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ANALYSIS OF THE APOLLO HEAT SHIELD PERFORMANCE

Volume II – CHAD Computer Program

By David W. Halstead, Kiandra S. Goudette,
Edwards F. del Casal, and Vladimir Dorlugin

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By David W. Halstead, Richard S. Gaudette,
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THE BOEING COMPANY

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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.

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* 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.

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* 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:

a	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.

$$\frac{\partial \dot{m}}{\partial y} = \dot{\rho}_s \tag{1}$$

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

$$\frac{\partial}{\partial t}(\rho_s i_s) + \frac{\partial}{\partial y}(\Sigma \dot{m}_i i_i) = \frac{\partial}{\partial y}\left(k_s \frac{\partial T}{\partial y}\right) \tag{2}$$

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

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

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:

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

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 diffusity, 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:

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

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:

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

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

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.

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

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

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

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:

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

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

$$\xi = 1 - \frac{\rho_s}{\rho^*} \tag{14}$$

where ξ = porosity

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

The porosity of the char is found from

$$\xi_{char} = 1 - \frac{\rho_{SiO_2}}{\rho_{SiO_2}^*} - \frac{\rho_C}{\rho_C^*} \tag{15}$$

where $\rho_{SiO_2}^*$ = 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

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

where Γ_1 = viscous permeability,

Γ_1^* = viscous permeability at the reference porosity,

and ξ^* = reference porosity.

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

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 ft^2/sec is found by

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

where

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

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

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

where

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

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

$$\vec{v} = \frac{\vec{\dot{m}}_v}{\rho_{g,v}} \tag{22}$$

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

where $\vec{\dot{m}}_v$ = gas mass flux per void area,

$\overline{M}$ = 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

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

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

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

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.

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

where $\dot{m}_{SiO_2}$ = lb_m SiO_2 reacted per ft^3-sec

ρ_{SiO_2} = density of silica per total volume,

and $\rho_{SiO_2,o}$ = 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

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

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

$$4.473 \times 10^4 < A < 6.729 \times 10^8$$
$$3.8315 \times 10^4 < B < 3.9855 \times 10^4$$
$$0 < n < 1$$

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)

$$\dot{m}_{comb,D} = B^*\psi H \tag{28}$$

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

$$\dot{m}_{comb,D} - B^* \psi H - K \dot{m}_g \tag{29}$$

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

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

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

$$\dot{q}_{char,comb} = \dot{m}_{char,comb} H_{char,comb} \tag{31}$$

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

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

where, for the sublimation of carbon, the constants are

$$A = 1.6 \times 10^7$$
$$B = 1.11 \times 10^5 \ {}^\circ R$$
$$C = 0.67$$

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

$$\dot{q}_{char,sub} = \dot{m}_{char,sub} H_{char,sub} \tag{33}$$

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

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

where $\dot{q}_{tot}$ = total flux,

$\dot{q}_{misc}$ = unblocked heating to surface,

$\dot{q}_{rad}$ = heat reradiated by ablation surface,

$\dot{q}_{comb,gp}$ = gas phase combustion,

$\dot{q}_{C,sub}$ = carbon sublimation,

$\dot{q}_{comb,s}$ = surface combustion,

ψ = blocking factor,

and $\dot{q}_{conv}$ = 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:

Table	Card no.	Card type	Format	Columns	Value
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

Table		Card no.	Card type	Format	Columns	Value
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.	2I10	1-10	3
					11-20	2
		2 to n-1	Table points	2F10.0	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.

Time	Print Time Step
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.

Card no.	Card type	Format	Columns	Value
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:

Card type	Format	Columns	Value
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/$d_1, d_2, \ldots, d_n$/, list/d_1, d_2, k*d3, ..., 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 ▲ is used to mark the required data values.

Material J Data

▲ ACTENV (I, J), I = 1, n	n = 1 to 2	Activation temperature (^{o}R)
▲ EFCOLV (I, J), I = 1,		Collision frequency (1/sec)
▲ 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).

▲ HOFM (J) Heat of pyrolysis at 536.67 ^{o}R (Btu/lb_m)

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

▲ 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/ft^2-sec-^{o}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$_m$-^{o}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$_m$/ft^3)
- ▲ 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 (^{o}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 (^{o}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 (Btu/lb_m-^oR 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) (lb_m/ft-sec)
▲ VISCON	Reference temperature for reference viscosity (^oR)

▲ DCOCM	Carbon monoxide	These are the constants D_C for the ablating surface diffusion where $D = D_C \psi H$
▲ DCODP	Gases other hydrogen produced in deposition reaction	
▲ DCOH	Hydrogen	
▲ DCON	Nitrogen	
▲ DCOO	Oxygen	
▲ DCOPY	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	

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 (^oR)
▲ 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:

$$\left.\begin{array}{l} CX(1) = X \\ CX(2) = Y \\ CX(3) = Z \end{array}\right\} \text{for } P_{H_2} \leq .02834 \text{ atm}$$

$$\left.\begin{array}{l} CX(4) = X \\ CX(5) = Y \\ CX(6) = Z \end{array}\right\} \text{for } P_{H_2} > .02834 \text{ atm}$$

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.

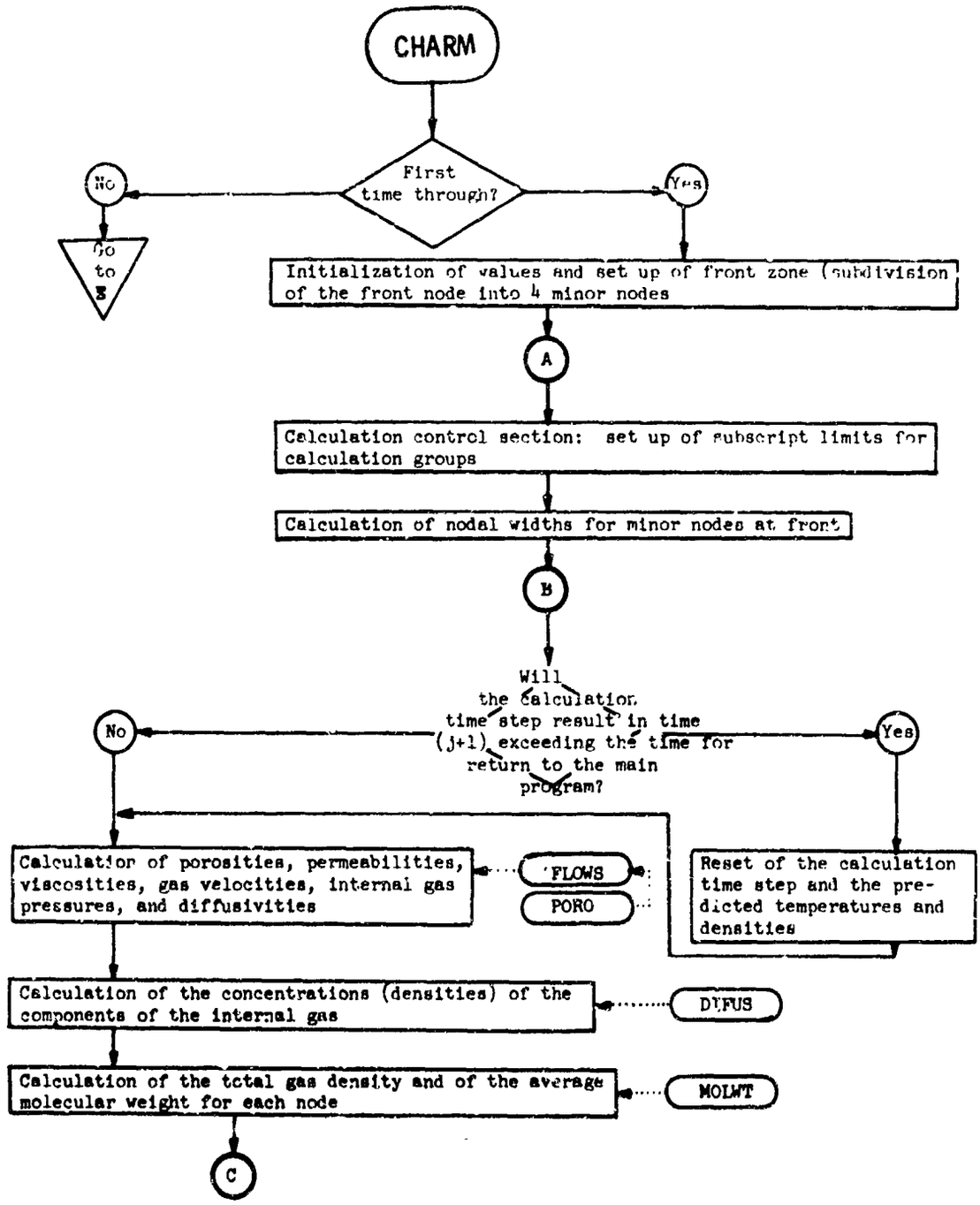
All subroutines are now listed in alphabetical order They are classified as CHARM, CHARM-Name, WRIT or Utility subroutines. Subroutines called from CHARM are classified as CHARM, subroutines reached from a subroutine called from CHARM are classified as CHARM-Name, and subroutines used by a number of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

Subroutine	Classification	Function
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

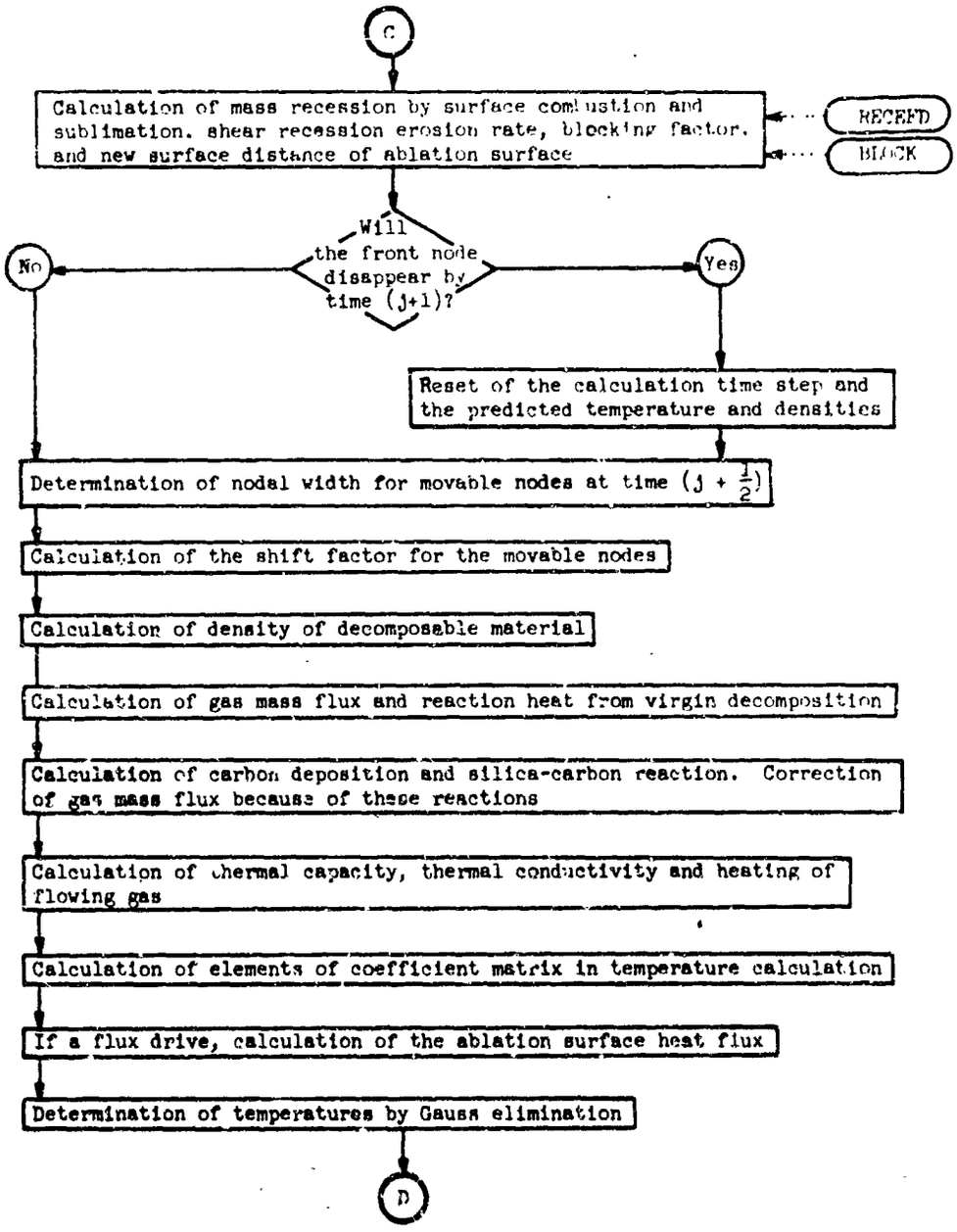
Subroutine	Classification	Function
FLOWS	CHARM	Calculates the internal pressures, internal gas velocities and the diffusion coefficients for hydrogen and other gases
FONEV	Utility	Linearly interpolates the value of f(x) from a table given the independent variable x
FREC	CHARM-RECEED	Calculates a simple 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 porosites and permeabilities of the solid and the viscosities of the internal gas

Subroutine	Classification	Function
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

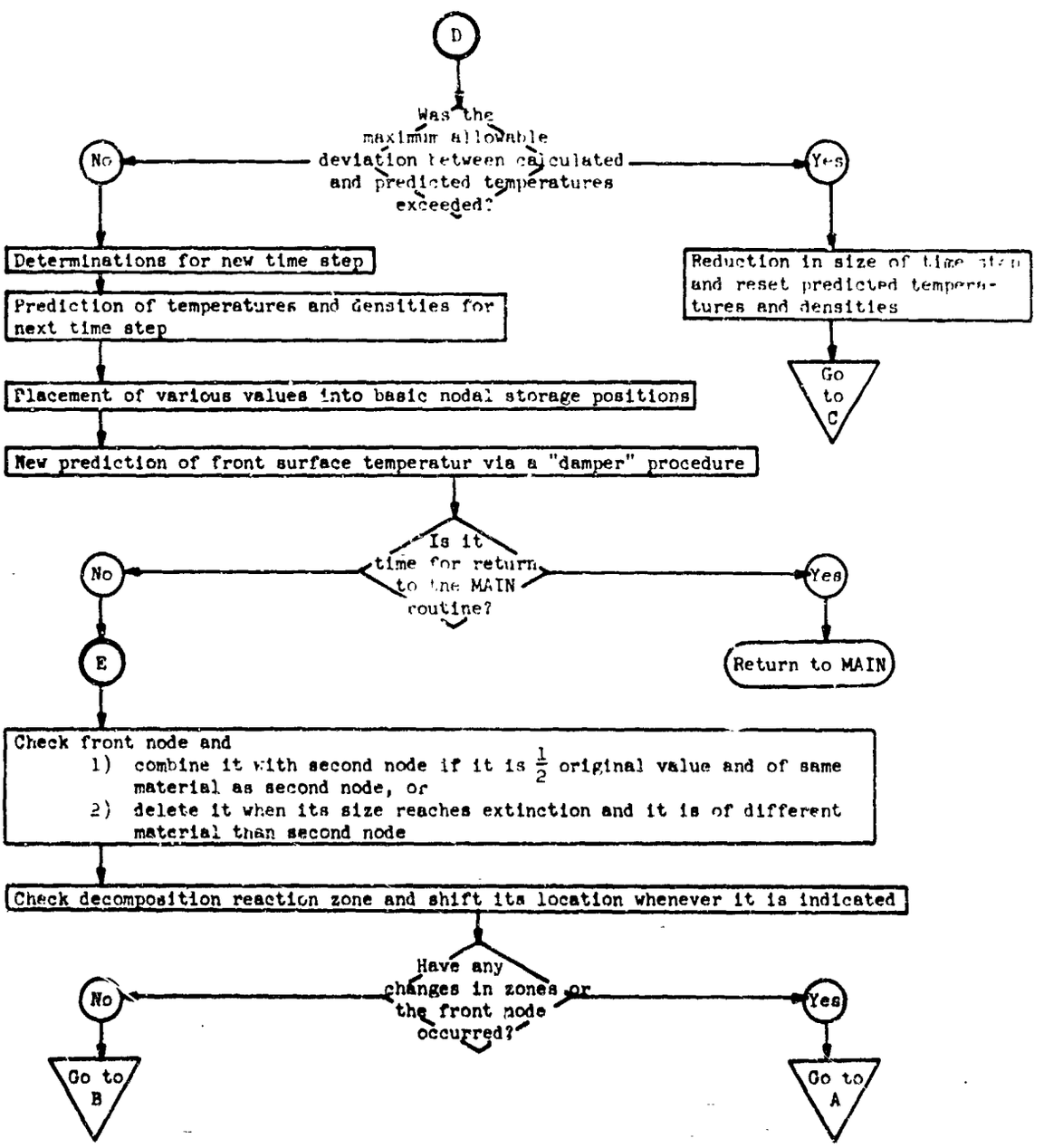
Flow charts.- Most of the subroutines are relatively simple and have been described in the previous section. A few subroutines are of sufficient complexity to warrant flow charts for the program user. They are CHARM, COMBIN, DIFUS, FRONT, and SHIFT1 and are presented here in that order.

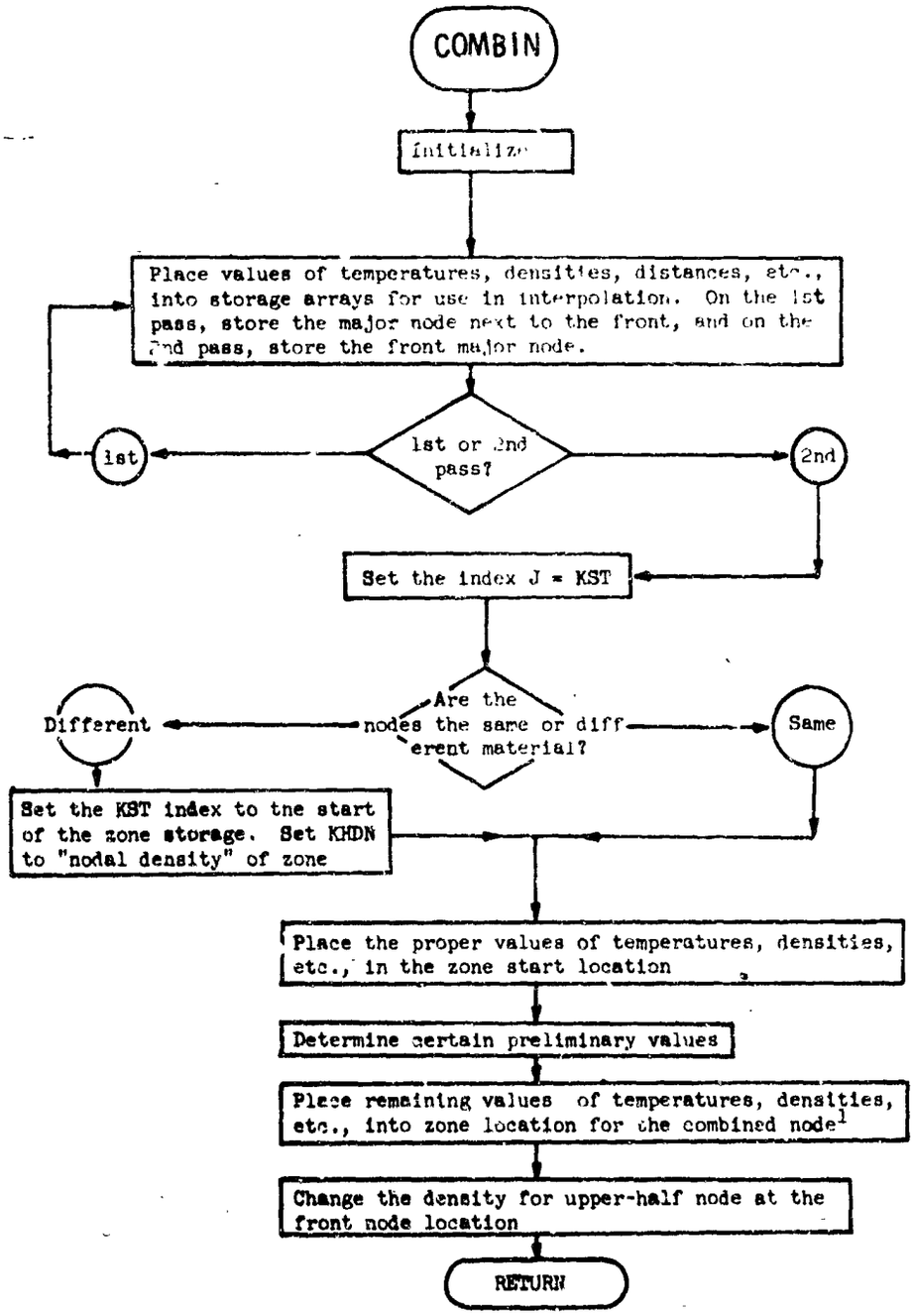

CHARM
First time through?
No
Yes
Go to B
Initialization of values and set up of front zone (subdivision of the front node into 4 minor nodes
A
Calculation control section: set up of subscript limits for calculation groups
Calculation of nodal widths for minor nodes at front
B
Will the calculation time step result in time (j+1) exceeding the time for return to the main program?
No
Yes
Calculation of porosities, permeabilities, viscosities, gas velocities, internal gas pressures, and diffusivities
FLOWS
PORO
Reset of the calculation time step and the predicted temperatures and densities
Calculation of the concentrations (densities) of the components of the internal gas
DIFUS
Calculation of the total gas density and of the average molecular weight for each node
MOLWT
C

CHARM (Continued)

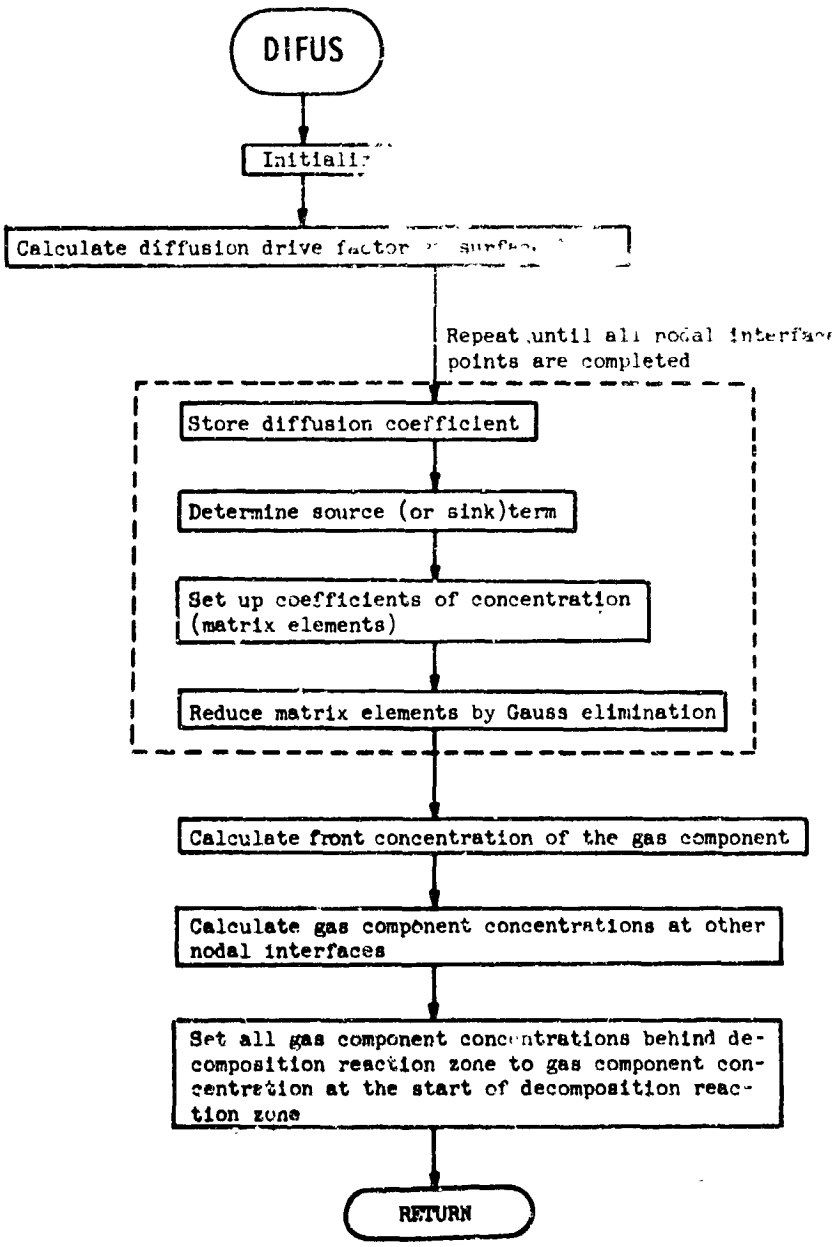


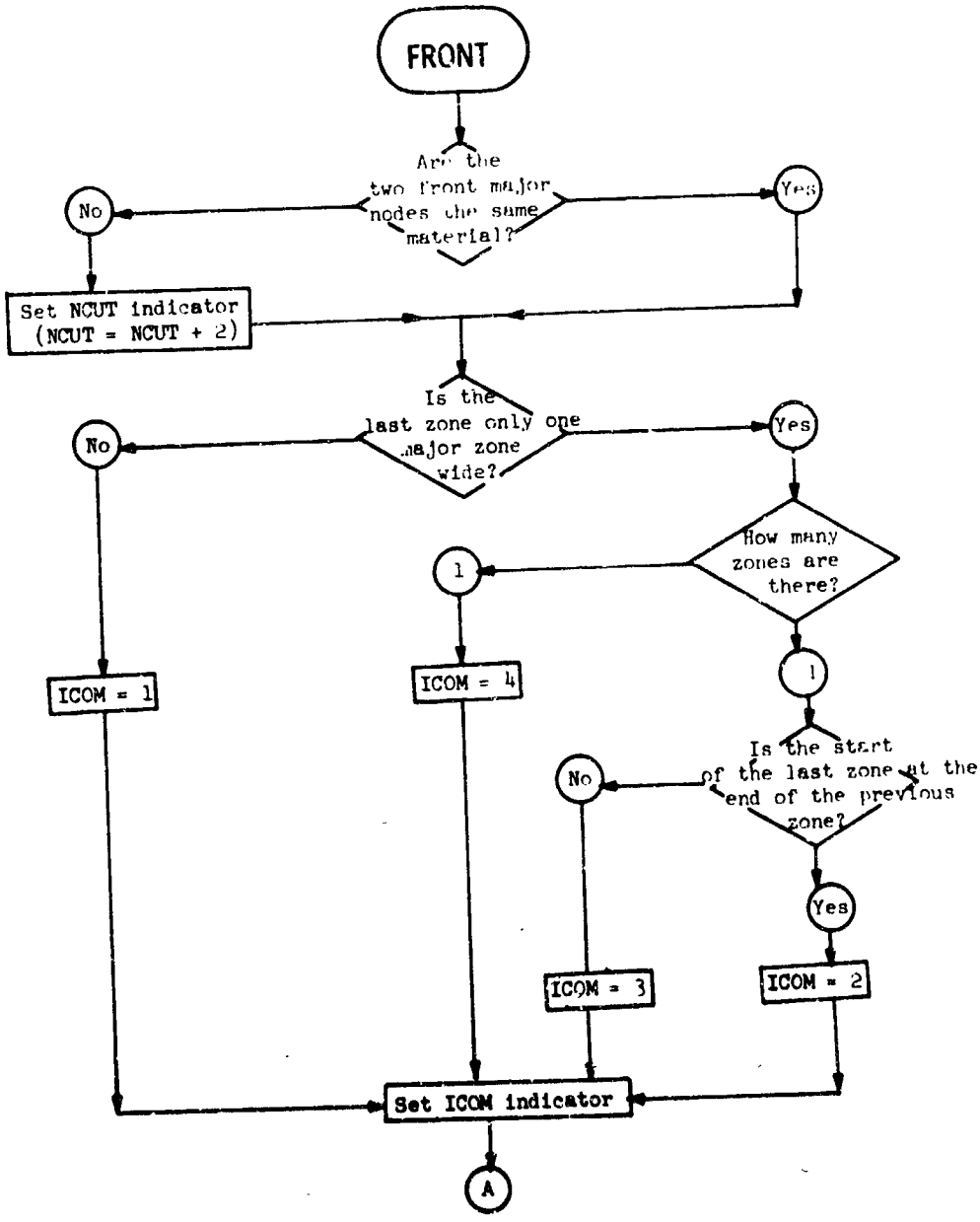
CHARM (Concluded)



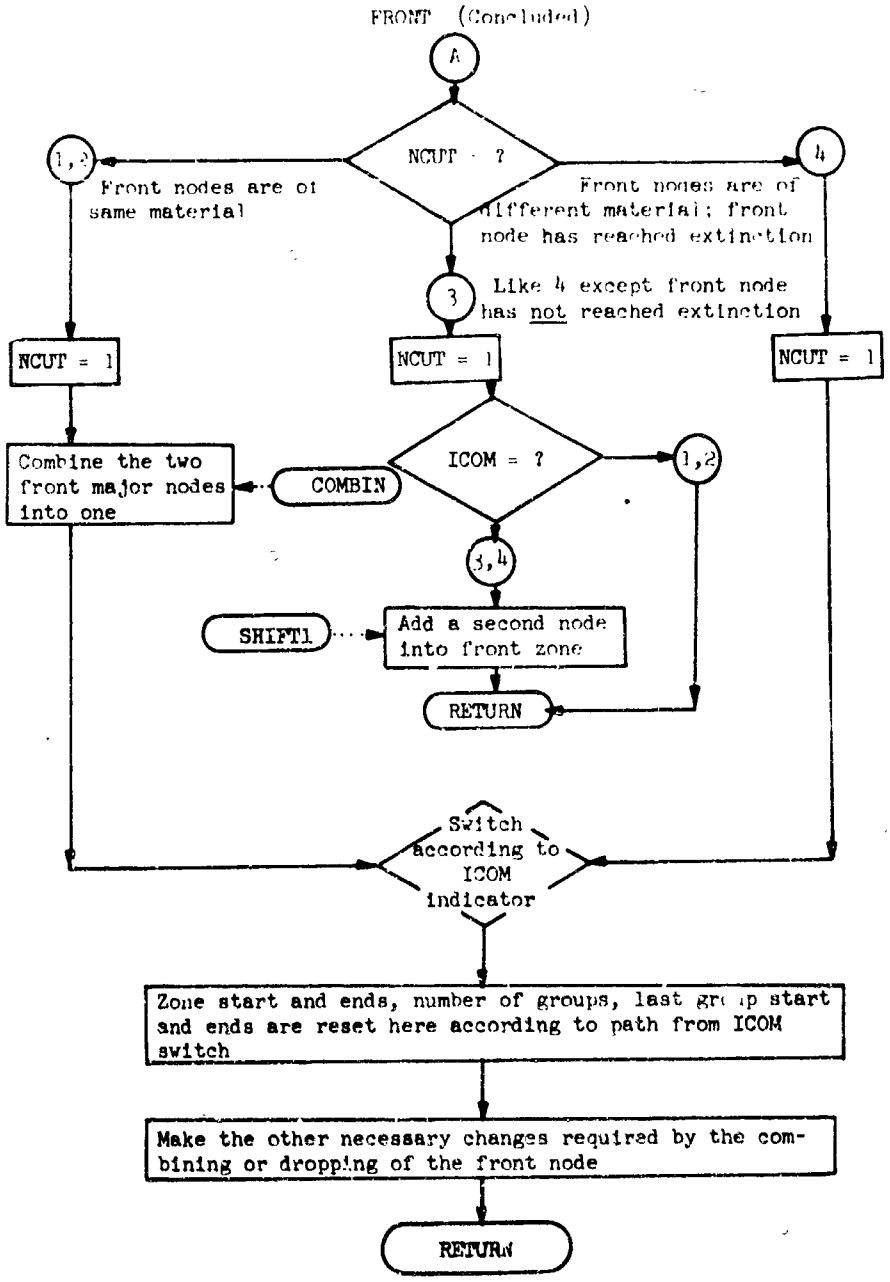


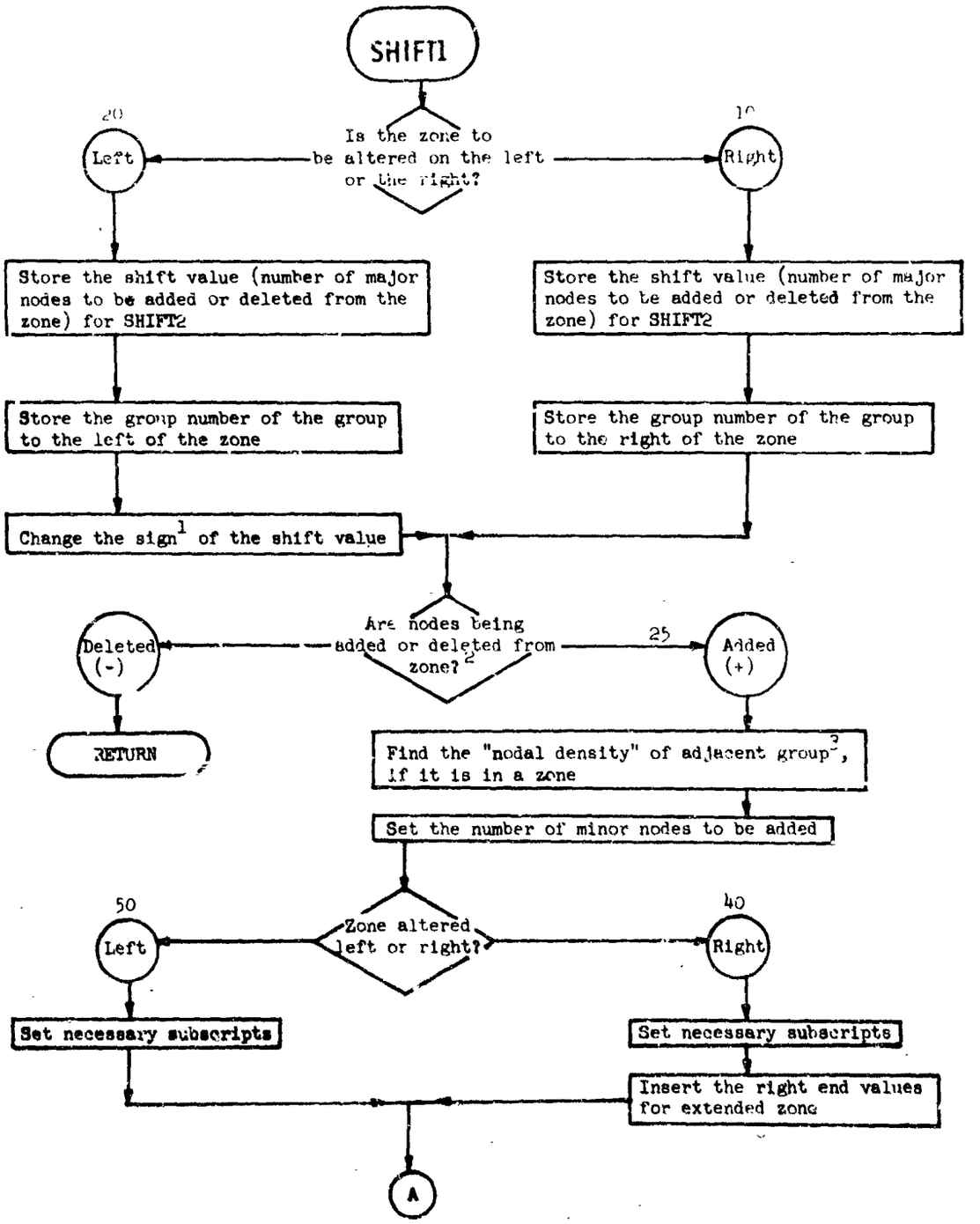
[1] In the case of different materials for the two front nodes, the front node is dropped because it is at extinction and the second node is placed in the zone storage position.

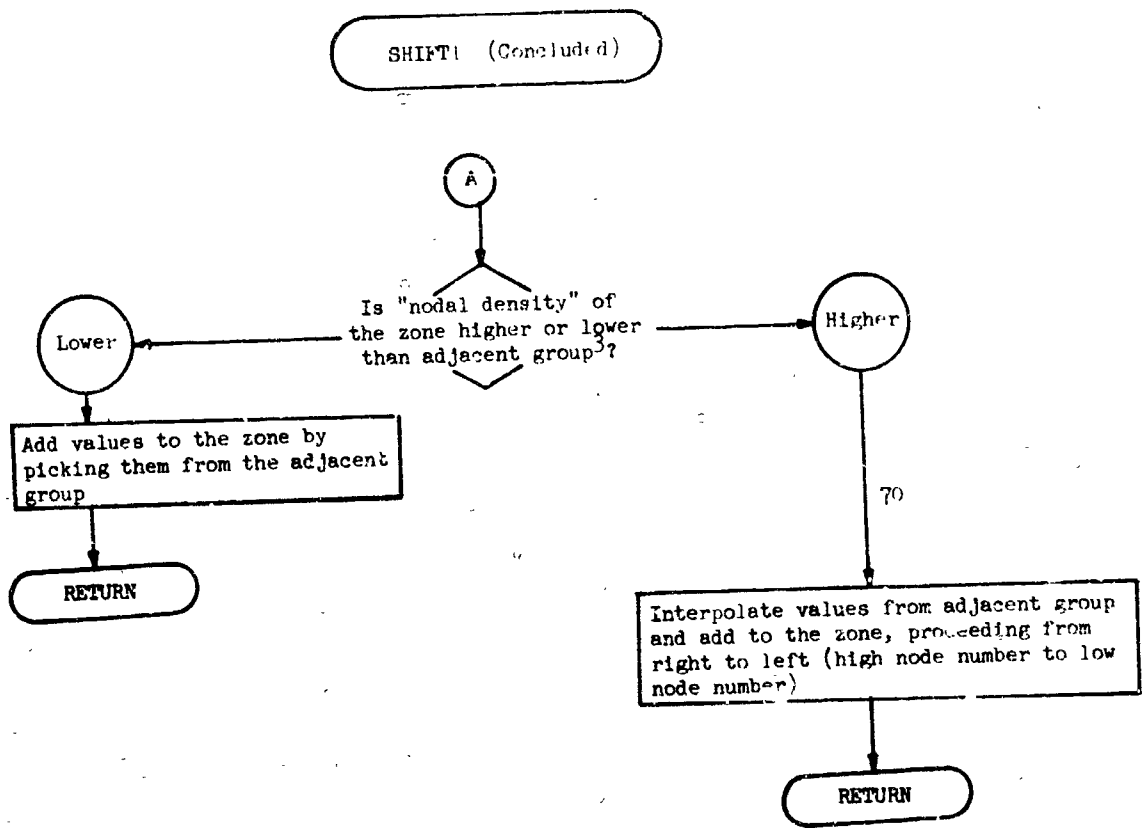

DIFUS
Initiali
Calculate diffusion drive factor
Repeat until all nodal interface points are completed
Store diffusion coefficient
Determine source (or sink)term
Set up coefficients of concentration (matrix elements)
Reduce matrix elements by Gauss elimination
Calculate front concentration of the gas component
Calculate gas component concentrations at other nodal interfaces
Set all gas component concentrations behind decomposition reaction zone to gas component concentration at the start of decomposition reaction zone
RETURN


FRONT
Are the two front major nodes the same material?
No
Yes
Set NCUT indicator (NCUT = NCUT + 2)
Is the last zone only one major zone wide?
No
Yes
How many zones are there?
1
1
ICOM = 1
ICOM = 4
Is the start of the last zone at the end of the previous zone?
No
Yes
ICOM = 3
ICOM = 2
Set ICOM indicator
A

FRONT (Concluded)




SHIFT1
Is the zone to be altered on the left or the right?
20
Left
10
Right
Store the shift value (number of major nodes to be added or deleted from the zone) for SHIFT2
Store the shift value (number of major nodes to be added or deleted from the zone) for SHIFT2
Store the group number of the group to the left of the zone
Store the group number of the group to the right of the zone
Change the sign[1] of the shift value
Are nodes being added or deleted from zone?[2]
Deleted (-)
25
Added (+)
RETURN
Find the "nodal density" of adjacent group[3], if it is in a zone
Set the number of minor nodes to be added
Zone altered left or right?
50
Left
40
Right
Set necessary subscripts
Set necessary subscripts
Insert the right end values for extended zone
A



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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-^oR	CHARM	Coefficient of temperature $(T_{i \pm 1})$
A	$\frac{\eta^A}{A}$	None	BLOCK	Term in equation for blocking function.
A	A_i	ft/sec.	DIFUS	Coefficient of gas component concentration $(C_{i \pm 1})$
A			ITER8	Temporary value calculated in this subroutine
ABSC	α_c	None		Char absorptivity for thermal radiation
ABSORP	α_v	None		Virgin absorptivity for thermal 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	^oR	RECEED	Activation temperature for char combustion
ACTENS	A_s	^oR	RECEED	Activation temperature for char sublimation
ACTENV	A_v	^oR	RHOSE	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^j	ft/sec	DIFUS	Gas velocity of node i at time j
ALPH	v_{i-1}^j	ft/sec	DIFUS	Gas velocity of node i-1 at time j
ALPHA	v_{i+1}^j	ft/sec	DIFUS	Gas velocity of node i+1 at time j
ALPHA	v_i^j	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)
AREA	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 -^oR	CHARM	Coefficient of temperature (T_i^{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 $(C_{l,i}^{i+1})$
B			IWR	Temporary value calculated in this subroutine
BDUM			RECEED	Temporary value calculated in this subroutine
BF	A_{si}	^oR	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-^oR	CHARM	Coefficient of temperature (T_{i+1}^{i+1})
C	C_i		CHARM	Coefficient of densities $(\rho_{i-1}^{i+1}$ and $\rho_{i+1}^{i+1})$ in density equations where nodes are "movable".
C	C_i	ft/sec	DIFUS	Coefficient of gas component concentration $(C_{l,i+1}^{i+1})$

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 j
CARBN5		lb_m/ft^3		Density of carbon in the char at time of j + 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 ($C_{1,i+1}^{i+1}$) after reduction of the original coefficient
CCPC		BTU/lb_m °R (for first term)		Coefficients of the cubic equation used to calculate char specific heat
CCPG		BTU/lb_m °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	$C_{s,CO}$	lb_m/ft^3		Surface concentration of carbon monoxide
CFXDP	$C_{s,dep}$	lb_m/ft^3		Surface concentration of "deposition gas" (gas other than hydrogen formed in carbon deposition reaction) [Not in use]
CFXH	$C_{s,H}$	lb_m/ft^3		Surface concentration of hydrogen
CFXN	$C_{s,N}$	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}sec ^oR (For first term)		Cubic coefficients for char conductivity equation
COEFT	$C_{p,v}$	BTU-in/ft^{2}sec ^oR (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-^oR-sec		Thermal conductance through a node
CONDC	K_c	BTU/ft^2-^oR-sec	CONDF	Char thermal conductance
CONDF				Function subroutine which calculates thermal conductance
CONDV	K_v	BTU/ft^2-^oR-sec	CONDF	Virgin thermal conductance
CONDX	K	BTU/ft^2-^oR-sec		Last thermal conductance determined in a group
CONDXX	K	BTU/Ft^2-^oR-sec		Last thermal conductance determined in the group prior to group under calculation
CONDO	K	BTU/ft^2-^oR-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-^oR-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$_m$-^oR		Specific heat of gas at mode i
CPC	$(\rho C_p)_c$	BTU/ft^3-^oR	PCAPF	Thermal capacity of the char
CPV	$(\rho C_p)_v$	BTU/ft^3-^oR	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-^oR	CHARM	The value D_i in the temperature equation: $A_i T_{i-1}^{j+1} + B_i T_i^{j+1} + C_i T_{i+1}^{j+1} = D_i$
D	D_i	ft/sec	DIFUS	The value D_i is the gas component concentration equation: $A_i C_{l,i-1}^{j+1} + B_i C_{l,i}^{j+1} + C_{l,i+1}^{j+1} = D_i$
DACT				The net amount of methane remaining in the exiting gas
DCO			DIFUS	The diffusion parameter D for the ablating surface for gas component l

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-^0R		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	$\Delta\tau$	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				Heat source to node i (Not in use)
EDFX				(Not in use)
EDFXX				(Not in use)
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
GRAF1				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)
IN1		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 locations 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 corresponding 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
NDOTSX	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	$lb_m ft^3/lb_f sec^2$		Viscous permeability multiplied by gc
PERM2	$lb_m ft^2/lb_f sec^2$		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	lb_m/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		FLOWS	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	[illegible]tch which is set to 1 for [illegible]omposition reaction and [illegible] for decomposition reaction [illegible] 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
FSQ		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	BTU/ft^2-sec		Heat flux to the back surface (Not in use)
QBRN	BTU/lb_m		Heat of reaction for internal combustion (Not in use)
QBYRAD	BTU/ft^2-sec		Heat radiated from the ablation surface
QCOMB	BTU/lb_m		Heat of surface combustion
QCOND	BTU/ft^2-sec		Conducted heat flux
QCONV			Unblocked convective heat flux to the ablation surface
QDEP	BTU/lb_m		Heat of reaction for carbon deposition
QGAS	BTU/ft^2-sec		Heat radiated by hot gas toward ablation surface
QGPCOM	BTU/ft^2-sec		Heat flux of gas phase combustion to ablation surface
QMISC	BTU/ft^2-sec		Heat to ablation surface that is not blocked
QMU	BTU/ft^2-sec		Storage array for unblocked heat flux (An input table)
QSAVE	BTU/ft^2-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		BTU/ft^2-sec		Partial total of heat fluxes to the ablation surface
QTOTAL		BTU/ft^2-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 combusion 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	$(\rho_a)_i^j$	lb_m/ft^3		Density of decomposable material at time j
RHO2	$(\rho_a)_i^{j+1}$ (est)	lb_m/ft^3		Estimated density of decomposable material at time j + 1
RHO3	$(\rho_a)_i^{j+1/2}$(est)	lb_m/ft^3		Estimated density of decomposable material at time of j + 1/2
RHO4	$(\rho_a)_{i+1/2}^{j+1/2}$ (est)	lb_m/ft^3		Average of RHO3 for two adjacent half-nodes

Program Symbol	Math. Symbol	Dim. Units	Subroutine	Description
RHO5	$(\rho_a)_i^{j+1}$(calc)	lb_m/ft^3		Calculated density of decomposable material at time j + 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 j + 1/2
SET			MAIN	Minimum COMMAX allowed
SILICA1	$(\rho_{SiO_2})^j$	lb_m/ft^3		Density of silica in the char at time j
SILICA5	$(\rho_{SiO_2})^{j+1}$	lb_m/ft^3		Density of silica in the char at time j + 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}	lb_m/lb mole		Molecular weight of silicon monoxide
SN		In		Thickness of movable nodes at time j + 1/2
SN1		In		Thickness of movable nodes at time j
SOURCE		lb_m/sec	DIFUS	Source of gas component i
SOX		lb_m/ft^3 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 impending calculation
TEMPA1	T_i^j	^oR		Temperature at a nodal interface at time j
TEMPA2	$(T_i^{j+1})_{est}$	^oR		Estimated temperature at a nodal interface at time j + 1
TEMPA3	$(T_i^{j+1/2})_{est}$	^oR		Estimated temperature at a nodal interface at time j + 1/2
TEMPA4	$(T_{i+1/2}^{j+1/2})_{est}$	^oR		Average of TEMPA3 for two adjacent nodal interfaces
TEMPA5	$(T_i^{j+1})_{calc.}$	^oR		Calculated temperature at a nodal interface at time j + 1
TEMPST				An array of temperatures corresponding 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 combustion and surface sublimation
TS	T_i^i	^oR		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 deposition sources needed for interpolation later in the routine
VISC	μ	lb_m/ft-sec		Viscosity of the internal gas
VISCO	μ^*	lb_m/ft-sec		Reference viscosity for viscosity calculation
VISCON	T^*	^oR		Temperature corresponding to the reference viscosity
VSTORE			COMBIN	Storage array for internal gas mass flux needed for interpolation later in the routine
WBRN		lb_m/sec		Source of carbon monoxide
WBRNX		lb_m/sec		The last WBRN value determined 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	lb_m/ft^2-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 GRAF1 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 combusion 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                                   TIME STEP CONTROL TABLE
         0.        1.0
        40.        0.2
       100.        1.0
       600.        2.0
      1078.        2.0
         0.         0.
         2                                    PRINT STEP CONTROL TABLE
         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.     .00930
       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.
         4                                    LOCAL STATIC PRESSURE AND FLOW
         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.
```

SAMPLE CASE I

Temperature drive - OUTPUT OF INITIAL INPUT TABLES

TITLE---- TEMPERATURE DRIVE SAMPLE CASE

CALCULATION TIME STEP CONTROL TABLE

TIME (SEC)	TIME STEP (SEC)
.00	1.0000
90.00	.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	.00009
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

LOCAL STATIC PRESSURE AND FLOW CONTROL TABLE

TIME (SEC)	LOC PRESS (LBF/FT2)	FLOW (--)	LOCAL STRESS (LBF/IN2)
.00	.0360	1.	.0000
40.00	1.7560	1.	.0006
50.00	10.5000	1.	.0019
60.00	64.0800	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.	.0119
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	364.0000	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)T**2+(.0000)T**3
CONDUCTIVITY,BTU-IN/FT2-SEC-DEG R (.2440-05)+(.4125-01)T+(.0000)T**2+(.0000)T**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)T**2+(.0000)T**3
CONDUCTIVITY,BTU-IN/FT2-SEC-DEG R (.1153-06)+(.9610-05)T+(.0000)T**2+(.0000)T**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	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 (.7000-001)+(.0000)T+(.0000)T**2+(.0000)T**3
HEAT OF GAS COMBUSTION,BTU/LBM 6173.00

OTHER CONSTANTS

THEORETICAL CARBON DENSITY,LBM/FT3 1[illegible]1.00
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 PARAM((-.6490-001)+(-.2540+01)ETA+(-.2300+01)ETA**2+(-.8700-00)ETA**3
HEAT OF REACTION, SIO2-C,[illegible]J/LBM .00
HEAT OF REACTION, C DEPOS TION, BTU/LBM 0

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

SIL CA D SITY IN INITIAL CHAR,LBM/FT3 8.19

CARBON DEPOSITION REACTION CONSTANTS

	LOW HYDROGEN	HIGH HYDROGEN
X	.136500-01	.60[illegible]000-03
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.

TIME= .00 TOTAL ITERATIONS= 1

NODE	DISTANCE FROM BACK (IN)	TEMP (DEG F)	CONDUCTED HEAT FLUX (BTU/FT2-SEC)	DENSITIES (LBM/FT3) TOTAL	DECOMP	CARBON	GRAPHITE	SILICA	INTERNAL PRESSURE (LBF/FT2)	MOL WT	VELOCITY (FT/SEC)
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) PYRO	DEPO	SI-C	INT COMB	CONCENTRATIONS (LBM/FT3 VOID) OXYGEN	NITROGEN	HYDROGEN	PYRO	DEPO	SIO	BURN	TOTAL
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	.5724-15	.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	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19

t = 0

35	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
33	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
32	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
31	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
30	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
29	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
28	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
27	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
26	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
25	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
24	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
23	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
22	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
21	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
20	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
19	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
18	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
17	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
16	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
15	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
14	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
13	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
12	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
11	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
10	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
9	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
8	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
7	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
6	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
5	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
4	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
3	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
2	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
1	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19

TIME= 100.00 TOTAL ITERATIONS= 389

NODE	DISTANCE FROM BACK (IN)	TEMP (DEG F)	CONDUCTED HEAT FLUX (BTU/FT2-SEC)	DENSITIES (LBM/FT3) TOTAL	DECOMP	CARBON	GRAPHITE	SILICA	INTERNAL PRESSURE (LBF/FT2)	MOL WT	VELOCITY (FT/SEC)
37	1.9653	4451.31	.0000	13.9551	-.0000	12.6819	.0000	1.2732	.82218+03	19.464	.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	19.086	.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	.0085	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

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

t = 1C

37	.4655-02	.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	.4595-02	.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	.139-02	.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	.216-03	.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

TIME= 200.00 TOTAL ITERATIONS= 547

NODE	DISTANCE FROM BACK (IN)	TEMP (DEG F)	CONDUCTED HEAT FLUX (BTU/FT2-SEC)	DENSITIES (LBM/FT3) TOTAL	DECOMP	CARBON	GRAPHITE	SILICA	INTERNAL PRESSURE (LBF/FT2)	MOL WT	VELOCITY (FT/SEC)
36	1.9315	2685.31	.0000	15.7289	-.0000	13.4931	.0000	2.2356	.79620+02	19.367	.36848+01
35	1.9182	2664.27	3.5573	16.3384	-.0000	13.2022	.0000	3.1363	.79830+02	19.140	.37086+01
35	1.9048	2642.71	3.6007	17.2726	-.0000	13.1389	.0000	4.1337	.80072+02	18.919	.37346+01
35	1.8914	2620.44	3.6796	19.3169	-.0000	14.1264	.0000	5.1905	.80398+02	18.700	.37919+01
35	1.8781	2597.47	3.8884	21.3513	-.0000	15.0299	.0000	6.3214	.80828+02	18.481	.38438+01
34	1.8216	2491.63	4.1985	24.4263	-.0000	15.7427	.0000	8.6836	.83547+02	17.637	.38288+01
33	1.7652	2369.83	4.4625	27.6521	.0000	18.0536	.0000	9.5984	.87544+02	16.870	.37251+01
32	1.7087	2229.01	4.5428	23.1680	.0000	13.2731	.0000	9.8949	.89902+02	16.238	.34288+01
31	1.6523	2067.94	4.5341	21.0153	-.0000	11.0375	.0000	9.9778	.91948+02	16.266	.36598+01
30	1.5958	1881.74	4.3928	20.0688	-.0000	10.0721	.0000	9.9968	.93863+02	16.868	.36168+01
29	1.5393	1658.49	4.2330	20.0002	.0002	10.0000	.0000	10.0000	.10749+03	17.779	.32768+01
28	1.5252	1594.46	4.1435	20.0000	.0000	10.0000	.0000	10.0000	.11054+03	18.085	.30300+01
28	1.5111	1525.08	3.9861	20.2405	.2405	10.0000	.0000	10.0000	.11370+03	18.390	.28195+01
28	1.4970	1443.23	3.5105	22.5993	2.5993	10.0000	.0000	10.0000	.11846+03	18.697	.24969+01
28	1.4829	1322.30	2.8318	29.0091	9.0091	10.0000	.0000	10.0000	.12638+03	18.952	.14407+01
27	1.4688	1100.45	2.1436	33.4154	13.4154	10.0000	.0000	10.0000	.12828+03	19.019	.20100-00
27	1.4547	844.09	1.5852	33.9725	13.9725	10.0000	.0000	10.0000	.12837+03	19.024	.82993-02
27	1.4405	648.48	1.1461	33.9989	13.9989	10.0000	.0000	10.0000	.12837+03	19.025	.28383-03
27	1.4264	506.85	.5354	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.54289-05
26	1.3700	241.73	.1924	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
25	1.3135	146.25	.0646	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
24	1.2571	119.15	.0200	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
23	1.2006	104.19	.0057	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
22	1.1441	101.32	.0015	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
21	1.0877	100.56	.0004	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
20	1.0312	100.36	.0001	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
19	.9748	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
18	.9183	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
17	.8619	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
16	.8054	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
15	.7489	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
14	.6925	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
13	.6360	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
12	.5796	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
11	.5231	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
10	.4667	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
9	.4102	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
8	.3537	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
7	.2973	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
6	.2408	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
5	.1844	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
4	.1279	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
3	.0715	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
2	.0150	100.30	.0000	484.0000	464.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000
1	.0000	100.30	.0000	.0000	-20.0000	10.0000	.0000	10.0000	.12837+03	19.025	.00000

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

t = 200

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	.169-03	.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	.261-03	.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	.289-03	.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

NODE	DISTANCE FROM BACK (IN)	TEMP (DEG F)	CONDUCTED HEAT FLUX (BTU/FT2-SEC)	DENSITIES (LBM/FT3) TOTAL	DECOMP	CARBON	GRAPHITE	SILICA	INTERNAL PRESSURE (LBF/FT2)	MOL WT	VELOCITY (FT/SEC)
35	1.8817	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	.38143-00
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	.42866-00
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	20.378	.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	1.2288	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	.48184-02
22	1.1865	763.38	.7972	33.9809	13.9809	10.0000	.0000	10.0000	.47588+03	20.483	.10294-02
22	1.1724	676.62	.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	164.81	.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

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

t = 50

35	.6834-03	.00	.26-11	.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	.8104-03	.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	.26-03	.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	.1698-07	.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 SAMPLE CASE
        1                                   TIME STEP CONTROL TABLE
       0.        1.0
      40.        0.2
     100.        1.0
     600.        2.0
    1078.        2.0
       0.         0.
        2                                   PRINT STEP CONTROL TABLE
       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.
        4                                   LOCAL STATIC PRESSURE AND FLOW
       0.      .0360         1.   .000403
      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

SAMPLE CASE 11

Heat flux drive - OUTPUT OF INITIAL INPUT TABLES

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/FT2-SEC)	MISC HEAT TO SURFACE (BTU/SEC)
.00	24751.00	.00004	-.000
20.00	24843.00	.00030	.047
40.00	24935.00	.00061	12.330
60.00	24854.00	.00391	33.880
80.00	22765.00	.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	10414.00	.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	.00665	.245
600.00	560.00	.00650	-.000
700.00	110.00	.01050	-.000
800.00	114.00	.01360	-.000
900.00	117.00	.01440	-.000
1000.00	123.00	.01550	-.000
1078.00	128.00	.01603	-.000

LOCAL STATIC PRESSURE AND FLOW CONTROL TABLE

TIME (SEC)	LOC PRESS (LBF/FT2)	FLOW (--)	LOCAL STRESS (LBF/IN2)
.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	589.0000	1.	.0087
120.00	410.9000	1.	.0077
130.00	349.0000	1.	.0067
140.00	296.0000	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) 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)T**2+(.0000)T**3	
CONDUCTIVITY,BTU-IN/FT2-SEC-DEG R	(.2440-05)+(.4125-01)T+(.0000)T**2+(.0000)T**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)T**2+(.0000)T**3	
CONDUCTIVITY,BTU-IN/FT2-SEC-DEG R	(.1153-06)+(.9610-05)T+(.0000)T**2+(.0000)T**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	.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 (.7000-001)+(.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 .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 (-.6990-001)+(-.2540+01)ETA+(-.2300+01)ETA**2+(-.8780-001)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	.36500-01	.406000-03
Y	.116200+03	.119000-01
Z	.577700+04	.922000+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) TOTAL	DECOMP	CARBON	GRAPHITE	SILICA	INTERNAL PRESSURE (LBF/FT2)	MOL WT	VELOCITY (FT/SEC)
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
35	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	0.0000	.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	.360 0-01	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	464.0000	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) PYRO	DEPO	SI-C	INT COMB	CONCENTRATIONS (LBM/FT3 VOID) OXYGEN	NITROGEN	HYDROGEN	PYRO	DEPO	SIO	BURN	TOTAL
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

t = 0

34	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
33	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
32	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
31	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
30	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
29	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
28	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
27	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
26	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
25	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
24	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
23	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
22	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
21	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
20	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
19	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
18	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
17	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
16	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
15	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
14	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
13	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
12	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
11	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
10	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
9	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
8	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
7	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
6	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
5	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
4	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
3	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
2	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19
1	.0000	.00	.00	.00	.00	.000	.000	.000	.000	.000	.000	.000	.100-19

TIME= 100.00 TOTAL ITERATIONS= 547

NODE	DISTANCE FROM BACK (IN)	TEMP (DEG F)	CONDUCTED HEAT FLUX (BTU/FT2-SEC)	DENSITIES (LBM/FT3) TOTAL	DECOMP	CARBON	GRAPHITE	SILICA	INTERNAL PRESSURE (LBF/FT2)	MOL WT	VELOCITY (FT/SEC)
37	1.9663	4336.85	23.7454	14.6052	-.0000	12.7620	.0000	1.8432	.82218+03	20.011	.21517+01
36	1.9584	4245.00	21.3768	17.0705	-.0000	14.4805	.0000	2.5900	.82266+03	19.732	.21625+01
36	1.9504	4149.62	23.3274	19.8252	-.0000	16.2775	.0000	3.4478	.82336+03	19.445	.21530+01
36	1.9425	4057.65	23.3552	20.9745	-.0000	16.6152	.0000	4.3593	.82415+03	19.153	.21059+01
36	1.9345	3965.63	22.7923	16.1255	.0000	10.6605	.0000	5.2650	.82453+03	18.874	.19466+01
35	1.8781	3420.83	21.5533	24.1026	-.0000	15.2006	.0000	8.9019	.83147+03	17.202	.17644+01
34	1.8216	2933.56	19.5486	23.5850	.0000	13.7459	.0000	9.8390	.83718+03	15.820	.15095+01
33	1.7652	2430.31	18.0470	20.1588	.1588	10.0000	.0000	10.0000	.86475+03	17.327	.17166+01
32	1.7511	2292.84	17.3659	20.0000	.0000	10.0000	.0000	10.0000	.87115+03	17.907	.15999+01
32	1.7369	2147.08	16.5950	20.0000	.0000	10.0000	.0000	10.0000	.87702+03	18.464	.14591+01
32	1.7228	1989.87	15.6619	20.0000	.0000	10.0000	.0000	10.0000	.88236+03	18.987	.13243+01
32	1.7087	1803.71	12.6184	21.6196	1.6196	10.0000	.0000	10.0000	.88963+03	19.492	.12377+01
31	1.6946	1459.86	7.1621	32.2143	12.2143	10.0000	.0000	10.0000	.93298+03	19.832	.50215-00
31	1.6805	803.22	3.5660	33.9976	13.9976	10.0000	.0000	10.0000	.90300+03	19.833	.49898-03
31	1.6664	444.50	1.7875	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.21016-06
31	1.6523	264.20	.3412	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
30	1.5958	125.98	.0529	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
29	1.5393	104.51	.0086	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
28	1.4829	101.02	.0014	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
27	1.4264	100.43	.0003	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
26	1.3700	100.33	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
25	1.3135	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
24	1.2571	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
23	1.2006	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
22	1.1441	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
21	1.0877	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
20	1.0312	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
19	.9748	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
18	.9183	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
17	.8619	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
16	.8054	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
15	.7489	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
14	.6925	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
13	.6360	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
12	.5796	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
11	.5231	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
10	.4667	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
9	.4102	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
8	.3537	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
7	.2973	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
6	.2408	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
5	.1844	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
4	.1279	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
3	.0715	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
2	.0150	100.30	.0000	484.0000	464.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000
1	.0000	100.30	.0000	.0000	-20.0000	10.0000	.0000	10.0000	.90300+03	19.833	.00000

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

t = 100

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	.208-03	.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
34	.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	.00	.00	.198-04	.202-03	.834-04	.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) TOTAL	DECOMP	CARBON	GRAPHITE	SILICA	INTERNAL PRESSURE (LBF/FT2)	MOL WT	VELOCITY (FT/SEC)
36	1.9354	2651.73	3.4510	16.5926	-.0000	13.9537	.0000	2.6389	.79620+02	19.608	.34208+01
35	1.9210	2629.47	3.2135	17.1729	.0000	13.5258	.0000	3.6471	.79857+02	19.361	.34425+01
35	1.9067	2603.69	3.5579	17.4830	.0000	12.7971	.0000	4.6859	.80105+02	19.121	.34489+01
35	1.8924	2578.62	3.5921	19.6921	-.0000	13.9537	.0000	5.7384	.80447+02	18.885	.35068+01
35	1.8781	2553.03	3.7676	21.7462	.0000	14.9016	.0000	6.8446	.80898+02	18.649	.35556+01
34	1.8216	2446.09	4.1042	27.6070	-.0000	18.6977	.0000	8.9092	.84585	17.778	.36019+01
33	1.7652	2323.28	4.2993	23.9600	.0000	14.2817	.0000	9.6783	.86997+	17.004	.33495+01
32	1.7087	2183.03	4.3823	23.6396	.0000	13.7206	.0000	9.9191	.89336+02	16.389	.32171+01
31	1.6523	2022.40	4.3432	20.6864	.0000	10.7027	.0000	9.9837	.91250+02	16.562	.35397+01
30	1.5958	1836.00	4.1972	20.0354	.0000	10.0376	.0000	9.9978	.93026+02	17.134	.33548+01
29	1.5393	1610.88	3.9952	20.0001	.0001	10.0000	.0000	10.0000	.10569+03	17.973	.30484+01
28	1.5252	1545.76	3.9459	20.0000	.0000	10.0000	.0000	10.0000	.10854+03	18.255	.26220+01
28	1.5111	1472.76	3.6552	21.1280	1.1280	10.0000	.0000	10.0000	.11219+03	18.546	.26714+01
28	1.4970	1376.64	3.0220	25.9376	5.9376	10.0000	.0000	10.0000	.11895+03	18.828	.20193+01
28	1.4829	1212.70	2.3689	32.0998	12.0998	10.0000	.0000	10.0000	.12406+03	18.980	.64223-00
27	1.4688	957.74	1.7851	33.8728	13.8728	10.0000	.0000	10.0000	.12448+03	18.999	.41555-01
27	1.4547	738.51	1.3251	33.9942	13.9942	10.0000	.0000	10.0000	.12449+03	19.001	.16566-02
27	1.4405	574.92	.9637	33.9997	13.9997	10.0000	.0000	10.0000	.12450+03	19.001	.63344-04
27	1.4264	455.83	.4631	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.14519-05
26	1.3700	226.87	.1717	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
25	1.3135	141.88	.0584	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
24	1.2571	112.89	.0182	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
23	1.2006	103.85	.0052	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
22	1.1441	101.24	.0014	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
21	1.0877	100.54	.0004	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
20	1.0312	100.34	.0001	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
19	.9748	100.31	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
18	.9183	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
17	.8619	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
16	.8054	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
15	.7489	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
14	.6925	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
13	.6360	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
12	.5796	100.30	.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
11	.5231	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
10	.4667	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
9	.4102	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
8	.3537	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
7	.2973	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
6	.2408	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
	.1844	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
4	.1279	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
3	.0715	100.30	-.0000	34.0000	14.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
2	.0150	100.30	.0000	484.0000	464.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000
1	.0000	100.30	.0000	.0000	-20.0000	10.0000	.0000	10.0000	.12450+03	19.001	.00000

NODE	GAS FLOW RATE (LBM/FT2-SEC)	SOURCES AND SINKS (LBM/NODE-SEC) PYRO	DEPO	SI-C	INT COMB	CONCENTRATIONS (LBM/FT3 VOID) 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	. 9-05	.145-03	.512-03

t = 200

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	.1014-02	.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) TOTAL	DECOMP	CARBON	GRAPHITE	SILICA	INTERNAL PRESSURE (LBF/FT2)	MOL WT	VELOCITY (FT/SEC)
35	1.8864	2258.67	-.2963	20.1544	.0000	14.6579	.0000	5.4965	.44895+03	24.500	.00829-00
34	1.8702	2262.03	-.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	1.7652	2239.11	1.2039	24.3865	-.0000	15.0354	.0000	9.3511	.46762+03	14.883	.35118-00
32	1.7087	2199.67	1.6378	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	.47256+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	2.3142	20.0001	.0001	10.0000	.0000	10.0000	.48067+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	.48756+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	.46799-03
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	176.54	.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

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

t = 500

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	.294-04	.192-03	.158-03	.122-02	.000	.141-04	.277-02	.436-02
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	.6441-04	.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-[illegible]	.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	.6099-09	.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 subroutines).

```
- FOR BLKD/D2,BLKD/D2,BLKD/C2
      BLOCK DATA                                                        CHD00000
      COMMON /BLOCKA/                                                   CHD00010
     1ABSORP(10)  ,ABSC        ,ACTENC      ,ACTENS      ,ACTENV(4,10),  CHD00020
     2BSTAR       ,CCPC(4)     ,CCPG(4)     ,CHARPT(101) ,CKC(4)      ,  CHD00030
     3COEFT(4,10) ,CONDC       ,CONDV(100)  ,CONST(4,10) ,COVERX(100) ,  CHD00040
     4CPBAR       ,CPC         ,CPV(100)    ,DIFREC      ,UMATER(10)  ,  CHD00050
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)    ,EMISC       ,  CHD00060
     6HOFM(10)    ,HCOM        ,HCOMG       ,HSUB        ,MAT(100)    ,  CHD00070
     7MATOMN      ,MATMNE      ,MN          ,NN          ,NNP         ,  CHD00080
     8NNSAVE      ,NRDIV       ,NREND       ,NRGO        ,NST         ,  CHD00090
     9PARTIN(101) ,PHI         ,QBYRAD      ,QCOMB       ,QEXTR       ,  CHD00100
     1QGPCOM      ,QSUBL       ,RECPRO      ,REORDC      ,REORDS      ,  CHD00110
     2REORDV(4,10),RHOSZ       ,RHOS(305)   ,RHOCPX(101) ,RHOC        ,  CHD00120
     3RHOV(10)    ,SABL        ,SABLC       ,SDOT        ,SDOTC       ,  CHD00130
     4SLOPE(10)   ,TMELT(10)   ,TSZ         ,TS(205)     ,TRCHAR      ,  CHD00140
     5WFZ         ,WF(205)     ,XCHAR       ,XINIT       ,XLEFT(101)  ,  CHD00150
     6XMASS       ,XMDOTC      ,XMDOTD      ,XMDOTG      ,XMDOTL      ,  CHD00160
     7XMDOTR      ,XMDOTS      ,XTOTAL      ,XVIRG(101)  ,XZONE          CHD00170
      COMMON/BLOCKC/                                                    CHD00180
     1BLPRES(20,11)           ,COMMAX      ,CUTOFF      ,F(20,11)    ,  CHD00190
     2FLOW(20,11) ,HCONV(20,11),IERROR      ,JUNCT       ,L           ,  CHD00200
     3N           ,NOSECH     ,QBACK       ,QCONV(20,11),QGAS(20,11) ,  CHD00210
     4QMISC       ,TIME       ,TPRINT      ,TWALL(20,11),XIWALL(20,11),  CHD00220
     5XIR(20,11)                                                        CHD00230
      COMMON /BLOCKJ/                                                   CHD00240
     1FLUXI(200),TEDEP(200),XEDEP(101),EDEP(101),NTEDEP,                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),      IZG(3,10),     CHD00310
     2IZGT(3),    JRSW,        NCSN(10),    NSHL(3),     NSHR(3),       CHD00320
     3NZEN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),     CHD00330
     4I           ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),     CHD00340
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                  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(20CHD00400
     35),WBRN(205),EMWT(205),FRG(205)                                   CHD00410
     4,TIMEX(50),TFT(50),NPTS                                           CHD00420
     5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS, CHD00430
     6PORT,PERT1,PERT2,DCOM,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,REO,PMW,DMW,HMW,AOMW,ANMW,SMW,BMW,CX(6)CHD00470
     1,QS,,QBRN,QDEP                                                    CHD00480
      DATA NST,L,N, COORD,AIRM,GCON/1,1,1,1.,28.96,1545./               CHD00490
      DATA CFXO,CFXN,CFXH,CFXPY,CFXDP,CFXSI,CFXCM/7*0./                 CHD00500
C THE ABOVE DATA STATEMENTS ARE NORMALLY LEFT UNCHANGED                 CHD00510
C MATERIAL 1 DATA                                                       CHD00520
      DATA (ACTENV(I,1),I=1,2)/23300.,0./                               CHD00530
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      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,PORT,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/2.0921E3,40755.,8.194,1./                   CHD00900
      DATA (CX(I),I=1,6)/.01365,116.2,1777.,6.06E-4,.0114,4.22/         CHD00910
      END                                                               CHD00920
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- FOR BLOCK,BLOCK
      SUBROUTINE BLOCK(XMC,TC,GAS,SLOPE,H,F,PHI)                        CHD00930
      XMG=GAS                                                           CHD00940
      TG=SLOPE                                                          CHD00950
      IF(F-1.1) 10,10,20                                                CHD00960
 10   A=(XMC*TC+XMG*TG)                                                 CHD00970
      GO TO 30                                                          CHD00980
 20   A=(XMC*TC**3+XMG*TG**3)/3.                                        CHD00990
 30   B=A/(H+1.E-20)                                                    CHD01000
      IF(B-88.)40,40,50                                                 CHD01010
 40   PHI=EXP (-B)                                                      CHD01020
      GO TO 60                                                          CHD01030
 50   PHI=0.                                                            CHD01040
 60   RETURN                                                            CHD01050
      END                                                               CHD01060
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000015 0001

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- FOR CHARM/S4,CHARM/S4
      SUBROUTINE CHARM                                                  CHD01070
C****    CHARM SUBROUTINE IN CHAP  --JULY 1966 VERSION                  CHD01080
C     LISTING FOR GAUDETTE 8528 TAPE                                    CHD01090
      COMMON /BLOCKA/                                                   CHD01100
     1ABSORP(10)  ,ABSC        ,ACTENC      ,ACTENS      ,ACTENV(4,10),  CHD01110
     2BSTAR       ,CCPC(4)     ,CCPG(4)     ,CHARPT(101) ,CKC(4)      ,  CHD01120
     3COEFT(4,10) ,CONDC       ,CONDV(100)  ,CONST(4,10) ,COVERX(100) ,  CHD01130
     4CPBAR       ,CPC         ,CPV(100)    ,DIFREC      ,UMATER(10)  ,  CHD01140
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)    ,EMISC       ,  CHD01150
     6HOFM(10)    ,HCOM        ,HCOMG       ,HSUB        ,MAT(100)    ,  CHD01160
     7MATOMN      ,MATMNE      ,MN          ,NN          ,NNP         ,  CHD01170
     8NNSAVE      ,NRDIV       ,NREND       ,NRGO        ,NST         ,  CHD01180
     9PARTIN(101) ,PHI         ,QBYRAD      ,QCOMB       ,QEXTR       ,  CHD01190
     1QGPCOM      ,QSUBL       ,RECPRO      ,REORDC      ,REORDS      ,  CHD01200
     2REORDV(4,10),RHO5Z       ,RHO5(305)   ,RHOCPX(101) ,RHOC        ,  CHD01210
     3RHOV(10)    ,SABL        ,SABLC       ,SDOT        ,SDOTC       ,  CHD01220
     4SLOPE(10)   ,TMELT(10)   ,TSZ         ,TS(205)     ,TRCHAR      ,  CHD01230
     5WFZ         ,WF(205)     ,XCHAR       ,XINIT       ,XLEFT(101)  ,  CHD01240
     6XMASS       ,XMDOTC      ,XMDOTD      ,XMDOTG      ,XMDOTL      ,  CHD01250
     7XMDOTR      ,XMDOTS      ,XTOTAL      ,XVIRG(101)  ,XZONE          CHD01260
      COMMON /BLOCKB/ USER(243),BLDEN(20,11)                            CHD01270
      COMMON/BLOCKC/                                                    CHD01280
     1BLPRES(20,11)            ,COMMAX      ,CUTOFF      ,F(20,11)    ,  CHD01290
     2FLOW(20,11) ,HCONV(20,11),IERROR      ,JUNCT       ,L           ,  CHD01300
     3N           ,NOSECH      ,QBACK       ,QCONV(20,11),QGAS(20,11) ,  CHD01310
     4QMISC       ,TIME        ,TPRINT      ,TWALL(20,11),XIWALL(20,11), CHD01320
     5XIR(20,11)                                                        CHD01330
      COMMON /BLOCKJ/                                                   CHD01340
     1FLUXI(200),TEDEP(200),XEDEP(101),EDEP(101),NTEDEP,                CHD01350
     2NXEDEP,ITEPEP,EDFLUX(100)                                         CHD01360
      COMMON /BLOCKK/NN1,QCOND(205)                                     CHD01370
      COMMON/BLOCKN/COORD                                               CHD01380
      COMMON/BLOCKR/DIFC(4),EROC(4),ERODE                               CHD01390
      COMMON /CHCOM/ DTAU,     IBE(10),     IBS(10),     IBSPN,         CHD01400
     1IGTYP(10),  IHDN(4),     IM,          IZB(3),      IZG(3,10),     CHD01410
     2IZGT(3),    JRSW,        NCSN(10),    NSHL(3),     NSHR(3),       CHD01420
     3NZEN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),     CHD01430
     4I           ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),     CHD01440
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                 CHD01450
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,                 CHD01460
     7SCHECK                                                            CHD01470
      COMMON/NUCOM/ NADA,                                               CHD01480
     1EM(42)                                                            CHD01490
      COMMON /DACOM/ A(42),                                             CHD01500
     1ABVAL ,ABVALM,ABVALS,B(42) ,C(42) ,          CC(205),COND(42),    CHD01510
     2CONDX ,CONDXX, D(42) ,DD(205),DELTX(101),DGAS,DQ,                 CHD01520
     3DTAUC ,DTAUS ,DTAUX ,DTF,DTR(3),EDFX,EDFXX,EMI(42),               CHD01530
     4ETA,ETAS,FHT(42),FHTX,FHTXX,GAGC,GAS1,GK,GX,GY,GZ,                CHD01540
     5HDA(5,10),IBSPM,IERR,IGC,IGL,IGLD,IGR,IGRL,IGT,IG2,               CHD01550
     6IHYS,INEG,IN1,IN2,IP,IPLUS,ITER,ITERT,IX,IY,IZ,J,JBE,             CHD01560
     7JBEM,JBEX,JBND1,JBND2,JBS,JBSM,JBSPM,JBSPN,JBX,JBXX,JCEN,         CHD01570
     8JCENM,JCSN,JCSNM,JE,JE1,JE2,JHDN,JHDN1,JLSW,JSLAB,JX,JZ,          CHD01580
     9K1,LANDID,LRT,MARK,NADD(42),NASW,NBNDST,NBND1(11),                CHD01590
     1NBSW,NDC,NDCM,NLSW(10),NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW,        CHD01600
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     2NRID,NRIDC,NRSW(10),NRZON,NSLAB(10),NSLABH(10),NSW,NXSW,          CHD01610
     3NZON,NZONC,ONE,PSI,QSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN,              CHD01620
     4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,          CHD01630
     5TEMPST(3),THREE,TWO,WFP,WFX,WFXX,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(20CHD01670
     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),XRI(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),AREAV(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 (RHOCPX(44),AREA(1),AREAV(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                                                      CHD02240
      DO 12 J=1,4                                                       CHD02250
   12 COEFT(J,I) = COEFT(J,I)*RHOV(I)/12.                               CHD02260
      ONE = RHOV(I)-RHOC                                                CHD02270
      IF (ONE) 13,13,10016                                              CHD02280
   13 CONTINUE                                                          CHD02290
      DO 14 J=1,4                                                       CHD02300
      EFCOLV(J,I) = 0.                                                  CHD02310
      HDA(J,I) = 0.                                                     CHD02320
   14 CONTINUE                                                          CHD02330
      GO TO 16                                                          CHD02340
10016 CONTINUE                                                          CHD02350
      TWO = 12./ONE                                                     CHD02360
      DO 20016 J=1,4                                                    CHD02370
      EFCOLV(J,I) = EFCOLV(J,I)*RHOV(I)/ONE**REORDV(J,I)                CHD02380
20016 HDA(J,I) = (CCPG(J)-TWO*(COEFT(J,I)-CCPC(J)))/FLOAT(J)            CHD02390
      TEMPA = 536.67                                                    CHD02400
      HDA(5,I) = HOFM(I)-(HDA(1,I)+(HDA(2,I)+(HDA(3,I)+HDA(4,I)         CHD02410
     1*TEMPA)*TEMPA)*TEMPA)*TEMPA                                       CHD02420
   16 RHOV(I)=ONE+1.E-10                                                CHD02430
      DO 9 K=1,42                                                       CHD02440
      AREA(K)=1.                                                        CHD02450
 9    AREAV(K)=1.                                                       CHD02460
C                                                                       CHD02540
C                                                                       CHD02550
C****    ZEROING AND INITIALIZATION                                     CHD02560
C                                                                       CHD02570
C        ZONE CONTROL VALUES SET                                        CHD02580
      IZB(1) = 119                                                      CHD02590
      IZB(2) = 187                                                      CHD02600
      IZB(3) = 187                                                      CHD02610
      IBSPM = 204                                                       CHD02620
      IBSPN = 203                                                       CHD02630
      IHDN(1) = 1                                                       CHD02640
      NHDN(1) = 4                                                       CHD02650
      NHDN(2) = 4                                                       CHD02660
      NHDN(3) = 4                                                       CHD02670
      NZSN(1) = NN                                                      CHD02680
      NZFN(1) = MNOD                                                    CHD02690
      NRZON = 1                                                         CHD02700
      NLZON = 1                                                         CHD02710
C                                                                       CHD02720
      IP = 3                                                            CHD02730
      NPE1N = 1                                                         CHD02740
      NPS2N = 1                                                         CHD02750
C        NODE DIVIDERS SET                                              CHD02760
      ND(1) = NN                                                        CHD02770
      ND(2) = 500                                                       CHD02780
C        ZEROING                                                        CHD02790
      DO 17 J=1,3                                                       CHD02800
      NSHL(J) = 0                                                       CHD02810
   17 NSHR(J) = 0                                                       CHD02820
      DGAS = 0.                                                         CHD02830
      GAS1 = 0.                                                         CHD02840
      I=0                                                               CHD02850
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      WF(1)=0.                                                          CHD02860
      ISAVE1=0                                                          CHD02862
      ISAVE2=0                                                          CHD02863
      ISAVE4=0                                                          CHD02864
      ISAVE5=0                                                          CHD02865
      ISAVE6=0                                                          CHD02866
      QGAS(1,1)=0.                                                      CHD02867
C                                                                       CHD02870
      ITERT = 0                                                         CHD02880
      NOTIME = 0                                                        CHD02890
C        OTHER VALUES SET                                               CHD02900
      PERT1=PERT1*32.2                                                  CHD02910
      PERT2=PERT2*32.2                                                  CHD02920
      NRIDC = 1                                                         CHD02930
      NZONC = 1                                                         CHD02940
      NST = 2                                                           CHD02950
      ETA = .005                                                        CHD02960
      NBSW = 1                                                          CHD02970
      NCUT = 1                                                          CHD02980
      NPTSW = 1                                                         CHD02990
      LFT = 1                                                           CHD03000
      LRT = 2                                                           CHD03010
      DO 18 J=1,3                                                       CHD03020
      TAUST(J) = 0.                                                     CHD03030
      DTR(J) = 0.                                                       CHD03040
      TEMPST(J) = TS(NN)                                                CHD03050
   18 CONTINUE                                                          CHD03060
C                                                                       CHD03070
C****    SETUP OF TEMPERATURES AND DENSITIES                            CHD03080
C****    PLACEMENT OF NODAL WIDTH VALUES INTO DELX ARRAY                CHD03090
C                                                                       CHD03100
      XLEFT(1)=0.                                                       CHD03110
      XSAVE=0.6*PARTIN(1)+XLEFT(1)                                      CHD03120
      DO 19 J=1,NN                                                      CHD03130
      I = MAT(J)                                                        CHD03140
      RHO1(J) = RHOV(I)                                                 CHD03150
      XLEFT(J+1)=XLEFT(J)+PARTIN(J)                                     CHD03160
   19 DELX(J) = PARTIN(J)                                               CHD03170
      DO 20 I=1,MNOD                                                    CHD03180
      TEMPA2(I) = TS(I)                                                 CHD03190
      TEMPA5(I) = TS(I)                                                 CHD03200
      RHO2(I) = RHO1(I)                                                 CHD03210
      RHO5(I) = RHO1(I)                                                 CHD03220
      J = I+IBSPM                                                       CHD03230
      RHO1(J) = RHO1(I)                                                 CHD03240
      RHO2(J) = RHO1(I)                                                 CHD03250
      RHO3(J) = RHO1(I)                                                 CHD03260
      RHO4(J) = RHO1(I)                                                 CHD03270
   20 RHO5(J) = RHO1(I)                                                 CHD03280
      I = IZB(1)-1                                                      CHD03290
      K = NHDN(1)+1                                                     CHD03300
      TEMPA = TEMPA1(NN)                                                CHD03310
C****    SETUP OF FRONT ZONE                                            CHD03320
      ONE = (TEMPA1(MNOD)-TEMPA1(NN))/FLOAT(NHDN(1))                    CHD03330
      DO 30 J=1,K                                                       CHD03340
```

```
      I = I+1                                                           CHD03350
      TEMPA1(I) = TEMPA                                                 CHD03360
      TEMPA2(I) = TEMPA                                                 CHD03370
      TEMPA5(I) = TEMPA                                                 CHD03380
      TEMPA = TEMPA+ONE                                                 CHD03390
      RHO1(I) = RHO1(NN)                                                CHD03400
      RHO2(I) = RHO1(I)                                                 CHD03410
   30 RHO5(I) = RHO1(I)                                                 CHD03420
      HOLD=RHOC-CHARRO                                                  CHD03430
      DO 40 J=1,205                                                     CHD03440
      CARBN1(J)=CHARRO                                                  CHD03450
      CARBN5(J)=CHARRO                                                  CHD03460
      GRAF1(J)=0.                                                       CHD03470
      GRAF5(J)=0.                                                       CHD03480
      SILCA1(J)=HOLD                                                    CHD03490
      SILCA5(J)=HOLD                                                    CHD03500
      PYRO(J)=1.                                                        CHD03510
      FMWT(J)=AIRM                                                      CHD03520
   40 CONTINUE                                                          CHD03530
      DO 50 J=1,100                                                     CHD03532
   50 EDFLUX(J)=0.                                                      CHD03534
C                                                                       CHD03540
C****    SETTING OF TIMES AND DELTA TIMES                               CHD03550
C                                                                       CHD03560
      TAUOUT = COMMAX                                                   CHD03570
      DTAU = COMMAX                                                     CHD03580
  211 DTAUS = DTAU                                                      CHD03590
      DTAUC = DTAU                                                      CHD03600
      DTAUX = 0.5*DTAU                                                  CHD03610
      TAU1 = 0.                                                         CHD03620
      TAU2 = DTAU                                                       CHD03630
C                                                                       CHD03640
C****    NORMALIZED DISTANCES AND NORMALIZED NODE WIDTHS                CHD03650
C                                                                       CHD03660
      IYS = ND(1)                                                       CHD03670
      SN1 = XLEFT(MNOD)-XLEFT(IYS)                                      CHD03680
      DO 230 J=IYS,MNOD                                                 CHD03690
      DISTL(J) = (XLEFT(J)-XLEFT(IYS))/SN1                              CHD03700
  230 DELX(J) = DELX(J)/SN1                                             CHD03710
C****                                                                   CHD03720
      SCHFCK = 0.5*SN1                                                  CHD03730
C                                                                       CHD03740
C****    CALCULATION CONTROL--2600-2684                                 CHD03750
C                                                                       CHD03760
 2600 NPBSW = IP                                                        CHD03770
      MARK = 1                                                          CHD03780
      IG = 1                                                            CHD03790
      LANDID = 1                                                        CHD03800
      NRID = NRIDC                                                      CHD03810
      NDC = 1                                                           CHD03820
      NDCM = 1                                                          CHD03830
 2603 IG2 = IG                                                          CHD03840
      GO TO (2606,2614,2615),NPBSW                                      CHD03850
 2606 NBND1(IG) = NBSW+5                                                CHD03860
      NCSN(IG) = 1                                                      CHD03870
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```
      NBNDST = 4                                                        CHD03880
 2608 NCEN(IG) = NPE1N                                                  CHD03890
      NSW = 1                                                           CHD03900
      GO TO 2640                                                        CHD03910
 2614 NBND1(IG) = 5                                                     CHD03920
      NCSN(IG) = NPS2N                                                  CHD03930
      GO TO 2620                                                        CHD03940
 2615 NBND1(IG) = NBSW+5                                                CHD03950
      NCSN(IG) = 1                                                      CHD03960
 2620 NZON = NZONC                                                      CHD03970
      NBNDST = 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 NCEN(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 NBNDST = NASW                                                     CHD04400
      NSW = 4                                                           CHD04410
 2655 IGTYP(IG) = NZON                                                  CHD04420
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      JHDN = NHDN(NZON)                                                 CHD04430
      IZG(NZON,IGC)= IG                                                 CHD04440
      IZGT(NZON) = IGC                                                  CHD04450
      IF (IGC-1) 2657,2657,2656                                         CHD04460
 2656 IBS(IG) = IBE(IG-1)                                               CHD04470
      GO TO 2658                                                        CHD04480
 2657 IBS(IG) = IZB(NZON)                                               CHD04490
 2658 IF (NZON-NRZON) 2660,2659,2660                                    CHD04500
 2659 NRSW(IG) = 3                                                      CHD04510
      NRID = 2                                                          CHD04520
      GO TO 2661                                                        CHD04530
 2660 NRSW(IG) = NRID                                                   CHD04540
 2661 NSLAB(IG) = NCEN(IG)-NCSN(IG)                                     CHD04550
      NSLABH(IG) = NSLAB(IG)*JHDN                                       CHD04560
      IF (NSLABH(IG)-40) 2666,2666,2680                                 CHD04570
 26   NBND2(IG) = NBNDST                                                CHD04580
      IBE(IG) = IBS(IG)+NSLABH(IG)                                      CHD04590
      NDCM = 1                                                          CHD04600
      IF (LANDID-2) 2667,2669,2668                                      CHD04610
 2667 NLSW(IG) = 1                                                      CHD04620
      GO TO 2670                                                        CHD04630
 2668 NLSW(IG) = 2                                                      CHD04640
      GO TO 2670                                                        CHD04650
 2669 NLSW(IG) = 1                                                      CHD04660
      IGLD=IG+1                                                         CHD04670
      LANDID = 3                                                        CHD04680
 2670 IGL = IG                                                          CHD04690
      IG = IG+1                                                         CHD04700
      GO TO (2671,2672,2673,2675,2674),NSW                              CHD04710
 2671 NPBSW = 2                                                         CHD04720
      GO TO 2603                                                        CHD04730
 2672 NCSN(IG) = NCEN(IGL)                                              CHD04740
      GO TO 2644.                                                       CHD04750
 2673 NZON = NZON+1                                                     CHD04760
      IGC = 0                                                           CHD04770
 2674 NCSN(IG) = NCEN(IGL)                                              CHD04780
      GO TO 2625                                                        CHD04790
 2675 MG = IGL                                                          CHD04800
      NOF = IBE(IGL)                                                    CHD04810
      GO TO 2685                                                        CHD04820
 2680 NSLAB(IG) = 40/JHDN                                               CHD04830
      NCEN(IG) = NCSN(IG)+NSLAB(IG)                                     CHD04840
      NBND2(IG) = 5                                                     CHD04850
      NSLABH(IG) = NSLAB(IG)*JHDN                                       CHD04860
      IBE(IG) = IBS(IG)+NSLABH(IG)                                      CHD04870
      GO TO (12683,12682) ,NDCM                                         CHD04880
12682 NDC = NDC - 1                                                     CHD04890
      NDCM = 1                                                          CHD04900
12683 CONTINUE                                                          CHD04910
      IF (LANDID-2) 2682,2682,2683                                      CHD04920
 2682 NLSW(IG) = 1                                                      CHD04930
      GO TO 2684                                                        CHD04940
 2683 NLSW(IG) = 2                                                      CHD04950
 2684 IG = IG+1                                                         CHD04960
      NCSN(IG) = NCEN(IG-1)                                             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=IZG(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
      CFXO=0.21*BLDEN(N,L)                                              CHD05278
      CFXN=0.79*BLDEN(N,L)                                              CHD05280
      CALL FLOWS                                                        CHD05290
      CALL DIFUS (DO ,1,DCOO ,CFXO ,AERO)                               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--2690-3370CHD05420
C                                                                       CHD05430
C****    ENTRANCE HERE FROM 3360+ FOR RECALC OF ALL GROUPS--DTAU/2      CHD05440
C                                                                       CHD05450
 2690 NXSW = 1                                                          CHD05460
      ITER = 1                                                          CHD05470
      ITERT = ITERT+1                                                   CHD05480
      IERR = 1                                                          CHD05490
C                                                                       CHD05500
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C****    ENTRANCE HERE FROM 3275+ FOR RECALC OF ALL GROUPS
C
 2693 CONTINUE
      IG = 1
      WFX = 0.
      FHTX = 0.
      PCX = 0.
      JBX = 0.
      EDFX = 0.
      WFDX=0.
      WBRNX=0.
      WDEPX=0.
      WSIX=0.
      DEPX=0.
      DWFDX=0.
C
C****    CALCULATION OF MASS RECESSION RATES
C
      TEMPA = 0.5*(TEMPA1(NOF)+TEMPA9(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+RHO2(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
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      GO TO 3296                                                        CHD06040
22710 CONTINUE                                                          CHD06050
C                                                                       CHD06060
      TEMPA3(1) = 0.5*(TEMPA1(1)+TEMPA5(1))                             CHD06070
C                                                                       CHD06080
C****    CALCULATE DELTAX                                               CHD06090
C                                                                       CHD06100
      DO 2696 J=IYS,MNOD                                                CHD06110
 2696 DELTAX(J) = DELTX(J)*SN                                           CHD06120
C                                                                       CHD06130
C****    ENTRANCE HERE FROM 3225+ FOR CALC OF NEXT GROUP                CHD06140
C                                                                       CHD06150
C****    GROUP INITIALIZATION                                           CHD06160
C                                                                       CHD06170
12696 JBS = IBS(IG)                                                     CHD06180
      JBSM = JBS-1                                                      CHD06190
      JLSW = NLSW(IG)                                                   CHD06200
      JRSW = NRSW(IG)                                                   CHD06210
      JE1 = NSPBH(IG)                                                   CHD06220
      JE = JE1+1                                                        CHD06230
      JE2 = JE1-1                                                       CHD06240
      JBND1 = NBND1(IG)-3                                               CHD06250
      JBND2 = NBND2(IG)                                                 CHD06260
      IGL = IG-1                                                        CHD06270
      JBE = IBE(IG)                                                     CHD06280
      JBEM = JBE-1                                                      CHD06290
      JCSN = NCSN(IG)                                                   CHD06300
      JCEN = NCEN(IG)                                                   CHD06310
      JCENM = JCEN-1                                                    CHD06320
      IGC = IGTYP(IG)                                                   CHD06330
      JHDN = NHDN(IGC)                                                  CHD06340
      JSLAB = NSLAB(IG)                                                 CHD06350
      JBSPM = IBSPN+JCSN                                                CHD06360
      JBSPN = JBSPM-1                                                   CHD06370
C                                                                       CHD06380
      TWO = SDN/(2.*CN)                                                 CHD06390
      WFXX = WFX                                                        CHD06400
      FHTXX = FHTX                                                      CHD06410
      CONDXX = CONDX                                                    CHD06420
      JBXX = JBX                                                        CHD06430
      PCXX = PCX                                                        CHD06440
      EDFXX=EDFX                                                        CHD06450
      WFDXX=WFDX                                                        CHD06460
      WDEPXX=WDEPX                                                      CHD06470
      WSIXX =WSIX                                                       CHD06480
      WBRNXX=WBRNX                                                      CHD06490
      DEPXX=DEPX                                                        CHD06503
      DWFDXX=DWFDX                                                      CHD06507
C                                                                       CHD06510
C****    SETUP OF NADD ARRAY (NUMBER OF                                 CHD06520
C**** MAJOR NODES OF SAME MATERIAL AND WIDTH)                           CHD06530
C                                                                       CHD06540
      JX = 1                                                            CHD06550
      IY = JCSN                                                         CHD06560
      IZ = JCENM-1                                                      CHD06570
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12697 NADD(JX)=1                                                        CHD06580
 2697 IX = IY                                                           CHD06590
      IY = IX+1                                                         CHD06600
      IF (IX-IZ) 2698,2698,2702                                         CHD06610
 2698 IF (DELTAX(IY)-DELTAX(IX)) 2701,2699,2701                         CHD06620
 2699 IF (MAT(IY)-MAT(IX)) 2701,2700,2701                               CHD06630
 2700 NADD(JX) = NADD(JX)+1                                             CHD06640
      GO TO 2697                                                        CHD06650
 2701 JX = JX+1                                                         CHD06660
      GO TO 12697                                                       CHD06670
C                                                                       CHD06680
 2702 GO TO (2708,2703),JLSW                                            CHD06690
C                                                                       CHD06700
C****    CALCULATION OF THE LANDAU MULTIPLYING FACTOR                   CHD06710
C                                                                       CHD06720
 2703 CONTINUE                                                          CHD06730
      KK = 0                                                            CHD06740
      DO 2707 J=JCSN,JCEN                                               CHD06750
      KK = KK+1                                                         CHD06760
      I = KK                                                            CHD06770
      EMI(KK) = TWO*DISTL(J)/DELTX(J)                                   CHD06780
      IF (J-JCEN) 2704,2707,2707                                        CHD06790
 2704 K = 2                                                             CHD06800
 2705 IF (K-JHDN) 2706,2706,2707                                        CHD06810
 2706 EMI(KK+1) = EMI(KK)+TWO                                           CHD06820
      KK = KK+1                                                         CHD06830
      K = K+1                                                           CHD06840
      GO TO 2705                                                        CHD06850
 2707 EMI(I) = TWO*2.*DISTL(J)/(DELTX(J)+DELTX(J-1))                    CHD06860
 2708 CONTINUE                                                          CHD06870
C                                                                       CHD06880
C****    ENTRANCE HERE FROM 3325+ FOR RECALC OF FRONT GROUP             CHD06890
C**** CALCULATE TEMPA3 AND TEMPA4                                       CHD06900
C                                                                       CHD06910
 2710 DO 2711 J=2,JE                                                    CHD06920
      K = JBSM+J                                                        CHD06930
      TEMPA3(J) = 0.5*(TEMPA1(K)+TEMPA5(K))                             CHD06940
 2711 TEMPA4(J-1) = 0.5*(TEMPA3(J)+TEMPA3(J-1))                         CHD06950
      TEMPA4(JE) = TEMPA3(JE)                                           CHD06960
      NSTILL=1                                                          CHD06970
      GO TO (2791,2712,2714),JRSW                                       CHD06980
 2712 I=MAT(JCSN)                                                       CHD06990
      IF (RHO1(JBS)-.01) 2791,2791,2714                                 CHD07000
 2714 CONTINUE                                                          CHD07010
      NSTILL=2                                                          CHD07020
      GO TO (2750,2716),JLSW                                            CHD07030
 2716 CONTINUE                                                          CHD07040
C                                                                       CHD07050
C****    CALCULATION OF DENSITY FOR LANDAU GROUP                        CHD07060
C                                                                       CHD07070
      K = 0                                                             CHD07080
      KL = JBSM                                                         CHD07090
      I =MAT(JCSN)                                                      CHD07100
      KK = JBSPM+JSLAB                                                  CHD07110
 2720 K = K+1                                                           CHD07120
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      KL = KL+1                                                         CHD07130
      CALL RHOSB (K,KL)                                                 CHD07140
      IF (K-1) 2720,2720,2732                                           CHD07150
 2732 IF (K-JE1) 2734,2733,2736                                         CHD07160
 2733 RHO1(KL+1) = RHO1(KK)                                             CHD07170
      RHO5(KL+1)=RHO5(KK)                                               CHD07180
 2734 D(K) = (RHO1(KL+1)-RHO1(KL-1))*EMI(K)+RHO1(KL)*EMBM(K)+AREAC(K)   CHD07190
     1*DTAU                                                             CHD07200
      GO TO 2720                                                        CHD07210
 2736 ONE = EMBM(K)-3.*EMI(K)                                           CHD07220
      C(K) = 4.*EMI(K)/ONE                                              CHD07230
      D(K) = ((EMBM(K)+3.*EMI(K))*RHO1(KL)-(4.*RHO1(KL-1)               CHD07240
     1-RHO1(KL-2))*EMI(K)+AREAC(K)*DTAU)/ONE                            CHD07250
      THREE = -EMI(K)/ONE                                               CHD07260
      K = K-1                                                           CHD07270
      TWO = EMBM(K)+EMI(K)*C(K+1)                                       CHD07280
      C(K) = EMI(K)*(1.+THREE)/TWO                                      CHD07290
      D(K) = (D(K)+EMI(K)*D(K+1))/TWO                                   CHD07300
 2737 K = K-1                                                           CHD07310
      IF (K-1) 2740,2740,2738                                           CHD07320
 2738 ONE = EMBM(K)+C(K+1)*EMI(K)                                       CHD07330
      C(K) = EMI(K)/ONE                                                 CHD07340
      D(K) = (D(K)+D(K+1)*EMI(K))/ONE                                   CHD07350
      GO TO 2737                                                        CHD07360
 2740 RHO5(JBS) = RHO1(JBS)+AREAC(1)*DTAU/EMBM(1)                       CHD07370
      KL = JBS                                                          CHD07380
      DO 2742 K=2,JE1                                                   CHD07390
      KL = KL+1                                                         CHD07400
 2742 RHO5(KL) = D(K)-C(K)*RHO5(KL-1)                                   CHD07410
      RHO5(KK) = D(JE)-C(JE)*RHO5(KL)-RHO5(KL-1)*THREE                  CHD07420
      GO TO 2774                                                        CHD07430
C                                                                       CHD07440
C**** CALCULATION OF DENSITY FOR REGULAR GROUP                          CHD07450
C                                                                       CHD07460
 2750 IX = 0                                                            CHD07470
      K = 0                                                             CHD07480
      KL = JBSM                                                         CHD07490
      KK = JBSPM                                                        CHD07500
      IM = JCSN                                                         CHD07510
 2760 IX = IX+1                                                         CHD07520
      I = MAT(IM)                                                       CHD07530
      IM = IM+NADD(IX)                                                  CHD07540
      IJ = JHDN*NADD(IX)                                                CHD07550
      KK = KK+NADD(IX)                                                  CHD07560
      DO 2763 J=1,IJ                                                    CHD07570
      K = K+1                                                           CHD07580
      KL = KL+1                                                         CHD07590
      IF (RHO1(KL)-.01*RHOV(I)) 2761,2761,2762                          CHD07600
 2761 RHO1(KL)=0.                                                       CHD07610
      RHO5(KL)=0.                                                       CHD07620
      GO TO 2763                                                        CHD07630
 2762 CONTINUE                                                          CHD07640
      CALL RHOSB(K,KL)                                                  CHD07650
      RHO5(KL)=RHO1(KL)+AREAC(K)/EMBM(K)*DTAU                           CHD07660
 2763 CONTINUE                                                          CHD07670
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```
      K=K+1                                                             CHD07680
      CALL RHO5B(K,KK)                                                  CHD07690
      RHO5(KK) = RHO1(KK)+AREAC(K)/EMBM(K)*DTAU                         CHD07700
      K=K-1                                                             CHD07710
      IF (IM-JCEN) 2760,2764,2764                                       CHD07720
 2764 CONTINUE                                                          CHD07730
C                                                                       CHD07740
C****    CHECK TO SEE THAT RHO5 IS GREATER THAN ZERO$ CALCULATE         CHD07750
C**** RHO3, RHO4, GAS FLOW, AND REACTION HEAT                           CHD07760
C                                                                       CHD07770
 2774 IX = 0                                                            CHD07780
      K = 0                                                             CHD07790
      IJ=0                                                              CHD07800
      IK=JHDN                                                           CHD07810
      KK = JBSPM                                                        CHD07820
      KL = JCSM                                                         CHD07830
      IM = JCSN                                                         CHD07840
 2775 IX =IX+1                                                          CHD07850
      I = MAT(IM)                                                       CHD07860
      IJ=IJ+JHDN*NADD(IX)                                               CHD07870
12775 KK = KK+1                                                         CHD07880
 2776 K = K+1                                                           CHD07890
      KL = KL+1                                                         CHD07900
      IF (RHO5(KL)-.01) 2777,2778,2778                                  CHD07910
 2777 RHO5(KL) = 0.                                                     CHD07920
 2778 RHO3(K) = (RHO1(KL)+RHO5(KL))/2.                                  CHD07930
      GO TO (12779,2779),JLSW                                           CHD07940
12779 WFP = (RHO1(KL) - RHO5(KL))/DTAU                                  CHD07950
      GO TO 2780                                                        CHD07960
 2779 WFP = RATE(KL)*(RHO1(KL)-RHO5(KL))-AREAC(K)                       CHD07970
 2780 WFD(KL)=WFP*DELTAX(IM)*AREAV(K)/12.                               CHD07980
      TEMPA = TEMPA3(K)                                                 CHD07990
      TWO = HDA(5,I)+(HDA(1,I)+(HDA(2,I)+(HDA(3,I)+HDA(4,I)             CHD08000
     1*TEMPA)*TEMPA)*TEMPA)*TEMPA                                       CHD08010
      IF (K-1) 2781,2781,2782                                           CHD08020
 2781 ONE = 0.5*WFD(KL)                                                 CHD08030
      WFD(KL)=WFDX+ONE                                                  CHD08040
      WF(KL) = WFX+ONE                                                  CHD08050
      FHT(K) = FHTX-ONE*TWO                                             CHD08060
      GO TO 2783                                                        CHD08070
 2782 RHO4(K-1) = (RHO3(K-1)+RHO3(K))/2.                                CHD08080
      FHT(K) = -TWO*WFD(KL)                                             CHD08090
      WF(KL) = WF(KL-1)+WFD(KL)                                         CHD08100
 2783 IF (K-IK) 2776,12783,12783                                        CHD08110
12783 CONTINUE                                                          CHD08120
      IK = IK+JHDN                                                      CHD08130
      IF (K-IJ) 12784,2784,2784                                         CHD08140
12784 RHO5(KK) = RHO5(KL+1)                                             CHD08150
      IF (RHO5(KK)-.01) 12785,12786,12786                               CHD08160
12785 RHO5(KK) = 0.                                                     CHD08170
12786 CONTINUE                                                          CHD08180
      GO TO 12775                                                       CHD08190
 2784 IF (RHO5(KK)-.01) 2785,2786,2786                                  CHD08200
 2785 RHO5(KK) = 0.                                                     CHD08210
 2786 RHO3(KK) = (RHO1(KK)+RHO5(KK))/2.                                 CHD08220
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      RHO4(K) = (RHO3(K)+RHO3(KK))/2.                                   CHD08230
      GO TO (12787,2787),JLSW                                           CHD08240
12787 WFP = (RHO1(KK) - RHO5(KK))/DTAU                                  CHD08250
      GO TO 2788                                                        CHD08260
 2787 WFP = RATE(KL+1)*(RHO1(KK)-RHO5(KK))-AREAC(K+1)                   CHD08270
 2788 ONE=WFP*0.5*DELTAX(IM)*AREAV(K+1)/12.                             CHD08280
      WFX = WF(KL)+ONE                                                  CHD08290
      WFDX=ONE                                                          CHD08300
      TEMPA = TEMPA3(K+1)                                               CHD08310
      TWO = HDA(5,I)+(HDA(1,I)+(HDA(2,I)+(HDA(3,I)+HDA(4,I)             CHD08320
     1*(TEMPA)*TEMPA)*TEMPA)*TEMPA                                      CHD08330
      FHTX = -ONE*TWO                                                   CHD08340
      IM = IM+NADD(IX)                                                  CHD08350
      IF (IM-JCENM) 2775,2775,2789                                      CHD08360
 2789 WF(JBE) = WFX                                                     CHD08370
      WFD(JBE)=WFDX                                                     CHD08380
      GO TO 3000                                                        CHD08390
C                                                                       CHD08400
 2791 DO 2793 J=1,JE                                                    CHD08410
      K = JBSM+J                                                        CHD08420
      RHO3(J) = RHO5(K)                                                 CHD08430
 2793 RHO4(J) = RHO5(K)                                                 CHD08440
      GO TO (2794,2797,3000),JRSW                                       CHD08450
 2794 DO 2795 J=JBS,JBE                                                 CHD08460
      WFD(J)=0.                                                         CHD08470
 2795 WF(J) = 0                                                         CHD08480
      GO TO 3000                                                        CHD08490
 2797 DO 2798 J=JBS,JBE                                                 CHD08500
      WFD(J)=0.                                                         CHD08510
 2798 WF(J) = WFX                                                       CHD08520
      WFD(JBS)=WFDX                                                     CHD08530
 3000 CONTINUE                                                          CHD08540
C                                                                       CHD08550
C****    CALCULATION OF DEPOSITION AND OTHER REACTIONS                  CHD08560
C                                                                       CHD08570
      DWFDX=DWFDX+.3767*(WFX-WFXX)                                      CHD08575
      GO TO (4990,5000,4990),JRSW                                       CHD08580
 4990 DO 4995 J=JBS,JBE                                                 CHD08590
      WBRN(J)=0.                                                        CHD08600
      WSI(J)=0.                                                         CHD08610
      WDEP(J)=0.                                                        CHD08620
 4995 CONTINUE                                                          CHD08630
      GO TO 5110                                                        CHD08640
 5000 CONTINUE                                                          CHD08650
      KL=JBSM                                                           CHD08660
      DEL=0.                                                            CHD08670
      SAVE= 0.                                                          CHD08680
      DELA = DELTAX(JCEN)                                               CHD08690
      DELTAX(JCEN) = 0.                                                 CHD08700
      DO 5100 J=1,JE                                                    CHD08710
      KL=KL+1                                                           CHD08720
      TEMPA=TEMPA3(J)                                                   CHD08730
      K=LLD(KL)                                                         CHD08740
      WF(KL)=WF(KL)+SAVE                                                CHD08753
      DACT=DWFDX-DEPX                                                   CHD08757
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      CALL SIC (K,KL,TEMPA,DEL)                                         CHD08758
      CALL DEPO (K,KL,TEMPA,DEL)                                        CHD08760
      DEPX=DEPX+1.3333*WDEP(KL)                                         CHD08780
      ONE=DWFDX-DEPX                                                    CHD08781
      IF (ONE) 5090,5092,5092                                           CHD08782
 5090 WDEP(KL)=WDEP(KL)+.75*ONE                                         CHD08783
      DEPX=DWFDX                                                        CHD08784
 5092 CONTINUE                                                          CHD08785
      HOW=WSI(KL)-WDEP(KL)+WBRN(KL)                                     CHD08786
      WF(KL)=WF(KL)+HOW                                                 CHD08787
      SAVE=SAVE+HOW                                                     CHD08788
      DEL=DELTAX(K)                                                     CHD08789
 5100 CONTINUE                                                          CHD08790
      GO TO (5108,5101),JLSW                                            CHD08800
 5101 CONTINUE                                                          CHD08810
      K=0                                                               CHD08820
      EF=2.*SDN/SN1                                                     CHD08830
      DO 5102 J=JBS,JBEM                                                CHD08840
      K=K+1                                                             CHD08850
      EK=K                                                              CHD08860
      EK=EK*EF                                                          CHD08870
      SILCA5(J+1)=SILCA5(J+1)*(1.+EK)-SILCA5(J)*EK                      CHD08880
      CARBN5(J+1)=CARBN5(J+1)*(1.+EK)-CARBN5(J)*EK                      CHD08890
 5102 CONTINUE                                                          CHD08900
 5108 CONTINUE                                                          CHD08910
      DELTAX(JCEN) = DELA                                               CHD08920
      WDEP(JBS)=WDEP(JBS)+WDEPX                                         CHD08930
      WSI(JBS) =WSI(JBS)+WSIX                                           CHD08940
      WBRN(JBS)=WBRN(JBS)+WBRNX                                         CHD08950
 5110 CONTINUE                                                          CHD08960
      WDEPX=WDEP(JBE)                                                   CHD08970
      WSIX =WSI(JBE)                                                    CHD08980
      WBRNX=WBRN(JBE)                                                   CHD08990
      WFX=WF(JBE)                                                       CHD09000
 5500 CONTINUE                                                          CHD09010
C                                                                       CHD09020
C****    CALCULATION OF THERMAL CAPACITY,CONDUCTIVITY,ENERGY DEPOSITION CHD09030
C                                                                       CHD09040
      IX = 0                                                            CHD09060
      K = 0                                                             CHD09070
      KK = JBSPM                                                        CHD09080
      K1 = 1                                                            CHD09090
      IM = JCSN                                                         CHD09100
 3005 IX = IX+1                                                         CHD09110
      I = MAT(IM)                                                       CHD09120
      IJ = JHDN*NADD(IX)                                                CHD09130
      KK = KK+NADD(IX)                                                  CHD09140
      DO 3015 J=1,IJ                                                    CHD09150
      K = K+1                                                           CHD09160
      PC(K) = PCAPF(K)                                                  CHD09170
      EDFLUX(K)=EDFLUX(K)*DELTAX(IM)/12.*(RHOV(I)+RHOC)                 CHD09180
      COND(K)=CONDF(K)                                                  CHD09190
      IY=JBS+K                                                          CHD09200
      QCOND(IY)=2.*COND(K)*(TEMPA3(K+1)-TEMPA3(K))                      CHD09210
 3015 CONTINUE                                                          CHD09220
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      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)*DELTAX(IM)/12.*(RHOV(I)+RHOC)                     CHD09290
      RHO3(K1) = ONE                                                    CHD09300
      IM = IM+NADD(IX)                                                  CHD09310
      IF (IM-JCFN) 3005,3031,3031                                       CHD09320
 3031 JBX = JBSM+K                                                      CHD09330
      CONDX = COND(K)                                                   CHD09340
C                                                                       CHD09350
C****    CALCULATION OF MATRIX ELEMENTS                                 CHD09360
C                                                                       CHD09370
 3040 TEMPA1(JBSM) = TEMPA1(JBXX)                                       CHD09380
      J = 0                                                             CHD09390
      COND(J) = CONDXX                                                  CHD09400
      WF(JBSM) = WF(JBXX)                                               CHD09410
      DO 3060 J=1,JE1                                                   CHD09420
      IX = J+JBSM                                                       CHD09430
      IPLUS = IX+1                                                      CHD09440
      INEG = IX-1                                                       CHD09450
      CALL CPBA (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+COND(J)                                               CHD09500
      A(J) = -GAGC+COND(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
      B(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+WBRN(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)=COND(1)*TEMPA1(JBS+1)+(PC(1)-COND(1))*TEMPA1(JBS)            CHD09700
      ONE = PC(1)+COND(1)                                               CHD09720
      CC(JBS) = -COND(1)/ONE                                            CHD09730
      DD(JBS) = D(1)/ONE                                                CHD09740
      GO TO 3200                                                        CHD09750
 3110 SBK = 2.*COND(1)                                                  CHD09760
 3115 CC(JBS) = 0.                                                      CHD09770
      DD(JBS) = TEMPA2(JBS)                                             CHD09780
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      GO TO 3200                                                        CHD09790
C****    INTERIOR BOUNDARY                                              CHD09800
 3120 ONE = B(1)+A(1)*CC(JBXX)                                          CHD09810
      CC(JBS) = -C(1)/ONE                                               CHD09820
      DD(JBS) = (D(1)+A(1)*DD(JBXX))/ONE                                CHD09830
 3200 DO 3202 J=2,JE1                                                   CHD09840
      K = JBSM+J                                                        CHD09850
      ONE = B(J)+A(J)*CC(K-1)                                           CHD09860
      CC(K) = -C(J)/ONE                                                 CHD09870
 3202 DD(K) = (D(J)+A(J)*DD(K-1))/ONE                                   CHD09880
C                                                                       CHD09890
C****    DIRECTOR--ENDING BOUNDARY OF GROUP                             CHD09900
C**** 1--(3240)--FLUX DRIVE (FRONT SURFACE)                             CHD09910
C**** 2--(3260)--TEMP DRIVE (FRONT SURFACE)                             CHD09920
C**** 3--(3260)--NOT IN USE                                             CHD09930
C**** 4--(3225)--FIXED TEMP (BOUNDARY FOR PROBLEM END IN INTERIOR)      CHD09940
C**** 5--(3225)--INTERIOR (NORMAL TYPE FOR BOUNDARY BETWEEN GROUPS)     CHD09950
C                                                                       CHD09960
      GO TO (3240,3210,3260,3225,3225),JBND2                            CHD09970
 3210 TEMPA5(NOF)=FONEV(TAU2,ISAVE1,TIME3,TT,NDOTS(3),1)                CHD09980
      GO TO 3260                                                        CHD09990
 3225 IG = IG+1                                                         CHD10000
      TEMPA3(1) = TEMPA3(JE)                                            CHD10010
      GO TO 12696                                                       CHD10020
 3240 PC(JE) = PCX                                                      CHD10030
      EDFLUX(JE)=EDFX                                                   CHD10040
      CALL CPBA (JE,NOF,TEMPA3(JE),CPBAR)                               CHD10050
      GAGC = -WF(NOF-1)*CPBAR/4.+PC(JE)*EMI(JE)                         CHD10060
      IX = IBSPM+JCENM                                                  CHD10070
      IM = JCENM                                                        CHD10080
      TEMPA4(JE) = TEMPA3(JE)                                           CHD10090
      RHO4(JE) = RHO3(IX)                                               CHD10100
      I = MAT(JCENM)                                                    CHD10110
      COND(JE)=CONDF(JE)                                                CHD10120
      QCOND(NOF+1)=4.*COND(JE)*(TEMPA3(JE)-TEMPA4(JE))                  CHD10130
      A(JE) = -GAGC+COND(JE)                                            CHD10140
      C(JE) = GAGC+COND(JE)                                             CHD10150
      GK = A(JE)+C(JE)                                                  CHD10160
      B(JE) = PC(JE)+GK                                                 CHD10170
      GX = .25*(COND(JE)+COND(JE1))                                     CHD10180
C                                                                       CHD10190
C                                                                       CHD10200
C        CALCULATION OF FRONT SURFACE HEAT INPUT                        CHD10210
C                                                                       CHD10220
C                                                                       CHD10230
      TEMPA = 0.5*(TEMPA1(NOF)+TEMPA5(NOF))                             CHD10240
      I = MAT(NN)                                                       CHD10250
      IX = 1                                                            CHD10260
13239 CONTINUE                                                          CHD10270
      KK=IBSPN+MNOD                                                     CHD10280
      IF (RHO1(KK)-.98*RHOV(I )) 13240,13241,13241                      CHD10290
13240 ONE = ABSC                                                        CHD10300
      TWO = EMISC                                                       CHD10310
      GO TO 13242                                                       CHD10320
13241 ONE = ABSORP(I )                                                  CHD10330
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      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.                                                 CHD10900
C         CALCULATION AND CHECK OF TEMPERATURES                         CHD10910
 3260 IGT = IG2                                                         CHD10920
      GAS=WFX                                                           CHD10933
      DGAS=(GAS-GAS1)/DTAUX                                             CHD10937
 3261 DO 3265 I=1,JE1                                                   CHD10938
      J = IBE(IG)-I                                                     CHD10940
      K = J+1                                                           CHD10950
      TEMPA = TEMPA5(J)                                                 CHD10960
      TEMPA5(J) = DD(J)-CC(J)*TEMPA5(K)                                 CHD10970
      ABVAL = ABS((TEMPA5(J)-TEMPA)/TEMPA)                              CHD10980
      IF (ABVAL-ABVALS) 13262,13262,13261                               CHD10990
13261 ABVALS = ABVAL                                                    CHD11000
13262 CONTINUE                                                          CHD11010
      GO TO (3262,3265),IERR                                            CHD11020
 3262 CONTINUE                                                          CHD11030
      IF (ABVAL-ETA) 3265,3265,3263                                     CHD11040
 3263 IERR = 2                                                          CHD11050
      IF (TEMPA5(J)) 3264,3265,3265                                     CHD11060
 3264 TEMPA5(J) = 10.                                                   CHD11070
 3265 CONTINUE                                                          CHD11080
      IF (IG-MG) 3267,3266,3266                                         CHD11090
 3266 ABVALM = ABVALS                                                   CHD11100
      ABVALS = 0.                                                       CHD11110
 3267 CONTINUE                                                          CHD11120
      GO TO (3270,3274),NXSW                                            CHD11130
 3270 NXSW = 2                                                          CHD11140
      IX = 1                                                            CHD11150
      GO TO (3274,3375),IERR                                            CHD11160
 3274 IF (IG-IGT) 3275,3275,3277                                        CHD11170
 3275 IF (IGL) 3278,3278,3276                                           CHD11180
 3276 IGT = 1                                                           CHD11190
 3277 IX = IBE(IGL)                                                     CHD11200
      JBS = IBS(IG)                                                     CHD11210
      TEMPA5(IX) = TEMPA5(JBS)                                          CHD11220
      IG = IGL                                                          CHD11230
      IGL = IGL-1                                                       CHD11240
      JE1 = NSLABH(IG)                                                  CHD11250
      GO TO 3261                                                        CHD11260
 3278 GO TO (3280,3290), IERR                                           CHD11270
C                                                                       CHD11280
C****    NO ERROR IN TEMPERATURES--DETERMINE NEW TIME STEP              CHD11290
C                                                                       CHD11300
 3280 ONE = ETA*DTAU                                                    CHD11310
      IF (ITER-2) 3282,3285,3287                                        CHD11320
 3282 IF (ABVALM-1.1*ABVALS) 3283,3284,3284                             CHD11330
 3283 DTAUC = 0.80*ONE/ABVALS                                           CHD11340
      GO TO 3400                                                        CHD11350
 3284 DTAUC = 1.0*ONE/(ABVALM+1E-6)                                     CHD11360
      GO TO 3400                                                        CHD11370
 3285 DTAUC=ONE/AMAX1(ABVALS,ABVALM,1E-6)                               CHD11380
 3287 DTAUC = 0.80*DTAUC                                                CHD11390
      GO TO 3400                                                        CHD11400
C                                                                       CHD11410
C****    ERROR IN TEMPERATURES--REITERATE OR CUT TIME STEP              CHD11420
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C**** AND RESTART ON CALCULATION                                        CHD11430
C                                                                       CHD11440
 3290 CONTINUE                                                          CHD11450
      IF (ITER-3) 3370,3295,3295                                        CHD11460
 3295 DTF = ETA/AMAX1(ABVALS,ABVALM)                                    CHD11470
      IF (DTF-.5) 13295,13297,13296                                     CHD11480
13295 DTF = .25                                                         CHD11490
      GO TO 13297                                                       CHD11500
13296 DTF = 0.5                                                         CHD11510
13297 CONTINUE                                                          CHD11520
C                                                                       CHD11530
C****    RESET OF DTAU,PREDICTED TEMPERATURES, AND PREDICTED DENSITIES  CHD11540
C                                                                       CHD11550
 3296 CONTINUE                                                          CHD11560
      ONE = DTF*DTAU                                                    CHD11570
      TWO = DTAU-ONE                                                    CHD11580
      TAU2 = TAU2-TWO                                                   CHD11590
      DTAU = ONE                                                        CHD11600
      DTAUX = DTAUX-TWO/2.                                              CHD11610
      DTAUC = DTAU                                                      CHD11620
 3340 DO 3360 I=1,MG                                                    CHD11630
      JBS = IBS(I)                                                      CHD11640
      JBE = IBE(I)                                                      CHD11650
      DO 3350 J=JBS,JBE                                                 CHD11660
      TEMPA2(J) = TEMPA1(J)+DTF*(TEMPA2(J)-TEMPA1(J))                   CHD11670
 3350 TEMPA5(J) = TEMPA2(J)                                             CHD11680
      IF (NRSW(I)-3) 3360,3355,3360                                     CHD11690
 3355 DO 3356 J=JBS,JBE                                                 CHD11700
      RHO2(J) = RHO1(J)+DTF*(RHO2(J)-RHO1(J))                           CHD11710
 3356 RHO5(J) = RHO2(J)                                                 CHD11720
      JBS = IBSPM+NCSN(IG)                                              CHD11730
      JBE = JBS+NSLAB(IG)-1                                             CHD11740
      DO 3357 J=JBS,JBE                                                 CHD11750
      RHO2(J) = RHO1(J)+DTF*(RHO2(J)-RHO1(J))                           CHD11760
 3357 RHO5(J) = RHO2(J)                                                 CHD11770
 3360 CONTINUE                                                          CHD11780
      GO TO 2690                                                        CHD11790
 3370 IG=1                                                              CHD11800
      IX = 2                                                            CHD11810
 3375 IERR=1                                                            CHD11820
      ITER = ITER+1                                                     CHD11830
      ITERT = ITERT+1                                                   CHD11840
      GO TO (3395,2693),IX                                              CHD11850
 3395 CONTINUE                                                          CHD11860
      JBS = IBS(MG)                                                     CHD11870
      TEMPA3(1) = 0.5*(TEMPA1(JBS)+TEMPA5(JBS))                         CHD11880
      WFX = WFXX                                                        CHD11890
      FHTX = FHTXX                                                      CHD11900
      CONDX = CONDXX                                                    CHD11910
      JBX = JBXX                                                        CHD11920
      PCX = PCXX                                                        CHD11930
      EDFX=EDFXX                                                        CHD11940
      WFDX=WFDXX                                                        CHD11950
      WDEPX=WDFPXX                                                      CHD11960
      WSIX =WSIXX                                                       CHD11970
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      WBRNX=WBRNXX                                                      CHD11980
      DFPX=DFPXX                                                        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-1/2CHD12250
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) = TEMPA5(NOF)                                           CHD12380
      IF(TAUST(3)-1.001*TAUST(1))3509,3509,13508                        CHD12390
13508 CONTINUE                                                          CHD12400
      DTR(3) = (TEMPA5(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)-(AUST(2))/(TAUST(3)-TAUST(1)))/2.                      CHD12470
      TEMPA5(NOF) = TEMPST(3)                                           CHD12480
      DTR(3) = (TEMPA5(NOF)-TEMPA1(NOF))/DTAUS                          CHD12490
 3509 CONTINUE                                                          CHD12500
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      JBF=1                                                             CHD12510
      DO 23505 IG=1,MG                                                  CHD12520
      JBS=IBS(IG)                                                       CHD12530
      JBEX=JBE                                                          CHD12540
      JBE=IBE(IG)                                                       CHD12550
      JBEM=JBE-1                                                        CHD12560
      QCOND(JBS)=QCOND(JBEX)                                            CHD12570
      K=NCSN(IG)-1                                                      CHD12580
      IF(IGTYP(IG))23505,23505,23503                                    CHD12590
23503 DO 23504 J=JBS,JBEM,JHDN                                          CHD12600
      K=K+1                                                             CHD12610
23504 QCOND(K)=QCOND(J)                                                 CHD12620
23505 QCOND(JBEX)=QCOND(JBS)                                            CHD12630
      QCOND(NOF)=QCOND(NOF+1)                                           CHD12640
      QCOND(MNOD)=QCOND(NOF)                                            CHD12650
      QCOND(1)=QBACK                                                    CHD12660
      JBS=IBS(1)                                                        CHD12670
      QCOND(JBS)=QBACK                                                  CHD12680
 3510 TWO = DTAU/DTAUS                                                  CHD12690
      ONE = 1.+TWO                                                      CHD12700
      JBE = 0                                                           CHD12710
      DO 3526 IG=1,MG                                                   CHD12720
      JBS = IBS(IG)                                                     CHD12730
      IF (JBS-JBE) 13511,13510,13511                                    CHD12740
13510 KK = JBS+1                                                        CHD12750
      GO TO 13512                                                       CHD12760
13511 KK = JBS                                                          CHD12770
13512 CONTINUE                                                          CHD12780
      JBE = IBE(IG)                                                     CHD12790
      JBEM = JBE-1                                                      CHD12800
      DO 3511 J=KK ,JBE                                                 CHD12810
      SILCA1(J)=SILCA5(J)                                               CHD12820
      CARBN1(J)=CARBN5(J)                                               CHD12830
      GRAF1(J)=GRAF5(J)                                                 CHD12840
      TEMPA2(J) = ONE*TEMPA5(J)-TWO*TEMPA1(J)                           CHD12850
      TEMPA1(J) = TEMPA5(J)                                             CHD12860
 3511 TEMPA5(J) = TEMPA2(J)                                             CHD12870
      IX = IGTYP(IG)                                                    CHD12880
      IF (IX) 3517,3517,3514                                            CHD12890
 3514 JHDN = NHDN(IX)                                                   CHD12900
 3515 JCSN = NCSN(IG)                                                   CHD12910
      JCSNM = JCSN-1                                                    CHD12920
      K = JCSNM                                                         CHD12930
      JCEN = NCEN(IG)                                                   CHD12940
      DO 3516 J=JBS,JBEM,JHDN                                           CHD12950
      K = K+1                                                           CHD12960
      WFD (K)=WFD (J)                                                   CHD12970
      SILCA1(K)=SILCA1(J)                                               CHD12980
      CARBN1(K)=CARBN1(J)                                               CHD12990
      GRAF1(K)=GRAF1(J)                                                 CHD13000
      TEMPA1(K) = TEMPA1(J)                                             CHD13010
      WF(K) = WF(J)                                                     CHD13020
      TEMPA2(K) = TEMPA2(J)                                             CHD13030
 3516 TEMPA5(K) = TEMPA2(J)                                             CHD13040
 3517 IF (NRSW(IG)-2) 3526,3518,3518                                    CHD13050
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 3518 CONTINUE                                                          CHD13060
 3519 IX = 1                                                            CHD13070
 3520 DO 3523 J=JBS,JBEM                                                CHD13080
      RHO2(J) = ONE*RHO5(J)-TWO*RHO1(J)                                 CHD13090
      IF (RHO2(J)) 3521,3522,3522                                       CHD13100
 3521 RHO2(J) = 0.                                                      CHD13110
 3522 RHO1(J) = RHO5(J)                                                 CHD13120
 3523 RHO5(J) = RHO2(J)                                                 CHD13130
      GO TO (3524,3526),IX                                              CHD13140
 3524 K = JCSNM                                                         CHD13150
      DO 3525 J=JBS,JBEM,JHDN                                           CHD13160
      K = K+1                                                           CHD13170
      RHO1(K) = RHO1(J)                                                 CHD13180
      RHO2(K) = RHO2(J)                                                 CHD13190
 3525 RHO5(K) = RHO5(J)                                                 CHD13200
      JBS = JCSN+IBSPM                                                  CHD13210
      JBEM = JCEN+IBSPN                                                 CHD13220
      IX = 2                                                            CHD13230
      GO TO 3520                                                        CHD13240
 3526 CONTINUE                                                          CHD13250
      WFD (MNOD)=WFD (NOF)                                              CHD13260
      WDEP(MNOD)=WDEP(NOF)                                              CHD13270
      WSI (MNOD)=WSI (NOF)                                              CHD13280
      WBRN(MNOD)=WBRN(NOF)                                              CHD13290
      WDEP(NN)=WDEP(NOF-4)                                              CHD13300
      WSI (NN)=WSI (NOF-4)                                              CHD13310
      WBRN(NN)=WBRN(NOF-4)                                              CHD13320
      TEMPA1(MNOD) = TEMPA1(NOF)                                        CHD13330
      TEMPA2(MNOD) = TEMPA2(NOF)                                        CHD13340
      TEMPA5(MNOD) = TEMPA5(NOF)                                        CHD13350
      GRAF1(MNOD)=GRAF1(NOF)                                            CHD13360
      SILCA1(MNOD)=SILCA1(NOF)                                          CHD13370
      CARBN1(MNOD)=CARBN1(NOF)                                          CHD13380
      WF(MNOD) = WF(NOF)                                                CHD13390
      GO TO (13529,13525),NPTSW                                         CHD13400
13525 CONTINUE                                                          CHD13410
      NPTSW = 1                                                         CHD13420
      DO 13526 J=1,153                                                  CHD13430
      DD(J) = RHO5(J)                                                   CHD13440
      CC(J) = RHO5(J+152)                                               CHD13450
13526 CONTINUE                                                          CHD13460
      DO 14000 J=1,203                                                  CHD13470
14000 RHO5(J)=RHO5(J)+SILCA1(J)+CARBN1(J)+GRAF1(J)                      CHD13480
      DO 14001 J=205,305                                                CHD13490
14001 RHO5(J)=RHO5(J)+SILCA1(J-203)+CARBN1(J-203)+GRAF1(J-203)          CHD13500
      RHO5(IBSPM) = 0.                                                  CHD13510
      NRDIV = NHDN(1)                                                   CHD13520
      NRGO = NZSN(1)                                                    CHD13530
      NREND = NZEN(1)                                                   CHD13540
      TWALL(N,L) = TEMPA1(NOF)                                          CHD13550
      XLEFT(MNOD) = SN1+XLEFT(IYS)                                      CHD13560
      RETURN                                                            CHD13570
13527 CONTINUE                                                          CHD13580
      DO 13528 J=1,153                                                  CHD13590
      RHO5(J) = DD(J)                                                   CHD13600
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13528 RHO5(J-152) = CC(J)                                              CHD13610
13529 CONTINUE                                                         CHD13620
C                                                                      CHD13630
C****    FRONT CONTROL                                                 CHD13640
C                                                                      CHD13650
      IF (SN1-SCHECK) 13530,13530,13531                                CHD13660
13530 CONTINUE                                                         CHD13670
      CALL FRONT                                                       CHD13680
      MARK = 2                                                         CHD13690
13531 CONTINUE                                                         CHD13700
      IF (NZONC-1) 2687,23529,2687                                     CHD13710
23529 CONTINUE                                                         CHD13720
C                                                                      CHD13730
C****    CHECK LOCATION OF REACTION ZONE                               CHD13740
C                                                                      CHD13750
      IGR = IZG(NRZON,1)                                               CHD13760
      JX = IZGT(NRZON)                                                 CHD13770
      IGRL = IZG(NRZON,JX)                                             CHD13780
      IG = IGRL                                                        CHD13790
      JHDN = NHDN(NRZON)                                               CHD13800
      IM = NCSN(IGR)                                                   CHD13810
      I = MAT(IM)                                                      CHD13820
      JBS = IBS(IGR)                                                   CHD13830
      JBE = IBE(IGR)                                                   CHD13840
      JBEM = JBE-1                                                     CHD13850
      JHDN1 = JHDN+1                                                   CHD13860
      IF (RHO1(JBS)-.03*RHOV(I)) 23527,23527,23528                     CHD13870
23527 IN1 = JBS-1                                                      CHD13880
      GO TO 3530                                                       CHD13890
23528 CONTINUE                                                         CHD13900
      KL = 0                                                           CHD13910
      DO 3528 J=JBS,JBEM                                               CHD13920
      IM = (KL/JHDN)+NCSN(IGR)                                         CHD13930
      KL = KL+1                                                        CHD13940
      I = MAT(IM)                                                      CHD13950
      IF (ABS(RHO1(J)-RHOV(I))-.03*RHOV(I)) 3528,3527,3527             CHD13960
 3527 IN1 = J-1                                                        CHD13970
      GO TO 3530                                                       CHD13980
 3528 CONTINUE                                                         CHD13990
      IN1 = JBEM                                                       CHD14000
 3530 JBS = IBS(IG)                                                    CHD14010
      JBE = IBE(IG)                                                    CHD14020
      JBEM = JBE-1                                                     CHD14030
      K = JBE                                                          CHD14040
      KL = JHDN                                                        CHD14050
      DO 3532 J=JBS,JBEM                                               CHD14060
      K = K-1                                                          CHD14070
      IM = NCEN(IG)-KL/JHDN                                            CHD14080
      KL = KL+1                                                        CHD14090
      IF (RHO1(K)-.15*RHOV(I)) 3532,3532,3531                          CHD14100
 3531 IN2 = K                                                          CHD14110
      GO TO 3533                                                       CHD14120
 3532 CONTINUE                                                         CHD14130
      IF (IG-IGR) 13533,13533,13532                                    CHD14140
13532 IG = IG-1                                                        CHD14150
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      GO TO 3530                                                        CHD14160
13533 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///52X15CHD14240
     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
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- FOR COMBIN,COMBIN
      SUBROUTINE COMBIN                                                 CHD14700
C****    THE COMBIN SUBROUTINE COMBINES 2 MAJOR NODES INTO 1.           CHD14710
       DIMENSION ASTORE (20), BSTORE(20), CSTORE(20),                   CHD14720
     1DSTORE(20),RSTORE(20),SSTORE(20)                                  CHD14730
      DIMENSION UHOLD(20),VHOLD(20),WHOLD(20),XHOLD(20)                 CHD14740
      DIMENSION NHDN(3), RHO4(305)                                      CHD14750
      DIMENSION DELTAX(1), TEMPA1(1)                                    CHD14760
      DIMENSION PSTORE(20),QSTORE(20)                                   CHD14770
      DIMENSION USTORE(20),VSTORE(20),WSTORE(20)                        CHD14780
      COMMON /BLOCKA/                                                   CHD14790
     1ABSORP(10)  ,ABSC        ,ACTENC      ,ACTENS      ,ACTENV(4,10), CHD14800
     2BSTAR       ,CCPC(4)     ,CCPG(4)     ,CHARPT(101) ,CKC(4)      , CHD14810
     3COEFT(4,10) ,CONDC       ,CONDV(100)  ,CONST(4,10) ,COVERX(100) , CHD14820
     4CPBAR       ,CPC         ,CPV(100)    ,DIFREC      ,UMATER(10)  , CHD14830
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)    ,EMISC       , CHD14840
     6HOFM(10)    ,HCOM        ,HCOMG       ,HSUB        ,MAT(100)    , CHD14850
     7MATOMN      ,MATMNF      ,MN          ,NN          ,NNP         , CHD14860
     8NNSAVE      ,NRDIV       ,NREND       ,NRGO        ,NST         , CHD14870
     9PARTIN(101) ,PHI         ,QBYRAD      ,QCOMB       ,QEXTR       , CHD14880
     10GPCOM      ,QSUBL       ,RECPRO      ,REORDC      ,REORDS      , CHD14890
     2REORDV(4,10),RHO5Z       ,RHO5(305)   ,RHOCPX(101) ,RHOC        , CHD14900
     3RHOV(10)    ,SABL        ,SABLC       ,SDOT        ,SDOTC       , CHD14910
     4SLOPE(10)   ,TMELT(10)   ,TSZ         ,TS(205)     ,TRCHAR      , CHD14920
     5WFZ         ,WF(205)     ,XCHAR       ,XINIT       ,XLEFT(101)  , CHD14930
     6XMASS       ,XMDOTC      ,XMDOTD      ,XMDOTG      ,XMDOTL      , CHD14940
     7XMDOTR      ,XMDOTS      ,XTOTAL      ,XVIRG(101)  ,XZONE         CHD14950
      COMMON/BLOCKC/                                                    CHD14960
     1BLPRES(20,11)           ,COMMAX      ,CUTOFF      ,F(20,11)    , CHD14970
     2FLOW(20,11) ,HCONV(20,11),IERROR      ,JUNCT       ,L           , CHD14980
     3N           ,NOSECH      ,QBACK       ,QCONV(20,11),QGAS(20,11) , CHD14990
     4QMISC       ,TIME        ,TPRINT      ,TWALL(20,11),XIWALL(20,11), CHD15000
     5XIR(20,11)                                                        CHD15010
      COMMON /CHCOM/ DTAU,     IBE(10),     IBS(10),     IBSPN,         CHD15020
     1IGTYP(10),  IHDN(4),     IM,          IZB(3),      IZG(3,10),     CHD15030
     2IZGT(3),    JRSW,        NCSN(10),    NSHL(3),     NSHR(3),       CHD15040
     3NZEN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),     CHD15050
     4I           ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),     CHD15060
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                  CHD15070
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,                 CHD15080
     7SCHECK                                                            CHD15090
      COMMON /NASCOM/ CHARRO,AIRM,                                      CHD15100
     1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)CHD15110
     2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205), WDEP(205),WSI(20CHD15120
     35),WBRN(205),EMWT(205),PRG(205)                                   CHD15130
     4,TIMEX(50),TET(50),NPTS                                           CHD15140
     5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS, CHD15150
     6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,CHD15160
     7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)                  CHD15170
     8,ALLGAS(205),GRAF1(205)                                           CHD15180
      EQUIVALENCE (IHDN(2),NHDN(1))                                     CHD15190
      EQUIVALENCE (RHO3(103),RHO4(1))                                   CHD15200
      EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))               CHD15210
      EQUIVALENCE (MNOD,NNP)                                            CHD15220
      SF = 1.                                                           CHD15230
```

```
      KX = 0.                                                           CHD15240
      IX = 0                                                            CHD15250
      DSTORE(1) = 0.                                                    CHD15260
      IG = MG-1                                                         CHD15270
    9 KHDN = JHDN                                                       CHD15280
      KST = JST                                                         CHD15290
      J=NCEN(IG-1)                                                      CHD15300
      ONE = DELTAX(J)*SF                                                CHD15310
      JX = IGTYP(IG)                                                    CHD15320
      JHDN = NHDN(JX)                                                   CHD15330
      JST = IBF(IG)-JHDN                                                CHD15340
      K = JST-1                                                         CHD15350
      JY = JHDN+IX                                                      CHD15360
    8 DO 10 I=1,JY                                                      CHD15370
      K = K+1                                                           CHD15380
      KX = KX+1                                                         CHD15390
      UHOLD(KX)=WFD (K)                                                 CHD15400
      VHOLD(KX)=WDEP(K)                                                 CHD15410
      WHOLD(KX)=WSI (K)                                                 CHD15420
      XHOLD(KX)=WBRN(K)                                                 CHD15430
      USTORE(KX)=EMWT(K)                                                CHD15440
      VSTORE(KX)=WF(K)                                                  CHD15450
      WSTORE(KX)=GRAF1(K)                                               CHD15460
      ASTORE(KX) = TEMPA1(K)                                            CHD15470
      BSTORE(KX) = TEMPA2(K)                                            CHD15480
      CSTORE(KX) = TEMPA5(K)                                            CHD15490
      DSTORE(KX+1) = DSTORE(KX  )+ONE                                   CHD15500
      PSTORE(KX)=SILCA1(K)                                              CHD15510
      QSTORE(KX)=CARBN1(K)                                              CHD15520
      RSTORE(KX) = RHO1(K)                                              CHD15530
   10 SSTORE(KX) = RHO2(K)                                              CHD15540
      SF = SN1/SN                                                       CHD15550
      IX = IX+1                                                         CHD15560
      IG = MG                                                           CHD15570
      GO TO (9,12),IX                                                   CHD15580
   12 CONTINUE                                                          CHD15590
      J = KST                                                           CHD15600
      IF (ICOM-2) 14 ,14,13                                             CHD15610
   13 KST = JST                                                         CHD15620
      KHDN = JHDN                                                       CHD15630
   14 CONTINUE                                                          CHD15640
      TEMPA1(KST) = TEMPA1(J  )                                         CHD15650
      TEMPA2(KST) = TEMPA2(J  )                                         CHD15660
      TEMPA5(KST) = TEMPA5(J  )                                         CHD15670
      SILCA1(KST)=SILCA1(J)                                             CHD15680
      CARBN1(KST)=CARBN1(J)                                             CHD15690
      WFD (KST)=WFD (J)                                                 CHD15700
      WDEP(KST)=WDEP(J)                                                 CHD15710
      WSI (KST)=WSI (J)                                                 CHD15720
      WBRN(KST)=WBRN(J)                                                 CHD15730
      EMWT(KST)=EMWT(J)                                                 CHD15740
      WF(KST)=WF(J)                                                     CHD15750
      GRAF1(KST)=GRAF1(J)                                               CHD15760
      RHO1(KST) = RHO1(J  )                                             CHD15770
      RHO2(KST) = RHO2(J)                                               CHD15780
```

```
      DX = .00009*DSTORE(KX)/FLOAT(KHDN)                                CHD15790
      DIS = 0.                                                          CHD15800
      K = 1                                                             CHD15810
      DO 30 J=1,KHDN                                                    CHD15820
      DIS = DIS+DX                                                      CHD15830
      KX = KST+J                                                        CHD15840
   20 ONE = DSTORE(K+1)-DIS                                             CHD15850
      IF (ONE) 21,23,23                                                 CHD15860
   21 K = K+1                                                           CHD15870
      GO TO 20                                                          CHD15880
   23 THREE = DSTORE(K+1)-DSTORE(K)                                     CHD15890
      ONE = ONE/THREE                                                   CHD15900
      TWO = (DIS-DSTORE(K))/THREE                                       CHD15910
      WFD (KX)=ONE*UHOLD(K)+TWO*UHOLD(K+1)                              CHD15920
      WDFP(KX)=ONE*VHOLD(K)+TWO*VHOLD(K+1)                              CHD15930
      WSI (KX)=ONE*WHOLD(K)+TWO*WHOLD(K+1)                              CHD15940
      WBRN(KX)=ONE*XHOLD(K)+TWO*XHOLD(K+1)                              CHD15950
      EMWT(KX)=ONE*USTORE(K)+TWO*USTORE(K+1)                            CHD15960
      WF(KX)=ONE*VSTORE(K)+TWO*VSTORE(K+1)                              CHD15970
      GRAF1(KX)=ONE*WSTORE(K)+TWO*WSTORE(K+1)                           CHD15980
      TEMPA1(KX) = ONE*ASTORE(K)+TWO*ASTORE(K+1)                        CHD15990
      TEMPA2(KX) = ONE*BSTORE(K)+TWO*BSTORE(K+1)                        CHD16000
      TEMPA5(KX) = ONE*CSTORE(K)+TWO*CSTORE(K+1)                        CHD16010
      SILCA1(KX)=ONE*PSTORE(K)+TWO*PSTORE(K+1)                          CHD16020
      CARBN1(KX)=ONE*QSTORE(K)+TWO*QSTORE(K+1)                          CHD16030
      RHO1(KX) = ONE*RSTORE(K)+TWO*RSTORE(K+1)                          CHD16040
   30 RHO2(KX) = ONE*SSTORE(K)+TWO*SSTORE(K+1)                          CHD16050
      K = IASPN+NN                                                      CHD16060
      RHO1(K) = RHO1(K+1)                                               CHD16070
      RHO2(K) = RHO2(K+1)                                               CHD16080
      RETURN                                                            CHD16090
      END                                                               CHD16100
```

```
- FOR CONDF,CONDF
      FUNCTION CONDF(K)                                                 CHD16110
C****    THE CONDF SUBROUTINE CALCULATES HEAT CONDUCTIVITY              CHD16120
      DIMENSION NHDN(3), RHO4(306)                                      CHD16130
      DIMENSION DELTAX(1), TEMPA1(1)                                    CHD16140
      COMMON /BLOCKA/                                                   CHD16150
     1ABSORP(10)  ,ABSC        ,ACTENC      ,ACTENS      ,ACTENV(4,10), CHD16160
     2BSTAR       ,CCPC(4)     ,CCPG(4)     ,CHARPT(101) ,CKC(4)      , CHD16170
     3COEFT(4,10) ,CONDC       ,CDUM (100)  ,CONST(4,10) ,COVERX(100) , CHD16180
     4CPBAR       ,CPC         ,CPV(100)    ,DIFREC      ,UMATER(10)  , CHD16190
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)    ,EMISC       , CHD16200
     6HOFM(10)    ,HCOM        ,HCOMG       ,HSUB        ,MAT(100)    , CHD16210
     7MATOMN      ,MATMNE      ,MN          ,NN          ,NNP         , CHD16220
     8NNSAVE      ,NRDIV       ,NREND       ,NRGO        ,NST         , CHD16230
     9PARTIN(101) ,PHI         ,QBYRAD      ,QCOMB       ,QEXTR       , CHD16240
     1QGPCOM      ,QSUBL       ,RECPRO      ,REORDC      ,REORDS      , CHD16250
     2REORDV(4,10),RHO5Z       ,RHO5(305)   ,RHOCPX(101) ,RHOC        , CHD16260
     3RHOV(10)    ,SABL        ,SABLC       ,SDOT        ,SDOTC       , CHD16270
     4SLOPE(10)   ,TMELT(10)   ,TSZ         ,TS(205)     ,TRCHAR      , CHD16280
     5WFZ         ,WF(205)     ,XCHAR       ,X[illegible]            ,XLEFT(101)  , CHD16290
     6XMASS       ,XMDOTC      ,XMDOTD      ,[illegible]             ,XMDOTL      , CHD16300
     7XMDOTR      ,XMDOTS      ,XTOTAL      [illegible]              ,XZONE         CHD16310
      COMMON/BLOCKC/                                                    CHD16320
     1BLPRES(20,11)            ,COMMAX      ,[illegible]             ,F(20,11)    , CHD16330
     2FLOW(20,11) ,HCONV(20,11),IERROR      [illegible]              ,L           , CHD16340
     3N           ,NOSECH      ,QBACK       ,Q[illegible]GAS(20,11) , CHD16350
     4QMISC       ,TIME        ,TPRINT      ,TWALL(20,11),XIWALL(20,11), CHD16360
     5XIR(20,11)                                                        CHD16370
      COMMON /CHCOM/ DTAU,     IBE(10),     IBS(10),     IBSPN,         CHD16380
     1IGTYP(10),  IHDN(4),     IM,          IZB(3),      IZG(3,10),     CHD16390
     2IZGT(3),    JRSW,        NCSN(10),    NSHL(3),     NSHR(3),       CHD16400
     3NZFN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),     CHD16410
     4I           ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),      CHD16420
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                  CHD16430
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,MD(3),NLZON,SN,SN1,                 CHD16440
     7SCHECK                                                            CHD16450
      COMMON /DACOM/ A(42),                                             CHD16460
     1ABVAL ,ABVALM,ABVALS,B(42) ,C(42) ,         CC(205),COND(42),     CHD16470
     2CONDX ,CONDXX, D(42) ,DD(205),DELTX(101),DGAS,DO,                 CHD16480
     3DTAUC ,DTAUS ,DTAUX ,DTF,DTR(3),EDFX,EDFXX,EMI(42),               CHD16490
     4ETA,ETAS,FHT(42),FHTX,FHTXX,GAGC,GAS1,GK,GX,GY,GZ,                CHD16500
     5HDA(5,10),IBSPM,IERR,IGC,IGL,IGLD,IGR,IGRL,IGT,IG2,               CHD16510
     6IHYS,INEG,IN1,IN2,IP,IPLUS,ITER,ITERT,IX,IY,IZ,J,JBE,             CHD16520
     7JBEM,JBFX,JBND1,JBND2,JBS,JBSM,JBSPM,JBSPN,JBX,JBXX,JCEN,         CHD16530
     8JCENM,JCSN,JCSNM,JE,JE1,JE2,JHDN,JHDN1,JLSW,JSLAB,JX,JZ,          CHD16540
     9K1,LANDID,LRT,MARK,NADD(42),NASW,NBNDST,NBND1(11),                CHD16550
     1NBSW,NDC,NDCM,NLSW(10),NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW,        CHD16560
     2NPID,NRIDC,NRSW(10),NRZON,NSLAB(10),NSLABH(10),NSW,NXSW,          CHD16570
     3NZON,NZONC,ONE,PSI,QSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN,              CHD16580
     4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,          CHD16590
     5TEMPST(3),THREE,TWO,WFP,WFX,WFXX,XI,XMCOM,XSAVE                   CHD16600
      COMMON /NASCOM/ CHARRO,AIRM,                                      CHD16610
     1CARBN1(205),CAPBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)CHD16620
     2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205), WDEP(205),WSI(20CHD16630
     35),WBRN(205),EMWT(205),PRG(205)                                   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,DCODP,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 (RHO4(103),RHO4(1))                                  CHD16710
  EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIM(1))              CHD16720
  EQUIVALENCE (MNOD,NNP)                                           CHD16730
  DIMENSION AREA(42),AREAV(42)                                     CHD16740
  EQUIVALENCE (RHOCPX(44),AREA(1),AREAV(43))                       CHD16750
  KL=JBSM+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,I)+TEMPA4(K)*(CONST(2,I)+TEMPA4(K)              CHD16830
 1*(CONST(3,I)+TEMPA4(K)*CONST(4,I)))                              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(I)+CONDC                     CHD16890
18 CONDF=CONDF*AREA(K)/(2.*DELTAX(IM))                             CHD16900
  RETURN                                                           CHD16910
  END                                                              CHD16920
```

```
- FOR CPBA,CPBA
      SUBROUTINE CPBA(J,K,TEMPA,CPBAR)                                  CHD16930
      COMMON /BLOCKA/USER(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(20CHD16970
     35),WBRN(205),FMWT(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)                                  CHD17060
C                                                                       CHD17070
C****    CARBON DEPOSITION                                              CHD17080
C                                                                       CHD17090
      COMMON /BLOCKA/                                                   CHD17100
     1ABSORP(10)  ,ABSC        ,ACTENC      ,ACTENS      ,ACTENV(4,10), CHD17110
     2BSTAR       ,CCPC(4)     ,CCPG(4)     ,CHARPT(101) ,CKC(4)      , CHD17120
     3COEFT(4,10) ,CONDC       ,CONDV(100)  ,CONST(4,10) ,COVERX(100) , CHD17130
     4CPBAR       ,CPC         ,CPV(100)    ,DIFREC      ,UMATER(10)  , CHD17140
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)    ,EMISC       , CHD17150
     6HOFM(10)    ,HCOM        ,HCOMG       ,HSUB        ,MAT(100)    , CHD17160
     7MATOMN      ,MATMNF      ,MN          ,NN          ,NNP         , CHD17170
     8NNSAVE      ,NRDIV       ,NREND       ,NRGO        ,NST         , CHD17180
     9PARTIN(101) ,PHI         ,QBYRAD      ,QCOMB       ,QEXTR       , CHD17190
     1QGPCOM      ,QSURL       ,RECPRO      ,REORDC      ,REORDS      , CHD17200
     2REORDV(4,10),RHO5Z       ,RHO5(305)   ,RHOCPX(101) ,RHOC        , CHD17210
     3RHOV(10)    ,SABL        ,SABLC       ,SDOT        ,SDOTC       , CHD17220
     4SLOPE(10)   ,TMELT(10)   ,TS2         ,TS(205)     ,TRCHAR      , CHD17230
     5WFZ         ,WF(205)     ,XCHAR       ,XINIT       ,XLEFT(101)  , CHD17240
     6XMASS       ,XMDOTC      ,XMDOTI      ,XMDOTG      ,XMDOTL      , CHD17250
     7XMDOTR      ,XMDOTS      ,XTOTAL      ,XVIRG(101)  ,XZONE         CHD17260
      COMMON/BLOCKC/                                                    CHD17270
     1BLPRES(20,11)            ,COMMAX      ,CUTOFF      ,F(20,11)    , CHD17280
     2FLOW(20,11) ,HCONV(20,11),IERROR      ,JUNCT       ,L           , CHD17290
     3N           ,NOSECH      ,QBACK       ,QCONV(20,11),QGAS(20,11) , CHD17300
     4QMISC       ,TIME        ,TPRINT      ,TWALL(20,11),XIWALL(20,11), CHD17310
     5XIR(20,11)                                                        CHD17320
      COMMON /BLOCKJ/                                                   CHD17330
     1FLUXI(200),TEDEP(200),XEDEP(101),EDEP(101),NTEDEP,                CHD17340
     2NXEDEP,ITEPEP,EDFLUX(100)                                         CHD17350
      COMMON /BLOCKK/NN1,QCOND(205)                                     CHD17360
      COMMON/BLOCKN/COORD                                               CHD17370
      COMMON/BLOCKR/DIFC(4),EROC(4),ERODE                               CHD17380
      COMMON /CHCOM/ DTAU,     IDE(10),     IBS(10),     IBSPN,         CHD17390
     1IGTYP(10),  IHDN(4),     IM,          IZB(3),      IZG(3,10),     CHD17400
     2IZGT(3),    JRSW,        NCSN(10),    NSHL(3),     NSHR(3),       CHD17410
     3NZEN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),     CHD17420
     4I           ,TEMPA2(20 ),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),      CHD17430
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                  CHD17440
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SNI,                 CHD17450
     7SCHECK                                                            CHD17460
C****    DIMENSION STATEMENTS                                           CHD17470
C                                                                       CHD17480
      DIMENSION DELTAX(1),TEMPA1(1)                                     CHD17490
      EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))               CHD17500
      COMMON /NASCOM/ CHARRO,AIRM,                                      CHD17510
     1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)CHD17520
     2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205), WDEP(205),WSI(20CHD17530
     35),WBRN(205),EMWT(205),PRG(205)                                   CHD17540
     4,TIMEX(50),TFT(50),NPTS                                           CHD17550
     5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS, CHD17560
     6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,CHD17570
     7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)                  CHD17580
     8,ALLGAS(205),GRAF1(205),GRAF5(205),SPEED(205),DIFCH(205),DIFR(205)CHD17590
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     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.)+ZMYHCHD17800
     1*YH)/(1.-YH+ZM-2.*ZMYH)**2                                       CHD17810
      HERE=(DELTAX(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
```

```
- FOR DIAG6,DIAG6
      SUBROUTINE DIAG6                                                  CHD17940
      COMMON /BLOCKC/ DUMMY(882),IERROR                                 CHD17950
      I=87                                                              CHD17960
      CALL PICKUP(I,X)                                                  CHD17970
      WRITE (6,1) X                                                     CHD17980
    1 FORMAT(1H1,4X,45HEXIT THROUGH MERR$ BECAUSE OF DIVIDE OVERFLOW/5X,CHD17990
     144HTHE ADDRESS OF THE OFFENDING INSTRUCTION IS ,O12)              CHD18000
      IERROR=17                                                         CHD18010
      CALL ERROR3                                                       CHD18020
      END                                                               CHD18030
```

```
FOR DIAG7,DIAG7
      SUBROUTINE DIAG7                                                  CHD18040
      COMMON /BLOCKC/                                                   CHD18050
     1BLPRES(20,11)            ,COMMAX       ,CUTOFF       ,F(20,11)    ,  CHD18060
     2FLOW(20,11) ,HCONV(20,11),IERROR        ,JUNCT        ,L           ,  CHD18070
     3N           ,NOSECH      ,QBACK        ,QCONV(20,11),QGAS(20,11) ,  CHD18080
     4QMISC       ,TIME        ,TPRINT       ,TWALL(20,11),XTWALL(20,11), CHD18090
     5XIR(20,11)                                                        CHD18100
      WRITE (6,1)                                                       CHD18110
1     FORMAT(///1H ,4X,29HEXIT BECAUSE OF JUMP TO MERR$)                CHD18120
      IERROR=17                                                         CHD18130
      CALL ERROR3                                                       CHD18140
      END                                                               CHD18150
```

```
- FOR DIFUS,DIFUS
      SUBROUTINE DIFUS (DIFCAL,NSOUR ,DCO,CFIX,CONC)                    CHD18160
      COMMON /BLOCKA/                                                   CHD18170
     1ABSORP(10)  ,ABSC        ,ACTENC      ,ACTENS      ,ACTENV(4,10), CHD18180
     2BSTAR       ,CCPC(4)     ,CCPG(4)     ,CHARPT(101) ,CKC(4)      , CHD18190
     3COEFT(4,10) ,CONDC       ,CONDV(100)  ,CONST(4,10) ,COVERX(100) , CHD18200
     4CPBAR       ,CPC         ,CPV(100)    ,DIFREC      ,UMATER(10)  , CHD18210
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)    ,EMISC       , CHD18220
     6HOFM(10)    ,HCOM        ,HCOMG       ,HSUB        ,MAT(100)    , CHD18230
     7MATOMN      ,MATMNE      ,MN          ,NN          ,NNP         , CHD18240
     8NNSAVF      ,NRDIV       ,NREND       ,NRGO        ,NST         , CHD18250
     9PARTIN(101) ,PHI         ,QBYRAD      ,QCOMB       ,QEXTR       , CHD18260
     1QGPCOM      ,QSUBL       ,RECPRO      ,REORDC      ,REORDS      , CHD18270
     2REORDV(4,10),RHOSZ       ,RHOS(305)   ,PHOCPX(101) ,RHOC        , CHD18280
     3RHOV(10)    ,SABL        ,SABLC       ,SDOT        ,SDOTC       , CHD18290
     4SLOPE(10)   ,TMELT(10)   ,TSZ         ,TS(205)     ,TRCHAR      , CHD18300
     5WFZ         ,WF(205)     ,XCHAR       ,XINIT       ,XLEFT(101)  , CHD18310
     6XMASS       ,XMDOTC      ,XMDOTD      ,XMDOTG      ,XMDOTL      , CHD18320
     7XMDOTR      ,XMDOTS      ,XTOTAL      ,XVIRG(101)  ,XZONE         CHD18330
      COMMON /BLOCKB/ USER(243),BLDEN(20,11)                            CHD18335
      COMMON/BLOCKC/                                                    CHD18340
     1BLPRES(20,11)            ,COMMAX      ,CUTOFF      ,F(20,11)    , CHD18350
     2FLOW(20,11) ,HCONV(20,11),IERROR      ,JUNCT       ,L           , CHD18360
     3N           ,NOSECH      ,QBACK       ,QCONV(20,11),QGAS(20,11) , CHD18370
     4QMISC       ,TIME        ,TPRINT      ,TWALL(20,11),XIWALL(20,11), CHD18380
     5XIR(20,11)                                                        CHD18390
      COMMON /BLOCKJ/                                                   CHD18400
     1FLUXI(200),TEDEP(200),XEDEP(101),EDEP(101),NTFDFP,                CHD18410
     2NXEDEP,ITEPEP,EDFLUX(100)                                         CHD18420
      COMMON /BLOCKK/NN1,QCOND(205)                                     CHD18430
      COMMON/BLOCKN/COORD                                               CHD18440
      COMMON/BLOCKR/DIFC(4),EROC(4),ERODE                               CHD18450
      COMMON /CHCOM/ DTAU,     IBE(10),     IBS(10),     IBSPN,         CHD18460
     1IGTYP(10),  IHDN(4),     IM,          IZB(3),      IZG(3,10),     CHD18470
     2IZGT(3),    JRSW,        NCSN(10),    NSHL(3),     NSHR(3),       CHD18480
     3NZEN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),     CHD18490
     4I           ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),     CHD18500
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                 CHD18510
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,                 CHD18520
     7SCHECK                                                            CHD18530
      COMMON/NUCOM/ NADA,                                               CHD18540
     1EM(42)                                                            CHD18550
      COMMON /DACOM/ A(42),                                             CHD18560
     1ABVAL ,ABVALM,ABVALS,B(42) ,C(42) ,          CC(205),COND(42),    CHD18570
     2CONDX ,CONDXX, D(42) ,DD(205),DELTX(101),DGAS,DQ,                 CHD18580
     3DTAUC ,DTAUS ,DTAUX ,DTF,DTR(3),EDFX,EDFXX,EMI(42),               CHD18590
     4ETA,ETAS,FHT(42),FHTX,FHTXX,GAGC,GAS1,GK,GX,GY,GZ,                CHD18600
     5HDA(5,10),IBSPM,IERR,IGC,IGL,IGLD,IGR,IGRL,IGT,IG2,               CHD18610
     6IHYS,INEG,IN1,IN2,IP,IPLUS,ITER,ITERT,IX,IY,IZ,J,JBE,             CHD18620
     7JBEM,JBEX,JBND1,JBND2,JBS,JBSM,JBSPM,JBSPN,JBX,JBXX,JCEN,         CHD18630
     8JCENM,JCSN,JCSNM,JE,JE1,JE2,JHDN,JHDN1,JLSW,JSLAB,JX,JZ,          CHD18640
     9K1,LANDID,LRT,MARK,NADD(42),NASW,NBNDST,NBND1(11),                CHD18650
     1NBSW,NDC,NDCM,NLSW(10),NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW,        CHD18660
     2NRID,NRIDC,NRSW(10),NRZON,NSLAB(10),NSLABH(10),NSW,NXSW,          CHD18670
     3NZON,NZONC,ONE,PSI,QSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN,              CHD18680
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     4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,          CHD18690
     5TEMPST(3),THREE,TWO,WFP,WFX,WFXX,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(20CHD18730
     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*WBRN(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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      D(K)=SOURCE(J)/POR(J)                                             CHD19240
  313 CONTINUE                                                          CHD19250
      A(K)=(DIFCOS+DIFCO(J))*6./DELTAX(KK)                              CHD19260
      SAVE=(DIFCO(J)+DIFCO(J+1))*6./ DELTAX(KL)                         CHD19270
      C(K)=-SAVE                                                        CHD19280
      B(K)=SAVE+A(K)+    ALP                                            CHD19290
      A(K)=-A(K)-    ALPH                                               CHD19300
      ALPH=ALP                                                          CHD19310
      ALP=ALPHA                                                         CHD19320
      DIFCOS=DIFCO(J)                                                   CHD19330
   10 CONTINUE                                                          CHD19340
      IF (IG-IGR) 11,11,12                                              CHD19350
   11 B(1)=A(1)+B(1)                                                    CHD19360
      CC(JBS)=C(1)/B(1)                                                 CHD19370
      DD(JBS)=D(1)/B(1)                                                 CHD19380
      GO TO 13                                                          CHD19390
   12 ONE=B(1)-CC(JBXX)*A(1)                                            CHD19400
      CC(JBS)=C(1)/ONE                                                  CHD19410
      DD(JBS)=(D(1)-A(1)*DD(JBXX))/ONE                                  CHD19420
   13 CONTINUE                                                          CHD19430
      DO 20 J=2,JF1                                                     CHD19440
      K=JBSM+J                                                          CHD19450
      ONE=B(J)-CC(K-1)*A(J)                                             CHD19460
      IF (ONE) 15,14,15                                                 CHD19470
   14 CC(K)=0                                                           CHD19480
      DD(K)=0                                                           CHD19490
      GO TO 20                                                          CHD19500
   15 CONTINUE                                                          CHD19510
      CC(K)=C(J)/ONE                                                    CHD19520
      DD(K)=(D(J)-A(J)*DD(K-1))/ONE                                     CHD19530
   20 CONTINUE                                                          CHD19540
      JBXX=JBEM                                                         CHD19550
  100 CONTINUE                                                          CHD19560
      A(1)=-ALPH-SAVE                                                   CHD19570
      B(1)= ALPHA+DCU+SAVE                                              CHD19580
      D(1)=DCU*CFIX+SOURCE(JBE)/(POR(JBE)+1.E-10)                       CHD19590
      IF (B(1)-CC(JBE-1)*A(1)) 105,103,105                              CHD19600
  103 CONC(JBE)=0.                                                      CHD19610
      GO TO 106                                                         CHD19620
  105 CONTINUE                                                          CHD19630
      CONC(JBE)=(D(1)-A(1)*DD(JBE-1))/(B(1)-CC(JBE-1)*A(1))             CHD19640
      IF (CONC(JBE))  103,103,106                                       CHD19650
  106 CONTINUE                                                          CHD19660
      JBX=JBE                                                           CHD19670
      DO 200 IG=MG,IGR,-1                                               CHD19680
      CALL GRIN(IG)                                                     CHD19690
      CONC(JBE)=CONC(JBX)                                               CHD19700
      DO 150 J=JBEM,JBS,-1                                              CHD19710
      CONC(J) = DD(J) - CC(J)*CONC(J+1)                                 CHD19720
      IF (CONC(J)) 108,108,150                                          CHD19730
  108 CONC(J) = 0.                                                      CHD19740
  150 CONTINUE                                                          CHD19750
      JBX=JBS                                                           CHD19760
  200 CONTINUE                                                          CHD19770
      HOLD=CONC(JBX)                                                    CHD19780
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      IF (IGR-1) 205,205,210                                    CHD19790
  205 IGRL=1                                                    CHD19800
      GO TO 215                                                 CHD19810
  210 IGRL=IGR-1                                                CHD19820
  215 CONTINUE                                                  CHD19830
      DO 250 IG=1,IGRL                                          CHD19840
      CALL GRIN(IG)                                             CHD19850
      DO 230 J=JBS,JBE                                          CHD19860
  230 CONC(J)=HOLD                                              CHD19870
  250 CONTINUE                                                  CHD19880
      RETURN                                                    CHD19890
      END                                                       CHD19900
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- FOR ERROR3,ERROR3
      SUBROUTINE ERROR3                                                 CHD19910
      COMMON /BLOCKA/                                                   CHD19920
     1ABSORP(10)   ,ABSC         ,ACTENC       ,ACTENS       ,ACTENV(4,10), CHD19930
     2BSTAR        ,CCPC(4)      ,CCPG(4)      ,CHARPT(101)  ,CKC(4)      , CHD19940
     3COEFT(4,10)  ,CONDC        ,CONDV(100)   ,CONST(4,10)  ,COVERX(100) , CHD19950
     4CPBAR        ,CPC          ,CPV(100)     ,DIFREC       ,UMATER(10)  , CHD19960
     5EFCOLC       ,EFCOLS       ,EFCOLV(4,10),FMIS(10)      ,EMISC       , CHD19970
     6HOFM(10)     ,HCOM         ,HCOMG        ,HSUB         ,MAT(100)    , CHD19980
     7MATOMN       ,MATMNE       ,MN           ,NN           ,NNP         , CHD19990
     8NNSAVE       ,NRDIV        ,NREND        ,NRGO         ,NST         , CHD20000
     9PARTIN(101)  ,PHI          ,QBYRAD       ,QCOMB        ,QEXTP       , CHD20010
     1QGPCOM       ,QSUBL        ,RECPRO       ,REORDC       ,REORDS      , CHD20020
     2REORDV(4,10),RHOSZ         ,RHOS(205)    ,RHOCPX(101)  ,RHOC        , CHD20030
     3RHOV(10)     ,SABL         ,SABLC        ,SDOT         ,SDOTC       , CHD20040
     4SLOPE(10)    ,TMELT(10)    ,TSZ          ,TS(205)      ,TRCHAR      , CHD20050
     5WFZ          ,WF(205)      ,XCHAR        ,XINIT        ,XLEFT(101)  , CHD20060
     6XMASS        ,XMDOTC       ,XMDOTD       ,XMDOTG       ,XMDOTL      , CHD20070
     7XMODER       ,XMDOTS       ,XTOTAL       ,XVIRG(101)   ,XZONE         CHD20080
      COMMON/BLOCKB/                                                    CHD20090
     1ALT          ,AOFA         ,AOFACH       ,BETA(20)     ,BLCOM(20,11), CHD20100
     2BLDEN(20,11),BLENT(20,11),BLTEM(20,11),BLVEL(20,11),BLRN(20,11) , CHD20110
     3BMULT        ,DIST(20,11)  ,FSCOM        ,FSGAM        ,LENGTH(21)  , CHD20120
     4NDIM         ,NTEMP        ,NTHETA       ,NTINE        ,PAMB        , CHD20130
     5PSP          ,PTOTAL       ,QAMB         ,QSHOUL       ,              CHD20140
     6R(20,11)     ,REFCOM(20,11)              ,REFDEN(20,11)             , CHD20150
     7REFENT(20,11)              ,REFRN(20,11),REFTEM(20,11)              , CHD20160
     8REFVIS(20,11)              ,RHOA         ,RHOVIS       ,RNPERF      , CHD20170
     9RTRAN        ,SOFS         ,SWEEP        ,THETA(11)    ,THETSH      , CHD20180
     1TTOTAL       ,UAMB         ,VISCOS       ,X(20,11)     ,XEQ(20,11)  , CHD20190
     2XIAMB        ,XISP         ,XLTRAN       ,XMACH        ,XX          , CHD20200
     3ATEMP        ,BLVIS(20,11),ZWALL         ,REFPR(20,11),HMAX           CHD20210
      COMMON /BLOCKC/                                                   CHD20220
     1BLPRES(20,11)            ,COMMAX       ,CUTOFF       ,F(20,11)    , CHD20230
     2FLOW(20,11) ,HCONV(20,11),IERROR       ,JUNCT        ,L           , CHD20240
     3N            ,NOSECH       ,QBACK        ,QCONV(20,11),QGAS(20,11) , CHD20250
     4QMISC        ,TIME         ,TPRINT       ,TWALL(20,11),XIWALL(20,11), CHD20260
     5XIR(20,11)                                                        CHD20270
      COMMON /BLOCKD/                                                   CHD20280
     1ALPHA(200) ,AMBP(200)    ,AMBT(200)    ,AMULT(200)   ,AXLD(200)   , CHD20290
     2BWTEST     ,IATMOS       ,IPR          ,IPRINT(20,10)             , CHD20300
     3IQ         ,IX           ,KK           ,MELTN        ,MELTL       , CHD20310
     4            MVTEST       ,NKK          ,NCHARM       ,NMATLU      , CHD20320
     5NMATL      ,NMATLD       ,NSTRES       ,NTBW         ,NTIME1      , CHD20330
     6NTIME2     ,PRINT        ,PUT(20)      ,QBAC(200)    ,QINC(20)    , CHD20340
     7QINCR      ,QM(200)      ,QTIME(20)    ,QTABLE(6,200)             , CHD20350
     8RPRINC     ,RQINC        ,RXINC        ,T(200)       ,TBW(200)    , CHD20360
     9TEMP(7)                                ,TNT(20)      ,TORIBW(200) , CHD20370
     1TSIN(101)  ,TT(200)      ,V(200)       ,XINC(20)                  , CHD20380
     2XINCR,       XTIME(20)   ,Z(200)       ,ZZ(200)                     CHD20390
      COMMON /BLOCKE/                                                   CHD20400
     1DIV        ,IP           ,IWPLOT       ,LPLOTH(20)   ,LPLOTQ(20)  ,CHD20410
     2LPLOCW(20) ,NCAM         ,NCPL(20)     ,NDRUMA       ,NDRUMB      ,CHD20420
     3NDRUMC     ,NDRUMD       ,NDRUME       ,NDRUMF       ,NLOCPH      ,CHD20430
     4NLOCPQ     ,NNLOCW       ,NNODEC       ,NNODET       ,NNSP        ,CHD20440
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5NPAGE        ,NPLOTH(20)   ,NPLOTQ(20)   ,NPLOCW(20)   ,NTIMEP        ,CHD20450
6NPL(20)      ,NVALUC(20)   ,NVALUT(20)   ,PLOTM        ,PINC(20)     ,CHD20460
7PINCR        ,PPRINT       ,PTIME(20)    ,RPLINC       ,SPECS(31)    ,CHD20470
8STOPPL       ,TM           ,NNPREV                                    CHD20480
 COMMON /BLOCKF/                                                       CHD20490
1ASTR(205)    ,AXLDEQ       ,CCOMSC(4)    ,CCOMSV(4,10),CFMODC(4)     ,CHD20500
2CEMODV(4,10),CEXPC(4)      ,CEXPV(4,10)  ,CLCOEF       ,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/                                                        CHD20570
1QBOLD        ,QBWTOT       ,QCLD(20,10)  ,QCOLD        ,QCONVT(20,10),CHD20580
2QGAST(20,10),QGLD(20,10)   ,QGOLD        ,QMISCT       ,QMOLD        CHD20590
 COMMON /CHCOM/ DTAU,     IBE(10),     IBS(10),     IBSPN,            CHD20600
1IGTYP(10),   IHDN(4),     IM,          IZB(3),      IZG(3,10),        CHD20610
2IZGT(3),     JRSW,        NCSN(10),    NSHL(3),     NSHR(3),          CHD20620
3NZEN(3),     NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),        CHD20630
4I            ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),        CHD20640
5             DELX(100),DISTL(100),DUM  (10),ICOM,                     CHD20650
6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,                     CHD20660
7SCHECK                                                                CHD20670
 COMMON /BLOCKH/                                                       CHD20680
1DABS(50)     ,DABSC(50)    ,DACTEC(50)   ,DACTES(50)   ,DACTEV(4,50),CHD20690
2DBSTAR(50)   ,DCCPC(4,50)  ,DCCPG(4,50)  ,DCCSC(4,50)  ,DCCSV(4,50) ,CHD20700
3DCEMC(4,50)  ,DCEMV(4,50)  ,DCEXPC(4,50),DCEXPV(4,50),DCKC(4,50)   ,CHD20710
4DCLCOE(50)   ,DCNUC(4,50)  ,DCNUV(4,50)  ,DCOE(4,50)   ,DCON(4,50)   ,CHD20720
5DCSHSC(4,50),DCSHSV(4,50),DCTSC(4,50)  ,DCTSV(4,50)  ,DDIFFU(50)   ,CHD20730
6DEFCOC(50)   ,DEFCOS(50)   ,DEFCOV(4,50),DEMIS(50)    ,DEMISC(50)   ,CHD20740
7DHCOM(50)    ,DHCOMG(50)   ,DHOFM(50)    ,DHSUB(50)    ,DMWGAS(4,50),CHD20750
8DPERMC(50)   ,DPORC(50)    ,DPORV(50)    ,DREORC(50)   ,DREORS(50)   ,CHD20760
9DREORV(4,50),DRHOC(50)    ,DRHOV(50)    ,DSLOPE(50)   ,DTMELT(50)   ,CHD20770
1DTRCHA(50)   ,DMATER(50)   ,XMATER(100,2)              ,TITLE(70)    ,CHD20780
2MELT1(50)    ,MELT2(50)    ,THICK(100)   ,MNODE(100)                 CHD20790
 COMMON /BLOCKM/CARD(14)                                               CHD20800
 COMMON /NASCOM/ DCHARR(5883)                                          CHD20810
 COMMON /DACOM/ A(42),                                                 CHD20820
1ABVAL ,ABVALM,ABVALS,B(42) ,C(42) ,          CC(205),COND(42),       CHD20830
2CONDX ,CONDXX, D(42) ,DD(205),DELTX(101),DGAS,DQ,                     CHD20840
3DTAUC ,DTAUS ,DTAUX ,DTF,DTR(3),EDFX,EDFXX,EMI(42),                   CHD20850
4ETA,ETAS,FHT(42),FHTX,FHTXX,GAGC,GAS1,GK,GX,GY,GZ,                    CHD20860
5HDA(5,10),IBSPM,IERR,IGC,IGL,IGLD,IGR,IGRL,IGT,IG2,                   CHD20870
6IHYS,INEG,IN1,IN2,I3,IPLUS,ITER,ITERT,I4,IY,IZ,J,JBE,                 CHD20880
7JBEM,JBEX,JBND1,JBND2,JBS,JBSM,JBSPM,JBSPN,JBX,JBXX,JCEN,             CHD20890
8JCENM,JCSN,JCSNM,JE,JE1,JE2,JHDN,JHDN1,JLSW,JSLAB,JX,JZ,              CHD20900
9K1,LANDID,LRT,MARK,NADD(42),NASW,NBNDST,NBND1(11),                    CHD20910
1NBSW,NDC,NDCM,NLSW(10),NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW,            CHD20920
2NRID,NRIDC,NRSW(10),NRZON,NSLAB(10),NSLABH(10),NSW,NXSW,              CHD20930
3NZON,NZONC,ONE,PSI,QSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN,                  CHD20940
4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,              CHD20950
5TEMPST(3),THREE,TWO,WFP,WFX,WFXX,XI,XMCOM,XSAVE                       CHD20960
 DIMENSION XQBOLD(1),XNAME(10),ISTOP(10),DALT(1)                       CHD20970
 DIMENSION  DDTAU(1),DDIV(1)                                           CHD20980
 EQUIVALENCE (DTAU,DDTAU(1)),(DIV,DDIV(1))                             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)/1944/    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 O6,1X,8E15.7)                                           CHD21390
      CALL EXIT                                                         CHD21400
      END                                                               CHD21410
```

```
- FOR FLOWS,FLOWS
      SUBROUTINE FLOWS                                                  CHD21420
      COMMON /BLOCKA/                                                   CHD21430
     1ABSORP(10)   ,ABSC         ,ACTEN        ,ACTENS       ,ACTENV(4,10),CHD21440
     2BSTAR        ,CCPC(4)      ,CCPG(4)      ,CHARPT(101)  ,CCC(4)     , CHD21450
     3COEFT(4,10)  ,CONDC        ,CONDV(100)   ,CONST(4,10)  ,COVERX(100) , CHD21460
     4CPBAR        ,CPC          ,CPV(100)     ,DIFREC       ,UMATER(10)   , CHD21470
     5EFCOLC       ,EFCOLS       ,EFCOLV(4,10),EMIS(10)      ,EMISC        , CHD21480
     6HOFM(10)     ,HCOM         ,HCOMG        ,HSUB         ,MAT(100)     , CHD21490
     7MATOMN       ,MATMNF       ,MN           ,NN           ,NNP          , CHD21500
     8NNSAVE       ,NRDIV        ,NREND        ,NRGO         ,NST          , CHD21510
     9PARTIN(101)  ,PHI          ,QBYRAD       ,QCOMB        ,QEXTR        , CHD21520
     10GPCOM       ,QSUBL        ,RECPRO       ,REORDC       ,REORDS       , CHD21530
     2REORDV(4,10),RHO5Z         ,RHOS(305)    ,RHOCPX(101)  ,RHOC         , CHD21540
     3RHOV(10)     ,SAPL         ,SABLC        ,SDOT         ,SDOTC        , CHD21550
     4SLOPE(10)    ,TMELT(10)    ,TSZ          ,TS(205)      ,TRCHAR       , CHD21560
     5WFZ          ,WF(205)      ,XCHAR        ,XINIT        ,XLEFT(101)   , CHD21570
     6XMASS        ,XMDOTC       ,XMDOTD       ,XMDOTG       ,XMDOTL       , CHD21580
     7XMDOTR       ,XMDOTS       ,XTOTAL       ,XVIRG(101)   ,XZONE          CHD21590
      COMMON/BLOCKC/                                                    CHD21600
     1BLPRES(20,11)             ,COMMAX       ,CUTOFF       ,F(20,11)     , CHD21610
     2FLOW(20,11) ,HCONV(20,11),IERROR        ,JUNCT        ,L            , CHD21620
     3N            ,NOSECH       ,QBACK        ,QCONV(20,11),QGAS(20,11) , CHD21630
     4QMISC        ,TIME         ,TPRINT       ,TWALL(20,11),XIWALL(20,11), CHD21640
     5XIR(20,11)                                                        CHD21650
      COMMON /BLOCKJ/                                                   CHD21660
     1FLUXI(200),TEDEP(200),XEDEP(101),EDEP(101),NTEDEP,                CHD21670
     2NXEDEP,ITEPEP,EDFLUX(100)                                         CHD21680
      COMMON /BLOCKK/NN1,QCOND(205)                                     CHD21690
      COMMON/BLOCKN/COORD                                               CHD21700
      COMMON/BLOCKR/DIFC(4),EROC(4),ERODE                               CHD21710
      COMMON /CHCOM/ DTAU,     IBE(10),     IBS(10),     IBSPN,         CHD21720
     1IGTYP(10),   IHDN(4),     IM,          IZB(3),      IZG(3,10),     CHD21730
     2IZGT(3),     JRSW,        NCSN(10),    NSHL(3),     NSHR(3),       CHD21740
     3NZFN(3),     NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),     CHD21750
     4I            ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),     CHD21760
     5             DELX(100),DISTL(100),DUM  (10),ICOM,                 CHD21770
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,                 CHD21780
     7SCHECK                                                            CHD21790
      COMMON /NUCOM/ DX(205),XNHD(205),NADA(42),MATA(205),              CHD21800
     1EM(42)                                                            CHD21810
      COMMON /DACOM/ A(42),                                             CHD21820
     1ABVAL ,ABVALM,ABVALS,B(42) ,C(42) ,          CC(205),COND(42),    CHD21830
     2CONDX ,CONDXX, D(42) ,DD(205),DELTX(101),DGAS,DQ,                 CHD21840
     3DTAUC ,DTAUS ,DTAUX ,DTF,DTR(3),FDFX,EDFXX,EMI(42),               CHD21850
     4ETA,ETAS,FHT(42),FHTX,FHTXX,GAGC,GAS1,GK,GX,GY,GZ,                CHD21860
     5HDA(5,10),IBSPM,IERR,IGC,IGL,IGLD,IGR,IGRL,IGT,IG2,               CHD21870
     6IHYS,INEG,IN1,IN2,IP,IPLUS,ITER,ITERT,IX,IY,IZ,J,JBE,             CHD21880
     7JBEM,JBEX,JBND1,JBND2,JBS,JBSM,JBSPM,JBSPN,JBX,JBXX,JCEN,         CHD21890
     8JCENM,JCSN,JCSNM,JE,JE1,JE2,JHDN,JHDN1,JLSW,JSLAB,JX,JZ,          CHD21900
     9K1,LANDID,LRT,MARK,NADD(42),NASW,NBNDST,NBND1(11),                CHD21910
     1NBSW,NDC,NDCM,NLSW(10),NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW,        CHD21920
     2NRID,NRIDC,NRSW(10),NRZON,NSLAB(10),NSLABH(10),NSW,NXSW,          CHD21930
     3NZON,NZONC,ONE,PSI,QSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN,              CHD21940
     4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,          CHD21950
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     5TEMPST(3),THRFE,TWO,WFP,WFX,WFXX,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(20CHD21990
     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(JBEX)                                            CHD22150
      PERM2(JBS)=PERM2(JBEX)                                            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-1CHD22270
     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),JPSW                                          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))*DELTAX(K)/12.                                                  CHD22510
    PRG(J)=SQRT(DSQ)                                                    CHD22520
    SPEED(J)=WF(J)*GCON*TEMPA1(J)/(    EMWT(J)*PRG(J)*POR(J)+1.E-15)    CHD22530
160 CONTINUE                                                            CHD22540
    DO 165 J=JBS,JBE                                                    CHD22550
    TEMPA=TEMPA1(J)**1.5                                                CHD22560
    TEMPB=TEMPA1(J)**2                                                  CHD22570
    DIFR(J)=.37803E-4*TEMPA/((PRG(J)+1.E-15)*EXP(-.1257E-3*TEMPA1(J)    CHD22580
   1+.6110E-8*TEMPB))*POR(J)                                            CHD22590
    DIFCH(J) =.67627E-4*TEMPA/((PRG(J)+1.E-15)*EXP(-.1847E-3*TEMPA1(J)CHD22600
   1+.1319E-7*TEMPB))*POR(J)                                            CHD22610
165 CONTINUE                                                            CHD22620
170 CONTINUE                                                            CHD22630
    PREFNT=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
      KDELT=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=KDELT+1
      IF(XRAY(KSAVE)-XRAY(1))80,20,120
 80   CONTINUE
      KSAVE=-KSAVE
 120  CONTINUE
      KSUBJ=IABS(KSAVE)
      KSUBI=KSUBJ-KDELT
      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=-KDELT
      KLIMIT=KDELT+1
      GO TO 140
 220  CONTINUE
      KSUB=KSUBI
      IF(FACTDX)320,300,280
 240  CONTINUE
      KPATH=KDELT
      KLIMIT=KDELT*(KPTS-1)+1
 260  CONTINUE
      KSUB=KSUBJ
      IF(FACTDX)280,300,320
 280  CONTINUE
      IF(KSUB-KLIMIT)140,320,140
 300  CONTINUE
      FONEV=Y2
```

```
      GO TO 340                                                         CHD23230
320   CONTINUF                                                          CHD23240
      X1=XRAY(KSUBI)                                                    CHD23250
      Y1=YRAY(KSUBI)                                                    CHD23260
      DXI=X2-X1                                                         CHD23270
      FONEV=-(Y2-Y1)/DXI*DX+Y2                                          CHD23280
340   CONTINUE                                                          CHD23290
      ISAVE=ISIGN(KSUB,KSAVE)                                           CHD23300
      RETURN                                                            CHD23310
1000  FORMAT(1H1,22HFONEV - IND VARIABLE =,E18.7)                       CHD23320
      END                                                               CHD23330
```

```
- FOR FREC,FREC
      FUNCTION FREC(RK,REORDC,RDUM,BDUM)                                CHD23340
      FREC=RDUM/(RDUM*BDUM+RK**(REORDC-1.)*(RK+1.))                     CHD23350
      RETURN                                                            CHD23360
      END                                                               CHD23370
```

```
- FOR FRONT,FRONT
      SUBROUTINE FRONT                                                  CHD23380
C****    THE FRONT SUBROUTINE DETERMINES IF FRONT NODE IS DROPPED OR    CHD23390
C**** COMBINED                                                          CHD23400
      DIMENSION NHDN(3), RHO4(306)                                      CHD23410
      DIMENSION DELTAX(1), TEMPA1(1)                                    CHD23420
      COMMON /BLOCKA/                                                   CHD23430
     1ABSORP(10)  ,ABSC        ,ACTENC      ,ACTENS      ,ACTENV(4,10), CHD23440
     2BSTAR       ,CCPC(4)     ,CCPG(4)     ,CHARPT(101) ,CKC(4)      , CHD23450
     3COEFT(4,10) ,CONDC       ,CONDV(100)  ,CONST(4,10) ,COVERX(100) , CHD23460
     4CPBAR       ,CPC         ,CPV(100)    ,DIFREC      ,UMATER(10)  , CHD23470
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)    ,EMISC       , CHD23480
     6HOFM(10)    ,HCOM        ,HCOMG       ,HSUB        ,MAT(100)    , CHD23490
     7MATOMN      ,MATMNE      ,MN          ,NN          ,NNP         , CHD23500
     8NNSAVE      ,NRDIV       ,NREND       ,NRGO        ,NST         , CHD23510
     9PARTIN(101) ,PHI         ,QBYRAD      ,QCOMB       ,QEXTR       , CHD23520
     1QGPCOM      ,QSUBL       ,RECPRO      ,REORDC      ,REORDS      , CHD23530
     2REORDV(4,10),RHO5Z       ,RHO5(305)   ,RHOCPX(101) ,RHOC        , CHD23540
     3RHOV(10)    ,SABL        ,SABLC       ,SDOT        ,SDOTC       , CHD23550
     4SLOPE(10)   ,TMELT(10)   ,TSZ         ,TS(205)     ,TRCHAR      , CHD23560
     5WFZ         ,WF(205)     ,XCHAR       ,XINIT       ,XLEFT(101)  , CHD23570
     6XMASS       ,XMDOTC      ,XMDOTD      ,XMDOTG      ,XMDOTL      , CHD23580
     7XMDOTR      ,XMDOTS      ,XTOTAL      ,XVIRG(101)  ,XZONE         CHD23590
      COMMON/BLOCKC/                                                    CHD23600
     1BLPRES(20,11)            ,COMMAX      ,CUTOFF      ,F(20,11)    , CHD23610
     2FLOW(20,11) ,HCONV(20,11),IERROR      ,JUNCT       ,L           , CHD23620
     3N           ,NOSECH      ,QBACK       ,QCONV(20,11),QGAS(20,11) , CHD23630
     4QMISC       ,TIME        ,TPRINT      ,TWALL(20,11),XIWALL(20,11), CHD23640
     5XIR(20,11)                                                        CHD23650
      COMMON /CHCOM/ DTAU,     IBE(10),     IBS(10),     IBSPN,         CHD23660
     1IGTYP(10),  IHDN(4),     IM,          IZB(3),      IZG(3,10),     CHD23670
     2IZGT(3),    JRSW,        NCSN(10),    NSHL(3),     NSHR(3),       CHD23680
     3NZEN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),     CHD23690
     4I           ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),     CHD23700
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                 CHD23710
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,                 CHD23720
     7SCHECK                                                            CHD23730
      EQUIVALENCE (IHDN(2),NHDN(1))                                     CHD23740
      EQUIVALENCE (RHO3(103),RHO4(1))                                   CHD23750
      EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))               CHD23760
      EQUIVALENCE (MNOD,NNP)                                            CHD23770
      IF (MAT(MNOD-2)-MAT(MNOD-1)) 310,320,310                          CHD23780
  310 NCUT = NCUT+2                                                     CHD23790
  320 IF (NZEN(NLZON)-NZSN(NLZON)-1) 330,340,330                        CHD23800
  330 ICOM = 1                                                          CHD23810
      GO TO 390                                                         CHD23820
  340 IF (NLZON-1) 350,350,360                                          CHD23830
  350 ICOM = 4                                                          CHD23840
      GO TO 390                                                         CHD23850
  360 IF (NZSN(NLZON)-NZEN(NLZON-1)) 370,380,370                        CHD23860
  370 ICOM = 3                                                          CHD23870
      GO TO 390                                                         CHD23880
  380 ICOM = 2                                                          CHD23890
  390 GO TO (420,420,400,430),NCUT                                      CHD23900
  400 NCUT = 1                                                          CHD23910
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      IF (ICOM-2) 415,415,410                                           CHD23920
  410 CALL SHIFT1 (NLZON,LFT,-1)                                        CHD23930
  415 RETURN                                                            CHD23940
 420  CONTINUE                                                          CHD23950
      CALL COMBIN                                                       CHD23960
  430 NCUT = 1                                                          CHD23970
      GO TO (440,450,460,460),ICOM                                      CHD23980
  440 MG = MG-1                                                         CHD23990
      IZGT(NLZON) = IZGT(NLZON)-1                                       CHD24000
      NZFN(NLZON) = NZFN(NLZON)-1                                       CHD24010
      GO TO 490                                                         CHD24020
  450 NLZON = 1                                                         CHD24030
      MG = MG-1                                                         CHD24040
      GO TO 490                                                         CHD24050
  460 IF (NCEN(MG-1)-NCSN(MG-1)-1) 470,470,480                          CHD24060
  470 IBS(MG-1) = IBS(MG)                                               CHD24070
      IBE(MG-1) = IBE(MG)                                               CHD24080
      IZG(NLZON,1) = MG-1                                               CHD24090
      NZFN(NLZON) = NZSN(NLZON)                                         CHD24100
      NZSN(NLZON) = NZSN(NLZON)-1                                       CHD24110
      MG = MG-1                                                         CHD24120
      GO TO 490                                                         CHD24130
  480 NZFN(NLZON) = NZSN(NLZON)                                         CHD24140
      NZSN(NLZON) = NZSN(NLZON)-1                                       CHD24150
      NCFN(MG) = NCSN(MG)                                               CHD24160
      NCSN(MG) = NCSN(MG)-1                                             CHD24170
      NCEN(MG-1) = NCEN(MG-1)-1                                         CHD24180
      IBE(MG-1) = IBE(MG-1)-1                                           CHD24190
  490 CONTINUE                                                          CHD24200
      ND(1) = ND(1)-1                                                   CHD24210
      XLEFT(NN) = XLEFT(IYS)+SN1                                        CHD24220
      MNOD = NN                                                         CHD24230
      NN = NN-1                                                         CHD24240
      IYS = ND(1)                                                       CHD24250
      SCHECK = 0.5*DELX(IYS)                                            CHD24260
      SN1 = XLEFT(MNOD)-XLEFT(IYS)                                      CHD24270
      DISTL(IYS) = 0.                                                   CHD24280
      DISTL(MNOD) = 1.                                                  CHD24290
      DELX(IYS)=1.                                                      CHD24300
      RETURN                                                            CHD24310
      END                                                               CHD24320
```

```
- FOR GPCOM,GPCOM
      SUBROUTINE GPCOM                                                  CHD24330
      COMMON /BLOCKA/                                                   CHD24340
     1ABSORP(10)   ,ABSC         ,ACTENC       ,ACTENS       ,ACTENV(4,10), CHD24350
     2BSTAR        ,CCPC(4)      ,CCPG(4)      ,CHARPT(101)  ,CKC(4)      , CHD24360
     3COEFT(4,10)  ,CONDC        ,CONDV(100)   ,CONST(4,10)  ,COVERX(100) , CHD24370
     4CPBAR        ,CPC          ,CPV(100)     ,DIFREC       ,UMATER(10)   , CHD24380
     5EFCOLC       ,EFCOLS       ,EFCOLV(4,10),EMIS(10)      ,EMISC        , CHD24390
     6HOFM(10)     ,HCOM         ,HCOMG        ,HSUB         ,MAT(100)     , CHD24400
     7MATOMN       ,MATMNF       ,MN           ,NN           ,NNP          , CHD24410
     8NNSAVF       ,NRDIV        ,NREND        ,NRGO         ,NST          , CHD24420
     9PARTIN(101)  ,PHI          ,QBYRAD       ,QCOMB        ,QEXTR        , CHD24430
     1QGPCOM       ,QSUBL        ,RECPRO       ,REORDC       ,REORDS       , CHD24440
     2REORDV(4,10),RHOSZ         ,RHOS(305)    ,RHOCPX(101)  ,RHOC         , CHD24450
     3RHOV(10)     ,SABL         ,SABLC        ,SDOT         ,SDOTC        , CHD24460
     4SLOPE(10)    ,TMELT(10)    ,TSZ          ,TS(205)      ,TRCHAR       , CHD24470
     5WFZ          ,WF(205)      ,XCHAR        ,XINIT        ,XLEFT(101)   , CHD24480
     6XMASS        ,XMDOTC       ,XMDOTD       ,XMDOTG       ,XMDOTL       , CHD24490
     7XMODTR       ,XMDOTS       ,XTOTAL       ,XVIRG(101)   ,XZONE          CHD24500
      COMMON /BLOCKC/                                                   CHD24510
     1PLPRES(20,11)            ,COMMAX       ,CUTOFF       ,F(20,11)     , CHD24520
     2FLOW(20,11) ,HCONV(20,11),IERROR       ,JUNCT        ,L            , CHD24530
     3N            ,NOSECH      ,QBACK        ,QCONV(20,11),QGAS(20,11)  , CHD24540
     4QMISC        ,TIME        ,TPRINT       ,TWALL(20,11),XIWALL(20,11), CHD24550
     5XIR(20,11)                                                        CHD24560
      IF (TIME-450.) 10,20,20                                           CHD24570
   10 CONTINUE                                                          CHD24580
      XKOE=.23144                                                       CHD24590
      XMDOTO=PHI*HCONV(N,L)*XKOE                                        CHD24600
      XMDOTB=XKOE*DIFREC*XMDOTG/(BSTAR+1.E-10)                          CHD24610
      QGPCOM=HCOMG*AMIN1(XMDOTO,XMDOTB)                                 CHD24620
      RETURN                                                            CHD24630
   20 CONTINUE                                                          CHD24640
      QGPCOM=0.                                                         CHD24650
      RETURN                                                            CHD24660
      END                                                               CHD24670
```

```
- EOF GRIN,GRIN
      SUBROUTINE GRIN(IG)                                               CHD24680
C****    CHARM SUBROUTINE IN CHAP  --JULY 1966 VERSION                  CHD24690
C     LISTING FOR GAUDETTE 8528 TAPE                                    CHD24700
      COMMON /BLOCKA/                                                   CHD24710
     1ABSORD(10)  ,ABSC        ,ACTENC       ,ACTENS       ,ACTENV(4,10), CHD24720
     2BSTAR       ,CCPC(4)     ,CCPG(4)      ,CHARPT(101)  ,CKC(4)      , CHD24730
     3COEFT(4,10) ,CONDC       ,CONDV(100)   ,CONST(4,10)  ,COVERX(100) , CHD24740
     4CPBAR       ,CPC         ,CPV(100)     ,DIFREC       ,UMATER(10)  , CHD24750
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)      ,EMISC       , CHD24760
     6HOFM(10)    ,HCOM        ,HCOMG        ,HSUB         ,MAT(100)    , CHD24770
     7MATOMN      ,MATMNF      ,MN           ,NN           ,NNP         , CHD24780
     8NNSAVE      ,NRDIV       ,NREND        ,NRGO         ,NST         , CHD24790
     9PARTIN(101) ,PHI         ,QBYRAD       ,QCOMB        ,QEXTR       , CHD24800
     1QGPCOM      ,QSUBL       ,RECPRO       ,REORDC       ,REORDS      , CHD24810
     2REORDV(4,10),RHOSZ       ,RHOS(305)    ,RHOCPX(101)  ,RHOC        , CHD24820
     3RHOV(10)    ,SABL        ,SABLC        ,SDOT         ,SDOTC       , CHD24830
     4SLOPE(10)   ,TMELT(10)   ,TSZ          ,TS(205)      ,TRCHAR      , CHD24840
     5WFZ         ,WF(205)     ,XCHAR        ,XINIT        ,XLEFT(101)  , CHD24850
     6XMASS       ,XMDOTC      ,XMDOTD       ,XMDOTG       ,XMDOTL      , CHD24860
     7XMDOTR      ,XMDOTS      ,XTOTAL       ,XVIRG(101)   ,XZONE         CHD24870
      COMMON/BLOCKC/                                                    CHD24880
     1BLPRES(20,11)            ,COMMAX       ,CUTOFF       ,F(20,11)    , CHD24890
     2FLOW(20,11) ,HCONV(20,11),IERROR       ,JUNCT        ,L           , CHD24900
     3N           ,NOSECH      ,QBACK        ,QCONV(20,11),QGAS(20,11)  , CHD24910
     4QMISC       ,TIME        ,TPRINT       ,TWALL(20,11),XIWALL(20,11), CHD24920
     5XIR(20,11)                                                        CHD24930
      COMMON /BLOCKJ/                                                   CHD24940
     1FLUXI(200),TEDEP(200),XEDEP(101),EDEP(101),NTEDEP,                CHD24950
     2NXEDEP,ITEPEP,EDFLUX(100)                                         CHD24960
      COMMON /BLOCKK/NN1,QCOND(205)                                     CHD24970
      COMMON/BLOCKN/COORD                                               CHD24980
      COMMON/BLOCKR/DIFC(4),EROC(4),ERODE                               CHD24990
      COMMON /CHCOM/ DTAU,     IBE(10),     IBS(10),     IBSPN,         CHD25000
     1IGTYP(10),  IHDN(4),     IM,          IZB(3),      IZG(3,10),     CHD25010
     2IZGT(3),    JRSW,        NCSN(10),    NSHL(3),     NSHR(3),       CHD25020
     3NZEN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),     CHD25030
     4I           ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),     CHD25040
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                  CHD25050
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,                 CHD25060
     7SCHECK                                                            CHD25070
      COMMON /DACOM/ A(42),                                             CHD25080
     1ABVAL ,ABVALM,ABVALS,B(42) ,C(42) ,          CC(205),COND(42),    CHD25090
     2CONDX ,CONDXX, D(42) ,DD(205),DELTX(101),DGAS,DQ,                 CHD25100
     3DTAUC ,DTAUS ,DTAUX ,DTF,DTR(3),EDFX,EDFXX,FMI(42),               CHD25110
     4ETA,ETAS,FHT(42),FHTX,FHTXX,GAGC,GAS1,GK,GX,GY,GZ,                CHD25120
     5HDA(5,10),IBSPM,IERR,IGC,IGL,IGLD,IGR,IGRL,IGT,IG2,               CHD25130
     6IHYS,INEG,IN1,IN2,IP,IPLUS,ITER,ITERT,IX,IY,IZ,J,JBE,             CHD25140
     7JBEM,JBEX,JBND1,JBND2,JBS,JBSM,JBSPM,JBSPN,JBX,JBXX,JCEN,         CHD25150
     8JCENM,JCSN,JCSNM,JE,JE1,JE2,JHDN,JHDN1,JLSW,JSLAB,JX,JZ,          CHD25160
     9K1,LANDID,LRT,MARK,NADD(42),NASW,NBNDST,NBND1(11),                CHD25170
     1NBSW,NDC,NDCM,NLSW(10),NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW,        CHD25180
     2NRID,NRIDC,NRSW(10),NRZON,NSLAB(10),NSLABH(10),NSW,NXSW,          CHD25190
     3NZON,NZONC,ONE,PSI,QSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN,              CHD25200
     4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,          CHD25210
```

```
STEMPST(3),THREE,TWO,WFP,WFX,WFXX,XI,XMCOM,XSAVE                    CHD25220
 DIMENSION NBND2(10),NHDN(3)                                        CHD25230
 EQUIVALENCE (NBND1(2),NBND2(1))                                    CHD25240
 EQUIVALENCE (IHDN(2),NHDN(1))                                      CHD25250
 JBS = IBS(IG)                                                      CHD25260
 JBSM = JBS-1                                                       CHD25270
 JLSW = NLSW(IG)                                                    CHD25280
 JRSW = NRSW(IG)                                                    CHD25290
 JE1 = NSLABH(IG)                                                   CHD25300
 JE = JE1+1                                                         CHD25310
 JE2 = JE1-1                                                        CHD25320
 JBND1 = NBND1(IG)-3                                                CHD25330
 JBND2 = NBND2(IG)                                                  CHD25340
 IGL = IG-1                                                         CHD25350
 JBE = IBE(IG)                                                      CHD25360
 JBEM = JBE-1                                                       CHD25370
 JCSN = NCSN(IG)                                                    CHD25380
 JCEN = NCEN(IG)                                                    CHD25390
 JCSNM=JCSN-1                                                       CHD25400
 JCENM = JCEN-1                                                     CHD25410
 IGC = IGTYP(IG)                                                    CHD25420
 JHDN = NHDN(IGC)                                                   CHD25430
 JSLAB = NSLAB(IG)                                                  CHD25440
 JBSPM = IBSPN+JCSN                                                 CHD25450
 JBSPN = JBSPM-1                                                    CHD25460
 RETURN                                                             CHD25470
 END                                                                CHD25480
```

```
- ASM INIT,INIT
        REGNAM                                                          CHD25490
$(1),INIT* SX,1 B11,SAVE                                                CHD25500
        M$SEA   MIDOF$,+(SLJ STUFF2)                                    CHD25510
        M$SEA   MIERR$,+(J DIAG7)                                       CHD25520
SAVE    J       0                                                       CHD25530
        END     .                                                       CHD25540
```

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

```
- FOR IWR,IWR
      SUBROUTINE IWR(Z,T,XI)                                            CHD25790
      A=5400./T                                                         CHD25800
      A=(2.-Z)*(2.5+A/(EXP(A)-1.))                                      CHD25810
      B=3.+106200./T                                                    CHD25820
      IF(Z-1.2)6,6,3                                                    CHD25830
3     IF(Z-2.)5,4,4                                                     CHD25840
4     ZERT=1.5*Z+(304200.*Z-424800.)/T                                  CHD25850
      GO TO 7                                                           CHD25860
5     ZERT=A+.2*B+(Z-1.2)*(3.+203400./T)                                CHD25870
      GO TO 7                                                           CHD25880
6     ZERT=A+(Z-1.)*B                                                   CHD25890
7     XI = .06855*T*(ZERT+Z)                                            CHD25900
      RETURN                                                            CHD25910
      END                                                               CHD25920
```

```
- FOR LLD,LLD
      FUNCTION LLD(J)                                                   CHD25930
      COMMON /CHCOM/ DTAU,     IBF(10),     IBS(10),     IBSDN,         CHD25940
     1IGTYP(10),  IHDN(4),     IM,          IZB(3),      IZG(3,10),     CHD25950
     2IZGT(3),    JRSX,        NCSN(10),    NSHL(3),     NSHR(3),       CHD25960
     3NZSN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),     CHD25970
     4I           ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),      CHD25980
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                  CHD25990
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,                 CHD26000
     7SCHECK                                                            CHD26010
      IF (J-102) 5,6,6                                                  CHD26020
    5 NZON=0                                                            CHD26030
      LLD=J                                                             CHD26040
      RETURN                                                            CHD26050
    6 IF (J-187) 7,8,8                                                  CHD26060
    7 NZON=1                                                            CHD26070
      GO TO 9                                                           CHD26080
    8 NZON=2                                                            CHD26090
    9 K=J-IZB(NZON)                                                     CHD26100
      KK=K/4                                                            CHD26110
      LLD=NZSN(NZON) + KK                                               CHD26120
      RETURN                                                            CHD26130
      END                                                               CHD26140
```

```
- FOR MAIN,MAIN
      COMMON /BLOCKC/ USER(220),COMMAX                                  CHD26150
      COMMON /BLOCKA/ FILL1(627),MAT(100),FILL2(3),NN,NNP,FILL3(5),PARTICHD26153
     1N(101),FILL4(492),TS(205)                                         CHD26157
      COMMON /DACOM/ UPPED(972),NASW,UPSIT(84),TAU1                     CHD26160
      COMMON /TABCOM/ NDOTS(4),TIME1(100),TIME2(100),TIME3(100),        CHD26170
     1TIME4(100),DSTEP(100),PSTEP(100),XRI(100),RH(100),OMU(100),       CHD26180
     2TT(100),PP(100),FF(100),AST(100)                                  CHD26190
      DIMENSION TITLE(12),NAME(2)                                       CHD26195
      TPRINT=0.                                                         CHD26200
      NTABT=0                                                           CHD26210
      TEND=1.E6                                                         CHD26220
      TAU1=0.                                                           CHD26230
      MTO=0                                                             CHD26233
      READ (5,990) TITLE                                                CHD26235
      WRITE (6,992) TITLE                                               CHD26238
    3 CONTINUE                                                          CHD26240
      READ (5,1000) NTAB,NTYP                                           CHD26250
      NTABT=NTABT+1                                                     CHD26260
      I=1                                                               CHD26270
      INFRST=1                                                          CHD26280
    5 CONTINUE                                                          CHD26290
      GO TO (10,20,30,40),NTAB                                          CHD26300
   10 CONTINUE                                                          CHD26310
      READ (5,1010) TIME1(I),DSTEP(I)                                   CHD26320
      TIMEZ = TIME1(I)                                                  CHD26330
      GO TO 50                                                          CHD26340
   20 CONTINUE                                                          CHD26350
      READ (5,1010) TIME2(I),PSTEP(I)                                   CHD26360
      TIMEZ = TIME2(I)                                                  CHD26370
      GO TO 50                                                          CHD26380
   30 CONTINUE                                                          CHD26390
      GO TO (33,36),NTYP                                                CHD26400
   33 READ (5,1010) TIME3(I),XRI(I),RH(I),OMU(I)                        CHD26410
      GO TO 37                                                          CHD26420
   36 READ (5,1010) TIME3(I),TT(I),RH(I)                                CHD26430
   37 TIMEZ=TIME3(I)                                                    CHD26440
      NASW=NTYP                                                         CHD26450
      GO TO 50                                                          CHD26460
   40 CONTINUE                                                          CHD26470
      READ (5,1010) TIME4(I),PP(I),FF(I),AST(I)                         CHD26480
      TIMEZ=TIME4(I)                                                    CHD26490
   50 CONTINUE                                                          CHD26500
      GO TO (62,60),INFRST                                              CHD26510
   60 IF (TIMEZ-TIMEY) 70,70,65                                         CHD26520
   62 INFRST=2                                                          CHD26530
   65 CONTINUE                                                          CHD26540
      I=I+1                                                             CHD26550
      TIMEY=TIMEZ                                                       CHD26560
      GO TO 5                                                           CHD26570
   70 NDOTS(NTAB)=I-1                                                   CHD26580
      TEND=AMIN1(TEND,TIMEY)                                            CHD26590
      IF (NTABT-4) 3,80,80                                              CHD26600
   80 CONTINUE                                                          CHD26610
      NDOTSX=NDOTS(1)                                                   CHD26620
```

```
      WRITE (6,1020) (TIME1(I),DSTEP(I),I=1,NDOTSX)                     CHD26630
      NDOTSX=NDOTS(2)                                                   CHD26640
      WRITE (6,1022) (TIME2(I),PSTEP(I),I=1,NDOTSX)                     CHD26650
      NDOTSX=NDOTS(3)                                                   CHD26660
      GO TO (90,95),NASW                                                CHD26670
   90 CONTINUE                                                          CHD26680
      WRITE (6,1024) (TIME3(I),XRI(I),RH(I),OMU(I),I=1,NDOTSX)          CHD26690
      NDOTSX=NDOTS(4)                                                   CHD26695
      GO TO 98                                                          CHD26700
   95 CONTINUE                                                          CHD26710
      WRITE (6,1026) (TIME3(I),TT(I),RH(I),I=1,NDOTSX)                  CHD26720
      NDOTSX=NDOTS(4)                                                   CHD26730
   98 CONTINUE                                                          CHD26740
      WRITE (6,1028) (TIME4(I),PP(I),FF(I),AST(I),I=1,NDOTSX)           CHD26748
      COMMAX=1.E-6                                                      CHD26749
      WRITE (6,1030)                                                    CHD26750
      NNP=0                                                             CHD26751
   99 CONTINUE                                                          CHD26752
      NN=NNP                                                            CHD26753
      READ (5,1031) MNO,NAME,WIDE,NUMERO                                CHD26754
      IF (MNO) 112,112,110                                              CHD26755
  110 NNP=NNP+NUMERO                                                    CHD26756
      NN=NN+1                                                           CHD26757
      WRITE (6,1033) MNO,NAME,WIDE,NUMERO                               CHD26758
      DWIDE=WIDE/FLOAT(NUMERO)                                          CHD26759
      MTO=MAX0(MTO,MNO)                                                 CHD26760
      DO 111 J=NN,NNP                                                   CHD26761
      MAT(J)=MNO                                                        CHD26762
      PARTIN(J)=DWIDE                                                   CHD26763
  111 CONTINUE                                                          CHD26764
      GO TO 99                                                          CHD26765
  112 NN=NNP                                                            CHD26766
      NNP=NN+1                                                          CHD26767
      READ (5,1032) TS(1)                                               CHD26768
      DO 113 J=1,100                                                    CHD26769
  113 TS(J)=TS(1)                                                       CHD26770
      CALL OUTPUT (MTO)                                                 CHD26771
      GO TO 109                                                         CHD26772
  100 IF (1.00001*TAU1-TPRINT) 104,102,102                              CHD26773
  102 CALL WRITE                                                        CHD26774
      DPRINT=TBSTEP(TPRINT,TIME2,PSTEP,NDOTS(2))                        CHD26780
      TPRINT=TPRINT+DPRINT                                              CHD26790
  104 CONTINUE                                                          CHD26800
      IF (TEND-1.00001*TAU1) 106,106,108                                CHD26810
  106 CALL EXIT                                                         CHD26820
  108 CONTINUE                                                          CHD26830
      DPRINT=,PRINT-TAU1                                                CHD26840
      DTEND=TEND-TAU1                                                   CHD26850
      COMMAX=TBSTEP(TAU1,TIME1,DSTEP,NDOTS(1))                          CHD26860
      COMMAX=AMIN1(COMMAX,DPRINT,DTEND)                                 CHD26870
      SET=1.E-6*TAU1                                                    CHD26880
      COMMAX=AMAX1(COMMAX,SET)                                          CHD26890
  109 CONTINUE                                                          CHD26895
      CALL CHARM                                                        CHD26900
      GO TO 100                                                         CHD26910
```

```
  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/19X4HTIME6X11HTEMPERATUCHD26980
     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                                                  CHD27020
      COMMON /BLOCKA/                                                   CHD27030
     1ABSORP(10)  ,ABSC        ,ACTENC      ,ACTENS      ,ACTENV(4,10), CHD27040
     2BSTAR       ,CCPC(4)     ,CCPG(4)     ,CHARPT(101) ,CKC(4)      , CHD27050
     3COEFT(4,10) ,CONDC       ,CONDV(100)  ,CONST(4,10) ,COVERX(100) , CHD27060
     4CPBAR       ,CPC         ,CPV(100)    ,DIFREC      ,UMATER(10)  , CHD27070
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)    ,EMISC       , CHD27080
     6HOFM(10)    ,HCOM        ,HCOMG       ,HSUB        ,MAT(100)    , CHD27090
     7MATOMN      ,MATMNF      ,MN          ,MN          ,NNP         , CHD27100
     8NNSAVE      ,NRDIV       ,NREND       ,NRGO        ,NST         , CHD27110
     9PARTIN(101) ,PHI         ,QBYRAD      ,QCOMB       ,QEXTR       , CHD27120
     1C PCOM      ,QSUBL       ,RECPRO      ,REORDC      ,REORDS      , CHD27130
     2REORDV(4,10),RHOSZ       ,RHOS(305)   ,RHOCPX(101) ,RHOC        , CHD27140
     3RHOV(10)    ,SABL        ,SABLC       ,SDOT        ,SDOTC       , CHD27150
     4SLOPE(10)   ,TMELT(10)   ,TSZ         ,TS(205)     ,TRCHAR      , CHD27160
     5WFZ         ,WF(205)     ,XCHAR       ,XINIT       ,XLEFT(101)  , CHD27170
     6XMASS       ,XMDOTC      ,XMDOTD      ,XMDOTG      ,XMDOTL      , CHD27180
     7XMDOTR      ,XMDOTS      ,XTOTAL      ,XVIRG(101)  ,XZONE         CHD27190
      COMMON/BLOCKC/                                                    CHD27200
     1PLPRES(20,11)            ,COMMAX      ,CUTOFF      ,F(20,11)    , CHD27210
     2FLOW(20,11) ,HCONV(20,11),IERROR      ,JUNCT       ,L           , CHD27220
     3N           ,NOSECH      ,QBACK       ,QCONV(20,11),QGAS(20,11) , CHD27230
     4QMISC       ,TIME        ,TPRINT      ,TWALL(20,11),XIWALL(20,11), CHD27240
     5XIR(20,11)                                                        CHD27250
      COMMON /BLOCKJ/                                                   CHD27260
     1FLUXI(200),TEDEP(200),XEDEP(101),EDEP(101),NTEDEP,                CHD27270
     2NXEDEP,ITEREP,EDFLUX(100)                                         CHD27280
      COMMON /BLOCKK/NN1,QCOND(205)                                     CHD27290
      COMMON/BLOCKN/COORD                                               CHD27300
      COMMON/BLOCKR/DIFC(4),EROC(4),ERODF                               CHD27310
      COMMON /CHCOM/ DTAU,     IBE(10),     IBS(10),     IBSPN,         CHD27320
     1IGTYP(10),  IHDN(4),     IM,          IZB(3),      IZG(3,10),     CHD27330
     2IZGT(3),    JRSW,        NCSN(10),    NSHL(3),     NSHP(3),       CHD27340
     3NZEN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),     CHD27350
     4I           ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),     CHD27360
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                 CHD27370
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,                 CHD27380
     7SCHECK                                                            CHD27390
      COMMON/NUCOM/ NADA,                                               CHD27400
     1EM(42)                                                            CHD27410
      COMMON /DACOM/ A(42),                                             CHD27420
     1ABVAL ,ABVALM,ABVALS,B(42) ,C(42) ,          CC(205),COND(42),    CHD27430
     2CONDX ,CONDXX, D(42) ,DD(205),DELTX(101),DGAS,DQ,                 CHD27440
     3DTAUC ,DTAUS ,DTAUX ,DTF,DTR(3),EDFX,EDFXX,EMI(42),               CHD27450
     4ETA,ETAS,FHT(42),FHTX,FHTXX,GAGC,GAS1,GK,GX,GY,GZ,                CHD27460
     5HDA(5,10),IBSPM,IERR,IGC,IGL,IGLD,IGR,IGRL,IGT,IG2,               CHD27470
     6IHYS,INEG,IN1,IN2,IP,IPLUS,ITER,ITERT,IX,IY,IZ,J,JBE,             CHD27480
     7JBEM,JBEX,JBND1,JBND2,JBS,JBSM,JBSPM,JBSPN,JBX,JBXX,JCEN,         CHD27490
     8JCENM,JCSN,JCSNM,JE,JE1,JE2,JHDN,JHDN1,JLSW,JSLAB,JX,JZ,          CHD27500
     9K1,LANDID,LRT,MARK,NADD(42),NASW,NBNDST,NBND1(11),                CHD27510
     1NBSW,NDC,NDCM,NLSW(10),NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW,        CHD27520
     2NRID,NRIDC,NRSW(10),NRZON,NSLAB(10),NSLABH(10),NSW,NXSW,          CHD27530
     3NZON,NZONC,ONE,PSI,QSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN,              CHD27540
     4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,          CHD27550
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     5TEMPST(3),THREE,TWO,WFP,WFX,WFXX,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), WDFP(205),WSI(20CHD27590
     35),WBRN(205),EMWT(205),PRG(205)                                    CHD27600
     4,TIMEX(50),TFT(50),NPTS                                            CHD27610
     5,POR(205),PERM1(205),PERM2(205),VISC(205),CCON,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(JBEX)                                           CHD27760
      EMWT(JBS)=EMWT(JBEX)                                               CHD27770
      KK=JBS+1                                                           CHD27780
      GO TO 40                                                           CHD27790
   30 KK=JBS                                                             CHD27800
   40 DO 50 J=KK,JBE                                                     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=IBS(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)                                                 CHD28030
C****    THE PCAPF SUBROUTINE CALCULATES THE DENSITY-SPECIFIC HEAT PRODUCHD28040
      DIMENSION NHDN(3), RHO4(306)                                      CHD28050
      DIMENSION DELTAX(1), TEMPA1(1)                                    CHD28060
      COMMON /BLOCKA/                                                   CHD28070
     1ABSORP(10)  ,ABSC        ,ACTENC      ,ACTENS      ,ACTENV(4,10), CHD28080
     2BSTAR       ,CCPC(4)     ,CCPG(4)     ,CHARPT(101) ,CKC(4)      , CHD28090
     3COEFT(4,10) ,CONDC       ,CONDV(100)  ,CONST(4,10) ,COVERX(100) , CHD28100
     4CPBAR       ,CPC         ,CDUM(100)   ,DIFREC      ,UMATER(10)   , CHD28110
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)    ,EMISC        , CHD28120
     6HOFM(10)    ,HCOM        ,HCOMG       ,HSUB        ,MAT(100)     , CHD28130
     7MATOMN      ,MATMNF      ,MN          ,NN          ,NNP          , CHD28140
     8NNSAVE      ,NRDIV       ,NREND       ,NRGO        ,NST          , CHD28150
     9PARTIN(101) ,PHI         ,QBYRAD      ,QCOMB       ,QEXTR        , CHD28160
     10GPCOM      ,QSUBL       ,RECPRO      ,REORDC      ,REORDS       , CHD28170
     2REORDV(4,10),RHO5Z       ,RHO5(305)   ,RHOGPX(101) ,RHOC         , CHD28180
     3RHOV(10)    ,SABL        ,SABLC       ,SDOT        ,SDOTC        , CHD28190
     4SLOPE(10)   ,TMELT(10)   ,TSZ         ,TS(205)     ,TRCHAR       , CHD28200
     5WFZ         ,WF(205)     ,XCHAR       ,XINIT       ,XLEFT(101)   , CHD28210
     6XMASS       ,XMDOTC      ,XMDOTD      ,XMDOTG      ,XMDOTL       , CHD28220
     7XMDOTR      ,XMDOTS      ,XTOTAL      ,XVIRG(101)  ,XZONE          CHD28230
      COMMON/BLOCKC/                                                    CHD28240
     1BLPRES(20,11)            ,COMMAX      ,CUTOFF      ,F(20,11)     , CHD28250
     2FLOW(20,11) ,HCONV(20,11),IERROR      ,JUNCT       ,L            , CHD28260
     3N           ,NOSECH      ,QBACK       ,QCONV(20,11),QGAS(20,11)  , CHD28270
     4QMISC       ,TIME        ,TPRINT      ,TWALL(20,11),XIWALL(20,11), CHD28280
     5XIR(20,11)                                                        CHD28290
      COMMON /CFCOM/ DTAU,     IBE(10),     IBS(10),     IBSPN,         CHD28300
     1IGTYP(10),  IHDN(4),     IM,          IZB(3),      IZG(3,10),     CHD28310
     2IZGT(3),    JRSW,        NCSN(10),    NSHL(3),     NSHR(3),       CHD28320
     3NZEN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),     CHD28330
     4I           ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),     CHD28340
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                 CHD28350
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,                 CHD28360
     7SCHECK                                                            CHD28370
      COMMON /DACOM/ A(42),                                             CHD28380
     1ABVAL  ,ABVALM,ABVALS,B(42) ,C(42) ,          CC(205),COND(42),   CHD28390
     2CONDX  ,CONDXX, D(42) ,DD(205),DELTX(101),DGAS,DQ,                CHD28400
     3DTAUC  ,DTAUS  ,DTAUX  ,DTF,DTR(3),EDFX,EDFXX,EMI(42),            CHD28410
     4ETA,ETAS,FHT(42),FHTX,FHTXX,GAGC,GAS1,GK,GX,GY,GZ,                CHD28420
     5HDA(5,10),IBSPM,IERR,IGC,IGL,IGLD,IGR,IGRL,IGT,IG2,               CHD28430
     6IHYS,INEG,IN1,IN2,IP,IPLUS,ITER,ITERT,IX,IY,IZ,J,JBE,             CHD28440
     7JBEM,JBEX,JBND1,JBND2,JBS,JBSM,JBSPM,JBSPN,JBX,JBXX,JCEN,         CHD28450
     8JCENM,JCSN,JCSNM,JE,JE1,JE2,JHDN,JHDN1,JLSW,JSLAB,JX,JZ,          CHD28460
     9K1,LANDID,LRT,MARK,NADD(42),NASW,NBNDST,NBND1(11),                CHD28470
     1NBSW,NDC,NDCM,NLSW(10),NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW,        CHD28480
     2NRID,NRIDC,NRSW(10),NRZON,NSLAB(10),NSLABH(10),NSW,NXSW,          CHD28490
     3NZON,NZONC,ONE,PSI,QSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN,              CHD28500
     4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,          CHD28510
     5TEMPST(3),THREE,TWO,WFP,WFX,WFXX,XI,XMCOM,XSAVE                   CHD28520
      COMMON /NASCOM/ CHARRO,AIRM,                                      CHD28530
     1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)CHD28540
     2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205), WDEP(205),WSI(20CHD28550
     35),WBRN(205),EMWT(205),PRG(205)                                   CHD28560
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  4,TIMEX(50),TFT(50),NPTS                                              CHD28570
  5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS,    CHD28580
  6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,CHD28590
  7CFXPY,CFXDP,CFXS  CFXCM,CF)N,DIFCO(205),SOX(205)                     CHD28600
  8,ALLGAS(205),GRA    205)                                             CHD28610
   EQUIVALENCE (IHD    ),NHDN(1))                                       CHD28620
   EQUIVALENCE (RHO3(103),RHO4(1))                                      CHD28630
   EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))                  CHD28640
   EQUIVALENCE (MNOD,NNP)                                               CHD28650
   IMENSION AREA(42),AREAV(42)                                          CHD28660
   EQUIVALENCE (RHOCPX(44),AREA(1),AREAV(43))                           CHD28670
   KL=JBSM+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,I)+TEMPA3(K)*(COEFT(2,I)+TEMPA3(K)*                    CHD28730
  1(COEFT(3,I)+TEMPA3(K)*COEFT(4,I)))                                   CHD28740
   CPV=CPV*RHO3(K)/RHOV(I)                                              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
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- ASM PICKUP,PICKUP
PICKUP* S       A0,WORK                 SAVE A0                                CHD28830
        L       A0,1,B11                SET ADDR TO FILL                       CHD28840
        S,HL    A0,PICK1                                                       CHD28850
        L       A0,*0,B11               PICK UP LOC TO PICKUP                  CHD28860
       S,HL     A0,PICK2          . SET ADDR TO PICKUP                         CHD28870
PICK2   L       A0,$-$                  PICKUP CONTENTS                        CHD28880
PICK1   S       A0,$-$                  MOVE                                   CHD28890
        L       A0,WORK                 RESTORE A0                             CHD28900
        J       2,B11                   RETURN                                 CHD28910
WORK    RES     1                                                              CHD28920
        JFACTO                                                                 CHD28930
        REGNAM                                                                 CHD28940
        END     .                                                              CHD28950
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- FOR PORO,PORO
      SUBROUTINE PORC                                                   CHD28960
      COMMON /BLOCKA/                                                   CHD28970
     1ABSORP(10)  ,ABSC        ,ACTENC      ,ACTENS      ,ACTENV(4,10), CHD28980
     2BSTAR       ,CCPC(4)     ,CCPG(4)     ,CHARPT(101) ,CKC(4)      , CHD28990
     3COEFT(4,10) ,CONDC       ,CONDV(100)  ,CONST(4,10) ,COVERX(100) , CHD29000
     4CPBAR       ,CPC         ,CPV(100)    ,DIFREC      ,UMATER(10)  , CHD29010
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)    ,EMISC       , CHD29020
     6HOFM(10)    ,HCOM        ,HCOMG       ,HSUB        ,MAT(100)    , CHD29030
     7MATOMN      ,MATMNE      ,MN          ,NN          ,NNP         , CHD29040
     8NNSAVE      ,NRDIV       ,NREND       ,NRGO        ,NST         , CHD29050
     9PARTIN(101) ,PHI         ,QBYRAD      ,QCOMB       ,QEXTR       , CHD29060
     1QGPCOM      ,QSUBL       ,RECPRO      ,REORDC      ,REORDS      , CHD29070
     2RECORDV(4,10),RHO5Z      ,RHO5(305)   ,RHOCPX(101) ,RHOC        , CHD29080
     3RHOV(10)    ,SABL        ,SABLC       ,SDOT        ,SDOTC       , CHD29090
     4SLOPE(10)   ,TMELT(10)   ,TSZ         ,TS(205)     ,TRCHAR      , CHD29100
     5WFZ         ,WF(205)     ,XCHAR       ,XINIT       ,XLEFT(101)  , CHD29110
     6XMASS       ,XMDOTC      ,XMDOTD      ,XMDOTG      ,XMDOTL      , CHD29120
     7XMDOTR      ,XMDOTS      ,XTOTAL      ,XVIRG(101)  ,XZONE         CHD29130
      COMMON/BLOCKC/                                                    CHD29140
     1BLPRES(20,11)            ,COMMAX      ,CUTOFF      ,F(20,11)    , CHD29150
     2FLOW(20,11) ,HCONV(20,11),IERROR      ,JUNCT       ,L           , CHD29160
     3N           ,NOSECH      ,QBACK       ,QCONV(20,11),QGAS(20,11) , CHD29170
     4QMISC       ,TIME        ,TPRINT      ,TWALL(20,11),XIWALL(20,11), CHD29180
     5XIR(20,11)                                                        CHD29190
      COMMON /BLOCKJ/                                                   CHD29200
     1FLUXI(200),TEDEP(200),XEDEP(101),EDEP(101),NTEDEP,                CHD29210
     2NXEDEP,ITEPEP,EDFLUX(100)                                         CHD29220
      COMMON /BLOCKK/NN1,QCOND(205)                                     CHD29230
      COMMON/BLOCKN/CCORD                                               CHD29240
      COMMON/BLOCKR/DIFC(4),EROC(4),ERODE                               CHD29250
      COMMON /CHCOM/ DTAU,     IBE(10),     IBS(10),     IBSPN,         CHD29260
     1IGTYP(10),  IHDN(4),     IM,          IZB(3),      IZG(3,10),     CHD29270
     2IZGT(3),    JRSW,        NCSN(10),    NSHL(3),     NSHR(3),       CHD29280
     3NZEN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),     CHD29290
     4I           ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),     CHD29300
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                 CHD29310
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,                 CHD29320
     7SCHECK                                                            CHD29330
      COMMON /NUCOM/ DX(205),XNHD(205),NADA(42),MATA(205),              CHD29340
     1EM(42)                                                            CHD29350
      COMMON /DACOM/ A(42),                                             CHD29360
     1ABVAL  ,ABVALM,ABVALS,B(42) ,C(42) ,          CC(205),COND(42),   CHD29370
     2CONDX  ,CONDXX, D(42) ,DD(205),DELTX(101),DGAS,DO,                CHD29380
     3DTAUC  ,DTAUS  ,DTAUX  ,DTF,DTR(3),EDFX,EDFXX,EMI(42),            CHD29390
     4ETA,ETAS,FHT(42),FHTX,FHTXX,GAGC,GAS1,GK,GX,GY,GZ,                CHD29400
     5HDA(5,10),IBSPM,IERR,IGC,IGL,IGLD,IGR,IGRL,IGT,IG2,               CHD29410
     6IHYS,INEG,IN1,IN2,IP,IPLUS,ITER,ITERT,IX,IY,IZ,J,JBE,             CHD29420
     7JBEM,JBEX,JBND1,JBND2,JBS,JBSM,JBSPM,JBSPN,JBX,JBXX,JCEN,         CHD29430
     8JCENM,JCSN,JCSNM,JE,JE1,JE2,JHDN,JHDN1,JLSW,JSLAB,JX,JZ,          CHD29440
     9K1,LANDID,LRT,MARK,NADD(42),NASW,NBNDST,NBND1(11),                CHD29450
     1NBSW,NDC,NDCM,NLSW(10),NOF,NOTIME,NPBSW,NPE1N,NPS2N,NPTSW,        CHD29460
     2NRID,NRIDC,NRSW(10),NRZON,NSLAB(10),NSLABH(10),NSW,NXSW,          CHD29470
     3NZON,NZONC,ONE,PSI,QSAVE,QTOT,QTOTAL,REFCTR,SBK,SDN,              CHD29480
     4SDOTN,SNS,SRA,TAR,TAUOUT,TAUST(3),TAU1,TAU2,TAU2S,TEMPA,          CHD29490
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     5TEMPST(2),THREE,TWO,WED,WEX,WEXX,XI,XMCOM,XSAVE                   CHD29500
      COMMON /NASCOM/ CHARRO,AIRM,                                      CHD29510
     1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)CHD29520
     2,HYD(205),AERO(205),AERN(205),BURN(205),WED(205), WDEP(205),WSI(20CHD29530
     35),WBRN(205),EMWT(205),PRG(205)                                   CHD29540
     4,TIMEX(50),TET(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,CEXH,CEXO,CHD29570
     7CEXPY,CEXDP,CEXSI,CEXCM,CEXN,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,AOMW,ANMW,SMW,BMW,CX(6)CHD29600
      DIMENSION NBND2(10),NHDN(3)                                       CHD29610
      EQUIVALENCE (NBND)(2),NBND2(1))                                   CHD29620
      EQUIVALENCE (IHDN(2),NHDN(1))                                     CHD29630
      DIMENSION TEMPA1(1)                                               CHD29640
      EQUIVALENCE (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
       ERM1(J)=PERM2(J)**2*HOLD*PERT1*(1.+.016*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
```

```
- FOR RECFED,RECFED
      SUBROUTINE RECFED(TEMPA)                                          CHD29800
      COMMON /BLOCKA/                                                   CHD29810
     1ABSORP(10)  ,ABSC        ,ACTENC      ,ACTENS      ,ACTENV(4,10),CHD29820
     2BSTAR       ,CCPC(4)     ,CCPG(4)     ,CHARPT(101) ,CKC(4)      , CHD29830
     3COEFT(4,10) ,CONDC       ,CONDV(100)  ,CONST(4,10) ,COVERX(100) , CHD29840
     4CPBAR       ,CPC         ,CPV(100)    ,DIFREC      ,UMATER(10)  , CHD29850
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)    ,EMISC       , CHD29860
     6HOFM(10)    ,HCOM        ,HCOMG       ,HSUB        ,MAT(100)    , CHD29870
     7MATOMN      ,MATMNF      ,MP          ,NN          ,NNP         , CHD29880
     8NNSAVE      ,NRDIV       ,NREND       ,NRGO        ,NST         , CHD29890
     9PARTIN(101) ,PHI         ,QBYRAD      ,QCOMB       ,QEXTR       , CHD29900
     1QGPCOM      ,QSUBL       ,RECPRO      ,REORDC      ,REORDS      , CHD29910
     2REORDV(4,10),RHO5Z       ,RHO5(305)   ,RHOCPX(101) ,RHOC        , CHD29920
     3RHOV(10)    ,SABL        ,SABLC       ,SDOT        ,SDOTC       , CHD29930
     4SLOPE(10)   ,TMELT(10)   ,TSZ         ,TS(205)     ,TRCHAR      , CHD29940
     5WFZ         ,WF(205)     ,XCHAR       ,XINIT       ,XLEFT(101)  , CHD29950
     6XMASS       ,XMDOTC      ,XMDOTD      ,XMDOTG      ,XMDOTL      , CHD29960
     7XMODTR      ,XMDOTS      ,XTOTAL      ,XVIRG(101)  ,XZONE         CHD29970
      COMMON /BLOCKC/                                                   CHD29980
     1BLPRES(20,11)           ,COMMAX      ,CUTOFF      ,F(20,11)    , CHD29990
     2FLOW(20,11) ,HCONV(20,11),IERROR      ,JUNCT       ,L           , CHD30000
     3N           ,NOSECH     ,QBACK       ,QCONV(20,11),QGAS(20,11) , CHD30010
     4QMISC       ,TIME       ,TPRINT      ,TWALL(20,11),XIWALL(20,11), CHD30020
     5XIR(20,11)                                                        CHD30030
      COMMON/BLOCKR/DIFC(4),EROC(4),ERODF                               CHD30040
C                                                                       CHD30050
C                                                                       CHD30060
C     XMDOTR IS SPELLED XMODTR IN COMMON.  WATCH THIS WHEN              CHD30070
C     EXAMINING DUMPS AND WHEN CODING.                                  CHD30080
C                                                                       CHD30090
C                                                                       CHD30100
      EXTERNAL FREC                                                     CHD30110
      IF(XMDOTG)2,2,4                                                   CHD30120
    2 XMDOTG=0.                                                         CHD30130
      DIFREC=0.                                                         CHD30140
      GO TO 6                                                           CHD30150
    4 OMG=ALOG(XMDOTG*TWALL(N,L)**.5*(.12*(1.E4/TWALL(N,L)))            CHD30160
     1/(BLPRES(N,L)/2116.2))/2.3026                                     CHD30170
      DIFREC=DIFC(1)+OMG*(DIFC(2)+OMG*(DIFC(3)+OMG*DIFC(4)))            CHD30180
    6 XMDUM=BSTAR*HCONV(N,L)                                            CHD30190
      XMDOTD=XMDUM-XMDOTG*DIFREC                                        CHD30200
      IF(XMDOTD-1.E-6)10,10,20                                          CHD30210
   10 XMDOTL=0.                                                         CHD30220
      GO TO 30                                                          CHD30230
   20 DR=EFCOLC*(BLPRES(N,L)/10077.)**REORDC                            CHD30240
      XMDOTR=DR*EXP(-ACTENC/TEMPA)                                      CHD30250
      XMODTR=XMDOTR                                                     CHD30260
      IF(XMDOTR-1.E-6)10,10,25                                          CHD30270
   25 RDUM=XMDOTD*BSTAR**REORDC/XMDOTR                                  CHD30280
      BDUM=(PHI*HCONV(N,L)+XMDOTG)/XMDOTD                               CHD30290
      RK=1./BDUM                                                        CHD30300
      CALL ITER8(RK,REORDC,RDUM,BDUM,FREC,1.E-3,II)                     CHD30310
      XMDOTL=XMDOTD*(1.-BDUM*RK)/(1.+RK)                                CHD30320
   30 DS=EFCOLS*XMDUM*(BLPRES(N,L)/2116.2)**(-REORDS)                   CHD30330
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```
      XMDOTS=DS*EXP(-ACTENS/TEMPA)                                      CHD30340
      IF(XMDOTS-1.E-6)40,40,50                                          CHD30350
40    XMDOTS=0.                                                         CHD30360
50    XMDOTC=XMDOTL+XMDOTS                                              CHD30370
      RETURN                                                            CHD30380
      END                                                               CHD30390
```

```
- FOR RHOSB,RHOSB
      SUBROUTINE  RHOSB (K,KL)                                          CHD30400
C****    THE RHOSB SUBROUTINE FINDS DATA NEEDED FOR DENSITY CALCULATIONSCHD30410
      DIMENSION DELTAX(1), TEMPA1(1)                                    CHD30420
      DIMENSION AREAC(1),EMBM(1),PC(1),RATE(1),RHO4(1),WFD(1)           CHD30430
      COMMON /BLOCKA/                                                   CHD30440
     1ABSORP(10)  ,ABSC        ,ACTENC       ,ACTENS       ,ACTENV(4,10), CHD30450
     2BSTAR       ,CCPC(4)     ,CCPG(4)      ,CHARPT(101)  ,CKC(4)      , CHD30460
     3COEFT(4,10) ,CONDC       ,CONDV(100)   ,CONST(4,10)  ,COVERX(100) , CHD30470
     4CPBAR       ,CPC         ,CPV(100)     ,DIFREC       ,UMATER(10)   , CHD30480
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)      ,EMISC        , CHD30490
     6HOFM(10)    ,HCOM        ,HCOMG        ,HSUB         ,MAT(100)     , CHD30500
     7MATOMN      ,MATMNF      ,MN           ,NN           ,NNP          , CHD30510
     8NNSAVE      ,NRDIV       ,NREND        ,NRGO         ,NST          , CHD30520
     9PARTIN(101) ,PHI         ,QBYRAD       ,QCOMB        ,QEXTR        , CHD30530
     1QGPCOM      ,QSUBL       ,RECPRO       ,REORDC       ,REORDS       , CHD30540
     2REORD...4,10),RHO5Z      ,RHO5(305)    ,RHOCPX(101)  ,RHOC         , CHD30550
     3RHOV(10)    ,SABL        ,SABLC        ,SDOT         ,SDOTC        , CHD30560
     4SLOPE(10)   ,TMELT(10)   ,TSZ          ,TS(2,5)      ,TRCHAR       , CHD30570
     5WFZ         ,WF(205)     ,XCHAR        ,XINIT        ,XLEFT(101)   , CHD30580
     6XMASS       ,XMDOTC      ,XMDOTD       ,XMDOTG       ,XMDOTL       , CHD30590
     7XMDOTR      ,XMDOTS      ,XTOTAL       ,XVIRG(101)   ,XZONE          CHD30600
      COMMON /CHCOM/ DTAU,     IBE(10),     IBS(10),     IBSPN,           CHD30610
     1IGTYP(10),  IHDN(4),     IM,          IZB(3),      IZG(3,10),       CHD30620
     2IZGT(3),    JRSW,        NCSN(10),    NSHL(3),     NSHR(3),         CHD30630
     3NZEN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),       CHD30640
     4I           ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),        CHD30650
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                    CHD30660
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,                   CHD30670
     7SCHECK                                                              CHD30680
      EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))                 CHD30690
      EQUIVALENCE (EMBM(1),PC(1))                                         CHD30700
      EQUIVALENCE (RHO3(103),RHO4(1))                                     CHD30710
      EQUIVALENCE (WF(1),WFD(1),RATE(1))                                  CHD30720
      EQUIVALENCE (RHO3(307), PC(1)), (RHO3(350),AREAC(1))                CHD30730
      ONE = (3.*RHO1(KL)+RHO5(KL))/4.                                     CHD30740
      AREAC(K)=0.                                                         CHD30750
      THREE=0.                                                            CHD30760
      IF (ONE-1.E-10) 2727,2727,2720                                      CHD30770
 2720 CONTINUE                                                            CHD30780
      DO 2725 J=1,2                                                       CHD30790
      TWO = -EFCOLV(J,I)*EXP(-ACTENV(J,I)/TEMPA3(K))                      CHD30800
      AREAC(K) = TWO*RHO1(KL)**REORDV(J,I)+AREAC(K)                       CHD30810
      THREE=TWO*REORDV(J,I)*ONE**(REORDV(J,I)-1.)+THREE                   CHD30820
 2725 CONTINUE                                                            CHD30830
 2727 CONTINUE                                                            CHD30840
      EMBM(K) = 1.-THREE*DTAU/2.                                          CHD30850
      IF (KL-205) 2730,2740,2740                                          CHD30860
 2730 RATE(KL)=THREE                                                      CHD30870
 2740 CONTINUE                                                            CHD30880
      RETURN                                                              CHD30890
      END                                                                 CHD30900
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```
- FOR SHIFT1,SHIFT1
      SUBROUTINE SHIFT1 (NZON, NLR, INCOM)                                CHD30910
C****    THE SHIFT1 SUBROUTINE INTERPOLATES NEW VALUES NEEDED FOR NODE   CHD30920
C**** ADDITION TO A ZONE                                                  CHD30930
      DIMENSION NHDN(3), RHO4(306)                                        CHD30940
      DIMENSION DELTAX(1), TEMPA1(1)                                      CHD30950
      COMMON /BLOCKA/                                                     CHD30960
     1ABSORP(10)  ,ABSC        ,ACTENC      ,ACTENS      ,ACTENV(4,10),  CHD30970
     2BSTAR       ,CCPC(4)     ,CCPG(4)     ,CHARPT(101) ,CKC(4)       ,  CHD30980
     3COEFT(4,10) ,CONDC       ,CONDV(100)  ,CONST(4,10) ,COVERX(100) ,  CHD30990
     4CPBAR       ,CPC         ,CPV(100)    ,DIFREC      ,UMATER(10)   ,  CHD31000
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)    ,EMISC        ,  CHD31010
     6HOFM(10)    ,HCOM        ,HCOMG       ,HSUB        ,MAT(100)     ,  CHD31020
     7MATOMN      ,MATMNF      ,MN          ,NN          ,NNP          ,  CHD31030
     8NNSAVE      ,NRDIV       ,NREND       ,NRGO        ,NST          ,  CHD31040
     9PARTIN(101) ,PHI         ,QBYRAD      ,QCOMB       ,QEXTR        ,  CHD31050
     1QGPCOM      ,QSUBL       ,RECPRO      ,REORDC      ,REORDS       ,  CHD31060
     2REORDV(4,10),RHOSZ       ,RHOS(305)   ,RHOCPX(101) ,RHOC         ,  CHD31070
     3RHOV(10)    ,SABL        ,SABLC       ,SDOT        ,SDOTC        ,  CHD31080
     4SLOPE(10)   ,TMELT(10)   ,TSZ         ,TS(205)     ,TRCHAR       ,  CHD31090
     5WFZ         ,WF(205)     ,XCHAR       ,XINIT       ,XLEFT(101)   ,  CHD31100
     6XMASS       ,XMDOTC      ,XMDOTD      ,XMDOTG      ,XMDOTL       ,  CHD31110
     7XMDOTR      ,XMDOTS      ,XTOTAL      ,XVIRG(101)  ,XZONE          CHD31120
      COMMON/BLOCKC/                                                      CHD31130
     1BLPRES(20,11)           ,COMMAX      ,CUTOFF      ,F(20,11)     ,  CHD31140
     2FLOW(20,11) ,HCONV(20,11),IERROR      ,JUNCT       ,L            ,  CHD31150
     3N           ,NOSECH     ,QBACK       ,QCONV(20,11),QGAS(20,11)  ,  CHD31160
     4QMISC       ,TIME       ,TPRINT      ,TWALL(20,11),XIWALL(20,11),  CHD31170
     5XIR(20,11)                                                          CHD31180
      COMMON /CHCOM/ DTAU,     IBE(10),     IBS(10),     IBSPN,           CHD31190
     1IGTYP(10),  IHDN(4),     IM,          IZB(3),      IZG(3,10),       CHD31200
     2IZGT(3),    JRSW,        NCSN(10),    NSHL(3),     NSHR(3),         CHD31210
     3NZEN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),       CHD31220
     4I           ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),       CHD31230
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                   CHD31240
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,                   CHD31250
     7SCHECK                                                              CHD31260
      COMMON /NASCOM/ CHARRO,AIRM,                                        CHD31270
     1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)CHD31280
     2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205), WDEP(205),WSI(20CHD31290
     35),WBRN(205),EMWT(205),PRG(205)                                     CHD31300
     4,TIMEX(50),TFT(50),NPTS                                             CHD31310
     5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS, CHD31320
     6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,CHD31330
     7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)                    CHD31340
     8,ALLGAS(205),GRAF1(205)                                             CHD31350
      EQUIVALENCE (IHDN(2),NHDN(1))                                       CHD31360
      EQUIVALENCE (RHO3(103),RHO4(1))                                     CHD31370
      EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))                 CHD31380
      EQUIVALENCE (MNOD,NNP)                                              CHD31390
      REAL MARY                                                           CHD31395
      NONE = INCOM                                                        CHD31400
      JHDN = NHDN(NZON)                                                   CHD31410
      GO TO (20,10),NLR                                                   CHD31420
   10 NSHR(NZON) = NONE                                                   CHD31430
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      IU = IZGT(NZON)                                                   CHD31440
      IG = IZG(NZON,IU)                                                 CHD31450
      IGX = IG+1                                                        CHD31460
      GO TO 22                                                          CHD31470
   20 NSHL(NZON) = NONE                                                 CHD31480
      IG = IZG(NZON,1)                                                  CHD31490
      NONE = -NONE                                                      CHD31500
      IGX = IG-1                                                        CHD31510
   22 IF (NONE) 80,80,25                                                CHD31520
   25 NZONX = IGTYP(IGX)                                                CHD31530
   30 KHDN = NHDN(NZONX)                                                CHD31540
   35 NTWO = NONE*JHDN                                                  CHD31550
      GO TO (50,40),NLR                                                 CHD31560
   40 IX = IBF(IG)+NTWO                                                 CHD31[illegible]
      IY = IBS(IGX)+NONE*KHDN                                           CHD31[illegible]
      IZ = IBSPN+NCSN(IGX)+NONE                                         CHD31[illegible]
      WFD (IX)=WFD (IY)                                                 CHD31600
      WDEP(IX)=WDEP(IY)                                                 CHD31610
      WSI (IX)=WSI (IY)                                                 CHD31620
      WBRN(IX)=WBRN(IY)                                                 CHD31630
      EMWT(IX)=EMWT(IY)                                                 CHD31640
      WF  (IX)=WF(IY)                                                   CHD31650
      GRAF1(IX)=GRAF1(IY)                                               CHD31660
      TEMPA1(IX) = TEMPA1(IY)                                           CHD31670
      TEMPA2(IX) = TEMPA2(IY)                                           CHD31680
      TEMPA5(IX) = TEMPA5(IY)                                           CHD31690
      SILCA1(IX)=SILCA1(IY)                                             CHD31700
      CARBN1(IX)=CARBN1(IY)                                             CHD31710
      GO TO 60                                                          CHD31720
   50 IX = IBS(IG)                                                      CHD31730
      IY = IBF(IGX)                                                     CHD31740
      IZ = IBSPN+NCSN(IG)                                               CHD31750
   60 IF (JHDN-KHDN) 65,65,70                                           CHD31760
   65 NTHREE = KHDN/JHDN                                                CHD31770
      DO 67 J=1,NTWO                                                    CHD31780
      IX = IX-1                                                         CHD31790
      IY = IY-NTHREE                                                    CHD31800
      WFD (IX)=WFD (IY)                                                 CHD31810
      WDEP(IX)=WDEP(IY)                                                 CHD31820
      WSI (IX)=WSI (IY)                                                 CHD31830
      WBRN(IX)=WBRN(IY)                                                 CHD31840
      EMWT(IX)=EMWT(IY)                                                 CHD31850
      WF  (IX)=WF(IY)                                                   CHD31860
      GRAF1(IX)=GRAF1(IY)                                               CHD31870
      RHO1(IX) = RHO1(IY)                                               CHD31880
      RHO2(IX) = RHO2(IY)                                               CHD31890
      SILCA1(IX)=SILCA1(IY)                                             CHD31900
      CARBN1(IX)=CARBN1(IY)                                             CHD31910
      TEMPA1(IX) = TEMPA1(IY)                                           CHD31920
      TEMPA2(IX) = TEMPA2(IY)                                           CHD31930
   67 TEMPA5(IX) = TEMPA5(IY)                                           CHD31940
      GO TO 80                                                          CHD31950
   70 NTHREF = JHDN/KHDN                                                CHD31960
      FIVF = 1./FLOAT(NTHREF)                                           CHD31970
      KNT1 = 0                                                          CHD31980
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71 KNT = 0                                                          CHD31990
72 ONE = (TEMPA1(IY)-TEMPA1(IY-1))*FIVE                             CHD32000
   TWO = (TEMPA2(IY)-TEMPA2(IY-1))*FIVE                             CHD32010
   HOLD=(SILCA1(IY)-SILCA1(IY-1))*FIVE                              CHD32020
   SAVE=(CARBN1(IY)-CARBN1(IY-1))*FIVE                              CHD32030
   GABY=(WFD (IY)-WFD (IY-1))*FIVE                                  CHD32040
   HECT=(WDEP(IY)-WDEP(IY-1))*FIVE                                  CHD32050
   MARY=(WSI (IY)-WSI (IY-1))*FIVE                                  CHD32060
   CRUZ=(WBRN(IY)-WBRN(IY-1))*FIVE                                  CHD32070
   CAJA=(EMWT(IY)-EMWT(IY-1))*FIVE                                  CHD32080
   TIENDA=(WF(IY)-WF(IY-1))*FIVE                                    CHD32090
   CINE=(GRAF1(IY)-GRAF1(IY-1))*FIVE                                CHD32100
   IF (KNT) 73,73,74                                                CHD32110
73 JX = IZ                                                          CHD32120
   GO TO 75                                                         CHD32130
74 JX = IY                                                          CHD32140
75 JY = IY                                                          CHD32150
   THREE = (RHO1(JX)-RHO1(IY-1))*FIVE                               CHD32160
   FOUR = (RHO2(JX)-RHO2(IY-1))*FIVE                                CHD32170
   DO 76 J=1,NTHREE                                                 CHD32180
   IX = IX-1                                                        CHD32190
   RHO1(IX) = RHO1(JX)-THREE                                        CHD32200
   RHO2(IX) = RHO2(JX)-FOUR                                         CHD32210
   SILCA1(IX)=SILCA1(JY)-HOLD                                       CHD32220
   CARBN1(IX)=CARBN1(JY)-SAVE                                       CHD32230
   TEMPA1(IX) = TEMPA1(JY)-ONE                                      CHD32240
   TEMPA2(IX) = TEMPA2(JY)-TWO                                      CHD32250
   TEMPA5(IX) = TEMPA2(IX)                                          CHD32260
   WFD (IX)=WFD (JY)-GABY                                           CHD32270
   WDEP(IX)=WDEP(JY)-HECT                                           CHD32280
   WSI (IX)=WSI (JY)-MARY                                           CHD32290
   WBRN(IX)=WBRN(JY)-CRUZ                                           CHD32300
   EMWT(IX)=EMWT(JY)-CAJA                                           CHD32310
   WF(IX)=WF(JY)-TIENDA                                             CHD32320
   GRAF1(IX)=GRAF1(JY)-CINE                                         CHD32330
   JX = IX                                                          CHD32340
76 JY = JX                                                          CHD32350
   KNT = KNT+1                                                      CHD32360
   IY = IY-1                                                        CHD32370
   IF (KNT-KHDN) 72,78,78                                           CHD32380
78 IZ = IZ-1                                                        CHD32390
   KNT1 = KNT1+1                                                    CHD32400
   IF (KNT1-NONE) 71,80,80                                          CHD32410
80 RETURN                                                           CHD32420
   END                                                              CHD32430
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- FOR SHIFT2,SHIFT2
      SUBROUTINE SHIFT2                                                 CHD32440
C****    THE SHIFT2 SUBROUTINE DOES SHIFT OF VALUES IN ZONES            CHD32450
      DIMENSION NHDN(3), RHO4(306)                                      CHD32460
      DIMENSION DELTAX(1), TEMPA1(1)                                    CHD32470
      COMMON /BLOCKA/                                                   CHD32480
     1ABSORP(10)  ,ABSC        ,ACTENC       ,ACTENS       ,ACTENV(4,10), CHD32490
     2BETAR       ,CCPC(4)     ,CCPG(4)      ,CHARPT(101)  ,CKC(4)      , CHD32500
     3COEFT(4,10) ,CONDC       ,CONDV(100)   ,CONST(4,10)  ,CP EDX(100) , CHD32510
     4CPBAR       ,CPC         ,CPV(100)     ,DIFREC       ,DMATER(10)  , CHD32520
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)      ,EMISC       , CHD32530
     6HOFM(10)    ,HCOM        ,HCOMG        ,HS R         ,MAT(100)    , CHD32540
     7MATOMN      ,MATMNF      ,MN           ,NS           ,NNP         , CHD32550
     8NNSAVE      ,NRDIV       ,NREND        ,N GO         ,NST         , CHD32560
     9PARTIN(101) ,PHI         ,QBYRAD          QMB        ,QEXTR       , CHD32570
     1QGPCOM      ,QSUBL       ,RECPRO          QRDC       ,REORDS      , CHD32580
     2REORDV(4,10),RHO5Z       ,RHO5(305)       QCPX(101)  ,RHOC        , CHD32590
     3RHOV(10)    ,SABL        ,SABLC           DOT        ,SDOTC       , CHD32600
     4SLOPE(10)   ,TMELT(10)   ,TSZ           , S(205)       (RCHAR     , CHD32610
     5WFZ         ,WF(205)     ,XCHAR        ,XINIT            EFT(101)  , CHD32620
     6XMASS       ,XMDOTC      ,XMDOTD       ,XMDOTG       ,XMDOTL      , CHD32630
     7XMDOTR      ,XMDOTS      ,XTOTAL       ,XVIRG(101)   ,XZONE         CHD32640
      COMMON/BLOCKC/                                                    CHD32650
     1BLPRES(20,11)            ,COMMAX       ,CUTOFF       ,F(20,11)    , CHD32660
     2FLOW(20,11) ,HCONV(20,11),IERROR       ,JUNCT        ,L           , CHD32670
     3N           ,NOSECH      ,QBACK        ,QCONV(20,11),QGAS(20,11)  , CHD32680
     4QMISC       ,TIME        ,TPRINT       ,TWALL(20,11),XIWALL(20,11), CHD32690
     5XIR(20,11)                                                        CHD32700
      COMMON /CHCOM/ DTAU,     IBE(10),     IBS(10),     IBSPN,          CHD32710
     1IGTYP(10),  IHDN(4),     IM,          IZB(3),      IZG(3,10),      CHD32720
     2IZGT(3),    JRSW,        NCSN(10),    NSHL(3),     NSHR(3),        CHD32730
     3NZEN(3),    NZSN(3),     RHO1(305),   RHO2(305),   RHO3(410),      CHD32740
     4I           ,TEMPA2(205),TEMPA3(42),TEMPA4(42) ,TEMPA5(205),      CHD32750
     5            DELX(100),DISTL(100),DUM  (10),ICOM,                  CHD32760
     6IYS,LFT,MG,MDUM,NCEN(10),NCUT,ND(3),NLZON,SN,SN1,                 CHD32770
     7SCHECK                                                            CHD32780
      COMMON /NASCOM/ CHARRO,AIRM,                                      CHD32790
     1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)CHD32800
     2,HYD(205),AERO(205),AERN(205),BURN(205),WED(205), WDEP(205),WSI(20CHD32810
     35),WBRN(205),EMWT(205),PRG(205)                                   CHD32820
     4,TIMEX(50),TFT(50),NPTS                                           CHD32830
     5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS, CHD32840
     6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,CHD32850
     7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)                  CHD32860
     8,ALLGAS(205),GRAF1(205)                                           CHD32870
      EQUIVALENCE (IHDN(2),NHDN(1))                                     CHD32880
      EQUIVALENCE (RHO3(103),RHO4(1))                                   CHD32890
      EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))               CHD32900
      EQUIVALENCE (MNOD,NNP)                                            CHD32910
      DO 70 NZON=1,3                                                    CHD32920
      IF (NSHL(NZON)) 10,60,10                                          CHD32930
   10 JHDN = NHDN(NZON)                                                 CHD32940
      NONF = NSHL(NZON)*JHDN                                            CHD32950
      JBS = IZB(NZON)+NONF                                              CHD32960
      IG = IZG(NZON,1)                                                  CHD32970
```

```
      IU = IZGT(NZON)                                                   CHD32980
      IGX = IZG(NZON,IU)                                                CHD32990
      JBE = IBE(IGX)+NSHR(NZON)*JHDN                                    CHD33000
      IF (NSHL(NZON)) 20,20,30                                          CHD33010
   20 JX = JBE                                                          CHD33020
      J = -1                                                            CHD33030
      GO TO 40                                                          CHD33040
   30 JX = JBS                                                          CHD33050
      J = 1                                                             CHD33060
   40 IY = JX-J                                                         CHD33070
      IX = IY-NONE                                                      CHD33080
      DO 50 K=JBS,JBE                                                   CHD33090
      IX = IX+J                                                         CHD33100
      IY = IY+J                                                         CHD33110
      TEMPA1(IX) = TEMPA1(IY)                                           CHD33120
      TEMPA2(IX) = TEMPA2(IY)                                           CHD33130
      TEMPA5(IX) = TEMPA5(IY)                                           CHD33140
      SILCA1(IX)=SILCA1(IY)                                             CHD33150
      CARBN1(IX)=CARBN1(IY)                                             CHD33160
      WFD (IX)=WFD (IY)                                                 CHD33170
      WDEP(IX)=WDEP(IY)                                                 CHD33180
      WSI (IX)=WSI (IY)                                                 CHD33190
      WBRN(IX)=WBRN(IY)                                                 CHD33200
      EMWT(IX)=EMWT(IY)                                                 CHD33210
      WF  (IX)=WF(IY)                                                   CHD33220
      GRAF1(IX)=GRAF1(IY)                                               CHD33230
      RHO1(IX) = RHO1(IY)                                               CHD33240
   50 RHO2(IX) = RHO2(IY)                                               CHD33250
      NZSN(NZON) = NZSN(NZON)+NSHL(NZON)                                CHD33260
      NSHL(NZON) =0                                                     CHD33270
   60 NZEN(NZON) = NZEN(NZON)+NSHR(NZON)                                CHD33280
   70 NSHR(NZON) = 0                                                    CHD33290
      RETURN                                                            CHD33300
      END                                                               CHD33310
```

```
- FOR SIC,SIC
      SUBROUTINE SIC (K,KL,TEMPA,DFL)                                   CHD33320
C                                                                       CHD33330
C****     SIO2-CARBON REACTION                                          CHD33340
C                                                                       CHD33350
      COMMON /BLOCKA/                                                   CHD33360
     1ABSORB(10)  ,ABSC        ,ACTENC      ,ACTENS      ,ACTENV(4,10), CHD33370
     2BSTAR       ,CCPC(4)     ,CCPG(4)     ,CHARPT(101) ,CKC(4)      , CHD33380
     3COEFT(4,10) ,CONDC       ,CONDV(100)  ,CONST(4,10) ,COVERX(100) , CHD33390
     4CPBAR       ,CPC         ,CPV(100)    ,DIFREC      ,UMATER(10)  , CHD33400
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)    ,EMISC       , CHD33410
     6HCEM(10)    ,HCOM        ,HCOMG       ,HSUB        ,MAT(100)    , CHD33420
     7MATOMN      ,MATMNF      ,MN          ,NN          ,NNF         , CHD33430
     8NNSAVE      ,NRDIV       ,NREND       ,NRGO        ,NST         , CHD33440
     9PARTIN(101) ,PHI         ,QBYRAD      ,QCOMB       ,QEXTR       , CHD33450
     1QGPCOM      ,QSUBL       ,RECPRO      ,REORDC      ,REORDS      , CHD33460
     2REORDV(4,10),RHOSZ       ,RHOS(305)   ,RHOCPX(101) ,RHOC        , CHD33470
     3RHOV(10)    ,SABL        ,SABLC       ,SDOT        ,SDOTC       , CHD33480
     4SLOPE(10)   ,TMELT(10)   ,TSZ         ,TS(205)     ,TRCHAR      , CHD33490
     5WFZ         ,WF(205)     ,XCHAR       ,XINIT       ,XLEFT(101)  , CHD33500
     6XMASS       ,XMDOTC      ,XMDOTD      ,XMDOTG      ,XMDOTL      , CHD33510
     7XMDOTR      ,XMDOTS      ,XTOTAL      ,XVIRG(101)  ,XZONE         CHD33520
      COMMON/BLOCKC/                                                    CHD33530
     1BLPRES(20,11)            ,COMMAX      ,CUTOFF      ,F(20,11)    , CHD33540
     2FLOW(20,11) ,HCONV(20,11),IERROR      ,JUNCT       ,L           , CHD33550
     3N           ,NOSECH      ,QBACK       ,QCONV(20,11),QGAS(20,11) , CHD33560
     4QMISC       ,TIME        ,TPRINT      ,TWALL(20,11),XIWALL(20,11), CHD33570
     5XIR(20,11)                                                        CHD33580
      COMMON /BLOCKJ/                                                   CHD33590
     1FLUXI(200),TEDEP(200),XEDEP(101),EDEP(101),NTEDEP,                CHD33600
     2NXEDEP,ITEPEP,EDFLUX(100)                                         CHD33610
      COMMON /BLOCKK/NN1,QCOND(205)                                     CHD33620
      COMMON/BLOCKN/COORD                                               CHD33630
      COMMON/BLOCKR/DIFC(4),FROC(4),FRODF                               CHD33640
      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),NLZCN,SN,SN1,                 CHD33710
     7SCHECK                                                            CHD33720
C****     DIMENSION STATEMENTS                                          CHD33730
C                                                                       CHD33740
      DIMENSION DELTAX(1),TEMPA1(1)                                     CHD33750
      EQUIVALENCE (TEMPA1(1),TS(1)),(DELTAX(1),PARTIN(1))               CHD33760
      COMMON /NASCOM/ CHARRO,AIRM,                                      CHD33770
     1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)CHD33780
     2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205), WDEP(205),WSI(20CHD33790
     35),WBRN(205),EMWT(205),PRG(205)                                   CHD33800
     4,TIMEX(50),TFT(50),NPTS                                           CHD33810
     5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS, CHD33820
     6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,CHD33830
     7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)                  CHD33840
     8,ALLGAS(205),GRAF1(205),GRAF5(205),SPEED(205),DIFCH(205),DIFR(205)CHD33850
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     9,VISCO,VISCON,AF,BF,SILICA,RFO,PMW,DMW,HMW,AOMW,ANMW,SMW,BMW,CX(6)CHD33860
C                                                                       CHD33870
      WSIO2=AF*EXP(-BF/TF*PA)*(SILCA1(KL)/SILICA)**RFO                  CHD33880
      SILCA5(KL)=SILCA1(KL)-WSIO2*DTAU                                  CHD33890
      IF (SILCA5(KL)) 5,6,6                                             CHD33900
    5 SILCA5(KL)=0.                                                     CHD33910
      WSIO2=(SILCA1(KL)-SILCA5(KL))/DTAU                                CHD33920
    6 CONTINUF                                                          CHD33930
      CARBN5(KL)=CARBN1(KL)-WSIO2*DTAU*.2                               CHD33940
      WSI(KL)=WSIO2*(DELTAX(K)+DEL)*.05                                 CHD33950
      RETURN                                                            CHD33960
      END                                                               CHD33970
```

```
- ASM STUFF2,STUFF2
        REGNAM
STUFF2* NOP                                                     CHD33980
        S       A0,STUFF3                                       CHD33990
        L       A0,0127                                         CHD34000
        AN,14   A0,2                                            CHD34010
        S       A0,0127                                         CHD34020
        L       A0,STUFF3                                       CHD34030
        J       DIAG6                                           CHD34040
STUFF3 +0                                                       CHD34050
        END                                                     CHD34060
                                                                CHD34070
```

```
- FOR SUBZ,SUBZ
      SUBROUTINE SUBZ(Z,T,P)                                            CHD34080
      XLN=ALOG(P/2116.2)/2.3026                                         CHD34090
      THETA=T*(.555556-.069444*XLN)                                     CHD34100
      IF (THETA-2000.) 1, 1, 2                                          CHD34110
    1 Z = 1.                                                            CHD34120
      GO TO 3                                                           CHD34130
    2 Z = 2.5+.1*TANH(THETA/500.-7.)+.4*TANH(THETA/1000.-7.) +TANH(THETACHD34140
     1/2500.-5.8)                                                       CHD34150
    3 RETURN                                                            CHD34160
      END                                                               CHD34170
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- FOR WRITE,WRITE
      SUBROUTINE WRITE                                                  CHD34220
      COMMON /BLOCKA/                                                   CHD34230
     1ABSORP(10)   ,ABSC         ,ACTENC       ,ACTENS       ,ACTENV(4,10), CHD34240
     2BSTAR        ,CCPC(4)      ,CCPG(4)      ,CHARPT(101)  ,CKC(4)      , CHD34250
     3COEFT(4,10)  ,CONDC        ,CONDV(100)   ,CONST(4,10)  ,COVERX(100) , CHD34260
     4CPBAR        ,CPC          ,CPV(100)     ,DIFREC       ,DMATER(10)   , CHD34270
     5EFCOLC       ,EFCOLS       ,EFCOLV(4,10),EMIS(10)      ,EMISC        , CHD34280
     6HOFM(10)     ,HCOM         ,HCOMG        ,HSUB         ,MAT(100)     , CHD34290
     7MATOMN       ,MATMNF       ,MN           ,NN           ,NNP          , CHD34300
     8NNSAVF       ,NRDIV        ,NREND        ,NRGO         ,NST          , CHD34310
     9PARTIN(101)  ,PHI          ,QBYRAD       ,QCOMB        ,QEXTR        , CHD34320
     1QGPCOM       ,QSUBL        ,RECPRO       ,REORDC       ,REORDS       , CHD34330
     2REORDV(4,10),RHO5Z         ,RHO5(205)    ,RHOCPX(101)  ,RHOC         , CHD34340
     3RHOV(10)     ,SABL         ,SABLC        ,SDOT         ,SDOTC        , CHD34350
     4SLOPE(10)    ,TMELT(10)    ,TSZ          ,TS(205)      ,TRCHAR       , CHD34360
     5WFZ          ,WF(205)      ,XCHAR        ,XINIT        ,XLEFT(101)   , CHD34370
     6XMASS        ,XMDOTC       ,XMDOTD       ,XMDOTG       ,XMDOTL       , CHD34380
     7XMODTR       ,XMDOTS       ,XTOTAL       ,XVIRG(101)   ,XZONE          CHD34390
      COMMON/BLOCKB/                                                    CHD34400
     1ALT          ,AOFA         ,AOFACH       ,BETA(20)     ,BLCOM(20,11), CHD34410
     2BLDEN(20,11),  ENT(20,11),BLTEM(20,11),BLVEL(20,11),BLRN(20,11)  , CHD34420
     3BMULT        ,DIST(20,11)  ,FSCOM        ,FSGAM        ,LENGTH(21)   , CHD34430
     4NDIM         ,NTEMP        ,NTHETA       ,NTIME        ,PAMB         , CHD34440
     5PRP          ,PTOTAL       ,QAMB         ,QSHOUL       ,             , CHD34450
     6R(20,11)     ,REFCOM(20,11)              ,REFDEN(20,11)              , CHD34460
     7REFENT(20,11)              ,REFRN(20,11),REFTEM(20,11)               , CHD34470
     8REFVIS(20,11)              ,RHOA         ,RHOVIS       ,RNPERF       , CHD34480
     9RTRAN        ,SOFS         ,SWEEP        ,THETA(11)    ,THETSH       , CHD34490
     1TTOTAL       ,UAMB         ,VISCOS       ,X(20,11)     ,XEQ(20,11)   , CHD34500
     2XIAMB        ,XISP         ,XLTRAN       ,XMACH        ,XY           , CHD34510
     3ATEMP        ,BLVIS(20,11),ZWALL         ,REFPR(20,11),HMAX            CHD34520
      COMMON /BLOCKC/                                                   CHD34530
     1BLDES(20,11)               ,COMMAX       ,CUTOFF       ,F(20,11)     , CHD34540
     2FLOW(20,11) ,HCONV(20,11),IERROR         ,JUNCT        ,L            , CHD34550
     3N            ,NOSECH       ,QBACK        ,QCONV(20,11),QGAS(20,11)  , CHD34560
     4QMISC        ,TIME         ,TPRINT       ,TWALL(20,11),XIWALL(20,11), CHD34570
     5XIR(20,11)                                                          CHD34580
      COMMON /BLOCKD/                                                   CHD34590
     1ALPHA(200)   ,AMBP(200)    ,AMBT(200)    ,AMULT(200)   ,AXLD(200)   , CHD34600
     2BWTEST       ,IATMOS       ,IPR          ,IPRINT(20,10)              , CHD34610
     3IC           ,IX           ,KK           ,MELTN        ,MELTL        , CHD34620
     4              MVTEST       ,NKK          ,NCHARM       ,NMATLU       , CHD34630
     5NMATL        ,NMATLD       ,NSTRES       ,NTBW         ,NTIME1       , CHD34640
     6NTIME2       ,PRINT        ,PUT(20)      ,QBAC(200)    ,QINC(20)     , CHD34650
     7QINCR        ,QM(200)      ,QTIME(20)    ,QTABLE(6,200)              , CHD34660
     8RPRINC       ,RQINC        ,RXINC        ,T(200)       ,TBW(200)     , CHD34670
     9TEMP(7)                                  ,TNT(20)      ,TORIBW(200)  , CHD34680
     1TSIN(101)    ,TT(200)      ,V(200)       ,XINC(20)                   , CHD34690
     2XINCF        ,XTIME(20)    ,Z(200)       ,ZZ(200)                      CHD34700
      COMMON /BLOCKE/                                                   CHD34710
     1ASTR(205)    ,AXLDEQ       ,CCOMSC(4)    ,CCOMSV(4,10),CEMODC(4)    , CHD34720
     2CEMODV(4,10),CEXPC(4)      ,CEXPV(4,10)  ,CLCOEF       ,CMWGAS(4)   , CHD34730
     3CNUC(4)      ,CNUV(4,10)   ,CSHRSC(4)    ,CSHRSV(4,10),CSTRO(205)   , CHD34740
     4CTENSC(4)    ,CTENSV(4,10),GP(205)       ,PERMC        ,PIN         , CHD34750
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     5POROSC        ,POROSV(10)   ,PSTR1(205)   ,PSTR2(205)   ,PSTR3(205)   , CHD34760
     6RIN           ,RSTRO(205)   ,SHRSTR(205)  ,SSMAX(205)   ,RAD(205)       CHD34770
     7,NSLART                                                                 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/BLOCKR/DIFC(4),FROC(4),FRODE                                     CHD34830
      COMMON /DACOM/ UPRED(897),ITERT,MAS(74),NASW,UPSIT(84),TAU1             CHD34840
      COMMON /MASCOM/ 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(20CHD34870
     35),WBRN(205),SMWT(205),PRG(205)                                         CHD34880
     4,TIMEX(50),TET(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 (RHO5(119),RHOR(1)) , (CHARPT(2),XR(1))                     CHD34950
     1            ,(RHOU(1),RHO5(205)) , (PRHOA(1),XVIRG(1))                  CHD34960
      DATA HLAM1/6H LAMIN/,HLAM2/2HAR/,HTURB1/6HTURBUL/,HTURB2/3HENT/         CHD34970
C                                                                             CHD34980
C                                                                             CHD34990
C                    PRINT TEMPERATURE, DENSITY, AND GAS PRESSURE DISTRIBUCHD35000
C                    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+203                                                             CHD35070
      IF (I-NREND) 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(LTCHD35300
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     1),SILCA1(LT),PRG(LT),FMWT(LT),SPEED(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)-XLEFT(1)                                            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),WDEP(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     VELOCITY/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,F12.5 ,F9.3,E13.5)     CHD35630
 1021 FORMAT(1H0,6X=3HGAS 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(I4,E11.4,1X,4F9.2,8E10.3)                                  CHD35700
      END                                                               CHD35710
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- FOR TBSTEP,TBSTEP
      FUNCTION   TBSTEP (TAU1,TIME1,DSTEP,NPTS)                         CHD35720
      DIMENSION TIME1(1),DSTEP(1)                                       CHD35730
      I=2                                                               CHD35740
    3 IF (I-NPTS) 5,5,4                                                 CHD35750
    4 TBSTEP=DSTEP(I-1)                                                 CHD35760
      RETURN                                                            CHD35770
    5 IF (TAU1-TIME1(I)) 7,6,6                                          CHD35780
    6 I=I+1                                                             CHD35790
      GO TO 3                                                           CHD35800
    7 CONTINUE                                                          CHD35810
      TBSTEP=TIME1(I)-TAU1                                              CHD35820
      TBSTEP=AMIN1(TBSTEP,DSTEP(I-1))                                   CHD35830
      RETURN                                                            CHD35840
      END                                                               CHD35850
                                                                        CHD35860
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- FOR OUTPUT,OUTPUT
      SUBROUTINE OUTPUT (MTO)                                           CHD35870
      COMMON /BLOCKA/                                                   CHD35880
     1ABSORP(10)  ,ABSC        ,ACTENC      ,ACTENS      ,ACTENV(4,10), CHD35890
     2BSTAR       ,CCPC(4)     ,CCPG(4)     ,CHARPT(101) ,CKC(4)      , CHD35900
     3COEFT(4,10) ,CONDC       ,CONDV(100)  ,CONST(4,10) ,COVERX(100) , CHD35910
     4CPBAR       ,CPC         ,CPV(100)    ,DIFREC      ,UMATER(10)  , CHD35920
     5EFCOLC      ,EFCOLS      ,EFCOLV(4,10),EMIS(10)    ,EMISC       , CHD35930
     6HOFM(10)    ,HCOM        ,HCOMG       ,HSUB        ,MAT(100)    , CHD35940
     7MATOMN      ,MATMNE      ,MN          ,NN          ,NNP         , CHD35950
     8NNSAVE      ,NRDIV       ,NREND       ,NRGO        ,NST         , CHD35960
     9PARTIN(101) ,PHI         ,QBYRAD      ,QCOMB       ,QEXTR       , CHD35970
     1QGPCOM      ,QSUBL       ,RECPRO      ,REORDC      ,REORDS      , CHD35980
     2REORDV(4,10),RHO5Z       ,RHO5(305)   ,RHOCPX(101) ,RHOC        , CHD35990
     3RHOV(10)    ,SABL        ,SABLC       ,SDOT        ,SDOTC       , CHD36000
     4SLOPE(10)   ,TMELT(10)   ,TSZ         ,TS(205)     ,TRCHAR      , CHD36010
     5WFZ         ,WF(205)     ,XCHAR       ,XINIT       ,XLEFT(101)  , CHD36020
     6XMASS       ,XMDOTC      ,XMDOTD      ,XMDOTG      ,XMDOTL      , CHD36030
     7XMDOTR      ,XMDOTS      ,XTOTAL      ,XVIRG(101)  ,XZONE         CHD36040
      COMMON/BLOCKC/                                                    CHD36050
     1BLPRES(20,11)            ,COMMAX      ,CUTOFF      ,F(20,11)    , CHD36060
     2FLOW(20,11) ,HCONV(20,11),IERROR      ,JUNCT       ,L           , CHD36070
     3N           ,NOSECH      ,QBACK       ,QCONV(20,11),QGAS(20,11) , CHD36080
     4QMISC       ,TIME        ,IPRINT      ,TWALL(20,11),XIWALL(20,11), CHD36090
     5XIR(20,11)                                                        CHD36100
      COMMON/BLOCKR/DIFC(4),EROC(4),ERODE                               CHD36110
      COMMON /NASCOM/ CHARRO,AIRM,                                      CHD36120
     1CARBN1(205),CARBN5(205),SILCA1(205),SILCA5(205),PYRO(205),DEP(205)CHD36130
     2,HYD(205),AERO(205),AERN(205),BURN(205),WFD(205), WDEP(205),WSI(20CHD36140
     35),WBRN(205),EMWT(205),PRG(205)                                   CHD36150
     4,TIMEX(50),TFT(50),NPTS                                           CHD36160
     5,POR(205),PERM1(205),PERM2(205),VISC(205),GCON,RHOTS,CARTS,SILTS, CHD36170
     6PORT,PERT1,PERT2,DCOH,DCOO,DCOPY,DCODP,DCOSI,DCOCM,DCON,CFXH,CFXO,CHD36180
     7CFXPY,CFXDP,CFXSI,CFXCM,CFXN,DIFCO(205),SOX(205)                  CHD36190
     8,ALLGAS(205),GRAF1(205),GRAF5(205),SPEED(205),DIFCH(205),DIFR(205)CHD36200
     9,VISCO,VISCON,AF,BF,SILICA,REO,PMW,DMW,HMW,AOMW,ANMW,SMW,BMW,CX(6)CHD36210
     1,QSI,QBRN,QDEP                                                    CHD36220
      WRITE (6,1049)                                                    CHD36230
      DO 10 I = 1,MTO                                                   CHD36240
      WRITE (6,1050) I                                                  CHD36250
      WRITE (6,1051)                                                    CHD36260
      WRITE (6,1052) ACTENV(I,1),ACTENV(I,2),EFCOLV(I,1),EFCOLV(I,2),   CHD36270
     1REORDV(I,1),REORDV(I,2)                                           CHD36280
      WRITE (6,1053) HOFM(I)                                            CHD36290
      WRITE(6,1054) (COEFT(I,J),J=1,4),(CONST(I,J),J=1,4)               CHD36300
      WRITE(6,1055) EMIS(I),ABSORP(I),RHOV(I),SLOPE(I)                  CHD36310
   10 CONTINUE                                                          CHD36320
      WRITE (6,1056)                                                    CHD36330
      WRITE (6,1057)                                                    CHD36340
      WRITE (6,1052) ACTENC,ACTENS,EFCOLC,EFCOLS,REORDC,REORDS          CHD36350
      WRITE (6,1058) HCOM                                               CHD36360
      WRITE (6,1060) HSUB                                               CHD36370
      WRITE (6,1061) EMISC,ABSC,RHOC,TRCHAR                             CHD36380
      WRITE (6,1062) CHARRO                                             CHD36390
      WRITE (6,1063)                                                    CHD36400
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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  (,I2,1H))                            CHD36540
 1051 FORMAT (1H0,59X10HFIRST REAC,6X11HSECOND REAC)                    CHD36550
 1052 FORMAT (1H ,24X,28HACTIVATION TEMPERATURE,DEG R ,6X,F10.1,6X,F10.1CHD36560
     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,26X,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 (1HC,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
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     129HDIFFUSION 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,14HREACTION 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,E14.6CHD37090
     3,E16.6)                                                          CHD37100
      RETURN                                                           CHD37110
      END                                                              CHD37120
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