H. EXAMPLE INTERACTION

The following pages contain an example interaction with the ONX program with the user inputs shown in bold type.

```
A>ONX
*************************************************************************
*    ONX - ON-DESIGN AIRCRAFT ENGINE CYCLE ANALYSIS PROGRAM - VERSION 2.2   *
*                  Copyright (C) by Dr. Jack D. Mattingly                  *
*                      May 1996.  All rights reserved.                     *
*                                                                          *
*  AIAA has exclusive license to promote and sell this copyrighted soft-   *
*  ware.  This program is provided "AS IS" without warranty of any kind.   *
*  Jack D. Mattingly and AIAA do not warrant or guarantee the use, or the  *
*  results of the use, of this software or accompanying user guide in      *
*  terms of correctness, accuracy, reliability, currentness, or otherwise. *
*  The entire risk and performance of the software is assumed by the user. *
*                                                                          *
*  ONX was written for use with the AIAA Education Series textbook AIRCRAFT *
*  ENGINE DESIGN and is based on the engine models contained therein.  It  *
*  is intended for educational use only and not as a replacement for the   *
*  more complex and highly accurate aircraft engine cycle decks used in the *
*  industry.  This program gives accurate performance trends within the    *
*  limitations of the models and user input data.                          *
*                                                                          *
*  The purchaser is granted the right to use one copy of this software     *
*  program on a single terminal connected to a single computer (i.e., with *
*  a single CPU).  You may NOT network this software program or otherwise  *
*  use it on more than one computer or computer terminal at the same time. *
*************************************************************************
            Press "Return" (Enter) key to continue    <CR>
     ***********************************************************
     *    The default printer name is "PRN", the standard for   *
     *    MS-DOS.  At this point in the program, this can be    *
     *    changed to a disk file, e.g. "A:OUTNAME.PRN".         *
     ***********************************************************
          WANT TO CHANGE THE DEFAULT (Y=1)?   <CR>

         ***********************************************************
         *                                                         *
         *             ON-DESIGN ENGINE ANALYSIS PROGRAM           *
         *                                                         *
         *                        MAIN MENU                        *
         *                                                         *
         ***********************************************************

              1 - ENGINE CYCLE SELECTION          (5)
              2 - CALC ITERATION VARIABLE         (4)
              3 - INPUT DATA
              4 - OUTPUT DEVICE                   (2)
              5 - PERFORM CALCULATIONS
              6 - EXIT PROGRAM

          ENTER YOUR SELECTION   1

        ***********************************************************
        *              ON-DESIGN ENGINE ANALYSIS PROGRAM          *
        *                                                         *
        *                    CYCLE SELECTION MENU                 *
        ***********************************************************
        YOUR CURRENT SELECTION IS #5

              1 - TURBOJET
              2 - TURBOJET WITH AFTERBURNER
              3 - TURBOFAN WITH TWO EXHAUSTS (CONV. NOZZLE)
              4 - TURBOFAN WITH MIXED EXHAUST
              5 - TURBOFAN WITH MIXED EXHAUST AND AFTERBURNER
              6 - TURBOPROP (CONV. NOZZLE)
              7 - RAMJET
              0 - RETURN TO MAIN ON-DESIGN MENU

        ENTER YOUR SELECTION   0
```

```
************************************************************
*                                                          *
*              ON-DESIGN ENGINE ANALYSIS PROGRAM           *
*                                                          *
*                         MAIN MENU                        *
*                                                          *
************************************************************

     1 - ENGINE CYCLE SELECTION           (5)
     2 - CALC ITERATION VARIABLE          (4)
     3 - INPUT DATA
     4 - OUTPUT DEVICE                    (2)
     5 - PERFORM CALCULATIONS
     6 - EXIT PROGRAM

ENTER YOUR SELECTION   2

************************************************************
*                    ITERATION VALUE MENU                  *
************************************************************
CURRENT ITERATION VARIABLE IS #4

MINIMUM VALUE =     16.00
MAXIMUM VALUE =     30.00
INCREMENT     =      1.00
     1 - SINGLE POINT CALCULATION
     2 - FLIGHT MACH NUMBER
     3 - MAX TEMPERATURE LEAVING MAIN BURNER (TT4)
     4 - COMPRESSOR PRESSURE RATIO
     5 - FAN PRESSURE RATIO
     6 - BYPASS RATIO
     0 - RETURN TO MAIN OFF-DESIGN MENU

ENTER SELECTION   0

************************************************************
*                                                          *
*              ON-DESIGN ENGINE ANALYSIS PROGRAM           *
*                                                          *
*                         MAIN MENU                        *
*                                                          *
************************************************************

     1 - ENGINE CYCLE SELECTION           (5)
     2 - CALC ITERATION VARIABLE          (4)
     3 - INPUT DATA
     4 - OUTPUT DEVICE                    (2)
     5 - PERFORM CALCULATIONS
     6 - EXIT PROGRAM

ENTER YOUR SELECTION   3

************************************************************
*                 ON-DESIGN INPUT DATA MENU                *
************************************************************

     1 - READ ON-DESIGN DATA FILE FROM DISK
     2 - WRITE ON-DESIGN DATA FILE TO DISK
     3 - CHANGE/VIEW CURRENT DATA FILE
     4 - PAUSE PROGRAM and USE DOS
     0 - RETURN TO MAIN ON-DESIGN MENU

ENTER YOUR SELECTION   3
```

```
************************************************************
*                  DATA  SET   1 , PAGE 1                  *
************************************************************
 1 - MACH NUMBER - - - - - - - - - - - - =  1.6000
 2 - ALTITUDE  - - - - - - - - - - - - - = 30000.0 FT
     AMBIENT:
 3 -   TEMPERATURE - - - - - - - - - - - =  411.90 R
 4 -   PRESSURE  - - - - - - - - - - - - =  4.3730 PSIA
 5 -   DENSITY - - - - - - - - - - - - - =.0008907 SLUG/CUFT
 6 - CP C  - - - - - - - - - - - - - - - =   .2380 BTU/LBM-R
 7 - GAMMA C - - - - - - - - - - - - - - =   1.400
 8 - CP T  - - - - - - - - - - - - - - - =   .2950 BTU/LBM-R
 9 - GAMMA T - - - - - - - - - - - - - - =   1.300
10 - FUEL HEATING VALUE  - - - - - - - - = 18000.0 BTU/LBM
11 - MAX TEMP (TT4) LVG COMBUSTOR  - - - =  3200.0 R
12 - MAX TEMP (TT7) LVG AFTERBURNER  - - =  3600.0 R
13 - CP A/B  - - - - - - - - - - - - - - =   .2950 BTU/LBM-R
14 - GAMMA A/B   - - - - - - - - - - - - =   1.300
15 - BLEED AIR FLOW (PERCENT)  - - - - - =     1.0 %
16 - COOLING AIR FLOW #1 - - - - - - - - =     5.0 %
17 - COOLING AIR FLOW #2 - - - - - - - - =     5.0 %
18 - POWER TAKE-OFF LOW  (CTOL)  - - - - =    .010
19 - POWER TAKE-OFF HIGH (CTOH)  - - - - =    .000

# OF VARIABLE YOU WISH TO CHANGE (0=NONE)   2
   ENTER NEW VALUE OF VARIABLE # 2   35000

   ************************************************************
   *                  DATA  SET   1 , PAGE 1                  *
   ************************************************************
    1 - MACH NUMBER - - - - - - - - - - - - =  1.6000
    2 - ALTITUDE  - - - - - - - - - - - - - = 35000.0 FT
        AMBIENT:
    3 -   TEMPERATURE - - - - - - - - - - - =  394.10 R
    4 -   PRESSURE  - - - - - - - - - - - - =  3.4680 PSIA
    5 -   DENSITY - - - - - - - - - - - - - =.0007382 SLUG/CUFT
    6 - CP C  - - - - - - - - - - - - - - - =   .2380 BTU/LBM-R
    7 - GAMMA C - - - - - - - - - - - - - - =   1.400
    8 - CP T  - - - - - - - - - - - - - - - =   .2950 BTU/LBM-R
    9 - GAMMA T - - - - - - - - - - - - - - =   1.300
   10 - FUEL HEATING VALUE  - - - - - - - - = 18000.0 BTU/LBM
   11 - MAX TEMP (TT4) LVG COMBUSTOR  - - - =  3200.0 R
   12 - MAX TEMP (TT7) LVG AFTERBURNER  - - =  3600.0 R
   13 - CP A/B  - - - - - - - - - - - - - - =   .2950 BTU/LBM-R
   14 - GAMMA A/B   - - - - - - - - - - - - =   1.300
   15 - BLEED AIR FLOW (PERCENT)  - - - - - =     1.0 %
   16 - COOLING AIR FLOW #1 - - - - - - - - =     5.0 %
   17 - COOLING AIR FLOW #2 - - - - - - - - =     5.0 %
   18 - POWER TAKE-OFF LOW (CTOL)   - - - - =    .010
   19 - POWER TAKE-OFF HIGH (CTOH)  - - - - =    .000

   # OF VARIABLE YOU WISH TO CHANGE (0=NONE)   18
   ENTER NEW VALUE OF VARIABLE # 18   .015
```

```
   ************************************************************
   *                  DATA  SET   1 , PAGE 1                  *
   ************************************************************
    1 - MACH NUMBER - - - - - - - - - - - - =  1.6000
    2 - ALTITUDE  - - - - - - - - - - - - - = 35000.0 FT
        AMBIENT:
    3 -   TEMPERATURE - - - - - - - - - - - =  394.10 R
    4 -   PRESSURE  - - - - - - - - - - - - =  3.4680 PSIA
    5 -   DENSITY - - - - - - - - - - - - - =.0007382 SLUG/CUFT
    6 - CP C  - - - - - - - - - - - - - - - =   .2380 BTU/LBM-R
    7 - GAMMA C - - - - - - - - - - - - - - =   1.400
    8 - CP T  - - - - - - - - - - - - - - - =   .2950 BTU/LBM-R
    9 - GAMMA T - - - - - - - - - - - - - - =   1.300
   10 - FUEL HEATING VALUE  - - - - - - - - = 18000.0 BTU/LBM
   11 - MAX TEMP (TT4) LVG COMBUSTOR  - - - =  3200.0 R
   12 - MAX TEMP (TT7) LVG AFTERBURNER  - - =  3600.0 R
   13 - CP A/B  - - - - - - - - - - - - - - =   .2950 BTU/LBM-R
   14 - GAMMA A/B   - - - - - - - - - - - - =   1.300
   15 - BLEED AIR FLOW (PERCENT)  - - - - - =     1.0 %
   16 - COOLING AIR FLOW #1 - - - - - - - - =     5.0 %
   17 - COOLING AIR FLOW #2 - - - - - - - - =     5.0 %
   18 - POWER TAKE-OFF LOW (CTOL)   - - - - =    .015
   19 - POWER TAKE-OFF HIGH (CTOH)  - - - - =    .000

   # OF VARIABLE YOU WISH TO CHANGE (0=NONE)    0

************************************************************
*                  DATA  SET   1 , PAGE 2                  *
************************************************************
20 - PI DIFFUSER (MAX)   - - - - - - - - - =  .970
21 - PI BURNER   - - - - - - - - - - - - - =  .970
22 - PI AFTERBURNER  - - - - - - - - - - - =  .960
23 - PI MIXER (MAX)  - - - - - - - - - - - =  .970
24 - PI NOZZLE   - - - - - - - - - - - - - =  .980
     POLYTROPIC EFFICIENCIES
26 -   LP COMPRESSOR [FAN]  (EC`)  - - - =  .890
27 -   HP COMPRESSOR (ECH) - - - - - - - =  .900
28 -   HP TURBINE (ETH)  - - - - - - - - =  .890
29 -   LP TURBINE (ETL)  - - - - - - - - =  .910
     COMPONENT EFFICIENCIES
30 -   BURNER  - - - - - - - - - - - - - - =  .980
31 -   AFTERBURNER   - - - - - - - - - - - =  .970
32 -   MECHANICAL (HIGH PRESS SPOOL) - - =  .980
33 -   MECHANICAL (LOW PRESS SPOOL)  - - =  .990
34 -   MECHANICAL (POWER TAKE-OFF LOW) - =  .980
35 -   MECHANICAL (POWER TAKE-OFF HIGH)  =  .980
36 -   P0/P9   - - - - - - - - - - - - - - = 1.000
37 -   MACH NUMBER AT STATION #5 - - - - =  .400

# OF VARIABLE YOU WISH TO CHANGE (0=NONE)    0

************************************************************
*                  DATA  SET   1 , PAGE 3                  *
************************************************************
     DESIGN CONDITIONS
40 -   PI C  - - - - - - - - - - - - - - = 16.000
41 -   PI C PRIME  - - - - - - - - - - - =  3.500
42 -   ALPHA   - - - - - - - - - - - - - =   .300

# OF VARIABLE YOU WISH TO CHANGE (0=NONE)    40

ENTER NEW VALUE OF VARIABLE # 40   17
```

```
************************************************************
*                  DATA  SET   1 , PAGE 3                  *
************************************************************
     DESIGN CONDITIONS
40 -   PI C  - - - - - - - - - - - - - - = 17.000
41 -   PI C PRIME  - - - - - - - - - - - - =  3.500
42 -   ALPHA   - - - - - - - - - - - - - - =   .300

# OF VARIABLE YOU WISH TO CHANGE (0=NONE)   41

ENTER NEW VALUE OF VARIABLE # 41   3.8

************************************************************
*                  DATA  SET   1 , PAGE 3                  *
************************************************************
     DESIGN CONDITIONS
40 -   PI C  - - - - - - - - - - - - - - = 17.000
41 -   PI C PRIME  - - - - - - - - - - - - =  3.800
42 -   ALPHA   - - - - - - - - - - - - - - =   .300

# OF VARIABLE YOU WISH TO CHANGE (0=NONE)   42

ENTER NEW VALUE OF VARIABLE # 42   .4

************************************************************
*                  DATA  SET   1 , PAGE 3                  *
************************************************************
     DESIGN CONDITIONS
40 -   PI C  - - - - - - - - - - - - - - = 17.000
41 -   PI C PRIME  - - - - - - - - - - - - =  3.800
42 -   ALPHA   - - - - - - - - - - - - - - =   .400

# OF VARIABLE YOU WISH TO CHANGE (0=NONE)   0

   ************************************************************
   *                ON-DESIGN INPUT DATA MENU                 *
   ************************************************************

        1 - READ ON-DESIGN DATA FILE FROM DISK
        2 - WRITE ON-DESIGN DATA FILE TO DISK
        3 - CHANGE/VIEW CURRENT DATA FILE
        4 - PAUSE PROGRAM and USE DOS
        0 - RETURN TO MAIN ON-DESIGN MENU

   ENTER YOUR SELECTION   2

   ENTER NAME OF DATA FILE + ".DAT" (MAX OF 14 CHAR)    AAFAB.DAT
   YOUR INPUT IS "AAFAB.DAT     ", IS THIS CORRECT (Y=l/N=0)?    1
   IS THIS A NEW FILE NAME (Y=l/N=0)?   1

   ************************************************************
   *                ON-DESIGN INPUT DATA MENU                 *
   ************************************************************

        1 - READ ON-DESIGN DATA FILE FROM DISK
        2 - WRITE ON-DESIGN DATA FILE TO DISK
        3 - CHANGE/VIEW CURRENT DATA FILE
        4 - PAUSE PROGRAM and USE DOS
        0 - RETURN TO MAIN ON-DESIGN MENU

   ENTER YOUR SELECTION   0
```

```
************************************************************
*                                                          *
*              ON-DESIGN ENGINE ANALYSIS PROGRAM           *
*                                                          *
*                         MAIN MENU                        *
*                                                          *
************************************************************

     1 - ENGINE CYCLE SELECTION           (5)
     2 - CALC ITERATION VARIABLE          (4)
     3 - INPUT DATA
     4 - OUTPUT DEVICE                    (2)
     5 - PERFORM CALCULATIONS
     6 - EXIT PROGRAM

ENTER YOUR SELECTION   4

************************************************************
*            ON-DESIGN ENGINE ANALYSIS PROGRAM             *
*                                                          *
*                   DATA OUTPUT DEVICE(S)                  *
************************************************************
CURRENT SELECTION IS ITEM #2

     1 - OUTPUT TO PRINTER ONLY
     2 - OUTPUT TO TERMINAL SCREEN ONLY
     3 - OUTPUT TO BOTH PRINTER AND TERMINAL SCREEN
     0 - RETURN TO MAIN MENU

ENTER YOUR SELECTION   0

************************************************************
*                                                          *
*              ON-DESIGN ENGINE ANALYSIS PROGRAM           *
*                                                          *
*                         MAIN MENU                        *
*                                                          *
************************************************************

     1 - ENGINE CYCLE SELECTION           (5)
     2 - CALC ITERATION VARIABLE          (4)
     3 - INPUT DATA
     4 - OUTPUT DEVICE                    (2)
     5 - PERFORM CALCULATIONS
     6 - EXIT PROGRAM

ENTER YOUR SELECTION   5


 ************************************************************
 *                                                          *
 *          You can save multiple iteration results         *
 *          as disk file(s) for later plotting in           *
 *          one of two file formats:                        *
 *                                                          *
 ************************************************************

      1 - SINGLE DISK FILE        (LOTUS or TWIN)
      2 - MULTIPLE DISK FILES     (GRAPHER)

 ENTER YOUR SELECTION (<CR>=DO NOT SAVE)    <CR>
```

```
FILE: DEFAULT          ON-DESIGN CALCULATIONS                PAGE  1

                TURBOFAN ENGINE WITH MIXED EXHAUST

 **********************      INPUT DATA      **********************
      MACH NO   =  1.600              ALPHA      =   .400
      ALT (FT)  = 35000.              PI C`      =  3.800
      T0 (R)    = 394.10              PI D (MAX) =   .97
      P0 (PSIA) = 3.4680              PI B       =   .97
      DENSITY   =.00073824            PI N       =   .98
      (SLUG/CUFT)                   EFFICIENCY
      CP C =  .238 BTU/LBM-R          BURNER     =   .98
      CP T =  .295 BTU/LBM-R          MECH HI PR =   .98
      GAMMA C = 1.400                 MECH LO PR =   .99
      GAMMA T = 1.300                 LP COMPR (FAN) =   .89 (EC`)
      TT4 MAX = 3200. (R)             HP COMPR       =   .90 (ECH)
      H - FUEL (BTU/LBM) = 18000.     HP TURBINE     =   .89 (ETH)
      CTO LOW         = .0150         LP TURBINE     =   .91 (ETL)
      CTO HIGH        = .0000         PWR MECH EFF L =   .98
      COOLING AIR #1  =  5.00 %       PWR MECH EFF H =   .98
      COOLING AIR #2  =  5.00 %       BLEED AIR      =  1.00 %
      P0/P9 =  1.00
                       ** AFTERBURNER **
      TT7 MAX   = 3600. (R)           PI AB      =   .96
      CP A/B =  .295 BTU/LBM-R        ETTA A/B   =   .97
      GAMMA A/B =  1.30
      *** MIXER ***                   PI MIXER MAX =   .97
 ************************    RESULTS    ************************
      TAU R =  1.512                  A0 =  973.1 FT/SEC
      PI R  =  4.250                  V0 = 1556.9 FT/SEC
      PI D  =   .933                  TAU L =  10.064

  PI C F/MDOT    S     M5   M5P TAUTL  M6   PT9/P9  V9/V0  T EFF  P EFF
 17.00 110.99  1.8102 .400 .498 .8580 .434  12.933   3.14  45.17  49.09
 18.00 111.15  1.8080 .400 .486 .8568 .432  13.024   3.14  45.26  49.05
 19.00 111.28  1.8062 .400 .476 .8557 .431  13.096   3.15  45.33  49.02
 20.00 111.38  1.8050 .400 .468 .8546 .429  13.151   3.15  45.38  49.00
 21.00 111.45  1.8042 .400 .463 .8535 .428  13.192   3.15  45.42  48.98
 22.00 111.50  1.8037 .400 .459 .8524 .427  13.219   3.15  45.44  48.97
 23.00 111.52  1.8036 .400 .457 .8513 .427  13.234   3.15  45.45  48.97
 24.00 111.53  1.8037 .400 .456 .8503 .427  13.238   3.15  45.45  48.96
 25.00 111.52  1.8042 .400 .457 .8493 .427  13.232   3.15  45.43  48.97
 26.00 111.50  1.8048 .400 .460 .8483 .427  13.217   3.15  45.41  48.97
 27.00 111.46  1.8057 .400 .463 .8473 .427  13.194   3.15  45.38  48.98
 28.00 111.41  1.8068 .400 .468 .8463 .428  13.164   3.15  45.34  49.00
 29.00 111.35  1.8081 .400 .474 .8453 .429  13.126   3.15  45.30  49.01
 30.00 111.27  1.8096 .400 .480 .8444 .429  13.083   3.15  45.24  49.03
 DATA SET  1 CALCULATED. ENTER ANY SINGLE CHARACTER TO CONTINUE.    <CR>
```

```
************************************************************
*                                                          *
*             ON-DESIGN ENGINE ANALYSIS PROGRAM            *
*                                                          *
*                        MAIN MENU                         *
*                                                          *
************************************************************

     1 - ENGINE CYCLE SELECTION          (5)
     2 - CALC ITERATION VARIABLE         (4)
     3 - INPUT DATA
     4 - OUTPUT DEVICE                   (3)
     5 - PERFORM CALCULATIONS
     6 - EXIT PROGRAM

ENTER YOUR SELECTION   2

************************************************************
*                   ITERATION VALUE MENU                   *
************************************************************
CURRENT ITERATION VARIABLE IS #4

MINIMUM VALUE =     17.00
MAXIMUM VALUE =     30.00
INCREMENT     =      1.00
     1 - SINGLE POINT CALCULATION
     2 - FLIGHT MACH NUMBER
     3 - MAX TEMPERATURE LEAVING MAIN BURNER (TT4)
     4 - COMPRESSOR PRESSURE RATIO
     5 - FAN PRESSURE RATIO
     6 - BYPASS RATIO
     0 - RETURN TO MAIN OFF-DESIGN MENU

ENTER SELECTION  1

************************************************************
*                                                          *
*             ON-DESIGN ENGINE ANALYSIS PROGRAM            *
*                                                          *
*                        MAIN MENU                         *
*                                                          *
************************************************************

     1 - ENGINE CYCLE SELECTION          (5)
     2 - CALC ITERATION VARIABLE         (1)
     3 - INPUT DATA
     4 - OUTPUT DEVICE                   (3)
     5 - PERFORM CALCULATIONS
     6 - EXIT PROGRAM

ENTER YOUR SELECTION   5
```

```
  FILE: DEFAULT           ON-DESIGN CALCULATIONS                 PAGE  1

                TURBOFAN ENGINE WITH MIXED EXHAUST

**********************       INPUT DATA       **********************
      MACH NO   =  1.600               ALPHA      =   .400
      ALT (FT)  = 35000.               PI C`      =  3.800
      T0 (R)    = 394.10               PI D (MAX) =   .97
      P0 (PSIA) = 3.4680               PI B       =   .97
      DENSITY   =.00073824             PI N       =   .98
      (SLUG/CUFT)                    EFFICIENCY
      CP C =  .238 BTU/LBM-R           BURNER     =   .98
      CP T =  .295 BTU/LBM-R           MECH HI PR =   .98
      GAMMA C = 1.400                  MECH LO PR =   .99
      GAMMA T = 1.300                  LP COMPR (FAN) =   .89 (EC`)
      TT4 MAX = 3200. (R)              HP COMPR       =   .90 (ECH)
      H - FUEL (BTU/LBM) = 18000.      HP TURBINE     =   .89 (ETH)
      CTO LOW         = .0150          LP TURBINE     =   .91 (ETL)
      CTO HIGH        = .0000          PWR MECH EFF L =   .98
      COOLING AIR #1  =  5.00 %        PWR MECH EFF H =   .98
      COOLING AIR #2  =  5.00 %        BLEED AIR      =  1.00 %
      P0/P9 =  1.00
                        ** AFTERBURNER **
      TT7 MAX   = 3600. (R)            PI AB      =   .96
      CP A/B =  .295 BTU/LBM-R         ETTA A/B   =   .97
      GAMMA A/B =  1.30
      *** MIXER ***                    PI MIXER MAX =   .97
**********************    RESULTS    **********************
      TAU R =  1.512                   A0 =  973.1 FT/SEC
      PI R  =  4.250                   V0 = 1556.9 FT/SEC
      PI D  =   .933                   MASS FLOW  =     200.00 LBM/SEC
      TAU L = 10.064                   AREA ZERO  =      5.408 SQFT
      PTO LO= 296.89 KW                AREA ZERO* =      4.326 SQFT
      PTO HI=    .00 KW
      PT5`/P0 = 15.077                 TT5`/T0 =  2.321
      PT5 /P0 = 14.100                 TT5 /T0 =  5.560
      PI C   = 17.00                   TAU M1  =  .9676
      PI C`  = 3.800                   TAU M2  =  .9732
      TAU C` = 1.535                   TAU M  =  .8602
      ETA C` = .8679                   PI M   =  .9749
      PI CH  = 4.474                   M5     =  .4000
      TAU CH = 1.609                   M5`    =  .4985
      ETA CH = .8773                   M6     =  .4340
      PI TH  = .4470                   A5`/A5 =  .1931
      TAU TH = .8476                   GAMMA M= 1.3227
      ETA TH = .8989                   CP M   =  .2790
      PI TL  = .4821                   ETA TL =  .9167
      TAU TL = .8580
    WITHOUT AB                       WITH AB
      PT9/P0 = 13.2021                 PT9/P0 = 12.9327
      F      =   .0356                 F      =   .0356
                                       FAB    =   .0334
                                       FO     =   .0558
      F/M    =  62.741 LBF/LBM/S       F/M    = 110.990 LBF/LBM/S
      S      =  1.2971 1/H             S      =  1.8102 1/H
      T9/T0  =  2.5485                 T9/T0  =  5.0600
      V9/V0  =    2.26                 V9/V0  =    3.14
      M9/M0  =    1.46                 M9/M0  =    1.45
      A9/A0  =  1.1452                 A9/A0  =  1.6914
      A9/A8  =  2.4625                 A9/A8  =  2.4808
      THRUST =  12548. LBF             THRUST =  22198. LBF
 DATA SET  2 CALCULATED. ENTER ANY SINGLE CHARACTER TO CONTINUE.    <CR>
```

NOTE: *The total pressure loss of the dry afterburner is assumed to be one-half of the wet loss in calculating the performance without afterburner.*

```
 ************************************************************
 *            ON-DESIGN ENGINE ANALYSIS PROGRAM             *
 *                                                          *
 *                       ENGINE SIZE                        *
 ************************************************************


 SPECIFIC THRUST           =  110.9899 LBF/LBM/SEC
 SPECIFIC FUEL CONSUMPTION =    1.8102 1/HR
 MASS FLOW RATE OF AIR     =  200.0000 LBM/SEC
 MASS FLOW RATE OF FUEL    =  40183.41 LBM/HR
 ENGINE THRUST AT DESIGN   =  22197.97 LBF

 WANT TO CHANGE ENGINE THRUST (Y=1/N=0)?   0

 WANT TO CHANGE MASS FLOW OF AIR (Y=1/N=0)?   0

 DO YOU WANT TO SAVE THESE RESULTS AS A REFERENCE DATA FILE
 THAT BECOMES THE INPUT TO THE OFF-DESIGN PROGRAM  (Y=1/N=0)?    1
 ENTER NAME OF DATA FILE + ".DAT" (MAX OF 14 CHAR)    OFFAB.DAT
 YOUR INPUT IS "OFFAB.DAT     ", IS THIS CORRECT  (Y=1/N=0)?    1

 ************************************************************
 *                                                          *
 *              ON-DESIGN ENGINE ANALYSIS PROGRAM           *
 *                                                          *
 *                         MAIN MENU                        *
 *                                                          *
 ************************************************************

     1 - ENGINE CYCLE SELECTION           (5)
     2 - CALC ITERATION VARIABLE          (4)
     3 - INPUT DATA
     4 - OUTPUT DEVICE                    (2)
     5 - PERFORM CALCULATIONS
     6 - EXIT PROGRAM

 ENTER YOUR SELECTION  6

 YOU ARE ABOUT TO EXIT THIS PROGRAM - ENTER A "X" TO EXIT
 OR ANY OTHER CHARACTER TO GET THE MAIN MENU.    X

Stop - Program terminated.

A>
```

I. OPTIMUM SOLUTIONS

Optimum solution for one design variable is available for the turbofan engine with separate exhaust and the turboprop engine. This optimum solution is obtained as follows:

Turbofan Engine with separate exhausts - the optimum bypass ratio when nozzle exit pressures equal ambient can be obtained by substituting a minus one (**-1**) for the value of bypass ratio (**ALPHA**, item **42** of Data Set). Since the computer will be searching for the bypass ratio giving minimum thrust specific fuel consumption, the bypass ratio can not be the iteration variable. If the fan pressure ratio causes choking of the fan stream exit nozzle, the optimum bypass ratio is calculated for the case of unchoked flow and the following warning is printed on the screen and/or printer:

FAN STREAM EXIT IS CHOKED, OPTIMUM BYPASS RATIO IS NOT EXACT

Turboprop Engine - the optimum turbine pressure ratio can be obtained by substituting a minus one (**-1**) for the value of turbine pressure ratio (**TAUT**, item **43** of Data Set). Since the computer will be searching for the turbine pressure ratio giving minimum thrust specific fuel consumption, the turbine pressure ratio can not be the iteration variable.