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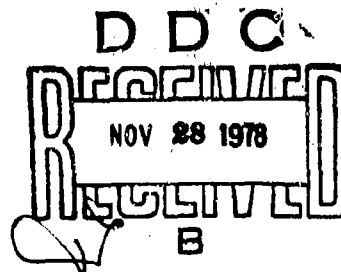
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**RAPID EVALUATION OF PROPULSION SYSTEM EFFECTS
Volume II—PIPSI Users Manual**

W.H. Ball and R.A. Atkins, Jr.

BOEING AEROSPACE COMPANY
SEATTLE, WASHINGTON 98124

JULY 1978



**TECHNICAL REPORT AFFDL-TR-78-91, VOLUME II
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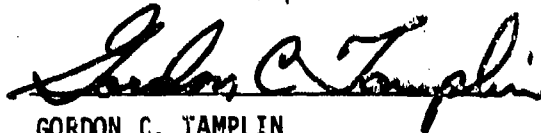
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GORDON C. TAMPLIN
Project Engineer
Vehicle Synthesis Branch



RAYMOND L. HAAS
Chief, Vehicle Synthesis Branch
AF Flight Dynamics Laboratory

FOR THE COMMANDER



MELVIN L. BUCK
Acting Chief
Aeromechanics Division

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19. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report presents the results of a research program to develop computerized preliminary analysis procedures for calculating propulsion system installation losses. These losses include inlet and nozzle internal losses and external drag losses for a wide variety of subsonic and supersonic aircraft configurations up to Mach 3.5. The calculation procedures used in the computer programs, which were largely developed from existing engineering procedures and experimental data, are suitable for preliminary studies of advanced aircraft configurations. Two interactive computer programs were developed (cont.)			

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during the contract: (1) A propulsion installation effects program that calculates installed performance, using input maps of inlet and nozzle/aftbody characteristics for specific configurations, and ~~(2)~~ derivative program that allows the user to generate new sets of input maps by perturbations to the geometries of the basic input maps. The work accomplished during the contract is documented in four separate volumes. Volume I is a Final Report discussing the analysis methods and data used to develop the programs, and major technical observations from the study. Volume II is a PIPSI Users Manual, containing documentation of the interactive propulsion installation program. Volume III is the Derivative Procedure (DERIVP) Users Manual, documenting the methods and usage of the derivative procedure. Volume IV is the library of input maps.

FOREWORD

This report documents the work accomplished during USAF Contract No. F33615-77-C-3085. The work consisted of developing an interactive PIPSI computer program, developing an interactive derivative computer program, and developing and documenting supporting data libraries. The work was accomplished in three phases. As part of the work accomplished in Phase I of the contract, the interactive PIPSI program was completed and delivered to the Air Force. As part of Phase II work, derivative parameters were selected and development work was completed on the derivative program. During Phase III a library of inlet and nozzle/aftbody characteristics was prepared, test cases were completed, documentation was accomplished, and final programs were delivered to the Air Force. The program was conducted under the direction of the Vehicle Synthesis Branch, Air Force Flight Dynamics Laboratory, Air Force Systems Command. Mr. Gordon Tamplin was the Air Force Program Monitor.

The program was initiated on 17 July 1977 and draft copies of the final reports were submitted for approval on 15 May 1978.

Mr. W. H. Ball was Program Manager for The Boeing Company. The following individuals contributed significantly to the work accomplished during this contract: R. A. Atkins, Jr., computer programming; T. E. Hickcox, inlet derivative procedure development; E. J. Kowalski, inlet configurations and performance; and J. E. Petit and R. M. Trayler, nozzle/aftbody procedure and configurations.

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LIST OF NOMENCLATURE AND SYMBOLS

A^*	Sonic area, in ²
A	Area, in ²
A_c	Inlet capture area, in ²
A_o	Local stream tube area ahead of the inlet, in ²
A_{oI}	Free-stream tube area of air entering the inlet, in ²
AR	Aspect ratio, W_c/H_c for inlets, W_g/H_g for nozzles, dimensionless
C_D	Drag coefficient, $\frac{D}{q A_{ref.}}$, dimensionless
C	Sonic velocity; ft/sec.
$C-D$	Convergent-divergent
C_{DADD}	Additive drag coefficient, $C_{DADD} = \frac{D_{ADD}}{q A_c}$, dimensionless
C_{DA10}	Afterbody drag coefficient, $\frac{DRAG}{q A_{10}}$, dimensionless
C_{DBase}	Base drag coefficient $\frac{(P_b - P_{\infty}) A_{base}}{q A_{10}}$, dimensionless
$C_{DA10-A9}$	
C_{DPAP}	Drag coefficient, $\frac{D}{q_o (A_{10} - A_9)}$, based on projected area, dimensionless
C_{DS}	Scrubbing drag coefficient, $\frac{DRAG}{q A_{10}}$, dimensionless
C_{fG}	Thrust coefficient, $\frac{F_g}{\frac{\dot{W}}{g} (V_{cp})}$ dimensionless
C_v	Nozzle velocity coefficient, dimensionless
Conv.	Convergent

LIST OF NOMENCLATURE AND SYMBOLS (Continued)

D	Drag, lb.; Hydraulic Diameter, $\frac{4A}{P}$, in., diameter, in.
F	Thrust, lb.
F _N	Net thrust, lb.
F _{NA}	Installed net thrust, lb.
F _{gi}	Ideal gross thrust (fully expanded), lb.
f/a	Fuel/air ratio, dimensionless
g	Gravitational constant, ft/sec ²
h	Enthalpy per unit mass, BTU/lb.; height, in.
h _{fan}	Enthalpy of fan discharge flow, BTU/lb
h _{pri}	Enthalpy of primary exhaust flow after heat addition, BTU/lb
h _t	Throat height, in ²
IMS _T	Integral mean slope parameter, truncated $IMS_T = - \frac{1}{(1 - A_0/A_{10})} \int_{A_0/A_{10}}^{1.0} \frac{d(A/A_{10})}{d(L/D_{eq})} d(A/A_{10})$
L	Length, in.
M	Mach number, dimensionless
P	Static pressure, lb/in ² , perimeter, in.
P _r	Relative pressure,; the ratio of the pressures p _a and p _b corresponding to the temperatures T _a and T _b , respectively, along a given isentrope, dimensionless
P.S.	Power setting
P _T	Total pressure, lb/in ²
Q	Effective heating value of fuel, BTU/lb.

LIST OF NOMENCLATURE AND SYMBOLS (Continued)

q	Dynamic pressure, lb/in ²
R	Gas constant
R, r	Radius, in.
R _F	Total pressure recovery
SFC	Specific fuel consumption
SFC _A	Installed specific fuel consumption
T	Temperature, °R
V	Velocity, ft/sec
W	Mass flow, lb/sec
W _{BX}	Bleed air removed from engine, lb/sec.
W _C	Corrected airflow, lb/sec. $\frac{W\sqrt{\theta}}{\delta}$
W _f	Weight flow rate of fuel, lb/sec.
W ₂	Weight flow rate of air, primary plus secondary, lb/sec.
W ₈	Primary nozzle airflow rate, lb/sec.
x	Length, in.
α	Angle of attack; convergence angle of nozzle, degrees
γ	Ratio of specific heats, dimensionless
δ _{T₂}	Pressure correction factor, P _{T₂} /P _{STD.}
ε	Diffuser loss coefficient, $\frac{\Delta P_T}{q}$, dimensionless
θ _{T₂}	Temperature correction factor, T _{T₂} /T _{STD.}

LIST OF NOMENCLATURE AND SYMBOLS (Concluded)

θ_N	2-D Nozzle wedge half-angle
θ_P	Round Plug nozzle half-angle
η_B	Burner efficiency, dimensionless
ν	Kinematic viscosity, ft ² /sec.
ρ	Density, lb/ft ³

SUBSCRIPTS

amb	Ambient
AB	Afterbody
B	Burner
B _x	Bleed airflow extracted from the engine
b, base	Base flow region
BP	Bypass
BLC	Boundary layer bleed
btail	Boattail

SECTION I

INTRODUCTION

As part of the work accomplished under Air Force Contract F33615-77-C-3085, an interactive computer program has been developed to calculate installed propulsion system performance. The computer program has been given the designation "Performance of Installed Propulsion Systems - Interactive" (PIPSI). The intended use of the program is to provide the AFFDL/FXB with the capability to make quick analyses of installed propulsion system performance, accounting for the effects of inlet total pressure recovery losses and drag, nozzle internal losses, and nozzle/aftbody drag. To reduce the time required to generate installed performance, the program can use a library of computer stored tables representing the performance characteristics of a wide variety of inlets and nozzle/aftbodies or a set of tables can be prepared for a specific configuration. Uninstalled engine data is supplied as program input in tabular input tables (Mark 12 format).

The purpose of this Manual is to provide a user oriented description of the program input requirements, program output, deck setup, and operating instructions. It also provides examples of tabular input tables that can be used as a test case to exercise the major calculation paths of the PIPSI program. An example of the terminal output from a typical calculation session is also included.

The PIPSI computer program has been developed with the following characteristics and limitations:

1. Assumes the use of the Network Operating System/- Batch Environment (NOS/BE).
2. Runs on either the CDC6600 or the Cyber-74 system
3. Runs interactively using INTERCOM.
4. Is coded in FORTRAN IV compatible with the FTN compiler.
5. Compiles, loads, and runs in less than 60,000 octal words.

The PIPSI program utilizes external data files as well as user supplied terminal input for generating installed engine performance data.

Figure 1 shows the data flow for the PIPSI program.

All tabular data are input to the program via previously built disk files. The user exercises various program options using an interactive mode of data input.

The output of the program is via the user terminal and an output disk file. Once the user has ascertained from the terminal output that a data case has been executed, the detailed output may be disposed to an auxiliary printer by utilizing control statements.

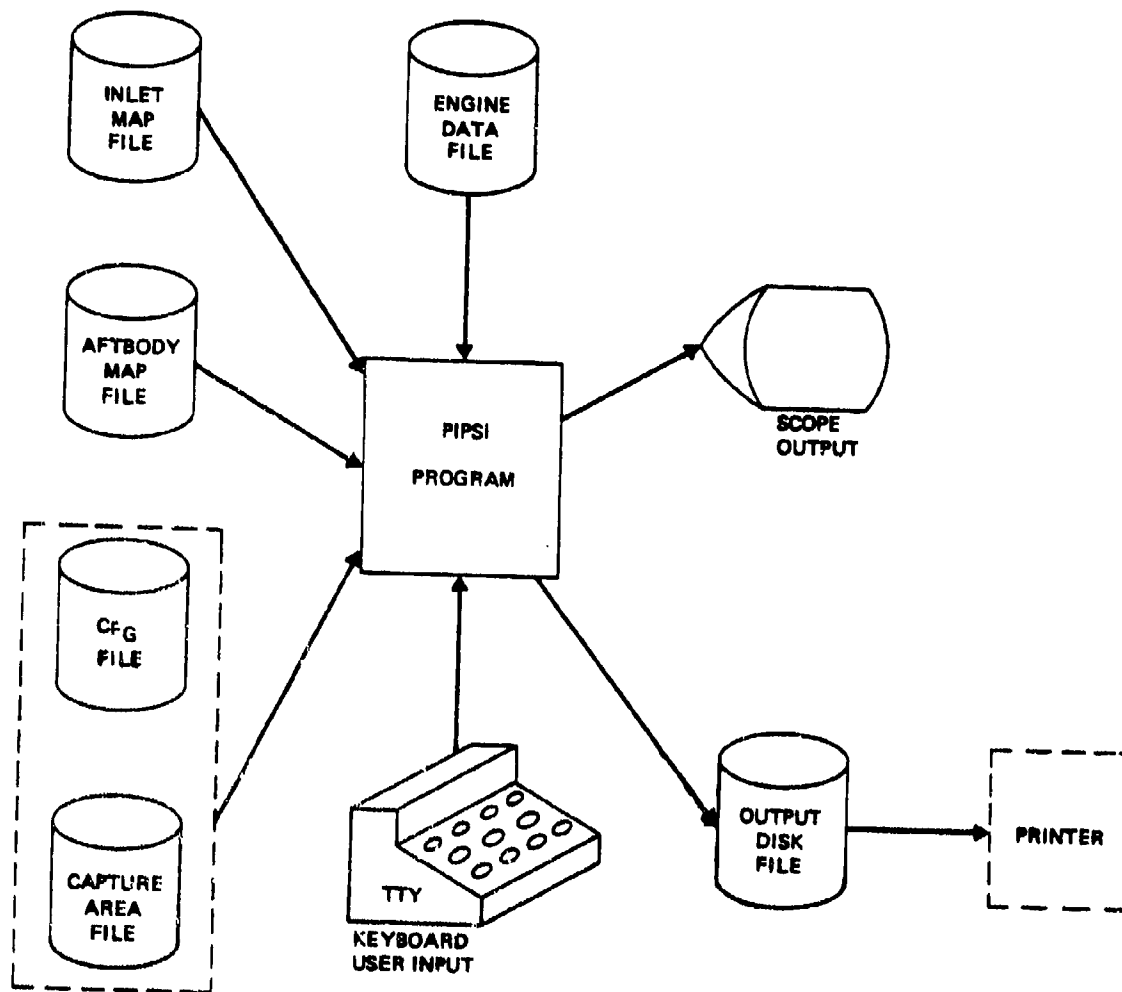


Figure 1. PIPSI Data Flow

SECTION II

ENGINEERING DESCRIPTION OF PIPSI PROGRAM

The use of the PIPSI Program is illustrated in Figure 2. The program is composed of four main parts:

- 1) Inlet Files
- 2) Nozzle/Afterbody Drag and Gross Thrust Coefficient Files
- 3) Uninstalled Engine Data Files
- 4) Computer Operation Subroutines

2.1 INLET SUBPROGRAM

The operation of the inlet subprogram is shown schematically in Figure 3. The connecting link between the engine data and the inlet subprogram is engine-plus-secondary corrected airflow. The sizing routine permits the inlet to be sized for operation at a desired inlet mass flow ratio and recovery using the design engine airflow demand. A specified capture area size can also be input, if desired, instead of requiring the program to calculate the size.

2.1.1 Inlet Performance

Inlet performance maps are input data to the inlet subprogram. This subprogram sizes the inlet capture area (if it is required) and converts the inlet performance maps into total pressure recovery and inlet drags that are matched to the corrected airflow demand of the engine.

The inlet input requires fourteen tables of input data which describe the performance characteristics of the inlet. Engineering data obtained from wind tunnel tests and theoretical calculations are used to obtain the

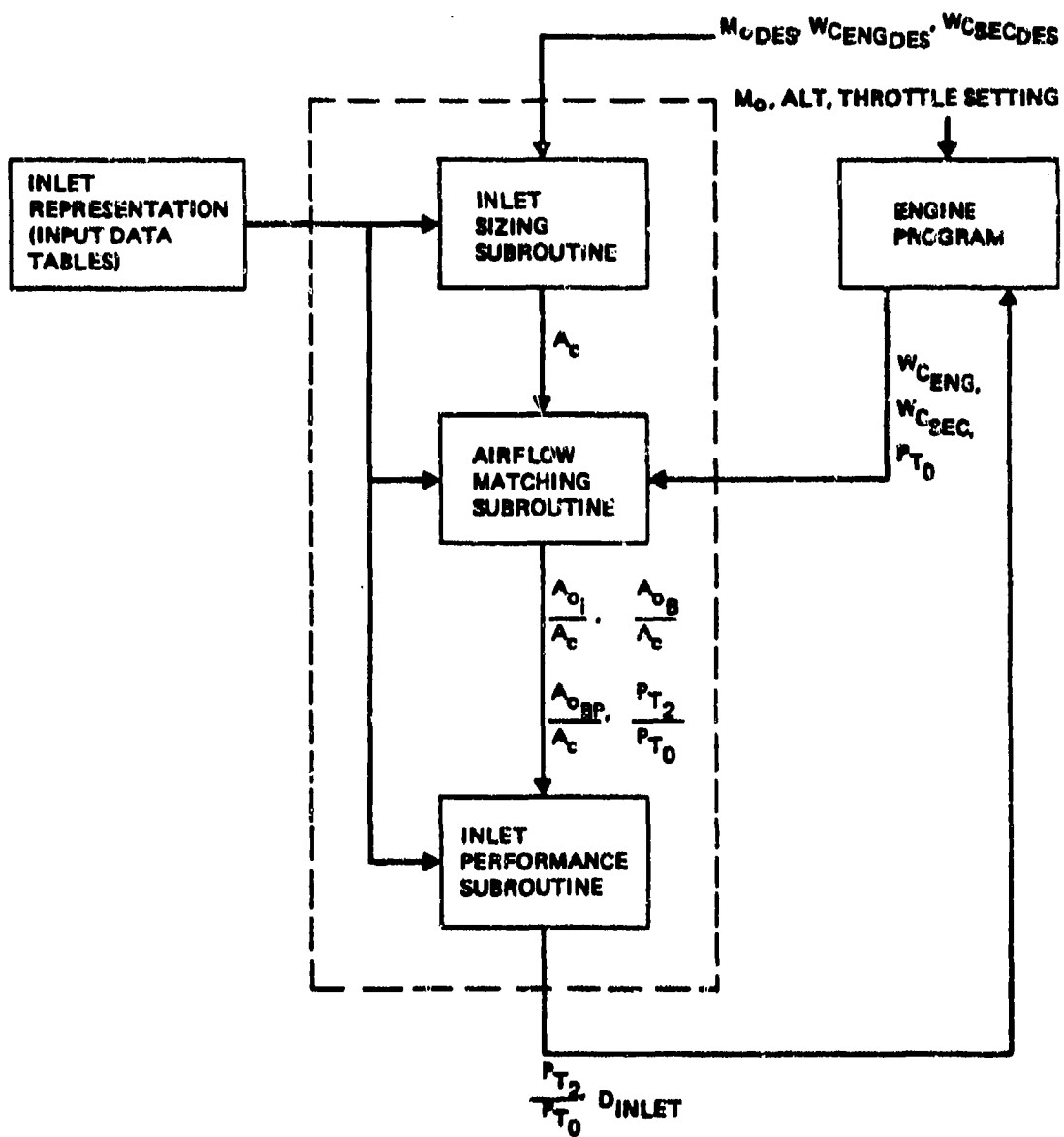


Figure 3, Inlet Procedure

inlet performance characteristics. The format for the inlet data is shown in Figure 4. Data taken from these engineering plots are punched on cards as part of the inlet library for input into PIPSI.

The inlet subroutine recognizes three modes of inlet operation: low-speed, external compression, and mixed compression. The low-speed mode is used only at very low Mach numbers, e.g., takeoff conditions, when only high engine power settings are likely to be of interest and inlet drag is negligible. The external-compression mode is used over the remaining Mach number regime for external-compression inlets. It is also used for the remaining subsonic regime and supersonic Mach numbers up to the starting Mach number for mixed-compression inlets. The mixed-compression mode is used at or above the starting Mach number for mixed-compression inlets.

- a) External-Compression Inlets. The PIPSI calculation of recovery and drag for an external-compression inlet is illustrated in Figure 5. The required performance maps are input as tables, as indicated. Table 1 is used to represent the effect of the airplane flow field on the local Mach number seen by the inlet. Table 2A gives the basic recovery/mass-flow-ratio characteristics of the inlet. The minimum Mach number for which data is input in Table 2A is taken by the program to be $M_{o_{min}}$, below which only the lowspeed mode is used.

In the low-speed mode, recovery is read directly out of Table 2B as a function of local Mach number only, and inlet drag is neglected.

If the local Mach number exceeds $M_{o_{min}}$, the recovery and mass flow ratio are determined using Table 2A, Table 7 (which gives the scheduled bypass flow, if any, as a function of engine mass flow ratio), and the engine corrected airflow demand. PIPSI iterates to solve simultaneously for the matchpoint recovery and inlet mass flow ratio, as well as the engine mass flow ratio and scheduled bypass flow. If the indicated buzz (Table 2D) or distortion (Table 2E) limits are exceeded, an appropriate warning message will appear, but

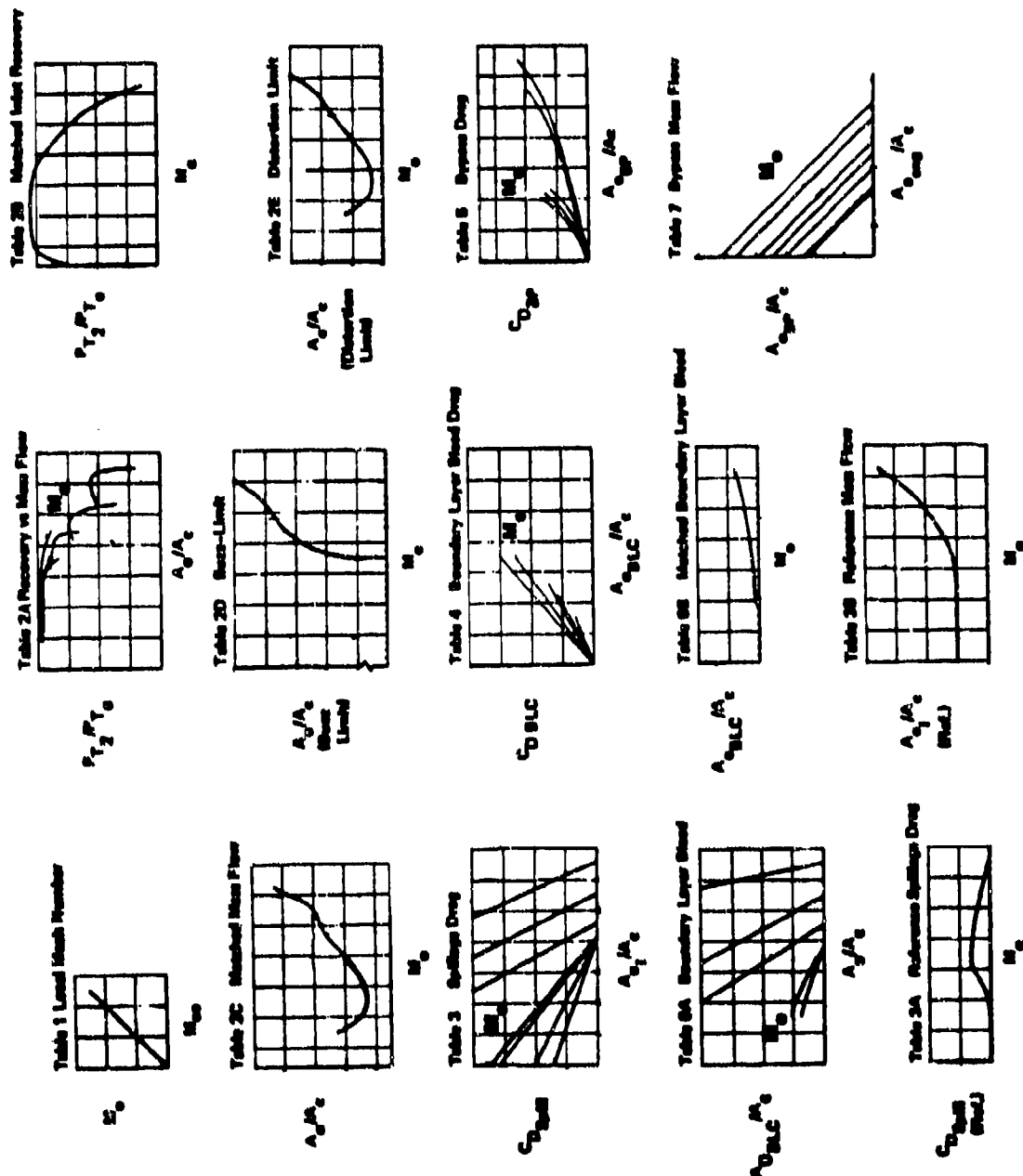


Figure 4. Format for the Inlet Performance Characteristics

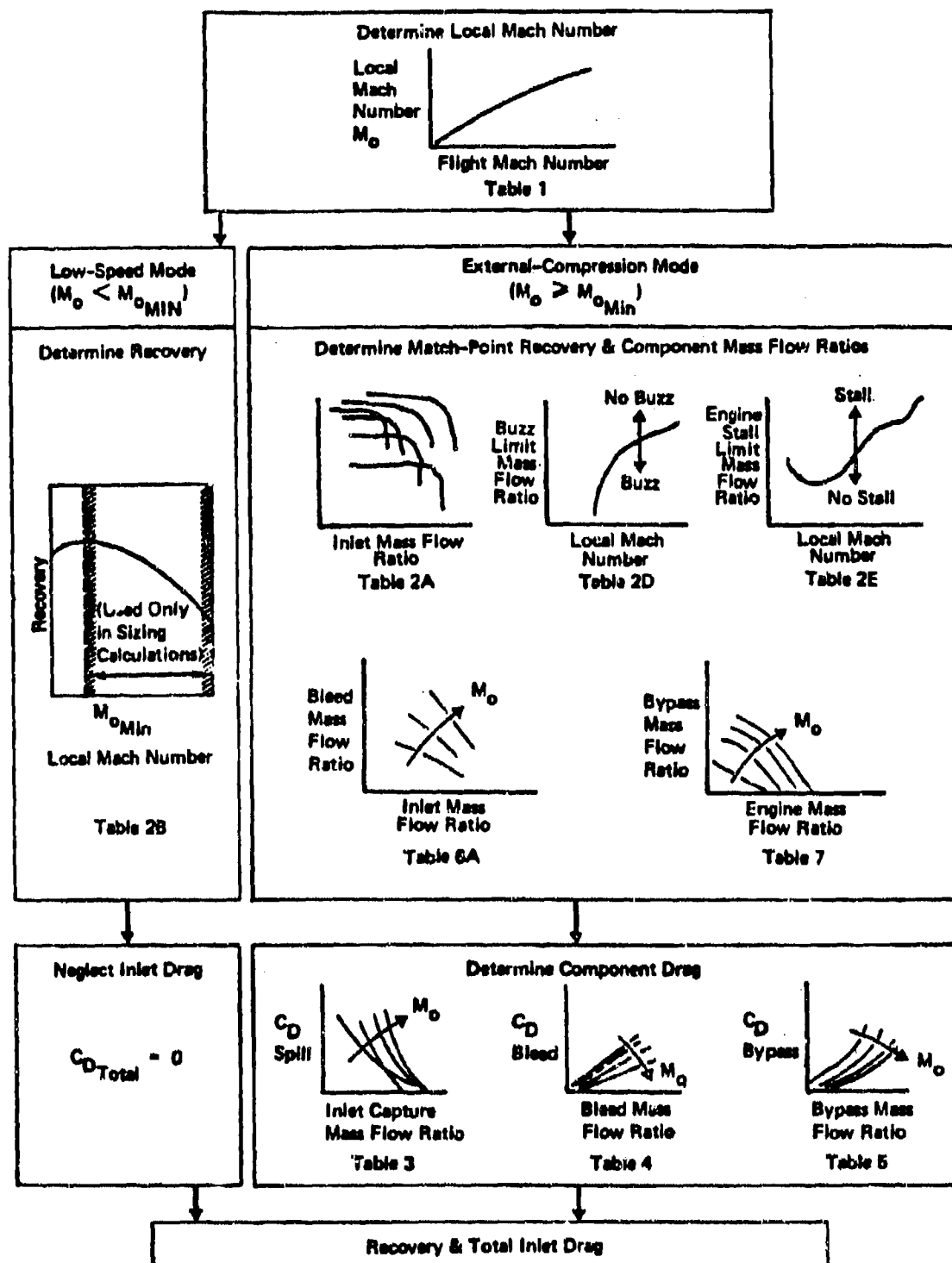


Figure 5. PIPSI Performance Calculation for an External-Compression Inlet

no fatal error will result. The bleed mass flow associated with the calculated inlet mass flow ratio is determined from Table 6A.

After the required mass flow ratios are determined, spillage, bleed, and bypass drags are found from Tables 3, 4, and 5, respectively. Spillage drag is the incremental change in additive drag and pressure drag on the airplane due to inlet operations at mass flow ratios less than a reference mass flow ratio. The bleed and bypass drags include door drags as well as momentum loss of the airflow.

- b) Mixed-Compression Inlets. The performance calculation for a mixed-compression inlet is illustrated in Figure 6. Below the starting Mach number M_S , the low-speed mode and external compression mode are used in the same way as in the case of an external-compression inlet. The mixed-compression mode, used at or above M_S , is based on the assumption that a closed-loop bypass system is available to remove all excess air. Thus, except for the case of excessive engine airflow demand, the inlet mass flow ratio, bleed flow, and recovery may all be scheduled as a function of local Mach number only; the bypass system compensates for changes in engine airflow demand.

If the corrected airflow delivered by the inlet is inadequate to meet the engine demand at the scheduled recovery, the program will permit the inlet to operate at an excessive supercritical margin. The recovery will be lowered sufficiently to match the engine corrected airflow demand, and an appropriate message will warn the user of an undersized inlet.

Inlet spillage, bleed, and bypass drag are found using Tables 3, 4, and 5, as in the external-compression mode. The data in these tables for Mach numbers equal to or greater than M_S apply only for started inlet operation.

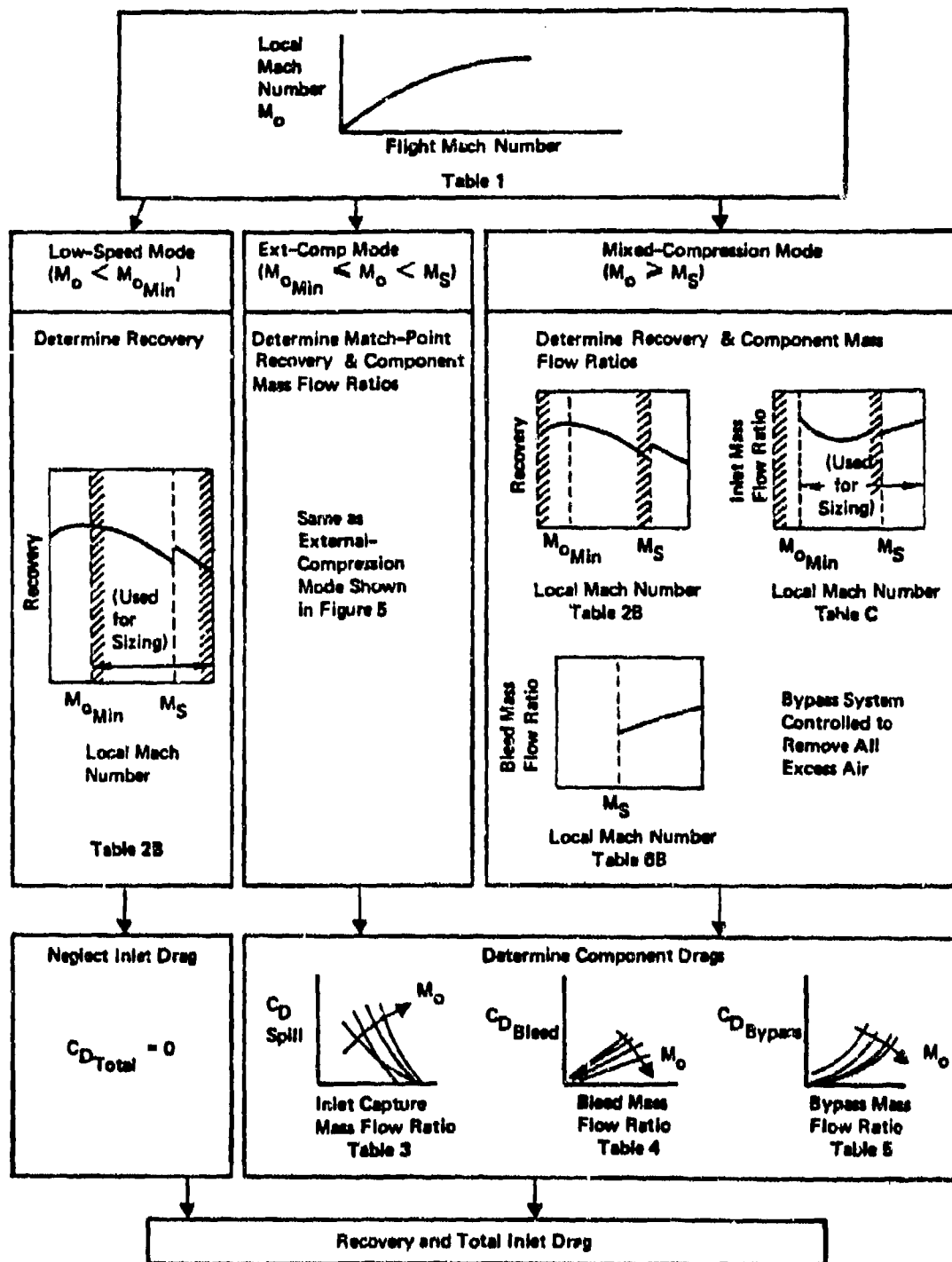


Figure 6. PIPSI Performance Calculation for a Mixed-Compression Inlet

2.1.2 Inlet Sizing

The inlet sizing procedure in the computer program determines the inlet capture area required to match the largest engine airflow demand at each Mach number. From these calculated inlet sizes, the largest required size is selected as the inlet capture area. For sizing calculations, an input curve (Table 2C) of recommended (matched) inlet airflow variations (A_0/A_C) vs. M_0 and an input curve (Table 2B) of recommended (matched) inlet total pressure recovery vs. M_0 are used to determine the required capture area variation with Mach number. These parameters are used in the following equation to calculate capture area, A_C :

$$A_{C, IN^2} = \frac{A_{0, eng}}{(A_0/A_C)_{matched}} = \frac{\frac{(W\sqrt{\theta})}{6} (P_{T2}/P_{T0})_{matched} (A/A^*)_0}{.343 (A_0/A_C)_{matched}}$$

2.1.3 Inlet Reference Condition

For purposes of aero-propulsion thrust/drag bookkeeping, a reference mass flow ratio is employed. This reference mass flow ratio is always shown in inlet input Table 35. It represents the inlet mass flow ratio, A_{0I}/A_C , at which the spillage drag is defined as zero. This reference provides the zero drag reference base for the input spillage drag variations vs. A_{0I}/A_C at each Mach number input as Table 3. The reference mass flow ratio is selected to be a mass flow ratio at or near the point of maximum inlet mass flow ratio at each M_0 . At this point, no further throttle-dependent inlet airflow variations would be expected. Therefore, at this mass flow ratio it is logical to include the drag of the spilled airflow in the airplane drag polar.

For users who prefer to use a mass flow ratio of 1.0, an option is included in the computer program to add the incremental reference spillage drag to the spillage drag input data of Table 3, thereby creating a reference mass flow ratio equal to 1.0.

2.1.4 Inlet Recovery Correction

The engine input provides the required data for inlet drag, inlet recovery, nozzle afterbody drag and nozzle coefficient calculations. The engine section of the PIPSI program calculates only the changes in internal performance due to changes in inlet recovery. Changes in inlet recovery produce a directly proportional change in nozzle pressure ratio, airflow, and fuel flow because the nozzle throat area does not change. Furthermore; it is assumed that engine data is calculated with MIL STD 5008 B recovery and all inlet recovery changes are made relative to that value. Provisions are also built into the program to allow the user to input a reference recovery schedule vs. Mach number that is different from MIL STD 5008B if he desires to do so. Thermodynamic data from Keenan and Keye tables has been "curve-fitted" and subroutines are provided to calculate the thermodynamic properties of the exhaust gases.

The calculation procedure is as follows: for each altitude, Mach number, and power setting, the net thrust (F_N), fuel flow (W_F), corrected airflow ($W\sqrt{\theta_2}/\delta_2$), nozzle throat area (A_θ), nozzle exit area (A_g), and nozzle thrust coefficient (C_{F_g}) are given.

Standard atmosphere and MIL Standard 5008 B inlet recovery are used to calculate the airflow at the engine face and gross thrust is calculated for the given engine data before any changes in inlet recovery.

$$F_{G\text{ OLD}} = F_N + \frac{W V_{e0}}{g}$$

The desired inlet recovery is obtained from the inlet subprogram and the engine gross thrust is first calculated with MIL Standard recovery and then with the calculated recovery. The new value of gross thrust is then found by ratio

$$F_{G\text{ NEW}} = F_{G\text{ OLD}} \frac{F_{G2}}{F_{G1}}$$

The ratio procedure is used to minimize any inaccuracies that may be caused by assuming burner efficiency (η_B) is constant for all engine operating conditions.

The net thrust and fuel flow after correction for inlet recovery are:

$$F_{NR} = F_{GNEW} - \frac{W V_{\infty}}{g} \frac{R_F}{R_{FMIL}}$$

$$W_{FR} = W_F \frac{R_F}{R_{FMIL}}$$

and the installed propulsion system thrust and SFC:

$$F_{NA} = F_{NR} - D_{INLET} - D_{NOZ} + D_{NOZ REF.}$$

$$SFC_A = \frac{W_{FR}}{F_{NA}}$$

2.2 NOZZLE SUBPROGRAM

The purpose of the nozzle/afterbody drag and C_{F_G} input data and calculation subprograms is to calculate nozzle internal losses (C_{F_G}) and nozzle/afterbody drag.

2:2.1 Nozzle/Afterbody Drag

The nozzle/afterbody drag is computed using maps which represent the afterbody drag characteristics (Figure 7) as a function of A_{10}/A_9 and M_0 , external input geometry and engine data. Engine data obtained internally from the engine subprogram include nozzle throat area, nozzle pressure ratio, freestream conditions, and ideal gross thrust. An essential geometry input is the nozzle exit area, A_9 , which is required for boattail drag computation. This parameter is obtained in either of two ways:

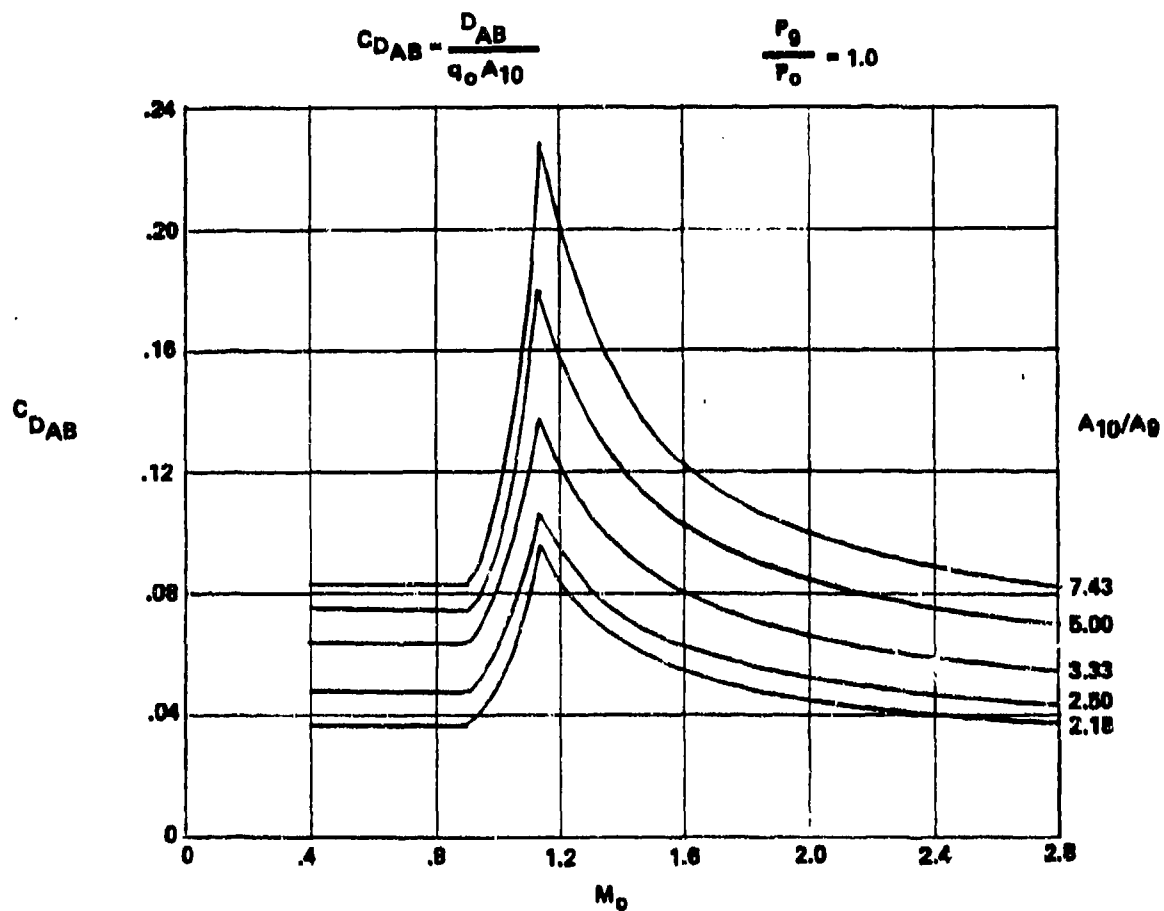


Figure 7. Data Format for Nozzle/Aftbody Drag

1. From the engine subprogram when the existing nozzle data are used;
2. From a calculation of fully-expanded A_9 as a function of nozzle total pressure ratio for wedge and plug nozzles.

The program currently has built in for the variation of base pressure, P_b/P_∞ , as a function of freestream Mach number. This is then used to calculate $C_{D_{Base}}$.

Fully-expanded nozzle/aftbody drag coefficient is obtained from tables such as those illustrated in Figure 7. The drag coefficient is obtained as a function of the ratio of nozzle exit to maximum cross-sectional area, A_9/A_{10} , and free-stream Mach number.

2.2.2 Nozzle Gross Thrust Coefficient

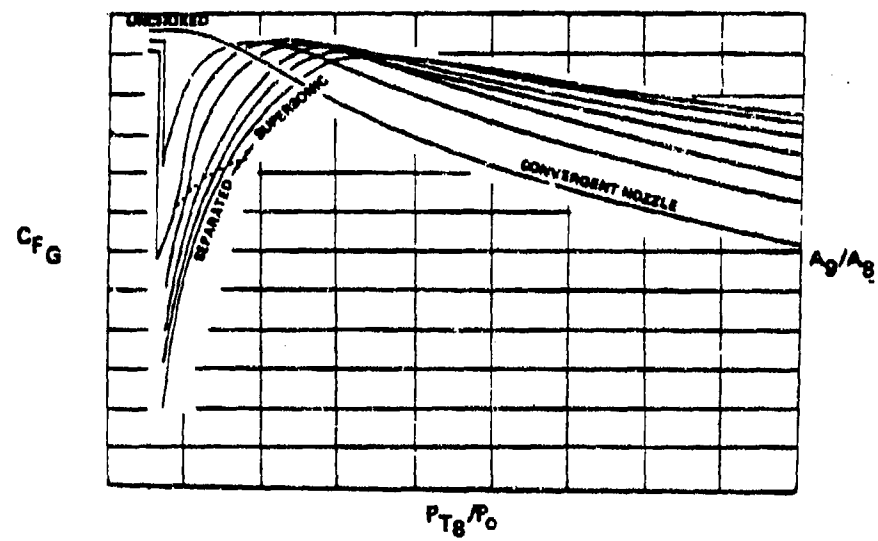
The nozzle gross thrust coefficient input data maps are used to provide a means for correcting uninstalled engine data for the effects of nozzle internal performance that is different from the nozzle internal performance used in generating the uninstalled engine data.

Two different types of nozzle C_{F_G} maps are provided, as shown in Figure 8. Figure 8a shows the data input format for a round nozzle and Figure 8b shows the data input format for two-dimensional nozzles. For round nozzles, the nozzle area ratio, A_9/A_8 is calculated from tabulated input values provided along with nozzle pressure ratio, P_{T_8}/P_0 , as part of the engine data.

For use with the two-dimensional nozzle C_{F_G} input, the engine power setting and nozzle pressure ratio are obtained from the engine input data by procedures programmed into the engine performance subprogram.

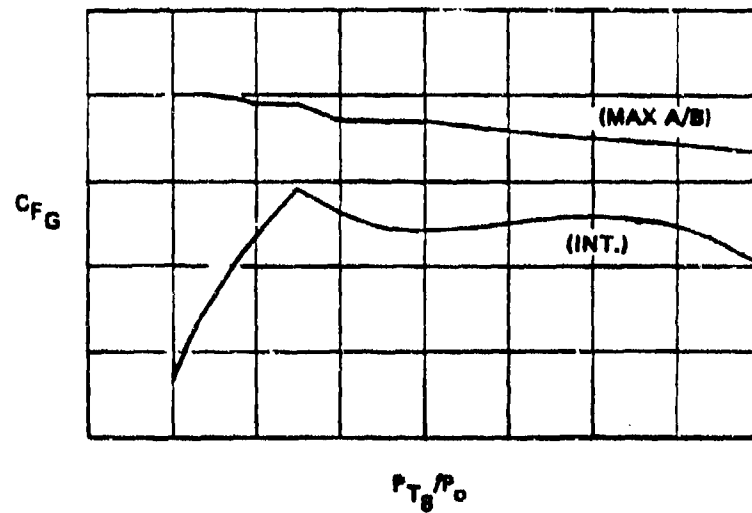
The data input table format for the round nozzle (Figure 8a) provides nozzle gross thrust coefficient as a function of nozzle total pressure ratio and area ratio. In the case of two-dimensional nozzles, however, the nozzle gross thrust coefficient (Figure 8b) is input as a function of

ROUND NOZZLES



(a)

TWO-DIMENSIONAL NOZZLES



(b)

Figure 8. Format for C_{FG} Maps

nozzle total pressure ratio for maximum afterburning and intermediate (dry) power settings. The two-dimensional nozzle input data format is based on the assumption that a variable area nozzle will be used which will be scheduled to provide an optimum variation of area ratio as a function of nozzle pressure ratio. Fundamentally, the gross thrust coefficient input data for both the round and two-dimensional nozzles could both be presented using the same format; in which case the data format for the round nozzle provides more generality because it allows for the selection of nozzle area ratio, A_9/A_8 . However, the lack of available data covering a wide range of two-dimensional nozzle area ratios plus the ability of the two-dimensional nozzle variable geometry to achieve a wider range of nozzle area ratios (and hence, be able to closely approach an optimum area ratio schedule) led to the selection of the simpler nozzle performance format for the two-dimensional nozzle shown in Figure 8b. If the future need arises to use the same format for both nozzle types the program can easily be modified to accomplish this. As an alternative, the user can enter the two-dimensional data in the same format as the round nozzle data and, during the PIPSI interactive terminal session, enter the input code that the nozzle type is a round rather than two-dimensional nozzle.

SECTION III

DATA FILES REQUIRED TO RUN PIPSI

There are a maximum of 5 external data files needed as input. These include:

- 1) Engine Data File (Sec 3.2)
- 2) Inlet Map File (Sec 3.3)
- 3) Afterbody Map File (Sec 3.4)
- 4) Nozzle Thrust Coefficient (CFG) File (Sec 3.5)
- 5) Capture Area File (Sec 3.6)

The first three files are always required as input in order to run PIPSI. The CFG file and capture area file are optional and apply only if the user asks for them when responding to an interactive prompt. In either case, if a file is going to be used during a PIPSI execution, it must be attached (see Section V) prior to program execution. The record structure of these files is identical to that of the Derivative Procedure Program (AFFDL-TR-78-91-Vol. III).

3.1 TABLE FORMAT

The values in the tables are stored on disk in a 10F7.0 card format. The meanings of the quantities placed in a card image differ depending on the type of table. There are four table types:

- a) One dimensional = Type 1
- b) Two dimensional (symmetric) = Type 2
- c) Two dimensional (non-symmetric) = Type 3
- d) Three-dimensional = Type 4

3.1.1 One Dimensional Table Definition

<u>Card 1</u>	<u>Table Definition Card</u>	<u>Format</u>
Cols.		
1-7	Table Name	A7
8-14	Number of X Values	F7.0
<u>Card 2</u>	<u>X Values</u>	
Cols.		
1-7	x_1	F7.0
8-14	x_2	F7.0
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
64-70	x_{10}	F7.0
<u>Card 3</u>	<u>Table Values</u>	
Cols.		
1-7	$f(x_1)$	F7.0
8-14	$f(x_2)$	F7.0
.	.	.
.	.	.
64-70	$f(x_{10})$	F7.0

3.1.2 Two-Dimensional Table Definition (Symmetric)

<u>Card 1</u>	<u>Table Definition Card</u>	<u>Format</u>
Cols.		
1-7	Table Title	A7
8-14	Number of X Values	F7.0
15-21	Number of Y Values	F7.0

<u>Card 2</u>		Y Values
Cols.		
1-7	Y_1	F7.0
8-14	Y_2	F7.0
.	.	.
.	.	.
.	.	.
64-70	Y_{10}	F7.0

<u>Card 3</u>		X Values
Cols.		
1-7	X_1	F7.0
8-14	X_2	F7.0
.	.	.
.	.	.
.	.	.
64-70	X_{10}	F7.0

<u>Card 4</u>		Table Values for Y_1 , and all X Values
Cols.		
1-7	$f(x_1, y_1)$	F7.0
8-14	$f(x_2, y_1)$	F7.0
.	.	.
.	.	.
.	.	.
64-70	$f(x_{10}, y_1)$	F7.0

<u>Card 5</u>		Table Values for Y_2 , and all X Values
Cols.		
1-7	$f(x_1, y_2)$	F7.0
8-14	$f(x_2, y_2)$	F7.0
.	.	.
.	.	.
.	.	.
64-70	$f(x_{10}, y_2)$	F7.0
Etc. for additional Y values		

3.1.3 Two-Dimensional Table (Non-Symmetric)

<u>Card 1</u>	<u>Table Definition Card</u>	<u>Format</u>
Cols.		
1-7	Table Name	A7
8-14	Number of Y values	F7.0
<u>Card 2</u>	Number of X Values for A Particular Y Value	
Cols.		
1-7	$NX(Y_1)$	F7.0
8-14	$NX(Y_1)$	F7.0
.	.	.
.	.	.
.	.	.
.	.	.
64-70	$NX(Y_{10})$	F7.0
<u>Card 3</u>	Y Values	
Cols.		
1-7	Y_1	F7.0
8-14	Y_2	F7.0
.	.	.
.	.	.
.	.	.
64-70	Y_{10}	F7.0
<u>Card 4</u>	X Values for Y_1	
Cols.		
1-7	$X_1(y_1)$	F7.0
8-14	$X_2(y_1)$	F7.0
.	.	.
.	.	.
.	.	.
64-70	$X_{10}(y_1)$	F7.0

Card 5	Table Values for (X_1-X_{10}, Y_1)	
Cols.		
1-7	$f(X_1, Y_1)$	F7.0
8-14	$f(X_2, Y_1)$	F7.0
.	.	.
.	.	.
.	.	.
64-70	$f(X_{10}, Y_1)$	F7.0

Card 6 X Values for Y_2
 (See Card 4)

Card 7 Table Values for (X_1-X_{10}, Y_2)
 (See Card 5)

Etc. for all Y values

3.1.4 Three-Dimensional Table Definition

<u>Card 1</u>	table definition card	<u>Format</u>
Cols.		
1-7	table name	A7
8-14	NX = number of X values	F7.0
15-21	NY = number of Y values	F7.0
22-28	NZ = number of Z values	F7.0

<u>Card 2</u>	Z Values	
Cols.		
1-7	Z_1	F7.0
8-14	Z_2	F7.0
.	.	.
.	.	.
.	.	.
64-70	Z_{10}	F7.0

<u>Card 3</u>	Y Values	
Cols.		
1-7	Y_1	F7.0
8-14	Y_2	F7.0
.	.	.
.	.	.
.	.	.
64-70	Y_{10}	F7.0

<u>Card 4</u>	X Values	
Cols.		
1-7	X_1	F7.0
8-14	X_2	F7.0
.	.	.
.	.	.
.	.	.
64-70	X_{10}	F7.0

<u>Card 5</u>	Table Values for Y_1, Z_1 , and all X Values	
Cols.		
1-7	$f(X_1, Y_1, Z_1)$	F7.0
8-14	$f(X_2, Y_1, Z_1)$	F7.0
.	.	.
.	.	.
.	.	.
64-70	$f(X_{10}, Y_1, Z_1)$	F7.0

<u>Card 6</u>	Table Values for Y_2, Z_1 and all X Values	
Cols.		
1-7	$f(X_1, Y_2, Z_1)$	F7.0
8-14	$f(X_2, Y_2, Z_1)$	F7.0
.	.	.
.	.	.
.	.	.
64-70	$f(X_{10}, Y_2, Z_1)$	F7.0

Etc. until Y Values have been gone through

Card 5 + NX

Table Values for Y_1, Z_2

Cols.

and all X Values

1-7

$f(X_1, Y_1, Z_2)$

F7.0

8-14

$f(X_2, Y_1, Z_2)$

F7.0

.

.

.

.

.

.

.

.

.

Etc. until all Y and Z Values have been gone through

3.1.5 Table Examples

Examples of tables in each of the 4 formats are shown in Figure 9.

Table 2E6

.55	.7	.8	1.2	1.6	2.0
1.055	.935	.89	.846	.89	.935

Table Type 1

Tables 7.

8.

0.	.8489	.85	1.0	1.2	1.4	1.7	2.20
0.	.04	.08	.12	.16	.20	.24	
0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	
0.	.062	.125	.198	.28	.38	.50	
0.	.05	.10	.156	.217	.29	.375	
0.	.036	.075	.117	.162	.22	.29	
0.	.03	.062	.097	.135	.185	.241	
0.	.025	.052	.081	.116	.16	.216	
0.	.02	.045	.074	.11	.153	.21	

Table Type 2

Figure 9. Examples of Four Table Types (continued)

Table 2A6

7.	6.	7.	7.	8.	9.		
.55	.70	.85	1.20	1.60	2.0		
.7	.8	.9	1.0	1.055	1.075	1.1	
.9915	.991	.985	.969	.95	.933	.875	
.6	.7	.8	.9	.95	.97		
.99	.99	.985	.974	.945	.90		
.5	.6	.7	.8	.85	.875	.905	
.99	.99	.989	.983	.975	.962	.90	
.5	.6	.7	.8	.85	.875	.902	
.98	.979	.977	.973	.967	.955	.90	
.500	.600	.700	.800	.850	.875	.885	.890
.976	.970	.965	.958	.955	.940	.925	.900
.5	.6	.7	.8	.9	.93	.935	.943
.958	.953	.949	.944	.935	.925	.92	.900
							.85

Table Type 3

Table AD

	5.	5.	4.	
2.180	3.930	5.650	7.430	
.400	.875	1.350	1.825	2.300
.500	1.000	1.500	2.000	3.000
.105	0.000	-.105	-.210	-.420
.114	-.000	-.114	-.227	-.455
.068	0.000	-.068	-.137	-.274
.015	0.000	-.015	-.030	-.061
.002	0.000	-.002	-.004	-.009
.036	0.000	-.036	-.071	-.143
.039	0.000	-.039	-.077	-.153
.023	0.000	-.023	-.047	-.093
.005	-.000	-.005	-.010	-.021
.001	0.000	-.001	-.001	-.003
.020	0.000	-.020	-.041	-.081
.022	0.000	-.022	-.044	-.088
.013	-.000	-.013	-.027	-.053
.003	-.000	-.003	-.006	-.012
.000	0.000	-.000	-.001	-.002
.014	0.000	-.014	-.027	-.054
.015	0.000	-.015	-.030	-.059
.009	0.000	-.009	-.018	-.036
.002	0.000	-.002	-.004	-.009
.000	0.000	-.000	-.001	-.001

Table Type 4

Figure 9. Examples of Four Table Types (Concluded)

3.2 ENGINE DATA FILE

The engine data file structure is shown in Figure 10.

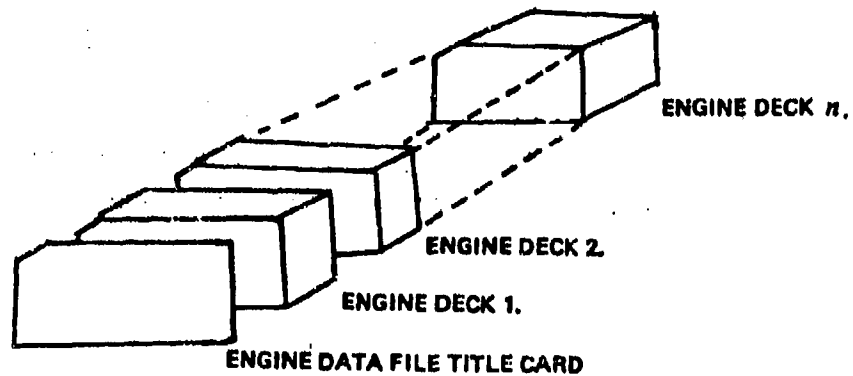


Figure 10. Engine Data File Structure

As can be seen from Figure 10, there may be multiple engine disks on an engine data file., Each deck is processed sequentially during a program execution using the user terminal input given at the beginning of the run. There is only one title card located at the beginning of the engine data file. The structure for an engine deck is shown in Figure 11.

POWER SETTING REDUCING - FASTEST CHANGING VARIABLE
MACH NUMBER INCREASING - SECOND VARIABLE
ALTITUDE INCREASING - SLOWEST CHANGING VARIABLE

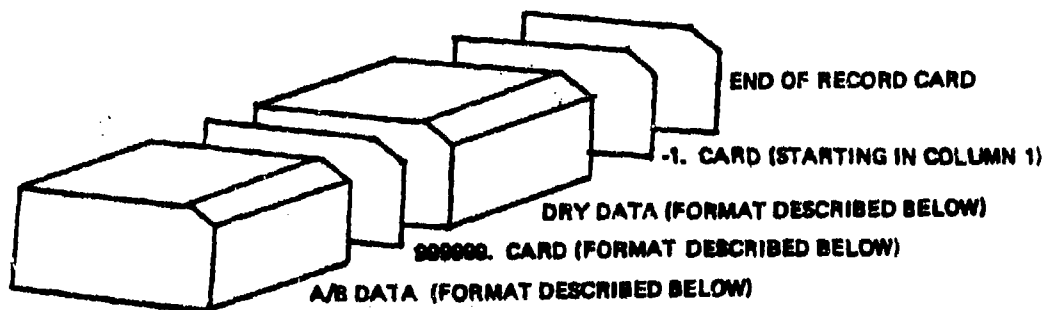


Figure 11. Engine Deck Structure

A data card in the engine deck has the following format:

<u>Cols.</u>		
1-7	Freestream Mach Number	F7.0
8-14	Pressure Altitude (ft)	F7.0
15-21	Power Setting	F7.0
22-28	Net Thrust (lbs)	F7.0
29-35	Fuel Flow (lbs/hr)	F7.0
36-42	Corrected Airflow, $W_a \sqrt{\theta/\delta}$ (lbs/sec)	F7.0
43-49	Nozzle Total Pressure Ratio	F7.0
50-56	Nozzle Throat Area	F7.0
57-63	Nozzle Exit Area	F7.0
64-70	Nozzle Thrust Coefficient	F7.0

3.3 INLET MAP FILE

The inlet map file consists of three separate sections of input

- (1) file name
- (2) other inlet parameters
- (3) tables

The tables can consist of a maximum of 15 maps or a minimum of 2 maps.

The standard form of inlet input data contains 14 data maps plus one additional data map that is added if the user wishes to include a reference recovery schedule that is different from MIL STD 5008B. The short form (2 map) inlet input consists of one inlet recovery map and one inlet total drag map, each as functions of $W\sqrt{\theta}/AC$ and M_0 . The short form input can be used any time the inlet data are provided in the specified two-map format. A common way to obtain the two-map format is by converting the 14-map format data into the two-map format by means of the INLTMAP computer program described in AFFDL-TR-72-147-Vol. II.

The file name is an 80 character title which correctly describes the inlet. The other inlet parameter needed for a PIPSI execution are described on 3 cards:

	<u>Description</u>	<u>Format</u>
Card 1	Blank	
Card 2	Blank	
Card 3		
Cols 21-28	Starting Mach number	F7.0

3.3.1 Inlet Maps File (Long)

This inlet map file consists of up to 15 tables. The tables are input in sequential order and are listed below. The inlet map file tables must be preceded by a card specifying the inlet starting Mach number. This is entered in Cols. 1-7 using an F7.0 format.

Table 1

A Type 1 table of Local Mach Number versus Freestream Mach Number. This table is used to account for the fact that the local flow field ahead of the inlet may be different from free-stream.

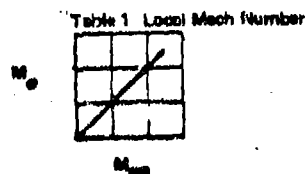


Table 2

A Type 3 table of Recovery versus Mass Flow and Local Mach Number. This table is used to obtain the inlet total pressure recovery as a function of "engine plus bypass" mass flow ratio for each free-stream Mach number.

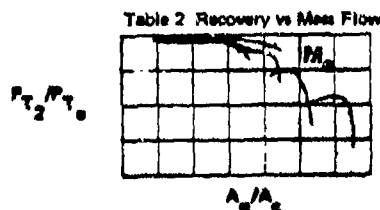


Table 2B

A Type 1 table of Matched Inlet Recovery versus Local Mach Number. This table is used to obtain the "matched" inlet total pressure recovery for sizing purposes and for mixed compression mode inlet operation at free-stream Mach numbers greater than M_{start} .

Table 2B Matched Inlet Recovery

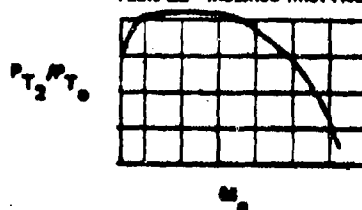


Table 2C

A Type 1 table of Matched Mass Flow versus Local Mach Number. The data in this table are used to obtain the "matched" engine-plus-bypass mass flow ratio for sizing purposes. The data from this table are also used for mixed-compression inlet operation above starting Mach number, M_{start} .

Table 2C Matched Mass Flow

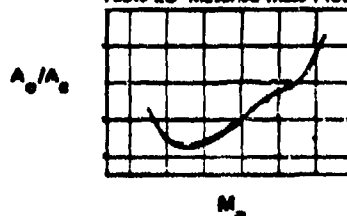


Table 2D

A Type 1 table of Buzz Limit versus Local Mach Number. This table provides a first-order estimate of the minimum inlet mass flow ratio at which buzz is likely to occur.

Table 2D Buzz Limit

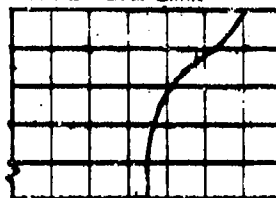
 A_0/A_c
(Buzz
Limit)

 M_0

Table 2E

A Type 1 table of Distortion Limit versus Local Mach Number. This table provides a first-order estimate of the maximum inlet mass flow ratio that can be reached before engine distortion limits are likely to be exceeded.

Table 2E Distortion Limit

 A_0/A_c
(Distortion
Limit)

 M_0

Table 3

A Type 3 table of Spillage Drag versus Inlet Supply ratio and Local Mach Number. This table provides the inlet spillage drag coefficient variation as a function of inlet mass flow ratio and Mach number. The drag coefficient data are "zeroed-out" at a reference mass flow ratio which is presented in Table 3B.

Table 3 Spillage Drag

 $C_{D_{spm}}$

 A_{01}/A_c

Table 3A

A Type 1 table of Reference Spillage Drag versus Local Mach Number. This table presents the reference spillage drag coefficient as a function of Mach number. This drag coefficient corresponds to the spillage drag of the excess airflow between the reference mass flow ratio and a mass flow ratio of 1.0.

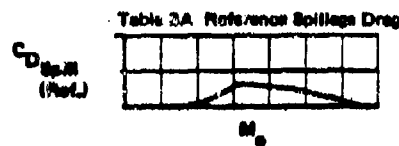


Table 3B

A Type 1 table of Reference Mass Flow versus Local Mach Number. This table specifies the reference mass flow used as a basis for spillage drag calculation. The spillage drag at the reference mass flow ratio is normally included in the aerodynamic drag polar, since it is not throttle-dependent.

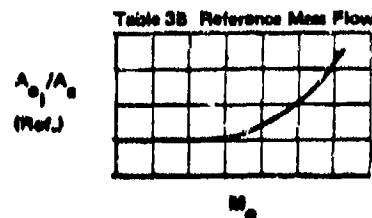


Table 4

A Type 2 table of Boundary Layer Bleed Drag versus Bleed Supply Ratio and Local Mach Number. This table is used to obtain the boundary layer bleed drag coefficient as a function of boundary layer bleed mass flow ratio and Mach number. This table is used during operation in the external-compression mode.

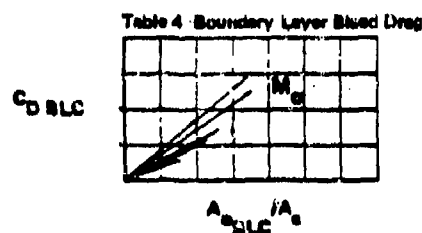


Table 5

A Type 2 table of Bypass Drag versus Bypass Supply Ratio and Local Mach Number. This table is used to obtain the bypass drag coefficient after the amount of bypass mass flow is determined at a given local Mach number.

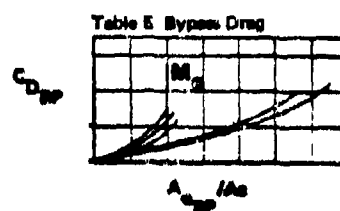


Table 6A

A Type 3 table of Bleed Supply ratio versus A_0/A_c and Local Mach Number. This table supplies the data required to obtain the boundary layer bleed mass flow ratio as a function of "engine-plus-bypass" mass flow ratio for a given local Mach number. It is used in the external-compression operating mode.

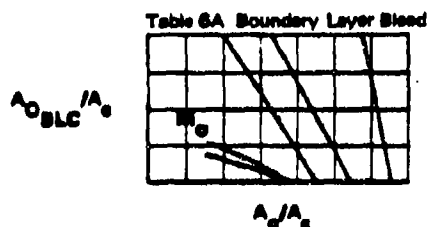


Table 6B

A Type 1 table of Matched Boundary Layer Bleed ratio versus Local Mach Number. This table provides the boundary layer bleed mass flow ratio for mixed-compression mode operation. For mixed-compression operation it is assumed that the bypass will be scheduled to keep the inlet operating at the design shock position.

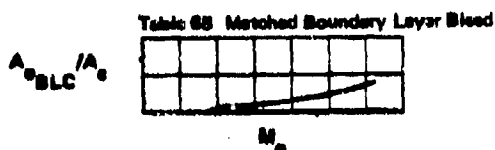


Table 7

A Type 3 table of Bypass Ratio versus Engine Supply ratio and Local Mach Number. This table is used to schedule the amount of bypass mass flow as a function of engine mass flow ratio and local Mach number for external-compression mode operation.

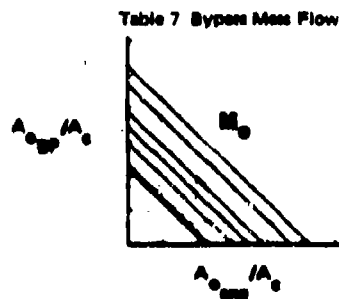
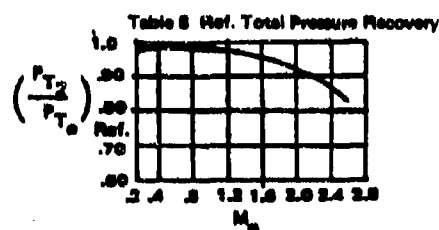


Table 8

This is an optional Type 1 table of reference recovery factor versus Free-stream Mach Number. This input table is used if the uninstalled engine data are based on a total pressure recovery schedule vs. Mach number that is different from MIL STD 5008B. The user can input the new schedule using this one-dimensional table. If the table is not present the program will assume that the uninstalled engine data are based on the MIL STD 5008B recovery schedule.



3.3.2 Inlet Map File (Short)

This inlet map file consists of only two tables. This input data format can be used if the inlet input data are available in the form of two comprehensive maps which include all the individual effects. The two-map format does not provide good visibility of the individual contributors to drag and recovery, but is sometimes preferred by users wishing to know only the total result. This format is not used very often because the two-maps are normally obtained by starting with the 14 maps and converting them to two maps. Therefore, if the 14 maps are already available, there is little reason to convert to the two-map format.

Table RF

A Type 2 table of Recovery versus $\frac{w\sqrt{\theta}}{\delta A_c}$ and Local Mach Number

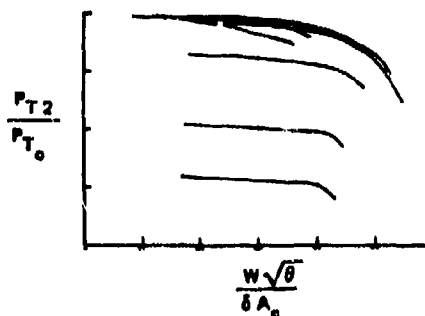
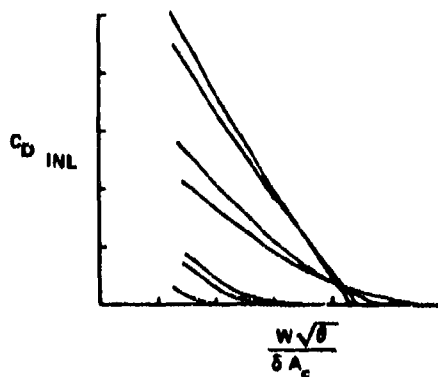


Table CD

A Type 2 table of Inlet Drag versus $\frac{w\sqrt{\theta}}{\delta A_c}$ and Local Mach Number



3.4 AFTERBODY MAP FILE

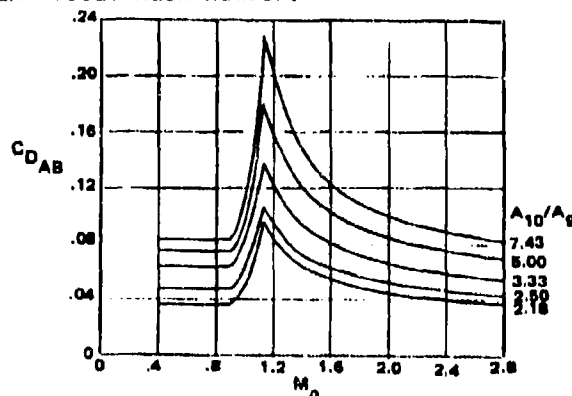
The afterbody file consists of three separate sections of input.

- (1) file name
- (2) other parameters
- (3) tables

The file name is an 80 character title which correctly describes the aft body being simulated. Following this are 4 blank cards or the cards described in Section 4.2.1.2 of the Derivative Procedure Document (Vol. III).

Table AB

The afterbody drag table is a type 2 (non-symmetric) table of afterbody drag versus A_{10}/A_9 and local Mach number.



The same table format is used for both round and two-dimensional nozzles; however, the afterbody drag coefficient in the input table for the two-dimensional nozzle is defined differently from that for the round nozzle input. These coefficients are defined as follows:

For Round Nozzle:

$$C_{DAB} = \frac{D_{AB}}{\rho_0 A_{10}}$$

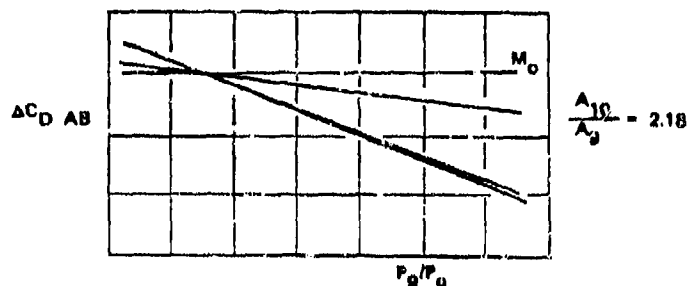
For Two-Dimensional Nozzle: $C_{DAB} = \frac{D_{AB}}{q_0 (A_{10} - A_9)}$

The present version of the input data maps for the two-dimensional nozzle is different from that for the round nozzle because the existing calculation routines were developed using the calculation routines from two different nozzle/aftbody computer routines - one developed for round nozzles and one developed specifically for two-dimensional nozzles. When the present program was developed both these calculation routines were included without change.

The two-dimensional nozzle drag coefficient was originally based on $(A_{10} - A_9)$ rather than A_{10} because it offered a more direct use of the correlated drag data.

Table AD

A type 4 table of afterbody drag correction versus pressure ratio, local Mach number and A_{10}/A_9 ratio. This table is optional and will be defaulted to zero if it is not present in the afterbody file.



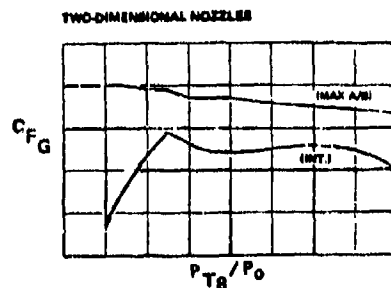
3.5 NOZZLE THRUST COEFFICIENT (C_{FG}) FILE

This is an optional file and is only needed if the user selects the tabular ($C_F = 1$) option when inputting data at the terminal. The C_{FG} file consists of three separate sections of input:

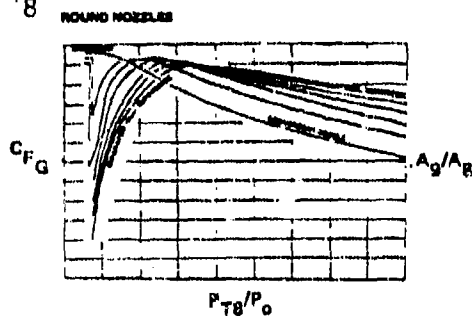
- (1) file name
- (2) other parameters
- (3) table

The file name is an 80 character title which correctly describes the C_{FG} data. Following this are two blank cards. The format of the table varies, depending on whether the user has selected a round or 2-dimensional nozzle.

For a 2-dimensional nozzle the table is a Type 2 table of nozzle thrust coefficient versus P_{T8}/P_0 and PS.



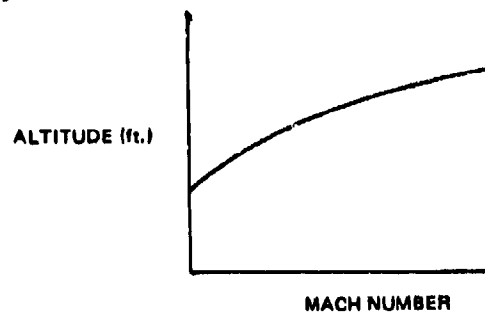
For a Round Nozzle the table is a Type 2 table of nozzle thrust coefficient versus A_9/A_8 and P_{T8}/P_0 .



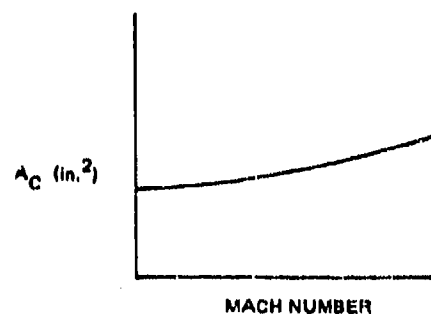
3.6 CAPTURE AREA FILE

This is an optional file which is only needed when the user selects the variable capture area options 2 and 3 (subsection 4.13.2) during a interactive session. The capture area file contains one table which is used to determine a capture area versus Mach number schedule to be used during the program execution.

If the user selects option 2, a Type 1 table of Mach number versus altitude is expected.



If the user selects option 3, a Type 1 table of capture area versus Mach number is expected.



SECTION IV

USER OPTIONS

The PIPSI program is designed to be run interactively. The user must enter data in response to program displayed questions in order to execute the program.

These questions are enumerated as follows:

4.1 NOZZLE THRUST COEFFICIENT FLAG

The user may input either

0. - for c_{FG} from engine deck
1. - for c_{FG} from c_{FG} table*
2. - for $c_{FG} = 1$.

*NOTE: c_{FG} file (subsection 3.5) must be attached.

4.2 NOZZLE TYPE FLAG

The user may input either

1. - for a round nozzle
2. - for a two-dimensional nozzle

4.3 CAPTURE AREA OPTION FLAG

The user may input either

1. - for constant capture area option (Must be used if short form inlet map is used)
2. - for variable capture area option

4.4 ENGINE NUMBER AND SCALE FACTOR

The user must input the number of engines and engine scale factor to be used in subsequent calculations.

4.5 MAXIMUM AND INTERMEDIATE POWER SETTINGS

The user must enter these values in order to determine the correct gamma.
(If power setting less than max power setting and greater than intermediate power setting the gamma = 1.3)

(If power setting less than intermediate power setting the gamma = 1.35)

4.6 A10 AND A10A9R

The user must enter the values for the maximum cross-sectional reference area in ft^2 and the reference nozzle exit area ratio.

4.7 REFERENCE MASS FLOW RATIO FLAG

The user may input either

0. - to use Tables 3A and 3B in spillage drag calculation
1. - use mass flow ratio of 1. in spillage drag calculation

4.8 ENGINE PRINT OPTION

The user may input either

1. - to not print the engine input data on TAPE6
2. - to have the engine input data listed on TAPE6

4.9 INLET BYPASS MODE

The user may input any of the following:

1. - to have all excess inlet airflow spilled externally
2. - to have all excess inlet airflow bypassed above an input Mach number (MOSBP)
3. - use scheduled bypass with rest of excess inlet airflow spilled (table 7)

4. - determine the optimum combination of bypass and spillage for a minimum inlet drag
5. determine the optimum combination of bypass and spillage for a minimum SFCA

4.10 ENTER MOSBP FOR START OF BYPASS

This prompt will only appear if the user has specified an inlet bypass mode = 2. In this case the user must enter a Mach number for start of bypass.

4.11 ENTER BYPASS PRINT OPTION

The user may enter either

0. - for no bypass printout
1. - to obtain hypass mode printout for bypass modes 4 or 5

4.12 ENTER RECOVERY AND DRAG MAPS FLAG*

The user may enter either

0. - to use the standard 15 inlet maps
1. - to use only 2 maps for the inlet

*NOTE: User should read section 3.3 for inlet map file structure.

4.13 CAPTURE AREA DETERMINATION OPTION

The program will now prompt the user as to the method by which the capture area is to be determined.

4.13.1 Constant Capture Area Options

If the user has selected the constant capture area option described in Section 2.3, the user must respond with either

1. - for the sizing envelope option
2. - for the sizing point option
3. - for input of a single capture area (must be used if short form inlet input is used)

For the sizing envelope option the user will be asked to input the low and high Mach numbers to be used for capture area sizing. The engine deck will be searched for all data cards with Mach numbers between these bounds. The maximum capture area for the cards in these bounds is the capture area to be used in subsequent calculations.

For the sizing point option the user will be asked to input a design Mach number and a design altitude. The engine deck will be searched until this combination is found on a data card and the capture area from this card is used in subsequent calculations. The program will not interpolate for this point so it must be in the engine deck input.

In option 3, the user simply inputs the capture area to be used.

4.13.2 Variable Capture Area Options

If the user selected the variable capture area option described in Section 3.6, then the user must respond with either

1. - for sizing envelope option
2. - for Mach number versus altitude schedule
3. - for Mach number versus capture area schedule

For the sizing envelope option the user will be asked to input the low and high Mach numbers to be used for determining a capture area versus Mach number schedule. The engine deck will be searched for all data cards with unique Mach numbers between these Mach number bounds. A schedule of capture area versus Mach number is developed from these cards.

If option 2 was selected, the user will be asked if the Mach altitude schedule is to input from terminal or input from the capture area file. The user must enter one of the following:

- 0. - if the schedule is to be input from the terminal
- 1. - if the schedule is from the capture area file

If the schedule is from the terminal, the data is input in the form (number of pairs followed by the pairs of Mach number - altitude values) all separated by blank spaces.

If option 3 was selected, the user will be asked if the capture area versus Mach number schedule is to be input from the terminal or input from the capture area file. The user must enter one of the following:

- 0. - if the schedule is to be input from the terminal
- 1. - if the schedule is from the capture area file

If the schedule is from the terminal the data is input in the form (number of pairs followed by the pairs of Mach number - capture area values) all separated by blank spaces.

4.14 CORRECTION DESIRED

After all these inputs have been entered, they will be displayed on the terminal for the user to peruse. The user will be asked to enter a correction desired flag. The user must respond with either

- 0. - no correction desired, which begins the processing of the engine decks
- 1. - change the variable that is incorrect. The user will then be asked the name of the incorrect variable and will be given the opportunity to correct it.

4.15 DATA FORMAT

If during a terminal session the user responds with an input which is in an incorrect format, an error message will appear on the terminal and the user will be asked to re-enter the data. If the user wishes to exit the program during the question and answer sequence a %A is entered in response to the input prompt.

When the engine deck has been processed, the first prompt will again be displayed to begin the next engine deck. At this point a normal exit can be accomplished by entering "END".

SECTION V

PROGRAM EXECUTION SEQUENCE

In order to execute PIPSI, all data files and the PIPSI program must be attached. The appropriate data files must be attached to specific file names recognized by the program. These are -

File name used in Program

TAPE51 = inlet map file
TAPE52 = afterbody map file
TAPE53 = C_F file
TAPE54 = Capture area file
TAPE1 = Engine data file

A typical CDC system set of control cards is shown in Figure 12. All of the program results not displayed on the terminal are placed on a file called TAPE6. This file may be saved or printed by the user utilizing the appropriate control statements. In Figure 12 output was disposed to the line printer. Examples of typical input data files are presented in Section VI.

ATTACH, TAPE51 = ATS2PM.	}	Attach necessary data files
ATTACH, TAPE52 = ATS2DM.		
ATTACH, TAPE53 = CV2DM.		
ATTACH, TAPE54 = MARY3M.		
ATTACH, TAPE1 = AFE.		
ATTACH, LG0 = PIPSI.	}	Attach PIPSI relocatable binary
PIPSI.		
PIPSI.	}	Execute program
REWIND, TAPE6.		
COPYBF, TAPE6, OUTPUT	}	Output results to line printer

Figure 12. Typical Set of Control Cards

6.1 INLET TABLES (LONG FORM)

53

RECEIVED

TABLE 3A 3.
0.000 1.000 2.500
0.000 0.000 0.000

TABLE 3B 3.
0.000 1.000 2.500
.999 .999 .999

TABLE 4 5. 6.
0.000 .849 .850 1.300 2.050 2.500
0.000 .011 .022 .044 .066

0.000 0.000 0.030 0.000 0.000
0.000 0.000 0.000 0.000 0.000
0.000 .007 .014 .028 .047
0.000 .010 .021 .042 .062
0.000 .011 .022 .044 .066
0.000 .011 .022 .044 .066

TABLE 5 7. 8.
0.000 .849 .950 1.000 1.300 1.600 2.050 2.500
0.000 .042 .043 .125 .166 .208 .249

0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.000
0.000 .062 .125 .198 .280 .380 .500
0.000 .050 .100 .156 .217 .290 .375
0.000 .036 .073 .117 .161 .217 .275
0.000 .030 .062 .096 .133 .181 .234
0.000 .026 .055 .084 .120 .164 .220
0.000 .023 .051 .083 .123 .170 .233

TABLE 6A 8.
2.000 2.000 3.000 3.000 4.000 4.000 6.000 6.000
0.000 .800 1.000 1.300 1.600 1.900 2.200 2.500

0.000 .797
0.000 0.000
0.001 .800
0.000 0.000

0.486 .567 .674 .731 .812
0.009 .008 .003 .003 0.000

0.500 .584 .702 .753 .836
0.015 .014 .011 .009 0.000

0.522 .611 .751 .788 .877
0.024 .022 .015 .013 0.000

0.545 .637 .730 .805 .891 .917
0.033 .032 .028 .027 .015 0.000

0.570 .666 .742 .865 .880 .957
0.048 .046 .041 .037 .023 0.000

0.594 .694 .794 .894 .926 .999
0.066 .061 .055 .041 .033 0.000

TABLE 6B 5.
0.000 .800 1.300 1.900 2.500
0.000 0.000 .011 .022 .033

TABLE 7 6.
2.000 2.000 4.000 4.000 4.000 4.000
0.000 1.599 1.600 1.600 2.200 2.500

0.000 1.000
0.000 0.000
0.000 0.000

0.350 .749 .752 1.000
0.404 .004 0.000 0.000

0.566 .798 .807 1.000
0.442 .009 0.000 0.000

0.583 .855 .864 1.000
0.485 .013 0.000 0.000

0.400 .015 .030 1.000
0.512 .015 0.000 0.000

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6.2 INLET TABLES (SHORT FORM)

TABLE RF10.									
.5	.75	1.0	1.25	1.5	1.75	2.0	.25	.5	.5
3.63	7.26	10.89	14.52	18.15	21.78	25.41	29.04	32.67	36.30
.9685	.9685	.9685	.9685	.9685	.9685	.9685	.9685	.9685	.9685
.99	.99	.99	.99	.99	.99	.99	.99	.99	.99
.9875	.9872	.9869	.9866	.9863	.9860	.9857	.9854	.9851	.9848
.9853	.9851	.9849	.9847	.9845	.9843	.9841	.9839	.9837	.9835
.9425	.9427	.9429	.9432	.9434	.9436	.9439	.9441	.9442	.9443
.9262	.9262	.9263	.9263	.9264	.9265	.9265	.9266	.9266	.9266
.9219	.9223	.9228	.9232	.9237	.9241	.9246	.9250	.9255	.9260
.9538	.9538	.9538	.9538	.9538	.9538	.9538	.9538	.9538	.9538
.9685	.9685	.9685	.9685	.9685	.9685	.9685	.9685	.9685	.9685
.9685	.9685	.9685	.9685	.9685	.9685	.9685	.9685	.9685	.9685
TABLE CD10.									
.5	.75	1.0	1.25	1.5	1.75	2.0	.25	.5	.5
3.63	7.26	10.89	14.52	18.15	21.78	25.41	29.04	32.67	36.30
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
.5928	.5053	.4198	.3333	.2467	.1735	.1133	.0675	.0336	.0399
.7475	.6505	.5535	.4567	.3598	.2732	.1974	.1377	.1143	.0946
.8769	.7682	.6598	.5517	.4438	.3467	.2650	.1968	.1684	.1401
1.065	.9508	.8366	.7223	.608	.4936	.3791	.2646	.2118	.1691
1.075	.9427	.8103	.6774	.5456	.4132	.2807	.1583	.1303	.0976
1.0776	.9154	.7531	.5906	.428	.2652	.1321	.0557	.0444	.0404
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

6.3 NOZZLE/AFTBODY DRAG TABLES

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CO2P INPUT MAP

1.00	2.00	3.00	.17	.10			
0.00							
7.00	7.00	7.00	7.00	7.00			
637.00	700.00	760.00	800.00	820.00	830.00	876.00	
44.50	41.50	35.00	31.00	25.00	20.50	20.50	
637.00	700.00	760.00	800.00	820.00	830.00	876.00	
44.50	41.50	35.00	31.00	25.00	20.50	17.84	
637.00	700.00	760.00	800.00	820.00	830.00	876.00	
44.50	41.50	35.00	31.00	25.00	20.50	13.30	
637.00	700.00	760.00	800.00	820.00	830.00	876.00	
44.50	41.50	35.00	31.00	25.00	20.50	8.92	
637.00	700.00	760.00	800.00	820.00	830.00	876.00	
44.50	41.50	35.00	31.00	25.00	20.50	6.00	

AFTBODY DERIVATIVE
PARAMETERSNOZZLE/AFTBODY AREA
DISTRIBUTION
DATA

CONSTANT PARAMETERS

TABLE A

2.180	2.500	3.330	5.000	7.430			
.400	.900	1.130	1.200	1.400	1.600	2.000	2.300
.096	.097	.156	.135	.103	.086	.068	.061
.107	.108	.167	.144	.110	.094	.076	.067
.123	.124	.198	.173	.132	.112	.089	.079
.134	.135	.240	.209	.159	.134	.108	.096
.142	.143	.288	.251	.184	.153	.123	.109

BASIC DRAG
MAP DATA
FOR
 $P_0/P_0 = 1.0$

TABLE B

2.180	3.430	5.630	7.430				
.400	.875	1.350	1.825	2.300			
.500	1.000	1.500	2.000	3.000			
.105	0.000	-.105	-.210	-.420			
.114	-.000	-.114	-.227	-.455			
.068	0.000	-.068	-.137	-.274			
.015	0.000	-.015	-.030	-.061			
.002	0.000	-.002	-.004	-.009			
.034	0.000	-.034	-.071	-.143			
.039	0.000	-.039	-.077	-.155			
.023	0.000	-.023	-.047	-.093			
.005	-.000	-.015	-.030	-.061			
.001	0.000	-.001	-.001	-.003			
.020	0.000	-.020	-.041	-.081			
.022	0.000	-.022	-.044	-.088			
.013	-.000	-.013	-.027	-.053			
.003	-.000	-.003	-.006	-.012			
.000	0.000	-.000	-.001	-.002			
.014	0.000	-.014	-.027	-.055			
.015	0.000	-.015	-.030	-.060			
.009	0.000	-.009	-.018	-.036			
.002	0.000	-.002	-.004	-.009			
.000	0.000	-.000	-.001	-.001			

OPTIONAL DRAG CORRECTION
DATA FOR EFFECTS OF
NOZZLE EXIT STATIC
PRESSURE $\neq 1.0$

6.4 NOZZLE GROSS THRUST COEFFICIENT TABLE

CV1 INPUT MAP									
0.	0.	0.	11.45						
0.	1.	0.							
TABLECV10.	7.								
1.	1.1	1.2	1.3	1.4	1.5	1.6			
1.8	2.0	3.0	4.0	5.0	6.0	8.0	10.	14.	18.
.992	.992	.986	.976	.966	.955	.938	.924	.903	.886
.932	.965	.984	.986	.982	.975	.968	.947	.925	.908
.688	.915	.977	.986	.988	.967	.970	.958	.938	.92
.962	.905	.965	.982	.986	.982	.972	.964	.947	.932
.840	.89	.942	.970	.983	.966	.976	.968	.954	.942
.622	.876	.932	.962	.977	.982	.978	.970	.958	.944
.9	.867	.922	.952	.97	.979	.978	.972	.961	.952

6.5 INLET CAPTURE AREA TABLE (OPTIONAL)

TABLE CM5.	1.2	1.6	2.0
.8	.95		
4.740	4.719	4.802	5.502 6.361

TABLE CM5. 1.2 1.6 2.0

6.6 ENGINE DATA TABLE

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AIR FORCE TEST CASE									
0.00	0.	1.00	18326.	36482.	182.68	2.767	3.753	3.842	.9858
.20	0.	1.00	19225.	39433.	182.68	2.982	3.752	3.962	.9859
.50	0.	1.00	21390.	43309.	182.68	3.471	3.704	4.184	.9863
.85	0.	1.00	24134.	53700.	157.86	4.129	3.7...	4.576	.9863
1.00	0.	1.00	25337.	58386.	158.66	4.491	3.726	4.994	.9860
1.20	0.	1.00	28031.	66436.	146.70	5.121	3.738	5.498	.9854
1.60	0.	1.00	35537.	86437.	121.41	6.624	3.807	6.608	.9840
1.78	0.	1.00	40482.	94250.	112.92	7.613	3.830	6.960	.9843
1.95	0.	1.00	46548.	114685.	106.69	8.846	3.835	7.272	.9849
2.12	0.	1.00	53272.	132392.	101.03	10.285	3.837	7.815	.9827
2.30	0.	1.00	60994.	153687.	95.80	12.063	3.831	8.004	.9814
0.00	10000.	1.00	12973.	25056.	182.68	2.762	3.863	3.863	.9856
.20	10000.	1.00	13623.	28054.	182.68	2.971	3.869	4.091	.9859
.50	10000.	1.00	15202.	32239.	182.68	3.456	3.822	4.822	.9865
.85	10000.	1.00	19544.	41635.	181.25	4.625	3.700	4.825	.9868
1.00	10000.	1.00	20659.	45137.	171.72	5.040	3.712	5.146	.9867
1.20	10000.	1.00	22776.	51088.	157.96	5.716	3.724	6.066	.9829
1.60	10000.	4.00	29635.	67608.	132.73	7.604	3.750	6.813	.9845
1.60	10000.	4.00	21277.	38290.	132.73	7.735	3.096	6.219	.9785
1.60	10000.	4.00	12842.	19181.	132.73	7.842	2.484	4.816	.9786
1.78	10000.	4.00	32293.	72588.	120.07	8.368	3.814	6.995	.9850
1.78	10000.	4.00	22992.	42696.	120.07	8.538	3.157	6.352	.9817
1.78	10000.	4.00	12629.	19625.	120.07	8.668	2.485	5.242	.9769
1.95	10000.	4.00	36560.	86208.	112.36	9.597	3.837	7.475	.9840
1.95	10000.	4.00	25833.	49823.	112.36	9.768	3.185	6.639	.9823
1.95	10000.	4.00	13325.	21278.	112.36	9.924	2.487	5.410	.9797
2.12	10000.	4.00	41561.	94632.	105.87	11.123	3.831	7.983	.9821
2.12	10000.	4.00	29210.	58087.	105.87	11.318	3.190	7.119	.9815
2.12	10000.	4.00	14273.	23424.	105.87	11.501	2.481	5.982	.9782
2.30	10000.	4.00	47345.	114606.	100.10	12.954	3.837	8.216	.9804
2.30	10000.	4.00	33025.	64907.	100.10	13.178	3.208	7.151	.9819
2.30	10000.	4.00	15111.	25769.	100.10	13.396	2.484	6.072	.9810
0.00	22500.	1.00	8107.	16323.	182.68	2.755	4.014	4.131	.9856
.20	22500.	1.00	8533.	17646.	182.68	2.961	4.025	4.268	.9859
.50	22500.	1.00	9557.	20285.	182.68	3.443	3.981	4.530	.9864
.85	22500.	1.00	12513.	26503.	182.68	4.665	3.839	5.044	.9868
1.00	22500.	1.00	14473.	30346.	182.68	5.527	3.755	5.393	.9870
1.20	22500.	1.00	17143.	35926.	175.51	6.669	3.706	6.386	.9846
1.60	22500.	4.00	21945.	47096.	146.17	8.776	3.736	7.050	.9849
1.60	22500.	4.00	13970.	26673.	146.17	8.929	3.079	6.190	.9827
1.60	22500.	4.00	10157.	13940.	146.17	9.047	2.484	5.159	.9795
1.78	22500.	4.00	24630.	53538.	134.49	10.517	3.743	7.194	.9837
1.78	22500.	4.00	17785.	30321.	134.49	10.190	3.090	6.532	.9823
1.78	22500.	4.00	10560.	19320.	134.49	10.329	2.482	5.515	.9797
1.95	22500.	4.00	26839.	59525.	122.63	11.862	3.795	7.913	.9821
1.95	22500.	4.00	14224.	33745.	122.63	11.257	3.140	7.169	.9805
1.95	22500.	4.00	10916.	15405.	122.63	11.424	2.485	5.713	.9803
2.12	22500.	4.00	29656.	67119.	113.50	12.418	3.833	8.056	.9810
2.12	22500.	4.00	21099.	78013.	113.50	12.639	3.180	7.238	.9815
2.12	22500.	4.00	11152.	16743.	113.50	12.840	2.485	6.059	.9804
2.30	22500.	4.00	33535.	77237.	106.70	14.386	3.835	8.298	.9784
2.30	22500.	4.00	28674.	43743.	106.70	14.639	3.194	7.582	.9798
2.30	22500.	4.00	11614.	18405.	106.70	14.877	2.484	6.274	.9806
0.00	35000.	1.00	4788.	9743.	182.68	2.757	4.146	4.284	.9856
.20	35000.	1.00	5061.	10538.	182.68	2.963	4.166	4.436	.9859
.50	35000.	1.00	5706.	12123.	182.68	3.441	4.140	4.725	.9864
.85	35000.	1.00	7527.	15740.	182.68	4.657	4.005	5.275	.9869
1.00	35000.	1.00	8733.	18164.	182.68	5.518	3.921	5.746	.9868
1.20	35000.	1.00	11041.	22449.	182.68	7.081	3.797	6.815	.9837
1.60	35000.	4.00	13560.	31618.	162.97	10.321	3.717	7.543	.9830

1.60	35000.	4.00	11474.	17907.	162.97	10.501	3.091	6.156	.9845
1.60	35000.	4.00	7667.	9789.	162.97	10.634	2.484	5.355	.9821
1.78	35000.	4.00	17419.	35821.	149.53	11.713	3.731	7.736	.9819
1.78	35000.	4.00	12741.	26288.	146.53	11.917	3.070	7.006	.9815
1.78	35000.	4.00	8141.	16721.	149.53	12.374	2.484	5.634	.9819
1.95	35000.	4.00	19375.	40433.	138.33	13.255	3.743	8.383	.9803
1.95	35000.	4.00	14066.	22899.	138.00	13.484	3.087	7.105	.9815
1.95	35000.	4.00	6726.	11718.	138.00	13.667	2.484	6.025	.9815
2.12	35000.	4.00	21239.	45227.	126.74	14.827	3.765	8.263	.9779
2.12	35000.	4.00	15307.	25614.	126.74	15.084	3.114	7.497	.9797
2.12	35000.	4.00	4036.	12510.	126.74	15.298	2.484	6.060	.9822
2.30	35000.	4.00	22899.	50176.	115.17	16.273	3.830	8.673	.9755
2.30	35000.	4.00	16360.	28417.	115.17	16.563	3.177	7.745	.9785
2.30	35000.	4.00	8819.	12682.	115.17	16.825	2.486	6.423	.9805
0.00	47500.	1.00	2566.	5306.	182.68	2.857	3.872	4.325	.9857
.20	47500.	1.00	2719.	5746.	182.68	3.066	3.914	4.197	.9860
.50	47500.	1.00	3080.	6620.	182.68	3.545	3.939	5.516	.9865
.85	47500.	1.00	4108.	8614.	182.68	4.770	3.881	5.161	.9869
1.00	47500.	1.00	4785.	9450.	182.68	5.623	3.831	5.648	.9867
1.20	47500.	1.00	6069.	12313.	182.68	7.206	3.731	6.697	.9841
1.60	47500.	4.00	8174.	16749.	157.43	9.947	3.720	7.312	.9839
1.60	47500.	4.00	6515.	9488.	157.43	10.121	3.056	6.467	.9822
1.60	47500.	4.00	3986.	5174.	157.43	10.250	2.485	5.327	.9816
1.78	47500.	4.00	9207.	19101.	145.25	11.366	3.733	7.334	.9821
1.78	47500.	4.00	6732.	10918.	145.25	11.583	3.074	6.034	.9820
1.78	47500.	4.00	4299.	5712.	145.25	11.716	2.484	5.647	.9814
1.95	47500.	4.00	10295.	21048.	134.56	12.914	3.744	8.015	.9807
1.95	47500.	4.00	7480.	12261.	134.56	13.137	3.092	7.111	.9816
1.95	47500.	4.00	4595.	6270.	134.56	13.315	2.485	5.563	.9830
2.12	47500.	4.00	11413.	24426.	124.60	14.595	3.760	8.260	.9783
2.12	47500.	4.00	8237.	13834.	124.60	14.846	3.114	7.439	.9800
2.12	47500.	4.00	4863.	6789.	124.60	15.057	2.485	6.265	.9808
2.30	47500.	4.00	12290.	27084.	113.16	15.979	3.832	8.629	.9759
2.30	47500.	4.00	8796.	15339.	113.16	16.263	3.182	7.726	.9787
2.30	47500.	4.00	4711.	8839.	113.16	16.522	2.487	6.349	.9806
0.00	60000.	1.00	1317.	2076.	182.68	3.040	3.364	3.530	.9860
.20	60000.	1.00	1386.	3109.	182.68	3.253	3.412	3.696	.9863
.50	60000.	1.00	1591.	3574.	182.68	3.743	3.516	4.034	.9867
.85	60000.	1.00	2159.	4660.	182.68	4.980	3.583	4.833	.9866
1.00	60000.	1.00	2404.	5214.	177.07	5.591	3.611	5.193	.9869
1.20	60000.	1.00	2804.	6069.	166.87	6.512	3.656	6.311	.9839
1.60	60000.	4.00	3898.	8325.	144.42	8.959	3.725	7.088	.9849
1.60	60000.	4.00	2855.	4715.	144.42	9.114	3.067	6.218	.9827
1.60	60000.	4.00	1850.	2926.	144.42	9.232	2.487	5.293	.9789
1.78	60000.	4.00	4492.	9610.	134.73	10.391	3.740	7.637	.9828
1.78	60000.	4.00	3269.	5447.	134.73	10.579	3.086	6.256	.9843
1.78	60000.	4.00	2043.	2834.	134.73	10.713	2.485	5.515	.9806
1.95	60000.	4.00	5112.	11023.	126.07	11.946	3.754	7.830	.9817
1.95	60000.	4.00	3704.	6243.	126.07	12.192	3.105	6.871	.9823
1.95	60000.	4.00	2230.	3149.	126.07	12.321	2.486	5.999	.9800
2.12	60000.	4.00	5782.	12609.	118.27	13.686	3.774	9.187	.9795
2.12	60000.	4.00	4156.	7141.	118.27	13.922	3.130	7.101	.9817
2.12	60000.	4.00	2395.	3451.	118.27	14.125	2.486	6.059	.9817
2.30	60000.	4.00	6286.	14093.	108.13	15.110	3.842	8.511	.9771
2.30	60000.	4.00	4495.	7982.	108.13	15.386	3.196	7.678	.9793
2.30	60000.	4.00	2343.	3513.	108.13	15.636	2.488	6.292	.9809
999999.									
.25	0.	5.00	12051.	11254.	182.68	3.151	2.416	2.421	.9862
.25	0.	6.67	6282.	5690.	135.51	2.144	2.416	2.135	.9841
.25	0.	8.34	2217.	2364.	90.17	1.415	2.416	1.992	.9850
.25	0.	10.00	713.	1344.	59.70	1.163	2.415	1.936	.9850

.50	0.	5.00	12719.	13116.	142.68	3.582	2.415	2.631	.9867
.50	0.	6.67	7105.	7238.	141.68	2.549	2.416	2.262	.9853
.50	0.	8.34	2924.	3372.	104.15	1.729	2.415	2.050	.9850
.50	0.	10.00	839.	1698.	74.75	1.321	2.416	1.972	.9851
.80	0.	5.00	13017.	14878.	170.74	4.148	2.416	2.750	.9862
.80	0.	6.67	7562.	8832.	137.64	3.072	2.415	2.474	.9860
.80	0.	8.34	3586.	4740.	109.02	2.244	2.416	2.173	.9844
.80	0.	10.00	1366.	2444.	87.25	1.682	2.417	2.044	.9850
.90	0.	5.00	12937.	15467.	164.82	4.372	2.416	3.124	.9830
.90	0.	6.67	7589.	9072.	135.14	3.298	2.415	2.640	.9854
.90	0.	8.34	3579.	5324.	109.58	2.472	2.415	2.338	.9831
.90	0.	10.00	900.	2852.	89.72	1.981	2.416	2.119	.9804
1.00	0.	5.00	12256.	16130.	158.66	4.632	2.416	3.361	.9808
1.00	0.	6.67	6703.	9969.	131.27	3.519	2.416	2.894	.9799
1.00	0.	8.34	2666.	5748.	108.34	2.681	2.415	2.532	.9795
1.00	0.	10.00	-98.	3150.	67.99	2.072	2.416	2.292	.9789
.25 20000.	5.00	5555.	4904.	182.68	3.154	2.416	2.476	.9862	
.25 20000.	6.67	2910.	2411.	135.35	2.150	2.416	2.135	.9841	
.25 20000.	8.34	1034.	1127.	89.79	1.419	2.416	1.994	.9850	
.25 20000.	10.00	354.	713.	58.75	1.171	2.416	1.938	.9850	
.50 20000.	5.00	5862.	5582.	182.68	3.596	2.415	2.623	.9867	
.50 20000.	6.67	3271.	4116.	141.24	2.548	2.416	2.259	.9853	
.50 20000.	8.34	1352.	1521.	103.67	1.730	2.417	2.053	.9850	
.50 20000.	10.00	406.	869.	74.39	1.326	2.416	1.976	.9850	
.80 20000.	5.00	7036.	7456.	182.68	4.590	2.415	2.960	.9853	
.80 20000.	6.67	4081.	4355.	145.73	3.324	2.416	2.559	.9863	
.80 20000.	8.34	1848.	2251.	111.86	2.332	2.416	2.202	.9847	
.80 20000.	10.00	513.	1166.	86.88	1.687	2.416	2.047	.9850	
.90 20000.	5.00	7658.	8424.	182.68	5.095	2.415	3.258	.9852	
.90 20000.	6.67	4432.	4985.	146.95	3.710	2.416	2.743	.9855	
.90 20000.	8.34	1968.	2607.	114.03	2.616	2.417	2.393	.9835	
.90 20000.	10.00	433.	1327.	89.29	1.883	2.417	2.121	.9809	
1.00 20000.	5.00	8160.	9617.	182.68	5.704	2.416	3.630	.9831	
1.00 20000.	6.67	4490.	5646.	146.74	4.134	2.416	3.272	.9795	
1.00 20000.	8.34	1692.	2918.	114.17	2.790	2.416	2.569	.9814	
1.00 20000.	10.00	-28.	1448.	89.49	2.071	2.416	2.231	.9789	
.25 30000.	5.00	3613.	3020.	182.68	3.165	2.416	2.477	.9863	
.25 30000.	6.67	2161.	1790.	143.13	2.217	2.415	2.173	.9847	
.25 30000.	8.34	1024.	976.	105.54	1.624	2.416	2.033	.9850	
.25 30000.	10.00	346.	608.	70.87	1.259	2.416	1.960	.9850	
.50 30000.	5.00	3808.	3496.	182.68	3.594	2.416	2.723	.9867	
.50 30000.	6.67	2370.	2181.	147.62	2.707	2.416	2.407	.9856	
.50 30000.	8.34	1212.	1242.	116.22	1.957	2.416	2.090	.9832	
.50 30000.	10.00	471.	745.	85.21	1.461	2.415	2.002	.9850	
.80 30000.	5.00	4565.	4645.	182.68	4.399	2.415	2.945	.9853	
.80 30000.	6.67	2917.	2856.	151.16	3.507	2.416	2.594	.9866	
.80 30000.	8.34	1561.	1745.	120.42	2.587	2.415	2.285	.9853	
.80 30000.	10.00	627.	1003.	95.55	1.910	2.416	2.082	.9829	
.90 30000.	5.00	4967.	5239.	182.68	5.103	2.415	3.260	.9852	
.90 30000.	6.67	3141.	3377.	151.76	3.895	2.416	2.868	.9852	
.90 30000.	8.34	1649.	1982.	121.76	2.872	2.416	2.502	.9839	
.90 30000.	10.00	465.	1123.	97.18	2.125	2.415	2.209	.9816	
1.00 30000.	5.00	5294.	5973.	162.68	5.715	2.415	3.620	.9832	
1.00 30000.	6.67	3211.	3816.	151.43	4.340	2.416	3.303	.9790	
1.00 30000.	8.34	1504.	2208.	121.61	3.172	2.416	2.683	.9824	
1.00 30000.	10.00	336.	1225.	97.28	2.336	2.416	2.344	.9797	
.25 45000.	5.00	1827.	1564.	182.68	3.231	2.415	2.499	.9863	
.25 45000.	6.67	1104.	962.	142.70	2.372	2.416	2.175	.9846	
.25 45000.	8.34	541.	563.	134.68	1.668	2.416	2.042	.9850	
.25 45000.	10.00	228.	360.	71.34	1.299	2.417	1.969	.9850	
.50 45000.	5.00	1428.	1747.	182.68	5.666	2.416	2.646	.9866	

.50	45000.	6.67	1209.	1146.	147.22	2.763	2.415	2.333	.9857
.50	45000.	8.34	833.	695.	113.15	2.003	2.416	2.094	.9834
.50	45000.	10.00	272.	439.	84.72	1.504	2.416	2.010	.9850
.80	45000.	5.00	2305.	2357.	192.68	4.876	2.416	2.969	.9853
.80	45000.	6.67	1481.	1538.	150.76	3.565	2.415	2.606	.9867
.90	45000.	8.34	806.	927.	119.83	2.630	2.416	2.301	.9854
.90	45000.	10.00	344.	575.	94.19	1.947	2.416	2.091	.9831
.90	45000.	5.00	2506.	2645.	182.68	5.184	2.416	3.252	.9854
.90	45000.	6.67	1593.	1728.	151.33	3.954	2.415	2.837	.9849
.90	45000.	8.34	851.	1038.	121.00	2.916	2.417	2.513	.9841
.90	45000.	10.00	332.	630.	95.86	2.157	2.416	2.227	.9815
1.00	45000.	5.00	2670.	3001.	182.68	5.798	2.416	3.642	.9832
1.00	45000.	6.67	1629.	1940.	150.96	4.398	2.416	3.313	.9794
1.00	45000.	8.34	785.	1148.	120.84	3.215	2.416	2.674	.9834
1.00	45000.	10.00	148.	675.	95.98	2.363	2.416	2.366	.9793
.25	60000.	5.00	956.	943.	182.68	3.395	2.416	2.557	.9865
.25	60000.	6.67	586.	614.	140.68	2.490	2.415	2.236	.9851
.25	60000.	8.34	302.	384.	101.24	1.762	2.416	2.057	.9850
.25	60000.	10.00	150.	291.	68.58	1.382	2.416	1.966	.9850
.50	60000.	5.00	1008.	1060.	182.68	3.838	2.416	2.664	.9868
.50	60000.	6.67	642.	713.	145.80	2.890	2.417	2.363	.9859
.50	60000.	8.34	352.	458.	109.47	2.107	2.415	2.168	.9838
.50	60000.	10.00	178.	317.	82.35	1.605	2.417	2.031	.9850
.80	60000.	5.00	1200.	1339.	182.68	4.863	2.418	3.178	.9848
.80	60000.	6.67	776.	910.	149.34	3.698	2.416	2.658	.9868
.80	60000.	8.34	441.	590.	117.33	2.739	2.415	2.344	.9856
.80	60000.	10.00	218.	385.	91.38	2.056	2.417	2.163	.9836
.90	60000.	5.00	1294.	1476.	182.09	5.362	2.416	3.267	.9859
.90	60000.	6.67	829.	999.	149.50	4.077	2.415	2.927	.9841
.90	60000.	8.34	464.	649.	118.75	3.024	2.416	2.570	.9841
.90	60000.	10.00	213.	416.	93.17	2.264	2.415	2.266	.9820
1.00	60000.	5.00	1294.	1566.	177.07	5.747	2.417	3.641	.9831
1.00	60000.	6.67	802.	1053.	146.03	4.384	2.416	3.319	.9794
1.00	60000.	8.34	415.	669.	117.32	3.273	2.416	2.732	.9820
1.00	60000.	10.00	151.	442.	93.50	2.471	2.415	2.417	.9796

-1.

SECTION VII

EXAMPLE OF A TERMINAL SESSION

N>GET,NSLR26,TAPE1=APE,TAPE51=TEST1,TAPE52=TEST2,TAPE53=TEST3

N>BATCH

C>RFL,60000

RFL,60000.

C>NSLR26

INPUT NOZZLE THRUST COEFFICIENT(CV) FLAG WHERE

CV=0 FOR CV FROM ENGINE DECK

CV=1 FOR CV FROM CV TABLE

CV=2 FOR CV=1.(PROGRAM DEFAULT)

I>1

INPUT NOZZLE TYPE WHERE

NOZZLE=1. FOR ROUND NOZZLE

NOZZLE=2. FOR 2-D NOZZLE

I>1.

INPUT CAPTURE AREA OPTION WHERE

(CONSTANT CAPTURE AREA=1.,VARIABLE OPTION=2.)

I>1.

INPUT NUMBER OF ENGINES AND ENGINE SCALE FACTOR

I>2. .9

INPUT POWER SETTINGS FOR GAMMA CALCULATION

(MAXIMUM POWER SETTING AND INTERMEDIATE POWER SETTING)

I>1. 5.

INPUT A10 AND A10/A9 REF

I>47.9 4.

INPUT REFERENCE MASS FLOW RATIO INDEX

(0. TO USE TABLES 3A AND 3B, 1. FOR MFR=1.0)

I>1.

INPUT ENGINE PRINT OPTION(NO=1. YES=2.)

I>2.

INPUT BYPASS MODE INDEX WHERE

XMODE=1. ALL EXCESS INLET AIRFLOW SPILLED EXTERNALLY
XMODE=2. ALL EXCESS INLET AIRFLOW BYPASSED ABOVE MOSBP
XMODE=3. SCHEDULED BYPASS WITH REST OF EXCESS INLET AIRFLOW SPILLED
XMODE=4. OPTIMUM COMBINATION OF BYPASS AND SPILLAGE FOR MIN INLET DRAG
XMODE=5. OPTIMUM COMBINATION OF BYPASS AND SPILLAGE FOR MIN SFCA

I>3.

ENTER 1. FOR BYPASS MODE PRINT OUT 0. OTHERWISE

I>0.

ENTER 1. IF ONLY RECOVERY AND DRAG MAPS ARE ON THE
INLET MAP FILE ENTER 0. IF THE INLET MAP FILE HAS
ALL INLET MAPS

I>0.

INLET SIZING INPUTS

INPUT ONE OF THE FOLLOWING CODES

1. XMLO, XMHI (SIZING ENVELOPE OPTION)
2. MACH, ALT (SIZING POINT OPTION)
3. ACAPT (INPUT CAPTURE AREA - SQ FT)

I>1.

INPUT XMLO AND XMHI (SIZING ENVELOPE OPTION)

I>.5 2.

CVFLAG=	1.00	XMOZFG=	1.00	CAPOPT=	1.00	SIZEFG=	0.00
ENGNO =	2.00	SCALE =	.90	XDBASE=	1.00	XMHI =	5.00
A10 =	47.90	A10A9R=	4.00	DPT =	2.00	DPTB =	3.00
DPTBP =	0.00	REFNER =	1.00	TABRF =	0.00		
XMLO =	.50	XMHI =	2.00				

ENTER 1 IF CORRECTION DESIRED, OTHERWISE ENTER 0

I>0

1

INLET SIZING DATA

INLET SIZING POINT MACH .80 ALT60000. WC 164.70
CAPTURE AREA 4.670 SQ FT

BEGIN PROCESSING MARK12 DECK
AIR FORCE TEST CASE

INPUT NOZZLE THRUST COEFFICIENT(CV) FLAG WHERE
CV=0 FOR CV FROM ENGINE DECK
CV=1 FOR CV FROM CV TABLE
CV=2 FOR CV=1.(PROGRAM DEFAULT)

I>"END"
4.157 CP SECONDS EXECUTION TIME
C>

SECTION VIII

NOMENCLATURE FOR INPUT AND OUTPUT

This section discusses the nomenclature used to define the quantities that appear in the PIPSI interactive input and output data. The nomenclature used in the input data are discussed first, followed by the nomenclature for the output data.

8.1 INPUT DATA NOMENCLATURE

<u>INPUT NAME</u>	<u>DEFINITION</u>	<u>UNITS</u>
A10	Reference cross-sectional area for calculation of nozzle/aftbody drag	ft ²
A10A9R	Ratio of aftbody reference area to maximum nozzle exit area	Dimensionless
CAPOPT	Capture area option input command. CAPOPT = 1 : Constant capture area CAPOPT = 1 : Variable capture area	Dimensionless
CVFLAG	Input command for selecting nozzle thrust coefficient option CV = 0: Use CV from engine deck CV = 1: Use CV from CV table CV = 2: Use CV = 1.0 (program default)	Dimensionless
ENGNO	Number of engines per airplane	Dimensionless
NOZZLE	Input command to specify nozzle type NOZZLE = 1: round nozzle NOZZLE = 2: 2-D nozzle	Dimensionless

OPT	Inlet capture area sizing option input Dimensionless OPT = 1: Sizes capture area for largest size required between a specified low (XML0) and high (XMHI) Mach numbers. OPT = 2: Sizes capture area to match the engine airflow at a specified Mach-altitude point. OPT = 3: Input a fixed capture area.
OPTB	Bypass mode index Dimensionless XMODE = 1. All excess inlet airflow spilled externally XMODE = 2. All excess inlet airflow bypassed above MOSBP XMODE = 3. Scheduled bypass with rest of excess inlet airflow spilled XMODE = 4. Optimum combination of bypass and spillage for minimum inlet drag XMODE = 5. Optimum combination of bypass and spillage for minimum SFCA
OPTBP	Bypass vs. spillage mode printout option Dimensionless 1. = bypass printout 0. = no bypass printout
REFMFR	Reference mass flow ratio index command: Dimensionless REFMFR = 1: MFR = 1.0 REFMFR = 0: Use tables 3A and 3B
SCALE	Scale factor for sizing engine airflow-related data items in engine input data table Dimensionless

SIZEFG	Interactive command to tell program the source of the input capture area table: SIZEFG = 0: Input from terminal SIZEFG = 1: Input from disk file	Dimensionless
TABRF	Interactive command to the program to use or not use the (2) total drag and recovery maps instead of the basic (14) data maps: TABRF = 0: Do not use drag and recovery maps. TABRF = 1: Use (2) drag and recovery maps	Dimensionless
XDBASE	Interactive input for user to indicate power setting code corresponding to max A/B power.	Dimensionless
XDNI	Interactive input for user to indicate power setting code corresponding to intermediate power.	Dimensionless
XMHI	Maximum Mach number for the inlet sizing envelope.	Dimensionless
XMLO	Minimum Mach number for the inlet sizing envelope.	Dimensionless

8.2 OUTPUT DATA NOMENCLATURE

<u>OUTPUT NAME</u>	<u>DEFINITION</u>	<u>UNITS</u>
CASE	Data point number	Dimensionless
MACH	Free-stream Mach number	Dimensionless
PS	Power setting	Dimensionless
FNA	Installed net thrust	lb
WFT RF	Installed fuel flow	lb/hr
SFCA	Specific fuel consumption	lb/hr lb
FNRF	Uninstalled thrust corrected for total pressure recovery	Dimensionless
FRAM	Ram drag of engine airflow	lb
RF	Inlet total pressure recovery	Dimensionless
REF RF	Total pressure recovery on which uninstalled engine data is based	Dimensionless
DINLET	Inlet drag	lb
CDSPL	Inlet spillage drag coefficient, $D_{spill}/q_o A_c$	Dimensionless
CDBLD	Inlet bleed drag coefficient, $D_{BLD}/q_o A_c$	Dimensionless
CDBYP	Inlet bypass drag coefficient, $D_{BP}/q_o A_c$	Dimensionless
CDINL	Inlet drag coefficient $D_{INL}/q_o A_c$	Dimensionless
DAFT	Nozzle/aftbody drag, $D_{AFT}/q_o A_{10}$	lb
CDPS	Power sensitive nozzle/ aftbody drag coefficient	Dimensionless

CDAB	Nozzle/aftbody drag coefficient, $D_{AB}/q_o A_{10}$	Dimensionless
CDAB REF	Nozzle/aftbody drag coefficient at reference conditions	Dimensionless
DPS	Power-sensitive nozzle/aftbody drag	lb
P8/P0	Uninstalled nozzle total pressure ratio	Dimensionless
A9	Nozzle exit area	ft ²
A8	Nozzle throat area	ft ²
A10	Aftbody cross-sectional reference area	ft ²
CFG	Nozzle gross thrust coefficient	Dimensionless
A10/A9	Ratio of aftbody cross-sectional to reference area to nozzle exit area	Dimensionless
FN INPUT	Uninstalled net thrust	lb
WF INPUT	Uninstalled fuel flow	lb/hr
SFC INPUT	Uninstalled specific fuel consumption	lb/hr lb
W INPUT	Uninstalled engine corrected airflow	lb/sec
W ABS	Uninstalled engine absolute airflow	lb/sec
FN/DELTA	Installed net thrust divided by δ_{AMB}	lb
WF COR	Installed fuel flow divided by $\delta_{AMB} \sqrt{\theta_{AMB}}$	lb/hr

SFC COR	Installed specific fuel consumption divided by $\sqrt{\theta_{AMB}}$	lb/hr lb
P9/P0	Nozzle exit static pressure ratio	Dimensionless
AOE/AC	Ratio of engine free-stream tube airflow to inlet capture area	Dimensionless
AOI/AC	Ratio of inlet supply free-stream tube airflow to inlet capture area	Dimensionless
AO/AC	Ratio of "engine plus bypass" free-stream tube airflow to inlet capture area	Dimensionless
STATUS	(Not used by current version of the computer program)	
P8PORF	Installed nozzle total pressure ratio	Dimensionless
W08RF	Installed nozzle absolute airflow	lb/sec

SECTION IX

SAMPLE OUTPUT DATA

ENGINE PERFORMANCE PROGRAM

ENGINE FILE * TAPER
NOZZLE AIR/BOY DRAG TABLE FILE * TAPER2
INLET DATA FILE * TAPER3
NOZZLE THRUST COEFFICIENT FILE * TAPER3

NUMBER OF ENGINES * 2.00
ENGINE SCALE FACTOR * .10

A10 * 47.95
A10/20 * 3.00

REFRER * 1.00

TABR * 8.00

BYPASS OPTION * BYPASS VS SPIRAGE FOR MIN SECA
BYPASS PRINT OPTION * ON

MAXIMUM POWER SETTING * 100.00
INTERMEDIATE POWER SETTING * 50.00
ENGINE PRINT OPTION * ON

NOZZLE TYPE * 2-9

NOZZLE THRUST COEFFICIENT OPTION * CV FROM FILE

CAPTURE AREA RICE * CONSTANT

IMPES * 1.95
ALTDIES * 00000.00

INLET START MACH NUMBER 3.000

TABLE NUMBER 1
0.000 2.00 2.000
0.000 2.00 2.000

TABLE NUMBER 2A

.550	.708	.858	1.208	1.600	2.000
.708	.895	.960	1.060	1.055	1.075
.992	.991	.985	.969	.958	.938
.600	.700	.800	.900	.950	.970
.966	.960	.965	.974	.985	.968
.980	.980	.700	.803	.850	.875
.990	.990	.960	.983	.975	.965
.580	.600	.700	.800	.850	.900
.980	.970	.977	.973	.967	.955
.500	.600	.700	.800	.850	.875
.978	.970	.965	.958	.955	.940
.500	.600	.700	.800	.900	.930
.958	.953	.949	.944	.935	.925

MINIMUM MACH NUMBER FOR INLET DRAG CALCULATIONS .550

ENGINE TABLE 2A

.700	.600	.500	.500	.500	.600	.700
------	------	------	------	------	------	------

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992	993	994	995	996	997	998	999	1000
991	990	989	988	987	986	985	984	983
990	989	988	987	986	985	984	983	982
989	988	987	986	985	984	983	982	981
988	987	986	985	984	983	982	981	980
987	986	985	984	983	982	981	980	979
986	985	984	983	982	981	980	979	978
985	984	983	982	981	980	979	978	977
984	983	982	981	980	979	978	977	976
983	982	981	980	979	978	977	976	975
982	981	980	979	978	977	976	975	974
981	980	979	978	977	976	975	974	973
980	979	978	977	976	975	974	973	972
979	978	977	976	975	974	973	972	971
978	977	976	975	974	973	972	971	970
977	976	975	974	973	972	971	970	969
976	975	974	973	972	971	970	969	968
975	974	973	972	971	970	969	968	967
974	973	972	971	970	969	968	967	966
973	972	971	970	969	968	967	966	965
972	971	970	969	968	967	966	965	964
971	970	969	968	967	966	965	964	963
970	969	968	967	966	965	964	963	962
969	968	967	966	965	964	963	962	961
968	967	966	965	964	963	962	961	960
967	966	965	964	963	962	961	960	959
966	965	964	963	962	961	960	959	958
965	964	963	962	961	960	959	958	957
964	963	962	961	960	959	958	957	956
963	962	961	960	959	958	957	956	955
962	961	960	959	958	957	956	955	954
961	960	959	958	957	956	955	954	953
960	959	958	957	956	955	954	953	952
959	958	957	956	955	954	953	952	951
958	957	956	955	954	953	952	951	950
957	956	955	954	953	952	951	950	949
956	955	954	953	952	951	950	949	948
955	954	953	952	951	950	949	948	947
954	953	952	951	950	949	948	947	946
953	952	951	950	949	948	947	946	945
952	951	950	949	948	947	946	945	944
951	950	949	948	947	946	945	944	943
950	949	948	947	946	945	944	943	942
949	948	947	946	945	944	943	942	941
948	947	946	945	944	943	942	941	940
947	946	945	944	943	942	941	940	939
946	945	944	943	942	941	940	939	938
945	944	943	942	941	940	939	938	937
944	943	942	941	940	939	938	937	936
943	942	941	940	939	938	937	936	935
942	941	940	939	938	937	936	935	934
941	940	939	938	937	936	935	934	933
940	939	938	937	936	935	934	933	932
939	938	937	936	935	934	933	932	931
938	937	936	935	934	933	932	931	930
937	936	935	934	933	932	931	930	929
936	935	934	933	932	931	930	929	928
935	934	933	932	931	930	929	928	927
934	933	932	931	930	929	928	927	926
933	932	931	930	929	928	927	926	925
932	931	930	929	928	927	926	925	924
931	930	929	928	927	926	925	924	923
930	929	928	927	926	925	924	923	922
929	928	927	926	925	924	923	922	921
928	927	926	925	924	923	922	921	920
927	926	925	924	923	922	921	920	919
926	925	924	923	922	921	920	919	918
925	924	923	922	921	920	919	918	917
924	923	922	921	920	919	918	917	916
923	922	921	920	919	918	917	916	915
922	921	920	919	918	917	916	915	914
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920	919	918	917	916	915	914	913	912
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918	917	916	915	914	913	912	911	910
917	916	915	914	913	912	911	910	909
916	915	914	913	912	911	910	909	908
915	914	913	912	911	910	909	908	907
914	913	912	911	910	909	908	907	906
913	912	911	910	909	908	907	906	905
912	911	910	909	908	907	906	905	904
911	910	909	908	907	906	905	904	903
910	909	908	907	906	905	904	903	902
909	908	907	906	905	904	903	902	901
908	907	906	905	904	903	902	901	900
907	906	905	904	903	902	901	900	899
906	905	904	903	902	901	900	899	898
905	904	903	902	901	900	899	898	897
904	903	902	901	900	899	898	897	896
903	902	901	900	899	898	897	896	895
902	901	900	899	898	897	896	895	894
901	900	899	898	897	896	895	894	893
900	899	898	897	896	895	894	893	892
899	898	897	896	895	894	893	892	891
898	897	896	895	894	893	892	891	890
897	896	895	894	893	892	891	890	889
896	895	894	893	892	891	890	889	888
895	894	893	892	891	890	889	888	887
894	893	892	891	890	889	888	887	886
893	892	891	890	889	888	887	886	885
892	891	890	889	888	887	886	885	884
891	890	889	888	887	886	885	884	883
890	889	888	887	886	885	884	883	882
889	888	887	886	885	884	883	882	881
888	887	886	885	884	883	882	881	880
887	886	885	884	883	882	881	880	879
886	885	884	883	882	881	880	879	878
885	884	883	882	881	880	879	878	877
884	883	882	881	880	879	878	877	876
883	882	881	880	879	878	877	876	875
882	881	880	879	878	877	876	875	874
881	880	879	878	877	876	875	874	873
880	879	878	877	876	875	874	873	872
879	878	877	876	875	874	873	872	871
878	877	876	875	874	873	872	871	870
877	876	875	874	873	872	871	870	869
876	875	874	873	872	871	870	869	868
875	874	873	872	871	870	869	868	867
874	873	872	871	870	869	868	867	866
873	872	871	870	869	868	867	866	865
872	871	870	869	868	867	866	865	864
871	870	869	868	867	866	865	864	863
870	869	868	867	866	865	864	863	862
869	868	867	866	865	864	863	862	861
868	867	866	865	864	863	862	861	860
867	866	865	864	863	862	861	860	859
866	865	864	863	862	861	860	859	858
865	864	863	862	861	860	859	858	857
864	863	862	861	860	859	858	857	856
863	862	861	860	859	858	857	856	855
862	861	860	859	858	857	856	855	854
861	860	859	858	857	856	855	854	853
860	859	858	857	856	855	854	853	852
859	858	857	856	855	854	853	852	851
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857	856	855	854	853	852	851	850	849
856	855	854	853	852	851	850	849	848
855	854	853	852	851	850	849	848	847
854	853	852	851	850	849	848	847	846
853	852	851	850	849	848	847	846	845
852	851	850	849	848	847	846	845	844
851	850	849	848	847	846	845	844	843
850	849	848	847	846	845	844	843	842
849	848	847	846	845	844	843	842	841
848	847	846	845	844	843	842	841	840
847	846	845	844	843	842	841	840	839
846	845	844	843	842	841	840	839	838
845	844	843	842	841	840	839	838	837
844	843	842	841	840	839	838	837	836
843	842	841	840	839	838	837	836	835
842	841	840	839	838	837	836	835	834
841	840	839	838	837	836	835	834	833
840	839	838	837	836	835	834	833	832
839	838	837	836	835	834	833	832	831
838	837	836	835	834	833	832	831	830
837	836	835	834	833	832	831	830	829
836	835	834	833	832	831	830	829	828
835	834	833	832	831	830	829	828	827
834	833	832	831	830	829	828	827	826
833	832	831	830	829	828	827	826	825
832	831	830	829	828	827	826	825	824
831	830	829	828	827	826	825	824	823
830	829	828	827	826	825	824	823	8

75

2,000	1,000
0.000	0.000
.400	.354
.141	1.000
.461	2.000

.400 .872 1.800
 .443 .010 1.800
 .400 .842 1.800
 .508 .014 6.000
 .400 .915 1.800
 .532 .015 0.000

TABLE NUMBER 822

10.000	5.010	3.333	2.500	2.000	1.667	1.410	1.250	1.000	3.000
.200	.800	.900	.900	1.000	1.200	1.410	1.600	1.800	3.000
.025	.025	.031	.033	.033	.038	.043	.050	.056	.066
.010	.019	.021	.027	.027	.028	.031	.032	.034	.038
.013	.013	.014	.016	.016	.017	.018	.019	.020	.022
.009	.009	.010	.011	.011	.012	.013	.013	.014	.015
.007	.007	.008	.008	.009	.009	.010	.010	.011	.012
.005	.005	.006	.006	.007	.007	.008	.008	.009	.010

TABLE NUMBER 823

100.000	50.000	4.000	5.000	6.000	4.000	10.000	12.000	14.000	16.000
2.000	3.000	.879	.979	.977	.977	.976	.975	.974	.973
.446	.957	.864	.864	.866	.864	.865	.866	.865	.863

INLET SIZING DATA

INLET SIZING POINT MACH 1.95 ALT 6000. MC 113.40
CAPTURE AREA 3.791 SQ FT

ALTITUDE 0. AIR FORCE TEST CASE

CAPTURE AREA 3.79 A10/A9 REF 3.000 A10 47.90
NAME 2116.2 TAMB 518.7 TIG 518.7 Q 0.0

CASE	1.000	CASE	
NACH	0.000	NACH	
PS	1.000	PS	
FMA	13646.422	FMA	
UFT RF	20550.420	UFT RF	
SFCA	2.166	SFCA	
FRF	13646.422	FRF	
FRAN	0.000	FRAN	
RF	0.000	RF	
REF RF	1.000	REF RF	
DIMLET	0.000	DIMLET	
CDSPC	0.000	CDSPC	
CDOLB	0.000	CDOLB	
CDYTP	0.000	CDYTP	
CDINL	0.000	CDINL	
DAFT	0.000	DAFT	
CBFS	0.000	CBFS	
CDAB	0.000	CDAB	
CDAB REF	0.000	CDAB REF	
BPS	0.000	BPS	
PRPG	2.767	PRPG	
AV	3.522	AV	
AS	3.378	AS	
CV	0.951	CV	
ATOTAV	0.201	ATOTAV	
FM INPUT	16493.400	FM INPUT	
WF INPUT	32833.600	WF INPUT	
SFC INPUT	1.991	SFC INPUT	
V INPUT	164.612	V INPUT	
W ABS	164.612	W ABS	
FM/DELTA	13646.422	FM/DELTA	
WF CM	20550.420	WF CM	
SFC CM	2.166	SFC CM	
PRPG	1.989	PRPG	
AGEFAC	0.000	AGEFAC	
AGEFAC	0.000	AGEFAC	
AGEFAC	0.000	AGEFAC	
STATUS	0.000	STATUS	
PRPG	2.000	PRPG	
WDRF	147.671	WDRF	

SFCOUT	FMA	RF	CDIML	COSPL	COBLO	COBYP	AOSPAC	AGIAC	AUAC	AUEAC	AJBAC
2.397422532-4734	.9370	.1017	.0574	.0442	0.0008	0.0000	.9290	.9312	.9312	.9312	.9312
2.396322532-0443	.9364	.0993	.0537	.0438	.0018	.0031	.9312	.9312	.9312	.9312	.9312
2.394822532-1348	.9357	.0949	.0499	.0438	.0036	.0073	.9312	.9312	.9312	.9312	.9312
2.392822532-7123	.9348	.0917	.0464	.0429	.0055	.0097	.9312	.9312	.9312	.9312	.9312
2.392722532-0913	.9339	.0925	.0429	.0422	.0075	.0132	.9312	.9312	.9312	.9312	.9312
2.391622491-9916	.9329	.0901	.0392	.0414	.0095	.0170	.9312	.9312	.9312	.9312	.9312
2.390422478-3375	.9319	.0877	.0353	.0406	.0117	.0209	.9312	.9312	.9312	.9312	.9312
2.010113222-8148	.9370	.1017	.0574	.0442	0.0008	0.0000	.9290	.9312	.9312	.9312	.9312
2.006113222-3001	.9364	.0993	.0537	.0438	.0018	.0031	.9312	.9312	.9312	.9312	.9312
2.004213222-1043	.9357	.0949	.0499	.0438	.0036	.0073	.9312	.9312	.9312	.9312	.9312
2.004013222-6453	.9348	.0917	.0464	.0429	.0055	.0097	.9312	.9312	.9312	.9312	.9312
2.003313222-0907	.9339	.0925	.0429	.0422	.0075	.0132	.9312	.9312	.9312	.9312	.9312
2.002013217-3592	.9329	.0901	.0392	.0414	.0095	.0170	.9312	.9312	.9312	.9312	.9312
2.000513212-0965	.9319	.0877	.0353	.0406	.0117	.0209	.9312	.9312	.9312	.9312	.9312
2.1071 6844-7667	.9370	.1017	.0574	.0442	0.0008	0.0000	.9290	.9312	.9312	.9312	.9312
2.1025 6855-4047	.9364	.0993	.0537	.0438	.0018	.0031	.9312	.9312	.9312	.9312	.9312
2.0982 6864-3765	.9357	.0949	.0499	.0438	.0036	.0073	.9312	.9312	.9312	.9312	.9312
2.0952 6877-1045	.9348	.0917	.0464	.0429	.0055	.0097	.9312	.9312	.9312	.9312	.9312
2.0921 6878-6863	.9339	.0925	.0429	.0422	.0075	.0132	.9312	.9312	.9312	.9312	.9312
2.0888 6874-2962	.9329	.0901	.0392	.0414	.0095	.0170	.9312	.9312	.9312	.9312	.9312
2.0854 6876-0367	.9319	.0877	.0353	.0406	.0117	.0209	.9312	.9312	.9312	.9312	.9312

ALTITUDE 2250. AIP FORCE TEST CASE

CAPTURE AREA 3.79 A10/A9 REF 3.003 A10 47.90
TAMB 438.5 TTS 771.9 0 2324.5

CASE 45.000 46.000 47.000 CASE
MACH 1.950 1.950 1.950 MACH
PS 6.000 6.000 6.000 PS
FMA 22678.357 15212.057 6878.037 FMA
WFT RF 53711.084 30431.261 16343.138 WFT RF

SFCA 2.390 2.000 2.005 SFCA
FMRF 2343.654 16849.482 9478.051 FMRF
FRAN 19637.712 15637.712 15637.712 FRAN
RF .932 .932 .932 RF
REF RF .530 .930 .930 REF RF

DIMLET 772.566 772.566 772.566 DIMLET
CDSPL .033 .035 .035 CDSPL
CDBLP .041 .041 .041 CDBLP
CDBYP .012 .012 .012 CDBYP
CDBML .006 .006 .006 CDBML

DAFT 1930.943 2619.743 3696.269 DAFT
CBPS .005 .016 .033 CBPS
COAB .035 .047 .066 COAB
COAB REF .020 .032 .034 COAB REF
BPS 292.711 865.839 1021.629 BPS

PO/PO 11.062 11.237 11.424 PO/PO
A9 7.252 6.862 6.850 A9
AC 3.416 2.826 2.237 AC
CV .966 .956 .966 CV
A107A9 3.303 3.951 4.449 A107A9

FM INPUT 24155.100 17305.200 9824.600 FM INPUT
WF INPUT 52624.700 10370.500 14314.500 WF INPUT
SFC INPUT 2.220 1.755 1.497 SFC INPUT
W INPUT 116.367 110.367 110.367 W INPUT
W ABS 251.305 251.305 251.381 W ABS

FM/DELTA 54469.483 36462.077 16646.959 FM/DELTA
WF CDR 141817.908 80205.702 37801.280 WF CDR
SFC CDR 2.680 2.176 2.268 SFC CDR
PO/PO 1.054 .952 .978 PO/PO
ABE/AC .889 .889 .889 ABE/AC

AOI/AC .942 .942 .942 AOI/AC
AOI/AC .010 .010 .010 AOI/AC
STATUS 6.000 6.000 6.000 STATUS
PO/PO 11.084 11.200 11.447 PO/PO
WDRF 251.488 251.488 251.606 WDRF

SECTION X

FLOW CHARTS

This section contains flow charts showing the operation of the PIPSI computer program.

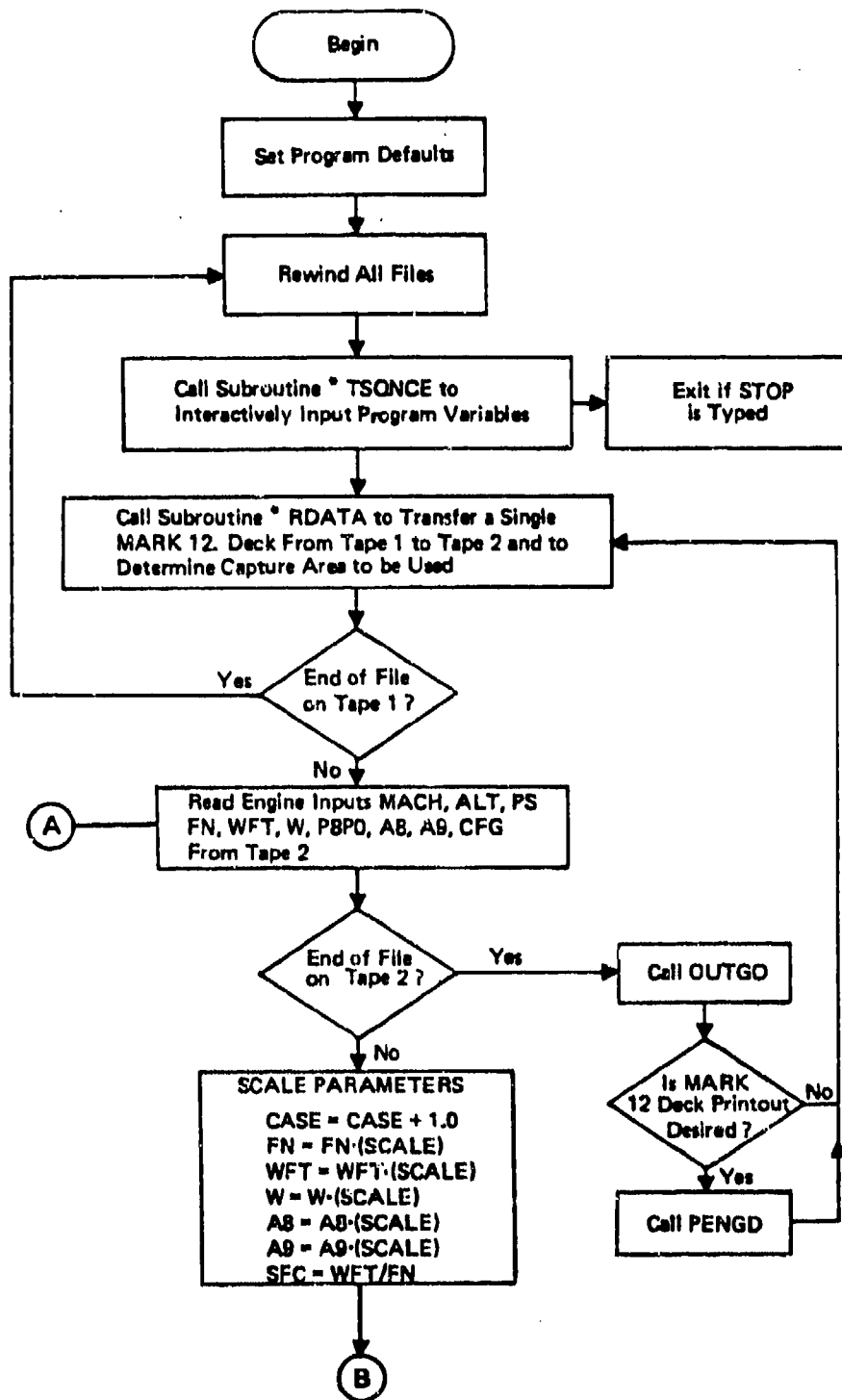


Figure 13. P.I.P.S.I. Main Program (Continued)

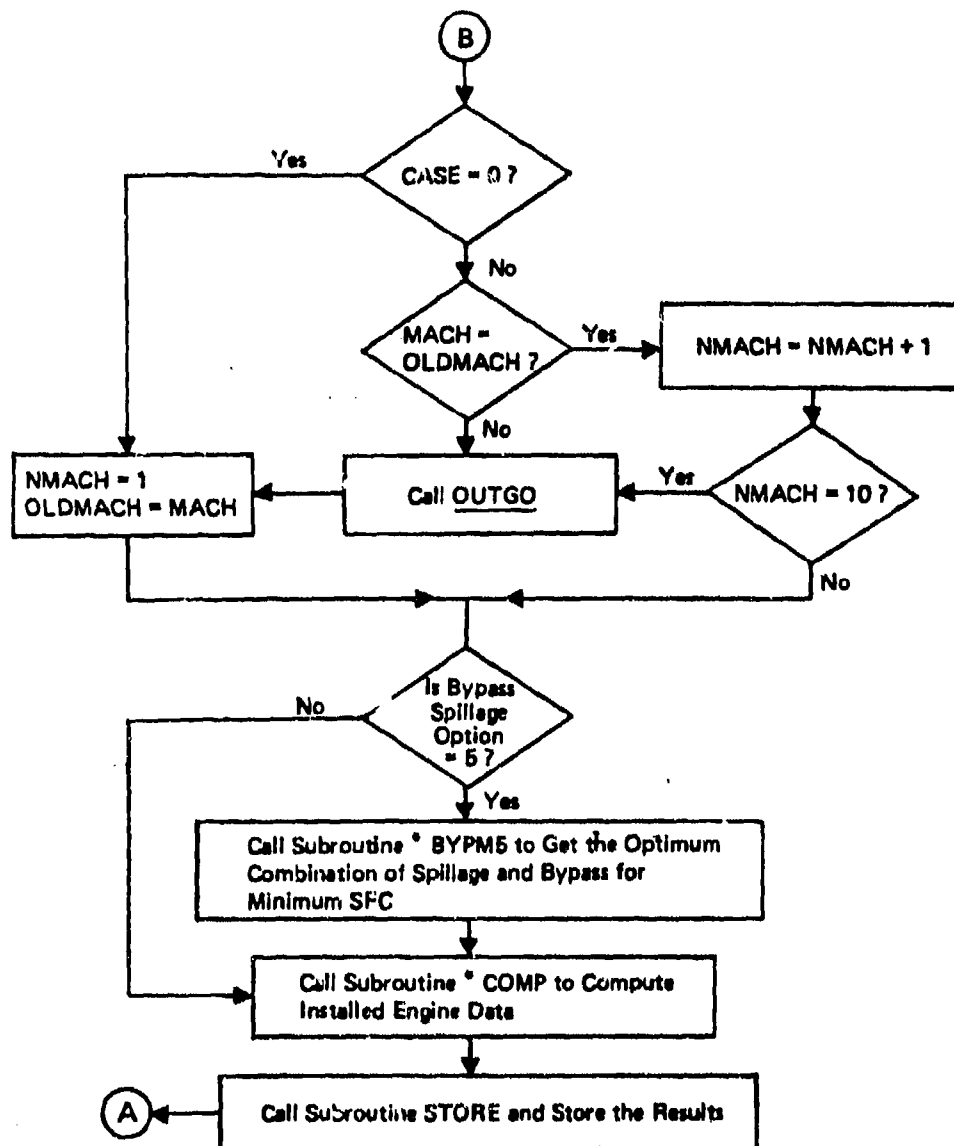


Figure 13. P.I.P.S.I. Main Program (Concluded)

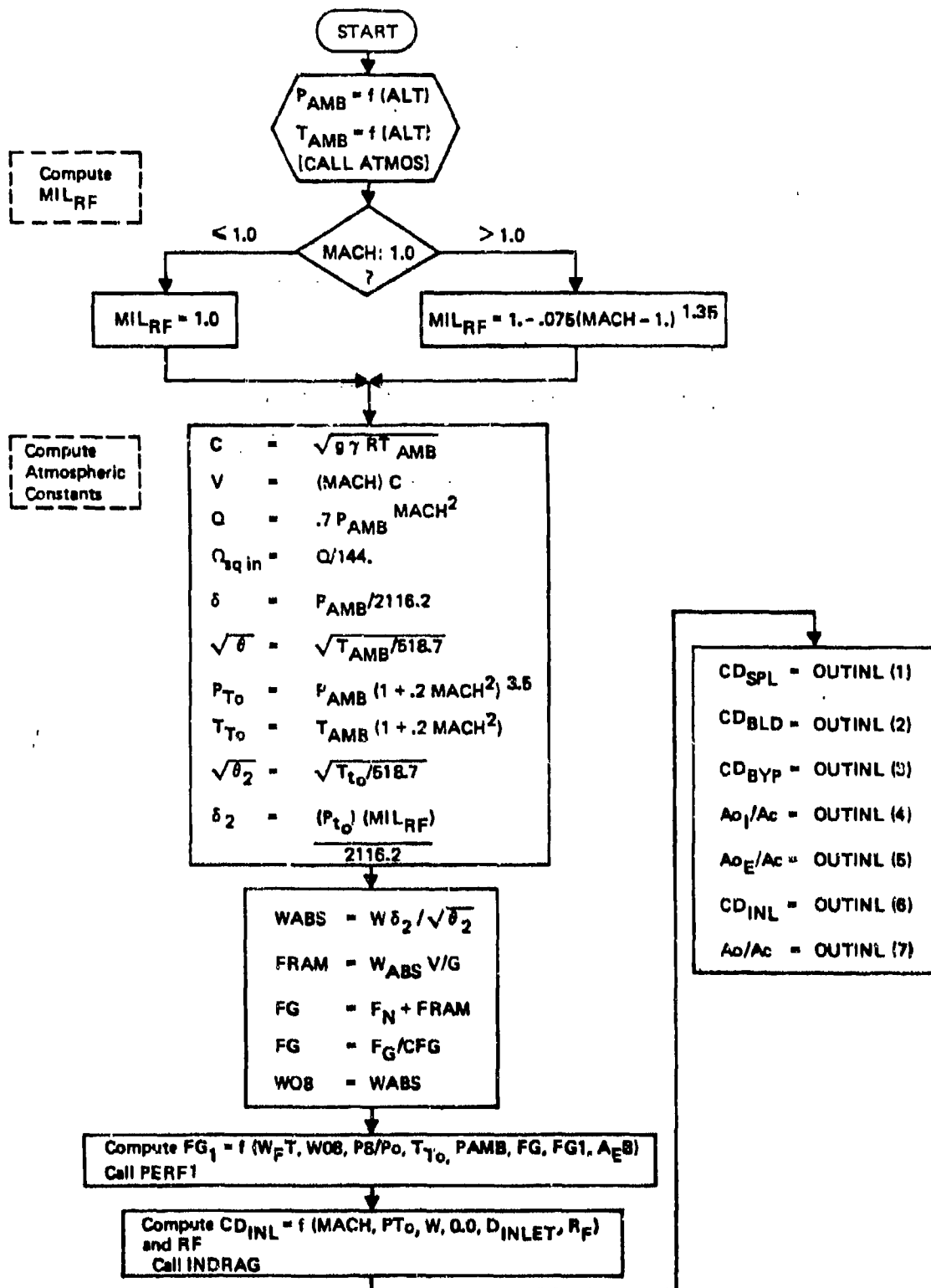


Figure 14. Subroutine COMP (Continued)

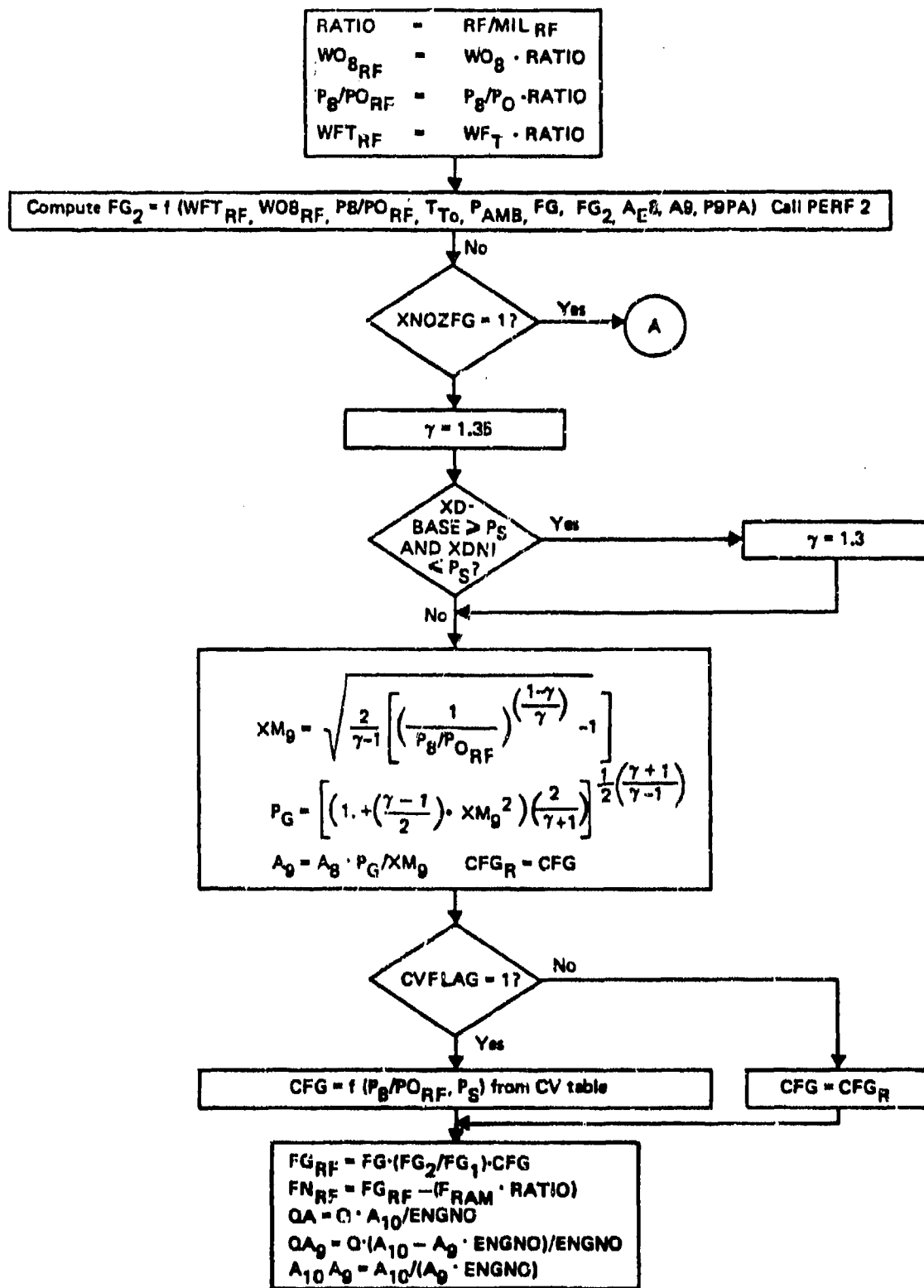


Figure 14. Subroutine COMP (Continued)

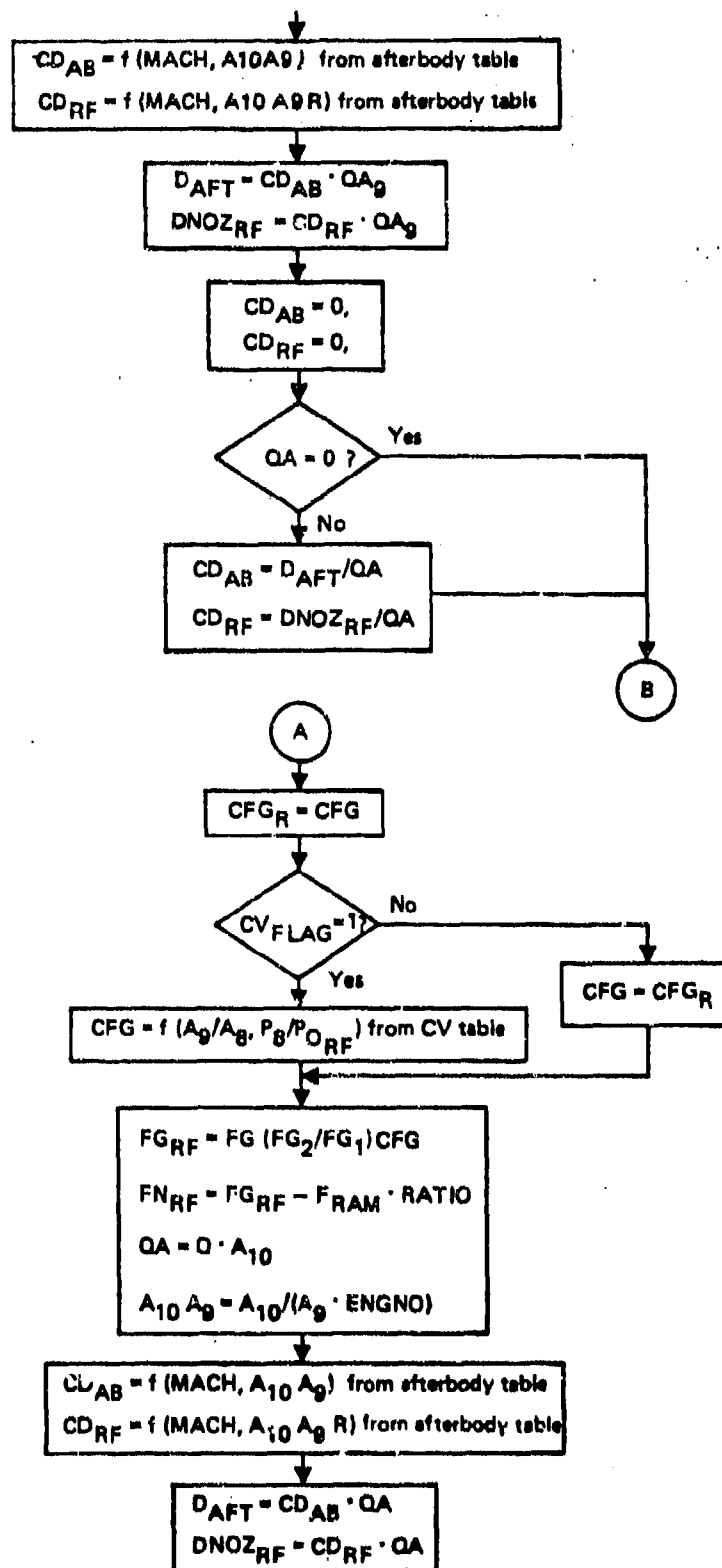


Figure 14. Subroutine COMP (Continued)

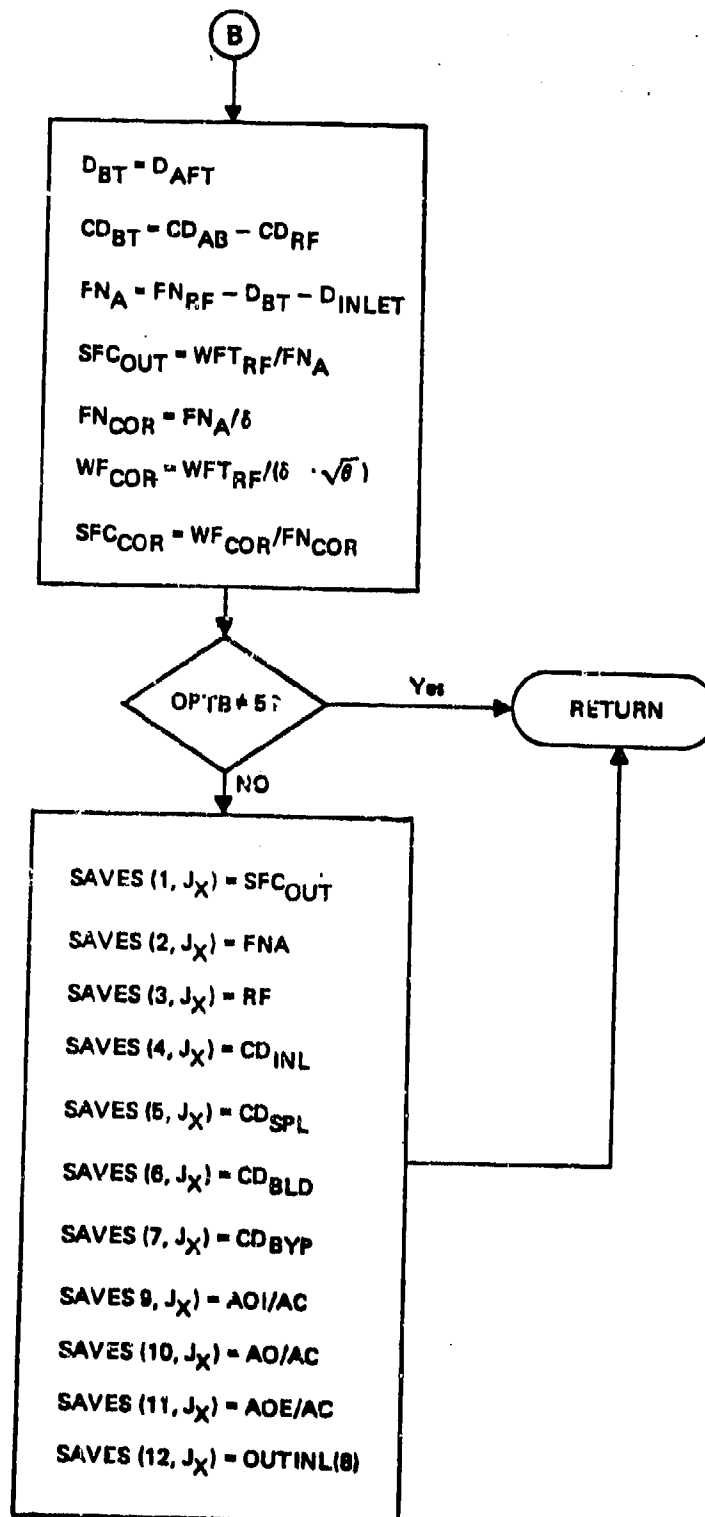


Figure 14. Subroutine COMP (Concluded)

Subroutine BYPM5—Determines a Combination of Bypass and Spillage Using Subroutine COMP—The Results are Used by Subroutine BYSPL

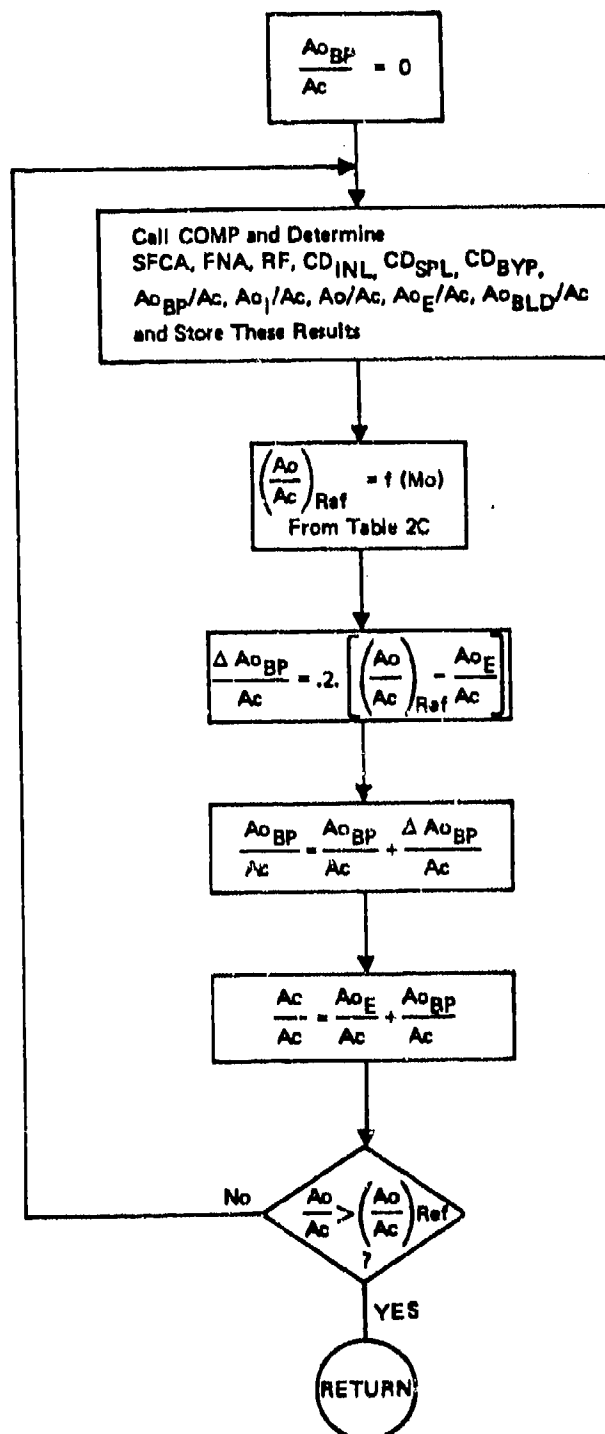


Figure 15. Subroutine BYPM5

Subroutine BYSPL—Determines AOBPAC Depending
on Bypass Spillage Option Input By User

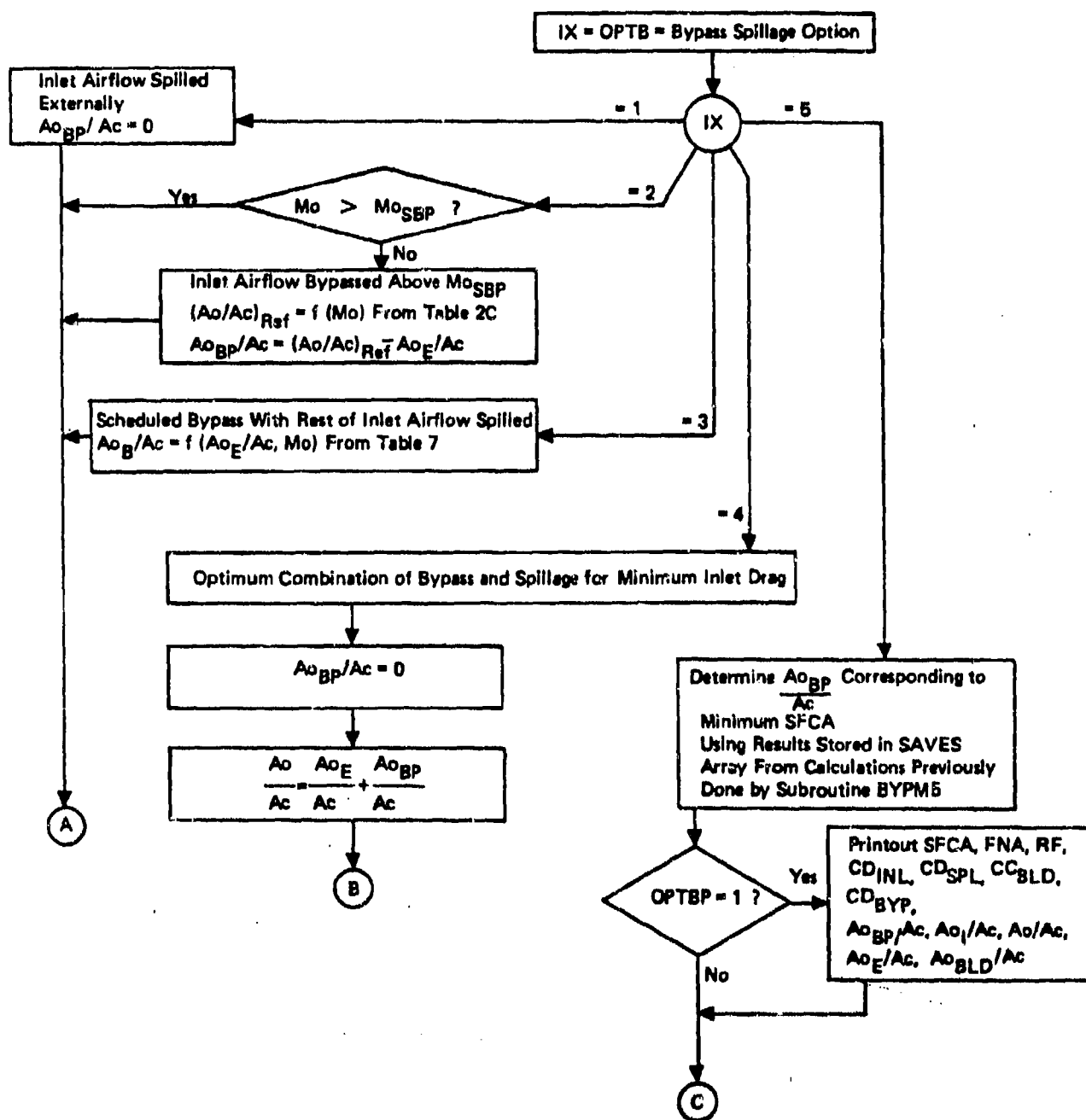


Figure 16. Subroutine BYSPL (Continued)

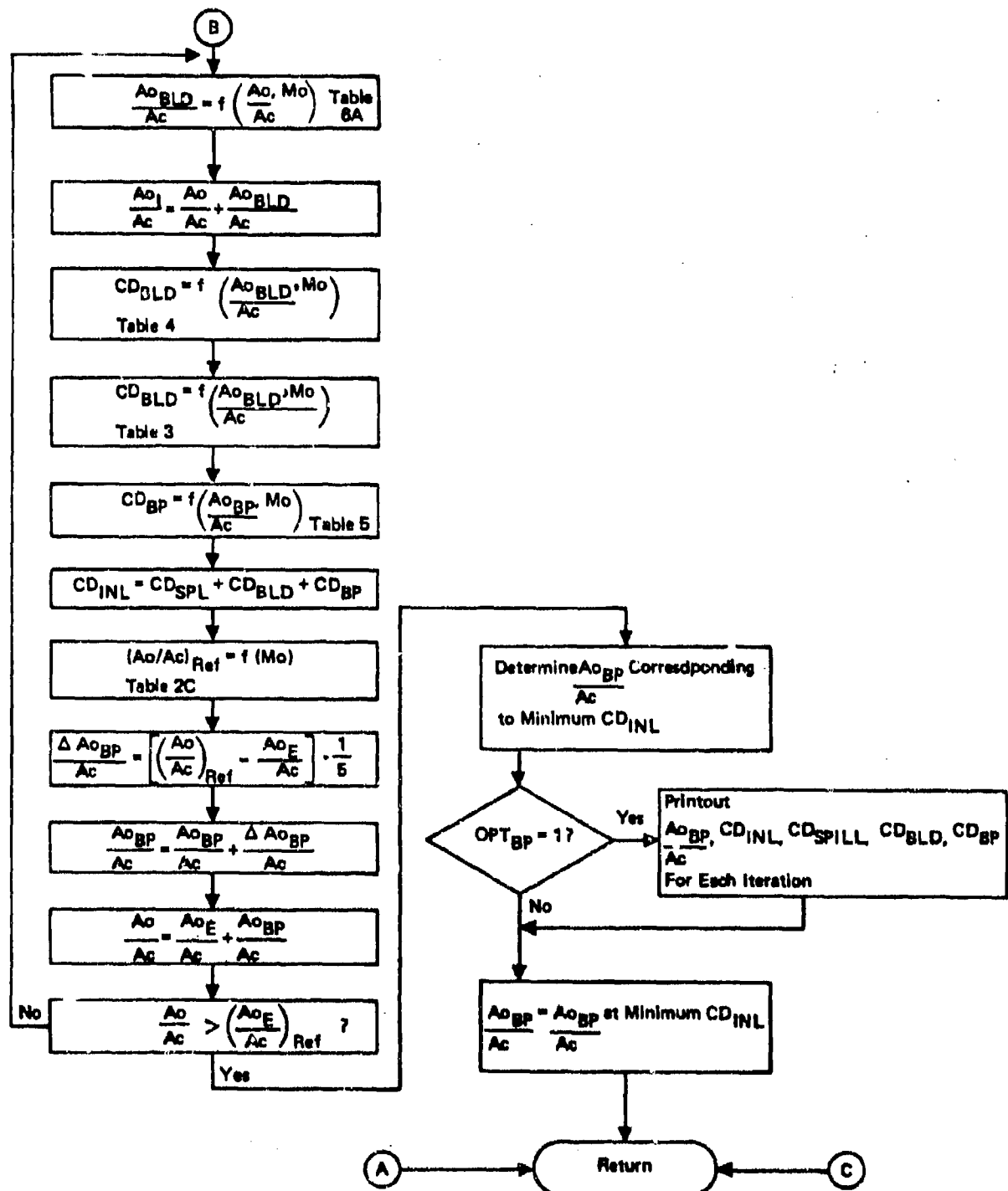


Figure 16. Subroutine BYSPL (Concluded)

Subroutine INDRAG

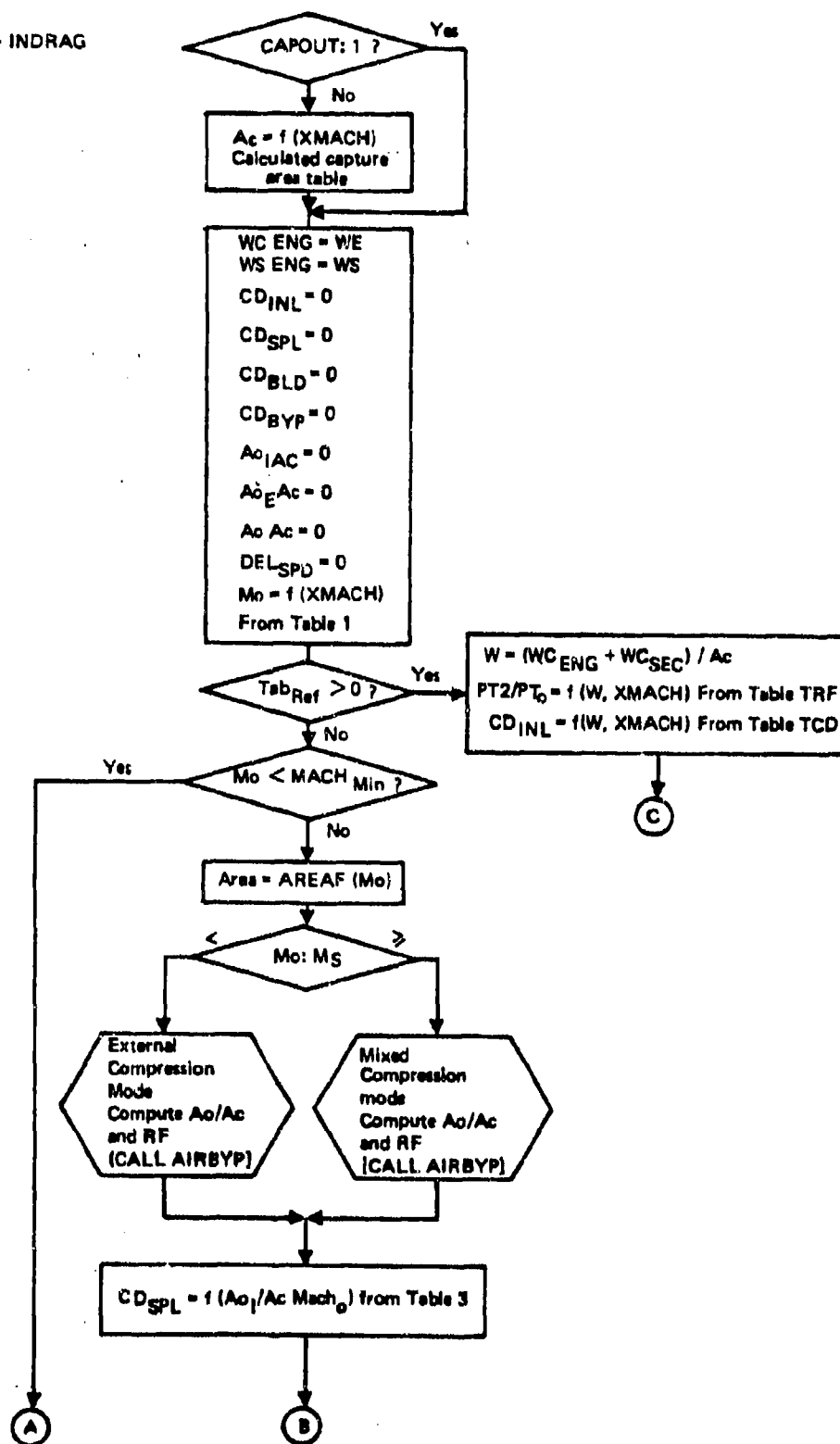


Figure 17. Subroutine INDRAG (Continued)

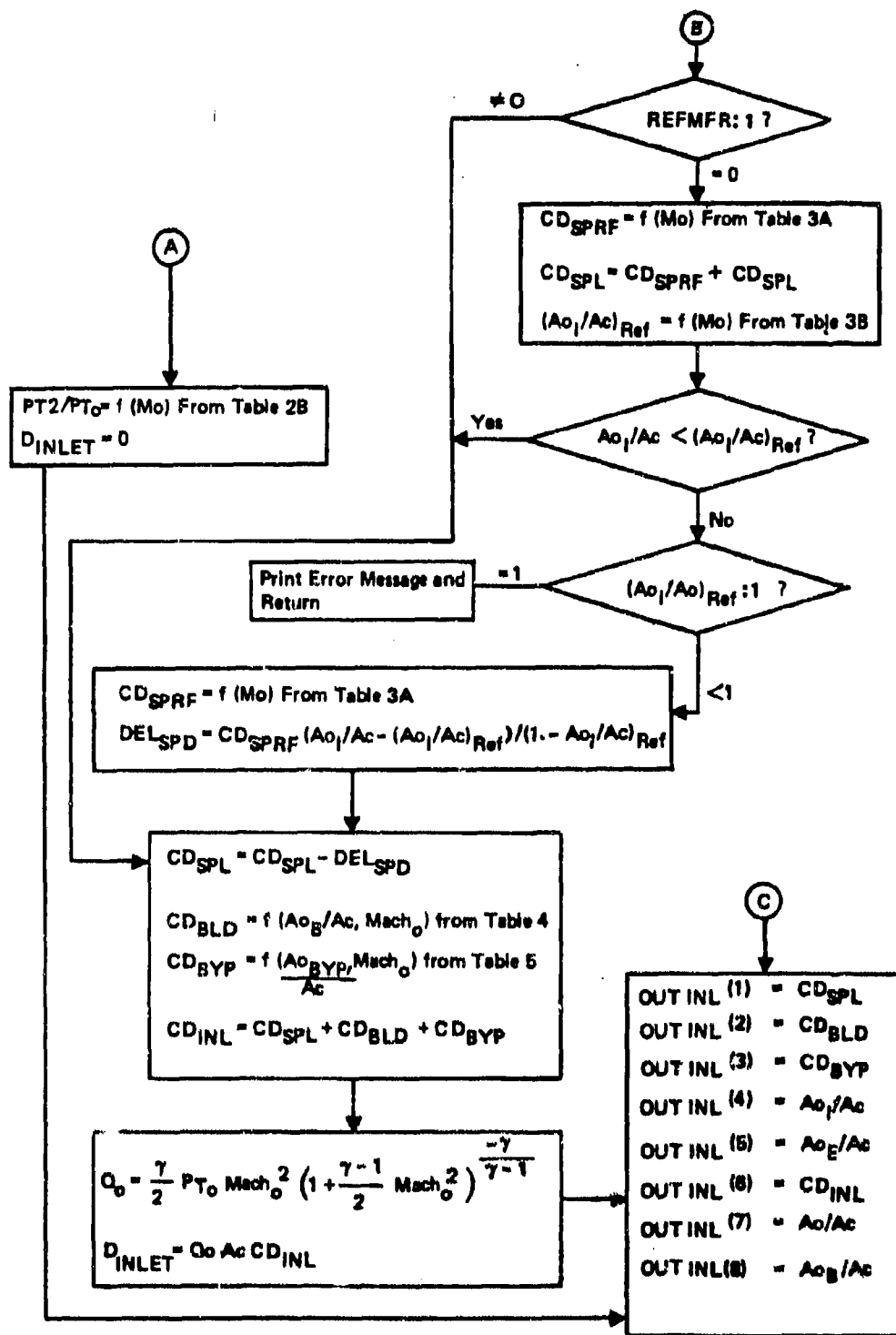


Figure 17. Subroutine INDRA (Concluded)

Subroutine RDATA—Transfers Engine Data From Tape 1 to Tape 2 and
Determines Capture Area Schedule to be Used

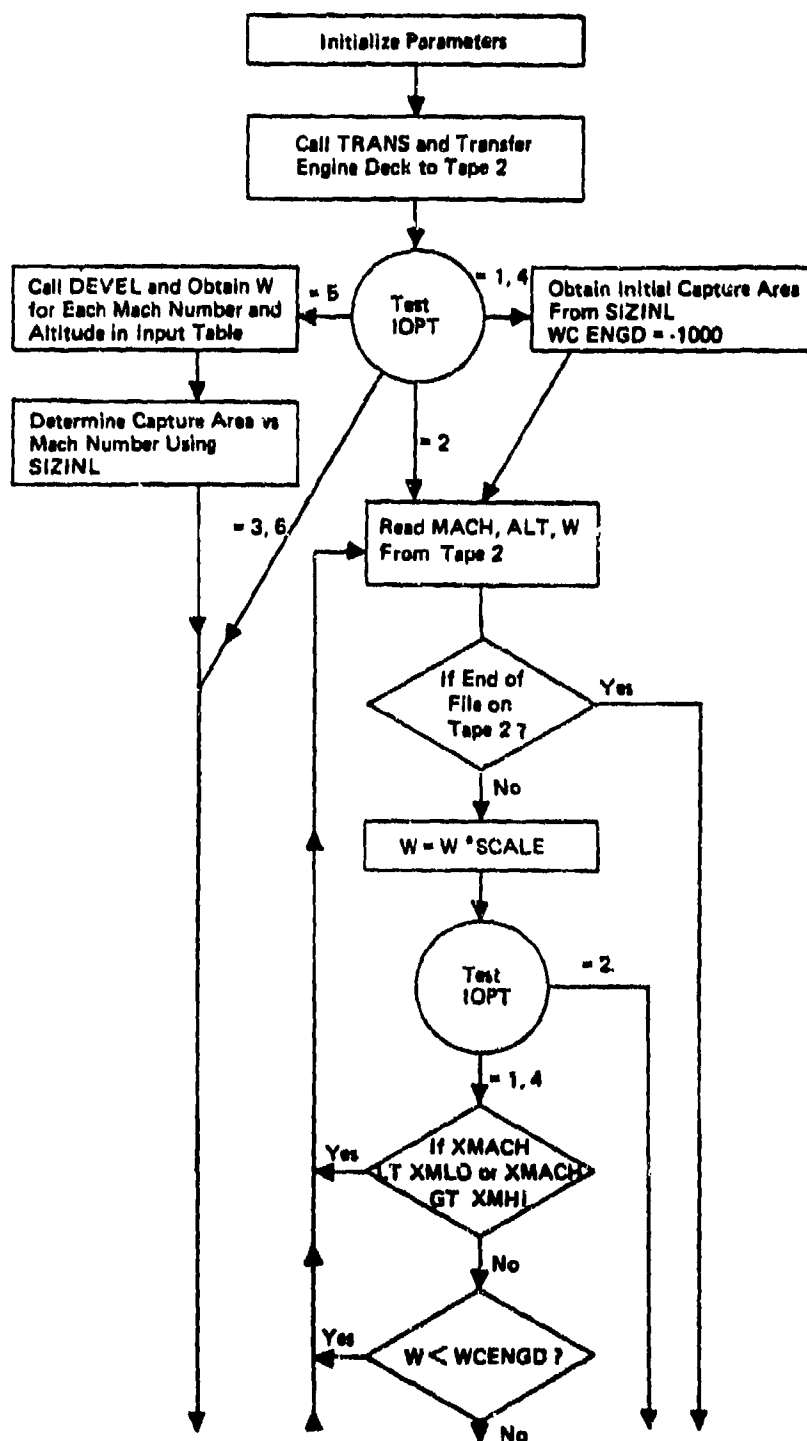


Figure 18. Subroutine RDATA (Continued)

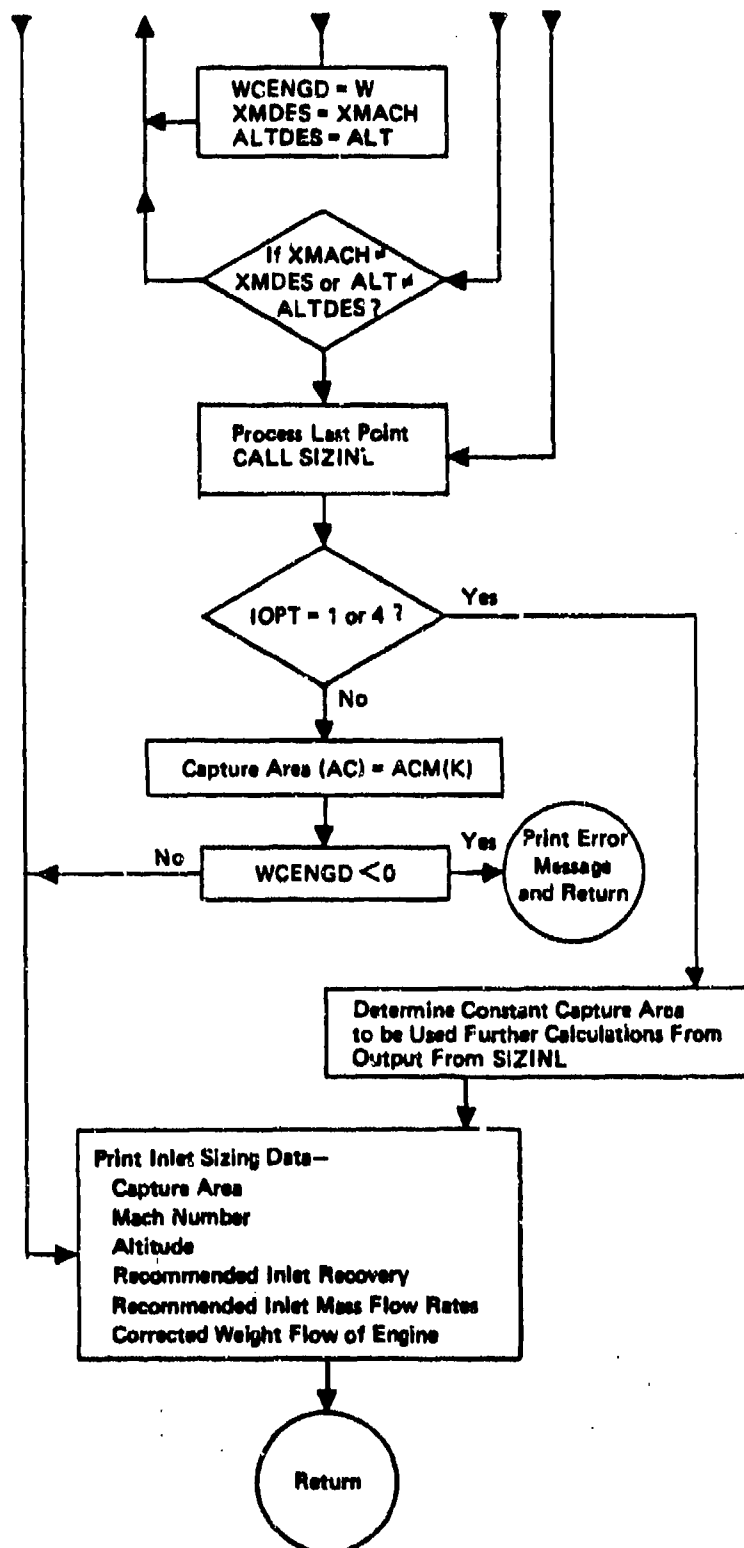


Figure 18. Subroutine RDATA (Concluded)

Subroutine TSONCE Interactively Asks
Questions and Inputs Data From the User's
Terminal

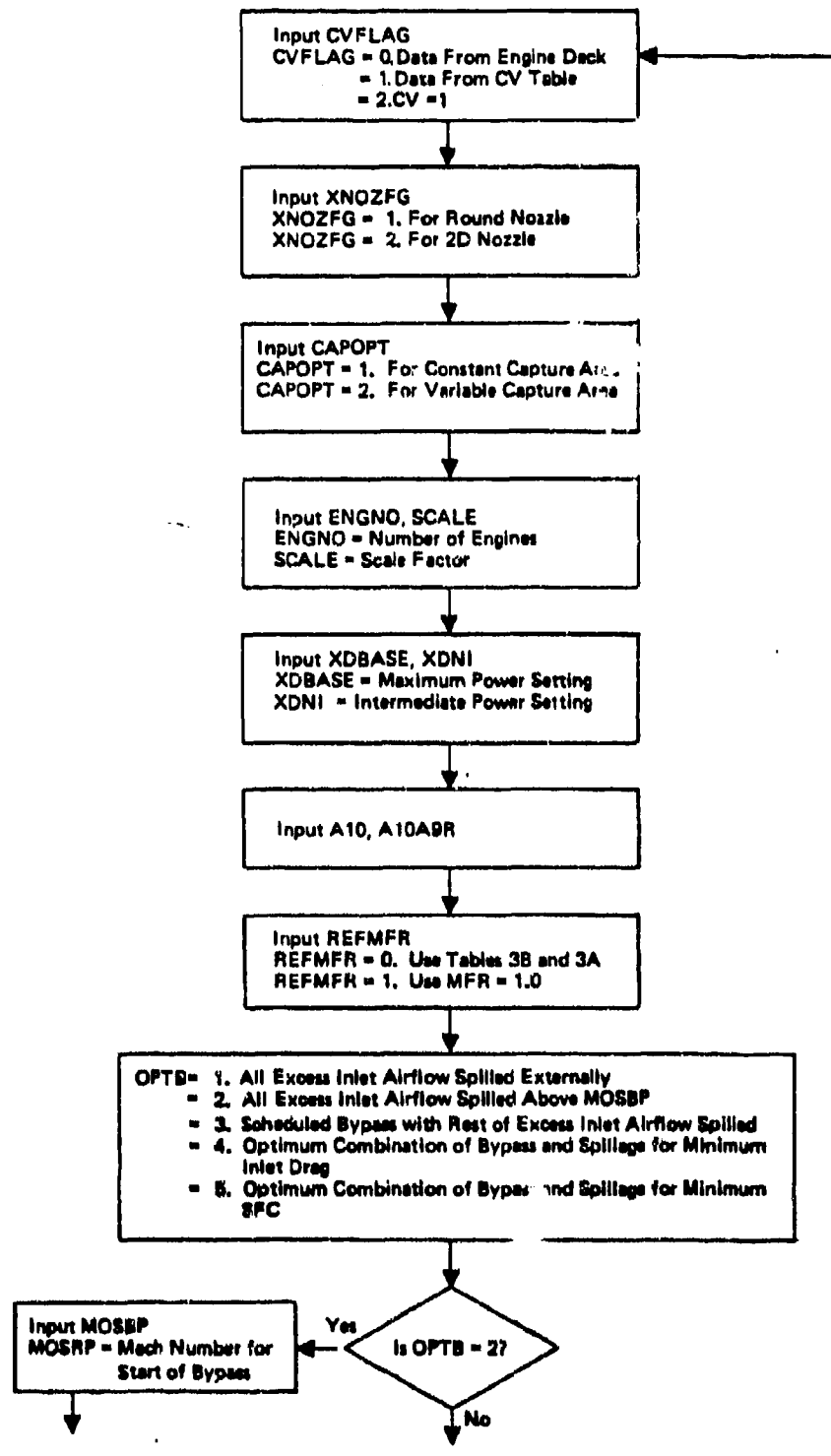


Figure 18. Subroutine TSONCE (Continued)

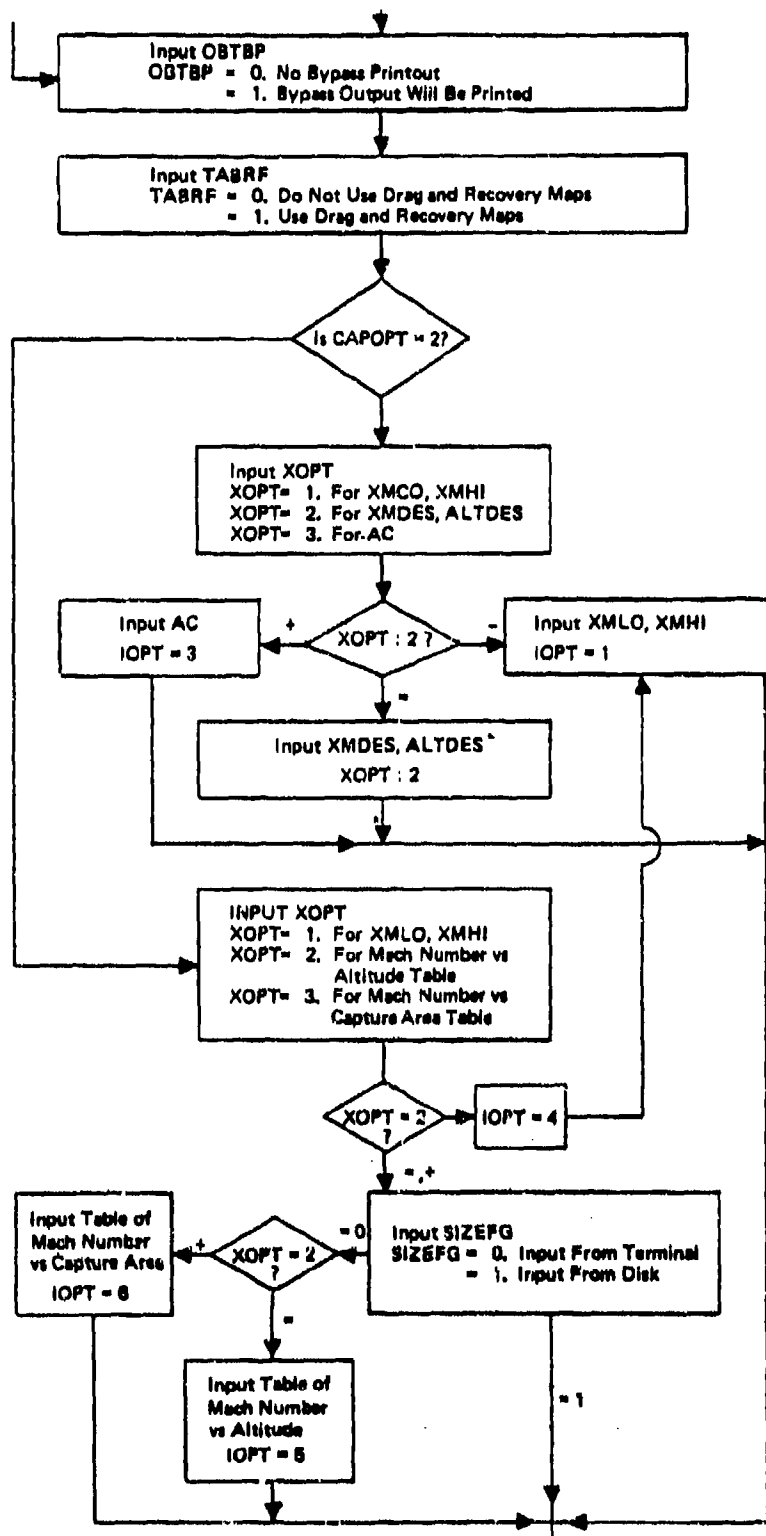


Figure 18. Subroutine TSQNC (Continued)

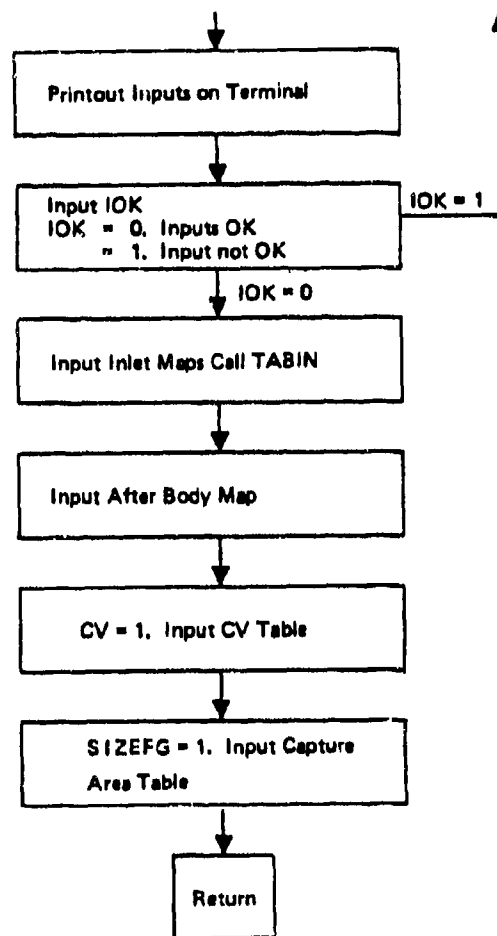


Figure 19. Subroutine TSONCE (Concluded)