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CONTRACTOR REPORT

PERFORMANCE OF SOLID FUEL RAMJET
GUIDED PROJECTILE FOR USN
5"/54 GUN SYSTEM

ODED AMICHAJ

March 1982

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The work reported herein was carried out for the Naval Postgraduate School by Oded Amichai under Contract Number N00228-81-C-H231. The work presented in this report is in support of solid fuel ramjet research and the exploration of Navy applications for Advanced Indirect Fire Support, AIFS. Both projects are funded by the Defense Advanced Research Projects Agency and are under the cognizance of Professor A. E. Fuhs.

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It was found that the cowl drag coefficient has a major influence on the results. Therefore, a separate program (AERO) was developed to calculate this parameter.

The 5th/54 solid fuel ramjet has a capability to produce fuel specific impulse in the order of 400 - 900 sec. depending mostly on the flight altitude. The thrust coefficient varies in the range of 0.3 ± 0.1 depending on the internal areas.

A range in the order of 50 miles can be achieved with the ramjet operation compared to only 13 miles achieved by the conventional projectile. At low-altitude launch, a range of over 18 miles can be reached in Air-Defense Scenario. The ramjet propelled projectile reaches the ranges mentioned above at high Mach numbers ($M_0 \geq 1.8$). It is, therefore, clear that the ramjet concept provides significant improvement and has an Anti-Ship Missile Defense (ASMD) capability.

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ABSTRACT

This report covers work done on performance analysis of a 5 inch, 54 caliber gun-launched guided projectile with solid fuel ramjet (SFRJ).

A computer program (TRAJET) was developed. The program contains ramjet and trajectory analysis. The ramjet part considers conical shock wave losses, inlet boundary layer losses, normal shock losses, subsonic diffuser recovery, expansion into combustor losses, heat losses at the combustor and nozzle losses.

A flat earth trajectory with drag and thrust was considered. The various drag coefficients which were considered are: cowl drag coefficient, skin drag coefficient, wing (or fin) wave drag coefficient and wing (or fin) friction drag coefficient. Base drag is assumed to be zero due to the jet from ramjet nozzle.

It was found that the cowl drag coefficient has a major influence on the results. Therefore, a separate program (AERO) was developed to calculate this parameter.

The 5"/54 solid fuel ramjet has a capability to produce fuel specific impulse in the order of 400-900 sec. depending mostly on the flight altitude. The thrust coefficient varies in the range of 0.3 ± 0.1 depending on the internal areas.

A range in the order of 50 miles can be achieved with the ramjet operation compared to only 13 miles achieved by the conventional projectile. At low-altitude launch, a range of over 18 miles can be reached with the ramjet version. Launches at high elevation angles can be useful in air-defense scenario. The ramjet propelled projectile reaches the ranges mentioned above at high Mach numbers ($M_0 \geq 1.8$). It is, therefore,

clear that the ramjet concept provides significant improvement and has an Anti Ship Missile Defense (ASMD) capability.

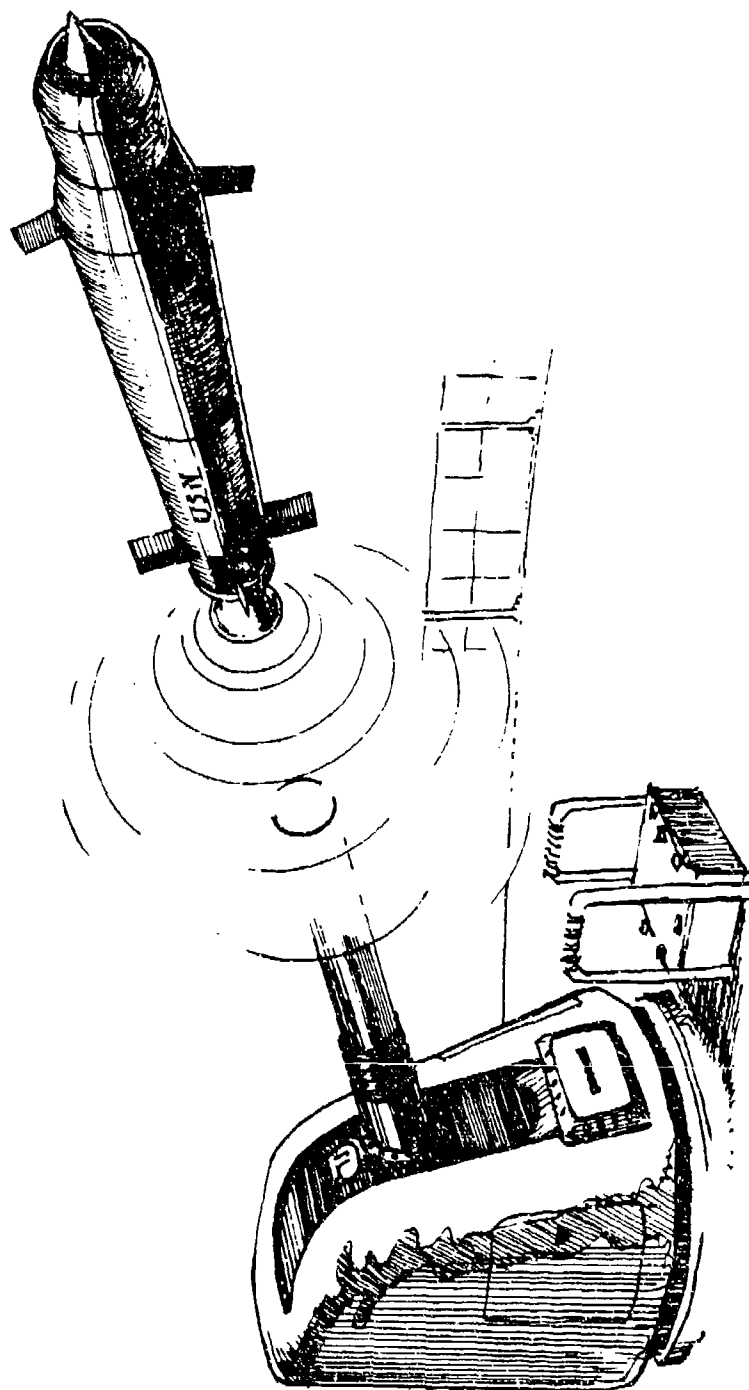
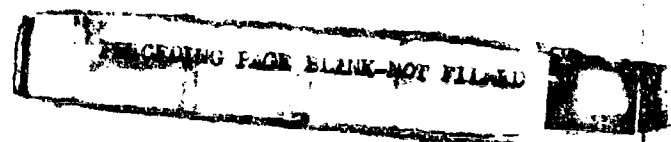


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1. INTRODUCTION

1.1 Background

This report covers work done on propulsion and flight mechanics of a gun-launched guided projectile. Gun-launched guided projectiles have been developed by Martia Marietta for the U.S. Army (Copperhead) [1,2] and more recently, also, for the U.S. Navy [3,4] (5"/54 Mark 46). The USN round has solid rocket propulsion.

The addition of a liquid fuel ramjet (LFRJ) to the Navy's version, was examined in the past by Brown [5]. This report concentrates on the addition of a solid fuel ramjet (SFRJ), instead.

It is believed that solid fuel ramjet has some potential advantages compared with the liquid fuel. Some of these advantages are:

- Simple design
- High reliability in operation
- Low cost
- Fuel control system not needed

On the other hand, there are also a few disadvantages to SFRJ compared to LFRJ. Some of these are:

- Difficult to control magnitude of thrust
- Difficulties in achieving high combustion efficiencies

In both cases, the addition of propulsion improves dramatically, the performance of the projectile by multiplication of range and enhanced maneuverability. Even more; to operate and produce thrust, the ramjet engine depends only on its forward motion at supersonic speeds and does not employ any moving parts. This fact, which is especially emphasized in SFRJ, leads to some advantages of the ramjet concept over the other

propulsion alternatives, at supersonic speed. On the other hand, the ramjet engine requires an auxiliary booster to accelerate it to its supersonic operating regime. The boost required causes some system difficulties. But, while solving these problems, the ramjet system becomes even more attractive for use with gun-launched guided projectile, like the U.S. Navy 5"/54.

A computer program was developed to analyze the performance of the SFRJ. The computer program was written for the IBM-370 computer at the Naval Postgraduate School, Monterey, California. HTPB was selected as a fuel, but performance with any other fuel can be tested, using the same model. A flat earth trajectory with drag and thrust was considered. Using solid fuel, a thrust-equal-drag trajectory is more difficult to achieve with SFRJ. Therefore, most of the results given in this report eliminate this case, and the exact value for drag, at each point, was calculated. However, if desired, it is possible to change the air mass flow, in order to obtain thrust-equal-drag flight. The computer program can calculate this case also.

1.2 Basic Concept

The ramjet engine consists of an air inlet, which serves as a diffuser, a combustion chamber, and an exhaust nozzle [6,7]. The diffuser admits air to the engine, which is mixed with fuel (solid or liquid) at the combustor. After the burning process, which adds heat to the flowing air within the system, the gases are transferred to the nozzle. The nozzle converts part of the thermal energy into kinetic energy to produce thrust.

The areas inside the ramjet engine are usually divided into six stations, as illustrated in Figure 1.1. Station 0 defines the cross-

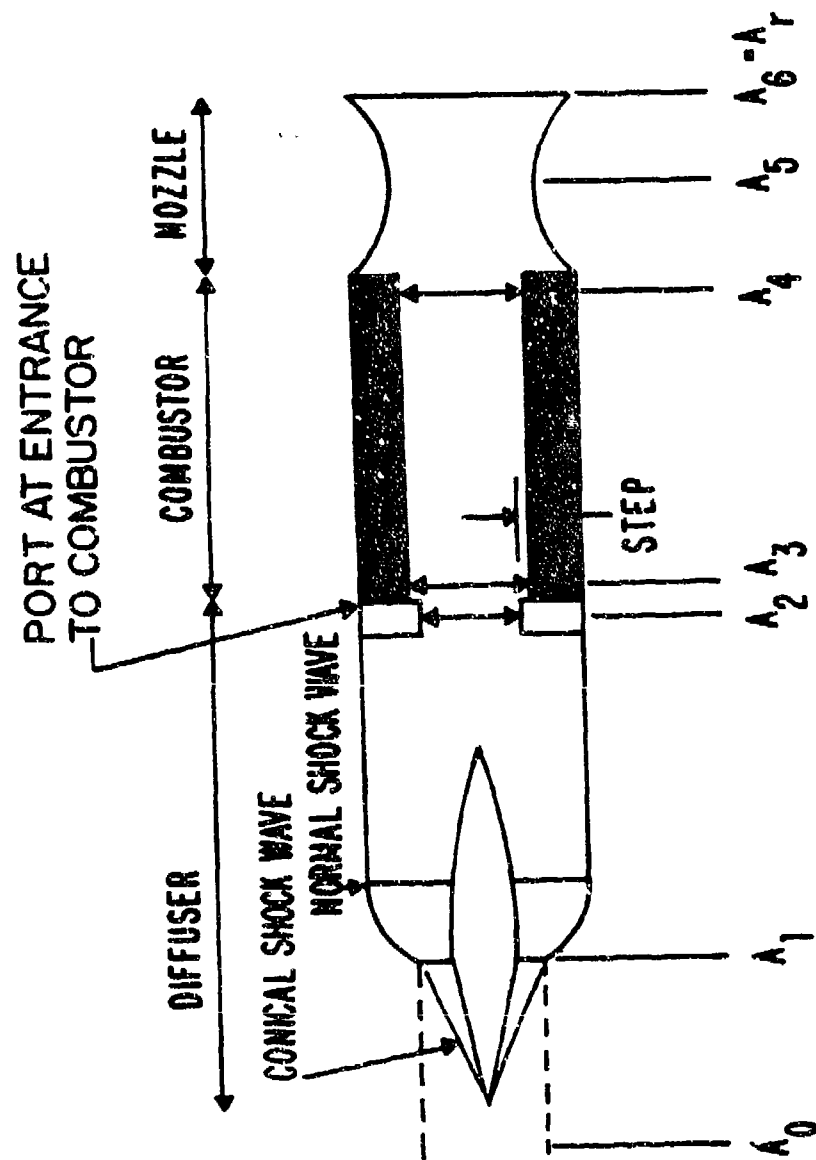


Figure 1.1 Schematic View of a Solid Fuel Ramjet

5-INCH GUIDED PROJECTILE

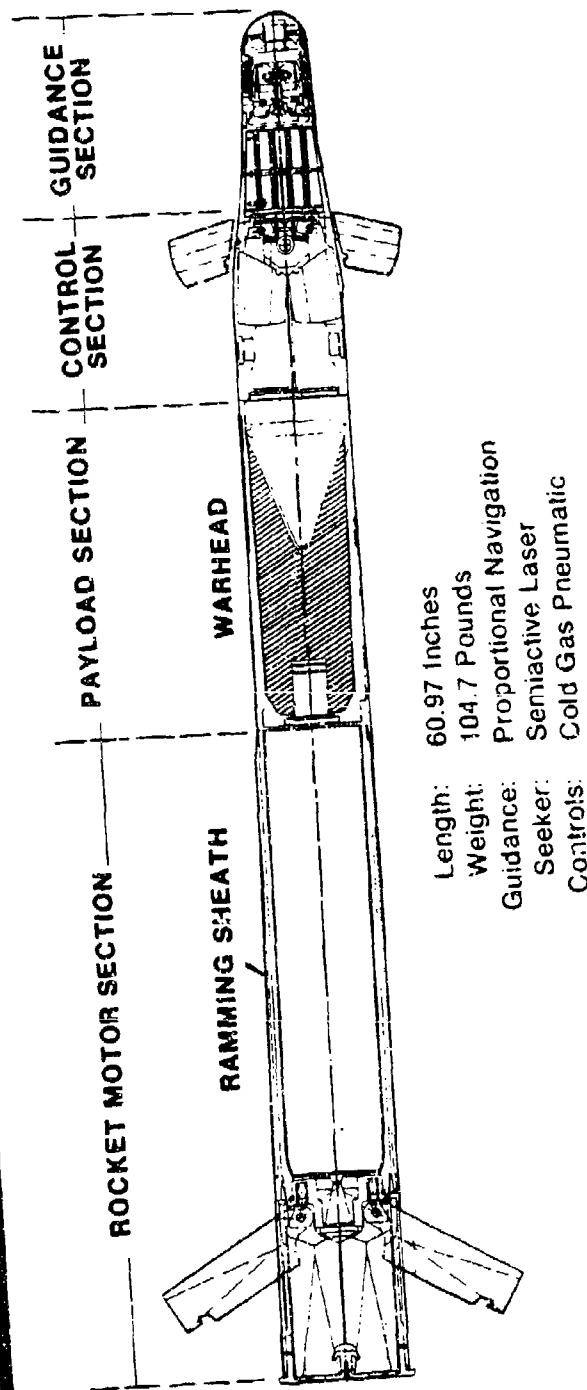


Figure 1.2 U.S. Navy 5"/54 Semi Active Laser Guided Projectile (SALGP).

section area of the stream tube captured by the inlet of the projectile. Stations 1 and 2 identify the diffuser. Station 1 itself is at the throat of the diffuser, but sub-station 1C is after the conical wave; sub-station 11 and S1 are ahead of the normal shock wave, located at the throat, or at the actual place, respectively; sub-stations 12 and S2 are as above, but behind the normal shock wave. Stations 3 and 4 refer to the entrance and to the exit of the fuel grain within the combustor, respectively. Note that both A_3 and A_4 increase with time as fuel burns. Station 5 and 6 belong to the nozzle's throat and to the exit of the nozzle, respectively.

1.3 Data

1.3.1 Dimensions

In order to be compatible with the Navy's 5 inch, 54 caliber, Mark 46 gun mount, as modified for gun launched guided projectiles (Figure 1.2), a set of requirements were adapted initially. These were:

- a. External shape of existing 5" guided SAL projectile
- b. Length - 60.97"
- c. Length of combustion chamber - 23"
- d. Total weight - 104.7 lb.
- e. Muzzle velocity - 2500 ft/sec.

Typical values for the internal areas in the ramjet within the projectile are (units - sq. in.):

A_r	A_0	A_1	A_2	A_3	A_5	A_6
19.3	5.2	2.6	4.3	8.2	7.5	13.1

Refer to Figure 1.1 for definition of the areas. A_r is a reference area.

For typical flight Mach number of: $M_0 = 3$, the appropriate Mach numbers at the main stations are typically:

M_{1C}	M_{11}	M_{12}	M_2	M_3	M_5	M_6
2.2	2.1	0.56	0.3	0.1	1	2

1.3.2 Combustion Process

Some of the losses in the total pressure were taken to be constant. These are:

- Inlet boundary layer losses (π'_D ; typically = 0.93).
- Subsonic diffuser recovery (π''_D ; typically = 0.93).
- Nozzle losses (π_n ; typically = 0.96).

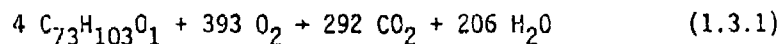
These values are typical and are not expected to vary too much.

All the other losses in total pressure, which are dominant to the projectile performance, were calculated. These are:

- Conical shock wave losses (π_C).
- Normal shock losses (π_{NS}).
- Losses due to expansion into the combustion chamber (π_e).
- Heat losses in the combustion chamber (π_h).

See section A 1.4.2 for definition of various π . Combustion efficiency was taken constant: $\eta_T = 0.90$

Air heat capacity ratio was also taken constant: $\gamma_a = 1.4$; however, the value for the gas heat capacities ratio of the combustion products (γ_f) was calculated from thermodynamic data for Hydroxy Terminated Polybutadiene, HTPB, burned in air [8]. The stoichiometric chemical reaction of HTPB burning with oxygen is as follows:



1.3.3 Trajectory

In the trajectory part of the program, the various drag coefficients were calculated. Those are:

- Cowl drag coefficient (C_{DN}), [9-12].

- b. Skin drag coefficient (C_{DS}), [13-15].
- c. Wing (or fin) wave drag coefficient (C_{DWW}), [16 - 20].
- d. Wing (or fin) friction drag coefficient (C_{DWF}), [13, 19].

Base drag [13, 21-23] is assumed to be negligible due to the jet from ramjet nozzle.

The model, which was chosen to calculate the cowl (nose) drag coefficient, was based on a theoretical development done by T. H. Gawain [9]. The modified program (AERO) is listed in Appendix G. However, program AERO as it is, appears to be too long to be used directly in the main program (TRAJET). Therefore, best fit curves for calculated results from AERO were used in TRAJET.

Skin drag coefficients were calculated for either laminar or turbulent flows. The same routine was also used to calculate wing or fin friction drag coefficients. To calculate the wing wave drag coefficients, a pseudo 3-dimensional model was developed.

The program also has an option to calculate a trajectory of a projectile without propulsion. In this case, the drag coefficients which are calculated are:

- a. Nose drag coefficient (a different model than the above).
- b. Base drag coefficient.
- c. Skin drag coefficient (as above).

1.3.4 Air Defense Scenario

In the air defense scenario, the program takes into account only cases in which the projectile exceeds a Mach number of at least 1.8. This value of minimum Mach number (XM_0) can easily be changed.

1.4 Results

Each section of the program was developed, tested and run separately. The ramjet part was first run without the trajectory part using

constant altitude (Typically - 10,000 ft). The same was done with the trajectory part using vacuum case, thrust-equal-drag flight, or constant thrust case. The final version was programmed to give the following optional printings:

- a. Loop on all possible values of A_0/A_r and A_5/A_r and print summary tables only.
- b. Print detailed, time dependent, tables for any specific area ratio chosen:
 - Results from combustion process (file name: CMB D)
 - Results from trajectory process (file name: TRJ D)
 - Various drag coefficients (file name: DRG D)
- c. Detailed print of every step during the calculation, for checkup.
- d. Variation of the above:
 - Detailed print of cases that were found not to be suitable:
 - Reasons only
 - Full detailed parameters
 - Loop on Mach numbers, also (output of subroutine CALCM)

2. TYPICAL RESULTS

Figure 2.1 presents the dependence of the fuel specific impulse (I_{sp} , in sec.) of the ramjet on the projectile Mach number at various altitudes. It appears that the 5"/54 ramjet has a capability to produce fuel specific impulse in the order of 400 - 900 sec., depending mostly on the flight altitude. The dependence of I_{sp} on the flight Mach number is weak.

Figures 2.2 and 2.3 present the dependence of the thrust coefficient (C_f) on the internal area ratios A_0/A_r and A_5/A_r . In figure 2.2, the change of C_f with altitude and with Mach number is also presented. The thrust coefficient (C_f) varies in the range of 0.3 ± 0.1 while A_0/A_r changes from 0.25 to 0.40 and A_5/A_r changes from 0.42 to 0.26.

The correlation between the fuel specific impulse (I_{sp}) and the thrust coefficient (C_f) is presented in figures 2.4 and 2.5. In both figures, a Mach number of $M_0 = 3.0$ was selected. In figure 2.4, the correlation was checked at various altitudes and at various A_0/A_5 area ratios. In figure 2.5, various internal area ratios (A_0/A_r , A_5/A_r) are presented.

More detailed results are presented in Appendix H. The dependence of the projectile performance on the other internal area ratios (A_1/A_0 , A_2/A_0 , A_3/A_r) was also checked. Some typical results are presented in that Appendix.

An altitude vs range dependence for various elevation angles is presented in figure 2.6. A range of over 80 km can be achieved with the ramjet operation, compared to only slightly more than 20 km achieved by the conventional projectile. A low-altitude launch (in this figure, an elevation angle of 15° was selected) is also presented reaching a range of over 30 km with the ramjet operation. The high elevation angles are mostly used in air-defense scenario. The drag of the projectile when the ramjet is not operating, for example,

after burnout, was not determined. The computer program does not account for the drag increase due to the ramjet not operating. Consequently some of the trajectory curves in figure 2.6 are in error. However, for trajectories at low gun elevation, the ramjet burns all the way to splash. These trajectories are accurate. For all trajectories, the curves are accurate to the point of ramjet burnout. The trajectories of interest to air defense are accurately calculated. Trajectory of thrust-equal-drag (vacuum) case is shown for comparison.

Results for air defense scenario are presented in figure 2.7. Only ranges where the projectile Mach number exceeds at least 1.8 were considered. The area ratios were chosen as specified in the figure. The two cowl angles, shown in figure 3.1 were 20° and 9.5° respectively. The gun elevation angle was varied from 7° to 80° . The change of atmospheric conditions with the altitude was taken into account. In table 2.1, some typical results for "Surface-to-Surface Mission" are presented.

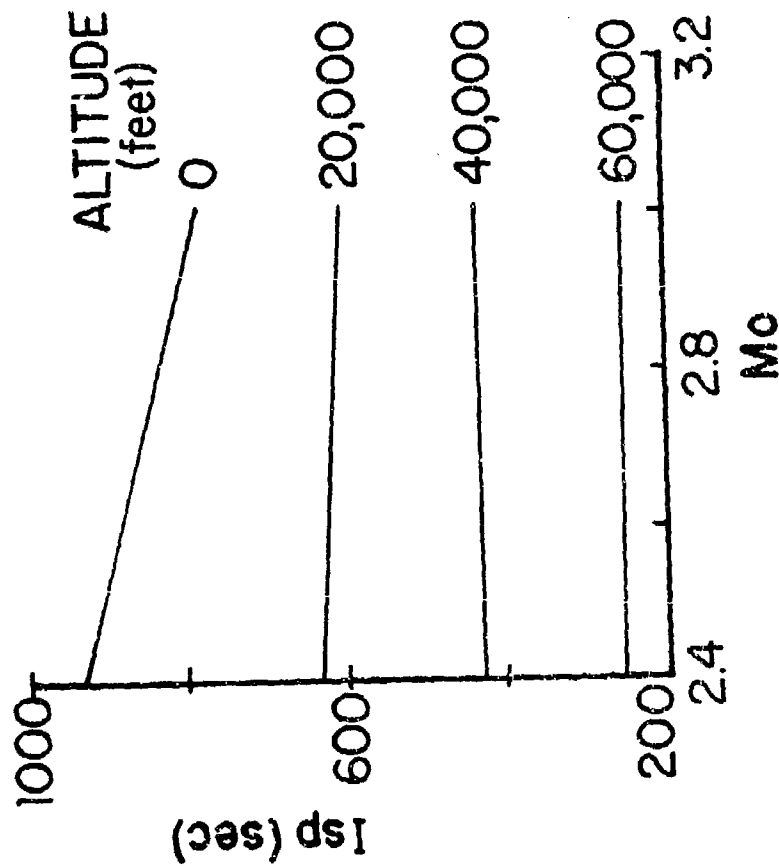


Figure 2.1 Solid Fuel Ramjet: Dependence of Fuel Specific Impulse (I_{sp}) on Flight Mach Number at Various Altitudes

Conditions: $A_0/A_r = 0.25$, $A_1/A_0 = 0.47$, $A_2/A_0 = 0.827$
 $A_3/A_r = 0.427$, $A_5/A_r = 0.28$, $A_6/A_r = 1$, $\theta = 45^\circ$, $t = 0$

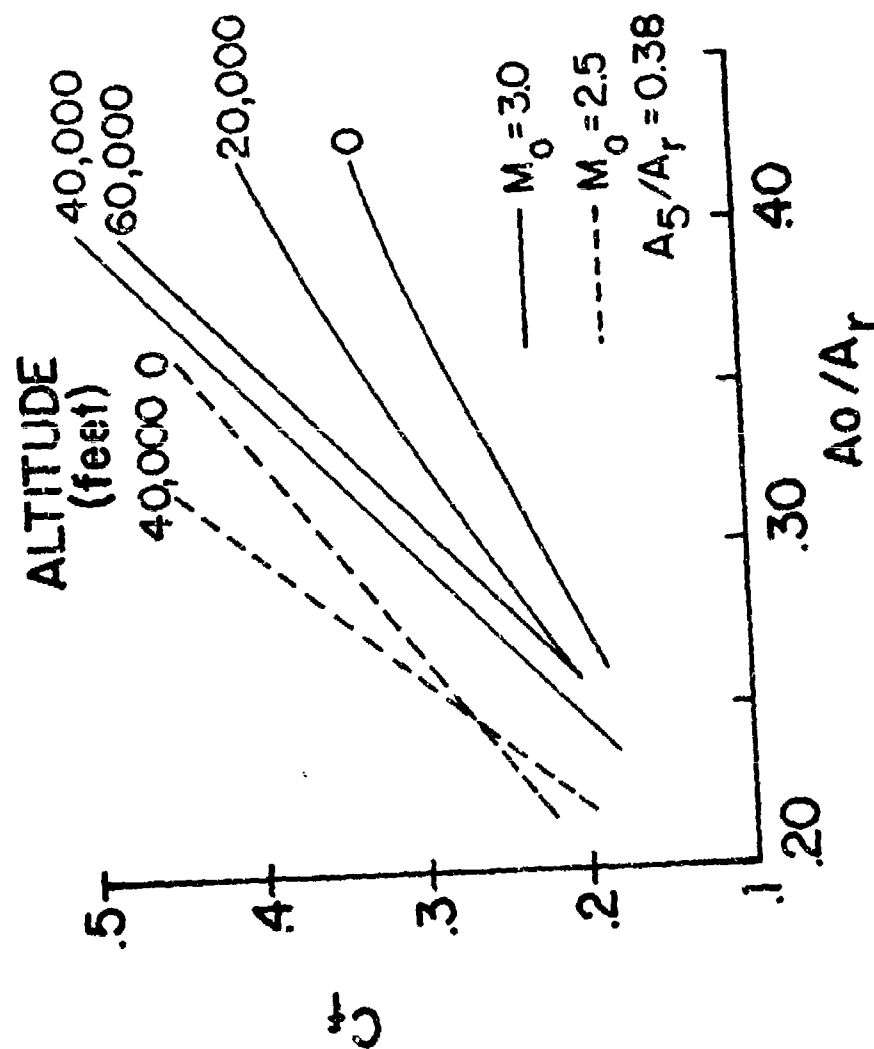


Figure 2.2 SFKJ: Dependence of Thrust Coefficient on Internal Area Ratio (A_0/A_r) at Various Altitudes

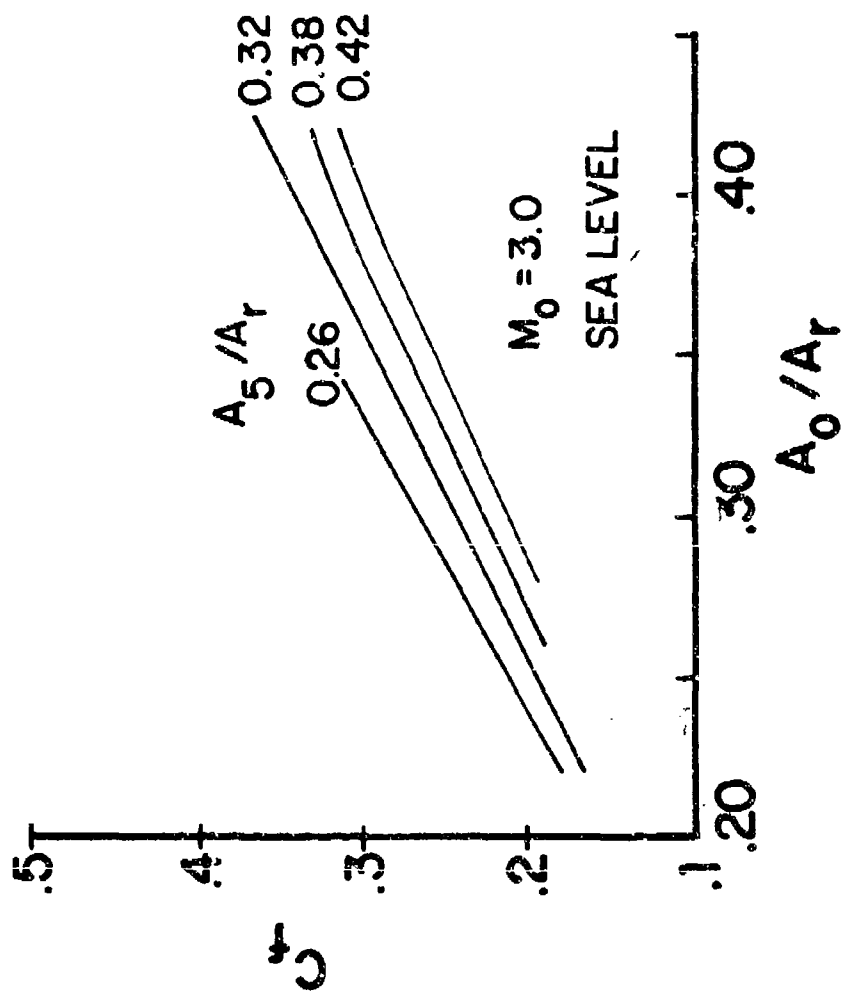


Figure 2.3 SFRJ: Dependence of Thrust Coefficient on Inlet and on Nozzle Area Ratios

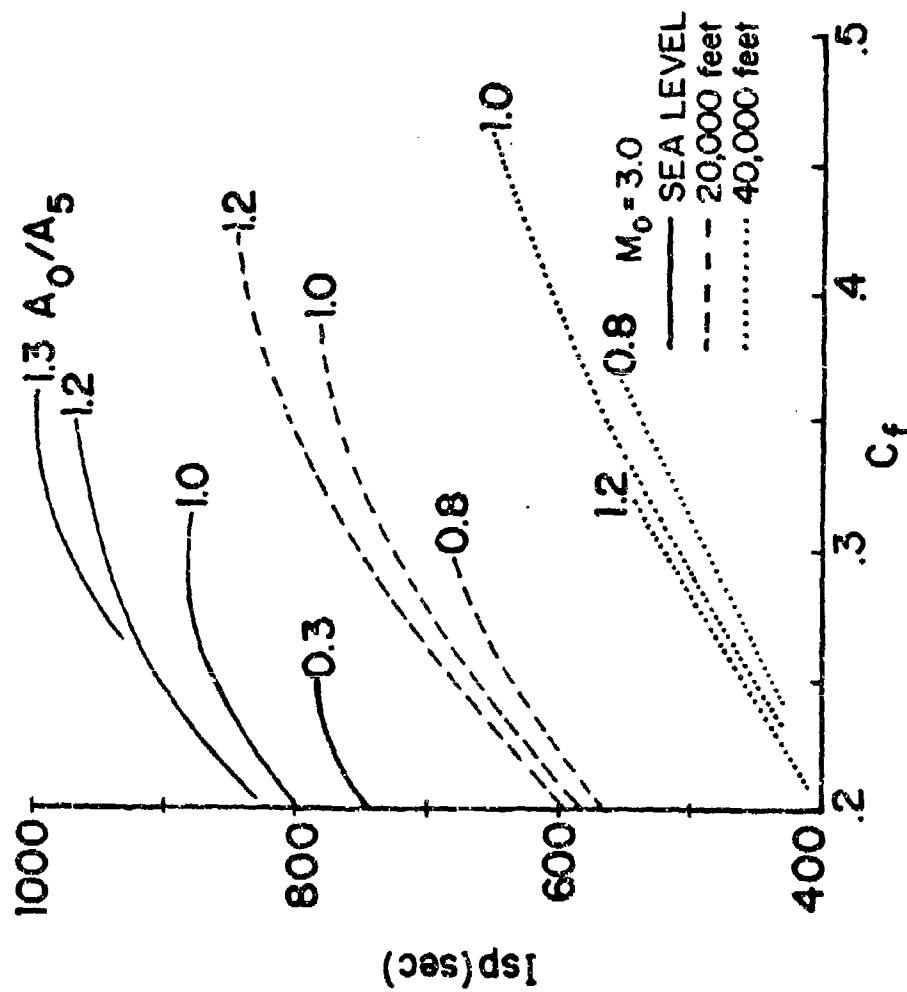


Figure 2.4 SFRJ: Dependence of Fuel Specific Impulse (I_{sp}) on Thrust Coefficient at Various Altitudes

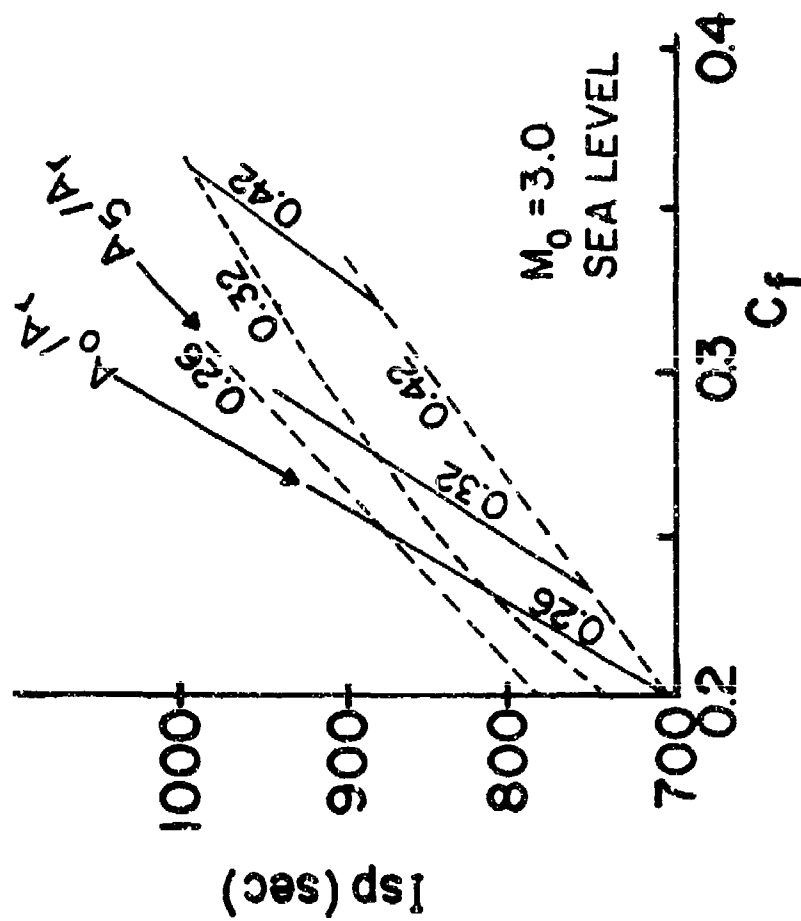


Figure 2.5 SFRJ: Dependence of Fuel Specific Impulse (I_{sp}) on Thrust Coefficient at Various Internal Area Ratios

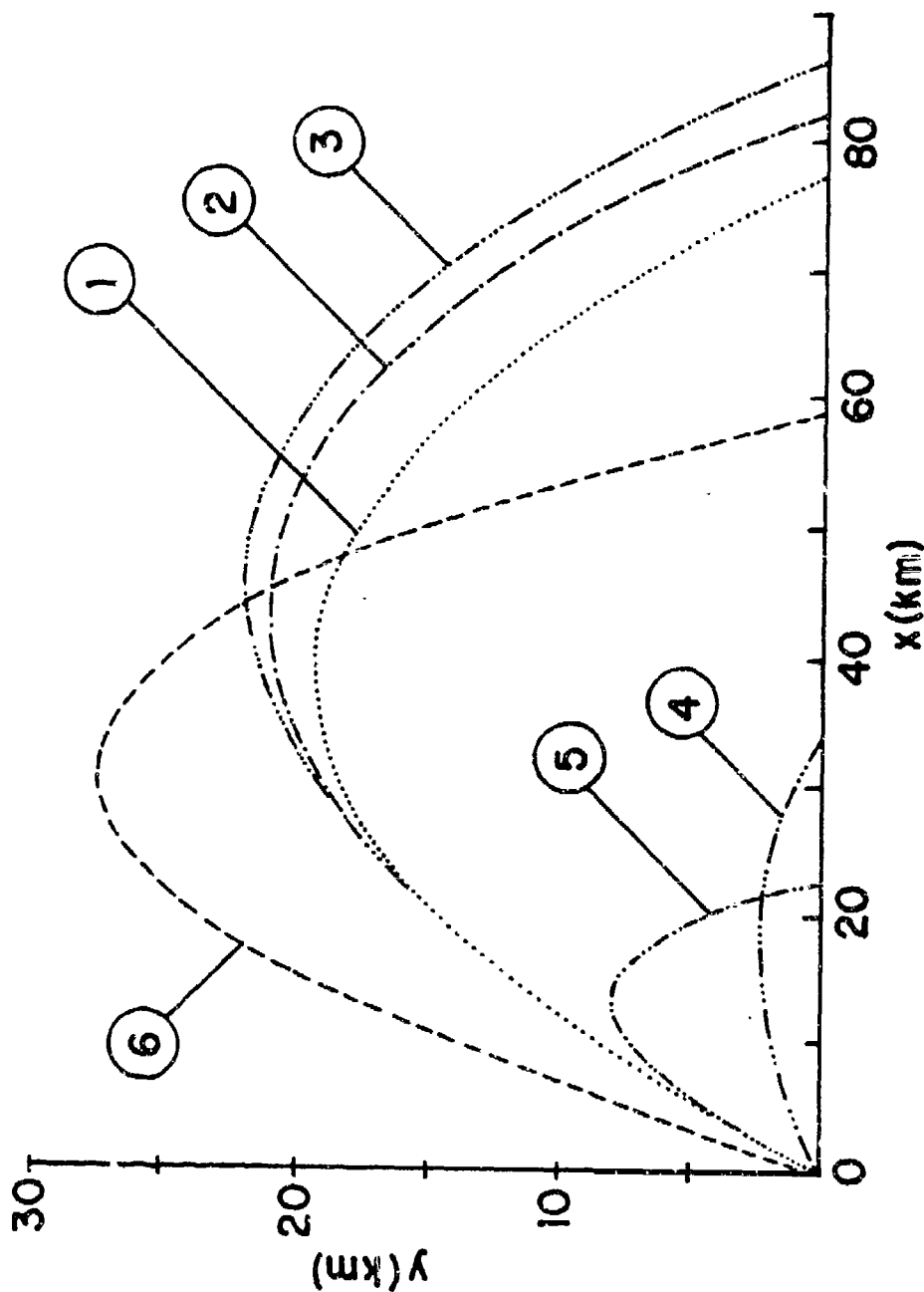


Figure 2.6 Comparison of Trajectory of SFRJ with Conventional Projectile at Various Conditions:

① Thrust-Equal Drag (Vacuum); ② SFRJ, $\theta=45^\circ$; $A_0/A_r=0.20$, $A_1/A_0=0.42$, $A_2/A_0=0.827$, $A_3/A_r=0.426$, $A_5/A_r=0.26$, $A_6/A_r=1$; ③ As in (2), but: $A_1/A_0=0.47$; ④ As in (3), but: $\theta=15^\circ$; ⑤ Projectile without Propulsion, $\theta=45^\circ$; ⑥ As in (3), but: $\theta=60^\circ$, $A_0/A_r=0.25$

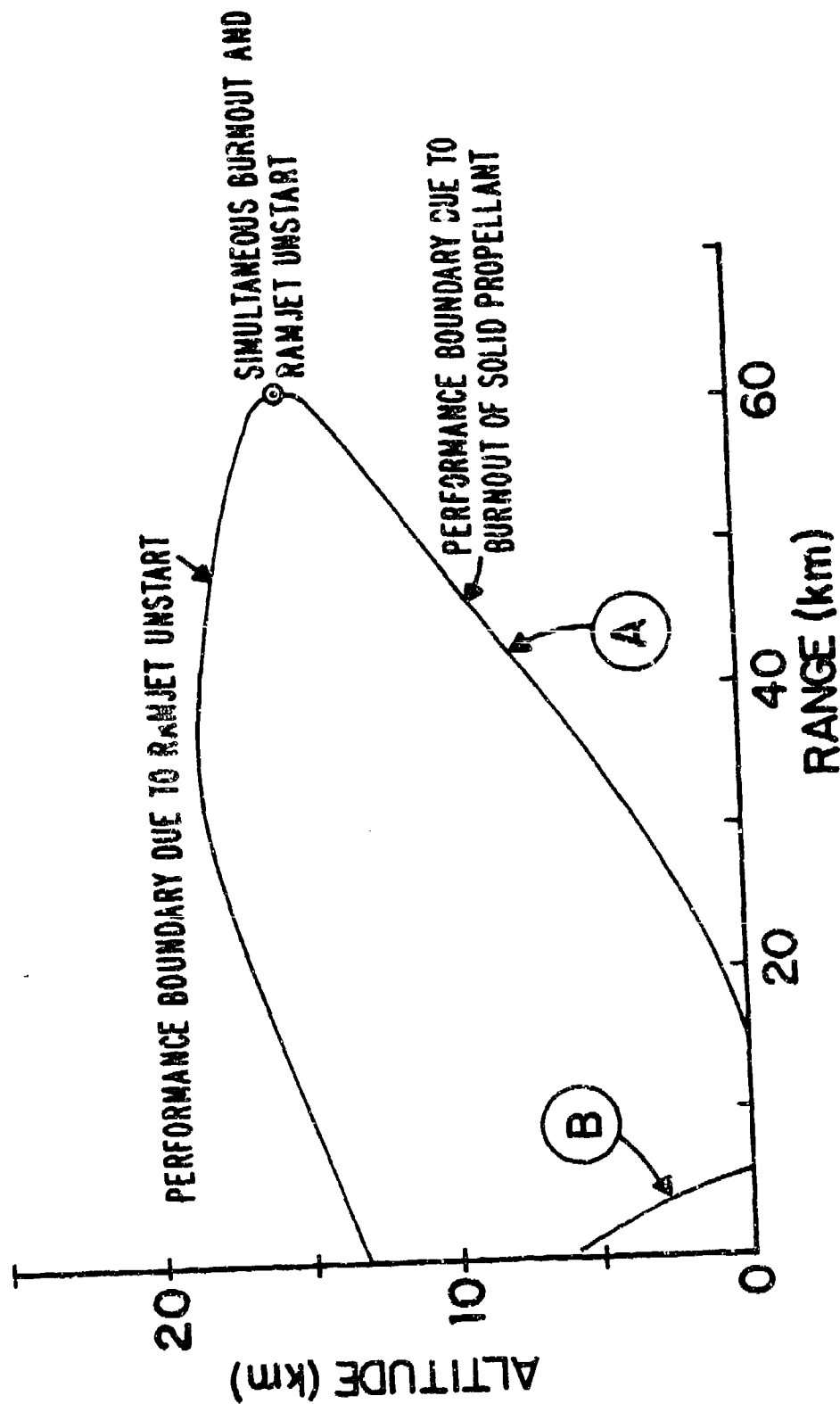


Figure 2.7 Solid Fuel Ramjet Propelled 5"/54 Projectile: Air Defense Mission

(A) Ramjet: $A_0/A_r=0.25$, $A_1/A_0=0.47$, $A_2/A_0=0.887$, $A_3/A_r=0.426$, $A_5/A_r=0.26$,
 $A_6/A_r=1$. ($M_0(\text{Min}) = 1.8$)

(B) Projectile Without Propulsion; Mach = 1.8 Boundary

TABLE 2.1

Solid Fuel Ramjet Propelled 5"/54 Projectile
Surface-to-Surface Mission
Ranges (km) vs Gun Elevation Angles

Elevation Angle	7°	25°	45°	65°	80°
a. Ramjet ⁽¹⁾	15.6	49.9	80.3	15.9	5.6
b. Projectile Without Propulsion	9.2	17.5	20.2	16.3	7.6

Note: 1. Area ratios as in Figure 2.7

3. Discussions

Looking back at figure 2.1, the dependence of I_{sp} on altitude and on Mach number should be explained. We shall do that by using the equations described in Appendix A.

From equations: (1.4.9a), (1.4.12), (1.4.16)

together with equations: (1.1.1), (1.1.2), (1.1.3)

one obtains:

$$I_{sp} = C_f \times X_3 \quad (3.1)$$

where: $X_3 = k_3 P_0^{0.4} M_0^{1.4} \quad (3.2)$

and: $C_f = X_2 - k_2 \quad (3.3)$

where: $X_2 = k_1 M_0^{-2} [X_1 - 1] \quad (3.4)$

$$X_1 = k_4 M_0 [1 + k_5 (P_0 M_0)^{-0.4}] \quad (3.5)$$

The parameters k_1 to k_5 are functions of the various area ratios, the temperature of air (T_0), the heat capacity ratio of air (γ_a) and the perfect gas constant (R_a). These parameters are assumed to be constants in discussing the influence of the change in altitude and in Mach number on the value of I_{sp} . The altitude dependence is mainly due to change in atmospheric pressure (P_0). In the conditions chosen for figure 2.1, the dependence of I_{sp} on pressure is approximately $P_0^{0.4}$ at $M_0 = 3$. That means that, in the region mentioned, I_{sp} pressure dependence is mostly due to change of X_3 (equations 3.1 & 3.2). From the same equations, the Mach number dependence of I_{sp} can also be explained. At high altitude, the change of X_3 ($M_0^{1.41}$) is very close to the C_f dependence on Mach number ($M_0^{-1.3}$) and therefore I_{sp} is almost constant while changing M_0 . On the other hand, at sea level, the change in X_3 ($M_0^{1.35}$) is smaller than that of C_f ($M_0^{-2.14}$) and therefore I_{sp} changes with M_0 as shown in figure 2.1.

Figures 2.2 - 2.5 present similar dependences of the ramjet performance, and can well be understood using the same equations.

Testing these results, together with those presented in Appendix H, the design of the ramjet internal area ratios can be completed. The results are listed in Table 3.1.

Table 3.1: Ramjet Design

Dimensions:

External diameter = 5"

Total length = 60.97"

Total weight = 104.7 lb (47.5 kg)

Area Ratios:

A_0/A_r	A_1/A_0	A_2/A_0	A_3/A_r	A_5/A_r	A_6/A_1
0.25	0.47	0.887	0.426	0.26	1

Reference Area:

$A_r = 19.3$ sq. in. (124.5 cm^2)

Combustor

Solid fuel: Hydroxy Terminated Polybutadiene (HTPB).

Fuel weight: 3 kg

Fuel density: 971.56 kg/m^3

Fuel specific impulse (I_{sp}): 400 - 900 sec.

Booster

Booster weight: 2 kg

Booster density: 1650 kg/m^3

Booster specific impulse (I_{sp}): 240 sec

Performance

Muzzle velocity: 762 m/sec

Velocity after booster: 863 m/sec

Thrust Coefficient (C_f): 0.2 - 0.4

In figures 3.1 - 3.4, the designed ramjet concept is presented. The guidance and the control sections as well as the warhead were not redesigned. The location of the tailfin is described in figures 3.3 - 3.4 [White,24]. The configuration of the solid fuel ramjet presented here, is in accordance with the design of the liquid fuel ramjet done previously by Brown [5]. The new design is also in agreement with the Navy's requirement to be compatible with its 5"/54 Mark 46 gun mount, as modified for gun launched guided projectiles.

Figure 2.6 presents a full-range comparison of the SFRJ 5"/54 projectile performance with that of the conventional projectile. The improvement in performance of the ramjet-propelled, guided projectile is very significant. The extended range of the ramjet concept can be used in a "Surface-to-Surface Mission" (Table 2.1). The main improvement of the ramjet concept might be in an "Air-Defense Mission" (figure 2.7). A minimum Mach number of $M_0 = 1.8$ was assumed for both the ramjet concept and the conventional projectile. At lower altitudes, the projectile is limited by burn-out of the fuel. At higher altitudes, the performance boundary is due to ramjet unstart. The conventional projectile is limited by the Mach number decay to values less than 1.8. It is self-evident that the ramjet concept provides significant improvement, and, therefore, has significant ASMD Capability.

ALL DIMENSIONS IN INCHES

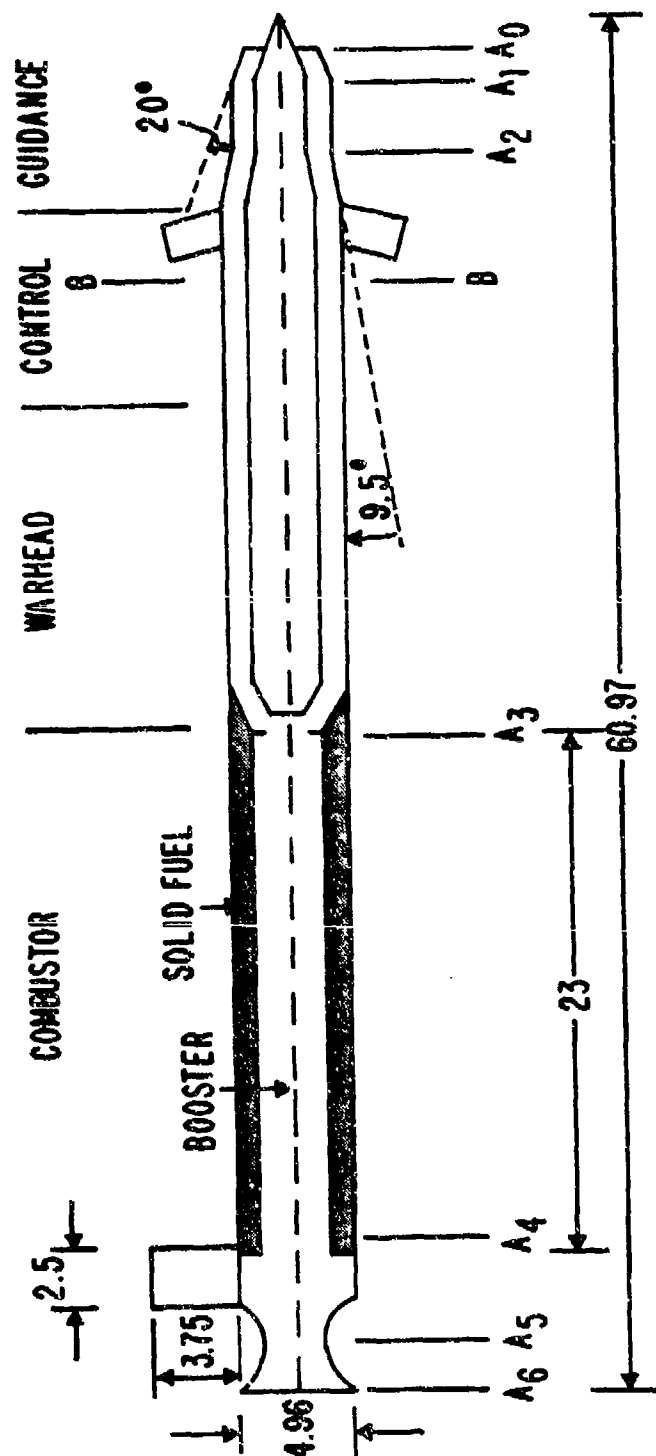


Figure 3.1 Solid Fuel Ramjet Propelled 5"/54 Projectile: Design

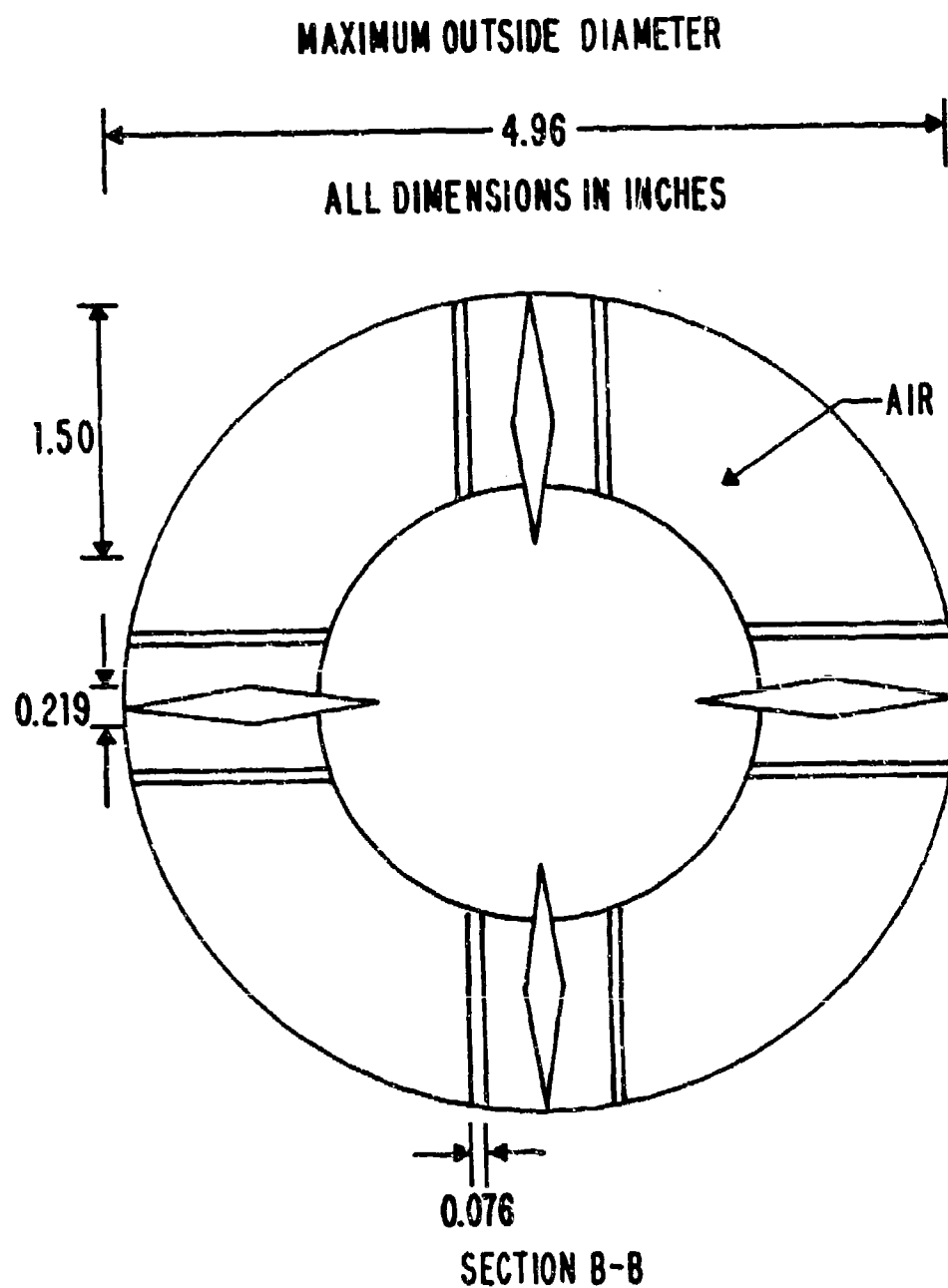


Figure 3.2 Solid Fuel Ramjet Propelled 5"/54
Projectile: Design, Section B-B

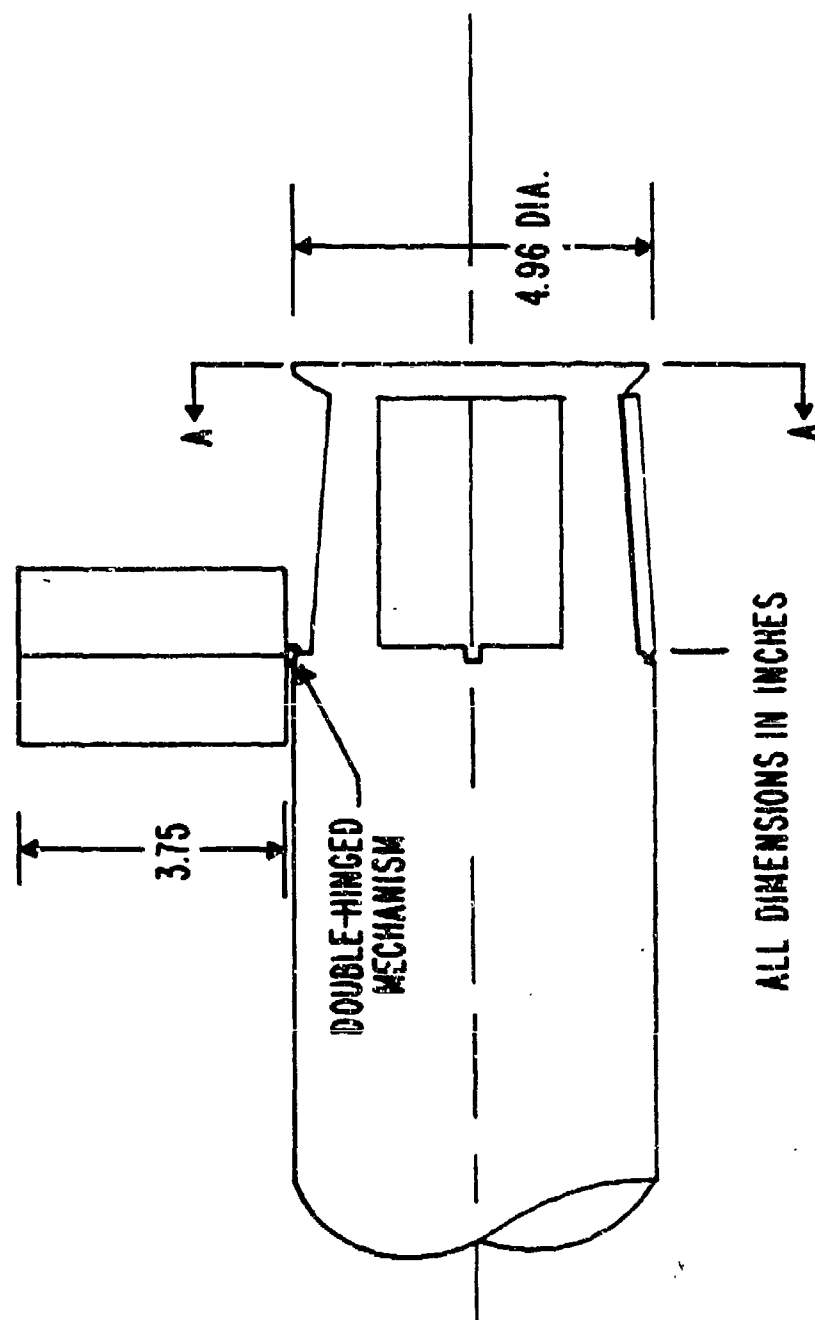


Figure 3.3 Aft Body Fin Design [24]

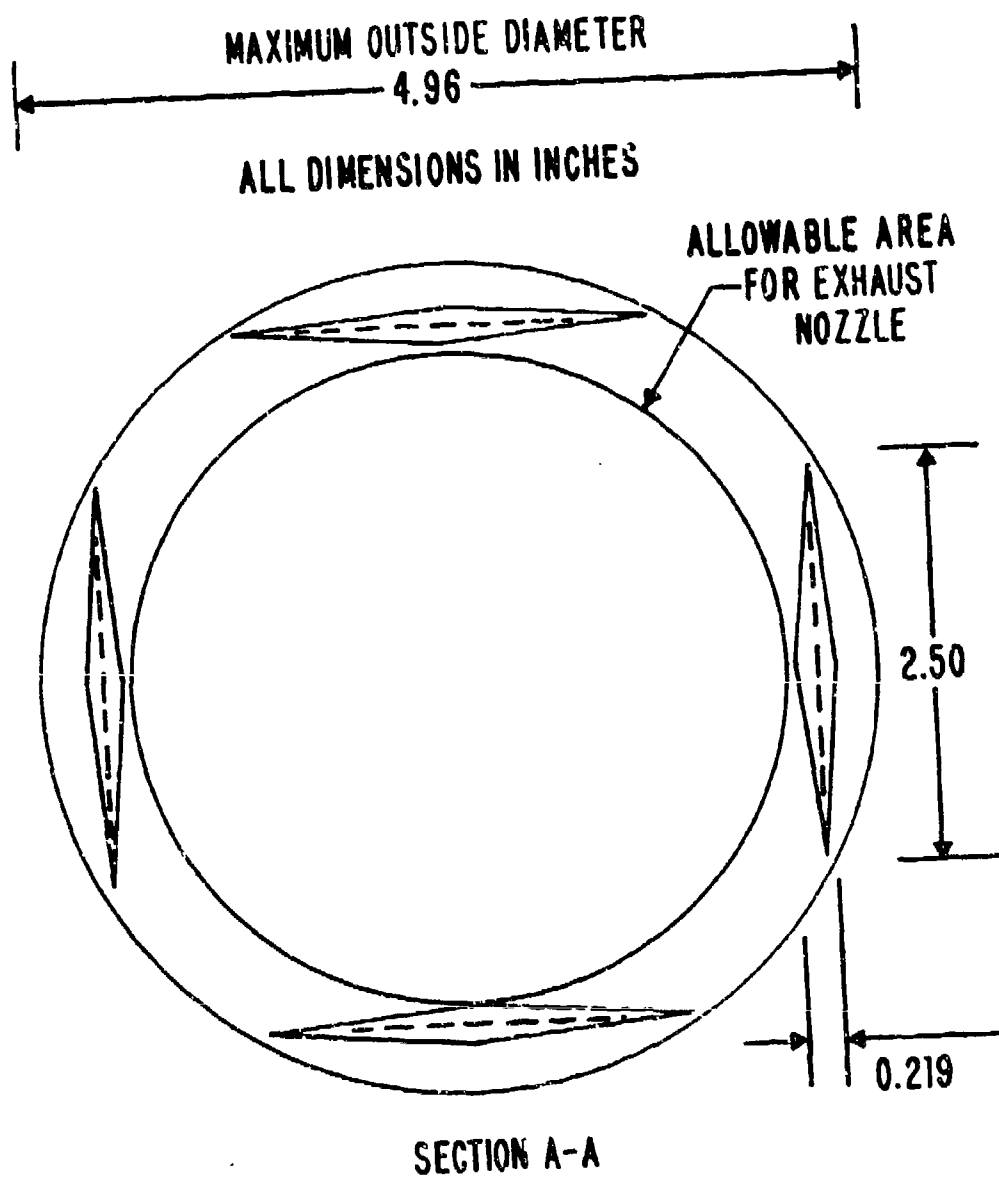


Figure 3.4 Aft Body Fin Design: Section A-A [24]

4. Conclusion

Based on the computer model discussed above, the ramjet-propelled, guided projectile provides significant improvement over the conventional projectile. The fuel specific impulse of the SFRJ is in the order of 600 ± 200 sec, depending mainly on the altitude of the projectile. The appropriate value of the rocket is only 300 sec. The thrust coefficient varies from 0.2 to 0.4, depending on the atmospheric conditions (altitude) and on the geometry of the projectile (internal areas). Therefore, the ramjet-propelled, guided projectile reaches a range of about 80 km compared to range of slightly more than 20 km in the conventional projectile. The improvement of the ramjet concept might be in both "Surface-to-Surface Mission" and in "Air-Defense Mission". It provides an ASMD weapon which is complementary to guided missiles.

More work is required to design an optical system incorporated into the inlet. For satisfactory ramjet performance at the flight Mach numbers, the lens must be a conical shape.

Appendix A: SOLID FUEL RAMJET: EQUATIONS

A1. Combustion

A1.1 Computation of fuel - regression rate, weight rate of burning fuel, and fuel - air ratio

Define G as the weight flow rate of air per unit through the entrance port to the combustor; see figure 1.1. Hence G is given by:

$$G = \frac{\dot{W}_a}{A_3} \quad (1.1.1)$$

and has dimensions of lb/sec.in². The simple form of the regression rate of a solid fuel, $\dot{r}$, is given by:

$$\dot{r} = aG^n \quad (1.1.2)$$

Where a and n are empirically determined constants. The dimensions for $\dot{r}$ are in/sec. Knowledge of the temperature dependence of the regression rate will allow the use of a more accurate model instead of equation (1.1.2).

The weight of fuel burned per unit of time is as follows:

$$\dot{W}_f = \rho_f \dot{r} \pi D_3 L_3 \quad (1.1.3)$$

Where ρ_f is the density of the fuel in lb/in³, D_3 is the inside diameter of the fuel grain. Note that D_3 increases as the fuel burns.

The length of fuel grain is L_3 inches. For the case of HTPB, the value of 0.0351 lb/in³ was taken. In an actual solid fuel ramjet, $\dot{r}$ varies along the grain; $\dot{r}$ is largest in the region immediately downstream of the entrance port of the combustor. However, for the ramjet model developed here, the value of $\dot{r}$ is assumed to be constant along the grain. Consequently:

$$D_3 = D_{30} + 2 \int_0^t \dot{r} dt \quad (1.1.4)$$

The integral form for the change in grain internal diameter is used since $\dot{r}$ may vary with time. The initial grain inside diameter is D_{30} inches, and the inside area for fuel grain as a function of time can be written as:

$$A_3 = \frac{\pi}{4} \left[\sqrt{\frac{4}{\pi} A_{30}} + 2 \int_0^t \dot{r} dt \right]^2 \quad (1.1.5)$$

By definition, the fuel - air ratio is:

$$f = \frac{W_f}{W_a} \quad (1.1.6)$$

The value for W_a is obtained from weight flow through the inlet, and the value for W_f is calculated using equation (1.1.3). The total mass flow through the nozzle is given by:

$$W_T = W_f + W_a = W_a(1 + f) \quad (1.1.7)$$

For HTPB burning in air, the stoichiometric value for f is 0.0728; high combustion efficiency is difficult when f is less than 0.025.

A1.2 Computation of Combustion Exit Condition

Combustor exit conditions are specified by four quantities as follows: stagnation temperature, T_{T4} , O_R ; stagnation pressure, P_{T4} , psi; ratio of heat capacities, γ_f ; and gas constant, R_f , in/ O_R . In the computer program, the appropriate mks units are used, i.e. O_K , kg/ m^2 , m/ O_K , respectively. To determine the exit conditions, two input quantities are needed. These are fuel - air ratio and stagnation temperature at the combustor inlet, T_{T0} . Note that $T_{T3} = T_{T0}$ has been assumed.

From the thermodynamic data for HTPB burning in air, one determines $T_{T4}(th)$, γ_f , R_f . The symbol $T_{T4}(th)$ is a theoretical temperature which results from 100% combustion efficiency. Introducing the definition of combustion efficiency yields:

$$T_{T4} = [\eta_T T_{T4(th)} - T_{T0}] + T_{T0} \quad (1.2.1)$$

As discussed previously, a constant value of η_T equal to 0.9 has been assumed.

The value for p_{T4} is calculated based on one-dimensional, choked nozzle flow. A certain value of p_{T4} is required to force a certain weight flow, W_T , through the nozzle. Assume that γ_f remains fixed through the nozzle. Define a function of γ_f as:

$$\Gamma = \sqrt{\gamma_f} \left[\frac{2}{\gamma_f + 1} \right]^{(\gamma_f + 1)/[2(\gamma_f - 1)]} \quad (1.2.2)$$

Define a characteristic nozzle velocity,

c^* , m/sec:

$$c^* = \frac{\sqrt{g R_f T_{T4}}}{\Gamma} \quad (1.2.3)$$

where g is the acceleration of gravity and has value of 9.807 m/sec^2 .

The required value for p_{T4} is given by:

$$p_{T4} = \frac{W_T c^*}{g A_5} \quad (1.2.4)$$

The decrease of flight stagnation pressure, p_{T0} , by inlet and combustor losses must not be too large. If the inlet and combustor do not provide the required p_{T4} , the inlet will unstart and W_a will decrease.

A1.3 Computation of Nozzle Exit Conditions

The relation between the area ratios and the Mach number is well known by the formula:

$$\frac{A_5}{A_6} = M_6 \left\{ \frac{(\gamma_f + 1)/2}{1 + \frac{\gamma_f - 1}{2} M_6^2} \right\}^{(\gamma_f + 1)/[2(\gamma_f - 1)]} \quad (1.3.1)$$

A_5 , A_6 are the areas at the throat and at the exit of the nozzle, respectively. Knowing γ_f , the exit Mach number (M_6) can be calculated for any nozzle area ratio (A_5/A_6). This indirect calculation is done in subroutine CALCM, using Newton - Raphson's iteration routine.

The total pressure at the exit of the nozzle (p_{T6}) is defined by:

$$p_{T6} = p_{T4} \pi_n \quad (1.3.2)$$

where the total pressure at the exit of the combustor (p_{T4}) was calculated previously (e.g. 1.2.4).

Knowing the total pressure at the exit of the nozzle (p_{T6}) and the Mach number at this point (M_6), the exit pressure (p_6) can be calculated:

$$p_6 = p_{T6} \left(1 + \frac{\gamma_f - 1}{2} M_6^2 \right)^{-\gamma_f/(\gamma_f - 1)} \quad (1.3.3)$$

A1.4 Computation of Thrust and Thrust Coefficient

A1.4.1 Thrust Coefficient (C_f)

The thrust of the engine is the net rate of change in momentum at a steady state condition, and is given by:

$$\begin{aligned} F &= p_6 A_6 + \dot{m}_6 U_0 - p_0 A_0 - \dot{m} U_0 - p_0 (A_4 - A_0) + p_0 (A_4 - A_6) \\ &= p_6 A_6 + \dot{m}_6 U_6 - p_0 A_6 - \dot{m}_0 U_0 \end{aligned} \quad (1.4.1)$$

where U_0 , U_6 , $\dot{m}_0$, $\dot{m}_6$ are the velocities and mass flow at the inlet entrance and at the nozzle exit, respectively.

From the continuity equation, the following relation arrives:

$$\dot{m}U = \rho U^2 A \quad (1.4.2)$$

Substituting for the density (ρ) from the perfect gas equation of state:

$$\rho = \frac{p}{RT} \quad (1.4.3)$$

gives:
$$\dot{m}U = \frac{p}{RT} U^2 A \quad (1.4.4)$$

From the definition of Mach number and speed of sound:

$$U^2 = M^2 a^2 ; a^2 = \gamma RT \quad (1.4.5)$$

Therefore:
$$\dot{m}U = \frac{p}{RT} M^2 \gamma RT A$$

$$\dot{m}U = \gamma M^2 p A \quad (1.4.7)$$

Substituting (1.4.7) into (1.4.1) gives:

$$F = p_6 A_6 (1 + \gamma_f M_6^2) - p_0 A_0 \left(\frac{A_6}{A_0} + \gamma_a M_0^2 \right) \quad (1.4.8)$$

The thrust coefficient is defined :

$$C_f = \frac{F}{q_0 A_r} \quad (1.4.9)$$

where:
$$q_0 = \frac{1}{2} \rho_0 U_0^2 = \frac{1}{2} \gamma_a p_0 M_0^2 \quad (1.4.10)$$

Combining equation (1.4.9) and 1.4.10) gives:

$$C_f = \frac{F}{\frac{\gamma_a}{2} p_0 M_0^2 A_r} \quad (1.4.11)$$

Substituting for the thrust from equation (1.4.8) turns equation (1.4.11) into:

$$C_f = \frac{2A_6/A_r}{\gamma_a M_0^2} \left[\frac{p_{T6}/p_0}{p_{T6}/p_6} (1 + \gamma_f M_6^2) - 1 \right] - \frac{2A_0}{A_r} \quad (1.4.12)$$

A1.4.2 Pressure Losses

The pressure ratios in the above formula:

$$\frac{P_{T6}/P_{T0}}{P_{T6}/P_6}$$

can be substituted by a function of pressure losses across the ramjet:

$$\frac{P_{T6}}{P_0} = \frac{P_{T6}}{P_{T4}} \frac{P_{T4}}{P_{T3}} \frac{P_{T3}}{P_{T2}} \frac{P_{T2}}{P_{T0}} \frac{P_{T0}}{P_0} \quad (1.4.13)$$

We define the pressure losses as follows:

$$\frac{P_{T6}}{P_{T4}} = \pi_n = \text{Nozzle losses}$$

$$\frac{P_{T4}}{P_{T3}} = \pi_h = \text{Rayleigh flow losses}$$

$$\frac{P_{T3}}{P_{T2}} = \pi_e = \text{Combustor expansion losses}$$

$$\frac{P_{T2}}{P_{T0}} = \pi_D = \text{Inlet losses} = (\text{conical wave loss}) * (\text{boundary layer loss}) *$$

$$*(\text{normal shock loss}) * (\text{subsonic diffuser recovery}) = \pi_C \pi_D' \pi_{NS} \pi_D''$$

Therefore:

$$\frac{P_{T6}}{P_0} = \pi_n \pi_h \pi_e \pi_C \pi_D' \pi_{NS} \pi_D'' \frac{P_{T0}}{P_0} = \left[\prod_{i=\text{losses}} (\pi_i) \right] \frac{P_{T0}}{P_0} \quad (1.4.14)$$

Finally, substituting for total pressure ratios (P_{T0}/P_0 ; P_{T6}/P_6) gives:

$$\frac{P_{T6}/P_0}{P_{T6}/P_6} = \left[\prod_{i=\text{losses}} (\pi_i) \right] \frac{\left[1 + \frac{\gamma_a - 1}{2} M_0^2 \right]^{\gamma_a / (\gamma_a - 1)}}{\left[1 + \frac{\gamma_f - 1}{2} M_6^2 \right]^{\gamma_f / (\gamma_f - 1)}} \quad (1.4.15)$$

This relation can be used in equation (1.4.12) which calculates the thrust coefficient of the system.

A1.4.3 Computation of Thrust

The thrust can easily be calculated from the thrust coefficient, using eq. (1.4.9):

$$F = C_f q_0 A_r \quad (1.4.9a)$$

The dimensions of F are Newtons (after multiplying eq. (1.4.9a) by the acceleration of gravity, g). The fuel specific impulse, I_{sp} , in N/kg/sec, is defined by:

$$I_{sp} = F/W_f \quad (1.4.16)$$

The specific fuel consumption, SFC, in kg/hour/N is given by:

$$SFC = 3600/I_{sp} \quad (1.4.17)$$

Ramjet performance is specified in terms of the performance parameters C_f , F , I_{sp} and SFC.

A2. Check for Choked Nozzle

The total pressure at the throat of the nozzle is given by:

$$p_{T5} = p_{T4} \sqrt{\pi_n} \quad (2.1)$$

Again, p_{T4} , is the total pressure at the exit of the combustor, and is calculated by eq. (1.2.4). π_n is the nozzle loss. It follows that:

$$p_5 = p_{T5} \left(\frac{2}{\gamma_f + 1} \right)^{\gamma_f / (\gamma_f + 1)} \quad (2.2)$$

The pressure at the throat of the nozzle (p_5) should be equal or greater than the atmospheric pressure (p_0).

$$p_5 \geq p_0 \quad (2.3)$$

When inequality (2.3) is satisfied, the nozzle is choked.

A3. Heat Losses at the Combustor

A3.1 Mach Number

a. Continuity

At the combustion chamber, fuel is added and the continuity equation is:

$$\rho_3 U_3 A_3 (1 + f/a) = \rho_4 U_4 A_4 \quad (3.1.1)$$

where A_3 and A_4 refer to the entrance and to the exit of the combustor, respectively. By assuming that $A_3 = A_4$, the continuity equation (eq. 3.1.1) can be written as follows:

$$\frac{\rho_3}{\rho_4} (1 + f/a) = \frac{U_4}{U_3} \quad (3.1.2)$$

Replacing the velocities (U_3 and U_4) by the appropriate Mach numbers (eq. 1.4.5), turns eq. (3.1.3) into:

$$\frac{\rho_3}{\rho_4} (1 + f/a) = \left(\frac{M_4}{M_3} \right) \sqrt{\frac{T_4 \gamma_f R_f}{T_3 \gamma_a R_a}} \quad (3.1.3)$$

Where R_a , R_f are the gas constants of air and of the combustion products, respectively. Hence:

$$\left(\frac{M_3}{M_4}\right) = \left(\frac{\rho_4}{\rho_3}\right) \left(\frac{T_4}{T_3}\right)^{\frac{1}{2}} \left(\frac{\gamma_f R_f}{\gamma_a R_a}\right) \left(\frac{1}{1 + f/a}\right) \quad (3.1.4)$$

b. Momentum

Applying the conservation law of momentum to the discussed problem:

$$p_3 + \rho_3 U_3^2 = p_4 + \rho_4 U_4^2 \quad (3.1.5)$$

From the definition of Mach number (eq. 1.4.5) and the perfect gas equation of state (eq. 1.4.3):

$$\rho_i U_i^2 = \gamma_i p_i M_i^2 \quad (3.1.6)$$

Substituting equation (3.1.6) in equation (3.1.5):

$$\frac{p_4}{p_3} = \frac{1 + \gamma_a M_3^2}{1 + \gamma_f M_4^2} \quad (3.1.7)$$

Again, from the perfect gas equation of state:

$$\frac{p_4}{p_3} = \left(\frac{\rho_4}{\rho_3}\right) \left(\frac{T_4}{T_3}\right) \quad (3.1.8)$$

Substitution of (3.1.8) into (3.1.7):

$$\left(\frac{\rho_4}{\rho_3}\right) = \left(\frac{T_3}{T_4}\right) \left(\frac{1 + \gamma_a M_3^2}{1 + \gamma_f M_4^2}\right) \quad (3.1.9)$$

Substituting (eq. 3.1.9) turns equation (3.1.4) into:

$$\left(\frac{M_3}{M_4}\right) \left(\frac{T_4}{T_3}\right)^{\frac{1}{2}} = \left(\frac{1 + \gamma_a M_3^2}{1 + \gamma_f M_4^2}\right) \left(\frac{\gamma_f R_f}{\gamma_a R_a}\right)^{\frac{1}{2}} \left(\frac{1}{1 + f/a}\right) \quad (3.1.10)$$

Replacing the temperatures T_3 and T_4 by the appropriate total temperatures:

$$T_i = T_{Ti} \left(1 + \frac{\gamma_i - 1}{2} M_i^2 \right)$$

and assuming that the change in total temperature up to the entrance of the combustor, is negligible ($T_{T0} = T_{T3}$), one obtains:

$$\left(\frac{M_3}{M_6} \right) \left(\frac{T_{T4}}{T_{T0}} \right)^{\frac{1}{2}} = \left(\frac{1 + \gamma_a M_3^2}{1 + \gamma_f M_4^2} \right) \left(\frac{1 + \frac{\gamma_f - 1}{2} M_4^2}{1 + \frac{\gamma_a - 1}{2} M_3^2} \right)^{\frac{1}{2}} \left(\frac{\gamma_f R_f}{\gamma_a R_a} \right)^{\frac{1}{2}} \left(\frac{1}{1 + f/a} \right) \quad (3.1.11)$$

c. Solution

The Mach number at the exit of the combustor (M_4) can be solved knowing the conditions at the throat of the nozzle:

$$\frac{A_5}{A_6} = M_4 \left\{ \frac{(\gamma_f + 1)/2}{1 + \frac{\gamma_f - 1}{2} M_4^2} \right\}^{(\gamma_f + 1)/[2(\gamma_f - 1)]} \quad (3.1.12)$$

The computation is again indirect, using subroutine CALCM. Knowing M_4 , Equation (3.1.11) is used to compute M_3 . The solution is received by iteration. As first approximation, M_3 can be solved from the following equation:

$$\frac{1}{M_3} \left(1 + \gamma_a M_3^2 \right) = B \quad (3.1.11a)$$

$$\text{where: } B = \left(\frac{1 + \gamma_f M_4^2}{M_4} \right) \left(\frac{T_{T4}}{T_{T0}} \right)^{\frac{1}{2}} \left(\frac{\gamma_a R_a}{\gamma_f R_f} \right)^{\frac{1}{2}} (1 + f/a) \quad (3.1.13)$$

consequently:

$$M_{3N} = \frac{+B - \sqrt{B^2 - 4\gamma_a}}{2\gamma_a} \quad (3.1.14)$$

The subscript N shows that the computation was made from the nozzle

direction. Now, B is changed to be:

$$B = B \left(\frac{1 + \frac{\gamma_a - 1}{2} M_3^2}{1 + \frac{\gamma_f - 1}{2} M_4^2} \right)^{\frac{1}{2}} \quad (3.1.15)$$

This expression is consistent with equation (3.1.11). Substituting back into (eq. 3.1.14) gives an improved value for M_3 . This procedure can be repeated several times, but it was found that even after two iterations, the value received for M_{3N} is accurate enough, due to the small change in B resulting from (eq. 3.1.15).

A3.2. Total Pressure

By definition:

$$\frac{p_{Ti}}{p_i} = \left\{ 1 + \frac{\gamma_i - 1}{2} M_i^2 \right\}^{\gamma_f / (\gamma_f - 1)} \quad (3.2.1)$$

Consequently:

$$\frac{p_{T3}}{p_{T4}} = \frac{p_3}{p_4} \left\{ \frac{\left[1 + \frac{\gamma_a - 1}{2} M_3^2 \right]^{\gamma_a / (\gamma_a + 1)}}{\left[1 + \frac{\gamma_f - 1}{2} M_4^2 \right]^{\gamma_f / (\gamma_f + 1)}} \right\} \quad (3.2.2)$$

Substituting for (p_3/p_4) from equation (3.1.7) results:

$$p_{T3N} = p_{T4} \left\{ \frac{1 + \gamma_f M_4^2}{1 + \gamma_a M_3^2} \right\} \left\{ \frac{\left[1 + \frac{\gamma_a - 1}{2} M_3^2 \right]^{\gamma_a / (\gamma_a + 1)}}{\left[1 + \frac{\gamma_f - 1}{2} M_4^2 \right]^{\gamma_f / (\gamma_f + 1)}} \right\} \quad (3.2.3)$$

Where the subscript N was defined previously.

A4. Computation of Mach Number and of Total Pressure at the Various Stations of the Inlet

A4.1 Initial Conditions

In the previous sections (A1 - A3) the pressure conditions at the combustor and at the nozzle region were calculated. Here, the pressure conditions at the inlet will be calculated independently. Knowing the total pressure conditions at the various stations of the inlet will allow the check of whether the inlet can supply the amount of air needed by the combustor. As will be seen afterwards, this check will also allow to specify the location of the normal shock wave at the inlet.

Assuming that the static pressure (p_0), the static temperature (T_0) and the flight Mach number (M_0) are known from the trajectory part of the program, the total pressure and the total temperature can be calculated:

$$P_{T0} = p_0 \left[1 + \frac{\gamma_a - 1}{2} M_0^2 \right]^{\gamma_a / (\gamma_a - 1)} \quad (4.1.1)$$

$$T_{T0} = T_0 \left[1 + \frac{\gamma_a - 1}{2} M_0^2 \right] \quad (4.1.2)$$

The weight flow through the inlet is given by:

$$W_a = p_0 U_0 A_0 \left(\frac{A_C}{A_0} \right) \quad (4.1.3)$$

Usually, when flight Mach number is equal or greater than the inlet design Mach number, the value for A_C/A_0 is unity. But for flight Mach number less than design Mach number, A_C/A_0 becomes less than 1.0. A value of 0.9 was selected as a constant value for A_C/A_0 . The additive drag due to $A_C/A_0 < 1$ was ignored.

A4.2 Conical Shock Wave Loss

In this section, the conical shock wave loss will be computed; the calculation results include the total pressure, Mach number and area behind the conical wave (p_{1C} , M_{1C} , A_{1C} , respectively).

A4.2.1 Pressure

The pressure coefficient can be defined as follows:

$$C_p = \frac{p_{1C} - p_0}{\frac{\gamma_a}{2} p_0 M_0^2} \quad (4.2.1)$$

For a cone, the pressure coefficient (C_p) can approximately be formulated as:

$$C_p = \left[0.083 + \frac{0.096}{M_0^2} \right] \left(\frac{\alpha}{10} \right)^{1.69} \quad (4.2.2)$$

where α is the cone half angle. The difference in pressure on surface and behind shock wave is ignored in this model.

Knowing C_p , the pressure ratio (p_{1C}/p_0) can be calculated (4.2.1)

$$\frac{p_{1C}}{p_0} = 1 + C_p \frac{\gamma_a}{2} M_0^2 \quad (4.2.1a)$$

The same pressure ratio, is also related to the Mach number, normal to the conical shock wave (M_n). Using (eq. 2.48a) in ref. [16], one can get:

$$\frac{p_{1C}}{p_0} = 1 + \frac{2\gamma_a}{\gamma_a + 1} (M_n^2 - 1) \quad (4.2.3)$$

Knowing (p_{1C}/p_0) from equation (4.2.1a), M_n can be calculated from equation (4.2.3) :

$$M_n = \left[1 + \left(\frac{p_{1C}}{p_0} - 1 \right) \frac{\gamma_a + 1}{2\gamma_a} \right]^{\frac{1}{2}} \quad (4.2.3a)$$

After computing the pressure ratio due to conical shock wave (equation 4.2.1a) and the Mach number normal to the cone (equation 4.2.3a), one can use equation (2.54) in reference [16] to compute the total pressure ratio at the conical shock wave:

$$\pi_C = \frac{P_{T1C}}{P_{T0}} = \left[1 + \frac{2\gamma_a}{\gamma_a + 1} (M_n^2 - 1) \right]^{-1/(\gamma_a - 1)} \left[\frac{(\gamma_a + 1)}{(\gamma_a - 1)} \frac{M_n^2}{M_n^2 + 2} \right]^{\gamma_a/(\gamma_a - 1)} \quad (4.2.4)$$

From equation (4.2.4) one obtains:

$$P_{T1C} = P_{T0} \pi_C \quad (4.2.4a)$$

A4.2.2 Mach Number Downstream of Conical Shock Wave

Using figures 4.1 and 4.2, the wave angle (β) can be defined

as:

$$\beta = \arcsin \left(\frac{M_n}{M_0} \right) \quad (4.2.5)$$

On the other hand, the deflection angle (θ) is defined from equation (4.10) in reference [16]:

$$\theta = \arctan \left[2 \cot(\beta) \frac{(M_n^2 - 1)}{M_0^2 (\gamma_a + \cos(2\beta)) + 2} \right] \quad (4.2.6)$$

The Mach number behind the conical shock wave (M_{1C}) may, therefore, be obtained using equation (4.7) in reference [16]:

$$M_{1C} = \left[\frac{1}{\sin^2(\beta - \theta)} \frac{1 + \frac{\gamma_a - 1}{2} M_n^2}{\gamma_a M_n^2 - \frac{\gamma_a - 1}{2}} \right]^{1/2} \quad (4.2.7)$$

The relation between the deflection angle (θ) and the wave angle (β) for various Mach numbers are shown in figure 4.3 (reproduced from figure 4.2 in reference [16]).

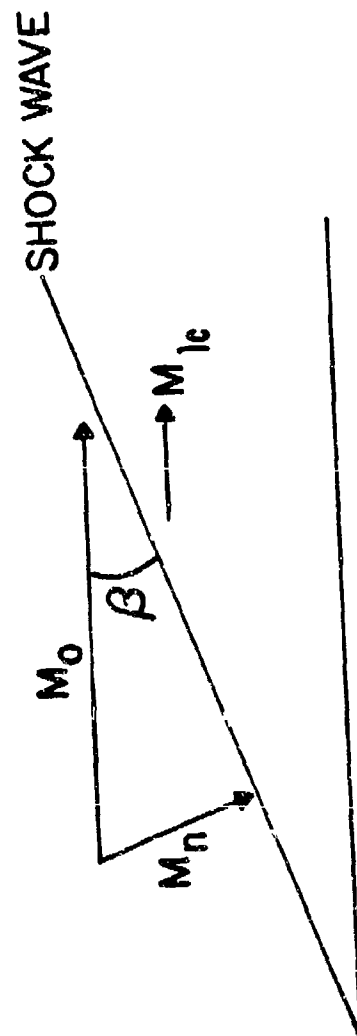


Figure A4.1 Geometry for Conical Shock Wave Showing
Normal Component of Mach Number

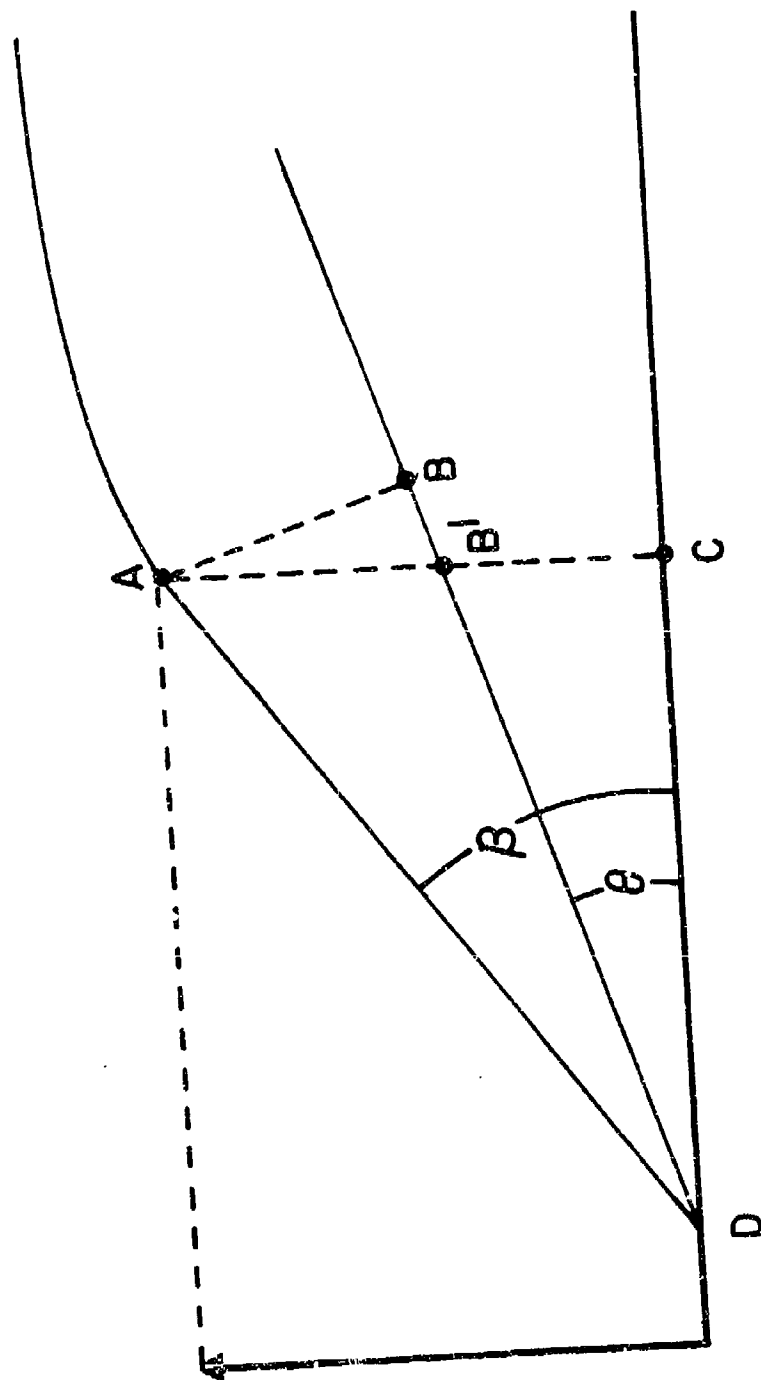


Figure AA.2 Geometry for Calculation of Inlet Annular

Flow Area Relative to Inlet Capture Area:

$$DC = \frac{AC}{\tan \beta}; B'C = \frac{AC}{\tan \beta} \tan \theta; AB' = AC(1 - \frac{\tan \theta}{\tan \beta}); \frac{AB}{AC} = (1 - \frac{\tan \theta}{\tan \beta}) \cos \theta$$

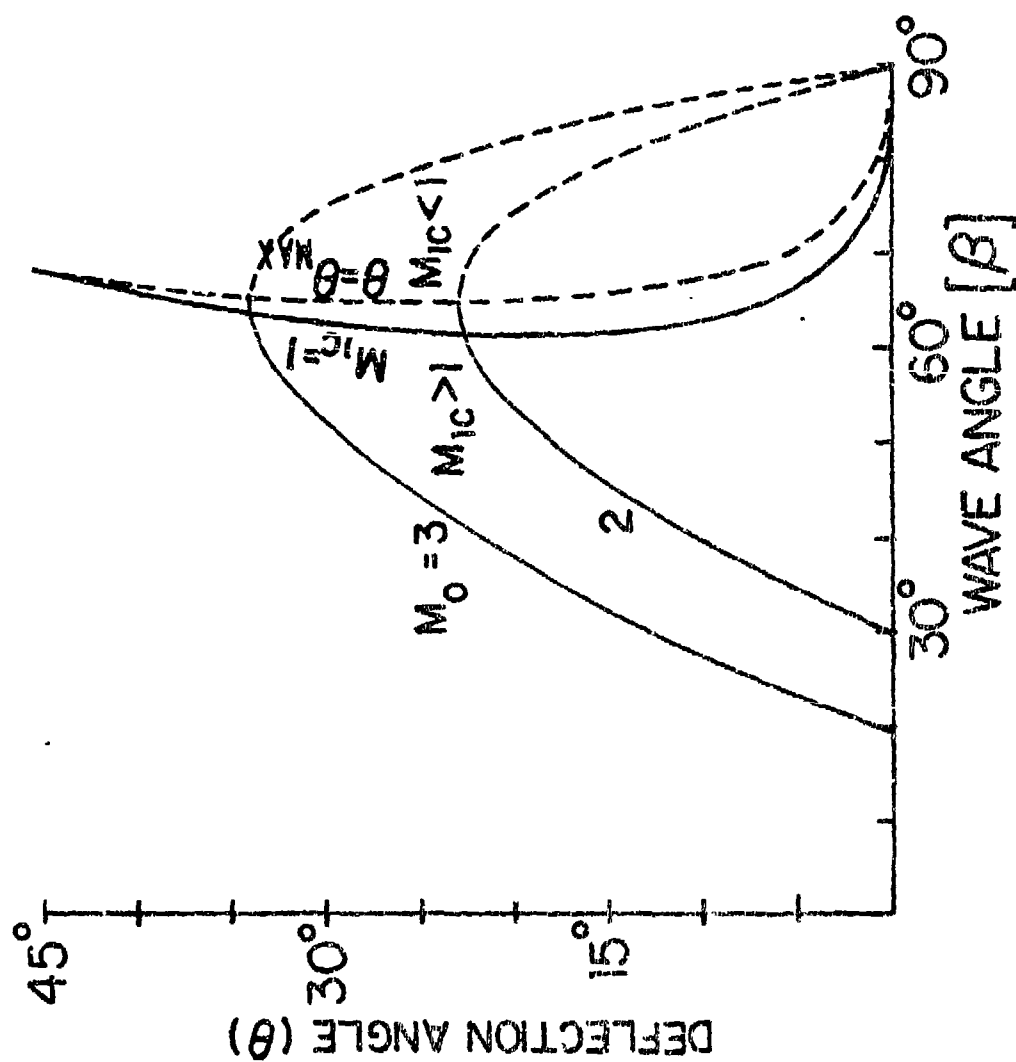


Figure A4.3 Oblique Shock Solutions [16]

A4.2.3 Area Ratio

Using figure 4.2, the area ratio behind the conical shock wave can be obtained:

$$\frac{A_{1C}}{A_0} = \frac{1 - \tan(\theta)}{\tan(\beta)} \cos(\theta) \quad (4.2.8)$$

Equation (4.2.8) gives the area normal to the flow at the inlet lip.

A4.3 Boundary Layer Loss

A4.3.1 Mach Number

The area ratio is related to the appropriate Mach number by the formula:

$$\frac{A_1^*}{A_{1C}} = M_{1C} \left\{ \frac{(\gamma_a + 1)/2}{1 + \frac{\gamma_a - 1}{2} M_{1C}^2} \right\}^{(\gamma_a + 1)/[2(\gamma_a - 1)]} \quad (4.3.1)$$

Where A_1^* is the area at the throat of the inlet. Similarly,

$$\frac{A_1^*}{A_{11}} = M_{11} \left\{ \frac{(\gamma_a + 1)/2}{1 + \frac{\gamma_a - 1}{2} M_{11}^2} \right\}^{(\gamma_a + 1)/[2(\gamma_a - 1)]} \quad (4.3.2)$$

Where A_{11} and M_{11} relates to the area and to the Mach number ahead of the normal shock wave. Dividing these two equations gives:

$$\frac{A_{11}}{A_{1C}} = \frac{M_{1C}}{M_{11}} \left\{ \frac{1 + \frac{\gamma_a - 1}{2} M_{11}^2}{1 + \frac{\gamma_a - 1}{2} M_{1C}^2} \right\}^{(\gamma_a + 1)/[2(\gamma_a - 1)]} \quad (4.3.3)$$

Knowing M_{1C} , γ_a , A_{1C} , A_{11} , equation (4.3.3) can be used to calculate M_{11} , indirectly, by subroutine CALM, which was mentioned previously. M_{11} should be supersonic ($M_{11} > 1$) to prevent unstart conditions.

A4.3.2 Pressure

The total pressure in front of the normal shock wave (P_{T11}) is received from the connection:

$$P_{T11} = P_{T1C} \pi_D' \quad (4.3.4)$$

Where π_D' , the boundary layer loss is assumed to be 0.93.

A4.4 Normal Shock Loss

The Mach number, behind the normal shock wave is defined as:

$$M_{12} = \left\{ \frac{M_{11}^2 + \frac{2}{\gamma_a - 1}}{\frac{2\gamma_a}{\gamma_a - 1} M_{11}^2 - 1} \right\}^{1/2} \quad (4.4.1)$$

The total pressure behind the normal shock wave is defined as:

$$P_{T12} = P_{T11} \left\{ \frac{\frac{\gamma_a + 1}{2} M_{11}^2}{1 + \frac{\gamma_a - 1}{2} M_{11}^2} \right\}^{\gamma_a / (\gamma_a - 1)} \left\{ \frac{2\gamma_a}{\gamma_a + 1} M_{11}^2 - \frac{\gamma_a - 1}{\gamma_a + 1} \right\}^{1 / (\gamma_a - 1)} \quad (4.4.2)$$

A4.5 Subsonic Diffuser Recovery

Similar to equation (4.3.3) one can obtain:

$$\frac{A_2}{A_{12}} = \frac{M_{12}}{M_2} \left\{ \frac{1 + \frac{\gamma_a - 1}{2} M_2^2}{1 + \frac{\gamma_a - 1}{2} M_{12}^2} \right\}^{(\gamma_a + 1) / [2(\gamma_a - 1)]} \quad (4.5.1)$$

Knowing M_{11} , γ_a , A_{12} , and A_2 , the Mach number at the exit of the inlet can be computed using subroutine CALCM. The total pressure at this station is defined as:

$$P_{T2} = P_{T12} \pi_D'' \quad (4.5.2)$$

Where the subsonic diffuser recovery (η_D) is assumed to be 0.93.

A4.6 Expansion Loss

A4.6.1 Mach Number

On their way to the combustor, the gases coming from the inlet expand at station 3; a sudden change in area from A_2 to A_3 occurs. The sudden change in area acts as a flameholder by creating a hot recirculation region. In this section, the loss in total pressure due to this expansion is calculated.

From the continuity equation:

$$\rho_2 U_2 A_2 = \rho_3 U_3 A_3 \quad (1.4.2a)$$

From perfect gas equation of state:

$$\rho = \frac{P}{RT} \quad (1.4.3)$$

and from the definition of Mach number and speed of sound:

$$M = U/a; \quad a = \sqrt{\gamma RT} \quad (1.4.5)$$

Equation (1.4.2a) turns, therefore, into the form:

$$\frac{P_2}{RT_2} M_2 \sqrt{\gamma_a RT_2} A_2 = \frac{P_3}{RT_3} M_3 \sqrt{\gamma_a RT_3} A_3 \quad (4.6.1)$$

For sudden expansion of an incompressible fluid, the change in static pressure going from small area A_2 to large area A_3 is given by [16, 25]:

$$\frac{P_3 - P_2}{q_2} = 2A_{23}(1 - A_{23}) \quad (4.6.2)$$

Where $A_{23} = A_2/A_3$. Also, for the incompressible case, the stagnation pressure ratio is given by [16, 25]:

$$\frac{P_{T3}}{P_{T2}} = 1 - \frac{q_2/P_2}{1 + q_2/P_2} (1 - A_{23})^2 \quad (4.6.3)$$

According to equation (4.6.3) as M_2 decreases P_{T3} approaches P_{T2} . The model for sudden expansion with compressible flow is much more complicated.

It was assumed that static pressure is constant in the expansion. This assumption, which is reasonable for low values of M_2 , is a conservative one, i.e. p_{T3}/p_{T2} is lower.

Substituting: $T_2/T_3 = \left[1 + \frac{\gamma_a - 1}{2} M_3^2\right] / \left[1 + \frac{\gamma_a - 1}{2} M_2^2\right]$

and $p_2 = p_3$, turns equation (4.6.1) to:

$$\frac{A_2}{A_3} = \frac{M_3}{M_2} \sqrt{\frac{1 + \frac{\gamma_a - 1}{2} M_3^2}{1 + \frac{\gamma_a - 1}{2} M_2^2}} \quad (4.6.4)$$

Solving equation (4.6.4) for M_3 :

$$M_{3I} = \sqrt{\frac{\sqrt{1 + 4\alpha\beta} - 1}{2\alpha}} \quad (4.6.5)$$

Where:

$$\alpha = \frac{\gamma_a - 1}{2} ; \quad \beta = \frac{A_2 M_2^2}{A_3} (1 + \alpha M_2^2) \quad (4.6.6)$$

The subscript I shows that the computation was made from the inlet direction.

A4.6.2 Pressure

By assuming again that $p_2 = p_3$,

$$\frac{p_{T3}}{p_{T2}} = \frac{p_{T3}/p_3}{p_{T2}/p_2} \quad (4.6.7)$$

and therefore:

$$p_{T3I} = p_{T2} \left(\frac{1 + \frac{\gamma_a - 1}{2} M_3^2}{1 + \frac{\gamma_a - 1}{2} M_2^2} \right)^{\gamma_a / (\gamma_a - 1)} \quad (4.6.8)$$

Where subscript I is as defined previously.

A4.7 Location of Normal Shock Wave

The main problem in computing the Mach numbers and the total pressures at the inlet arises from the fact that the exact location of the normal shock wave is not known, and must be found. The way of solving this problem is as follows:

First, solve for two extreme conditions by assuming that the normal shock wave is located at the throat and at the exit of the inlet, respectively. After knowing the lower and the upper values for M_{3I} , P_{T3I} , iteration can be made to find the exact location of the normal shock wave. The criteria for this iteration is matching of values for M_3 , P_{T3} from both the inlet and the nozzle directions, i.e.:

$$M_{3I} = M_{3N}, P_{T3I} = P_{T3N} \quad (4.7.1)$$

APPENDIX B: TRAJECTORY EQUATIONS

B1. Atmospheric Functions

Best fit curves were calculated for basic atmospheric functions, pressure, density, temperature and viscosity of air as a function of the flight altitude. The basic formula which was used for this process is as follows:

$$F = A \exp(-B \times 10^{-6} h^C) \quad (1.1)$$

Where h is the altitude in meters, and A, B, C are numerical parameters.

The appropriate atmospheric functions are as follows:

$$p_0 = 1.03322 \times 10^4 \exp(-59.148 \times 10^{-6} h^{1.09}) \quad (1.2)$$

$$\rho_0 = 1.224845 \exp(-29.0144 \times 10^{-6} h^{1.15}) \quad (1.3)$$

$$T_0 = 288.16 \exp(-13.232 \times 10^{-6} h^{1.0709})$$

$$\text{When: } h = 0 - 11,000\text{m} \quad (1.4)$$

$$T_0 = 217.24^\circ, \text{ when } h = 11,000 - 32,000\text{m} \quad (1.4a)$$

$$\mu_0 = 1.793 \times 10^{-5} \exp(-45.1374 \times 10^{-6} h^{0.8924})$$

$$\text{When: } h = 0 - 11,000\text{m} \quad (1.5)$$

$$\mu_0 = 1.41724 \times 10^{-5}, \text{ when } h \geq 11,000 \text{ m} \quad (1.5a)$$

In these formulae, the pressure (p_0) has dimensions of kg/m^2 , the density (ρ_0) is given in kg/m^3 , the temperature (T_0) is given in $^\circ\text{K}$, and the viscosity (μ_0) is given in $\text{kg/(m}\cdot\text{sec)}$ (or: $\text{N}\cdot\text{sec/m}^2$).

B2. Drag

B2.1 Cowl Drag Coefficient

2.1.1 It was found that the cowl drag coefficient has a strong influence on the results. Therefore, a new model for this cowl drag coefficient was developed. The model was based on a theoretical development done previously by Prof. T. H. Gawain [9]. The main

difference between this development and the classical theory, is that the boundary conditions are applied at the body surface rather than along the axis.

2.1.2 The model, which originally was developed for simple cases (cones, etc.) was modified to fit the shape of the projectile, illustrated in Figure 1.1.

2.1.3 The modified program is listed in Appendix G. In the combined program (TRAJET) an interpolation procedure was used as a subroutine in order to simplify the calculation process.

82.2 Base Drag

After checking the influence of the nozzle exit area (A_g) on the performance, it was decided to allow A_g to reach the maximum value possible (A_p), in order to reduce base drag. In this case, the base drag is negligible.

B2.3 Skin Drag Coefficient

The Reynolds number is well known to be:

$$Re_L = \frac{\rho_0 U_0 L}{\mu} \quad (2.3.1)$$

The transition Reynolds number of

$$Re^* = 2 \cdot 10^6$$

is usually taken as criterion for transition between laminar flow (lower values) and turbulent flow (higher values). The incompressible laminar skin friction coefficient is related to the Reynolds number as follows:

$$C_{DS,L} = 1.328 / \sqrt{Re_L} \quad (2.3.2)$$

Where the subscripts DS,L stand for skin drag coefficient, and laminar flow, respectively. On the other hand, the turbulent skin friction coefficient ($C_{DS,T}$) is calculated indirectly from the formula:

$$\sqrt{C_{DS,T}} \log_{10}(C_{DS,T} Re_L) = 0.242 \quad (2.3.3)$$

The computation is done in subroutine CALDC, which works in a similar way to subroutine CALCM which has been described earlier concerning the calculation of various Mach numbers.

B2.4 Wing and Fin Drag Coefficients

The wings and the fins of the projectile, also contribute to drag. Basically, each of these drag coefficients contains two parts:

- Wing/fin wave drag.
- Wing/fin friction drag.

2.4.1 A psuedo 3-dimensional model was chosen to simulate the wave coefficient. The basic formulae used in this calculation are:

$$\nu(M_0) = \sqrt{\frac{\gamma_a+1}{\gamma_a-1}} \tan^{-1} \sqrt{\frac{\gamma_a-1}{\gamma_a+1} (M_0^2-1)} - \tan^{-1} \sqrt{M_0^2-1} \quad (2.4.1)$$

$$p_0/p_{T0} = (1 + \frac{\gamma_a+1}{2} M_0^2)^{-\gamma_a/(\gamma_a+1)} \quad (2.4.2)$$

The effective span could be taken as (see fig. B2.1):

$$b' = b - \frac{\ell}{2} \quad (2.4.3)$$

Substituting: $\tan \mu = \ell/c$, $\sin \mu = 1/M$ gives:

$$b' = b - \frac{c}{2 \sqrt{M_0^2-1}} \quad (2.4.4)$$

The drag coefficient would, therefore, be:

$$C_{DWW} = \frac{2}{\gamma M_0^2} \left(\frac{p_{01}/p_{T0}}{p_0/p_{T0}} - \frac{p_{02}/p_{T0}}{p_0/p_{T0}} \right) \frac{tb'}{A_r} \quad (2.4.5)$$

The way this simulation uses the above equations could easily be understood when looking at the formulae together with the flow chart of the appropriate subroutine (Appendix C). Interference drag is ignored.

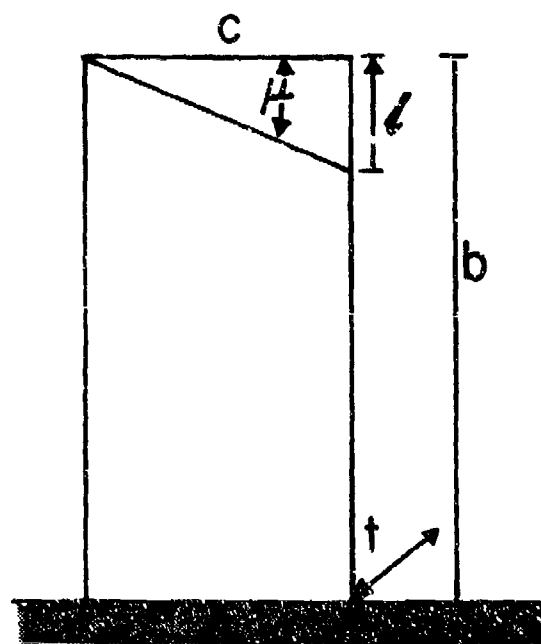


Figure B2.1 Schematic View of an Wing/Fin:
 b =span, c =chord, t =thickness

2.4.2 The friction drag coefficient was calculated using the existing model for skin drag coefficient. (See Section B2.3)

B2.5 Calculation of Drag

Define the dynamic pressure (q) as follows:

$$q = \frac{1}{2} \rho_0 U_0^2 \quad (2.5.1)$$

When q is in units of kg/(m.sec²), (or: N/m²). Also, define the following geometrical units:

$$A_p = \pi R^2; \quad S_p = 2\pi RL \quad (2.5.2)$$

Where R, L are the radius and the length of the projectile, respectively.

Similarly, for the wings or the fins:

$$S_{WW} = nbc \quad (2.5.3)$$

Where n is the total number of wings/fins (a value of 8 was taken for n), and b, c are the span and the chord of the wing/fin (see fig. B2.1)

Consequently, the drag (D) is given by:

$$D = q \left\{ A_p C_{DN} + S_p C_{DS} + S_{WW} (C_{DWW} + C_{DWF}) \right\} \quad (2.5.4)$$

B2.6 Drag Coefficient of a Conventional Projectile Without Propulsion

The program has an option to calculate also the trajectory of a projectile without a propulsion. The projectile is a conventional round. The formulae used to calculate the drag coefficients in this case are:

2.6.1 Nose Drag

$$C_{DN} = (0.083 + 0.096/M_0^2)(\alpha/10)^{1.69}$$

Where α is the cone half angle.

2.6.2 Base Drag

$$C_{DB} = (0.6837 - 0.3165 M + 0.0525 M^2)(2/\pi)$$

2.6.3 Skin Drag

Skin drag is calculated as discussed in section B2.3.

2.5.4 Drag

$$D = \text{Drag} = q \left\{ A_p (C_{DN} + C_{DB}) + S_p C_{DS} \right\}$$

63. Booster

The projectile has an initial muzzle velocity of 2500 ft/sec. Part of the combustor volume can be used as a booster to accelerate the projectile even more so that starting the ramjet will be easier.

Define exhaust velocity (U_e) as:

$$U_e = I_{sp,B} g \quad (3.1)$$

Where $I_{sp,B}$ is the specific impulse of the booster's fuel (in sec) and g is the acceleration of gravity (in m/sec).

From Newton's law [6, p. 323]

$$F = \dot{m}_B U_e = (\dot{m}_p - \dot{m}_B t) \frac{dU}{dt} \quad (3.2)$$

Where $\dot{m}_p$ and $\dot{m}_B$ are the mass of the projectile and the mass flow of the booster respectively.

$$dU = \dot{m}_B U_e \frac{dt}{\dot{m}_p - \dot{m}_B t} \quad (3.3)$$

Consequently:

$$\Delta U = U(\tau) - U(0) = -U_e \ln \frac{\dot{m}_p - \dot{m}_B \tau}{\dot{m}_p} \quad (3.4)$$

Where τ is the booster burn time. Hence,

$$\Delta U = U_e \frac{\dot{m}_B \tau}{\dot{m}_p - \dot{m}_B \tau} \quad (3.5)$$

ΔU is the change in initial velocity due to the booster, where $\dot{m}_B$ is the mass of the booster.

B4. Dynamics

The flat earth trajectory with drag and thrust is well known.

The differential equations of motion are:

$$\frac{d^2 y}{dt^2} = -g + (F-D) \sin \theta / m_p \quad (4.1)$$

$$m_p \frac{d^2 x}{dt^2} = (F-D) \cos \theta \quad (4.2)$$

where y is the altitude, t is the time, g is the acceleration of gravity, F is the thrust, D is the drag, θ is the elevation angle, m_p is the projectile mass.

For numerical solution of equations (4.1) and (4.2) a finite difference form can be used as follows:

$$x_{j+2} = (F-D) \cos \theta \Delta t^2 / m_p + 2x_{j+1} - x_j \quad (4.3)$$

$$y_{j+2} = [-g + (F-D) \sin \theta / m_p] \Delta t^2 + 2y_{j+1} - y_j \quad (4.4)$$

The values for $j = 1$ are from initial conditions, i.e.

$$x_1 = 0, y_1 = 0 \quad (4.5)$$

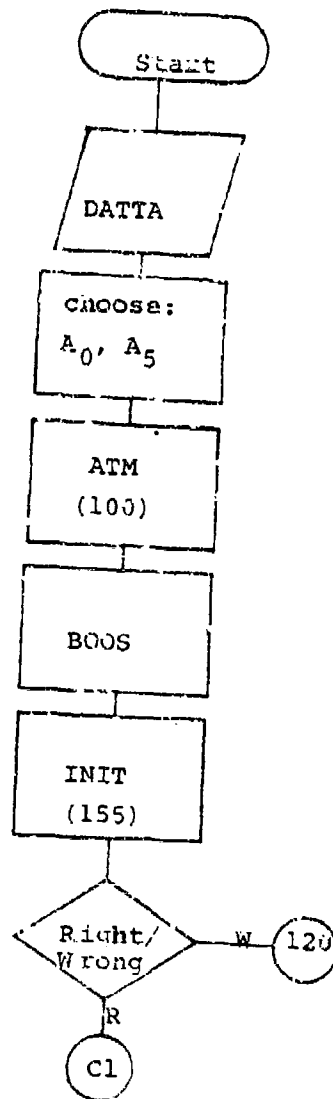
$$x_2 = U_0 * \cos \theta * \Delta t, y_2 = U_0 * \sin \theta * \Delta t \quad (4.6)$$

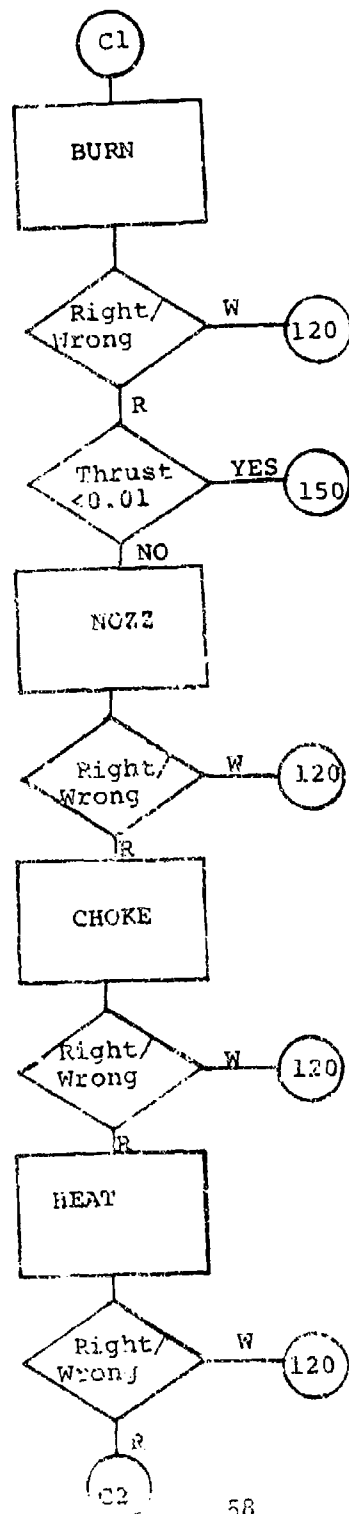
$$\theta = \arctan \left[\frac{y_{j+2} - y_{j+1}}{x_{j+2} - x_{j+1}} \right] \quad (4.7)$$

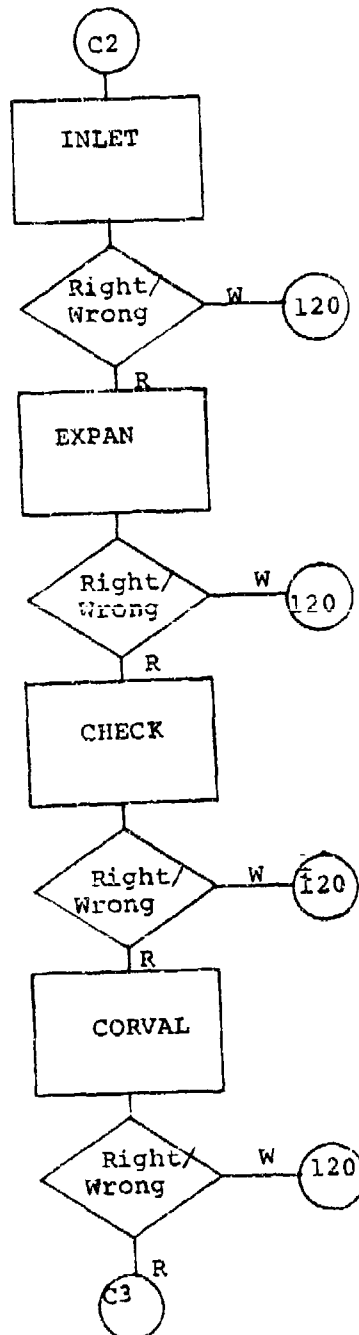
Having calculated x_{j+2} and y_{j+2} from (eq. 4.3, and 4.4), one obtained new values for trajectory parameters using (eq. 4.7). Also thrust, drag and projectile mass are updated for $j+2$.

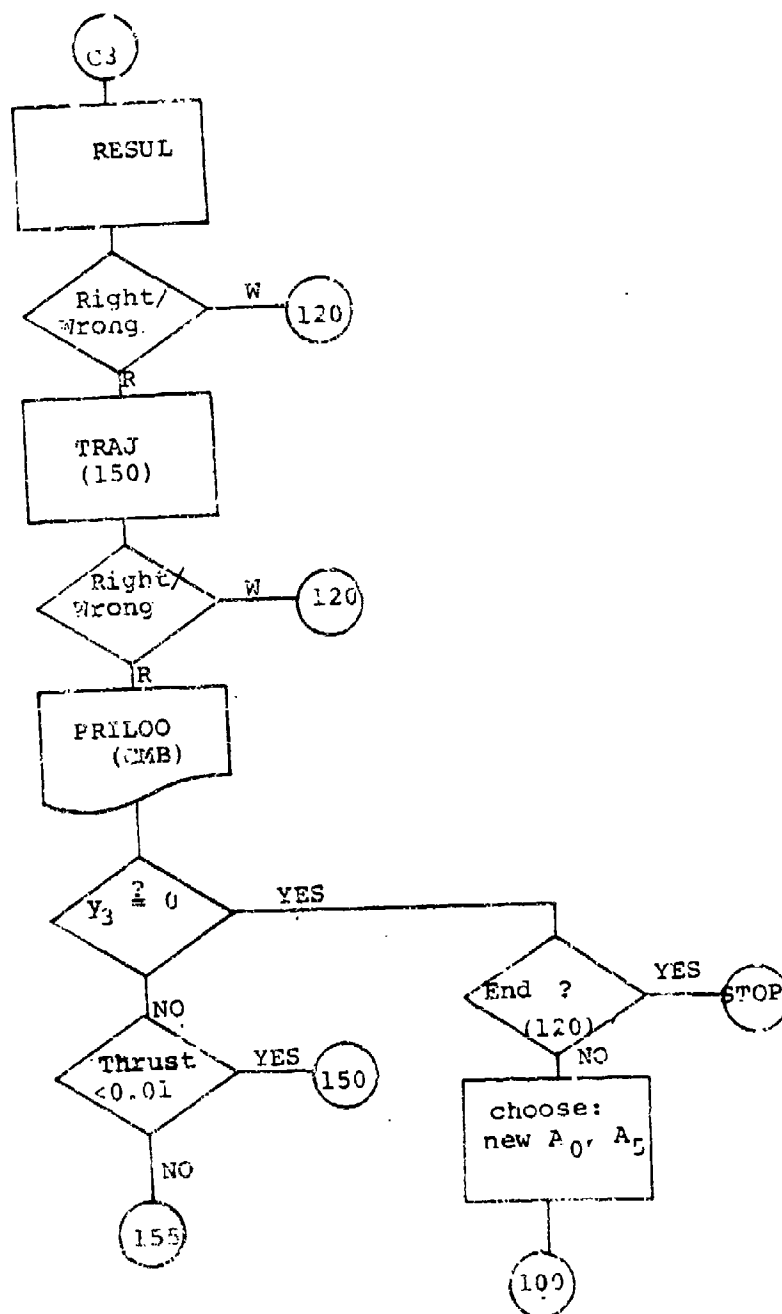
Appendix C: Flow Chart of the Computer Program (TRAJET)

C 1. Main Program



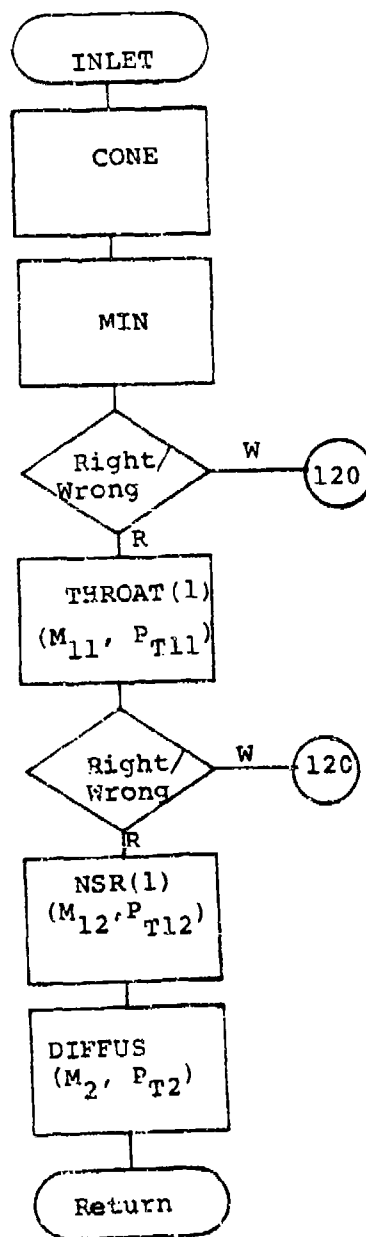


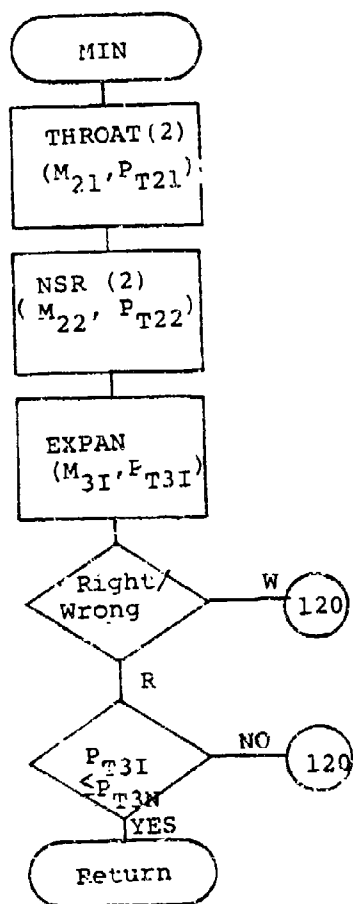


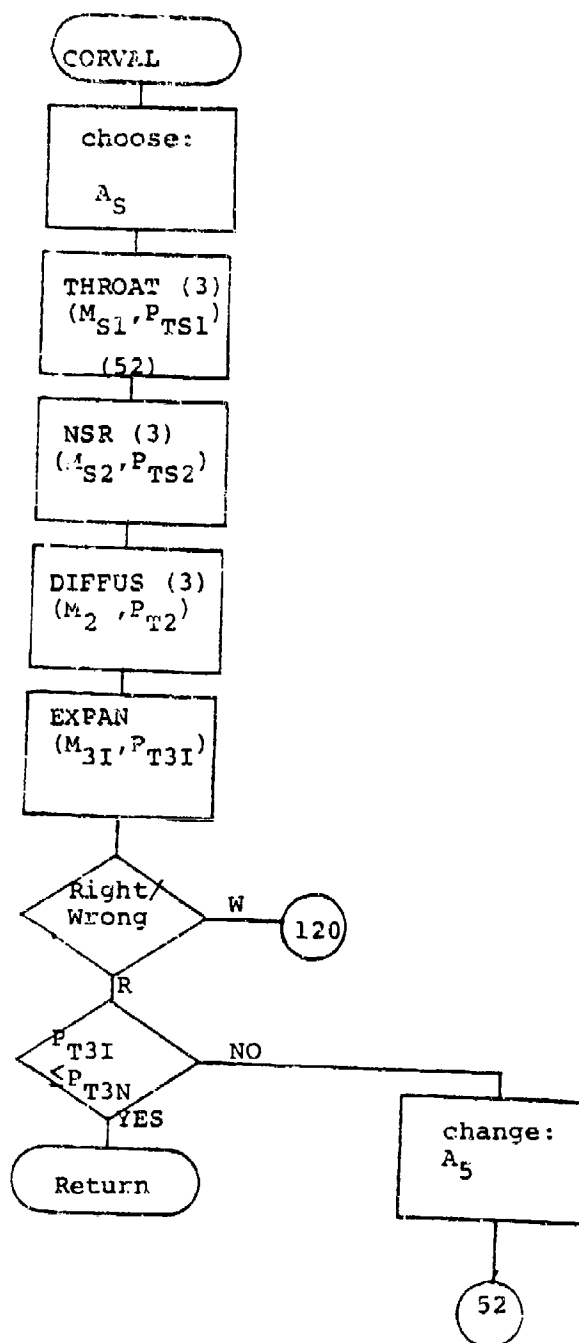


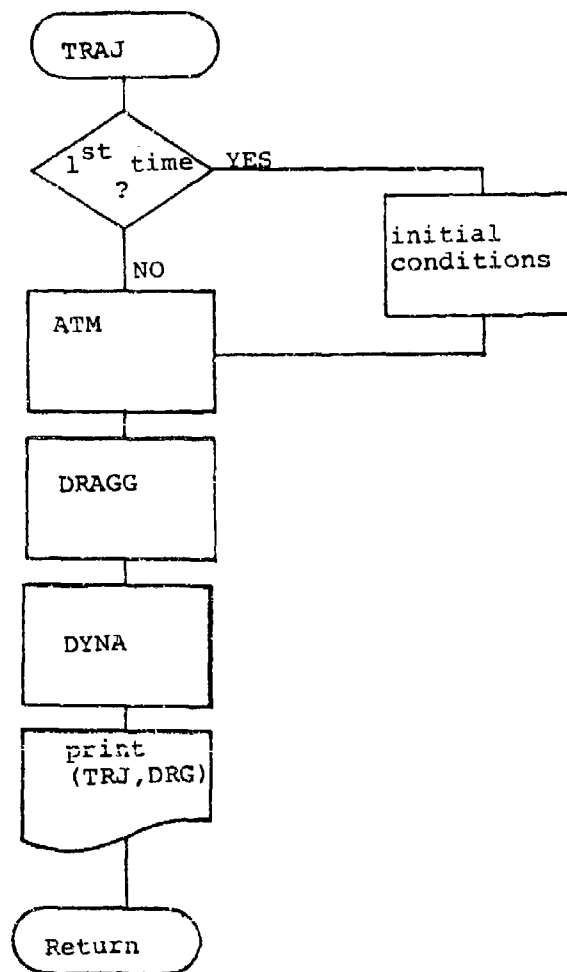
5

C2. Command Subroutines

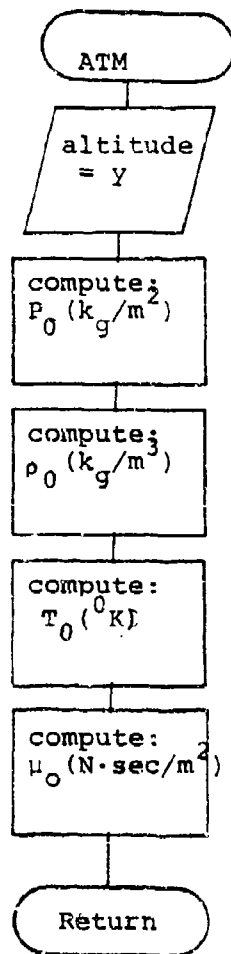


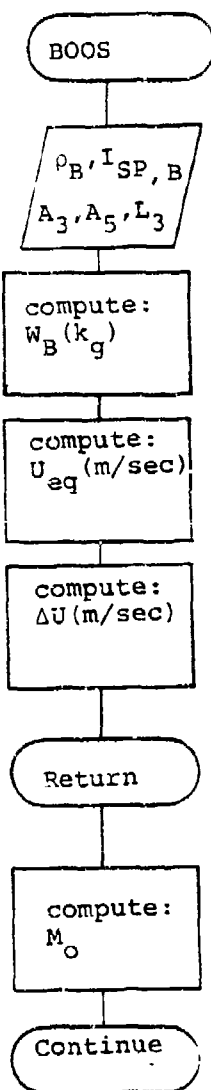


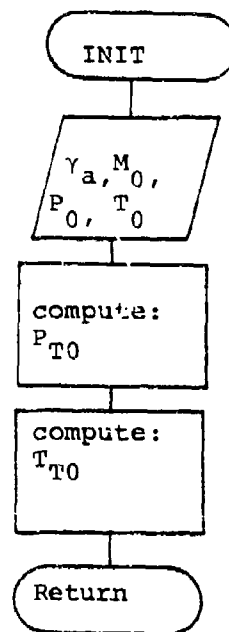


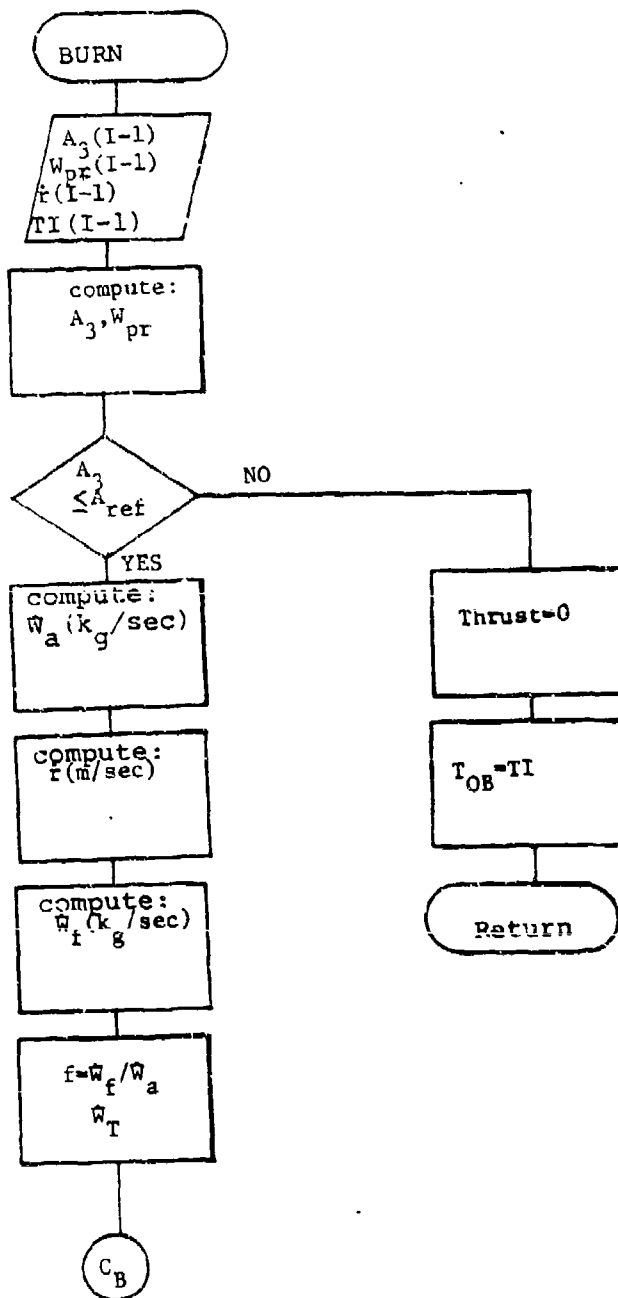


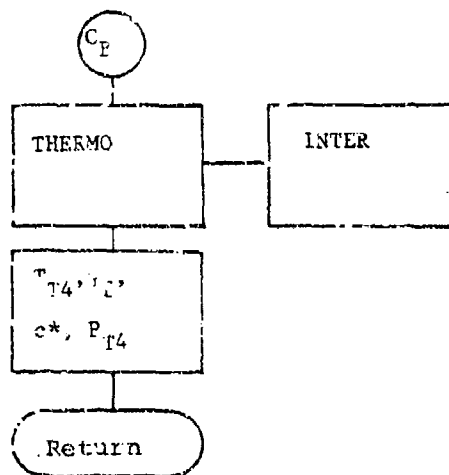
C 3. Individual Subroutines

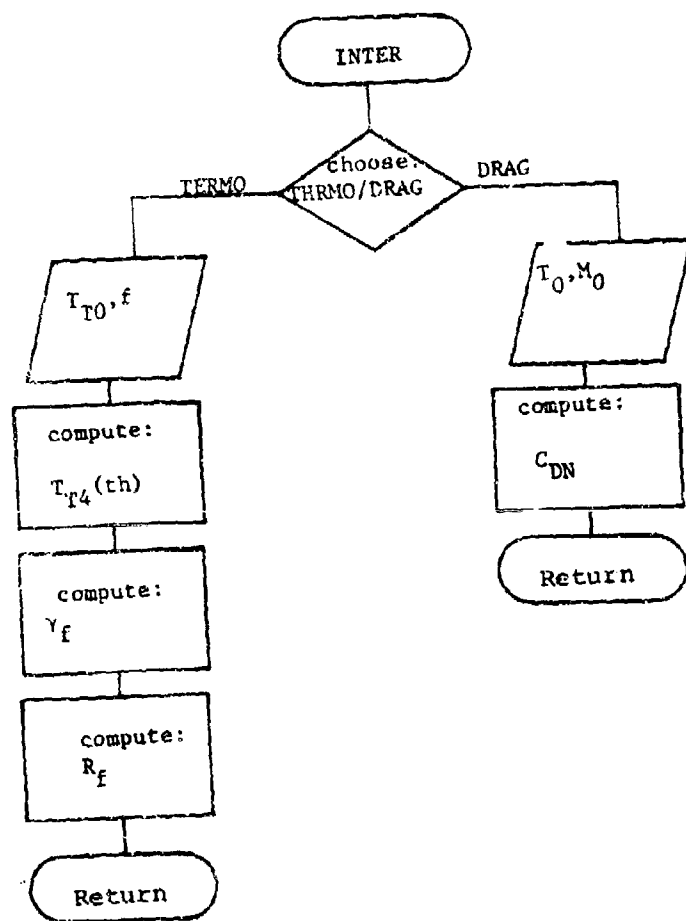


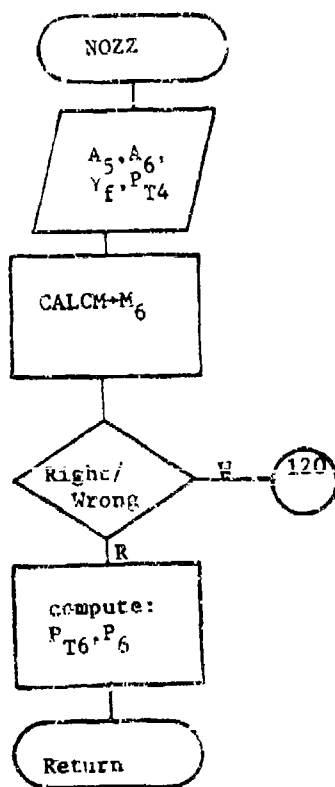


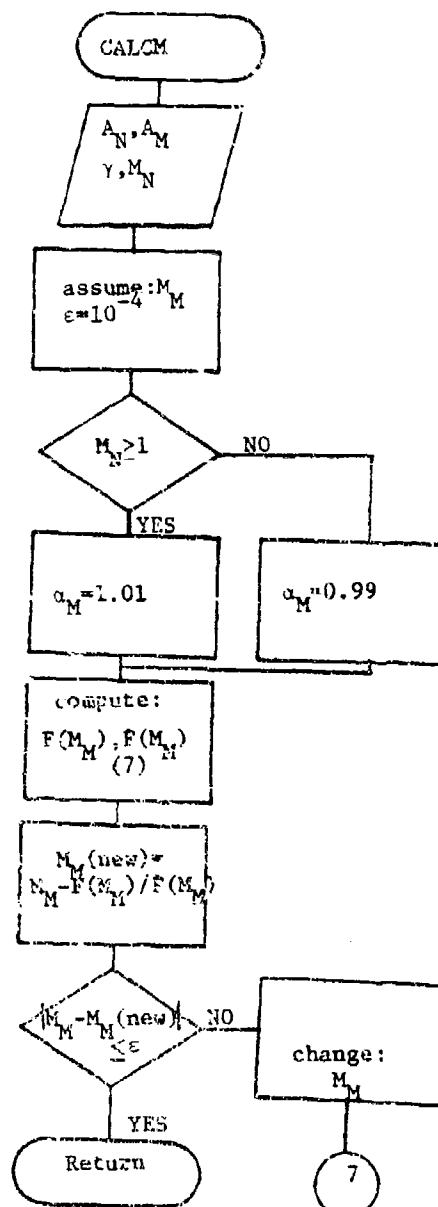










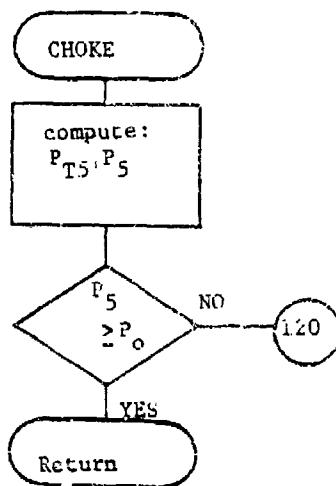


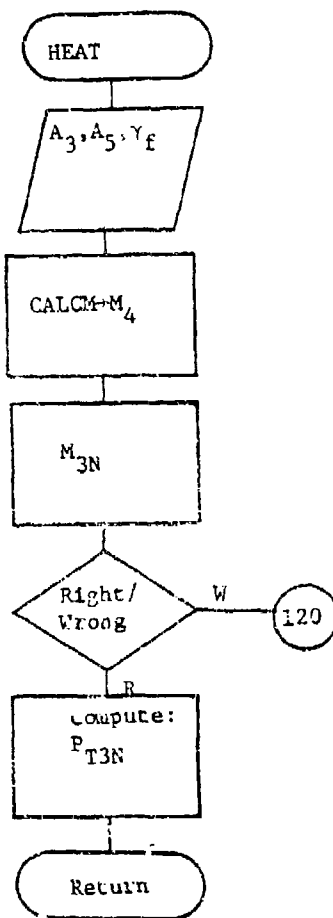
notes: 1. A_N, A_M = area at known and at unknown mach number, respectively.

$\gamma = \gamma_a$ or γ_c

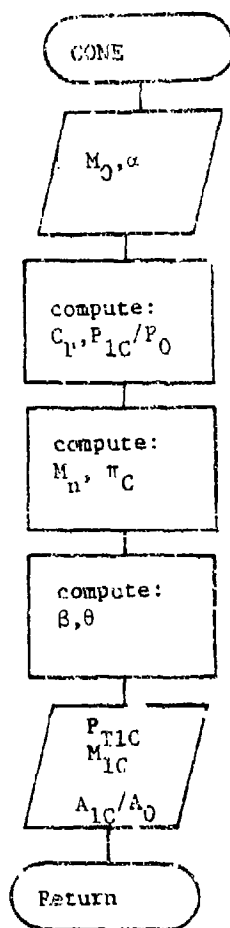
M_N = known mach number

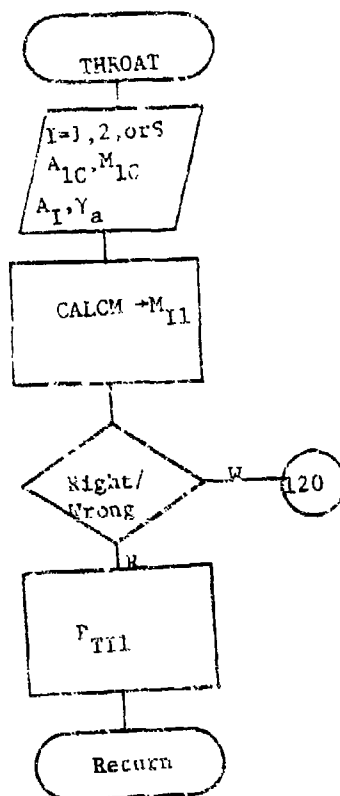
2. CALCD works in a similar way.

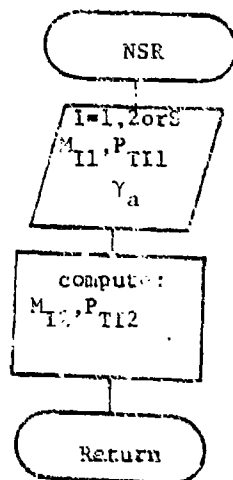


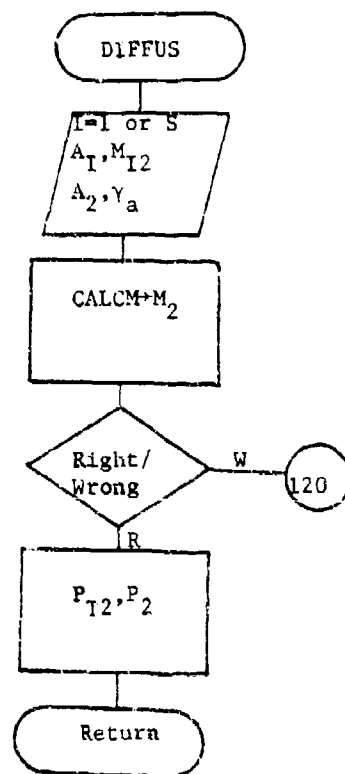


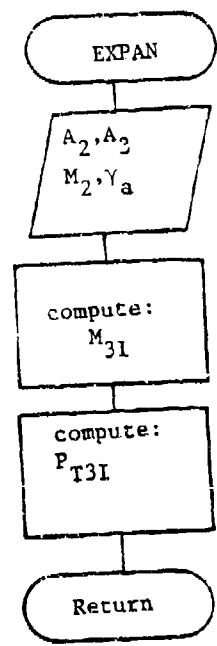
C3.8 INLET

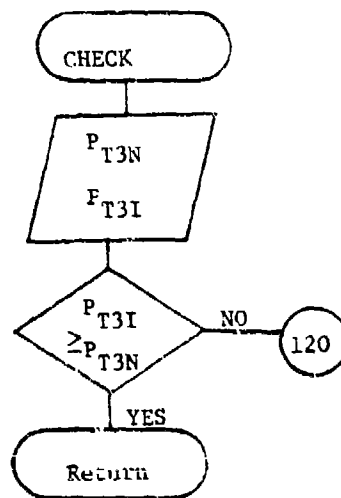


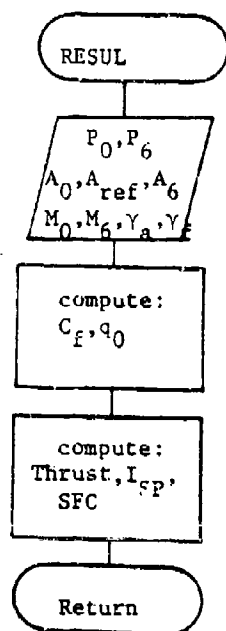


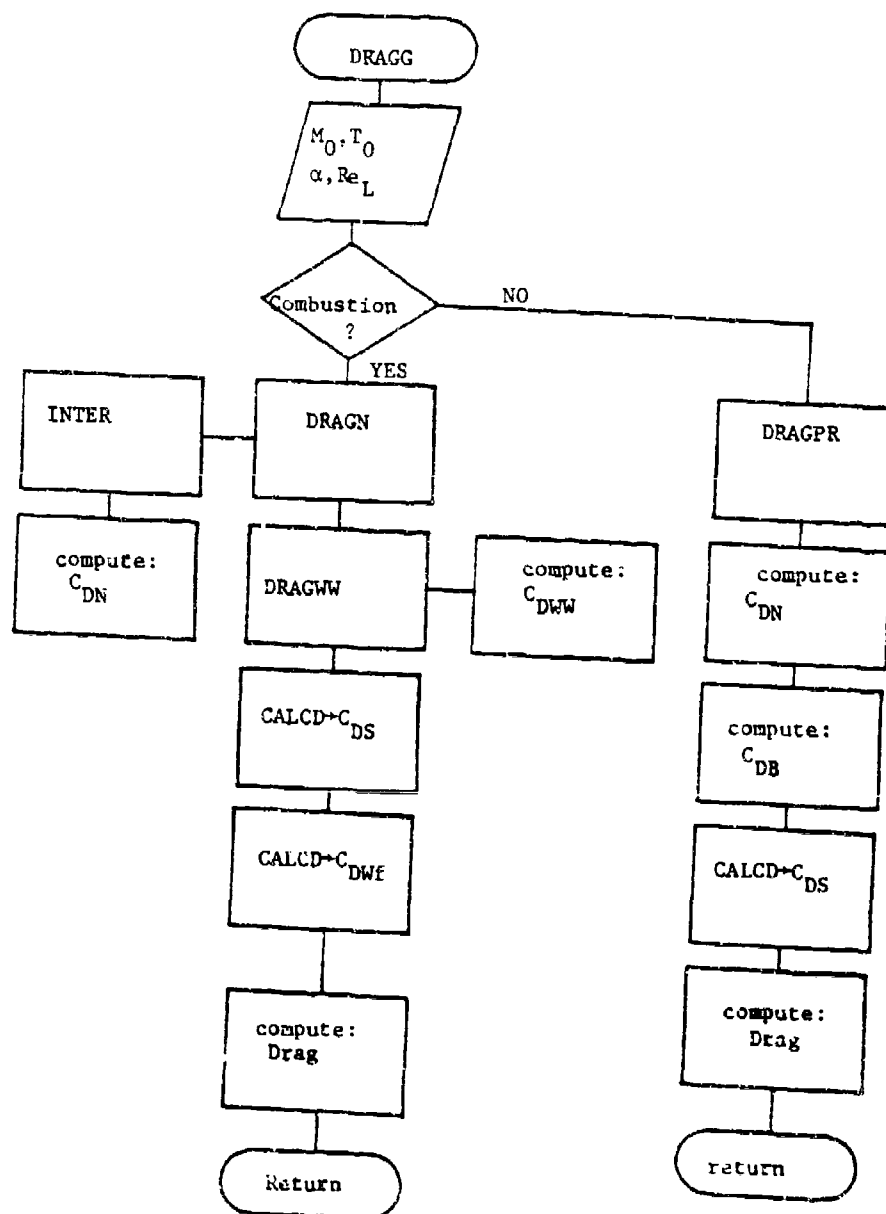


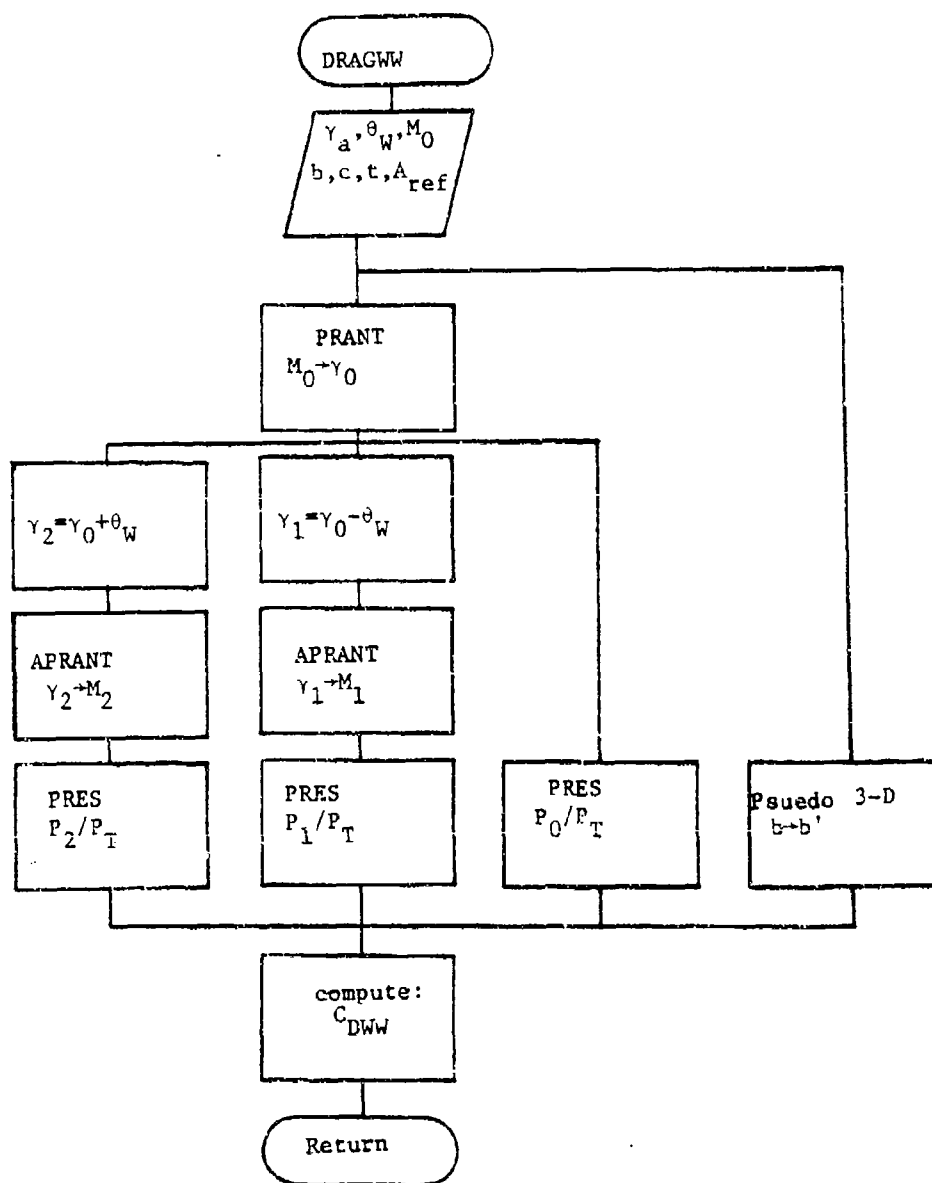


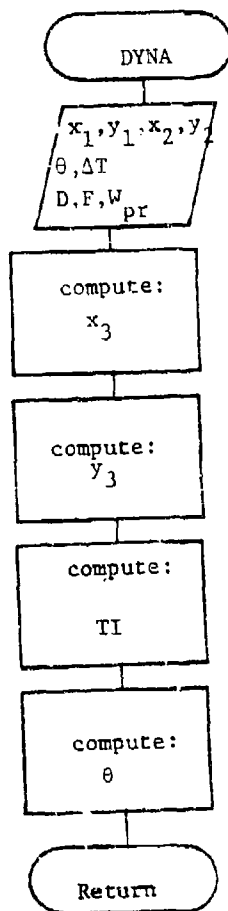












APPENDIX D:
PROGRAM TRAJET: LISTING

FILE: TRAJET FORTRAN A NAVAL POSTGRADUATE SCHOOL

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CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
PROGRAM TRAJET
THIS IS A PROGRAM FOR SOLID FUSI, RAMJET+TRAJECTORY
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC

COMMON/GE0/AREF,A0,A1,A2,A30,A3,A5,A6,L3,ADAR,ASAR,IL00,IPR
* A1A0,A2A0,A3A0,A3AR
COMMON/AR0/GA1,GAL2,GA3,RMDA,TO,PO,UD,MO,GRAY
COMMON/FUEL/RHCF,PTAT,A1N
COMMON/LESS/PI01,PI02,PI01,PI02,PIN
COMMON/BLR/MA,WF,WT,F,ROOT,CSTAR,PT4,TT4
COMMON/GFI/RF,GF,GFI,GF2,GF12,GF3
COMMON/NE/ME,PT6,PA
COMMON/MES/CF,TRUST,ISP,SFC
COMMON/CFO/PTS,PS
COMMON/IAI/PTG,TT0
COMMON/CEN/PTLC,MIC,ALC,ALFA
COMMON/TFM/MIL,PT11,M21,PT21,M51,PTS1
COMMON/NS/M12,PT12,M22,PT22,M52,PTS2
COMMON/DIF/M2,PT2,P2
COMMON/CFE/M3,M31,PT3,PT3M,M4,AS
COMMON/TRA/PI,MUA,ORAG,ORPH,LPR,WPR,U,WE,DELU,DELT,TI,TETA,IRAN,
* IL,IL0,Y,Y0,TOR,X1,Y1,X2,Y2,X3,Y3,WPRB,XTOM8,ITRA,TETA0D,XOM,YOB
COMMON/DAG/TETP,CEN,CFT,COWW,COWF,APR,SPR,SMW,Q,RMO
REAL NO,PIC,M11,M12,M2,M3M,M31,M4,M5,M6
REAL L3,A,ISP,M21,M22,M51,M52
REAL MUA,LPR
CALL DATT
IFIRAM,GT,AREFIGO TO 120
Y=0.
CALL ATM
IFIRAM,EQ,GJGO TO 100
ITPA=-1
THRUST=0.
DELU=0.
GC TO 140
100 THRUST=1.
CALL RDCS
140 U=LODDELU
MOMU/SGRY(GA+GRAY*W*Y0)
ROCT=0.
DELT=0.
WPRQ=WPR
ACAR=A0/ARCE
ASAR=A5/AREF
A6A5=A6/A5
ACC=A0
ALAO=A1/A0
AZAO=A2/A0
IPR=1
IF(ETRA,GT,0) GO TO 155
PRINT 80C
800 FCPMAT(1F1,30X,'SOLID FUEL RAMJET & TRAJECTORY',//43X,'SUMMARY',//
* SX,'A0/AR',BX,'A5/AR',GX,'TOR',HX,'XOB',IX,'YOB',JX,'TOP',
* SX,'XTOM8',SX,'TETP',SX,'TETA',//)
CC THIS PART IS FOR A0,A5-CHANGES ONLY
IFNO=41
IFIRAM,EQ,1,END=26
DO 111 1A5=26,1END
IF(1A5,FC,1)GO TO C 110
A5=11A5-1,0,01*AREF
110 A6=A0A5*AS
IF(1A6,GT,AREF)GO TO 120
AQ=A00
DC 114 1A0=26,1END
11C0=0
Y=0.
IFIRAM,GT,1,IRAM=1
IFIRAM,EQ,1,GO TO 145
THRUST=1.

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TRAO0010
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 TRAO0030
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 TRAO0050
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 TRAO0270
 TRAO0280
 TRAO0290
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 TRAO0720

FILE: TRAJET FORTRAN A NAVAL POSTGRADUATE SCHOOL

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CALL ATM
CALL SODE
145 U=UO*DEL
      H=HJ*DEL(GA*GRAV*R*TO)
      PCT=O.
      DELT=O.
      LPR=MPRO
      ITRA=-1
      TI=O.
      TCRB=O.
      XCR=O.
      YCR=O.
      IF(I1A0.EC.1)GO TO 113
      AO=(150-1)*O.O1*AREF
      A1=A1A0*AO
      A2=A2A0*AO
113 CONTINUE
      ACAP=AC/AREF
      ASAR=AS/AREF
155 IF(I1PA.EQ.1)GO TO 150
      CALL INIT
      CALL INPR
      IF(I1LC.GT.1)GO TO 120
      IF(I1TH.UST.LT.O.O1)GO TO 130
      CALL NOZZ
      IF(I1LU.GT.1)GO TO 120
      CALL CHOME
      IF(I1LD.GT.1)GO TO 120
      CALL HEAT
      IF(I1LCU.GT.1)GO TO 120
      CALL INLET
      IF(I1LD.GT.1)GO TO 120
      CALL EXPAN
      CALL CHECK
      IF(I1LE.LT.O.1)GO TO 130
      TCRB=O.
      TCR=O.
      XCR=X2
      YCR=Y2
      ILOOC
      GO TO 150
130 CALL CORVAL
      IF(I1LG.GT.1)GO TO 120
      CALL RESL
      IF(I1LG.GT.1)GO TO 120
150 CALL TRAJ
      IF(I1LO.GT.1)GO TO 120
      IF(I1PR.LT.O1)GO TO 152
      IF(I1TH.UST.LE.O.O1)GO TO 150
      IF(I1TR.LT.O1)GO TO 155
      CALL PRICD(IPRIN)
152 IF(I1TH.UST.LE.O.O1)GO TO 150
      GO TO 155
120 CONTINUE
      IF(I1TP.GT.O1)GO TO 157
114 CONTINUE
111 CONTINUE
157 PRINT 2,2,ILDO,AOAR,ASAP,A1A0,A2A0,A3AR,
      TETP,TETAO,IP4,ITRA,KMO,PI01,PI02,PIIN
222 FORMAT(1P1,2(1,1),13,2(1,1),/5X,'INPUT DATA: ',/2X,9F10.3,
      /2X,2F6.1,2F3.4F6.3)
      STOP
      END

SUBROUTINE INIT
COMMON/GEN/AREF,AO,A1,A2,A30,A3,A5,A6,L3,AOAR,ASAR,ILOO,IPR
COMMON/ATR/GA,GAL,GA2,GA12,GA3,RMOA,TO,PO,UC,UG,GRAV
COMMON/FLTL/RMCP,PTAT,A,N
COMMON/LCSS/PI01,PI02,PIR1,PIR2,PIIN
COMMON/BLR/AA,AF,AT,E,ADOT,CSTAR,PT4,TT4
COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
COMMON/NC2/H6,PT6,P6

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TRA00730
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TRA00970
TRA00980
TRA00990
TRA01000
TRA01010
TRA01020
TRA01030
TRA01040
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TRA01070
TRA01080
TRA01090
TRA01100
TRA01110
TRA01120
TRA01130
TRA01140
TRA01150
TRA01160
TRA01170
TRA01180
TRA01190
TRA01200
TRA01210
TRA01220
TRA01230
TRA01240
TRA01250
TRA01260
TRA01270
TRA01280
TRA01290
TRA01300
TRA01310
TRA01320
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TRA01360
TRA01370
TRA01380
TRA01390
TRA01400
TRA01410
TRA01420
TRA01430
TRA01440

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COMMON/RES/CF,THURST,ISP,SFC
COMMON/CVP/PT5,P5
COMMON/AL/PTO,TTC
COMMON/CCN/PTIC,MIC,ALC,ALFA
COMMON/TH/PTM1,P11,P12,P13,P14,P15,P16,P17,P18,P19,P20,P21,P22,P23,P24,P25,P26,P27,P28,P29,P30,P31,P32,P33,P34,P35,P36,P37,P38,P39,P40,P41,P42,P43,P44,P45,P46,P47,P48,P49,P50,P51,P52,P53,P54,P55,P56,P57,P58,P59,P60,P61,P62,P63,P64,P65,P66,P67,P68,P69,P70,P71,P72,P73,P74,P75,P76,P77,P78,P79,P80,P81,P82,P83,P84,P85,P86,P87,P88,P89,P90,P91,P92,P93,P94,P95,P96,P97,P98,P99,P100,P101,P102,P103,P104,P105,P106,P107,P108,P109,P110,P111,P112,P113,P114,P115,P116,P117,P118,P119,P120,P121,P122,P123,P124,P125,P126,P127,P128,P129,P130,P131,P132,P133,P134,P135,P136,P137,P138,P139,P140,P141,P142,P143,P144,P145,P146,P147,P148,P149,P150,P151,P152,P153,P154,P155,P156,P157,P158,P159,P160,P161,P162,P163,P164,P165,P166,P167,P168,P169,P170,P171,P172,P173,P174,P175,P176,P177,P178,P179,P180,P181,P182,P183,P184,P185,P186,P187,P188,P189,P190,P191,P192,P193,P194,P195,P196,P197,P198,P199,P200,P201,P202,P203,P204,P205,P206,P207,P208,P209,P210,P211,P212,P213,P214,P215,P216,P217,P218,P219,P220,P221,P222,P223,P224,P225,P226,P227,P228,P229,P230,P231,P232,P233,P234,P235,P236,P237,P238,P239,P240,P241,P242,P243,P244,P245,P246,P247,P248,P249,P250,P251,P252,P253,P254,P255,P256,P257,P258,P259,P260,P261,P262,P263,P264,P265,P266,P267,P268,P269,P270,P271,P272,P273,P274,P275,P276,P277,P278,P279,P280,P281,P282,P283,P284,P285,P286,P287,P288,P289,P290,P291,P292,P293,P294,P295,P296,P297,P298,P299,P300,P301,P302,P303,P304,P305,P306,P307,P308,P309,P310,P311,P312,P313,P314,P315,P316,P317,P318,P319,P320,P321,P322,P323,P324,P325,P326,P327,P328,P329,P330,P331,P332,P333,P334,P335,P336,P337,P338,P339,P340,P341,P342,P343,P344,P345,P346,P347,P348,P349,P350,P351,P352,P353,P354,P355,P356,P357,P358,P359,P360,P361,P362,P363,P364,P365,P366,P367,P368,P369,P370,P371,P372,P373,P374,P375,P376,P377,P378,P379,P380,P381,P382,P383,P384,P385,P386,P387,P388,P389,P390,P391,P392,P393,P394,P395,P396,P397,P398,P399,P400,P401,P402,P403,P404,P405,P406,P407,P408,P409,P410,P411,P412,P413,P414,P415,P416,P417,P418,P419,P420,P421,P422,P423,P424,P425,P426,P427,P428,P429,P430,P431,P432,P433,P434,P435,P436,P437,P438,P439,P440,P441,P442,P443,P444,P445,P446,P447,P448,P449,P450,P451,P452,P453,P454,P455,P456,P457,P458,P459,P460,P461,P462,P463,P464,P465,P466,P467,P468,P469,P470,P471,P472,P473,P474,P475,P476,P477,P478,P479,P480,P481,P482,P483,P484,P485,P486,P487,P488,P489,P490,P491,P492,P493,P494,P495,P496,P497,P498,P499,P500,P501,P502,P503,P504,P505,P506,P507,P508,P509,P510,P511,P512,P513,P514,P515,P516,P517,P518,P519,P520,P521,P522,P523,P524,P525,P526,P527,P528,P529,P530,P531,P532,P533,P534,P535,P536,P537,P538,P539,P540,P541,P542,P543,P544,P545,P546,P547,P548,P549,P550,P551,P552,P553,P554,P555,P556,P557,P558,P559,P560,P561,P562,P563,P564,P565,P566,P567,P568,P569,P570,P571,P572,P573,P574,P575,P576,P577,P578,P579,P580,P581,P582,P583,P584,P585,P586,P587,P588,P589,P590,P591,P592,P593,P594,P595,P596,P597,P598,P599,P600,P601,P602,P603,P604,P605,P606,P607,P608,P609,P610,P611,P612,P613,P614,P615,P616,P617,P618,P619,P620,P621,P622,P623,P624,P625,P626,P627,P628,P629,P630,P631,P632,P633,P634,P635,P636,P637,P638,P639,P640,P641,P642,P643,P644,P645,P646,P647,P648,P649,P650,P651,P652,P653,P654,P655,P656,P657,P658,P659,P660,P661,P662,P663,P664,P665,P666,P667,P668,P669,P670,P671,P672,P673,P674,P675,P676,P677,P678,P679,P680,P681,P682,P683,P684,P685,P686,P687,P688,P689,P690,P691,P692,P693,P694,P695,P696,P697,P698,P699,P700,P701,P702,P703,P704,P705,P706,P707,P708,P709,P710,P711,P712,P713,P714,P715,P716,P717,P718,P719,P720,P721,P722,P723,P724,P725,P726,P727,P728,P729,P730,P731,P732,P733,P734,P735,P736,P737,P738,P739,P740,P741,P742,P743,P744,P745,P746,P747,P748,P749,P750,P751,P752,P753,P754,P755,P756,P757,P758,P759,P760,P761,P762,P763,P764,P765,P766,P767,P768,P769,P770,P771,P772,P773,P774,P775,P776,P777,P778,P779,P780,P781,P782,P783,P784,P785,P786,P787,P788,P789,P790,P791,P792,P793,P794,P795,P796,P797,P798,P799,P800,P801,P802,P803,P804,P805,P806,P807,P808,P809,P810,P811,P812,P813,P814,P815,P816,P817,P818,P819,P820,P821,P822,P823,P824,P825,P826,P827,P828,P829,P830,P831,P832,P833,P834,P835,P836,P837,P838,P839,P840,P841,P842,P843,P844,P845,P846,P847,P848,P849,P850,P851,P852,P853,P854,P855,P856,P857,P858,P859,P860,P861,P862,P863,P864,P865,P866,P867,P868,P869,P870,P871,P872,P873,P874,P875,P876,P877,P878,P879,P880,P881,P882,P883,P884,P885,P886,P887,P888,P889,P890,P891,P892,P893,P894,P895,P896,P897,P898,P899,P900,P901,P902,P903,P904,P905,P906,P907,P908,P909,P910,P911,P912,P913,P914,P915,P916,P917,P918,P919,P920,P921,P922,P923,P924,P925,P926,P927,P928,P929,P930,P931,P932,P933,P934,P935,P936,P937,P938,P939,P940,P941,P942,P943,P944,P945,P946,P947,P948,P949,P950,P951,P952,P953,P954,P955,P956,P957,P958,P959,P960,P961,P962,P963,P964,P965,P966,P967,P968,P969,P970,P971,P972,P973,P974,P975,P976,P977,P978,P979,P980,P981,P982,P983,P984,P985,P986,P987,P988,P989,P990,P991,P992,P993,P994,P995,P996,P997,P998,P999,P1000,P1001,P1002,P1003,P1004,P1005,P1006,P1007,P1008,P1009,P1010,P1011,P1012,P1013,P1014,P1015,P1016,P1017,P1018,P1019,P1020,P1021,P1022,P1023,P1024,P1025,P1026,P1027,P1028,P1029,P1030,P1031,P1032,P1033,P
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[illegible]

THAO2170
THAO2180
THAO2190
THAO2200
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THAO2900

FILE: TRAJET FORTRAN A NAVAL POSTGRADUATE SCHOOL

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*0.0521,0.0504/
DATA DAT(037,0,0,0.1638,0.1106,0.1049,0.099,0.2893,0.0932,0.0817
*0.0893,0.0875,0.0858,0.0841,0.0826,0.0811,0.1798,0.0782,0.0769
*0.0744,0.0732/
DATA DAT(047,0,0,0.2210,0.1504,0.1478,0.1361,0.1300,0.1272,0.1246
*0.1220,0.1196,0.1170,0.1151,0.113,0.1109,0.1090,0.1071,0.1054
*0.1036,0.1024/
DATA DAT(057,0,0,0.3099,0.2136,0.2032,0.1938,0.1855,0.1816,0.1779
*0.1744,0.1710,0.1678,0.1647,0.1618,0.1590,0.1563,0.1537,0.1512
*0.1484,0.1443/
C
GO TO (21,21,21,24),IDATA
21 IF=0
IFA=20
DO 22 IZ=1,5
22 ZVFC(IZ)=TIOVFC(IZ)
GO TO 24
24 IF=0
IDA=10
DO 25 IZ=1,5
25 ZVFC(IZ)=TIVFC(IZ)
GO TO (31,31,35,37),IDATA
31 IFA=0
DO 31 IFA=1,IDA
XVFC(IFA)=FAVFC(IFA)
YVFC(1,IFA)=DAT0(IFA)
YVFC(2,IFA)=DAT1(IFA)
YVFC(3,IFA)=DAT2(IFA)
YVFC(4,IFA)=DAT3(IFA)
51 YVFC(5,IFA)=DAT4(IFA)
GO TO 33
33 IFA=0
DO 33 IFA=1,IFA
XVFC(IFA)=FAVFC(IFA)
YVFC(1,IFA)=DAT0(IFA)
YVFC(2,IFA)=DAT2(IFA)
YVFC(3,IFA)=DAT3(IFA)
YVFC(4,IFA)=DAT4(IFA)
53 YVFC(5,IFA)=DAT5(IFA)
GO TO 35
35 IFA=0
DO 35 IFA=1,IDA
XVFC(IFA)=FAVFC(IFA)
YVFC(1,IFA)=DAT0(IFA)
YVFC(2,IFA)=DAT2(IFA)
YVFC(3,IFA)=DAT3(IFA)
YVFC(4,IFA)=DAT4(IFA)
55 YVFC(5,IFA)=DAT5(IFA)
GO TO 37
37 IFA=0
DO 37 IFA=1,IDA
XVFC(IFA)=FAVFC(IFA)
YVFC(1,IFA)=DAT0(IFA)
YVFC(2,IFA)=DAT2(IFA)
YVFC(3,IFA)=DAT3(IFA)
YVFC(4,IFA)=DAT4(IFA)
57 YVFC(5,IFA)=DAT5(IFA)
C
39 IF((ZP=1,DF=06),LT,ZVFC(3))GO TO 67
IF((ZP=1,DF=06),GT,ZVFC(3))GO TO 67
IF((ZP=1,DF=06),LT,XVFC(2))GO TO 67
IF((ZP=1,DF=06),GT,XVFC(2))GO TO 67
IF((DATA,GT,4))GO TO 67
IFA=1
DO 41 IFA=2,IDA
IF((ZP=1,DF=06),XVFC(IFA))63,63,65
41 IF=1
DO 41 IT=2,5
IF((ZP=1,DF=06),ZVFC(IT))73,73,75
73 IT=1
DO 41 IT=1,2
ITO=IT-2+IT1

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TRA03000
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TRA03590
TRA03600

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      YZ(IIT0)= (XP-XVEC(IFA-1))/(XVEC(IFA)-XVEC(IFA-1))
      *YVEC(IIT0,IFA)-YVEC(IIT0,(IFA-1))YVEC(IIT0,(IFA-1))
81 CONTINUE
      YP=(ZP-ZVEC(IT-1))/(ZVEC(IT)-ZVEC(IT-1))
      *YZ(IIT-1)-YZ(IIT-1)*YZ(IIT-1)
      RETURN
75 CONTINUE
71 CONTINUE
65 CONTINUE
61 CONTINUE
67 IF(IIT-1) RETURN
PRINT A4,A5AR,40AR,ZP,XP,DATA
69 FORMAT(1X,ZF7.3,5X,ZF12.4,13,5X,'MISSING DATA TO INTER')
RETURN
END

SUBROUTINE NOZZ
COMMON/GEOP/ARFF,30,A1,A2,A3C,43,AS,A6,L3,40AR,ASAR,ILOO,IPR
COMMON/ALF/GA1,GA2,GA12,GA3,ANO,TO,PO,UO,MO,GRAY
COMMON/FLF/PRCF,PTAT,AIN
COMMON/FLCS/PI01,PI02,PI03,PI04,PI05,PI06,PI07,PI08,PI09,PI10
COMMON/RF/FA,WF,WT,F,ROOT,CSTAR,PT4,TT4
COMMON/GF/GF1,GF2,GF3,GF4,GF5,GF6,GF7,GF8,GF9,GF10,GF11,GF12,GF13
COMMON/NGI/MO,PT6,P6
COMMON/KES/CF,THGUST,ISP,SFC
COMMON/CHC/PT5,P5
COMMON/TNI/PT1,PT2
COMMON/CC/PT1C,CF,ALC,ALFA
COMMON/THP/M1,PT11,M21,PT21,MS1,PT51
COMMON/THP/M2,PT12,M22,PT22,MS2,PT52
COMMON/DIF/M2,PT12
COMMON/CFE/M3,M31,PT3,PT3M,M4,AS
REAL M0,PI0,M1,M2,M3,M31,M4,M5,M6
REAL L3,N,ISP,M21,M22,MS1,MS2
M0=1.0
CALL CALCHM0,AS,A6,GF1,GF2,GF12)
IF(ILOO.LE.1) GO TO 11
IF(ILOO)
  RETURN
11 PT6=PT4*PIN
  P6=PT6*(1.0GF2*M6**2)**(-GF3)
  RETURN
END

SUBROUTINE CALCHM(X,AN,AM,G1,G2,G12)
COMMON/GEOP/ARFF,30,A1,A2,A3C,43,AS,A6,L3,40AR,ASAR,ILOO,IPR
THIS SECTION COMPUTES MACH NUMBER FROM AREA RATIOS.
THE BASIC FORMULA IS:
AN/AM=(G1/(1.0G2X**2))**G12X
AN/AM=(G1/ANARPA AT KNOWN MACH NUMBER
DATA MEECD) ANARPA AT NEW MACH NUMBER
G1,G2,G12=GAMMA RATIOS FOR:
-AIR FLOW(GA1,GA2,GA12)
-MOT FLOW(GF1,GF2,GF12)
X=KNOWN MACH NUMBER AT AN=ANM
X IS THE COMPUTED MACH NUMBER (THE SAME X IS USED FOR IN/OUT)
IMACH=1
XAN=X
IF(XAN-1.014,5.5
4 ALFAM=0.99
GO TO 6
5 ALFAM=0.91
6 CONTINUE
EPS=1.E-04
7 GFUN=(G1/(1.0G2X**2))
FX=GFUN**G12-AN/AM
IF(1.E-04) PRINT 999,X,FX
999 FORMAT(1X,ZF10.4)
FXDOT=(GFUN**G12)*(1.-2.0G2*G12/ALFA*(X**2)/(1.0G2X**2))
XNEW=X-FX/FXDOT
DIFF=ABS(X-XNEW)

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[illegible]

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10000
IF(IPR.LT.1)RETURN
PRINT 33,ASAR,AOAR,P5
53 FORMAT(1X,2F7.3,3X,'NOZZLE IS NOT CHOKED,P5=*,E10.2)
IF(IPR.GE.2)CALL PRIN
RETURN
END

SUBROUTINE INLET
COMMON/GEN/ARFF,A0,A1,A2,A30,A3,A5,A6,L3,AOAR,ASAR,ILOO,IPR
COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHO4,TO,P0,UO,MO,GRAY
COMMON/FLEL/RHOF,PTAT,A,N
COMMON/LCSS/PI01,PI02,PI01,PI02,PIN
COMMON/RLEF/M4,MF,MT,F,ROOT,CSTAR,PT4,TT4
COMMON/GF1/R1,GF,GF1,GF2,GF12,GF3
COMMON/NC4/M4,PT0,P6
COMMON/RES/CF,THO,LSI,ISP,SFC
COMMON/CHP/PT5,P5
COMMON/IN1/PT0,TT0
COMMON/CCN/PTIC,MIC,AIC,ALFA
COMMON/TPPV/M1,PT11,M21,PT21,M51,PT51
COMMON/NS/M12,PT12,M22,PT22,M52,PT52
COMMON/OTF/M2,PT2,P2
COMMON/CFE/M3,M31,PT3,PT3M,M4,AS
REAL M0,MIC,M11,M12,M2,M3N,M31,M4,M5,M6
REAL L3,N,ISP,M21,M22,M51,M52
CALL CONE
CALL MIN
IF(ILOO.LE.1)GO TO 11
ILOO=1
RETURN
11 CALL THROAT(1,M11,M1)
IF(ILOO.LE.1)GO TO 13
ILOO=2
RETURN
13 CALL NSP(1,M11,M12,PT11,PT12)
CALL DIFFUS(1,A1,P12)
IF(ILOO.GT.1)ILOO=3
RETURN
END

SUBROUTINE CONE
COMMON/GEN/ARFF,A0,A1,A2,A30,A3,A5,A6,L3,AOAR,ASAR,ILOO,IPA
COMMON/AIR/GA,GA1,GA2,GA12,GA3,RHO4,TO,P0,UO,MO,GRAY
COMMON/FLEL/RHOF,PTAT,A,N
COMMON/LCSS/PI01,PI02,PI01,PI02,PIN
COMMON/RLEF/M4,MF,MT,F,ROOT,CSTAR,PT4,TT4
COMMON/GF1/R1,GF,GF1,GF2,GF12,GF3
COMMON/NC4/M4,PT0,P6
COMMON/RES/CF,THO,LSI,ISP,SFC
COMMON/CHP/PT5,P5
COMMON/IN1/PT0,TT0
COMMON/CCN/PTIC,MIC,AIC,ALFA
COMMON/TPPV/M1,PT11,M21,PT21,M51,PT51
COMMON/NS/M12,PT12,M22,PT22,M52,PT52
COMMON/OTF/M2,PT2,P2
COMMON/CFE/M3,M31,PT3,PT3M,M4,AS
REAL M0,MIC,M11,M12,M2,M3N,M31,M4,M5,M6
REAL L3,N,ISP,M21,M22,M51,M52
REAL M0,M1
ALFA = THE HALF ANGLE OF THE CONE
CP=1.001+.006/M0**2)/((ALFA/10.)**1.69
PIPO=1.+CP*GA/2**CP**2
MN=SQRT(1.+(PIPO-1.)*(GA+1)/(2*GA))
PTIPTUP=PIPO*(1.-1.)/(GA-1.1)+(GA+1)*MN**2/
/(GA-1.1)*MN**2.11*(GA/(GA-1.1))
BETA=ASIN(MN/MCI)
TETA=ATAN12.*COTAN(BETA)*(MN**2-1.)/
/(M0**2*(CA+CUS(2*BETA))*.2.1)
M1=SQRT(1.+(GA-1.1/2*MN**2)/(CA*MN**2-(GA-1.1/2)/
/ASIN(BETA-TETA))**2)
ALZU=(1.-TAN(TETA)/TAN(BETA))*COS(TETA)

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PTIC=PTO*PT1PTO
PIC=MI
AIC=AO*AI*AO
RETURN
END

SUBROUTINE MIN
COMMON/GE0/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
COMMON/AIR/GA,GAL,GA2,GA12,GA3,RMOA,TO,PO,UD,MO,GRAV
COMMON/FUEL/RHCF,ETAT,A,N
COMMON/LCSS/PI01,PI02,PI01,P102,PIN
COMMON/BLR/WA,WL,WL,P,ROOT,CSTAR,PT4,TT4
COMMON/GEL/RF,GF,CF1,GF2,GF12,GF3
COMMON/NCE/MO,PT0,P0
COMMON/RCS/CE,THRUST,ISP,SFC
COMMON/CHC/PT0,P5
COMMON/INI/PT0,TT0
COMMON/CCN/PTIC,MIC,AIC,ALFA
COMMON/TRPO/M11,PT11,M21,PT21,MS1,PT51
COMMON/MS/M12,PT12,M22,PT22,MS2,PT52
COMMON/PIE/M2,PT2,P2
COMMON/CHC/MAN,M11,PT3,PT1M,M4,AS
PE21,M0,MIC,M11,M12,M2,M3M,M31,M4,M5,M6
REAL L3,N,ISP,M21,M22,MS1,MS2
CALL THRPT12,M21,M22,PT21,PT22)
M2,M22
PT2,PT22
P2=PT2*(1.0+GA2*M2**2)**(-GA3)
CALL EXPRN
IF(ILOO,GT.1)RETURN
IF(PT54,LE,PT3)RETURN
ILOO=10
IF(ILOO,LT,1)RETURN
PRINT 13,ASAR,A0AR
33 FORMAT(12,2F7.3,3X,'PT3 IS LESS THAN MIN VALUE ALLOWED')
IF(ILOO,GE,2)CALL PRIN
RETURN
END

SUBROUTINE THRPT12,M11,A11
COMMON/GE0/AREF,A0,A1,A2,A30,A3,A5,A6,L3,A0AR,A5AR,ILOO,IPR
COMMON/AIR/GA,GAL,GA2,GA12,GA3,RMOA,TO,PO,UD,MO,GRAV
COMMON/FUEL/RHCF,ETAT,A,N
COMMON/LCSS/PI01,PI02,PI01,P102,PIN
COMMON/BLR/WA,WL,WL,P,ROOT,CSTAR,PT4,TT4
COMMON/GEL/RF,GF,CF1,GF2,GF12,GF3
COMMON/NCE/MO,PT0,P0
COMMON/RCS/CE,THRUST,ISP,SFC
COMMON/CHC/PT0,P5
COMMON/INI/PT0,TT0
COMMON/CCN/PTIC,MIC,AIC,ALFA
COMMON/TRPO/M11,PT11,M21,PT21,MS1,PT51
COMMON/MS/M12,PT12,M22,PT22,MS2,PT52
COMMON/PIE/M2,PT2,P2
COMMON/CHC/MAN,M11,PT3,PT1M,M4,AS
REAL M0,MIC,M11,M12,M2,M3M,M31,M4,M5,M6
REAL L3,N,ISP,M21,M22,MS1,MS2
REAL M11
AN=AIC*MIC
G1=1.0+GA2*MIC**2
PIE=MIC
CALL CALCHIMT1,AN,A1,G1,GA2,GA12)
IF(ILOO,GT.1)RETURN
IF(M11,GE,1.100 TO 17,18,19),1
ILOO=10
IF(ILOO,LT,1)RETURN
PRINT 15,ASAR,A0AR
15 FORMAT(11,2F7.3,3X,'UNSTART CONDITIONS')
IF(ILOO,GE,2)CALL PRIN
RETURN
17 PT1=PTIC*PI01

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RETURN
18 PT1=PTIC*PI01*PI02
RETURN
19 FAC=(A1-A11)/(A2-A11)
PT025=1.-FAC*(1.-PT02)
PT1=PTIC*PI01*PI025
RETURN
END

SUBROUTINE NSR(I, M1, M2, PT1, PT2)
COMMON/GEOP/REF, AO, A1, A2, A30, A3, A5, A6, L3, AOAR, ASAR, ILOO, IPR
COMMON/ALR/GA, GA1, GA2, GA12, GA3, RHGA, TO, PO, UO, NO, GRAV
COMMON/RLR/MA, MP, WT, F, P001, CSTAR, PT4, TT4
COMMON/LCSS/PI01, PI02, PI01, PI02, PIN
COMMON/ALR/MA, MP, WT, F, P001, CSTAR, PT4, TT4
COMMON/GFI/RF, GF, GF1, GF2, GF12, GF3
COMMON/NCZ/M6, BT0, PA
COMMON/RES/CF, TNUST, ISP, SFC
COMMON/CH/PTS, PS
COMMON/INT/PTO, TFO
COMMON/CCN/PTIC, MIC, AIC, ALFA
COMMON/THN/MI1, PT11, MI2, PT21, MS1, PT51
COMMON/MS/MI2, PT12, MI22, PT22, MS2, PT52
COMMON/DLE/M2, PT12, MI22, PT22, MS2, PT52
COMMON/CE/M31, M31, PT3, PT3M, M4, AS
REAL NO, MIC, MI1, MI2, M2, M3N, M31, M4, M5, M6
REAL L3, A, ISP, M21, M22, MS1, MS2
END

CCC
CCC
THIS SECTION COMPUTES NORMAL SHOCK RATIO LOSSES
REF. TO PT12, MI2-SHAPIRO VOL. 1, P. 118-119.
PT12=PT11*(GA1+1)*2/1.-GA2*(MI1+2)*2/1.-GA3
PT122=(GA1+1)*2/1.-GA2*(MI1+2)*2/1.-GA3
PT122=PT12/PT122
MI2=MI2*(MI1+2)*2/1.-GA2*(MI1+2)*2/1.-GA3
RETURN
END

SUBROUTINE DIFFUS(I, A1, MI2)
COMMON/GEOP/REF, AO, A1, A2, A30, A3, A5, A6, L3, AOAR, ASAR, ILOO, IPR
COMMON/ALR/GA, GA1, GA2, GA12, GA3, RHGA, TO, PO, UO, NO, GRAV
COMMON/RLR/MA, MP, WT, F, P001, CSTAR, PT4, TT4
COMMON/GFI/RF, GF, GF1, GF2, GF12, GF3
COMMON/NCZ/M6, BT0, PA
COMMON/RES/CF, TNUST, ISP, SFC
COMMON/CH/PTS, PS
COMMON/INT/PTO, TFO
COMMON/CCN/PTIC, MIC, AIC, ALFA
COMMON/THN/MI1, PT11, MI2, PT21, MS1, PT51
COMMON/MS/MI2, PT12, MI22, PT22, MS2, PT52
COMMON/DLE/M2, PT12, MI22, PT22, MS2, PT52
COMMON/CE/M31, M31, PT3, PT3M, M4, AS
REAL NO, MIC, MI1, MI2, M2, M3N, M31, M4, M5, M6
REAL L3, A, ISP, M21, M22, MS1, MS2
END

CCC
CCC
THIS SECTION COMPUTES EXPANSION FROM THROAT OF THE INLET
IC POINT 2
GA1=1.-GA2*(MI2+2)*2/1.-GA3
MI2=MI2
CALL CALCH(M2, AN, AZ, G1, GA2, GA12)
IF (A1-TO, GT, 1) RETURN
GO TO 31, 33, 35
31 PT2=PT12*PI02
GO TO 35
33 FAC=(A2-A11)/(A2-A11)
PT025=1.-FAC*(1.-PT02)
PT2=PT2*PI025
35 P2=PT2*(1.-NO*(2+2)*2/1.-GA3)
RETURN
END

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SUBROUTINE EXPAN
COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,AOAR,ASAR,ILOO,IPR
COMMON/AIR/GA,GAL,GA2,GA12,GA3,RHDA,T0,P0,U0,M0,GRAY
COMMON/FUEL/RHOF,ETAT,A,N
COMMON/FLSS/PI01,PI02,PIB1,PIB2,PIB
COMMON/ALR/MA,MI,MT,F,ROOT,CSTAR,PT4,TT4
COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
COMMON/NCZ/M6,PT6,P6
COMMON/RES/CF,THRUST,ISP,SFC
COMMON/CRO/PT5,P5
COMMON/TAI/PT0,TT0
COMMON/CCN/PTIC,MIC,AIC,ALFA
COMMON/TRO/M11,PT11,M21,PT21,M51,PT51
COMMON/MS/M12,PT12,M22,PT22,M52,PT52
COMMON/DIF/M2,PT2,P2
COMMON/CFE/M3N,M31,PT3,PT3N,M4,AS
REAL M0,MIC,M11,M12,M2,M3N,M31,M4,M5,M6
REAL L3,N,ISP,M21,M22,M51,M52
THIS SUBROUTINE COMPUTES LOSSES DUE TO EXPANSION INTO COMBUSTOR
M11=M0*(P02/P01)**0.5*(1+GA2*M2/M1-1)/(1+GA2)
M31=M0*(P02/P01)**0.5*(1+GA2*M2/M1-1)/(1+GA2)
G1=1+GA2*M2**2
PT3N=PT2*(1+(1+GA2*M31**2)/(G1**GA3)
RETURN
END

SUBROUTINE CHECK
COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,AOAR,ASAR,ILOO,IPR
COMMON/AIR/GA,GAL,GA2,GA12,GA3,RHDA,T0,P0,U0,M0,GRAY
COMMON/FUEL/RHOF,ETAT,A,N
COMMON/FLSS/PI01,PI02,PIB1,PIB2,PIB
COMMON/ALR/MA,MI,MT,F,ROOT,CSTAR,PT4,TT4
COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
COMMON/NCZ/M6,PT6,P6
COMMON/RES/CF,THRUST,ISP,SFC
COMMON/CRO/PT5,P5
COMMON/TAI/PT0,TT0
COMMON/CCN/PTIC,MIC,AIC,ALFA
COMMON/TRO/M11,PT11,M21,PT21,M51,PT51
COMMON/MS/M12,PT12,M22,PT22,M52,PT52
COMMON/DIF/M2,PT2,P2
COMMON/CFE/M3N,M31,PT3,PT3N,M4,AS
REAL M0,MIC,M11,M12,M2,M3N,M31,M4,M5,M6
REAL L3,N,ISP,M21,M22,M51,M52
IF(PT3N.CF.PT3)RETURN
IF(PT3N.LT.1)DETUNO
PRINT 33,ASAR,AOAR
33 FORMAT(1X,2F7.3,3X,'PT3 IS MORE THAN MAX. VALUE ALLOWED')
IF(IPR.EQ.2)CALL PRIN
RETURN
END

SUBROUTINE HEAT
COMMON/GEO/AREF,A0,A1,A2,A30,A3,A5,A6,L3,AOAR,ASAR,ILOO,IPR
COMMON/AIR/GA,GAL,GA2,GA12,GA3,RHDA,T0,P0,U0,M0,GRAY
COMMON/FUEL/RHOF,ETAT,A,N
COMMON/FLSS/PI01,PI02,PIB1,PIB2,PIB
COMMON/ALR/MA,MI,MT,F,ROOT,CSTAR,PT4,TT4
COMMON/GFI/RF,GF,GF1,GF2,GF12,GF3
COMMON/NCZ/M6,PT6,P6
COMMON/RES/CF,THRUST,ISP,SFC
COMMON/CRO/PT5,P5
COMMON/TAI/PT0,TT0
COMMON/CCN/PTIC,MIC,AIC,ALFA
COMMON/TRO/M11,PT11,M21,PT21,M51,PT51
COMMON/MS/M12,PT12,M22,PT22,M52,PT52
COMMON/DIF/M2,PT2,P2
COMMON/CFE/M3N,M31,PT3,PT3N,M4,AS
REAL M0,MIC,M11,M12,M2,M3N,M31,M4,M5,M6
REAL L3,N,ISP,M21,M22,M51,M52

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TRAO7210
 TRAO7220
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 TRAO7280
 TRAO7290
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FILE: TRAJET. FORTRAN A NAVAL POSTGRADUATE SCHOOL

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REAL *31
RA=20.314
M4=0.7
CALL CALCM(M4,A5,A3,GF1,GF2,GF12)
T=1
P=SQRT(1+T/T0)*((1.+GF*M4**2)/M4+SQRT(GA/GF*RA/RP)*(1.+P)
70 DEC=RM**2+.4*GA
IF (DEC.LT.0.)GO TO 74
M3N=K-SQRT(DEC)/(1+GA)
IF (T.CY.1)GO TO 72
M3=M3N
DEC=(1.+GA-1)/2.*M31**2)/(1.+GF-1)/2.*M4**2)
B=8*SQRT(DEC)
T=2
GO TO 70
72 M3N=(M3N+M31)/2
PIB2=(1.+GF-1)/2*M4**2)*((GF/(GF-1))/
/(1.+GA-1)/2*M3N**2))*((GA/(GA-1))*1+GA*M3N**2)/(1+GF*M4**2)
PI=PIB2/PIB2
RETURN
74 ILC=3
IF (ILC.LT.1)RETURN
PRINT 75,ASR,ADAR
75 FORMAT(13,2F7.3,5X,'NEGATIVE ARGUMENT FOR M3')
IF (100.GE.2)CALL PRIN
RETURN
END

SUBROUTINE COMVAL
COMMON/GEF/AREF,A0,A1,A2,A30,A3,A5,A6,L3,ADAR,ASR,ILCC
COMMON/ALR/GA,GAL1,GAL2,GAL3,PHCA,TO,PO,UO,M0,GRAY
COMMON/LEL/RMCF,PTAT,A,M
COMMON/LEL/PI01,PI02,PI03,PI04,PI05,PI06,PI07,PI08,PI09,PI10,PI11,PI12,PI13,PI14,PI15,PI16,PI17,PI18,PI19,PI20,PI21,PI22,PI23,PI24,PI25,PI26,PI27,PI28,PI29,PI30,PI31,PI32,PI33,PI34,PI35,PI36,PI37,PI38,PI39,PI40,PI41,PI42,PI43,PI44,PI45,PI46,PI47,PI48,PI49,PI50,PI51,PI52,PI53,PI54,PI55,PI56,PI57,PI58,PI59,PI60,PI61,PI62,PI63,PI64,PI65,PI66,PI67,PI68,PI69,PI70,PI71,PI72,PI73,PI74,PI75,PI76,PI77,PI78,PI79,PI80,PI81,PI82,PI83,PI84,PI85,PI86,PI87,PI88,PI89,PI90,PI91,PI92,PI93,PI94,PI95,PI96,PI97,PI98,PI99,PI100
COMMON/BLA/WA,WF,WT,F,POOT,ICSTAR,PT4,TT4
COMMON/GEF/RF,GF,GF1,GF2,GF12,GF3
COMMON/RCZ/M4,PTU,P6
COMMON/RES/CF,THRUST,ISP,SFC
COMMON/CHD/PT5,P5
COMMON/INT/PT0,TT0
COMMON/INT/PT1C,MIC,ALC,ALE4
COMMON/TRA0/M1,PT11,M21,PT21,MS1,PT51
COMMON/MS/M12,PT12,M22,PT22,MS2,PT52
COMMON/DEF/M2,PT2,P2
COMMON/DEF/M3N,M31,PT3,PT3N,M4,AS
REAL M0,PI0,M11,M12,M2,M3N,M31,M4,M5,M6
REAL L3,N,ISP,M21,M22,M51,M52
THIS SUBROUTINE CALCULATES CORRECT PLACE OF NORMAL SHOCK
AND THEREFORE CORRECT VALUES OF LOSSES AT EVERY STATION
CEE
ASL=M1
ASR=M2
IAS=0
52 AS=(ASL+ASR)/2.
IF (IAS.GT.15)GO TO 55
CALL THRUST(1,MS1,AS)
CALL MSR(1,MS1,M2,PT51,PT52)
CALL DIFFUS(1,AS,MS2)
CALL EXPAW
IF (ILOD.LE.1)GO TO 53
ILCC=1
RETURN
53 DEL=PT3N-PT3
ACFL=ABS(DEL)/PT3N
IF (ACFL.LE.1.005)GO TO 55
IF (DEL/154.55.56
54 GO TO 52
55 PT11=PT51
PT12=PT52
M11=MS1
PT1=M52
RETURN

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TRA07930
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 TRA08000
 TRA08010
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[illegible]

FILE: TRAJET - FORTRAN A NAVAL POSTGRADUATE SCHOOL

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REAL M0,M1C,M11,M12,M2,M3N,M31,M4,M5,M6
REAL L3,M13P,M21,M22,M31,M32,M4,M5,LPR
A0AR=A0/AREF
A1CAO=A1C/A0
A1AO=A1/A0
A2AO=A2/A0
A2AP=A3/AREF
A5A=A5/AREF
A6AS=A6/AS
A5AO=A5/A0
P1CPO=PTIC/PTO
P11PIC=P11/PTIC
P12P11=P12/PT11
P2P12=P2/PT12
P3P2=P3/PT2
P3P3=P3/PT3
P4P3=P4/PT3
P6P4=P6/PT4
P6PO=PT6/PTO
MFA=MFC/ICO
IF (IPIC IN .GT. 2) GO TO 77
IPR1=7
PRINT 211C
PRINT 214C
PRINT 216C
PRINT 218C
PRINT 222C,AREF,L3,TETP
PRINT 226C,A0AR,A1CAO,A1AO,A2AO,A3AR,A5A,A6AS
PRINT 232C,M0,M1C,M6
PRINT 236C,P1O1,P1O2,P1N
PRINT 244C
PRINT 246C
PRINT 248C,P0,TO,RMOA,PTO,TTG,GA
PRINT 250C
77 CONTINUE
PRINT 250C,M1,M2,M3N,M31,M4,
MFCPO,M13P,M21,M22,M31,M32,M4,M5,LPR
MFCITV,CFTHRUST,L3P
210 FORMAT(1H1,40X,'CCCCCCCCCCCCCCCCCCCCCCCC')
212 FORMAT(1H1,40X,'CCCCCCCCCCCCCCCCCCCCCCCC')
214 FORMAT(1H1,40X,'SOLID FUEL RAMJET CCCC')
216 FORMAT(1H1,40X,'CCCCCCCCCCCCCCCCCCCCCCCC')
218 FORMAT(1H1,40X,'CCCCCCCCCCCCCCCCCCCCCCCC')
220 FORMAT(1H1,40X,'FORMETICAL DATA: //')
222 FORMAT(1H1,40X,'AREF=,E11.4,M21,3X,M31,E11.4,M31,3X,TETP=,F5.1//')
224 FORMAT(1H1,40X,'A0/AREF=,3X,A1C/A0=,3X,A1/A0=,3X,A2/A0=,3X,A3/AREF=,4X,A5/AREF=,4X,A6/AS=,')
226 FORMAT(1H1,40X,'M1C=,7X,M6=,')
232 FORMAT(1H1,40X,'M1C=,7X,M6=,')
234 FORMAT(1H1,40X,'CONSTANT LOSSES: //')
236 FORMAT(1H1,40X,'P1O1=,F7.3,3X,P1O2=,F7.3,3X,P1N=,F7.3//')
244 FORMAT(1H1,40X,'INITIAL FLIGHT CONDITIONS: //')
246 FORMAT(1H1,40X,'P1O1=,F7.3,P1O2=,F7.3,P1N=,F7.3,P1O1=,F7.3,P1O2=,F7.3,P1N=,F7.3')
248 FORMAT(1H1,40X,'P1O1=,F7.3,P1O2=,F7.3,P1N=,F7.3,P1O1=,F7.3,P1O2=,F7.3,P1N=,F7.3')
250 FORMAT(1H1,40X,'P1O1=,F7.3,P1O2=,F7.3,P1N=,F7.3,P1O1=,F7.3,P1O2=,F7.3,P1N=,F7.3')
252 FORMAT(1H1,40X,'P1O1=,F7.3,P1O2=,F7.3,P1N=,F7.3,P1O1=,F7.3,P1O2=,F7.3,P1N=,F7.3')
254 FORMAT(1H1,40X,'P1O1=,F7.3,P1O2=,F7.3,P1N=,F7.3,P1O1=,F7.3,P1O2=,F7.3,P1N=,F7.3')
256 FORMAT(1H1,40X,'P1O1=,F7.3,P1O2=,F7.3,P1N=,F7.3,P1O1=,F7.3,P1O2=,F7.3,P1N=,F7.3')
RETURN
END
SURFCUTINE TRAJ

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TRA09370
TRA09380
TRA09390
TRA09400
TRA09410
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TRA10000
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TRA10070
TRA10080

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FILE: TRAJET FORTRAN 4 NAVAL POSTGRADUATE SCHOOL

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COMMON/TRAJ/P1,MUA,DRAG,APR,LPR,WPR,U,WB,DELTA,TI,TETA,IRAM,
*IL,ILO,Y,YO,TOR,X1,Y1,X2,Y2,X3,Y3,WPRB,A,TORR,ITRA,TETA00,XOB,YOB
COMMON/GEOP/ARF,AD,A1,A2,A30,A3,A5,AC,L3,AQAR,ASAR,ILOO,IPR
COMMON/ATRG/GA,GAL,GA2,GA12,GA3,RHMA,TO,PO,UO,MO,GRAY
COMMON/BLR/WA,W,WT,F,RDOT,CSTAR,PT4,TT4
COMMON/RES/CF,THRUST,ISP,SFC
COMMON/CDX/PTIC,MIC,ALFA
COMMON/DRO/TETD,CDN,CFT,COWW,COWF,APR,SPR,SWW,Q,XMO
REAL MO,L04,L3,MUR,ISP,MIC
A1TRA=ITRA
A1TRA=ABS(A1TRA)
IF(A1TRA,UT,L,IGD TO 23
IF(1TRA,CT,0)ITRA=2
IF(1TRA,LT,0)ITRA=-2
Y1=0
Y0=0
Y=0
TETA0=TETA00*PI/180.
TETA=TETA0
CCC
VACUUM TIME OF FLIGHT(TOFV):
TOFV=2.*USIN(TETA)/GRAY
IL=0
CELT=TOFV/50./ILO
IF(1TRA,LT,0)IGD TO 125
WRITE(2,131)
WRITE(3,131)
131 FORMAT(1H1///,40X,'RAMJET TRAJECTORY'///)
WRITE(3,132)
132 FORMAT(1H1,'(OPAG COEF.)'///)
WRITE(2,133)
WRITE(3,133)
133 FORMAT(4X,'LPR',7X,'WPR',7X,'A30',7X,'AQ/AR',5X,'A5/AR',5X,'L3',
*8X,'UO',8X,'U',8X,'WB',8X,'TOFV')
WRITE(2,135)IPR,WPR,A30,AQAR,ASAR,L3,UO,U,WB,TOFV
135 FORMAT(27,10F10.3///)
WRITE(2,137)
137 FORMAT(4X,'TI',8X,'X1',8X,'Y3',8X,'TETA',6X,'MO',4X,'PO',8X,
*8X,'RHMA',6X,'TO',8X,'MUA',7X,'WPR',3X,'DRAG',2X,'THRUST')
WRITE(2,140)
140 FORMAT(4X,'TETD',6X,'CDN',7X,'CDS',7X,'COWW',6X,'COWF',6X,
*4X,'SPR',7X,'SWW',7X,'Q',9X,'XMO')
125 IL=ILO
Y1=0
Y0=0
X2=USIN(TETA)*DELTA
Y2=USIN(TETA)*DELTA
23 CALL ATM
MO=U/SORT(GA*GPAV*R*TO)
AIR DEFENCE CASE:DO NOT LET MO BE TOO SMALL,TO ALLOW MANUVERING
IF(IRAM,GT,1)IGD TO 138
IF(MO,LT,XMO)IGD TO 29
138 CALL DRAG
IF(1LO,GT,1)RETURN
IF YOU WANT DRAG=0 OR THRUST=DRAG CASE,SPECIFY THAT HERE.
CALL DYNA
Y=V/D,304R
TETO=TETA0180./PI
IF(Y3,LT,YO)IL=ILO
IF(1L,LT,ILO)IGD TO 28
IL=0
IF(1TRA,LT,0)IGD TO 127
WRITE(2,134)TI,X3,Y3,TETD,MO,PO,RHMA,TO,MUA,WPR,DRAG,THRUST
139 FORMAT(1H1,'(OPAG COEF.)'///)
WRITE(3,141)TETD,CDN,CFT,COWW,COWF,APR,SPR,SWW,Q,XMO
141 FORMAT(1X,F5.2,5X,8E10.3,2X,F5.2)
127 IF(Y3,LT,YO)IGD TO 29
IL=0
RETURN

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29 IF (TRA.GT.0.001) GO TO 30
   TORR=TI-DELTA
   XCM=X3
   YCM=Y3
   IF (IRAN.NE.1) GO TO 30
   IRAN=2
   GO TO 133
30 IF (TRA.LT.1) GO TO 31
   PRINI=1.5, TETAOD, TORR, XCM, YCM
146 COMMON/111, //, IGA, TETAN, FS, TX, TIME OF BURNING=
   , F0.2, IX, SEC, TX, RANGE OF BURNING=, F10.4, IX, KMS, TX,
   , MEANLEY OF BURNING=, F10.4, IX, KMS)
   STOP
31 PRIN=148, A0AP, A5AP, TORR, XCM, YCM, TI, X3, Y3, TETAOD, TETAOD
148 FORMAT(2X,10F11.3)
   ILNO=70
   RETURN
END

SUBROUTINE ATN
COMMON/TRA/PI, MIA, DRAG, APR, LPR, WPR, U, WB, DELU, DELT, TI, TETA, IRAN,
IL, IL0, Y, YU, CA, XI, Y1, X2, Y2, X3, Y3, WPRB, R, TORR, ITFA, TETAOD, XCM, YCM
COMMON/FCN/ARFF, AG, AI, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17, A18, A19, A20, A21, A22, A23, A24, A25, A26, A27, A28, A29, A30, A31, A32, A33, A34, A35, A36, A37, A38, A39, A40, A41, A42, A43, A44, A45, A46, A47, A48, A49, A50, A51, A52, A53, A54, A55, A56, A57, A58, A59, A60, A61, A62, A63, A64, A65, A66, A67, A68, A69, A70, A71, A72, A73, A74, A75, A76, A77, A78, A79, A80, A81, A82, A83, A84, A85, A86, A87, A88, A89, A90, A91, A92, A93, A94, A95, A96, A97, A98, A99, A100, A101, A102, A103, A104, A105, A106, A107, A108, A109, A110, A111, A112, A113, A114, A115, A116, A117, A118, A119, A120, A121, A122, A123, A124, A125, A126, A127, A128, A129, A130, A131, A132, A133, A134, A135, A136, A137, A138, A139, A140, A141, A142, A143, A144, A145, A146, A147, A148, A149, A150, A151, A152, A153, A154, A155, A156, A157, A158, A159, A160, A161, A162, A163, A164, A165, A166, A167, A168, A169, A170, A171, A172, A173, A174, A175, A176, A177, A178, A179, A180, A181, A182, A183, A184, A185, A186, A187, A188, A189, A190, A191, A192, A193, A194, A195, A196, A197, A198, A199, A200, A201, A202, A203, A204, A205, A206, A207, A208, A209, A210, A211, A212, A213, A214, A215, A216, A217, A218, A219, A220, A221, A222, A223, A224, A225, A226, A227, A228, A229, A230, A231, A232, A233, A234, A235, A236, A237, A238, A239, A240, A241, A242, A243, A244, A245, A246, A247, A248, A249, A250, A251, A252, A253, A254, A255, A256, A257, A258, A259, A260, A261, A262, A263, A264, A265, A266, A267, A268, A269, A270, A271, A272, A273, A274, A275, A276, A277, A278, A279, A280, A281, A282, A283, A284, A285, A286, A287, A288, A289, A290, A291, A292, A293, A294, A295, A296, A297, A298, A299, A300, A301, A302, A303, A304, A305, A306, A307, A308, A309, A310, A311, A312, A313, A314, A315, A316, A317, A318, A319, A320, A321, A322, A323, A324, A325, A326, A327, A328, A329, A330, A331, A332, A333, A334, A335, A336, A337, A338, A339, A340, A341, A342, A343, A344, A345, A346, A347, A348, A349, A350, A351, A352, A353, A354, A355, A356, A357, A358, A359, A360, A361, A362, A363, A364, A365, A366, A367, A368, A369, A370, A371, A372, A373, A374, A375, A376, A377, A378, A379, A380, A381, A382, A383, A384, A385, A386, A387, A388, A389, A390, A391, A392, A393, A394, A395, A396, A397, A398, A399, A400, A401, A402, A403, A404, A405, A406, A407, A408, A409, A410, A411, A412, A413, A414, A415, A416, A417, A418, A419, A420, A421, A422, A423, A424, A425, A426, A427, A428, A429, A430, A431, A432, A433, A434, A435, A436, A437, A438, A439, A440, A441, A442, A443, A444, A445, A446, A447, A448, A449, A450, A451, A452, A453, A454, A455, A456, A457, A458, A459, A460, A461, A462, A463, A464, A465, A466, A467, A468, A469, A470, A471, A472, A473, A474, A475, A476, A477, A478, A479, A480, A481, A482, A483, A484, A485, A486, A487, A488, A489, A490, A491, A492, A493, A494, A495, A496, A497, A498, A499, A500, A501, A502, A503, A504, A505, A506, A507, A508, A509, A510, A511, A512, A513, A514, A515, A516, A517, A518, A519, A520, A521, A522, A523, A524, A525, A526, A527, A528, A529, A530, A531, A532, A533, A534, A535, A536, A537, A538, A539, A540, A541, A542, A543, A544, A545, A546, A547, A548, A549, A550, A551, A552, A553, A554, A555, A556, A557, A558, A559, A560, A561, A562, A563, A564, A565, A566, A567, A568, A569, A570, A571, A572, A573, A574, A575, A576, A577, A578, A579, A580, A581, A582, A583, A584, A585, A586, A587, A588, A589, A590, A591, A592, A593, A594, A595, A596, A597, A598, A599, A600, A601, A602, A603, A604, A605, A606, A607, A608, A609, A610, A611, A612, A613, A614, A615, A616, A617, A618, A619, A620, A621, A622, A623, A624, A625, A626, A627, A628, A629, A630, A631, A632, A633, A634, A635, A636, A637, A638, A639, A640, A641, A642, A643, A644, A645, A646, A647, A648, A649, A650, A651, A652, A653, A654, A655, A656, A657, A658, A659, A660, A661, A662, A663, A664, A665, A666, A667, A668, A669, A670, A671, A672, A673, A674, A675, A676, A677, A678, A679, A680, A681, A682, A683, A684, A685, A686, A687, A688, A689, A690, A691, A692, A693, A694, A695, A696, A697, A698, A699, A700, A701, A702, A703, A704, A705, A706, A707, A708, A709, A710, A711, A712, A713, A714, A715, A716, A717, A718, A719, A720, A721, A722, A723, A724, A725, A726, A727, A728, A729, A730, A731, A732, A733, A734, A735, A736, A737, A738, A739, A740, A741, A742, A743, A744, A745, A746, A747, A748, A749, A750, A751, A752, A753, A754, A755, A756, A757, A758, A759, A760, A761, A762, A763, A764, A765, A7
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45 CALL DRAGWH(XM,GA,BWING,CWING,COWF)
   CALL CALCDILOPR(CFT)
   CALL CALCDICWING,COWF)
   APR=PI*RR**2
   SPR=2*PI*PPR*LPR
   SWH=BRAWINGC*WING
   Q=0.5*RHCA**2
   DRAG=U*(APR+CDB+SPR+CFT+SWH*(COWH+COWF))
   RETURN
50 CALL DRAGPR
   RETURN
END

SUBROUTINE DRAGPP
COMMON/ITER/MUA,DRAG,APR,LPR,WPR,U,WB,DELU,DELT,TI,TETA,IRAN,
+ILO,Y,NO,IAR,X1,Y1,X2,Y2,X3,Y3,APR,A,YOR,I,TET,TETAQ,XCB,YCB
COMMON/GEF/AREF,AO,A1,A2,A30,A3,A5,A6,L3,A0AR,ASAR,IL0Q,IPR
COMMON/ATR/GA,JAL,G2,GA12,GA3,RHMA,TD,PQ,UQ,MO,GRAY
COMMON/BLF/WA,WB,WI,F,ROOT,CSTAR,PTA,TT4
COMMON/PRES/CF,THROST,ISP,SFC
COMMON/CEN/PLIC,MIC,ALC,ALFA
COMMON/CDR/TETP,LCM,CFT,CDBH,COWF,APR,SPR,SWH,Q,XMO
REAL NO,LPR,L3,MUA,ISP,MIC
COWH=C
CDB=C
CDX=(0.083+0.066/MO**2)*(ALFA/13.1)**1.69
CPI=(0.6837-0.3165*MO*0.0525*MO**2)*(2.7/P1)
CALL CALCDILOPR(CFT)
APR=PI*RR**2
SPR=2*PI*PPR*LPR
Q=0.5*RHCA**2
DRAG=C*(APR+(CDB+CDBH)+SPR+CFT)
RETURN
END

SUBROUTINE DRAGTETP,XM,CON)
COMMON/GEF/AREF,AO,A1,A2,A30,A3,A5,A6,L3,A0AR,ASAR,ILOQ,IPR
+IFXW,GF,I,SI,GO TO 13
CEN=(0.6837-0.3165*MO*0.0525*MO**2)*1.21
ATIMO=LT-1.25 PROGRAM COWH, WHICH CALCULATES CON, DOES NOT WORK.
THE APPROXIMATE VALUE HERE FITS AT THE BOUNDARY.
IF LUPPROX. IS EXCEPTED BECAUSE DRAG IS SMALL ANYHOW.
RETURN
13 CALL INTERIA,TETP,XM,CON)
RETURN
END

SUBROUTINE DRAGWH(XM,GA,BWING,CWING,COWF)
PI=4*ATAN(1.)
RAREF=PI*IRO
DATA C/5.,DREF/5.,H/O.09525/,C/O.0635/,T/U.01/
AREF=PI*(DREF*O.0254)**2/4.
BWING=C
CWING=C
ALL LENGTHS IN METERS.
IF(XM-1E-125)GO TO 13
COWH=0.01
THE SUBROUTINE DOES NOT WORK ATIMO=LT-1.25)
THE APPROX. IS EXCEPTED BECAUSE DRAG IS SMALL ANYHOW.
RETURN
13 TH=TW+AOEG
XM1=XM
XM2=XM
CALL PPANT(XM,GA,ANI2)
ANI1=ANIC-TW
ANI2=ANIC+TW
CALL PRES(XM,GA,POPT)
CALL APPRANT(XM1,GA,ANI1)
CALL APPS(XM1,GA,PLPT)
CALL APPRANT(XM2,GA,ANI2)
CALL PRES(XM2,GA,P2PI)

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FILES TRAFFY PORTMAN A NAVAL POSTGRADUATE SCHOOL

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09=0-C/2/(SOR T(XH#02-1))
CWMH=(Z/(GA=XH#02))=((PIRT/PORT-P2PT/PORT)*(T*BP/AREF)
RETURN
END
SUBROUTINE PPRAT(XM1,GA,ANI)
BETA=SOR T(XM1#2-1)
GARAT=SCFT1(GA-1,1/(GA+1))
ANI=ATAN(GARAT*BETA)/GARAT-ATAN(BETA)
RETURN
END
SUBROUTINE APRAT(XM1,GA,ANI)
IF(XM1,LE,1.0)GO TO 558
IF(ANI,LT,0.0)GO TO 559
BETA=SOR T(XM1#2-1)
GARAT=SOR T1(GA-1,1/(GA+1))
10RT=0
F=ATAN(GARAT*BETA)/GARAT-ATAN(BETA)-ANI
FP=1./((1.+GARAT*BETA)#2-1./((1.+BETA#2)
IBETA=IETA+1
IF(1BETA,GT,1.2)GO TO 558
IF(FP,GT,0.0)GO TO 558
BETAN=ABS(BETA)/FP
IF(ABS(BETAN-RETAI),LE,(1.E-03))GO TO 556
BETA=ABS(BETAN)
GO TO 552
556 XM1=SOR T(BETA#2+1.)
RETURN
558 PRINT 56C,1BETA,ANI,F,FP,BETA
560 FORMAT(' ',5DPA FROM 560',13,4(2X,E11.4))
STOP
END
SUBROUTINE PRES(XM1,GA,PIPT)
PIPT=(1.+(GA-1.)/2.*XM1#2)*(-GA/(GA-1.))
RETURN
END
SUBROUTINE CALCPIXL(X)
COMMON/TRAFF1/US,DRAG,RPB,LPR,WPR,U,WS,DELU,DELT,YI,TETA,IRAW,
1 CMMN/GN/GN/REF,AO,A1,A2,A30,A3,A5,A6,L3,AAOR,ASAR,LEOD,IPR
CCMMN/ATR/3A,GAL,GAZ,GAL2,G43,RHGA,TO,PO,UO,MO,GRAV
CCMMN/HIR/WA,BF,NT,ESTAR,PT4,TT4
CCMMN/MES/CF,TW,LCST,ISP,SFC
CCMMN/CN/PTIC,MIC,AIC,ALFA
RZL=NO,IPR,L3,MUR,ISP,MIC
E=EXP(L)
IX=J
EPS=1.E-07
X=2.E-03
REL=PHNDA*WXL/MUA
IF(1F1,LE,2.0)GO TO 4
7 FX=SOR T(1+AL*PI*Q(X*REL))-0.752
FXUOT=1./SOR T(1+AL*Q(X*REL))
XNEW=X-FXUOT
DI=ABS(X-XNEW)
IF(DI,LE,EP)SRETURN
X=XNEW
IX=IX+1
IF(IX,GT,13)GO TO 9
GO TO 7
8 X=1.328/SQR T(REL)
RETURN
9 ILCO=20
PRINT 11,X,DI,F
11 FORMAT(15,2'DO NOT FIND A SOLUTION TO CFT: X=',E10.3,5X,'DI=F',
1 F10.3)
STOP
END

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SUERCUTINE DYNA
COMMON/TRAJ/100,MUA,DRAG,APR,LPR,WPR,UJ,WB,DELU,DELT,TI,TETA,IRAM,
C=110,Y=70,TOR=100,A1=A2,Y2=Y3,Y3=MPA9,TTRA,TET=300,XCS,XCB
COMMON/GEO/ARFF,A0,A1,A2,A3,A4,A5,A6,L3,A0AR,ASAR,TL00,TPR
COMMON/AIR/GA,GAL1,GAL2,GAL3,RMOA,TC,P0,U0,NO,GRAV
COMMON/BLK/WA,WB,WT,F,ROOT,CSTAR,PT4,TT4
COMMON/PRES/CF,THRUST,ISP,SFC
COMMON/CKN/PT1,C,MIC,AIC,ALFA
CEAL MO,PIC,M1,M2,M3,M4,M5,M6
X=1,THRUST=DRAG*G1S1(TETA1)*DEL T**2/WPR*2*X2-X1
Y1=-GRAV*(THRUST=DRAG)*S1(TETA1)/WPR)*DELT**2*2*Y2-Y1
DATA CON NEXT LOOP:
Y1=TL*PFLT
TETA=ATAN1(Y1-Y2)/(X1-X2))
UX=X1-X2/DELT
UY=Y1-Y2/DELT
US=SQRT(UX**2+UY**2)
X1=X2
Y1=Y2
X2=X3
Y2=Y3
RTURN
END

SUERCUTINE DATT
COMMON/GEO/ARFF,A0,A1,A2,A3,A4,A5,A6,L3,A0AR,ASAR,TL00,TPR
C=110,A2=80,A0=5,A3=8
COMMON/AIR/GA,GAL1,GAL2,GAL3,RMOA,TC,P0,U0,NO,GRAV
COMMON/BLK/WA,WB,WT,F,ROOT,CSTAR,PT4,TT4
COMMON/GCF/AR,GF,C1,GF2,GF3,GF4
COMMON/NCI/MO,PT6,PA
COMMON/PRES/CF,THRUST,ISP,SFC
COMMON/CKN/PT1,PS,PS
COMMON/INI/PT0,PT0
COMMON/CKN/PT1,C,MIC,AIC,ALFA
COMMON/THRO/M1,PT1,M2,PT21,MS1,PT51
COMMON/NS/M1,PT12,M2,PT22,MS2
COMMON/DIF/M1,PT2,PT2
COMMON/CKN/M3,M3,PT3,PT3M4,A5
COMMON/TRAJ/100,MUA,DRAG,APR,LPR,WPR,UJ,WB,DELU,DELT,TI,TETA,IRAM,
C=110,Y=70,TOR=100,A1=A2,Y2=Y3,Y3=MPA9,TTRA,TET=300,XCS,XCB
COMMON/DAG/TET,CON,CET,CON,CONF,APR,SPR,SWW,Q,XMO
REAL MO,PIC,M1,M2,M3,M4,M5,M6
REAL L3,A1,ISP,M21,M22,M31,M32,MUA,LPR
GEOMETRIC DATA:
-INCHES OF SQ. INCHES (ORIGINAL)
-KE=5000 P.17 CR CSD P.13
LOSSES
PIDL=M1,L,PID2=SUBSONIC DIF.RECOVERY,
PINNOZZLE LOSSES
100 FOR DETAIL PRINTINGS=0 CLEAN RAM+TRAJ=1 NO PRINT
=2 ALSO PRINT=3 ALSO LOOP ON MACH.=4 TRAJECTORY,
TRAJ,FCR TRAJECTORY & LOOP ON BREAK
**1 ALL OR C1 FOR PRINTS=1 MILL LOOP & PRINT ONLY SUMMARY
1,702 MACH=1 NOZZLE=6 CHOKER=6 HEAT=6 INLET161 MIN.
61 THRUST=63 DIFFUSION=7 CHOKER=6 CORVALLI EXPLAN,82 IAS,GT,151:
=9 RESULT=20 TRAJJZ2 DRAG:
XMO=MIN. MACH MINER ALLOWED.
C=1 MACH=1 PROJECTILE.
ARFF=10-2-3256**2
READ (5,*) AJER,ASAR,ALAO,A2A0,A3AR
READ (5,*) ALFA,TETA0,TETP
READ (5,*) IPR,ITRA,XMO,IRAM
READ (5,*) PID1,PID2,PIN
A0=AOAR=ARFF
A1=AO=ALAO
A2=AO=A2A0
A3=AO=AF=ASAR
A1=AJU
A5=AS1R=AREF

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A6=AREF
RPR=2.5*C.0254
LPR=60.97*0.0254
WPR=104.7*0.4535
PI=3.1415926
LI=23.0*C254
CCC AIR FLOW
CA=1.4
RHOA IN KG/M3, TO IN DEG. KELVIN, PO IN ATM. ARE GIVEN FROM TRAJ
CCC FUEL=HTPB
CCC ETAT=0.0
DATA FOR ROOT=A*WAA3**N, IN/SEC
A=0.06
N=6.0
RHO=20.0351
CCC RHO IN (LB/IN3)=972 KG/M3
RHO=MMHOF*.453597(2.54/100)**3
CCC FLIGHT CONDITIONS:
CCC UC IN FT/SEC; 1FT=.30.48CM
UC=25.0
UC=UC*.3048
GPRV=9.807
CCC GRAY IN M/SEC2 . R=PERFECT GAS CONSTANT(FOR AIR).
R=29.114
RETURN
END

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TRAJ 3690
TRAJ 3700
TRAJ 3710
TRAJ 3720
TRAJ 3730
TRAJ 3740
TRAJ 3750
TRAJ 3760
TRAJ 3770
TRAJ 3780
TRAJ 3790
TRAJ 3800
TRAJ 3810
TRAJ 3820
TRAJ 3830
TRAJ 3840
TRAJ 3850
TRAJ 3860
TRAJ 3870
TRAJ 3880
TRAJ 3890
TRAJ 3900
TRAJ 3910
TRAJ 3920
TRAJ 3930
TRAJ 3940

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APPENDIX E: COMPUTER PROGRAM LIST OF SYMBOLS

<u>PROGRAM</u>	<u>EQUATIONS</u>	<u>UNITS</u>	<u>MEANING</u>
<u>SYMBOL</u>	<u>SYMBOL</u>		
		<u>GEOMETRICAL SYMBOLS</u>	
AREF	A_r	m^2	Reference area
AJ	A_j	m^2	Area at station j
AIC	A_{1c}	m^2	Area behind a conical shock wave
AJ1*	A_{j1}	m^2	Area ahead of a normal shock wave
AJ2*	A_{j2}	m^2	Area behind a normal shock wave
A30	A_{30}	m^2	Initial area at station 3
AIAJ	A_i/A_j	-	Area ratios
L3	L_3	m	Length of combustion chamber
LPR	L_p	m	Length of projectile
RPR	R_p	in	Radius of projectile
ALFA	α	deg.	Inlet cone half angle

*When: J=1,2,5, the shock wave is at station 1 2 real case, respectively.

<u>PROGRAM</u> <u>SYMBOL</u>	<u>EQUATIONS</u> <u>SYMBOL</u>	<u>UNITS</u>	<u>MEANING</u>
<u>ATMOSPHERIC SYMBOLS</u>			
TO	T_0	$^{\circ}\text{K}$	Static temperature at altitude y_3
PO	P_0	kg/m^2	Static pressure at altitude y_3
RHOA	ρ_0	kg/m^3	Air density at altitude y_3
MUA	μ_0	$\text{N}\cdot\text{sec/m}^2$	Air viscosity at altitude y_3
UO	U_0	m/sec	Projectile muzzle velocity
MO	M_0	-	Projectile initial mach number
GRAV	g	m/sec^2	Gravity (9.807)
GA	γ_a	-	Air heat capacities ratio (c_p/c_v)
GA1	-	-	$(\gamma_a+1)/2$
GA2	-	-	$(\gamma_a-1)/2$
GA12	-	-	$(\gamma_a+1)/[2(\gamma_a-1)]$
GA3	-	-	$\gamma_a/(\gamma_a-1)$

<u>PROGRAM</u>	<u>EQUATIONS</u>	<u>UNITS</u>	<u>MEANING</u>
<u>SYMBOL</u>	<u>SYMBOL</u>		
<u>COMBUSTION CHAMBER'S SYMBOLS</u>			
RHOF	ρ_f	kg/m ³	Fuel density
ETAT	η_T	-	Burning efficiency
A,N	A,N	-	Burning rate parameters
WA	$\dot{w}_a$	kg/sec	Air mass flow
WF	$\dot{w}_f$	kg/sec	Fuel mass flow
WT	$\dot{w}_T$	kg/sec	Total mass flow
F	F	-	$\dot{w}_f/\dot{w}_a$
RDOT	$\dot{r}$	m/sec	Burning rate
CSTAR	C*	m/sec	$\sqrt{g \cdot R_f \cdot T_4} / \Gamma$ (when: $\Gamma = \Gamma(\gamma_f)$).
RF	R_f	m ³ /K	Hot gas constant $\left[= \frac{R(\text{J/mole}^\circ\text{K})}{\text{MW}(\text{kg/mole}) \cdot g(\text{m/sec}^2)} \right]$
GF	γ_f	-	Hot gas heat capacities ratio (c_p/c_v)
GF1	-	-	$(\gamma_f + 1)/2$
GF2	-	-	$(\gamma_f - 1)/2$
GF12	-	-	$(\gamma_f + 1)/[2(\gamma_f - 1)]$
GF3	-	-	$\gamma_f/(\gamma_f - 1)$

<u>PROGRAM</u> <u>SYMBOL</u>	<u>EQUATIONS</u> <u>SYMBOL</u>	<u>UNITS</u>	<u>MEANING</u>
<u>THERMODYNAMIC SYMBOLS</u>			
TJ	T_j	$^{\circ}\text{K}$	Static temperature at station j
TTJ	T_{Tj}	$^{\circ}\text{K}$	Total temperature at station j
PJ	P_j	kg/m^2	Static pressure at station j
PTJ	P_{Tj}	kg/m^2	Total pressure at station j
MJ	M_j	-	Mach number at station j
PTJ1, PTJ2	P_{Tj1}, P_{Tj2}	}	As above with AJ1, AJ2
MJ1, MJ2	M_{j1}, M_{j1}		
T3M	T_{3M}	kg/m^2	Maximum T_3 available
M3N, M3I	M_{3N}, M_{3I}	-	M_3 calculated from nozzle and inlet direction, respectively.

<u>PROGRAM</u>	<u>EQUATIONS</u>	<u>UNITS</u>	<u>MEANING</u>
<u>SYMBOL</u>	<u>SYMBOL</u>		
		<u>LOSSES SYMBOLS</u>	
PID1	π_D'	-	Boundary layer losses
PID2	π_D''	-	Subsonic diffuser recovery
PIN	π_n	-	Nozzle losses
-	π_c	-	Conical wave losses
-	π_{NS}	-	Normal shock losses
-	π_e	-	Expansion losses
-	π_h	-	Heat losses

<u>PROGRAM</u> <u>SYMBOL</u>	<u>EQUATIONS</u> <u>SYMBOL</u>	<u>UNITS</u>	<u>MEANING</u>
<u>RAMJET PERFORMANCE SYMBOLS</u>			
CF	C_f	-	Thrust coefficient
Thrust	F	N (or kg)	Thrust
ISP	I_{sp}	N/kg.sec (or sec)	Fuel specific impulse
SFC	SFC	kg/hour/N	Specific fuel consumption

<u>PROGRAM</u> <u>SYMBOL</u>	<u>EQUATIONS</u> <u>SYMBOL</u>	<u>UNITS</u>	<u>MEANING</u>
<u>TRAJECTORY SYMBOLS</u>			
Drag	D	N	Drag
WPR	W_p	kg	Mass of projectile
WB	W_B	kg	Mass of booster
DELU	ΔU	m/sec	Change in initial velocity due to booster
U	U	m/sec	$U_0 + \Delta U$
DELT	ΔT	sec	Change in time
TI	t	sec	Time
TOB	t_{OB}	sec	Time of burning
TETA	e	deg.	Gun elevation angle
TETP	θ_p	deg.	Projectile second cowl angle
<u>DRAG COEFFICIENT</u>			
CDN	C_{DN}	-	Nose drag coefficient
CDWW	C_{DWW}	-	Wing wave drag coefficient
CDWF	C_{DWF}	-	Wing friction drag coefficient
CDS	C_{DS}	-	Skin drag coefficient (laminar/turbulent)
CDB	C_{DB}	-	Base drag coefficient

<u>PROGRAM</u>	<u>EQUATIONS</u>	<u>UNITS</u>	<u>MEANING</u>
<u>SYMBOL</u>	<u>SYMBOL</u>		
		<u>MATHEMATICAL SYMBOLS</u>	
PI	π	-	3.14159
IPR	-	-	Printing parameter: ≥ 0 combustion results together with trajectory (on different files): = 0 working results only; = 1 also reasons for not running = 2 also full reasons for not running = 3 also loop on mach number (CALCM) = -1 trajectory prints only
ITRA	-	-	Loop parameter: = +1 single value for A_0/A_r , A_5/A_r = -1 loop on A_0/A_r , A_5/A_r , and print summary, only.
ILOO	-	-	Check parameter: < 1 regular run ≥ 1 doesn't have a solution
IL, ILO	-	-	Trajectory printing parameter (prints every ILO point).
IRAM	-	-	Ramjet parameter: = 0 ramjet in operation = 1 projectile without propulsion
XMO	X_{MO}	-	Stopping mach number

<u>PROGRAM</u>	<u>EQUATIONS</u>	<u>MEANING</u>
<u>SYMBOL</u>	<u>SYMBOL</u>	
<u>SUBROUTINES</u>		
INIT	-	Computes initial conditions
BURN	-	Computes combustion chamber's performance
TERMO	-	Thermodynamic comand subroutine
INTER	-	Computes, by interpolation, thermodynaic conditions, or cowl drag coefficients.
NOZZ	-	Computes nozzle performance
CALCM	-	Computes mach number indirectly
RESUL	-	Computes ramjet performance
CHOKE	-	Checks if nozzle is choked
INLET	-	Command subroutine for inlet
CONE	-	Computes conical wave loss
THROAT	-	Computes boundary layer loss
NSR	-	Computes normal shock loss
DIFFUS	-	Computes subsonic diffuser performance
MIN	-	Command subroutine to compute situation when normal shock is at point 2
.CORVAL	-	Command subroutine to compute situation when normal shock is at the correct place
EXPAN	-	Computes losses due to expansion into the combustion chamber
HEAT	-	Computes heat losses at combustion chamber
CHECK	-	Check for pressure capability
TRAJ	-	Command subroutine to compute trajectory
ATM	-	Computes atmospheric conditions as a function of altitude (y)

<u>PROGRAM</u>	<u>EQUATIONS</u>	<u>MEANING</u>
<u>SYMBOL</u>	<u>SYMBOL</u>	
BOOS	-	Computes booster performance
DRAGG	-	Computes drag
CALCD	-	Computes skin drag coefficient, indirectly
DRAGH	-	Cowl drag command subroutine
DRAGWW	-	Computes wing/fin wave drag coefficient (command subroutine)
PRANT	-	Computes Prandtl-Meyer angle (ν) from a given mach number
APRANT	-	Computes mach number from a given Prandtl-Meyer angle (ν)
PRES	-	Pressure ratios formula
DRAGPR	-	Computes drag coefficients of a projectile without combustion
DYNA	-	Computes the dynamics of the projectile
DATTA	-	Initial data
PRIL00	-	Prints ramjet performance
PRIN	-	Prints detailed values when does not find solution

APPENDIX F: COMPUTER PROGRAM USERS GUIDE

F1. Input Data

AOAR, A5AR, A1AO, A2AO, A3AR

ALFA, TETA, TETP

IPR, ITRA, XMO, IRAM

PID1, PID2, PIN

Options

ALFA = Inlet cone half angle

TETA = Gun elevation angle

TETP = Second cowl angle

IRP = 0 clean print of RAM + TRAJ

= 1, 2, 3 more details on RAM

= -1 TRAJ only

ITRA = 1 works on one set of data

= -1 loop on AO&A5

IRAM = 0 Ramjet

= 1 Projectile without propulsion

F2. Execution Commands (For use with IBM 370)

F2.1 Opening Commands

LΔXXXXP

Password

GLOBAL TXTLIB FORTMOD2 MOD2EEH

F2.2 Compilation

FORTG1 TRAJET

F2.3 Run on Terminal

FILEDEF 02 DISK TRJ D(RECFM F BLOCK 132 PERM

FILEDEF 03 DISK DRG D(RECFM F BLOCK 132 PERM

FILEDEF 05 DISK INP D

FILEDEF 06 DISK CMB D

EXEC RUN TRAJET

XEDIT CMB D

(or: XEDIT TRJ D)

(or: XEDIT DRG D)

Note: CMB D will contain the combustion process results .

TRJ D will contain the trajectory part.

DRG D will contain drag coefficients.

F2.4 Hard Copy

FILE

PRINT CMB D

PRINT TRJ D

PRINT DRG D

APPENDIX G:

G1. PROGRAM AERO^(*): LISTING

(*) The original program was developed by T. M. Gawain [9]. The modification listed here was prepared for this report to calculate the cowl drag coefficient.

```

SPECIFICATION STATEMENTS
IMPLICIT REAL*4(A-H,O-Z), INTEGER*4(I-N)

DIMENSION K(7021), R(7021), R0(7021), X(7021), RP(7021), GP(7021),
+G(7021), QAO(7021), NA(7021), ONA(7021), ONA(7021), K(18)

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AF0000990
AF0001000

FILE: AERO FORTRAN A NAVAL POSTGRADUATE SCHOOL

```

** EACH OF THE NL UNIFORM INTERVALS, AND AT X=XL, INDEX J=1.// AFR00730
** (2,3) IN(2) DESIGNATES THESE POINTS. AT POINT J THE AXIAL// AFR00740
** COORDINATE, THE PARTIAL COORDINATE AND THE BODY SLOPE ARE// AFR00750
** EXPRESSED AS X(J), R(J) AND RP(J), RESPECTIVELY. THESE// AFR00760
** APPAYS ARE CALCULATED AFTER THE INPUT PARAMETERS HAVE// AFR00770
** BEEN ENTERED.// AFR00780
** THE THERMAL AND AXIAL FORCE COEFFICIENTS ARE OF THE// AFR00790
** FOLLOWING FORM:  $WHERF(S) = C_N \sin A$  AND  $COSINE OF A$ // AFR0800
** THE ANGLE OF ATTACK, THUS  $C_N = C_NA \cos S$  AND  $C_A = C_A0 + C_AZ * S ** 2$ // AFR0810
WRITE(6,2001) AFR0820
2001 FORMAT(' THIS PROGRAM COMPUTES THE NUMERICAL VALUES OF// AFR0830
** COEFFICIENTS  $C_N$ ,  $C_A$  AND  $C_AZ$  AS WELL AS THE COORDINATE  $XAC$ // AFR0840
** OF THE AERODYNAMIC CENTER. PARAMETERS  $C_NA$ ,  $C_A0$  AND  $C_AZ$  ARE// AFR0850
** REQUIRED BY INTERPOLATING CORRESPONDING DISTRIBUTIONS  $C_NA$ ,  $C_A0$ // AFR0860
** AND  $C_AZ$  WITH RESPECT TO X OVER THE LENGTH OF THE BODY.// AFR0870
** THESE DISTRIBUTIONS CAN BE OBTAINED IN TABULAR AND GRAPH// AFR0880
**ICAL FORM. THE PROGRAM CAN BE CONTROLLED BY FOLLOWING THE// AFR0890
** PROMPTING INSTRUCTIONS WHICH APPEAR AT THE TERMINAL. THE// AFR0900
** PROGRAM STEPS ENTER INPUT PARAMETERS, COMPUTE GEOMETRIC// AFR0910
** PARAMETERS, CALCULATE OUTPUT AND PLOT OUTPUT MUST BE REQ// AFR0920
** UERED IN THE ORDER LISTED SINCE EACH STEP GENERATES DATA// AFR0930
** NEEDED FOR THE NEXT STEP.// AFR0940
WRITE(6,2005) AFR0950
2005 FORMAT(' CHANGES: ADDING SECOND CONICAL TAIL.// AFR0960
**  $IN2$ ,  $IN2Z$  ARE INTEGERS, SIMILAR TO THE ABOVE;  $IN2Z$  DEFINES THE// AFR0970
**  $IN2$  AND DECREASE IN RADIUS OVER THE TAIL SECTION IN ORDER.// AFR0980
**  $IN2Z$  RECEIVE INCREASE IN RADIUS,  $IN2Z$  SHOULD BE NEGATIVE.// AFR0990
**  $IN2$  AND TAIL VES NOT ARRANGED FOR TAIL PROFILE.// AFR1000
** THE  $IN2$  PART  $IN2$  CAN BE INCLUDED IN  $C_AZ$  CALCULATION.// AFR1010
**  $IN2Z=1$  IS IT CAN BE USED ONLY TO ARRANGE THE FLOW.// AFR1020
**  $IN2Z=0$  IS IT CAN BE USED ONLY TO ARRANGE THE FLOW.// AFR1030
GO TO 1001 AFR1040
C
ENTER INPUT PARAMETERS
2001 WRITE(6,2101)  $XN$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR1050
2101 FORMAT(' PRESENT INPUT PARAMETERS ARE:// AFR1060
** ITEM 1  $XP=1$ // AFR1070
** ITEM 2  $XL=1$ // AFR1080
** ITEM 3  $OL=1$ // AFR1090
** ITEM 4  $NL=1$ // AFR1100
** ITEM 5  $NA=1$ // AFR1110
** ITEM 6  $NB=1$ // AFR1120
** ITEM 7  $NTAB=1$ // AFR1130
** ITEM 8  $IN2=0$ // AFR1140
** ITEM 9  $IN2Z=0$ // AFR1150
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR1160
** ITEM 11  $IN2=1$ // AFR1170
** ITEM 12  $IN2Z=1$ // AFR1180
** ITEM 13  $IN2=1$ // AFR1190
** ITEM 14  $IN2Z=1$ // AFR1200
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR1210
** TO EXIT ENTER -01// AFR1220
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR1230
2101 FORMAT('// AFR1240
** ITEM 1  $XP=1$ // AFR1250
** ITEM 2  $XL=1$ // AFR1260
** ITEM 3  $OL=1$ // AFR1270
** ITEM 4  $NL=1$ // AFR1280
** ITEM 5  $NA=1$ // AFR1290
** ITEM 6  $NB=1$ // AFR1300
** ITEM 7  $NTAB=1$ // AFR1310
** ITEM 8  $IN2=0$ // AFR1320
** ITEM 9  $IN2Z=0$ // AFR1330
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR1340
** ITEM 11  $IN2=1$ // AFR1350
** ITEM 12  $IN2Z=1$ // AFR1360
** ITEM 13  $IN2=1$ // AFR1370
** ITEM 14  $IN2Z=1$ // AFR1380
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR1390
** TO EXIT ENTER -01// AFR1400
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR1410
2101 FORMAT('// AFR1420
** ITEM 1  $XP=1$ // AFR1430
** ITEM 2  $XL=1$ // AFR1440
** ITEM 3  $OL=1$ // AFR1450
** ITEM 4  $NL=1$ // AFR1460
** ITEM 5  $NA=1$ // AFR1470
** ITEM 6  $NB=1$ // AFR1480
** ITEM 7  $NTAB=1$ // AFR1490
** ITEM 8  $IN2=0$ // AFR1500
** ITEM 9  $IN2Z=0$ // AFR1510
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR1520
** ITEM 11  $IN2=1$ // AFR1530
** ITEM 12  $IN2Z=1$ // AFR1540
** ITEM 13  $IN2=1$ // AFR1550
** ITEM 14  $IN2Z=1$ // AFR1560
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR1570
** TO EXIT ENTER -01// AFR1580
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR1590
2101 FORMAT('// AFR1600
** ITEM 1  $XP=1$ // AFR1610
** ITEM 2  $XL=1$ // AFR1620
** ITEM 3  $OL=1$ // AFR1630
** ITEM 4  $NL=1$ // AFR1640
** ITEM 5  $NA=1$ // AFR1650
** ITEM 6  $NB=1$ // AFR1660
** ITEM 7  $NTAB=1$ // AFR1670
** ITEM 8  $IN2=0$ // AFR1680
** ITEM 9  $IN2Z=0$ // AFR1690
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR1700
** ITEM 11  $IN2=1$ // AFR1710
** ITEM 12  $IN2Z=1$ // AFR1720
** ITEM 13  $IN2=1$ // AFR1730
** ITEM 14  $IN2Z=1$ // AFR1740
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR1750
** TO EXIT ENTER -01// AFR1760
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR1770
2101 FORMAT('// AFR1780
** ITEM 1  $XP=1$ // AFR1790
** ITEM 2  $XL=1$ // AFR1800
** ITEM 3  $OL=1$ // AFR1810
** ITEM 4  $NL=1$ // AFR1820
** ITEM 5  $NA=1$ // AFR1830
** ITEM 6  $NB=1$ // AFR1840
** ITEM 7  $NTAB=1$ // AFR1850
** ITEM 8  $IN2=0$ // AFR1860
** ITEM 9  $IN2Z=0$ // AFR1870
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR1880
** ITEM 11  $IN2=1$ // AFR1890
** ITEM 12  $IN2Z=1$ // AFR1900
** ITEM 13  $IN2=1$ // AFR1910
** ITEM 14  $IN2Z=1$ // AFR1920
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR1930
** TO EXIT ENTER -01// AFR1940
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR1950
2101 FORMAT('// AFR1960
** ITEM 1  $XP=1$ // AFR1970
** ITEM 2  $XL=1$ // AFR1980
** ITEM 3  $OL=1$ // AFR1990
** ITEM 4  $NL=1$ // AFR2000
** ITEM 5  $NA=1$ // AFR2010
** ITEM 6  $NB=1$ // AFR2020
** ITEM 7  $NTAB=1$ // AFR2030
** ITEM 8  $IN2=0$ // AFR2040
** ITEM 9  $IN2Z=0$ // AFR2050
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR2060
** ITEM 11  $IN2=1$ // AFR2070
** ITEM 12  $IN2Z=1$ // AFR2080
** ITEM 13  $IN2=1$ // AFR2090
** ITEM 14  $IN2Z=1$ // AFR2100
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR2110
** TO EXIT ENTER -01// AFR2120
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR2130
2101 FORMAT('// AFR2140
** ITEM 1  $XP=1$ // AFR2150
** ITEM 2  $XL=1$ // AFR2160
** ITEM 3  $OL=1$ // AFR2170
** ITEM 4  $NL=1$ // AFR2180
** ITEM 5  $NA=1$ // AFR2190
** ITEM 6  $NB=1$ // AFR2200
** ITEM 7  $NTAB=1$ // AFR2210
** ITEM 8  $IN2=0$ // AFR2220
** ITEM 9  $IN2Z=0$ // AFR2230
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR2240
** ITEM 11  $IN2=1$ // AFR2250
** ITEM 12  $IN2Z=1$ // AFR2260
** ITEM 13  $IN2=1$ // AFR2270
** ITEM 14  $IN2Z=1$ // AFR2280
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR2290
** TO EXIT ENTER -01// AFR2300
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR2310
2101 FORMAT('// AFR2320
** ITEM 1  $XP=1$ // AFR2330
** ITEM 2  $XL=1$ // AFR2340
** ITEM 3  $OL=1$ // AFR2350
** ITEM 4  $NL=1$ // AFR2360
** ITEM 5  $NA=1$ // AFR2370
** ITEM 6  $NB=1$ // AFR2380
** ITEM 7  $NTAB=1$ // AFR2390
** ITEM 8  $IN2=0$ // AFR2400
** ITEM 9  $IN2Z=0$ // AFR2410
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR2420
** ITEM 11  $IN2=1$ // AFR2430
** ITEM 12  $IN2Z=1$ // AFR2440
** ITEM 13  $IN2=1$ // AFR2450
** ITEM 14  $IN2Z=1$ // AFR2460
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR2470
** TO EXIT ENTER -01// AFR2480
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR2490
2101 FORMAT('// AFR2500
** ITEM 1  $XP=1$ // AFR2510
** ITEM 2  $XL=1$ // AFR2520
** ITEM 3  $OL=1$ // AFR2530
** ITEM 4  $NL=1$ // AFR2540
** ITEM 5  $NA=1$ // AFR2550
** ITEM 6  $NB=1$ // AFR2560
** ITEM 7  $NTAB=1$ // AFR2570
** ITEM 8  $IN2=0$ // AFR2580
** ITEM 9  $IN2Z=0$ // AFR2590
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR2600
** ITEM 11  $IN2=1$ // AFR2610
** ITEM 12  $IN2Z=1$ // AFR2620
** ITEM 13  $IN2=1$ // AFR2630
** ITEM 14  $IN2Z=1$ // AFR2640
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR2650
** TO EXIT ENTER -01// AFR2660
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR2670
2101 FORMAT('// AFR2680
** ITEM 1  $XP=1$ // AFR2690
** ITEM 2  $XL=1$ // AFR2700
** ITEM 3  $OL=1$ // AFR2710
** ITEM 4  $NL=1$ // AFR2720
** ITEM 5  $NA=1$ // AFR2730
** ITEM 6  $NB=1$ // AFR2740
** ITEM 7  $NTAB=1$ // AFR2750
** ITEM 8  $IN2=0$ // AFR2760
** ITEM 9  $IN2Z=0$ // AFR2770
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR2780
** ITEM 11  $IN2=1$ // AFR2790
** ITEM 12  $IN2Z=1$ // AFR2800
** ITEM 13  $IN2=1$ // AFR2810
** ITEM 14  $IN2Z=1$ // AFR2820
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR2830
** TO EXIT ENTER -01// AFR2840
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR2850
2101 FORMAT('// AFR2860
** ITEM 1  $XP=1$ // AFR2870
** ITEM 2  $XL=1$ // AFR2880
** ITEM 3  $OL=1$ // AFR2890
** ITEM 4  $NL=1$ // AFR2900
** ITEM 5  $NA=1$ // AFR2910
** ITEM 6  $NB=1$ // AFR2920
** ITEM 7  $NTAB=1$ // AFR2930
** ITEM 8  $IN2=0$ // AFR2940
** ITEM 9  $IN2Z=0$ // AFR2950
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR2960
** ITEM 11  $IN2=1$ // AFR2970
** ITEM 12  $IN2Z=1$ // AFR2980
** ITEM 13  $IN2=1$ // AFR2990
** ITEM 14  $IN2Z=1$ // AFR3000
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR3010
** TO EXIT ENTER -01// AFR3020
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR3030
2101 FORMAT('// AFR3040
** ITEM 1  $XP=1$ // AFR3050
** ITEM 2  $XL=1$ // AFR3060
** ITEM 3  $OL=1$ // AFR3070
** ITEM 4  $NL=1$ // AFR3080
** ITEM 5  $NA=1$ // AFR3090
** ITEM 6  $NB=1$ // AFR3100
** ITEM 7  $NTAB=1$ // AFR3110
** ITEM 8  $IN2=0$ // AFR3120
** ITEM 9  $IN2Z=0$ // AFR3130
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR3140
** ITEM 11  $IN2=1$ // AFR3150
** ITEM 12  $IN2Z=1$ // AFR3160
** ITEM 13  $IN2=1$ // AFR3170
** ITEM 14  $IN2Z=1$ // AFR3180
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR3190
** TO EXIT ENTER -01// AFR3200
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR3210
2101 FORMAT('// AFR3220
** ITEM 1  $XP=1$ // AFR3230
** ITEM 2  $XL=1$ // AFR3240
** ITEM 3  $OL=1$ // AFR3250
** ITEM 4  $NL=1$ // AFR3260
** ITEM 5  $NA=1$ // AFR3270
** ITEM 6  $NB=1$ // AFR3280
** ITEM 7  $NTAB=1$ // AFR3290
** ITEM 8  $IN2=0$ // AFR3300
** ITEM 9  $IN2Z=0$ // AFR3310
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR3320
** ITEM 11  $IN2=1$ // AFR3330
** ITEM 12  $IN2Z=1$ // AFR3340
** ITEM 13  $IN2=1$ // AFR3350
** ITEM 14  $IN2Z=1$ // AFR3360
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR3370
** TO EXIT ENTER -01// AFR3380
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR3390
2101 FORMAT('// AFR3400
** ITEM 1  $XP=1$ // AFR3410
** ITEM 2  $XL=1$ // AFR3420
** ITEM 3  $OL=1$ // AFR3430
** ITEM 4  $NL=1$ // AFR3440
** ITEM 5  $NA=1$ // AFR3450
** ITEM 6  $NB=1$ // AFR3460
** ITEM 7  $NTAB=1$ // AFR3470
** ITEM 8  $IN2=0$ // AFR3480
** ITEM 9  $IN2Z=0$ // AFR3490
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR3500
** ITEM 11  $IN2=1$ // AFR3510
** ITEM 12  $IN2Z=1$ // AFR3520
** ITEM 13  $IN2=1$ // AFR3530
** ITEM 14  $IN2Z=1$ // AFR3540
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR3550
** TO EXIT ENTER -01// AFR3560
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR3570
2101 FORMAT('// AFR3580
** ITEM 1  $XP=1$ // AFR3590
** ITEM 2  $XL=1$ // AFR3600
** ITEM 3  $OL=1$ // AFR3610
** ITEM 4  $NL=1$ // AFR3620
** ITEM 5  $NA=1$ // AFR3630
** ITEM 6  $NB=1$ // AFR3640
** ITEM 7  $NTAB=1$ // AFR3650
** ITEM 8  $IN2=0$ // AFR3660
** ITEM 9  $IN2Z=0$ // AFR3670
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR3680
** ITEM 11  $IN2=1$ // AFR3690
** ITEM 12  $IN2Z=1$ // AFR3700
** ITEM 13  $IN2=1$ // AFR3710
** ITEM 14  $IN2Z=1$ // AFR3720
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR3730
** TO EXIT ENTER -01// AFR3740
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR3750
2101 FORMAT('// AFR3760
** ITEM 1  $XP=1$ // AFR3770
** ITEM 2  $XL=1$ // AFR3780
** ITEM 3  $OL=1$ // AFR3790
** ITEM 4  $NL=1$ // AFR3800
** ITEM 5  $NA=1$ // AFR3810
** ITEM 6  $NB=1$ // AFR3820
** ITEM 7  $NTAB=1$ // AFR3830
** ITEM 8  $IN2=0$ // AFR3840
** ITEM 9  $IN2Z=0$ // AFR3850
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR3860
** ITEM 11  $IN2=1$ // AFR3870
** ITEM 12  $IN2Z=1$ // AFR3880
** ITEM 13  $IN2=1$ // AFR3890
** ITEM 14  $IN2Z=1$ // AFR3900
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR3910
** TO EXIT ENTER -01// AFR3920
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR3930
2101 FORMAT('// AFR3940
** ITEM 1  $XP=1$ // AFR3950
** ITEM 2  $XL=1$ // AFR3960
** ITEM 3  $OL=1$ // AFR3970
** ITEM 4  $NL=1$ // AFR3980
** ITEM 5  $NA=1$ // AFR3990
** ITEM 6  $NB=1$ // AFR4000
** ITEM 7  $NTAB=1$ // AFR4010
** ITEM 8  $IN2=0$ // AFR4020
** ITEM 9  $IN2Z=0$ // AFR4030
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR4040
** ITEM 11  $IN2=1$ // AFR4050
** ITEM 12  $IN2Z=1$ // AFR4060
** ITEM 13  $IN2=1$ // AFR4070
** ITEM 14  $IN2Z=1$ // AFR4080
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR4090
** TO EXIT ENTER -01// AFR4100
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR4110
2101 FORMAT('// AFR4120
** ITEM 1  $XP=1$ // AFR4130
** ITEM 2  $XL=1$ // AFR4140
** ITEM 3  $OL=1$ // AFR4150
** ITEM 4  $NL=1$ // AFR4160
** ITEM 5  $NA=1$ // AFR4170
** ITEM 6  $NB=1$ // AFR4180
** ITEM 7  $NTAB=1$ // AFR4190
** ITEM 8  $IN2=0$ // AFR4200
** ITEM 9  $IN2Z=0$ // AFR4210
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR4220
** ITEM 11  $IN2=1$ // AFR4230
** ITEM 12  $IN2Z=1$ // AFR4240
** ITEM 13  $IN2=1$ // AFR4250
** ITEM 14  $IN2Z=1$ // AFR4260
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR4270
** TO EXIT ENTER -01// AFR4280
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR4290
2101 FORMAT('// AFR4300
** ITEM 1  $XP=1$ // AFR4310
** ITEM 2  $XL=1$ // AFR4320
** ITEM 3  $OL=1$ // AFR4330
** ITEM 4  $NL=1$ // AFR4340
** ITEM 5  $NA=1$ // AFR4350
** ITEM 6  $NB=1$ // AFR4360
** ITEM 7  $NTAB=1$ // AFR4370
** ITEM 8  $IN2=0$ // AFR4380
** ITEM 9  $IN2Z=0$ // AFR4390
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR4400
** ITEM 11  $IN2=1$ // AFR4410
** ITEM 12  $IN2Z=1$ // AFR4420
** ITEM 13  $IN2=1$ // AFR4430
** ITEM 14  $IN2Z=1$ // AFR4440
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR4450
** TO EXIT ENTER -01// AFR4460
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR4470
2101 FORMAT('// AFR4480
** ITEM 1  $XP=1$ // AFR4490
** ITEM 2  $XL=1$ // AFR4500
** ITEM 3  $OL=1$ // AFR4510
** ITEM 4  $NL=1$ // AFR4520
** ITEM 5  $NA=1$ // AFR4530
** ITEM 6  $NB=1$ // AFR4540
** ITEM 7  $NTAB=1$ // AFR4550
** ITEM 8  $IN2=0$ // AFR4560
** ITEM 9  $IN2Z=0$ // AFR4570
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR4580
** ITEM 11  $IN2=1$ // AFR4590
** ITEM 12  $IN2Z=1$ // AFR4600
** ITEM 13  $IN2=1$ // AFR4610
** ITEM 14  $IN2Z=1$ // AFR4620
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR4630
** TO EXIT ENTER -01// AFR4640
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR4650
2101 FORMAT('// AFR4660
** ITEM 1  $XP=1$ // AFR4670
** ITEM 2  $XL=1$ // AFR4680
** ITEM 3  $OL=1$ // AFR4690
** ITEM 4  $NL=1$ // AFR4700
** ITEM 5  $NA=1$ // AFR4710
** ITEM 6  $NB=1$ // AFR4720
** ITEM 7  $NTAB=1$ // AFR4730
** ITEM 8  $IN2=0$ // AFR4740
** ITEM 9  $IN2Z=0$ // AFR4750
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR4760
** ITEM 11  $IN2=1$ // AFR4770
** ITEM 12  $IN2Z=1$ // AFR4780
** ITEM 13  $IN2=1$ // AFR4790
** ITEM 14  $IN2Z=1$ // AFR4800
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR4810
** TO EXIT ENTER -01// AFR4820
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR4830
2101 FORMAT('// AFR4840
** ITEM 1  $XP=1$ // AFR4850
** ITEM 2  $XL=1$ // AFR4860
** ITEM 3  $OL=1$ // AFR4870
** ITEM 4  $NL=1$ // AFR4880
** ITEM 5  $NA=1$ // AFR4890
** ITEM 6  $NB=1$ // AFR4900
** ITEM 7  $NTAB=1$ // AFR4910
** ITEM 8  $IN2=0$ // AFR4920
** ITEM 9  $IN2Z=0$ // AFR4930
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR4940
** ITEM 11  $IN2=1$ // AFR4950
** ITEM 12  $IN2Z=1$ // AFR4960
** ITEM 13  $IN2=1$ // AFR4970
** ITEM 14  $IN2Z=1$ // AFR4980
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR4990
** TO EXIT ENTER -01// AFR5000
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR5010
2101 FORMAT('// AFR5020
** ITEM 1  $XP=1$ // AFR5030
** ITEM 2  $XL=1$ // AFR5040
** ITEM 3  $OL=1$ // AFR5050
** ITEM 4  $NL=1$ // AFR5060
** ITEM 5  $NA=1$ // AFR5070
** ITEM 6  $NB=1$ // AFR5080
** ITEM 7  $NTAB=1$ // AFR5090
** ITEM 8  $IN2=0$ // AFR5100
** ITEM 9  $IN2Z=0$ // AFR5110
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR5120
** ITEM 11  $IN2=1$ // AFR5130
** ITEM 12  $IN2Z=1$ // AFR5140
** ITEM 13  $IN2=1$ // AFR5150
** ITEM 14  $IN2Z=1$ // AFR5160
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR5170
** TO EXIT ENTER -01// AFR5180
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR5190
2101 FORMAT('// AFR5200
** ITEM 1  $XP=1$ // AFR5210
** ITEM 2  $XL=1$ // AFR5220
** ITEM 3  $OL=1$ // AFR5230
** ITEM 4  $NL=1$ // AFR5240
** ITEM 5  $NA=1$ // AFR5250
** ITEM 6  $NB=1$ // AFR5260
** ITEM 7  $NTAB=1$ // AFR5270
** ITEM 8  $IN2=0$ // AFR5280
** ITEM 9  $IN2Z=0$ // AFR5290
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR5300
** ITEM 11  $IN2=1$ // AFR5310
** ITEM 12  $IN2Z=1$ // AFR5320
** ITEM 13  $IN2=1$ // AFR5330
** ITEM 14  $IN2Z=1$ // AFR5340
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR5350
** TO EXIT ENTER -01// AFR5360
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NTAB$ ,  $IN2$ ,  $IN2Z$ ,  $KAP(6)$ ,  $KAP(7)$  AFR5370
2101 FORMAT('// AFR5380
** ITEM 1  $XP=1$ // AFR5390
** ITEM 2  $XL=1$ // AFR5400
** ITEM 3  $OL=1$ // AFR5410
** ITEM 4  $NL=1$ // AFR5420
** ITEM 5  $NA=1$ // AFR5430
** ITEM 6  $NB=1$ // AFR5440
** ITEM 7  $NTAB=1$ // AFR5450
** ITEM 8  $IN2=0$ // AFR5460
** ITEM 9  $IN2Z=0$ // AFR5470
** ITEM 10 IDENTIFICATION NUMBER=1, 2A4// AFR5480
** ITEM 11  $IN2=1$ // AFR5490
** ITEM 12  $IN2Z=1$ // AFR5500
** ITEM 13  $IN2=1$ // AFR5510
** ITEM 14  $IN2Z=1$ // AFR5520
** TO CHANGE ANY ITEM ENTER ITEM NUMBER IN I3 FORMAT.// AFR5530
** TO EXIT ENTER -01// AFR5540
2101 READ(5,2101)  $XP$ ,  $XL$ ,  $OL$ ,  $NL$ ,  $NA$ ,  $NB$ ,  $NT$ 
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FILE: AERO FORTRAN A NAVAL POSTGRADUATE SCHOOL

```

C INPUT ERROR MESSAGE
2161 WRITE(6,2161)
2161 FORMAT(1,' INPUT ERROR, REENTER ITEM NUMBER.')
GO TO 2121

C ENTER MACH NUMBER XM
2201 WRITE(6,2221)
2221 FORMAT(1,' ENTER XM IN DECIMAL FORMAT.')
READ(5,2241,FPR=2161) XM
2241 FORMAT(F7.4)
GO TO 2081

C ENTER LENGTH XL
2261 WRITE(6,2281)
2281 FORMAT(1,' ENTER XL IN DECIMAL FORMAT.')
READ(5,2301,FPR=2161) XL
2301 FORMAT(F6.3)
GO TO 2081

C ENTER TAIL TAPER DL
2321 WRITE(6,2341)
2341 FORMAT(1,' ENTER DL IF APPLICABLE, IN DECIMAL FORMAT.')
READ(5,2361,FPR=2161) DL
2361 FORMAT(F6.4)
GO TO 2081

C ENTER ROCV LENGTH INTEGER NL
2401 WRITE(6,2401)
2401 FORMAT(1,' ENTER NL IN I3 FORMAT.')
READ(5,2421,FPR=2161) NL
2421 FORMAT(I3)
GO TO 2081

C ENTER NOSE LENGTH INTEGER NA
2441 WRITE(6,2441)
2441 FORMAT(1,' ENTER NA IN I3 FORMAT.')
READ(5,2421,FPR=2161) NA
GO TO 2081

C ENTER MIDSECTION LENGTH INTEGER NB
2481 WRITE(6,2501)
2501 FORMAT(1,' ENTER NB IN I3 FORMAT.')
READ(5,2421,FPR=2161) NB
GO TO 2081

C ENTER TABULAR INTERVAL NTAB
2521 WRITE(6,2541)
2541 FORMAT(1,' ENTER NTAB IN I3 FORMAT.')
READ(5,2421,FPR=2161) NTAB
GO TO 2081

C ENTER CODE FOR CONICAL OR OGIVAL NOSE
2561 WRITE(6,2561)
2561 FORMAT(1,' ENTER NOSE CODE "CN" OR "ON".')
READ(5,2601,FPR=2161) KNOSE
2601 FORMAT(A2)
GO TO 2081

C ENTER CODE FOR CONICAL OR OGIVAL TAIL
2621 WRITE(6,2641)
2641 FORMAT(1,' ENTER TAIL CODE "CT" OR "OT" IF APPLICABLE.')
READ(5,2601,FPR=2161) KTAIL

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AERO1450
AERO1460
AERO1470
AERO1480
AERO1490
AERO1500
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AERO1600
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AERO2080
AERO2090
AERO2100
AERO2110
AERO2120
AERO2130
AERO2140
AERO2150
AERO2160

FILE: AERO FORTRAN A NAVAL POSTGRADUATE SCHOOL

```

2661 FORMAT(A2)
GO TO 2081
C
ENTER IDENTIFICATION NUMBER
2681 WRITE(6,2701)
2701 FORMAT(' ',ENTER OPTIONAL ID NUMBER IN A8 FORMAT. ')
READ(5,2721,ERR=2161) KAP(6),KAP(7)
2721 READ(5,2721,ERR=2161) KAP(6),KAP(7)
GO TO 2081
C
ENTER FIRST TAIL LENGTH INTEGER NC
2683 WRITE(6,2703)
2703 FORMAT(' ',ENTER NC IN I3 FORMAT. ')
READ(5,2741,ERR=2161) NC
GO TO 2081
C
ENTER SECOND MIDSECTION LENGTH INTEGER NB2
2685 WRITE(6,2705)
2705 FORMAT(' ',ENTER NB2 IN I3 FORMAT. ')
READ(5,2741,ERR=2161) NB2
GO TO 2081
C
ENTER TAIL SECOND TAPER DL2
2687 WRITE(6,2707)
2707 FORMAT(' ',ENTER DL2, IF APPLICABLE, IN DECIMAL FORMAT. ')
READ(5,2741,ERR=2161) DL2
GO TO 2081
C
ENTER INCSE OPTION
2689 WRITE(6,2709)
2709 FORMAT(' ',ENTER INCSE IN I3 FORMAT. ')
READ(5,2741,ERR=2161) INCSE
GO TO 2081
C
CALCULATE GEOMETRICAL ARRAYS
SET UP INPUT AND CALCULATE A(I)
2741 IF(NB2.EC.O) INC=NL-NA-NB
NC2=NL-NA-NB-NC-NB2
DELX=XI/FLCAT(NL)
AL=DELX*FLCAT(NA)
BL=DELX*FLCAT(NB)
CL=DELX*FLCAT(NC)
CL2=DELX*FLCAT(NC2)
JAL=NA+1
JAR=JAL+1
JBL=NB+AR+1
JEP=JAR+1
JCL=NA+NB+NC+1
JCE=JCL+1
JF2L=NA+AR+NC+NB2+1
JF2P=JF2L+1
X(1)=0.
R(1)=0.
NL2=NL+1
NL3=NL+2
X(NL2)=XL
DO 2761 J=2,NL2
  UCLJ=FLCAT(J)-1.5
  UELJ=DELX*DELJ
2761 CONTINUE
2781 IF(INCSE.EC.KOM) GO TO 3001
C
CALCULATE RIJ) AND RPIJ) FOR CONICAL NOSE

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AERO2170
AERO2180
AERO2190
AERO2200
AERO2210
AERO2220
AERO2230
AERO2240
AERO2250
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AERO2800
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AERO2830
AERO2840
AERO2850
AERO2860
AERO2870
AERO2880

FILE: AERO FORTRAN: A NAVAL POSTGRADUATE SCHOOL

```

C
2801 RPA=L/AL
    RPI=L/PA
    DO 2821 J=2,JAL
        R(J)=X(J)/AL
        RPI(J)=RPA
    2821 CONTINUE
2841 IF(NA.LT.NLI) GO TO 3081
2861 R(MLP2)=L
    RPI(MLP2)=RPA
    GO TO 3241

C
    CALCULATE R(J) AND RPI(J) FOR OGIVAL NOSE
C
3001 RA=(L+AL**2)/2.
    DO 3021 J=1,JAL
        R(J)=RA-(AL-X(J))**2).GE.0.01GO TO 3026
        WR1/R(2.3024)J,RA,AL,X(J),R(J),RPI(J)
    3024 FCFMAT(1,1,3024,2X,13,2X,5(F10.3,2X,1)
        GO TO 3777
    3026 R(J)=SQRT(RA*RA-(AL-X(J))**2)-RA+1.
        RPI(J)=(AL-X(J))/(RA-L+R(J))
    3021 CONTINUE
2841 IF(NA.LT.NLI) GO TO 3081
3061 R(MLP2)=L
    RPI(MLP2)=RPA
    GO TO 3241

C
    CALCULATE R(J) AND RPI(J) FOR CYLINDRICAL MIDSECTION
C
3081 IF(NB2.EQ.0) GO TO 3121
    DO 3101 J=JBR,JCL
        R(J)=L
        RPI(J)=RPA
    3101 CONTINUE
    IF((NA+NP)-LT.NL)GO TO 3121
    R(MLP2)=L
    RPI(MLP2)=RPA
    GO TO 3241
3121 IF(KTAIL.EQ.KOT) GO TO 3161

C
    CALCULATE R(J) AND RPI(J) FOR CONICAL TAIL
C
    RPT=L/CL
    RPL=L/CL
    DO 3141 J=JBR,JCL
        R(J)=L+RPT*(X(J)-RXL+CL)
        RPI(J)=RPT
    3141 CONTINUE
    IF((NA+NP+NC)-LT.NL)GO TO 3123
    R(MLP2)=L+RPL
    RPI(MLP2)=RPT
    GO TO 3241

C
    CALCULATE R(J) AND RPI(J) FOR SECOND MIDSECTION
C
3123 IF(NB2.EQ.0) GO TO 3241
    DO 3125 J=JCF,JCL
        R(J)=L
        RPI(J)=RPA
    3125 CONTINUE
    IF((NA+NP+NC+NB2)-LT.NL)GO TO 3127
    R(MLP2)=L+RPL
    RPI(MLP2)=RPA
    GO TO 3241

C
    CALCULATE R(J) AND RPI(J) FOR SECOND CONICAL TAIL
C
3127 RPT2=L/CL2
    DO 3129 J=JBR2,NLP2
        R(J)=L+RPT2*(X(J)-RXL+CL2)
        RPI(J)=RPT2

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AERO2800
AERO2800
AERO2810
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AERO2990
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AERO3600

```

3129 CONTINUE
GO TO 3241

C
CALCULATE R(J) AND R0(J) FOR OGIVAL TAIL
3131 IF (DL.GT.0..AND.DL.LE.1.) GO TO 3201
WRITE(6,3101)
3131 FORMAT(1,' REVERSE INPUT. DL.GT.0..AND.DL.LE.1..')
GO TO 1001
3201 RC=CL(J)+DL*DL)/(2.*DL)
DO 3221 J=JBP,NLD2
R(J)=1.-RC*SQRT(RC*RC-(X(J)-XL+CL)**2)
R0(J)=(X(J)-XL+CL)/(RC-1.-R(J))
3221 CONTINUE

C
COMPLETION MESSAGE
3241 WRITE(6,3201)
3201 FORMAT(1,' GEOMETRICAL ARRAYS COMPLETED. ')
GO TO 1001

C
CALCULATE OUTPUT
3281 BETA=SQRT(XM*XM-1.)
X(1)=0.
T=X(2)**2-(BETA**2)**2
IF (T.EQ.0.01) GO TO 3286
WRITE(2,3204) X(2),R(2),BETA,T
3284 FORMAT(1,' 3284',4E10.3,2X1)
GO TO 3177
3286 T=SQRT(T)
G(1)=0.
CA0(1)=0.
CAZ(1)=0.
CXA(1)=0.
CXA0(1)=0.
CXA2=0.
CXA0=0.
CXA=0.
CA01=C.
CA03=C.

C
DO 3341 J=2,NLP2
SUMC=C.
SUMR=C.
SUMA=C.
S1=0.
T2=0.
T3=0.
IF (S1.NE.0.01) GO TO 3345
WRITE(2,3343) X(J),R(J),R0(J)
3343 FORMAT(1,' 3343',2X,13,3E10.31)
GO TO 3177
3345 X(1)=X(J)-BETA*R(J)
M=X(1)-X(J)-1
M=X(1)-X(J)-1
T=X(1)**2-(BETA*R(J))**2
IF (T.EQ.0.) GO TO 3348
WRITE(2,3346) X(J),R(J),R0(J),BETA,T,J
3346 FORMAT(1,' 3346',5E10.3,2X,13)
GO TO 3177
3348 T=SQRT(T)
C
IF (J.EQ.1) GO TO 3321
C
J1=J-1
DO 3351 I=2,J1
T=X(J1)-X(I)**2-(BETA*R(J1))**2
IF (T.EQ.0.) GO TO 3302
T=SQRT(T)

```

124

[illegible]

125

FIL2: AERO FORTRAN A NAVAL POSTGRADUATE SCHOOL

```

      IF(CNA.NE.0.0)GO TO 3355
      WRITE(2,3353)CNA
3353  FORMAT(1,' ',3353,'E10.3)
      GO TO 3777
3355  KACHC=4/CNA
      WRITE(2,3361)
3361  FORMAT(1,' ',CALCULATION COMPLETED')
      GO TO 1001
C
      TABULATE OUTPUT
3381  WRITE(2,3401)
3401  FORMAT(1,' ',16X,'FORCE COEFFICIENTS FOR A SLENDER, POINTED'//
      '16X,'BODY OF REVOLUTION IN SUPERSONIC FLOW')
      WRITE(2,3421) XM,XL,DL,DL2,NL,NA,N4,NC,NH2,NC2,NTAB,INOSE,
      'KNGSF,KTAIL,KAP(6),KAP(7),CNA,CAO,CA2,XAC
3421  FORMAT(1,' ',XN='F7.4',T18,'XL='F7.4',T36,'DL='F6.4,T54,
      ' *DL='F6.4,
      ' *NL='I3,T18,'NA='I3,T36,'NH2='I3,T54,'NC='I3/
      ' *NA2='I3,T18,'NC2='I3,T36,'NTAB='I3,T54,'INOSE='I2/
      ' *INOSE CODE='A2,T27,'TAIL CODE='A2,T54,
      ' *IN='A2,T47,' *CNA='F6.4,T18,'CAO='F6.4,T36,'CA2='F7.4,
      ' *T44,'XAC='F8.3)
3441  DO 3461 J=1,NL,X=1,XL,'X',15X,'R',14X,'RP')
      DO 3461 J=2,NL,P2,NTAB
      WRITE(2,3561) J,X(J),P1(J),P2(J)
3461  CONTINUE
      WRITE(2,3541)
3541  FORMAT(1,' ',12X,'J',15X,'X',15X,'UNAT',15X,'CAO',12X,'CA2')
      DO 3561 J=2,NL,P2,NTAB
      WRITE(2,3561) J,X(J),QNA(J),QAO(J),QAZ(J)
3561  FORMAT(1,' ',13,4E16.4)
3581  CONTINUE
      GO TO 1001
C
      PLOT OUTPUT
      WRITE OUTPUT FOR PLOT INTO FILE FTO1R001
3601  WRITE(1,3621) XM,NL,DL,NL,NA,N4,NTAB,KNGSF,KTAIL,
      'KAP,CNA,CAO,CA2,XAC
3621  FORMAT(1,' ',3E16.5,4(2X,I3),2(2X,A2),' ',8A4,' ',4E16.4)
      DO 3661 J=1,NL,P2
      WRITE(1,3641) J,X(J),P1(J),QNA(J),QAO(J),QAZ(J)
3641  FORMAT(1,' ',5E16.4)
3661  CONTINUE
C
      WRITE(1,3681)
3681  FORMAT(1,' ',1//*)
      WRITE(1,3701)
3701  FORMAT(1,' ',TO OBTAIN PLOTS, FIRST ENTER OT TO QUIT PROGRAM, //
      ' * * THEN ISSUE THE FOLLOWING COMMANDS: //
      ' * * 16X, FOR PRINTER PLOTS, * * 16X, ENTER *CHARTS PRINTER* //
      ' * * 16X, FOR PLOTTER GRAPHS, * * 16X, ENTER *CHARTS PLOTTER* //
      GO TO 1001
C
      QUIT PROGRAM
3721  CONTINUE
      WRITE(2,3741)
3741  FORMAT(1,' ',EXECUTION TERMINATED')
3777  STOP
      END

```

AERO 5050
 AERO 5050
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 AERO 5680

G2. PROGRAM COWL

ADJUSTMENT OF AERO FOR DO-LOOP ROUTINE

FILE: COML FORTRAN A NAVAL POSTGRADUATE SCHOOL

```

      XM=1.95
      GA=1.4
      NO 33 J=1,22
      IF(J.EQ.1) XM=1.45
      CALL DPAGN(XM,CAO)
      CALL DRAGMI(XM,GA,COMW)
      IF(J.EQ.1) XM=1.95
33  CONTINUE
      STOP
      END

      SUBROUTINE DPAGN(XM,CAO)
      IMPLICIT REAL*4(A-H,O-Z), INTEGER*4(I-N)
      DIMENSION XI(702),PI(702),RPI(702),XI(702),FP(702),OAU(702),KAP(4)
      CALCULATE GEOMETRICAL ARRAYS
      DATA FOR DL21
      =0.12077=6.5 DEG, 1-0.1770=9.5 DEG, 1-0.2250=12 DEG, 1-0.2840=
      =15 DEG
      DATA XL/17.50/,ML/500/,NA/203/,NR/200/,NC/ 6/,NB2/ 6/
      *DL/-0.07360/,DL2/-0.1770/
      *XL/15.76/,NA/212/,NR/209/,NC/ 79/,NB2/0/,DL/-0.2780/
      SET UP INHIT AND CALCULATE XI(J)
2741 IF(MDZ.FC.OJ) NC=ML-NA-NB
      NC2=NC-NA-NB-NC-NB2
      DELX=XL/FL0AT(ML)
      AL=DELX*FL0AT(NA)
      BL=DELX*FL0AT(NB)
      CL=DELX*FL0AT(NC)
      FL2=DELX*FL0AT(NC2)
      JAL=NA+1
      JAP=NL+1
      JRL=NA+NB+1
      JBR=JRL+1
      JCL=NA+NB+NC+1
      JCR=JCL+1
      JB2=NA+NB+NC+NB2+1
      JR2=JB2+1
      RI1=0.
      RI2=0.
      NL0=NL+1
      NL2=NL+2
      XI(NL0)=XL
      DO 2761 J=2,NB1
      *FL J=FL0AT(J)-1.5 /
      *J1=CELEX*DELJ
2761 CONTINUE
      CALCULATE RI(J) AND RPI(J) FOR ORIVAL MSL
3001 RA=(1.+AL*2)/2.
      DO 3021 J=1,JAL
      IF(RA*2-[1-XI(J)]*2).GE.0.0100 GO TO 3026
      WRITE(2,2074) J,RA,AL,XI(J),RI(J),RPI(J)
3024 FORMAT(1,' 3024',2X,13,2X,5(10,1,2X))
      STOP
3026 RI(J)=SORT(RA*2-(AL-XI(J))*2)-RA+1.
      RPI(J)=(AL-XI(J))/(RA-1.+RI(J))
3021 CONTINUE
3041 IF(NA.LT.ML) GO TO 3081
3061 RI(NL0)=1.
      RPI(NL0)=0
      GO TO 3241
      CALCULATE RI(J) AND RPI(J) FOR CYLINDRICAL INTERSECTION
3081 IF(NR.EQ.0) GO TO 3121

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COM03010
COM03020
COM03030
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COM03100
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COM03700
COM03710
COM03720

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FILE: CONL: FORTRAN A NAVAL POSTGRADUATE SCHOOL

```

3101 RPIJ=.0
CONTINUE
IF((NA+NB).LT.NL)GO TO 3121
R(NLP2)=1.
R(NLP2)=0.
GO TO 3241
3121 CONTINUE
C
C CALCULATE RI(J) AND RPI(J) FOR CONICAL TAIL
C
RPT=-OL/CL
RXL=AL+BL*CL
DO 3141 J=JBR,JCL
RI(J)=1.-RPT*(X(IJ)-RXL+CL)
RPI(J)=RPT
3141 CONTINUE
IF((NA+NB+NC).LT.NL)GO TO 3123
R(NLP2)=1.-OL
R(NLP2)=0.
GO TO 3241
C
C CALCULATE RI(J) AND RPI(J) FOR SECOND BISECTION
C
3123 IF(NB2.EQ.0) GO TO 3241
DO 3125 J=JCR,JB2L
RI(J)=1.-OL
RPI(J)=0.
3125 CONTINUE
IF((NA+NB+NC+NC2).LT.NL)GO TO 3127
R(NLP2)=1.-OL
R(NLP2)=0.
GO TO 3241
C
C CALCULATE RI(J) AND RPI(J) FOR SECOND CONICAL TAIL
C
3127 RPT2=-OL2/CL2
DO 3129 J=JBR2,NLP2
RI(J)=1.-OL OR RPT2*(X(IJ)-XL+OL2)
RPI(J)=RPT2
3129 CONTINUE
C
3241 CONTINUE
CALCULATE OUTPUT
C
3281 BETA=SQRT(XM*XP-1.)
XI(1)=0.
T=X(2)**2-(BETABR(2))**2
IF(T.EQ.0)GO TO 3286
WRIT=1.0/X(2)*BETA.T
3284 FORMAT(' ',3284,'*(E10.5,2X)')
STOP
3286 T=SQRT(T)
OAC(1)=0.
CAO1=C.
CAO3=C.
CAO=0.
C
DO 3341 J=2,NLP2
SUM=C.
SUM=C.
SUM=C.
SX=0.
TX=0.
TX=0.
IF(RI(J).NE.0)GO TO 3345
WRITE(1,3343)X(1),RI(J),RPI(J)
3343 FORMAT(' ',3343,'(2X),5,'(2X,E10.3)')
STOP
3345 XI(J)=X(IJ)-RPTA*R(J)
HX=X(IJ)-X(J-1)
HA=X(IJ)-X(IJ-1)
TX(IJ)=2-(BETABR(J))**2

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COW01240
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COW01270
COW01280
COW01290
COW01300
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COW01320
COW01330
COW01340
COW01350
COW01360
COW01370
COW01380
COW01390
COW01400
COW01410
COW01420
COW01430
COW01440

FILE: COM. FORTRAN A NAVAL POSTGRADUATE SCHOOL

```

CALL APRANT(XM1,GA,ANI)
CALL PRES(XM1,GA,PIPT)
CALL APRANT(XM2,GA,PIPT)
CALL PRES(XM2,GA,PIPT)
C
BP=B-C/2/SQRT(XM**2-1)
COWM=1-1/(GA*XM**2))*((PIPT/POPT-P2PT/POPT)*(TORP/AREF)
WRITE(1,334) XM,XM1,XM2,POPT,PIPT,P2PT,TM,B,RP,C,COWM
334 FORMAT(1,' ',334,'.6(2X,F8.5) / ',1,' ',5(2X,F8.5) /
      1,' ',75(' '))
      RET(10)
      END
SUBROUTINE PRANT(XM1,GA,ANI)
      BETA=SQRT(XM1**2-1)
      GARAT=SQRT((GA-1)/(GA+1))
      ANI=ATAN(GARAT*BETA)/GARAT-ATAN(BETA)
      RETURN
      END
SUBROUTINE APRANT(XM1,GA,ANI)
      BETA=SQRT(XM1**2-1)
      GARAT=SQRT((GA-1)/(GA+1))
      ANI=ATAN(GARAT*BETA)/GARAT-ATAN(BETA)-ANI
      FP=1/(1+(GARAT*BETA)**2)-1/(1+(BETA**2))
      IF (BETA.GT.1) GO TO 558
      IF (FP.EQ.0) GO TO 558
      BETA=1/BETA
      IF (ABS(BETAN-BETA)).LE.(1.E-05) GO TO 556
      BETA=3*ATAN
      GO TO 553
556 XM1=SQRT(BETA**2+1)
      RETURN
558 WRITE(2,560) (BETA,ANI,F,FP,BETA)
560 FORMAT(1,' ',560,'.13,(2X,F11.4))
      STOP
      END
SUBROUTINE PRES(XM1,GA,PIPT)
      PIPT=1/(GA-1)/(2.*XM1**2))*(-GA/(GA-1))
      RETURN
      END

```

COW02170
COW02180
COW02190
COW02200
COW02210
COW02220
COW02230
COW02240
COW02250
COW02260
COW02270
COW02280
COW02290
COW02300
COW02310
COW02320
COW02330
COW02340
COW02350
COW02360
COW02370
COW02380
COW02390
COW02400
COW02410
COW02420
COW02430
COW02440
COW02450
COW02460
COW02470
COW02480
COW02490
COW02500
COW02510
COW02520
COW02530
COW02540
COW02550
COW02560
COW02570
COW02580
COW02590
COW02600

G3. PLOT ROUTINES FOR USE WITH AERO [9]

- PREPLOT P (PLOT ON PRINTER)
- PREPLOT G (PLOT ON PLOTTER)
- CHARTS (CONTROL)

FILE: PRELOTP FORTRAN A NAVAL POSTGRADUATE SCHOOL

```

//AMIC3250 JPR 13250.02581.'AMICHA1 X2935'.CLASS=A
// EXEC FRTXCLGP
//PORT.SYSIN CD *
C
C SPECIFICATION STATEMENTS
C
C IMPLICIT REAL*4(A-H,O-X),INTEGER*4(I-N)
C
C DIMENSION X(502),R(502),QNA(502),QAO(502),QAZ(502),KAP(8)
C
      REAO(5,1000) XM,XL,OL,NL,NA,KB,NTAB,KNOSE,KTAIL,
      *KAP,CNA,CAO,CAZ,XAC
1000  FORMAT(13,3E14.5,4(2X,13),2(2X,A21/LX,6A4/LX,4E14.5)
      NLP2=NLP2+2
      DO 1040 J=1,NLP2
1020    RF4(12,1020) X(J),R(J),QNA(J),QAO(J),QAZ(J)
1040    RF4(12,1020) X(J),R(J),QNA(J),QAO(J),QAZ(J)
1040  CONTINUE
      WRITE(6,1060)
1060  FORMAT(11,'SUMMARY OF RESULTS'///)
      WRITE(6,1080) XM,XL,OL,NL,NA,KB,NTAB,KNOSE,KTAIL,KAP(4),KAP(7),
      *CNA,CAO,CAZ,XAC
1080  FORMAT(17,'XN=',F7.4,'T18',XL='F7.4',T36,'OL=',F8.4,'T54,'NL=',T3/
      *'0',NA='T13,T18,'NB='T13,T36,'NTAB='T13,T54,'KNOSE CODE='A3/
      *'0',TAIL CODE='A2,T36,'ID=',Z44/'0',CNA='F8.6,T18,'CAO=',
      *'F8.6,T36,'CAZ=',F7.6,T54,'XAC=',F8.3)
      WRITE(6,1100) XM,KAP(6),KAP(7)
1100  FORMAT(11,'RADIUS R VS X XN=',F7.4,' ID=',Z44///)
      CALL PLOTPIX,R,NLP2,4)
      WRITE(6,1120)
1120  FORMAT(11,'NORMAL FORCE COEFFICIENT QNA VS X'//)
      WRITE(6,1140) CNA,XAC,KAP(6),KAP(7)
1140  FORMAT(11,'36X,'CNA=',F7.4,' XAC=',F7.4,' ID=',Z44///)
      CALL PLOTPIX,CNA,NLP2,4)
      WRITE(6,1160)
1160  FORMAT(11,'36X,'AXIAL FORCE COEFFICIENT QAO VS X'//)
      WRITE(6,1180) CAO,KAP(6),KAP(7)
1180  FORMAT(11,'36X,'CAO=',F7.4,' ID=',Z44///)
      CALL PLOTPIX,CAO,NLP2,4)
      WRITE(6,1200)
1200  FORMAT(11,'36X,'AXIAL FORCE COEFFICIENT QAZ VS X'//)
      WRITE(6,1220) CAZ,KAP(6),KAP(7)
1220  FORMAT(11,'36X,'CAZ=',F7.4,' ID=',Z44///)
      CALL PLOTPIX,CAZ,NLP2,4)
      STOP
      END
//GO.SYSIN DD *

```

PRE00010
 PRE00020
 PRE00030
 PRE00040
 PRE00050
 PRE00060
 PRE00070
 PRE00080
 PRE00090
 PRE00100
 PRE00110
 PRE00120
 PRE00130
 PRE00140
 PRE00150
 PRE00160
 PRE00170
 PRE00180
 PRE00190
 PRE00200
 PRE00210
 PRE00220
 PRE00230
 PRE00240
 PRE00250
 PRE00260
 PRE00270
 PRE00280
 PRE00290
 PRE00300
 PRE00310
 PRE00320
 PRE00330
 PRE00340
 PRE00350
 PRE00360
 PRE00370
 PRE00380
 PRE00390
 PRE00400
 PRE00410
 PRE00420
 PRE00430
 PRE00440
 PRE00450
 PRE00460
 PRE00470
 PRE00480

PRF00010
PRF00020
PRF00030
PRF00040
PRF00050
PRF00060
PRF00070
PRF00080
PRF00090
PRF00100
PRF00110
PRF00120
PRF00130
PRF00140
PRF00150
PRF00160
PRF00170
PRF00180
PRF00190
PRF00200
PRF00210
PRF00220
PRF00230
PRF00240
PRF00250
PRF00260
PRF00270
PRF00280
PRF00290
PRF00300
PRF00310
PRF00320
PRF00330
PRF00340
PRF00350

PRE00010
PRE00020
PRE00030
PRE00040
PRE00050

FILE: CHARTS EXEC A NAVAL POSTGRADUATE SCHOOL

```
SCONTROL ERROR
EIF .CL EQ .PRINTER GGOTO -PRINTER
EIF .CL EQ .PLOTTER GGOTO -PLOTTER
CTYPE REPEAT. SPECIFY PRINTER OR PLOTTER.
EXIT
-PRINTER SCONTINUE
ENAME = PREPLOT
GGOTO -OO
-PLOTTER SCONTINUE
ENAME = PREPLOTG
-CC SCONTINUE
COPYFILE ENAME FORTRAN A FILE FTQIFOL A PLOT FORTRAN A (REPLACE
EXEC SUBMIT PLCT FORTRAN
```

G4. Results from AERO/COWL

G4.1 The symbols used in programs AERO and COWL are defined in AERO and are presented in Figure G4.1. The values of a , b_1 , c_1 , b_2 , c_2 are normalized with respect to r_1 . NA , NB , NC , NB_2 , NC_2 are the appropriate numbers of points used in the program. The cowl angles α_1 , α_2 were selected as 20° , 9.5° , respectively.

To create flow at the first cowl in Figure G4.1 which is the same as for a ramjet inlet, an extension to the body was used. The extension consists of the cone of length a and cylinder of length b_1 in Figure G4.1. The cone angle, β_1 , is 8 degrees. The value of b_1 was varied until the pressure at the first cowl was equal to ambient; a value of b_1 equal to $7r_1$ gives this condition.

G4.2 The normalized values of the various variables which were selected are as follow:

$$a = 7.11, b_1 = 7, c_1 = 0.2, b_2 = 2.13, c_2 = 1.06 \text{ units} \\ - DL = 0.0736, - DL_2 = 0.177 \text{ units.}$$

The appropriate numbers of points are:

$$NA = 203, NB = 200, NC = 6, NB_2 = 61, NC_2 = 30$$

The dimensional values are:

$$c_1 = 0.40, b_2 = 4.22, c_2 = 2.1 \text{ inch} \\ r_1 = 1.98, r_2 = 2.13, r_3 = 2.48 \text{ inch}$$

G4.3 It was found that the cowl drag coefficient is sensitive to the magnitude of projected cowl area. For example, another combination of these variables:

$$a = 7.11, b_1 = 7., c_1 = 0.38, b_2 = 2.16, c_2 = 1.46$$

$$NA = 196, NB = 193, NC = 11, NB_2 = 60, NC_2 = 40$$

$$-DL = 0.138(20^\circ), -DL_2 = 0.243(9.5^\circ)$$

Gives higher values of the cowl drag coefficient:

Mo	3.0	2.3
G4.2	0.0732	0.0953
G4.3	0.1214	0.1562

Therefore, attention was made to select an inlet shape as smooth as possible.

G4.4 AERO can produce also graphical results. A typical example is illustrated in Figure G4.2.

G4.5 Computer Program Users Guide

Use opening commands and compilation similar to that defined in F2.1, F2.2.

The routine to run AERO on the terminal is defined in program itself.

The routine to run COWL on the terminal is as follows:

```
FILEDEF 02 DISK OUT D (RECFM F BLOCK 132 PERM
EXEC RUN COWL
PRINT OUT D
XEDIT OUT D
```

} optional

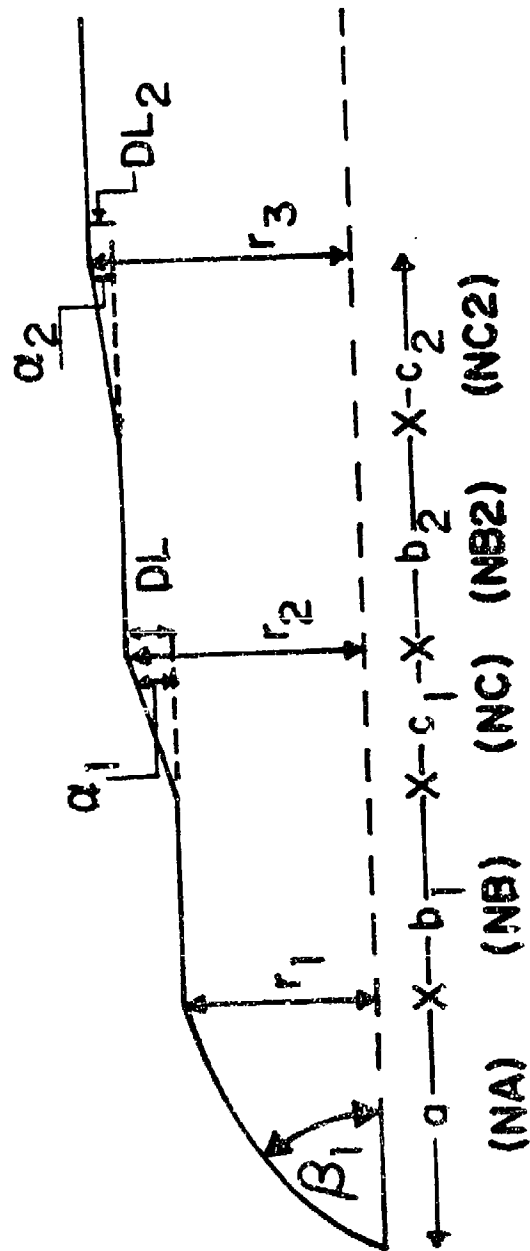


Figure G4.1 Geometry for Calculation of Cowl-Drag-Coefficient (Programs AERO & COWL) Showing Definition of Symbols

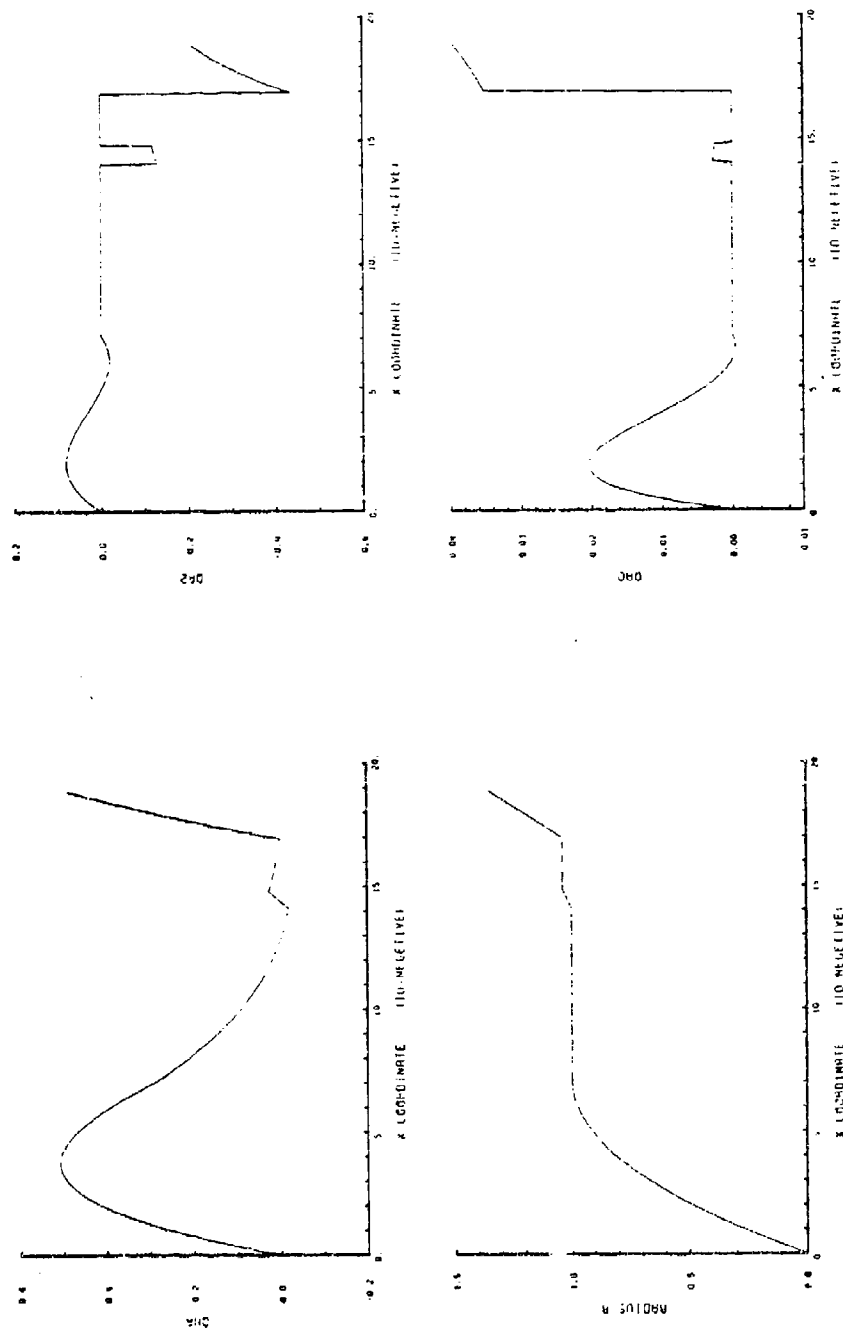


Figure 64.2 Typical Results from AERO
 XM=3.0, XL=18.88, HL=500, NA=188, NB=185, NC=20, NB2=56, NC2=51
 DL=0.0327, DL₂=-0.3199, Nose Code=ON, Tail Code=Ct
 C_{DN}(=CA₀)=0.0737; The symbols are defined in the program

APPENDIX H: RESULTS

H1. SUMMARY

A_0/A_r	A_5/A_r	A_1/A_0	A_2/A_0	A_3/A_r	θ_p	θ
0.25-0.40	0.25-0.40	0.47	0.887	0.426	9.5	15
						25
						35
						40
						45
						65
0.25-0.40	0.25-0.40	0.50	0.827	0.426	9.5	80
						7
						25
						45
						65
0.25-0.40	0.25-0.40	0.42 0.58	0.827	0.426	9.5	80
						45
						45
0.25-0.40	0.25-0.40	0.47	0.75	0.426	9.5	45
			0.827			
			0.91			
			0.827			
0.25-0.40	0.25-0.40	0.47	0.827	0.27	9.5	45
				0.32		
				0.47		
0.25-0.40	0.25-0.40	0.47	0.827	0.426	6.5	45
					11.5	

1

SOLID FUEL WARF I & TRAJECTORY

SUMMARY

AO/AR	AS/AR	TIM	XDH	YDH	TOF	X(MAX)	V(MAX)	Y(TP)	T(FA)
0.250E+00	0.250E+00	0.442E+02	0.346E+05	0.613E+04	0.700E+02	0.310E+05	0.177E+04	0.950E+01	0.250E+02
0.250E+00	0.250E+00	0.440E+02	0.346E+05	0.613E+04	0.719E+02	0.318E+05	0.974E+03	0.950E+01	0.250E+02
0.270E+00	0.250E+00	0.431E+02	0.344E+05	0.646E+04	0.718E+02	0.340E+05	0.116E+04	0.950E+01	0.250E+02
0.280E+00	0.250E+00	0.427E+02	0.344E+05	0.659E+04	0.745E+02	0.348E+05	0.116E+04	0.950E+01	0.250E+02
0.290E+00	0.250E+00	0.423E+02	0.343E+05	0.671E+04	0.753E+02	0.357E+05	0.113E+04	0.950E+01	0.250E+02
0.300E+00	0.250E+00	0.419E+02	0.341E+05	0.670E+04	0.755E+02	0.366E+05	0.410E+04	0.950E+01	0.250E+02
0.310E+00	0.250E+00	0.417E+02	0.340E+05	0.689E+04	0.774E+02	0.375E+05	0.385E+04	0.950E+01	0.250E+02
0.320E+00	0.250E+00	0.416E+02	0.339E+05	0.709E+04	0.780E+02	0.384E+05	0.399E+04	0.950E+01	0.250E+02
0.330E+00	0.250E+00	0.415E+02	0.338E+05	0.729E+04	0.780E+02	0.393E+05	0.399E+04	0.950E+01	0.250E+02
0.340E+00	0.250E+00	0.414E+02	0.337E+05	0.749E+04	0.780E+02	0.402E+05	0.399E+04	0.950E+01	0.250E+02
0.350E+00	0.250E+00	0.413E+02	0.336E+05	0.769E+04	0.780E+02	0.411E+05	0.399E+04	0.950E+01	0.250E+02
0.360E+00	0.250E+00	0.412E+02	0.335E+05	0.789E+04	0.780E+02	0.420E+05	0.399E+04	0.950E+01	0.250E+02
0.370E+00	0.250E+00	0.411E+02	0.334E+05	0.809E+04	0.780E+02	0.429E+05	0.399E+04	0.950E+01	0.250E+02
0.380E+00	0.250E+00	0.410E+02	0.333E+05	0.829E+04	0.780E+02	0.438E+05	0.399E+04	0.950E+01	0.250E+02
0.390E+00	0.250E+00	0.409E+02	0.332E+05	0.849E+04	0.780E+02	0.447E+05	0.399E+04	0.950E+01	0.250E+02
0.400E+00	0.250E+00	0.408E+02	0.331E+05	0.869E+04	0.780E+02	0.456E+05	0.399E+04	0.950E+01	0.250E+02
0.410E+00	0.250E+00	0.407E+02	0.330E+05	0.889E+04	0.780E+02	0.465E+05	0.399E+04	0.950E+01	0.250E+02
0.420E+00	0.250E+00	0.406E+02	0.329E+05	0.909E+04	0.780E+02	0.474E+05	0.399E+04	0.950E+01	0.250E+02
0.430E+00	0.250E+00	0.405E+02	0.328E+05	0.929E+04	0.780E+02	0.483E+05	0.399E+04	0.950E+01	0.250E+02
0.440E+00	0.250E+00	0.404E+02	0.327E+05	0.949E+04	0.780E+02	0.492E+05	0.399E+04	0.950E+01	0.250E+02
0.450E+00	0.250E+00	0.403E+02	0.326E+05	0.969E+04	0.780E+02	0.501E+05	0.399E+04	0.950E+01	0.250E+02
0.460E+00	0.250E+00	0.402E+02	0.325E+05	0.989E+04	0.780E+02	0.510E+05	0.399E+04	0.950E+01	0.250E+02
0.470E+00	0.250E+00	0.401E+02	0.324E+05	1.009E+04	0.780E+02	0.519E+05	0.399E+04	0.950E+01	0.250E+02
0.480E+00	0.250E+00	0.400E+02	0.323E+05	1.029E+04	0.780E+02	0.528E+05	0.399E+04	0.950E+01	0.250E+02
0.490E+00	0.250E+00	0.399E+02	0.322E+05	1.049E+04	0.780E+02	0.537E+05	0.399E+04	0.950E+01	0.250E+02
0.500E+00	0.250E+00	0.398E+02	0.321E+05	1.069E+04	0.780E+02	0.546E+05	0.399E+04	0.950E+01	0.250E+02
0.510E+00	0.250E+00	0.397E+02	0.320E+05	1.089E+04	0.780E+02	0.555E+05	0.399E+04	0.950E+01	0.250E+02
0.520E+00	0.250E+00	0.396E+02	0.319E+05	1.109E+04	0.780E+02	0.564E+05	0.399E+04	0.950E+01	0.250E+02
0.530E+00	0.250E+00	0.395E+02	0.318E+05	1.129E+04	0.780E+02	0.573E+05	0.399E+04	0.950E+01	0.250E+02
0.540E+00	0.250E+00	0.394E+02	0.317E+05	1.149E+04	0.780E+02	0.582E+05	0.399E+04	0.950E+01	0.250E+02
0.550E+00	0.250E+00	0.393E+02	0.316E+05	1.169E+04	0.780E+02	0.591E+05	0.399E+04	0.950E+01	0.250E+02
0.560E+00	0.250E+00	0.392E+02	0.315E+05	1.189E+04	0.780E+02	0.600E+05	0.399E+04	0.950E+01	0.250E+02
0.570E+00	0.250E+00	0.391E+02	0.314E+05	1.209E+04	0.780E+02	0.609E+05	0.399E+04	0.950E+01	0.250E+02
0.580E+00	0.250E+00	0.390E+02	0.313E+05	1.229E+04	0.780E+02	0.618E+05	0.399E+04	0.950E+01	0.250E+02
0.590E+00	0.250E+00	0.389E+02	0.312E+05	1.249E+04	0.780E+02	0.627E+05	0.399E+04	0.950E+01	0.250E+02
0.600E+00	0.250E+00	0.388E+02	0.311E+05	1.269E+04	0.780E+02	0.636E+05	0.399E+04	0.950E+01	0.250E+02
0.610E+00	0.250E+00	0.387E+02	0.310E+05	1.289E+04	0.780E+02	0.645E+05	0.399E+04	0.950E+01	0.250E+02
0.620E+00	0.250E+00	0.386E+02	0.309E+05	1.309E+04	0.780E+02	0.654E+05	0.399E+04	0.950E+01	0.250E+02
0.630E+00	0.250E+00	0.385E+02	0.308E+05	1.329E+04	0.780E+02	0.663E+05	0.399E+04	0.950E+01	0.250E+02
0.640E+00	0.250E+00	0.384E+02	0.307E+05	1.349E+04	0.780E+02	0.672E+05	0.399E+04	0.950E+01	0.250E+02
0.650E+00	0.250E+00	0.383E+02	0.306E+05	1.369E+04	0.780E+02	0.681E+05	0.399E+04	0.950E+01	0.250E+02
0.660E+00	0.250E+00	0.382E+02	0.305E+05	1.389E+04	0.780E+02	0.690E+05	0.399E+04	0.950E+01	0.250E+02
0.670E+00	0.250E+00	0.381E+02	0.304E+05	1.409E+04	0.780E+02	0.699E+05	0.399E+04	0.950E+01	0.250E+02
0.680E+00	0.250E+00	0.380E+02	0.303E+05	1.429E+04	0.780E+02	0.708E+05	0.399E+04	0.950E+01	0.250E+02
0.690E+00	0.250E+00	0.379E+02	0.302E+05	1.449E+04	0.780E+02	0.717E+05	0.399E+04	0.950E+01	0.250E+02
0.700E+00	0.250E+00	0.378E+02	0.301E+05	1.469E+04	0.780E+02	0.726E+05	0.399E+04	0.950E+01	0.250E+02
0.710E+00	0.250E+00	0.377E+02	0.300E+05	1.489E+04	0.780E+02	0.735E+05	0.399E+04	0.950E+01	0.250E+02
0.720E+00	0.250E+00	0.376E+02	0.299E+05	1.509E+04	0.780E+02	0.744E+05	0.399E+04	0.950E+01	0.250E+02
0.730E+00	0.250E+00	0.375E+02	0.298E+05	1.529E+04	0.780E+02	0.753E+05	0.399E+04	0.950E+01	0.250E+02
0.740E+00	0.250E+00	0.374E+02	0.297E+05	1.549E+04	0.780E+02	0.762E+05	0.399E+04	0.950E+01	0.250E+02
0.750E+00	0.250E+00	0.373E+02	0.296E+05	1.569E+04	0.780E+02	0.771E+05	0.399E+04	0.950E+01	0.250E+02
0.760E+00	0.250E+00	0.372E+02	0.295E+05	1.589E+04	0.780E+02	0.780E+05	0.399E+04	0.950E+01	0.250E+02
0.770E+00	0.250E+00	0.371E+02	0.294E+05	1.609E+04	0.780E+02	0.789E+05	0.399E+04	0.950E+01	0.250E+02
0.780E+00	0.250E+00	0.370E+02	0.293E+05	1.629E+04	0.780E+02	0.798E+05	0.399E+04	0.950E+01	0.250E+02
0.790E+00	0.250E+00	0.369E+02	0.292E+05	1.649E+04	0.780E+02	0.807E+05	0.399E+04	0.950E+01	0.250E+02
0.800E+00	0.250E+00	0.368E+02	0.291E+05	1.669E+04	0.780E+02	0.816E+05	0.399E+04	0.950E+01	0.250E+02
0.810E+00	0.250E+00	0.367E+02	0.290E+05	1.689E+04	0.780E+02	0.825E+05	0.399E+04	0.950E+01	0.250E+02
0.820E+00	0.250E+00	0.366E+02	0.289E+05	1.709E+04	0.780E+02	0.834E+05	0.399E+04	0.950E+01	0.250E+02
0.830E+00	0.250E+00	0.365E+02	0.288E+05	1.729E+04	0.780E+02	0.843E+05	0.399E+04	0.950E+01	0.250E+02
0.840E+00	0.250E+00	0.364E+02	0.287E+05	1.749E+04	0.780E+02	0.852E+05	0.399E+04	0.950E+01	0.250E+02
0.850E+00	0.250E+00	0.363E+02	0.286E+05	1.769E+04	0.780E+02	0.861E+05	0.399E+04	0.950E+01	0.250E+02
0.860E+00	0.250E+00	0.362E+02	0.285E+05	1.789E+04	0.780E+02	0.870E+05	0.399E+04	0.950E+01	0.250E+02
0.870E+00	0.250E+00	0.361E+02	0.284E+05	1.809E+04	0.780E+02	0.879E+05	0.399E+04	0.950E+01	0.250E+02
0.880E+00	0.250E+00	0.360E+02	0.283E+05	1.829E+04	0.780E+02	0.888E+05	0.399E+04	0.950E+01	0.250E+02
0.890E+00	0.250E+00	0.359E+02	0.282E+05	1.849E+04	0.780E+02	0.897E+05	0.399E+04	0.950E+01	0.250E+02
0.900E+00	0.250E+00	0.358E+02	0.281E+05	1.869E+04	0.780E+02	0.906E+05	0.399E+04	0.950E+01	0.250E+02
0.910E+00	0.250E+00	0.357E+02	0.280E+05	1.889E+04	0.780E+02	0.915E+05	0.399E+04	0.950E+01	0.250E+02
0.920E+00	0.250E+00	0.356E+02	0.279E+05	1.909E+04	0.780E+02	0.924E+05	0.399E+04	0.950E+01	0.250E+02
0.930E+00	0.250E+00	0.355E+02	0.278E+05	1.929E+04	0.780E+02	0.933E+05	0.399E+04	0.950E+01	0.250E+02
0.940E+00	0.250E+00	0.354E+02	0.277E+05	1.949E+04	0.780E+02	0.942E+05	0.399E+04	0.950E+01	0.250E+02
0.950E+00	0.250E+00	0.353E+02	0.276E+05	1.969E+04	0.780E+02	0.951E+05	0.399E+04	0.950E+01	0.250E+02
0.960E+00	0.250E+00	0.352E+02	0.275E+05	1.989E+04	0.780E+02	0.960E+05	0.399E+04	0.950E+01	0.250E+02
0.970E+00	0.250E+00	0.351E+02	0.274E+05	2.009E+04	0.780E+02	0.969E+05	0.399E+04	0.950E+01	0.250E+02
0.980E+00	0.250E+00	0.350E+02	0.273E+05	2.029E+04	0.780E+02	0.978E+05	0.399E+04	0.950E+01	0.250E+02
0.990E+00	0.250E+00	0.349E+02	0.272E+05	2.049E+04	0.780E+02	0.987E+05	0.399E+04	0.950E+01	0.250E+02
1.000E+00	0.250E+00	0.348E+02	0.271E+05	2.069E+04	0.780E+02	0.996E+05	0.399E+04	0.950E+01	0.250E+02

INPUT DATA:
 C-400 3.263 0.473 0.047 0.426
 9.5 75.0 0 -2 1.000 0.930 0.930 0.960

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SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	AS/AR	TOB	XOB	YOB	TOF	KIMAX	YMAX	TETP	TEFA
C.25CF+00	0.250F+00	0.676F+02	0.537F+05	0.115F+05	0.109F+03	0.757F+05	-0.264F+02	0.950F+01	0.350F+02
C.26CF+00	0.250F+00	0.684F+02	0.519F+05	0.118F+05	0.109F+03	0.777F+05	-0.252F+02	0.950F+01	0.350F+02
C.270F+00	0.250F+00	0.681F+02	0.522F+05	0.121F+05	0.110F+03	0.794F+05	-0.120F+03	0.950F+01	0.350F+02
C.280F+00	0.250F+00	0.681F+02	0.524F+05	0.122F+05	0.111F+03	0.810F+05	-0.602F+02	0.950F+01	0.350F+02
C.29CF+00	0.250F+00	0.686F+02	0.518F+05	0.127F+05	0.112F+03	0.828F+05	-0.363F+02	0.950F+01	0.350F+02
C.30CF+00	0.250F+00	0.188F+02	0.116F+05	0.641F+04	0.113F+02	0.116F+05	0.641F+04	0.950F+01	0.350F+02
C.31CF+00	0.250F+00	0.166F+02	0.102F+05	0.541F+04	0.111F+02	0.105F+05	0.581F+04	0.950F+01	0.350F+02
C.32CF+00	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.33CF+J3	0.250F+00	0.173F+02	0.106F+05	0.611F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.34CF+J3	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.350F+00	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.360F+J3	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.370F+00	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.38CF+00	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.39CF+00	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.40CF+J3	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.25CF+J3	0.250F+00	0.676F+02	0.537F+05	0.115F+05	0.109F+03	0.757F+05	-0.264F+02	0.950F+01	0.350F+02
C.26CF+J3	0.250F+00	0.684F+02	0.519F+05	0.118F+05	0.109F+03	0.777F+05	-0.252F+02	0.950F+01	0.350F+02
C.270F+J3	0.250F+00	0.681F+02	0.522F+05	0.121F+05	0.110F+03	0.794F+05	-0.120F+03	0.950F+01	0.350F+02
C.280F+J3	0.250F+00	0.681F+02	0.524F+05	0.122F+05	0.111F+03	0.810F+05	-0.602F+02	0.950F+01	0.350F+02
C.29CF+J3	0.250F+00	0.686F+02	0.518F+05	0.127F+05	0.112F+03	0.828F+05	-0.363F+02	0.950F+01	0.350F+02
C.30CF+J3	0.250F+00	0.188F+02	0.116F+05	0.641F+04	0.113F+02	0.116F+05	0.641F+04	0.950F+01	0.350F+02
C.31CF+J3	0.250F+00	0.166F+02	0.102F+05	0.541F+04	0.111F+02	0.105F+05	0.581F+04	0.950F+01	0.350F+02
C.32CF+J3	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.33CF+J3	0.250F+00	0.173F+02	0.106F+05	0.611F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.34CF+J3	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.350F+J3	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.360F+J3	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.370F+J3	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.38CF+J3	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.39CF+J3	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02
C.40CF+J3	0.250F+00	0.173F+02	0.106F+05	0.601F+04	0.114F+02	0.106F+05	0.601F+04	0.950F+01	0.350F+02

INPUT DATA:
 9.5 35.0 0.260 0.970 0.947 0.426
 0.2 1.000 0.930 0.730 0.960

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A NAVAL POSTGRADUATE SCHOOL

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SOLID FUEL ROCKET & TRAJECTORY

SUMMARY

INCOME DATA					
C.400	J.340	0.470	0.891	0.426	
4.5	40.0	0.2	1.000	0.930	0.960

0.400	0.340	0.470	0.897	0.426
4.5 40.0	0 -2 1.000	0.930	0.930	0.960

1 SOLID FUEL~RAMJET & TRAJECTORY

SUMMARY

AO/AP	AS/AR	TOB	XOB	YOB	TOT	XMAXT	YMAXT	TTOT	YTOT
C.250F+00	C.250F+00	C.269F+02	C.169F+05	C.132F+05	C.129F+03	C.697F+05	-0.768F+02	C.950F+01	C.450F+02
C.260F+00	C.250F+00	C.252F+02	C.159F+05	C.126F+05	C.130F+03	C.705F+05	-0.198F+02	C.950F+01	C.450F+02
C.270F+00	C.250F+00	C.238F+02	C.152F+05	C.127F+05	C.130F+03	C.706F+05	-0.475F+02	C.950F+01	C.450F+02
C.280F+00	C.250F+00	C.219F+02	C.140F+05	C.115F+05	C.130F+03	C.707F+05	-0.112F+03	C.950F+01	C.450F+02
C.290F+00	C.250F+00	C.194F+02	C.125F+05	C.105F+05	C.128F+03	C.684F+05	-0.660F+02	C.950F+01	C.450F+02
C.300E+00	C.250F+00	C.175F+02	C.105F+05	C.905F+02	C.127F+03	C.947F+05	-0.805F+02	C.950F+01	C.450F+02
C.310E+00	C.250F+00	C.167F+02	C.105F+05	C.176F+05	C.118F+03	C.916F+05	C.716F+04	C.950F+01	C.450F+02
C.320F+00	C.250F+00	C.169F+02	C.105F+05	C.782F+05	C.125F+03	C.925F+05	C.925F+04	C.950F+01	C.450F+02
C.330F+00	C.250F+00	C.167F+02	C.945F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.340F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.350F+00	C.250F+00	C.169F+02	C.945F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.360F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.370F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.380F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.390F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.400F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.410F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.420F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.430E+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.440F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.450F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.460F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.470F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.480F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.490F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.500F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.510F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.520F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.530F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.540F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.550F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.560F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.570F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.580F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.590F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.600F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.610F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.620F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.630F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.640F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.650F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.660F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.670F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.680F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.690F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.700F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.710F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.720F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.730F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.740F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.750F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.760F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.770F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.780F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.790F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.800F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.810F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.820F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.830F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.840F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.850F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.860F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.870F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.880F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.890F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.900F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.910F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.920F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.930F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.940F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.950F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.960F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.970F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.980F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.990F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02
C.1000F+00	C.250F+00	C.169F+02	C.924F+04	C.782F+04	C.125F+02	C.924F+04	C.772F+04	C.950F+01	C.450F+02

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      C.400      0.260      0.470      0.987      0.426
9.5  45.0  0-2  1.000  0.430  0.930  0.960

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SOLID FUEL ROCKET & TRAJECTORY

SUMMARY

AO/AR	AS/AR	TCR	XCR	YCR	TOR	X(MAX)	Y(MAX)	TEP	TEA
0.250E+00	0.250E+00	0.161E+02	0.613E+04	0.114E+05	0.361E+02	0.131E+05	0.220E+05	0.950E+01	0.650E+02
0.260E+00	0.250E+00	0.155E+02	0.613E+04	0.114E+05	0.371E+02	0.137E+05	0.226E+05	0.950E+01	0.650E+02
0.270E+00	0.250E+00	0.155E+02	0.565E+04	0.109E+05	0.369E+02	0.137E+05	0.226E+05	0.950E+01	0.650E+02
0.280E+00	0.250E+00	0.129E+02	0.503E+04	0.931E+04	0.353E+02	0.130E+05	0.218E+05	0.950E+01	0.650E+02
0.290E+00	0.250E+00	0.112E+02	0.444E+04	0.885E+04	0.337E+02	0.121E+05	0.209E+05	0.950E+01	0.650E+02
0.300E+00	0.250E+00	0.161E+02	0.550E+04	0.104E+05	0.160E+02	0.150E+05	0.104E+05	0.950E+01	0.650E+02
0.310E+00	0.250E+00	0.152E+02	0.523E+04	0.997E+04	0.160E+02	0.152E+05	0.999E+04	0.950E+01	0.650E+02
0.320E+00	0.250E+00	0.161E+02	0.545E+04	0.104E+05	0.150E+02	0.148E+05	0.104E+05	0.950E+01	0.650E+02
0.330E+00	0.250E+00	0.161E+02	0.545E+04	0.104E+05	0.160E+02	0.148E+05	0.104E+05	0.950E+01	0.650E+02
0.340E+00	0.250E+00	0.161E+02	0.545E+04	0.104E+05	0.160E+02	0.148E+05	0.104E+05	0.950E+01	0.650E+02
0.350E+00	0.250E+00	0.161E+02	0.545E+04	0.104E+05	0.160E+02	0.148E+05	0.104E+05	0.950E+01	0.650E+02
0.360E+00	0.250E+00	0.161E+02	0.545E+04	0.104E+05	0.160E+02	0.148E+05	0.104E+05	0.950E+01	0.650E+02
0.370E+00	0.250E+00	0.161E+02	0.545E+04	0.104E+05	0.160E+02	0.148E+05	0.104E+05	0.950E+01	0.650E+02
0.380E+00	0.250E+00	0.161E+02	0.545E+04	0.104E+05	0.160E+02	0.148E+05	0.104E+05	0.950E+01	0.650E+02
0.390E+00	0.250E+00	0.161E+02	0.545E+04	0.104E+05	0.160E+02	0.148E+05	0.104E+05	0.950E+01	0.650E+02
0.400E+00	0.250E+00	0.161E+02	0.545E+04	0.104E+05	0.160E+02	0.148E+05	0.104E+05	0.950E+01	0.650E+02
0.250E+00	0.260E+00	0.175E+02	0.664E+04	0.126E+05	0.367E+02	0.135E+05	0.228E+05	0.950E+01	0.650E+02
0.260E+00	0.260E+00	0.168E+02	0.642E+04	0.123E+05	0.376E+02	0.139E+05	0.228E+05	0.950E+01	0.650E+02
0.270E+00	0.260E+00	0.159E+02	0.642E+04	0.118E+05	0.376E+02	0.139E+05	0.228E+05	0.950E+01	0.650E+02
0.280E+00	0.260E+00	0.152E+02	0.547E+04	0.104E+05	0.383E+02	0.143E+05	0.233E+05	0.950E+01	0.650E+02
0.290E+00	0.260E+00	0.120E+02	0.471E+04	0.937E+04	0.351E+02	0.129E+05	0.217E+05	0.950E+01	0.650E+02
0.300E+00	0.260E+00	0.159E+02	0.543E+04	0.113E+05	0.167E+02	0.143E+05	0.103E+05	0.950E+01	0.650E+02
0.310E+00	0.260E+00	0.151E+02	0.513E+04	0.946E+04	0.159E+02	0.116E+05	0.988E+04	0.950E+01	0.650E+02
0.320E+00	0.260E+00	0.151E+02	0.513E+04	0.946E+04	0.159E+02	0.116E+05	0.988E+04	0.950E+01	0.650E+02
0.330E+00	0.260E+00	0.151E+02	0.513E+04	0.946E+04	0.159E+02	0.116E+05	0.988E+04	0.950E+01	0.650E+02
0.340E+00	0.260E+00	0.151E+02	0.513E+04	0.946E+04	0.159E+02	0.116E+05	0.988E+04	0.950E+01	0.650E+02
0.350E+00	0.260E+00	0.151E+02	0.513E+04	0.946E+04	0.159E+02	0.116E+05	0.988E+04	0.950E+01	0.650E+02
0.360E+00	0.260E+00	0.151E+02	0.513E+04	0.946E+04	0.159E+02	0.116E+05	0.988E+04	0.950E+01	0.650E+02
0.370E+00	0.260E+00	0.151E+02	0.513E+04	0.946E+04	0.159E+02	0.116E+05	0.988E+04	0.950E+01	0.650E+02
0.380E+00	0.260E+00	0.151E+02	0.513E+04	0.946E+04	0.159E+02	0.116E+05	0.988E+04	0.950E+01	0.650E+02
0.390E+00	0.260E+00	0.151E+02	0.513E+04	0.946E+04	0.159E+02	0.116E+05	0.988E+04	0.950E+01	0.650E+02
0.400E+00	0.260E+00	0.151E+02	0.513E+04	0.946E+04	0.159E+02	0.116E+05	0.988E+04	0.950E+01	0.650E+02

```

      0.400 0.350 0.260 0.170 0.087 0.047
      1 + + + + + 2) + + + + +
      INPUT DATA:
      0.400 0.260 0.170 0.087 0.047
      9.5 15.0 0 -2 1.800 0.930 0.930 0.969

```


1

SUMMARY

[illegible]

INPUT DATA:

0.400	0.260	0.570	0.427	0.426
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9.5 7.0 0 -2 1.000 0.930 0.930 0.960

PAGE 001

SOLID FUEL RAMJET & TRAJECTORY

AD/AR	AS/AR	T0B	T0C	Y0D	T0E	X(MAX)	Y(MAX)	TFTD	TFTA
0.250E+00	0.250E+00	0.442E+02	0.346E+05	0.613E+04	0.700E+02	0.510E+05	0.177E+04	0.950E+01	0.250E+02
0.260E+00	0.250E+00	0.440E+02	0.348E+05	0.633E+04	0.739E+02	0.518E+05	0.994E+03	0.950E+01	0.250E+03
0.270E+00	0.250E+00	0.431E+02	0.346E+05	0.646E+04	0.738E+02	0.515E+05	0.116E+04	0.950E+01	0.250E+02
0.280E+00	0.250E+00	0.191E+02	0.126E+05	0.620E+04	0.195E+02	0.119E+05	0.220E+04	0.950E+01	0.250E+02
0.290E+00	0.250E+00	0.171E+02	0.112E+05	0.383E+04	0.174E+02	0.112E+05	0.399E+04	0.950E+01	0.250E+02
0.300E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.183E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.310E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.183E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.320E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.183E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.330E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.183E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.340E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.183E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.350E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.183E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.360E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.183E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.370E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.183E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.380E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.183E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.390E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.183E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.400E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.183E+02	0.116E+05	0.399E+04	0.950E+01	0.250E+02
0.410E+00	0.250E+00	0.431E+02	0.346E+05	0.613E+04	0.627E+02	0.507E+05	0.184E+04	0.950E+01	0.250E+02
0.420E+00	0.250E+00	0.438E+02	0.343E+05	0.625E+04	0.629E+02	0.507E+05	0.110E+04	0.950E+01	0.250E+02
0.430E+00	0.250E+00	0.431E+02	0.346E+05	0.636E+04	0.732E+02	0.536E+05	0.116E+04	0.950E+01	0.250E+02
0.440E+00	0.250E+00	0.424E+02	0.311E+05	0.652E+04	0.733E+02	0.533E+05	0.135E+04	0.950E+01	0.250E+02
0.450E+00	0.250E+00	0.190E+02	0.124E+05	0.615E+04	0.193E+02	0.119E+05	0.415E+04	0.950E+01	0.250E+02
0.460E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.173E+02	0.113E+05	0.399E+04	0.950E+01	0.250E+02
0.470E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.173E+02	0.113E+05	0.399E+04	0.950E+01	0.250E+02
0.480E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.173E+02	0.113E+05	0.399E+04	0.950E+01	0.250E+02
0.490E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.173E+02	0.113E+05	0.399E+04	0.950E+01	0.250E+02
0.500E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.173E+02	0.113E+05	0.399E+04	0.950E+01	0.250E+02
0.510E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.173E+02	0.113E+05	0.399E+04	0.950E+01	0.250E+02
0.520E+00	0.250E+00	0.176E+02	0.116E+05	0.393E+04	0.173E+02				

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1+-----+-----+-----+-----+-----+-----+-----+-----+
INPUT DATA: 20-----+-----+-----+-----+-----+-----+
C.600      0.260      0.500      0.827      0.426
9.5 25.0 0 -2 1.800 0.430 0.930 0.960

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1

SOLID FUEL-RAKET & TRAJECTORY

SUMMARY

AOZAR	ASZAR	TIM	XIM	YIM	TIF	X(MAX)	Y(MAX)	TFTF	YFTA
0.250E+00	0.250E+00	0.175E+02	0.109E+05	0.935E+04	0.476E+02	0.279E+05	0.178E+05	0.950E+01	0.450E+02
0.260E+00	0.250E+00	0.175E+02	0.923E+04	0.862E+04	0.459E+02	0.267E+05	0.168E+05	0.950E+01	0.450E+02
0.270E+00	0.250E+00	0.175E+02	0.834E+04	0.784E+04	0.440E+02	0.255E+05	0.158E+05	0.950E+01	0.450E+02
0.280E+00	0.250E+00	0.175E+02	0.745E+04	0.706E+04	0.422E+02	0.243E+05	0.148E+05	0.950E+01	0.450E+02
0.290E+00	0.250E+00	0.169E+02	0.656E+04	0.627E+04	0.405E+02	0.231E+05	0.138E+05	0.950E+01	0.450E+02
0.300E+00	0.250E+00	0.169E+02	0.567E+04	0.548E+04	0.388E+02	0.219E+05	0.128E+05	0.950E+01	0.450E+02
0.310E+00	0.250E+00	0.169E+02	0.478E+04	0.469E+04	0.371E+02	0.207E+05	0.118E+05	0.950E+01	0.450E+02
0.320E+00	0.250E+00	0.169E+02	0.389E+04	0.390E+04	0.354E+02	0.195E+05	0.108E+05	0.950E+01	0.450E+02
0.330E+00	0.250E+00	0.169E+02	0.300E+04	0.311E+04	0.337E+02	0.183E+05	0.98E+04	0.950E+01	0.450E+02
0.340E+00	0.250E+00	0.169E+02	0.211E+04	0.232E+04	0.320E+02	0.171E+05	0.88E+04	0.950E+01	0.450E+02
0.350E+00	0.250E+00	0.169E+02	0.122E+04	0.153E+04	0.303E+02	0.159E+05	0.78E+04	0.950E+01	0.450E+02
0.360E+00	0.250E+00	0.169E+02	0.34E+03	0.55E+03	0.286E+02	0.147E+05	0.68E+04	0.950E+01	0.450E+02
0.370E+00	0.250E+00	0.169E+02	0.25E+03	0.46E+03	0.269E+02	0.135E+05	0.58E+04	0.950E+01	0.450E+02
0.380E+00	0.250E+00	0.169E+02	0.16E+03	0.37E+03	0.252E+02	0.123E+05	0.48E+04	0.950E+01	0.450E+02
0.390E+00	0.250E+00	0.169E+02	0.7E+02	0.18E+03	0.235E+02	0.111E+05	0.38E+04	0.950E+01	0.450E+02
0.400E+00	0.250E+00	0.169E+02	0.2E+02	0.9E+02	0.218E+02	0.1E+05	0.28E+04	0.950E+01	0.450E+02
0.410E+00	0.250E+00	0.169E+02	0.1E+02	0.4E+02	0.201E+02	0.9E+04	0.18E+04	0.950E+01	0.450E+02
0.420E+00	0.250E+00	0.169E+02	0.5E+01	0.2E+02	0.184E+02	0.8E+04	0.8E+03	0.950E+01	0.450E+02
0.430E+00	0.250E+00	0.169E+02	0.2E+01	0.1E+02	0.167E+02	0.7E+04	0.4E+03	0.950E+01	0.450E+02
0.440E+00	0.250E+00	0.169E+02	0.1E+01	0.5E+01	0.150E+02	0.6E+04	0.2E+03	0.950E+01	0.450E+02
0.450E+00	0.250E+00	0.169E+02	0.5E+00	0.2E+01	0.133E+02	0.5E+04	0.1E+03	0.950E+01	0.450E+02
0.460E+00	0.250E+00	0.169E+02	0.2E+00	0.1E+01	0.116E+02	0.4E+04	0.5E+02	0.950E+01	0.450E+02
0.470E+00	0.250E+00	0.169E+02	0.1E+00	0.5E+00	0.1E+02	0.3E+04	0.2E+02	0.950E+01	0.450E+02
0.480E+00	0.250E+00	0.169E+02	0.5E-01	0.2E+00	0.9E+01	0.2E+04	0.1E+02	0.950E+01	0.450E+02
0.490E+00	0.250E+00	0.169E+02	0.2E-01	0.1E+00	0.8E+01	0.1E+04	0.5E+01	0.950E+01	0.450E+02
0.500E+00	0.250E+00	0.169E+02	0.1E-01	0.5E-01	0.7E+01	0.5E+03	0.2E+01	0.950E+01	0.450E+02
0.510E+00	0.250E+00	0.169E+02	0.5E-02	0.2E-01	0.6E+01	0.4E+03	0.1E+01	0.950E+01	0.450E+02
0.520E+00	0.250E+00	0.169E+02	0.2E-02	0.1E-01	0.5E+01	0.3E+03	0.5E+00	0.950E+01	0.450E+02
0.530E+00	0.250E+00	0.169E+02	0.1E-02	0.5E-02	0.4E+01	0.2E+03	0.2E+00	0.950E+01	0.450E+02
0.540E+00	0.250E+00	0.169E+02	0.5E-03	0.2E-02	0.3E+01	0.1E+03	0.1E+00	0.950E+01	0.450E+02
0.550E+00	0.250E+00	0.169E+02	0.2E-03	0.1E-02	0.2E+01	0.5E+02	0.5E+00	0.950E+01	0.450E+02
0.560E+00	0.250E+00	0.169E+02	0.1E-03	0.5E-03	0.1E+01	0.4E+02	0.2E+00	0.950E+01	0.450E+02
0.570E+00	0.250E+00	0.169E+02	0.5E-04	0.2E-03	0.5E+00	0.3E+02	0.1E+00	0.950E+01	0.450E+02
0.580E+00	0.250E+00	0.169E+02	0.2E-04	0.1E-03	0.4E+00	0.2E+02	0.5E+00	0.950E+01	0.450E+02
0.590E+00	0.250E+00	0.169E+02	0.1E-04	0.5E-04	0.3E+00	0.1E+02	0.2E+00	0.950E+01	0.450E+02
0.600E+00	0.250E+00	0.169E+02	0.5E-05	0.2E-04	0.2E+00	0.5E+01	0.1E+00	0.950E+01	0.450E+02
0.610E+00	0.250E+00	0.169E+02	0.2E-05	0.1E-04	0.1E+00	0.4E+01	0.5E+00	0.950E+01	0.450E+02
0.620E+00	0.250E+00	0.169E+02	0.1E-05	0.5E-05	0.5E+00	0.3E+01	0.2E+00	0.950E+01	0.450E+02
0.630E+00	0.250E+00	0.169E+02	0.5E-06	0.2E-05	0.4E+00	0.2E+01	0.1E+00	0.950E+01	0.450E+02
0.640E+00	0.250E+00	0.169E+02	0.2E-06	0.1E-05	0.3E+00	0.1E+01	0.5E+00	0.950E+01	0.450E+02
0.650E+00	0.250E+00	0.169E+02	0.1E-06	0.5E-06	0.2E+00	0.5E+00	0.2E+00	0.950E+01	0.450E+02
0.660E+00	0.250E+00	0.169E+02	0.5E-07	0.2E-06	0.1E+00	0.4E+00	0.1E+00	0.950E+01	0.450E+02
0.670E+00	0.250E+00	0.169E+02	0.2E-07	0.1E-06	0.5E+00	0.3E+00	0.5E+00	0.950E+01	0.450E+02
0.680E+00	0.250E+00	0.169E+02	0.1E-07	0.5E-07	0.4E+00	0.2E+00	0.2E+00	0.950E+01	0.450E+02
0.690E+00	0.250E+00	0.169E+02	0.5E-08	0.2E-07	0.3E+00	0.1E+00	0.1E+00	0.950E+01	0.450E+02
0.700E+00	0.250E+00	0.169E+02	0.2E-08	0.1E-07	0.2E+00	0.5E+00	0.5E+00	0.950E+01	0.450E+02
0.710E+00	0.250E+00	0.169E+02	0.1E-08	0.5E-08	0.1E+00	0.4E+00	0.2E+00	0.950E+01	0.450E+02
0.720E+00	0.250E+00	0.169E+02	0.5E-09	0.2E-08	0.5E+00	0.3E+00	0.1E+00	0.950E+01	0.450E+02
0.730E+00	0.250E+00	0.169E+02	0.2E-09	0.1E-08	0.4E+00	0.2E+00	0.5E+00	0.950E+01	0.450E+02
0.740E+00	0.250E+00	0.169E+02	0.1E-09	0.5E-09	0.3E+00	0.1E+00	0.2E+00	0.950E+01	0.450E+02
0.750E+00	0.250E+00	0.169E+02	0.5E-10	0.2E-09	0.2E+00	0.5E+00	0.1E+00	0.950E+01	0.450E+02
0.760E+00	0.250E+00	0.169E+02	0.2E-10	0.1E-09	0.1E+00	0.4E+00	0.5E+00	0.950E+01	0.450E+02
0.770E+00	0.250E+00	0.169E+02	0.1E-10	0.5E-10	0.5E+00	0.3E+00	0.2E+00	0.950E+01	0.450E+02
0.780E+00	0.250E+00	0.169E+02	0.5E-11	0.2E-10	0.4E+00	0.2E+00	0.1E+00	0.950E+01	0.450E+02
0.790E+00	0.250E+00	0.169E+02	0.2E-11	0.1E-10	0.3E+00	0.1E+00	0.5E+00	0.950E+01	0.450E+02
0.800E+00	0.250E+00	0.169E+02	0.1E-11	0.5E-11	0.2E+00	0.5E+00	0.2E+00	0.950E+01	0.450E+02
0.810E+00	0.250E+00	0.169E+02	0.5E-12	0.2E-11	0.1E+00	0.4E+00	0.1E+00	0.950E+01	0.450E+02
0.820E+00	0.250E+00	0.169E+02	0.2E-12	0.1E-11	0.5E+00	0.3E+00	0.5E+00	0.950E+01	0.450E+02
0.830E+00	0.250E+00	0.169E+02	0.1E-12	0.5E-12	0.4E+00	0.2E+00	0.2E+00	0.950E+01	0.450E+02
0.840E+00	0.250E+00	0.169E+02	0.5E-13	0.2E-12	0.3E+00	0.1E+00	0.1E+00	0.950E+01	0.450E+02
0.850E+00	0.250E+00	0.169E+02	0.2E-13	0.1E-12	0.2E+00	0.5E+00	0.5E+00	0.950E+01	0.450E+02
0.860E+00	0.250E+00	0.169E+02	0.1E-13	0.5E-13	0.1E+00	0.4E+00	0.2E+00	0.950E+01	0.450E+02
0.870E+00	0.250E+00	0.169E+02	0.5E-14	0.2E-13	0.5E+00	0.3E+00	0.1E+00	0.950E+01	0.450E+02
0.880E+00	0.250E+00	0.169E+02	0.2E-14	0.1E-13	0.4E+00	0.2E+00	0.5E+00	0.950E+01	0.450E+02
0.890E+00	0.250E+00	0.169E+02	0.1E-14	0.5E-14	0.3E+00	0.1E+00	0.2E+00	0.950E+01	0.450E+02
0.900E+00	0.250E+00	0.169E+02	0.5E-15	0.2E-14	0.2E+00	0.5E+00	0.1E+00	0.950E+01	0.450E+02
0.910E+00	0.250E+00	0.169E+02	0.2E-15	0.1E-14	0.1E+00	0.4E+00	0.5E+00	0.950E+01	0.450E+02
0.920E+00	0.250E+00	0.169E+02	0.1E-15	0.5E-15	0.5E+00	0.3E+00	0.2E+00	0.950E+01	0.450E+02
0.930E+00	0.250E+00	0.169E+02	0.5E-16	0.2E-15	0.4E+00	0.2E+00	0.1E+00	0.950E+01	0.450E+02
0.940E+00	0.250E+00	0.169E+02	0.2E-16	0.1E-15	0.3E+00	0.1E+00	0.5E+00	0.950E+01	0.450E+02
0.950E+00	0.250E+00	0.169E+02	0.1E-16	0.5E-16	0.2E+00	0.5E+00	0.2E+00	0.950E+01	0.450E+02
0.960E+00	0.250E+00	0.169E+02	0.5E-17	0.2E-16	0.1E+00	0.4E+00	0.1E+00	0.950E+01	0.450E+02
0.970E+00	0.250E+00	0.169E+02	0.2E-17	0.1E-16	0.5E+00	0.3E+00	0.5E+00	0.950E+01	0.450E+02
0.980E+00	0.250E+00	0.169E+02	0.1E-17	0.5E-17	0.4E+00	0.2E+00	0.2E+00	0.950E+01	0.450E+02
0.990E+00	0.250E+00	0.169E+02	0.5E-18	0.2E-17	0.3E+00	0.1E+00	0.1E+00	0.950E+01	0.450E+02
1.000E+00	0.250E+00	0.169E+02	0.2E-18	0.1E-17	0.2E+00	0.5E+00	0.5E+00	0.950E+01	0.450E+02

1.000E+00 0.250E+00 0.169E+02 0.109E+05 0.935E+04 0.476E+02 0.279E+05 0.178E+05 0.950E+01 0.450E+02

0.420 0.267 0.500 0.477 0.426

0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5

1 SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AQ/AM	AS/AP	TOM	XOM	YOM	TOF	X(MAX)	Y(MAX)	TFYP	TETA
C.250F+00	C.250F+00	0.351E+02	0.222E+05	0.158E+05	0.132E+03	0.751E+05	-0.295E+02	0.950E+01	0.450E+02
C.240F+00	0.250F+00	0.346E+02	0.222E+05	0.159F+05	0.133E+03	0.772E+05	-0.774E+02	0.950E+01	0.450E+02
C.230F+00	0.250F+00	0.345E+02	0.223E+05	0.160F+05	0.133E+03	0.788F+05	-0.544F+02	0.950F+01	0.450F+02
C.220F+00	0.250F+00	0.344E+02	0.223E+05	0.162E+05	0.136E+03	0.806F+05	-0.313F+01	0.950F+01	0.450F+02
C.210F+00	0.250F+00	0.343E+02	0.223E+02	0.162E+05	0.136E+03	0.806F+05	-0.313F+01	0.950F+01	0.450F+02
C.200F+00	0.250F+00	0.342E+02	0.216F+05	0.169F+05	0.238F+03	0.813F+05	-0.176F+02	0.950F+01	0.450F+02
C.190F+00	0.250F+00	0.320F+02	0.213F+05	0.159F+05	0.191F+03	0.863F+05	-0.176F+02	0.950F+01	0.450F+02
C.180F+00	0.250F+00	0.330E+02	0.231F+05	0.153E+05	0.134F+03	0.844F+05	-0.303F+02	0.950F+01	0.450F+02
C.170F+00	0.250F+00	0.318E+02	0.188F+05	0.806E+04	0.193E+02	0.950E+05	0.836E+04	0.950F+01	0.450F+02
C.160F+00	0.250F+00	0.318E+02	0.188F+05	0.806E+04	0.193E+02	0.950E+05	0.836E+04	0.950F+01	0.450F+02
C.150F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.140F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.130F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.120F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.110F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.100F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.90F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.80F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.70F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.60F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.50F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.40F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.30F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.20F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.10F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02
C.00F+00	0.250F+00	0.169E+02	0.974E+04	0.702E+04	0.175E+02	0.924E+04	0.782E+04	0.950F+01	0.450F+02

INPUT RATE		0.250		0.420		0.827		0.426	
9.5	45.0	0.2	1.000	0.930	0.530	0.960			

1

SOLSD FUGC RAKUFI & TRAJEC FUGV

SUMMARY

[illegible]

STUDY OF WAGON & TRAJECTORY

SUMMARY

AU/R	AS/R	T09	X-38	Y00	T07	X1MAX1	Y1MAX1	T07P	T07A
0.250E+00	0.250E+00	0.250E+00	0.133E+05	0.134E+05	0.130E+03	0.704E+08	-0.212E+02	0.950E+01	0.450E+02
0.260E+00	0.250E+00	0.250E+00	0.163E+05	0.129E+05	0.130E+03	0.704E+08	-0.245E+02	0.950E+01	0.450E+02
0.270E+00	0.250E+00	0.250E+00	0.156E+05	0.125E+05	0.130E+03	0.711E+08	-0.135E+02	0.950E+01	0.450E+02
0.280E+00	0.250E+00	0.250E+00	0.145E+05	0.118E+05	0.130E+03	0.710E+08	-0.176E+02	0.950E+01	0.450E+02
0.290E+00	0.250E+00	0.250E+00	0.129E+05	0.108E+05	0.127E+03	0.699E+08	-0.100E+02	0.950E+01	0.450E+02
0.300E+00	0.250E+00	0.250E+00	0.117E+05	0.105E+05	0.122E+03	0.655E+08	0.805E+00	0.950E+01	0.450E+02
0.310E+00	0.250E+00	0.250E+00	0.108E+05	0.106E+05	0.115E+03	0.635E+08	0.116E+00	0.950E+01	0.450E+02
0.320E+00	0.250E+00	0.250E+00	0.100E+05	0.100E+05	0.112E+03	0.620E+08	0.140E+00	0.950E+01	0.450E+02
0.330E+00	0.250E+00	0.250E+00	0.097E+05	0.097E+05	0.105E+03	0.595E+08	0.178E+00	0.950E+01	0.450E+02
0.340E+00	0.250E+00	0.250E+00	0.090E+05	0.092E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.350E+00	0.250E+00	0.250E+00	0.087E+05	0.092E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.360E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.370E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.380E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.390E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.400E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.410E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.420E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.430E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.440E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.450E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.460E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.470E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.480E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.490E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.500E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.510E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.520E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.530E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.540E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.550E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.560E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.570E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.580E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.590E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.600E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.610E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.620E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.630E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.640E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.650E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.660E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.670E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.680E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.690E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.700E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.710E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.720E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.730E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.740E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.750E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.760E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.770E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.780E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.790E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.800E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.810E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.820E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.830E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.840E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.850E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.860E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.870E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.880E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.890E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.900E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.910E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.920E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.930E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.940E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.950E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.960E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.970E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.980E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
0.990E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02
1.000E+00	0.250E+00	0.250E+00	0.087E+05	0.082E+05	0.102E+03	0.574E+08	0.178E+00	0.950E+01	0.450E+02

[illegible]

INPUT DATA:

0.400	0.280	0.470	0.912	0.476
4.5 45.0	0 -2 1.000	0.430	0.930	0.960

4.5	45.0	0 - 2	1,000	(1.430)	0.930	(1.960)
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SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	AS/AR	YOM	XOM	YOM	TOF	X(MAX)	Y(MAX)	TFIP	YETA
0.250E+00	0.250E+00	0.265E+02	0.168E+03	0.131E+05	0.120E+03	0.700E+05	-0.727E+03	0.950E+01	0.450E+02
0.270E+00	0.250E+00	0.248E+02	0.153E+03	0.173E+05	0.131E+03	0.710E+05	-0.718E+03	0.950E+01	0.451E+02
0.290E+00	0.250E+00	0.193E+02	0.125E+03	0.106E+05	0.120E+03	0.687E+05	-0.765E+03	0.950E+01	0.450E+02
0.310E+00	0.250E+00	0.122E+02	0.099E+04	0.121E+04	0.431E+02	0.752E+05	-0.166E+05	0.950E+01	0.450E+02
0.330E+00	0.250E+00	0.167E+02	0.103E+05	0.859E+04	0.193E+02	0.103E+05	0.859E+04	0.950E+01	0.450E+02
0.340E+00	0.250E+00	0.187E+02	0.147E+05	0.854E+04	0.196E+02	0.104E+05	0.864E+04	0.950E+01	0.450E+02
0.350E+00	0.250E+00	0.187E+02	0.147E+05	0.854E+04	0.196E+02	0.104E+05	0.864E+04	0.950E+01	0.450E+02
0.360E+00	0.250E+00	0.187E+02	0.134E+05	0.855E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.370E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.450E+02
0.380E+00	0.250E+00	0.187E+02	0.134E+05	0.855E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.390E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.400E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.410E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.420E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.430E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.440E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.450E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.460E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.470E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.480E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.490E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.500E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.510E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.520E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.530E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.540E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.550E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.560E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.570E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.580E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.590E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.600E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.610E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.620E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.630E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.640E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.650E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.660E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.670E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.680E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.690E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.700E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.710E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.720E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.730E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.740E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.750E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.760E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.770E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.780E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.790E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.800E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.810E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.820E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.830E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.840E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.850E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.860E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.870E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.880E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.890E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.900E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.910E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.920E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.930E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.940E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.950E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.960E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.970E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.980E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
0.990E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02
1.000E+00	0.250E+00	0.187E+02	0.104E+05	0.865E+04	0.194E+02	0.104E+05	0.865E+04	0.950E+01	0.451E+02

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SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AOZAR	ASZAR	TON	XOR	VIR	TOF	X(MAX)	Y(MAX)	YCTP	TEYA
0.250E+00	0.250E+00	0.388E+02	0.259E+05	0.191E+05	0.138E+03	0.841E+05	-0.100E+03	0.650E+01	0.450E+02
0.260E+00	0.250E+00	0.371E+02	0.250E+05	0.178E+05	0.140E+03	0.859E+05	-0.305E+03	0.250E+01	0.450E+02
0.270E+00	0.250E+00	0.363E+02	0.246E+05	0.178E+05	0.140E+03	0.872E+05	-0.305E+03	0.650E+01	0.450E+02
0.280E+00	0.250E+00	0.351E+02	0.240E+05	0.176E+05	0.147E+03	0.887E+05	-0.119E+03	0.650E+01	0.450E+02
0.290E+00	0.250E+00	0.338E+02	0.233E+05	0.173E+05	0.143E+03	0.901E+05	-0.260E+03	0.650E+01	0.450E+02
0.300E+00	0.250E+00	0.325E+02	0.218E+05	0.164E+05	0.151E+03	0.916E+05	-0.114E+03	0.250E+01	0.450E+02
0.310E+00	0.250E+00	0.312E+02	0.198E+05	0.150E+05	0.158E+03	0.931E+05	0.110E+03	0.650E+01	0.450E+02
0.320E+00	0.250E+00	0.300E+02	0.182E+05	0.131E+05	0.163E+03	0.946E+05	0.111E+03	0.650E+01	0.450E+02
0.330E+00	0.250E+00	0.287E+02	0.162E+05	0.111E+05	0.168E+03	0.961E+05	0.111E+03	0.650E+01	0.450E+02
0.340E+00	0.250E+00	0.275E+02	0.142E+05	0.111E+05	0.173E+03	0.976E+05	0.111E+03	0.650E+01	0.450E+02
0.350E+00	0.250E+00	0.262E+02	0.122E+05	0.111E+05	0.178E+03	0.991E+05	0.111E+03	0.650E+01	0.450E+02
0.360E+00	0.250E+00	0.250E+02	0.102E+05	0.111E+05	0.183E+03	0.100E+06	0.111E+03	0.650E+01	0.450E+02
0.370E+00	0.250E+00	0.237E+02	0.082E+05	0.111E+05	0.188E+03	0.101E+06	0.111E+03	0.650E+01	0.450E+02
0.380E+00	0.250E+00	0.225E+02	0.062E+05	0.111E+05	0.193E+03	0.102E+06	0.111E+03	0.650E+01	0.450E+02
0.390E+00	0.250E+00	0.212E+02	0.042E+05	0.111E+05	0.198E+03	0.103E+06	0.111E+03	0.650E+01	0.450E+02
0.400E+00	0.250E+00	0.200E+02	0.022E+05	0.111E+05	0.203E+03	0.104E+06	0.111E+03	0.650E+01	0.450E+02
0.250E+00	0.240E+00	0.417E+02	0.272E+05	0.177E+05	0.139E+03	0.841E+05	-0.100E+03	0.650E+01	0.450E+02
0.260E+00	0.240E+00	0.406E+02	0.272E+05	0.177E+05	0.139E+03	0.861E+05	-0.154E+03	0.650E+01	0.450E+02
0.270E+00	0.240E+00	0.398E+02	0.259E+05	0.177E+05	0.141E+03	0.878E+05	-0.154E+03	0.650E+01	0.450E+02
0.280E+00	0.240E+00	0.386E+02	0.243E+05	0.176E+05	0.142E+03	0.893E+05	-0.192E+03	0.650E+01	0.450E+02
0.290E+00	0.240E+00	0.373E+02	0.223E+05	0.176E+05	0.143E+03	0.910E+05	-0.288E+03	0.650E+01	0.450E+02
0.300E+00	0.240E+00	0.361E+02	0.203E+05	0.176E+05	0.144E+03	0.926E+05	-0.124E+03	0.650E+01	0.450E+02
0.310E+00	0.240E+00	0.348E+02	0.183E+05	0.176E+05	0.145E+03	0.943E+05	0.108E+03	0.650E+01	0.450E+02
0.320E+00	0.240E+00	0.336E+02	0.163E+05	0.176E+05	0.146E+03	0.959E+05	0.108E+03	0.650E+01	0.450E+02
0.330E+00	0.240E+00	0.323E+02	0.143E+05	0.176E+05	0.147E+03	0.976E+05	0.108E+03	0.650E+01	0.450E+02
0.340E+00	0.240E+00	0.311E+02	0.123E+05	0.176E+05	0.148E+03	0.993E+05	0.108E+03	0.650E+01	0.450E+02
0.350E+00	0.240E+00	0.298E+02	0.103E+05	0.176E+05	0.149E+03	0.101E+06	0.108E+03	0.650E+01	0.450E+02
0.360E+00	0.240E+00	0.286E+02	0.083E+05	0.176E+05	0.150E+03	0.102E+06	0.108E+03	0.650E+01	0.450E+02
0.370E+00	0.240E+00	0.273E+02	0.063E+05	0.176E+05	0.151E+03	0.103E+06	0.108E+03	0.650E+01	0.450E+02
0.380E+00	0.240E+00	0.261E+02	0.043E+05	0.176E+05	0.152E+03	0.104E+06	0.108E+03	0.650E+01	0.450E+02
0.390E+00	0.240E+00	0.248E+02	0.023E+05	0.176E+05	0.153E+03	0.105E+06	0.108E+03	0.650E+01	0.450E+02
0.400E+00	0.240E+00	0.236E+02	0.003E+05	0.176E+05	0.154E+03	0.106E+06	0.108E+03	0.650E+01	0.450E+02

INPUT DATA:
C=400 0.260 0.410 0.877 0.475
6.5 45.0 0 -2 1.400 0.030 0.030 0.060

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SOLID FUEL RAMJET & TRAJECTORY

SUMMARY

AO/AR	AS/AR	TOP	XHM	YH	THF	XEMAXI	YEMAXI	YETP	YETA
0.250E+00	0.250E+00	0.248E+02	0.186E+02	0.111E+02	0.133E+02	0.721E+02	-0.113E+02	0.115E+02	0.450E+02
0.260E+00	0.250E+00	0.247E+02	0.184E+02	0.110E+02	0.132E+02	0.747E+02	-0.112E+02	0.115E+02	0.450E+02
0.270E+00	0.250E+00	0.246E+02	0.182E+02	0.109E+02	0.131E+02	0.774E+02	-0.111E+02	0.114E+02	0.450E+02
0.280E+00	0.250E+00	0.245E+02	0.181E+02	0.108E+02	0.130E+02	0.801E+02	-0.110E+02	0.114E+02	0.450E+02
0.290E+00	0.250E+00	0.244E+02	0.180E+02	0.107E+02	0.129E+02	0.828E+02	-0.109E+02	0.113E+02	0.450E+02
0.300E+00	0.250E+00	0.243E+02	0.179E+02	0.106E+02	0.128E+02	0.855E+02	-0.108E+02	0.113E+02	0.450E+02
0.310E+00	0.250E+00	0.242E+02	0.178E+02	0.105E+02	0.127E+02	0.882E+02	-0.107E+02	0.112E+02	0.450E+02
0.320E+00	0.250E+00	0.241E+02	0.177E+02	0.104E+02	0.126E+02	0.909E+02	-0.106E+02	0.112E+02	0.450E+02
0.330E+00	0.250E+00	0.240E+02	0.176E+02	0.103E+02	0.125E+02	0.936E+02	-0.105E+02	0.111E+02	0.450E+02
0.340E+00	0.250E+00	0.239E+02	0.175E+02	0.102E+02	0.124E+02	0.963E+02	-0.104E+02	0.111E+02	0.450E+02
0.350E+00	0.250E+00	0.238E+02	0.174E+02	0.101E+02	0.123E+02	0.990E+02	-0.103E+02	0.110E+02	0.450E+02
0.360E+00	0.250E+00	0.237E+02	0.173E+02	0.100E+02	0.122E+02	0.1017E+03	-0.102E+02	0.110E+02	0.450E+02
0.370E+00	0.250E+00	0.236E+02	0.172E+02	0.099E+02	0.121E+02	0.1044E+03	-0.101E+02	0.109E+02	0.450E+02
0.380E+00	0.250E+00	0.235E+02	0.171E+02	0.098E+02	0.120E+02	0.1071E+03	-0.100E+02	0.109E+02	0.450E+02
0.390E+00	0.250E+00	0.234E+02	0.170E+02	0.097E+02	0.119E+02	0.1098E+03	-0.099E+02	0.108E+02	0.450E+02
0.400E+00	0.250E+00	0.233E+02	0.169E+02	0.096E+02	0.118E+02	0.1125E+03	-0.098E+02	0.108E+02	0.450E+02
0.410E+00	0.250E+00	0.232E+02	0.168E+02	0.095E+02	0.117E+02	0.1152E+03	-0.097E+02	0.107E+02	0.450E+02
0.420E+00	0.250E+00	0.231E+02	0.167E+02	0.094E+02	0.116E+02	0.1179E+03	-0.096E+02	0.107E+02	0.450E+02
0.430E+00	0.250E+00	0.230E+02	0.166E+02	0.093E+02	0.115E+02	0.1206E+03	-0.095E+02	0.106E+02	0.450E+02
0.440E+00	0.250E+00	0.229E+02	0.165E+02	0.092E+02	0.114E+02	0.1233E+03	-0.094E+02	0.106E+02	0.450E+02
0.450E+00	0.250E+00	0.228E+02	0.164E+02	0.091E+02	0.113E+02	0.1260E+03	-0.093E+02	0.105E+02	0.450E+02
0.460E+00	0.250E+00	0.227E+02	0.163E+02	0.090E+02	0.112E+02	0.1287E+03	-0.092E+02	0.105E+02	0.450E+02
0.470E+00	0.250E+00	0.226E+02	0.162E+02	0.089E+02	0.111E+02	0.1314E+03	-0.091E+02	0.104E+02	0.450E+02
0.480E+00	0.250E+00	0.225E+02	0.161E+02	0.088E+02	0.110E+02	0.1341E+03	-0.090E+02	0.104E+02	0.450E+02
0.490E+00	0.250E+00	0.224E+02	0.160E+02	0.087E+02	0.109E+02	0.1368E+03	-0.089E+02	0.103E+02	0.450E+02
0.500E+00	0.250E+00	0.223E+02	0.159E+02	0.086E+02	0.108E+02	0.1395E+03	-0.088E+02	0.103E+02	0.450E+02
0.510E+00	0.250E+00	0.222E+02	0.158E+02	0.085E+02	0.107E+02	0.1422E+03	-0.087E+02	0.102E+02	0.450E+02
0.520E+00	0.250E+00	0.221E+02	0.157E+02	0.084E+02	0.106E+02	0.1449E+03	-0.086E+02	0.102E+02	0.450E+02
0.530E+00	0.250E+00	0.220E+02	0.156E+02	0.083E+02	0.105E+02	0.1476E+03	-0.085E+02	0.101E+02	0.450E+02
0.540E+00	0.250E+00	0.219E+02	0.155E+02	0.082E+02	0.104E+02	0.1503E+03	-0.084E+02	0.101E+02	0.450E+02
0.550E+00	0.250E+00	0.218E+02	0.154E+02	0.081E+02	0.103E+02	0.1530E+03	-0.083E+02	0.100E+02	0.450E+02
0.560E+00	0.250E+00	0.217E+02	0.153E+02	0.080E+02	0.102E+02	0.1557E+03	-0.082E+02	0.100E+02	0.450E+02
0.570E+00	0.250E+00	0.216E+02	0.152E+02	0.079E+02	0.101E+02	0.1584E+03	-0.081E+02	0.099E+02	0.450E+02
0.580E+00	0.250E+00	0.215E+02	0.151E+02	0.078E+02	0.100E+02	0.1611E+03	-0.080E+02	0.099E+02	0.450E+02
0.590E+00	0.250E+00	0.214E+02	0.150E+02	0.077E+02	0.099E+02	0.1638E+03	-0.079E+02	0.098E+02	0.450E+02
0.600E+00	0.250E+00	0.213E+02	0.149E+02	0.076E+02	0.098E+02	0.1665E+03	-0.078E+02	0.098E+02	0.450E+02
0.610E+00	0.250E+00	0.212E+02	0.148E+02	0.075E+02	0.097E+02	0.1692E+03	-0.077E+02	0.097E+02	0.450E+02
0.620E+00	0.250E+00	0.211E+02	0.147E+02	0.074E+02	0.096E+02	0.1719E+03	-0.076E+02	0.097E+02	0.450E+02
0.630E+00	0.250E+00	0.210E+02	0.146E+02	0.073E+02	0.095E+02	0.1746E+03	-0.075E+02	0.096E+02	0.450E+02
0.640E+00	0.250E+00	0.209E+02	0.145E+02	0.072E+02	0.094E+02	0.1773E+03	-0.074E+02	0.096E+02	0.450E+02
0.650E+00	0.250E+00	0.208E+02	0.144E+02	0.071E+02	0.093E+02	0.1800E+03	-0.073E+02	0.095E+02	0.450E+02
0.660E+00	0.250E+00	0.207E+02	0.143E+02	0.070E+02	0.092E+02	0.1827E+03	-0.072E+02	0.095E+02	0.450E+02
0.670E+00	0.250E+00	0.206E+02	0.142E+02	0.069E+02	0.091E+02	0.1854E+03	-0.071E+02	0.094E+02	0.450E+02
0.680E+00	0.250E+00	0.205E+02	0.141E+02	0.068E+02	0.090E+02	0.1881E+03	-0.070E+02	0.094E+02	0.450E+02
0.690E+00	0.250E+00	0.204E+02	0.140E+02	0.067E+02	0.089E+02	0.1908E+03	-0.069E+02	0.093E+02	0.450E+02
0.700E+00	0.250E+00	0.203E+02	0.139E+02	0.066E+02	0.088E+02	0.1935E+03	-0.068E+02	0.093E+02	0.450E+02
0.710E+00	0.250E+00	0.202E+02	0.138E+02	0.065E+02	0.087E+02	0.1962E+03	-0.067E+02	0.092E+02	0.450E+02
0.720E+00	0.250E+00	0.201E+02	0.137E+02	0.064E+02	0.086E+02	0.1989E+03	-0.066E+02	0.092E+02	0.450E+02
0.730E+00	0.250E+00	0.200E+02	0.136E+02	0.063E+02	0.085E+02	0.2016E+03	-0.065E+02	0.091E+02	0.450E+02
0.740E+00	0.250E+00	0.199E+02	0.135E+02	0.062E+02	0.084E+02	0.2043E+03	-0.064E+02	0.091E+02	0.450E+02
0.750E+00	0.250E+00	0.198E+02	0.134E+02	0.061E+02	0.083E+02	0.2070E+03	-0.063E+02	0.090E+02	0.450E+02
0.760E+00	0.250E+00	0.197E+02	0.133E+02	0.060E+02	0.082E+02	0.2097E+03	-0.062E+02	0.090E+02	0.450E+02
0.770E+00	0.250E+00	0.196E+02	0.132E+02	0.059E+02	0.081E+02	0.2124E+03	-0.061E+02	0.089E+02	0.450E+02
0.780E+00	0.250E+00	0.195E+02	0.131E+02	0.058E+02	0.080E+02	0.2151E+03	-0.060E+02	0.089E+02	0.450E+02
0.790E+00	0.250E+00	0.194E+02	0.130E+02	0.057E+02	0.079E+02	0.2178E+03	-0.059E+02	0.088E+02	0.450E+02
0.800E+00	0.250E+00	0.193E+02	0.129E+02	0.056E+02	0.078E+02	0.2205E+03	-0.058E+02	0.088E+02	0.450E+02
0.810E+00	0.250E+00	0.192E+02	0.128E+02	0.055E+02	0.077E+02	0.2232E+03	-0.057E+02	0.087E+02	0.450E+02
0.820E+00	0.250E+00	0.191E+02	0.127E+02	0.054E+02	0.076E+02	0.2259E+03	-0.056E+02	0.087E+02	0.450E+02
0.830E+00	0.250E+00	0.190E+02	0.126E+02	0.053E+02	0.075E+02	0.2286E+03	-0.055E+02	0.086E+02	0.450E+02
0.840E+00	0.250E+00	0.189E+02	0.125E+02	0.052E+02	0.074E+02	0.2313E+03	-0.054E+02	0.086E+02	0.450E+02
0.850E+00	0.250E+00	0.188E+02	0.124E+02	0.051E+02	0.073E+02	0.2340E+03	-0.053E+02	0.085E+02	0.450E+02
0.860E+00	0.250E+00	0.187E+02	0.123E+02	0.050E+02	0.072E+02	0.2367E+03	-0.052E+02	0.085E+02	0.450E+02
0.870E+00	0.250E+00	0.186E+02	0.122E+02	0.049E+02	0.071E+02	0.2394E+03	-0.051E+02	0.084E+02	0.450E+02
0.880E+00	0.250E+00	0.185E+02	0.121E+02	0.048E+02	0.070E+02	0.2421E+03	-0.050E+02	0.084E+02	0.450E+02
0.890E+00	0.250E+00	0.184E+02	0.120E+02	0.047E+02	0.069E+02	0.2448E+03	-0.049E+02	0.083E+02	0.450E+02
0.900E+00	0.250E+00	0.183E+02	0.119E+02	0.046E+02	0.068E+02	0.2475E+03	-0.048E+02	0.083E+02	0.450E+02
0.910E+00	0.250E+00	0.182E+02	0.118E+02	0.045E+02	0.067E+02	0.2502E+03	-0.047E+02	0.082E+02	0.450E+02
0.920E+00	0.250E+00	0.181E+02	0.117E+02	0.044E+02	0.066E+02	0.2529E+03	-0.046E+02	0.082E+02	0.450E+02
0.930E+00	0.250E+00	0.180E+02	0.116E+02	0.043E+02	0.065E+02	0.2556E+03	-0.045E+02	0.081E+02	0.450E+02
0.940E+00	0.250E+00	0.179E+02	0.115E+02	0.042E+02	0.064E+02	0.2583E+03	-0.044E+02	0.081E+02	0.450E+02
0.950E+00	0.250E+00	0.178E+02	0.114E+02	0.041E+02	0.063E+02	0.2610E+03	-0.043E+02	0.080E+02	0.450E+02
0.960E+00	0.250E+00	0.177E+02	0.113E+02	0.040E+02	0.062E+02	0.2637E+03	-0.042E+02	0.080E+02	0.450E+02
0.970E+00	0.250E+00	0.176E+02	0.112E+02	0.039E+02	0.061E+02	0.2664E+03	-0.041E+02	0.079E+02	0.450E+02
0.980E+00	0.250E+00	0.175E+02	0.111E+02	0.038E+02	0.060E+02	0.2691E+03	-0.040E+02	0.079E+02	0.450E+02
0.990E+00	0.250E+00	0.174E+02	0.110E+02	0.037E+02	0.059E+02	0.2718E+03	-0.039E+02	0.078E+02	0.450E+02
1.000E+00	0.250E+00	0.173E+02	0.109E+02	0.036E+02	0.058E+02	0.2745E+03	-0.038E+02	0.078E+02	0.450E+02

1+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
 INPUT DATA:
 0.400 0.260 0.470 0.871 0.426
 11.5 45.0 0 -2 1.400 0.930 0.930 0.960

H2. DETAILED RESULTS

A_0/A_r	A_1/A_0	A_2/A_0	A_3/A_r	A_5/A_r	θ_p	θ
0.28	0.47	0.827	0.426	0.26	9.5	15
0.28	0.42	0.827	0.426	0.26	9.5	45
0.28	0.47	0.887	0.426	0.26	9.5	45
0.28	0.47	0.91	0.426	0.26	9.5	45
0.28	0.47	0.827	0.47	0.26	9.5	45
0.25	0.47	0.827	0.426	0.26	9.5	60
0.28	0.47	0.827	0.426	0.26	6.5	45

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CCC SOLID ENVI MANJEV CCC
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GEOMETRICAL DATA

APPT= C.1245E-01M2 L3= 0.5842E+00M TF7P= 9.5

A0/A0F	A1/A0	A1/A0	A2/A0	A3/A0F	A5/A0F	A6/A5
0.7800	0.8194	0.4700	0.8765	0.4250	0.7600	3.8467

NO	NIC	MA
2.5136	2.311K	2.6646

CONSTANT (OSSES)

PIG1= 0.930 PID2= 0.930 P1P= 0.960

INITIAL FLIGHT CONDITIONS:

POIRG/M2	TOIRK	NOIRG/M2	PTORG/M2	TIORK	GA
0.1037+05	0.2887+05	0.1222+01	0.1667+01	0.4595+01	1.400

TIME	MO	AS/A0	MA	M/A0	M2	M3	M4	TOTAL PERS. STIFFS										CF	F/M1	CF	F/M1
								10/0	12/11	3/2	4/3	6/0	GF	11/41	12/11	13/12	14/13				
0.23	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
0.46	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
0.69	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
0.91	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
1.14	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
1.37	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
1.59	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
1.82	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
2.05	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
2.28	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
2.50	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
2.73	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
2.96	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
3.19	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
3.42	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
3.64	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
3.87	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
4.10	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
4.33	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
4.56	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
4.78	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
5.01	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
5.24	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
5.46	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
5.69	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
5.92	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
6.15	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
6.38	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			
6.60	2.33	0.509	2.977	6.506	0.327	0.163	0.180	0.395	0.996	0.938	0.945	0.940	0.620	1.25	2258.0	0.242	1270.6	7094.0			

RAMJET TRAJECTORY

LPR NPS A30 A0/AR AS/A* LS U0 U WR TDEV
 0.155E+01 0.475E+02 0.540E-02 0.280E+00 0.260E+00 0.584E+00 0.762E+03 0.863E+01 0.199E+01 0.455E+02

TI	X3	V3	TFTE	NO	PO	PMIA	TQ	MJA	WDF	ORAG	THRUST
0.278E+00	1.380E+03	0.101E+05	0.149E+02	2.534	0.173E+05	0.122E+01	0.288E+03	0.179E-04	47.5	1381.3	1376.6
0.14E+01	0.114E+04	0.297E+03	0.147E+02	2.533	0.101E+05	0.120E+01	0.287E+03	0.178E-04	47.1	1353.0	1378.4
0.205E+01	0.190E+04	0.486E+03	0.137E+02	2.534	0.288E+04	0.119E+01	0.286E+03	0.177E-04	47.2	1378.9	1381.3
0.266E+01	0.266E+04	0.666E+03	0.131E+02	2.534	0.458E+04	0.118E+01	0.285E+03	0.176E-04	47.3	1385.0	1378.6
0.327E+01	0.342E+04	0.846E+03	0.125E+02	2.541	0.644E+04	0.117E+01	0.284E+03	0.175E-04	46.3	1378.1	1372.3
0.488E+01	0.418E+04	0.101E+04	0.123E+02	2.544	0.910E+04	0.116E+01	0.282E+03	0.174E-04	46.7	1264.3	1361.0
0.569E+01	0.572E+04	0.110E+04	0.114E+02	2.545	0.912E+04	0.115E+01	0.281E+03	0.173E-04	46.6	1245.3	1341.8
0.650E+01	0.672E+04	0.111E+04	0.108E+02	2.545	0.945E+04	0.115E+01	0.280E+03	0.172E-04	46.4	1224.1	1318.5
0.731E+01	0.688E+04	0.115E+04	0.102E+02	2.545	0.940E+04	0.114E+01	0.279E+03	0.171E-04	46.1	1211.8	1291.1
0.812E+01	0.688E+04	0.115E+04	0.102E+02	2.545	0.853E+04	0.114E+01	0.278E+03	0.171E-04	46.2	1186.6	1291.4
0.893E+01	0.633E+04	0.113E+04	0.100E+02	2.542	0.753E+04	0.114E+01	0.278E+03	0.171E-04	46.0	1169.3	1271.1
0.974E+01	0.633E+04	0.113E+04	0.100E+02	2.542	0.818E+04	0.114E+01	0.277E+03	0.170E-04	45.8	1169.3	1271.1
0.105E+02	0.958E+04	0.104E+04	0.098E+02	2.584	0.827E+04	0.113E+01	0.276E+03	0.170E-04	45.6	1167.5	1261.1
0.112E+02	0.958E+04	0.104E+04	0.098E+02	2.590	0.816E+04	0.113E+01	0.275E+03	0.170E-04	45.7	1166.5	1261.5
0.121E+02	0.104E+05	0.206E+04	0.097E+02	2.599	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.130E+02	0.111E+05	0.212E+04	0.096E+02	2.600	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.139E+02	0.119E+05	0.222E+04	0.095E+02	2.600	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.148E+02	0.128E+05	0.232E+04	0.094E+02	2.603	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.157E+02	0.137E+05	0.242E+04	0.093E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.166E+02	0.146E+05	0.252E+04	0.092E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.175E+02	0.155E+05	0.262E+04	0.091E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.184E+02	0.164E+05	0.272E+04	0.090E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.193E+02	0.173E+05	0.282E+04	0.089E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.202E+02	0.182E+05	0.292E+04	0.088E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.211E+02	0.191E+05	0.302E+04	0.087E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.220E+02	0.200E+05	0.312E+04	0.086E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.229E+02	0.209E+05	0.322E+04	0.085E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.238E+02	0.218E+05	0.332E+04	0.084E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.247E+02	0.227E+05	0.342E+04	0.083E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.256E+02	0.236E+05	0.352E+04	0.082E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.265E+02	0.245E+05	0.362E+04	0.081E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.274E+02	0.254E+05	0.372E+04	0.080E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.283E+02	0.263E+05	0.382E+04	0.079E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.292E+02	0.272E+05	0.392E+04	0.078E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.301E+02	0.281E+05	0.402E+04	0.077E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.310E+02	0.290E+05	0.412E+04	0.076E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.319E+02	0.299E+05	0.422E+04	0.075E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.328E+02	0.308E+05	0.432E+04	0.074E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.337E+02	0.317E+05	0.442E+04	0.073E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.346E+02	0.326E+05	0.452E+04	0.072E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.355E+02	0.335E+05	0.462E+04	0.071E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.364E+02	0.344E+05	0.472E+04	0.070E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.373E+02	0.353E+05	0.482E+04	0.069E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.382E+02	0.362E+05	0.492E+04	0.068E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.391E+02	0.371E+05	0.502E+04	0.067E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.400E+02	0.380E+05	0.512E+04	0.066E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.409E+02	0.389E+05	0.522E+04	0.065E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.418E+02	0.398E+05	0.532E+04	0.064E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.427E+02	0.407E+05	0.542E+04	0.063E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.436E+02	0.416E+05	0.552E+04	0.062E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.445E+02	0.425E+05	0.562E+04	0.061E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.454E+02	0.434E+05	0.572E+04	0.060E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.463E+02	0.443E+05	0.582E+04	0.059E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.472E+02	0.452E+05	0.592E+04	0.058E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.481E+02	0.461E+05	0.602E+04	0.057E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.490E+02	0.470E+05	0.612E+04	0.056E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.499E+02	0.479E+05	0.622E+04	0.055E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.508E+02	0.488E+05	0.632E+04	0.054E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.517E+02	0.497E+05	0.642E+04	0.053E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.526E+02	0.506E+05	0.652E+04	0.052E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.535E+02	0.515E+05	0.662E+04	0.051E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.544E+02	0.524E+05	0.672E+04	0.050E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.553E+02	0.533E+05	0.682E+04	0.049E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.562E+02	0.542E+05	0.692E+04	0.048E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.571E+02	0.551E+05	0.702E+04	0.047E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.580E+02	0.560E+05	0.712E+04	0.046E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.589E+02	0.569E+05	0.722E+04	0.045E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.598E+02	0.578E+05	0.732E+04	0.044E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.607E+02	0.587E+05	0.742E+04	0.043E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.616E+02	0.596E+05	0.752E+04	0.042E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.625E+02	0.605E+05	0.762E+04	0.041E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.634E+02	0.614E+05	0.772E+04	0.040E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.643E+02	0.623E+05	0.782E+04	0.039E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.652E+02	0.632E+05	0.792E+04	0.038E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.661E+02	0.641E+05	0.802E+04	0.037E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.170E-04	45.6	1167.5	1272.1
0.670E+02	0.650E+05	0.812E+04	0.036E+02	2.612	0.856E+04	0.113E+01	0.275E+03	0.			

FILED DRG 0 1 A NAVAL POSTGRADUATE SCHOOL

PAGE 002

9.56 0.149E+00 0.724E-02 0.155E-01 0.376E-02 0.127E-01 0.618E+00 0.444E-01 0.182E+06 1.40

18.46	2.77	0.534	0.930	10.009	0.323	0.099	0.117	0.244	0.479	0.686	0.939	0.972	0.519	1.24	21.68	2	0.282	494.7	3316.0
19.49	2.77	0.534	0.894	10.329	0.322	0.108	0.116	0.244	0.494	0.687	0.939	0.972	0.519	1.24	21.68	2	0.279	460.6	3314.6
20.51	2.77	0.534	0.859	10.649	0.322	0.117	0.116	0.244	0.509	0.687	0.939	0.972	0.519	1.24	21.68	2	0.275	445.8	3302.8
21.54	2.77	0.534	0.824	10.969	0.322	0.126	0.116	0.244	0.524	0.687	0.939	0.972	0.519	1.24	21.68	2	0.272	421.1	3289.1
22.57	2.77	0.534	0.789	11.289	0.322	0.135	0.116	0.244	0.539	0.687	0.939	0.972	0.519	1.24	21.68	2	0.269	404.3	3271.6
23.60	2.77	0.534	0.754	11.609	0.322	0.144	0.116	0.244	0.554	0.687	0.939	0.972	0.519	1.24	21.68	2	0.266	390.7	3254.0
24.63	2.77	0.534	0.719	11.929	0.322	0.153	0.116	0.244	0.569	0.687	0.939	0.972	0.519	1.24	21.68	2	0.263	377.4	3236.4
25.66	2.77	0.534	0.684	12.249	0.322	0.162	0.116	0.244	0.584	0.687	0.939	0.972	0.519	1.24	21.68	2	0.260	365.0	3218.8
26.69	2.77	0.534	0.649	12.569	0.322	0.171	0.116	0.244	0.599	0.687	0.939	0.972	0.519	1.24	21.68	2	0.257	353.2	3201.2
27.72	2.77	0.534	0.614	12.889	0.322	0.180	0.116	0.244	0.614	0.687	0.939	0.972	0.519	1.24	21.68	2	0.254	341.8	3183.6
28.75	2.77	0.534	0.579	13.209	0.322	0.189	0.116	0.244	0.629	0.687	0.939	0.972	0.519	1.24	21.68	2	0.251	330.4	3166.0
29.78	2.77	0.534	0.544	13.529	0.322	0.198	0.116	0.244	0.644	0.687	0.939	0.972	0.519	1.24	21.68	2	0.248	319.0	3148.4
30.81	2.77	0.534	0.509	13.849	0.322	0.207	0.116	0.244	0.659	0.687	0.939	0.972	0.519	1.24	21.68	2	0.245	307.6	3130.8
31.84	2.77	0.534	0.474	14.169	0.322	0.216	0.116	0.244	0.674	0.687	0.939	0.972	0.519	1.24	21.68	2	0.242	296.2	3113.2
32.87	2.77	0.534	0.439	14.489	0.322	0.225	0.116	0.244	0.689	0.687	0.939	0.972	0.519	1.24	21.68	2	0.239	284.8	3095.6
33.90	2.77	0.534	0.404	14.809	0.322	0.234	0.116	0.244	0.704	0.687	0.939	0.972	0.519	1.24	21.68	2	0.236	273.4	3078.0
34.93	2.77	0.534	0.369	15.129	0.322	0.243	0.116	0.244	0.719	0.687	0.939	0.972	0.519	1.24	21.68	2	0.233	262.0	3060.4
35.96	2.77	0.534	0.334	15.449	0.322	0.252	0.116	0.244	0.734	0.687	0.939	0.972	0.519	1.24	21.68	2	0.230	250.6	3042.8
36.99	2.77	0.534	0.299	15.769	0.322	0.261	0.116	0.244	0.749	0.687	0.939	0.972	0.519	1.24	21.68	2	0.227	239.2	3025.2
38.02	2.77	0.534	0.264	16.089	0.322	0.270	0.116	0.244	0.764	0.687	0.939	0.972	0.519	1.24	21.68	2	0.224	227.8	3007.6
39.05	2.77	0.534	0.229	16.409	0.322	0.279	0.116	0.244	0.779	0.687	0.939	0.972	0.519	1.24	21.68	2	0.221	216.4	2990.0
40.08	2.77	0.534	0.194	16.729	0.322	0.288	0.116	0.244	0.794	0.687	0.939	0.972	0.519	1.24	21.68	2	0.218	205.0	2972.4
41.11	2.77	0.534	0.159	17.049	0.322	0.297	0.116	0.244	0.809	0.687	0.939	0.972	0.519	1.24	21.68	2	0.215	193.6	2954.8
42.14	2.77	0.534	0.124	17.369	0.322	0.306	0.116	0.244	0.824	0.687	0.939	0.972	0.519	1.24	21.68	2	0.212	182.2	2937.2
43.17	2.77	0.534	0.089	17.689	0.322	0.315	0.116	0.244	0.839	0.687	0.939	0.972	0.519	1.24	21.68	2	0.209	170.8	2919.6
44.20	2.77	0.534	0.054	18.009	0.322	0.324	0.116	0.244	0.854	0.687	0.939	0.972	0.519	1.24	21.68	2	0.206	159.4	2902.0
45.23	2.77	0.534	0.019	18.329	0.322	0.333	0.116	0.244	0.869	0.687	0.939	0.972	0.519	1.24	21.68	2	0.203	148.0	2884.4
46.26	2.77	0.534	0.000	18.649	0.322	0.342	0.116	0.244	0.884	0.687	0.939	0.972	0.519	1.24	21.68	2	0.200	136.6	2866.8
47.29	2.77	0.534	0.000	18.969	0.322	0.351	0.116	0.244	0.899	0.687	0.939	0.972	0.519	1.24	21.68	2	0.197	125.2	2849.2
48.32	2.77	0.534	0.000	19.289	0.322	0.360	0.116	0.244	0.914	0.687	0.939	0.972	0.519	1.24	21.68	2	0.194	113.8	2831.6
49.35	2.77	0.534	0.000	19.609	0.322	0.369	0.116	0.244	0.929	0.687	0.939	0.972	0.519	1.24	21.68	2	0.191	102.4	2814.0
50.38	2.77	0.534	0.000	19.929	0.322	0.378	0.116	0.244	0.944	0.687	0.939	0.972	0.519	1.24	21.68	2	0.188	91.0	2796.4
51.41	2.77	0.534	0.000	20.249	0.322	0.387	0.116	0.244	0.959	0.687	0.939	0.972	0.519	1.24	21.68	2	0.185	79.6	2778.8
52.44	2.77	0.534	0.000	20.569	0.322	0.396	0.116	0.244	0.974	0.687	0.939	0.972	0.519	1.24	21.68	2	0.182	68.2	2761.2
53.47	2.77	0.534	0.000	20.889	0.322	0.405	0.116	0.244	0.989	0.687	0.939	0.972	0.519	1.24	21.68	2	0.179	56.8	2743.6
54.50	2.77	0.534	0.000	21.209	0.322	0.414	0.116	0.244	1.004	0.687	0.939	0.972	0.519	1.24	21.68	2	0.176	45.4	2726.0
55.53	2.77	0.534	0.000	21.529	0.322	0.423	0.116	0.244	1.019	0.687	0.939	0.972	0.519	1.24	21.68	2	0.173	34.0	2708.4
56.56	2.77	0.534	0.000	21.849	0.322	0.432	0.116	0.244	1.034	0.687	0.939	0.972	0.519	1.24	21.68	2	0.170	22.6	2690.8
57.59	2.77	0.534	0.000	22.169	0.322	0.441	0.116	0.244	1.049	0.687	0.939	0.972	0.519	1.24	21.68	2	0.167	11.2	2673.2
58.62	2.77	0.534	0.000	22.489	0.322	0.450	0.116	0.244	1.064	0.687	0.939	0.972	0.519	1.24	21.68	2	0.164	0.0	2655.6
59.65	2.77	0.534	0.000	22.809	0.322	0.459	0.116	0.244	1.079	0.687	0.939	0.972	0.519	1.24	21.68	2	0.161	0.0	2638.0
60.68	2.77	0.534	0.000	23.129	0.322	0.468	0.116	0.244	1.094	0.687	0.939	0.972	0.519	1.24	21.68	2	0.158	0.0	2620.4
61.71	2.77	0.534	0.000	23.449	0.322	0.477	0.116	0.244	1.109	0.687	0.939	0.972	0.519	1.24	21.68	2	0.155	0.0	2602.8
62.74	2.77	0.534	0.000	23.769	0.322	0.486	0.116	0.244	1.124	0.687	0.939	0.972	0.519	1.24	21.68	2	0.152	0.0	2585.2
63.77	2.77	0.534	0.000	24.089	0.322	0.495	0.116	0.244	1.139	0.687	0.939	0.972	0.519	1.24	21.68	2	0.149	0.0	2567.6
64.80	2.77	0.534	0.000	24.409	0.322	0.504	0.116	0.244	1.154	0.687	0.939	0.972	0.519	1.24	21.68	2	0.146	0.0	2550.0
65.83	2.77	0.534	0.000	24.729	0.322	0.513	0.116	0.244	1.169	0.687	0.939	0.972	0.519	1.24	21.68	2	0.143	0.0	2532.4
66.86	2.77	0.534	0.000	25.049	0.322	0.522	0.116	0.244	1.184	0.687	0.939	0.972	0.519	1.24	21.68	2	0.140	0.0	2514.8
67.89	2.77	0.534	0.000	25.369	0.322	0.531	0.116	0.244	1.199	0.687	0.939	0.972	0.519	1.24	21.68	2	0.137	0.0	2497.2
68.92	2.77	0.534	0.000	25.689	0.322	0.540	0.116	0.244	1.214	0.687	0.939	0.972	0.519	1.24	21.68	2	0.134	0.0	2479.6
69.95	2.77	0.534	0.000	26.009	0.322	0.549	0.116	0.244	1.229	0.687	0.939	0.972	0.519	1.24	21.68	2	0.131	0.0	2462.0
70.98	2.77	0.534	0.000	26.329	0.322	0.558	0.116	0.244	1.244	0.687	0.939	0.972	0.519	1.24	21.68	2	0.128	0.0	2444.4
72.01	2.77	0.534	0.000	26.649	0.322	0.567	0.116	0.244	1.259	0.687	0.939	0.972	0.519	1.24	21.68	2	0.125	0.0	2426.8
73.04	2.77	0.534	0.000	26.969	0.322	0.576	0.116	0.244	1.274	0.687	0.939	0.972	0.519	1.24	21.68	2	0.122	0.0	2409.2
74.07	2.77	0.534	0.000	27.289	0.322	0.585	0.116	0.244	1.289	0.687	0.939	0.972	0.519	1.24	21.68	2	0.119	0.0	2391.6
75.10	2.77	0.534	0.000	27.609	0.322	0.594	0.116	0.244	1.304	0.687	0.939	0.972	0.519	1.24	21.68	2	0.116	0.0	2374.0
76.13	2.77	0.534	0.000	27.929	0.322	0.603	0.116	0.244	1.319	0.687	0.939	0.972	0.519	1.24	21.68	2	0.113	0.0	2356.4
77.16	2.77	0.534	0.000	28.249	0.322	0.612	0.116	0.244	1.334	0.687	0.939	0.972	0.519	1.24	21.68	2	0.110	0.0	2338.8
78.19	2.77	0.534	0.000	28.569	0.322	0.621	0.116	0.244	1.349	0.687	0.939	0.972	0.519	1.24	21.68	2	0.107	0.0	2321.2
79.22	2.77	0.534	0.000	28.889	0.322	0.630	0.116	0.244	1.364	0.687	0.939	0.972	0.519	1.24	21.68	2	0.104	0.0	2303.6
80.25	2.77	0.534	0.000	29.209	0.322	0.639	0.116	0.244	1.379	0.687	0.939	0.972	0.519	1.24	21.68	2	0.101	0.0	2286.0
81.28	2.77	0.534	0.000	29.529	0.322	0.648	0.116	0.244	1.394	0.687	0.939	0							

JANET TRAJECTORY

LPR MPR A30 AU/AR AS/AP L3 UO U NR TRPV
 0.155E+01 0.475E+02 0.530E-02 0.780E+00 0.260E+01 0.584E+00 0.762E+03 0.863E+03 0.198E+01 0.124E+03

TE	N3	V3	TE TE	MO	PO	RMIA	TO	MIA	MPR	DPAG	TIME
0.622E+00	0.155E+03	0.755E+03	0.447E+02	2.534	0.103E+03	0.122E+03	0.788E+03	0.179E-04	47.5	1381.3	1370.0
0.311E+01	0.328E+04	0.223E+04	0.433E+02	2.557	0.812E+04	0.109E+03	0.275E+03	0.179E-04	47.6	1443.9	1365.2
0.660E+01	0.341E+04	0.368E+04	0.423E+02	2.567	0.859E+04	0.489E+03	0.225E+03	0.168E-04	46.7	973.3	1258.9
0.407E+01	0.341E+04	0.506E+04	0.411E+02	2.600	0.559E+04	0.753E+03	0.255E+03	0.164E-04	46.5	876.0	1174.7
0.106E+02	0.101E+04	0.442E+04	0.380E+03	2.672	0.470E+04	0.635E+03	0.240E+03	0.160E-04	46.3	780.1	979.9
0.131E+02	0.106E+04	0.774E+04	0.380E+03	2.710	0.380E+04	0.445E+03	0.240E+03	0.157E-04	46.1	564.3	775.0
0.156E+02	0.103E+04	0.901E+04	0.372E+03	2.742	0.373E+04	0.458E+03	0.231E+03	0.154E-04	46.0	475.8	572.0
0.408E+02	0.120E+04	0.102E+05	0.345E+03	2.765	0.269E+04	0.189E+03	0.274E+03	0.150E-04	45.9	401.0	512.6
0.295E+02	0.130E+04	0.114E+05	0.345E+03	2.778	0.255E+04	0.132E+03	0.271E+03	0.147E-04	45.9	337.4	423.3
0.233E+02	0.135E+04	0.124E+05	0.371E+03	2.784	0.190E+04	0.784E+03	0.251E+03	0.145E-04	45.9	289.3	345.3
0.251E+02	0.170E+04	0.130E+05	0.316E+03	2.785	0.162E+04	0.245E+03	0.271E+03	0.145E-04	45.9	247.0	315.7
0.240E+02	0.187E+04	0.140E+05	0.301E+03	2.685	0.174E+04	0.127E+03	0.271E+03	0.145E-04	45.9	214.0	275.1
0.105E+02	0.204E+04	0.140E+05	0.247E+03	2.656	0.114E+04	0.185E+03	0.271E+03	0.145E-04	45.9	184.1	247.0
0.333E+02	0.223E+04	0.165E+05	0.270E+03	2.628	0.144E+04	0.163E+03	0.271E+03	0.145E-04	45.9	163.0	219.2
0.355E+02	0.237E+04	0.173E+05	0.253E+03	2.601	0.922E+03	0.144E+03	0.271E+03	0.145E-04	45.9	143.1	195.3
0.379E+02	0.249E+04	0.181E+05	0.237E+03	2.575	0.403E+03	0.124E+03	0.271E+03	0.145E-04	45.9	127.7	173.0
0.104E+02	0.257E+04	0.180E+05	0.220E+03	2.550	0.716E+03	0.124E+03	0.271E+03	0.145E-04	45.9	114.4	155.9
0.479E+02	0.261E+04	0.190E+05	0.207E+03	2.537	0.654E+03	0.105E+03	0.271E+03	0.145E-04	45.9	103.2	142.2
0.492E+02	0.300E+04	0.201E+05	0.185E+03	2.506	0.564E+03	0.054E+03	0.271E+03	0.145E-04	45.9	91.7	126.0
0.474E+02	0.324E+04	0.206E+05	0.166E+03	2.459	0.415E+03	0.079E+03	0.271E+03	0.145E-04	45.9	85.4	110.0
0.504E+02	0.341E+04	0.211E+05	0.148E+03	2.431	0.405E+03	0.081E+03	0.271E+03	0.145E-04	45.9	78.2	95.0
0.529E+02	0.360E+04	0.215E+05	0.129E+03	2.396	0.462E+03	0.163E+03	0.271E+03	0.145E-04	45.9	72.1	80.0
0.554E+02	0.377E+04	0.219E+05	0.109E+03	2.364	0.416E+03	0.075E+03	0.271E+03	0.145E-04	45.9	67.5	65.0
0.579E+02	0.394E+04	0.221E+05	0.094E+03	2.336	0.416E+03	0.093E+03	0.271E+03	0.145E-04	45.9	61.7	50.0
0.601E+02	0.411E+04	0.224E+05	0.072E+03	2.311	0.470E+03	0.068E+03	0.271E+03	0.145E-04	45.9	56.7	35.0
0.623E+02	0.428E+04	0.226E+05	0.067E+03	2.290	0.389E+03	0.050E+03	0.271E+03	0.145E-04	45.9	51.5	20.0
0.653E+02	0.445E+04	0.228E+05	0.079E+03	2.273	0.481E+03	0.055E+03	0.271E+03	0.145E-04	45.9	46.9	5.0
0.678E+02	0.462E+04	0.231E+05	0.114E+03	2.254	0.374E+03	0.031E+03	0.271E+03	0.145E-04	45.9	41.9	0.0
0.703E+02	0.479E+04	0.227E+05	0.140E+03	2.247	0.374E+03	0.031E+03	0.271E+03	0.145E-04	45.9	35.9	0.0
0.728E+02	0.496E+04	0.226E+05	0.151E+03	2.239	0.360E+03	0.029E+03	0.271E+03	0.145E-04	45.9	29.7	0.0
0.753E+02	0.510E+04	0.229E+05	0.156E+03	2.231	0.340E+03	0.051E+03	0.271E+03	0.145E-04	45.9	23.4	0.0
0.778E+02	0.525E+04	0.227E+05	0.174E+03	2.211	0.601E+03	0.064E+03	0.271E+03	0.145E-04	45.9	17.2	0.0
0.803E+02	0.540E+04	0.220E+05	0.194E+03	2.181	0.416E+03	0.093E+03	0.271E+03	0.145E-04	45.9	11.0	0.0
0.827E+02	0.555E+04	0.217E+05	0.155E+03	2.154	0.492E+03	0.072E+03	0.271E+03	0.145E-04	45.9	4.7	0.0
0.852E+02	0.570E+04	0.213E+05	0.140E+03	2.130	0.463E+03	0.076E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.877E+02	0.584E+04	0.209E+05	0.160E+03	2.104	0.430E+03	0.081E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.902E+02	0.600E+04	0.206E+05	0.180E+03	2.076	0.330E+03	0.079E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.927E+02	0.617E+04	0.204E+05	0.200E+03	2.046	0.560E+03	0.044E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.952E+02	0.634E+04	0.202E+05	0.220E+03	2.009	0.418E+03	0.101E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.977E+02	0.651E+04	0.198E+05	0.239E+03	1.974	0.185E+03	0.111E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.100E+03	0.668E+04	0.194E+05	0.258E+03	1.938	0.787E+03	0.128E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.103E+03	0.684E+04	0.191E+05	0.276E+03	1.904	0.486E+03	0.161E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.106E+03	0.700E+04	0.187E+05	0.294E+03	1.868	0.180E+03	0.159E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.110E+03	0.717E+04	0.184E+05	0.312E+03	1.830	0.180E+03	0.159E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.113E+03	0.734E+04	0.181E+05	0.330E+03	1.792	0.533E+03	0.131E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.116E+03	0.751E+04	0.178E+05	0.348E+03	1.754	0.778E+03	0.164E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.119E+03	0.768E+04	0.175E+05	0.367E+03	1.716	0.259E+04	0.110E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.123E+03	0.785E+04	0.172E+05	0.385E+03	1.678	0.260E+04	0.418E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.127E+03	0.802E+04	0.169E+05	0.403E+03	1.640	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.131E+03	0.819E+04	0.166E+05	0.421E+03	1.602	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.135E+03	0.836E+04	0.163E+05	0.439E+03	1.564	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.139E+03	0.853E+04	0.160E+05	0.457E+03	1.526	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.143E+03	0.870E+04	0.157E+05	0.475E+03	1.488	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.147E+03	0.887E+04	0.154E+05	0.493E+03	1.450	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.151E+03	0.904E+04	0.151E+05	0.511E+03	1.412	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.155E+03	0.921E+04	0.148E+05	0.529E+03	1.374	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.159E+03	0.938E+04	0.145E+05	0.547E+03	1.336	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.163E+03	0.955E+04	0.142E+05	0.565E+03	1.298	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.167E+03	0.972E+04	0.139E+05	0.583E+03	1.260	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.171E+03	0.989E+04	0.136E+05	0.601E+03	1.222	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.175E+03	1.006E+04	0.133E+05	0.619E+03	1.184	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.179E+03	1.023E+04	0.130E+05	0.637E+03	1.146	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.183E+03	1.040E+04	0.127E+05	0.655E+03	1.108	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.187E+03	1.057E+04	0.124E+05	0.673E+03	1.070	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.191E+03	1.074E+04	0.121E+05	0.691E+03	1.032	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.195E+03	1.091E+04	0.118E+05	0.709E+03	9.94	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.199E+03	1.108E+04	0.115E+05	0.727E+03	9.56	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.203E+03	1.125E+04	0.112E+05	0.745E+03	9.18	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.207E+03	1.142E+04	0.109E+05	0.763E+03	8.80	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.211E+03	1.159E+04	0.106E+05	0.781E+03	8.42	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.215E+03	1.176E+04	0.103E+05	0.799E+03	8.04	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.219E+03	1.193E+04	0.100E+05	0.817E+03	7.66	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.223E+03	1.210E+04	0.097E+05	0.835E+03	7.28	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.227E+03	1.227E+04	0.094E+05	0.853E+03	6.90	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.231E+03	1.244E+04	0.091E+05	0.871E+03	6.52	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.235E+03	1.261E+04	0.088E+05	0.889E+03	6.14	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.239E+03	1.278E+04	0.085E+05	0.907E+03	5.76	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.243E+03	1.295E+04	0.082E+05	0.925E+03	5.38	0.564E+03	0.485E+03	0.271E+03	0.145E-04	45.9	0.0	0.0
0.247E+03											

FILE: TRJ 0 : A NAVAL POSTGRADUATE SCHOOL

PAGE 002

0.142E+03 0.687E+05-0.135E+03-0.522E+02 1.714 0.132E+05 0.121E+01 0.267E+03 0.179E-04 45.8 848.6 0.0

NAVJET TRAJECTORY

(ORAG COEFF.)

LPR MPR A30 AO/A4 AS/AP L3 UO U WR TREV
0.155E+01 0.475E+02 0.530E-02 0.280E+00 0.260E+03 0.584E+00 0.762E+03 0.863E+03 0.199E+01 0.124E+03

TEVP	CON	COS	CMM	CWF	APR	SPR	SMW	Q	KPO
9.50	0.864E-01	0.710E-02	0.974E-02	0.346E-02	0.27E-01	0.61E+00	0.484E-01	0.48E+06	.40
9.50	0.857E-01	0.714E-02	0.967E-02	0.355E-02	0.27E-01	0.61E+00	0.484E-01	0.475E+06	.40
9.50	0.850E-01	0.718E-02	0.960E-02	0.363E-02	0.27E-01	0.61E+00	0.484E-01	0.470E+06	.40
9.50	0.843E-01	0.722E-02	0.953E-02	0.371E-02	0.27E-01	0.61E+00	0.484E-01	0.465E+06	.40
9.50	0.836E-01	0.726E-02	0.946E-02	0.379E-02	0.27E-01	0.61E+00	0.484E-01	0.460E+06	.40
9.50	0.829E-01	0.730E-02	0.939E-02	0.387E-02	0.27E-01	0.61E+00	0.484E-01	0.455E+06	.40
9.50	0.822E-01	0.734E-02	0.932E-02	0.395E-02	0.27E-01	0.61E+00	0.484E-01	0.450E+06	.40
9.50	0.815E-01	0.738E-02	0.925E-02	0.403E-02	0.27E-01	0.61E+00	0.484E-01	0.445E+06	.40
9.50	0.808E-01	0.742E-02	0.918E-02	0.411E-02	0.27E-01	0.61E+00	0.484E-01	0.440E+06	.40
9.50	0.801E-01	0.746E-02	0.911E-02	0.419E-02	0.27E-01	0.61E+00	0.484E-01	0.435E+06	.40
9.50	0.794E-01	0.750E-02	0.904E-02	0.427E-02	0.27E-01	0.61E+00	0.484E-01	0.430E+06	.40
9.50	0.787E-01	0.754E-02	0.897E-02	0.435E-02	0.27E-01	0.61E+00	0.484E-01	0.425E+06	.40
9.50	0.780E-01	0.758E-02	0.890E-02	0.443E-02	0.27E-01	0.61E+00	0.484E-01	0.420E+06	.40
9.50	0.773E-01	0.762E-02	0.883E-02	0.451E-02	0.27E-01	0.61E+00	0.484E-01	0.415E+06	.40
9.50	0.766E-01	0.766E-02	0.876E-02	0.459E-02	0.27E-01	0.61E+00	0.484E-01	0.410E+06	.40
9.50	0.759E-01	0.770E-02	0.869E-02	0.467E-02	0.27E-01	0.61E+00	0.484E-01	0.405E+06	.40
9.50	0.752E-01	0.774E-02	0.862E-02	0.475E-02	0.27E-01	0.61E+00	0.484E-01	0.400E+06	.40
9.50	0.745E-01	0.778E-02	0.855E-02	0.483E-02	0.27E-01	0.61E+00	0.484E-01	0.395E+06	.40
9.50	0.738E-01	0.782E-02	0.848E-02	0.491E-02	0.27E-01	0.61E+00	0.484E-01	0.390E+06	.40
9.50	0.731E-01	0.786E-02	0.841E-02	0.499E-02	0.27E-01	0.61E+00	0.484E-01	0.385E+06	.40
9.50	0.724E-01	0.790E-02	0.834E-02	0.507E-02	0.27E-01	0.61E+00	0.484E-01	0.380E+06	.40
9.50	0.717E-01	0.794E-02	0.827E-02	0.515E-02	0.27E-01	0.61E+00	0.484E-01	0.375E+06	.40
9.50	0.710E-01	0.798E-02	0.820E-02	0.523E-02	0.27E-01	0.61E+00	0.484E-01	0.370E+06	.40
9.50	0.703E-01	0.802E-02	0.813E-02	0.531E-02	0.27E-01	0.61E+00	0.484E-01	0.365E+06	.40
9.50	0.696E-01	0.806E-02	0.806E-02	0.539E-02	0.27E-01	0.61E+00	0.484E-01	0.360E+06	.40
9.50	0.689E-01	0.810E-02	0.799E-02	0.547E-02	0.27E-01	0.61E+00	0.484E-01	0.355E+06	.40
9.50	0.682E-01	0.814E-02	0.792E-02	0.555E-02	0.27E-01	0.61E+00	0.484E-01	0.350E+06	.40
9.50	0.675E-01	0.818E-02	0.785E-02	0.563E-02	0.27E-01	0.61E+00	0.484E-01	0.345E+06	.40
9.50	0.668E-01	0.822E-02	0.778E-02	0.571E-02	0.27E-01	0.61E+00	0.484E-01	0.340E+06	.40
9.50	0.661E-01	0.826E-02	0.771E-02	0.579E-02	0.27E-01	0.61E+00	0.484E-01	0.335E+06	.40
9.50	0.654E-01	0.830E-02	0.764E-02	0.587E-02	0.27E-01	0.61E+00	0.484E-01	0.330E+06	.40
9.50	0.647E-01	0.834E-02	0.757E-02	0.595E-02	0.27E-01	0.61E+00	0.484E-01	0.325E+06	.40
9.50	0.640E-01	0.838E-02	0.750E-02	0.603E-02	0.27E-01	0.61E+00	0.484E-01	0.320E+06	.40
9.50	0.633E-01	0.842E-02	0.743E-02	0.611E-02	0.27E-01	0.61E+00	0.484E-01	0.315E+06	.40
9.50	0.626E-01	0.846E-02	0.736E-02	0.619E-02	0.27E-01	0.61E+00	0.484E-01	0.310E+06	.40
9.50	0.619E-01	0.850E-02	0.729E-02	0.627E-02	0.27E-01	0.61E+00	0.484E-01	0.305E+06	.40
9.50	0.612E-01	0.854E-02	0.722E-02	0.635E-02	0.27E-01	0.61E+00	0.484E-01	0.300E+06	.40
9.50	0.605E-01	0.858E-02	0.715E-02	0.643E-02	0.27E-01	0.61E+00	0.484E-01	0.295E+06	.40
9.50	0.598E-01	0.862E-02	0.708E-02	0.651E-02	0.27E-01	0.61E+00	0.484E-01	0.290E+06	.40
9.50	0.591E-01	0.866E-02	0.701E-02	0.659E-02	0.27E-01	0.61E+00	0.484E-01	0.285E+06	.40
9.50	0.584E-01	0.870E-02	0.694E-02	0.667E-02	0.27E-01	0.61E+00	0.484E-01	0.280E+06	.40
9.50	0.577E-01	0.874E-02	0.687E-02	0.675E-02	0.27E-01	0.61E+00	0.484E-01	0.275E+06	.40
9.50	0.570E-01	0.878E-02	0.680E-02	0.683E-02	0.27E-01	0.61E+00	0.484E-01	0.270E+06	.40
9.50	0.563E-01	0.882E-02	0.673E-02	0.691E-02	0.27E-01	0.61E+00	0.484E-01	0.265E+06	.40
9.50	0.556E-01	0.886E-02	0.666E-02	0.699E-02	0.27E-01	0.61E+00	0.484E-01	0.260E+06	.40
9.50	0.549E-01	0.890E-02	0.659E-02	0.707E-02	0.27E-01	0.61E+00	0.484E-01	0.255E+06	.40
9.50	0.542E-01	0.894E-02	0.652E-02	0.715E-02	0.27E-01	0.61E+00	0.484E-01	0.250E+06	.40
9.50	0.535E-01	0.898E-02	0.645E-02	0.723E-02	0.27E-01	0.61E+00	0.484E-01	0.245E+06	.40
9.50	0.528E-01	0.902E-02	0.638E-02	0.731E-02	0.27E-01	0.61E+00	0.484E-01	0.240E+06	.40
9.50	0.521E-01	0.906E-02	0.631E-02	0.739E-02	0.27E-01	0.61E+00	0.484E-01	0.235E+06	.40
9.50	0.514E-01	0.910E-02	0.624E-02	0.747E-02	0.27E-01	0.61E+00	0.484E-01	0.230E+06	.40
9.50	0.507E-01	0.914E-02	0.617E-02	0.755E-02	0.27E-01	0.61E+00	0.484E-01	0.225E+06	.40
9.50	0.500E-01	0.918E-02	0.610E-02	0.763E-02	0.27E-01	0.61E+00	0.484E-01	0.220E+06	.40
9.50	0.493E-01	0.922E-02	0.603E-02	0.771E-02	0.27E-01	0.61E+00	0.484E-01	0.215E+06	.40
9.50	0.486E-01	0.926E-02	0.596E-02	0.779E-02	0.27E-01	0.61E+00	0.484E-01	0.210E+06	.40
9.50	0.479E-01	0.930E-02	0.589E-02	0.787E-02	0.27E-01	0.61E+00	0.484E-01	0.205E+06	.40
9.50	0.472E-01	0.934E-02	0.582E-02	0.795E-02	0.27E-01	0.61E+00	0.484E-01	0.200E+06	.40
9.50	0.465E-01	0.938E-02	0.575E-02	0.803E-02	0.27E-01	0.61E+00	0.484E-01	0.195E+06	.40
9.50	0.458E-01	0.942E-02	0.568E-02	0.811E-02	0.27E-01	0.61E+00	0.484E-01	0.190E+06	.40
9.50	0.451E-01	0.946E-02	0.561E-02	0.819E-02	0.27E-01	0.61E+00	0.484E-01	0.185E+06	.40
9.50	0.444E-01	0.950E-02	0.554E-02	0.827E-02	0.27E-01	0.61E+00	0.484E-01	0.180E+06	.40
9.50	0.437E-01	0.954E-02	0.547E-02	0.835E-02	0.27E-01	0.61E+00	0.484E-01	0.175E+06	.40
9.50	0.430E-01	0.958E-02	0.540E-02	0.843E-02	0.27E-01	0.61E+00	0.484E-01	0.170E+06	.40
9.50	0.423E-01	0.962E-02	0.533E-02	0.851E-02	0.27E-01	0.61E+00	0.484E-01	0.165E+06	.40
9.50	0.416E-01	0.966E-02	0.526E-02	0.859E-02	0.27E-01	0.61E+00	0.484E-01	0.160E+06	.40
9.50	0.409E-01	0.970E-02	0.519E-02	0.867E-02	0.27E-01	0.61E+00	0.484E-01	0.155E+06	.40
9.50	0.402E-01	0.974E-02	0.512E-02	0.875E-02	0.27E-01	0.61E+00	0.484E-01	0.150E+06	.40
9.50	0.395E-01	0.978E-02	0.505E-02	0.883E-02	0.27E-01	0.61E+00	0.484E-01	0.145E+06	.40
9.50	0.388E-01	0.982E-02	0.498E-02	0.891E-02	0.27E-01	0.61E+00	0.484E-01	0.140E+06	.40
9.50	0.381E-01	0.986E-02	0.491E-02	0.899E-02	0.27E-01	0.61E+00	0.484E-01	0.135E+06	.40
9.50	0.374E-01	0.990E-02	0.484E-02	0.907E-02	0.27E-01	0.61E+00	0.484E-01	0.130E+06	.40
9.50	0.367E-01	0.994E-02	0.477E-02	0.915E-02	0.27E-01	0.61E+00	0.484E-01	0.125E+06	.40
9.50	0.360E-01	0.998E-02	0.470E-02	0.923E-02	0.27E-01	0.61E+00	0.484E-01	0.120E+06	.40
9.50	0.353E-01	1.002E-02	0.463E-02	0.931E-02	0.27E-01	0.61E+00	0.484E-01	0.115E+06	.40
9.50	0.346E-01	1.006E-02	0.456E-02	0.939E-02	0.27E-01	0.61E+00	0.484E-01	0.110E+06	.40
9.50	0.339E-01	1.010E-02	0.449E-02	0.947E-02	0.27E-01	0.61E+00	0.484E-01	0.105E+06	.40
9.50	0.332E-01	1.014E-02	0.442E-02	0.955E-02	0.27E-01	0.61E+00	0.484E-01	0.100E+06	.40
9.50	0.325E-01	1.018E-02	0.435E-02	0.963E-02	0.27E-01	0.61E+00	0.484E-01	0.095E+06	.40
9.50	0.318E-01	1.022E-02	0.428E-02	0.971E-02	0.27E-01	0.61E+00	0.484E-01	0.090E+06	.40
9.50	0.311E-01	1.026E-02	0.421E-02	0.979E-02	0.27E-01	0.61E+00	0.484E-01	0.085E+06	.40
9.50	0.304E-01	1.030E-02	0.414E-02	0.987E-02	0.27E-01	0.61E+00	0.484E-01	0.080E+06	.40
9.50	0.297E-01	1.034E-02	0.407E-02	0.995E-02	0.27E-01	0.61E+00	0.484E-01	0.075E+06	.40
9.50	0.290E-01	1.038E-02	0.400E-02	1.003E-02	0.27E-01	0.61E+00	0.484E-01	0.070E+06	.40
9.50	0.283E-01	1.042E-02	0.393E-02	1.011E-02	0.27E-01	0.61E+00	0.484E-01	0.065E+06	.40
9.50	0.276E-01	1.046E-02	0.386E-02	1.019E-02	0.27E-01	0.61E+00	0.484E-01	0.060E+06	.40
9.50	0.269E-01	1.050E-02	0.379E-02	1.027E-02	0.27E-01	0.61E+00	0.484E-01	0.055E+06	.40
9.50	0.262E-01	1.054E-02	0.372E-02	1.035E-02	0.27E-01	0.61E+00	0.484E-01	0.050E+06	.40
9.50	0.255E-01	1.058E-02	0.365E-02	1.043E-02	0.27E-01	0.61E+00	0.484E-01	0.045E+06	.40
9.50	0.248E-01	1.062E-02	0.358E-02	1.051E-02	0.27E-01	0.61E+00	0.484E-01	0.040E+06	.40
9.50	0.241E-01	1.066E-02	0.351E-02	1.059E-02	0.27E-01	0.61E+00	0.484E-01	0.035E+06	.40
9.50	0.234E-01	1.070E-02	0.344E-02	1.067E-02	0.27E-01	0.61E+00	0.484E-01	0.030E+06	.40
9.50	0.227E-01	1.074E-02	0.337E-02	1.075E-02	0.27E-01	0.61E+00	0.484E-01	0.025E+06	.40
9.50	0.220								

FILE: DRG

D

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A NAVAL POSTGRADUATE SCHOOL

PAGE 002

9.50	0.105E+00	0.239E-02	0.117E-01	0.943E-03	0.127E-01	0.618E+00	0.484E-01	0.123E+05	1.40
9.50	0.110E+00	0.245E-02	0.127E-01	0.181E-02	0.127E-01	0.618E+00	0.484E-01	0.190E+06	1.40
9.50	0.118E+00	0.255E-02	0.128E-01	0.376E-02	0.127E-01	0.618E+00	0.484E-01	0.204E+06	1.40
9.50	0.127E+00	0.222E-02	0.135E-01	0.372E-02	0.127E-01	0.618E+00	0.484E-01	0.213E+06	1.40
9.50	0.134E+00	0.221E-02	0.141E-01	0.370E-02	0.127E-01	0.618E+00	0.484E-01	0.210E+06	1.40

FILE: CMR D : A NAVAL POSTGRADUATE SCHOOL

PAGE 002

1.46	2.77	0.535	0.930	10.009	0.298	0.099	0.115	0.244	0.994	0.685	0.949	0.972	0.519	1.26	21.68	0.282	494.7	5314.0
1.49	2.77	0.542	0.895	10.168	0.301	0.098	0.116	0.244	0.994	0.676	0.948	0.972	0.516	1.26	21.68	0.279	460.6	5168.6
1.51	2.78	0.547	0.859	10.329	0.303	0.098	0.116	0.243	0.974	0.674	0.944	0.972	0.512	1.26	21.68	0.275	445.8	5026.8
1.53	2.78	0.545	0.825	10.492	0.303	0.097	0.116	0.242	0.974	0.669	0.947	0.972	0.509	1.27	21.68	0.273	423.4	4884.1
1.57	2.76	0.542	0.793	10.656	0.303	0.097	0.116	0.242	0.974	0.669	0.947	0.972	0.509	1.27	21.68	0.272	401.7	4741.6
1.60	2.75	0.535	0.761	10.822	0.301	0.097	0.114	0.241	0.974	0.670	0.948	0.972	0.515	1.27	21.68	0.270	390.7	4771.6
1.63	2.75	0.535	0.734	10.989	0.299	0.097	0.114	0.241	0.974	0.666	0.947	0.972	0.521	1.27	21.68	0.269	377.6	4631.0
1.67	2.75	0.535	0.706	11.157	0.299	0.096	0.113	0.240	0.974	0.690	0.948	0.972	0.527	1.27	21.68	0.268	365.0	4611.3
1.70	2.74	0.529	0.680	11.327	0.296	0.096	0.113	0.240	0.974	0.701	0.949	0.972	0.533	1.27	21.68	0.268	353.2	4546.1
1.73	2.73	0.522	0.655	11.498	0.297	0.096	0.113	0.239	0.974	0.705	0.949	0.972	0.530	1.27	21.68	0.267	341.8	4510.5
1.76	2.72	0.522	0.631	11.670	0.296	0.096	0.112	0.239	0.974	0.716	0.950	0.972	0.545	1.27	21.68	0.266	330.6	4490.7
1.79	2.71	0.522	0.609	11.843	0.295	0.096	0.112	0.239	0.974	0.720	0.950	0.972	0.551	1.27	21.68	0.265	319.7	4440.7
1.82	2.71	0.516	0.586	12.016	0.292	0.096	0.111	0.239	0.974	0.731	0.951	0.972	0.557	1.28	21.68	0.264	309.0	4394.0
1.85	2.70	0.516	0.565	12.191	0.293	0.095	0.111	0.238	0.974	0.735	0.950	0.972	0.563	1.28	21.68	0.263	298.8	4348.4
1.88	2.69	0.509	0.542	12.367	0.290	0.095	0.110	0.238	0.974	0.747	0.951	0.972	0.569	1.28	21.68	0.262	288.9	4297.7
1.91	2.68	0.509	0.520	12.543	0.291	0.095	0.110	0.238	0.974	0.751	0.951	0.972	0.574	1.28	21.68	0.261	279.1	4247.9
1.94	2.67	0.506	0.500	12.720	0.290	0.095	0.109	0.238	0.974	0.758	0.951	0.972	0.580	1.28	21.68	0.260	269.4	4198.9
1.97	2.66	0.501	0.481	12.898	0.289	0.095	0.109	0.238	0.974	0.766	0.952	0.972	0.587	1.29	21.68	0.259	259.7	4149.9
2.00	2.66	0.496	0.471	13.075	0.286	0.095	0.108	0.238	0.974	0.778	0.953	0.972	0.593	1.29	21.68	0.258	250.0	4099.9
2.03	2.66	0.496	0.458	13.254	0.287	0.095	0.108	0.238	0.974	0.782	0.952	0.972	0.599	1.29	21.68	0.257	240.3	4049.9
2.06	2.65	0.490	0.448	13.432	0.284	0.095	0.107	0.238	0.974	0.793	0.953	0.972	0.606	1.29	21.68	0.256	230.7	3999.9
2.09	2.64	0.485	0.439	13.611	0.285	0.095	0.107	0.238	0.974	0.797	0.953	0.972	0.612	1.29	21.68	0.255	221.0	3949.9
2.12	2.63	0.483	0.435	13.789	0.282	0.095	0.107	0.238	0.974	0.805	0.954	0.972	0.618	1.29	21.68	0.254	211.3	3899.9
2.15	2.63	0.483	0.432	13.968	0.283	0.095	0.107	0.238	0.974	0.811	0.954	0.972	0.624	1.29	21.68	0.253	201.6	3849.9
2.18	2.62	0.477	0.430	14.146	0.280	0.095	0.106	0.238	0.974	0.825	0.954	0.972	0.630	1.29	21.68	0.252	191.9	3799.9
2.21	2.61	0.477	0.427	14.325	0.281	0.095	0.106	0.238	0.974	0.829	0.954	0.972	0.636	1.29	21.68	0.251	182.2	3749.9
2.24	2.61	0.471	0.426	14.503	0.280	0.095	0.106	0.238	0.974	0.846	0.954	0.972	0.642	1.29	21.68	0.250	172.5	3699.9

TOTAL= 45.0

TIME OF BURNING= 34.84 SEC

RANGE OF BURNING=0.2342E+05 KM

HEIGHT OF BURNING=0.1709E+05 KM

1

RAMJET TRAJECTORY

IPR	APP	A30	A0/AR	A5/AR	L1	U0	U	M0	TRFV
0.155E+01	0.475E+02	0.530E+02	0.280E+00	0.280E+00	0.584E+00	0.762E+03	0.863E+03	0.199E+01	0.174E+03

X1	X3	Y3	TETA	W0	P0	QWTA	T0	MHA	WPP	DRAG	THRUST
0.622E+00	0.759E+03	0.755E+03	0.447E+02	2.534	0.103E+05	0.122E+01	0.288E+03	0.179E-04	47.5	1381.3	1370.6
0.311E+01	0.228E+04	0.223E+04	0.433E+02	2.557	0.812E+04	0.104E+01	0.276E+03	0.172E-04	47.0	1143.9	1365.0
0.560E+01	0.547E+04	0.536E+04	0.473E+02	2.587	0.649E+04	0.106E+01	0.267E+03	0.168E-04	46.7	974.3	1256.8
0.807E+01	0.101E+05	0.995E+04	0.481E+02	2.630	0.500E+04	0.753E+00	0.257E+03	0.164E-04	46.5	826.0	1104.7
0.106E+02	0.164E+05	0.160E+05	0.504E+02	2.672	0.470E+04	0.618E+00	0.244E+03	0.160E-04	46.1	700.1	919.9
0.131E+02	0.164E+05	0.174E+05	0.504E+02	2.710	0.389E+04	0.440E+00	0.244E+03	0.157E-04	46.1	564.3	775.8
0.156E+02	0.103E+05	0.102E+05	0.572E+02	2.742	0.373E+04	0.458E+00	0.231E+03	0.151E-04	46.0	475.8	632.6
0.180E+02	0.120E+05	0.118E+05	0.572E+02	2.765	0.270E+04	0.349E+00	0.234E+03	0.140E-04	45.9	401.0	515.6
0.205E+02	0.136E+05	0.134E+05	0.572E+02	2.778	0.225E+04	0.337E+00	0.211E+03	0.141E-04	45.9	331.4	423.1
0.230E+02	0.152E+05	0.150E+05	0.572E+02	2.786	0.190E+04	0.286E+00	0.211E+03	0.141E-04	45.9	288.3	365.0
0.255E+02	0.168E+05	0.166E+05	0.572E+02	2.794	0.161E+04	0.245E+00	0.211E+03	0.141E-04	45.8	247.7	314.7
0.280E+02	0.184E+05	0.182E+05	0.572E+02	2.804	0.138E+04	0.212E+00	0.211E+03	0.141E-04	45.8	218.0	271.1
0.305E+02	0.204E+05	0.202E+05	0.572E+02	2.814	0.119E+04	0.185E+00	0.211E+03	0.141E-04	45.8	190.1	241.9
0.330E+02	0.221E+05	0.219E+05	0.572E+02	2.824	0.100E+04	0.163E+00	0.211E+03	0.141E-04	45.8	163.0	219.7
0.355E+02	0.236E+05	0.234E+05	0.572E+02	2.831	0.870E+03	0.144E+00	0.211E+03	0.141E-04	45.8	143.7	0.0
0.379E+02	0.254E+05	0.252E+05	0.572E+02	2.841	0.760E+03	0.129E+00	0.211E+03	0.141E-04	45.8	125.4	0.0
0.404E+02	0.273E+05	0.271E+05	0.572E+02	2.844	0.671E+03	0.116E+00	0.211E+03	0.141E-04	45.8	113.5	0.0
0.429E+02	0.285E+05	0.283E+05	0.572E+02	2.848	0.600E+03	0.105E+00	0.211E+03	0.141E-04	45.8	108.1	0.0
0.454E+02	0.298E+05	0.296E+05	0.572E+02	2.851	0.540E+03	0.095E+00	0.211E+03	0.141E-04	45.8	100.7	0.0
0.479E+02	0.313E+05	0.311E+05	0.572E+02	2.850	0.490E+03	0.085E+00	0.211E+03	0.141E-04	45.8	94.2	0.0
0.504E+02	0.329E+05	0.327E+05	0.572E+02	2.851	0.440E+03	0.076E+00	0.211E+03	0.141E-04	45.8	88.7	0.0
0.529E+02	0.345E+05	0.343E+05	0.572E+02	2.851	0.400E+03	0.068E+00	0.211E+03	0.141E-04	45.8	84.3	0.0
0.554E+02	0.362E+05	0.360E+05	0.572E+02	2.851	0.360E+03	0.061E+00	0.211E+03	0.141E-04	45.8	80.7	0.0
0.579E+02	0.379E+05	0.377E+05	0.572E+02	2.851	0.320E+03	0.055E+00	0.211E+03	0.141E-04	45.8	77.9	0.0
0.603E+02	0.397E+05	0.395E+05	0.572E+02	2.851	0.280E+03	0.050E+00	0.211E+03	0.141E-04	45.8	75.9	0.0
0.628E+02	0.416E+05	0.414E+05	0.572E+02	2.851	0.240E+03	0.045E+00	0.211E+03	0.141E-04	45.8	74.2	0.0
0.653E+02	0.436E+05	0.434E+05	0.572E+02	2.851	0.200E+03	0.041E+00	0.211E+03	0.141E-04	45.8	72.7	0.0
0.678E+02	0.457E+05	0.455E+05	0.572E+02	2.851	0.160E+03	0.037E+00	0.211E+03	0.141E-04	45.8	71.4	0.0
0.703E+02	0.479E+05	0.477E+05	0.572E+02	2.851	0.120E+03	0.034E+00	0.211E+03	0.141E-04	45.8	70.2	0.0
0.728E+02	0.493E+05	0.491E+05	0.572E+02	2.851	0.080E+03	0.031E+00	0.211E+03	0.141E-04	45.8	69.1	0.0
0.753E+02	0.509E+05	0.507E+05	0.572E+02	2.851	0.040E+03	0.028E+00	0.211E+03	0.141E-04	45.8	68.1	0.0
0.778E+02	0.526E+05	0.524E+05	0.572E+02	2.851	0.000E+03	0.025E+00	0.211E+03	0.141E-04	45.8	67.2	0.0
0.803E+02	0.545E+05	0.543E+05	0.572E+02	2.851	0.000E+03	0.022E+00	0.211E+03	0.141E-04	45.8	66.4	0.0
0.828E+02	0.565E+05	0.563E+05	0.572E+02	2.851	0.000E+03	0.020E+00	0.211E+03	0.141E-04	45.8	65.7	0.0
0.853E+02	0.586E+05	0.584E+05	0.572E+02	2.851	0.000E+03	0.018E+00	0.211E+03	0.141E-04	45.8	65.1	0.0
0.878E+02	0.608E+05	0.606E+05	0.572E+02	2.851	0.000E+03	0.016E+00	0.211E+03	0.141E-04	45.8	64.6	0.0
0.903E+02	0.631E+05	0.629E+05	0.572E+02	2.851	0.000E+03	0.015E+00	0.211E+03	0.141E-04	45.8	64.2	0.0
0.928E+02	0.655E+05	0.653E+05	0.572E+02	2.851	0.000E+03	0.014E+00	0.211E+03	0.141E-04	45.8	63.9	0.0
0.953E+02	0.680E+05	0.678E+05	0.572E+02	2.851	0.000E+03	0.013E+00	0.211E+03	0.141E-04	45.8	63.7	0.0
0.978E+02	0.706E+05	0.704E+05	0.572E+02	2.851	0.000E+03	0.012E+00	0.211E+03	0.141E-04	45.8	63.5	0.0
1.003E+02	0.733E+05	0.731E+05	0.572E+02	2.851	0.000E+03	0.011E+00	0.211E+03	0.141E-04	45.8	63.4	0.0
1.028E+02	0.761E+05	0.759E+05	0.572E+02	2.851	0.000E+03	0.010E+00	0.211E+03	0.141E-04	45.8	63.3	0.0
1.053E+02	0.790E+05	0.788E+05	0.572E+02	2.851	0.000E+03	0.009E+00	0.211E+03	0.141E-04	45.8	63.2	0.0
1.078E+02	0.820E+05	0.818E+05	0.572E+02	2.851	0.000E+03	0.008E+00	0.211E+03	0.141E-04	45.8	63.1	0.0
1.103E+02	0.851E+05	0.849E+05	0.572E+02	2.851	0.000E+03	0.007E+00	0.211E+03	0.141E-04	45.8	63.0	0.0
1.128E+02	0.883E+05	0.881E+05	0.572E+02	2.851	0.000E+03	0.006E+00	0.211E+03	0.141E-04	45.8	62.9	0.0
1.153E+02	0.916E+05	0.914E+05	0.572E+02	2.851	0.000E+03	0.005E+00	0.211E+03	0.141E-04	45.8	62.8	0.0
1.178E+02	0.950E+05	0.948E+05	0.572E+02	2.851	0.000E+03	0.004E+00	0.211E+03	0.141E-04	45.8	62.7	0.0
1.203E+02	0.985E+05	0.983E+05	0.572E+02	2.851	0.000E+03	0.003E+00	0.211E+03	0.141E-04	45.8	62.6	0.0
1.228E+02	1.021E+05	1.019E+05	0.572E+02	2.851	0.000E+03	0.002E+00	0.211E+03	0.141E-04	45.8	62.5	0.0
1.253E+02	1.058E+05	1.056E+05	0.572E+02	2.851	0.000E+03	0.001E+00	0.211E+03	0.141E-04	45.8	62.4	0.0
1.278E+02	1.096E+05	1.094E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	62.3	0.0
1.303E+02	1.135E+05	1.133E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	62.2	0.0
1.328E+02	1.175E+05	1.173E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	62.1	0.0
1.353E+02	1.216E+05	1.214E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	62.0	0.0
1.378E+02	1.258E+05	1.256E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	61.9	0.0
1.403E+02	1.301E+05	1.299E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	61.8	0.0
1.428E+02	1.345E+05	1.343E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	61.7	0.0
1.453E+02	1.390E+05	1.388E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	61.6	0.0
1.478E+02	1.436E+05	1.434E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	61.5	0.0
1.503E+02	1.483E+05	1.481E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	61.4	0.0
1.528E+02	1.531E+05	1.529E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	61.3	0.0
1.553E+02	1.580E+05	1.578E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	61.2	0.0
1.578E+02	1.630E+05	1.628E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	61.1	0.0
1.603E+02	1.681E+05	1.679E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	61.0	0.0
1.628E+02	1.733E+05	1.731E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	60.9	0.0
1.653E+02	1.786E+05	1.784E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	60.8	0.0
1.678E+02	1.840E+05	1.838E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	60.7	0.0
1.703E+02	1.895E+05	1.893E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	60.6	0.0
1.728E+02	1.951E+05	1.949E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	60.5	0.0
1.753E+02	2.008E+05	2.006E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	60.4	0.0
1.778E+02	2.066E+05	2.064E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	60.3	0.0
1.803E+02	2.125E+05	2.123E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	60.2	0.0
1.828E+02	2.185E+05	2.183E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	60.1	0.0
1.853E+02	2.246E+05	2.244E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	60.0	0.0
1.878E+02	2.308E+05	2.306E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03	0.141E-04	45.8	59.9	0.0
1.903E+02	2.371E+05	2.369E+05	0.572E+02	2.851	0.000E+03	0.000E+00	0.211E+03				

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JANET TRAJECTORY

(DRAG COEFF.)

LPR APR A30 AO/AR AS/AR LB UO U WR TDEV
 0.155E+01 0.475E+02 0.530E-02 0.280E+00 0.260E+00 0.594E+00 0.762E+03 0.963E+03 0.197E+01 0.174E+03

YFPR	CON	COS	CONW	CONF	APR	SBR	SWW	O	YMO
9.50	0.864E-01	0.211E-02	0.974E-02	0.344E-02	0.127E-01	0.618E+00	0.484E-01	0.456E+06	1.40
9.50	0.857E-01	0.214E-02	0.977E-02	0.345E-02	0.127E-01	0.618E+00	0.484E-01	0.457E+06	1.40
9.50	0.845E-01	0.218E-02	0.955E-02	0.341E-02	0.127E-01	0.618E+00	0.484E-01	0.458E+06	1.40
9.50	0.837E-01	0.223E-02	0.935E-02	0.337E-02	0.127E-01	0.618E+00	0.484E-01	0.459E+06	1.40
9.50	0.814E-01	0.227E-02	0.925E-02	0.333E-02	0.127E-01	0.618E+00	0.484E-01	0.460E+06	1.40
9.50	0.804E-01	0.232E-02	0.913E-02	0.328E-02	0.127E-01	0.618E+00	0.484E-01	0.461E+06	1.40
9.50	0.794E-01	0.238E-02	0.901E-02	0.323E-02	0.127E-01	0.618E+00	0.484E-01	0.462E+06	1.40
9.50	0.782E-01	0.244E-02	0.886E-02	0.318E-02	0.127E-01	0.618E+00	0.484E-01	0.463E+06	1.40
9.50	0.769E-01	0.247E-02	0.872E-02	0.312E-02	0.127E-01	0.618E+00	0.484E-01	0.464E+06	1.40
9.50	0.757E-01	0.251E-02	0.857E-02	0.305E-02	0.127E-01	0.618E+00	0.484E-01	0.465E+06	1.40
9.50	0.747E-01	0.254E-02	0.843E-02	0.300E-02	0.127E-01	0.618E+00	0.484E-01	0.466E+06	1.40
9.50	0.736E-01	0.258E-02	0.828E-02	0.294E-02	0.127E-01	0.618E+00	0.484E-01	0.467E+06	1.40
9.50	0.725E-01	0.262E-02	0.813E-02	0.288E-02	0.127E-01	0.618E+00	0.484E-01	0.468E+06	1.40
9.50	0.714E-01	0.267E-02	0.797E-02	0.282E-02	0.127E-01	0.618E+00	0.484E-01	0.469E+06	1.40
9.50	0.703E-01	0.271E-02	0.782E-02	0.276E-02	0.127E-01	0.618E+00	0.484E-01	0.470E+06	1.40
9.50	0.692E-01	0.276E-02	0.766E-02	0.270E-02	0.127E-01	0.618E+00	0.484E-01	0.471E+06	1.40
9.50	0.681E-01	0.281E-02	0.750E-02	0.264E-02	0.127E-01	0.618E+00	0.484E-01	0.472E+06	1.40
9.50	0.670E-01	0.286E-02	0.734E-02	0.258E-02	0.127E-01	0.618E+00	0.484E-01	0.473E+06	1.40
9.50	0.659E-01	0.291E-02	0.718E-02	0.252E-02	0.127E-01	0.618E+00	0.484E-01	0.474E+06	1.40
9.50	0.648E-01	0.296E-02	0.702E-02	0.246E-02	0.127E-01	0.618E+00	0.484E-01	0.475E+06	1.40
9.50	0.637E-01	0.301E-02	0.686E-02	0.240E-02	0.127E-01	0.618E+00	0.484E-01	0.476E+06	1.40
9.50	0.626E-01	0.306E-02	0.670E-02	0.234E-02	0.127E-01	0.618E+00	0.484E-01	0.477E+06	1.40
9.50	0.615E-01	0.311E-02	0.654E-02	0.228E-02	0.127E-01	0.618E+00	0.484E-01	0.478E+06	1.40
9.50	0.604E-01	0.316E-02	0.638E-02	0.222E-02	0.127E-01	0.618E+00	0.484E-01	0.479E+06	1.40
9.50	0.593E-01	0.321E-02	0.622E-02	0.216E-02	0.127E-01	0.618E+00	0.484E-01	0.480E+06	1.40
9.50	0.582E-01	0.326E-02	0.606E-02	0.210E-02	0.127E-01	0.618E+00	0.484E-01	0.481E+06	1.40
9.50	0.571E-01	0.331E-02	0.590E-02	0.204E-02	0.127E-01	0.618E+00	0.484E-01	0.482E+06	1.40
9.50	0.560E-01	0.336E-02	0.574E-02	0.198E-02	0.127E-01	0.618E+00	0.484E-01	0.483E+06	1.40
9.50	0.549E-01	0.341E-02	0.558E-02	0.192E-02	0.127E-01	0.618E+00	0.484E-01	0.484E+06	1.40
9.50	0.538E-01	0.346E-02	0.542E-02	0.186E-02	0.127E-01	0.618E+00	0.484E-01	0.485E+06	1.40
9.50	0.527E-01	0.351E-02	0.526E-02	0.180E-02	0.127E-01	0.618E+00	0.484E-01	0.486E+06	1.40
9.50	0.516E-01	0.356E-02	0.510E-02	0.174E-02	0.127E-01	0.618E+00	0.484E-01	0.487E+06	1.40
9.50	0.505E-01	0.361E-02	0.494E-02	0.168E-02	0.127E-01	0.618E+00	0.484E-01	0.488E+06	1.40
9.50	0.494E-01	0.366E-02	0.478E-02	0.162E-02	0.127E-01	0.618E+00	0.484E-01	0.489E+06	1.40
9.50	0.483E-01	0.371E-02	0.462E-02	0.156E-02	0.127E-01	0.618E+00	0.484E-01	0.490E+06	1.40
9.50	0.472E-01	0.376E-02	0.446E-02	0.150E-02	0.127E-01	0.618E+00	0.484E-01	0.491E+06	1.40
9.50	0.461E-01	0.381E-02	0.430E-02	0.144E-02	0.127E-01	0.618E+00	0.484E-01	0.492E+06	1.40
9.50	0.450E-01	0.386E-02	0.414E-02	0.138E-02	0.127E-01	0.618E+00	0.484E-01	0.493E+06	1.40
9.50	0.439E-01	0.391E-02	0.398E-02	0.132E-02	0.127E-01	0.618E+00	0.484E-01	0.494E+06	1.40
9.50	0.428E-01	0.396E-02	0.382E-02	0.126E-02	0.127E-01	0.618E+00	0.484E-01	0.495E+06	1.40
9.50	0.417E-01	0.401E-02	0.366E-02	0.120E-02	0.127E-01	0.618E+00	0.484E-01	0.496E+06	1.40
9.50	0.406E-01	0.406E-02	0.350E-02	0.114E-02	0.127E-01	0.618E+00	0.484E-01	0.497E+06	1.40
9.50	0.395E-01	0.411E-02	0.334E-02	0.108E-02	0.127E-01	0.618E+00	0.484E-01	0.498E+06	1.40
9.50	0.384E-01	0.416E-02	0.318E-02	0.102E-02	0.127E-01	0.618E+00	0.484E-01	0.499E+06	1.40
9.50	0.373E-01	0.421E-02	0.302E-02	0.096E-02	0.127E-01	0.618E+00	0.484E-01	0.500E+06	1.40
9.50	0.362E-01	0.426E-02	0.286E-02	0.090E-02	0.127E-01	0.618E+00	0.484E-01	0.501E+06	1.40
9.50	0.351E-01	0.431E-02	0.270E-02	0.084E-02	0.127E-01	0.618E+00	0.484E-01	0.502E+06	1.40
9.50	0.340E-01	0.436E-02	0.254E-02	0.078E-02	0.127E-01	0.618E+00	0.484E-01	0.503E+06	1.40
9.50	0.329E-01	0.441E-02	0.238E-02	0.072E-02	0.127E-01	0.618E+00	0.484E-01	0.504E+06	1.40
9.50	0.318E-01	0.446E-02	0.222E-02	0.066E-02	0.127E-01	0.618E+00	0.484E-01	0.505E+06	1.40
9.50	0.307E-01	0.451E-02	0.206E-02	0.060E-02	0.127E-01	0.618E+00	0.484E-01	0.506E+06	1.40
9.50	0.296E-01	0.456E-02	0.190E-02	0.054E-02	0.127E-01	0.618E+00	0.484E-01	0.507E+06	1.40
9.50	0.285E-01	0.461E-02	0.174E-02	0.048E-02	0.127E-01	0.618E+00	0.484E-01	0.508E+06	1.40
9.50	0.274E-01	0.466E-02	0.158E-02	0.042E-02	0.127E-01	0.618E+00	0.484E-01	0.509E+06	1.40
9.50	0.263E-01	0.471E-02	0.142E-02	0.036E-02	0.127E-01	0.618E+00	0.484E-01	0.510E+06	1.40
9.50	0.252E-01	0.476E-02	0.126E-02	0.030E-02	0.127E-01	0.618E+00	0.484E-01	0.511E+06	1.40
9.50	0.241E-01	0.481E-02	0.110E-02	0.024E-02	0.127E-01	0.618E+00	0.484E-01	0.512E+06	1.40
9.50	0.230E-01	0.486E-02	0.094E-02	0.018E-02	0.127E-01	0.618E+00	0.484E-01	0.513E+06	1.40
9.50	0.219E-01	0.491E-02	0.078E-02	0.012E-02	0.127E-01	0.618E+00	0.484E-01	0.514E+06	1.40
9.50	0.208E-01	0.496E-02	0.062E-02	0.006E-02	0.127E-01	0.618E+00	0.484E-01	0.515E+06	1.40
9.50	0.197E-01	0.501E-02	0.046E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.516E+06	1.40
9.50	0.186E-01	0.506E-02	0.030E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.517E+06	1.40
9.50	0.175E-01	0.511E-02	0.014E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.518E+06	1.40
9.50	0.164E-01	0.516E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.519E+06	1.40
9.50	0.153E-01	0.521E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.520E+06	1.40
9.50	0.142E-01	0.526E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.521E+06	1.40
9.50	0.131E-01	0.531E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.522E+06	1.40
9.50	0.120E-01	0.536E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.523E+06	1.40
9.50	0.109E-01	0.541E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.524E+06	1.40
9.50	0.098E-01	0.546E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.525E+06	1.40
9.50	0.087E-01	0.551E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.526E+06	1.40
9.50	0.076E-01	0.556E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.527E+06	1.40
9.50	0.065E-01	0.561E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.528E+06	1.40
9.50	0.054E-01	0.566E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.529E+06	1.40
9.50	0.043E-01	0.571E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.530E+06	1.40
9.50	0.032E-01	0.576E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.531E+06	1.40
9.50	0.021E-01	0.581E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.532E+06	1.40
9.50	0.010E-01	0.586E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.533E+06	1.40
9.50	0.000E-01	0.591E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.534E+06	1.40
9.50	0.000E-01	0.596E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.535E+06	1.40
9.50	0.000E-01	0.601E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.536E+06	1.40
9.50	0.000E-01	0.606E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.537E+06	1.40
9.50	0.000E-01	0.611E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.538E+06	1.40
9.50	0.000E-01	0.616E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.539E+06	1.40
9.50	0.000E-01	0.621E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.540E+06	1.40
9.50	0.000E-01	0.626E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.541E+06	1.40
9.50	0.000E-01	0.631E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.542E+06	1.40
9.50	0.000E-01	0.636E-02	0.000E-02	0.000E-02	0.127E-01	0.618E+00	0.484E-01	0.543E+06	1.40
9.50	0.000E-01	0.64							

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FILE: DEC 0 : A NAVAL POSTGRADUATE SCHOOL

9.50	0.112E+00	0.228E-01	0.124E-01	0.394E-02	0.127E-01	0.618E+00	0.494E-01	0.178E+06	1.40
9.50	0.120E+00	0.225E-01	0.130E-01	0.378E-02	0.127E-01	0.618E+00	0.494E-01	0.197E+06	1.40
9.50	0.129E+00	0.223E-01	0.134E-01	0.374E-02	0.127E-01	0.618E+00	0.494E-01	0.201E+06	1.40
9.50	0.138E+00	0.227E-01	0.144E-01	0.371E-02	0.127E-01	0.618E+00	0.494E-01	0.205E+06	1.40

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CCCCCCCCCCCCCCCCCCCCCCCCCCCC
 CFC
 CFC SDN 19 FUEL RAMJET CFC
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GEOMETRICAL DATA:

ARFF= 0.1245E+01M2 L3= 0.5842E+00M TETP= 5.5

AO/ARFF	A1/AO	A2/AO	A3/ARFF	A4/ARFF	A5/ARFF	A6/A5
0.2800	0.8194	0.4700	0.9100	0.4259	0.2600	3.8462

M0	M1C	M6
2.5336	2.3136	2.6646

CONSTANT LOSSES:

PID1= 0.930 PID2= 0.930 PIN= 0.960

INITIAL FLIGHT CONDITIONS:

PO(KG/M2)	TO(K)	RO(KG/M3)	PTO(KG/M2)	TYO(K)	GA
0.103E+05	0.288E+03	0.122E+01	0.186E+06	0.658E+03	1.470

TIME	M0	AS/AO	MA	WF/WA	M2	M3M	M31	M4	TOTAL PRES. RATIOS				CF	TT4(W)	CF	FIN)	TSM	
									IC/0	12/11	3/2	4/3						
0.62	5.53	0.510	2.479	6.596	0.209	0.143	0.180	0.391	0.995	0.827	0.961	0.940	0.670	1.23	2259.9	0.242	1370.6	7094.8
1.24	5.54	0.510	2.479	6.570	0.209	0.158	0.173	0.373	0.996	0.827	0.960	0.944	0.614	1.23	2259.0	0.241	1361.8	7087.8
1.87	5.55	0.510	2.479	6.543	0.209	0.173	0.165	0.355	0.996	0.831	0.959	0.947	0.628	1.23	2258.3	0.240	1353.0	7080.8
2.50	5.56	0.510	2.479	6.516	0.209	0.188	0.158	0.337	0.996	0.835	0.958	0.951	0.642	1.23	2257.6	0.239	1344.2	7073.8
3.13	5.57	0.510	2.479	6.489	0.209	0.203	0.151	0.319	0.996	0.839	0.957	0.954	0.656	1.23	2256.9	0.238	1335.4	7066.8
3.76	5.58	0.510	2.479	6.462	0.209	0.218	0.144	0.301	0.996	0.843	0.956	0.957	0.670	1.23	2256.2	0.237	1326.6	7059.8
4.39	5.59	0.510	2.479	6.435	0.209	0.233	0.137	0.283	0.996	0.847	0.955	0.958	0.684	1.23	2255.5	0.236	1317.8	7052.8
5.02	5.60	0.510	2.479	6.408	0.209	0.248	0.130	0.265	0.996	0.851	0.954	0.959	0.698	1.23	2254.8	0.235	1309.0	7045.8
5.65	5.61	0.510	2.479	6.381	0.209	0.263	0.123	0.247	0.996	0.855	0.953	0.960	0.712	1.23	2254.1	0.234	1300.2	7038.8
6.28	5.62	0.510	2.479	6.354	0.209	0.278	0.116	0.229	0.996	0.859	0.952	0.961	0.726	1.23	2253.4	0.233	1291.4	7031.8
6.91	5.63	0.510	2.479	6.327	0.209	0.293	0.109	0.211	0.996	0.863	0.951	0.962	0.740	1.23	2252.7	0.232	1282.6	7024.8
7.54	5.64	0.510	2.479	6.300	0.209	0.308	0.102	0.193	0.996	0.867	0.950	0.963	0.754	1.23	2252.0	0.231	1273.8	7017.8
8.17	5.65	0.510	2.479	6.273	0.209	0.323	0.095	0.175	0.996	0.871	0.949	0.964	0.768	1.23	2251.3	0.230	1265.0	7010.8
8.80	5.66	0.510	2.479	6.246	0.209	0.338	0.088	0.157	0.996	0.875	0.948	0.965	0.782	1.23	2250.6	0.229	1256.2	7003.8
9.43	5.67	0.510	2.479	6.219	0.209	0.353	0.081	0.139	0.996	0.879	0.947	0.966	0.796	1.23	2249.9	0.228	1247.4	6996.8
10.06	5.68	0.510	2.479	6.192	0.209	0.368	0.074	0.121	0.996	0.883	0.946	0.967	0.810	1.23	2249.2	0.227	1238.6	6989.8
10.69	5.69	0.510	2.479	6.165	0.209	0.383	0.067	0.103	0.996	0.887	0.945	0.968	0.824	1.23	2248.5	0.226	1229.8	6982.8
11.32	5.70	0.510	2.479	6.138	0.209	0.398	0.060	0.085	0.996	0.891	0.944	0.969	0.838	1.23	2247.8	0.225	1221.0	6975.8
11.95	5.71	0.510	2.479	6.111	0.209	0.413	0.053	0.067	0.996	0.895	0.943	0.970	0.852	1.23	2247.1	0.224	1212.2	6968.8
12.58	5.72	0.510	2.479	6.084	0.209	0.428	0.046	0.049	0.996	0.899	0.942	0.971	0.866	1.23	2246.4	0.223	1203.4	6961.8
13.21	5.73	0.510	2.479	6.057	0.209	0.443	0.039	0.031	0.996	0.903	0.941	0.972	0.880	1.23	2245.7	0.222	1194.6	6954.8
13.84	5.74	0.510	2.479	6.030	0.209	0.458	0.032	0.013	0.996	0.907	0.940	0.973	0.894	1.23	2245.0	0.221	1185.8	6947.8
14.47	5.75	0.510	2.479	6.003	0.209	0.473	0.025	0.005	0.996	0.911	0.939	0.974	0.908	1.23	2244.3	0.220	1177.0	6940.8
15.10	5.76	0.510	2.479	5.976	0.209	0.488	0.018	0.007	0.996	0.915	0.938	0.975	0.922	1.23	2243.6	0.219	1168.2	6933.8
15.73	5.77	0.510	2.479	5.949	0.209	0.503	0.011	0.009	0.996	0.919	0.937	0.976	0.936	1.23	2242.9	0.218	1159.4	6926.8
16.36	5.78	0.510	2.479	5.922	0.209	0.518	0.004	0.011	0.996	0.923	0.936	0.977	0.950	1.23	2242.2	0.217	1150.6	6919.8
16.99	5.79	0.510	2.479	5.895	0.209	0.533	0.007	0.013	0.996	0.927	0.935	0.978	0.964	1.23	2241.5	0.216	1141.8	6912.8
17.62	5.80	0.510	2.479	5.868	0.209	0.548	0.010	0.015	0.996	0.931	0.934	0.979	0.978	1.23	2240.8	0.215	1133.0	6905.8
18.25	5.81	0.510	2.479	5.841	0.209	0.563	0.013	0.017	0.996	0.935	0.933	0.980	0.992	1.23	2240.1	0.214	1124.2	6898.8
18.88	5.82	0.510	2.479	5.814	0.209	0.578	0.016	0.019	0.996	0.939	0.932	0.981	1.006	1.23	2239.4	0.213	1115.4	6891.8
19.51	5.83	0.510	2.479	5.787	0.209	0.593	0.019	0.021	0.996	0.943	0.931	0.982	1.020	1.23	2238.7	0.212	1106.6	6884.8
20.14	5.84	0.510	2.479	5.760	0.209	0.608	0.022	0.023	0.996	0.947	0.930	0.983	1.034	1.23	2238.0	0.211	1097.8	6877.8
20.77	5.85	0.510	2.479	5.733	0.209	0.623	0.025	0.025	0.996	0.951	0.929	0.984	1.048	1.23	2237.3	0.210	1089.0	6870.8
21.40	5.86	0.510	2.479	5.706	0.209	0.638	0.028	0.027	0.996	0.955	0.928	0.985	1.062	1.23	2236.6	0.209	1080.2	6863.8
22.03	5.87	0.510	2.479	5.679	0.209	0.653	0.031	0.029	0.996	0.959	0.927	0.986	1.076	1.23	2235.9	0.208	1071.4	6856.8
22.66	5.88	0.510	2.479	5.652	0.209	0.668	0.034	0.031	0.996	0.963	0.926	0.987	1.090	1.23	2235.2	0.207	1062.6	6849.8
23.29	5.89	0.510	2.479	5.625	0.209	0.683	0.037	0.033	0.996	0.967	0.925	0.988	1.104	1.23	2234.5	0.206	1053.8	6842.8
23.92	5.90	0.510	2.479	5.598	0.209	0.698	0.040	0.035	0.996	0.971	0.924	0.989	1.118	1.23	2233.8	0.205	1045.0	6835.8
24.55	5.91	0.510	2.479	5.571	0.209	0.713	0.043	0.037	0.996	0.975	0.923	0.990	1.132	1.23	2233.1	0.204	1036.2	6828.8
25.18	5.92	0.510	2.479	5.544	0.209	0.728	0.046	0.039	0.996	0.979	0.922	0.991	1.146	1.23	2232.4	0.203	1027.4	6821.8
25.81	5.93	0.510	2.479	5.517	0.209	0.743	0.049	0.041	0.996	0.983	0.921	0.992	1.160	1.23	2231.7	0.202	1018.6	6814.8
26.44	5.94	0.510	2.479	5.490	0.209	0.758	0.052	0.043	0.996	0.987	0.920	0.993	1.174	1.23	2231.0	0.201	1009.8	6807.8
27.07	5.95	0.510	2.479	5.463	0.209	0.773	0.055	0.045	0.996	0.991	0.919	0.994	1.188	1.23	2230.3	0.200	1001.0	6800.8
27.70	5.96	0.510	2.479	5.436	0.209	0.788	0.058	0.047	0.996	0.995	0.918	0.995	1.202	1.23	2229.6	0.199	992.2	6793.8
28.33	5.97	0.510	2.479	5.409	0.209	0.803	0.061	0.049	0.996	0.999	0.917	0.996	1.216	1.23	2228.9	0.198	983.4	6786.8
28.96	5.98	0.510	2.479	5.382	0.209	0.818	0.064	0.051	0.996	1.003	0.916	0.997	1.230	1.23	2228.2	0.197	974.6	6779.8
29.59	5.99	0.510	2.479	5.355	0.209	0.833	0.067	0.053	0.996	1.007	0.915	0.998	1.244	1.23	2227.5	0.196	965.8	6772.8
30.22	6.00	0.510	2.479	5.328	0.209	0.848	0.070	0.055	0.996	1.011	0.914	0.999	1.258	1.23	2226.8	0.195	957.0	6765.8
30.85	6.01	0.510	2.479	5.301	0.209	0.863	0.073	0.057	0.996	1.015	0.913	1.000	1.272	1.23	2226.1	0.194	948.2	6758.8
31.48	6.02	0.510	2.479	5.274	0.209	0.878	0.076	0.059	0.996	1.019	0.912	1.001	1.286	1.23	2225.4	0.193	939.4	6751.8
32.11	6.03	0.510	2.479	5.247	0.209	0.893	0.079	0.061	0.996	1.023	0.911	1.002	1.300	1.23	2224.7	0.192	930.6	6744.8
32.74	6.04	0.510	2.479	5.220	0.209	0.908	0.082	0.063	0.996	1.027	0.910	1.003	1.314	1.23	2224.0	0.191	921.8	6737.8
33.37	6.05	0.510	2.479	5.193	0.209	0.923	0.085	0.065	0.996	1.031	0.909	1.004	1.328	1.23	2223.3	0.190	913.0	6730.8
34.00	6.06	0.510	2.479	5.166	0.209	0.938	0.088	0.067	0.996	1.035	0.908	1.005	1.342	1.23	2222.6	0.189	904.2	6723.8
34.63	6.07	0.510	2.479	5.139	0.209	0.953	0.091	0.069	0.996	1.039	0.907	1.006	1.356	1.23	2221.9	0.188	895.4	6716.8
35.26	6.08	0.510	2.479	5.112	0.209	0.968	0.094	0.071	0.996	1.043	0.906	1.007	1.370	1.23	2221.2	0.187	886.6	6709.8
35.89	6.09	0.510	2.479	5.085	0.209	0.983	0.097	0.073	0.996	1.047	0.905	1.008	1.384	1.23	2220.5	0.186	87	

FILE: CMB 0 1 A NAVAL POSTGRADUATE SCHOOL

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18.66	2.77	0.533	0.970	0.009	0.292	0.799	0.116	0.244	0.994	0.681	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
19.03	2.77	0.542	0.894	0.168	0.293	0.799	0.116	0.244	0.994	0.670	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
19.40	2.77	0.546	0.825	0.447	0.293	0.799	0.116	0.244	0.994	0.660	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
19.77	2.77	0.546	0.733	0.656	0.293	0.799	0.116	0.244	0.994	0.647	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
20.14	2.75	0.533	0.633	0.849	0.293	0.799	0.116	0.244	0.994	0.633	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
20.51	2.75	0.533	0.533	1.049	0.293	0.799	0.116	0.244	0.994	0.617	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
20.88	2.73	0.519	0.433	1.257	0.293	0.799	0.116	0.244	0.994	0.600	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
21.25	2.73	0.519	0.333	1.466	0.293	0.799	0.116	0.244	0.994	0.583	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
21.62	2.71	0.519	0.233	1.675	0.293	0.799	0.116	0.244	0.994	0.567	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
21.99	2.70	0.519	0.133	1.884	0.293	0.799	0.116	0.244	0.994	0.550	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
22.36	2.69	0.519	0.033	2.093	0.293	0.799	0.116	0.244	0.994	0.533	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
22.73	2.68	0.506	0.000	2.302	0.293	0.799	0.116	0.244	0.994	0.517	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
23.10	2.66	0.492	0.000	2.511	0.293	0.799	0.116	0.244	0.994	0.500	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
23.47	2.64	0.477	0.000	2.720	0.293	0.799	0.116	0.244	0.994	0.483	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
23.84	2.62	0.463	0.000	2.929	0.293	0.799	0.116	0.244	0.994	0.467	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
24.21	2.60	0.447	0.000	3.138	0.293	0.799	0.116	0.244	0.994	0.450	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
24.58	2.58	0.433	0.000	3.347	0.293	0.799	0.116	0.244	0.994	0.433	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
24.95	2.56	0.417	0.000	3.556	0.293	0.799	0.116	0.244	0.994	0.417	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
25.32	2.54	0.401	0.000	3.765	0.293	0.799	0.116	0.244	0.994	0.401	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
25.69	2.52	0.385	0.000	3.974	0.293	0.799	0.116	0.244	0.994	0.385	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
26.06	2.50	0.369	0.000	4.183	0.293	0.799	0.116	0.244	0.994	0.369	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
26.43	2.48	0.353	0.000	4.392	0.293	0.799	0.116	0.244	0.994	0.353	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
26.80	2.46	0.337	0.000	4.601	0.293	0.799	0.116	0.244	0.994	0.337	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
27.17	2.44	0.321	0.000	4.810	0.293	0.799	0.116	0.244	0.994	0.321	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
27.54	2.42	0.305	0.000	5.019	0.293	0.799	0.116	0.244	0.994	0.305	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
27.91	2.40	0.289	0.000	5.228	0.293	0.799	0.116	0.244	0.994	0.289	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
28.28	2.38	0.273	0.000	5.437	0.293	0.799	0.116	0.244	0.994	0.273	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
28.65	2.36	0.257	0.000	5.646	0.293	0.799	0.116	0.244	0.994	0.257	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
29.02	2.34	0.241	0.000	5.855	0.293	0.799	0.116	0.244	0.994	0.241	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
29.39	2.32	0.225	0.000	6.064	0.293	0.799	0.116	0.244	0.994	0.225	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
29.76	2.30	0.209	0.000	6.273	0.293	0.799	0.116	0.244	0.994	0.209	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
30.13	2.28	0.193	0.000	6.482	0.293	0.799	0.116	0.244	0.994	0.193	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
30.50	2.26	0.177	0.000	6.691	0.293	0.799	0.116	0.244	0.994	0.177	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
30.87	2.24	0.161	0.000	6.900	0.293	0.799	0.116	0.244	0.994	0.161	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
31.24	2.22	0.145	0.000	7.109	0.293	0.799	0.116	0.244	0.994	0.145	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
31.61	2.20	0.129	0.000	7.318	0.293	0.799	0.116	0.244	0.994	0.129	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
31.98	2.18	0.113	0.000	7.527	0.293	0.799	0.116	0.244	0.994	0.113	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
32.35	2.16	0.097	0.000	7.736	0.293	0.799	0.116	0.244	0.994	0.097	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
32.72	2.14	0.081	0.000	7.945	0.293	0.799	0.116	0.244	0.994	0.081	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
33.09	2.12	0.065	0.000	8.154	0.293	0.799	0.116	0.244	0.994	0.065	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
33.46	2.10	0.049	0.000	8.363	0.293	0.799	0.116	0.244	0.994	0.049	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
33.83	2.08	0.033	0.000	8.572	0.293	0.799	0.116	0.244	0.994	0.033	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
34.20	2.06	0.017	0.000	8.781	0.293	0.799	0.116	0.244	0.994	0.017	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
34.57	2.04	0.001	0.000	8.990	0.293	0.799	0.116	0.244	0.994	0.001	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
34.94	2.02	0.000	0.000	9.199	0.293	0.799	0.116	0.244	0.994	0.000	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
35.31	2.00	0.000	0.000	9.408	0.293	0.799	0.116	0.244	0.994	0.000	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0
35.68	2.00	0.000	0.000	9.617	0.293	0.799	0.116	0.244	0.994	0.000	0.951	0.972	0.519	1.76	2.168	2	0.282	494.7	5314.0

TETA= 45.0

TIME OF RIPPING= 35.46 SEC

RANGE OF BURNING=0.2135E+05 KM

HEIGHT OF BURNING=0.1730E+05 KM

FILE: DRG

D : A NAVAL POSTGRADUATE SCHOOL

PAGE 002

4.50	0.111E+00	0.224E-02	0.124E-01	0.364E-02	0.121E-01	0.118E+00	0.444E-01	0.177E+00	1.40
4.50	0.111E+00	0.224E-02	0.124E-01	0.364E-02	0.121E-01	0.118E+00	0.444E-01	0.177E+00	1.40
4.50	0.111E+00	0.224E-02	0.124E-01	0.364E-02	0.121E-01	0.118E+00	0.444E-01	0.177E+00	1.40
4.50	0.137E+00	0.277E-02	0.144E-01	0.371E-02	0.127E-01	0.014E+00	0.484E-01	0.207E+00	1.40

FILE: CPH 0 A NAVAL POSTGRADUATE SCHOL

PAGE 002

19.26	2.72	0.937	0.893	0.153	0.323	0.092	0.109	0.228	0.994	0.676	0.938	0.975	0.909	1.26	2153.6	0.274	450.7	5129.1
19.50	2.79	0.943	0.897	0.320	0.326	0.092	0.110	0.227	0.994	0.668	0.937	0.976	0.905	1.26	2136.1	0.271	435.6	4984.0
20.54	2.78	0.943	0.813	0.489	0.375	0.092	0.099	0.246	0.994	0.666	0.937	0.976	0.907	1.26	2118.1	0.268	412.9	4748.1
21.18	2.77	0.942	0.180	0.660	0.376	0.091	0.099	0.276	0.994	0.666	0.937	0.976	0.906	1.27	2101.2	0.271	396.6	4748.1
21.83	2.77	0.937	0.749	0.832	0.323	0.191	0.109	0.225	0.994	0.678	0.938	0.976	0.912	1.27	2084.3	0.275	382.4	4717.4
22.47	2.76	0.937	0.720	1.006	0.324	0.091	0.109	0.274	0.994	0.687	0.938	0.976	0.918	1.27	2067.2	0.279	367.6	4665.6
23.11	2.75	0.931	0.692	1.111	0.311	0.091	0.107	0.315	0.994	0.692	0.938	0.976	0.925	1.27	2050.4	0.283	350.9	4615.4
23.75	2.74	0.926	0.665	1.135	0.314	0.091	0.106	0.354	0.994	0.703	0.939	0.976	0.931	1.27	2034.4	0.286	345.0	4588.3
24.39	2.73	0.926	0.617	1.155	0.320	0.190	0.107	0.374	0.994	0.707	0.939	0.976	0.937	1.27	2017.7	0.292	333.4	4570.3
25.04	2.73	0.920	0.615	1.174	0.317	0.190	0.106	0.424	0.995	0.717	0.940	0.976	0.944	1.27	2001.3	0.296	322.1	4469.7
25.68	2.72	0.915	0.592	1.189	0.313	0.190	0.103	0.424	0.995	0.727	0.941	0.976	0.950	1.28	1984.7	0.300	311.1	4417.6
26.32	2.71	0.915	0.570	1.175	0.313	0.190	0.105	0.473	0.995	0.732	0.941	0.976	0.956	1.28	1968.1	0.304	301.4	4364.0
26.96	2.70	0.909	0.549	1.125	0.313	0.190	0.104	0.523	0.995	0.747	0.941	0.976	0.962	1.28	1951.5	0.307	291.0	4311.4
27.60	2.69	0.903	0.529	1.149	0.314	0.190	0.104	0.573	0.995	0.744	0.941	0.976	0.968	1.28	1934.8	0.310	279.9	4259.8
28.24	2.69	0.903	0.510	1.163	0.311	0.190	0.103	0.623	0.995	0.757	0.942	0.976	0.974	1.28	1918.2	0.314	271.2	4197.6
28.89	2.68	0.903	0.492	1.140	0.312	0.190	0.104	0.673	0.995	0.761	0.942	0.976	0.981	1.28	1901.2	0.318	261.7	4155.4
29.53	2.67	0.908	0.474	1.129	0.310	0.190	0.103	0.723	0.995	0.772	0.943	0.976	0.987	1.28	1884.9	0.322	251.7	4116.1
30.17	2.66	0.902	0.458	1.111	0.310	0.190	0.102	0.773	0.995	0.782	0.943	0.976	0.994	1.28	1868.6	0.327	246.0	4076.4
30.81	2.65	0.903	0.442	1.116	0.308	0.189	0.102	0.823	0.995	0.787	0.943	0.976	0.991	1.28	1852.4	0.331	239.5	4035.8
31.46	2.65	0.907	0.427	1.158	0.306	0.189	0.101	0.873	0.995	0.797	0.944	0.976	0.997	1.28	1836.1	0.335	231.2	3994.6
32.10	2.64	0.901	0.413	1.173	0.303	0.189	0.101	0.923	0.995	0.808	0.945	0.976	0.994	1.29	1819.9	0.339	225.2	3952.9
32.74	2.63	0.901	0.400	1.191	0.304	0.189	0.101	0.973	0.995	0.812	0.945	0.976	0.997	1.29	1803.7	0.343	217.4	3910.9
33.39	2.63	0.906	0.385	1.115	0.302	0.189	0.100	0.973	0.995	0.823	0.945	0.976	0.997	1.29	1787.5	0.346	211.8	3868.7
34.02	2.62	0.906	0.374	1.120	0.303	0.189	0.100	0.973	0.995	0.827	0.945	0.976	0.997	1.29	1771.4	0.350	205.4	3826.1
34.67	2.61	0.907	0.362	1.146	0.302	0.189	0.100	0.973	0.995	0.834	0.945	0.976	0.997	1.29	1755.1	0.353	198.4	3783.9

TETA= 45.0

TIME OF BURNING= 34.67 S'C

RANGE OF BURNING=0.2342F+05 KM

HEIGHT OF BURNING=0.1719F+05 KM

RAPIER TRAJECTORY

EPR MPR A30 AO/AR AS/AR L3 UO U MR TDFV
 0.155E+01 0.475E+02 0.585E-02 0.780E+00 0.760E+01 0.544E+00 0.767E+03 0.490E+03 0.242E+01 0.12E+03

T1	X3	Y3	TETA	MO	PO	RHOA	TQ	MISA	MP1	ORIG	THRU57
0.642E+00	0.807E+03	0.800E+03	0.447E+02	2.614	0.103E+03	0.122E+01	0.248E+03	0.179E-04	47.5	1444.3	167.9
0.321E+01	0.241E+04	0.235E+04	0.435E+02	2.601	0.420E+04	0.102E+01	0.276E+03	0.172E-04	47.0	1460.0	174.4
0.578E+01	0.403E+04	0.385E+04	0.473E+02	2.621	0.820E+04	0.263E+00	0.276E+03	0.167E-04	46.7	1479.9	181.1
0.835E+01	0.567E+04	0.535E+04	0.410E+02	2.651	0.551E+04	0.733E+00	0.246E+03	0.163E-04	46.4	1513.2	195.6
0.105E+02	0.733E+04	0.671E+04	0.347E+02	2.644	0.453E+04	0.677E+00	0.246E+03	0.159E-04	46.1	1541.7	209.6
0.135E+02	0.907E+04	0.801E+04	0.384E+02	2.730	0.371E+04	0.519E+00	0.238E+03	0.156E-04	46.1	1568.4	231.1
0.160E+02	0.107E+05	0.938E+04	0.371E+02	2.759	0.136E+04	0.437E+00	0.220E+03	0.152E-04	46.0	1557.4	251.4
0.189E+02	0.125E+05	0.110E+05	0.357E+02	2.780	0.255E+04	0.365E+00	0.221E+03	0.149E-04	45.9	1581.1	265.3
0.212E+02	0.142E+05	0.111E+05	0.342E+02	2.774	0.212E+04	0.313E+00	0.213E+03	0.147E-04	45.9	1597.7	280.6
0.238E+02	0.159E+05	0.110E+05	0.327E+02	2.741	0.174E+04	0.267E+00	0.217E+03	0.144E-04	45.9	1611.9	294.0
0.263E+02	0.177E+05	0.141E+05	0.312E+02	2.709	0.151E+04	0.230E+00	0.217E+03	0.141E-04	45.8	1622.7	300.4
0.289E+02	0.194E+05	0.151E+05	0.297E+02	2.678	0.128E+04	0.199E+00	0.217E+03	0.141E-04	45.8	1630.4	261.1
0.315E+02	0.212E+05	0.161E+05	0.282E+02	2.647	0.113E+04	0.173E+00	0.217E+03	0.141E-04	45.8	1637.8	271.2
0.341E+02	0.230E+05	0.173E+05	0.267E+02	2.618	0.930E+03	0.151E+00	0.217E+03	0.141E-04	45.8	1644.8	281.2
0.366E+02	0.247E+05	0.178E+05	0.252E+02	2.589	0.819E+03	0.136E+00	0.217E+03	0.141E-04	45.8	1651.8	291.2
0.392E+02	0.265E+05	0.186E+05	0.237E+02	2.564	0.744E+03	0.119E+00	0.217E+03	0.141E-04	45.8	1658.8	301.2
0.418E+02	0.282E+05	0.193E+05	0.221E+02	2.540	0.666E+03	0.104E+00	0.217E+03	0.141E-04	45.8	1665.8	311.2
0.444E+02	0.300E+05	0.199E+05	0.207E+02	2.512	0.601E+03	0.090E+00	0.217E+03	0.141E-04	45.8	1672.8	321.2
0.469E+02	0.317E+05	0.209E+05	0.192E+02	2.488	0.549E+03	0.080E+00	0.217E+03	0.141E-04	45.8	1679.8	331.2
0.494E+02	0.334E+05	0.220E+05	0.177E+02	2.469	0.503E+03	0.073E+00	0.217E+03	0.141E-04	45.8	1686.8	341.2
0.520E+02	0.351E+05	0.231E+05	0.172E+02	2.452	0.473E+03	0.068E+00	0.217E+03	0.141E-04	45.8	1693.8	351.2
0.546E+02	0.368E+05	0.241E+05	0.171E+02	2.439	0.444E+03	0.064E+00	0.217E+03	0.141E-04	45.8	1700.8	361.2
0.571E+02	0.385E+05	0.250E+05	0.165E+02	2.431	0.425E+03	0.060E+00	0.217E+03	0.141E-04	45.8	1707.8	371.2
0.597E+02	0.401E+05	0.259E+05	0.167E+02	2.406	0.409E+03	0.058E+00	0.217E+03	0.141E-04	45.8	1714.8	381.2
0.623E+02	0.417E+05	0.268E+05	0.165E+02	2.385	0.398E+03	0.056E+00	0.217E+03	0.141E-04	45.8	1721.8	391.2
0.648E+02	0.434E+05	0.277E+05	0.163E+02	2.365	0.387E+03	0.055E+00	0.217E+03	0.141E-04	45.8	1728.8	401.2
0.674E+02	0.450E+05	0.285E+05	0.161E+02	2.353	0.375E+03	0.053E+00	0.217E+03	0.141E-04	45.8	1735.8	411.2
0.700E+02	0.467E+05	0.293E+05	0.161E+02	2.344	0.364E+03	0.053E+00	0.217E+03	0.141E-04	45.8	1742.8	421.2
0.725E+02	0.483E+05	0.302E+05	0.161E+02	2.334	0.353E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1749.8	431.2
0.751E+02	0.500E+05	0.310E+05	0.161E+02	2.325	0.342E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1756.8	441.2
0.777E+02	0.516E+05	0.322E+05	0.161E+02	2.315	0.330E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1763.8	451.2
0.802E+02	0.531E+05	0.331E+05	0.161E+02	2.307	0.319E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1770.8	461.2
0.828E+02	0.547E+05	0.341E+05	0.161E+02	2.303	0.308E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1777.8	471.2
0.853E+02	0.563E+05	0.350E+05	0.161E+02	2.300	0.297E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1784.8	481.2
0.879E+02	0.579E+05	0.360E+05	0.161E+02	2.290	0.286E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1791.8	491.2
0.905E+02	0.594E+05	0.369E+05	0.201E+02	2.283	0.275E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1798.8	501.2
0.931E+02	0.609E+05	0.378E+05	0.222E+02	2.281	0.264E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1805.8	511.2
0.957E+02	0.624E+05	0.387E+05	0.242E+02	2.283	0.253E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1812.8	521.2
0.982E+02	0.640E+05	0.396E+05	0.262E+02	2.290	0.242E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1819.8	531.2
1.008E+02	0.655E+05	0.405E+05	0.282E+02	2.304	0.231E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1826.8	541.2
1.033E+02	0.670E+05	0.414E+05	0.301E+02	2.325	0.220E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1833.8	551.2
1.059E+02	0.684E+05	0.423E+05	0.319E+02	2.351	0.215E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1840.8	561.2
1.084E+02	0.699E+05	0.432E+05	0.337E+02	2.389	0.211E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1847.8	571.2
1.110E+02	0.713E+05	0.441E+05	0.355E+02	2.404	0.205E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1854.8	581.2
1.136E+02	0.727E+05	0.450E+05	0.372E+02	2.416	0.197E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1861.8	591.2
1.161E+02	0.741E+05	0.459E+05	0.389E+02	2.426	0.189E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1868.8	601.2
1.187E+02	0.755E+05	0.468E+05	0.405E+02	2.438	0.181E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1875.8	611.2
1.212E+02	0.769E+05	0.477E+05	0.421E+02	2.470	0.170E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1882.8	621.2
1.238E+02	0.783E+05	0.485E+05	0.437E+02	2.484	0.159E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1889.8	631.2
1.263E+02	0.797E+05	0.493E+05	0.453E+02	2.504	0.147E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1896.8	641.2
1.289E+02	0.811E+05	0.501E+05	0.469E+02	2.514	0.135E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1903.8	651.2
1.314E+02	0.825E+05	0.509E+05	0.485E+02	2.531	0.123E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1910.8	661.2
1.340E+02	0.839E+05	0.517E+05	0.501E+02	2.544	0.111E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1917.8	671.2
1.365E+02	0.853E+05	0.525E+05	0.517E+02	2.554	0.100E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1924.8	681.2
1.391E+02	0.867E+05	0.533E+05	0.533E+02	2.564	0.088E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1931.8	691.2
1.416E+02	0.881E+05	0.541E+05	0.549E+02	2.574	0.077E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1938.8	701.2
1.442E+02	0.895E+05	0.549E+05	0.565E+02	2.584	0.065E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1945.8	711.2
1.467E+02	0.909E+05	0.557E+05	0.581E+02	2.594	0.054E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1952.8	721.2
1.493E+02	0.923E+05	0.565E+05	0.597E+02	2.604	0.043E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1959.8	731.2
1.518E+02	0.937E+05	0.573E+05	0.613E+02	2.614	0.032E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1966.8	741.2
1.544E+02	0.951E+05	0.581E+05	0.629E+02	2.624	0.021E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1973.8	751.2
1.569E+02	0.965E+05	0.589E+05	0.645E+02	2.634	0.010E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1980.8	761.2
1.595E+02	0.979E+05	0.597E+05	0.661E+02	2.644	0.000E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1987.8	771.2
1.620E+02	0.993E+05	0.605E+05	0.677E+02	2.654	0.000E+03	0.052E+00	0.217E+03	0.141E-04	45.8	1994.8	781.2
1.646E+02	0.1007E+06	0.613E+05	0.693E+02	2.664	0.000E+03	0.052E+00	0.217E+03	0.141E-04	45.8	2001.8	791.2
1.671E+02	0.1021E+06	0.621E+05	0.709E+02	2.674	0.000E+03	0.052E+00	0.217E+03	0.141E-04	45.8	2008.8	801.2
1.697E+02	0.1035E+06	0.629E+05	0.725E+02	2.684	0.000E+03	0.052E+00	0.217E+03	0.141E-04	45.8	2015.8	811.2
1.722E+02	0.1049E+06	0.637E+05	0.741E+02	2.694	0.000E+03	0.052E+00	0.217E+03	0.141E-04	45.8	2022.8	821.2
1.748E+02	0.1063E+06	0.645E+05	0.757E+02	2.704	0.000E+03	0.052E+00	0.217E+03	0.141E-04	45.8	2029.8	831.2
1.773E+02	0.1077E+06	0.653E+05	0.773E+02	2.714	0.000E+03	0.052E+00	0.217E+03	0.141E-04	45.8	2036.8	841.2
1.799E+02	0.1091E+06	0.661E+05	0.789E+02	2.724	0.000E+03	0.052E+00	0.217E+03	0.141E-04	45.8	2043.8	851.2
1.824E+02	0.1105E+06	0.669E+05	0.805E+02	2.734	0.000E+03	0.052E+00	0.217E+03	0.141E-04	45.8	2050.8	861.2
1.850E+02	0.1119E+06	0.677E+05	0.821E+02	2.744	0.000E+03	0.052E+00	0.217E+03	0.141E-04	45.8	2057.8	871.2
1.875E+02	0.1133E+06	0.685E+05	0.837E+02	2.754	0.000E+03	0.052E+00	0.217E+03	0.141E-04	45.8	2064.8	881.2
1.901E+02	0.1147E+06	0.693E+05	0.853E+02	2.764	0.000E+03	0.052E+00	0.217E+03	0.141E-04	45.8	2071.8	891.2
1.926E+02	0.1161E+06	0.701E+05	0.869E+02	2.774	0.000E+03	0.052E+00	0.217E+03	0.141E-04	45.8	2078.8	901.2
1.952E+02	0.										

FILE: DRG 0 A NAVAL POSTGRADUATE SCHOOL

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9.50	0.1245+00	0.2245-02	0.1325-01	0.3755-02	0.1275-01	0.6185+00	0.4845-01	0.2005+06	1.40
9.50	0.1335+00	0.2225-02	0.1405-01	0.3775-02	0.1275-01	0.6185+00	0.4845-01	0.2005+06	1.40
9.50	0.1385+00	0.2225-02	0.1445-01	0.3715-02	0.1275-01	0.6185+00	0.4845-01	0.2005+06	1.40

10

PAGE 001

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CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCC -SOLID, FUEL MANJF          CCC
CCC                               CCC
CCC                               CCC
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GEOMETRICAL DATA:

ARCF= 0.1245E-01M2 L3= 0.5842E+00M TFTP= 9.5

A0/ARFF	A17/A0	A1/A0	A2/A0	A3/ARFF	A5/ARFF	A6/A5
0.2500	0.8194	0.4700	0.8269	0.4259	0.2600	3.8462

MO	MIC	MS
2.5336	2.3136	2.6634

CONSTANT LOSSES:

P171= 0.930 P172= 0.930 P174= 0.960

INITIAL FLIGHT CONDITIONS:

PO(KG/M ²)	VO(K)	ROO(KG/M ³)	PTQ(KK/M ²)	TTQ(K)	GA
0.103E+05	0.288E+03	0.122E+01	0.186E+06	0.658E+03	1.400

TIME	MO	AS/AD	WA	WF/WA	M2	M3N	M3I	M4	TOTAL CREQ. RATIOS				GF	T14IKI	CF	F(M)	FSD
									1C/D	12/11	4/2	4/3					
0-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
1-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
2-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
3-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
4-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
5-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
6-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
7-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
8-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
9-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
10-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
11-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
12-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
13-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
14-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
15-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
16-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
17-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
18-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
19-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
20-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
21-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
22-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
23-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
24-16	2	3	3	6	6	0	0	0	0.986	0.171	0.438	0.958	1.29	2750.8	0.200	136.1	6794.9
25-16	2																

FILE: CMR D NAVAL POSTGRADUATE SCHOOL

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22.86 2.50 0.481 0.434 13.675 0.316 0.101 0.109 0.263 0.996 0.080 0.941 0.967 0.660 1.28 1817.9 0.346 245.5 4154.4
21.62 2.48 0.476 0.408 12.020 0.315 0.101 0.109 0.263 0.996 0.080 0.941 0.967 0.675 1.29 1791.7 0.346 235.3 4061.3

TEPA= 60.0

TIME OF BURNING= 23.62 SEC

RANGE OF BURNING=0.1091E+05 KM

HEIGHT OF BURNING=0.1598E+05 KM

PARAJET TRAJECTORY

LPR WPR A30 AO/AR AS/AR LT UO U WS TDFV
 0.155E+01 0.475E+02 0.430E-02 0.250E+00 0.260E+03 0.544E+03 0.762E+03 0.863E+01 0.149E+01 0.152E+03

TI	X3	Y3	TETA	NO	PO	RHOA	TD	MHA	WPR	DPAC	THRUST
0.762E+00	0.656E+03	0.113E+04	0.597E+02	2.534	0.103E+03	0.122E+01	0.288E+01	0.179E-04	47.5	181.7	1136.1
0.381E+01	0.195E+04	0.132E+04	0.597E+02	2.527	0.138E+04	0.840E+00	0.273E+01	0.170E-04	47.0	1027.4	1161.8
0.086E+01	0.229E+04	0.544E+04	0.570E+02	2.557	0.553E+04	0.135E+00	0.256E+01	0.163E-04	46.7	772.0	995.7
0.000E+01	0.464E+04	0.751E+04	0.565E+02	2.593	0.412E+04	0.464E+00	0.342E+01	0.158E-04	46.3	561.8	769.7
0.130E+01	0.601E+04	0.953E+04	0.553E+02	2.623	0.337E+04	0.439E+00	0.229E+01	0.157E-04	46.3	425.4	573.6
0.160E+02	0.740E+04	0.115E+05	0.540E+02	2.639	0.230E+04	0.338E+00	0.218E+01	0.148E-04	46.3	320.5	416.8
0.140E+02	0.877E+04	0.133E+05	0.527E+02	2.579	0.171E+04	0.261E+00	0.217E+01	0.141E-04	46.2	244.8	314.8
0.221E+02	0.107E+05	0.151E+05	0.513E+02	2.516	0.132E+04	0.201E+00	0.217E+01	0.141E-04	46.2	187.1	240.2
0.251E+02	0.116E+05	0.168E+05	0.498E+02	2.441	0.101E+04	0.159E+00	0.217E+01	0.141E-04	46.2	161.6	209.2
0.281E+02	0.130E+05	0.184E+05	0.482E+02	2.355	0.786E+03	0.125E+00	0.217E+01	0.141E-04	46.2	139.0	180.0
0.312E+02	0.144E+05	0.199E+05	0.464E+02	2.234	0.621E+03	0.101E+00	0.217E+01	0.141E-04	46.2	119.9	159.0
0.343E+02	0.158E+05	0.213E+05	0.446E+02	2.149	0.549E+03	0.821E-01	0.217E+01	0.141E-04	46.2	101.7	139.0
0.373E+02	0.171E+05	0.226E+05	0.428E+02	2.065	0.478E+03	0.615E-01	0.217E+01	0.141E-04	46.2	87.7	120.0
0.404E+02	0.185E+05	0.237E+05	0.409E+02	1.986	0.394E+03	0.465E-01	0.217E+01	0.141E-04	46.2	74.1	102.0
0.434E+02	0.198E+05	0.248E+05	0.389E+02	1.913	0.279E+03	0.479E-01	0.217E+01	0.141E-04	46.2	63.6	86.0
0.465E+02	0.212E+05	0.259E+05	0.369E+02	1.844	0.217E+03	0.407E-01	0.217E+01	0.141E-04	46.2	54.8	73.0
0.495E+02	0.224E+05	0.267E+05	0.349E+02	1.783	0.235E+03	0.355E-01	0.217E+01	0.141E-04	46.2	48.2	64.2
0.526E+02	0.237E+05	0.275E+05	0.329E+02	1.723	0.179E+03	0.311E-01	0.217E+01	0.141E-04	46.2	43.3	57.0
0.556E+02	0.250E+05	0.282E+05	0.309E+02	1.670	0.159E+03	0.278E-01	0.217E+01	0.141E-04	46.2	39.7	51.0
0.587E+02	0.265E+05	0.289E+05	0.289E+02	1.623	0.131E+03	0.251E-01	0.217E+01	0.141E-04	46.2	36.4	46.0
0.617E+02	0.278E+05	0.294E+05	0.269E+02	1.582	0.115E+03	0.231E-01	0.217E+01	0.141E-04	46.2	34.4	42.0
0.648E+02	0.291E+05	0.297E+05	0.249E+02	1.546	0.102E+03	0.215E-01	0.217E+01	0.141E-04	46.2	32.0	39.0
0.678E+02	0.305E+05	0.302E+05	0.229E+02	1.516	0.114E+03	0.211E-01	0.217E+01	0.141E-04	46.2	30.0	36.0
0.709E+02	0.318E+05	0.304E+05	0.209E+02	1.493	0.109E+03	0.194E-01	0.217E+01	0.141E-04	46.2	28.4	34.0
0.739E+02	0.331E+05	0.306E+05	0.189E+02	1.476	0.102E+03	0.188E-01	0.217E+01	0.141E-04	46.2	27.1	32.0
0.770E+02	0.344E+05	0.308E+05	0.169E+02	1.465	0.104E+03	0.185E-01	0.217E+01	0.141E-04	46.2	26.0	30.0
0.800E+02	0.358E+05	0.309E+05	0.149E+02	1.461	0.104E+03	0.185E-01	0.217E+01	0.141E-04	46.2	24.9	28.0
0.830E+02	0.371E+05	0.309E+05	0.129E+02	1.464	0.106E+03	0.184E-01	0.217E+01	0.141E-04	46.2	24.0	26.0
0.861E+02	0.384E+05	0.309E+05	0.109E+02	1.474	0.109E+03	0.183E-01	0.217E+01	0.141E-04	46.2	23.3	24.0
0.891E+02	0.397E+05	0.309E+05	0.089E+02	1.491	0.114E+03	0.202E-01	0.217E+01	0.141E-04	46.2	22.6	22.0
0.922E+02	0.410E+05	0.297E+05	0.069E+02	1.514	0.121E+03	0.213E-01	0.217E+01	0.141E-04	46.2	22.0	20.0
0.952E+02	0.424E+05	0.297E+05	0.049E+02	1.544	0.130E+03	0.229E-01	0.217E+01	0.141E-04	46.2	21.4	18.0
0.983E+02	0.437E+05	0.296E+05	0.029E+02	1.579	0.142E+03	0.247E-01	0.217E+01	0.141E-04	46.2	20.9	16.0
1.013E+03	0.449E+05	0.290E+05	0.009E+02	1.620	0.157E+03	0.275E-01	0.217E+01	0.141E-04	46.2	20.4	14.0
1.044E+03	0.462E+05	0.277E+05	0.000E+02	1.665	0.177E+03	0.307E-01	0.217E+01	0.141E-04	46.2	19.9	12.0
1.074E+03	0.475E+05	0.264E+05	0.000E+02	1.714	0.201E+03	0.348E-01	0.217E+01	0.141E-04	46.2	19.4	10.0
1.105E+03	0.488E+05	0.252E+05	0.000E+02	1.765	0.231E+03	0.403E-01	0.217E+01	0.141E-04	46.2	18.9	8.0
0.314E+03	0.501E+05	0.240E+05	0.000E+02	1.819	0.273E+03	0.465E-01	0.217E+01	0.141E-04	46.2	18.4	6.0
0.317E+03	0.513E+05	0.227E+05	0.000E+02	1.775	0.324E+03	0.544E-01	0.217E+01	0.141E-04	46.2	17.9	4.0
0.120E+03	0.526E+05	0.212E+05	0.000E+02	1.933	0.380E+03	0.652E-01	0.217E+01	0.141E-04	46.2	17.4	2.0
0.123E+03	0.539E+05	0.200E+05	0.000E+02	1.992	0.442E+03	0.787E-01	0.217E+01	0.141E-04	46.2	16.9	0.0
0.126E+03	0.552E+05	0.189E+05	0.000E+02	2.051	0.516E+03	0.957E-01	0.217E+01	0.141E-04	46.2	16.4	0.0
0.129E+03	0.564E+05	0.178E+05	0.000E+02	2.109	0.601E+03	0.114E+00	0.217E+01	0.141E-04	46.2	15.9	0.0
0.132E+03	0.577E+05	0.167E+05	0.000E+02	2.166	0.697E+03	0.145E+00	0.217E+01	0.141E-04	46.2	15.4	0.0
0.135E+03	0.590E+05	0.156E+05	0.000E+02	2.215	0.804E+03	0.187E+00	0.217E+01	0.141E-04	46.2	14.9	0.0
0.138E+03	0.603E+05	0.145E+05	0.000E+02	2.261	0.925E+03	0.242E+00	0.217E+01	0.141E-04	46.2	14.4	0.0
0.141E+03	0.616E+05	0.134E+05	0.000E+02	2.305	0.104E+04	0.309E+00	0.217E+01	0.141E-04	46.2	13.9	0.0
0.144E+03	0.629E+05	0.123E+05	0.000E+02	2.357	0.125E+04	0.387E+00	0.217E+01	0.141E-04	46.2	13.4	0.0
0.147E+03	0.642E+05	0.112E+05	0.000E+02	2.404	0.147E+04	0.467E+00	0.217E+01	0.141E-04	46.2	12.9	0.0
0.150E+03	0.655E+05	0.101E+05	0.000E+02	2.454	0.173E+04	0.558E+00	0.217E+01	0.141E-04	46.2	12.4	0.0
0.153E+03	0.668E+05	0.090E+05	0.000E+02	2.504	0.204E+04	0.673E+00	0.217E+01	0.141E-04	46.2	11.9	0.0
0.156E+03	0.681E+05	0.079E+05	0.000E+02	2.557	0.241E+04	0.807E+00	0.217E+01	0.141E-04	46.2	11.4	0.0
0.159E+03	0.694E+05	0.068E+05	0.000E+02	2.604	0.285E+04	0.971E+00	0.217E+01	0.141E-04	46.2	10.9	0.0
0.162E+03	0.707E+05	0.057E+05	0.000E+02	2.654	0.337E+04	0.117E+01	0.217E+01	0.141E-04	46.2	10.4	0.0
0.165E+03	0.720E+05	0.046E+05	0.000E+02	2.704	0.397E+04	0.145E+01	0.217E+01	0.141E-04	46.2	9.9	0.0
0.168E+03	0.733E+05	0.035E+05	0.000E+02	2.754	0.467E+04	0.185E+01	0.217E+01	0.141E-04	46.2	9.4	0.0
0.171E+03	0.746E+05	0.024E+05	0.000E+02	2.804	0.547E+04	0.237E+01	0.217E+01	0.141E-04	46.2	8.9	0.0
0.174E+03	0.759E+05	0.013E+05	0.000E+02	2.854	0.637E+04	0.303E+01	0.217E+01	0.141E-04	46.2	8.4	0.0
0.177E+03	0.772E+05	0.002E+05	0.000E+02	2.904	0.737E+04	0.383E+01	0.217E+01	0.141E-04	46.2	7.9	0.0
0.180E+03	0.785E+05	0.000E+05	0.000E+02	2.954	0.847E+04	0.477E+01	0.217E+01	0.141E-04	46.2	7.4	0.0
0.183E+03	0.798E+05	0.000E+05	0.000E+02	3.004	0.967E+04	0.587E+01	0.217E+01	0.141E-04	46.2	6.9	0.0
0.186E+03	0.811E+05	0.000E+05	0.000E+02	3.054	0.109E+05	0.713E+01	0.217E+01	0.141E-04	46.2	6.4	0.0
0.189E+03	0.824E+05	0.000E+05	0.000E+02	3.104	0.123E+05	0.857E+01	0.217E+01	0.141E-04	46.2	5.9	0.0
0.192E+03	0.837E+05	0.000E+05	0.000E+02	3.154	0.138E+05	0.102E+02	0.217E+01	0.141E-04	46.2	5.4	0.0
0.195E+03	0.850E+05	0.000E+05	0.000E+02	3.204	0.154E+05	0.123E+02	0.217E+01	0.141E-04	46.2	4.9	0.0
0.198E+03	0.863E+05	0.000E+05	0.000E+02	3.254	0.171E+05	0.150E+02	0.217E+01	0.141E-04	46.2	4.4	0.0
0.201E+03	0.876E+05	0.000E+05	0.000E+02	3.304	0.189E+05	0.183E+02	0.217E+01	0.141E-04	46.2	3.9	0.0
0.204E+03	0.889E+05	0.000E+05	0.000E+02	3.354	0.208E+05	0.223E+02	0.217E+01	0.141E-04	46.2	3.4	0.0
0.207E+03	0.902E+05	0.000E+05	0.000E+02	3.404	0.228E+05	0.270E+02	0.217E+01	0.141E-04	46.2	2.9	0.0
0.210E+03	0.915E+05	0.000E+05	0.000E+02	3.454	0.249E+05	0.325E+02	0.217E+01	0.141E-04	46.2	2.4	0.0
0.213E+03	0.928E+05	0.000E+05	0.000E+02	3.504	0.271E+05	0.388E+02	0.217E+01	0.141E-04	46.2	1.9	0.0
0.216E+03	0.941E+05	0.000E+05	0.000E+02	3.554	0.294E+05	0.459E+02	0.217E+01	0.141E-04	46.2	1.4	0.0
0.219E+03	0.954E+05	0.000E+05	0.000E+02	3.604	0.318E+05	0.538E+02	0.217E+01	0.141E-04	46.2	0.9	0.0
0.222E+03	0.967E+05	0.000E+05	0.000E+02	3.654	0.343E+05	0.625E+02	0.217E+01	0.141E-04	46.2	0.4	0.0
0.225E+03	0.980E+05	0.000E+05	0.000E+02	3.704	0.369E+05	0.720E+02	0.217E+01	0.141E-04	46.2	0.0	0.0
0.228E+03	0.993E+05	0.000E+05	0.000E+02	3.754	0.396E+05	0.823E+02	0.217E+01	0.141E-04	46.2	0.0	0.0
0.231E+03	1.006E+05	0.000E+05	0.000E+02	3.804	0.424E+05	0.934E+02	0.217E+01	0.141E-04	46.2	0.0	0.0
0.234E+03	1.019E+05	0.000E+05	0.000E+02	3.854	0.453E+05	0.105E+03	0.217E+01	0.141E-04	46.2	0.0	

FILE: DRG 0 : A NAVAL POSTGRADUATE SCHOOL

PAGE 002

9.50 0.127E+00 0.220E-02 0.135E-01 0.367E-02 0.127E-01 0.618E+00 0.484E-01 0.237E+06 1.40

FILE: CMB D A NAVAL POSTGRADUATE SCHOOL

PAGE 007

18.66	2.82	0.554	0.914	10.094	0.329	0.100	0.119	0.245	0.999	0.640	0.937	0.972	0.963	1.26	2169.0	0.254	451.4	4920.9
19.29	2.89	0.559	0.917	10.248	0.332	0.099	0.120	0.244	0.999	0.632	0.936	0.972	0.963	1.26	2150.9	0.251	420.4	4777.4
19.91	2.89	0.559	0.942	10.413	0.332	0.099	0.120	0.244	0.999	0.630	0.936	0.972	0.963	1.26	2133.6	0.248	409.7	4638.0
20.53	2.82	0.559	0.909	10.581	0.332	0.098	0.119	0.243	0.999	0.628	0.936	0.972	0.963	1.27	2116.0	0.245	398.3	4502.7
21.15	2.81	0.559	0.177	10.750	0.332	0.098	0.119	0.243	0.999	0.631	0.936	0.972	0.963	1.27	2099.2	0.244	387.1	4364.0
21.78	2.81	0.554	0.166	10.927	0.330	0.098	0.118	0.242	0.999	0.640	0.937	0.972	0.963	1.27	2082.4	0.241	375.8	4229.2
22.40	2.80	0.554	0.177	11.094	0.330	0.098	0.118	0.242	0.999	0.644	0.936	0.972	0.963	1.27	2065.5	0.235	364.4	4092.0
23.02	2.79	0.548	0.166	11.268	0.328	0.098	0.117	0.241	0.999	0.651	0.937	0.972	0.963	1.27	2049.3	0.230	352.2	3957.2
23.64	2.78	0.548	0.166	11.444	0.328	0.097	0.117	0.241	0.999	0.657	0.937	0.972	0.963	1.27	2033.1	0.226	340.2	3822.5
24.26	2.77	0.542	0.161	11.620	0.326	0.097	0.116	0.241	0.999	0.667	0.938	0.972	0.963	1.27	2016.8	0.227	327.5	3687.6
24.88	2.77	0.533	0.161	11.794	0.325	0.097	0.115	0.240	0.999	0.676	0.939	0.972	0.963	1.27	2000.4	0.221	315.1	3552.8
25.51	2.76	0.517	0.152	11.968	0.324	0.097	0.115	0.240	0.999	0.681	0.939	0.972	0.963	1.28	1983.9	0.216	302.9	3418.4
26.13	2.75	0.511	0.150	12.144	0.324	0.097	0.114	0.240	0.999	0.693	0.939	0.972	0.963	1.28	1967.4	0.219	290.3	3283.4
26.75	2.74	0.533	0.159	12.320	0.322	0.097	0.113	0.240	0.999	0.694	0.939	0.972	0.963	1.28	1950.8	0.221	277.3	3148.5
27.37	2.73	0.527	0.159	12.496	0.319	0.097	0.113	0.240	0.999	0.704	0.940	0.972	0.963	1.28	1934.1	0.226	264.0	3013.4
27.99	2.73	0.527	0.153	12.673	0.318	0.097	0.113	0.240	0.999	0.708	0.940	0.972	0.963	1.28	1917.2	0.227	250.3	2878.8
28.62	2.72	0.523	0.147	12.849	0.317	0.096	0.113	0.240	0.999	0.718	0.941	0.972	0.963	1.28	1900.3	0.221	237.5	2743.2
29.24	2.71	0.515	0.145	13.023	0.315	0.096	0.112	0.240	0.999	0.728	0.943	0.972	0.963	1.28	1883.5	0.224	224.5	2608.5
29.86	2.70	0.515	0.145	13.198	0.315	0.096	0.112	0.240	0.999	0.731	0.943	0.972	0.963	1.28	1866.0	0.229	212.4	2473.0
30.49	2.70	0.507	0.143	13.374	0.313	0.096	0.112	0.239	0.999	0.742	0.943	0.972	0.963	1.28	1849.2	0.230	200.8	2337.6
31.11	2.69	0.509	0.142	13.549	0.314	0.096	0.111	0.239	0.999	0.746	0.942	0.972	0.963	1.28	1832.4	0.230	189.4	2202.3
31.73	2.68	0.503	0.141	13.726	0.311	0.096	0.111	0.239	0.999	0.756	0.943	0.972	0.963	1.29	1815.7	0.231	177.0	2067.5
32.35	2.68	0.503	0.140	13.903	0.312	0.096	0.111	0.239	0.999	0.761	0.943	0.972	0.963	1.29	1799.0	0.231	165.7	1932.0
32.97	2.67	0.498	0.138	14.079	0.310	0.096	0.110	0.240	0.999	0.773	0.944	0.972	0.963	1.29	1782.5	0.237	154.8	1796.6
33.59	2.66	0.498	0.135	14.256	0.310	0.096	0.110	0.240	0.999	0.777	0.943	0.972	0.963	1.29	1765.2	0.230	143.8	1661.0
34.22	2.65	0.492	0.133	14.432	0.309	0.096	0.109	0.240	0.999	0.785	0.944	0.972	0.963	1.29	1748.0	0.231	132.0	1525.3
34.84	2.65	0.492	0.132	14.609	0.308	0.096	0.110	0.240	0.999	0.788	0.944	0.972	0.963	1.29	1730.9	0.236	120.4	1389.4
35.46	2.64	0.487	0.131	14.785	0.306	0.096	0.109	0.240	0.999	0.799	0.945	0.972	0.963	1.29	1713.7	0.239	108.7	1253.5
36.08	2.63	0.487	0.130	14.961	0.307	0.096	0.109	0.240	0.999	0.803	0.945	0.972	0.963	1.29	1696.4	0.232	97.1	1117.7
36.70	2.63	0.481	0.127	15.138	0.304	0.096	0.108	0.240	0.999	0.813	0.946	0.972	0.963	1.29	1679.1	0.234	85.4	981.0
37.33	2.62	0.481	0.127	15.314	0.305	0.096	0.108	0.240	0.999	0.817	0.945	0.972	0.963	1.29	1661.8	0.237	73.9	845.8
37.95	2.61	0.474	0.127	15.491	0.303	0.096	0.108	0.240	0.999	0.827	0.946	0.972	0.963	1.30	1644.5	0.239	62.2	710.2
38.57	2.61	0.476	0.124	15.668	0.303	0.096	0.108	0.240	0.999	0.831	0.946	0.972	0.963	1.30	1627.2	0.242	50.7	574.1
39.19	2.60	0.471	0.125	15.845	0.302	0.096	0.108	0.240	0.999	0.834	0.946	0.972	0.963	1.30	1610.0	0.243	39.1	438.1

TETA = 45.0

TIME OF BURNING = 39.19 SEC

RANGE OF BURNING = 0.2679 * 05 KM

HEIGHT OF BURNING = 0.1878 * 05 KM

RAKJET TRAJECTORY

LCR LPR A30 AO/R AS/R L3 UN II MR TRFW
 0.155F+01 0.475F+02 0.530F+02 0.280F+20 0.260F+20 0.584F+00 0.762F+03 0.863F+03 0.199F+01 0.124F+03

Y1	X3	Y3	TETA	MO	PO	PIMA	Yp	MIA	WPR	DRAG	TRUST
0.622E+00	0.760F+03	0.756F+03	0.447E+02	2.534	0.133F+05	0.123F+01	0.288F+03	0.179F+04	47.5	1276.7	1170.6
0.311E+01	0.230F+04	0.224F+04	0.435F+02	2.572	0.831F+04	0.104F+01	0.276F+03	0.172F+04	47.0	1928.7	1332.6
0.360F+01	0.366F+04	0.367F+04	0.474E+02	2.619	0.687F+04	0.184F+00	0.266F+03	0.168F+04	46.7	281.0	1706.7
0.609F+01	0.546F+04	0.551F+04	0.411E+02	2.669	0.568F+04	0.749F+00	0.247F+03	0.146F+04	46.5	750.5	1508.0
0.106E+02	0.108F+04	0.644F+04	0.349F+02	2.715	0.456F+04	0.633F+00	0.248F+03	0.160F+04	46.3	630.1	886.4
0.131F+02	0.874F+04	0.787F+04	0.386F+02	2.756	0.744F+04	0.514F+00	0.249F+03	0.150F+04	46.1	570.7	774.2
0.156F+02	0.104F+05	0.913F+04	0.374F+02	2.785	0.317F+04	0.451F+00	0.231F+03	0.133F+04	46.0	420.5	586.2
0.180F+02	0.121F+05	0.106F+05	0.360F+02	2.814	0.264F+04	0.347F+00	0.213F+03	0.115F+04	46.0	369.6	474.3
0.205F+02	0.135F+05	0.111F+05	0.347F+02	2.851	0.233F+04	0.275F+00	0.213F+03	0.115F+04	45.9	319.0	384.3
0.230F+02	0.155F+05	0.127F+05	0.333F+02	2.889	0.185F+04	0.277F+00	0.217F+03	0.141F+04	45.9	259.2	335.2
0.255F+02	0.174F+05	0.133F+05	0.318F+02	2.958	0.177F+04	0.234F+00	0.217F+03	0.141F+04	45.9	227.2	282.9
0.280F+02	0.194F+05	0.148F+05	0.313F+02	2.977	0.134F+04	0.205F+00	0.217F+03	0.141F+04	45.9	191.4	242.2
0.305F+02	0.207F+05	0.159F+05	0.298F+02	2.997	0.115F+04	0.179F+00	0.217F+03	0.141F+04	45.9	166.3	225.4
0.330F+02	0.224F+05	0.167F+05	0.273E+02	2.989	0.975F+03	0.157F+00	0.217F+03	0.141F+04	45.9	145.3	195.8
0.355F+02	0.242F+05	0.175F+05	0.248F+02	2.981	0.469F+03	0.139F+00	0.217F+03	0.141F+04	45.9	127.8	177.0
0.379F+02	0.259F+05	0.181F+05	0.225F+02	2.964	0.785F+03	0.123F+00	0.217F+03	0.141F+04	45.9	114.3	157.2
0.404F+02	0.277F+05	0.191F+05	0.224F+02	2.957	0.679F+03	0.113F+00	0.217F+03	0.141F+04	45.9	100.0	0.3
0.429F+02	0.294F+05	0.198F+05	0.238F+02	2.934	0.609F+03	0.997F+00	0.217F+03	0.141F+04	45.9	89.5	0.0
0.454F+02	0.311F+05	0.204F+05	0.188F+02	2.930	0.552F+03	0.905F+00	0.217F+03	0.141F+04	45.9	80.1	0.0
0.479F+02	0.327F+05	0.210F+05	0.170F+02	2.949	0.515F+03	0.831F+00	0.217F+03	0.141F+04	45.9	72.8	0.0
0.504F+02	0.343F+05	0.215F+05	0.151F+02	2.933	0.447F+03	0.772F+00	0.217F+03	0.141F+04	45.9	66.6	0.0
0.529F+02	0.359F+05	0.221F+05	0.132F+02	2.939	0.415F+03	0.725F+00	0.217F+03	0.141F+04	45.9	61.5	0.0
0.554F+02	0.383F+05	0.223F+05	0.113F+02	2.969	0.410F+03	0.684F+00	0.217F+03	0.141F+04	45.9	57.5	0.0
0.579F+02	0.396F+05	0.229F+05	0.926E+01	2.922	0.390F+03	0.653F+00	0.217F+03	0.141F+04	45.9	53.2	0.0
0.603F+02	0.418F+05	0.228F+05	0.731F+01	2.999	0.175F+03	0.629F+00	0.217F+03	0.141F+04	45.9	51.7	0.0
0.628F+02	0.430F+05	0.230F+05	0.511F+01	2.979	0.164F+03	0.611F+00	0.217F+03	0.141F+04	45.9	49.4	0.0
0.653F+02	0.444F+05	0.231F+05	0.709F+01	2.963	0.157F+03	0.590F+00	0.217F+03	0.141F+04	45.9	48.4	0.0
0.678F+02	0.463F+05	0.233F+05	0.941F+00	2.964	0.153F+03	0.591E+00	0.217F+03	0.141F+04	45.9	47.5	0.0
0.703F+02	0.480F+05	0.233F+05	0.112F+01	2.238	0.352F+03	0.593F+00	0.217F+03	0.141F+04	45.9	47.2	0.0
0.728F+02	0.496F+05	0.230F+05	0.324F+01	2.731	0.356F+03	0.598F+00	0.217F+03	0.141F+04	45.9	47.1	0.0
0.753F+02	0.512F+05	0.229F+05	0.546F+01	2.727	0.352F+03	0.608F+00	0.217F+03	0.141F+04	45.9	47.9	0.0
0.778F+02	0.527F+05	0.227F+05	0.748E+01	2.755	0.373F+03	0.624F+00	0.217F+03	0.141F+04	45.9	49.0	0.0
0.803F+02	0.545F+05	0.225F+05	0.959F+01	2.757	0.383F+03	0.637F+00	0.217F+03	0.141F+04	45.9	50.6	0.0
0.828F+02	0.561F+05	0.222F+05	0.117F+02	2.231	0.405F+03	0.676F+00	0.217F+03	0.141F+04	45.9	52.7	0.0
0.852F+02	0.577F+05	0.218F+05	0.137F+02	2.234	0.429F+03	0.713F+00	0.217F+03	0.141F+04	45.9	55.5	0.0
0.877F+02	0.593F+05	0.214F+05	0.158F+02	2.267	0.449F+03	0.754F+00	0.217F+03	0.141F+04	45.9	59.0	0.0
0.902F+02	0.609F+05	0.207F+05	0.176F+02	2.238	0.493F+03	0.814F+00	0.217F+03	0.141F+04	45.9	61.2	0.0
0.927F+02	0.625F+05	0.203F+05	0.186F+02	2.271	0.518F+03	0.887F+00	0.217F+03	0.141F+04	45.9	68.1	0.0
0.952F+02	0.640F+05	0.197F+05	0.217F+02	2.286	0.588F+03	0.960F+00	0.217F+03	0.141F+04	45.9	74.5	0.0
0.977F+02	0.656F+05	0.191F+05	0.246E+02	2.302	0.631F+03	0.105F+00	0.217F+03	0.141F+04	45.9	81.9	0.0
0.100E+03	0.671F+05	0.184F+05	0.252F+02	2.379	0.709F+03	0.131F+00	0.217F+03	0.141F+04	45.9	90.9	0.0
0.105F+03	0.688F+05	0.176F+05	0.273F+02	2.318	0.817F+03	0.131F+00	0.217F+03	0.141F+04	45.9	101.3	0.0
0.108F+03	0.707F+05	0.166F+05	0.271E+02	2.356	0.927F+03	0.147F+00	0.217F+03	0.141F+04	45.9	113.6	0.0
0.110F+03	0.718F+05	0.154F+05	0.290F+02	2.374	0.136F+04	0.166F+00	0.217F+03	0.141F+04	45.9	125.6	0.0
0.113F+03	0.732F+05	0.140F+05	0.328F+02	2.397	0.132F+04	0.189F+00	0.217F+03	0.141F+04	45.9	146.1	0.0
0.115F+03	0.747F+05	0.126F+05	0.362F+02	2.424	0.131F+04	0.217F+00	0.217F+03	0.141F+04	45.9	166.8	0.0
0.118F+03	0.761F+05	0.127F+05	0.358F+02	2.472	0.145F+04	0.250F+00	0.217F+03	0.141F+04	45.9	198.1	0.0
0.120F+03	0.775F+05	0.119F+05	0.374F+02	2.434	0.104F+04	0.239F+00	0.217F+03	0.141F+04	45.9	219.6	0.0
0.123F+03	0.790F+05	0.104F+05	0.389F+02	2.441	0.276F+04	0.136F+00	0.217F+03	0.141F+04	45.9	252.8	0.0
0.125F+03	0.805F+05	0.960F+04	0.404F+02	2.404	0.271F+04	0.190F+00	0.224F+03	0.150F+04	45.9	294.9	0.0
0.128F+03	0.821F+05	0.862F+04	0.418F+02	2.365	0.172F+04	0.457F+00	0.231F+03	0.151F+04	45.9	341.9	0.0
0.130F+03	0.830F+05	0.770F+04	0.431F+02	2.316	0.143F+04	0.534F+00	0.230F+03	0.156F+04	45.9	394.8	0.0
0.133F+03	0.841F+05	0.697F+04	0.440F+02	2.261	0.113F+04	0.723F+00	0.247F+03	0.160F+04	45.9	455.2	0.0
0.135F+03	0.857F+05	0.671F+04	0.472F+02	2.195	0.113F+04	0.770F+00	0.250F+03	0.161F+04	45.9	514.5	0.0
0.137F+03	0.877F+05	0.647F+04	0.473F+02	2.121	0.108F+04	0.961F+00	0.250F+03	0.167F+04	45.9	613.1	0.0
0.140F+03	0.899F+05	0.621F+04	0.490F+02	2.037	0.107F+04	0.963F+00	0.250F+03	0.170F+04	45.9	688.3	0.0
0.142F+03	0.924F+05	0.594F+04	0.507F+02	1.944	0.107F+04	0.111F+01	0.250F+03	0.174F+04	45.9	767.7	0.0

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0.142E+03 0.098E+05-0.290E+03-0.518E+02 1.854 0.103E+04 0.122E+01 0.248E+01 0.179E-04 45.9 798.6 0.0

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6.50	0.492E-01	0.230E-02	0.112E-01	0.941E-03	0.127E-01	0.618E+00	0.484E-01	0.180E+06	1.40
6.50	0.711E-01	0.226E-02	0.116E-01	0.180E-02	0.127E-01	0.618E+00	0.484E-01	0.201E+06	1.40
6.50	0.753E-01	0.223E-02	0.121E-01	0.174E-02	0.127E-01	0.618E+00	0.484E-01	0.240E+06	1.40
6.50	0.807E-01	0.218E-02	0.126E-01	0.169E-02	0.127E-01	0.618E+00	0.484E-01	0.280E+06	1.40
6.50	0.866E-01	0.214E-02	0.131E-01	0.164E-02	0.127E-01	0.618E+00	0.484E-01	0.320E+06	1.40

References

1. P. H. Morrison and D. S. Amberntson - "Guidance and Control of a Canon-Launched Guided Projectile," Journal of Spacecraft and Rockets, Vol. 14 (6), pp. 328-334 (1977).
2. P. H. Morrison - "A Lesson Learned about Cannon-Launched Guided Projectiles," Journal of Guidance and Control, Vol. 3(2), pp. 154-157 (1980).
3. Surface Warfare, pp. 18-19 (October, 1980).
4. "Martin Marietta 5" Guided Projectile," Maritime Defense, Vol. 4(4), p. 128 (1979).
5. G. L. Brown - "Propulsion for Ramjet Propelled Guided Projectile for 5"/54," Master's Thesis, NPS, Monterey, CA (December 1980).
6. Philip G. Hill and Carl R. Peterson - "Mechanics and Thermodynamics of Propulsion," Addison-Wesley Publishing Company, Inc. (1965).
7. E. A. Bonney, M. J. Zucrow, C. W. Besserer - "Aerodynamics, Propulsion, Structures and Design Practice," D. Van Nostrand Company, Inc. (1956).
8. D. R. Cruise - "Theoretical Computation of Equilibrium Compositions, Thermodynamic Properties and Performance Characteristics of Propellant Systems," NWC-TP-6037 (Naval Weapons Center, China Lake, CA 93555, April 1979).
9. T. H. Gawain - "On the Inviscid Supersonic Flow About a Slender Body of Revolution," NPS-67-81-007 (Naval Postgraduate School, Monterey, CA 93940, April 1981).
10. James E. Calogeras and Edward T. Meleason - "Wind-Tunnel Investigation of Techniques for Reducing Cowl Drag of an Axisymmetric External-Compression Inlet at Mach 2.49," NASA TM X-1516, March 1968.

11. Frank G. Moore and Roy C. Swanson, Jr. - "Aerodynamics of Tactical Weapons to Mach Number 3 and Angle of Attack 15", Part I-Theory and Application," NSWC/DL-TR-3584, February 1977.
12. Fred R. DeJarnette and Kenneth M. Jones - "Development of a Computer Program to Calculate Aerodynamic Characteristics of Bodies and Wing-Body Combinations," NSWC/DL-TR-3829, April 1978.
13. Sighard F. Hoerner - "Fluid-Dynamic Drag," Hoerner Fluid Dynamics, P.O. Box 342, Brick Town, NJ 08723 (1965).
14. A. E. Fuhs - "Ramjet Propulsion Lecture Notes," Naval Postgraduate School, Monterey, CA 93940 (January - March 1981).
15. William W. Hager, Fred R. DeJarnette and Frank G. Moore - "Optimal Projectile Shapes for Minimum Total Drag," NSWC/DL-TR-3597, May 1977.
16. H. W. Liepmann and A. Roshko - "Elements of Gasdynamics," John Wiley & Sons, Inc. (1957).
17. John J. Bertin and Michael L. Smith - "Aerodynamics for Engineers," Prentice-Hall, Inc., Englewood Cliffs, NJ 07632 (1979).
18. Ralph M. Rotty - "Introduction to Gas-Dynamics," John Wiley & Sons, Inc. (1962).
19. Frank G. Moore - "Aerodynamics of Guided and Unguided Weapons, Part I-Theory and Application," NWL Technical Report TR-3018, December 1973.
20. Frank G. Moore - "Aerodynamics of Guided and Unguided Weapons, Part II-Computer Program and Usage," NWL Technical Report TR-3036, January 1974.
21. W. G. Rogers and Spyridon Livanis - "Ballistic Performance Evaluation of Swedish Base Bleed Adapted to 5"/54 Projectile," IHRT 628, July 1979.
22. Joseph Huerta - "The Effect of Rocket Nozzle Geometry and Secondary Flow Field on Base Drag at Mach Numbers 2.50 and 3.00, an Experimental Investigation," BRL-MR-1829 (AD-815444), March 1967.

23. George D. Shrewsbury - "Effect of Boattrail Juncture Shape on Pressure Drag Coefficients of Isolated Afterbodies," NASA-TM-X-1517, March 1968.
24. J. S. White - "Aerodynamics and Control of a 5"/54 Gun Launched Missile," Master's Thesis, NPS, Monterey, CA (December 1980).
25. W. Kaufmann - "Fluid Mechanics," McGraw-Hill Book Co., 1963.

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