00154    43*          RVY(J,I) = ( RV(J,I-1) + RV(J,I) )/2.                              GNAT0306
00155    44*          GO TO 90                                                           GNAT0307
00156    45*       70 CONTINUE                                                           GNAT0308
00157    46*          RUY(J,I) = ( -RU(J,I-2) +6.*RU(J,I-1) +3.*RU(J,I) )/8.             GNAT0309
00160    47*          RVY(J,I) = ( -RV(J,I-2) +6.*RV(J,I-1) +3.*RV(J,I) )/8.             GNAT0310
00161    48*          GO TO 90                                                           GNAT0311
00162    49*       80 CONTINUE                                                           GNAT0312
00163    50*          RUY(J,I) = ( 3.*RU(J,I-1) +6.*RU(J,I) - RU(J,I+1) )/8.             GNAT0313
00164    51*          RVY(J,I) = ( 3.*RV(J,I-1) +6.*RV(J,I) - RV(J,I+1) )/8.             GNAT0314
00165    52*       90 CONTINUE                                                           GNAT0315
00166    53*      100 CONTINUE                                                           GNAT0316
00171    54*          RETURN                                                             GNAT0317
00172    55*          END                                                                GNAT0318

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
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@ FOR MEANB, MEANB                                    GNAT0319          27 JAN 71          14:33:40.474
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018M
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:33:40


   SUBROUTINE MEANB     ENTRY POINT 000332

   STORAGE USED (BLOCK, NAME, LENGTH)

      0001   *CODE   000347
      0000   *DATA   000043
      0002   *BLANK  000000
      0003   DATA    007164
      0004   NODWAL  010472


   EXTERNAL REFERENCES (BLOCK, NAME)

      0005   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001    000005 113G      0001    000034 120G      0001    000125 20L       0001    000146 30L       0001    000166 50L
    0001    000237 70L       0001    000260 80L       0001    000300 90L       0003 R  000000 A         0000 I  000003 I
    0000 I  000001 II        0000 I  000002 I2        0000 I  000000 J         0003    000050 LIMITS    0003 I  000121 NF
    0003 I  000050 NG        0003 I  000074 NS        0003 I  000120 NO        0003 R  000744 R         0003    000044 RATES
    0003 R  004704 RE        0004 R  006710 REX       0004 R  007601 REY       0004 R  000000 RVX       0004 R  000671 RVY
    0004 R  001562 RVX       0004 R  002453 RVY       0004 R  005126 RX        0004 R  006017 RY        0003    000144 STATE
    0003 R  002424 U         0004 R  003344 UX        0003 R  003244 V         0004 R  004235 VY


00101     1*         SUBROUTINE MEANB                                                    GNAT0320
00101     2*   C                                                                         GNAT0321
00101     3*   C  INTERPOLATE VALUES OF VELOCITY, DENSITY, AND ENERGY AT NODE FACES      GNAT0322
00101     4*   C                                                                         GNAT0323
00103     5*         COMMON /DATA/ A(3700)                                               GNAT0324
00104     6*         COMMON /NODWAL/ RVX(21,21),RVY(21,21),RVX(21,21),RVY(21,21)         GNAT0325
00104     7*        1,  UX(21,21),VY(21,21),RX(21,21),RY(21,21),REX(21,21),REY(21,21)   GNAT0326
00104     8*   C                                                                         GNAT0327
00105     9*         DIMENSION RATES(1400),STATE(2000),LIMITS(50),NG(20),NS(20)          GNAT0328
00106    10*         DIMENSION U(20,20),V(20,20),R(20,20),RE(20,20)                      GNAT0329
00107    11*         EQUIVALENCE (A(41),LIMITS), (A(101),STATE), (A(2101),RATES)         GNAT0330
00110    12*         EQUIVALENCE (STATE(1201),U), (STATE(1601),V)                        GNAT0331
00110    13*        1,  (STATE(401),R), (RATES(401),RE)                                  GNAT0332
00111    14*         EQUIVALENCE (LIMITS(1),NG), (LIMITS(2),NS)                          GNAT0333
00111    15*        1,  (LIMITS(41),NO), (LIMITS(42),NF)                                 GNAT0334
00111    16*   C                                                                         GNAT0335
00112    17*         DO 100 J=NO,NF                                                      GNAT0336
00115    18*           II = NG(J) + 1                                                    GNAT0337
00115    19*           I2 = NS(J)                                                        GNAT0338
00117    20*         DO 100 I=I1,I2                                                      GNAT0339
00122    21*          UX(I,J) = ( U(I-1,J) +  U(I,J) )/2.                                GNAT0340
00123    22*          VY(J,I) = ( V(J,I-1) +  V(J,I) )/2.                                GNAT0341
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00124    23*          IF( (UX(I-1,J)*GT*0.)*AND*(I*GT*1) ) GO TO 20                    GNAT0342
00126    24*          IF( (UX(I,J)*LT*0.)*AND*(I*LT*2) ) GO TO 30                      GNAT0343
00130    25*          R X(I,J) = ( R (I-1,J) + R (I,J) )/2.                            GNAT0344
00131    26*          REX(I,J) = ( RE(I-1,J) + RE(I,J) )/2.                            GNAT0345
00132    27*          GO TO 50                                                         GNAT0346
00133    28*       20 CONTINUE                                                         GNAT0347
00134    29*          R X(I,J) = ( -R (I-2,J) +6.*R (I-1,J) +3.*R (I,J) )/8.           GNAT0348
00135    30*          REX(I,J) = ( -RE(I-2,J) +6.*RE(I-1,J) +3.*RE(I,J) )/8.           GNAT0349
00136    31*          GO TO 50                                                         GNAT0350
00137    32*       30 CONTINUE                                                         GNAT0351
00140    33*          R X(I,J) = ( 3.*R (I-1,J) +6.*R (I,J) -R (I+1,J) )/8.            GNAT0352
00141    34*          REX(I,J) = ( 3.*RE(I-1,J) +6.*RE(I,J) -RE(I+1,J) )/8.            GNAT0353
00142    35*       50 CONTINUE                                                         GNAT0354
00143    36*          IF ( (VY(J,I),GT.0.),AND.(I.GT.1) ) GO TO 70                     GNAT0355
00145    37*          IF ( (VY(J,I),LT.0.),AND.(I.LT.2) ) GO TO 80                     GNAT0356
00147    38*          R Y(J,I) = ( R (J,I-1) + R (J,I) )/2.                            GNAT0357
00150    39*          REY(J,I) = ( RE(J,I-1) + RE(J,I) )/2.                            GNAT0358
00151    40*          GO TO 90                                                         GNAT0359
00152    41*       70 CONTINUE                                                         GNAT0360
00153    42*          R Y(J,I) = ( -R (J,I-2) +6.*R (J,I-1) +3.*R (J,I) )/8.           GNAT0361
00154    43*          REY(J,I) = ( -RE(J,I-2) +6.*RE(J,I-1) +3.*RE(J,I) )/8.           GNAT0362
00155    44*          GO TO 90                                                         GNAT0363
00156    45*       80 CONTINUE                                                         GNAT0364
00157    46*          R Y(J,I) = ( 3.*R (J,I-1) +6.*R (J,I) - R (J,I+1) )/8.           GNAT0365
00160    47*          REY(J,I) = ( 3.*RE(J,I-1) +6.*RE(J,I) - RE(J,I+1) )/8.           GNA[illegible]6
00161    48*       90 CONTINUE                                                         GNA[illegible]7
00162    49*      100 CONTINUE                                                         GNA[illegible]8
00165    50*          RETURN                                                           GNAT0369
00166    51*          END                                                              GNAT0370

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
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90

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@ FOR  DIFF, DIFF                                   GNAT0371              27 JAN 71          14:33:42.615
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 FS018H
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:33:42


   SUBROUTINE DIFF      ENTRY POINT 000613

   STORAGE USED (BLOCK, NAME, LENGTH)

      0001   *CODE   000674
      0000   *DATA   000032
      0002   *BLANK  000000
      0003   DATA    007164
      0004   D1      000G14
      0005   NORMAL  010472
      0006   CSTS    000006


   EXTERNAL REFERENCES (BLOCK, NAME)

      0007   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

 0001    000152 Z10L       0001    000243 Z11L       0001    000248 Z12L       0001    000303 Z20L       0001    000374 Z21L
 0001    000414 Z22L       0001    000434 Z30L       0001    000473 Z31L       0001    000515 Z40L       0001    000554 Z41L
 0001    000575 300L       0003 R 000000 A          0006 R 000003 CST12       0006 R 000000 CST1L       0006 R 000003 CST1L2
 0006 R 000001 CST2L       0004 R 000009 CST2L2      0006 R 000002 CST4L       0006 R 000005 CST4L2      0004 R 000000 DPDX
 0004 R 000001 DPDY        0004 R 000010 DRUUDX      0004 R 000013 DRUVDY      0004 R 000012 DRVUDX      0004 R 000011 DRVYDY
 0004 R 000006 D2UDXY      0004 R 000002 D2UDX2      0004 R 000004 D2UDY2      0004 R 000007 D2VDXY      0004 R 000003 D2VDX2
 0004 R 000005 D2VDY2      0003    001404 H          0000 I 000001 I1          0000 I 000002 I2          0000 I 000003 J1
 0000 I 000004 J2          0000 R 000000 L           0003    000050 LIMITS     0003 I 000050 NG          0003 I 000074 NS
 0003 R 000144 P           0003    004064 RATES      0003    004704 RE         0005 R 006710 REX         0005 R 007601 REY
 0003    005524 RU         0005 R 000000 RUX         0005 R 000671 RUY         0003    006344 RV         0005 R 001562 RVX
 0005 R 002453 RVY         0005 R 005126 RX          0005 R 006017 RY          0003    000144 STATE      0003 R 002424 U
 0005 R 003344 UX          0003 R 003244 V           0005 R 004235 VY
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00101     1*        SUBROUTINE DIFF (I,J)                                          GNAT0372
00103     2*        COMMON /DATA/ A(3700)                                          GNAT0373
00104     3*        COMMON /D1/ DPDX,DPDY,D2UDX2,D2VDX2,D2UDY2,D2VDY2,             GNAT0374
00104     4*       1    D2UDXY,D2VDXY,DRUUDX,DRVVDY,DRVUDX,DRUVDY                  GNAT0375
00105     5*        COMMON /NORMAL/ RUX(21,21),RUY(21,21),RVX(21,21),RVY(21,21)    GNAT0376
00105     6*       1, UX(21,21),VY(21,21),RX(21,21),RY(21,21),REX(21,21),REY(21,21) GNAT0377
00106     7*        COMMON /CSTS/ CST1L,CST2L,CST4L,CST1L2,CST2L2,CST4L2           GNAT0378
00107     8*        EQUIVALENCE          (CST12,CST1L2)                            GNAT0379
00110     9*        DIMENSION RATES(1600), RE(20,20), RU(20,20), RV(20,20)         GNAT0380
00111    10*        EQUIVALENCE (A(2101),RATES), (RATES(801),RE)                   GNAT0381
00111    11*       1, (RATES(801),RU), (RATES(1201),RV)                           GNAT0382
00112    12*        EQUIVALENCE (A(41),LIMITS), (A(101),STATE)                     GNAT0383
00113    13*        DIMENSION LIMITS(50),NG(20),NS(20),STATE(2000)                 GNAT0384
00113    14*       1, P(20,20),          H(20,20),U(20,20),V(20,20)               GNAT0385
00114    15*        EQUIVALENCE (LIMITS(1),NG), (LIMITS(21),NS)                    GNAT0386
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00114    16*        1,  (STATE(   1),P)                                          GNATD387
00114    17*        3,  (STATE( 80)),H)                                          GNATD388
00114    18*        4,  (STATE(120)),U)                                          GNATD389
00114    19*        5,  (STATE(160)),V)                                          GNATD390
00115    20*         REAL L                                                      GNATD391
00116    21*         L = 1./CSTIL                                                GNATD392
00116    22*  C                                                                  GNATD393
00117    23*         I1 = NG(J)                                                  GNATD394
00120    24*         I2 = NS(J)                                                  GNATD395
00121    25*         J1 = NG(I)                                                  GNATD396
00122    26*         J2 = NS(I)                                                  GNATD397
00122    27*  C                                                                  GNATD398
00123    28*         DRUUDX = (RUX(I+1,J)*UX(I+1,J) - RUX(I,J)*UX(I,J)) /L       GNATD399
00124    29*         DRVUDX = (RVX(I+1,J)*UX(I+1,J) - RVX(I,J)*UX(I,J)) /L       GNATD400
00125    30*         DRUVDY = (RUY(I,J+1)*VY(I,J+1) - RUY(I,J)*VY(I,J)) /L       GNATD401
00126    31*         DRVVDY = (RVY(I,J+1)*VY(I,J+1) - RVY(I,J)*VY(I,J)) /L       GNATD402
00126    32*  C                                                                  GNATD403
00127    33*         IF (I.EQ.I1) GO TO 210                                      GNATD404
00131    34*         IF (I.EQ.I2) GO TO 220                                      GNATD405
00133    35*         IF (J.EQ.J1) GO TO 230                                      GNATD406
00135    36*         IF (J.EQ.J2) GO TO 240                                      GNATD407
00135    37*  C  COMPUTE AT CENTRAL POSITIONS                                    GNATD408
00137    38*         DPDX = CST2L *( P(I+1,J) - P(I-1,J) )                       GNATD409
00140    39*         DPDY   = CST2L *( P(I,J+1) - P(I,J-1) )                     GNATD410
00141    40*         D2UDX2= CSTL2 *( U(I-1,J) -2.*U(I,J) +U(I+1,J) )            GNATD411
00142    41*         D2VDX2= CSTL2 *( V(I-1,J) -2.*V(I,J) +V(I+1,J) )            GNATD412
00143    42*         D2UDY2 = CSTL2 *( U(I,J-1) -2.*U(I,J) +U(I,J+1) )           GNATD413
00144    43*         D2VDY2 = CSTL2 *( V(I,J-1) -2.*V(I,J) +V(I,J+1) )           GNATD414
00145    44*         D2UDXY = CST4L2 *(U(I+1,J+1)+U(I-1,J-1)-U(I+1,J-1)-U(I-1,J+1) )  GNATD415
00146    45*         D2VDXY = CST4L2 *(V(I+1,J+1)+V(I-1,J-1)-V(I+1,J-1)-V(I-1,J+1) )  GNATD416
00147    46*         GO TO 300                                                   GNATD417
00147    47*  C                                                                  GNATD418
00147    48*  C  COMPUTE AT LEFT WALL                                            GNATD419
00150    49*    210 CONTINUE                                                     GNATD420
00151    50*         DPDX = CSTIL *( P(I+1,J) - P(I,J) )                         GNATD421
00152    51*         D2UDX2 = CSTL2 *( U(I+1,J) - 3.*U(I,J) )                    GNATD422
00153    52*         D2VDX2 = CSTL2 *( V(I+1,J) - 3.*V(I,J) )                    GNATD423
00154    53*         IF (J.EQ.J1) GO TO 211                                      GNATD424
00156    54*         IF (J.EQ.J2) GO TO 212                                      GNATD425
00160    55*         DPDY   = CST2L *( P(I,J+1) - P(I,J-1) )                     GNATD426
00161    56*         D2UDY2 = CSTL2 *( U(I,J-1) -2.*U(I,J) +U(I,J+1) )           GNATD427
00162    57*         D2VDY2 = CSTL2 *( V(I,J-1) -2.*V(I,J) +V(I,J+1) )           GNATD428
00163    58*         D2UDXY = CST2L2 *(U(I+1,J+1)+U(I,J-1)-U(I+1,J-1)-U(I,J+1) )  GNATD429
00164    59*         D2VDXY = CST2L2 *(V(I+1,J+1)+V(I,J-1)-V(I+1,J-1)-V(I,J+1) )  GNATD430
00165    60*         GO TO 300                                                   GNATD431
00166    61*    211 CONTINUE                                                     GNATD432
00167    62*         D2UDXY = CSTIL2 *( U(I+1,J+1)+U(I,J)-U(I,J+1)-U(I+1,J) )    GNATD433
00170    63*         D2VDXY = CSTIL2 *( V(I+1,J+1)+V(I,J)-V(I,J+1)-V(I+1,J) )    GNATD434
00171    64*         GO TO 231                                                   GNATD435
00172    65*    212 CONTINUE                                                     GNATD436
00173    66*         D2UDXY = CSTIL2 *( U(I+1,J)+U(I,J-1)-U(I+1,J-1)-U(I,J) )    GNATD437
00174    67*         D2VDXY = CSTIL2 *( V(I+1,J)+V(I,J-1)-V(I+1,J-1)-V(I,J) )    GNATD438
00175    68*         GO TO 241                                                   GNATD439
00175    69*  C                                                                  GNATD440
00175    70*  C  COMPUTE AT RIGHT WALL                                           GNATD441
00176    71*    220 CONTINUE                                                     GNATD442
00177    72*         DPDX = CSTIL *( P(I,J) - P(I-1,J) )                         GNATD443
00200    73*         D2UDX2 = CSTL2 *( U(I-1,J) - 3.*U(I,J) )                    GNATD444
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00201    74*          D2VDX2 = CST2L =( V(I-1,J) - 3.*V(I,J) )                                  GNAT0445
00202    75*          IF (J.EQ.J1) GO TO 221                                                    GNAT0446
00204    76*          IF (J.EQ.J2) GO TO 222                                                    GNAT0447
00206    77*          DPDY   = CST2L *( P(I,J+1) - P(I,J-1) )                                   GNAT0448
00207    78*          D2UDY2 = CST2L2 *( U(I,J-1) -2.*U(I,J) +U(I,J+1) )                        GNAT0449
00210    79*          D2VDY2 = CST2L2 *( V(I,J-1) -2.*V(I,J) +V(I,J+1) )                        GNAT0450
00211    80*          D2UDXY = CST2L2 *( U(I,J+1)+U(I-1,J-1)-U(I-1,J+1)-U(I,J-1) )              GNAT0451
00212    81*          D2VDXY = CST2L2 *( V(I,J+1)+V(I-1,J-1)-V(I-1,J+1)-V(I,J-1) )              GNAT0452
00213    82*          GO TO 300                                                                 GNAT0453
00214    83*        221 CONTINUE                                                                GNAT0454
00215    84*          D2UDXY = CST1L2 *( U(I,J+1)+U(I-1,J)-U(I-1,J+1)-U(I,J) )                  GNAT0455
00216    85*          D2VDXY = CST1L2 *( V(I,J+1)+V(I-1,J)-V(I-1,J+1)-V(I,J) )                  GNAT0456
00217    86*          GO TO 231                                                                 GNAT0457
00220    87*        222 CONTINUE                                                                GNAT0458
00221    88*          D2UDXY = CST1L2 *( U(I,J)+U(I-1,J-1)-U(I-1,J)-U(I,J-1) )                  GNAT0459
00222    89*          D2VDXY = CST1L2 *( V(I,J)+V(I-1,J-1)-V(I-1,J)-V(I,J-1) )                  GNAT0460
00223    90*          GO TO 241                                                                 GNAT0461
00223    91*    C                                                                               GNAT0462
00223    92*    C  COMPUTE AT BOTTOM WALL                                                       GNAT0463
00224    93*      230 CONTINUE                                                                  GNAT0464
00225    94*          DPDX = CST2L *( P(I+1,J) - P(I-1,J) )                                     GNAT0465
00226    95*          D2UDX2= CST2L2 *( U(I-1,J) -2.*U(I,J) +U(I+1,J) )                         GNAT0466
00227    96*          D2VDX2= CST2L2 *( V(I-1,J) -2.*V(I,J) +V(I+1,J) )                         GNAT0467
00230    97*          D2UDXY = CST2L2 *( U(I+1,J+1)+U(I-1,J)-U(I-1,J+1)-U(I+1,J) )              GNAT0468
00231    98*          D2VDXY = CST2L2 *( V(I+1,J+1)+V(I-1,J)-V(I-1,J+1)-V(I+1,J) )              GNAT0469
00232    99*        231 DPDY   = CST1L *( P(I,J+1) - P(I,J) )                                   GNAT0470
00233   100*          D2UDY2 = CST2L2 *( U(I,J+1) - 3.*U(I,J) )                                 GNAT0471
00234   101*          D2VDY2 = CST2L2 *( V(I,J+1) - 3.*V(I,J) )                                 GNAT0472
00235   102*          GO TO 300                                                                 GNAT0473
00235   103*    C                                                                               GNAT0474
00235   104*    C  COMPUTE AT TOP WALL                                                          GNAT0475
00236   105*      240 CONTINUE                                                                  GNAT0476
00237   106*          DPDX = CST2L *( P(I+1,J) - P(I-1,J) )                                     GNAT0477
00240   107*          D2UDX2= CST2L2 *( U(I-1,J) -2.*U(I,J) +U(I+1,J) )                         GNAT0478
00241   108*          D2VDX2= CST2L2 *( V(I-1,J) -2.*V(I,J) +V(I+1,J) )                         GNAT0479
00242   109*          D2UDXY = CST2L2 *( U(I+1,J)+U(I-1,J-1)-U(I-1,J)-U(I+1,J-1) )              GNAT0480
00243   110*          D2VDXY = CST2L2 *( V(I+1,J)+V(I-1,J-1)-V(I-1,J)-V(I+1,J-1) )              GNAT0481
00244   111*        241 DPDY   = CST1L *( P(I,J) - P(I,J-1) )                                   GNAT0482
00245   112*          D2UDY2 = CST2L2 *( U(I,J-1) - 3.*U(I,J) )                                 GNAT0483
00246   113*          D2VDY2 = CST2L2 *( V(I,J-1) - 3.*V(I,J) )                                 GNAT0484
00246   114*    C                                                                               GNAT0485
00247   115*      300 CONTINUE                                                                  GNAT0486
00250   116*          RETURN                                                                    GNAT0487
00251   117*          END                                                                       GNAT0488

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
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@ FOR DIFF2, DIFF2                                    GNAT0489          27 JAN 71          14:33:45.982
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:33:46

   SUBROUTINE DIFF2     ENTRY POINT 000236

   STORAGE USED (BLOCK, NAME, LENGTH)

      0001   *CODE   000275
      0000   *DATA   000032
      0002   *BLANK  000000
      0003   DATA    007164
      0004   D2      000010
      0005   NODWAL  010472
      0006   TRNSMT  000005


   EXTERNAL REFERENCES (BLOCK, NAME)

      0007   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000110 10L        0001   000143 100L       0001   000165 110L       0001   000203 120L       0001   000126 20L
    0001   009220 200L       0003 R 000000 A          0003   000172 AVE        0000 R 000001 CSTL2      0000 R 000000 CSTIL
    0006 R 000001 DQ1        0006 R 000002 DQ2        0006 R 000003 DQ3        0006 R 000004 DQ4        0004 R 000002 DREUDX
    0004 R 000003 DREVDY     0004 R 000000 DRUDX      0004 R 000001 DRVDY      0004 R 000004 DUDX       0004 R 000005 DVDY
    0004 R 000006 D2HDX2     0004 R 000007 D2HDY2     0003 R 004604 H          0000 I 000002 I1         0000 I 000003 I2
    0000 I 000004 J1         0000 I 000005 J2         0006 I 000000 K          0003 R 000031 L          0003   000050 LIMITS
    0003 I 000050 NG         0003 I 000074 NS         0003   000024 PROP       0003   000764 R          0003   004064 RATES
    0003   000134 RBAR       0003   004704 RE         0005 R 004710 REX        0005 R 007601 REY        0003   005529 RU
    0005 R 000000 RUX        0005 R 000671 RUY        0003   006344 RV         0005 R 001562 RVX        0005 R 002453 RVY
    0005 R 005126 RX         0005 R 006017 RY         0003   000144 STATE      0003   002424 U          0005 R 003344 UX
    0003   003244 V          0005 R 004235 VY


00101     1*         SUBROUTINE DIFF2 (I,J)                                                GNAT0490
00103     2*         COMMON /DATA/ A(3700)                                                 GNAT0491
00104     3*         COMMON /D2/ DRUDX,DRVDY,DREUDX,DREVDY,DUDX,DVDY,D2HDX2,D2HDY2         GNAT0492
00105     4*         COMMON /NODWAL/ RUX(21,21),RUY(21,21),RVX(21,21),RVY(21,21)           GNAT0493
00105     5*        1,  UX(21,21),VY(21,21),RX(21,21),RY(21,21),REX(21,21),REY(21,21)     GNAT0494
00106     6*         COMMON /TRNSMT/ K,DQ1,DQ2,DQ3,DQ4                                     GNAT0495
00107     7*         DIMENSION RATES(1600), RE(20,20), RU(20,20), RV(20,20)                GNAT0496
00110     8*         EQUIVALENCE (A(2101),RATES), (RATES(401),RE)                          GNAT0497
00110     9*        1,  (RATES(801),RU), (RATES(1201),RV)                                  GNAT0498
00110    10*        2,  (A(21),PROP), (PROP(6),L)                                          GNAT0499
00111    11*         EQUIVALENCE (A(91),LIMITS), (A(101),STATE), (A(91),AVE)               GNAT0500
00112    12*         DIMENSION  LIMITS(50),NG(20),NS(20),STATE(2000),AVE(10),PROP(10)      GNAT0501
00112    13*        1,            R(20,20),H(20,20),U(20,20),V(20,20)                     GNAT0502
00113    14*         EQUIVALENCE (LIMITS(1),NG), (LIMITS(21),NS), (AVE(3),RBAR)            GNAT0503
00113    15*        2,  (STATE(401),R)                                                     GNAT0504
00113    16*        3,  (STATE(801),H)                                                     GNAT0505
```

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00113    17*          4,  (STATE(120)),U)                                        GNAT0506
00113    18*          5,  (STATE(160)),V)                                        GNAT0507
00114    19*           REAL L                                                    GNAT0508
00115    20*           CSTIL = 1. / L                                            GNAT0509
00116    21*           CSTL2 = CSTIL * CSTIL                                     GNAT0510
00116    22*     C                                                               GNAT0511
00117    23*           I1 = NG(J)                                                GNAT0512
00120    24*           I2 = NS(J)                                                GNAT0513
00121    25*           J1 = NG(I)                                                GNAT0514
00122    26*           J2 = NS(I)                                                GNAT0515
00122    27*     C                                                               GNAT0516
00123    28*           DUDX =   (UX(I+1,J) - UX(I,J)) /L                         GNAT0517
00124    29*           DVDY   = (VY(I,J+1) - VY(I,J)) /L                         GNAT0518
00125    30*           DRUDX  = (RX(I+1,J)*UX(I+1,J) - RX(I,J)*UX(I,J)) /L       GNAT0519
00126    31*           DRVDY  = (RY(I,J+1)*VY(I,J+1) - RY(I,J)*VY(I,J)) /L       GNAT0520
00127    32*           DREUDX = (REX(I+1,J)*UX(I+1,J) - REX(I,J)*UX(I,J)) /L     GNAT0521
00130    33*           DREVDY = (REY(I,J+1)*VY(I,J+1) - REY(I,J)*VY(I,J)) /L     GNAT0522
00130    34*     C                                                               GNAT0523
00131    35*           IF (I.EQ.I1) GO TO 10                                     GNAT0524
00133    36*           IF (I.EQ.I2) GO TO 20                                     GNAT0525
00135    37*           D2HDX2= CSTL2 *( H(I-1,J) -2.*H(I,J) +H(I+1,J) )          GNAT0526
00136    38*           GO TO 100                                                 GNAT0527
00137    39*        10 D2HDX2 = CSTIL *( CSTIL *( H(I+1,J)-H(I,J) ) + DQ1/K )    GNAT0528
00140    40*           GO TO 100                                                 GNAT0529
00141    41*        20 D2HDX2 = CSTIL *(-DQ2/K - CSTIL *( H(I,J) - H(I-1,J) ) )  GNAT0530
00141    42*     C                                                               GNAT0531
00142    43*       100 CONTINUE                                                  GNAT0532
00143    44*           IF (J.EQ.J1) GO TO 110                                    GNAT0533
00145    45*           IF (J.EQ.J2) GO TO 120                                    GNAT0534
00147    46*           D2HDY2 = CSTL2 *( H(I,J-1) -2.*H(I,J) + H(I,J+1) )        GNAT0535
00150    47*           GO TO 200                                                 GNAT0536
00151    48*       110 D2HDY2 = CSTIL *( CSTIL *( H(I,J+1)-H(I,J) ) + DQ3/K )    GNAT0537
00152    49*           GO TO 200                                                 GNAT0538
00153    50*       120 D2HDY2 = CSTIL *(-DQ4/K - CSTIL *( H(I,J) - H(I,J-1) ) )  GNAT0539
00154    51*       200 CONTINUE                                                  GNAT0540
00155    52*           RETURN                                                    GNAT0541
00156    53*           END                                                       GNAT0542

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
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```
@ FOR HEATER                                                    GNAT0543                    27 JAN 71            14:33:48, 89
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:33:48


   SUBROUTINE HEATER    ENTRY POINT 000020

   STORAGE USED (BLOCK, NAME, LENGTH)

       0001   *CODE   000022
       0000   *DATA   000010
       0002   *BLANK  000000
       0003   DSTATE  003100


   EXTERNAL REFERENCES (BLOCK, NAME)

       0004   NERR3S


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0003 R 000000 DR          0003 R 000620 DRE         0003 R 001440 DRU         0003 R 002260 DRV         0000 I 000000 I
    0000 I 000001 J


00101     1*          SUBROUTINE HEATER ( DQHEAT, L3 )                                  GNAT0544
00103     2*          REAL L3                                                           GNAT0545
00104     3*          COMMON /DSTATE/ DR(20,20), DRE(20,20), DRU(20,20), DRV(20,20)     GNAT0546
00104     4*    C                                                                       GNAT0547
00104     5*    C  INSERT HEAT AT SELECTED NODES                                        GNAT0548
00104     6*    C                                                                       GNAT0549
00105     7*          I = 12                                                            GNAT0550
00106     8*          J = 10                                                            GNAT0551
00107     9*          DRE(I,J) = DRE(I,J) + DQHEAT / L3                                 GNAT0552
00110    10*      100 CONTINUE                                                          GNAT0553
00111    11*          RETURN                                                            GNAT0554
00112    12*          END                                                               GNAT0555

       END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
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```
@ FOR BCOUT, BCOUT                                    GNAT0556          27 JAN 71          14:33:49.412
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018M
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:33:49


   SUBROUTINE BCOUT     ENTRY POINT 000114

   STORAGE USED (BLOCK, NAME, LENGTH)

       0001   *CODE   000122
       0000   *DATA   000017
       0002   *BLANK  000000
       0003   DATA    007164
       0004   DSTATE  003100


   EXTERNAL REFERENCES (BLOCK, NAME)

       0005   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000045 2L         0003 R 000000 A          0003   000132 AVE        0003   000000 CTL        0004 R 000000 DR
    0004 R 000620 DRE        0004 R 001440 DRU        0004 R 002260 DRV        0000 I 000000 I          0000 I 000001 J
    0003 R 000031 L          0003 D 000132 PBAR       0003   000024 PROP       0003 R 000764 R          0003   004064 RATES
    0003 D 000134 RBAR       0003 R 004704 RE         0003 D 000136 REBAR      0003 R 005524 RU         0003 R 006344 RV
    0003   000144 STATE      0000 R 000002 UWALL


00101     1*         SUBROUTINE BCOUT (N,NDOT)                                          GNAT0557
00103     2*         REAL L                                                             GNAT0558
00104     3*         COMMON /DATA/ A(3700)                                              GNAT0559
00105     4*         COMMON /DSTATE/ DR(20,20), DRE(20,20), DRU(20,20), DRV(20,20)      GNAT0560
00106     5*         DIMENSION AVE(10), RATES(1600), STATE(2000)                        GNAT0561
00107     6*         DIMENSION CTL(20), PROP(10)                                        GNAT0562
00110     7*         EQUIVALENCE                                                        GNAT0563
00110     8*        1   (A(1),CTL)                                                      GNAT0564
00110     9*        2,  (A(21),PROP)                                                   GNAT0565
00110    10*        4,  (A(91),AVE)                                                    GNAT0566
00110    11*        5,  (A(101),STATE)                                                 GNAT0567
00110    12*        3,  (A(2101),RATES)                                                GNAT0568
00111    13*         EQUIVALENCE (PROP(6),L)                                           GNAT0569
00112    14*         DIMENSION R(20,20)                                                GNAT0570
00113    15*         DIMENSION  RE(20,20), RU(20,20), RV(20,20)                        GNAT0571
00114    16*         EQUIVALENCE                                                       GNAT0572
00114    17*        2   (STATE(401),R)                                                GNAT0573
00114    18*        7,  (RATES(401), RE )                                             GNAT0574
00114    19*        8,  (RATES(801),RU )                                              GNAT0575
00114    20*        9,  (RATES(1201),RV )                                             GNAT0576
00115    21*         DOUBLE PRECISION PBAR, RBAR, REBAR                               GNAT0577
00116    22*         EQUIVALENCE (AVE(1),PBAR), (AVE(3),RBAR), (AVE(5),REBAR)         GNAT0578
00117    23*         I = 20                                                           GNAT0579
00120    24*         J = 10                                                           GNAT0580
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00121    25*          IF (N.EQ.2) GO TO 2                                        GNATO581
00123    26*        1 CONTINUE                                                   GNATO582
00124    27*          UWALL = WDOT / (R(I,J)*RBAR) /L/L                          GNATO583
00125    28*          DRU(I,J) = DRU(I,J) - RU(I,J) * UWALL /L                   GNATO584
00126    29*          DRV(I,J) = DRV(I,J) - RV(I,J) * UWALL /L                   GNATO585
00127    30*          RETURN                                                     GNATO586
00130    31*        2 CONTINUE                                                   GNATO587
00131    32*          DR(I,J) = DR(I,J) - (R(I,J)*RBAR) * UWALL /L               GNATO588
00132    33*          DRE(I,J) = DRE(I,J) - (RE(I,J)*REBAR*PBAR) * UWALL /L      GNATO589
00133    34*          RETURN                                                     GNATO590
00134    35*          END                                                        GNATO591

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
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```
@ FOR  TEMP, TEMP                                                GNAT0592                  27 JAN 71            14:33:50.670
UNIVAC 1108 FORTRAN V LEVEL   2204 0018
THIS COMPILATION WAS DONE ON 27 JAN 71        3:50

   FUNCTION TEMP        ENTRY POINT 000003

   STORAGE USED (BLOCK, NAME, LENGTH)

      0001   *CODE   000112
      0000   *DATA   000020
      0002   *BLANK  000000
      0003   TEFCTN  000074


   EXTERNAL REFERENCES (BLOCK, NAME)

      0004   NERR3S


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000016 10L        0001   000030 20L        0001   000044 30L        0001   000070 40L        0003 R 000036 E
    0000 R 000004 EIN        0000 I 000002 I          0000 I 000001 IS         0000 I 000003 N          0003 R 000000 T
    0000 R 000000 TEMP
```

```
00101     1*         FUNCTION TEMP ( ERHO, RHO )                                          GNAT0593
00103     2*         COMMON /TEFCTN/ T(30), E(30)                                         GNAT0594
00104     3*         DATA E / -59.167,-51.263,-43.223,-34.915,-26.027,-15.997,-10.023,    GNAT0595
00104     4*        1  -6.467, -2.068,  4.884, 16.978, 22.865, 26.302, 31.008, 34.553,   GNAT0596
00104     5*        2  37.545, 40.220, 42.687, 45.006, 49.341, 53.400, 57.273, 61.014,   GNAT0597
00104     6*        3  64.657, 68.225, 71.734, 75.198, 78.627, 2*0./                     GNAT0598
00106     7*         DATA T /    160.,   180.,   200.,   220.,   240.,   260.,   270.,    GNAT0599
00106     8*        1    275.,   280.,   285.,   290.,   295.,   300.,   310.,   320.,  GNAT0600
00106     9*        2    330.,   340.,   350.,   360.,   380.,   400.,   420.,   440.,  GNAT0601
00106    10*        3    460.,   480.,   500.,   520.,   540., 2*0./                     GNAT0602
00110    11*         DATA   I, N  / 10, 28 /                                             GNAT0603
00110    12*   C                                                                         GNAT0604
00113    13*         EIN = ERHO / RHO / .2505E+E5                                        GNAT0605
00114    14*         IF ( EIN .GT. E(1) ) GO TO 10                                       GNAT0606
00116    15*         TEMP = T(1)                                                         GNAT0607
00117    16*         RETURN                                                              GNAT0608
00120    17*      10 IF ( EIN .LT. E(N) ) GO TO 20                                       GNAT0609
00122    18*         TEMP = T(N)                                                         GNAT0610
00123    19*         RETURN                                                              GNAT0611
00124    20*      20 CONTINUE                                                            GNAT0612
00125    21*         IF ( EIN .LT. E(I) ) GO TO 30                                       GNAT0613
00127    22*         IF ( EIN .GT. E(I+1) ) GO TO 40                                     GNAT0614
00127    23*   C  INTERPOLATE TEMPERATURE                                                GNAT0615
00131    24*         TEMP = T(I) + (EIN-E(I)) * (T(I+1)-T(I)) / (E(I+1)-E(I))            GNAT0616
00132    25*         RETURN                                                              GNAT0617
00133    26*      30 I = I - 1                                                           GNAT0618
00134    27*         GO TO 20                                                            GNAT0619
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00135    28*       40 I = I + 1                                                  GNAT0620
00136    29*          GO TO 20                                                   GNAT0621
00137    30*          END                                                        GNAT0622

       END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
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```
@ FOR BETA, BETA                                        GNAT0623          27 JAN 71          14:33:52. 29
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 FS018H
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:33:52


   FUNCTION BETA        ENTRY POINT 000075

   STORAGE USED (BLOCK, NAME, LENGTH)

      0001   *CODE   000106
      0000   *DATA   000016
      0002   *BLANK  000000
      0003   TEFCTN  000074


   EXTERNAL REFERENCES (BLOCK, NAME)

      0004   NERR3S


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000014 10L        0001   000040 117G       0001   000032 20L        0001   000050 40L        0000 R 000000 BETA
    0003 R 000036 E          0000 I 000003 I          0000 I 000001 M          0000 I 000002 N1         0003 R 000000 T
```

101

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00101     1*         FUNCTION BETA (TO)                                          GNAT0624
00103     2*         COMMON /TEFCTN/ T(30), E(30)                                GNAT0625
00104     3*         M = 28                                                      GNAT0626
00105     4*         IF ( TO .GT. T(1) ) GO TO 10                                GNAT0627
00107     5*         BETA = T(1)                                                 GNAT0628
00110     6*         RETURN                                                      GNAT0629
00111     7=      10 IF ( TO .LT. T(M) ) GO TO 20                                GNAT0630
00113     8*         BETA = T(M)                                                 GNAT0631
00114     9*         RETURN                                                      GNAT0632
00114    10*   C  FIND I SUCH THAT  T(I) .LE. TO .LE. T(I+1)                     GNAT0633
00115    11*      20 M1 = M-1                                                    GNAT0634
00116    12*         DO 30 I=1,M1                                                GNAT0635
00121    13*      30 IF ( T(I+1) .GE. TO ) GO TO 40                              GNAT0636
00124    14*      40 BETA = T(I) + (E(I+1)-E(I)) * (TO-T(I))/(T(I+1)-T(I))       GNAT0637
00125    15=         RETURN                                                      GNAT0638
00126    16*         END                                                         GNAT0639

      END OF UNIVAC 1108 FORTRAN V COMPILATION,     0 *DIAGNOSTIC* MESSAGE(S)
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```
@ FOR PRESS, PRESS                                          GNAT0640          27 JAN 71          14:33:53.353
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:33:53


   SUBROUTINE PRESS      ENTRY POINT 000024

   STORAGE USED (BLOCK, NAME, LENGTH)

         0001   *CODE   000030
         0000   *DATA   000010
         0002   *BLANK  000000
         0003   DATA    007164


   EXTERNAL REFERENCES (BLOCK, NAME)

         0004   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0003 R 000000 A          0003   000132 AVE        0003 D 000132 PBAR       0000 D 000000 PP         0003   000024 PROP
    0003 D 000134 RBAR       0003 R 000032 RCONST     0003 R 000030 Z


00101      1*          SUBROUTINE PRESS ( P, R, HH )                                    GNAT0641
00103      2*          COMMON /DATA/ A(3750)                                            GNAT0642
00104      3*          DOUBLE PRECISION PBAR, RBAR, PP, HH                              GNAT0643
00105      4*          DIMENSION PROP(10), AVE(10)                                      GNAT0644
00106      5*          EQUIVALENCE (A(21),PROP), (A(91),AVE)                            GNAT0645
00107      6*          EQUIVALENCE (AVE(1),PBAR), (AVE(3),RBAR)                         GNAT0646
00110      7*          EQUIVALENCE (PROP(5),Z), (PROP(7), RCONST)                       GNAT0647
00111      8*          PP = Z* (RBAR+R) * RCONST * HH                                   GNAT0648
00112      9*          P = PP - PBAR                                                    GNAT0649
00113     10*          RETURN                                                           GNAT0650
00114     11*          END                                                              GNAT0651

       END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
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```
@ FOR  RTPRES,RTPRES                                    GNAT0652              27 JAN 71          14:33:54.409
UNIVAC 1106 FORTRAN V LEVEL   2206 0018 FS018H
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:33:54


   FUNCTION RTPRES      ENTRY POINT 000210

   STORAGE USED (BLOCK, NAME, LENGTH)

      0001   *CODE   000218
      0000   *DATA   000113
      0002   *BLANK  000000


   EXTERNAL REFERENCES (BLOCK, NAME)

      0003   NEXP&S
      0004   EXP
      0005   NERR3S


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0000 I 000041 I5          0000 R 000004 N           0000 R 000040 N25P2       0000 R 000052 ODT1        0000 R 000053 ODT2
    0000 R 000050 P           0000 R 000043 PMPC2       0000 R 000042 PMPC28      0000 R 000041 PN28        0000 R 000044 PDUT
    0000 R 000056 P2          0000 R 000057 P3          0000 R 000040 P4          0000 R 000003 R           0000 R 000001 RHOC
    0000 R 000000 RTPRES      0000 R 000051 T           0000 R 000002 TC          0000 R 000054 TMTC        0000 R 000055 TMTC2
    0000 R 000045 TN10        0000 R 000046 TN2427      0000 R 000047 TN26        0000 R 000043 TN4         0000 R 000044 TN5
    0000 R 000042 TN6
```

```
00101     1*          FUNCTION RTPRES (RHO,TO)                                          GNAT0653
00101     2*    C                                                                       GNAT0654
00101     3*    C         THIS ROUTINE CALCULATES STEWART'S EQUATION OF STATE FOR OXYGENGNAT0655
00101     4*    C                                                                       GNAT0656
00101     5*    C         INPUT  -                                                      GNAT0657
00101     6*    C         RHO    - DENSITY              - LB / CU-FT                   GNAT0658
00101     7*    C         TO     - TEMPERATURE          - DEGREES RANKIN               GNAT0659
00101     8*    C         OUTPUT -                                                      GNAT0660
00101     9*    C         RTPRES - PRESSURE             - PSIA                         GNAT0661
00101    10*    C         RTDPDT - PARTIAL OF PRESSURE  - PSIA / D-R                   GNAT0662
00101    11*    C                  WITH RESPECT TO                                    GNAT0663
00101    12*    C                  TEMPERATURE                                        GNAT0664
00101    13*    C         RTDPDR - PARTIAL OF PRESSURE  - PSIA / (LB/CU-FT)            GNAT0665
00101    14*    C                  WITH RESPECT TO                                    GNAT0666
00101    15*    C                  DENSITY                                            GNAT0667
00101    16*    C         CONSTANTS -                                                   GNAT0668
00101    17*    C         RHOC   - CRITICAL DENSITY     - G-MOL / LITER                GNAT0669
00101    18*    C         TC     - CRITICAL TEMPERATURE - DEGREES KELVIN              GNAT0670
00101    19*    C         R      - GAS CONSTANT         - LITER-ATM / G-MOL-D KELVIN   GNAT0671
00101    20*    C                                                                       GNAT0672
00103    21*          DATA  RHOC ,    TC  ,     R     /                                GNAT0673
00103    22*         *     13.333,  154.77,  0.0820535 /                                GNAT0674
00103    23*    C         COEFFICIENTS FOR THE EQUATION OF STATE FOR OXYGEN            GNAT0675
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```
00107    24*          REAL N(28), N2SP2                                                  GNAT0676
00110    25*          DATA N /                                                           GNAT0677
00110    26*         1          3.3875908E-3, -1.3160622E+0, -7.3882852E+3,              GNAT0678
00110    27*         4          1.9204907E+7, -2.9026001E+10, 5.7010116E-8,              GNAT0679
00110    28*         7          7.9682238E-5,  6.0702250E-3, -2.7101966E+0,              GNAT0680
00110    29*         0         -3.5941960E+1,  1.0220956E+6,  1.9045451E-4,              GNAT0681
00110    30*         3          1.2170839E-5,  2.4425595E-3,  1.7365551E+2,              GNAT0682
00110    31*         6          3.0175284E+5, -3.4952852E+7,  8.8672400E-11,             GNAT0683
00110    32*         9         -2.6781767E+2,  1.0567098E+5,  5.6377108E-3,              GNAT0684
00110    33*         2         -1.1201282E+0,  1.4682944E+2,  9.9886692E-9,              GNAT0685
00110    34*         5         -0.00560      , -0.157      , -0.350      , 0.90 /       GNAT0686
00112    35*          DATA  TN6, TN4, TN5, TN10, TN2927, TN26 / -1.4020232E-8,          GNAT0687
00112    36*         * 3.8409814E+7, -8.7078803E+10, -7.1883920E+1, -6.9920424E-4,      GNAT0688
00112    37*         * -.314 /                                                          GNAT0689
00112    38*    C         CONVERT THE INPUT FROM LB/CU FT AND DEGREES RANKIN TO         GNAT0690
00112    39*    C                              G-MOL/LITER AND DEGREES KELVIN          GNAT0691
00121    40*          P = RHO * .500575 * 32.2                                          GNAT0692
00122    41*          T = TO * .55555556                                                GNAT0693
00123    42*          ODT1 = 1. / T                                                     GNAT0694
00124    43*          ODT2 = ODT1 * ODT1                                                GNAT0695
00125    44*          TMTC = T - TC                                                     GNAT0696
00126    45*          TMTC2 = TMTC * TMTC                                               GNAT0697
00127    46*          P2   = P  * P                                                     GNAT0698
00130    47*          P3   = P2 * P                                                     GNAT0699
00131    48*          P4   = P3 * P                                                     GNAT0700
00132    49*          N2SP2 = N(28)*P2                                                  GNAT0701
00133    50*          PN28 = P**N(28)                                                   GNAT0702
00134    51*          PMPC28 = PN28 * RHOC**N(28)                                       GNAT0703
00135    52*          PMPC2 = PMPC28 * PMPC28                                           GNAT0704
00135    53*    C                                                                       GNAT0705
00135    54*    C         CALCULATE THE EQUATION OF STATE                               GNAT0706
00135    55*    C                                                                       GNAT0707
00136    56*          POUT = P*R*T                                                      GNAT0708
00136    57*         C               + P2*(N(1)*T+N(2)+(N(3)+(N(4)+N(5)*ODT2)*ODT2)*ODT2)GNAT0709
00136    58*         C               + P3*((N(6)*T+N(7))*T+N(8)+(N(9)+N(10)*ODT1)*ODT1)  GNAT0710
00136    59*         C               + P4*(N(11)*T+N(12)+P*(N(13)+N(14)*ODT1))           GNAT0711
00136    60*         C               + P3*ODT2*EXP(N2SP2) * (                            GNAT0712
00136    61*         C                      (N(15)+(N(16)+N(17)*ODT1)*ODT1)     +        GNAT0713
00136    62*         C                     ((N(18)+(N(19)+N(20)*ODT1)*ODT1)     +        GNAT0714
00136    63*         C                      (N(21)+(N(22)+N(23)*ODT1)*ODT1)*P2)*P2 )    GNAT0715
00136    64*         C               + N(24)*P*PN28*PMPC28*EXP(N(26)*PMPC2+N(27)*TMTC2)  GNAT0716
00136    65*    C                                                                       GNAT0717
00137    66*          RTPRES = POUT * 14.696 * 144.                                     GNAT0718
00140    67*          RETURN                                                            GNAT0719
00141    68*          END                                                               GNAT0720

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
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```
@ FOR BULK, BULK                                        GNAT0721          27 JAN 71          14:33:56.377
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:33:56

   SUBROUTINE BULK      ENTRY POINT 00022)

   STORAGE USED (BLOCK, NAME, LENGTH)

      0001   *CODE   000230
      0000   *DATA   000046
      0002   *BLANK  000000
      0003   DATA    007164


   EXTERNAL REFERENCES (BLOCK, NAME)

      0004   TEMP
      0005   RTPRES
      0006   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001    000015 I27G      0001    00003D 134G      0001    000070 150G      0001    000103 155G      0003 R 000000 A
    0003    000132 AVE       0003    000000 CTL       0000 R 000012 DPBAR     0000 R 000013 DRBAR     0000 R 000019 DREBAR
    0003 R  001604 H         0000 R  000017 HBAR      0003 R 000044 HBAR1     0003 R 000045 HMAX      0003 R 000043 HMIN
    0000 I  000006 I         0000 I  000011 J         0000 I 000007 J1        0000 I 000010 J2        0003 R 000031 L
    0003 R  000036 LABEL     0003    000050 LIMITS    0003 I 000121 NF        0003 I 000050 NG        0003 R 000122 NODES
    0003 I  000074 NS        0003 I  000120 NO        0003 R 000144 P         0003 D 000132 PBAR      0003 R 000046 PCOL
    0003    000024 PROP      0000 D  000002 PT        0003 R 000764 R         0003    004064 RATES    0003 D 000134 RBAR
    0000 R  000015 RBAR1     0003 R  004704 RE        0003 D 000136 REBAR     0000 R 003016 REBAR1    0000 D 000004 RET
    0000 D  000000 RT        0005 R  000000 RTPRES    0003    000144 STATE     0004 R 003000 TEMP      0003 R 000047 WT
    0003    000024 WTM       0003    000030 Z


00101     1*          SUBROUTINE  BULK                                                    GNAT0722
00103     2*          COMMON /DATA/ A(3700)                                               GNAT0723
00104     3*          REAL NODES, L, LABEL                                                GNAT0724
00105     4*          EQUIVALENCE                                                         GNAT0725
00105     5*         1   (A(1),CTL)                                                       GNAT0726
00105     6*         2,  (A(21),PROP)                                                     GNAT0727
00105     7*         3,  (A(31),LABEL)                                                    GNAT0728
00105     8*         3,  (A(41),LIMITS)                                                   GNAT0729
00105     9*         4,  (A(91),AVE)                                                      GNAT0730
00105    10*         5,  (A(101),STATE)                                                   GNAT0731
00105    11*         6,  (A(2101),RATES)                                                  GNAT0732
00106    12*          DIMENSION P(20,20),R(20,20),H(20,20),RE(20,20)                      GNAT0733
00107    13*          EQUIVALENCE                                                         GNAT0734
00107    14*         1   (STATE( 1),P)                                                   GNAT0735
00107    15*         2,  (STATE(401),R)                                                   GNAT0736
00107    16*         3,  (STATE(801),H)                                                   GNAT0737
00107    17*         7,  (RATES(401), RE )                                                GNAT0738
00110    18*          DIMENSION AVE(10), RATES(1600), STATE(2000)                         GNAT0739
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00111    19*          DOUBLE PRECISION PBAR, RBAR, REBAR, RT, PT, RET                    GNAT0740
00112    20*          EQUIVALENCE (AVE(1),PBAR), (AVE(3),RBAR), (AVE(5),REBAR)           GNAT0741
00113    21*          DIMENSION LABEL(10)                                                GNAT0742
00114    22*          EQUIVALENCE                                                        GNAT0743
00114    23*         6    (LABEL(6),HMIN)                                               GNAT0744
00114    24*         7,   (LABEL(7),HBAR1)                                              GNAT0745
00114    25*         8,   (LABEL(8),HMAX)                                               GNAT0746
00114    26*         9,   (LABEL(9),PCOL)                                               GNAT0747
00114    27*         *,   (LABEL(10),WT)                                                GNAT0748
00115    28*          DIMENSION LIMITS(50)                                               GNAT0749
00116    29*          DIMENSION NG(20), NS(20), PROP(10)                                 GNAT0750
00117    30*          EQUIVALENCE (LIMITS(1),NG),(LIMITS(21),NS)                         GNAT0751
00117    31*         1, (LIMITS(41),ND),(LIMITS(42),NF),(LIMITS(43),NODES)               GNAT0752
00120    32*          EQUIVALENCE (PROP(1),WTH), (PROP(5),Z), (PROP(6),L)                GNAT0753
00120    33*    C                                                                        GNAT0754
00121    34*          PT = 0.                                                            GNAT0755
00122    35*          RT = 0.                                                            GNAT0756
00123    36*          RET = 0.                                                           GNAT0757
00124    37*          HMIN = 1000.                                                       GNAT0758
00125    38*          HMAX =-1000.                                                       GNAT0759
00126    39*          DO 100 I=ND,NF                                                     GNAT0760
00131    40*          J1 = NG(I)                                                         GNAT0761
00132    41*          J2 = NS(I)                                                         GNAT0762
00133    42*          DO 100 J=J1,J2                                                     GNAT0763
00134    43*          PT = PT + P(I,J)                                                   GNAT0764
00137    44*          RT = RT + R(I,J)                                                   GNAT0765
00140    45*          RET = RET + RE(I,J)                                                GNAT0766
00141    46*      100 CONTINUE                                                           GNAT0767
00144    47*          DPBAR = PT / NODES                                                 GNAT0768
00145    48*          DRBAR = RT / NODES                                                 GNAT0769
00146    49*          DREBAR = RET / NODES                                               GNAT0770
00147    50*          DO 200 I=ND,NF                                                     GNAT0771
00152    51*            J1 = NG(I)                                                       GNAT0772
00153    52*            J2 = NS(I)                                                       GNAT0773
00154    53*          DO 200 J=J1,J2                                                     GNAT0774
00157    54*          P(I,J) = P(I,J) - DPBAR                                            GNAT0775
00160    55*          R(I,J) = R(I,J) - DRBAR                                            GNAT0776
00161    56*          RE(I,J) = RE(I,J) - DREBAR                                         GNAT0777
00162    57*          HMIN = AMIN1(HMIN, H(I,J) )                                        GNAT0778
00163    58*          HMAX = AMAX1(HMAX, H(I,J) )                                        GNAT0779
00164    59*      200 CONTINUE                                                           GNAT0780
00167    60*          PBAR = PBAR + DPBAR                                                GNAT0781
00170    61*          RBAR = RBAR + DRBAR                                                GNAT0782
00171    62*          REBAR = REBAR + DREBAR                                             GNAT0783
00172    63*          RBAR1 = RBAR                                                       GNAT0784
00173    64*          REBAR1 = REBAR                                                     GNAT0785
00174    65*          HBAR = TEMP ( REBAR1, RBAR1 )                                      GNAT0786
00175    66*          HBAR1 = HBAR                                                       GNAT0787
00176    67*          PCOL = RTPRES ( RBAR1, HBAR1 )  / 144.                             GNAT0788
00177    68*          WT  = 32.2 * RBAR * NODES * L**3                                   GNAT0789
00200    69*          RETURN                                                             GNAT0790
00201    70*          END                                                                GNAT0791

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
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```
@ FOR OUTPUT, OUTPUT                                    GNAT0792          27 JAN 71          14:33:58. 44
UNIVAC 1108 FORTRAN V LEVEL   2204 0018 FS018H
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:33:58


   SUBROUTINE OUTPUT    ENTRY POINT 000140

   STORAGE USED (BLOCK, NAME, LENGTH)

       0001   *CODE   000152
       0000   *DATA   000047
       0002   *BLANK  000000
       0003   DATA    007164


   EXTERNAL REFERENCES (BLOCK, NAME)

       0004   TAPEPR
       0005   TAPEMR
       0006   DISPLY
       0007   TAPECK
       0010   NWDU$
       0011   NIO1$
       0012   NIO2$
       0013   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000020 I25G       0001   000043 SOL        0000   000022 910F       0000   000003 915F       0003 R 000000 A
    0003   000132 AVE        0003   000000 CTL        0003   004064 DR         0003 R 001604 H          0003 D 000136 HBAR
    0003   000015 ITAPE      0003 I 000020 IUNIT#     0000 I 000001 I$         0003 R 000036 LABEL      0000 I 000002 LSTAT
    0003 R 000144 P          0003 D 000132 PBAR       0003 R 000041 PBARI      0003   000024 PROP       0003 R 000764 R
    0003   004064 RATES      0003 D 000134 RBAR       0003 R 000042 RBARI      0003   009704 RE         0003   005524 RU
    0003   006344 RV         0003   000144 STATE      0000 R 000000 TIME       0003 R 002424 U          0003 R 003244 V


00101     1*          SUBROUTINE OUTPUT ( T, DT, DTCR, REF1, REF2, REF3 )                    GNAT0793
00103     2*          COMMON /DATA/ A(3700)                                                  GNAT0794
00104     3*          REAL LABEL                                                             GNAT0795
00105     4*          EQUIVALENCE                                                            GNAT0796
00105     5*         1   (A(1),CTL)                                                          GNAT0797
00105     6*         2,  (A(21),PROP)                                                       GNAT0798
00105     7*         3,  (A(31),LABEL)                                                      GNAT0799
00105     8*         4,  (A(91),AVE)                                                        GNAT0800
00105     9*         5,  (A(101),STATE)                                                     GNAT0801
00105    10*         6,  (A(2101),RATES)                                                    GNAT0802
00106    11*          DIMENSION AVE(10), RATES(1600), STATE(2000)                            GNAT0803
00107    12*          DIMENSION P(20,20),R(20,20),H(20,20),U(20,20),V(20,20)                 GNAT0804
00110    13*          DIMENSION DR(20,20),  RU(20,20),  RV(20,20),  RE(20,20)                GNAT0805
00111    14*          EQUIVALENCE                                                            GNAT0806
00111    15*         1   (STATE( 1),P)                                                      GNAT0807
00111    16*         2,  (STATE(401),R)                                                     GNAT0808
00111    17*         3,  (STATE(801),H)                                                     GNAT0809
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00111    18*        4,  (STATE(120),U)                                          GNATO810
00111    19*        5,  (STATE(160),V)                                          GNATO811
00111    20*        6,  (RATES(1),DR)                                           GNATO812
00111    21*        7,  (RATES(40),  RE )                                       GNATO813
00111    22*        8,  (RATES(80),  RU )                                       GNATO814
00111    23*        9,  (RATES(120),  RV )                                      GNATO815
00112    24*         DIMENSION LABEL(10)                                        GNATO816
00113    25*         EQUIVALENCE                                                GNATO817
00113    26*        4    (LABEL(4),PBAR)                                       GNATO818
00113    27*        5,  (LABEL(5),RBAR)                                         GNATO819
00114    28*         DOUBLE PRECISION PBAR, RBAR, HBAR                          GNATO820
00115    29*         EQUIVALENCE (AVE(1),PBAR), (AVE(3),RBAR), (AVE(5),HBAR)    GNATO821
00116    30*         DIMENSION ITAPE(6)                                         GNATO822
00117    31*         EQUIVALENCE (CTL(14),ITAPE ), (ITAPE(4),IUNITW)            GNATO823
00117    32*    C                                                               GNATO824
00120    33*         TIME = T                                                   GNATO825
00121    34*         PBAR1 = PBAR / 144.                                        GNATO826
00122    35*         RBAR1 = RBAR * 32.2                                        GNATO827
00123    36*         WRITE (6,915) LABEL                                        GNATO828
00131    37*       915 FORMAT (1H1, 20X, 35HGENERAL NUMERICAL ANALYSIS OF TRANSPORT,  GNATO829
00131    38*          1   10X, 14HP J HEIBMILLER // 10E12.7 // )                GNATO830
00132    39*         IF (IUNITW.LE.0) GO TO 50                                  GNATO831
00134    40*         CALL TAPEPR (0,IUNITW)                                     GNATO832
00135    41*         CALL TAPEWR (0,IUNITW,3700,A,LSTAT)                        GNATO833
00136    42*        50 CONTINUE                                                 GNATO834
00137    43*         CALL DISPLY ( P,REF1,.004944 )                             GNATO835
00140    44*         WRITE (6,910)                                              GNATO836
00142    45*       910 FORMAT (1H1)                                             GNATO837
00143    46*         CALL DISPLY ( R,REF2,32.2 )                                GNATO838
00144    47*         WRITE (6,910)                                              GNATO839
00146    48*         CALL DISPLY ( H,REF3, 1. )                                 GNATO840
00147    49*         WRITE (6,910)                                              GNATO841
00151    50*         CALL DISPLY ( U, 0., 1. )                                  GNATO842
00152    51*         WRITE (6,910)                                              GNATO843
00154    52*         CALL DISPLY ( V, 0., 1. )                                  GNATO844
00155    53*         IF (IUNITW.GT.0) CALL TAPECK (LSTAT)                       GNATO845
00157    54*         RETURN                                                     GNATO846
00160    55*         END                                                        GNATO847

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
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```
@ FOR DISPLY, DISPLY                                    GNAT0848          27 JAN 71          14:33:59.404
UNIVAC 1108 FORTRAN V LEVEL   2204 0018 FS018H
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:33:59


   SUBROUTINE DISPLY    ENTRY POINT 000173

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE   000207
        0000   *DATA   000663
        0002   *BLANK  000000
        0003   DATA    007164


   EXTERNAL REFERENCES (BLOCK, NAME)

        0004   NWDU$
        0005   NIO1$
        0006   NIO2$
        0007   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000016 112G       0001   000036 117G       0001   000047 127G       0001   000067 135G       0001   000123 150G
    0001   000150 157G       0000   000625 900F       0000   000631 901F       0003 R 000000 A          0003   000000 CTL
    0000 I 000623 I          0000 I 000621 I1         0000 I 000622 I2         0000 I 000620 J          0000 I 000624 K
    0003   000050 LIMITS     0003 I 000121 NF         0003 I 000050 NG         0003   000122 NODES      0003 I 000074 NS
    0003 I 000120 NO         0003 R 000040 TIME       0000 R 000000 Y


00100      1*          SUBROUTINE DISPLY ( X, XBAR, CONST )                                  GNAT0849
00103      2*          COMMON /DATA/ A(3700)                                                 GNAT0850
00104      3*          EQUIVALENCE                                                           GNAT0851
00104      4*         1   (A(1),CTL)                                                         GNAT0852
00104      5*         3,  (A(41),LIMITS)                                                    GNAT0853
00105      6*          EQUIVALENCE (A(33),TIME)                                              GNAT0854
00106      7*          DIMENSION LIMITS(50), NG(20), NS(20)                                  GNAT0855
00107      8*          EQUIVALENCE (LIMITS(1),NG),(LIMITS(21),NS)                            GNAT0856
00107      9*         1, (LIMITS(41),NO),(LIMITS(42),NF),(LIMITS(43),NODES)                  GNAT0857
00110     10*          DIMENSION X(20,20), Y(20,20)                                          GNAT0858
00110     11*    C                                                                           GNAT0859
00111     12*          DO 100 J=NO,NF                                                        GNAT0860
00114     13*            I1 = NG(J)                                                          GNAT0861
00115     14*            I2 = NS(J)                                                          GNAT0862
00116     15*          DO 200 I=I1,I2                                                        GNAT0863
00121     16*          Y(I,J) = ( X(I,J) - XBAR ) * CONST                                    GNAT0864
00122     17*      200 CONTINUE                                                              GNAT0865
00124     18*      100 CONTINUE                                                              GNAT0866
00126     19*          DO 300 K=NO,NF                                                        GNAT0867
00131     20*          J = NF +1 -K                                                          GNAT0868
00132     21*      300 WRITE (6,901) J, (Y(I,J),I=NO,10)                                     GNAT0869
00142     22*          WRITE (6,900) TIME                                                    GNAT0870
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00145    23*          IF ( NF.LE.10 ) RETURN                                    GNAT0871
00147    24*          DO 400 K=ND,NF                                            GNAT0872
00152    25*          J = NF +1 -K                                              GNAT0873
00153    26*          I2 = NS(J)                                                GNAT0874
00154    27*      400 WRITE (6,901) J, (Y(I,J),I=11,I2)                         GNAT0875
00164    28*      900 FORMAT (1H , 6HTIME =, F12.3 )                            GNAT0876
00165    29*      901 FORMAT(1H , I3, 3X, 10E12.5   )                           GNAT0877
00166    30*          RETURN                                                    GNAT0878
00167    31*          END                                                       GNAT0879

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
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```
@ FOR   CR2TAP,CR2TAP                                   GNAT0880          27 JAN 71          14:34: 1.  1
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:34:01

   SUBROUTINE CR2TAP    ENTRY POINT 000112

   STORAGE USED (BLOCK, NAME, LENGTH)

        0001   *CODE   000124
        0000   *DATA   000052
        0002   *BLANK  000000


   EXTERNAL REFERENCES (BLOCK, NAME)

        0003   NREW$
        0004   NWDU$
        0005   NIO1$
        0006   NIO2$
        0007   NRDU$
        0010   NERR3$


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0001   000006 100L       0001   000014 111G       0001   000024 116G       0001   000033 122G       0001   000045 130G
    0001   000061 137G       0000   000020 2000F      0000   000022 2100F      0000   000026 4000F      0001   000074 900L
    0000 I 000000 DATA       0000 I 000016 I          0000 I 000017 I$
```

```
00101     1.        SUBROUTINE CR2TAP (OPTERM,INDATA,IMAGES)                          GNAT0881
00101     2.    C *** THIS PROGRAM WILL GENERATE A BCD CARD IMAGE TAPE FOR USE AS AN   GNAT0882
00101     3.    C     ALTERNATE INPUT DATA FILE.  INPUT IS EXPECTED ON UNIT FIVE AND AN GNAT0883
00101     4.    C     'OPTERM' IS EXPECTED IN CARD COLUMNS 1-6 AT END OF EACH OPERATION.GNAT0884
00101     5.    C     ARGUMENT  TYPE    EXAMPLE   DESCRIPTION                         GNAT0885
00101     6.    C      OPTERM  INTEGER  DEKEND   OPERATION TERMINATOR, SIX HOLERITH CHARGNAT0886
00101     7.    C      INDATA  INTEGER    9      ALTERNATE DATA INPUT FILE DESIGNATOR  GNAT0887
00101     8.    C                                1.LE.INDATA.LE.29(XCLUDE 5-7,25,26)   GNAT0888
00101     9.    C      IMAGES  INTEGER   39      NUMBER OF CARD IMAGES PER HEADING     GNAT0889
00101    10.    C                                NORMALLY LINES PER PAGE LESS T*0      GNAT0890
00103    11.         INTEGER DATA  , OPTERM                                           GNAT0891
00104    12.         DIMENSION DATA  (14)                                             GNAT0892
00104    13.    C              REWIND THE ALTERNATE INPUT DATA FILE                   GNAT0893
00105    14.         REWIND INDATA                                                    GNAT0894
00106    15.       100  CONTINUE                                                     GNAT0895
00106    16.    C *** PAGE EJECT PRELIMINARY TO WRITING THE RECORDS IN THE CARD TO TAPE GNAT0896
00106    17.    C     OPERATION PLUS COLUMN INDICATORS                                GNAT0897
00107    18.         WRITE (6,4000) (I,I=1,8)                                         GNAT0898
00115    19.         DO 500 I = 1,IMAGES                                              GNAT0899
00115    20.    C *** READ AN INPUT DATA CARD                                         GNAT0900
00120    21.          READ (5,2000) DATA                                              GNAT0901
00120    22.    C              WRITE THE IMAGE ON THE ALTERNATE DATA INPUT FILE       GNAT0902
00124    23.         WRITE (INDATA,2008) DATA                                         GNAT0903
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00126    24*   C *** WRITE OUTPUT TAPE                                                GNAT0904
00134    25*         WRITE ( 6,2100) I,DATA                                           GNAT0905
00134    26*   C               IF OPERATION TERMINATOR, CEASE PROCESSING              GNAT0906
00143    27*         IF  (DATA(1),EQ,OPTERM) GO TO 900                                GNAT0907
00146    28*     500 CONTINUE                                                         GNAT0908
00147    29*         GO TO 100                                                        GNAT0909
00150    30*     900 CONTINUE                                                         GNAT0910
00150    31*   C               REWIND THE ALTERNATE INPUT DATA FILE                   GNAT0911
00151    32*         REWIND   INDATA                                                  GNAT0912
00152    33*          RETURN                                                          GNAT0913
00153    34*    2000 FORMAT (13A6,A2)                                                 GNAT0914
00154    35*    2100 FORMAT (I5,2H,*,13A6,A2,1H*)                                     GNAT0915
00155    36*    4000 FORMAT(10H1 CARD COL,I7,7110)                                    GNAT0916
00156    37*          END                                                             GNAT0917

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
   CR2TAP          SYMBOLIC                          23 DEC 70  23:05:21   0  01451556    14   100  (DELETED)
   CR2TAP  CODE    RELOCATABLE                       23 DEC 70  23:04:21   1  01660446    29     1  (DELETED)
                                                                           0  01660676    14    14
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```
@ FOR RDTAPE, RDTAPE                                    GNAT0918          27 JAN 71          14:34: 2.395
UNIVAC 1108 FORTRAN V LEVEL   2206 0018 F5018H
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:34:02


   SUBROUTINE RDTAPE    ENTRY POINT 000065

   STORAGE USED (BLOCK, NAME, LENGTH)

       0001   *CODE   000047
       0000   *DATA   000016
       0002   *BLANK  000000
       0003   DATA    007164


   EXTERNAL REFERENCES (BLOCK, NAME)

       0004   TAPERW
       0005   TAPEPS
       0006   TAPEPR
       0007   TAPERD
       0010   TAPECK
       0011   NERR3S


   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

    0003 R 000000 A          0003   000000 CTL        0003 I 000016 IFILER     0003 I 000017 IRECR      0003   000015 ITAPE
    0003 I 000015 IUNITR     0000 I 000001 JFILER     0000 I 000002 JRECR      0000 I 000000 JUNITR     0000 I 000003 LSTAT
```

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00101     1*         SUBROUTINE RDTAPE                                                GNAT0919
00103     2*         COMMON /DATA/ A(3700)                                            GNAT0920
00104     3*         DIMENSION CTL(20), ITAPE(6)                                      GNAT0921
00105     4*         EQUIVALENCE (A(1),CTL), (CTL(14),ITAPE)                          GNAT0922
00105     5*        1,   (ITAPE(1),IUNITR), (ITAPE(2),IFILER), (ITAPE(3),IRECR)      GNAT0923
00106     6*         JUNITR = IUNITR                                                  GNAT0924
00107     7*         JFILER = IFILER                                                  GNAT0925
00110     8*         JRECR  = IRECR                                                   GNAT0926
00111     9*         CALL TAPERW (0,JUNITR)                                           GNAT0927
00112    10*         CALL TAPEPS (0,JUNITR,JFILER   ,JRECR+1)                         GNAT0928
00113    11*         CALL TAPEPR (0,JUNITR)                                           GNAT0929
00114    12*         CALL TAPERD (0,JUNITR,3700,A,LSTAT)                              GNAT0930
00115    13*         CALL TAPECK (LSTAT)                                              GNAT0931
00116    14*         CALL TAPERW (0,JUNITR)                                           GNAT0932
00117    15*         IUNITR = JUNITR                                                  GNAT0933
00120    16*         IFILER = JFILER                                                  GNAT0934
00121    17*         IRECR  = JRECR                                                   GNAT0935
00122    18*         RETURN                                                           GNAT0936
00123    19*         END                                                              GNAT0937

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
```

UNIVAC 1108 FORTRAN V LEVEL 2204 0018 F5018H
THIS COMPILATION WAS DONE ON 27 JAN 71 AT 14:34:03

SUBROUTINE TAPEPS ENTRY POINT 000362

TAPERD ENTRY POINT 000441

TAPEWR ENTRY POINT 000527

TAPERW ENTRY POINT 000615

TAPEOF ENTRY POINT 000663

TAPEPR ENTRY POINT 000731

TAPECK ENTRY POINT 000777

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 001005
0000 *DATA 000142
0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NTRAN
0004 QQFIL
0005 QQREC
0006 KILLER
0007 NREWS
0010 NRBUS
0011 NIOIS
0012 NIO2S
0013 NWBUS
0014 NWEFS
0015 NWDUS
0016 NERR3S

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000025 10L	0001 000325 100L	0001 000253 120L	0001 000222 140L	0001 000273 190L
0001 000053 20L	0000 000104 200F	0001 000175 221G	0001 000232 240G	0001 000043 30L
0001 000063 35L	0001 000064 40L	0001 000074 45L	0001 000165 50L	0001 000124 55L
0001 000334 70L	0001 000140 80L	0001 000336 90L	0000 I 000103 I	0000 I 000074 I$
0000 I 000075 I4	0000 I 000000 JFILE	0000 I 000035 JREC	0000 I 000077 JSR	0000 I 000074 KFILE
0000 I 000101 KREC	0000 I 000100 NSTAT	0000 I 000102 NSTAT	0000 I 000072 TYPE	

00100 1* C GNAT0939
00100 2* C ITYPE * TYPE OF DATA TAPE GNAT0940

```
00100     3*  C                 0 = NTRAN                                                GNATD941
00100     4*  C                 1 = FORTRAN BINARY                                       GNATD942
00100     5*  C     IUNIT  = PHYSICAL UNIT FOR TAPE ASSIGNMENT                           GNATD943
00100     6*  C     IFILE  = FILES TO BE SKIPPED                                         GNATD944
00100     7*  C     IREC   = RECORDS TO BE SKIPPED                                       GNATD945
00100     8*  C     IWORDS = NUMBER OF DATA WORDS                                        GNATD946
00100     9*  C     A      = STORAGE AREA FOR DATA WORDS                                 GNATD947
00100    10*  C     LSTAT  = STATUS WORD FOR NTRAN READ/WRITE                            GNATD948
00100    11*  C                -1 = TRANSMISSION NOT COMPLETE                           GNATD949
00100    12*  C                -2 = END-OF-FILE FOR READ, END-OF-TAPE OR DRUM-FILE      GNATD950
00100    13*  C                   FOR WRITE                                             GNATD951
00100    14*  C                -3 = DEVICE ERROR                                        GNATD952
00100    15*  C                -4 = TRANSMISSION ABORTED                                GNATD953
00100    16*  C                 N = NUMBER OF WORDS (IWORDS) TRANSMITTED WHEN           GNATD954
00100    17*  C                     TRANSMISSION IS COMPLETE                            GNATD955
00100    18*  C     LSTAT  = STATUS WORD FOR FORTRAN READ/WRITE                          GNATD956
00100    19*  C                 N = NUMBER OF WORDS (IWORDS) TRANSMITTED WHEN           GNATD957
00100    20*  C                     TRANSMISSION IS COMPLETE                            GNATD958
00100    21*  C                                                                         GNATD959
00100    22*  C     NSTAT  = STATUS WORD FOR FORTRAN FILE SKIPPING                       GNATD960
00100    23*  C                 0 = NORMAL COMPLETION AS REQUESTED                      GNATD961
00100    24*  C                 1 = INAPPROPRIATE FORTRAN UNIT                          GNATD962
00100    25*  C                 2 = NOT USED                                            GNATD963
00100    26*  C                 3 = UNEXPECTED TERMINATION BY A PERMANENT READ ERROR    GNATD964
00100    27*  C     NSTAT  = STATUS WORD FOR FORTRAN RECORD SKIPPING                     GNATD965
00100    28*  C                 0 = NORMAL COMPLETION AS REQUESTED                      GNATD966
00100    29*  C                 1 = INAPPROPRIATE FORTRAN UNIT                          GNATD967
00100    30*  C                 2 = UNEXPECTED TERMINATION BY SKIPPING THROUGH AN       GNATD968
00100    31*  C                     END-OF-FILE OR REACHING THE BEGINNING OF TAPE       GNATD969
00100    32*  C                 3 = UNEXPECTED TERMINATION BY A PERMANENT READ ERROR    GNATD970
00100    33*  C                                                                         GNATD971
00101    34*        SUBROUTINE TAPEPS (ITYPE,IUNIT,IFILE,IREC)                          GNATD972
00103    35*        DIMENSION JFILE(29), JREC(29)                                       GNATD973
00104    36*        INTEGER TYPE(2)                                                     GNATD974
00105    37*        DATA JFILE, JREC, / 29*0, 29*0 /                                    GNATD975
00110    38*        DATA TYPE / 6H  NTRA,6HFORTRA /                                     GNATD976
00112    39*        DATA I6 / 6 /                                                       GNATD977
00112    40*  C                                                                         GNATD978
00112    41*  C         THIS ROUTINE WILL POSITION EITHER AN NTRAN OR A FORTRAN         GNATD979
00112    42*  C         BINARY TAPE TO THE PROPER FILE AND/OR RECORD.                   GNATD980
00112    43*  C                                                                         GNATD981
00114    44*        IF (IFILE .EQ. 0) GO TO 45                                          GNATD982
00116    45*        KFILE = IFILE                                                       GNATD983
00117    46*      5 CONTINUE                                                            GNATD984
00120    47*        JSR = JFILE(IUNIT) + KFILE                                          GNATD985
00120    48*  C         TEST FOR TYPE OF TAPE                                           GNATD986
00121    49*        IF (ITYPE .EQ. 1) GO TO 30                                          GNATD987
00121    50*  C         NTRAN TAPE                                                      GNATD988
00123    51*        IF (JSR .GT. 0) GO TO 10                                            GNATD989
00125    52*        CALL NTRAN (IUNIT,10)                                               GNATD990
00126    53*        GO TO 35                                                            GNATD991
00127    54*     10 CONTINUE                                                            GNATD992
00130    55*        CALL NTRAN (IUNIT,8,KFILE-1)                                        GNATD993
00131    56*        CALL NTRAN (IUNIT,8,1)                                              GNATD994
00132    57*        GO TO 40                                                            GNATD995
00133    58*     30 CONTINUE                                                            GNATD996
00133    59*  C         BINARY TAPE                                                     GNATD997
00134    60*        IF (JSR .GT. 0) GO TO 20                                            GNATD998
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00136    61*          REWIND IUNIT                                                GNAT0999
00137    62*          GO TO 35                                                    GNAT1000
00140    63*       20 CONTINUE                                                    GNAT1001
00141    64*          CALL QQFIL (IUNIT,KFILE,NSTAT)                              GNAT1002
00142    65*          IF (NSTAT .NE. 0) GO TO 70                                  GNAT1003
00144    66*          GO TO 90                                                    GNAT1004
00145    67*       35 CONTINUE                                                    GNAT1005
00146    68*          JSR = 0                                                     GNAT1006
00147    69*       90 CONTINUE                                                    GNAT1007
00150    70*          JFILE(IUNIT) = JSR                                          GNAT1008
00151    71*          JREC(IUNIT) = 0                                             GNAT1009
00152    72*          IF (IREC .LT. 0) GO TO 90                                   GNAT1010
00154    73*       45 CONTINUE                                                    GNAT1011
00154    74*    C        POSITION TAPE TO PROPER RECORD                          GNAT1012
00153    75*          IF (IREC .EQ. 0) GO TO 90                                   GNAT1013
00157    76*          KREC = JREC(IUNIT) + IREC                                   GNAT1014
00160    77*          IF (KREC .LT. 0) GO TO 80                                   GNAT1015
00162    78*          JREC(IUNIT) = KREC                                          GNAT1016
00162    79*    C        TEST FOR TYPE OF TAPE                                   GNAT1017
00163    80*          IF (ITYPE .EQ. 1) GO TO 55                                  GNAT1018
00163    81*    C        NTRAN TAPE                                              GNAT1019
00165    82*          CALL NTRAN (IUNIT,7,IREC)                                   GNAT1020
00166    83*          GO TO 90                                                    GNAT1021
00167    84*       55 CONTINUE                                                    GNAT1022
00167    85*    C        BINARY TAPE                                             GNAT1023
00170    86*          CALL QQREC (IUNIT,IREC,NSTAT)                               GNAT1024
00171    87*          IF (NSTAT .EQ. 2) GO TO 90                                  GNAT1025
00173    88*          IF (NSTAT .NE. 0) GO TO 70                                  GNAT1026
00175    89*          GO TO 90                                                    GNAT1027
00176    90*       80 CONTINUE                                                    GNAT1028
00177    91*          JREC(IUNIT) = 0                                             GNAT1029
00200    92*          KFILE = -1                                                  GNAT1030
00201    93*          IF (ITYPE) 20,10,20                                         GNAT1031
00201    94*    C                                                                 GNAT1032
00204    95*          ENTRY TAPERD (ITYPE,IUNIT,IWORDS,A,LSTAT)                   GNAT1033
00206    96*          INTEGER A(1)                                                GNAT1034
00206    97*    C                                                                 GNAT1035
00206    98*    C        THIS ROUTINE WILL READ FROM EITHER A FORTRAN BINARY TAPE OR GNAT1036
00206    99*    C        AN NTRAN TAPE AND STORE IWORDS AMOUNT OF INFORMATION INTO GNAT1037
00206   100*    C        THE ARRAY A.                                            GNAT1038
00206   101*    C                                                                 GNAT1039
00207   102*          JREC(IUNIT) = JREC(IUNIT) + 1                               GNAT1040
00210   103*          IF (ITYPE) 50,60,50                                         GNAT1041
00213   104*       60 CONTINUE                                                    GNAT1042
00213   105*    C        READ NTRAN TAPE AND STORE DATA INTO A                   GNAT1043
00214   106*          CALL NTRAN (IUNIT,2,IWORDS,A,LSTAT)                         GNAT1044
00215   107*          GO TO 90                                                    GNAT1045
00216   108*       50 CONTINUE                                                    GNAT1046
00216   109*    C        READ BINARY TAPE AND STORE DATA INTO A                  GNAT1047
00217   110*          READ (IUNIT) (A(I),I=1,IWORDS)                              GNAT1048
00225   111*          LSTAT = IWORDS                                              GNAT1049
00226   112*          GO TO 90                                                    GNAT1050
00226   113*    C                                                                 GNAT1051
00227   114*          ENTRY TAPEWR (ITYPE,IUNIT,IWORDS,A,LSTAT)                   GNAT1052
00227   115*    C                                                                 GNAT1053
00227   116*    C        THIS ROUTINE WILL WRITE EITHER A BLOCK OF INFORMATION IWORDS GNAT1054
00227   117*    C        LONG ON AN NTRAN TAPE OR A RECORD OF IWORDS ON A FORTRAN GNAT1055
00227   118*    C        BINARY TAPE                                             GNAT1056
```

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00227   119*   C                                                                GNAT1057
00231   120*          JREC(IUNIT) = JREC(IUNIT) + 1                             GNAT1058
00231   121*   C        TEST FOR TYPE OF TAPE                                    GNAT1059
00232   122*          IF (ITYPE) 140,140,160                                    GNAT1060
00235   123*     140 CONTINUE                                                   GNAT1061
00235   124*   C        WRITE AN NTRAN BLOCK                                     GNAT1062
00236   125*          CALL NTRAN (IUNIT,1,IWORDS,A,LSTAT)                       GNAT1063
00237   126*          GO TO 90                                                  GNAT1064
00240   127*     160 CONTINUE                                                   GNAT1065
00240   128*   C        WRITE A FORTRAN RECORD                                   GNAT1066
00241   129*          WRITE (IUNIT) (A(I),I=1,IWORDS)                           GNAT1067
00247   130*          LSTAT = IWORDS                                            GNAT1068
00250   131*          GO TO 90                                                  GNAT1069
00250   132*   C                                                                GNAT1070
00251   133*          ENTRY TAPERW (ITYPE,IUNIT)                                GNAT1071
00251   134*   C                                                                GNAT1072
00251   135*   C        THIS ROUTINE WILL REWIND EITHER AN NTRAN OR A FORTRAN    GNAT1073
00251   136*   C        BINARY TAPE.                                             GNAT1074
00251   137*   C                                                                GNAT1075
00253   138*          JFILE(IUNIT) = 0                                          GNAT1076
00254   139*          JREC (IUNIT) = 0                                          GNAT1077
00254   140*   C        TEST FOR TYPE OF TAPE                                    GNAT1078
00255   141*          IF (ITYPE) 120,110,120                                    GNAT1079
00260   142*     110 CONTINUE                                                   GNAT1080
00260   143*   C        REWIND THE NTRAN TAPE                                    GNAT1081
00261   144*          CALL NTRAN (IUNIT,10)                                     GNAT1082
00262   145*          GO TO 90                                                  GNAT1083
00263   146*     120 CONTINUE                                                   GNAT1084
00263   147*   C        REWIND FORTRAN BINARY TAPE                               GNAT1085
00264   148*          REWIND IUNIT                                              GNAT1086
00265   149*          GO TO 90                                                  GNAT1087
00265   150*   C                                                                GNAT1088
00266   151*          ENTRY TAPEOF (ITYPE,IUNIT)                                GNAT1089
00266   152*   C                                                                GNAT1090
00266   153*   C        THIS ROUTINE WILL WRITE AN END OF FILE MARK ON EITHER AN GNAT1091
00266   154*   C        NTRAN TAPE OR A FORTRAN BINARY TAPE.                     GNAT1092
00266   155*   C                                                                GNAT1093
00270   156*          JREC(IUNIT) = 0                                           GNAT1094
00271   157*          JFILE(IUNIT) = JFILE(IUNIT) + 1                           GNAT1095
00271   158*   C        TEST FOR TYPE OF TAPE                                    GNAT1096
00272   159*          IF (ITYPE) 190,180,190                                    GNAT1097
00275   160*     180 CONTINUE                                                   GNAT1098
00275   161*   C        WRITE AN EOF MARK ON THE NTRAN TAPE                      GNAT1099
00276   162*          CALL NTRAN (IUNIT,9)                                      GNAT1100
00277   163*          GO TO 90                                                  GNAT1101
00300   164*     190 CONTINUE                                                   GNAT1102
00300   165*   C        WRITE AN EOF MARK ON THE FORTRAN BINARY TAPE             GNAT1103
00301   166*          END FILE IUNIT                                            GNAT1104
00302   167*          GO TO 90                                                  GNAT1105
00302   168*   C                                                                GNAT1106
00303   169*          ENTRY TAPEPR (ITYPE,IUNIT)                                GNAT1107
00303   170*   C                                                                GNAT1108
00303   171*   C        THIS ROUTINE WILL PRINT THE STATUS OF THE UNIT IUNIT.    GNAT1109
00303   172*   C                                                                GNAT1110
00305   173*          KFILE = JFILE(IUNIT) + 1                                  GNAT1111
00306   174*          KREC  = JREC (IUNIT) + 1                                  GNAT1112
00307   175*          WRITE (16,200) TYPE(ITYPE+1), IUNIT, KFILE, KREC          GNAT1113
00315   176*          GO TO 90                                                  GNAT1114
```

```
00315   177*    C                                                              GNAT1115
00316   178*          ENTRY TAPECK (JSTAT)                                     GNAT1116
00316   179*    C                                                              GNAT1117
00316   180*    C          THIS ROUTINE WILL TEST THE STATUS OF JSTAT FOR NTRAN I/O GNAT1118
00316   181*    C                                                              GNAT1119
00320   182*       100 IF (JSTAT .EQ. -1) GO TO 100                            GNAT1120
00322   183*           IF (JSTAT) 70,70,90                                     GNAT1121
00322   184*    C          ERROR HAS OCCURRED                                  GNAT1122
00325   185*        70 CONTINUE                                                GNAT1123
00326   186*           CALL KILLER                                             GNAT1124
00326   187*    C                                                              GNAT1125
00327   188*        90 CONTINUE                                                GNAT1126
00330   189*           RETURN                                                  GNAT1127
00330   190*    C                                                              GNAT1128
00331   191*       200 FORMAT (1XA6,6HN UNIT13,11H IS ON FILE13,7H RECORD14)   GNAT1129
00332   192*           END                                                     GNAT1130

      END OF UNIVAC 1108 FORTRAN V COMPILATION.     0 *DIAGNOSTIC* MESSAGE(S)
```

@ ELT QQPOS/VER2,3,700312, 47524	GNAT1131	27 JAN 71	14:34: 6.107
@ ELT TRACER/CODE,3,680115, 61945	GNAT1144	27 JAN 71	14:34: 6.345

STARTING ADDRESS 014000

CORE LIMITS 014000 034374 100000 137523 163772 163777

```
MAIN  /CODE
0   100000-100136
1   014000-015246

NSTOPS/CODE
1   015247-015264

NIERS /CODE
0   100137-100137
1   015265-015571
2   100140-100231

NFKTS /CODE
1   015572-016457
2   100232-100245

NCNVTS/CODE
1   016460-016667
2   100246-100331

NFTVS /CODE
1   016670-016712

NOTINS/CODE
1   016713-017306
2   100332-100374

FPACKS/CODE
1   017307-017352

DEPTH /******
0   100375-100402

NERRS /CODE
0   100403-100542
1   017353-017755

NIOINS/CODE
1   017756-020023
2   100543-100573
```

```
NOUT$ /CODE
0    100574-100576
1    020024-020674
2    100577-100614

NTAB$ /CODE
0    100615-100743

NBDCY$/CODE
0    100744-101130

NLINP$/CODE
0    101131-101137
1    020675-022263
2    101140-101312

NININ$/CODE
1    022264-022435
2    101313-101343

OUTPUT/CODE
0    101344-101412
1    022436-022607

DISPLY/CODE
0    101413-102275
1    022610-023014

BULK  /CODE
0    102276-102343
1    023017-023246

TEMP  /CODE
0    102344-102363
1    023247-023360

HEATER/CODE
0    102364-102373
1    023361-023402

DIFF2 /CODE
0    102374-102425
1    023403-023677

MEANB /CODE
0    102426-102470
1    023700-024246

BCOUT /CODE
0    102471-102507
1    024247-024370

DIFF  /CODE
0    102510-102541
1    024371-025264

MEANA /CODE
```

```
0    102542=102610
1    025265=025657

NODWAL/******
0    102611=113302

RTPRES/CODE
0    113303=113415
1    025660=026075

EXP   /CODE
1    026076=026166
2    113416=113435

NEXP&S/CODE
1    026167=026204
2    113436=113436

NXPAFS/CODE
1    026205=026363
2    113437=113443

NXPAXS/CODE
1    026364=026406
2    113444=113444

ALOG  /CODE
1    026407=026474
2    113445=113521

THERM /CODE
0    113522=113612
1    026475=027517

BINSER/CODE
0    113613=113635
1    027520=027711

TPCB  /******
0    113636=123021

BETA  /CODE
0    123022=123037
1    027712=030017

TEFCTN/******
0    123040=123133

TAPEIO/CODE
0    123134=123275
1    030020=031024

NFOUTS/CODE
1    031025=031246
2    123276=123277

NBUFFS/CODE
1    031247=031270
```

```
2   123300=124310

NFINPS/CODE
1   031271=031530
2   124311=124312

NRWNDS/CODE
1   031531=031623

TRACER/CODE
0   124313=124314
1   031624=031635

QQPOS /VER2
1   031636=031750
2   124315=124321

NTRAN /CODE
0   124322=124322
1   031751=033251
2   124323=124452

TLABLS/CODE
0   124453=124462

TSCRHS/CODE
0   124463=124535

THRUS /CODE
0   124536=124653

TSWAPS/CODE
0   124654=124754

TINTLS/CODE
0   124755=125053

RDTAPE/CODE
0   125054=125071
1   033252=033340

CR2TAP/CODE
0   125072=125143
1   033341=033464

NINPTS/CODE
0   125144=125145
1   033465=034379
2   125146=125200

DSTATE/******
0   125201=130300

TRNSMT/******
0   130301=130305

CSTS  /******
0   130306=130313
```

```
D2     /******
D    130314-130323

D1     /******
0    130324-130337

DATA   /******
0    130340-137523


END OF ALLOCATION 1103 0039A 09099
```

```
CARD COL    1        2        3        4        5        6        7        8
  1.* * APOLLO BOTTLE CROSS SECTION - 20 NODE DIAMETER                      *
  2.* * HEATER NODES -  I = 12, J = 10                                      *
  3.* * SCALE FACTOR IS 2400                                                *
  4.* * GY = -2. E-8                                                        *
  5.* *                                                                     *
  6.* *                                                                     *
  7.* $INPUT                                                               *
  8.* PROP(4) = 1.2E-2                                                      *
  9.* PROP(8)= 850., 200.                                                  *
 10.* CTL(12) = -2.E-8                                                      *
 11.* CTL(13) = 2400.                                                       *
 12.* CTL(5) = 1.4                                                          *
 13.* CTL(6) = 526.6                                                        *
 14.* CTL(2) = .5E-4, .6, .025                                             *
 15.* CTL(3) = .9                                                          *
 16.* CTL(4) = .0125                                                       *
 17.* ITAPE(4) = 1,1,1                                                     *
 18.* CTL(20) = 2.                                                        *
 19.* $END                                                                 *
NTRAN UNIT  1 IS ON FILE  1 RECORD    1
```

.0000000 .5000000-04 .0000000 .8500000+03 .6545085+02 .0000000 .0000000 .0000000 .0000000 .0000000

NTRAN UNIT 1 IS ON FILE 1 RECORD 1

20	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.16358+02	.16358+02	.16358+02
19	.00000	.00000	.00000	.00000	.00000	.16362+02	.16362+02	.16362+02	.16362+02	.16362+02
18	.00000	.00000	.00000	.16367+02	.16367+02	.16367+02	.16367+02	.16367+02	.16367+02	.16367+02
17	.00000	.00000	.16370+02	.16370+02	.16370+02	.16370+02	.16370+02	.16370+02	.16370+02	.16370+02
16	.00000	.00000	.16375+02	.16375+02	.16375+02	.16375+02	.16375+02	.16375+02	.16375+02	.16375+02
15	.00000	.16379+02	.16379+02	.16379+02	.16379+02	.16379+02	.16379+02	.16379+02	.16379+02	.16379+02
14	.00000	.16383+02	.16383+02	.16383+02	.16383+02	.16383+02	.16383+02	.16383+02	.16383+02	.16383+02
13	.16387+02	.16387+02	.16387+02	.16387+02	.16387+02	.16387+02	.16387+02	.16387+02	.16387+02	.16387+02
12	.16390+02	.16390+02	.16390+02	.16390+02	.16390+02	.16390+02	.16390+02	.16390+02	.16390+02	.16390+02
11	.16395+02	.16395+02	.16395+02	.16395+02	.16395+02	.16395+02	.16395+02	.16395+02	.16395+02	.16395+02
10	.16399+02	.16399+02	.16399+02	.16399+02	.16399+02	.16399+02	.16399+02	.16399+02	.16399+02	.16399+02
9	.16404+02	.16404+02	.16404+02	.16404+02	.16404+02	.16404+02	.16404+02	.16404+02	.16404+02	.16404+02
8	.16407+02	.16407+02	.16407+02	.16407+02	.16407+02	.16407+02	.16407+02	.16407+02	.16407+02	.16407+02
7	.00000	.16411+02	.16411+02	.16411+02	.16411+02	.16411+02	.16411+02	.16411+02	.16411+02	.16411+02
6	.00000	.1641 2	.16416+02	.16416+02	.16416+02	.16416+02	.16416+02	.16416+02	.16416+02	.16416+02
5	.00000	.00000	.16420+02	.16420+02	.16420+02	.16420+02	.16420+02	.16420+02	.16420+02	.16420+02
4	.00000	.00000	.16423+02	.16423+02	.16423+02	.16423+02	.16423+02	.16423+02	.16423+02	.16423+02
3	.00000	.00000	.00000	.16428+02	.16428+02	.16428+02	.16428+02	.16428+02	.16428+02	.16428+02
2	.00000	.00000	.00000	.00000	.00000	.16432+02	.16432+02	.16432+02	.16432+02	.16432+02
1	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.16436+02	.16436+02	.16436+02

TIME =	.000									
20	.16358+02	.16358+02	.16358+02							
19	.16362+02	.16362+02	.16362+02	.16362+02	.16362+02					
18	.16367+02	.16367+02	.16367+02	.16367+02	.16367+02	.16367+02	.16367+02			
17	.16370+02	.16370+02	.16370+02	.16370+02	.16370+02	.16370+02	.16370+02	.16370+02		
16	.16375+02	.16375+02	.16375+02	.16375+02	.16375+02	.16375+02	.16375+02	.16375+02		
15	.16379+02	.16379+02	.16379+02	.16379+02	.16379+02	.16379+02	.16379+02	.16379+02	.16379+02	
14	.16383+02	.16383+02	.16383+02	.16383'	.16383+02	.16383+02	.16383+02	.16383+02	.16383+02	
13	.16387+02	.16387+02	.16387+02	.16387'..	.16387+02	.16387+02	.16387+02	.16387+02	.16387+02	.16387+02
12	.16390+02	.16390+02	.16390+02	.16390+02	.16390+02	.16390+02	.16390+02	.16390+02	.16390+02	.16390+02
11	.16395+02	.16395+02	.16395+02	.16395+02	.16395+02	.16395+02	.16395+02	.16395+02	.16395+02	.16395+02
10	.16399+02	.16399+02	.16399+02	.16399+02	.16399+02	.16399+02	.16399+02	.16399+02	.16399+02	.16399+02
9	.16404+02	.16404+02	.16404+02	.16404+02	.16404+02	.16404+02	.16404+02	.16404+02	.16404+02	.16404+02
8	.16407+02	.16407+02	.16407+02	.16407+02	.16407+02	.16407+02	.16407+02	.16407+02	.16407+02	.16407+02
7	.16411+02	.16411+02	.16411+02	.16411+02	.16411+02	.16411+02	.16411+02	.16411+02	.16411+02	
6	.16416+02	.16416+02	.16416+02	.16416+02	.16416+02	.16416+02	.16416+02	.16416+02	.16416+02	
5	.16420+02	.16420+02	.16420+02	.16420+02	.16420+02	.16420+02	.16420+02	.16420+02		
4	.16423+02	.16423+02	.16423+02	.16423+02	.16423+02	.16423+02	.16423+02	.16423+02		
3	.16428+02	.16428+02	.16428+02	.16428+02	.16428+02	.16428+02	.16428+02			
2	.16432+02	.16432+02	.16432+02	.16432+02	.16432+02					
1	.16436+02	.16436+02	.16436+02							

20	.00000	.00000	.00000	.00000	.00000	.00000	.00000	-.56618-04	-.56618-04	-.56618-04
19	.00000	.00000	.00000	.00000	.00000	-.49901-04	-.49901-04	-.49901-04	-.49901-04	-.49901-04
18	.00000	.00000	.00000	-.44143-04	-.44143-04	-.44143-04	-.44143-04	-.44143-04	-.44143-04	-.44143-04
17	.00000	.00000	-.38385-04	-.38385-04	-.38385-04	-.38385-04	-.38385-04	-.38385-04	-.38385-04	-.38385-04
16	.00000	.00000	-.31668-04	-.31668-04	-.31668-04	-.31668-04	-.31668-04	-.31668-04	-.31668-04	-.31668-04
15	.00000	-.25910-04	-.25910-04	-.25910-04	-.25910-04	-.25910-04	-.25910-04	-.25910-04	-.25910-04	-.25910-04
14	.00000	-.19193-04	-.19193-04	-.19193-04	-.19193-04	-.19193-04	-.19193-04	-.19193-04	-.19193-04	-.19193-04
13	-.14395-04	-.14395-04	-.14395-04	-.14395-04	-.14395-04	-.14395-04	-.14395-04	-.14395-04	-.14395-04	-.14395-04
12	-.95963-05	-.95963-05	-.95963-05	-.95963-05	-.95963-05	-.95963-05	-.95963-05	-.95963-05	-.95963-05	-.95963-05
11	-.28789-05	-.28789-05	-.28789-05	-.28789-05	-.28789-05	-.28789-05	-.28789-05	-.28789-05	-.28789-05	-.28789-05
10	.28789-05	.28789-05	.28789-05	.28789-05	.28789-05	.28789-05	.28789-05	.28789-05	.28789-05	.28789-05
9	.95963-05	.95963-05	.95963-05	.95963-05	.95963-05	.95963-05	.95963-05	.95963-05	.95963-05	.95963-05
8	.15354-04	.15354-04	.15354-04	.15354-04	.15354-04	.15354-04	.15354-04	.15354-04	.15354-04	.15354-04
7	.00000	.22072-04	.22072-04	.22072-04	.22072-04	.22072-04	.22072-04	.22072-04	.22072-04	.22072-04
6	.00000	.28789-04	.28789-04	.28789-04	.28789-04	.28789-04	.28789-04	.28789-04	.28789-04	.28789-04
5	.00000	.00000	.34547-04	.34547-04	.34547-04	.34547-04	.34547-04	.34547-04	.34547-04	.34547-04
4	.00000	.00000	.40305-04	.40305-04	.40305-04	.40305-04	.40305-04	.40305-04	.40305-04	.40305-04
3	.00000	.00000	.00000	.47022-04	.47022-04	.47022-04	.47022-04	.47022-04	.47022-04	.47022-04
2	.00000	.00000	.00000	.00000	.00000	.52780-04	.52780-04	.52780-04	.52780-04	.52780-04
1	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.58538-04	.58538-04	.58538-04

TIME = .000										
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19	-.49901-04	-.49901-04	-.49901-04	-.49901-04	-.49901-04					
18	-.44143-04	-.44143-04	-.44143-04	-.44143-04	-.44143-04	-.44143-04	-.44143-04			
17	-.38385-04	-.38385-04	-.38385-04	-.38385-04	-.38385-04	-.38385-04	-.38385-04	-.38385-04		
16	-.31668-04	-.31668-04	-.31668-04	-.31668-04	-.31668-04	-.31668-04	-.31668-04	-.31668-04		
15	-.25910-04	-.25910-04	-.25910-04	-.25910-04	-.25910-04	-.25910-04	-.25910-04	-.25910-04	-.25910-04	
14	-.19193-04	-.19193-04	-.19193-04	-.19193-04	-.19193-04	-.19193-04	-.19193-04	-.19193-04	-.19193-04	
13	-.14395-04	-.14395-04	-.14395-04	-.14395-04	-.14395-04	-.14395-04	-.14395-04	-.14395-04	-.14395-04	-.14395-04
12	-.95963-05	-.95963-05	-.95963-05	-.95963-05	-.95963-05	-.95963-05	-.95963-05	-.95963-05	-.95963-05	-.95963-05
11	-.28789-05	-.28789-05	-.28789-05	-.28789-05	-.28789-05	-.28789-05	-.28789-05	-.28789-05	-.28789-05	-.28789-05
10	.28789-05	.28789-05	.28789-05	.28789-05	.28789-05	.28789-05	.28789-05	.28789-05	.28789-05	.28789-05
9	.95963-05	.95963-05	.95963-05	.95963-05	.95963-05	.95963-05	.95963-05	.95963-05	.95963-05	.95963-05
8	.15354-04	.15354-04	.15354-04	.15354-04	.15354-04	.15354-04	.15354-04	.15354-04	.15354-04	.15354-04
7	.22072-04	.22072-04	.22072-04	.22072-04	.22072-04	.22072-04	.22072-04	.22072-04	.22072-04	
6	.28789-04	.28789-04	.28789-04	.28789-04	.28789-04	.28789-04	.28789-04	.28789-04	.28789-04	
5	.34547-04	.34547-04	.34547-04	.34547-04	.34547-04	.34547-04	.34547-04	.34547-04		
4	.40305-04	.40305-04	.40305-04	.40305-04	.40305-04	.40305-04	.40305-04	.40305-04		
3	.47022-04	.47022-04	.47022-04	.47022-04	.47022-04	.47022-04	.47022-04			
2	.52780-04	.52780-04	.52780-04	.52780-04	.52780-04					
1	.58538-04	.58538-04	.58538-04							

20	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
19	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
18	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
17	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
16	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
15	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
14	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
13	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
12	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
11	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
10	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
9	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
8	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
7	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
6	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
5	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
4	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
3	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
2	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
1	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000

TIME = .000

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19	.00000	.00000	.00000	.00000	.00000					
18	.00000	.00000	.00000	.00000	.00000	.00000	.00000			
17	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000		
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4	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000		
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2	.00000	.00000	.00000	.00000	.00000					
1	.00000	.00000	.00000							

20	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
19	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
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17	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
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15	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
14	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
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1	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000

TIME = .000

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18	.00000	.00000	.00000	.00000	.00000	.00000	.00000			
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2	.00000	.00000	.00000	.00000	.00000					
1	.00000	.00000	.00000							

20	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
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1	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000

TIME = .000

20	.00000	.00000	.00000							
19	.00000	.00000	.00000	.00000	.00000					
18	.00000	.00000	.00000	.00000	.00000	.00000	.00000			
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4	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000		
3	.00000	.00000	.00000	.00000	.00000	.00000	.00000			
2	.00000	.00000	.00000	.00000	.00000					
1	.00000	.00000	.00000							

.500000-04 PFLAG = 1.

* CHAR UN/FLOW AT 024411
* CHAR UN/FLOW AT 024411
* CHAR UN/FLOW AT 024411
* CHAR UN/FLOW AT 024410
* CHAR UN/FLOW AT 024406
* CHAR UN/FLOW AT 024410

• CHAR UN/FLOW AT 024406

• CHAR UN/FLOW AT 024410

• CHAR UN/FLOW AT 024410

• CHAR UN/FLOW AT 024410

•1249999-01 •5000000-04 •4999995+00 •6685481+03 •6544808+02 •1999957+03 •2003298+03 •2094832+03 •8683396+03 •2068159+02

RELATIVE PRESSURE (PSI)

NTRAN UNIT 1 IS ON FILE 1 RECORD 2

20	•00000	•00000	•00000	•00000	•00000	•00000	•00000	-•56003+00	-•63342+00	-•2017D+00
19	•00000	•00000	•00000	•00000	•00000	-•2330+00	-•17557+00	-•20643+00	-•28685+00	•2788D+00
18	•00000	•00000	•00000	-•26784-01	-•45775+00	-•1774+00	•11576+00	-•92888-01	-•12214+00	•14728+00
17	•00000	•00000	-•31645+00	•40838-01	-•41840+00	-•3394-01	-•17252+00	-•16109+00	-•16183+00	•21571+00
16	•00000	•00000	-•43832-01	•58185-01	-•37078+00	-•83781-01	•39960+00	•16158+00	•36959+00	•61696+00
15	•00000	-•68984-01	-•43599+00	•18294+00	-•11288+00	-•16341-01	-•14219+00	•13266+00	•11204-01	•30898+00
14	•00000	•17393+00	•23426+00	•19300+00	•20956+00	-•17559+00	•23395+00	•45903+00	-•35313-02	•70611+00
13	-•80126-01	•12836+00	-•17967+00	•46013+00	-•25496-01	-•4579+00	-•18712+00	•42986+00	-•54935+00	•15744+00
12	-•28811+00	-•18345+00	-•24980-01	•58320-01	•26917+00	•19572+00	-•47130+00	•88524-01	•13062-01	•49990+00
11	-•68519-03	-•24266+00	-•37909+00	•89114-01	•34770+00	•45853+00	-•36025+00	•10818-01	-•12924+01	-•12879+00
10	•11291+00	•84489-01	-•15215-01	•16027+00	•10803+00	•18386+00	•83269-01	•36837-01	•33233+00	•32027+00
9	-•58236-01	-•53136-01	-•45216-01	•23396+00	-•15004+00	-•12791+00	-•55342+00	•39484-02	-•83697+00	•57527+00
8	-•31655+00	-•45385+00	-•11874+00	-•76199-01	•87462-02	•36917+00	-•53468+00	•46949+00	•37827+00	•97094+00
7	•00000	•10013+00	-•32948-01	•20692+00	•46979+00	•44251+00	-•41086+00	•47553+00	•50402-02	•71105+00
6	•00000	•44351-01	-•38855-01	-•87090-01	-•35708+00	•16819+00	•79247-01	•29241+00	•11332+00	•64716+00
5	•00000	•00000	-•10851+00	•30969+00	-•52956+00	•44251+00	-•45994+00	•11094+00	-•93146-01	-•26947+00
4	•00000	•00000	•27025+00	•12994+00	•97631-01	-•14330+00	•59026-01	•12360+00	•94356-01	-•91586-01
3	•00000	•00000	•00000	•10656+00	-•14101+00	•19575+00	-•60077+00	-•20797+00	•39540+00	-•29194-01
2	•00000	•00000	•00000	•00000	•00000	•45868-01	-•33646+00	•37323+00	-•31991+00	-•46762-01
1	•00000	•00000	•00000	•00000	•00000	•00000	•00000	•13809+00	•12188-01	•22712-01

TIME = •500

20	-•14665+00	•76623-01	•57466-01							
19	•22010+00	•45365+00	-•18531-01	•14804+00	-•64725-01					
18	•25303-01	-•50987-01	•33949+00	•62640-01	-•32621+00	-•56676+00	-•68808+00			
17	•25598+00	•97774-01	-•28685+00	•66973+01	•33182-01	-•12703+00	-•21735+00	•13184+00		
16	-•73860-01	•52773+00	•34637+00	•35800-01	-•46297+00	-•33595+00	-•47757+00	•44250-03		
15	-•20871-01	-•13558+00	-•20296+00	-•36463+00	-•33688+00	-•21210+00	•46297-01	-•47906+00	-•23532+00	
14	•28504+00	-•10828-01	-•91566-01	•30620+00	•13981+00	-•15921+00	-•42483+00	-•18248+00	-•43814+00	
13	-•10720+01	•81641-01	-•55776+00	-•13130+00	-•13876+00	•25812+00	•69934+00	-•46603+00	•46791+00	-•17 09-01
12	•52781+00	•31203+00	•21651+00	•90128+00	•56413+00	•43147+00	•44931+00	-•51597+00	-•11527+00	-•2 791+00
11	-•27271+00	•11436+00	-•37984+00	•10026+00	-•52112+00	-•39775+00	-•18687-01	-•48355-01	•47404+00	-•68646+00
10	•15966+00	•72191+00	•54103+00	•91763+00	•57636-01	-•25105+00	-•26398+00	-•27182+00	•55759-02	-•39303+00
9	-•10353+01	•56028-01	-•56612+00	•46442+00	-•53445+00	•24725+00	•16859+00	•68490-03	-•24079+00	-•33011+00
8	•72615-01	•80345+00	•33493+00	•86025+00	-•32791+00	•23134+00	-•59076+00	-•32738+00	-•10322+00	-•92474-01
7	-•42602+00	•57464+00	•33899-01	•23789+00	-•42312+00	-•75833-01	-•65987-01	•17199-01	-•60073-01	
6	•35040+00	•21993+00	-•89151-01	•31880+00	•23699+00	-•25569+00	-•69782+00	-•32686+00	-•31689+00	
5	•12013+00	•11515+00	•24164+00	•28495-01	•13492+00	-•12700+00	•34685+00	•83359-02		
4	•29933+00	-•55455-01	•29933+00	-•37524+00	-•22116+00	-•39539+00	-•34335+00	-•45678+00		
3	•68352+00	•13547+00	•26311+00	-•14689+00	•45719+00	-•73453-01	•20100+00			
2	•51736-01	•28639+00	•21429+00	-•21804+00	-•87190-02					
1	•21687+00	•32400+00	•23065+00							

RELATIVE DENSITY (LBM/FT^3)

20	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.50865-02	.49819-02	.56062-02
19	.00000	.00000	.00000	.00000	.00000	.55742-02	.56426-02	.55991-02	.54828-02	.62999-02
18	.00000	.00000	.00000	.58573-02	.52348-02	.57285-02	.60648-02	.57641-02	.57206-02	.41086-02
17	.00000	.00000	.54399-02	.59545-02	.52910-02	.58633-02	.56476-02	.56642-02	.56625-02	.62088-02
16	.00000	.00000	.58334-02	.59805-02	.53606-02	.57757-02	.64751-02	.61302-02	.64315-02	.67875-02
15	.00000	.57972-02	.52676-02	.61623-02	.57346-02	.58726-02	.56916-02	.60903-02	.59129-02	.63454-02
14	.00000	.61541-02	.62372-02	.61776-02	.61999-02	.56436-02	.62368-02	.65612-02	.58925-02	.69176-02
13	.57830-02	.60832-02	.56379-02	.65631-02	.58596-02	.53969-02	.56269-02	.65194-02	.51023-02	.61255-02
12	.54819-02	.56331-02	.58406-02	.59818-02	.62869-02	.41814-02	.52157-02	.60252-02	.59159-02	.66204-02
11	.58963-02	.55469-02	.53472-02	.60265-02	.64022-02	.48510-02	.53758-02	.59131-02	.40289-02	.57128-02
10	.60611-02	.60201-02	.58751-02	.61589-02	.60534-02	.41642-02	.60182-02	.59494-02	.63810-02	.70929-02
9	.58134-02	.58210-02	.58328-02	.62369-02	.56799-02	.57123-02	.50968-02	.59036-02	.44883-02	.67300-02
8	.54399-02	.52416-02	.57275-02	.57882-02	.59101-02	.42863-02	.51248-02	.68651-02	.64460-02	.73015-02
7	.00000	.60432-02	.58499-02	.61987-02	.65786-02	.45395-02	.53053-02	.65860-02	.59047-02	.69264-02
6	.00000	.59610-02	.58420-02	.57733-02	.53879-02	.41417-02	.60121-02	.63215-02	.60628-02	.68336-02
5	.00000	.00000	.57414-02	.63459-02	.51334-02	.45385-02	.52316-02	.60593-02	.57641-02	.55160-02
4	.00000	.00000	.62883-02	.60870-02	.60390-02	.56913-02	.59830-02	.60773-02	.60343-02	.57679-02
3	.00000	.00000	.00000	.60528-02	.56955-02	.41816-02	.50289-02	.55990-02	.64712-02	.58634-02
2	.00000	.00000	.00000	.00000	.00000	.59930-02	.54110-02	.64385-02	.54357-02	.58314-02
1	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.60975-02	.59160-02	.59316-02
TIME =	.500									
20	.56853-02	.60074-02	.59794-02							
19	.62158-02	.65532-02	.58705-02	.61101-02	.58040-02					
18	.59336-02	.58228-02	.63896-02	.59873-02	.54251-02	.50762-02	.49023-02			
17	.62665-02	.60380-02	.54828-02	.59929-02	.59437-02	.57138-02	.55834-02	.60887-02		
16	.57908-02	.66607-02	.64002-02	.59476-02	.52282-02	.54116-02	.52065-02	.58970-02		
15	.58663-02	.57012-02	.56041-02	.53704-02	.54092-02	.55905-02	.59633-02	.52045-02	.55572-02	
14	.63101-02	.58820-02	.57664-02	.63408-02	.60990-02	.56666-02	.52842-02	.56338-02	.52637-02	
13	.43476-02	.60170-02	.50900-02	.57079-02	.56973-02	.42702-02	.69082-02	.52238-02	.65748-02	.58716-02
12	.66614-02	.71264-02	.62132-02	.72009-02	.67113-02	.45228-02	.65490-02	.51518-02	.57310-02	.55946-02
11	.47604-02	-.14979-02	.53333-02	.60430-02	.51432-02	.53947-02	.58697-02	.58276-02	.65832-02	.49043-02
10	-.10437-02	-.18295+01	-.14244-02	.80925-02	.59829-02	.55344-02	.55156-02	.55031-02	.59059-02	.53289-02
9	.43884-02	-.15437-02	.50654-02	.65706-02	.51243-02	.42551-02	.61414-02	.58976-02	.55478-02	.54214-02
8	.60034-02	.78304-02	.63844-02	.71422-02	.54240-02	.42331-02	.50429-02	.54250-02	.57490-02	.57658-02
7	.52818-02	.67298-02	.59470-02	.62436-02	.52866-02	.47897-02	.58031-02	.59232-02	.58114-02	
6	.64036-02	.62171-02	.67693-02	.63595-02	.62412-02	.55273-02	.48898-02	.54255-02	.54401-02	
5	.65062-02	.60652-02	.62481-02	.60113-02	.60939-02	.57148-02	.64006-02	.59108-02		
4	.63321-02	.58181-02	.63312-02	.53562-02	.55785-02	.53270-02	.54021-02	.52380-02		
3	.68861-02	.60942-02	.62788-02	.56886-02	.65605-02	.57926-02	.61883-02			
2	.59727-02	.63122-02	.62092-02	.55836-02	.58859-02					
1	.62126-02	.63671-02	.62330-02							

RELATIVE TEMPERATURE (R)

20	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.12016-03	.10872-03	.16594-03
19	.00000	.00000	.00000	.00000	.00000	.16403-03	.16975-03	.16594-03	.15450-03	.22888-03
18	.00000	.00000	.00000	.18883-03	.13351-03	.17548-03	.20599-03	.17738-03	.17548-03	.21172-03
17	.00000	.00000	.15068-03	.19836-03	.13733-03	.18883-03	.16785-03	.16975-03	.16975-03	.22125-03
16	.00000	.00000	.18692-03	.19836-03	.14305-03	.18120-03	.24223-03	.21172-03	.24033-03	.27084-03
15	.00000	.18120-03	.13351-03	.21362-03	.17548-03	.18883-03	.17164-03	.20599-03	.19264-03	.23079-03
14	.00000	.21172-03	.22125-03	.21362-03	.21744-03	.16594-03	.22125-03	.24986-03	.18883-03	.28419-03
13	.17738-03	.20599-03	.16594-03	.24796-03	.18692-03	.14305-03	.16594-03	.24605-03	.11635-03	.20961-03
12	.15068-03	.16403-03	.18692-03	.19646-03	.22316-03	.21362-03	.12779-03	.20027-03	.18883-03	.25558-03
11	.18883-03	.15450-03	.13924-03	.19836-03	.23270-03	.27466-03	.14114-03	.18883-03	.19073-04	.16594-03
10	.20218-03	.19836-03	.18692-03	.21172-03	.20218-03	.21172-03	.19836-03	.19455-03	.22125-03	-.36488-02
9	.17929-03	.17929-03	.18120-03	.21744-03	.16975-03	.17166-03	.11444-03	.18692-03	.76294-04	.25749-03
8	.14687-03	.12779-03	.16975-03	.17738-03	.18883-03	.22316-03	.11635-03	.27466-03	.23460-03	.31471-03
7	.00000	.19836-03	.18120-03	.21172-03	.24605-03	.24223-03	.13161-03	.24796-03	.18692-03	.27847-03
6	.00000	.19264-03	.18120-03	.17357-03	.14114-03	.20599-03	.19646-03	.22316-03	.20027-03	.27084-03
5	.00000	.00000	.17166-03	.22697-03	.11444-03	.24223-03	.12589-03	.19836-03	.17166-03	.14877-03
4	.00000	.00000	.22125-03	.20027-03	.19836-03	.16594-03	.19264-03	.20027-03	.19646-03	.17166-03
3	.00000	.00000	.00000	.19836-03	.16403-03	.20981-03	.10490-03	.15450-03	.23460-03	.18120-03
2	.00000	.00000	.00000	.00000	.00000	.19264-03	.14114-03	.23270-03	.14305-03	.17738-03
1	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.20218-03	.18311-03	.18692-03

TIME = .500										
20	.17357-03	.20218-03	.20027-03							
19	.22125-03	.25368-03	.18883-03	.21172-03	.18311-03					
18	.19455-03	.18692-03	.23460-03	.20027-03	.14877-03	.11826-03	.10109-03			
17	.22507-03	.20409-03	.15259-03	.20027-03	.19646-03	.17548-03	.16212-03	.20790-03		
16	.18120-03	.25940-03	.23460-03	.19455-03	.13161-03	.14687-03	.12970-03	.19264-03		
15	.18692-03	.17166-03	.16403-03	.14305-03	.14687-03	.16403-03	.19646-03	.12779-03	.15831-03	
14	.22697-03	.18692-03	.17738-03	.22888-03	.20981-03	.16975-03	.13351-03	.16594-03	.13351-03	
13	.47684-04	.18883-03	.11635-03	.17166-03	.16975-03	.22316-03	.28038-03	.12779-03	.24796-03	.18692-03
12	.25368-03	.38872-02	.20981-03	.30708-03	.26512-03	.24605-03	.24605-03	.12016-03	.13351-03	.16212-03
11	.15068-03	.40277-01	.21172-03	.19455-03	.12016-03	.14305-03	.18692-03	.18311-03	.24986-03	.99182-04
10	.38225-01	.94832-01	.43213-01	-.42953-02	.17929-03	.15450-03	.15259-03	.15259-03	.18692-03	.14305-03
9	.11635-03	.40064-01	.18311-03	.24033-03	.11826-03	.22125-03	.20981-03	.18883-03	.15450-03	.14305-03
8	.18883-03	-.37975-02	.27324-03	.29945-03	.14305-03	.21744-03	.10872-03	.14305-03	.17357-03	.17357-03
7	.12970-03	.24986-03	.18883-03	.21553-03	.13161-03	.17548-03	.17738-03	.18883-03	.17738-03	
6	.23270-03	.21362-03	.17548-03	.22697-03	.21744-03	.15259-03	.91553-04	.14305-03	.14496-03	
5	.24033-03	.19836-03	.21744-03	.19646-03	.20218-03	.16975-03	.23079-03	.18692-03		
4	.22316-03	.17738-03	.22316-03	.13542-03	.15450-03	.13351-03	.13924-03	.12398-03		
3	.27466-03	.20218-03	.21744-03	.16403-03	.24223-03	.17357-03	.21172-03			
2	.18883-03	.22125-03	.21172-03	.15450-03	.18120-03					
1	.21172-03	.22507-03	.21172-03							

VELOCITY U (FT/SEC)

20	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.12140-01	-.44521-02	.67307-02
19	.00000	.00000	.00000	.00000	.00000	.10373-01	.12598-01	.13673-01	.32422-03	.91088-02
18	.00000	.00000	.00000	.10834-01	-.62345-02	.83485-03	-.56524-02	-.69215-04	-.78909-03	.34625-02
17	.00000	.00000	-.13644-02	.10319-01	-.33589-02	.65705-03	.73743-02	.35997-02	.52658-02	.85693-02
16	.00000	.00000	-.17226-01	-.10688-02	-.47648-02	.33310-02	-.79392-02	.10740-02	-.52214-02	.65648-05
15	.00000	-.11557-01	.33239-03	.83107-02	-.36630-02	.16477-01	.13995-02	.38593-02	.51936-02	-.35795-02
14	.00000	-.27466-02	-.13812-01	.64269-02	-.11873-01	-.98543-02	-.12724-01	-.12248-01	-.44248-02	.78119-02
13	-.12174-02	.23293-02	-.70905-02	.69049-02	-.46604-02	.13023-01	.23597-02	-.34699-02	-.61187-03	-.13694-02
12	-.10275-01	.96796-02	-.21978-01	.23350-04	-.18437-01	-.18892-01	-.20945-01	-.10495-01	-.12630-01	.50162-02
11	-.76220-02	.55110-02	.34505-02	.68497-02	.45188-02	.10909-01	-.17375-01	-.53152-02	-.13714-01	.11134-01
10	-.26425-02	.10310-02	-.28601-01	-.33429-03	-.22444-01	-.17683-01	-.21975-01	-.73144-02	-.52641-01	-.92617-02
9	-.98995-02	.10607-01	-.16977-02	-.16781-02	-.11495-02	.92304-02	-.14685-01	.44280-03	-.12576-02	.28056-02
8	-.27576-02	.13309-02	-.17884-01	-.64099-03	-.23147-01	-.73646-02	-.11232-01	-.38335-02	-.18732-01	-.72649-02
7	.00000	.47305-02	.38662-02	.10498-01	-.31857-02	.79129-02	-.12989-01	.67350-02	.26632-03	-.27096-02
6	.00000	.10122-01	-.14870-01	-.43196-02	-.10763-01	-.36107-02	-.12306-01	-.86892-02	-.10787-01	.56870-02
5	.00000	.00000	.46979-02	-.32801-02	-.52601-02	.13682-01	-.46197-02	.10573-01	-.51991-02	.77017-02
4	.00000	.00000	-.13762-01	-.74106-02	-.15284-01	.35611-03	-.41223-02	.43751-02	-.10778-01	.81632-02
3	.00000	.00000	.00000	-.61227-02	-.49538-02	-.41670-03	-.54231-02	.16840-01	.15348-03	-.44781-02
2	.00000	.00000	.00000	.00000	.00000	.45328-02	.49369-02	.10888-01	-.64847-02	.40542-02
1	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.15298-01	-.66307-02	-.13345-02
TIME =	.500									
20	.93905-02	.11032-02	.17804-01							
19	.33170-02	-.19348-02	.47907-02	-.76474-03	.92313-02					
18	.10057-01	.11967-01	.16616-01	-.45232-04	.56152-02	.29395-02	.76136-02			
17	-.58224-02	-.13165-02	.51931-02	.35033-02	.12995-01	.15576-02	.67021-02	.15994-02		
16	.10223-01	.10461-01	.10527-01	-.46773-03	.70277-02	.44175-02	.21654-01	.98425-02		
15	-.97260-02	.67896-02	-.35521-02	-.42354-02	.15625-01	.82619-03	.12549-01	-.12411-02	.65301-02	
14	-.12606-01	.72636-02	.20794-01	.13623-01	.21535-01	.44480-02	.31735-01	.10135-01	.18324-01	
13	-.10531-01	.68516-02	.73711-02	.40432-02	.17313-01	-.23481-02	.11587-01	.50661-02	.15954-01	-.98207-03
12	-.39263-01	.35281-02	.48300-01	.23473-01	.41498-01	.16281-01	.34653-01	.13416-01	.34649-01	.60402-02
11	-.86599-02	-.13077-02	.13056-01	.38271-02	.29028-01	.24225-02	.24474-01	.10733-01	.21237-02	-.23597-01
10	-.11660+00	.19529-01	.13099+00	.70971-02	.68482-01	.15859-01	.61042-01	.46713-01	.61246-01	.41385-01
9	-.14500-01	.74698-02	.28791-01	.68531-02	.13029-01	-.43797-02	.20783-01	.44174-02	.98178-02	.42473-02
8	-.39637-01	.60636-02	.36193-01	.16377-01	.52993-01	.56354-02	.43005-01	.24417-01	.23519-01	.16627-01
7	-.21396-03	-.21591-02	.72550-02	-.28039-02	.15427-01	.67557-02	.11760-01	.18552-02	.10139-01	
6	-.15600-03	.16337-02	.19179-01	.19350-01	.26294-01	.80601-03	.31094-01	.16888-01	.89037-02	
5	-.50783-03	-.70317-02	.13889-01	.68070-02	.19307-01	-.35925-02	-.97079-03	-.10470-01		
4	.99762-02	.15484-02	.15728-01	.52898-03	.31144-01	.38587-02	.60435-02	.21454-02		
3	.60573-02	.12252-01	.11320-01	.29513-02	.12711-01	-.27385-02	.26119-02			
2	.71613-02	.85743-02	.91706-02	-.24291-02	.16898-01					
1	.71779-02	.63188-02	.24053-01							

VELOCITY V (FT/SEC)

20	.00000	.00000	.00000	.00000	.00000	.00000	.00000	-.89937-02	-.97350-02	-.19374-01
19	.00000	.00000	.00000	.00000	.00000	.84248-02	-.59099-02	.17854-01	.56183-02	.13706-01
18	.00000	.00000	.00000	-.11703-01	-.22060-01	-.42615-02	-.13949-01	.62753-03	-.40884-02	-.42708-02
17	.00000	.00000	.10708-01	.76950-02	.52954-02	.59972-02	.25903-02	.82873-02	.13751-02	.12706-01
16	.00000	.00000	.37724-02	-.29758-02	.55229-02	-.26113-02	-.10301-01	.34755-02	-.10568-01	.36711-02
15	.00000	.10183-01	-.80494-03	.29518-02	-.83692-02	.10056-01	.47238-02	.14843-01	.17912-01	.14034-01
14	.00000	-.43628-02	-.13663-01	.29481-02	-.11657-01	.40163-02	-.82038-02	.31962-02	-.87726-03	.92495-02
13	.40342-02	-.28001-02	-.14623-01	.50455-02	-.82717-02	.11612-01	.64208-03	.19852-01	-.13577-02	.28062-01
12	.88931-02	.11827-01	.51778-02	.12883-02	.52382-02	-.78386-02	.73593-02	.12035-01	.92042-02	.25545-01
11	-.32501-02	-.69725-02	.50845-03	-.33270-03	.83123-03	.36894-02	-.47173-03	.47758-02	-.27924-02	.45064-01
10	-.34761-02	-.22559-02	-.84356-02	.29063-02	.93669-04	.85748-02	.17709-02	.58838-02	-.39862-02	-.65756-02
9	.66738-02	.65445-02	.60518-02	-.42073-02	.63939-02	-.35226-02	-.38247-02	-.14323-01	-.69628-02	-.48510-01
8	-.39746-04	-.27765-02	.99892-02	-.85004-02	-.21872-02	-.15240-02	-.86971-03	-.83669-02	-.71587-02	-.10301-01
7	.00000	.37587-02	.15090-02	.44306-03	.52347-02	-.11940-01	.16029-02	-.10886-01	.67049-02	-.18831-01
6	.00000	.63968-02	.38248-02	.24733-02	.17351-01	.44672-02	.11583-01	-.40398-02	.77490-02	.11750-02
5	.00000	.00000	-.43025-02	-.17539-01	-.13682-02	-.13018-01	-.52372-02	-.21213-01	-.18168-01	-.21201-01
4	.00000	.00000	-.15192-01	.29809-02	.47782-03	.29879-02	.14871-01	.36140-02	.86107-02	-.18627-02
3	.00000	.00000	.00000	.28105-02	.80163-02	-.72807-02	.59193-02	-.15940-01	-.31497-03	-.20181-01
2	.00000	.00000	.00000	.00000	.00000	.29369-02	.10342-02	-.12250-01	.41073-02	-.50263-02
1	.00000	.00000	.00000	.00000	.00000	.00000	.00000	-.63909-02	-.58518-02	-.54634-02

TIME = .500

20	-.14230-01	-.69774-02	-.97164-02							
19	.90563-02	.13236-01	-.20279-02	.94254-02	.43300-02					
18	-.35395-02	.49051-02	-.36762-02	-.44822-02	-.84300-02	-.16848-01	-.17792-01			
17	.47731-02	.12537-01	.62739-02	.18628-01	.67279-02	.16823-01	.52933-02	.20310-01		
16	.15783-02	.76816-02	-.65346-02	.16307-01	.12039-02	.13530-01	.19441-02	.79915-02		
15	.99705-02	.36813-01	.13172-01	.26618-01	-.74867-03	.12144-01	-.25954-02	.25763-02	-.14133-02	
14	-.31007-02	.10393-01	-.31735-02	-.90231-03	-.11476-01	-.29871-02	-.83564-02	-.21117-02	-.13729-01	
13	.10391-02	.54444-01	.47773-02	.27238-01	-.46219-02	.73180-02	-.14122-01	.45086-02	-.17509-01	-.12203-01
12	-.33859-03	.25314-01	.48446-02	.17955-01	.50253-02	.27788-02	.15974-03	-.74066-02	-.57889-02	.53664-02
11	.86755-02	.12240+00	-.68888-02	.39691-01	.11218-01	.12430-01	.12091-01	-.13987-01	-.20727-01	-.36299-01
10	.43581-02	-.14967-03	-.44250-02	-.16477-01	-.74649-02	-.47951-03	.33374-02	.32152-02	.96784-02	-.40953-02
9	-.73430-02	-.12545+00	.56873-02	-.30646-01	-.53165-02	-.14873-01	.44596-02	.32037-02	.26240-01	.35507-01
8	-.16471-02	-.26230-01	.79871-02	-.30244-02	.17671-01	-.49666-02	.36047-02	.43241-02	.55086-02	-.17358-01
7	-.58473-02	-.58036-01	-.14146-02	-.41339-01	-.48355-02	-.14668-01	-.32749-03	-.28766-02	.58355-02	
6	-.24508-02	.11292-02	.22302-02	-.51370-02	-.73575-02	-.87308-02	.20404-02	.34855-02	-.42963-02	
5	-.20506-01	-.31283-01	-.20418-01	-.27882-01	-.17594-02	-.19762-01	-.50117-02	.50423-02		
4	.20792-01	-.85164-02	.15147-02	-.58485-02	.53852-02	.91862-03	.48086-02	-.15536-02		
3	.38373-02	-.17383-01	-.31462-02	-.10360-01	-.65181-04	-.89583-02	-.31980-02			
2	.75682-03	-.63833-02	.79970-02	-.69482-03	.15431-01					
1	.46688-02	-.57520-02	.99285-02							