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ENGINEL

A SINGLE ROTOR TURBOJET ENGINE CYCLE MATCH PERFORMANCE PROGRAM

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ABSTRACT

ENGINEL is a computer program which was developed to generate the design and off-design performance of a single rotor turbojet engine with or without afterburning using a cycle match procedure. It is capable of producing engine performance over a wide range of altitudes and Mach numbers. The flexibility, of operating with a variable geometry turbine, for improved off-design fuel consumption or with a fixed geometry turbine as in conventional turbojets, has been incorporated. In addition, the option of generating engine performance with JP4, liquid hydrogen or methane as a fuel is provided.

FOREWARD

This document presents in users format, with a brief description of computational procedures and examples, a Single Rotor Turbojet Engine Cycle Match Performance Program designated ENGINEL, developed by Mr. Arvid L. Keith, Jr., of the NASA Langley Research Center.

The Vought Corporation Hampton Technical Center provides technical support to the SCAR Program Officer of the Aeronautical Systems Division under Contract No. NAS1-13500. The work was performed under the LaRC Project Manager, Mr. Cornelius Driver, Head of the Vehicle Integration Branch, Aeronautical Systems Division. This report was prepared by Mr. W. A. Lovell, under the direction of Mr. C. W. Pearce, the Vought Hampton Advanced Aircraft Technology Projects Supervisor. The report was edited by Mr. Emanuel Boxer, of the Vehicle Integration Branch, LaRC, and Mr. B. F. Downie of Vought Hampton.

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The computer program ENGINEL was developed to provide engine performance for a single spool turbojet engine with or without afterburning, using a cycle match procedure. ENGINEL will generate, as specified by the user, engine design point performance at sea level static standard day conditions and will both develop and retain the parameters required to generate off design performance. It is then capable of producing engine performance over a wide range of altitudes and Mach numbers as requested by the user.

In the cycle match computational procedure ENGINEL utilizes a non-dimensional compressor map, constant efficiencies for the combustor, turbine, afterburner and a constant thrust coefficient for the convergent-divergent nozzle. A turbine map is not used, instead the cycle match is accomplished by flow matching using a constant turbine flow function, determined in the design point calculation.

ENGINEL has the option, exercised by user request, of generating performance with a variable geometry turbine, for improved off-design fuel consumption, or a fixed geometry turbine as in conventional turbojet engines. In addition, the option of generating engine performance with JP4, liquid hydrogen or methane as a fuel is provided.

Included as Appendix A to this document is a complete FORTRAN IV listing of ENGINEL. Sample problems, with input explanation, showing the various printed output options along with the normal engine control options are provided in Appendix B.

INTRODUCTION

The computer program described in this document provides engine performance for a single spool turbojet engine with and without afterburning. This program, ENGINEL, was developed by Mr. Arvid L. Keith, Jr., of the NASA Langley Research Center (LaRC), to generate the engine performance presented in the Reference 1 document. It was originally programmed by Mrs. Francis T. Meissner, also of NASA (LaRC), for the LaRC-CDC 6400-6600 computer complex using the ICOPS system.

Since its inception, this program has proved to be an exceptionally useful tool. It has been used extensively in the study of Advanced Supersonic Transport type aircraft. During the course of its use, it has been modified by Mr. W. A. Lovell of the Vought Corporation Hampton Technical Center to be operational on the present LaRC-CDC Cyber computer complex using the NOS system. It has also been modified several times by Mr. Lovell to provide the additional engine performance required for engine/aircraft acousitc studies. A complete listing of the program is provided in Appendix A.

The program is capable of four modes of operation based on user selection as follows:

° Fixed geometry turbine with or without afterburning.

° Variable geometry turbine with or without afterburning.

With any of these modes of operation the user may select fullpower operation only or full and part power operation. This is explained in more detail elsewhere in this document and is shown by example in Appendix B.

SYMBOLS

A	area (ft^2)
CPR	operating compressor pressure ratio (PT_2/PT_1)
CPRD	design compressor pressure ratio $(PT_2/PT_1)_d$
°K	degrees Kelvin
M	Mach number
N	rotational speed, percent of design value
N_{corr}	corrected rotational speed, $N/\sqrt{\theta}$, percent
PT	stagnation or total pressure (lbf/ft^2)
°R	degrees Rankine
TT4N	design maximum turbine inlet temperature (°R)
W_{corr}	corrected air flow, $W\sqrt{\theta}/\delta$ (lbm/sec)
ΔdB	change in noise level, decibels
δ	ratio of local pressure to standard sea-level pressure
η	efficiency
θ	ratio of local temperature to standard sea-level temperature

Subscripts:

d	design
max	maximum

sls	sea level static conditions
surge	compressor surge
0	free stream station
1	compressor inlet
2	compressor outlet
7	exhaust nozzle throat

COMPUTATIONAL PROCEDURE

The engine performance computational procedure described below has been extracted from Reference 1, rewritten, and expanded so as to provide a basic explanation of the methods used in the ENGINEL program.

This computer program utilizes a cycle match procedure to generate the performance of a single rotor turbojet engine. The program computes the design point cycle performance by conducting progressive, step-by-step thermodynamic calculations from the undisturbed free-stream, to the air intake, through each of the engine components and finally through the exhaust nozzle. In the cycle match iteration, a turbine map is not used. instead it is assumed that the work output is available at a constant efficiency (input). The corrected flow parameter, determined from the design point calculation at the turbine inlet, is, therefore, retained and used to define, by flow matching, all possible operating points of a given design cycle. The nondissociated thermodynamic properties of gases from Reference 2 are used in the cycle calculation.

The nondimensionalized compressor map characteristics, shown in Figure 1 are typical of a single rotor supersonic turbojet engine compressor. These are input to the program in its present form, however, may be replaced by another compressor should it be desired. Nondimensionalization is accomplished as defined in the input parameter identification list.

The nondimensionalized compressor map is constructed so that the surge line pressure ratio (TABPT2 versus TABNST - Figure 1a) is defined from the design pressure ratio, PT2T1D (input) and the design surge margin, Y (input). The X value (input) sets the lower limit of pressure ratio for all rotational speed lines (TABNST) relative to the surge pressure ratio of each speed line. With the PT2T1D, Y and X parameters, a design point compressor pressure ratio function (Z) is formed. This Z function is then used to establish the compressor design point shown by the target symbol (on Figures 1b and 1c).

For the usual case, Y = 1.1, the design surge pressure ratio margin is ten percent greater than the operating pressure ratio and X = 0.1, the lower pressure ratio limit of the map is one tenth of the local surge pressure ratio. The purpose of the X parameter is to allow the intervals of the local

values of pressure ratio (TABZ, 0 to 1.0) to be squeezed together, for maximum accuracy in matching or spread apart, to insure that the matching values (as determined by the compressor map) of pressure ratio and corrected flow can be obtained.

Off-design compressor operating points are established by iteration along constant corrected speed lines until the corrected flow at the turbine inlet is matched with the value determined in the design point calculation. Off-design corrected speed is defined by Mach number, altitude and the engine power level.

Definition of off-design operating points by constant corrected turbine inlet flow was selected as a reasonable simplification to the computational procedure. The alternate method would be to include a map of the turbine work and flow characteristics. Variables which compromise the choice of constant corrected turbine inlet flow as a matching parameter are:

1. Turbine inlet Mach number less than unity.

2. Unknown effective turbine inlet flow area.

3. Variations in the ratio of specific heats and the specific gas constant, due to changes in turbine-inlet temperature and gas constituency, from the design value.

Of the three effects, only item (3) was considered to be significant. Examination of the effects of the specific heat ratio and the specific gas constant when varied from their design values indicated a maximum variation in the corrected compressor inlet flow of less than two percent of the design value, when the turbine inlet temperature is varied from high values at design to very low values at off-design. The variation in compressor corrected inlet flow with Mach number and associated altitude resulting from the selected flow match procedure is shown on Figure 2 for a wide range of conditions.

Control for the fixed geometry turbine mode of operation is accomplished by giving values to two and solving for the third of the following parameters:

1. Compressor physical rotational speed.

2. Turbine inlet temperature.

3. Exhaust nozzle throat area.

Maximum power at all off-design conditions is determined by setting the compressor rotational speed at 100 percent of design, turbine inlet temperature at the design value and computing the required nozzle throat area. Partial power is defined by a schedule of the ratio of nozzle throat area (Figure 3) as a function of compressor rotational speed. This manner of engine control requires the computer program to iterate to satisfy flow

matching, at both the turbine inlet and nozzle throat by varying turbine inlet temperature.

Control for the variable geometry turbine mode of operation is initially the same as for the fixed geometry turbine in that the maximum power point is computed in the same manner. On completion of this solution, the computational procedure differs in that the compressor map operating point is retained in the computer memory. Part power operating points are produced by reducing the turbine inlet temperature to provide lower than maximum power, while maintaining the compressor map operating point constant. The turbine inlet area is then reduced to match the design corrected turbine inlet flow and the exhaust nozzle throat area required, to pass the internal flow, is calculated. The program recognizes a maximum variation in turbine area by the value assigned to the variable geometry turbine control parameter (A4A4DN). To solve for this limit, iteration of turbine inlet temperature and area is conducted until the limiting A4A4DN input value is obtained.

The inlet total pressure recovery schedule as a function of Mach number, presently input to the program is shown on Figure 4. This schedule is considered typical of fully variable internal-external compression inlets, however, it may be replaced with any other suitable schedule if so desired.

The exhaust nozzle, incorporated in the program, is a fully variable convergent-divergent nozzle, that operates in the fully expanded mode for all operating conditions. The nozzle schedule for controlling part-power engine operation (Figure 3) is typical of turbojet engines designed for supersonic speeds.

Current FAA regulations require jet engines and aircraft to meet specific noise requirements. Advanced turbojet engines, while operating at maximum power do not meet these regulations without the aid of jet noise suppression. The performance characteristics of an advanced jet suppressor have been extracted from Reference 3 and incorporated in the program. These characteristics are shown graphically on Figure 5, with jet suppressor effectiveness (dB) as a function of exhaust jet velocity (ft/sec).

A complete listing of the ENGINEL computer program is provided in Appendix A. Provided in Appendix B are several sample problems with the required input data and examples of the three printed output formats.

DISCUSSION

The ENGINEL computer program provides the performance of single rotor turbojet engines, as defined by the user selection of sea level static design component performance. It requires a storage capacity of approximately 60,000 octal words and computation times as follows:

Time to compile ≈ 5.26 seconds

Run time for a design point ≈ .13 seconds

Run time per data point ≈ .03 seconds

With this program engine performance can be generated for wide ranges of Mach number, altitude and engine power setting with and without afterburning.

Incorporated in the program are the nondissociated thermodynamic properties of gases from Reference 2, which will provide the combustion characteristics with air of Methane (CH_4), Hydrogen (H_2), and simulate those of JP fuel (CH_2). Computation of engine performance with any of these three fuels can be accomplished by input of the appropriate control parameter (IFUEL). The thermodynamic properties of air are also taken from Reference 2, therefore, the temperature tables for air are also applicable to the fuels used, requiring the input of only one temperature table.

All of the input to the program is by the namelist method and all of the parameters shown in the following list must be input for every design or off design point computed. The namelist method of input, however, provides the flexibility of only changing those parameters which are required to generate the desired engine performance. These parameters are normally Mach number, altitude, and the program controls which determine the number of afterburning and/or dry part power operating points. This is explained in the examples shown in Appendix B.

As shown in Appendix B the user may select any combination of internal component design values, such as overall compressor pressure ratio, compressor efficiency, turbine inlet temperature, turbine polytropic efficiency, airflow rate, etc. The program will then dimensionalize the nondimensional compressor map, determine the turbine flow function to be used as a matching parameter when computing off-design performance. It will also establish a nondimensional exhaust nozzle throat area to be used as a reference when computing all of the afterburning and part power data points requested.

Output from the program may be obtained in several forms as listed below and explained later under the output options control coding.

1. Long form printed output contains state point data at each engine location defined in Figure 6 as well as the overall engine performance.

2. Long form printed output and card deck for use in LaRC airplane mission analysis computer program.

3. Short form printed output - contains overall engine performance and key data for acoustic analysis only.

4. Short form printed output and card deck for use in LaRC airplane missions analysis computer program.

5. Printed output at a specified thrust level, providing performance data specifically for use in acoustic analysis. Data for acoustic analysis is also written on tape 8 which may be saved for use at a later time.

The input required to operate the program, the variable name, control options, and iteration intervals used, along with explanation where necessary, are contained in the following list. The numbers included in the parameter in the following list refer to engine station locations as shown in Figure 6.

Input Parameter Identification

I. Single Value Inputs

A. Design Installation and Flight Variable

ALT - Geometric altitude (ft) - must equal 0 for the design case.

CV - Exhaust nozzle internal gross thrust coefficient (decimal value)

DTEMP - Desired increment from standard day temperature (°C) - used in subroutine AT65SP (atmosphere).

1. If DTEMP is input with standard atmospheric pressures (PBTAB), the calculated performance will be for a simple hot day; i.e., pressure variation with altitude is the same as standard day (pressure altitude) while the ambient temperature is for a standard day +DTEMP atmosphere.

2. If DTEMP is input with the correct PBTAB for that specific atmosphere - the calculated performance will be for the correct hydrostatic equilibrium day.

EMACH - Flight Mach number - must equal 0 for the design case.

ENN - Compressor design rotational speed ratio - equals 1.0 for compressor-map used in the program.

ETA2D - Compressor design adiabatic efficiency (decimal value).

ETA4 - Combustion efficiency (decimal value).

ETA5 - Turbine polytropic efficiency (decimal value).

ETA6 - Afterburner combustion efficiency (decimal value).

HPEXT - Power extraction from the turbine (horsepower, HP).

PT2T1D - Compressor design total pressure ratio.

PT4T2D - Combustor design total pressure ratio, (decimal value).

PT65AD - Design afterburner total pressure ratio (constant, decimal value) - If PT65AD < 1.0, the data produced will be for an engine equipped with an afterburner. If PT65AD = 1.0, there is no afterburner pressure loss, therefore, a non-afterburning case will provide data the same as if the engine did not have an afterburner.

PT8PT6 - Exhaust nozzle to afterburner total pressure ratio, (decimal value).

TT4N - Design maximum turbine inlet temperature, (°R).

TT6MAX - Maximum afterburner temperature, (°R).

W1D - Design sea level static air flow rate, (lbm/sec) - must be the same as the parameter WIDE.

WB - Bleed flow rate from compressor discharge, (lbm/sec) - air bleed quantity is fixed for all operating conditions.

WCOW1 - Turbine cooling flow factor (decimal value), such that the cooling flow ratio WC/W1 = WCOW1 (TT4-2160°R).

NOTE: Turbine cooling flow is returned to the cycle downstream of the turbine. The associated pressure loss is fixed in the program.

WIDE - Design sea level static air flow rate, (lbm/sec) - must be the same as the parameter W1D.

X - Factor for lower limit of the compressor pressure ratio - Equals 0.1 for the compressor use in the program.

XMNSLU - Flight Mach number at which the compressor rotational speed is held constant at 100%.

Y - Compressor surge margin at design - Equals PT2T1S/PT2T1D, Equals 1.1 for the compressor used in the program.

B. Standard Constants

AJ - Mechanical equivalent of heat (778.156 ft-lbf/Btu).

G - Acceleration due to gravity (32.174 ft/sec^2).

GAMO - Ratio of specific heats for air (1.4) - assumed constant for all operating conditions.

PSLS - Atmospheric pressure at sea level static, standard day conditions (2116.2381 lbf/ft^2).

RO - Gas constant for air (53.33 ft-lbf/lbm-°R).

TSLS - Atmospheric temperature at sea level static, standard day conditions (518.67°R).

C. Iteration Intervals and Miscellaneous

AVAL - Interval used in the partial power routine to define the desired accuracy of matching the nozzle throat area ratio with the scheduled nozzle throat ratio (decimal value, .005 = interval used).

ICASE - Case number - program has no provision for automatic indexing.

NLIM - Maximum number of interations in the Iteration Subroutine (ITT).

T5VAL - Iterative constant for turbine outlet total temperature (decimal value, .001 = constant used).

T7VAL - Iterative constant for nozzle throat static temperature (decimal value, .01 = constant used).

T8VAL - Iterative constant for nozzle exit static temperature (decimal value, .001 = constant used).

VAL - Interval used to determine nozzle throat total to static pressure ratio (choke) when the nozzle exhaust Mach number is supersonic (decimal value, .025 = interval used).

II. Tabular Inputs

NOTE: The numbers in parenthesis following the variable name are the number of values that must be contained in the variable array.

A. Atmospheric Pressure

PBTAB (8) - Atmospheric pressure for a standard hydrostatic equilibrium day from the U.S. Standard Atmosphere 1962 - with DTEMP = 0°C and the PBTAB table input to the program, atmospheric pressures and temperatures as a function of altitude will be generated for a standard hydrostatic equilibrium day. Should DTEMP $\neq$ 0 be input, then to produce data for a non-standard hydrostatic equilibrium day a new PBTAB table derived from the U.S. Standard Atmosphere 1962 and corresponding to the input DTEMP will have to replace the current PBTAB table. Should the PBTAB table not be replaced the atmospheric data generated will be for a simple non-standard day, where the temperatures will be non-standard and the pressures will be for a standard day.

B. Air Inlet Total Pressure Recovery - Figure 4

TABM (19) - Mach number.

TABPT1 (19) - Inlet pressure recovery.

C. Compressor Map - Figure 1

TABETA (99) - Adiabatic efficiency ratioed to the surge value of adiabatic efficiency at each compressor rotational speed (N).

TABNST (9) - Corrected Compressor rotational speed ($N/\sqrt{\theta_{T1}}$) ratioed to design corrected speed.

TABPT2 (9) - Surge line pressure ratio - surge pressure ratio at each speed (N) is ratioed to the surge pressure ratio at design speed (100% N).

TABW1 (99) - Corrected air flow ratio - corrected air flow ($Wa\sqrt{\theta_{T1}}/\delta_{T1}$) is ratioed to the surge corrected air flow at each rotational speed (N).

TABZ (11) - Interval of pressure ratio along a corrected speed line.

D. Air Thermodynamic Tables - Reference 2

TABH (78) - Enthaply of dry air (H, Btu/lbm).

TABPHI (78) - Constant pressure entropy of air (ϕ, Btu/lbm °R).

TABTEM (78) - Temperature (°R, from 0 to 5000).

E. Part Power Speed/Nozzle Throat Area Control - Figure 3

TABA7 (12) - Nozzle throat area ratio.

TABN (12) - Engine rotational speed ratio.

F. Exhaust Nozzle Sound Suppressor - Figure 5

TABDLDB (17) - Sound level suppression (dB)

TABVJ (17) - Exhaust nozzle jet velocity (ft/sec)

III. Program Operating Controls

A. Design and Operating Code - IDES

IDES = 0 Used to calculate the design values of the turbine flow function

$(W_4\sqrt{\theta_{T4}}/\delta_{T4})$ and the nozzle area ratio (A_7/A_{7D}), which are then used in the matching process for that particular engine design at off-design operating conditions. IDES must be input as 0 before normal operating cases are computed.

IDES = 1 Following an engine design case (IDES = 0), IDES = 1 must be input to fix the design matching parameters which are used in subsequent normal operation. Then IDES = 1 must be maintained for all normal operation with variable inputs of Mach number, power setting, altitude, etc., for an engine design determined previously with IDES = 0.

B. Power Setting Codes - IPC, ZTHRUST and IDDBS

IDDBS = 0 Provides engine performance without suppression.

IDDBS = 1 Estimates the available jet suppression (dB) based on the computed exhaust jet velocity and the tables TABDLDB and TABVJ. It also reduces the computed gross thrust by 0.5% for each dB of estimated available suppression. However, when the exhaust jet velocity is equal to or less than 1000 ft/sec no jet suppression is available and no thrust loss is assessed.

IPC = 1 Provides power points from maximum afterburning to maximum dry power.

IPC = 2 Provides a maximum dry power point only.

IPC = 3 Provides power points from maximum afterburning to maximum dry power and on through minimum dry partial power.

IPC = 4 Provides power points from maximum dry power through minimum dry partial power.

ZTHRUST This control is used when data is required at a specific thrust value.

ZTHRUST=0 This control is inoperative and the engine operating mode is determined by the IDDBS and IPC controls.

ZTHRUST>0 When this control is specified the IPC control must be set to 1, 3, or 4, since the ZTHRUST control causes tables of data from maximum through minimum partial power to be generated. From these tables at the specified ZTHRUST are interpolated the specific engine parameters required for engine acoustic analysis. Use of this control overrides the normal output control and provides a printed output as shown in Example 6 of Appendix B. It also causes the program to write the parameters required for acoustics analysis on tape 8

which can be saved. The parameters written on tape 8 and the format in which they are written are given below:

Parameters: CAPA8, WG, V8, FN, EMACH, T8
(For parameter definitions, see output parameter identification)

Format: (F10.4, F10.3, F10.2, F10.1, F10.4, F10.2)

C. Fuel Code - IFUEL

The fuel code will cause the program to select the thermodynamic properties of the desired fuel with which to compute the thermodynamic properties of combustion and subsequently, engine performance.

IFUEL = 1 Selects JP4 (CH_2) fuel.

IFUEL = 2 Selects methane (CH_4) fuel.

IFUEL = 3 Selects hydrogen (LH_2) fuel.

D. Variable Geometry Turbine - A4A4DN

The variable geometry turbine can only be employed for partial power engine performance calculations, therefore, use of this control can only be accomplished when IPC = 3 or 4 which causes entry into the part power routine.

A4A4DN $\geq$ 1.0 will produce part power performance for standard fixed area turbine engines.

A4A4DN < 1.0 defines the lower limit of turbine area variation from the design area. The routine will divide the difference between 1.0 and the input value of A4A4DN into 0.05 increments, from which the program will adjust the turbine inlet temperature to provide a flow match while maintaining a constant compressor pressure ratio and compressor corrected inlet flow. When the incremented value comes within 0.025 of the input value of A4A4DN, the routine will iterate to define performance conditions at A4A4DN.

A7A7DN $\geq$ 1.0 with A4A4DN < 1.0 will provide partial power data at values lower than that permitted by the A4A4DN control alone. With A4A4DN $\geq$ 1.0 will provide partial power data by standard routine for a fixed geometry turbine.

A7A7DN < The partial power data will be determined by the A4A4DN control only.

E. Afterburner

IPS - Number of afterburner points from maximum afterburning through minimum afterburning.

IPS = 1 with IPC = 1 or 3 produces maximum dry power only.

IPS = 2 with IPC = 1 or 3 produces no data and causes the program to dump.

IPS = 3 with IPC = 1 produces maximum afterburning power, minimum afterburning and maximum dry power. With IPC = 3, in addition to the above, the program will produce data from maximum dry power through minimum partial power.

IPS > 3 with IPC = 1 or 3 will produce data similar to the data when IPS = 3 except that there will be additional data points between the maximum and minimum afterburning data points.

F. Nozzle Codes

NFINAL - Number of partial power cases desired - must be equal to or less than the number of values contained in TABA7 or TABN.

NSTART - Counter to determine the interval in the TABA7/TABN tables for the part power calculation:

NSTART = 1 Read the first table value for the first calculation.

NSTART = 2 Read the second table value for the first calculation.

NUMBER - Sequence of TABA7/TABN lookup.

NUMBER = 1 Use each value.

NUMBER = 2 Use every other value.

P8OP8 - Exhaust nozzle exit static pressure ratio - equal to 1.0 provides performance for a fully expanded convergent-divergent nozzle.

NOTE: At the present time this is the only option available.

G. Output Code - IPUNCH

IPUNCH = 0 Long form printed output only (Examples 1-4, Appendix B)

IPUNCH = 1 Long form printed output plus punched cards in the missions analysis format.

Card output parameters and mission format are:

Parameters: EMACH, ALT, POWER, FG, FD, WF, V8, CAPA8, WG
(For parameter definitions, see output parameter identification.)

Mission Format: (F5.2, F10.1, F5.0, 4F10.1, F10.3, F10.1)

IPUNCH = 2 Short form printed output only (Example 5, Appendix B)

IPUNCH = 3 Short form printed output plus punched cards in the missions analysis format.

(See also the explanation of the ZTHRUST for other modes of output.)

The output parameters along with their definitions are presented in the following list:

Output Parameter Identification

A4/A4D - Turbine flow area ratio - actual to design.

A7/A7D - Nozzle throat area ratio - actual to design.

A8 - Acoustic velocity of the exhaust gas at the nozzle exit. (ft/sec)

A8/A7 - Nozzle area ratio - exit to throat.

ALT - Geometric altitude (ft) (input).

CAPA8 - Nozzle exit area (ft^2).

CASE = ICASE - Case number - program has no provision for indexing (input).

CV - Nozzle internal gross thrust coefficient (input).

DFGS - Gross thrust loss due to exhaust jet noise suppression (lbf).

DH2-1 - The actual enthalpy change across the compressor minus 1. (Btu/lbm) (design case only).

DLDB - Available exhaust jet noise suppression (dB).

DTEMP - Temperature variation from standard day temperature (°C) (input).

ETA2 - Compressor adiabatic efficiency (decimal value).

ETA5 - Turbine polytropic efficiency (decimal value-input) (design case only).

ETAC - Cycle efficiency (decimal value).

ETAO - Overall propulsion efficiency (decimal value)

ETAP - Propulsive efficiency (decimal value)

F4 - Primary combustor fuel air ratio

F6 - Afterburner fuel air ratio (if nonafterburning then F6 = F5A = fuel air ratio at afterburner inlet).

FD - Ram drag (lbf).

FG - Gross thrust (lbf).

FG1 - Gross thrust corrected for exhaust jet suppression loss (lbf).

FN - Net engine thrust (lbf).

FN1 - Net engine thrust corrected for exhaust jet suppression loss (lbf).

FN/W1 - Specific net thrust (lbf/lbm/sec).

FN/W1D - Specific net thrust based on sea level static design airflow (lbf/lbm/sec).

HPEXT - Power extracted (horsepower) (input).

HT1 - Enthalpy of the air entering the compressor (Btu/lbm) (design case only).

HT2I - Ideal enthalpy of the air at the compressor discharge. (Btu/lbm) (design case only).

IDDBS - Exhaust jet suppressor control parameter. (input)

M8 - Nozzle exit Mach number.

MACH = EMACH - Flight Mach number. (input)

N - Compressor rotational speed (%RPM).

N/SRT - Corrected compressor rotational speed - $N/\sqrt{\theta_{T1}}$ (%RPM)

ONSRT - Corrected compressor rotational speed - $N/\sqrt{\theta_{T1}}$ (%RPM)

(design case only).

P3 = PS - Afterburner power point index - varies from 1 through IPS. For a nonafterburning case, it is equal to I = indeterminant.

PC = IPC - Engine power setting code. (input)

POWER = TT4 - Turbine inlet temperature (°R).

PT1PT0 - Inlet pressure recovery (design case only).

PT1/PT0 - Inlet pressure recovery.

PT1PT7 - Engine pressure ratio.

PT2T1D - Design compressor pressure ratio (input) (design case only).

PT2/PT1 - Compressor pressure ratio.

PT4/PT2 - Combustor pressure ratio.

PT5/PT4 - Turbine expansion ratio.

PT5T5A - Pressure ratio - total pressure before turbine cooling air is returned to the cycle to total pressure after the turbine cooling air is returned to the cycle - PT5/PT5A.

PT6/PT5A - Afterburner total pressure ratio.

PT6T5A - Afterburner total pressure ratio - PT6/PT5A.

PT7P7 - Total to static pressure ratio at exhaust nozzle throat.

PT8PT6 - Exhaust nozzle exit to afterburner total pressure ratio.

PT8/P8 - Total to static pressure ratio at the nozzle exit.

SFC - Specific fuel consumption (lbm/hr/lbf).

SFC1 - Specific fuel consumption corrected for exhaust jet suppression loss (lbm/hr/lbf).

T8 - Nozzle exit total temperature (°R).

TT0 - Free stream total temperature (°R).

TT1 - Total temperature at the compressor inlet (°R).

TT2 - Compressor discharge total temperature (°R).

TT4 - Combustor exit (turbine inlet) total temperature (°R).

TT5 - Turbine discharge total temperature (°R).

TT5A - Total temperature at the afterburner inlet (°R). (Temperature after the turbine cooling air has been returned to the cycle.)

TT6 - Afterburner exit total temperature (°R).

VO - Flight velocity (ft/sec).

V8 - Nozzle exit velocity (ft/sec).

W1 - Actual compressor inlet air flow (lbm/sec).

W1DCOR - Corrected compressor air flow ratioed to the surge value at a given speed ratio (design case only).

W1K - Corrected compressor inlet airflow ($W\sqrt{\theta_{T1}}/\delta_{T1}$ - lbm/sec).

WB - Service air bleed (lbm/sec) (input).

WBOW1 - Ratio of service air bleed to actual compressor air flow (WB/W1).

WC - Turbine cooling air flow (lbm/sec).

WCOW1 - Turbine cooling bleed factor [Turbine cooling airbleed ratio = WC/W1 = WCOW1 (TT4-2160°R)] (input).

WF - Total engine fuel flow = engine fuel flow plus afterburner fuel flow (lbm/hr).

WG - Engine exhaust gas flow (lbm/sec).

Z - Compressor pressure ratio function.

ZTHRUST - Engine power control (input).

REFERENCES

1. "Effects of Variable Turbine Area on Subsonic Cruise Performance of Turbojets Designed for Supersonic Application" - by Arvid L. Keith, Jr., NASA TN D-5962, October 1970.

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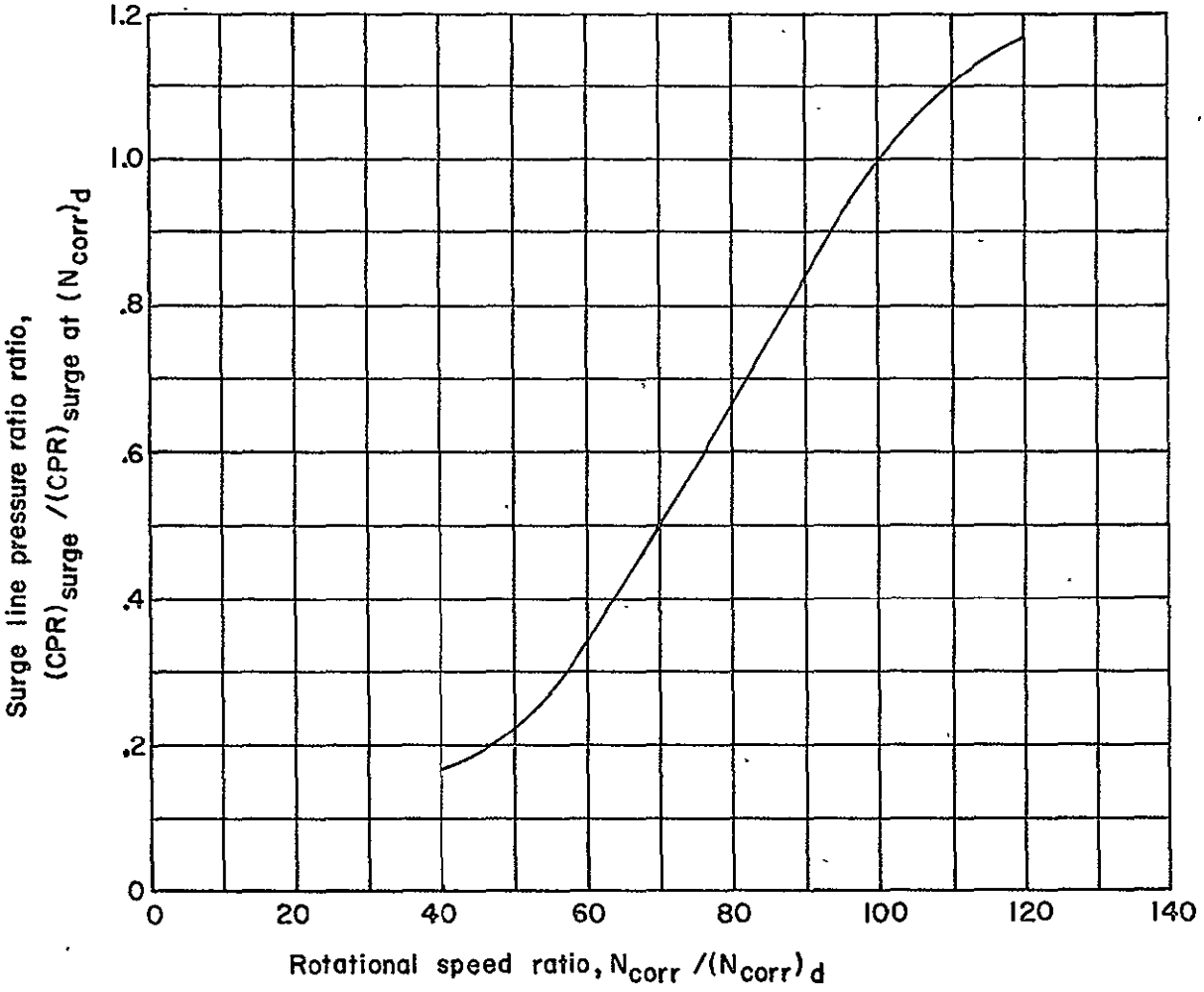
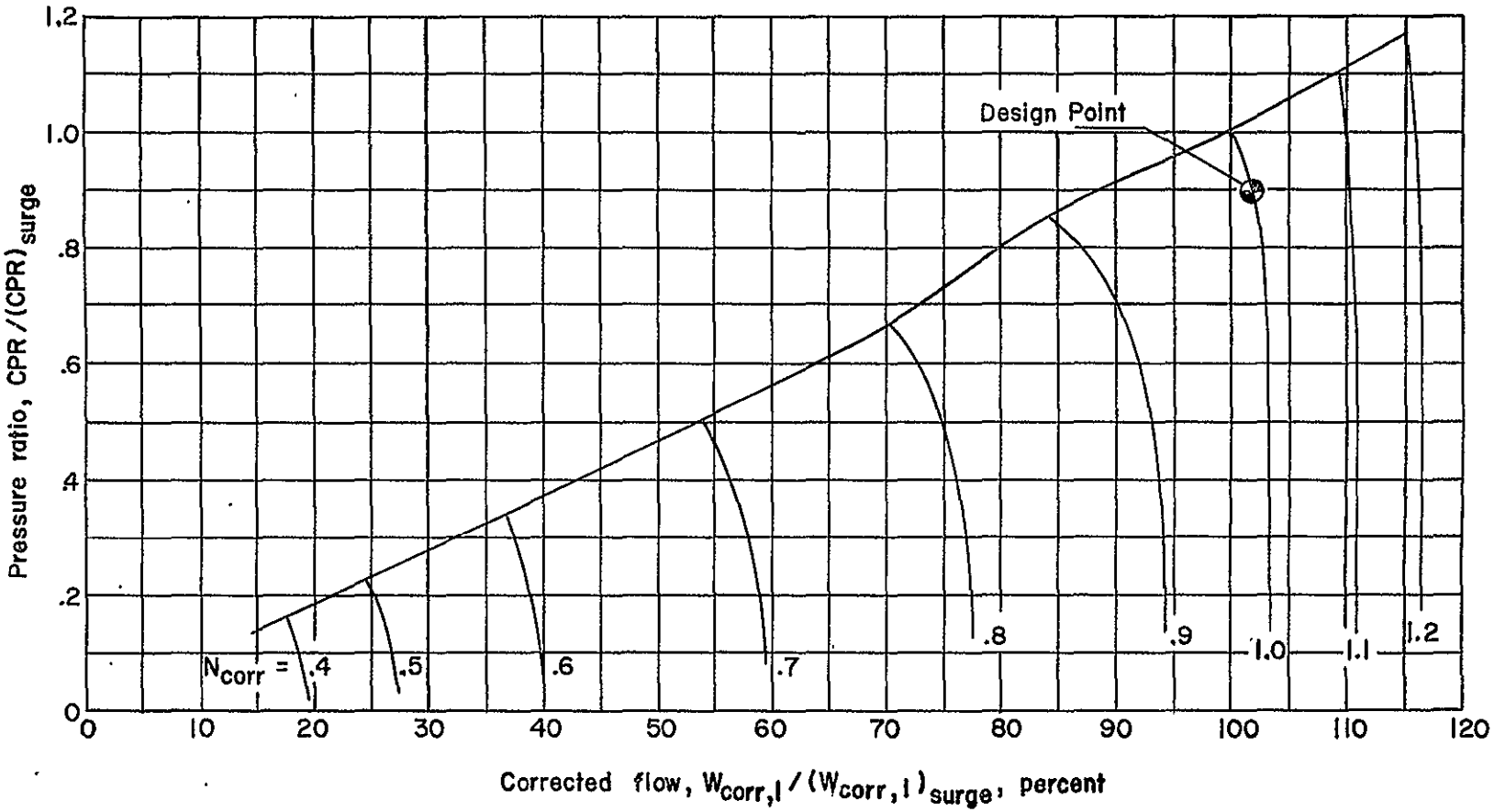
3. "Propulsion Technology Advances Needed for a Quiet Supersonic Transport" - by R. L. Foss and E. L. Bragdon, SAE Paper No. 730898, October 1973.



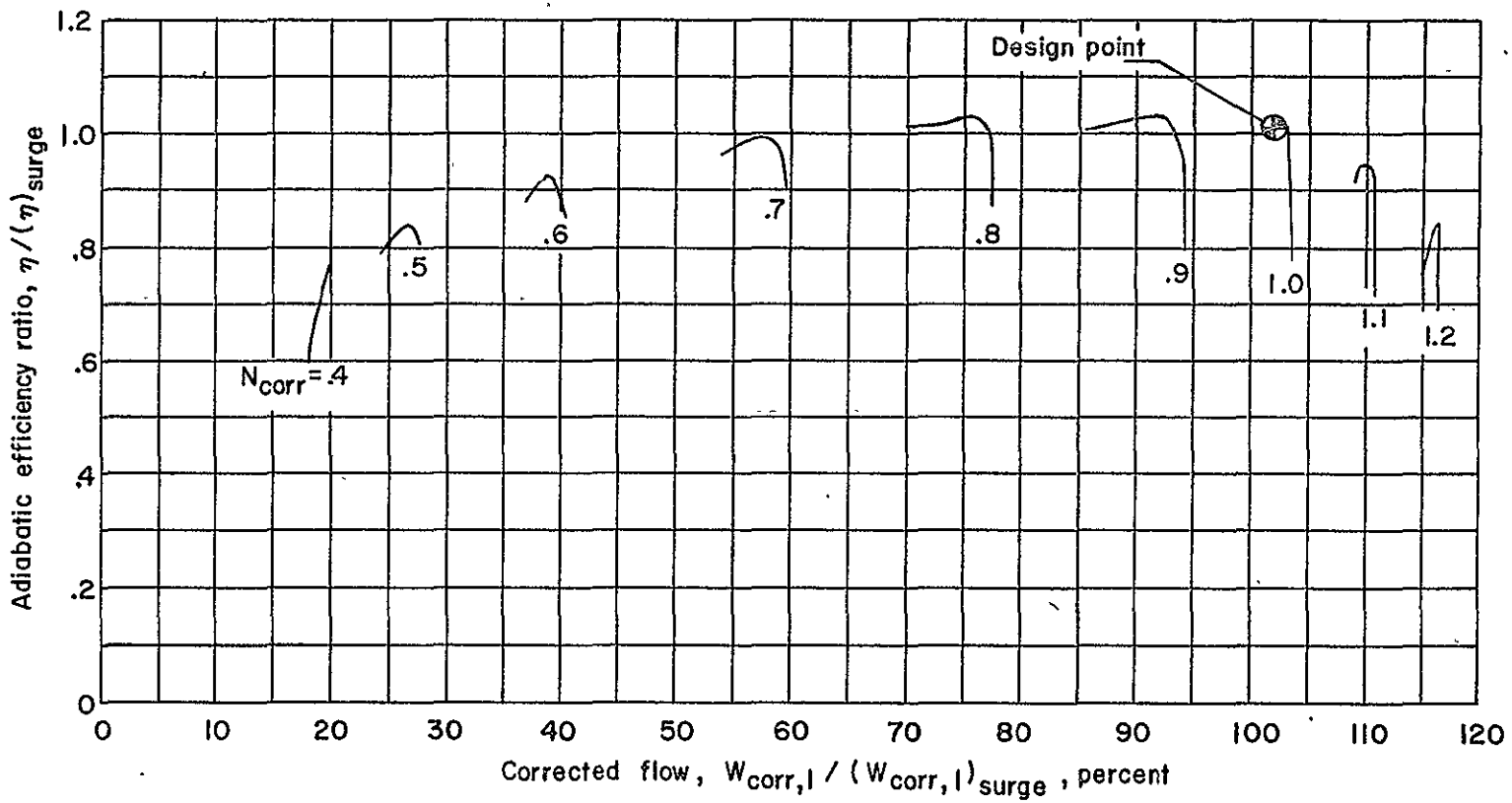
(a) Surge Line Pressure Ratio Ratio as a Function of Rotational Speed Ratio

Figure 1 – Nondimensional Compressor Map



(b) Pressure Ratio as a Function of Corrected Flow

Figure 1 - Continued



(c) Efficiency as a Function of Corrected Flow

Figure 1. – Concluded

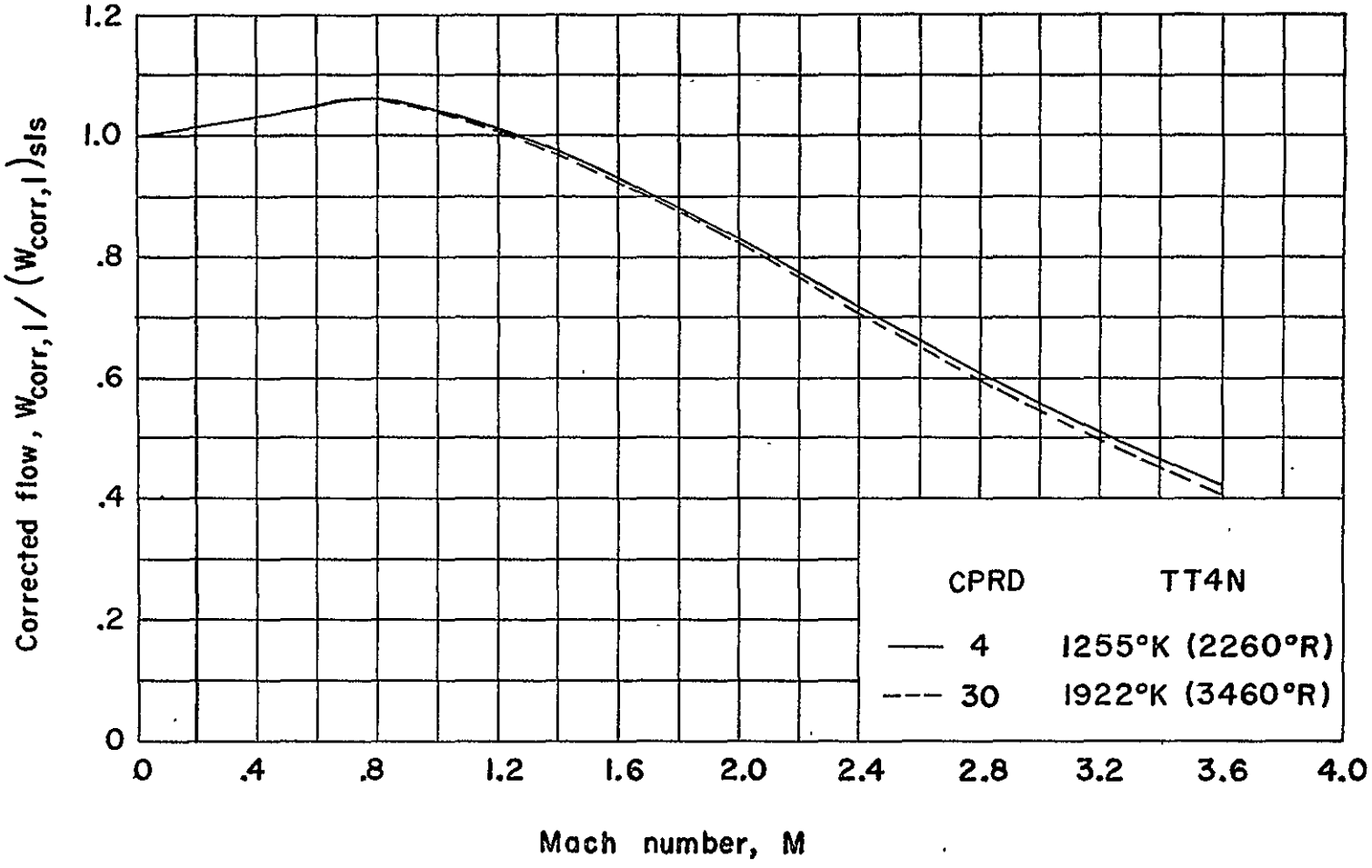


Figure 2 – Variation of Compressor Corrected Inlet Flow with Mach Number for a Range of Design Engines.

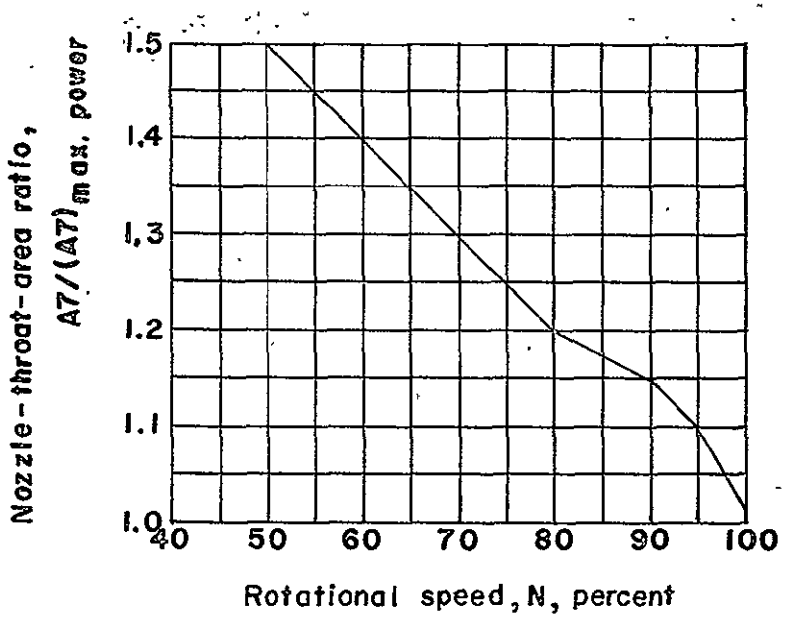


Figure 3 – Schedule of Exhaust-Nozzle-Throat Area Ratio used for Partial Power Control.

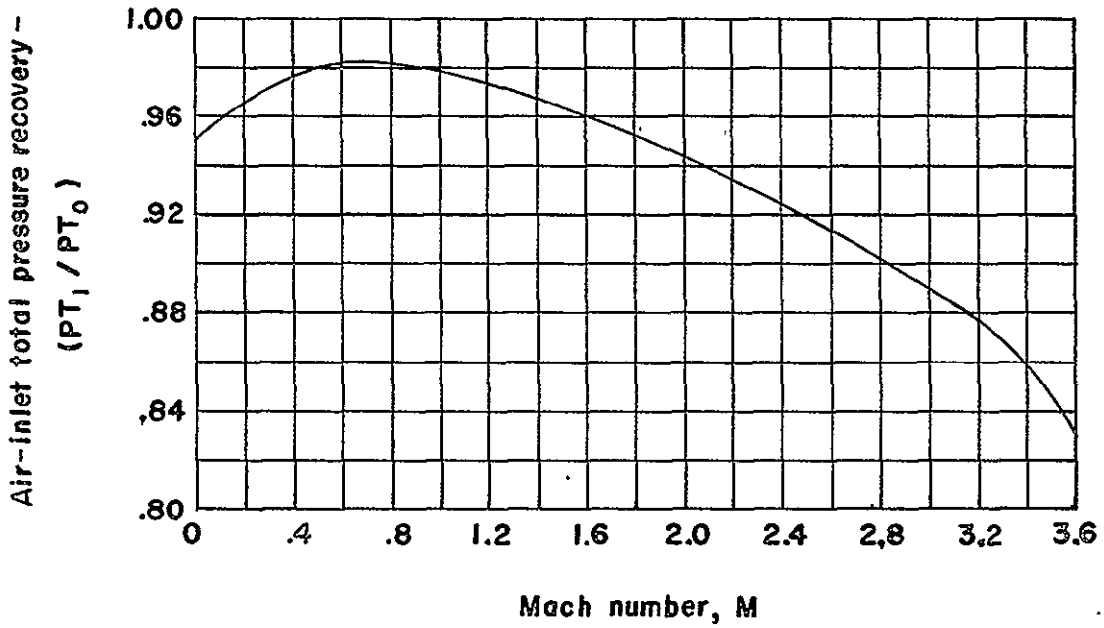


Figure 4 - Schedule of Air-Inlet Total Pressure Recovery

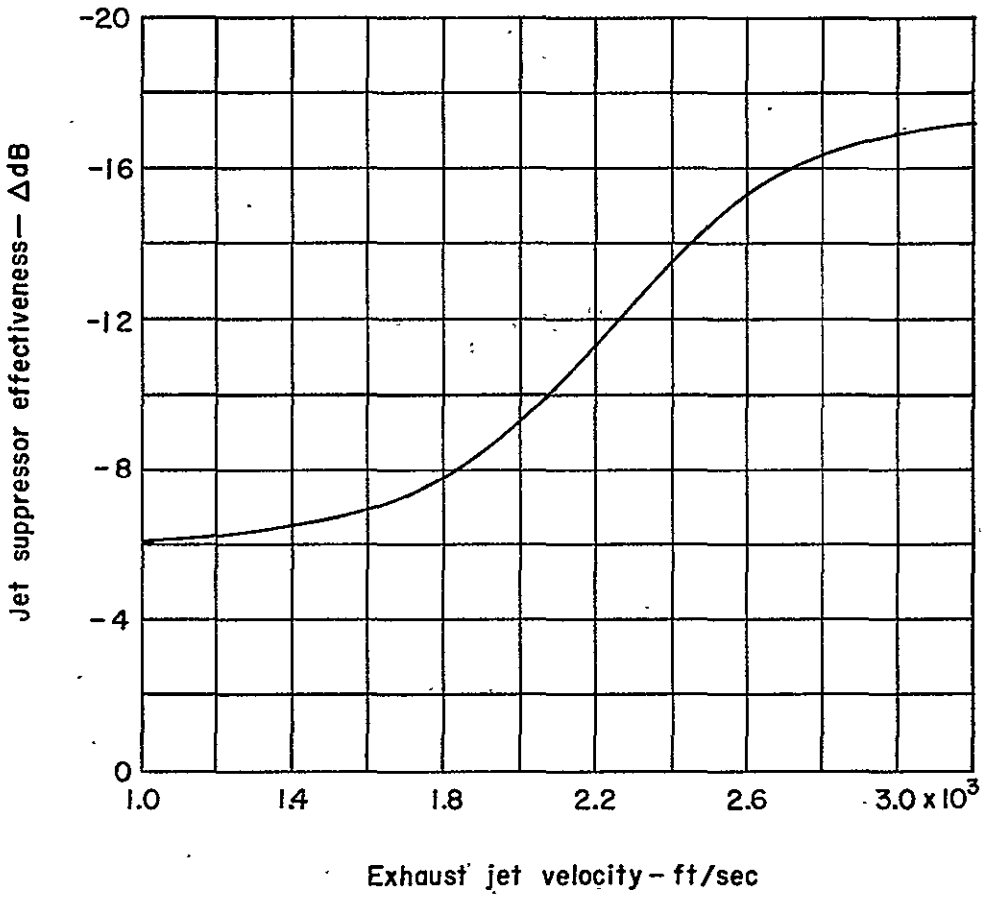
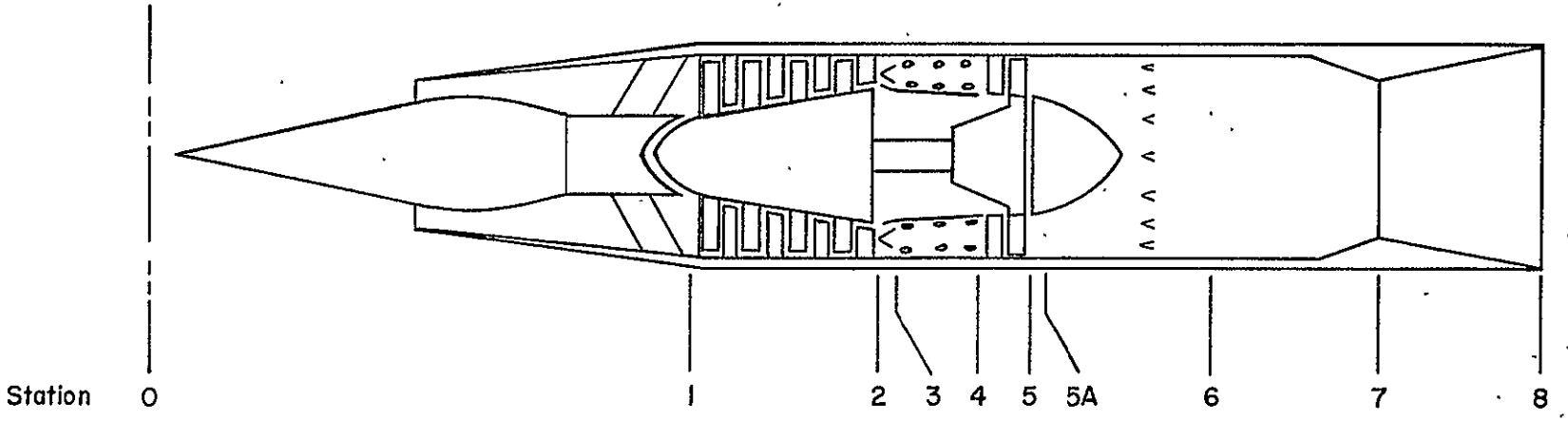


Figure 5 — Predicted Jet Noise Suppressor Effectiveness



Station	
0	Free stream
1	Compressor inlet
2	Compressor outlet
3	Combustor inlet
4	Combustor outlet (Turbine nozzle inlet)
5	Turbine outlet
5A	Turbine cooling air returned to cycle (Afterburner inlet)
6	Afterburner outlet
7	Exhaust-nozzle throat
8	Exhaust-nozzle exit

Figure 6 - Engine Station Identification

APPENDIX A

ENGINEL
PROGRAM LISTING

```
      PROGRAM ENGINEL(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,PUNCH,TAPE8)   A    1
      COMMON /IEP/ IE                                                      A    2
      IE=0                                                                 A    3
      CALL MAIN                                                            A    4
      END                                                                  A    5-



      SUBROUTINE MAIN                                                      B    1
C     MAIN PROGRAM                                                         B    2
      DIMENSION ALTSAV(15), EMSAV(15), NOSAV(15), FNSAV(15), W2SAV(15),    B    3
     1SFCSAV(15)                                                           B    4
      DIMENSION TABTEM(78), TABH(78), TABPHI(78), TABPSH(78), TABM(19),    B    5
     1TABPT1(19), TABNST(9), TABPT2(09), TABZ(11), TABW1(99), TABETA(99)   B    6
     2, ANS(5), SFCC(25), TABPSP(78)                                       B    7
      DIMENSION TABPH5(78), TABH4(78)                                      B    8
      DIMENSION TABN(12), TABA7(12), RAT(2), T4(3)                         B    9
      DIMENSION PBTAB(8), HDT(20), DTTAB(20)                               B   10
      DIMENSION ZFN(50), YFN(50,10), ZEE(10)                               B   11
      DIMENSION TABVJ(17), TABDLDB(17)                                     B   12
      DIMENSION HJ(3), HSJ(3), TFJ(3), FSJ(3), AMPJ(3)                     B   13
      DIMENSION TABH4J(78,3), TABPH5J(78,3), TABPSHJ(78,3), TABPSPJ(78,3   B   14
     1)                                                                    B   15
      DIMENSION ZZ(936)                                                    B   16
      EQUIVALENCE (TABH4J(1),ZZ(1)), (TABPH5J(1),ZZ(235))                  B   17
      EQUIVALENCE (TABPSHJ(1),ZZ(469)), (TABPSPJ(1),ZZ(703))               B   18
C                                                                          B   19
      COMMON /ZPARAM/ ZFN,YFN,NZCNT,ZTHRUST                                B   20
C     INPUT                                                                B   21
C                                                                          B   22
      COMMON /BK1/ ALT,EMACH,PT2T1D,TT4N,WCOW1,WB,A7A7DN,PT65AD,A4A4DN,P   B   23
     180P8,W1D,H,ETA2D,ENN,X,Y,TF,PT8PT6,CV,TT6MAX,PT6T5A,ETA6,IDES,VAL,  B   24
     2GAMO,RO,AJ,TSLS,PSLS,G,TABTEM,TABH,TABPHI,TABPSH,TABPSP,TABM,TABNS   B   25
     3T,TABPT2,TABZ,TABW1,TABETA,TABPT1,IDDBS,TABVJ,TABDLDB,IFUEL          B   26
C                                                                          B   27
C     COMPUTED VALUES                                                      B   28
C                                                                          B   29
      COMMON /BK2/ WBOW1,AOAS,ABCOR,A80A7,A7A7D,ANS,APO,A4A4D,A7,A8,AO,A   B   30
     180W1,ABEM7,TO,T8,T7,T7I,T8I,TTO,TT2,TT1,TT2I,TT2TT1,TT5,TT5A,TT7TT  B   31
     21,TT6,TT7TT6,TT4,PO,P80PO,PT7,HF,H8M,H8,H8I,H8IM,H7M,H7,H7MI,HAB,H   B   32
     3AB5,HO,HTO,HT2,HT2I,HT4M,HT4,HT5M,HT5,HT505,HT5AM,HT5H,HT7M,HT7MI,  B   33
     4HT6M,HT8M,HT5A05,PHIO,PHITO,PHIT2I,PHIT1,PHIT4M,PHIT4,PHIT5A,PHT5A  B   34
```

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5M,PHI8M,PHIT8M,PHI8,PHI2I,PHIT6M,PHI7M,PHIT6,PHIT7M,PHOF6,PHOH6,PT   B   35
60P0,PT1PT0,PT2T1S,PT2PT1,PT4PT2,PT5PT4,PT5T5A,PT8P8,PT1PT7,PT7P7,P   B   36
7T6PT5,PT6T5D,PT5AM,PT55AD,PSIH4,PSPI4,PSIH5,PSP15A,PSIH5A,PSPI8,PS   B   37
8IH8,PSIH7,PSPI6,PSIPHI,PSIH6,PSIH8I,PSPI7,EN,ETA2,ET5A,ETETS,ETA2S   B   38
9,ET2D,EM7,EM8,W1COR,W1DCOR,W4COR,W4DCOR,W7COR,W7DCOR,W4TOT4,W4TEST   B   39
$,W1,W1K,DH2M1,STTO,DELTO,DELTOD,GAMA8,GAMA7,VO,V7,V8,GAM7P1,GAM7M1   B   40
$,ONSRT,SFC,SFCC,OF4,OF6,FOF6,F4,F5A,FAB,F6,FNOW1,FN,F6A,FOF4,FO5A,   B   41
$W8,RT5,RTA,RT6,RT5A,CP7,CP8,CAPA8,CAPA7,OWB,WCB,ICOMB,IPP,IS,ICOUN   B   42
$T,IKONT,JCONT,IC,KTEST,THET1,THETO,DW1,DW2,DDHP,Z1,Z2,Z3,Z,ETAC,ET   B   43
$AO,FNOW1D,HT6,PHIH6,T5A,T4,RAT,WCOW1C,PBTAB,HDT,DTTAB,IPS,DTEMP,ET   B   44
$AP,ALTSAV,EMSAV,NOSAV,FNSAV,W2SAV,SFCSAV,NO,INOZZ,TT2T1D,HT5A,PHT1   B   45
$,TT4TT2,PHIT5,PSPI5,PHIT5M,HT1,PT2T1L,PS,TABA7,T8VAL,T7VAL,NLIM,NU   B   46
$MBER,NSTART,NFINAL,AVAL,XMNSLU,TABN,ETA4,ETA5,TABPH5,TABH4,HPEXT,I   B   47
$CASE,IPC,PT4T2D,HS,T5VAL,WC                                          B   48
 COMMON /IEP/ IE                                                      B   49
 COMMON /NEW/ FD,FG,WF,DLDB,DFGS,FG1,FN1,SFC1                         B   50
 COMMON /RRR/ AMP28,FS28MP,AMP                                        B   51
 COMMON /PPP/ IPUNCH                                                  B   52
 COMMON /WWW/ WIDE                                                    B   53
 NAMELIST /ENPUT/ ALT,EMACH,PT2T1D,TT4N,WCOW1,WB,A7A7DN,PT65AD,A4A4   B   54
1DN,P80P8,W1D,  ETA2D,ENN,X,Y,   PT8PT6,CV,TT6MAX,ETA6,IDES,VAL,GAM   B   55
20,RO,AJ,TSLS,PSLS,G,TABTEM,TABH,TABPHI,                TABM,TABNST,T   B   56
3ABPT2,TABZ,TABW1,TABETA,TABPT1,ETA4,ETA5,               HPEXT,ICASE,   B   57
4IPC,PT4T2D,   T5VAL,T8VAL,T7VAL,NLIM,NUMBER,NSTART,NFINAL,AVAL,XMN   B   58
5SLU,TABN,TABA7,DTEMP,PBTAB,IPS,WIDE,        IPUNCH,ZTHRUST,IDDBS,TA   B   59
6BVJ,TABDLDB,IFUEL                                                    B   60
 DATA HJ/20000.,23919.,62000./                                        B   61
 DATA HSJ/1600.,2319.,10400./                                         B   62
 DATA TFJ/536.,536.,536./                                             B   63
 DATA FSJ/.06763,.05801,.02916/                                       B   64
 DATA AMPJ/28.907,27.741,24.648/                                      B   65
 DATA (ZZ(I),I=1,78)/0.00000,180.50000,255.02000,267.44000,279.9400   B   66
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276000,382.94000,396.21000,409.57000,423.04000,436.60000,450.28000,   B   68
3464.06000,477.94000,491.92000,506.08000,520.28000,534.58000,549.05   B   69
4000,563.55000,578.15000,592.85000,607.70000,622.58000,637.56000,65   B   70
52.64000,667.79000,683.02000,698.33000,713.73000,729.20000,744.7300   B   71
60,760.34000,776.01000,791.76000,807.67000,823.43000,839.35000,855.   B   72
734000,871.38000,887.48000,903.60000,919.82000,936.06000,952.36000,   B   73
8968.70000,985.08000,1001.51000,1017.98000,1034.49000,1051.04000,10   B   74
967.63000,1084.26000,1100.92000,1117.62000,1134.35000,1151.11000,11   B   75
$67.91000,1184.74000,1201.59000,1218.47000,1235.39000,1252.33000,12   B   76
$69.30000,1286.29000,1303.31000,1320.35000,1337.42000,1354.51000,13   B   77
$71.62000,1543.89000,1717.92000/                                      B   78
```

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26.73000,440.38000,454.13000,467.97000,481.91000,495.94000,510.1000
30,524.34000,538.70000,553.15000,567.81000,582.48000,597.27000,612.
425000,627.24000,642.33000,657.53000,672.90000,688.29000,703.78000,
5719.39000,735.06000,750.82000,766.67000,782.60000,798.61000,814.70
6000,830.86000,847.10000,863.42000,879.79000,896.24000,912.74000,92
79.32000,945.96000,962.65000,979.40000,996.21000,1013.07000,1029.99
8000,1046.96000,1063.97000,1081.04000,1098.15000,1115.31000,1132.51
9000,1149.55000,1167.05000,1184.37000,1201.73000,1219.13000,1236.57
$000,1254.05000,1271.56000,1289.10000,1306.68000,1324.28000,1341.93
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$000,1466.18000,1645.77000,1827.33000/
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204.02000,619.17000,634.40000,649.71000,665.11000,680.61000,696.240
300,711.95000,727.77000,743.69000,759.92000,776.09000,792.36000,808
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8.75000,1271.60000,1290.52000,1309.50000,1328.56000,1347.67000,1366
9.84000,1386.06000,1405.34000,1424.69000,1444.08000,1463.52000,1483
$.01000,1502.55000,1522.15000,1541.79000,1561.47000,1581.19000,1600
$.95000,1620.77000,1640.62000,1660.50000,1680.42000,1700.39000,1720
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58631,1.99351,2.00059,2.00754,2.01436,2.02107,2.02766,2.03414,2.040
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8.13533,2.14024,2.14509,2.14988,2.15461,2.15929,2.16391,2.16847,2.1
97298,2.17743,2.18184,2.18619,2.19050,2.23107,2.26774/
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14204,1.66719,1.69026,1.71162,1.73150,1.75020,1.76771,1.78427,1.799
299,1.81496,1.82926,1.84296,1.85608,1.86905,1.88097,1.89279,1.90423
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4.99387,2.00265,2.01124,2.01965,2.02788,2.03595,2.04385,2.05161,2.0
55922,2.06668,2.07401,2.08121,2.08829,2.09524,2.10207,2.10880,2.115
641,2.12191,2.12832,2.13462,2.14083,2.14694,2.15296,2.15890,2.16475
7,2.17052,2.17621,2.18181,2.18734,2.19280,2.19819,2.20350,2.20875,2
```

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3,21392,2,21903,2,22408,2,22907,2,23399,2,23886,2,24367,2,24842,2,2  B 123
95311,2,25776,2,26234,2,26688,2,27137,2,31367,2,35192/                B 124
 DATA (ZZ(I),I=391,468)/0,00000,1,48289,1,71863,1,75792,1,79266,1,8   B 125
12383,1,85210,1,87796,1,90184,1,92401,1,94483,1,96429,1,98265,2,000   B 126
204,2,01660,2,03240,2,04753,2,06204,2,07601,2,08948,2,10249,2,11514  B 127
3,2,12731,2,13918,2,15075,2,16194,2,17285,2,18348,2,19390,2,20403,2  B 128
4,21393,2,22360,2,23308,2,24237,2,25146,2,26038,2,26912,2,27771,2,2  B 129
58613,2,29439,2,30252,2,31050,2,31836,2,32607,2,33366,2,34113,2,348  B 130
649,2,35560,2,36286,2,36987,2,37679,2,38361,2,39033,2,39695,2,40349  B 131
7,2,40993,2,41629,2,42256,2,42875,2,43486,2,44089,2,44684,2,45272,2  B 132
8,45852,2,46425,2,46992,2,47551,2,48104,2,48651,2,49191,2,49725,2,5  B 133
90253,2,50775,2,51291,2,51801,2,52306,2,57072,2,61392/                B 134
 DATA (ZZ(I),I=469,546)/0,00000,934,30000,982,30000,990,30000,999,1   B 135
10000,1008,70000,1019,30000,1030,60000,1042,80000,1055,80000,1070,3   B 136
20000,1084,70000,1099,80000,1115,90000,1132,10000,1148,80000,1165,9   B 137
30000,1183,90000,1202,00000,1220,40000,1239,30000,1259,60000,1279,3   B 138
40000,1299,40000,1320,90000,1341,70000,1363,00000,1384,60000,1407,3   B 139
50000,1429,60000,1452,30000,1475,50000,1499,00000,1522,70000,1546,8   B 140
60000,1571,30000,1596,00000,1621,10000,1646,40000,1672,10000,1698,0   B 141
70000,1724,20000,1750,80000,1777,40000,1804,50000,1831,80000,1859,4   B 142
80000,1886,90000,1915,10000,1943,40000,1971,80000,2000,50000,2029,4   B 143
90000,2058,50000,2087,70000,2117,20000,2146,80000,2176,70000,2206,7   B 144
$0000,2236,80000,2267,20000,2297,60000,2328,20000,2358,90000,2389,8   B 145
$0000,2420,80000,2451,90000,2483,10000,2514,50000,2545,90000,2577,4   B 146
$0000,2609,00000,2640,70000,2672,50000,2704,40000,2736,40000,3059,5   B 147
$0000,3387,20000/                                                     B 148
 DATA (ZZ(I),I=547,624)/0,00000,1972,50000,2088,90000,2108,30000,21   B 149
128,40000,2149,30000,2171,10000,2193,60000,2216,90000,2241,00000,22   B 150
266,60000,2292,10000,2318,30000,2345,60000,2372,90000,2400,80000,24   B 151
329,10000,2458,60000,2488,00000,2518,00000,2548,40000,2581,10000,26   B 152
412,60000,2644,50000,2678,70000,2711,70000,2745,20000,2779,30000,28   B 153
514,90000,2850,00000,2885,50000,2922,00000,2958,60000,2995,70000,30   B 154
633,30000,3071,40000,3109,90000,3148,90000,3188,30000,3228,20000,32   B 155
768,60000,3309,30000,3350,50000,3392,00000,3434,00000,3476,40000,35   B 156
819,20000,3562,50000,3605,80000,3649,70000,3693,90000,3738,50000,37   B 157
983,30000,3828,60000,3874,10000,3920,00000,3966,10000,4012,50000,40   B 158
$59,20000,4106,10000,4153,30000,4200,80000,4248,40000,4296,30000,43   B 159
$44,50000,4392,80000,4441,30000,4490,10000,4539,00000,4588,10000,46   B 160
$37,30000,4686,70000,4736,30000,4786,10000,4835,90000,4886,00000,53   B 161
$92,70000,5908,70000/                                                 B 162
 DATA (ZZ(I),I=625,702)/0,00000,9183,30000,9788,10000,9886,60000,99   B 163
185,40000,10084,70000,10184,60000,10284,90000,10385,70000,10486,800   B 164
200,10590,30000,10692,70000,10795,90000,10901,30000,11006,00000,111   B 165
311,60000,11218,10000,11327,40000,11435,90000,11545,70000,11656,300   B 166
```

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400,11775.00000,11888.30000,12003.10000,12119.50000,12242.90000,123   B 167
561.90000,12482.50000,12608.30000,12731.80000,12856.90000,12985.800   B 168
600,13114.10000,13244.00000,13375.40000,13508.30000,13642.80000,137   B 169
778.80000,13916.20000,14055.00000,14195.50000,14337.20000,14480.600   B 170
800,14624.70000,14771.20000,14918.50000,15067.40000,15117.50000,153   B 171
968.80000,15521.40000,15675.30000,15830.40000,15986.60000,16144.200   B 172
$00,16302.80000,16462.50000,16623.10000,16785.00000,16947.80000,171   B 173
$11.60000,17276.30000,17441.90000,17608.30000,17775.70000,17943.900   B 174
$00,18113.00000,18282.60000,18453.20000,18624.50000,18796.40000,189   B 175
$69.00000,19142.20000,19316.20000,19490.80000,19665.80000,19841.600   B 176
$00,21626.50000,23452.30000/                                          B 177
 DATA (ZZ(I),I=703,780)/0.00000,-.19680,-.06420,-.04210,-.02100,-.0   B 178
10060,.01930,.03900,.05850,.07800,.09730,.11650,.13550,.15370,.1713   B 179
20,.18830,.20520,.22150,.23730,.25290,.26850,.28420,.29900,.31370,.   B 180
332830,.34260,.35640,.37020,.38380,.39720,.41040,.42320,.43590,.448   B 181
450,.46100,.47340,.48560,.49770,.50970,.52140,.53310,.54460,.55600,   B 182
5.56730,.57850,.58950,.60040,.61110,.62180,.63240,.64280,.65320,.66   B 183
6340,.67350,.68350,.69340,.70320,.71290,.72250,.73200,.74140,.75070   B 184
7,.75990,.76900,.77800,.78690,.79570,.80450,.81310,.82170,.83020,.8   B 185
83850,.84680,.85500,.86320,.87120,.94730,1.01630/                     B 186
 DATA (ZZ(I),I=781,858)/0.00000,.60580,.92020,.97260,1.02030,1.0645   B 187
10,1.10590,1.14500,1.18240,1.21830,1.25370,1.28660,1.31820,1.34990,   B 188
21.37950,1.40800,1.43590,1.46230,1.48870,1.51410,1.53910,1.56430,1.   B 189
358830,1.61130,1.63460,1.65720,1.67900,1.70070,1.72210,1.74300,1.76   B 190
4370,1.78350,1.80350,1.82330,1.84290,1.86210,1.88120,1.90000,1.9185   B 191
50,1.93690,1.95500,1.97290,1.99060,2.00810,2.02540,2.04260,2.05950,   B 192
62.07620,2.09280,2.10920,2.12540,2.14150,2.15740,2.17310,2.18870,2.   B 193
720410,2.21930,2.23440,2.24940,2.26410,2.27880,2.29330,2.30760,2.32   B 194
8180,2.33580,2.34980,2.36350,2.37720,2.39070,2.40400,2.41720,2.4303   B 195
90,2.44330,2.45610,2.46890,2.48150,2.60080,2.70950/                   B 196
 DATA (ZZ(I),I=859,936)/0.00000,6.18860,7.76960,8.03310,8.26620,8.4   B 197
17560,8.66590,8.84010,9.00140,9.15150,9.29510,9.42740,9.55210,9.672   B 198
260,9.78600,9.89400,9.99840,10.09840,10.19540,10.28860,10.37950,10.   B 199
347070,10.56350,10.63970,10.72330,10.80340,10.88110,10.95770,11.033   B 200
430,11.10700,11.17970,11.24910,11.31940,11.38880,11.45700,11.52430,   B 201
511.59070,11.65630,11.72090,11.78470,11.84780,11.91020,11.97180,12.   B 202
603250,12.09290,12.15250,12.21140,12.26890,12.32740,12.38440,12.440   B 203
790,12.49680,12.55210,12.60680,12.66110,12.71470,12.76790,12.82020,   B 204
812.87260,12.92420,12.97530,13.02580,13.07590,13.12550,13.17460,13.   B 205
922320,13.27140,13.31940,13.36640,13.41310,13.45950,13.50540,13.550   B 206
$90,13.59590,13.64050,13.68470,14.10500,14.48970/                     B 207
 CONTINUE                                                             B 208
 KTEST=0                                                              B 209
 IP=-1                                                                B 210
```

```
      IF (IE.EQ.0.0) GO TO 5                                                    B 211
2     IF (ZTHRUST.EQ.0.0) GO TO 5                                               B 212
      NLC=NZCNT-1                                                               B 213
      IF (IDDBS.EQ.0) GO TO 3                                                   B 214
      CALL MTLUP (ZTHRUST,ZEE,2,NLC,50,10,IP,ZFN,YFN)                           B 215
      GO TO 4                                                                   B 216
3     CALL MTLUP (ZTHRUST,ZEE,2,NLC,50,10,IP,ZFN,YFN)                           B 217
      DLDB=0.0                                                                  B 218
4     WRITE (6,19) ZTHRUST,(ZEE(I),I=1,10)                                      B 219
      WRITE (8,20) ZEE(3),ZEE(1),ZEE(2),ZEE(5),EMACH,ZEE(10)                    B 220
5     READ (5,ENPUT)                                                            B 221
      IF (EOF(5)) 18,6                                                          B 222
6     H=HJ(IFUEL)                                                               B 223
      HS=HSJ(IFUEL)                                                             B 224
      TF=TFJ(IFUEL)                                                             B 225
      FS=FSJ(IFUEL)                                                             B 226
      AMP=AMPJ(IFUEL)                                                           B 227
      DO 7 I=1,78                                                               B 228
      TABH4(I)=TABH4J(I,IFUEL)                                                  B 229
      TABPH5(I)=TABPH5J(I,IFUEL)                                                B 230
      TABPSH(I)=TABPSHJ(I,IFUEL)                                                B 231
7     TABPSP(I)=TABPSPJ(I,IFUEL)                                                B 232
      IF (IE) 8,8,9                                                             B 233
8     WRITE (6,ENPUT)                                                           B 234
      IE=IE+1                                                                   B 235
9     NO=0                                                                      B 236
      NZCNT=1                                                                   B 237
      AMP28=AMP*28.97                                                           B 238
      FS28MP=((1.+FS)*28.97-AMP)/FS                                             B 239
      WRITE (6,23) ICASE,IPC,PS,ALT,EMACH,HPEXT,IDDBS,WCOW1,WB,CV,ZTHRUS        B 240
     1T                                                                         B 241
      IPP=0                                                                     B 242
      EN=ENN                                                                    B 243
      P80P0=P80P8                                                               B 244
      TT4=TT4N                                                                  B 245
      CALL FRES                                                                 B 246
      HNEW=ALT                                                                  B 247
      ICODE=1                                                                   B 248
      IF (IDES-1) 10,11,11                                                      B 249
C                                                                               B 250
C     DESIGN CASE                                                               B 251
C                                                                               B 252
10    PT2PT1=PT2T1D                                                             B 253
C                                                                               B 254
```

```
C       WIDE IS INPUT FOR WID                                                  B 255
        W1D=WIDE                                                               B 256
        DELTOD=STTO/DELTO*1./PT1PTO                                            B 257
        EN=ENN                                                                 B 258
        A4A4D=1.                                                               B 259
        CALL COND                                                              B 260
        CALL TURB                                                              B 261
        CALL COOL                                                              B 262
        HT6M=HT5AM                                                             B 263
        PHIT6M=PHT5AM                                                          B 264
        F6=F5A                                                                 B 265
        TT6=TT5A                                                               B 266
        OF6=1.+F6                                                              B 267
        PT6T5A=PT65AD                                                          B 268
        CALL NOZZ                                                              B 269
        CALL ENG                                                               B 270
        WRITE (6,21) PT2T1D,W1DCOR,Z,ONSRT,ETA2,PT1PTO,TTO,TT2,TT4,DH2M1,E     B 271
       1TA5                                                                    B 272
        WRITE (6,22) HT1,HT2I                                                  B 273
        GO TO 16                                                               B 274
C                                                                              B 275
C       REGULAR CASE                                                           B 276
C                                                                              B 277
11      CALL MATCH                                                             B 278
        CALL TURB                                                              B 279
        CALL COOL                                                              B 280
        IF (IPC-2) 13,12,17                                                    B 281
12      HT6M=HT5AM                                                             B 282
        PHIT6M=PHT5AM                                                          B 283
        F6=F5A                                                                 B 284
        TT6=TT5A                                                               B 285
        OF6=1.+F6                                                              B 286
        PT6T5A=PT65AD                                                          B 287
        CALL NOZZ                                                              B 288
        CALL ENG                                                               B 289
        GO TO 16                                                               B 290
C       NO AFTERBURNER                                                         B 291
C       AFTERBURNER                                                            B 292
13      CALL AFTER                                                             B 293
14      IF (IPP-1) 2,15,15                                                     B 294
15      CALL PARP                                                              B 295
        GO TO 2                                                                B 296
16      POWER=TT4                                                              B 297
        CALL OUTPUN (POWER)                                                    B 298
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      GO TO 14                                                          B 299
17    IPP=1                                                             B 300
      IF (IPC-3) 13,13,12                                               B 301
18    STOP                                                              B 302
C                                                                       B 303
19    FORMAT (/30X,58HOUTPUT ENGINE PARAMETERS CORRESPONDING TO THRUST V B 304
     1ALUE OF ,1F8.1,5HLBS. /1X,10HGASFLOW = ,1F7.1,8H LBS/SEC,2X15HJET B 305
     2VELOCITY = ,1F7.2,7HFT/SEC,2X,11HJET AREA = ,1F7.3,7HSQ.FT.,2X11HR B 306
     3AM DRAG = ,1F8.1,5HLBS. /1X13HNET THRUST = ,1F8.1,5HLBS. ,2X19HTUR B 307
     4BINE IN TEMP. = ,1F7.2,2HR.2X18HNOISE REDUCTION = ,1F7.3,3HDB.,2X1 B 308
     59HATMOSPHERE = STD + ,1F3.1,3H C./1X28HSPECIFIC FUEL CONSUMPTION = B 309
     6 ,1F6.4,11HLBM/HR/LBF.,1X20HTURBINE EXIT TEMP = ,1F6.1,2H R)      B 310
20    FORMAT (1F10.4,1F10.3,1F10.2,1F10.1,1F10.4,1F10.2)                B 311
21    FORMAT (1H06X11HDESIGN CASE5X6HPT2T1DE16.8,4X6HW1DCORE16.8,9X1HZE1 B 312
     16.8,5X5HONSRTE16.8/6X4HETA2E16.8,4X6HPT1PTOE16.8,7X3HTTOE16.8,7X3H B 313
     2TT2E16.8,7X3HTT4E16.8/6X5HDH2-1E16.8,6X4HETA5E16.8)               B 314
22    FORMAT (1H06X3HHT15XE16.8,5X4HHT214XE16.8/)                       B 315
23    FORMAT (1H06X5HINPUT5X4HCASE4XI4,5X2HPC6XI4,5X2HP36XE16.8/7X3HALTE B 316
     116.8,6X4HMACHE16.8,5X5HHPEXTE16.8,5X5HIDDBS4XI4/5X5HWCOW1E16.8,8X2 B 317
     22HWBE16.8,8X2HCVE16.8,3X7HZTHRUSTE16.2/)                          B 318
      END                                                               B 319-
```

```
      SUBROUTINE MATCH                                                  C   1
      DIMENSION ALTSAV(15), EMSAV(15), NOSAV(15), FNSAV(15), W2SAV(15),  C   2
     1SFCSAV(15)                                                        C   3
      DIMENSION TABTEM(78), TABH(78), TABPHI(78), TABPSH(78), TABM(19),  C   4
     1TABPT1(19), TABNST(9), TABPT2(09), TABZ(11), TABW1(99), TABETA(99) C   5
     2, ANS(5), SFCC(25), TABPSP(78)                                    C   6
      DIMENSION PBTAB(8), HDT(20), DTTAB(20)                            C   7
      DIMENSION TABPH5(78), TABH4(78)                                   C   8
      DIMENSION TABN(12), TABA7(12), RAT(2), T4(3)                      C   9
      DIMENSION TABVJ(17), TABDLDB(17)                                  C  10
C                                                                       C  11
C     INPUT                                                             C  12
C                                                                       C  13
      COMMON /BK1/ ALT,EMACH,PT2T1D,TT4N,WCOW1,WB,A7A7DN,PT65AD,A4A4DN,P C  14
     180P8,W1D,H,ETA2D,ENN,X,Y,TF,PT8PT6,CV,TT6MAX,PT6T5A,ETA6,IDES,VAL, C  15
     2GAMO,RO,AJ,TSLS,PSLS,G,TABTEM,TABH,TABPHI,TABPSH,TABPSP,TABM,TABNS C  16
     3T,TABPT2,TABZ,TABW1,TABETA,TABPT1,IDDBS,TABVJ,TABDLDB              C  17
C                                                                       C  18
```

```
C      COMPUTED VALUES                                                    C  19
C                                                                         C  20
       COMMON /BK2/ WBOW1,AOAS,ABCOR,A80A7,A7A7D,ANS,AP0,A4A4D,A7,A8,AO,A  C  21
      1BOW1,ABEM7,TO,T8,T7,T7I,T8I,TTO,TT2,TT1,TT2I,TT2TT1,TT5,TT5A,TT7TT  C  22
      21,TT6,TT7TT6,TT4,PO,P80P0,PT7,HF,H8M,H8,H8I,H8IM,H7M,H7,H7MI,HAB,H  C  23
      3AB5,HO,HTO,HT2,HT2I,HT4M,HT4,HT5M,HT5,HT505,HT5AM,HT5H,HT7M,HT7MI,  C  24
      4HT6M,HT8M,HT5A05,PHIO,PHITO,PHIT2I,PHIT1,PHIT4M,PHIT4,PHIT5A,PHT5A  C  25
      5M,PHI8M,PHIT8M,PHI8,PHI2I,PHIT6M,PHI7M,PHIT6,PHIT7M,PHOF6,PHOH6,PT  C  26
      60P0,PT1PTO,PT2T1S,PT2PT1,PT4PT2,PT5PT4,PT5T5A,PT8P8,PT1PT7,PT7P7,P  C  27
      7T6PT5,PT6T5D,PT5AM,PT55AD,PSIH4,PSPI4,PSIH5,PSP15A,PSIH5A,PSPI8,PS  C  28
      8IH8,PSIH7,PSPI6,PSIPHI,PSIH6,PSIH8I,PSPI7,EN,ETA2,ET5A,ETETS,ETA2S  C  29
      9,ET2D,EM7,EM8,W1COR,W1DCOR,W4COR,W4DCOR,W7COR,W7DCOR,W4TOT4,W4TEST  C  30
      $,W1,W1K,DH2M1,STTO,DELTO,DELTOD,GAMA8,GAMA7,VO,V7,V8,GAM7P1,GAM7M1  C  31
      $,ONSRT,SFC,SFCC,OF4,OF6,FOF6,F4,F5A,FAB,F6,FNOW1,FN,F6A,FOF4,FO5A,  C  32
      $W8,RT5,RTA,RT6,RT5A,CP7,CP8,CAPA8,CAPA7,OWB,WCB,ICOMB,IPP,IS,ICOUN  C  33
      $T,IKONT,JCONT,IC,KTEST,THET1,THETO,DW1,DW2,DDHP,Z1,Z2,Z3,Z,ETAC,ET  C  34
      $AO,FNOW1D,HT6,PHIH6,T5A,T4,RAT,WCOW1C,PBTAB,HDT,DTTAB,IPS,DTEMP,ET  C  35
      $AP,ALTSAV,EMSAV,NOSAV,FNSAV,W2SAV,SFCSAV,NO,INOZZ,TT2T1D,HT5A,PHT1  C  36
      $,TT4TT2,PHIT5,PSPI5,PHIT5M,HT1,PT2T1L,PS,TABA7,T8VAL,T7VAL,NLIM,NU  C  37
      $MBER,NSTART,NFINAL,AVAL,XMNSLU,TABN,ETA4,ETA5,TABPH5,TABH4,HPEXT,I  C  38
      $CASE,IPC,PT4T2D,HS,T5VAL,WC                                        C  39
       ICOUNT=0                                                           C  40
       JCOUNT=1                                                           C  41
       THET1=THETO                                                        C  42
       ONSRT=EN/SQRT(THET1)                                               C  43
       Z=1.                                                               C  44
       CALL DISCOT (ONSRT,ONSRT,TABNST,TABPT2,TABPT2,-11,09,0,PT2T1L)     C  45
       PT2T1L=PT2T1L*PT2T1S                                               C  46
     1 CALL DISCOT (ONSRT,Z,TABNST,TABW1,TABZ,11,99,11,W1COR)             C  47
       CALL DISCOT (ONSRT,Z,TABNST,TABETA,TABZ,11,99,11,ETETS)            C  48
       PT2PT1=(Z*(1.-X)+X)*(PT2T1L-1.)+1.                                 C  49
       ETA2=ETETS*ETA2S                                                   C  50
       IF (PT2PT1.LT.0) GO TO 11                                          C  51
       PHIT2I=PHT1+RO/AJ*ALOG(PT2PT1)                                     C  52
       CALL DISCOT (PHIT2I,PHIT2I,TABPHI,TABTEM,TABTEM,-11,78,0,TT2I)     C  53
       CALL DISCOT (TT2I,TT2I,TABTEM,TABH,TABH,-11,78,0,HT2I)             C  54
       DH2M1=(HT2I-HT1)/ETA2                                              C  55
       HT2=HT1+DH2M1                                                      C  56
       CALL DISCOT (HT2,HT2,TABH,TABTEM,TABTEM,-11,78,0,TT2)              C  57
       TT2TT1=TT2/TT1                                                     C  58
       W1K=W1COR/W1DCOR*W1D*DELTOD                                        C  59
       W1=W1K*DELTO/STTO*PT1PTO                                           C  60
       WBOW1=WB/W1                                                        C  61
       OWB=1.-WBOW1                                                       C  62
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```
      CALL COMB                                                          C  63
      DW2=W4DCOR-W4COR*1.0/A4A4D                                         C  64
      ABCOR=ABS(DW2)                                                     C  65
      W4TEST=.001*W4DCOR                                                 C  66
      IF (JCOUNT-2) 2,8,7                                                C  67
2     IF (DW2) 4,5,3                                                     C  68
3     IF (ABCOR-W4TEST) 5,5,6                                            C  69
4     WRITE (6,12) W4DCOR,W4COR                                          C  70
      ICOUNT=2                                                           C  71
5     Z=Z2                                                               C  72
      RETURN                                                             C  73
6     JCOUNT=JCOUNT+1                                                    C  74
      DW1=DW2                                                            C  75
      Z2=0                                                               C  76
      Z1=Z                                                               C  77
      Z=Z2                                                               C  78
      GO TO 1                                                            C  79
7     IF (ABCOR-W4TEST) 5,5,10                                           C  80
8     IF (DW2) 9,5,4                                                     C  81
9     IF (ABCOR-W4TEST) 10,5,10                                          C  82
10    Z3=Z1-(((Z1-Z2)*DW1)/(DW1-DW2))                                    C  83
      IF (Z3.LT.0) Z3=.5*Z2                                              C  84
      IF (Z3.GT.1.) Z3=.5*Z1                                             C  85
      Z1=Z2                                                              C  86
      Z2=Z3                                                              C  87
      Z=Z2                                                               C  88
      DW1=DW2                                                            C  89
      JCOUNT=JCOUNT+1                                                    C  90
      IF (JCOUNT-25) 1,1,4                                               C  91
11    WRITE (6,13) PT2PT1,X,Z,PT2T1L                                     C  92
      WRITE (6,14) Z1,Z2,Z3,DW1,DW2                                      C  93
      STOP                                                               C  94
C                                                                        C  95
12    FORMAT (1H06X11HNO SOLUTION6X6HW4DCOR2XE16.8,5X5HW4COR3XE16.8/)    C  96
13    FORMAT (1H06X4E15.8)                                               C  97
14    FORMAT (1H06X2HZ1E15.8,2X2HZ2E15.8,2X2HZ3E15.8,2X3HDW1E15.8,2X3HDW C  98
     12E15.8/)                                                           C  99
      END                                                                C 100-
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```
      SUBROUTINE NOZZ                                                    D    1
      DIMENSION ALTSAV(15), EMSAV(15), NOSAV(15), FNSAV(15), W2SAV(15),  D    2
     1SFCSAV(15)                                                         D    3
      DIMENSION TABTEM(78), TABH(78), TABPHI(78), TABPSH(78), TABM(19),  D    4
     1TABPT1(19), TABNST(9), TABPT2(09), TABZ(11), TABW1(99), TABETA(99) D    5
     2, ANS(5), SFCC(25), TABPSP(78)                                     D    6
      DIMENSION PBTAB(8), HDT(20), DTTAB(20)                             D    7
      DIMENSION TABPH5(78), TABH4(78)                                    D    8
      DIMENSION TABN(12), TABA7(12), RAT(2), T4(3)                       D    9
      DIMENSION TABVJ(17), TABDLDB(17)                                   D   10
C                                                                        D   11
CC    INPUT                                                              D   12
C                                                                        D   13
      COMMON /BK1/ ALT,EMACH,PT2T1D,TT4N,WCOW1,WB,A7A7DN,PT65AD,A4A4DN,P  D   14
     180P8,W1D,H,ETA2D,ENN,X,Y,TF,PT8PT6,CV,TT6MAX,PT6T5A,ETA6,IDES,VAL, D   15
     2GAMO,RO,AJ,TSLS,PSLS,G,TABTEM,TABH,TABPHI,TABPSH,TABPSP,TABM,TABNS  D   16
     3T,TABPT2,TABZ,TABW1,TABETA,TABPT1,IDDBS,TABVJ,TABDLDB              D   17
C                                                                        D   18
CC    COMPUTED VALUES                                                    D   19
C                                                                        D   20
      COMMON /BK2/ WBOW1,AOAS,ABCOR,A80A7,A7A7D,ANS,APO,A4A4D,A7,A8,AO,A  D   21
     180W1,ABEM7,TO,T8,T7,T7I,T8I,TTO,TT2,TT1,TT2I,TT2TT1,TT5,TT5A,TT7TT D   22
     21,TT6,TT7TT6,TT4,PO,P80P0,PT7,HF,H8M,H8,H8I,H8IM,H7M,H7,H7MI,HAB,H  D   23
     3AB5,HO,HTO,HT2,HT2I,HT4M,HT4,HT5M,HT5,HT505,HT5AM,HT5H,HT7M,HT7MI,  D   24
     4HT6M,HT8M,HT5A05,PHIO,PHITO,PHIT2I,PHIT1,PHIT4M,PHIT4,PHIT5A,PHT5A  D   25
     5M,PHI8M,PHIT8M,PHI8,PHI2I,PHIT6M,PHI7M,PHIT6,PHIT7M,PHOF6,PHOH6,PT  D   26
     60P0,PT1PTO,PT2T1S,PT2PT1,PT4PT2,PT5PT4,PT5T5A,PT8P8,PT1PT7,PT7P7,P  D   27
     7T6PT5,PT6T5D,PT5AM,PT55AD,PSIH4,PSPI4,PSIH5,PSPI5A,PSIH5A,PSPI8,PS  D   28
     8IH8,PSIH7,PSPI6,PSIPHI,PSIH6,PSIH8I,PSPI7,EN,ETA2,ET5A,ETETS,ETA2S  D   29
     9,ET2D,EM7,EM8,W1COR,W1DCOR,W4COR,W4DCOR,W7COR,W7DCOR,W4TOT4,W4TEST  D   30
     $,W1,W1K,DH2M1,STTO,DELTO,DELTOD,GAMA8,GAMA7,VO,V7,V8,GAM7P1,GAM7M1  D   31
     $,ONSRT,SFC,SFCC,OF4,OF6,FOF6,F4,F5A,FAB,F6,FNOW1,FN,F6A,FOF4,FO5A,  D   32
     $W8,RT5,RTA,RT6,RT5A,CP7,CP8,CAPA8,CAPA7,OWB,WCB,ICOMB,IPP,IS,ICOUN  D   33
     $T,IKONT,JCONT,IC,KTEST,THET1,THETO,DW1,DW2,DDHP,Z1,Z2,Z3,Z,ETAC,ET  D   34
     $AO,FNOW1D,HT6,PHIH6,T5A,T4,RAT,WCOW1C,PBTAB,HDT,DTTAB,IPS,DTEMP,ET  D   35
     $AP,ALTSAV,EMSAV,NOSAV,FNSAV,W2SAV,SFCSAV,NO,INOZZ,TT2T1D,HT5A,PHTI  D   36
     $,TT4TT2,PHIT5,PSPI5,PHIT5M,HT1,PT2T1L,PS,TABA7,T8VAL,T7VAL,NLIM,NU  D   37
     $MBER,NSTART,NFINAL,AVAL,XMNSLU,TABN,ETA4,ETA5,TABPH5,TABH4,HPEXT,I  D   38
     $CASE,IPC,PT4T2D,HS,T5VAL                                           D   39
      COMMON /RRR/ AMP28,FS28MP,AMP                                      D   40
      PHIT7M=PHIT6M                                                      D   41
      IIKONT=0                                                           D   42
      FOF6=F6/(1.+F6)                                                    D   43
      PT8P8=PTOP0*PT1PTO*PT2PT1*PT4PT2*PT5PT4*1./PT5T5A*PT8PT6*PT6T5A*(1 D   44
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```
      1./P80P8)                                                                 D  45
       IF (PT8P8-1.005) 1,1,2                                                   D  46
1      WRITE (6,31)                                                             D  47
       GO TO 8                                                                  D  48
2      IF (F6-F5A) 3,4,3                                                        D  49
3      RT6=1545.*FOF6*(FS28MP+AMP/F6)/AMP28                                     D  50
       GO TO 5                                                                  D  51
4      RT6=RT5A                                                                 D  52
       TT6=TT5A                                                                 D  53
5      PHIT8M=PHIT6M                                                            D  54
       PHI8M=PHIT8M-(RT6/AJ*ALOG(PT8P8))                                        D  55
       IROU=8                                                                   D  56
       CALL ITT (PHI8M,TABPH5,TABPHI,TABTEM,TABPSP,T8VAL,FOF6,IROU,T8,PHI       D  57
      18,PSPI8)                                                                 D  58
       CALL DISCOT (T8,T8,TABTEM,TABH,TABH,-11,78,0,H8)                         D  59
       CALL DISCOT (T8,T8,TABTEM,TABPSH,TABPSH,-11,78,0,PSIH8)                  D  60
       H8M=H8+PSIH8*FOF6                                                        D  61
       HT8M=HT6M                                                                D  62
       IF (HT8M-H8M) 6,6,9                                                      D  63
6      WRITE (6,32)                                                             D  64
       IF (IDES) 7,7,8                                                          D  65
7      STOP                                                                     D  66
8      A4A4D=1.                                                                 D  67
       CALL MAIN                                                                D  68
9      V8=SQRT(2.*G*AJ*(HT8M-H8M))                                              D  69
       T8I=T8+2.                                                                D  70
       CALL DISCOT (T8I,T8I,TABTEM,TABH,TABH,-11,78,0,H8I)                      D  71
       CALL DISCOT (T8I,T8I,TABTEM,TABPSH,TABPSH,-11,78,0,PSIH8I)               D  72
       H8IM=H8I+PSIH8I*FOF6                                                     D  73
       CP8=(H8IM-H8M)/(T8I-T8)                                                  D  74
       W8=W1*OF6*OWB                                                            D  75
       CAPA8=(W8*RT6*T8)/(V8*P80P0*P0)                                          D  76
       GAMA8=CP8/(CP8-RT6/AJ)                                                   D  77
       A8=SQRT(GAMA8*RT6*T8*G)                                                  D  78
       PT1PT7=(PT2PT1*PT4PT2*PT5PT4*1./PT5T5A*PT6T5A*PT8PT6)**(-1)              D  79
       TT7TT1=TT2TT1*TT4/TT2*TT5/TT4*TT5A/TT5*TT6/TT5A                          D  80
       IF (IDES-1) 10,11,11                                                     D  81
10     W7DCOR=W1DCOR*(1.-WBOW1)*OF6*SQRT(TT7TT1)*PT1PT7                         D  82
       A7A7D=1.                                                                 D  83
       GO TO 12                                                                 D  84
11     W7COR=W1COR*(1.-WBOW1)*OF6*SQRT(TT7TT1)*PT1PT7                           D  85
12     EM8=V8/A8                                                                D  86
       IF (EM8-1.) 13,13,16                                                     D  87
13     A80A7=1.                                                                 D  88
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```
      EM7=EM8                                                                D  89
      GAMA7=GAMA8                                                            D  90
      V7=V8                                                                  D  91
      GAM7P1=GAMA7+1.                                                        D  92
      GAM7M1=GAMA7-1.                                                        D  93
      AOAS=(2./GAM7P1)**(GAM7P1/(2.*GAM7M1))*1./EM7*(1.+GAM7M1/2.*EM7**2     D  94
     1)**(GAM7P1/(2.*GAM7M1))                                                D  95
      IF (IDES-1) 14,15,15                                                   D  96
14    AOASD=AOAS                                                             D  97
      RETURN                                                                 D  98
15    A7A7D=(W7COR*AOAS)/(W7DCOR*AOASD)                                      D  99
      RETURN                                                                 D 100
16    AOAS=1.                                                                D 101
      PT7P71=1.8                                                             D 102
      PT7P7=PT7P71                                                           D 103
17    CONTINUE                                                               D 104
      IF (PT7P7) 18,19,19                                                    D 105
18    WRITE (6,33) PT7P7                                                     D 106
      CALL MAIN                                                              D 107
19    CONTINUE                                                               D 108
      PHI7M=PHIT7M-RT6/AJ*ALOG(PT7P7)                                        D 109
      IROU=7                                                                 D 110
      CALL ITT (PHI7M,TABPH5,TABPHI,TABTEM,TABPSP,T7VAL,FOF6,IROU,T7,PHI     D 111
     17,PSPI7)                                                               D 112
      CALL DISCOT (T7,T7,TABTEM,TABH,TABH,-11,78,0,H7)                       D 113
      CALL DISCOT (T7,T7,TABTEM,TABPSH,TABPSH,-11,78,0,PSIH7)                D 114
      H7M=H7+FOF6*PSIH7                                                      D 115
      HT7M=HT6M                                                              D 116
      IF (HT7M-H7M) 20,21,21                                                 D 117
20    WRITE (6,34)                                                           D 118
      PRINT 35, H7M,HT7M                                                     D 119
      IF (IDES) 7,7,8                                                        D 120
21    V7=SQRT(2.*G*AJ*(HT7M-H7M))                                            D 121
      T7I=T7+2.                                                              D 122
      CALL DISCOT (T7I,T7I,TABTEM,TABH,TABH,-11,78,0,H7I)                    D 123
      CALL DISCOT (T7I,T7I,TABTEM,TABPSH,TABPSH,-11,78,0,PSIH7I)             D 124
      H7IM=H7I+FOF6*PSIH7I                                                   D 125
      CP7=(H7M-H7IM)/(T7-T7I)                                                D 126
      GAMA7=CP7/(CP7-RT6/AJ)                                                 D 127
      A7=SQRT(GAMA7*RT6*T7*G)                                                D 128
      EM7=V7/A7                                                              D 129
      IIKONT=IIKONT+1                                                        D 130
      IF (IIKONT-2) 22,27,27                                                 D 131
22    EM71=EM7                                                               D 132
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```
      IF (EM7.GE..999.AND.EM7.LE.1.001) GO TO 30                        D 133
      IF (EM7-1.) 23,30,26                                              D 134
23    PT7P72=PT7P71+VAL                                                 D 135
24    IIKONT=IIKONT+1                                                   D 136
      PT7P7=PT7P72                                                      D 137
25    IF (IIKONT-10) 17,17,29                                           D 138
26    PT7P72=PT7P71-VAL                                                 D 139
      GO TO 24                                                          D 140
27    IF (EM7.GE..999.AND.EM7.LE.1.001) GO TO 30                        D 141
      IF (EM7.LT..999.OR.EM7.GT.1.001) GO TO 28                         D 142
28    EM72=EM7                                                          D 143
      PT7P73=PT7P71-((EM71-1.)/(EM71-EM72)*(PT7P71-PT7P72))             D 144
      PT7P71=PT7P72                                                     D 145
      PT7P72=PT7P73                                                     D 146
      EM71=EM72                                                         D 147
      PT7P7=PT7P73                                                      D 148
      IIKONT=IIKONT+1                                                   D 149
      GO TO 25                                                          D 150
29    WRITE (6,36)                                                      D 151
      PRINT 37, T7,H7,PSIH7,H7M,V7,HT7M,PHI7,PSPI7,FOF6,T7I,H7I,PSIH7I,H D 152
     17IM,A7,CP7,GAMA7,EM7,PT7PT3,IIKONT,PT7P7                          D 153
30    CAPA7=(W1*OF6*RT6*T7)/(V7*(PT8P8*1./PT8PT6*1./PT7P7*P80PO*PO))*OW8 D 154
      A8OA7=CAPA8/CAPA7                                                 D 155
      IF (IDES) 14,14,15                                                D 156
C                                                                       D 157
31    FORMAT (1H06X37HNOZZLE PRESSURE RATIO LESS THAN 1.005)            D 158
32    FORMAT (1H0,6X,*HT8MISLESSTHANH8M*)                               D 159
33    FORMAT (1H0,6X,*PT7P7ISNEGATIVE=*,E14.6)                          D 160
34    FORMAT (1H0,6X,*HT7MISLESSTHANH7M*)                               D 161
35    FORMAT (1H ,2X,3HH7M,F12.5,2X,4HHT7M,F12.5)                       D 162
36    FORMAT (1H06X24HSTOPPED IN M7 ITTERATION)                         D 163
37    FORMAT (1H ,2X,2HT7,F12.5,3X,2HH7,F12.5,3X,5HPSIH7,F12.5,3X,3HH7M, D 164
     1F12.5,2X,2HV7,F12.5,2X,4HHT7M,F12.5,2X,4HPHI7,F12.5/1X,3HT7I,F12.5 D 165
     2,2X,3HH7I,F12.5,2X,6HPSIH7I,F12.5,2X,4HH7IM,F12.5,2X,2HA7,F12.5,3X D 166
     3,3HCP7,F12.5,1X,5HGAMA7,F12.5/1X,3HEM7,F12.5,1X,4HFOF6,F12.5,2X,6H D 167
     4IIKONT,I4,1X,5HPSPI7,F12.5,1X,5HPT7P7,F12.5,1X,6HPT7PT3,F12.5)    D 168
      END                                                               D 169-
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```
      SUBROUTINE COOL                                                   E   1
      DIMENSION ALTSAV(15), EMSAV(15), NOSAV(15), FNSAV(15), W2SAV(15),  E   2
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     1SFCSAV(15)                                                                E    3
      DIMENSION TABTEM(78), TABH(78), TABPHI(78), TABPSH(78), TABM(19),         E    4
     1TABPT1(19), TABNST(9), TABPT2(09), TABZ(11), TABW1(99), TABETA(99)        E    5
     2, ANS(5), SFCC(25), TABPSP(78)                                            E    6
      DIMENSION PBTAB(8), HDT(20), DTTAB(20)                                    E    7
      DIMENSION TABPH5(78), TABH4(78)                                           E    8
      DIMENSION TABN(12), TABA7(12), RAT(2), T4(3)                              E    9
      DIMENSION TABVJ(17), TABDLDB(17)                                          E   10
C                                                                               E   11
C     INPUT                                                                     E   12
C                                                                               E   13
      COMMON /BK1/ ALT,EMACH,PT2T1D,TT4N,WCOW1,WB,A7A7DN,PT65AD,A4A4DN,P        E   14
     180P8,W1D,H,ETA2D,ENN,X,Y,TF,PT8PT6,CV,TT6MAX,PT6T5A,ETA6,IDES,VAL,       E   15
     2GAMO,RO,AJ,TSLS,PSLS,G,TABTEM,TABH,TABPHI,TABPSH,TABPSP,TABM,TABNS        E   16
     3T,TABPT2,TABZ,TABW1,TABETA,TABPT1,IDDBS,TABVJ,TABDLDB                     E   17
C                                                                               E   18
C     COMPUTED VALUES                                                           E   19
C                                                                               E   20
      COMMON /BK2/ WBOW1,AOAS,ABCOR,A80A7,A7A7D,ANS,APO,A4A4D,A7,A8,AO,A        E   21
     180W1,ABEM7,TO,T8,T7,T7I,T8I,TTO,TT2,TT1,TT2I,TT2TT1,TT5,TT5A,TT7TT       E   22
     21,TT6,TT7TT6,TT4,PO,P80PO,PT7,HF,H8M,H8,H8I,H8IM,H7M,H7,H7MI,HAB,H       E   23
     3AB5,HO,HTO,HT2,HT2I,HT4M,HT4,HT5M,HT5,HT505,HT5AM,HT5H,HT7M,HT7MI,       E   24
     4HT6M,HT8M,HT5A05,PHIO,PHITO,PHIT2I,PHIT1,PHIT4M,PHIT4,PHIT5A,PHT5A       E   25
     5M,PHI8M,PHIT8M,PHI8,PHI2I,PHIT6M,PHI7M,PHIT6,PHIT7M,PHOF6,PHOH6,PT       E   26
     60PO,PT1PTO,PT2T1S,PT2PT1,PT4PT2,PT5PT4,PT5T5A,PT8P8,PT1PT7,PT7P7,P       E   27
     7T6PT5,PT6T5D,PT5AM,PT55AD,PSIH4,PSPI4,PSIH5,PSP15A,PSIH5A,PSPI8,PS       E   28
     8IH8,PSIH7,PSPI6,PSIPHI,PSIH6,PSIH8I,PSPI7,EN,ETA2,ET5A,ETETS,ETA2S       E   29
     9,ET2D,EM7,EM8,W1COR,W1DCOR,W4COR,W4DCOR,W7COR,W7DCOR,W4TOT4,W4TEST        E   30
     $,W1,W1K,DH2M1,STTO,DELTO,DELTOD,GAMA8,GAMA7,VO,V7,V8,GAM7P1,GAM7MI       E   31
     $,ONSRT,SFC,SFCC,OF4,OF6,FOF6,F4,F5A,FAB,F6,FNOW1,FN,F6A,FOF4,FO5A,       E   32
     $W8,RT5,RTA,RT6,RT5A,CP7,CP8,CAPA8,CAPA7,OWB,WCB,ICOMB,IPP,IS,ICOUN       E   33
     $T,IKONT,JCONT,IC,KTEST,THET1,THETO,DW1,DW2,DDHP,Z1,Z2,Z3,Z,ETAC,ET       E   34
     $AO,FNOW1D,HT6,PHIH6,T5A,T4,RAT,WCOW1C,PBTAB,HDT,DTTAB,IPS,DTEMP,ET       E   35
     $AP,ALTSAV,EMSAV,NOSAV,FNSAV,W2SAV,SFCSAV,NO,INOZZ,TT2T1D,HT5A,PHT1       E   36
     $,TT4TT2,PHIT5,PSPI5,PHIT5M,HT1,PT2T1L,PS,TABA7,T8VAL,T7VAL,NLIM,NU       E   37
     $MBER,NSTART,NFINAL,AVAL,XMNSLU,TABN,ETA4,ETA5,TABPH5,TABH4,HPEXT,I       E   38
     $CASE,IPC,PT4T2D,HS,T5VAL                                                 E   39
      COMMON /RRR/ AMP28,FS28MP,AMP                                             E   40
      HT5AM=(HT5M*WCB*OF4+HT2*WCOW1C)/(OF4*WCB+WCOW1C)                          E   41
      F5A=F4*WCB/OWB                                                            E   42
      FO5A=F5A/(1.+F5A)                                                         E   43
      IROU=6                                                                    E   44
      CALL ITT (HT5AM,TABH4,TABH,TABTEM,TABPSH,T5VAL,FO5A,IROU,TT5A,HT5A        E   45
     1,PSIH5A)                                                                  E   46
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```
1       CALL DISCOT (TT5A,TT5A,TABTEM,TABPHI,TABPHI,-11,78,0,PHIT5A)          E  47
        CALL DISCOT (TT5A,TT5A,TABTEM,TABPSP,TABPSP,-11,78,0,PSPI5A)          E  48
        RT5A=1545.*F05A*(FS28MP+AMP/F5A)/AMP28                                E  49
        PHT5AM=PHIT5A+PSPI5A*F05A                                             E  50
        PT5T5A=1.                                                             E  51
        RETURN                                                                E  52
        END                                                                   E  53-



        SUBROUTINE ITT (PHOM,H45TAB,PHOTAB,TEMTAB,PSITAB,TVAL,FOFF,IROU,T3    F   1
       1,PHO,PSIO)                                                            F   2
        DIMENSION ALTSAV(15), EMSAV(15), NOSAV(15), FNSAV(15), W2SAV(15),     F   3
       1SFCSAV(15)                                                            F   4
        DIMENSION TABTEM(78), TABH(78), TABPHI(78), TABPSH(78), TABM(19),     F   5
       1TABPT1(19), TABNST(9), TABPT2(09), TABZ(11), TABW1(99), TABETA(99)    F   6
       2, ANS(5), SFCC(25), TABPSP(78)                                        F   7
        DIMENSION PBTAB(8), HDT(20), DTTAB(20)                                F   8
        DIMENSION TABPH5(78), TABH4(78)                                       F   9
        DIMENSION TABN(12), TABA7(12), RAT(2), T4(3)                          F  10
        DIMENSION TABVJ(17), TABDLDB(17)                                      F  11
C                                                                             F  12
C       INPUT                                                                 F  13
C                                                                             F  14
        COMMON /BK1/ ALT,EMACH,PT2T1D,TT4N,WCOW1,WB,A7A7DN,PT65AD,A4A4DN,P     F  15
       180P8,W1D,H,ETA2D,ENN,X,Y,TF,PT8PT6,CV,TT6MAX,PT6T5A,ETA6,IDES,VAL,    F  16
       2GAMO,RO,AJ,TSLS,PSLS,G,TABTEM,TABH,TABPHI,TABPSH,TABPSP,TABM,TABNS     F  17
       3T,TABPT2,TABZ,TABW1,TABETA,TABPT1,IDDBS,TABVJ,TABDLDB                 F  18
C                                                                             F  19
C       COMPUTED VALUES                                                       F  20
C                                                                             F  21
        COMMON /BK2/ WBOW1,AOAS,ABCOR,A80A7,A7A7D,ANS,APO,A4A4D,A7,A8,AO,A     F  22
       180W1,ABEM7,TO,T8,T7,T7I,T8I,TTO,TT2,TT1,TT2I,TT2TT1,TT5,TT5A,TT7TT    F  23
       21,TT6,TT7TT6,TT4,PO,P8OPO,PT7,HF,H8M,H8,H8I,H8IM,H7M,H7,H7MI,HAB,H     F  24
       3AB5,HO,HTO,HT2,HT2I,HT4M,HT4,HT5M,HT5,HT5O5,HT5AM,HT5H,HT7M,HT7MI,     F  25
       4HT6M,HT8M,HT5AO5,PHIO,PHITO,PHIT2I,PHIT1,PHIT4M,PHIT4,PHIT5A,PHT5A    F  26
       5M,PHI8M,PHIT8M,PHI8,PHI2I,PHIT6M,PHI7M,PHIT6,PHIT7M,PHOF6,PHOH6,PT    F  27
       60PO,PT1PTO,PT2T1S,PT2PT1,PT4PT2,PT5PT4,PT5T5A,PT8P8,PT1PT7,PT7P7,P     F  28
       7T6PT5,PT6T5D,PT5AM,PT55AD,PSIH4,PSPI4,PSIH5,PSPI5A,PSIH5A,PSPI8,PS    F  29
       8IH8,PSIH7,PSPI6,PSIPHI,PSIH6,PSIH8I,PSPI7,EN,ETA2,ET5A,ETETS,ETA2S    F  30
       9,ET2D,EM7,EM8,W1COR,W1DCOR,W4COR,W4DCOR,W7COR,W7DCOR,W4TOT4,W4TEST     F  31
       $,W1,W1K,DH2M1,STTO,DELTO,DELTOD,GAMA8,GAMA7,VO,V7,V8,GAM7P1,GAM7M1    F  32
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     $,ONSRT,SFC,SFCC,OF4,OF6,FOF6,F4,F5A,FAB,F6,FNOW1,FN,F6A,FOF4,FO5A,   F   33
     $W8,RT5,RTA,RT6,RT5A,CP7,CP8,CAPA8,CAPA7,OWB,WCB,ICOMB,IPP,IS,ICOUN   F   34
     $T,IKONT,JCONT,IC,KTEST,THET1,THETO,DW1,DW2,DDHP,Z1,Z2,Z3,Z,ETAC,ET   F   35
     $AO,FNOW1D,HT6,PHIH6,T5A,T4,RAT,WCOW1C,PBTAB,HDT,DTTAB,IPS,DTEMP,ET   F   36
     $AP,ALTSAV,EMSAV,NOSAV,FNSAV,W2SAV,SFCSAV,NO,INOZZ,TT2T1D,HT5A,PHT1   F   37
     $,TT4TT2,PHIT5,PSPI5,PHIT5M,HT1,PT2T1L,PS,TABA7,T8VAL,T7VAL,NLIM,NU   F   38
     $MBER,NSTART,NFINAL,AVAL,XMNSLU,TABN,ETA4,ETA5,TABPH5,TABH4,HPEXT,I   F   39
     $CASE,IPC,PT4T2D,HS,T5VAL                                            F   40
      DIMENSION PHOTAB(1), TEMTAB(1), PSITAB(1), H45TAB(1)                F   41
      CALL DISCOT (PHOM,PHOM,H45TAB,TEMTAB,TEMTAB,-11,78,0,T1)            F   42
      KONT=0                                                              F   43
      TO=T1                                                               F   44
1     CALL DISCOT (TO,TO,TEMTAB,PHOTAB,PHOTAB,-11,78,0,PHO)               F   45
      CALL DISCOT (TO,TO,TEMTAB,PSITAB,PSITAB,-11,78,0,PSIO)              F   46
      RATIO=PHOM/(PHO+PSIO*FOFF)                                          F   47
      KONT=KONT+1                                                         F   48
      IF (KONT-2) 2,3,5                                                   F   49
2     R1=RATIO                                                            F   50
      T2=T1*R1                                                            F   51
      TO=T2                                                               F   52
      GO TO 1                                                             F   53
3     R2=RATIO                                                            F   54
4     T3=(1.-R2)/(R2-R1)*(T2-T1)+T2                                       F   55
      TO=T3                                                               F   56
      GO TO 1                                                             F   57
5     R3=RATIO                                                            F   58
      TPLUS=1.+TVAL                                                       F   59
      TMIN=1.-TVAL                                                        F   60
      IF (R3-TPLUS) 6,9,7                                                 F   61
6     IF (R3-TMIN) 7,9,9                                                  F   62
7     R1=R2                                                               F   63
      R2=R3                                                               F   64
      T1=T2                                                               F   65
      T2=T3                                                               F   66
      IF (KONT-NLIM) 4,8,8                                                F   67
8     WRITE (6,10) IROU                                                   F   68
9     RETURN                                                              F   69
C                                                                         F   70
10    FORMAT (1H06X16HDID NOT CONVERGE3XI4)                               F   71
      END                                                                 F   72-
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      SUBROUTINE OUTPUN (POWER)                                          G    1
      DIMENSION ALTSAV(15), EMSAV(15), NOSAV(15), FNSAV(15), W2SAV(15),  G    2
     1SFCSAV(15)                                                         G    3
      DIMENSION TABTEM(78), TABH(78), TABPHI(78), TABPSH(78), TABM(19),  G    4
     1TABPT1(19), TABNST(9), TABPT2(09), TABZ(11), TABW1(99), TABETA(99) G    5
     2, ANS(5), SFCC(25), TABPSP(78)                                     G    6
      DIMENSION TABPH5(78), TABH4(78)                                    G    7
      DIMENSION TABN(12), TABA7(12), RAT(2), T4(3)                       G    8
      DIMENSION PBTAB(8), HDT(20), DTTAB(20)                             G    9
      DIMENSION ZFN(50), YFN(50,10)                                      G   10
      DIMENSION TABVJ(17), TABDLDB(17)                                   G   11
C                                                                        G   12
      COMMON /ZPARAM/ ZFN,YFN,NZCNT,ZTHRUST                              G   13
C     INPUT                                                              G   14
C                                                                        G   15
      COMMON /BK1/ ALT,EMACH,PT2T1D,TT4N,WCOW1,WB,A7A7DN,PT65AD,A4A4DN,P  G   16
     180P8,W1D,H,ETA2D,ENN,X,Y,TF,PT8PT6,CV,TT6MAX,PT6T5A,ETA6,IDES,VAL, G   17
     2GAMO,RO,AJ,TSLS,PSLS,G,TABTEM,TABH,TABPHI,TABPSH,TABPSP,TABM,TABNS G   18
     3T,TABPT2,TABZ,TABW1,TABETA,TABPT1,IDDBS,TABVJ,TABDLDB              G   19
C                                                                        G   20
C     COMPUTED VALUES                                                    G   21
C                                                                        G   22
      COMMON /BK2/ WBOW1,AOAS,ABCOR,A80A7,A7A7D,ANS,APO,A4A4D,A7,A8,AO,A  G   23
     180W1,ABEM7,TO,T8,T7,T7I,T8I,TTO,TT2,TT1,TT2I,TT2TT1,TT5,TT5A,TT7TT G   24
     21,TT6,TT7TT6,TT4,PO,P80PO,PT7,HF,H8M,H8,H8I,H8IM,H7M,H7,H7MI,HA8,H G   25
     3A85,HO,HTO,HT2,HT2I,HT4M,HT4,HT5M,HT5,HT505,HT5AM,HT5H,HT7M,HT7MI, G   26
     4HT6M,HT8M,HT5A05,PHIO,PHITO,PHIT2I,PHIT1,PHIT4M,PHIT4,PHIT5A,PHT5A G   27
     5M,PHI8M,PHIT8M,PHI8,PHI2I,PHIT6M,PHI7M,PHIT6,PHIT7M,PHOF6,PHOH6,PT G   28
     60PO,PT1PTO,PT2T1S,PT2PT1,PT4PT2,PT5PT4,PT5T5A,PT8P8,PT1PT7,PT7P7,P G   29
     7T6PT5,PT6T5D,PT5AM,PT55AD,PSIH4,PSPI4,PSIH5,PSPI5A,PSIH5A,PSPI8,PS G   30
     8IH8,PSIH7,PSPI6,PSIPHI,PSIH6,PSIH8I,PSPI7,EN,ETA2,ET5A,ETETS,ETA2S G   31
     9,ET2D,EM7,EM8,W1COR,W1DCOR,W4COR,W4DCOR,W7COR,W7DCOR,W4TOT4,W4TEST G   32
     $,W1,W1K,DH2M1,STTO,DELTO,DELTOD,GAMA8,GAMA7,VO,V7,VB,GAM7P1,GAM7M1 G   33
     $,ONSRT,SFC,SFCC,OF4,OF6,FOF6,F4,F5A,FAB,F6,FNOW1,FN,F6A,FOF4,FO5A, G   34
     $W8,RT5,RTA,RT6,RT5A,CP7,CP8,CAPA8,CAPA7,OWB,WCB,ICOMB,IPP,IS,ICOUN G   35
     $T,IKONT,JCONT,IC,KTEST,THET1,THETO,DW1,DW2,DDHP,Z1,Z2,Z3,Z,ETAC,ET G   36
     $AO,FNOW1D,HT6,PHIH6,T5A,T4,RAT,WCOW1C,PBTAB,HDT,DTTAB,IPS,DTEMP,ET G   37
     $AP,ALTSAV,EMSAV,NOSAV,FNSAV,W2SAV,SFCSAV,NO,INOZZ,TT2T1D,HT5A,PHT1 G   38
     $,TT4TT2,PHIT5,PSPI5,PHIT5M,HT1,PT2T1L,PS,TABA7,T8VAL,T7VAL,NLIM,NU G   39
     $MBER,NSTART,NFINAL,AVAL,XMNSLU,TABN,ETA4,ETA5,TABPH5,TABH4,HPEXT,I G   40
     $CASE,IPC,PT4T2D,HS,T5VAL,WC                                        G   41
      COMMON /NEW/ FD,FG,WF,DLDB,DFGS,FG1,FN1,SFC1                       G   42
      COMMON /PPP/ IPUNCH                                                G   43
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      WG=W1*(1.+F6)                                                     G  44
      IF (ZTHRUST.GT.0.0) GO TO 2                                       G  45
      IF (IPUNCH.GT.0) GO TO 3                                          G  46
1     WRITE (6,7) FN,SFC,FNOW1,PT1PT0,PT2PT1,ETA2,W1K,ONSRT,TT0,TT2,TT4,  G  47
     1PT4PT2,TT5,PT5PT4,TT5A,TT6,PT6T5A,F6,T8,PT8P8,V0,V8,EM8,EN,A4A4D,A  G  48
     27A7D,A80A7,A8,CAPA8,W1,ETAP,ETAC,ETA0,FNOW1D,WF,WG,PT7P7,PT1PT7,PT  G  49
     35T5A,PT6T5A,PT8PT6,TT1,WB,WB0W1,DLDB,DFGS,FG1,FN1,SFC1,DTEMP,WC,F4  G  50
      IF (IPUNCH.EQ.0) GO TO 6                                          G  51
      IF (IPUNCH.EQ.1) GO TO 4                                          G  52
2     ZFN(NZCNT)=FN1                                                    G  53
      YFN(NZCNT,1)=WG                                                   G  54
      YFN(NZCNT,2)=V8                                                   G  55
      YFN(NZCNT,3)=CAPA8                                                G  56
      YFN(NZCNT,4)=FD                                                   G  57
      YFN(NZCNT,5)=FN                                                   G  58
      YFN(NZCNT,6)=TT4                                                  G  59
      YFN(NZCNT,7)=DLDB                                                 G  60
      YFN(NZCNT,8)=DTEMP                                                G  61
      YFN(NZCNT,9)=SFC                                                  G  62
      YFN(NZCNT,10)=T8                                                  G  63
      NZCNT=NZCNT+1                                                     G  64
      RETURN                                                            G  65
3     IF (IPUNCH.EQ.1) GO TO 1                                          G  66
      IF (IPUNCH.EQ.2) GO TO 5                                          G  67
      IF (IPUNCH.EQ.3) GO TO 5                                          G  68
4     PUNCH 8, EMACH,ALT,POWER,FG1,FD,WF,V8,CAPA8,WG                    G  69
      RETURN                                                            G  70
5     WRITE (6,9) FN,FG,FD,SFC,WF,W1,WG,FN1,FG1,EN,SFC1,W1K,V8,CAPA8,TT4  G  71
     1,A4A4D,TT1                                                        G  72
      IF (IPUNCH.EQ.3) GO TO 4                                          G  73
6     CONTINUE                                                          G  74
      RETURN                                                            G  75
C                                                                       G  76
7     FORMAT (1H07X2HFNF12.5,6X3HSFCF12.5,4X5HFN/W1F12.5,2X7HPT1/PT0F12.  G  77
     15,2X7HPT2/PT1F12.5,5X4HETA2F12.5/6X3HW1KF12.5,4X5HN/SRTF12.5,6X3HT  G  78
     2T0F12.5,6X3HTT2F12.5,6X3HTT4F12.5,2X7HPT4/PT2F12.5/6X3HTT5F12.5,2X  G  79
     37HPT5/PT4F12.5,5X4HTT5AF12.5,6X3HTT6F12.5,1X8HPT6/PT5AF12.5,7X2HF6  G  80
     4F12.5/7X2HT8F12.5,3X6HPT8/P8F12.5,7X2HV0F12.5,7X2HV8F12.5,7X2HM8F1  G  81
     52.5,8X1HNF12.5/3X6HA4/A4DF12.5,3X6HA7/A7DF12.5,4X5HA8/A7F12.5,7X2H  G  82
     6A8F12.5,4X5HCAPA8F12.5,7X2HW1F12.5/5X4HETAPF12.5,5X4HETACF12.5,5X4  G  83
     7HETA0F12.5,3X6HFN/W1DF12.5,7X2HWFF12.5,7X2HWGF12.5/4X5HPT7P7F12.5,  G  84
     83X6HPT1PT7F12.5,3X6HPT5T5AF12.5,3X6HPT6T5AF12.5,3X6HPT8PT6F12.5,6X  G  85
     93HTT1F12.5/7X2HWBF12.5,4X5HWB0W1F12.5,5X4HDLDBF12.5,5X4HDFGSF12.5,  G  86
     $6X3HFG1F12.5,6X3HFN1F12.5/5X4HSFC1F12.5,4X5HDTEMPF12.5,7X2HWCF12.5  G  87
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     $,7X2HF4F12.5)                                                          G  87A
8     FORMAT (F5.2,F10.1,F5.0,4F10.1,F10.3,F10.1)                            G  88
9     FORMAT (1H03X2HFNF11.4,5X2HFGF11.4,6X2HFDF11.4,6X3HSFCF10.5,7X2HWF     G  89
     1F10.4,7X2HW1F10.4,7X2HWGF10.4/3X3HFN1F11.4,4X3HFG1F11.4,6X1HNF11.5    G  90
     2,5X4HSFC1F10.5,6X3HW1KF10.4,7X2HV8F10.4,4X5HCAPA8F10.4/3X3HTT4F11.    G  91
     35,1X6HA4/A4DF11.5,5X3HTT1F11.5)                                       G  92
      END                                                                   G  93-
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      SUBROUTINE TURB                                                       H   1
      DIMENSION ALTSAV(15), EMSAV(15), NOSAV(15), FNSAV(15), W2SAV(15),     H   2
     1SFCSAV(15)                                                            H   3
      DIMENSION TABTEM(78), TABH(78), TABPHI(78), TABPSH(78), TABM(19),     H   4
     1TABPT1(19), TABNST(9), TABPT2(09), TABZ(11), TABW1(99), TABETA(99)    H   5
     2, ANS(5), SFCC(25), TABPSP(78)                                        H   6
      DIMENSION PBTAB(8), HDT(20), DTTAB(20)                                H   7
      DIMENSION TABPH5(78), TABH4(78)                                       H   8
      DIMENSION TABN(12), TABA7(12), RAT(2), T4(3)                          H   9
      DIMENSION TABVJ(17), TABDLDB(17)                                      H  10
C                                                                           H  11
C     INPUT                                                                 H  12
C                                                                           H  13
      COMMON /BK1/ ALT,EMACH,PT2T1D,TT4N,WCOW1,WB,A7A7DN,PT65AD,A4A4DN,P     H  14
     18OP8,W1D,H,ETA2D,ENN,X,Y,TF,PT8PT6,CV,TT6MAX,PT6T5A,ETA6,IDES,VAL,    H  15
     2GAMO,RO,AJ,TSLS,PSLS,G,TABTEM,TABH,TABPHI,TABPSH,TABPSP,TABM,TABNS     H  16
     3T,TABPT2,TABZ,TABW1,TABETA,TABPT1,IDDBS,TABVJ,TABDLDB                 H  17
C                                                                           H  18
C     COMPUTED VALUES                                                       H  19
C                                                                           H  20
      COMMON /BK2/ WBOW1,AOAS,ABCOR,A8OA7,A7A7D,ANS,APO,A4A4D,A7,A8,AO,A    H  21
     18OW1,ABEM7,TO,T8,T7,T7I,T8I,TTO,TT2,TT1,TT2I,TT2TT1,TT5,TT5A,TT7TT    H  22
     21,TT6,TT7TT6,TT4,PO,P8OPO,PT7,HF,H8M,H8,H8I,H8IM,H7M,H7,H7MI,HA8,H    H  23
     3AB5,HO,HTO,HT2,HT2I,HT4M,HT4,HT5M,HT5,HT5O5,HT5AM,HT5H,HT7M,HT7MI,    H  24
     4HT6M,HT8M,HT5AO5,PHIO,PHITO,PHIT2I,PHIT1,PHIT4M,PHIT4,PHIT5A,PHT5A    H  25
     5M,PHI8M,PHIT8M,PHI8,PHI2I,PHIT6M,PHI7M,PHIT6,PHIT7M,PHOF6,PHOH6,PT    H  26
     60PO,PT1PTO,PT2T1S,PT2PT1,PT4PT2,PT5PT4,PT5T5A,PI8P8,PT1PI7,PI7P7,P    H  27
     7T6PT5,PT6T5D,PT5AM,PT55AD,PSIH4,PSPI4,PSIH5,PSPI5A,PSIH5A,PSPI8,PS    H  28
     8IH8,PSIH7,PSPI6,PSIPHI,PSIH6,PSIH8I,PSPI7,EN,ETA2,ET5A,ETETS,ETA2S    H  29
     9,ET2D,EM7,EM8,W1COR,W1DCOR,W4COR,W4DCOR,W7COR,W7DCOR,W4TOT4,W4TEST    H  30
     $,W1,W1K,DH2M1,STTO,DELTO,DELTOD,GAMA8,GAMA7,VO,V7,V8,GAM7P1,GAM7M1    H  31
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```
     $,ONSRT,SFC,SFCC,OF4,OF6,FOF6,F4,F5A,FAB,F6,FNOW1,FN,F6A,FOF4,FO5A,   H   32
     $W8,RT5,RTA,RT6,RT5A,CP7,CP8,CAPA8,CAPA7,OWB,WCB,ICOMB,IPP,IS,ICOUN   H   33
     $T,IKONT,JCONT,IC,KTEST,THET1,THETO,DW1,DW2,DDHP,Z1,Z2,Z3,Z,ETAC,ET   H   34
     $AO,FNOW1D,HT6,PHIH6,T5A,T4,RAT,WCOW1C,PBTAB,HDT,DTTAB,IPS,DTEMP,ET   H   35
     $AP,ALTSAV,EMSAV,NOSAV,FNSAV,W2SAV,SFCSAV,NO,INOZZ,TT2T1D,HT5A,PHT1   H   36
     $,TT4TT2,PHIT5,PSPI5,PHIT5M,HT1,PT2T1L,PS,TABA7,T8VAL,T7VAL,NLIM,NU   H   37
     $MBER,NSTART,NFINAL,AVAL,XMNSLU,TABN,ETA4,ETA5,TABPH5,TABH4,HPEXT,I   H   38
     $CASE,IPC,PT4T2D,HS,T5VAL                                            H   39
      COMMON /RRR/ AMP28,FS28MP,AMP                                       H   40
      FOF4=F4/OF4                                                         H   41
      HT4M=HT4+PSIH4*FOF4                                                 H   42
      CALL DISCOT (TT4,TT4,TABTEM,TABPHI,TABPHI,-11,78,0,PHIT4)           H   43
      CALL DISCOT (TT4,TT4,TABTEM,TABPSP,TABPSP,-11,78,0,PSPI4)           H   44
      PHIT4M=PHIT4+PSPI4*FOF4                                             H   45
      DDHP=.7068*HPEXT/W1                                                 H   46
      DH2M1=DH2M1+DDHP                                                    H   47
      HT5M=HT4M-DH2M1/(OF4*WCB)                                           H   48
      IROU=5                                                              H   49
      CALL ITT (HT5M,TABH4,TABH,TABTEM,TABPSH,T5VAL,FOF4,IROU,TT5,HT5,PS   H   50
     1IH5)                                                                H   51
      CALL DISCOT (TT5,TT5,TABTEM,TABPHI,TABPHI,-11,78,0,PHIT5)           H   52
      CALL DISCOT (TT5,TT5,TABTEM,TABPSP,TABPSP,-11,78,0,PSPI5)           H   53
      PHIT5M=PHIT5+PSPI5*FOF4                                             H   54
      RT5=1545.*FOF4*(FS28MP+AMP/F4)/AMP28                                H   55
      PT5PT4=EXP(((PHIT5M-PHIT4M)*AJ)/(ETA5*RT5))                         H   56
      RETURN                                                              H   57
      END                                                                 H   58-
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```
      SUBROUTINE COND                                                     I    1
      DIMENSION ALTSAV(15), EMSAV(15), NOSAV(15), FNSAV(15), W2SAV(15),   I    2
     1SFCSAV(15)                                                          I    3
      DIMENSION TABTEM(78), TABH(78), TABPHI(78), TABPSH(78), TABM(19),   I    4
     1TABPT1(19), TABNST(9), TABPT2(09), TABZ(11), TABW1(99), TABETA(99)  I    5
     2, ANS(5), SFCC(25), TABPSP(78)                                      I    6
      DIMENSION PBTAB(8), HDT(20), DTTAB(20)                              I    7
      DIMENSION TABPH5(78), TABH4(78)                                     I    8
      DIMENSION TABN(12), TABA7(12), RAT(2), T4(3)                        I    9
      DIMENSION TABVJ(17), TABDLDB(17)                                    I   10
C                                                                         I   11
C     INPUT                                                               I.  12
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C                                                                       I  13
      COMMON /BK1/ ALT,EMACH,PT2T1D,TT4N,WCOW1,WB,A7A7DN,PT65AD,A4A4DN,P  I  14
     180P8,W1D,H,ETA2D,ENN,X,Y,TF,PT8PT6,CV,TT6MAX,PT6T5A,ETA6,IDES,VAL,  I  15
     2GAMO,RO,AJ,TSLS,PSLS,G,TABTEM,TABH,TABPHI,TABPSH,TABPSP,TABM,TABNS  I  16
     3T,TABPT2,TABZ,TABW1,TABETA,TABPT1,IDDBS,TABVJ,TABDLDB              I  17
C                                                                       I  18
C     COMPUTED VALUES                                                   I  19
C                                                                       I  20
      COMMON /BK2/ WBOW1,AOAS,ABCOR,A80A7,A7A7D,ANS,APO,A4A4D,A7,A8,AO,A  I  21
     180W1,ABEM7,TO,T8,T7,T7I,T8I,TTO,TT2,TT1,TT2I,TT2TT1,TT5,TT5A,TT7TT  I  22
     21,TT6,TT7TT6,TT4,PO,P80PO,PT7,HF,H8M,H8,H8I,H8IM,H7M,H7,H7MI,HAB,H  I  23
     3AB5,HO,HTO,HT2,HT2I,HT4M,HT4,HT5M,HT5,HT505,HT5AM,HT5H,HT7M,HT7MI,  I  24
     4HT6M,HT8M,HT5AO5,PHIO,PHITO,PHIT2I,PHIT1,PHIT4M,PHIT4,PHIT5A,PHT5A  I  25
     5M,PHI8M,PHIT8M,PHI8,PHI2I,PHIT6M,PHI7M,PHIT6,PHIT7M,PHOF6,PHOH6,PT  I  26
     60PO,PT1PTO,PT2T1S,PT2PT1,PT4PT2,PT5PT4,PT5T5A,PT8P8,PT1PT7,PT7P7,P  I  27
     7T6PT5,PT6T5D,PT5AM,PT55AD,PSIH4,PSPI4,PSIH5,PSP15A,PSIH5A,PSPI8,PS  I  28
     8IH8,PSIH7,PSPI6,PSIPHI,PSIH6,PSIH8I,PSPI7,EN,ETA2,ET5A,ETETS,ETA2S  I  29
     9,ET2D,EM7,EM8,W1COR,W1DCOR,W4COR,W4DCOR,W7COR,W7DCOR,W4IOI4,W4IES1  I  30
     $,W1,W1K,DH2M1,STTO,DELTO,DELTOD,GAMA8,GAMA7,VO,V7,V8,GAM7P1,GAM7M1  I  31
     $,ONSRT,SFC,SFCC,OF4,OF6,FOF6,F4,F5A,FAB,F6,FNOW1,FN,F6A,FOF4,FO5A,  I  32
     $W8,RT5,RTA,RT6,RT5A,CP7,CP8,CAPA8,CAPA7,OWB,WCB,ICOMB,IPP,IS,ICOUN  I  33
     $T,IKONT,JCONT,IC,KTEST,THET1,THETO,DW1,DW2,DDHP,Z1,Z2,Z3,Z,ETAC,ET  I  34
     $AO,FNOW1D,HT6,PHIH6,T5A,T4,RAT,WCOW1C,PBTAB,HDT,DTTAB,IPS,DTEMP,ET  I  35
     $AP,ALTSAV,EMSAV,NOSAV,FNSAV,W2SAV,SFCSAV,NO,INOZZ,IT2T1D,HI5A,PHT1  I  36
     $,TT4TT2,PHIT5,PSPI5,PHIT5M,HT1,PT2T1L,PS,TABA7,T8VAL,T7VAL,NLIM,NU  I  37
     $MBER,NSTART,NFINAL,AVAL,XMNSLU,TABN,ETA4,ETA5,TABPH5,TABH4,HPEXT,I  I  38
     $CASE,IPC,PT4T2D,HS,T5VAL                                          I  39
      W1D=W1D*PT1PTO                                                    I  40
      W1=W1D                                                            I  41
      PT2T1S=Y*PT2T1D                                                   I  42
      ONSRT=1.                                                          I  43
      Z=((PT2T1D-1.)/(PT2T1S-1.)-X)*1./(1.-X)                           I  44
      CALL DISCOT (ONSRT,Z,TABNST,TABW1,TABZ,11,99,11,W1DCOR)           I  45
      CALL DISCOT (ONSRT,Z,TABNST,TABETA,TABZ,11,99,11,ETETS)           I  46
      ETA2S=ETA2D/ETETS                                                 I  47
      ETA2=ETETS*ETA2S                                                  I  48
      PHT1=PHITO                                                        I  49
      PHIT2I=PHT1+RO/AJ*ALOG(PT2T1D)                                    I  50
      CALL DISCOT (PHIT2I,PHIT2I,TABPHI,TABTEM,TABTEM,-11,78,0,TT2I)    I  51
      CALL DISCOT (TT2I,TT2I,TABTEM,TABH,TABH,-11,78,0,HT2I)            I  52
      DH2M1=(HT2I-HT1)/ETA2                                             I  53
      HT2=HT1+DH2M1                                                     I  54
      CALL DISCOT (HT2,HT2,TABH,TABTEM,TABTEM,-11,78,0,TT2)             I  55
      TT2T1D=TT2/TT1                                                    I  56
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      TT2TT1=TT2T1D                                                     I   57
      WBOW1=WB/W1                                                       I   58
      OWB=1.-WBOW1                                                      I   59
      WCOW1C=WCOW1                                                      I   60
      WCB=(1.-WCOW1-WBOW1)                                              I   61
      CALL COMB                                                         I   62
      RETURN                                                            I   63
      END                                                               I   64-



      SUBROUTINE FRES                                                   J    1
      DIMENSION ALTSAV(15), EMSAV(15), NOSAV(15), FNSAV(15), W2SAV(15),  J    2
     1SFCSAV(15)                                                        J    3
      DIMENSION TABTEM(78), TABH(78), TABPHI(78), TABPSH(78), TABM(19),  J    4
     1TABPT1(19), TABNST(9), TABPT2(09), TABZ(11), TABWI(99), TABETA(99) J    5
     2, ANS(5), SFCC(25), TABPSP(78)                                    J    6
      DIMENSION PBTAB(8), HDT(20), DTTAB(20)                            J    7
      DIMENSION TABPH5(78), TABH4(78)                                   J    8
      DIMENSION TABN(12), TABA7(12), RAT(2), T4(3)                      J    9
      DIMENSION TABVJ(17), TABDLDB(17)                                  J   10
C                                                                       J   11
CC    INPUT                                                             J   12
C                                                                       J   13
      COMMON /BK1/ ALT,EMACH,PT2T1D,TT4N,WCOW1,WB,A7A7DN,PT65AD,A4A4DN,P  J   14
     1BOP8,W1D,H,ETA2D,ENN,X,Y,TF,PT8PT6,CV,TT6MAX,PT6T5A,ETA6,IDES,VAL,  J   15
     2GAMO,RO,AJ,TSLS,PSLS,G,TABTEM,TABH,TABPHI,TABPSH,TABPSP,TABM,TABNS  J   16
     3T,TABPT2,TABZ,TABW1,TABETA,TABPT1,IDDBS,TABVJ,TABDLDB              J   17
C                                                                       J   18
CC    COMPUTED VALUES                                                   J   19
C                                                                       J   20
      COMMON /BK2/ WBOW1,AOAS,ABCOR,ABOA7,A7A7D,ANS,APO,A4A4D,A7,A8,AO,A  J   21
     1BOW1,ABEM7,TO,T8,T7,T7I,T8I,TTO,TT2,TT1,TT2I,TT2TT1,TT5,TT5A,TT7TT  J   22
     21,TT6,TT7TT6,TT4,PO,P8OPO,PT7,HF,H8M,H8,H8I,H8IM,H7M,H7,H7MI,HAB,H  J   23
     3AB5,HO,HTO,HT2,HT2I,HT4M,HT4,HT5M,HT5,HT5O5,HT5AM,HT5H,HT7M,HT7MI,  J   24
     4HT6M,HT8M,HT5AO5,PHIO,PHITO,PHIT2I,PHIT1,PHIT4M,PHIT4,PHIT5A,PHT5A  J   25
     5M,PHI8M,PHIT8M,PHI8,PHI2I,PHIT6M,PHI7M,PHIT6,PHIT7M,PHOF6,PHOH6,PT  J   26
     6OPO,PT1PTO,PT2T1S,PT2PT1,PT4PT2,PT5PT4,PT5T5A,PT8P8,PT1PT7,PT7P7,P  J   27
     7T6PT5,PT6T5D,PT5AM,PT55AD,PSIH4,PSPI4,PSIH5,PSPI5A,PSIH5A,PSPI8,PS  J   28
     8IH8,PSIH7,PSPI6,PSIPHI,PSIH6,PSIH8I,PSPI7,EN,ETA2,ET5A,ETETS,ETA2S  J   29
     9,ET2D,EM7,EM8,W1COR,W1DCOR,W4COR,W4DCOR,W7COR,W7DCOR,W4TOT4,W4TEST  J   30
     $,W1,W1K,DH2M1,STTO,DELTO,DELTOD,GAMA8,GAMA7,VO,V7,V8,GAM7P1,GAM7M1  J   31
```

```
      $,ONSRT,SFC,SFCC,OF4,OF6,FOF6,F4,F5A,FAB,F6,FNOW1,FN,F6A,FOF4,FO5A,   J  32
      $W8,RT5,RTA,RT6,RT5A,CP7,CP8,CAPA8,CAPA7,OWB,WCB,ICOMB,IPP,IS,ICOUN   J  33
      $T,IKONT,JCONT,IC,KTEST,THET1,THETO,DW1,DW2,DDHP,Z1,Z2,Z3,Z,ETAC,ET   J  34
      $AO,FNOW1D,HT6,PHIH6,T5A,T4,RAT,WCOW1C,PBTAB,HDT,DTTAB,IPS,DTEMP,ET   J  35
      $AP,ALTSAV,EMSAV,NOSAV,FNSAV,W2SAV,SFCSAV,NO,INOZZ,TT2T1D,HT5A,PHT1   J  36
      $,TT4TT2,PHIT5,PSPI5,PHIT5M,HT1,PT2T1L,PS,TABA7,T8VAL,T7VAL,NLIM,NU   J  37
      $MBER,NSTART,NFINAL,AVAL,XMNSLU,TABN,ETA4,ETA5,TABPH5,TABH4,HPEXT,I   J  38
      $CASE,IPC,PT4T2D,HS,T5VAL                                            J  39
       HDT(1)=-1.                                                          J  40
       CALL AT62SP (ALT,ANS,DTEMP,PBTAB,HDT,DTTAB)                         J  41
       PO=ANS(2)                                                           J  42
       AO=ANS(4)                                                           J  43
       TO=ANS(3)*1.8                                                       J  44
       TT4=TT4N                                                            J  45
C                                                                          J  46
CC     STANDARD DAY                                                        J  47
C                                                                          J  48
1      CALL DISCOT (TO,TO,TABTEM,TABH,TABH,-11,78,0,HO)                    J  49
       HTO=HO+(GAMO*EMACH**2*TO*RO)/(2.*AJ)                                J  50
       HT1=HTO                                                             J  51
       CALL DISCOT (HTO,HTO,TABH,TABTEM,TABTEM,-11,78,0,TTO)               J  52
       CALL DISCOT (TO,TO,TABTEM,TABPHI,TABPHI,-11,78,0,PHIO)              J  53
       CALL DISCOT (TTO,TTO,TABTEM,TABPHI,TABPHI,-11,78,0,PHITO)           J  54
       PTOPO=EXP(AJ/RO*(PHITO-PHIO))                                       J  55
       STTO=SQRT(TTO/TO*TO/TSLS)                                           J  56
       THETO=STTO**2                                                       J  57
       TT1=TTO                                                             J  58
       PHT1=PHITO                                                          J  59
       DELTO=PTOPO*PO/PSLS                                                 J  60
C                                                                          J  61
CC     INLET CONDITIONS                                                    J  62
C                                                                          J  63
       CALL DISCOT (EMACH,EMACH,TABM,TABPT1,TABPT1,-11,19,0,PT1PTO)        J  64
       RETURN                                                              J  65
       END                                                                 J  66-
```

```
       SUBROUTINE COMB                                                     K   1
       DIMENSION TABTEM(78), TABH(78), TABPHI(78), TABPSH(78), TABM(19),   K   2
      1TABPT1(19), TABNST(9), TABPT2(09), TABZ(11), TABW1(99), TABETA(99)  K   3
      2, ANS(5), SFCC(25), TABPSP(78)                                      K   4
```

```
      DIMENSION PBTAB(8), HDT(20), DTTAB(20)                              K    5
      DIMENSION ALTSAV(15), EMSAV(15), NOSAV(15), FNSAV(15), W2SAV(15),   K    6
     1SFCSAV(15)                                                          K    7
      DIMENSION TABPH5(78), TABH4(78)                                     K    8
      DIMENSION TABN(12), TABA7(12), RAT(2), T4(3)                        K    9
      DIMENSION TABVJ(17), TABDLDB(17)                                    K   10
C                                                                         K   11
C     INPUT                                                               K   12
C                                                                         K   13
      COMMON /BK1/ ALT,EMACH,PT2T1D,TT4N,WCOW1,W8,A7A7DN,PT65AD,A4A4DN,P   K   14
     180P8,W1D,H,ETA2D,ENN,X,Y,TF,PT8PT6,CV,TT6MAX,PT6T5A,ETA6,IDES,VAL,  K   15
     2GAMO,RO,AJ,TSLS,PSLS,G,TABTEM,TABH,TABPHI,TABPSH,TABPSP,TABM,TABNS  K   16
     3T,TABPT2,TABZ,TABW1,TABETA,TABPT1,IDDBS,TABVJ,TABDLDB               K   17
C                                                                         K   18
C     COMPUTED VALUES                                                     K   19
C                                                                         K   20
      COMMON /BK2/ W8OW1,AOAS,ABCOR,A8OA7,A7A7D,ANS,APO,A4A4D,A7,A8,AO,A  K   21
     180W1,ABEM7,TO,T8,T7,T7I,T8I,TTO,TT2,TT1,TT2I,TT2TT1,TT5,TT5A,TT7TT  K   22
     21,TT6,TT7TT6,TT4,PO,P8OPO,PT7,HF,H8M,H8,H8I,H8IM,H7M,H7,H7MI,HAB,H  K   23
     3AB5,HO,HTO,HT2,HT2I,HT4M,HT4,HT5M,HT5,HT5O5,HT5AM,HT5H,HT7M,HT7MI,  K   24
     4HT6M,HT8M,HT5AO5,PHIO,PHITO,PHIT2I,PHIT1,PHIT4M,PHIT4,PHIT5A,PHT5A  K   25
     5M,PHI8M,PHIT8M,PHI8,PHI2I,PHIT6M,PHI7M,PHIT6,PHIT7M,PHOF6,PHOH6,PT  K   26
     60PO,PT1PTO,PT2T1S,PT2PT1,PT4PT2,PT5PT4,PT5T5A,PT8P8,PT1PT7,PT7P7,P  K   27
     7T6PT5,PT6T5D,PT5AM,PT55AD,PSIH4,PSPI4,PSIH5,PSP15A,PSIH5A,PSPI8,PS  K   28
     8IH8,PSIH7,PSPI6,PSIPHI,PSIH6,PSIH8I,PSPI7,EN,ETA2,ET5A,ETETS,ETA2S  K   29
     9,ET2D,EM7,EM8,W1COR,W1DCOR,W4COR,W4DCOR,W7COR,W7DCOR,W4TOT4,W4TEST  K   30
     $,W1,W1K,DH2M1,STTO,DELTO,DELTOD,GAMA8,GAMA7,VO,V7,V8,GAM7P1,GAM7M1  K   31
     $,ONSRT,SFC,SFCC,OF4,OF6,FOF6,F4,F5A,FAB,F6,FNOW1,FN,F6A,FOF4,FO5A,  K   32
     $W8,RT5,RTA,RT6,RT5A,CP7,CP8,CAPA8,CAPA7,OWB,WCB,ICOMB,IPP,IS,ICOUN  K   33
     $T,IKONT,JCONT,IC,KTEST,THET1,THETO,DW1,DW2,DDHP,Z1,Z2,Z3,Z,ETAC,ET  K   34
     $AO,FNOW1D,HT6,PHIH6,T5A,T4,RAT,WCOW1C,PBTAB,HDT,DTTAB,IPS,DTEMP,ET  K   35
     $AP,ALTSAV,EMSAV,NOSAV,FNSAV,W2SAV,SFCSAV,NO,INOZZ,TT2T1D,HT5A,PHT1  K   36
     $,TT4TT2,PHIT5,PSPI5,PHIT5M,HT1,PT2T1L,PS,TABA7,T8VAL,T7VAL,NLIM,NU  K   37
     $MBER,NSTART,NFINAL,AVAL,XMNSLU,TABN,ETA4,ETA5,TABPH5,TABH4,HPEXT,I  K   38
     $CASE,IPC,PT4T2D,HS,T5VAL,WC                                         K   39
      IF (TT4.LT.TT2) GO TO 2                                             K   40
      IF (TT4.GT.TT4N) GO TO 1                                            K   41
      GO TO 3                                                             K   42
1     TT4=TT4N                                                            K   43
      GO TO 3                                                             K   44
2     TT4=TT2+50.                                                         K   45
3     IF (TT4.LE.2160.) GO TO 8                                           K   46
      WCOW1C=WCOW1*(TT4-2160.)                                            K   47
      WC=WCOW1C*W1                                                        K  47A
```

```
4       WCB=(1.-WCOW1C-WBOW1)                                                   K  48
        HF=.5*(TF-536.)                                                         K  49
        CALL DISCOT (TT4,TT4,TABTEM,TABH,TABH,-11,78,0,HT4)                     K  50
        CALL DISCOT (TT4,TT4,TABTEM,TABPSH,TABPSH,-11,78,0,PSIH4)               K  51
        F4=(HT4-HT2)/(ETA4*(H-HS)-HT4-PSIH4+HS+HF)                              K  52
        OF4=1.+F4                                                               K  53
        IF (IDES-1) 5,6,6                                                       K  54
5       W4DCOR=W1DCOR*SQRT(TT4/TT2*TT2T1D)*1./(PT2T1D*PT4T2D)*OF4*WCB           K  55
        PT4PT2=PT4T2D                                                           K  56
        GO TO 7                                                                 K  57
6       PT4PT2=1.-((1.-PT4T2D)*W1COR**2*W1DCOR**(-2)*(PT2T1D/PT2PT1)**2*TT      K  58
      12TT1/TT2T1D)                                                             K  59
        IF (PT4PT2.LT..7) PT4PT2=.7                                             K  60
        W4COR=W1COR*SQRT(TT4/TT2*TT2TT1)*1./(PT2PT1*PT4PT2)*OF4*WCB             K  61
7       RETURN                                                                  K  62
8       WCOW1C=0                                                                K  63
        GO TO 4                                                                 K  64
        END                                                                     K  65-
```



```
        SUBROUTINE PARP                                                         L   1
        DIMENSION ALTSAV(15), EMSAV(15), NOSAV(15), FNSAV(15), W2SAV(15),       L   2
      1SFCSAV(15)                                                               L   3
        DIMENSION TABTEM(78), TABH(78), TABPHI(78), TABPSH(78), TABM(19),       L   4
      1TABPT1(19), TABNST(9), TABPT2(09), TABZ(11), TABW1(99), TABETA(99)       L   5
      2, ANS(5), SFCC(25), TABPSP(78)                                           L   6
        DIMENSION PBTAB(8), HDT(20), DTTAB(20)                                  L   7
        DIMENSION TABPH5(78), TABH4(78)                                         L   8
        DIMENSION TABN(12), TABA7(12), RAT(2), T4(3)                            L   9
        DIMENSION TABVJ(17), TABDLDB(17)                                        L  10
C                                                                               L  11
C       INPUT                                                                   L  12
C                                                                               L  13
        COMMON /BK1/ ALT,EMACH,PT2T1D,TT4N,WCOW1,WB,A7A7DN,PT65AD,A4A4DN,P       L  14
      1BOP8,W1D,H,ETA2D,ENN,X,Y,TF,PT8PT6,CV,TT6MAX,PT6T5A,ETA6,IDES,VAL,       L  15
      2GAMO,RO,AJ,TSLS,PSLS,G,TABTEM,TABH,TABPHI,TABPSH,TABPSP,TABM,TABNS       L  16
      3T,TABPT2,TABZ,TABW1,TABETA,TABPT1,IDDBS,TABVJ,TABDLDB                    L  17
C                                                                               L  18
C       COMPUTED VALUES                                                         L  19
C                                                                               L  20
        COMMON /BK2/ WBOW1,A0AS,ABCOR,A80A7,A7A7D,ANS,AP0,A4A4D,A7,A8,A0,A      L  21
```

```
      180W1,ABEM7,TO,T8,T7,T7I,T8I,TTO,TT2,TT1,TT2I,TT2TT1,TT5,TT5A,TT7TT   L   22
      21,TT6,TT7TT6,TT4,PO,P80PO,PT7,HF,H8M,H8,H8I,H8IM,H7M,H7,H7MI,HAB,H   L   23
      3AB5,HO,HTO,HT2,HT2I,HT4M,HT4,HT5M,HT5,HT505,HT5AM,HT5H,HT7M,HT7MI,   L   24
      4HT6M,HT8M,HT5A05,PHIO,PHITO,PHIT2I,PHIT1,PHIT4M,PHIT4,PHIT5A,PHT5A   L   25
      5M,PHI8M,PHIT8M,PHI8,PHI2I,PHIT6M,PHI7M,PHIT6,PHIT7M,PHOF6,PHOH6,PT   L   26
      60PO,PT1PTO,PT2T1S,PT2PT1,PT4PT2,PT5PT4,PT5T5A,PT8P8,PT1PT7,PT7P7,P   L   27
      7T6PT5,PT6T5D,PT5AM,PT55AD,PSIH4,PSPI4,PSIH5,PSP15A,PSIH5A,PSPI8,PS   L   28
      81H8,PSIH7,PSPI6,PSIPHI,PSIH6,PSIH81,PSPI7,EN,ETA2,ET5A,ETETS,ETA2S   L   29
      9,ET2D,EM7,EM8,W1COR,W1DCOR,W4COR,W4DCOR,W7COR,W7DCOR,W4TOT4,W4TEST   L   30
      $,W1,W1K,DH2M1,STTO,DELTO,DELTOD,GAMA8,GAMA7,VO,V7,V8,GAM7P1,GAM7M1   L   31
      $,ONSRT,SFC,SFCC,OF4,OF6,FOF6,F4,F5A,FAB,F6,FNOW1,FN,F6A,FOF4,FO5A,   L   32
      $W8,RT5,RTA,RT6,RT5A,CP7,CP8,CAPA8,CAPA7,OWB,WCB,ICOMB,IPP,IS,ICOUN   L   33
      $T,IKONT,JCONT,IC,KTEST,THET1,THETO,DW1,DW2,DDHP,Z1,Z2,Z3,Z,ETAC,ET   L   34
      $AO,FNOW1D,HT6,PHIH6,T5A,T4,RAT,WCOW1C,PBTAB,HDT,DTTAB,IPS,DTEMP,ET   L   35
      $AP,ALTSAV,EMSAV,NOSAV,FNSAV,W2SAV,SFCSAV,NO,INOZZ,TT2T1D,HT5A,PHT1   L   36
      $,TT4TT2,PHIT5,PSPI5,PHIT5M,HT1,PT2T1L,PS,TABA7,T8VAL,T7VAL,NLIM,NU   L   37
      $MBER,NSTART,NFINAL,AVAL,XMNSLU,TABN,ETA4,ETA5,TABPH5,TABH4,HPEXT,I   L   38
      $CASE,IPC,PT4T2D,HS,T5VAL                                            L   39
       ITJ=0                                                               L   40
       IPP=0                                                               L   41
       EN=ENN                                                              L   42
       ITT4=0                                                              L   43
       IM=0                                                                L   44
       W4C1=W4COR                                                          L   45
       IF (A4A4DN-1.) 2,18,18                                              L   46
1      GO TO 35                                                            L   47
C                                                                          L   48
C      VARIABLE A4/A4D ROUTINE                                             L   49
C                                                                          L   50
2      TT4=TT4N*A4A4DN**2                                                  L   51
       IF (TT4.LT.(TT2+100.)) GO TO 3                                      L   52
       GO TO 4                                                             L   53
3      TT4=TT2+100.                                                        L   54
       A4A4DN=SQRT(TT4/TT4N)                                               L   55
4      DELTAT=(TT4N-TT4)/((1.-A4A4DN)/.05)                                 L   56
       IF (IM) 5,5,6                                                       L   57
5      TT4=TT4N-DELTAT                                                     L   58
       IM=1                                                                L   59
       GO TO 7                                                             L   60
6      TT4=TT4-DELTAT                                                      L   61
       T4(1)=TT4                                                           L   62
7      CALL COMB                                                           L   63
       W4C2=W4COR                                                          L   64
       A4A4D=W4C2/W4C1                                                     L   65
```

```
      IF (IM-1) 8,8,9                                                                  L  66
8     IF (A4A4D-(A4A4DN+.025)) 11,9,9                                                  L  67
9     CALL TURB                                                                        L  68
      CALL COOL                                                                        L  69
      PT6T5A=PT65AD                                                                    L  70
      HT6M=HT5AM                                                                       L  71
      PHIT6M=PHT5AM                                                                    L  72
      F6=F5A                                                                           L  73
      OF6=1.+F6                                                                        L  74
      FOF6=F6/OF6                                                                      L  75
      CALL NOZZ                                                                        L  76
      CALL ENG                                                                         L  77
      EN=ENN                                                                           L  78
      IF (IM-1) 10,10,11                                                               L  79
10    POWER=TT4                                                                        L  80
      CALL OUTPUN (POWER)                                                              L  81
      IF (FNOW1.LT.0.) GO TO 35                                                        L  82
      IF (A4A4D-(A4A4DN+.025)) 11,11,6                                                 L  83
11    ABSA4=ABS(A4A4D-A4A4DN)                                                          L  84
      ITJ=ITJ+1                                                                        L  85
      IF (ITJ-1) 13,13,12                                                              L  86
12    IF (ABSA4-.001) 17,17,13                                                         L  87
13    IF (IM-2) 14,15,15                                                               L  88
14    T4(2)=T4(1)*(A4A4DN**2)/(A4A4D**2)                                               L  89
      A4C1=A4A4D                                                                       L  90
      IM=2                                                                             L  91
      TT4=T4(2)                                                                        L  92
      GO TO 7                                                                          L  93
15    A4C2=A4A4D                                                                       L  94
      IF (A4C1.EQ.A4C2) GO TO 35                                                       L  95
      T4(3)=T4(1)-((A4C1**2-A4A4DN**2)/(A4C1**2-A4C2**2))*(T4(1)-T4(2))                L  96
      T4(1)=T4(2)                                                                      L  97
      T4(2)=T4(3)                                                                      L  98
      TT4=T4(3)                                                                        L  99
      A4C1=A4C2                                                                        L 100
      IM=IM+1                                                                          L 101
      IF (IM-25) 7,7,16                                                                L 102
16    WRITE (6,36)                                                                     L 103
      GO TO 35                                                                         L 104
17    POWER=TT4                                                                        L 105
      CALL OUTPUN (POWER)                                                              L 106
      IF (FNOW1.LT.0.) GO TO 35                                                        L 107
      IF (A7A7DN-1.) 35,18,18                                                          L 108
C     PPCNA                                                                            L 109
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```
18    TPLUS=1.+AVAL                                                    L 110
      TMIN=1.-AVAL                                                     L 111
      A7A7DS=A7A7D                                                     L 112
      T4(1)=TT4-100.                                                   L 113
      DO 34 JT=NSTART,NFINAL,NUMBER                                    L 114
      TTP=TT4                                                          L 115
      INUM=0                                                           L 116
      II=1                                                             L 117
      EN=TABN(JT)                                                      L 118
      A7A7DL=TABA7(JT)                                                 L 119
      A7A7DO=A7A7DS*A7A7DL                                             L 120
      IF (EMACH-XMNSLU) 20,19,19                                       L 121
19    EN=1.                                                            L 122
20    TT4=T4(1)                                                        L 123
21    CALL MATCH                                                       L 124
      IF (ICOUNT-2) 22,1,22                                            L 125
22    IF (ONSRT-.4) 34,34,23                                           L 126
23    CALL TURB                                                        L 127
      CALL COOL                                                        L 128
      PT6T5A=PT65AD                                                    L 129
      HT6M=HT5AM                                                       L 130
      PHIT6M=PHT5AM                                                    L 131
      F6=F5A                                                           L 132
      OF6=1.+F6                                                        L 133
      FOF6=F6/OF6                                                      L 134
      CALL NOZZ                                                        L 135
      RAT(II)=A7A7DO/A7A7D                                             L 136
      INUM=INUM+1                                                      L 137
      IF (RAT(II)-TPLUS) 24,31,28                                      L 138
24    IF (RAT(II)-TMIN) 25,31,31                                       L 139
25    IF (INUM-2) 27,30,26                                             L 140
26    IF (INUM-25) 30,30,32                                            L 141
27    CONTINUE                                                         L 142
      T4(2)=T4(1)+(TTP-T4(1))*.5                                       L 143
      TT4=T4(2)                                                        L 144
      II=2                                                             L 145
      GO TO 21                                                         L 146
28    IF (INUM-2) 29,30,26                                             L 147
29    T4(2)=T4(1)-(TTP-T4(1))*.5                                       L 148
      TT4=T4(2)                                                        L 149
      II=2                                                             L 150
      GO TO 21                                                         L 151
30    CONTINUE                                                         L 152
      IF (RAT(1).EQ.RAT(2)) RAT(2)=RAT(1)*1.01                         L 153
```

```
      T4(3)=((1.-RAT(2))/(RAT(2)-RAT(1))*(T4(2)-T4(1)))+T4(2)          L 154
      IF (T4(3).GT.TTP) T4(3)=TTP-25.                                  L 155
      IF (T4(3).LT.TT2) T4(3)=TT2+50.                                  L 156
      TT4=T4(3)                                                        L 157
      T4(1)=T4(2)                                                      L 158
      T4(2)=T4(3)                                                      L 159
      RAT(1)=RAT(2)                                                    L 160
      II=2                                                             L 161
      GO TO 21                                                         L 162
31    CALL ENG                                                         L 163
      POWER=TT4                                                        L 164
      CALL OUTPUN (POWER)                                              L 165
      GO TO 33                                                         L 166
32    WRITE (6,36)                                                     L 167
33    T4(1)=TT4-100.                                                   L 168
      IF (FNOW1.LT.0.) GO TO 35                                        L 169
34    CONTINUE                                                         L 170
35    A4A4D=1.                                                         L 171
      RETURN                                                           L 172
C                                                                      L 173
36    FORMAT (1H06X26HITTERATION GREATER THAN 25)                      L 174
      END                                                              L 175-
```

```
      SUBROUTINE ENG                                                   M   1
      DIMENSION ALTSAV(15), EMSAV(15), NOSAV(15), FNSAV(15), W2SAV(15),  M   2
     1SFCSAV(15)                                                       M   3
      DIMENSION TABTEM(78), TABH(78), TABPHI(78), TABPSH(78), TABM(19),  M   4
     1TABPT1(19), TABNST(9), TABPT2(09), TABZ(11), TABW1(99), TABETA(99)  M   5
     2, ANS(5), SFCC(25), TABPSP(78)                                   M   6
      DIMENSION PBTAB(8), HDT(20), DTTAB(20)                           M   7
      DIMENSION TABPH5(78), TABH4(78)                                  M   8
      DIMENSION TABN(12), TABA7(12), RAT(2), T4(3)                     M   9
      DIMENSION TABVJ(17), TABDLDB(17)                                 M  10
C                                                                      M  11
C     INPUT                                                            M  12
C                                                                      M  13
      COMMON /BK1/ ALT,EMACH,PT2T1D,TT4N,WCOW1,WB,A7A7DN,PT65AD,A4A4DN,P  M  14
     1BOP8,W1D,H,ETA2D,ENN,X,Y,TF,PT8PT6,CV,TT6MAX,PT6T5A,ETA6,IDES,VAL,  M  15
     2GAMO,RO,AJ,TSLS,PSLS,G,TABTEM,TABH,TABPHI,TABPSH,TABPSP,TABM,TABNS  M  16
     3T,TABPT2,TABZ,TABW1,TABETA,TABPT1,IDDBS,TABVJ,TABDLDB             M  17
```

```
C                                                                       M  18
CC     COMPUTED VALUES                                                  M  19
C                                                                       M  20
       COMMON /BK2/ WBOW1,AOAS,ABCOR,A80A7,A7A7D,ANS,AP0,A4A4D,A7,A8,AO,A   M  21
      180W1,ABEM7,TO,T8,T7,T7I,T8I,TTO,TT2,TT1,TT2I,TT2TT1,TT5,TT5A,TT7TT  M  22
      21,TT6,TT7TT6,TT4,P0,P80P0,PT7,HF,H8M,H8,H8I,H8IM,H7M,H7,H7MI,HAB,H  M  23
      3AB5,H0,HT0,HT2,HT2I,HT4M,HT4,HT5M,HT5,HT505,HT5AM,HT5H,HT7M,HT7MI,  M  24
      4HT6M,HT8M,HT5A05,PHI0,PHIT0,PHIT2I,PHIT1,PHIT4M,PHIT4,PHIT5A,PHT5A  M  25
      5M,PHI8M,PHIT8M,PHI8,PHI2I,PHIT6M,PHI7M,PHIT6,PHIT7M,PH0F6,PH0H6,PT  M  26
      60P0,PT1PT0,PT2T1S,PT2PT1,PT4PT2,PT5PT4,PT5T5A,PT8P8,PT1PT7,PT7P7,P  M  27
      7T6PT5,PT6T5D,PT5AM,PT55AD,PSIH4,PSPI4,PSIH5,PSPI5A,PSIH5A,PSPI8,PS  M  28
      8IH8,PSIH7,PSPI6,PSIPHI,PSIH6,PSIH8I,PSPI7,EN,ETA2,ET5A,ETETS,ETA2S  M  29
      9,ET2D,EM7,EM8,W1COR,W1DCOR,W4COR,W4DCOR,W7COR,W7DCOR,W4TOT4,W4TEST  M  30
      $,W1,W1K,DH2M1,STTO,DELTO,DELTOD,GAMA8,GAMA7,V0,V7,V8,GAM7P1,GAM7M1  M  31
      $,ONSRT,SFC,SFCC,0F4,0F6,F0F6,F4,F5A,FAB,F6,FNOW1,FN,F6A,F0F4,F05A,  M  32
      $W8,RT5,RTA,RT6,RT5A,CP7,CP8,CAPA8,CAPA7,OWB,WCB,ICOMB,IPP,IS,ICOUN  M  33
      $T,IKONT,JCONT,IC,KTEST,THET1,THETO,DW1,DW2,DDHP,Z1,Z2,Z3,Z,ETAC,ET  M  34
      $A0,FNOW1D,HT6,PHIH6,T5A,T4,RAT,WCOW1C,PBTAB,HDT,DTTAB,IPS,DTEMP,ET  M  35
      $AP,ALTSAV,EMSAV,NOSAV,FNSAV,W2SAV,SFCSAV,NO,INOZZ,TT2T1D,HT5A,PHT1  M  36
      $,TT4TT2,PHIT5,PSPI5,PHIT5M,HT1,PT2T1L,PS,TA8A7,T8VAL,T7VAL,NLIM,NU  M  37
      $MBER,NSTART,NFINAL,AVAL,XMNSLU,TABN,ETA4,ETA5,TABPH5,TABH4,HPEXT,I  M  38
      $CASE,IPC,PT4T2D,HS,T5VAL                                         M  39
       COMMON /NEW/ FD,FG,WF,DLDB,DFGS,FG1,FN1,SFC1                     M  40
       COMMON /WWW/ WIDE                                                M  41
       V0=EMACH*A0                                                      M  42
       A80W1=(OWB*0F6*RT6*T8)/(P80P0*P0*V8)                             M  43
       FNOW1=OWB*0F6*(V8*CV/G)-V0/G+(P80P0-1.)*A80W1*P0                 M  44
       FN=FNOW1*W1                                                      M  45
       SFC=F6*OWB/FNOW1*3600.                                           M  46
       FD=W1*V0/G                                                       M  47
       FG=FN+FD                                                         M  48
       WF=SFC*FN                                                        M  49
       IF (IDDBS.EQ.0) GO TO 1                                          M  50
       IF (V8.LT.1000) GO TO 2                                          M  51
       CALL FTLUP (V8,DLDB,2,17,TABVJ,TABDLDB)                          M  52
       DFGS=1.-.005*DLDB                                                M  53
       FG1=FG*DFGS                                                      M  54
       FN1=FG1-FD                                                       M  55
       SFC1=WF/FN1                                                      M  56
1      IF (IDDBS.GT.0) GO TO 3                                          M  57
2      DLDB=0.                                                          M  58
       FG1=FG                                                           M  59
       FN1=FN                                                           M  60
       SFC1=SFC                                                         M  61
```

```
3       IF (VO) 5,5,4                                                          M  62
4       VJE=((FNOW1+VO/G)*G)/(OWB*OF6)                                         M  63
        ETAP=(2.*G*FNOW1*VO)/(OWB*OF6*(VJE**2-VO**2))                          M  64
        ETAC=(OWB*OF6*(VJE**2-VO**2))/(2.*G*AJ*OWB*F6*(H-HS))                  M  65
        FNOW1D=FN/WIDE                                                         M  66
        ETAO=ETAP*ETAC                                                         M  67
        GO TO 6                                                                M  68
5       ETAC=0                                                                 M  69
        ETAP=0                                                                 M  70
        ETAO=0                                                                 M  71
        FNOW1D=FN/WIDE                                                         M  72
6       RETURN                                                                 M  73
        END                                                                    M  74-
```

```
        SUBROUTINE AFTER                                                       N   1
        DIMENSION ALTSAV(15), EMSAV(15), NOSAV(15), FNSAV(15), W2SAV(15),      N   2
       1SFCSAV(15)                                                             N   3
        DIMENSION TABTEM(78), TABH(78), TABPHI(78), TABPSH(78), TABM(19),      N   4
       1TABPT1(19), TABNST(9), TABPT2(09), TABZ(11), TABW1(99), TABETA(99)     N   5
       2, ANS(5), SFCC(25), TABPSP(78)                                         N   6
        DIMENSION PBTAB(8), HDT(20), DTTAB(20)                                 N   7
        DIMENSION TABPH5(78), TABH4(78)                                        N   8
        DIMENSION TABN(12), TABA7(12), RAT(2), T4(3)                           N   9
        DIMENSION TABVJ(17), TABDLDB(17)                                       N  10
C                                                                              N  11
C       INPUT                                                                  N  12
C                                                                              N  13
        COMMON /BK1/ ALT,EMACH,PT2T1D,TT4N,WCOW1,WB,A7A7DN,PT65AD,A4A4DN,P      N  14
       180P8,W1D,H,ETA2D,ENN,X,Y,TF,PT8PT6,CV,TT6MAX,PT6T5A,ETA6,IDES,VAL,     N  15
       2GAMO,RO,AJ,TSLS,PSLS,G,TABTEM,TABH,TABPHI,TABPSH,TABPSP,TABM,TABNS     N  16
       3T,TABPT2,TABZ,TABW1,TABETA,TABPT1,IDDBS,TABVJ,TABDLDB                  N  17
C                                                                              N  18
C       COMPUTED VALUES                                                        N  19
C                                                                              N  20
        COMMON /BK2/ WBOW1,AOAS,ABCOR,A8OA7,A7A7D,ANS,APO,A4A4D,A7,A8,AO,A     N  21
       180W1,ABEM7,TO,T8,T7,T7I,T8I,TTO,TT2,TT1,TT2I,TT2TT1,TT5,TT5A,TT7TT     N  22
       21,TT6,TT7TT6,TT4,PO,P8OPO,PT7,HF,H8M,H8,H8I,H8IM,H7M,H7,H7MI,HAB,H     N  23
       3AB5,HO,HTO,HT2,HT2I,HT4M,HT4,HT5M,HT5,HT5O5,HT5AM,HT5H,HT7M,HT7MI,     N  24
       4HT6M,HT8M,HT5AO5,PHIO,PHITO,PHIT2I,PHIT1,PHIT4M,PHIT4,PHIT5A,PHT5A     N  25
       5M,PHI8M,PHIT8M,PHI8,PHI2I,PHIT6M,PHI7M,PHIT6,PHIT7M,PHOF6,PHOH6,PT     N  26
```

```
      60P0,PT1PT0,PT2T1S,PT2PT1,PT4PT2,PT5PT4,PT5T5A,PT8P8,PT1PT7,PT7P7,P   N  27
      7T6PT5,PT6T5D,PT5AM,PT55AD,PSIH4,PSPI4,PSIH5,PSPI5A,PSIH5A,PSPI8,PS   N  28
      8IH8,PSIH7,PSPI6,PSIPHI,PSIH6,PSIH8I,PSPI7,EN,ETA2,ET5A,ETETS,ETA2S   N  29
      9,ET2D,EM7,EM8,W1COR,W1DCOR,W4COR,W4DCOR,W7COR,W7DCOR,W4TOT4,W4TEST   N  30
      $,W1,W1K,DH2M1,STTO,DELTO,DELTOD,GAMA8,GAMA7,VO,V7,V8,GAM7P1,GAM7M1   N  31
      $,ONSRT,SFC,SFCC,OF4,OF6,FOF6,F4,F5A,FA8,F6,FNOW1,FN,F6A,FOF4,FO5A,   N  32
      $W8,RT5,RTA,RT6,RT5A,CP7,CP8,CAPA8,CAPA7,OWB,WCB,ICOMB,IPP,IS,ICOUN   N  33
      $T,IKONT,JCONT,IC,KTEST,THET1,THETO,DW1,DW2,DDHP,Z1,Z2,Z3,Z,ETAC,ET   N  34
      $AO,FNOW1D,HT6,PHIH6,T5A,T4,RAT,WCOW1C,PBTA8,HDT,DTTA8,IPS,DTEMP,ET   N  35
      $AP,ALTSAV,EMSAV,NOSAV,FNSAV,W2SAV,SFCSAV,NO,INOZZ,TT2T1D,HT5A,PHT1   N  36
      $,TT4TT2,PHIT5,PSPI5,PHIT5M,HT1,PT2T1L,PS,TA8A7,T8VAL,T7VAL,NLIM,NU   N  37
      $MBER,NSTART,NFINAL,AVAL,XMNSLU,TABN,ETA4,ETA5,TABPH5,TABH4,HPEXT,I   N  38
      $CASE,IPC,PT4T2D,HS,T5VAL                                             N  39
       CPS=IPS                                                              N  40
       DO 4 I=1,IPS                                                         N  41
       PS=I                                                                 N  42
       IF (I-IPS) 1,3,3                                                     N  43
1      TT6=(TT5A+50.)+(TT6MAX-TT5A-50.)*(CPS-1.-PS)/(CPS-2.)                N  44
       PT6T5A=PT65AD-2.*10.**(-5)*(TT6MAX-TT5A-50.)*(CPS-1.-PS)/(CPS-2.)    N  45
       CALL DISCOT (TT6,TT6,TABTEM,TABH,TABH,-11,78,0,HT6)                  N  46
       CALL DISCOT (TT6,TT6,TABTEM,TABPSH,TABPSH,-11,78,0,PSIH6)            N  47
       FAB=(HT6-HT5A)/(ETA6*(H-HS)+HS-HT6-PSIH6+HF)*(1.+F5A*(1.+(PSIH6-PS   N  48
      1IH5A)/(HT6-HT5A)))                                                   N  49
       F6=F5A+FAB                                                           N  50
       OF6=1.+F6                                                            N  51
       HT6M=HT6+PSIH6*F6/(OF6)                                              N  52
       CALL DISCOT (TT6,TT6,TABTEM,TABPSP,TABPSP,-11,78,0,PSPI6)            N  53
       CALL DISCOT (TT6,TT6,TABTEM,TABPHI,TABPHI,-11,78,0,PHIT6)            N  54
       PHIT6M=PHIT6+PSPI6*F6/OF6                                            N  55
2      CALL NOZZ                                                            N  56
       CALL ENG                                                             N  57
       POWER=TT6                                                            N  58
       CALL OUTPUN (POWER)                                                  N  59
       GO TO 4                                                              N  60
3      TT6=TT5A                                                             N  61
       PHIT6M=PHT5AM                                                        N  62
       HT6M=HT5AM                                                           N  63
       FAB=0                                                                N  64
       PT6T5A=PT65AD                                                        N  65
       F6=F5A                                                               N  66
       OF6=1.+F6                                                            N  67
       GO TO 2                                                              N  68
4      CONTINUE                                                             N  69
       RETURN                                                               N  70
```

```
      END                                                                N  71-
      SUBROUTINE AT62SP (H,ANS,DTEMP,PBTAB,HDT,DTTAB)                    0   1
C                                                                        0   2
C     ANSWERS COMPATIBLE WITH THOSE OF AT62                              0   3
C                                                                        0   4
C         AT62SP CONVERTED TO CDC  1-67                                  0   5
C     SUBROUTINE AT62SP WILL COMPUTE THE STANDARD DAY,1962 ATMOSPHERIC   0   6
C     PROPERTIES (PRESSURE,DENSITY,TEMP,SONIC SPEED,AND REYNOLDS NO,PER  0   7
C     MACH-FT.)AS A FUNCTION OF AN INPUT ALTITUDE (H,GEOMETRIC FT.)      0   8
C     FROM S.L. TO 200000 FT..                                           0   9
C                                                                        0  10
C     IN ADDITION A NON-STANDARD DAY MAY BE COMPUTED IN SEVERAL OPTIONAL 0  11
C     WAYS.                                                              0  12
C     BY INPUTING A TEMPERATURE INCREMENT(DTEMP,DEG.KELVIN) A HOT DAY    0  13
C     UTILIZING THE STANDARD DAY TEMPERATURE GRADIENTS MAY BE COMPUTED.  0  14
C     THIS ATMOS.WILL USE THE HYDROSTATIC EQUA.AND THE EQUA.OF STATE.    0  15
C                                                                        0  16
C     BY INPUTING A TABLE OF TEMPERATURE INCREMENTS AS A                 0  17
C     FUNCTION OF ALTITUDE (DTTAB VS HDT) A HOT DAY MAY BE COMPUTED      0  18
C     WHICH WILL OBEY THE EQUA.OF STATE BUT NOT THE HYDROSTATIC EQUA..   0  19
C                                                                        0  20
C     COMBINATIONS OF THESE TWO OPTIONS MAY BE USED TO COMPUTE           0  21
C     A WIDE VARIETY OF NON-STANDARD ATMOSPHERES.                        0  22
C     FOR EITHER ATMOS. DESIRED, A TABLE OF PRESSURES AT SPECIFIED       0  23
C     ALTITUDES MUST BE INPUT (PBTAB(8)). THIS TABLE WILL BE SUPPLIED    0  24
C     BY ACG FOR SELECTED DTEMP VALUES.                                  0  25
C     (THE BASIC TEMPS.AND GRADIENTS ARE BUILT IN )                      0  26
C                                                                        0  27
      DIMENSION ANS(5), HMTAB(9), HBTAB(8), ELMTAB(8), TMBTAB(8)         0  28
      DIMENSION PBTAB(8), HDT(20), DTTAB(20)                             0  29
      DIMENSION ZDPR(1), HDPR(1)                                         0  30
C     DOUBLE PRECISION  ZDPR   , HDPR   , Z6     , Z6P    , TEMP2        0  31
C     DOUBLE PRECISION  TEM2   , TEM3   , TEM4   , TEM5   , TEM9         0  32
C     DOUBLE PRECISION  SINZ   , DSIN   , DLOG   , DCOS                  0  33
      DATA (HMTAB(I),I=1,9),(HBTAB(I),I=1,8),(ELMTAB(I),I=1,8),(TMBTAB(I 0  34
     1),I=1,8)/-99999999.,11000.,20000.,32000.,47000.,52000.,61000.,7900 0  35
     20.,99999999.,0.,11000.,20000.,32000.,47000.,52000.,61000.,79000.,- 0  36
     3.0065,.0,.001,.0028,.0,-.002,-.004,.0,288.15,216.65,216.65,228.65, 0  37
     4270.65,270.65,252.65,180.65/                                       0  38
```

```
      EMOR=.00348368                                                    0  39
      GAM=1.4                                                           0  40
      GO=9.80665                                                        0  41
      CONV1=.3048                                                       0  42
      CONV2=.45359237                                                   0  43
      ZFT=H                                                             0  44
C     CONVERT Z FT. TO Z METERS                                         0  45
      Z=ZFT*CONV1                                                       0  46
C     COMPUTE H DOUBLE PRECISION                                        0  47
C     1111 CALL STORE(ZDPR,ZDPR(1),1,Z)                                 0  48
      ZDPR=Z                                                            0  49
C     CALL STORE(ZDPR,ZDPR(2),1,0.0)                                    0  50
C     Z6=ZDPR(1)*.000001D0                                              0  51
      Z6=ZDPR*.000001                                                   0  52
C     210 Z6P=Z6+6.3675708D0                                            0  53
      Z6P=Z6+6.3675708                                                  0  54
C     211 TEMP2=.00105591 79D0*Z6+1.5640943D0                           0  55
      TEMP2=.00105591 79*Z6+1.5640943                                   0  56
      TEM2=Z6P*Z6P                                                      0  57
      TEM3=TEM2*Z6P                                                     0  58
      TEM4=TEM2*TEM2                                                    0  59
      TEM5=TEM2*TEM3                                                    0  60
      TEM9=TEM4*TEM5                                                    0  61
C     SINZ=DSIN(.00052795893D0*Z6+.78204713D0)                          0  62
      SINZ=SIN(.00052795893*Z6+.78204713)                               0  63
C     217 HDPR(1)=-40648635.D0/(Z6P)-894899.28D0/TEM3-16302410.D0/TEM9-7 0  64
C     13724D0/TEM4-135.55760D0*Z6*Z6-1724.8490D0*Z6+(2684697.8D0/TEM3)*( 0  65
C     2INZ*SINZ)                              +(708.70509D0/TEM2-256757.85D0 0  66
C     3Z6-1634923.8D0+.00079017959D0*DLOG(ZDPR(1)+6367570.8D0))*(DSIN(TE 0  67
C     4P2))+(.74833436D0/      (Z6P)-243160820.D0)*(DCOS(TEMP2))+9646530. 0  68
C     5284232D0                                                         0  69
      HDPR=-40648635./(Z6P)-894899.28/TEM3-16302410./TEM9-7408.3724/TEM4 0  70
     1-135.55760*Z6*Z6-1724.8490*Z6+(2684697.8/TEM3)*(SINZ*SINZ)+(708.70 0  71
     2509/TEM2-256757.85*Z6-1634923.8+.00079017959*ALOG(ZDPR(1)+6367570. 0  72
     38))*(SIN(TEMP2))+(.74833436/(Z6P)-243160820.)*(COS(TEMP2))+9646530 0  73
     4.7284232                                                          0  74
C     H    =PART(HDPR,HDPR(1),1)                                        0  75
      H=HDPR                                                            0  76
      IF (Z-90000.0) 1,1,13                                             0  77
C     Z LESS THAN 90000.M FIND H IN HMTAB TABLE                         0  78
1     N=1                                                               0  79
2     IF (H-HMTAB(N)) 5,4,3                                             0  80
3     N=N+1                                                             0  81
      GO TO 2                                                           0  82
```

```
4       J=N                                                                    0  83
        GO TO 6                                                                0  84
5       J=N-1                                                                  0  85
C       FIND HB,PB,ELM,TMB,TM                                                  0  86
6       HB=HBTAB(J)                                                            0  87
        PB=PBTAB(J)                                                            0  88
        ELM=ELMTAB(J)                                                          0  89
        TMB=TMBTAB(J)+DTEMP                                                    0  90
        TM=TMB+ELM*(H-HB)                                                      0  91
        IF (HDT(1).LT.0.) GO TO 7                                              0  92
        CALL DISCOT (ZFT,ZFT,HDT,DTTAB,DTTAB,-011,20,00,DT)                    0  93
C       TM IN KELVIN                                                           0  94
        TM=TM+DT                                                               0  95
        TMB=TMB+DT                                                             0  96
7       IF (22640.-PBTAB(2)) 10,10,8                                           0  97
8       IF (PBTAB(2)-22630.) 10,10,9                                           0  98
9       DTSAVE=TMB-TMBTAB(J)                                                   0  99
        TM=TM-DTSAVE                                                           0 100
        TMB=TMB-DTSAVE                                                         0 101
10      IF (ELM) 11,12,11                                                      0 102
C       IF ELM NOT =0 COMPUTE P                                                0 103
11      P=EXP(ALOG(PB)-(GO*EMOR/ELM)*ALOG(TM/TMB))                             0 104
        GO TO 14                                                               0 105
C       IF ELM=0 COMPUTE P                                                     0 106
12      P=EXP(ALOG(PB)-(GO*EMOR)*((H-HB)/TMB))                                 0 107
13      Z=Z                                                                    0 108
C       CONVERT P  NT/M2 TO PSF                                                0 109
14      PRESS=P/47.880183                                                      0 110
C       T DEGREES KELVIN                                                       0 111
        IF (22640.-PBTAB(2)) 17,17,15                                          0 112
15      IF (PBTAB(2)-22630.) 17,17,16                                          0 113
16      TM=TM+DTSAVE                                                           0 114
17      T=TM                                                                   0 115
C       RHO KG/M3                                                              0 116
        RHO=EMOR*(P/TM)                                                        0 117
C       CS M/SEC                                                               0 118
        CS=SQRT(GAM*TM/EMOR)                                                   0 119
C       CONVERT RHO KG/M3 TO LB/FT3                                            0 120
        RHO=RHO*CONV1*CONV1*CONV1/CONV2                                        0 121
C       CS FT/SEC                                                              0 122
        CS=CS/CONV1                                                            0 123
C       VISCOS IN LB/FT-SEC                                                    0 124
        CONST=(CONV1/CONV2)*1.458/10.**6.                                      0 125
        VISCOS=CONST*T**1.5/(T+110.4)                                          0 126
```

```
C       RNOML IN RN/MACH-FT                                              O 127
        RNOML=RHO*CS/VISCOS                                              O 128
C       CONVERT RHO LB/FT3 TO SLUG/FT3                                   O 129
        RHO=RHO/.321740485E+02                                           O 130
        ANS(1)=RHO                                                       O 131
        ANS(2)=PRESS                                                     O 132
        ANS(3)=T                                                         O 133
        ANS(4)=CS                                                        O 134
        ANS(5)=RNOML                                                     O 135
        H=ZFT                                                            O 136
        RETURN                                                           O 137
        END                                                              O 138-



        SUBROUTINE FTLUP (X,Y,M,N,VARI,VARD)                             P   1
        DIMENSION VARI(1), VARD(1), V(3), YY(2)                          P   2
        DIMENSION II(43)                                                 P   3
        DATA (II(J),J=1,43)/43*-1/                                       P   4
        MA=IABS(M)                                                       P   5
        LI=MOD(LOCF(VARI(1)),43)+1                                       P   6
        I=II(LI)                                                         P   7
        IF (I.GE.0) GO TO 6                                              P   8
        IF (N.LT.2) GO TO 6                                              P   9
        IF (VARI(2)-VARI(1)) 2,2,4                                       P  10
1       K=LOCF(VARI(1))                                                  P  11
        PRINT 17, J,K,(VARI(J),J=1,N),(VARD(J),J=1,N)                    P  12
        STOP                                                             P  13
2       DO 3 J=2,N                                                       P  14
        IF (VARI(J)-VARI(J-1)) 3,1,1                                     P  15
3       CONTINUE                                                         P  16
        GO TO 6                                                          P  17
4       DO 5 J=2,N                                                       P  18
        IF (VARI(J)-VARI(J-1)) 1,1,5                                     P  19
5       CONTINUE                                                         P  20
6       IF (I.LE.0) I=1                                                  P  21
        IF (I.GE.N) I=N-1                                                P  22
        IF (N.LE.1) GO TO 7                                              P  23
        IF (MA.NE.0) GO TO 8                                             P  24
7       Y=VARD(1)                                                        P  25
        GO TO 16                                                         P  26
8       IF ((VARI(I)-X)*(VARI(I+1)-X)) 11,11,9                           P  27
```

```
9       IN=SIGN(1.0,(VARI(I+1)-VARI(I))*(X-VARI(I)))                    P  28
10      IF ((I+IN).LE.0) GO TO 11                                       P  29
        IF ((I+IN).GE.N) GO TO 11                                       P  30
        I=I+IN                                                          P  31
        IF ((VARI(I)-X)*(VARI(I+1)-X)) 11,11,10                         P  32
11      IF (MA.EQ.2) GO TO 12                                           P  33
        Y=(VARD(I)*(VARI(I+1)-X)-VARD(I+1)*(VARI(I)-X))/(VARI(I+1)-VARI(I)  P  34
       1)                                                               P  35
        GO TO 16                                                        P  36
12      IF (N.EQ.2) GO TO 1                                             P  37
        IF (I.EQ.(N-1)) GO TO 14                                        P  38
        IF (I.EQ.1) GO TO 13                                            P  39
        SK=VARI(I+1)-VARI(I)                                            P  40
        IF ((SK*(X-VARI(I-1))).LT.(SK*(VARI(I+2)-X))) GO TO 14          P  41
13      L=I                                                             P  42
        GO TO 15                                                        P  43
14      L=I-1                                                           P  44
15      V(1)=VARI(L)-X                                                  P  45
        V(2)=VARI(L+1)-X                                                P  46
        V(3)=VARI(L+2)-X                                                P  47
        YY(1)=(VARD(L)*V(2)-VARD(L+1)*V(1))/(VARI(L+1)-VARI(L))         P  48
        YY(2)=(VARD(L+1)*V(3)-VARD(L+2)*V(2))/(VARI(L+2)-VARI(L+1))     P  49
        Y=(YY(1)*V(3)-YY(2)*V(1))/(VARI(L+2)-VARI(L))                   P  50
16      II(LI)=I                                                        P  51
        RETURN                                                          P  52
C                                                                       P  53
17      FORMAT (1H1,*TABLEBELOWOUTOFORDERFORFTLUPATPOSITION*,I5,/*XTABLEIS  P  54
       1STOREDINLOCATION*,O6,//(8G15.8))                                P  55
        END                                                             P  56-
```

```
        SUBROUTINE DISCOT (XA,ZA,TABX,TABY,TABZ,NC,NY,NZ,ANS)           Q   1
C       THE DIMENSIONS IN THIS SUBROUTINE ARE ONLY DUMMY DIMENSIONS.    Q   2
        DIMENSION TABX(2), TABY(2), TABZ(2), NPX(8), NPY(8), YY(8)      Q   3
C       DIMENSION TABX(2),TABY(2),TABZ(2),NPX(8),NPY(8),YY(8)           Q   4
        CALL UNS (NC,IA,IDX,IDZ,IMS)                                    Q   5
        IF (NZ-1) 1,1,2                                                 Q   6
1       CALL DISSER (XA,TABX(1),1,NY,IDX,NN)                            Q   7
        NNN=IDX+1                                                       Q   8
        CALL LAGRAN (XA,TABX(NN),TABY(NN),NNN,ANS)                      Q   9
        GO TO 12                                                        Q  10
```

```
2       ZARG=ZA                                                          Q   11
        IP1X=IDX+1                                                       Q   12
        IP1Z=IDZ+1                                                       Q   13
        IF (IA) 3,5,3                                                    Q   14
3       IF (ZARG-TABZ(NZ)) 5,5,4                                         Q   15
4       ZARG=TABZ(NZ)                                                    Q   16
5       CALL DISSER (ZARG,TABZ(1),1,NZ,IDZ,NPZ)                          Q   17
        NX=NY/NZ                                                         Q   18
        NPZL=NPZ+IDZ                                                     Q   19
        I=1                                                              Q   20
        IF (IMS) 6,6,8                                                   Q   21
6       CALL DISSER (XA,TABX(1),1,NX,IDX,NPX(1))                         Q   22
        DO 7 JJ=NPZ,NPZL                                                 Q   23
        NPY(I)=(JJ-1)*NX+NPX(1)                                          Q   24
        NPX(I)=NPX(1)                                                    Q   25
7       I=I+1                                                            Q   26
        GO TO 10                                                         Q   27
8       DO 9 JJ=NPZ,NPZL                                                 Q   28
        IS=(JJ-1)*NX+1                                                   Q   29
        CALL DISSER (XA,TABX(1),IS,NX,IDX,NPX(I))                        Q   30
        NPY(I)=NPX(I)                                                    Q   31
9       I=I+1                                                            Q   32
10      DO 11 LL=1,IP1Z                                                  Q   33
        NLOC=NPX(LL)                                                     Q   34
        NLOCY=NPY(LL)                                                    Q   35
11      CALL LAGRAN (XA,TABX(NLOC),TABY(NLOCY),IP1X,YY(LL))              Q   36
        CALL LAGRAN (ZARG,TABZ(NPZ),YY(1),IP1Z,ANS)                      Q   37
12      RETURN                                                           Q   38
        END                                                              Q   39-
```



```
        SUBROUTINE UNS (IC,IA,IDX,IDZ,IMS)                               R    1
        IF (IC) 1,1,2                                                    R    2
1       IMS=1                                                            R    3
        NC=-IC                                                           R    4
        GO TO 3                                                          R    5
2       IMS=0                                                            R    6
        NC=IC                                                            R    7
3       IF (NC-100) 4,5,5                                                R    8
4       IA=0                                                             R    9
        GO TO 6                                                          R   10
```

```
5       IA=1                                                        R  11
        NC=NC-100                                                   R  12
6       IDX=NC/10                                                   R  13
        IDZ=NC-IDX*10                                               R  14
        RETURN                                                      R  15
        END                                                         R  16-


        SUBROUTINE DISSER (XA,TAB,I,NX,ID,NPX)                      S   1
        DIMENSION TAB(2)                                            S   2
C       DIMENSION TAB(2)                                            S   3
        NPT=ID+1                                                    S   4
        NPB=NPT/2                                                   S   5
        NPU=NPT-NPB                                                 S   6
        IF (NX-NPT) 2,1,2                                           S   7
1       NPX=I                                                       S   8
        RETURN                                                      S   9
2       NLOW=I+NPB                                                  S  10
        NUPP=I+NX-(NPU+1)                                           S  11
        DO 3 II=NLOW,NUPP                                           S  12
        NLOC=II                                                     S  13
        IF (TAB(II)-XA) 3,4,4                                       S  14
3       CONTINUE                                                    S  15
        NPX=NUPP-NPB+1                                              S  16
        RETURN                                                      S  17
4       NL=NLOC-NPB                                                 S  18
        NU=NL+ID                                                    S  19
        DO 5 JJ=NL,NU                                               S  20
        NDIS=JJ                                                     S  21
        IF (TAB(JJ)-TAB(JJ+1)) 5,6,5                                S  22
5       CONTINUE                                                    S  23
        NPX=NL                                                      S  24
        RETURN                                                      S  25
6       IF (TAB(NDIS)-XA) 8,7,7                                     S  26
7       NPX=NDIS-ID                                                 S  27
        RETURN                                                      S  28
8       NPX=NDIS+1                                                  S  29
        RETURN                                                      S  30
        END                                                         S  31-
```

```
      SUBROUTINE LAGRAN (XA,X,Y,N,ANS)                                  T    1
      DIMENSION X(2), Y(2)                                              T    2
C     DIMENSION X(2),Y(2)                                               T    3
      SUM=0.0                                                           T    4
      DO 3 I=1,N                                                        T    5
      PROD=Y(I)                                                         T    6
      DO 2 J=1,N                                                        T    7
      A=X(I)-X(J)                                                       T    8
      IF (A) 1,2,1                                                      T    9
1     B=(XA-X(J))/A                                                     T   10
      PROD=PROD*B                                                       T   11
2     CONTINUE                                                          T   12
3     SUM=SUM+PROD                                                      T   13
      ANS=SUM                                                           T   14
      RETURN                                                            T   15
      END                                                               T   16-
```



```
      SUBROUTINE MTLUP (X,Y,M,N,MAX,NTAB,I,VARI,VARD)                   U    1
      DIMENSION VARI(1), VARD(MAX,1), Y(1), V(3), YY(2)                 U    2
      LOGICAL EX                                                        U    3
      IF (M.EQ.0) GO TO 17                                              U    4
      IF (N.LE.1) GO TO 17                                              U    5
      EX=.F.                                                            U    6
      IF (I.GE.0) GO TO 6                                               U    7
      IF (N.LT.2) GO TO 6                                               U    8
      IF (VARI(2)-VARI(1)) 2,2,4                                        U    9
1     K=LOCF(VARI(1))                                                   U   10
      PRINT 19, J,K,(VARI(J),J=1,N)                                     U   11
      STOP                                                              U   12
2     DO 3 J=2,N                                                        U   13
      IF (VARI(J)-VARI(J-1)) 3,1,1                                      U   14
3     CONTINUE                                                          U   15
      GO TO 6                                                           U   16
4     DO 5 J=2,N                                                        U   17
      IF (VARI(J)-VARI(J-1)) 1,1,5                                      U   18
5     CONTINUE                                                          U   19
6     IF (I.LE.0) I=1                                                   U   20
```

```
      IF (I.GE.N) I=N-1                                                  U  21
      IF ((VARI(I)-X)*(VARI(I+1)-X)) 10,10,7                             U  22
7     IN=SIGN(1.0,(VARI(I+1)-VARI(I))*(X-VARI(I)))                       U  23
8     IF ((I+IN).LE.0) GO TO 9                                           U  24
      IF ((I+IN).GE.N) GO TO 9                                           U  25
      I=I+IN                                                             U  26
      IF ((VARI(I)-X)*(VARI(I+1)-X)) 10,10,8                             U  27
9     EX=.T.                                                             U  28
10    IF (M.EQ.2) GO TO 12                                               U  29
      DO 11 NT=1,NTAB                                                    U  30
11    Y(NT)=(VARD(I,NT)*(VARI(I+1)-X)-VARD(I+1,NT)*(VARI(I)-X))/(VARI(I+ U  31
     11)-VARI(I))                                                        U  32
      IF (EX) I=I+IN                                                     U  33
      RETURN                                                             U  34
12    IF (N.EQ.2) GO TO 1                                                U  35
      IF (I.EQ.(N-1)) GO TO 14                                           U  36
      IF (I.EQ.1) GO TO 13                                               U  37
      SK=VARI(I+1)-VARI(I)                                               U  38
      IF ((SK*(X-VARI(I-1))).LT.(SK*(VARI(I+2)-X))) GO TO 14             U  39
13    L=I                                                                U  40
      GO TO 15                                                           U  41
14    L=I-1                                                              U  42
15    V(1)=VARI(L)-X                                                     U  43
      V(2)=VARI(L+1)-X                                                   U  44
      V(3)=VARI(L+2)-X                                                   U  45
      DO 16 NT=1,NTAB                                                    U  46
      YY(1)=(VARD(L,NT)*V(2)-VARD(L+1,NT)*V(1))/(VARI(L+1)-VARI(L))      U  47
      YY(2)=(VARD(L+1,NT)*V(3)-VARD(L+2,NT)*V(2))/(VARI(L+2)-VARI(L+1))  U  48
16    Y(NT)=(YY(1)*V(3)-YY(2)*V(1))/(VARI(L+2)-VARI(L))                  U  49
      IF (EX) I=I+IN                                                     U  50
      RETURN                                                             U  51
17    DO 18 NT=1,NTAB                                                    U  52
18    Y(NT)=VARD(1,NT)                                                   U  53
      RETURN                                                             U  54
C                                                                        U  55
19    FORMAT (1H1,*TABLEBELOWOUTOFORDERFORMTLUPATPOSITION*,I5,/*XTABLEIS  U  56
     1STOREDINLOCATION*,06,//(8G15.8))                                   U  57
      END                                                                U  58-
```

APPENDIX B

SAMPLE PROBLEMS

The examples, which follow, were chosen to show the proper sequence for establishing an engine design and to show samples of the three modes of printed output.

Example 1 (Case 1) - The following input (ENPUT) data is required to establish an engine design.

```
$ENPUT

ALT=0.,CV=.985,DTEMP=0.,EMACH=0.,ENN=1.,ETA2D=.875,ETA4=.98,ETA5=.9,ETA6=.9,
HPEXT=0.,PT2T1D=15.,PT4T2D=.95,PT65AD=1.,PT8PT6=1.,TT4N=3060.,TT6MAX=4060.,
W1D=700.,WB=0.,WCOW1=.0001,WIDE=700.,X=.1,XMNSLU=1.5,Y=1.1,

AJ=778.156,G=32.174,GAMO=1.4,PSLS=2116.2381,RO=53.330321,TSLS=518.66999,

AVAL=.005,ICASE=1,NLIM=20,TSVAL=.001,T7VAL=.01,T8VAL=.0001,VAL=.025,

PBTAB=101325.,22632.025,5474.8705,868.01404,110.90547,
  59.000452,18.209893,1.0376983,

TABM=0.,.2,.4,.6,.8,1.,1.2,1.4,1.6,1.8,2.,2.2,2.4,2.6,2.8,3.,3.2,3.4,3.6,

TABPT1=19*1.,

TABETA=.7609,.8045,.86,.901,.87,.797,.777,.721,.695,.7538,.8139,.876,.927,.909,
.83,.807,.753,.735,.7409,.8245,.89,.951,.942,.886,.871,.807,.783,.7232,.8292,
.901,.968,.974,.933,.926,.87,.815,.7091,.8316,.912,.984,1.001,.973,.965,.903,
.839,.6867,.8316,.922,.991,1.016,1.005,.989,.919,.846,.6714,.8292,.923,.995,
1.025,1.025,1.005,.931,.848,.6478,.828,.919,.994,1.028,1.031,1.013,.939,.847,
.6207,.8174,.91,.989,1.025,1.029,1.013,.942,.837,.5971,.8045,.895,.978,1.015,
1.021,1.009,.937,.806,.5689,.7845,.878,.961,1.014,1.007,1.,.919,.753,

TABNST=.4,.5,.6,.7,.8,.9,1.,1.1,1.2,

TABPT2=.1648,.2235,.3409,.5038,.6685,.84,1.,1.105,1.1695,

TABW1(1)=.1959,.276,.4027,.5975,.7751,.9428,1.0359,1.108,1.165,
.1948,.2743,.4005,.5954,.7751,.9428,1.0359,1.108,1.165,.1938,.2724,
.3994,.5943,.7751,.9428,1.0359,1.108,1.165,.1927,.2704,.3979,.591,.7748,.9428,
1.0316,1.108,1.165,.1905,.2685,.394,.5878,.7718,.9396,1.0316,1.108,1.165,.1884,
.2663,.3908,.5845,.7675,.9353,1.0305,1.108,1.165,.1862,.2639,.3875,.577,.7621,
.9299,1.0305,1.108,1.165,.184,.2607,.3843,.5716,.7532,.9221,1.0305,1.106,1.165,
.1819,.2565,.3778,.5629,.7415,.9060,1.0284,1.103,1.163,.1797,.2511,.3735,.5521,
```

```
TABZ=0.,.1,.2,.3,.4,.5,.6,.7,.8,.9,1.,

TABH(1)= 0.,121.40,192.8,204.7,216.65,228.62,240.62,252.64,264.7,276.79,288.88,
301.05,313.27,325.52,337.86,350.27,362.75,375.29,387.92,400.63,413.42,426.28,
439.24,452.26,465.38,478.56,491.81,505.14,518.56,532.02,545.56,559.17,572.84,
586.57,600.35,614.20,628.10,642.04,656.04,670.09,684.20,698.35,712.53,726.76,
741.03,755.35,769.70,784.08,798.50,812.96,827.45,841.98,856.53,871.12,885.73,
900.38,915.05,929.75,944.48,959.23,974.00,988.80,1003.63,1018.48,1033.36,
1048.25,1063.16,1078.09,1093.05,1108.03,1123.02,1138.04,1153.08,1168.13,
1183.20,1198.29,1350.09,1503.36,

TABPHI(1)=0.,1.30757,1.49849,1.53031,1.55845,1.58368,1.60656,1.62748,1.64679,
1.66471,1.68146,1.69717,1.71200,1.72598,1.73932,1.75206,1.76423,1.77591,
1.78713,1.79796,1.80840,1.81846,1.82823,1.83771,1.84691,1.85584,1.86454,
1.87300,1.88128,1.88932,1.89716,1.90486,1.91235,1.91967,1.92684,1.93384,
1.94071,1.94743,1.95402,1.96048,1.96682,1.97304,1.97914,1.98513,1.99102,
1.99680,2.00249,2.00807,2.01357,2.01897,2.02494,2.02950,2.03467,2.03974,
2.04474,2.04967,2.05452,2.05930,2.06401,2.06866,2.07324,2.07776,2.08222,
2.08662,2.09096,2.09524,2.09948,2.10365,2.10778,2.11185,2.11588,2.11986,
2.12379,2.12767,2.13151,2.13531,2.17106,2.20336,

TABTEM(1)=0.,50.,350.,400.,450.,500.,550.,600.,650.,700.,750.,800.,850.,900.,
950.,1000.,1050.,1100.,1150.,1200.,1250.,1300.,1350.,1400.,1450.,1500.,1550.,
1600.,1650.,1700.,1750.,1800.,1850.,1900.,1950.,2000.,2050.,2100.,2150.,2200.,
2250.,2300.,2350.,2400.,2450.,2500.,2550.,2600.,2650.,2700.,2750.,2800.,2850.,
2900.,2950.,3000.,3050.,3100.,3150.,3200.,3250.,3300.,3350.,3400.,3450.,3500.,
3550.,3600.,3650.,3700.,3750.,3800.,3850.,3900.,3950.,4000.,4500.,5000.,

TABA7=1.01,1.05,1.1,1.15,1.175,1.2,1.25,1.3,1.35,1.4,1.45,1.5,

TABN=1.,.975,.95,.90,.85,.8,.75,.7,.65,.6,.55,.5,

TABDLDB(1)=6.15,6.25,6.55,6.7,6.95,7.3,7.85,8.5,9.3,11.35,13.5,14.5,
15.35,15.95,16.35,16.95,17.2,

TABVJ(1)=1000.,1200.,1400.,1500.,1600.,1700.,1800.,1900.,2000.,2200.,
2400.,2500.,2600.,2700.,2800.,3000.,3200.,

IDES=0,IDDBS=0,IPC=2,ZTHRUST=0.,IFUEL=1,A4A4DN=1.,A7A7DN=1.,IPS=5,NFINAL=12,
NSTART=1,NUMBER=1,P80P8=1.,IPUNCH=0,

$
```

It should be noted that to establish an engine design that it must be done at sea level static standard day conditions and all parameters associated with installation effects must be zeroed out, that is the following parameters must be as specified below; for a non-afterburning engine.

ALT	= 0.	WB	= 0.
DTEMP	= 0.	TABPT1	= 19*1.
EMACH	= 0.	IDES	= 0.
HPEXT	= 0.	IDDS	= 0.
PT65AD	= 1.	IPC	= 2.
PT8PT6	= 1.	ZTHRUST	= 0.

For the afterburning design case values which are typical of afterburner pressure losses must be specified. That is PT65AD and PT8PT6 should have a value less than one and the control IPC = 1.

Example 1 is for a non-afterburning design point case with the long form printed output as follows:


```
 INPUT     CASE       1     PC          2     P3                    I
   ALT  0.                 MACH  0.                HPEXT  0.              IDDBS       0
 WCOW1    .10000000E-03      WB  0.                  CV   .98500000E+00   ZTHRUST       0.


  DESIGN CASE     PT2T1D   .15000000E+02   W1DCOR   .10193376E+01      Z   .89247312E+00    DNSRT  .10000000E+01
  ETA2   .87500000E+00    PT1PT0   .10000000E+01      TT0   .51867000E+03      TT2   .11698770E+04      TT4   .30600000E+04
 DH2-1   .16495593E+03      ETA5   .90000000E+00

  HT1       .23310080E+03     HT2I       .37743724E+03


    FN 73466.09100      SFC       .97996    FN/W1   104.95156  PT1/PT0     1.00000  PT2/PT1    15.00000     ETA2       .87500
  W1K             I    N/SRT     1.00000     TT0   518.67000     TT2  1189.87698     TT4  3060.00000  PT4/PT2       .95000
   TT5  2488.03128  PT5/PT4       .35665    TT5A  2384.70808     TT6  2384.70808  PT6/PT5A     1.00000       F6       .02857
    T8  1623.04063   PT8/P8     5.08232      V0     0.00000      V8  3332.91509      M8     1.73554        N     1.00000
A4/A4D     1.00000  A7/A7D     1.00000    A6/A7     1.41268      A8  1920.38657   CAPA8     8.84445       W1   700.00000
  ETAP     0.00000    ETAC     0.00000    ETAD     0.00000  FN/W10   104.95156      WF 71994.10768       W6   719.99836
PT7P7      1.82262  PT1PT7       .19676  PT5T5A     1.00000  PT6T5A     1.00000  PT8PT6     1.00000      TT1   518.67000
   WB      0.00000    WBOW1     0.00000    DLDB     0.00000    DFGS           I     FG1 73466.09100      FN1 73466.09100
 SFC1       .97996   DTEMP     0.00000      WC    63.00000      F4       .03139
```

Example 2 (Case 2) - The second step in establishing an engine design is to lock in or fix the flow matching parameters established in the design point case. This is accomplished by setting IDES = 1.

```
$ENPUT
ICASE=2,IDES=1,
$
```

At the same time that IDES is set equal to 1, the off-design data calculations may also be initiated, however, for simplicity off-design performance has been delayed until Example 3.

Case 2, which follows, is also in a long form printed output.

```
 INPUT     CASE       2     PC          2     PS                        I
   ALT  0.                   MACH  0.                HPEXT  0.                IDDBS        0
WCOW1    .10000000E-03        WB  0.                   CV    .98500000E+00  ZTHRUST        0.

    FN 73465.69230       SFC       .97995    FN/W1    104.95184  PT1/PTO      1.00005  PT2/PT1     15.00117     ETA2       .87500
  W1K   700.00032    N/SRT       1.00000      TTO    518.67000      TT2   1189.90631      TT4   3060.00000  PT4/PT2       .95001
  TT5  2488.00433  PT5/PT4        .35664     TT5A   2384.68525      TT6   2384.68525  PT6/PT5A      1.00000       F6       .02857
   T8  1623.01096   PT8/P8       5.08249       VC      0.00000       V8   3332.92536       M8      1.73556        N      1.00000
A4/A4D     1.00000  A7/A7D        .99995     A8/A7      1.41270       A8   1920.36919     CAPA8      8.84418       W1    699.99432
 ETAP      0.00000    ETAC       0.00000     ETAD      0.00000  FN/W10    104.95099       WF 71992.49154       WG    719.99224
PT7P7      1.82262  PT1PT7        .19675   PT5T5A      1.00000  PT6T5A      1.00000  PT8PT6      1.00000      TT1    518.67000
   WB      0.00000    WBOW1       0.00000     DLDB      0.00000    DFGS            1     FG1 73465.69230      FN1 73465.69230
 SFC1       .97995    DTEMP       0.00000       WC     62.99949      F4       .03139
```

Example 3 (Case 3) - The next step in the normal operating sequence is to introduce the installation effects of service airbleed, power extraction inlet recovery, non-standard day temperatures and exercise the variable turbine geometry mode of operation. This is accomplished by changing the parameters shown below:

```
$ENPUT
ICASE=3.IPC=4.
WB=1..HPEXT=200..
TABPT1=.95,.968,.977,.982,.982,.978,.973,.967,.96,.952,.943,.934,.924,.914,
.902,.891,.877,.859,.831,
DTEMP=8.,
A4A4DN=.8,
$
```

Engine performance generated by introducing the above parameters is for full and part power without afterburning at sea level static standard +8°C atmospheric conditions. It should be noted that this step could have been combined with Step 2 (Example 2) above. Output is in the long format as follows:

```
 INPUT    CASE    3    PC        4     P3                    I
 ALT  0.              MACH  0.              HPEXT   .20000000E+03     IDDBS      0
 WCOW1   .10000000E-03        W8   .10000000E+01        CV   .98500000E+00   ZTHRUST      0.

   FN 65792.78604      SFC       .99745   FN/W1   101.96592  PT1/PTO       .95000  PT2/PT1    14.54179      ETA2       .87684
  W1K   688.57289    N/SRT       .98640    TTO   533.07000      TT2  1209.09110       TT4  3060.00000  PT4/PT2       .94910
  TT5  2480.70097  PT5/PT4       .35170   TT5A  2379.13398      TT6  2379.13398  PT6/PT5A      1.00000       F6       .02830
   T8  1658.34116   PT8/P8      4.61135     VO     0.00000       V8  3243.98985        M8      1.67162        N      1.00000
A4/A4D     1.00000  A7/A7D      1.01289    A8/A7     1.34675       A8  1940.63186     CAPA8      8.54264       W1    645.24292
 ETAP      0.00000    ETAC      0.00000     ETAD     0.00000   FN/W1D     93.98969        WF  65625.19385       WG    663.50043
PT7P7      1.82500  PT1PT7       .20601   PT5T5A     1.00000   PT6T5A      1.00000   PT8PT6      1.00000      TT1    533.07000
   WB      1.00000    WBOW1       .00155     DLDB     0.00000     DFGS            I      FG1  65792.78604      FN1  65792.78604
 SFC1       .99745    DTEMP     8.00000       WC    58.07186       F4       .03110

   FN 60548.63215      SFC       .92864   FN/W1    93.83851  PT1/PTO       .95000  PT2/PT1    14.54179      ETA2       .87684
  W1K   688.57289    N/SRT       .98640    TTO   533.07000      TT2  1209.09110       TT4  2784.60000  PT4/PT2       .94910
  TT5  2204.15092  PT5/PT4       .32019   TT5A  2147.92018      TT6  2147.92018  PT6/PT5A      1.00000       F6       .02424
   T8  1519.05364   PT8/P8      4.19820     VO     0.00000       V8  2997.23055        M8      1.60781        N      1.00000
A4/A4D      .97787  A7/A7D      1.05296    A8/A7     1.28504       A8  1864.17185     CAPA8      8.43488       W1    645.24292
 ETAP      0.00000    ETAC      0.00000     ETAD     0.00000   FN/W1D     86.49805        WF  56220.11165       WG    660.88506
PT7P7      1.82500  PT1PT7       .22629   PT5T5A     1.00000   PT6T5A      1.00000   PT8PT6      1.00000      TT1    533.07000
   WB      1.00000    WBOW1       .00155     DLDB     0.00000     DFGS            I      FG1  60548.63215      FN1  60548.63215
 SFC1       .92864    DTEMP     8.00000       WC    40.30187       F4       .02586
```

FN	54754.19207	SFC	.85182	FN/W1	84.85326	PT1/PT0	.95000	PT2/PT1	14.54179	ETA2	.87684
W1K	688.57289	N/SRT	.98640	TT0	533.07000	TT2	1209.09110	TT4	2509.20000	PT4/PT2	.94910
TT5	1927.96840	PT5/PT4	.28750	TT5A	1904.96503	TT6	1904.96503	PT6/PT5A	1.00000	F6	.02011
T8	1371.05672	PT8/P8	3.70955	V0	0.00000	V8	2721.38205	M8	1.53030	N	1.00000
A4/A4D	.95089	A7/A7D	1.09993	A8/A7	1.21471	A8	1778.52503	CAPA8	8.84980	W1	645.24292
ETAP	0.00000	ETAC	0.00000	ETA0	0.00000	FN/W1D	78.22027	WF	46640.76335	WG	658.21880
PT7P7	1.84421	PT1PT7	.25202	PT5T5A	1.00000	PT6T5A	1.00000	PT8PT6	1.00000	TT1	533.07000
WB	1.00000	W80W1	.00155	DLDB	0.00000	DFGS	I	FG1	54754.19207	FN1	54754.19207
SFC1	.85182	DTEMP	8.00000	WC	22.53188	F4	.02084				

FN	48050.80358	SFC	.76787	FN/W1	74.46932	PT1/PT0	.95000	PT2/PT1	14.54179	ETA2	.87684
W1K	688.57289	N/SRT	.98640	TT0	533.07000	TT2	1209.09110	TT4	2233.80000	PT4/PT2	.94910
TT5	1647.72963	PT5/PT4	.24753	TT5A	1644.69101	TT6	1644.69101	PT6/PT5A	1.00000	F6	.01591
T8	1217.47082	PT8/P8	3.24558	V0	0.00000	V8	2398.08822	M8	1.42496	N	1.00000
A4/A4D	.91848	A7/A7D	1.18214	A8/A7	1.14248	A8	1682.91560	CAPA8	8.37820	W1	645.24292
ETAP	0.00000	ETAC	0.00000	ETA0	0.00000	FN/W1D	68.64401	WF	36896.60453	WG	655.50788
PT7P7	1.84548	PT1PT7	.29271	PT5T5A	1.00000	PT6T5A	1.00000	PT8PT6	1.00000	TT1	533.07000
WB	1.00000	W80W1	.00155	DLDB	0.00000	DFGS	I	FG1	48050.80358	FN1	48050.80358
SFC1	.76787	DTEMP	8.00000	WC	4.76189	F4	.01603				

FN	39150.25499	SFC	.67692	FN/W1	60.67522	PT1/PT0	.95000	PT2/PT1	14.54179	ETA2	.87684
W1K	688.57289	N/SRT	.98640	TT0	533.07000	TT2	1209.09110	TT4	1958.40000	PT4/PT2	.94910
TT5	1352.18872	PT5/PT4	.19392	TT5A	1352.18872	TT6	1352.18872	PT6/PT5A	1.00000	F6	.01143
T8	1055.87805	PT8/P8	2.54255	V0	0.00000	V8	1962.54370	M8	1.24685	N	1.00000
A4/A4D	.86243	A7/A7D	1.36221	A8/A7	1.04812	A8	1574.62824	CAPA8	8.33825	W1	645.24292
ETAP	0.00000	ETAC	0.00000	ETA0	0.00000	FN/W1D	55.92894	WF	26501.75746	WG	652.61594
PT7P7	1.86511	PT1PT7	.37364	PT5T5A	1.00000	PT6T5A	1.00000	PT8PT6	1.00000	TT1	533.07000
WB	1.00000	W80W1	.00155	DLDB	0.00000	DFGS	I	FG1	39150.25499	FN1	39150.25499
SFC1	.67692	DTEMP	8.00000	WC	4.76189	F4	.01143				

FN	28105.72120	SFC	.60227	FN/W1	43.55836	PT1/PT0	.95000	PT2/PT1	14.54179	ETA2	.87684
W1K	688.57289	N/SRT	.98640	TT0	533.07000	TT2	1209.09110	TT4	1699.64340	PT4/PT2	.94910
TT5	1066.41963	PT5/PT4	.13720	TT5A	1066.41963	TT6	1066.41963	PT6/PT5A	1.00000	F6	.00730
T8	907.83307	PT8/P8	1.79894	V0	0.00000	V8	1414.67193	M8	.96490	N	1.00000
A4/A4D	.80021	A7/A7D	1.70461	A8/A7	1.00000	A8	1466.13749	CAPA8	10.49749	W1	645.24292
ETAP	0.00000	ETAC	0.00000	ETA0	0.00000	FN/W1D	40.15103	WF	16927.14210	WG	649.95220
PT7P7	1.86511	PT1PT7	.52609	PT5T5A	1.00000	PT6T5A	1.00000	PT8PT6	1.00000	TT1	533.07000
WB	1.00000	W80W1	.00155	DLDB	0.00000	DFGS	I	FG1	28105.72120	FN1	28105.72120
SFC1	.60227	DTEMP	8.00000	WC	4.76189	F4	.00730				

FN	27354.68604	SFC	.58923	FN/W1	42.36349	PT1/PT0	.95000	PT2/PT1	14.45092	ETA2	.87710
W1K	689.07525	N/SRT	.98640	TT0	533.07000	TT2	1206.74075	TT4	1674.64348	PT4/PT2	.94849
TT5	1045.50730	PT5/PT4	.13533	TT5A	1045.50730	TT6	1045.50730	PT6/PT5A	1.00000	F6	.00694
T8	895.14919	PT8/P8	1.76219	V0	0.00000	V8	1376.34752	M8	.94399	N	1.00000
A4/A4D	.80021	A7/A7D	1.72654	A8/A7	1.00000	A8	1458.00560	CAPA8	10.64295	W1	645.71367
ETAP	0.00000	ETAC	0.00000	ETA0	0.00000	FN/W1D	39.07812	WF	16118.21302	WG	650.19789
PT7P7	1.86511	PT1PT7	.53910	PT5T5A	1.00000	PT6T5A	1.00000	PT8PT6	1.00000	TT1	533.07000
WB	1.00000	W80W1	.00155	DLDB	0.00000	DFGS	I	FG1	27354.68604	FN1	27354.68604
SFC1	.58923	DTEMP	8.00000	WC	4.76189	F4	.00694				

FN	24122.20640	SFC	.58308	FN/W1	38.53141	PT1/PTO	.95000	PT2/PT1	13.75074	ETA2	.88032
W1K	668.08044	N/SRT	.96174	TTO	533.07000	TT2	1187.27637	TT4	1611.57693	PT4/PT2	.94738
TT5	995.72072	PT5/PT4	.13162	TT5A	995.72072	TT6	995.72072	PT6/PT5A	1.00000	F6	.00625
T8	870.71162	PT8/P8	1.62894	VO	0.00000	V8	1252.77130	M8	.87108	N	.97500
A4/A4D	.80021	A7/A7D	1.78776	A8/A7	1.00000	A8	1438.18897	CAPA8	11.01866	W1	626.04000
ETAP	0.00000	ETAC	0.00000	ETAO	0.00000	FN/W1D	34.46029	WF	14065.27018	WG	629.95327
PT7P7	1.86511	PT1PT7	.58320	PT5T5A	1.00000	PT6T5A	1.00000	PT8PT6	1.00000	TT1	533.07000
W8	1.00000	WBOW1	.00160	DLDB	0.00000	DFGS	I	FG1	24122.20640	FN1	24122.20640
SFC1	.58308	DTEMP	8.00000	WC	4.76189	F4	.00625				

FN	21052.53082	SFC	.57973	FN/W1	34.71029	PT1/PTO	.95000	PT2/PT1	13.07423	ETA2	.88364
W1K	647.25107	N/SRT	.93708	TTO	533.07000	TT2	1167.78453	TT4	1550.59924	PT4/PT2	.94627
TT5	948.49931	PT5/PT4	.12814	TT5A	948.49931	TT6	948.49931	PT6/PT5A	1.00000	F6	.00560
T8	846.71615	PT8/P8	1.50607	VO	0.00000	V8	1129.32493	M8	.79573	N	.95000
A4/A4D	.80021	A7/A7D	1.87223	A8/A7	1.00000	A8	1419.22978	CAPA8	11.50735	W1	606.92136
ETAP	0.00000	ETAC	0.00000	ETAO	0.00000	FN/W1D	30.07504	WF	12204.73660	WG	609.91716
PT7P7	1.86511	PT1PT7	.63078	PT5T5A	1.00000	PT6T5A	1.00000	PT8PT6	1.00000	TT1	533.07000
W8	1.00000	WBOW1	.00165	DLDB	0.00000	DFGS	I	FG1	21052.53082	FN1	21052.53082
SFC1	.57973	DTEMP	8.00000	WC	4.76189	F4	.00560				

FN	16921.46888	SFC	.58768	FN/W1	29.99917	PT1/PTO	.95000	PT2/PT1	11.84806	ETA2	.88793
W1K	601.94308	N/SRT	.88776	TTO	533.07000	TT2	1132.60961	TT4	1471.34021	PT4/PT2	.94512
TT5	897.71741	PT5/PT4	.12916	TT5A	897.71741	TT6	897.71741	PT6/PT5A	1.00000	F6	.00491
T8	821.68869	PT8/P8	1.37398	VO	0.00000	V8	976.83984	M8	.69859	N	.90000
A4/A4D	.80021	A7/A7D	1.95438	A8/A7	1.00000	A8	1398.30199	CAPA8	11.99664	W1	564.06448
ETAP	0.00000	ETAC	0.00000	ETAO	0.00000	FN/W1D	24.17353	WF	9944.40820	WG	566.83172
PT7P7	1.86511	PT1PT7	.69142	PT5T5A	1.00000	PT6T5A	1.00000	PT8PT6	1.00000	TT1	533.07000
W8	1.00000	WBOW1	.00177	DLDB	0.00000	DFGS	I	FG1	16921.46888	FN1	16921.46888
SFC1	.58768	DTEMP	8.00000	WC	4.76189	F4	.00491				

FN	13373.72161	SFC	.61379	FN/W1	26.04554	PT1/PTO	.95000	PT2/PT1	10.54602	ETA2	.88651
W1K	547.95588	N/SRT	.83844	TTO	533.07000	TT2	1096.11391	TT4	1406.06951	PT4/PT2	.94444
TT5	865.35002	PT5/PT4	.13550	TT5A	865.35002	TT6	865.35002	PT6/PT5A	1.00000	F6	.00445
T8	806.88532	PT8/P8	1.28211	VO	0.00000	V8	848.63466	M8	.61239	N	.85000
A4/A4D	.80021	A7/A7D	2.00525	A8/A7	1.00000	A8	1385.78292	CAPA8	12.33607	W1	513.47454
ETAP	0.00000	ETAC	0.00000	ETAO	0.00000	FN/W1D	19.10532	WF	8208.65120	WG	515.75917
PT7P7	1.86511	PT1PT7	.74097	PT5T5A	1.00000	PT6T5A	1.00000	PT8PT6	1.00000	TT1	533.07000
W8	1.00000	WBOW1	.00195	DLDB	0.00000	DFGS	I	FG1	13373.72161	FN1	13373.72161
SFC1	.61379	DTEMP	8.00000	WC	4.76189	F4	.00445				

FN	10496.02714	SFC	.65817	FN/W1	22.74348	PT1/PTO	.95000	PT2/PT1	9.29191	ETA2	.88211
W1K	492.48698	N/SRT	.78912	TTO	533.07000	TT2	1058.74038	TT4	1351.32592	PT4/PT2	.94416
TT5	844.38375	PT5/PT4	.14568	TT5A	844.38375	TT6	844.38375	PT6/PT5A	1.00000	F6	.00417
T8	799.71876	PT8/P8	1.21417	VO	0.00000	V8	741.41572	M8	.53731	N	.80000
A4/A4D	.80021	A7/A7D	2.04027	A8/A7	1.00000	A8	1379.85954	CAPA8	12.57155	W1	461.49615
ETAP	0.00000	ETAC	0.00000	ETAO	0.00000	FN/W1D	14.99432	WF	6908.12951	WG	463.41924
PT7P7	1.86511	PT1PT7	.78242	PT5T5A	1.00000	PT6T5A	1.00000	PT8PT6	1.00000	TT1	533.07000
W8	1.00000	WBOW1	.00217	DLDB	0.00000	DFGS	I	FG1	10496.02714	FN1	10496.02714
SFC1	.65817	DTEMP	8.00000	WC	4.76189	F4	.00417				

FN	7808.89989	SFC	.75154	FN/W1	19.21616	PT1/PTO	.95000	PT2/PT1	8.03708	ETA2	.86794
W1K	433.66057	N/SRT	.73980	TTO	533.07000	TT2	1022.50712	TT4	1306.76938	PT4/PT2	.95412
TT5	833.39027	PT5/PT4	.15925	TT5A	833.39027	TT6	833.39027	PT6/PT5A	1.00000	F6	.00402
T8	801.46116	PT8/P8	1.14608	VO	0.00000	V8	626.70398	M8	.45372	N	.75000
A4/A4D	.80021	A7/A7D	2.13142	A6/A7	1.00000	A8	1381.25986	CAPA8	13.11916	W1	406.37151
ETAP	0.00000	ETAC	0.00000	ETAD	0.00000	FN/W10	11.15557	WF	5868.68838	WG	408.00573
PT7P7	1.86511	PT1PT7	.82747	PT5T5A	1.00000	PT6T5A	1.00000	PT8PT6	1.00000	TT1	533.07000
W8	1.00000	W8GW1	.00246	DLDB	0.00000	DFGS	I	FG1	7808.89989	FN1	7808.89989
SFC1	.75154	DTEMP	8.00000	WC	4.76189	F4	.00402				

NOZZLE PRESSURE RATIO LESS THAN 1.005

Example 4 (Case 4) - To generate engine performance with afterburning requires changing the afterburner pressure losses and the power control parameter (IPC), as shown below.

```
$ENPUT
ICASE=4,IPC=1,PT8PT6=.98,PT65AD=.95,
$
```

The values introduced for the pressure losses, above, are typical of current afterburners. It was not necessary in this case to introduce afterburner combustion efficiency or the maximum afterburner temperature since these were input in Example 1. It was possible to do this in Case 1 since these parameters are used in the cycle match calculation only if the power control calls for an afterburning case. Pressures, on the other hand, could not be input in Case 1 since they are used in the calculation reguardless of whether or not the power control calls for an afterburning case.

Shown below is afterburning engine performance at sea level static standard +8°C atmospheric conditions from maximum afterburning to maximum non-afterburning, with the output in the long form format.

INPUT	CASE	4	PC	1	P3		I				
ALT	0.		MACH	0.		HPEXT	.20000000E+03	IDDBS	0		
WCOW1	.10000000E-03		WB	.10000000E+01		CV	.98500000E+00	ZTHRUST	0.		
FN	87448.45146	SFC	1.75800	FN/W1	135.52795	PT1/PT0	.95000	PT2/PT1	14.54179	ETA2	.87684
W1K	688.57289	N/SRT	.98640	TT0	533.07000	TT2	1209.09110	TT4	3060.00000	PT4/PT2	.94910
TT5	2480.70097	PT5/PT4	.35170	TT5A	2379.13398	TT6	4060.00000	PT6/PT5A	.91738	F6	.06629
T8	3035.52731	PT8/P8	4.14576	V0	0.00000	V8	4158.12654	M8	1.61971	N	1.00000
A4/A4D	1.00000	A7/A7D	1.52614	A8/A7	1.32880	A8	2557.20614	CAPA8	12.66504	W1	645.24292
ETAP	0.00000	ETAC	0.00000	ETAD	0.00000	FN/W1D	124.92636	WF	153734.79550	WG	688.01331
PT7P7	1.80000	PT1PT7	.22915	PT5T5A	1.00000	PT6T5A	.91738	PT8PT6	.98000	TT1	533.07000
WB	1.00000	W80W1	.00155	DLDB	0.00000	DFGS	I	FG1	87448.45146	FN1	87448.45146
SFC1	1.75800	DTEMP	8.00000	WC	58.07186	F4	.03110				
FN	80355.60331	SFC	1.52572	FN/W1	124.53543	PT1/PT0	.95000	PT2/PT1	14.54179	ETA2	.87684
W1K	688.57289	N/SRT	.98640	TT0	533.07000	TT2	1209.09110	TT4	3060.00000	PT4/PT2	.94910
TT5	2480.70097	PT5/PT4	.35170	TT5A	2379.13398	TT6	3516.37799	PT6/PT5A	.92826	F6	.05286
T8	2591.53855	PT8/P8	4.19489	V0	0.00000	V8	3869.58325	M8	1.62154	N	1.00000
A4/A4D	1.00000	A7/A7D	1.38599	A8/A7	1.32746	A8	2386.36657	CAPA8	11.46788	W1	645.24292
ETAP	0.00000	ETAC	0.00000	ETAD	0.00000	FN/W1D	114.79372	WF	122599.76960	WG	679.35127
PT7P7	1.81019	PT1PT7	.22647	PT5T5A	1.00000	PT6T5A	.92826	PT8PT6	.98000	TT1	533.07000
WB	1.00000	W80W1	.00155	DLDB	0.00000	DFGS	I	FG1	80355.60331	FN1	80355.60331
SFC1	1.52572	DTEMP	8.00000	WC	58.07186	F4	.03110				

FN	72981.81769	SFC	1.28873	FN/W1	113.10751	PT1/PT0	.95000	PT2/PT1	14.54179	ETA2	.87684
W1K	688.57289	N/SRT	.98640	TT0	533.07000	TT2	1209.09110	TT4	3060.00000	PT4/PT2	.94910
TT5	2480.70097	PT5/PT4	.35170	TT5A	2379.13398	TT6	2972.75599	PT6/PT5A	.93913	F6	.04055
T8	2155.09983	PT8/P8	4.24403	V0	0.00000	V8	3556.06396	M8	1.62375	N	1.00000
A4/A4D	1.00000	A7/A7D	1.24488	A8/A7	1.33100	A8	2190.03303	CAPA8	10.25210	W1	645.24292
ETAP	0.00000	ETAC	0.00000	ETAD	0.00000	FN/W1D	104.25974	WF	94053.98272	WG	671.40958
PT7P7	1.81424	PT1PT7	.22384	PT5T5A	1.00000	PT6T5A	.93913	PT8PT6	.98000	TT1	533.07000
WB	1.00000	W8OW1	.00155	DLDB	0.00000	DFGS	I	FG1	72981.81769	FN1	72981.81769
SFC1	1.28873	DTEMP	8.00000	WC	58.07186	F4	.03110				

FN	65194.59372	SFC	1.04169	FN/W1	101.03884	PT1/PT0	.95000	PT2/PT1	14.54179	ETA2	.87684
W1K	666.57289	N/SRT	.98640	TT0	533.07000	TT2	1209.09110	TT4	3060.00000	PT4/PT2	.94910
TT5	2480.70097	PT5/PT4	.35170	TT5A	2379.13398	TT6	2429.13398	PT6/PT5A	.95000	F6	.02928
T8	1726.20456	PT8/P8	4.29316	V0	0.00000	V8	3211.41503	M8	1.62401	N	1.00000
A4/A4D	1.00000	A7/A7D	1.10039	A8/A7	1.32816	A8	1977.46563	CAPA8	8.99133	W1	645.24292
ETAP	0.00000	ETAC	0.00000	ETAD	0.00000	FN/W1D	93.13513	WF	67912.68519	WG	664.13683
PT7P7	1.82500	PT1PT7	.22128	PT5T5A	1.00000	PT6T5A	.95000	PT8PT6	.98000	TT1	533.07000
WB	1.00000	W8OW1	.00155	DLDB	0.00000	DFGS	I	FG1	65194.59372	FN1	65194.59372
SFC1	1.04169	DTEMP	8.00000	WC	58.07186	F4	.03110				

FN	64493.53907	SFC	1.01755	FN/W1	99.95734	PT1/PT0	.95000	PT2/PT1	14.54179	ETA2	.87684
W1K	688.57289	N/SRT	.98640	TT0	533.07000	TT2	1209.09110	TT4	3060.00000	PT4/PT2	.94910
TT5	2480.70097	PT5/PT4	.35170	TT5A	2379.13398	TT6	2379.13398	PT6/PT5A	.95000	F6	.02830
T8	1687.53930	PT8/P8	4.29316	V0	0.00000	V8	3179.92897	M8	1.62437	N	1.00000
A4/A4D	1.00000	A7/A7D	1.08796	A8/A7	1.32816	A8	1957.64151	CAPA8	8.86817	W1	645.24292
ETAP	0.00000	ETAC	0.00000	ETAD	0.00000	FN/W1D	92.13303	WF	65625.19385	WG	663.50043
PT7P7	1.82500	PT1PT7	.22128	PT5T5A	1.00000	PT6T5A	.95000	PT8PT6	.98000	TT1	533.07000
WB	1.00000	W8OW1	.00155	DLDB	0.00000	DFGS	1	FG1	64493.53907	FN1	64493.53907
SFC1	1.01755	DTEMP	8.00000	WC	58.07186	F4	.03110				

Example 5 (Case 5) - This case is similar to Case 4 except that this case is for a Mach number of 2.62 at an altitude of 65000 ft. with a fixed geometry turbine as determined by the input parameters shown below:

```
$ENPUT
ICASE=5,IPC=3,IPUNCH=2,A4A4DN=1.0,ALT=65000.,EMACH=2.62,
$
```

Engine performance for this case is generated from maximum afterburning through maximum non-afterburning to minimum non-afterburning power as determined by the program. Output is in the short form format.

```
   INPUT     CASE        5     PC        3     P3          .50000000E+01
     ALT   .65000000E+05       MACH   .26200000E+01    HPEXT   .20000000E-03     IDDBS      0
   WCDW1   .10000000E-03         WB   .10000000E+01       CV   .98500000E+00   ZTHRUST      0.

 FN 37673.7338      FG 65271.4233      FD 27597.6896      SFC   1.96014      WF73845.8690      W1  343.7901      WG  364.3627
FN1 37673.7338     FG1 65271.4233       N   1.00000     SFC1   1.96014      W1K  439.3817      V8 5868.4462    CAPA8   54.0292
TT4 3060.00000 A4/A4D    1.00000      TT1  954.22444

 FN 31792.3841      FG 59390.0737      FD 27597.6896      SFC   1.79135      WF56951.4319      W1  343.7901      WG  359.6561
FN1 31792.3841     FG1 59390.0737       N   1.00000     SFC1   1.79135      W1K  439.3817      V8 5409.5405    CAPA8   47.9313
TT4 3060.00000 A4/A4D    1.00000      TT1  954.22444

 FN 25737.6580      FG 53335.3476      FD 27597.6896      SFC   1.61280      WF41509.8198      W1  343.7901      WG  355.3542
FN1 25737.6580     FG1 53335.3476       N   1.00000     SFC1   1.61280      W1K  439.3817      V8 4916.8568    CAPA8   41.7628
TT4 3060.00000 A4/A4D    1.00000      TT1  954.22444

 FN 19367.3264      FG 46965.0160      FD 27597.6896      SFC   1.41545      WF27413.5730      W1  343.7901      WG  351.4272
FN1 19367.3264     FG1 46965.0160       N   1.00000     SFC1   1.41545      W1K  439.3817      V8 4377.9726    CAPA8   35.5354
TT4 3060.00000 A4/A4D    1.00000      TT1  954.22444

 FN 18810.2355      FG 46407.9250      FD 27597.6896      SFC   1.39437      WF26228.2612      W1  343.7901      WG  351.0970
FN1 18810.2355     FG1 46407.9250       N   1.00000     SFC1   1.39437      W1K  439.3817      V8 4330.1103    CAPA8   34.9767
TT4 3060.00000 A4/A4D    1.00000      TT1  954.22444

 FN 18254.8938      FG 45860.4162      FD 27605.5224      SFC   1.38795      WF25336.9580      W1  343.8877      WG  350.9462
FN1 18254.8938     FG1 45860.4162       N   1.00000     SFC1   1.38795      W1K  439.5064      V8 4280.8594    CAPA8   34.7560
TT4 3010.00000 A4/A4D    1.00000      TT1  954.22444

 FN 15851.5265      FG 43492.5910      FD 27641.0646      SFC   1.36532      WF21642.3891      W1  344.3304      WG  350.3597
FN1 13851.5265     FG1 43492.5910       N   1.00000     SFC1   1.36532      W1K  440.0722      V8 4066.6150    CAPA8   33.9167
TT4 2804.43746 A4/A4D    1.00000      TT1  954.22444

 FN 13339.3236      FG 41023.0049      FD 27683.6812      SFC   1.34914      WF17996.6543      W1  344.8613      WG  349.8749
FN1 13339.3236     FG1 41023.0049       N   1.00000     SFC1   1.34914      W1K  440.7507      V8 3841.0030    CAPA8   33.1212
TT4 2603.44037 A4/A4D    1.00000      TT1  954.22444
```

FN	11339.1437		FG	39057.3279		FD	27718.1842		SFC	1.34509		WF15251.1399		W1	345.2911		WG	349.5398
FN1	11339.1437		FG1	39057.3279		N	1.00000		SFC1	1.34500		W1K	441.3001		V8 3660.4481		CAPA8	32.5537
TT4	2453.44037	A4/A4D		1.00000		TT1	954.22444											
FN	10649.8952		FG	38380.3800		FD	27730.4847		SFC	1.34582		WF14332.8041		W1	345.4448		WG	349.4372
FN1	10649.8952		FG1	38380.3800		N	1.00000		SFC1	1.34582		W1K	441.4959		V8 3598.0562		CAPA8	32.3617
TT4	2403.44037	A4/A4D		1.00000		TT1	954.22444											
FN	9589.0587		FG	37338.6314		FD	27749.5727		SFC	1.35193		WF12963.6959		W1	345.6821		WG	349.2936
FN1	9589.0587		FG1	37338.6314		N	1.00000		SFC1	1.35193		W1K	441.7998		V8 3501.8275		CAPA8	32.1120
TT4	2328.99281	A4/A4D		1.00000		TT1	954.22444											
FN	8118.8698		FG	35895.5990		FD	27776.7292		SFC	1.36960		WF11119.6021		W1	346.0204		WG	349.1182
FN1	8118.8698		FG1	35895.5990		N	1.00000		SFC1	1.36960		W1K	442.2321		V8 3368.1741		CAPA8	31.7750
TT4	2228.99281	A4/A4D		1.00000		TT1	954.22444											
FN	6755.3663		FG	34561.7014		FD	27806.3352		SFC	1.40251		WF 9474.4447		W1	346.3892		WG	349.0285
FN1	6755.3663		FG1	34561.7014		N	1.00000		SFC1	1.40251		W1K	442.7035		V8 3243.8328		CAPA8	31.5048
TT4	2140.12151	A4/A4D		1.00000		TT1	954.22444											
FN	5762.7769		FG	33598.7224		FD	27835.9455		SFC	1.45293		WF 8372.9401		W1	346.7581		WG	349.0906
FN1	5762.7769		FG1	33598.7224		N	1.00000		SFC1	1.45293		W1K	443.1749		V8 3152.8815		CAPA8	31.5132
TT4	2080.62404	A4/A4D		1.00000		TT1	954.22444											
FN	4922.5401		FG	32783.6636		FD	27881.1235		SFC	1.51473		WF 7456.3208		W1	347.0717		WG	349.1489
FN1	4922.5401		FG1	32783.6636		N	1.00000		SFC1	1.51473		W1K	443.5758		V8 3075.8753		CAPA8	31.5144
TT4	2030.62404	A4/A4D		1.00000		TT1	954.22444											
FN	4076.0262		FG	31962.6335		FD	27886.6074		SFC	1.60494		WF 6541.7854		W1	347.3892		WG	349.2116
FN1	4076.0262		FG1	31962.6335		N	1.00000		SFC1	1.60494		W1K	443.9815		V8 2998.2972		CAPA8	31.4918
TT4	1980.62404	A4/A4D		1.00000		TT1	954.22444											
FN	3188.7874		FG	31101.1387		FD	27912.3512		SFC	1.76727		WF 5635.4473		W1	347.7099		WG	349.2798
FN1	3188.7874		FG1	31101.1387		N	1.00000		SFC1	1.76727		W1K	444.3914		V8 2916.9061		CAPA8	31.5783
TT4	1930.62404	A4/A4D		1.00000		TT1	954.22444											

Example 6 (Case 6) - This case is an example of the use of the ZTHRUST control mode. When ZTHRUST is specified at an altitude and Mach number as shown below, and with a part power control operational, IPC = 3 from Case 5, the program will interpolate the generated data at the specified ZTHRUST, altitude and Mach number to determine specific data used in engine acoustic analysis.

```
$ENPUT
ICASE=6,ZTHRUST=70000.,ALT=1000.,EMACH=.3,
$
```

Output is for standard +8°C atmospheric conditions in the format shown below:

```
    INPUT     CASE        6     PC          3     PS          .50000000E+01
      ALT   .10000C00E+04       MACH   .3000C000E+00     HPEXT   .20000C00E+03     IDOBS        0
    WCOW1   .10000000E-03         WB   .10000000E+C1        CV   .98500000E+00   ZTHRUST          .70E+05

 NOZZLE PRESSURE RATIO LESS THAN 1.005

                          OUTPUT ENGINE PARAMETERS CORRESPONDING TO THRUST VALUE OF  70000.0LBS.

GASFLOW =  697.4 LBS/SEC  JET VELOCITY = 3614.37FT/SEC,  JET AREA =  10.609SQ.FT.,  RAM DRAG =  7053.1LBS.
NET THRUST =  70000.0LBS.   TURBINE IN TEMP. = 3060.0DF.  NOISE REDUCTION =   0.000DB.  ATMOSPHERE = STD + 8.0 C.
SPECIFIC FUEL CONSUMPTION = 1.3780LBM/HR/LBF. TURBINE EXIT TEMP = 2104.5 R
```