

J. DEFAULT INPUT DATA FILES

```

Engine Cycle 1: Turbojet without afterburner
*****
*           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
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)

*****
*           DATA SET 1 , PAGE 2           *
*****
20 - PI DIFFUSER (MAX) - - - - - = .970
21 - PI BURNER - - - - - = .970
22 - PI AFTERBURNER - - - - - = .960
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
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

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

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

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

```

Note that data input variable 22 is displayed and can be changed to account for the dry total pressure loss of the afterburner.

Engine Cycle 2: Turbojet with afterburner

```
*****
*                               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)

```
*****
*                               DATA SET 1 , PAGE 2                               *
*****
20 - PI DIFFUSER (MAX) - - - - - = .970
21 - PI BURNER - - - - - = .970
22 - PI AFTERBURNER - - - - - = .960
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
```

OF VARIABLE YOU WISH TO CHANGE (0=NONE)

```
*****
*                               DATA SET 1 , PAGE 3                               *
*****
  DESIGN CONDITIONS
40 - PI C - - - - - = 16.000
41 - PI C PRIME - - - - - = 3.500
```

OF VARIABLE YOU WISH TO CHANGE (0=NONE)

Engine Cycle 3: Turbofan with separate exhausts

```
*****
*                               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
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)

```
*****
*                               DATA SET 1 , PAGE 2                               *
*****
20 - PI DIFFUSER (MAX) - - - - - = .970
21 - PI BURNER - - - - - = .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
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
```

OF VARIABLE YOU WISH TO CHANGE (0=NONE)

```
*****
*                               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)

Engine Cycle 4: Turbofan with mixed exhaust and no afterburner

```

*****
*                               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
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)

*****
*                               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
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)

*****
*                               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)

```

Note that data input variable 22 is displayed and can be changed to account for the dry total pressure loss of the afterburner.

Engine Cycle 5: Turbofan with mixed exhaust and afterburner

```
*****
*                               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)

```
*****
*                               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)

```
*****
*                               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)

Engine Cycle 6: Turboprop

```
*****
*                               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
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)

```
*****
*                               DATA SET 1 , PAGE 2                               *
*****
20 - PI DIFFUSER (MAX) - - - - - = .970
21 - PI BURNER - - - - - = .970
24 - PI NOZZLE - - - - - = .980
  POLYTROPIC EFFICIENCIES
27 - COMPRESSOR (EC) - - - - - = .900
28 - HP TURBINE (ETH) - - - - - = .890
29 - LP TURBINE (ETL) - - - - - = .910
  COMPONENT EFFICIENCIES
30 - BURNER - - - - - = .980
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
38 - PROPELLER - - - - - = .820
39 - PROPELLER GEAR - - - - - = .990
```

OF VARIABLE YOU WISH TO CHANGE (0=NONE)

```
*****
*                               DATA SET 1 , PAGE 3                               *
*****
  DESIGN CONDITIONS
40 - PI C - - - - - = 16.000
43 - TAUT - - - - - = .8000
```

OF VARIABLE YOU WISH TO CHANGE (0=NONE)

Engine Cycle 9: Ramjet

```

*****
*          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
15 - BLEED AIR FLOW (PERCENT) - - - - - = 1.0 %

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

*****
*          DATA SET 1 , PAGE 2          *
*****
20 - PI DIFFUSER (MAX) - - - - - = .970
21 - PI BURNER - - - - - = .970
24 - PI NOZZLE - - - - - = .980
  COMPONENT EFFICIENCIES
30 - BURNER - - - - - = .980
36 - P0/P9 - - - - - = 1.000

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

```

K. ERROR MESSAGES

This section contains typical error messages that may appear on the screen and/or printer and the description of the error.

1. INPUT DATA MENU

When trying to read a reference data file, the following message is displayed on the screen.

```

DATA FILE ACCESSED IS NOT AN ON-DESIGN DATA FILE.
PLEASE TRY AGAIN.

```

When trying to exit page 3 of the data set, one of the following messages may appear on the screen. The first lets you know that a negative value of fan pressure ratio is not allowed; however, if you input a value of 0.5 for the fan pressure ratio and the cycle is a turbojet, then the program calculates the fan pressure ratio as the square root of the compressor pressure ratio. The second message concerning determination of the optimum bypass ratio while iterating on the bypass ratio is self explanatory.

```

ACTUALLY PI C PRIME CAN NOT BE LESS THAN 1.0. HOWEVER
YOU MAY INPUT A VALUE OF 0.5 FOR THE TURBOJET CYCLE AND
THE PROGRAM WILL AUTOMATICALLY DETERMINE A VALUE FOR
THE FAN OR LOW PRESSURE COMPRESSOR PI.

```

```

PREVIOUSLY, YOU SELECTED ALPHA AS YOUR ITERATION VARIABLE
AND NOW YOU WANT THE PROGRAM TO FIND ALPHA*. THESE TWO
REQUIREMENTS ARE NOT COMPATIBLE. IF YOU DESIRE ALPHA*,
YOU MUST ITERATE ON ANY VARIABLE EXCEPT ALPHA.
NOW YOU MUST INPUT A POSITIVE VALUE FOR ALPHA BEFORE
PROCEEDING.

```

2. CALCULATIONS

After selection of item 5 - **PERFORM CALCULATIONS** from the **MAIN MENU**, the following message will be displayed on the screen when the iteration variable and engine cycle do not correspond.

**INVALID ITERATION VARIABLE (#) FOR CYCLE (#)
YOU MUST CHANGE EITHER.**

Sometimes during iterative calculations the exit total pressure of the core stream is less than that required for flow to exist. The program first discovers this when trying to calculate either the exit velocity or the exit Mach number, and one of the following messages is displayed/printed.

VE2 IS NEGATIVE. THIS CASE IS MEANINGLESS.

or

ME2 IS NEGATIVE. THIS CASE IS MEANINGLESS.

If this occurs for the fan stream of the separate stream turbofan, the following message is displayed/printed.

VE'2 IS NEGATIVE. THIS CASE IS MEANINGLESS.

For the turboprop engine cycle, the following message may appear during calculations because the required temperature ratio of the low pressure turbine is greater than one.

TAU TL IS GREATER THAN ONE. THIS CASE IS MEANINGLESS.

Also for the turboprop engine cycle, the following message may appear when trying to obtain the optimum turbine temperature ratio.

TAUT DID NOT CONVERGE IN 20 ITERATIONS.

Solution for the mixed flow turbofan engine cycle requires that the Kutta condition be satisfied ($P_5 = P_5'$) at the mixer splitter plate while keeping the Mach number of either stream less than 0.95. If this is not possible, one of the following messages is displayed/printed.

CORE TOTAL PRESSURE IS TOO HIGH FOR MIXING $PT_5/PT_5' = XX.XXXX$

FAN TOTAL PRESSURE IS TOO HIGH FOR MIXING $PT_5/PT_5' = XX.XXXX$

When the total pressure of the core stream is too high, a solution can usually be obtained by increasing the fan pressure ratio. When the total pressure of the fan stream is too high, a solution can usually be obtained by decreasing the fan pressure ratio.

Sometimes during solution, the total pressure at the exit of the mixer is not sufficient for a solution to exist and the following messages is displayed/printed.

M62 IS NEGATIVE. NO SOLUTION IS POSSIBLE FOR THE MIXER.