PROPELLANT IGNITION AND COMBUSTION IN THE 155MM HOWITZER E. B. Fisher, et al Calspan Carporation

AD-A013 577

Prepared for: Picatinny Arsenal

January 1975

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PROPELLANT IGNITION AND COMBUSTION IN THE 155MM HOWITZER

E. B. Fisher and K. W. Graves

Calspan Report No. VQ-5524-D-2

Prepared For: U.S. ARMY PICATINNY ARSENAL DOVER, NEW JERSEY

JANUARY 1975 CONTRACT NO. DAA A21-74-C-0401 AMCMS CODE NO. 4932.05.41861 FINAL REPORT

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FOREWORD

The work of this technical report was performed under Contract No. DAAA21-74-C-0401, by the Thermal Research Branch, Systems Research Department of Calspan Corporation for the Quality Assurance Directorate, Picatinny Arsenal, United States Army. The work was monitored by Messrs. F.J. Fitzsimmons and P. Serao of Picatinny Arsenal. The work described in this report was conducted during the period from May to December 1974.

This report contains only those modifications that were made to the Calspan 175mm gun model. It is recommended that References 1 and 2 be reviewed in order to obtain a better understanding of the details of the complete model.

ABSTRACT

A mathematical model has been formulated and programmed in FORTRAN IV, for use in the propellant charge design and investigation of the performance anomalies for the 155mm howitzer. The model solves the unsteady gas dynamic equations for conservation of mass, momentum, and energy by finite differencing simultaneously with auxiliary expressions for such important features as gas generation, bed friction. barrel boundary layer development, and projectile acceleration, until the projectile leaves the muzzle. This report details the mathematical concepts and experimental results that were incorporated into modifications of an existing mathematical model (for the 175mm gun) from which the 155mm howitzer model is derived.

The major modifications to the basic model include a better description of propellant movement, propellant bed compression, and more detailed representation of primer jet effects upon ignition sequences such as igniter base pad penetration, and heating of black powder. Flame spread in the base pad was also incorporated as well as center core loading tie failure and its subsequent compression and jamming in the igniter tube. Phenomena observed from movies of ignition sequence experiments were delay time for the important events and the effectiveness of ignition of the center core loading without benefit of the base pad igniter. Experiments were also conducted to measure propellant bed friction factor and to investigate the validity of the expression for bed friction.

Sensitivity analyses were performed using the computer program. They revealed the exceptional effectiveness of center core ignition for promoting uniform chamber pressure distribution during firing. The wave dynamics detected from some of the firing tests using the XM123E2 highperformance propellant charge were reproduced by the computer program only for charge configurations involving abnormal ignition such as a flawed igniter tube. One common cause of waves is the interference in the action of the igniter tube to relieve longitudinal pressure differences. The extreme case of the lack of this relief is represented by the end ignition configuration which was shown to be very sensitive to the initial conditions of standoff, loading, density, and chamber length. The first two conditions were of little significance to performance with a properly functioning center core igniter.

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1.0 INTRODUCTION

The 155mm howitzer is in the process of being upgraded to higher performance levels. The high performance propellant charge is designated XM123 and contains M30Al propellant. The charge design incorporates a black powder base pad and center core igniter tube with a black powder charge.

Chamber pressure measurements made during firing tests with this propellant charge have exhibited dynamic wave phenomena under certain conditions. The waves have been strong enough in several instances to result in breech-blow gun failures. Pressures as high as 90,000 psi have been detected at the breech during one such failure. Subsequent investigation into the causes of dynamic phenomena have identified at least three sensitive parameters. These are charge standoff (the distance from the primer flash hole to the base of the charge), primer strength, and propellant loading density. For example, strong waves were observed with a strong primer, zero standoff, and high loading density.

Calspan has been actively engaged in formulating mathematical simulations of mortar and artillery systems. The mathematical model of the 175mm gun (References 1 and 2) was recently completed under Contract No. DAAA21-72-C-0577. This model provided representation of center core ignition, flame spread, and interior ballistics of the gun. Using this model it is possible to assess the sensitivity of propellant ignition and combustion characteristics on muzzle velocity as well as to aid in the understanding of phenomena associated with center core ignition.

The ultimate object of this project was to use Calspan's dynamic simulation of propelling charge ignition phenomena as an analytical tool to reveal details of the mechanisms that lead to wave generation, identify any additional sensitive parameters, and pose potential solutions to the problem.

The basic 175mm gun code was modified during this program to represent a variety of gun features and postulated events that could conceivably occur during a gun firing. The code underwent an exhaustive debugging and validation period and finally was used to conduct a parameter sensitivity analysis. The details of the code modification and improvements, and the results of the sensitivity analysis are presented in this report.

2.0 SUMMARY OF ASSUMPTIONS

The 155mm howitzer gun is a rather complex system. Performance depends on the action and interaction of numerous components and physical and chemical phenomena. Exact representation of all these would be impractical both in the implementation of the model and in its execution. Certain simplifying assumptions have helped to make the problem tractable while at the same time, the essential features have been retained. The important assumptions of the model are listed below:

- The igniter tube is allowed to fail, grid by grid, either by tensile or compressive loading. In addition, combustion can cause the tube to disappear and allow propellant to shift into the region formerly occupied by the tube.
- (2) Propellant grains are assumed to have the thermal properties of good insulators and to be effectively semi-infinite in thickness for surface temperature calculations.
- (3) Ignition is assumed to occur when the surface temperature of a propellant or black powder grain reaches a critical value. This is allowed to occur in two stages: one due to the convective heating of gas flow through the propellant bed, and one due to direct impingement of gas flow through igniter tube holes. The latter stage affects only a small fraction of the total amount of propellant in a grid.
- (4) The gas state is assumed to be adequately represented by the ideal gas equation of state with secant values of gas properties defined by the ideal gas equation; that is, $H = c_n T$ and $R = P/_{2} T$.
- (5) The propellant in each finite difference grid is represented by the dimensions of a typical grain, which are subject to change due to burning and an averaging process associated with propellant movement.
- (6) Main charge bag strength is assumed to be negligible considering the high pressures generated by the gas.

- (7) If a fraction of a grid contains a portion of the main charge igniter, that portion is assumed to be evenly distributed throughout the grid.
- (8) Propellant in the chamber is free to move in either axial direction but not radially.
- (9) Propellant in the barrel is free to move only in the direction of the projectile.
- (10) The rotating band of the projectile forms a perfect seal with the barrel.
- (11) Combustion of black powder and M30 propellant is assumed to be pressure dependent only. Erosive burning effects are not included.
- (12) The bands and grooves of the rifling are assumed to have no influence upon the character and growth of the boundary layer.

3.0 MATHEMATICAL MODEL CONFIGURATION

The mathematical model of the 155mm howitzer as modified from the existing 175mm gun model, is intended to serve as an analytical tool to aid in determining the causes of dynamic wave phenomena that have been observed in the XM123 propelling charge. The identification of these causes permits use of the mathematical simulation to evaluate potential engineering solutions to the problem. The model represents all elements of ignition, combustion, and their relationship to the wave problem.

The problem of interest involves the ignition, flame propagation, propellant deflagration, and unsteady gas and propellant flow that occur during the firing of the 155mm gun. The interactions of the various components and phenomena are illustrated in Figure 1. It is important to include all these phenomena in the mathematical model so that the individual effects of each can be ascertained and applied to the general functional representation of gun dynamics.

The mathematical model consists of two major routines, the Chamber and Barrel Routines with domains as illustrated by Figure 2. The Chamber Routine calculates propellant ignition and deflagration in the gun chamber. The Barrel Routine handles the unsteady gas flow, boundary layer, and projectile motion through the barrel. The components of the 155mm howitzer that are considered in the model are defined and discussed in Section 3.1, while the actual structures of the two major routines are described in the remainder of the chapter.

3.1 GENERAL CONFIGURATION OF 155MM HOWITZER

The general configuration of the 155mm howitzer is shown in Figure 3. The shell provides the major portion of the cross-sectional area upon which the pressure acts. The rotating band performs a sealing function as well as the means for producing rotational acceleration. Any leaks past the band tend to reduce system efficiency. However, because this band undergoes an interference fit as it enters the barrel, the seal is assumed to be tight, allowing negligible loss of gas.

The ignition system and main propelling charge occupy the gun chamber. The maximum propelling charge consists of eight zones of M3OA1 multiperf propellant. The maximum charge contains a nominal 26 lbs. of propellant. The full charge length is no more than 30.5 in., which is slightly less than the distance from the breech to the base of the projectile. The breech spindle of the XM198 155mm howitzer has positioning pads to assure a charge standoff of at least one inch. With this, the charge nearly touches the projectile base. The outer diameter of the charge is somewhat less than the chamber diameter in order to facilitate loading. This gap can allow gas to flow around in addition to through the bed of propellant and through a center core igniter tube.

Figure 1 BREAKDOWN OF 155 mm HOWITZER PROPULSION SYSTEM



BARREL BALLISTICS: BARREL FLOW AND PROJECTILE DYNAMICS





The last

Figure 2 SCHEMATIC DIAGRAM OF THE 155 mm HOWITZER SYSTEM ILLUSTRATING THE DOMAINS OF THE TWO COMPUTER ROUTINES



The XM123-Zone 8 propellant charge contains an igniter consisting of a nitrocellulose center-core tube enclosing a bag of black powder, which is tied to the tube at each end, known as the center core loading or snake. A base pad of black powder is located at the entrance to the center igniter tube. A gap of three inches separates the base pad from the beginning of the snake. The igniter tube contains a few holes near either end to anchor the center core loading. The tube is capped at the projectile end.

The actual gun system firing sequence is initiated when the primer is fired and primer gas flows from the flash tube. This causes a sequence of events resulting in black powder ignition. Hot gas and burning particles generated by the burning black powder flow through the igniter tube and into the end of the propellant bed. The grains of the main propellant charge and the combustible igniter tube are heated by this flow and eventually become ignited. After ignition, the propellant burns at a rate governed by local conditions. Gas flow through the propellant creates forces that result in movement of the bed. As pressure increases, loads on the burning igniter tube increase and eventually cause the tube to collapse. At this point, the space between the propellant bed and the chamber walls probably becomes loaded with propellant so that the chamber system may be simply represented as having a homogenous cross section of burning propellant.

As the pressure builds up in the system, the force created by pressure acting upon the projectile base overcomes the force restraining the projectile. This restraining force is a result of the material extrusion/shearing phenomena that occur while the rotating band is engraved. When this "shot start" force is reached, the projectile begins significant acceleration. As the projectile travels through the barrel, it is accelerated in a rotational direction at a rate proportional to the axial acceleration. These inertia forces, along with friction and engraving forces, constitute the projectile retarding forces.

Gas and propellant flow into the barrel behind the moving projectile. The gas loses energy and momentum through the boundary layer while it does work in overcoming retarding forces. The sequence of events of interest in this model terminates when the projectile leaves the muzzle.

3.2 CHAMBER ROUTINE

The Chamber Routine calculates all phenomena concerned with ignition, gas generation, and flow inside the chamber of the 155mm howitzer. This routine is basically the same as the corresponding routine for the 175mm gun code. The grid formulation consists of parallel onedimensional networks, one to describe the center core igniter tube, one for the main charge, and one for the gap between the main charge and chamber as shown in Figure 4. This system has many advantages, such as flexibility in defining the radial dimension of each grid network as a function of axial position, and arbitrary selection of grid size. Gas is allowed to flow between grid networks through simulated or pseudo holes in the boundary thereby achieving a semblance of radial mass and energy transport.

The basic equations of fluid motion with terms to take the porous, variable area bed into account are used to calculate flow propagation through the bed. These equations are the well-known, universal relationships that express conservation of mass, momentum, and energy. These equations contain terms to include gas generation by burning propellant and other source or sink terms such as heat transfer losses and mass flow through igniter tube and pseudo holes. In addition, equations expressing conservation of mass and momentum are included in order to express movement and compaction of the propellant bed.

The primer output is represented in terms of jet pressure, mass, and energy flux. The loads on the base pad and train of powder in the igniter tube are computed to determine (1) if a hole is punched in the base pad and (2) if the igniter charge of black powder is torn loose and driven down the tube. While ignition can occur naturally, instantaneous black powder and/or propellant ignition has been represented at time zero in one or more grids for sensitivity study purposes, in order to accelerate and accentuate certain events. In any case, remaining black powder becomes ignited by convective heating from the primer and previously ignited portions of the charge.

The treatment of flow through igniter tube and pseudo holes has been simplified but still retains the essential features. Gas flows sonically or subsonically through the holes, according to the existing pressure ratio, across the hole. This radial outflow creates radial gradients in the bed, but the model assumes that an exhausting elemental volume loses gas uniformly.

At some point, the igniter tube fails due to either tension or compression, it is or simply consumed by combustion. The failure is allowed to occur on a grid by grid basis. When the interior pressure exceeds the outer pressure by a given amount, the tube is assumed to split and a pseudo hole is added to the grid where a solid boundary had previously existed. If failure occurs in compression, the tube is assumed to collapse, a pseudo hole is added, and, in addition, propellant from the main charge is mixed with the black powder on the axis. When the black powder is completely consumed, the multiple one-dimensional grid matrix is converted into a single one-dimensional network. This is achieved through a weighted average of all grids at each axial location throughout the chamber.



Figure 4 MULTIPLE ONE-DIMENSIONAL CHAMBER GRID NETWORK FOR THE 155 mm HOWITZER

The breech end of the chamber is assumed to be reflective; that is, waves are reflected with no losses. The multiple one-dimensional formulation requires no specification of wall boundary conditions. The downstream end of the chamber is non-reflective and allows a smooth flow of gas into the barrel after the projectile has moved at least one grid length. Prior to this, the projectile base conditions are computed by the chamber routine and the base is assumed to be a reflective surface.

Basic inputs for the Chamber Routine include the chamber and propelling charge geometry pertinent to propellant ignition, gas generation and flow, and propellant geometry and burning characteristics. Essentially all elements of the igniter system that could conceivably influence gun performance were included in the mathematical model. Virtually none of these elements is built into the program but, rather each is an input that can be varied independently from the others.

3.3 BARREL ROUTINE

The Barrel Routine accepts the flow of gas and burning propellant from the chamber and performs the unsteady gas flow and projectile motion calculations until the projectile eventually passes from the barrel. These calculations are performed in a one-dimensional framework which assumes that all two-dimensional effects can be assigned to boundary layer -type calculations. The grid network used to represent the barrel is shown in Figure 5.

The one-dimensional equations of fluid motion, modified to take the presence of solid propellant grains into account, are used to calculate the gas flow. These equations express conservation of mass, momentum, and energy for each grid and include losses of momentum and energy as well as the mass flow area constriction due to viscous effects of the boundary layer in the barrel and heat transfer to the barrel wall. Propellant movement is calculated from pressure gradients and drag forces exerted by gas flow. This is simplified by allowing propellant to move in one direction, away from the breech.

The individual items that influence projectile motion have been accounted for separately rather than being lumped into an effective projectile mass or resistance function. The main propelling force is that due to pressure acting on the projectile base. Retarding forces are considered individually and consist of the force required to engrave the rotating band, the component of the accelerating force producing rotational acceleration, and frictional resistance. The engraving force is a result of the extrusion process and subsequent slip fit/galling condition encountered by the projectile rotating band as it begins motion through the barrel. Rotational acceleration depends upon the axial moment of



inertia and the twist of rifling. It is a component of the total acceleration that detracts from the effect of the pressure force, and in this sense, it acts as a retarding mechanism. The frictional force is determined as a result of rotational acceleration. The torque required for rotational acceleration is supplied by a resultant force normal to the rifling. The retarding force occurs as a result of the coefficient of friction between the rotating band and the rifling and this force. Another resistance force that has been included is the pressure head that is developed ahead of the projectile.

Barrel Routine calculations are initiated with the projectile at rest and located at the first or second grid of the barrel network, whichever is specified. When the pressure force exceeds the assumed initial resistance force the projectile starts to move. As the projectile travels through the barrel, grids are added to the network. Initially, a relatively small grid size is required in order to supply the required computational accuracy. As the projectile moves through the barrel, the number of grids in the entire system is cut in half from time to time, greatly accelerating the calculation while providing acceptable accuracy.

The one-dimensional barrel calculations require no specification of radial boundary conditions. The initial grid of the barrel network is common with the last row of chamber grids and is loaded with weighted averages of parameters from these chamber grids. Therefore, no specific boundary conditions are applied to the barrel entrance. The barrel grid network is terminated at the projectile base, which is a reflective boundary moving at the projectile velocity.

Inputs to the Barrel Routine consist mainly of projectile characteristics, which include equivalent pressures to represent retarding forces, mass and moment of inertia, representative base radius, and friction coefficient. Barrel length and constants describing the twist of the rifling are also input parameters.

4.0 EXPERIMENTAL SUPPORT

A variety of experiments were conducted to investigate peculiarities of the action of some components and to measure certain quantities to aid in the description of associated phenomena. The use of properly designed experiments for these purposes is necessary to insure that the simulations are realistic in those cases where the available theory and experimental results are deficient. The experiments deemed necessary for adequate modeling of the 155mm gun included tests for measuring ignition temperatures of black powder and M30 propellant, experimental studies of center core ignition by high speed photography, compression characteristics of black powder, and propellant bed resistance to flow. Details of these experiments are described in the subsequent paragraphs.

4.1 BLACK POWDER AND PROPELLANT GRAIN IGNITION TESTS

Tests were conducted to measure the ignition temperature of both M30 propellant and black powder using the hot plate method. A steel plate, 1/2 inch thick, 4 inches by 6 inches, was fitted with an imbedded chromel alumel thermocouple by peening it into a shallow hole at the center of the plate. It was placed on a tripod for heating by a large Bunsen flame so that the thermocouple wires were not exposed to flame. Readout was done by means of a Brown potentiometer. The procedure was to adjust the flame to obtain a steady plate temperature, and then to drop the powder granule or grain onto the plate near the thermocouple while simultaneously starting a stopwatch. The stopwatch was stopped in the case of the propellant when vigorous degassing started (this was usually followed by flame in one or two seconds). In the case of black powder it was stopped when the black powder exploded into flame. Only the larger size black powder granules were used in the tests because it was found that small or thin granules ignited much sooner than the bulkier granules. The contacting surface of these larger granules was approximately 3/16 x 3/16 in.

Results are plotted in Figures 6 and 7. Although this method produces heat transfer to the grain in a different manner than it experiences in a gun chamber, and the actual temperature measured is that of the plate that heats the grain instead of the surface of the grain, the method is used universally and provides a relative value for ignition temperature that is useful. It is especially easy to interpret if, as plate temperature is slowly decreased, a point is reached where delay begins to increase rapidly. This is definitely the case with M30 propellant. The curve for black powder does not show this point because test temperatures were limited to 860° F but the trend is obvious. The inputs to the computer program require a single value of ignition temperature of each component. It can be seen from the figure that 850° F for black powder and 450° F for M30 would be reasonable values to use for the program.



Figure 6 HOT PLATE IGNITION TESTS FOR M30 PROPELLANT

15



Figure 7 HOT PLATE IGNITION TESTS FOR BLACK POWDER

4.2 CENTER CORE IGNITER SYSTEM TESTS

High speed motion pictures were taken of the ignition sequences and burning with the center core loading installed in a transparent tube. The test setup was the same as previously used for similar studies of the 175mm igniter system, Ref. 1. It was arranged so that the MS2 primer fired through a 1/4 inch inside-diameter flash tube, 5 1/2 inches long. The jet emerging from this tube was directed into a transparent tygon tube of 1 inch inside diameter across a gap that could be varied in distance to represent standoff and to accommodate the base igniter pad. The transparent tube was 28.5 inches long with holes in its walls for securing the center core loading as in the 155mm igniter tube. Two Fastax motion picture cameras were set up several feet away to photograph the burning sequences. A large shield was fitted over the transparent tube, located 1 inch from its primer end and secured in an orientation perpendicular to the tube axis to delay obscuration by smoke in the optical path of the cameras. The test setup is shown schematically in Figure 8.

Three firings were conducted. The first incorporated a full igniter charge complete with base pad and center core loading at a standoff of 1/2 inch. The second used only a partial center core loading (1/2 oz. of black powder) sewn snugly into a shortened igniter bag and secured in the transparent tube with its primer end situated exactly as would the end of a full charge. The purpose of this test was to measure the ignition delay at a total gap of 1 inch without benefit of the base igniter pad.

The third test again used a full igniter charge but at 0 standoff to determine if the center core loading would move down the tube in any manner during the early stages of its burning.

No perceptible movement of the igniter bag took place during the first test. After initial flow of the primer jet (ignition of the base pad could not be distinguished from this) the powder in the base pad burned vigorously. But its incandescence was considerably diminished before initial ignition occurred in the igniter tube. This delay was 335 milliseconds! The center core loading ignited several points along the tube and by 20 milliseconds later it had erupted into a single bright image over the full length of the tube.

The second test revealed that the center core loading ignited almost instantly 5 milliseconds after firing of the primer even though the nearest grains of black powder were 4 inches from the jet exit. Once again the ribbons securing the igniter bag were not torn away by the primer jet blast. These tests vividly demonstrate that the presence of the base pad seriously delays center core ignition.

The third test showed the same events even more clearly than did the first. Ignition spots on the center core loading were very



distinct and after eruption gases could be seen to flow in both directions away from the central regions of the tube. Again the ribbons securing the igniter bag held the charge until all was flame in spite of the zero standoff, which demonstrates that as long as the M82 primer is used for the 155mm gun this igniter system can be considered to burn in its original loaded configuration. The delay between the appearance of flame from the burning base pad and ignition of the center core loading was 90 milliseconds.

4.3 STRENGTH TEST OF RIBBONS FOR SECURING IGNITER

A test was conducted to measure the strength of the pair of ribbons that are used to secure the center core loading in the igniter tube. The test fixture was arranged to load the ribbons as well as their attachment to the loading bag so that failure would reveal the weaker point, as well as a measurement of its strength. The bag was clamped in a vise so that the ribbons hung below it where they could be attached to a pan for applying the load by hanging weights. This was done in increments of one pound until a total weight of 24 pounds was reached whereupon the ribbons tore away at their point of attachment to the bag.

4.4 COMPRESSION TEST OF CENTER CORE LOADING

A test was devised to measure the compression characteristics of the center core charge in the igniter tube. A center core charge was cut to a four inch black powder bed length and the cut end was closed by stitching. It was placed in a six-inch long rigid tube having the same inside diameter as the igniter tube (1.17 in.) and this was placed upon a weighing scale so that it rested on one end. A cylindrical shaped ram was placed in the other end (its diameter was only slightly less than the tube I.D.) so that its lower end contacted the bag of black powder. The ram extended several inches above the upper end of the tube so that it could be pressed into the tube a sufficient distance to crush the loading completely.

The whole apparatus was placed in an arbor press for application of the compressive load. It was applied slowly and interrupted at intervals, while a steady load was maintained so that the travel of the ram could be measured by a vernier scale. The load was increased in steps in this manner until a load of 200 lbs. was reached.

Results are presented in Table I as compressive force vs. ram travel. These data were proportioned for a full length core loading of 24 in. (multiplied by 6) and presented in the third column as equivalent deflection of core loading.

TABLE I

Compression Characteristics of the Center Core Loading in the Igniter Tube of the 155mm Gun

oading - in													
Equivalent Deflection of Core Lo	2.166	2.832	4.686	5.526	6.480	6.750	7.218	8.436	8.622	10.122	10.590	11.250	12.378
Ram Travel -inches	0.361	0.472	0.781	0.921	1.080	1.125	1.203	1.406	1.437	1.687	1.765	1.475	2.063
orce 1b.	20	30	40	50	60	70	80	06	100	110	160	170	200

MEASUREMENT OF PROPELLANT BED RESISTANCE TO FLOW

4.5

The resistance to gas flow offered by a bed of gun propellant is a governing factor that determines the movement of the propellant. Therefore, flow resistance data for actual 155mm gun propellant is necessary for use in the mathematical model if proper movement of the propullant is to be simulated. Because specific data was nonexistent a special apparatus was fabricated for its measurement using steady air flow through a bed of actual or inert propellant. The test philosophy was based upon duplication of grain dimensions in a bed of representative size, and duplication of Reynolds number for modeling the flow conditions. The use of cold air for testing was made possible by the fact that the Reynolds number for hot propellant gas flow, at conditions of chamber pressure above 20,000 psi, can be duplicated in cold air flowing at comparable velocity but with pressures from 10 to 100 psi. The object was to obtain sufficient data to evaluate bed friction factor and to determine the validity of the relations used for computing bed friction, i.e., drag in the model.

The apparatus confines a bed of propellant within a 4-inchdiameter pipe between heavy screens so that air may be blown upward through it over a wide range of pressure. To achieve this, the apparatus is connected to a compressed air supply so that pressure at the bed entrance may be varied up to 250 psi. A schematic diagram of the apparatus is shown by Figure 9. It is essentially a 4-inch I.D. pipe fixed in a vertical orientation, with a 1 foot long removable length that can be filled with propellant grains. These are restrained from falling through by a heavy screen of 3/16 inch diameter wire spaced 3 x 3 to the inch. In addition, an upper screen of the same material is provided to prevent lifting of the bed by the air flow. This screen can be positioned at various heights by the use of spacers. Pressure taps and thermocouple fittings are provided along the bed walls at 2-inch intervals. The pipe outlet is fitted with a precision orifice meter made and installed to satisfy requirements as a choked-flow meter according to Ref. 3.

Inert M30 propellant was tested over a wide range of air flow from that just sufficient to lift the bed off its lower screen, at a Reynolds number = 4500, based upon bulk velocity and effective particle size, to a flow rate 25 times greater where the particle Reynolds number was 163,000. Average grain length was 0.80 inch and outer diameter was 0.42 inch for an effective particle size, $D_p = 0.59$ inch (defined as the diameter of a sphere having the same volume as the particle). In addition, a shape factor of 0.82 was computed from the relation $\phi_s = 4d/(d+4L)$ where L is grain length and d is its diameter, Ref. 4.

In preparation for the tests, 1326 grams of inert propellant were placed in the test section. When it was vibrated until completely settled, the bed depth was 7 1/2 inches. At this condition, the measured





voidage was 0.41, obtained by pouring a measured amount of water into a straight sided container holding similarly packed propellant to a known depth. Bed pressure drop was measured for the fluidized bed configuration, which was obtained with the upper screen located 2 inches above the top of the bed. Pressure drop at higher flow rates was measured with the bed restrained completely. Test data and results are presented in Table II. Friction factor was computed from the relation:

$$f = \frac{0.25 \phi_s \phi^3 \Delta P}{1 - \phi} / \frac{L}{\rho} / \frac{V^2}{D_p z_g}$$

where

n	is the diameter of a sphere having the same
P	volume as the particle
L	is the bed length, ft.
$\Delta_{\mathbf{p}}$	is the pressure drop, psf.
v	is the superficial velocity, = \emptyset times actual
	velocity, fps
P	is the fluid density, lbs/ft ²
Ø	is the porosity
ø	is the shape factor, equal to the area of a sphere
3	having the same volume as the particle divided
	by the particle surface area

The results show that friction factor varies only slightly over the test range of Reynolds number. The amount of variation is approximately the same as the experimental error, except for the first and last run. Furthermore, the fact that f is almost invariant over the range of Reynolds number from 40,000 to 140,000 range lends credence to the validity of the expression for bed friction from which the foregoing relation for f is derived. This expression was, of course, originally obtained by a correlation of results from tests similar to those described in this report but using different shapes of granulated materials.

4.6 CONCLUSIONS AND SUMMARY OF EXPERIMENTAL EFFORT

Results obtained from experiments described in this report were very useful to the correct representation of the 155mm howitzer by the computer model. Specific phenomena were demonstrated and their natures defined in sufficient detail to permit mathematical description.

The ignition temperature as a function of delay was measured by the hot plate method for black powder and the M30 propellant grain. Although this method suffers obvious disadvantages as pointed out previously its results were easy to interpret in the case of black powder and M30 propellant, thereby yielding useful values for ignition temperature as required by the computer program. Specifically, these were 850°F for the black powder, and 450°F for the M30 propellant.

TABLE II

Pressure Drop Test Results in Inert M30 Propellant Bed

	1.102	0.916	0.955	0.922	0.916	0.950	0.920	106.0	0.820
Rep	4530	47200	73300	86000	108700	121300	131200	141400	163300
£	7.5	2.0	_				_	_	-
∆ P across height, h~in.	0.82	7.0	8.0	9.0	11.5	12.5	13.0	14.0	15.0
Bulk Air Velocity fps	12.6	45.2	46.5	46.3	47.0	45.5	45.4	45.8	46.3
Average Bed Air Denşity 1b/ft	180	.225	.254	.298	.373	.416	.450	.485	.560
Air flow rate lb/sec	0.09	0.927	1.030	1.204	1.528	1.652	1.780	1.938	2.260
Run	•_	2	3	4	s	9	1	80	6

indicates the fluidized bed condition. The pressure drop of 0.82 psi was just sufficient to lift the total weight of 2178 gms. (4.78 lb.) constituted by the propellant bed and the upper screen.

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High speed motion pictures of very good quality were taken of the ignition and burning of the center core loading both with and without the base igniter pad. This was made practical by the use of a thick tough transparent tube for simulating the igniter tube that houses the center core loading. Certain time delays were measured that could prove useful in assessing the effectiveness of the computer codes. Furthermore, specific phenomena were revealed such as the fact that the M82 primer jet does not dislocate the center core black powder charge, and that the charge ignites over its full length quite rapidly once it becomes ignited at some point. In addition, it was demonstrated that the presence of the base igniter pad absorbs some of the impact of the primer and drastically delays ignition of the center core charge.

The ribbons that secure the center core loading to the igniter tube were strength tested. Although the forces of the M82 primer jet will not cause ribbon failure, the data has been used in the program for studying the effects of firing with the XM119 primer, which may create forces sufficiently high to cause failure.

The center core loading was compression tested. These results mainly apply to the representation of the charge configuration with the stronger primer, because the need is contingent upon ribbon failure.

Propellant bed flow resistance was measured over a wide range of flow rate and particle Reynolds number. Results show that the revised relation for computing bed resistance to flow, as postulated in this report (See Section 5.8), is a valid formula for this purpose inasmuch as it provides a correlation of test data with a constant value for friction coefficient over the Reynolds number range of interest. Friction coefficient for M30 propellant was computed to be 0.95 from the data for the range of interest.

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5.0 DETAILS OF THE MATHEMATICAL MODEL

The 155mm howitzer computer code consists of the 175mm gun model described in Ref. 1 and 2 with several additions and modifications. The majority of the forty subroutines employed in the model experienced no or only minor changes. Only those new significantly modified subroutines are described in this chapter. However, all subroutines are listed in Section 5.1 and given a one-line description. A program flow chart and complete FORTRAN IV machine listing are given in Appendices A and B. Program input and output are discussed in Appendix C.

5.1 LIST OF SUBROUTINES

The computerized mathematical model is characterized as consisting of two major routines: Chamber and Barrel. The subroutines contained in these major routines as well as those that perform a function not specifically associated with a routine are given a one-line description below. A detailed discussion of the subroutines in the original code is presented in Ref. 2, while those subroutines added or modified during this program are described in subsequent sections.

Chamber Routine

(1)	AREAS	Calculates grid volumes and areas for use in finite difference calculations.
(2)	AXIS	Performs finite difference calculations in the igniter tube, the axis of the propellant charge.
(3)	AXIT	Performs two-dimensional finite differ- ence calculations in the propellant bed adjacent to the igniter tube.
(4)	AXIT2	Performs one-dimensional finite differ- ence calculations in the propellant bed.
(5)	AXIT3	Performs one-dimensional finite differ- ence calculations in the void space betweer the propellant charge and chamber wall.

(6)	BNDY	Performs two-dimensional finite differ- ence calculations at the outer boundary.
(7)	BPFIR	Calculates heating and eventual ignition of black powder grains.
(8)	BPINIT	Reads in and initializes black powder igniter charge.
(9)	BSURFA	Performs two-dimensional finite differ- ence calculations on the axis of an upstream solid boundary (breech).
(10)	BSURA2	Performs one-dimensional finite differ- ence calculations in the igniter tube at the breech.
(11)	BSURFB	Performs two-dimensional finite differ- ence calculations at the outer radial boundary of an upstream, solid axial boundary.
(12)	BSURFI	Performs two-dimensional finite differ- ence calculations at an interior point of an upstream solid boundary.
(13)	BSURFT	Performs two-dimensional finite differ- ence calculations at the outside igniter tube surface and an upstream solid boundary.
(14)	BSURT2	Performs one-dimensional finite differ- ence calculations for the propellant charge at the breech end.
(15)	BSURT3	Performs one-dimensional finite differ- ence calculations for the void region between the propellant charge and the chamber wall at the breech end.
(16)	CHSET	Reads in initial chamber data, initializes the chamber grid matrix and performs other necessary preliminary calculations before finite difference calculations begin.
(17)	DRAG	Performs simultaneous solution of drag

and updated gas velocity for finite difference subroutines.
- (18) FSURFA Performs two-dimensional finite difference calculations at the axis of a downstream solid boundary.
- (19) FSURFB Performs two-dimensional finite difference calculations at the outer radial boundary of a downstream solid boundary.
- (20) FSURFI Performs two-dimensional finite difference calculations at interior grid points at a downstream solid boundary.
- (21) FSURFT Performs two-dimensional finite difference calculations at the outer boundary of the igniter tube and a downstream solid boundary.
- (22) HOLES Calculates the igniter tube hole area that is assigned to each grid.
- (23) HOLSET Sets up the arrays of holes to include both igniter tube holes and "pseudo" holes that provide transport between adjacent grid networks.
- (24) INTER Performs two-dimensional finite difference calculations at interior points of the grid matrix.
- (25) MFLOW Calculates mass flow through igniter tube and pseudo holes.
- (26) ONEDIM Transforms the Chamber grid matrix from multiple one-dimensional or two-dimensional network into a single one-dimensional grid network.
- (27) PATHS Assigns values to an array of parameters that permits logical selection of the proper finite difference subroutine.
- (28) PRIMER Calculates burning of black powder in the 155mm howitzer.
- (29) PROPEL Calculates movement of propellant grains in the chamber.

(30)	PRPFIR	Calculates two-stage heating of propellant grains and eventual ignition.
(31)	PRPVEL	Calculates propellant grain velocity and black powder movement.
(32)	REGRES	Calculates burning of main charge.
(33)	TUBFAL	Calculates failure of igniter tube due to pressure loading and combustion.

Barrel Routine

(1)	BARSET	Reads in barrel and projectile input data,
		initializes the barrel matrix, and per-
		forms other initializing functions prior
		to start of finite difference calculations.

- (2) BNDLYR Calculates the tube boundary layer with associated viscous and heat transfer losses.
- (3) DIMIN Calculates deflagration of propellant that has moved into the barrel.
- (4) MOTION Calculates projectile acceleration and movement.
- (5) PROPMO Calculates velocity and movement of propellant that has moved into the barrel.
- (6) RHOUH Performs all finite difference calculations in the barrel grid matrix.

Other Subroutines

- (1) CLEAR Zeroes specified arrays or blocks of common storage.
- (2) GSPROP Calculates propellant gas properties.
- (3) MAIN Performs main logic function for the 155mm howitzer mathematical model.
- (4) NEWDX Reduces the number of grids involved in the finite difference grid matrix.

(5) UPDATE Updates the finite difference variables to the next time interval and provides for output of these variables.

The more significant additions and improvements provide for representation of such phenomena as: penetration of the igniter base pad by the force of the primer jet, radial flame spread in the igniter base pad after ignition at its center by the primer jet, movement of both propellant and black powder in large slugs packed to maximum density and encompassing many grid lengths, as well as in slugs of single grid length across grid boundaries, elastic response of the packed propellant when loaded in compression, and a more thorough expression for determining pressure drop through the propellant bed based upon actual experiments on the M30 propellant bed.

5.2 IGNITER BASE PAD PENETRATION

Base pad penetration can be brought about by either the process of burn-through after ignition or by shear failure as a result of primer The former phenomenon was featured in the basic computer jet blast. program as were some of the fundamental statements required to describe jet blast. Specifically, this included the statements for computing stagnation pressure in the primer jet in terms of time. However, it was necessary to add a factor to show dependence upon distance from the jet exit. Additional information on the jet width was needed which was obtained from a correlation (curve fit) of supersonic jet data from Ref. 5. This is:

$$\frac{\Psi}{r_{e}} = 1 + \left(\frac{\chi}{r_{e}}\right)^{\circ.815}$$

for the radius to the point where stagnation pressure falls off. (r, is the radius of the jet exit, i.e., the primer tube). The expressions used for determining stagnation pressure are:

PPX, t, MBZ =

PPx,t, MBZ = 2060×10 te -0.6358/r. for t < 0.004 sec.

sec.

and

$$1.33 \times 10^6 e^{-0.635 S/r_0 - 1200t}$$
 for t > 0.004

where

- $p_{P_{x,t,MBZ}}$ is the pressure in the primer jet as a function of distance from the flash hole and time for the M82 primer,
 - is standoff, the distance between the spindle and the 8 base pad

and r is the flash tube radius

Then the shear force per unit length of jet circumference is

 $F_T = P_{P_{x,t},M82} \frac{y}{2}$

This is resisted by the shear strength of the pad, i.e., allowable stress times thickness. Note that the resistance or reaction force of the pad is assumed to be the maximum shear force that can be exerted by it. This is realistic because the action of the jet is impulsive and the pad inertia provides the reaction necessary for development of the shear condition. Maximum shear will occur, then, around the edge of the jet, i.e., where its radial pressure gradient is a maximum, as long as the pad is unsupported in the region of jet impact, which is the case for a centrally located primer tube, because the pad bears against the end of the tube, and the inside diameter is greater than the diameter of the jet.

Inputs required by the pad penetration logic are flash tube diameter, called FTUBR, and pad allowable stress, called PDALST. A logical variable, PENFF, is initialized as FALSE and when penetration occurs PENET is set to TRUE, and the words "base igniter pad penetrated," are printed. The black powder in the sheared out volume is assumed to be displaced to the first grid containing the center core loading, and porosity for each grid is adjusted accordingly. Of course, the base pad is heated by the primer jet over its whole exposed surface, and base pad penetration can occur as a result of burn through as well as by shear.

Subsequent to base pad penetration, the primer jet heating is applied to the near end of the center core loading in the igniter tube. This is accomplished in the logic for primer jet heating of black powder by using "flags" and the logical variable, PENET, as controls. The procedure insures that primer jet heating is applied only in one axial grid and when the black powder there is consumed a search is made to find the next grid containing black powder. This logic is located in subroutine BPFIR.

5.3 FLAME SPREAD IN THE BASE PAD

Flame spread in a bed of propellant has been studied in the closed bomb and it was found to exhibit characteristics similar to the linear burning rate relation, $r = bp^n$, where p is the chamber, or bomb pressure, Ref. 6. The rate of increase of burning surface area was found to obey the relation, $s = cp^m$ for M1 propellant, for which m = 2.2 and $c = 1.45 \times 10^{-5}$ in 2/sec-psi³. For black powder a value for $c = 1.8 \times 10^{-5}$ was first attempted. This was incorporated into the logic for

black powder burning in subroutine PRIMER. But first, the mass generation logic of the primer jet was moved to MAIN so that it would be continuously credited. Then the logical variable BPLEFT was made TRUE in a different location of the sequence for detecting black powder ignition and depletion so that subroutine PRIMER would be called at all times until black powder is depleted, including the time previous to its igntion.

Flame spread is assumed to start with the ignition of black powder in the first axial grid that contains it. Then it proceeds radially outward from the periphery of that axial grid, and computes the change in porosity of the black powder in the J = 2 grid and the mass of gas generated. Entry to the base pad flame spread logic is permitted only when the loop (within which it is located) is executed for the axial grid of the base pad, inasmuch as it constitutes the source of flame spread. When the base pad is consumed as a result of the flame spread, a logical variable, BRNOWT, is set true and this ends entry to the flame spread logic. At the same point, porosity of the black powder is set at 1.0.

5.4 PROPELLANT AND PROPELLANT BED MOVEMENT

The basic mathematical model has been demonstrated to simulate gas motion in the gun very effectively. However, its representation of propellant movement is inadequate to treat the problem of wave formation and its propagation back and forth in the chamber of the 155mm gun. The large pressure gradients that have been recorded in this chamber are sufficient to cause vigorous movement of propellant and it is very likely that this movement in turn affects the wave formation and its shape, i.e., pressure distribution. This would especially be the case where bed porosity is low as when the propellant is packed to maximum density. This is exactly the condition that the basic math model was incapable of simulating and yet is so necessary to the study of gun behavior.

A new subroutine has been written and extensively debugged for description of propellant movement. In addition to describing the independent one-dimensional motion of propellant in each grid the new PRPVEL subroutine describes the movement that results when two or more adjacent grids become tightly packed with propellant so that it moves as a single slug. Furthermore, in its new form the subroutine can treat the situation arising when a slug separates into two slugs as a result of a pressure peak occurring within it. Execution of this subroutine starts with computations for pressure gradient in each grid, DPDX. From these values, a total force on the propellant is computed grid by grid. It depends of course, upon propellant porosity, PHIBG (I,J) and is obtained by summing drag force per unit area and the pressure gradient.

After this, a computation sequence is entered to evaluate the acceleration and velocity of propellant in each grid, if it is not packed, i.e., if the porosity is greater than the minimum allowed value. The acceleration is simply force divided by mass. Then, the change in velocity is computed for the computing interval.

If a packed grid is identified, the solution flows to a repetitive sequence where the force and mass of propellant in all adjacent packed grids are summed. This is preparatory to the computation of acceleration and velocity for the slug, which moves as a single mass through many grids, unless it splits into two separate masses because of a pressure peak. In the process of distinguishing this phenomenon, the end grids of each slug of packed grids must be identified. The first packed grid in the search is called LF1, and the last one of the first packed group is LF2. If the slug separates into two separate groups the first grid of the second group is assigned the name MF1, and its last grid is called MF2.

In order to determine whether a slug separates, the individual value for the velocity of each grid is compared as soon as it is computed with the average value of velocity for all packed grids that were computed previously for the slug during the looping. If the individual value exceeds the average value, separation is indicated and the computer is routed to another section of the program. This contains logic similar to that for grids LF1 to LF2, for the purpose of computing acceleration and velocity of grids MF1 to MF2.

It can be shown by momentum theory that the imposition of the group velocity upon an individual mass within a group of masses in intimate contact is valid unless the individual's velocity is greater and it is located at the forward boundary. This fact has been applied to the propellant bed movement logic by maintaining a running sum for grids packed with propellant, of mass and force on the group which is used to compute group acceleration and updated velocity. When a grid is encountered where propellant velocity is greater than that for the group, separation is indicated as described previously. If not, the logic continues to the last packed grid, updating velocity with each loop. When this is complete the final average velocity is assigned to the propellant in all packed grids. The same logic is provided for packed grids in a second group if it is identified. Execution of the program using this logic has proven its validity by a printout of propellant velocity from subroutine PROPEL as well as PRPVEL. Subroutine PROPEL actually makes a check on propellant velocity using statements based upon momentum theory. In a variety of computations, the results obtained from PROPEL always have been the same as from PRPVEL, as indicated by the special printout.

5.5 BLACK POWDER MOVEMENT IN THE IGNITER THBE

Experiments have shown that the igniter core loading may be driven far along the igniter tube by the force of the primer jet, prior to ignition of the black powder (Ref. 1). Of course, a prerequisite for this action is the penetration of the igniter base pad at the breech end of the charge, which is a demonstrated capability of the M82 primer jet. This phenomenon has been modeled as discussed in previous paragraphs. (The M82 primer has approximately 1/2 the energy of the XM119 primer that has been used in some firings of the XM123E2 charge in the 155mm gun). In addition, logic was formulated and incornorated to represent the effect of the primer jet forces upon the igniter core loading.

The stagnation pressure of the primer jet is modified by $P_{P_{x,t}} = r P_{P_{x,t},M_{02}}$ to permit the representation of primers other than the M82. The quantity r, which is given by the input quantity PRMCOF, is the ratio of the strength of the primer used relative to that of the M82 primer. Presently, a factor of 2.15, (the weight ratio of black powder content) is being used in lieu of test results for the XM119 primer.

Resistance to movement of the igniter core loading is provided by its inertia but initially it is tied to the igniter tube near its breech end by two ribbons. A strength test of these ribbons revealed that they could be torn from their attachments by a total tensile force of 24 pounds. Therefore, this force was made an input to be used in logic contained in subroutine PRPVEL. In this subroutine, this logic is entered when the center core calculations are made (J = I) and the base pad has been penetrated (PENET is true). Then $P_{P_{X,t}}$ is evaluated and converted to a force (BGFCE), which is summed along with the forces of fluid flow for several grids along the igniter core loading. If this sum of forces, called FORCE, at any time exceeds TYFCE a logical variable, BGJAM is set to TRUE, which permits entry to the movement logic for the igniter core loading.

The method for treating the actual movement of black powder in the igniter tube is one of considering the velocity, and therefore, the distance moved during a time interval, to be an average value for all the powder, i.e., it all moves simultaneously at the same rate, until the forward end of the core loading encounters the base of the projectile. Subsequently, it becomes compressed by the prevailing forces that are induced by gas flow, according to compression characteristics that were determined by test.

After obtaining the sum of the forces caused by the gas flow at all grids, the weight of black powder is summed for all grids. Then the black powder is movee from grid to grid under the control of an indexing system. The intent here was eventually to make the indexing rate a function of the computing interval and an input quantity, to be determined as a result of actual tests of core loading movement in a transparent igniter tube, as done for the 175mm gun model (Ref. 1). Presently, the indexing rate corresponds to a powder velocity of about 200 fps.

After sufficient movement the igniter core loading is stopped by a limitation on NEND, an input variable, called INBP, that represents the grid where the loading is assumed to jam. Next, the variable BGSTP is set TRUE, permitting entry to the powder compression logic. Basically, this logic determines the powder volume, i.e. core loading length after compression, and the porosity in each packed center grid, using the previously determined powder weight. The expression for minimum compressed length is

$$l_{min} = \sum l (1 - 0.03145 (F - 10)^{0.545})$$

where $\sum f$ is the sum of the loading lengths and F is the force. One of the first steps in this logic is to identify the first grid containing powder, IBGNP. The next grid after IBGNP is, of course, the first packed grid, called LLI, because the breech end of the igniter hag is not always located at a grid boundary.

The total deformation by compression is not permitted to occur during only one computing interval after encounter with the limiting grid, INBP. Instead, IBGNP is advanced one grid for each computing interval. A test is made each time this occurs to detect the event when compressed length reaches the minimum compressed length.

5.6 COMPRESSIBLE PROPELLANT BED

The elasticity of a porous granular bed such as that typified by a propellant charge when loaded in compression may be represented as a proportionality between compressive force and the bed solidity, $(1-\emptyset)$ instead of bed deflection inasmuch as the two properties are directly related. This fact has been utilized in providing for bed elasticity effects in the force balance on the propellant grains within each grid. Furthermore, the new logic in subroutine PRPVEL lends itself very well to the accommodation of bed compressibility in this manner because of the individual treatment given each grid.

It was necessary only to add a new pair of terms to the force balance on the propellant that account for the difference in the reactions in each direction caused by the elasticity of propellant in adjoining grids. In addition, the lower limit of bed porosity was reduced to a small fraction of the original porosity, \emptyset_0 , i.e., bed porosity was permitted to be as low as $0.2\emptyset_0$ to represent compaction to very high solidity.

This logic should provide for a better representation of dynamic effects within the propellant bed as gases flow within and through at ever changing conditions. For example, the situation can be envisioned where wave formation in the gases is reinforced by the action of the propellant. Another example is the action that the free ends may exhibit when influenced by the arrival of an impact-induced shock wave.

5.7 PROJECTILE RESISTANCE TO MOVEMENT

The previous logic for describing the variation of projectile resistance to movement through the barrel was inconvenient to implement because considerable preparation of inputs was required. Consequently, it has been changed so that data that are conventionally used to describe the pressure during the projectile may be directly applied as inputs to the program. The conventional format is a plot of pressure vs. distance along the barrel. Four significant points on this plot may be selected that will adequately describe the most important part of the plot, i.e., for the first foot or two of travel. The remainder can be expressed by simple statements that are based upon isentropic compression of the air in the barrel that is ahead of the projectile. The coordinates of the four points of the driving pressure plot constitute the inputs and the logic provides all the rest, i.e., the conversion to force, FDPRIM, for all values of XP the distance traveled. Referring to Figure 10, these points are (PZO, 0) (PDMAX, WOB), (PINT, XINT), and (PLO, XLO). Then, for values of XP> XLO the pressure is computed from the expression:

$$\Delta p = Y p \Delta U / (c - (\frac{Y+I}{4}) \Delta U)$$

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Figure 10 BARREL RESISTANCE FUNCTIONS BUILT INTO THE 155 mm HOWITZER CODE



DISTANCE ALONG BARREL

The value of ΔU used, i.e., the change in projectile velocity, is obtained from the previous computation. For Air, $\mathcal{T} = 1.4$.

5.8 NEW DRAG EXPRESSION

A more nearly complete expression for drag has been incorporated that is useful because it is valid for any particle shape of the porous bed. The expression was obtained from Perry's Chemical Engineers' Handboom, pg. 5-53, Ref. 4, and has been verified for M30 propellant by experiment as previously discussed:

$$\frac{\Delta P}{P} = \left[\frac{4 f_m (1-\phi)^{3-n}}{\phi_3^{3-n} \phi^3}\right] \left(\frac{L}{D_P}\right) \left(\frac{V^2}{2g}\right)$$

where

Ap is the pressure drop, psf

- ρ is the fluid density, $1bs/ft^3$
- fm is the friction factor
- is the porosity
- ψ_s is the shape factor, equal to the area of a sphere having the same volume as the particle divided by the particle surface area
 - n is the function of the Reynolds number approximately equal to 2 for Re > 3000 based upon Re = $\rho VD_p/\mu$
- ^µ is fluid viscosity
- V is the superficial velocity, = ϕ times actual velocity, fps
- D_p is the diameter of a sphere having the same volume as the particle

6.0 SENSITIVITY STUDIES CONDUCTED WITH THE COMPUTER PROGRAM

After exercising the computer program thoroughly to eliminate "bugs" it was employed in a sensitivity analysis of a number of the variables associated with the XM123 propelling charge and its loading configuration. These variables include; the chamber length, which could be established by the distance the projectile is rammed into the barrel; the loading density or degree of initial compaction, which is defined in the program by chamber diameter and igniter tube length for a given charge weight; the standoff, i.e., the distance separating the breech from the end of the charge; the propellant burn rate at the low pressure end of the range for which existing data is of somewhat dubious value; the friction factor of the propellant bed which has been measured but whose significance has been little understood; the shot start value, i.e., the engraving force on the projectile; the primer strength; and the initial temperature of the propellant.

A large part of the study was devoted to the ammunition configuration in which ignition is accomplished wholly by an igniter base pad to identify the significance of each variable to the development of pressure waves in the chamber. A few computer runs were made with the igniter base pad located at the barrel end of the charge. Finally, the input combinations that produced the most interesting effects were submitted and the complete center core igniter logic was invoked. The center core igniter exercises provide a variety of situations for examining the consequences of using the strong primer, i.e., the XM119 primer, inasmuch as it has not yet been demonstrated that this primer is incapable of dislocating the center core loading before its burning is well under way. It is easy to speculate that if the XM119 primer does have such a capability, the manner of ignition of the propellant charge must be abnormal, to say the least.

A description of the input conditions and configuration of each computer exercise, or run, is given by data in Table III. Each is also identified by a run number for use in the following discussion. Charge weight was 25.5 lb. for all cases.

The first run, R-1, represented a loosely compacted charge in a moderate length chamber with breech end ignition and zero standoff. Propellant minimum burning rate was 0.36 in/sec up to 600 psi, chamber pressure. Pressure throughout the chamber rose uniformly, climbing steadily to a peak value of 61000 psi without any unusual effects.

For the next run, R-2, all conditions were similar to those of R-1 except that initial charge compaction was increased to a moderate level. The effect of this was to produce an unsteady rise in pressure such that at any given time the pressure at each point along the chamber Table III

INPUT CONDITIONS AND RESULTS OF COMPUTER EXERCISES

TEMARKS																	8							E	DLI
MAX. POBITIVE DIFFERENCE IN PRESUME AT PROJECTILE MINUS BREECH - MI	•	3	2	1148	3	1			4790	2000	-		0058		0005	1200	00555	0094.1	0098	•	0001	2700	0051	2400	4300
PEAK CHAMBER	61000	61300	0002.45	47000	00088	-0000	17500	64700	00295	57700	009255	76700	Diamon and a second	ı	000005	53000	00045	72100	~	57000	609528	62400	00000	00529	00900
PRIMER STRENGTH COEFFICIENT	0.1																	-	2.15	9					•
PROPELLANT INITIAL TEMPERATURE - "F	ø	_												8		2									•
PRESSURE -	10,000										-	20,000	2,700	10,000											•
RATE OF PROPELLANT (SEE NOTES)	HGH							•	MEDIUM	MEDIUM	LOW ³	MEDIUM				•		нен				•	MEDIUM ²		-
BED FRICTION FACTOR	0.5						-	20.0	30						•	0.2	30								•
STANDOFF in.	0 -	_			•	1.5	99	0	•	1.5	1.5	•	15				•	•	0	15	15	0	15	•	•
CHAMBER LENGTH - In.	s a			0 MC	0.0	22														-	992	30.0	34.0	0.05	30.0
-IGNITER TUBE LENGTH - IN.	215	25.0	22.0	0.52						_															•
RUN NO.	1-8	R .2	5	2	9 E	2	R.7		ŝ	A-10	8.11	R-12	R-13	R-14	R 15	816	R.17	8-1	C.1	C:2	63	2	C.6	•	67

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NOTES:

¹HIGH BURNING RATE INDICATES A MINIMUM RATE - 0.36 m/m

²MEDIUM BURNING RATE INDICATES A RATE THAT CONFORMS VEAY CLOSELY TO THE CLOSED BOMB RATE FOR MOD OVER THE WHOLE PRESSURE RANGE

³LOW BURNING RATE MEANS THAT BGEN = .005

CB - CRUSHING AND BREAKUP OF PROPELLANT WHEN COMPRESSED FIT - FLAWED IGNITER TUBE

DLI - DENSELY LOADED IGNITER

IGNITER TUBE LENGTH IS AN INDICATION OF THE INITIAL COMPACTION OF PROPELLANT

rose at a different rate compared to others and this rate was variable with time. In fact, the pressure decreased briefly on a couple of occasions before peaking. The peak value indicated was 61300 psi at the breech end. This peculiar behavior of chamber pressure history is interpreted to indicate the existence of pressure waves, which is confirmed by the regular progress of the pressure variations along the chamber and their reflection at the ends. The character of these waves can be appreciated by examining the history of the difference between pressures at the projectile end and the breech end of the chamber. This history is plotted in Figure 11 for run R-2. It is similar to the plot obtained from firing test data (Figure 12), except that initially the pressure drops to a much greater negative value than for test. (The time scale cannot be compared on an absolute basis because no attempt was made to duplicate the early ignition mechanisms.) The compaction of the propellant bed apparently promotes local pressure buildup, which leads to the formation of waves.

Run R-3 represents a highly compacted bed, which was obtained at the expense of increased gap between the end of the propelling charge and the projectile. Pressure waves were obtained but they were greatly reduced in intensity. The first positive excursion in end pressure differences peaked at only 2900 psi compared to the 6800 of Figure 11 for Run R-2. A possible explanation for this is that the large gap strongly attenuates the waves.

When the conditions of R-2 were repeated except that a longer chamber was input making the gap even greater, run R-4, the waves disappeared completely (in the sense that the projectile base pressure never exceeded the breech pressure), and the peak pressure reached was 47000 psi, which tends to support the speculation that pressure waves are attenuated by a large gap. In addition, it demonstrates the effect of chamber volume relative to charge volume, which was too low for R-1, causing excessive peak pressure.

Run R-5 was similar to R-4 except that the chamber length was reduced to a minimum. Even so the gap was 4.5 inches (allowing for a 1/2 inch thick base igniter pad). Again, the result was very strong waves. Chamber pressure histories are plotted in Figure 13, which shows the interrupted pressure rise and how exaggerated it becomes at the projectile end.

All previous runs had been conducted for a zero standoff so the effect of increasing this variable was studied. For the first run (R-6), all inputs were at moderate values (standoff = 1.5) except that the .36 in/sec minimum burn rate was retained. This made the run the same as Run R-2 except for standoff. Waves that were almost as strong

6 00 Figure 11 HISTORY OF PRESSURE DIFFERENCE AT CHAMBER ENDS ~ RUN R-2 2 9 TIME ~ MILLISECS S Bm, Lm, SI, Fm, Rh, Zm, Tm 4 3 CONFIGURATION N 0 10 -10 s 0 ņ (bBRO1 - BREECH)~ PSI × 10.3











as for R-2 were obtained, see Fig. 14. Furthermore, the nature of this plot is very much like that obtained from the firing test data (Figure 11). Chamber pressure histories for each end are plotted in Figure 15.

A further increase in standoff placed the propellant charge much closer to the projectile than the breech for Run R-7. Gap was 1.0 inch while standoff was 6.0 inches. This caused even stronger wave action than previously with the projectile end pressure going above breech pressure when they were only 1540 psi. The first positive excursion peaked at a difference of 11800 psi when the projectile end pressure was 15000 psi. The highest peak chamber pressure was recorded also for this run a value of 72500 psi. Our interpretation of this run is that if a strong ignition, which means that a large amount of propellant is ignited suddenly, occurs at the breech end of the propellant charge, waves will be present regardless of the standoff. However, increased standoff reduces the probability of a strong ignition.

A run was conducted for very high bed friction factor. Other conditions for run R-8 were the same as R-1, which produced no wave action although peak pressure was excessive because the charge was confined. Vigorous wave action resulted for R-8 demonstrating that friction of the bed and excessive compression are related conditions that promote wave formation. The effect of increasing initial bed compaction was nearly the same (run R-2) although this cannot be construed as an independent cause of wave action inasmuch as the compaction must be maintained for a period of time to be effective in promoting wave formation.

In order to determine whether the high initial value of hurning rate contributes to the formation of waves, Pun R-2 was repeated with a much lower value of burning rate as Run R-9. The result was that the wave action decreased slightly in amplitude, and it was very much like that of run R-6. Peak pressure was 59,300. The next run, R-10 was conducted with the same inputs as R-6 except for the moderate initial burning rate, (increased standoff compared to run R-9). Waves were even more vigorous than for either run R-9 or R-6. The history of chamber end pressure difference is plotted in Figure 16. Obviously, propellant burn rate at low pressure is not a critical factor. This was confirmed by Run R-11, which was the same as R-6 except that BGEN = .005 instead of .0057. Its effect was to delay everything slightly and to produce a flatter, lower peak, see Figure 17.

Run R-12 was then made with a high shot start pressure. Other inputs were the same as for run R-9. Wave action was very similar to that for run R-9 with end pressure histories crossing and recrossing at nearly the same pressure levels. However, peak chamber pressure went to 76700 psi as a direct result of increasing the projectile resistance to movement.







5.4

PRESSURE ~ PSI × 10.3

Figure 15 CHAMBER PRESSURE HISTORIES \sim RUN R-6





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The effect of initial propellant temperature was studied by means of the next two runs, R-14 and R-15. Run R-14, at the low temperature level, was carried out to 12 millisecs and no propellant ignited so efforts were discontinued. Run R-15 exhibited an end pressure difference peak of 5000 psi when projectile pressure was at 17000 psi and at 3.86 millisecs but the second positive excursion of pressure difference occurred at a very high chamber pressure level. In fact it was near the peaking point for chamber pressure at 7.4 millisecs. Compared with run R-6 it can be appreciated that action was considerably accelerated by the high initial temperature although the development of the second wave was not sufficient in strength to raise it beyond the breech pressure.

Run R-16 was conducted to complete the series on the variation of shot start pressure, which was only 2700 psi for this case. Very moderate wave activity was manifested and chamber pressure peaked at 53000 psi. Wave action was similar to that of run R-9.

The final two runs of this series were made to investigate the effect of grain breakup due to impact at the ends of the chamber and to crushing by compression of the propellant bed. This was formulated temporarily into the logic in subroutine PROPEL by operating on XL(I,J). For the first it was stipulated that whenever velocity of propellant entering the end grids exceeded 20 fps, that entering was broken into 100 pieces from each grain. Results of this run, R-17, showed a slightly greater rate of pressure rise compared to run R-6, but otherwise results were similar. For the other run, XL(I,J) was diminished by 5 percent for each computing interval during the time and wherever the propellant bed was compacted to less than 0.9 PHIO. This produced an excessive rate of pressure rise that was unreal, leading to conditions that the program could not accommodate. Although the peak pressure was not obtained results served to demonstrate that crumbling of the propellant is very significant to performance and could be a critical factor in simulation.

The run that represents end ignition by a base pad at the barrel end of the charge is labeled B-l in Table III. It was computed for near-zero standoff to study the effect of reflection of pressure waves at the breech. This extreme configuration was expected to yield extreme results, which were fully realized, in the form of very strong waves. The first peak of end pressure difference for Run B-l (after propellant ignition) reached a positive value of 17,500 psi. see Figure 18. Projectile base pressure at this point showed a peak of 36100 psi and dropped thereafter to a low of 19,840 psi before climbing again to later exceed breech pressure by 14200 psi. Maximum breech pressure reached was 72100 psi.

One object of conducting run B-1 was to provide data for comparison with the computation for the charge with a full center-core



Figure 18 COMPARISON OF CHAMBER PRESSURE WAVES FOR END IGNITION AND ABNORMAL CENTER CORE IGNITION

igniter, in particular with the configuration using the strong primer where the bag ribbons fail and the center core loading is pushed down the tube and jammed at the end. This run is identified as C-1 and is the first of a series of center core igniter runs. It resulted in propellant ignition starting at the barrel end of the charge and progressing rapidly towards the breech so that ignition was complete by 1.3 millisecondsafter it started. (The sequence lasted 3 milliseconds for run 8-1.) Initially, the chamber pressure at the projectile was pushed up to a peak of 1430 psi, 840 psi in excess of breech pressure as a result of black powder burning. However, this situation was not sustained by burning of propellant. The pressure at the projectile end did not again exceed breech pressure until it rose above 15500 psi, whereupon it reached a pressure difference of 4500 psi. This run is also plotted in Figure 18 where it can be contrasted with the results of run B-1. Frequency of the excursions for both runs is roughly the same but the peak amplitudes are obviously far different. One possible explanation for this is that the igniter tube of the center core configuration acts as a relief device to prevent extreme longitudinal gradient in pressure from developing. Even though tube collapse interupts the suppression of pressure wave development, this effect is manifested beyond the time of tube failure. It is obvious that suppression is no longer needed after the rate of chamber pressure rise reaches a maximum.

Run C-2 is a center core igniter run for a configuration that produced vigorous waves with end ignition (same configuration as for run R-2). Run C-2 used the fixed center core loading and weak primer. Propellant ignited in an orderly progression from the breech end to the projectile end. This sequence lasted only 1.5 milliseconds although it was 1.2 milliseconds for run R-2. Peak chamber pressure was 57000 psi but no waves developed.

Run C-3 was conducted with the same inputs as Run C-2 except that chamber length was reduced to 30.0. Ignition required about the same length of time as for run C-2. Wave action apparently started but never became substantial. Chamber pressure at projectile was in excess of breech pressure for a considerable length of time (centered at the 6000 psi level) but their difference never exceeded 1000 psi.

Inputs for Run C-4 were the same as for C-3, and a fixed center core igniter again, except that standoff was reduced to 0. Definite wave forms were initially exhibited ($\Delta P = 2700$ psi at 13000 psi chamber pressure) but the second pulse did not materialize.

Run C-5 might be considered a standard configuration-fixed center core igniter, and chamber length = 34.0 in. with everything else moderate. Peak pressure was 46000 psi.

Run C-6 represents a deliberate attempt to produce waves in the chamber by introducing a flawed igniter tube into the charge configuration. This was done by assigning large values of radius to pseudo holes, one in each of the first four whole grids at the breech end. The total grid length affected was 3 in. In addition, the other inputs were conducive to wave formation for the end ignition case (same as for Run R-5). Results showed that ignition was very rapid, requiring only 1 millisecond to progress from the breech end to the other. (In R-5 it required 1.7 milliseconds.) Wave formation was initiated, (the first Δ p peak was 2400 psi) but it quickly damped out and chamber pressure distribution assumed the usual character with the breech pressure maintained at a higher level than at the other end. Run C-6 was repeated with low strength values assigned to the tube material in an effort to simulate overall early failure which can be expected to promote wave formation. (PHOOP = PCOMP = 100.) llowever, the failure did not occur sufficiently early to have any great effect. Of course, to carry this concept much further in reality would be to reach the end ignition situation which would practically constitute a repeat of run R-5, because of the considerable ignition delay observed with the center core loading, i.e., drastic tube failure starting near the breech end would cause restriction of flow through the center core region so that ignition would move progressively from the breech end through the propellant in the same manner as it does using only a base pad igniter.

Run C-7 represents another deliberate attempt to induce wave formation in the gun chamber. This simulates the folded igniter bag such that all the black powder is jammed into half the tube length at the breech end, thereby restricting pressure relief between chamber ends that the igniter tube normally provides. Results revealed that the chamber end pressure difference reached a peak at the point where projectile end pressure was 16600 psi and exceeded breech pressure by 4300 psi. The difference went to zero at the 17000 psi level and to a negative peak of 6100 psi as breech pressure rose to 40500 psi. Projectile end pressure equalled the breech pressure at 46300 but never again exceeded it. Pressure peaked at 60,500 psi.

7.0 CONCLUSIONS AND RECOMMENDATIONS

In addition to numerous conclusions derived from the computer results of the sensitivity analysis, some very interesting conclusions have been reached by observation during the formulation of the mathematical model and as a result of the various experiments that were conducted in support of this formulation.

1. Sensitivity analysis showed that the center core igniter of the 155mm XM123 propelling charge promotes a desirable, near-uniform chamber pressure distribution by providing pressure relief between the ends of the chamber. If the tube remains intact and severe flow restriction does not occur until chamber pressure rise rate approaches its maximum, this uniformity of pressure distribution is practically assured.

2. If the center core igniter tube remains intact during the early period of propellant burning, initial conditions such as standoff, loading density and propellant temperature will have little effect upon chamber pressure history and its distribution according to the results of the sensitivity analysis.

3. The mathematical model showed that if the center core igniter tube fails before chamber pressure exceeds approximately 2000 psi, drastic pressure disturbances will result depending upon initial conditions of standoff and loading density.

4. It was also demonstrated that if the center core loading becomes jammed in the igniter tube either by deliberately loading it that way or as a result of strong primer action, pressure maldistribution will result. Its severity depends upon the degree of tube flow restriction introduced and the initial conditions of the propelling charge.

5. Initial conditions that promote pressure maldistribution, given an igniter abnormality such as those already cited, are very large or very small standoff, reduced chamber length, high loading density, high shot start resistance and over-strong primer action. In other words these conditions can aggravate an unfavorable XM123 ammunition condition but each one, by itself, will not induce maldistribution of chamber pressure, given an intact igniter tube.

6. A propelling charge configuration using end ignition exhibits performance in the 155mm gun chamber that is very sensitive to the initial conditions of standoff, chamber length, and loading density, as well as to their interaction. Zero standoff does not cause maldistributions if the air space at the other end of the charge is over several inches in length. On the other hand, if this length of space is divided by centering the charge in the chamber having the same length, pressure waves could be severe.

7. Computer results show that propellant burn rate affects chamber pressure level and wave activity somewhat; increased rate being an aggravation given other conditions conducive to the development of waves. Crushing of the propellant, such as might be caused by bed compression, can result in increased burning rate and excessive pressures.

8. Results obtained from computer exercises, which represent a variety of propellant charge configurations, generally indicate that the more severe chamber pressure waves of the firing test results were caused by abnormalities of the propelling charge.

9. Ignition sequence experiments revealed that the presence of the base igniter pad causes a manifold increase in ignition delay of the center core loading. Furthermore, the igniter pad was demonstrated to be unnecessary to center core ignition at room temperature given the proper alignment. Computer code results show that propellant ignition by the center core loading is at least as rapid or more so than ignition started at either end of the propellant charge. These results should be useful to any effort to redesign the center core igniter for improved effectiveness.

Additional work on the computer program could produce improved simulation and effectiveness in its use as a design aid. It is recommended that the computation be accelerated temporarily during the early period before center core ignition. This might be done by a combination of procedures including either the lengthening of computing interval or providing another interval for primer action and black powder heatup, combined with an intermittent use of the finite differencing subroutines. The present computer code requires the use of artifices to avoid long executing time such as initialization of black powder to ignition temperature in selected grids. The recommended improvements would permit more effective simulation of ignition delay in all its phases.

A better simulation would result from the representation of black powder movement. This could be implemented by modifying the propellant movement subroutines to accept the black powder variables. The effect of this improvement would be to provide for the spread of burning powder grains as their ignition propagates and pressure gradients develop.

Propellant bed compression tests are recommended. These would provide data on the modulus of elasticity and the characteristics of the quasi-plastic flow regime, i.e., the state of no recovery, where actual crushing of propellant occurs. In addition, it would be useful to measure bed friction at this compacted, crushed condition. The required fixtures already exist, inasmuch as the test section of the propellant bed friction test apparatus was designed for such a contingency. It nas sufficiently thick walls that it can contain the bed for compression tests and without disturbing the compacted bed it can be moved to the friction test apparatus for air flow tests.

8.0 REFERENCES

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PROGRAM FLOW CHART (CONT.)





PROGRAM FLOW CHART (CONT.)



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PROGRAM FLOW CHART (CONT.)




APPENDIX B FORTRAN IV MACHINE LISTING

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	NHUNG (NPI AND = NHUNLA)		PIPET IN	104
		and a second	PIALIN	102
			MAIN	106
	Hoo(HP110) = Ho(2)		MAIN	107
	P C		MAIN	108
	HUTDO(METO) = HUT(S)		MAIN_	109
	PHICP(NPI+J) = 1.0		MAIN	110
	$U^{PB}(RP_{1},U) = UP(2)$		MAIN	111
1.0	COM I INDE		MAIN	112
6			MAIN	113
L			MATN	114
105	LUNIINUL		MATN	115
	11 (UNED) 60 10 170		MATA	114
	$RHU(\mathbf{f}_1) = \mathbf{h}_1$		MAIN	116
		an a	MAIN	
			MAIN	118
			MAIN	119
	P(1) = 0.0		MAIN	120
	$PH_{1}(1) = 0.0$		MAIN	121
	0P(1) = 0.0		MAIN	122
<u>(</u>			MAIN	123
	UU 160 U=1.NUK		MAIN	124
	HUG(1) = HHUG(1) + HHUGG(NGX+U)+HEA	G(_)	MAIN	125
	UG(1) = UG(1) + ULU(NGX.J)*AREAULL)		MATN	126
	HU(1) = HU(1) + HEGENGA. J) #AREALL		MATN	107
in	FU(1) = FUILT + FUHLNDX. JIMARFAST.)		MATN	100
	PULLED = PULLED + PULKGINGX. ILA - AGI	.0	TIM LIV	120
and a second sec	$w^{2}(1) = w^{2}(1) + w^{2}(1)^{2}(2) + w^{2}(1)^{2}(2) + w^{2}(1)^{2}(2)$	1 C - DutociNCY, ILL	<u>MAIN</u>	129
	Challes	THE - FETBOLNOVION)	MAIN	130
	CONTEAN OL		MAIN	131
C			MAIN	132
	RHOULT = RHOULT/AFLACH		MAIN	133
	UU(1) = UU(1)/4 + EAU(1)		MAIN	134
	HULLI = HULLI/ANLALI		MAIN	135
	PUILI = POILI/ANEALH		MAIN	130
	PHILLE PHILLIJAKEALH		MAIN	137
	1+ (PH1(1) .51. 0.999) 60 TO 165		MATN	134
	UP(1) = UP(1)/(AHEALH+11.0 - PHT(1))		MATN	136
	66 TO 160		A TA	140
1			PIA ATT	140
L			PT AL A TM	141

	60 10 1r.	4 *********** ********	
		MAIN	143
110	(HOG(1) = (HOBG(NUX+1)	MATH	144
	$O((1) = ORC(VCV^{+})$	MATH	145
	16(1) = H86(168+))	MATH	146
	$P_{\Theta}(1) = PCH(EGA+1)$	MAIN	147
	PHI(1) = PHIND(NGX,1)	MATH	148.
	UP(1) = UPH(KOX,1)	MAIN	149
L		ITALN	150
<u> </u>		MAIN	151
C		MAIN	152
6		MAIN	153
6++++		MAIN	154
L (HAMBER SUBRUUTINES	MAIN	155
		MAIN	156
6		MAIN	157
	IFT.NUT. BPIGA CALL BPEIR	MAIN	158
LL	UGICAL VARIABLE BELEFT WILL BE SET IN FALSE IN DUTING INFO	MAIN	159
L B	SLACK PUNDER IS HURNELL	MAIN	160
	IF (BPLEFT) CALL PRIMA	MAIN	161
	GAMEP=1.35	MAIN	162
	UFRM=155,1+5681(((),MmsF=1,0)+H84)	M000925	16
a competition of space	AF (IAME .GE. DUDGED DUTMENTS (GETEND. DOD	h000925	17
	IF (11ML .LT UD04) COTMMENDED AT LASTACTARE AAX	HOD0925	18
industriant of a local	IF(TIPE GT. (05) LOTMPAND	M000925	19
	UUIMPAEPRMC GE aluli MPM	M000925	20
	FLubzu.	MOD0925	21
	10 17/ J=1. http:	MOD0925	22
		N000925	23
		M000925	24
1998 1995		MUD0925	25
		M000925	26
hale en men her		M0D0925	27
		M000925	28
		M000925	29
111		N000925	30
	THENOT, ONEL CALL MELOW	MAIN	163
1 6		MATN	164
1 14	ST AND CALLED UNTIL ALL PROPELLANT IS IGNITED.	MAIN	165
C 10	USE NOT USE FOTAL FORCESTLY IN PHILES ANRAY HERE	N000925	31
L		M000925	10
	IF (INOT: IGAII) CALL PRPFIR	MATN	144
	CALL NEORES	MATN	100
•	IF (TIME .GT. DELT) CALL PROVEL	5001017	10/
	IF (TIPE .GT. DELT) CALL PRUPEL	MODIATZ	3
		MATN	170
L		MATA	170
C PL	THE TOTAL PURUSITY INTO ARRAY PHILES FOR LSE IN THE PATH	ATN	170
L SL	DRADATIES.	MATN	172
	JU IYU JEL+NGK	MATN	175
L	JU 190 J=1,N6X	MATN	174
	PHING(1.J) = PHIBB(1.J) + PHIEP(1.J) - 1.0	MATN	175
120 6		MATN.	176
L F#	IN SUBROUTINES	MATH	177
	cu = -ux		170
L	JU 300 1x=1,1.6x	MATA	179
L	JU JUU IR=1.NGR		180
	1PA = 1PATH(1x,1k)	MAIN	181
			143

	10 10 (011.20, 205, 20, 205, 206, 206, 208, 209, 210, 211, 212), 1PA	MAIN	185
		MAIN	184
e'v1		MAIN	185
	30 10 301	MATN	186
6UC	IF (CHAMI) CALL AAII	MAIN	187
	IF (CHAP2) CALL AXIZ	MAIN	188
	IF (CHAMS AND, IN . LU, SI CALL ANTS	MATN	189
	IF (CHAMS AND IN .NE. SI CALL AXITE	MATN	190
		MATN	191
4 0 3	CALL INTER	TIPS LIVE	107
	JU 10 300	FIAIN	176
204	LALL BRUT	MAIN	195
	GU 10_300	MAIN.	134
in a	CALL FSUNFA	MAIN	195
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e 118	LALL FSURFI	MIAN	197
	5U 10 Sut	MAIN.	196
512	CALL ESUBEL	MAIN	199
	SU 10 Ann	MAIN	200
		MAIN	201
e li l		MAIN	202
		MAIN	203
209		MAIN	204
	IP (INVI: CHAPIT CREE BOOKRE	MAIN	205
		MAIN	206
41U	IF (CHAPI) CALL ESURFI	MAIN	207
	IF (LNAR,) CALL ESUNIZ	MATN	208
	IF (CHARD AND IN ALLO DI CALL EDERIE	MATN	204
	IF (CHAPS .AND. IN .NE. 3) CALL NSCRIZ	AUTN	210
	60 TO 300	MATH	211
č. i	LALL BSURFI	MATN	212
		TAL	212
211	LALL BSURFD	MAIN	210
344	LONIINUL	MAIN	214
6		MAIN	215
L		MAIN	216.
L	FIX ARRAY PHIEG SU THAT IT ONLY REPRESENTS PEROSITY OF THE	MAIN	211
L	PROPELLANT AND NOT THE TOTAL POROSITT.	MAIN	218
	UU 310 J=1,NGM	MAIN	219
	UU 510 1=1.16A	MAIN	220
	$PHIDG(1, \cup) = PHIDG(1, \cup) + 1.0 = PHIDP(1, \cup)$	MAIN	221
51.0	LOHIMUE	MAIN	222
		MAIN	223
		MAIN	224
E.	HANNEL SURKUUTINES	MAIN	225
		MAIN	226
		MAIN	227
C	INTERNET AT AN INC. TO ADD	MAIN	226
		HAIN	229
	The second state of the state o	MAIN	230
- and a		MAIN	231
		MAIN	232
		MAIN	233
323		MAIN	234
		MAIN	235
			0.14
L		MAIN	6.30
Ĺ		MAIN	237
L L L + + +	********	MAIN	237

	a a a a a a a a a a a a a a a a a a a	MAIN	240
·	AF (NA	MAIN	241
	LALL NEWDA	MAIN	242
	PRII = .INUE.	MAIN	243
L		MAIN	244
21.4	L GRI INGE	MAIN	245
	CALL UPUATE	MAIN	246
L		MAIN	247
	ATTAP .LT. ALEART GO TO STO	MAIN	248
	210F	MAIN	249
L		MAIN	250
540	CONTINUE	MAIN	251
the state of the	AF (14ME .LT. 11) GU 10 400	MAIN	252
	wi(1)E(E,2000) 11ME	MAIN	253
	2104	MAIN	254
L		MAIN	255
400	IME = IIME + LELT	MAIN	256
	1 + 1 + 1 + 1	MAIN	257
	00 16 16	MAIN	258
1		MAIN	259
L		MAIN	260
1000	+UNMA1(35L1)	MAIN	261
2000	FURMAIL - 11ML = . 1.13.7. SU WE STOP	MAIN	262
elle	+ UKIA 1 (1HU, DA, 35L3)	MAIN	263
LUS	FURMALLIMI, +ANNAY IDEBUG+)	MAIN	264
2004	FURFAI(1HU.5X.+ 1 2 3 4 5 6 / 8 9 10 11 12 13 14 15 16 17	MAIN	265
	10 19 20 21 22 23 24 25 26 27 26 29 20 31 22 33 34 35*1	MAIN	266
		MAIN	267
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	A ANNA A REPORT AND A AND A CONTRACT AND A CONTRACT AND A DATA AND A CONTRACT AND A DATA AND AND AND AND AND AND AND AND AND AN	CHSEI	2	
	COM ON INVERTENT AN APPENDATION OF A BORK A TEPPE	MUDU925	55	
	a DEGIC(5) (ALIC(5)	MUDU925	36	- +
	COMMONZY PTZTEF (;), DEP(2), CEP(2), FTUDK, PDALST	MUD0925	37	
	UUMMUUVAHI FLUVUT I PA JUANMAUPHMAPHMAPATAI USHRAGSPAKSAPHMCUF	M000925	38	
	ししぶり いとうとんましにとう おんしにすった かいいどっとていかやっとうしゃ えんていはっとみましょ MEAIL(60)。	LHSET	4	
	1 BULENCUDEPERETETEE	MUD0925	39	
	COMPONIZING KINE ZOCHIA, AL, VP, BOKED, POPUK, BUKEDE, DT280, DT050	CHSET	L	
	COMPONENT THE CLIPE AT	CHSET	7	
	CUMMUR/CHAM/12, 14. AL . NO. NO. NOR. IPE DE. ILNDB. IPATH(60.5). AREAGIST.	CHAMTX	5	trainin administra
	AREACE AREALTED ALLED A COLLECTOR A LAMPATIST LISP DISA DISA.	CHAMTX	2	
		CHANTY		
	A AF ARS INTERNING INTERNING COMPANY AND AND A COMPANY	CLAMTY		
	Compared of the track of the start of the st	LHAFILA		
		CHSEI		
	COMPOSIZE AREASTAPACAL FARPOWZ, APROWS, ARISE	MUD0301	1	
	COMPONIZER CONTRACT.	M0D1215	1	
	COMPONYTUBE/IENCIC(5), ITOBE, IBEGTC(_), INBP	M001115	1	
	└∁⋈⋈⋳й∕と⋧⋈⋦∕∪∣∟у₊Т∠└₭ኁТ≳⋃Ӿ₊Ŧ₩Ѻ҄҄҄ТЛ҄Ҝҡш┼└╷ҡѨӍ҈ҌӄТҜҨӃ┛ӻѺѴѦӾӀЅӻѺѴѦӾӀҬӄ	EUNS	2	
	U UX10498X160116611464	LUNS	\$	
	COMPONELY PROPERTIES + PROBUTIES + 5)	CHSET	12	
	LUMMUNZEASCULZKU, PKU, EVU, EVH	CHSET	13	
	LUMPUNJUNSES/NUME+NKUPE+LV0"6+CVMPE+NUBF+KRCBP+CVDBP+CVHBP	CHSET	14	
	LUMMUN/LENACI/ ENACI: + HACT2	CHSET	15	
applan a	CUMPLUNZGRAINZ ALLEUSS). UUI60.51. LIGO.51. EN.	GHATN		5 Mail/10-10-5
) $\lambda = 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1$	GEATA.	2	
	\sim A = 1003. (0.1360). (18(100). (0.1.100). (0.0.100)(100). (0.0.100)	CHAIN	····· ¥ ····	
		UNALIV	4	
	Composition Contraction (Contraction) ACC (BS) (AREAR (BU))	HULSA	2	
	a ARIGUJ, FRALILEU)	HULLA	3	
	COMPONYINPUTS/CI.(2.C3,C4) C. TEM+GLCKS.RHOF.PHIG.TF,CA.RHOO.	INPUTS	2	· · · · · · · · · · · · · · · · · · ·
	J MUTPUTUTUTUTUTUTTERETIGEBPTGRCUNSTOTM	INPUTS	3	
	LOMMON/P/IPHINI FOUCH MOUGH PRII ILEUG(35)	H	····· 2	
	COMMONASHTWAATHOFP209FKVA(2002) * 46FMEL * ROENEL * FXARb	PRIMV	ż	
	LUMMUN/046/PHJLC((0,5), RHUHG(60,5), r8G(60,5), UBG(60,5),	HAG	2	
	1 Vob(20+5)+ Cr2(60+5)+ PCH(60+5)+ 122(60+5)+	ISAG	3	
	2 DUIMIG(60), GHAG(60,5), XDRAG(60,5), DOTMB(60,5), UPBDT(60,5),	BAG	4	
	5 Phib(D(60,5), Khub)u(60,5), F6G(L(20,5), UBGTU(60.5).	HAG	5	the second se
	4 V6010(60.5).T66(60.5).D0TM66(60).C.TMP(66.5).PHT6P(60.5).	HAG	6	
	Philipic60.51.176(60.5)	HAG	7	
	CUMPUNZBARREZ PETITEN, REDGETORS, PETERS, USETORS, UPITORS,	DARRI	5	
Briterikaliketeri interioanatio	1 - P(1)(1) + 1(1)(1) + 1(1)(1)(1) + 1(1)(1)(1) + 1(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)	CADD1		
	= $=$ $=$ $=$ $=$ $=$ $=$ $=$ $=$ $=$	DANNE	5	
		DARAL		
	- DALMESTICO, APORTICE, ALMERTINO, CAMASSINO, CAMOMIAN,	BARRL	5	
		BARKL	· · · · •	
	LOGICAL IGNII, GED, CHAMI, CHAMI, CHAMI, CHAMI, CHAMI, BURGN	CHAMLOG	2	
	LUGICAL PRILILING	PLOG	ē.	
	LUGICAL FAIL	CHSET	25	
10-10-10-10-1-1-1-10-1	LUGILAL PENET	MODQ605	3	
ί		CHSET	26	
	UAIA GRAV.XJLL.+1.+1.FIJF/32.16.778.13.1.1593785398/	CHSET	27	
	NAMELIST/CH11 F/	CHSET	28	
	1	M001215	2	
	2 RUND . MROMO . C VONE . C VIME . KHOP . CHWI.	CHSET	30	+ 8 m
	J HAR ILGNO ICO FUO ULO VUO TWO AGE BEEN. CGEN. PEXP.	CHSET	31	
	4 ALPHA. HETA. LI.C.2. C.3. LA. HMAY TF.	CHSET	30	
	5 NGR (NGZ (UN AURAN, ALLA) + GAP, NHULFS,, NROUL,	CHORT	71	
		CHOLI	35	
	- THE ALATH TETH FILTETATA ALT AND ALT 1991 1941	CHOLI	34	

C RUBP+KRUDP+LPKAUD+FPLEAS+ALFAMS+	PP10+11FCE+ MOD0925	40
STOPBAP + MAP + CMUER + CMUER - TIGNEP - XM		
+ INLENT-PHOGE FCOMPANTUMANTUMAN		57
	10000425	42
	CHSET	39
	CHSET	40
	CHSET	41
I NEAD THEATS AND CALLERATE CONSTANT		
LAND AND THE OTO AND CALCOLATE CONSTANT	TS FOR SUBRICITINES CHSET	43
11 2021 F = 1.21	CHSEI	44
	CHISET	45
	CHSET	46
	CHSET	47
CALL CELAR(IFICF(1))INICA(60))	CHSET	48
	CHSET	49
	CHSET	50
TELIDEBOG(2)1 WEITE(BILPINP)	CHSET	51
	ChSET	.52
L INKER DIFFERENT VERSIONS OF THE CI	HAMBER CAN EE RUN. CHSET	53
L IF CHAPIL IS THUE, THE LHAMBER CON	SISIS OF AN INTERDEPENDENT TWO- CHSET	54
L LIPENSIUNAL SYSTEP.	CHSET	55
L IF CHAME IS THUE, THE CHAMBLE CONS	SISIS OF TWC INDEPENDENT ONE- CHSET	56
L UIMENSIULAL SYSTEMS.	LHSET	57
C IF CHAMS IS IFUE, THE CHAMBER CONS	SISIS OF THREE INDEPENDENT ONE- CHSET	56
L LINENSLUNAL SISTERS.	(HSET	54
L	CHSET	60
FN = FLUAT (NFEMF)	CLEFT	60
INACKI = INICK1/12.0		6 1
UU 1 1=1,60		67
1 IHICK(1)=THICK]		65
PHUUP = PHOUP +144.0		64
PLUMP = PEUPPALLA	CHSET	65
BUB=BTUN/ 12 . US144	CHSLT	66
$ALB = \lambda 10/12.$	CHSET	67
$a_{10} = a_{10} a_{12}$	CHSET	68
	CHSET	69
	CHSET	70
	CHSET	71
UIANZ - UIANZ/12.	CHSET	72
0101 + 0101/12	CHSET	73
0152 = 0152/12.	CHSET	74
0155 - 0155/12.	CHSET	75
0154 = 0154/12.	CHSET	76
UIAMBI = UIAPBT/12.	CHSET	77
JKAM = URAM/12.	CHSET	78
GAP = GAP/12.	LHSET	79
XLUEL = XLUEL/12.	CHSET	AD
ICPGAP = TOPUAP/12.	CHSET	61
P0 = P0+144.	CHSET	82
AGEN = AGEN/(12.+144.++PEXP)	(HCFT	AZ
1666N = 666N/(12.+144.++PEXP)	CHOLT	AL
LUEN = CGEN/12.	CHEFT	AL
BERADU = BERADU/12.		00
010ENS = 6PULNS/454.+10.38+1728.		42
AGENEY = AGENEY / 12.0+144.0++FX00		01
UGENBY = Bat 100 / 12.0	LINSET	89
	LHSET	90
INITIALLY THE GAS CLASS ANTE ADE TO	CHSET	91
C CONTRACT THE SAG CONSTANTS ARE IN	THAT OF THE BLACK PUWDER. CHSET	92

L	AFTER LACH TIME INTERVAL, IN UPDATE, INE GAS CONSTANTS WILL BE	CHSET	93	
	CALCOLATED ON THE MASIS OF THE GASES PRESENT.	CHSET		
	$AU = KU_{L}P$	CHSET	95	
	KRU = NAGBP	CHSET	96	
	LVU = LVOBP	CHSET	97	
	UVN = Lynor	CHSET	96	
L		CHSET	94	0 · · · ·
L.	LUNED WAS TAKEN OUT OF MARINE HEREEN. IT IS NEEDED HERE FOR AREA	CHSET	100	
1	Lattin 611005.	CHSET	101	
•	shirts a table 1.73 a	LIGET	101	
	ADDER = DENDER ZZ	CHARI	102	
		LHSET	105	
	BOREN - FITBORENTBOREN	CHSEI	104	
L	TANK IN THE TANK THE TANK	CHSET	105	
L	DETERMANC DAT TEEDS TEEDE	CHSEI	106	
	OX = DRAMY ECAT (1.6X-1)	CHSET	107	
	IF (XLUEL + GAP DRAM) G7P = DRAM - XLBEL	CHSET	108	
L		CHSET	109	
- 4	IN THE LELL TUBE BEGINS IN GRID 1. FUSI IT INTO GRID 2.	CHSET	110	and an
	$BLEEL = DRAN - (\lambda LELL + GAP)$	CHSET	111	
	INTELETTER ALTER AND	CHSET	112	
	10L68=1126C	CHSET	113	
	LELEND = URAT - UN	CHSET	114	
	1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 +	CHSET	116	
		CHOLT	115	
	AND THE AND AND AND THE EBACTIONS OF CALLS INCO AND TEADS	CHALI	116	
C	TRACTI AND TRACT? FRE THE TRACTIONS OF ORIDA ADEOD AND ACHUM	CHSET	117	
	REGTERING INAL INCLUE TOBE OF OF ALS.	CHSET	116	
	IF (18200.20.1) FFAC(121.0-2.0+HELBEG/LA	CHSET	115	
	IF (IDEDE.GI.I)FRACII=((FLOAT(IBEGB)-0.5)+DX-BELBEG)/DX	CHSET	120	
	FRACT2 = (BELEWL - (FLOAT(IFNOB) - 1.2) + DX)/DX	CHSET	121	
		CHSET	122	· · · · · ·
L	UNAGUNSA AND GOUDS AND WELDED IN SUBROUTINE PRPFIR.	CHSET	123	
	UN = (1.5+000+000+xLb)++0.333	CHSET	124	
	ULUNS = 2.045647(ALMHA/3.141593)/XK	CHSET	125	
	GHLUNS = 2.0+SUNT(ALPHOP/3.141593)/ANOP	CHSET	126	
	PURAD=DIANB(/2.	M000925	43	
(INCET	107	
	ALPH AND CT ONE NEEDED FOR CALCULATE & THE DIRA BATE TH RECORS	CHEET	121	
U	ATEL = ACTENTS A MARKE	LINGET	120	
		LINE	129	
,		CHSET	130	
		CHSET	131	
c	VISE 13 A CONSTANT USED IN SUPROUTINE DRAG	CHSET	132	
	VISG = DM+GRAV	CHSET	133	
Ĺ		CHSET	134	
	CALCOLATE HE FRON TH AND PU	CHSET	135	
	LALL GSPRGP(HU+HHU+H+CVU+LVH+CV+PO+HH+TW+RHCDUM+0+0+0+0+GAM+CP+1)	CHSET	136	
ç		CHISET	137	
L		CHSET	138	
6444	*****************	CHSET	139	
C	INITIALIZE ARKAY IPATH.	CHSET	140	· · · · · · · · ·
(+++	***************************************	CHSET	141	
6		CHSET	142	
-	LALL PATHS	CHEET	142	
		LINE	145	
		LHSET	144	
	······································	CHSET	145	40. est solar lares
1.***	***************************************	CHSET	146	
	DETERMINE DELT AND CALCULATE CONSTANTS FOR FINITE DIFFERENCE EQNS.	CHSET	147	
	***************************************	CHEFT	9 4. 13	

L		CHSET	149
L	START TIPE AT U.U AND DETERMINE DELL, THE TIPE INTERVAL LENGTH	CHSET	150
	iint P 0.0	CHSET	151
-	OU = ORAVAJUL	CHSET	152
		CHSET	153
	$\Box E \Box T = T E T T + D Y / S G H T (T K U G U + H M A X)$	CHSET	154
	$1 \times 0 \times 1 = 2 \cdot 0 \cdot 1 \times 1$	CHSET	155
		CHSET	156
	DIDR = ULLIZUR	CHSET	157
	IZUK = 0.5-DIDK	CHSET	158
		CHSET	159
	$1 \times 0 \times 10^{10} = 2 \times 0.4 \times 10^{10} \times 10^{10}$	CHSET	160
6		CHSET	161
L		CHSET	162
L		CHSET	163
1	***************************************	CHSET	164
L	CALCULATE CRUSS-SECTIONAL AREAS ASSOCIATED WITH THE CHAMBER	CHSET	165
	***************************************	CHSET	166
L		CHSET	167
L		CHSET	166
	LALL AREAS	CHSET	169
L.		CHSET	176
C		CHSET	171
L	and the state of the	MUD0301	2
L	USING THE AREAS JUST CALCULATED, CALCULATE THE INITIAL VOLUME	M0D0301	3
L	OF CHAPPER RADIAL RUNS 1. 2 AND 3. ALSO CALCOLATE THE TOTAL	M0D0301	4
C	CRAMBER VOLUPE.	MUD0301	5
	ARROWI = (FLCAT(NGA) - U.S)+DX+AREAAX	M000301	6
L		H0D0301	7
	$ARROWZ = ARLAR(1) + DA+U_0 5$	MUD0301	6
	50 100 I = 2.NGA	M000301	5
	ARRUNZ = ARRUNZ + AREAR(1)+1X	MUD0301	.10
1.00		MUD0301	11
L		MG00301	12
	ARIOI = ARROWI + ERMORS	M000301	13
	IF (CHARZ) GU TU IZU	MUD0301	14
L		M0D0301	15
	ARROND = AREAGY (1'+LX+0.5	M000301	16
	$\frac{1}{10} \frac{1}{1} = 2 \frac{1}{10} \frac{1}{10$	M000301	17
	ARROWS = ARROWS + AREAGP(1)+DX	M0D0301	16
110		MUD0301	19
	APTOT - ARTOT + ARROWS	MUD0301	20
L	C Constantino S	M0D0301	21
1.0		MUD0301	22
(****		LHSET	172
	THITTALZE CHARDER MAINIA	CHSET	175
		CHSET	174
	LALE THEAMPHER TALLED GEN	CHSET	175
		CHSET	176
	IALL LIFARIPHI (13.1), THE (60.5))	CHSET	177
		LISLI	178
	CALL LLY AN (PE (ME + 1) - 1) - FEDERITIAN SV.	CHSET	179
ſ	ANAL	LHSET	180
	UPD IS INTERTY (C)	CHSET	181
L	THE ATTACK THE PROVIDENT OF A THEN PLANET THAT LAND	CHSET	182
1	THE PLACE OF PUPPPINE TO USE AND TO THE THEN CHANGE THOSE THAT HAVE	UNSET	185
L.		CHOCI	184

	510 J=1,06K	CHEET.	
JU	510 1=1,.68	CHOLT	180
	Ph186(1.0) = 1.0	CLEET	100
	$Pn_{LOTU(1+J)} = 1.0$	CASET	187
	$\text{FRIEP}(1, \omega) = 1.0$	CHEFT	. 100
-*	PH1PTU(1.0) = 1.0	LISET	189
510 00	I INUL	CHORT	190
		CHOLI	191
L LILL	ULATE INITIAL FORUSTITES OF & IDS CUNTATING BLACK POWDER	CHALL	192
L	Contraction of the second	LINGET	195
LA	L1 19 1617	CHSLT	194
L		CHSET	195
L		CHSET	196
JU	1001 1=1.66x	CHSET	197
		CHSET	198
4P	166// (1) = 56-6 AL.D	CHSET	199
1		CHSEI	200
1001 16		CHSET	201
1 1.00	ATA UE GRUS OF THE	CHSET	202
in the second se	TILLIS-TAFG	CHSET	208
il ta		CHSET	209
i 1	1 = 1666 + 1615	CHSET	210
	ha = aplog + 1013	CHSET	211
• C 1 T		CHSET	212
		CHSET	213
1		LHSET	214
	LE LAS TRANSPORTATION AND AND AND AND AND AND AND AND AND AN	CHSET	215
L Links	THE THILDER ETVISION BY 3 FIGHT INVOLVE TRUNCATION THE LAST	CHSET	216
	NO OF THE TUBE PAT HAVE MORE THAN NOT3 GRIDS.	CHSET	217
C	the set of	CHSET	216
10	SSU TEIBEUS-LIFI	CHSET	215
	OPKAD(1.1) = OPFALU	LHSET	220
	(0 + (1, 1) = 1)	CHSET	221
536 CU	NT INCE	CHSET	222
	540 1=18662,0142	CHSET	223
	5PKAU(1+1) = UPKAUU	CHSET	224
· ·····	18P(1+1) = 10	CHSET	225
546 600	INT LINUE.	CHSET	226
υU	550 1=10663.1E100	CHSET	227
	0PRAU(1.1) = CPRAUU	CHSET	228
	10P(1+1) = 10	CHSET	229
556 601	N 1 (N) E	CHSET	230
		CHSET	230
L		CHSET	222
L FRUM	PELLANT IS PACALE IN GAIDS ABOVE THE BELL TUBE ONLY. GRAIN	CHSET	235
t utre	INSTONS AND CHAIN SUNFACE TEMPENALUNE WILL BE LEFT 0.0 AT OTHER	CHSET	215
L bul	JS.	CHSET	236
11 ((CHAMS) No = c	(HSET	287
11 ((NUL CHALST I.P. = Not	CHSET	234
UU	570 1=Incotteluiur	CHSET	230
120		CHSET	205
υu	155 JEZ 1 141.	CHSET	241
n Alla da viante anna an	XL(1,J) = ALU	CHEET	241
	U(1,J) = U(J)	(LEFT	242
	$U_{\pm}(1, J) = U_{\pm}(J)$	CHOET	245
	146(1.J) = 10	CHOCI	244
	ALIUT(1)=x10	CHEET	240
	J01=1(1, L)=U0(CHEET	240

	04101(1.0)=010		
t.	J CONTINUE	CHSET	248
11		CHSET	249
L L		CHSET	250
μ.		CHSET	251
ι	CALCULATE VULLME GROUP THE ALLE THE & D DODODTE OF THE	CHSET	252
ι	WITH PROPER ANT.	CHSET	253
	10P1 = 10000 + 1	CHSET	254
	LDC1 = 1EdDo - 1	CHSET	255
	OLLIDEAMEARCHICHINGAER, (1) STY 2	CHSET	256
	1+(1)+(1)+(1)+(1)+(1)+(1)+(1)+(1)+(1)+(1	CHSET	257
	de 566 IEIGHI, Jaki	CHSET	258
		CHSET	259
201	CONTINUE	CHSET	260
L		CHSET	261
	stat Chity - with characteristic contraction	CHSET	262
	VECTIO - VOLUNO + AREAR(IEBO))*FRALIC+DX	CHSET	263
		CHSET	264
· · · ·		CHSET	245
,	PUTO-T.O-RHOF/REOP	MODITI	200.
<u> </u>	na na sente a sente se a sente de la se La la la la la la la la sente de la sente	CHELT	1
	00 565 J=2,14	CLOCY	_ 60/
	PHING(IEEGB+C)=1+U-FRACT1 + FRACT1+(1-U-KHOE/RHOP)	LADUDDE	268
965	CONTINUE	FI000925	44
· · · ·		LHSET	270
	00 590 J=2,000	CHSET	271
	UU 590 1=18F1.10F1	CHSET	272
	Ph1bu(1,J)=1.0-RhUb/RhUF	CHSET	273
5.0	LUNIINE	M0D0925	45
L		CHSET	275
	10 520 CE	CHSET	276
	PHALU(ILNUHAU)=1, 0=66ALTZ + FRACTAL A O W CO. DO AND	CHSET	277
270	CONTINUE	M0D0925	46
L	LETERALLE MIL AND PRICE LAND AS ANTES TO A CONTRACT	LHSET	279
	LALL STRUP (SHERE AND A THOUSE AND TO AND GSPROP	CHSET	280
C C		CHSET	201
-		CHSET	282
		CHSET	283
		CHSET	200
		CHSET	205
		CHSET	200
	RHORG(1, J) = RHOU	CHSET	207
	000(1,0) = 00	CHSET	201
	$v_{\text{DG}}(1,\omega) = v_{\text{C}}$	CHOLT	288
	$100(f_{\bullet,0}) = 10$	CHALI	289
ULU		LHSET	290
L		CHSET	291
	$I + (IULLUU(3)) = while (e_{0} < 006)$	CHALT	565
	UU 630 UII HILDE	CHSEJ	293
	It (IDEBUG(0)) WEITE($6,2007$) detEtableTa, latelances	CHSET	294
ພວບ	CONTINUE	LHSET	295
L		CHSET	296
	it (1Ut CUU(3)) WELTLIGICUUB)	CHSET	297
	UU 640 U = 1. NUR	CHSET	296
	4+ (10 100 (3)) white (5.2007) to a set	CHSET	295
	THE	CHSET	300
646	LUNITHUL		
646		CHSET	301
646 6	CONTINUE	CHSET	301 302
الانون ال (4 4 4 4		CHSET CHSET CHSET	301 302 303

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		CHSET	305
	***************************************	INSET	306
L		CHSET	307
ι.	SET UP HELLS IN HELL TUBE AND ANY PSEUD HOLES BETWEEN RADIAL ROWS	CHSET	308
L	UNE AND IND.	CHSET	309
	CALL MULSEI	CHSET	310
	•••••	CHEFT	311
	THE HULE AND A AT FACE FULL DETAFTE FULL, C.A. LOLS ONE AND THO	LISET	311
	THE ME AND THE AND THE AND THE AND THE AND THE AND THE	LISCI	216
		CHSET	515
		LINSET	314
L	CET HOLE AREA AT EACH GRID BETTEEN RACIAL ROLS THU AND THREE IF	CHSET	315
L	CHAMS IS THUE. IT IS CALCULATED USING AN AVERAGE DIAMETER	CHSET	316
L	UBLAINED FRUM SURRUUTINE AREAS.	CHSET	317
	IF (.I.UT. CHARS) OF THE YUU	CHSET	318
	AHEANE = 0.JS+(11/6L1A)+0.5+(DAVG - 1.PGAP)+TOPGAP+	CHSET	319
	3 SUNI(2.02(00M - 3.0))	LASET	320
1		CHOSEI	320
		CHACI	521
		CHSET	\$22
100	CONTINCE	CHSET	323
L		CHSET	324
C+++	· · · · · · · · · · · · · · · · · · ·	CHSET	325
L	CUNPULE TOTAL MASS IN THE SYSTEM	CHSET	326
		CHSET	327
		CHEET	824
	LANAL AS GOT WHITTAN CON LHAND TRUE	CHELT	320
		CHALL	329
	THE AREA AND AND A	CHSET	550
		CHSET	331
L		CHSET	332
L	TO FIND THE TOTAL GAS FASS, SUM THE PHUDUCT CF TOTAL POROSITY#	CHSET	333
ţ.	LENSITY OF GAS+VOLUME AT EACH GRID.	CHSET	334
L	STICE GAS BENSITY AND GRID LENGTH AND CONSTANT, MULTIPLY BY THEP	CHSET	335
-	AFTER SUMMING.	CHSET	336
L	FINST SUP ALUNG THE AXID. THERE ALL AREAS ARE APPEARY SO FACTOR IT	CHSET	317
-	Sid = 1.54/Phillipitate Philipitate of	CHOLT	331
		CHOCI	220
		CHSET	339
-	300 = 300 + 0.000(1+1) + 0.000(1+1) = 1.0	CHSET	340
100		CHSET	341
	LOTM = SUM#AKEAAX	CHSET	342
L		CHSET	343
-	SUM = 0.5+(PHIBG(1+2) + PHIBP(1+2) - 1.0) + AFEAR(1)	CHSET	344
	00 /30 1=c,10X	I HSET	345
	$SU_1 = SU_1 + (1 + 1) + (1 + 2) + PPIEP(1,2) - 1 - 1) + ARFAR(1)$	CHSET	344
7	LOGINUP CONTRACTOR CONTRACTOR	CHEET	
	1010 = 1010 + 500	CHOCI	347
		CHALL	240
-		CHSET	349
	AFTCHARE GUID /50	CHSET	350
	APRIDU(1.3) AND PHIDP(1.3) ARE 1.0 FUR ALL I	CHSET	351
	SUM = $0.5 \pm AREAUP(1)$	CHSET	352
	JU 740 1=2,NGX	CHSET	353
	SUP = SUP + AKLAGE(1)	CHSET	354
740		CHSET	365
	101h = 101# + 50M	CHSET	354
		LEFT	330
7	(fred lists	CHOLI	33/
100	Constances	CHSET	356
	TOTE - TOTMPROUPUA	CHSET	359
		CHSET	360
	ADU IN PASS OF BLACK POWDER AND PROFILLANT.	CHSET	361

1.0	UIM = TUTM + BPCHG + CI	ha I	CHSET	362
600 L	UNTINUE		CHEET	363
6			LIGET	364
11	MALLISI/CHAIN/XLU.UUU.	UID . HAUHUL . P SEN . XCL . NRUWH.	CHSET	365
4	NHULLS . AREAM . I ITL . ULL	1. TWOGJ. UTCA. CIDH. T2CH. 12LX. TWOIDR. PHID.	CHSET	367
\$	HU+KHUU+10+UVAXIS+LVAX	II. CONS. ATPOLT. VISC. HW. UIAMI. DIAM2.	CHSET	368
4	UIS1.0152.0153.0154.01	HED. IGNIT. AGLA. CGEN.	CHSET	369
\$	ULAMBT, CHAMZ, HUFLU, BUI	HEN, FOREA, AHLAAX, AREACH.	CHSET	370
1	HPRAUC . DPULNS . AULINEF . 1	HU. KRU. CHWT . Er CHG.	M001215	3
a	URAM . GAP . ALBEL . UA . ILE	GC. IMEGB. IENUE.	CHSET	372
2	OLLOLG. ADU. BLLENU. FRAD	LI1+FRACT2+VLL_HG+RHCH.	CHSET	373
4	KHUDP1 . KHUPP2 . HHUDPS . F	NUT . 11613 . LAN LBEG2 . LIM2 . LBEG3 .	CHSET	374
t	IUPDAL . UAVU . UAM . ANEAM	2. TUTH , DM. GULC. S. AH. FRACT. JPS1 . JPS2	CHSET	375
1	FILLEUUG(4)) WHITEIDILT	HNINJ	CHSET	376
L			CHSET	377
L			CHSET	378
L			CHSET	375
1	LIUKN	a dev a magan	CHSET	140
L			CHSET	341
CUUL F	UNPATITION LOUIC FUR FI	INUING TOTP WELN CHAPT IS TRUE IS NOT WETTE	CHSET	342
÷ ۱.	N YE1+)		LHSET	383
EULE H	UNMAIL///. AKHAY PHILSU	5' • /)	CHSET	384
2107 F	URMAIL HADIAL HUN	12./.(20x.10.10.10.6))	CHSET	385
ette t	UNMALLITT ANHAY FHIN	P* • /)	CHSET	100
L	NU		CHSET	365
	The second		Chaci	301
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		PATHS	2	where a new particular strength of
diversity when some the s	CUMMON/CHAP/IX, IK, AB, KD, NOX, NER, JELGE, JENDE, IPATH(60,5), AREAG(5),	CHAMIX	2	
	AREALHAAREAC(00).16W1F.00.ED.01AM1.LIAM2.CIS1.01S2.01S3.01S4.	CHAMIX	3	
201	AREAR(60), AREAAX, UHAM1, CHAM2, CHAM2, IOHGAP, AREAGP(60), DAVG,	CHAMIX	4	
	AREADZ, DIAMOT, ULLEND, BELBEG, IPS1, 1F52, RADES, BPIGN	CHAMIX	5	renter of contraction of
	CORMON/F/IFRINT, MODCH, MODGR, PRI1, IDEELG(35)	μ	2	
	COSICAL IGNIT.ORED.CHAMI.CHAM2.CHAMO.CPIG.	CHAML OG		
	CUBLAL PHILIPLOU	PLOG	5	
L		HATHS	** * *** h 7	
_ L	SUBRUUTINE PATHS INITIALIZES ARRAY IFAIR.	HATHS		
C C	VALUES OF IPATH CORRESPOND TO THE PATH SUBROLTINES IN THE	PATHS.	6	
L.	FOLLOWING WAY	UATHE		
L	1 - AXIS C - AXIT 3 - INTER 4 - HNDY	DATHS	10	***
	5 - FSURFA 6 - FSURFI 7 - FSURFI 8 - FSURFA	PATHS	11	
Ĺ	9 - BSUNFA 10 - BSURFT 11 - SURFT 12 - BSURFB	LATHS		
··· • ·	IF CHAME IS THUE THE CHAMBER CONSISTS OF TWO ONE-DIMENSTONAL ROLE.	PATHS	15	
Ĺ	UNE NUW USING AXIS NOUTINES. THE OTHER USING AXIT HOUTINES.	PAINS.	14	and a straightformula
L	IN CHAP'S IS THUE THE CHAPUER CONSISTS OF THREE ONE DIMENSIONAL	PATHS	15	
L	RUWS, INU KENS LINE THUSE WHEN CHAN, 15 THUE AND THE THIND HELD	PAINS	16	-
L	SAPALAR POUTINES VALUES OF IPATH LUNASPONE TO THE NEW BOUTTALS	PAIRS	17	
L	AS FULLUNS	PAINS	16	
····· 6	< - AX12,AX113	PATHS	19	
L	9 - BSUKAZ	PATHS	20	
······ 6	14 - BSUR12 . DSUR1A	PATHS	21	
L		PATHS	22	-
	IF (CHANZ - UNA CHANS) 60 IU AN	PATHS	23	
L		PATHS	24	
		PATHS	25	
L	WITH 1=1. USUNFA. (SUNFL. AND RSHUFL A.S. CALLED	PATHS	26	
	IPAIn(1,1) = 9	PATHS	27	
		PATHS	28	- No. Her to " Specifica
14	Arabico a li	PATHS	29	
		PATHS	30	
		PATHS	31	
		PATHS	.32 .	
		PATHS	33	
	FRIDE 12, UNITA 144 CARA S FITTLE TOP	PATHS	34 _	1 1000 v
í.	AND LALITY BELL IGNITER TOEL, LXIS, INTER, AND BNDY	PATHS	35	
		PATHS		
~		PATHS	37	
		PATHS	38	
		PATHS	39	
4 .		PATHS	40	
50		FATHS	41	minute de
		PATHS	42	
		PATHS	43	a contraction of the state of the
whether	$\frac{1}{1} + \frac{1}{1} = 4$	PATHS	44	
		PATHS	45	
-		PATHS	46	
	Figh Wallies OF 1 active 1.4 active tensors and a second	PATHS	47	Bright same inc
······································	AND HEARS OF I WITHE THE BELL IGNIILH TUBE IS AXIS, AXIT, INTER,	PATHS	48	
C .	A B TAB SHIT AND LALLEL.	PATHS	44	and the state of t
	THE UNIT OF THE SUNFACE OF THE DELL IGNITED TUBE AT EITHER	PATHS	50	
L.	COULTHING IS CALLED.	PATHS	51	
- 40	Trisec.ithut) 60 TO eu	PATHS	52	
		PATHS	53	-
-	<u>AFAIN(1+2) = 2</u>	PATHS	54	
		PATHS	54	
			55	

,79

	(Fabrilio) = 3	CATHE	a a develop
20		PAINS	56
	11 (J.L1., Uh) 60 10 50	PAIRS	2/
	1 + a(1)(1 + a) = 4	PAINS	20
64 e 8+	1=1+1	PAIDE	27
	60 10 40	PAINS	60
L .		PAINS	61
ĩ	AFTER DE BELL LUGITER TUDE IS PASSELL AXIS. INT H. AND HNDY ARE	PAIRS	62
L	CALLED.	PATHS	62
64	1+11.01.85X) 60 10 50	PATHS	64
	P(A) = 1	PAINS	65
	2=0	PAINS	66
71.	1PAIn(1+j) = 5	PATHS	61
		PATHS	68
	1F(J.L].16k1 60 10 70	PAINS	69
	(PAIh(1+a)) = 4	PAINS	70
and the set	4=4+1	PAINS	71
	00 l0 66	PATHS	72
L		PATHS	73
L.		PATHS	74
Č	THE FULLUWING LUGIC IS USED FOR BOTH CLAMS AND CHAME TRUE	PAIRS	
0.0	CONTINUE	PATHS	76
andreadly should be at a	1PA[n(1,1) = 9	PATHS	
	1PATh(1,2) = 10	PAINS	70
the manufacture and the second second	4PAID $(1,3) = 10$	PATHS	19
	UU DI IIZANGK	PATHS	80
and the second	1PATH(1,1) = 1	PATHS	01
	4 PATh(1), = 2	PATHS	02
with a	$A^{r}A(1)(1,3) = 2$	PATHS	83
e.,	LUNTAFILE	PATHS	64
E		PATHO	65
ĩ		PAINS	86
31	CONTINUE	PATHO	0/
	AFT. HUL. TO BUG (533 RELING)	PAINS	86
	WAIF 16.2000	PAINS	89
		PATHS	90
	WELLE CLASSING & STATEMENT AND A THE AND A THE AND A	PATHS	91
ч		PATHS	92
		PATHS	93
(PATHS	94
2000	FURMALLIZZA ANNAY INATHINA	PATHS	95
<1000	FURMALLY RANIAL RUNT, 12, 2, 108, 30/10	PATHS	96
	CAN	PATHS	97
		PATHS	96

DMP GN/LMAT/1X,1N,AD,KD, NGX,NGK, 18LGG, 1ENDB, JPATH160,5);AREAG(5); AREAL(,AREAC(60),IGNII,ORED,DIAMI,JIAM2,CISI,DIS2,DIS3,DIS4, AREAN(60),AREAAX,CHAMI,CHAM2,CHAM3,IOPGAP,AREAGP(60),DAVG, AREAN2,DIAMDI,RELEND,BELBEG,IPS1,1F52,RADFS,BPIGN OMPOW/LGNS/LILA,I20K,T2DX,TWOIDR;DILK,HMB;IWOGJ,DVAXIS;DVAXIT, OX,UK,MX,OG,IWODI,HBP OMPOW/MULEAZRALDQL(85),MPOCH;NHOLLS(5),XCL(85),AREAH(60), AH(60),FRACI(66)	CHAMIX CHAMIX CHAMIX CHAMIX EGNS EGNS HOLEA HOLEA HOLSET CHAMLOG	2 3 4 5 2 3 2 3 6
AREACH, AREAC(60), ICHII, ORED, DIAMI, LIAM2, CISI, UIS2, DIS3, UIS4, AREAR(60), AREAAX, CHAMI, CHAM2, CHAM3, IOPGAP, AREAGP(60), DAVG, AREAR2, DIAMDI, HELEND, BELBEG, IPS1, IFS2, RADES, BPIGN COMPON/LUNS/LILA, IZDX, TWOIDR, DILL, HMB, IWOGJ, DVAXIS, DVAXIT, UX, UK, MX, OU, IWOID, HBP COMPON/MULEAZRALDQL(25), MROCH, NHOLLS(25), XCL(45), AREAH(60), AH(60), FRACT(66) IMENSION DIEMP(50), NICPP(50), RTEMP(50) CONCAL IGNIT, CH.D, CHAM1, CH.M., CHAM3, UPIGN IN USIANCE (I, 19, CHAM1, CH.M., CHAM3, UPIGN	CHAMIX CHAMIX CHAMIX EGNS EGNS HOLEA HOLEA HOLEA HOLSET CHAMLOG	3 4 5 2 3 2 3 6
ANCAR(60), ANCAAX, CHAM1, CHAM2, CHAM3, 10PGAP, ARCAGP(60), DAVG, ANCAR(50), ANCAAX, CHAM1, CHAM2, CHAM3, 10PGAP, ARCAGP(60), DAVG, ANCAR2, DIAMD1, HELEND, BELBEG, IPS1, IFS2, RADFS, BPIGN COMPUNZIONSZEILA, 120K, 120K, 1WOIDR, DIELK, HMB, IWOGJ, DVAXIS, DVAXIS, UX, UK, AX, OU, IWODI, HBP COMPUNZIOUCAZRALDUC(25), MPOUN, NHOLES(25), XCL(85), AREAH(60), AH(60), FRACI(66) AH(60), FRACI(6	CHAMIX CHAMIX EGNS HOLEA HOLEA HOLSET CHAMLOG	3 2 3 2 3 5 2 3 5
ANEANL2. DIAMBI, HELEND, BELBEG, IPSI, FS2. KADFS, BPIGN UNAUK, UNS/LUNS/LUN, 120K, T20X, TWOIDR, DIUK, HMB, IWOGJ, DYAXIS, DYAXII, UX, UK, MX, UK, MA, UDI, HBP UMMUN/HULAZRALDUL(ES), MPOUM, NHOLLS(LS), XCL(AS), AREAH(60), AH(60), FRACI(66) AH(60), FRACI(66) AH(60), FRACI(66) AH(60), FRACI(66) AH(60), FRACI(66) AH(60), FRACI(66) AU(60), FRACI(66) AU(66), FRACI(66) AU(66), FRACI(CHAMIX EGNS EGNS HOLEA HOLEA HOLSET CHAMLOG	5 2 3 2 3 6
ANCANZIOTANSTUTUA, TEURITEURITEURITEURITEURITEURADEURDIUN UNIONZUUNSZUTUA, TEURITEURITEURITEURITEURITEURITEURITEURI	EGNS EGNS HOLEA HOLEA HOLSET CHAMLOG	2 3 2 3 5
$\partial A + \partial K + \partial X + \partial A + A +$	LUNS HULEA HULEA HULSET CHAMLOG	3 2 3 6
UX-UK-MX-GGTTWODTTHEP UM-UK-MX-GGTTWODTTHEP AH(60) FRACT(60) AH(60) FRACT(60) AH	HULEA HOLEA HULSET CHAMLOG	3 6
AMOUNZHULEAZRALDUL(BD)+MOUN+NHULES(BD)+XELIBD)+AREAH(BU)+ AM(BU)+FRACT(BG) AMUNDIUN DIEMP(SU)+MTEMP(SU)+RTEMPISU) OGICAL IGNIT+CH.D+CHAM1+CHAM1+CHAM3+GPIGN HE DISTANCE (II, INCHES) BETWEEN THE CENTER LINE OF HOLES IN ROW I	HOLEA HOLEA HOLSET CHAMLOG	3
AH(60),FRACT(66) AMEHSTON DIENP(50),MTEMP(50),RTEMP(50) OGICAL IGNIT,GRED,CHAMI,CHAMI,CHAM3,BPIGN IE DISTANCE (11, 18CHES) BETWEEN THE CENTER LINE OF HOLES IN ROW I	HOLEA HULSET CHAMLOG	3
HUNDERSTON DIENP(50)+MICHP(50)+RTEMP(50) OGICAL IGNIT+GALD+CHAMI+CHAMI+CHAM3+DPIGN IL DISTANCE (14, 10CHES) BETWEEN THE CENTER LINE OF HOLES IN ROW I	CHAMLOG	6
UGICAL IGNIT. GELD. CHAMI. CHAMI. CHAMIS. PIGN	CHAMLOG	
IL DISTANCE (11, 19CHES) BETWEEN THE CENTER LINE OF HOLES IN ROW I		2
IL DISTANCE (14 INCHES) BETWEEN THE CENTER LINE OF HOLES IN ROW I	HOLSET	6
	HOLSET	9
AN THE CENTER LINE OF THE PREVIOUS ACA OF HELES SAS INPUT INTO	HULSET	10
(1). XLI(1) CONTAILS THE DISTANCE OF THE CENTER LINE OF HOLES	HOLSET	11
HUM TERMATES OF STATING OF THE SET TUBE.	HOL SET	12
MARK AR ARTIST REPORT AND STATE NEAR STATE	HOL SET	12
	HUL OF T	10
THIS OF POLLS IN NOW I WAS INTO THIS RADICALLY.	HULALI	
SOLO HOLLS VILL BE PUT BEFORE AND AFTER THE BELL TOBE AND	HULSET	15
LATED THE SAME AS HOLES ON THE BELL TUBE.	HOLSET	
TE PUSITION OF THE CENTER LINE OF HULLS IN FOW I (IN FEET)	HOLSET	17
LL BE PUT INTO ACL(I).	HULSET	16
	HOLSET	19
PURARILY STORE THE INPUT DATA ABOUT THE HELES.	HOLSET	20
(F(MAUWH .Eu. 0) 66 TO 102	HOLSET	21
U 100 1=1+1+KOWH	HOLSET	22
U[EMP(1) = x(L(1)/12)	HOLSET	23
W = W = W = W = W = W = W = W = W = W =	HOLSET	24
	HOL SET	25
	HOLSET	24
	HOLSET	20
	HULSET	21
These is work where the state of the	HULALI	28
T FSEULO HOLES BEFORE THE BELL TUBE.	HULSET	29
ADPS, THE MALTOS OF THE PSEUDO HOLES, IS CALCULATED TO GIVE ABOUT	HULSEI	50
LLE AS MUCH AREA AS HULES ON THE BELL TUBE.	HOLSET	31
(AUPS=0,1+SGHT(EIAMBT+DX)	MQD0925	48
IPS1 = IBEGR	HOLSET	33
	HOLSET	.34
10 105 1=1,1+S1	HOLSET	37
CL(1)=FLUAT(I-1)+UX+CX/4.	NUD0925	49
IMULES(I) = 1	HOLSET	34
RAUNOL(1) = RAUPS	HOLSET	4.0
	HOLSET	41
	HOLDE T	45
	HOLGET	
A sub-sub-static test of static library	HULSET	40
TOP HOLES CA THE BELL TOBE.	HULSE	44
	HULSET	45
11 = 1PS1 + 1	HOLSET	46
CL(11) = BELOEG + UTEMP(1)	HOLSET	47
HULES(11) = 1.11(1+(1))	HOLSET	48
(AUHUL(11) = K1200(1)	HULSET	49
LF (NKUW1 .Eu. 1) 60 10 115	HOLSET	50
10 110 1=2+chOwh	HOLSET	51
11 = 11 + 1	HOLSET	52
AU(11) = XU(11-1) + UTEMP(1)	HULSET	53
NHULES(11) = NIEMF(1)	HULSET	54
	HOLSET	55
	<pre>NUM 1 PROF THE DECLINERG OF THE DELT TUBE. MORE OF HOLLS IN NOW 1 WAS INPUT INTO NADES(1). DIDS OF HOLLS IN NOW 1 WAS INPUT INTO RADHCL(1). DIDS OF HOLLS IN NOW 1 WAS INPUT INTO RADHCL(1). DIDS OF HOLLS IN NOW 1 WAS INPUT INTO RADHCL(1). DIDS OF HOLLS VILL BE PUT DEFORE AND AFTER THE BELL TUBE AND HALLO THE SAME AS HULLS ON THE BELL TUBE. POSITION OF THE CENTER LINE OF HOLLS IN FOW I (IN FEET) LL DE FUT INTO ALL(1). PPONABALLY STORE THE INPUT DATA ABOUT THE HELLS. FIRADUM .EU. 0) GG TO 102 O LUD TELEMADNH OTEPP(1) = NACL(1)/12. WILPP(1) = NACL(1)/12. WILPP(1) = NACHOL(1)/12. UNTIT THE MACHOL(1)/12. UNTIT THE MACHOL NOT THE BELL TUBE. DUPS THE MALUS OF THE PSEUDO HOLES, IS CALCULATED TO GIVE ABOUT ALL AS MUCH AREA AS HOLES ON THE DELL TUBE. AUDSDUTSENT(LIANDITAUX) PS1 = 10EGM NO TOS TELESTICATION THE DELL TUBE. AUDSDUTSENT(LIANDITAUX) PS1 = 10EGM NO TOS TELESTICATION THE DELL TUBE. AUDSDUTSENT (LIANDITAUX) PS1 = 10EGM NO TOS TELESTICATION THE DELL TUBE. AUDSDUTSENT TO ANY AUDIC (1)=KAUHOL(1)=S_NT(BELBEG/UX) .T OF HOLES ON THE DELL TUBE. AUDIC (1) = NTEPF(1) ANDUES ON THE DELL TUBE. AUDIC (1) = NTEPF(1) ANDUES (1) = hTEPF(1) ANDUES (1) = hTEPF(1)</pre>	Liti. Acting to be and to be the determine the termine to notes in notes in the provided in the determined in the provided in the determined in the notes in note

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	IF (ACL(11) + FAUHUL(11) .LT. ELLEND) GO TO 110	HUL SET	56
	$1(A_{3}) = 1 - 1$	MUL SET	67
	WAITE (5,2010) PRUMITILAST	HOLSET	50
	11 = 11 - 1	HULSET	00
	60 16 115	HULSET	23
110	CONTINUE	HULSET	60
11.		HOLSET	61
		HOLSET	62
	Tak LuSh datud tr in the second state	HULSET	63
L	THE LAST VALUE OF IT IS THE TUMBER OF HULES SO FAR.	HULSET	64
L	SET OF PSEUDO HOLES AFTER THE HELL TURL.	HULSET	65
11.5	1.KOm4=11	HOLSET	66
	IPS2 = IENDB	HUL SET	67
6		HOLSET	10
L	IF THE BELL TUBE EXTENDS BEYOND GRID PLINT IFNDE. THERE SHOULD NOT	LOISET	60
L	DE A PSEULOHOLE AT GRIL PUINT LENGH	HOLDET	67
	IF (BELERG . GT. FLUAT (IF NUB - 1) +DV1 TUS - TEADD . 1	HULSEI	70
-nation of stations and	of 120 1=1052 MGY	HULSET	71
		HOLSET	72
		HOLSET	73
	ACE (NROWH)=FEOAT(1-1)+UX	HOLSET	74
	NOULS (NKOWI)=1	HULSET	75
	RADHOL(NKOWH) = RAUPS	HOLSET	76
	1+ (NROWH, EW, 85)60 TU 140	HOLSET	77
120	CONTINUE	HOLSET	70
C		HULSET	10
C	LLEAR HULE ARNAT ENTRIES WHERE THENE AND NO LOLES	HULDET	19
	INKI = ARBER + 1	HULSEI	80
		HOLSET	81
		HOLSET	82
	The CEAR (RADHOL (MR]), RADHOL (85))	HULSET	83
	10 130 1=1R1,E5	HOLSET	84
	NHCLES(1) = 0	HOLSET	85
100	LONTANUE	HOL SET	86
L		HOL SET	
24.0		INFRE !	
	CONTRICC	1 01 EFT	
6		HOLSET	88
		HOLSET	88 89
2011	RETURN FORMATIZZING AND THE MEMORY OF RENS OF HOUSE ON THE OF	HOLSET HOLSET HOLSET	88 89 90
_2011	RETURN + FORMAT (//,15, + WAS INFUT AS THE NUMBER OF REWS OF HOLES ON THE BEL S. TUBL, HUT UNLY ".14." FIT ON THE T. BET	HOLSET HOLSET HOLSET	88 89 90 91
_24071	RETURN + FORMAT (77,15, * WAS INFUT AS THE NUMBER OF REWS OF HOLES ON THE BEL SL TUBL, BUT UNLY *.14.* FIT ON THE TUBE*) ENU	HOLSET HOLSET HOLSET HOLSET	88 89 90 91 92
د _لاب1	RETURN FORMAT(77,15, * WAS INFUT AS THE NUMBER OF REWS OF HOLES ON THE BEL SE TUBLE BUT UNLY ".14." FIT ON THE TUBE") ENU	HOLSET HOLSET HOLSET HOLSET HOLSET	88 89 90 91 92 93
د _צע1	RETURN - FORMAT(//,15, * WAS INFUT AS THE NUMBER OF REWS OF HOLES ON THE BEL SL TUBL, BUT UNLY ',14, * FIT ON THE TUBE') ENU	HOLSET HOLSET HOLSET HOLSET HOLSET	88 89 90 91 92 93
2011	REIURN - FORMAT(//,15, * WAS IMPUT AS THE NUMBER OF REWS OF HOLES ON THE BEL SL TUBL, BUT UNLY *.14.* FIT ON THE TUBE*) ENU	HOLSET HOLSET HOLSET HOLSET HOLSET	88 89 90 91 92 93
L_2U1	REIURN - FORNAT (//,15, * WAS INFUT AS THE NUMBER OF REWS OF HOLES ON THE BEL SL TUBL, BUT UNLY *.14.* FIT ON THE TUBE*) ENU	HOLSET HOLSET HOLSET HOLSET HOLSET	88 89 90 91 92 93
C 201	RETURN FORMAT(77,15, * WAS INFUT AS THE NUMBER OF REWS OF HOLES ON THE BEL SL TUBL, BUT UNLY *,14, * FIT ON THE TUBE*) ENU	HOLSET HOLSET HOLSET HOLSET HOLSET	88 89 90 91 92 93
C2(1)	REIURIN FORFAI(//,15, * WAS IMFUT AS THE NUMBER OF REWS OF HOLES ON THE BEL SL TUBL, BUT UNLY *,14, * FIT ON THE TUBE*) ENU	HOLSET HOLSET HOLSET HOLSET HOLSET HOLSET	88 89 90 91 92 93
C	KEIUKIN FORFAI(//,15,* AAS IMFUT AS THE NUMBER OF REWS OF HOLES ON THE BEL SL TUBL, BUT UNLY *,14,* FIT ON THE TUBE*) ENU	HOLSET HOLSET HOLSET HOLSET HOLSET HOLSET	88 89 90 91 92 93
C 201	KEIUKIN FORFAI(//,15,* AAS INFUT AS THE NUMBER OF REWS OF HOLES ON THE BEL SL TUBL, BUT UNLY *,14,* FIT ON THE TUBE*) ENU	HOLSET HOLSET HOLSET HOLSET HOLSET HOLSET	88 89 90 91 92 93
C 201	INCLURIN - FORMAT(//,15, * WAS INFUT AS THE NUMBER OF REMS OF HOLES ON THE BEL SL TUBL, BUT CHLY *,14, * FIT ON THE TUBE*) ENU	HOLSET HOLSET HOLSET HOLSET HOLSET HOLSET	88 89 90 91 92 93
C 201	REIUNN - FORMAI(//,15., WAS INFUT AS THE NUMBER OF REWS OF HOLES ON THE BEL SL TUBL. BUT UNLY '.14., FIT ON THE TUBE') ENU	HOLSET HOLSET HOLSET HOLSET HOLSET HOLSET	88 89 90 91 92 93
C 201	RETURN - FORMAT(//,15,* WAS IMPUT AS THE NUMBER OF REWS OF HOLES ON THE BEL SL TUBL, BUT CHUY *,14,* FIT ON THE TUBE*) ENU	HOLSET HOLSET HOLSET HOLSET HOLSET HOLSET	88 89 90 91 92 93

		- apple -	
	JUBRUUTINE OF LES	HULES	*
	THE REPORT OF A	CHANTY	
	che dony that y i x i x i x i x i x i x i x i x i x i	CHANTY	-
	AREACTION AND A CONTROLOGICAL AND A APARTON AND AND	CHANIA	3
	AREAR (DI) + ALEAAX + CHAMI + CHAM2 + CHAM3 + 10POAP + AREAGP (B0) + DAVG +	CHARIA	*
	ARCANZ, DIAMOT, ALLIN, DELET 6, IPS1, 1452, HADES, BPIGN	CHAMIA	5
	LLAMONZEUNSZLTAZATZUKATZUKATNOTOKADILKANMBATNOGJADVAXISAUVAXITA	LUNS	5
	2 UKOLASUSINULIONDI	LUNS	3
	CCAMON/HOLEA/KACHCL(85),NROWHATHCLES(35),XCL(85),AREAH(60),	HOLEA	2
	· AN(00) + RALI(60)	HULLA	3
	, 10E1.5105. 1A(85)	HULES	7
	COSICAL IGNIL.CLED.CHAMI.CHAMZ.CHAMS.mPIGN	CHAMLOG	2
	640 P174.3015947	HOLES	9
	0000 · 17001010707	UNLES	10
		HULLS	
L	A REPORT OF THE	HULLS	11
6.	SUBRUUTITE HULES CALCULATES THE HULE AREA EXPOSED TO EACH AXIAL	HULLS	12
6.	UNID. IT FURPS ARRAY AREAN. AREAPILY GIVES THE EXPOSED HOLE	HOLES	13
	ANEA AT GRIL I. THE HULE AREA EXPOSEL TO A GRID IS CALCULATED	HOLES	14
	AS THE HOLE AREA LEFT OF THE RIGHT BUCKDARY OF THE GRID MINUS	HULES	15
L.+	THE HULL AREA LEFT OF THE LEFT BOUNDARY OF THE GRID.	HULES	16
(•		HULES	17
(+	HAVEN - LUNDLA OF NUES OF HOLES	HOLES	18
1.	ALALLED - (FOTTER LINE OF HOLES TO BUE T	HOLES	19
	saudelet ty _ saudels like and ES TN ROW .	HOLES	20
	ALL A LAND ALL A ALL AND A POLY A LANDEADY IS ASSIGNED TO	HOLES	6V
6.4	TATA - HOLE ANEA OF HOLE FOR I THAT ALRED T IS ASSIGNED TO	HULLS	21
<u> </u>	A GRIL, INTIALLY TATT IS SET AS U. AFTER AREAAP IS	HULES	
C.+	CALCULATED, TATI) IS SET IC AREAXP.	HULLS	23
L.+		HOLES	24
C		HOLES	25
	UALL ULEAR(TA(1),TA(05))	HULES	26
	LALL LLEAK(ANEAH(1)+AFEAH(6())	HULLS	27
6		HULES	28
(+	I INDEALS THE OFILS	HULES	29
		HULES	30
	10 41 11-1, UX	HALLES	31
1.		LOLES	21
	A 15 THE COOR LOCAL OF THE CENTRE CO. L. T. T.	NULLS	72
(+	7 13 THE CONDITATE OF THE CENTER OF GRID 11	HULLS	33
		HULCS	
	GRUERU = X + .5 + 0.2	HULLS	55
6.		HOLES	36
L+	LETERMARE THE AREA OF EACH ROW OF FULLS THAT LIES BEFORE THE	HULES	37
6.*	ELU OF THE GRAD	HULES	38
L		HULES	39
L+	12 INDERES THE RUNS OF HULES	HULES	40
	$\Delta U = 3U = 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1$	HOLES	41
1.+		HOLES	42
	THE FLO OF SHALL AT AN THE LEFT CO HOLES TO HOW 12 (AND THUS	HULES	43
(4	THE REAL OF THE REAL TO MORE BULL AND IS EXPOSED TO GRID 11	HULES	44
		HOLES	44
	$\mathbf{F} = \mathbf{F} + $	HULLS	40
		HULLS	
L		HULLS	47
6.	IF THE LED OF THE GRED IS TO THE RIGHT OF THE HULES IN ROW 12, ADD	HOLES	46
L+	THE ENTINE AREA (F THE HULES IN FON IN TO AREAXP	HOLES	49
6+	CHERALDE THE END OF THE ORIF LIFS WITTIN HOLES IN ROW 12 AND	HULLS	50
6.	THE AMOUNT OF EASTSEL AREA WILL HE DEFERMINES.	HULES	51
100 C	ATTO TO TO TO TO	HOLES	52
anna ar fidagair sin airdina a	AYEAXY = FURIEP1ERALFUL(12) = FAUHOL(1, 1)	HULES	53

	00 10 20	HULES	54
		HOLES	55
		HOLES	56
1		HULES	
1.0	L = 0 $L = 0$ $L = 1$ $L = 1$	HOLES	58
	THE THE OF THE CENTRAL ANGLE TO THE CHORD AT THE GRID END	HOLES	59
	THETA = ACUSTABS(TERM)/RADHOL(12))	HOLES	60
-	LIAM AMAR ARE CREATED THE CONTRACTOR	HULES	61
L+	FIND AREA OF CIRCULAR SECTOR WHUSE CLAIRAL ANGLE IS 2+THETA AND	HOLES	62
6.	AREA OF TRIANGLE FORFED BY THE CHORD AND RADII	HOLES	63
	$RSU = RALHUL(12) \bullet RAUHUL(12)$	HOLES	64
	AREAS = THEITARISG	HOLES	65
	ANCAL = SURT(RSG - TERMATERE) + ABS(TERM)	HULES	66
- <u>L</u> .	A CANNA IN A REAL OF TAXAN AND A REAL OF TAXAN	HOLES	67
	LAPUSED AREA FROM ONE HULE IS SECTCH ANEA - TRIANGLE AREA ON THE	HOLES	68
1	HOLE AREA MINUS THIS	HOLES	69
	ANEAAF = (AREAS - AREAT) +FUH	HOLES	70
	AFTIENT . U. U. U. AKLAAP = PI+KSO+FAF - AREAXP	HULES	71
L.		HOLES	72
e 4	AREAH(11) = AREAH(11) + AREARP - TALLE)	HULES	73
C+		HOLES	74
	A(12) = AREAXP	HOLES	75
50	CONTINUE	HOLES	76
6		HOLES	77
	IF(AREAH(11) .LT. U.UUUU1) AREAF(11) = 0.C	HOLES	78
40	CONTINUE	HOLES	79
C		HOLES	80
Ļ		HOLES	81
C	CALCULATE AH(1), THE BELL TUBE AREA IN GRID I. AH(1) DOES NOT	HOLES	A2
٤.	INCLUDE AREA OF PSEUDO-HULES.	HOLES	02
	LALL LLEAR(AH(1),AH(60))	HOLES	
	dv = 0 $1 = 1 = 0$	HOLES	04
	AH(1) = AREAH(1)	HOLES	00
6 U	I, UN T I NUL	LOLES	00
L		HOLES	
L	AF THERE IS A PSEUDU HOLE AT GRID INEGO OR AT GRID TENDR. ITS	HULLS	88
C	AREA SHUULL NUT HAVE BEEN INCLUDED.	HULLS	89
	APSEUD = PIARAUPSARAUPS	HULES	90
	IF (IPS2 . LU. ILIUS) AH (ILNUS) = AF (IENDE) - APSEUD	HULES	71
	IF (ANTIENDE) .LT. U.) AH(IEHDB) = U.	MODADA	76
	WN=IBLOH+1	MODUASS	
	UU 76 LENNA HUX	H000923	51
L		HUUU923	52
L	LALLULAIE FRACT(I), THE FRACTIONAL VILLAR OF & GRID NOT UNDER THE	HULLS	95
L	THELUENLE OF THE BELL TUBE HOLES. THE VOLUME CONSTDERED TO BE	HULES	94
L	INFLUENCED IS HASED ON THREE TIMES THE HERMISPHERICAL VOLUME	NULLS	95
C	CUMPUTED FROM THE HADIUS OF A TUBE HULLA	NULLS	
	FRACT(1) = 1.0 - 2.0+SUNT(AH(1)+AH(1)+AH(1)/PI)/(APFAD(1)-1.0)	HULES	97
	IF (FRACT(1) .LI. U.U) FRACT(1) =D	HULES	99
70	CONTINUL	HULLS	100
	ILE. IUNIN	HULLS	101
	LIU	HULLS	102
	· · · · · · · · · · · · · · · · · · ·	HULLS	103

	- to we fit at the tax			
	CONTRACTOR ANTAS	AREAS	2	
	Com Diver And Contract of the Bore of the Reverse States of the States o	AREAS		
	the result of the rest of the	CHAMIX	2	
	the second secon	CHAMIX	÷ _	
	and an isolated a strate contrast ion and a long areas (60), DAVG,	CHAMIX	4	
	a ARCANZ (UTA) DI POLLEDU POLLO DI POLL	CHAMIX	5	alan alan ber eta
	CONTENTS / TO , TEDR, TEDR, TWO TOP CITER (HEB, TWOGD, DVAYIS, DVAXIT,	EUNS	2	
	- A A A A A A A A A A A A A A A A A A A	LUNS	3	
	CITED OF A DECEMBER OF A DUCK, PRI 1, ILLELG (35)	P	2	
	CHOICAE IGNII, GUED, CHAMI, CH M2, CHAMI, CH	CHAMLOG	2	
		PLOG	2	
	DATA FILEV. 7053987	AREAS	9	1. AMP
6		AREAS	10	
	SURROUTINE AREAS CALCULATES CRUSS-SECTIONAL FREAS AND VOLUME	AREAS	11	
ι	THEREMENTS ASSULTATED WITH I'L CHAPDLE.	AREAS	12	
		AREAS	13	
C	ARCAAN - AMEN OF HELL IGNITER TULE	AREAS	14	
·	AREAUFILI - AFFA OF GAP AT TOP OF CHAMBER AT AXIAL GRID I	AKEAS	15	- (m
ų.	AREAC(1) - AREA OF ENTIRE CHAMBER , T AXIAL GRID I WHEN CHAMBER	AREAS	16	
<u></u>	DECOMES ONE DIMENSIONAL SU HAT CALCULATIONS IN AXIS GO	AKEAS	_ 17	
C	SMODINEY, AREAL(1) IS INITIALLY SET TO 1.0 IF CHAMI IS	AREAS	18	
- 6	INUE AND AREAAX OTHERWISE	AKEAS	19	
L	ANEAN(I) - ATEA OF ENTIRE CHAMBER FINUS THE BELL IGNITER TUBE	AREAS	20	
C	AT AATAL GATE I IF CHAMI GE CHAMZ IS THUE. IF CHAMB IS	AREAS	21	Pr - 4940-1
L	INUE, APEROP(1) IS ALSO SUDIAACTED.	AREAS	22	
	AREALLY) - ULALKALIZED ANEA GE KADIAL GRID J. USED FOR	AREAS	23	
L	SETTING DUMMY DAMKEL GRID I FRUPERTIES. IF CHAM2 IS	AREAS	24	
- L	INUE AREAG(1) IS AREAAX AND AREAG(2) IS AREAR(NGX).	AREAS	25	
L	IF CHAMES IS THUE AREAG(1) AND AFEAG(2) ARE THE SAME AS	AREAS	26	
L	WHEN CHARZ IS INVE AND AREAGED IS AREAGPINGED. IF CHAMI	AREAS	27	
6	IS THUE, AREAULUS IS SET USING DR.	AREAS	26	
	ARCALL - ARCAULT + · · · + AREAULAGE	AREAS	29	-
Ĺ	IF CHAMI IS THUE, AREAC IS USED FOR MAKING THE CHAMBER ONE	AREAS	30	
κ.	UIMENSIUMAL AT EVENT I. IF CHAM2 IS INDER AREAAX AND AREAR(I) ARE	AREAS	31	
ί	USED AT BRID 1. IF CHAP,3 IS TRUE. AREAGY(I) IS ALSO USED.	AREAS	32	
6	FOR DOTAID AND DOTADD TERMS VOLUME INCREMENTS ARE NEEDED.	AREAS	33	
L	LVANIS - VOLULE INLIGEMENT OF GALLS FOR J = 1.	ANEAS	34	
k.	UVANI - VOLUE INCREMENT OF GHILS FOR J = 2. DVANIT WOULD	AREAS	35	
C	HELD TO BE AN ARRAY FOR CHAPE OF CHAMB TRUE BUT IT IS NOT	AKEAS	36	
- L	MELULU Inche	AREAS	37	
L		ANEAS	30	dealer
Ļ		ANEAS	39	
	AHEAAA = PIJEFULANDIULANDI	AREAS	40	
		ANEAS	41	
L	CALUDEATE ARRAY MIERC AND FRUM 17 GLI "REAR	AREAS	4.5	spinor in a subsection of the second
. L	CALULAIT ARRAY ANTADE IF CHAMB IS INCL.	CHEAS	43	
L	ALSO CALCULATE AVERAGE DIAMETER TO UL USED IN CALCULATING PSEUDO-	AHEAS	44	
6	HULES IF CHAMS IS INCL.	AREAS	45	
		AREAS	46	
	INUGHT = 2. UPTUFUAL	ANEAS	47	
	At' = 0.0	AREAS	46	
L		AREAS	44	
L	THE CHAMBLER DIARETER IS DIARE UP TO LIST	ANEAS	50	
	JIAPSU = UINFIELAPPI	AKEAS	51	
	IF (UNASS) DZ = LIAFI - THOURF	AREAS	52	- +-
	11 ((+ Ar 2)) 236 = 1 (+ U =	ANEAS	53	
	00 250 1=1.44CA	ANEAS	54	
			1	

LLOP = L	AREAS	55
ANCAC(1) = +10++01AMSC	HREAS	56
IF(CHAPS) ARCAUP(I) = AREAC(I) - FIDE*0250	AREAS	57
IF (CHAMS) DAVE = LAVE + DIAMS	ANFAS	54
XU = XU + UX	AREAS	59
11 (1) .61. (151) 60 10 260	AREAS	60
LUNT LINUE.	AHFAS	60
00 10 350	ANEAS	62
	ALFAS	
	ANCAS	65
THE CHARTER DIADETER DELPEASES LINEARLY FROM DIST TO DIST	ANEAS	64
LONTINUE	ANCAS	63
1 = IIECP	ANCAS	60
	AREAS	67
11 (AnS(G1S) - 0452) - 61 - 0.00001 - 0.0 245	ANEAD	68
	AREAS	67
	AREAS	
	AKLAS	71
	ARLAS	72
.0 270 l=11.t6x	AREAS	73
111MD = 1	AKEAS	74
$\frac{1}{100} = 1$	ANEAS	75
$\mathbf{U}_{\mathbf{A}\mathbf{P}} = \mathbf{U}_{\mathbf{A}\mathbf{D}1} + \mathbf{S}_{\mathbf{U}\mathbf{P}\mathbf{L}^{\dagger}}(\mathbf{X}) = (\mathbf{I}_{\mathbf{S}1})$	AREAS	76
IF (CHAPS) U2 = DIAM - TKOGAP	AREAS	77
AREAC(I) = PIUP+DIAM+DIAM	AREAS	78
IF(CHAM3) ARLAGF(I) = AREAC(I) = FIDF+D2+D2	AREAS	79
IF (CHAM3) DAVE = DAVE + DIAM	AKEAS	80
AD = AB + DA	AKEAS	81
IF (XB , G1, UIS2) GO TO 280	AREAS	82
CONTINUE	AKEAS	63
60 10 350	AKEAS	84
	AKEAS	85
	AKEAS	86
THE CHAMBER DIANTTER IS DIAME BETWEEN LISE AND DISS	AREAS	87
CONTINUE	AKEAS	86
1 = 11EMP	AREAS	89
11 = 1 + 1	AREAS	90
JIAMSU = UIAM2+UIAM2	AREAS	91
IF (CHAM3) D2 = CIAME - TWOGAP	AREAS	92
IF (LHAM3) U256 = U2402	AREAS	93
UU 290 1=11+NGA	AREAS	94
LILMP = 1	AREAS	95
ARCAC(1) = +1L++UIANSU	ANEAS	96
IF (CHAMS) AFEAGE(I) = AREAC(I) = FIDF+D2+U2	AKEAS	97
IT ICHAMSI UAVE = LAVE + UIAM2	AKEAS	91
Χ ⁰ = λ ⁰ + Uλ	ARFAS	94
IT (AB .01. 0150) 60 TO 300	AREAS	100
CUNTINUE	AKFAS	101
JU 10 350	AREAS	102
	ARFAS	103
	ANFAC	104
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1 = 11600	AREAS	106
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	The P = 1 Ancac(1) = 1 DF + QLAPSC P (CHAPS) ANCHOP(1) = AKEAC(1) = FIDF + DESC P (CHAPS) P (CHAPS) = DESC P (CHAPS) P (CHAPS) = DESC CONTINUE 1 = 1 + 1 P (APS) = DESC = D	ILEPT = 1AREASARCASARCASIF (CHARD) ARCHOP(1) = AREAC(1) - FIDF#1250AREASIF (CHARDS) ARCHOP(1) = AREAC(1) - FIDF#1250AREASIF (CHARDS) CALL OF 2 LAVO + DIAM1AREASIF (CHARDS) D 2 CIAM2AREASIF (CHARDS) D 2 CIAM2AREASIF (CHARDS) D 2 CIAM2AREASIF (CHARDS) CALL OF 2 LAVO + DIAM1AREASIF (CHARDS) D 2 CIAM2AREASIF (CHARDS) D 2 CIAM2AREASIF (CHARDS) D 2 CIAM2AREASIF (CHARDS) D 2 CIAM2AREASIF (CHARDS) D 2 CIAM2AREAS

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		ANEAS	113	
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	$\frac{\partial f}{\partial t} = \frac{\partial f}{\partial t} \frac{\partial f}{\partial t} = \frac{\partial f}{\partial t} $	AREAS 112 AREAS 113 AREAS 114 AREAS 114 AREAS 115 AREAS 115 AREAS 117 AREAS 117 AREAS 117 AREAS 117 AREAS 119 AREAS 121 AREAS 122 AREAS 122 AREAS 122 AREAS 124 AREAS 124 AREAS 125 AREAS 126 AREAS 126 AREAS 127 AREAS 126 AREAS 127 AREAS 126 AREAS 127 AREAS 127 AREAS 126 AREAS 127 AREAS 127 AREAS 127 AREAS 126 AREAS 126 AREAS 127 AREAS 126 AREAS 127 AREAS 126 AREAS 126 AREAS 127 AREAS 126 AREAS 127 AREAS 126 AREAS 127 AREAS 126 AREAS 127 AREAS 126 AREAS 127 AREAS 126 AREAS 127 AREAS 126 AREAS 126 AREAS 127 AREAS 126 AREAS 127 AREAS 126 AREAS 127 AREAS 126 AREAS 126 AREAS 127 AREAS 126 AREAS 126 AREAS 127 AREAS 126 AREAS 127 AREAS 126 AREAS 126 AREAS 127 AREAS 126 AREAS 127 AREAS 126 AREAS 126 AREAS 127 AREAS 126 AREAS 127 AREAS 126 AREAS 136 AREAS 136 AREAS 136 AREAS 135 AREAS 135 AREAS 135 AREAS 135 AREAS 135 AREAS 140 AREAS 140 AREAS 140 AREAS 140 AREAS 150 AREAS 150		
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	IF(CHAMS) ARLAGF(I) = AREAC(I) = FIDF+D2+L2	AREAS	118	
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c		AREAS	132	
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30.	, CONTINUE	AREAS	138	
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		ANEAD	16.9	
	A sala F A bell a	ARCAS	142	
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	IF (CHAP2 . UR. CHAP37 60 TO 400	AREAS	144	
L		AREAS	145	
L	CALCULATIONS WHEN CHAMI IS THUE	AREAS	146	
	UC 380 1=1,66P1	AREAS	147	
	AREAC(1) = 1.0	AREAS	148	
501	J CUNTINUE	AREAS	149	
L		AREAS	150	
	i.6rt1 = 1:6is = 1	AREAS	151	
	MIUKSW = HIALKALK	ANEAS	152	
	AREAU(1) = 0.25+F1086	AREAS	153	
	JU 370 J≈2,WGK1	AHEAS	154	
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		ANEAS	150	
		JEAS	1.0	
	CONTRACT - FILTER - CONTRACTOR	ALEAS	100	
		ARCAS	101	
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-	ANEALLI) = AMEAAA	AHEAS	169
416	CUNTINUE	AREAS	170
Contracting the set operation in	ANLAULI) = ANLAAX	AREAS	171
	AFLAGIZ) = AREAR(16)	AREAS	
	IF (LHAM3) ARLAU(3) = AREAGP(NOX)	AREAS	173
	AREACH = AREAU(1) + AREAU(2)	AREAS	174
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	UVAXIS = AREAAX+UX	AREAS	176
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500	CUNTINUE	AREAS	179
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	IFT.NUT. JUEDUG(E)) KETUKN	AREAS	181
	nkilt(0.2002)	AKEAS	182
	WK11E(6+2003) (AREAR(1)+1=1+1.GP1)	ANLAS	105
	WK11L10.2004)	AKEAS	
	<pre>nkl1L(6+2003) (AREAC(1)+1=1+NGP1)</pre>	AKEAS	185
	WHITE (6.2005) (AREAN(I).1=1.HGR)	ANEAS	105
	IFICHAMS) WRITE(6.2006)	AREAS	187
	IF (CHAMS) WRITE (6+2003) (AREAGP(I)+1=1+NGP1)	AKEAS	100
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eulue	FURMAL (/// . ANFAY AREAR //)	AKEAS	171
euus	FURMA1(91.10+11.7./)	AKLAS	172
2004	FURMAIL///. ANNAY ANEAC .//)	AKLAS	173
2005	FORMALI///. * AKKAY AKEAG * // 20x + 5411.7)	AKLAS	195
2000	FURMATI/// AKKAY AREAGP +//)	AREAS	195
		ARLAD	170
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	SUBROUTINE BARSET CUMMON/SARKEZ/SONEA.XF.VF.HORED.BCH.H.BOREDA.DT260.DTUS0.XLBAR	BARSET	2
		HARSET	4
		MODAROS	23
	COMPANY OF ADMATCH A 120 A 120 A TEOIDRAD CASHAR THOG LOVATIS ADVATTA	CONS	2 2
		CUNG	2
		LWN9	
	COMPONERATIVY AL (60.5), DO(60.5), DI(60.5), FRI	GRAIN	2
		GRAAN	
	2 XLB(100), COB(100), DIB(100), CALG(100), CDOB(100), DDIB(100)	GRAIN	4
-	COMMON/INPUTS/C1+C2+C3+C4+TC+TLGT1GCLChS+RHQE+PHI0+TE+CA+RHOO+	INPUIS	
	3 NU+PG+UU+GTRHCP+HW+UM+/1GLBP+GBCUNS+IOTM	INPUTS	3
	LUMMUN/MOLON/CUN1+CUN2+CUN3+CUN4+CUN5+AREAPE+Z0+WUB+XUB+ROTK+	BARSET	8
	\$ FUMAX+CUN6+XINT+XLO+PINT+PLO	M001111	2
	LOMMON/P/1PRINT,MODCH,MODLK,PRI1,4LEELG(35)	P	2
	CUMPUN/BARRL/ PHI(100), RHUG(100), HG(100), UG(100), UP(100),	BARRL	2
	1 PG(100), TG(100), PMDUT(100), SL(100), UERAG(100), FRICT(100).	HARRL	3
	2 GLUNY(100), UUP(100), UPHI(100), UHEDG(100), UHG(100), UUG(100).	BARRL	4
	A AMASSIJUUL, AMONIJUUL, AFERIJUUL, AMASSIJUUL, HAMOMIJUUL.	HARRI	5
		LADDI	
		BARRE	0
		PLUG	
	DATA GRAV/32.16/	BARSEI	15
L		BARSEI	
	HAMELIST/BARINE/THETA.DEPTH, RADPB.PL DB.PMASS.PINER.ROTK.CF.	MOD1111	3
	NA.XLUAR.XMAX.XINJ.XLU.PZ0.POMAX.PIAI.PL0	MOD1111	
	KLAD(D+BARINF)	HARSET	17
	IF (IDEBUG(7)) WEITE (6:BARINP)	BARSET	18
C		BARSET	19
	KAUPE = RAUPE/12.	BARSET	20
	ALBAK = XLBAN/12.	BARSET	21
	AUB = WOB/12.	HARSET	22
t wall in observations	HPTH = DEPTH/12.	LARSET	23
		NOD1111	6
		MODILLI	4
		MODILII	
		HUDIALA.	
		MUUIIII	8
	PZU=PZU=144	MUD1111	9
	PUMAX=PUMAX+144.	MOD1111	10
	PINI=PINI+144.	M001111	11
	PLU=PLU+144,	MOD1111	12
<u>.</u>		BARSET	25
6		BARSET	26
C***	***************************************	BARSET	27
C	CUNSTANTS FOR BARREL SUBRUUTINES	BARSET	28
C+++	***************************************	HARSET	29
C		BARSET	30
c	CONSTANTS FOR SUBROUTINE MOTION	HARSET	31
··· ····		PARSET	20
	SN = SIN(HETA)	DAPSET	11
		DADGET	14
	COME - CO - CF TON	DARGE	34
	TEMP = SENTLED	DARGET	33
		BARSEI	36
	ARCAPD = 3.141593+RAUPS+RAUPS	BARSET	39
	CUND = 0.5+DELT+DELT	BARSET	40
	LOND=(PDMAX-FZU)+AREAPB/XMAX	MOD1111	13
	CON4=(FDMAX-PINT)+AREAPB/(XINT-XMAX)	MUD1111	14
	LIMAN - DIMANANDCADA	MOD1111	15
	FURA - FURATAREAFD	INANTTAT	1.4

	CONC+CFINI+FLU}/(ALU+AINI))#AREAPL	MOD1111	17
-	L LILALLY THE DECTILE IN ADVENCE	HARSET	41
L	INTIALLY THE PROJECTILE IS NOT POVING	HARSET	42
		BARSET	43
		HARSET	44
	DAPRIM = DX	M000301	24
C		BARSET	45
L		HARSET	46
L	LUNSTANIS FOR SUBROUTINE UNDLYR	BARSET	47
	SUREUS = SURED/S.U	BARSET	48
	UTUSE = DELT+FURED+BURED	BARSET	49
	UI280 =U.5+DELT/BURED	HARSET	50
C		BARSET	51
L		HARSET	52
C	LUNSTANT FUR SUBACUTINE PROPMO	HARSET	53
	UTKHUP = GRAV#DELT/HHOP	RARSET	54
L		BARSET	55
C	FINISH TOTALLING THE GAS MASS. NOTE THAT PHI IS 1.0 NOW.	HARSET	56
	1+ (NX .L. 1) CU 1U 30	HARSET	67
	1+ (NX + La + 2) 60 10 25	HARSET	RA
	101M = 101M + (FLUAI(NX - 2) + 0.5)+N-00+BOREA+DX	PARSET	50
	60 TU 30	UAPSET	57
22	IUTH = IOTH + U.SAKHORAHUKEAADX	HARSET	60
30	LUNIINDE	DANGET	01
		BAROLI	62
-	NAMELASI / BANCHIN / PALPA OH . DFPTH DON YOR CS. SN. CON CON.	BARSEI	63
	LUNA CONA - CONA - CHOSA - A PARA IP - VP. ROPE - A PHORE CONCEPTION CONCERNED	BARSET	64
	UISHUTTTA	HARSET	65
	TE CHEROFERAN ENTITE (2. SANCHY)	BARSEI	66
		BARSET	67
		BARSET	66
		BARSET	69
		HARSET	70
	ANALARE DAPREL ARRAIS	HARSET	71
		EARSET	72
	CALL CLEAR (PILLI), DAENER (100))	BARSET	73
	CALL CLEAR(ALB(I), ULIB(100))	BARSET	74
C		BARSET	75
	1F (NX : EG. 1) GO 10 60	BARSET	76
	D0 50 1=2.NX	BARSET	77
dipension and making adjust	RHOG(1) = RHOG	BARSET	78
	NG(1) = HU	BARSET	79
	Po(1) = PU	BARSET	80
	O(1) = 00	BARSET	81
	10(1) = 10	HARSET	82
	AMASS(1) = BURLA	BARSET	83
	AFUM(1) = BONEA	HARSET	84
	ALNER(1) = BUREA	BARSET	85
	UAMASS(I) = BOHEA	BARSET	86
	UANUA(I) = BUREA	BARSET	87
	UALNER(1) = BUREA	HARSET	88
		HARSET	89
6	PAUUT AND UP HAVE ALREAUT BEEN CLEAKLU	HARSET	90
54	CUATINUE	HARSET	91
-		HARSET	99
L	SET AREAS AT BARKEL GRID 1 TO BURE ANE OF BARREL.	HARSET	43
tu	CONTINUE	HARSET	94
statements and address of the			

		-	
A = U + (1) = U + (0) A	BARSET	96	
	LANSE		-
	HARSET	98	
	UAROLI	99	
	BARGET	100	
	DANGET	101	- 4-1 5
SET ALL ENTRIES IN ARRAYS PHT AND LOUT TO S.C. SO THAT WHEN OUTDS AN	UANSET	102	
C THERE WILL HE NU PROFELLANT IN THE STORE TO SAL OF THE WHEN WADS HE	UARET		
	BAROLI	104	
	HANGE	105	
L(PH(I)) = 1.0	BARGET	106	
CONTAINIE	BARALI		
NE LUKN	DARSET	108	
ENU EN	GARSET	110	
	BANGE		
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	and the spin type of the state	anter a million conducto a specializza-	
and and a second	des a service - decar de		
	the the support of the		
	the same advanced. As to be		Ber fronti Appliedens
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	SOBROUTINE MELOK	MFLOW	2
L		MELOW	3
L		MELOW	4
	CUMMUN/CHAM/IX, 18, XB, NB, NGX, NGK, 12EGE, 1ENDB, 1PATH(6C, 5), AREAG(5),	CHAMIX	2
	AKLACH, ANLAC(00), IONII, ONED. DIAR.1. LAM2.CIS1.DIS2.DIS3.DIS4.	CHAMIX	3
	* AKLAR (60), AKLAAA, CHAM1. CHAM2. CHAM5. 10PGAP. AREAGP (60). DAVG.	CHAMTX	4
	ARLAN2, UIANEL, DILLAL, BELBEG, IPS1, IFS2, RADES, BPIGN	CHAMTX	5
	COMMON/64.5COM/KD+RKG.EVD+CVD	MELOW	
an- ofte	LOMMONZELOCKZINE - UK I	hubland	1912 - 100 -
	I (MARIN RATE ADDITE STREAM NOT STREAM AND STREAM ADDITES AND ADDITES AND ADDITES ADDI	MUUTUUZ	4
	Control Contro	HULLA	\$
	J ANYOU / FRALIEGO/	HOLEA	5
	COMPONYINFUTS/C1+C2+C3+C4+T +TIGN+UCCAS+RHOF+PHI0+TF+CA+RHO0+	INPUTS	2
	3 HU .FU . UU . GIRNUP . HE . UN . I IGNSP . QBCUNS . TOTM	INPUTS	3
	COMPON/BAC/PHILE[HU.5], HHORE(60.5), FBG[60,5], UBG[60,5],	HAG	2
	1 VB0(60,5), UPB(60,5), PCH(60,5), 120(60,5),	BAG	3
	2 DUTMIG(BU), UBAU(BU, 5), JUMAG(60, 5), DOTMB(60, 5), UPBDT(60, 5),	RAG	4
	3 PH4010(60+5), FH0010(60+5), HB010(60+5), UB610(60+5),	HAG	5
	4 V8610(60,5),T80(20,5),D0TM86(60),C,1MP(60,5),PHIBP(60,5),	HAG	
	5 Ph1PTU(60,5),725(60),18P(60.5)	RAG	7
	JIMENSION DOLMAN	MEL ON	
	LUGICAL IGNITSONFD.CHAMISCHAM2.CHAM.S. DIGN	CHANLOC	10
•		LIANLUS	4
		MELOW	12
		MELOW	13
	transfer they are a set of the se	MFLOW	14
L	SUPROUTINE MELOW CALCULATES THE MASS OF GAS FLOWING BETWEEN TWO	MFLOW	15
L	NAULAL ROWS INKOUGH FULES IN THE BELL AGNITER TUBE AND THROUGH	MFLOW	16
L	I SEULO HULES. AFLON CALCULATES THE ENTRIES OF ARRAY DOTMIG AND IF	MFLOW	17
L	LHAMS IS TRUE. THE ENTRIES OF ARRAY LUIMBG.	MELOW	1.6
Ú.	USTAIL(1) IS THE GAS MASS FLOWING BLINLEN GRIDS (1.1) AND (1.2).	MELON	14
C	+ LUIMIG(1) OLCUPS IN THE PATH ROUTINES FOR GRIDS WHERE JES AND	MELOW	26
(- UUTNILL(1) whithe J=2.	MELOW	21
L	CUIMBG(1) IS THE GAS MASS FLOWING BEING FRIDS (1.2) AND (1.3)	MELOW	23
1	STEA RAULAL BLAS 2 AND A ARE CONSTOLATE. INDEED THE THE THE THE ARE TOWEN	MFLOW	
	CYTERS AND A WE STARE CONSIDERED INDEPENDENT UNEDIPENSIONAL	MPLUW	25
C .	a high best in a first to had been point a for first integer to a to	MELOW	24
C .	+ EUTROSTIT OCCURS IN THE PATH ROUTINES FOR GRIDS WHERE JEZ AND	MFLOW	25
L	- DUMBG(1) OCCURS WHERE JES.	MFLOW	26
C	ARRATS OUTFIG AND DUTMEG ARE CLEARED IN MAIN AT EACH TIME INTERVAL.	MFLOW	27
L		MELOW	28
	NGA1 = AGA - 1	MFLOW	29
		NELOW	34
	1+(CHAM3) 10 = >	MELON	31
	J = 1	MELON	3.5
	50 TO 20	MELON	15
L		MELON	33
5	AU = 1	HILUN .	
		PIPLUN	35
		MFLOW	36
	C DATE HALE	MFLOW	37
21		MFLOW	38
		MFLOW	39
	CALL CLEAR(DUTA(1)+DUTA(60))	MELOW	40
L		MFLOW	41
C		MELOW	42
L+++	***************************************	MELOW	43
ũ	CUMPUTE GAS MASS FLUW PER UNIT AREA	MELOW	44
	***************************************	MELOW	45
	DU BU I=1.NSA	MELON	45
C		ALL OF	40
-		TIT LUW	47

	$FK = FCr(1_{0}U)$	MELOW	48
	PA = P(H ₁ 1,JP1)	MELQ	49
L		MFLOW	50
L+	IF PREPA THERE IS TO FLOW	MELOW	51
	IF (A6S(FF - FA) +LT+ 0.001) 60 10 80	NELOW	52
L		MELON	53
L.+	LETERMANE THE DATELITOR OF THE FLOW. IF PR IS GREATER THAN PA.	MELOW	54
L.	GAS FLOWS OUT OF THE TUR' OTHERWISE 1. FLOWS THTO THE LURE.	MELOW	55
	IF I FA II FA ISO ID ON	MELOW.	
		MP LOW	36
	How = HDG(1+0)	MELUW	57
L	· · · · · · · · · · · · · · · · · · ·	MELOW	58
¢*	FLOPP IS AN APPICAINAIL STATIC PRESSURL FOR CHOKED (MACH NO. 1)	MELOW	59
£.	FLOW. ASSUME POURP IS NOT LESS THAN FA.	MFLOW	60
	PLUPP = U.D3+PR	MELOH	61
	IF (PLUMP .LT. PA) PLUMP = PA	MFLOW	62
L		MELOW	63
-	CALL GSPROPIRU . RRU. K. CVU. CVH. LV. F. DMP. HAR. TOUM. RHODUM.	MELON	24
		ALC ON	16
		DELVI	00
	$(1053 - 2) 077.0587 \times 1.03$	HPLUW	66
		MELOW	67
	rwk = Gpr/Gpr/1	MFLOW	68
	CONS2 = 2.0/6MM1	MELOW	69
C		MFLOW	70
Ç#	PSTAT IS SUNIC_STATIC PRESSURE	MELOW	71
	PSTAT = PR+CUNS1++P#R	MELOW	72
6		MELOW	73
C+	FM 15 MACH NUMBER. IF PA IS LESS IMAN PSTAT. FM=1. OTHERWISE	MELOW	74
C.	FO AS NOT 1. AND MUST HE CALCULATED	MELOH	75
-		MELOU	······
		NELOW	10
		MFLOW	
		MELUW	78
		MELON	79
L		MFLOW	80
16	HSTAT = HRR/(1.U + FM+FM/CUNS2)	MFLOW	.81
C		MFLOW	82
C	SINCE GAS IS FLUWING FRUM GRID (I,J) IL GRID (I,J+1), DOTH SHOULD	MFLOW	83
C	BE NEGATIVE.	MELOW	84
C***	+15 PH186(1.2) OKAY	MELON	85
	UU[h(1) = -2US+GPM+PSTAT+FM+C4/S-RT(GMPH)+HSTAT+PHIBG(1.2))	NEL ON	A4
	60 10 B0	AFLOW	87
6		WEL OL	
		AFLOW AFT	00
		MILUW	89
C	The Could burn to be take than be the statement of the statement	MELOW	90
	THE COUNTY WHEP PR TO LESS THAN PA IS ESENTIALLY THE SAME AS ABOVE	MELOW	91
L	PATH TH AND PA INTERCHANGED.	MFLOW	92
40	CONTINUE	MFLOW	93
	HAA = HBG(1, JF1)	MFLOW	94
	PLUMP_= 0.53+PA	MFLOW	95
	IFT PEOPE .LT. FR) PEOPE = PR	MELOW	96
	LALL USPHOP (RU. HRU. HOUNCVI. CV. FLOMP. HAA. TOUM. RHODUM.	MELON	97
	\$ U16(1,JF1)+0.0+6MM+CF-31	MELOW	94
L		MELOW	99
	UDDM1 = GMP = 1.4	MELOW	100
	$C \log S = S = 0.000 (S \otimes 1.0)$	HPLOW .	100
	Condi - Caultana	MELOW	101
		MFLOW	102
	LUIS2 = 2,0/0MM1	MELOW	103
		MELOL'	104

	PSIAT = FA+COTSI++Phr	MELOW	105
		MELOW	105
Teo monte de la	Fn = 1.0	MELOW	107
	AFT PR ALT. PSIAT) 60 TO 50	MELOW	104
	FP = SQR1(((PA/Ph)) + (bMM1/GPM) - 1.0) + CONS2)	MALOW	109
	PSIAT = FR	MELOW	110
24	HOLAT = MAA/11.0 + FMOFM/CONS21	MELOW	111
1		NELOW	112
1	SINCE WAS IS FLUEING FRUM GRID (L. MAL) TO GRID (L. M. DOTH SHOWLD	MEL ON	112
ĩ	The Pusitive.	AFLOW	113
	IS PHIDULLED ONAY	MELOW	114
• • • • •	DUTHILL =	MELOW	115
1		P.F.L.ON	110
Hu	C GIVE & NUE	HFLOW HELOW	117
	14 (CHAP.5 Add. 11 + 40-1) 50 TO 12.	DELVI	118
		MFLOW	119
		MELOW	120
		MELOW	121
1	FILL AKKAY INTAIG	MELOW.	122
	***************************************	HFLUW	125
		MELOW	124
č	AVENAGE DAS MOSS FLOW AT FACH GRID	MELOW	125
	DIRIGIT = 0.54(0)1M(1) + COTMONIANEAN(4)	MFLOW	126
	AN THE THE NEWS	HFLOW	127
	DU AUGULTA A DEALOIMAT AN A STATTA A DOTATA A DOTATA A DOTATA A	MELOW	128
		MFLOW	129
1		MFLOW	130
100	AUTHINEDER - A SALATAINEVIL A OFT A SYLLADEAU MANY	MFLOW	151
	Bonizerier - 0.3-(Deliningel) + Deliningeliereringel	MFLUW	132
•	0 10 (200 5) 15	MFLOW	135
		MFLOW	134
		MELOW	135
(MELOW	136
		MELOW	137
C		MFLOW	138
C+++.		MFLUE	139
	Clust Date	MFLOW	140
140		MFLOW	141
	to the light of the sector and the s	MELOW	142
		MELOW	143
at	Doings(1) = 0.25*(Doin(1+1) + Doin(1) + Doin(1) + Doin(1+1))*	MELOW	144
1		MELOW	145
130		MFLOW	146
	UNTIDATION - C.D+LOUTHINONI + DELMINONI + NEWEAHS	MFLUW	147
2		MFLOW	148
COU		MFLOW	149
C	ու որուս։ ի Լուի	MELOW	150
		MFLOW	151
n signa ang si			a darmining ann a agus an angu

SUBNOUTAL OFFIN	HFIR	2
CUMMUNZEENSZETUX. JZUK. TZUX. TWOTCR. UTEN. HMB. TWCGJ. OVAXIS. DVAXIT.	MUDU925	53
N UX-64-6X-690-La00LabbiP	MUD0925	54
LI MODRANGIA I PIZI, DEPIZI, CEPIZI, FILMA, PDALSI	MGD0925	55
LINE DIN ZES MELL ZULLT DE CALUPRO AUPRO APRO APRO A COSHRA COPHKS A PROCOF	MUD0925	56
COMPANY/COMPANY, COLOR DE COMPANY, NEW THE R. TEMPR. TPATHICC. ST. ARIAGIST.	CHAMTX	2
COMPANY TALENA IN THE TRANSPORT TO THE TRANSPORT TO THE TRANSPORT	CHAMTX	
3 AREACH, AREAC (20), IGNII, ONE UTINE IL TARE IL SI (1.5240.004)	CHAMTX	
AREAR((U), AREARA, CHAPTICHAPZ, CHAPJ, UPAPIANEAG, BUTONEG	CHANTY	E
a AREAN, UTAPUT, ULLEND, PELKEG, IPSI, IPS2, RAUPS, BPION	UNAMIA	5
LUMPUN/LUCK/TIPE+UELT	BPF IR	
CUMPUN/FRU/LF1+LF2+MF1+MF2+MGJAM+BGS1++NVSP+IBGNP	NUD0925	57
LOW ON TEAL ON TEAL OFFER OF RECEDENCE OF OF OPPER OF THE PROPERTY OF A CONTRACT OF A	MUD0925	58
1 066666(5)+XLTC(5)	MUD0925	59
LOMMON/FAILEL/THICKT, FROUP, PCOMP, PTUE, XATUB, FAIL, MFAIL (60),	MUD0605	4
1 THILKIEU), PEWLT, THEL	MUD0925	60
CUMMUN/INPUTS/L1.L2.L3.C4.T0.T1GN.WLCNS.RHOF.PHIU.TF.CA.RHOO.	INPUTS	2
HU.FG.OD.OTHMOF.HK.LM. HURBP.GBCU.S.TOTM	INPUTS	3
UMMONZEZIPRINI, MOLA H. MONGR, PKII, LA EVE(35)	P	2
COMPANY A DIAN AND AND AND AND AND AND AND AND AND A	PRTMV	2
COMMUNICATION CONTRACTOR STRACTOR FORMER CONTRACTOR	RAG	2
	LAG	1
	BAG	
2 LUTPIG(60), GUAG(60,5), XDRAG(60,5), DUTPB(60,5), UPDU(60,5),	HAU	· · · · · · · · · · · · · · ·
5 MALDID(60.5), MHODID(60.5), MBGID(60.5), UBGID(60.5),	BAG	5
4 VEGIL(60,5),15G(60,5),DUTMEG(60),LUTPP(60,5),PHJBP(60,5),	BAG	6.
2 PHIPIL(60+5)+T2K(60)+T0P(60+5)	BAG	7
LUGICAL IGNIT. ULED. CHAM1. CHAM2. CHAM2. CHAMALEPIGN	CHAMLOG	2
LULAL PRII. LUEBUG	FLOG	2
	HPFIR	12
ANNAT WING IS CLEARED IN UPDATE FACE TAME INTERVAL.	HFIR	13
THE WILL SENALL THUS UNLY TE AT EALE GRID THERE IS NO BLACK	HPFIR	14
C Print File Repair for Contract Contract	UPETR	1.5
C FUNDER OF THE BLACK FUNDER IS INNIFED.	BIT AN	15
	MUUNBUT	
LUGICAL BUSKI	MUDU925	61
STUDFFELLUEG-TLP(1)	M000922	62
1126FM=5TU0FF/0X + 1.5	HUD0925	63
1+ (10EUFP .LT. 1) IEEUFP=1	MQD0925	64
IF (10P(IBEGFF,1) .LT. IIGNHP) GO TU IU	M0D0925	65
641611= 1 RUE .	MOD0925	
L IF THE IGHTTER FAU IS PENETHATED BY ELIFER BURNING OR PRIMER JET BLAS	H000925	67
I PINET IS TRUE AND THE FOLLOWING BLAST EVALUATIONS WILL	MUD0925	66
C St BYPASSEU.	M000925	69
	MGD0925	70
16 (16 (16) 50, 0, 00, 17 (13) 50, 60 Tr 30	MUD1002	3
	M000405	7
	MODORYS	
RAPUT-F 100R#11,413100FF/F10MR/F#,6157	M000925	7.4
PRMAP=2060.66*(EXP(-,635*S100F7/F106M7)*11ME	MUUU925	16
IF(11FL .GL0004) PRM P=1.3366*(ExF(635*STD0FF/FT08*-1200.	MUUU925	15
1 #11P(L)	W000925	- 74
PRMXP=PRMUOF+PRMXP	M000925	75
PUSHR = TEP(1)++ LALST	M0D1611	1
JTSHR=FKMXP#FAFJ1/2.	M000605	12
1+ (HOBRIG) GU TU 20	M000925	76
LE (UISTR .LI. FUSTIK) GU 10 30	NOD1611	2
L LONTANUE	M0D0925	77
	MUD0925	78
STORMATIZAN SHITNE = FIG.7.3X-27486- IGNITER PAD PENETRATEDI	MUD0925	79
A A A A A A A A A A A A A A A A A A A	The second se	
	PUD0405	16

	STUUFFEBLLBLG	NUD0605	17
	SUBRN= . INUE .	m000925	80
	GWDP=CEP(1)+(D1AMBT/UEP(1))++2.	MUD0925	81
	$(16P(16EGP_{1}) = 1.4)$	MUD0925	82
i	(10E0FP + 1 + 1) = 1	M0D1115	3
	HIBPLITE CH, 1) = FHIBF (IHE OD, 1) - DWDF/ OF LENS AREAAX + DX	M001115	4.
	PHIPID(IREGFP+1+1) = PHIPP(IREGFP+1+1)	M0D0925	86
	HIPTU(IBEGFF,1)=PHIBP(INEGFP,1)	M0D0925	87
	PhiPiD(16t63+1)=FHIBP(Ibc68+1)	MOD1115	5
36	UNITANCE	MODOGOS	23
-	LAGI=U.	M0D0925	88
	10 100 J=1,4CK	HPFIR	. 17.
	IF(J +LU, 2) FLAGJ=0.	M000925	89
	JU 100 1=1,46x	HPFIR	18
	IF (PHIBP(1+J) + 6E + 999) GU TO 100	MUD1002	5
	1+ (TBP(I.J) .GE. TIGNBP) GO TC LOU	BPFIR	20
	BPIGH = "FALSE"	HPFIR	21
L		BPEIR	22
	AS ILMPERATURE	BPFIR	23
	11A = TBU(1,J)	BPFIR	24
	ILFP = TTX + SvFI(TTX)	BPFIR	25
L		BPFIR	26
6.	AS VISLUSITY	BPFIR	27
	1Xhu = C1+1EHP/(TTX + C2)	HPFIR	28
	οι το στο στο στο στο στο στο στο στο στο	HPFIR	29
11	HENMAL CONDUCTIVITY OF GAS	HPFIR	30
	$I\lambda h = C J + T L F H / (T T \lambda + C 4)$	BPFIR	31
-		HPFIR	32
L hi	TNOLUS NUMBER	APFIR	33
	RETABP = RHCBG(I,J) + ABS(UBG(I,J)) + BPRAD(I,J)/TXMU	HPFIR	34
	LF (REIXEP .LT	M001017	3
		APFIR	35
L bel	JSSELT NUMHER	APEIR	36
	IXNUBP = $0.3 + RETXBP + 0.62 + 0.5 + Surt(PCF(I.J)/144.)$	HPFIR	37
		APETR	14
c bl	PRAULIOJ) SHOULD NOT BE LESS THAN G.GUIO RECAUSE OTHERWISE	HPFIR	39
L 11	IBP(1.J) WOLLD HAVE BEEN SET TO 1.0 IN PRIPER.	APEIR	40
	AUVIP = 3.0+(1.0 - PHIBP(1.0))/(FRAU(1.0))	APETR	41
		LUEID	
. 11	AT FLUX TU BLACK POWDER	LOFTO	42
	ULUNUP = TANUL PATXA/BPRADILADALLY - TAPLIAD	LIPETO	4.4
	BLGC=1HLGH	MADAADA	
	FI NUL BOTH ANU INFILLEGPALL TTENROL GO TO SO	NUD0025	90
	FIFLASI SEVE AS SANUS FLAGS SER. 3 1 60 TO 50	H000925	71
		1000923	76
	HAJ2=0.5+(111411-114HH1)-TOPGAP	DFFIR	40
	F(J,EU, 2) SPUJEG, b+(The J2+UTAMHT)	brrak upete	. 49
	ISPRESPOJESTEDEF	BFFAR	50
	F(11ML	BEFAR	21
5	+ USPRKS	MUDU925	
	FILAPE LL. D. DODA) WEREL SAFESLUT, THENEYDE TO CONTEND.	HU00925	95
	+ UNPARS	MUD0925	96
	PMRESLAT / DRACOC LABLAN	M000925	97
	5 (CURE CT	MOD0925	98
		BPFIR	54
	Internet in FLAGIEL.	mUD0925	99
1		M0D0925	100

47 FURPALL . 4X . / NUPPER = LI4.5. 3X. 6HDISPH = L14.5.3X.4HI = 12.5X.	MUD0925	102
5 4HJ = 12)	MUD0925	103
SU CONTINUE	BPFIR	55
1+ (CONSF .LT. 0.001) GC TO 10L	SFFIR	56
	HPFIR	57
16mP=2.0.4860NS+600HBF	MUDD925	104
]₽₽₽₽₽ = ((TBH(1+J) → 16)/TEMP)++∠	APFIR	27
IFIDEFED TIMES TUFFEP = TAME	BRETH	
$TBP(I \bullet J) = TBP(I \bullet J) +$	BPFIR	61
JEMP+(SURT(JEFEP + DELT) - SURT(TEFFBPI)	BPFIR	62
IF (PORAG .LE. U.S.UIAFGT) G + TO 90	MUD1213	4
18P(15L66,2)=T16L6P	MUU1213	3
10P(1066P)=71000P	MUD1213	5
UCUNIINUE	MUUIZID	13
IF (1 _B P(1,J) ,L1, 11(1 _B P) 60 10 105	OFFIN	65
1F(10EBUG(9)) WHITE(6,2000) TIML, 110	Brean	64
1LU LONIINUE	NODOR25	145
IF (PENET) GO TU 150	M004923	-10-1
1F(18P(18EGFP,3) SL1, 760,) 60 1. 150	M001115	7
IF (10P(10EGEP+1,J) alla 760al 66 (6 120	N001115	6
BGBRN=. FRUE.	MUD0925	116
150 CONTINUE	APEIR	65
c	HPEIR	67
	HPFIR	68
L . EDWARTER I TIME WELLTE ALL DIACH PULLER AT GRIDELILITE.	BPFIR	69
KUUD FUNDALIAN IARE -YAKANADI' DEREN FUNDEN DI KNAM HETEATE	HPFIR	70
	BPFIR	71
LIND		
		-an an ada + Mirral a
		. e-main
	-	
anda kan an	-	4 an i shu i the second
Minde (1494)		
Pas * # 5/*		
		der in oppen oppen som kningen skale s
adas gadema		Spation of the second se
		cp up privilip

an anadalla ay addan.	SUBROUTINE PRIMER	PRIMER	2
		MODIADO	
	COMPONY IGNIE / PURAL, BPCHO, BRNOUT, BOBRN, IPPBG,	HUDIOUZ	
3	ECGIC(5) +XLIC(5)	MUUIDUZ	
	LUMMON/PRAFLU/LUTAPA, UPAM, UPAM, UPAPAPAPAPAPAS SPARS PARCUP	MUDUY25	118
	LUMMON/CLUCK/TIFE.DELT	PRIMER	. <u> </u>
	CUMMUN/DPT/TEP(2)+DEP(2)+CEP(2)+FTugH+PUALST	M0D0925	119
	CUMMUN/FAILEL/INICKI, PHOUP, PCOMP, ETUE, XNTUB, FAIL, MFAIL(60).	h000925	150
	THILN(60),PENET,TIFCE	MUD0925	121
	LOMMUN/LHAM/1X+1R+AB+RD+NGA+NGA+NGK+IELGE+IENDB+IPATH(60+5)+AREAG(5)+	CHAMIX	2
****	ARLACH.ARLAL(60).16011.001.0.01Am1IAM2.CIS1.0IS2.0IS3.0IS4.	CHAMIX	3
;	ARLAK(60).ARLAAX,CHAM1.CHAM2.CHAM3.IOPGAP.AREAGP(60).DAVG.	CHAMIX	4
	ANLANZ, UIARBI, UELEND, ELLBEG, IPS1, IFS2, MADES, BPIGN	CHAMIX	5
	COMMON/LONS/LIGA.TOUR. 120X. TWOTDR	EONS	2
	UX-UK-64-64-6-6-6-6-6-6-6-6-6-6-6-6-6-6-6-6-	FUNS	3
	COMMUNICATION CONCERNENT CONCERNENT CONSTRUCTION TE CA. RHOR	INPUTS	2
-		THPLITS	te en vandesten Sameraan K
		DHTMU	-
gan aquipan - a		PAR	E
	CONTINUE ACTANTRE (01-2) + KUNIC (01-2) + PR(01-2) + ORG(01-2) +	BAG	2
	VB(60,5), UPB(60,5), PCH(60,5), 12C(60,2),	BAG	3
	2 UUIMIG(60), WEAG(60,5), XDRAG(60,5), DOTPB(60,5), UPBDT(60,5),	BAG	4
	5 PH10TU(60,5), RH0BTU(60,5), HBGTU(c0,5), UBGTD(60,5),	BAG	5
	+ V3610(60.5).166(60.5).00TMBG(60).C.TMP(60.5).PHIBP(60.5).	BAG	6
	5 PHIP10(60+5)+T2K(60)+T8P(60+5)	BAG	7
une unter eine eine eine	LUGICAL IGNIT. UNLU. CHAM1. CHAM2. CHAMA. JPIGN	CHAMLOG	2
	LOULAL HPLEFT	PRIMER	12
	LUBICAL PECET	M000605	24
	COSCAL AMMONT HAS N	h000925	122
		M0D0925	123
		CHIMEN	13
	DATA (0F1F174,1801207	ALL THE	10
L		PRIMER	14
L		PRIMER	12
L		PRIMER	16
L :	CALCULATE PRIFER VELOCITY AND MASS FLC. HATE	PRIMER	. 17
L		PRIMER	18
	1H02=10F00	HUD0925	124
- +00+ 0+-(TEMP=.UGOU1	MUD0925	125
C		PRIMER	23
		PRIMER	24
ĩ		PRIMER	25
	HEFT WILL AND THE THUS THE THERE TS SCARE BLACK POWDER LEFT AND	PRIMER	26
	THE PRIME SILL OF CALLED ALLEN.	PRTAFR	27
	WINE CI - EALCE	DHTMEN	
	Drefr - MALDE,	OB THER	20
4		PRIMER	- 27
	00 00 0 = 1 + NOT.	PRIMER	50
a services of descenarios	LU BU I = 19RGA	PRIMER	31
	IF (PENET .ANU. U .EU. 1 .AND. I .EU. 182) 60 TO 42	MOD1215	8
	1+ (PHIBH(1,J) .6E. U.999) GO TU 35	PRIMER	32_
	IF (6PMAD(1.J) .LTUU01) GO TO 35	MUD0925	126
	BPLEF1 = .1RUE.	M0D0925	127
and the particular states	IF (TBP(I,J) ,LI. TIGNBP) GU TC 55	PRIMER	33
	1+ (PCH(1.J) .LT. U.U) WRITE (6,7004) PCH(1.J).I.J	PRIMER	36
7000	FUNFAL(1),	PRIMER	37
1000	H = AGENINPADCHAI, HATETADRP + H. ANP	FRIMER	3.0
		CHTMEN	10
	White a Reduct Discourse of the state	DETMEN	00
		PRIMER	40
	DEMADITADI = REMADITADI + DOMUT	PHIMEN	41

No. L'Alger	1 (LPKAL (1 . J . UL. U. U01) 60 TC 40	PRIMER	42
	WRITE (BACOUD) 14J, BPHAD (14J)	PRIMER	43
5%	$OMRAD(1, \omega) = 0.0$	PRIMEN	44
	P(1bP(1, u) = 1, u	PRIMER	45
	00 10 55	FRIMER	46
		PRIMEN	47
4.1	6 UK 1 11.00	PRIMER	46
•0		PRIMER	44
and a second sec		LRTMER	5 ()
	$P(n) = \{0, n \in P(n) \in \{1, \dots, n\} \neq V(n)\}$	URTHER	51
		ONTMEN	50
		PRIMER	52
		PRIMER	55
L	CONFORT EFFECT OF FORDER OF FLAM SPREAD	MUDU925	126
Mitt	COPPARE WITH EFFET OF BORPING RALL	MUD0925	129
	IFTI .La. 1862 .ALC. J .LE. 1) 60 11 .2	HUDU925	130
	00 10 48	MUD0925	131
14 c	CONTINUE	MUD0925	132
	1+ (BRNUUT) GU TU 48	MUD0925	133
	PrtSC=FCH(1802+2)/144.	M0D0925	134
	IF (PRESC , LI, U,) Pi(ESC=U,	NUD0925	135
	AFUU1=.00004+(FRESC++2.2)	P.001002	e
	ULLIN=0,159+(ARCOT/TEF(1))+0ELT	MUD0925	137
	PUKAD=DELTH + PURAD	MUD0925	136
	1+ (PUKAU +L[+ +5+12P(1)) 60 TO 45	NUD0925	139
	ATL12(6,430)11ML	HUD0925	140
4 30	FORMATIZASA, THIME = E14.7.5X.23HIUNTIER PAC BURNED AWAY)	N0D0925	141
	PH46F(46H2.2) = 1.0	NUD0925	142
	$P(1P 10(1hb_{2}, z)=1, 0)$	M0D0425	343
	abadal = TRU-	MID0925	144
	and has been	+(D0025	141.
r	The REDITE TO STINT OF MUCT BE TASH. TO	1000765	5 T 17
		NUD0925	140
	AN STATES IN TO BELL CHARGENES IN CALLS ONLY	NUDAD25	1.1.A
C 71	of other and the second concerned on a second concerned concerne	MUD0925	140
40		N000925	147
46		M0D0925	150
4/	IF (FM117 .GI,	F000925	151
	JLVUL=6.283+FDRAU+LELIR	MUD0925	152
		MUD0925	153
	JENS=(LEP(1)/TEP(1))/(0.785+(DEP(1)+LEP(1)-EIAMBT++2.))	M000925	154
	UTMF=1EP(1)+DENS+DEVUE	MUD0925	155
	001WF(1085*5) = 001Fb(1085*5) + 01WF	MUD0925	156
-	HIDE(1082,2)=F11EF(1082,2)+DLVOL	MUD0925	157
	PhiPID(1002,2) = PhibP(1002,2)	MUD0925	158
40		N000925	159
	PhirTu(I+J) = PhibP(I+J) + TEPr	PRIMER	54
	60 IU 5c	MUD0925	160
L		PRIMER	56
54	FH1PTL(I+J) = FH1EF(I+J)	FRIMER	57
be	1+ (+H140+(1,J) .619999) PH18P(1.J=1.0	MUD0925	161
	1+ (Phile)U(1,J) . J	NUD0925	162
ta 11	LUNIINUL	PRIMER	58
1		LATE R	50
	ICE LURN	DRTMEN	60
		LINTME D	00
	FORMALIZZE BATTAS OF MALK POWDED AT ATAN. TATA. TO EAR AN	DETMEN	61
£ 6 0 0	THE TAY PROTOS OF CLACK FORDER AT GAID'S 134134' 13' (F10,4)	PRIMEN	64
		PUTUEN	<u>ь</u> э
	SUBROUTINE PRPFIR	PRPFIR	2
------------------------	--	---------	------------
<u> </u>		PRPFIR	3
L	SUBRUUTINE PRPFIR CALCULATES PROPELLANT HEAT TRANSFER AND	PRPFIR	4
<u>C</u>	TEMPERATURE RISE LEADING TO IGNITICN.	PHPFIN	5
L	IZC(110) - SURFACE TEMPERATURE OF PROPELLANT NOT UNDER THE	PRPFIR	6
	INFLUENCE OF BELL TUBE HOLES AT GAID (1, J)	PRPFIR	
C	IZR(1) - SURFACE TEMPERATURE OF PROPELLANT UNDER THE INFLUENCE	PRPFIR	8
6	OF BELL TUBE HOLES AT GRID (1,2)	PRPFIR	9
L		PRPFIR	10
		PRPFIR	11
	CUMPON/CHAM/IX, IR, XB, KB, NGX, NGR, IELGB, IENDB, IPATH(60,5), AREAG(5),	CHAMIX	2
-	AREALH, ARLAC(60), IGNI (.0. ED, DIAM1, LIAM2, EIS1, DIS2, DIS3, DIS4,	CHAMIX	3
	ARLAR(60), AREAAX, CHAM1, CHAM2, CHAM2, 10PGAP, AREAGP(60), DAVG.	CHAMIX	4
	> AHEAH2, DIAMBI, HELEND, BELBEG, IPS1, IPS2, RADPS, BPIGN	CHAMIX	5
	COMMON/EQNS/UTUX, 12UK, T2UX, TWOTDR, UICK, HMB, TWOGJ, DVAXIS, DVAXIT,	EONS	2
	S UX • UK • NX • GU • TWOUT • HBP	EONS	3
	COMMON/CLOCK/TIME, DELT	PRPFIR	14
	COMMON/GRAIN/ XL(60.5), DO(60.5), U1(60.5), FN.	GRAIN	2
	1 ALTUI(60,5), DUTDI(60,5), DITUT(60,5), XLO, DOU, DIO.	GRAIN	3
	2 XLB(100), DUB(100), DIB(100), UXLB(100), LDOB(100), UDIB(100)	GRAIN	4
	CCMMUN/HOLEA/RALHUL(85) +NRUWH + NHOLES(35) +XCL(85) +AREAH(60) +	HOLEA	2
	\$ AH(6U),FRACT(60)	HOLEA	1
	COMMON/INPUIS/C1,C2,C3,C4,T0,TIGN, WLGNS, RHOF, PHID, TF, CA. RHOD.	TAPUTS	2
	S HU, PU, UU, GTRHOP, HS, UM, FIGNBP, GBCUNS, TOTM	THRUTS	1
	COMMUN/P/IPRINT.MOUCH.MOUGR.PRI1.IULELG(35)	D	
	COMMON/BAG/PHI86(EU.5), KHOB6(60.5), p36(60.5), UB6(60.5).	PAG	2
	1 VBU(60,5), UPU(60,5), PCH(60,5), 1/C(60,5),	DAG	
	2 DOTMIG(60). GRAG(50.5). XDRAG(60.5). DOTMB(60.5). UPBDT(60.5).	DAG	3
-	3 Phib10(60.5), Khuk10(60.5), Hagi, (-0.5), UBGT0(60.5),	DAC	
	4 VBUILIGU.5).TBG(60.5).DOTMBG/60. C(TMP/60.5).PHTPD/60.5)	BAG	5
	5 PHIP10(60.5), 128(60), THP(60.5)	BAU	ь
		BAG	7
		PRPFIR	20
		PRPFIR	21
	LOGICAL TONT ADDEL CHAM2 CHAM2 DICA	PRPEIR	55
	IGELCAL DRITTERDIG	CHAMLUG	2
	CONCAL FUELDEDUD	PLOG	- 2
	EIDE DEMATING THE RETERIED FILME CLARKE AND AND ADDRESS	PRPFIR	25
	THE REMAINS THE AFTER THE FIRST PROPELLANT GRID IGNITES	PRPFIR	26
c	ANDAY HULP TO CLEATER A HULLTON AND A THE ANDARA	PRPFIR	27
aladay — selasir isa m	ANNAL WOAG IS CLEAPED IN UPDATE AT EACH TIME INTERVAL,	PRPFIR	28
5	A THE DEL THE CALLULATING UPDATEC ENTHALPY IN THE PATH ROUTINES.	PRPFIR	29
	A TERM HAT HAVE ALREADT BEEN ADDED TO SAG IN SUBROUTINE BPFIR.	PRPFIR	30
L		PRPFIR	31
<u> </u>	IGNIS WILL REMAIN TRUE ONLY IF AT EALH GRID THERE IS NO	PRPFIR	32
L	PROPELLANT OR THE PROPELLANT IS IGNIEL.	PRPFIR	33
	IGNIT = TRUE.	PRPFIR	34
	DO 100 J=1, NGR	PRPFIR	35
-	RUN2 = J .L 2	PRPFIR	36
	DU 95 I=1+NGX	PRPFIR	37
	IF (PHIDE(1,J) .6T. 0,999) GO TO 95	MOD1017	4
L		PHPFIR	39
٢	CALCULATE RISE IN TZC.	PRPFIR	40
	IF(12C(1.J) .64. TIGN) 60 10 35	PRPFIR	41
	IGNIT = .FALSE.	PRPETR	42
	11X = 186(1+J)	PRPFIK	H A
	$\frac{11X = 180(1+0)}{16MP} = 1TX + Surt(1TX)$	PRPFIK	45

L	UAS VISCUSITY	UNDETH	hr
	$T\lambda MU = C1 + TEMP/(TX + C2)$	ORDETR	46
C	······································	DROFTH	
C	THERMAL CONDUCTIVITY OF GAS	DROFTR	40
	$TXK = C_3 * TEMP/(T1X + C4)$	PRETR	
C		PRPFIN	50
L	FLYNULUS NUMBER	OFFETR	
	TEMP1 = RHOGG(I+J) + DM/TXML	PRPFIN	52
	HELA = TEMP1+ABS(UBG(I+J))	OUDETH	22
	1F (KEIX .LT. ,60001) (EIX=.00001	PRFFIR	54
L		HULUL/	
L	NUSSELT WEREER	PRPFIR	55
	$TEMP2 = 0.5 \pm SORT(FCH(1.5))/100 $	PREFIN	
	$T_{ANUS} = 0.3 + 65 T_{X+x0} - 62 + T_{A+x0}$	PAPPIA	57
L		PRPFIR	58
L	SURFACE AREA OF PROPELLANT IN GRID U. P. VOLUME TARDEMENT	PRPFIR	59
*.		PRPEIN	.60
	$\frac{100}{10} \frac{1}{10} \frac{1}{10}$	PRPFIR	61
· · · ·	= (DO(1+0)+DO(1+0) - FN=D1(1+0)+D1(1+0)) + 0.57XL(1+0))	PRPFIR	. 62
c	HEAT FLUX TO PRODUCT ANT ANTIGETAGE A	PRPFIR	63
¥	THE THE AND THE	PRPFIR	64
		PRPFIR	65
100 100 10	SCONVA = IXNUS+ILMP3+(ITX - I4C(1,J))	PRPFIR	66
	1+ (QUNVA .LT. 0.001) GO TU SU	PRPFIR	67
- demokrator a	ILMP = GCONVA+AUV	PRPFIR	68
	1F(ROW2) TEMP = TEMP+FRACT(1)	PRPFIK	69
	$\mathbf{QBAG(1,J)} = \mathbf{GBAG(1,J)} + \mathbf{TEMP}$	PRPFIR	70
	TEMP = GCONS+QCONVA	PRPFIR	71
	$1EFF = ((T2C(1+J) - T0)/TE_{Dr}) + 2$	PRPETR	72
	IF (TEFF .GT. TIME) TEFF = TIME	PRPFIN	73
•	MA AND ADDRESS OF MANY AND ADDRESS OF MANY ADDRESS	PRPETR	74
-	HEAT THANSFEH CALCULATION USING SEPI-INFINITE HEAT CONDUCTION	PRPETR	76
	LUUATION WITH AN EFFECTIVE TIME	PRPETR	75
	$TZC(1 \cdot J) = TZC(1 \cdot J) + TEMP +$	PHPETH	77
	SUNT(TEFF + DELT) - SUNT, TEFF))	PRPETR	74
	IF (IBF(1.J) .GE. TIGNBP) TZC(I.J)=TIGN	MGD1205	19
	IF(12C(1.J) .LI. TIGN) GO TU DO	DRDETR	70
	FRACT(1) = 1.0	DUDE + U	
	FIRE = TRUE	PRFF1A	80
	IF(IDEBUG(14)) WRITE(6+2004) IIME	DEDETR	81
		PUPP IN	82
-		PRPLIN	.85
-		PRPFIR	84
2	CALCULATE RISE IN TZR	PRPFIR	85
50	CUNIINUE	PRPFIR	86
	IF(.NOI, RUND) GU 10 95	PRPEIK	
		PRPFIR	88
ND -0-1		PRPFIR	
		PRPFIR	90
		PRPFIR	91
	RESULTANT VELOCITY	PRPFIK	92
	UVAS = UNG(1).11	PRPFIR	93
	1 + (1 - 5) +	PRPFIR	94
	$\frac{1}{1}$	PRPFIR	95
		PRPFIR	96
attative lawson -	She Tille - Statistic telle and a ling of the	PRPFIR	97
	STATUM = SERT (USASEUGAS + VBG(1)+VBG(1))	PRPFIR	98
	REIAM = IEMPLASURTUH	PRPFIR	99
	TANUSH T R. SARETANAAD 60 A 14400		

IF (GCONVH .LT. 0.001) GO TU 92 WBAG(1.J) = WBAG(I.J) + QCONVH*ADV*(1.0 - FRACT(I)) IEMP = QCONSECONVH IEFF = ((12K(1) - T0)/TEMP)** IF (IEFF .G1.]IML) TEFF =]IPL IZR(I) = I2K(I) + TEMP*(SGKI(IEFF + DELT) - SURT(TEFF)) IF (IDEDUG(11)) HTTE (6.2001) IIME.I.J YD UNTINUE IF (IZC(1.J) .LT. TIGN) GO TC 95 IF (IDEDUG(11)) WHITE (6.2001) IIME.I.J YD UNTINUE IF (IZC(1.J) .LT. TZC(2.J)) TZC(1.J) = TZC(2.J) Ivu LINU VD UNTINUE IF (IZC(1.J) .LT. TZC(2.J)) TZC(1.J) = TZC(2.J) Ivu UNTINUE IF (IZC(1.J) .LT. TZC(2.J)) TZC(1.J) = TZC(2.J) Ivu UNTINUE IF (IZC(1.J).UE.TGN)FKACI(1)=1.0 KETURN C 2000 FORMAT(/.* TIME =* .E14.8.* PROPELLANT AT GRID*.I4.I4.* IS IGNITED* * J 2001 FORMAT(/.* TIME =* .E14.8.* PROPELLANT UNDER INFLUENCE OF BELL TUBE * HULES IN GRID*.I4.I4.* IS IGNITEC*) ENU	PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR	102 103 104 105 106 107 108 109 110 112 113 114 115 116
UBAG(1+J) = UBAG(1+J) + GCUNVH*ADV*(1.0 - FRACT(1)) TEMP = GCONS*CONVH TEFF = ((12R(1) - T0)/TEMP)** IF(1EFF, G1.)IML) TEFF = 11PL T2R(1) = T2R(1) + TEMP*(SCRI(1EFF + DELT) - SURT(TEFF)) IF(T2R(1), LT. T16N) GO TC 35 IF(1DEBUG(11)) WRITE(6+2001) IME,I,J Y5 CUNTINUE IF(T2C(1,J).LT. T2C(2,J)) T2C(1+J) = T2C(2,J) Ibuu CUNTINUE IF(T2C(1,J).LT. T2C(2,J)) T2C(1+J) = T2C(2,J) Ibuu CUNTINUE IF(T2C(1,J).LT. T2C(2+J)) T2C(1+J) = T2C(2+J) Ibuu CUNTINUE IF(T2C(1,J).LT. T2C(2+J)) T2C(1+J) = T2C(2+J) Ibuu CUNTINUE IF(T2C(1+J).ETEFF+ETETEE) Ibuu CUNTINUE IF(T2C(1+J).ETEFF+ETETEE) RETURN C PROPELLANT AT GRID*, I4+I4+* IS IGNITED* PULES IN GRID*, I4+I4+* IS IGNITEC+) ENU	PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR	103 104 105 106 107 108 109 111 112 113 114 115 116
TEFF = ((12K(1) - T0)/TEMP)** IF(1EFF = 01, 1)ML) TEFF = 11PL T2R(1) = 12K(1) + TEMP*(SCRI(1EFF + DELT) = SQRT(TEFF)) IF(1DEBUG(11)) WHITE(6+2001) IIME,I.J 95 LVNTINUE IF(12C(1,J) .LT. T2C(2,J)) T2C(1,J) = T2C(2,J) 100 LUNTINUE IF(12C(1,J) .LT. T2C(2,J)) T2C(1,J) = T2C(2,J) 100 C RETURN C 2000 FORMAT(/,* TIME =**L14.8** PROPELLANT AT GRID**I4*I4** IS IGNITED* 5 J 2001 FORMAT(/,* TIME =**E14*8** PROPELLANT UNDER INFLUENCE OF BELL TUBE S HULES IN GRID**I4*I4** IS IGNITEC*) END END	PHPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR	104 105 106 107 108 109 110 111 112 113 114 115 116
IF (IEFF , G1, 11ML) TEFF = 11PL IZR(1) = 12K(I) + TEMP*(SCKI(IEFF + DELT) - SQRT(TEFF)) IF (IZR(1) ,LT, TIGN) GO TC 95 IF (IDEBUG(11)) WHITE (G+2001) IIME,I,J 95 CONTINUE IF (IZC(1,J) ,LT, TZC(2,J)) TZC(1,J) = TZC(2,J) 100 CONTINUE IF (IZC(1,2),GE, IIGN)FKACI(1)=1.0 C RETURN C 2000 FORMAT(/,* TIME =**E14.8** PROPELLANT AT GRID**I4*I4** IS IGNITED* 5] 2001 FORMAT(/,* TIME =**E14.8** PROPELLANT AT GRID**I4*I4** IS IGNITED* 5] 2001 FORMAT(/,* TIME =**E14.8** PROPELLANT UNDER INFLUENCE OF BELL TUBE S HULES IN GRID**I4*I4** IS IGNITEC*) END	PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR	105 106 107 108 109 110 111 112 113 114 115 116
TZR(1) = TZR(1) + TEMP*(SCRI(TEFF + DELT) - SURT(TEFF)) IF(TZR(1) .LT. TIGN) GO TC 95 IF(TDEBUG(11)) WHITE(6+2001) TIME.I.J 90 CUNTINUE IF(TZC(1.J) .LT. TZC(2.J)) TZC(1.J) = TZC(2.J) 100 CUNTINUE IF(TZC(1.J) .LT. TZC(2.J)) 1100 CUNTINUE 2000 FORMAT(/ TIME = * .LT4.8.* 2001 FORMAT(/ TIME = * .ET4.8.* PROPELLANT UNDER INFLUENCE OF BELL TUBE 2001 FORMAT(/ TIME = * .ET4.8.* ISTREC*)	PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR	105 107 108 109 110 111 112 113 114 115 116
IF (TZR(I) .LT. TIGN) GO TC 95 IF (IDEBUG(11)) WHITE (6+2001) IDME.I.J 90 CUNTINUE IF (TZC(1.J) .LT. TZC(2.J)) TZC(1.J) = TZC(2.J) 100 CUNTINUE IF (TZC(1.2).GE.TIGN)FRACT(1)=1.0 METURN C 2000 FURMAT(/,* TIME =*.E14.8.* PROPELLANT AT GRID*.I4.I4.* IS IGNITED* 5.) 2001 FORMAT(/,* TIME =*.E14.8.* PROPELLANT AT GRID*.I4.I4.* IS IGNITED* 5.) 2001 FORMAT(/,* TIME =*.E14.8.* PROPELLANT UNDER INFLUENCE OF BELL TUBE S HULES IN GRID*.I4.I4.* IS IGNITEC*)	PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR	107 108 109 110 111 112 113 114 115 116
IF (IDEBUG(11)) WRITE (6+2001) (IME,I,J YD CUNTINUE IF (TZC(1,J) .LT. TZC(2,J)) TZC(1,J) = TZC(2,J) IUU CUNTINUE IF (TZC(1,2).GE.TIGN)FRACT(1)=1.0 RETURN C ZGUU FURMAT(/,* TIME =*.E14.8.* PROPELLANT AT GRID*.I4.I4.* IS IGNITED* \$ J 2001 FORMAT(/,* TIME =*.E14.8.* PROPELLANT AT GRID*.I4.I4.* IS IGNITED* \$ J 2001 FORMAT(/,* TIME =*.E14.8.* PROPELLANT UNDER INFLUENCE OF BELL TUBE \$ HULES IN GRID*.I4.I4.* IS IGNITEC*) END	PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR	109 110 111 112 113 114 115 116
<pre> 25 CONTINUE IF(TZC(1,J) .LT. TZC(2,J)) TZC(1,J) = TZC(2,J) 100 CUNTINUE IF(TZC(1,2).GE.TIGN)FRACT(1)=1.0 C C C C C C C C C</pre>	PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR	110 111 112 113 114 115 116
LUNTINUE IF (TZC(1+J) * TZC(1+J) * TZC(2+J) IF (TZC(1+2)+GE+TIGN)FRACT(1)=1+0 HETURN C ZGUD FORMAT(7+* TIME =*+E14+8+* PROPELLANT AT GRID*+I4+I4+* IS IGNITED* \$) 2001 FORMAT(7+* TIME =*+E14+8+* PROPELLANT UNDER INFLUENCE OF BELL TUBE \$ HULES IN GRID*+I4+I4+* IS IGNITEC*) END	PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR	111 112 113 114 115 116
LF (TZL(1,2).GE.TIGN)FRACI(1)=1.0 HETURN C ZUUD FORMAI(/,* TIME =*.E14.8.* PROPELLANT AT GRID*.I4.I4.* IS IGNITED* 5.) 2001 FORMAI(/,* TIME =*.E14.8.* PROPELLANT UNDER INFLUENCE OF BELL TUBE S HULES IN GRID*.I4.I4.* IS IGNITEC*) END	PHPEIR PHPFIR PHPFIR PHPFIR PHPFIR PHPFIR PHPFIR	112 113 114 115 116
L RETURN C 2000 FORMAI(/, * TIME =* +L14.8+* PROPELLANT AT GRID*+I4+I4+* IS IGNITED* 5) 2001 FORMAI(/, * TIME =* +E14.8+* PROPELLANT UNDER INFLUENCE OF BELL TUBE S HULES IN GRID*+I4+I4+* IS IGNITEC*) END	PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR	113 <u>114</u> 115 <u>116</u>
RETURN C 2000 FORMAT(/.º TIME = ".E.14.8." PROPELLANT AT GRID".14.14." IS IGNITED" 5) 2001 FORMAT(/.º TIME = ".E.14.8." PROPELLANT UNDER INFLUENCE OF BELL TUBE 5 HULES IN GRID".14.14.0 IS IGNITEC") END	PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR PRPFIR	114 115 116
C 2000 FORMAT(/." TIME =".L14.8." PROPELLANT AT GRID".14.14." IS IGNITED" 5) 2001 FORMAT(/." TIME =".E.14.8." PROPELLANT UNDER INFLUENCE OF BELL TUBE 5 HULES IN GRID".14.14." IS IGNITEC") END	PRPFIR PRPFIR PRPFIR PRPFIR	115
2000 FORMAT(/, " TIME = "+E14.8" PROPELLANT AT GRID + 14.14, " IS IGNITED" 3) 2001 FORMAT(/, " TIME = "+E14.8" PROPELLANT UNDER INFLUENCE OF BELL TUBE 3 HULES IN GRID + 14.14. IS IGNITEC +) END	PRPFIR PRPFIR PRPFIR	110
2001 FORMAT(/, " TIME =" .F.14.8." PROPELLANT UNDER INFLUENCE OF BELL TUBE S HULES IN GRID .I4.14. 15 IGNITEC .) END	PRPFIR	17/
SHULES IN GRID + 14 + 14 + 15 IGNITEC +)	PRPFIR	118
ENU		119
	PRPFIR	120
	PRPFIR	121
	· ··· ··· ··· ··· ··· ··· ··· ··· ···	Miler or evenings that the description of any
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	10 April - 1	they apar where the
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and the second sec		_
102		

	SUBROUTINE REGRES	REGRES	·
	COMMUN/BURN/ATPOSCISPEXP	NEGRES	2
	LOMMUN/CHAM/IX, IK, XD, RD, NGX, NGK, IEF HE, IE NDB, IPATH(60, 51, APE AG(5),	CHANTY	
	AREACH AREAL (60) . IGNIT . ONED . DIAM IAM2. CIST. DIS2. DISA. DIS4.	CHRMIN	-
	AKEAR (60) - ARFASA - CHAM1 - CHAM2 - CHAM2 - CHAM	CHARITY	······ · · · · · · · · · · · · · · · ·
	AREAD UTAMAT, HELEND BELERE TOEL CA BADE OTACH	CHAMIX	4
· · · · · · · · · · · · · · · · · · ·	COMMIN / ONS / TO: TON TO THE THOTOGRAPHIC TO THE THOTOGRAPHIC TO THE TOTOGRAPHIC TO THE	CHAMIX	5
	to the law of the territer the the the the the standy by AXIS BY AXIT	EQNS	2
	COMMON (NA GOT NOUT HBP	EGNS	3
	COMPON/GRAIN/ XL(60.5), U0(60.5), U1(60.5), FN.	GRAIN	2
	1 XLIDI(60,5), DOTDT(60,5), DITDT(60,5), XLQ, DOO, DIO,	GRAIN	3
	2 XLH(100), DOB(100), DIB(100), UXLB(100), LDOB(100), UDIB(100)	GHAIN	4
	COMMUN/HOLEA/RADHGL(85) + NROWF , MHOLES(65) + XCL(85) + AREAH(60) +	HOLEA	2
	\$ AH(60) + FRACT(60)	HOLSA	2 · · · · · · · · · · · · · · · · · · ·
	COMMON/INPUTS/C1+C2+C3+C4+T0+TIGN+LLCAS+RHOF+PHID+TF+CA+RHOA+	TNDIITE	5
	3 HO.PU.UD.GTRHUP.NW.UM.LIGH.P.ORCONS.TOTM	THEUTS	<u> </u>
	COMMON/SPLINT/PHOLEC. PHOLEG	INPUIS	3
the part angugan and	CUMMON/HAG/PHTHG/GU.S. HHODG/GO S. DECKO S. UDD.CO S.	REGRES	
	1 VH6/60.51, UD0/60/57, H000/60,3), H00(60,3), UD0(60,3),	BAG	2
		BAG	
	WHITTO COLO BAD (60,5), XURAG (60,5), DOTPB (60,5), UPBDT (60,5),	BAG	4
	5 FRADUSO 31, KHUBIU (60,5), HBGIU (60,5), UBGTD (60,5),	BAG	5
	4 VB01D(60+5)+TB0(60+5)+D0TMBG(60)+C0TMP(60+5)+PHIBP(60+5)+	BAG	6
	5 PHIPTD(6015)172R(60)170P(6015)	RAG	7
	LOGILAL IGNII. UNED. CHAM1. CHAM2. CHAM3. PIGN	CHAMLOG	2 Contraction of Cont
	LOGICAL HOLLC. HOLEB	PEGRES	12
	LUGICAL ROW2.PART	nucors	
	UATA PIDE/ 785398/	KLURES	15
C		REGRES	
é	SUBROUTINE REGRES CALLULATES HOMASS. C. ALL STREAMED AND SERVICE	REGRES	15
X	OUT TO HIENTAL OF CALCULATES DEVALED GRAIN DIMENSIONS AND POROSITY	REGRES	16
č	BOL TO BORNING OF HE PROPELLANT. PHIEID IS USED IN THE PATH	REGRES	17
	ROOTINES AND OPDATED GRAIN DIMENSIONS ARE USED IN PROPEL.	REGRES	18
C		REGRES	19
		REGRES	20
C	ARRAY DOTMB IS CLEARED IN UPDATE AT EACH TIME INTERVAL	REGRES	21
	U0 50 J=1.NGK	REGRES	22
	KUW2 = J .EU. 2	DECHES	
	U0 98 1=1,NGX	ACCACO	23
C		REGRES	. 24
	IF (PHIBG(1.J).66.0.99999) 60 TO 48	REGRES	25
	PART = KON2 AND EXACTLY IE & DODD	REGRES	26
		REGRES	27
5	IE PHILPELLAND IN THE CUTH TO AND TO THE TOTAL	REGRES	
č	CALCHART IN THE GRID IS NOT IGNII'D, DC NOT DO THE BURN	REGRES	29
	CALUCATIONS	REGRES	30
	1+ (12(1,J).GE.TIGN) 60 10 10	REGRES	31
	IF (PART ANU, TERIL) .LT. TIGN G. TO 45	REGRES	32
	IF (.NUT. PART .ANU. TZC(I,J) LI. TIGN) GO TO 45	REGRES	22
	LU CONTINUE	PECRES	34
	$K = ATPB + PCH(I \cdot J) + PEXP + CT$	DECRES	35
	BUKNL = RAINOUT	PLOPES	30
C		NEVOLO	30
C	UPUATE GRAIN LENGTH.	NEGUES	57
	$X = \{U, U\} = X = \{1,\} = BURNI$	REGRES	38
С		REGRES	39
ſ	SEE 15 GRAIN HAS SOLIT INTO COLUMPEN.	REGRES	40
Cas	AAANUT TAAT MAD STELL AND STELNERS	REGRES	41
	THE OLD DIFICUSIONS ARE BEING ISSTED,	REGRES	42
	1, 00(1,0) .LE. 3.0*D1(1,0)) 6C TO 20	REGRES	43
		REGRES	44
C		REGRES	45

-	UPUALE UTHER DIMENSIONS	REGRES	40
	uutbt(1,J) = DU(1,J) - BURNL	KEGRES	
	$UIIUT(I_{\bullet}J) = DI(I_{\bullet}J) + BURNL$	REGRES	40
6		REGRES	-49
C.	CALLULATE OLD AND NEW VOLUMES OF A GRAIN.	REGRES	50
	$vold = PlDF * xL(I_1J) * (DO(I \cdot J) * U_U(I \cdot J) - FN*DI(I \cdot J) * UI(I \cdot J))$	REGRES	
ide av 18194 Herei	VNEW = PIDF+XLTUT(I,J)+(DOTDT(I+J)+DOTCT(I+J) -	REGRES	52
	\$ FN+DITDT(I,J)+DITUT(I,J)	REGRES	55
	60 10 30	REGRES	54
c		REGRES	55
c .		REGRES	56
ř	CALCULATE OLD AND NEW GRAIN VOLUMES.	REGRES	57
с	AFTER THE WHAIN HAS SPLINTERED, VALUES FOR THE CROSS-SECTIONAL	REGRES	58
c	AREA UP THE PARTICLES GU INTO ARRAY LC AND VALUES FOR PENIMETER	REGRES	.59
<u> </u>	TO INTU ARRAY DI. IF THE GRAIN HAS JUST SPLINTERED. AREA AND	REGRES	60
	PENIMETER HAVE TO BE INITIALIZED. IS THE GRAIN HAS JUST	REGRES	61
	SPIINTERED DOLLAD IS APPROXIMATELY ANDILLAD AND IF NOT	REGRES	62
~	Init Lady with BE LESS THAN DICLED.	REGRES	63
2	I'DATINIE	REGRES	64
20	THE DOLLARD ALE DILLARD CONS.	REGRES	65
		REGRES	66
	ANSA \neq BIDE+(D)(T.()+D)((T.d)) = (A+D)(T.A.)+D)((T.d))	REGRES	67
	ANEN - PAULTIULIUITULIUTULIUTULIUTULI	REGRES	68
		PEGRES	69
	DU(1,J) = AREA	PECRES	70
C		OFCRES	71
25		DECRES	72
	DOIDT(1,0) = DO(1,0) = DI(1,0) + DECK	NEGRES	72
C		HEGRES	74
	1F (DOTDT(1.J) .GE. 1.0E-7) 60 10 27	ALGALS	75
	00107(1+3) = 0.0	REURES	13
	UITUT(I,J) = 0.0	REGRES	10
	$x \Box T \Box T (I_{1,0}) = 0.0$	REGRES	
	PHIETO(1,J) = 1.0	KEGRED	10
-	JU 10 48	M000925	163
L		REGRES	80
27	CONTINUE	REGRES	81
C	ASSUME THE NATIO OF PERIMETER SQUARE, TO CROSS-SECTIONAL AREA IS	REGRES	82
C	CONSTANT	REGRES	83
	UITUT(I,J) = SWRT(UI(I,J)*DI(I,J)*DO(I,J)*DOTDT(I,J))	REGRES	84
L	an akanakanakana an ing ing ing ing ing ing ing ing ing in	REGRES	85
L	VOLUME IS LENGTH TIMES CHUSS-SECTIONAL AREA	REGRES	86
	vULU = xL(1,J) + UU(1,J)	REGRES	87
	VNEh = XLTDT(1,J) + DUIDT(1,J)	REGRES	88
L		REGRES	89
C		REGRES	90
30	1+ (VNEW .LL. 0.0) 60 TO 45	REGRES	
C		REGRES	92
	ULLTAV = VULD - VNEW	REGRES	93
C		REGRES	94
C	CALCULATE NUMBER OF GRAINS PER GRIC/VCLUME OF GRID	REGRES	95
	FNUV = (1.0 - FH160(1.J))/VOLC	HEGRES	96
	IF (PART) PNUV = PNUV+(1.0 - FRALILI)	REGRES	97
	16MP = PNOV+DELTAV	REGRES	98
		REGRES	99
6	CALCULATE GAS MASS GENERATED BY RURNING PROPELLANT/GRID VOLUME	REGRES	100
C	DUIND (1.J) = TEMPERHUP	REGRES	101

UPDATE PORCEITY PPIUDILIUJ = PPIDU(1+J) + TEPP IP(PART) DUTUT(1+J) = DUTUT(1+J)+1+0 - FRACT(I)) + DO(I+J)+ S FRACT(1) IP(PART) DITUT(1+J) = DITUT(1+J)+(1+0 - FRACT(I)) + DI(1+J)+ FRACT(1) IP(PART) XLTUT(1+J) = XLTUT(1+J)+(1+0 - FRACT(I)) + XL(1+J)+ FRACT(1) BU [0 48 45 PPIETU(1+J) = PPIBB(1+J) 46 CONTINUL SL CONTINUL KLUDRM LHU	REGRES HEGRES HEGRES REGRES REGRES REGRES REGRES REGRES HEGRES REGRES REGRES REGRES REGRES	103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119
Philuid(i,j) = Philu(i,j) + TEPP IP (PART) DUTUT(1,j) = DUTUT(1,j,+,1,0 - FRACT(I)) + DO(1,j)* IP (PART) DITUT(1,j) = UITUT(1,j,+,1,0 - FRACT(I)) + DI(1,j)* PRACI(1) IP (PART) XLTUT(1,j) = XLTUT(1,j,+,1,0 - FRACT(I)) + XL(1,j)* S FRACIL1 UP (PART) XLTUT(1,j) = XLTUT(1,j,+,1,0 - FRACT(I)) + XL(1,j)* S FRACIL1 UP (PART) XLTUT(1,j) = XLTUT(1,j,+,1,0 - FRACT(I)) + XL(1,j)* S FRACIL1 UP (D 40 Y PHILU(1,j) = FRIBE(1,j) Y CUMINUL X CUMINUL	HEGRES HEGRES HEGRES HEGRES HEGRES REGRES HEGRES HEGRES HEGRES HEGRES REGRES REGRES HEGRES	104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119
<pre>1+(PART; DUTUT(1,J) = U(1)(1,J)+(1+0 - FRACT(1)) + DO(1,J)+</pre>	HEGRES HEGRES HEGRES HEGRES REGRES HEGRES HEGRES HEGRES HEGRES REGRES REGRES	105 106 107 108 109 110 111 112 113 114 115 116 117 118 119
<pre>S</pre>	HEGRES HEGRES HEGRES REGRES REGRES HEGRES HEGRES HEGRES REGRES REGRES REGRES	106 107 108 109 110 111 112 113 114 115 116 117 118 119
IP (PART) DIT.(1,J) = DITDT(I:J,+(1.0 - FRACT(I)) + DI(I,J) = FRACT(I)) + XL(I,J) = XLTDT(I:J) + XL(I,J) = XLTDT(I,J) = XLTDT(I,J) = XLTDT(I,J) = XLTDT(I,J) = XLTDT(I,J) = XLT	HEGRES HEGRES REGRES REGRES HEGRES HEGRES HEGRES HEGRES REGRES REGRES	107 108 109 110 111 112 113 114 115 116 117 118 119
<pre>> FRACI(1) 1+ (PART) XLUU1(1.J) = XLTOT(1.J)+(1.0 - FRACT(1)) + XL(1.J)+ > FRACI(1) bu TO 40 45 PH1E1U(1.J) = PH1EU(1.J) 48 CUM1AMUL SU CUM1AMUL RETURM LNU</pre>	REGRES REGRES REGRES REGRES REGRES REGRES REGRES REGRES REGRES REGRES	108 109 110 111 112 113 114 115 116 117 118 119
<pre>IP(PAPT) XLUU(1.J) = XLUU(1.J)+(1.0 - FRACT(1)) + XL(1.J)+</pre>	RLGRES REGRES RLGRES RLGRES RLGRES RLGRES RLGRES RLGRES REGRES REGRES	109 110 111 112 113 114 115 116 117 118 119
bu (0 48 45 46 50 47 48 49 49 49 40 40 41 42 43 44 45 46 47 48 49 49 40 40 41 41 41 42 43 44 44 45 46 47 48 49 49 40 40 41 42 43 44 44 45 46 47 48 48 49 49 49 40	REGRES REGRES REGRES REGRES REGRES REGRES REGRES REGRES	110 111 112 113 114 115 116 117 118 119
45 PHICID(1.J) = PHIBS(1.J) 40 LUNI 50 LUNI 100 LUNI	REGRES REGRES REGRES REGRES REGRES REGRES REGRES REGRES	111 112 113 114 115 116 117 118 119
45 PHIEID(1.J) = PHIBG(1.J) 48 CUNTIMUE 50 CUNTIMUE REUNN END	HEGHES HEGRES REGRES HEGRES REGRES REGRES REGRES	112 113 114 115 116 117 118 119
Y0 LUNTIMUL SL LUNT KLUNK* LNU	REGRES REGRES REGRES REGRES REGRES REGRES	115 114 115 116 117 118 119
	REGRES HEGRES REGRES REGRES	115 116 117 118 119
	HLGRES REGRES REGRES	116 117 118 119
κΕ Ι UK ⁴ L ^{HD}	REGRES	117 118 119
	REGRES	118 119
	REGRES	119

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105		

	SUBRUUTINE PRPVEL	MUD0925	164
	CUMPON/CHAP/IX, IR, XD, ND, NGX, NGK, 18LUE, 1ENDB, IPATH(60,5), AREAG(5).	MUD0925	165
	1 AREACH, AREAC(60), IGNIT, UNEU, DIAP1, CLAM2, DIS1, DIS2, UIS3, DIS4,	MUD0925	166
	AREAR (60) . AREAAX . CHAN 1. CHAM2 . CHAM3 . TUPGAP . AREAGP (60) . DAVG.	MUD0925	16.7
	3 AREAH2.0IAMUT.HELLAD.BELHEG.IPS1.1PS2.RADPS.BPIGN	MUD0925	14.8
	LUMMUN/LLUCK/TIPE.ULLT	MUDBASS	100
	LUMMUN/EGNS/LTU> .T2UK.T2UX.TWUTDR.UIEK.HMH.TWOGJ.UVAXTS.OVAXTT.	1000723	167
	1 UX-UK-NX-GU-IKOUI-HBP	1000923	170
	CUMMUN/FUNCE/PFUNCE(60.5) . PFORDTIGUES	100425	171
	CUMMUN/P/IPRINT MOUCH MOUGH PRIT THE GIVEN	M0D0925	172
~ .	CUMMON/16NTE/PERAD. 6PF at an MOUT . BOLL THEORY	MUD0925	173
	\$ heble(5).xilc(5)	M0D0925	174
40-01 H	CUMPUNZEALLEDZINTCHT PHOUP OF OND AN A THE THE THE	M000925	175
	1 HI(B(G)) STATEST TYPES	M0D0925	176
		MUD0925	177
	COMMUNICATION OF DENS BERADIGO 51 + AGENEP + BGENEP + EXPBP	MUD0925	178
	COMMENT ROLLE 2 FF1 F1 FF2 BGJAM BGSTF NVSP BGNP	MOD0925	179
	COMMONT RHELOZDOTHER . UPKM . UPKM . UPRM . PRP XP . FDSHR . CSPRKS . PRMCOF	MUD0925	180
	COMPONIDE 17 TEP (2) + LEP (2) + CEP (2) + FTUUH , PDALST	MUD0925	1.81
	COMMON/INPUTS/C1.C2.C3.C4.T0.TIGN.w.C.S.RHOF.PHIG.TF.CA.RHOD.	MOD0925	182
	3 NO.PO.UU.UTRHOP.HK.UM. IIGNBP.OBCUNS.TOTM	N000925	102
	COMMON/TUBE/IENUTC(5), ITUBE, IBEGTC(5), INBP	KUD1115	105
	CUMMUN/BAG/PH186(60.5), MH086(60.5), BB6(60.5), UB6(60.5),	H000025	
	1 VBG(60.5), UPH(60.5), PCH(60.5), 12, (60.5),	FI000925	104
	2 UUIM16(60) + UBA6(60.5) + XIRAG(60.5) + DOTMB(60.5) + UBBOT(0.5)	M000925	185
	3 Phiblu(60.5), Rhublu(60.5), Hoging, St. 1000000000000000000000000000000000000	M0D0925	186
	4 VBULL(60.5), THE (60.5), DOT MEGICE CONTROL CONTROL ST	MUD0925	187
-10 -10	PHIPIU(60.51.1201001 THOUSE (BU), CCTHP (60.5), PHIBP(50.5),	MUD0925	188
		M000925	189
		M0D0925	190
	LOLAL INTITUDEDICHAMICHAMZICHAMOTOPIGN	MUD0925	191
-	LOSICAL PRILIDEBUG	HUD0925	192
	LUGICAL BGJAP, EGSTP, PENET	M000925	193
	UATA GRAV/32.16/	M0D0925	194
		MOD1115	10
-	UATA NERN/0/	M001115	10
	CALL LLEAR (PFORCE(1+1), PFORDT(60.5))	N000035	
	CALL LLEAR (PPROP (1.1), PPROP (60.5))	M000923	193
C*		MUDU925	196
C	SUBROUTINE PREVEL CALCULATES UPDATED EXOPELLANT VELOCITY	MUD0925	197
L	LASSUMING PROFELIANT IS FREE TO MOVE TO THE PROFEEDRE VELOCITY	MUD0925	198
C+	TO THE TO THE TO HOVE!	MUD0925	199
	oft 41 Em1, MGY	F0D0925	200
		MUD0925	201
	DO DI GIIRGR	M0D0925	202
C#		MOD0925	203
	THIBTE VALUES SHOULD BE PUT INTO ARKAY PHIRG AND USED HERE	M0D0925	204
L+		MUDA925	205
	PHIAVE=(4,0-PHIDP(1,J)-PHIBP(1+1,J)-PHIBG(1,J)-PHIBG(1+1,J))/2,0	NUD0925	205
	IF(1.NL.1) PHIAVE=PHIAVE/2.0+(4.0-PHIAP(1.J)-PHIBP(1-1.J)	NUD0025	200
	*-PHIBU(1,J)-PHIBU(1-1,J))/4.0	H000925	207
	IF (PHIAVE .NE. U.U) AURAG(I.J)=XURAG()=	1000925	208
	* (2.0-FHIDG(1.J)-FHIRP(1.J))/PHTAV	MUDU925	209
	Phibs(1,J) = Phibiu(1,J)	MUD0925	210
	PH1BP(1,J)=Ph1PTD(1,J)	MUD0925	211
	Ph4E6(1.1)=Ph1m(1.1)APH18P(1.1)	MOD0925	212
C	······································	M0D0925	213
	It (Pisture) is the second of the second s	M0D0925	214
	1 (NOD0925	215
		M0D0925	216
-	CALCOLATE TUTAL PRESSURE GRADIENT	M000925	317

IFA = IFATH(1.4)	N000925	210	
g0 10 10.10.10.15.15.15.15.20.20.20.10.104	H000925	220	
10 JPUX = (PCH(1-1,.1) - PCH(1+1,.1) + 100 Graves	8000925	201	
60 TU 25	A000925	200	
15 UPUX = (PCH(1-1, J) - PCH(1, J))/OX	HUD0925	201	
60 10 25	H000925	204	
2000000000000000000000000000000000000	M000925	298	
25 CONTINUE	+000025	226	
$\frac{1}{2} PP(U) (1, J) = x URAG(1, J) + (DPDx - x DRAG(1, J) + (1, -PH)BG(1, J))$	H000925	207	
PHI((1, d) = Phi((1, d) + 1, d) = Phi((1, d))	HOD0925	204	
	M000925	200	
L THE CURRELT VALUES FOR ARRAY PHIBS MLSI E RECOVERED	MUD0925	230	
C BECAUSE CHANGES ARE GUING TU BE MADE AN EMIRP. PHIAPPPP THAT IS	6000925	230	
	MODOR25	919	
31 CUNIINUE	M000925	232	
100 00 900 J=1.NGR	000025	230	
1=1	000925	275	
ACCLL=0.	HODOD25	200	
ALLIM = D.	H000925	230	
	HODAGOS	210	
		230	
	HODO025	207	
mt 1=0	H000925	240	
AF 2=0	HUDUYZD	241	
SUFFLE = 0.	M000925	242	
	HODOODE	240	
10 FFCE=0	HODODAS	244	
100,0000	MUDDO925	245	
	MUD0925	240	
	- C26000W	247	
	MOD0925	246	
and CONTANIE	M000925	249	
STUDEFEARLOFG_TED/11	MOD0925	250	
	MUD0925	253	
	M001215		
	MUD1215	10	
	MOD1215	11	
	M001205	2	
1 (100 100 10004) REAL 1350010404-0550010000771008-1200	MOD1205		
	M000925	256	
	MOD0925	257	
	M001215	12	
- LALTANEAAAA (DGFLE-FLA(IDGNF(U))	M0D0925	560	
	MOD0925	261	
	M0D0925	565	
	M000925	263	
nDnn = nBnn + 1	MOD1115	21	
	MOD1115	55	
	M0D0925	264	
	M000925	265	
	M000925	266	
	M000925	267	il alter
TO T	M0D0925	268	
	M0D0925	269	
LOINE CULETISTITITITOTUENSTUX/2.44KLAAX	M000925	270	
	M0D0925	271	
HIVE I DET DET DET DE	M000925	272	

1031 FURPATTY SX. CHILME = E14.7, X.23HIGALIER BAG TIES FAILED)	M000925	273
184 TO 42 T = 1 N.C.	M0D0925	274
	MUD0925	275
IF (PHANP(1, 1) IT DED. C. TO L.T.	M000925	276
1 42 CINH (1960) .CT999) 60 TO 1033	MUD0925	277
	MUD0925	278
	M0D0925	279
Law IF (PhiloD(L.)) OF CONSIGNED	M0D0925	280
state = (1 = (1 = (1 = (1 = (1 = (1 = (1 = (MUD0925	281
THE	M0D0925	282
	NUD0925	285
10 10 10 1001	NOD0925	284
	M000925	285
IF INGSE CALLS SHE	MUD0925	286
	MUD0925	287
MUNITERUS BUART GO TO 1045	M0D0925	288
	MOD1115	23
	M001115	24
NE NIL-NE NE. U) 60 TO 1045	M0D1115	25
	M0D0925	289
	M000925	290
	MUD0925	291
	MODOG25	292
	8000925	291
ISTPP=TENDIC(ITUE)+1	N001115	273
IF (INDP .LT. ISTPP) INBP=ISTPP	MODIIIS	20
IF (INBP .GT. IENDE) INEP=IENDE	MODIOG	- 21
IF (BOSTP) NEND=INBP	HOD1111	
VULBG=FLOAT (NENU-IBGNF+1) + AREAAX+DX	HODODOS	17
PHIPP=1WEGHT/(BPUENS+VULBG)	MUUU923	295
LL ICHG=VOLBG/AREAAX	HUDU925	296
LBPELICHG/DX	MUUU925	297
FRAT =LLTCHG/DX-FLUAT(LBP)	<u>6260000</u>	298
	1000925	299
IBUNP IDENTIFIES THE FIRST GRID WITH PENDER AFTER TENTTED	M001111	50
PAD FAILURE. LLI IDENTIFIES THE FIRST FACKED GRID	MODILLL	21
	MUUIIII	22
IF(PHIPP .LT. U.UO1) PHIPP=0.001	M0D0925	303
PHIBP(186NP, U) = 1FRAT+(1PHIPP)	MOD1111	23
1+ (B651P) GO TU 1047	M0D0925	305
IF (NEND .LT. INHP) GO TU 1047	M0D0925	306
BGSTP=.TRUE.	M0D1111	24
WK11L(6,1046)	M0D0925	306
1046 FURMAI(3X+13HEGSTP IS TRUE)	MUD1111	25
60 10 109	MOD1111	26
1047 CONTINUE	hUD0925	309
105 CONTINUE	MQD0925	310
00 1055 1=186NP. NEND	M0D0925	311
1055 FURLEFURCE + PERCECT ANALYAND AND	H0D1111	27
IFIFURLE GT. 350.1 EULCESSO	M000925	313
IF (FURLE ALT, 10.) EDECESSO	M0D0925	314
SMLICEXLTC/ILAVI TC/21441 CC/2144	MUD0925	315
ELT = SEITCHIA (AAHAAUTOPALTCIA)+ALTC(8)	MUD1111	28
VULP=AKF AAV+611	MOD1111	29
LLAPELIT /DV	MOD0925	317
	MODO925	316
HINNPENEND LLED	MUD0925	319
	H001111	20

FRATN=ELT/DX-FLOAT(LLBP)	M0D0925	321
LL1=186NP+1	M000925	322
PHIBP(IBGNP,J)=1WEGHT*FRATN/(VOLP*BrDENS)	M0D0925	323
PH1PF=1_=kEGHT/(VOLP+6PULNS)	M000925	324
14 (PHIPP .L1. 0.001) PHIPP=0.001	HUD1111	31
TOA CONTINUE	NOD0925	326
PHIPID(IBGNP,J)=PHIBP(IBGNP,J)	1000925	327
00 1090 1=LL1.NEND	M0D0925	328
	M000925	329
PHABP(1)=PhIPP	MUD0925	330
1, 40 CONTINUE	M000925	331
	M0D0925	332
	*(ID0925	111
	MOD0925	333
	NUDADO	175
	1000923	335
1190 CONTINUE	MUDUAS	330
1200 641=661	M0D0925	357
	MOD1111	52
GU TU 460	M0D0925	339
	MUD0925	340
1F(LF2 .GT. U .ANU. PHIBU(1,J) .LE+PHIO) GO TO 534	MOD1215	13
1F(PH46(1+1) +Lt2*PH10) 60 TO 200	M0D1215	14
FACPH=1PHIBG(1.J)	M0D0925	343
$IF(FAUPH + T_{1}, 001) FAUPH = 0.$	MOD1017	b
1F(1 + EW. 1) 60 TU 111	MUD1215	15
PFURCE(1-1.J) = (1.45E3/(1.0-PHI0)*(Fn10/PHIBG(I-1.J)-1.0))/DX	MOD1215	16
PEURCE(1+1,J) = (1,45E3/(1,0-PHI0)*(PEI0/PHIBG(1+1,J)-1.0))/DX	N000301	25
$I \in (PEuble (I = 1 ad) all (u = 1 ad) PEORCE (I = 1 ad) = 0.$	MUD1215	18
$F(FFURCE(1A1au)) = (T_{a}, u_{a}) PEORCE(1A1au) = 0.$	M0D1215	19
FORCE = PPROPALAN + PEORCE(T=1,A) = FORCE(TA1,A)	M(D1215	20
TELEVISION AND A DATA FOOD - POWERTAN	NOD1015	31
	HOD1215	22
	HODIADO	0
GRASS-RHUF#FALFR	MUDIOUE	7
	MUUU925	240
1F(GMASS .E4. 0.) 60 10 120	WOD0925	347
	M000925	
LA GET PROPELLANT VELOCITY IN EACH GRID	M0D0925	349
<u>c</u>	M0D0925	350
ACUL = FURCH/GHASS	M0D1215	23
120 ULLUP = ACCL+ULLT+GRAV	M0D0925	352
$UPsDl(I_{I}J) = UPs(I_{I}J) + DELUP$	M0D0925	353
IF(1 .64. 1 .AND. UPBUT(1.J) .LT. U.) UPBUT(1.J) = 0.	MOD0925	354
1F(1 .LC. NGX) GO TO 600	M0D0925	355
150 1=1+1	M000925	356
JO TO 110	M0D0925	357
¢	MUD0925	358
LA IDENTIFY THE FIRST WRIT THAT IS PACKED FULL WITH PROPELLANT	N000925	359
C	MUD0925	360
200 LF1 = 1	MUD0925	361
	MUD0925	362
IISIM=U.	M001017	7
	N001017	
	M001017	Q
EUE CONTAINE	HODIOLI	10
CIPEL INT ACCULATION IN CATE 1	MODIOIT	10
C FIRST OFT ALLELERATION IN ORID 140	HODIOIT	11
	MUD1017	12
IF (FLFM aLTa aU01) FLFM=Va	MU01017	13

	MUD1017	14
	MOD1017	15
1F (GHASS .L4. 0.) 60 10 211	M001017	16
ACCEPTROP(I)J/GMASS	MOD1017	17
211 DELOP-ACCL+DELT+GRAV	MOD1017	18
	MOD1017	19
	MUD1017	20
C NOW TEST FOR SEPARATION OF PACKED GHILS INTO THE GROUPS	MUD1017	21
	MOD1017	22
IF(1 (EQ, (F1) GO 10 212	MUD1017	23
IF (0F001(1.0) .GT. CPP0) GO TO 525	MOD1017	24
212 CONTINUE	MOD1017	25
SURFLE = SUMPLE + PROP(1.J)	MOD1017	26
SURASS = SURASS + KHUPAFCPH	MOD1017	27
	MOD1017	28
IF (SURASS - EQ. 0,) CU TO 231	MOD1017	22
ALLEF = SUMPLE/SUMASS	MOD1017	30
	MODIO17	
	MOD1017	32
	MOD1017	33
UPPO - USUMIN + DELUP	MOD1017	34
	M001017	35
IFILFI .EU. I .AND. UPPU .LT. 0.) 60 10 480	MOD1017	36
60 10 520	MOD1017	37
	MOD1017	38
500 0PDD1(1,0) = 0.	MOD1017	39
IFILFZ .EW. NGX) GU TO 800	MOD1017	40
	MUD0925	417
IF (FRIBG(1,J) .GI. 0.24PHIO) FLAG=0.	M0D1215	24
1F(1 .61, N6X) 60 10 530	MOD0925	418
IF (FRADG(1.J) .GT. 0,24PHIO) GO TC 53.	M001215	25
	M0D0925	420
THE LAST GRID IN THE FIRST GRUUP OF PACKED GRIDS	MOD0925	421
	HOD0925	422
	MOD0925	423
	MOD0925	424
	M0D0925	425
	M0D0925	426
	MOD1115	29
	M000925	428
	M0D0925	429
	MOD0925	430
	MOD1017	41
	MOD1017	42
SSS TOTTCE + PPRUP(1,J)	M0D0925	431
· LIMIL AND CALL VELOCITY TOTAL AND THE AND TH	M000925	432
TIND AVERAGE VELUCITY INCREASE FOR SEPARATED GROUP OF PACKED GRIDS	M0D0925	433
	MOD0925	434
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF	M000925	435
$\frac{\Delta r}{(\Delta r)} + \frac{1}{2} $	MOD1017	43
IVITAGE IVITAS+RHOP+FFPH	MOD1002	11
	MUD0925	438
IF LIVITAS . LV. 0.) 60 TO 541	MUD0925	439
ALLEN = TOTFLE/TOTMAS	MOD0925	440
541 ULLUP=ACCLM#DELT+6KAV	MUD0925	441
	MOD1017	44
	MOD1017	45

		M001017	44
	A = A + 1		40
600	CONTINUE	MODINI	47
	we 10 660	MUD0925	464
1.20	DU 650 1=MF1.MF0	M0D0925	465
1.0.0	UPBUILD. DED.	MUD0925	466
	60 10 ann	MUD0925	467
		M0D1017	48
600		856000M	469
	1F(1 •61, NGA) 60 10 665	MOD0925	470
	IF (PHIDG(I,J) .GT. U.24PHIU) GO TC be	M0D1215	26
	60 10 535	M000925	472
	UU_667 1=MF1,MF2	M000925	473
607	UPBUT(I,J) = UPPU	MOD1115	30
074	CONTINUE	M000925	475
	IFIMEZ .EW. KGX) GU TO BUU	MODA925	476
700	FLAG = 0.	M000925	470
720	60 IO 110	4000825	478
000	CONTINUE	1000725	470
	1+ (PK11) WHITE (6.731) LF1 (LF2.)	MVUUJED	
731	FUNMALI/.8x.4HLF1=15.3x.4HLF2=15.3. 0. 1-13.	M000925	480
and the Re-	IF(PRIT) HRTTF(6.753)MF1.MF2.1	M000925	481
7.55	FURMALL/.88.44651=15.37.44653=15.3. 4 1053=15.3. 4 1053	M0D0925	482
Selic.	1 (m1) Not	M0D0925	483
100	ME TINN	M0D0925	484
nan the second		M000925	485
		MOD0925	486
			P1 04 64
			47 m 44

	SUDRUUTINE PROPEL	PROPEL	2
C+	THIS SUBROUTINE PRODUCES THE ACTUAL MCVEMENT OF PROPELLANT	PROPEL	
L		PROPEL	4
	CUMPON/CHAM/IX, IK, X8, KB, NGX, NGK, IBLUB, IENDB, IPATH(60.5) . AREAG(5).	CHAMTX	2
	ANLACH, ANLAL (60), IGNIT, ONED, DIAMIALIAM2, CISI, DIS2, DIS3, UTS4.	CHANTY	
	> AKEAK (60) . ARE AAX . CHAM1 . CHAM2 . CHAM2 . (IPGAD . APFAUD/ CALL	CHANTY	3
	AKEAH2 UTANHT SELEND SELAFG. IDS1 . 6.2. PADES UPTEN	L'IATIA .	1
	COMMUNICE DESTING THE CONTROL OF THE	CHANIX	5
	COMMINIE ONS CLARK TADE TONY THOTOD AND THESE DRIVES OF THE	PROPEL	
	CONTROL & STOLAT 20 A TEOR TO THE TWO FOR THE TWO GJ, DVAXIS DVAXIT,	EUNS	2
	· DATOR INA GOT WOUT HEP	EGNS	
	COMPONYGRAIN/ XL(63.5), D0(60.5), U1(60.5), FN.	GRAIN	2
	1 XLIDI(60,5), DUIDI(60,5), DITDT(60,5), XL0, D00, D10,	GRAIN	3
	2 ALB(100), DOB(100), DIB(100), UXLB(100), LDOB(100), UDIB(100)	GRAIN	4
	COMMUN/INPUTS/C1.C2.C3.C4.T0.TIGN.QLONS.RHOF.PHI0.TF.CA.RHOD.	INPUTS	2
	S HU, PU, UU, GTRHOP, HW, UN, TIGNBP, GBCUNS, TOTM	INPUTS	3
	LOMMON/SPLINT/WHOLEC, WHOLEB	PROPEL	10
	CUMMON/PRU/LF1+LF2+MF1+MF2+BGJAM+BGSTF+NVSP+IBGNP	M000925	487
	LUMMUN/P/IPRINT, MODCH, MOUGR, PRII, JULELG(35)	M000925	4.8.8
	LUMMUN/646/PHI86(60.5), KHUB6(60.5), D86(60.5), UB6(60.5).	DAG	400
	1 VB6(60.5), UPB(60.5), PCH(60.5), I.C.(60.6),	DAZ	4
	2 DUINIG(60), GHAG(60,5), YDRAG(60,5), DOTNELLO,5), UPPDTLO,5)	DAG	3
	3 PHISTO(60.5), HEORIN(60.5), HEET (.0.5) (BCTO(5), OFDI(60.5),	BAG	4
		SAG	
		BAG	6
		HAG	7
	LOUIDAL IGNIT, ONED, CHAMI, CHAM2, CHAM3, BPIGN	CHAMLOG	2
	LUGICAL WHOLES	PROPEL	13
	LUGICAL BPLEFT	M000925	489
-	LOGICAL PRI1. IDEBUG	M0D0925	490
	LOGICAL BGJAM, BGSTP	M000925	491
C		PHOPEL	14
C	ARRAY UPBOT IS CLEARED IN MAIN AT EACH TIME INTERVAL	PROPEL	15
C	UPUATED VALUES OF POROSITY (FROM REGRES) HERE PUT INTO ARRAY PHILOG	DAOPEI	1.5
C	IN PRPVEL, UPDATED VALUES OF UPB (LACA PRPVEL) HERE PUT INTO	PROPEL	10
C	ARRAY UPB IN FREVEL. UPLATED GRAIN LAENSTORS (FROM RECRES) HERE	PHOPEL	17
C	PUT INTO ARKAYS Y HO. DI TN RECOL	PROFEL	18
C.	the stand of the stand stands.	PROPEL	19
	(10) 10 .101 . NGL	PROPEL	20
		PROPEL	21
		PROPEL	22
	FR4D(I,J) = FR1B(D(I,J))	PROPEL	23
	x L(1,3) = x L(1) L(1,3)	PROPEL	24
	DO(1,3) = DOTDT(1,3)	PROPEL	25
	$\Box I (1, J) = \Box I T (1, J)$	PROPEL	26
16	CONTINUE	PROPEL	27
C.		PROPEL	26
	UU BU J=1+NGK	PROPEL	20
	UO 70 1=1,NGA	PROFEL	27
arrend reduce a se	INCHE = 1	PROPEL	
L	TEST VELOCITY IN ITH GRID TO DETERMIN. INTO HUTCH AD LOCENT	PROPEL	51
	GRID THE PROPERTANT WANTS TO STORT THE THIS WATCH ADDALENT	PROPEL	32
-		PROPEL	33
		PROPEL	34
		PROPEL	35
Secondary and the		PROPEL	36
	IUNE - I + INCKE	PROPEL	37
-10040	$\mathbf{UPI} = \mathbf{UPBUT}(\mathbf{I},\mathbf{J})$	PROPEL	38
	IF (I .EQ. 1) GO TO 15	PROPEL	29
	1F (J .EQ. 2) 60 TO 12	PROPEL	40
	APAN - ALCAL ALS		40

	Mr. damen		
ARINU = AREAL (TTEO)	PROPEL	42	
AhEAFI = AdEAC (I+I)	PROPEL	43	
ABEARL = ARRA((1-1))	PROPEL	44	
ou lu le	PROPEL	45	
12 AREAN = AREAR (1)	PROPEL	46	
AKUNE = ARLAR (1005)	PROPEL	47	
	PROPEL	48	
	PROPEL	49	
A[0, A[0]] = A[0, A[0]] (1 + 1)	PROPEL	50	
50 10 1A	PROPEL	51	
	PROPEL	52	
ABCAR = ABCAR (A)	PROPEL	53	
	PROPEL	54	and course the
	PROPEL	55	
	PROPEL	56	
ADLAFI = ADLAL (1+1)	PROPEL	57	
	PROPEL	58	
IO ANERA = AREAR (1)	PROPEL	59	
ARONE - AREAR (IONE)	PHOPEL	60	
ARIWO = AREAR (IIWO)	PROPEL	61	
AREAPI = AREAR (1+1)	PROPEL	62	
	PHOPEL	63	
CALLULATE THE ADJACENT GRID MASS BALANCE PARAMETERS	PROPEL	60	· · · · · · · · · · · · · · · · · · ·
DMP11 = (1.0 - PH1BG(10NE+J))+DELT+ARUNE+ABS(UPBUT(IONE+J))	PROPEL	65	
UMPI = (1.0 - PHIBG (I,J)) + DELT + AREAA + ABS (UPBDT(I,J))	PROPEL	44	
	PHOPEL	60	
ULTERMINE IF THE AUJACENT GRID LIES ON A BOLNDARY	PUOPEL	b/	
IF (LUNE EE al) 60 TU 20	CHOPEL	60	
IF (FLUAT(INCRE)+UPBUT(ITWO+J)+LE.C.U) DMPI2=(1.0 - PHIBG(ITWO+J))	DEADEL		
1 *ABS(UPBDT(11W0+J))+UELT+ARTWO	DEARCI	70	
C PERFORM MASS BALANCE ON 1+1+INCRE GAL	DROPEL	74	
$PHIII = PHIBG (IGNE_{1J}) + (DMPII - LEFI2 - DPPI) / (ARONE_DX)$	CHOPEL	72	
	LLOPEL	12	
20 PHILL = PHIBG(IONE+J) + 2.0+(DMPIL = LMPI)/ (ARONE+DX)	DHAPEL	74	
C IF THE RESULTING AMOUNT OF PROPELLANT IN THE I+INCRE GRID	MIDAO25	10	
C IS MURE THAN IT CAN HOLD, SET VELOCATLES EQUAL IN THE TWO GRIDS	M000923	492	
SU LONTINUE	1000925	493	
$\underline{IF(ABS(UPI) _LI _ 0.001)UPI=0.0}$	M0002213	21	
UPOUT(1,J) = UFI	FIVDU923	470	
C CALCULATE PAHAMETERS FOR THE ITH GALL MASS FALANCE.	DROPEL	82	
UMP1P1 =0.0	PROFEL	63	
$UMPI = (1 \cdot 0 - PHIBG(I \cdot J)) + (ELT + ARE_UX + ARS (UPHOT(I \cdot J))$	PROPEL	84	
DMPIM1 = 0.0	PRUPEL	85	-
WILL ON MILLER, A LAN	PROPEL	86	
$\frac{1}{1}$	PROPEL		
$x_{LL} = x_{L}(1-1+J)$		88	
X = X = X = X = (1 + 1 + J) X = U = U = U = U = U = U = U = U = U =	PROPEL		
$\begin{array}{rcl} x \cup z & x \cup (1 + 1 + J) \\ x \cup z & x \cup (1 - 1 + J) \\ 0 \cup u &= u \cup (1 + 1 + J) \\ 0 \cup u &= u \cup (1 - 1 + J) \end{array}$	PROPEL	89	
$\begin{array}{rcl} X \cup U &= & X \cup (1 + 1 + J) \\ X \cup U &= & X \cup (1 - 1 + J) \\ U \cup U &= & U \cup (1 + 1 + J) \\ U \cup U &= & U \cup (1 - 1 + J) \\ U \cup U &= & U \cup (1 + 1 + J) \end{array}$	PROPEL PROPEL PROPEL	89 90	
$\begin{array}{rcl} X \cup U &= & X \cup (1 + 1 + J) \\ X \cup U &= & X \cup (1 - 1 + J) \\ U \cup U &= & U \cup (1 + 1 + J) \\ U \cup U &= & U \cup (1 - 1 + J) \\ U \cup U &= & U \cup (1 - 1 + J) \\ U \cup U &= & U \cup (1 - 1 + J) \end{array}$	PROPEL PROPEL PROPEL PROPEL	89 90 91	
$\begin{array}{rcl} AL &=& AL(1+1+0) \\ XLL &=& XL(1-1+0) \\ UOU &=& UO(1+1+0) \\ UUL &=& UO(1-1+0) \\ UIL &=& UI(1+1+0) \\ UIL &=& UI(1-1+0) \\ UFU &=& UFB(1+1+0) \end{array}$	PROPEL PROPEL PROPEL PROPEL PROPEL	89 90 91 92	1000 dagan
$\begin{array}{rcl} AL &=& AL(1+1+J) \\ AL &=& XL(1-1+J) \\ UOU &=& UO(1+1+J) \\ UOL &=& UO(1-1+J) \\ UIL &=& UI(1+1+J) \\ UIL &=& UI(1-1+J) \\ UPU &=& UPB(1+1+J) \\ \end{array}$	PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL	89 90 91 92 93	
$\begin{array}{rcl} AU &=& AU(1+1+1) \\ AU &=& XU(1-1+0) \\ UUU &=& UO(1+1+0) \\ UUU &=& UO(1-1+0) \\ UIU &=& UI(1+1+0) \\ UIU &=& UIU(1-1+0) \\ UFU &=& UFB(1+1+0) \\ UFU &=& UFB(1+1+0) \\ IZ(U=IZU(1+1+0) \end{array}$	PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL FROPEL	89 90 91 92 93 94	49 - 19 - 19 - 19 - 19 - 19 - 19 - 19 -
$\begin{array}{rcl} ALU &= & AL(1+1+J) \\ ALL &= & XL(1-1+J) \\ UOU &= & UO(1+1+J) \\ UOU &= & UO(1-1+J) \\ UOU &= & UI(1+1+J) \\ UIU &= & UI(1-1+J) \\ UPU &= & UPB(1+1+J) \\ UPU &= & UPB(1-1+J) \\ IZCU=IZC(1+1+J) \\ IZCU=IZC(1+1+J) \end{array}$	PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL	89 90 91 92 93 94 95	
ALU = AL(1+1+J) $ALL = XL(1-1+J)$ $JUU = U0(1+1+J)$ $UU = U0(1-1+J)$ $UIU = U1(1+1+J)$ $UFU = UFB(1+1+J)$ $UFU = UFB(1+1+J)$ $IZU=IZU(1+1+J)$ $IZU=IZU(1+1+J)$ $IZU=IZU(1+1+J)$ $UFU = IF THE ITH GRIU LIES ON A HUUNDARY FOR$	PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL	89 90 91 92 93 94 95 95 96	
ALU = AL(1+1+J) ALL = XL(1-1+J) UU = U0(1+1+J) UU = U0(1-1+J) UI = U1(1+1+J) UPU = UFB(1+1+J) UPL = UPB(1-1+J) 12CU=12C(1+1+J) 12CU=12C(1+1+J)<	PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL	89 90 91 92 93 94 95 96 97	
ALU = AL(1+1+J) ALL = XL(1-1+J) UOU = U0(1+1+J) UOL = U0(1-1+J) UIL = U1(1+1+J) UPU = UFB(1+1+J) UPU = UFB(1+1+J) 12CL=12C(1+1+J) 12CL=12C(1+1+J) 12CL=12C(1+1+J) L UE1ERMINE 1F THE ITH GRID LIES ON A BUUNDARY FOR C SPECIAL TREATMENT. IF(1+L+1) GRID	PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL PROPEL	89 90 91 92 93 94 95 95 96 97 98	

	1 #UELI#AREAHI#AUS(UPBUT(1+1,J))	PROPEL	101
	$\frac{1}{1} + \frac{1}{1} + \frac{1}$	PROPEL	102
	· · · · · · · · · · · · · · · · · · ·	PROPEL	103
44.11		PHOPEL	104
40	1 11 0 0 0 1 ANUS UPBUIL2,0] .LT. 0.0) OMFIPI = 2.0+	PROPEL	105
- 04 -	TILD - PHIDD(2:0))=DELI=AREAP(=ABS(GPBD1(2:0))	PROPEL	106
	UPFI - 2.0 + DMPI	PROPEL	107
	THE DELENCE ON THE ITH OKID TO DEJERTINE NEW VALUE	PROPEL	108
6		PROPEL	109
50		MOD1215	28
	AND	MUD1215	29
		MUD1215	30
	$F(I \rightarrow CW, MGA, AMU, MA, CW, I) [MP[H] = 0.$	MOD1215	31
	1641 - FHIDG(1:0) + (UMP1-UMP1P1-UMP1P1)/(AREAX+0X)	MUD1215	32
		PROPEL	111
		PROPEL	
		PROPEL	113
		PROPEL	114
		PROPEL	115
		PROPEL	116
DE	17(7741,01,,73737) 00 10 63	M0D1205	8
	U = BU(1,0) = (U = C) = (1,0) = (1,0) = C = C = C = C = C = C = C = C = C =	PROPEL	118
	· · · · · · · · · · · · · · · · · · ·	PROPEL	119
	$\frac{1}{2} \frac{1}{100} \frac{1}{100} - \frac{1}{100} \frac{1}$	PROPEL	120
	1F(UPDUT(1+1) +L(+ U+) UPBUT(1+1)=6.	M0D0925	496
	1 + (0 + 0 + 1) + (1 + 2) + (1 + 2) = 0	MUD0925	497
	$xL_{1}U(1,J) = (xL(1,J)+(1,0) - PHIBG(1,J))+AREAX+Dx + xLU$	PROPEL	121
-	T TUMPIPI + XLLTUMPIPI - XL(I+J)TUMPI) / ((1.0 - PHII)TAREAXTOX)	PROPEL	122
	IT (WHOLEC) DUTET(1,J) = (DO(1,J)*(1,0-PHIBG(1,J))*AREAX+DX + DOU	PROPEL	123
	1 = 00000000000000000000000000000000000	PROPEL	124
	IF (WHULEC) DITUT(I+J) = (DI(I+J)+(1+0-PHIBG(I+J))+AREAX+DX + DIU	PROPEL	125
	*UNPIP1 + CIL+UMPIM1 - 01(1.0)+CMP1) / ((1.0 - PHII)+AREAX+DA)	PROPEL	126
	1+(12C(1,3)) .L1. G.001) $12C(1,3) = 12CL$	PROPEL	127
	IF(12C(I,J),LT.TIGN) T2C(I,J)=(T2C(I,J)+(1,0-PHIBG(I,J))	PROPEL	125
	*AREAX*DX + 12CU+DMPIP1 + TZCL+DMPIM1	PROPEL	125
	+ -TZC(1,J)+OMPI)/((1,O-PHII)*AREAX+UX)	PROPEL	130
63	CONTINUE	MUD0620	1
	PRIBTU(1,J)=PH11	PROPEL	132
70	CONTINUE	M0D0925	498
L	LOMPARE NEW GRAIN SIZE BASED ON A MASS AVERAGE	PROPEL	134
C	OF EXISTING PROPELLANT WITH THAT ADDEL.	PROPEL	135
80	CONTINUE	M0D0620	2
C	a annana an ann ann ann ann ann ann ann	PROPEL	137
	KLIUKN	PROPEL	138
	ENU	PROPEL	139

6	SUBROUTINE DEAG(URAGX+11.0 +, J)	URAG	2
L	SUBRULINE DRAG CALCULATES CURRENT AND IPDATED VALUES FOR DRAG	DRAG	
	IN THE AXIAL DIRECTION AND UPDATES UNCL AND VIDT.	DHAG	4
L	THE ACTUAL URAG USED IN THE FINITE USE FRENCE CALCULATIONS IS	OHAG	· ··· D ·····
C	AN AVENAGE OF THE CURRENT AND UPDATES MALIES	DRAG	6
L	The second	UNAV	
	COMMON/BARHI PUTCHOD, RHOGITODA, SGITODA UCITODA UDITODA	ORAG	8
n an	1 Philippia Tellippia Philippia Contraction of the second second	BARRL	2
	2 = 0.0011001, 0.001100 , 0.001100 , 0.001000 , 0.00000 , 0.00000 , 0.0000 , 0.0000 , 0.00000 , 0.00000 , 0.00000 , 0.0000	BARKL	3
	A ARASSINGLA ANOMYLOGIA ANNELIGIA ANTICIA ANTICIA ANTICIA ANTICIA ANTICA	BARKL	- 4
	4 14 14 14 14 14 14 14 14 14 14 14 14 14	BARRL	5
	COMMON ANGOT PROTOT DETEND SETAND A CUT DECAME HOR OF	BARRL	6
	S HALL VE AUGUST AT THE TRADE PRIAVE + KICAVE + UBEAVE + UPBAVE +	URAG	10
		DRAG	
		URAG	12
	COMPONY CROLINY VISG FRUTP	MUD1215	. 33
	COMPONYGRAIN/ AL(60.5), D0(60.5), L1(60.5), FN.	GRAIN	2
	1 XLIDI(60.5), DUTUT(60.5), DITUT(60.5), XLO, DOG. DIG.	GRAIN	3
	2 ALB(100), LOB(100), DIB(100), UXLB(100), LDOB(100), UDIB(100)	GRAIN	4
	CONFONZERINYZBEDENS BERAD (60.5) AGEILER BEEREPALXPBP	PRIMY	2
	COMMON/BAG/Ph166(60,5), NHOR6(60,5), PB6(60,5), UB6(60,5),	BAG	2
	A VB6(60.5), UFB(60.5), PCH(60.5), TZC(60.5),	BAG	3
	2 DUTMIG(60), GBAG(60,5), XDRAG(60,5), DOT+B(60,5), UPBDT(60,5),	BAG	4
	3 PHIBTD(60.5), HHUBTD(60.5), HBGTD(60.5), UBGTD(60.5),	BAG	5
	4 V8610(60,5),186(60,5),007M86(60),007MP(60,5),PHIBP(60,5),	HAG	6
-	5 PHIP10(60,5),12R(60),TBP(60,5)	HAG	7
	LOUICAL INB	DRAG	17
-	UAIA 6KAV/32.16/	DRAG	14
C		DHAG	10
- Ç	THE LUGICAL VARIABLE IND IS TRUE IF SUBROUTINE DRAG WAS CALLED	DRAG	20
L	FRUM & UNE-DIMENSIONAL SYSTEM WHERE THERE IS NO RADIAL VELOCITY	ORAG	
k	AND .FALSE. IF CALLED FROM A SYSTEP _FLRE THERE IS RADIAL VELOCITY.	URAG	22
C		DPAG	21
		URAG	23
C	A AND B ARE THE SAME IN BUTH THE AXIAL AND RAUTAL CALCULATIONS.	DRAG.	29
C	THE RUUTINE CALLING DRAG SHOULD HAVE ALREADY CHECKED THAT PHIAVE	DHAG	23
C	15 NOT 1.0.	CHAC.	
	IF (INB) GO TU 5	URAG	21
	UM=(1.5+)U(I,J)+DC(I,J)+XL(I,J))	DRAG	20
	IF (DU(1,J).LT.U1(I.J)) DM=0.844+(Din-10)##2#XL(T.I)	DEAG	27
	IF (UM.LE.O.) DM=1.6-5	DEAC	30
	DR=Um++0.333	DRAG	31
	VFRUP=0.7854+XL(I,J)+(U0(I,J)+D0(I,J)-7.0+D1(T,J)+D1(I,J))	DRAG	32
	1F (VPROP.LT.1.E-5) VPROP=1.E-5	UNAG	33
	V6P=4+189+8PKAD(1,J)+8PKAD(1,J)+8PKAC(1,J)	DRAG	
	IF (V8P .LT.1.E-5) V6P=1.E-5	DRAG	35
	1 ENAP= (PH18P(1,J)-PH186(1,J)/VPRCP	UNAS	36
	1EKM8P=(1.0-PH16P(1.J))/V8P	UNAG	57
	IF ((TERMP+TERMUF).LT.1.F-D) IERMP=1	OPAG	30
	VTS6G=32,16+(DM+TERMP+2,0+BPRAD(I.,)+(FRMAP)/(TFRMATFRMAD)	ORAG	37
	60 TO 7	NRAG	40
	5 UM=1.5+008(I)+U06(1)+XLB(I)	ORAG	41
	1F(DUB(1).LI.D1B(1)) DM=(0.844#(DC(-C.D. +=24)) 8(7))	OHAG	42
	1F(DM+LE.O.) DM=1.E-5	DRAG	45
and the second spectrum state of	UM=UM++0.333	DRAG	44
	VISG6=32.16+DM	URAG	45
7	CONTINUE	URAG	46
		UKAG	47

	IF (PHIAVE -1 T. H. 1) PHIAVE - 1	DRAG	48
	SHAPETO, 7 S	M000925	499
		M001018	4
No.	DEFE EII 5-0017 DOLTOJ LES U. ON, KL(Is) LES 0, 60 TO 9	M001018	5
		MOD1018	6
	16 (SHADE 17 (10(1-0)+(X((1-0)+,5+00(1-0)))	M001016	7
	CONTINUE (LI) ULI SHAPE = 0.1	MUD1018	8
		MODIOIS	9
	CONST = 2.04FRC1F4(1PHIAVE)/(SHAPL4PHIAVE+VTS6)	MUD1215	34
č		DRAG	50
C	A = CONSTADUCTOR	URAG	51
		URAG	52
r	D = 2.0+PHIRHOV(()LLI+GRAV)	DRAG	53
~	THE FOLLOWING CALCULATION AND AND AND AND AND AND AND AND AND AN	DRAG	54
r	THE THE OWING CALCULATIONS INCORPORATE THE SIMULTANEOUS SOLUTIONS	DRAG	55
-	TO CALCULATE THE TOW AND FINITE DIFFERENCE ECUATIONS FOR UBG	DRAG	56
č	CALCULATIONS ARE OPDATED GUANTITY FOR UBG EXFLICITLY.	DRAG	57
	CHECOLATIONS ARE DONE IN THE FOLLOWING SEQUENCE (DRXT AND	DRAG	58
6	CHATCH ARE THE CURRENT AND UPDATED LHAG IN THE AXIAL DIRECTION)	DRAG	59
		DRAG	60
č	2) COPULE UTDI - UPBAVE, (LAU), WHICH IS THE	DRAG	61
	SULUTION OF A QUADRATIC AND THEN GET UTDT	DRAG	62
	S) COMPOLE DRXTUT	DRAG	63
	4) COMPUTE DRAGX	DRAG	64
L	Lifebra a lucate and a	URAG	65
	ICAL DEGAVE - UPBAVE	DRAG	66
	IF (ABS(DIFFU).GT0001)60 TO 10	DRAG	67
		URAG	68
~		DRAG	69
L		DRAG	70
10	DRAT = CONST*RHOAVE+DIFFU+ABS(DIFFU)	ORAG	71
	C = DRXT - B+(UTUT-UPBAVE)	DRAG	72
	$DISCRP = B + B - 4_0 0 + A_{F}C$	DRAG	72
	IF (DISCRM.LT.0.0)GU TO (.4	DRAG	74
	UHU = (-B + SQRT(DISCRM))/(A+A)	DHAG	76
		ORAG	76
6		DRAG	19
20	USCRP = B*B + 4.0*A*C	DRAG	78
	UHU = (U - SGRT(DISCRP))/(A+A)	DRAG	79
		DRAG	20
30	UTDT = UMU + UPBAVE	DRAG	.0.
	URATUI = A+URU+ABS(UML)	DHAG	01
	DRAGX = (DRXT + DRXTDT) + U + 5	DRAG	01
		DRAG	03
		DRAG	0.4
40	1F(INB) RETURN	OPAG	03
		DRAG	01
	UPDATE VIDT. DRAGH DOES NOT NEED TO BE CALCULATED SINCE IT IS	DRAG	0/
	NUT USED EXPLICITLY IN THE FINITE CIFFERENCE EQUATIONS.	DEAG	00
	IF (ADS(VUGAVE) .LE. 0,0001) HETURN	ONAG	67
		CHAG	
	UKKT = CONST+RHOAVE+VBGAVE+ABS(VBGAVE)	DUAG	91
	C = DKKT - B*VTUT	DRAG	92
-	UISCHM = H+B - 4.0+A+C	DRAG	93
	1F(U1SCHM.LT.0.0)60 TU 60	DHAG	- 94
	VTUT = (-B + SURT(DISCRM))/(A+A)	URAG	95
			44

UKAG UKAG DRAG UKAG DRAG DKAG L 98 UISCRP = 8+3 + 4.0+A+C VIUT = (8 - SORT(DISCRP))/(A+A) RETURN -99 100 101 102 103 ι LIVU

• 1

. . . .

(OMMONTARE GARNUT (NUTROUNDEVUSEVE) (V.P.H.T.RHO.U.V.GAN.CP.IPRUP)	GSPROP	2
CONTRACTOR STOR TOR TOR TO TOR OTCH ON THOSE OVAXIS OVAXIS OVAXIS	EONS	2
	LONS	3
	GSPROP	4
C 1PROP = 1 = GIVEN T ARG D	GSPROP	5
	GSPROP	6
	GSPROP	7
	GSPROP	
THE VILLE AND GAN AND THE CALCUMATER ALONG OF THE WARRANG	GSPPOP	9
THE INV THAT ARE NOT STVEN ARE TO BE CALCULATED. ALL OF TO PO HO AND KHO	GSPROP	
C C C C C C C C C C C C C C C C C C C	GSPROP	11
60 10 (10,20,30), 1PS0P	GSPROP	12
	GSPROP	13
THE EQUATIONS FOR IPROPER ARE VALUE ANNUATING GAS VELOCITY TS O	GSPROP	14
10 R = 0.5+R0 + SWRT(0.25+R0+R0 + RRC+0/1)	GSPROP	15
ATERY = T+CVH	GSPROP	16
$CV = (CVO + XTEMP + R/XJUL)/(1.0 - XT_MP)$	GSPROP	17
LP = H/XJUL + CV	GOPROP	18
GAM = CP/CV	GOPROP	19
h = T+CP	CSPROP	20
	CSPROP	21
RETURN	CSPROP	22
	GSPROP	23
20 IF (RHU .LE. 0.) RHO = .00001	N000925	501
K=K0 + KRU+KHU	M000925	502
1F(H .LE. 0.) H=.1	M000925	503
CV = CVU + CVHeH	GSPROP	26
LP = R/XJOL + CV	GSPROP	27
GAR = CP/CV	GSPROP	28
	GSPROP	29
P = AUL + (GAH - 1.0)/GAH + HO + (H - (U+U+V+V)/TWOGJ)	GSPROP	30
IF (P .LE. 0.1) P=0.1	M000925	504
REFURN	GSPROP	31
The least of the second s	GSPROP	32
$0 \downarrow 4 \uparrow (1) \downarrow (1) \downarrow (2) \downarrow (2$	NOD0925	505
	MOD0925	506
	GSPROP	34
K = YIFAD & SAMTYYI MERYYAULI	GSPROP	35
CP = CV + PARIA	GSPROP	36
DAM = CP/CV	GSPROP	37
	GSPROP	38
KHU=P/(K+T)	GSPROP	39
KETUKN	GSPROP	40
ENU	GSPROP	41
	GSPROP	42

	SUBROUTINE AXIS	AVTE	
	IX IS A HERE, IN IS J	AAIS	2
	LUMMUN/AVGUT/RHOTUT, PHIRHO, PHIAVE, NHGAVE, UREAVE, UPBAVE,	ANTS	
	3 UIUI.VBGAVE.VTUT	AA19	
	COMMUN/FAILEU/THICKT, PHOUP, PCOMP, 81, 8, XNTUB, FAIL, MFAIL (60).	MUDAP25	507
	1 INICK(60) PENET. IYECE	+000925	507
	LUMMUN/CHAM/I .J .XB.RB.NGX.NGK. IELDE. IENDB. IPATHIGD.51.AFFAGES1.	CHAMI	300
	3 ARLACH.ARLAL(60).IGNII.UNED.DIAMA.LIAM2.CIS1.DIS2.DIS3.DIS4.	CHAMT	2
	S AREAK (60) + AREAAX + CHAM1 + CHAM2 + CHAM2 + 10PGAP + AREAGP (60) + DAVG -	CHAMT	
	3 AREAH2, DIAMBT, BELENU, HELBEG, IPS1, 1F52, RADFS, BPIGN	CHAMT	5
	LUMMON/CLUCK/TIME + DELT	AXIS	**************************************
-	LUMMON/EONS/UTDA.T2UR.T2UX.THOTOR.UICA.HMB.THOGJ.DVAXIS.DVAXIT.	EONS	2
	S UX.UK.NX.GU.TWCDT.HBP	FONS	
	COMMON/LASCON/RO.RRO.CVQ.CVH	AXIS	9
	CUMMUN/INPUTS/C1.C2.C3.C4.I0.TIGN.GLCAS.RHOF.PHID.TF.CA.RHOD,	M000925	509
8 v	3 HU, PU, UD, GTRHOP, HW UN, TIGNEP, GBCUNS, TOTH	MUD0925	510
	COMMON/HAG/PH1bG(60+5), KHOBG(60+5), BBG(60+5), UBG(60+5),	BAG	2
1 Jun	1 VB6(60,5), UPB(60,5), PCH(60,5), 12C(60,5),	BAG	3
	2 DUTFIG(60), OBAG(60,5), XDRAG(60,5), DOTFB(60,5), UPBDT(60,5),	HAG	4
	3 PH16TD(60,5), RH06TD(60,5), HB61L(60,5), UB6TD(60,5),	BAG	5
	4 VB610(60.5).TB6(60.5).UOTMB6(60).LUTMP(60.5).PHIBP(60.5).	BAG	6
avenue o en	5 PH1P1U(60,5),T2R(60),T8P(60,5)	HAG	7
	LUGICAL IGNIT, ONED, CHAM1, CHAM2, CHAM3, GPIGN	CHAMLOG	2
	LUGACAL PENEI	M000925	511
	UATA GRAV/32.16/	M0D0925	512
-		AXIS	13
		AXIS	14
-	AD-ADTUA	AXIS	15
	CALL GEROOP, NO. BUA & CVO. CHILLEY DE LE LIBERT A DEST	AXIS	16
	HONG (1. IN UNCLASSICATION PLACE, DATE (1. J) HEE (1. J) TOUM,	AXIS	17
	Allister - 16AM - 2047.04	AXIS	18
		AXIS	19
		AXIS	20
		AXIS	_ 21
		AXIS	22
-	IN THIS SUBROUTING PHYLE REPRESENTS IN TOTAL DODOGTTY NOT THAT	AXIS	23
	FURNITY OF THE DROPLIANT.	AXIS	24
	F5 = PhiBo(1,d)	AXIS	25
	A5 = AKEAC(1)	AXIS	26
	92 = KHUB6 ([M1)	ANIS	. 27
	64 = MH0B6(1P1.J)	AXIS	28
	$G_{5} = Kn(H_{6}(1,J))$	ANIS	29
	$L_2 = 62 + 0.06 (1.01 + 0.0)$	AXIS	30
	E4 = U4 + UbG(1P1, J)	AXIS	
	15 = 65+UBG(1.J)	ANTS .	32
	$H2 = PH1BG(IP1,J) + AREAC(IP1) + E_2$	AALD	33
	H4 = PHIHG(IP1,J) + AKEAL(IP1) + E4	STAN	34
	C2 = 62 + HBG(1M1.J)	ATTS	30
_	C4 = 64 + HBG(1P1,J)	AXIS	30
	(5 = 65 + H86(1,J)	AXTS	10
	D2 = BUGGER+ UBG(IM1+U) + L2	AXIS	20
	U4 = DUGGER + UBG(1F1+J) + E4	AXIS	40
	U5 = BUGGER + UHG(1.J) + E5	AXIS	40
		AXIS	40
-	PHIAVE = (PHIBOLIMI+J) + F5 + F5 + PFIBG(IP1+J)+8.25	AXTS	42
	RHUAVE = (62 + 65 + 65 + 64) = 0.25	AVIS	

$U_{10}U_{11} = (UBG(1F1,J) + UBG(1,J) + UBG(1,J) + UBG(1P1,J)) = 0.25$	AXIS	45
UPBAVE = (IP)(1M1) + IPRAT	AXIS	46
L	AXIS	47
PHITUI = PHIBTD(I,J) + PHIPTD(I,J) = 1.0	AXIS	48
REGIDT = (FS+RHOAVE - T20X+(H4 - N/1/45 - FEI TADOTHTG/T1/094475	AXIS	49
3 + DUIMB(1,J) + DUIMP(1,J) / P. ITAT	AXIS	50
PHIKHU = PHITOT*RHUTOT	AXIS	51
ILKM=U.U	AAIA	
IF (DUIMIG(1),LT.0.0) JEKM=1.0	61AA	53
C	ANTS	
$UTUT = (F5*(E_2 + E5 + E5 + E4)*0*20$	ANTS	33
1 - 12UX + (H4 + UBG(1 + 1 + J)) - H2 + UEG(1 + L)	AXIS	87
2 + GRAV+AREAC(1)+PCH(IF1,-)	AXIS	58
3 - GRAV+AREAC(1)+PCH(1#1)/A5	AXIS	59
+ +UELIBDIMIG(I)+UBG(1+J)/UVAXIS+LRP	AXIS	60
4 + UOTHB(1.J)+UFB(1.J))/PF1KHU	AXIS	61
IF (ABS(UTUT).LT. 0.1)UTDT = 0.0	AXIS	62
	AXIS	63
	AXIS	64
IF (PHIAVE) TO GEODERIC WITH A POPLE	AXIS	65
a IT HANDLOLIOUS SYSTEALL URAG (XURAG (100) + FALSE + I.J)	AXIS	66
HIGN = HDG(T.S)	AXIS	67
	AXIS	68
1 + 1 = 0.00001 + 0.000001 + 0.000001 + 0.000001 + 0.000001 + 0.000001 + 0.0000000000	AXIS	69
HHUTUL (ALL) = GARAL FEALCHARD FEAR COMPANY	AXIS	70
1	AXIS	71
	AXIS	72
	AXIS	73
+ -AURAGITA ITALIANI TATAT	AXIS	74
	AXIS	75
L	AXIS	76
KHUBIU(1.J) = KHOTUT	AXIS	77
UBGTO(1,J) = UTOT	AXIS	78
VBGTU(1.J) = VIGT	ALIS	79
KETUKN	ALIS	80
LNU	AX15	81

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	vill discontage i — i dan	na anto i deseto
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and a second and a second a s		n tiden Agen
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		a mig-des globe : Then investigation	
	SUBRUCTINE AXIT	AXIT	2
<u>¥</u>	COMMIN AND TARACTIC DETUND DETANT - COME DECANE DECANE	AXIT	3
	CONTRACT A REAL AND A	AXIT	4
-1010 400 -101 -1	CONTRACTOR AND A VE DO NEY NED TO F TRACK TO THE TO T	AXII	5
	ANTACK ADLACK ON TO THE TOWN OF THE USE TENDES TO THE TOWN OF THE ADLACE OF THE TOWN OF TOWN O	CHAMI	2
	ALACHIMICAC (BUILIGNII ONED DIAMI, CIAM21CISI, DIS2, UIS3, DIS4.	CHAMI	
	a AREAN (60) AREAAX CHAMI CHAM2 CHAM3 IDPGAP AREAGP (60) DAVG	CHAMI	4
	AREAMZIDIANDI BULLENU	CHANI	5
	CUMMON/CLUCK/TIME, DELT	AXIT	7
	COMMUNZEONSZUTUX, T20, T20X, TWOTOR + UILN, HMB, TWOGJ, DVAXIS, DVAXIT,	LUNS	2
	S DA.DR.NX.GJ.TWODI.HEP	EONS	3
	COMMON/GASCON/RU, RRO, CVL, CVH	ANIT	9
	COMMON/BAG/PH186(60+5), KH086(60+5), H86(60+5), UB6(60+5),	BAG	2
	1 VH6(60,5), UPB(60,5), PCH(60,5), 12C(60,5),	BAG	3
	2 DOIMIG(60), UBAG(60,5), XDRAG(60,5), DOTMB(60,5), UPBDT(60,5),	HAG	4
Men oldensi talahili elitekkensi semilari	3 PH1BTD(60,5), RHOBTU(60,5), HBGTU(60,5), UBGTD(60,5),	RAG	5
	4 VB61D(60,5),186(60,5),001M86(60),Cu1MP(60,5),PHIBP(60,5),	BAG	6
-	5 PH1PTU(60,5),TZR(60),TBP(60,5)	RAG	7
	LOUICAL IGNIT. ONED. CHAM1. CHAM2. CHAM3. BPIGN	CHAMLOG	2
	UATA GRAV/32.16/	AXIT	12
С		AXIT	12
AND IN COMPANY AND IN COMPANY	Rb = Nb + DR	AXTT	14
	CALL SPROP (KO, RRO, K, CVO, CVH, CV, PCH(1, J), HAC(1, J), TDUM.	AXTT	15
III monotoni magazia	*	AXIT	16
	BUGGER = (GAM - 1.0)/1=00J	AVIT	17
	1P1 = 1+1	AVIT	10
	141 = 1 -1	AVIT	10
	JP1 = J+1	AA11	19
	F1 = Phing(1, JP1)	AALI	20
	F2 = PHIBG(IM1, J)	AALT	~1
	F4 = MH146(161)	AALI	22
	F5 = Philo(1,1)	AKII	23
	$b1 = F1 = F(0) + (1 + (P_1))$	- 4111	
		AXII	25
and an ana		AALI	
		AXII	27
wheth sign dar 1		AXII	- 28
		AXIT	29
			30
		AXIT	31
		AXII.	32
		AXIT	33
Mighton ar - web a	12 = 624667181.11	AXIT	
		AXIT	35
		AXII	36
	ul = Victoriliu)	AXIT	37
99	HI = HIMEFTAL NEGTATURA 11474 + V06(1, 1, 1, 1, 1, 2, 1, 3, 2, 1, 4, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	AXII.	38
	RH = HUGGERATING(TH), 11442 + VEG[14]+J]##2]#62	AXIT	39
te er t ennetigenske - C-	H5 = H166 LA (164 (1 - 164) + 166 (1/1) + 172) +64	TIXA	40
C .	05 - 0000EK+(0B0(1:0)++2 + VB0(1:0)++21+05	AXIT	41
	1. FNUM - C1 + C0 + C4 + C5	AXIT	42
		AXIT	43
		AXIT	44
	$a_{PP} = r^{2} + r^{2} + r^{2}$	AXIT	45
den er er er er		AXIT	46
		AXIT	47
	UDBAYE = SIGE/SIG6	TIXA	48
	VDGAVE = 0.0	AXIT	49

	UPDA'C = [UPN(I al) + (NP)(I) (NY) (III)		
1	(1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,	AXIT	50
ri - 1840 (basi - 184	PHENDER PRITATION	ANIT	51
	lenmeu.a	AXIT	52
	IF (DUINIG(I), GT. O. UNTERMANA O	AXIT	53
	KHUIUI = (F5+KHUAVF = T2DY=(F4, F2, DTD=)	AXIT	54
	1 - UELTabloTelG(T)/WAYT - CONTRACT	ANIT	55
	PHINHU = PHIIDIARHUTUI	AXIT	56
nite dia dalam nya unterspon	U1U1 = (F5+S16E/DENOM - 120V+C F44. C 104	TIXA	57
	+ (HAV APP(ID) + (ID) + (IP)(IP) + (IP)(IP	AXIT	58
	+ +DELI+DUTMIG(I)+UHG(I)+UHG(I)+UHIG) - GHAV +FCH(IM1+J))	AXIT	59
		AXIT	60
	IF (AUS(UTDT) ALT, 0.1) HIGT OF B(1, J) #UPE(1, J) //PHIRHO	AXIT	61
C*		AXIT	62
64		AXIT	63
	$v_{10} = 0.0$	AXIT	64
	IF (PHIAVE .LT. 0.995) CALL URAGINDRAGING THE FALSE	AXIT	65
C+	CARGE CARGE ACTING ACTING ACTING	AXIT	66
	HIGN = HBG(1+1)	AXIT	67
L#		AXIT	68
	AF (DUIMIG(1) .67. 0.00001) HIGN = Mag(1.2)	AXIT	69
the sector day as as	HBGTU(1.J) = GAM+(F5+(C1+B)+C2+B2+ HAHHACEABE) (DENOM-CAM	AXIT	70
	S =T2DX+(C4+UBG(1P1+J) = C2+UBG(TM1-J) (UENOH+GAH)	AXIT	71
terreturi en sen sen se	• DTUR*C1+VBG(1,JP1)	AXIT	72
	S - DELT+(COTMIG(1)/DVAXITAHILA + OBAC(T IL)	AXIT	73
	* -XUKAG(1.J)*UPB(1.J)*ULLT/788.	AXIT	74
	S + DOTAB(1,J)+HMB - BUGGER+LL, LAUTOT-EMTPHO/CAM - MUTOLO	AXIT	75
6+	CONTRACTOR CONTRACTOR (CONTRACTOR CONTRACTOR CONTR	AXIT	76
	KHUBTU(1+J) = KHGTDT	AXIT	77
	Jbbl(1+J) = Ut(t)	AXIT	78
	VBGTU(1.J) = VTDT	AXIT	79
	IL FURN	AXIT	80
	ENU	AXIT	81 82
	ENU	AXIT	61 62
	ENU	AXIT	<u>61</u> 62
	LNU	AXIT	81 82
	LNU	AXIT	81 82
	LNU	AXIT	<u>81</u> 82
	LNU	AXIT	81 82
	LNU	AXIT	81 82
	LNU	AXIT	81 82
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		AXIT	
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		AXIT	

-	SUBRUUTINE INTER	INTER	2
	CUMMUN/AVGDT/RHOTDT, PHIRHO, PHIAVE, NHCAVE, UBEAVE, UPBAVE,	INTER	3
1	UTUI:VBGAVE.VTDT	INTER	4
-	CUMMUN/CHAM/1 .U .XB. HB. NGX. NGK. IELUE. IENDB. IPATH (60.5) .AREAG(5).	CHAMI	2
3	AKLACH, ARLAC(60), IGNII, ONED, DIAM1, LIAM2, CIS1, DIS2, DIS3, DIS4,	CHAMI	3
*	ALLAR(60), ARE 'AX, CHAM1, CHAM2, CHAM3, 10PGAP, AREAGP(60), DAVG,	CHAMI	. 4
5	AREAH2, DIANB1, BELEND, BELBEC, 1PS1, 1PS2, RADFS, BPIGN	CHAMI	5
-	COMMON/LLOCK/IIME.DELI	INTER	6
	COMMUN/EUNS/LTIX.T2UR.T2UX.TWOTOR.LICK.HMB.TWOGJ.DVAXIS.DVAXIT.	LONS	2
5	UX+UK+KX+GU+INODT+HBP	ENNS	
	LONMON/GASCON/RU.RRG.CVO.LVH	INTER	8
	CUMPUN/BAG/PHIBG(60:5): KHORG(60:5): HBG(60:5): UBG(60:5):	BAG	2
1	VB6(60+5)+ UP8(60+5)+ PCH(60+5)+ 120(60+5)+	BAG	3
	UUINIG(60), UDAG(60,5), XDRAG(60,5), DOTPB(60,5), UPBOT(60,5),	BAG	4
3	PH18T0(60.5), RHOBTD(60.5), HBGTU(60.5), UBGTD(60.5),	BAG	5
4	VBGTD(60,5),TBG(60,5),DOTABG(60),CUTMP(60,5),PHIBP(60,5),	BAG	6
5	PH1PTU(60,5),T2R(60),TBP(60,5)	BAG	7
	LUGICAL IGNIT, UNED, CHAM1 + CHAM2 + CHAMA + EPIGN	CHAMLOG	2
na Angen e	JATA 6RAV/32.16/	INTER	11
C		INTER	12
	RB = KB + DR	INTER	13
	CALL SSPROP(RO.RRO.R.CVO.CVH.CV.PCH(1.J).HAG(1.J).TOUM.	INTER	14
5	RHOBG(1.J).UBG(1.J).VBG(1.J).(A* CP.2)	INTER	15
	HUGGFK = (GAM - 1, 0)/TWOGJ	THTER	16
de e sjondbirterrigdene Gesti		TNTEP	
		TNTER	14
		THIER	19
		THIER	19
ant discipling and		THIER	24
		THEF	21
		INTER	26
		THIER	25
		INTER	24
		INTER	25
		INJER	
		INTER	27
	es = Laskunge(1'nuT)	INTER	28
	G4 = F4 # KHOBG(1P1,J)	INTER	29
		INTER	30
	$E_2 = 62 + 0 BG(1H_{1}, J)$	INTER	31
	L3 = 63 + 0 B G (1, JM1)	INTER	
	E4 = 64 + 086(1P1, J)	INTER	33
	u1 = 61 + VB6(1 + JP1)	INTER	34
	$u_2 = 62 + VBG(1M1, J)$	INTER	35
	$US = 63*YBG(1, JM_1)$	INTER	36
	04 = 64*VBG(1P1,J)	INTER	37
dependent over all the	C1 = 61 + HBG(I, JP1)	INTER	.38
	C2 = 62 + HBG(1M1, J)	INTER	39
	C3 = 63 + HBG(1 + JM1)	INTER	40
	L4 = 64*HBG(1P1,J)	INTER	41
	B1 = BUGGER+(UHG(I.JP1)++2 + VBG(1.JP1)++2)+61	INTER	42
	02 = DUGGER+(UHG(1M1+J)++2 + VBG(1M1+J)++2)+62	INTER	43
	H3 = BUGGER+(UBG(1.JM1)++2 + VPG(1.JM1)++2)+63	INTER	44
	64 = BUGGER+(UBG(1P1+J)++2 + VBG(1P1+J)++2)+64	INTER	45
	URP = (KB + DR)/KB	INTER	46
	URM = (K6 - UK)/K6	INTER	47
L+		INTER	48
And a state of the second seco	(16 MGM - C3 , C3 , C4		

	5106 = 61 + 62 + 63 + 64	INTER	50	
	SIGD = 01 + 02 + 03 + 04	INTER	51	
	Slot = L1 + L2 + L3 + E4	INTER	52	
	PHIAVE = DENOMAU.25	INTER	53	
	RHUAVE = SIGG/DENOM	INTER	54	
	UBGAVE = SIGE/SIGG	INTER	55	
	VBGAVE = SIGU/SIGG	INTER	56	-
	UPBAVE = (UPB(1,JP1) + UPB(IM1,J) + UPB(1,JP1) + UPB(IP1,J)) = 0.25	INTER	57	
	AVPHI = F5/UENUM	INTER	58	» «»«»»»» «»»
C+		INTER	59	
	HAIDI = PHIBTU(I,J)	INTER	60	
	KHUIUI = (F5*KH:OAVE - T2HX*(E4 - E))	INTER	61	
	+ 120F*(DRP+11 + DRM+D3)	TATED	62	nere rede des sussesses
	> + DOTMB(1.J) J/PHITOT	TATER	62	
	PHIKHU = PHIIDT+RHUTHT	TATER	<u> </u>	
	UTUT = (AVPHIASIGE = T2DX+(FLALIG(TPLAN) = F2+)BG(TMLAN)	THIER	64	
	3 + 6kav sech(1P1.d) = .Hay security of	THTER		-
	5 = 120R + (DRP + 1 + Vbb (1 + 101) = CP + 3 + VBC (1 + 101))	THEF	66	
an alpala	\$ + DOTER(T,J)AUPR(1,J) //PHTS-C	THIER		
	$\mathbf{F}(\mathbf{ABS}(\mathbf{U}(\mathbf{D}))) = [\mathbf{T}_{\mathbf{D}}(\mathbf{D}_{\mathbf{D}})] = \mathbf{D}_{\mathbf{D}}(\mathbf{D})$	INTER	68	
1.4		INICK	69	
	VIII = (AVDELESTON	INTER	70	
	S - TONY FRANKLING IN - FOR OUT AND SA	INTER	71	
		INTER	72	
	- TEURIC CREAT CIANDICION + GRAV PPCH(1,0PI))	INTER	73	
	- DENTAL DEVERSION (CONTINUE (CONTINUE))	INTER	74	
		INTER	75	
	1 + (ABS(VIDT) - LT - 0.1) VIDT = 0.0	INTER	76	
	AND THE ADDRESS OF TH	INTER	. 77	
6	ARRAT ADRAG IS CLEARED IN MAIN AT THE BEGINNING OF EACH TIME	INTER	78	
	INTERVAL SO IF SUBROUTINE DRAG IS NOT LALLED, XURAG(I.J) IS 0.0.	INTER	79	
	IF (PHIAVE .LT. 0.999) CALL DRAG(XURAG(I.J), .FALSE.)	INTER	80	
<u>(+</u>		INTER	81	
C4		INTER	82	
	HEGTU(1.J) = GAM+(AVPH1+(C1+B1+C2+E2+L3+B3+C4+B4)/GAM	INTER	83	
	= T2DX + (C4 + UBG(1P1 + J) - C2 + UBG(1M1 + J))	INTER	84	
	5 = T2DR*(DKP*C1*VBG(I,JP1) = UKP*C3*VEG(I,JM1))	INTER	85	
	S - DELT+WEAG(I,J) + DOTMB(I,J)+hMB	INTER	86	
	- BUGGER+(UTUT+UTUT + VTDT+VICI)+PHIRHO/GAM) / PHIRHO	INTER	87	
L#		INTER	AA	
C		TNTER	29	
	KHOBTU(I,J) = KHOTUT	INTER	97	
	(1+J) = 0 T D T	THTEP	91	
and with the second second	vests(1, j) = vict	TATED	71	
	KEIUKN	THIER	76	
	ENU	TATER	72	
		TWIEK	94	

-	SUBRUUTINE BODY	BINDY	2
	LOMMON/AVGOT/RHUTOT. PHIKHO, PHIAVE . RHLAVE . UBEAVE . UPBAVE .	UNDY	3
		HNDY	4
	COMMON/CHAM/I	CHAMI	2
	ANTACHANTAL (40) - 16NI - ONED - DIAM - LIAM2 - LISI - DIS2 - DIS3 - DIS4 -	CHAMI	3
	ARCHERTAR ARCHINE AND CHAMISCHAMISCHAMISCHAMISCHART AREAGPIGAD - DAVES	CHAMI	4
	3 AREAR (BUT ARCHARTCHARTCHARTCHARTCHARTCHARTCHARTCHA	CHAMI	5
	S AREAZ ULARBI PELENDIBLEBEGIARSI (FSETRADIOTE) IN	HADY	6
	COMPONICLOCK/ITELOEL	EUNS	2
	COMMUNYE GNS/DIDX, 12DR, 12DX, WOTOR DILK THEBETWOOD DEALSTOPALT	E CAIS	4
	S DX OK WX GU I WOD I HBP		
	COMMUN/GASCON/RG+RRO+LVO+LVH	BNDT	0
	COMMON/EAG/PHILG(60.5), HOUG(60.5), HEG(60.5), UBG(60.5),	BAU.	
	1 VBG(66,5), UPH(60,5), PCH(60,5), 12C(60,2),	BAG	5
	2 UUINIG(60), GHAG(60,5), XDRAG(60,5), DOTP8(60,5), UPBU (60,5),	UAG	
	3 PHIBID(60,5), KHUBID(60,5), HEGTU(60,5), UBGTD(60,5).	BAG	5
	4 VB610(60,5),T86(60,5),00TM86(60),CUTMP(6C,5),PHIBP(60,5),	BAG	6
	5 PHIPTU(60,5),TZK(60),TBP(60,5)	BAG	7
	LUGICAL IGNIT, UNED, CHAM1, CHAM2, CHAM3, BPIGN	CHAMLOG	5
	UAIA 9KAV/32.16/	BNDY	11
		BNDY	12
*		HNDY	13
		BNDY	14
	CALL ISOPPOPTED ARDARDER (VO. CVH. CV. PCH(1.J) - HBE (I.J) - TDUM.	HNDY	15
		HNDY	16
		BNDY	17
	BUGGER = (GAR + 1.07/10000	HNDY	18
		GNDY	19
	IMI = 1 -1	DIVDY	20
	JM1 = J-1		21
	F2 = PHIBG(IA1.J)	BNUT	21
	F3 = 2H1Be(1+JH1)	BUDI	
	F4 = PH1BG(1F1,J)	BRDT	25
	$F_{2} = Phisc(1,y)$	BNDT	24
	$\sigma_2 = +2 \pm R + OBG(1M1 \cdot J)$	BNDY	25
	$63 = +3 \times RHOBG(1, JM1)$	BNDY	26
	$4 = 1 + 4 + \mathbf{R} + 0 + 0 + 0 + 1 + 0$	BNDY	27
	$L_2 = 62 * 0 B G (1 M_1, J)$	BNDY	28
	$E_3 = 63 \pm 0 BG(1, JM1)$	BNDY	29
	$\mathbf{r} \mathbf{u} = \mathbf{u} \mathbf{u} \mathbf{n} \mathbf{i} \mathbf{k} \mathbf{G} (1 \mathbf{P} 1 \mathbf{u})$	BNDY	30
	$\sqrt{3} = 123 \times 10^{-1}$	BINDY	31
		HNDY	32
	V6 - T571024141/612/	BNDY	33
		BNDY	34
		ANDY	35
	$D_{2} = DUCCERTUDU(17)(17)(17)(17)(27)(27)(27)(27)(27)(27)(27)(27)(27)(2$	ANDY	36
	do = DUGERAL UBCLIGHTITE * VECTIGTITECT	BNDY	37
	U4 = BUGGER+UHG(IF1+J)++2+64	DNDY	3.4
Ç.*		DNDY	10
	UENUM = F2 + F3 + F3 + F4	DNUT	40
	5166 = 62 + 63 + 63 + 64	BNUT	40
	Slut = t2 + t3 + t3 + t4	BNUT	41
	PHIAVE = DENUMAD.25	BNUT	46
	RHUAVE = SIGG/LENCM	BNUT	45
	UBUAVE = SIGE/SIGG	BNDY	. 44
	VEGAVE = U.U	BNDY	45
	UPBAVE = (UPB(1M1.J) + 2.0+UPB(1.JN1) + UPB(1P1.J))+0.25	HNDY	46
1.8		BNDY	47
••	PHILL = PHINTU(I,J)	BNDY	48
	THEYATER CONCERNENCE	BNDY	49

> + DOTAB(1,J))/PHITUT	BNDY	50
PAIKHU 2 PHITUT+NHOTUT	BNDY	51
	BNDY	52
	BNDY	53
i +DTUR+Ei+v66(1.JM1)	HNDT	54
> + DOTNB(I,J) + UPH(I,J))/PHIHLO	BNUT	55
IFI AUS(UTDT) .LT. U.1) UTDT = 0.0	BNOY	50
v1U1=U.U	ANDY	58
	BNDY	59
IFI PHIAVE .LT. U.999) CALL DRAG(XURAU(I.J)FALSE.)	BNDY	60
	BNDY	61
	BNDY	62
T2DY= (C4+1146 (TD1+1) - C0+10 (- M4 (1+14+10) (DENOM+GAM)	BNDY	63
\$ + 0TDK#(1+10) + C2+CBG(1+10)	BNDT	64
S - UELT+UBAG(1.J) + DOTMB(Tell+MB	BNDT	65
5 - BUGGER+UTUT+UTDT+PHIRHO/GAM //PHIRHO	ANDY	67
C+	BNDY	68
<u>(</u>	BNDY	69
KHUBTU(I,J) = KHOTOT	BNDY	70
	UNDY	71
NF 11MN	BNDY	72
	HNDY_	73
	BNDT	74

4	IX IS A HERE. TH IS A	BSURFA	2
		BSURFA	5
	S HILL WEAVE AVE AVE AVE AVE AVE AVE AVE AVE AVE	BSURFA	4
		BSURFA	5
	CONTRACTION AD AD AND AND AND AND AND AND AND AND	CHAMI	ż
	ARCACH, AREAC(60), IGNIT, ONED, DIAN, , LIAM2, CIS1, UIS2, DIS3, DIS4,	CHAMI	3
	3 AREAR (GU), AREAAX, CHAM1, CHAM2, CHAM2, 10PGAP, AREAGP (GU), DAVG.	CHAMT	4
- 210 10 10 10	AREAH2, ULAMUT, ULLENU, ULLBEG, IPS1, AF32, RADES, BPIGN	CHANT	
	LOMMUN/CLUCK/TIME.DELT	USHREA	• • • • • • • • • • • • • • • • • • •
	CUMPUN/LONS/UTUX, T2UK, 12UX, TWOTDR, UTUR, HMB, TWOGJ, DVAXIS, DVAXIT,	CUNS	,
	· UA+UK+NX+GU+TW001+HLP	CONS	· · · · · · · · · · · · · · · · · · ·
	CUMMUN/GACCUN/NG,RNJ,CVU,CVH	FANS	5
	LUMMUN/PAG/PHING(60.5), NHODG(60.5) -BG(60.5) UBC(CO.5)	BSURFA	9
	1 Vab(a0.5), UE0.60.51, BCU(a.5), BC(b0.5), UB0(60.5),	BAG	2
		BAG	3
	5 FHILD (50, 5) BURG (50, 5) + DURAG (50, 5) + DUTPB (60, 5) + UPBDT (60, 5) +	BAG	4
-	UBTD(0(5), HOBID(00,5), HBGID(00,5), UBGTD(60,5),	BAG	5
	4 0000000.5), 18000.5), DUTMBG(60), CUTMP(60,5), PHIBP(60,5),	BAG	6
	5 FAIF 10(60,5),12k(60),18P(60,5)	BAG	7
	LUGICAL IGNIT.ONED.CHAM1.CHAM2.CHAM3.UPIGN	CHAMI OG	2
		DSUREA	12
	KB=0.0	USIDEA	
	XB = Xb + DX	DSURFA	15
С		BOURFA	14
	CALL USPROP(RO.KRO.K.CVA.CVA.CV.PCH. 1. 1) HOG (T. 1) TOUR	BSURFA	15
	S KIONG(1,s,), bbG(1,s)) sygG(1, 1), as (0, 0)	BSURFA	16
	BUGGER = (GAM - 1, GAT) THO(GAT) GAT(FT2)	HSURFA	17
		BSURFA	18
		BSURFA	19
		BSURFA	20
	$F_{1} = F_{1}BB(1+JF_{1})$	ASURFA	21
	F4 = FHIBG(IP1,J) + AHEAC(IP1)	HSURFA	22
	F5 = PHIBG(1,J) + AHEAC(1)	SURFA	21
	G1 = F1 * RH(3B(F1, JP1))	DSUPEA	20
	64 = F4+RhJB6(1P1.J)	LEUREA	
-	L4 = 04+066(1P1+J)	DOURFA	25
	J = J + V + J + (1, J + 1)	BOURFA	_26
	C1 = 61*HBG(1,JP1)	BSURFA	27
	$C4 = 54 \pm HBG(1P1,)$	BSURFA	28
	B1 = BUGGERATING (T. B1) WA2 + VBC/T - C. MADANCA	BSURFA	29
		BSURFA	30
(±		SURFA	31
	16 10/16 - 23 . 24	BSURFA	32
		BSURFA	33
	THANK = UENUTY (AREAC(1) + AREAC(1P1))	BSURFA	34
	ANUAVE = (G1+G4)/DENUM	BSURFA	35
	UPOAVE = 0,0	ASURFA	36
	VBGAVE = 0.0	RSURFA	27
	UPBAVE = (UPB(1,JP1) + UPB(IP1,J)) + u = 1	RSUREA	36
6+		DECHDEA	20
	PHITUI = PHIBTU(I,J)	BOURPA	39
	KHUTUI = (FS+RHOAVE - UTUX+E4 - THOIDAHDI	DOURPA	40
-	5 + UELT+UOTHIG(1)/UVAXIS + EULHOUTANEAGEACTTA	BOURFA	41
	\$ (PH10T+aftAC(1))	BOURFA	42
	PHIKHU = PHITOTARHOTOTARHEAC(T)	BSURFA	43
L		BSURFA	44
-	UTUL = 0.6	BSURFA	45
		HSURFA	46
r •		BSURFA	47
_		HSURFA	48
し し デキキキ	- IF (FRIANCE .LI. 0.999) CALL DRAG(XOKLUL).J). FALSE.)	DCHUEA	1.5

1.0		BSURFA 50
ι. +	HGN = HBG(I,1)	HSURFA 51
and the specific strength of the state	IF (UUIMIG(I) .GT. U.00001) HIGN = hg6(1.2)	BSURFA 52
C	THE THE PARTY CONTRACTOR OF A CHOMADAMA	BSURFA 53
	$\frac{10010(1,J) = GAP*(F5*(C1+B1+C4+P4)/(JENUPSEAP)}{10010(1,J) = TWOTOWAR, eHRG(1,JP1)}$	HSURFA 55
~ · · · ·	+ DELT+(DOTMIG(I)/DVAXIS+FLUN - QBAG(I,J))	USURFA 56
3	+ DUTHE(1,J)+HMB+AREAC(1))/++AHO	BSUREA 57
L*		BSURFA 58
		BSURFA 59
	$(H_0 B_1 D_1 (1, J) = (H_0 T_0 T_1)$	BOURFA 60
des		BSURFA 62
	KL TUKN	BSURFA 63
	ENU	BSURFA 64
ala	12 420 (0.1 - 0.1	en de la contra de la
		олал на самарат ондерфи и миналери и област — на област
		a a mage a considerate per la constance e ma
a - 1001	a the man of an entry and an a set of a	
the test of column day		na procina - Andrea Anglanda da A antida ana da ang a cana a cana
		a be pill deal adaptions and the two a
and a star of the star	ւնը, սորիսու է ները էն հետը են հետը են են կողջեցիցիները հատկանաներ հետ է հետը հետը հետը հետը է հետը ետը է հետը է հետը ետը է հետը է հետը ետը ետը ետը ետը ետը ետը ետը	
• • ••• ••	na a wandoor a dab ay - a a wandoo ay daba daraan ay ay faa ka ka kaadada dab	n maar oo anaa a an aagan aanaantiga ayyaa aha oo ah ah ah ah ah ah ah
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- Yahra am		on programme and
	an a succession of a succession of the successio	and in take of the state of the

	SUBRUUTINE USURFT	BSURF T	2	
C	1X IS I HERE, IN IS J	BSURFT	3	
	CUMMUN/AVGUT/RHU1D1+PHIRHO+PHIAVE+RHC+VE+UBGAVE+UPBAVE+	BSURFT	4	
	S UTULIVICAVE, VTUT	HSURFT	*1	
	LUMMUN/LHAM/1 .J .Xb. NB. NGK. NGK. IBLUE. IENDB. IPATH(60.5) . AREAG(5).	CHANT	2	
	AREACH, AREAL (CO), IGNII, UNED, DIAMA, LIAM2. EISI. UIS2. UISS. UIS4.	CHAMT	4	
	AREAK (60) . AREAAX . CHAMI . CHAM2 . CHAM IDEGAD . ARE AGE (60) . DAVG.	A SLAMT	4	
	S AREAH2. UIAMBI. MILENU. BELMEG. 1951. 15 .2. HADES. HPTGN	CHANT		
	(OMEON/ILOCK/ILOCA/ILOCA/ILOCA/ICA/ICA/ICA/ICA/ICA/ICA/ICA/ICA/ICA/I	UNPER T	P	
	LIMPLINTEANSTITUTE LINE TOUR TWOTEN LINE HAD THOSE DUAYTE DUAYTE	BONKET	1	
	A THE AND A TO THE ATTENT TO THE THE THE THE THE AND	LANS	2	
		EGNS	3	
•		BSURFT	9	
	COMMON DAD/PRIBC(60+5); KNU.0(60+5), MBC(60+5); UBG(60+5);	HAG	2	
	1 VO(E0(5), OP(E015), PCH(E015), [20(60,1),	BAG	3	
	2 DOTHIGTED), CEASTED, 5), XDRAG(60,5), DOTPB(60,5), UPBDT(60,5),	BAG	4	
	5 PHIBID(60,5), KHOBID(60,5), HBGID(60,5), UBGID(60,5),	BAG	5	· · · · · · · · · · · · · · · · · · ·
	4 VBOID(60,5), THE(E0,5), DOTMB6(60), LUTMP(60,5), PHIRP(60,5),	BAG	6	
	5 PhIP10(60,5),T2F(60),TBP(60,5)	BAG	7	
	LOUICAL IGNIT, ONED, CHAMI, CHAM2, CHAM3, OPIGN	CHAMLOG	2	
b		BSURFT	12	
	RUERDRUR	ASURFT	13	
6		ASURFT	14	
	LALL SPROP(RO.RRO.R.CVO.CVH.CV.PCH.I.J.HBE(I.J).TOUM.	HSURFT	15	factors : " trip conting of and
	3 RHQUG(1,J),UUG(1,J),VRG(1,J),LAF+CP+2)	HSURFT	16	
	BUGGER = $(GAP - 1.0)/TWGGJ$	ASURET	17	
	1P1 = 1 + 1	ASURET	1.0	
	JP1 = J+1	USHPET	10	Contraction Contraction Contraction
	F1 = PhiBG(1,JP1)	SUPET	17	
	F4 = Fh16b(1F1)	HOURF I	20	
	$F_{5} = Phiag(1, j)$	BOURFI	21	
	$(x) = b \frac{1}{2} b \frac{1}{2$	BOURFI	22	
		BSURFT	23	
		HSUKEI	24	
		HSURF I	25	
••		BSUKFT	26	
		BSURFT	27	
		BSURFT	28	et sin engenierinsigning oranografia.
	D1 - DUGGER*(UBG(1+JP1)**2 + VBG(1+JP1)**2)*G1	BSURFT	29	
	C4 = DUGGER#(UB6)1P2,J)##2 + VB6(1P1,J)##2)#64	HSURFT	30	
	DENOM = FI + F4	BSURFT	31	
	PHIAVE = DENOM+0.5	BSURFT	. 32	
	RHOAVE = (G1+G4)/DENOR	BSURFT	33	
	OBGAVE = 0.0	BSURFT	34	
	v B G A v E = 0.0	HSURFT	35	-
	UPBAVE = (UPB(I,JFI) + UPB(IPI,J)) + UPB(IPI,J)	HSURFT	36	
L#		HSURFT	37	
	$PHIIJI = PHIBTU(I_{1}J)$	HSURFT	38	
	RHUTUT = (F5+RHUAVE - UTDX+E4 - CTUR+D1	HSURFT	39	· ····································
Nam dar som an appaper ogs	S - DELI+UUTNIG(1)/UVAXIT + CU[MU(I+J))/PHITDT	BSURFT	40	
	PHIRHU = PHITDT+RHOTDT	HSURFT	41	a at the contractional second
		BSURFT	42	
	viui = 0.0	HSURFT	43	
C+		ASURFT	44	
L***	**1F(PHIAVE .LI. U.999) CALL DRAG(XCHuG(I.J).FALSE.)	ASURFT	45	• •
C.*		HSURET	45	
	hIoN = HEG(1,1)	HSURET	40	
	1 + (10) + 16(1) + 67 + 0 + 00001) + 16N = + -6(1-2)	USURET	41	
L		OSUNP T	40	
-		Gant I	49	

HBGTU(1.J) = GAM#(F5*(C1+B1+C4+B4)/(LENOM*EAM) - UTDX*C4*UBG(1P1.J) - DTDR*C1*VBG(1.JP1) - UEL1*(DOTMIG(1)/UVAXIT*HIGA + OBAG(1.J)) + UOTMB(1.J)*HMB)/PHIKHO BSURFT 50 BSURFT 51 5 BSURFT 3 BSURFT 55 1+ 1 SURFT BSURFT 54 55. KHUBIU(1,J) = RHUTUT UBGID(1.J) = UTOT VHOTU(1.J) = VTDT BSURFT 57 HSURFT 58 RETURN BSURFT 59 LNU 60 130

-	All of the second s	emailer e		
	SUBRUVIINE ASURFI	BSURFI	2	
	COMMONYAVODIZANOTTI PRIANO PRIAVE «KNCAVE «UBEAVE » UPBAVE »	BSURFI	3	
	S UTDI VHGAVE VTDI	HSURFI	4	
	COMMON/CHAM/1 .J .XB.KD.NGX.NGR.IELGE, 1ENDB. IPATH(60.5) .AREAG(5).	CHAMI	2	-
	AREACH, AREAC(60), IGNII, UNED, DIAMI, LIAM2, CISI, UIS2, DIS3, UIS4,	CHAMI	3	
	S AREAR (60) + AREAA + CHAM1 + CHAM2 + CHAM2 + 10PGAP + AREAGP (60) + DAVG +	CHAMI	4	
	ARLANZ, UIANOT, BELENU, BELBEG, IPS1, IPS2, RADES, BPIGN	CHAMT		Ann agus subgr
	CUMMUN/CLUCK/TINE UELT	USURFT	6	
	LUMMUN/LUNS/LTUX, 1208, 120X, TWOTOR LN, HMB. TWOGJ. DVAXIS. DVAXIS.	FONS	······································	
	1 UX+UK+NX+60+TWODT+MEP	CONS	-	
	LUMP.UN/GASCON/RD.KRO.LVD.CVH	LUNG		
	COMP.UN/DAG/PhibG(60.5), MMORG(60.5), pRG(60.5), URG(40.5),	DOUNP A	0	
	1 Vov160.51. 000160.51. P(4(60.5), 1/0(60.5)	DAG	· · ·	
	2 LUMIGIGHIL GHAGIGUSIL YDRAGIGUGU CA DOTHRIGO SA UDROTICO SA	DAG	3	
	A PHISTUGASS, HEIGTOGAS, HEAT OF DETAILS AND	LAD		
		BAG	5	
		BAG	6	
		BAG	7	
w 401 M	LOSICAL IGNII, UNED, CHAMI (CHAM2, CHAM3, UPI6N	CHAMLOG	2	_
	UATA GRAV/32.16/	BSURFI	11	
<u> </u>		BSURFI	12	
	KB=KB+DK	BSURFI	13	
6.		HSURFI	14	
	CALL GSPROP(K0+RK0+K+CV0+CV++CV+PCH(1+J)+HBE(I+J)+TDUM+	6SURF I	15	
	3 KHOBG(1,J), UBG(1,J), VBG(1,J), LAR, (CP,2)	HSURFI	16	
	dUGEK = (GAM - 1.0)/TWOGJ	ASURFI	17	
	1P1 = 1 + 1	ASURET	1.6	
	JP1 = J+1	USUPET	10	
	JM1 = J-1	LEURET	17	
	f1 = PHIBG(I.JP1)	BOUNFI	20	
	$F_3 = MhlBG(1, Jm1)$	BOURPI	21	
	F4 = PHIBG(TF1)	BOURFI	- 22	-
		BSURFI	23	
		BSURFI		
		BSURFI	25	
		BSURFI	_26	-
		BSURFI	27	
11-100 March 1	24 = 04#UBG(1P1,J)	BSURFI	26	
	D1 = G1 + vBG(1, JP1)	BSURFI	29	
	$U_3 = G_3 * VBG(1, JM_1)$	ASURFI	30	
	$U4 = 64 \pm VBG(1P1,J)$	BSURFI	31	
- transpoler + spin	c1 = b1 + HBG(1 + JP1)	HSURF1	32	
	$C_3 = U_3 + HBG(I_1 J_{11})$	BSURFI	33	en de bleirenderige
	L4 = 64 + HBG(IP1, J)	ASURFI	34	
	61 = BUGGER*(UBG(1.JP1)**2 + VBG(1.JP1)**2)461	HSURFT	35	
	3 = 5066ER+(066(1,0M1)++2 + V86(1.001)++2)+63	HSURE T	34	
	04 = BUGGER+(UBG(121,J)++2 + VEG(1-1.J)++2)+64	USURET	27	
	UKP = (RB + DK)/RE	GOURP I	31	
	DRM = (RB - DK)/KB	COURT I		
C#		BOURF I	39	
	UENUM = F1 + F3 + F4 + F4	BOURF I	40	-
		BSURFI	41	
		BSURFI	42	
		BSURFI	43	
the second		BSURFI	44	
		BSURFI	45	
		BSURFI	46	
	ABAAR = 2100/2100	BSURFI	47	
	UPBAVE = (UPB(I,JP1) + UPB(I,JM1) + 2,0+UPB(IP1,J))+0.25	BSURFI	48	
C.		HSURFT	49	

	PHITUI = PHIBTU(I,J)	BSURFI	50
	KHUTUI = (F5+KHOAVE - UIDX+E4 - T2UK+(URP+C1 - URM+D3)	ASURFI	51
	\$ + UUTRB(I,J))/PHITOT	ASURFI	52
	PHIKHU = PHITDI + RHOTDT	ASURFI	53
L+		ASURFI	64
	101 = 0.0	ASURFI	55
	VTU1 = (F5+S160/DENCH - UTDX+E4+V8+(1+1+4)	ASURFI	56
	5 - T2DR+(DKP+(U1+VBG(I,JP1) + GRAV +PCH(I,JP1))	HSURFI	57
	$3 \qquad - DHM*(D3*VBG(I,JP1) + GRAV + PCH(I,JM1))$	HSURFI	58
	\$ + UELT+GKAV+PCH(1+J)/PB) / PHINHO	ASURFI	B.Q.
	1F(AbS(VTU1) .LT. 0.1) VTUT = 0.0	LSURF I	60
C+		BSURFI	61
6	ARKAY XURAG IS LLEARED IN MAIN AT THE DEGINNING OF EACH TIME	BSURFI	62
L	INTERVAL SU IF SUBROUTINE DRAG IS NOT LALLED. XURAG(I.J) IS 0.0.	BSURFI	63
L#+#	++1F(PHIAVE .LT. 0.999) CALL DRAG(XCKAG(I,J), FALSE.)	BSURFI	64
C#		HSURFI	65
	HB610(1+J) = GAM+(FE+(C1+B1+C3+B3+L4+C4+B4+B4)/(DENOM+GAM)	HSURFI	66
	• UTDX+C4+UBG(IP1,J)	BSURFI	67
	3 - T2UH*(URP*C1*VBG(I+JP1) - UKF*C3*VBE(I+JM1))	BSURFI	68
	3 - DELT+OBAG(I.J) + DOTMB(I.J)+nMB	BSURFI	69
	3 - BUGGER+VTUT+VIDT+PHIRHC/LAr J/PHIRHO	BSURFI	70
C+		BSURFI	71
C		BSURFI	72
	$RHUBTU(1,\mathbf{J}) = RHOTUT$	BSURFI	73
	UEGID(1,J) = UTCT	BSURFI	74
	VBGTU(1+J) = VTDT	BSURFI	75
	HE TUKN	BSURFI	76
	L CIU	BSURFI	77
-		 A set of the set of	· · · · · · · · · · · · · · · · · · ·
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and and tripping of managements of	SUDAUTINE DOUNT D	HSURFA	2
	CUMMUN/AVGUI/KHOTCI +EMIKHU +PHIAVE + HALAVE + UBGAVE + UPBAVE +	BSURFA	а. Х
	S UILI-VBGAVE-VTUT	HSURER	4
	COMMUNICHAM/1 10 .XB. HO. NGX. NGK. IELGE. IENDB. IPATHIGD. 51. AREAGIN.	CHANT	3
	3 AKEALH.AKEAL(60).IGNII.ONEU.DIAM. JAM2.FISI.DIS2.DIS.DIS4.	CHART	· · ·· · · · · · · · · · · · · · · · ·
	AKLAN (6U) . AKEAAX . CHAM1 . CHAM2 . CHAM2 . JOPGAP . ARE AGP (60) . DAVG.	CHANT	5
	AREAN, CLAMBT, HELENL, BELSEG, IPS1 (ES2, RADES HETCH	COARL	
	COMMON/CLUCK/TIME - DELT	CHAHI	5
	COMPONIE ONS ALLINY A 1200 TODY TO OTOM TO THE THOSE OWNERS	BSURFB	6
	S US UN ANA DE LOOT AND THE ATTENT OF DECEMPENTING OF DVAXISEDVAXISE	EQNS	2
		EQNS	3
		BSURFB	8
rite weigh	Common CACYFRIDE(60,5), RHOE (60,5), NBG(60,5), UBG(60,5),	BAG	2
	1 VIOLEU(5), CP8(60,5), PCH(60,5), [4C(60,#),	BAG	3
	2 UDIMIGIBULS GUAGIEU.S), XURAGIEU.S., DOIMBIGO.S), UPBDIGO.S),	BAG	4
	3 PHIBID(60.5), RHOBID(60.5), HBGID(60.5), UBGID(60.5),	BAG	5
	4 V6610(60,5),106(60,5),00TMBG(60),00TMP(60,5),PHIBP(60,5),	BAG	6
	5 PHIPTU(60+5)+TZR(60)+TBP(60+5)	HAG	7
	LUGICAL IGNIT, UNED, CHAM1, CHAM2, CHAM2, HPIGN	CHAMI OG	
6		I CLIDED	
	Kb=Kb+UK	BOUNFD	11
C.		HAURPD	
	CALL SPROPING REGERECTION CONTRACTOR	BOURFB	15
an-sinelysine size	\$ RECEGUIANDOGUIANDEGUIANDOGUIAND	BSURFA	
		BSURFB	15
		BSURFB	16
		USURFB	17
		BSURFB	18
	$r_3 = r_{HBG}(1, J_{H1})$	BSURFB	19
	F4 = Fh1b(1F1iJ)	BSURFB	20
	F5 = PHIBG(I+J)	BSURFB	21
-	-53 = F3 = F3 = RHOB(1, JR1)	ASURFA	22
	$64 = 14 6 \mathbf{R} \mathbf{H} 6 6 6 1 1 1 1 1$	ASUREA	22
	L4 = b4 + ubg(LP1 + d)	DSURER	24
	U3 = 634V66(1.0M1)	0511929	
	C3 = C3 + HDG(1, JM1)	DOUNFO	25
	L4 = 64 * HBG(IP1)	BAUNPO	
	BS = BUGGERAVAG(IP.) SANDAGE	BSURFB	27
	14 = BUGGERA(1866)P1.JIA2 A VBC/TU., 1942 ACC	BANKER	28
C.a.		BSURFB	29
	DENIM TELLE	ASUREB	30
		BSURFB	31
- Indensity as -		BSURFB	32
	RUAVE = (63+64)/DEHUM	BSURFB	33
	OBGAVE = 0.0	BSURFB	34
	OPBAVE = (OPB(1,JMI) + OPB(IP1,J)) + U+3	BSURFB	35
	$VBGAVE = 0_0$	ASUREB	36
C#		BSURFA	87
	$-\mathbf{H}\mathbf{I}\mathbf{I}\mathbf{I}\mathbf{I} = -\mathbf{H}\mathbf{I}\mathbf{U}\mathbf{I}\mathbf{I}\mathbf{I}\mathbf{I}\mathbf{I}$	DSUREA	30
	RHUIUI = (F5+RHUAVE - DIDX+E4 + C1.N+U3	DOUNT D	30
	\$ + DOTMB(1,J))/PHITDT	DOUNFO	37
	PHIKHU = PHITDT+RHOTUT	OSURPO	40
		BOURFD	41
		BOURFB	42
6.4		BSUKFB	43
L####	ATTE (PHIAVE	BSURFB	44
1.4	CALL CONTRACTOR (1.0) + FALSE)	BSURFB	45
* 1043 at 108 4	HHISTILL IS - CANAL SEALDARD HISTORY	BSURFB	46
		BSURFB	47
	$- \frac{10A+U+0EG(I+1+J)}{10} + \frac{010R+U+0BG(I+M1)}{10}$	BSURFB	48
	- ULLI+GUAG(I+J) + DOTMB(I+J++MB)/PHIRHO	BSURFB	49

BSURFB BSURFB BSURFB BSURFB BSURFB BSURFB ... 50 51 52 53 54 55 55 KHUBTU(1,J) = KHOTUT UBGTU(1,J) = UTUT VBGTU(1,J) = VTUT KETUKN END 134

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The second

	SUBRUUTINE FSUNFA	FSURFA	2	be der i an
	COMMUNZAVGUIZRHOTDISPHIAMOSPHIAVESAAVESUBCAVESUPBAVES	FSURFA	3	
	S UTDITOHGAVE.VTCT	FSURFA	4	
	CUMPON/CHAM/I .J .XB, KD, NGX, NGK, IELGE, IENDB, IPATH(60,5) .AREAG(5).	CHAMI	2	
	AREACH + AREAL (60) + IGN1 + ONED + DIAM1 + LIAM2 • CIS1 • DIS2 • DIS3 • DIS4 •	CHAMI	3	
	> AREAR (60) + AREAAX + CHAM1 + CHAM2 + CHAM3 + 10PGAP + AREAGP (60) + DAVG +	CHAMI	4	
	> AREAH2. UIAMBI. BELENU, BELBEG. IPS1, 1P32, RADES. BPIGN	CHAMI	5	-
	COMMON/CLUCK/TINE.UELT	FSURFA	6	
	COMMUN/EGNS/LTUX.12CR.12UX.TWOTOR.DIER.HMB.THOGJ.DVAXIS.DVAXIS.	LONS	2	- 100+ H
	3 UX-UN-NX-GU-TWOUT-HAP	A CIAIS		
	COMMON/GASCON/NO. BRO. CVO. CVH	CEURCA		
	LUMMUN/SEG/PHING(60.5), HHOPG(60.5), SEG(60.5), SEC(60.5)	FOUNTA		
an a an -	White a start white a start white a start a st	DAG	2	
	= 10101(1607) + 0.000(0) + 0.000(0) + 1000(0) + 0.000(0) + 0.0	BAG	3	
		BAG	4	
		BAG	5	
	VOID(60,5), 100(60,5), 001080(60), CUTMP(60,5), PHIBP(60,5),	BAG	6	
	5 PHIPID(60:5) (12R(60), 18P(60:5)	BAG	7	
	LOGICAL IGNIT, CNED, CHAM1, CHAM2, CHAP3, BPIGN	CHAMLOG	2	
C		FSURFA	11	
	KB=0.0	FSURFA	12	
	4U=XU+UX	FSURFA	13	
· · ·		FSURFA	14	
	CALL SPROP(RO+RRO+R+LVO+CV++CV+PCH(1+J)+HBG(1+J)+TOUM+	ESUREA	1 4 T	
	\$ KHODG(1.J).UBG(1.J).VBG(1.J).(AF (P.2)	ESUREA	16	
	BUGGER = (GAR + 1.0)/Tw05J	COUREA	19	
	161 = 1 - 1	FOURFA	17	
	(H) = (H)	P.SURPA	18	
		FSURFA	19	
		FSURFA	20	
	$r_2 = rniBG(in1+J) + AnLAL(in1)$	FSURFA	21	
140	FD = FHIBG(1,J) + AREAC(I)	FSURFA	22	
	$01 = \mathbf{F1} + \mathbf{R} + 0 $	FSURFA	23	
	$u^2 = F_{2} = F_{2} = F_{1} $	FSURFA	24	
	$L2 = 62 \pm 0 BG(1M1,J)$	FSURFA	25	
	o1 = 61 + VBG(1, JP1)	ESURFA	26	
	$c1 = b1 \neq HBG(1, JP1)$	ESUREA	27	* = 0.4+
	$C_2 = G_{2*HBG(1M1,J)}$	FSURFA	24	
Design of the second	B1 = BUGGER + (UBG(1, JP1) + 2 + VBG(1, JP) + 2) + G1	ESHPEA	20	-
	d2 = bubgERaubC(1M) + 11 = 2 = 62	FOURFA	27	
(*		PSURPA	30	
	114 NOW - 61 2 65	FSURFA	31	
		FSURFA	32	
	PHANE - DENOR/(AREAL(I) + AREAL(IMI))	FSURFA	33	
	THORACE = (GI+G2)/DENOM	FSURFA	34	AP-101 10
	UDVAVE = 0.0	FSURFA	35	
-	VBGAVE = 0,0	FSURFA	36	
	$UPBAVE = (UPB(1_{\bullet}JP1) + UPB(IM1_{\bullet}J)) * U_{\bullet::}$	FSURFA	37	
C*		FSURFA	38	
	PHITOT = PHIETO(1.J)	FSURFA	39	ar 100-14
and the second states of	KHUIUI = (F5+KHUAVE + DIDX+E2 - TwuTuR+D1	FSURFA	44	
	\$ + UELI&UUTAIG(1)/UVAXIS + CUTAL(1.J)*AREAC(1))/	FSURFA	41	
	S (PHITDT+AREAC(1))	ESUREA	42	
	PHIKHU = PHITDT+KHUTDT+AREAC(I)	ESUREA	43	
	(1) = 0.0	ESUREA	40	
	VIU1 = 0.0	FOURPA	44	
C.#		FSURFA	45	
1° m	ALE (PHIAVE IT A DAGA CALL AGAG, MALL & THE FALLER	FSURFA	46	-
C-+++	TALL URAD (XURAD (1.0) + + + L + + + + + + + + + + + + + + +	FSURFA	47	
<u>L</u> #		FSURFA	48	
	- 118(1+1)	FSURFA	49	
			FOURFR	50
--	--	--	--	---------------------------------------
HUG1	UIL+J) = GAMAL +5+(B	1+C1+82+C21/1. ENGMACAN	ESURFA	51
\$	+ DTDA+C2+UBG(IM1	(J) - THOTHER INHOUT HOLE	FSURFA	52
2	+ DELI+(DOTMIG(1	J/DVAXISAFTIA ODAC(T)	FSURFA	53
	+ DOTEB(I+J)+HMA+	AREAC(I)) / WH , PHO	FSURFA	54
C+			FSURFA	.55
<u> </u>			FSURFA	56
KHUU	(U(1,J) = RHUTDT		ESURFA	57
Ubul	U(1,J) = UTOT		FSURFA	58
VUGT	$J(1,J) = VI_{\rm U}T$	1 because days	FSURFA	
REIU	civ		FSURFA	60
LNU		the second se	FSUBFA	61
-			FSURFA	62
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	SUBRUUTINE FSURFT	FSURFT	2	** ************************************
	COMON AVOIT ARD ID . PHIRD , PHIAVE , KHCAVE , UBEAVE , UPBAVE ,	FSURFT	3	
		FSURFT	4	
-	COMPONICHAMIA , J , AB, RB, NGX, NGR, IELGE, IENDB, IPATH(60,5), AREAG(5),	CHAMI	2	
	* ALEACH ARCAL(60) IGNITUNED DIAMIULAM2.CISI.DIS2.DIS3.UIS4.	CHAMI	3	
	AREAR(60), AREAAX, CHAMI, CHAMZ, CHAMJ, IDPGAP, AREAGP(60), DAVG,	CHAMI	. 4	
	ANCANZIOIANDIIBLEADIBLEADIBLEBEGIPSIIIPSZIRADESIBPIGN	CHAMI	5	
		FSURFT	6	
	COMPONZE WNSZUTUX, TZCK, TZCK, TWOIDR, DICK, HMB, TWOGJ, DVAXIS, DVAXIT,	EQNS	2	
		EUNS	3	
	COMPONINGASCONTRO, FRO, CVO, CVA	FSURFT	8	
	COMMON/CAC/PHIB6(60.5), KHUB6(60.5), MBG(60.5), UBG(60.5),	BAG	2	
	1 VB0(60,5), 0P8(60,5), PCH(60,5), 12C(60,5),	BAG	3	
	2 DUTHIGIEU, CONG(60,5), XDRAG(60,5), DOTPB(60,5), UPBDT(60,5),	BAG	4	
	5 FRADIU(60,5), RHOBTD(60,5), HR61u(60,5), UBGTD(60,5),	BAG	5	
	4 VB01D(60,5),186(60,5),D0TF86(60),CuTMP(60,5),PHIBP(60,5),	BAG	6	
	5 PHIPIU(60,5),T2R(60),TBP(60,5)	BAG	7	
	LUGICAL IGNIT, UNED. CHAM1. CHAM2. CHAM3. UPIGN	CHAMLOG	2	
C*		FSURFT	11	
	KE=NB+DK	FSURFT	12	
C		FSURFT	13	
and the section and	CALL SSPROP(NO.RRO.R.CVU.CVH.CV.PCHLI.J)+HBG(I.J)+TDUM,	FSURFT	14	
	kH0BG(1+J)+USG(1+J)+VRG(1+J)+GAr+CP+2)	FSURFT	15	
	BUGGER = [GAM - 1.0]/TWGGJ	FSURFT	16	
	$1m_1 = 1 - 1$	FSURFT	17	· ·····
	1 = 1 + 1	FSURFT	18	
	F1 = Philo(1, JF1)	FSURFT	19	
	F2 = PHIBG(IM1, U)	FSURFT	20	
	F5 = PH1BG(1,J)	FSURFT	21	
andarfang oo dat saw	S1 = F1 + RHOBG(1, JP1)	FSURFT	22	
	$b^2 = F^2 + RHOBG(1M_{1,0})$	FSURFT	23	Weiter and the second statements
	$L2 = 62 * UBG(1M_{1,J})$	ESURET	24	
	u1 = u1 + vBG(1, JP1)	FSURFT	25	
	$C1 = C1 + HBG(1, JP_1)$	FSURFT	26	
	$C_2 = 02 + HBG(1M_{1,J})$	FSURFT	27	Handler Hamun IV
	B1 = BUGGER + (UGG(1, JP1) + 2 + VBG(1, JP1) + 2) + 61	ESURET	28	
	D2 = BUGGER*(UBG(IM1,J)**2 + VBG(IM1,J)**2)*62	ESURET	20	the design of the second secon
6.4		CSURET	27	
	UENUM = F1 + F2	ESHOET	24	
	PHIAVE = DEROMAD.5	ESURET	30	
	AHUAVE = (G1+62)/DENOM	ESURET	32	
des muchos	UNGAVE = 0.0	CSUPET	33	
	VOUAVE = 0.0	COUPET		
	$UPBAVE = (UPB(1, JP1) + UPB(IM1, J))au_{a}$	CSUPET	33	
C		FOURFT	20	
	PHIJUI = PHIBTU(I.J)	FOURFI	31	
	RHUTUI = (F5+RHOAVE + UTDX+E2 - CTURADI	COUPET		
	5 - DELT+DOTMIG(I)/UVAXIT + C((N)(I)))/PHITDY	FOURFI	59	
Contraction States	PHIRHU = PHITDT+RHUTOT	FOURFI	40	
	utul = 0.0	FSURFI	41	
	VTu1 = 0.0	COURT	42	
C		FOURFI	43	
C++++	+1+ (PHIAVE .LI. 0.999) CALL DRAG(XCH.G.T.I. FALSE.)	FOURFI		
L+		COURCE	45	
	HIGN = HBG(1,1)	FSURFI	46	
	1F(UUIMIG(1) . 5T. 0.00001) HIGN = 446.1.21	FSURFT	47	
C		FSURFI	48	
-		FSURFT	49	

 nB010(1.J) = GAM*(F5*(b1+C1+B2+C2)/(LENOM*EAM)

 + U10x*(2*080(1M1+J) = UTDH*(1*VBG(1+JP1))

 - GELT*(U0TMIG(1)/DVAXIT*FIGN + 0BAG(1+J))

 + D0TMB(1+J)*HMB)/PHIKHO

 FSURFT 50 51 3 > FSURFT 52 FSURFT 53 \$ 6. FSURET C 55 56 57 RHUBIU(1.J) = KHUTUT $\frac{UBGIU(1,J) = UTUT}{VBGTU(1,J) = VTUT}$ ESURET FSURFT 58 REIURN FSURFT 59 LINU FSURFT 60 138

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	CONCOMPTINE FROM TO CONTACT AND A CONTACT	FSURFI	2
	CONTRACT AND TO THE PHILAND PHIAVE INHEAVE I UBEAVE , UPBAVE ,	FSURFI	3
		FSURFI	4
	COMPONICHAMI IS INCINENTAL NER ILEGE, IENDE, 1PATH(60.5) AREAG(5).	CHANI	2
	ARCHERTAREAC(ED), IGNIT, ONED, DIAM1, LIAM2, CIS1, DIS2, DIS3, DIS4,	CHAMI	3
	AREAR (60) (AREAA) (CHAM1 (CHAM2 (CHAM3) TOPGAP (AREAGP (60)) DAVG	CHAMI	4
	AREAL	CHAMI	5
	CURRON/CLUCK/TINE, DELT	FSURFI	6
	COMMON/EUNS/DIDX.I2DR.I2DX.IWOTDR.DICK.HMB.TWOGJ.DVAXIS.DVAXIT.	EONS	2
-		EONS	3
	COMMON/GASCOR/R0, RR0, CV0, CVH	FSURFI	8
	CUMPUN/LAG/PHIBG(60,5), MML G(60,5), BG(60,5), UBG(60,5),	BAG	2
	1 VBG(60,5), UPB(60,5), PCH(60,5), 12C(60,5),	HAG	3
	2 LUINIG(60), UDAG(60,5), XURAG(60,5), DOTPB(60,5), UPBOT(60,5),	BAG	4
	3 Pristu(60.5), KHOBTU(60.5), HBGTU(60.5), UBGTU(60.5),	HAG	5
	4 V0670(60,5),786(60,5),00(MB6(60),CuTMP(60,5),PHIBP(60,5),	BAG	6
	5 PH1PTU(60+5)+T2H(60)+TBP(60+5)	HAG	7 ···· 7
	LOUICAL IGNII . UNED . CHAMI . CHAM2 . CHAM2 . UPIGN	CHAMI OG	2
	JAIA 0KAV/32.16/	ESHRET	
<u>C*</u>		ESURET	12
	KU=KU+UK	ESHOET	12
_ C .		FOURFI	15
	CALL SSPRUP (KO.KRO.K.LVO.LVH.CV.PCH.I.J.HBG(T.I.T.T.T.	ESUPET	
	http://www.seconder.com/se seconder.com/seconder.com/seconder.com/seconder.com/seconder.com/seconder.com/seconder.com/seconder.com/seconder.com/seconder.com/seconder.com/seconder.com/seconder.com/seconder.com/seconder.com/seconder.com/seconder.com/seconder.com/s	FOURFI	15
	3UGEK = (GAM - 1.0)/Tw0GJ	FOURFI	
	$1m_1 = 1 - 1$	FSURFI	17
	JF1 = J+1	FSURFI	18
	JM1 = J=1	FSURFI	19
	F1 = Phing(I, JP)	FSURFI	20
	$F_{2} = Phiab(Im1,)$	FSURFI	21
-4.0	F3 = Philip (1.103)	FSUREI	22
	ES = Phillip (Link)	FSURFI	23
	$(3) = b \pm b + 0 + 0 + 1 + 0 + 1$	FSUREI	-24
		FSURFI	25
		FSURFI	26
		FSURFI	27
		FSURFI	.28
		FSURFI	29
		FSUREI	30
	03 - 03 + 06 (1,0M1)	FSURFI	31
		FSURFI	
		FSURFI	33
	$C_{2} = O_{2} + B_{2} (I_{1} \cup F_{1})$	FSURFI	34
	B1 = BUGGER + (UBG(1, JP1) + + 2 + VBG(1, JP1) + + 2) + 61	FSURFI	35
	82 = BUGGER+(UBG(1111)++2 + VBG(111)++2)+62	FSURFI	36
	$B_3 = BUGGER + (UBG(1,JM1) + +2 + VBG(1,UR1) + +2) + G_3$	FSURFI	37
	DKP = (KB + DR)/KB	FSURFI	38
	URM = (KB - LR)/Rb	FSURFI	39
		FSURFI	40
	UENUM = F1 + F2 + F2 + F3	FSURFI	41
	5166 = 61 + 62 + 62 + 63	FSURFI	42
	S160 = 01 + 02 + 03	FSURFI	43
	PHIAVE = DENUM+0,25	FSURFI	44
	RHUAVE = SIGU/UENOM	FSURFI	45
	UBGAVE = U.U	FSURFI	46
	VBUAVE = SIGU/SIGU	ESURE1	47
	UPBAVE = (UPB(1, JP1) + 2.0 * UPB(IM1.J) + UPB(I.JM1)) * 0.25	FSURFT	4.9
L#		ESUBET	40
		r gunr 1	47

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	SUBROUTINE FSURFO	FSURFB	2
	LONMON/AVGUT/RHUIUI + HIRHO, PHIAVE, KHGAVE, UBCAVE, UPBAVE,	FSURFB	3
	3 UIU1,VHGAVE,VTLT	FSURFE	4
	CUMPUT/CHAM/1 .J .XB.KB.NGX.NGK.IBLGE.IENDB.IPATH(60.5).AREAG(5).	CHAMI	2
	AREACH, AREAC(60), IGNII, UNED, DIAMI, LIAM2.CIS1.DIS2.DIS3.DIS4.	CHAMI	3
	ANT ARTENT ANT ANT ALL CHAMI CHAM2 CHAP IDPGAP. ARE AGPIENT. DAVG.	CHAMT	4
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	a DATUK INA SOFTWOOT HEP	EUNS	3
	COMPLENZEASCONZKO+ERO+EVO+EVO	FSURFB	6
	LUMMON/BAG/PH180(60,5), KHU56(60,5), MBG(60,5), UBG(60,5),	HAG	2
	1 V66(60,5), UPB(60,5), PCH(60,5), [2C(60,5),	BAG	3
	Z UUIMIG(60), GRAG(60,5), XURAG(60,5), DOTAB(60,5), UPHDT(60,5),	.6AG	4
	3 PHILETD(60+5), RHOBTU(60+5), HEGTU(20+5), UBGTD(60+5),	HAG	5
	4 VB610(60,5),TB6(60,5),D0TMB6(60),CCTMP(60,5),PHIBP(60,5),	LAG	6
	2 = 2 + 1 + 1 + (6 + 5) + 1 + 2 + (6 + 1) + 1 + 1 + (6 + 5) + 1 + 2 + (6 + 5) + 1 + (6 + 5) + 1 + (6 + 5) + (7 + 5) + (7	6AG	7
	LUGICAL IGNIT, UNED, CHAM1, CHAM2, CHAMA, PIGN	CHAMLOG	2
C.s.		ESHREA	11
•••	A MERKA HUM	ESHREA	10
1		COUSEA	
L +	CALL SCURDING, DUG, N. FUG, FUG, FUG, FU, DELLE, A. UDITY, A. TOUM	FSURFO	15
		FSURPO .	14
	\$ RHOBG(1+3), CBG(1+3)+VEG(1+3)+GAP+(P+2)	FSURFB	15
	$BUGGER = (GAP_1 - 1.0)/TWOGJ$	FSURFB	16
	161 = 1 - 1	FSURFB	17
	7w1 = 7-1	FSURFB	18
	$F_{2} = Ph1BG(1h1+J)$	FSURFB	19
	$F_3 = Phild(1, Jhi)$	FSUREB	20
	FP = HIRP((1))	FSURFB	21
	$62 = 12 \times 1000 (101.0)$	FSURFB	22
	$u_3 = t_3 + RHOBG(1, JM1)$	ESUREA	23
	$E^2 = 62 + (0) G(101 + 1)$	ESURER	24
	d3 = 63av66(11.1)	ESUPER	25
	$C_2 = b_2 + b_3 + b_4 $	ECHPEN	20
		FOURFD	<u>ZP</u>
		FSURFB	21
		FSURFB	26
	$B_2 = COGGER*(ORG(1,JM1)**2 + ABG(1,G(1)**2)*G2$	FSURFB	29
6#		FSURFB	30
	$DENOP_{F} = F2 + F3$	FSURFB	31
	PHIAVE = DENGM+0.5	FSURFB	32
	KHUAVL = (G2+G3)/UENOM	FSURFB	33
	URGAVE = 0.0	FSURFB	34
	VEGAVE = 0.0	FSURFB	35
	$UPBAVE = (UPb(1M1,J) + UPB(I,JM1)) \ast u_{\bullet,2}$	FSURFB	36
L.+		FSURFA	37
	PHITUT = PHITTUT	FSURFA	3A
• MIN - + + + + + + + + + + + + + + + + + +	REVIUL = (ESARGUAVE + DIOXAE2 + CT. 8-03	ESUREA	20
		ESURES	4.0
	PhIRHU = PHIIGTARHOIGT	E SUREA	40
		COURED	41
		FOURPO	42
		FSURFB	45
L		FSURFB	44
L###	ATT (PHIAVE .LI. U.999) LALL DRAG(XCHAG(I.J), FALSE.)	FSURFB	45
1	HBUIU(1+J) = GAP+(+5+(B2+C2+B3+C3)/(JENOM+GAM)	FSURFB	46
•	S + UTDX+E2+HBG(IN1+J) + UTDR+U3+HBG(I+JM1)	FSURFB	47
	3 - DELT+GBAG(1,J) + DOTMB(1,J)+mMB)/PHIRHO	FSURFB	48
L#		FSURFB	49

Ĺ	RHOBTU(1,J) = RHOTU	r				FSURFB FSURFB	50 51
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		CUMPONZEUNSZEIDX, 120K, 120X, TWOIDR, UIEN, HMB, TWOGJ, DVAXIS, DVAXIT,	EONS	5
		S DX.UKINA, GUITHOUTHEP	EWNS	3
		COMMUN/GRAIN/ XL(60,5), D0(60,5), U1(60,5), FN.	GRAIN	2
		1 XL101(00+5)+ 00T07(60+5)+ 01107(60+5/+ XL0+ 000+ 010+	GRAIN	3
		ALB(100), DOP(100), DIB(100), UXLe(100), LDOB(100), UDIB(100)	GRAIN	4
		COMPON/INFUTS/C1.C2.C3.C4.T0.T1CN.GCCKS.RHOF.PHID.TF.CA.RHOD.	INPUTS	2
		S HONFUNDONGIKHUP NIWNDHN I IGNBPNQBCUNS, TOTM	INPUTS	3
		COMMUN/SPLINT/NHULEC, WHOLEB	DIMIN	11
		CUMMUN/HARRL/ FHI(100), RHUG(100), HU(100), UG(100), UP(100).	HARRI	2
		1 PG(100), TG(100), F=00T(100), G_(100), UERAG(100), FRICT(100).	LARRI	3
		2 WCUNV(100), UUP(100), UPHI(100), UNDUG(100), UHG(100), UUG(100),	DADRI	
		3 AMASS(100), AMOM (100), AENER(100), LAMASS(100), HAMOM(100).	UADRI	
		4 UAENER(100)	DADDA	3
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	1	SUMMULT HE HITTE CALCULATES HOUT FOR USE THE PHONE AND THE DOODED	DIMIN	15
	č	IT UPUATES GEALS OF A FOR USE IN MOUNT AND IN PROPHO.	DIMIN	16
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	c	CORNY MALOT TO COTACED TA MATA AN C. C. THAN AND A	DIMIN	18
	<u> </u>	ANNAL FREUT IS CLEARED IN MAIN AT EACH TIME INTERVAL.	DIMIN	19
	L		UIMIN	20
-		LU 50 1=2,NX	DIMIN	. 21
	2	IF (PHI(1)-GE.0.99999) GU TO 45	DIMIN	22
	L		DIMIN	23
		h = ATPB * PG(1) * PEXP + CT	DIMIN	24
		BORINE = K+TWODT	DIMIN	25
		UXLU(I) = XLH(I) = HUKNL	DIMIN	26
	Ç		DIMIN	27
		1+(UUB(1) .LE. 3.0*DIB(1)) GU TU 20	DIMIN	28
	Ç.		DIMIN	20
	C	CODING FOR CYLINDICICAL PROPELLANT GRAINS	OTMIN	10
		UUCE(1) = UOB(1) - BURNL	DIMIN	30
		UD1E(I) = UIE(I) + BURNL	DIMIN	23
		vULL = Pl0F*xLB(1)*(D0B(1)*DC6(1) = FN*DTB(1)*DTB(1))	DIMIN	32
		VNEK = PIDF+UXLB(I)+(UDOB(I)+(mCr(1) -	DININ	33
		FN+UDIB(I)+UDIB(I))		34
-		60 10 30	OTHIN	55
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dent	21	(UNITALE CALLER THE CLEAR OF ALKS	DIHIN	39
		It (hoar) it, had a so to s	DIMIN	40
100- 0-	- •	while $H \rightarrow L + L + L + L + L + L + L + L + L + L$	DIMIN	41
			DIMIN	42
			DIMIN	43
		$\frac{1}{10}$	DIMIN	44
		COD(1) = ARLA	UIMIN	45
	L.		DIMIN	46
	25	ULLK = BURNL #0.5	DIMIN	47
		ODOB(1) = OOB(1) - DIB(1) + DELR	DIMIN	48
		1F(LDUB(1) .CE. 1.LE-7) GO TO 2/	DIMIN	49
		OUOB(1) = 0.0	T.T.M.T.M.	50

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UPHILIS = 100 UPHILIS		UXLB(1) = 0.0	0			DIMIN	51
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vml.k # UKL011)*UUUG(1) uml.k uml.		VULU = XLB(1)+UUB(1)			DININ	57
1 1 <td>and a star in the second se</td> <td>VNEW = UXLU</td> <td>11+0006(1</td> <td>)</td> <td>an anna a mar a dan a dhasar is adhasa da</td> <td>UIMIN</td> <td></td>	and a star in the second se	VNEW = UXLU	11+0006(1)	an anna a mar a dan a dhasar is adhasa da	UIMIN	
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30 UP (WHE = (1,10 - PH)(11) / YOULD Diffin 63 PHOLY = (1,10 - PH)(11) / YOULD Diffin 65 UP (1,1) = TERPENNOP Diffin 67 UP (1,1) = TERPENNOP Diffin 70 UP (1,1) = TERPENNOP Diffin 71 UP (1,1) = TERPENNOP Diffin 72 UP (1,1) = TERPENNOP Diffin 73 UP (1,1) = TERPENNOP Diffin 74 UP (1,1) = TERPENNOP Diffin 74 UP (1,1) = TERPENNOP Diffin 75 UP (1,1) = TERPENNOP Diffin <t< td=""><td>C</td><td></td><td></td><td></td><td></td><td>DIMIN</td><td>61</td></t<>	C					DIMIN	61
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	SUBRUUTINE REQUE	KHOUH	2	6 1 Million - 100
L		KHOUH	3	
C	SUBRULINE RHUUH PERFORMS THE FINITE CAFFERENCE CALCULATIONS AT	RHOUH	4	
L	THE BARALL GRIDS.	RHOUH	6	
E.		DHOUL		
	CUMPONZAVGDIZURUOT, PRIMHU, PHTAVE, RM. AVE, HGAVE, HDAVE, HDIT,	RHOUH		
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	CCHRONZEOCKZIJNE DEET	KHOUH	10	
	COMMONYEARS/DIDX, 12DK, 12DX, TWOILR, DICA, HMB, TWOGJ, DVAXIS, DVAXIT,	EWNS	2	
	L UX ON ONX OUT HOUT HISP	EWNS	3	
	COMMUN/CASCON/KO+RKO+CVO+CVH	KHOUH	12	
	LUARUN/GRIDNX/GZERIM	MOD0301	26	
	COMMON/DARRL/ FHI(100), RHUG(100), HU(100), UG(100), UP(100).	HARRL	2	
	1 PG(100), FG(100), PMOUT(100), GL(100), UCRAG(100), FRICT(100),	HARRL	3	
	2 JUNV(100), UUP(100), UPHT(100), UHDG(100), UHG(100), UUG(100).	BARRI	4	
	3 AMASS(100), ANOM(100), AEDER(100), LAMASS(100), HAMOM(100).	BARRI	6	······································
	4 UAENER(100)	DARRE		
1		DAKAL	0_	
C	1014 BRAU142.167	RHOUH	14	
,		KHUVH	15	
-		RHOUH	16	
		RHOUH	17	
	NFI = NX - I	RHOUH	18	
	NP1 = NX+1	RHOUH	19	
	PHI(WP1) = PHI(WM1)	RHOUH	20	
	HOG(NP1) = HOG(NP1)	RHOUH	21	
	UG(NF1) = 2.0 + VP - UG(NM1)	RHOUH	22	
	Amass(nm1) = Amass(nm1)	RHOUH	23	
	AMOM(NP1) = AMOM(NM1)	HOUH	24	
	ALMER(INP1) = AENER(NM1)	RHOUH	25	
	$H_{\rm C}({\rm WP1}) = H_{\rm C}({\rm We1})$	PHOLIN	20	the followed and service
	UP(NP1) = 20VP - UP(NP1)	H001005	20	
	$P_{1}(NP_{1}) = P_{0}(nN_{1})$	MULLING.		
		RHOUH	28	
	and shall be shown to show the state of the	RHDUH	29	
	THE CALLED IF WA IS 1.	RHOUH	30	
· · ·		RHOUH	31	
	10 100 I=2.NX	RHOUH	32	
	<u>IM1=1-1</u>	RHOUH	33	
	121=1+1	RHOUH	34	
C		RHOUH	35	
	CALL GSPROP(R0+RR0+R+CV0+CV+FC(I)+HE(I)+TDUM+RHOG(I)+	RHOUH	36	
	3 UG(1)+U-U+GAM+CP+2)	KHOUH	37	
	UUGER = (GAM - 1.0) / TWOGJ	RHOUH	3.4	
6		MUD0301	27	
L	WHEN I = NX - 1, UNIU I + 1 SHOULD BE THE SAME DISTANCE AWAY AS	MODOSOL	24	An ordering a
C	UNIU NX - 2 (GRIU NX WILL PROMANIY OF FARTHER AWAY). SO USE	MODOTOT	20	
L	LINEAN INTERPOLATION TO GET THE PRODERTIES AT TAS IST OUT	NUD0301	20	
	ACTAIN THE SAME.	H000301	30	
		HUDUSUI	51	see stronge
		MUDU301	52	
		MUUU301	- 55	
		M0D0301	34	
		NOD0301	35	
	POS = PO(11X)	M0D0301	36	
	OPS = OP(NX)	MUD0301	37	
	KAILU = DX/UXPKIH	M0D0301	36	sina aju
	$\kappa HUG(1P1) = \kappa HUG(1) + \kappa A HUG(RHOG(1P1) - RHCG(1))$	MUD0301	39	

-	HG(1P1) = HG(1) + hAT10*(HG(1P1) - HG(1))	M000301	41
	PG(1P1) = PG(1) + KAT10*(PG(1P1) - PG(1))	M000301	42
	UP(1P1) = UP(I) + RATIU + (UP(IP1) = UF(I))	M0D0301	43
L		MODO301	
L	AT GAID NX UXPRIM SHOULD BE USED RATHER THAN DX. SO T2DX MUST BE	MOD0301	45
L	LHANGED.	MOD0301	46
34	CONTINUL	MOD0301	47
	1+(1 .NE. NX) 60 TU 40	MUD0301	48
and the second	120 AS = 120 A	M000301	49
	120X = 0FL1/12.0+0XPRIM)	MOD0301	50
1		M000301	51
4.0	LON LINE	MOD0301	52
r		RHOUH	39
C	LI - DUTITATI	RHOUH	4.6
		PHOUH	41
	r = -r n a v a r a v	PHOLIN	42
		PHOLIN	41
	GI = RHOG(IFI)	BUOUN	- 3
		BHOUL	
	O = KHO(1)	RHOUH	40
	LI = 01+00([M])	CHUCH	40
	L = 02 + 00(1P1)	RHUUH	47
-	$L_{2} = 62 + 16(1)$	RHOUH	48
	CI = G1 * iG(IM1)	RHOUH	49
	C2 = 62 + 6(1P1)	RHOUH	50
	C5 = 65 * hG(1)	RHOUH	51
	B1 = BUGGER+UG(1M1)+L1	RHOUH	52
an alasaddagar ol i'r do	b2 = BUGGEK * UG(1P1) * 2	RHOUH	53
	bb = BUGGEK*UG(1)*Eb	RHOUH	54
6		RHOUH	55
	PHIAVE = (F1 + F5 + F5 + F2) = 0.25	RHOUH	56
	$h_{HUAVE} = (61 + 65 + 65 + 62) = 0.25$	RHOUH	57
	$U_{\text{L}} = (U_{\text{L}} (1 M_{1}) + U_{\text{L}} (1) + U_{\text{L}} (1) + U_{\text{L}} (1F_{1}) + 0.25$	RHOUH	58
	IF (UPLI) - FRAUL AND - PHIAVE - NF - 0 - 1LP - I - EUGAVE	RHOUH	59
	(PAV) = (1)P(1M) + (P(1) + (P(1) + (P(1)) + (P(1))) + (P(1)) + (RHOUH	60
		SHOUH	61
L		PHOUH	62
		PHOLIN	41
C			44
		PHOLIN	45
		ANOUN	65
	2 + PHUOT(I)+ANASS(I) J/(UPFI)+CANASS(I)	RHUUH	00
C		RHOUR	61
	PHIRHO = UPHIT+URHOT	RHUUH	60
C		RHOUH	69
	GRAVA = GRAV+AMOM(1)	RHOUH	70
	UUT = (F5*AMOM(1)*(E1 + E5 + E3 + E2)*0.25	RHOUH	71
_	1 - T2LX*(F2*AMUM(1P1)*E2*UG(1P1) - F1*AMOM(IM1)*E1*UG(IM1)	RHOUH	72
	+ GRAVA + PG(IP1) - GRAVA + FG(IP1)	RHOUH	73
	3 - DELT+FRICT(I) + AMOM(I)+PMCUT(I)+LP(I) 1/	RHOUH	74
	4 (PHIKHU=UAMUM(I))	RHOUH	75
C		RHOUH	76
	1+ (ABS(UUT) .LT. U.1) UUT = 0.0	KHOUH	77
	IF (PHIAVE .LT. 0.999) CALL DRAG (UDRAGILI TRUE 1.0)	RHOUH	78
		RHOUH	79
•	UM6(1) = GARA(F584ENER(1)*(C1++1+C5+R5+C5+R5+C2+B2)/	RHOUH	AG
	(4.08648) - T20X+(52+45NF0.101)+529+6(TP1) -	RHOUH	AL
	FLACENER/IMIJALIANG/THALL	RHOUH	82
-		PHOUL	42
			00

	a subscriptor (1) to be transmission of the subscriptor (1) / 766.	RHOUH	84
	- NUGER + OUT + OUT + PMIKHU+UALNER(I)/GAM)/	RHOUH	85
	D (PHIKHU+UAENEK(I))	RHOUH	86
		RHOUH	87
L		RHOUH	AA
	OKHOG(1) = UKHOT	RHOUH	A9
	000(1) = 001	RHOUH	90
4	THE SAVED PRUPERTIES AT URID NX SHOULL BE PLT BACK INTO THE	MODOJOJ	50
6	APPRUPRIATE ARKAYS BEFURE 1 IS SET IC NX.	MODORAL	33
	JF(1, NE, NX - 1) 60 10 100	MODUSUL	34
	RHUG(NX) = RHOS	FIVUUSUL	
	UG(NX) = UGS	M000301	56
	HEINAL = HES	M0D0301	57
	Ph(Nx) = PGS	MOD0301	58
		MOD0301	59
		M000301	60
		MOD0301	61
		MOD0301	62
6		RHOUH	91
100	CONTRACT	NHOLIH	0.2
6		HIDORAL	12
L	REPLACE TOUR BY ITS SAVED VALUE.	MODATAL	
	12UX = 120XS	MODUSUL	64
C		MUDUSUI	65
	KETURN	RHOUH	93
L		RHOUH	
-	+ ND	RHOUH	95
		RHOUH	96
		400-10-1 ×	
test shipperson		and the design and the standard service descention	
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anaan ah ah a	SUBRUUIINE PROPMO	PROPMO	2
Ç		PROPMO	3
L	SUBROUTINE PROPAD CALCULATES PROPELLANT MOTION IN THE BARREL.	PROPMO	4
4		PROPMO	
	COMMON/CHAM/1X,IK,XG,KG,NGX,NGR,IELGE,IENDB,IPATH(60,5),AREAG(5),	CHAMIX	2
	AREACH, AREAC (60), IGNI, UNED, DIARL, LAM2, CIS1, DIS2, DIS3, DIS4,	CHAMIX	3
	AREAR(60),AREAAX,CHAM1,CHAM2,CHAM3,10PGAP,AREAGP(60),DAVG,	CHAMIX	4
	AREAH2, UIAMB1, BELEND, BELBEG, 1PS1, 1F32, RADES, BPIGN	CHANIX	5
	COMMUN/LENS/LTUX, T2UK, 12UX, TWOTOR, UICK, HMB, TWOGJ, DVAXIS, DVAXIT,	EUNS	2
	3 UX, UK, NX, GJ, TWODT, HGP	EQNS	3
despected of	CCMMUN/6KA1N/ XL(60.5), U0(60.5). 01(60.5). FN.	GRAIN	2
	1 XLTUT(60.5), 0010T(60.5), DITOT(60.5), XLO, D00, DIO,	GRAIN	3
	<pre>2 XLB(100), LUB(100), UB(100), UXLB(100), LDOB(100), UDIB(100)</pre>	GRAIN	4
	LUMPUN/INPUIS/C1.C2.C3.C4.T0.TIGN.GLCAS.RHOF.PHI0.TF.CA.RHOO.	INPUTS	2
the second s	S INU. PU.LU.GINHOP.HW.LM.TIGNUP.GBCU.S.TOTM	INPUTS	3
	(GMMON/SPL INT/MHULEC . MHULER	PROPMO	10
	CUAMUN/LAG/PH186(60.5). HH086(60.5). H86(60.5). UB6(60.5).	HAG	2
	1 Vib(60,5), (PR(60,5), PCH(60,5), [/(60,6),	HAG	5
-	UNING AND CHARLESS YOR ACTAL ST. DOTRIGO.ST. UDADTIGO.ST.	BAG	4
	A DALLANGERS BUILDER ADDREED AND A DEPENDENT AND A DEPENDENT AND A DEPENDENT AND A DEPENDENT ADDREED AND A DEPENDENT ADDREED A	DAG	
		DAU	
		DAG	7
	5 PHIFIU(60,5),12K(50),10P(60,5)	BAU	
	CUMPON/EARRE/ PH1(150), RHOG(100), HG(100), UG(100), UP(100),	BARKL	2
	1 PG(160), TG(100), PHOOT(100), GL(160), UCRAG(100), FRICT(100),	BARRI	3
	2 GCUNV(100), UUP(100), UPHI(10C), UHRDG(100), UHG(100), UUG(100),	BARKL	4
	3 AFASS(100), AMUM(100), AENER(100), JAMASS(100), JAMOM(100),	BARRL	5
	4 UALNER(160)	BARRL	6
	LCUICAL IGNIT, UNEU, CHAM1, CHAM2, CHAM3, OPIGN	CHAMLOG	. 2
	LUGICAL WHOLEG, WHOLEB	PROPMO	14
L		PROPMO	15
L	I UAD GRID 1 WITH FORUSITY AND GRAIN LIPENSIONS UPDATED BY REGRES	PROPMO	16
L	AND PROPELLANT VELOCITY OPDATED BY PREVEL.	PROPMO	17
	1F (UNED) 60 10 10	PROPMO	16
	PHI(1) = 0.0	PHOPMO	19
-1 Generalize	$ALm(1) \equiv 0.0$	PHOPMO	20
		PHOPMO	21
		PROPHO	22
		PROPMO	23
		DROPHO	24
L	and the same to have be	DROPHO	25
	DU J DELINGR	DHOPHO	26
	THAT IS THE TOTAL TOTAL TOTAL AND A THE TOTAL	DROPHO	20
	$\mathbf{r}_{\mathbf{r}} = (1 \cdot 0 - \mathbf{r} 1 0 0 1 0 \mathbf{A} + 0 1 \mathbf{A} \mathbf{n} \mathbf{L} 0 0 1$	PROPHO	21
	$A = D \left[1 \right] = A = B \left[1 \right] + A = B \left[B = 0 \right] + B = B \left[B = 0 \right]$	PROPER	20
	DOE(1) = DOB(1) + DO(NGX, J) + TEFP	PROPHO	
	UIE(1) = UIE(1) + UI(NGX+J) + TEMP	PROPHU	30
-	UP(1) = UP(1) + UPE(NGX, J) * TEPP	PROPMO	31
5		PROPMO	32
L		PROPMO	33
	PHI(1) = PHI(1)/AREACH	PROPMO	34
	11 (PH1(1) . ut. 0.99995) 60 TO 8	M0D0620	3
	$IEMF = (1 \cdot 0 - PhI(1)) * AREACH$	PROPMO	36
	XLB(1) = XLB(1)/IEMP	PROPMO	37
	008(1) = 003(1)/TEMP	PKOPMO	38
	OIS(1) = OIS(1)/TEMP	PHOPMO	39
	VP(1) = UP(1)/TEMP	PROPMO	40
	Let Let 16	NHOPMO	4.1

	S CUNTINUE	PROPMO	43	
	$XLO(1) = U_0 U$	PROPMO	44	
	303(1) = 0.0	PROPMO	45	
	-13(1) = 0.0	PROPMO	46	
	OP(1) = 0.0	PROPMO	47	
	60 10 15	PROPMO	48	
L		PHOPMO	49	
	$1 \cup PHI(1) = PHIBG(NGX, 1)$	PROPMO		
	ALB(1) = AL(1, GX, 1)	PROPMU	51	
	$JOB(1) = DO(IIGX_{1})$	PROPMO	52	
	$\sigma_{10}(1) = \sigma_{1}(r_{0}, 1)$	PROPMO	53	
	UP(1) = UPH(NGX.1)	PHOPMO	54	albeda e ano
L		PROPMO	55	
		PROPMO	56	
	IF(.NUT. WHOLEC .AND. UOB(1) .LE. DIB(1)) WHOLEB = .FALSE.	PROPHO	57	
c		PROPHO	. 58	
C	ARRAY UUP IS LLEARED IN MAIN AT EACH TIME INTERVAL.	PROPHO	59	
С		PROPMO	60	
L	PUT UPUATED PURUSITY AND GRAIN DIMENSIONS CALCULATED IN DIMIN INTO	PROPMO	61	
C.	ANNAYS MHI. JUB. LID. ALB.	PROPMO	62	
		PROPMO	63	
	$e_{1}(\tau) = 0e_{1}(\tau)$	PROPMO	64	
		PHOPMO	46	
	$\alpha_{1} = \alpha_{1} = \alpha_{1}$	OPOPMO	65	
		OFORMO	67	
		DROPHO		
		PROPHO	60	
L		PROPPIO	67	
		PRUPHV	.70	
L	THE TO REPORT AT MELICETY DUT NOT TO VALLED THE POLY UD	PROPMO	71	
	OPDATE PROPELLANT VELOCITY. POT OPDATED VALLES IN ARRAT OP.	PRUPMU	72	
C	USE AN AVERAGE PUROSITY IN UPDATING UP.	PROPMU	73	
	GINDUP IS GRAVELELIZABUP	PROPMO	74	
	PHIAVE = (PHI(1-1) + PHI(1) + PHI(1) + FHI(1+1)) + 0.25	PROPMO	75	
	$IF(I \in U = NX) PHIAVE = (PHI(I-1) + PHI(I)) + 0.5$	PROPMO	76	-
	IF (FHIAVE .GE. 0.99999) GO TO SU	PROPMO	77	
	$DELOP = GTRHOP + DDRAG(\mathbf{I}) / (1 \cdot 0 - PHAVE)$	PROPMO	76	-
	ur(1) = ur(1) + 0ELUr	PROPMO	79	
		PROPMO		-
C	AMOURT OF PROPELLANT MOVED FROM ITH GRID INTO I+1ST GRID.	PROPMO	81	
	SU LUNTINUE	PROPMO	82	
	UMPN = (1.0 - PH1(1))#UTDX#UP(1)	PROPMO	83	
L		PROPMO	84	-
L	AMOUNT OF PROPELLANT MOVED FROM I-IST GRID INTO ITH GRID.	PROPMO	85	
¢	****1113 STATEMENT WILL GET PROPELLANT INTO THE EARREL ORIGINALLY.	PROPMO	86	
	UPPP1 = (1.0 - PHI(1-1)) * OTDX* UP(1-1)	PROPMO	87	
L		PROPMO	88	
L	LPUATED PORUSITY AS A RESULT OF MOVERENT	PROPMO	89	
	(h1) = Ph1(1) + UMPN - DMPh1	PROPMO	90	
	1F (Philis LT. U. 99999) 66 TU 40	PROPMU	91	-
	UUP(1)=66(1)	PROPMO	92	
	UPH1(1) = 1.0	PROPMO	93	
	$U \times L U (I) = A L U (I)$	PROPMO	94	
	UUUB(1) = UCB(1)	PROPHO	95	
	UIi:(1) = UIE(1)	PROPMO	96	
	CU 10 50	PROPMO	97	
(PROPMO	98	
		PHOPMO	00	

<u>(</u>]	LEULITT AND PRUP	LLEMMIN DATE	NSIUNS ARE	AUJUSTED ON THE	BASIS UP	PROPHO	100
	HE MUVENENT					PROPHU	101
4 U	CUNTINUE					PROPHU	102
	OUP(I) = (U)	P(1) + (1 + 0) =	PH1(I)) +	UF (I-1)+0MPH1		PROPMU	105
\$	•	UP(1)+LMPN	1/11.0 - +	HIN)		PROPMO	104
	UALB(I) = (XLB(1)+(1.0	- PHI(1))	+ XLB(1-1) + DMPH	u	PROPHO	1.05
3	-	XLB(I)+UMP	N)/(1.0 - F)	HIN)		PROPHU	106
	IF (WHOLED .C	R. LUB(I) .	LT. 1.04-10) UDOE(I) =		PROPHO	107
3	(DOP(1)	+(1.0 - PHI	(1)) + 0081	1-1)*[mpm1 * 00	DB(I)=UMPN)/	PROPHO	108
*	$(1 \cdot 0 - P)$	HIN)				PROPHU	109
	IF (WHULLE .U	R. DIR(I) .	LI. I.UL-10) UDIE(1) =	D. T	PROPHO	110
	(DIE(I)	+(1+0) = PHI	(1)) + DIG(1-1)+LMPM1 • 0)	B(1) TUMPN 1/	PROPHO	111
,	(1.0 - P)	41793				PROPHO	112
	15 4	T 0 64011	111D/11 - 0	٨		PROPHO	113
		1. 0.00017	UVERTS = U.	0		PROPHO	114
• • • • • • • • • • • • • • • • • • • •	AT TOREBLET .	17 1 15 -71		0.0		PHOPHO	116
		LT+ 1+0E=71		0.0		DECOPIO	117
	IT TOUTBILLY .	LI. 1.0L-//	0010(1) -		an allowed as the allowed the state of the	PROPHO	110
L	UMMILIN - DL	T				PHOPHO	110
Г	011111 - Ph					PROPMO	120
-	CONTENTS.					PROPMO	121
					6 4) shind share -an 640.0	PROPMO	122
	RE TURN					PROPMO	123
	r Ista	999 - 100 - 100	Quantum and	talla sinalipalità e tiru -	geganning at lagen of the segment of the	PHOPMO	124
	anan 20 - Sanan kalangahan dar seriak san daran	nan an a - a corran analosi an basis i - sino - s					
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SUBROUTINE BUTTON	MOTION	2
	MOTION	3
COMMUNYBARRL2/BOREA . XP . VP . BORED . BOREA . BOREDE . DT280 . DTUSO . XLBAR	MOTION	4
COMMUN/CLOCK/TIME.OEL1	MOTION	5
COMMON/EGNS/DTUX+T2DK+T2UX+TWOTDR+DTCK+HMB+TWOGJ+DVAXIS+DVAXIT+	EONS	2
3 UX UR NX GU TWODI HBP	EGNS	3
	MUTION	7
LUMMUN/BRAIN/ XLIGUISI: U0(60:5): U1(60:5): FN:	M000301	66
1 XLIU(60,5), DUTDT(60,5), DITDT(60,5), XLO, DOO, DID.	MUD0301	67
2 XLU(100), UUB(100), DIB(100), UXLU(100), LDOB(100), UDIB(100)	MODOBOI	68
CUMMUN/GRIUNX/UXPRIM	NODORAL	
COMMUN/MOLON/CON1.CON2.CON3.CON4.CUN5.AREAPE.ZO.LOB.X08.ROTK.	MOTION	65
1 FUMAX+CUNB+XINT+XL0+PINT+PL0	NOD1411	
CUMMUN/P/IPHINT. MODCH. MODGR. PRIT. TO- HI GARA	HOUTIT	55
COMPONIZABRE / PETCARTA RHOG (2001 - GARONA DELECTOR) UP (2001	- P	2
	BARKL	2
- HUNVIIN, HUNING HUNING CITUDIA DERACIDIA FRANCILADIA	BARKL	_ 3
	BARKL	4
INFERIORIAN ANDRIADUTA ACNERTINUS, GARASS(100), UANOR(100),	BARRL	5
	BARKL	6
CORCAL PRINTERVE	PLOG	2
LOGICAL NAGE2	MOTION	13
UATA NAGE2/.FALSE./	MOTION	14
JATA DFRES/2116./	MOD1111	34
UAIA LSPD/1100./	MOD1111	35
UATA DELU/0./	M001111	36
	MOTION	15
JAIN XJUL/776./	MOTION	16
	MOTION	17
LETERMINE FROPULSIVE FORCE ACTING ON THE PROJECTILE	MOTION	
F = FU(NX) + AKEAFB	MOTTON	10
	NOTION	17
LETERPLANE FUPRING THE ENGRAVING FORCE ON SLIDING RESISTANCE	MOTION	20
AUG 15 THE INITIAL PROJECTILE POSTTLES - POSTTLON LIFES FAREAVING	TION	- 21
BEGINS. BOR IS THE LEAGTH OF THE FALL AND	MUTION	22
IS ME = XP - YOU	MUTION	
	MUTION	24
	MOTION	25
	MOTION	26
	MOD1111	37
	MUTION	28
30 IF (AP , GI, (XIMI-XOB)) GU TO 40	MOD1111	30
FUPRIMEFUMAX-CUN4+(TEFP-WOB)	MOD1111	39
60 10 50	M0D1111	40
40 LONTINUE	MOD1111	41
<u>FUPHIM=PINT#AREAPE-CUNG#(TEMP-XINT)</u>	MOD1111	42
45 UELC=0.2+DELU	MUD1111	43
CSPU=LSPU + LELC	M001111	44
ULLY= 1.4+8PKES+0ELU/(CSYD-0.6+DELU)	MOD1111	45
DPRES = BPRES + DELP	M001111	46
FPN IM= DPKES+ANEAPD	NOD1111	40
AF (FUMRIM .LT. FPRIM) FOMMIMEPRIM	MOD1111	47
SU LONTINUE	MODIAL	40
	HUUIIII	47
LETENMINE PROJECTILE AXIAL ACCELEDAT.C.	MOTION	32
ACL = CONDACTACE = FORTMA	HOTION	35
	MUTION	34
IF INFRE TS ALL MUNCHEST IN AND AND A STARS THE BALL	MOTION	35
ALL ALL IS NO HOVENENT, WA AND DAFKIF REMAI THE SAME.	MOTION	36
TTTTAT NEW AD UDEU ELDEWNEREN MARE AT NUNNEGATIVE BEFORE RETURNING	MUTION	37

,	IF (ALC +LL+ C+U) RETURN	MUTION	38
<u> </u>	PROJECTER AND UFLOCITY	MUTION	37
•		HOTION	40
	VP = VPO + ACCALLE	MOTION	
		MOD1111	50
		MOTION	47
C I	PRODUCTION F AND DAR VELOCITY	HOTION	43
-		MUTTON	44
	5. 20x - Konkett + 3. 3433	NOTION	43
	CADARCELLE AVIA COSTININ	MUTION	40
-		MOTION	47
		MOTION	40
	THE THEM THE NUMBER OF GRIDS. NY THE STOP OF THE LAST OPTI-	MUTION	47
	LAG SAVES THE MUNCER OF GALOST DECAN AND THE STEE OF THE LAST ONLY	MUTTON	50
C	and a start of the	MOTION	21
		MUTION	
	WHEN DE GED S TH DECIMAL FORM AFTLE DO ISSTILL MOTION	MUTTON	23
L	NONDER OF GRIDS IN DECIMAL FORM AFTER PROJECTILE MOTION	MUTION	54
	AND - AF/6A Y 1.0	HUILUN	55
<u>c</u>		MUTION	- 26
L	NUMBER OF TRUE ORATIO	MUTION	57
	NA E ANG	MUTION	58
L		MOTION	59
L		MUD0301	.70
L		MOD0301	71
<u> </u>	SAVE THE PREVIOUS DAPRIM	MUD0301	72
	DAPS = DAPRIF	M0D0301	73
C .		M0D0301	
C	DAPRIM IS THE WIDTH OF THE LAST GAID.	MOD0301	75
٤	JAPRIM WILL BE .GE. UX AND .LT. 24UA.	MOD0301	76
	UXPRIM = (XNC - FLUAT(NX - 1)) + DX	MOD0301	77
4		MOTION	64
C		MUTION	65
C		MOTION	66
C	FILL THE ARRAY VALUES AT GRID NX	MUTION	67
6		MOTION	68
L	GET UPDATED PRESSURE AND GAM AT PREVICES GRIE NX	MUTION	69
	1 (NX62) GJ TU 80	MUTION	70
	IF (NA . EQ. 1) GO TO 100	MUTION	71
	NAGE2 = . THUE.	MUTION	72
	UHG(1) = HG(1)	MUTION	73
	URHUG(1) = RHUG(1)	MOTION	74
	UU(1) = U(1)	MUTION	75
ØŲ		MOTION	76
	LALL SSPROP(HU+HHC+H+LVU+CV++CV+PG(HGL)+UHG(NGC)+TOUH+UHHOG(NGC)+	MOTION	77
	\$UUG(1.GC)+U+GAM+CP+2)	MUTION	78
	GAM1 = GAM - 1.0	MUTION	79
	$UELVP = VP - VP_0$	MOTION	80
	C = SWRT(GAM1+(GJ+UHG(NGC) - VM0+VPU+U.5))	MOTION	81
	LPRIN = C - U.S.+GAMI+DELVP	MUTION	82
L		MUTION	83
6	DAS VELOCITY AT GRID NX IS THAT OF THE PROJECTILE	MOTION	84
	UUG(NX) = VP	MUTION	85
C		MOTION	86
	ILMF = GAM+ULLVP/(C + CPRIM)	MOTION	87
C		MUTION	88
- Canada and and and and	THE THAT WALCON WHEDE WHENTED DEFICE F AT EDEUTOLIC AN COTA	NO STOL	

	PALS = FG(NGL)+(1.0 - 7LMP)/(1.0 + 1EPP)	NUTION	90	· ···
		NUTION	91	
	ILAP = VP+VP/THUGJ	MUTION	92	te interes de saille de
L .		NUD1002	15	
	$utu(0\lambda) = CPN1M+CPN1M/(UAM1+GJ) + 1_PP$	MUTION	95	
		MUTION	94	
	URHUG(NA) = GAM/GAMI+IKES/(XJUL+(CHUINX) = TEMP))	MOTION	Ph.	
		NUTTON	73	
	IF INA AUT AUC ALL INA ALU DI LUGANY) - UDIN	MULLUN	- 70	
	It (b) d_1 , b_1 , b_2 , d_1 , b_2 , d_2 , d_1 , d_2 , d_2 , d_3 , d_4 , d_1 , d_2 , d_3	M000301	/0	
	= 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1	1000301	19	
	1 + (COT(NA)) = (CO(NA))	MUTION	98	
	IF (WA	M0D0301	80	101.1 (dor man)
	THE FULLWING MAY BUT BL NECESSARY	MUTION	99	
	UAMASS(NX) = UAMASS(NX-1)	MUTION	100	
	OAnOm(NX) = OAnOm(NX-1)	MOTION	101	
	UALNEK(NX) = UALNEK(NX-1)	MOTION	102	
		MUTION	103	
65		M000301	A1	
		H000301	60	Anno 1111 - 40 - 1110 - 10
	LEINX JUL, MGC) GU TO MU	H000301	02	
	APPLICATE TO DE TO	-HUUU301		
		MULUSUI	84	
		MUD0301	85	
		MUD0301	86	
•		MOD0301	87	· · · · · · · · · · · · · · · · · · ·
20	CONTINUE	MUD0301	88	
	LF (NA .61, 2) 60 TU 95	MUD0301	89	
	$OPHI(N_{A}) = PHI(1)$	MOD0301	90	
	$UDUB(N\lambda) = UUB(1)$	M0D0301	91	
	ULID(NX) = UI6(1)	M0D0301	92	40.0-00.000-0.0
	UXLD(NX) = XLD(1)	M000301	01	
	60 10 100	1000301	55	might-scholarar
		MODUSUI	94	
	(Dall I Naa	MUDUSUI		
15		MUD0301	96	
	OFHICK/ = 1.0 = (1.0 = OFHICKEL) + (LAPS = LATU.5)/	M000301	97	
	\$ (DAFRIM + DA#0.5)	MOD0301	90	
	ODOB(NX) = ODOB(I, X - 1)	m0D0301	99	
	UDIE(NX) = UDIE(N) - 1)	MOD0301	100	
	UXLD(NX) = UXLD(NX - 1)	MUD0301	101	
		M0D0301	102	
	IF A NEW UNIL HAS BEEN AUDED, GRIC NX - 1 DEES NOT HAVE THE PROPER	M000301	103	
	VALUES EXCEPT FOR UAMASS. UAMON. AND LAENER (IN UNDER AREAS	MUD0301	104	-aprile Medicality of
	AT URLU NX ANE SET TU THUSE UP NX - 11. IN THIS CASE NGC IS NUL	MUD0301	105	
	······································	50D0301	104	
	FRALT = DXZ(LX + DXFRIM)	1000304	100	
reliender dauge	URHOUTEX = 1) = URHOUTEX = 2) + ERUITATIONOG(NY) = UNHOEANY = 555	M000304	107	
	$u_{10}(x) = 1 + u_{10}(x) + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + $	FI000301	108	
	$\frac{1}{2} = \frac{1}{2} = \frac{1}{2} = \frac{1}{2} = \frac{1}{2} + \frac{1}$	MODUSUL	109	
	OHO(HX = 1) = OHO(HX = 2) + FRACT+(LFG(HX) + OHO(HX = 2))	M0D0301	110	
	OOP(NX = 1) = OOP(NX = 2) + FRACT+(OUP(NX) = OOP(NX = 2))	M0D0301	111	for the second second
	OPHI(NX = 1) = OPHI(NX)	MOD0301	112	
		MUTION	104	
100	CONTINUE	MOTION	105	
	IF(XP .GE. XLBAR) PRI1 = .TRUE.	MUTION	106	
	LE (. NUI . PRII) RETURN	MUTION	107	-
	14 (U I . 1 DEBUG (23)) KETUKN	MUTION	108	
	IF (AP .GE. XLBAN) WRITE (6. SUDD) TIME	MOTION	109	
	WRITE (6.4000) TIME	MUTION	110	
	BR11 (6.1000)	MOTION	110	
			111	

1300 FURF 1 10 2 4F 3 4V 9 40 2400 F04M	PRES = PG UISP = XPG WHITE(6+20 WHITE(6+20 HI(///+20X++1N A++RUJLCTILE+ RUJECTILE++7X+ ELULITY++10X++1 PROJECTILE+ AL(0E20-10)	NX)/144. 12. 100) ALC.VP. 1010 BALLI 1010.+*PROJEC FRESSURE AT JISPLACEMENT	UISF.UML STICS LU IILE**10 BASL**/ **10X**V	GA.FDFRIM.PRE TPUT 4,7/15X X.+ROIATIONAL 4X.+ACCELER ELUCITY++14X	S *PROJECTILE*, L*:10X: ATION*:10X: *DHAG*:12X:	MUTION MOTION MOTION MUTION MUTION MUTION MUTION MUTION	112 113 114 115 116 117 116 117 116 119
2000 FORM 3000 FORM 3 E1 4000 FORM RETU	AI(1H1,+ INE P) 4+0) AI(1H0,+ TIME) KN	KUJECTILE HA	IS GLINE U	UT OF THE BAI	RHEL AT TIME+,	MOTION HUTION MUTION MUTION MUTION	121 122 123 124 125
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SUBROUTINE OF DATE	UPDATE	ż	
	UPDATE	3	
SUBROUTINE UPDATE UPLATES THE ARRATS AT EACH TIME INTERVAL AND	UPDATE	4	
	UPDATE	. 5	
	UPDATE	6	
LUMMON/FAILEL/IHICKT, PHOUP, PCOMP, ETUE, XNTUB, FAIL, MFAIL(60),	UPDATE	7	
1 1H1CK(60)+PENET+1YFCE	MUD0925	516	
LUMMUN/BANHLZ/BUNEAIAF, VP, BORED, BCKER, BOREDE, DT280, DTUS9, XLBAR	UPDATE	2	-
LUMMUN/CHAM/IX,1K,X5,KB,NGX,NGK,IELGE,IENDB,IPATH(60,5)+AREAG(5)	CHAMIX	2	
AREACH, AREAC (60) . IGHI I. UNED. DIAMI. LIAM2. CIS1. UIS2. DIS3. DIS4.	CHAMIX	3	-
ANLAN (60) AREAAX A CHAMI A CHAM2 A CHAMA A I OPGAP A AREAGP (60) A DAVGA	CHAMIX	4	
AREAN2, UIAMBT, BELEND, BELBEU, IPS1, 1F52, RADES, BPIGN	CHAMIX	_ 5	
LUMMUN/CLUCK/TIME, UEL1	UPDATE	11	
CUMMUN/IGNTE/PDKAD.BPCHG.BKNOUT,BGBAN,TMPBG,	MUD1002	14	
» ULGIL(5)+XL1C(5)	MOD1002	15	
CUMMUM/EGNS/UTUX, T2UK, 12UX, TWOTDR, LICK, HMB, TWOGJ, DVAXIS, DVAXIT,	EUNS	2	
> UX+UK+NX+GU+T+ULT+NEP	EUNS	3	ark
LUMMUN/GASCON/KU, KHU, CVU, CVH	UFDATE	13	
LUMMUN/GRIDNX/UXPRIM	MODOJUL	113	
LUMMUN/GASES/RUMG, KKUMG, CVUMG, CVHME, RUBP, RRCBP, CVOBP, CVHBP	UPDATE	14	
LUMMUN/BPT/IEP(2), DEP(2), CEP(2), FTUBB, PDALST	MUD0925	517	dan dije onlynn
LUMMUN/PRMFLU/UDIMPA.UPAM.UPAM.PRF.XF.FDSHR.CSPRKS.PRMCOF	MUD0925	518	
COMMON/6RA16/ XL (60.5). D0(60.5)	GRAIN	2	0-50 - 101-
1 ALIUI(50.5), 00101(50.5), 01101(60.5), XLO, 000, 010.	GRAIN	3	
< ALB(100), 000(160), 018(100), 000, 000, 1006(100), 0018(100)	GHAIN	4	 rijverselge in
CUMPUN/INPUTS/C1.C2.C3.C4.T0.TIGN.G.C0.S.BHOF.PHID.TF.CA.BHDD.	INPUTS	2	
* HU-PO-HU-GIRHOP-HE-DM-IIGNP-OBCO-S-TOTM	TUPUTS		
I (MMUN / P / TP I NI - MOUCH - MOUGH - PHIA - TC H. 6 / 35)	D	2	
LUMMUN ZER INV ZAPUEN SALEHAU (ADAS) AGE DE AGENEPAE YPAP	PRTMU	2	
(DAMON/HAG/PHIE(SGLS), HOBG(SGLS), BG(SGLS), UEG(SGLS),	HAG	2	
	UNY		
$1 \rightarrow 10^{-1}$ (6.0.5), 10^{-1} (6.5), 10^{-1} (7.5),	DAG	4	
A PHINTO(60.5), ENGRID(60.5), HRG11 (.0.5), HRG10(60.5),	DAG	5	
4 VIII510(60,51,186(60,5),00174 10((2015), 0016(5),0016(0))	GAG	4	
	DAG	7	
COMPLEX ARE CONTRACTOR TO THE REAL OF THE STATE STAT	DAG	2	
A SETTION FRANCE FRANCE AND THOUSE OF A SETTION FRANCE	DANK	4	1 Mpc
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TORTIGETTEDU	SANNL OG	0	
LOUCHL IDITTIONED COMMITCHARZ COMPAGED FION	CHARLOS	6	
	PLUG	2	
LUGICAL PRIZIVAR	UPDATE	25	
	UPDAIL		
A LATTICE LATER ENTRY OF UNE ALL A	MUDUEUS	21	
	UPDATE	52	
UNTA 124707	UPUAIL	20	
	UPUATE	21	
	UPDATE	28	
	UPDATE	- 29 -	
	UPDATE	30	
	+ UPDATE	31	
UPDATE CHARBER ARRATS	UPDATE	52	
***************************************	- UPDATE	33	
A CARACTER AND THE CONTRACT OF A CONTRACT THE	UPDATE	34	
TELEDORIZI ANDA RETTA METERBASHOTI TARINIALTUR	UPUATE	55	
a see aan o' a taa taan di fadahii daa di da sheka ti ti ka di da di da di da di da da da da da da da saa saa s	1.000 4		

C	IF THE POROSITY CONDITION IS NOT SATISFIED, VAR WILL BE SET FALSE.	UPDATE	37
1		UPDATE	38
C	of the I-1 set	UPDATE	39
		UPDATE	40
	THE MONTH THE ACTION AND A CONTRACT	UPDATE	41
	IF (HOD(I, HODGR) , EG. 0 , CR. 1 , LO. 1 , OR, I , EG. NGX)	UPDATE	42
	$3 \qquad PRI2 = .TRUE.$	UPDATE	43
		UPDATE	44
	DU 50 J=1,16R	UPDATE	45
	PHIBC(1,J) = PHIBTD(1,J)	UPDATE	46
	PHIBP(1,J) = FHIPTD(1,J)	UPDATE	47
	$RHOBG(I_{\bullet}J) = RHOBTD(I_{\bullet}J)$	UPDATE	46
	UbG(1,J) = UbG(D(1,J))	UPDATE	49
	VBG(1,0) = VBGID(1,0)	UPDATE	50
	HBG(1,J) = HESTD(1,J)	UPDATE	<u></u>
	UPB(1,u) = UP(u)(1,u)	UPDATE	21
6		VPDATE	
C	UPDATE THE AND PCH BY CALLING GSDPCU SATE HER AND PHOOP	UPUATE	53
	CALL GSPROP (RU, RHOAR CVO. CV. AV DOUT IN HOCKT AN	UPUATE	54
		UPDATE	55
1	(BU(10) (KNOBU(10) (BB(10) (VEU(10) (BAF)(P(2)	UPDATE	56
¢.		UPDATE	57
		UPDATE	58
	00(1.3) = 00101(1.3)	UPDATE	59
	DI(1,J) = DITUT(1,J)	UPDATE	60
	IF (PCH(I+J).LE.0.0.0.0R.HB6(I,J).LE.0.0R.RHCBG(I+J).LE.0.0)	UPDATE	61
	+GC TU 10	UPDATE	62
L		UPDATE	63
	IF(.NOT. PK11) GU TO 40	UPDATE	64
	IF (.1.01. 10EBUG(15)) GU TC 40	UPDATE	65
	IF (.NOT. FRI2) 60 TO 40	UPDATE	65
1	CONTINUE	UPDATE	00
-	PHES = P(H(Las)/144	UPDATE	61
	WETTH (A. 2001) THE PUTPERT IN PUPPERT IN UPPERT IN UPPERT	UPDATE	68
		UPUATE	69
		UPDATE	70
	<pre>c</pre>	UPDATE	71
	J	UPDATE	72
40	CONTINUE	UPDATE	73
6		UPDATE	74
50	CUNTINUE	UPDATE	75
L		UPDATE	76
C	FURUSITY TEST	UPDATE	77
	1 (UNED) GO TO 100	UPDATE	78
	1+ (.NUT. VAR) 60 TU 100	UPDATE	70
	1+ (1.LE. IBEGB)60 TO 100	UPDATE	80
	1+(1 .GT. 1ENDE) 60 10 100	LIPOATE	41
	1+ (PH18P(1,1) + LT. 0.999) VAR	UPDATE	01
100	LUNI MUL	UPDATE	82
6		UPUATE	85
	NAMEL 1ST 2001 2001 M15 + 001 MHG - 720	UPUATE	84
		UPDATE	85
		UPDATE	86
	CONTINUE (CONTO) AND. PRIL WRITE(6.001)	UPDATE	87
110	CONTINUE	UPDATE	88
C		UPDATE	89
C		UPDATE	90
C+++4	***************************************	UPDATE	91
C	LETERMINE WHETHER THE CHAMBER SHOULD BE MADE 1-DIMENSIONAL	UPDATE	92
C+++	******	LIDDATE	07

L		HODATE	-	
	<u>IF (UNED) 60 TO 150</u>	UPDATE	94	
	1+ (.NUI. VAR) 60 10 150	UPDATE		
	1F(.NU). IGNIT) GO TU 150	UPUATE	96	
	UNED = .INUE.	UPDATE	- 97	·• •
	CALL UNEUIN	UPDATE	98	
	1+(10EBUG(17)) WRITE(6.2006) Time	UPDATE	99	
-	1+(14600(17)) BRI1E(6:2009) 1PMINT	UPDATE	100	
	1+ (.NUT. IDEBUG(18)) 60 TO 150	UPUATE		
	wk17E(0:2007)	UPDATE	102	
	UU 130 [=1.0HUX	UPDATE	103	
	PRES = PCH(1,1)/144	UPDATE	104	
	WRITE (0,2008) 1, PHIMO(1.1), NHUBG(1.1), UBG(1.1), HBG(1.1)	UPDATE	105	- terre a
	The first set and the state of	UPUATE	106	
1.50	CUNTINUE	UPDATE	107	
L		UPDATE	105	
100	CONTINUE	UPDATE	109	
L		UPDATE	110	
C		UPDATE	111	
64++4	*********	UPDATE	112	
C	UPUAIL BARKEL ANHAYS	UPDATE		
6+++4	**********	UPDATE	114	
C		UPDATE	115	
	11 (+ NUI - PRII) 50 TO 170	UPDATE	116	
	14 L. NUT. 1DEBUG(19)) 60 10 170	UPDATE	117	
	WELTE (b, 2004)	UPDATE	116	
	1 = 1	UPDATE		
	PRES = P6(1)/144	UPDATE	120	
	WHITE (6.2005) 1. PHI(1), RHOG(T), G(1), HG(T), TG(T), PRES 10.11	UPDATE	121	
	3 UL(I), UURAG(I), PMDOT(I), AMASS, (), AMEMITY, AFAFFFTT	UPDATE	122	
	3 XLB(1), UB(I), DIB(I)	UPDATE	123	
174	CONTINUE	UPDATE	124	
6		UPDATE	125_	
	1+ (NX +L] + 2) 60 TU 220	UPDATE	126	
	00 200 1=2.NX	UPDATE	127	-
	PHI(1) = UPHI(1)	UPDATE	128	
	$RHUG(\mathbf{I}) = URHUG(\mathbf{I})$	UPDATE	129	
	$U_{G}(I) = UU_{G}(I)$	UPDATE	130	
	Hb(1) = UHG(1)	UPDATE	131	
	OP(1) = OUP(1)	UPDATE	132	
C		UPDATE	. 133	-
6	UPDATE TO AND PO BY CALLING GSPROP ANTA NO AND PHONE	UPDATE	134	
	CALL GSPROP (RO+RRO+R+CVA+CVA+CVA+CVA+CVA+CVA+CVA+CVA+CVA+CVA	UPDATE	135	
	UG(1):0.0.6AM.CP.2)	UPDATE	136	
C		UPDATE		
-	ALB(I) = UXEB(I)	UPDATE	138	
	UUB(1) = UU0E(1)	UPDATE	139	
	U1B(1) = UU1B(1)	UPDATE	140	
L	a tradition of the second	UPUATE	141	
	AMASS(I) = UAMASS(I)	UPUATE	142	
	AMOM(1) = UAMOM(1)	UPUATE	143	
	ALNER(I) = UAENER(I)	UPUATE	144	
	1F(PG(1).LE.U.U.OR.HG(1).LE.O.O.OH.HHLG(1).LF.D.D. CO TO 140	UPUATE	145	
L.		UPDATE	146	
	1+ (.NOI. PHII) GU TU 200	UPUATE	147	
	1F(.NUI. 10EBUG(19)) GU 10 200	UPUATE	148	
150	CONTINUE	UPUATE	149	
		UPDATE	150	

PRES = P6(1)/144.	UNDATE	161
#KITE(6.2005) I.PHI(I).KHOG(I).G(I).HG(I).TG(I).PRES.	LUDATE	162
> UP(1), QL(1), UUKAG(1), PMDOT(1), - MASS(1), AMOM(1), AENFH(1).	UPDATE	104
1 $xLB(1) \cdot DUP(1) \cdot DIB(1)$	UPDATE	100
200 CUNIINUT	UPUATE	154
ZEU CUNTINUE	UPUATE	155
	UPUATE	156
(**************************************	UPDATE	157
C PRINT OUT CERTAIN PRESSURES	+ UPDATE	158
	UPDATE	159
	+ UPDATE	160
1F(.60T. PRIT) 60 TO 266	UPDATE	161
IFLINUL, THENERATIN AN AND	UPDATE	162
	UPDATE	163
	UPDATE	164
	UPDATE	165
200 CONTINUE	UPDATE	166
	UPDATE	167
	UPDATE	166
	+ UPDATE	169
C CONFORT MASS OF GAS IN THE SYSTEM AND THE MASS OF BLACK POWDER	UPDATE	170
C AND PROPELLANT IN THE SYSTEM	UPDATE	171
_*************************************	+ UPDATE	172
L	UPDATE	173
C CALCULATIONS WILL BE DONE EACH TIME INTERVAL AND DENSITIES WILL BE	UPDATE	174
C AUJUSTED IF MASS IS LOSI.	UPDATE	175
<u> </u>	UPDATE	176
C LUGIC IS NOT WRITTEN FOR THE CASE WHENE CHAMI IS TRUE	UPDATE	177
1F(NUT CHAM1) GO TU 250	UPDATE	170
KLIL(6.2010)	UNDATE	170
ού το δύα	UPDATE	1/7
	UPDATE	100
250 CONTINUE	UPDATE	181
1F (UNEC) 60 10 300	UPDATE	182
VOL = UVAXIS+0.5	UPDATE	183
UASMAS = (PH186(1.1) + PHI8P(1.1) = 1 ()+PHCBE(1.1)+VO	UPDATE	184
$PRUMAS = \{ (1,0) - PHIR((1,1)) = PHIR((0,1,1)) = PHIR((1,1,1))$	UPUATE	185
A VUL	UPUATE	186
JOL = DVAXIS	UPDATE	187
	UPDATE	188
VOLHPU = VOLEAPOINS	UPDATE	189
	UPDATE	190
GASMAS - GASMAS - (Defection - C tubit as - A anthropped	UPDATE	191
- GASHAS + (FRAB(111) + PFIBP(11) = 1.0)*RHOBG(1.1)*	UPDATE	192
	UPDATE	193
+ + + + + + + + + + + + + + + + + + +	UPDATE	194
	UPDATE	195
COU CONTINUE	UPDATE	196
	UPDATE	197
VOL = AREAR(1)+DX+0.5	UPDATE	198
SASTAS = GASTAS + (PHING(1.2) + PHINP(1.2) = 1.0)*RHOBG(1.2)*VOL	UPDATE	199
= PRUMAS = PRUMAS + ((1,0) - PHIBG(1,2)) + RHOP +	UPDATE	200
3 (1.0 - PHIBP(1+2))+BPDENS)+VCL	UPDATE	201
00 270 1=2,NGX	UPDATE	202
VUL = AREAK(I)*DX	UPDATE	203
GASMAS = GASMAS + (PH186(1+2) + Fr18P(1+2) - 1.0)*RH086(1.2)*	UPDATE	204
\$ VOL	UPDATE	205
PRUMAS = PRUMAS + ((1.0 - PHIB: (1.2)) + FHOP +	HEDATE	205
S (1.U - PHIBP(1,2))++PDENS LAWLL	UPDATE	200
	UPUMIC	201

270	CONTINUE	UPDATE	208
	1 (CHAM2) 60 TU 320	UPDATE	209
£		UPDATE	210
L	THE AL AND PROPELLANT AND NO BLACK FUNDER IN RADIAL ROW 3 (WHEN	UPDATE	211
L	LAAMS IS THUE)	HPDATE	212
	VUL = AREAGP(1) + UX = 0.5	UPDATE	212
	GASMAS = GASMAS + RHOBG(1,3)+VOL	UPDATE	£13
	LU 260 1=2.146X	UPDATE	214
	VUL = AREAGP(I) + ()	UPUATE	
	UASMAS = GASMAS + HHURGITAAAAVO	UPUATE	216
200	CONTINUE	UPDATE	217
	60 10 A20	UPDATE	218
C.		UPDATE	219
í.	CALCULATIONS WHELL CHANNER IS ONE OTH A TONAL	UPDATE	220
5l	CONTINUE CHAFTER IS ONE DIFLESIONAL	UPDATE	221
000		UPDATE	222
		UPDATE	223
	$H_{1} = 1.0 + RHCBG(1.1) + PHIBP(1.1) = 1.0 + RHCBG(1.1) + VOL$	UPDATE	224
	-ROMAS = ((1.0 - PHIBG(1.1)) + RHOP + (1.0 - PHIBP(1.1)) + BPDENS)+	UPDATE	225
	S VOL	UPDATE	226
	00 310 1=2,HGX	UPDATE	227
	VOL = ARLAC(1)+DX	UPDATE	226
	GASPAS = GASPAS + (PHIBG(1+1) + PHIBP(1+1) - 1+0) + RHOBG(1+1) +	UPDATE	229
	s VOL	UPDATE	230
	$PRUMAS = PRUMAS + ((1.0 - PH_{Bu}(1.1)) * PHOP +$	UPDATE	231
	(1.0 - PHISP(1.1)) + BPDENS) + VUL	UDDATE	212
324	CONTINUE	UNDATE	232
C		ULUDATE	230
C	BARKEL LALLULATIONS	UPDATE	234
Jeu	CONTINUE	UPDALE	235
	1+ (NX + EQ. 1) 60 TO 360	UPUATE	236
	VUL = BUREA+UX	UPDATE	237
	VOLROP = VOL+RHOP	UPDATE	238
	1F (NA . EQ. 2) 60 TO 340	UPDATE	239
	$a \times 1 = a \times - 1$	UPDATE	240
	UU 334 1=2.611	UPDATE	241
	GASMAS - GASMAS - DELITIENDACION - OF	UPDATE	242
		UPDATE	243
340		UPDATE	244
(UPDATE	245
54.0	1 Dut thick	UPDATE	246
040		UPDATE	247
	VII HIN - VII ADEAD	MOD0301	114
		MOD0301	115
	HEIRA - HASTAS + PHILINAJAKEUGINXJAVCL	MOD0301	116
	PROPAS = PROPAS + (1.0 - PHIMA)) + yuknop	MOD0301	117
		UPDATE	250
360	IF (PRIL .AND. IDEBUG(20)) WRITE (6.2011) GASPAS PROMAS	UPDATE	251
L		UPDATE	252
L	AUJUST DENSITIES	UPDATE	253
	ALIGAS = TOTH - PROMAS	UPDATE	254
	AUJUST = ACTGAS/GASMAS	UPDATE	255
	DU 370 J=1.NUR	UPDATE	254
- Wester Mar	UU 370 1=1,NGX	UPDATE	257
	HOUG(I,J) = HOUG(I,J)+ADJUST	IPDATE	257
570	CONTINUE	UPDATE	250
	UU 360 1=2.NA	UPDATE	259
	RMOG(1) = RHOG(1) + ADJUST	UPDATE	260
300	CONTINUE	UPUATE	261
-		UPDATE	262

6		UPDATE	263
	IF (PRIL , ANU. LUEBUG(20)) WRITE (6.2013) ACTEAS, ADJUST	UPDATE	264
Ĺ		UPDATE	265
L	ar de jarrende de en i e el e es de de de un outrestadaden et ide un aderende ader de rede de ances de aderende aderende aderende de aderende ader	UPDATE	266
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C .	ALLE A KUNNING SUM OF LOTAB, DOTAP, AND PHOOT TERMS AND	UPDATE	260
L	ULTERMINE GAS CONSTANTS ON THE BASIS OF THESE	UPDATE	269
		UPDATE	270
L		UPDATE	271
L		UPDATE	272
L	IF UHAMI IS TRUE THIS LUGIC IS SKIPPEC.	UPDATE	273
400	CONTINUE	UPDATE	274
	IF (UNEU) GU 10 420	UPDATE	275
	UUIMES = DOTMES + (DUTME(1+1)+DVAX15 + DOTME(1+2)+AREAR(1)+DX)+0+5	UPDATE	276
	DUTAPS = DOTAPS + (DUTAP(1+1)+DVAXIS + DOTAP(1+2)+AREAR(1)+DX)+0+5	UPDATE	277
	UO 410 1=2,NGX	UPDATE	278
	DUTMBS = DUTMBS + DOTMB(1+1)+CVAXIS + DCTMB(1+2)+AREAR(1)+DX	UPDATE	279
	DUTMPS = DUTMPS + UOTMP(1,1)+CVAX1S + DCTMP(1,2)+AREAR(1)+DX	UPDATE	280
410	CONTINUE	UPDATE	281
	60 10 440	UPDATE	282
6		UPDATE	283
C	CALCULATIONS WHEN THE CHAMBER IS ONE EIMENSICNAL	UPDATE	284
420	CONTINUE	UPDATE	285
-	UUIMUS = DOTHES + UOTHU(1+1)+ANEAC(1)+DX+0.	UPDATE	286
	UDIMPS = DOTMPS + DOTMP(1+1) + AMEAC(1) + DX+0+	UPDATE	287
	JC 430 1=2,NGX	UPDATE	288
	DUTHES = DUTHES + DUTHE(I+1)+ARLAL(I)+DX	UPDATE	289
-	DUTMPS = DUTMPS + DOTMP(1,1)+AREAL(1)+D)	UPDATE	290
450	CONTINUE	UPDATE	291
L		UPDATE	292
C		UPDATE	293
C	BARREL CALCULATIONS	UPDATE	294
440	CONTINUE	UPDATE	295
	IF (NX + EQ. 1) 60 TO 470	UPDATE	296
	VOL = BOREA+DX	UPDATE	297
	IF (NX , EQ. 2) GO TO 460	UPDATE	298
	NX1 = NX - 1	UPDATE	299
	00 450 1=2,NX1	UPDATE	300
450	PHDUTS = PHDUTS + PHDUT(I)+VOL	UPDATE	301
L		M000801	118
460	PROUTS = PROUTS + PROUT(NX)+BUREA+(UXFRIR - DX+0.5)	MOD0301	119
		UPDATE	303
470		UPDATE	304
	PROPS = DUTABS + PHD01S	UPDATE	305
		UPDATE	306
		UPDATE	307
		UPDATE	308
-		UPDATE	309
	NU - TRAUNSTRUNG T FRAUDETRUDE NNN - EVAENLADDAMA A EVAEDDADDADD	UPDATE	510
		UPDATE	311
	TVM + EHACMA+CVUNC + EHALDD+CVNOP	UPDATE	512
	CALL - LUNCHONACANUD & LUNCOLACAUDL	UPUATE	513
	C (b) I Du (b	UPDATE	314
400	TELEVIL AND THENRESSIN HOTELS AND	UPDATE	315
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		UPDATE	317

INT REGUY FOR THE NEXT LIME INTERVAL	UPDATE	310
	UPDATE	320
	UPDATE	121
C	UPDATE	321
SUU CONTINUE	UPDATE	326
	UPDATE	323
CLEAR ARRATS COTMIS AND DUTMES FOR SCENDUTINE MELOW, ARRAT DOTHE	UPDATE	324
L FOR PRIMER, ARRAY WOAD FOR PEPETR, ARRAY DOTED FOR REGRES, AND	UPDATE	325
L ANNAT UPBDI FUR PRPVEL.	UPDATE	326
CALL LLEAR(DOTMIG(1). UBAG(00.5))	UPDATE	327
LALL LLLAK(DOTMH(1,1), UPHOT(60,5))	UPDATE	328
LALL LLEAK(DUTNEG(1),DUTMP(60,5))	UPDATE	329
	UPDATE	330
	HPDATE	331
C CLEAN ANNAY MODULE ON SUPROUTINE DINA. ANDAY OF FOR HNDLYR.	UNDATE	332
A STARY TOWAR FOR FOUL AND ARRAY HE & PROFILE	UPDATE	777
C ANAL SURGE FOR ROOM, AND ARAL SEP FOR FROME,	UPDATE	333
CALL CLEAR PROVIDIT OFFICE	UPDATE	234
P11=PCP(1,1)/144.0	UPDATE	335
P12=PCH(1,2)/144.0	UPDATE	336
PN1=PCH(NGX+1)/140+0	UPDATE	337
PN2=PCH(N6X12)/144,0	UPDATE	338
P6N=P6(f(X)/144.0	UPDATE	339
xPPF=XP+12.0	UPDATE	340
124=124+1	UPDATE	341
1124=800(124,10)	UPDATE	342
IF CLUE HE GEDELAND, TIDELE W. ONWRITE C. DUISITES INT. TIME. P11.	UPDATE	343
	UPDATE	344
	WEDDCOS	
IFIDEDOGISH) AND, TIME LI, U,UUS) ANTIELEIZUIS/	MODUEUS	20
• IIACIUUIMPRIIGPRIFRAZIIPUSAK	MUUUGU4	6
C .	UPDATE	345
IL TURN	UPDATE	346
C	UPDATE	347
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L C C C C C C C C C C C C C C C C C C C	UPDATE	349
C+++++++++++++++++++++++++++++++++++++	UPDATE	350
L	UFDATE	351
2001 FURMAI(/,215,7(2X,E14,6))//10X,7(2X,E14,8)./.	UPDATE	352
5 104-6(24-6) 1	UPDATE	353
2103 FORMALIZAT IPRINT = 1.16	UPDATE	354
A 11 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	UPDATE	365
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A THE ART OF THE THE THE THE TIME TO THE TIME THE	UPDATE	330
2 /1134 THIDT 1114 UPB 1134 TZC 1134 WBPG 1114 TURAW 1114	UPDATE	357
3 'DUTHE'.11X. 'DUTHP'./.16X. 'TBP'.14X. 'XL'.14X. DU'.14X. DI')	UPDATE	358
2004 FURMAI(///,3X+'I'+5X,"PHI"+13X+"RHUU"+13X+"LG"+14X+"HG"+14X+	UPDATE	359
1 '16'.14%.*P6'.14%.*UP'./.29%.*6L*2%.*UCRAG*.11%.*PMDOT*.	UPDATE	360
2 11X. * AMASS* 12X. * AMUM* . 11X. * AE.E.K.* .	UPDATE	361
3 /•28X•*XLE*•13X•*DUE*•13X•*DIE*;	UPDATE	362
2005 FORMAL(//.15. 7(2X.E14.8)./. 21X. 6(24.E14.6). /.21X. 3(2X.E14.8)	UPDATE	363
CUUD FURMAIL'I AT TIME '+E13.7+ THE HAMBER WAS MADE 1-DIMENSION	UPDATE	364
51 * 3	UPDATE	365
2007 FORMALL////.Ax. 11.6x. PHING. 114	UPDATE	366
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TURNELL DE JURE CHE PERSON OF DE ANDRE DE TRANSPORTENT	UFURIC	367
2000 FURNILLAIDALLARDALARDALARDALARDALARDALARDALA	UPDATE	368
2009 FURNAL (//+ IFKIN) = +,13)	UPDATE	369
2010 FURMAIL LOGIC FUR SUMMING GAS MASS AND PROPELLANT MASS HAS NOT E	UPDATE	370
SEEN WEITTEN FOR CHAMI IRUE!)	UPDATE	371
2011 FURMALLS THE MASS OF GAS IN THE SYSTEM IS .F10.4.1/1	UPDATE	372
A THE MARY OF GROOL LANT AND DI DOLOFD TH THE EVETEN TEL	HPDATE	373

5 F10 2012 F0KM 5 F10 5 E10 2015 F0KM 2014 F0KM 2014 F0KM 2016 F0KM 4 5X. ENU	J.4) AI(//.* DUIMBS = *.+ AI(//.* FUK THE NEXT J.4.//.* FUK THE NEXT J.4./ CVU = *.Elu.4.* AI(* ACTUAL GAS IN TH AUJUSTING +KACIION J AI(1HU.++RESSURE AT (AI(2X. 15. 3X. 6(E13. AI(//.2X.5HTIME=.E14. DHUMPR=.E14.5.5X.6HP)	-10.4.* CUIMPS = *.F10.4.* PMDOTS = *. I TIME INTERVAL RO =*.E10.4.* MRO =*. CVH =*.E10.4./) ME SYSTEM IS*. F10.4. LS*.F10.4./) GRID (1.1) IS*. E20.10) 6.2X)) .8.3X.7HDCIMFF=.E14.5. MMXP=.E14.5.3A.6HPDSHR=.E14.5)	UPDATE UPDATE UPDATE UPDATE UPDATE UPDATE UPDATE UPDATE MODOG11 MODDG11 UPDATE	374 375 376 377 378 379 380 381 6 7 382
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	COMPONED AND LE TO AND	ONEDIM	4
	Compary IA IN AL AB HOATNOR I LEGE IENDE IPATH (60.5) AREAG(E)	CHAMIX	2
	ARCACHAREAC(50), IGNI, ONED, DIAM1, LIAM2, CIS1, DIS2, DIS3, DIS4,	CHAMIX	3
	aREAR(60), AND AAX, CHAM1, CHAM2, CHAM3, 10PGAP, AREAGP(60), DAVG,	CHAMIX	4
	3 AREAH2, DIAMBT, BELEND, BELBEG, 1PS1, 1P32, RADFS, BPIGN	CHAMIX	5
	CUMMUN/EQNS/DIDX 120R 120X TWOIDR .DIGK .HMB TWOGJ DYAXIS .DVAXIT	LONS	2
	S UX, UK, NX, GU, INUDT, HEP	IONS	3
	LOMMUL/GASCOK/RIJAKKOALVUACVA	ONFUTM	7
	LUMMON/GRAIN/ XL(60.5), DU(60.5), L160.5), FN.	GHATN	9
	1 XL101(60.5), 00101(60.5), 1707(60.5), XL0, 000, 010.	CHAIN	-
	< ALD(100), LOB(100), JB(100), DB(5/00), LOB(100), UDTR/100)	COMBAN	3
	LOMMUNZINPUTSZUI . C2.C4.C4.T0.TIGN.C.C.S. PHOE. DUTO TE CA. PHOP	GRAIN	4
and the stands against	historia in the second state in the second sta	INPUTS	2
		INPUTS	3
**	COMPANY ALL YOF LESS PRADIES 101 AVENEP BENEP LESS	PRIMY	2
	Company DAC/PHIBG(80.5), RHURG(60.5), HBG(60.5), UBG(60.5),	HAG	2
	1 VB0(E0,5), UFB(60,5), PCH(60,5), 12C(60,5),	BAG	3
	2 UUIMIG(UU), WBAG(BU,5), XDRAG(GU,5), DOTPB(60,5), UPBDT(60,5),	HAG	4
-	3 PHID10(60,5), HHUBTU(60,5), HBGTU(60,5), UBGTU(60,5).	BAG	5
	4 V0610(60+5)+T86(60+5)+D0TMBG(60)+C+TMP(66+5)+PHIBP(60+5)+	BAG	f.
	5 PHIPTU(60,5),T2k(60),TUP(60,5)	BAG	7
	LOGICAL IGNIT, UNED . CHAPIT . CHAM2 . CHAP Sour PIGN	CHANLOG	· · · · · · · · · · · · · · · · · · ·
C		CHANCOU	
Ū.	THIS SUBROUTINE PUTS THE CORRECT CHAMBER AREAS INTO APPAY APEAC	ONEDIM	
c	FUTS VULIME - LETINTED AVERAGES OF THE C S ADDAVE TATO ANAL AREAS	UNEDIM	14
C C	LIEPTNIS AT GRID 1. CLEARS THE GAS ARRAIS INTO THE ARRAI	ONEDIA	15
í	AND STIS ACE TO THE CLEARS THE DAS ARMATS AT THE UTHER GRIDS,	ONEDIM	16
r	AND SETS NOR IV IL	ONEDIM	
L		ONEDIM	18
Mittalierin k e	DATA FIUF/. (03398/	ONEDIM	
C.		ONEDIM	20
<u> </u>		ONEDIM	21
L		ONEDIM	22
(++++	***************************************	ONEDIM	23
6	FILL ANNAY ANEAC	ONEDIM	24
6++++	***************************************	ONFOTH	25
C		ONEDIM	2.9
	AF (CHAMS) GO TO 30	UNEDIA	26
	00 20 L=1.NGx	UNEDIA	
	ANTAL TIT - ADLANTI A ADEAAV	ONEDIM	28
20		ONEDI	29
« U		ONEDIM	30
	66 16 50	ONEDIM	.31
6		ONEDIM	32
	CONTINUE	ONEDIM	. 33
	UU 40 1=1.NGX	ONEDIM	34
	$A^{R}LAC(1) = AREAR(1) + AREAAR + AREAGP(1)$	ONEDIM	35
40	CONTINUE	ONFOTH	36
		ONEDTM	37
50	APLAL(NGX+1) = DORLA	ONEDIM	TA
6		ONEDTH	10
L		ONEDTH	
C++++	*********	UNEDIM	40
L	FILL LALH CHAMBER ARRAY AL (1.1) LTL. HE VOLUME DE CONTRACTOR	UNEDIM	41
i.	UF THE ARRAY LALIES AT 1.	UNEDIM	42
		ONEDIM	43
6		ONEDIM	44
-		ONEDIM	45

		ONEDIM	47
*	00 500 I=1,NGX	ONEDIM	48
C		ONEDIM	49
C	PARE IZE GREATER THAN TIGN SO THAT REGRES CALCULATIONS ARE DONE.	ONEDIM	50
	$T_{2}(1,1) = T_{1}(0, + 1, 0)$	ONEDIM	51
C		ONEDIM	52
	RMUBG(1,1) = RHUBG(1,1) + AREAG(1)	ONEDIM	53
	HBG(1,1) = HBG(1,1) * AREAG(1)	ONEDIM	54
	UHG(I+1) = UHG(1+1) * AKEAG(1)	ONEDIM	55
1 mg 10-010-1 m	$PCH(1,1) = PCH(1,1) + ARE \Delta G(1)$	ONEDIM	56
	$1EMP = (1 \cdot 0 - PHIBG(1 \cdot 1)) * AREAG(1)$	ONEDIM	57
	$UPU(\mathbf{I},1) = UPH(\mathbf{I},1) + IEMP$	ONEDIM	58
	XL(1,1) = XL(1,1) + TEMP	ONEDIA	59
	DU(1,1) = DO(1,1) + TEMP	ONEDIM	60
	UI(1,1) = UI(1,1) + FEMP	ONEDIM	61
L	THIS STATEMENT SHOULD COME AFTER THE CALCULATIONS OF TEMP.	ONEDIM	62
	$PHIBG(1,1) = PHIBG(1,1) \ast AREAG(1)$	ONEDIM	63
	BPRAD(I+1) = BPRAU(I+1) * (1+0 - P+1BP(I+1)) * AREAG(1)	ONEDIM	64
	PHIBP(1,1) = PHIBP(1,1) + AREAG(1)	ONEDIM	65
C		ONEDIM	66
	UU 250 J=2,NGR	ONEDIM	67
	RHUBG(I,1) = RHUBG(I,1) + RFUBG(I,U) + AREAG(J)	ONEDIM	68
	HBG(I,1) = HBG(I,1) + HBG(I,J) * AREAG(J)	ONEDIM	69
	$UBG(I \bullet 1) = UBG(I \bullet 1) + UBG(I \bullet J) + AREAG(J)$	ONEDIM	70
	PCH(1,1) = PCH(1,1) + PCH(1,1) + AREAG(J)	ONEDTH	71
	PHIBG(1+1) = PHIBG(1+1) + PHIBG(1+J) + AREAG(J)	ONEDIM	72
Broken der verstenden	$TEMP = (1.0 - PHIBG(I,J)) \bullet AHE_AG(J)$	ONEDIM	73
	UPB(I+1) = UPB(I+1) + UPB(1++) + TEMP	ONEDTH	74
	$XL(1,1) = XL(1,1) + XL(1,0) + I_MP$	ONEDTM	75
	$DO(I+1) = DO(I+1) + DO(I+J) + T_MP$	ONEDIM	76
and the state	$DI(I+1) = DI(I+1) + DI(I++) + I_{E}MP$	ONEDTH	77
	BPRAD(1,1) = BPRAD(1,1) + bPRAD(1,J)*(1,0 - PHIBP(1,J))*	ONEDIM	78
	3 AREAG(J)	ONEDIM	79
	PHIBP(1,1) = PHIBP(1,1) + PHIBP(1,J) + AREAG(J)	ONEDIM	80
250	CUNTINUE	ONEDIM	81
C		ONEDIM	82
	RHOBG(I,1) = RHOBG(I,1) / ARSACH	ONFDIM	AB
	HBG(1+1) = HBG(1+1)/AREACH	ONEDIM	84
	UBG(1,1) = UBG(1,1) / AREACH	ONEDIM	85
	$PCH(I_1) = PCH(I_1)/AREACH$	ONEDIM	86
	PHIMP(1.1) = PHIMP(1.1)/AREACH	ONEDIM	A7
	ILMP2 = (1.0 - PHIBP(1.1))+AREALH	ONFOTA	AA
	IF(TLMP2 .LT000001) GU TO 255	M001205	10
	BPRAD(I,1) = BPRAD(I,1)/TEMP2	ONFOIM	90
	6U TO 258	ONEDIM	91
6		ONEDTH	82
255	CUNTINUE	ONFOTA	- 76
	dPRAU(I,1) = 0.0	ONEDTH	93
C	n din independential and a second of a compare which and address of the water of a second address of the secon	ONEDIA	OF.
258	CUNTINUE	ONEDIM	73
	PHIBG(I,1) = PHIBG(I,1)/ARLACH	ONEDIA	97
	1644 = (1.0 - HHIBG(1.1))+AREACH	ONEDIM	94
	1FITEMF .LT U00001) 60 TO 260	M001205	11
	UPB(I,1) = UPB(1,1)/TEMP	ONEDIM	100
	AL(1,1) = XL(1+1)/TEMP	ONEDTM	101
	UU(1,1) = UO(I,1)/TEMP	ONFOTH	102
and the second second second second			AVE

	UU 10 300 .	ONEDIM	104	
<u>C</u>		ONEDIM	105	
« L L	UPB(I,1) = 0.0	ONEDIM	106	
	$\mathbf{xL}(1,1) = 0_{0}0$	ONEDIM	107	
	$JU(1,1) = U_0$	ONEDIM	108	
	$\cup I \{ I \cdot I \} = U \cdot U$	ONEDIM	109	
٤		ONEDIM	110	
JUL LU		ONEDIM	111	
50	ТО 600	ONEDIM	112	
6		ONEDIM	113	
L		ONEDIM	114	
C		ONEDIM	115	
L LAL	LULATIONS FOR CHAP 2 TRUE	ONEDIM	116	-tr affred
460 CC	INT INCE	ONFUTM	117	
نان	450 1=1,NGX	ONEDTH	118	
	4C(1,1) = 116N + 1.0	ONEDIM	110	
	FILMP1 = (FH186(1,1) + PH18P(1) - 1.0)*AREAAX	ONFOTM	120	
	PIEPP2 = (PHIEU(1,2) + PHIEP(1,2) = 1.01#ARFAR(1)	ONFOTH	121	
	UPHAD(I.1) = UPHAD(I.1)+(1.0 - PHIRP(I.1))+ARFAAY	ONEDIM	122	
*	BPRAU(1.2)+(1.0 - PHIBP(T.L.)AARFAR(T)	ONEDIM	102	
	PHICH(I.)) = (PHICH(I.)) + ANFAAL A DAIDDIT, ON-ADFAULTING		125	
	ANFALLIS	ONEDIM	124	
·· ··	TEMP = () (_ PELEPILATIEADEA, ()	- UNEDIM	125 .	
	$\frac{1}{11} = 1200 = 112011012010000000000000000000$	UNEDIM	126	
		M001205	12	
	OFRAD(1,1) = OFRAD(1,1)/TEMP	ONEDIM	128	
45	60 10 420	ONEDIM	129	-
6		ONEDIM	130	
910	CONTINUE	ONEDIM	131	
	BPRAD(1,1) = 0.0	ONEDIM	132	
C		ONEDIM	133	-
460	CURTINUE	ONEDIM	134	
	IEPP1 = (1.0 - PHLUG(1.1)) * AREAAX	ONEDIM	135	
	$1EMF2 = (1 \cdot 0 - FH1BO(1 \cdot 2)) + AREAH(1)$	ONEDIM	136	
	PHIBG(I+1) = (PHIBG(I+1) + AREAAX + PHIBG(I+2) + AREAR(I))/	ONEDIM	137	
3	AREAL(1)	ONEDIM	138	
	TEMP3 = (1+0 - PHIDG(1+1))+AREAL(1)	ONEDIM	139	
1+	(1LMP3 .LT000001) 60 TO 430	MOD1205	13	
_	UPB(1+1) = (UPB(1+1)+TEMP1 + UPB(1+2)+TEMP2)/TEMP3	ONEDIM	141	
	XL(1,1) = (XL(1,1)+TEMP1 + XL(1,2)+TEMP2)/TEMP3	ONFDIM	142	
	UU(1,1) = (UU(1,1)+TEMP1 + DO(1.2)+TEMP2)/TEMP3	ONEDIM	143	
	L1(1,1) = (U1(1,1)+TLMP1 + 01(1.2)+TEMP2)/TEMP3	ONFOIM	144	
1+	(XL(1+1) .LE. DUR. UU(1+1) .Lt. uOR. DI(1+1) .LE.	M0D1205	14	
	U.) PHI8G(1,1) = 1.0	MODIONS	16	
	60 10 440	ALEDIM	146	
430	$UFb(I \cdot 1) = 0.0$	ONFOTH	142	
	$X_{1}(1,1) = 0.0$	ONEDIN	140	
	UV(1.1) = 0.0	UNEDIN	.147.	-
		UNEUIN	148	
LF	(XI 11.1) IF. 0	UNEDIA	149	
	0.3 PHIRGELAN = 1 0	M001202	16	
· ·		HU01205	17	
44.0	(118-7 TAULE	ONEDIM	150	
440		ONEDIM	151	
•	$r_{1}r_{0} = (r_{1}r_{0}r_{1}r_{1}) + r_{1}r_{0}r_{1}r_{1} = 1.0) + AREAC(1)$	ONEDIM	152	
		ONEDIM	153	-
L####PIL	TTO SHOULD NEVER BE 0.0	ONEDIM	154	-
	KHUSAV = (KHUBG(1,1)+PTEMP1 + KHCbG(1,2)+PTEMP2)/PTEMP3	ONEDIM	155	
	$HOU(I \cdot 1) = (HOU(I \cdot 1) + TEMP1 + RHung(I \cdot 1) +$	ONFUTM	156	

	HAGIT STARTENESS HHUGGIT STATUTENESS HAGSAVE	ONFOTA	157
		ONEDIM	164
		ONEDIM	159
		ONEDIM	140
	AUCOULT - AUCOR	ONEDIM	141
	TH ENERGY TH HUNATE DES	ONEDIM	162
-	ALL GONOUTRO HEALT ALCONCOLOU. C. B. HIT. S. HEGT. S. TAIM.	ONEDIM	143
		ONEDTH	164
		ONEAR	145
450		UNCOIN	144
		ONEDIA	904
		ONEDIM	107
		ONEDIN	100
L	CALLULATIONS LINE CHART THIS	ONEDIA	167
		ONEDIM	171
500		ONEDIM	111
-		UNEDIM	172
	(2C(1)) = (100 + 10)	UNEDIM	1/3
L	A THE THE DATE AND THE PARTY THE PARTY	ONEDIM	174
L .	DAVE IVIAL PURUSIIT KINED ANEA	UNEUIN	175
	P = (P + IBG(1, 1) + P + IBP(1, 1) - 1, 0) + AREAAX	ONEDIT	176
	PIEPPZ = (PHAUG(1,2) + PHIDP(1,2) - 1.0) + AREAR(1)	ONEDIM	1//
	PIEMPS = AREAGP(I)	ONEDIM	170
C		ONEDIM	179
L I	NOTE (ΠA) (1.0 - PHIBP(1.3)) + AREAGP(1) 15 0.0	ONEDIM	100
	BPRAD(1,1) = BPRAD(1,1) + (1,0) - PFIBP(1,1)) + AREAAX +	ONEDIM	181
	3 = BPRAU(1,2) + (1,0) - PHIBP(1,2) + ARCAR(1)	ONEDIM	182
	PHIDP(1,1) = (PHIDP(1,1) + AREAAX + PHIDP(1,2) + AREAR(1) +	ONEDIM	185
	5 PHIBP(1,3) #AREAGP(1) // AREAC(1)	ONEDIM	184
	IEMP = (1.0 - PHIBP(1.1)) + AREAL(1)	ONEDIM	185
	IF (IEAP .LT000001) GO TO 510	M0D1205	16
	BPRAD(I+1) = BPRAD(I+1)/TEMP	ONEDIM	187
	60 10 520	ONEDIM	188
C		ONEDIM	189
210	CONTINUE	ONEDIM	190
	BPRAD(1,1) = 0.0	ONEDIM	191
C		ONEDIM	192
SEU	CONTINUE	ONEDIM	193
	TEMP1 = (1.0 - PHIBG(1.1)) + AREAAX	UNEDIM	194
	$1E_{1}=(1.0 - PHBG(1.2)) + AREAR(1)$	ONEDIM	195
L		ONEDIM	196
C	NUTE THAT (1.U - PHIBG(1.3)) + AREAGP(1) IS 0.0	ONEDIM	197
-	PHIBG(1,1) = (PHIBG(1,1) + AREAAX + PHIBG(1,2) + AREAR(1) + AREAR(1) + PHIBG(1,2) + AREAR(1) + AREA	ONEDIM	198
	S PHIBG(1+3) #AREAGP(1))/AREAL(1)	ONEDIM	199
	TLMP4 = (1.0 - PHIBG(1.1)) * AREAL(1)	ONEDIM	200
	IF(TEMP4 .L1000001) GV TO 530	MOD1205	19
	UPB(I+1) = (UPE(I+1) + TEMP1 + UPU(1+2) + TEMP2)/TEMP4	ONEDIM	202
	XL(1,1) = (XL(1,1)+TEMP1 + XL(1,2)+TEMP2)/TEMP4	ONEDIM	203
	UU(1,1) = (CO(1,1)+TEMP1 + DO(1,2)+TEMP2)/TEMP4	ONEDIM	204
	DI(1.1) = (DI(1.1)+TEMP1 + DI(1.2)+TEMP2)/TEMP4	ONEDIM	205
	60 10 540	ONEDIM	206
530	UPB(1:1) = 0.0	ONEDIM	207
	xL(1,1) = 0.0	ONEDIM	208
	UU(1,1) = 0.0	ONEDIM	209
	U1(1,1) = 0.0	ONEDIM	210
L		ONEDIM	211
540	CONTINUE	ONEDIM	212
	PIENPH = (PHIHG(1,1) + PHIHP(1,1) - 1,0) = ARFAC(1)	ONFOIM	213

*

	ONEDIM	214
ARARTIEMPA SHOULD NUT BE D.U	ONEDIM	215
RHOSAV = (NOOBG(1,1)+PTEMP1 + NOCGG(1,2)+PTEMP2 +	ONEDIM	216
* RHUAU (1,3)+PTEMP3)/PTEMP4	ONEDIM	217
$HBG(I \cdot 1) = (HBG(I \cdot 1) + PTEMP1 + RHong(I \cdot 1) +$	ONEDIM	218
1 HING (1,2) + PTEMP2+KHOBG(1,2) + FgG(1,3) + PTEMP3+RHOBG(1,3))/	ONEDIM	219
3 (FIEMP4+RHUSAV)	ONEDIM	220
UBG(1,1) = (UHG(1,1) * PTEMP1 * RFUnG(1,1) *	ONEDIM	221
106(1.2)*FTEMP2*10086(1.2) + L86(1.2)*PTEMP3*RH086(1.3))/	ONEDIM	222
(PTEMPSARHOSAV)	ONEDIM	223
Hut(G(1,1) = RHUSAV	ONEDIM	224
	ONEDIM	225
C LALL SPROP TO UPDATE PRESSURE	ONEDIM	226
CALL GSPROPIRG. HRU. R. CVG. LVH. CV. FCH(1.1) +HBG(1.1) • TOUM.	ONEDIM	227
RHUdb(1,1),Ubb(1,1),U.0,GAM,Cr,2)	ONEDIM	228
550 LONTINUE	ONEDIM	.229
	ONEDIM	230
	ONEDIM	231
TITEAN ANNAY VOG AND OTHER CHAMBER ARNAIS AT GRIDS NOT ON THE AXIS	ONEDIM	232
	ONEDIM	233
	ONEDIM	234
	ONEDIM	235
(ALL CLEAR(VEG(1.3).VEG(60.5))	ONEDIM	236
LALL LLEAR (RHOFIG (1:2) - RHUBG (60.5))	ONEDIM	237
(ALL CLEAR (PHT66(1.2), PH186(60,5))	ONEDIM	238
(ALL LLFAR(HBG(1,2),HBG(6D,5))	ONEDIM	239
(ALL (LEAK(1)(61)(2)(1)(60(5)))	ONEDIM	240
(ALL LEFAR(1)+B(1,2)+1+B(60+5))	ONEDIM	241
LALL LLEAR(PCH(1.2).PCH(60.5))	ONEDIM	242
LALL CLEAK (Thg(1.2).166(60.5))	ONEDIM	243
CALL CLEAR (XL(1.2).XL(50.5))	ONEDIM	244
CALL CLEAR(DU(1.2).D0(60.5))	ONEDIM	245
LALL (LEAR(0)(1.2), (1(50,5))	ONEDIM	246
LALL (LEAR (PHIMP(1,2),PHIMP(60,5))	ONEDIM	247
CALL LLEAN (HERAD(1,2), HERAD(60,5))	ONEDIM	248
	ONEDIM	249
	ONEDIM	250
-	ONEDIM	251
ибК = 1	ONEDIM	252
C	ONEDIM	253
IN LUKN	ONEDIM	254
	ONEDIM	255
	ONEDIM	256

	SUBROUTINE NEWLY	NEWDX	2
C		NEWUX	3
C	SUBRUUTINE NEWDA IS CALLED WHEN THE BARREL GETS A 21ST GRID.	NEWUX	4
6	THE GRID SIZE DA IS DUDBLED, THE BARNEL IS CLT DOWN TO 11 GRIDS,	NEWDX	
L	ANU THE NUMBER OF CHAMBER GRIDS IS HALVED.	NEWDX	6
L	A NEW TIPE INTERVAL IS ALSO CALCULATED.	NEWDX	. 7
6		NEWDX	8
•	LUMPUN/BARRL2/BURLA, XP, VP, BOREU, BORER, BOREDE, DT2BU, DT0S9, XLBAR	NEWDX	9
	LUMMUN/CAKEAS/ARROW1.ARROW2.ARROW3.ARIOT	M0D0301	120
	LOMMON/GRIDNX/DXFRIM	MOD0301	121
	(UMPUN/L HAM/1X, 1K, XH, KH, NGX, NGX, THE LH, IENDB, IPATH(60.5) + AREAG(5) +	CHAMIX	2
	ANT ACH, AREAL (FOL), TANLE ONED, DIAMAN, TAM2, FISL, DIS2, DIS3, UIS4,	CHAMTX	3
	ALLANIAGI ALLANIAGUNIAGUNIAGUNIAGUNIAGUNIAGUNIAGUNIAG	CHAMTX	4
	A ANALISU TANATA ATANATA ANALITA ANALIT	CHAMTX	5
	3 AREARZ UTAFOI DELENCIOLOGUITATI TAZINAUTATO TON	NEHDY	4 9
		NEWDA	11
	COMMONYEONS/DIDX. 12DR. 12DX. THOTDR. LIER HMB. THOGO DVAXIS UVAXIT	LUNS	
	3. DA, DR, NX, GU, TWODT, HBP	EUNS	3
	CUMMUN/GRAIN/ XL(60.5). D0(60.5). UI(60.5). FN.	GRAIN	2
	1 XLID1(60,5), DOTDT(60,5), DITDT(60,5), XLO, DOO, DIO,	GRAIN	3
	2 XLH(100), LOB(160), UIB(100), UXLo(100), LDOB(100), UDIB(100)	GRAIN	4
	LOMMUN/HOLEA/RADHOL(65) + NROWH + NHOLLS(65) + XCL(85) + AREAH(60)	NEWDX	14
	LUMMUN/INPUTS/C1,C2,C3,C4,T0,TIGN, WLCh,S,RHOF,PHIU,TF,CA,RHUO,	INPUTS	2
a da 1	3 MU.PU.UD.GTRHOP.HW.UM.IIGNBP.OBCUNS.TOTM	INPUTS	3
	CUMMUN/MOCON/CUN1.CON2.CUN3.CON4.CUN5.AREAPE.ZO.WOB.XUB.ROTK.	NEWDX	16
	- FUMAX, CUNS, XINT, XLU, PINT, PLO	MOD1111	51
		p	2
		PAG	2
		CAC.	
		DAG	3
	2 DOIMIG(60), GRAG(60,5), XDRAG(60,5), DOIPB(60,5), OPDI(60,5),	BAG	-
	3 PHIBTD(60.5), RHOBTD(60.5), HRGTD(60.5), OBGTD(60.5),	BAG	2
	4 VUGTU(60,5),THE(60,5),DOTMBG(60),CUTMP(6C,5),PHIRP(60,5),	BAG	6
	5 PH1P1D(60.5).12P(60.5)	BAG	
	COMMUN/BARRL/ PHI(100), RHOG(100), HG(100), UG(100), UP(100),	BARRL	5
	1 PG(100), TG(100), PMDUT(100), GL(100), UCRAG(100), FRICT(100),	BARRL	3
	2 ULUNV(100), UUF(100), UPHI(100), UNFOG(10C), UHG(100), UUG(100),	BARRL	4
	A AMASS(100), AMUM(100), AENER(100), LAMASS(100), UAMOM(100),	BARRL	5
	4 (14+ N+ 5 (3 00)	BARRL	6
	A CHERCH TOUT AND FLOCHAMS - CHAMS - CHAMS - CHAMS - PTGN	CHAML OG	2
		DIOG	2
		HEHOY	
	DATA 0(44/32,16/	NEWDA	27
C		NEWUX	24
	iv X = 11	NEWUX	25
C		NEWDX	26
C	PUT THE BARREL AFRAY VALUES AT THE UUC-NUMBERED GRIDS INTO GRIDS	NEWDX	27
C	I INKUUGH 11.	NEWDX	28
	<u>۲=۵</u>	NEWOX	29
	00 10 1=2.11	NEWDX	30
	\$+U=U	NEWDX	31
	UPSI(1) = UPSI(4)	NEWDX	32
	u = u = u = u = u = u = u = u = u = u =	NEWDX	33
	10(6(T) - 0)(10(T))	NEWDY	34
		NELDY	26
-		NEWUX	55
	OOP(1) = OOP(3)	NEWUX	36
	UDRAU(1)=UDRAG(J)	NEWUX	37
	UXLB(I) = UXLB(J)	NEWDX	39
	OUOB(1) = ODOB(3)	NEWDX	39
	UUIB(I) = UBIB(J)	NEWDX	40

	UAMASS(1) = UAMASS(J)	NEWDX	41
		NEWDX	42
	$UAE_NER(1) = UAERER(0)$	NEWDX	43
10	CONTRACT	NEWDX	44
C		NEWDX	45
6	REDUCE THE NUMBER OF GRIDS IN THE CHAPTER	NEWDX	46
L	FUT THE TOTAL HULE AREA INTO THE NEW GRIDS.	NEWDX	47
	1F(NGA .EW. 1) 60 TO 50	NEWDY	46
	ARLAH(1) = AREAH(1) + AREAH(2)	NE HDY	<u>р</u> и
	AKLANZ = AKLANZ + AKLANZ	NE HOY	50
	64 = (863 + 1)/2	ALCUDY	E1
	(16P) = 16X + 1	NEWDA	51
		NETHA.	32
č	HIT THE CHANGER AND A LINE AT THE . A. MUNOSDED OFTOG THEAT THE	NEWDX	53
i and the second	TO THE CHARGES ANAL VALUES AT THE LELENDHERED GRIDS THID THE	NEWUX	54
L	NEW CHAMBER GRIDS.	NEWDX	55
	TE (NGA . LW. 1) 60 10 50	NEWDX	. 56
	J=1	NEWDX	57
	UG 40 1=21NGA	NEWDX	58
	J=0+2	NEWDX	59
	AREAH(1) = AREAH(J) + AREAH(J+1)	NEWDX	60
	DU 30 K=1.10R	NEWDX	61
_	$PHIBID(\mathbf{I}_{i}K) = PHIBID(J_{i}K)$	NEWDX	62
	$RHOBTD(I_{I}K) = RHOBTD(J_{I}K)$	NEWDX	63
	UBGTU(1,h) = UBGTU(J,K)	NEWDX	64
	VBGTL(I,K) = VBGID(J,K)	NEWDX	65
	HBGTL(1,K) = HBGTD(J,K)	NEWOX	66
	uPBul(1,K) = uPBul(J,K)	NEWDX	L7
	XLT(T) = X(T) T (J (K))	NEWDY	61
	$\mu(0,\tau)$ (1.6) = $\mu(0,\tau)$ (1.6)	AL HOY	
	(1, 1) $(1, k)$ = $((1)(1, 1), k)$	NENDA	87
•		NEWDA	10
90		NEWDX	71
		. NEWLX	
	AREAU(1) = AREAU(0)	NEWDX	73
	(CHAPS) AREAGR(1) = AREAGR(0)	MQD0301	122
40	CUNTING	NEWDX	74
	FOT THE VOLUME LOST IN THE BARKEL INTO THE CHAMBER.	M000301	123
	VLUSI = 0.5+UX+BUKLA	MUD0301	124
	IFJUNEU) GO TO 45	MOD0301	125
	1+ (U] . CHAM2) GO TO 44	M0D0301	126
	SUM = AREAR(1462) + AREAAX	M0D0301	127
	ARHOW2 = ARROW2 + (AREAR(NGX)/SUM)+vLLST	MOD0301	128
	ARRUNI = ARRUNI + (AREAAX/SUM)*VLCSI	MOD0301	129
	AKTUT = ARROW1 + AKKUN2	M0D0301	130
	GU TU 50	NOD0301	131
L		M000301	132
44	CONTINUE.	M(D0301	1 1 1
	14 (.NUT . CHAM 3) 60 TO 50	MUD0301	174
	SUP = ALEAR (NGA) + AREAGP (NGA) + AR. ALA	8000301	1 25
	ANNUNI = ARRUNI + LANFAAA/SUMIAVICSI	N000301	174
	ARRUNZ = ARRUNZ + LAREARINGX1/SUM1. ST	M000301	1 2 7
	ARTURS = ARTURS + (ALLAGPINGY) (SIN) + 0.05T	H000301	13/
		MODUJUI	1 70
	ST U 56	MUUUSUI	139
1		MUD0301	140
	/ front a board	MUD0301	141
46		MUD0301	142
	ANTOT = ARTUL + VLOSI	MOD0301	143
L		M0D0301	144

L L		MODO301	145
1	LUANDE UX. DELT. AND CONSTANTS DEPENDER ON THEM	NENDY	
	A DELINE CONTRACT DEPENDING ON THEF.	NEWDA	76
50		MODATAL	[]
		MUDUSUI	146
		NEWDX	- 19
		NEWUX	7
		NEWUX	81
	NING - ULLIVUA	NEWUX	81
		NEWDX	
	120R = 0.54010R	NEWUX	83
		NEWDX	84
	1001DV = 5.0401DK	NEWDX	8
<u>L</u>		NEWDX	8
L		NEWDX	87
	CONS = 0.5+DELT+DELT	NEWDX	80
	DIDSG = DELT+BORED+BORED	NEWDX	85
	01260 = -0.5 + DEL1/BORED	NEWDX	90
	GINNUP = GRAV+UELT/RHUP	NEWDX	91
<u> </u>		M0D0301	147
L	CALCULATE THE CHAMBER VOLUME. IF II MAS CHANGED ADJUST THE AREAS.	M0D0301	146
	IF(UNED) 60 10 150	HQD0301	149
	AKK1 = (FLUAT(NGX) - 0.5) + UX + AREAAX	MOD0301	150
6		MOD0301	151
	$AKK2 = AREAK(1) + DX + U_{5}$	M000301	152
	IF (Nox .EW. 1) GC TO By	MOD0301	153
	10701 = 2.06x	M0D0301	154
	AKR2 = ARR2 + AKEAR(1) + UX	M0D0301	15
10	CONTINUE	MOD0301	15
L		M0D0301	15
00	CUNTINUE	M0D0301	150
	1F (CHAN2) 60 TU 100	MOD0301	159
L		MOD0301	160
	AKK3 = AREAGH (1)+DX+0.5	M0D0301	161
	1F (AGX .EG. 1) GO TO 100	MUD0301	16
	00 50 1 = 2.NGX	MOD0301	161
	ARRS = ARRS + AREAGE(1)+UX	MGD0301	164
94	CONTINUE	M0D0301	16
L		NOD0301	166
100	CUNTINUE	M000301	147
		M000301	144
c	AUJUST AREAAX AND ARKAY AREAC	M000301	140
2	ALJUST = ARKLW1/ARK1	M050301	19/
	APEAAX = AREAAX*COJUST	NO00301	1 7 1
	JU 100 I = 1.16x	M(100301	17
	AFEAC(1) = AFEE(11) BAL HIST	NOD0301	- / -
1	LUNTING	N000201	1 1 2
-05		HODUSUL	174
1	AUJUST ARKAY ANTAR	1000301	10
-	413051 = 400000000000000000000000000000000000	HOUUSUI	176
-	10 110 1 2 1.MAY	H000301	17]
	AREALIN = AREALINAD UNT	HUDUSUI	178
1	INTINIA ANCAR (174AUJUO)	M000301	179
TT U	LETERANCE IN THE STATE	M0D0301	180
-		MOD0301	181
	at dist attant Air and	MOD0301	182
L	AUGUST AKKAT AKLAGP	MOD0301	183

		4000301		-			
	abt abr (1) = abb (1) = ab (1) = a	MUD0301	185				
1.49		H000301	100				
• c. 0		M0D0301	188				
-		HUDOROJ	100.				
		N000301	100				
	LUBLE MORE OLDER IS INC.	HODOLDI	101				
11.11		M000301	102				
		NODOTU1	101				
	1+ (NUX _FH. 1) (0) T() 170	MODUSUA	173				
		HODO301	105				
	$\Delta E = \Delta E = \Delta E \Delta E (1) + 1$	MODUSUL	170				
1.0.01	Conline	M000304	107	· · · ·			
1		MODUSUA	104				
1/0		MODOTO1	100				
	AUJUST = ARTUT/ANT	M000304	177				
		MODDEUL	200				
	ABEAL (1) = AREAC (T) AAL IIIST	MCD0301	203				
1	CONTEND	MOD0301	202				
r.		M000301	203				
		<u>MUUUUUUU</u>	204				
in the second	e alian a avelas	MODUSUI	205				
200		MODUSUI	206	a famo - seguratoriada e			
C	ELE ANTAS AGA VILLANCES	NEWUX	92				
		NEWUX	95	1 - 49464			
		MODUSUI	207				
		NEWUX	- 72				
		NEWUX	96				
	50 10 220	M000301	208				
C	. (b. 1) (with	NEWDX	95				
e10		MODUSUI	209				
	ARCAU(2) = ARCAR(WOX)	NEWDX	100				
	Tricher and Antavisi - Angadrinoa	NEWDX	_101_				
	$\frac{1}{1} \frac{1}{1} \frac{1}$	NEWUX	102				
	IF (COARS) AREACH = AREACH + AREAG(2)	NEWDX	103	1 appents			
	UVAAIS = ARCAAATUA	NEWDX	104				
L	4 Av. 5 8 Av	NEWDX	105				
e e U		M0D0301	210				
	IF TONED AREACTION BUREA	NEWDX	107				
	ARCAR(NOP1) = BUREA - AREAAX	NEWDX	108				
	IF (CHARIS) AREAR(R.GP1) = AREAR(NGP1) - AREAGF(NGP1)	NEWDX	109				
	IF (LUCBUG(12)) WRITE (6,2000) IPRIAT, NCX	NEWDX	110				
	WARLLIST/WEWLHK/UX. DELT. WODI. CTDX. LILK. 12DF. T2DX. TWOTOK.	NEWDX	111				
	5 CONSTUTUES DI 280 GTRHOP DVAXIS CVAALT AREACH	NEWDX	112				
	IF (IUEBUG(13)) WAITE (6 NEWCHK)	NEWOX	113				
	IF (INVI. IDEBUG(14)) RETURN	NEWDX	114				
	WK11E(6+2006)	NEWDX	115				
	AHIIL(6.2003) (AHEAGP(1).I=1.NGP1)	NEWDX	116				
	wKIIL(6+2002)	NEWDX	117				
	<pre>wkite(6.2003) (AREAK(1).1=1.NGP1)</pre>	NEWDX	118				
-	nHillibe2004)	NEWDX	119				
	WMIILIE (2003) (AREAU(1) + I=1 + NGP1)	NEWDX	120				
	AMIIL(6+2005) (AKEAG(1)+1=1+NGK)	NEWDX	121				
2000	FURMATIVE NEWER CALLED, IPRINT =*+10+/+* NGR =*+15)	NEWDX	122				
2000	FURMAT(///. ANRAY AREAR 1/)	NEWUX	123				
2003	FORMAI(9X+10+11.7+/)	NEWDX	124				
2004	FURMATCHILS ARRAY AREAC .//)	NEWDX	125				
2005	FURMAI(///. ARKAY AKLAG . //.20X.5+11.7)	NEWDX	126				
KETUN ENU	N	ARLAGE		a anna an an an an <mark>an an a</mark>		NEWDX NEWDX NEWDX	127 <u>128</u> 129
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			172	2			

		SUDRUUTINE ARTIE	ALTZ	2	
	C	SUBRUITINE ANTE IS CALLED FOR GRICS IN THE 2ND RADIAL ROW WHEN	ANTTO	<u>د</u>	
	C	THE CHAMPER HAS 2 SEPARATE ONE DIMENSIONAL REAS	ANTTO		
		CUNNUL/AVOUT/KNUTI I PHIKNO PHIAVE CHISCAVE CUREAVE CUPAVE .	AA112		
		UIDI.VAGAVL.VIDI	AALIZ	5	
		LUMMUNZLHAMZA	AX112	6	
		Art at which is the first out of the provide the provi	CHAMI	5	
		AND AN CALLED THEN TONE OF THE	CHAMI	3	
		A HAR COTTACE AN ICHAPITICHAPITICHAPITIC DE CAPITARE AGP (60) DAVG	CHAMI		
		ARCHIZIDIAMOIIBLENDIBELBEGIIPSIIIFSZIKADESIBPIGN	CHAMI	5	
			AXIT2	8	
		COMMONY EUNS/DIDX, 12DR, 12DX, TWOIDR, DICA, HMB, TWOGJ, DVAXIS, DVAXIT,	EUNS	2	
		\$ DX+DK+KX+G0+1K0D1+HBP	EUNS	3	
			AXIT2	10	all apre-
		CUMMUN/BAG/PHIBU(60.5), HHONG(60.5), HBG(60.5), UBG(60.5),	RAG	2	
		1 V66(60.5). UP6(60.5). PCH(60.5), 12C(60.2).	BAG		
		- UUINIG(60), GHAG(60,5), XURAG(60,5), DOTPB(60,5), UPHDT(60,5).	GAG	4	
		5 FH1810(60.5), KH0610(60.5), H8610(60.5), U8610(60.5).	DAG		www.ene
		4 V0010(60,5),TBG(60,5),D0TMBG(60,.C.TMP(60,5),PHT8P(60,5),	HAG		
		5 PhiPTL(60.5), 12x(60), TBP(60.5)	DAG		
		LUGICAL IGNI , DUF D. (HAM) - CHAM2 - CHAN - DIGN	BAG	7	
Contraction descent and	the desire second	JATA GRAV/32,16/	CHAMLUG	2	
			AXIT2	13	
			AXIT2	14	
	C		AXIT2	15	
		CALL SSPROP (NURRUIR, CVUCCHICV, PCH(1,J), HBE(1,J), TDUM,	AXIT2	16	
		x ROBE(1,3), UBC(1,3), VAG(1,3), GAR (CP,2)	AXIT2	17	
		BUGGER = (GAP - 1.U)/THEGJ	AXII2	18	
		$1^{+1} = 1^{+1}$	AXIT2	19	
		$1 \times 1 = 1 = 1$	AXTT2	20	
	L		AXITO	21	
-	L		AXITO	22	
	C .	IN THIS SUBROUTINE PHIBS REPRESENTS THE TOTAL POROSITY. NOT JUST	AXTIO	22	
-	6	PURUSITY OF THE PROPELLANT.	ANTTO	23	
		F5 = PH1BG(1,J)	ANTTO		
		A5 = AREAR(1)	AALIZ	25	
		$62 = \text{KHOB6}(\text{IM1}_{1})$	AALIZ	26	
		64 = RH0RG(1F1, 1)	AX112	27	
		95 = HHDHG(I, A)	AXI12	28	
		$r_2 = b_2 + b_1 + b_2 + b_1 + b_2 $	AXI12	29	
	da-anti-aga von		AXII2		
			AXIT2	31	
			AXIT2	32	
		$n_2 = n_1 n_2 n_1 n_3 + AREAR(1m_1) + E_2$	AXIT2	33	
		$n_4 = PhiBo(irl_4J) + cRear(iPl) + E4$	AXIT2	34	
		CZ = GZ + HBG(IM1,J)	AXIT2	35	and the des
		C4 = 64 + HBC(1P1, J)	AXIT2	36	
		L5 = 65 + HBG(1,J)	AXIT2	37	
		$d2 = MUGER \bullet Ung(IM1, J) \bullet E2$	AXITS	3.0	
		34 = 0006ER + 000(1P1+J) + E4	AXITS	30	···
_		35 = 5066ER + 086(1.0) + E5	ATTO	41.	
		VUL = AREAR(1)+LX	AVITO	40	
	L		ANTIC	41	
		PHIAVE = (PHIAU(IMI+J) + F5 + F5 + CHIAG(ID1-1)140 05	ANTTO	42	
		RHUAVE = (G2 + G2 + G2 + G2 + G41a6, 25	AATT2	45	
		CHUAVE = (UHG(1%1.4)) + UHG(1.4) A UNG(1.1) A UNG(1.1) A UNG(1.1)	AX112	44	
		VHGAVE = 0.0	AXI15	45	
			AXIT2	46	
	1	0 + 0 + 1 = - (0 + 0 + 1 + 0 + 1 + 0 + 0 + 0 + 0 + 0 +	AXIT2	47	
			AXIT2	48	
		$P(1,\mathbf{U}) = P(1,\mathbf{U}) + P(1,\mathbf{U}) = 1 \cdot 0$	AXIT2	49	

	REDIDI = 1 FORMOAVE - 120X+(H4 - H2)/A5	AXIT2	50
	1 - UELT+(UOTM1G(I) - UOTMBG(L))/VOL	AXIT2	51
	$z \rightarrow (001MB(1.0) + 00TMP(1.0))/PhITDT$	AXIT2	52
	PHIKHU = PHIIDT+RHUTUT	AXIT2	53
	1EKM1=0.0	AXIT2	54
	1+ (DUIMIG(1).6[.U.U)TLNM1=1.0	AXIT2	. 55
	11.KM2=0.0	AXIT2	56
	1F(DUIMBG(1),L).0.0)7EKM2=1.0	AXIT2	57
L		AXIT2	58
	$0101 = (F_{5*}(E_{2} + E_{5} + E_{5} + E_{4})*0.25$	AXIT2	59
	- T2DX + (H4 + UBG (IP1 + J) - H2 + GEG (IP1 + J)	AXIT2	60
	<pre>// + GRAV+AREAK(I)+PCH(IP1)</pre>	AXIT2	61
	5 - GRAV+AKLAK(1)+PCH(IP1,-))/A5	AXIT2	62
		AXIT2	63
	4 + UOTMB(I,J)+UPB(I,J))/PFINEL	AXIT2	64
	1F (AHS(U)UT).LT. 0.1)UTDT = 0.0	AXIT2	65
L		AXIT2	66
	VIU = 0.0	AXIT2	67
C		AXIT2	68
	IF (PHIAVE.LT.0.999) CALL URAG (XURAG (10.) + FALSE + 1. J)	AXIT2	69
L		AXIT2	70
	mlow = mBo(1,1)	AXIT2	71
-	1F (UUTMIG(1) .GT. 0.00001) HIGA = (BG(1.2)	AXIT2	72
	HEGN = HBG(1.2)	AXIT2	73
-	1F (DUIMBG(I) . 5T. 0.00001) HBGN = HaG(I.3)	AXIT2	74
L		AXIT2	75
* *** **** * ***	HUGTU(1+J) = GAM+(F5+(C2+B2+C5+C5+B5+35+C4+B4)/(4.0+GAM)	AXIT2	76
	1 - T2UX+(H4+H6G(1P1+J) - H2+H6G(IM1+J)/A5	AXIT2	77
	+ UELT+((UOTMBG(1)+HBGN - UUTFIG(1)+HIGN)/VOL	AXIT2	78
	5 - GHAG(I,J)) + DUTMB(I,J)+HMH + DOTPP(1,J)+HBP	AXIT2	79
	+ ->UKAG(I.J)+UPB(I.J)+UELT/788.	AXIT2	80
	4 - BUGGERSPHIKHUSUTDTSUTDTZGAP JZPHIRHO	AXIT2	81
C		AXIT2	82
•	KNUB[D(I,J)] = KNUTD]	AXIT2	83
-	uHelD(1,J) = UTOT	AXIT2	84
	V_{H} (1) = VI01	AXITS	85
	RELUKIN	AXITS	86
		ANGIE	

	SUBRUULINE AX113			
L	CUBRUUTINE AATTS IS CALLED FOR GRICS IN THE OND RADIAL ROW WHEN	AALIS	2	
L	THE CHAPOLE HAS 3 SEPARATE ONE DIMENSIONAL REWS.	ANTTE	2	
	COMMON/AVODT/RHCTUT+HTKHO, PHIAVE +KNCAVE + UBGAVE + UPBAVE -	ANTT3	4	
		AXTTZ	2	
	LUMMUN/LHAM/1 .J .XU. NO. NOK. ILLUC. ILNDB. IPATH (60.5) .ARE AGEN.	CHANT	0	
	ANEACH, AREAC(00), 10011, ONED, DIAMI, JAM2, CISI, DIS2, DIS3, DIS4,	CHAMT	4	
	ARLAN (60) ARLAAD CHAMI . CHAMI . CHAMA . 10PGAP . AREAGPIGOI . DAVG.	CHANT	5	
	ANLAN, DIANNI, BELENI, DELDI G. 1951, 1832, RADES. BPIGN	CHAMT	T	
	CUMMON/CLUCK/TINE.DELT	LUARIA	5	
	COMMON/EURS/DID: 1208.1208.TWOTOR (DICA: HMB: TWOGJ-DVAXIS-DVAXIS-	AALIJ -	8	· • —
	1 DX+DK+NX+CO+FRODI+HEP	LUNG	2	
		LUND	2	· · · · ·
	COMMON/046/20100(10000), RHUB6(60000), HB6(6005), UB6(60.5),	AALIS DAC	10	
	1 V00(60.5), 6P0(60,5), PCH(60,5), 1/C(60.5),	BAG	2	
	2 UUIMIG(60), GBAU(60,5), SURAG(60,5), DOTMB/60,5), UDBDT/60,5)	BAG	3	
	3 PH1610(60,5), FH0610(60,5), HHG10(-0.5), UHGT0(60,5),	DAU	4	** ** ** *
	4 V8610(60,5),186(60,5),001M86(60),C.TMP(60,5),PHT60(60,5)	BAG	5	
	5 PhiPiu(60.5).12h(00).10P(60.5)	BAG	6	
and a set of the set o	LUGICAL IGNIL, ULEU, CHAMI, CHAM2, CHAMASINPIGN	BAG	7	
	JATA GRAV/32.16/	CHAMLOG		
L		AXII3	13	
C		AXITS	14	-
	LALL USHRUP(NO)KKUIKUVUILUVHILUIPCHIIIIIAHBEITIIIATOIM	AXIT3	15	
	\$ KHOEG(1+J)+UBE(1+J)+VAG(1+J)+VAG(1+J)+VAG(2)	AXIIS	16	THE REPORT FRAME AND
nite and a set of the second part of the	BUGGEN = (GAM - 1.0)/TWOGU	AX113	17	
L		AXII3	18	-
. L	IN THIS SUBRULTINE PHILE REPRESENTS IN. TOTAL DEPOSITY, NOT WEL	AXIT3	19	
L	FURUSITY OF THE PROPERLANT.	AXII3	20	
	$1P_{1} = 1 + 1$	AXIT3	21	
	101 = 1 - 1	AXIT3	22	•
	$F_{2} = P_{1} + F_{1} + F_{2} + F_{2$	AXIT3	23	
	A5 = AREAGP(1)	AXII3	_24	
	$y^2 = -RhDids(1)(1, 0)$	AXIT3	25	
	64 = RHORS(1P1.1)	AXII3	26	
	ab = Rhund(1)	AXIT3	27	
	$E^2 = b_2 a_1 b_2 c_1 a_2 \dots a_n$	AXIT3	26	
	E4 = 64 statistic 1P	AXIT3	29	
Contraction Contractions of		AXITS	.30	
	12 = FBIHGLED, ILLASSELLY THE VALUE	AXITS	31	
	$H = \Gamma H H G (1F) + H A B F A B F (1F) + L A B F A B $	AXIT3	32	
	L2 = 0.4 HBG(1M)	AXIT3	33	
		AXIT3	34	
		AXIT3	35	
	02 = BUGG Radius (18.1. day 2	AXII3	36	
	34 = 5006ERathers (101-1) + 64	AXIT3	37	
	35 = bligh failets (Tariat s	AXITS	38	
L		AXIT3	39	
•	VUL = AFFAGP(I).	AXIT3	40	
		AXIT3	41	
L		AXIT3	42	
	PHILUL = PHILULLAN + PHILUTDAL AND A	AXIT3	43	
		AXIT3	44	
	- TZDXA(104 - 12)/ A5	AXIT3	45	
		AXIT3	46	
		AXIT3	47	whitty a
6		AXIT3	48	
		AXIT3	49	· ····

	0101 = 1	165+112 + 11 - 1202+114+1 + 680440540	b + cb + c $bbb(1P1+J)$ $ch(1P1+J)$	4)+0.25 - H2408611M	11.J) H(IP1.J1)/A5)/PHIRHO	AXITS AXITS AXITS	50 51 52
	AFL AD	S(UIUI) .LT.	0.1) UTD	T = 0.0			AXITS	53
L					workeld Br. ender Snahn Indewgonyer, s	nan rentr al rentr toto della del	AXITS	54
	1166N =	1156(1+2)				12 1 1 1000 - 100 - 100 - 100 - 1	AXITS.	55
	IFIUUI	NbG(1) .61.	0.00001) H	BGN = HUGII	3)		AXITS	56
	HEGIUL	$I \bullet J = GAM \bullet I$	15+162+62	+C4+84+15+85	+C5+B5)/(4	(#GAM)	AXITS	57
	3	- 161 1-10781	AG(IPI+U)	- H2+H80(1r	1.01 17A5		ANTTE	50
	1	- BUGGER+UTI	J1+U1U1+PH	INHO/GAR I/H	HIRFO	-disease int 148 - 148 - 16	AXITS	60
L							AXIT3	61
	REUBTU	(1.J) = KHOT	1				AXITS	62
	UBGIUI	$I \cdot J = UT UT$					AXITS	63
	RE LURN						AALIS	64
	LIND				-united spectra dec. 60% rando di com	construction of the second second second	. AA113	
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	stude.011n#_0510652	ISURA2	2	an a san a " in shee be de
		BSURAZ	3	
A	WE A FAT TORS ARE NOT NETLED IN THIS SE ROUTINE BECAUSE THEY WOULD	HSURA2	4	
c	AREA THEFTONS ARE NOT RECEDE IN THE DECIDENCE DECIDENT	HSURA2	5	
6		HSURA2	6	
L	and the second second second second second	LSURA2	7	
	COMPONER RELOVED THE OF NO	ISURA2		
	COMMONYAVGDIYKHCIDI (PHIKHO) (H)AVE (KHCAVE (OBGAVE (OFBAVE)	HOUNAE	0	
	i UTUT.VUGAVE.VIUT	HSURAS		
	COMMON/CHAM/I J , AB, KB, NGX, NGR, IELGE, IENDB, IPATH(60, 5), AREAG(5),	CHAMI	2	
	AREACH.AREAC(60).16011.00.00.001401.1402.0151.0152.0153.0154.	CHADI	3	
	3 AREAR(60), AREAAX, CHAM1, CHAM2, CLAM2, 10PGAP, AREAGP(60), DAVG,	CHAMI	4	
	ARCAN2, DIAND1, HELEND, HELDEND, IPS1, 1932, RADES, BPIGN	CHAMI	5	
	LUMMUN/LLUCK/TIME,ULLT	BSURA2	11	
	CUMPUN/INPUTS/C1+C2+C3+C4+T0+T1GN+ULC+S+RHOF+PHI0+TF+CA+RHO0+	M000925	519	
and the second se	5 HO.PU.ID. STRHOP. HE DA. IIGHBP. GBCUNS, TOTM	MUD0925	520	
	LUMMUN/FAILEU/THICKT.FHOUP.PCOMP.BILE,XNTUB.FAIL,MFAIL(60),	MQD0925	521	return
	1 Jourston, Prive 1. TYPE	M000925	522	
	OMMUNICHONS ZUTTY, 1208, 120X, TWOTOR U.A. HMB. TWOGJ. DVAXIS. DVAXIT.	EUNS	2	
		FUNS	3	
	3 DATURINAIGUTINUUTINEE	HSURA2	13	
	COMPANY DAG UNITED TO TOTAT	HAG	2	a de anti-ficilité d'alle de la company
		DAG	4	
	1 VB($(0,5)$; UFB($(0,5)$; PCP($(0,5)$; 12($(0,5)$; UPBDT($(0,5)$; UPBDT($(0,5)$;	DAY		a a segura a
	2 DUIMIG(60), UBAG(60,5), XDRAG(60,5), DUIPD(80(5), OPDI(80(5))	DAG	6	
	3 PHIBID(60,5), RHOBID(60,5), HBGID(C015), OBGID(60,5))	DAG		
	4 V6616(60,5),T66(60,5),D0TMBG(60),CCTMP(60,5),PH18P(60,5),	BAG	5	
	5 PHIPIC (60+5)+12+(60)+18P(60+5)	BAG	I	
	LOUICAL IGHIT, ONEU, CHAMI, CHAM2, CHAM3, UPIGN	CHAMLUG	2	
	LUGICAL PENET	M0D0925	523	
L		M0D0925	524	
	LALL USPROP(KO,KKO,K,CVO,LVH,CV,PCH,1,J),HBG(I,J),TDUM,	BSURA2	17	
	\$ RHOBE(1.J), UNE(1.J), VUG(1.J), GAT + CP + 2)	LSURA2	10	
	HUBGER = (GAF - 1, 0) / Tw09J	HSURA2	. 19	
the subscription of the su	$10^{-1} = 1 + 1$	6SURA2	20	
		HSURA2	21	
	THE THEN STIRDAUTING PHILES REPORTENTS IN TOTAL PURUSITY, NOT JUST	HSURA2	22	
C .		HSURA2	23	
		HSURA2	24	4 0
		OSLIBA2	25	
d	$F_5 = PhiBo(1,0)$	USURA2	26.	
	64 = F4*RH0B6(1P1+0)	LIDA2	27	
	GD = r D + RHOBG(1+J)	CCUPAS	28	
	E4 = 64 + 000 (1P1, J)	DOURAL	20	
	L5 = U.U	HOURAS	27	and prove out
	C4 = 64*HBG(1P1,J)	BSURA2	50	
	$c_{2} = c_{2} + b_{2} (1, J)$	BSURAZ	51	
	84 = 64+8066ER+086(1P1+J)++2	USURA2	52	
	45 = 0.0	BSURA2	33	
	UENUR = F4 + F5	ASURA2	34	
	PHIAVE = DENUMAU.5	BSURA2	35	
* **	KNUAVE = (G4 + G5)/CENOM	HSURA2	36	
	JBGAVE = 0.0	BSURA2	37	
	UPBAVE = (UPb(1P1, J) + UPB(1, J)) *0.5	HSURA2	38	
		SURA2	39	
·	PHATHI = PHILTU(1,J) + PHIPTD(1,J) = 1.0	BSURA2	40	+*** **
	HUTDI= (FSANDOAVE -LTDIAE 4 + DELT + (C.TMIG(1) + DOTMPM)/	BSURA2	41	
	1 = 0 (VALSA) (-1) (-1) (-1) (-1) (-1)	HSURA2	42	
		USURA2	43	

	0101 = 0.0					BSURA2	45
					annelanda didesinti sanja apita suranya dibardapangangangan su	USURA2	46
c	alute = 10.6(1.1)					BSURAZ	47
- 6				the sub-integrate to a	 All oth risk discovery i even evene and a 	ESURA2	49
	IF (DUIMIG(I) .GT.	U.00001) HI	GN = HaGII	,2)		HSURA2	50
	HUGIL(1.J) = GAMA	1 F5+(C4+84+	C5+851/1LE	NOM+CAM)	41 i i anai	HSURA2	51
	1 – D1	UX+C4+UBG(1P	1.J)			USURA2	52
	<pre>c + DELT +</pre>	((LUTMIG(I)	+ HIGN + D	OTMPP + HBP) :	+ 2.0/	BSURA2	53
	S DVAXIS -	0-AG(1.J)) +	DOTFBILIJ) + FWB	* ** **	HSURA2	54
	4 + UOTMP(1	(+J) + HBP)/P	HIRHC			BSURA2	55
L	117117-12 114 1151 7 11		M (D)((C = 1))		0112 01.00 % at	BSURA2	56
	HEURID(1,1) = EH	TOTAPE + UPK	CANNEL TO IA	VAXIS		BSURAZ	57
and the second second	UBGTU(1.J) = U101	en der sonen er en en er			-	LISURA2	20
	VBUTU(1.J) = VIDT					ASURA2	57
	KETUKN			den e en endre e qualqu	+ 00 - 4 p. s. s.p.s.	ASURA2	61
	LNU					HSURA2	62
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			ол на ферен на последници понфицина и филосо на)	
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	SUDRUUTINE ISUNT?			
	COMPONIAVEL LIPHOTOL + PHIKMO + PHIAVE + REC. VE + UBCAVE - UPDAVE	HSUR12	2	
	> UIUI+VBGAVE+VTUT	HSURT2	3	
	CUMPUN/LHAM/1 .J .XU.KU.NGX.NGK.THE.H ILNOD TOATLACE S. ANA	BSURT2	4	
	* AREACH AREAL (60) . 16411 . ONED . DIAN	CHAMI	2	
	\$ AKEAKIGO) AKEANA CHAMI CHAMO CHAMO CHAMI CORAD AL AL DISS UISS UISS	CHAMI	3	
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and the second state		BSURT2	6	
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		FUNS	3	
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	CCTTLEW DAD/PHILD(60.5), KHOR((6(+5), HBG(60.5), UBG(60.5),	HAG	2	
	1 100160,5), 648(60,5), 664(60,5), (20(60,5),	HAG		- minder
-	UTMIG(60), GUAG(60,5), XDRAG(60,5), DOTPB(60,5), UPBDT(60,5)	LAG	3	
	5 Phiblu(60.5), Khuglu(60.5), HeGlu(20.5), URGTU(60.5),	MAG		
	4 VUG1L(60,5),Th6(60,5),D0TM86(60),CuTMP(6(,5),PHTHP(40,5)	BAG	5	
	5 PhiPlu(60.5).12K(60).18P(60.5)	BAG	6	
	LUGICAL IGNIT, UNED, CHAMI, CHAM2, CHAM2, CHAM, AND TCH	BAG	7	
L		CHAMLOG	2	-
	LALL USPROPING. KKO. N. CVG. CVG. CVG. CVG. CVG. CVG. CVG. CVG	ASURT2	11	
and the other states are	hubble (Lad Lieber 1 . 1) and (The real (J. J. And (T. J. And	HSURT2	12	
		BSURT2	13	tille till hing in skiller för är den statlingen
		HSURT2	14	
		HSURT2	15	
	Let IVIN Strangers a construction of the second	HSURT2	16	
	TH THIS SUBRUTTINE FILLS REPRESENTS IFL TOTAL PORUSITY. NOT JUST	HSURT2	17	
	FUFUSION OF THE PROPELLANT.	LUNTO		
	F4 = PHIBG(IF1,J) + AKEAK(IP1)	UCHRTO	10	te entrained successinglesis enclosing
	$F5 = Fn_{10}(1+J) * AREAR(1)$	L SURT2	19	
	$54 = \mathbf{F4} + \mathbf{FHOB} + \mathbf{(1P1} + \mathbf{J})$	BSURTZ	20	
	0 = $+$ 0 $+$ 10 $+$ 0	PSURT2	21	
	L4 = 64 + 066(1P1 + J)	ISURT2	55	
		HSURT2	23	
	$C4 = 64*HBG(1P_{1,s,1})$	BSURT2	24	
	b = bbanbb(1)	HSURT2	25	
	14 = 64 a hUll the Relative the stand	BSURT2	26	
		HSURT2	27	
		HSURT2	28	
	shall a far far	HSURT2	20	
		HSURT2	20	
	$F_{\text{HAVE}} = D_{\text{ENOM}} (AF_{\text{EAK}}(1F_{1}) + ARE_{\text{EAK}}(1))$	LSUNT2		
-	RNUAVE = (G4 + G5)/LENUM	SUPTO	21	
	UBGAVE = 0.0	SUNTE	32	
	$UPBAVE = (UPB(IP1,J) + UPB(I,J)) * 0_{\bullet,D}$	BSUR12	33	
Ĺ		BSURT2	34	
	- +hitui = (Phibiu(I+u) + PhiPTO(I+u) = 1.01+APEAD(T)	BSURT2	35	
L		ESURT2	36	-
	KHUTUT = (FS+KHOAVE = HEEV+EH = D3 + HEEV+EH	HSURT2	37	
	+ (authoritical) + hormer = Lica + Lormig(1) = DotmBG(1))	BSURT2	34	
L	CONDITION + COMPTINGIAALEAR(I) JPHITDT	HSURT2	39	
	PHIRLU - PHILDIADUATET	BSURT2	40	
		ESURT2	41	
		HSURT2	4.2	
		HSURT2	42	
		DELIRTO	43	
C		L SINTS	44	
	HIGN = HEG(1,1)	HOURIZ	45	
	1+ (001016(1) .61. 0.00001) HIGN = H.G.1.2)	BSURT2	46	
	11501 = H56([.2)	BSUKT2	47	
	IF (UUIMpigitI) - ST. N. AANAIN LIGEN - C. T.	BSURT2	46	
				the second se

L	$\frac{HIGIU(1,J) = GAM + (F_{2} + (C_{4} + B_{4} + C_{5} + B_{5})/(L_{c} + NOM + CAM)}{1 - UIUX + (C_{4} + UBG(1M1,J) + UCT_{MIG}(1) + HIGN - UOTMBG(1) + HBGN)}{2 + AREAR(1) + (DOTMB(1, +) + HrB + DCTMP(1, J) + HBP)}{3 - DELT + GBAG(1, J)) / PHIHNUNHUBIU(1,J) = KHOTUTURGIU(1,J) = KHOTUTURGIU(1,J) = UTUTVBGIU(1,J) = UTUTKEIUKNENU$	BSURT2 BSURT2 BSURT2 BSURT2 BSURT2 BSURT2 BSURT2 BSURT2 BSURT2 BSURT2 BSURT2	50 51 52 53 54 55 55 56 57 58 59
		aniti tak	
An and an and a second second second second second		· · · · · · · · · · · · · · · · · · ·	· · · · ·
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			a Alian Anian
	180		

	SUBRUUT THE BOURTS	BSURT3	2	complete this can be according
	COMMUNZAVGUTZRHOTDT.PHIRHO,PHIAVE, BUCAVE, UBEAVE, UPBAVE,	BSURT3	3	
	3 UTUT, VBGAVE, VTUT	HSURT3	4	
	LUMMUN/CHAM/I 1J 1XU, RUINGX, NGR, IELGE, IENDB, IPATH(60,5) AREAG(5)	CHAMI	2	
	AHLACH, AHLAC (GU), IGNII, UNED. DIAMI, LIAM2, CISI, DIS2, DIS3, DIS4,	CHAMI	3	The state of the second second
	ANLAR (60) + AREAAX + CHARL + CHAM2 + CHAM2 + 10PGAP + AREAGP (60) + DAVG +	CHAMT	u.	
	AREANE, UIANDI, BELENU, LLLBEG, IPS1, JPS2, RALFS, BPIGN	CHAMT	6	and a second second second a
	LUMMUN/CLUCK/TIME, DEL1	DEHETZ	5	
	UNMUN/EGNS/UTUX, TEUR, TEUX, TWOTOR . UIE HMB. TWOGJ. DVAXIS. DVAXIT.	CONS		
	5 UX UK NX GU IWOOI HEP	LUNG	2	
	UMMUN/GASCUL/RUSKKUSCVDSCVD	LUND		-
	COMMUN/BAG/PHIHU (60.5), NHUNG (60.5), BG (60.5), UBC (60.5)	BSURIS	8	
		BAG	5	
		BAG	3	
	A PLATICA CONTENTS A CONTENTS I OUTPOLEDISI OPBUT (60,5);	BAG	4	
	- Weblight Filler (0,5), Heblight (60,5), UBGTU(60,5),	HAG	5	
-	4 VB010(00(5))190(00(5))00(MB0(60)).L(IMP(60(5))PHIBP(60(5))	BAG	6	
	5 FATTU(60(5)) 724(60), 194(60,5)	BAG	7	
	LUGICAL IGNIT.UNED.CHAM1.CHAM2.CHAM3.DPIGN	CHAMLOG	2	
С		HSURT3	11	
	CALL GSPROPING, RROIR, CVD, LVH, CV, PGHIL, J), HBE(I, J), TDUM,	HSURT3	12	
	\$ KhObG(1+J)+UbG(1+J)+VEG(1+J)+GAr+CP+2)	HSURT3	13	
	UUGER = (GAN - 1.0)/1WUGJ	HSURT3	14	
	1P1 = 1+1	asilara	10	
		L CHIDTZ	15	
6	IN THIS SUBRUUTINE PHILL REPRESENTS IN TOTAL PUROSITY, NOT HIST	SURT :	.16	
6	FURUSILY OF THE PROPELLANI.	BSURTS	17	
	F4 = PhiBb(iF1,) + AREA(P(IP1))	BOURIS	18	
	$F_{2} = PHIBG(I_{2}) + ABFAGP(I)$	BSURTS	19	
	54 = F4&RHOR6(101,)	BSURIS	20	
		BSURT3	21	
		BSURT3	22	
		BSURT3	23	
additional devices and the		BSURT3	24	
	C4 = 04 HBG(1P1, 0)	BSURT3	25	
	$C_{2} = O_{2} + B_{2} (1, J)$	BSURT3	26	_
	$B4 = 64 \pm 0.06 ER \pm 0.06 (1P1, J) \pm 2$	BSURT3	27	
	u5 = 0.0	ASURT3	24	
L		4 SURTS	24	*** ** *
	$U_{\rm LNUC} = F_4 + F_2$	LICHATA	20	
L	PHIAVE = UENCM/(AREAGP(1P1) + ANFAGP(1))	OSHDY1		
	RHUAVE = (64 + 65)/DENUM	DELIDER	51	
6	UBGAVE = 0.0	BAUKIS	.52	-
C	UPBAVE = (UPB(1P1+J) + UPB(1+.1)+0 .	BSURIS	35	
L		BONKIS	34	
•	Phillip = (Peisticitation Peistory and Antonio	BSURT3	35	
1	The second secon	HSURT3	36	
•		BSURT3	37	
1	THOTOT = (PSERHOAVE - DIDATES - CTLA+DOTMBE(I))/PHITOT	BSURT3	38	-
	JULINAL - DUTTON DUTTON	BSURT3	39	
	PHINO = PHIDISKNOLDI	BSURT3	40	
L		6SURT3	41	an a sur a fair fa star san garger san garger
-		BSURT3	42	
C		HSURT3	43	
All the second sec	HBON = HBO(1.5)	HSURT3	44	
	$1F(UOIMBG(1) .GT. 0.00001) HBGN = H_{13}G(1.3)$	ASURTS	45	
L		ASURTA	45	
	HEGTU(1+J) = GAM+(+5+(C4+84+C5+85)/(_ENOM+EAM)	HSURTS	47	
	- DTUX+(C4+UBG(IP1,4) + DOTMAG(TIAHAAN))/PHTPHO	D SLIPT 2	40	
	RHUBIU(1,J) = RHOTUT	DELIDYI	70	
		Baukia	49	

UBGTU(1+J) = UTJ] KLTUKN		BSURT3 50 GSURT3 51
LNU		Renute 25
		•••• •• ••• •• ••
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	separate the second second	
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	SUBRUCITIVE MINDETK	BNDLYR	2	m
t		BNDLYR	3	
	CUMMUN/BARREZZICH A.XP. VP.BORED. HCKER. BOREDE. DT2BU. GTDSO	BNDLYR	4	
	CUMMONZE ONSZUTEX. 120R. 12UX. TWOTOR . UICH . HMB. TWOGJ. DVAXIS. DVAXIT.	EUNS	2	
	L UX+DK+NX+GU+1WUF1+HBP	LUNS	3	· · · · · · · · · · · · · · · · · · ·
		BNDLYR	6	
	CUMMUN/10PUTS/C1+C2+C3+C4+T0+TIGN+GCCKS+RHOF+PHIU+TF+CA+RHU0+	INPUTS	2	- the statement of the same
	3 HUSPESUSSINNERSHUPSHWSCHSILGNBPSOBCONSSTOTM	INPUTS	1	
	LUMMUN/BARRL/ PHI(100), RHUG(100), EG(100), UG(100), UP(100),	ATTLATY		
	1 PG(100), TG(100), PMUUT(100), Statudt, UFRAG(100), ERICIADAS,	DARKE		
	LUNVIION, MPRIMAS, MPRIMAS, PROFILE PROFILE PROFILE PROFILE	DARAL	9	them it
	AMASSIDDI, AMASIDDI, ACI (1007 CHORIDIT CHORIDIT CONTINUE)	HARKL	4	
	L ALS (100), A CALLOUT ALL (100), CAMAS(100), DAMOM(100),	BARRL	5	
		BARRL	6	
		HNOLYR	9	
		BNDLYR	10	
	SUBRUUTINE BRULTH CALCULATES THE THALKNESSES OF THE BOUNDARY LAYERS	BNDLYR	11	
L	FURNED AS PROPELLANT GAS FLOWS THROUGH THE BARREL.	BNDLYR	12	
C	AMASS IS THE AREA AVAILABLE FUR MASS FLOW	BNDLYR	13	
C	AMUM IS THE AREA OUTSIDE THE FUMENTLE LAYER	SNDLYR	14	
L	AENER IS THE AREA OUTSIDE THE ENERGY BOUNDARY LAYER	HNDLYR	15	
C	11 ALSU CALCULATES GL, THE HEAT TRANSFERRED FROM THE GRID TO OR	HNDLYR	16	
C	FRUM THE BARREL.	UNDLYR	17	
C	ARRAY WE CONTAINS 0.015 AT THE BEGINNING OF FACH TIME INTERVAL	DADLYR	1.4	an a
6		CADL NR	10	
C		BNULLN	19	
-		BNULTR	20	
6		HNULIK	21	
•	SPUX = 0 D	BNDLYK	22	
		BNDLYB	23	
		BNDLYR	24	
		BNDLYR	. 25	
	1 + (0 + L) + 10 + 10 = 10.	BNDLYR	26	
		BNDLYR	27	
L		BNDLYR	28	
L	STATIC ENTHALPY	UNDLYR	29	
	HSTAT = (HG(I)+HG(I)+HG(I-1)+FG(I+1))+0.252E-4+USO	BNDLYR	30	Der date a by
	CALL GSPHOP(RU,RHG,H,CVO,CVH,CV,PG(I),HSTAT,TSTAT,RHODUM.	ANDLYR	31	
	1 U.O.1.U.66AM.CF.3)	HNDLYR	32	Mana an
	GAM1 = GAM - 1.0	ONDLYR	11	
	GAM3 = (3.0+GAM - 1.0)/(2.0+GAM)	LINDLYR	Z ()	
		UNDLYR	34	
C	VISLOSITY	DUMEIN	20 .	
	$V^{1}S = C1 + ISTA1 + SURT(ISTAT) / (ISTAT) / (ISTAT) + CO)$	SNULTR	36	
L		BNULTA	51	
Ĺ	ALYNULD'S NUMBER/FOUT	BNDLYK	38	
And a state of the	RE = (RHULLIANHULLIARHULLIA	BNDLYK		
r	(moo(1)+moo(1)+moo(1-1)+moo(1+1))+0.23+0/VIS	BNDLYK	40	
****	Pat H NUMMER SCHAPEL	BNDLYR	41	
	MARKER SUCAREL	BNDLYR	42	
	(150) 152,15* GAP*K*15141)	BNDLYK	43	dest with destances
	AND AND ADD TO THE PLANE.	BNDLYR	44	
	FACH NONDER WEIGHTING FUNCTION	BNDLYR	45	
	THESA = FALISU+MACHSU/((1.0 + 0.5+GAM1+PACHS0)++GAM3)	BNOLYR	46	
	PUA = PRESIEUX	HNDLYR	47	
	SFUX = SFUX + FUX	BNDLYR	46	10-0-0
C		HNDLYR	49	
L	LUULVALENT FLAT PLATE LENGTH	HNDLYR	50	The Providence of the
	LAF = SPUX/PRESX	HNDLYR	51	
L		HNDL VA	E 1	
		DUDEIN	26	

L	KLYNULU'S NUMBER	UNDLYR	53
	KLX = RL + EXI	BNDLTR	54
	GFUN1 = (1.0 + 0.25 + GAM1 + MACHSG) + + (-0.7)	BNDLYR	55
	GFUN2 = (1.0 + 2.0+GAM1+MACHSE)++0.44	BNDLYR	
	1+(REX .LT. 5.0E6) GO TU 30	BNDLYR	57
	KLF = EXF/KEX++0.1667	BNDLYR	
	ULLTA = 0.23 REF	BNDLYR	59
		HNDLYR	60
	IT (UELTA .LT. BORER) GO TO 20	HNDLYR	61
	LILMP = 1	HNDLYR	62
	6V TU 150	BNDLYR	63
-		BNDLYR	64
	USPLACEMENT BOUNDARY LAYER THICKNESS	GNDLYR	65
20	LUNTINUE	INDLYR	66
++	DELSTR = 0.028+6FUN2+REF	HNDLYR	67
		ANDLYR	6.8
	PUMENTUM HOUMDARY LAYER THICKNESS	UNDLYR	69
-		ANDLYR	70
		CHOL YR	71
		BILDE YP	71
	Che - Fye did data 0. 6	BNULTA	
30	ncr = EAr/REA*+0.2	BNULTH	13
	UELTA = 0.374KEF	BNULTA	
-		BNDLTR	75
	IF (DELTA .LT. BURER) GO TO 35	BNDLYK	
	11EmP = 1	BNDLYN	77
	GU TO <u>1</u> 50	BNDLYR	78
-		BNDLYR	79
35	CUNTINUE	BNDLYR	80
	ULLSTR = 0.046+GFUN2+REF	BNDLYR	81
	1HE1A = 0.036 * GFUN1 * REF	UNDLYR	82
		BNDLYR	83
	LNERGY BOUNDARY LAYER THICKNESS	HNDLYR	84
40	UELUST = 1.269+UELSTR/(DELSTR/InEIA - 0.379)	BNOLYR	85
r -		HNDLYR	86
	MASS FLOW AREA	BNOLYR	87
	UAMASS(I) = PIDEA(HORED = 2+1+1)+15TR)++2	ANDLYR	88
		HNOL YR	49
		ONDI VR	90
4		LINDL VR	91
-			00
¥	LAN WEY ET ON AVEA	BRULIN	76
-	LALINGI FLUN AREA	BINDLIK	75
	OWENCU(1) = LINL+(DOUSD - 5.0+CFF051)++5	BNULTA	
•		BNOLTK	95
-	AVERAGE (REFERENCE) ENIMALPY IN BOUNLANT LATER	UNDLTK	
	HOTAK = 0.5+(HG(1) + HW) - 6.12HE-6+USQ	BNOLYK	97
	CALL GSPRUP (HU, HHU, H, CVO, CVH, CV, PU(I), HETAR, TSTAR, RHOSTR,	BNDLYN	96
	+ U.U.V.D.GAM.CP.3)	BNDLYR	99
	CALL SSPRUP(RO, RRO, R, CVO, CVH, CV, PDUP, HG(I),	BNDLYK	100
	* IUUM.KHOG(1).U.G.G.GAM.CP.2)	BNDLYR	101
	64M1 = 6AM - 1.0	BNDLYK	102
	HALHSQ = USQ/(32.16+GAM+R+TSTAK)	BNDLYR	103
	VISTR = C1+TSTAR+SQRI(TSTAR)/(TSTAR + C2)	BNDLYR	104
40	RESTRX = RHUSTR+U/VISTR+EXF	BNDLYK	105
		HNDLYR	106
π. Γ	LUMPRESSIBLE SHIN FRICTION COEFFICIENT	BNDLYR	107
	LH = (1.0 + 6AM1 + 6AM1 + 6AM1 + MACHSQ) = 1(-0.6)	BINDLYK	104

	to at the second	HADLYR.	110	
	TCAT FLUX	HOLYR	111	
	GE(I) = 3.141593#BURED#DX+QD0T	INDLYR	112	
- 6		RNDLYR	112	
· ·		HNDLYR	194	
- C- U		HNDLYR	115	
	GO TO 200	LINDI YH	41.2	
		DIVUL TR	110	
L		LUDI VP		
Ļ		ONDE IN	118	
L		- BUDFIN		
10	IC CONTINUE	CHULTR	120	
	JO 110 1=2.0001	DINULIA	121	
	UAMASS(1) = UUKLA	BNULTR	122	
	UANUM(1) = BUREA	BNULTR	123	
	UNERER(I) = BUREA	BNULTR	124	
11	U CONTINUE	BINDLTH	125	
and the second second	UQ TO 200	BNDLYK	126	
L		BNDLYR	127	
6		BNDLYR	128	
15	0 CUNTINUE	HNDLYR	129	
	A = IIENP	BNDLYR	130	
	$i_1 = i_{-1}$	BNDLYR	131	-
	JAHASS(1) = LAHASS(1)	BNDLYR	132	
	UAMOM(1) = UAMON(1)	BNDLYR	133	
	UALNER(1) = LAFEFULTS	BNDLYR	134	
L		SNDLYR	135	
	KED = NE+HOHED	BINDLYR	136	· ······
		GNDLYR	137	
	IF IF PSI (IN IT O COME CONTROL OF CONTROL OF COME CONTROL OF COME CONTROL OF COME CONTROL OF COME CONTROL OF	BINDLYR	136	a con transfer document
(1. 1. OLON (LT, 0,0001) EPSLON = 0.0	BNDLYR	139	
c		HNDLYR	140	- Hitse
1	= 0.3164/RCD + 10.23 + EPSLON	HNDLYR	141	
		BNDLYR	142	
	HOG - (RHOG(I) + RHOG(I) + RHOG(I=1) + RHOG(I+1))+0.25+U	HNDLYR	143	
1		HNDLYR	144	T -T-T-T-R Address of
	Laber of the second s	HNOLYR	14.6	
L	DUREDS IS BURED/6.	ANDLYR	140	
	FRICI(I) = LAMU*RHOU*BURED8	DINDE AD	146	
Ļ		UNDLYP		
	UI2BU IS -0.5+UELT/BURED	DHOF LK	140	
L	DITISE IS DELT *BUKED*BOKED	DIVULIN	149	
	GLONV(1) = PlOF*((HG(1) + HG(1) + HG(1+1)) + HG(1+1)) + HG(1+1)	BNULTS	150	
	1 +(1.U - EXP(LAMU+UT2BU))+RHUL+DTDS9	BNULTK	151	
		ENDLIK	152	
C		BNULYH	153	
	12 = 1 + 1	BNDLYK	154	
L		UNDLYK	155	
	JU 16U 1=2,NP1	BNDLTR	156	
	UAMASS(1) = UAMASS(11)	BNULYK	1.57	Straight frequency making water
	UAMUK(1) = UAMUM(1)	BNULYK	158	
	UALNER(I) = UALNER(II)	BNULTK	159	
L	A REAL PROPERTY AND A REAL	BNDLYR	160	
	U=(U6(1)+U6(1)+U6(1+1)+U6(1+1))+0.25	UNDLYR	161	
	1+ (U .LT. 10.) U = 10.	BNDLYR	162	
	US4 = U+U	BNDLYR	163	_
	HATAT - CHECKLARD AND AND AND AND AND AND AND AND AND AN	BNDLYR	164	diameter and
Characteristics of the local sectors of the local s	HUTHE # THULLE + HULLE + HUTELL + LOTTALLES -			
- Marandjan (Spinson - Alar dan Bar, Alar -	LALL 65PhOP (R0+HHC+K+CV0+CVH-CH-F-HG(1+1))+0.252E-4+050	BNDLYK	165	

	KHUU = (KHU	5(1) + RHUG	(I) + REULL	-1) + RHOG(T+1	140.2541	WOL YR	140
	KEU = KHUU/V	IS+BUKED				BNOLYR	170
	LYSLON = 0.1	UUS+ALUG (H	ED) - 0.005;	.6	antine destriction and a substantiation of	BNDLYR	171
	IF (LPSLON	T. U.00011	EPSLON = U	U		BNDLYR	172
1						BNDLYR	173
	LAMUDA = 0.	3164/HEU++0	1.25 + EFSLU)		BNDLYR	174
	LAMU = LAMU	JA+U				BNOLYK	175
		(Burney Aller B	ANDE DA	una anangangan a sain sasanga aya ay		BNOLYR	_ 176
	$\frac{PNALI(1) = 1}{UL(NV(1) = 1}$	ARUTRHUUTE	NA HOUT A			BNDLYR	177
		EXECT AMUNI	Tof()) + HU. 1.	0201011 + 1011	11140+55 -HMI	BNDLTR	178
160	CONTINUE	EN CENTON	12001140100	01030		BNULTR	100
(HNOL YR	181
C						ANDLYR	182
200	CONTINUE				a direct of designation of the state of	BNDLYR	183
	00 220 1=2, WM1			#** 10 0 ventes p		BNDLYR	184
	UAMASS(I) =	(4.0+AMASS	S(I) + UAMAS:	s(1))/E+0		HINDLYR	185
	UAMUM(I) =	4.0+AHUM(1) + UAMCHI	1/5.0		BNDLYR	186
	UAENER(1) =	(4.0*AEI+EH	(I) + UALINER	(1))/8.0		BNDLYR	187
220	CONTINUE			tern der under der der der der gesternen		BNOLYR	188
	ET AREAS AT 144				-	BNDLYR	189
	HALL IMMENTATELY	PRECEDING	TE TROUCETTE	OL IFE SAME A	THUSE AT THE	BNULTR	190
	UAMASSINX) = HA	ASSINAL				BUDETE	191
	UANUMINX) = UAN	OF (NH1)				GNDL YR	193
	UALNER (NX) = UAI	ENER (NM1)				BNDLYR	194
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L						BNDLYR	196
	LIVU					HNDLYK	197
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SUBRUITINE TUREAL	TUBEAL	2	
LUMMUN/CLUCK/TIME.ULL1	TUBFAL	3	
LUMPONZE GNSZUTUX . TZUK . TZUK . TWOTOK . DIER . HMB . TWOGJ . DVAXIS . DVAXIT .	IUNS	2	
3 UX-UK-NX-6- LUULI-MAP	FUNS	3	
LUMPUNZHPTZTEPIZY. UEPIZY. CEPIZY. Flumb. PUALST	H000925	528	arene
COMMONZERMELUZIOIMEN. UERM. OPHM. PREAF + DSHR. CSPSKS. PRACOF	MUD0925	529	
(OMMON/GRAIN/ SLIPESS) DUIGOSSA LEGESSA ENA	GRAIN	2	
	GRAIN		
2 416(100), (06(100), (16(100), (01), (01), (01), (010), (018(100))	GHATN		······································
COMPARENT CONTROL PROTOCOLOGICAL AND A CONTROL AND A CONTROL	TIDEAL	-	
The state of the s	HODDER		an analor - 1
	MUDU923	230	
	DAG		
	BAG	5	
	DAG		
	HAG	5	
	BAG	0	
	HAG	1	
COMPONENTIALEA/RADHOL(85) INKOUNINHOLES(85) ACL(85) AREAH(80)	HULLA		
3 AH(60)+FRACI(60)	HULEA	3	
COMPONICHAM/IX, IR, AB, RB, NOX, NOR, IELGE, IENDE, IPAIH(60, 5) (AREAGID)	CHAMIX		
\$ AREALH, AREAC(EU), IGHI + ONED, DIAM, 1, LIAM2, LISI, DIS2, DIS3, DIS4,	CHAMIX	3	
S ARLAR (GU), AREAAX, CHAMI, CHAM2, CHAM3, 10PGAP, AREAGP(60), DAVG,	CHAMIX	4	
ARLAHZ, DIAMBT, BELERD, BELBEG, IPS1, 1432, RADES, BPIGN	CHAMIX	5	
COMPUNZINPUTSZL1+C2+C3+C4+T0+TIGN+GLC+S+RHOF+PHI0+TF+CA+RHO0+	INPUTS	_ 2	
S HO.PO.UO.GIRHOP.HW.DM.TIGNBP.GBCUNS.TCTM	INPUTS	3	
L THIS SUBRUTINE CALCULATES FAILURE OF THE CENTER CORE IGNITER TUBE	TUBEAL	13	
C DUE TO COMPRESSIVE OR TENSILE (HOOP) PRESSURE LOADING.	TUBFAL	14	
L INCLUDED IS STRENGTH DEGRADATION DUE TO TUBE COMBUSTION	TUBEAL	15	
C MFAIL(1) - TUBE STATUS INDEX%	TUBFAL	16	
	TUBFAL		
U TUBE HAS NOT FAILED	TUBFAL	18	
k	TUBFAL	19	
C 1 TUBE HAS FAILED IN JENSION	TUBFAL	20	
ANU A PSEUDO HOLE HAS BEEN ADDED	TUBFAL	21	6 9 minute a subject the second
L TO SIMULATE FORMATION OF A CRACK	TUBFAL	22	
	TUBFAL	23	+ + attinições conjunt
C 2 TUBE HAS FAILED IN LUPPRESSION.	TUBFAL	24	
L A PSEULO HOLE HAS USEN AUDEC.	TUBFAL		
L AND PROPELLANT HAS PLUED INTO THE CENTER CORE.	TUBFAL	26	
	TUBEAL	27	
C PLUMP - CUMPRESSIVE STRENGTH OF LONITER TUBE	TUBFAL	28	
C PHULP - TENSILE UN HUUP STRENGTH CF IGNITER TUBE	TUBFAL	29	
C THICKT - INITIAL IGNITER TUBE THICKNESS	TUBFAL	30	
LUGICAL PENLI	M000605	31	
LUGICAL FAIL	TUBFAL	31	
FAIL = .TRUE.	TUBFAL	32	- de trainder - de ce
00 100 I=10E0K.IE0DK	TUBFAL	33	
1F(MFALL(1).EQ.c) 60 10 100	TUBEAL	34	
IF (PHOUP .LW.U.ANU.PLUMP.EC.0.0) 6. 10 20	TUBFAL	35	
FALL = FALSE.	TUBFAL	36	
L IF THE TUBE HAS ALREADY FAILED IN COMPRESSION,	TUBFAL	37	
L 11 IS ASSUMED TO BE NONEXISTENT IN THAT URID.	TUBFAL	38	
UELP=PCH(I,1)-PCH(I,c)	TUBFAL	39	
C LELP IS POSITIVE FOR HOOP STRESS.	TUBFAL	46	
L CUPPUIE CURRENT TUBE STRENGTH AFTER IT PAS BEEN DEGRADED DUE TO BURNI	TUBFAL	41	
ULLINI = 0.0	TUBFAL	42	
ULL182 = 0.0	TUBFAL	43	

D IF PROPELLANT IGNITION HAS OCCURRED.	TUBFAL	44
ASSUME THE AUJACENT TUBE SUMFACE IS ALSO IGNITED	TUBFAL	40
IF (IBP(I+1) .GE. TIGNEF .UR. TZC(I.1) .GE. TIGN) DELTRI = ATUS .	TUBFAL	46
+PCH(1+1)+*XHTUB+DEL1	TUBFAL	47
IN (ILL(I.2) . UL. ILGN . UR. TZR(I) .GE. TIGN) ULLTR2 = BIUB .	TUBFAL	46
+PCH(1+2)++XNTUD+DELT	TUBFAL	49
INICK(1) = THICK(1) - DELTR1 - DELTR2	TUBFAL	50
KALLU = THICK(1) / THICKI	TURFAL	51
PHUOPL = PHUOP + NATIO	TURFAL	52
PCGNPL = PCUMP + HALLO	TURFAL	83
IF (DELP .LT. PHOOPL .AND. DELP .GTPCOMPL .AND. HEATL(1) .EV. 0	IUDPAL	34
») GO TO 100	IUBPAL	33
20 15 (MEALL (1), EO. 0) ANEAH(1) = 3.1416.4.75.074MBT. COPT (DV1)2	TUDEAL	84
TE (MEAT) (TA EO O AND T EO AL AREAN (ALAREAN TA (A	TUDEAL	30
I CALLED A AND REAM FOR A AND COMPERATION AND A TRANSPORTATION	THEFAL	
$(\mathbf{F}_{\mathbf{A}}) = 1$	TURFAL	
TE (LELP	TUDEAL	
	TUNFAL	E.
F12 = 2.0 = FH10(1.3) = PH10PT 3	TUBEAL	
	TUNPAL	17
AREAT = AREATA & AREATAT	THOPAL	90
$\mathbf{E} TA \mathbf{E} \mathbf{E} \mathbf{A} = \mathbf{A} E E A E T A E E E E T A E E E E E E E E$	TUNPAL	
AUATI	TUNFAL	50
	TUMPAL	66
A A A A A A A A A A A A A A A A A A A	TUBEAL	
TERETALI	TURFAL	68
	TUMPAL	69
	TURFAL	70
	TURFAL	
	TURFAL	72
	TUBFAL	73
$RAF = \{P_{i} B_{0}(1,1) + P_{i} B_{i}(1,1) - 1,0\} \neq RHOB(\{1,1\}) \neq AFFAC(1)$	TURFAL	74
$KAP \ge (PHBG(1,2) + PHBP(1,2)-1,0) + KHOBG(1,2) + ARFAR(1)$	TUBFAL	75
AFNI = (FIHGEI + FHIAP(1,1) - 1.0) + ARFAC(1)	TURFAL	76
AFN2 = (FIRGN2 + PHIGP(1,2) - 1,0) + AREAR(1)	TURFAL	
RHOHGN = (RAF2 + RAF1)/(AFN1 + AFN2)	TURFAL	78
UHGN = (RAF2 + 1HG(1.2) + KAF1 + UKH(1.1))/	TURFAL	. 79
1 (RHOUGH + (AFN1 + AFN2))	TUBFAL	AG
HEGN = (RAF2 + HAG(1.2) + RAF1 + FAG(1.1))/	TURFAL	A1
1 (RHOBGN + (AFN1 + AFN2))	TUBFAL	82
APHI2 = AREAR(I) + (FIRGH2 - PHIRG(1+/))	TURFAL	. 83
APHI1 = AREAC(I) + (1.0) - PHIRG(I.1.1)	TURFAL	84
aPmIn1 = AREAC(T) + (1.0 - FIBGN1)	TURFAL	85
UPN1 = (UPB(1.2) + APH12 + UPB(1.1) + APH11)/APHIN1	TURFAL	86
xLN1 = (xL(1+2) + APH12 + XL(1+1) + AFH11)/APH1N1	TUBFAL	87
UUN1 = ()((1.2) + AFH12 + U((1.1) + AFH11)/APHIN1	TURFAL	AA
UIN1 = (DI(T.2) + APHT2 + UT(T.1) + APHT1)/APHTN1	TURFAL	89
PHIBG(1.1) = FIRGN1	TURFAL	90
Ph186(1,2) = F186N2	TURFAL	91
RHOBG(1.1) = RHORGN	TURFAL	92
$RHOB(1,2) = RHORG(\mathbf{v})$	TURFAL	93
URG(I+1) = URGN	TUBFAL	QL
UBG(1+2) = UBGN	TUBEAL	95
HBG(I+1) = HBGN	TURFAL	04
HEG(1.2) = HEGN	TURFAL	67
UPB(I,1) = UPN1	TUREAL	04
xL(1,1) = x(N)	TURFAL	60
	- UNPERL	

	D1(1.1) = D1%1 C1D1(1.1)=XLM1 D0TDT(1.1)=D0%1 D1TDT(1.1)=D1%1 SPOD1(1.1)=OF%1 ZC(1.1)=TZC(I.2) C0%T1%0F RETURN .ND		-			TURFAL TURFAL TURFAL TURFAL TURFAL TURFAL	101 102 103 104 105 106
100 C	LIGI(I.1)=XLN1 00TDT(1.1)=D0N1 0TDT(1.1)=DIN1 0F0U1(1.1)=OFN 1 2C(1.11-TZC(I.2) 0NT1NUF ETURN NO					TURFAL TURFAL TURFAL TURFAL TURFAL	102 103 104 105 106
	00TDT(1+1)=D0N1 DTDT(1+1)=DIN1 0F0D1(1+1)=OFN1 2C(1+1)=TZC(I+2) 0NT1NUF EFTURN					TURFAL TURFAL TURFAL TURFAL	103 104 105 106
1 100 C	DITUT(1+1)=DIN1 POUT(1+1)=UFN1 2C(1+1)=TZC(I+2) UNTINUF ETURN NU		_			TURFAL TURFAL	104 105 106
106 0	09801(1+1)=0FN1 2C(1+1)-12C(I+2) 0NT1NUF UETURN NU	ter a balance descended subject				TURFAL	105
100 (2C(1+1)-T2C(1+2) CONTINUF RETURN NU			dan op-	· ··· ··	TUREAL	106
100 (LETURN	- Ger + Mandhe als Monagadardir andre end	and a state of the	didana uniter		I LIVER AND A	100
i	IETURN	-Ber e kandle als biosepaintie entrinni in in	-			TUBEAL	1.47
t	NU	r die e kinelle ale klosepairtik websteid in eine w	approximation of their dependencies and ministration of			TUMPAL	107
	NU					TUREAL	
						TURFAL	109
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					ndy p		

SUBROUTINE HEINTT	APINIT	2
COMMON/IGNTF/PHRAD.BPCHG.BRMOUT.BGRRA.TPFRG,	MUDDOODE	510
\$ HEGTC(5) *XLTC(5)		512
CGIAMUN/RPT/TEP(2).UEP(2).CEP(2).FTUMR.PUALST	AUAMTY	-2.17
COMMON/CHAM/IX, TR.XH. RR.NGX, NGR. TEFGP, IENDR. IPATH(60.5) AREAGING	CHARTY	-
AREACH.AREACIAN. TGUIT.ONED. DIAMI IAMP.CIST.UISP.013310134	CHANTY	
AREAR (GU) . ARE MAX . CHAM1 . CHAM2 . CHAM4 . I DPGAP . ARE AGP (GU) . UAVG.	CHARTY	-
3 AREAH2, UTAPRI, HELEND, BELEFG, IPSI, (PS2, HADES, BPIGN	ORTAN	
COMMUN/PRIMV/HEDENS+HERAU(60+5)+AGE+PP+PGENE+EXPBP	PRIME	
LONMUN/FONS/LTDX+T2DR+F2DX+TWOTOR+DIC++HMR+TWOGJ+DVAXIS+DVAXIT+	+ WNS	
1 DX+DK+NX+GU+TWODF+HRP	FUNS	5
COMMON/FAG/PHIBG(AC.5), RHORG(60.5), FBG(60.5), UBG(60.5),	RA6	
1 V66(60.5), UPA(60.5), PCH(60.5), 12C(60.5),	RAN	
2 LUTHIG (601) OHAC (60,5) . 104AG (60.5) . DOTHE (60,5) . UPBUT (60,5) .	HAN	
3 Philutp(60.5), PHONTD(60.5), HRG1D(+0.5), URGTD(60.5),	14A17	2
4 V66TU(60.5).TRC(60.5).U0TMRG(60).CUTMF[60.5).PHIRP(60.5).	HAB	
5 PH1P10(60.5).T7*(60).T8P(60.5)	HAD	
SUBROUTINE APINIT CALCULATES INITIAL PORUSITY	APINTI	
L VALUES AT EACH GRID THAT CONTAINS BLACK	APINII	4
POWDER. THE SULROUTINE READS IN THE FOLLOWING PARAMETERS	APINI	10
C TEP(2)- THICKNESS OF ENDPADS 1 + 2 (INCHES)	RETNTI	11
DEP(2) - UIAMFTER OF FNUPADS 1 + 2 (TNCHES)	RPINII	
CEP(2)- CHANGE WEIGHT OF ENDEADS 1 + 2 (02.)	APINTI	13
C ITUBE- NUMBER OF TUHE CHARGES	APINIT	14.
BEGIC (5) - LOCATION OF IN TURE CHARGES (INCHES)	BPINTT	15
C XLTC(5) - LENGTH OF THE IUBE CHARGES (INCHES)	APINIT	16
C CHTRIS)- CHARGE WEIGHT OF THE TUBE CHARGES (02.)	APINIT	17
	RPINIT	18
LUMMON/P/ IPKINT.MULCH.MODGR.PRT1.INEHUG(35)	HPINIT	19
COMMUN/CERACT/ FRACT1.FRACT2	PPINIT	20
COMMON/TUBE/IENNTC(5).ITUBE, IBESTC(5).TNBP	MOD1115	31
	APINIT	21
UIMENSION TERACT(5)	RPINIT	22
UIMENSION ENUTCISS,	MOD0925	5.34
• CHTC(5).FRACT(2.60)	MUD1115	32
LOGICAL IPAD(2), IDEBUG(35)	APINIT	25
MAMELIST/BPCHK/ FPUBFG.FPDEND.BPOBFH.BPDEND.IREGFP.TFNDFP.IREGBP.	APINIT	26
. IFNURP BEGT . FNOTC . HE BEG. BELEND. IBFGB. IENDB. DA.	RPINIT	27_
. IREGTC.IENDTC.TWODR.IWODKR	RPINIT	2A
	APINIT	. 29.
TUITIALIZE PAD THICKNESS ARRAY	HPINTT	30
	APINIT	. 31
TEP(1) = 0.0	APINIT	32
1 P(2) = 0	BPINIT	33
	APTNTT	34
TENTIAL LEF FRACT ARRAY	APINIT	
	APINIT	36
CALL CLEAR (FRACT(1.1), FRACT(2.60))	HPINIT	
	RPINIT	38
	APINIT	39
C	APTNTT	40
(PAD(1) = FALSE	APINIT	41
	APINTT	42
	APINIT	43
HAMELISS HETRE ATEP. DEP. DEF. CH. BEGTC . XI TC. CHTC. ITUHE . FTIBR . PDALST	MODALA	11
state P P 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	APINIT	45
	discussion and the local discussion of the local discu	the second se

(RPINIT	47	
	RPINIT	NA	
	MONOAOA	13	
IT (IDENG(Z)) WHITE(A.BPINP)	APTNIT	. 49	
	APINIT	50	
	APINIT	51	- 844
$\frac{1}{10} \frac{1}{10} \frac$	HPTNTT	92	
	- APINII		
	RPINTI	54	
	APINII	55	-
IF (TTHEF FE OF 6C TO AND	PPINTI	56	
	APINII.	57	manifere de l'un
	RPINIT	58	
	RPINII	59	
	RPINTI	60	
as (Pertaine	RPINII	. 61	
	APTNTT	62	
I TEALTHY TO SET THUS TO TEAL AN A CALL AND A AND A	RPINIT.	- 63	vegen
C TRADIT - O CLI STATE IF TETTI I CONTAINT HAN HAU.	RPINIT	£4	
I RULE LOU ALL AIR LA AF LEI LEI LEI ANDEALEN INAN UAUS	APINII	- 65-	
C IN THEMINE THE RECET DAD THE DAR & D	APINIT	66	
C DELETING AFR THE FOURT FAULT THE MACK FAU	RPINII.	. 67	
r on norn bener Ponter Parts and Preserve	HPINII	68	
SAL LET TERTS OF A TRANSS - TOP	- APINIT	69	wir unter eine einer beite
1F (TFF) = (T + 0) = (T + 0) T + 0 = T + 0 = T + 0 = 0	RPINII	70	
	BPINII	71	
	MUDINOP	16	
L CALCHLATE BANTUS FOR BANTAL GUTD NUMAR	APINIT	72	
C CALCOLATE RADIUS FOR RADIAL ORIGINIPER 2.	APINII	73	
ILDER - LARSACITORIAN - AREAD/TOFEC	APINII	74	
The second stands and the second stand second stands and second stands and stands and stands and second stand a	APINII	75	
	RPINII	76	
THOORE - LARFACITENDES & AREARITEN	HPINTI	77	
THOORS - SORI (THOORS)	HPINII.	···· ··· ··· ·· ·· ·· ·· ·· ·· ·· ·· ··	19 10 10 10 10 10 10 10 10 10 10 10 10 10
	APINII	79	
	RPINIT	RO	eren elingia gi an
	HPINII	A1	
	BPINIT		
C CALCULATE POSITION OF FRONT PAN. THE GML S IT LIES IN	HPINIT	8.5	
C AND THE FRACTIONS OF THE GRIDS IT LIFE IN	NDTNTT		An a server with represent
	DTNTT	84	
C IF THE FRUNT PAU EXTENUS HEYOND RADIAL	DETNIT	00	· · · · · · · · · · · · · · · · · · ·
L GRID HUNDER 2 - REDISTRIBUTE IT IN RADIAL	OPTNET		
C GRIUS 1 AND 2 AT INCREASING TEP(1).	DTNTT		
C	ADTNIT	80	
500 KEP1 = 0 EP(1) / 2.0	OPTNIT	71	
IF (REP1 .LF. TWORK) 60 10 505	PPTNTT	02	
TEP(1) = REP1+KFP1+TFP(1)/(TWODP+TwOCA)	OPINIT	03	te openanje
KEP1 = TWODK	RPINTT	04	
505 FPUNEG = BELBEG - TEP(1)	ADTNIT	05	
C	HPTNTT	04	
C DETERMINE WHICH GRIDS THE PAD IS IN	APTNET	67	and a surgerise of the
L	APTNIT	98	
IF (FPUBEG .GE S+DX) GU TO 506	RPINIT	60	and selected as a
1516FP = 1	APTNIT	100	
60 TU 509	HPINIT	101	
	we full	101	

506	IPLGEP = EPOBEG / UX + .5	APTNIT	102
Bernete alle Prinselsande dies	$I^{\mu}LGFP = IBELSP + 1$	APINIT	103
51.9	IENDEP = IHFGH	RPINTT	104
C FR	ACT IS AN ARRAY WHICH WILL CONTAIN THE FRACTIONS OF GRIDS THE PAD O	RPINIT_	105
	A = IBEGFP	RPINIT	106
	IF (K .EQ. 11 GO TO 600	HPINIT_	. 107
	1F(K.L1. IFNDFP) GU TO 601	RPINIT	108
	FRACT(1+1ENDEP) = TEP(1)/DX	RPINIT	109
	60 TU 603	RPINIT	110
601	FRACT(1+K) = ((FLOAT(IREGFP)5)+0X - FPDPEG)/DX.	RP127T	111
	60 TU 604	APTNTT	112
600	1F(M +LT. IEBUFP) GU 10 602	APINIT	
	FRACT(1.TENDEP) = TEP(1)/($s = 0$)	APTNTT	114
	v0 IV 663	APINIT	115
1.172	FPACT(1+IBEGFP) = ((FLUAT(IREGFP)+)+DX - FPDBEG)/(.5+DX)	APINIT	116
.604	K = K + 1	APINIT	117
	LO 512 1=K. IENDEP	APTNTT	118
	1F(1 .EG. 1ENDFP) GO TO 605	BPINIT	119
	FRACT(1,1) = 1.0	OPINIT	120
512	CONTINUE	OPINIT	121
605	FRACT(1,1ENDEP) = 1.0 - FRACT1	RPINIT	122
. 685	IF(NOT. IPADIAL) 60 TO 515	PINTT	123
(ODINIT	104
c no.	CALCULATIONS FOR RACK PAD	DTNTT	105
(OUTNYT	120
C 16	THE MACK HAD EXTENDS REVOND RADIAL COLD	OPTNET	126
C NL	HER 2 - REDISTRIUM TI IN RADIAL CHI.S	APINIT -	12/
C 1	2 O RY INCHEASTAG TED ON	RPINIT	128
c I I		APINII	
	VEPS = AEDIAL / A A	APINIT	130
510		RPINI	1.1.1.1.1
		APINIT	132
	1EP(2) = REP2*REP2*IFP12J7(1WODRB#1=GORR)	APINIT	133
	REF2 + IWODRB	APTNIT	134
C	· · · · · · · · · · · · · · · · · · ·	APINIT	
C	and a second	APTNTT	136
_511	IREGRA = TENDE	APINIT	137
	BUDDE = HELLNL	APINIT	138
	BPDEND = BELENC + JEP(2)	RPINIT	139
	1ENDHP = BPDENU/DX++5	APINIT	140
	1ENDBP = IENUBP + 1	BPINIT	141
	FFACT(1.THEGHE) = 1.0 - FRACT2	APTNTT	142
	1F(18668P .FQ. TEKDAP) GO TO 515	APINIT	143
	NB = IBEGBP + 1	APTNIT	144
	10 514 1 = KbalENIBP	RPINIT	145
	1F (1 .LQ. 1ENDAP) 60 TO 521	APTNTT	146
	FRACT(1:1) = 1.0	APINIT	147
514	CONTINUE	RPTNTT	148
521	FRACT(1.IENDEP) = (HPOFNO - (FLOAT(IENDEP) - 1.5)+DX)/DX	RPINTT	149
515	1F(.NUT. 1PAU(1)) GU TU 608	APTNTT	150
6		RPINIT	151
C CAL	CULATE PROPER VALUES FOR FRACT(2,1)	RPINIT	152
6		OPTNIT	151
	IEMPVL = REP1+KFP1+3.141593	DDTNTT	154
	1F(16E6FP .67. 1 . 60 10 606	DOTNET	155
	VOL1 = (TEMPVI - AKEAC(1)) OVE SEEVELIS	APTNET	178
	****		176
	FRACT(2.1) = VO(1/(AFFAR(1)))X(5)	OD7NTT	1

HOR VOLI = (TEMPVI - ANEAC(JUEG(P))+DX+ENUCT(1. INFGFP)			
	HPINIT	154	6.0100 HOM-1488
$FFACI(2 \bullet IBEGFP) = VOL1/(AREAR(IBEGF+) \bullet Dx)$	BPINTT	160	
607 K = 18E6FP + 1	OPTNIT	161	
IF (F .GT. IENDER) GO TO 608	OPTNIT	169	
DO 509 T-K. IFNOFP	BETRET.	102	concernance of a state
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	HP LNI I	164	white a
$FRACT 2 \circ C J = V O T J (AAF AF (1) U X)$	APTNTT	165	
IT LA SEG TENERPI GUIQ 508	APINII	166.	
MUS CONTINUE	RPINIT	167	
605 IF(.401. IPAD(2)) 50 TO 516	AFINIT	168	Leonada de
1ENPV = RLP2+REP2+3+141593	REINTT	169	
VOL2 = (TEMPV - AREAC(IBEGBP))+DX+FHALT(1+IEEGBP)	APINIT	170	
$FRACT(2 \bullet THEGEP) = VUL2/(AREAR(IPFGHP) \bullet DX)$	APTNTT	171	
nB = 16EGBP + 1	RPINTT	172	
LF (No GT. TENDAP) 60 10 516	APTNIT	178	
10 700 L = KE. LENDH	ODTHTT		
	APINII.		-
	APINII	175	
$r_{\text{Rec}}(2,1) = VDL2/(AREAR(1))VDX)$	APINIT	176	
7NU CONTINUT	HPINIT	177	
	APINIT	178	
C COMPUTE LOCATION OF THE CHARGES AND THE PROFER FRACTIONS	RPINIT	174	
C FUN THE UNIDS THEY OCCUPY	APINIT	180	
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C CHICK FOR EXTENSION OF THE CHARGES	ODTMAT	100	
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	APINIT	187	
Ar (Beollill .Ll. Belero) Go to 12h	APINII	188	
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IF LENUICITUBEL .61. HELENDI GO TU 121	HPINIT	190.	-
Ĺ	APINIT	191	
L HETERMINE GRIDS IN WHICH FACH TUBE CHANGE BEGINS AND ENDS.	APINIT	192	
c	APTNIT	193	
UO 100 I=1.IIUBF	APTNIT	194	
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HEGTC(1) = 1	ODINIT	17.5	
	RPINII	147	
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186010(1) = 186010(1) + 1	APINIT	500	-
$ene \ LEADTC(1) = ENDTC(1)/Dx + 5$	RPINTT	201	
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L C C C C C C C C C C C C C C C C C C C	HPINIT	203	
C. CALCULATE FRACTIONS OF REGINNING AND FNC GRIDS	HPINIT	204	
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KE = ILMOTC(1)	ODTNIT	207	
1F(1 +56, 1) 60 TO 806	LDTNTT	204	
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- THE TARTE - TRUTCHI - TELORITHE - 1.5HUXI/UX	APTNTT	211	
	AFINIT	212	No-dillocal sup-
1+1K +64. 1) FFACT(1+K) = ((FLOAT(K)5) +DX - REGTC(1))/.5+DY	APTNIT	213	
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1	RPINIT	218
u0 101 1=1.11Ubr	RPINIT	219
NELGELERGTC(1) +1	HPINTT	220
AEAU = 1ENDTL(1) - 1	RPINIT	221
1F (KBEG .LT. KENT) GO TO 183	APINIT	222
+ RACI (1.4KULG) = 1.0	RPINIT	_ 223
UC 10 101	HPINTT	224
113 00 102 JE HHEGONEMU	HPINIT	225
FFACT(1,J) = 1.0	APTNIT	221.
102 CONTINUE	RPINIT	227
1.1 CONTINUE	HPINIT	22A
	RPINIT	229
L ISING THE FRACTIONS STUNED IN ARRAY FRACT.	HPINIT	230
C CALULATE THE PUPUSITIES FOR EACH GRID	RPINIT	2.31
	REINTT	232
L FRUNT PAD	RPINIT	233
MAG IF (.NOT. 1PAD(1)) 60 TC 140	RPINIT	234
	BPINIT	235
UP 110 1=1HF6FF. IF MIFF	APINIT	236
UO 111 J=1.2	RPINIT	237
VOLF = 3.141593+PFP1+FFP1+TFP(1)	APINIT	234
PHIBP(1,J) = 1.0 - ICEP(1) +FRACT(RPINIT	239
111 CONTINUE	PINIT	240
130 CONTINUE	BPINIT	241
	APINIT	242
C HALA PAU	RPINIT	243
140 IEC -001. TPAD(2) 100 10 150	RPINIT	244
	RPINIT	245
00 112 1 - INFLOP, IENDEP	RPINTT	246
	BPINIT	247
V() = 2 1 11593.46 224FF221FP(2)	RPINTT	24A
VELD 1	GPINIT	249
	RPINTT	250
	HPINIT	251
112 CONTINUE	PINT	252
	APTNIT	253
UNIC LITARUTS models and a second and a second and the second sec	RPINIT	254
	DETNIT	255
	DOTNIT	286
KMI = DIAMNIZAD	UDTNTT	257
	DINT	264
	PLOTALT	250
	AP INT I	207
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IF (INLGEP ,FU. 1 .ALD. ILNDEP .FU. 1) GO TO CTO	BMINII	260
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$H_{11} + HACTS = TEP(1)/(.5*0X)$	HP INT F	204
HIT IF (IBEGRP .FG. TENGHP) GU TO P12	RPINII	247
FPACT4 = 1.0 - FRACT2	HPINTI	2hh
60 TO 613	APINIT	267
E12 FFACT4 = TEP(2)/DX	PPINTT	268
H13 K = NBEG	PTNTT	269
a = KERD	HPINIT	270
VOLC = #8150+XLTC(J)+3.141543	HPINIT	271
UL 116 JEKIEG. PEND	HPINTT	272

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	WAMELIST/BILLT/ VOLC TUBVOL CHIC TO ALT VULCHPOENS	APTNIT	273
	WARELIST/BILLEY VOIC WOLD CERTERAL TRACK TOPPENS TRACUT	APINIT	274
	MAMELIST/BILLEY VOLF WILESCEP FRACTASCHICKTE, PPHENS, FREDP	RPINIT	275
	CHA = PHTAP(1.1)	APTNIL	276
	FREUE FRACTES.	APINIT	277
	FPEL2 = FRACT(1), 1(1)	RPINIT	278
	FRET = FRACTLY IN	APINIT	279
	IF (IFNDED EL MOEA) BUTUDIN AN ANTINATION	BPINIT	240
	$\frac{1}{1} + \frac{1}{1} + \frac{1}$	APTNTT	241
	TURNING TO THE TRACT IN THE GITZ VOLET	HPINIT	242
	IEI DEGUGERRA AND ICALED VOLCIVARE, NS)	APINIT	283
	IF (JE FOUD CALLENDER LENDER LE	APINIT	284
	1 (1000) - (VCLC+CFP(2)+(FRACT4)	RPINTT	245
and the state of t	This Colevols FRACT(1 KEAL))/(VCL8+	APINIT	286
	LEA TOPHUGARA AND TOPONO VOLCIZARCENS)	APINIT	247
	I LI LE A CALLED LASS AND THEORY .EV. KENC) WRITE (6.81LLB)	APINIT	244
		APINTT	249
	- RATAWAR 1L(J+1)+3.141593	APINIT	290
	L = 10EoTL(0)	APINIT	291
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	THE TOP	APTNIT	293
	CONTRACTOR AND AND A FORCE AND A FOR THE STORE AND AND A FORTAL	HPINTT.	994
116		BPINIT	295
		APINIT	204
RUZ	IF (IDEBUG(3A)) LRTTE(6.8PCHK)	BPINTT	297
		APTNIT	204
120		RPINTT	200
······	SIDE	APTNIT	100
121	APTIE (6,1001)	OPINIT	301
	STOP	AUTNET	302
1060	FURMATITHE TUPF CHARGE = 1 EXTENCS CUTSIDE THE HELT TUBE .)	APTNIT	101
101,1	FURGALLING, TUBE CHARGE = 5 EXTENCS CUTSIDE THE HELL TUBE .)	DETNIT	100
	LNU	APINIT	305
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APPENDIX C

REQUIRED INPUT AND OUTPUT

REQUIRED INPUT

Α.

The input quantities for the computer code are read in with five separate statements. The first quantity, IDEBUG, is read in with an L format where card spaces 1 through 35 are marked with either a T or an F to denote various output displays. The other four quantities are read in with a NAMELIST format. The first of these, called MØDS, contains two items that are used to regulate the time and space intervals of the primary program output. The second group, called CHINP (for chamber input), contains those inputs required to perform all calculations in the gun chamber and is called from subroutine CHSET. The third group, called BPINP (for black powder input), reads in all input required to load black powder into the center core ignition system and is called from subroutine BPINIT. The last group, called BARINP (for barrel input), contains those additional inputs required to perform the barrel calculations and is read in from subroutine BARSET. This appendix gives a description of all the required input quantities and a value used to represent the XM185 gun with the XM123E2 propelling charge and projectile.

OUTPUT SELECTION - IDEBUG

IDEBUG A logical variable array with a dimension of 35 that is used to specify which output is to be displayed for a given computer run. If IDEBUG(K) is TRUE, the Kth block of output will be displayed (see B. OUTPUT).

OUTPUT CONTROL - NAMELIST MØDS

- MØDCH The number of time step intervals between normal data printouts. A value of 100 has proved satisfactory for most computer runs where a fairly detailed history of all flow parameters is desired.
- MØDGR The number of I intervals between print locations. A value of 4 will result in data printout for I = 1, 4, 8, 12, 16, and 20, for all values of J.

CHAMBER INPUTS - NAMELIST CHINP

AGEN The "A" term in the propellant burning rate equation

 $\dot{r} = (AT_{\bullet} + B) p^{\varepsilon} + CT_{\bullet}$

In this expression, p is in psi, 7. in ^OR, and \dot{r} is in in/sec. Temperature dependence was not used for M6 propellant, and this term was set equal to zero.

AGENBP Similar to AGEN but for black powder. This term was set equal to .248.

ALPHA The thermal diffusivity of the propellant. This quantity is assumed not to differ significantly between the various propellants. A value of $1.0 \times 10^{-6} \text{ ft}^2/\text{sec}$ was assumed for the checkout calculations.

- ALPHBP The thermal diffusivity for black powder. This quantity is assumed to be 1.0×10^{-6} ft²-sec, the same as for the propellant.
- BETA A parameter that is required to maintain a stable finite difference solution to the differential equations of fluid motion. A value of 0.5 is known to work satisfactorily, but values up to 1.0 may work under certain conditions. BETA is directly proportional to the time interval between calculations and therefore inversely proportional to the machine time required for the calculation.
- BGEN The "B" term in the propellant burning rate equation (see AGEN). A value of .0057 was used for M30 propellant in the checkout runs.
- BGENBP Similar to BGEN but for black powder. This term was set equal to 0.
- BØRED Average barrel diameter, taking lands and grooves of the rifling into account, = 6.962 in.
- BPDENS Black powder granule density, = 116 lbm/ft^3 .

BPRADO Initial effective radius of black powder granules assuming a spherical configuration, = 0.067 in.

BTUB The coefficient in the equation, $\Delta t_h = B p''$, which calculates center core tube wall recession due to combustion, assumed equal to 0.001 for recession measured in inches and pressure in psi.

- CA Flow coefficient for igniter tube and "pseudo" holes, = 0.8.
- CGEN The "C" term in the burning rate equation (see AGEN), set equal.to 0.1246×10^{-3} . for the propellant.
- CHAM1 Logical variable set .TRUE. when the chamber grid matrix is two dimensional. This feature is not operational on the program described in this report, and it should always be set .FALSE.
- CHAM2 Logical variable set .TRUE. when the chamber grid matrix consists of two parallel onedimensional networks. Otherwise, it is set .FALSE.
- CHAM3 Logical variable set .TRUE. when the chamber grid matrix consists of three parallel onedimensional networks. Otherwise it is set .FALSE.
- CHWT Propellant charge weight, set equal to 25.5 lb. for the 155mm gun xM123E2 charge.
- CVHBP Slope of the specific heat versus enthalpy curve for black powder, assumed equal to $0.555 \times 10^{-4}/_{OR}$.
- CVIM6 Slope of the specific heat versus enthalpy curve, equal to $0.358 \times 10^{-4}/OR$.
- CVOBP Intercept term in the equation for specific heat of black powder, assumed equal to 0.177.

CV0M6 Intercept term in the specific heat equation, $C_V = C_{VO} + C_{VH} H$, equal to 0.198 Btu/1bm ^OR.

- C1,C2 Constants in Sutherland's equation for viscosity in 1bm/ft-sec. C1 = 0.7535 x 10^{-6} ; C2 = 262.5.
- C3,C4 Constants in Sutherland's equation for thermal conductivity in Btu/ft-sec $^{\circ}R$. C3 = 0.291 x 10^{-6} ; C4 = 170.1.
- DIAMBT Inside diameter of the igniter tube, equal to 1.17 in.

DIAM1 Chamber dimensions as defined by the following DIAM2 sketch:



- DIO Propellant grain minor or perforation diameter, equal to 0.03 in. for M6 propellant.
- DØO Propellant grain major or exterior diameter, equal to 0.420 in. for M6 propellant.
- DR Radial grid dimension for the two-dimensional chamber grid matrix. This is not used in the version of the computer program described in this report.
- DRAM Distance from the projectile base to the breech, equal to 32.5 in. for the 155mm gun base run configuration.
- EXPBP Black powder burn rate pressure exponent, = 0.24.

FRCTF The flow friction factor of the propellant bed which was determined by experiment to be nearly equal to 1.0.

- GAP Distance from the projectile base to the nearest end of the ball igniter tube.
- HBP Heat of combustion of black powder, equal to 1223 Btu/lbm.

HMAX An approximate estimate of the maximum enthalpy to be encountered. This is used with BETA to determine a stable time interval for calculation. A value of 2200 Btu/lbm is good for the expected range of calculations.

- IMB The internal energy added by burning propellant. This is not the same as heat of reaction. For M30, this is approximately 1540 Btu/1bm.
- INBP The index that defines the grid number where the igniter becomes jammed in the event of failure of the bag ties.
- NGR Number of radial grids in the chamber matrix. This number must coincide with the matrix selected by CHAM1, CHAM2, or CHAM3. Currently, the most this number can be is 5, as dictated by common storage allocated to the variables.
- NGX Number of axial grids in the chamber matrix. This number cannot exceed 60, which is the number currently allocated the variables in common storage.
- NHØLES Array giving the number of holes in a circumferential row on the igniter tube, a row being defined as all the holes with the same axial position on the tube. The 155mm gun igniter tube has holes at each axial position and NHOLES is filled with 4 * 1, 81 * 0, to fill up the entire array of 85 potential rows.
- NPERF Number of perforations in the grains of the main charge. The M30 propellant used in the 155mm gun has 7 perforations.
- NRØWH Number of rows of holes in the igniter tube, equal to 4 for the 155mm gun.
- PCØMP Pressure load required for the center core tube to fail in compression, equal to 150 psi.
- PEXP Pressure exponent to the propellant burn rate equation (see AGEN), equal to 0.65 for the base run.
- PliØP Pressure load required for the center core tube to fail in tension, equal to 150 psi.
- PO Initial pressure, = 14.7 psi.
- PRMCOF Primer strength (energy) ratio compared to the M82 primer.
- QSPRKS fhe heating by the primer jet due to sparks. A value of 10 has been used (Btu/ft²-sec) for present results.
- RADHØL Igniter tube hole radius array, equal to 0.125 in. for the 155mm gun igniter tube. The entire array is filled by 4 * 0.125, 81 * 0.0.

RRØBP	Slope of the curve of gas state parameter versus density for black powder, assumed to be the same as a similar constant for the propellant, 1.9 $(ft^4-lbf)/(lbm^2-^{\circ}R)$, for the base run.
RRØM6	Slope of the curve of gas state parameter versus density for the propellant, equal to 1.9 $(ft^4-lbf)/(lbm^2-^{O}R)$ for the base run (see Figure 23).
ROBP	The ordinate intercept of the curve of gas state parameter versus density for black powder, assumed to be the same as a similarly defined

- for the base run. ROM6 The ordinate intercept of the curve of gas state parameter versus density for the propellant, equal
- to 63 ft-1bf/1bm ^OR for the base run (see Figure 23).

parameter for the propellant, 66 ft-lbf/lbm-OR,

- RHØP Grain density of M30 propellant, equal to 103.7 lbm/ft³.
- TF Time extent of the calculation. This provides an alternate method to terminate a computer run.
- THICKT Initial thickness of the center core tube, equal to 0.117 in.
- TIGN Propellant grain surface temperature at which ignition occurs, $\approx 900^{\circ}R$ for M6 propellant.
- TIGNBP Ignition temperature for black powder, assumed equal to 1300°R.
- TØPGAP Average distance between the main propellant charge and the gun chamber. This assumes that the charge is symmetrically located in the chamber. A value of 0.25 in. was used for base run calculations.
- TW Initial temperature of gun surface, equal to 535°R.
- TO Initial temperature of the gas and propellant grains, 535^oR.
- U0 Initial gas velocity in the axial direction, equal to 0.0 ft/sec.

- TYFCE Strength of igniter center core loading bag ties, equal to 24 lbs.
- V0 Initial gas velocity in the radial direction, equal to 0.0 ft/sec.
- XCL Array that specifies the axial position of igniter tube holes with respect to the breech. It is specified as the location of the first hole and the distance between adjacent holes. The program inputs are XCL = 1.5, 1.75, 3.5, 15, 81 *0.0 for the 155mm gun, with all distances given in inches.
- XK Thermal conductivity of a grain of propellant, assumed equal to 0.2×10^{-4} Btu/ft-sec-^OR.
- XKBP Thermal conductivity of black powder, assumed equal to 0.2 x 10⁻⁴ Btu/ft-sec-^oR.
- XLBEL Location of the igniter tube end nearest the projectile, equal to 25 in. for the base run.
- XLO Average initial propellant grain length, equal to 0.90 in. for M30 propellant.
- XNTUB Pressure exponent for igniter tube burn rate equation, $\Delta th = Bp^{\prime\prime}$, and assumed equal to 0.86.

BLACK POWDER INPUTS - NAMELIST BPINP

- BEGTC() Axial position of the beginning of the tube charge, the bag of black nowder positioned inside the igniter tube, equal to (TEP + 0.5 + standoff, 4 x 0.). for the 155mm gun.
- CEP() Black powder charge for the end pads, equal to 1.0, 0.0 oz. for the 155mm gun.
- CHTC() Black powder charge for the bags located in the igniter tubes, equal to 4.0, 4 x 0.
- DEP() Diameter of the end pads, equal to 6.10 in.
- FTUBR Flash tube diameter, equal to 0.0104 ft.
- ITUBE Number of tube charges in gun configuration of interest, equal to 1 for the 155mm gun.
- PDALST End pad allowable dynamic shear stress, equal to 10,000 psi.

TEP()	End pad	thickness,	assumed	equal	to	0.5,	0.0
	for the	155mm gun.					

XLTC() Length of the black powder tube charges, equal to 22., 4 x 0. for the 155mm gun.

BARREL INPUTS - NAMELIST BARINP

- CF Coefficient of friction between projectile rotating band and the barrel, assumed equal to 0.0 in order to obtain reasonable agreement of interior ballistics calculations.
- DEPTH The distance a land extends above the barrel surface, equal to 0.05 in. for the 15mm gun.
- NX Number of barrel grids set initially, normally equal to 1.
- PDMAX Maximum pressure encountered during engraving of rotating band, corresponding to the shot-start force, assumed equal to 6,400 psi for the base run.
- PINER Projectile moment of inertia about its axis, approximately equal to .107 lbf/sec²-ft.
- PMASS Projectile mass, equal to 95.6 lb.
- PL Portion of the rotating band circumference to be engraved, 1.164 ft.
- PLO Barrel pressure at point XLO equal to 800 psi.
- PZO Barrel pressure at point 0, equal to 2700 psi.
- PINT Barrel pressure at point XINT, equal to 2000 psi.
- RADPB Effective radius of the projectile crosssection upon which the pressure acts, equal to 3.08 in.
- RØTK Proportionality constant relating projectile rotational and axial velocities. This constant is related to the twist of the rifling and is equal to 0. 619 circumferential radius per foot of barrel.
- THETA Pitch of rifling, equal to 0.157 rad. ft. or 9 degrees. The input number is in radians.
- WØB Width of the obturator, or rotating band, equal to 1.0 in.

- XLBAR Total length of the barrel, equal to 238 in. for the 175mm gun.
- XINT Intermediate point of barrel pressure plot, equal to 10 inches.
- XLO End point of barrel pressure plot, equal to 17.0 inches.
- XPMAX Point on barrel pressure plot corresponding to PDMAX, equal to 1.5 inches. (Same as WOB).

B. OUTPUT

The complete program output consists of several initial NAMELIST and array printouts and the primary output from the grid matrix during the run. The amount of output is regulated through the logical input array, IDEBUG. This variable provides optional display of the following groups of output:

- IDEBUG (1) Printout of those quantities input to the program through NAMELIST MØDS.
 - (2) Printout of those quantities input to the program through NAMELIST CHINP.
 - (3) Printout of initial porosity arrays, PHIBG and PHIBP.
 - (4) Printout of NAMELIST CHKIN which lists many converted quantities and computed perameters in the units that are used in the program from subroutine CHSET.
 - (5) Printout of the IPATH array, that governs the logical flow through the sequence of finite difference subroutines.
 - (b) Printout of chamber grid cross-sectional area arrays.

- (7) Printout of those quantities input to the program through NAMELIST BARINP.
- (8) Printout of NAMELIST BARCHK which lists many converted quantities and computed parameters in the units that are used in the program for subroutine BARSET.
- (9) Printout from subroutine BPFIR that states the time and indices of a grid when the black powder in that grid becomes ignited.
- (10) Printout from subroutine PRPFIR that states time and grid indices upon propellant ignition in that grid.
- (11) Printout from subroutine PRPFIR that states time and grid indices upon ignition of propellant under the influence of the holes in the igniter tube.
- (12) Printout of the time interval number, IPRINT, and the revised number of grids in the chamber, NGX, when subroutine NEWDX is called.
- (13) Printout of NAMELIST NEWCHK from subroutine NEWDX that displays computational parameters that were changed as a result of changing the grid size.
- (14) Printout of the revised chamber grid area arrays, AREAGP, AREAR, AREAC, and AREAG, from subroutine NEWDX after the grid matrix size is reduced.
- (15) Printout of all variables for the chamber grid matrix at time intervals specified by MØDCH and space intervals specified by MØDGR. A sample printout is shown at the end of Appendix C.
- (16) Printout of NAMELIST DOT from subroutine UPDATE that includes the arrays DOTMIG, DOTMBG, and TZR, shown at the end of Appendix C.
- (17) Printout from UPDATE of the time and time interval number at which the multiple one-dimensional grid network was reduced to a single one-dimensional network.

- (18) Printout from UPDATE of variables from the chamber grid matrix after it has been reduced to a onedimensional network.
- (19) Printout of all variables from the barrel grid matrix at time intervals specified by MØDCH. A sample printout is shown at the end of Appendix C.
- (20) Printout of statements regarding the masses of propellant and gas that actually exist or were loaded into the system and those that are computed by summing over all the grids in the system and multiplier applied to the computed mass of gas to make the computed mass equal the actual mass, printed from subroutine UPDATE. A sample printout is shown at the end of Appendix C.
- (21) Printout from UPDATE of cumulative amount of propellant and black powder burned in chamber and barrel and the revised gas constants based on an average of black powder and propellant properties according to the amount of each in the system at time intervals regulated by MØDCH. A sample printout is shown at the end of Appendix C.
- (22) Printout from UPDATE of pressure PCH(1,1)at intervals regulated by MØDCH.
- (23) Printout from subroutine MOTION of projectile motion variables at intervals regulated by MØDCH and the time the projectile passes from the barrel.
- (24) Printout from UPDATE of certain pressures in addition to projectile displacement and velocity and the time and time interval of the printout. This occurs every ten intervals and is not regulated by MØDCH. The items printed out do not have a heading but occur as follows:

TIME, IPRINT, PCH(1,1), PCH(1,2), PCH(NGX,1), PCH(NGX,2), PG(NX), XP, VP.

- (25) Not used at present.
- to
- (29)

- (30) Printout from subroutine BPINIT of certain parameters pertaining to initial black powder distribution calculations performed in that subroutine.
- (31) Not used at present.
- (33) and 35
- (34) Printout of primer jet characteristics from subroutine UPDATE.

The title blocks and sample printcuts for several of the output options are given below. The terms are defined in Appendices C and D. The units of these terms follow the following rule:

Velocity	ft/sec								
Density	1bm/ft ³								
Enthalpy	Btu/1bm								
Pressure	lbf/in ²								
Propellant grain dimensions	ft.								
Propellant burning	lbm/ft ³								
Gas resistance	psf/ft								
Areas	ft ²								
Heat flux	Btu/ft ² -sec								
Temperatures	°R								
;	1-1 1.		16		-				
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			Bas IsB	<u> </u>			#414 #++	rin tale	HATON
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APPENDIX D

GLOSSARY

(1) Most of the FORTRAN words used in the computer program are defined here. A cross-reference list linking the terms used in this report to their respective FORTRAN names follows the glossary. Many definitions are given in Appendix C, and those are not repeated here. All items listed here contain units of 1bm, ft, sec, and Btu, as used in the code.

ACC Projectile acceleration.

ACCL, ACCLF Propellant acceleration.

- ADJUST Factor applied to porosity and gas density in order to maintain the proper gas and propellant mass in the system.
- ADV Propellant grain surface area in one grid.
- ADVBP Black powder granule surface area in one grid.
- AENER(I) Barrel cross-sectional area less that included in the energy thickness of the boundary layer.
- AFN1, Parameters representing the product of
 AFN2 area and porosity in grids j = 1 and 2 in subroutine TUBFAL.

AGEN See Appendix C.

AGENBP See Appendix C.

AH Igniter tube or pseudo hole area.

ALPHA See Appendix D.

- AMASS(I) Barrel cross-sectional area less that included in the boundary layer displacement thickness.
- AMØM(I) Barrel cross-sectional area less that included in the boundary layer momentum thickness.

ARDOT	Rate of increase of surface area due to advancing flame spread along radius of base pad.
AREA	Surface area of a grain of propellant or black powder at the beginning of a time interval.
AREAAX	Cross-sectional area of the igniter tube.
AREAC(I)	Area of the chamber grid matrix $J = 1$. This includes the igniter tube when NGR > 1 and the entire chamber when NGR = 1.
AREACH	Chamber cross-sectional area obtained by summing AREAG(J) from $J = 1$ to NGR.
AREAG(J)	Generalized chamber grid area at grid J, assumed to be constant over the chamber length.
AREAGP(I)	Area of the gap between the propellant charge and the main bed.
AREAH(I)	Area of hole contained in an axial grid, connecting radial grids $J = 1$ and $J = 2$.
AREAH2(I)	Area of pseudo holes connecting radial rows 2 and 3 when CHAM3 is TRUE.
AREAPB	Area of the projectile base.
AREAR(I)	Area of the chamber less the igniter tube and the gap between the propellant charge and the chamber wall.
AREAS	Area of a sector of a circle involved in hole area calculations of Subroutine HOLES.
AREAT	Area of the triangle portion of the sector involved in hole area calculations of Subroutine HOLES.

- AREAXP That portion of the area of a row of holes exposed to grid I.
- ATPB Propellant burning parameter, = AGEN * TO + BGEN.

BEGTC(K) See Appendix C.

- BELBEG Location of the breech end of the igniter tube with respect to the primer flash hole.
- BELEND Location of the end of the igniter tube nearest the projectile with respect to the breech.
- BETA See Appendix C.
- BGBRN Logical variable set to TRUE when base pad burns through as a result of primer jet heating.
- BGEN See Appendix C.
- BGENBP See Appendix C.
- BGFCE Pressure exerted on center core loading by primer jet.
- BGJAM Logical variable that indicates bag tie failure when set to TRUE.
- BGSTP Logical variable that indicates the end of travel of center core loading after it is pushed by the primer jet to grid INBP.
- BØREA Barrel cross-sectional area.
- BØRED See Appendix C.
- BØRED8 Diameter of the barrel divided by 8.

BØRER Radius of the barrel.

- BPCHG The total weight of all black powder in the charge.
- BPDENS See Appendix C.
- BPIGN Logical variable set .TRUE. when all black powder is ignited and is used to eliminate the call to subroutine BPFIR when it is no longer required.

BPRAD(I,J) Radius of black powder grains.

BPRADO See Appendix C.

BRNOIT Logical variable indicating base pad burnout by flame spread when TRUE.

BTUB	See Appendix C.
BURNL	The overall recession of a grain of pro- pellant or black powder in one time interval, based on diameter and length change.
CA	See Appendix C.
CEP(K)	See Appendix C.
CF	See Appendix C.
CFR	Ratio of compressible to incompressible skin friction coefficient used in boundary layer calculations.
CGEN	See Appendix C.
CHAM1	See Appendix C.
CHAM2	See Appendix C.
CHAM3	See Appendix C.
CHTG(K)	See Appendix C.
CHWT	See Appendix C.
CØN1 CØN2 CØN3 CØN4 CØN5	Constants calculation in BARSET for use in subroutine MOTION.
СР	Specific heat at constant pressure
СТ	Burn rate parameter CGEN * TO.
CV	Specific heat at constant volume.
CVH	See Appendix C.
CV0	See Appendix C.
C1,C2	See Appendix C.
C3,C4	See Appendix C.
DAVG	Average chamber diameter.

DELDST	Boundary layer energy displacement thickness.
DELSTR	Boundary layer displacement thickness.
DELT	Time interval for a calculation.
DELTA	Boundary layer thickness.
DELTR	Change in hole radius in base pad due to flame spread from center.
DELTR1, DELTR2	Thickness of igniter tube wall burned in one time interval at the boundary of grids J = 1 and $J = 2$, respectively.
DEP(K)	See Appendix C.
DEPTH	See Appendix C.
DI(I,J)	Propellant grain perforation diameter in the chamber matrix.
DIN1	New propellant grain perforation diameter at $J = 1$ after the igniter tube has failed in compression and propellant has shifted to the axis.
DIAMBT	See Appendix C.
DIAM1	See Appendix C.
DIAM2	See Appendix C.
DIB(I)	Propellant grain perforation diameter in the barrel matrix.
DISCRP	Discriminant of the qualmatic and
DISCRM	solved in Subroutine DRAG, P is positive and M is negative.
DIS1	See Appendix C.
DIS2	See Appendix C.
DIS3	See Appendix C.
DIS4	See Appendix C.
DISPR	Net distance from the flash hole to the central point of the pad in the Jth grid

DITDT(I,J) Chamber	matrix p	per-	ber-				
interval.	alameter	at	the	end	of	a time	!

DIO See Appendix C.

DM Equivalent propellant grain diameter, = $(1.5 \text{ N} \% 0^2 \text{ x } \text{ LO})^{\frac{1}{3}}$

- DMPI Mass of propellant shifted from grid I during a time interval.
- DMPI1 Mass of propellant shifted from grid I1 during a time interval, where I1 is the grid adjacent to I into which the propellant from I is moving.
- DMP12 The mass of propellant moving from grid 12 into grid 11 where grid 12 and 1 are the grids adjacent to 11.
- DMPIM1 The mass of propellant moving from grid I-1 into grid I.
- DMPIP1 The mass of propellant moving from grid I+1 into grid I.
- $D\phi(I,J)$ Outside diameter of propellant located in the chamber at the beginning of a time interval.
- DØB(I) Outside diameter of propellant located in the barrel at the beginning of a time interval.
- DØN1 New propellant grain exterior diameter at J = 1 after igniter tube has failed in compression and propellant has shifted to the axis.
- DØTDT(I,J) Outside diameter of propellant located in the chamber at the end of a time interval.
- DØTM(I,J) Dummy mass flow array used in Subroutine MFLOW.
- DØTMBG(I) Mass of gas flowing between grids (I,2) and (I,3).

D Ø TMBS	Cumulative amount of propellant burned up to time t, Subroutine UPDATE.
DØTMIG(I,	J) Mass of gas flowing between grids (I,1) and I,2).
DØTMP(I,J) Mass of black powder burned in one grid volume.
DØTMPM	Mass flow produced by primer.
DØO	See Appendix C.
DR	See Appendix C.
DRAM	See Appendix C.
DTDR	Finite difference parameter, DELT/DR
DTDSQ	Parameter used in boundary layer calculations, DELT * BORED * BORED.
DTDX	Finite difference parameter, DELT/DX.
DT2BD	Parameter used in boundary layer calculations, -0.5 * DELT/BORED.
DVAXIS	Volume of the grids (I,1).
DVAXIT	Volume of the grids (I,2).
DX	Axial grid length for both chamber and barrel matrices.
ELT	Minimum compressed length of center core loading as a result of gas pressure forces (FORCE).
ELTCHG	Length of center core loading during the time compression is occurring.
ENDTC(K)	Axial location of the end of the kth black powder igniter tube charge.
EXF	Equivalent flat plate length used in boundary layer calculations.
EXPBP	See Appendix C.
FAIL	A logical variable set equal to .TRUE. when the center core igniter tube has failed air compression along its entire length.

FDMAX	See Appendix C.
FDPRIM	Rotating band engraving force and sliding resistance,
FIBGN1, FIBGN2	New porosity in grids $i,J = 1$, $i,J = 2$ after compressive igniter tube failure.
FIRE	Logical variable set to TRUE after propellant ignition occurs in at least one grid.
FM	Mach number of flow through igniter tube and pseudo holes.
FN	Number of propellant grain perforations.
FORCE	Force exerted on center core loading by primer jet and pressure gradients
FPDBEG	Axial leading edge position of the base pad nearest the breech.
FRACT(I)	Fraction of propellant not associated with the accelerated heating that occurs adja- cent to an igniter tube hole (subroutine PRPFIR).
FRACT(J, I) Fraction of the I,J grid occupied by any given black powder charge (subroutine BPINIT).
FRACTI.	Fractional portion of a grid at each
FRACT2	end of the main propellant charge initially occupied by propellant, subroutine CHSET.
FRCTF	See Appendix C.
FRICT	Skin friction in boundary layer calculation.
FTUBR	See Appenlix C.
GAM	Ratio of specific heats, cp/cv, for propellant gas.

GAMBP Ratio of specific heats for black powder gas.

GAP	See Appendix C.
GASMAS	Total amount of propellant gas in the system.
ស	Product of the gravitational constant and the mechanical equivalent of heat, = 25006.
GRAV	Gravitational constant, = 32.1416.
GTRHØP	Parameter used in computing propellant movement in the barrel, GRAV*DELT/RHØP.
HBG	Total enthalpy at grid I,J in the chamber matrix.
HBGN	Enthalpy of the gas flowing through the "pseudo" holes connecting the second and third parallel grid matrices. Also, new gas enthalpy calculated in subroutine TUBFAL after compressive tube failure.
HBGTD(I	J) Updated total enthalpy at chamber matrix grid I,J.
HBP	See Appendix C.
HG(I)	Total enthalpy at barrel grid I.
HIGN	Enthalpy of gas flowing between the first and second parallel one dimensional grid matrices.
HMAX	See Appendix C.
НМВ	See Appendix C.
HSTAR	Reference enthalpy used in boundary layer heat transfer calculations.
HSTAT	Static enthalpy used in mass flow and boundary layer calculations.
HW	Enthalpy of the gas at the wall or gum surface temperature.
но	Gas enthalpy at the initial temperature.
I	Axial index.

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IBEGB and IBEGC	Grid at which the initial portion of the charge, including the base pad, is located.
IBEGBP	Axial grid at which end pad of black powder nearest the projectile begins.
IBEGFP	Axial grid at which end pad of black powder nearest the breech begins.
IBEGTC (K)	Axial grid in which the kth igniter tube black powder charge begins.
IDEBUG(N)	See Appendix C.
IENDB	Grid at which the bell igniter tube ends. (nearest the projectile).
IENDBP	Axial grid at which end pad of black powder nearest the projectile ends.
IENDFP	Axial grid at which end pad of black powder nearest the breech ends.
IENDTC(K)	Axial grid in which the kth igniter tube black powder charge ends.
IGNIT	Logical variable set time when all pro- pellant in the chamber is ignited.
INBP	See Appendix C.
INCRE	Indicator to determine which direction propellant in chamber grid I will move.
IPAD(K)	Logical variable set .TRUE. if the kth end pad of black powder exists.
IPATH	Indicator to denote which finite difference subroutines are to be called and the sequence in which they are to be called.
IPRINT	Counter used in conjunction with M/DCH to print data periodically.

- IPS1, Equal to IBEGB and IENDB, respectively, used IPS2 in subroutine HOLSET.
- IR Radial index.

IX	Axial index
ITUBE	See Appendix C.
J	Radial index.
JTSHR	Computed shear force in end pad caused be primer jet impingement.
LAMBDA	Friction coefficient parameter used in boundary layer calculations.
LF1	First grid containing packed pro- pellant in first slug of propellant.
LF2	Last grid containing packed pro- pellant in first slug of propellant.
LIMI	End of the first igniter tube segment.
LIM2	End of the second igniter tube segment.
MACHSQ	Mach number squared, used in boundary layer calculations.
MFAIL(I)	Index denoting igniter tube status: 0 means not in state of failure, 1 means failure in tension, 2 means failure in compression.
MM1	First grid containing packed pro- pellant in second slug of propellant.
MM2	Last grid containing packed propellant in second slug of propellant.
MØDCH	See Appendix C.
MØDGR	See Appendix C.
NGR	See Appendix C.
NGT	Number of grids in the igniter tube.
NGT 3	Number of grids in one-third of the igniter tube.
NGT 3 NGX	Number of grids in one-third of the igniter tube. See Appendix C.

NHØLES See Appendix C.

NPERF See Appendix C.

NROWH See Appendix C.

- NX Number of barrel grids currently in the system. Also see Appendix C.
- ØMEGA Projectile rotational velocity in RPM.
- ØNED Logical variable to convert the chamber matrix into a single one dimensional matrix when all propellant is ignited and the black powder is consumed.
- PU See Appendix C.
- PCH(I,J) Pressure at chamber grid (I,J).
- PCOMP See Appendix C.
- PCOMPL Igniter tube compressive failure pressure, reduced from PCØMP by tube combustion.
- PDALST See Appendix C.
- PDRAD Radius of hole in base pad during flame spread from central grid.
- PDSHR Shear strength of base pad.
- PENET Logical variable indicating base pad penetration when TRUE.
- PEXP Pressure exponent in propellant burn rate expression, see AGEN.
- PFORCE(I,J)Reaction force transmitted through a compacted bed of propellant as a result of elasticity.
- PG(I) Pressure at barrel grid I.
- PHI(I) Porosity at barrel grid I.
- PHI1 Estimated updated porosity in the grid, adjacent to the ith grid, to determine whether there is room for propellant to flow from the ith grid.

PHIAVE	Average porosity calculated by the same
	averaging technique used in the finite
	difference subroutines (see Chapt. 6 of Ref.1)

PHIBG(I,J) Propellant porosity at chamber grid I,J. Also, combined propellant and black powder porosity in chamber finite difference subroutines.

PHIBTD(I,J) Updated chamber grid propellant porosity.

PHIBP(I,J) Black powder porosity at chamber grid I,J.

- PHII Updated porosity in the ith grid after propellant movement.
- PHIPP Porosity in grids containing the compressed center core loading.

PHIPTD(I,J) Updated black powder porosity.

PHIRHØ Product of updated density and porosity used in chamber finite difference routines.

PHIO Initial porosity of the main charge.

PHØØP See Appendix C.

PHØØPL Igniter tube tensile failure pressure, reduced from PHØØP by tube combustion.

- PINER See Appendix C.
- PINT See Appendix C.
- PLO See Appendix C.
- PL See Appendix C.
- PMASS See Appendix C.
- PMDØT(I) Local mass of gas generated due to burning propellant in the barrel.
- PPR/P(I,J) Local pressure loading force on a bed of packed propellant.
- PRESX Mach number weighting function used in boundary layer calculations.
- PRI1 Logical variable set TRUE during those time intervals when printouts are desired.

- PRMCOF See Appendix C.
- PRMXP Maximum stagnation pressure of primer jet.
- **PRØMAS** Total mass of propellant in the system, subroutine UPDATE.
- PSTAT Static pressure used in calculation of flow through igniter tube and pseudo holes.
- PZO See Appendix C.
- QBAG(I,J) Heat lost from the gas due to heat transfer to the grains of propellant prior to propellant ignition.
- QBCØNS Parameter used in the calculation of black powder temperature rise.
- QCØN3P Heat lost from gas as result of heating black powder.
- QCØNS Parameter required for propellant surface temperature rise calculations, = 2 * SQRT (ALPHA/3.1416)/XK.
- QCØNV Heat transfer per ft² used in PRPFIR and BNDLYR.
- QDØT Heat flux per unit area to the barrel, subroutine BNDLYR.
- QPMR Heat transfer rate to a solid surface impinged upon by the primer jet.
- QL(I) Total convective heat transfer to the barrel, computed in subroutine BNDLYR.
- R Propellant burn rate.
- RAPHØL See Appendix C.
- RADPB See Appendix C.
- RADPS Calculated pseudo hole radius Subroutines CHSET and HØLSET
- RAPJT Radius of primer jet at base pad. 223

RAF1, RAF2	Parameters used in subroutine TUBFAL that represent the products of density, area, and porosity for $J = 1$ and 2, respectively.
RB	Radial position of Chamber grid I,J - when CHAM1 is true.
RDRAG	Drag due to radial gas flow through the propellant. This parameter does not actually exist in the current code.
RE	Reynolds number based on equivalent flat plate length, used in boundary layer calculations.
RESTRX	Reynolds number evaluated with the reference enthalpy in boundary layer calculations.
RETX	Reynolds number based on effective propellant grain diameter, used in propellant heat transfer calculations.
RETXBP	Reynolds number based on diameter, used in black powder heat transfer calculations.
RETXH	Reynolds number based on effective pro- pellant grain diameter, used in calcula- tionsof heat transfer to propellant opposite an igniter tube hole.
RGAS	Gas state parameter.
RHØAVE	Average of gas density used in certain calculations, formed with the same averaging technique used in the finite difference subroutines discussed in Chapt. 6 of Ref. 1.
RHØB	Propellant bed density.

RHØBG(I,J) Gas density in chamber grid I,J.

- RHØBGN New value of gas density in the grid i,J = 1 after compressive tube failure.
- RHØBTD(I,J) Updated gas density in chamber grid, I,J.

RHØG(I)	Gas density in barrel grid I.
RHØP	See Appendix C.
RHØSTR	Gas density based on static pressure and reference enthalpy for boundary layer calculations.
RHØO	Initial gas density.
RØTK	See Appendix C.
RRØ	Dummy variable used for RRØBP and RRØM6.
RRØBP	See Appendix C.
RRØM6	See Appendix C.
RO	Dummy variable for ROM6 and ROBP.
ROBP	See Appendix C.
ROM6	See Appendix C.
SMLTC	Sum of lengths of center core loadings.
SPDJ	Distance from the axis of the base pad to the center of the pad in the Jth grid.
STDOFF	Distance from flash hole exit to the black powder igniter base pad.
TO	See Appendix C.
TA(I)	Total area of a row of igniter tube holes exposed up to and including the i-l grid.
TBG(I,J)	Gas temperature at chamber grid I,J.
TBP(I,J)	Black powder surface temperature in grid I,J.
TEFF	Effective time used propellant surface temperature calculations.
TEP(K)	See Appendix C.

TERMBP	A parameter used in subroutine DRAG that reflects the number of black powder granules in a grid.		
TERMP	A paramtrer used in DRAG that reflects the number of propellant grains in a grid.		
TF	See Appendix C.		
TG(I)	Gas temperature at barrel grid I.		
THETA	See Appendix C.		
THICK(I)	Local thickness of the igniter tube at grid I as it is reduced by combustion.		
THICKT	Initial igniter tube wall thickness.		
TIGN	See Appendix C.		
TIGNBP	See Appendix C.		
TIME	Elapsed time from the instant the black powder begins to burn.		
TØPGAP	See Appendix C.		
тøтм	Total mass of black powder and propellant initially in the system.		
TSTAR	Gas temperature based on reference enthalpy for boundary layer calculations.		
TW	See Appendix C.		
TWØITT	Calculation parameter, 2 * DFLT.		
TWORI	Calculation parameter, 2 * GJ.		
TWØTDR	Calculation parameter, 2 * DTDR.		
ТХК	Gas thermal conductivity.		
TXMU	Gas viscosity.		
TXNUS	Nusselt number expressing the heat transfer coefficient to a grain of propellant.		

TXNUBP	Nusselt number expressing the heat transfer coefficient to a granule of black powder.
TXNUSH	Nusselt number expressing the heat transfer coefficient to a grain of propellant opposite an igniter tube hole.
TZC(I,J)	Propellant grain surface temperature.
TZR(I,J)	Surface temperature of a propellant grain adjacent to an igniter tube hole.
T2DR	Calculation parameter, 0.5 * DELT/DR.
T2DX	Calculation parameter, 0.5 + DELT/DX.
ΰο	See Appendix C.
UAENER(I)	Updated harrel area less the boundary layer energy thickness.
UAMASS(I)	Updated barrel area less the houndary layer energy thickness.
UAMØM(I)	Updated barrel area less the boundary layer momentum thickness.
UBG(I,J)	Gas axial velocity at chamber grid I,J.
UBGAVE	Average gas velocity formed with the same averaging techniques used in the finite difference routines described in Chapter 6 of Ref. 1.
UBGN	New velocity for the chamber after tube failure has occurred.
UBGTD(I,J) Updated gas velocity in chamber grid I,J.
UDIB(1)	Updated propellant perforation diameter in barrel grid I.
UDØB(I)	Updated propellant grain exterior diameter in barrel grid I.

UDRAG(I) Drag at barrel grid I due to gas flow through a porous bed.

UG(I)	Updated gas axial velocity at barrel grid I.
UGAS	Resultant gas velocity used in propellant heating calculation adjacent to an igniter tube hol.
UHG(I)	Updated gas total enthalpy at barrel grid I.
UHØLE	Velocity of gas flowing through an igniter tube hole.
UP(I)	Propellant grain velocity in harrel grid I.
UPB(I,J)	Propellant grain velocity in chamber grid I,J.
UPBAVE	Average propellant grain velocity, calcu- lated with the same averaging techniques used in the finite difference subroutines discussed in Chapter 6 of Ref. 1.
UPBDT(I,	J) Updated propellant grain velocity in chamber grid I,J, in Chapt. 6 of Ref. 1.
UPHI(I)	Updated porosity in harrel grid I.
UPN1	New propellant velocity on the axis $(J = 1)$ after tube failure.
UPRM	Velocity of primer gas as it flows from the flash hole.
URHØG(I)	Updated gas density in harrel grid I.
UTDT	Scalar version of updated axial gas velocity in the chamber, used to load the UBGTD array.
UUG(I)	Updated gas velocity in barrel grid I.
INIP (I)	Updated propellant grain velocity in barrel grid I.
UXLB(I)	Updated propellant grain length in barrel grid I.

vo	See Appendix C.
VBG(I,J)	Gas radial velocity in chamber grid I,J.
VBGAVE	Average gas velocity, calculated with the same averaging techniques used in the finite difference subroutines discussed in Chapt. 6 of Ref. 1.
VBGTP(I,J) Updated radial gas velocity in chamber grid I,J.
VBP	Volume of a black powder granule.
VISTR	Gas viscosity based on the reference enthalpy, as used in boundary layer calculations.
VNEW	Updated propellant or black powder grain size as a result of combustion.
VØLCHG	Total volume of the main propellant charge, subroutine CHSET.
VØLD	Propellant or black powder grain size at the beginning of a time interval.
VP	Projectile velocity.
VPRØP	Volume of a propellant grain.
VTDT	Scalar version of updated radial gas velocity in the chamber, used to load the VBGTD array.
VTSG	Parameter used in subroutine Drag, equal to (1.5 * DØA ** 2 * XLA)** 0.333 * GRAV.
VTSGG	Parameter calculated in subroutine DRAG, similar to VTSG, but based on current rather than initial propellant dimensions.
WEGHT	Weight of black powder in motion after bag tie failure.

WHØLEB	Logical variable set FALSE in subroutine REGRES when the propellant in at least one barrel grid forms splinters.
WHØLEC	Logical variable set FALSE in subroutine REGRES when the propellant in at least one chamber grid forms splinters.
WØB	See Appendix C.
ХВ	Axial location of grid I,J.
XCL	See Appendix C.
XDRAG(I,	J) Drag due to axial gas flow through a porous bed at chamber grid I,J.
XJUL	Mechanical equivalent of heat, 778 ft- lbf/Btu.
ХК	See Appendix C.
XL(I,J)	Propellant grain length in chamber grid, I,J.

- XLB(I) Propellant grain length in barrel grid I.
- XLBAR See Appendix C.
- XLBEL See Appendix C.
- XLN1 New propellant grain length for J = 1 after compressive igniter tube failure.
- XLTC(K) See Appendix C.
- XLTØT(I,J) Updated propellant grain length in chamber grid I,J.
- XLO See Appendix C.
- XNTUB See Appendix C.
- XØB Initial position of the projectile with respect to the barrel matrix.
- XP Axial location of the projectile as a function of time.
- XPMAX See Appendix C.

A	AGEN	B _t	втив
A	AGENBP	С	CGEN
A	AREAH	Cbeo	BEGTC
2	ACC	Ccn	CHTC
A	ADVBP	C _{CD}	CEP
bp A	ARRAC	cf	CF
C1 A	ADJUST	c _{f/c} fi	CFR
Aener	AENER	Chwt	CHWT
Aener	UAENER	CL	XLTC
t+4t Aex.	AREAXP	ср	СР
1,n Aex	TA	cv	CV
A.	AREAH	Cvit	CVH
fi Ac.	AFN1	cvo	CVO
Aco	AFN2		
12	ADCACD	D,D ₀	UND
gpi	ARLAGP	d,Di	DI
[^] hi		d _{bt}	DI AMBT
Amass	AMASS	de	DIAM1
Amass t+dt	UAMASS	dep	DEP
Amom	AMUM	U_	DEFF
Amom t+At	UAMUM	2	
Ар	ADV	t+at	DWTDT
Ari	AREAR	t+At	DITUT
Asector	AREAS	DINI	DIN1
Atriangle	AREAT	dis	DISCRM, DISCRP
B	BGEN	Døn1	DION 1
В	BGENBP	dpr	DM
Beg	BELBEG	Dr	RDRAG
Bend	BELEND	dram	URAM
BPcha	BPCHG	Ux	XDRAG

(2) This list is a cross-reference between the terms used in this report and Reference 1 and their corresponding FORTRAN names. The definition of these terms is given in the glossary preceding this list.

E	PEXP	I	IENDFP
e	ЕХРВР	epd Incre	INCRE
f	FRACT	J	XJUL
Fd	FDPRIM		
Fdmax	FDMAX	*	ROTE
f _{bi}	FRACT		TYK
Fractl	FRACT1	~ij	YK.
Fract2	FRACT2	~₽	~~
Frict	FRICT		V.
fm	FRCTF	L	XL.
	CDAV	Lt+4t	XLIDI
8	GRAV	Limi	LIMI
gp	GAP	Lim2	LIM2
gt	Төрдар	lmin	ELT
£L.	HBG	м	EM
"t+4t	HBGTD	M2	MACHSO
H. .	HSTAR -	m	DMASS
H	НО		IVITM
Hbgn	HBGN		DITA
14	нвр		Dania
п	HG	mM	DØTMB
118	HBGN	m ,g	PROMAS
BP H.	HIGN	mgp	DØTMBG
H_	HMAX	mign	DØTMIG
max II.	HMR	m _p	GASMAS
mi) ti	HSTAT	mp	PMDØT
s H stat	HSTAT	mpr	DØTMPM
		Nipp	TERMBP
	PINER	Ngr	NGR
begb	IBEGB	N	NGT
begc	IBEGC	N	NGT 3
endb	IENDB	N	NGX
epb	IBEGFP	gx	

n	NRØWH	rbn	BPRAD
Npr	TERMP	Ro	20
n	XNTUB	Ke	RETX
Nu	TXNUS	Re [*]	RESTRX
Nu	TXNUBP	Repp	RETXBP
Nu.	TXNUSH	Reh	RETXH
n		Rey	RE
р	РСН	r _h	RADHØL
Po	Po	r	FTUBR
Po	PCØMPL	r _{nh}	ĸ
Pao	PCØMP	r	RADPS
Pforce	PFORCE	Rp	RRØ
Pa	PG		
Pho	рнøøр	S,	STUØFF
P ₁	PHØØPL	uo S,:	SPLJ
р,	PL	a) S ₁₀ , c	DISPR
Putton	PRØP		AREA
p.	PSTAT	o	
P,	PRESX	Т	TBC
P	PRMXP	Т	TG
px,t,M82		t	TIME
0	() I N #11	Т	то
Y O	QUAL	T	TSTAR
ч 0	OBAG	Tbp	твр
ч _b	QDAG	teff	TEFF
Ч _{bp}	QCONDI	t _{en}	ТЕР
⁴ conv	(CONV	t _{enl}	TEP(1)
11		Thi	THICK
к D	RADPB	Tuo	THICKT
	KUAS	T,	TZC
r	K	-	
^R afl	KAF1	u	UBG
ⁿ af2	KAF 2	u _{bgn}	UBGN

uhi	UHØLE	20	20
Uteat	UBGTD	Z_1	ZD
uave	UBGAVE	Ζ.,	20
u	UG	u	
u	UPB	a	ALPHA
unt+At	UPBDT	в	BETA
unave	UPBAVE	ð	GAM
u _{nn1}	UPN1	X has	GAMBP
Upr	UPRM	δ	DELTA
U _p	UGAS	8	DEPTH , STDOFF
K		8*	DELSTR
v	VBG	б**	DELDST
V	VBGTD	⊿m.	DØTMP
V(t)	VNEW	bp	DMP11
VØ	VØLD		DMP I
V	UBGAVE		DMP12
V _h	VBP	⊐ mpi2 ∕mpi+1	DMPIP1
Vcha	VØLCHG	∆mpi-1	DMP IM1
Vnew	VNEW	A r	DR
Vold	VØLD	۸r.	DELTR1
V	VP		DELTR2
V.	VPRØP	D-2	BURNL
p.		∆ t bp	DELT
Wah	WØB	AV .	DVAXIS
00		axis	DVAXIT
x	EXF	axit AX	DX
x	XB		
X	XCL	λ	LAMBDA
Xanh	FPDBEG		
X _{1b}	XLBEL	и	TXMU
X _{Lp1}	XLN1	(t)	BURNL
Xob	XØB	· · ·	VISTR
x	XP		
P			

\$ or \$bg	PIIIBG	p *	RHØSTR
ϕ_{11}	FIBGN1	<i>i</i> ° o	RHØO
¢12	FIBGN2	(° ave	RHØAVE
Øi t+∆t	PHII	Pb	RHØB
\$il t+st	PHI1	/ ^o bgn	RHØBGN
Pt+At	PHIBTD	bp	BPDENS
¢0	PHIO	/° g	RHØG
¢ bp	PHIBP	° D	RHØP
¢,	рні	1 P	
Ϋ́s	SHAPE	P	ТНЕТА
p or pog	RHØBG	(ØMEGA
P t+At	RHØBTD		