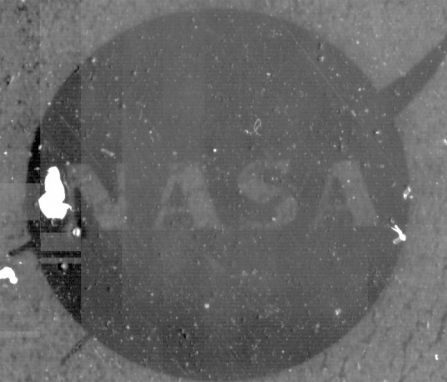


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ANALYSIS OF THE APOLLO HEAT SHIELD PERFORMANCE

Volume II - CHAD Computer Program

By David W. Halstead, Richard S. Gaudette,
Eduardo P. del Casal, and Vladimir Deriugin

April 1969

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PREFACE

This report was prepared by the Aerospace Systems Division, Aerospace Group of The Boeing Company, Seattle, Washington 98124. The Boeing Company program manager was Mr. Vladimir Deriugin, head of Heat Transfer and Thermal Protection in the Structures Research & Development Organization.

The program was initiated under NASA Contract NAS 9-7964, Analysis of the Apollo Heat Shield Performance, issued through the National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Texas 77058. The NASA technical monitors were Messrs. Don M. Curry and Paul Murad of the Thermal Technology Branch of the Structures and Mechanics Division.

Results obtained during this study are published in two volumes: Volume I, Analytical Methods; and Volume II, CHAD Computer Program. Boeing document numbers assigned to these volumes are D2-114433-1 and -2, respectively.

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GENERAL INFORMATION

The one-dimensional CHAD (CHarring Ablation with Diffusion) computer program described in this document was developed from the ablation analysis portion of the existing Boeing CHAP* program. This was done in support of the analytical investigation on the ablation performance of the Apollo vehicle ablation material (AVCOAT 5026-39/HC-G).

The CHAD computer program was developed to include the following areas of analysis:

- 1) Three reaction zones (virgin plastic pyrolysis, silica-carbon reactions, and carbon deposition).
- 2) Temperature, composition, and pressure variant thermal conductivity and specific heat for the char and virgin plastic.
- 3) Variable char density and variable char composition.
- 4) Gas specific heat which can be varied with time and composition.
- 5) Internal pressure profile determined and gas diffusion calculated.
- 6) Erosion rate prediction by the shear recession correlation of reference 1.

The CHAD ablation model is given the boundary layer conditions as input data. The surface heat balance includes surface sublimation and surface combustion terms. The program is written in Fortran IV. It is machine independent and, as much as possible, system independent.

* The CHAP program is a combination convective heating and ablation analysis program. The ablation analysis portion is commonly called the CHARM program. Reference 2 describes the CHAP program, and reference 3 describes the initial CHARM program.

Purpose

The purpose of the CHAD computer program is to predict the performance of charring ablators with more confidence. It provides an ablation analysis of more sophistication than previous programs by including multiple internal reactions and internal diffusion. Surface recession is determined and profiles of temperature, densities, gas flow rate, internal pressure, and gas concentrations are calculated.

Assumptions

A number of assumptions are made to simplify the program model. A brief list follows:

- 1) Virgin material is considered to be a combination of char material and decomposable material. The char material is considered to be silica and carbon.
- 2) Internal radiation may be accounted for in the thermal conductivity term.
- 3) The thermal conductivity of the ablation material is a linear combination of the thermal conductivity of the char material and of the decomposable material.
- 4) The thermal capacity of the ablation material is a linear combination of the thermal capacity of the char and of the decomposable material.
- 5) Thermal expansion or contraction is neglected.
- 6) The mass flow rate of the gas equals the amount formed or used up; that is, there is no capacity term in the gas flow equation.
- 7) The gas is in thermal equilibrium with the solid.
- 8) There is no separately-considered gas thermal conduction.

The finite-difference equations, which approximate the mathematical model, use the following assumptions:

- 1) The temperature of a nodal interface represents the temperature of the adjacent half-nodes.

- 2) Each half-node may be represented by a single density.
- 3) The thermal conductivity at the midpoint between nodal interfaces is a function of the average temperature and density of the two adjacent half-nodes.

Limitations

Limitations of the CHAD computer program are:

- 1) The maximum number of materials for one problem is 10.
- 2) The maximum number of nodes is 100 and the minimum is 2.
- 3) Char thermal properties and density are the same for all materials.
- 4) The maximum number of major nodes* in the pyrolysis reaction zone is 16. The program, as it operates, will not allow more nodes to be included in the pyrolysis reaction zone. It will wait until a node is dropped by near exhaustion (85%) of decomposable material before picking up a deeper node for the reaction zone.

There is some limitation inherent in the problems input to the program. Very high surface recession can cause the problem solution to become unstable. A rapidly oscillating heating rate to the ablation surface can result in an unstable problem solution. In each case above, the problem solutions require small time-steps for calculation resulting in excessive use of computer time and, in some cases, a computer error stop would result.

PROCEDURE

The following sections deal with the mathematical model used in the CHAD computer program. The governing equations and procedure of solution are discussed. All quantities are in consistent f.p.s. units, unless otherwise noted in the text. Most symbols are defined both in the nomenclature and in the immediate context of their use.

* Major nodes are the nodes as input. They are quartered by the program for the pyrolysis reaction zone.

Nomenclature

A	frequency factor; area
B	activation temperature
B^*	blowing parameter
c_p	specific heat
C_i	concentration of species
C_i	source (or sink) of species i
D	binary diffusivity
f_{dep}	weight fraction of pyrolysis gas which is deposited as solid carbon
g_c	gravitational constant
H	heat transfer coefficient
H_T	heat of decomposition at temperature T
k	thermal conductivity; specific reaction rate
K	diffusion reduction parameter, eq. (29)
K_{eq}	equilibrium constant
$\dot{m}$	mass flux
M	molecular weight
n	order of reaction
P	pressure
$\dot{q}$	heat flux
Q	total heat flux
r	radius; reaction rate
R	gas constant
$\dot{s}$	surface recession rate
t	time
T	temperature
v	velocity in y -direction
w	mass fraction
x	distance

y	distance
Z	compressibility factor
α	absorptivity
Γ	permeability
ϵ	emissivity
η	y/S
μ	viscosity
ξ	porosity
ρ	density
σ	Stefan-Boltzmann constant
τ	tortuosity
ψ	blocking efficiency
ω	mass fraction
Ω	

Subscripts and Indexes:

α	average quantity
ac	of active (decomposable) material
air	of air
char	of char formed after virgin plastic pyrolysis
conv	convective
C	carbon
CH ₄	methane
comb	combustion
d	decomposable
D	diffusion regime
dep	of deposition of carbon
eq	equilibrium
f	of fluid
g	of gases

gp	gas phase
H	of hydrogen
i	species index
j	time-step index
k	see eq. (24)
m	of porous matrix
o	initial value
O ₂	of oxygen
p	at constant pressure
p, pyr	of pyrolysis gas
r	reactant
R	reaction regime
s	of solid; at surface
SiO	of silicon monoxide
sub	sublimation total
trans	transition regime
T	temperature
v	of void
VP	virgin plastic
x	in x-direction
1	viscous
2	inertial
∞	freestream or unsaturated condition
+	on positive side of interface
-	on negative side of interface

Superscripts:

.	time derivative
—	average quantity
→	vector quantity
*	reference quantity
/	corrected value

Mathematical Model

The mathematical model represents a simplified physical model that will be described briefly. The virgin ablation material is considered a porous char filled with decomposable material. When the decomposable material is heated, it decomposes to form a gaseous product. Eventually only the char remains. The gas flows freely toward the heated surface. Within the char, the gaseous hydrocarbons can undergo a deposition reaction which results in carbon depositing in the char and hydrogen gas being formed. The char is assumed to be a combination of carbon and silica. The carbon and silica may react to form gaseous SiO (silicon monoxide) and CO (carbon monoxide). The char at the surface may sublime, burn, and erode which results in surface recession. Thermal expansion and contraction are neglected.

Main Governing Equations

Equation of continuity for the fluid. - The simplified equation assumes that the change in mass flux of the gas equals the change in solid density; that is, there is no capacity term in the gas flow.

$$\frac{\partial \dot{m}}{\partial y} = \dot{\rho}_s \quad (1)$$

Energy equation for the solid. - The thermal conductivity of the solid includes the radiative component. Gaseous conduction is neglected.

$$\frac{\partial}{\partial t} (\rho_s i_s) + \frac{\partial}{\partial y} (\sum \dot{m}_i i_i) = \frac{\partial}{\partial y} (k_s \frac{\partial T}{\partial y}) \quad (2)$$

For use in the CHAD program, this equation is recast as follows:

$$\rho_s c_{p,s} \frac{\partial T}{\partial t} = \frac{\partial}{\partial y} (k_s \frac{\partial T}{\partial y}) - c_{p,g} \dot{m}_g \frac{\partial T}{\partial y} + \sum (H_{T,i} \frac{\partial \rho_i}{\partial t}) \quad (3)$$

where H_T = heat of reaction at temperature T ,

$\dot{m}_g$ = gas flux,

and ρ_i = density of reactant i .

Diffusion equation. - To determine the concentrations of different gases within the ablation material, the following equation is used:

$$\frac{\partial}{\partial y} (C_i v - D_i \frac{\partial C_i}{\partial y}) = \dot{C}_i \quad (4)$$

Convection - Diffusion = Source

where C_i = concentration of species i , mass per unit void volume,
 $\dot{C}_i$ = source (or sink) of species i ,
 D_i = binary diffusivity, used as an approximation of diffusivity in the multicomponent mixture,
 and v = velocity in y -direction

Pressure distribution. - The following modified Darcy equation is used for the pressure distribution in the porous media:

$$\frac{\partial P}{\partial y} + \frac{\mu v}{\Gamma_1} + \frac{\rho v^2}{\Gamma_2} = 0 \quad (5)$$

where Γ_1 = viscous permeability
 and Γ_2 = inertial permeability.

Equations for thermal and flow properties. - The virgin plastic ablation material undergoes pyrolysis upon being sufficiently heated and eventually reduces to an irreducible char. The properties of the partially decomposed material are considered to vary between those of the virgin material and those of the char. The mathematical model used treats the virgin material as a combination of active (decomposable) material and irreducible char.

Heat capacity of the solid. - The heat capacity of the solid ($\rho_s c_{p,s}$ term) is solved in terms of the virgin plastic and char properties for the pyrolysis reaction zone and beyond. The specific heats are considered to be a function of temperature and are determined by the following cubic equations:

$$c_{p,VP} = E_{VP} + F_{VP} T + G_{VP} T^2 + H_{VP} T^3 \quad (6a)$$

$$c_{p,char} = E_{char} + F_{char} T + G_{char} T^2 + H_{char} T^3 \quad (6b)$$

The cubic coefficients are part of the input data.

In the pyrolysis reaction zone, the char density is held constant. The following equation is used for the heat capacity:

$$\rho_s c_{p,s} = \left[(\rho_{VP} c_{p,VP}) - (\rho_{char} c_{p,char}) \right] \frac{\rho_{ac}}{\rho_{VP} - \rho_{char}} + \rho_{char} c_{p,char} \quad (7)$$

where ρ_{ac} is the density of the active material, and varies between

$$0 \leq \rho_{ac} \leq (\rho_{VP} - \rho_{char})$$

The magnitude of ρ_{ac} depends on the extent of decomposition in the region being considered. It is zero when the material is completely decomposed and is $(\rho_{VP} - \rho_{char})$ when decomposition has not yet been initiated.

Beyond the pyrolysis reaction zone in the direction of the ablation surface, the char density varies because of the char deposition and silica-carbon reactions. The heat capacity of the char in this region is determined as $\rho_{char} c_{p,char}$ using the $c_{p,char}$ found from the cubic equation for the char.

Thermal conductivity of the solid. - The thermal conductivities of the virgin plastic and of the char are considered to be functions primarily of temperature and are determined by the following cubic equations:

$$k_{VP} = A_{VP} + B_{VP} T + C_{VP} T^2 + D_{VP} T^3 \quad (8a)$$

$$k_{char} = A_{char} + B_{char} T + C_{char} T^2 + D_{char} T^3 \quad (8b)$$

The cubic coefficients are part of the input data. The following correction is applied to the calculated virgin conductivity to take into account the effect of pressure.

$$k'_{VP} = \left[\frac{k_{VP}}{\left(.622 + 2.164 \frac{T}{P} \right)} \right] + .0001120 \quad (9)$$

In the pyrolysis reaction zone, the thermal conductivity depends on the extent of the decomposition of the virgin material.

$$k_{tot} = (k_{VP} - k_{char}) \left(\frac{\rho_{ac}}{\rho_{VP} - \rho_{char}} \right) + k_{char} \quad (10)$$

Beyond the pyrolysis reaction zone in the direction toward the ablation surface, the char conductivity may at times be considered a function of density as well as of temperature. (The present documented version of the program is not using any variation of char thermal conductivity with density.) Equation (10) is still used, if any decomposable material remains.

Specific heat of the gas. - The specific heat of the gas is considered to be a function of temperature only. It is determined by a cubic equation whose cubic coefficients are included in the input data.

$$c_{p,g} = A_g + B_g T + C_g T^2 + D_g T^3 \quad (11)$$

Viscosity of the gas. - The viscosity of the gas is determined from the following relation:

$$\mu_g = \mu^* \left[\frac{T}{T^*} \right]^{0.7} \quad (12)$$

Where μ^* is the viscosity at the reference temperature T^* .

Molecular weight of the gas. - The average molecular weight of the total gas is found by the following:

$$\bar{M} = \frac{\rho_g}{\sum \left(\frac{\rho_{g,i}}{M_i} \right)} \quad (13)$$

Porosity of the solid. - The porosity of the virgin plastic or of the material in the pyrolysis reaction zone is found by

$$\xi = 1 - \frac{\rho_s}{\rho^*} \quad (14)$$

where ξ = porosity

and ρ^* = theoretical maximum density of the virgin material.

The porosity of the char is found from

$$\xi_{\text{char}} = 1 - \frac{\rho_{\text{SiO}_2}}{\rho_{\text{SiO}_2}^*} - \frac{\rho_C}{\rho_C^*} \quad (15)$$

where $\rho_{\text{SiO}_2}^*$ = theoretical maximum density of silica

and ρ_C^* = theoretical maximum density of carbon.

Permeabilities of the solid. - The viscous and inertial permeabilities are given by the following relationships

$$\Gamma_1 = \Gamma_1^* \left(\frac{\xi}{\xi^*} \right)^3 \left(\frac{1 - \xi^*}{1 - \xi} \right)^2 \left(1 + .016 \frac{T}{P}^{1.4} \right) \quad (16)$$

where Γ_1 = viscous permeability,

Γ_1^* = viscous permeability at the reference porosity,

and ξ^* = reference porosity.

$$\Gamma_2 = \Gamma_2^* \left(\frac{\xi}{\xi^*} \right)^2 \left(\frac{1 - \xi^*}{1 - \xi} \right) \quad (17)$$

where Γ_2 = inertial permeability,

Γ_2^* = inertial permeability at the reference porosity,

and ξ^* = reference porosity.

Diffusivities of the gases. - The diffusivity for hydrogen through the other gases in ft²/sec is found by

$$D_{H_2} = \frac{.0551 T^{3/2}}{(30.48)^2 P \Omega} \quad (18)$$

where

$$\Omega = 0.877 e^{-.0181 \left(\frac{T}{98} \right) \left[1 - .007 \left(\frac{T}{98} \right) \right]} \quad (19)$$

The diffusivity for each of the other gases through the remaining gas is found by

$$D_{O_2} = \frac{.0308 T^{3/2}}{(30.48)^2 P \Omega} \quad (20)$$

where

$$\Omega = 0.877 e^{-.0181 \left(\frac{T}{144} \right) \left[1 - .007 \left(\frac{T}{144} \right) \right]} \quad (21)$$

Velocity of the gas. - The velocity of the gas is determined by

$$\vec{v} = \frac{\vec{m}_v}{\rho_{g,v}} \quad (22)$$

with the gas density, based on void volume, defined as $\rho_{g,v} = \frac{P \bar{M}}{R T}$ (23)

where $\vec{m}_v$ = gas mass flux per void area,
 $\bar{M}$ = average molecular weight of the gas,
 P = pressure,
 R = gas constant,
 T = temperature,
and $\rho_{g,v}$ = gas density based on void volume

Reaction equations. - There are three different types of in-depth reactions in the ablating material which are provided for in the CHAD program. They are the virgin material decomposition reaction, the carbon deposition reaction, and the silica-carbon reaction.

Virgin material decomposition reaction. - The ablation rate of the virgin plastic is assumed to follow an Arrhenius rate law. The ablation rate is

$$\frac{\partial \rho_{ac}}{\partial t} = - \sum_{k=1}^2 A_k \rho_{VP} \left[\frac{\rho_{ac}}{\rho_{VP} - \rho_{char}} \right]^{n_k} e^{-B_k/T} \quad (24)$$

The Arrhenius equation is present in this form since it readily uses the constants available in the literature and since it behaves in a manner compatible with the ablation model. A series of two reaction terms is used to represent the decomposition of the active material.

Carbon deposition reaction. - The carbon deposition reaction uses a Langmuir-Hinshelwood model. It is

$$\dot{m}_{C,dep} = - \eta^* \times \frac{\left\{ 4P_{H_2} y + \left[(P_{H_2}^2 / K_{eq, dep}) - P_{CH_4} \right] z + 4P_{CH_4} P_{H_2} yz - 4P_{CH_4} P_{H_2}^2 y^2 z \right\}}{\left[1 - P_{H_2} y + P_{CH_4} z - 2P_{CH_4} P_{H_2} yz \right]^2} \quad (25)$$

For more details on this equation, including values of the constants, see Volume 1, page 23, of this report.

Silica-carbon reaction. - An Arrhenius type equation is used for the reaction of silica and carbon.

$$\dot{m}_{SiO_2} = A_f e^{-B_f/T} \left[\frac{\rho_{SiO_2}}{\rho_{SiO_2,o}} \right]^{n_f} \quad (26)$$

where $\dot{m}_{\text{SiO}_2} = \text{lb}_m \text{ SiO}_2 \text{ reacted per ft}^3\text{-sec}$
 $\rho_{\text{SiO}_2} = \text{density of silica per total volume,}$
 and $\rho_{\text{SiO}_2,0} = \text{initial density of silica}$

The reaction constants are part of the input data.

Surface recession equations. - Surface recession results from surface sublimation and combustion and from surface erosion. The combination of these processes gives the total surface recession.

Surface combustion. - The combustion is either reaction-controlled, diffusion-controlled, or a combination of these.

Reaction regime. - For the reaction regime (low surface temperatures), the combustion rate is determined using an Arrhenius type relationship which is

$$\dot{m}_{\text{comb},R} = A \left[\frac{0.21 P}{2116.2} \right]^n e^{-B/T} \quad (27)$$

For carbon, the constants in this equation are shown in reference 4 to be

$$\begin{aligned} 4.473 \times 10^4 &< A < 6.729 \times 10^8 \\ 3.8315 \times 10^4 &< B < 3.9855 \times 10^4 \\ 0 &< n < 1 \end{aligned}$$

Generally the reaction order n is taken to be $1/2$.

Diffusion regime. - For moderate surface temperatures, the diffusion regime is the controlling regime. The diffusion controlled combustion rate is (reference 5)

$$\dot{m}_{\text{comb},D} = B^* \psi H \quad (28)$$

The constant B^* , called the blowing parameter, is shown in reference 5 for carbon to be

$$B^* = 0.1737$$

The blowing parameter B^* is usually determined for a reaction between oxygen and a single surface material. Reference 6, however, performs a simplified analysis showing the effects of the ablation gases competing with the surface material for the oxygen in the boundary layer. After a slight modification, the results of the analysis are

$$\dot{m}_{\text{comb}, D} = B^* \psi H - K \dot{m}_g \quad (29)$$

where K is a material property herein called the diffusion reduction parameter. This equation indicates that the combustion rate is reduced due to the oxygen in the boundary layer reacting in part with the ablation gases rather than entirely with the surface.

Transition regime. - The transition regime consists of the gradual transition from the reaction regime to the diffusion regime. The ablation rate is shown in reference 7 to be

$$\left(\frac{1}{\dot{m}_{\text{char}, \text{comb}}} \right)^{1/n} = \left(\frac{1}{\dot{m}_{\text{comb}, R}} \right)^{1/n} + \left(\frac{1}{\dot{m}_{\text{comb}, D}} \right)^{1/n} \quad (30)$$

where n is the reaction order. The above equation is used to define the surface combustion rate for all regimes. The heat flux to the surface is increased by the amount of surface combustion, which is assumed to be

$$\dot{q}_{\text{char}, \text{comb}} = \dot{m}_{\text{char}, \text{comb}} H_{\text{char}, \text{comb}} \quad (31)$$

Surface char sublimation. - At high temperatures the char begins subliming. Reference 7, which analyzes carbon, shows the sublimation rate to be

$$\dot{m}_{\text{char}, \text{sub}} = A \dot{m}_{\text{comb}, D} \left[\frac{P_s}{2116.2} \right]^C e^{-B/T} \quad (32)$$

where, for the sublimation of carbon, the constants are

$$\begin{aligned} A &= 1.6 \times 10^7 \\ B &= 1.11 \times 10^5 \text{ } ^\circ\text{R} \\ C &= 0.67 \end{aligned}$$

As the char surface sublimates, the heat flux to the surface is reduced by the heat absorbed in char sublimation which is assumed to be

$$\dot{q}_{\text{char, sub}} = \dot{m}_{\text{char, sub}} H_{\text{char, sub}} \quad (33)$$

Surface erosion. - A shear removal correlation for the surface recession of the Apollo ablation material was developed in a previous NASA contract. For ease of analytical input this correlation is divided into three straight lines for use in the CHAD program (see Volume 1, page 35), and the amount of material lost by shear removal is included in the surface recession calculated.

Ablation surface heating. - The heat flux to the surface is the sum of a number of individual fluxes

$$\dot{q}_{\text{tot}} = \dot{q}_{\text{misc}} - \dot{q}_{\text{rad}} + \dot{q}_{\text{comb, g}} - \dot{q}_{\text{C, sub}} + \dot{q}_{\text{comb, s}} - \psi \dot{q}_{\text{conv}} \quad (34)$$

where	$\dot{q}_{\text{tot}}$	= total flux,
	$\dot{q}_{\text{misc}}$	= unblocked heating to surface,
	$\dot{q}_{\text{rad}}$	= heat reradiated by ablation surface,
	$\dot{q}_{\text{comb, gp}}$	= gas phase combustion,
	$\dot{q}_{\text{C, sub}}$	= carbon sublimation,
	$\dot{q}_{\text{comb, s}}$	= surface combustion,
	ψ	= blocking factor,
and	$\dot{q}_{\text{conv}}$	= unblocked convective heating.

Procedure of Solution

The calculation of temperatures is the backbone of the solution. The size of the time step and the decision on whether or not to reiterate at a given time step is controlled by the amount of deviation between estimated and calculated temperatures.

The one-dimensional heat equation is solved by the implicit Crank-Nicolson finite difference method (reference 8). The material properties which are functions of a number of variables, particularly temperature, are determined at a temperature which is an average of the old-calculated and the new-estimated temperatures. The variables other than temperature are largely decoupled from each other.

In the Crank-Nicolson finite difference procedure, a matrix equation of the form $A \vec{T} = d$ results where A is a tridiagonal matrix. The set of simultaneous equations is reduced by Gauss elimination.

The order of solution is briefly:

- (1) Internal gas pressures are calculated from the modified form of Darcy's equation.
- (2) The gas component concentrations are separately determined by an implicit finite-difference solution of the diffusion equation.
- (3) Temperatures and decomposable densities are estimated for the end of the time step $(j + 1)$.
- (4) Surface recession is determined. This establishes the position of moving nodes at times $(j + 1/2)$ and $(j + 1)$.
- (5) Decomposable densities are calculated via an Arrhenius type equation. Pyrolysis gas rate and pyrolysis reaction heat are found for each node.
- (6) Similarly, the silica-carbon and the carbon deposition reactions are calculated to determine the silica and carbon densities, the sources of silicon monoxide and carbon monoxide, and the sink for pyrolysis gas.
- (7) Thermal conductivity and thermal capacity are determined.
- (8) The elements of the tridiagonal matrix for the temperature determinations are calculated and are reduced by Gauss elimination.
- (9) The front ablation surface heat balance is calculated.
- (10) Temperatures are calculated from the front to the back.
- (11) If the temperatures estimated agree (within the error criterion) with those calculated, the time step is complete. Otherwise, the process from step 3 through step 10 is repeated. If the process does not succeed in 3 attempts, the time step is reduced in size.

RESULTS AND DISCUSSION

The accuracy of the program is difficult to verify when it is run with all possible complexities, such as reactions, surface recession, and variable thermal and flow properties.

The basic one-dimensional solid thermal conductivity model within the program has been verified to give excellent agreement with analytical results determined independently for the following cases:

1. Finite slab, constant properties, uniform initial temperature, insulated at the rear surface, constant heat flux at the front surface.
2. Finite slab, constant properties, uniform initial temperature, insulated at the rear surface, constant temperature at the front surface.
3. Semi-infinite slab, constant properties, variable initial temperature, constant temperatures at both surfaces, one surface which is moving with a constant velocity.

The other parts of the program - those sections where surface recession rates, gas component concentrations, internal and surface reaction rates, and internal gas pressures and velocities are determined - were checked separately by comparing their results with expected results.

CONCLUSIONS AND RECOMMENDATIONS

The CHAD program is based upon the CHAP program which has been used successfully for nearly three years. The CHAD program which has been developed from it through modification is a very versatile tool for the examination of new parameters not previously open to examination, such as the effect of permeability, diffusivity, char-density changes, char-deposition reaction, and the silica-carbon reaction. It will find its greatest initial use in the investigation of these parameters.

Because the contract for which CHAD was developed was a study of the Apollo heat shield performance, the program is rather specific to this material. In addition, because it is a modification of a more general program [and was kept compatible with that program (CHAP), so that it might be used as a part of it] it contains many parts from CHAP which are not needed in the present CHAD program.

In its present form, CHAD can be considered as a good basis for a more generalized ablation performance prediction program.

INPUT-OUTPUT

Input

All user supplied input is via punched cards. There are two types of data cards provided to the program. One type is the standard data cards; the other type is a set of block data subroutine cards. The standard data cards are in the order: TITLE, TABLES, MATERIALS, and INITIAL TEMPERATURE.

Standard data card input, TITLE. - The first data card is the title card, and all information in columns 1-72 on this card is printed out on the run output.

Standard data card input, TABLES. - There must be four tables provided. Either table 3-1 or table 3-2 is input, not both. The independent variable in all cases is time. The tables must be in the order of increasing time except for the last card. The last card, which is not actually a point of the table, has time equal to zero to signal the end of the table. From the four tables, the lowest maximum time is picked for the end problem time. Each of the tables can have a maximum of 99 data points. The tables are listed below:

<u>Table</u>	<u>Card no.</u>	<u>Card type</u>	<u>Format</u>	<u>Columns</u>	<u>Value</u>
1. Max. calculation time-step control	1	Table no.	110	1-10	1
	2 to n-1	Table points	2F10.0	1-10	Time, sec
				11-20	Max. calculation time-step, sec
	n	End	F10.0	1-10	0
2. Print time-step control	1	Table no.	110	1-10	2
	2 to n-1	Table points	2F10.0	1-10	Time, sec
				11-20	Print time-step, sec
	n	End	F10.0	1-10	0
3-1 Surface heat flux	1	Table no.	2110	1-10	3
				11-20	1

<u>Table</u>	<u>Card no.</u>	<u>Card type</u>	<u>Format</u>	<u>Columns</u>	<u>Value</u>
3-1 Surface heat flux (Concluded)	2 to n-1	Table points	4F10.0	1-10	Time, sec
				11-20	Recovery enthalpy Btu/lb _m
				21-30	Heat transfer parameter, lb _m /ft ² -sec
				31-40	Heat flux unaffected by blocking, Btu/ft ² -sec
	n	End	F10.0	1-10	0
3-2 Surface temperature	1	Table no.	2110	1-10	3
	2 to n-1	Table points	2F10.0	11-20	2
				1-10	Time, sec
				11-20	Temperature, °R
	n	End	F10.0	1-10	0
4. Local static pressure and flow condition	1	Table no.	110	1-10	4
	2 to n-1	Table points	4F10.0	1-10	Time, sec
				11-20	Local static pressure, lb _f /ft ²
				21-30	1. for laminar or 2. for turbulent
				31-40	Local shear stress, lb _f /in ²
	n	End	F10.0	1-10	0

The maximum calculation time-step control table is used to set the maximum time-step that the program may use in the calculation. The print time-step control table sets the times for print. The following table will illustrate.

<u>Time</u>	<u>Print Time Step</u>
0.	3.
10.	50.
100.	300.
1000.	300.

The times that would be printed are 0., 3., 6., 9., 10., 60., 100., 400., 1000. Table 3-1, the surface heat flux table, provides the data for a heat flux drive to the ablation surface while Table 3-2, the surface temperature table, provides a temperature drive for the ablation surface. Table 4, the local static pressure and flow condition table needs no added explanation.

Standard data card input, MATERIALS and INITIAL TEMPERATURE. - The material widths and noding are input by cards in the format shown below. They are ended by a final card with a zero for the material number.

<u>Card no.</u>	<u>Card type</u>	<u>Format</u>	<u>Columns</u>	<u>Value</u>
1 to n-1	Material	I10	1-10	Material number
		2A6	11-22	Material name
		F10.4	31-40	Material width, in.
		I10	41-50	Number of nodes
n	End	F10.0	1-10	0

Materials are numbered from 1 to 10. The material number must correspond to the proper material data in the block data subroutine. In the supplied block data subroutine Material 1 is AVCOAT 5026-39/HC-G and Material 2 is aluminum (2024T3). The order of the material cards must be from back surface to front ablation surface.

The final data card is the initial temperature card:

<u>Card type</u>	<u>Format</u>	<u>Columns</u>	<u>Value</u>
Initial temperature	F10.4	1-10	Initial temperature for all nodes

Block data input. - Material properties, reaction constants, erosion constants, nodal spacing, and initial temperatures are introduced as data via a block data subroutine, BLKD/D2. See page 99 for a listing of the block data program from the sample cases. All cards above the second DATA statement card are always required

without change as is the final END card. Data is introduced by the DATA statement cards which have the following format:

DATA list/ $d_1, d_2, \dots, d_n$ /, list/ $d_1, d_2, k*d_3, \dots, d_m$ /,

where

1. list contains the names of the variables being defined,
2. d's are the values corresponding to the variables in list,
- and 3. k is an integer constant which indicates the number of times the value is repeated.

(Block data subroutines and DATA statements are a standard part of FORTRAN IV)

The required DATA statements fall into the following groups:

Material 1 data

Material 2 data

Material J data ($J = 1$ to 10)

Char data

Gas data

Internal flow and diffusion constants

Miscellaneous data

Each group will be separately considered and described. A sign $\blacktriangle$ is used to mark the required data values.

Material J Data

- | | | |
|--|--------------|---|
| $\blacktriangle$ ACTENV (I, J), $I = 1, n$ | $n = 1$ to 2 | Activation temperature ($^{\circ}\text{R}$) |
| $\blacktriangle$ EFCOLV (I, J), $I = 1,$ | | Collision frequency (1/sec) |
| $\blacktriangle$ REORDV (I, J), $I = 1,$ | | Reaction order |

The above reaction constants are for the pyrolysis reaction of the decomposable material. Up to 2 simultaneous reactions may be used to describe the pyrolysis reaction, in which case $n = 2$, see equation (24).

$\blacktriangle$ HOFM (J) Heat of pyrolysis at 536.67°R (Btu/lb_m)

$\blacktriangle$ COEFT (I, J), $I = 1, 4$ Cubic coefficients for virgin specific heat equation

$\blacktriangle$ CONST (I, J), $I = 1, 4$ Cubic coefficients for virgin conductivity equation

The conductivity and specific heat of the virgin material are inserted as a function of temperature in the form of cubic equations. The equations are represented as

$$k = A + BT + CT^2 + DT^3$$

$$c_p = E + FT + GT^2 + HT^3$$

where

- COEFT (1, J) = A = Constant term (Btu-in/ft²-sec-°R)
 COEFT (2, J) = B = Linear term
 COEFT (3, J) = C = Square term
 COEFT (4, J) = D = Cubic term

and

- CONST (1, J) = E = Constant term (Btu/lb_m-°R)
 CONST (2, J) = F = Linear term
 CONST (3, J) = G = Square term
 CONST (4, J) = H = Cubic term

- ▲ EMIS (J) Virgin emissivity
- ▲ ABSORP (J) Virgin absorptivity
- ▲ RHOV (J) Virgin density (lb_m/ft³)
- ▲ SLOPE (J) Transpiration factor for ablation gases. This value is the value for laminar flow

Material data is listed for each separate material.

Char Data

- ▲ ACTENC Activation temperature (°R)
- ▲ EFCOLC Collision frequency (1/sec)
- ▲ REORDC Reaction order
- ▲ HCOM Heat of combustion (Btu/lb_m)

These reaction constants are for the surface combustion reaction

- ▲ ACTENS Activation temperature (°R)
- ▲ EFCOLS Collision frequency (1/sec)

- ▲ REORDS Reaction order
 - ▲ HSUB Heat of sublimation (Btu/lb_m)
- These reaction constants are for surface sublimation.
- ▲ CCPC (I), $I = 1, 4$ Cubic coefficients for char specific heat equation
 - ▲ CKC (I), $I = 1, 4$ Cubic coefficients for char conductivity equation
 - ▲ EMISC Char emissivity
 - ▲ ABSC Char absorptivity
 - ▲ RHOC Char density after pyrolysis and before char deposition or silica-carbon reaction (lb_m/ft^3)
 - ▲ TRCHAR Transpiration factor for the char combustion and char sublimation gases
 - ▲ CHARRO The carbon density in the char formed by pyrolysis (lb_m/ft^3)

Gas Data

- ▲ CCPG (I), $I = 1, 4$ Cubic coefficients for gas heat capacity ($\text{Btu/lb}_m - ^\circ\text{R}$ for the constant term)
- ▲ HCOMG Heat of combustion for the gas phase at the surface (Btu/lb_m)

Internal Flow and Diffusion Constants

- ▲ CARTS Theoretical maximum density of carbon (lb_m/ft^3)
- ▲ RHOTS Theoretical maximum density of the char formed by pyrolysis and before char deposition of silica-carbon reaction (lb_m/ft^3)
- ▲ SILTS Theoretical maximum density of silica (lb_m/ft^3)
- ▲ PORT Reference porosity for permeability calculation -- equations (16) and (17)
- ▲ PERT1 Reference viscous permeability for viscous permeability calculation -- equation (16) (ft^2)
- ▲ PERT2 Reference inertial permeability for inertial permeability calculation -- equation (17) (ft)
- ▲ VISCO Reference viscosity in viscosity calculation -- equation (12) ($\text{lb}_m/\text{ft-sec}$)
- ▲ VISCON Reference temperature for reference viscosity ($^\circ\text{R}$)

▲ DCOCM	Carbon monoxide
▲ DCODP	Gases other hydrogen produced in deposition reaction
▲ DCOH	Hydrogen
▲ DCON	Nitrogen
▲ DCOO	Oxygen
▲ DCOPI	Methane
▲ DCOSI	Silicon monoxide
▲ ANMW	Molecular weight of nitrogen
▲ AOMW	Molecular weight of oxygen
▲ BMW	Molecular weight of carbon monoxide
▲ DMW	Molecular weight of deposition gas
▲ HMW	Molecular weight of hydrogen
▲ PMW	Molecular weight of methane
▲ SMW	Molecular weight of silicon monoxide

These are the constants D_C for the ablating surface diffusion where $D = D_C \psi H$

Miscellaneous Constants

▲ BSTAR	Blowing parameter
▲ DIFC(I), $I = 1, 4$	Cubic coefficients for diffusion reduction parameter calculation -- equation (29)
▲ QSI	Heat of reaction for the silica-carbon reaction (Btu/lb _m of reactants)
▲ QDEP	Heat of reaction for the carbon deposition reaction (Btu/lb of carbon deposited)
▲ QBRN	(Not in use)
▲ AF	Collision frequency for silica-carbon reaction (1/sec)
▲ BF	Activation temperature for silica-carbon reaction ($^{\circ}R$)
▲ SILICA	Initial density of silica before the silica-carbon reaction begins
▲ REO	Reaction order of the silica-carbon reaction

▲ CX(I), I = 1, 6

Values for the carbon deposition reaction (see equation (25) on page 12). The relationship is as follows:

$$\left. \begin{array}{l} \text{CX}(1) = \text{X} \\ \text{CX}(2) = \text{Y} \\ \text{CX}(3) = \text{Z} \end{array} \right\} \text{for } P_{\text{H}_2} \leq .02834 \text{ atm}$$

$$\left. \begin{array}{l} \text{CX}(4) = \text{X} \\ \text{CX}(5) = \text{Y} \\ \text{CX}(6) = \text{Z} \end{array} \right\} \text{for } P_{\text{H}_2} > .02834 \text{ atm}$$

Listing of Input

The listing of data card input is included with each sample case. The block data input used with these sample cases may be found as the first subroutine listing in the Program Listing section of this report.

Output

The two sample cases may be referred to as examples of output listing.

OPERATING INSTRUCTIONS

Deck Setup

The deck setup for a run requires, in addition to the usual control cards and data cards, the inclusion of the block data subroutine. For the SRU 1108 computer with the program tape, the deck setup will be as follows:

[Initial Control Cards]

ASG A = (Program Tape No.)

XQT CUR

TRW A

IN A

TRI A

[Block Data Subroutine]

XQT MAIN

[Data Cards]

Run Time and Amount of Output

A typical run time for an Apollo heating rate input is six minutes on the SRU 1108 computer. Two or three pages of output are printed for each time point requested in the data input.

PROGRAMMING INFORMATION

Program Design

The original CHARM program was completely rewritten to make it a part of the CHAP program. This gave a combined program with both a complex ablation program and a sophisticated convective heating routine. The CHAD computer program described herein was developed from the ablation analysis part of CHAP by deleting the convective heating routines and adding input and output routines, two more internal reaction calculations, an internal pressure determination, and the calculations of gas concentrations by the diffusion equation.

Noding. - The materials are divided into major nodes which are numbered consecutively from 1 to n , n being the total number of major nodes. At the ablation surface and in the region where the virgin decomposition reaction is occurring, a higher number of nodes is needed than elsewhere. The major nodes are subdivided in these regions into more nodes which are called minor nodes. The subdivided regions are called zones - the front zone and the reaction zone. The ratio of minor nodes to major nodes is called the "nodal density".

Temperatures are estimated and calculated at nodal interfaces. When one node is of one material type and the next node is of another material type, the temperature at the nodal interface in-between is applied only to the adjacent half-nodes for reaction calculations and decomposable density calculations.

Movable node. - Only the front major node is a movable node. It is divided into equal-size minor nodes. As the ablation surface recedes, these minor nodes decrease equally in size. Corrections for this nodal shift are made for values involved.

Subscripting and storage. - The major nodes are stored according to their nodal numbers. The minor nodes are stored starting at 119 in the storage array for zone 1 and at 187 for zone 2. The decomposable densities for the upper half-nodes which are next to major nodal interfaces are the only ones necessary to calculate or store. They are stored starting at 205 in the storage arrays for densities.

Grouping. - The procedure of calculation has been set up on the basis of groups of nodes. The nodes are divided by the calculation control section into groups of nodes which satisfy the following:

1. All the nodes of a group are either in no zone or the same zone.
2. All the nodes of a group are either non-moving nodes or moving nodes.
3. No more than 40 minor or major nodes are allowed in a group.

Problem types. - The original setup of CHAP provided for three problem types: 1) nodes changing at the surfaces but not in the center, 2) nodes changing only at the ablation surface, and 3) all nodes changing. The present CHAD program is fixed at problem type 3.

Temperature calculation. - Temperatures are calculated by reducing the matrix elements of nodal groups from the back surface to the ablation surface. The front group temperatures are then found. If they deviate by more than set limits from predicted temperatures, the front group temperatures are again predicted and calculated. All temperatures of other groups are calculated. If any calculated temperature deviates by more than the set limits from predicted temperatures, all temperatures are again predicted, and temperatures of all groups are again calculated. If the third iteration has not resulted in calculated and predicted temperatures that are within the limits, the size of the time step is reduced. By this procedure, problem stability is obtained while the time step is kept as large as possible.

Node shifting and combining. - The front major node is movable; that is, it changes in size. If the major node next to it is of the same material type, the two are combined whenever the front major node reaches one-half the size of the original node that was added to the front node. If the two front nodes are of different materials, the front node is allowed to decrease in size to zero. The time step is controlled so that the front node goes to zero just at the end of the time step.

Main Routine and Subroutine Descriptions

Purpose of each subroutine. - MAIN is the main routine. It is a short routine which handles the input of the initial required data and the output of this initial data, the control of the calculation time step, the control of the output of calculated information, and the control of the ending time for the problem calculation. Other than system or utility routines there are only three subroutines which are called from MAIN: WRITE and CHARM.

WRITE is the output routine for calculated data.

CHARM does the calculation of the ablation analysis with the help of a large number of subroutines that it calls upon.

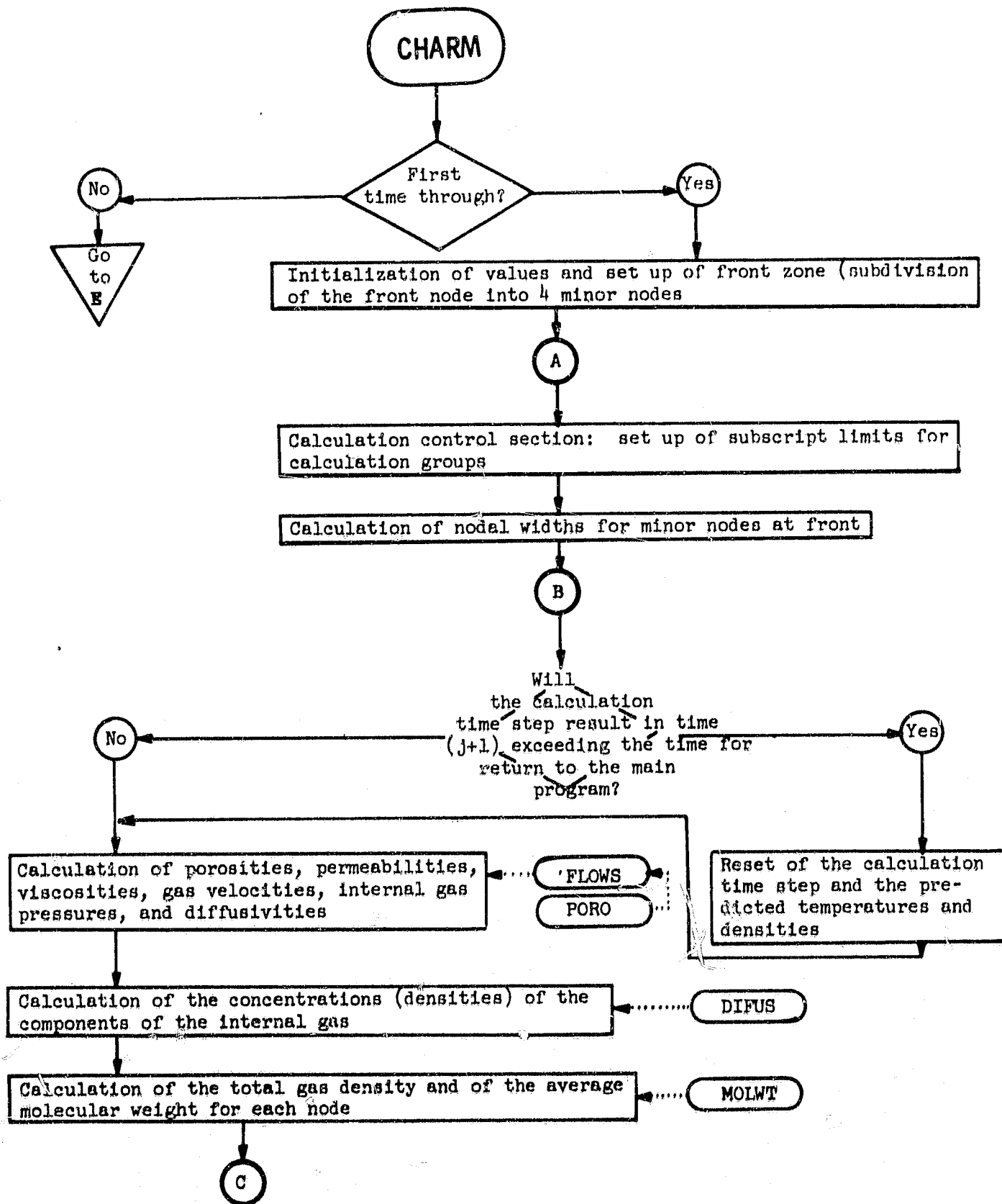
All subroutines are now listed in alphabetical order. They are classified as CHARM, CHARM-Name, WRITE or Utility subroutines. Subroutines called from CHARM are classified as CHARM, subroutines reached from a subroutine called from CHARM are classified as CHARM-Name, and subroutines used by a number of subroutines are classified as Utility.

<u>Subroutine</u>	<u>Classification</u>	<u>Function</u>
BLKD/D2	Utility	Provides input data to the program. It is a Block Data subroutine
BLOCK	CHARM	Calculates the blocking function
CHARM/S4		Calculates ablation analysis with help of many subroutines
COMBIN	CHARM-FRONT	Combines 2 front major nodes into 1 major node
CONDF	CHARM	Calculates thermal conductivity
CPBA	CHARM	Calculates internal gas specific heat
DEPO	CHARM	Calculates the rate of carbon deposition and the change in solid carbon density
DIFUS	CHARM	Calculates the concentrations of the gaseous components

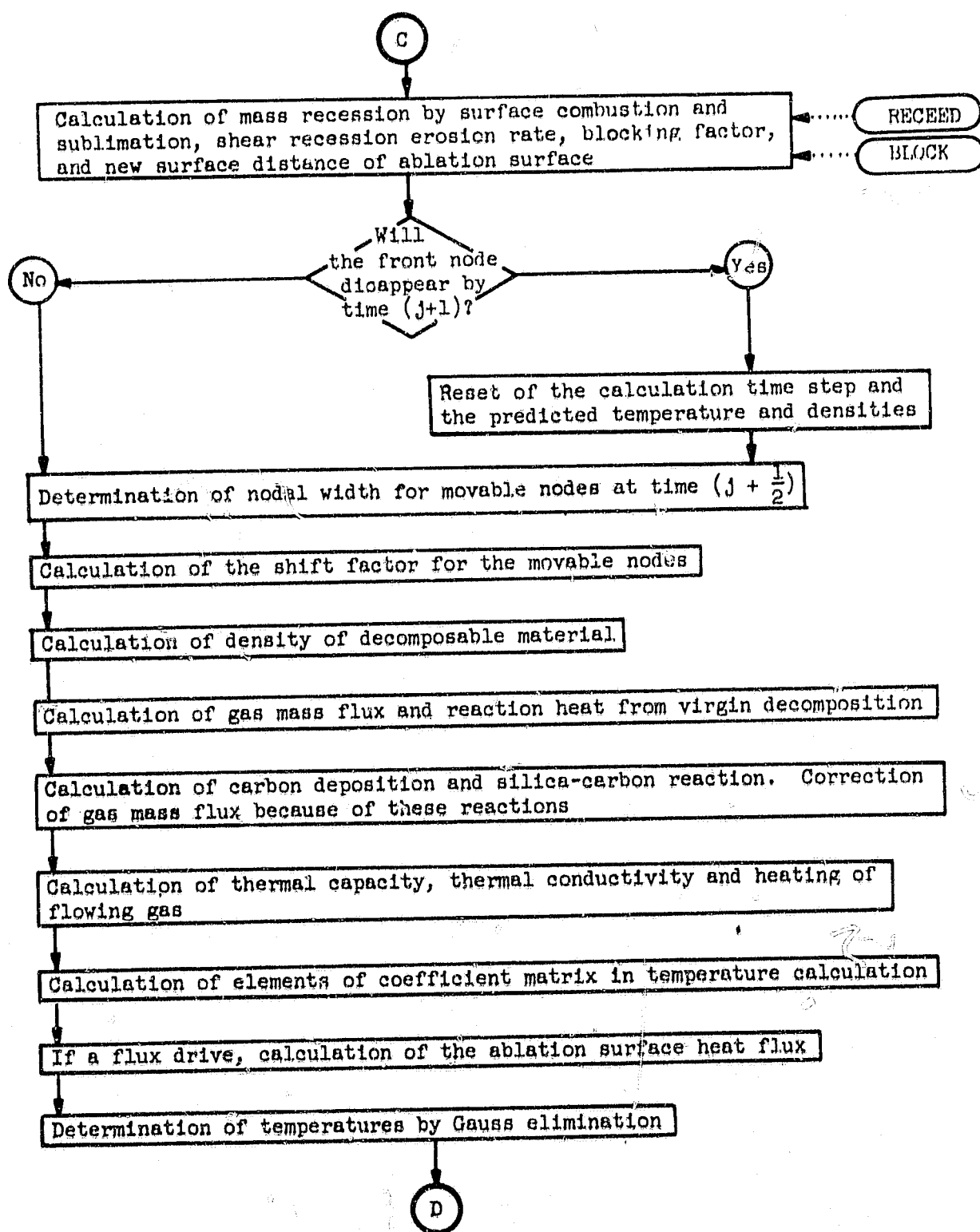
<u>Subroutine</u>	<u>Classification</u>	<u>Function</u>
FLAWS	CHARM	Calculates the internal pressures, internal gas velocities and the diffusion coefficients for hydrogen and other gases
FONEV	Utility	Linearly interpolates the value of $f(x)$ from a table given the independent variable x
FREC	CHARM-RECEED	Calculates a simple arithmetic function for RECEED
FRONT	CHARM	Determines whether to drop the front major node, to combine it with the one next to it, or to divide the major node next to the front
GPCOM	CHARM	Calculates the heat to the ablating surface from exterior gas phase combustion
GRIN	Utility	Provides the subscripting from arrays needed for calculation
ITER8	CHARM-RECEED	Finds a solution for x in the equation $x = f(x)$
IWR	CHARM	Calculates enthalpy given the temperature and the compressibility factor
LLD	Utility	Determines the major node number given a minor node number
MOLWT	CHARM	Calculates the molecular weight of the internal gas from the gas component concentrations
PCAPF	CHARM	Calculates the thermal capacity of a node (or half-node)
PORO	CHARM-FLOWS	Calculates the porosities and permeabilities of the solid and the viscosities of the internal gas

<u>Subroutine</u>	<u>Classification</u>	<u>Function</u>
RECEED	CHARM	Determines the material lost by carbon combustion and carbon sublimation
RHOSB	CHARM	Determines the rate of virgin decomposition and required accessory values
SHIFT1	CHARM CHARM-FRONT	Shifts storage of minor nodes and adds values to zone storage when a major node is subdivided
SHIFT 2	CHARM	Shifts location of minor nodes in zone storage
SIC	CHARM	Calculates the rate of the silica-carbon reaction and the changes in silica and carbon densities
SUBZ	CHARM	Calculates the compressibility factor given the temperature and pressure
TBSTEP	Utility	Finds the value of the step function $f(x)$ given the independent variable x
WRITE		Outputs all desired calculated information

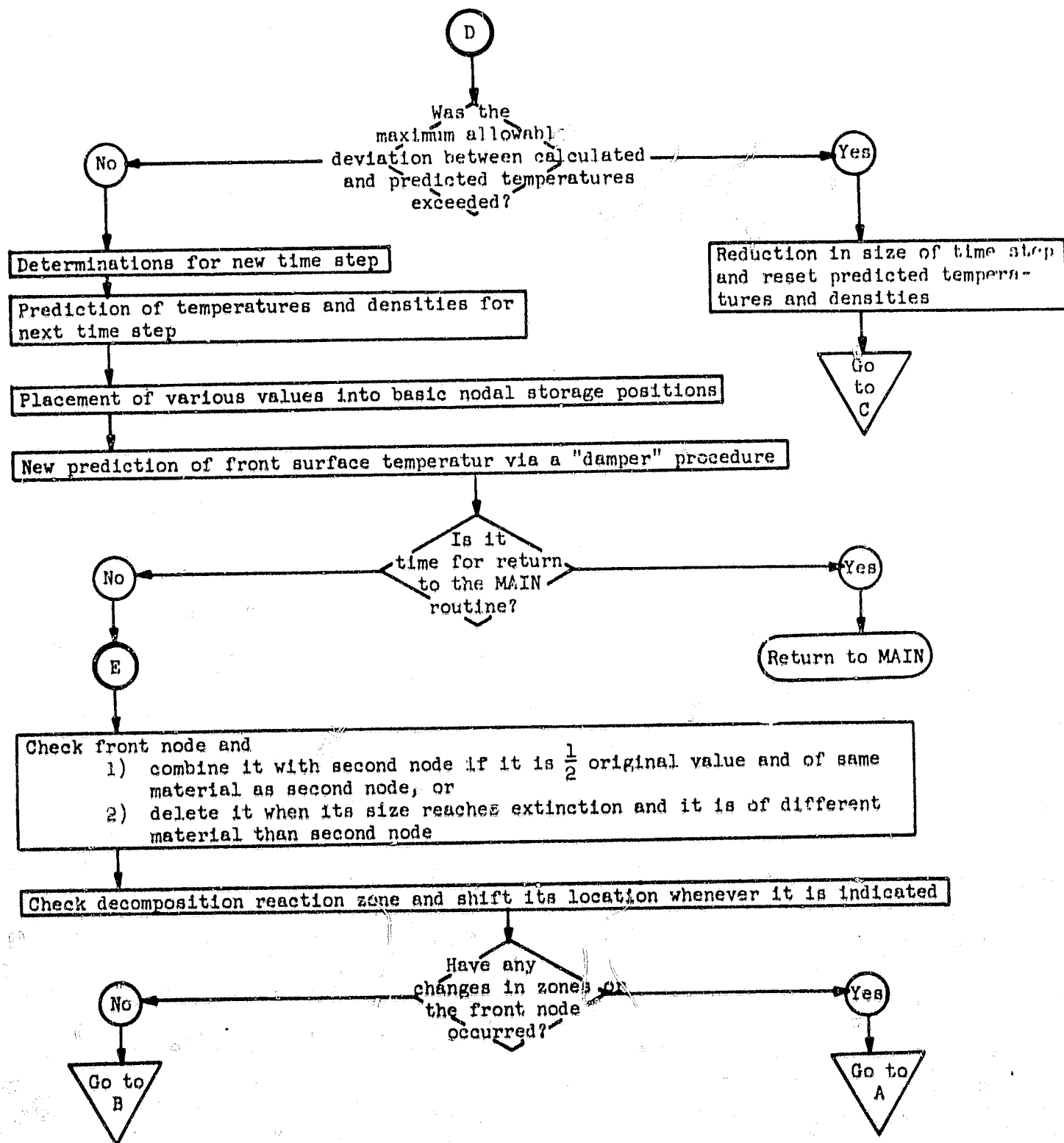
Flow charts. - Most of the subroutines are relatively simple and have been described in the previous section. A few subroutines are of sufficient complexity to warrant flow charts for the program user. They are CHARM, COMBIN, DIFUS, FRONT, and SHIFT1 and are presented here in that order.

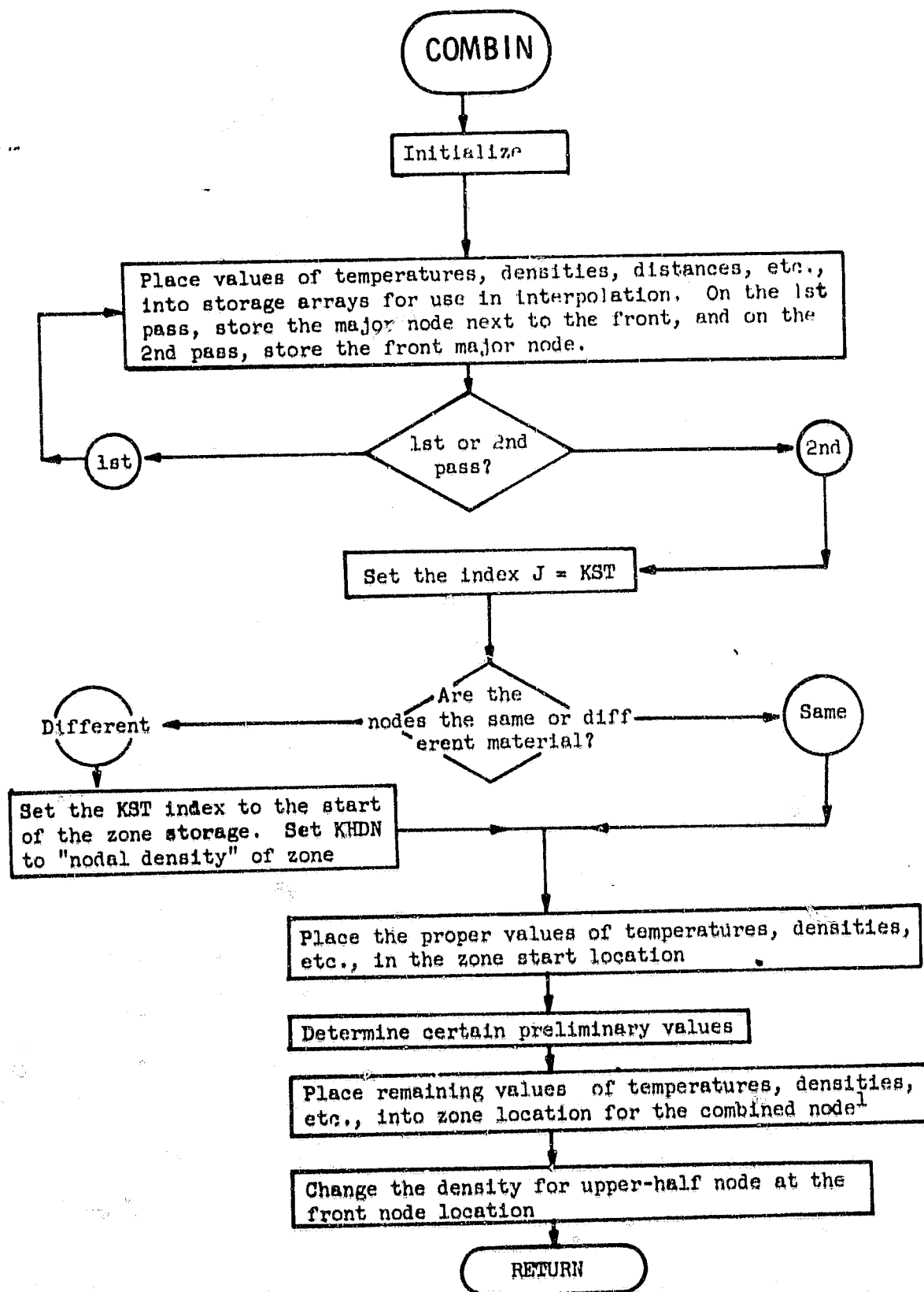


CHARM (Continued)

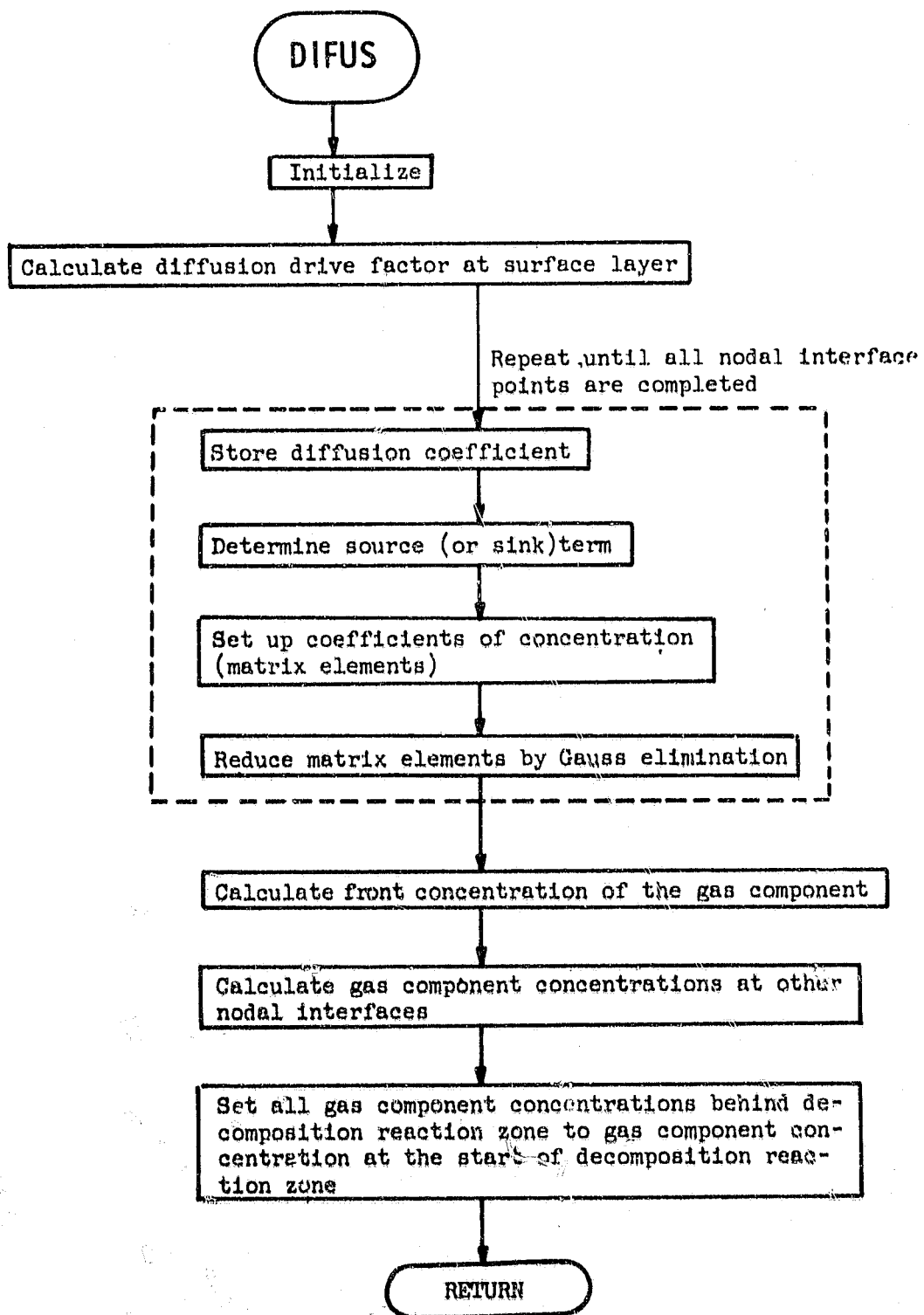


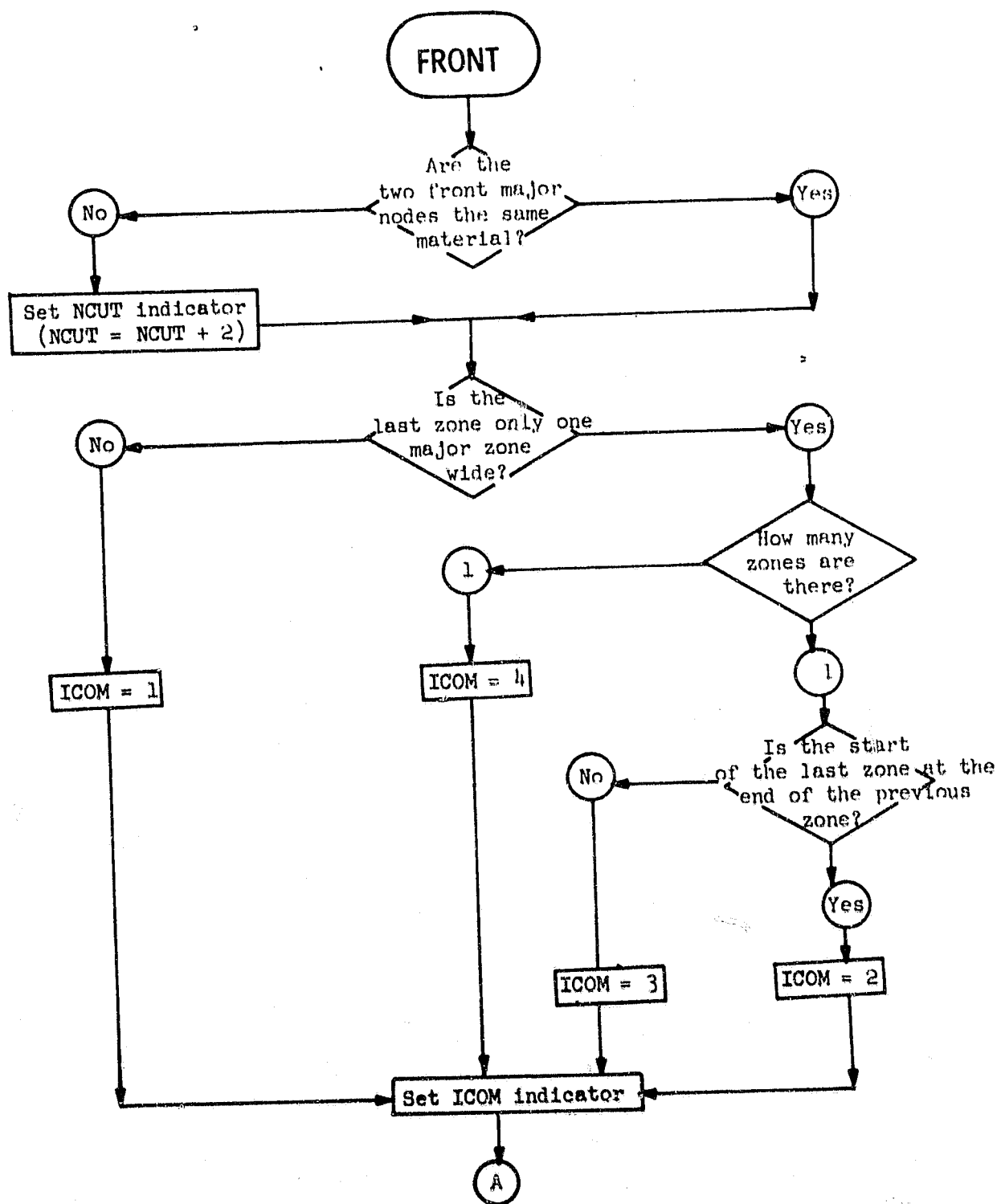
CHARM (Concluded)

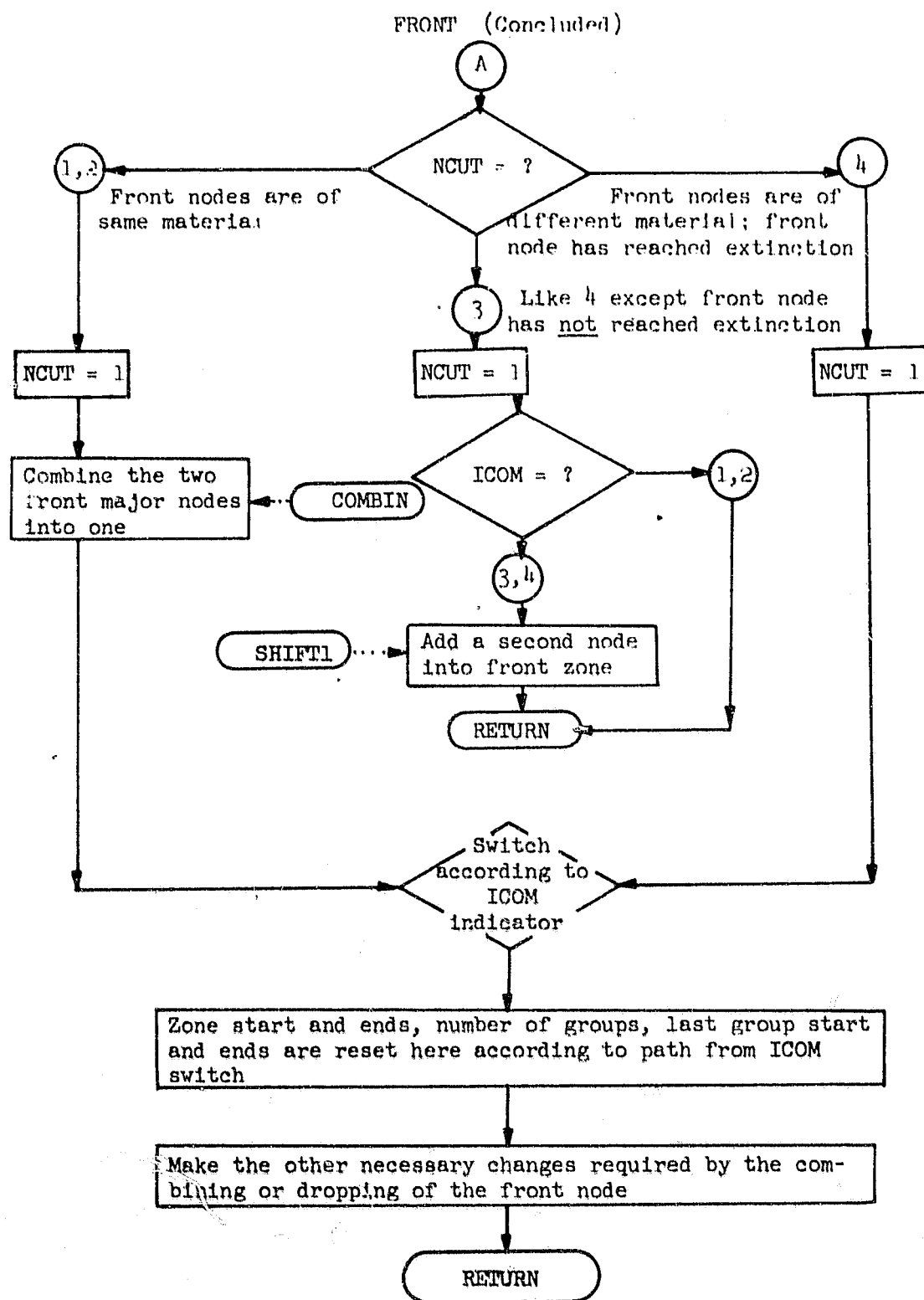


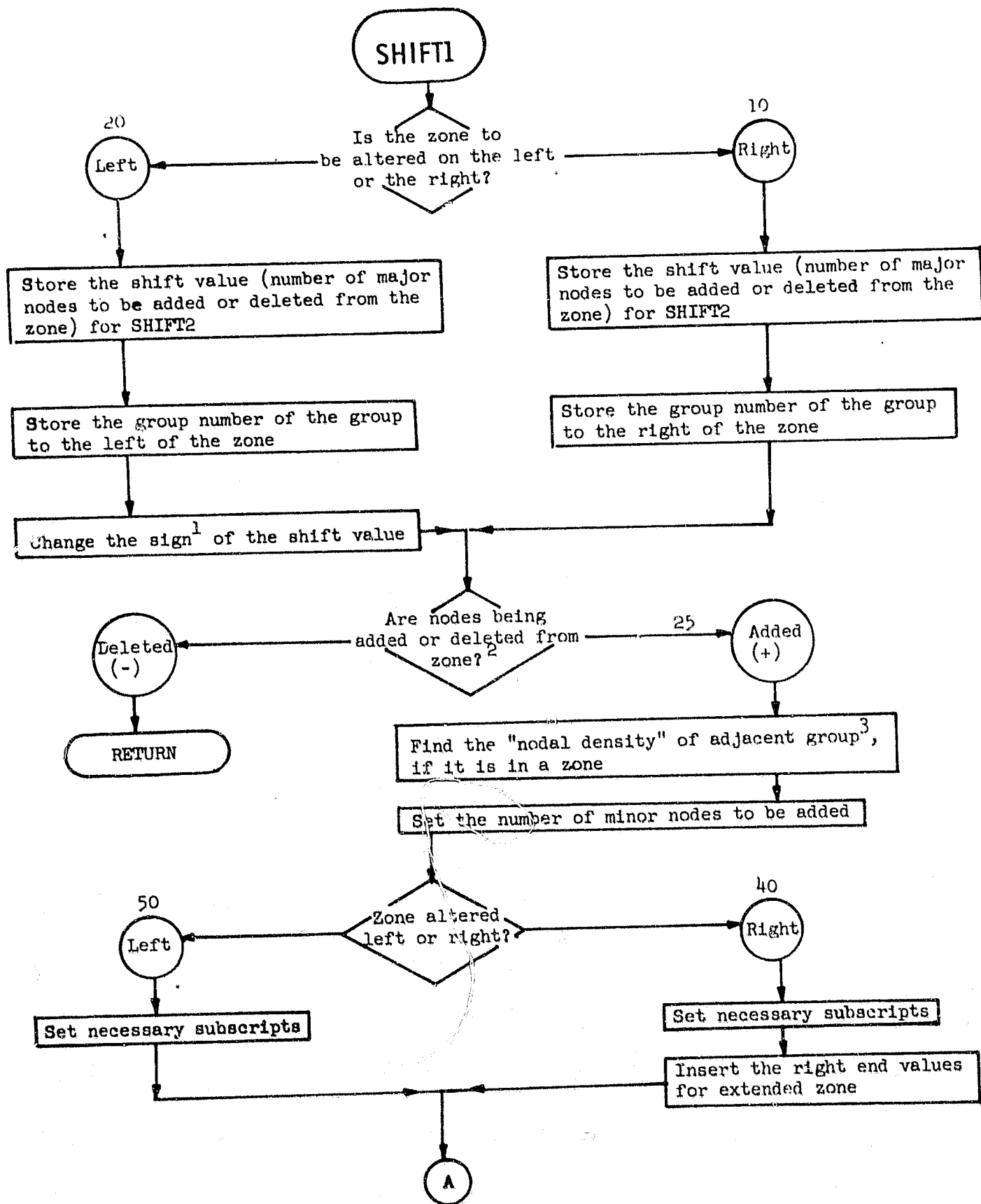


¹ In the case of different materials for the two front nodes, the front node is dropped because it is at extinction and the second node is placed in the zone storage position.

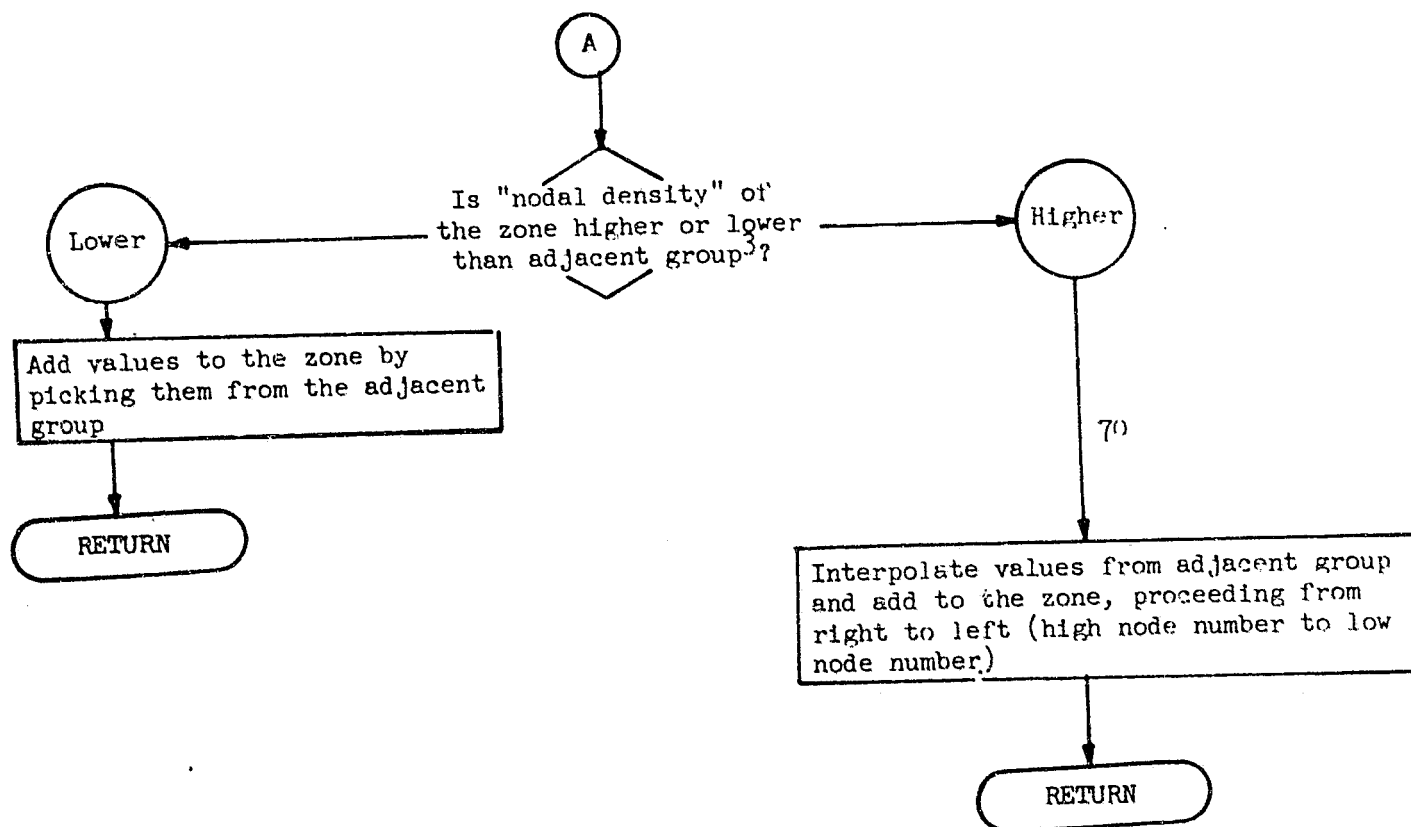








SHIFT1 (Concluded)



- 1 The sign of the shift value is minus for zone boundary movement to the left and positive for zone boundary movement to the right.
- 2 The sign of the shift value at this point indicates whether nodes are being added (+) or deleted (-).
- 3 The adjacent group is the group next to the zone side which is being added to.

Program nomenclature. - The nomenclature of all CHAD routines is included in the following section. The listing indicates a subroutine only when the quantity is specific to that subroutine.

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
A	A_i	BTU/sec-°R	CHARM	Coefficient of temperature ($T_i + 1$) ($T_i - 1$)
A	$\frac{\eta^A}{A}$	None	BLOCK	Term in equation for block- ing function.
A	A_i	ft/sec.	DIFUS	Coefficient of gas compon- ent concentration ($C_i + 1$) ($C_i - 1$)
A			ITER8	Temporary value calculated in this subroutine
ABSC	α_c	None		Char absorptivity for ther- mal radiation
ABSORP	α_v	None		Virgin absorptivity for ther- mal radiation
ABVAL	ϵ	None		Relative absolute error of calculated temperature; $\epsilon_{calc} = \frac{T_{calc} - T_{pred}}{T_{pred}}$
ABVALM	$\epsilon_{s, max}$	None		Maximum relative absolute error for front group
ABVALS	ϵ_{max}	None		Maximum relative absolute error for all groups except the front group
ACTENC	A_c	°R	RECEED	Activation temperature for char combustion
ACTENS	A_s	°R	RECEED	Activation temperature for char sublimation
ACTENV	A_v	°R	RHOSB	Activation temperature for virgin decomposition
AERN	C_N	lbm/ft ³ void		Concentration of nitrogen in gas phase
AERO	C_{O_2}	lbm/ft ³ void		Concentration of oxygen in gas phase

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
AF	B_{si}	1/sec	SIC	Collision frequency for silica-carbon reaction
AIRM	M_{air}	lb _m /mole		Molecular weight of air (28.96)
ALLGAS	C_T	lb _m /ft ³ void		Concentration of total gas in the gas phase
ALP	v_i^i	ft/sec	DIFUS	Gas velocity of node i at time j
ALPH	v_{i-1}^i	ft/sec	DIFUS	Gas velocity of node i-1 at time j
ALPHA	v_{i+1}^i	ft/sec	DIFUS	Gas velocity of node i+1 at time j
ALPHA	v_i^i	ft/sec	FLows	Temporary storage for gas velocity
ANMW	M_N	lb _m /mole		Molecular weight of nitrogen
AOMW	M_{O_2}	lb _m /mole		Molecular weight of oxygen
AREA	A_K	ft ²		Area for thermal conduction (It is set equal to 1 for this program)
AREAC				Value calculated in the determination of decomposable density
AREAV	A_v	ft ²		Area for heat capacity. (This area multiplied by nodal thickness gives a volume. It is set equal to 1. for this program)
ARM	A_{dep}	meter ² /gm	DEPO	Effective surface area for the carbon deposition reaction
AST		lb _f /in ²		Aerodynamic shear force
ASTORE			COMBIN	Storage array for TEMPA1 values needed for interpolation later in the routine

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
B	B_i	BTU/sec-°R	CHARM	Coefficient of temperature (T_{i+1})
B	λ	None	BLOCK	The power λ in the blocking function $\psi = e^{-\lambda}$
B	B_i	ft/sec	DIFUS	Coefficient of gas component concentration (C_{i+1})
B			IWR	Temporary value calculated in this subroutine
BDUM			RECEED	Temporary value calculated in this subroutine
BF	A_{si}	°R	SIC	Activation Temperature for silica-carbon reaction
BLDEN	$\rho_{g,s}$	lb _m /ft ³		Local density at surface
BLPRES	p_s	lb _f /ft ²		Local pressure at surface
BMW	M_{burn}	lb _m /mole		Molecular weight of carbon monoxide gas
BSTAR				Blowing parameter associated with the diffusion of the ablation gases into the boundary layer
BSTORE			COMBIN	Storage array for TEMPA2 values for interpolation later in the routine
BURN	C_{burn}	lb _m /ft ³ void		Concentration of carbon monoxide gas phase
C	C_i	BTU/sec-°R	CHARM	Coefficient of temperature (T_{i+1})
C	C_i		CHARM	Coefficient of densities $(\rho_{i+1} \text{ and } \rho_{i+1})$ in density equations where nodes are "movable".
C	C_i	ft/sec	DIFUS	Coefficient of gas component concentration (C_{i+1})

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
CAJA			SHIFT1	Rate of change of molecular weight
CAR		1/ft	DEPO	Effective surface area per unit volume for the silica-carbon reaction
CARBN1		lb_m/ft^3		Density of carbon in the char at time i
CARBN5		lb_m/ft^3		Density of carbon in the char at time of $i + 1$
CARTS		lb_m/ft^3		Theoretical maximum density of carbon
CC			CHARM	The coefficient of the temperature (T_{i+1}) after reduction of the original coefficients
CC			DIFUS	The coefficient of the gas component concentration (C_{i+1}) after reduction of the original coefficient
CCPC		$\text{BTU}/\text{lb}_m^{\circ}\text{R}$ (for first term)		Coefficients of the cubic equation used to calculate char specific heat
CCPG		$\text{BTU}/\text{lb}_m^{\circ}\text{R}$ (for first term)		Coefficients of the cubic equation used to calculate gas specific heat
CFIX	$C_{s,i}$	lb_m/ft^3	DIFUS	Surface concentration of gas component i
CFXCM	$C_{s,\text{CO}}$	lb_m/ft^3		Surface concentration of carbon monoxide
CFXDP	$C_{s,\text{dep}}$	lb_m/ft^3		Surface concentration of "deposition gas" (gas other than hydrogen formed in carbon deposition reaction) [Not in use]
CFXH	$C_{s,\text{H}}$	lb_m/ft^3		Surface concentration of hydrogen
CFXN	$C_{s,\text{N}}$	lb_m/ft^3		Surface concentration of nitrogen

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
CFXO	C_{s, O_2}	lb_m/ft^3		Surface concentration of oxygen
CFXPY	$C_{s, pyr}$	lb_m/ft^3		Surface concentration of pyrolysis gas
CFXSI	$C_{s, SiO}$	lb_m/ft^3		Surface concentration of silicon monoxide
CHARRO	ρ_{carb}	lb_m/ft^3		Carbon density in the char formed by pyrolysis
CINE			SHIFT1	Rate of change of graphite (Not in use)
CKC	k_c	$BTU-in/ft^2 \cdot sec \cdot ^\circ R$ (For first term)		Cubic coefficients for char conductivity equation
COEFT	$C_{p, v}$	$BTU-in/ft^2 \cdot sec \cdot ^\circ R$ (For first term)		Cubic coefficients for virgin specific heat equation
COMMAX	Δt_{max}	sec.		Maximum time step the CHARM subroutine is allowed to take
CONC	C_i	lb_m/ft^3 void	DIFUS	Concentration of gas component i
COND	K_i	$BTU/ft^2 \cdot ^\circ R \cdot sec$		Thermal conductance through a node
CONDC	K_c	$BTU/ft^2 \cdot ^\circ R \cdot sec$	CONDF	Char thermal conductance
CONDF				Function subroutine which calculates thermal conductance
CONDV	K_v	$BTU/ft^2 \cdot ^\circ R \cdot sec$	CONDF	Virgin thermal conductance
CONDX	K	$BTU/ft^2 \cdot ^\circ R \cdot sec$		Last thermal conductance determined in a group
CONDXX	K	$BTU/ft^2 \cdot ^\circ R \cdot sec$		Last thermal conductance determined in the group prior to group under calculation
CONDO	K	$BTU/ft^2 \cdot ^\circ R \cdot sec$		Thermal conductance of node 0. This is a dummy value for use in calculations for back boundary
CONST	K_v	$BTU-in/ft^2 \cdot ^\circ R \cdot sec$ (For first term)		Cubic coefficients for virgin conductivity equation

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
COORD				Type of one-dimensional coordinate system: 1 = cartesian, 2 = cylindrical, 3 = spherical (Not in use)
CPBAR	$C_{p_g, i}$	BTU/lb _m -°R		Specific heat of gas at mode i
CPC	$(\rho C_p)_c$	BTU/ft ³ -°R	PCAPF	Thermal capacity of the char
CPV	$(\rho C_p)_v$	BTU/ft ³ -°R	PCAPF	Thermal capacity of the virgin
CRUZ			SHIFT1	Rate of change of carbon monoxide source
CSTORE			COMBIN	Storage array for TEMPA5 values for interpolation later in the routine
CX			DEPO	(See description in the block data subroutine input in the INPUT-OUTPUT section of this volume)
D	D_i	BTU/sec-°R	CHARM	The value D_i in the temperature equation: $A_i T_{i-1}^{i+1} + B_i T_i^{i+1} + C_i T_{i+1}^{i+1} = D_i$
D	D_i	ft/sec	DIFUS	The value D_i is the gas component concentration equation: $A_i C_{i-1, i-1}^{i+1} + B_i C_{i, i}^{i+1} + C_i C_{i+1, i+1}^{i+1} = D_i$
DACT				The net amount of methane remaining in the exiting gas
DCO			DIFUS	The diffusion parameter D for the ablating surface for gas component i

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
DCOCM DCODP DCOH DCON DCOO DCOPY DCOSI				The diffusion parameter D for the ablating surface for gas components carbon monoxide, "deposition gas" (not in use), hydrogen, nitrogen, oxygen, pyrolysis gas, and silicon monoxide, respectively
DCU			DIFUS	The diffusion coefficient for the ablating surface. $D_s = D\psi_H$
DD			CHARM	The value D after reduction (See the program symbol D for subroutine CHARM)
DD			DIFUS	The value D after reduction (See the program symbol D for subroutine DIFUS)
DEL				The nodal width of previous node used in calculation of deposition and silica-carbon reactions
DELA				Temporary storage of the nodal width used in calculation of deposition and silica-carbon reactions
DELTAX		In.		The nodal width for all minor nodes and non-subdivided major nodes
DELTX		None		The normalized nodal width for the moving minor nodes
DELX	Δx	In.		The nodal width for all major nodes
DEP	C_{dep}	lb_m/ft^3 void		Concentration of "deposition gas in gas phase (Not in use)
DEPX				(Not in use)
DEPXX				(Not in use)

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
DGAS				The time rate of change of the exiting gas mass/flux
DIFC			RECEED	Cubic coefficients in the equation for calculation of the diffusion reduction parameter
DIFCAL			DIFUS	(Not in use)
DIFCH		ft ³ /sec		Diffusion coefficients for hydrogen
DIFCO		ft ² /sec	DIFUS	Storage locations in DIFUS subroutine for diffusion coefficients
DIFCOS		ft ² /sec	DIFUS	Temporary storage of diffusion coefficient (i - 1)
DIFR		ft ² /sec		Diffusion coefficients for gases other than hydrogen
DIFREC			RECEED	Diffusion reduction parameter see equation (30)
DIS		In	COMBIN	Distance value used for interpolation in combining front nodes
DISTL		In		Normalized distances for moving nodes
DMW		lb _m /mole		Molecular weight of the "deposition gas" (Not in use)
DPRINT		Sec	MAIN	Print interval
DQ		BTU/lb _m ⁰ R		Rate of change of net ablation surface heating with temperature
DR			RECEED	Surface combustion rate
DS			RECEED	Surface sublimation rate
DSTEP		Sec	MAIN	Storage array of max. calculation interval (An input table)
DSTORE			COMBIN	Storage array for distance values for use in interpolation
DTAU	ΔT	Sec	CHARM	Calculation time step
DTAUC		Sec	CHARM	Maximum calculation time step determined by CHARM

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
DTAUS		Sec.	CHARM	Calculation time step for previous step
DTAUX		Sec.	CHARM	An average of the old and new calculation time steps
DTEND		Sec	MAIN	Time until the end-of-problem time
DTF		None	CHARM	Calculation time step factor used in cases where calculation time step is too large
DTR			CHARM	An array of surface temperature rate of change with time used in "damper" procedure
DWFDX				Amount of methane formed between back surface and end node of group being calculated
DWFDXX				DWFDX (see above) value at previous group calculation
DX	Δx		COMBIN FONEV WRITE	It is used separately in each of the subroutines COMBIN, FONEV, and WRITE for (distance)
EDFLUX				
EDFX				
EDFXX				
EF			CHARM	The normalized distance at time j multiplied by 2
EFCOLC	B_c	1/sec		Collision frequency for the surface char combustion reaction
EFCOLS	B_s	1/sec		Collision frequency for the surface carbon sublimation process
EFCOLV	B_v	1/sec		Collision frequency for virgin plastic decomposition reaction
EK				Factor used in interpolations of carbon and silica densities to account for moving nodal interfaces

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
EMBM				Value calculated for the determination of decomposable density
EMI				Factor for shift correction of movable nodes
EMIS	e_v	None		Emissivity of virgin material
EMISC	e_c	None		Emissivity of char
EMWT		Lb _m /mole		Average molecular weight of the total internal gas
EROC				Constants in the surface shear removal correlation
ERODE		lb _m /sec		The mass eroded by aerodynamic shear removal
ETA				Fixed error criterion for calculated temperature
ETAS				The minimum of ETA (see above) and a second error criterion: 40/T
F		lb _f /in ²		Aerodynamic shear stress at the surface
FCT			ITER8	Argument of an external function
FF				Storage array for flow condition indication (laminar or turbulent) (An input table)
FHT				Nodal heat input from the virgin decomposition reaction
FHTX				The last FHT (see above) determined in a group
FHTXX				The last FHT (see 2 items above) determined in the group prior to group under consideration
FIVE			SHIFT1	Value used for interpolation
FLOW				Turbulent or laminar flow indication (1 for laminar and 2 for turbulent)

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
FMFP			DEPO	Factor used in determination of partial pressures
FNRDIV			WRITE	Floating point equivalent of NRDIV
FONEV				Function subroutine which performs a table lookup using linear interpolation
FOUR			SHIFT1	Rate of change of decomposable density for time $(j + 1)$ with respect to distance
GABY			SHIFT1	Rate of change of pyrolysis gas source
GAGC				Interim value found in the calculation of coefficient matrix elements for temperature determination
GAS	$\dot{m}_{g,s}$			The ablation gas mass flux at the surface at time $j + 1/2$
GAS1	$\dot{m}_{g,s}$			The ablation gas mass flux at the surface at time $j - 1/2$
GCON	R	ft-lb _f /lb mole -°R		Gas constant which equals 1545 for these dimensional units
GK				Interim value determined in finding matrix element for ablation surface node temperature equation
GRAFI				Graphite density at time j (Not in use)
GRAF5				Graphite density at time $j + 1$ (Not in use)
GX				Interim value determined in finding ablation surface temperature
GY				Interim value determined in finding the ablation surface temperature

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
GZ				One-half the rate of change of the ablation surface heat flux with temperature
HCOM	$H_{c,c}$	BTU/lb _m		Heat of combustion of the ablation surface
HCOMG	$H_{g,c}$	BTU/lb _m		Heat of combustion of the gas phase at surface
HCONV	H	lb _m /ft ² -sec		Heat transfer parameter at the surface
HDA				Coefficients of the quartic equation for determining the heat of reaction for the decomposition reaction
HECT			SHIFT1	Rate of change of carbon deposition source
HERE			DEPO	Interim value in determination of carbon deposition rate
HMW	M_H			Molecular weight of hydrogen
HOFM		BTU/lb _m		Heat of virgin decomposition reaction at 536.67 °R (25 °C)
HOLD				Temporary storage location
HOW				Temporary storage location
HSUB		BTU/lb _m		Heat of carbon sublimation
HYD		lb _m /ft ³ void		Concentration of hydrogen in the gas phase
HYDC		atm	DEPO	Partial pressure of hydrogen
I				Subscript for general use, but particularly for material type
IBE				Array of the ending interfaces of the groups
IBS				Array of the starting interfaces of the groups
IBSPM				[Starting location in decomposable density storage arrays for upper half-node values] - 1
IBSPN				IBSPM - 1

Program Symbol	Subroutine	Description
ICOM	FRONT	An indicator which determines the direction through the latter part of the subroutine
IERR		Error indicator in comparison of predicted and calculated temperatures. (1 = no error, 2 = error)
IERROR		Error indicator for major program errors resulting in problem being ended
IG		Group number
IGC		Used for certain group numbers
IGL		IG - 1
IGLD	CHARM	Group indicator used in calculation control section
IGR		First reaction group number
IGRL		Last reaction group number. (Used otherwise also)
IGT		Used for certain group numbers
IGTYP		The group type (0 for no zone, 1 for zone 1, 2 for zone 2)
IGX		Used for certain group numbers
IG2		Lowest group number of problem type 2
IHDN		An array of the numbers of minor nodes per major node for each group type
IHYS		(Not in use)
INCOM	SHIFT1	Shift value
INEG		IX - 1
INFRST	MAIN	Indicator of the table point number (1 - first, 2 - other than first)
INI		Major nodal interface number for decomposition reaction zone start
IN2		Major nodal interface number for decomposition reaction zone end

Program Symbol	Subroutine	Description
IP		Problem number
IPLUS		$IX + 1$
ISAVE1 ISAVE2 ISAVE3 ISAVE4 ISAVE5 ISAVE6		Table entry positions saved after table lookup by FONEV subroutine
ISPY	WRITE	Indicator of direction through routine (1 - first pass, 2 - second pass)
ITER		Number of iterations for the time step
ITERT		Total number of iterations
IU	SHIFT1, SHIFT2,	Number of groups in the zone
IYS		Major nodal interface at start of moving nodes
IZB		Array of starting storage loca- tions for the zones
IZG		Array of group numbers for each zone
IZGT		Total number of groups in a zone
JBE		Ending interface for a group
JBEM		$JBE - 1$
JBND1		Starting boundary type
JBND2		Ending boundary type
JBS		Starting interface for a group
JBSM		$JBS - 1$
JBSPM		$IBSPN + JCSN$
JBSPN		$JBSPM - 1$
JBX		Last minor node number for the group

Program Symbol	Subroutine	Description
JBXX		Last minor node number for the previous group
JCEN		The major nodal interface for the end of a group
JCENM		JCEN - 1
JCSN		The major nodal interface for the start of a group
JCSNM		JCSN - 1
JE		JE1 + 1
JE1		The number of minor nodes in a group
JE2		JE1 - 1
JHDN		The number of minor nodes per major node for the group
JHDN	COMBIN	The number of minor nodes per major node for the front group
JHDN	SHIFT1	The number of minor nodes per major node for the zone
JLSW		Indicator for whether group has moving nodes or not (1 - not moving, 2 - moving)
JRSW		Indicator for whether group is in decomposition reaction zone or not (1 - before zone, 2 - after zone, 3 - in zone)
JSLAB		Number of major nodes in a group
JSUB	WRITE	Storage location of decomposable density for upper half node at ablation surface
KHDN	COMBIN	The number of minor nodes per major node for the new combined node
KHDN	SHIFT1	The number of minor nodes per major node
KK		Commonly used for the storage location of the decomposable density for the upper half node

Program Symbol	Dim. Units	Subroutine	Description
KK		DIFUS	Major node number below major node KL
KL			Commonly used for relative storage location of the minor nodes
KL		DIFUS	Major node number
KSUBI		FONEV	One of the table points for use in the linear interpolation
KSUBJ		FONEV	The other table point for use in the linear interpolation
K1			$K + 1$
L			Always equal to 1 in CHAD
LANDID			An indicator in the Calculation Control section of CHARM
LFT			Left (toward back) indicator for side of zone to be added to or subtracted from
LLD			Function subroutine which determines major node corres- ponding to a minor node
LRT			Right (toward ablation surface) indicator for the side of zone to be added to or subtracted from
MARK			Indicator of whether or not to enter calculation control (1 - No, 2 - Yes)
MARY		SHIFT1	Rate of change of silicon monoxide source with respect to distance
MAT			An array of material numbers which indicate material type for each major node
MCXT		DEPO	Rate factor for the carbon deposition reaction
METC	atm	DEPO	Partial pressure of methane

Program Symbol	Subroutine	Description
MG		The total number of groups
MNOD		The front major nodal interface number
N		Always equal to 1 in CHAD
N	ITER8	
NADD		An array for a group of the number of major nodes of the same material and width in the group
NASW		The type of boundary at the ablation surface
NBNDST		Used in calculation control section of CHARM
NBND1		An array of starting boundary types for the groups
NBND2		An array of the ending boundary types for the groups
NBSW		The type of boundary at the back surface
NCEN		An array of the ending major interface numbers for the groups
NCSN		An array of the starting major interface numbers for the groups
NCVT		An indicator used by FRONT subroutine (See FRONT flow sheet)
ND		Node divider array. ND(1) is used to indicate position between moving and non-moving nodes
NDOTS		An array of the number of points in the input tables
NDOT SX	MAIN	A subscript limit used in table output section
NHDN		An array of the number of minor nodes per major node for each zone
NLR	SHIFT1	Left-right switch. (See LFT and LRT)

Program Symbol	Subroutine	Description
NLSW		An array of the indicators for each group of whether the nodes are moving or non-moving
NLZON		The largest zone number
NN		The maximum major node number
NNP		The maximum major nodal interface number. Equals $NN + 1$
NOF		The ablation surface interface number (minor node basis)
NONE	SHIFT1	The shift value
NOTIME		Total number of time steps
NPBSW		Switch based on problem type and is used in the calculation control section of CHARM
NPE1N		Major nodal interface for the ending of problem 1
NPS2N		Major nodal interface for the start of problem 2
NPTSW		Switch for returning from CHARM back to MAIN (1 - Stay, 2 - Return)
NRDIV		The number of minor nodes per major node
NREND		The ending major interface of the zone
NRGO		The starting major interface of the zone
NRID		Indicator used in calculation control section in CHARM
NRSW		An array of the indicators for each group of where or not the group is in the decomposition reaction zone
NRZON		The zone number for the reaction zone
NSHL		An array of the shift values to the left for each zone

Program Symbol	Dim. Units	Subroutine	Description
NZSN			An array used for the major nodal interfaces of the start of zones
OMG		RECEED	Interim value used in calculating diffusion reduction parameter
ONE			Temporary storage location
P		SUBZ	Local pressure at the surface
PARTIN			Same as DELTA X
PC	BTU/sec		Thermal capacity divided by time step
PCAPF	BTU/sec		Function subroutine which calculates thermal capacity
PCX			Last PC calculated in a group
PCXX			Last PC determined in just prior group
PERM1	$\text{lb}_m \text{ft}^3 / \text{lb}_f \text{sec}^2$		Viscous permeability multiplied by gc
PERM2	$\text{lb}_m \text{ft}^2 / \text{lb}_f \text{sec}^2$		Inertial permeability multiplied by gc
PERT1	ft^2		Reference viscous permeability for viscous permeability calculation
PERT2	ft		Reference inertial permeability for inertial permeability calculation
PHI	None		Blocking parameter
PMW	$\text{lb}_m / \text{lb mole}$		Molecular weight of pyrolysis gas
POR	None		Porosity
PORT			Reference porosity for porosity calculation
PP			Storage array for local surface pressure (An input table)
PRFRNT		FLAWS	Local surface pressure
PRG			Internal gas pressure
PSI			Parameter calculated for use in aerodynamic shear erosion determination

Program Symbol	Subroutine	Description
NSHR		An array of the shift values to the right for each zone
NSLAB		An array of the number of major nodes in each group
NSLABH		An array of the number of minor nodes in each group
NSOUR	DIFUS	Switch in DIFUS set in CHARM according to the gas component being determined
NST	CHARM	Switch used in CHARM which is set to 1 for first pass into CHARM and to 2 thereafter
NSTILL	CHARM	Switch which is set to 1 for no decomposition reaction and to 2 for decomposition reaction occurring within the group
NSW	CHARM	Switch in calculation control section of CHARM
NTAB	MAIN	Table number
NTABT	MAIN	The total of tables what have been input
NTYP	MAIN	The type of table 3 temperature or heat flux
NXSW	CHARM	Switch in iteration control section which allows recalculation of front group of error found there on first iteration
NZEN		An array of the ending major nodal interfaces for the zones
NZON		Subscript used for zone numbers
NZONC		Initializing value for calculation control section. It equals 1 normally and 2 when there is no decomposition reaction zone
NZONX	SHIFT1	Zone type for group adjacent to zone being changed

Program Symbol	Dim. Units	Subroutine	Description
PSQ	.	FLows	The square of the internal gas pressure
PSTORE		COMBIN	Storage array for SILCA1 values needed for interpolation later in the routine
PSTEP			Storage array for print intervals (An input table)
PYRO	lb_m/ft^3 void		Concentration of methane in the gas phase
QBACK	$\text{BTU}/\text{ft}^2\text{-sec}$		Heat flux to the back surface (Not in use)
QBRN	BTU/lb_m		Heat of reaction for internal combustion (Not in use)
QBYRAD	$\text{BTU}/\text{ft}^2\text{-sec}$		Heat radiated from the ablation surface
QCOMB	BTU/lb_m		Heat of surface combustion
QCOND	$\text{BTU}/\text{ft}^2\text{-sec}$		Conducted heat flux
QCONV			Unblocked convective heat flux to the ablation surface
QDEP	BTU/lb_m		Heat of reaction for carbon deposition
QGAS	$\text{BTU}/\text{ft}^2\text{-sec}$		Heat radiated by hot gas toward ablation surface
QGPCOM	$\text{BTU}/\text{ft}^2\text{-sec}$		Heat flux of gas phase combustion to ablation surface
QMISC	$\text{BTU}/\text{ft}^2\text{-sec}$		Heat to ablation surface that is not blocked
QMU	$\text{BTU}/\text{ft}^2\text{-sec}$		Storage array for unblocked heat flux (An input table)
QSAVE	$\text{BTU}/\text{ft}^2\text{-sec}$		Total heat flux to ablation surface
QSI	BTU/lb_m		Heat of reaction for silica-carbon reaction
QSTORE		COMBIN	Storage array for CARBN1 values needed for interpolation later in the routine
QSUBL	BTU/lb_m		Heat of sublimation

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
QTOT		$\text{BTU/ft}^2\text{-sec}$		Partial total of heat fluxes to the ablation surface
QTOTAL		$\text{BTU/ft}^2\text{-sec}$		Total heat flux to the ablation surface
RATE				Virgin material decomposition rate
REO	n	None		Reaction order of the silica-carbon reaction
REORDC		None		Reaction order of the surface combustion reaction
REORDS		None		Reaction order of the surface sublimation
REORDV		None		Reaction order of the virgin decomposition reaction
REQ		None		Same as REO
RH				Storage array for heat transfer parameters (An input table)
RHO		lb_m/ft^3	WRITE	Density value for print-out
RHOC	ρ_c	lb_m/ft^3		Char density after pyrolysis and before char deposition or silica-carbon reaction
RHODE	ρ_a	lb_m/ft^3	WRITE	Density of decomposable material
RHOTS				Theoretical maximum density of virgin material
RHOV	ρ_v	lb_m/ft^3		Density of the virgin material
RHO1	$(\rho_a)_i$	lb_m/ft^3		Density of decomposable material at time i
RHO2	$(\rho_a)_i^{i+1} \text{ (est)}$	lb_m/ft^3		Estimated density of decomposable material at time i + 1
RHO3	$(\rho_a)_i^{i+1/2} \text{ (est)}$	lb_m/ft^3		Estimated density of decomposable material at time of i + 1/2
RHO4	$(\rho_a)_{i+1/2}^{i+1/2} \text{ (est)}$	lb_m/ft^3		Average of RHO3 for two adjacent half-nodes

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
RHO5	$(\rho_a)_i^{i+1}(\text{calc})$	lb_m/ft^3		Calculated density of decomposable material at time $i+1$
RSTORE			COMBIN	Storage array for RHO1 values needed for interpolation later in the routine
SAVE				Temporary storage
SCHECK		In		Front nodal thickness at which the front node is combined with the next one if materials are the same
SDN		In		Amount of surface recession for half a time step
SDOTN		in/sec		Surface recession rate at time $i+1/2$
SET			MAIN	Minimum COMMAX allowed
SILICA1	$(\rho_{\text{SiO}_2})^i$	lb_m/ft^3		Density of silica in the char at time i
SILICA5	$(\rho_{\text{SiO}_2})^{i+1}$	lb_m/ft^3		Density of silica in the char at time $i+1$
SILICA		lb_m/ft^3		Initial density of silica before the silica-carbon reaction begins
SILTS		lb_m/ft^3		Theoretical maximum density of silica
SLOPE				Transpiration factor for ablation gases
SMW	M_{SiO}	$\text{lb}_m/\text{lb mole}$		Molecular weight of silicon monoxide
SN		In		Thickness of movable nodes at time $i+1/2$
SN1		In		Thickness of movable nodes at time i
SOURCE		lb_m/sec	DIFUS	Source of gas component i
SOX		$\text{lb}_m/\text{ft}^3 \text{ void}$		Concentration of oxygen in the gas phase
SPEED		ft/sec		Velocity of the gas internally

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
TAR				Area of back surface (Not in use)
TAUOUT				Time for return from CHARM to the MAIN routine
TAUST				An array of times corresponding to TEMPST and DTR for use in "damper" procedure
TAU1				Time j start of the time step
TAU2				Time $j + 1$ the end of the time step
TAU2S				Time $j + 1$ for the previous iteration
TBSTEP				Function subroutine which does a table lookup on a step function
TEMPA				Temperature for use in an im- pending calculation
TEMPA1	T_i^j	$^{\circ}R$		Temperature at a nodal inter- face at time j
TEMPA2	$(T_i^{j+1})_{est}$	$^{\circ}R$		Estimated temperature at a nodal interface at time $j + 1$
TEMPA3	$(T_i^{j+1/2})_{est}$	$^{\circ}R$		Estimated temperature at a nodal interface at time $j + 1/2$
TEMPA4	$(T_{i+1/2}^{j+1/2})_{est}$	$^{\circ}R$		Average of TEMPA3 for two adjacent nodal interfaces
TEMPA5	$(T_i^{j+1})_{calc.}$	$^{\circ}R$		Calculated temperature at a nodal interface at time $j + 1$
TEMPST				An array of temperatures corres- ponding to TAUST for use in "damper" procedure
TEND			MAIN	End compute time
TEST			DEPO	A limit imposed on carbon deposition based on amount of methane produced
TIENDA			SHIFT1	Rate of change of internal gas mass flux
TIME		Sec	MAIN	Same as TAU1

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
TIME1 TIME2 TIME3 TIME4		Sec.		Time arrays for the input tables
TPRINT	τ	Sec		Time for output of calculated data
TRCHAR	η	None		Transpiration factor for gases resulting from surface combus- tion and surface sublimation
TS	T_i	$^{\circ}R$		Same as TEMPA1
TT				Storage array for ablation surface temperature (An input table)
TWALL				Ablation surface temperature
UHOLD			COMBIN	Storage array for WFD values needed for interpolation later in the routine
USTORE			COMBIN	Storage array for EMWT values needed for interpolation later in the routine
VHOLD			COMBIN	Storage array for carbon deposi- tion sources needed for inter- polation later in the routine
VISC	μ	$lb_m/ft\text{-}sec$		Viscosity of the internal gas
VISCO	μ^*	$lb_m/ft\text{-}sec$		Reference viscosity for viscosity calculation
VISCON	T^*	$^{\circ}R$		Temperature corresponding to the reference viscosity
VSTORE			COMBIN	Storage array for internal gas mass flux needed for interpola- tion later in the routine
WBRN		lb_m/sec		Source of carbon monoxide
WBRNX		lb_m/sec		The last WBRN value deter- mined in the group
WBRNXX		lb_m/sec		The last WBRN value determined in the group prior to the group under consideration

Program Symbol	Dim. Units	Subroutine	Description
WDEP	lb_m/sec		Source of deposited carbon
WDEPX	lb_m/sec		WDEP value determined in the group prior to the group under consideration
WDEP	lb_m/sec		Source of deposited carbon
WDEPX	lb_m/sec		The last WDEP value determined in a group
WDEPXX	lb_m/sec		The last WDEP value determined in the group prior to the group under consideration
WF	$\text{lb}_m/\text{ft}^2\text{-sec}$		Internal gas mass flux
WFD			Source of pyrolysis gas
WFDX			Last WFD value determined in the group
WFDXX			Last WFD value determined in the group prior to the last group under consideration
WFP			Interim value in the calculation of WF
WFX			Last WF value determined in a group
WFXX			Last WF value determined in a group prior to the last group under consideration
WHOLD		COMBIN	Storage array for silicon monoxide source needed for interpolation later in the routine
WSI			Silicon monoxide source
WSIO2		SIC	
WSIX			The last WSI value determined in the group
WSIXX			The last WSI value determined in the group prior to the group under consideration
WSTORE		COMBIN	Storage array for GRAP1 values needed for interpolation later in the routine

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
XHOLD			COMBIN	Storage array for WBRN values needed for interpolation later in the routine
XIR	I_r	BTU/lb _m		Recovery enthalpy
XIWALL	I_w			Enthalpy at the wall
XLEFT		In		Distance to major nodal interfaces from the back surface
XMDOTC		lb _m /sec		Mass recession at the ablation surface from combustion and sublimation
XMDOTD		lb _m /sec		Diffusion-limited surface combustion rate
XMDOTG				Same as GAS
XMDOTL		lb _m /sec		Surface combustion rate
XMDOTR		lb _m /sec		Reaction rate limited surface combustion rate
XMDOTS		lb _m /sec		Surface sublimation rate
XRI				Storage array for recovery enthalpies (An input table)
XSAVE				Test value for determining whether to end the problem or not because of complete loss of ablating material
ZWALL	z	None		Compressibility factor at the ablation surface

SAMPLE CASES

The two sample cases presented have used the same basic data. The first case (I) is a temperature drive input and the second case (II) is a heat flux drive input. The calculated data output at a limited number of time points is shown for each case.

SAMPLE CASE I

Temperature drive - DATA INPUT CARDS

- XQT MAIN
TEMPERATURE DRIVE SAMPLE CASE

1	
0.	1.0
40.	0.2
100.	1.0
600.	2.0
1078.	2.0
0.	0.

2	
0.	10.
100.	20.
600.	100.
1078.	100.
0.	0.

3	2	
0.	560.	.00004
20.	1708.	.00030
40.	1849.	.00061
60.	3262.	.00391
80.	5625.	.01086
100.	4911.	.01341
120.	4193.	.00932
140.	3905.	.00786
160.	3655.	.00660
180.	3374.	.00503
200.	3145.	.00395
220.	2994.	.00335
240.	2924.	.00308
260.	2881.	.00295
280.	2842.	.00282
300.	2802.	.00268
320.	2831.	.00285
340.	2866.	.00302
360.	2904.	.00326
380.	2997.	.00381
400.	3142.	.00475
420.	3293.	.00607
440.	3401.	.00755
460.	3194.	.00865
480.	3009.	.00979
500.	2708.	.00861
540.	2113.	.00685
600.	1628.	.00650
700.	990.	.01030
800.	703.	.01360
900.	641.	.01460
1000.	612.	.01550
1078.	599.	.01603
0.	0.	

TIME STEP CONTROL TABLE

PRINT STEP CONTROL TABLE

4		
0.	.0360	1. .0000403
40.	1.756	1. .000639
50.	10.5	1. .001944
60.	66.08	1. .004779

LOCAL STATIC PRESSURE AND FLOW

70.	393.0	1.	.008396
80.	512.8	1.	.012207
85.	767.0	1.	.01308
90.	1030.0	1.	.013202
95.	920.0	1.	.012724
100.	818.1	1.	.012542
105.	755.0	1.	.011384
110.	651.0	1.	.009522
115.	549.0	1.	.008698
120.	410.9	1.	.007690
130.	349.0	1.	.006707
140.	298.0	1.	.006108
150.	258.0	1.	.005552
160.	213.4	1.	.004909
170.	156.0	1.	.004192
180.	125.1	1.	.003612
190.	96.9	1.	.003218
200.	77.7	1.	.00277
210.	66.2	1.	.002416
240.	47.5	1.	.002095
300.	36.3	1.	.001795
350.	49.8	1.	.002061
370.	61.5	1.	.002261
390.	90.6	1.	.002834
410.	147.	1.	.003475
430.	236.	1.	.004399
450.	366.	1.	.005078
470.	459.	1.	.005091
480.	496.	1.	.004893
490.	480.	1.	.004296
510.	411.	1.	.003504
530.	318.	1.	.002628
550.	287.	1.	.002214
570.	307.	1.	.001667
706.	734.	1.	.00118
756.	1115.	1.	.001561
1078.	2117.	1.	.001972

0. 0.
2 ALUMINUM
1 AVCOAT
0

.015
1.976

1
35

560.

TITLE---- TEMPERATURE DRIVE SAMPLE CASE

CALCULATION TIME STEP CONTROL TABLE

TIME (SEC)	TIME STEP (SEC)
.00	1.0000
40.00	.2000
100.00	1.0000
600.00	2.0000
1078.00	2.0000

PRINT TIME STEP CONTROL TABLE

TIME (SEC)	TIME STEP (SEC)
.00	10.0000
100.00	20.0000
600.00	100.0000
1078.00	100.0000

SURFACE TEMPERATURE TABLE

TIME (SEC)	TEMPERATURE (DEG R)	HEAT TRANSFER PARAMETER (LBM/FT2-SEC)
.00	560.00	.00004
20.00	1708.00	.00030
40.00	1849.00	.00061
60.00	3262.00	.00391
80.00	5625.00	.01086
100.00	4911.00	.01341
120.00	4193.00	.00932
140.00	3905.00	.00786
160.00	3655.00	.00660
180.00	3374.00	.00503
200.00	3145.00	.00395
220.00	2994.00	.00335
240.00	2924.00	.00308
260.00	2881.00	.00295
280.00	2842.00	.00282
300.00	2802.00	.00268
320.00	2831.00	.00285
340.00	2866.00	.00302
360.00	2904.00	.00326
380.00	2997.00	.00381
400.00	3142.00	.00475
420.00	3293.00	.00607
440.00	3401.00	.00755
460.00	3194.00	.00865
480.00	3009.00	.00939
500.00	2708.00	.00861
540.00	2113.00	.00685
600.00	1628.00	.00650
700.00	990.00	.01030
800.00	703.00	.01360
900.00	641.00	.01460
1000.00	612.00	.01550
1078.00	599.00	.01603

SAMPLE CASE I

Temperature drive - OUTPUT OF INITIAL INPUT TABLES

LOCAL STATIC PRESSURE AND FLOW CONTROL TABLE

TIME (SEC)	LOC PRESS (LBF/FT ²)	FLOW (--)	LOCAL STRESS (LBF/IN ²)
.00	.0360	1.	.0000
40.00	1.7560	1.	.0006
50.00	10.5000	1.	.0019
60.00	66.0800	1.	.0048
70.00	393.0000	1.	.0084
80.00	512.8000	1.	.0122
85.00	767.0000	1.	.0131
90.00	1030.0000	1.	.0132
95.00	920.0000	1.	.0127
100.00	818.1000	1.	.0125
105.00	755.0000	1.	.0114
110.00	651.0000	1.	.0095
115.00	549.0000	1.	.0087
120.00	410.9000	1.	.0077
130.00	349.0000	1.	.0067
140.00	298.0000	1.	.0061
150.00	258.0000	1.	.0056
160.00	213.4000	1.	.0049
170.00	156.0000	1.	.0042
180.00	125.1000	1.	.0036
190.00	96.9000	1.	.0032
200.00	77.7000	1.	.0028
210.00	66.2000	1.	.0024
240.00	47.5000	1.	.0021
300.00	36.3000	1.	.0018
350.00	49.8000	1.	.0021
370.00	61.5000	1.	.0023
390.00	90.6000	1.	.0028
410.00	147.0000	1.	.0035
430.00	236.0000	1.	.0044
450.00	366.0000	1.	.0051
470.00	459.0000	1.	.0051
480.00	496.0000	1.	.0049
490.00	480.0000	1.	.0043
510.00	411.0000	1.	.0035
530.00	318.0000	1.	.0026
550.00	287.0000	1.	.0022
570.00	307.0000	1.	.0017
706.00	734.0000	1.	.0012
756.00	1114.9999	1.	.0016
1076.00	2117.0000	1.	.0020

MATERIALS

MATERIAL NAME	THICKNESS (IN)	NUMBER OF NODES
(2) ALUMINUM	.0150	1
(1) AVECOAT	1.9760	35

MATERIAL PROPERTIES OF VIRGIN MATERIALS

MATERIAL (1)

	FIRST REAC	SECOND REAC
ACTIVATION TEMPERATURE, DEG R	23300.0	.0
COLLISION FREQUENCY, 1/SEC	.112090+05	.000000
REACTION ORDER	1.0000	.0
HEAT OF DECOMPOSITION, BTU/LBM	350.00	
SPECIFIC HEAT, BTU/LBM-DEG R	(.4300-00)+1	.9936-01)T+(.0000)T**2+(.0000)T**3
CONDUCTIVITY, BTU-IN/FT2-SEC-DEG R	(.2440-05)+1	.4125-01)T+(.0000)T**2+(.0000)T**3
EMISSION	.9000	
ABSORPTIVITY	.9000	
DENSITY, LBM/FT3	34.00	
TRANSPIRATION FACTOR (ABL GASES)	1.2000	

MATERIAL (2)

	FIRST REAC	SECOND REAC
ACTIVATION TEMPERATURE, DEG R	.0	.0
COLLISION FREQUENCY, 1/SEC	.000000	.000000
REACTION ORDER	.0000	.0
HEAT OF DECOMPOSITION, BTU/LBM	120.00	
SPECIFIC HEAT, BTU/LBM-DEG R	(.0000)+1	.1642-04)T+(.0000)T**2+(.0000)T**3
CONDUCTIVITY, BTU-IN/FT2-SEC-DEG R	(.1153-04)+1	.9410-05)T+(.0000)T**2+(.0000)T**3
EMISSION	.2000	
ABSORPTIVITY	.6000	
DENSITY, LBM/FT3	484.00	
TRANSPIRATION FACTOR (ABL GASES)	.7000	

MATERIAL PROPERTIES OF THE CHAR

	COMBUSTION REACTION	CHAR SUBLIMATION
ACTIVATION TEMPERATURE, DEG R	39855.0	.0
COLLISION FREQUENCY, 1/SEC	.673000+09	.000000
REACTION ORDER	.5000	.0
HEAT OF COMBUSTION, BTU/LBM	.00	
HEAT OF SUBLIMATION, BTU/LBM	.00	
EMISSION	.6500	
ABSORPTIVITY	1.0000	
DENSITY, LBM/FT3	20.00	

TRANSPIRATION FACTOR (CHAR GASES) 1.0000

DENSITY OF THE CARBON IN CHAR, LBM/FT³ 10.00

ABLATION GAS PROPERTIES

SPECIFIC HEAT, BTU/LBM-DEG R (.7000-00)+(.0000)T+(.0000)T**2+(.0000)T**3
HEAT OF GAS COMBUSTION, BTU/LBM 6173.00

OTHER CONSTANTS

THEORETICAL CARBON DENSITY, LBM/FT³ 131.00
THEORETICAL VIRGIN DENSITY, LBM/FT³ 70.00
THEORETICAL SILICA DENSITY, LBM/FT³ 137.30

REFERENCE POROSITY .7500
REFERENCE VISCOUS PERMEABILITY, FT² 1.00000-09
REFERENCE INERTIAL PERMEABILITY, FT 1.00000+02

REFERENCE VISCOSITY, LBM/FT-SEC .100000-04
REFERENCE TEMPERATURE FOR VISC., R 530.00

SURFACE DIFFUSION CONSTANT, FT²/SEC

CARBON MONOXIDE 1.00000+01
DEPOSITION GAS (EXCEPT HYDROGEN) 1.00000+01
NITROGEN 1.00000+01
OXYGEN 1.00000+01
METHANE 1.00000+01
SILICON MONOXIDE 1.00000+01

BLOWING PARAMETER .4300
DIFFUSION REDUCTION PARAMETER (-.6490-00)+(-.2540+01)ETA+(-.2300+01)ETA**2+(-.8780-00)ETA**3
HEAT OF REACTION, SiO₂-C, BTU/LBM .00
HEAT OF REACTION, C DEPOSITION, BTU/LBM .00

SILICA-CARBON REACTION CONSTANTS

ACTIVATION TEMPERATURE, DEG R 40765.0
COLLISION FREQUENCY, 1/SEC 1.209210+04
REACTION ORDER 1.0000

SILICA DENSITY IN INITIAL CHAR, LBM/FT³ 8.19

CARBON DEPOSITION REACTION CONSTANTS

	LOW HYDROGEN	HIGH HYDROGEN
X	.136500-01	.406000-03
Y	.116200+03	.114000-01
Z	.177700+04	.422000+01

SAMPLE CASE I

Temperature drive - OUTPUT OF CALCULATED DATA AT VARIOUS TIMES

The following listing shows the CHAD program output at time = 0, 100, 200, and 500 seconds.

76

50

[illegible]

78

NODE	DISTANCE FROM BACK (IN)	TEMP (DEG F)	CONDUCTED HEAT FLUX (BTU/FT2-SEC)	-----DENSITIES (LBM/FT3)-----					INTERNAL PRESSURE (LBF/FT2)	MOL WT	VELOCITY (FT/SEC)
				TOTAL	DECOMP	CARBON	GRAPHITE	SILICA			
37	1.9653	4451.31	.0000	13.9551	-.0000	12.6819	.0000	1.2732	.82218+03	19.484	.24311+01
36	1.9576	4354.16	24.5975	16.1514	-.0000	14.2669	.0000	1.8844	.82263+03	19.225	.24423+01
36	1.9499	4257.84	24.3944	18.3166	-.0000	15.6783	.0000	2.6384	.82326+03	18.962	.24275+01
36	1.9422	4162.34	24.1939	19.0571	-.0000	15.5575	.0000	3.4996	.82394+03	18.699	.23743+01
36	1.9345	4067.62	23.5312	15.2327	.0000	10.8188	.0000	4.4139	.82431+03	18.447	.22225+01
35	1.8781	3483.63	22.2217	24.0674	-.0000	15.3771	.0000	8.6902	.83221+03	16.907	.20221+01
34	1.8216	2983.11	20.1754	24.0039	-.0000	14.1982	.0000	9.8057	.83901+03	15.628	.17153+01
33	1.7652	2473.63	18.5757	20.2223	.2223	10.0000	.0000	10.0000	.86982+03	17.295	.19114+01
32	1.7511	2335.91	17.8489	20.0000	.0000	10.0000	.0000	10.0000	.87696+03	17.931	.17808+01
32	1.7369	2190.69	17.0325	20.0000	.0000	10.0000	.0000	10.0000	.88350+03	18.530	.16215+01
32	1.7228	2035.18	16.0691	20.0000	.0000	10.0000	.0000	10.0000	.88946+03	19.080	.14717+01
32	1.7087	1859.58	13.7226	20.7059	.7059	10.0000	.0000	10.0000	.89607+03	19.588	.13519+01
31	1.6946	1559.69	8.3959	30.4073	10.4073	10.0000	.0000	10.0000	.91624+03	20.030	.90466-00
31	1.6805	890.88	4.0808	33.9922	13.9922	10.0000	.0000	10.0000	.91629+03	20.033	.16674-02
31	1.6664	479.45	2.0232	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.53120-06
31	1.6523	275.28	.3673	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
30	1.5958	126.32	.0538	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
29	1.5393	104.45	.0065	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
28	1.4829	101.00	.0014	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
27	1.4264	100.43	.0003	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
26	1.3700	100.33	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
25	1.3135	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
24	1.2571	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
23	1.2006	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
22	1.1441	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
21	1.0877	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
20	1.0312	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
19	.9748	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
18	.9183	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
17	.8619	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
16	.8054	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
15	.7489	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
14	.6925	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
13	.6360	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
12	.5796	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
11	.5231	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
10	.4667	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
9	.4102	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
8	.3537	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
7	.2973	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
6	.2408	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
5	.1844	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
4	.1279	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
3	.0715	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
2	.0150	100.30	.0000	484.0000	464.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000
1	.0000	100.30	.0000	.0000	-20.0000	10.0000	.0000	10.0000	.91629+03	20.033	.00000

t = 100

NODE	GAS FLOW RATE (LBM/ FT2-SEC)	-----SOURCES AND SINKS-----				-----CONCENTRATIONS-----							
		(LBM/NODE-SEC)				(LBM/FT3 VOID)							
		PYRO	DEPO	SI-C	INT COMB	OXYGEN	NITROGEN	HYDROGEN	PYRO	DEPO	SIO	BURN	TOTAL

37	.4555-02	.00	.00	.31-04	.00	.361-03	.139-02	.110-03	.159-03	.000	.187-03	.108-02	.328-02
36	.4624-02	.00	.00	.79-04	.00	.337-03	.130-02	.115-03	.173-03	.000	.203-03	.117-02	.330-02
36	.4545-02	.00	.00	.93-04	.00	.313-03	.121-02	.120-03	.187-03	.000	.217-03	.127-02	.331-02
36	.4452-02	.00	.30-08	.10-03	.00	.291-03	.113-02	.125-03	.201-03	.000	.228-03	.136-02	.333-02
36	.4349-02	.00	.20-05	.45-03	.00	.270-03	.106-02	.131-03	.215-03	.000	.237-03	.145-02	.336-02
35	.3902-02	.00	.47-04	.41-03	.00	.174-03	.711-03	.172-03	.306-03	.000	.236-03	.200-02	.360-02
34	.3543-02	.00	.12-02	.10-03	.00	.105-03	.468-03	.221-03	.427-03	.000	.165-03	.255-02	.393-02
33	.4719-02	.00	.00	.00	.00	.540-04	.290-03	.161-03	.119-02	.000	.866-04	.299-02	.478-02
32	.4719-02	.00	.00	.00	.00	.408-04	.246-03	.139-03	.147-02	.000	.654-04	.317-02	.512-02
32	.4719-02	.00	.00	.00	.00	.307-04	.215-03	.119-03	.173-02	.000	.493-04	.339-02	.553-02
32	.4719-02	.00	.00	.00	.00	.231-04	.195-03	.102-03	.199-02	.000	.371-04	.366-02	.601-02
32	.4719-02	.14-02	.00	.00	.00	.172-04	.183-03	.874-04	.228-02	.000	.276-04	.400-02	.659-02
31	.3303-02	.33-02	.00	.00	.00	.136-04	.186-03	.769-04	.266-02	.000	.218-04	.454-02	.750-02
31	.1165-04	.12-04	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
31	.5609-08	.56-08	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
31	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
30	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
29	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
28	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
27	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
26	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
25	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
24	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
23	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
22	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
21	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
20	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
19	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
18	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
17	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
16	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
15	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
14	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
13	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
12	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
11	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
10	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
9	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
8	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
7	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
6	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
5	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
4	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
3	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
2	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02
1	.0000	.00	.00	.00	.00	.136-04	.186-03	.768-04	.266-02	.000	.217-04	.455-02	.751-02

TOTAL ITERATIONS= 547

8

t = 200

NODE	GAS FLOW RATE (LBM/ FT ² -SEC)	-----SOURCES AND SINKS----- (LBM/NODE-SEC)				-----CONCENTRATIONS----- (LBM/FT ³ VOID)							
		PYRO	DEPO	SI-C	INT COMB	OXYGEN	NITROGEN	HYDROGEN	PYRO	DEPO	SI-C	BURN	TOTAL
36	.1013-02	.00	.52-11	.91-06	.00	.645-04	.247-03	.166-04	.246-04	.000	.371-05	.149-03	.505-03

35	.1012-02	.00	.52-11	.24-05	.00	.620-04	.238-03	.172-04	.263-04	.000	.396-05	.159-03	.507-03
35	.1009-02	.00	.52-11	.28-05	.00	.595-04	.229-03	.178-04	.281-04	.000	.420-05	.170-03	.508-03
35	.1006-02	.00	.21-10	.32-05	.00	.571-04	.220-03	.185-04	.298-04	.000	.441-05	.180-03	.510-03
35	.1003-02	.00	.12-07	.93-05	.00	.546-04	.211-03	.191-04	.316-04	.000	.458-05	.191-03	.512-03
34	.9939-03	.00	.30-06	.13-04	.00	.454-04	.178-03	.219-04	.386-04	.000	.491-05	.233-03	.521-03
33	.9814-03	.00	.74-05	.78-05	.00	.370-04	.147-03	.250-04	.458-04	.000	.466-05	.275-03	.535-03
32	.9811-03	.00	.18-03	.38-05	.00	.297-04	.121-03	.281-04	.535-04	.000	.404-05	.315-03	.552-03
31	.1162-02	.00	.17-03	.14-05	.00	.232-04	.974-04	.276-04	.808-04	.000	.325-05	.343-03	.575-03
30	.1328-02	.00	.21-04	.40-06	.00	.177-04	.773-04	.241-04	.125-03	.000	.250-05	.366-03	.612-03
29	.1349-02	.00	.00	.00	.00	.132-04	.621-04	.206-04	.184-03	.000	.187-05	.421-03	.703-03
28	.1349-02	.00	.00	.00	.00	.118-04	.575-04	.194-04	.206-03	.000	.167-05	.443-03	.739-03
28	.1349-02	.90-04	.00	.00	.00	.105-04	.534-04	.183-04	.230-03	.000	.149-05	.468-03	.782-03
28	.1259-02	.49-03	.00	.00	.00	.940-05	.502-04	.173-04	.256-03	.000	.133-05	.499-03	.833-03
28	.7695-03	.64-03	.00	.00	.00	.868-05	.485-04	.166-04	.281-03	.000	.123-05	.533-03	.889-03
27	.1345-03	.13-03	.00	.00	.00	.854-05	.483-04	.164-04	.289-03	.000	.121-05	.544-03	.907-03
27	.7020-05	.67-05	.00	.00	.00	.853-05	.483-04	.164-04	.287-03	.000	.121-05	.545-03	.909-03
27	.2895-06	.28-06	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
27	.6450-08	.64-08	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
26	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
25	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
24	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
23	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
22	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
21	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
20	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
19	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
18	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
17	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
16	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
15	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
14	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
13	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
12	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
11	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
10	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
9	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
8	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
7	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
6	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
5	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
4	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
3	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
2	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03
1	.0000	.00	.00	.00	.00	.853-05	.483-04	.164-04	.289-03	.000	.121-05	.545-03	.909-03

TIME= 500.00

TOTAL ITERATIONS= 853

82 NODE	DISTANCE FROM BACK (IN)	TEMP (DEG F)	CONDUCTED HEAT FLUX (BTU/FT2-SEC)	DENSITIES (LBM/FT3)					INTERNAL PRESSURE (LBF/FT2)	MOL WT	VELOCITY (FT/SEC)
				TOTAL	DECOMP	CARBON	GRAPHITE	SILICA			
35	1.8517	2248.31	.0000	19.8110	.0000	14.6114	.0000	5.1996	.44895+03	24.403	.31142-00
34	1.8667	2251.84	-.2102	21.1016	.0000	15.0143	.0000	6.0874	.44912+03	23.916	.32148-00
34	1.8516	2253.95	-.0487	22.0713	.0000	15.2461	.0000	6.8252	.44932+03	23.455	.33032-00
34	1.8366	2254.65	.1122	22.9149	-.0000	15.4413	.0000	7.4736	.44954+03	23.018	.33856-00
34	1.8216	2253.94	.4890	23.7701	.0000	15.6436	.0000	8.1266	.44980+03	22.604	.34662-00
33	1.7652	2238.83	1.0740	27.9185	-.0000	18.6949	.0000	9.2236	.45141+03	21.243	.36143-00
32	1.7087	2203.70	1.5388	26.9829	-.0000	17.3087	.0000	9.6742	.45319+03	20.572	.45836-00
31	1.6523	2151.17	1.9447	29.3131	.0000	19.4532	.0000	9.8599	.45551+03	20.007	.46919-00
30	1.5958	2081.10	2.1741	22.3873	-.0000	12.4477	.0000	9.9396	.45660+03	19.751	.46075-00
29	1.5393	1997.25	2.3213	20.7011	-.0000	10.7261	.0000	9.9750	.45749+03	19.693	.45820-00
28	1.4829	1899.71	2.4057	20.1596	.0000	10.1690	.0000	9.9907	.45830+03	19.730	.44336-00
27	1.4264	1787.11	2.4319	20.0287	-.0000	10.0316	.0000	9.9971	.45907+03	19.821	.42109-00
26	1.3700	1656.42	2.3973	20.0037	.0000	10.0043	.0000	9.9993	.45979+03	19.948	.39358-00
25	1.3135	1501.90	2.3371	20.0002	.0002	10.0000	.0000	10.0000	.46511+03	20.130	.42886-00
24	1.2994	1458.58	2.3060	20.0000	.0000	10.0000	.0000	10.0000	.46631+03	20.189	.41348-00
24	1.2853	1412.52	2.2455	20.2273	.2273	10.0000	.0000	10.0000	.46754+03	20.250	.40340-00
24	1.2712	1361.99	2.1090	21.3553	1.3553	10.0000	.0000	10.0000	.46899+03	20.314	.38418-00
24	1.2571	1302.26	1.8662	24.5102	4.5102	10.0000	.0000	10.0000	.47106+03	20.376	.33176-00
23	1.2429	1223.26	1.5819	28.9487	8.9487	10.0000	.0000	10.0000	.47366+03	20.434	.21679-00
23	1.2286	1113.16	1.3266	32.2779	12.2779	10.0000	.0000	10.0000	.47527+03	20.467	.86420-01
23	1.2147	984.71	1.1148	33.5653	13.5653	10.0000	.0000	10.0000	.47575+03	20.479	.22079-01
23	1.2006	865.61	.9411	33.9439	13.9439	10.0000	.0000	10.0000	.47585+03	20.482	.46184-02
22	1.1865	763.38	.7972	33.9809	13.9809	10.0000	.0000	10.0000	.47588+03	20.483	.10294-02
22	1.1724	676.63	.6770	33.9954	13.9954	10.0000	.0000	10.0000	.47588+03	20.484	.22004-03
22	1.1583	603.05	.5745	33.9989	13.9989	10.0000	.0000	10.0000	.47588+03	20.484	.44186-04
22	1.1441	540.68	.4160	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.47090-05
21	1.0877	360.48	.2543	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
20	1.0312	250.24	.1509	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
19	.9748	184.81	.0877	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
18	.9183	146.73	.0498	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
17	.8619	125.07	.0275	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
16	.8054	113.12	.0147	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
15	.7489	106.72	.0076	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
14	.6925	103.42	.0038	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
13	.6360	101.76	.0018	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
12	.5796	100.96	.0009	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
11	.5231	100.59	.0004	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
10	.4667	100.42	.0002	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
9	.4102	100.35	.0001	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
8	.3537	100.32	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
7	.2973	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
6	.2408	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
5	.1844	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
4	.1279	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
3	.0715	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
2	.0150	100.30	.0000	484.0000	464.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000
1	.0000	100.30	.0000	.0000	-20.0000	10.0000	.0000	10.0000	.47588+03	20.484	.00000

t = 500

GAS FLOW		SOURCES AND SINKS					CONCENTRATIONS				
NODE	RATE(LBM/ FT2-SEC)	DEPO		INT COMB	OXYGEN	NITROGEN	HYDROGEN	DEPO		SIO	TOTAL
		PYRO	SI-C					PYRO	DEPO		

35	.6834-03	.00	.24-11	.30-06	.00	.587-03	.222-02	.396-04	.504-04	.000	.507-05	.339-03	.324-02
34	.6831-03	.00	.16-10	.72-06	.00	.570-03	.216-02	.450-04	.638-04	.000	.639-05	.429-03	.327-02
34	.6823-03	.00	.34-09	.81-06	.00	.553-03	.210-02	.503-04	.770-04	.000	.763-05	.517-03	.330-02
34	.6815-03	.00	.84-08	.89-06	.00	.536-03	.204-02	.557-04	.900-04	.000	.878-05	.604-03	.333-02
34	.6806-03	.00	.54-05	.23-05	.00	.520-03	.197-02	.610-04	.103-03	.000	.982-05	.690-03	.336-02
33	.6838-03	.00	.13-03	.38-05	.00	.457-03	.175-02	.800-04	.150-03	.000	.127-04	.981-03	.343-02
32	.8109-03	.00	.00	.32-05	.00	.389-03	.150-02	.847-04	.281-03	.000	.136-04	.122-02	.349-02
31	.8077-03	.00	.65-04	.24-05	.00	.329-03	.128-02	.892-04	.398-03	.000	.134-04	.142-02	.353-02
30	.8703-03	.00	.38-04	.16-05	.00	.276-03	.109-02	.872-04	.535-03	.000	.122-04	.159-02	.358-02
29	.9063-03	.00	.16-04	.91-06	.00	.232-03	.924-03	.818-04	.672-03	.000	.108-04	.172-02	.364-02
28	.9210-03	.00	.56-05	.46-06	.00	.195-03	.786-03	.753-04	.807-03	.000	.927-05	.184-02	.371-02
27	.9261-03	.00	.16-05	.19-06	.00	.162-03	.670-03	.687-04	.940-03	.000	.783-05	.197-02	.382-02
26	.9276-03	.00	.35-06	.62-07	.00	.135-03	.571-03	.623-04	.107-02	.000	.653-05	.210-02	.395-02
25	.9279-03	.00	.00	.00	.00	.109-03	.477-03	.555-04	.124-02	.000	.526-05	.229-02	.418-02
24	.9279-03	.00	.00	.00	.00	.101-03	.449-03	.533-04	.129-02	.000	.488-05	.236-02	.426-02
24	.9279-03	.34-04	.00	.00	.00	.933-04	.423-03	.512-04	.135-02	.000	.451-05	.242-02	.434-02
24	.8938-03	.14-03	.00	.00	.00	.863-04	.399-03	.492-04	.140-02	.000	.418-05	.250-02	.444-02
24	.7579-03	.28-03	.00	.00	.00	.803-04	.378-03	.473-04	.146-02	.000	.389-05	.257-02	.455-02
23	.4819-03	.28-03	.00	.00	.00	.760-04	.365-03	.460-04	.152-02	.000	.368-05	.265-02	.466-02
23	.1970-03	.14-03	.00	.00	.00	.740-04	.359-03	.454-04	.155-02	.000	.358-05	.270-02	.474-02
23	.5426-04	.41-04	.00	.00	.00	.733-04	.357-03	.452-04	.157-02	.000	.355-05	.272-02	.477-02
23	.1287-04	.99-05	.00	.00	.00	.732-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
22	.2969-05	.23-05	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
22	.6814-06	.54-06	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
22	.1460-06	.13-06	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
22	.1648-07	.16-07	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
21	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
20	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
19	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
18	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
17	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
16	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
15	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
14	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
13	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
12	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
11	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
10	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
9	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
8	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
7	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
6	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
5	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
4	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
3	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
2	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02
1	.0000	.00	.00	.00	.00	.731-04	.356-03	.451-04	.157-02	.000	.354-05	.273-02	.478-02

SAMPLE CASE I I

Heat flux drive - DATA INPUT CARDS

- XQT MAIN

FLUX DRIVE SAMPLF CASE

TIME STEP CONTROL TABLE

1
0. 1.0
40. 0.2
100. 1.0
600. 2.0
1078. 2.0
0. 0.

PRINT STEP CONTROL TABLE

2
0. 10.
100. 20.
600. 100.
1078. 100.
0. 0.

3 1
0. 24751. .00004
20. 24843. .00030 .067
40. 24935. .00061 12.33
60. 24854. .00391 33.88
80. 22965. .01086 192.31
100. 18058. .01341 30.31
120. 14524. .00932 7.25
140. 12713. .00786 3.91
160. 11419. .00660 2.43
180. 10614. .00503 1.75
200. 10133. .00395 1.47
220. 9810. .00335 1.36
240. 9572. .00308 1.26
260. 9408. .00295 1.22
280. 9240. .00282 1.19
300. 9076. .00268 1.15
320. 8902. .00285 1.10
340. 8727. .00302 1.05
360. 8530. .00326 .985
380. 8275. .00381 .925
400. 7880. .00475 .905
420. 7280. .00607 .97
440. 6420. .00755 1.115
460. 5245. .00865 1.22
480. 3858. .00939 1.14
500. 2720. .00861 .785
540. 1245. .00685 .245
600. 560. .00650
700. 110. .01030
800. 114. .01360
900. 117. .01460
1000. 123. .01550
1078. 124. .01603
0. 0.

LOCAL STATIC PRESSURE AND FLOW

4
0. .0360 1. .0000403
40. 1.756 1. .000639
50. 10.5 1. .001944
60. 66.08 1. .004779

70.	393.0	1.	.008396
80.	512.8	1.	.012207
85.	767.0	1.	.01308
90.	1030.0	1.	.013202
95.	920.0	1.	.012724
100.	818.1	1.	.012542
105.	755.0	1.	.011384
110.	651.0	1.	.009522
115.	549.0	1.	.008698
120.	410.9	1.	.007690
130.	349.0	1.	.006707
140.	298.0	1.	.006108
150.	258.0	1.	.005552
160.	213.4	1.	.004909
170.	156.0	1.	.004192
180.	125.1	1.	.003612
190.	96.9	1.	.003218
200.	77.7	1.	.00277
210.	66.2	1.	.002416
240.	47.5	1.	.002095
300.	36.3	1.	.001795
350.	49.8	1.	.002061
370.	61.5	1.	.002261
390.	90.6	1.	.002834
410.	147.	1.	.003475
430.	236.	1.	.004399
450.	366.	1.	.005078
470.	459.	1.	.005091
480.	496.	1.	.004893
490.	480.	1.	.004296
510.	411.	1.	.003504
530.	318.	1.	.002628
550.	287.	1.	.002214
570.	307.	1.	.001667
706.	734.	1.	.00118
756.	1115.	1.	.001561
1078.	2117.	1.	.001972
0.	0.		
2	ALUMINUM	.015	1
1	AVCOAT	1.976	35
0			

560.

001882

0036

TITLE----

FLUX DRIVE SAMPLE CASE

CALCULATION TIME STEP CONTROL TABLE

TIME (SEC)	TIME STEP (SEC)
.00	1.0000
40.00	.2000
100.00	1.0000
600.00	2.0000
1078.00	2.0000

PRINT TIME STEP CONTROL TABLE

TIME (SEC)	TIME STEP (SEC)
.00	10.0000
100.00	20.0000
600.00	100.0000
1078.00	100.0000

SURFACE HEAT FLUX TABLE

TIME (SEC)	RECOVERY ENTHALPY (BTU/LBM)	HEAT TRANSFER PARAMETER (LBM/FT ² -SEC)	MISC HEAT TO SURFACE (BTU/SEC)
.00	24751.00	.00004	-.000
20.00	24843.00	.00030	.067
40.00	24935.00	.00061	12.330
60.00	24854.00	.00391	33.880
80.00	22965.00	.01086	192.310
100.00	18058.00	.01341	30.310
120.00	14524.00	.00932	7.250
140.00	12713.00	.00786	3.910
160.00	11419.00	.00660	2.430
180.00	10614.00	.00503	1.750
200.00	10133.00	.00395	1.470
220.00	9810.00	.00335	1.360
240.00	9572.00	.00308	1.260
260.00	9408.00	.00295	1.220
280.00	9240.00	.00282	1.190
300.00	9076.00	.00268	1.150
320.00	8902.00	.00285	1.100
340.00	8727.00	.00302	1.050
360.00	8530.00	.00326	.985
380.00	8275.00	.00381	.925
400.00	7880.00	.00475	.905
420.00	7280.00	.00607	.970
440.00	6420.00	.00755	1.115
460.00	5245.00	.00865	1.220
480.00	3858.00	.00939	1.140
500.00	2720.00	.00861	.785
540.00	1245.00	.00685	.245
600.00	560.00	.00650	-.000
700.00	110.00	.01030	-.000
800.00	114.00	.01360	-.000
900.00	117.00	.01460	-.000
1000.00	123.00	.01550	-.000
1078.00	124.00	.01603	-.000

Heat flux drive - OUTPUT OF INITIAL INPUT TABLES

SAMPLE CASE 11

LOCAL STATIC PRESSURE AND FLOW CONTROL TABLE

TIME (SEC)	LOC PRESS (LBF/FT ²)	FLOW (--)	LOCAL STRESS (LBF/IN ²)
.00	.0360	1.	.0000
40.00	1.7560	1.	.0006
50.00	10.5000	1.	.0019
60.00	66.0800	1.	.0048
70.00	393.0000	1.	.0084
80.00	512.8000	1.	.0122
85.00	767.0000	1.	.0131
90.00	1030.0000	1.	.0132
95.00	920.0000	1.	.0122
100.00	818.1000	1.	.0125
105.00	755.0000	1.	.0114
110.00	651.0000	1.	.0095
115.00	549.0000	1.	.0087
120.00	410.9000	1.	.0077
130.00	349.0000	1.	.0067
140.00	298.0000	1.	.0061
150.00	258.0000	1.	.0056
160.00	213.4000	1.	.0049
170.00	156.0000	1.	.0042
180.00	125.1000	1.	.0036
190.00	96.9000	1.	.0032
200.00	77.7000	1.	.0028
210.00	66.2000	1.	.0024
240.00	47.5000	1.	.0021
300.00	36.3000	1.	.0018
350.00	49.8000	1.	.0021
370.00	61.5000	1.	.0023
390.00	90.6000	1.	.0028
410.00	147.0000	1.	.0035
430.00	236.0000	1.	.0044
450.00	366.0000	1.	.0051
470.00	459.0000	1.	.0051
480.00	496.0000	1.	.0049
490.00	480.0000	1.	.0043
510.00	411.0000	1.	.0035
530.00	318.0000	1.	.0026
550.00	287.0000	1.	.0022
570.00	307.0000	1.	.0017
706.00	734.0000	1.	.0012
756.00	1114.9999	1.	.0016
1078.00	2117.0000	1.	.0020

MATERIALS

MATERIAL NAME	THICKNESS (IN)	NUMBER OF NODES
(2) ALUMINUM	.0150	1
(1) AVCOAT	1.9760	35

MATERIAL PROPERTIES OF VIRGIN MATERIALS

MATERIAL (1)

	FIRST REAC	SECOND REAC				
ACTIVATION TEMPERATURE, DEG R	23300.0	.0				
COLLISION FREQUENCY, 1/SEC	.112090+05	.000000				
REACTION ORDER	1.0000	.0				
HEAT OF DECOMPOSITION, BTU/LBM	350.00					
SPECIFIC HEAT, BTU/LBM-DEG R	(.4300-00) + (	.9936-01) T + (	.0000	1T+2+ (	.0000	1T+3
CONDUCTIVITY, BTU-IN/FT2-SEC-DEG R	(.2440-05) + (	.4125-01) T + (	.0000	1T+2+ (	.0000	1T+3
EMISSIVITY	.9000					
ABSORPTIVITY	.9000					
DENSITY, LBM/FT3	34.00					
TRANSPIRATION FACTOR (ABL GASES)	1.2000					

MATERIAL (2)

	FIRST REAC	SECOND REAC				
ACTIVATION TEMPERATURE, DEG R	.0	.0				
COLLISION FREQUENCY, 1/SEC	.000000	.000000				
REACTION ORDER	.0000	.0				
HEAT OF DECOMPOSITION, BTU/LBM	120.00					
SPECIFIC HEAT, BTU/LBM-DEG R	(.0000) + (	.1642-04) T + (	.0000	1T+2+ (	.0000	1T+3
CONDUCTIVITY, BTU-IN/FT2-SEC-DEG R	(.1153-06) + (	.9610-05) T + (	.0000	1T+2+ (	.0000	1T+3
EMISSIVITY	.2000					
ABSORPTIVITY	.6000					
DENSITY, LBM/FT3	484.00					
TRANSPIRATION FACTOR (ABL GASES)	.7000					

MATERIAL PROPERTIES OF THE CHAR

	COMBUSTION REACTION	CHAR SUBLIMATION
ACTIVATION TEMPERATURE, DEG R	39855.0	.0
COLLISION FREQUENCY, 1/SEC	.673000+09	.000000
REACTION ORDER	.5000	.0
HEAT OF COMBUSTION, BTU/LBM	.00	
HEAT OF SUBLIMATION, BTU/LBM	.00	
EMISSIVITY	.6500	
ABSORPTIVITY	1.0000	
DENSITY, LBM/FT3	7.00	

TRANSPIRATION FACTOR (CHAR GASES) .0000

DENSITY OF THE CARBON IN CHAR, LBM/FT3 10.00

ABLATION GAS PROPERTIES

SPECIFIC HEAT, BTU/LBM-DEG R (.7000-00)+1 .0000 1T+1 .0000 1T+2+1 .0000 1T+3
HEAT OF GAS COMBUSTION, BTU/LBM 6173.00

OTHER CONSTANTS

THEORETICAL CARBON DENSITY, LBM/FT3 131.00
THEORETICAL VIRGIN DENSITY, LBM/FT3 70.00
THEORETICAL SILICA DENSITY, LBM/FT3 137.30

REFERENCE POROSITY .7500
REFERENCE VISCOUS PERMEABILITY, FT2 .100000-09
REFERENCE INERTIAL PERMEABILITY, FT .100000+02

REFERENCE VISCOSITY, LBM/FT-SEC .100000-04
REFERENCE TEMPERATURE FOR VISC., R 530.00

SURFACE DIFFUSION CONSTANT, FT2/SEC

CARBON MONOXIDE .100000+01
DEPOSITION GAS (EXCEPT HYDROGEN) .100000+01
NITROGEN .100000+01
OXYGEN .100000+01
METHANE .100000+01
SILICON MONOXIDE .100000+01

BLOWING PARAMETER .4300
DIFFUSION REDUCTION PARAMETER (-.6490-00)+(-.2540+01)ETA+(-.2300+01)ETA**2+(-.8780-00)ETA**3
HEAT OF REACTION, SiO2-C, BTU/LBM .00
HEAT OF REACTION, C DEPOSITION, BTU/LBM .00

SILICA-CARBON REACTION CONSTANTS

ACTIVATION TEMPERATURE, DEG R 40765.0
COLLISION FREQUENCY, 1/SEC .209210+04
REACTION ORDER 1.0000

SILICA DENSITY IN INITIAL CHAR, LBM/FT3 8.19

CARBON DEPOSITION REACTION CONSTANTS

	LOW HYDROGEN	HIGH HYDROGEN
X	.136500-01	.60+000-03
Y	.116200+03	.114000-01
Z	.177700+04	.422000+01

SAMPLE CASE I I

Heat flux drive - OUTPUT OF CALCULATED DATA AT VARIOUS TIMES

The following listing shows the CHAD program output at time = 0, 100, 200, and 500 seconds.

TIME = .00 TOTAL ITERATIONS = 1

NODE	DISTANCE FROM BACK (IN)	TEMP (DEG F)	CONDUCTED HEAT FLUX (BTU/FT2-SEC)	DENSITIES (LBM/FT3)					INTERNAL PRESSURE (LBF/FT2)	MOL WT	VELOCITY (FT/SEC)
				TOTAL	DECOMP	CARBON	GRAPHITE	SILICA			
37	1.9910	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
36	1.9769	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
36	1.9628	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
36	1.9487	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
36	1.9345	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
35	1.8781	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
34	1.8216	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
33	1.7652	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
32	1.7087	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
31	1.6523	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
30	1.5958	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
29	1.5393	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
28	1.4829	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
27	1.4264	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
26	1.3700	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
25	1.3135	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
24	1.2571	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
23	1.2006	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
22	1.1441	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
21	1.0877	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
20	1.0312	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
19	.9748	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
18	.9183	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
17	.8619	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
16	.8054	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
15	.7489	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
14	.6925	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
13	.6360	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
12	.5796	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
11	.5231	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
10	.4667	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
9	.4102	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
8	.3537	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
7	.2973	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
6	.2408	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
5	.1844	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
4	.1279	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
3	.0715	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
2	.0150	100.31	.0000	484.0000	464.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000
1	.0000	100.31	.0000	.0000	-20.0000	10.0000	.0000	10.0000	.36000-01	20.000	.00000

NODE	GAS FLOW RATE (LBM/ FT2-SEC)	-----SOURCES AND SINKS----- (LBM/NODE-SEC)							-----CONCENTRATIONS----- (LBM/FT3 VOID)				
		PYRO	DEPO	SI-C	INT COMB	OXYGEN	NITROGEN	HYDROGEN	PYRO	DEPO	SIO	BURN	TOTAL
91	37 .1527-14	.19-15	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
	36 .1336-14	.38-15	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
	36 .9544-15	.38-15	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
	36 .5726-15	.38-15	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
	36 .1909-15	.19-15	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
	35 .0000	.0	.00	.00	.00	.000	.000	.000	.000	.000	.0	.000	.100-19

10

[illegible]

TIME= 100.00 TOTAL ITERATIONS= 547

NODE	DISTANCE FROM BACK (IN)	TEMP (DEG F)	CONDUCTED HEAT FLUX (BTU/FT2-SEC)	DENSITIES (LBM/FT3)				INTERNAL PRESSURE (LBF/FT2)	MOL WT	VELOCITY (FT/SEC)	
				TOTAL	DECOMP	CARBON	GRAPHITE				SILICA
37	1.9663	4336.85	23.7454	14.6052	-0.0000	12.7020	0.0000	1.8432	82218+03	20.011	21514+01
36	1.9584	4245.00	21.3768	17.0705	-0.0000	14.4805	0.0000	2.5900	82266+03	19.732	21625+01
36	1.9504	4149.62	23.3274	19.8252	-0.0000	16.3775	0.0000	3.4478	82336+03	19.445	21530+01
36	1.9425	4057.65	23.3552	20.9745	-0.0000	16.6152	0.0000	4.3593	82415+03	19.153	21059+01
36	1.9345	3965.63	22.7923	16.1255	0.0000	10.8605	0.0000	5.2650	82453+03	18.874	19466+01
35	1.9381	3420.83	21.5533	24.1026	-0.0080	15.2006	0.0000	6.9019	83147+03	17.202	17644+01
34	1.8216	2933.56	19.5486	23.5850	0.0000	13.7459	0.0000	9.8390	83718+03	15.820	15095+01
33	1.7652	2430.31	18.0470	20.1588	.1588	10.0000	0.0000	10.0000	86475+03	17.327	17166+01
32	1.7511	2292.84	17.3659	20.0000	0.0000	10.0000	0.0000	10.0000	87115+03	17.907	15999+01
32	1.7369	2147.08	16.5950	20.0000	0.0000	10.0000	0.0000	10.0000	87702+03	18.464	14571+01
32	1.7228	1989.87	15.4619	20.0000	0.0000	10.0000	0.0000	10.0000	88236+03	18.987	13243+01
32	1.7087	1803.71	12.6184	21.6196	1.6196	10.0000	0.0000	10.0000	88963+03	19.492	12377+01
31	1.6946	1459.86	7.1621	32.2143	12.2143	10.0000	0.0000	10.0000	90298+03	19.832	50215+00
31	1.6805	803.22	3.5660	33.9976	13.9976	10.0000	0.0000	10.0000	90300+03	19.833	49898+03
31	1.6664	444.50	1.7875	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	21016+06
31	1.6523	264.20	.3412	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
30	1.5958	125.98	.0529	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
29	1.5393	104.51	.0086	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
28	1.4829	101.02	.0014	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
27	1.4264	100.43	.0003	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
26	1.3700	100.33	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
25	1.3135	100.31	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
24	1.2571	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
23	1.2006	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
22	1.1441	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
21	1.0877	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
20	1.0312	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
19	.9748	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
18	.9183	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
17	.8619	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
16	.8054	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
15	.7489	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
14	.6925	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
13	.6360	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
12	.5796	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
11	.5231	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
10	.4667	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
9	.4102	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
8	.3537	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
7	.2973	100.30	-0.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
6	.2408	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
5	.1844	100.30	-0.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
4	.1279	100.30	-0.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
3	.0715	100.30	-0.0000	34.0000	14.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
2	.0150	100.30	.0000	484.0000	464.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000
1	.0000	100.30	.0000	.0000	-20.0000	10.0000	0.0000	10.0000	90300+03	19.833	00000

$$= 100$$

-----SOURCES AND SINKS-----						-----CONCENTRATIONS-----						
GAS FLOW NODE RATE(LBM/ FT ² -SEC)		(LBM/NODE-SEC)										
	PYRO	DEPO	SI-C	INT COMB	OXYGEN	NITROGEN	HYDROGEN	PYRO	DEPO	SIO	BURN	TOTAL

37	.4296-02	.00	.00	.39-04	.00	.393-03	.150-02	.104-03	.137-03	.000	.191-03	.101-02	.334-02
36	.4258-02	.00	.00	.91-04	.00	.368-03	.141-02	.109-03	.150-03	.000	.200-03	.110-02	.335-02
36	.4166-02	.00	.00	.10-03	.00	.343-03	.132-02	.114-03	.164-03	.000	.223-03	.120-02	.336-02
36	.4063-02	.00	.00	.11-03	.00	.319-03	.124-02	.120-03	.178-03	.000	.236-03	.130-02	.338-02
36	.3954-02	.00	.00	.44-03	.00	.298-03	.116-02	.125-03	.191-03	.000	.245-03	.139-02	.340-02
35	.3517-02	.00	.43-04	.35-03	.00	.198-03	.799-03	.167-03	.276-03	.000	.239-03	.193-02	.361-02
34	.3208-02	.00	.11-02	.86-04	.00	.124-03	.537-03	.215-03	.386-03	.000	.170-03	.247-02	.390-02
33	.4281-02	.00	.00	.00	.00	.666-04	.335-03	.160-03	.112-02	.000	.930-04	.289-02	.467-02
32	.4281-02	.00	.00	.00	.00	.513-04	.283-03	.139-03	.138-02	.000	.717-04	.306-02	.499-02
32	.4281-02	.00	.00	.00	.00	.395-04	.245-03	.121-03	.164-02	.000	.551-04	.327-02	.537-02
32	.4281-02	.00	.00	.00	.00	.303-04	.218-03	.105-03	.189-02	.000	.423-04	.353-02	.582-02
32	.4281-02	.23-02	.00	.00	.00	.229-04	.201-03	.902-04	.218-02	.000	.320-04	.387-02	.639-02
31	.1984-02	.20-02	.00	.60	.00	.198-04	.202-03	.804-04	.248-02	.000	.276-04	.430-02	.711-02
31	.3564-05	.36-05	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
31	.2103-08	.21-08	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
31	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
30	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
29	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
28	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
27	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
26	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
25	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
24	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
23	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
22	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
21	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
20	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
19	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
18	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
17	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
16	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
15	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
14	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
13	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
12	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
11	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
10	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
9	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
8	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
7	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
6	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
5	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
4	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
3	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
2	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02
1	.0000	.00	.00	.00	.00	.197-04	.202-03	.834-04	.248-02	.000	.276-04	.430-02	.711-02

TIME= 200.00 TOTAL ITERATIONS= 755

NODE	DISTANCE FROM BACK (IN)	TEMP (DEG F)	CONDUCTED HEAT FLUX (BTU/FT2-SEC)	DENSITIES (LBM/FT3)					INTERNAL PRESSURE (LBF/FT2)	MOL WT	VELOCITY (FT/SEC)
				TOTAL	DECOMP	CARBON	GRAPHITE	SILICA			
36	1.9354	2651.73	3.4510	16.5926	-0.0000	13.9537	0.0000	2.6389	.79620+02	19.608	.34208+01
35	1.9210	2629.47	3.2135	17.1729	0.0000	13.5258	0.0000	3.6471	.79857+02	19.361	.34425+01
35	1.9067	2603.69	3.5579	17.4830	0.0000	12.7971	0.0000	4.6859	.80105+02	19.121	.34489+01
35	1.8924	2578.62	3.5921	19.6921	-0.0000	13.9537	0.0000	5.7384	.80447+02	18.885	.35068+01
35	1.8781	2553.03	3.7876	21.7462	0.0000	14.9016	0.0000	6.8446	.80898+02	18.649	.35556+01
34	1.8216	2446.09	4.1042	27.6070	-0.0000	18.6977	0.0000	8.9092	.84585+	17.778	.36019+01
33	1.7652	2323.28	4.2993	23.9600	0.0000	14.2817	0.0000	9.6783	.86997+	17.004	.33495+01
32	1.7087	2183.03	4.3823	23.6396	0.0000	13.7206	0.0000	9.9191	.89336+02	16.389	.32121+01
31	1.6523	2022.40	4.3432	20.6864	0.0000	10.7027	0.0000	9.9837	.91250+02	16.562	.35397+01
30	1.5958	1836.00	4.1972	20.0354	0.0000	10.0376	0.0000	9.9978	.93026+02	17.134	.33548+01
29	1.5393	1610.88	3.9952	20.0001	0.0001	10.0000	0.0000	10.0000	.10569+03	17.973	.30484+01
28	1.5252	1545.76	3.9459	20.0000	0.0000	10.0000	0.0000	10.0000	.10854+03	18.255	.26220+01
28	1.5111	1472.76	3.6552	21.1280	1.1280	10.0000	0.0000	10.0000	.11219+03	18.546	.26714+01
28	1.4970	1376.64	3.0220	25.9376	5.9376	10.0000	0.0000	10.0000	.11895+03	18.828	.20193+01
28	1.4829	1212.70	2.3689	32.0998	12.0998	10.0000	0.0000	10.0000	.12406+03	18.980	.64223+00
27	1.4688	957.74	1.7851	33.8728	13.8728	10.0000	0.0000	10.0000	.12448+03	18.999	.41555+01
27	1.4547	738.51	1.3251	33.9942	13.9942	10.0000	0.0000	10.0000	.12449+03	19.001	.16566+02
27	1.4405	574.92	.9637	33.9997	13.9997	10.0000	0.0000	10.0000	.12450+03	19.001	.62344+04
27	1.4264	455.88	.4631	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.14519+05
26	1.3700	226.87	.1717	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
25	1.3135	141.88	.0584	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
24	1.2571	112.89	.0182	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
23	1.2006	103.85	.0052	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
22	1.1441	101.24	.0014	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
21	1.0877	100.54	.0004	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
20	1.0312	100.36	.0001	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
19	.9748	100.31	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
18	.9183	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
17	.8619	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
16	.8054	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
15	.7489	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
14	.6925	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
13	.6360	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
12	.5796	100.30	.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
11	.5231	100.30	-0.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
10	.4667	100.30	-0.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
9	.4102	100.30	-0.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
8	.3537	100.30	-0.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
7	.2973	100.30	-0.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
6	.2408	100.30	-0.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
5	.1844	100.30	-0.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
4	.1279	100.30	-0.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
3	.0715	100.30	-0.0000	34.0000	14.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
2	.0150	100.30	.0000	484.0000	464.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000
1	.0000	100.30	.0000	.0000	-20.0000	10.0000	0.0000	10.0000	.12450+03	19.001	.00000

t = 200

GAS FLOW NODE RATE (LBM/ FT2-SEC)	SOURCES AND SINKS							CONCENTRATIONS					
	PYRO	DEPO	SI-C	INT COMB	OXYGEN	NITROGEN	HYDROGEN	PYRO	DEPO	SIO	BURN	TOTAL	
36	.9628-03	.0	.26-11	.97-06	.00	.672-04	257-03	.162-04	.239-04	.000	.7-05	.145-03	.512-03

35	.9618-03	.00	.26-11	.24-05	.00	.645-04	.247-03	.169-04	.258-04	.000	.355-05	.156-03	.514-03
35	.9594-03	.00	.26-11	.29-05	.00	.619-04	.238-03	.175-04	.277-04	.000	.377-05	.168-03	.516-03
35	.9565-03	.00	.26-10	.31-05	.00	.593-04	.228-03	.182-04	.295-04	.000	.396-05	.179-03	.518-03
35	.9534-03	.00	.16-07	.83-05	.00	.567-04	.219-03	.189-04	.314-04	.000	.413-05	.190-03	.520-03
34	.9451-03	.00	.37-06	.11-04	.00	.473-04	.185-03	.218-04	.387-04	.000	.439-05	.234-03	.531-03
33	.9349-03	.00	.93-05	.62-05	.00	.388-04	.154-03	.249-04	.459-04	.000	.412-05	.276-03	.544-03
32	.9381-03	.00	.23-03	.29-05	.00	.317-04	.129-03	.278-04	.535-04	.000	.359-05	.315-03	.560-03
31	.1168-02	.00	.11-03	.11-05	.00	.248-04	.103-03	.263-04	.866-04	.000	.288-05	.340-03	.584-03
30	.1275-02	.00	.13-04	.28-06	.00	.191-04	.826-04	.231-04	.130-03	.000	.223-05	.366-03	.622-03
29	.1288-02	.00	.00	.00	.00	.144-04	.668-04	.199-04	.188-03	.000	.169-05	.421-03	.711-03
28	.1288-02	.00	.00	.00	.00	.130-04	.619-04	.188-04	.209-03	.000	.152-05	.443-03	.747-03
28	.1288-02	.27-03	.00	.00	.00	.116-04	.575-04	.177-04	.233-03	.000	.136-05	.470-03	.791-03
28	.1016-02	.65-03	.00	.00	.00	.105-04	.545-04	.168-04	.258-03	.000	.123-05	.502-03	.844-03
28	.3637-03	.33-03	.00	.00	.00	.101-04	.535-04	.165-04	.275-03	.000	.118-05	.525-03	.881-03
27	.3009-04	.29-04	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
27	.1463-05	.14-05	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
27	.6562-07	.64-07	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
27	.1683-08	.17-08	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
26	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
25	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
24	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
23	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
22	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
21	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
20	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
19	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
18	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
17	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
16	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
15	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
14	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
13	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
12	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
11	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
10	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
9	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
8	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
7	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
6	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
5	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
4	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
3	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
2	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03
1	.0000	.00	.00	.00	.00	.100-04	.534-04	.164-04	.277-03	.000	.118-05	.528-03	.886-03

TIME= 500.00

TOTAL ITERATIONS= 1078

NODE	DISTANCE FROM BACK (IN)	TEMP (DEG F)	CONDUCTED HEAT FLUX (BTU/FT2-SEC)	DENSITIES (LBM/FT3)					INTERNAL PRESSURE (LBF/FT2)	MOL WT	VELOCITY (FT/SEC)
				TOTAL	DECOMP	CARBON	GRAPHITE	SILICA			
35	1.8864	2258.67	-0.2963	20.1544	.0000	14.6579	.0000	5.4965	.44895+03	24.500	.30829-00
34	1.8702	2262.03	-0.1518	21.8084	.0000	15.3808	.0000	6.4277	.45202+03	19.735	.31774-00
34	1.8540	2263.43	.0943	23.5730	.0000	16.4121	.0000	7.1609	.45590+03	17.409	.32659-00
34	1.8378	2263.23	.2607	25.2916	.0000	17.5084	.0000	7.7832	.46070+03	16.008	.33447-00
34	1.8216	2261.08	.7047	27.0208	.0000	18.6123	.0000	8.4085	.46659+03	15.071	.34151-00
33	1.7452	2239.11	1.2039	24.3865	.0000	15.0354	.0000	9.3511	.46762+03	14.883	.35118-00
32	1.7087	2199.67	1.6878	29.3171	.0000	19.5871	.0000	9.7301	.46980+03	14.942	.44411-00
31	1.6523	2141.72	2.0415	27.6216	.0000	17.7371	.0000	9.8845	.47162+03	15.009	.43583-00
30	1.5958	2067.43	2.2416	21.8138	.0000	11.8632	.0000	9.9506	.47258+03	15.222	.43594-00
29	1.5393	1979.72	2.3664	20.5022	.0000	10.5223	.0000	9.9799	.47340+03	15.516	.43177-00
28	1.4829	1878.34	2.4312	20.1104	.0000	10.1177	.0000	9.9927	.47416+03	15.867	.41653-00
27	1.4264	1761.58	2.4393	20.0189	.0000	10.0210	.0000	9.9978	.47488+03	16.263	.39461-00
26	1.3700	1625.94	2.3870	20.0022	.0000	10.0026	.0000	9.9996	.47555+03	16.700	.36783-00
25	1.3135	1464.72	2.3149	20.0001	.0001	10.0000	.0000	10.0000	.48037+03	17.252	.39922-00
24	1.2994	1419.02	2.2603	20.1650	.1650	10.0000	.0000	10.0000	.48187+03	17.433	.36620-00
24	1.2853	1369.25	2.1391	21.0770	1.0770	10.0000	.0000	10.0000	.48324+03	17.615	.36980-00
24	1.2712	1311.30	1.9119	23.8359	3.8359	10.0000	.0000	10.0000	.48515+03	17.797	.32667-00
24	1.2571	1236.01	1.6286	28.2045	8.2045	10.0000	.0000	10.0000	.48758+03	17.955	.22569-00
23	1.2429	1130.60	1.3650	31.9193	11.9193	10.0000	.0000	10.0000	.48929+03	18.053	.97133-01
23	1.2288	1002.63	1.1385	33.4663	13.4663	10.0000	.0000	10.0000	.48983+03	18.091	.25280-01
23	1.2147	882.20	.9437	33.8774	13.8774	10.0000	.0000	10.0000	.48994+03	18.103	.49609-02
23	1.2006	782.57	.6414	33.9213	13.9213	10.0000	.0000	10.0000	.48995+03	18.107	.48799-03
22	1.1865	705.24	.6416	33.9984	13.9984	10.0000	.0000	10.0000	.48996+03	18.109	.34569-03
22	1.1724	635.10	.6422	33.9995	13.9995	10.0000	.0000	10.0000	.48996+03	18.110	.21676-03
22	1.1583	566.37	.6427	33.9999	13.9999	10.0000	.0000	10.0000	.48997+03	18.111	.10153-03
22	1.1441	501.51	.3822	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.71247-11
21	1.0877	334.51	.2284	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
20	1.0312	235.44	.1357	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
19	.9748	176.55	.0792	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
18	.9183	142.21	.0450	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
17	.8619	122.65	.0248	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
16	.8054	111.85	.0133	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
15	.7489	106.06	.0068	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
14	.6925	103.10	.0034	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
13	.6360	101.62	.0016	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
12	.5796	100.90	.0008	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
11	.5231	100.56	.0003	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
10	.4667	100.41	.0002	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
9	.4102	100.34	.0001	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
8	.3537	100.32	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
7	.2973	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
6	.2408	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
5	.1844	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
4	.1279	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
3	.0715	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
2	.0150	100.30	.0000	484.0000	464.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000
1	.0000	100.30	.0000	.0000	-20.0000	10.0000	.0000	10.0000	.48997+03	18.111	.00000

t = 500

NODE	GAS FLOW RATE (LBM/ FT2-SEC)	SOURCES AND SINKS (LBM/NODE-SEC)					CONCENTRATIONS (LBM/FT3 VOID)					BURN	TOTAL
		PYF	DEPO	SINK	INT COMB	OXYGEN	NITROGEN	HYDROGEN	PYRO	DEPO			

35	.6800-03	.00	.60-04	.36-06	.00	.586-03	.221-02	.382-04	.528-04	.000	.513-05	.334-03	.323-02
34	.7399-03	.00	.29-04	.87-06	.00	.395-03	.153-02	.109-03	.216-03	.000	.206-04	.136-02	.363-02
34	.7683-03	.00	.00	.97-06	.00	.262-03	.105-02	.167-03	.328-03	.000	.304-04	.207-02	.391-02
34	.7673-03	.00	.00	.11-05	.00	.171-03	.719-03	.215-03	.403-03	.000	.359-04	.254-02	.409-02
34	.7662-03	.00	.00	.25-05	.00	.110-03	.497-03	.254-03	.452-03	.000	.384-04	.286-02	.421-02
33	.7637-03	.00	.00	.38-05	.00	.969-04	.450-03	.261-03	.464-03	.000	.379-04	.290-02	.421-02
32	.7599-03	.00	.48-04	.32-05	.00	.828-04	.396-03	.251-03	.554-03	.000	.351-04	.287-02	.419-02
31	.8045-03	.00	.64-04	.23-05	.00	.701-04	.348-03	.242-03	.637-03	.000	.315-04	.284-02	.417-02
30	.8664-03	.00	.34-04	.14-05	.00	.591-04	.305-03	.227-03	.746-03	.000	.275-04	.279-02	.415-02
29	.8995-03	.00	.15-04	.81-06	.00	.498-04	.269-03	.209-03	.862-03	.000	.236-04	.275-02	.416-02
28	.9132-03	.00	.51-05	.39-06	.00	.419-04	.238-03	.191-03	.979-03	.000	.200-04	.273-02	.420-02
27	.9179-03	.00	.14-05	.16-06	.00	.351-04	.213-03	.174-03	.110-02	.000	.168-04	.273-02	.426-02
26	.9191-03	.00	.27-06	.47-07	.00	.292-04	.192-03	.158-03	.122-02	.000	.141-04	.277-02	.438-02
25	.9194-03	.00	.00	.00	.00	.236-04	.173-03	.141-03	.138-02	.000	.113-04	.286-02	.459-02
24	.9194-03	.26-04	.00	.00	.00	.218-04	.168-03	.135-03	.143-02	.000	.105-04	.290-02	.466-02
24	.8933-03	.11-03	.00	.00	.00	.202-04	.163-03	.130-03	.148-02	.000	.974-05	.294-02	.475-02
24	.7789-03	.26-03	.00	.00	.00	.188-04	.160-03	.125-03	.154-02	.000	.906-05	.299-02	.485-02
24	.5233-03	.29-03	.00	.00	.00	.178-04	.157-03	.122-03	.160-02	.000	.855-05	.306-02	.496-02
23	.2300-03	.16-03	.00	.00	.00	.172-04	.157-03	.120-03	.164-02	.000	.830-05	.310-02	.504-02
23	.6641-04	.50-04	.00	.00	.00	.171-04	.157-03	.119-03	.165-02	.000	.821-05	.313-02	.508-02
23	.1637-04	.12-04	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.313-02	.509-02
23	.4197-05	.29-05	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.510-02
22	.1286-05	.95-06	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.510-02
22	.3376-06	.27-06	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
22	.6976-07	.64-07	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
22	.6099-08	.61-08	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
21	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
20	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
19	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
18	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
17	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
16	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
15	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
14	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
13	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
12	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
11	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
10	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
9	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
8	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
7	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
6	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
5	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
4	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
3	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
2	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02
1	.0000	.00	.00	.00	.00	.170-04	.157-03	.119-03	.166-02	.000	.819-05	.314-02	.511-02

PROGRAM LISTING

This is a sequenced listing of the CHAD computer program (including sub-routines).

- FOR BLKD/D2,BLKD/D2,BLKD/C2

BLOCK DATA				CHD00000
COMMON /BLOCKA/				CHD00010
1ABSORP(10)	ABSC	ACTENC	ACTENS	CHD00020
2BSTAR	CCPC(4)	CCPG(4)	CHARPT(101)	CHD00030
3COEFT(4,10)	CONDC	CONDV(100)	CONST(4,10)	CHD00040
4CPBAW	CPC	CPV(100)	DIFREC	CHD00050
5EFCOLC	EFCOLS	EFCOLV(4,10)	EMIS(10)	CHD00060
6HOFM(10)	HCOM	HCOMG	HSUB	CHD00070
7MATOMN	MATMNE	MN	NN	CHD00080
8NNSAVE	NRDIV	NREND	NRGO	CHD00090
9PARTIN(101)	PHI	QBYRAD	QCOMB	CHD00100
10GPCOM	QSUBL	RECPR	REORDC	CHD00110
2REORDV(4,10)	RHO5Z	RHO5(305)	RHOCPX(101)	CHD00120
3RHOV(10)	SABL	SABLC	SDOT	CHD00130
4SLOPE(10)	TMELT(10)	TSZ	TS(205)	CHD00140
5WFZ	WF(205)	XCHAR	XINIT	CHD00150
6XMASS	XMDOTC	XMDOTD	XMDOTG	CHD00160
7XMDOTR	XMDOTS	XTOTAL	XVIRG(101)	CHD00170
COMMON/BLOCKC/				CHD00180
1BLPRES(20,11)	COMMAX	CUTOFF	F(20,11)	CHD00190
2FLOW(20,11)	HCONV(20,11)	IERROR	JUNCT	CHD00200
3N	NOSECH	QBACK	QCONV(20,11)	CHD00210
4QMISC	TIME	TPRINT	TWALL(20,11)	CHD00220
5XIR(20,11)				CHD00230
COMMON /BLOCKJ/				CHD00240
1FLUXI(200)	TEDEP(200)	XEDEP(101)	EDEP(101)	CHD00250
2NXEDEP	ITEPEP	EDFLUX(100)		CHD00260
COMMON /BLOCKK/NN1,QCOND(205)				CHD00270
COMMON/BLOCKN/COORD				CHD00280
COMMON/BLOCKR/DIFC(4),EROC(4),ERODE				CHD00290
COMMON /CHCOM/ DTAU, IBE(10), IBS(10), IBSPN,				CHD00300
1IGTYP(10)	IHDN(4)	IM,	IZB(3),	CHD00310
2IZGT(3)	JRSW,	NCSN(10),	NSHL(3),	CHD00320
3NZEN(3)	NZSN(3),	RHO1(305),	RHO2(305),	CHD00330
4I	TEMPA2(205),	TEMPA3(42),	TEMPA4(42)	CHD00340
5	DELX(100),	DISTL(100),	DUM (10),	CHD00350
6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,				CHD00360
7SCHECK				CHD00370
COMMON /NASCOM/ CHARRO,AIRM,				CHD00380
1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)				CHD00390
2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205), WDEP(205),WSI(205)				CHD00400
35),WBRN(205),EMWT(205),PRG(205)				CHD00410
4,TIMEX(50),TFT(50),NETS				CHD00420
5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CAPTS,SILTS,				CHD00430
6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,				CHD00440
7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)				CHD00450
8,ALLGAS(205),GRAF1(205),GRAF5(205),SPEED(205),DIFCH(205),DIFR(205)				CHD00460
9,VISCO,VISCON,AF,BF,SILICA,REQ,PMW,DMW,HMW,AOMW,ANMW,SMW,BMW,CX(6)				CHD00470
1,QSI,QBRN,QDEP				CHD00480
DATA NST,L,N, COORD,AIRM,GCON/1,1,1,28.96,1545./				CHD00490
DATA CFXO,CFXN,CFXH,CFXPY,CFXDP,CFXSI,CFXCM/7*0./				CHD00500
E ABOVE DATA STATEMENTS ARE NORMALLY LEFT UNCHANGED				CHD00510
TERIAL 1 DATA				CHD00520
DATA (ACTENV(I,1),I=1,2)/23300.,0./				CHD00530

DATA (EFCOLV(I,1),I=1,2)/11209.,0./	CHD00540
DATA (REORDV(I,1),I=1,2)/1.,0./	CHD00550
DATA HOFM(1)/350./	CHD00560
DATA (COEFT(I,1),I=1,4)/.43,0.,0.,0./	CHD00570
DATA (CONST(I,1),I=1,4)/.244E-5,11.53E-8,-1.67E-11,0./	CHD00580
DATA EMIS(1),ABSORP(1),RHOV(1),SLOPE(1)/.9,.9,34.,1.2/	CHD00590
C MATERIAL 2 DATA	CHD00600
DATA (ACTENV(I,2),I=1,2)/0.,0./	CHD00610
DATA (EFCOLV(I,2),I=1,2)/0.,0./	CHD00620
DATA (REORDV(I,2),I=1,2)/0.,0./	CHD00630
DATA HOFM(2)/120./	CHD00640
DATA (COEFT(I,2),I=1,4)/.09936.,.1642E-4.,.4055E-8.,.1389E-10/	CHD00650
DATA (CONST(I,2),I=1,4)/.04125.,.961E-5,0.,0./	CHD00660
DATA EMIS(2),ABSORP(2),RHOV(2),SLOPE(2)/.2.,.6,484.,.7/	CHD00670
C CHAR DATA	CHD00680
DATA ACTENC,EFCOLC,REORDC,HCOM /39855.,.673E9.,.5,0./	CHD00690
DATA ACTENS,EFCOLS,REORDS,HSUB /0.,0.,0.,0./	CHD00700
DATA (CCPC(I),I=1,4)/.42,0.,0.,0./	CHD00710
DATA (CKC(I),I=1,4)/.168E-2,-.2968E-5,.1751E-8,-.2402E-12/	CHD00720
DATA EMISC,ABSC,RHOC,TRCHAR/.65,1.0,20.,1./	CHD00730
DATA CHARRO/10./	CHD00740
C GAS DATA	CHD00750
DATA (CCPG(I),I=1,4),HCOMG/.7,0.,0.,0.,.6173./	CHD00760
C INTERNAL FLOW AND DIFFUSION CONSTANTS	CHD00770
DATA CARTS,RHOTS,SILTS,POR,PERT1,PERT2/131.,70.,137.3.,75.,	CHD00780
11.E-10,10./	CHD00790
DATA VISCO,VISCON/1.E-5,530./	CHD00800
DATA DCOCM,DCODP,DCOH,DCON,DCOO,DCOPY,DCOSI/7*1./	CHD00810
DATA ANMW,AOMW,BMW,DMW,HMW,PMW,SMW/28.,32.,28.,20.,2.,16.,44./	CHD00820
C MISCELLANEOUS CONSTANTS	CHD00830
DATA BSTAR,(DIFC(I),I=1,4)/.43,-.649,-2.54,-2.30,-.878/	CHD00840
DATA QSI,QDEP,QBRN/0.,0.,0./	CHD00850
DATA AF,BF,SILICA,REO/2.0921E3,40765.,8.194,1./	CHD00900
DATA (CX(I),I=1,6)/.01365,116.2,1777.,6.06E-4.,.0114,4.22/	CHD00910
END	CHD00920

```

- FOR BLOCK,BLOCK
SUBROUTINE BLOCK(XMC,TC,GAS,SLOPE,H,F,PHI)
XMG=GAS
TG=SLOPE
IF(F-1.1) 10,10,20
10  A=(XMC*TC+XMG*TG)
GO TO 30
20  A=(XMC*TC**3+XMG*TG**3)/3.
30  B=A/(H+1.E-20)
IF(B-88.) 40,40,50
40  PHI=EXP (-B)
GO TO 60
50  PHI=0.
60  RETURN
END

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CHD00930
CHD00940
CHD00950
CHD00960
CHD00970
CHD00980
CHD00990
CHD01000
CHD01010
CHD01020
CHD01030
CHD01040
CHD01050
CHD01060

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000015

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- FOR CHARM/S4,CHARM/S4
SUBROUTINE CHARM
C**** CHARM SUBROUTINE IN CHAP --JULY 1966 VERSION
C LISTING FOR GAUDETTE 8528 TAPE
COMMON /BLOCKA/
1ABSORP(10) ,ABSC ,ACTENC ,ACTENS ,ACTENV(4,10),
2BSTAR ,CCPC(4) ,CCPG(4) ,CHARPT(101) ,CKC(4) ,
3COEFT(4,10) ,CONDC ,CONDV(100) ,CONST(4,10) ,COVERX(100) ,
4CPBAR ,CPC ,CPV(100) ,DIFREC ,UMATER(10) ,
5EFCOLC ,EFCOLS ,EFCOLV(4,10) ,EMIS(10) ,EMISC ,
6HOFM(10) ,HCOM ,HCOMG ,HSUB ,MAT(100) ,
7MATOMN ,MATMNE ,MN ,NN ,NNP ,
8NNSAVE ,NRDIV ,NREND ,NRGO ,NST ,
9PARTIN(101) ,PHI ,QBYRAD ,QCOMB ,QEXTR ,
10GPCOM ,QSUBL ,RECPRO ,REORDC ,REORDS ,
2REOROV(4,10) ,RHOSZ ,RHOS(305) ,RHOCPX(101) ,RHOC ,
3RHOF(10) ,SABL ,SABLC ,SDOT ,SDOTC ,
4SLOPE(10) ,TMELT(10) ,TSZ ,TS(205) ,TRCHAR ,
5WFZ ,WF(205) ,XCHAR ,XINIT ,XLEFT(101) ,
6XMASS ,XMDOTC ,XMDOTD ,XMDOTG ,XMDOTL ,
7XMDCTR ,XMDOTS ,XTOTAL ,XVIRG(101) ,XZONE
COMMON /BLOCKB/ USER(243) ,BLDEN(20,11)
COMMON /BLOCKC/
1BLPRES(20,11) ,COMMAX ,CUTOFF ,F(20,11) ,
2FLOW(20,11) ,HCONV(20,11) ,IERROR ,JUNCT ,L ,
3N ,NOSECH ,QBACK ,QCONV(20,11) ,QGAS(20,11) ,
4QMISC ,TIME ,TPRINT ,TWALL(20,11) ,XIWALL(20,11) ,
5XIR(20,11)
COMMON /BLOCKJ/
1FLUXI(200) ,TEDEP(200) ,XEDEP(101) ,EDEP(101) ,NTEDEP ,
2NXEDEP ,ITEPEP ,EDFLUX(100)
COMMON /BLOCKK/ NN1 ,QCOND(205)
COMMON /BLOCKN/COORD
COMMON /BLOCKR/ DIFC(4) ,EROC(4) ,ERODE
COMMON /CHCOM/ DTAU ,IBE(10) ,IBS(10) ,IBSPN ,
1IGTYP(10) ,IHDN(4) ,IM ,IZB(3) ,IZG(3,10) ,
2IZGT(3) ,JRSW ,NCSN(10) ,NSHL(3) ,NSHR(3) ,
3NZEN(3) ,NZSN(3) ,RHO1(305) ,RHO2(305) ,RHO3(410) ,
4I ,TEMPA2(205) ,TEMPA3(42) ,TEMPA4(42) ,TEMPA5(205) ,
5 DELX(100) ,DISTL(100) ,DUM (10) ,ICOM ,
6IYS ,LFT ,MG ,MDUM ,NCEN(10) ,NCUT ,ND(3) ,NLZON ,SN ,SN1 ,
7SCHECK
COMMON /NUCOM/ NADA ,
1EM(42)
COMMON /DACOM/ A(42) ,
1ABVAL ,ABVALM ,ABVALS ,B(42) ,C(42) , CC(205) ,COND(42) ,
2CONDX ,CONDXX ,D(42) ,DD(205) ,DELTX(101) ,DGAS ,DQ ,
3DTAUC ,DTAUS ,DTAUX ,DTF ,DTR(3) ,DFX ,EDFXX ,EMI(42) ,
4ETA ,ETAS ,FHT(42) ,FHTX ,FHTXX ,GAGC ,GAS1 ,GK ,GX ,GY ,GZ ,
5HDA(5,10) ,IBSPM ,IERR ,IGC ,IGL ,IGLD ,IGR ,IGRL ,IGT ,IG2 ,
6IHYS ,INEG ,IN1 ,IN2 ,IP ,IPLUS ,ITER ,ITERT ,IX ,IY ,IZ ,J ,JBE ,
7JBEM ,JBEX ,JBND1 ,JBND2 ,JBS ,JBSM ,JBSPM ,JBSPN ,JBX ,JBXX ,JCEN ,
8JCENM ,JCSN ,JCSNM ,JE ,JE1 ,JE2 ,JHDN ,JHDN1 ,JLSW ,JSLAB ,JX ,JZ ,
9K1 ,LANDID ,LRT ,MARK ,NADD(42) ,NASW ,NBNDST ,NBND1(11) ,
1NBSW ,NDC ,NDCM ,NLSW(10) ,NOF ,NOTIME ,NPBSW ,NPE1N ,NPS2N ,NPTSW ,

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CHD01070
CHD01080
CHD01090
CHD01100
CHD01110
CHD01120
CHD01130
CHD01140
CHD01150
CHD01160
CHD01170
CHD01180
CHD01190
CHD01200
CHD01210
CHD01220
CHD01230
CHD01240
CHD01250
CHD01260
CHD01270
CHD01280
CHD01290
CHD01300
CHD01310
CHD01320
CHD01330
CHD01340
CHD01350
CHD01360
CHD01370
CHD01380
CHD01390
CHD01400
CHD01410
CHD01420
CHD01430
CHD01440
CHD01450
CHD01460
CHD01470
CHD01480
CHD01490
CHD01500
CHD01510
CHD01520
CHD01530
CHD01540
CHD01550
CHD01560
CHD01570
CHD01580
CHD01590
CHD01600

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2NRID,NRIDC,NRSW(10),NRZON,NSLAB(10),NSLABH(10),NSW,NXSW,	CHD01610
3NZON,NZONC,ONE,PSI,OSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN,	CHD01620
4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,	CHD01630
5TEMPST(3),THREE,TWO,WFP,WFX,WFX,XI,XMCOM,XSAVE	CHD01640
COMMON /NASCOM/ CHARRO,AIRM,	CHD01650
1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)	CHD01660
2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205),WDEP(205),WSI(205)	CHD01670
35),WBRN(205),EMWT(205),PRG(205)	CHD01680
4,TIMFX(50),TFT(50),NPTS	CHD01690
5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS,	CHD01700
6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,	CHD01710
7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)	CHD01720
8,ALLGAS(205),GRAF1(205),GRAF5(205),SPEED(205),DIFCH(205),DIFR(205)	CHD01730
9,VISCO,VISCON,AF,BF,SILICA,REO,PMW,DMW,HMW,AOMW,ANMW,SMW,BMW,CX(6)	CHD01740
1,QSI,QBRN,QDEP,DACT	CHD01750
COMMON /TABCOM/ NDOTS(4),TIME1(100),TIME2(100),TIME3(100),	CHD01760
1TIME4(100),DSTEP(100),PSTEP(100),XR1(100),RH(100),QMU(100),	CHD01770
2TT(100),PP(100),FF(100),AST(100)	CHD01780
DIMENSION AREAC(42),CONDO(43),EMBM(42),NBND2(10),NHDN(3),	CHD01790
1PC(42),RATE(42),RHO4(306), DELTAX(1),TEMPA1(1)	CHD01800
C**** DIMENSION STATEMENTS	CHD01810
C	CHD01820
DIMENSION AREA(42),ARFAV(42)	CHD01830
C	CHD01840
C**** COMMON STATEMENTS	CHD01850
C	CHD01860
C	CHD01870
C**** EQUIVALENCE STATEMENTS	CHD01880
C	CHD01890
EQUIVALENCE (NBND1(2),NBND2(1))	CHD01900
EQUIVALENCE (WF(1),RATE(1))	CHD01910
EQUIVALENCE (IHDN(2),NHDN(1))	CHD01920
EQUIVALENCE (RHO3(103),RHO4(1))	CHD01930
EQUIVALENCE (CONDO(2),COND(1))	CHD01940
EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))	CHD01950
EQUIVALENCE (EMBM(1),PC(1))	CHD01960
EQUIVALENCE (XMDOTG,GAS)	CHD01970
EQUIVALENCE (MNOD,NNP)	CHD01980
EQUIVALENCE (RHO3(307),PC(1)),(RHO3(350),AREAC(1))	CHD01990
EQUIVALENCE (RHOCPIX(44),AREA(1),ARFAV(43))	CHD02000
C	CHD02020
C**** ENTRY POINT TO SUBROUTINE	CHD02030
C	CHD02040
TAUOUT=TAU1+COMMAX	CHD02050
GO TO (10,13527),NST	CHD02060
C	CHD02070
C**** INITIAL SECTION--10-2599 (PASS THROUGH ON FIRST ENTRY ONLY)	CHD02080
C	CHD02090
C**** SETUP OF VARIOUS COEFFICIENTS-- SPECIFIC HEAT,	CHD02100
C**** DECOMPOSITION REACTION FREQUENCY FACTORS,HEAT OF DECOMPOSITION	CHD02110
C	CHD02120
10 CONTINUE	CHD02130
TWALL(1,1)=TS(NNP)	CHD02170
DO 11 J=1,4	CHD02220
11 CCPC(J) = RHOC*CCPC(J)/12.	CHD02230

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DO 16 I=1,10
DO 12 J=1,4
12 COEFT(J,I) = COEFT(J,I)*RHOV(I)/12.
ONE = RHOV(I)-RHOC
IF (ONE) 13,13,10016
13 CONTINUE
DO 14 J=1,4
EFCOLV(J,I) = 0.
HDA(J,I) = 0.
14 CONTINUE
GO TO 16
10016 CONTINUE
TWO = 12./ONE
DO 20016 J=1,4
EFCOLV(J,I) = EFCOLV(J,I)*RHOV(I)/ONE**REORDV(J,I)
20016 HDA(J,I) = (CCPG(J)-TWO*(COEFT(J,I)-CCPC(J)))/FLOAT(J)
TEMPA = 536.67
HDA(5,I) = HOFM(I)-(HDA(1,I)+(HDA(2,I)+(HDA(3,I)+HDA(4,I)
1*TEMPA)*TEMPA)*TFMPA)*TFMPA
16 RHOV(I)=ONE+1.E-10
DO 9 K=1,42
AREA(K)=1.
9 AREAV(K)=1.
C
C
C**** ZEROING AND INITIALIZATION
C
C      ZONE CONTROL VALUES SET
IZB(1) = 119
IZB(2) = 187
IZB(3) = 187
IBSPM = 204
IBSPN = 203
IHON(1) = 1
NHON(1) = 4
NHON(2) = 4
NHON(3) = 4
NZSN(1) = NN
NZFN(1) = MNOD
NRZON = 1
NLZON = 1
C
IP = 3
NPE1N = 1
NPS2N = 1
C      NODE DIVIDERS SET
ND(1) = NN
ND(2) = 500
C
C      ZEROING
DO 17 J=1,3
NSHL(J) = 0
17 NSHR(J) = 0
DGAS = 0.
GAS1 = 0.
I=0

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CHD02240
CHD02250
CHD02260
CHD02270
CHD02280
CHD02290
CHD02300
CHD02310
CHD02320
CHD02330
CHD02340
CHD02350
CHD02360
CHD02370
CHD02380
CHD02390
CHD02400
CHD02410
CHD02420
CHD02430
CHD02440
CHD02450
CHD02460
CHD02540
CHD02550
CHD02560
CHD02570
CHD02580
CHD02590
CHD02600
CHD02610
CHD02620
CHD02630
CHD02640
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CHD02660
CHD02670
CHD02680
CHD02690
CHD02700
CHD02710
CHD02720
CHD02730
CHD02740
CHD02750
CHD02760
CHD02770
CHD02780
CHD02790
CHD02800
CHD02810
CHD02820
CHD02830
CHD02840
CHD02850

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WF(I)=0.
ISAVE1=0
ISAVE2=0
ISAVE4=0
ISAVE5=0
ISAVE6=0
QGAS(1,1)=0.
C
  ITER = 0
  NOTIME = 0
C
  OTHER VALUES SET
  PERT1=PERT1*32.2
  PERT2=PERT2*32.2
  NRINC = 1
  NZONC = 1
  NST = 2
  ETA = .005
  NRSW = 1
  NCUT = 1
  NPTSW = 1
  LFT = 1
  LRT = 2
  DO 18 J=1,3
    TAUST(J) = 0.
    DTR(J) = 0.
    TEMPST(J) = TS(NN)
  18 CONTINUE
C
C****  SETUP OF TEMPERATURES AND DENSITIES
C****  PLACEMENT OF NODAL WIDTH VALUES INTO DELX ARRAY
C
  XLEFT(1)=0.
  XSAVE=0.6*PARTIN(1)+XLEFT(1)
  DO 19 J=1,NN
    I = MAT(J)
    RHO1(J) = RHOV(I)
    XLEFT(J+1)=XLEFT(J)+PARTIN(J)
  19 DELX(J) = PARTIN(J)
    DO 20 I=1,MNOD
      TEMP2(I) = TS(I)
      TEMP5(I) = TS(I)
      RHO2(I) = RHO1(I)
      RHO5(I) = RHO1(I)
      J = I+IBSPM
      RHO1(J) = RHO1(I)
      RHO2(J) = RHO1(I)
      RHO3(J) = RHO1(I)
      RHO4(J) = RHO1(I)
    20 RHO5(J) = RHO1(I)
      I = IZB(1)-1
      K = NHDN(I)+1
      TEMP2 = TEMP2(NN)
C****  SETUP OF FRONT ZONE
      ONE = (TEMP2(MNOD)-TEMP2(NN))/FLOAT(NHDN(1))
      DO 30 J=1,K

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CHD02860
CHD02862
CHD02863
CHD02864
CHD02865
CHD02866
CHD02867
CHD02870
CHD02880
CHD02890
CHD02900
CHD02910
CHD02920
CHD02930
CHD02940
CHD02950
CHD02960
CHD02970
CHD02980
CHD02990
CHD03000
CHD03010
CHD03020
CHD03030
CHD03040
CHD03050
CHD03060
CHD03070
CHD03080
CHD03090
CHD03100
CHD03110
CHD03120
CHD03130
CHD03140
CHD03150
CHD03160
CHD03170
CHD03180
CHD03190
CHD03200
CHD03210
CHD03220
CHD03230
CHD03240
CHD03250
CHD03260
CHD03270
CHD03280
CHD03290
CHD03300
CHD03310
CHD03320
CHD03330
CHD03340

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I = I+1
TEMPA1(I) = TEMPA
TEMPA2(I) = TEMPA
TEMPA5(I) = TEMPA
TEMPA = TEMPA+ONE
RHO1(I) = RHO1(NN)
RHO2(I) = RHO1(I)
30 RHO5(I) = RHO1(I)
HOLD=RHOC-CHARRO
DO 40 J=1,205
CARBN1(J)=CHARRO
CARBN5(J)=CHARRO
GRAF1(J)=0.
GRAF5(J)=0.
SILCA1(J)=HOLD
SILCA5(J)=HOLD
PYRO(J)=1.
FMWT(J)=AIRM
40 CONTINUE
DO 50 J=1,100
50 EDFLUX(J)=0.
C
C*****  SETTING OF TIMES AND DELTA TIMES
C
TAUOUT = COMMAX
DTAU = COMMAX
211 DTAUS = DTAU
DTAUC = DTAU
DTAUX = 0.5*DTAU
TAU1 = 0.
TAU2 = DTAU
C
C*****  NORMALIZED DISTANCES AND NORMALIZED NODE WIDTHS
C
IYS = ND(1)
SN1 = XLEFT(MNOD)-XLEFT(IYS)
DO 230 J=IYS,MNOD
DISTL(J) = (XLEFT(J)-XLEFT(IYS))/SN1
230 DELX(J) = DELX(J)/SN1
C*****
SCHECK = 0.5*SN1
C
C*****  CALCULATION CONTROL--2600-2684
C
2600 NPBSW = IP
MARK = 1
IG = 1
LANDID = 1
NRID = NRIDC
NDC = 1
NDCM = 1
2603 IG2 = IG
GO TO (2606,2614,2615),NPBSW
2606 NBND1(IG) = NBSW+5
NCSN(IG) = 1

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CHD03350
CHD03360
CHD03370
CHD03380
CHD03390
CHD03400
CHD03410
CHD03420
CHD03430
CHD03440
CHD03450
CHD03460
CHD03470
CHD03480
CHD03490
CHD03500
CHD03510
CHD03520
CHD03530
CHD03532
CHD03534
CHD03540
CHD03550
CHD03560
CHD03570
CHD03580
CHD03590
CHD03600
CHD03610
CHD03620
CHD03630
CHD03640
CHD03650
CHD03660
CHD03670
CHD03680
CHD03690
CHD03700
CHD03710
CHD03720
CHD03730
CHD03740
CHD03750
CHD03760
CHD03770
CHD03780
CHD03790
CHD03800
CHD03810
CHD03820
CHD03830
CHD03840
CHD03850
CHD03860
CHD03870

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	NRNDST = 4	CHD03880
2608	NCFN(IG) = NPE1N	CHD03890
	NSW = 1	CHD03900
	GO TO 2640	CHD03910
2614	NRND1(IG) = 4	CHD03920
	NCSN(IG) = NP52N	CHD03930
	GO TO 2620	CHD03940
2615	NRND1(IG) = NBSW+5	CHD03950
	NCSN(IG) = 1	CHD03960
2620	NZON = NZONC	CHD03970
	NRNDST = 5	CHD03980
	IGC = 0	CHD03990
2625	IF (NCSN(IG)-NZSN(NZON)) 2628,2644,2644	CHD04000
2628	IF (NZSN(NZON)-ND(NDC)) 2635,2635,2629	CHD04010
2629	IF (NCSN(IG)-ND(NDC)) 12630,12629,12629	CHD04020
12629	LANDID=3	CHD04030
	NDC = NDC+1	CHD04040
	NDCM=1	CHD04050
	IGLD=IG	CHD04060
	GO TO 2635	CHD04070
12630	NCEN(IG)=ND(NDC)	CHD04080
	NDC = NDC+1	CHD04090
	LANDID=2	CHD04100
	NSW = 5	CHD04110
	NDCM = 2	CHD04120
	GO TO 2640	CHD04130
2635	NCEN(IG) = NZSN(NZON)	CHD04140
	NSW = 2	CHD04150
2640	IGTYP(IG) = 0	CHD04160
	JHDN = 1	CHD04170
	IBS(IG) = NCSN(IG)	CHD04180
	GO TO 2660	CHD04190
2644	IGC = IGC+1	CHD04200
	IF (NZEN(NZON)-ND(NDC)) 2648,2646,2645	CHD04210
2645	IF (NCSN(IG) - ND(NDC)) 12646,12645,12645	CHD04220
12645	LANDID = 3	CHD04230
	NDC = NDC + 1	CHD04240
	NDCM=1	CHD04250
	IGLD=IG	CHD04260
	GO TO 2648	CHD04270
12646	NSW = 2	CHD04280
	GO TO 2647	CHD04290
2646	NSW = 3	CHD04300
2647	NCFN(IG) = ND(NDC)	CHD04310
	NDC = NDC+1	CHD04320
	NDCM = 2	CHD04330
	LANDID = 2	CHD04340
	GO TO 2655	CHD04350
2648	NCEN(IG) = NZEN(NZON)	CHD04360
	IF (NZEN(NZON)-MNOD) 2650,2651,2651	CHD04370
2650	NSW = 3	CHD04380
	GO TO 2655	CHD04390
2651	NRNDST = NASW	CHD04400
	NSW = 4	CHD04410
2655	IGTYP(IG) = NZON	CHD04420

```

JHDN = NHDN(NZON)
IZG(NZON,IG) = IG
IZGT(NZON) = IGC
IF (IGC-1) 2657,2657,2656
2656 IBS(IG) = IBE(IG-1)
GO TO 2658
2657 IBS(IG) = IZB(NZON)
2658 IF (NZON-NRZON) 2660,2659,2660
2659 NRSW(IG) = 3
NRID = 2
GO TO 2661
2660 NRSW(IG) = NRID
2661 NSLAB(IG) = NCEN(IG)-NCSN(IG)
NSLABH(IG) = NSLAB(IG)*JHDN
IF (NSLABH(IG)-40) 2666,2666,2680
2662 NBND2(IG) = NBNDST
IBE(IG) = IBS(IG)+NSLABH(IG)
NDCM = 1
IF (LANDID-2) 2667,2669,2668
2667 NLSW(IG) = 1
GO TO 2670
2668 NLSW(IG) = 2
GO TO 2670
2669 NLSW(IG) = 1
IGLD=IG+1
LANDID = 3
2670 IGL = IG
IG = IG+1
GO TO (2671,2672,2673,2675,2674),NSW
2671 NPBSW = 2
GO TO 2603
2672 NCSN(IG) = NCEN(IGL)
GO TO 2644.
2673 NZON = NZON+1
IGC = 0
2674 NCSN(IG) = NCEN(IGL)
GO TO 2625
2675 MG = IGL
NOF = IBE(IGL)
GO TO 2685
2680 NSLAB(IG) = 40/JHDN
NCEN(IG) = NCSN(IG)+NSLAB(IG)
NBND2(IG) = 5
NSLABH(IG) = NSLAB(IG)*JHDN
IBE(IG) = IBS(IG)+NSLABH(IG)
GO TO (12683,12682),NDCM
12682 NDC = NDC - 1
NDCM = 1
12683 CONTINUE
IF (LANDID-2) 2682,2682,2683
2682 NLSW(IG) = 1
GO TO 2684
2683 NLSW(IG) = 2
2684 IG = IG+1
NCSN(IG) = NCEN(IG-1)

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CHD04430
CHD04440
CHD04450
CHD04460
CHD04470
CHD04480
CHD04490
CHD04500
CHD04510
CHD04520
CHD04530
CHD04540
CHD04550
CHD04560
CHD04570
CHD04580
CHD04590
CHD04600
CHD04610
CHD04620
CHD04630
CHD04640
CHD04650
CHD04660
CHD04670
CHD04680
CHD04690
CHD04700
CHD04710
CHD04720
CHD04730
CHD04740
CHD04750
CHD04760
CHD04770
CHD04780
CHD04790
CHD04800
CHD04810
CHD04820
CHD04830
CHD04840
CHD04850
CHD04860
CHD04870
CHD04880
CHD04890
CHD04900
CHD04910
CHD04920
CHD04930
CHD04940
CHD04950
CHD04960
CHD04970

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GO TO (2608,2625,2644,2644,2625),NSW	CHD04980
C	CHD04990
C**** CALCULATION OF NODE WIDTHS FOR MINOR NODES	CHD05000
C	CHD05010
2685 DO 2686 IG=1,MG	CHD05020
NZON = IGTYP(IG)	CHD05030
ONE = NHDN(NZON)	CHD05040
JCSN = NCSN(IG)	CHD05050
JCENM = NCEN(IG)-1	CHD05060
DO 2686 K=JCSN,JCENM	CHD05070
DELTX(K) = DELX(K)/ONE	CHD05080
DELTAX(K) = DELTX(K)	CHD05090
2686 CONTINUE	CHD05100
DELTX (JCENM+1) = DELTX (JCENM)	CHD05110
DELTAX(JCENM+1) = DELTAX(JCENM)	CHD05120
C	CHD05130
C**** CHECK COMMAX (DELTA TIME FROM CHAP)	CHD05140
C**** AND RESET DTAU, PREDICTED TEMPERATURES, AND PREDICTED DENSITIES	CHD05150
C**** IF DTAU LARGER THAN COMMAX	CHD05160
C	CHD05170
12687 CONTINUE	CHD05180
IGR=1ZG(NRZON,1)	CHD05190
IF (IGR-1)12688,12688,12689	CHD05200
12688 IGR=2	CHD05210
12689 CONTINUE	CHD05220
BLPRES(N,L)=FONEV(TAU1,ISAVE2,TIME4,PP,NDOTS(4),1)	CHD05230
CALL SUBZ (ZWALL,TEMPA1(NOF),BLPRES(N,L))	CHD05240
BLDEN(N,L)=BLPRES(N,L)*AIRM/(ZWALL*GCON*TEMPA1(NOF))	CHD05250
FLOW(N,L)=TBSTEP(TAU1,TIME4,FF,NDOTS(4))	CHD05270
F(N,L)=FONEV(TAU1,ISAVE2,TIME4,AST,NDOTS(4),1)	CHD05273
HCONV(N,L)=FONEV(TAU1,ISAVE6,TIME3,RH,NDOTS(3),1)	CHD05277
CFX0=0.21*BLDEN(N,L)	CHD05278
CFXN=0.79*BLDEN(N,L)	CHD05280
CALL FLOWS	CHD05290
CALL DIFUS (DO ,1,DCOO ,CFX0 ,AEPO)	CHD05300
CALL DIFUS (DN ,2,DCON ,CFXN ,AERN)	CHD05310
CALL DIFUS (DH ,3,DCOH ,CFXH ,HYD)	CHD05320
CALL DIFUS (DPY,4,DCOPY,CFXPY,PYRO)	CHD05330
CALL DIFUS (DSI,6,DCOSI,CFXSI,SOX)	CHD05340
CALL DIFUS (DCM,7,DCOCM,CFXCM,BURN)	CHD05350
CALL MOLWT	CHD05360
2687 CONTINUE	CHD05370
IF (TAUOUT-TAU1-.99*DTAU) 2688,2690,2690	CHD05380
2688 DTF=(TAUOUT-TAU1)/DTAU	CHD05390
GO TO 3296	CHD05400
C	CHD05410
C**** SETUP OF COEFFICIENTS AND CALCULATION OF TEMPERATURES--2690-3370	CHD05420
C	CHD05430
C**** ENTRANCE HERE FROM 3360+ FOR RECALC OF ALL GROUPS--DTAU/2	CHD05440
C	CHD05450
2690 NXSW = 1	CHD05460
ITFR = 1	CHD05470
ITERT = ITERT+1	CHD05480
IERR = 1	CHD05490
C	CHD05500

C**** ENTRANCE HERE FROM 3375+ FOR RECALC OF ALL GROUPS

C

2693 CONTINUE

IG = 1
WFX = 0.
FHTX = 0.
PCX = 0.
JBX = 0.
EDFX = 0.
WFDX=0.
WRRNX=0.
WDEPX=0.
WSIX=0.
DEPX=0.
DWFDX=0.

C

C**** CALCULATION OF MASS RECESSION RATES

C

TEMPA = 0.5*(TEMPA1(NOF)+TEMPA5(NOF))
GAS = GAS1+DGAS*DTAUX
CALL RECEED(TEMPA)
I=MAT(NN)
SLOP=1.12*SLOPE(I)
CALL BLOCK(XMDOTC,TRCHAR,GAS,SLOP,HCONV(N,L),FLOW(N,L),PHI)
REFCTR=1.
PSI=PHI*F(N,L)*4632.5*0.5**((1.E4/TWALL(N,L))
EROC(1)=-3.672
EROC(2)=.3347
IF (PSI.LT.3.3) GO TO 4600
IF (PSI.GT.9.0) GO TO 4550
EROC(1)=-4.22915
EROC(2)= 1.34309
GO TO 4600

4550 EROC(1)=-9.04655

EROC(2)=6.36877

4600 PSI=ALOG10(PSI+1.E-15)

ERODE=EROC(1)+PSI*(EROC(2)+PSI*(EROC(3)+PSI*EROC(4)))

ERODE=(20./16.5)*10.**ERODE

JRSW=NRSW(MG)

GO TO (2694,2695,2694),JRSW

2694 CONTINUE

SDOTN=(-XMDOTC-ERODE)/(RHOC+RH02(NOF-1))*12.

GO TO 2692

2695 SDOTN=(-XMDOTC-ERODE)/(CARBN1(NOF-1)+SILCA1(NOF-1)+GRAF1(NOF-1))
1*12.

2692 CONTINUE

SDN = SDOTN*DTAU/2.

SN = SN1+SDN

C
C**** CHECK SIZE OF FRONT NODE AND ADJUST DTAU, IF
C**** NECESSARY TO PREVENT TIME STEP BEING TOO LARGE

C

IF (SN+SDN) 22696,22710,22710

22696 DTF = -SN1/(2.*SDN)

NCUT = 2

CHD05510
CHD05520
CHD05530
CHD05540
CHD05550
CHD05560
CHD05570
CHD05580
CHD05590
CHD05600
CHD05610
CHD05620
CHD05630
CHD05643
CHD05647
CHD05648
CHD05650
CHD05660
CHD05670
CHD05680
CHD05690
CHD05700
CHD05710
CHD05720
CHD05730
CHD05740
CHD05750
CHD05760
CHD05770
CHD05780
CHD05790
CHD05800
CHD05810
CHD05820
CHD05830
CHD05840
CHD05850
CHD05860
CHD05870
CHD05880
CHD05890
CHD05900
CHD05910
CHD05920
CHD05930
CHD05940
CHD05950
CHD05960
CHD05970
CHD05980
CHD05990
CHD06000
CHD06010
CHD06020
CHD06030

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GO TO 3296
22710 CONTINUE
C
TEMPA3(1) = 0.5*(TEMPA1(1)+TEMPA5(1))
C
C**** CALCULATE DELTAX
C
DO 2696 J=IYS,MNOD
2696 DELTAX(J) = DELTX(J)*SN
C
C**** ENTRANCE HERE FROM 3225+ FOR CALC OF NEXT GROUP
C
C**** GROUP INITIALIZATION
C
12696 JBS = IBS(IG)
JBSM = JBS-1
JLSW = NLSW(IG)
JRSW = NRSW(IG)
JE1 = NSLABH(IG)
JE = JE1+1
JE2 = JE1-1
JBND1 = NBND1(IG)-3
JBND2 = NBND2(IG)
IGL = IG-1
JBE = IRF(IG)
JBEM = JBE-1
JCSN = NCSN(IG)
JCEN = NCEN(IG)
JCENM = JCEN-1
IGC = IGTYP(IG)
JHDN = NHDN(IGC)
JSLAB = NSLAB(IG)
JBSPM = IBSPN+JCSN
JBSPN = JBSPM-1
C
TWO = SDN/(2.*SN)
WFXX = WFX
FHTXX = FHTX
CONDX = CONDX
JBXX = JBX
PCXX = PCX
EDFXX = EDFX
WFDXX = WFDX
WDEPXX = WDEPX
WSIXX = WSIX
WBRNXX = WBRNX
DEPXX = DEPX
DWFDXX = DWFDX
C
C**** SETUP OF NADD ARRAY (NUMBER OF
C**** MAJOR NODES OF SAME MATERIAL AND WIDTH)
C
JX = 1
IY = JCSN
IZ = JCENM-1

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CHD06040
CHD06050
CHD06060
CHD06070
CHD06080
CHD06090
CHD06100
CHD06110
CHD06120
CHD06130
CHD06140
CHD06150
CHD06160
CHD06170
CHD06180
CHD06190
CHD06200
CHD06210
CHD06220
CHD06230
CHD06240
CHD06250
CHD06260
CHD06270
CHD06280
CHD06290
CHD06300
CHD06310
CHD06320
CHD06330
CHD06340
CHD06350
CHD06360
CHD06370
CHD06380
CHD06390
CHD06400
CHD06410
CHD06420
CHD06430
CHD06440
CHD06450
CHD06460
CHD06470
CHD06480
CHD06490
CHD06503
CHD06507
CHD06510
CHD06520
CHD06530
CHD06540
CHD06550
CHD06560
CHD06570

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12697 NADD(JX)=1
2697 IX = IY
      IY = IX+1
      IF (IX-IZ) 2698,2698,2702
2698 IF (DELTAX(IY)-DELTAX(IX)) 2701,2699,2701
2699 IF (MAT(IY)-MAT(IX)) 2701,2700,2701
2700 NADD(JX) = NADD(JX)+1
      GO TO 2697
2701 JX = JX+1
      GO TO 12697
C
2702 GO TO (2708,2703),JLSW
C
C**** CALCULATION OF THE LANDAU MULTIPLYING FACTOR
C
2703 CONTINUE
      KK = 0
      DO 2707 J=JCSN,JCEN
      KK = KK+1
      I = KK
      EMI(KK) = TWO*DISTL(J)/DELT(X(J))
      IF (J-JCEN) 2704,2707,2707
2704 K = 2
2705 IF (K-JHDN) 2706,2706,2707
2706 EMI(KK+1) = EMI(KK)+TWO
      KK = KK+1
      K = K+1
      GO TO 2705
2707 EMI(I) = TWO*2.*DISTL(J)/(DELT(X(J))+DELT(X(J-1)))
2708 CONTINUE
C
C**** ENTRANCE HERE FROM 3325+ FOR RECALC OF FRONT GROUP
C**** CALCULATE TEMPA3 AND TEMPA4
C
2710 DO 2711 J=2,JE
      K = JBSM+J
      TEMPA3(J) = 0.5*(TEMPA1(K)+TEMPA5(K))
2711 TEMPA4(J-1) = 0.5*(TEMPA3(J)+TEMPA3(J-1))
      TEMPA4(JF) = TEMPA3(JE)
      NSTILL=1
      GO TO (2791,2712,2714),JRSW
2712 I=MAT(JCSN)
      IF (RHO1(JBS)-.01) 2791,2791,2714
2714 CONTINUE
      NSTILL=2
      GO TO (2750,2716),JLSW
2716 CONTINUE
C
C**** CALCULATION OF DENSITY FOR LANDAU GROUP
C
      K = 0
      KL = JBSM
      I = MAT(JCSN)
      KK = JBSPM+JSLAB
2720 K = K+1

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CHD06580
CHD06590
CHD06600
CHD06610
CHD06620
CHD06630
CHD06640
CHD06650
CHD06660
CHD06670
CHD06680
CHD06690
CHD06700
CHD06710
CHD06720
CHD06730
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CHD06790
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CHD06970
CHD06980
CHD06990
CHD07000
CHD07010
CHD07020
CHD07030
CHD07040
CHD07050
CHD07060
CHD07070
CHD07080
CHD07090
CHD07100
CHD07110
CHD07120

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      KL = KL+1
      CALL RHOSR (K, KL)
      IF (K-1) 2720, 2720, 2732
2732 IF (K-JE1) 2734, 2733, 2736
2733 RHO1(KL+1) = RHO1(KK)
      RHO5(KL+1) = RHO5(KK)
2734 D(K) = (RHO1(KL+1) - RHO1(KL-1)) * EMI(K) + RHO1(KL) * EMBM(K) + AREAC(K)
      1 * DTAU
      GO TO 2720
2736 ONE = EMBM(K) - 3. * EMI(K)
      C(K) = 4. * EMI(K) / ONE
      D(K) = ((EMBM(K) + 3. * EMI(K)) * RHO1(KL) - (4. * RHO1(KL-1)
      1 - RHO1(KL-2)) * EMI(K) + AREAC(K) * DTAU) / ONE
      THREE = -EMI(K) / ONE
      K = K-1
      TWO = EMBM(K) + EMI(K) * C(K+1)
      C(K) = EMI(K) * (1. + THREE) / TWO
      D(K) = (D(K) + EMI(K) * D(K+1)) / TWO
2737 K = K-1
      IF (K-1) 2740, 2740, 2738
2738 ONE = EMBM(K) + C(K+1) * EMI(K)
      C(K) = EMI(K) / ONE
      D(K) = (D(K) + D(K+1) * EMI(K)) / ONE
      GO TO 2737
2740 RHO5(JBS) = RHO1(JBS) + AREAC(1) * DTAU / EMBM(1)
      KL = JBS
      DO 2742 K=2, JE1
      KL = KL+1
2742 RHO5(KL) = D(K) - C(K) * RHO5(KL-1)
      RHO5(KK) = D(JE) - C(JE) * RHO5(KL) - RHO5(KL-1) * THREE
      GO TO 2774
C
C**** CALCULATION OF DENSITY FOR REGULAR GROUP
C
2750 IX = 0
      K = 0
      KL = JBSM
      KK = JBSPM
      IM = JCSN
2760 IX = IX+1
      I = MAT(IM)
      IM = IM + NADD(IX)
      IJ = JHDN * NADD(IX)
      KK = KK + NADD(IX)
      DO 2763 J=1, IJ
      K = K+1
      KL = KL+1
      IF (RHO1(KL) - .01 * RHOV(I)) 2761, 2761, 2762
2761 RHO1(KL) = 0.
      RHO5(KL) = 0.
      GO TO 2763
2762 CONTINUE
      CALL RHOSB(K, KL)
      RHO5(KL) = RHO1(KL) + AREAC(K) / EMBM(K) * DTAU
2763 CONTINUE

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CHD07130
CHD07140
CHD07150
CHD07160
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CHD07590
CHD07600
CHD07610
CHD07620
CHD07630
CHD07640
CHD07650
CHD07660
CHD07670

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      K=K+1
      CALL RHOSB(K, KK)
      RHO5(KK) = RHO1(KK)+AREAC(K)/EMBM(K)*DTAU
      K=K-1
      IF (IM-JCEN) 2760,2764,2764
2764 CONTINUE
C
C**** CHECK TO SEE THAT RHO5 IS GREATER THAN ZEROS CALCULATE
C**** RHO3, RHO4, GAS FLOW, AND REACTION HEAT
C
2774 IX = 0
      K = 0
      IJ=0
      IK=JHDN
      KK = JBSPM
      KL = JBSM
      IM = JCSN
2775 IX = IX+1
      I = MAT(IM)
      IJ=IJ+JHDN*NADD(IX)
12775 KK = KK+1
2776 K = K+1
      KL = KL+1
      IF (RHO5(KL)-.01) 2777,2778,2778
2777 RHO5(KL) = 0.
2778 RHO3(K) = (RHO1(KL)+RHO5(KL))/2.
      GO TO (12779,2779),JLSW
12779 WFP = (RHO1(KL) - RHO5(KL))/DTAU
      GO TO 2780
2779 WFP = RATE(KL)*(RHO1(KL)-RHO5(KL))-AREAC(K)
2780 WFD(KL)=WFP*DELTA(X(IM)*AREAV(K)/12.
      TEMPA = TEMPA3(K)
      TWO = HDA(5,I)+(HDA(1,I)+(HDA(2,I)+(HDA(3,I)+HDA(4,I)
1*TEMPA)*TEMPA)*TEMPA)*TEMPA
      IF (K-1) 2781,2781,2782
2781 ONE = 0.5*WFD(KL)
      WFD(KL)=WFDX+ONE
      WF(KL) = WFX+ONE
      FHT(K) = FHTX-ONE*TWO
      GO TO 2783
2782 RHO4(K-1) = (RHO3(K-1)+RHO3(K))/2.
      FHT(K) = -TWO*WFD(KL)
      WF(KL) = WF(KL-1)+WFD(KL)
2783 IF (K-1K) 2776,12783,12783
12783 CONTINUE
      IK = IK+JHDN
      IF (K-IJ) 12784,2784,2784
12784 RHO5(KK) = RHO5(KL+1)
      IF (RHO5(KK)-.01) 12785,12786,12786
12785 RHO5(KK) = 0.
12786 CONTINUE
      GO TO 12775
2784 IF (RHO5(KK)-.01) 2785,2786,2786
2785 RHO5(KK) = 0.
2786 RHO3(KK) = (RHO1(KK)+RHO5(KK))/2.

```

```

CHD07680
CHD07690
CHD07700
CHD07710
CHD07720
CHD07730
CHD07740
CHD07750
CHD07760
CHD07770
CHD07780
CHD07790
CHD07800
CHD07810
CHD07820
CHD07830
CHD07840
CHD07850
CHD07860
CHD07870
CHD07880
CHD07890
CHD07900
CHD07910
CHD07920
CHD07930
CHD07940
CHD07950
CHD07960
CHD07970
CHD07980
CHD07990
CHD08000
CHD08010
CHD08020
CHD08030
CHD08040
CHD08050
CHD08060
CHD08070
CHD08080
CHD08090
CHD08100
CHD08110
CHD08120
CHD08130
CHD08140
CHD08150
CHD08160
CHD08170
CHD08180
CHD08190
CHD08200
CHD08210
CHD08220

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```

      RHO4(K) = (RHO3(K)+RHO3(KK))/2.
      GO TO (12787,2787),JLSW
12787 WFP = (RHO1(KK) - RHO5(KK))/DTAU
      GO TO 2788
2787 WFP = RATE(KL+1)*(RHO1(KK)-RHO5(KK))-AREAC(K+1)
2788 ONE=WFP*0.5*DELTAX(IM)*AREAV(K+1)/12.
      WFX = WF(KL)+ONE
      WFDX=ONE
      TEMPA = TEMPA3(K+1)
      TWO = HDA(5,I)+(HDA(1,I)+(HDA(2,I)+(HDA(3,I)+HDA(4,I)
1*TFMPA)*TEMPA)*TFMPA)*TFMPA
      FHTX = -ONE*TWO
      IM = IM+NADD(IX)
      IF (IM-JCENM) 2775,2775,2789
2789 WF(JBE) = WFX
      WFD(JBE)=WFDX
      GO TO 3000

```

```

C
2791 DO 2793 J=1,JE
      K = JBSM+J
      RHO3(J) = RHO5(K)
2793 RHO4(J) = RHO5(K)
      GO TO (2794,2797,3000),JRSW
2794 DO 2795 J=JRS,JBE
      WFD(J)=0.
2795 WF(J) = 0
      GO TO 3000
2797 DO 2798 J=JBS,JBE
      WFD(J)=0.
2798 WF(J) = WFX
      WFD(JBS)=WFDX
3000 CONTINUE

```

```

C
C****      CALCULATION OF DEPOSITION AND OTHER REACTIONS
C

```

```

      DWFDX=DWFDX+.3767*(WFX-WFXX)
      GO TO (4990,5000,4990),JRSW
4990 DO 4995 J=JBS,JBE
      WBRN(J)=0.
      WFI(J)=0.
      WDEP(J)=0.
4995 CONTINUE
      GO TO 5110
5000 CONTINUE
      KL=JBSM
      DEL=0.
      SAVE= 0.
      DELA = DELTAX(JCEN)
      DELTAX(JCEN) = 0.
      DO 5100 J=1,JE
      KL=KL+1
      TEMPA=TEMPA3(J)
      K=LLD(KL)
      WF(KL)=WF(KL)+SAVE
      DACT=DWFDX-DEPX

```

```

CHD08230
CHD08240
CHD08250
CHD08260
CHD08270
CHD08280
CHD08290
CHD08300
CHD08310
CHD08320
CHD08330
CHD08340
CHD08350
CHD08360
CHD08370
CHD08380
CHD08390
CHD08400
CHD08410
CHD08420
CHD08430
CHD08440
CHD08450
CHD08460
CHD08470
CHD08480
CHD08490
CHD08500
CHD08510
CHD08520
CHD08530
CHD08540
CHD08550
CHD08560
CHD08570
CHD08575
CHD08580
CHD08590
CHD08600
CHD08610
CHD08620
CHD08630
CHD08640
CHD08650
CHD08660
CHD08670
CHD08680
CHD08690
CHD08700
CHD08710
CHD08720
CHD08730
CHD08740
CHD08753
CHD08757

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```

CALL SIC (K,KL,TEMPA,DEL)
CALL DFPO (K,KL,TEMPA,DFL)
DEPX=DEPX+1.3333*WDEP(KL)
ONE=DWFDX-DEPX
IF (ONE) 5090,5092,5092
5090 WDEP(KL)=WDEP(KL)+.75*ONE
DEPX=DWFDX
5092 CONTINUE
HOW=WSI(KL)-WDEP(KL)+WBRN(KL)
WF(KL)=WF(KL)+HOW
SAVE=SAVE+HOW
DEL=DELTAX(K)
5100 CONTINUE
GO TO (5108,5101),JLSW
5101 CONTINUE
K=0
EF=2.*SDN/SN1
DO 5102 J=JBS,JBEM
K=K+1
EK=K
EK=EK*EF
SILCA5(J+1)=SILCA5(J+1)*(1.+EK)-SILCA5(J)*EK
CARBN5(J+1)=CARBN5(J+1)*(1.+EK)-CARBN5(J)*EK
5102 CONTINUE
5108 CONTINUE
DELTAX(JCEN) = DELA
WDEP(JBS)=WDEP(JBS)+WDEPX
WSI(JBS) =WSI(JBS)+WSIX
WBRN(JBS)=WBRN(JBS)+WBRNX
5110 CONTINUE
WDFPX=WDFP(JBE)
WSIX =WSI(JBE)
WBRNX=WBRN(JBE)
WFX=WF(JBE)
5500 CONTINUE
C
C**** CALCULATION OF THERMAL CAPACITY,CONDUCTIVITY,ENERGY DEPOSITION
C
IX = 0
K = 0
KK = JBSPM
K1 = 1
IM = JCSN
3005 IX = IX+1
I = MAT(IM)
IJ = JHDN*NADD(IX)
KK = KK+NADD(IX)
DO 3015 J=1,IJ
K = K+1
PC(K) = PCAPF(K)
EDFLUX(K)=EDFLUX(K)*DELTAX(IM)/12.*(RHOV(I)+RHOC)
COND(K)=CONDF(K)
IY=JBS+K
QCOND(IY)=2.*COND(K)*(TEMPA3(K+1)-TEMPA3(K))
3015 CONTINUE

```

CHD08758
CHD08760
CHD08780
CHD08781
CHD08782
CHD08783
CHD08784
CHD08785
CHD08786
CHD08787
CHD08788
CHD08789
CHD08790
CHD08800
CHD08810
CHD08820
CHD08830
CHD08840
CHD08850
CHD08860
CHD08870
CHD08880
CHD08890
CHD08900
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CHD08990
CHD09000
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CHD09130
CHD09140
CHD09150
CHD09160
CHD09170
CHD09180
CHD09190
CHD09200
CHD09210
CHD09220

PC(K1) = (PCX+PC(K1))/2.	CHD09230
EDFLUX(K1)=(EDFX+EDFLUX(K1))/2.	CHD09240
K1 = K+1	CHD09250
ONE = RHO3(K1)	CHD09260
RHO3(K1) = RHO3(KK)	CHD09270
PCX = PCAPF(K1)	CHD09280
EDFX=EDFLUX(K1)*DELTA(X(1M))/12.*(RHOV(1)+RHO3(K1))	CHD09290
RHO3(K1) = ONE	CHD09300
1M = 1M+NADD(IX)	CHD09310
IF (1M-JCFN) 3005,3031,3031	CHD09320
3031 JBX = JBXM+K	CHD09330
CONDX = COND(K)	CHD09340
C	CHD09350
C**** CALCULATION OF MATRIX ELEMENTS	CHD09360
C	CHD09370
3040 TEMPA1(JBXM) = TEMPA1(JBXX)	CHD09380
J = 0	CHD09390
CONDX(J) = CONDX	CHD09400
WF(JBXM) = WF(JBXX)	CHD09410
DO 3060 J=1,JE1	CHD09420
IX = J+JBXM	CHD09430
IPLUS = IX+1	CHD09440
INEG = IX-1	CHD09450
CALL CPRA (J,IX,TEMPA3(J),CPBAR)	CHD09460
GAGC = -WF(INEG)*CPBAR/4.	CHD09470
GO TO (3046,3045),JLSW	CHD09480
3045 GAGC = GAGC+PC(J)*EMI(J)	CHD09490
3046 C(J) = GAGC+CONDX(J)	CHD09500
A(J) = -GAGC+CONDX(J-1)	CHD09510
GK = A(J)+C(J)	CHD09520
D(J) = C(J)*TEMPA1(IPLUS)+(PC(J)-GK)*TEMPA1(IX)	CHD09530
1+A(J)*TEMPA1(INEG)+EDFLUX(J)	CHD09540
R(J) = PC(J)+GK	CHD09550
GO TO (3060,3052,3056),JRSW	CHD09560
3052 CONTINUE	CHD09570
D(J)=D(J)+WDEP(IX)*QDEP+WSI(IX)*QSI+WRN(IX)*QBRN	CHD09580
GO TO (3060,3056),NSTILL	CHD09590
3056 D(J) = D(J)+FHT(J)	CHD09600
3060 CONTINUE	CHD09610
C	CHD09620
C**** DIRECTOR--STARTING BOUNDARY OF GROUP	CHD09630
C**** 1--(3115)--FIXED TEMP (BOUNDARY FOR PROBLEM START IN INTERIOR)	CHD09640
C**** 2--(3120)--INTERIOR (NORMAL TYPE FOR BOUNDARY BETWEEN GROUPS)	CHD09650
C**** 3--(3105)--FLUX DRIVE (BACK SURFACE)	CHD09660
C**** 4--(3110)--TEMP DRIVE (BACK SURFACE)	CHD09670
C	CHD09680
GO TO (3115,3120,3105,3110),JBND1	CHD09690
3105 D(1)=CONDX(1)*TEMPA1(JBS+1)+(PC(1)-CONDX(1))*TEMPA1(JBS)	CHD09700
ONE = PC(1)+CONDX(1)	CHD09720
CC(JBS) = -CONDX(1)/ONE	CHD09730
DD(JBS) = D(1)/ONE	CHD09740
GO TO 3200	CHD09750
3110 SBK = 2.*CONDX(1)	CHD09760
3115 CC(JBS) = 0.	CHD09770
DD(JBS) = TEMPA2(JBS)	CHD09780

	TWO = EMIS(I)	CHD10340
13242	QBYRAD=TWO*.481E-12*TEMPA**4	CHD10350
	TIME=TAU1	CHD10355
	CALL GPCOM	CHD10360
	XMCOM=XMDOTL+XMDOTG*(DIFREC-1.711)	CHD10370
	IF(XMCOM)3241,3242,3242	CHD10380
3241	XMCOM=0.	CHD10390
3242	QCOMB=HCOM*XMCOM	CHD10400
	QSUBL=HSUB*XMDOTS	CHD10410
	XIR(N,L)=FONEV(TAU1,ISAVE4,TIME3,XRI,NDOTS(3),1)	CHD10420
	QMISC=FONEV(TAU1,ISAVE5,TIME3,QMU,NDOTS(3),1)	CHD10430
	HCONV(N,L)=FONEV(TAU1,ISAVE6,TIME3,RH,NDOTS(3),1)	CHD10440
	QTOT = QMISC+QCOMB-QSUBL+QGPCOM	CHD10450
	CALL SUBZ (ZWALL,TEMPA,BLPRES(N,L))	CHD10460
	CALL IWR (ZWALL,TEMPA,XI)	CHD10470
	QCONV(N,L) = HCONV(N,L)*(XIR(N,L)-XI)	CHD10480
	QTOTAL = QTOT+ONE*QGAS(N,L)+PHI*QCONV(N,L)-QBYRAD	CHD10490
	QTOTAL=QTOTAL*AREA(JE)	CHD10500
	GO TO (13243,13244),IX	CHD10510
13243	CONTINUE	CHD10520
	QSAVE = QTOTAL	CHD10530
	TEMPA = TEMPA+10.	CHD10540
	CALL RECEED(TEMPA)	CHD10550
	IX=2	CHD10560
	GO TO 13242	CHD10570
13244	CONTINUE	CHD10580
	DQ = -(QTOTAL-QSAVE)/10.	CHD10590
	GZ = DQ/2.	CHD10600
	GY = QSAVE+GZ*TEMPA5(NOF)	CHD10610
	ONE = C(JE)/GX	CHD10620
	D(JE)=(PC(JE)-GK)*TEMPA1(NOF)+GK*TEMPA1(NOF-1)+ONE*GY+EDFLUX(JE)	CHD10630
	GO TO (3244,3246,3243),JRSW	CHD10640
3246	GO TO (3247,3243),NSTILL	CHD10650
3243	D(JE) = D(JE)+2.*FHTX	CHD10660
3247	CONTINUE	CHD10670
	D(JE)=D(JE)+2.*(WDEP(NOF)*QDEP+WSI(NOF)*QSI+WBRN(NOF)*QBRN)	CHD10680
3244	ONE = B(JE)+ONE*GZ+GK*CC(NOF-1)	CHD10690
C		CHD10700
C****	TEMPERATURE CHECK AND DETERMINATION OF DIRECTION	CHD10710
C****	OF FURTHER CALCULATION	CHD10720
C		CHD10730
C	CALCULATION AND CHECK OF SURFACE TEMPERATURE	CHD10740
C		CHD10750
	ABVALS = 0.	CHD10780
	ABVALM = 0.	CHD10790
	TEMPA = TEMPA5(NOF)	CHD10800
	TEMPA5(NOF) = (D(JE)+GK*DD(NOF-1))/ONE	CHD10810
	ABVAL = ABS((TEMPA5(NOF)-TEMPA)/TEMPA)	CHD10820
	ETAS=AMIN1(ETA,40./TEMPA)	CHD10830
	IF (ABVAL-ABVALS) 13246,13246,13245	CHD10840
13245	ABVALS = ABVAL	CHD10850
13246	CONTINUE	CHD10860
	IF(ABVAL-ETAS)3260,3260,3245	CHD10870
3245	IERR = 2	CHD10880
	IF (TEMPA5(NOF)) 3250,3260,3260	CHD10890

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3250 TEMPA5(NOF) = 10.
C      CALCULATION AND CHECK OF TEMPERATURES
3260 IGT = IG2
      GAS=WFX
      DGAS=(GAS-GAS1)/DTAUX
3261 DO 3265 I=1,JE1
      J = IBE(IG)-I
      K = J+1
      TEMPA = TEMPA5(J)
      TEMPA5(J) = DD(J)-CC(J)*TEMPA5(K)
      ABVAL = ABS((TEMPA5(J)-TEMPA)/TEMPA)
      IF (ABVAL-ABVALS) 13262,13262,13261
13261 ABVALS = ABVAL
13262 CONTINUE
      GO TO (3262,3265),IERR
3262 CONTINUE
      IF (ABVAL-ETA) 3265,3265,3263
3263 IERR = 2
      IF (TEMPA5(J)) 3264,3265,3265
3264 TEMPA5(J) = 10.
3265 CONTINUE
      IF (IG-MG) 3267,3266,3266
3266 ABVALM = ABVALS
      ABVALS = 0.
3267 CONTINUE
      GO TO (3270,3274),NXSW
3270 NXSW = 2
      IX = 1
      GO TO (3274,3375),IERR
3274 IF (IG-IGT) 3275,3275,3277
3275 IF (IGL) 3278,3278,3276
3276 IGT = 1
3277 IX = IBE(IGL)
      JBS = IBS(IG)
      TEMPA5(IX) = TEMPA5(JBS)
      IG = IGL
      IGL = IGL-1
      JE1 = NSLABH(IG)
      GO TO 3261
3278 GO TO (3280,3290), IERR
C
C**** NO ERROR IN TEMPERATURES--DETERMINE NEW TIME STEP
C
3280 ONE = ETA*DTAU
      IF (ITER-2) 3282,3285,3287
3282 IF (ABVALM-1.1*ABVALS) 3283,3284,3284
3283 DTAUC = 0.80*ONE/ABVALS
      GO TO 3400
3284 DTAUC = 1.0*ONE/(ABVALM+1E-6)
      GO TO 3400
3285 DTAUC=ONE/AMAX1(ABVALS,ABVALM,1E-6)
3287 DTAUC = 0.80*DTAUC
      GO TO 3400
C
C**** ERROR IN TEMPERATURES--REITERATE OR CUT TIME STEP

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CHD10900
CHD10910
CHD10920
CHD10933
CHD10937
CHD10938
CHD10940
CHD10950
CHD10960
CHD10970
CHD10980
CHD10990
CHD11000
CHD11010
CHD11020
CHD11030
CHD11040
CHD11050
CHD11060
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CHD11100
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CHD11200
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CHD11270
CHD11280
CHD11290
CHD11300
CHD11310
CHD11320
CHD11330
CHD11340
CHD11350
CHD11360
CHD11370
CHD11380
CHD11390
CHD11400
CHD11410
CHD11420

```

C**** AND RSTART ON CALCULATION

C

3290 CONTINUE

IF (ITER-3) 3370,3295,3295

3295 DTF = ETA/AMAX1(ABVALS,ABVALM)

IF (DTF-.5) 13295,13297,13296

13295 DTF = .25

GO TO 13297

13296 DTF = 0.5

13297 CONTINUE

C

C**** RESET OF DTAU,PREDICTED TEMPERATURES, AND PREDICTED DENSITIES

C

3296 CONTINUE

ONE = DTF*DTAU

TWO = DTAU-ONE

TAU2 = TAU2-TWO

DTAU = ONE

DTAUX = DTAUX-TWO/2.

DTAUC = DTAU

3340 DO 3360 I=1,MG

JBS = IBS(I)

JBE = IBE(I)

DO 3350 J=JBS,JBE

TEMPA2(J) = TEMPA1(J)+DTF*(TEMPA2(J)-TEMPA1(J))

3350 TEMPA5(J) = TEMPA2(J)

IF (NRSW(I)-3) 3360,3355,3360

3355 DO 3356 J=JBS,JBE

RHO2(J) = RHO1(J)+DTF*(RHO2(J)-RHO1(J))

3356 RHO5(J) = RHO2(J)

JBS = IBSPM+NCSN(IG)

JBE = JBS+NSLAB(IG)-1

DO 3357 J=JBS,JBE

RHO2(J) = RHO1(J)+DTF*(RHO2(J)-RHO1(J))

3357 RHO5(J) = RHO2(J)

3360 CONTINUE

GO TO 2690

3370 IG=1

IX = 2

3375 IERR=1

ITER = ITER+1

ITERT = ITERT+1

GO TO (3395,2693),IX

3395 CONTINUE

JBS = IBS(MG)

TEMPA3(1) = 0.5*(TEMPA1(JBS)+TEMPA5(JBS))

WFX = WFX

FHTX = FHTX

CONDX = CONDX

JRX = JRX

PCX = PCX

EDFX=EDFX

WFDX=WFDX

WDEPX=WDEPX

WSIX = WSIX

CHD11430

CHD11440

CHD11450

CHD11460

CHD11470

CHD11480

CHD11490

CHD11500

CHD11510

CHD11520

CHD11530

CHD11540

CHD11550

CHD11560

CHD11570

CHD11580

CHD11590

CHD11600

CHD11610

CHD11620

CHD11630

CHD11640

CHD11650

CHD11660

CHD11670

CHD11680

CHD11690

CHD11700

CHD11710

CHD11720

CHD11730

CHD11740

CHD11750

CHD11760

CHD11770

CHD11780

CHD11790

CHD11800

CHD11810

CHD11820

CHD11830

CHD11840

CHD11850

CHD11860

CHD11870

CHD11880

CHD11890

CHD11900

CHD11910

CHD11920

CHD11930

CHD11940

CHD11950

CHD11960

CHD11970

WBRNX=WBRNXX	CHD11980
DEPX=DEPXX	CHD11993
DWFDX=DWFDXX	CHD11997
GO TO 2710	CHD11998
C	CHD12000
C**** NEW TIME STEP	CHD12010
C	CHD12020
3400 CONTINUE	CHD12030
C	CHD12040
C**** SETTING OF TIMES AND DELTA TIMES	CHD12050
C	CHD12060
DTAUS = DTAU	CHD12070
NOTIME = NOTIME+1	CHD12080
3424 CONTINUE	CHD12090
3426 DTAU = DTAUC	CHD12100
IF (TAU2+1.1*DTAU-TAUOUT) 3500,3427,3427	CHD12110
3427 TAU2S=1.0000001*TAU2	CHD12120
IF (TAU2S-TAUOUT) 3428,3430,3430	CHD12130
3428 DTAU = TAUOUT-TAU2	CHD12140
GO TO 3500	CHD12150
3430 TAU2 = TAUOUT	CHD12160
NPTSW = 2	CHD12170
3432 TAUOUT = TAU2+COMMAX	CHD12180
GO TO 3424	CHD12190
3500 CONTINUE	CHD12200
TAU1 = TAU2	CHD12210
TAU2 = TAU2+DTAU	CHD12220
DTAUX = 0.5*(DTAU+DTAUS)	CHD12230
C	CHD12240
C**** CALCULATION OF SURFACE DISTANCE AT J AND SETTING OF GAS AT J-1/2	CHD12250
C	CHD12260
SN1 = SN+SDN	CHD12270
GAS1 = GAS	CHD12280
C	CHD12290
C**** PREDICTIONS OF TEMPERATURES AND DENSITIES FOR NEXT STEP.	CHD12300
C**** PLACEMENT OF VALUES INTO BASIC NODES	CHD12310
C	CHD12320
DO 3505 J=1,2	CHD12330
TAUST(J) = TAUST(J+1)	CHD12340
TEMPST(J) = TEMPST(J+1)	CHD12350
3505 DTR(J) = DTR(J+1)	CHD12360
TAUST(3) = TAU1	CHD12370
TEMPST(3) = TEMPAS(NOF)	CHD12380
IF (TAUST(3)-1.001*TAUST(1)) 3509,3509,13508	CHD12390
13508 CONTINUE	CHD12400
DTR(3) = (TEMPAS(NOF)-TEMPA1(NOF))/DTAUS	CHD12410
IF (DTR(3)-DTR(2)) 3506,3509,3507	CHD12420
3506 IF (DTR(2)-DTR(1)) 3509,3509,3508	CHD12430
3507 IF (DTR(2)-DTR(1)) 3508,3509,3509	CHD12440
3508 CONTINUE	CHD12450
TEMPST(3) = (TEMPST(2)+TEMPST(3)+(TEMPST(3)-TEMPST(1))	CHD12460
1*(TAUST(3)-TAUST(2))/(TAUST(3)-TAUST(1)))/2.	CHD12470
TEMPAS(NOF) = TEMPST(3)	CHD12480
DTR(3) = (TEMPAS(NOF)-TEMPA1(NOF))/DTAUS	CHD12490
3509 CONTINUE	CHD12500

```

JBE=1
DO 23505 IG=1, MG
JBS=IBS(IG)
JBEX=JBE
JBF=IBE(IG)
JBEM=JBE-1
QCOND(JBS)=QCOND(JBEX)
K=NCSN(IG)-1
IF(IGTYP(IG)) 23505, 23505, 23503
23503 DO 23504 J=JBS, JBEM, JHDN
K=K+1
23504 QCOND(K)=QCOND(J)
23505 QCOND(JBEX)=QCOND(JBS)
QCOND(NOF)=QCOND(NOF+1)
QCOND(MNOD)=QCOND(NOF)
QCOND(1)=QBACK
JBS=IRS(1)
QCOND(JBS)=QBACK
3510 TWO = DTAU/DTAUS
ONE = 1.+TWO
JBE = 0
DO 3526 IG=1, MG
JBS = IBS(IG)
IF (JBS-JBE) 13511, 13510, 13511
13510 KK = JBS+1
GO TO 13512
13511 KK = JBS
13512 CONTINUE
JBE = IBE(IG)
JBEM = JBE-1
DO 3511 J=KK, JBE
SILCA1(J)=SILCA5(J)
CARBN1(J)=CARBN5(J)
GRAF1(J)=GRAF5(J)
TEMPA2(J) = ONE*TEMPA5(J)-TWO*TEMPA1(J)
TEMPA1(J) = TEMPA5(J)
3511 TEMPA5(J) = TEMPA2(J)
IX = IGTYP(IG)
IF (IX) 3517, 3517, 3514
3514 JHDN = NHDN(IX)
3515 JCSN = NCSN(IG)
JCSNM = JCSN-1
K = JCSNM
JCEN = NCEN(IG)
DO 3516 J=JBS, JBEM, JHDN
K = K+1
WFD(K)=WFD(J)
SILCA1(K)=SILCA1(J)
CARBN1(K)=CARBN1(J)
GRAF1(K)=GRAF1(J)
TEMPA1(K) = TEMPA1(J)
WF(K) = WF(J)
TEMPA2(K) = TEMPA2(J)
3516 TEMPA5(K) = TEMPA2(J)
3517 IF (NRSW(IG)-2) 3526, 3518, 3518

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CHD12510
CHD12520
CHD12530
CHD12540
CHD12550
CHD12560
CHD12570
CHD12580
CHD12590
CHD12600
CHD12610
CHD12620
CHD12630
CHD12640
CHD12650
CHD12660
CHD12670
CHD12680
CHD12690
CHD12700
CHD12710
CHD12720
CHD12730
CHD12740
CHD12750
CHD12760
CHD12770
CHD12780
CHD12790
CHD12800
CHD12810
CHD12820
CHD12830
CHD12840
CHD12850
CHD12860
CHD12870
CHD12880
CHD12890
CHD12900
CHD12910
CHD12920
CHD12930
CHD12940
CHD12950
CHD12960
CHD12970
CHD12980
CHD12990
CHD13000
CHD13010
CHD13020
CHD13030
CHD13040
CHD13050

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```

3518 CONTINUE
3519 IX = 1
3520 DO 3523 J=JRS,JBEM
      RHO2(J) = ONE*RHO5(J)-TWO*RHO1(J)
      IF (RHO2(J)) 3521,3522,3522
3521 RHO2(J) = 0.
3522 RHO1(J) = RHO5(J)
3523 RHO5(J) = RHO2(J)
      GO TO (3524,3526),IX
3524 K = JCSNM
      DO 3525 J=JRS,JBEM,JHDM
        K = K+1
        RHO1(K) = RHO1(J)
        RHO2(K) = RHO2(J)
3525 RHO5(K) = RHO5(J)
        JBS = JCSN+IBSPM
        JBEM = JCEN+IBSPN
        IX = 2
        GO TO 3520
3526 CONTINUE
      WFD(MNOD)=WFD(NOF)
      WDEP(MNOD)=WDEP(NOF)
      WSI(MNOD)=WSI(NOF)
      WBRN(MNOD)=WBRN(NOF)
      WDEP(NN)=WDEP(NOF-4)
      WSI(NN)=WSI(NOF-4)
      WBRN(NN)=WBRN(NOF-4)
      TEMP1(MNOD) = TEMP1(NOF)
      TEMP2(MNOD) = TEMP2(NOF)
      TEMP5(MNOD) = TEMP5(NOF)
      GRAF1(MNOD)=GRAF1(NOF)
      SILCA1(MNOD)=SILCA1(NOF)
      CARBN1(MNOD)=CARBN1(NOF)
      WF(MNOD) = WF(NOF)
      GO TO (13529,13525),NPTSW
13525 CONTINUE
      NPTSW = 1
      DO 13526 J=1,153
        DD(J) = RHO5(J)
        CC(J) = RHO5(J+152)
13526 CONTINUE
      DO 14000 J=1,203
14000 RHO5(J)=RHO5(J)+SILCA1(J)+CARBN1(J)+GRAF1(J)
      DO 14001 J=205,303
14001 RHO5(J)=RHO5(J)+SILCA1(J-203)+CARBN1(J-203)+GRAF1(J-203)
      RHO5(IBSPM) = 0.
      NRDIV = NHDN(1)
      NRGO = NZSN(1)
      NREND = NZEN(1)
      TWALL(N,L) = TEMP1(NOF)
      XLEFT(MNOD) = SN1+XLEFT(IYS)
      RETURN
13527 CONTINUE
      DO 13528 J=1,153
        RHO5(J) = DD(J)

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CHD13060
CHD13070
CHD13080
CHD13090
CHD13100
CHD13110
CHD13120
CHD13130
CHD13140
CHD13150
CHD13160
CHD13170
CHD13180
CHD13190
CHD13200
CHD13210
CHD13220
CHD13230
CHD13240
CHD13250
CHD13260
CHD13270
CHD13280
CHD13290
CHD13300
CHD13310
CHD13320
CHD13330
CHD13340
CHD13350
CHD13360
CHD13370
CHD13380
CHD13390
CHD13400
CHD13410
CHD13420
CHD13430
CHD13440
CHD13450
CHD13460
CHD13470
CHD13480
CHD13490
CHD13500
CHD13510
CHD13520
CHD13530
CHD13540
CHD13550
CHD13560
CHD13570
CHD13580
CHD13590
CHD13600

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```

13528 RHO5(J+152) = CC(J)
13529 CONTINUE
C
C**** FRONT CONTROL
C
      IF (SN1-SCHECK) 13530,13530,13531
13530 CONTINUE
      CALL FRONT
      MARK = 2
13531 CONTINUE
      IF (NZONC-1) 2687,23529,2687
23529 CONTINUE
C
C**** CHECK LOCATION OF REACTION ZONE
C
      IGR = IZG(NRZON,1)
      JX = IZGT(NRZON)
      IGRL = IZG(NRZON,JX)
      IG = IGRL
      JHDN = NHDN(NRZON)
      IM = NCSN(IGR)
      I = MAT(IM)
      JBS = IBS(IGR)
      JBE = IBE(IGR)
      JBEM = JBE-1
      JHDN1 = JHDN+1
      IF (RHO1(JBS)-.03*RHOV(I)) 23527,23527,23528
23527 IN1 = JBS-1
      GO TO 3530
23528 CONTINUE
      KL = 0
      DO 3528 J=JBS,JBEM
      IM = (KL/JHDN1)+NCSN(IGR)
      KL = KL+1
      I = MAT(IM)
      IF (ABS(RHO1(J)-RHOV(I))-.03*RHOV(I)) 3528,3527,3527
3527 IN1 = J-1
      GO TO 3530
3528 CONTINUE
      IN1 = JRFM
3530 JBS = IBS(IG)
      JBE = IBE(IG)
      JBEM = JBE-1
      K = JBE
      KL = JHDN
      DO 3532 J=JBS,JBEM
      K = K-1
      IM = NCEN(IG)-KL/JHDN
      KL = KL+1
      IF (RHO1(K)-.15*RHOV(I)) 3532,3532,3531
3531 IN2 = K
      GO TO 3533
3532 CONTINUE
      IF (IG-IGR) 13533,13533,13532
13532 IG = IG-1

```

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CHD13610
CHD13620
CHD13630
CHD13640
CHD13650
CHD13660
CHD13670
CHD13680
CHD13690
CHD13700
CHD13710
CHD13720
CHD13730
CHD13740
CHD13750
CHD13760
CHD13770
CHD13780
CHD13790
CHD13800
CHD13810
CHD13820
CHD13830
CHD13840
CHD13850
CHD13860
CHD13870
CHD13880
CHD13890
CHD13900
CHD13910
CHD13920
CHD13930
CHD13940
CHD13950
CHD13960
CHD13970
CHD13980
CHD13990
CHD14000
CHD14010
CHD14020
CHD14030
CHD14040
CHD14050
CHD14060
CHD14070
CHD14080
CHD14090
CHD14100
CHD14110
CHD14120
CHD14130
CHD14140
CHD14150

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13533	GO TO 3530	CHD14160
	CONTINUE	CHD14170
	IN2 = JBS-1	CHD14180
C		CHD14190
C****	ZONE SHIFT	CHD14200
C		CHD14210
3533	IF (XLEFT(MNOD)-XSAVE) 3536, 3536, 3534	CHD14220
3536	WRITE(6,100) TIME	CHD14230
100	FORMAT(1H //41X36HALL VIRGIN MATERIAL HAS BEEN ABLATED//52X15	CHD14240
	1HCASE TERMINATED//51X7HTIME = F10.4)	CHD14250
	CALL EXIT	CHD14260
3534	J=NZEN(NRZON)-NCEN(MG)	CHD14280
	JBEM = IBE(IGRL)-1	CHD14290
	IF (JBEM-IN2) 3535, 3535, 3542	CHD14300
3535	IF (J+1) 3540, 3538, 3545	CHD14310
3538	NLZON = NLZON-1	CHD14320
3540	CALL SHIFT1 (NRZON, LRT, 1)	CHD14330
	MARK = 2	CHD14340
	GO TO 3545	CHD14350
3542	IF (JBEM-IN2-JHDN-1) 3545, 3543, 3543	CHD14360
3543	CALL SHIFT1 (NRZON, LRT, -1)	CHD14370
	MARK = 2	CHD14380
	IF (J) 3545, 3544, 3544	CHD14390
3544	CONTINUE	CHD14400
	IZGT(2) = 1	CHD14410
	IZG(2,1) = MG+1	CHD14420
	IGTYP(MG+2) = 1	CHD14430
	IBE(MG+1) = IZB(2)	CHD14440
	IBS(MG+2) = IBE(MG)-NHDN(1)	CHD14450
	NCSN(MG+2) = NCEN(MG)-1	CHD14460
	NZSN(NRZON+1) = NCSN(MG+2)	CHD14470
	NZEN(NRZON+1) = NCSN(MG+2)	CHD14480
	CALL SHIFT1 (NRZON+1, LRT, 1)	CHD14490
	MARK = 2	CHD14500
	NLZON = NLZON+1	CHD14510
3545	IF ((NZEN(NRZON)-NZSN(NRZON)+1)*JHDN-68) 3546, 3554, 3554	CHD14520
3546	JBS = IBS(IGR)	CHD14530
	IF (IN1-JBS-1) 3550, 3550, 3554	CHD14540
3550	IF (NZSN(NRZON)-1) 3556, 3556, 3552	CHD14550
3552	CALL SHIFT1 (NRZON, LFT, -1)	CHD14560
	MARK = 2	CHD14570
	GO TO 3556	CHD14580
3554	IF (IN1-JBS-JHDN-1) 3556, 3556, 3555	CHD14590
3555	CALL SHIFT1 (NRZON, LFT, 1)	CHD14600
	MARK = 2	CHD14610
3556	CALL SHIFT2	CHD14620
	IF (NZEN(NRZON)-NZSN(NRZON)) 3558, 3557, 3558	CHD14630
3557	NZONC = 2	CHD14640
	NRIDC = 2	CHD14650
	GO TO 2600	CHD14660
3558	CONTINUE	CHD14670
	GO TO (12687, 2600), MARK	CHD14680
	END	CHD14690

```

- FOR COMBIN,COMBIN
  SUBROUTINE COMBIN
C**** THE COMBIN SUBROUTINE COMBINES 2 MAJOR NODES INTO 1.
  DIMENSION ASTORE (20), BSTORE(20), CSTORE(20),
  1DSTORE(20),RSTORE(20),SSTORE(20)
  DIMENSION UHOLD(20),VHOLD(20),WHOLD(20),XHOLD(20)
  DIMENSION NHDN(3), PHO4(306)
  DIMENSION DELTAX(1), TEMP1(1)
  DIMENSION PSTORE(20),QSTORE(20)
  DIMENSION USTORE(20),VSTORE(20),WSTORE(20)
  COMMON /BLOCKA/
  1ABSORP(10) ,ABSC      ,ACTENC      ,ACTENS      ,ACTENV(4,10),
  2BSTAR      ,CCPC(4)   ,CCPG(4)    ,CHARPT(101) ,CKC(4)    ,
  3COEFT(4,10) ,CONDC    ,CONDV(100) ,CONST(4,10) ,COVERX(100),
  4CPBAR      ,CPC      ,CPV(100)   ,DIFREC    ,UMATER(10) ,
  5EFCOLC     ,EFCOLS   ,EFCOLV(4,10),EMIS(10)   ,EMISC     ,
  6HOFM(10)   ,HCOM     ,HCOMG     ,HSUB      ,MAT(100)   ,
  7MATOMN     ,MATMNE   ,MN        ,NN        ,NNP      ,
  8NNSAVE     ,NRDIV    ,NREND     ,NRGO      ,NST       ,
  9PARTIN(101) ,PHI     ,QBYRAD    ,QCOMB     ,QEXTR     ,
  10GPCOM     ,QSUBL    ,RECPRO    ,REORDC    ,REORDS    ,
  2REORDV(4,10),RH05Z   ,RH05(305) ,RHOCPX(101) ,RHOC     ,
  3RHOV(10)   ,SABL     ,SABLC     ,SDOT      ,SDOTC     ,
  4SLOPE(10)  ,TMELT(10),TSZ      ,TS(205)   ,TRCHAR    ,
  5WFZ        ,WF(205)  ,XCHAR     ,XINIT     ,XLEFT(101) ,
  6XMASS      ,XMDOTC   ,XMDOTD    ,XMDOTG    ,XMDOTL    ,
  7XMDOTR     ,XMDOTS   ,XTOTAL    ,XVIRG(101) ,XZONE     ,
  COMMON/BLOCKC/
  1BLPRES(20,11) ,COMMAX      ,CUTOFF      ,F(20,11) ,
  2FLOW(20,11) ,HCONV(20,11),IERROR     ,JUNCT     ,L ,
  3N            ,NOSECH     ,QBACK      ,QCONV(20,11),QGAS(20,11) ,
  4QMISC       ,TIME       ,TPRINT     ,TWALL(20,11),XIWALL(20,11),
  5XIR(20,11)
  COMMON /CHCOM/ DTAU,      IBE(10),      IBS(10),      IBSPN,
  1IGTYP(10), IHDN(4),      IM,          IZB(3),      IZG(3,10),
  2IZGT(3),   JRSW,        NCSN(10),   NSHL(3),      NSHR(3),
  3NZEN(3),   NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),
  4I          ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),
  5          ,DELX(100),DISTL(100),DUM (10),ICOM,
  6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,
  7SCHECK
  COMMON /NASCOM/ CHARRO,AIRM,
  1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)
  2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205), WDEP(205),WS1(20
  35),WBRN(205),EMWT(205),PRG(205)
  4,TIMEX(50),TFT(50),NPTS
  5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS,
  6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,
  7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)
  8,ALLGAS(205),GRAF1(205)
  EQUIVALENCE (IHDN(2),NHDN(1))
  EQUIVALENCE (RHO3(103),RHO4(1))
  EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))
  EQUIVALENCE (MNOD,NNP)
  SF = 1.

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CHD14700
CHD14710
CHD14720
CHD14730
CHD14740
CHD14750
CHD14760
CHD14770
CHD14780
CHD14790
CHD14800
CHD14810
CHD14820
CHD14830
CHD14840
CHD14850
CHD14860
CHD14870
CHD14880
CHD14890
CHD14900
CHD14910
CHD14920
CHD14930
CHD14940
CHD14950
CHD14960
CHD14970
CHD14980
CHD14990
CHD15000
CHD15010
CHD15020
CHD15030
CHD15040
CHD15050
CHD15060
CHD15070
CHD15080
CHD15090
CHD15100
CHD15110
CHD15120
CHD15130
CHD15140
CHD15150
CHD15160
CHD15170
CHD15180
CHD15190
CHD15200
CHD15210
CHD15220
CHD15230

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```

KX = 0.
IX = 0
DSTORE(1) = 0.
IG = MG-1
3 KHDN = JHDN
KST = JST
J=NCFN(IG-1)
ONE = DFLTAX(J)*SF
JX = IGTYP(IG)
JHDN = NHDN(JX)
JST = IRF(IG)-JHDN
K = JST-1
JY = JHDN+IX
5 DO 10 I=1,JY
K = K+1
KX = KX+1
UHOLD(KX)=WFD(K)
VHOLD(KX)=WDEP(K)
WHOLD(KX)=WSI(K)
XHOLD(KX)=WBRN(K)
USTORE(KX)=EMWT(K)
VSTORE(KX)=WF(K)
WSTORE(KX)=GRAF1(K)
ASTORE(KX) = TEMP1(K)
RSTORE(KX) = TEMP2(K)
CSTORE(KX) = TEMP5(K)
DSTORE(KX+1) = DSTORE(KX) + ONE
PSTORE(KX)=SILCA1(K)
QSTORE(KX)=CARBN1(K)
RSTORE(KX) = RHO1(K)
10 SSTORE(KX) = RHO2(K)
SF = SN1/SN
IX = IX+1
IG = MG
GO TO (3,12),IX
12 CONTINUE
J = KST
IF (ICOM-2) 14,14,13
13 KST = JST
KHDN = JHDN
14 CONTINUE
TEMP1(KST) = TEMP1(J)
TEMP2(KST) = TEMP2(J)
TEMP5(KST) = TEMP5(J)
SILCA1(KST)=SILCA1(J)
CARBN1(KST)=CARBN1(J)
WFD(KST)=WFD(J)
WDEP(KST)=WDEP(J)
WSI(KST)=WSI(J)
WBRN(KST)=WBRN(J)
EMWT(KST)=EMWT(J)
WF(KST)=WF(J)
GRAF1(KST)=GRAF1(J)
RHO1(KST) = RHO1(J)
RHO2(KST) = RHO2(J)

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CHD15240
CHD15250
CHD15260
CHD15270
CHD15280
CHD15290
CHD15300
CHD15310
CHD15320
CHD15330
CHD15340
CHD15350
CHD15360
CHD15370
CHD15380
CHD15390
CHD15400
CHD15410
CHD15420
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CHD15630
CHD15640
CHD15650
CHD15660
CHD15670
CHD15680
CHD15690
CHD15700
CHD15710
CHD15720
CHD15730
CHD15740
CHD15750
CHD15760
CHD15770
CHD15780

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DX = .999999*DSTORE(KX)/FLOAT(KHDN)
DIS = 0.
K = 1
DO 30 J=1,KHDN
DIS = DIS+DX
KX = KST+J
20 ONE = DSTORE(K+1)-DIS
IF (ONE) 21,23/23
21 K = K+1
GO TO 20
23 THREE = DSTORE(K+1)-DSTORE(K)
ONE = ONE/THREE
TWO = (DIS-DSTORE(K))/THREE
WFD(KX)=ONE*UHOLD(K)+TWO*UHOLD(K+1)
WDEP(KX)=ONE*VHOLD(K)+TWO*VHOLD(K+1)
WSI(KX)=ONE*WHOLD(K)+TWO*WHOLD(K+1)
WRN(KX)=ONE*XHOLD(K)+TWO*XHOLD(K+1)
EMWT(KX)=ONE*USTORE(K)+TWO*USTORE(K+1)
WF(KX)=ONE*VSTORE(K)+TWO*VSTORE(K+1)
GRAF1(KX)=ONE*WSTORE(K)+TWO*WSTORE(K+1)
TEMPA1(KX) = ONE*ASTORE(K)+TWO*ASTORE(K+1)
TEMPA2(KX) = ONE*BSTORE(K)+TWO*BSTORE(K+1)
TEMPA5(KX) = ONE*CSTORE(K)+TWO*CSTORE(K+1)
SILCA1(KX)=ONE*PSTORE(K)+TWO*PSTORE(K+1)
CARBN1(KX)=ONE*QSTORE(K)+TWO*QSTORE(K+1)
RHO1(KX) = ONE*RSTORE(K)+TWO*RSTORE(K+1)
30 RHO2(KX) = ONE*SSTORE(K)+TWO*SSTORE(K+1)
K = IRSPN+NN
RHO1(K) = RHO1(K+1)
RHO2(K) = RHO2(K+1)
RETURN
END

```

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CHD15790
CHD15800
CHD15810
CHD15820
CHD15830
CHD15840
CHD15850
CHD15860
CHD15870
CHD15880
CHD15890
CHD15900
CHD15910
CHD15920
CHD15930
CHD15940
CHD15950
CHD15960
CHD15970
CHD15980
CHD15990
CHD16000
CHD16010
CHD16020
CHD16030
CHD16040
CHD16050
CHD16060
CHD16070
CHD16080
CHD16090
CHD16100

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- FOR CONDF,CONDF
  FUNCTION CONDF(K)
C**** THE CONDF SUBROUTINE CALCULATES HEAT CONDUCTIVITY
  DIMENSION NHDN(3), RHO4(306)
  DIMENSION DELTAX(1), TEMPA1(1)
  COMMON /BLOCKA/
1ABSORP(10) ,ABSC ,ACTENC ,ACTENS ,ACTENV(4,10),
2BSTAR ,CCPC(4) ,CCPG(4) ,CHARPT(101) ,CKC(4) ,
3COEFT(4,10) ,CONDC ,CDUM (100) ,CONST(4,10) ,COVERX(100) ,
4CPBAR ,CPC ,CPV(100) ,DIFREC ,UMATER(10) ,
5EFCOLC ,EFCOLS ,EFCOLV(4,10) ,EMIS(10) ,EMISC ,
6HOFM(10) ,HCOM ,HCOMG ,HSUB ,MAT(100) ,
7MATOMN ,MATMNE ,MN ,NN ,NNP ,
8NNSAVE ,NRDIV ,NREND ,NRGO ,NST ,
9PARTIN(101) ,PHI ,QBYRAD ,QCOMB ,QEXTR ,
10GPCOM ,QSUBL ,RECPRO ,REORDC ,REORDS ,
2REORDV(4,10) ,RHO5Z ,RHO5(305) ,RHOC PX(101) ,RHOC ,
3RHOV(10) ,SABL ,SABLC ,SDOT ,SDOTC ,
4SLOPE(10) ,TMELT(10) ,TSZ ,TS(205) ,TRCHAR ,
5WFZ ,WF(205) ,XCHAR ,XINIT ,XLEFT(101) ,
6XMASS ,XMDOTC ,XMDOTD ,XMDOTG ,XMDOTL ,
7XMDOTR ,XMDOTS ,XTOTAL ,XVIRG(101) ,XZONE ,
  COMMON/BLOCKC/
1BLPRES(20,11) ,COMMAX ,CUTOFF ,F(20,11) ,
2FLOW(20,11) ,HCONV(20,11) ,IERROR ,JUNCT ,L ,
3N ,NOSECH ,QBACK ,QCONV(20,11) ,QGAS(20,11) ,
4QMISC ,TIME ,TPRINT ,TWALL(20,11) ,XIWALL(20,11) ,
5XIR(20,11) ,
  COMMON /CHCOM/ DTAU, IBE(10), IBS(10), IBSPN,
1IGTYP(10), IHDN(4), IM, IZB(3), IZG(3,10),
2IZGT(3), JRSW, NCSN(10), NSHL(3), NSHR(3),
3NZEN(3), NZSN(3), RHO1(305), RHO2(305), RHO3(410),
4I ,TEMPA2(205),TEMPA3(42),TEMPA4(42),TEMPA5(205),
5 DELX(100),DISTL(100),DUM (10),ICOM,
6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,
7SCHECK
  COMMON /DACOM/ A(42),
1ABVAL ,ABVALM,ABVALS,B(42) ,C(42) , CC(205),COND(42),
2CONDX ,CONDXX, D(42) ,DD(205),DELT X(101),DGAS,DO,
3DTAUC ,DTAUS ,DTAUX ,DTF,DTR(3),EDFX,EDFX X,EMI(42),
4ETA,ETAS,FHT(42),FHTX,FHTXX,GAGC,GAS1,GK,GX,GY,GZ,
5HDA(5,10),IBSPM,IERR,IGC,IGL,IGLD,IGR,IGRL,IGT,IG2,
6IHYS,INEG,IN1,IN2,IP,IPLUS,ITER,ITER T,IX,IY,IZ,J,JBE,
7JBEM,JBFX,JBND1,JBND2,JBS,JBSM,JBSPM,JBSPN,JBX,JBXX,JCEN,
8JCENM,JCSN,JCSNM,JE,JE1,JE2,JHDN,JHDN1,JLSW,JSLAB,JX,JZ,
9K1,LANDID,LRT,MARK,NADD(42),NASW,NBNDST,NBND1(11),
1NBSW,NDC,NDCM,NLSW(10),NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW,
2NPID,NRID,NRSW(10),NRZON,NSLAB(10),NSLABH(10),NSW,NXSW,
3NZON,NZONC,ONE,PSI,OSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN,
4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,
5TEMPST(3),THREE,TWO,WFP,WFX,WFX X,XI,XMCOM,XSAVE
  COMMON /NASCOM/ CHARRO,AIRM,
1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205),
2HYD(205),AERO(205),AERN(205),BURN(205),WFD(205),WDEP(205),WSI(205),
3WBURN(205),EMWT(205),PRG(205)

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CHD16110
 CHD16120
 CHD16130
 CHD16140
 CHD16150
 CHD16160
 CHD16170
 CHD16180
 CHD16190
 CHD16200
 CHD16210
 CHD16220
 CHD16230
 CHD16240
 CHD16250
 CHD16260
 CHD16270
 CHD16280
 CHD16290
 CHD16300
 CHD16310
 CHD16320
 CHD16330
 CHD16340
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 CHD16360
 CHD16370
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 CHD16390
 CHD16400
 CHD16410
 CHD16420
 CHD16430
 CHD16440
 CHD16450
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 CHD16480
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 CHD16500
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 CHD16530
 CHD16540
 CHD16550
 CHD16560
 CHD16570
 CHD16580
 CHD16590
 CHD16600
 CHD16610
 CHD16620
 CHD16630
 CHD16640

4, TIMEX(50), TFT(50), NPTS	CHD16650
5, POR(205), PERM1(205), PERM2(205), VISC(205), GCON, RHOTS, CARTS, SILTS,	CHD16660
6PORT, PERT1, PERT2, DCOH, DCOO, DCOPY, DCDP, DCOSI, DCOCM, DCON, CFXH, CFXO,	CHD16670
7CFXPY, CFXDP, CFXSI, CFXCM, CFXN, DIFCO(205), SOX(205)	CHD16680
8, ALLGAS(205), GRAF1(205)	CHD16690
EQUIVALENCE (IHDN(2), NHDN(1))	CHD16700
EQUIVALENCE (RHO3(103), RHO4(1))	CHD16710
EQUIVALENCE (TEMPA1(1), TS(1)), (DELTAX(1), PARTIN(1))	CHD16720
EQUIVALENCE (MNOD, NNP)	CHD16730
DIMENSION AREA(42), AREAV(42)	CHD16740
EQUIVALENCE (RHOC PX(44), AREA(1), AREAV(43))	CHD16750
KL=JB SM+K	CHD16760
TEMPA=TEMPA4(K)	CHD16770
GO TO (13,4,4), JRSW	CHD16780
4 CONTINUE	CHD16790
IF (TEMPA4(K)-4460.) 7,7,5	CHD16800
5 TEMPA=4460.	CHD16810
7 CONDC=CKC(1)+TEMPA*(CKC(2)+TEMPA*(CKC(3)+TEMPA*CKC(4)))	CHD16820
13 CONDV = CONST(1,1)+TEMPA4(K)*(CONST(2,1)+TEMPA4(K)	CHD16830
1*(CONST(3,1)+TEMPA4(K)*CONST(4,1)))	CHD16840
CONDV=CONDV/(.622+2.164*TEMPA4(K)/(BLPRES(N,L)+1.E-10))+.0001120	CHD16850
GO TO (15,17,17), JRSW	CHD16860
15 CONDF = CONDV	CHD16870
GO TO 18	CHD16880
17 CONDF = (CONDV-CONDC)*RHO4(K)/RHOV(1)+CONDC	CHD16890
18 CONDF=CONDF*APEA(K)/(2.*DELTAX(1M))	CHD16900
RETURN	CHD16910
END	CHD16920

- FOR CPRA,CPRA	
SUBROUTINE CPRA(J,K,TEMPA,CPBAR)	CHD16930
COMMON /BLOCKA/USFR(58),CCPG(4)	CHD16940
COMMON /NASCOM/ CHARRO,AIRM,	CHD16950
1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)	CHD16960
2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205), WDEP(205),WSI(205)	CHD16970
35),WBRN(205),EMWT(205),PRG(205)	CHD16980
4,TIMEX(50),TFT(50),NPTS	CHD16990
5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS,	CHD17000
6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,	CHD17010
7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)	CHD17020
8,ALLGAS(205),GRAF1(205)	CHD17030
CPBAR=CCPG(1)+TEMPA*(CCPG(2)+TEMPA*(CCPG(3)+TEMPA*CCPG(4)))	CHD17040
END	CHD17050

- FOR DEPO,DEPO
SUBROUTINE DEPO (K,KL,TEMPA,DEL)

C

C**** CARBON DEPOSITION

C

COMMON /BLOCKA/

1ABSORP(10)	,ABSC	,ACTENC	,ACTENS	,ACTENV(4,10)	CHD17060
2BSTAR	,CCPC(4)	,CCPG(4)	,CHARPT(101)	,CKC(4)	CHD17070
3COEFF(4,10)	,CONDC	,CONDV(100)	,CONST(4,10)	,COVERX(100)	CHD17080
4CPBAR	,CPC	,CPV(100)	,DIFREC	,UMATER(10)	CHD17090
5EFCOLC	,EFCOLS	,EFCOLV(4,10)	,EMIS(10)	,EMISC	CHD17100
6HOFM(10)	,HCOM	,HCOMG	,HSUB	,MAT(100)	CHD17110
7MATOMN	,MATMNE	,MN	,NN	,NNP	CHD17120
8NNSAVE	,NRDIV	,NREND	,NRGO	,NST	CHD17130
9PARTIN(101)	,PHI	,QBYRAD	,QCOMB	,QEXTR	CHD17140
1QGPCOM	,QSUBL	,RECPRO	,REORDC	,REORDS	CHD17150
2REORDV(4,10)	,RHO5Z	,RHO5(305)	,RHOCPX(101)	,RHOC	CHD17160
3RHOV(10)	,SABL	,SABLC	,SDOT	,SDOTC	CHD17170
4SLOPE(10)	,TMELT(10)	,TSZ	,TS(205)	,TRCHAR	CHD17180
5WFZ	,WF(205)	,XCHAR	,XINIT	,XLEFT(101)	CHD17190
6XMASS	,XMDOTC	,XMDOTD	,XMDOTG	,XMDOTL	CHD17200
7XMDOTR	,XMDOTS	,XTOTAL	,XVIRG(101)	,XZONE	CHD17210

COMMON/BLOCKC/

1BLPRES(20,11)	,COMMAX	,CUTOFF	,F(20,11)	CHD17220
2FLOW(20,11)	,HCONV(20,11)	,IERROR	,JUNCT	CHD17230
3N	,NOSECH	,QBACK	,QCONV(20,11)	CHD17240
4QMISC	,TIME	,TPRINT	,TWALL(20,11)	CHD17250
5XIR(20,11)			,XIWALL(20,11)	CHD17260

COMMON /BLOCKJ/

1FLUXI(200),TEDEP(200),XEDEP(101),EDEP(101),NTEDEP, CHD17270

2NXEDEP,ITEPEP,EDFLUX(100) CHD17280

COMMON /BLOCKK/NN1,QCOND(205)

COMMON/BLOCKN/COORD CHD17290

COMMON/BLOCKR/DIFC(4),ERO(4),ERODE CHD17300

COMMON /CHCOM/ DTAU, IBE(10), IBS(10), IRSPN, CHD17310

1IGTYP(10), IHDN(4), IM, IZB(3), IZG(3,10), CHD17320

2IZGT(3), JRSW, NCSN(10), NSHL(3), NSHR(3), CHD17330

3NZEN(3), NZSN(3), RHO1(305), RHO2(305), RHO3(410), CHD17340

4I, TEMPA2(205),TEMPA3(42),TEMPA4(42),TEMPA5(205), CHD17350

5 DELX(100),DISTL(100),DUM (10),ICOM, CHD17360

6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1, CHD17370

7SCHECK CHD17380

C**** DIMENSION STATEMENTS

C

DIMENSION DELTAX(1),TEMPA1(1) CHD17390

EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1)) CHD17400

COMMON /NASCOM/ CHARRO,AIRM, CHD17410

1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205) CHD17420

2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205), WDEP(205),WSI(205) CHD17430

35),WBRN(205),EMWT(205),PRG(205) CHD17440

4,TIMEX(50),TFT(50),NPTS CHD17450

5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS, CHD17460

6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO, CHD17470

7CFXPY,CFXDP,CFXS1,CFXCM,CFXN,DIFCO(205),SOX(205) CHD17480

8,ALLGAS(205),GRAF1(205),GRAF5(205),SPEED(205),DIFCH(205),DIFR(205) CHD17490

9, VISCO, VISCON, AF, BF, SILICA, REQ, PMW, DMW, HMW, AOMW, ANMW, SMW, BMW, CX(6)	CHD17600
1, QSI, QBRN, QDEP, DACT	CHD17605
REAL MCXT, METC	CHD17610
FMFP=EMWT(KL)/ALLGAS(KL)*PRG(KL)/2116.	CHD17620
METC= PYRO(KL)/16.*FMFP	CHD17640
HYDC=.2*METC	CHD17645
IF (HYDC-.02834) 10,10,20	CHD17650
10 M=1	CHD17660
GO TO 30	CHD17670
20 M=2	CHD17680
30 CONTINUE	CHD17690
50 ARM=1.	CHD17730
60 CONTINUE	CHD17740
CAR=ARM*4882.4*RHOC	CHD17750
MCXT=328900.*EXP(-51894./TEMPA)*CX(3*M-2)	CHD17760
YH=HYDC*CX(3*M-1)	CHD17770
ZM=METC*CX(3*M)	CHD17780
ZMYH=ZM*YH	CHD17790
WDEP(KL)=-CAR*MCXT*4.*(YH+(HYDC**2*CX(3*M)/20048.-ZM/4.))+ZMYH-ZMYH	CHD17800
1*YH)/(1.-YH+ZM-2.*ZMYH)**2	CHD17810
HERE=(DELTA(X(K))+DEL)/24.	CHD17820
TEST=.72*DACT/HERE	CHD17830
IF (WDEP(KL)-TEST) 80,80,70	CHD17840
70 WDEP(KL)=TEST	CHD17850
GO TO 90	CHD17860
80 IF (WDEP(KL)) 85,90,90	CHD17870
85 WDEP(KL)=0.	CHD17880
90 CONTINUE	CHD17890
CARBN5(KL)=CARBN5(KL)+WDEP(KL)*DTAU	CHD17900
WDEP(KL)=WDEP(KL)*HERE	CHD17910
RETURN	CHD17920
END	CHD17930

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- FOR DIAG6,DIAG6
  SUBROUTINE DIAG6
  COMMON /BLOCKC/ DUMMY(882),IERROR
  I=87
  CALL PICKUP(I,X)
  WRITE (6,1) X
1  FORMAT(1H1,4X,45HEXIT THROUGH MERR$ BECAUSE OF DIVIDE OVERFLOW/5X,
144HTHE ADDRESS OF THE OFFENDING INSTRUCTION IS ,012)
  IERROR=17
  CALL ERROR3
  END

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CHD17940
CHD17950
CHD17960
CHD17970
CHD17980
CHD17990
CHD18000
CHD18010
CHD18020
CHD18030

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- FOR DIAG7,DIAG7						CHD18040
SUBROUTINE DIAG7						CHD18050
COMMON /BLOCKC/						CHD18060
1RLPRES(20,11)	,COMMAX	,CUTOFF	,F(20,11)	,		CHD18070
2FLOW(20,11)	,HCONV(20,11),IERROR	,JUNCT	,L	,		CHD18080
3N	,NOSECH	,QBACK	,QCONV(20,11),QGAS(20,11)	,		CHD18090
4QMISC	,TIME	,TPRINT	,TWALL(20,11),XIWALL(20,11)	,		CHD18100
5XIR(20,11)						CHD18110
WRITE (6,1)						CHD18120
1 FORMAT(///1H ,4X,29HEXIT BECAUSE OF JUMP TO MERR\$)						CHD18130
IERROR=17						CHD18140
CALL FRROR3						CHD18150
END						

- FOR DIFUS,DIFUS

SUBROUTINE DIFUS (DIFCAL,NSOUR,DCO,CFIX,CONC)

COMMON /BLOCKA/

1ABSORP(10)	,ABSC	,ACTENC	,ACTENS	,ACTENV(4,10),	CHD18160
2BSTAR	,CCPC(4)	,CCPG(4)	,CHARPT(101)	,CKC(4)	CHD18170
3COEFT(4,10)	,CONDC	,CONDV(100)	,CONST(4,10)	,COVERX(100)	CHD18180
4CPBAR	,CPC	,CPV(100)	,DIFREC	,UMATER(10)	CHD18190
5EFCOLC	,EFCOLS	,EFCOLV(4,10)	,EMIS(10)	,EMISC	CHD18200
6HOFM(10)	,HCOM	,HCOMG	,HSUB	,MAT(100)	CHD18210
7MATOMN	,MATMNE	,MN	,NN	,NNP	CHD18220
8NNSAVF	,NRDIV	,NREND	,NRGO	,NST	CHD18230
9PARTIN(101)	,PHI	,QBYRAD	,QCOMB	,QEXTR	CHD18240
10GPCOM	,QSUBL	,RECPRO	,REORDC	,REORDS	CHD18250
2REORDV(4,10)	,RHO5Z	,RHO5(305)	,RHOCPX(101)	,RHOC	CHD18260
3RHOV(10)	,SABL	,SABLC	,SDOT	,SDOTC	CHD18270
4SLOPE(10)	,TMELT(10)	,TSZ	,TS(205)	,TRCHAR	CHD18280
5WFZ	,WF(205)	,XCHAR	,XINIT	,XLEFT(101)	CHD18290
6XMASS	,XMDOTC	,XMDOTD	,XMDOTG	,XMDOTL	CHD18300
7XMDOTR	,XMDOTS	,XTOTAL	,XVIRG(101)	,XZONE	CHD18310

COMMON /BLOCKB/ USER(243),BLDEN(20,11)

COMMON /BLOCKC/

1BLPRES(20,11)	,COMMAX	,CUTOFF	,F(20,11)	,CHD18335
2FLOW(20,11)	,HCONV(20,11)	,IERROR	,JUNCT	,CHD18340
3N	,NOSECH	,QBACK	,QCONV(20,11)	,CHD18350
4QMISC	,TIME	,TPRINT	,TWALL(20,11)	,CHD18360
5XIR(20,11)			,XIWALL(20,11)	,CHD18370

COMMON /BLOCKJ/

1FLUXI(200),TEDEP(200),XEDEP(101),EDEP(101),NTFEDEP,
2NXEDEP,ITEPEP,EDFLUX(100)

COMMON /BLOCKK/NN1,QCOND(205)

COMMON /BLOCKN/COORD

COMMON /BLOCKR/DIFC(4),ERO(4),ERODE

COMMON /CHCOM/ DTAU,	IBE(10),	IBS(10),	IBSPN,	CHD18400
1IGTYP(10),	IHDR(4),	IM,	IZB(3),	CHD18410
2IZGT(3),	JRSW,	NCSN(10),	NSHL(3),	CHD18420
3NZEN(3),	NZSN(3),	RHO1(305),	RHO2(305),	CHD18430
4I	,TEMPA2(205),	TEMPA3(42),	TEMPA4(42),	CHD18440
5	DELX(100),	DISTL(100),	DUM (10),	CHD18450
6IYS,LFT,MG,MDUM,NCEN(10),	NCUT,ND(3),	NLZON,SN,SN1,		CHD18460
7SCHECK				CHD18470

COMMON /NUCOM/ NADA,

1EM(42)

COMMON /DACOM/ A(42),

1ABVAL ,ABVALM,ABVALS,B(42) ,	C(42) ,	CC(205),COND(42),	CHD18480
2CONDX ,CONDXX, D(42) ,DD(205),	DELTX(101),	DGAS,DQ,	CHD18490
3DTAUC ,DTAUS ,DTAUX ,DTF,DTR(3),	EDFX,EDFXX,EMI(42),		CHD18500
4ETA,ETAS,FHT(42),FHTX,FHTXX,	GAGC,GAS1,GK,GX,GY,GZ,		CHD18510
5HDA(5,10),IBSPM,IERR,IGC,IGL,	IGLD,IGR,IGRL,IGT,IG2,		CHD18520
6IHYS,INEG,IN1,IN2,IP,IPLUS,	ITER,ITER,IX,IY,IZ,J,JBE,		CHD18530
7JBEM,JBEX,JBND1,JBND2,JBS,	JBSM,JBSPM,JBSPN,JBX,JBXX,JCEN,		CHD18540
8JCENM,JCSN,JCSNM,JE,JE1,JE2,	JHDN,JHDN1,JLSW,JSLAR,JX,JZ,		CHD18550
9K1,LANDID,LRT,MARK,NADD(42),	NASW,NBNDST,NBND1(11),		CHD18560
1NBSW,NDC,NDCM,NLSW(10),	NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW,		CHD18570
2NRID,NRIDC,NRSW(10),NRZON,	NSLAB(10),NSLABH(10),NSW,NXSW,		CHD18580
3NZON,NZONC,ONE,PSI,QSAVE,	QTOT,QTOTAL,REFCTR,SBK,SDN,		CHD18590

4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,	CHD18690
5TEMPST(3),THREE,TWO,WFP,WFX,WFX,XI,XMCOM,XSAVE	CHD18700
COMMON /NASCOM/ CHARRO,AIRM,	CHD18710
1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)	CHD18720
2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205),WDEP(205),WSI(205)	CHD18730
35),WBRN(205),EMWT(205),PRG(205)	CHD18740
4,TIMEX(50),TFT(50),NPTS	CHD18750
5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS,	CHD18760
6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,	CHD18770
7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)	CHD18780
8,ALLGAS(205),GRAF1(205),GRAF5(205),SPEED(205),DIFCH(205),DIFR(205)	CHD18790
DIMENSION NBND2(10),NHDN(3)	CHD18800
EQUIVALENCE (NBND1(2),NBND2(1))	CHD18810
EQUIVALENCE (IHDN(2),NHDN(1))	CHD18820
EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))	CHD18830
DIMENSION DELTAX(1),TEMPA1(1)	CHD18840
DIMENSION SOURCE(205),CONC(1)	CHD18850
DIFCOS=0.	CHD18860
ALPH=0.	CHD18870
DCU=DCO*PHI*HCONV(N,L)/BLDEN(N,L)	CHD18880
DO 100 IG=IGR,MG	CHD18890
CALL GRIN(IG)	CHD18900
DO 9 J=JBS,JBE	CHD18910
DIFCO(J)=DIFR(J)*POR(J)	CHD18920
GO TO (1,2,3,4,5,6,7),NSOUR	CHD18930
1 SOURCE(J)=-1.3333*WARN(J)	CHD18940
GO TO 9	CHD18950
2 SOURCE(J)=.01798*WFD(J)	CHD18960
GO TO 9	CHD18970
3 SOURCE(J)=.00002*WFD(J)+.3333*WDEP(J)	CHD18980
DIFCO(J)=DIFCH(J)*POR(J)	CHD18990
GO TO 9	CHD19000
4 SOURCE(J)=.3767*WFD(J)-1.3333*WDEP(J)	CHD19010
GO TO 9	CHD19020
5 SOURCE(J)=0.	CHD19030
GO TO 9	CHD19040
6 SOURCE(J)=.61111*WSI(J)	CHD19050
GO TO 9	CHD19060
7 SOURCE(J)=.6053*WFD(J)+2.3333*WBRN(J)+.38889*WSI(J)	CHD19070
9 CONTINUE	CHD19080
K=0	CHD19090
ALP=SPEED(JBS)*POR(JBS)	CHD19100
DO 10 J=JBS,JBEM	CHD19110
K=K+1	CHD19120
KL=LLD(J)	CHD19130
KK=LLD(J-1)	CHD19140
IF (KK-KL) 307,307,306	CHD19150
306 KK=KL-1	CHD19160
307 CONTINUE	CHD19170
IF (POR(J)) 309,309,312	CHD19180
309 ALPHA=0.	CHD19190
D(K)=0.	CHD19200
GO TO 313	CHD19210
312 CONTINUE	CHD19220
ALPHA=SPEED(J+1)*POR(J+1)	CHD19230

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      DI(K)=SOURCE(J)/POR(J)
313 CONTINUE
      A(K)=(DIFCOS+DIFCO(J))*6./DELTAX(KK)
      SAVF=(DIFCO(J)+DIFCO(J+1))*6./DELTAX(KL)
      C(K)=-SAVF
      B(K)=SAVF+A(K)+ALP
      A(K)=-A(K)-ALPH
      ALPH=ALP
      ALP=ALPHA
      DIFCOS=DIFCO(J)
10 CONTINUE
      IF (IG-IGR) 11,11,12
11 B(1)=A(1)+B(1)
      CC(JRS)=C(1)/B(1)
      DD(JBS)=D(1)/B(1)
      GO TO 13
12 ONE=B(1)-CC(JBXX)*A(1)
      CC(JRS)=C(1)/ONE
      DD(JRS)=(D(1)-A(1)*DD(JRXX))/ONE
13 CONTINUE
      DO 20 J=2,JE1
      K=JBSM+J
      ONF=B(J)-CC(K-1)*A(J)
      IF (ONE) 15,14,15
14 CC(K)=0
      DD(K)=0
      GO TO 20
15 CONTINUE
      CC(K)=C(J)/ONE
      DD(K)=(D(J)-A(J)*DD(K-1))/ONE
20 CONTINUE
      JBXX=JBEM
100 CONTINUE
      A(1)=-ALPH-SAVF
      B(1)=ALPHA+DCU+SAVF
      D(1)=DCU*CFIX+SOURCE(JBF)/(POR(JBE)+1.E-10)
      IF (B(1)-CC(JBE-1)*A(1)) 105,103,105
103 CONC(JBE)=0.
      GO TO 106
105 CONTINUE
      CONC(JBE)=(D(1)-A(1)*DD(JBE-1))/(B(1)-CC(JBE-1)*A(1))
      IF (CONC(JBF)) 103,103,106
106 CONTINUE
      JBX=JBE
      DO 200 IG=MG,IGR,-1
      CALL GRIN(IG)
      CONC(JBF)=CONC(JBX)
      DO 150 J=JBEM,JBS,-1
      CONC(J)=DD(J)-CC(J)*CONC(J+1)
      IF (CONC(J)) 108,108,150
108 CONC(J)=0.
150 CONTINUE
      JBX=JBS
200 CONTINUE
      HOLD=CONC(JBX)

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CHD19240
CHD19250
CHD19260
CHD19270
CHD19280
CHD19290
CHD19300
CHD19310
CHD19320
CHD19330
CHD19340
CHD19350
CHD19360
CHD19370
CHD19380
CHD19390
CHD19400
CHD19410
CHD19420
CHD19430
CHD19440
CHD19450
CHD19460
CHD19470
CHD19480
CHD19490
CHD19500
CHD19510
CHD19520
CHD19530
CHD19540
CHD19550
CHD19560
CHD19570
CHD19580
CHD19590
CHD19600
CHD19610
CHD19620
CHD19630
CHD19640
CHD19650
CHD19660
CHD19670
CHD19680
CHD19690
CHD19700
CHD19710
CHD19720
CHD19730
CHD19740
CHD19750
CHD19760
CHD19770
CHD19780

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IF (IGR-1) 205,205,210
205 IGRL=1
GO TO 215
210 IGRL=IGR-1
215 CONTINUE
DO 250 IG=1,IGRL
CALL GRIN(IG)
DO 230 J=JBS,JBE
230 CONC(J)=HOLD
250 CONTINUE
RFTURN
END

CHD19790
CHD19800
CHD19810
CHD19820
CHD19830
CHD19840
CHD19850
CHD19860
CHD19870
CHD19880
CHD19890
CHD19900

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- FOR FRROR3,FRROR3
SURROUTINE FRROR3
COMMON /BLOCKA/
1ABSORP(10) ,ABSC ,ACTENC ,ACTENS ,ACTENV(4,10),
2BSTAR ,CCPC(4) ,CCPG(4) ,CHARPT(101) ,CKC(4) ,
3COEFT(4,10) ,CONDC ,CONDV(100) ,CONST(4,10) ,COVERX(100) ,
4CPBAR ,CPC ,CPV(100) ,DIFREC ,UMATER(10) ,
5EFCOLC ,EFCOLS ,EFCOLV(4,10) ,EMIS(10) ,EMISC ,
6HOFM(10) ,HCOM ,HCOMG ,HSUB ,MAT(100) ,
7MATOMN ,MATMNE ,MN ,NN ,NNP ,
8NNSAVE ,NRDIV ,NREND ,NRGO ,NST ,
9PARTIN(101) ,PHI ,QBYRAD ,QCOMB ,QEXTP ,
10GPCOM ,QSUBL ,RECPRO ,REORDC ,REORDS ,
2REORDV(4,10) ,RHO5Z ,RHO5(305) ,RHOC PX(101) ,PHOC ,
3RHOV(10) ,SABL ,SABLC ,SDOT ,SDOTC ,
4SLOPE(10) ,TMELT(10) ,TSZ ,TS(205) ,TRCHAR ,
5WFZ ,WF(205) ,XCHAR ,XINIT ,XLEFT(101) ,
6XMASS ,XMDOTC ,XMDOTD ,XMDOTG ,XMDOTL ,
7XMODTR ,XMDOTS ,XTOTAL ,XVIRG(101) ,XZONE
COMMON /BLOCKB/
1ALT ,AOFA ,AOFACH ,BETA(20) ,BLCOM(20,11) ,
2BLDEN(20,11) ,BLEN(20,11) ,BLTEM(20,11) ,BLVEL(20,11) ,BLRN(20,11) ,
3BMULT ,DIST(20,11) ,FSCOM ,FSGAM ,LENGTH(21) ,
4NDIM ,NTEMP ,NTHETA ,NTIME ,PAMB ,
5PSP ,PTOTAL ,QAMB ,QSHOUL ,
6R(20,11) ,REFCOM(20,11) ,REFDEN(20,11) ,
7REFENT(20,11) ,REFRN(20,11) ,REFTEM(20,11) ,
8REFVIS(20,11) ,RHOA ,RHOVIS ,RNPERF ,
9RTRAN ,SOFS ,SWEEP ,THETA(11) ,THETSH ,
1TTOTAL ,UAMB ,VISCOS ,X(20,11) ,XEQ(20,11) ,
2XIAMB ,XISP ,XLTRAN ,XMACH ,XX ,
3ATEMP ,BLVIS(20,11) ,ZWALL ,REFPR(20,11) ,HMAX
COMMON /BLOCKC/
1BLPRES(20,11) ,COMMAX ,CUTOFF ,F(20,11) ,
2FLOW(20,11) ,HCONV(20,11) ,IERROR ,JUNCT ,L ,
3N ,NOSECH ,QBACK ,QCONV(20,11) ,QGAS(20,11) ,
4QMISC ,TIME ,TPRINT ,TWALL(20,11) ,XIWALL(20,11) ,
5XIR(20,11)
COMMON /BLOCKD/
1ALPHA(200) ,AMBP(200) ,AMBT(200) ,AMULT(200) ,AXLD(200) ,
2BWTEST ,IATMOS ,IPR ,IPRINT(20,10) ,
3IQ ,IX ,KK ,MELTN ,MELTL ,
4 ,MVTEST ,NKK ,NCHARM ,NMATLU ,
5NMATL ,NMATLD ,NSTRES ,NTBW ,NTIME1 ,
6NTIME2 ,PRINT ,PUT(20) ,QBAC(200) ,QINC(20) ,
7QINCR ,QM(200) ,QTIME(20) ,QTABLE(6,200) ,
8RPRINC ,RQINC ,RXINC ,T(200) ,TBW(200) ,
9TEMP(7) ,TNT(20) ,TORIBW(200) ,
1TSIN(101) ,TT(200) ,V(200) ,XINC(20) ,
2XINCR ,XTIME(20) ,Z(200) ,ZZ(200)
COMMON /BLOCKE/
1DIV ,IP ,IWPLLOT ,LPLOTH(20) ,LPLOTQ(20) ,
2LPLQCW(20) ,NCAM ,NCPL(20) ,NDRUMA ,NDRUMB ,
3NDRUMC ,NDRUMD ,NDRUME ,NDRUMF ,NLOCPH ,
4NLOCPQ ,NNLOCW ,NNODEC ,NNODET ,NNSP

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5NPAGF      ,NPLOTH(20) ,NPLOTQ(20) ,NPLOCW(20) ,NTIMEP      ,CHD20450
6NTPL(20)   ,NVALUC(20) ,NVALUT(20) ,PLOTM      ,PINC(20)     ,CHD20460
7PINCR      ,PPRINT     ,PTIME(20)  ,RPLINC     ,SPECS(31)    ,CHD20470
8STOPPL     ,TM         ,NNPRFV     ,             ,             ,CHD20480
COMMON /BLOCKF/
1ASTR(205)  ,AXLDEQ     ,CCOMSC(4) ,CCOMSV(4,10),CEMODC(4) ,CHD20500
2CEMODV(4,10),CEXPC(4) ,CEXPV(4,10),CLCOFF ,CMWGAS(4) ,CHD20510
3CNUC(4)    ,CNUV(4,10) ,CSHRSC(4) ,CSHRSV(4,10),CSTRO(205) ,CHD20520
4CTENSC(4)  ,CTENSV(4,10),GP(205)   ,PERMC     ,PIN       ,CHD20530
5POROSC     ,POROSV(10) ,PSTR1(205),PSTR2(205),PSTR3(205) ,CHD20540
6RIN        ,RSTRO(205) ,SHRSTR(205),SSMAX(205),RAD(205) ,CHD20550
7,NSLART    ,             ,             ,             ,             ,CHD20560
COMMON /BLOCKG/
1QBOLD      ,QBWTOT     ,QCLD(20,10) ,QCOLD      ,QCONVT(20,10),CHD20570
2QGAST(20,10),QGGLD(20,10),QGOLD     ,QMISCT     ,QMOLD      ,CHD20580
COMMON /CHCOM/ DTAU, IBE(10), IBS(10), IBSPN, ,CHD20590
1IGTYP(10), IHDN(4), IM, IZB(3), IZG(3,10), ,CHD20600
2IZGT(3), JRSW, NCSN(10), NSHL(3), NSHR(3), ,CHD20610
3NZEN(3), NZSN(3), RHO1(305), RHO2(305), RHO3(410), ,CHD20620
4I          ,TEMPA2(205),TEMPA3(42),TEMPA4(42),TEMPA5(205), ,CHD20630
5          ,DELX(100),DISTL(100),DUM (10),ICOM, ,CHD20640
6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1, ,CHD20650
7SCHECK     ,             ,             ,             ,             ,CHD20660
COMMON /BLOCKH/
1DABS(50)   ,DABSC(50) ,DACTEC(50) ,DACTES(50) ,DACTEV(4,50),CHD20670
2DBSTAR(50) ,DCCPC(4,50),DCCPG(4,50),DCCSC(4,50),DCCSV(4,50),CHD20680
3DCEMC(4,50),DCEMV(4,50),DCEXPC(4,50),DCEXPV(4,50),DCKC(4,50),CHD20690
4DCLCOE(50) ,DCNUC(4,50),DCNUV(4,50),DCOE(4,50),DCON(4,50),CHD20700
5DCSHSC(4,50),DCSHSV(4,50),DCTSC(4,50),DCTSV(4,50),DDIFFU(50),CHD20710
6DEFCOC(50) ,DEFCOS(50),DEFCOV(4,50),DEMIS(50),DEMISC(50),CHD20720
7DHCOM(50)  ,DHCOMG(50),DHOFM(50),DHSUR(50),DMWGAS(4,50),CHD20730
8DPERMC(50) ,DPORC(50),DPORV(50),DREORC(50),DREORS(50),CHD20740
9DREORV(4,50),DRHOC(50),DRHOV(50),DSLOPE(50),DTMELT(50),CHD20750
1DTRCHA(50) ,DMATER(50),XMATER(100,2), ,TITLE(70),CHD20760
2MELT1(50) ,MELT2(50),THICK(100),MNODE(100), ,CHD20770
COMMON /BLOCKM/CARD(14)
COMMON /NASCOM/ DCHARR(5883)
COMMON /DACOM/ A(42),
1ABVAL ,ABVALM,ABVALS,B(42),C(42), ,CC(205),COND(42),CHD20780
2CONDX ,CONDXX, D(42),DD(205),DELTX(101),DGAS,DQ,CHD20790
3DTAUC ,DTAUS ,DTAUX ,DTF,DTR(3),EDFX,EDFXX,EMI(42),CHD20800
4ETA,ETAS,FHT(42),FHTX,FHTXX,GAGC,GAS1,GK,GX,GY,GZ,CHD20810
5HDA(5,10),IBSPM,IERR,IGC,IGL,IGLD,IGR,IGRL,IGT,IG2,CHD20820
6IHYS,INEG,IN1,IN2,I3,IPLUS,ITER,ITERT,I4,IY,IZ,J,JBE,CHD20830
7JBEM,JBEX,JBND1,JBND2,JBS,JBSM,JBSPM,JBSPN,JBX,JRXX,JCEN,CHD20840
8JCENM,JCSN,JCSNM,JE,JE1,JE2,JHDN,JHDN1,JLSW,JSLAB,JX,JZ,CHD20850
9K1,LANDID,LRT,MARK,NADD(42),NASW,NBNDST,NBND1(11),CHD20860
1NBSW,NDC,NDCM,NLSW(10),NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW,CHD20870
2NRID,NRIDC,NRSW(10),NRZON,NSLAB(10),NSLABH(10),NSW,NXSW,CHD20880
3NZON,NZONC,ONE,PSI,QSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN,CHD20890
4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,CHD20900
5TEMPST(3),THREE,TWO,WFP,WFX,WFX,XI,XMCOM,XSAVE,CHD20910
DIMENSION XQBOLD(1),XNAME(10),ISTOP(10),DALT(1),CHD20920
DIMENSION DDTAU(1),DDIV(1),CHD20930
EQUIVALENCE (DTAU,DDTAU(1)),(DIV,DDIV(1))CHD20940
CHD20950
CHD20960
CHD20970
CHD20980
CHD20990

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	EQUIVALENCE (XQBOLD(1),QBOLD),(DALT(1),ALT)	CHD21000
	DATA XNAME(1)/6HBLOCKA/,XNAME(2)/6HBLOCKB/,XNAME(3)/6HBLOCKC/	CHD21010
	DATA XNAME(4)/6HBLOCKD/,XNAME(5)/6HBLOCKE/,XNAME(6)/6HBLOCKF/	CHD21020
	DATA XNAME(7)/6HBLOCKG/,XNAME(8)/5HCHCOM/	CHD21030
	DATA XNAME(9),XNAME(10)/5HDACOM,6HNASCOM/	CHD21040
	DATA ISTOP(1)/1865/,ISTOP(2)/4045/,ISTOP(3)/1991/,ISTOP(4)/4451/	CHD21050
	DATA ISTOP(5)/311/,ISTOP(6)/2335/,ISTOP(7)/806/,ISTOP(8)/1844/	CHD21060
	DATA ISTOP(9),ISTOP(10)/1080,5883/	CHD21070
	DATA NPT1/200/,NPT2/100/	CHD21080
	DO 400 I=1,10	CHD21090
	GO TO (250,400,250,400,400,400,400,250,250,250),I	CHD21100
250	NSTOP=ISTOP(I)	CHD21110
	WRITE (6,1018)XNAME(I)	CHD21120
	DO 390 J=1,NSTOP,8	CHD21130
	KGO=J-1	CHD21140
	KSTOP=J+7	CHD21150
	GO TO (310,320,330,340,350,360,370,380,384,388),I	CHD21160
310	WRITE (6,1019)KGO,(ABSORP(K),K=J,KSTOP)	CHD21170
	GO TO 390	CHD21180
320	WRITE (6,1019)KGO,(DALT(K),K=J,KSTOP)	CHD21190
	GO TO 390	CHD21200
330	WRITE (6,1019)KGO,(BLPRFS(K,1),K=J,KSTOP)	CHD21210
	GO TO 390	CHD21220
340	WRITE (6,1019)KGO,(ALPHA(K),K=J,KSTOP)	CHD21230
	GO TO 390	CHD21240
350	WRITE (6,1019)KGO,(DDIV(K),K=J,KSTOP)	CHD21250
	GO TO 390	CHD21260
360	WRITE (6,1019)KGO,(ASTR(K),K=J,KSTOP)	CHD21270
	GO TO 390	CHD21280
370	WRITE (6,1019)KGO,(XQBOLD(K),K=J,KSTOP)	CHD21290
	GO TO 390	CHD21300
380	WRITE (6,1019)KGO,(DDTAU(K),K=J,KSTOP)	CHD21310
	GO TO 390	CHD21320
384	WRITE (6,1019)KGO,(A(K),K=J,KSTOP)	CHD21330
	GO TO 390	CHD21340
388	WRITE (6,1019) KGO,(DCHARR(K),K=J,KSTOP)	CHD21350
390	CONTINUE	CHD21360
400	CONTINUE	CHD21370
1018	FORMAT(1H160X16HDECIMAL DUMP OF A6/)	CHD21380
1019	FORMAT(1H 06,1X,8E15.7)	CHD21390
	CALL EXIT	CHD21400
	END	CHD21410

- FOR FLOWS, FLOWS
SUBROUTINE FLOWS

COMMON /BLOCKA/

1ABSORP(10)	,ABSC	,ACTENC	,ACTENS	,ACTENV(4,10)	CHD21420
2BSTAR	,CCPC(4)	,CCPG(4)	,CHARPT(101)	,CKC(4)	CHD21430
3COEFT(4,10)	,CONDC	,CONDV(100)	,CONST(4,10)	,COVERX(100)	CHD21440
4CPBAR	,CPC	,CPV(100)	,DIFREC	,UMATER(10)	CHD21450
5EFCOLC	,EFCOLS	,EFCOLV(4,10)	,EMIS(10)	,EMISC	CHD21460
6HOFM(10)	,HCOM	,HCOMG	,HSUB	,MAT(100)	CHD21470
7MATOMN	,MATMNF	,MN	,NN	,NNP	CHD21480
8NNSAVE	,NRDIV	,NREND	,NRGO	,NST	CHD21490
9PARTIN(101)	,PHI	,QBYRAD	,QCOMB	,QEXTR	CHD21500
10GPCOM	,QSUBL	,RECPRO	,REORDC	,REORDS	CHD21510
2REORDV(4,10)	,RHOSZ	,RHO5(305)	,RHOCPX(101)	,RHOC	CHD21520
3RHOV(10)	,SABL	,SABLC	,SDOT	,SDOTC	CHD21530
4SLOPE(10)	,TMELT(10)	,TSZ	,TS(205)	,TRCHAR	CHD21540
5WFZ	,WF(205)	,XCHAR	,XINIT	,XLEFT(101)	CHD21550
6XMASS	,XMDOTC	,XMDOTD	,XMDOTG	,XMDOTL	CHD21560
7XMDOTR	,XMDOTS	,XTOTAL	,XVIRG(101)	,XZONE	CHD21570

COMMON/BLOCKC/

1BLPRES(20,11)	,COMMAX	,CUTOFF	,F(20,11)	CHD21600
2FLOW(20,11)	,HCONV(20,11)	,IERROR	,JUNCT	CHD21610
3N	,NOSECH	,QBACK	,QCONV(20,11)	CHD21620
4QMISC	,TIME	,TPRINT	,QWALL(20,11)	CHD21630
5XIR(20,11)			,XIWALL(20,11)	CHD21640

COMMON /BLOCKJ/

1FLUXI(200)	,TEDEP(200)	,XEDEP(101)	,EDEP(101)	,NTEDEP	CHD21650
2NXEDEP	,ITEPEP	,EDFLUX(100)			CHD21660

COMMON /BLOCKK/NN1,QCOND(205)

COMMON/BLOCKN/COORD

COMMON/BLOCKR/DIFC(4),ERO(4),ERODE

COMMON /CHCOM/	DTAU,	IBE(10),	IBS(10),	IBSPN,	CHD21700
1IGTYP(10),	IHDN(4),	IM,	IZR(3),	IZG(3,10),	CHD21710
2IZGT(3),	JRSW,	NCSN(10),	NSHL(3),	NSHR(3),	CHD21720
3NZFN(3),	NZSN(3),	RHO1(305),	RHO2(305),	RHO3(410),	CHD21730
4I	,TEMPA2(205),	TEMPA3(42),	TEMPA4(42),	TEMPA5(205),	CHD21740
5	DELX(100),	DISTL(100),	DUM (10),	ICOM,	CHD21750
6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,					CHD21760

7SCHFCK

COMMON /NUCOM/ DX(205),XNHD(205),NADA(42),MATA(205),

1EM(42)

COMMON /DACOM/ A(42),

1ABVAL ,ABVALM,ABVALS,B(42),C(42), CC(205),COND(42),

2CONDX ,CONDXX, D(42),DD(205),DELTX(101),DGAS,DQ,

3DTAUC ,DTAUS ,DTAUX ,DTF,DTR(3),EDFX,EDFXX,EMI(42),

4ETA,ETAS,FHT(42),FHTX,FHTXX,GAGC,GAS1,GK,GX,GY,GZ,

5HDA(5,10),IBSPM,IERR,IGC,IGL,IGLD,IGR,IGRL,IGT,IG2,

6IHYS,INEG,IN1,IN2,IP,IPLUS,ITER,ITER,IX,IY,IZ,J,JBE,

7JBEM,JBEX,JBND1,JBND2,JBS,JBSM,JBSPM,JBSPN,JBX,JBXX,JCEN,

8JCENM,JCSN,JCSNM,JE,JE1,JE2,JHDN,JHDN1,JLSW,JSLAB,JX,JZ,

9K1,LANDID,LRT,MARK,NADD(42),NASW,NBNDST,NBND1(11),

1NBSW,NDC,NDCM,NLSW(10),NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW,

2NRID,NRIDC,NRSW(10),NRZON,NSLAB(10),NSLABH(10),NSW,NXSW,

3NZON,NZONC,ONE,PSI,QSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN,

4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,

CHD21950

5TEMPST(3),THREE,TWO,WFP,WFX,WFX,XI,XMCOM,XSAVE	CHD21960
COMMON /NASCOM/ CHARRO,AIRM,	CHD21970
1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)	CHD21980
2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205),WDEP(205),WSI(205)	CHD21990
35),WBRN(205),EMWT(205),PRG(205)	CHD22000
4,TIMEX(50),TFT(50),NPTS	CHD22010
5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS,	CHD22020
6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,	CHD22030
7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)	CHD22040
8,ALLGAS(205),GRAF1(205),GRAF5(205),SPEED(205),DIFCH(205),DIFR(205)	CHD22050
DIMENSION NBND2(10),NHDN(3)	CHD22060
DIMENSION DELTAX(1),TEMPA1(1)	CHD22070
EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))	CHD22080
EQUIVALENCE (NBND1(2),NBND2(1))	CHD22090
EQUIVALENCE (IHDN(2),NHDN(1))	CHD22100
DO 100 IG=IGR,MG	CHD22110
CALL GRIN(IG)	CHD22120
IF (IG-IGR) 30,30,20	CHD22130
20 POR(JBS)=POR(JBEX)	CHD22140
PERM1(JBS)=PERM1(JRFX)	CHD22150
PERM2(JBS)=PERM2(JBFX)	CHD22160
VISC(JBS)=VISC(JBEX)	CHD22170
KK=JBS+1	CHD22180
GO TO 40	CHD22190
30 KK=JBS	CHD22200
40 DO 50 J=KK,JBE	CHD22210
CALL PORO	CHD22220
50 CONTINUE	CHD22230
JBEX=JBE	CHD22240
100 CONTINUE	CHD22250
PRFRNT=BLPRES(N,L)	CHD22260
ALPHA=WF(JBE)*GCON*TEMPA1(JBE)/(EMWT(JBE)*PRFRNT*POR(JBE)+1.E-1	CHD22270
15)	CHD22280
DO 200 IG=MG,1,-1	CHD22290
CALL GRIN(IG)	CHD22300
PRG(JBE)=PRFRNT	CHD22310
SPEED(JBE)=ALPHA	CHD22320
GO TO (140,150,150),JRWS	CHD22330
140 CONTINUE	CHD22340
DO 142 J=JBEM,JBS,-1	CHD22350
SPEED(J)=0.	CHD22360
142 PRG(J)=PRFRNT	CHD22370
GO TO 170	CHD22380
150 DO 160 J=JBEM,JBS,-1	CHD22390
K=LLD(J)	CHD22400
IF (POR(J)) 151,151,153	CHD22410
151 PRG(J)=PRG(J+1)	CHD22420
SPEED(J)=0.	CHD22430
GO TO 160	CHD22440
153 CONTINUE	CHD22450
IF (PERM1(J)) 151,151,155	CHD22460
155 IF (PERM2(J)) 151,151,157	CHD22470
157 CONTINUE	CHD22480
PSQ=PRG(J+1)**2+GCON*TEMPA1(J)/(EMWT(J)+1.E-10)*(VISC(J)*WF(J)/(	CHD22490
1POR(J)*PERM1(J)+1.E-15)+(WF(J)/(POR(J)+1.E-15))**2/(PERM2(J)+1.E-	CHD22500

220)) *DELTA X(K) / 12.	CHD22510
PRG(J) = SQRT(PSQ)	CHD22520
SPEED(J) = WF(J) * GCON * TEMP A1(J) / (EMWT(J) * PRG(J) * POR(J) + 1.F - 15)	CHD22530
160 CONTINUE	CHD22540
DO 165 J = JBS, JBE	CHD22550
TEMPA = TEMP A1(J) ** 1.5	CHD22560
TEMPB = TEMP A1(J) ** 2	CHD22570
DIFR(J) = .37803E - 4 * TEMP A / ((PRG(J) + 1.F - 15) * EXP(-.1257E - 3 * TEMP A1(J)	CHD22580
1 + .6110E - 8 * TEMPB)) * POR(J)	CHD22590
DIFCH(J) = .67627E - 4 * TEMP A / ((PRG(J) + 1.F - 15) * EXP(-.1847E - 3 * TEMP A1(J)	CHD22600
1 + .1319E - 7 * TEMPR)) * POR(J)	CHD22610
165 CONTINUE	CHD22620
170 CONTINUE	CHD22630
PRFRNT = PRG(JBS)	CHD22640
ALPHA = SPEED(JBS)	CHD22650
200 CONTINUE	CHD22660
RETURN	CHD22670
END	CHD22680

```

- FOR FONEV,FONEV
  FUNCTION FONEV(ARG,ISAVE,XRAY,YRAY,NPTS,IDELT)
  DIMENSION XRAY(1) ,YRAY(1)
C   KPATH = 0 - FIRST PASS OF SEARCH IN XRAY
C   KPATH = -IDELT - DECREASE ISAVE
C   KPATH = IDELT - INCREASE ISAVE
  KDELTA=IDELT
  KPTS=NPTS
  KSAVE=ISAVE
  XARG=ARG
  KPATH=0
  IF(KPTS)20,20,40
20  CONTINUE
  WRITE OUTPUT TAPE 6,1000,XARG
  CALL EXIT
40  CONTINUE
  IF(KSAVE)120,60,120
60  CONTINUE
  KSAVE=KDELTA+1
  IF(XRAY(KSAVE)-XRAY(1))80,20,120
80  CONTINUE
  KSAVE=-KSAVE
120 CONTINUE
  KSUBJ=IABS(KSAVE)
  KSUBI=KSUBJ-KDELTA
  FACT=ISIGN(1,KSAVE)
  GO TO 160
140 CONTINUE
  KSUBI=KSUBJ
  KSUBJ=KSUBJ+KPATH
160 CONTINUE
  X2=XRAY(KSUBJ)
  Y2=YRAY(KSUBJ)
  DX=X2-XARG
  FACTDX=FACT*DX
  IF(KPATH)220,180,260
180 CONTINUE
  IF(FACTDX)240,260,200
200 CONTINUE
  KPATH=-KDELTA
  KLIMIT=KDELTA+1
  GO TO 140
220 CONTINUE
  KSUB=KSUBI
  IF(FACTDX)320,300,280
240 CONTINUE
  KPATH=KDELTA
  KLIMIT=KDELTA*(KPTS-1)+1
260 CONTINUE
  KSUB=KSUBJ
  IF(FACTDX)280,300,320
280 CONTINUE
  IF(KSUB-KLIMIT)140,320,140
300 CONTINUE
  FONEV=Y2

```

```

CHD22690
CHD22700
CHD22710
CHD22720
CHD22730
CHD22740
CHD22750
CHD22760
CHD22770
CHD22780
CHD22790
CHD22800
CHD22810
CHD22820
CHD22830
CHD22840
CHD22850
CHD22860
CHD22870
CHD22880
CHD22890
CHD22900
CHD22910
CHD22920
CHD22930
CHD22940
CHD22950
CHD22960
CHD22970
CHD22980
CHD22990
CHD23000
CHD23010
CHD23020
CHD23030
CHD23040
CHD23050
CHD23060
CHD23070
CHD23080
CHD23090
CHD23100
CHD23110
CHD23120
CHD23130
CHD23140
CHD23150
CHD23160
CHD23170
CHD23180
CHD23190
CHD23200
CHD23210
CHD23220

```

```

320  GO TO 340
      CONTINUE
      X1=XRAY(KSUBI)
      Y1=YRAY(KSUBI)
      DXI=X2-X1
      FONEV=- (Y2-Y1)/DXI*DX+Y2
340  CONTINUE
      ISAVE=ISIGN(KSUB,KSAVE)
      RETURN
1000  FORMAT(1H1,22HFONEV - IND VARIABLE =,E18.7)
      END

```

```

CHD23230
CHD23240
CHD23250
CHD23260
CHD23270
CHD23280
CHD23290
CHD23300
CHD23310
CHD23320
CHD23330

```

- FOR FREC,FREC
FUNCTION FREC(RK,RFORDC,RDUM,BDUM)
FREC=RDUM/(RDUM*BDUM+RK** (REORDC-1.)*(RK+1.))
RETURN
END

CHD23340
CHD23350
CHD23360
CHD23370

```

- FOR FRONT,FRONT
SUBROUTINE FRONT
C**** THE FRONT SUBROUTINE DETERMINES IF FRONT NODE IS DROPPED OR
C**** COMBINED
DIMENSION NHDN(3), RHO4(306)
DIMENSION DELTAX(1), TEMP1(1)
COMMON /BLOCKA/
1ABSORP(10), ABSC, ACTENC, ACTENS, ACTENV(4,10),
2BSTAR, CCPC(4), CCPG(4), CHARPT(101), CKC(4),
3COEFT(4,10), CONDC, CONDV(100), CONST(4,10), COVERX(100),
4CPBAR, CPC, CPV(100), DIFREC, UMATER(10),
5EFCOLC, EFCOLS, EFCOLV(4,10), EMIS(10), EMISC,
6HOFM(10), HCOM, HCOMG, HSUB, MAT(100),
7MATOMN, MATMNE, MN, NN, NNP,
8NNSAVE, NRDIV, NREND, NRGO, NST,
9PARTIN(101), PHI, QBYRAD, QCOMB, QEXTR,
10GPCOM, QSUBL, RECPRO, REORDC, REORDS,
2REORDV(4,10), RHO5Z, RHOC(101), RHOC,
3RHOF(10), SABL, SABL, SDOT, SDOTC,
4SLOPE(10), TMELT(10), TSZ, TS(205), TRCHAR,
5WFZ, WF(205), XCHAR, XINIT, XLEFT(101),
6XMASS, XMDOTC, XMDOTD, XMDOTG, XMDOTL,
7XMDOTR, XMDOTS, XTOTAL, XVIRG(101), XZONE,
COMMON/BLOCKC/
1BLPRES(20,11), COMMAX, CUTOFF, F(20,11),
2FLOW(20,11), HCONV(20,11), IERROR, JUNCT, L,
3N, NOSECH, QBACK, QCONV(20,11), QGAS(20,11),
4QMISC, TIME, TPRINT, TWALL(20,11), XIWALL(20,11),
5XIR(20,11)
COMMON /CHCOM/ DTAU, IBE(10), IRS(10), IBSPN,
1IGTYP(10), IHDN(4), IM, IZB(3), IZG(3,10),
2IZGT(3), JRSW, NCSN(10), NSHL(3), NSHR(3),
3NZEN(3), NZSN(3), RHO1(305), RHO2(305), RHO3(410),
4I, TEMP1(205), TEMP2(42), TEMP3(42), TEMP4(205),
5 DELX(100), DISTL(100), DUM (10), ICOM,
6IYS, LFT, MG, MDUM, NCEN(10), NCUT, ND(3), NLZON, SN, SN1,
7SCHECK
EQUIVALENCE (IHDN(2), NHDN(1))
EQUIVALENCE (RHO3(103), RHO4(1))
EQUIVALENCE (TEMP1(1), TS(1)), (DELTAX(1), PARTIN(1))
EQUIVALENCE (MNOD, NNP)
IF (MAT(MNOD-2)-MAT(MNOD-1)) 310,320,310
310 NCUT = NCUT+2
320 IF (NZEN(NLZON)-NZSN(NLZON)-1) 330,340,330
330 ICOM = 1
GO TO 390
340 IF (NLZON-1) 350,350,360
350 ICOM = 4
GO TO 390
360 IF (NZSN(NLZON)-NZEN(NLZON-1)) 370,380,370
370 ICOM = 3
GO TO 390
380 ICOM = 2
390 GO TO (420,420,400,430), NCUT
400 NCUT = 1

```

CHD23380
CHD23390
CHD23400
CHD23410
CHD23420
CHD23430
CHD23440
CHD23450
CHD23460
CHD23470
CHD23480
CHD23490
CHD23500
CHD23510
CHD23520
CHD23530
CHD23540
CHD23550
CHD23560
CHD23570
CHD23580
CHD23590
CHD23600
CHD23610
CHD23620
CHD23630
CHD23640
CHD23650
CHD23660
CHD23670
CHD23680
CHD23690
CHD23700
CHD23710
CHD23720
CHD23730
CHD23740
CHD23750
CHD23760
CHD23770
CHD23780
CHD23790
CHD23800
CHD23810
CHD23820
CHD23830
CHD23840
CHD23850
CHD23860
CHD23870
CHD23880
CHD23890
CHD23900
CHD23910

```

      IF (ICOM-2) 415,415,410
410  CALL SHIFT1 (NLZON,LFT,-1)
415  RETURN
420  CONTINUE
      CALL COMBIN
430  NCUT = 1
      GO TO (440,450,460,460),ICOM
440  MG = MG-1
      IZGT(NLZON) = IZGT(NLZON)-1
      NZEN(NLZON) = NZEN(NLZON)-1
      GO TO 490
450  NLZON = 1
      MG = MG-1
      GO TO 490
460  IF (NCEN(MG-1)-NCSN(MG-1)-1) 470,470,480
470  IBS(MG-1) = IBS(MG)
      IBE(MG-1) = IBE(MG)
      IZG(NLZON,1) = MG-1
      NZEN(NLZON) = NZSN(NLZON)
      NZSN(NLZON) = NZSN(NLZON)-1
      MG = MG-1
      GO TO 490
480  NZFN(NLZON) = NZSN(NLZON)
      NZSN(NLZON) = NZSN(NLZON)-1
      NCFN(MG) = NCSN(MG)
      NCSN(MG) = NCSN(MG)-1
      NCEN(MG-1) = NCEN(MG-1)-1
      IBE(MG-1) = IBE(MG-1)-1
490  CONTINUE
      ND(1) = ND(1)-1
      XLEFT(NN) = XLEFT(IYS)+SN1
      MNOD = NN
      NN = NN-1
      IYS = ND(1)
      SCHECK = 0.5*DELX(IYS)
      SN1 = XLEFT(MNOD)-XLEFT(IYS)
      DISTL(IYS) = 0.
      DISTL(MNOD) = 1.
      DELX(IYS)=1.
      RETURN
      END

```

```

CHD23920
CHD23930
CHD23940
CHD23950
CHD23960
CHD23970
CHD23980
CHD23990
CHD24000
CHD24010
CHD24020
CHD24030
CHD24040
CHD24050
CHD24060
CHD24070
CHD24080
CHD24090
CHD24100
CHD24110
CHD24120
CHD24130
CHD24140
CHD24150
CHD24160
CHD24170
CHD24180
CHD24190
CHD24200
CHD24210
CHD24220
CHD24230
CHD24240
CHD24250
CHD24260
CHD24270
CHD24280
CHD24290
CHD24300
CHD24310
CHD24320

```

```

- FOR GPCOM, GPCOM
  SUBROUTINE GPCOM
    COMMON /BLOCKA/
      1ABSORP(10) ,ABSC      ,ACTENC      ,ACTENS      ,ACTENV(4,10),
      2BSTAR      ,CCPC(4)   ,CCPG(4)     ,CHARPT(101) ,CKC(4)    ,
      3COEFT(4,10) ,CONDC     ,CONDV(100)  ,CONST(4,10) ,COVERX(100),
      4CPBAR      ,CPC       ,CPV(100)   ,DIFREC     ,UMATER(10) ,
      5EFCOLC     ,EFCOLS    ,EFCOLV(4,10),EMIS(10)   ,EMISC     ,
      6HOFM(10)   ,HCOM      ,HCOMG      ,HSUB       ,MAT(100)  ,
      7MATOMN     ,MATMNF    ,MN         ,NN         ,NNP       ,
      8NNSAVE     ,NRDIV     ,NREND      ,NRGO       ,NST       ,
      9PARTIN(101) ,PHI      ,QBYRAD     ,QCOMB      ,QEXTR     ,
      10GPCOM     ,QSUBL     ,RECPRO     ,REORDC     ,REORDS    ,
      2REORDV(4,10),RHO5Z    ,RHO5(305)  ,RHOCPX(101) ,RHOC     ,
      3RHQV(10)   ,SABL      ,SABLC      ,SDOT       ,SDOTC     ,
      4SLOPE(10)  ,TMELT(10) ,TSZ       ,TS(205)   ,TRCHAR    ,
      5WFZ        ,WF(205)   ,XCHAR      ,XINIT      ,XLEFT(101) ,
      6XMASS      ,XMDOTC    ,XMDOTD     ,XMDOTG     ,XMDOTL    ,
      7XMODTR     ,XMDOTS    ,XTOTAL     ,XVIRG(101) ,XZONE     ,
    COMMON /BLOCKC/
      1PLPRES(20,11) ,COMMAX      ,CUTOFF      ,F(20,11) ,
      2FLOW(20,11)  ,HCONV(20,11),IERROR     ,JUNCT     ,L      ,
      3N            ,NOSECH     ,QBACK      ,QCONV(20,11),QGAS(20,11) ,
      4QMISC       ,TIME       ,TPRINT     ,TWALL(20,11),XIWALL(20,11),
      5XIR(20,11)
      IF (TIME-450.) 10,20,20
10  CONTINUE
      XKOE=.23144
      XMDOTO=PHI*HCONV(N,L)*XKOE
      XMDOTB=XKOE*DIFREC*XMDOTG/(BSTAR+1.E-10)
      QGPCOM=HCOMG*AMINI(XMDOTO,XMDOTB)
      RETURN
20  CONTINUE
      QGPCOM=0.
      RETURN
      END

```

CHD24330
 CHD24340
 CHD24350
 CHD24360
 CHD24370
 CHD24380
 CHD24390
 CHD24400
 CHD24410
 CHD24420
 CHD24430
 CHD24440
 CHD24450
 CHD24460
 CHD24470
 CHD24480
 CHD24490
 CHD24500
 CHD24510
 CHD24520
 CHD24530
 CHD24540
 CHD24550
 CHD24560
 CHD24570
 CHD24580
 CHD24590
 CHD24600
 CHD24610
 CHD24620
 CHD24630
 CHD24640
 CHD24650
 CHD24660
 CHD24670

```

- FOR GRIN,GRIN
SUBROUTINE GRIN(IG)
C**** CHARM SUBROUTINE IN CHAP --JULY 1966 VERSION
C LISTING FOR GAUDFTT 8528 TAPE
COMMON /BLOCKA/
1ABSORP(10) ,ABSC ,ACTENC ,ACTENS ,ACTENV(4,10),
2RSTAR ,CCPC(4) ,CCPG(4) ,CHARPT(101) ,CKC(4) ,
3COEFT(4,10) ,CONDC ,CONDV(100) ,CONST(4,10) ,COVERX(100) ,
4CPBAR ,CPC ,CPV(100) ,DIFREC ,UMATER(10) ,
5EFCOLC ,EFCOLS ,EFCOLV(4,10) ,EMIS(10) ,EMISC ,
6HOFM(10) ,HCOM ,HCOMG ,HSUB ,MAT(100) ,
7MATOMN ,MATMNE ,MN ,NN ,NNP ,
8NNSAVE ,NRDIV ,NREND ,NRGO ,NST ,
9PARTIN(101) ,PHI ,QBYRAD ,QCOMB ,QEXTR ,
10GPCOM ,QSUBL ,RECPRO ,REORDC ,REORDS ,
2REORDV(4,10) ,RHOSZ ,RHOS(305) ,RHOCPX(101) ,RHOC ,
3RHOV(10) ,SABL ,SABLC ,SDOT ,SDOTC ,
4SLOPE(10) ,TMELT(10) ,TSZ ,TS(205) ,TRCHAR ,
5WFZ ,WF(205) ,XCHAR ,XINIT ,XLEFT(101) ,
6XMASS ,XMDOTC ,XMDOTD ,XMDOTG ,XMDOTL ,
7XMDOTR ,XMDOTS ,XTOTAL ,XVIRG(101) ,XZONE ,
COMMON /BLOCKC/
1BLPRES(20,11) ,COMMAX ,CUTOFF ,F(20,11) ,
2FLOW(20,11) ,HCONV(20,11) ,IERROR ,JUNCT ,L ,
3N ,NOSECH ,QBACK ,QCONV(20,11) ,QGAS(20,11) ,
4QMISC ,TIME ,TPRINT ,TWALL(20,11) ,XIWALL(20,11) ,
5XIR(20,11) ,
COMMON /BLOCKJ/
1FLUXI(200) ,TEDEP(200) ,XEDEP(101) ,EDEP(101) ,NTEDEP ,
2NXFDEP ,ITEFPF ,EDFLUX(100) ,
COMMON /BLOCKK/NN1,QCOND(205) ,
COMMON /BLOCKN/COORD ,
COMMON /BLOCKR/DIFC(4) ,EROC(4) ,ERODE ,
COMMON /CHCOM/ DTAU ,IBE(10) ,IBS(10) ,IBSPN ,
1IGTYP(10) ,IHDN(4) ,IM ,IZB(3) ,IZG(3,10) ,
2IZGT(3) ,JRSW ,NCSN(10) ,NSHL(3) ,NSHR(3) ,
3NZEN(3) ,NZSN(3) ,RHO1(305) ,RHO2(305) ,RHO3(410) ,
4I ,TEMPA2(205) ,TEMPA3(42) ,TEMPA4(42) ,TEMPA5(205) ,
5 DELX(100) ,DISTL(100) ,DUM (10) ,ICOM ,
6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1 ,
7SCHECK ,
COMMON /DACOM/ A(42) ,
1ABVAL ,ABVALM,ABVALS,B(42) ,C(42) , CC(205),COND(42) ,
2CONDX ,CONDXX ,D(42) ,DD(205) ,DELTX(101) ,DGAS,DQ ,
3DTAUC ,DTAUS ,DTAUX ,DTF,DTR(3) ,EDFX,EDFXX,FMI(42) ,
4ETA,ETAS,FHT(42) ,FHTX,FHTXX,GAGC,GAS1,GK,GX,GY,GZ ,
5HDA(5,10) ,IBSPM,IERR,IGC,IGL,IGLD,IGR,IGRL,IGT,IG2 ,
6IHYS,INEG,IN1,IN2,IP,IPLUS,ITER,ITER,IX,IY,IZ,J,JBE ,
7JBEM,JBEX,JBND1,JBND2,JBS,JBSM,JBSPM,JBSPN,JBX,JBXX,JCEN ,
8JCENM,JCSN,JCSNM,JE,JE1,JE2,JHDN,JHDN1,JLSW,JSLAB,JX,JZ ,
9K1,LANDID,LRT,MARK,NADD(42) ,NASW,NBNDST,NBND1(11) ,
1NBSW,NDC,NDCM,NLSW(10) ,NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW ,
2NRID,NRIDC,NRSW(10) ,NRZON,NSLAB(10) ,NSLABH(10) ,NSW,NXSW ,
3NZON,NZONC,ONE,PSI,QSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN ,
4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3) ,TAU1,TAU2,TAU2S,TEMPA ,

```

```

51EMPST(3),THREE,TWO,WFP,WFX,WFX,XI,XMCOM,XSAVE
DIMENSION NRND2(10),NHON(3)
EQUIVALENCE (NBND1(2),NBND2(1))
EQUIVALENCE (IHON(2),NHON(1))
JRS = IRS(IG)
JRSM = JRS-1
JLSW = NLSW(IG)
JRSW = NRSW(IG)
JE1 = NSLABH(IG)
JE = JE1+1
JE2 = JE1-1
JBND1 = NRND1(IG)-3
JBND2 = NBND2(IG)
IGL = IG-1
JRF = IRF(IG)
JBEM = JRE-1
JCSN = NCSN(IG)
JCEN = NCEN(IG)
JCSNM=JCSN-1
JCENM = JCEN-1
IGC = IGTYP(IG)
JHON = NHON(IGC)
JSLAB = NSLAB(IG)
JBSPM = IRSPN+JCSN
JBSPN = JBSPM-1
RETURN
END

```

```

CHD25220
CHD25230
CHD25240
CHD25250
CHD25260
CHD25270
CHD25280
CHD25290
CHD25300
CHD25310
CHD25320
CHD25330
CHD25340
CHD25350
CHD25360
CHD25370
CHD25380
CHD25390
CHD25400
CHD25410
CHD25420
CHD25430
CHD25440
CHD25450
CHD25460
CHD25470
CHD25480

```

- ASM INIT,INIT
REGNAM
\$11),INIT* SX,1 B11,SAVE
M\$SEA MIDOF\$,(SLJ STUFF2)
M\$SEA MIERR\$,(J DIAG7)
SAVE J 0
END .

CHD25490
CHD25500
CHD25510
CHD25520
CHD25530
CHD25540

- FOR ITER8,ITER8	CHD25550
SUBROUTINE ITER8(T,XI,Z,P,FCT,TOL,I)	CHD25560
T1=T	CHD25570
DO 4 N=1,100	CHD25580
T2=FCT (T1,XI,Z ,P)	CHD25590
T3=FCT (T2,XI,Z ,P)	CHD25600
IF(T3)10,1,10	CHD25610
10 IF(ABS((T3-T2)/T3)-.01)5,5,1	CHD25620
1 IF(T2-T1)11,2,11	CHD25630
11 A=(T3-T2)/(T2-T1)	CHD25640
IF(A-1.)3,2,3	CHD25650
2 T1=T3	CHD25660
GO TO 4	CHD25670
3 Q=A/(A-1.)	CHD25680
T1=Q*T2+(1.-Q)*T3	CHD25690
IF(T1)4,2,4	CHD25700
4 CONTINUE	CHD25710
WRITE (6,1000)	CHD25720
1000 FORMAT(1H040X33HCONVERGENCE NOT ACHIEVED IN ITER8)	CHD25730
WRITE(6,2000)T1,XI,Z,P	CHD25740
2000 FORMAT(1H030X4HT = E10.4,5X5HXI = E10.4,5X4HZ = E10.4,5X4HP = E10.	CHD25750
14)	CHD25760
5 T=T3	CHD25770
RETURN	CHD25780
END	

```

- FOR IWR,IWR
  SUBROUTINE IWR(Z,T,XI)
    A=5400./T
    A=(2.-Z)*(2.5+A/(EXP(A)-1.))
    B=3.+106200./T
    IF(Z-1.2)6,6,3
3   IF(Z-2.)5,4,4
4   ZERT=1.5*Z+(304200.*Z-424800.)/T
    GO TO 7
5   ZERT=A+.2*B+(Z-1.2)*(3.+203400./T)
    GO TO 7
6   ZERT=A+(Z-1.)*B
7   XI = .06855*T*(ZERT+Z)
    RETURN
  END

```

```

CHD25790
CHD25800
CHD25810
CHD25820
CHD25830
CHD25840
CHD25850
CHD25860
CHD25870
CHD25880
CHD25890
CHD25900
CHD25910
CHD25920

```

- FOR LLD,LLD

```
FUNCTION LLD(J)
COMMON /CHCOM/ DTAU, IBE(10), IBS(10), IRSPN,
1 IGTYP(10), IHDN(4), IM, IZB(3), IZG(3,10),
2 IZGT(3), JRSW, NCSN(10), NSHL(3), NSHR(3),
3 NZEN(3), NZSN(3), RHO1(305), RHO2(305), RHO3(410),
4 ,TEMPA2(205),TEMPA3(42),TEMPA4(42),TEMPA5(205),
5 DELX(100),DISTL(100),DUM (10),ICOM,
6 IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,
7 SCHECK
IF (J-102) 5,6,6
5 NZON=0
LLD=J
RETURN
6 IF (J-187) 7,8,8
7 NZON=1
GO TO 9
8 NZON=2
9 K=J-IZR(NZON)
KK=K/4
LLD=NZSN(NZON) + KK
RETURN
END
```

CHD25930
CHD25940
CHD25950
CHD25960
CHD25970
CHD25980
CHD25990
CHD26000
CHD26010
CHD26020
CHD26030
CHD26040
CHD26050
CHD26060
CHD26070
CHD26080
CHD26090
CHD26100
CHD26110
CHD26120
CHD26130
CHD26140

- FOR MAIN,MAIN	CHD26150
COMMON /BLOCKC/ USER(220),COMMAX	CHD26153
COMMON /BLOCKA/ FILL1(627),MAT(100),FILL2(3),NN,NNP,FILL3(5),PARTI	CHD26157
IN(101),FILL4(492),TS(205)	CHD26160
COMMON /DACOM/ UPPED(972),NASW,UPSIT(84),TAU1	CHD26170
COMMON /TABCOM/ NDOTS(4),TIME1(100),TIME2(100),TIME3(100),	CHD26180
1TIME4(100),DSTEP(100),PSTEP(100),XRI(100),RH(100),QMU(100),	CHD26190
2TT(100),PP(100),FF(100),AST(100)	CHD26195
DIMENSION TITLE(12),NAMF(2)	CHD26200
TPRINT=0.	CHD26210
NTAB=0	CHD26220
TFND=1.F6	CHD26230
TAU1=0.	CHD26233
MTO=0	CHD26235
READ (5,990) TITLE	CHD26238
WRITE (6,992) TITLE	CHD26240
3 CONTINUE	CHD26250
READ (5,1000) NTAB,NTYP	CHD26260
NTAB=NTAB+1	CHD26270
I=1	CHD26280
INFRST=1	CHD26290
5 CONTINUE	CHD26300
GO TO (10,20,30,40),NTAB	CHD26310
10 CONTINUE	CHD26320
READ (5,1010) TIME1(I),DSTEP(I)	CHD26330
TIMEZ = TIME1(I)	CHD26340
GO TO 50	CHD26350
20 CONTINUE	CHD26360
READ (5,1010) TIME2(I),PSTEP(I)	CHD26370
TIMEZ = TIME2(I)	CHD26380
GO TO 50	CHD26390
30 CONTINUE	CHD26400
GO TO (33,36),NTYP	CHD26410
33 READ (5,1010) TIME3(I),XRI(I),RH(I),QMU(I)	CHD26420
GO TO 37	CHD26430
36 READ (5,1010) TIME3(I),TT(I),RH(I)	CHD26440
37 TIMEZ=TIME3(I)	CHD26450
NASW=NTYP	CHD26460
GO TO 50	CHD26470
40 CONTINUE	CHD26480
READ (5,1010) TIME4(I),PP(I),FF(I),AST(I)	CHD26490
TIMEZ=TIME4(I)	CHD26500
50 CONTINUE	CHD26510
GO TO (62,60),INFRST	CHD26520
60 IF (TIMEZ-TIMEY) 70,70,65	CHD26530
62 INFRST=2	CHD26540
65 CONTINUE	CHD26550
I=I+1	CHD26560
TIMEY=TIMEZ	CHD26570
GO TO 5	CHD26580
70 NDOTS(NTAB)=I-1	CHD26590
TEND=AMIN1(TEND,TIMEY)	CHD26600
IF (NTABT-4) 3,80,80	CHD26610
80 CONTINUE	CHD26620
NDOT SX=NDOTS(1)	

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WRITE (6,1020) (TIME1(I),DSTEP(I),I=1,NDOTSX)
NDOTSX=NDOTS(2)
WRITE (6,1022) (TIME2(I),PSTEP(I),I=1,NDOTSX)
NDOTSX=NDOTS(3)
GO TO (90,95),NASW
90 CONTINUE
WRITE (6,1024) (TIME3(I),XRI(I),RH(I),QMU(I),I=1,NDOTSX)
NDOTSX=NDOTS(4)
GO TO 98
95 CONTINUE
WRITE (6,1026) (TIME3(I),TT(I),RH(I),I=1,NDOTSX)
NDOTSX=NDOTS(4)
98 CONTINUE
WRITE (6,1028) (TIME4(I),PP(I),FF(I),AST(I),I=1,NDOTSX)
COMMAX=1.E-6
WRITE (6,1030)
NNP=0
99 CONTINUE
NN=NNP
READ (5,1031) MNO,NAME,WIDE,NUMERO
IF (MNO) 112,112,110
110 NNP=NNP+NUMERO
NN=NN+1
WRITE (6,1033) MNO,NAME,WIDE,NUMERO
DWIDTH=WIDTH/FLOAT(NUMERO)
MTO=MAX0(MTO,MNO)
DO 111 J=NN,NNP
MAT(J)=MNO
PARTIN(J)=DWIDTH
111 CONTINUE
GO TO 99
112 NN=NNP
NNP=NN+1
READ (5,1032) TS(1)
DO 113 J=1,100
113 TS(J)=TS(1)
CALL OUTPUT (MTO)
GO TO 109
100 IF (1.00001*TAU1-TPRINT) 104,102,102
102 CALL WRITE
DPRINT=TBSTEP(TPRINT,TIME2,PSTEP,NDOTS(2))
TPRINT=TPRINT+DPRINT
104 CONTINUE
IF (TEND-1.00001*TAU1) 106,106,108
106 CALL EXIT
108 CONTINUE
DPRINT=TPRINT-TAU1
DTEND=TEND-TAU1
COMMAX=TBSTEP(TAU1,TIME1,DSTEP,NDOTS(1))
COMMAX=AMIN1(COMMAX,DPRINT,DTEND)
SET=1.E-6*TAU1
COMMAX=AMAX1(COMMAX,SET)
109 CONTINUE
CALL CHARM
GO TO 100

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CHD26630
CHD26640
CHD26650
CHD26660
CHD26670
CHD26680
CHD26690
CHD26695
CHD26700
CHD26710
CHD26720
CHD26730
CHD26740
CHD26748
CHD26749
CHD26750
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CHD26768
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CHD26770
CHD26771
CHD26772
CHD26773
CHD26774
CHD26780
CHD26790
CHD26800
CHD26810
CHD26820
CHD26830
CHD26840
CHD26850
CHD26860
CHD26870
CHD26880
CHD26890
CHD26895
CHD26900
CHD26910

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990 FORMAT (12A6)	CHD26913
992 FORMAT (4X12H TITLE----- 12A6//)	CHD26917
1000 FORMAT (2I10)	CHD26920
1010 FORMAT (4F10.0)	CHD26930
1020 FORMAT (1H09X35HCALCULATION TIME STEP CONTROL TABLE/19X4HTIME7X,	CHD26940
19HTIME STEP/19X5H(SEC)8X5H(SEC)/(F25.2,F13.4))	CHD26945
1022 FORMAT (1H09X29HPRINT TIME STEP CONTROL TABLE/19X4HTIME7X,	CHD26950
19HTIME STEP/19X5H(SEC)8X5H(SEC)/(F25.2,F13.4))	CHD26955
1024 FORMAT (1H0.9X23HSURFACE HEAT FLUX TABLE/	CHD26960
119X4HTIME8X8HRECOVERY3X13HHEAT TRANSFER3X9HMISC HEAT/	CHD26970
231X8HENTHALPY5X9HPARAMETER5X11H TO SURFACE/19X5H(SEC)6X9H(BTU/LBM)	CHD26973
33X13H(LBM/FT2-SEC)3X9H(BTU/SEC)/(F25.2,F13.2,F13.5,F15.3))	CHD26977
1026 FORMAT (1H0.9X25HSURFACE TEMPERATURE TABLE/19X4HTIME6X11HTEMPERATURE	CHD26980
1RE2X13HHEAT TRANSFER/44X9HPARAMETER/19X5H(SEC)7X7H(DEG R)4X13H(LBMCHD26983	
2/FT2-SEC)/(F25.2,F13.2,F13.5))	CHD26987
1028 FORMAT (1H0.9X44HLOCAL STATIC PRESSURE AND FLOW CONTROL TABLE/	CHD26990
119X4HTIME6X9HLOC PRESS4X4HFLOW4X12HLOCAL STRESS/19X5H(SEC)5X9H(LBFCHD26991	
2/FT2)4X4H(--)5X9H(LBF/IN2)/(F25.2,F13.4,F8.0,F13.4))	CHD26992
1030 FORMAT (1H19X9HMATERIALS///15X36HMATERIAL NAME THICKNESS NUMBERCHD26993	
1 OF/33X4H(IN)7X5HNODES)	CHD26996
1031 FORMAT (I10,2A6,F18.4,I10)	CHD26997
1032 FORMAT (F10.4)	CHD26998
1033 FORMAT (13X,1H(I1,1H)2A6,F10.4,I9)	CHD27000
END	CHD27010

- FOR MOLWT,MOLWT

SUBROUTINE MOLWT

COMMON /BLOCKA/

1ABSORP(10)	,ABSC	,ACTENC	,ACTENS	,ACTENV(4,10)	CHD27020
2BSTAR	,CCPC(4)	,CCPG(4)	,CHARPT(101)	,CKC(4)	CHD27030
3COEFT(4,10)	,CONDC	,CONDV(100)	,CONST(4,10)	,COVERX(100)	CHD27040
4CPBAR	,CPC	,CPV(100)	,DIFREC	,UMATER(10)	CHD27050
5EFCOLC	,EFCOLS	,EFCOLV(4,10)	,EMIS(10)	,EMISC	CHD27060
6HOFM(10)	,HCOM	,HCOMG	,HSUB	,MAT(100)	CHD27070
7MATOMN	,MATMNF	,MN	,NN	,NNP	CHD27080
8NNSAVE	,NRDIV	,NREND	,NRGO	,NST	CHD27090
9PARTIN(101)	,PHI	,QBYRAD	,QCOMB	,QEXTR	CHD27100
10GPCOM	,QSUBL	,RECPRO	,REOPDC	,REFORDS	CHD27110
2REORDV(4,10)	,RHO5Z	,RHO5(305)	,RHOC PX(101)	,RHOC	CHD27120
3RHOV(10)	,SABL	,SABLC	,SDOT	,SDOTC	CHD27130
4SLOPE(10)	,TMFLT(10)	,TSZ	,TS(205)	,TRCHAR	CHD27140
5WFZ	,WF(205)	,XCHAR	,XINIT	,XLEFT(101)	CHD27150
6XMASS	,XMDOTC	,XMDOTD	,XMDOTG	,XMDOTL	CHD27160
7XMDOTR	,XMDOTS	,XTOTAL	,XVIRG(101)	,XZONF	CHD27170

COMMON /BLOCKC/

1BLPRES(20,11)	,COMMAX	,CUTOFF	,F(20,11)	CHD27200
2FLOW(20,11)	,HCONV(20,11)	,JUNCT	,L	CHD27210
3N	,NOSECH	,QBACK	,QCONV(20,11)	CHD27220
4QMISC	,TIME	,TPRINT	,QGAS(20,11)	CHD27230
5XIR(20,11)			,TWALL(20,11)	CHD27240
			,XIWALL(20,11)	CHD27250

COMMON /BLOCKJ/

1FLUXI(200)	,TEDEP(200)	,XFEDEP(101)	,EDEP(101)	,NTEDEP	CHD27260
2NXFEDEP	,ITFPEP	,EDFLUX(100)			CHD27270

COMMON /BLOCKK/NN1,QCOND(205)

COMMON /BLOCKN/COORD

COMMON /BLOCKR/DIFC(4),ERO(4),ERODF

COMMON /CHCOM/	DTAU,	IBE(10),	IBS(10),	IBSPN,	CHD27300
1IGTYP(10),	IHDN(4),	IM,	IZB(3),	IZG(3,10),	CHD27310
2IZGT(3),	JRSW,	NCSN(10),	NSHL(3),	NSHP(3),	CHD27320
3NZEN(3),	NZSN(3),	RHO1(305),	RHO2(305),	RHO3(410),	CHD27330
4I	,TEMPA2(205),	TEMPA3(42),	TEMPA4(42),	TEMPA5(205),	CHD27340
5	DELX(100),	DISTL(100),	DUM (10),	ICOM,	CHD27350
6IYS,	LFT,MG,MDUM,	NCEN(10),	NCUT,ND(3),	NLZON,SN,SN1,	CHD27360
7SCHECK					CHD27370

COMMON /NUCOM/ NADA,

1EM(42)					CHD27380
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COMMON /DACOM/ A(42),

1ABVAL ,ABVALM,ABVALS,B(42) ,C(42) ,	CC(205),COND(42),	CHD27390
2CONDX ,CONDXX, D(42) ,DD(205),DELTX(101),DGAS,DQ,		CHD27400
3DTAUC ,DTAUS ,DTAUX ,DTF,DTR(3),EDFX,EDFX,X,EMI(42),		CHD27410
4ETA,ETAS,FHT(42),FHTX,FHTXX,GAGC,GAS1,GK,GX,GY,GZ,		CHD27420
5HDA(5,10),IBSPM,IERR,IGC,IGL,IGLD,IGR,IGRL,IGT,IGZ,		CHD27430
6IHYS,INEG,IN1,IN2,IP,IPLUS,ITER,ITERT,IX,IY,IZ,J,JBE,		CHD27440
7JBEM,JBEX,JBND1,JBND2,JBS,JBSM,JRSPM,JBSPN,JRX,JRXX,JCFN,		CHD27450
8JCENM,JCSN,JCSNM,JE,JE1,JE2,JHDN,JHDN1,JLSW,JSLAB,JX,JZ,		CHD27460
9K1,LANDID,LRT,MARK,NADD(42),NASW,NBNDST,NBND1(11),		CHD27470
1NBSW,NDC,NDCM,NLSW(10),NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW,		CHD27480
2NRID,NRIDC,NRSW(10),NRZON,NSLAB(10),NSLABH(10),NSW,NXSW,		CHD27490
3NZON,NZONC,ONE,PSI,QSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN,		CHD27500
4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,		CHD27510

5TEMPST(3),THREE,TWO,WFP,WFX,WFX,XI,XMCOM,XSAVE	CHD27560
COMMON /NASCOM/ CHARRO,AIRM,	CHD27570
1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)	CHD27580
2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205),WDEP(205),WSI(205)	CHD27590
35),WBRN(205),EMWT(205),PRG(205)	CHD27600
4,TIMEX(50),TFT(50),NPTS	CHD27610
5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS,	CHD27620
6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,	CHD27630
7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)	CHD27640
8,ALLGAS(205),GRAF1(205),GRAF5(205),SPEED(205),DIFCH(205),DIFR(205)	CHD27650
9,VISCO,VISCON,AF,BF,SILICA,REQ,PMW,DMW,HMW,AOMW,ANMW,SMW,BMW,CX(6)	CHD27660
DIMENSION NBND2(10),NHDN(3)	CHD27670
EQUIVALENCE (NBND1(2),NBND2(1))	CHD27680
EQUIVALENCE (IHDN(2),NHDN(1))	CHD27690
EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))	CHD27700
DIMENSION DELTAX(1),TEMPA1(1)	CHD27710
DO 100 IG=IGR,MG	CHD27720
CALL GRIN(IG)	CHD27730
IF (IG-IGR) 30,30,20	CHD27740
20 CONTINUE	CHD27750
ALLGAS(JBS)=ALLGAS(JREX)	CHD27760
EMWT(JBS)=EMWT(JBEX)	CHD27770
KK=JBS+1	CHD27780
GO TO 40	CHD27790
30 KK=JBS	CHD27800
40 DO 50 J=KK,JBFX	CHD27810
ALLGAS(J)=PYRO(J)+DEP(J)+HYD(J)+AERO(J)+AERN(J)+SOX(J)+BURN(J)	CHD27820
1+1.E-20	CHD27830
EMWT(J)=ALLGAS(J)/(PYRO(J)/PMW+DEP(J)/DMW+HYD(J)/HMW+AERO(J)/AOMW	CHD27840
1+AERN(J)/ANMW+SOX(J)/SMW+BURN(J)/BMW+5.E-22)	CHD27850
50 CONTINUE	CHD27860
JBEX=JBE	CHD27870
100 CONTINUE	CHD27880
IF (IGR-1) 205,205,210	CHD27890
205 IGRL=1	CHD27900
GO TO 215	CHD27910
210 IGRL=IGR-1	CHD27920
215 CONTINUE	CHD27930
JBEX=JBS(IGR)	CHD27940
DO 250 IG=1,IGRL	CHD27950
CALL GRIN(IG)	CHD27960
DO 230 J=JBS,JBE	CHD27970
EMWT(J)=EMWT(JBEX)	CHD27980
230 ALLGAS(J)=ALLGAS(JBEX)	CHD27990
250 CONTINUE	CHD28000
RETURN	CHD28010
END	CHD28020

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- FOR PCAPF,PCAPF
FUNCTION PCAPF(K)
C**** THE PCAPF SUBROUTINE CALCULATES THE DENSITY-SPECIFIC HEAT PRODUCTION
DIMENSION NHDN(3), RHO4(306)
DIMENSION DFLTAX(1), TEMPA1(1)
COMMON /BLOCKA/
1ABSORP(10), ABSC, ACTENC, ACTENS, ACTENV(4,10),
2BSTAR, CCPC(4), CCPG(4), CHARPT(101), CKC(4),
3COEFT(4,10), CONDC, CONDV(100), CONST(4,10), COVERX(100),
4CPBAR, CPC, CDUM(100), DIFREC, UMATER(10),
5EFCOLC, EFCOLS, EFCOLV(4,10), EMIS(10), EMISC,
6HOFM(10), HCOM, HCOMG, HSUB, MAT(100),
7MATOMN, MATMNF, MN, NN, NNP,
8NNSAVE, NRDIV, NREND, NRGO, NST,
9PARTIN(101), PHI, QBYRAD, QCOMB, QEXTR,
10GPCOM, QSUBL, RECPRO, REORDC, REORDS,
2REORDV(4,10), RHO5Z, RHO5(305), RHOGPX(101), RHOC,
3RHOV(10), SABL, SABL, SDOT,
4SLOPE(10), TMELT(10), TSZ, TS(205), TRCHAR,
5WFZ, WF(205), XCHAR, XINIT, XLEFT(101),
6XMASS, XMDOTC, XMDOTD, XMDOTG, XMDOTL,
7XMDOTR, XMDOTS, XTOTAL, XVIRG(101), XZONE
COMMON/BLOCKC/
1BLPRES(20,11), COMMAX, CUTOFF, F(20,11),
2FLOW(20,11), HCONV(20,11), IERROR, JUNCT, L,
3N, NOSECH, QBACK, QCONV(20,11), QGAS(20,11),
4QMISC, TIME, TPRINT, TWALL(20,11), XIWALL(20,11),
5XIR(20,11)
COMMON/CHCOM/ DTAU, IBE(10), IBS(10), IBSPN,
1IGTYP(10), IHDN(4), IM, IZB(3), IZG(3,10),
2IZGT(3), JRSW, NCSN(10), NSHL(3), NSHR(3),
3NZEN(3), NZSN(3), RHO1(305), RHO2(305), RHO3(410),
4I, TEMPA2(205), TEMPA3(42), TEMPA4(42), TEMPA5(205),
5 DELX(100), DISTL(100), DUM (10), ICOM,
6IYS, LFT, MG, MDUM, NCEN(10), NCUT, ND(3), NLZON, SN, SN1,
7SCHECK
COMMON/DACOM/ A(42),
1ABVAL, ABVALM, ABVALS, B(42), C(42), CC(205), COND(42),
2CONDX, CONDX, D(42), DD(205), DELTX(101), DGAS, DQ,
3DTAUC, DTAUS, DTAUX, DTF, DTR(3), EDFX, EDFXX, EMI(42),
4ETA, ETAS, FHT(42), FHTX, FHTXX, GAGC, GAS1, GK, GX, GY, GZ,
5HDA(5,10), IBSPM, IERR, IGC, IGL, IGLD, IGR, IGR1, IGT, IG2,
6IHYS, INEG, IN1, IN2, IP, IPLUS, ITER, ITERT, IX, IY, IZ, J, JBE,
7JBEM, JBEX, JBND1, JBND2, JBS, JBSM, JBSPM, JBSPN, JBX, JBXX, JCEN,
8JCENM, JCSN, JCSNM, JE, JE1, JE2, JHDN, JHDN1, JLSW, JSLAB, JX, JZ,
9K1, LANDID, LRT, MARK, NADD(42), NASW, NBNDST, NBND1(11),
1NBSW, NDC, NDCM, NLSW(10), NOF, NOTIME, NPBSW, NPE1N, NPS2N, NPTSW,
2NRID, NRIDC, NRSW(10), NRZON, NSLAB(10), NSLABH(10), NSW, NXSW,
3NZON, NZONC, ONE, PSI, QSAVE, QTOT, QTOTAL, REFCTR, SBK, SDN,
4SDOTN, SNS, SRA, TAR, TAUOUT, TAU(3), TAU1, TAU2, TAU2S, TEMPA,
5TEMPST(3), THREE, TWO, WFP, WFX, WFX, XI, XMCOM, XSAVE
COMMON/NASCOM/ CHARRO, AIRM,
1CARBN1(205), CARBN5(205), SILCA1(205), SILCA5(205), PYRO(205), DEP(205),
2HYD(205), AERO(205), AERN(205), BURN(205), WFD(205), WDEP(205), WSI(205),
3WBPN(205), EMWT(205), PRG(205)

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CHD28030

CHD28040

CHD28050

CHD28060

CHD28070

CHD28080

CHD28090

CHD28100

CHD28110

CHD28120

CHD28130

CHD28140

CHD28150

CHD28160

CHD28170

CHD28180

CHD28190

CHD28200

CHD28210

CHD28220

CHD28230

CHD28240

CHD28250

CHD28260

CHD28270

CHD28280

CHD28290

CHD28300

CHD28310

CHD28320

CHD28330

CHD28340

CHD28350

CHD28360

CHD28370

CHD28380

CHD28390

CHD28400

CHD28410

CHD28420

CHD28430

CHD28440

CHD28450

CHD28460

CHD28470

CHD28480

CHD28490

CHD28500

CHD28510

CHD28520

CHD28530

CHD28540

CHD28550

CHD28560

4, TIMEX(50), TFT(50), NPTS	CHD28570
5, POR(205), PERM1(205), PERM2(205), VISC(205), GCON, RHOTS, CARTS, SILTS,	CHD28580
6, PORT, PERT1, PERT2, DCOH, DCOO, DCOPY, DCDP, DCOSI, DCOCM, DCON, CFXH, CFXO,	CHD28590
7, CFXPY, CFXDP, CFXS, CFXCM, CFXN, DIFCO(205), SOX(205)	CHD28600
8, ALLGAS(205), GRAF(205)	CHD28610
EQUIVALFNC (IHD(1), NHDN(1))	CHD28620
EQUIVALENCE (RHO3(103), RHO4(1))	CHD28630
EQUIVALENCE (TEMPA1(1), TS(1)), (DELTAX(1), PARTIN(1))	CHD28640
EQUIVALENCE (MNOD, NNP)	CHD28650
DIMENSION AREA(42), AREAV(42)	CHD28660
EQUIVALENCE (RHOC PX(44), AREA(1), AREAV(43))	CHD28670
KL=JB SM+K	CHD28680
GO TO (13,7,7), JRSW	CHD28690
7 CPC = CCPC(1)+TEMPA3(K)*(CCPC(2)+TEMPA3(K)*(CCPC(3)	CHD28700
1+TEMPA3(K)*CCPC(4)))	CHD28710
CPC=CPC*(CARBN1(KL)+GRAF1(KL)+SILCA1(KL))/RHOC	CHD28720
13 CPV = COEFT(1,1)+TEMPA3(K)*(COEFT(2,1)+TEMPA3(K)*	CHD28730
1(COEFT(3,1)+TEMPA3(K)*COEFT(4,1)))	CHD28740
CPV=CPV*RHO3(K)/RHOV(1)	CHD28750
GO TO (15,17,17), JRSW	CHD28760
15 PCAPF = CPV	CHD28770
GO TO 18	CHD28780
17 PCAPF=CPV+CPC	CHD28790
18 PCAPF=PCAPF*DELTAX(IM)*AREAV(K)/(DTAU+1.E-20)	CHD28800
RETURN	CHD28810
END	CHD28820

- ASM PICKUP,PICKUP

PICKUP* S A0,WORK
L A0,1,B11
S,HL A0,PICK1
L A0,*0,B11
S,HL A0,PICK2
PICK2 L A0,\$-\$
PICK1 S A0,\$-\$
L A0,WORK
J 2,B11
WORK RFS 1
JFACTO
REGNAM
END .

SAVE A0
SET ADDR TO FILL

PICK UP LOC TO PICKUP
• SET ADDR TO PICKUP
PICKUP CONTENTS
MOVE
RESTORE A0
RETURN

CHD28830
CHD28840
CHD28850
CHD28860
CHD28870
CHD28880
CHD28890
CHD28900
CHD28910
CHD28920
CHD28930
CHD28940
CHD28950

- FOR PORO,PORO

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SUBROUTINE PORO
COMMON /PLOCKA/
1ABSORP(10) ,ABSC ,ACTENC ,ACTENS ,ACTENV(4,10),
2BSTAR ,CCPC(4) ,CCPG(4) ,CHARPT(101) ,CKC(4) ,
3COEFT(4,10) ,CONDC ,CONDV(100) ,CONST(4,10) ,COVERX(100) ,
4CPBAR ,CPC ,CPV(100) ,DIFREC ,UMATER(10) ,
5EFCOLC ,EFCOLS ,EFCOLV(4,10) ,EMIS(10) ,EMISC ,
6HOFM(10) ,HCOM ,HCOMG ,HSUB ,MAT(100) ,
7MATOMN ,MATMNE ,MN ,NN ,NNP ,
8NNSAVE ,NRDIV ,NRENE ,NRGO ,NST ,
9PARTIN(101) ,PHI ,QBYRAD ,QCOMB ,QEXTP ,
10GPCOM ,QSUBL ,RECPRO ,REORDC ,REORDS ,
2REORDV(4,10) ,RHO5Z ,RHO5(305) ,RHOCPX(101) ,RHOC ,
3RHOV(10) ,SABL ,SABLC ,SDOT ,SDOTC ,
4SLOPE(10) ,TMELT(10) ,TSZ ,TS(205) ,TRCHAR ,
5WFZ ,WF(205) ,XCHAR ,XINIT ,XLEFT(101) ,
6XMASS ,XMDOTC ,XMDOTD ,XMDOTG ,XMDOTL ,
7XMDOTR ,XMDOTS ,XTOTAL ,XVIRG(101) ,XZONE
COMMON /BLOCKC/
1BLPRES(20,11) ,COMMAX ,CUTOFF ,F(20,11) ,
2FLOW(20,11) ,HCONV(20,11) ,IERROR ,JUNCT ,L ,
3N ,NOSECH ,QBACK ,QCONV(20,11) ,QGAS(20,11) ,
4QMISC ,TIME ,TPRINT ,TWALL(20,11) ,XIWALL(20,11) ,
5XIR(20,11)
COMMON /BLOCKJ/
1FLUX!(200) ,TEDEP(200) ,XEDEP(101) ,EDEP(101) ,NTFDFP ,
2NXEDEP ,ITEPEP ,EDFLUX(100)
COMMON /BLOCKK/NN1,QCOND(205)
COMMON /BLOCKN/COORD
COMMON /BLOCKR/DIFC(4) ,ERO(4) ,ERODE
COMMON /CHCOM/ DTAU , IBE(10) , IBS(10) , IBSPN ,
1IGTYP(10) , IHDN(4) , IM , IZB(3) , IZG(3,10) ,
2IZGT(3) , JRSW , NCSN(10) , NSHL(3) , NSHR(3) ,
3NZEN(3) , NZSN(3) , RHO1(305) , RHO2(305) , RHO3(410) ,
4I , TEMPA2(205) , TEMPA3(42) , TEMPA4(42) , TEMPA5(205) ,
5 DELX(100) , DISTL(100) , DUM (10) , ICOM ,
6IYS , LFT , MG , MDUM , NCEN(10) , NCUT , ND(3) , NLZON , SN , SN1 ,
7SCHECK
COMMON /NUCOM/ DX(205) , XNHD(205) , NADA(42) , MATA(205) ,
1EM(42)
COMMON /DACOM/ A(42) ,
1ABVAL , ABVALM , ABVALS , B(42) , C(42) , CC(205) , COND(42) ,
2CONDX , CONDX , D(42) , DD(205) , DELTX(101) , DGAS , DQ ,
3DTAUC , DTAUS , DTAUX , DTF , DTR(3) , EDFX , EDFXX , EMI(42) ,
4ETA , ETAS , FHT(42) , FHTX , FHTXX , GAGC , GAS1 , GK , GX , GY , GZ ,
5HDA(5,10) , IBSPM , IERR , IGC , IGL , IGLD , IGR , IGR , IGT , IG2 ,
6IHYS , INEG , IN1 , IN2 , IP , IPLUS , ITER , ITERT , IX , IY , IZ , J , JBE ,
7JBEM , JBEX , JBND1 , JBND2 , JBS , JBSM , JRSPM , JRSPN , JBX , JBXX , JCEN ,
8JCENM , JCSN , JCSNM , JE , JE1 , JE2 , JHDN , JHDN1 , JLSW , JSLAB , JX , JZ ,
9K1 , LANDID , LRT , MARK , NADD(42) , NASW , NBNDST , NBND1(11) ,
1NBSW , NDC , NDCM , NLSW(10) , NOF , NOTIME , NPBSW , NPE1N , NPS2N , NPTSW ,
2NRID , NRIDC , NRSW(10) , NRZON , NSLAB(10) , NSLABH(10) , NSW , NXSW ,
3NZON , NZONC , ONE , PSI , QSAVE , QTOT , QTOTAL , REFCTR , SBK , SDN ,
4SDOTN , SNS , SRA , TAR , TAUOUT , TAUST(3) , TAU1 , TAU2 , TAU2S , TEMPA ,

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5TEMPST(3),THREE,TWO,WFP,WFX,WFX,XI,XMCOM,XSAVE          CHD29500
COMMON /NASCOM/ CHARO,AIRM,                                CHD29510
1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)CHD29520
2,HYD(205),AFRO(205),AERN(205),BURN(205),WFD(205),WDEP(205),WSI(205)CHD29530
3,WB RN(205),EMWT(205),PRG(205)                             CHD29540
4,TIMFX(50),TFT(50),NPTS                                    CHD29550
5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS, CHD29560
6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,CHD29570
7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)           CHD29580
8,ALLGAS(205),GRAF1(205),GRAF5(205),SPEED(205),DIFCH(205),DIFR(205)CHD29590
9,VISCO,VISCON,AF,BF,SILICA,REQ,PMW,DMW,HMW,AQMW,ANMW,SMW,BMW,CX(6)CHD29600
DIMENSION NRND2(10),NHON(3)                                  CHD29610
EQUIVFNCE (NRND1(2),NRND2(1))                                CHD29620
EQUIVFNCE (IHON(2),NHON(1))                                  CHD29630
DIMENSION TEMPA1(1)                                           CHD29640
EQUIVFNCE (TEMPA1(1),TS(1))                                   CHD29650
GO TO (10,20,10),JRSW                                         CHD29660
10 POR(J)=1.-(RHO1(J)+RHOC)/RHOTS                               CHD29670
GO TO 30                                                        CHD29680
20 POR(J)=1.-SILCA1(J)/SILTS-(CARBN1(J)+GRAF1(J))/CARTS      CHD29690
30 HOLD=POR(J)/PORT                                             CHD29700
SAVE=(1.-PORT)/(1.-POR(J))                                     CHD29710
PERM2(J)=HOLD*SAVE                                              CHD29720
PERM1(J)=PERM2(J)**2*HOLD*PERT1*(1.+0.16*TEMPA1(J)**1.4/(PRG(J)+1. CHD29730
1E-15))                                                         CHD29740
PERM2(J)=PERM2(J)*HOLD*PERT2                                    CHD29750
C INSERT VISCOSITY DETERMINATION                                CHD29760
VISC(J)=VISCO*(TEMPA1(J)/VISCON)**.7                          CHD29770
RETURN                                                         CHD29780
END                                                            CHD29790

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- FOR RECEFD,RFCEFD
  SUBROUTINE RECEED(TEMPA)
    COMMON /BLOCKA/
      1ABSORP(10) ,ABSC ,ACTENC ,ACTENS ,ACTENV(4,10) ,
      2BSTAR ,CCPC(4) ,CCPG(4) ,CHAPPT(101) ,CKC(4) ,
      3COEFT(4,10) ,CONDC ,CONDV(100) ,CONST(4,10) ,COVERX(100) ,
      4CPBAR ,CPC ,CPV(100) ,DIFREC ,UMATER(10) ,
      5EFCOLC ,EFCOLS ,EFCOLV(4,10) ,EMIS(10) ,FMISC ,
      6HOFM(10) ,HCOM ,HCOMG ,HSUB ,MAT(100) ,
      7MATOMN ,MATMNE ,MN ,NN ,NNP ,
      8NNSAVE ,NRDIV ,NREND ,NRGO ,NST ,
      9PARTIN(101) ,PHI ,QBYRAD ,QCOMB ,QEXTR ,
      10GPCOM ,QSUBL ,RECPRO ,REORDC ,RFORDS ,
      2REORDV(4,10) ,RH05Z ,RH05(305) ,RH0CPX(101) ,PHOC ,
      3RHQV(10) ,SABL ,SABLC ,SDOT ,SDOTC ,
      4SLOPE(10) ,TMELT(10) ,TSZ ,TS(205) ,TRCHAR ,
      5WFZ ,WF(205) ,XCHAR ,XINIT ,XLEFT(101) ,
      6XMASS ,XMDOTC ,XMDOTD ,XMDOTG ,XMDOTL ,
      7XMODTR ,XMDOTS ,XTOTAL ,XVIRG(101) ,XZONE
    COMMON /BLOCKC/
      1BLPRES(20,11) ,COMMAX ,CUTOFF ,F(20,11) ,
      2FLOW(20,11) ,HCONV(20,11) ,IERROR ,JUNCT ,L ,
      3N ,NOSECH ,QBACK ,QCONV(20,11) ,QGAS(20,11) ,
      4QMISC ,TIME ,TPRINT ,TWALL(20,11) ,XIWALL(20,11) ,
      5XIR(20,11)
    COMMON/BLOCKR/DIFC(4),ERO(4),FRODF
    XMDOTR IS SPELLED XMODTR IN COMMON. WATCH THIS WHEN
    EXAMINING DUMPS AND WHEN CODING.
    EXTERNAL FREC
    IF(XMDOTG)2,2,4
    2 XMDOTG=0.
    DIFREC=0.
    GO TO 6
    4 OMG=ALOG(XMDOTG*TWALL(N,L)**.5*(.12**((1.E4/TWALL(N,L))))
    1/((BLPRES(N,L)/2116.2))/2.3026
    DIFREC=DIFC(1)+OMG*(DIFC(2)+OMG*(DIFC(3)+OMG*DIFC(4)))
    6 XMDUM=BSTAR*HCONV(N,L)
    XMDOTD=XMDUM-XMDOTG*DIFREC
    IF(XMDOTD-1.E-6)10,10,20
    10 XMDOTL=0.
    GO TO 30
    20 DR=EFCOLC*(BLPRES(N,L)/10077.)*REORDC
    XMDOTR=DR*EXP(-ACTENC/TEMPA)
    XMODTR=XMDOTR
    IF(XMDOTR-1.E-6)10,10,25
    25 RDUM=XMDOTD*BSTAR*REORDC/XMDOTR
    RDUM=(PHI*HCONV(N,L)+XMDOTG)/XMDOTD
    RK=1./BDUM
    CALL ITER8(RK,REORDC,RDUM,BDUM,FREC,1.E-3,11)
    XMDOTL=XMDOTD*(1.-BDUM*RK)/(1.+RK)
    30 DS=EFCOLS*XMDUM*(BLPRES(N,L)/2116.2)**(-REORDS)

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XMDOTS=DS*EXP(-ACTENS/TEMPA)  
IF(XMDOTS-1.E-6)40,40,50  
40 XMDOTS=0.  
50 XMDOTC=XMDOTL+XMDOTS  
RETURN  
END
```

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CHD30340  
CHD30350  
CHD30360  
CHD30370  
CHD30380  
CHD30390
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- FOR RHOSB,RHOSB
  SUBROUTINE RHOSB (K,KL)
C**** THE RHOSB SUBROUTINE FINDS DATA NEEDED FOR DENSITY CALCULATIONS
  DIMENSION DELTAX(1), TEMPA1(1)
  DIMENSION AREAC(1),EMBM(1),PC(1),RATE(1),RH04(1),WFD(1)
  COMMON /BLOCKA/
1ABSORP(10),ABSC,ACTENC,ACTENS,ACTENV(4,10),
2BSTAR,CCPC(4),CCPG(4),CHARPT(101),CKC(4),
3COEFT(4,10),CONDC,CONDV(100),CONST(4,10),COVERX(100),
4CPBAR,CPC,CPV(100),DIFREC,UMATER(10),
5EFCOLC,EFCOLS,EFCOLV(4,10),FMIS(10),EMISC,
6HOFM(10),HCOM,HCOMG,HSUB,MAT(100),
7MATOMN,MATMNE,MN,MN,MNP,
8NNSAVE,NRDIV,NREND,NRGO,NST,
9PARTIN(101),PHI,QBYRAD,QCOMB,QEXTR,
10GPCOM,QSUBL,RECPRO,REORDC,REORDS,
2REORDV(4,10),RHO5Z,RHO5(305),RHOCPX(101),RHOC,
3RHOV(10),SABL,SABLC,SDOT,SDOTC,
4SLOPE(10),TMELT(10),TSZ,TS(205),TRCHAR,
5WFZ,WF(205),XCHAR,XINIT,XLEFT(101),
6XMASS,XMDOTC,XMDOTD,XMDOTG,XMDOTL,
7XMDOTR,XMDOTS,XTOTAL,XVIRG(101),XZONE
  COMMON /CHCOM/ DTAU,IBE(10),IBS(10),IBSPN,
1IGTYP(10),IHDN(4),IM,IZB(3),IZG(3,10),
2IZGT(3),JRSW,NCSN(10),NSHL(3),NSHR(3),
3NZEN(3),NZSN(3),RHO1(305),RHO2(305),RHO3(410),
4I,TEMPA2(205),TEMPA3(42),TEMPA4(42),TEMPA5(205),
5DELX(100),DISTL(100),DUM(10),ICOM,
6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,
7SCHECK
  EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))
  EQUIVALENCE (EMBM(1),PC(1))
  EQUIVALENCE (RHO3(103),RHO4(1))
  EQUIVALENCE (WF(1),WFD(1),RATE(1))
  EQUIVALENCE (RHO3(307),PC(1)),(RHO3(350),AREAC(1))
  ONE = (3.*RHO1(KL)+RHO5(KL))/4.
  AREAC(K)=0.
  THREE=0.
  IF (ONE-1.E-10) 2727,2727,2720
2720 CONTINUE
  DO 2725 J=1,2
  TWO = -EFCOLV(J,I)*EXP(-ACTENV(J,I)/TEMPA3(K))
  AREAC(K) = TWO*RHO1(KL)**REORDV(J,I)+AREAC(K)
  THREE=TWO*REORDV(J,I)*ONE**((REORDV(J,I)-1.))+THREE
2725 CONTINUE
2727 CONTINUE
  EMBM(K) = 1.-THREE*DTAU/2.
  IF (KL-205) 2730,2740,2740
2730 RATE(KL)=THREE
2740 CONTINUE
  RETURN
  END

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CHD30400
 CHD30410
 CHD30420
 CHD30430
 CHD30440
 CHD30450
 CHD30460
 CHD30470
 CHD30480
 CHD30490
 CHD30500
 CHD30510
 CHD30520
 CHD30530
 CHD30540
 CHD30550
 CHD30560
 CHD30570
 CHD30580
 CHD30590
 CHD30600
 CHD30610
 CHD30620
 CHD30630
 CHD30640
 CHD30650
 CHD30660
 CHD30670
 CHD30680
 CHD30690
 CHD30700
 CHD30710
 CHD30720
 CHD30730
 CHD30740
 CHD30750
 CHD30760
 CHD30770
 CHD30780
 CHD30790
 CHD30800
 CHD30810
 CHD30820
 CHD30830
 CHD30840
 CHD30850
 CHD30860
 CHD30870
 CHD30880
 CHD30890
 CHD30900

```

- FOR SHIFT1,SHIFT1
SUBROUTINE SHIFT1 (NZON, NLR, INCOM)
C**** THE SHIFT1 SUBROUTINE INTERPOLATES NEW VALUES NEEDED FOR NODE
C**** ADDITION TO A ZONE
DIMENSION NHDN(3), RHO4(306)
DIMENSION DELTAX(1), TEMPA1(1)
COMMON /BLOCKA/
1ABSORP(10), ABSC, ACTENC, ACTENS, ACTENV(4,10),
2BSTAR, CCPC(4), CCPG(4), CHARPT(101), CKC(4),
3COEFT(4,10), CONDC, CONDV(100), CONST(4,10), COVERX(100),
4CPBAR, CPC, CPV(100), DIFRFC, UMATER(10),
5EFCOLC, EFCOLS, EFCOLV(4,10), EMIS(10), EMISC,
6HOFM(10), HCOM, HCOMG, HSUB, MAT(100),
7MATOMN, MATMNE, MN, NN, NNP,
8NNSAVE, NRDIV, NREND, NRG0, NST,
9PARTIN(101), PHI, QBYRAD, QCOMB, QEXTR,
10GPCOM, QSUBL, RECPRO, REORDC, REORDS,
2REORDV(4,10), RHO5Z, RHO5(305), RHOC PX(101), RHOC,
3RHOV(10), SABL, SABL C, SDOT, SDOTC,
4SLOPF(10), TMELT(10), TSZ, TS(205), TRCHAR,
5WFZ, WF(205), XCHAR, XINIT, XLEFT(101),
6XMASS, XMDOTC, XMDOTD, XMDOTG, XMDOTL,
7XMDOTR, XMDOTS, XTOTAL, XVIRG(101), XZONE,
COMMON/BLOCKC/
1BLPRES(20,11), COMMAX, CUTOFF, F(20,11),
2FLOW(20,11), HCONV(20,11), IERROR, JUNCT, L,
3N, NOSECH, QBACK, QCONV(20,11), QGAS(20,11),
4QMISC, TIME, TPRINT, TWALL(20,11), XIWALL(20,11),
5XIR(20,11)
COMMON /CHCOM/ DTAU, IBE(10), IRS(10), IRSPN,
1IGTYP(10), IHDN(4), IM, IZB(3), IZG(3,10),
2IZGT(3), JRSW, NCSN(10), NSHL(3), NSHR(3),
3NZEN(3), NZSN(3), RHO1(305), RHO2(305), RHO3(410),
4I, TEMPA2(205), TEMPA3(42), TEMPA4(42), TEMPA5(205),
5, DELX(100), DISTL(100), DUM (10), ICOM,
6IYS, LFT, MG, MDUM, NCEN(10), NCUT, ND(3), NLZON, SN, SN1,
7SCHFCK
COMMON /NASCOM/ CHARRO, AIRM,
1CARBN1(205), CARBN5(205), SILCA1(205), SILCA5(205), PYRO(205), DEP(205),
2, HYD(205), AERO(205), AERN(205), BURN(205), WFD(205), WDEP(205), WSI(205),
35), WBRN(205), EMWT(205), PRG(205),
4, TIMEX(50), TFT(50), NPTS,
5, POR(205), PERM1(205), PERM2(205), VISC(205), GCON, RHOT5, CARTS, SILTS,
6PORT, PERT1, PERT2, DCOH, DCOO, DCOY, DCOOP, DCOSI, DCOCM, DCON, CFXH, CFXO,
7CFXPY, CFXDP, CFXSI, CFXCM, CFXN, DIFCO(205), SOX(205),
8, ALLGAS(205), GRAF1(205)
EQUIVALENCE (IHDN(2), NHDN(1))
EQUIVALENCE (RHO3(103), RHO4(1))
EQUIVALENCE (TEMPA1(1), TS(1)), (DELTAX(1), PARTIN(1))
EQUIVALENCE (MNOD, NNP)
REAL MARY
NONE = INCOM
JHDN = NHDN(NZON)
GO TO (20,10), NLR
10 NSHR(NZON) = NONE

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CHD30910
CHD30920
CHD30930
CHD30940
CHD30950
CHD30960
CHD30970
CHD30980
CHD30990
CHD31000
CHD31010
CHD31020
CHD31030
CHD31040
CHD31050
CHD31060
CHD31070
CHD31080
CHD31090
CHD31100
CHD31110
CHD31120
CHD31130
CHD31140
CHD31150
CHD31160
CHD31170
CHD31180
CHD31190
CHD31200
CHD31210
CHD31220
CHD31230
CHD31240
CHD31250
CHD31260
CHD31270
CHD31280
CHD31290
CHD31300
CHD31310
CHD31320
CHD31330
CHD31340
CHD31350
CHD31360
CHD31370
CHD31380
CHD31390
CHD31395
CHD31400
CHD31410
CHD31420
CHD31430

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IU = IZGT(NZON)
IG = IZG(NZON,IU)
IGX = IG+1
GO TO 22
20 NSHL(NZON) = NONE
IG = IZG(NZON,1)
NONF = -NONF ,
IGX = IG-1
22 IF (NONF) 80,80,25
25 NZONX = IGTYP(IGX)
30 KHDN = NHDN(NZONX)
35 NTWO = NONE*KHDN
GO TO (50,40),NLR
40 IX = IBF(IG)+NTWO
IY = IBS(IGX)+NONE*KHDN
IZ = IBSPN+NCSN(IGX)+NONE
WFD (IX)=WFD (IY)
WDEP(IX)=WDEP(IY)
WSI (IX)=WSI (IY)
WBRN(IX)=WBRN(IY)
FMWT(IX)=EMWT(IY)
WF (IX)=WF(IY)
GRAF1(IX)=GRAF1(IY)
TEMPA1(IX) = TEMPA1(IY)
TEMPA2(IX) = TEMPA2(IY)
TEMPA5(IX) = TEMPA5(IY)
SILCA1(IX)=SILCA1(IY)
CARBN1(IX)=CARBN1(IY)
GO TO 60
50 IX = IBS(IG)
IY = IBF(IGX)
IZ = IBSPN+NCSN(IG)
60 IF (JHDN-KHDN) 65,65,70
65 NTHREE = KHDN/JHDN
DO 67 J=1,NTWO
IX = IX-1
IY = IY-NTHREE
WFD (IX)=WFD (IY)
WDEP(IX)=WDEP(IY)
WSI (IX)=WSI (IY)
WBRN(IX)=WBRN(IY)
EMWT(IX)=EMWT(IY)
WF (IX)=WF(IY)
GRAF1(IX)=GRAF1(IY)
RHO1(IX) = RHO1(IY)
RHO2(IX) = RHO2(IY)
SILCA1(IX)=SILCA1(IY)
CARBN1(IX)=CARBN1(IY)
TEMPA1(IX) = TEMPA1(IY)
TEMPA2(IX) = TEMPA2(IY)
67 TEMPA5(IX) = TEMPA5(IY)
GO TO 80
70 NTHREE = JHDN/KHDN
FIVE = 1./FLOAT(NTHREE)
KNT1 = 0

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CHD31440
CHD31450
CHD31460
CHD31470
CHD31480
CHD31490
CHD31500
CHD31510
CHD31520
CHD31530
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CHD31840
CHD31850
CHD31860
CHD31870
CHD31880
CHD31890
CHD31900
CHD31910
CHD31920
CHD31930
CHD31940
CHD31950
CHD31960
CHD31970
CHD31980

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71 KNT = 0
72 ONE = (TEMPA1(IY)-TEMPA1(IY-1))*FIVE
TWO = (TEMPA2(IY)-TEMPA2(IY-1))*FIVE
HOLD=(SILCA1(IY)-SILCA1(IY-1))*FIVE
SAVE=(CARBN1(IY)-CARBN1(IY-1))*FIVE
GABY=(WFD(IY)-WFD(IY-1))*FIVE
HECT=(WDEP(IY)-WDEP(IY-1))*FIVE
MARY=(WSI(IY)-WSI(IY-1))*FIVE
CRUZ=(WRN(IY)-WRN(IY-1))*FIVE
CAJA=(EMWT(IY)-EMWT(IY-1))*FIVE
TIENDA=(WF(IY)-WF(IY-1))*FIVE
CINE=(GRAF1(IY)-GRAF1(IY-1))*FIVE
IF (KNT) 73,79,74
73 JX = IZ
GO TO 75
74 JX = IY
75 JY = IY
THREE = (RHO1(JX)-RHO1(IY-1))*FIVE
FOUR = (RHO2(JX)-RHO2(IY-1))*FIVE
DO 76 J=1,NTHREE
IX = IX-1
RHO1(IX) = RHO1(JX)-THREE
RHO2(IX) = RHO2(JX)-FOUR
SILCA1(IX)=SILCA1(JY)-HOLD
CARBN1(IX)=CARBN1(JY)-SAVE
TEMPA1(IX) = TEMPA1(JY)-ONE
TEMPA2(IX) = TEMPA2(JY)-TWO
TEMPA5(IX) = TEMPA2(IX)
WFD(IX)=WFD(JY)-GABY
WDEP(IX)=WDEP(JY)-HECT
WSI(IX)=WSI(JY)-MARY
WRN(IX)=WRN(JY)-CRUZ
EMWT(IX)=EMWT(JY)-CAJA
WF(IX)=WF(JY)-TIENDA
GRAF1(IX)=GRAF1(JY)-CINE
JX = IX
76 JY = JX
KNT = KNT+1
IY = IY-1
IF (KNT-KHDN) 72,78,78
78 IZ = IZ-1
KNT1 = KNT1+1
IF (KNT1-NONE) 71,80,80
80 RETURN
END

```

```

CHD31990
CHD32000
CHD32010
CHD32020
CHD32030
CHD32040
CHD32050
CHD32060
CHD32070
CHD32080
CHD32090
CHD32100
CHD32110
CHD32120
CHD32130
CHD32140
CHD32150
CHD32160
CHD32170
CHD32180
CHD32190
CHD32200
CHD32210
CHD32220
CHD32230
CHD32240
CHD32250
CHD32260
CHD32270
CHD32280
CHD32290
CHD32300
CHD32310
CHD32320
CHD32330
CHD32340
CHD32350
CHD32360
CHD32370
CHD32380
CHD32390
CHD32400
CHD32410
CHD32420
CHD32430

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- FOR SHIFT2,SHIFT2
SUBROUTINE SHIFT2
C**** THE SHIFT2 SUBROUTINE DOES SHIFT OF VALUES IN ZONES
DIMENSION NHDN(3), RHO4(306)
DIMENSION DELTAX(1), TEMPA1(1)
COMMON /BLOCKA/
1ABSORP(10) ,ABSC ,ACTENC ,ACTENS ,ACTENV(4,10),
2BSTAR ,CCPC(4) ,CCPG(4) ,CHARPT(101) ,CKC(4) ,
3COEFT(4,10) ,CONDC ,CONDV(100) ,CONST(4,10) ,COVERX(100) ,
4CPBAR ,CPC ,CPV(100) ,DIFREC ,UMATER(10) ,
5EFCOLC ,EFCOLS ,EFCOLV(4,10) ,FMIS(10) ,FMISC ,
6HQFM(10) ,HCOM ,HCOMG ,HSUB ,MAT(100) ,
7MATOMN ,MATMNF ,MN ,NN ,NNP ,
8NNSAVE ,NRDIV ,NRFND ,NRGO ,NST ,
9PARTIN(101) ,PHI ,QBYRAD ,QCOMP ,QFXT ,
10GPCOM ,QSUBL ,RFCPRO ,RFOPDC ,REORDS ,
2REORDV(4,10) ,RHO5Z ,RHO5(305) ,RHOCPX(101) ,RHOC ,
3RHOV(10) ,SABL ,SABLC ,SDOT ,SDOTC ,
4SLOPE(10) ,TMELT(10) ,TSZ ,TS(205) ,TRCHAR ,
5WFZ ,WF(205) ,XCHAR ,XINIT ,XLEFT(101) ,
6XMASS ,XMDOTC ,XMDOTD ,XMDOTG ,XMDOTL ,
7XMDOTR ,XMDOTS ,XTOTAL ,XVIRG(101) ,XZONF ,
COMMON/BLOCKC/
1BLPRES(20,11) ,COMMAX ,CUTOFF ,F(20,11) ,
2FLOW(20,11) ,HCONV(20,11) ,IERROR ,JUNCT ,L ,
3N ,NOSECH ,QBACK ,QCONV(20,11) ,QGAS(20,11) ,
4QMISC ,TIME ,TPRINT ,TWALL(20,11) ,XIWALL(20,11) ,
5XIR(20,11) ,
COMMON /CHCOM/ DTAU, IBE(10), IRS(10), IRSPN,
1IGTYP(10), IHDN(4), IM, IZB(3), IZG(3,10),
2IZGT(3), JRSW, NCSN(10), NSHL(3), NSHR(3),
3NZEN(3), NZSN(3), RHO1(305), RHO2(305), RHO3(410),
4I ,TEMPA2(205),TEMPA3(42),TEMPA4(42),TEMPA5(205),
5 ,DELX(100),DISTL(100),DUM (10),ICOM,
6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,
7SCHECK ,
COMMON /NASCOM/ CHARRO,AIRM,
1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205),
2HYD(205),AERO(205),AERN(205),BURN(205),WFD(205),WDFP(205),WSI(205),
3WBURN(205),EMWT(205),PRG(205),
4TIMFX(50),TFT(50),NPTS ,
5POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS,
6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,
7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205),
8ALLGAS(205),GRAF1(205) ,
EQUIVALENCE (IHDN(2),NHDN(1)) ,
EQUIVALENCE (RHO3(103),RHO4(1)) ,
EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1)) ,
EQUIVALENCE (MNOD,NNP) ,
DO 70 NZON=1,3
IF (NSHL(NZON)) 10,60,10
10 JHDN = NHDN(NZON)
NONE = NSHL(NZON)*JHDN
JRS = IZR(NZON)+NONE
IG = IZG(NZON,1)

```

```

IU = IZGT(NZON)
IGX = IZG(NZON,IU)
JBE = IBE(IGX)+NSHR(NZON)*JHON
IF (NSHL(NZON)) 20,20,30
20 JX = JBE
   J = -1
   GO TO 40
30 JX = JBS
   J = 1
40 IY = JX-J
   IX = IY-NONE
   DO 50 K=JBS,JBE
     IX = IX+J
     IY = IY+J
     TEMPA1(IX) = TEMPA1(IY)
     TEMPA2(IX) = TEMPA2(IY)
     TEMPA5(IX) = TEMPA5(IY)
     SILCA1(IX)=SILCA1(IY)
     CARBN1(IX)=CARBN1(IY)
     WFD (IX)=WFD (IY)
     WDEP(IX)=WDEP(IY)
     WSI (IX)=WSI (IY)
     WBRN(IX)=WBRN(IY)
     EMWT(IX)=EMWT(IY)
     WF  (IX)=WF(IY)
     GRAF1(IX)=GRAF1(IY)
     RHO1(IX) = RHO1(IY)
50 RHO2(IX) = RHO2(IY)
   NZSN(NZON) = NZSN(NZON)+NSHL(NZON)
   NSHL(NZON) = 0
60 NZEN(NZON) = NZEN(NZON)+NSHR(NZON)
70 NSHR(NZON) = 0
   RETURN
   FND

```

```

CHD32980
CHD32990
CHD33000
CHD33010
CHD33020
CHD33030
CHD33040
CHD33050
CHD33060
CHD33070
CHD33080
CHD33090
CHD33100
CHD33110
CHD33120
CHD33130
CHD33140
CHD33150
CHD33160
CHD33170
CHD33180
CHD33190
CHD33200
CHD33210
CHD33220
CHD33230
CHD33240
CHD33250
CHD33260
CHD33270
CHD33280
CHD33290
CHD33300
CHD33310

```

- FOR SIC,SIC
SURROUTINE SIC (K,KL,TEMPA,DEL)

C

C****

SIO2-CARBON REACTION

C

COMMON /BLOCKA/

1ABSORP(10)	,ABSC	,ACTENC	,ACTENS	,ACTENV(4,10)	CHD33320
2BSTAR	,CCPC(4)	,CCPG(4)	,CHARPT(101)	,CKC(4)	CHD33330
3COEFT(4,10)	,CONDC	,CONDV(100)	,CONST(4,10)	,COVERPX(100)	CHD33340
4CPBAR	,CPC	,CPV(100)	,DIFREC	,UMATER(10)	CHD33350
5EFCOLC	,EFCOLS	,EFCOLV(4,10)	,EMIS(10)	,EMISC	CHD33360
6HOFM(10)	,HCOM	,HCOMG	,HSUR	,MAT(100)	CHD33370
7MATOMN	,MATMNF	,MN	,NN	,NNP	CHD33380
8NNSAVE	,NRDIV	,NREND	,NRGO	,NST	CHD33390
9PARTIN(101)	,PHI	,QBYRAD	,QCOMB	,QFXTF	CHD33400
10GPCOM	,QSUBL	,RECPRO	,REORDC	,REORDS	CHD33410
2REORDV(4,10)	,RHO5Z	,RHO5(305)	,RHOCPX(101)	,RHOC	CHD33420
3RHOV(10)	,SABL	,SABLC	,SDOT	,SDOTC	CHD33430
4SLOPE(10)	,TMELT(10)	,TSZ	,TS(205)	,TRCHAR	CHD33440
5WFZ	,WF(205)	,XCHAP	,XINIT	,XLEFT(101)	CHD33450
6XMASS	,XMDOTC	,XMDOTD	,XMDOTG	,XMDOTL	CHD33460
7XMDOTR	,XMDOTS	,XTOTAL	,XVIRG(101)	,XZONE	CHD33470

COMMON/BLOCKC/

1BLPRES(20,11)	,COMMAX	,CUTOFF	,F(20,11)	CHD33540
2FLOW(20,11)	,HCONV(20,11)	,JUNCT	,L	CHD33550
3N	,NOSECH	,QBACK	,QCONV(20,11)	CHD33560
4QMISC	,TIME	,TPRINT	,TWALL(20,11)	CHD33570
5XIR(20,11)			,XIWALL(20,11)	CHD33580

COMMON /BLOCKJ/

1FLUXI(200),TEDEP(200),XEDEP(101),EDEP(101),NTEDEP,
2NXFDEP,ITEPEP,EDFLUX(100)

COMMON /BLOCKK/NN1,QCOND(205)

COMMON/BLOCKN/COORD

COMMON/BLOCKR/DIFC(4),FROC(4),FRODE

COMMON /CHCOM/	DTAU,	IBE(10),	IBS(10),	IBSPN,	CHD33650
1IGTYP(10),	IHDN(4),	IM,	IZB(3),	IZG(3,10),	CHD33660
2IZGT(3),	JRSW,	NCSN(10),	NSHL(3),	NSHR(3),	CHD33670
3NZEN(3),	NZSN(3),	RHO1(305),	RHO2(305),	RHO3(410),	CHD33680
4I	,TEMPA2(205),	TEMPA3(42),	TEMPA4(42),	TEMPA5(205),	CHD33690
5	DELX(100),	DISTL(100),	DUM (10),	ICOM,	CHD33700
6IYS,LFT,MG,MDUM,	NCEN(10),	NCUT,ND(3),	NLZON,SN,SN1,		CHD33710
7SCHECK					CHD33720

C**** DIMENSION STATEMENTS

C

DIMENSION DELTAX(1),TEMPA1(1)

EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))

COMMON /NASCOM/ CHARRO,AIRM,

1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)

2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205), WDEP(205),WSI(205)

35),WBRN(205),EMWT(205),PRG(205)

4,TIMFX(50),TFT(50),NPTS

5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS,

6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,

7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)

8,ALLGAS(205),GRAF1(205),GRAF5(205),SPEED(205),DIFCH(205),DIFR(205)

C	9,VISCO,VISCON,AF,BF,SILICA,REO,PMW,DMW,HMW,AOMW,ANMW,SMW,BMW,CX(6)	CHD33860
	WSIO2=AF*EXP(-BF/TEMPA)*(SILCA1(KL)/SILICA)**REO	CHD33870
	SILCA5(KL)=SILCA1(KL)-WSIO2*DTAU	CHD33880
	IF (SILCA5(KL)) 5,6,6	CHD33890
5	SILCA5(KL)=0.	CHD33900
	WSIO2=(SILCA1(KL)-SILCA5(KL))/DTAU	CHD33910
6	CONTINUE	CHD33920
	CARBN5(KL)=CARBN1(KL)-WSIO2*DTAU*.2	CHD33930
	WSI(KL)=WSIO2*(DELTAX(K)+DEL)*.05	CHD33940
	RETURN	CHD33950
	END	CHD33960
		CHD33970

```

- ASM STUFF2,STUFF2
  REGNAM
STUFF2* NOP
  S      A0,STUFF3
  L      A0,0127
  AN,14  A0,2
  S      A0,0127
  L      A0,STUFF3
  J      DIAG6
STUFF3 +0
  END

```

```

CHD33980
CHD33990
CHD34000
CHD34010
CHD34020
CHD34030
CHD34040
CHD34050
CHD34060
CHD34070

```

```

- FOR SURZ,SURZ
  SUBROUTINE SURZ(Z,T,P)
  XLN=ALOG(P/2116.2)/2.3026
  THETA=T*(.555556-.069444*XLN)
  IF (THETA-2000.) 1, 1, 2
1  Z = 1.
  GO TO 3
2  Z = 2.5+.1*TANH(THETA/500.-7.)+.4*TANH(THETA/1000.-7.) +TANH(THETA/
  1/2500.-5.8)
3  RETURN
  END

```

```

CHD34080
CHD34090
CHD34100
CHD34110
CHD34120
CHD34130
CHD34140
CHD34150
CHD34160
CHD34170

```

- FOR WRITE,WRITE

SUBROUTINE WRITE

COMMON /BLOCKA/

1ABSORP(10) ,ABSC
2RSTAR ,CCPC(4)
3COEFT(4,10) ,CONDC
4CPRAR ,CPC
5EFCOLC ,EFCOLS
6HOFM(10) ,HCOM
7MATOMN ,MATMNE
8NNSAVF ,RDIV
9PARTIN(101) ,PHI
10GPCOM ,QSUBL
2REORDV(4,10) ,RH05Z
3RHOV(10) ,SABL
4SLOPE(10) ,TMELT(10)
5WFZ ,WF(205)
6XMASS ,XMDOTC
7XMODTR ,XMDOTS

,ACTENC
,CCPG(4)
,CONDV(100)
,CPV(100)
,EFCOLV(4,10)
,HCOMG
,MN
,NREND
,QBYRAD
,RECPRO
,RH05(305)
,SABLC
,TSZ
,XCHAR
,XMDOTD
,XTOTAL

,ACTENS
,CHARPT(101)
,CONST(4,10)
,DIFRFC
,EMIS(10)
,HSUB
,NN
,NRGO
,QCOMB
,REORDC
,RHOC PX(101)
,SDOT
,TS(205)
,XINIT
,XMDOTG
,XVIRG(101)

,ACTENV(4,10)
,CKC(4)
,COVERX(100)
,UMATER(10)
,EMISC
,MAT(100)
,NNP
,NST
,QEXTR
,REORDS
,RHOC
,SDOTC
,TRCHAR
,XLEFT(101)
,XMDOTL
,XZONE

CHD34220
CHD34230
CHD34240
CHD34250
CHD34260
CHD34270
CHD34280
CHD34290
CHD34300
CHD34310
CHD34320
CHD34330
CHD34340
CHD34350
CHD34360
CHD34370
CHD34380
CHD34390
CHD34400

COMMON/BLOCKB/

1ALT ,AOFA
2BLDEN(20,11) ,BLEN(20,11)
3BMULT ,DIST(20,11)
4NDIM ,NTEMP
5PSP ,PTOTAL
6R(20,11) ,REFCOM(20,11)
7REFENT(20,11)
8REFVIS(20,11)
9RTRAN ,SOFS
1TTOTAL ,UAMB
2XIAMB ,XISP
3ATEMP ,BLVIS(20,11)

,AOFACH
,BLTEM(20,11)
,FSCOM
,NTHETA
,QAMB
,REFRN(20,11)
,RHOA
,SWEEP
,VISCOS
,XLTRAN
,ZWALL

,BETA(20)
,BLVEL(20,11)
,BLRN(20,11)
,FSGAM
,LENGTH(21)
,PAMB
,QSHOUL
,REFDEN(20,11)
,REFTEM(20,11)
,RHOVIS
,RNPERF
,THETA(11)
,THETSH
,X(20,11)
,XEQ(20,11)
,XMACH
,XX
,REFPR(20,11)
,HMAX

CHD34410
CHD34420
CHD34430
CHD34440
CHD34450
CHD34460
CHD34470
CHD34480
CHD34490
CHD34500
CHD34510
CHD34520
CHD34530

COMMON /BLOCKC/

1BLPRES(20,11)
2FLOW(20,11) ,HCONV(20,11)
3N ,NOSECH
4QMISC ,TIME
5XIR(20,11)

,COMMAX
,IERROR
,QBACK
,TPRINT

,CUTOFF
,JUNCT
,QCONV(20,11)
,TWALL(20,11)

,F(20,11)
,L
,QGAS(20,11)
,XIWALL(20,11)

CHD34540
CHD34550
CHD34560
CHD34570
CHD34580
CHD34590

COMMON /BLOCKD/

1ALPHA(200) ,AMBP(200)
2BWTEST ,IATMOS
3IQ ,IX
4 ,MVTEST
5NMATL ,NMATLD
6NTIME2 ,PRINT
7QINCR ,QM(200)
8RPRINC ,ROINC

,AMBT(200)
,IPR
,KK
,NKK
,NSTRES
,PUT(20)
,QTIME(20)
,RXINC

,AMULT(200)
,IPRINT(20,10)
,MELTN
,NCHARM
,NTBW
,QBAC(200)
,QTABLE(6,200)
,T(200)
,TNT(20)
,XINC(20)
,ZZ(200)

,AXLD(200)
,MELTL
,NMATLU
,NTIME1
,QINC(20)
,TRW(200)
,TORIBW(200)

CHD34600
CHD34610
CHD34620
CHD34630
CHD34640
CHD34650
CHD34660
CHD34670
CHD34680
CHD34690
CHD34700
CHD34710

COMMON /BLOCKF/

1ASTR(205) ,AXLDEQ
2CEMODV(4,10) ,CEXPC(4)
3CNUC(4) ,CNUV(4,10)
4CTENSC(4) ,CTENSV(4,10)

,CCOMSC(4)
,CEXPV(4,10)
,CSHRSC(4)
,GP(205)

,CCOMSV(4,10)
,CLCOEF
,CSHPSV(4,10)
,PERMC

,CEMODC(4)
,CMWGAS(4)
,CSTRO(205)
,PIN

CHD34720
CHD34730
CHD34740
CHD34750

5POROSC	,POROSV(10)	,PSTR1(205)	,PSTR2(205)	,PSTR3(205)	,CHD34760
6RIN	,RSTRO(205)	,SHRSTR(205)	,SSMAX(205)	,RAD(205)	CHD34770
7,NSLABT					CHD34780
COMMON/BLOCKG/					CHD34790
1QBOLD	,QBWTOT	,QCLD(20,10)	,QCOLD	,QCONVT(20,10)	CHD34800
2QGAST(20,10)	,QGLD(20,10)	,QGOLD	,QMISCT	,QMOLD	CHD34810
COMMON /BLOCKK/NN1,QCOND(205)					CHD34820
COMMON/BLOCKP/DIFC(4),FROC(4),ERODF					CHD34830
COMMON /DACOM/ UPPED(897),ITERT,MAS(74),NASW,UPSIT(84),TAU1					CHD34840
COMMON /NASCOM/ CHARRO,AIRM,					CHD34850
1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)					CHD34860
2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205), WDEP(205),WSI(205)					CHD34870
35),WBRN(205),EMWT(205),PRG(205)					CHD34880
4,TIMEX(50),TFT(50),NPTS					CHD34890
5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS,					CHD34900
6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,					CHD34910
7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)					CHD34920
8,ALLGAS(205),GRAF1(205),GRAF5(205),SPEED(205)					CHD34930
DIMENSION RHOR(1),XR(1),PRHOA(1),RHOU(1)					CHD34940
EQUIVALENCE (RHOS(119),RHOR(1)) , (CHARPT(2),XR(1))					CHD34950
1 , (RHOU(1),RHOS(205)) , (PRHOA(1),XVIRG(1))					CHD34960
DATA HLAM1/6H LAMIN/,HLAM2/2HAR/,HTURB1/6HTURBUL/,HTURB2/3HENT/					CHD34970
					CHD34980
					CHD34990
	PRINT TEMPERATURE, DENSITY, AND GAS PRESSURE DISTRIBUTION				CHD35000
	FOR DETAILED DESIGN				CHD35010
WRITE (6,1000) TAU1,ITERT					CHD35020
390 WRITE (6,1015)					CHD35030
ISPY=1					CHD35040
392 CONTINUE					CHD35050
DO 470 I=NNP,1,-1					CHD35060
IPLUS=I+20%					CHD35070
IF (I-NRFND) 403,403,400					CHD35080
400 IF (I-NNP) 460,401,401					CHD35090
401 JSUB=192					CHD35100
GO TO 410					CHD35110
403 IF (I-NRGO) 460,460,404					CHD35120
404 JSUB=NRDIV*(I-NRGO)+120					CHD35130
410 FNRDIV=NRDIV					CHD35140
DX=(XLEFT(I)-XLEFT(I-1))/FNRDIV					CHD35150
XDUM=XLEFT(I)-XLEFT(1)+DX					CHD35160
DO 450 J=1,NRDIV					CHD35170
XDUM=XDUM-DX					CHD35180
LT=JSUB-J					CHD35190
TDUM=TS(LT)-459.69					CHD35200
IF (J-1)420,420,430					CHD35210
420 RHO=RHO5(IPLUS)					CHD35220
M=I					CHD35230
GO TO 444					CHD35240
430 RHO=RHO5(LT)					CHD35250
M=I-1					CHD35260
444 GO TO (445,446),ISPY					CHD35270
445 CONTINUE					CHD35280
RHODE=RHO-CARBN1(LT)-SILCA1(LT)-GRAF1(LT)					CHD35290
WRITE (6,1016) M,XDUM,TDUM,QCOND(LT),RHO,RHODE,CARBN1(LT),GRAF1(LT)					CHD35300

1)	SILCA1(LT),PRG(LT),FMWT(LT),SPFED(LT)	CHD35310
	GO TO 450	CHD35320
446	CONTINUE	CHD35330
	WRITE (6,1022) M,WF(LT),WFD(LT),WDEP(LT),WSI(LT),WBRN(LT),AERO(LT)	CHD35340
	1,AERN(LT),HYD(LT),PYRO(LT),DEP(LT),SOX(LT),BURN(LT),ALLGAS(LT)	CHD35350
450	CONTINUE	CHD35360
	GO TO 470	CHD35370
460	TDUM=TS(I)-459.69	CHD35380
	XDUM=XLEFT(I)-XLFFT(I)	CHD35390
	GO TO (461,462),ISPY	CHD35400
461	CONTINUE	CHD35410
	RHO=RHO5(IPLUS)	CHD35420
	RHODE=RHO5(IPLUS)-CARBN1(I)-SILCA1(I)-GRAF1(I)	CHD35430
	WRITE (6,1016) I,XDUM,TDUM,QCOND(I),RHO,RHODE,CARBN1(I),GRAF1(I),	CHD35440
	1SILCA1(I),PRG (I),FMWT(I),SPEED(I)	CHD35450
	GO TO 463	CHD35460
462	CONTINUE	CHD35470
	WRITE (6,1022) I,WF(I),WFD(I),WDFP(I),WSI(I),WBRN(I),AERO(I),	CHD35480
	1AERN(I),HYD(I),PYRO(I),DEP(I),SOX(I),BURN(I),ALLGAS(I)	CHD35490
463	CONTINUE	CHD35500
470	CONTINUE	CHD35510
	GO TO (471,472),ISPY	CHD35520
471	ISPY=2	CHD35530
	WRITE (6,1021)	CHD35540
	GO TO 392	CHD35550
472	CONTINUE	CHD35560
1000	FORMAT (1H1,6H TIME=F8.2,5X17HTOTAL ITERATIONS=I6//)	CHD35570
1015	FORMAT(1H0,7X8HDISTANCE14X9HCONDUCTED7X18H-----	CHD35580
	135H-DENSITIES (LBM/FT3)-----2X 8HINTERNAL/9H NODE FR	CHD35590
	230HOM BACK TEMP HEAT FLUX7X28HTOTAL DECOMP CARBONCHD35600	
	34X 17HGRAPHITE SILICA 6X30HPRESSURE MOL WT VFLOCITY/9X	CHD35610
	4 4H(IN)6X22H(DEG F) (BTU/FT2-SEC)59X 9H(LBF/FT2)14X8H(FT/SEC)/)	CHD35620
1016	FORMAT (1H ,I3,F10.4,F12.2,F15.4,2X,5F11.4,E12.5 ,F9.3,E13.5)	CHD35630
1021	FORMAT(1H0,6X=8HGAS FLOW,3X,32H-----SOURCES AND SINKS----- 5XCHD35640	
	174H-----CONCENTRATIONS-----CHD35650	
	2-----/15H NODE RATE(LBM/,12X14H(LBM/NODE-SEC),49X14H(LBM/FT3CHD35660	
	3 VOID)/7X53HFT2-SEC) PYRO DEPO SI-C INT COMB OXYGEN CHD35670	
	43X27H NITROGEN HYDROGEN PYRO,6X,4HDEPO,6X3HSIO7X4HBURN6X5HTOTACHD35680	
	5L/)	CHD35690
1022	FORMAT(14,E11.4,1X,4E9.2,8E10.3)	CHD35700
	END	CHD35710

```

- FOR TBSTEP, TBSTEP
  FUNCTION TBSTEP (TAU1, TIME1, DSTEP, NPTS)
    DIMENSION TIME1(1), DSTEP(1)
    I=2
    3 IF (I-NPTS) 5,5,4
    4 TBSTEP=DSTEP(I-1)
    RETURN
    5 IF (TAU1-TIME1(I)) 7,6,6
    6 I=I+1
    GO TO 3
    7 CONTINUE
    TBSTEP=TIME1(I)-TAU1
    TBSTEP=AMIN1(TBSTEP, DSTEP(I-1))
    RETURN
  END

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CHD35720
CHD35730
CHD35740
CHD35750
CHD35760
CHD35770
CHD35780
CHD35790
CHD35800
CHD35810
CHD35820
CHD35830
CHD35840
CHD35850
CHD35860

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- FOR OUTPUT, OUTPUT

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SUBROUTINE OUTPUT (MTO)
COMMON /BLOCKA/
1ABSORP(10) ,ABSC ,ACTENC ,ACTENS ,ACTENV(4,10) ,
2BSTAR ,CCPC(4) ,CCPG(4) ,CHARPT(101) ,CKC(4) ,
3COEFT(4,10) ,CONDC ,CONDV(100) ,CONST(4,10) ,COVERX(100) ,
4CPBAR ,CPC ,CPV(100) ,DIFREC ,UMATER(10) ,
5EFCOLC ,EFCOLS ,EFCOLV(4,10) ,EMIS(10) ,EMISC ,
6HOFM(10) ,HCOM ,HCOMG ,HSUB ,MAT(100) ,
7MATOMN ,MATMNE ,MN ,NN ,NNP ,
8NNSAVE ,NRDIV ,NREND ,NRGO ,NST ,
9PARTIN(101) ,PHI ,QBYRAD ,QCOMB ,QEXTR ,
10GPCOM ,QSUBL ,RECPRO ,REORDC ,REORDS ,
2REORDV(4,10) ,RH05Z ,RH05(305) ,RHOCPX(101) ,RHOC ,
3RHOV(10) ,SABL ,SABLC ,SDOT ,SDOTC ,
4SLOPE(10) ,TMELT(10) ,TSZ ,TS(205) ,TRCHAR ,
5WFZ ,WF(205) ,XCHAR ,XINIT ,XLEFT(101) ,
6XMASS ,XMDOTC ,XMDOTD ,XMDOTG ,XMDOTL ,
7XMDOTR ,XMDOTS ,XTOTAL ,XVIRG(101) ,XZONE
COMMON /BLOCKC/
1BLPRES(20,11) ,COMMAX ,CUTOFF ,F(20,11) ,
2FLOW(20,11) ,HCONV(20,11) ,IERROR ,JUNCT ,L ,
3N ,NOSECH ,QBACK ,QCONV(20,11) ,QGAS(20,11) ,
4QMISC ,TIME ,TPRINT ,TWALL(20,11) ,XIWALL(20,11) ,
5XIR(20,11)
COMMON /BLOCKR/DIFC(4) ,ERO(4) ,ERODE
COMMON /NASCOM/ CHARRO ,AIRM ,
1CARBN1(205) ,CARBN5(205) ,SILCA1(205) ,SILCA5(205) ,PYRO(205) ,DEP(205) ,
2HYD(205) ,AERO(205) ,AERN(205) ,BURN(205) ,WFD(205) ,WDEP(205) ,WSI(205) ,
3WBURN(205) ,EMWT(205) ,PRG(205) ,
4TIMEX(50) ,TFT(50) ,NPTS ,
5POR(205) ,PERM1(205) ,PERM2(205) ,VISC(205) ,GCON ,RHOTS ,CARTS ,SILTS ,
6PORT ,PERT1 ,PERT2 ,DCOH ,DCOO ,DCOPY ,DCODP ,DCOSI ,DCOCM ,DCON ,CFXH ,CFXO ,
7CFXPY ,CFXDP ,CFXSI ,CFXCM ,CFXN ,DIFCO(205) ,SOX(205) ,
8ALLGAS(205) ,GRAF1(205) ,GRAF5(205) ,SPEED(205) ,DIFCH(205) ,DIFR(205) ,
9VISCO ,VISCON ,AF ,BF ,SILICA ,REO ,PMW ,DMW ,HMW ,AOMW ,ANMW ,SMW ,BMW ,CX(8) ,
1QSI ,QBRN ,QDEP
WRITE (6,1049)
DO 10 I = 1,MTO
WRITE (6,1050) I
WRITE (6,1051)
WRITE (6,1052) ACTENV(I,1) ,ACTENV(I,2) ,EFCOLV(I,1) ,EFCOLV(I,2) ,
1REORDV(I,1) ,REORDV(I,2)
WRITE (6,1053) HOFM(I)
WRITE (6,1054) (COEFT(I,J) ,J=1,4) , (CONST(I,J) ,J=1,4)
WRITE (6,1055) EMIS(I) ,ABSORP(I) ,RHOV(I) ,SLOPE(I)
10 CONTINUE
WRITE (6,1056)
WRITE (6,1057)
WRITE (6,1058) ACTENC ,ACTENS ,EFCOLC ,EFCOLS ,REORDC ,REORDS
WRITE (6,1059) HCOM
WRITE (6,1060) HSUB
WRITE (6,1061) EMISC ,ABSC ,RHOC ,TRCHAR
WRITE (6,1062) CHARRO
WRITE (6,1063)

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WRITE (6,1064) (CCPG(J),J=1,4)	CHD36410
WRITE(6,1065) HCOMG	CHD36420
WRITE (6,1066)	CHD36430
WRITE(6,1067) CARTS,RHOTS,SILTS	CHD36440
WRITE (6,1068) PORT,PERT1,PERT2	CHD36450
WRITE (6,1069) VISCO,VISCON	CHD36460
WRITE (6,1070) DCOCM,DCODP,DCON,DCOO,DCOPY,DCOSI	CHD36470
WRITE (6,1071) BSTAR,(DIFC(J),J=1,4)	CHD36480
WRITE (6,1072) QSI,QDFP	CHD36490
WRITE (6,1073) BF,AF,REO	CHD36500
WRITE (6,1074) SILICA	CHD36510
WRITE (6,1075) CX(1),CX(4),CX(2),CX(5),CX(3),CX(6)	CHD36520
1049 FORMAT (1H0,10X,39HMATERIAL PROPERTIES OF VIRGIN MATERIALS)	CHD36530
1050 FORMAT (1H0,14X,11HMATERIAL (,12,1H))	CHD36540
1051 FORMAT (1H0,59X10HFIRST REAC,6X11HSECOND REAC)	CHD36550
1052 FORMAT (1H ,24X,28HACTIVATION TEMPERATURE,DEG R ,6X,F10.1,6X,F10.1	CHD36560
1 /25X,25HCOLLISION FREQUENCY,1/SEC ,9X,E14.6,E16.6	CHD36570
2/25X,14HREACTION ORDER,20X,F10.4,6X,F10.1)	CHD36580
1053 FORMAT (1H0,24X,29HHEAT OF DECOMPOSITION,BTU/LBM,5X,F10.2)	CHD36590
1054 FORMAT (1H0,24X,27HSPECIFIC HEAT,BTU/LBM-DEG R ,7X,1H(E10.4,3H)+	CHD36600
1(,E10.4,4H)T+(,E10.4,7H)T**2+(,E10.4,5H)T**3/25X,34HCONDUCTIVITY,BCHD36610	
2TU-IN/FT2-SEC-DEG R ,1H(E10.4,3H)+(,E10.4,4H)T+(,E10.4,7H)T**2+(,	CHD36620
3E10.4,5H)T**3)	CHD36630
1055 FORMAT (1H0,24X,10HEMISSIVITY,24X,F10.4/25X12HABSORPTIVITY,22X,	CHD36640
1F10.4/25X15HDENSITY,LBM/FT3,19X,F10.2/25X34HTRANSPIRATION FACTOR (CHD36650	
2ABL GASES) ,F10.4)	CHD36660
1056 FORMAT (1H0/10X31HMATERIAL PROPERTIES OF THE CHAR)	CHD36690
1057 FORMAT (1H0,53X,19HCOMBUSTION REACTION,3X,16HCHAR SUBLIMATION)	CHD36700
1058 FORMAT (1H0,24X,26HHEAT OF COMBUSTION,BTU/LBM,8X,F10.2)	CHD36710
1060 FORMAT (1H ,24X,27HHEAT OF SUBLIMATION,BTU/LBM,7X,F10.2)	CHD36720
1061 FORMAT (1H0,24X,10HEMISSIVITY,24X,F10.4/25X12HABSORPTIVITY,22X,	CHD36730
1F10.4/25X15HDENSITY,LBM/FT3,19X,F10.2/25X34HTRANSPIRATION FACTOR (CHD36740	
2CHAR GASES) ,F10.4)	CHD36750
1062 FORMAT (1H0,24X,38HDENSITY OF THE CARBON IN CHAR,LBM/FT3 ,F7.2)	CHD36760
1063 FORMAT (1H0/10X23HABLATION GAS PROPERTIES)	CHD36770
1064 FORMAT (1H0,24X,27HSPECIFIC HEAT,BTU/LBM-DEG R ,7X,1H(E10.4,3H)+	CHD36780
1(,E10.4,4H)T+(,E10.4,7H)T**2+(,E10.4,5H)T**3)	CHD36790
1065 FORMAT (1H ,24X,30HHEAT OF GAS COMBUSTION,BTU/LBM,4X,F10.2)	CHD36800
1066 FORMAT (1H0/10X15HOTHER CONSTANTS)	CHD36810
1067 FORMAT (1H0,24X34HTHEORETICAL CARBON DENSITY,LBM/FT3,F10.2/	CHD36820
125X,34HTHEORETICAL VIRGIN DENSITY,LBM/FT3,F10.2/	CHD36830
225X,34HTHEORETICAL SILICA DENSITY,LBM/FT3,F10.2)	CHD36840
1068 FORMAT (1H0,24X,18HREFERENCE POROSITY,16X,F10.4/	CHD36850
125X,34HREFERENCE VISCOUS PERMEABILITY,FT2,E14.6/	CHD36860
225X,35HREFERENCE INERTIAL PERMEABILITY,FT ,E13.6)	CHD36870
1069 FORMAT (1H0,24X,30HREFERENCE VISCOSITY,LBM/FT-SEC,E14.6/	CHD36880
125X,34HREFERENCE TEMPERATURE FOR VISC.,R ,F10.2)	CHD36890
1070 FORMAT (1H0,14X,34HSURFACE DIFFUSION CONSTANT,FT2/SEC/	CHD36900
125X,15HCARBON MONOXIDE,19X,E14.6/	CHD36910
225X,32HDEPOSITION GAS (EXCEPT HYDROGEN),2X,E14.6/	CHD36920
325X,8HNITROGEN,26X,E14.6/	CHD36930
425X,8HOXYGEN ,26X,E14.6/	CHD36940
525X,7HMETHANE,27X,E14.6/	CHD36950
625X,16HSILICON MONOXIDE,18X,E14.6)	CHD36960
1071 FORMAT (1H0/25X, 17HBLOWING PARAMETER,17XF10.4/25X,	CHD36970

129H	DIFFUSION REDUCTION PARAMETER, 5X1H(E10.4,3H)+(,E10.4,6H)ETA+(,	CHD36980
	2E10.4,9H)ETA**2+(,F10.4,7H)ETA**3)	CHD36990
1072	FORMAT (25X,32HHEAT OF REACTION, SIO2-C,BTU/LBM,2XF10.2/	CHD37000
	125X,39HHEAT OF REACTION, C DEPOSITION, BTU/LBM,F8.2)	CHD37010
1073	FORMAT (1H0,14X,32HSILICA-CARBON REACTION CONSTANTS/	CHD37020
1	25X,28HACTIVATION TEMPERATURE,DEG R ,6X,F10.1/	CHD37030
2	25X,25HCOLLISION FREQUENCY,1/SEC ,9X,E14.6	CHD37040
3/25X,14H	REACTION ORDER,20X,F10.4)	CHD37050
1074	FORMAT (1H0,24X,38HSILICA DENSITY IN INITIAL CHAR,LBM/FT3, F8.2)	CHD37060
1075	FORMAT (1H0,14X,36HCARBON DEPOSITION REACTION CONSTANTS/	CHD37070
	11H0,58X, 12HLOW HYDROGEN,6X,13HHIGH HYDROGEN/	CHD37080
	225X,1HX,33X, E14.6,E16.6/25X,1HY,33X,E14.6,E16.6/25X,1HZ,33X,E14.6	CHD37090
	3,E16.6)	CHD37100
	RETURN	CHD37110
	END	CHD37120

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