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AUTHORITY

AFAPL ltr, 12 Apr 1972
SIMULATION OF TURBOFAN ENGINE

PART II. USER'S MANUAL AND
COMPUTER PROGRAM LISTING

JOHN S. McKINNEY, CAPTAIN, USAF

TECHNICAL REPORT AFAPL-TR-67-125, PART II

NOVEMBER 1967

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SIMULATION OF TURBOFAN ENGINE

PART II. USER'S MANUAL AND
COMPUTER PROGRAM LISTING

JOHN S. McKinney, Captain, USAF

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son AFB, Ohio.
FOREWORD

This report was prepared in the Components Branch (AFTC), Turbine Engine Division, Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base, Ohio, under Project 3066, "Gas Turbine Technology." Task 306603, "Advanced Engine Studies," with Charles E. Bentz as Project Engineer.

This report covers work conducted within the Components Branch in the time period between July 1965 and June 1967 and was submitted by the author 31 August 1967.

This technical report has been reviewed and is approved.

ERNEST C. SIMPSON
Chief, Turbine Engine Division
Air Force Aero Propulsion Laboratory
ABSTRACT

This report describes a digital computer program titled SMOTE (Simulation of Turbofan Engine). SMOTE is a computer program for balancing-cycle turbofan engines capable of running both design and off-design points. The program is written in Fortran IV language and was designed for use on an IBM 7090 Digital Computer, although it has also been run on an IBM System 360. Performance maps (Block Data format) of the major engine components are required. Information for setting up the Block Data and input data is given in the report. Also included in the report is a complete program listing with description of each subroutine and a sample data pack.

(Distribution of the abstract is unlimited.)
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<tr>
<th>STATION NUMBERS</th>
<th>SYMBOLS</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>ambient</td>
</tr>
<tr>
<td>2</td>
<td>fan</td>
</tr>
<tr>
<td>21</td>
<td>fan exit/compressor and duct entrance</td>
</tr>
<tr>
<td>3</td>
<td>compressor exit/burner entrance</td>
</tr>
<tr>
<td>4</td>
<td>burner exit/hi pressure turbine entrance</td>
</tr>
<tr>
<td>5</td>
<td>hi press. turbine exit/lo press. turbine entrance</td>
</tr>
<tr>
<td>55</td>
<td>lo press. turbine exit</td>
</tr>
<tr>
<td>6</td>
<td>afterburner entrance</td>
</tr>
<tr>
<td>7</td>
<td>afterburner exit</td>
</tr>
<tr>
<td>8</td>
<td>main nozzle throat</td>
</tr>
<tr>
<td>9</td>
<td>main nozzle exit</td>
</tr>
<tr>
<td>23</td>
<td>duct burner entrance</td>
</tr>
<tr>
<td>24</td>
<td>duct burner exit</td>
</tr>
<tr>
<td>25</td>
<td>duct exit (if mixed-flow engine)</td>
</tr>
<tr>
<td>26</td>
<td>duct nozzle throat</td>
</tr>
<tr>
<td>27</td>
<td>duct nozzle exit</td>
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<tr>
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<tbody>
<tr>
<td>T</td>
<td>total temperature (degrees R)</td>
</tr>
<tr>
<td>H</td>
<td>total enthalpy</td>
</tr>
<tr>
<td>P</td>
<td>total pressure (atmospheres)</td>
</tr>
<tr>
<td>S</td>
<td>total entropy</td>
</tr>
<tr>
<td>TS</td>
<td>static temperature (degrees R)</td>
</tr>
<tr>
<td>PS</td>
<td>static pressure (atmospheres)</td>
</tr>
<tr>
<td>FAR</td>
<td>fuel-air ratio</td>
</tr>
<tr>
<td>AM</td>
<td>Mach number</td>
</tr>
<tr>
<td>V</td>
<td>velocity (feet/second)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMPONENT SYMBOLS</th>
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<tbody>
<tr>
<td>F</td>
<td>fan</td>
</tr>
<tr>
<td>C</td>
<td>compressor</td>
</tr>
<tr>
<td>E</td>
<td>burner</td>
</tr>
<tr>
<td>COM</td>
<td>burner</td>
</tr>
<tr>
<td>H</td>
<td>hi pressure turbine</td>
</tr>
<tr>
<td>TLP</td>
<td>lo pressure turbine</td>
</tr>
<tr>
<td>A</td>
<td>afterburner</td>
</tr>
<tr>
<td>APT</td>
<td>afterburner</td>
</tr>
<tr>
<td>D</td>
<td>duct</td>
</tr>
<tr>
<td>DUC</td>
<td>duct</td>
</tr>
<tr>
<td>M</td>
<td>main nozzle</td>
</tr>
<tr>
<td>NOZ</td>
<td>nozzle</td>
</tr>
<tr>
<td>OB</td>
<td>overboard</td>
</tr>
<tr>
<td>T</td>
<td>total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ENGINE SYMBOLS</th>
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<tr>
<td>ETAR</td>
<td>ram recovery</td>
</tr>
<tr>
<td>CN</td>
<td>corrected speed ratio</td>
</tr>
<tr>
<td>PCN</td>
<td>percent speed</td>
</tr>
<tr>
<td>PR</td>
<td>pressure ratio</td>
</tr>
<tr>
<td>Z</td>
<td>pressure-ratio ratio</td>
</tr>
<tr>
<td>ETA</td>
<td>efficiency</td>
</tr>
<tr>
<td>TFF</td>
<td>turbine flow function</td>
</tr>
<tr>
<td>DNTC</td>
<td>turbine delta enthalpy (temperature corrected)</td>
</tr>
<tr>
<td>DDT</td>
<td>turbine delta enthalpy</td>
</tr>
<tr>
<td>WA</td>
<td>air flow (pounds/sec)</td>
</tr>
<tr>
<td>WF</td>
<td>fuel flow (pounds/sec)</td>
</tr>
<tr>
<td>WG</td>
<td>gas flow (pounds/sec)</td>
</tr>
<tr>
<td>PCBL</td>
<td>percent bleed</td>
</tr>
<tr>
<td>BL</td>
<td>bleed (pounds/sec)</td>
</tr>
<tr>
<td>HPETXT</td>
<td>horsepower extracted</td>
</tr>
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**SYMBOLS (CONT)**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>DP</td>
<td>pressure drop</td>
</tr>
<tr>
<td>DT</td>
<td>temperature increase</td>
</tr>
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</table>

**MISCELLANEOUS**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>area</td>
</tr>
<tr>
<td>ALTP</td>
<td>altitude</td>
</tr>
<tr>
<td>AM</td>
<td>Mach number of aircraft</td>
</tr>
<tr>
<td>BYPASS</td>
<td>bypass ratio</td>
</tr>
<tr>
<td>CF</td>
<td>correction factor</td>
</tr>
<tr>
<td>CS</td>
<td>ambient speed of sound</td>
</tr>
<tr>
<td>CV</td>
<td>nozzle velocity coefficient</td>
</tr>
<tr>
<td>DEL</td>
<td>delta degradation coefficient</td>
</tr>
<tr>
<td>DS</td>
<td>design value</td>
</tr>
<tr>
<td>DUM</td>
<td>dummy (not used)</td>
</tr>
<tr>
<td>FG</td>
<td>gross thrust</td>
</tr>
<tr>
<td>FGM</td>
<td>momentum thrust</td>
</tr>
<tr>
<td>FGP</td>
<td>pressure thrust</td>
</tr>
<tr>
<td>FN</td>
<td>net thrust</td>
</tr>
<tr>
<td>FRD</td>
<td>ram drag</td>
</tr>
<tr>
<td>GU</td>
<td>initial or guess values</td>
</tr>
<tr>
<td>ITRYS</td>
<td>number of loops thru engine before quitting</td>
</tr>
<tr>
<td>SFC</td>
<td>specific fuel consumption</td>
</tr>
<tr>
<td>TOLALL</td>
<td>tolerance</td>
</tr>
<tr>
<td>VA</td>
<td>velocity of aircraft</td>
</tr>
<tr>
<td>VJ</td>
<td>jet velocity</td>
</tr>
</tbody>
</table>

**NOTE:** Some symbols may be truncated when combined with other symbols due to six character limit imposed by Fortran Computer Language.
SECTION I

INTRODUCTION

The purpose of this report is to describe a digital computer program for balancing-cycle turbofan engines. The program, titled SMOTE (Simulation of Turbofan Engine), was developed in the Components Branch, Turbine Engine Division, Air Force Aero Propulsion Laboratory. The program, as written and described in this report, is intended for use on an IBM 7090 Digital Computer, but it has also been modified and tested on an IBM System 360. It is written in Fortran IV language.

The performance of the major engine components is based on component maps which must be converted into Block Data subroutines for use by SMOTE. Presently included in the program are maps for the fan, compressor, combustor, and both turbines.

SMOTE uses a Namelist input and a controlled output, whereby only selected variables will be printed for each run.

Part I of this report describes the method of engine calculations and the balancing technique and gives some sample results. Part II is intended as a user's manual and includes instructions for setting up and running the program, as well as a program listing. The parts may be used independently of one another.
SECTION II

BLOCK DATA

To provide the basic component performance requires the maps for the fan, compressor, combustor, and both turbines to be converted to Block Data subroutines. The Block Data presented in this report is very general and does not represent any specific engine. For the following discussion on setting up Block Data, refer to the program listing, Section V. The format for all the maps is very similar, with a maximum of 15 curves and a maximum of 15 points for each curve. "N" refers to the number of curves and "NP" is an array of the number of points on each curve.

For the fan and compressor maps, the corrected speed (CN) is input as a ratio of the actual corrected speed curve to the design corrected speed. The pressure ratio (PR), corrected airflow (WAC), and efficiency (ETA) are input in groups, with a group for each corrected speed curve. The corrected speeds and pressure ratios must be loaded low to high. Note that there are two points per card.

For the combustor map, curves of pressure entering the combustor (P3) in PSI are loaded low to high, as well as delta-T (T4 - T3) points for each curve. The efficiencies (ETA) corresponding to each DELT are loaded in one array. Note that in this array, each column is obtained from one pressure curve.

For the turbine maps, turbine flow function (TFF) curves are input low to high, and the corrected speed (CN), delta-H (DH), and efficiency (ETA) are input in groups, with a group for each TFF line. The corrected speed must be loaded low to high. TFF, CN, and DH are defined as

\[
\text{TFF} = \frac{\text{WG} \sqrt{T_{IN}}}{P_{IN}}
\]

\[
\text{CN} = \frac{\text{PCNC}}{\sqrt{T_{IN}}}
\]

\[
\text{DH} = \frac{H_{IN} - H_{OUT}}{T_{IN}}
\]

Formats other than those presented here may be used for the component performance maps. However, some change in logic would then be required.
SECTION III

INPUT DATA

The input data is divided into two sections; data cards for the controlled output, and data cards in Namelist format for running each point. For the following discussion on setting up the input data, refer to the listing of sample data immediately following the program listing.

1. CONTROLLED OUTPUT

The variables that are to be output are selected by the first section of data cards. Any variable that is in one of the main commons (DESIGN, FRONT, SIDE, or BACK) may be selected for output by punching the name of the variable as it appears in the common (with trailing blanks, if necessary) in Columns 1 through 6. Up to 102 variables (seventeen lines of six variables) may be chosen for a particular run. During the output phase, the name of the variable is printed out, with its value printed immediately below the name.

Another feature of the controlled output is the ability to change the name of a variable to be output; for example, it may be desired to change a station designation to one more common to a particular programmer. In this case, the variable name would be punched in Columns 1 through 6 as described above, but in addition, the desired name would be punched in Columns 13 through 18. Special symbols, such as /, may be used in the new name. The last card of the controlled output must be a card with "THEEND" punched in Columns 1 through 6.

2. NAMELIST INPUT

The normal data for running the desired points follows the controlled output data and is in a Namelist format, where the name of the Namelist is DATAIN. Usually the first set of data is the design point, as shown in the sample input data. When the design point is run (IDES=1), all map scaling or correction factors are printed out, as well as being retained in common. Therefore, it is possible to run off-design points immediately following the design point by making use of the values in common, or to begin running an off-design point immediately by inputting the scaling or correction factors. The first method is usually easier, but the second method may be desired if many points are to be run using the same engine parameters with no changes except for power setting, Mach number, and altitude.

The controls which fix the type of turbofan, the mode of operation, the method of calculating ram recovery, etc., are explained in the listing of subroutine INPUT. Subroutine ZERO determines what values in common will be zeroed between points. None of the design values or correction factors are ever zeroed.

A title card must be input immediately after the first point of the data pack, and ITITLE must be set equal to 1 in the data for the first point. This is because a title is always printed for each point and must, therefore, be previously defined. The input format for the title is 12A6, and the resulting 72 spaces are centered on the page when printed out. The title may be changed by setting ITITLE = 1 and inserting a new title card after the Namelist data for the point.

When an afterburning or duct-burning point is run, the exhaust nozzle areas are allowed to float to obtain optimum expansion. This means that there can be no balancing at the point, and it is necessary to prebalance the engine cycle in a nonaugmented mode. That is, an identical point, except that it is nonaugmented, must be run before either afterburning or ductburning. When either IAFTBN or IDBURN is greater than zero, the program will automatically set INIT = 1 and use the balanced values from the preceding point. The nozzle areas are returned to their standard design values after completing an augmented point. Some examples of this type of afterburning are given in the sample data listing.
SECTION IV

SUBROUTINE DESCRIPTIONS

The following will be a brief description of what each subroutine calculates or controls. See Figure 1 for a subroutine flow chart.

SMOTE Dummy main program to initiate the calculations and cause the input of the controlled output variables. Because of the looping between subroutines, control is never transferred back to this routine.

ENGBAL Main subroutine. Controls all engine balancing loops, checks tolerances and number of loops, and loops matrix.

MATRIX Solves error matrix.

INPUT Reads Namelist data and title. Prints title.

ZERO Zeroes common and certain controls.

COINLT Determines ram recovery and performs inlet calculations.

ATMO62 1952 ARDC Atmosphere Tables.

RAM Calculates ram recovery defined by MIL-E-5008B Specifications.

GUESS Determines initial values of independent variables (PCNF, PCNC, and T4) at each point. It may be desired to change these equations to suit a particular engine. The closer the initial values are to the final values, the faster the program will balance.

COFAN Uses Block Data to perform fan calculations.

COCOMP Uses Block Data to perform compressor calculations.

COCOMB Uses Block Data to perform combustor calculations. May use either T4 or WFD as the main parameter.

COHFTB Uses Block Data to perform high pressure turbine calculations. Calculates ERR(1) and ERR(2).

COLPTB Uses Block Data to perform low pressure turbine calculations. Calculates ERR(3) and ERR(4).

FRTOSD Dummy routine to transfer values from common FRONT to common SIDE.

CODUCT Performs duct and duct-burning calculations. May use either T24 of WFD as the main parameter for duct-burning. Controls the duct nozzle and calculates ERR(5) if in separate-flow mode.

FASTBK Dummy routine to transfer values from common FRONT and SIDE to common BACK.
Figure 1. SMOTE Subroutine Flow Chart
COMIX Performs gas-mixing calculations if in mixed-flow mode. At design points it calculates areas from either an input static pressure (P55) or an input Mach number (AM55) if P55 = 0. At off-design points it calculates static pressures and Mach numbers from the design areas. Calculates ERR(6).

COAFEN Performs after-burning calculations. May use either T7 or WFA as the main parameter.

COMNOZ Controls the main nozzle and calculates ERR(6).

PERF Calculates performance after the engine is balanced.

OUTPUT Prints output except for controlled output. Prints the main commons in a close format after each point.

CONOUT Controls and prints the controlled output variables.

ERROR Controls all printouts if an error occurs. Prints name of subroutine where error occurred and also prints the values of all variables in the main commons.

SYG Controls printing from UNIT08. Throughout the program and particularly in ENGBAL, certain messages, variables, and matrix values are written on UNIT08 as an aid in determining why an error occurred or why a point did not balance. These values are printed out if subroutine ERROR is called and IDUMP is greater than zero, or after a good point if IDUMP = 2.

TAPES Defines UNIT08, which is just a "scratch" disk and does not require a $SETUP card. Normal input and output are on UNIT05 and UNIT06, respectively.

THCOMP Performs isentropic calculations for compressors.

THTURB Performs isentropic calculations for turbines.

THERMO Provides thermodynamic conditions using PROCOM.

PROCOM Calculates thermodynamic gas properties for either air or a fuel-air mixture, based on JP-4.

SEARCH General table look-up and interpolation routine to obtain data from the Block Data subroutines.

MAPBAC Used when calculations result in values not on the turbine maps. Changes the map value and an independent variable (PCNF, PCNC, or T4) in an attempt to rectify the situation.

CONVRG Performs nozzle calculations for a convergent nozzle.

CONDIV Performs nozzle calculations for a convergent-divergent nozzle.

AFQUR General quadratic interpolation routine.
SECTION V

PROGRAM LISTING

The following is a complete listing of all subroutines required to run SMOTE. Immediately following the program listing is a listing of a sample input data pack.
APAPL-TR-67-125
Part II

$IBFTE SMOTE DECK,94/2,XR7
COMMON /POINT/IDATPT
IDATPT=0
CALL COMOUT(1)
CALL ENGBAL
STOP
END
SUBROUTINE ENGBAL
COMMON / ALL/ 
1WORD, IDES, JDSS, KDES, NOUT, INIT, IDUMP, IAMP,
2GASMX, IOUT, IFTBN, IDCD, IMD, I0SHOC, IIMSHOC, NOZFLT,
3ITRYS, ILOOPER, NMAP, NUMAP, MAPEDG, TOLALL, ERR(6)
CUNKNW /DESIGN/
1PCNCGU, PNCNCGU, T4GU, DUM01, DUM02, DELFG, DELSN, DELSFC,
2ZFD, PCNFDS, PKFDS, ETAFDS, WAFDS, PRFCF, ETAFCF, WAFCCF,
3ZCOS, PNCOSDS, PRCOSDS, ETAFCOS, WACOS, ETAFCOS, WACOSCF,
4TFDS, KFDOS, DTCDOS, ETAPOS, WACOSCD, DTPDOS, ETAFCOS, ETABCF,
5TFCDOS, CHNPDOS, ETHPOS, ETHPCF, CNHPCEF, ETHPCF, DNHPCF, T2DS,
6TFLPDS, CNDLPDS, ETFLPDS, FLPCF, CNFLPCF, ETHPCF, DNHPCF, T2DS,
7TFDOS, KFDOS, DTDDOS, ETAADD, WA23DS, DPDUDOS, DTDDUCF, ETAACF,
8T7DOS, KFADS, DTDADS, ETAADS, WGDADS, DPAFDS, DTAFCCF, ETAACF,
9A55, A25, A6, A7, A8, A9, A28, A29,
A55R, CVNOZ, CVNOZ, A8S0V, A8S0V, A825AV, A29SAV
COMMON / FRONT/ 
1T1, P1, H1, S1, T2, P2, H2, S2,
2T21, P21, H21, S21, T3, P3, H3, S3,
3T4, P4, H4, S4, T5, P5, H5, S5,
4T55, P55, H55, S55, BLF, BLC, BLDU, BLOB,
5CNE0, PRF, ETAF, WAF, WAF, WA3, W54, FAR4,
6NC0, PRC, ETA, WAC, ETA, ETAB, DPCON, DUMF,
7CHNHP, ETAHTHP, DHTCLHP, DHTC, BBLP, W55, FARK, CS,
8CNHP, ETAHTLP, DHTCLLP, DHTF, BLLP, W55, FARK, HPEXT,
9AK, AHTLP, E4, AR, ZF, PCNF, ZC, PCNC, WFB,
ATFFHP, TFFLP, PCBLF, PCBLF, PCBLD, PCBLD, PCBLH, PCBLH
COMMON / SIDE/ 
XXP1, XWAF, XWAC, XBLF, XBLD, XH3, DUM51, DUM52,
XXT2, XW21, X121, X221, T23, P23, H23, S23,
ZT24, P24, H24, S24, T25, P25, H25, S25,
4T20, P28, H28, S28, T29, P29, H29, S29,
5MDW, WFD, WGD, FAR24, ETAD, DPPDC, BPASS, DUM53,
6T528, P528, V28, AM28, T529, P529, V29, AM29,
COMMON / BACK/ 
XXT55, XPS5, XSM5, XSS5, XST5, XPS5, XHS5, XSM5,
XXMB, XW55, XFA55, XWFD, XW24, XFA24, XPP1, DMB8,
3T6, P6, H6, S6, T7, P7, H7, S7,
4T8, P8, H8, S8, T9, P9, H9, S9,
5WGS, WFA, ETA, FART, ETA, DPAFT, W55, V55,
6P56, V6, AM6, TS7, PS7, V7, AM7, AK25,
7T58, PS8, V8, AM8, TS9, PS9, V9, AM9,
8BVA, FRD, VJO, FGND, VMJ, FGMN, FGPD, FPFM,
9FGR, FG, WFT, WGT, FART, FG, FN, SFC
DIMENSION VAR(6), DEL(6), EFRB(6), DELVAR(6), EMAT(6,6), VMAT(6),
IAMAT16)
DATA ANK0D/6ENG0BAL/
CALL INPUT
IF(INIT.ED.1) GO TO 50
TFFHP=TFNFS
TLFFPL=TFNFS
50 LOOPER=0
NMAP=0
1 LOOP=0
NMAP=0
ISO=2
DO 2 1=1,6
VMAT(1)=0.
AMAT(1)=0.
DELVAR(1)=0.
9
DO 2 L=1,6
2 EMAT(I,L)=0.
3 LOOPER=LOOPER+1
CALL COFAN
WHDO=ANYTHING
IF(LOOPER.GT.ITRYS) GO TO 18
IF(NDMAP.GT.0) GO TO 1
NUMMAP=0
VAR(1)=ZF=100.,
VAR(2)=PCNF
VAR(3)=ZC=100.
IF(MODE.EQ.0.OR.MODE.EQ.2) VAR(4)=PCNC
IF(MODE.EQ.1) VAR(4)=T4/10.
VAR(5)=TFFHP
VAR(6)=TFFLP
DO 4 I=1,6
4 IF(Abs(ERR(I)).GT.TOLALL) GO TO 5
CALL PERF
CALL ERRUR
5 IF(LOMAP.GT.0) GO TO 7
MAPEDG=0
MAPSET=0
DU 6 I=1,6
6 IZERB(I)=ERR(I)
GO TO 9
7 IF(MAPEDG.EQ.0) GO TO 70
MAPEDG=0
MAPSET=1
VAR(LUOP)=VAR(LUOP)+4*DELLUOP
GO TO 10
70 IF(MAPSET.EQ.01) VAR(LUOP)=VAR(LUOP)+DELLUOP
IF(MAPSET.EQ.01) LLUOP=VAR(LUOP)-DELLUOP
MAPSET=0
DU 8 I=1,6
8 EMAT(I,LUOP)=(IZERB(I)-IZERB(I))/DELLUOP
9 LUOP=LUOP+1
IF(LOMAP.GT.0) GO TO 11
VAR(LUOP)=VAR(LUOP)-DELLUOP
10 ZF=VAR(11)/100.
PCNF=VAR(2)
ZC=VAR(3)/100.
IF(MODE.EQ.0.OR.MODE.EQ.2) PCNC=VAR(4)
IF(MODE.EQ.1) T4=VAR(4)/10.
TFFHP=VAR(5)
TFFLP=VAR(6)
IF(ZE.0.05) IF(0.05)
IF(ZC.0.05)
GO TO (1,3,160
11 DU 12 I=1,6
12 AMAT(I)=IZERB(I)
DO 14 I=1,6
14 IZERD=0
DO 13 LUOP=1,6
13 IF(EMAT(I,LUOP).EQ.0.) IZERD=IZERD+1
IF(IZERD.LT.6) GO TO 14
WRITE(6,1001)
LUOPER=ITRYS+100
GO TO 10
14 CONTINUE
DO 16 LUOP=1,6

10
IZERO=0
DO 15 I=1,6
15 IF(EMAT(I,LOOP).EQ.0.) IZERO=IZERO+1
IF(IZERO.LT.6) GO TO 16
WRITE(6,101) LOOP
LOOP=ITrys+100
GO TO 16
CONTINUE
CALL MATRIX(EMAT,VMAT,AMAT)
DO 17 LOOP=1,6
DELVAR(LOOP)=0.6*VMAT(LOOP)
IF(ABS(DELVAR(LOOP)).GT.0.05*VAR(LOOP))
1 DELVAR(LOOP)=0.05*VAR(LOOP)*DELVAR(LOOP)/ABS(DELVAR(LOOP))
VAR(LOOP)=VAR(LOOP)+DELVAR(LOOP)
WRITE(8,102) LOOP
DO 19 I=1,6
WRITE(8,103) AMAT(I),(EMAT(I,L),L=1,6),VMAT(I),DELVAR(I),VAR(I)
ERRAVE=(ABS(ERRB(1))+ABS(ERRB(2))+ABS(ERRB(3))+
1 ABS(ERRB(4))+ABS(ERRB(5))+ABS(ERRB(6)))/6.
DELAVE=(ABS(DELVAR(1))+ABS(DELVAR(2))+ABS(DELVAR(3))+
1 ABS(DELVAR(4))+ABS(DELVAR(5))+ABS(DELVAR(6)))/6.
WRITE(8,104) ERRAVE,DELAVE
IF(LOOP.LT.ITrys) GO TO 10
CALL ERROR
RETURN
100 FORMAT(4HOROW112,16H IS ZERO IN EMAT)
101 FORMAT(7HOCOLUMN12,16H IS ZERO IN EMAT)
102 FORMAT(8H8, ERRB,28X23HERROR MATRIX AFTER LOOP,14,29X4HVMAT,
16X6HDELVAR,7X14HVARABLESSSSS)
103 FORMAT(1HO,F8.4,8X6F10.4,10XFF10.4,11.4,4XF11.4,6HSSSSSS)
104 FORMAT(1HO,F8.4,32X14HAVEAGE VALUES,42XF11.4,6HSSSSSS)
END
SUBROUTINE MATRIX(E,V,A)
DIMENSION E(6,6),V(6),A(6),PIV(7),T(6,7)
DO 1 I=1,6
T(I,7)=A(I)
DO 1 J=1,6
1 T(I,J)=E(I,J)
DO 7 I=1,6
TEMP=0.
DO 2 J=1,6
IF(TEMP.GT.ABS(T(J,I))) GO TO 2
TEMP=ABS(T(J,I))
PIV=J
2 CONTINUE
IP1=1+1
DO 3 J=IP1,7
PIV(J)=T(J,PIV,J)/T(PIV,I)
IFROM=6
IT0=6
4 IF(IFROM.EQ.1.EQ.1) GO TO 6
RM=-T(IFROM,I)
DO 5 J=IP1,7
5 T(IT0,J)=T(IT0,J)+RM*PIV(J)
IT0=IT0-1
6 IFROM=IFROM-1
IF(IFROM.GE.1) GO TO 4
DO 7 J=IP1,7
7 T(I,J)=PIV(J)
DO 8 I=1,6
J=7-1
K=6-1
DO 8 L=J,6
8 T(K,L)=T(K,L)-T(L,7)
DO 9 I=1,6
9 V(I)=T(I,7)
RETURN
END
AFAPL-TR-67-125
Part II
C *** ITITLE = 1 WILL READ IN TITLE
C *** IDES = 1 FOR CALCULATING DESIGN POINT
C *** MODE = 0 FOR CONSTANT T4
C *** MODE = 1 FOR CONSTANT PCNC
C *** MODE = 2 FOR CONSTANT WB
C *** INIT = 1 WILL NOT INITIALIZE POINT
C *** IDUMP = 1 WILL DUMP LOOPING WRITE-OUTS IF ERROR OCCURS
C *** IDUMP = 2 WILL DUMP LOOPING WRITE-OUTS AFTER EVERY POINT
C *** IAMTP = 0 WILL USE INPUT AM AND MIL SPEC ETAR
C *** IAMTP = 1 WILL USE INPUT AM AND INPUT ETAR
C *** IAMTP = 2 WILL USE T2 AS T1=T1+T2 AND STANDARD PI
C *** IAMTP = 3 WILL USE P2 AND STANDARD T1
C *** IAMTP = 4 WILL USE T2 AND P2
C *** IGASMX=1 SEPARATE FLOW, INPUT A6
C *** IGASMX=0 SEPARATE FLOW, A6=A55
C *** IGASMX=1 WILL MIX DUCT AND MAIN STREAMS, A6=A25+A55
C *** IGASMX=2 WILL MIX DUCT AND MAIN STREAMS, INPUT A6
C *** IDOBURN=1 FOR DUCT BURNING, INPUT T24
C *** IDOBURN=2 FOR DUCT BURNING, INPUT WB
C *** IAFBURN=1 FOR AFTERBURNING, INPUT T7
C *** IAFBURN=2 FOR AFTERBURNING, INPUT WB
C *** IDOCD = 1 DUCT NOZZLE WILL BE C-D
C *** IDOCD = 1 MAIN NOZZLE WILL BE C-D
C *** NOZFLT=1 FOR FLOATING MAIN NOZZLE
C *** NOZFLT=2 FOR FLOATING DUCT NOZZLE
C *** NOZFLT=3 FOR FLOATING MAIN AND DUCT NOZLFS
C *** ITKYS = N NUMBER OF PASSES THRU ENGINE BEFORE QUITTING

DIMENSION TITLE(12)
DATA AWRD,6H INPUT/
IDATP=IDATP+1
PRINT 100, IDATP
CALL ZERO
WURD=AWRD
READ(5,DATAIN)
IF(IATBURN,GT.0,.OR.IDOBURN,GT.0) INIT=1
IF(IATITF,EQ.1) READ(9,101) TITLE
ITITLE=0
WRITE(10,102) TITLE
IF(IDMODE,EQ.0) WRITE(8,103) IDES,AM,ALTP,T4,T24,T7
IF(IDMODE,EQ.1) WRITE(8,104) IDES,AM,ALTP,PCNC,T24,T7
IF(INMODE,EQ.2) WRITE(8,105) IDES,AM,ALTP,WB,T24,T7
CALL CUITNT
RETURN

100 FORMAT(11H DATA POINT,13)
101 FORMAT(12A6)
102 FORMAT(1H,13X12A6)
193 FORMAT(1H0,7H IDES=,13,10X7H AM=,F7.3,6X7H ALTP=,F7.0,16X7H T=,F8.2,5X7H T24=,F8.2,5X7H T7=,F8.2,6H$SSSSS$)
104 FORMAT(1H0,7H IDES=,13,10X7H AM=,F7.3,6X7H ALTP=,F7.0,16X7H PCNC=,F8.3,5X7H T24=,F8.2,5X7H T7=,F8.2,6H$SSSSS$)
105 FORMAT(1H0,7H IDES=,12,10X7H AM=,F7.3,6X7H ALTP=,F7.0,16X7H WB=,F8.4,5X7H T24=,F8.2,5X7H T7=,F8.2,6H$SSSSS$)
END
APAPL-T2-67-125
Part II

SUBROUTINE ZER1
COMMON / ALL/
1WORD , IDES , JOES , KDES , MODE , INIT , IDUMP , IANTP ,
2IGASMX , IDBURN , IAFTHR , IDCC , IMCG , IDSHUC , IMSHUC , MZFLT ,
3ITRYS , LOOPER , NOMAP , NUMAP , MAPEDT , IDALL , ERR1

COMMON / FRONT/
1T1 , P1 , H1 , S1 , T2 , P2 , H2 , S2 .
2T21 , P21 , H21 , S21 , T3 , P3 , H3 , S3 .
3T4 , P4 , H4 , S4 , T5 , P5 , H5 , S5 .
4T55 , P55 , H55 , S55 , TBLF , TBL , TBLU , TBLV .
5TNSF , PNSF , HNSF , SNSF , TNSF , TNSF , SNSF , SNSF .
6TNC , PNC , ETAC , MACC , MAC , TAB , PNC , SNC , SNC .
7NCNP , ETANCNP , DNTCLP , DNTCL , DNTC , DNTC , DNTC , DNTC .
8CLP , ETACL , DNTCLP , DNTCL , DNTCL , DNTCL , DNTCL , DNTCL .
9AM , ALT , TLA , TLA , TLA , TLA , TLA , TLA .
AFFFNP , TFFLP , PLC , PLC , PLC , PLC , PLC , PLC .

COMMON / SIDE/
XPL , XWA , XWA , XBLF , XBLF , XFA , XFA , XFA , XFA .
XPP , XPP , XPP , XPP , XPP , XPP , XPP , XPP , XPP .
XNC , XNC , XNC , XNC , XNC , XNC , XNC , XNC , XNC .
4T4 , P4 , H4 , S4 , T4 , P4 , H4 , S4 , S4 .
6T75 , P75 , H75 , S75 , T75 , P75 , H75 , S75 , S75 .
7SR , P7 , S7 , T7 , P7 , S7 , T7 , P7 , S7 .
8TA , PTVAC , PTVAC , PTVAC , PTVAC , PTVAC , PTVAC , PTVAC , PTVAC .
9MGB , MGB , MGB , MGB , MGB , MGB , MGB , MGB , MGB .

COMMON / BACK/
XT55 , XTP5 , XTP5 , XT55 , XT55 , XT55 , XT55 , XT55 , XT55 .
XK55 , XTP5 , XTP5 , XTP5 , XTP5 , XTP5 , XTP5 , XTP5 , XTP5 .
XPP , XPP , XPP , XPP , XPP , XPP , XPP , XPP , XPP .
3T6 , P6 , H6 , S6 , T6 , P6 , H6 , S6 , S6 .
4T4 , P4 , H4 , S4 , T4 , P4 , H4 , S4 , S4 .
6T75 , P75 , H75 , S75 , T75 , P75 , H75 , S75 , S75 .
7SR , P7 , S7 , T7 , P7 , S7 , T7 , P7 , S7 .
8TA , PTVAC , PTVAC , PTVAC , PTVAC , PTVAC , PTVAC , PTVAC , PTVAC .
9MGB , MGB , MGB , MGB , MGB , MGB , MGB , MGB , MGB .

DIMENSION 111031 , 121431 , 131721
EGVCORENCE (121 , T1 , J22 , XP1 , 123 , XT55 ,
1DES = 0
JOES = 0
INIT = 0
IDBurn = 0
IATBHR = 0
IDSHUC = 3
IMSHUC = 3
T2O = T2
P2O = P2
T4D = T4
DO 1 I = 1 , 163
21(1) = 0.
11I = 1 , 49
21(1) = 0.
3 I = 1 , 72
3(1) = 0.
T2 = T2
P2 = P2
T4 = T4
CALL SYG11
RETURN
**APAP-TR-87-125**

**Part D**

**SUBRoutines COINLT**

**COMMON / ALL**

- IDRS, IDES, IODES, IODE, IIT, IDUMP, IAMPT, ZIGASMF, IBDURN, IAFYBD, ICD, IUSD, IMSHUC, IHOZFLT

- ITRY, LUPR, HMAP, MLHMAP, MCREDF, TOLALL, ERR(16)

**COMMON / CODE*/

1PCNFS, PCNCUS, T4GU, DUNO1, DUNO2, DELFG, DELFU, DELSFC, 2FDS, PCNFDS, PKFD, ETAFO, WAFOS, PPSC, ETAFCF, WAPCF

3CDS, PCNCDS, PKCDS, ETAADS, MACDS, PPCF, ETAACF, WACCF

4TADS, NFAD, DIUCDS, ETAADS, WACD, DPCGDS, DIUCCF, ETAFCB

5TINFADS, CNHPO, ETNPOCS, TPNPCH, CINHP, THNPCH, EHNPPCH, T30DS, 6TTPM, CNHCPS, CNLS, ETFS, CPFLCF, CMPC, ETFLPC, DMLPCF, T21DS

7T24DS, NFDGS, GTGUDS, ETAADS, WAT23DS, DGDPS, DTDUCF, ETAFCF

8T2DS, NFAADS, ETAADDS, W5CDS, DPAFDOS, DTAACF, ETAACF

9455, I45, I46, IA7, I48, I49, I428, I429

AP55, AX55, CVNLD, CVNND, ABA5AV, ABA5AV, ABA5AV, ABA5AV

**COMMON / FRONT**

1T1, P1, S1, T2, P2, H2, S2

2T21, P21, P21, T21, P21, H21, S21

3T4, P4, S4, T5, P5, H5, S5

4T55, P55, H55, S55, BLF, BLC, BLOU, BLOD

5CNF, PHF, ETA, WAF, ETA2, WAF, ETA, WAF4

6CNF, PRC, ETA, WAC, WAC, ETA, DCO, DUM

7CNHF, ETAHNP, HTCPLT, HTS, B1HP, MG5, FAK5, CS

8CNHF, ETAHNP, HTCPLT, HTS, IRLP, MG5, FAK5, HPX5, HPX5

9ATFP, HC, PC, RTP, ETLPC, WBO, TFLPF, PCEFL, PCBF, PCACL, PCBF

**DATA AMORO/6C01NLT/50**

**WORD=AKORD**

A=778, B=26

C=52, D74069

ALT=ALTP*2, 0555531E07/12, 0555531E07+ALTP)

CALL ATNOS(ALT, 1, XX1, XX2, XX3, P1, CS, XX4, I1ER)

IF(IAMPT.EQ.2), T1=TI+T2

1 IF(IAMPT.EQ.1) CALL RAMAN, ETAR

FAAR=0, U=0

CALL PROCDM(FAR, T1, CS, XX2, XX3, P1, EXO, R1, PH1, H1)

S1=PH1-R1#ALOG(P1)

H2=H1*(AMCS)/2*(1.2#A2G)

P2T=1.0

DD 2=1=1.10

CALL THERMO(P2T, H2, T2, S2, TAV, 0, 0, 0, 1, 0)

IF(ABS(S2-T1.5, E0.0001S) GO TO 3

2 P2T=P1*E#(1A4, 966375)*[(S2-T1.5)+1.906375]/AV1*ALOG(P2T/P11)

CALL ERROD

RETURN

3 IF(IAMPT.EQ.3, OR, IAMPT.EQ.4, ETAR=P2/P2T)

P2=ETAR*P2T

IF(IAMPT.EQ.4, CALL THERMO(P2, H2, T2, S2, XX5, 0, 0, 0, 1)

IF(1, IAMPT.EQ.4, CALL THERMO(P2, H2, T2, S2, XX5, 0, 0, 0, 1)

IF(IAMPT.EQ.1), GO TO 6

IF(1, IAMPT.EQ.1), GO TO 4

IF(1, IAMPT.EQ.4), GO TO 6

IF(1, IAMPT.EQ.4), GO TO 6

PCN=1, MG3N(IDOE, I44, T4DS, PCNC, PCNCDS, WFB, WFBDS, T2, T2DS, PCNFDS)

PCNFDS=PCNF

GO TO 5

4 PCNF=PCNFDS

PCNFDS=PCNF

T2DS=T2

5 ZF=ZFD

6 RETURN
END
SUBROUTINE ATMS (ZFT, TM, SIGMA, RHU, THETA, DELTA, CA, AMU, K)
C THIS IS A SUBROUTINE TO COMPUTE CERTAIN ELEMENTS OF THE 1962
C U.S. STANDARD ATMOSPHERE UP TO 90 KILOMETERS.
C CALLING SEQUENCE...
C
C CALL ATMS (ZFT, TM, SIGMA, RHU, THETA, DELTA, CA, AMU, K)
ZFT = GEOMETRIC ALTITUDE (FEET)
TM = MOLECULAR SCALE TEMPERATURE (DEGREES KELVIN)
SIGMA = RATIO OF DENSITY TO THAT AT SEA LEVEL
RHU = DENSITY (LB-SEC²-FT⁻⁴) OR SLUGS-FT⁻³)
THETA = RATIO OF TEMPERATURE TO THAT AT SEA LEVEL
DELTA = RATIO OF PRESSURE TO THAT AT SEA LEVEL
CA = SPEED OF SOUND (FT/SEC)
AMU = VISCOSITY COEFFICIENT (LB-SEC/FT⁻²)

X = 1 NORMAL
C = 2 ALTITUDE LESS THAN ~5000 METERS OR GREATER THAN 90 KM
C = 3 FLOATING POINT OVERFLOW
C
C ALL DATA AND FUNDAMENTAL CONSTANTS ARE IN THE METRIC SYSTEM AS
C THESE QUANTITIES ARE DEFINED AS EXACT IN THIS SYSTEM.
C
C THE RADIUS OF THE EARTH (REFT59) IS THE VALUE ASSOCIATED WITH THE
C 1959 ADP ATMOSPHERE SO THAT PROGRAMS CURRENTLY USING THE LIBRARY
C ROUTINE WILL NOT REQUIRE ALTERATION TO USE THIS ROUTINE.

DIMENSION HB'(10), TMH(10), DELTAB(11), ALM(10)

DATA (H0), (TMH(I), UTMH(I), UTLMB(I), ALM(I), I=1,10)/
A -3.0, 320.65, 1.75363E 00, -6.5,
B 0.0, 288.15, 1.00000E 00, -6.5,
C 11.0, 216.65, 2.23361E-01, 0.0,
D 20.0, 216.65, 5.40328E-02, 1.0,
E 32.0, 228.65, 8.56663E-03, 2.8,
F 47.0, 270.65, 1.09455E-03, 0.0,
G 52.0, 270.65, 5.82289E-04, -2.0,
H 61.0, 292.65, 1.79718E-04, -4.0,
I 79.0, 180.65, 1.0264 E-05, 0.0,
J 86.743, 180.65, 1.6223 E-05, 0.0,
K 90.0, 160.65, 1.0264 E-05, 0.0,
L 92.743, 160.65, 1.6223 E-05, 0.0,
M 95.0, 160.65, 5.27477E-05, -4.0,
N 97.0, 160.65, 1.87735E-05, -6.0,
O 99.0, 160.65, 5.27477E-05, -6.0,

DATA REF59/2.0855531E 07/, GZ /9.80665/, 0.0
A AM2 /28.9664/, KSTAR /8.31427/, 0.0
B FTOKM/0.04861E-04/, S /110.0/, 0.0
C AMUZ /1.2024E-09/, TPL /1110.4/, 0.0
P KMLZ /0.076474/, GZENG /32.1741/, 0.0

C CONVERT GEOMETRIC ALTITUDE TO GEOPOTENTIAL ALTITUDE
HFT = (REF59/(REF59+ZFT)) x ZFT

C CONVERT HFT AND ZFT TO KILOMETERS
K = FTOKM(2)
H = FTOKM(K+FT)
M = 1
TMH = TMH(2)
IF (H-LT.-5.0.OR.Z.GT.9.0) G0 TO 16
IF (M-11.EQ.0) G0 TO 16
I = 12
G0 TO 16

10 CONTINUE
GO TO 16

C GRADIENT IS NON ZERO, PAGE 10, EQUATION 1.2.10(13)
DELTA = DELTAB(I)*(TRMB(I)+ALM(I))
GO TO 14
13 TMK = TMB(M)
C GRADIENT IS ZERO, PAGE 10, EQUATION 1.2.10-14
   DELTA = DELTAB(M)*EXP1-GZ=AMZ=DELH/(RSTAR*TMB(M))
14 THETA = TMK/THZ
   SIGMA = DELTA/THETA
   ALPHA = SORT(THETA==3)*((THZ+S)/(TMKS1))
C CONVERSION TO ENGLISH UNITS
   TM = 1.8*TMK
   RHO = RHOZ*SIGMA/GZENG
   CA = CAZ=SORT(THETA)
   AMU = AMUZ=ALPHA/GZENG
   CALL 3VERFL(J)
   GO TO (15+17), J
15 K = K+2
   GO TO 17
16 K = 2
17 RETURN
   END
SUBROUTINE RAM(AM, ETAR)
   IF(AM.GT.1.) GO TO 2
   ETAR=1.
   RETURN
1   IF(AM.GT.5.) GO TO 3
   ETAR=1.-0.075*((AM-1.)**1.35)
   GO TO 1
3   ETAR=800./((AM**4)+935.)
   GO TO 1
END
FUNCTION GUESS(M, T, TU, P, PD, W, WD, D, DD, VD)
IF(M.EQ.0) GUESS=VD*(((T/TD)**1.60)*((DD/D)**0.50)
IF(M.EQ.1) GUESS=VD*(((P/PD)**1.80)*((DD/D)**0.33)
IF(M.EQ.2) GUESS=VD*(((W/WD)**0.33)*((DD/D)**1.00)
IF(M.EQ.3) GUESS=VD*(((W/WD)**0.00)*((P/PD)**0.50)
IF(M.EQ.4) GUESS=VD*(((W/WD)**0.00)*((W/PD)**0.50)
IF(M.EQ.5) GUESS=VD*(((T/TD)**1.10)*((DD/D)**0.60)
IF(M.EQ.6) GUESS=VD*(((P/PD)**1.00)*((D/DD)**0.25)
RETURN
END
$IBFTC COFAN

DECK, N94/Z, AR7

SUBROUTINE COFAN

COMMON / ALL/
1MD0, IDES, JD5ES, XDES, MGDE, INIT, IDUMP, IAMP
2IGASRX, IDBSMN, IAFTBN, ICD0, IMC0, IDS1HC, I3HSHC, ID2HPL
31TRYS, L0OPER, N0MAP, LLM00AP, NAEDEG, T0LALL, ERR(6)

COMMON / DESIGN/
1PCNF1, PCNG1, T4GU, DUM01, DUM02, DELFG, DELFN, DELSFC,
22FDS, PCON1, PRD0S, ETAF1, HAF1S, PRCF, ETAFCF, WAFCF,
32GDS, PCNC0D, PRCOD, ETA0D, MAC0D, PRC1F, ETA0CF, WACCF,
4T4D0S, NBP0D, D0TC0D, ETA0D, WAC0D, DPCM0D, D0TC0F, ETA0CF,
5T9H0D, CNHP0D, T0H0D, THF1CF, ENH0CF, E0HCFC, IC0H0CF, 10H0CF, 20H0S
6TFLP0D, C0N, TC0D, T0L0D, TFL0CF, C0L0CF, ETLP0D, OHL0CF, T20H0S,
7T240S, WFD0D, D0TD0S, ETA0D, WAC0D, D0P0D, D0TD0F, ETA0CF,
8T70D, WFD0D, D0TD0D, ETA0D, WAC0D, D0P0D, D0TD0F, ETA0CF,
9055, A25, V46, A7, A8, A9, A29, A29
AP55, AM55, CVD0D, CVH0D, ASR, Y, ANY1, A2S1, A2S1

COMMON / FRONT/
IT, pH, s1, T2, P2, N2, S2
2T2, P21, H21, S21, T3, P3, S3
3T4, P4, M4, T5, P5, N5, S5
4T5, P5, M5, S55, BLF, BLR, S55, S55
5CNF, PRF, ETA0, WACF, WA1, MG4, F4A0, FA4;
6CN0, PRC, ETA0, MAC, E1AB, DPCM, D0MF
7CNHP, ETATHP, DMTCHP, DMTF, B1LF, MG5, FA5, CS
8CNMP, ETATLP, DMTCLP, DMTF, B1LF, MG5, FA55, HP0E6
9AN, ALTP, ETA0, ZF, PCNF, ZP, PCNC, W6B,
ATFHF, TFLLP, PCBLF, PCBLC, PCBLU, PCBLB, PCB0L, PCB0L
COMMON / FAN/CNX(15), PRX(15,15), WACX(15,15), ETA0X(15,15),
1CN0, NPT(15)

DIMENSION WLH(2)

DATA AWORD, WLH/6H COFAN, 6H (LO), 6H (HI) /
WORD=format

THETA=SNRT(T2/S18.666)
CNF=CNF61100+THETA)
IF(ZF.LT.O.) ZF=O.
IF(ZF.GT.1.) ZF=1.

CNFS=CNF

CALL SSEARCH(ZF, CNF, PRF, WACF, ETA0, WACF)

1CMX(11), NCR, PRX(11,11), WACX(11,11), ETA0X(11,11), NPT(11,15,15,15)
IF(CNF=CNFS) GT(0.0005*CNF) MAPEDG=1

IF(110, EO.1, EO.1, EO.2) WRITE(1, 1000) CNFS, WLH(N15)

1000 FORMAT(19H00, 0, CNF UPP MAP, F10.4, 2, 2, X, 2, A, 11, H, 0, 11 SSSSSS)

WACF=WACF*P2/THETA

IF(IDES.NE.1) GO TO 1
PRFCF=(PRFDS-1.1)/(PRF-1.)
ETAFCF=ETAFCF/ETA0

WACF=WACF/WACF

WRITE(6, 1001) PRFCF, ETAFCF, OUTCF, T20S

100 FORMAT(11HOFAN DESIGN, 13HXH PRFCF, E15.8, 8H ETAFCF=E15.8,
18H WACF=E15.8, 8H T20S=E15.8)
1 PRCF=PRFCF+(PRF-1.1)*1.
ETA0=ETA0C+ETA0

WACF=WACF*WACF

PCNF=CNF
DUM01=PCNF
CALL TMUOMP(PR, ETA0, T2, H2, S2, P2, T2, H21, S21, P21)
IF(PCBLF.GT.0.) BLF=PCBLF*WACF
IF(JDES.EQ.1) GO TO 7

JD0S=1

IF(INIT.EQ.1) GO TO 6

22
IF(IDES.EQ.1) GO TO 4
IF(MODE.EQ.2) GO TO 2
T4=GUESS(3,Y1,Y2,PCNF,PCNFUS,WFB,WFBDS,Y7,Y8,T4DS)
PCNC=GUESS(4,Y1,Y2,PCNF,PCNFDS,WFB,WFBDS,Y7,Y8,PCNCDS)
GO TO 5
2 IF(MODE.EQ.1) GO TO 3
PCNC=GUESS(5,T4,T4DS,Y3,Y4,Y5,Y6,T21,T21DS,PCNCDS)
GO TO 5
3 T4=GUESS(6,Y1,Y2,PCNC,PCNCDS,Y5,Y6,T21,T21DS,T4DS)
GO TO 5
4 PCNC=PCNCDS
T4=T4DS
WFB=WFBDS
T21DS=T21
5 ZC=ZCDS
PCNCGU=PCNC
T4GU=T4
6 INIT=0
7 CALL CUCOMP
IF(NOHAP.EQ.7) PCHF=DUMD1
RETURN
END
DIMENSION ML(12),

100 DATA (100.0, 100.0, 100.0, 100.0, 100.0, 100.0, 100.0, 100.0, 100.0, 100.0, 100.0, 100.0, 100.0)

1000 IF (D(Data) .LT. 1.0E-6) GO TO 2

1000 IF (Data .GT. 0.0) 

WRITE(10,9999) CNCSICIH(!C4J3

100 FORM1AT(10.4,21X,1H1

* SSSS

1Ff WES .NE. 1) GO TO 2

PRCCF=(PRC-1.)/PRC-1. -1

ETCCF=ETACCFETAC

MAC=VACCFETAC

IF (PCBLS.GT.0.0)

LC=PCBLSWAC

6LHP=FCBLT4PC

204

128

PRC=PRCCF*(PRC-1.)+g*1.

ETAC-ETACCFQETAC

MAC=VACCFETAC

IF (PCBLS.LT.0.0)

LC=PCBLSWAC

6LHP=FCBLT4PC

204

128

PRC=PRCCF*(PRC-1.)-g*1.

ETAC-ETACCFQETAC

MAC=VACCFETAC

CALL SEARCH(ZCC,NC*PRC, WACC,ETAC, 

IF(HODE.EQ.0.1) GO TO 1

*IF(IGO.EQ.1.1) WRITE(10,1000) CNCSICIH(!C4J3

1000 FORM1AT(10.4,21X,1H1

* SSSS

wAC-WACCtrP21/ThETh

1Ff WES.NE.1) GO TO 2

PRCCF=(PRC-1.)/PRC-1. +1

ETCCF=ETACCFWACCF

WRITE(6,100)PRCCFETACCFWACCF, T4-1DS

100 FORM1AT(10.4,21X,1H1

* SSSS

wAC-WACCtrP21/ThETh

1Ff WES.NE.1) GO TO 2

PRCCF=(PRC-1.)/PRC-1. -1

ETCCF=ETACCFWACCF

WRITE(6,100)PRCCFETACCFWACCF, T4-1DS

100 FORM1AT(10.4,21X,1H1

* SSSS
BLLP=PC\#LLP\#HLC
IF(MODE.NE.1) GO TO 3
IF(ABS(CNC-CNCS).LE.0.001*CNCS) GO TO 4
WRITE(8,2000)CNCS,CNC
2000 FORMAT(IOHOCNC WAS= ,E15.8,E15.8H AND M(W) =E15.8,
125H CHECK PCNC INPUT$$$$$$$$$$
CALL ERROR
3 PCNC=100.=THETA=CNC
4 CALL COCOMB
RETURN
END
AFAPL-TR-67-125
Part II

IF (MODE.NC.-2) GOTO 1
ERK= (WFB-WBIX)/WFB
1)H=SUKT(WFB/WBIX)
CALL AFWUX(I.1), T4, ERK, O., 20., 0.0001, D1N, T4T, 16D)
G0 TO (6,9,7,16D)
9 T4=T4+1
G9 TO 1
7 CALL ERKUR
8 WFB=WFBX
9 CALL THFUXI(P4,H4,T4,S4,XX2,1,PAK4,0)
W4=WFB-WA3
IF (IDES.EU.1) WRITE(6,100) WA3CDS, ETARCH, UTCUCF
CALL CHMPTB
RETURN
END
AFAPL-TR-67-125
Part II

TFHPCF=TFHPDS/TFHCAL
DHHPCF=DHTCC/DHTCHP
ETHPCF=ETHPD/ETHATHP
WRITE(6,102)NHPCF,TFHPCF,ETHPCF,DHHPCF
102 FORMAT(2(H00.0,P. TURBINE DESIGN,5X7CNHPCF=E15.8,RH TFHPCF=E15.8, 
18H ETHPCF=E15.8,RH DHHPCF=E15.8)
6 TFHCAL=TFHPCF*TFHCAL
DHTCHP=DHHPCF*DHTCHP
ETHATHP=ETHPCF*ETHATHP
DHTC=DHTCC+T4
ERK(1)=(TFHCAL-TFFHP)/TFHCAL
ERK(2)=(DHTCC-DHTCHP)/DHTCC
CALL THTURB(DHTC,ETHATHP,FAR4,H4,S4,P4,T5,H5,S5,P5)
IF(BLHP.LE.0.) GO TO 7
2*AR5=WFB/(WA3+BLHP)
W5=WG4+BLHP
H5=(BLHP*H3+WG4*H5)/W5
CALL THEM0(P5,H5,T5,S5,XX2,1,FAR5,1)
GO TO 8
7 FAR5=FAR4
W5=WG4
8 CALL COLPTB
RETURN
END
DHLPCF=DHTCF/DHTCLP
ETLPCF=ETLPDS/ETATLP
WRITE(6,102)CMLPCF,TFLPCF,ETLPCF,DHLPCF
102 FORMAT(2OHOL.P.* TURBINE DESIGN,5X7HCNLPFCF=,E15.8,AM TFLPCF=,E15.8, 14H ETLPCF=,E15.8,8H DHLPCF=,E15.8)
6 TFLCAL=TFLPCF*TFLCAL
DHTCLP=DHLPCF=DHTCLP
ETATLP=ETLPDF=ETATLP
DHTF=DHTCF*T5
ERR(3)=(TFLCAL-TFFLP)/TFLCAL
ERR(4)=(DHTCF-DHTCLP)/DHTCF
CALL TMTRB(DHTF,ETATLP,FAR5,H5,S5,P5,T55,H55,S55,P55)
IF (BLLP.LE.0.) GO TO 7
FAR55=WFB/(WA3+BLLP+BLLP)
WG55=WG5+BLLP
H55=(BLLP*H3+WG5*H55)/WG55
CALL THERMO(P55,H55,T55,S55,XX2,1,FAR55,1)
GO TO 8
7 FAR55=FAR5
WG55=WG5
8 CALL FRTOSD
RETURN
END
SUBROUTINE CONDUCT
COMMON / ALL/
1WORD, IDES, IDDES, MDES, INIT, IDUMP, IAMTP, 
21GAMX, IDOIRN, IAFBN, ICOD, IMCD, IDSHOC, IMSHOC, NOZFLT, 
3ITRYS, LOPER, NDMAP, NURMAP, MAPEDG, TDALL, ERR16
COMMON /DESIGN/
1PCNFGU, PCNCGU, T4GU, DUN1, DUN2, DELFG, DELFN, DELSFC, 
22FOS, PCNFOS, PAFOS, ETAFOS, WAFOS, PRFCF, ETAFCF, WAFCF, 
32COS, PCNCOS, PRDCS, ETACOS, MACOS, PRCCF, ETAFCF, WACCF, 
4T4OS, WFDOS, DTCOS, ETAOS, WACOS, DPODOS, DTCOCF, ETAFCF, 
5FHPDOS, CHNPDOS, ETPHPD, TPHPCF, CHPCF, ETPHC, DHPHC, T2DOS, 
6TODPDI, ETODPDI, TFDPCF, DTLPCF, DMLPCF, T1DOS, 
7T2DAS, WFDAS, DTDUDS, ETAADSS, WADGDS, DPAFDS, DTAFCF, ETAACF, 
8T55S, A25, A36, A7, A8, A9, A28, A29, 
A555, AM55, CVNDOZ, CVNHDOZ, A85AV, A95AV, A285AV, A295AV
COMMON /SIDE/
1P1, , WAF, WAC, BLF, BLDU, H3, DUNS1, DUNS2, 
2T21, P21, H21, S21, T23, P23, H23, S23, 
3T24, P24, H24, S24, T25, P25, H25, S25, 
4T52, P28, H28, S28, T29, P29, H29, S29, 
5S24, S28, W24, S28, F24, ETAAD, DPDUC, DPDUC, DPDUC, 
6T528, P528, V28, AM29, TS29, PS29, V29, AM29
DIMENSION Q(9)
DATA AWORD1, AMORD2, 6HCODUCT, 6H/DNO2ZL/
WORD=AMORD1, Q(2)=0, Q(3)=0,
WAF=WAF-WAC-BLF, 
WAD=WAD+SLDU,
P23=P21, 
H23=(BLDU+3+WAF-H21)/WAD, 
CALL THERMO(P23-H23, T23, S23, XX21, 0.0, 0.1, 
BYPASS=(WAF=WAC)/WAC, 
WAD=SQR(T231, P23, 
IF(IDES.EQ.0), WAD=WAD/SQR(T231, P23, 
IF(IDES.EQ.0), WAD=WAD/WAD, 
DPDUC=DPDUS*(W23/A23S), 
IF(IDPDUC.GT.1), DPDUC=1, 
IF(IDPDUC.GT.1), DPDUC=1, 
P24=P23*(1.0-1), 
IF(IDA3X.HG.0) IDOIRN=0, 
IF(IDOIRN NE.0) GO TO 2, 
T24=T23, 
WFD=0.0, 
FAR24=0.0, 
GO TO 7, 
2 IF(IDOIRN.EQ.0) T24=T23+2000, 
3 IF(T24.GT.4000) T24=4000, 
IF(T24.LT.T23) T24=T23, 
C *** IF DESIRED, ENTER CALCULATIONS FOR ETAAD HERE 
HY=(111111-4593317=19T24+.2034116=19T24+.27234343=11T24+ 
19T24+.2453116-6031T24+.9333286-6031T24+.8443537E+05 
CALL THERMO(P24, H24, T24, XX2, 0.0, 0.0, 0.0, 0.0), 
FAR24=(HA-H231/(HY/ETAAD) 
IF(FAR24.LT.0) FAR24=0, 
WFDX=FAR24/WAD, 
IF(IDOIRN NE.2) GO TO 6, 
ERRW=(WFD-WFDX)/WFD, 
DIR=SORT(WFD/WFDX), 
CALL AFQDIR(Q(1), T24, ERRW, 0.0, 0.0, 0.0, 0.0), 
GO TO 1(5,7,5), 160)
4 T24=T24
GO TO 3
5 CALL ERROR
6 WFD=WFDX
7 CALL THERMO(P24,H24,T24,S24,XX2,1,FAR24,0)
H24=WFD+WAD
IF(IDES.EQ.1) WRITE(6,101) W23DS
101 FORMAT(12HDUCT DESIGN,12X8H WA23DS=,E15.8)
C *** IF DESIRED, ENTER OTHER LOSSES HERE
T25=T24
P25=P24
H25=H24
S25=S24
IF(IGASHX.GT.0) GO TO 11
WORD=AWORD2
A28SAV=A28
A29SAV=A29
NOZD=0
IDNOZ=0
IF(NOZFL.T.EQ.2.OR.NOZFLT.EQ.3) NOZD=1
IF(IDES.EQ.1.OR.IDBURN.GT.0.OR.NOZD.EQ.1) IDNOZ=1
IF(IDC.DO.EQ.1) GO TO 8
CALL CONVRG(-25,H25,P25,S25,FAR24,H24,P1,NOZD,A28,A29,P25R,
1T28,H28,P28,S28,T28,PS28,V28,AM28,ICON)
GO TO (9,9,9,5),ICON
8 CALL CONDIV(T25,H25,P25,S25,FAR24,H24,P1,NOZD,A28,A29,P25R,
1T28,H28,P28,S28,T29,H29,P29,S29,T28,TS28,PS28,PS29,V28,V29,AM28,
2AM29,ICON)
IDSHOC=ICON
GO TO (10,10,10,5),ICON
9 T29=T28
H29=H28
P29=P28
S29=S28
TS29=TS28
PS29=PS28
V29=V28
AM29=AM28
A29=A28
IDSHOC=ICON+3
10 ERR(5)=(P25-P25)/P25R
IF(IDNOZ.EQ.1) WRITE(6,100) A28,AM28,A29,AM29
100 FORMAT(9HDUCT NOZZLE DESIGN,5X8H A28=,E15.8,8H AM28=,E15.8,
18H A29=,E15.8,8H AM29=,E15.8)
11 CALL FAST8K
RETURN
END
SUBROUTINE FASTBK

COMMON / FRONT/
1T1 , P1 , H1 , S1 , T2 , P2 , H2 , S2 ,
2T21 , P21 , H21 , S21 , T3 , P3 , H3 , S3 ,
3T4 , P4 , H4 , S4 , T5 , P5 , H5 , S5 ,
4T55 , P55 , H55 , S55 , BLF , BLC , BLDU , BLOB ,
5CNF , PRF , ETAF , MAFC , WAF , WA3 , MG4 , FAR4 ,
6CNC , PRC , ETAC , MACC , MAC , ETAB , DPCON , DUMF ,
7CNHP , ETAHP , DHTCP , DHTC , BLHP , MG5 , FAR5 , CS ,
8CNLP , ETAFLP , DHTCLP , DHTF , BLLP , MG55 , FAR55 , HPEXT ,
9AM , ALTP , ETAR , ZF , PCNF , ZC , PCNC , MFB ,
ATFFHP , TFFLP , PCBLF , PCBL , PCBLDU , PCBLO , PCBLHP , PCBLLP ,
COMMON / SIDE/
XXP1 , XWAF , XMAC , XBLF , XBLDU , XH3 , DUMS1 , DUMS2 ,
XXY121 , XYP21 , XH21 , XS21 , T23 , P23 , H23 , S23 ,
3T24 , P24 , H24 , S24 , T25 , P25 , H25 , S25 ,
4T28 , P28 , H28 , S28 , T29 , P29 , H29 , S29 ,
5WAD , NFD , MG24 , FAR24 , ETAD , DPDUC , BYPASS , DUMS3 ,
6TS28 , PS28 , V28 , AM28 , TS29 , PS29 , V29 , AH29 ,
COMMON / BACK/
XXT55 , XP55 , XH55 , XS55 , XT25 , XP25 , XH25 , XS25 ,
XXWF5B , XWG55 , XFR55 , XWF0 , XWG24 , XFR24 , XXP1 , DUM8 ,
3T6 , P6 , H6 , S6 , T7 , P7 , H7 , S7 ,
4T8 , P8 , H8 , S8 , T9 , P9 , H9 , S9 ,
5MG6 , MFA , W7 , FAR7 , ETA2 , DPAFT , V55 , V25 ,
6PS6 , V6 , AM6 , TS7 , PS7 , V7 , AM7 , AM25 ,
7TS8 , PS8 , V8 , AM8 , TS9 , PS9 , V9 , AN9 ,
8VA , FRD , VD , FGND , VJN , FGMN , FGPD , FGMN ,
9FGM , FGP , MFP , WFT , MG7T , FART , PG , FN , SFC ,
XT55=T55 ,
XP55=P55 ,
XH55=H55 ,
XS55=S55 ,
XT25=T25 ,
XP25=P25 ,
XH25=H25 ,
XS25=S25 ,
XXWF5B=WFB ,
XWG55=MG55 ,
XFR55=FAR55 ,
XWF0=WFO ,
XWG24=MG24 ,
XFR24=FAR24 ,
XXXP1=P1 ,
CALL COMIX
RETURN
END
AAPL-TR-67-125

Part II

$IBFTC COMIX DEX, W94/2, XR7

SUBROUTINE COMIX

COMMON / ALL/
1WORD, IDES, KDES, MODE, INIT, IDUMP, LAMTF,
21GASX, IBMURN, IDFTBN, ICLASS, IDSOC, IMSOC, NOZPLT,
3ITRYS, LOOPDR, NONMAP, NUNMAP, NADGEO, TOLALL, ENR(16)

COMMON / DESIGN/
1PCFNGU, PCGEOU, T4GU, DUND1, DUND2, DELFG, DELFN, DELSFC,
22DFS, PCHFDS, PRFDS, ETAFDS, WAFDS, PRPCF, ETAFCF, WAFCF,
32CDS, PNCDCD, PRCCDS, ETAEDS, WACDS, PRCCCF, ETAACCF, WACCDF,
47ADSS, MWBDS, HTCDDS, ETAEDS, WACDS, DPCDDS, DTCDDS, ETAACCF,
5MPHDPS, CMNHDPS, ETNPDPS, TFWPCCF, CM WCPCF, ETNPCF, DWRPCF, T2BDS,
6FLPDDS, CHLPPDDS, TFLPDPS, CHLPPCF, ETHLPF, BHLPCF, T21IDS,
7TFDOS, NFDOS, DTUDOS, ETAEDS, WAC2DS, DPOUDS, DTDOCF, ETAACDF,
87TDDS, NFTADS, DTATADS, W6G6CDS, DPAFDADS, DTAFCCF, ETAACCF,
9A55, A25, A6, AT, A8, A9, A28, A29,
AP55, A55, CVNOD2, CVNOD2, A8SAY, A9SAY, A28SAY, A29SAY

COMMON / BACK/
1T55, P55, G55, T55, T25, P23, H25, S25,
24F8, W55, FAR5, WFG, W24, FAR24, P1, DUMS,
375, P6, H6, S6, T7, B7, S7,
478, P8, H8, S8, T9, P9, H9, S9,
5W56, NFA, WG7, FAR7, ETA, DPAFT, V55, V25,
6PS6, V6, AR6, TS7, PS7, V7, AN7, AR25,
7T55, PS9, V8, ARB, TS9, PS9, V9,
8VA, FRO, VJD, FPRD, VJM, FGRM, FGPPO, FGPW,
9FNG, FGP, NFT, WGT, FART, F6, FN, SFC

DATA AWORD/6H COMIX/
DIMENSION Q(I9)
WORD=AWORD
AJ=778,26
CAPSF=2116,2170
C=32,174049
CALL PROCOM(FAR5, T55, XX1, XX2, XX3, XX4, PHI55, XX5)
CALL PROCOM(FAR24, T25, XX1, XX2, XX3, XX4, PHI25, XX5)
IF(IDDES.EQ.0.0) GO TO 6
C *** CALCULATE A55 AND A25 WITH PS25=PS55
IF(PS55.EQ.0.0) GO TO 50
TSS5*T55*(PS55/PS55)**0.285
DO 1 I=1,15
CALL PROCOM(FAR5, TSS5, TSS5, AX55, CP55, REX55, PHI55, HS55)
PH155=PH155+REX55*ALOC(P55/PS55)
DELPH1=PH155
IF(ABS(DELPH1).LE.0.0001*PH155) GO TO 3
1 TSS5=TSS5*EXP(4.0*DELPH1)
2 CALL ERROR
RETURN
50 TSS5=0.75*T55
DO 91 I=1,15
CALL PROCOM(FAR5, TSS5, TSS5, AX55, CP55, REX55, PHI55, HS55)
VSS=AM55*G55
HSCAL=HS55-VSS**2/12.+G*AJ
DELHS=HSCAL-DS55
IF(ABS(DELHS).LE.0.0005*HSCAL) GO TO 52
91 TSS5=DS55*DELHS/CP55
GO TO 2
52 PS55=PS55/EXP1(PH155-2*HS551/REX55)
3 IF(HS55.GT.HS55) GO TO 51
WRITE(6, 10110P55, PS55, T55, T55, HS55, HS55)
I01 FORMAT(22HOSORT OF HS5-HS55 NEG ,6E15.6,6HSSSSSS)
CALL ERROR

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Part II

53  V5S=SQR(T2.045*AM55*H5S5)*H5S5)
    RH0=CAPSF*PS55/(AJ*REX55*TS55)
    A55=H5S5/(RH0*V5S)
    AM55=V5S/CS55
    IF (IGASN5.GT.0) GO TO 54
    WRITE(16,104)AES5,AM55
104  FORMAT(20M0MTURBINE AREA DESIGN,6X6H A55=E15.8,8H AM55=E15.8)
    GO TO 28
54  PS25=PS55
    TS25=TS55*(PS25/P2S5)**0.286
    DO 4 1=1,5
    CALL PROC(FARZ4,TS25,CS25,AK25,CP25,REX25,PHI525,HS25)
    PHI25=PHI25*EXP(-0.0001*PHI25) GO TO 5
4   TS25=TS25*EXP(4.0*DELPHI)
    Go TO 2
5   IF (H25.GT.HS25) GO TO 55
    WRITE(8,102)PS25,TS25,T25,TS25,H25,HS25
102  FORMAT(22M00SORT OF H55-HS25 NEG .6E15.6,6HSSS$)
    CALL ERROR
55  V25=SORT(2.0*6.6J/H25-HS25)
    RH0=CAPSF*PS25/(AJ*REX25*TS25)
    A25=KG25/(RH0*V25)
    AM25=V25/CS25
    WRITE(6,100)AES5,AM55,A25,AM25
100  FORMAT(200M0MTURBINE/DUCT AREA DESIGN,7H A55=E15.8,8H AM55=E15.8)
    GO TO 20
C ++CALCULATE PS55 AND PS25
6   WOA=W55/AS5
    C1=P55*SORT(6/(T55*AJ))*CAPSF
    MCNX=0
    QO0(2)=0.
    QO0(3)=QO0(2)+0.
    AM55=0.50
    TS55=0.875*T55
7   DO 8 I=1,15
    CALL PROCM(FAR55,TS55,CS55,AK55,CP55,REX55,PHI555,HS55)
    V55=AM55*CS55
    HSCL=H55-V55**2/(1.6G*AJ)
    DELHS=HSCL-HS55
    IF (ABS(DELHS),EQ.0.0005*HSCL) GO TO 9
8   TS55=TS55+DELHS/EP55
    GO TO 2
9   WQAT=C1*SORT(AK55*REX55)*AM55/(1.+(AK55-1.)*AM55**2/2.)**
    (1/(AK55+1.1)/(2.+(AK55-1.1)))
    AM55=AM55
    IGOO=0
10  DIP=WQA/WOAT
    E=(WQA-WOAT)/WOAT
    CALL AFOU1RE(QO0(1),AM5,EW,0.0,30.,0.0005,DIP,AMXT,ICON)
    GO TO (11,15,2),ICON
11  IF (AMXT.LT.0.0) GO TO 13
    AMXT=0.7
    MCNX=MCNX+1
    IF (MCNX.LE.1) GO TO 13
    PENF=0
    WRITE(8,103)PCNF,AM55,PS55,PS55,P2S5,PS2S
103  FORMAT(20M00COMIX PCNF=,-F7.4,4H AM5=,-F8.6,5H P55=,-F9.5,16H P55=,-F9.5,5H P2S5=-F9.5,6H SS$SS$)
    IGOO=10

PCNF=1.01*PCNF
DUND1=PCNF
12  IF(IOMAP.GE.1) GO TO 14
    AM55=AMXT
    GO TO 7
14  AM25=AMXT
    GO TO 16
15  IF(IOMAP.EQ.1) GO TO 19
    PS55=PS55/EXP((PHI55-PHIS55)/REX55)
    IF(IGASMX.LE.0) GO TO 28
    WQA=WG24/A25
    CI=P25*SQRT((H25*AJ)*CAPSF
    MGON=0
    QQ(2)=0.
    QQ(3)=0.
    AM25=0.25
    TS25=0.875*T25
16  DO 17 I=1,15
    CALL PROCOM(FAR24,T525,CS25,AK25,CP25,H525,PHI525,HS25)
    V25=AM25*CS25
    HSCAL=H525-V25**2/12.*G*AJ
    DELHS=HSCAL-H525
    IF(ABS(DELHS).LE.0.0005*HSCAL) GO TO 18
17  TS25=TS25+DELHS/CP25
    GO TO 2
18  WQAT=C1*SQRT((AK25/REX25)*AM25/(1.+AK25-1.)*AM25**2/2.)**
    1/(AK25+1.)/(2.*(AK25-1.))
    AMX=AM25
    IOMAP=1.
    GO TO 10
20  W6=WG24+WG55
    ERR(5)=(PS25-PS55)/PS25
    WF6=WFD+MF6
    FAR6=WF6/(WG6-WF6)
    HS=(WG24+125+WG6+155)/WG6
    CALL THERMO(1.+H6,T6,PHI6,AMX,1,FAR6,1)
    CI5=PS55*AM55/(1.+AK55*AM55**2)+PS25*AM25*(1.+AK25*AM25**2)
    TS6=0.833*T6
22  DO 25 I=1,15
    CALL PROCOM(FAR6,T65,CS6,AK6,CP6,REX6,PHI6,HS6)
    C2=2G6*SQRT(AJ*REX6*T6/(AK6*G))
    C3=C2/(CAPSF*C1)
    C4=AK6-1.)/(2.-(C3*AK6)**2
    C5=1.-2.*AK6*C3**2
    C6=C5**2+4.*C4*C3**2
    IF(C6).LT.0.625 CALL ERROR
25  RETURN
21  AM62=C5/12.*C4
    GO TO 24
23  AM62=(SQRT(C6)-C5./12.*C4)
24  IF(AM62.LE.0.) GO TO 21
    AM6=SQRT(AM62)
    V6=AM6*CS6
    HSCAL=H6-V6**2/12.*G*AJ
    DELHS=HSCAL-H56
    IF(ABS(DELHS).LE.0.0005*HSCAL) GO TO 26
25  TS6=TS6+DELHS/CP6
GO TO 21
IF(IGASMX.EQ.2) GO TO 27
A6=A25+A55

27  C7=SQRT(1.+(AK6-1.)*AM62/2.)
PS6=C2/(CAPSF=A6*AM6*C7)
P6=PS6=EXP((PH16-PHIS6)/REX6)
CALL THERMO(P6,H6,T6,S6,XX1,1,FAR6,0)
S6AVE=(WG24*S25+WG55*S55)/WG6
IF(S6.GE.S6AVE) GO TO 29
S6=S6AVE
P6=EXP(AHX*(PH16-S6)/1.986375)
GO TO 29

28  T6=T55
P6=P55
H6=H55
S6=S55
WG6=WG55
PS6=PS55
V6=V55
AM6=AM55
IF(IGASMX.EQ.0) A6=A55

29  CALL COAF8N
RETURN
END
SUBROUTINE COAFRN
COMMON / ALL/
1WORD , IDES , JDES , KDES , MODE , INIT , IGUMP , IAMTP , 2GASMX , LGBURN , IAFBKE , ICDO , IXCDO , IDFHOC , IFMCOC , NOZFLT , 31TRYS , LOOPER , NUMAP , MAPPED , TOLALL , ERR ( )
COMMON /DESIGN/
1PCHFP5 , PCNHGU , TAGU , DUD1 , DUD2 , DELFG , DFLNP , DELPFC , 22FDS , PCNFD5 , PRD5 , ETADFS , WFAD5 , PRFCF , ETAIF , MAPFCF , 32CDS , PCNCD5 , PRD5 , ETAED5 , MACD5 , PRCCF , ETAECF , HACCF , 47TDS , WFBD5 , DTCOD5 , ETAOD5 , WACD5 , PDCOD5 , DTCOD5 , ETAOCF , ETBACF , 5TFHP5 , GCHP5 , ETPHD5 , THFPCF , CHMPCF , ETHPFCF , DTHPFCF , T2DS , 6TLPDS , CNLDP5 , ETLP5 , TLPFCF , CHLPCF , ETLPCF , DHRPCF , T2IDS , 772D5 , WFBD5 , DTOD5 , ETAOD5 , WAZD5 , DPUD5 , DTPPCF , ETOACF , 87TDS , WFAD5 , DTAPO5 , ETAAD5 , WACOD5 , DPAD5 , DTAFCF , ETAACF , 9A55 , A25 , A6 , A7 , A8 , A9 , A28 , A29 , APS55 , AM55 , CYMND5 , CVMND5 , A65AV , A9SAV , A26SAV , A29SAV
COMMON / BACK/
1T55 , P55 , H55 . S55 , T25 , P25 , H25 , S25 , 2N5B , M55 , FARG5 , WFS , MG24 , FARG24 , P1 , DUK8 , 3T6 , P6 , H6 , S6 , T7 , P7 , H7 , S7 , 4T8 , P8 , H8 , S8 , T9 , P9 , H9 , S9 , 5H6B , WHA , WST , FART2 , EAA , DPAFT , V55 , V25 , 6PS6 , P6 , AM6 , TS7 , PS7 , V7 , AM7 , AM25 , 7TS8 , P8 , V8 , AM8 , TS9 , PS9 , VS , AM9 , 8VA , FRD , VJD , FGRD5 , VJM , FGM , FGPD , FPM1 , 9FGM , FGP , WFT , WST , HST , HST , WST , FG , FN , SFC
DIMENSION Q(9)
DATA ANWORD/6MCOAFRN/
WORD=ANWORD
Q12=0.
Q13=0.
AJ=778.26
CAPSF=2116.2170
G=32.174049
WF6=WF6
IF IGASMX.GT.01 WF=WF6+WF6
WF6=WF6
C = DRY / LOSS
WG6=WG6+SRGT(/66/6
2 IF IDES .EQ.11 WGD6=6G6
DPAFT=6PAFT=6G6/M666/D666)
IF (DPAFT.GT.1.) DPAFT=1.
PT=P6*(1.-DPAFT)
A7=A6
FAR6=WF6/M66
CALL PROCD(FAR6,T6,XX1,XX2,XX3,XX4,PHI6,XX6)
WDA=MG6/A7
C=PT*SRGT(6/T6=AJ)=CAPSF
AM7=AM6
720=0.875*T6
20 GO 22 I=1,15
CALL PROCD(FAR6,TST,CST,AK7,CP7,REX7,PHI57,T57)
V7=AM7+6CST
HSCAL=HST-V7*2/12.*66=A7)
DELHS=HSCAL-H57
IF (ABS(DELHS).LE.0.0005) GO TO 24
22 T57=157+DELHS/CP7
GO TO 8
24 WQAT=C1*SRGT(977+REX7)=AM7/(1.+(AK7-1.)*AM7=2/2.)=1+
1((AK7+1.)/(2.*((AK7-1.))))
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DIR=NOA/WGAT
EW=(NGO3-NOAT)/NOA
CALL AFQUIR((011),A/,E,N,0.,30.,0.005,DIR,AM7,T,IGO)
GO TO (26,29,8),IGO
26 AM7=AM7
IF(AM7,SE,1.0) AM7=0.9
GO TO 20
28 PS7=P7/EXP(IPHI6-PHST7)/REXT7
IF(I(AFTHOT,GT,0.0) GO TO 4
C *** NON-AFTERBURNING
3 T7=T6
WFA=0.0
FAR7=FAR6
WGT=WG6
GO TO 13
C *** AFTERBURNING
4 IF(I(AFTHOT,EQ,2)) T7=T6+2000.
IF(T7,LE,T6) ED TO 3
RH05=CAPSF*PS7/IAJ*REXT7#TS7
PS65=PS7
V65=V7
Q(2)=0.
Q(3)=0.
5 IF(T7,GT,4000.) T7=4000.
C *** IF DESIRED, ENTER CALCULATIONS FOR ETA A HERE
HV=IV((11+4594317E-19077-263611E-151#T7+2786343E-111*T7
1.205150E-07)*T7-2451116E-031*T7-9433296E-011*T7.1645537E+05
CALL THERMO(T7,M7,T7,XA1,XX2,G,0,0,0)
FAR7=(H7-H6)/HV#ETA6
IF(FAR7,GT,0.) GO TO 6
T7=T6
GO TO 5
6 WFA=FAR7=WG6
IF(I(AFTHOT,EQ,1)) GO TO 9
ERR=IF(WFAX=WFA);WFA
DIR=SQT(WFA/NFA)
CALL AFQUIR((011),T7;ERR7,9.120.,0.6001,DIR,T7,T7,IGO)
GO TO (7,10,8),IGO
7 T7=T7
GO TO 5
8 CALL ERRDR
9 WFA=WFA
10 FAR7=WFAX=WFA
WGT=WG6+WGFA
C *** MOUTHPUT LOSS
CALL PROCOM(FS7,T7,XX1,XX2,XX3,REXT7,PH77,MT)
RH07=CAPSF*PH77/IAJ;REXT7#T71
V7=W7/(RH07#A7)
Q(2)=0.
Q(3)=0.
PS7=PS7-0.01
11 RH07=W7/(V7=A7)
HST=HT-V7#2/(2.*C=AJ)
CALL THERMO(1.0,HST,T7,PHST7,XX2,1,FAR7,1)
IF(TST7,6.E,301.) GO TO 110
CALL THERMO(1.0,HST,400.,PHST7,XX2,1,FAR7,0)
V7=SQR(2.56*A7*(H7-HST7))
GO TO 11
110 PS7=RH07*A7*REXT7#TS7/CAPSF
PS7A=PS55+(RH055*V65**2-RH07*V7**2)/(G#CAPSF)
DIR=SQT(A7#PS7/PS7A))
EP = (PS7 - PS7A) / PS7
CALL AFQUIR(Q1), V7, EP, 0., 50., 1.0005, DIR, V7, IGO
V7 = V7T
IF(V7.LT.100.) V7 = 100.
GO TO (11, 12, 61) IGO
12 P7 = PS7 * EXP((PH17 - PHIS7) / REX7)
CALL PROCOM(FAR7, TS7, CS7, XX2, XX3, XX4, XX5, XX6)
AM7 = V7 / CS7
13 CALL THERMO(P7, H7, T7, S7, XX2.1, FAR7, 0)
IF(IDES.EQ.1) WRITE(6, 100) WG6CD5
100 FORMAT(19HOAFTERBURNER DESIGN, 5X8H WGGCD5=, E15.8)
CALL COHNOZ
RETURN
END
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Part II

**SIBFTC COMMON DECK**, 9K/4/2, XRT

**SUBROUTINE COMMON**

**COMMON**, **/ ALL/**

**1HOAD** | **1DES** | **1KDES** | **1MODE** | **1INIT** | **1DUMP** | **1AMP** |

| 1GMASX | 10BURN | 1AFTBN | 1addock | 1ICD | 1DSHC | 1SHOC | 1NOZFLT |

| 1TRYS | 1OPER | 1QMAP | 1NUMMAP | 1HAPEDG | 1TOLALL | 1ERR | 1E (E) |

**COMMON** | **/ DESIGNS/**

| 1PCFNG | 1PCFCU | 1T4GU | 1DUMD1 | 1DUMD2 | 1DELFG | 1DELFN | 1DELSFC |

| 2FOS | 2PCFDS | 2PCFD | 2ETFADS | 2HSFDS | 2ETFAD | 2MPCF | 2WPCF |

| 3ICOS | 3PCDCS | 3PCDCS | 3ETFACD | 3HACOS | 3ETFACF | 3MPCF | 3WPCF |

| 4TFS | 4PCDS | 4PCDS | 4ETFADS | 4HASCS | 4ETFACF | 4MPCF | 4WPCF |

| 5TFDPOS | 5CNPOS | 5TFLEPOS | 5TLPCF | 5CNPCF | 5ETLPCF | 5DLPFCF | 5TDS |

| 7TFDOS | 7NFDS | 7QTDOS | 7ETFADD | 7HSDOS | 7ETFADF | 7MADCF | 7TAACF |

| 9TDS | 9PCD5 | 9APE5 | 9AP55 | 9AM5S | 9CVDNOZ | 9CVDNOZ | 9ABSAV | 9ABSAV | 9ABSAV |

| CMS | / BACK/ |

| 1T55 | 1PS5 | 1H55 | 1S5 | 1T25 | 1P25 | 1H25 | 1S25 |

| 2W56 | 2MS5 | 2FAR5 | 2WFC | 2HS2 | 2FAR2 | 2P1 | 2DUMB |

| 3T6 | 3P6 | 3H6 | 3S6 | 3T7 | 3P7 | 3H7 | 3S7 |

| 4T6 | 4P8 | 4H8 | 4S8 | 4T9 | 4P9 | 4H9 | 4S9 |

| 5MG6 | 5FA | 5G7 | 5FAR7 | 5ETAA | 5DPAFT | 5V55 | 5V25 |

| 6P56 | 6V6 | 6H6 | 6S6 | 6TS7 | 6PS7 | 6V7 | 6AH7 | 6AM25 |

| 7TS | 7PS | 7V8 | 7AM8 | 7TS9 | 7PS9 | 7V9 | 7AM9 |

| 8N6 | 8FRD | 8VJ | 8ICMD | 8VJN | 8FGH | 8FGFD | 8FGP |

| 9GM | 9FGP | 9WFT | 9WGT | 9FART | 9PG | 9FH | 9SF |

**DATA ANORD/6HMKNOZLL**

| NDZ=AMRD |

| NDZAV=48 |

| 955AV=99 |

| PZM=0 |

| *MNOS=0 |

| IF (NOZFLT, EQ, 1, OR, NOSZFL, EQ, 3) NDZM=1 |

| IF (1DES, EQ, 1, OR, 1AFTBN, GT, 0, OR, 1NOZM, EQ, 1) MNOS=1 |

| IF (1MDS, EQ, 1, OR, 1GD, TO, 1) CALL CONVRG (7T, 7N, 7T, 7FAR, 7G7, 7P1, 1MNOS, 1AS, 1PTR, 1T8, 8H6, 8P8, 8S8, 8T8, 8PS8, 8V8, 8AH8, 8ICHD) |

| GO TO (3, 3, 3, 2, 1) | ICN |

| CALL CONDIV (7T, 7H7, 7T, 7T, 7T7, 7FAR, 7H7, 7P1, 1MNOS, 1AH, 19S, 19T, 1T8, 8H8, 8P8, 8S8, 8T9, 8H9, 8S9, 8T8, 8TS8, 8PS8, 8V8, 8V9, 8AH9, 8AM9, 8AH9, 8ICND) |

| 1MMHAD=1 |

| 1SO TO (4, 4, 4, 4, 2, 1) |

| CALL ERROR |

| 2 |

| CALL ERROR |

| 3 |

| T9=7B |

| H9=HL |

| P9=P8 |

| S9=S8 |

| T9=T8 |

| PS9=PS8 |

| V9=V8 |

| AM9=AM8 |

| A9=AB |

| IMSHC=1ICND+3 |

| 4 |

| ERR16=1 (PTR=7) |

| IF (1MNOS, EQ, 1) WRITE (6, 100) 1AH, 1AM8, 19S, 1AH9 |

| FORMAT (14HMONOZ, 1DESIG, 10XH, 1AB, *E15.8, 18H, 1AM9, *E15.8, 18H, 1AH9, *E15.8) |

| A9=*E15.8, 18H | AM9=*E15.8, 18H |

| RETURN |

| END |

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$IBFTC PERF

DECK:994/2,ART7

SUBROUTINE PERF

COMMON / ALL/

1NORD, 1DES, 1DES, KODES, NODE, INIT, IDUMP, IAMTP,
2IDASMX, IDASMR, 1AFTEN, 1ACD, 1MCD, IDSMCA, 1MISHOC, NOSFLT,
3TRYS, LOOPMP, NOMAP, HUMMAP, MAPEOD, TOLALI, ERR(16)

COMMON / DESIGN/ 1PCMPG, 1PCMCU, TACU, DOND, DOND2, DELFG, DELRN, DELSFC,
2FDFS, FPFDS, FPFDS, ETAFDS, MAFS, PRFCF, ETAFCF, NACFCF,
3ZCDS, PCPCDS, ETAACS, ETAACS, ETAACS, ETAACS, ETAACS, ETAACS,
4TDFS, MFDFS, DTDFCS, ETAACS, MAADS, DPDCDS, DTDFCS, ETAACS,
5TDFCS, CHIPDS, ETAACS, ETAACS, ETAACS, ETAACS, ETAACS, ETAACS,
6YFDF, CNLFD, YFDF, CNLFD, CNLFD, CNLFD, CNLFD, YTDF5,
7TDF5, RNFDF, DTDFCS, ETAACS, MAADS, DPDFDS, DTDFCS, ETAACS,
8TDF5, RNFDF, DTDFCS, ETAACS, MAADS, DPDFDS, DTDFCS, ETAACS,
9TDF5, RNFDF, DTDFCS, ETAACS, MAADS, DPDFDS, DTDFCS, ETAACS,
APR55, APR55, APR55, APR55, APAP55, APR55, APR55, APR55

COMMON / FRONT/ 1T1, 1T1, 1T1, 1T1, 1T1, 1T1, 1T1, 1T1,
2T1, 2T1, 2T1, 2T1, 2T1, 2T1, 2T1, 2T1,
3T4, 3T4, 3T4, 3T4, 3T4, 3T4, 3T4, 3T4,
4T5, 4T5, 4T5, 4T5, 4T5, 4T5, 4T5, 4T5,
5CNF, 5CNF, 5CNF, 5CNF, 5CNF, 5CNF, 5CNF, 5CNF,
6CNF, 6CNF, 6CNF, 6CNF, 6CNF, 6CNF, 6CNF, 6CNF,
7CNF, 7CNF, 7CNF, 7CNF, 7CNF, 7CNF, 7CNF, 7CNF,
8CNF, 8CNF, 8CNF, 8CNF, 8CNF, 8CNF, 8CNF, 8CNF,
9AM, 9AM, 9AM, 9AM, 9AM, 9AM, 9AM, 9AM

COMMON / SIDE/

X1M1, X1M1, X1M1, X1M1, X1M1, X1M1, X1M1, X1M1,
2X1M1, 2X1M1, 2X1M1, 2X1M1, 2X1M1, 2X1M1, 2X1M1, 2X1M1,
3T6, 3T6, 3T6, 3T6, 3T6, 3T6, 3T6, 3T6,
4T8, 4T8, 4T8, 4T8, 4T8, 4T8, 4T8, 4T8,
5GK6, 5GK6, 5GK6, 5GK6, 5GK6, 5GK6, 5GK6, 5GK6,
6TS5, 6TS5, 6TS5, 6TS5, 6TS5, 6TS5, 6TS5, 6TS5,
7TS8, 7TS8, 7TS8, 7TS8, 7TS8, 7TS8, 7TS8, 7TS8,
8BCA, 8BCA, 8BCA, 8BCA, 8BCA, 8BCA, 8BCA, 8BCA,
9BCA, 9BCA, 9BCA, 9BCA, 9BCA, 9BCA, 9BCA, 9BCA

COMMON / BACK/

X1T55, X1T55, X1T55, X1T55, X1T55, X1T55, X1T55, X1T55,
2X1T55, X2T55, X2T55, X2T55, X2T55, X2T55, X2T55, X2T55,
3T16, 3T16, 3T16, 3T16, 3T16, 3T16, 3T16, 3T16,
4T18, 4T18, 4T18, 4T18, 4T18, 4T18, 4T18, 4T18,
5H66, 5H66, 5H66, 5H66, 5H66, 5H66, 5H66, 5H66,
6H55, 6H55, 6H55, 6H55, 6H55, 6H55, 6H55, 6H55,
7H55, 7H55, 7H55, 7H55, 7H55, 7H55, 7H55, 7H55,
8H55, 8H55, 8H55, 8H55, 8H55, 8H55, 8H55, 8H55,
9H55, 9H55, 9H55, 9H55, 9H55, 9H55, 9H55, 9H55

COMMON / SMD/

DATA ANGRO/AMPER/F

WZ00=WZ00

G=32.174049
CSFSF=2114.2170
WFT=WF+WF+WF
WAT=WR=SLNB
WGT=WAT=WFT
WFT=WFT=WAT
Y=3NC5
FRO=FRA=SFMAP-9
Y=CM=VHDBZ=V3
FGRDV=M=CM=VH7/G
FGPFR=CSFSF=PS9=PLA9
IF=IC5PRA=GT.0) GO TO 1
VJ=CM=VHDBZ=V9
FGRD=VJ=HG24/G

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\[ \text{FGPD} = \text{CAPSF} \times (PS29 - P1) \times A29 \]
\[ \text{FGM} = \text{FGM} + \text{FGMD} \]
\[ \text{FGP} = \text{FGPM} + \text{FGPD} \]
\[ \text{FG} = \text{FGM} + \text{FGP} \]
\[ \text{FN} = \text{FG} \times \text{FRD} \]
\[ \text{SFC} = 3600 \times \frac{WFT}{FN} \]
\[ \text{FG} = \text{DELFG} \times \text{FG} \]
\[ \text{FN} = \text{DELFN} \times \text{FN} \]
\[ \text{SFC} = \text{DELSFC} \times \text{SFC} \]

CALL OUTPUT
CALL ERROR
RETURN
END
SUBROUTINE OUTPUT
COMMON / ALL /
1KORD , IDES , IPD , KODE , IFID1 , IDUMP , IAPM ,
21GASMX , IDBRH , IAFBN , IEDO , IFMC , IDSHOC , 1HSDC , ID2FLT ,
31TRYS , IDLOOP , ICMAP , NUMMAP , MAFEOO , TOLLALL , ERR(6)
COMMON / DESIGN /
1PCHI=0U , PCNCGU , T4GU , DUMDI , DUM2 , DELFG , DELFN , DELSFC ,
2DFDS , PCNFDIS , PRFDS , ETAFPS , WAPDS , PRCF , ETAFCF , NAFCF ,
3DFDS , PCNFDIS , PRGDS , ETAODS , MACDS , PRCDF , ETAOCF , NAOCF ,
4TFDS , WPBDS , DTFCODS , ETABDS , WA3CDS , DPCODS , DTFCO , ETAFCF ,
5TFHPS , CNHPS , ETHPDS , TEPHPS , CNHPS , ETCF , DMTFCF , DHMPFCF , T2DS ,
6FLPDS , CNLPDS , ETLPDS , TFLPCF , CMLPCF , ETLPFCF , DMLPCF , T21DS ,
7TFDOS , NFOS , DTUDOS , ETADOS , NW23DS , DOUDOS , DTUDCF , ETDFC ,
8TFDOS , NDFAS , DTAFDS , ETADFS , NWGCDS , OPAFDS , DTAFCF , ETAFCF ,
9A55 , A25 , A6 , A7 , A8 , A9 , A28 , A29 ,
APS55 , AM55 , CVNOZ2 , CVNOZ2 , A85AV , A95AV , A285AV , A295AV
COMMON / FRONT /
7T1 , P1 , N1 , S1 , T2 , P2 , H2 , S2 ,
2T21 , P21 , H21 , S21 , T3 , P3 , H3 , S3 ,
3T4 , P4 , H4 , S4 , T5 , P5 , H5 , S5 ,
4T55 , P55 , H55 , S55 , B1F , BLC , BLDU , BLOB ,
5CNF , PRF , ETAF , WACF , MAF , MASC , H4 , B4R ,
6CNF , PRG , ETAO , WACD , MAC , MACTAB , DPMDC , DUHCF ,
7CNHP , EDDHCF , DTCHCF , DTPTC , BLMK , NS5 , FARS , CS ,
8CNLP , EDDLPCF , DTDLCF , DTF , BLLP , NG5 , FARS5 , HPEXT ,
9AM , ALTPS , ETAR , 2F , PCNF , IC , PCNC , WOF8 ,
ATFFHP , TPFLP , PCBLF , PCBLFD , PCBDLB , PCBLBLF , PCBLPL
COMMON / SIDE /
X2P1 , XMAF , XWAC , XBLF , XBLDU , XH3 , DUN51 , DU52 ,
X2T21 , XP21 , XH21 , XS21 , T23 , P23 , H23 , S23 ,
3T24 , P24 , H24 , S24 , T25 , P25 , H25 , S25 ,
4T28 , P28 , H28 , S28 , T29 , P29 , H29 , S29 ,
5MAETAD , XG24 , ETAFDF , ETAD , DPOUDS , DUSPAS , DUN53 ,
6T28 , P528 , V28 , AM28 , T29S , P529 , V29 , AM29
COMMON / BACK /
X2T5S , XP55 , XN55 , XS55 , XT5S , XP5S , XH25 , XS5S ,
X2MFB , XK55 , XFA55 , XMFD , XG24 , XFA24 , XPS1 , DOU5B ,
3T6 , P6 , H6 , S6 , T7 , P7 , H7 , S7 ,
4T6 , P8 , H8 , S8 , T9 , P9 , H9 , S9 ,
5MG6 , NFA , XGT , FAR7 , ETA , DPAF , V55 , V5S ,
6PS6 , V6 , AM6 , TS7 , PS7 , V7 , AM7 , AN25 ,
7T5S , PS8 , V8 , AM8 , TS9 , PS9 , V9 , AM9 ,
8T5F , PFDF , VJDF , FCMG , FCMG , FGPD , FGMK ,
9FGM , FGP , FGFT , WGT , FART , FG , FD , STC
DIMENSION WIS5 , ANS150 , ANS250 , ANS350 , ANS4721
EQUIVALENCE ( ANS1 , PCNFGU ) , ( ANS2 , T21 ) , ( ANS3 , XP1 ) , ( ANS4 , T55 )
DATA ANDORD , ANDORD2 , NOOUTPUT , WMCOMNOR /
DATA M(2,i) = 1 + 1 / 6HSMOC , 6HINSIDE , 6MHCD , 6HMODZ ,
DATA M(2,i) = 1 , 4 / 6HSMOC , 6HINSIDE , 6MHCD , 4HMODZ ,
DATA M(i,3) = 1 , 4 / 6HMODZ , 6HCD , 6HMODZ ,
DATA M(i,4) = 1 , 4 / 6HOMZ , 6HCONV , 6HFACT , 6HMODZ ,
DATA M(5,i) = 1 , 4 / 6HFACT , 6HCONV , 6HFACT , 4HMODZ ,
WORD = ANDORD
IF ( IDES .EQ. 11 ) GO TO 4
IF ( IDOBRH .GT. G ) GO TO 2
IF ( IAFBN .GT. G ) GO TO 1
WRITE ( 100 ) WORD , AM , ALTPS , T4 , ETAR
GO TO 3
WRITE ( 101 ) WORD , AM , ALTPS , T4 , T7 , ETAR
GO TO 3
WRITE(6,102)WORD,AH,ALTP,T4,T24,ETAR
CALL CONOUT(2)
WRITE(6,104)(W(IMSHOC,I),I=1,4),FG,FN,SFC
IF(IGASHX.GT.0) GO TO 5
WRITE(6,105)(W(IDSHOC,I),I=1,4)
WRITE(6,106)LOOPER
WORD=AMORD2
WRITE(6,107)WORD,2F,PCNF,TC,PCNC,T4,MODE
WRITE(6,108)
WRITE(6,109)ANS1(I),I=1,80
WRITE(6,108)
WRITE(6,109)ANS2(I),I=1,80
WRITE(6,108)
WRITE(6,109)ANS3(I),I=1,48
WRITE(6,108)
WRITE(6,109)ANS4(I),I=1,72
IF(IDES.EQ.1) GO TO 6
A8=ABSAY
A9=A9SAV
A28=A28SAV
A29=A29SAV
IF(IDUMP.NE.2) GO TO 6
WRITE(6,110)
CALL SYG(2)
RETURN
100 FORMAT(1HB,A6,14X7H AM=,F7.3,6X7H ALTP=,F7.0,
       16X7H T4=,F8.2,5X7H ETAR=,F7.4)
101 FORMAT(1HB,A6,14X7H AM=,F7.3,6X7H ALTP=,F7.0,
       16X7H T4=,F8.2,5X7H T7=,F8.2,5X7H ETAR=,F7.4)
102 FORMAT(1HB,A6,14X7H AM=,F7.3,6X7H ALTP=,F7.0,
       16X7H T4=,F8.2,5X7H T24=,F8.2,5X7H ETAR=,F7.4)
104 FORMAT(6HOMAIN ,4A6,9X3HF5=,F9.2,18X3HF5=,F9.2,18X4HSFC=,F8.5)
105 FORMAT(6HDUCT ,4A6)
126 FORMAT(16HICONVERGED AFTER,14,6H LOGPS,/,1HB)
127 FORMAT(1H ,A6,9X5E15.6,14)
128 FORMAT(1H )
109 FORMAT(1H ,8E15.6)
11C FORMAT(1H1)
END
AFAPL-TR-37-125
Part II

$IBFTS CONOUT DECK,904/2,9X7
(SUBROUTINE CONOUT ICON)
COMMON / ALL/
1WORD, IDES, IDES, IDDES, MODE, INIT, IDUMP, IAMTP,
2GASK, IDBURN, IAFBBN, ICDC, IC 0D, IDSMDC, IMSHOC, NDZFLT,
SIMS, FLDEP, NDMP, MNUMAP, MAPEDG, TOLLALL, ERR(16)
COMMON /DESIGN/
1PCFGU, POCNUGU, T4G, DUNO, DUNO, DELFG, DELFN, DELSCF,
2FDS, PNCFDS, PRFDS, ETAFDS, WAFDS, PRFCCF, ETAFCF, MAFCF,
3ICDS, PCCNCD, PRACDS, ETAACDS, WACDS, PRACCF, ETAACCF, MAACCF,
4TFDS, WPBDS, OTCDOS, ETAODS, WACODS, OTCDDF, ETAODCF, ETAACDF,
5TFHPDS, CNPHPD, THPDFS, THPCF, CNPHPCF, ETMPCF, DMPHF, T2DS,
6FLPDS, CNUPLDS, ETNLDPS, TFLPCF, CNLPCF, ENLPFC, DHLPCF, T2IDS,
7T2ADS, WFDOS, OTODOS, ETAODS, WAPDS, DTODUCF, ETAODCF,
8TADS, NPADS, OTADS, ETAADS, WACADS, OTACDF, ETAACF,
9CMON / FRONT/
171, P1, H1, S1, T2, P2, H2, S2,
2T21, P21, H21, S21, T3, P3, H3, S3,
3T4, P4, H4, S4, T5, P5, H5, S5,
4T55, P55, H55, S55, BLF, BLC, BLDU, BLOB,
5ECH, PAF, ETAF, MACF, MAF, MA3, MG4, FA4,
6MNC, PEAC, ETAAC, AACF, ETAP, DPCOM, DURF,
7CHIP, ETAACP, DMTCPA, DMTLC, DMTCP, DMTCH, DMTPCF, DMTPCF,
8CNLPCF, ETAFTLP, DMTCLP, DMTFT, DMTLC, DMTPCF, DMTPCF,
9AN, ALTP, ETAAR, ZF, PCRF, ZC, PCRC, WBF,
ATFPCP, TFLPCP, PCLLF, PCLLC, PCLBDU, PCLBDU, PCBLHP, PCBLLP,
COMMON / SIDE/
XIP1, XWAP, XWAC, XBLF, XBDL, XCH3, DUN51, DUN52,
XTX2, XP21, XH21, X521, T23, P23, H23, S23,
3T24, P24, H24, S24, T25, P25, H25, S25,
4T26, P26, H26, S26, T29, P29, H29, S29,
5XAD, WFDO, H24, TAR24, ETAAD, DPTUCF, BYPASS, DUNK53,
6T528, P.28, V28, AM29, T529, P529, V52, AM29,
COMMON / BACK/
XTX5, XP55, AX55, AX55, T25, P25, H25, S25,
XXW5, AX55, XAR55, XPFD, XN24, XAR24, XRP1, DURB,
3T5, P6, H6, S6, T7, P7, H7, S7,
4T8, P8, H8, S8, T9, P9, H9, S9,
5WG6, WFA, WGT, FAR7, ETA8, DPAFT, VS55, V525,
6P6S, V6, AM6, TST7, PST7, V7, AM7, AM85,
7T58, PSB, V8, AMS, T59, P59, V9, AM9,
8V5A, SFRD, V9D, FCMD, Y1M1, FGMM, FGPD, FPGP,
9FGA, FG6, WFT, NGT, FART, FG, FN, SFC,
DIMENSION PARAM(280), WORDY(260), IOUT(103), AOUT(16), AOUT(16)
EQUIVALENCE (PARAM, PCFGU)
DATA (WORDY(1), I1, I1, H81, I1, H81)
16HPMCFGS, 6MHPCGGU, 4MTAGU, 6MODUN1, 6MNOO2, 6MDDELG, 6MDDELN,
26MDDEL, S6MHPFD, 6MPRDFDS, 6MPRDPDS, 6MHPACF, 6MPACF,
36MTACF, 6MPACF, 6MTACD, 6MPACD, 6MHPACDS, 6MHPACDS,
46MPACDS, 6MHPACDS, 6MHPACDS, 6MHPACDS, 6MHPACDS,
56MHPACDS, 6MHPACDS, 6MHPACDS, 6MHPACDS, 6MHPACDS,
66MHPACDS, 6MHPACDS, 6MHPACDS, 6MHPACDS, 6MHPACDS,
76MHPACDS, 6MHPACDS, 6MHPACDS, 6MHPACDS, 6MHPACDS,
86MHPACDS, 6MHPACDS, 6MHPACDS, 6MHPACDS, 6MHPACDS,
96MHPACDS, 6MHPACDS, 6MHPACDS, 6MHPACDS, 6MHPACDS, 6MHPACDS,
1004ATAFCF, 6HATS, 6HATS, 6HATS, 6HATS, 6HATS,
116HATS, 6HATS, 6HATS, 6HATS, 6HATS, 6HATS,
126HATS, 6HATS, 6HATS, 6HATS, 6HATS, 6HATS,
48
DATA (WORDY(1),I=1,199,189)/
56NS21 5H73 6HP3 6HS3 6HT4 6HP4 /
DATA (WORDY(1),I=1,190,280)/
16HP29 6HS29 6HP29 6HMD 6HNFD 6HM24 6MFAR24 /
26HMD 6HpD3 6HMDS5 6HMDS3 6HMDS28 6HMDS28 6HM28 /
36HE28 6HT29 6HT29 6HVP29 6HMA29 6HMT35 3 Montreal5 /
46HHE55 6HSS5 6HST52 6HSP25 6HSM25 6HSM25 6HSPF8 /
56HE55 6H8AR55 6H8R55 6H8RF24 6H8RF21 6H8RF21 6H8RF21 /
66HT6 6HS6 6HS6 6HT7 6HP7 6HP7 /
76HS7 6HFS 6HP8 6HFS 6HSP9 /
86HOM 6HOM 6HOM 6HNFA 6HNG7 6HFA7 6HEAA /
96HMAP 6HMP5 6HMP5 6HMP6 6HMP6 6HMP6 6HMP6 /
16HMP7 6HMP7 6HMP7 6HMP7 6HMP7 6HMP7 6HMP7 /
26HM8 6HMS9 6HMS9 6HS9 6HMAS 6HMS9 6HMS9 /
30HMD 6HMD 6HMD 6HMD 6HMD 6HMD 6HMD /
46HMD 6HMD 6HMD 6HMD 6HMD 6HMD 6HMD /
DATA THEEND, BLANK, LIMIT/8HHE9END, 6H ,280/
GO TO [1,1,12]+ICON
C *** INPUT SECTION
1 DO 4 N=1,102
NUM=N
READ(5,1001AIN, CHANGE
IF(IN.EQ.,THEEND) GO TO 5
DO 2 J=1,LIMIT
J=J
IF(IN.EQ.,WORDY(J)) GO TO 3
2 CONTINUE
WRITE(6,1011AIN
GO TO 4
3 IOUT(NUM)=J
IF(CHANGE,NE BLANK) WORDY(J)=CHANGE
4 CONTINUE
WRITE(6,102)
5 NUM=NUM+1
RETURN
C *** OUTPUT SECTION
12 IF(INUM,60) GO TO 16
N=NUN
J=J
DO 15 I=1,NUN+6
IF(INUM,GT,6) GO TO 13
J=J
13 N=N-6
DO 14 X=1, J
L=1+X
M=IOUT(L)
WOUT(K)=WORDY(H)
14 AOUT(K)+PARA(N)
GO TO 12
WRITE(6,103)(W(I),I=1,5)
WRITE(6,104)XOUT(5:51)
IF(N LE 0) 50 TO 16
15 CONTINUE
16 RETURN
100 FORMAT(A6,6X,A6)
101 FORMAT(10X'THE WORD ',A6,26H NOT FOUND IN COMMON ARRAY')
102 FORMAT('ERROR IN CONDUIT INPUT')
103 FORMAT(40X,5(9X,A6))
104 FORMAT(5X,20X6E15.6)
END
IF (IOMRP, EQ, 0) GO TO 1
WRITE (6, 105)
CALL SYG(2)
2 CALL ENGBAL
RETURN
100 FORMAT (2AH0AH ERROR HAS BEEN FOUND IN A6)
102 FORMAT (1H0, A6, 9X, 5E15.6, 14)
103 FORMAT (2H0 )
104 FORMAT (1H0, 8E15.6)
105 FORMAT (1H1)
106 FORMAT (25H0 FAILED TO CONVERGE AFTER, I4, 6H LOOPS)
END
$IBFTC SYG  DECK,M94/2,WR
SUBROUTINE SYG(ICON)
DIMENSION WORD(132)
DATA ONEDOL/6MS /
GO TO (1,2),ICON
1 END FILE 8
REWIND 8
RETURN
C TERMINATE THE FILE
2 WRITE(8,500)
500 FORMAT(12H$-----------------------------------)
END FILE 8
REWIND 8
C READ RECORD
5 READ(8,501) (WORD(I),I=1,132)
501 FORMAT(132A)
C CHECK FOR 12 LEADING DOLLAR SIGNS
DO 10 I=1,12
10 IF(WORD(I)-ONEDOL)11,10,11
CONTINUE
RETURN
C CHECK FOR 6 TRAILING DOLLAR SIGNS
11 DO 15 I=1,132
15 I=
IF(WORD(I)-ONEDOL)15,12,15
12 K=I+5
DO 13 J=I+K
IF(WORD(J)-ONEDOL)15,13,15
CONTINUE
GO TO 20
15 CONTINUE
WRITE(6,502)
502 FORMAT(1HO,HERROR IN SYG)
RETURN
C PRINT LINE
20 I=I-1
WRITE(6,501) (WORD(M),M=1,I)
GO TO 5
END
SUBROUTINE THCOMP(PR, ETA, T, H, S, P, TO, HO, SO, PO)
  PO=P*PR
  TP=T*PR*0.28572
  DO 1 I=1,25
  CALL THERMO(PO, HP, TP, SP, X1, 0, X2, 0)
  DELS=SP-S
  IF(ABS(DELSS).LE.0.00005*S) GO TO 2
  1 TP=TP/EXP(4.*DELS)
  CALL ERROR
  2 HO=H+(HP-H)/ETA
  CALL THERMO(PO, HO, TO, SO, X1, 0, X2, 1)
  RETURN
END
SUBROUTINE THTURB(DH, ETA, FAR, H, S, PO)
    HO=H-DH
    HOP=H-DH/ETA
    PT=P/2.
    DO 1 I=1,25
    CALL THERhJ(PH, HOP, TT, ST, AMWT, 1, FAR, 1)
    DELS=ST-S
    IF(ABS(DELS).LE.0.00005*S) GO TO 2
1     PT=P*EXP(DELS*AMWT/1.966375+ALOG(PT/P))
    CALL ERROR
2     PO=PT
    CALL THERhD(PO, HO, TO, SO, X1, 1, FAR, 1)
    RETURN
END
$1BFTC THERMO DECK,M94/2,XR7
SUBROUTINE THERMO(PX,HX,TX,SX,AMX,L,FAR,K)
FX=0.
IF(L.EQ.1) FX=FAR
IF(K.EQ.1) GO TO 1
CALL PROCOH(FX,TX,CS,AK,CP,R,PHI,HX)
GO TO 3
1 TX=4.*HX
DO 2 I=1,15
CALL PROCOM(FX,TX,CS,AK,CP,R,PHI,H)
DELH=HX-H
IF(ABS(DELH).LE.0.00001*HX) GO TO 3
2 TX=TX+4.*DELH
WRITE(8,100)
100 FORMAT(31HMONO CONVERGENCE IN THERMOS$$$$)
3 SX=PHI-R*ALOG(PX)
AMX=1.986375/4
RETURN
END
SUBROUTINE PROCOM, TEX, CSEX, AKE, CPEX, REX, PHI, HEX
IEE(FARX.LE.0.067623) GO TO 1
FARX=0.067623
WRITE(8,101)
1 IF(TEX.GE.300.) GO TO 2
TEX=300.
WRITE(8,102)
2 IF(TEX.LE.4000.) GO TO 3
TEX=4000.
WRITE(8,103)
3 IF(FARX.GE.0.) GO TO 4
FARX=0.0
WRITE(8,104)
C AIR PATH
4 CPA=((1.011554E-25*TEX-1.4526770E-21)*TEX
1+7.621576E-18)*TEX-1.5128259E-14)*TEX-6.7108376E-12)
2*TEX+6.551948E-08)*TEX-5.1536789E-05)*TEX+2.502005E-01
HEA=((1.12644425E-26*TEX-2.0752522E-22)*TEX
1+1.2702630E-18)*TEX-3.0256518E-15)*TEX-1.6794594E-12)*TEX
2+2.1839826E-08)*TEX-2.5768440E-05)*TEX+2.502005E-01)*TEX
3-1.7558886E+00
SEA=+2.502005E-01)*ALOG(TEX)+((1.4450767E-26*TEX
1-2.4211288E-22)*TEX+1.5243153E-18)*TEX-3.7830648E-15)*TEX
2-2.2392790E-12)*TEX+3.7259743E-08)*TEX-5.1576879E-05)*TEX
3+1.5432300E-02
IF(FARX.LE.0.) GO TO 5
C FUEL/AIR PATH
CF ((1.72678710E-25*TEX-1.335366E-20)*TEX
1+1.0212913E-15)*TEX-4.2051104E-13)*TEX+9.9686793E-10)*TEX
2-1.771901E-06)*TEX-1.2258630E-03)*TEX-7.3816638E-02
HEF=((9.084828E-26*TEX-1.9050949E-21)*TEX
1+1.7021525E-17)*TEX-8.4102208E-14)*TEX+2.4921698E-10)*TEX
2-4.5906392E-07)*TEX+9.1293150E-04)*TEX-7.3816638E-02)
3*TEX-3.6581530E+01
SEF=+7.361636E-02)*ALOG(TEX)+((1.0382570E-25)*TEX
1-2.2226118E-21)*TEX-2.0425826E-17)*TEX-1.052776E-13)*TEX
2+3.3228928E-10)*TEX-6.3859505E-07)*TEX+1.2258630E-03)*TEX
3+6.483978E-01
5 CPEX=ICPA+FARX=CPF/((1.+FARX)
HEX=(HEA+FARX+HEF)/(1.+FARX)
PHI=(SEA+FARX+SEF)/(1.+FARX)
AH=28.97-946186+FARX
REX=1.98375/AMH
AKE=CPEX/(CPEX-REX)
CSEX=SORT(AKE*TEX*25031.37)
RETURN
101 FORMAT(1HO,63HINPUT FUEL-AIR RATIO ABOVE LIMITS, IT HAS BEEN RESET
2T0 0.067623,6HSSSSSSS)
102 FORMAT(1HO,35HPROCOM INPUT TEMPERATURE BELOW 300.,6HSSSSSSS)
103 FORMAT(1HO,35HPROCOM INPUT TEMPERATURE ABOVE 4000.,6HSSSSSSS)
104 FORMAT(1HO,35HPROCOM INPUT FUEL-AIR RATIO BELOW ZERO,6HSSSSSSS)
END
A few lines of code from a larger program, likely a FORTRAN program, with comments and variables defined. The code appears to involve calculations and conditional logic, but the specifics are not fully legible due to the handwriting and space constraints. The program seems to be working on some sort of numerical or algorithmic calculation, possibly involving arrays or vectors.
\begin{verbatim}
CH = CX(IH, JL) - PR * (CX(IH, JH) - CX(IH, JL))
DH = DX(IH, JL) - PR * (DX(IH, JH) - DX(IH, JL))

PR = (BX(IL, KL) - BL) / (BX(IL, KH) - BX(IL, KL))
CL = CX(IL, KL) - PR * (CX(IL, KH) - CX(IL, KL))
DL = DX(IL, KL) - PR * (DX(IL, KH) - DX(IL, KL))

BT = BL + PR * (BH - BL)
CT = CL + PR * (CH - CL)
DT = DL + PR * (DH - DL)

IF (P*GE.0.) GO TO 13
DIR = SQRT(B/BT)
ERR = (B - BT) / B
CALL AFQUIR(Q(1), PP, ERR, 0., 25., 0.001, DIR, PT, ICON)
GO TO (11, 13, 12), ICON

11
PP = PT
IF (PP*LT.0.) PP = 0.
IF (PP*GT.1.) PP = 1.
GO TO 6

12
NCODE = 7

B = BT
C = CT
D = DT
RETURN
END
\end{verbatim}
SUBROUTINE MAPBAC(MAP,HAPGO,TFFS,TFF,CNS,CN,PCN,MODE,IGO,NUM)
DATA WH,WL,WT,WS,6H H,P.,6H L,P.,6H TFF,6HSPEED /
1 FORMAT(1H0,A6,12HTURBINE MAP,A6,4HWAS=,E13.6,10H AND NOW=,E13.6,16H$$$$) 2 FORMAT(1H0,A6,A6,22HWAS ALSO CHANGED FROM,E13.6,5H TO,E13.6,16H$$$$)
   IF(NUM.GT.0) GO TO 3  NUMH=0  NUML=0  3 IGO=MAPG0+3*(MAP-1)  GO TO (100,200,300,400,500,600,IGO)
C *** HIGH PRESSURE TURBINE
100 TFF=TFF+0.1*(TFF-TFFS)  WRITE(8,1)WH,WT,TFFS,TFF  RETURN  200 CN=CN+0.05*(CN-CNS)  IF(MODE.NE.1) PCN=PCN*(CN/CNS)  IF(MODE.EQ.1) T =T *(CNS/CN)**2  WRITE(8,1)WH,WS,CNS,CN  IF(NUMH.GT.2) GO TO 210  NUM=1  NUMH=NUMH+1  RETURN  210 DELCN=CN-CNS  IF(DELCN.GE.0.) RETURN  TFF=TFF*(1.+DELCN/CN)  WRITE(8,2)WH,WT,TFFS,TFF  RETURN  300 TFF=TFF+0.1*(TFF-TFFS)  WRITE(8,1)WH,WT,TFFS,TFF  GO TO 200  C *** LOW PRESSURE TURBINE
400 TFF=TFF+0.1*(TFF-TFFS)  WRITE(8,1)WL,WT,TFFS,TFF  RETURN  500 CN=CN+0.05*(CN-CNS)  PCN=PCN*(CN/CNS)  WRITE(8,1)WL,WS,CNS,CN  IF(NUML.GT.2) GO TO 510  NUM=1  NUML=NUML+1  RETURN  510 DELCN=CN-CNS  IF(DELCN.GE.0.) RETURN  TFF=TFF*(1.+DELCN/CN)  WRITE(8,2)WL,WT,TFFS,TFF  RETURN  600 TFF=TFF+0.1*(TFF-TFFS)  WRITE(8,1)WL,WT,TFFS,TFF  GO TO 400 END
SUBROUTINE CONVRG(TI,HI,PI,SI,FAR,WG,PA,IDES,AO,PR,
    10,NO,PO,SO,TSO,PSO,V0,A0,ICON)
C ICON=1 SUBSONIC, COMPARE PI WITH PR
C ICON=2 SONIC, COMPARE PI WITH PR
C ICON=4 ERROR
AJ=778.26
CAPSF=2116.217
G=32.174049
CALL PROCON(FAR,TI,XX1,XX2,XX3,XX4,PHI,XX6)

C *** SONIC CALCULATIONS
J=0
TSS=0.833*TI
1 J=J+1
CALL PROCON(FAR,TSS,CSS,AKS,CP,REXS,PHISS,HSS)
HSCAL=HI-CSS**2/(2.*G**AJ)
DELHS=HSCAL-HSS
IF(ABS(DELHS)-0.00005*HSCAL)<4.4,2
2 TSS=TSS+DELHS/CP
IF(J=1511,1,3)
3 ICON=4
RETURN
4 IF(IDES)12,12,5

C *** ISENTROPIC EXPANSION CALCULATIONS
5 J=0
TSI=TI*(PA/PI)**0.286
6 J=J+1
CALL THERMO(PA,HSI,SSI,SSI,XX1,1,FAR,0)
IF(ABS(SSI-SI)-0.0001*SI)<8,8,7
7 TSI=TSI/EXP(4.*(SSI-SI))
IF(J=30)696,3
8 VIS=SQRT(2.*G**AJ*(HI-HSI))
IF(VIS-CSS)<9,11,11

C *** SUBSONIC DESIGN, CALCULATE AO
9 VO=VIS
TSO=TSI
PSO=PA
CALL PROCON(FAR,TSO,CSO,XX2,XX3,REX,PHISO,HSO)
RHO=CAPSF*PSO/(AJ*REX*TSO)
AO=WG/(RHO*VO)
A0=VO/CSO
PR=PI
ICON=1
10 TO=TI
HO=HI
PO=PI
SO=SI
RETURN

C *** SONIC DESIGN, CALCULATE AO
11 VO=CSS
TSO=TSS
PSO=PI*(TSO/TO)**(AKS/(AKS-1.1))
RHO=CAPSF*PSO/(AJ*REXS*TSO)
W-4

Part II

\[ A_0 = \frac{WG}{(RHO \cdot VO)} \]
\[ AMO = 1.0 \]
\[ PR = PI \]
\[ ICON = 2 \]
GO TO 10

C *** NON-DESIGN, CALCULATE CRITICAL CONDITIONS

12 \[ VO = CSS \]
\[ TSO = TSS \]
\[ PSO = PA \]
\[ RHO = CAPSF \cdot PSO / (AJ \cdot REX \cdot TSO) \]
\[ AOCRIT = \frac{WG}{(RHO \cdot VO)} \]
\[ AMO = 1.0 \]
\[ PR = PSO \cdot (TI / TSO)^{\frac{AKS}{(AKS - 1.0)}} \]
IF(AO - AOCRIT) < 13, 13, 14

C *** NON-DESIGN, CRITICAL AND SUPERCRITICAL CONDITIONS

13 \[ PSO = PSO \cdot AOCRIT / AO \]
\[ PR = PR \cdot AOCRIT / AO \]
\[ ICON = 2 \]
GO TO 10

C *** NON-DESIGN, SUBSONIC CALCULATIONS

14 \[ PSO = PA \]
\[ J = 0 \]
\[ TSO = 0.833 \cdot TSO \]

15 \[ J = J + 1 \]
CALL PROCOM(FAR, TSO, CSA, AKO, CP, REX, PHISO, HSO)
\[ RHO = CAPSF \cdot PSO / (AJ \cdot REX \cdot TSO) \]
\[ VO = WG / (RHO \cdot AO) \]
\[ HSCALE = HI - VO^{\frac{2}{Z \cdot G \cdot Aj}} \]
\[ DELHS = HSCALE - HSO \]
IF(ABS(DELHS) < 0.0005 * HSCALE) 17, 17, 16

16 \[ TSO = TSO + DELHS / CP \]
IF(J < 15) 15, 15, 3

17 \[ AMO = VO / CSO \]
\[ PR = PSO \cdot (TI / TSO)^{\frac{AKO}{(AKO - 1,0)}} \]
\[ ICON = 1 \]
GO TO 10
END
SUBROUTINE CONDIV(Ti,PI,Si,FAR,NG,PA,IDES,AT,AD,PIR, 
+ Ti,PT,ST,TD,HO,PO,SD,TST,TSO,PST,PSO,VT,VO,AMT,AMO,ICON) 
C ICON=1 SUBSONIC, COMPARE PIR WITH PI 
C ICON=2 SONIC, SHOCK INSIDE NOZZLE, COMPARE PIR WITH PI 
C ICON=3 SONIC, SHOCK OUTSIDE NOZZLE, COMPARE PIR WITH PI 
C ICON=4 ERADCF 
DIMENSION Q(9) 
Q(1)=0. 
Q(3)=0. 
AJ=778.26 
CAPSF=2116.2170 
G=32.1740 
CALL PROCOM(FAR,TI,XX1,XX2,XX3,XX4,PHII,XX6) 
C *** SONIC CALCULATIONS 
J=0 
TSS=0.833*TI 
1 J=J+1 
CALL PROCOM(FAR,TSS,CSS,AK,CP,REX,PHISS,HSS) 
HSCAL=H1-CSS+0.2/(2.*G*AJ) 
DELHS=HSCAL-HSS 
IF(ABS(DELHS)-0.0005*HSCAL)=4,4,2 
2 TSS=TSS+DELHS/CP 
IF(10*151111.5 
ICON=4 
RETURN 
4 IF(DIDES)(11,1,5 
C *** SONIC DESIGN, CALCULATE AT 
5 VT=CSS 
TST=TSS 
PST=PI*(TST/TI)**0.4*(AK/AK-1)) 
RMD=CAPSF*PST/(AJ*REX*TST) 
AT=NG/(RHO*VT) 
AMT=1.0 
C *** IDEAL EXPANSION DESIGN, CALCULATE AO 
P=PA 
J=0 
PSO=TI*(PSO/PI)**.286 
6 J=J+1 
CALL PROCOM(FAR,TSO,CSO,AK,CP,REX,PI:ISO,HSO) 
PHICAL=PHII-REX*LOG(P/PSO) 
GELPHI=PHICAL-PHISO 
IF(ABS(GELPHI)-0.0001*PHICAL)=8,8,7 
7 TSO=TSO*EXP((4.*DELPHI) 
IF(J<1516.63 
8 VO=SORT2.4*G*AJ*(H1-HS0) 
AMO=VO/CSO 
AO=(AT/AMO)**2*(1.+(AK-1.)*AMO)**2/2.1/(AK+1.)**((AK+1.)/(12.* 
1*(AK-1.)))) 
PIR=PI 
ICON=3 
9 TO=TI 
HO=H1 
PD=PI 
SO=31
C *** ASSUME SONIC THROAT AND ISENTROPIC EXPANSION TO AO

12 VT=CSS
   AMT=1.0
   TST=TSS
   RHOD=(AT+VT)
   PSTR=RHO0*A3*REX0*TST/CAPS
   PI=PST*(TI/TST)**(AK/(AK-1.))
   IF(PST-PA)<12,24,24

13 CALL PROCON(FAR,TSO,CSD,AK,CP,REX,PHISO,HSO)
   AMD=SQR(2.0*(TI/TSO)-1.)/(AK-1.)
   AOCAL=*(AM)*#1.0*(AK-1.)*#(AMD)**(2/1.)/(AK+1.)**((AK+1.)/
1.0*(AK-1.))
   EA=(AD-AOCAL)/AD
   DIT=SQR(AD/AOCAL)
   CALL AQURX(0.0,TSD,EA,0.0,100.0,0.0001,DIR,TSO,TSC)
   GO TO (14,15,13,14)

14 TSO=TSD
   IF(TSO-TI)140,C,141

140 TSC=2.0*(TI/(AK+1.))
   IF(TSO>TSC) GO TO 142

141 TSO=0.98*TI
   GO TO 13

142 IF[(Q21.0.OR.AMO.LT.0.95.OR.MAN.EQ.1) GO TO 13
   TSO=2.0*(TI/(2.0+0.98*(AK-1.)))
   MAN=1
   GO TO 13

15 PSO=PIR*(ITPSO/TI)**(AK/(AK-1.))
   IF(PST-PA)<17,16,24

C *** CRITICAL FLOW, ISENTROPIC EXPANSION TO PA

16 VO=AMO*CSO
   ICON=1
   GO TO 9

C *** SUBSONIC FLOW

17 PPS=*PA
   Q12=0.0
   Q13=0.0
   J=0
   TSO=0.833*TI

18 J=J+1
   CALL PROCON(FAR,TSO,CSD,AK,CP,REX,PHISO,HSO)
   RHOD=CAPS0/PS0/(AJ*REX*TS0)
   VO=GN/(RHOD*AP)
   MSCP=V0*#2/12.0*G_AJ
   DELM=MSCAL-MSC0
   IF(ABS(DELM)<0.0005*MSCAL120,20,19

19 TSO=TSG+DELM/CP
   IF(J)1518,18,3

20 AMO=VG0/CSO
   PIR=PS0*(ITPSO/TI)**(AK/(AK-1.1)

10 TT=TI
   HT=HI
   PT=PI
   ST=SI
   RETURN
21  CALL PROCON(FAR,TST,CST,AK,CP,REX,PHI,T,HST)
    PST=PIR*(TST/TI)**(AK/(AK-1.))
    RHO=PIR*CSA/(AK*REX*TST)
    VT=MG/RHO*AT
    HSCAL=H-VT**2/12.*G*AJ
    EH=(HSCAL-HSTI)/HSCAL
    DIR1=1+HSCAL-HSTI/(CP*TST)
    CALL AFGUR(t(i),TST;EH,0.20,6.0005,DIR,TSTJ,ICON)
    GO TO (22,23,3),JCON
22  TST=TST
    GO TO 21
23  AMT=VT/CST
    ICON=1
    GO TO 9

C *** SUPERCRITICAL FLOW, ISENTROPIC EXPANSION TO PA
24  PSS=PA
    J=0
25  TSO=TI*(PSR/PIR)**.286
    J=J+1
    CALL PROCON(FAR,TSO,CSO,AK,CP,REX,PHISO,HSO)
    PHI=PHI-I-REX*LOG(PIR/PSO)
    DELPHI=PHISO-PHISO
    IFABS(DELPHI-0.0001*PHICAL)27,27,26
26  TSO=TSO*EXP(4.0*DELPHI)
    IF(J-15)25,25,2
27  VD=SORT(2.*G*AJ[H-HISO])
    AMO=VS/CSO
    AOIO=[AT/AMO](2.+1.+AK-1.*AMO**2/2.)/(AK+1.)**(AK+1.)/(AK+1.)
    ICON=3
    N=0
    IF(AO-AOIO)18,9,29

C *** SUPERCRITICAL FLOW, ISENTROPIC EXPANSION TO AO
28  N=1
29  TSO=0.833*TI
    J=0
30  J=J+1
    CALL PROCON(FAR,TSO,CSO,AK,CP,REX,PHISO,HSO)
    AMO=SRT[2.+TI/TSO-1.]/(AK-1.)
    AOCAL=[AT/AMO](2.+1.+AK-1.*AMO**2/2.)/(AK+1.)**(AK+1.)/(AK+1.)
    DELA=AO-AOCAL
    IFABS(DAE-9.0001*AO)32,32,31
31  TSO=TSO*SORT(AOCAL/AO)
    IF(J-50130,30,3
32  IF(N134,34,33

C *** UNDEREXPANDED, SHOCK OUTSIDE NOZZLE
33  PSO=PIR*(TSO/TI)**(AK/(AK-1.))
    VD=AMO*CSO
    GO TO 9

C *** OVEREXPANDED, FINO SHOCK POSITION
34  PSX=PIR*(TSO/TI)**(AK/(AK-1.))
AFAPL-TR-57-128
Part II

\[
\text{PSY} = \text{PSX} \times \left(2 \times \text{AK} \times \text{AMO}^{2} \div (\text{AK} + 1) - (\text{AK} - 1) \div (\text{AK} + 1)\right)
\]
\[\text{IF (PA-PSY)}35,36,36\]

C *** OVEREXPANDED, SHOCK OUTSIDE NOZZLE

35 \text{PSO} = \text{PSX}
\text{VO} = \text{AMO} \times \text{CSO}
\text{GO TO 9}

C *** OVEREXPANDED, SHOCK INSIDE NOZZLE

36 \text{PSO} = \text{PA}
\text{J} = 0
\text{TSO} = 0.833 \times \text{TI}
37 \text{J} = \text{J} + 1
\text{CALL PROCOM} (\text{FAR, TSO, CSO, AK, CP, REX, PHISO, HS0})
\text{RHO} = \text{CAPSF} \times \text{PSO} \div (\text{AJ} \times \text{REX} \times \text{TSO})
\text{VO} = \text{MG} \div (\text{RHO} \times \text{AO})
\text{HSCAL} = \text{HI} - \text{VO} \times 2 \div (2 \times 6 \times \text{AJ})
\text{DELHS} = \text{HSCAL} - \text{HS0}
\text{IF (ABS (DELHS)} - 0.0005 \times \text{HSCAL}) 39,39,38
38 \text{TSO} = \text{TSO} + \text{DELHS} \div \text{CP}
\text{IF (J} = 15) 37,37,3
39 \text{AMV} = \text{VO} \times \text{CS0}
\text{TO} = \text{TI}
\text{HO} = \text{HI}
\text{PO} = \text{PSO} \times \text{TO} \div \text{TSO} \times (\text{AK} \div (\text{AK} - 1)).
\text{SO} = \text{PHII} - \text{REX} \times \text{ALOG} \text{PO}
\text{ICON} = 2
\text{GO TO 10}
END
$\textbf{AFQUIR} \ DECK, M94/2, XR7

SUBROUTINE AFQUIR(X, AIND, DEPEND, ANS, AJ, TOL, DIR, ANEW, ICON)

DIMENSION X(9)

C X(1)=NAME OF ARRAY TO USE
C AIND=DEPENDANT VARIABLE
C DEPEND= DEPENDANT VARIABLE
C ANS=ANSWER UPON WHICH TO CONVERGE
C AJ=MAX NUMBER OF TRIYS
C TOL=PERCENT TOLERANCE FOR CONVERGENCE
C DIR=DIRECTION AND PERCENTAGE FOR FIRST GUESS
C ANEW=CALCULATED VALUE OF NEXT TRY AT INDEPENDANT VARIABLE
C ICON=CONTROL =1 GO THRU LOOP AGAIN
C =2 YOU HAVE REACHED THE ANSWER
C =3 COUNTER HAS HIT LIMITS
C X(2)=COUNTER STORAGE
C X(3)=CHOSES METHOD OF CONVERGENCE
C X(4)=THIRD DEPEND VAR
C X(5)=THIRD IND VAR
C X(6)=SECOND DEPEND VAR...
C X(7)=SECOND IND VAR
C X(8)=FIRST DEPEND VAR
C X(9)=FIRST IND VAR
C X(3) MUST BE ZERO UPON FIRST ENTRY TO ROUTINE

Y=0.

1 DEP=DEPEND-ANS
   TOLANS=TOL=ANS
   GO TO 3
2 DEP=DEPEND
   TOLANS=TOL
   IF(ABS(DEP)-TOLANS)5,5,4
   IF(X(2)=E4)6,8,7
5 ANEW=AIND
   X(2)=0.
   ICON=2
   RETURN

6 AMEN=Y
   X(2)=X(2)+1.
   ICON=1
   RETURN

7 AMEN=Y
   X(2)=0.
   ICON=3
   RETURN

8 IF(X(3)9,9,12
C *** FIRST GUESS USING DIR

9 X(3)=1.
   X(8)=DEP
   X(9)=AIND
   IF(AIND)10,11,10
10 Y=DIR=AIND
   GO TO 6
11 Y=DIR
   GO TO 6

12 IF(X(3)=E1)13,13,16
C *** LINEAR GUESS
13 X(3)=2.
   X(6)=DEP
   X(7)=AIND
   IF(X(8)=X(6))14,9,14
14 IF(X(9)=X(7))*15,9,15
15 A=(X(9)-X(7))/X(8)
16 Y=X(8)-A*X(8)
17 IF(ABS(A)*X(9))=ABS(Y)*9,9,6
C ** QUADRATIC GUESS
18 X(4)=DEP
19 X(5)=AIND
20 IF(X(7)=X(5))18,17,18
21 IF(X(6)=X(4))19,13,19
22 IF(X(9)=X(5))23,20,23
23 IF(X(8)=X(4))21,22,21
24 X(9)=X(7)
25 X(8)=X(6)
26 GO TO 13
27 IF(X(9)=X(7))
28 X(5)=X(6)
29 X(3)=1
30 IF(X(9))10,11,10
31 IF(X(8)=X(4))124,21,24
32 F=(X(6)-X(4))/X(7)-X(5))
33 A=(X(8)-X(4))F=(X(9)-X(5)))/((X(9)-X(7))*X(9)-X(5))
34 B=F-A*X(5)*X(7)
35 C=X(4)+X(5)+A*X(7)-F
36 IF(A<124),240,242
37 IF(B>243),7,241
38 Y=-C/8
39 GO TO 37
40 IF(B>247),243,247
41 IF(C>1245),244,245
42 Y=0
43 GO TO 37
44 G=-C/A
45 IF(G<7,246
46 Y=SQR(T)G
47 Y=SQR(T)G
48 GO TO 270
49 IF(C<1249),248,249
50 Y=-B/A
51 Y=0
52 GO TO 270
53 D=-A*C/B**2
54 IF(D<113),25,26
55 Y=-B/(2*A)
56 GO TO 37
57 E=SQR(T)(A-D)
58 Y=-D/(2*A)=(1+*E)
59 YY=-D/(2*A)*(1+*E)
60 J=4
61 DEPMIN=ABS(X(4))
62 DO 29 I=6,8,2
63 IF(DEPMIN=ABS(X(1))29,29,28
64 J=1
65 DEPMIN=ABS(X(1))
66 CONTINUE
67 K=J+1
68 IF(X(K)-Y#(X(K)-YY))32,32,30
69 IF(ABS(X(K)-Y)=ABS(X(K)-YY))37,37,31
70 Y=YY
71 GO TO 37
72 IF(J=6)33,34,34
AFAPL-TR-67-125
Part II

33 \( JJ=J+2 \)
   \( KK=K+2 \)
   GO TO 35
34 \( JJ=J-2 \)
   \( KK=K-2 \)
35 \[ SLOPE=(X(KK)-X(K))/(X(JJ)-X(J)) \]
   \( IF(SLOPE*X(J)>(X(K)-Y))36,36,37 \)
36 \( Y=YY \)
37 \( X(9)=X(7) \)
   \( X(8)=X(6) \)
   \( X(7)=X(5) \)
   \( X(16)=X(4) \)
   GO TO 6
END
AFAPL-TR-67-125
Part II

SIBFTC FANDAT DECK $\times 94/2 \times 27$

BLOCK DATA

COMMON

$\frac{\text{FAHCN(15),PR(15,15),MAC(15,15),ETA(15,15),NNP(15)}}{1}$

DATA $\frac{\text{NNP(10,6,3)P(7,5,10,8,5,9)}}{0}$

DATA $\frac{\text{CN(0,3,0,0,0,0,0,7,0,8,0,9,1,0,1,1,2,5,0,0)}}{1}$

DATA $\frac{\text{(PR(1,J),MAC(1,J),ETA(1,J),J=1,6))}}{1}$

$\frac{A 1.000}{B 1.070}$

$\frac{C 1.112}{D 1.250}$

$\frac{E 1.100}{F 1.188}$

$\frac{G 1.250}{H 1.600}$

$\frac{I 1.128}{J 2.290}$

$\frac{K 1.370}{L 1.448}$

$\frac{M 1.220}{N 1.400}$

$\frac{O 1.000}{P 1.296}$

$\frac{Q 1.544}{R 1.370}$

$\frac{S 1.448}{T 1.610}$

$\frac{U 1.000}{V 1.400}$

$\frac{W 1.570}{X 1.680}$

$\frac{Y 1.756}{Z 1.400}$

$\frac{A 1.330}{B 1.650}$

$\frac{C 1.828}{D 1.978}$

$\frac{E 1.000}{F 1.338}$

$\frac{G 1.736}{H 2.000}$

$\frac{I 1.120}{J 1.400}$

$\frac{K 1.550}{L 2.000}$

$\frac{M 2.250}{N 2.420}$

$\frac{O 2.420}{P 1.000}$

$\frac{Q 2.250}{R 2.430}$

END
<table>
<thead>
<tr>
<th>DATA</th>
<th>PR(15), MAC(15), ETA(15, 15), N, NP(15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.000, 0.5700, 1.599, 21.1, 0.6000</td>
</tr>
<tr>
<td>B</td>
<td>2.018, 0.6200, 2.335, 20.5, 0.6300</td>
</tr>
<tr>
<td>C</td>
<td>3.024, 0.6500, 3.533, 18.7, 0.6200</td>
</tr>
<tr>
<td>D</td>
<td>4.036, 4.0700, 4.293, 19.7, 0.5100</td>
</tr>
<tr>
<td>E</td>
<td>5.048, 5.0700, 5.298, 20.0, 0.6000</td>
</tr>
<tr>
<td>F</td>
<td>6.060, 6.0700, 6.284, 19.6, 0.6200</td>
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<tr>
<td>G</td>
<td>7.072, 7.0700, 7.282, 20.0, 0.6300</td>
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<tr>
<td>H</td>
<td>8.084, 8.0700, 8.280, 19.7, 0.6100</td>
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<tr>
<td>I</td>
<td>9.096, 9.0700, 9.280, 19.6, 0.6300</td>
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<tr>
<td>J</td>
<td>10.108, 10.0700, 10.279, 20.0, 0.6700</td>
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<tr>
<td>K</td>
<td>11.120, 11.0700, 11.279, 20.0, 0.6300</td>
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<tr>
<td>L</td>
<td>12.132, 12.0700, 12.279, 20.0, 0.6100</td>
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<tr>
<td>M</td>
<td>13.144, 13.0700, 13.279, 20.0, 0.6200</td>
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<tr>
<td>N</td>
<td>14.156, 14.0700, 14.279, 20.0, 0.6300</td>
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<tr>
<td>O</td>
<td>15.168, 15.0700, 15.279, 20.0, 0.6700</td>
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<tr>
<td>P</td>
<td>16.180, 16.0700, 16.279, 20.0, 0.6300</td>
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<tr>
<td>Q</td>
<td>17.192, 17.0700, 17.279, 20.0, 0.6100</td>
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<tr>
<td>R</td>
<td>18.204, 18.0700, 18.279, 20.0, 0.6200</td>
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<tr>
<td>S</td>
<td>19.216, 19.0700, 19.279, 20.0, 0.6300</td>
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<td>T</td>
<td>20.228, 20.0700, 20.279, 20.0, 0.6700</td>
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<tr>
<td>U</td>
<td>21.240, 21.0700, 21.279, 20.0, 0.6300</td>
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<tr>
<td>V</td>
<td>22.252, 22.0700, 22.279, 20.0, 0.6100</td>
</tr>
<tr>
<td>W</td>
<td>23.264, 23.0700, 23.279, 20.0, 0.6200</td>
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<tr>
<td>X</td>
<td>24.276, 24.0700, 24.279, 20.0, 0.6300</td>
</tr>
</tbody>
</table>

END
$IBFTC CMBDAT DECK,M94/2,XR7

BLOCK DATA
COMMEN / COMB/PSI(15),DELT(15,15),ETA(15,15),N,KP(15)
DATA N,KP/8,8*11,7*0/
DATA PSI/10,20,30,40,50,60,70,80,90,100/
DATA DELT/15*800,15*900,15*975,15*1175,15*1260,15*1325,15*1450,15*1550,15*1685,15*1800,15*60,0,0/
DATA ETA/
BG,8600,0.8820,0.9020,0.9200,0.9360,0.9500,0.9600,0.9500,7*0,*
CG,8783,0.8996,0.9183,0.9347,0.9489,0.9615,0.9710,0.9787,7*0,*
DG,8889,0.9100,0.9282,0.9435,0.9573,0.9694,0.9782,0.9850,7*0,*
EG,9000,0.9200,0.9372,0.9520,0.9653,0.9769,0.9850,0.9850,7*0,*
FG,9080,0.9272,0.9444,0.9587,0.9718,0.9830,0.9850,0.9850,7*0,*
GG,9100,0.9290,0.9460,0.9610,0.9740,0.9840,0.9850,0.9850,7*0,*
HG,9087,0.9275,0.9448,0.9600,0.9733,0.9840,0.9850,0.9850,7*0,*
IG,9000,0.9195,0.9376,0.9543,0.9699,0.9800,0.9850,0.9850,7*0,*
JG,8886,0.9090,0.9284,0.9470,0.9630,0.9750,0.9850,0.9850,7*0,*
KG,8660,0.8890,0.9110,0.9328,0.9515,0.9672,0.9792,0.9850,7*0,*
LG,8400,0.8670,0.8930,0.9180,0.9400,0.9600,0.9730,0.9800,7*0,*
M,*4*0,*4*0,*4*0,*4*0,*4*0,*4*0,*4*0,*4*0,*28*0,*
END
SIBFTC HPTDAT DECK,M94/2,XR7

<table>
<thead>
<tr>
<th>Block</th>
<th>Data Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMMON</td>
<td>HTRB/TFFF(15),CN(15,15),DH(15,15),ETA(15,15),N,NP(15)</td>
</tr>
<tr>
<td>DATA N,NP/10,9915,12,500/</td>
<td></td>
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<tr>
<td>DATA TFF/</td>
<td>16.86,18.27,20.17,20.66,20.90</td>
</tr>
<tr>
<td>DATA (1,1),DH(1,1),ETA(1,1)/</td>
<td>A0.191,0.0029,0.6150,0.346,0.0051,0.7000</td>
</tr>
<tr>
<td>B0.526,0.0310,0.7760,0.727,0.0097,0.8000</td>
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</tr>
<tr>
<td>C0.957,0.0120,0.8000,1.167,0.0137,0.7875</td>
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<tr>
<td>D1.340,0.0148,0.7692,1.569,0.0157,0.7340</td>
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<tr>
<td>E1.761,0.0161,0.7000,1.971,0.0158,0.7550</td>
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<tr>
<td>F2.193,0.0150,0.6000,2.454,0.0130,0.5250</td>
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<tr>
<td>G2.641,0.0108,0.4720,2.842,0.0074,0.4000</td>
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<tr>
<td>H3.005,0.0031,0.3000</td>
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<tr>
<td>DATA (3,1),DH(3,1),ETA(3,1)/</td>
<td>Q0.191,0.0303,0.3000,0.4002,0.0072,0.7000</td>
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<tr>
<td>R0.670,0.0130,0.8000,0.890,0.0166,0.8400</td>
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<tr>
<td>S1.091,0.0194,0.8448,1.263,0.0216,0.8420</td>
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<td>T1.493,0.0241,0.8400,1.722,0.0263,0.8315</td>
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<td>U2.009,0.0254,0.8170,2.358,0.0298,0.8000</td>
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<td>V2.603,0.0310,0.7495,2.861,0.0311,0.7000</td>
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<td>W3.100,0.0306,0.6578,3.330,0.0292,0.6000</td>
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<tr>
<td>X3.445,0.0281,0.5800</td>
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<tr>
<td>DATA (4,1),DH(4,1),ETA(4,1)/</td>
<td>Y0.191,0.0047,0.5580,0.260,0.0061,0.6000</td>
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<tr>
<td>Z0.488,0.0108,0.7000,0.708,0.0148,0.8000</td>
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<tr>
<td>A0.933,0.0184,0.8400,1.167,0.0220,0.8500</td>
<td></td>
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<tr>
<td>B1.252,0.0252,0.8500,1.593,0.0274,0.8480</td>
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<tr>
<td>C1.837,0.0302,0.8440,2.019,0.0320,0.8400</td>
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<tr>
<td>D2.325,0.0349,0.8270,2.564,0.0371,0.8170</td>
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<tr>
<td>E2.890,0.0397,0.8000,3.205,0.0475,0.7710</td>
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<tr>
<td>F3.445,0.0445,0.7500</td>
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<tr>
<td>DATA (5,1),DH(5,1),ETA(5,1)/</td>
<td>G0.191,0.0050,0.5500,0.306,0.0079,0.6000</td>
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74
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|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0.191 | 0.0072 | 0.5005 | 0.440 | 0.0148 | 0.6000 | 0.0698 | 0.0212 | 0.7000 | 0.976 | 0.0277 | 0.8000 | 0.1225 | 0.0335 | 0.8400 | 1.411 | 0.0374 | 0.8600 | 0.541 | 0.0403 | 0.8700 | 1.651 | 0.0428 | 0.8800 | 0.780 | 0.0459 | 0.8855 | 1.899 | 0.0490 | 0.8900 | 0.995 | 0.0518 | 0.6910 | 2.040 | 0.0540 | 0.8900 | 0.086 | 0.0562 | 0.8880 | 2.124 | 0.0594 | 0.8826 | 0.143 | 0.0630 | 0.8695 | / |

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|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0.191 | 0.0079 | 0.4995 | 0.493 | 0.0176 | 0.6000 | 0.746 | 0.0245 | 0.7000 | 0.899 | 0.0284 | 0.7580 | 0.043 | 0.0320 | 0.8000 | 1.167 | 0.0353 | 0.8200 | 0.306 | 0.0389 | 0.8400 | 1.397 | 0.0414 | 0.8500 | 0.493 | 0.0439 | 0.8600 | 1.627 | 0.0475 | 0.8710 | 0.708 | 0.0504 | 0.8750 | 1.780 | 0.0536 | 0.8750 | 0.837 | 0.0576 | 0.8690 | 1.852 | 0.0598 | 0.8600 | 0.856 | 0.0624 | 0.8495 | / |

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**AFAPL-TR-67-125**  
Part II

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ZF
PHE
WAF
PCNC
CMC
ZC
PRC
WACC
MAC
T2
T21
P21
T3
P3
PCRLF
RLE:
PCBLC
BLG
PCBLOG
BLOR
PCBLHP
BLHP
PCBLLP
BLLP
T4
P4
M45
MFB
WGA
FAR4
ETAB
DPCOM
TTFHP
CNHP
DHTCHP
DHTC
TS
PS
TFELP
CNLP
DHTCLP
DHTF
TS5
P55
PCBLDU
BLDU
T24
P24
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WFD
WZ24
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DPDUC
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SLS MILITARY

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SLS MILITARY

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SUPERSONIC AT MILITARY POWER
$D$ATAIN $T_4=2400.0, AM=1.6, ALTP=50000.0, TITLE=1$
SET-UP SUPERSONIC WITH AFTERBURNER
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SUPERSONIC FULL A/B
$E$EOF
This report describes a digital computer program titled SMOTE (Simulation of Turbofan Engine). SMOTE is a computer program for balancing-cycle turbofan engines capable of running both design and off-design points. The program is written in Fortran IV language and was designed for use on an IBM 7090 Digital Computer, although it has also been run on an IBM System 360. Performance maps (Block Data format) of the major engine components are required. Information for setting up the Block Data and input data is given in the report. Also included in the report is a complete program listing with a description of each subroutine and a sample data pack.

(Distribution of the abstract is unlimited.)
Turbine Engine Simulation
Turbine Engine Computer Programs
Turbine Engine Cycle Analysis

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