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AFAPL-TR-67-125
PART II

AD825198

SIMULATION OF TURBOFAN ENGINE

PART II. USER'S MANUAL AND COMPUTER PROGRAM LISTING

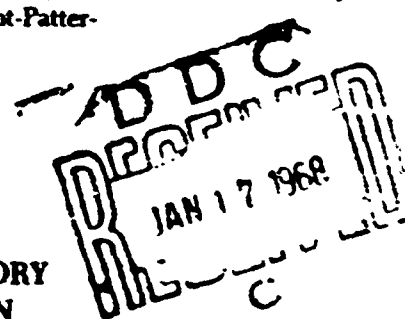
JOHN S. McKINNEY, CAPTAIN, USAF

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

NOVEMBER 1967

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**AIR FORCE AERO PROPULSION LABORATORY
RESEARCH AND TECHNOLOGY DIVISION
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PART II

SIMULATION OF TURBOFAN ENGINE

PART II. USER'S MANUAL AND COMPUTER PROGRAM LISTING

JOHN S. McKINNEY, CAPTAIN, USAF

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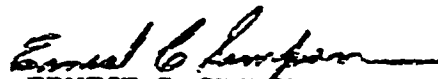
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FOREWORD

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

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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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SYMBOLS

STATION NUMBERS

1	ambient
2	fan entrance
21	fan exit/compressor and duct entrance
3	compressor exit/burner entrance
4	burner exit/hi pressure turbine entrance
5	hi press. turbine exit/lo press. turbine entrance
55	lo press. turbine exit
6	afterburner entrance
7	afterburner exit
8	main nozzle throat
9	main nozzle exit
23	duct burner entrance
24	duct burner exit
25	duct exit (if mixed-flow engine)
28	duct nozzle throat
29	duct nozzle exit

THERMODYNAMIC PROPERTIES

T	total temperature (degrees R)
H	total enthalpy
P	total pressure (atmospheres)
S	total entropy
TS	static temperature (degrees R)
PS	static pressure (atmospheres)
FAR	fuel-air ratio
AM	Mach number
V	velocity (feet/second)

COMPONENT SYMBOLS

F	fan
C	compressor
B	burner
COM	burner
THP	hi pressure turbine
TLP	lo pressure turbine
A	afterburner
AFT	afterburner
D	duct
DUC	duct
M	main nozzle
NOZ	nozzle
OB	overboard
T	total

ENGINE SYMBOLS

ETAR	ram recovery
CN	corrected speed ratio
PCN	percent speed
PR	pressure ratio
Z	pressure-ratio ratio
ETA	efficiency
TFF	turbine flow function
DRTC	turbine delta enthalpy (temperature corrected)
DET	turbine delta enthalpy
WA	air flow (pounds/sec)
WF	fuel flow (pounds/sec)
WG	gas flow (pounds/sec)
PCBL	percent bleed
BL	bleed (pounds/sec)
HPEXT	horsepower extracted

SYMBOLS (CONT)

DP	pressure drop
DT	temperature increase

MISCELLANEOUS

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

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 air-flow (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

$$TFF = \frac{WG \sqrt{T_{IN}}}{P_{IN}}$$

$$CN = \frac{PCNC}{\sqrt{T_{IN}}}$$

$$DH = \frac{H_{IN} - H_{OUT}}{T_{IN}}$$

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 IAFBN 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 loop matrix.
MATRX	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.
ATM062	1962 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 WFB 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 or W/FD 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 commons FRONT and SIDE to common BACK.

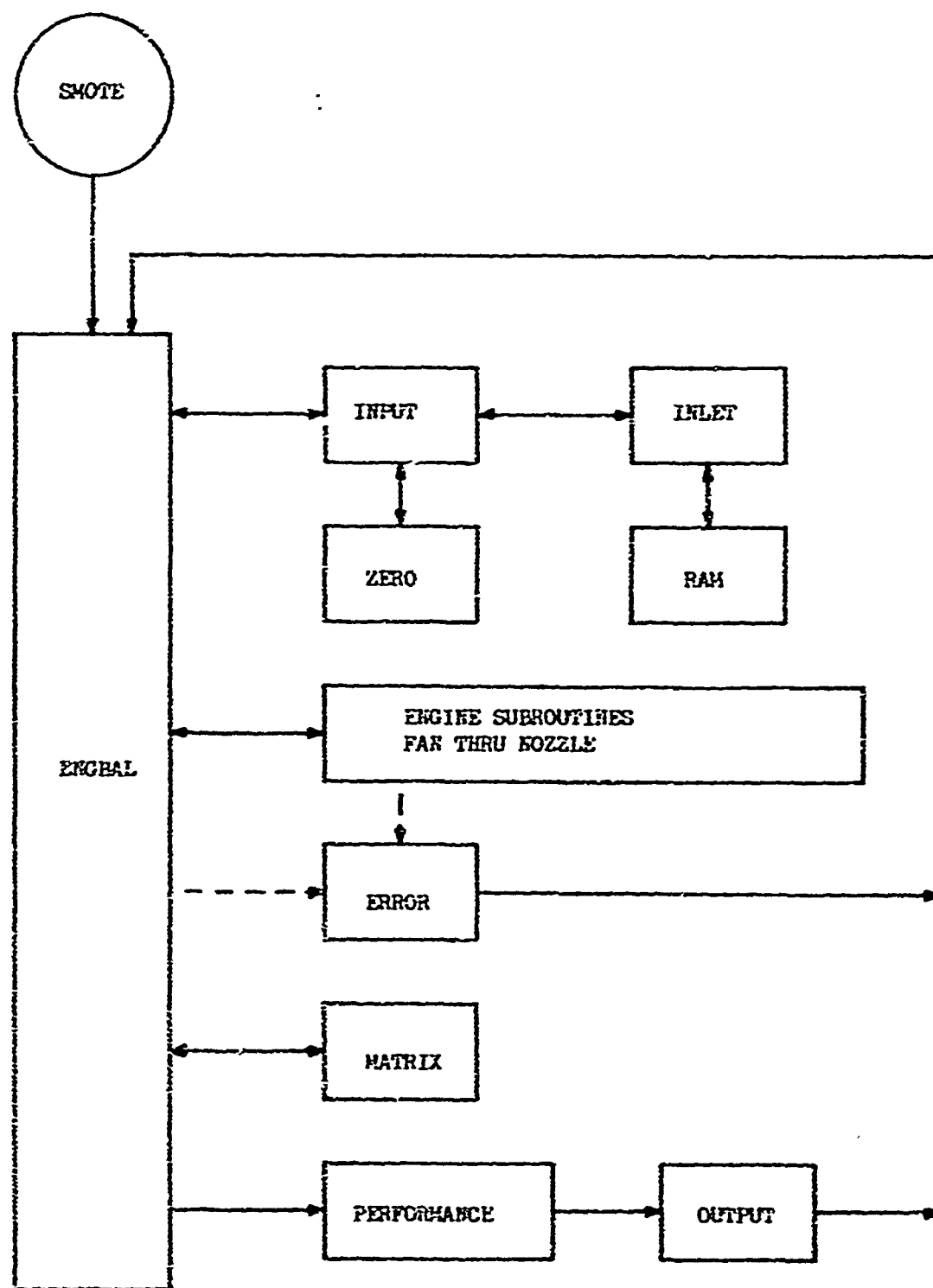


Figure 1. SMOTE Subroutine Flow Chart

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COMIX	Performs gas-mixing calculations if in mixed-flow mode. At design points it calculates areas from either an input static pressure (PS55) or an input Mach number (AM55) if PS55 = 0. At off-design points it calculates static pressures and Mach numbers from the design areas. Calculates ERR(5).
COAFBN	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.
AFQUIR	General quadratic interpolation routine.

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FANDAT	Block Data for fan.
CMPDAT	Block Data for compressor.
CMBDAT	Block Data for combustor.
HPTDAT	Block Data for high pressure turbine.
LPTDAT	Block Data for low pressure turbine.

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.

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```
91BFTC SHOTE  DECK,M94/2,XR7  
COMMON /POINT/IDATPT  
IDATPT=0  
CALL COMOUT(1)  
CALL ENGBAL  
STOP  
END
```

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```

$IFTC ENGBAL DECK,M94/2,XR7
SUBROUTINE ENGBAL
COMMON / ALL/
1WORD ,IDES ,JDES ,KDES ,MODE ,INIT ,IDUMP ,IAMTP ,
2IGASHX ,IDBURN ,IAFTBN ,IDCD ,IMCD ,IDSHOC ,IMSHOC ,NOZFLT ,
3ITRYS ,LOOPER ,NOMAP ,NUMMAP ,MAPEDG ,TOLALL ,ERR(6)
COMMON / DESIGN/
1PCNFGU ,PCNCGU ,T4GU ,DUMD1 ,DUMD2 ,DELF6 ,DELSN ,DELSFC ,
2ZFDS ,PCNFDS ,PKFDS ,ETAFDS ,WAFDS ,PRFCF ,ETAFCF ,WAFCF ,
3ZCDS ,PCNCDS ,PRCDS ,ETACDS ,WACDS ,PRCCF ,ETACCF ,WACCF ,
4T4DS ,WFBDS ,DTCCDS ,ETABDS ,WA3CDS ,DPCDS ,DTCCCF ,ETABCF ,
5TFHPDS ,CNHPDS ,ETHPDS ,TFHPCF ,CNHPCF ,ETHPCF ,DHHPCF ,T2DS ,
6TFLPDS ,CNLPDS ,ETLPDS ,TFLPCF ,CNLPCF ,ETLPCF ,DHLPCF ,T2IDS ,
7T2DS ,WFDS ,DTDDDS ,ETADDS ,WA23DS ,DPDUS ,DTDUCF ,ETADCF ,
8T7DS ,WFADS ,DTAFDS ,ETAADS ,WG6CDS ,DPAFDS ,DTAFCF ,ETAACF ,
9A55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A28 ,A29 ,
AP55 ,AM55 ,CVDNOZ ,CVHNUZ ,ABSAV ,A9SAV ,A28SAV ,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 ,BL0B ,
5CNF ,PRF ,ETAF ,WAF ,WAF ,WA3 ,WG4 ,FAR4 ,
6CNC ,PRC ,ETAC ,WACC ,WAC ,ETAB ,DPCOM ,DUMF ,
7CNHP ,ETATHP ,DHTCMP ,DHTC ,BLHP ,WG5 ,FAR5 ,CS ,
8CNLP ,ETATLP ,DHTCLP ,DHTF ,BLLP ,WG55 ,FAR55 ,HPEXT ,
9AM ,ALTP ,ELAR ,ZF ,PCNF ,ZC ,PCNC ,WFB ,
ATFFHP ,TFFLP ,PCBLF ,PC8LC ,PCBLDU ,PC8L0B ,PCBLHP ,PC8LLP
COMMON / SIDE/
XXP1 ,XWAF ,XWAC ,XBLF ,XBLDU ,XH3 ,DUMS1 ,DUMS2 ,
XXT21 ,XP21 ,XH21 ,XS21 ,T23 ,P23 ,H23 ,S23 ,
3T24 ,P24 ,H24 ,S24 ,T25 ,P25 ,H25 ,S25 ,
4T28 ,P28 ,H28 ,S28 ,T29 ,P29 ,H29 ,S29 ,
5WAD ,WFD ,WG24 ,FAR24 ,ETA0 ,DPDUC ,BYPASS ,DUMS3 ,
6TS28 ,PS28 ,V28 ,AM28 ,TS29 ,PS29 ,V29 ,AM29
COMMON / BACK/
XXT55 ,XP55 ,XH55 ,XS55 ,XT25 ,XP25 ,XH25 ,XS25 ,
XXWFB ,XWG55 ,XFAR55 ,XWFD ,XWG24 ,XFAR24 ,XXP1 ,DUM8 ,
3T6 ,P6 ,H6 ,S6 ,T7 ,P7 ,H7 ,S7 ,
4T8 ,P8 ,H8 ,S8 ,T9 ,P9 ,H9 ,S9 ,
5WG6 ,WFA ,WG7 ,FAR7 ,ETAA ,DPAFT ,V55 ,V25 ,
6PS6 ,V6 ,AM6 ,TS7 ,PS7 ,V7 ,AM7 ,AM25 ,
7TS8 ,PS8 ,V8 ,AM8 ,TS9 ,PS9 ,V9 ,AM9 ,
8VA ,FRD ,VJD ,FGMD ,VJM ,FGMM ,FGPD ,FGPM ,
9FGM ,FGP ,WFT ,WGT ,FART ,FG ,FN ,SFC
DIMENSION VAR(6),DEL(6),EFRB(6),DELVAR(6),EMAT(6,6),VMAT(6),
IAMAT(6)
DATA AMOKD/6HENGBAL/
CALL INPUT
IF(INIT.EQ.1) GO TO 50
TFFHP=YFHPDS
TFFLP=TFLPDS
50 LOOPER=0
NUMMAP=0
1 LOOP=0
NOMAP=0
ISO=2
DO 2 I=1,6
VMAT(I)=0.
AMAT(I)=0.
DELVAR(I)=0.

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```

      DO 2 I=1,6
2      EMAT(I,L)=0.
3      LOOPER=LOOPER+1
      CALL COFAN
      WUKD=AYURG
      IF(LOOPER.GT.ITRYS) GO TO 18
      IF(NOMAP.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 ERKUR
5      IF(LOOP.GT.0) GO TO 7
      MAPEOG=0
      MAPSET=0
      DO 6 I=1,6
      ERKB(I)=ERR(I)
6      DEL(I)=0.001*VAR(1)
      GO TO 9
7      IF(MAPEOG.EQ.0) GO TO 70
      MAPEOG=0
      MAPSET=1
      VAR(LOOP)=VAR(LOOP)+2.*DEL(LOOP)
      GO TO 10
70     IF(MAPSET.EQ.0) VAR(LOOP)=VAR(LOOP)+DEL(LOOP)
      IF(MAPSET.EQ.1) VAR(LOOP)=VAR(LOOP)-DEL(LOOP)
      MAPSET=0
      DO 8 I=1,6
8      EMAT(I,LOOP)=(ERKB(I)-ERR(I))/DEL(LOOP)
9      LOOP=LOOP+1
      IF(LOOP.GT.6) GO TO 11
      VAR(LOOP)=VAR(LOOP)-DEL(LOOP)
10     ZF=VAR(1)/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(ZF.LT.0.) ZF=0.05
      IF(ZC.LT.0.) ZC=0.05
      GO TO (1,3),160
11     DO 12 I=1,6
12     AMAT(I)=-ERKB(I)
      DO 14 I=1,6
      IZERO=0
      DO 13 LOOP=1,6
13     IF(EMAT(I,LOOP).EQ.0.) IZERO=IZERO+1
      IF(IZERO.LT.6) GO TO 14
      WRITE(6,100)I
      LOOPER=ITRYS+100
      GO TO 18
14     CONTINUE
      DO 16 LOOP=1,6

```

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      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
      LOOPER=ITRYS+100
      GO TO 18
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))
17     DELVAR(LOOP)=0.05*VAR(LOOP)*DELVAR(LOOP)/ABS(DELVAR(LOOP))
      VAR(LOOP)=VAR(LOOP)+DELVAR(LOOP)
18     WRITE(8,102) LOOPER
      DO 19 I=1,6
19     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
      IGO=1
      IF (LOOPER.LT.ITRYS) GO TO 10
      CALL ERROR
      RETURN
100    FORMAT(4HROW,I2,16H IS ZERO IN EMAT)
101    FORMAT(7HCOLUMN,I2,16H IS ZERO IN EMAT)
102    FORMAT(8H8   ERRB,28X23HERROR MATRIX AFTER LOOP,14,29X4HVMAT,
16X6HDELVAR,7X14HVARIALES$$$$$$)
103    FORMAT(1H0,F8.4,8X6F10.4,10XF10.4,F11.4,4XF11.4,6H$$$$$$):
104    FORMAT(1H0,F8.4,32X14HAVERAGE VALUES,42XF11.4,6H$$$$$$)
      END

```

```

SIBFTC MATRIX DECK,M94/2,XR7
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))
  IPIV=J
2  CONTINUE
  IPI=I+1
DO 3 J=IPI,7
3  PIV(J)=T(IPIV,J)/T(IPIV,I)
  IFROM=6
  ITO=6
4  IF(IFROM.EQ.IPIV) GO TO 6
  RM=-T(IFROM,I)
DO 5 J=IPI,7
5  T(ITO,J)=T(IFROM,J)+RM*PIV(J)
  ITO=IT0-1
6  IFROM=IFROM-1
  IF(IFROM.GE.1) GO TO 4
DO 7 J=IPI,7
7  T(I,J)=PIV(J)
DO 8 I=1,5
  J=7-I
  K=6-I
DO 8 L=J,6
8  T(K,7)=T(K,7)-T(K,L)*T(L,7)
DO 9 I=1,6
9  V(I)=T(I,7)
RETURN
END

```

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$IBFTC INPUT  DECK,M94/2,XR7
SUBROUTINE INPUT
COMMON /POINT/IDATPT
COMMON / ALL/
1WORD ,IDES ,JDES ,KDES ,MODE ,INIT ,IDUMP ,IAMTP ,
2IGASHX,IDBURN,IAFTBN,IDCD ,IMCD ,IDSHOC,IMSHUC,NOZFLT,
3ITRYS ,LOOPER,NOMAP ,NUMMAP,MAPEUG,TOLALL,ERR(6)
COMMON /DESIGN/
1PCNFGU,PCNCGU,T4GU ,DUMD1 ,DUMD2 ,DELFG ,DELFP ,DELSFC,
2ZFDS ,PCNFDS,PRFDS ,ETAFDS,MAFDS ,PRFCF ,ETAFCF,MAFCF ,
3ZCDS ,PCNCDS,PRCDS ,ETACDS,WACDS ,PRCCF ,ETACCF,WACCF ,
4T4DS ,WFBDS ,DTCDS,ETABDS,WA3CDS,DPCDS,DTCOCF,ETABCF,
5TFHPDS,CNHPDS,ETHPDS,TFHPCF,CNHPCF,ETHPCF,DHHPCF,T2DS ,
6TFLPDS,CNLPDS,ETLPDS,TFLPCF,CNLPKF,ETLPKF,DHLPKF,T2IDS ,
7T24DS ,WFDDDS ,DTDDDS,ETADDS,WA23DS,DPODUS,DTDDCF,ETADCF,
8T7DS ,WFADS ,DTAFDS,ETAADS,WG6CDS,DPAFDS,DTAFCF,ETAACF,
9A55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A28 ,A29 ,
APSSS ,AM55 ,CVUNDZ,CVMNUZ,ABSAV ,A9SAV ,A2BSAV,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 ,BLUB ,
5CNF ,PRF ,ETAF ,MAFC ,WAF ,WAB ,WGA ,FAR4 ,
6CNC ,PRC ,ETAC ,WACC ,WAC ,ETAB ,DPCOM ,DUMF ,
7CNHP ,ETATHP,DHTCHP,DHTC ,BLHP ,WGS ,FAR5 ,CS ,
8CNLP ,ETATLP,DHTCLP,DHTF ,BLLP ,WGS5 ,FAR55 ,HPEXT ,
9AM ,ALTP ,ETAR ,ZF ,PCNF ,ZC ,PCNC ,WFB ,
ATFFHP ,TFFLP ,PCBLF ,PCBLC ,PCBLDU,PCBLOS,PC LAP,PCBLLP
COMMON / SIDE/
XXP1 ,XAF ,XWAC ,XBLF ,XBLDU ,XH3 ,DUMS1 ,DUMS2 ,
XXT21 ,XP21 ,XH21 ,XS21 ,T23 ,P23 ,H23 ,S23 ,
3T24 ,P24 ,H24 ,S24 ,T25 ,P25 ,H25 ,S25 ,
4T28 ,P28 ,H28 ,S28 ,T29 ,P29 ,H29 ,S29 ,
5WAD ,WFD ,WG24 ,FAR24 ,ETAD ,DPOUC ,BYPASS,DUMS3 ,
6TS28 ,PS28 ,V28 ,AM28 ,TS29 ,PS29 ,V29 ,AM29
COMMON / BACK/
XXT55 ,XP55 ,XH55 ,XS55 ,XT25 ,XP25 ,XH25 ,XS25 ,
XXWF8 ,XWG55 ,XFAR55,XWFD ,XWG24 ,XFAR24,XXP1 ,DUMB ,
3T6 ,P6 ,H6 ,S6 ,T7 ,P7 ,H7 ,S7 ,
4T8 ,P8 ,H8 ,S8 ,T9 ,P9 ,H9 ,S9 ,
5WG6 ,WFA ,WG7 ,FAR7 ,ETAA ,DPAFT ,V55 ,V25 ,
6PS6 ,V6 ,AM6 ,TS7 ,PS7 ,V7 ,AM7 ,AM25 ,
7TS8 ,PS8 ,V8 ,AM8 ,TS9 ,PS9 ,V9 ,AM9 ,
8VA ,FRD ,VJD ,FGMD ,VJM ,FGMM ,FGPD ,FGPM ,
9FGM ,FGP ,WFT ,WGT ,FART ,FG ,FM ,SFC
NAMELIST /DATAIN/
A1TITLE,IDES ,MODE ,INIT ,IDUMP ,IAMTP ,IGASHX,
IDBURN,IAFTBN,IDCD ,IMCD ,NOZFLT,ITRYS ,TOLALL,
CZFDS ,PCNFDS,PRFDS ,ETAFDS,MAFDS ,PRFCF ,ETAFCF,MAFCF ,
DZCDS ,PCNCDS,PRCDS ,ETACDS,WACDS ,PRCCF ,ETACCF,WACCF ,
ET4DS ,WFBDS ,DTCDS,ETABDS,WA3CDS,DPCDS,DTCOCF,ETABCF,
FTFHPDS,CNHPDS,ETHPDS,TFHPCF,CNHPCF,ETHPCF,DHHPCF,T2DS ,
GTFLPDS,CNLPDS,ETLPDS,TFLPCF,CNLPKF,ETLPKF,DHLPKF,T2IDS ,
HT24DS ,WFDDDS ,DTDDDS,ETADDS,WA23DS,DPODUS,DTDDCF,ETADCF,
IT7DS ,WFADS ,DTAFDS,ETAADS,WG6CDS,DPAFDS,DTAFCF,ETAACF,
J55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A28 ,A29 ,
KT2 ,P2 ,T4 ,ZF ,PCNF ,ZC ,PCNC ,
LWFB ,TFFHP ,TFFLP ,AM ,ALTP ,ETAR ,HPEXT ,
MPCBLF ,BLF ,PCBLC ,BLC ,PCBLDU,BLDU ,PCBLOS,BLOS ,
NPCBLHP,BLHP ,PCBLLP,BLLP ,

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Part II

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      UPS55 ,AM55 ,T24 ,ETAD ,WFD ,
      PT7 ,ETAA ,WFA ,CVDNOZ,CVMNOZ,DELF5 ,DELFN ,DELSFC
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 WFB
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 P1
C *** IAMTP =3 WILL USE P2 AND STANDARD T1
C *** IAMTP =4 WILL USE T2 AND P2
C *** IGASHX=-1 SEPARATE FLOW, INPUT A6
C *** IGASHX=0 SEPARATE FLOW, A6=A55
C *** IGASHX=1 WILL MIX DUCT AND MAIN STREAMS, A6=A25+A55
C *** IGASHX=2 WILL MIX DUCT AND MAIN STREAMS, INPUT A6
C *** IDURN=1 FOR DUCT BURNING, INPUT T24
C *** IDURN=2 FOR DUCT BURNING, INPUT WFD
C *** IAFTBN=1 FOR AFTERBURNING, INPUT T7
C *** IAFTBN=2 FOR AFTERBURNING, INPUT WFA
C *** IDCU =1 DUCT NOZZLE WILL BE C-D
C *** IMED =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 NOZZLES
C *** ITRYS =N NUMBER OF PASSES THRU ENGINE BEFORE QUITTING
      DIMENSION TITLE(12)
      DATA AWORD/6H INPUT/
      IDATPT=IDATPT+1
      PRINT 100, IDATPT
      CALL ZERO
      WORD=AWORD
      READ(5,DATAIN)
      IF((IAFTBN.GT.0.OR.IDURN.GT.0) .AND. INIT=1)
      IF((ITITLE.EQ.1) .AND. READ(5,101) TITLE)
      ITITLE=0
      WRITE(6,102) TITLE
      IF(MODE.EQ.0) WRITE(8,103) IDES,AM,ALTP,T4 ,T24,T7
      IF(MODE.EQ.1) WRITE(8,104) IDES,AM,ALTP,PCNC,T24,T7
      IF(MODE.EQ.2) WRITE(8,105) IDES,AM,ALTP,WFB ,T24,T7
      CALL CUINLT
      RETURN
100  FORMAT(11H DATA POINT,13)
101  FORMAT(12A6)
102  FORMAT(1H1,30X12A6)
103  FORMAT(1H0,7H IDES=,13,10X7H AM=,F7.3,6X7H ALTP=,F7.0,
16X7H T4=,F8.2,5X7H T24=,F8.2,5X7H T7=,F8.2,6HSS$2SS)
104  FORMAT(1H0,7H IDES=,13,10X7H AM=,F7.3,6X7H ALTP=,F7.0,
16X7H PCNC=,F8.3,5X7H T24=,F8.2,5X7H T7=,F8.2,6HSS$2SS)
105  FORMAT(1H0,7H IDES=,13,10X7H AM=,F7.3,6X7H ALTP=,F7.0,
16X7H WFB=,F8.4,5X7H T24=,F8.2,5X7H T7=,F8.2,6H$2SS$2SS)
      END

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Part II

SIBFTC ZERO DECK, H94/2, XN7

SUBROUTINE ZERU

COMMON / ALL/

1WORD ,ID23 ,JDES ,KDES ,MODE ,INIT ,IDUMP ,IANTP ,
2IGASMX ,IDBURN ,IAFTBN ,IDCG ,IMCU ,IDSHUC ,IMSHUC ,AUZFLT ,
3ITRYS ,LGOPEP ,NUMAP ,NUMKAP ,MAPEDG ,TUI ALL ,ERR (6)

COMMON / FRONT/

1T1 ,P1 ,H1 ,S1 ,T2 ,P2 ,H2 ,S2 ,
2T71 ,P21 ,H21 ,S21 ,T3 ,P3 ,H3 ,S3 ,
3T4 ,P4 ,H4 ,S4 ,T5 ,P5 ,H5 ,S5 ,
4T55 ,P55 ,H55 ,S55 ,BLF ,BLC ,BLDU ,BLU9 ,
5CNF ,PRF ,ETAF ,WAF ,WAF ,WAF ,WAF ,WAF ,
6CNC ,PNC ,ETAC ,WACC ,WAC ,WAC ,WAC ,WAC ,
7CNHP ,ETATMF ,DHTCHP ,DHTC ,BLHP ,WGS ,FAR5 ,US ,
8CNLP ,ETATLP ,DHTCLP ,DHTF ,ULLP ,WGS5 ,FAR55 ,HPEXT ,
9AM ,ALTP ,ETAR ,ZF ,PCNF ,ZC ,PCNC ,WFB ,
ATFFHP ,TFFLP ,PC2LF ,PCBLC ,PCB1DU ,PCBLOB ,PCBLHP ,PCBLLP

COMMON / SIDE/

XXP1 ,XWAF ,XWAC ,XBLF ,XBLDU ,XH3 ,DUMS1 ,DUMS2 ,
XXT21 ,XP21 ,XH21 ,XS21 ,T23 ,P23 ,H23 ,S23 ,
3T24 ,P24 ,H24 ,S24 ,T25 ,P25 ,H25 ,S25 ,
4T26 ,P26 ,H26 ,S26 ,T29 ,P29 ,H29 ,S29 ,
5WAD ,WFD ,WGS24 ,FAR24 ,ETAD ,DFDUC ,CYPASS ,CUMS3 ,
6TS28 ,PS28 ,V28 ,AH28 ,TS29 ,PS29 ,V29 ,AH29

COMMON / BACK/

XXT55 ,XP55 ,XH55 ,XS55 ,XT25 ,XP25 ,XH25 ,XS25 ,
XXNFB ,XWGS5 ,XFAR55 ,XWFD ,XWGS24 ,XFAR24 ,XXP1 ,DUMB ,
3T6 ,P6 ,H6 ,S6 ,T7 ,P7 ,H7 ,S7 ,
4T8 ,P8 ,H8 ,S8 ,T9 ,P9 ,H9 ,S9 ,
5WGS ,WFA ,WGS7 ,FAR7 ,ETAA ,DPAFT ,V55 ,V25 ,
6FS6 ,V6 ,AH6 ,TS7 ,PS7 ,V7 ,AH7 ,AH25 ,
7TSR ,PS8 ,V8 ,AH8 ,TS9 ,PS9 ,V9 ,AH9 ,
8VA ,FRD ,VJD ,FGMD ,VJM ,FGMM ,FGPD ,FGPM ,
9FGM ,FGP ,WFT ,WST ,FART ,FG ,FN ,SFC

DIMENSION 21(53), 22(48), 23(72)

EQUIVALENCE (21, T1), (22, XP1), (23, XT55)

IDES=0

JDES=0

INIT=0

IDBURN=0

IAFTBN=0

IDSHUC=3

IMSHUC=3

T2Q=T2

P29=P2

T4Q=T4

DO 1 I=1,53

1 21(I)=0.

DO 2 I=1,48

2 22(I)=0.

DO 3 I=1,72

3 23(I)=0.

T2=T2Q

Q2=P2Q

T4=T4Q

CALL SYG(1)

RETURN

END

APAFI-TR-57-125
Part II

```

SIBFTE COINLT DECK,M94/2,XR7
SUBROUTINE COINLT
COMMON / ALL/
INORD ,IDES ,JDES ,KDES ,MODE ,INIT ,IDUMP ,IAMTP ,
ZIGASHZ ,IDSRUN ,IAFTBN ,IDCD ,INCD ,IDSHOC ,IMSHOC ,NOZFLT ,
BITRYS ,LOOPER ,NOMAP ,NUMMAP ,RAPEUG ,TOLALL ,ERR(6)
COMMON / DESIGN/
IPCNFGU ,PCNFGU ,T4GU ,DUMD1 ,DUMD2 ,DELFG ,DELFN ,DELSFC ,
Z2FDS ,PCNFDS ,PRFDS ,ETAFDS ,WAFDS ,PRFCF ,ETAFCF ,WAFCF ,
Z2CDS ,PCNCDS ,PCDCS ,ETACDS ,WACDS ,PRCCF ,ETACCF ,WACCF ,
T4DS ,WFBDS ,DTCDUS ,ETARDS ,WACDS ,DPCDS ,DTCCF ,ETABCF ,
STHFPDS ,CNHPDS ,ETHPDS ,TFHPCF ,CNHPCF ,ETHPCF ,DHHPCF ,T2DS ,
ATFLPDS ,CNLPDS ,ETLPDS ,TFLPCF ,CNLPFC ,ETLPCF ,DHLPCF ,T2IDS ,
T24DS ,WFBDS ,GTCDUS ,ETAADS ,WACDS ,DPCDS ,DTCCF ,ETADCF ,
BT7DS ,WFAUS ,DTAFDS ,ETAADS ,WACDS ,DPCDS ,DTCCF ,ETADCF ,
9A55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A26 ,A29 ,
APS55 ,AX55 ,CVKNOZ ,CVKNOZ ,ABSAV ,A9SAV ,A28SAV ,A29SAV
COMMON / FRONT/
IT1 ,P1 ,H1 ,S1 ,T2 ,P2 ,H2 ,S2 ,
T2T1 ,P21 ,H21 ,S21 ,T3 ,P3 ,H3 ,S3 ,
T4 ,P4 ,H4 ,S4 ,T5 ,P5 ,H5 ,S5 ,
T55 ,P55 ,H55 ,S55 ,BLF ,BLC ,BLDU ,BLOB ,
SCNF ,PKF ,ETAF ,WAF ,WAF ,WAF ,H43 ,W4 ,FAR4 ,
6CNC ,PRC ,ETAC ,WACC ,WAC ,ETAB ,DPCOM ,DUMF ,
7CNHP ,ETATHP ,DHTCHP ,DHTC ,BLHP ,H5 ,FAR5 ,CS ,
8CNLP ,ETATLP ,DHTCLP ,DHTF ,RLP ,H55 ,FAR5 ,HPEXT ,
9AM ,ALTP ,ETAR ,ZF ,PCNF ,ZC ,PCNC ,WFB ,
ATFFHP ,TFPLP ,PCBLF ,PCBLC ,PCBLDU ,PCBLUB ,PCBLHP ,PCBLLP
DATA ANORD/6HCOINLT/
MURD=AKORD
AJ=778.26
G=32.174049
ALT=ALTP*2.0855531E+07/(2.0855531E+07-ALTP)
CALL ATMODS(ALT,T1,XX1,XX2,XX3,P1,CS,XX4,IIER)
IF(IAMTP.EQ.2) T1=T1+T2
1 IF(IAMTP.NE.1) CALL RAM(AM,ETAR)
FAR=0.0
CALL PROCOM(FAR,T1,CS,XX2,XX3,R1,PH11,H1)
S1=PH11-R1*ALOG(P1)
H2=H1+(AM*CS)**2/(2.*AJ*G)
P2T=1.
DO 2 I=1,10
CALL THERMO(P2T,H2,T2T,S2T,AM,0,0,0,1)
IF(ABS(S2T-S1).LE.0.0001*S1) GO TO 3
2 P2T=P1*EXP((AM/1.986375)*((S2T-S1)/(1.986375/AM)*ALOG(P2T/P1)))
CALL ERROR
RETURN
3 IF(IAMTP.EQ.3.OR.IAMTP.EQ.4) ETAR=P2/P2T
P2=ETAR*P2T
IF(IAMTP.NE.4) CALL THERMO(P2,H2,T2,S2,XX5,0,0,0,1)
IF(IAMTP.EQ.4) CALL THERMO(P2,H2,T2,S2,XX5,0,0,0,1)
IF(INIT.EQ.1) GO TO 6
IF(IDES.EQ.1) GO TO 4
PCNF=GUESS(MODE,T4,T4DS,PCNC,PCNCDS,WFB,WFBDS,T2,T2DS,PCNFDS)
PCNFGU=PCNF
GO TO 5
4 PCNF=PCNFDS
PCNFGU=PCNF
T2DS=T2
ZF=Z2FDS
5 RETURN
6 RETURN

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Part II

END

AFAPL-TR-67-125
Part II

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SIBFTC ATM062 DECK,M94/2,XR7
      SUBROUTINE ATMOS (ZFT, TM, SIGMA, RHO, 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 ATMOS (ZFT, TM, SIGMA, RHO, THETA, DELTA, CA, AMU, X)
C       ZFT = GEOMETRIC ALTITUDE (FEET)
C       TM  = MOLECULAR SCALE TEMPERATURE (DEGREES RANKINE)
C       SIGMA = RATIO OF DENSITY TO THAT AT SEA LEVEL
C       RHO  = DENSITY (LB-SEC**2-FT**(-4) OR SLUGS-FT**3)
C       THETA = RATIO OF TEMPERATURE TO THAT AT SEA LEVEL
C       DELTA = RATIO OF PRESSURE TO THAT AT SEA LEVEL
C       CA   = SPEED OF SOUND (FT/SEC)
C       AMU  = VISCOSITY COEFFICIENT (LB-SEC/FT**2)
C
C       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 ARDC ATMOSPHERE SO THAT PROGRAMS CURRENTLY USING THE LIBRARY
C   ROUTINE WILL NOT REQUIRE ALTERATION TO USE THIS ROUTINE.
      DIMENSION HB(10),TMB(10),DELTAB(10),ALM(10)
      DATA(HB(1), TMB(1), DELTAB(1), ALM(1),1=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, 5.40528E-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, 252.65, 1.79718E-04, -4.0,
I   79.0, 180.65, 1.0241 E-05, 0.0,
J   88.743, 180.65, 1.6223 E-06, 0.0/
      DATA REFT59/2.0855531E 07/, GZ /9.80665/,
A   AMZ /28.9644 /, RSTAR /8.31432/,
B   FTTOKM/3.048E-04 /, S /110.4 /,
C   AMUZ /1.2024E-05 /, CAL /1116.45/,
D   RHOZ /0.076474 /, GZENG /32.1741/
C   CONVERT GEOMETRIC ALTITUDE TO GEOPOTENTIAL ALTITUDE
      HFT = (REFT59/(REFT59+ZFT))*ZFT
C   CONVERT HFT AND ZFT TO KILOMETERS
      Z = FTTOKM*ZFT
      H = FTTOKM*HFT
      K = 1
      TM7 = TMB(2)
      IF (H.LT.-5.0.OR.2.GT.90.0) GO TO 16
      DO 10 M=1,10
      IF (H-HB(M)) 11,12,10
10  CONTINUE
      GO TO 16
11  M = M-1
12  DELH = H-HB(M)
      IF (ALM(M).EQ.0.0) GO TO 13
      TMX = TMB(M)+ALM(M)*DELH
2   GRADIENT IS FROM ZENON, PAGE 10, EQUATION 1.2.10-(3)
      DELTA = DELTAB(M)*((TMB(M)/TMX)**(GZ*AMZ/(RSTAR*ALM(M))))

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Part II

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      GO TO 14
13  TMK = TMB(M)
C  GRADIENT IS ZERO, PAGE 10, EQUATION 1.2.10-(4)
   DELTA = DELTAB(M)*EXP(-GZ*AMZ*DELH/(RSTAR*TMB(M)))
14  THETA = TMK/THZ
   SIGMA = DELTA/THETA
   ALPHA = SORT(THETA**3)*((TMZ+S)/(TMK+S))
C  CONVERSION TO ENGLISH UNITS
   TM = 1.8*TMK
   RHO = RHOZ*SIGMA/GZENG
   CA = CAZ*SORT(THETA)
   AMU = AMUZ*ALPHA/GZENG
   CALL OVERFL(J)
      GO TO (15,17), J
15  K = K+2
      GO TO 17
16  K = 2
17  RETURN
   END
```

AFAPL-TR-67-125
Part II

```
SIBFTC RAM    DECK,M94/2,XR7
SUBROUTINE RAM(AM,ETAR)
IF(AM.GT.1.) GO TO 2
ETAR=1.
1  RETURN
2  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
```

AFAPL-TR-67-125

Part II

```
$1BFTC GUESS DECK,M94/2,XR7
FUNCTION GUESS(M,T,TD,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)*((P/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
```

AFAPL-TR-67-125
Part II

```

$18FTC COFAN DECK,M94/2,XR7
SUBROUTINE COFAN
COMMON / ALL/
1WORD ,IDES ,JDES ,KDES ,MCDE ,INIT ,IDUMP ,IAMTP ,
2IGASHX,IDBURN,IAFTBN,IDCD ,IMCU ,IDSHOC,IMSHUC,NUZFLT,
3ITRYS ,LOOPER,NOMAP ,NUMMAP,MAPEDG,TOLALL,ERR(6)
COMMON /DESIGN/
1PCNFGU,PCNCGU,T4GU ,DUMD1 ,DUMD2 ,DELF6 ,DELFN ,DELSFC,
2ZFDS ,PCNFDS,PRFDS ,ETAFDS,HAFDS ,PRFCF ,ETAFCF,MAFCF ,
3ZCDS ,PCNCDS,PRCDS ,ETACDS,WACDS ,PRCCF ,ETACCF,WACCF ,
4T4DS ,WF8DS ,DTCDSD,ETABDS,WA3CDS,DPCDSD,DTCCCF,ETABCF,
5TFHPDS,CNHPDS,ETHPDS,TFHPCF,CNHPCF,ETHPCF,DHHPCF,T2DS ,
6TFLPDS,CNLPDS,ETLPDS,TFLPCF,CNLPFC,ETLPFC,DHLPFC,T21DS ,
7T24DS ,WF8DS ,DTDUDS,ETAUDS,WA23DS,DPDUDS,DTDUFC,ETADCF,
8T7DS ,WFADS ,DTAFDS,ETAADS,WG6CDS,DPAFDS,DTAFCF,ETAACF,
9A55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A28 ,A29 ,
APSS5 ,AM55 ,CYDMOZ,CVMNUZ,ARS.V ,A9SAV ,A28SAV,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 ,
5CNF ,PRF ,ETAF ,WAF ,WAF ,WA3 ,WG4 ,FAR4 ,
6CNC ,PRC ,ETAC ,WACC ,WAC ,ETAB ,DPCOM ,DUMF ,
7CNHP ,ETATHP,DHTCMP,DHTC ,BLHP ,WG5 ,FAR5 ,CS ,
8CNLP ,ETATLP,DHTCLP,DHTF ,BLLP ,WG55 ,FAR55 ,HPEXT ,
9AM ,ALTP ,ETAK ,ZF ,PCNF ,ZC ,PCNC ,WF8 ,
ATFFHP ,TFFLP ,PCBLF ,PCBLC ,PCBLDU,PCBLOB,PCBLHP,PCBLP,
COMMON / FAN/CNX(15),PRX(15,15),WACX(15,15),ETAX(15,15),
1NCN,NPT(15)
DIMENSION WLH(2)
DATA AWORD,WLH/6H COFAN,6H (LU) ,6H (HI) /
WORD=AWORD
THETA=SQRT(T2/518.668)
CNF=PCNF/(100.*THETA)
IF(ZF.LT.0.) ZF=0.
IF(ZF.GT.1.) ZF=1.
CNFS=CNF
CALL SFARCH(ZF,CNF,PRF,WAF,ETAF,
1CNX(1),NCN,PRX(1,1),WACX(1,1),ETAX(1,1),NPT(1),15,15,IGU)
IF((CNF-CNFS).GT.0.0005*CNF) MAPEDG=1
IF(IGU.EQ.1.OR.IGU.EQ.2) WRITE(8,1000) CNFS,WLH(IGU)
1000 FORMAT(19H0* * * CNF OFF MAP,F10.4,2XA6,11H0 * *SSSSSS)
WAF=WAF*P2/THETA
IF(IDES.NE.1) GO TO 1
PRFCF=(PRFDS-1.)/(PRF-1.)
ETAFCF=ETAFDS/ETAF
WAFCF=WAFDS/WAF
WRITE(6,100)PRFCF,ETAFCF,WAFCF,T2DS
100 FORMAT(11HOFAN DESIGN,13X8H PRFCF=,E15.8,8H ETAFCF=,E15.8,
18H WAFCF=,E15.8,8H T2DS=,F15.8)
1 PRF=PRFCF*(PRF-1.)+1.
ETAF=ETAFCF*ETAF
WAF=WAFCF*WAF
PCNF=100.*THETA*CNF
DUMD1=PCNF
CALL THCOMP(PRF,ETAF,T2,H2,S2,P2,T21,H21,S21,P21)
IF(PCBLF.GT.0.) BLF=PCBLF*WAF
IF(JDES.EQ.1) GO TO 7
JDES=1
IF(INIT.EQ.1) GO TO 6

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Part II

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IF (IDES.EQ.1) GO TO 4
IF (MODE.NE.2) GO TO 2
T4=GUESS(3,Y1,Y2,PCNF,PCNFDS,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 (NOMAP.EQ.7) PCNF=DUMD1
RETURN
END
```

AFAPL-TP-67-125
Part II

31BFPC COCOMP DECK,M94/2,XR7

SUBROUTINE COCOMP

COMMON / ALL/

1WORD ,IDES ,JUES ,KDES ,MODE ,INIT ,IDUMP ,IAMTP ,
2IGASHX ,IDBURN ,IAFTBN ,IDCD ,IMCD ,IDSHUC ,INSHUC ,NUZFLT ,
3ITRYS ,LOOPER ,KOMAP ,NUMMAP ,MAPEUG ,TOLALL ,ERR(6)

COMMON / DESIGN/

1PCNFCU ,PCNCGU ,T4GU ,DUMU1 ,DUMU2 ,DELFG ,DELFN ,DELSFC ,
2IFDS ,PCNFDS ,PRFDS ,ETAFDS ,WAFDS ,PRFCF ,ETAFCH ,WAFCH ,
3ZCDS ,PCNCDZ ,PRCDZ ,ETACDS ,WACDS ,PRCCF ,ETACCF ,WACCF ,
4T4DS ,WFBDS ,DTCDZ ,ETACDS ,WACDS ,UPCUDZ ,DTCCF ,ETACCF ,
5TFHPDS ,CNHPDS ,ETHPDS ,TFHPCF ,CNHPCF ,ETHPCF ,DHHPCF ,T2DS ,
6TFLPDS ,CNLPDS ,ETLPDS ,TFLPCF ,CNLPFC ,ETLPFC ,DHLPCF ,T2IDS ,
7T2DS ,WFDUS ,DTUUDS ,ETAADS ,WAGDS ,DPAIDS ,UTAFCF ,ETAACF ,
8T7DS ,WAFDS ,UTAFDS ,ETAADS ,WAGDS ,DPAIDS ,UTAFCF ,ETAACF ,
9A55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A28 ,A29 ,
APS55 ,AM55 ,CVDNUZ ,CVMNUZ ,ARSAV ,A9SAV ,A28SAV ,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 ,
5CNC ,PRF ,ETAF ,WAF ,WAF ,WAG ,WAG ,FAR4 ,
6CNC ,PRC ,ETAC ,WACC ,WAC ,ETAB ,DPCOM ,DUMF ,
7CHHP ,ETATHP ,DHTCHP ,DHTC ,BLHP ,WGS ,FARS ,CS ,
8CNLP ,ETATLP ,DHTCLP ,DHTF ,BLLP ,WGS5 ,FARS5 ,HPEXT ,
9AM ,ALTP ,ETAK ,ZF ,PCNF ,ZC ,PCNC ,WFB ,
ATFFHP ,TFFLP ,PCBLF ,PCBLC ,PCBLDU ,PCBLUB ,PCBLHP ,PCBLLP

COMMON / COMP/CNX(15),PRX(15,15),WACX(15,15),ETAX(15,15),
1NCN,NPT(15)

DIMENSION WLH(2)

DATA AWORD,WLH/6HCGCOMP,6H (LO) ,6H (H1) /

WORD=WORD

THETA=SUXT(T21/518.668)

CNC=PCNC/(100.*THETA)

IF(ZC.LT.0.) ZC=0.

IF(ZC.GT.1.) ZC=1.

CNCS=CNC

CALL SEARCH(ZC,CNC,PRC,WACC,ETAC,

1CNX(1),NCN,PRX(1,1),WACX(1,1),ETAX(1,1),NPT(1),15,15,16U)

IF(MODE.EQ.1) GO TO 1

IF((CNC-CNCS).GT.0.0005*CNC) MAPEDG=1

1 IF(16U.EQ.1.OR.16U.EQ.2) WRITE(8,100) CNCS,WLH(16U)

1000 FORMAT(10H* * * CNC OFF MAP,F10.4,2XA6,11H* * *S55555)

WAC=WACC*P21/THETA

IF(IDES.NE.1) GO TO 2

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

ETACCF=ETACDS/ETAC

WACCF=WACDS/WAC

WRITE(6,100)PRCCF,ETACCF,WACCF,T21DS

100 FORMAT(18HCOMPRESSOR DESIGN,6X8H PRCCF=,E15.8,8H ETACCF=,E15.8,

18H WACCF=,E15.8,8H T21DS=,F15.8)

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

ETAC=ETACCF*ETAC

WAC=WACCF*WAC

CALL THCOMP(PRC,ETAC,T21,H21,S21,P21,T3,H3,S3,P3)

IF(PCBLC.GT.0.) BLC=PCBLC*WAC

WAG=WAC-BLC

BLDU=PCBLDU*WAC

BLOB=PCBLOB*WAC

BLHP=PCBLHP*WAC

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Part II

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BLLP=PCBLLP#BLC
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(10HOCNC WAS= ,E15.8,11H AND NIM= ,E15.8,
124H CHECK PCNC INPUT$$$$$)
CALL ERROR
3 PCNC=100.#THETA#CNC
4 CALL COCOMB
RETURN
END
```

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Part II

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SUBROUTINE CUCOMB DECK,M94/2,XR7
COMMON / ALL/
1WORD ,IDES ,JDES ,KDES ,MODE ,INIT ,IDUMP ,IATMP ,
2IGASHX ,IDURN ,IAFTBH ,IDCU ,IMCO ,IDSMOC ,IMSHUC ,NUZFLT ,
3ITRYS ,LOOPER ,NUMAP ,NUMMAP ,MAPEDG ,TOLALL ,ERR(6)
COMMON /DESIGN/
1PCNFGU ,PCNCGU ,T4CU ,DUMD1 ,DUMD2 ,DELFG ,DELFN ,DELSFC ,
2ZFDS ,PCNFDS ,PRFDS ,ETAFDS ,WAFUS ,PRFCF ,ETAFCF ,WAFCF ,
3ZCD ,PCNCDS ,PRCDS ,ETACDS ,WACDS ,PRCCF ,ETACCF ,WACCF ,
4T4DS ,WF8DS ,DTCDUS ,ETABDS ,WA3CDS ,UPCDS ,DTCCF ,ETACCF ,
5TFHPS ,CNHPS ,ETHPS ,TFHPCF ,CNHPCF ,ETHPCF ,DUMHPCF ,Y2IS ,
6TFLPDS ,CNLPDS ,ETLPDS ,TFLPCF ,CNLPFC ,ETLPFC ,DMLPCF ,T2IDS ,
7T24DS ,WF8DS ,DTDUUS ,ETABDS ,WA23DS ,OPDUS ,DTUUCF ,ETAUCF ,
8T7DS ,WFAOS ,DTAFDS ,ETAUS ,WG6CDS ,OPAFDS ,DTAFCF ,ETAACF ,
9A55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A28 ,A29 ,
AR555 ,AR55 ,CVMH02 ,CVMH02 ,A83AV ,A95AV ,A285AV ,A295AV
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 ,BLDB ,
5LNF ,PRF ,ETAF ,WAF ,WAF ,WAF ,WAF ,WAF ,WAF ,WAF ,
6CNC ,PRF ,ETAF ,WAF ,WAF ,WAF ,WAF ,WAF ,WAF ,WAF ,
7CNHP ,PRF ,ETAF ,WAF ,WAF ,WAF ,WAF ,WAF ,WAF ,WAF ,
8CNLP ,ETATLP ,DNTLP ,DNTF ,BLLP ,WG55 ,FAR55 ,HPEXT ,
9AM ,ALTP ,ETAK ,ZF ,PCNF ,ZC ,PCNC ,WFB ,
ATFFHP ,TFFLP ,PCBLF ,PCBLC ,PCBLDU ,PCBLUS ,PCBLHP ,PCBLLP
COMMON / COMB/PS(15),DELT(15,15),ETA(15,15),NPS,NPT(15)
DIMENSION U(9),DUMBU(15,15)
DATA AMGRD/6HCUOMB/
WORD=AMGRD
U(2)=0.
G(3)=0.
P3PSI=14.695*P3
WA3C=WA3*50*(T3)/P3PSI
IF (IDES.EQ.1) WA3C=WA3C
DPCOM=DPCDS*(WA3C/WA3CDS)
IF (DPCOM.ST.1.) DPCOM=1.
P4=P3*(1.-DPCOM)
1 IF (T4.GT.3000.) T4=3000.
IF (T4.GE.1000.) GO TO 2
T=1000.
2 IF (MODE.EQ.1) MAPEDG=1
DTCD=T4-T3
IF (IDES.NE.1) GO TO 3
DTCCF=DTCDUS/DTCD
3 DTCCF=DTCCF*DTCD
P3PSIN=P3PSI
CALL SEARCH(-1.,P3PSIN,DTCD,ETAB,DUMMY,
1PSI(1),NPS,DELT(1,1),ETA(1,1),DUMBU(1,1),NPT(1,15,15,160)
IF (IGD.EQ.7) CALL ERROR
4 IF (IDES.NE.1) GO TO 5
ETABCF=ETABDS/ETAB
5 ETAB=ETABCF*ETAB
MV=((((-4594317E-19*T4)-.2034116E-15)*T4+.2783643E-11)*T4
1+.2051501E-07)*T4-.2453116E-03)*T4-.5433296E-01)*T4+.1845537E+05
CALL THERMUIP4,HA,T4,XX1,XX2,U,0,0,0)
FAR4=(HA-T3)/(MV*ETAB)
IF FAR4.LT.0. FAR4=0.
WF8X=FAR4*WA3

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Part II

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      IF (MODE.NE.2) GO TO 8
      ERRW=(WFB-WFBX)/WFB
      DIK=SQRT(WFB/WFBX)
      CALL AFQUIR(0.1),T4,ERRW,0.,20.,0.0001,DIK,T4T,IGU)
      GO TO (6,9,7),IGU
6      T4=T4T
      GO TO 1
7      CALL ERRUR
8      WFB=WFBX
9      CALL THERMU(P4,H4,T4,S4,XX2,1,FAH4,0)
      WG4=WFB-WA3
      IF (IDES.EQ.1) WRITE(6,100) WA3CDS,ETABCF,DTCUCF
100  FORMAT(17HOCOMBUSTOR DESIGN,7X8H WA3CDS=,E15.8,8H ETABCF=,E15.8,
      18H DTCUCF=,E15.8)
      CALL COMPTB
      RETURN
      END

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AFAPL-TR-57-125
Part II

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SUBROUTINE COMPTB DECK,M94/2,XR7
COMMON / ALL/
1WORD ,IDES ,JDES ,KDES ,MODE ,INIT ,IDUMP ,IATMP ,
21GASMX ,IDURN ,IAFT6H ,IDCD ,IMCD ,IDSHOC ,IMSHOC ,NOZFLT ,
3ITRYS ,LUGPEX ,NDMAP ,NUMMAP ,MAPEDG ,TOLALL ,ERR(6)
COMMON /DESIGN/
1PCNFGU ,PCNCGU ,T4GU ,DUMD1 ,DUMD2 ,DELEF ,DELFN ,DELSFC ,
2ZFDG ,PCNFDS ,PRFDS ,ETAFDS ,WAFDS ,PRCF ,ETAFCF ,WAFCF ,
3ZCDS ,PCNCDG ,PRCDG ,ETACDS ,WACDS ,PRCCF ,ETACCF ,WACCF ,
4T4DS ,W4FDS ,DTCDG ,ETACDS ,WACDS ,PRCCF ,ETACCF ,WACCF ,
5TFHPS ,CNHPS ,ETHPDS ,TFHPCF ,CNHPCF ,ETHPCF ,DHPHCF ,T2DS ,
6TFLPDS ,CNLPDS ,ETLPDS ,TFLPCF ,CNLPCF ,ETLPCF ,DHLPCF ,T2IDS ,
7T24DS ,W4FDS ,DT4DS ,ET4DS ,W43DS ,DPAFDS ,DT4DCF ,ET4DCF ,
8T2DS ,W4FDS ,DTAFDS ,ETAADS ,W4CDS ,DPAFDS ,DTAFCF ,ETAACF ,
9A55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A28 ,A29 ,
A955 ,A55 ,CVDMOZ ,CVHMOZ ,ABSAV ,A9SAV ,A28SAV ,A29SAV
COMMON / FRONT
1I1 ,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 ,BLUB ,
5CNF ,PRF ,ETAF ,WAF ,WAF ,W43 ,W44 ,FAR4 ,
6CNC ,PHC ,ETAC ,WAC ,WAC ,ETAB ,DPCOM ,DUMF ,
7CNHP ,ETATHP ,DMTCHP ,DMTC ,BLMP ,WGS ,FAR5 ,CS ,
8CNLP ,ETATLP ,DMTCLP ,DMTF ,BLLP ,WGS5 ,FAR55 ,HPEXT ,
9AM ,ALTP ,ETAR ,ZF ,PCNF ,ZC ,PCNC ,WFB ,
ATFFHP ,TFFLP ,PCBLF ,PCBLC ,PCBLDU ,PCBLUB ,PCBLHP ,PCBLP
COMMON /HTURB/TFFX(15),CNX(15,15),DMTCX(15,15),ETATX(15,15),
INTFFS,NPTTFF(15)
DATA AWORD,WLO,WHI/6HCOMPTB,6H (LO) ,6H (HI) /
WORD=AWORD
IF (IDES.EQ.0) GO TO 1
CNHPCF=CNHPS+SURT(T4)/PCNC
1 CNHP=CNHPCF*PCNC/SURT(T4)
CNHPS=CNHP
TFFHPS=TFFHP
CALL SEARCH(-1.,TFFHP,CNHP,DMTCHP,ETATHP,
1TFFX(1),INTFFS,CNX(1,1),DMTCX(1,1),ETATX(1,1),NPTTFF(1),15,15,(GO)
IF (IGU.EQ. 1.GU.IGU.EQ.11.IGU.EQ.21) WRITE(8,1000)TFFHPS,WL7
IF (IGU.EQ. 2.IGU.EQ.12.IGU.EQ.22) WRITE(8,1000)TFFHPS,WL1
IF (IGU.EQ.10.IGU.EQ.11.IGU.EQ.12) WRITE(8,2000) CNHPS,WLO
IF (IGU.EQ.20.IGU.EQ.21.IGU.EQ.22) WRITE(8,2000) CNHPS,WL1
1000 FORMAT(19H=====TFFHP OFF MAP,F10.4,2XA6,11H=====SSSSS)
2000 FORMAT(19H=====CNHP OFF MAP,F10.4,2XA6,11H=====SSSSS)
IF (IGU.NE.7) GO TO 3
2 CALL ERROR
RETURN
3 MAPGO=0
IF (ABS(TFFHPS-TFFHP).LE.0.001=TFFHPS) GO TO 4
MAPGO=1
IF (ABS(CNHPS-CNHP).GT.0.001=CNHPS) MAPGO=3
GO TO 5
4 IF (ABS(CNHPS-CNHP).GT.0.001=CNHPS) MAPGO=2
5 IF (MAPGO.GT.0) CALL MAPRAC(1,MAPGO,TFFHPS,TFFHP,CNHPS,CNHP,PCNC,
1T4,MODE,NDMAP,NUMMAP)
IF (KMAP.GT.0) RETURN
TFHCAL=W44*SURT(T4)/(14.696*P4)
BTUEXT=0.706705*HPEXT
DMTEC=(BTUEXT+WAC*(H3-H2))/(W44*T4)
IF (IDES.EQ.0) GO TO 6

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Part II

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      TFHPCF=TFHPDS/TFHCAL
      DHMPCF=DHTCC/DHTCHP
      ETHPCF=ETHPDS/ETATHP
      WRITE(6,102)CNHPCF,TFHPCF,ETHPCF,DHMPCF
102  FORMAT(20H0H.P. TURBINE DESIGN,5X7HCNHPCF=,E15.8,8H TFHPCF=,E15.8,
      18H ETHPCF=,E15.8,8H DHMPCF=,E15.8)
6    TFHCAL=TFHPCF*TFHCAL
      DHTCHP=DHMPCF*DHTCHP
      ETATHP=ETHPCF*ETATHP
      DHTC=DHTCC*T4
      ERK(1)=(TFHCAL-TFFHP)/TFHCAL
      EPR(2)=(DHTCC-DHTCHP)/DHTCC
      CALL THTURB(DHTC,ETATHP,FAR4,H4,S4,P4,T5,H5,S5,P5)
      IF(BLHP.LE.0.) GO TO 7
      FAR5=WFB/(WA3+BLHP)
      WG5=WG4+BLHP
      H5=(BLHP*H3+WG4*H5)/WG5
      CALL THERMO(P5,H5,T5,S5,XX2,1,FAR5,1)
      GO TO 8
7    FAR5=FAR4
      WG5=WG4
8    CALL COLPTB
      RETURN
      END

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ASAPL-TR-07-125
Part II

SIBFTC COLPTB DECK, #94/2, XR7

SUBROUTINE COLPTB

COMMON / ALL/

1WORD, IDGS, JDES, KDES, MODE, INIT, IDUMP, IANP,
2IGASHX, IDURN, IFTBN, IDCO, IACU, IDSHOC, IASHUC, NOZFLT,
3ITRYS, LOOPER, IUMAP, NUMMAP, MAPEDG, TOLALL, ERR(6)

COMMON / DESIGN/

1PCNFGU, PCACGU, T4GU, DUMD1, DUMD2, DELFG, DELFN, DELSFC,
2ZFDS, PCNFDS, PRFDS, ETAFDS, WAFDS, PRFCF, ETAFCF, WAFCF,
3ZCDS, PCNCDS, PRCD, ETACDS, WACDS, PRCCF, ETACCF, WACCF,
4T4DS, WFBDS, DTCDS, ET4BDS, WA3CDS, DPCDS, DTCDCF, ET4BDF,
5TFHPDS, CHHPDS, ETHPDS, TFHPCF, CHHPCF, ETHPCF, DHHPCF, T2DS,
6TFLPDS, CNLPDS, ETLPDS, TFLPCF, CNLPCF, ETLPDF, DHLPDF, T21DS,
7T24DS, WFDOS, DTODDS, ETADDS, WA3DS, DPDUOS, DTODCF, ETADCF,
8T7DS, WFAOS, DTAFDS, ETADDS, WG3CDS, DPADDS, DTAFCF, ETADCF,
9A55, A25, A6, A7, A8, A9, A28, A29,
APS55, AM55, CYDMOZ, CYMNOZ, ABSAV, A9SAV, A28SAV, 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, BLOS,
5CNF, PRF, ETAF, WAF, WAF, WA3, WG4, FAR4,
6CNC, PRC, ETAC, WACC, WAC, ETAB, DPCDH, DUMF,
7CHHP, ETATHP, DHTCHP, DHTC, BLHP, W65, FAR5, CS,
8CNLP, ETATLP, DHTCLP, DHTF, BLLP, W655, FAR55, HPEXT,
9AM, ALTP, ETAR, ZF, PCNF, ZC, PCNC, WFB,
ATFFHP, TFFLP, PCBLF, PCBL, PCBLD, PCBLD, PCBLHP, PCBLP
COMMON / LTRB/TFFX(15), CNX(15,15), DHTCX(15,15), ETATX(15,15),
INTFFS, NPTTFF(15)

DATA AWORD, WLO, WHI/6HCOLPTB, 6H (LO), 6H (HI) /

WORD=AWORD

IF(IDGS.EQ.0) GO TO 1

CN, PCF=CNLPDS*SORT(T5)/PCNF

1 CNLP=CNLP*PCF/SORT(T5)

CNLP=CNLP

TFFLP=TFFLP

CALL SEARCH(-1, TFFLP, CNLP, DHTCLP, ETATLP,

1TFFX(1), TFFS, CNX(1,1), DHTCX(1,1), ETATX(1,1), NPTTFF(1), 15, 15, IGO)

IF(IGO.EQ. 1.OR.IGO.EQ.11.OR.IGO.EQ.21) WRITE(8,1000)TFFLP,WLO

IF(IGO.EQ. 2.OR.IGO.EQ.12.OR.IGO.EQ.22) WRITE(8,1000)TFFLP,WHI

IF(IGO.EQ.10.OR.IGO.EQ.11.OR.IGO.EQ.12) WRITE(8,2000) CNLP,WLO

IF(IGO.EQ.20.OR.IGO.EQ.21.OR.IGO.EQ.22) WRITE(8,2000) CNLP,WHI

1000 FORMAT(19H0****TFFLP OFF MAP,F10.4,2XA6,11H*****SSSSSS)

2000 FORMAT(19H0**** CNLP OFF MAP,F10.4,2XA6,11H*****SSSSSS)

IF(IGO.NE.7) GO TO 3

2 CALL ERROR

RETURN

3 MAPGO=0

IF(ABS(TFFLP-TFFLP).LE.0.001*TFFLP) GO TO 4

MAPGO=1

IF(ABS(CNLP-CNLP).GT.0.001*CNLP) MAPGO=3

GO TO 5

4 IF(ABS(CNLP-CNLP).GT.0.001*CNLP) MAPGO=2

5 IF(MAPGO.ST.0) CALL MAPBAC(2, MAPGO, TFFLP, TFFLP, CNLP, CNLP, PCNF,

IT4, MODE, NOMAP, NUMMAP)

IF(NOMAP.EQ.0) RETURN

TFLCAL=MG5*SORT(T5)/(14.696*F5)

DHTCF=WAF*(H21-H2)/(MG5*F5)

IF(IDGS.EQ.0) GO TO 6

TFLPCF=TFLPDS/TFLCAL

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Part II

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      DMLPCF=DHTCF/DHTCLP
      ETLPCF=ETLPDS/ETATLP
      WRITE(6,102)CNLPCF,TFLPCF,ETLPCF,DMLPCF
102   FORMAT(20HOL.P. TURBINE DESIGN,5X7HCNLPCF=,E15.8,8H TFLPCF=,E15.8,
      19H ETLPCF=,E15.8,8H DMLPCF=,E15.8)
6     TFLCAL=TFLPCF*TFLCAL
      DHTCLP=DMLPCF*DHTCLP
      ETATLP=ETLPCF*ETATLP
      DHTF=DHTCF*T5
      ERR(3)=(TFLCAL-TFFLP)/TFLCAL
      ERR(4)=(DHTCF-DHTCLP)/DHTCF
      CALL THTURB(DHTF,ETATLP,FAR5,H5,S5,P5,T55,H55,S55,P55)
      IF(BLLP.LE.0.) GO TO 7
      FAR55=WFB/(WA3+BLHP+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 FRTO5D
      RETURN
      END
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Part II

\$18FTC FRTOSD DECK,M94/2,XR7

SUBROUTINE FRTOSD

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	,BLUB	,
5CNF	,PRF	,ETAF	,WAF	,WAF	,WAB	,WAB	,FAR4	,
6CNC	,PRC	,ETAC	,WACC	,WAC	,ETAB	,DPCOM	,DUMF	,
7CNHP	,ETATHP	,DHTCHP	,DHTC	,BLHP	,WG5	,FAR5	,CS	,
8CNLP	,ETATLP	,DHTCLP	,DHTF	,BLLP	,WG55	,FAR55	,HPEXT	,
9AM	,ALTP	,ETAR	,ZF	,PCNF	,ZC	,PCNC	,WFB	,
ATFFHP	,TFFLP	,PCBLF	,PCBLC	,PCBLDU	,PCBLUB	,PCBLHP	,PCBLLP	,

COMMON / SIDE/

XXP1	,XWAF	,XWAC	,XBLF	,XBLDU	,XH3	,DUMS1	,DUMS2	,
XXT21	,XP21	,XH21	,XS21	,T23	,P23	,H23	,S23	,
3T24	,P24	,H24	,S24	,T25	,P25	,H25	,S25	,
4T28	,P28	,H28	,S28	,T29	,P29	,H29	,S29	,
5WAD	,WFD	,WG24	,FAR24	,ETAU	,DPDUC	,BYPASS	,DUMS3	,
6TS28	,PS28	,V28	,AM28	,TS29	,PS29	,V29	,AM29	,

XP1=P1

XWAF=WAF

XWAC=WAC

XBLF=BLF

XBLDU=BLDU

XH3=H3

XT21=T21

XP21=P21

XH21=H21

XS21=S21

CALL CUDUCT

RETURN

END

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Part II

SIBFTC CONDUCT DECK,M94/2,XR7

SUBROUTINE CONDUCT

COMMON / ALL/

1WORD ,IDES ,JDES ,KDES ,MODE ,INIT ,IDUMP ,IANTP ,
ZIGACMX ,IDBURN ,IAFTBN ,IDCD ,IMCD ,IDSHOC ,IMSHOC ,NOZFLT ,
3ITRYS ,LOOPER ,NOMAP ,NUMMAP ,MAPEDG ,TOLALL ,ERR(6)

COMMON /DESIGN/

1PCNFGU ,PCNCGU ,T4GU ,DUMD1 ,DUMD2 ,DELF6 ,DELFN ,DELSFC ,
2ZFDS ,PCNFDS ,PRFDS ,ETAFDS ,WAFDS ,PRFCF ,ETAFCF ,WAFCF ,
3ZCDS ,PCNCDS ,PRCDS ,ETACDS ,WACDS ,PRCCF ,ETACCF ,WACCF ,
4T4DS ,WFBDS ,DTCCDS ,ETABDS ,KA3CDS ,DPCDS ,DTCCCF ,ETABCF ,
5TFHPDS ,CNHPDS ,ETHPDS ,TFHPCF ,CNHPCF ,ETHPCF ,DMHPCF ,T2DS ,
6TFLPDS ,CNLPDS ,ETLPDS ,TFLPCF ,CNLPCF ,ETLPCF ,DHLPCF ,T2IDS ,
7T24DS ,WFDOS ,DTODDS ,ETADDS ,WA23DS ,DPDUDS ,DTODCF ,ETADCF ,
8T7DS ,WFAOS ,DTAFDS ,ETAADS ,WG6CDS ,DPAFDS ,DTAFCF ,ETAACF ,
9A55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A28 ,A29 ,
APS55 ,AM55 ,CVDNDZ ,CVMNDZ ,A8SAV ,A9SAV ,A28SAV ,A29SAV

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 ,
4T28 ,P28 ,H28 ,S28 ,T29 ,P29 ,H29 ,S29 ,
5HAD ,WFD ,WG24 ,FAR24 ,ETAD ,DPDUC ,BYPASS ,DUNS3 ,
6TS28 ,PS28 ,V28 ,AM28 ,TS29 ,PS29 ,V29 ,AM29

DIMENSION Q(9)

DATA AWORD1 ,AWORD2 /6HCONDUCT,6HNDZZL/

WORD=AWORD1

Q(2)=0.

Q(3)=0.

WAX=WAF-WAC-BLF

WAD=WAX+BLDU

P23=P21

H23=(BLDU*H3+WAX*H21)/WAD

CALL THERMO(P23-H23,T23,S23,XX2,1,0,0,1)

BYPASS=(WAF-WAC)/WAC

WA23C=WAD*SQR(T23)/P23

IF(IDES.EQ.1) WA23DS=WA23C

DPDUC=DPDUDS*(WA23C/WA23DS)

IF(DPDUC.GT.1.) DPDUC=1.

P24=P23*(1.-DPDUC)

IF(IGASM.GT.0) IDBURN=0

IF(IDBURN.NE.0) GO TO 2

T24=T23

WFD=0.

FAR24=0.

GO TO 7

2 IF(IDBURN.EQ.2) T24=T23+2000.

3 IF(T24.GT.4000.) T24=4000.

IF(T24.LT.T23) T24=T23

C *** IF DESIRED, ENTER CALCULATIONS FOR ETAD HERE

HV=(((((1.-.4594317E-19*T24)-.2034116E-15)*T24+.2783643E-11)*T24+

1.2051501E-07)*T24-.2453116E-03)*T24-.9433296E-01)*T24+.1845537E+05

CALL THERMO(P24,HA,T24,XX1,XX2,0,0,0,0)

FAR24=(HA-H23)/(HV*ETAD)

IF(FAR24.LT.0.) FAR24=0.

WFDX=FAR24*WAD

IF(IDBURN.NE.2) GO TO 6

ERRX=(WFD-WFDX)/WFD

DIR=SQR(WFD/WFDX)

CALL AFQUIR(Q(1),T24,ERRX,0.,20.,0.0001,DIR,T24T,IG0)

GO TO (4,7,5),IG0

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Part II

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4      T24=T24T
      GO TO 3
5      CALL ERROR
6      WFD=WFDX
7      CALL THERMO(P24,H24,T24,S24,XX2,1,FAR24,0)
      WG24=WFD+WAD
      IF(IDES.EQ.1) WRITE(6,101) WA23DS
101    FORMAT(12HODUCT DESIGN,12X8H WA23DS=,E15.8)
C *** IF DESIRED, ENTER OTHER LOSSES HERE
      T25=T24
      P25=P24
      H25=H24
      S25=S24
      IF(IGASMGT.0) GO TO 11
      WORD=AWORD2
      A28SAV=A28
      A29SAV=A29
      NOZD=0
      IDNOZ=0
      IF(NOZFLT.EQ.2.OR.NOZFLT.EQ.3) NOZD=1
      IF(IDES.EQ.1.OR.IDBURNGT.0.OR.NOZD.EQ.1) IDNOZ=1
      IF(IDCD.EQ.1) GO TO 8
      CALL CONVRG(T25,H25,P25,S25,FAR24,WG24,P1,IDNOZ,A28,      P25R,
1T28,H28,P28,S28,TS28,PS28,V28,AM28,ICON)
      GO TO (9,9,9,5),ICON
8      CALL CONDIV(T25,H25,P25,S25,FAR24,WG24,P1,IDNOZ,A28,A29,P25R,
1T28,H28,P28,S28,T29,H29,P29,S29,TS28,TS29,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)=(P25R-P25)/P25R
      IF(IDNOZ.EQ.1) WRITE(6,100) A28,AM28,A29,AM29
100    FORMAT(19HODUCT NOZZLE DESIGN,5X8H      A28=,E15.8,8H      AM28=,E15.8,
18H      A29=,E15.8,2H      AM29=,E15.8)
11     CALL FAST8K
      RETURN
      END

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Part II

\$IBFTC FASTBK DECK,M94/2,XR7
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	,WAF	,WAF	,WA3	,WG4	,FAR4	,
6CNC	,PRC	,ETAC	,WACC	,WAC	,ETAB	,DPCOM	,DUMF	,
7CNHP	,ETATHP	,DHTCHP	,DHTC	,BLHP	,WG5	,FAR5	,CS	,
8CNLP	,ETATLP	,DHTCLP	,DHTF	,BLLP	,WG55	,FAR55	,HPEXT	,
9AM	,ALTP	,ETAR	,ZF	,PCNF	,ZC	,PCNC	,WFB	,
ATFFHP	,TFFLP	,PCBLF	,PCBLC	,PCBLDU	,PCBLOB	,PCBLHP	,PCBLLP	,

COMMON / SIDE/

XXP1	,XWAF	,XWAC	,XBLF	,XBLOU	,XH3	,DUMS1	,DUMS2	,
XXT21	,XP21	,XH21	,XS21	,T23	,P23	,H23	,S23	,
3T24	,P24	,H24	,S24	,T25	,P25	,H25	,S25	,
4T28	,P28	,H28	,S28	,T29	,P29	,H29	,S29	,
5HAD	,WFD	,WG24	,FAR24	,ETAD	,DPDUC	,BYPASS	,DUMS3	,
6TS28	,PS28	,V28	,AM28	,TS29	,PS29	,V29	,AM29	,

COMMON / BACK/

XXT55	,XP55	,XH55	,XS55	,XT25	,XP25	,XH25	,XS25	,
XXWFB	,XWG55	,XFAR55	,XWFD	,XWG24	,XFAR24	,XXP1	,DUMB	,
3T6	,P6	,H6	,S6	,T7	,P7	,H7	,S7	,
4T8	,P8	,H8	,S8	,T9	,P9	,H9	,S9	,
5WG6	,WFA	,WG7	,FAR7	,ETAF	,DPAFT	,V55	,V25	,
6PS6	,V6	,AM6	,TS7	,PS7	,V7	,AM7	,AM25	,
7TS8	,PS8	,V8	,AM8	,TS9	,PS9	,V9	,AM9	,
8VA	,FRD	,VJD	,FGND	,VJN	,FGMN	,FGPD	,FGPM	,
9FGM	,FGP	,WFT	,WGT	,FART	,FG	,FN	,SFC	,

XT55=T55

XP55=P55

XH55=H55

XS55=S55

XT25=T25

XP25=P25

XH25=H25

XS25=S25

XWFB=WFB

XWG55=WG55

XFAR55=FAR55

XWFD=WFD

XWG24=WG24

XFAR24=FAR24

XXP1=P1

CALL COMIX

RETURN

END

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Part II

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$IBFTC COMIX  DECK,H94/2,XR7
SUBROUTINE COMIX
COMMON / ALL/
1WORD ,IDES ,JDES ,KDES ,MODE ,INIT ,IDUMP ,IANTF ,
2IGASHX,IOBURN,IAFTBN,IDCD ,IMCD ,IDSHOC,IMSHOC,NOZFLT,
3ITRYS ,LOOPER,NOHAP ,NURMAP,MAPEDG,TOLALL,ERR(6)
COMMON /DESIGN/
1PCNFGU,PCNCGU,T4GU ,DUMD1 ,DUMD2 ,DELFG ,DELFN ,DELSFC,
2ZFDS ,PCRFDS,PRFDS ,ETAFDS,MAFDS ,PRFCF ,ETAFCF,MAFCF ,
3ZCDS ,PCNCDS,PRCDS ,ETACDS,WACDS ,PRCCF ,ETACCF,WACCF ,
4T4DS ,WFBDS ,OTCDS,ETABDS,MA3CDS,DPCDS,OTCOCF,ETABCF,
5TFHPDS,CNHPDS,ETHPDS,TFHPCF,CNHPCF,ETHPCF,DHHPCF,T2DS ,
6TFLPDS,CNLPDS,ETLPDS,TFLPCF,CNLPDF,ETLPDF,DHLPDF,T21DS ,
7T24DS ,WFDOS ,DTODDS,ETADDS,MA2SDS,DPODSD,DTODCF,ETADCF,
8T7DS ,WFAOS ,DTAFDS,ETAADS,WG6CDS,DPAFDS,DTAFCF,ETAACF,
9A55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A28 ,A29 ,
AP55 ,AM55 ,CVDNDZ,CVMNDZ,A6SAV ,A9SAV ,A28SAV,A29SAV
COMMON / BACK/
1T55 ,P55 ,H55 ,S55 ,T25 ,P25 ,H25 ,S25 ,
2WFB ,W655 ,FAR55 ,WFD ,W624 ,FAR24 ,P1 ,DUMB ,
3T6 ,P6 ,H6 ,S6 ,T7 ,P7 ,H7 ,S7 ,
4T8 ,P8 ,H8 ,S8 ,T9 ,P9 ,H9 ,S9 ,
5W66 ,WFA ,W67 ,FAR7 ,ETAA ,DPAFT ,V55 ,V25 ,
6PS6 ,V6 ,AM6 ,TS7 ,PS7 ,V7 ,AM7 ,AM25 ,
7TS8 ,PS8 ,V8 ,AM8 ,TS9 ,PS9 ,V9 ,AM9 ,
8VA ,FRD ,VJD ,FGKD ,VJM ,FGMD ,FGPD ,FGPM ,
9FCN ,FGP ,WFT ,WGT ,FART ,FG ,FN ,SFC
DATA AWORD/6H COMIX/
DIMENSION QQ(9)
WORD=AWORD
AJ=778.26
CAPSF=2116.2170
G=32.174049
CALL PROCOM(FAR55,T55,XX1,XX2,XX3,XX4,PHI55,XX5)
CALL PROCOM(FAR24,T25,XX1,XX2,XX3,XX4,PHI25,XX5)
IF(IIDES.EQ.0) GO TO 6
C *** CALCULATE A55 AND A25 WITH PS25=PS55
IF(PS55.EQ.0.) GO TO 50
TS55=T55*(PS55/P55)**0.285
DO 1 I=1,15
CALL PROCOM(FAR55,TS55,CS55,AK55,CP55,REX55,PHI55,H55)
PHIS=PHI55-REX55*ALOG(P55/PS55)
DELPHI=PHIS-PHI55
IF(ABS(DELPHI).LE.0.0001*PHIS) GO TO 3
1 TS55=TS55*EXP(4.0*DELPHI)
2 CALL ERROR
RETURN
50 TS55=0.875*T55
DO 51 I=1,15
CALL PROCOM(FAR55,TS55,CS55,AK55,CP55,REX55,PHI55,H55)
V55=AM55*CS55
MSCAL=H55-V55**2/(2.*S*AJ)
DELHS=MSCAL-H55
IF(ABS(DELHS).LE.0.0005*MSCAL) GO TO 52
51 TS55=TS55+DELHS/CP55
GO TO 2
52 P55=P55/EXP((PHI55-PHI55)/REX55)
3 IF(H55.GT.H555) GO TO 53
WRITE(5,101)P55,PS55,T55,TS55,H55,H555
101 FORMAT(22HOSQRT OF H55-H555 NEG ,6E15.6,6H$$$$$)
CALL ERROR

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53  V55=SCRT(2.*G*AJ*(H55-HS55))
    RHQ=CAPSF*PS55/(AJ*REX55*TS55)
    A55=WG55/(RHQ*V55)
    AM55=V55/CS55
    IF(IGASHX.GT.0) GO TO 54
    WRITE(6,104)A55,AM55
104  FORMAT(20HOTURBINE AREA DESIGN,6X6H A55=,E15.8,8H AM55=,E15.8)
    GO TO 28
54  PS25=PS55
    TS25=TS55*(PS25/P25)*0.286
    DO 4 I=1,5
    CALL PROCOR(FAR24,TS25,CS25,AK25,CP25,REX25,PHIS25,HS25)
    PHIS=PHIS25-REX25*ALOG(P25/PS25)
    DELPHI=PHIS-PHIS25
    IF(ABS(DELPHI).LE.0.0001*PHIS) GO TO 5
4    TS25=TS25*EXP(4.0*DELPHI)
    GO TO 2
5    IF(H25.GT.HS25) GO TO 55
    WRITE(8,102)P25,PS25,T25,TS25,H25,HS25
102  FORMAT(22HOSQRT OF H25-HS25 NEG ,6E15.6,6H555555)
    CALL ERROR
55  V25=SQRT(2.*G*AJ*(H25-HS25))
    RHQ=CAPSF*PS25/(AJ*REX25*TS25)
    A25=WG24/(RHQ*V25)
    AM25=V25/CS25
    WRITE(6,100)A55,AM55,A25,AM25
100  FORMAT(25HOTURBINE/DUCT AREA DESIGN,7H A55=,E15.8,
    18H AM55=,E15.8,8H A25=,E15.8,8H AM25=,E15.8)
    GO TO 20
C *** CALCULATE PS55 AND PS25
6  WQA=WG55/A55
    C1=PS5*SQRT(6/(TS5*AJ))*CAPSF
    MCON=0
    QQ(2)=0.
    QQ(3)=0.
    AM55=0.50
    TS55=0.875*TS5
7  DO 8 I=1,15
    CALL PROCOR(FAR55,TS55,CS55,AK55,CP55,REX55,PHIS55,HS55)
    V55=AM55*CS55
    HSCAL=H55-V55**2/(2.*G*AJ)
    DELHS=HSCAL-H555
    IF(ABS(DELHS).LE.0.0005*HSCAL) GO TO 9
8  TS55=TS55+DELHS/CP55
    GO TO 2
9  WQAT=C1*SQRT(AK55/REX55)*AM55/(1.+(AK55-1.)*AM55**2/2.)*
    1/((AK55+1.)/(2.-(AK55-1.)))
    AMX=AM55
    IGOG=0
10  DIP=WQA/WQAT
    E=(WQA-WQAT)/WQA
    CALL AFOUR(QQ(1),AMX,EM,C.,30.,0.0005,DIP,AMXT,ICON)
    GO TO (11,15,2),ICON
11  IF(AMXT.LE.1.0) GO TO 13
    AMXT=0.7
    MCON=MCON+1
    IF(MCON.LE.1) GO TO 13
    PCNF=DUMD1
    WRITE(8,103)PCNF,AMX,PS5,PS55,P25,PS25
103  FORMAT(22HOCOMIX PCNF=,F7.4,4H AM=,F8.6,5H PS5=,F9.5,
    16H PS55=,F9.5,5H P25=,F9.5,6H PS25=,F9.5,6H555555)

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PCNF=1.01*PCNF
DUMD1=PCNF
12  NOMAP=7
    RETURN
13  IF(IGOGO.EQ.1) GO TO 14
    AM55=AMXT
    GO TO 7
14  AM25=AMXT
    GO TO 16
15  IF(IGOGO.EQ.1) GO TO 19
    PS55=P55/EXP((PHI55-PHIS55)/REX55)
    IF(IGASMX.LE.0) GO TO 28
    WQA=WG24/A25
    C1=P25*SQRT(IG/(T25*AJ))*CAPSF
    MCON=0
    QQ(2)=0.
    QQ(3)=0.
    AM25=0.25
    TS25=0.875*T25
16  DO 17 I=1,15
    CALL PROCOM(FAR24,TS25,CS25,AK25,CP25,REX25,PHIS25,HS25)
    V25=AM25*CS25
    HSCAL=H25-V25**2/(2.*G*AJ)
    DELHS=HSCAL-HS25
    IF(ABS(DELHS).LE.0.0005*HSCAL) GO TO 18
    TS25=TS25+DELHS/CP25
    GO TO 2
17  WQAT=C1*SQRT(AK25/REX25)*AM25/(1.+(AK25-1.)*AM25**2/2.)*
18  1*((AK25+1.)/(2.*(AK25-1.)))
    AMX=AM25
    IGOGO=1
    GO TO 10
19  PS25=P25/EXP((PHI25-PHIS25)/REX25)
20  WG6=WG24+WG55
    ERR(5)=(PS25-PS55)/PS25
    WF6=WFD+WFB
    FAR6=WF6/(WG6-WF6)
    H6=(WG24*H25+WG55*H55)/WG6
    CALL THERMO(1.,H6,T6,PHI6,AMX,1,FAR6,1)
    C1=PS55*A55*(1.+AK55*AM55**2)+PS25*A25*(1.+AK25*AM25**2)
    TS6=0.833*T6
    DO 23 I=1,15
    CALL PROCOM(FAR6,TS6,CS6,AK6,CP6,REX6,PHIS6,HS6)
    C2=WG6*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)21,22,23
21  CALL ERROR
    RETURN
22  AM62=-C5/(2.*C4)
    GO TO 24
23  AM62=(SQRT(C6)-C5)/(2.*C4)
24  IF(AM62.LE.0.) GO TO 21
    AM6=SQRT(AM62)
    V6=AM6*CS6
    HSCAL=H6-V6**2/(2.*G*AJ)
    DELHS=HSCAL-HS6
    IF(ABS(DELHS).LE.0.0005*HSCAL) GO TO 26
25  TS6=TS6+DELHS/CP6

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26      GO TO 21
      IF (IGASHX.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((PHI6-PHIS6)/REX6)
      CALL THERMO(P6,H6,T6,S6,XX1,1,FAR6,0)
      S6AVE=(HG24*S25+HG55*S55)/HG6
      IF (S6.GE.S6AVE) GO TO 29
      S6=S6AVE
      P6=EXP(AMX*(PHI6-S6)/1.986375)
      GO TO 29
28      T6=T55
      P6=P55
      H6=H55
      S6=S55
      HG6=HG55
      PS6=P555
      V6=V55
      AM6=AM55
      IF (IGASHX.EQ.0) A6=A55
29      CALL COAF8N
      RETURN
      END
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Part II

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SUBROUTINE COAFBN DECK,M94/2,XR7
  SUBROUTINE COAFBN
  COMMON / ALL/
  INORD ,IDES ,JDES ,KDES ,MODE ,INIT ,IDUMP ,IAMTP ,
  2IGASHX,I6BURN,IAFTBN,IDCD ,IYCO ,IDSHOC,IFCHOC,NOZFLT,
  3ITRYS ,LOOPER,NUMAP ,NUMMAP,MAPEDG,TOLALL,ERR( )
  COMMON / DESIGN/
  1PCNFGJ,PCNFGU,T4GU ,DUMD1 ,DUMD2 ,DELF6 ,D5LFN ,DELSFC,
  2ZFDS ,PCNFDS,PRFDS ,ETAADS,MAFDS ,PRFCF ,ETA1SF,MAFCF ,
  3ECDS ,PCNCDS,PRCDS ,ETACDS,WACDS ,PRCCF ,ETACCF,WACCF ,
  4T4DS ,WF8DS ,DTCCDS,ETABDS,WA3CDS,DPCODS,DTCCCF,ETABCF,
  5TFHPDS,CNHPDS,ETHPDS,TSHPCF,CNHPCF,ETHPCF,DHHPCF,T2DS ,
  6TFLPDS,CNLPDS,ETLPDS,TFLPCF,CNLPDF,ETLPDF,DHLPDF,T21DS ,
  7T24DS ,WF0DS ,DT0DS,ETAADS,WA23DS,DPCUDS,DT0PCF,ETADC ,
  8T7DS ,MFADS ,DTAFDS,ETAADS,WG6CDS,DPAFDS,DTAFCF,ETAACF,
  9A55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A28 ,A29 ,
  AFS55 ,AM55 ,CVDNDZ,CVMNDZ,ABSAY ,A9SAV ,A28SAV,A29SAV
  COMMON / BACK/
  1T55 ,P55 ,H55 ,S55 ,T25 ,P25 ,H25 ,S25 ,
  2WF8 ,WG55 ,FAR55 ,WF9 ,WG24 ,FAR24 ,P1 ,DUM8 ,
  3T6 ,V6 ,H6 ,S6 ,T7 ,P7 ,H7 ,S7 ,
  4T8 ,V8 ,H8 ,S8 ,T9 ,P9 ,H9 ,S9 ,
  5WG6 ,WFA ,WGT ,FAR7 ,ETAA ,DPAFT ,V55 ,V25 ,
  6PS6 ,V6 ,AM6 ,TS7 ,P57 ,V7 ,AM7 ,AM25 ,
  7TS8 ,PS8 ,V8 ,AM8 ,TS9 ,PS9 ,V9 ,AM9 ,
  8VA ,FRD ,VJD ,FG83 ,VJM ,FGHM ,FGPD ,FGPH ,
  9FGM ,FGP ,WFT ,WGT ,FART ,FG ,FN ,SFC
  DIMENSION Q(9)
  DATA AWORD/6HCOAFBN/
  NORD=AWORD
  Q(2)=0.
  Q(3)=0.
  AJ=778.26
  CAPSF=2116.2170
  G=32.174049
  WF6=WF8
  IF (IGASHX.GT.0) WF6=WF6+WF0
  WA6=WF6-WF8
  C *** DRY LOSS
  WG6C=WG6*SQR(T6)/P6
  2 IF (IDES.EQ.1) WG6CDS=WG6C
  DPAFT=DPAFDS*(WG6C/WG6CDS)
  IF (DPAFT.GT.1.) DPAFT=1.
  P7=P6*(1.-DPAFT)
  A7=A6
  FAR6=WF6/WA6
  CALL PROCOM(FAR6,T6,XX1,XX2,XX3,XX4,PHI6,XX6)
  WQA=WG6/A7
  C1=P7*SQR(G/(T6-AJ))=CAPSF
  AM7=AM6
  TS7=0.875*T6
  20 DO 22 I=1,15
  CALL PROCOM(FAR6,TS7,CS7,AK7,CP7,REX7,PHI7,TS7)
  V7=AM7*CS7
  HSCAL=H6-V7**2/(2.*G-AJ)
  DELHS=HSCAL-HS7
  IF (ABS(DELHS).LE.0.0005*HSCAL) GO TO 24
  22 TS7=TS7+DELHS/CP7
  GO TO 8
  24 WQAT=C1*SQR(1+AK7/REX7)=AM7/(1.+(AK7-1.)*AM7**2/2.)*
  1/(1+AK7+1./(2.+(AK7-1.)))

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Part II

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DIR=WQA/WQAT
EW=(WQ1-WQAT)/WQA
CALL AFQUIR(Q11),AM7,EX0,,30.,0.0005,DIR,AM7T,IG01
GO TO (26,28,8),I60
26 AM7=AM7T
   IF(AM7.GE.1.0) AM7=0.9
   GO TO 20
28 PS7=P7/EXP((PHI6-PHIS7)/REX7)
   IF(IAFTBN.GT.0) GO TO 4
C *** HCN-AFTERBURNING
3   T7=T6
   WFA=0.0
   FAR7=FAR6
   WG7=WG6
   GO TO 13
C *** AFTERBURNING
4   IF(IAFTBN.EQ.2) T7=T6+2000.
   IF(T7.LE.T6) GO TO 3
   RHO65=CAPSF*P7/(AJ*REX7*TS7)
   PS65=PS7
   V65=V7
   Q(2)=0.
   Q(3)=0.
5   IF(T7.GT.4000.) T7=4000.
C *** IF DESIRED, ENTER CALCULATIONS FOR ETAA HERE
   HV=((((-4594317E-19*T7)-.2034116E-15)+T7+.2762643E-11)*T7
   +.2051501E-07)*T7-.2453116E-03)*T7-.9433296E-01)+T7+.1645537E+05
   CALL THERMO(P7,HA,T7,XX1,XX2,0,0,0,0)
   FAR7=(HA-H6)/(HV*ETAA)
   IF(FAR7.GT.0.) GO TO 6
   T7=T6
   GO TO 5
6   WFAX=FAR7*WG6
   IF(IAFTBN.EQ.1) GO TO 9
   ERRW=(WFA-WFAX)/WFA
   DIR=SQRT(WFA/WFAX)
   CALL AFQUIR(Q11),T7,ERRW,7.,20.,0.0001,DIR,T7T,I601
   GO TO (7,10,8),I60
7   T7=T7T
   GO TO 5
8   CALL ERROR
9   WFA=WFAX
10  FAR7=(WF6+WFA)/WA6
   WG7=WG6+WFA
C *** MOMENTUM LOSS
   CALL PROCOM(FAR7,T7-XX1,XX2,XX3,REX7,PHI7,H7)
   RHO7=CAPSF*P7/(AJ*REX7*T7)
   V7=WG7/(RHO7*A7)
   Q(2)=0.
   Q(3)=0.
   PS7=PS65-0.01
   RHO7=MS7/(V7*A7)
   HS7=H7-V7**2/(2.*G*AJ)
   CALL THERMO(1.0,HS7,TS7,PHIS7,XX2,1,FAR7,1)
   IF(TS7.GE.301.) GO TO 110
   CALL THERMO(1.0,HS7,400.,PHIS7,XX2,1,FAR7,0)
   V7=SQRT(2.*G*AJ*(H7-HS7))
   GO TO 11
110 PS7=RHO7*AJ*REX7*TS7/CAPSF
   PS7A=PS65+(RHO65*V65**2-RHO7*V7**2)/(G*CAPSF)
   DIR=SQRT(A55*(PS7/PS7A))

```

```
EP=(PS7-PS7A)/PS7
CALL AFQUIR(Q(1),V7,EP,0.,50.,0.0005,DIR,V7T,IGO)
V7=V7T
IF(V7.LT.100.) V7=100.
GO TO (11,12,8),IGO
12 P7=PS7*EXP((PH17-PH1S7)/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) WG6CDS
100 FORMAT(19H0AFTERBURNER DESIGN,5X8H WG6CDS=,E15.8)
CALL COMNOZ
RETURN
END
```

Part II

SIBFTC COMNDZ DECK,M94/2,XR7

SUBROUTINE COMNDZ

COMMON / ALL/

1WORD ,IDES ,JDES ,KDES ,MODE ,INIT ,IDUMP ,IANTP ,
 2IGASMX ,IDBURN ,IAFTBN ,IDCD ,IMCD ,IDSHOC ,INSHOC ,NOZFLT ,
 3ITRYS ,LOOPER ,KONAP ,KUNMAP ,MAPEDG ,TOLALL ,ERR(6)

COMMON /DESIGN/

1PCNFGU ,PCNCSU ,TAGU ,DUMD1 ,DUMD2 ,DELF6 ,DELFN ,DELSFC ,
 2ZFDS ,PCNFDS ,PRFDS ,ETAFDS ,WAFDS ,PRFCF ,ETAFCF ,WAFCF ,
 3ZCDS ,PCNCDS ,PRCDS ,ETACDS ,WACDS ,PRCCF ,ETACCF ,WACCF ,
 4T4DS ,WFBDS ,DTCODS ,ETABDS ,WA3CDS ,DPCODS ,DTCOCF ,ETABCF ,
 5TFHPDS ,CNHPDS ,ETHPDS ,TFHPCF ,CNHPCF ,ETHPCF ,DNHPCF ,T2DS ,
 6TFLPDS ,CNLPDS ,ETLPDS ,TFLPCF ,CNLPCF ,ETLPCF ,DHLPCF ,T1DS ,
 7T24DS ,WFDOS ,DTODS ,ETAODS ,WA23DS ,DPDUDS ,DTDUCF ,CTADCF ,
 8T7DS ,WFADS ,DTAFDS ,ETAADS ,WGSCDS ,DPAFDS ,DTAFCF ,ETAACF ,
 9A55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A28 ,A29 ,
 APS55 ,AM55 ,CYDNOZ ,CVMNOZ ,A8SAV ,A9SAV ,A28SAV ,A29SAV

COMMON / BACK/

1T55 ,P55 ,H55 ,S55 ,T25 ,P25 ,H25 ,S25 ,
 2WFB ,WG55 ,FAR55 ,WFO ,WG24 ,FAR24 ,P1 ,DUMB ,
 3T6 ,P6 ,H6 ,S6 ,T7 ,P7 ,H7 ,S7 ,
 4T8 ,P8 ,H8 ,S8 ,T9 ,P9 ,H9 ,S9 ,
 5WG6 ,WFA ,WG7 ,FAR7 ,ETAA ,DPAFT ,V55 ,V25 ,
 6PS6 ,V6 ,AM6 ,TS7 ,PS7 ,Y7 ,AM7 ,AM25 ,
 7TS8 ,PS8 ,V8 ,AM8 ,TS9 ,PS9 ,V9 ,AM9 ,
 8VA ,FRD ,VJD ,FCHD ,VJM ,FGMR ,FGFD ,FSPH ,
 9FGH ,FGP ,WFT ,HGT ,FART ,FG ,FH ,SFC

DATA ANORD/6HNOZZL/

HORD=AMGRD

A8SAV=A8

A9SAV=A9

A02M=0

HNOZ=0

IF (NOZFLT.EQ.1.OR.NOZFLT.EQ.3) NOZM=1

IF (IDES.EQ.1.OR.IAFTBN.GT.0.OR.NOZM.EQ.1) IMNOZ=1

IF (IMCD.EQ.1) GO TO 1

CALL CONVRG(T7,H7,P7,S7,FAR7,WG7,P1,IMNOZ,A8,P7R,

T8,H8,P8,S8,TS8,PS8,V8,AM8,ICON)

GO TO (3,3,3,2),ICON

1 CALL CONDIY(T7,H7,P7,S7,FAR7,WG7,P1,IMNOZ,A8,A9,P7R,

T8,H8,P8,S8,T9,H9,P9,S9,TS8,TS9,PS8,PS9,V8,V9,AM8,AM9,ICON)

IMSHOC=ICON

SO TO (4,4,4,2),ICON

2 CALL ERROR

3 T9=T8

H9=H8

P9=P8

S9=S8

TS9=TS8

PS9=PS8

V9=V8

AM9=AM8

A9=A8

IMSHOC=ICON+3

4 ERR(6)=(P7R-P7)/P7R

IF (IMNOZ.EQ.1) WRITE(6,100) A8,AM8,A9,AM9

100 FORMAT(14HNOZZLE DESIGN,10X3H A8=.E15.8,3H AM8=.E15.8,

18H A9=.E15.8,2H AM9=.E15.8)

RETURN

END

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Part II

SIBFTC PERF DECK,M94/2,XR7

SUBROUTINE PERF

COMMON / ALL/

1WORD ,IDES ,JDES ,KDES ,NODE ,INIT ,IDUMP ,IAMTP ,
2IGASHX ,IDURN ,IAFTN ,IDCD ,IMCO ,IDSHOC ,IMSHOC ,NOZFLT ,
3ITKYS ,LOOPER ,NOKAP ,NUMMAP ,MAPEDG ,TOLALI ,ERR(6)

COMMON /DESIGN/

1PCNFGU ,PCNCGU ,T4GU ,DUMD1 ,DUMD2 ,DELFG ,DELFN ,DELSFC ,
2ZFDS ,PCNFDS ,PFDS ,ETAFDS ,MAFDS ,PRFCF ,ETAFCF ,MAFCF ,
3ZCDS ,PCNCDS ,PRCDS ,ETACDS ,WACDS ,PRCCF ,ETACCF ,MACCF ,
4T4DS ,MFEDS ,DTCODS ,ETABDS ,WA3CDS ,DPCODS ,OTCCOF ,ETABCF ,
5TFHPDS ,CNHPDS ,ETHPDS ,TFHPCF ,CNHPCF ,ETHPCF ,DHHPCF ,T2DS ,
6YFLPOS ,CNLPDS ,ETLPDS ,TFLPCF ,CNLPFC ,ETLPFC ,DHEPCF ,T2IDS ,
7T24DS ,MFUDS ,DTUDS ,ETACDS ,WA23DS ,DPUDS ,DTUCLF ,ETADCF ,
8T7DS ,MFADS ,DTAFDS ,ETAADS ,WG6CDS ,DPAFDS ,DTAFCF ,ETAACF ,
9A55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A28 ,A29 ,
APSS5 ,AM55 ,CVGN0Z ,CVKNOZ ,A8SAV ,A9SAV ,A28SAV ,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 ,BLOU ,BLOB ,
5CHF ,PRF ,ETAF ,MAFC ,MAF ,MA3 ,WG4 ,FAR4 ,
6CHC ,PRC ,ETAC ,MACC ,MAC ,ETAB ,DPCOM ,DUMF ,
7CHHP ,ETATHP ,DHTCHP ,DHTC ,BLHP ,WG5 ,FAR5 ,CS ,
8CHLP ,ETATLP ,DHTCLP ,DHTF ,BLLP ,WG55 ,FAR55 ,HPEXT ,
9AM ,ALTP ,ETAR ,ZF ,PCNF ,ZC ,PCNC ,WFB ,
ATFFHP ,TSFLP ,PCBLF ,PCBLC ,PCBLW ,PCBLOB ,PCBLHP ,PCBLLP

COMMON / SIDE/

XXP1 ,XMAF ,XWAC ,XBLF ,XBLOU ,XM3 ,DUMS1 ,DUMS2 ,
XXT21 ,XP21 ,XH21 ,XS21 ,T23 ,P23 ,H23 ,S23 ,
3T24 ,P24 ,H24 ,S24 ,T25 ,P25 ,H25 ,S25 ,
4T28 ,P28 ,H28 ,S28 ,T29 ,P29 ,H29 ,S29 ,
5WAD ,WFD ,WG24 ,FAR24 ,ETA0 ,DPDUM ,BYPASS ,DUMS3 ,
6TS28 ,PS28 ,V28 ,AM28 ,TS29 ,PS29 ,V29 ,AM29

COMMON / BACK/

XXT55 ,XP55 ,XH55 ,XS55 ,XT23 ,XP23 ,XH23 ,XS23 ,
XXWFB ,XWG55 ,XFAR55 ,XWFD ,XWG24 ,XFAR24 ,XXP1 ,DUMB ,
3T6 ,P6 ,H6 ,S6 ,T7 ,P7 ,H7 ,S7 ,
4T8 ,P8 ,H8 ,S8 ,T9 ,P9 ,H9 ,S9 ,
5WG6 ,WFA ,WG7 ,FAR7 ,ETAA ,DPAFT ,V55 ,V25 ,
6PS4 ,V6 ,AM6 ,TS7 ,PS7 ,V7 ,AM7 ,AM25 ,
7TS8 ,PS8 ,V8 ,AM8 ,TS9 ,PS9 ,V9 ,AM9 ,
8JA ,FRD ,VJD ,FGMD ,VJM ,FGMM ,FGPD ,FGPM ,
9FGN ,FCP ,WFT ,WGT ,FART ,FG ,FH ,SFC

DATA AMORD/6H PERF/

WORD=AMORD

G=32,174049

CAPSF=2116,2170

WFT=WF0+WFD+WFA

WAT=WAC-WLNB

WGT=WAT+WFT

FART=WFT/WAT

YA=AMPCS

FRD=YA*WAF,5

VJM=CVKNOZ/VG

FGHRCV=AM*WG7/5

VGPR=CAPSP*(PS9-P1)*A9

IF(IGASHX,GT,0) GO TO 1

VJD=CAPSDZ+V29

FGMD=VJD*WG24/G

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1  FGPC=CAPSF*(PS29-21)*A29
    FGM=FGMH+FGMD
    FGP=FGPM+FGPD
    FG=FGH+FGP
    FN=FG-FRD
    SFC=3600.*WFT/FN
    FG=DELFG*FG
    FN=DELFN*FN
    SFC=DELSFC*SFC
    CALL OUTPUT
    CALL ERROR
    RETURN
    END
```

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Part II

SIBFTC OUTPUT DECK,M94/2,XR7

SUBROUTINE OUTPUT

COMMON / ALL/

1WORD ,IDES ,JDES ,KDES ,MODE ,INIT ,IDUMP ,IAHTP ,
 2IGASHX ,IDURN ,IAFTBN ,IDCD ,IMCD ,IDSHOC ,IMSHOC ,NOZFLT ,
 3ITRYS ,LOOPER ,NOMAP ,NUMMAP ,MAPEOG ,TOLALL ,ERR(6)

COMMON / DESIGN/

1PCNFGU ,PCNCGU ,T4GU ,DUMD1 ,DUMD2 ,DELFG ,DELFN ,DELSFC ,
 2ZFCDS ,PCNFDS ,PRFDS ,ETAFDS ,WAFDS ,PRFCF ,ETAFCF ,WAFCF ,
 3ZCDS ,PCNCDS ,PRGDS ,ETACDS ,WACDS ,PRCCF ,ETACCF ,WACCF ,
 4T4DS ,WFBDS ,OTCDS ,ETABDS ,WA3CDS ,OPCDS ,OTCOEF ,ETABCF ,
 5TFHPDS ,CNHPDS ,ETHPDS ,TFHPCF ,CNHPCF ,ETHPCF ,DMHPCF ,T2DS ,
 6TFLPDS ,CNLPDS ,ETLPDS ,TFLPCF ,CNLPCF ,ETLPCF ,DMHPCF ,T2IDS ,
 7T24DS ,WFGDS ,OTDUDS ,ETADDS ,WA23DS ,DPDUDS ,OTDUCF ,ETADCF ,
 8T7DS ,WAFDS ,OTAFDS ,ETAAOS ,WG6CDS ,OPAFDS ,DTAFCF ,ETAACF ,
 9A55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A28 ,A29 ,
 APS55 ,AM55 ,CYDNOZ ,CYKHOZ ,A8SAV ,A9SAV ,A28SAV ,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 ,BLG ,BLDU ,BLDB ,
 5CNF ,PRF ,ETAF ,WAF ,WAF ,WA3 ,HG4 ,FAR4 ,
 6CNC ,PRC ,ETAC ,WACC ,WAC ,ETAB ,OPCOM ,DUMF ,
 7CNHP ,ETATHP ,DHTCHP ,DHTC ,BLMP ,S5 ,FAR5 ,CS ,
 8CNLP ,ETATLP ,DHTCLP ,DHTF ,BLLP ,HG55 ,FAR55 ,HPEXT ,
 9AM ,ALT ,ETAR ,ZF ,PCNF ,ZC ,PCNC ,WFB ,
 ATFFHP ,TFFLP ,PCBLF ,PCBLC ,PCBLDU ,PCBLDB ,PCBLHP ,PCBLLP

COMMON / SIDE/

XXP1 ,XWAF ,XWAC ,XBLF ,XBLDU ,XH3 ,DUMS1 ,DUMS2 ,
 XXT21 ,XP21 ,XH21 ,XS21 ,T23 ,P23 ,H23 ,S23 ,
 3T24 ,P24 ,H24 ,S24 ,T25 ,P25 ,H25 ,S25 ,
 4T28 ,P28 ,H28 ,S28 ,T29 ,P29 ,H29 ,S29 ,
 5WAD ,WFD ,WG24 ,FAR24 ,ETAD ,OPDUC ,BYPASS ,DUMS3 ,
 6TS28 ,PS28 ,V28 ,AM28 ,TS29 ,PS29 ,V29 ,AM29

COMMON / BACK/

XXT55 ,XP55 ,XH55 ,XS55 ,XT25 ,XP25 ,XH25 ,XS25 ,
 XXNFB ,XWG55 ,XFAR55 ,XWFD ,XWG24 ,XFAR24 ,XXP1 ,DUMB ,
 3T6 ,P6 ,H6 ,S6 ,T7 ,P7 ,H7 ,S7 ,
 4T8 ,P8 ,H8 ,S8 ,T9 ,P9 ,H9 ,S9 ,
 5WG6 ,WFA ,WG7 ,FAR7 ,ETAA ,DPAFT ,V55 ,V25 ,
 6PS6 ,V6 ,AM6 ,TS7 ,PS7 ,V7 ,AM7 ,AM25 ,
 7TS8 ,PS8 ,V8 ,AM8 ,TS9 ,PS9 ,V9 ,AM9 ,
 8VA ,FRD ,VJD ,FGMD ,VJM ,FGM ,FGPD ,FGPM ,
 9FGM ,FGP ,WFT ,WGT ,FART ,FG ,FM ,SFC

DIMENSION W(5,4),ANS1(80),ANS2(80),ANS3(40),ANS4(72)

EQUIVALENCE (ANS1,PCNFGU),(ANS2,T1),(ANS3,XP1),(ANS4,XT55)

DATA ANORD1,ANORD2/6HOUTPUT,6HCOMMON/

DATA (W(1,1),I=1,4)/6HSUBSON,6HIC C-D,6H NOZZLE,6HE /

DATA (W(2,1),I=1,4)/6HSHOCK ,6HINSIDE,6H C-D ,6HNOZZLE /

DATA (W(3,1),I=1,4)/6HSHOCK ,6HOUTSID,6H C-D ,6HNOZZLE /

DATA (W(4,1),I=1,4)/6HSHOCK ,6HIC CON,6HYERE ,6HNOZZLE /

DATA (W(5,1),I=1,4)/6HSHOCK ,6HCONVER,6HGEANT N,6HNOZZLE /

WORD=ANORD1

IF(IDES.EQ.1) GO TO 4

IF(IDURN.GT.0) GO TO 2

IF(IAFTBN.GT.0) GO TO 1

WRITE(6,100)WORD,AM,ALT, T4,ETAR

GO TO 3

1 WRITE(6,101)WORD,AM,ALT, T4,T7,ETAR

GO TO 3

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2  WRITE(6,102)WORD,AM,ALTP,T4,T24,ETAR
3  CALL CONOUT(2)
4  WRITE(6,104)(W(IMSHOC,I),I=1,4),FG,FN,SFC
   IF(IGASM.GT.0) GO TO 5
   WRITE(6,105)(W(IDSHOC,I),I=1,4)
5  WRITE(6,106)LOOPER
   WORD=AWORD2
   WRITE(6,107)WORD,ZF,PCNF,ZC,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=A8SAV
   A9=A9SAV
   A28=A28SAV
   A29=A29SAV
   IF(IDUMP.NE.2) GO TO 6
   WRITE(6,110)
   CALL SYG(2)
6  CALL ENGBAL
   RETURN
100 FORMAT(1H8,A6,14X7H   AM=,F7.3,6X7H  ALTP=,F7.0,
16X7H   T4=,F8.2,25X7H  ETAR=,F7.4)
101 FORMAT(1H6,A6,14X7H   AM=,F7.3,6X7H  ALTP=,F7.0,
16X7H   T4=,F8.2,5X7H   T7=,F8.2,5X7H  ETAR=,F7.4)
102 FORMAT(1H8,A6,14X7H   AM=,F7.3,6X7H  ALTP=,F7.0,
16X7H   T4=,F8.2,5X7H   T24=,F8.2,5X7H  ETAR=,F7.4)
103 FORMAT(6HMAIN ,4A6,9X3HFG=,F9.2,18X3HFN=,F9.2,18X4HSFC=,F8.5)
105 FORMAT(6H DUCT ,4A6)
106 FORMAT(16H1CONVERGED AFTER,14,6H LOGPS,/,1H8)
107 FORMAT(1H ,A6,9X,5E15.6,14)
108 FORMAT(1H )
109 FORMAT(1H ,8E15.6)
110 FORMAT(1H1)
   END

```

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Part II

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$IBFTC CONOUT DECK,M94/2,XR7
SUBROUTINE CONOUT(ICON)
COMMON / ALL/
1WORD ,IDES ,JDES ,KDES ,MODE ,INIT ,IDUMP ,IAMTP ,
2IGASKX ,IDBURN ,IAFTBN ,IDCD ,IMCD ,IDSMOC ,IMSHOC ,NOZFLT ,
3ITRYS ,LGOPER ,NOMAP ,NUMHAP ,MAPEDG ,TOLALL ,ERR(6)
COMMON / DESIGN/
1PCNFGU ,PCNCGU ,T4GU ,DUMD1 ,DUMD2 ,DELFG ,DELFN ,DELSFC ,
2ZFDS ,PCNFDS ,PRFDS ,ETAFDS ,WAFDS ,PRFCF ,ETAFCF ,WAFCF ,
3ZCDS ,PCNCDS ,PRCDS ,ETACDS ,WACDS ,PRCCF ,ETACCF ,WACCF ,
4T4DS ,WFBDS ,OTCDS ,ETABDS ,WA3CDS ,DPCDS ,OTCOCF ,ETABCF ,
5TFHPDS ,CHHPDS ,ETHPDS ,TFHPCF ,CHHPCF ,ETHPCF ,DHHPCF ,T2DS ,
6TFLPDS ,CHLPDS ,ETLPCF ,TFLPCF ,CHLPCF ,ETLPCF ,DHLPCF ,T21DS ,
7T24DS ,WFDD ,OTOUDS ,ETADDS ,WA23DS ,DPDUUS ,DTOUUCF ,ETADCF ,
8TTDS ,WFAOS ,DTAFDS ,ETAADS ,WGSCDS ,GFAFDS ,DTAFCF ,ETAACF ,
9A55 ,A25 ,A6 ,A7 ,A8 ,A9 ,A28 ,A29 ,
AP55 ,AM55 ,CYDNOZ ,CYMNOZ ,AESAV ,A9SAV ,A28SAV ,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 ,BLGB ,
5CHF ,PRF ,ETAF ,WAF ,WAF ,WA3 ,WG4 ,FAR4 ,
6GHC ,PRC ,ETAC ,WACC ,WAC ,ETA8 ,DPCOM ,DUMF ,
7T4M2 ,ETATHP ,DHTCHP ,DHTC ,BLHP ,WG5 ,FAR5 ,CS ,
8CNLP ,ETATLP ,DHTCLP ,DHTF ,BLLP ,WG55 ,FAR55 ,HPEXT ,
9AM ,ALP ,ETAR ,ZF ,PCNF ,ZC ,PCHC ,W5B ,
ATFFHP ,TFFLP ,PCBLF ,PCBLC ,PCBLDU ,PCBLOB ,PCBLHP ,PCBLP
COMMON / SIDE/
XXP1 ,XWAF ,XWAC ,XBLF ,XBLOU ,XH3 ,DUMS1 ,DUMS2 ,
XXT21 ,XP21 ,XH21 ,XS21 ,T23 ,P23 ,H23 ,S23 ,
3T24 ,P24 ,H24 ,S24 ,T25 ,P25 ,H25 ,S25 ,
4T26 ,P26 ,H26 ,S26 ,T29 ,P29 ,H29 ,S29 ,
5WAD ,WFD ,WG24 ,FAR24 ,ETA8 ,DPDUC ,BYPASS ,DUMS3 ,
6TS28 ,PS28 ,V28 ,AM28 ,TS29 ,PS29 ,V29 ,AM29
COMMON / BACK/
XXT55 ,XP55 ,XH55 ,XS55 ,XT25 ,XP25 ,XH25 ,XS25 ,
XXWFB ,XWG55 ,XFAR55 ,XWFD ,XWG24 ,XFAR24 ,XXP1 ,DUMB ,
3T4 ,P6 ,H6 ,S6 ,T7 ,P7 ,H7 ,S7 ,
4T8 ,P8 ,H8 ,S8 ,T9 ,P9 ,H9 ,S9 ,
5WG6 ,WFA ,WG7 ,FAR7 ,ETAA ,DPAFT ,V55 ,V25 ,
6FS6 ,V6 ,AM6 ,TS7 ,PS7 ,V7 ,AM7 ,AM25 ,
7TS8 ,PS8 ,V8 ,AM8 ,TS9 ,PS9 ,V9 ,AM9 ,
8VA ,FRD ,VJD ,FGMD ,VJM ,FGMH ,FGPD ,FGPM ,
9FCR ,FGP ,WGT ,FART ,FG ,FN ,SFC
DIMENSION PARAM(280),WORDY(250),IOUT(103),AOUT(6),WOUT(6)
EQUIVALENCE (PARAM,PCNFGU)
DATA (WORDY(I),I=1,98)/
16HPCNFGU,6HPCNCGU,6HT4GU ,6HOUND1 ,6HOUND2 ,6HDELF6 ,6HDELFN ,
26HDELSFC,6H2FDS ,6HPCNFDS,6HPRFDS ,6HETAFDS,6HWAFDS ,6HPRFCF ,
36HETAFCF,6HWAFCF ,6HZCDS ,6HPCNCDS,6HPRCDS ,6HETACDS,6HWACDS ,
46HPRCCF ,6HETACCF,6HWACCF ,6HT4DS ,6HWFBD ,6HOTCDS,6HETABDS ,
56HWA3CDS,6HDPCDS ,6HOTCOCF,6HETA2CF,6HTFHPDS,6HCHHPDS,6HETHPDS ,
66HTFHPCF,6HCHHPCF,6HETHPCF,6HCHHPCF,6HT2DS ,6HTFLPDS,6HCHLPDS ,
76HETLPDS,6HTFLPCF,6HCHLPF,6HETLPF,6HCHLPF,6HT21DS ,6HT24DS ,
86HWFDD ,6HDTOUUS,6HETADDS,6HWA23DS,6HDPDUUS,6HOTOUCF,6HETADCF ,
96HT7DS ,6HWFADS ,6HDTAFDS,6HETAADS,6HWG6CDS,6HOPA1DS,6HDTAFCF ,
16HETAACF,6HA55 ,6HA25 ,6HA6 ,6HA7 ,6HA8 ,6HA9 ,
26HA28 ,6HA29 ,6HPS55 ,6HAM55 ,6HCYDNOZ,6HCYANDZ,6HA8SAV ,
36HA9SAV ,6HA28SAV,6HA29SAV,6HT1 ,6HT21 ,6HT21 ,6HT21 ,
46HT2 ,6HT2 ,6HT2 ,6HT2 ,6HT21 ,6HT21 ,6HT21 ,

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56HS21 ,6HT3 ,6HP3 ,6HM3 ,6HS3 ,6HT4 ,6HP4 /
DATA (WORDY(I),I=99,189)/
63HM4 ,6HS4 ,6HT5 ,6HP5 ,6HM5 ,6HS5 ,6HT55 ,
76HP55 ,6HM55 ,6HS55 ,6HBLF ,6HBLC ,6HBLDU ,6HBLDB ,
86HCNF ,6HPAF ,6HETAF ,6HMAFC ,6HMAF ,6HMA3 ,6HMA4 ,
96HFAR4 ,6HPC ,6HPRC ,6HETAC ,6HMACC ,6HMAC ,6HETAB ,
18HDFCOM ,6HDUMF ,6HCNHP ,6HETATHP ,6HDHTCHP ,6HDHTC ,6HBLHP ,
26HMG5 ,6HFAR5 ,6HCS ,6HCNLP ,6HETATLP ,6HDHTCLP ,6HDHTF ,
36HBLP ,6HMG55 ,6HFAR55 ,6HHPXT ,6HAM ,6HMLTP ,6HETAR ,
46HZF ,6HPCNF ,6H2C ,6HPCNC ,6HMF8 ,6HTFFHP ,6HTFFLP ,
56HPCBLF ,6HPCBLC ,6HPCBLDU ,6HPCBLOB ,6HPCSLHP ,6HPCSLP ,6HXP1 ,
66HXMWAF ,6HXMWAC ,6HXBLC ,6HXBLOU ,6HXM3 ,6HDUMS1 ,6HDUMS2 ,
76HXT21 ,6HXT21 ,6HXM21 ,6HXS21 ,6HT23 ,6HP23 ,6HM23 ,
86HS23 ,6HT24 ,6HP24 ,6HM24 ,6HS24 ,6HT25 ,6HP25 ,
96HM25 ,6HS25 ,6HT28 ,6HP28 ,6HM28 ,6HS28 ,6HT29 /
DATA (WORDY(I),I=190,280)/
16HP29 ,6HM29 ,6HS29 ,6HMD ,6HMF ,6HMG24 ,6HFAR24 ,
26HETAD ,6HDPDU ,6HBPSS ,6HDUMS3 ,6HTS28 ,6HPS28 ,6HV28 ,
36HAM28 ,6HTS29 ,6HPS29 ,6HV29 ,6HAM29 ,6HXT55 ,6HXP55 ,
46HXM55 ,6HXS55 ,6HXT25 ,6HXP25 ,6HXM25 ,6HXS25 ,6HXMFB ,
56HXMW55 ,6HMFAR55 ,6HXMFD ,6HXMG24 ,6HMFAR24 ,6HXP1 ,6HDMB ,
66HT6 ,6HP6 ,6HM6 ,6HS6 ,6HT7 ,6HP7 ,6HM7 ,
76HS7 ,6HT8 ,6HP8 ,6HM8 ,6HS8 ,6HT9 ,6HP9 ,
86HM9 ,6HS9 ,6HMG6 ,6HMA ,6HMG7 ,6HFAR7 ,6HETAA ,
96HDPFT ,6HV55 ,6HV25 ,6HPS6 ,6HV6 ,6HAM6 ,6HTS7 ,
16HP57 ,6HV7 ,6HAM7 ,6HAM25 ,6HTS8 ,6HPS8 ,6HV8 ,
26HAM8 ,6HTS9 ,6HPS9 ,6HV9 ,6HAM9 ,6HVA ,6HFRD ,
36HVJD ,6HFGMD ,6HVJM ,6HFGMM ,6HFGPD ,6HFGPM ,6HFGM ,
46HFGP ,6HMF ,6HMG7 ,6HFAR7 ,6HFG ,6HFM ,6HSFC /
DATA THEEND,BLANK,LIMIT/6HTHEEND,6H ,280/
GO TO (1,12),ICGN
C *** INPUT SECTION
1 DO 4 N=1,102
  NUM=N
  READ(5,100)AIN,CHANGE
  IF(AIN.EQ.THEEND) GO TO 5
  DO 2 J=1,LIMIT
    JJ=J
    IF(AIN.EQ.WORDY(J)) GO TO 3
  CONTINUE
  WRITE(6,101)AIN
  GO TO 4
2 IOUT(NUM)=JJ
  IF(CHANGE.NE.BLANK) WORDY(JJ)=CHANGE
  CONTINUE
  WRITE(6,102)
3 NUM=NUM+1
  RETURN
C *** OUTPUT SECTION
12 IF(NUM.EQ.1) GO TO 16
  N=NUM
  J=5
  DO 15 I=1,NUM,6
    IF(N.GT.6) GO TO 13
    J=N
13 N=N-6
    DO 14 K=1,J
      L=I+K-1
      M=IOUT(L)
      WOUT(K)=WORDY(M)
14 AOUT(K)=PARAM(M)

```

```

WRITE(5,103)INOUT(5),X(1,1)
WRITE(5,104)INOUT(5),X(1,1)
IF(N.LE.9) GO TO 16
15 CONTINUE
16 RETURN
100 FORMAT(A6,6X,A6)
101 FORMAT(104#THE WORD ,A6,26H NOT FOUND IN COMMON ARRAY)
102 FORMAT(10#ERROR IN CONOUT INPUT)
103 FORMAT(1H0,25XA6,5(9XA6))
104 FORMAT(1H ,20X6E15.6)
END

```

```

COMMON / ALL /
IMOR , IDES , JDES , ADES , RDES , IRIT , IDUAP , IAMP ,
, IACM , IUBRM , IAP78M , IUCD , IRSD , IDSNOG , IFSHOC , KOZFLT ,
, ITRY5 , LOOPER , NGMAP , MJMAP , MAPEDG , TOLALL , ERR(6)
COMMON / DESIGN /
1PCNFGU , PCNCGU , T4G4 , DUMD1 , DUMD2 , DELFG , DELFN , DELSFC ,
21FGS , PCNFDS , PRFDS , ETAFDS , WAFDS , PRFCF , ETAFCF , WAFCF ,
32CDS , PCNCDS , PRCDs , ETACDS , WACDS , PRCCF , ETACCF , WACCF ,
4T4DS , WFBDS , DTCDS , ETABDS , WACDS , DPCDS , DTCOCF , ETABCF ,
5TFHPOS , CHHPOS , ETHPOS , TFHPCF , CHHPCF , ETHPCF , OHHPCF , T2DS ,
6TFLPOS , CNLPOS , ETLPOS , TFLPCF , CNLPCF , ETLPCF , OHLPCF , T21DS ,
7T24DS , WFDS , DTGDS , ETADS , WAGDS , DPGDS , DTGOCF , ETADCF ,
8T7DS , WFADS , DTAADS , ETADS , WAGDS , DPAADS , DTAADF , ETAACF ,
9A55 , A25 , A6 , A7 , A8 , A9 , A28 , A29 ,
AP55 , AH55 , CYDNOZ , CVHNOZ , A8SAV , A9SAV , A28SAV , A29SAV
COMMON / FRONT /
IT1 , 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 , WAF , WAF , WAF , WAF , WAF ,
6CNC , PRC , ETAC , WACC , WAC , ETAB , DFCOM , DUMF ,
7CNHP , ETATHP , DHTCHP , DHTC , BLHP , HG5 , FAR5 , CS ,
8CNLP , ETATLP , DHTCLP , DHTF , BLLP , WG55 , FAR55 , HPEXT ,
9AM , ALTP , ETAR , ZF , PCNF , ZC , PCNC , WFB ,
ATFFHP , TFFLP , PCBLF , PCBL , PCBLDU , PCBLB , PCBLHP , PCBLP
COMMON / SIDE /
XXP1 , XWAF , XWAC , XBLF , XBLOU , XH3 , DUMS1 , DUMS2 ,
XT21 , XP21 , XH21 , XS21 , T23 , P23 , H23 , S23 ,
3T24 , P24 , H24 , S24 , T25 , P25 , H25 , S25 ,
4T28 , P28 , H28 , S28 , T29 , P29 , H29 , S29 ,
5W20 , WFD , WGT24 , FAR24 , ETAD , DPGUC , EYPASS , DUMS3 ,
6T528 , PS28 , V28 , AM26 , TS29 , PS29 , V29 , AM29
COMMON / BACK /
XT55 , XP55 , XH55 , XS55 , XT25 , XP25 , XH25 , XS25 ,
XXWF8 , XWG55 , XFAR55 , XWF2 , XWG24 , XFAR24 , XXP1 , DUM8 ,
3T6 , P6 , H6 , S6 , T7 , P7 , H7 , S7 ,
4T8 , P8 , H8 , S8 , T9 , P9 , H9 , S9 ,
5WG6 , WFA , WG7 , FAR7 , ETAA , DPAFT , V55 , V25 ,
6PS6 , V6 , AM6 , TS7 , P37 , V7 , AM7 , AM25 ,
7TS8 , PS8 , V8 , AM8 , TS9 , PS9 , V9 , AM9 ,
8YA , FRD , VJD , FGND , VJM , FGMM , FGPD , FGPM ,
9FGM , FGP , WFT , WGT , FART , FG , FN , SFC
DIMENSION TRASH1(80), TRASH2(80), TRASH3(48), TRASH4(72)
EQUIVALENCE (TRASH1, PCNFGU), (TRASH2, T1), (TRASH3, XP1), (TRASH4, XT55)
DATA ANGRD/6HCOMMON/
WRITE(6,100)WORD
WORD=ANGRD
WRITE(6,102)WORD, ZF, PCNF, ZC, PCNC, T4, RODE
WRITE(6,103)
WRITE(6,104)(TRASH1(I), I=1,80)
WRITE(6,105)
WRITE(6,104)(TRASH2(I), I=1,80)
WRITE(6,103)
WRITE(6,104)(TRASH3(I), I=1,48)
WRITE(6,103)
WRITE(6,104)(TRASH4(I), I=1,72)
WRITE(6,103)
WRITE(6,106)LOOPER

```

PC 13

```
      IF(10WRP.EQ.0) GO TO 2
      WRITE(6,105)
      CALL SYG(2)
2     CALL ENGBAL
      RETURN
100    FORMAT(28H0AN 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(25H0FAILED TO CONVERGE AFTER,14,6H LOOPS)
      END
```

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```
118FTC SYG      DECK,M94/2,XR7
      SUBROUTINE SYG(ICON)
      DIMENSION WORD(132)
      DATA ONEDOL/6H$ /
      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(132A1)

C          CHECK FOR 12 LEADING DOLLAR SIGNS

      DO 10 I=1,12
      IF(WORD(I)-ONEDOL)11,10,11
10     CONTINUE
      RETURN

C          CHECK FOR 6 TRAILING DOLLAR SIGNS
11     DO 15 I=1,132
      I=I
      IF(WORD(I)-ONEDOL)15,12,15
12     K=I+5
      DO 13 J=I,K
      IF(WORD(J)-ONEDOL)15,13,15
13     CONTINUE
      GO TO 20
15     CONTINUE
      WRITE(6,502)
502     FORMAT(1H0,12HERROR IN SYG)
      RETURN

C          PRINT LINE

20     I=I-1
      WRITE(6,501)(WORD(I),I=1,I)
      GO TO 5
      END
```

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RTH

SIDMAP	TAPES	DECK
	ENTRY	.UNIT08.
.UNIT08.	PZE	UNIT08
UNIT08	FILE	,C(1),BCD,BLK=22,READY,INGUT
	END	

* 18 FIC 18 FIC 18 FIC
18 FIC

```
*18 FIC THCOMP DECK, #74/2, XR7
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 (DELS) .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
```

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Part II

```
2IBFTC THTURB DECK,M94/2,XR7
SUBROUTINE THTURB(DH,ETA,FAR,H,S,P,TO,HO,SO,PQ)
HO=H-DH
HOP=H-DH/ETA
PT=P/2.
DO 1 I=1,25
CALL THERHJ(PT,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/1.986375+ALOG(PT/P))
CALL ERROR
2 PQ=PT
CALL THERMO(PQ,HO,TO,SO,X1,1,FAR,1)
RETURN
END
```

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Part II

```
$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 PROCOM(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(31HNO CONVERGENCE IN THERMO$$$$$)
3      SX=PHI-R*ALOG(PX)
      AMX=1.986375/R
      RETURN
      END
```

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Part II

```

518FTC PROCOM DECK,M94/2,XR7
  SUBROUTINE PROCOM(FARX,TEX,CSEX,AKEX,CPEX,REX,PHI,HEX)
  IF(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.0.0) GO TO 4
  FARX=0.0
  WRITE(8,104)
C  AIR PATH
4  CPA =((((1.0115540E-25*TEX-1.4526770E-21)*TEX
1+7.6215767E-18)*TEX-1.5128259E-14)*TEX-6.7178376E-12)
2*TEX+6.5519466E-08)*TEX-5.1536879E-05)*TEX+2.5020051E-01
  HEA =((((1.2644425E-26*TEX-2.0752522E-22)*TEX
1+1.2702630E-18)*TEX-3.0256518E-15)*TEX-3.6794594E-12)*TEX
2+2.1839826E-08)*TEX-2.5768440E-05)*TEX+2.5020051E-01)*TEX
3-1.7558886E+00
  SEA =+2.5020051E-01*ALOG(TEX)/((((1.4450767E-26*TEX
1-2.4211288E-22)*TEX+1.5243153E-18)*TEX-3.7850648E-13)*TEX
2-2.2392790E-12)*TEX+3.2759743E-08)*TEX-5.1576879E-05)*TEX
3+4.5432390E-02
  IF(FARX.LE.0.0) GO TO 5
C  FUEL/AIR PATH
  CPF =((((7.2678710E-25*TEX-1.3335668E-20)*TEX
1+1.0212913E-13)*TEX-4.2051104E-13)*TEX+9.9686793E-10)*TEX
2-1.3771901E-06)*TEX+1.2258630E-03)*TEX+7.3816638E-02
  HEF =((((9.0848388E-26*TEX-1.9050949E-21)*TEX
1+1.7021525E-17)*TEX-8.4102208E-14)*TEX+2.4921698E-10)*TEX
2-4.5906332E-07)*TEX+6.1293150E-04)*TEX+7.3816638E-02)
3*TEX+3.0581530E+01
  SEF =+7.3816638E-02*ALOG(TEX)/((((1.0382670E-25*TEX
1-2.2226118E-21)*TEX+2.0425826E-17)*TEX-1.0512776E-13)*TEX
2+3.3228928E-10)*TEX-6.3859505E-07)*TEX+1.2258630E-03)*TEX
3+6.465398E-01
5  CPEX=(CPA+FARX*CPF)/(1.+FARX)
  HEX=(HEA+FARX*HEF)/(1.+FARX)
  PHI=(SEA+FARX*SEF)/(1.+FARX)
  AMW=28.97-.946186*FARX
  REX=1.985375/AMW
  AKEX=CPEX/(CPEX-REX)
  CSEX=SQRT(AKEX*REX*TEX*25031.37)
  RETURN
101 FORMAT(1H0,63HINPUT FUEL-AIR RATIO ABOVE LIMITS, IT HAS BEEN RESET
2TD 0.067623,6H$$$$$$)
102 FORMAT(1H0,35HPROCOM INPUT TEMPERATURE BELOW 300.,6H$$$$$$)
103 FORMAT(1H0,36HPROCOM INPUT TEMPERATURE ABOVE 4000.,6H$$$$$$)
104 FORMAT(1H0,38HPROCOM INPUT FUEL-AIR RATIO BELOW ZERO,6H$$$$$$)
  END

```

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```

SUBROUTINE SEARCHN (NPA, NPA2, X97
  SUBROUTINE SEARCHN, I, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA, AB, AC, AD, AE, AF, AG, AH, AI, AJ, AK, AL, AM, AN, AO, AP, AQ, AR, AS, AT, AU, AV, AW, AX, AY, AZ, BA, BB, BC, BD, BE, BF, BG, BH, BI, BJ, BK, BL, BM, BN, BO, BP, BQ, BR, BS, BT, BU, BV, BW, BX, BY, BZ, CA, CB, CC, CD, CE, CF, CG, CH, CI, CJ, CK, CL, CM, CN, CO, CP, CQ, CR, CS, CT, CU, CV, CW, CX, CY, CZ, DA, DB, DC, DD, DE, DF, DG, DH, DI, DJ, DK, DL, DM, DN, DO, DP, DQ, DR, DS, DT, DU, DV, DW, DX, DY, DZ, EA, EB, EC, ED, EE, EF, EG, EH, EI, EJ, EK, EL, EM, EN, EO, EP, EQ, ER, ES, ET, EU, EV, EW, EX, EY, EZ, FA, FB, FC, FD, FE, FF, FG, FH, FI, FJ, FK, FL, FM, FN, FO, FP, FQ, FR, FS, FT, FU, FV, FW, FX, FY, FZ, GA, GB, GC, GD, GE, GF, GG, GH, GI, GJ, GK, GL, GM, GN, GO, GP, GQ, GR, GS, GT, GU, GV, GW, GX, GY, GZ, HA, HB, HC, HD, HE, HF, HG, HH, HI, HJ, HK, HL, HM, HN, HO, HP, HQ, HR, HS, HT, HU, HV, HW, HX, HY, HZ, IA, IB, IC, ID, IE, IF, IG, IH, II, IJ, IK, IL, IM, IN, IO, IP, IQ, IR, IS, IT, IU, IV, IW, IX, IY, IZ, JA, JB, JC, JD, JE, JF, JG, JH, JI, JJ, JK, JL, JM, JN, JO, JP, JQ, JR, JS, JT, JU, JV, JW, JX, JY, JZ, KA, KB, KC, KD, KE, KF, KG, KH, KI, KJ, KK, KL, KM, KN, KO, KP, KQ, KR, KS, KT, KU, KV, KW, KX, KY, KZ, LA, LB, LC, LD, LE, LF, LG, LH, LI, LJ, LK, LL, LM, LN, LO, LP, LQ, LR, LS, LT, LU, LV, LW, LX, LY, LZ, MA, MB, MC, MD, ME, MF, MG, MH, MI, MJ, MK, ML, MM, MN, MO, MP, MQ, MR, MS, MT, MU, MV, MW, MX, MY, MZ, NA, NB, NC, ND, NE, NF, NG, NH, NI, NJ, NK, NL, NM, NN, NO, NP, NQ, NR, NS, NT, NU, NV, NW, NX, NY, NZ, OA, OB, OC, OD, OE, OF, OG, OH, OI, OJ, OK, OL, OM, ON, OO, OP, OQ, OR, OS, OT, OU, OV, OW, OX, OY, OZ, PA, PB, PC, PD, PE, PF, PG, PH, PI, PJ, PK, PL, PM, PN, PO, PP, PQ, PR, PS, PT, PU, PV, PW, PX, PY, PZ, QA, QB, QC, QD, QE, QF, QG, QH, QI, QJ, QK, QL, QM, QN, QO, QP, QQ, QR, QS, QT, QU, QV, QW, QX, QY, QZ, RA, RB, RC, RD, RE, RF, RG, RH, RI, RJ, RK, RL, RM, RN, RO, RP, RQ, RR, RS, RT, RU, RV, RW, RX, RY, RZ, SA, SB, SC, SD, SE, SF, SG, SH, SI, SJ, SK, SL, SM, SN, SO, SP, SQ, SR, SS, ST, SU, SV, SW, SX, SY, SZ, TA, TB, TC, TD, TE, TF, TG, TH, TI, TJ, TK, TL, TM, TN, TO, TP, TQ, TR, TS, TT, TU, TV, TW, TX, TY, TZ, UA, UB, UC, UD, UE, UF, UG, UH, UI, UJ, UK, UL, UM, UN, UO, UP, UQ, UR, US, UT, UY, UZ, VA, VB, VC, VD, VE, VF, VG, VH, VI, VJ, VK, VL, VM, VN, VO, VP, VQ, VR, VS, VT, VU, VV, VW, VX, VY, VZ, WA, WB, WC, WD, WE, WF, WG, WH, WI, WJ, WK, WL, WM, WN, WO, WP, WQ, WR, WS, WT, WU, WV, WW, WX, WY, WZ, XA, XB, XC, XD, XE, XF, XG, XH, XI, XJ, XK, XL, XM, XN, XO, XP, XQ, XR, XS, XT, XU, XV, XW, XX, XY, XZ, YA, YB, YC, YD, YE, YF, YG, YH, YI, YJ, YK, YL, YM, YN, YO, YP, YQ, YR, YS, YT, YU, YV, YW, YX, YY, YZ, ZA, ZB, ZC, ZD, ZE, ZF, ZG, ZH, ZI, ZJ, ZK, ZL, ZM, ZN, ZO, ZP, ZQ, ZR, ZS, ZT, ZU, ZV, ZW, ZX, ZY, ZZ)
  DIMENSION AX(100), BX(100), CX(100), DX(100), EX(100), FX(100), GX(100), HX(100), IX(100), JX(100), KX(100), LX(100), MX(100), NX(100), OX(100), PX(100), QX(100), RX(100), SX(100), TX(100), UX(100), VX(100), WX(100), YX(100), ZX(100)
  C *** NEEDS SUBROUTINE AFOUR
  C *** AX AND BX MUST BE STORED LG TO HI
  C *** P=INPUT PROPORTION BETWEEN 0.0 AND 1.0
  C *** IF NOT INPUT, P MUST EQUAL -1.
  C *** NCODE=00 OK
  C NCODE=01 A LG
  C NCODE=02 A HI
  C NCODE=07 ERROR
  C NCODE=10 B LG
  C NCODE=20 B HI
  C NCODE=0
  C=0.
  D=0.
  C *** FIND A
  DO 1 I=1, NA
    IH=I
    IF(A.LT.AX(IH)) GO TO 2
  1 CONTINUE
    IF(A.GT.AX(IH)) NCODE=2
    A=AX(IH)
    GO TO 3
  2 IF(IH.GT.1) GO TO 3
    NCODE=1
    IH=2
    A=AX(IH)
  3 IL=IH-1
    LIMH=NO(IH)
    LIML=NO(IL)
  C *** FIND B
    PRM=(A-AX(IL))/(AX(IH)-AX(IL))
    PP=P
    IF(P.GE.0.) GO TO 6
    BL=BX(IL,1)+PRM*(BX(IH,1)-BX(IL,1))
    BH=BX(IL,LIML)+PRM*(BX(IH,LIMH)-BX(IL,LIML))
    IF(B.GE.BL) GO TO 4
    NCODE=NCODE+10
    B=BL
    GO TO 5
  4 IF(B.LE.BH) GO TO 5
    NCODE=NCODE+20
    B=BH
  5 PP=0.5
    Q(2)=B.
    Q(3)=0.
  6 BH=PP*(BX(IH,LIMH)-BX(IH,1))+BX(IH,1)
    BL=PP*(BX(IL,LIML)-BX(IL,1))+BX(IL,1)
    DO 7 J=2, LIMH
      JH=J
      IF(BH.LT.BX(IH,J)) GO TO 8
  7 CONTINUE
      JL=JH-1
      DO 9 K=2, LIML
        KH=K
        IF(BL.LT.BX(IL,K)) GO TO 10
  9 CONTINUE
  10 KL=KH-1

    PR=(BX(IH,JL)-BH)/(BX(IH,JH)-BX(IH,JL))

```

Part II

```

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 AFQUER(Q(1),PP,ERR,0.,25.,0.001,DIR,PT,ICON)
GO TO (11,13,13),ICON
11 PP=PT
IF(PP.LT.0.) PP=0.
IF(PP.GT.1.) PP=1.
GO TO 6
12 NCODE=7
.3 B=BT
C=CT
D=DT
RETURN
END

```

AFAPL-TR-67-125
Part II

```

$IBFTC MAPBAC DECK,M94/2,XR7
      SUBROUTINE MAPBAC(MAP,MAPGO,TFFS,TFF,CNS,CN,PCN,T,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=MAPGO+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

```

AFAPL-TR-87-125
Part II

```

SIBFTC CONVRG DECK,M94/2,XR7
SUBROUTINE CONVRG(TI,HI,PI,SI,FAR,WG,PA,IDES,AO,PR,
1TO,HO,PO,SO,TSO,PSO,VO,AMO,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 PROCOM(FAR,TI,XX1,XX2,XX3,XX4,PHI1,XX6)

```

C *** SONIC CALCULATIONS

```

J=0
TSS=0.833*T1
1 J=J+1
CALL PROCOM(FAR,TSS,CSS,AKS,CP,REXS,PHISS,HSS)
HSCAL=HI-CSS**2/(2.*G*AJ)
DELHS=HSCAL-HSS
IF(ABS(DELHS)-0.0005*HSCAL)4,4,2
2 TSS=TSS+DELHS/CP
IF(J-15)1,1,3
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,TSI,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)6,6,3
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 PROCOM(FAR,TSO,CSO,XX2,XX3,REX,PHISO,HSO)
RHO=CAPSF*PSO/(AJ*REX*TSO)
AO=WG/(RHO*VO)
AMO=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/TI)**(AKS/(AKS-1.))
RHO=CAPSF*PSO/(AJ*REXS*TSO)

```

AFAPL-TR-67-125
Part II

AO=WG/(RHO*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*PSO/(AJ*REXS*TSO)
AOCRT=WG/(RHO*VO)
AMO=1.0
PR=PSO*(TI/TSO)**(AKS/(AKS-1.))
IF(AO-AOCRT)13,13,14

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

13 PSO=PSO*AOCRT/AO
PR=PR*AOCRT/AO
ICON=2
GO TO 10

C *** NON-DESIGN, SUBSONIC CALCULATIONS

14 PSO=PA
J=0
TSO=0.833*TSO
15 J=J+1
CALL PROCOM(FAR,TSO,CSO,AKO,CP,REX,PHISO,HSO)
RHO=CAPSF*PSO/(AJ*REX*TSO)
VO=WG/(RHO*AO)
HSCAL=HI-VO**2/(2.*G*AJ)
DELHS=HSCAL-HSO
IF(ABS(DELHS)-0.0005*HSCAL)17,17,16
16 TSO=TSO+DELHS/CP
IF(J-15)15,15,3
17 AMO=VO/CSO
PR=PSO*(TI/TSO)**(AKO/(AKO-1.))
ICON=1
GO TO 10
END

AFAPL-TR-67-125
Part II

```

$IBFTC CONDIV DECK,M94/2,XR7
SUBROUTINE CONDIV(TI,HI,PI,SI,FAR,WG,PA,IDES,AT,AO,PIR,
  ITT,HT,PT,ST,TO,HO,PO,SO,TST,TSD,PST,PSO,VT,VO,AMT,ANO,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 ERROR
DIMENSION Q(9)
Q(2)=0.
Q(3)=0.
AJ=778.26
CAPSF=2116.2170
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,AK,CP,REXS,PHISS,HSS)
HSCAL=HI-CSS**2/(2.*G*AJ)
DELHS=HSCAL-HSS
IF(ABS(DELHS)-0.0005*HSCAL)4,4,2
2 TSS=TSS+DELHS/CP
IF(J-15)1,1,3
3 ICON=4
RETURN
4 IF(IDES)11,11,5

C *** SONIC DESIGN, CALCULATE AT

5 VT=CSS
TST=TSS
PST=PI*(TST/TI)**AK/(AK-1.)
RHO=CAPSF*PST/(AJ*REXS*TST)
AT=WG/(RHO*VT)
AMT=1.0

C *** IDEAL EXPANSION DESIGN, CALCULATE AO

PSO=PA
J=0
TSO=TI*(PSO/PI)**.286
J=J+1
CALL PROCON(FAR,TSO,CSO,AK,CP,REX,PHISO,HSO)
PHICAL=PHI-REX*ALOG(PI/PSO)
DELPHI=PHICAL-PHISO
IF(ABS(DELPHI)-0.0001*PHICAL)8,8,7
7 TSO=TSO*EXP(4.*DELPHI)
IF(J-15)6,6,3
8 VO=SQRT(2.*G*AJ*(HI-HSO))
ANO=VO/CSO
AO=(AT/ANO)*(2.*(1.+(AK-1.)*ANO**2/2.)/(AK+1.))**((AK+1.)/(2.*
  1(AK-1.)))
PIR=PI
ICON=3
9 TO=TI
HO=HI
PO=PI
SO=SI

```

AFAPL-TR-67-125
Part II

```

10  TT=TI
    HT=HI
    PT=PI
    ST=SI
    RETURN

C *** ASSUME SONIC THROAT AND ISENTROPIC EXPANSION TO AO

11  VT=CSS
    AKT=1.0
    TST=TSS
    RHO=MG/(AT*VT)
    PST=RHO*AJ*REXS*TST/CAPSF
    PIR=PST*(TI/TST)**(AK/(AK-1.))
    IF(PST-PA)12,24,24
12  TSO=G.95*TI
    NAM=0
13  CALL PROCOM(FAR,TSO,CSO,AK,CP,REX,PHISO,HSO)
    AMO=SQRT(2.*((TI/TSO)-1.)/(AK-1.))
    AOCAL=(AT/AMO)*(2.*(1.+(AK-1.)*AMO**2/2.)/(AK+1.))*((AK+1.)/
1(2.*(AK-1.)))
    EA=(AO-AOCAL)/AO
    DIR=SQRT(AO/AOCAL)
    CALL AFQUIR(Q(1),TSO,EA,0.,100.,0.0001,DIR,TSOT,JCON)
    GO TO (14,15,3),JCON
14  TSO=TSOT
    IF(TSO-TI)140,13,141
140 TSC=2.*TI/(AK+1.)
    IF(TSO.GT.TSC) GO TO 142
141 TSO=0.95*TI
    GO TO 13
142 IF(Q(2).LT.30.0.OR.AMO.LT.0.95.OR.NAM.EQ.1) GO TO 13
    TSO=2.*TI/(2.+0.98*(AK-1.))
    NAM=1
    GO TO 13
15  PSO=PIR*(TSO/TI)**(AK/(AK-1.))
    IF(PSO-PA)17,16,24
C *** CRITICAL FLOW, ISENTROPIC EXPANSION TO PA

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

C *** SUBSONIC FLOW

17  PSO=PA
    Q(2)=0.
    Q(3)=0.
    J=0
    TSO=0.833*TI
18  J=J+1
    CALL PROCOM(FAR,TSO,CSO,AK,CP,REX,PHISO,HSO)
    RHO=CAPSF*PSO/(AJ*REX*TSO)
    VO=MG/(RHO*AO)
    HSCAL=HI-VO**2/(2.*G*AJ)
    DELHS=HSCAL-H30
    IF(ABS(DELHS)-0.0005>HSCAL)20,20,19
19  TSO=TSO+DELHS/CP
    IF(J-15)18,18,3
20  AMO=VO/CSO
    PIR=PSO*(TI/TSO)**(AK/(AK-1.))

```

Part II

```

21  TST=TSO
    CALL PROCOM(FAR,TST,CST,AK,CP,REX,PHI,T,HST)
    PST=PIR*(TST/TI)**(AK/(AK-1.))
    RHO=PST*CAPSF/(AJ*REX*TST)
    VT=HG/(RHO*AT)
    HSCAL=HI-VT**2/12.*G*AJ)
    EH=(HSCAL-HST)/HSCAL
    DIR=1.+(HSCAL-HST)/(CF*TST)
    CALL AFGUIR(Q11,TST,EH,0.,20.,0.0005,DIR,TSTT,JCON)
    GO TO (22,23,3),JCON
22  TST=TSTT
    GO TO 21
23  ANT=VT/CST
    ICON=1
    GO TO 9

C *** SUPERCRITICAL FLOW, ISENTROPIC EXPANSION TO PA
24  PSO=PA
    J=0
    TSO=TI*(PSO/PIR)**.286
25  J=J+1
    CALL PROCOM(FAR,TSO,CSO,AK,CP,REX,PHISO,HSO)
    PHICAL=PHI-REX*ALOG(PIR/PSO)
    DELPHI=PHICAL-PHISO
    IF(ABS(DELPHI)-0.0001*PHICAL)27,27,26
26  TSO=TSO*EXP(4.0*DELPHI)
    IF(J-15)25,25,3
27  VO=SQRT(2.*G*AJ*(HI-HSO))
    AMO=VO/CSO
    AOID=(AT/AMO)*(2.*(1.+(AK-1.)*AMO**2/2.)/(AK+1.))*((AK+1.)/
1(2.*(AK-1.)))
    ICON=3
    N=0
    IF(AO-AOID)28,9,29

C *** SUPERCRITICAL FLOW, ISENTROPIC EXPANSION TO AO
28  N=1
29  TSO=0.833*TI
    J=0
30  J=J+1
    CALL PROCOM(FAR,TSO,CSO,AK,CP,REX,PHISO,HSO)
    AMO=SQRT(2.*((TI/TSO)-1.)/(AK-1.))
    AOAL=(AT/AMO)*(2.*(1.+(AK-1.)*AMO**2/2.)/(AK+1.))*((AK+1.)/
1(2.*(AK-1.)))
    DELA=AG-AOAL
    IF(ABS(DELA)-0.0001*AO)32,32,31
31  TSO=TSO*SQRT(AOAL/AO)
    IF(J-50)30,30,3
32  IF(N)34,34,33

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

C *** OVEREXPANDED, FIND SHOCK POSITION
34  PSX=PIR*(TSO/TI)**(AK/(AK-1.))

```

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Part II

PSY=PSX*(2.*AK*AM0**2/(AK+1.)-(AK-1.)/(AK+1.))
IF(PA-PSY)35,36,36

C *** OVEREXPANDED, SHOCK OUTSIDE NOZZLE

35 PSO=PSX
 V0=AM0*CS0
 GO TO 9

C *** OVEREXPANDED, SHOCK INSIDE NOZZLE

36 PSO=PA
 J=0
 TSO=0.833*TI
37 J=J+1
 CALL PROCOM(FAR,TSO,CS0,AK,CP,REX,PHISO,HSO)
 RHO=CAPSF*PSO/(AJ*REX*TSO)
 V0=WG/(RHO*AO)
 HSCAL=HI-V0**2/(2.*G*AJ)
 DELHS=HSCAL-HSO
 IF(ABS(DELHS)-0.0005*HSCAL)39,39,38
38 TSO=TSO+DELHS/CP
 IF(J-15)37,37,3
39 AM0=V0/CS0
 TO=TI
 HO=HI
 PO=PSO*(TO/TSO)**(AK/(AK-1.))
 SO=PHI1-REX*ALOG(PO)
 ICON=2
 GO TO 10
 END

AFAPL-TR-67-125

Part II

```

$15FTC 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=INDEPENDANT VARIABLE
  C DEPEND=DEPENDANT VARIABLE
  C ANS=ANSWER UPON WHICH TO CONVERGE
  C AJ=MAX NUMBER OF TRYs
  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)=CHOOSES 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.
      IF(ANS)1,2,1
1     DEP=DEPEND-ANS
      TOLANS=TOL*ANS
      GO TO 3
2     DEP=DEPEND
      TOLANS=TOL
3     IF(ABS(DEP)-TOLANS)5,5,4
4     IF(X(2)-AJ)8,8,7
5     ANEW=AIND
      X(2)=0.
      ICON=2
      RETURN
6     ANEW=Y
      X(2)=X(2)+1.
      ICON=1
      RETURN
7     ANEW=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
      IE(AIND)10,11,10
10    Y=DIR*AIND
      GO TO 6
11    Y=DIR
      GO TO 6
12    IF(X(3)-1.)13,13,16
  C *** LINEAR GUESS
13    X(3)=2.
      X(6)=DEP
      X(7)=AIND
      IF(X(8)-X(6))14,9,14

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14  IF(X(9)-X(7))15,9,15
15  A=(X(9)-X(7))/(X(8)-X(6))
    Y=X(9)-A*X(8)
    IF(ABS(10.*X(9))-ABS(Y))9,9,6
C *** QUADRATIC GUESS
16  X(4)=DEP
    X(5)=AIND
    IF(X(7)-X(5))18,17,18
17  IF(X(6)-X(4))13,9,13
18  IF(X(6)-X(4))19,13,19
19  IF(X(9)-X(5))23,20,23
20  IF(X(8)-X(4))21,22,21
21  X(9)=X(7)
    X(8)=X(6)
    GO TO 13
22  X(9)=X(7)
    X(8)=X(6)
    X(3)=1.
    IF(X(9))10,11,10
23  IF(X(8)-X(4))24,21,24
24  F=(X(6)-X(4))/(X(7)-X(5))
    A=(X(8)-X(4)-F*(X(9)-X(5)))/(X(9)-X(7)*(X(9)-X(5)))
    B=F-A*(X(5)+X(7))
    C=X(4)+X(5)*(A*X(7)-F)
    IF(A)242,240,242
    IF(B)241,7,241
240 Y=-C/B
    GO TO 37
242 IF(B)247,243,247
243 IF(C)245,244,245
244 Y=0.
    GO TO 37
245 G=-C/A
    IF(G)7,7,246
246 Y=SQRT(G)
    YY=-SQRT(G)
    GO TO 270
247 IF(C)249,248,249
248 Y=-B/A
    YY=0.
    GO TO 270
249 D=4.*A*C/B**2
    IF(1.-D)13,25,26
25  Y=-B/(2.*A)
    GO TO 37
26  E=SQRT(1.-D)
27  Y=(-B/(2.*A))*(1.+E)
    YY=(-B/(2.*A))*(1.-E)
270 J=4
    DEPMIN=ABS(X(4))
    DO 29 I=6,8,2
    IF(DEPMIN-ABS(X(I)))29,29,28
28  J=I
    DEPMIN=ABS(X(I))
29  CONTINUE
    K=J+1
    IF((X(K)-Y)*(X(K)-YY))32,32,30
30  IF(ABS(X(K)-Y)-ABS(X(K)-YY))37,37,31
31  Y=YY
    GO TO 37
32  IF(J-6)33,34,34

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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(6)=X(4)
    GO TO 6
    END
```

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Part II

SIBFTC FANDAT DECK,M94/2,XR7

BLOCK DATA

COMMON / FAN/CN(15),PR(15,15),WAC(15,15),ETA(15,15),N,HP(15)

DATA N,NP/10,6,3*7,5*10,8,5*0/

DATA CN/0.3,0.4,0.5,0.6,0.7,0.8,0.9,1.0,1.1,1.2,5*0.1/

DATA (PR(1,J),WAC(1,J),ETA(1,J),J=1, 6)/

A	1.000	, 73.0	,0.7300	, 1.030	, 69.0	,0.7350	,
B	1.070	, 60.0	,0.7400	, 1.096	, 50.0	,0.7300	,
C	1.112	, 40.0	,0.7900	, 1.120	, 26.0	,0.6200	/

DATA (PR(2,J),WAC(2,J),ETA(2,J),J=1, 7)/

D	1.000	, 86.0	,0.7300	, 1.050	, 81.0	,0.7500	,
E	1.100	, 76.0	,0.7650	, 1.146	, 70.0	,0.7700	,
F	1.188	, 62.9	,0.7750	, 1.230	, 55.0	,0.7500	,
G	1.250	, 47.0	,0.7150	/			

DATA (PR(3,J),WAC(3,J),ETA(3,J),J=1, 7)/

H	1.000	, 100.0	,0.7250	, 1.064	, 96.8	,0.7500	,
I	1.128	, 92.0	,0.7750	, 1.200	, 87.5	,0.8000	,
J	1.290	, 78.0	,0.8150	, 1.330	, 72.0	,0.8000	,
K	1.370	, 64.0	,0.7500	/			

DATA (PR(4,J),WAC(4,J),ETA(4,J),J=1, 7)/

L	1.000	, 115.0	,0.7200	, 1.092	, 112.8	,0.7500	,
M	1.220	, 107.5	,0.8000	, 1.310	, 102.0	,0.8250	,
N	1.400	, 94.0	,0.8500	, 1.474	, 83.0	,0.8000	,
O	1.488	, 80.0	,0.7800	/			

DATA (PR(5,J),WAC(5,J),ETA(5,J),J=1,10)/

P	1.000	, 132.0	,0.7000	, 1.160	, 131.0	,0.7500	,
Q	1.296	, 128.5	,0.8000	, 1.370	, 126.2	,0.8250	,
R	1.460	, 122.0	,0.8500	, 1.524	, 118.0	,0.8700	,
S	1.544	, 116.5	,0.8730	, 1.560	, 115.0	,0.8700	,
T	1.610	, 110.5	,0.8500	, 1.668	, 102.8	,0.8000	/

DATA (PR(6,J),WAC(6,J),ETA(6,J),J=1,10)/

U	1.000	, 150.0	,0.6650	, 1.250	, 149.9	,0.7500	,
V	1.400	, 148.0	,0.8000	, 1.500	, 145.6	,0.8250	,
W	1.570	, 143.0	,0.8500	, 1.638	, 140.0	,0.8700	,
X	1.680	, 137.0	,0.8800	, 1.716	, 134.5	,0.8700	,
Y	1.756	, 130.0	,0.8500	, 1.830	, 122.0	,0.7950	/

DATA (PR(7,J),WAC(7,J),ETA(7,J),J=1,10)/

Z	1.000	, 170.0	,0.6200	, 1.190	, 170.0	,0.7000	,
A	1.380	, 170.0	,0.7500	, 1.548	, 168.0	,0.8000	,
B	1.650	, 166.0	,0.8300	, 1.724	, 163.5	,0.8500	,
C	1.828	, 158.6	,0.8700	, 1.904	, 152.8	,0.8500	,
D	1.978	, 145.0	,0.8000	, 2.000	, 142.2	,0.7900	/

DATA (PR(8,J),WAC(8,J),ETA(8,J),J=1,10)/

E	1.000	, 190.0	,0.5200	, 1.110	, 190.0	,0.6200	,
F	1.338	, 190.0	,0.7000	, 1.582	, 189.9	,0.7500	,
G	1.736	, 187.8	,0.8000	, 1.850	, 185.0	,0.8200	,
H	2.000	, 180.0	,0.8500	, 2.070	, 176.0	,0.8200	,
I	2.120	, 173.0	,0.8000	, 2.200	, 166.0	,0.7600	/

DATA (PR(9,J),WAC(9,J),ETA(9,J),J=1,10)/

J	1.000	, 210.0	,0.5500	, 1.260	, 210.0	,0.6200	,
K	1.550	, 210.0	,0.7000	, 1.810	, 210.0	,0.7500	,
L	2.000	, 213.0	,0.7750	, 2.120	, 209.5	,0.7800	,
M	2.250	, 208.0	,0.7750	, 2.334	, 205.0	,0.7500	,
N	2.420	, 200.0	,0.7200	, 2.460	, 197.0	,0.7000	/

DATA (PR(10,J),WAC(10,J),ETA(10,J),J=1, 6)/

O	1.000	, 225.0	,0.5600	, 1.400	, 225.0	,0.6200	,
P	1.760	, 225.0	,0.7000	, 2.070	, 225.0	,0.7300	,
Q	2.300	, 225.0	,0.7300	, 2.350	, 225.0	,0.7250	,
R	2.450	, 224.5	,0.7000	, 2.650	, 221.0	,0.6200	/

END

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Part II

SIBFTC CMPDAT DECK,M94/2,XR7

BLOCK DATA

COMMON / COMP,CN(15),PR(15,15),WAC(15,15),ETA(15,15),N,NP(15)

DATA N,NP/10,2*6,2*8,4*10,2*8,5*0/

DATA CN/0.5,0.6,0.7,0.8,0.89,0.92,0.95,1.0,1.1,1.15,5*0./

DATA (PR(1,J),WAC(1,J),ETA(1,J),J=1, 6)/

A 1.000 , 21.4 ,0.5700 , 1.599 , 21.1 ,0.6000 ,

B 2.018 , 20.8 ,0.6200 , 2.335 , 20.5 ,0.6300 ,

C 3.024 , 19.6 ,0.6500 , 3.533 , 18.7 ,0.6200 /

DATA (PR(2,J),WAC(2,J),ETA(2,J),J=1, 6)/

D 1.000 , 24.9 ,0.5700 , 1.689 , 24.9 ,0.6200 ,

E 2.497 , 24.7 ,0.6700 , 3.096 , 24.3 ,0.7000 ,

F 3.635 , 23.8 ,0.7200 , 4.234 , 23.1 ,0.7000 /

DATA (PR(3,J),WAC(3,J),ETA(3,J),J=1, 8)/

G 1.000 , 29.4 ,0.5650 , 1.599 , 29.4 ,0.6200 ,

H 2.198 , 29.4 ,0.6600 , 2.719 , 29.2 ,0.7000 ,

I 3.515 , 28.9 ,0.7500 , 4.174 , 28.5 ,0.7650 ,

J 4.796 , 27.9 ,0.7500 , 4.946 , 27.6 ,0.7430 /

DATA (PR(4,J),WAC(4,J),ETA(4,J),J=1, 8)/

K 1.000 , 35.6 ,0.5600 , 1.719 , 35.6 ,0.6200 ,

L 2.737 , 35.6 ,0.7000 , 3.575 , 35.6 ,0.7500 ,

M 4.353 , 35.3 ,0.7800 , 5.012 , 35.0 ,0.8000 ,

N 5.671 , 34.3 ,0.7800 , 5.970 , 33.8 ,0.7650 /

DATA (PR(5,J),WAC(5,J),ETA(5,J),J=1,10)/

O 1.000 , 42.7 ,0.5520 , 2.084 , 42.7 ,0.6200 ,

P 3.132 , 42.7 ,0.7000 , 4.054 , 42.7 ,0.7500 ,

Q 4.922 , 42.5 ,0.7800 , 5.431 , 42.4 ,0.8100 ,

R 6.000 , 42.0 ,0.8300 , 6.407 , 41.8 ,0.8100 ,

S 6.988 , 41.2 ,0.7800 , 7.138 , 40.9 ,0.7780 /

DATA (PR(6,J),WAC(6,J),ETA(6,J),J=1,10)/

T 1.000 , 45.4 ,0.5500 , 2.323 , 45.4 ,0.6200 ,

U 3.353 , 45.4 ,0.7000 , 4.293 , 45.4 ,0.7500 ,

V 5.240 , 45.2 ,0.7800 , 5.731 , 45.0 ,0.8100 ,

W 6.389 , 44.8 ,0.8300 , 6.808 , 44.5 ,0.8100 ,

X 7.377 , 43.9 ,0.7800 , 7.587 , 43.7 ,0.7760 /

DATA (PR(7,J),WAC(7,J),ETA(7,J),J=1,10)/

Z 1.000 , 48.1 ,0.5400 , 2.617 , 48.2 ,0.6200 ,

A 3.683 , 48.1 ,0.7000 , 4.653 , 48.1 ,0.7500 ,

B 5.611 , 48.1 ,0.7800 , 6.222 , 48.0 ,0.8100 ,

C 6.868 , 47.7 ,0.8200 , 7.168 , 47.6 ,0.8100 ,

D 7.796 , 47.3 ,0.7800 , 8.133 , 47.2 ,0.7700 /

DATA (PR(8,J),WAC(8,J),ETA(8,J),J=1,10)/

E 1.000 , 51.6 ,0.5200 , 1.491 , 51.6 ,0.5500 ,

F 3.036 , 51.6 ,0.6200 , 4.192 , 51.6 ,0.7000 ,

G 5.192 , 51.6 ,0.7500 , 6.263 , 51.6 ,0.7800 ,

H 6.689 , 51.5 ,0.7950 , 7.347 , 51.3 ,0.8100 ,

I 8.078 , 51.1 ,0.7800 , 8.725 , 50.7 ,0.7500 /

DATA (PR(9,J),WAC(9,J),ETA(9,J),J=1, 8)/

J 1.000 , 58.7 ,0.4600 , 3.395 , 58.7 ,0.5800 ,

K 5.731 , 58.7 ,0.7000 , 7.587 , 58.7 ,0.7500 ,

L 8.186 , 58.7 ,0.7550 , 0.784 , 58.6 ,0.7500 ,

M 9.683 , 58.5 ,0.7000 ,10.042 , 58.4 ,0.6750 /

DATA (PR(10,J),WAC(10,J),ETA(10,J),J=1, 8)/

N 1.000 , 61.4 ,0.4500 , 2.976 , 61.4 ,0.5500 ,

O 4.916 , 61.4 ,0.6200 , 6.838 , 61.4 ,0.7000 ,

P 7.587 , 61.4 ,0.7250 , 8.485 , 61.4 ,0.7250 ,

Q 9.365 , 61.4 ,0.7000 ,10.581 , 61.4 ,0.6200 /

END

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Part II

\$IBFTC CMBOAT DECK,M94/2,XR7

BLOCK DATA

COMMON / COMB/PSI(15),DELT(15,15),ETA(15,15),N,RP(15)

DATA N,NP/8,8*11,7*0/

DATA PSI/10.,20.,30.,40.,50.,60.,70.,7*0./

DATA DELT/15*800.,15*900.,15*975.,15*1065.,15*1175.,15*1260.,
15*1325.,15*1450.,15*1550.,15*1685.,15*1800.,60*0./

DATA ETA/

BC.8600,0.8820,0.9020,0.9200,0.9360,0.9500,0.9600,0.9680,7*0.,
CO.8783,0.8996,0.9183,0.9347,0.9489,0.9615,0.9710,0.9787,7*0.,
DO.8895,0.9100,0.9282,0.9435,0.9573,0.9694,0.9782,0.9850,7*0.,
EO.9000,0.9200,0.9372,0.9520,0.9653,0.9769,0.9850,0.9850,7*0.,
FO.9080,0.9272,0.9444,0.9587,0.9718,0.9830,0.9850,0.9850,7*0.,
GO.9100,0.9290,0.9460,0.9610,0.9740,0.9850,0.9850,0.9850,7*0.,
HO.9087,0.9275,0.9448,0.9600,0.9733,0.9840,0.9850,0.9850,7*0.,
IO.9000,0.9195,0.9376,0.9543,0.9690,0.9800,0.9850,0.9850,7*0.,
JO.8886,0.9090,0.9284,0.9470,0.9630,0.9750,0.9850,0.9850,7*0.,
KO.8660,0.8890,0.9110,0.9328,0.9515,0.9672,0.9792,0.9850,7*0.,
LO.8400,0.8670,0.8930,0.9180,0.9400,0.9600,0.9730,0.9800,7*0.,
M4*0. ,4*0. ,4*0. ,4*0. ,4*0. ,4*0. ,4*0. ,4*0. ,28*0./

END

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Part II

SIBFTC HPTDAT DECK,M94/2,XR7

BLOCK DATA

COMMON / HTURB/TFF(15),CN(15,15),DH(15,15),ETA(15,15),N,NP(15)

DATA N,NP/10,9*15,12,5*0/

DATA TFF/	16.86	18.27	20.17	20.66	20.90	,
121.08	21.25	21.43	21.64	21.92	5*0.0	/
DATA (CN(1,J),DH(1,J),ETA(1,J),J=1,15)/						
A0.191	0.0029	0.6150	0.344	0.0051	0.7000	,
B0.526	0.0076	0.7780	0.727	0.0097	0.8000	,
C0.957	0.0120	0.8000	1.167	0.0137	0.7875	,
D1.340	0.0148	0.7692	1.569	0.0157	0.7340	,
E1.761	0.0161	0.7000	1.971	0.0158	0.7550	,
F2.193	0.0150	0.6000	2.454	0.0130	0.5250	,
G2.641	0.0108	0.4720	2.842	0.0074	0.4000	,
H3.005	0.0031	0.3000	/			
DATA (CN(2,J),DH(2,J),ETA(2,J),J=1,15)/						
I0.191	0.0034	0.6000	0.402	0.0072	0.7000	,
J0.593	0.0102	0.8000	0.727	0.0122	0.8200	,
K0.861	0.0140	0.8270	1.000	0.0158	0.8300	,
L1.129	0.0173	0.8275	1.301	0.0191	0.8210	,
M1.474	0.0205	0.8162	1.741	0.0223	0.8000	,
N2.009	0.0234	0.7610	2.316	0.0235	0.7000	,
O2.751	0.0217	0.6000	3.158	0.0169	0.5000	,
P3.445	0.0115	0.4150	/			
DATA (CN(3,J),DH(3,J),ETA(3,J),J=1,15)/						
Q0.191	0.0041	0.5700	0.445	0.0090	0.7000	,
R0.670	0.0130	0.8000	0.890	0.0166	0.8400	,
S1.091	0.0194	0.8448	1.263	0.0216	0.8420	,
T1.493	0.0241	0.8400	1.722	0.0263	0.8315	,
U2.009	0.0234	0.8170	2.258	0.0298	0.8000	,
V2.603	0.0310	0.7495	2.861	0.0311	0.7000	,
W3.100	0.0306	0.6578	3.330	0.0292	0.6000	,
X3.445	0.0281	0.5800	/			
DATA (CN(4,J),DH(4,J),ETA(4,J),J=1,15)/						
Y0.191	0.0047	0.5520	0.260	0.0061	0.6000	,
Z0.488	0.0108	0.7000	0.708	0.0148	0.8000	,
AG.933	0.0184	0.8400	1.167	0.0220	0.8500	,
B1.416	0.0252	0.8500	1.593	0.0274	0.8480	,
C1.837	0.0302	0.8440	2.019	0.0320	0.8400	,
D2.325	0.0349	0.8270	2.564	0.0371	0.8170	,
E2.890	0.0397	0.8000	3.205	0.0325	0.7710	,
F3.445	0.0445	0.7500	/			
DATA (CN(5,J),DH(5,J),ETA(5,J),J=1,15)/						
G0.191	0.0050	0.5500	0.306	0.0079	0.6000	,
H0.536	0.0130	0.7000	0.765	0.0173	0.8000	,
I0.993	0.0212	0.8400	1.301	0.0259	0.8600	,
J1.512	0.0289	0.8599	1.799	0.0324	0.8566	,
K2.086	0.0360	0.8519	2.383	0.0400	0.8460	,
L2.698	0.0446	0.8426	2.928	0.0486	0.8400	,
M3.138	0.0536	0.8400	3.215	0.0576	0.8437	,
N3.225	0.0595	0.8475	/			
DATA (CN(6,J),DH(6,J),ETA(6,J),J=1,15)/						
O0.191	0.0061	0.5250	0.364	0.0108	0.6000	,
P0.632	0.0173	0.7000	0.880	0.0227	0.8000	,
Q1.115	0.0270	0.8400	1.311	0.0306	0.8600	,
R1.531	0.0346	0.8721	1.722	0.0379	0.8800	,
S1.952	0.0425	0.8840	2.167	0.0472	0.8870	,
T2.316	0.0508	0.8875	2.471	0.0551	0.8876	,
U2.545	0.0576	0.8868	2.588	0.0601	0.8838	,
V2.607	0.0628	0.8798	/			
DATA (CN(7,J),DH(7,J),ETA(7,J),J=1,15)/						

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W0.191	,0.0072	,0.5005	,0.440	,0.0148	,0.6000	,
X0.698	,0.0212	,0.7000	,0.976	,0.0277	,0.8000	,
Y1.225	,0.0335	,0.8400	,1.411	,0.0374	,0.8600	,
Z1.541	,0.0403	,0.8700	,1.651	,0.0428	,0.8800	,
A1.780	,0.0459	,0.8855	,1.899	,0.0490	,0.8900	,
B1.995	,0.0518	,0.8910	,2.040	,0.0540	,0.8900	,
C2.086	,0.0562	,0.8880	,2.124	,0.0594	,0.8826	,
D2.143	,0.0630	,0.8695	/			
DATA (CN(8,J),DH(8,J),ETA(8,J),J=1,15)/						
E0.191	,0.0079	,0.4995	,0.493	,0.0176	,0.6000	,
F0.746	,0.0245	,0.7000	,0.899	,0.0284	,0.7580	,
G1.043	,0.0320	,0.8000	,1.167	,0.0353	,0.8200	,
H1.306	,0.0389	,0.8400	,1.397	,0.0414	,0.8500	,
I1.493	,0.0439	,0.8600	,1.627	,0.0475	,0.8710	,
J1.708	,0.0504	,0.8750	,1.780	,0.0536	,0.8750	,
K1.837	,0.0576	,0.8690	,1.852	,0.0598	,0.8600	,
L1.856	,0.0624	,0.8495	/			
DATA (CN(9,J),DH(9,J),ETA(9,J),J=1,15)/						
M0.191	,0.0084	,0.4855	,0.344	,0.0143	,0.5320	,
N0.545	,0.0209	,0.6000	,0.689	,0.0256	,0.6500	,
O0.823	,0.0297	,0.7000	,0.938	,0.0331	,0.7380	,
P1.033	,0.0360	,0.7690	,1.148	,0.0399	,0.8000	,
Q1.244	,0.0432	,0.8100	,1.340	,0.0472	,0.8210	,
R1.397	,0.0500	,0.8255	,1.435	,0.0522	,0.8270	,
S1.474	,0.0551	,0.8230	,1.493	,0.0576	,0.8150	,
T1.497	,0.0601	,0.8000	/			
DATA (CN(10,J),DH(10,J),ETA(10,J),J=1,12)/						
U0.191	,0.0119	,0.4210	,0.287	,0.0162	,0.4695	,
V0.388	,0.0205	,0.5000	,0.478	,0.0241	,0.5300	,
W0.574	,0.0283	,0.5620	,0.651	,0.0317	,0.5875	,
X0.703	,0.0342	,0.6000	,0.751	,0.0371	,0.6110	,
Y0.785	,0.0396	,0.6170	,0.823	,0.0428	,0.6240	,
Z0.842	,0.0454	,0.6195	,0.847	,0.0477	,0.6050	/
END						

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SIBFTC LPTDAT DECK,M94/2,XR7

BLOCK DATA

COMMON / LTURB/TFF(15),CN(15,15),DH(15,15),ETA(15,15),N,NP(15)

DATA N,NP/11,9*15,12,9,4*0/

DATA TFF/

131.50	,36.60	,41.60	,46.05	,50.22	,51.89	,
253.41	,54.60	,55.69	,56.89	,58.10	,4*0.0	/
DATA (CN(1,J),DH(1,J),ETA(1,J),J=1,15)/						
A0.365	,0.0029	,0.7120	,0.529	,0.0042	,0.7300	,
B0.730	,0.0056	,0.7472	,0.967	,0.0070	,0.7300	,
C1.204	,0.0081	,0.7140	,1.405	,0.0089	,0.7000	,
D1.606	,0.0095	,0.6850	,1.752	,0.0098	,0.6730	,
E2.007	,0.0100	,0.6452	,2.203	,0.0098	,0.6200	,
F2.445	,0.0092	,0.6000	,2.591	,0.0085	,0.5750	,
G2.792	,0.0070	,0.5310	,2.920	,0.0056	,0.5000	,
H3.285	,0.0001	,0.3850	/			
DATA (CN(2,J),DH(2,J),ETA(2,J),J=1,15)/						
I0.365	,0.0042	,0.8000	,0.547	,0.0063	,0.8100	,
J0.785	,0.0086	,0.8200	,1.058	,0.0111	,0.8300	,
K1.277	,0.0128	,0.8300	,1.432	,0.0139	,0.8290	,
L1.679	,0.0153	,0.8100	,1.879	,0.0162	,0.8000	,
M2.044	,0.0167	,0.7850	,2.208	,0.0171	,0.7600	,
N2.354	,0.0173	,0.7450	,2.600	,0.0170	,0.7000	,
O2.847	,0.0162	,0.6800	,3.029	,0.0151	,0.6450	,
P3.285	,0.0123	,0.5900	/			
DATA (CN(3,J),DH(3,J),ETA(3,J),J=1,15)/						
Q0.365	,0.0050	,0.8000	,0.586	,0.0081	,0.8300	,
R0.858	,0.0114	,0.8600	,1.067	,0.0139	,0.8630	,
S1.241	,0.0159	,0.8670	,1.423	,0.0178	,0.8700	,
T1.606	,0.0195	,0.8720	,1.825	,0.0215	,0.8720	,
U2.007	,0.0229	,0.8700	,2.226	,0.0243	,0.8670	,
V2.409	,0.0252	,0.8600	,2.573	,0.0259	,0.8500	,
W2.755	,0.0265	,0.8300	,3.029	,0.0268	,0.8000	,
X3.285	,0.0263	,0.7600	/			
DATA (CN(4,J),DH(4,J),ETA(4,J),J=1,15)/						
Y0.365	,0.0053	,0.7995	,0.420	,0.0061	,0.8000	,
Z0.675	,0.0098	,0.8400	,0.876	,0.0125	,0.8600	,
A1.095	,0.0153	,0.8680	,1.277	,0.0176	,0.8730	,
B1.496	,0.0201	,0.8800	,1.733	,0.0226	,0.8830	,
C2.025	,0.0254	,0.8835	,2.190	,0.0266	,0.8830	,
D2.354	,0.0279	,0.8800	,2.582	,0.0293	,0.8740	,
E2.847	,0.0305	,0.8300	,3.102	,0.0312	,0.8350	,
F3.285	,0.0315	,0.8200	/			
DATA (CN(5,J),DH(5,J),ETA(5,J),J=1,15)/						
G0.365	,0.0057	,0.7750	,0.502	,0.0078	,0.8000	,
H0.730	,0.0113	,0.8480	,0.967	,0.0148	,0.8600	,
I1.277	,0.0191	,0.8750	,1.551	,0.0226	,0.8900	,
J1.715	,0.0248	,0.8912	,1.952	,0.0276	,0.8940	,
K2.080	,0.0290	,0.8955	,2.244	,0.0307	,0.8970	,
L2.412	,0.0323	,0.8961	,2.646	,0.0343	,0.8900	,
M2.920	,0.0362	,0.8790	,3.157	,0.0376	,0.8671	,
N3.285	,0.0382	,0.8600	/			
DATA (CN(6,J),DH(6,J),ETA(6,J),J=1,15)/						
O0.365	,0.0061	,0.7600	,0.611	,0.0103	,0.8000	,
P0.830	,0.0139	,0.8450	,1.095	,0.0181	,0.8600	,
Q1.277	,0.0208	,0.8730	,1.515	,0.0243	,0.8900	,
R1.722	,0.0273	,0.8950	,1.934	,0.0300	,0.9000	,
S2.194	,0.0334	,0.9005	,2.409	,0.0362	,0.9010	,
T2.628	,0.0390	,0.9004	,2.837	,0.0415	,0.9000	,
U3.111	,0.0457	,0.8900	,3.230	,0.0485	,0.8800	,
V3.285	,0.0510	,0.8735	/			

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DATA (CN( 7,J),DH( 7,J),ETA( 7,J),J=1,15)/
W0.365 ,0.0070 ,0.7310 ,0.766 ,0.0142 ,0.8900 ,
X1.004 ,0.0184 ,0.8300 ,1.255 ,0.0226 ,0.8600 ,
Y1.460 ,0.0259 ,0.8750 ,1.664 ,0.0290 ,0.8900 ,
Z1.825 ,0.0315 ,0.8930 ,2.007 ,0.0348 ,0.8975 ,
A2.171 ,0.0376 ,0.8999 ,2.280 ,0.0400 ,0.9000 ,
B2.372 ,0.0424 ,0.8980 ,2.482 ,0.0454 ,0.8937 ,
C2.536 ,0.0474 ,0.8900 ,2.591 ,0.0502 ,0.8799 ,
D2.609 ,0.0527 ,0.8710 /
DATA (CN( 8,J),DH( 8,J),ETA( 8,J),J=1,15)/
E0.365 ,0.0077 ,0.7100 ,0.602 ,0.0125 ,0.7450 ,
F0.785 ,0.0163 ,0.7680 ,0.967 ,0.0198 ,0.8000 ,
G1.223 ,0.0245 ,0.8380 ,1.442 ,0.0284 ,0.8600 ,
H1.624 ,0.0321 ,0.8712 ,1.825 ,0.0362 ,0.8780 ,
I1.934 ,0.0387 ,0.8800 ,2.062 ,0.0418 ,0.8775 ,
J2.135 ,0.0438 ,0.8760 ,2.190 ,0.0456 ,0.8722 ,
K2.244 ,0.0479 ,0.8660 ,2.281 ,0.0502 ,0.8600 ,
L2.285 ,0.0514 ,0.8480 /
DATA (CN( 9,J),DH( 9,J),ETA( 9,J),J=1,15)/
M0.365 ,0.0086 ,0.6780 ,0.547 ,0.0128 ,0.7000 ,
N0.657 ,0.0153 ,0.7125 ,0.821 ,0.0190 ,0.7350 ,
O1.004 ,0.0226 ,0.7690 ,1.159 ,0.0256 ,0.8000 ,
P1.223 ,0.0270 ,0.8060 ,1.369 ,0.0301 ,0.8225 ,
Q1.515 ,0.0334 ,0.8395 ,1.606 ,0.0357 ,0.8450 ,
R1.733 ,0.0390 ,0.8470 ,1.825 ,0.0421 ,0.8445 ,
S1.879 ,0.0446 ,0.8330 ,1.898 ,0.0463 ,0.8235 ,
T1.907 ,0.0485 ,0.8080 /
DATA (CN(10,J),DH(10,J),ETA(10,J),J=1,12)/
U0.365 ,0.0098 ,0.6380 ,0.474 ,0.0125 ,0.6550 ,
V0.639 ,0.0167 ,0.6700 ,0.748 ,0.0195 ,0.6850 ,
W0.856 ,0.0223 ,0.7000 ,0.967 ,0.0251 ,0.7110 ,
X1.095 ,0.0290 ,0.7180 ,1.191 ,0.0321 ,0.7180 ,
Y1.259 ,0.0348 ,0.7170 ,1.296 ,0.0368 ,0.7140 ,
Z1.325 ,0.0390 ,0.7000 ,1.329 ,0.0401 ,0.6890 /
DATA (CN(11,J),DH(11,J),ETA(11,J),J=1, 9)/
A0.365 ,0.0111 ,0.6000 ,0.438 ,0.0137 ,0.6000 ,
B0.547 ,0.0169 ,0.6120 ,0.639 ,0.0197 ,0.6170 ,
C0.730 ,0.0226 ,0.6210 ,0.821 ,0.0254 ,0.6258 ,
D0.876 ,0.0275 ,0.6250 ,0.931 ,0.0298 ,0.6230 ,
E0.963 ,0.0322 ,0.6089 /
END

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Part II

SOATA
PCNF
CNF
ZF
PRF
MAFC
MAF
PCNC
CNC
ZC
PRC
MACC
MAC
T2
P2
T21
P21
T3
P3
PCBLF
BLF
PCBLC
BLC
PCBLOS
BLOS
PCBLMP
BLMP
PCBLLP
BLLP
T4
P4
MA3
WFB
MG4
EAR4
ETAB
DPCON
TFFHP
CNSP
DHTCHP
DHTC
T5
P5
TFFLP
CNLP
DHTCLP
DHTF
T55
P55
PCBLDU
BLDU
T24
P24
T25
P25
WAD
WFD
WG24
FAR24
ETAD
DPDUC

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Part II

ETAF
ETAC
ETATHP
ETATLP
AM55
AM25
T6
P6
PS6
AM6
V6
WG6
T7
WFA
WG7
FAR7
ETAA
DPAFT
PS8
AMS
V8
PS9
AM9
Y9
PS28
AM28
V28
PS29
AM29
V29
BYPASS
HPEXT
WFT
WGT
VA
FRD
CYMNOZ
VJH
CYDNOZ
VJD
FGM
FGP
THEEND

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IGASMX=1,ICCD=0,IMCD=0,NOZFLT=0,ITRYS=210,TOLALL=0.005,
ZFDS=0.833333,PCMFDS=100.,PRFDS=2.00,ETAFDS=0.850,WAFDS=180.,
ZCDS=0.814598,PCNCDS=100.,PRCDS=6.00,ETACDS=0.830,WACDS=75.0,
T4DS=2400.,DTCODS=1260.,ETABDS=0.985,DPCODS=0.05,
TFHPDS=21.25,CNHPDS=2.040,ETHPDS=0.890,
TFLPDS=53.41,CNLPDS=2.280,ETLPDS=0.900,
DPOUDS=0.04,DPAFDS=0.04,
AK=0.0,ALTP=0.0,HPEXT=0.0,PCBLE=0.0,PCBLC=0.05,
PCBLDU=0.20,PCBLOS=0.0,PCBLHP=0.80,PCBLLP=0.0,
PS55=1.88,CYDNOZ=0.985,CYVNOZ=0.985,DELF6=1.0,DELFN=1.0,DELSFC=1.08
SMOTE DESIGN POINT
\$DATAIN T4=1750.,AM=0.0,ALTP=00000.,ITITLE=18
SLS IDLE
\$DATAIN T4=2400.,AM=0.0,ALTP=00000.,ITITLE=18
SLS MILITARY
\$DATAIN T4=2400.,AM=0.0,ALTP=00000.,ITITLE=1,
IAFTEN=1,T7=3200.,ETAA=0.918

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SLS TAKE-OFF

\$DATAIN T4=2400.,AM=1.2,ALTP=00500.,ITITLE=1\$

SET-UP LOW ALTITUDE DASH

\$DATAIN T4=2400.,AM=1.2,ALTP=00500.,ITITLE=1,
IAFTBN=1,T7=3200.,ETAA=0.91\$

LOW ALTITUDE DASH

\$DATAIN T4=2100.,AM=0.8,ALTP=36100.,ITITLE=1\$

SUBSONIC CRUISE

\$DATAIN T4=2400.,AM=1.2,ALTP=50000.,ITITLE=1\$

SUPERSONIC AT MILITARY POWER

\$DATAIN T4=2400.,AM=1.6,ALTP=50000.,ITITLE=1\$

SET-UP SUPERSONIC WITH AFTERBURNER

\$DATAIN T4=2400.,AM=1.6,ALTP=50000.,ITITLE=1,
IAFTBN=1,T7=1700.,ETAA=0.94\$

SUPERSONIC PARTIAL A/B

\$DATAIN T4=2400.,AM=1.6,ALTP=50000.,ITITLE=1,
IAFTBN=1,T7=3200.,ETAA=0.91\$

SUPERSONIC FULL A/B

\$EOF

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DOCUMENT CONTROL DATA - R&D		
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1. ORIGINATING ACTIVITY (Corporate author)		2a. REPORT SECURITY CLASSIFICATION
Air Force Aero Propulsion Laboratory Wright-Patterson Air Force Base, Ohio 45433		Unclassified
		2b. GROUP
3. REPORT TITLE		
SIMULATION OF TURBOFAN ENGINE Part II. User's Manual and Computer Program Listing		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)		
5. AUTHOR(S) (Last name, first name, initial)		
McKinney, John S. Captain, USAF		
6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
November 1967	94	0
8a. CONTRACT OR GRANT NO.	8b. ORIGINATOR'S REPORT NUMBER(S)	
b. PROJECT NO. 3066	AFAPL-TR-67-125, Part II	
c. Task No. 306603	8c. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
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13. 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 a description of each sub-routine and a sample data pack. (Distribution of the abstract is unlimited.)		

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Turbine Engine Computer Programs						
Turbine Engine Cycle Analysis						

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