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Airplane Performance Monitoring Software User Manual

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Abstract

Airplane Performance Monitoring (APM) is an application which is used to compute airplane fuel mileage and compare the results to expected values for the conditions. Results are used by airlines to calibrate their flight planning systems, which minimizes unnecessary fuel carriage.

1 INTRODUCTION

The Boeing Airplane Performance Monitoring (APM) program enables the user to calculate four types of performance deviations: power setting required (EPR or %Nl), thrust required, fuel flow, and fuel mileage. The APM program is provided to assist operators in the performance monitoring of their Boeing airplanes. Program results are primarily intended to be used for tracking long term airframe/engine performance trends. The program is not intended to isolate short term engine malfunctions or predict engine failures.

By analyzing cruise performance data, the APM program will indicate airplanes for which performance has deviated from the applicable baseline. This information may assist an operator in identifying the need for possible airframe or engine maintenance action and may also be used to develop factors to apply to flight planning fuel values or as Flight Management System (FMS) performance adjustments.

The program uses the Operations Manual cruise performance level as the baseline. The APM program incorporates the following features, some of which are model dependent:

- Automated or manual cruise data input
- A variety of outputs, both tabular or one page per cruise data point
- Center of gravity corrections to drag
- Fuel lower heating value corrections to fuel flow
- Gravity variation corrections to gross weight
- Energy corrections to drag
- Off-nominal engine power extraction (generator load) corrections to fuel flow
- Simple keyword inputs to control program execution
- Ability to base analysis on Captain's or First officer's instruments
- Option to create a file to be used for post-processing (see MASTER file)
- Input screening for values out of bounds
- Automatic instrument switching if one Flight Management Computer (FMC) is inoperative
- Capability to calculate the airplane gross weight several different ways

1.1 About the Documentation

The APM program documentation is separated into several sections:

- A Quick Start Guide is provided to show what basic items and information are needed to run the program either as a component of the Performance Engineer's Tool (PET) or as a stand alone program.
- Input Data Description section describes automated and manual input data.
- The Algorithm and Analysis section discussed the equations and deviations the program uses and specific corrections available to the user.
- The Output Options section describes the various types of output APM produces.
- The Troubleshooting section is written to help resolve problems.
- There are several appendices with detail information on the APM tables and scalars and model specific data (Appendices D through M).

The APM program documentation covers a wide variety of topics and makes use of many symbols and abbreviations. An attempt was made to explain most within the documentation. However, if there is a symbol or abbreviation that is not understood, please refer to the Glossary.

If, after reading the documentation, there are still difficulties in using the APM program, please do not hesitate to contact Boeing.

1.2 Program Overview

In Figure 1, arrows show flow of data from one process or source to another.

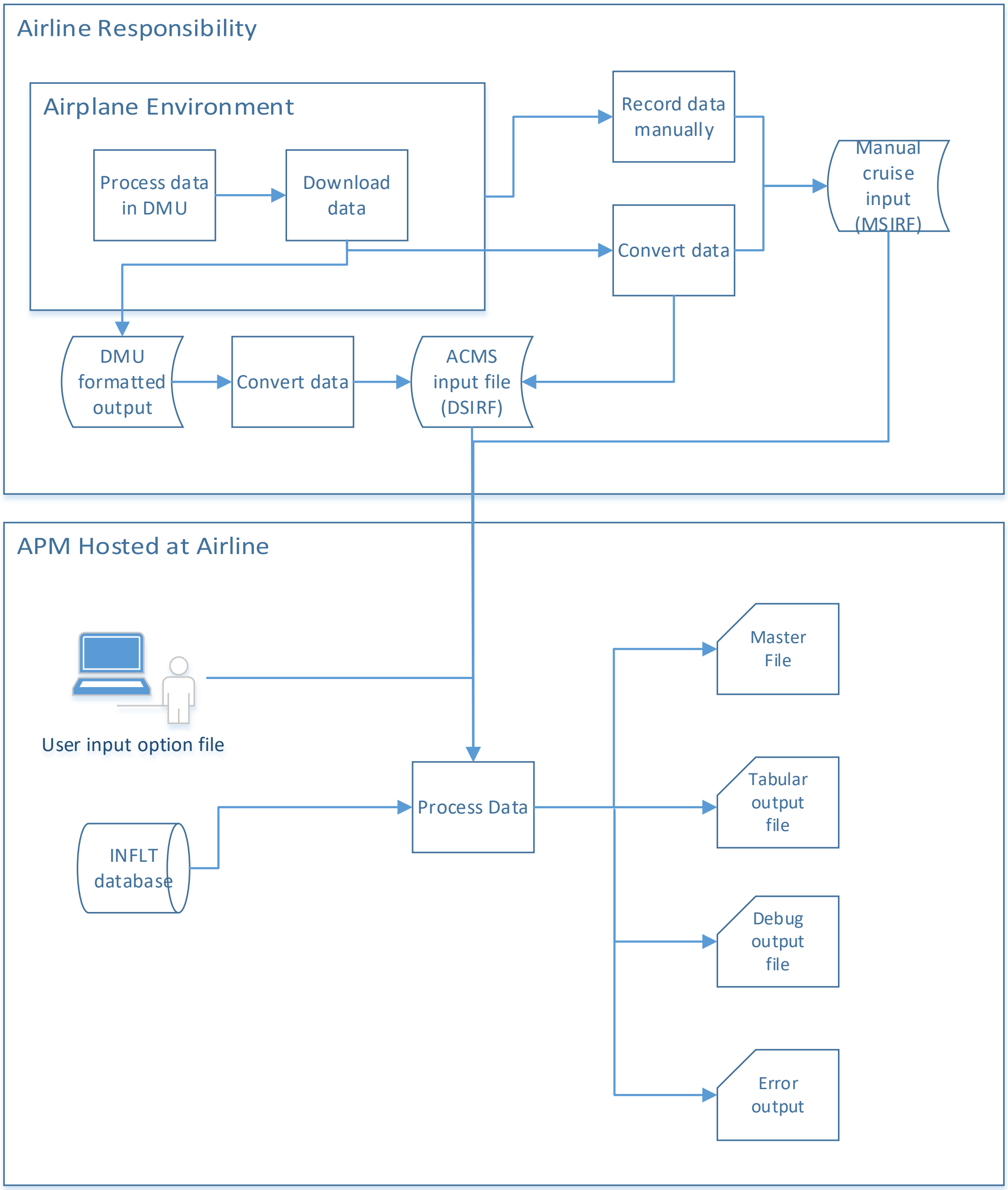


Figure 1: APM System Context Diagram

1.2.1 Airplane Environment

The airplane environment involves collection and downloading of airplane performance related data, either automatically by the Data Management Unit (DMU)/Digital Flight Data Acquisition Unit (DFDAU) or manually by an observer/flight crew member. With either the DMU or DFDAU, data can be downloaded to the Ground Support Equipment in many ways: Cassette, Disk, Aircraft Communications Addressing and Reporting System (ACARS), or Printer/Optical.

1.2.2 Airline Responsibility

Airline processes deal with conversion of data collected and downloaded from the DMU/DFDAU, to a format acceptable for use with the APM program. Ground Support Equipment is normally provided by the DMU/DFDAU vendors to transcribe airborne recorded data to DSIRF. Operators using other means for transmission of performance data, such as ACARS, or a Paper/Optical method (as well as operators who are designing their own Ground Support environment) will be responsible for converting airplane data into one of the compatible formats (DSIRF or MSIRF).

1.2.3 APM (hosted at airline)

The APM environment includes input, processing, and output to/within/from the APM program. Inputs to the APM program are: the User-Input file APMINP, the Database, and the cruise data input file (DSIRF or MSIRF). Outputs from the APM program are: Tabular output, Master file, Debug file, and Error messages

A flow chart reflecting the recommended Airplane Condition Monitoring (ACM) processes is shown in Figure 2.

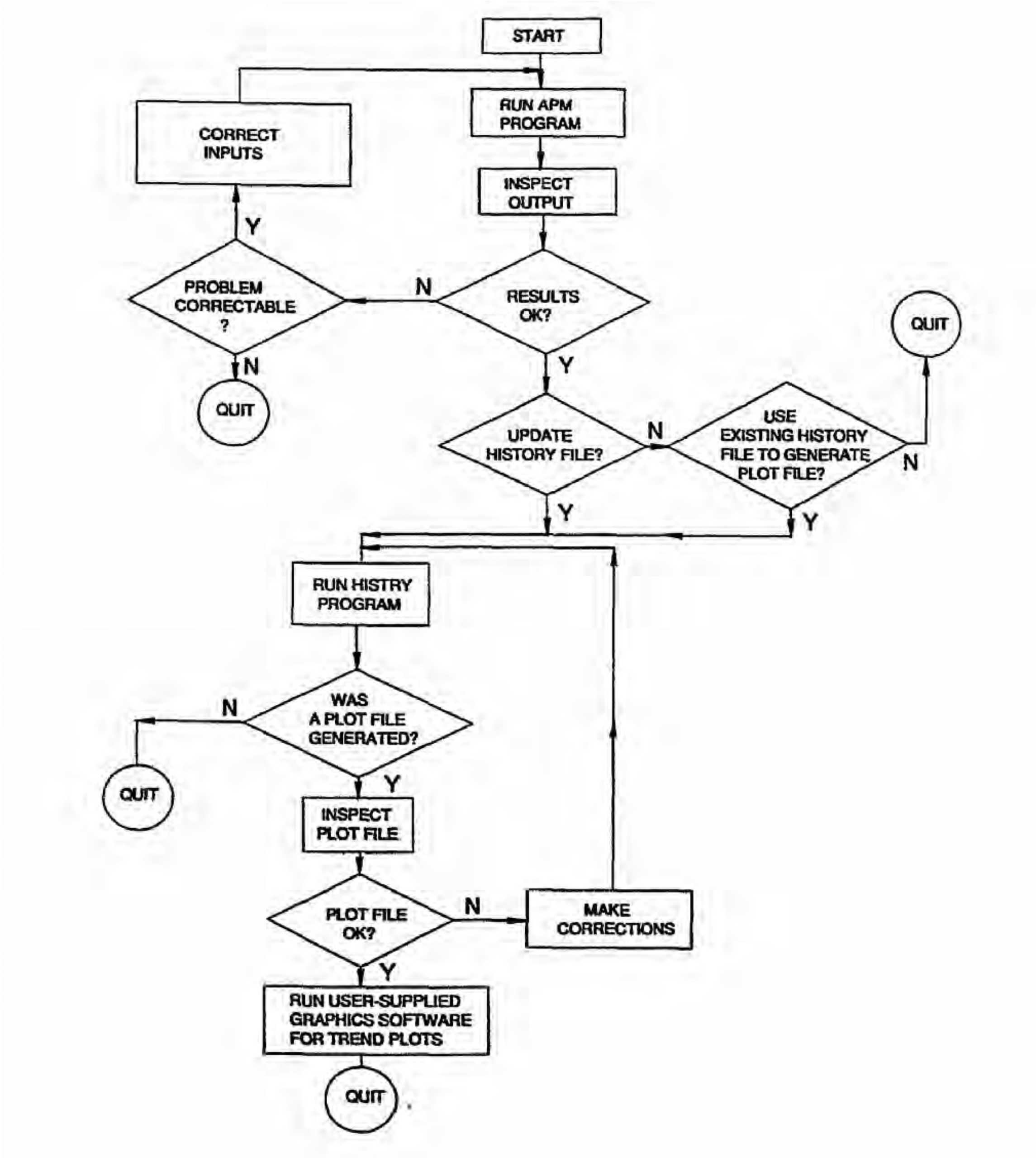


Figure 2: Airplane Condition Monitoring (ACM) Processes

2 QUICK START GUIDE

The Boeing Airplane Performance Monitoring (APM) program enables the user to calculate four types of performance deviations: power setting required (EPR or N1), thrust required, fuel flow and fuel mileage. The cruise data used by APM can be gathered by either manually recording points or by automated recording using the Aircraft Condition Monitoring System (ACMS). The formats for each type of cruise data are referred to as either MSIRF for manually recorded data or DSIRF for automatically recorded data. A sample of each format is included in the APM package. The use of automated recording requires either a customized ACMS which creates a DSIRF format directly or ground-based software which converts raw ACMS into DSIRF. ACMS manufacturers (Honeywell, Teledyne, etc.) have software available to perform this conversion. MSIRF format is represented by a loadsheet in the appropriate model appendix of the APM User Guide.

The following are brief instructions to get you started running APM. These instructions refer to running APM on a PC.

2.1 Input

Files needed to run APM:

- APM.exe – Executable file which is the program itself.
- APMINP – User-input file which controls execution of the program and directs it to the various input/output files and specifies program options to run.
- Database file – This file contains all aircraft data necessary to calculate "book" values of cruise performance.
- Cruise data file – This can be any valid filename, is either of MSIRF or DSIRF format and contains the actual cruise data points to be analyzed.

The executable file APM.exe and the user-input file APMINP must be in the same folder on your PC. Since the APMINP file directs the program to other files, those files can be in different folders providing the correct path is specified in the file definitions in APMINP. Sample contents of a typical APMINP file are shown here:

APM INPUT FILE (APMINP)	DESCRIPTION
SAMPLE.DAT CONFIG50 /CASE APM INPUT=ACMS CRZFIL=SAMPLE_CRUISE_FILE.CRZ OUTPUT=BRIEF OUTFIL=SAMPLE_OUTPUT_FILE.TXT	The first line of this APMINP file contains the performance database file name. In this example it is SAMPLE.DAT. Although this line is not required it is rarely omitted. The default value, if omitted, is DATBAS.
	The second line specifies the configuration within the database to be used (CONFIG50).
	/CASE marks the beginning of a case. Options set with keywords follow this line. Multiple cases can be run in one execution by using additional /CASE lines. Note that all keywords are reset to default values after each /CASE line. APM is the keyword that signals the program to begin executing the performance monitoring calculation. It must be placed immediately following any case block delimiter.

Below is a summary of the optional keywords available in the APM program.

Table 1: APM Keywords

KEYWORD	DESCRIPTION	DEFAULT	OPTIONS
ADJUSTWT	Activates weight adjustment option	NO	NO, FILE, APMINP
AIR-ENG	Airplane/engine combination	747-400	Text
CG	Toggle for CG Calculation	NO	NO, YES or DMU
CGMOM	Delta moment for gear / flap retraction	0	Moment in inch - pounds
CRZFIL	Cruise data point filename	CRZFIL	Valid filename
DATE	Date format	DD-MM-YY	MM-DD-YY, YY-MM-DD
DEBFIL	Debug output filename	DEBUG	Valid filename
DEBUG	Toggle for DEBUG Output	NO	NO or YES,
DRGFAC	Drag factor	1.00	Valid constant
ELASTIC	Toggle for Elasticity Correction	NO	NO or YES
ENERGY	Toggle for Energy Calculation	NO	NO or YES
EPRHI	Power setting deviation tolerance	0.15/ 15%N1	Valid tolerance
EPRLO	Power setting deviation tolerance	-0.15/-15%N1	Valid tolerance

KEYWORD	DESCRIPTION	DEFAULT	OPTIONS
FFA0	1st polynomial coeff for FF bias correction	0	Valid coefficient
FFA1	2nd polynomial coeff for FF bias correction	0	Valid coefficient
FFA2	3rd polynomial coeff for FF bias correction	0	Valid coefficient
FFA3	4th polynomial coeff for FF bias correction	0	Valid coefficient
FFCAL	Indicated Fuel Flow bias correction option	NO	NO or YES
FLEETAVG	Toggle for Fleet Avg Calculation	TAIL	TAIL or ALL
FMHI	Fuel mileage deviation tolerance	15	Valid tolerance
FMLO	Fuel mileage deviation tolerance	-15	Valid tolerance
GRAVITY	Toggle for Gravity Calculation	NO	NO or YES
INPUT	Cruise data input format	ACMS	ACMS or MANUAL
INSTR	Instrument source	C	C, FO, BOTH
LHEATV	Toggle for Fuel Lower Heat Value	NO	NO, YES or DMU
LHVB	Y-intercept of LHV Equation	22777	Valid coefficient
LHVM	Slope of LHV Equation	-5220	Valid coefficient
MASFIL	Master output filename	MASTER	Valid filename
MASTER	Toggle for MASTER Output	NO	NO or YES
OUTFIL	Output filename	APMOUT	Valid filename
OUTPUT	Output option	BRIEF	BRIEF or DETAIL
OVERRIDE	Used to override bleed checks	NO	NO, BLEED, ALL
PAGEBRK	Switch from ANSI to Fortran page breaks	ANSI	Any character string
POWERX	Toggle for Power Extraction	NO	NO or YES QUALTOL
QUALTOL	Quality factor tolerance	95	Valid tolerance
REYNLD	Toggle for Reynolds # Calculation	YES	NO or YES
SPDFIL	Spreadsheet filename	SPREAD.CSV	Valid filename
SPDPRM	Desired spreadsheet parameters	List is too long to show here, see user guide	
SPDSHT	Activates spreadsheet option	NO	NO, YES, APPEND

KEYWORD	DESCRIPTION	DEFAULT	OPTIONS
SPEED	Speed parameter	MACH	IAS, CAS, or MACH
TAILID	Aircraft ID for weight adjustment option		
TEMPUNTIN	Input temperature units	C	F or C
TEMPUNTOUT	Output temperature units	C	F or C
TITLE	Output title	Monthly Avg	Text
TRQDHI	Thrust required deviation tolerance	15	Valid tolerance
TRQDL0	Thrust required deviation tolerance	-15	Valid tolerance
TWTADJ	Weight adjustment for TAILID specified	0	Weight increment
TWTFIL	Optional file containing weight adjustments	TWTFIL	Valid filename
WEIGHT	Weight calculation option	A	A, B, C, D, E, or DMU
WFFAC	Fuel flow factor	1.00	Valid constant
WFHI	Fuel flow deviation tolerance	15	Valid tolerance
WFLO	Fuel flow deviation tolerance	-15	Valid tolerance
WTUNITIN	Inout weight units	LB	KG or LB
WTUNITOUT	Output weight units	LB	KG or LB

2.1.1 Cruise Data File

There is a minimum set of parameters required to do an APM analysis.

- Fuel Flow,
- Power Setting,
- Mach Number,
- Flight Level,
- TAT,
- Cruise Weight and
- Engine Bleed

These parameters represent this minimum set required for an APM analysis. The format for this cruise data file (either DSIRF or MSIRF) varies slightly, depending on aircraft model. These formats are shown in detail in the full user guide for APM. Examples of each type are included in the APM software package under the names ACMN1.DAT & ACMEPR.DAT in DSIRF format and MANEPR.DAT, MANEP2.DAT & MANN1.DAT in MSIRF format.

2.2 Output

The main text output of APM which is printed to the file specified by the **OUTFIL** keyword, can be created in several different formats.

- BRIEF – For each point analyzed, the deviations from book values are shown as well as these basic input parameters; Date, Flight number, Flight level, CAS, TAT, Weight, Mach, Average power setting & Quality factor. Also, a fleet or tail number summary of deviations is printed at the end of the file.

- DETAIL – This output is the same as the BRIEF format with the following additional input parameters shown for each point:

    - DeptDest,
    - Lat,
    - CG,
    - Gen Load,
    - LHV. dVg/dt, dHp/dt

- DETAIL2 – This output is the same as the BRIEF format with the addition of DeptDest & Fuel Flow deviations for each individual engine.

- SUMMARY – This output format prints an input specifications page and a fleet or tail number summary of deviations. The listing of individual points is not printed.

- SUMMARY2 – This output format is the same as the SUMMARY output but without input specifications page.

Other output options include the creation of separate files. One is a master file containing many input and output parameters for post-processing. Another is a customizable spreadsheet file where specific parameters to be written to the file, are chosen by the user. See the user guide for more details on these output options.

2.3 Program Execution

The APM program can be executed as a stand alone program, from within the Performance Engineers Tool (PET), or from within the Boeing Performance Software (BPS). The majority of the effort is collecting the necessary files. In particular obtaining the cruise data in the proper format can even be a challenge. There are several methods that can be used depending on the aircraft and the ACMS system installed. These can include ACARS, MAT, QAR, etc. Choosing which method is ultimately up to the operator based on cost and availability of personnel to download data.

2.3.1 Running APM from Performance Engineers Tool (PET)

The recommended way to run APM is through the Performance Engineers Tool (PET). A brief description of running APM through PET is provided here. For more detailed information on using the PET program, please refer to the PET Help System included with that program package.

- This guide assumes that PET is already installed on your computer. If it is not, or if you need more detailed instructions, please refer to the README-PET-installation document included in the PET program package.

- This guide assumes that the approporiate High Speed (Enroute) database has been imported in PET. Refer to the PET Help System for more information.

From the PET main menu, select the APM tab. The following PET screen appears:

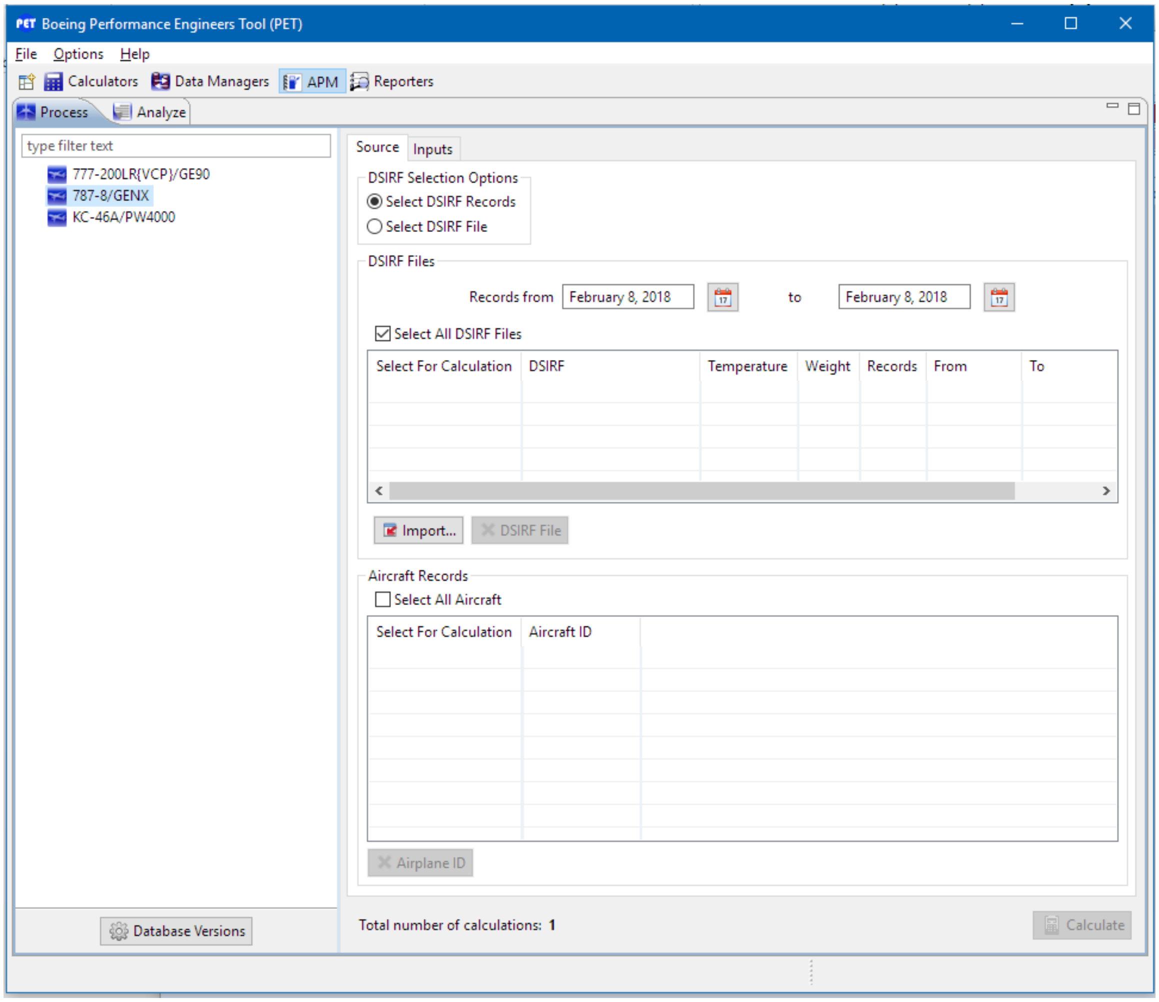


Figure 3: PET APM Screen

This screen allows the user to import a DSIRF file(s) and/or to select a specific DSIRF record for analysis. The Import process requires the user to select a weight option. After the import is complete, the user can select the aircraft to be included in the analysis.

2.3.2 Stand Alone Program Installation and Execution

The APM program is provided in an executable form for PCs operating Windows7™ operating system or later.

Follow the steps listed below to install the program.

1. Create a new folder using any name desired
2. Copy the program executable files to this folder
3. Copy, or create using an ASCII text editor, the user input file APMINP in this folder
4. Copy the APM/INFLT database(s) to this folder**
5. Copy the APM sample input files to this folder**

**Alternate locations can be used for these files. See Alternate File Locations section below.

Once these steps have been accomplished, APM is fully installed and ready for execution.

This section assumes the following files are available:

- Program executables APM.EXE
- User-Input File, APMINP
- Airframe/Engine Database*
- Cruise data file* (either in DSIRF or MSIRF format).

The database and cruise input file names are specified in the user input file `APMINP`.

Running APM as a stand alone program on a PC can be done by navigating to the folder containing the executable file (APM.EXE) and double-clicking on it. The output file(s) will be created in the same folder unless a path is specified in the APMINP file. An alternative would be to open a Command Prompt window, changing to the necessary folder, typing APM at the command prompt and pressing Enter. This second method provides the opportunity of seeing any messages the program writes to the screen.

Another alternative is to execute APM in a batch mode. A batch or command file can contain a sequence of interactive commands that would be executed by launching this file. Once created, a batch file can be launched by any of the methods listed above.

The batch file is an ASCII text file with the file extension "`.BAT`". It can be created using any text editor such as Notepad. There are several advantages to this method of execution. A shortcut to this batch file can be placed anywhere (like the desktop) and the batch file can be paused after program execution to see any possible error messages.

A simple batch file could be used just to pause after the execution to see any possible error messages sent to the screen. More complex batch files can be created to prompt the user for file names and locations as well as user input options. The example show below simply opens the user input file for editing then executes APM and pauses after execution.

```
@ECHO OFF
IF NOT EXIST APMINP. GOTO ERROR_NOAPMINP C:\WINNT\SYSTEM32\NOTEPAD APMINP.
APM
PAUSE
GOTO QUIT
:ERROR_NOAPMINP
ECHO ERROR -- NO APM USER INPUT FILE FOUND!
PAUSE
:QUIT
EXIT
```

<u>Alternate file location</u>

The locations of all input and output files (except APMINP) can be in any existing windows folder on the computer system. As shown in the example below, the path is then specified in the user input file. If no path is specified, the program assumes the file is located (or will be created in the case of an output file) in the same folder as the program executable. The example below just illustrates the possibilities in file locations. The user can use any desired Windows folder.

Example of APMINP file showing file paths:

```
C:\PROGRAM FILES\APM\7X7\SAMPLE.DAT
CONFIG10
/CASE
APM
AIR-ENG=7X7-XXX/FANJET
DEBUG=YES
DEBFIL=C:\PROGRAM FILES\APM\7X7\DEBFIL1.OUT
INPUT=ACMS
CRZFIL=C:\PROGRAM FILES\APM\7X7\CRUISE DATA\ACMSEPR.TXT
OUTPUT=BRIEF
OUTFIL=C:\PROGRAM FILES\APM\7X7\OUTPUT\OUTFIL1.OUT
MASTER=YES
MASFIL=C:\PROGRAM FILES\HISTRY\7X7\MASTER1.DAT
```

Included in the package with the APM program should be a number of sample input files. A description of these samples is provided in Appendix C, Sample Input and Output. We have included these files to aid you in learning how to execute APM and to also insure that the data you generate matches expected results. Appendix C lists each sample input file, followed by the expected results from a successful execution. Accomplish the following steps to execute the examples in Appendix C.

3 INPUT DATA DESCRIPTION

Note in Figure 1, the APM program was structured to accept input from three sources:

- ACMS automated input (DSIRF) or manual input (MSIRF),
- User-input options, and
- Airframe/engine database.

A description of these sources follows.

3.1 Automated (ACMS) Input Data

Onboard systems can transfer DMU/DFDAU-collected data via one of four hardware device types, depending on airplane configuration:

1. Cassette (Quick Access Recorder QAR)
2. Disk (Airborne Data Loader ADL)
3. Paper/optical (Printer/hardcopy available in cockpit)
4. ACARS (Aircraft Communications Addressing and Reporting System)

Note: Only device types 1 and 2 provide the full complement of parameters to be described later in this section.

The standard ACMS input format designated in Figure 1 is a DSIRF (Digital Standard Input Record Format) file. This file will contain data collected automatically during each flight by the DMU/DFDAU, later "downloaded" to vendor supplied Ground Support Equipment via either cassette or disk, and finally converted from DMU/DFDAU- formatted output to the DSIRF format.

The complement of DMU/DFDAU recorded data is designed to cover the requirements for Airplane Performance Monitoring (APM), Engine Condition Monitoring (ECM), and for some airplanes, Auxiliary Power Unit (APU) Monitoring, and Environmental Control System (ECS) Monitoring. To facilitate the interface task of transferring airborne recorded DMU/DFDAU data to the Airline Host programs (e.g. APM), a standardized data record format has been defined for each of the four types of monitoring. In practice, a collection of the four data record format types is contained in a file designated in Figure 1 as a DSIRF file.

This file will contain data collected automatically during each flight by the DMU/DFDAU, later transmitted to vendor-supplied Ground Support Equipment (GSE) via either cassette or disk, and finally converted from DMU/DFDAU-formatted output to the DSIRF file. Airlines implementing their own GSE will be responsible for this conversion of DMU/DFDAU formatted data to the DSIRF file. Airlines will also be responsible for interfacing with ACARS and/or paper/optical methods of data transmittal.

From the user viewpoint, the DSIRF file is generated by the DMU/DFDAU vendor GSE and contains the monitoring data to be analyzed. The required user action will be to make the DSIRF file available to the monitoring program. A description of the APM program cruise data structure and content in the DSIRF file follows.

The DMU/DFDAU GSE will convert DMU/DFDAU-formatted output to the DSIRF format (see Figure 1). Airlines implementing their own Ground Support Equipment will be responsible for this conversion of DMU/DFDAU-formatted data to the DSIRF format. With the exception of the header, the DSIRF format consists of parameters separated by commas written to an ASCII file.

A detailed explanation of the DSIRF parameters, format, resolution, and sequence is in the following section.

3.1.1 Structure

The DSIRF file contains records consisting of a contiguous set of ASCII characters with a maximum record length of 1200 characters. Within this record are 181 parameters. Since the DSIRF can be a variable length record, it is recommended that the ASCII character string for carriage return/line feed be used to indicate the physical end of a particular DSIRF record. The maximum number of records capable of being read into APM is 500,000.

3.1.2 Content

Each record has three component parts: header, used parameters, and unused parameters. These parts are described here with reference to section 3.1.3 List of Automated Parameters. The list is arranged in five columns consisting of Field, Parameter Name, Sample Data, Units and Maximum Resolution. The column labeled Sample Data contains asterisked numbers, which refer to notes contained in the page titled General Notes.

3.1.2.1 Header

The header contains fields (parameters) 1 through 16. Field 1 contains the DSIRF Dataset Title which identifies the type of record (APM, ECM, APU, ECS) as explained in General Notes *2-3. Only those records containing "APM" pertain to the program described herein. Except for field 1, the header parameters are identical for all four record types.

3.1.2.2 Used Parameters

Fields 17 through 120 comprise those parameters, which can be utilized in the computational algorithms described in Section 4. While many of these parameters are essential, others are needed only if certain user input options are specified. For example, initial fuel tank quantities and center of gravity information is only necessary if the user wants to correct drag for center of gravity effects.

Fields 61-63 (Present Position Longitude) and 75-77 (Inertial Vertical Velocity) are not used and therefore are treated as unused parameters.

3.1.2.3 Unused Parameters

Fields 121 through 181 comprise those parameters, which are informational only and are NOT used in the computational algorithms. However, these parameters are output to the MASTER file for possible post processing purposes. If the user decides these parameters are not necessary for monitoring, the APM program will function correctly without them.

3.1.3 Sample List of Automated Input Parameters

The following is a sample DSIRF for a generic four-engine airplane. Beginning with Appendix D, information can be found regarding the DSIRF for a specific model.

3.1.3.1 Sample Data Set: Header Data

Table 2: DSIRF Header Data Fields

FIELD	PARAMETER NAME	SAMPLE[1,2] DATA	UNITS	MAX RESOLUTION
1	DSIRF Dataset Title	AAAAA[3]	N/A	N/A
2	Subcategory	N	N/A	N/A
3	Dataset Sequence Number	NN	N/A	N/A
4	Aircraft ID Number	AAAAAAAAA	alphanumeric	N/A
5	Aircraft Serial Number	NNNNN	N/A	N/A
6	Aircraft Type Code	NN	N/A	N/A
7	Flight Number	AAAAAAAA	N/A	N/A
8	Depart/Destin Airports	AAAAAAAA	N/A	N/A
9	Day	NN	day	1 day
10	Month	NN	month	1 month
11	Year	NN	year	1 year
12	Time - Hours	NN	hours	1 hour
13	Time - Minutes	NN	minutes	1 minute
14	Time - Seconds	NN,	seconds	1 second
15	Variable Header 1	A. . .A,[4]	N/A	N/A
16	Variable Header 2	A. . .A,[4]	N/A	N/A

NOTES

1. NNN denotes only numeric data; AAA denotes alphanumeric characters in data.
2. The first fourteen (14) data fields in the header are fixed, and no data delimiters (commas) are specified. The 15th and 16th header fields are variable, as are data fields in the DSIRF dataset body. The variable fields are separated by commas, such that no data available/required may be denoted by ",," for a specific data field (i.e. blanks/zeros are not required).

3. DSIRF dataset title for Airplane Performance Monitoring (APM) is "APM " (the letters APM plus two blanks).

4. The maximum field size is to be 40 characters.

5. Standard input units for DSIRF parameters are given in the DSIRF definition. However, the APM Program will accept units of kilograms for the following selected parameters;

   a. gross weight,

   b. fuel flow,

   c. fuel quantity,

   d. fuel used and

   e. initial gross weight, zero fuel weight, and fuel quantity.

   If weight units of kilograms are used, then fuel density must be in kilograms per liter.

6. Due to the fact that the DSIRF can be a variable length record (maximum record length is 1200), it is recommended that the ASCII character string of a carriage return followed by a line feed be used to indicate the end of a DSIRF record.

3.1.3.2 Sample Data Set: Used Parameters

Table 3: DSIRF Used Parameters

FIELD	PARAMETER NAME	DATA	UNITS	RESOLUTION
17	Mach, ADC Left	.NNN,	MACH	0.001 M
18	Mach, ADC Right	.NNN,	MACH	0.001 M
19	Mach, ADC Center	.NNN,	MACH	0.001 M
20	IAS/CAS, ADC Left	NNN.N,	Kt	0.1 Kt
21	IAS/CAS, ADC Right	NNN.N,	Kt	0.1 Kt
22	IAS/CAS, ADC Center	NNN.N,	Kt	0.1 Kt
23	TAT, ADC Left	+/-NN.NN,	Deg C	0.25 Deg
24	TAT, ADC Right	+/-NN.NN,	Deg C	0.25 Deg
25	TAT, ADC Center	+/-NN.NN,	Deg C	0.25 Deg
26	Altitude (29.92), ADC Left	NNNNN,	Ft	1 Ft
27	Altitude (29.92), ADC Right	NNNNN,	Ft	1 Ft
28	Altitude (29.92), ADC Center	NNNNN,	Ft	1 Ft
29	Gross Weight, FMC Left	NNNNNN,	Pounds	40 Lbs
30	Gross Weight, FMC Right	NNNNNN,	Pounds	40 Lbs

FIELD	PARAMETER NAME	DATA	UNITS	RESOLUTION
31	Gross Weight, FMC Center	NNNNNN,	Pounds	40 Lbs
32	Fuel Flow Engine 1	NNNN,	Lbs/Hr	1 Lb/Hr
33	Fuel Flow Engine 2	NNNN,	Lbs/Hr	1 Lb/Hr
34	Fuel Flow Engine 3	NNNN,	Lbs/Hr	1 Lb/Hr
35	Fuel Flow Engine 4	NNNN,	Lbs/Hr	1 Lb/Hr
36	Power Setting Engine 1	N.NNN/NNN.NN,	EPR/%N1	.001EPR/.01%N1
37	Power Setting Engine 2	N.NNN/NNN.NN,	EPR/%N1	.001EPR/.01%N1
38	Power Setting Engine 3	N.NNN/NNN.NN,	EPR/%N1	.001EPR/.01%N1
39	Power Setting Engine 4	N.NNN/NNN.NN,	EPR/%N1	.001EPR/.01%N1
40	Calculated Quality Factor	NN.N,	N/A	0.1
41	Ground Speed, FMC Left	NNN.N,	Kt	0.1 Kt
42	Ground Speed, FMC Right	NNN.N,	Kt	0.1 Kt
43	Ground Speed, FMC Center	NNN.N,	Kt	0.1 Kt
44	Bleed Config Discrete 1	N,	Discrete	N/A
45	Bleed Config Discrete 2	N,	Discrete	N/A
46	Bleed Config Discrete 3	N,	Discrete	N/A
47	Bleed Config Discrete 4	N,	Discrete	N/A
48	Bleed Config Discrete 5	N,	Discrete	N/A
49	Bleed Config Discrete 6	N,	Discrete	N/A
50	Bleed Config Discrete 7	N,	Discrete	N/A
51	Bleed Config Discrete 8	N,	Discrete	N/A
52	Bleed Config Discrete 9	N,	Discrete	N/A
53	Bleed Config Discrete 10	N,	Discrete	N/A
54	Bleed Config Discrete 11	N,	Discrete	N/A
55	Bleed Config Discrete 12	N,	Discrete	N/A
56	Bleed Config Discrete 13	N,	Discrete	N/A
57	Bleed Config Discrete 14	N,	Discrete	N/A
58	Present Pos Latitude, FMC Left	+/-NN.NNNN,	Degrees	0.0001 Deg Must be within +/- 90 degrees[1,2]

FIELD	PARAMETER NAME	DATA	UNITS	RESOLUTION
59	Present Pos Latitude, FMC Right	+/-NN.NNNN,	Degrees	0.0001 Deg Must be within +/- 90 degrees[1,2]
60	Present Pos Latitude, FMC Center	+/-NN.NNNN,	Degrees	0.0001 Deg Must be within +/- 90 degrees[1,2]
61	Present Pos Long, FMC Left	Not used		
62	Present Pos Long, FMC Right	Not used		
63	Present Pos Long, FMC Center	Not used		
64	True Heading, FMC Left	+/-NNN.N,	Degrees	0.1 Deg Must be within +/- 180 degrees[1]
65	True Heading, FMC Right	+/-NNN.N,	Degrees	0.1 Deg Must be within +/- 180 degrees[1]
66	True Heading, FMC Center	+/-NNN.N,	Degrees	0.1 Deg Must be within +/- 180 degrees[1]
67	Drift Angle, FMC Left	+/-NN.N,	Degrees	0.1 Deg Must be within +/- 90 degrees[1]
68	Drift Angle, FMC Right	+/-NN.N,	Degrees	0.1 Deg Must be within +/- 90 degrees[1,2]
69	Drift Angle, FMC Center	+/-NN.N,	Degrees	0.1 Deg Must be within +/- 90 degrees[1,2]
70	True Track Angle, FMC Left	+/-NNN.N,	Degrees	0.1 Deg Must be within +/- 180 degrees[1]
71	True Track Angle, FMC Right	+/-NNN.N,	Degrees	0.1 Deg Must be within +/- 180 degrees[1]
72	True Track Angle, FMC Center	+/-NNN.N,	Degrees	0.1 Deg Must be within +/- 180 degrees[1]
73	Calculated dHp/dt	+/-NN.NNN,	Ft/Sec	0.001 Ft/Sec
74	Calculated dVg/dt	+/-N.NNN,	Kt/Sec	0.001 Kt/Sec

FIELD	PARAMETER NAME	DATA	UNITS	RESOLUTION
75	Inertial Vertical Spd IRU Left	Not used		
76	Inertial Vertical Spd IRU Right	Not used		
77	Inertial Vertical Spd IRU Center	Not used		
78	Fuel Density	N.NNN,	Lbs/USgal	.001 Lb/Gal
79	Fuel Temperature	+/-NNN,	Degrees C	1 Deg
80	Fuel Quantity Tank 1	NNNNN,	Pounds	100 Lbs
81	Fuel Quantity Tank 2	NNNNN,	Pounds	100 Lbs
82	Fuel Quantity Tank 3	NNNNN,	Pounds	100 Lbs
83	Fuel Quantity Tank 4	NNNNN,	Pounds	100 Lbs
84	Fuel Quantity Tank 5	NNNNN,	Pounds	100 Lbs
85	Fuel Quantity Tank 6	NNNNN,	Pounds	100 Lbs
86	Fuel Quantity Tank 7	NNNNN,	Pounds	100 Lbs
87	Fuel Quantity Tank 8	NNNNN,	Pounds	100 Lbs
88	Fuel Used Engine 1	NNNNN,	Pounds	1 Lb
89	Fuel Used Engine 2	NNNNN,	Pounds	1 Lb
90	Fuel Used Engine 3	NNNNN,	Pounds	1 Lb
91	Fuel Used Engine 4	NNNNN,	Pounds	1 Lb
92	APU Operating Time	NN.N,	Minutes	0.1 minute
93	Generator Load Engine 1	NNN,	%	1 %
94	Generator Load Engine 2	NNN,	%	1 %
95	Generator Load Engine 3	NNN,	%	1 %
96	Generator Load Engine 4	NNN,	%	1 %
97	Initial Gross Weight, FMC Left	NNNNNN,	Pounds	40 Lbs
98	Initial Gross Weight, FMC Right	NNNNNN,	Pounds	40 Lbs
99	Initial Gross Weight, FMC Center	NNNNNN,	Pounds	40 Lbs
100	Initial CG, FMC Left	NN.NN,	% MAC	0.05 %
101	Initial CG, FMC Right	NN.NN,	% MAC	0.05 %

FIELD	PARAMETER NAME	DATA	UNITS	RESOLUTION
102	Initial CG, FMC Center	NN.NN,	% MAC	0.05 %
103	Initial ZFW, FMC Left	NNNNNN,	Pounds	40 Lbs
104	Initial ZFW, FMC Right	NNNNNN,	Pounds	40 Lbs
105	Initial ZFW, FMC Center	NNNNNN,	Pounds	40 Lbs
106	Init. Fuel Quantity Tank 1	NNNNN,	Pounds	100 Lbs
107	Init. Fuel Quantity Tank 2	NNNNN,	Pounds	100 Lbs
108	Init. Fuel Quantity Tank 3	NNNNN,	Pounds	100 Lbs
109	Init. Fuel Quantity Tank 4	NNNNN,	Pounds	100 Lbs
110	Init. Fuel Quantity Tank 5	NNNNN,	Pounds	100 Lbs
111	Init. Fuel Quantity Tank 6	NNNNN,	Pounds	100 Lbs
112	Init. Fuel Quantity Tank 7	NNNNN,	Pounds	100 Lbs
113	Init. Fuel Quantity Tank 8	NNNNN,	Pounds	100 Lbs
114	Serial Number Engine 1	AAAAAAAA,	N/A	N/A
115	Serial Number Engine 2	AAAAAAAA,	N/A	N/A
116	Serial Number Engine 3	AAAAAAAA,	N/A	N/A
117	Serial Number Engine 4	AAAAAAAA,	N/A	N/A
118	Calc Gross Weight	NNNNNN,	Pounds	40 Lbs
119	Calc CG Position	NN.NN,	% MAC	0.1 %
120	Calc LHV	NNNNN,	BTU/Lb	1.0 BTU/Lb

NOTES

1. Positive Angles are clockwise from North
2. Northern latitudes are positive

3.1.3.3 Sample Data Set: Unused Parameters

The following parameters are not used in the performance calculations in APM. They are included in the DSIRF as supplemental information. They will be included in the MASTER file for possible use by post- processing.

Table 4: DSIRF Unused Parameters

FIELD	PARAMETER NAME	DATA	UNITS	RESOLUTION
121	N1 Engine 1	NNN.N,	% RPM	0.1 %
122	N1 Engine 2	NNN.N,	% RPM	0.1 %

FIELD	PARAMETER NAME	DATA	UNITS	RESOLUTION
123	N1 Engine 3	NNN.N,	% RPM	0.1 %
124	N1 Engine 4	NNN.N,	%RPM	0.1 %
125	N2 Engine 1	NNN.N,	% RPM	0.1 %
126	N2 Engine 2	NNN.N,	% RPM	0.1 %
127	N2 Engine 3	NNN.N,	% RPM	0.1 %
128	N2 Engine 4	NNN.N,	% RPM	0.1 %
129	N3 Engine 1 (RR Only)	NNN.N,	% RPM	0.1 %
130	N3 Engine 2 (RR Only)	NNN.N,	% RPM	0.1 %
131	N3 Engine 3 (RR Only)	NNN.N,	% RPM	0.1 %
132	N3 Engine 4 (RR Only)	NNN.N,	% RPM	0.1 %
133	EGT Engine 1	NNN.N,	Degrees C	0.5 Deg C
134	EGT Engine 2	NNN.N,	Degrees C	0.5 Deg C
135	EGT Engine 3	NNN.N,	Degrees C	0.5 Deg C
136	EGT Engine 4	NNN.N,	Degrees C	0.5 Deg C
137.	Turb Case Cool Eng 1 (P&W Only)	NNN.N,	%	0.1 %
138	Turb Case Cool Eng 2 (P&W Only)	NNN.N,	%	0.1 %
139	Turb Case Cool Eng 3 (P&W Only)	NNN.N,	%	0.1 %
140	Turb Case Cool Eng 4 (P&W Only)	NNN.N,	%	0.1 %
141	SAT, ADC Left	+/-NN.N,	Degrees C	0.5 Deg
142	SAT, ADC Right	+/-NN.N,	Degrees C	0.5 Deg
143	SAT, ADC Center	+/-NN.N,	Degrees C	0.5 Deg
144	Indicated AOA, ADC Left	+/-NN.N,	Degrees	0.05 Deg
145	Indicated AOA, ADC Right	+/-NN.N,	Degrees	0.05 Deg
146	Indicated AOA, ADC Center	+/-NN.N,	Degrees	0.05 Deg
147	Roll Angle, IRU Left	+/-NN.N,	Degrees	0.1 Deg
148	Roll Angle, IRU Right	+/-NN.N,	Degrees	0.1 Deg
149	Roll Angle, IRU Center	+/-NN.N,	Degrees	0.1 Deg
150	Pitch Angle, IRU Left	+/-NN.N,	Degrees	0.1 Deg
151	Pitch Angle, IRU Right	+/-NN.N,	Degrees	0.1 Deg
152	Pitch Angle, IRU Center	+/-NN.N,	Degrees	0.1 Deg
153	Stabilizer Position	+/-NN.N,	Units	0.05 Unit

FIELD	PARAMETER NAME	DATA	UNITS	RESOLUTION
154	Left Spoiler Position	NN.N,	Degrees	0.1 Deg
155	Right Spoiler Position	NN.N,	Degrees	0.1 Deg
156	High Speed Left Aileron Position	+/-NN.N,	Degrees	0.1 Deg
157	High Speed Right Aileron Position	+/-NN.N,	Degrees	0.1 Deg
158	Low Speed Left Aileron Position	+/-NN.N,	Degrees	0.1 Deg
159	Low Speed Right Aileron Position	+/-NN.N,	Degrees	0.1 Deg
160	Upper Rudder Position	+/-NN.N,	Degrees	0.1 Deg
161	Lower Rudder Position	+/-NN.N,	Degrees	0.1 Deg
162	Left Inboard Elevator Position	+/-NN.N,	Degrees	0.1 Deg
163	Right Inboard Elevator Position	+/-NN.N,	Degrees	0.1 Deg
164	Left Outboard Elevator Position	+/-NN.N,	Degrees	0.1 Deg
165	Right Outboard Elevator Position	+/-NN.N,	Degrees	0.1 Deg
166	TE Flap Position, Left Outboard	NN.N,	Degrees	0.1 Deg
167	TE Flap Position, Right Outboard	NN.N,	Degrees	0.1 Deg
168	TE Flap Position, Left Inboard	NN.N,	Degrees	0.1 Deg
169	TE Flap Position, Right Inboard	NN.N,	Degrees	0.1 Deg
170	Along TK Horiz Accel, IRU Left	+/-N.NN,	G’s	0.01 G
171	Along TK Horiz Accel, IRU Right	+/-N.NN,	G’s	0.01 G
172	Along TK Horiz Accel, IRU Center	+/-N.NN,	G’s	0.01 G
173	Flight Path Accel, IRU Left	+/-N.NN,	G's	0.01 G
174	Flight Path Accel, IRU Right	+/-N.NN,	G's	0.01 G
175	Flight Path Accel, IRU Center	+/-N.NN,	G's	0.01 G
176	Vertical Accel, IRU Left	+/-N.NN,	G’s	0.01 G
177	Vertical Accel, IRU Right	+/-N.NN,	G’s	0.01 G
178	Vertical Accel, IRU Center	+/-N.NN,	G’s	0.01 G
179	Calculated dIVV/dt	+/-NN.NNN,	Ft/Sec2	0.001 Ft/Sec2
180	Fuel Imbal. Roll Moment	+/-NN.NN,	106In-Lb	0.0lxl06In-Lb
181	Angle of Sideslip	+/-N.NN,	Degrees	0.01 Degrees

3.1.4 Standard Configurations

To be eligible for analysis by the APM program, each candidate APM data record is checked to determine if the bleed configuration is compatible with the standard airplane bleed configuration(s) as specified in the database (See section 3.3.6 Database at the end of this chapter and Appendices A and B). The status of the following bleeds are used to define this configuration.

- Thermal anti-ice bleeds
- Air conditioning packs
- Air conditioning pack flow rate
- Engine bleed
- Isolation valve (model dependent)

Information regarding bleed configuration(s) for specific models can be found in the specific model appendices (Appendix D and subsequent). The APM program will reject those records that do not comply with the standard bleed configuration(s) because of incompatibilities with the database model.

3.1.5 DMU/DFDAU Calculated Parameters

Certain operators may have negotiated with the DMU/DFDAU vendors to have various parameters described in Section 4 calculated within the DMU/DFDAU rather than within the APM program. This reduces the required computations inside APM, and reduces the amount of data to be transmitted in an ACARS environment. Provisions to accommodate both options (DMU/DFDAU calculated parameters and APM calculated parameters) exist in the APM DSIRF. User input, described in Section 3.3, specifies to the APM program which alternative is desired. When available, the DMU/DFDAU calculated parameters are the following:

- Field 118 DMU/DFDAU Calculated Gross Weight,
- Field 119 DMU/DFDAU Calculated CG Position, and
- Field 120 DMU/DFDAU Calculated Fuel Lower Heat Value (LHV).

3.1.6 DSIRF Data Quality Factor

Field 40 contains the parameter named Quality Factor. The quality factor is a DMU/DFDAU calculated relative measure of the stability of the cruise data point. This parameter has a range from 0 (highest quality) to 99.9 (lowest quality). Regardless of the actual value, the data is acceptable for analysis based on the fact that the DMU/DFDAU stable cruise criteria were met in order for the data point to be recorded.

Basic stability criteria involve examining the variability of a set of parameters (e.g. speed, altitude, thrust, temperature, etc.) each parameter consisting of 180 samples within a three minute time frame. Each parameter must not fluctuate outside a specified tolerance band to satisfy basic stable cruise criteria. (Please consult your DMU/DFDAU vendor for questions concerning the quality factor calculation and basic stability criteria.)

For a given parameter, the variability from its mean value within the time frame is used to assign a quality index. The less the variability from the mean, the smaller its standard deviation. Hence, the quality factor may be interpreted analogous to standard deviation: the smaller the value, the better the data sample.

As explained in the User-Input description (Section 3.3), the acceptability of data points can be restricted by specifying a maximum acceptable quality factor (See QUALTOL, Section 3.3.4).

3.2 Manual Input Data

This method of inputting airplane cruise performance data into the APM program is very similar to the method that has been used historically with the Boeing Cruise Performance Analysis program. Data may be recorded during cruise flight onto a prescribed "log form" and, at a later time on the ground, the log form data can be transcribed via some keyboard entry device to produce an APM manual input file, referred to in Figure 1 as MANUAL CRUISE INPUT - MSIRF (Manual Standard Input Record Format).

Due to constraints imposed by the manual recording process, the number of parameters recordable will be limited. Hence, the manual input data will comprise a subset of that obtainable from the DSIRF. This will preclude specifying certain user options that are available with the DSIRF. For example, instrument switching cannot be fully realized because not all data (e.g. FMC gross weight) is available from both instrument sources (left-captain's and right-first officer's). For these cases the program will set the right instrument source value equal to the left source. Also, the weight option E (initial gross weight minus fuel used), cannot be utilized because fuel used is not available for manual recording (refer to Section 3.3.4.43 WEIGHT). A sample Performance Log for a generic four-engine airplane is shown in Section 3.2.1.

Performance Logs for specific models can be found in the specific model appendices (Appendix D and subsequent).

3.2.1 Manual Input Form

The manual input form consists of two components: the header and cruise monitor data. The header is used to set airplane identification number, date, flight number, APU operating time, and initial center of gravity information. The cruise monitor data comprises the, inflight data.

The header consists of up to three lines of data. The first line is mandatory and is used to identify data by date, flight number, and airplane. If the user chooses to use the center of gravity adjustments tq drag, or the APU operating time adjustment to gross weight, then the two optional header lines are required. A plus (+) in column 80 will instruct the program to read the two additional header lines. If either of these performance adjustment options are desired, then **BOTH optional lines** must be input. The header line data will be kept until the next header.

Monitor data reflects a stable cruise event to be analyzed by the APM program. Not all of the data specified on the performance log form needs to be entered for the APM program to analyze the data point. The required parameters are:

- Speed parameter (Mach or IAS/CAS)
- TAT
- Altitude
- Power Setting (EPR or %N1)
- Fuel Flow
- Gross Weight (or its equivalent, see Section 3.3.4.43 WEIGHT)

The rest of the data can be used to make adjustments to the book performance (e.g. CG, Power extraction, or LHV).

The weight and temperature units of the manual input can be switched from their defaults with the use of User-Input keywords (see Section 3.3.4.38 TEMPUNTIN/OUT and Section 3.3.4.45 WTUNITIN/OUT). The weight units must be consistent for all weight related items: TOW, ZFW, fuel tank quantities, fuel flow, and gross weight. The default weight unit is pounds (LB). Temperature units pertain to TAT and fuel temperature. A summary of inputs and their units is given in the table below.

Table 5: Manual Input Parameters

PARAMETER	DEFAULT UNITS	OPTIONS
Header Data		
Model	Character	N/A
Airline	Character	N/A
Aircraft	Character	N/A
Flight	Character	N/A
Flight Leg	Character	N/A
Date (DDMMYY)	Character	N/A
TOW	LB	LB or KG
ZFW	LB	LB or KG
Init CG	%MAC	N/A
Engine Serial Numbers	Character	N/A
APU Time	Minutes	N/A
Initial Fuel Tank Quantities	LB	LB or KG
Monitor Data		
CAS	Knots	N/A
TAT	Deg. C	Deg. C or F

PARAMETER	DEFAULT UNITS	OPTIONS
Altitude	FT	N/A
Mach	N/A	N/A
Bleed	N/A	N/A
Power Setting	EPR or %N1	N/A
Fuel Flow	LB/Hr	LB or KG
Fuel Quantities	LB	LB or KG
Gen Load	%	N/A
Heading (Hdg)	Degrees(+/-180.0)[1]	N/A
True Track	Degrees(+/-180.0) [1]	N/A
Drift Angle	Degrees(+/-90.0) [1]	N/A
A/C (reserved for future use)	Bleed Code	N/A
Gross Weight	LB	LB or KG
Fuel Temperature	Deg. C	Deg. C or F
Fuel Density	Depends on Weight Units Wt in LB LB/US Gal Wt in KG KG/Liter	N/A
Latitude	Degrees (+/-90.0000) [2]	N/A
Ground Speed (GS)	Kt	N/A
dHp/dt	Ft/Sec	N/A
dVg/dt	Kt/Sec	N/A

NOTES

1. Angles are positive clockwise from North.

2. North latitudes are position

One must take special care when using the manual input option. Certain key fields are used for data sequencing with this option. In the header line, the first field contains the model description. The first letters of this field must be a 7, B7, MD or DC as in the following examples: 747-400, B737-800, MD-11 or DC-10.The APM program keys off these letters to signify this is a header line. Also, the engine number parameters in column 7 of the monitor point section are very critical to program execution. The most critical is the 1 in column 7 to signify a new monitor point. If some other text was in this location, the program would not read in the monitor point correctly. **For MSIRF to be processed correctly, the data must be in chronological order for each airplane.** The key items for the manual input are:

1. A 7, B7, MD or DC in column 1 for the header line,

2. A plus (+) in column 80 to signify **two** optional header lines. These lines are used to calculate center of gravity corrections and to record engine serial numbers. If this data is not desired the two optional lines need not be input. If a plus (+) is entered in column 80, then both optional lines must be entered.

3. A 1 in column 7 to signify a monitor point,

4. The keyword AVERAGE to signify end of this tail number's points,

5. The keyword FLEET to signify end of run, compute fleet average,

6. The keyword END to signify end of run, quit.

To provide flexibility, several fields have been duplicated on the manual input form. The duplicated fields are: CAS, altitude, and Mach. The fields on the left section are for captain's instruments, the right for first officer's. See input description for INSTR later in this chapter for details on instrument switching.

Some operators may choose to develop a small program to assist in the manual input of performance data.

APU time is used to estimate APU fuel burn to correct the FMC gross weight if the APU is used after the FMC gross weight is entered. Subsequent FMC gross weight is based upon initial gross weight minus fuel used for each engine and would not account for the APU fuel usage. If gross weight is based upon ZFW plus fuel tank quantities, then this value is not required.

Figure 4 is a general example of stacking the manual input according to the rules previously outlined. In this example a fleet of three airplanes is analyzed.

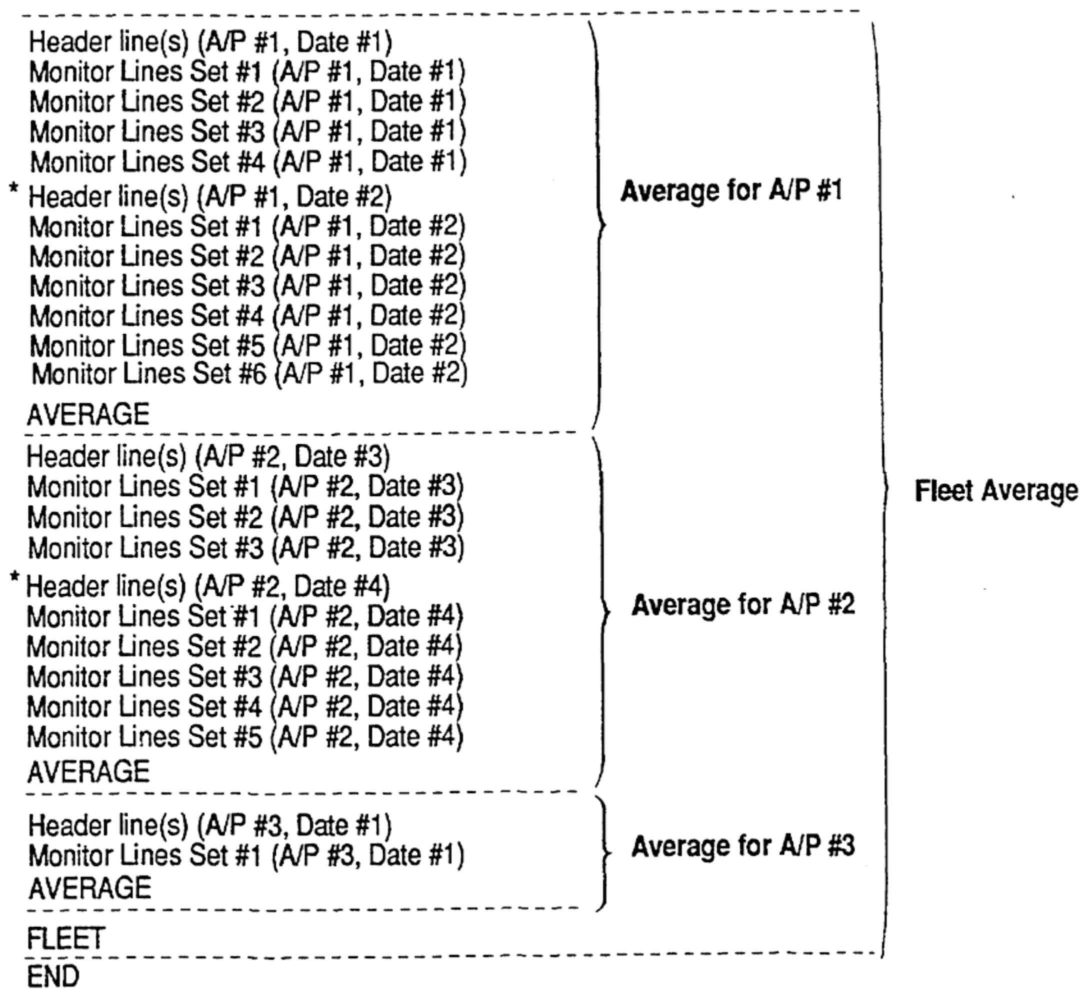


Figure 4: Manual Input Structure

NOTES: The “*” header lines were used to change date and are optional.

Below is a sample method for manually collecting performance data for manual input.

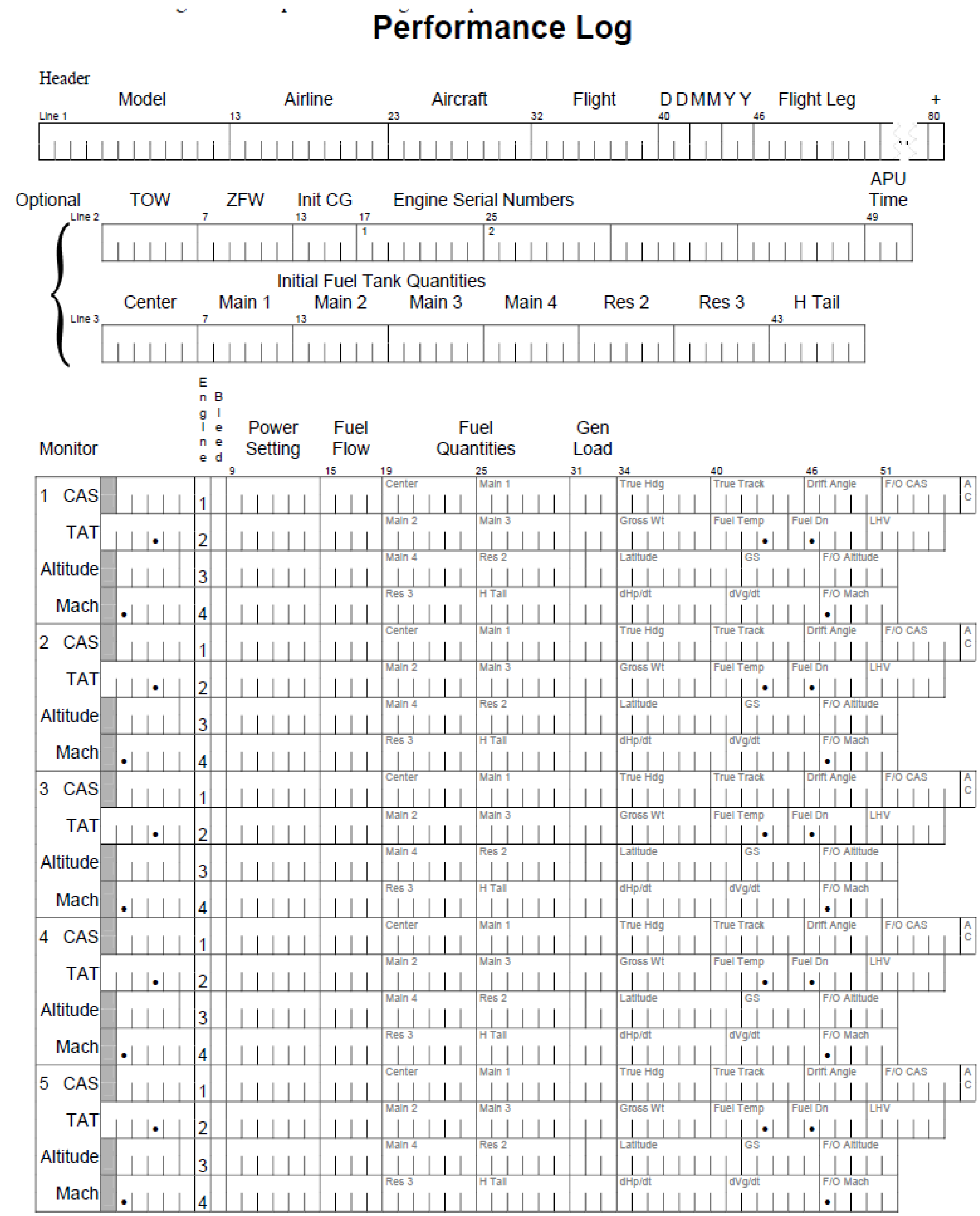


Figure 5: Performance Log

RECOMMENDED RECORDING PROCEDURES:

1. Record Model, Airline, Aircraft, Flight Number and Date.

2. If desired record takeoff gross weight, ZFW, initial center of gravity, engine serial numbers, APU operating time, and initial fuel tank quantities.

3. Wait until the airplane is stabilized in cruise:

    a. Smooth air

    b. No thrust lever movement (auto-throttles off) for more than five minutes

    c. Anti-ice and fuel heat off for more than five minutes

    d. Less than one degree variation in indicated temperature during the preceding three minutes

    e. Less than .005 Mach (two knots CAS) variation in speed during the preceding three minutes

4. Quickly record Mach, EPR or %N1 and Fuel Flow.

5. Record TAT, Altitude, CAS, FMC Gross Weight (see Note 4).

6. Recheck Mach. If the Mach has changed more than .005 (two knots CAS) discard the point.

7. Record Individual Tank Fuel Quantities and Bleed Code (see Note 5).

8. The rest of the parameters on the Log form are optional, record those now if necessary.

9. Wait at least thirty minutes before recording the next data point in order to obtain data over a range of weights.

NOTES:

- Data can be taken at any stabilized speed. There is no need to return the airplane to a published speed schedule before recording data.

- The airplane identification number should be entered under aircraft. (Data sorting is done using this variable along with date.)

- All gross weight data and fuel quantities must be specified in the same units.

- If the FMC or total gross weight is known, it can be entered in the box labeled "Gross Wt".

- Bleed Config: For 3 A/C Packs operating, record the number of A/C Packs in “HIGH FLOW”, i.e., 0, 1, 2, or 3. For only 2 A/C Packs operating, record a zero to indicate a 2 A/C Packs/High Flow Config. The bleed code should be the same for all four engines.

- If acceleration data (dHp/dt and dVg/dt) are desired, a separate time history must be kept for ground speed and altitude.

3.2.2 Sample MSIRF File

A sample manual input cruise file is shown below. A column counter line is also shown, but is not part of the file

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
7X7-ABC     AIRLINE   AC001    0010    081290SEALAX                            +
70000033500019.411111111222222223333333344444444 60
85000.35000.75000.75000.35000.25000.25000.10000.
   2861  1.1414902 50250 30190 31                   286
-14.22   1.1414902 50920 50920 31571039 20.06.9
330003   1.1414902 30190  8040 31   29.17  52033000
 .8034   1.1414902  8040  7489 31 0.0060-.0071.803
 2971    1.2425777 85090 30190 32                   297
-13.72   1.2425777 84058 84058 32667531 20.06.9
340003   1.2425777 30190  8040 32   29.02  54634000
 .8484   1.2425777  8040  2865 32 0.0060 .0021.848
7X7-ABC     AIRLINE   AC001    0030    101290SEALAX                            +
70000033500019.411111111222222223333333344444444 30
85000.35000.75000.75000.35000.25000.25000.10000.
   3451  1.08 6306 36750 30190 28              345
   4.52  1.08 6306 36080 36080 28540469 20.06.9
 273003  1.08 6306 30190  8040 28   29.75  51727300
  .8514  1.08 6306  8040 20100 28 0.0060 .0050.851
AVERAGE
7X7-ABC     AIRLINE   AC002   0020     061290LAXSEA                            +
70000033500019.411111111222222223333333344444444 15
85000.35000.75000.75000.35000.25000.25000.10000.
   2801  1.30 5763 94470 30190 32              280
 -18.32  1.30 5763 84058 84058 32684659 20.06.9
 350003  1.30 5763 30190  8697 32   29.91   43035000
  .8204  1.30 5763  8697  9299 32 0.0050 .0018.820
   3011  1.09 5029 48184 30190 33              301
  -8.12  1.09 5029 47514 47514 33550653 20.06.9
 305003  1.09 5029 30190  4020 33   29.29   47830500
  .8014  1.09 5029  4020  4020 33 0.0050 .0018.801
AVERAGE
FLEET
END
```

3.3 User Input Data

The description of the User-Input file begins with a brief discussion of its function and purpose. The structural components are defined followed by the details describing the keywords that control program execution. Finally, sample input files are presented.

3.3.1 Function

The User-Input file contains the parameters, which control execution of the APM program. The parameters specified serve the following purposes:

- Select and specify by name input/output files
- Identify the computational algorithm options to be exercised
- Identify input/output weight/temperature units
- Define tolerance ranges used to screen computed performance deviations for acceptability
- Identify airframe/engine configuration

Only those items, which change from the default values, need to be input. If a value is input, which is the same as the default value, the program will still run successfully. A detailed description of the entire complement of input parameters follows in a later subsection.

It is important to note that files are utilized exclusively as a vehicle for input/output communication with the program, and that the naming and usage conventions must conform to the requirements of the operating system. To allow for maximum system independence, **the filename of the User-Input file must be APMINP**.

Before describing the input parameters in detail, the structural layout of the input file is presented next in terms of its component parts.

3.3.2 User Input File Structure

The component parts of the input file consist of one or more lines of characters with a maximum record length of 80 characters. The program looks for particular keywords and assigns the values to certain program variables. There are only a few distinct choices for each keyword. If a value is input for a keyword that the program does not understand, the default value is used. A diagram of the general structure is given in Figure 6.

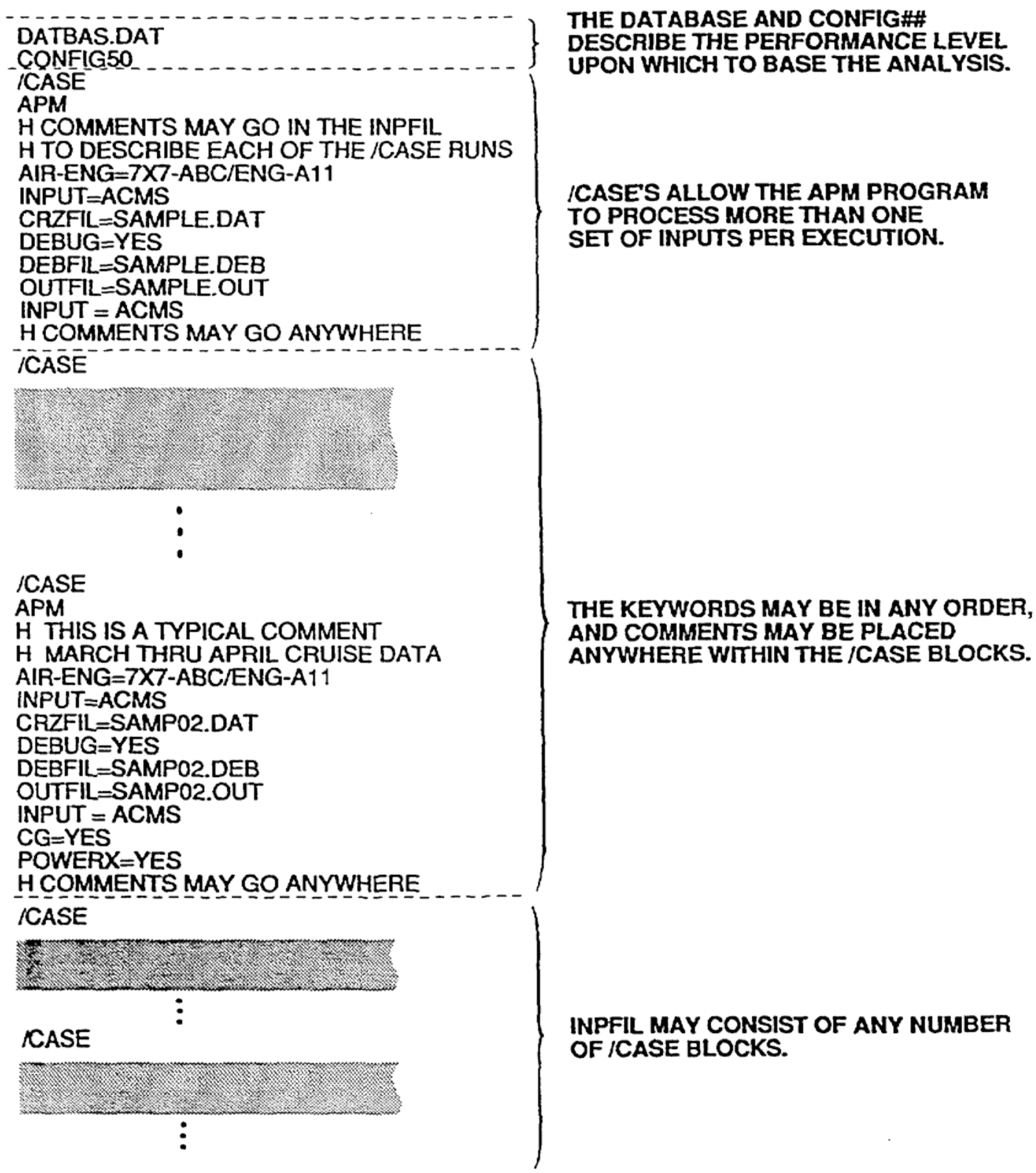


Figure 6: General APMINP Structure

There are three component parts comprising the input file structure: the database file name, the airplane/engine configuration specification and any number of /CASE blocks. A brief description of each component is given below.

1. The first line specifies the database file name. This entry must be compatible with file naming conventions according to the computer operating system as mentioned in the preceding section.

2. The second component consists of the characters "CONFIG" followed by a two-digit extension (01 to 99). This parameter determines what data, within the database file, is loaded into the computer to model the airframe/engine configuration.

3. The third component consists of a /CASE block. The /CASE block contains the parameters that actually control program execution according to the specified options. A line containing /CASE serves as a delimiter indicating the beginning of a block. The block contains line entries, each of which specifies a keyword parameter name and for most (but not all), an associated value. The keyword parameter names and associated value options are detailed in the next section. As noted in the layout above, comment line entries may be placed anywhere within a /CASE block. Comment lines must begin with the letter "H".

Multiple case runs may be useful for analyzing a given set of cruise data with different input options to compare the resulting effects.

3.3.3 Comments

Comments begin with the letter "H" followed by a space and then characters to describe the comment. Any line that begins with an "H" is treated as a comment. No User-Input keywords begin with the letter "H". A few sample comment lines are given below:

```
H THIS IS A SAMPLE COMMENT: THE LINE BEGINS WITH "H".
H ANY INFORMATION CAN BE PLACED IN A COMMENT, BUT THE LINE MUST
H BEGIN WITH A LETTER "H". IF IT BEGINS WITH AN "H" AND VALID
H KEYWORDS FOLLOW, THE KEYWORDS ARE TREATED AS COMMENTS AND ARE
H NOT USED BY THE PROGRAM. THE PROGRAM DOES NOT USE THE
H COMMENTS IN ANY WAY.
```

3.3.4 User Input Keyword Descriptions

This section contains a brief description of the keywords used in the user-input file "APMINP". It is recommended that the reader consult the specific model appendices to determine if the keyword specified option is available for a specific airplane type.

3.3.4.1 ADJUSTWT

The value assigned to this keyword activates the weight adjustment option. The tail identification and weight adjustment can be read in from the APMINP file through a new input file specified by the **TWTFIL** keyword. The weight adjustment is an increment that is applied to the airplane cruise weight for the baseline thrust required, power setting required, and fuel mileage values. These resulting baseline values are then used to calculate performance deviations. Holding all other parameters constant, a positive weight adjustment would result in more favorable thrust required, power setting required and fuel mileage deviations. Examples:

`ADJUSTWT=NO`	default
`ADJUSTWT=APMINP`	Weight adjustment will be read from APMINP file. (see TAILID& TWTADJ)
`ADJUSTWT=FILE`	Weight adjustment will be read from TWTFIL file.

3.3.4.2 APM

This keyword signals the program to begin executing the performance monitoring calculation. It must be placed immediately following **/CASE**. This keyword does not have a value assigned to it.

3.3.4.3 AIR-ENG

The value assigned to this keyword is a label for the airframe-engine combination text. The text is carried through to the first page of the analysis or debug outputs. The size allotted for the text is 16 characters. If imbedded spaces are desired, enclose the text inside dollar signs ($). The default text is blank spaces. Examples:

`AIR-ENG=747-400/PW4256`	
`AIR-ENG=$747-400 CF6-80C2$`	imbedded spaces
`AIR-ENG=`*`(blank)`*	default

3.3.4.4 CG

The value assigned to this keyword determines the user-desired option for the center-of-gravity (CG) calculation. The options are: NO, YES, and DMU.

- By choosing NO, the user specifies no adjustments are to be made to the book performance for CG position effects (see Section 4.1.7.1 Center of Gravity Correction to Cd calculation details).
- Selecting YES or DMU will adjust the book performance for **CG** effects. The DMU option instructs the program to anticipate a DMU (DFDAU on some airplanes) calculated **CG** position in the DSIRF. If the DMU option is selected and the DSIRF does not contain the CG position, an error will result. If MSIRF is to be used the two optional header lines must be used. The default is NO. Examples:

CG=YES	
CG=NO	default
CG=DMU	("DMU" should also be used if airplane is equipped with a DFDAU instead of a DMU)

3.3.4.5 CGMOM

The value assigned to this keyword specifies the delta moment, in In-Lbs, for flap and gear retraction. A negative moment is nose-down and is equivalent to a forward CG shift. This results in a higher book value for drag, which in turn shows a lower thrust required deviation.

3.3.4.6 CONFIG##

CONFIG## identifies a special data block within the database. This special data block determines which tables and scalars are to be loaded from the database into the program. These tables and scalars define the baseline performance for the airframe/engine model. Generally, the **CONFIG##** for APM will be **CONFIG50**. Please note that this keyword does not use an equal (=) sign to denote its value. Example:

`CONFIG50`	
`CONFIG02`	
`CONFIG=50`	will not work properly and will result in an error

3.3.4.7 CRZFIL

This keyword specifies the name of the input file that contains the cruise points. This is the filename for the DSIRF or MSIRF. The default filename is **CRZFIL** with no extension. File names with spaces can be used provided the file name is enclosed in dollar signs ($). Examples of filenames:

`CRZFIL=MAR04CRZDAT`	Filename
`CRZFIL=$TEST CASE1.DAT$`	Filename with spaces
`CRZFIL=CRZFIL`	default
`CRZFIL=MARCHDATA.RUN1`	Filename with extension

3.3.4.8 DATE

Refers to the output format of the date. The input formats are fixed in the MSIRF and DSIRF. However, the option was designed for users who wish to view the date in a different format. The choices are: DD-MM- YY, MM-DD-YY, and YY-MM-DD, where DD is the day of the month, MM is the month, and YY is the last two digits of the year. The default is DD-MM-YY. Examples:

`DATE=MM-DD-YY`	
`DATE=DD-MM-YY`	default
`DATE=YY-MM-DD`	
`DATE=YY-DD-MM`	will not work properly and will yield DD-MM-YY

3.3.4.9 DEBFIL

Specifies the output file name for the debug output option (see **DEBUG**). If the computing system needs a file extension, then one must be provided. Some systems do not use file extensions. If the computing system supports default extensions, they may be used to advantage. The default filename is **DEBUG** with no extension.. File names with spaces can be used provided the file name is enclosed in dollar signs ($). Examples of filenames:

`DEBFIL=MAR89.DEB`	Filename with extension
`DEBFIL=$TEST RUN$`	Filename with spaces
`DEBFIL=DEBUG.OUT`	Filename with extension
`DEBFIL=DEBUG`	default

3.3.4.10 DEBUG

This is the option to provide debugging output to the user. The DEBUG output is a one point per page summary of the critical parameters in the deviation calculations. This provides the user with a detailed look at each deviation calculation. The choices are: NO, YES and YESFULL.

NOTE: **If CRZFIL has a lot of points, care should be taken, as using the DEBUG option will generate a very large file.**

Examples:

`DEBUG=NO`	default
`DEBUG=YES`	
`DEBUG=YESFULL`	(to print DSIRF/MSIRF in DEBFIL)

3.3.4.11 DRGFAC

This is a factor to be applied to the book calculation of drag (i.e. total drag equals calculated drag multiplied by **DRGFAC**). This factor is simply a multiplication constant. Examples:

`DRGFAC=1.008`	0.8% higher drag
`DRGFAC=1.0`	default
`DRGFAC=0.992`	0.8% lower drag

3.3.4.12 ELASTIC

This keyword specifies whether or not the effects of aeroelastic deflections of the wing are to be considered in the calculation of the airplane drag. The options are NO or YES. By choosing NO, the user specifies that the corrections for the effects of aeroelasticity not be considered in calculating the drag of the airplane. Selecting YES will adjust the drag for the effects of aeroelasticity. The default is NO because aeroelasticity effects on drag are negligible for most airplanes* and therefore not considered in the Operations Manual performance level.

* The effects of aeroelasticity are included in the Operations Manual performance level for the 747-400.

3.3.4.13 ENERGY

This keyword specifies the option to apply acceleration effects to the book drag performance level (see section 4 Algorithm and Analysis). The option uses the ground speed and altitude deviations to adjust performance for these accelerations. Since the recommended 3-minute stability parameters are +/- 100 feet for pressure altitude and +/- 4 knots for IRU ground speed, these accelerations are not large. However, these factors do affect the performance level. The choices are NO, or YES. The default value is NO.

3.3.4.14 EPRHI EPRLO

These are the tolerances to be applied to the analysis for the primary power setting deviation calculation (see section 4 Algorithm and Analysis). The tolerances are used to identify those points, which do not meet the tolerance criteria. If the computed EPR/%N1 deviation does not meet the tolerance input, then the data point is rejected from the analysis, and not included in the average deviation calculation. This point is displayed on the output, but with asterisks (*) where the deviations are normally presented. An "EPR" flag will appear at the far right side of the output line to signify the EPR tolerance was exceeded.

- The **EPRHI** tolerance signifies the highest acceptable positive deviation. For example, a calculated deviation of 0.18 would be rejected if **EPRHI**=0.15.

- The **EPRLO** tolerance signifies the lowest acceptable negative deviation. A calculated deviation of -0.16 would be rejected if **EPRLO**=-0.15. **EPRLO** can be input as a positive number, but the program will always make a negative number from it.

The default is 0.15 and -0.15 for EPR engines and +/-15 for %N1 engines. (Remember the EPR/%N1 deviations are just deviations, not percent deviations.) Examples:

`EPRHI=0.15`	default
`EPRHI=0.10`	
`EPRLO=-.15`	default
`EPRLO=0.10`	will be reset by program to EPRLO=-0.10

3.3.4.15 FFCAL

This keyword is the used for correcting measured fuel flow for a bias in meter calibration. This correction, if invoked, will be applicable to all engines. A third order polynomial curve will be used to compute the bias as a function of measured fuel flow. Polynomial coefficients are to be specified as shown below. The equations representing this correction are as follows.

$\%\Delta FF = A_0 + A_1(FFmea) + A_2(FFmea)^2 + A_3(FFmea)^3$

$FFcorr = [1 + (\%\Delta FF/100)]\ [FFmea]$

FFCAL=NO	default
FFCAL=YES	Invoke fuel flow meter calibration
FFA0 = A_0 value	
FFA1 = A_1 value	
FFA2 = A_2 value	
FFA3 = A_3 value	

NOTE: Coefficients must be based upon the same units used for input of fuel flow.

3.3.4.16 FLEETAVG

The value assigned to this keyword is the user-desired option for computing the fleet average data. The options are: ALL, or TAIL. By choosing ALL, the user specifies that the fleet average data are to be computed using the sum of all the data points analyzed in the computer run. Selecting TAIL, the fleet average data are computed using the sum of the averages for each aircraft (tail number) analyzed in the computer run. The default is TAIL.

3.3.4.17 FMHI FMLO

These are the tolerances to be applied to the analysis for the fuel mileage deviation calculation (see section 4 Algorithm and Analysis). The tolerances are used to identify those points, which do not meet the tolerance criteria. If the computed fuel mileage deviation does not meet the tolerance input, then the data point is rejected from the analysis, and not included in the average deviation calculation. This point is displayed on the output, but with asterisks (*) where the deviations are normally presented. An "FM" flag will appear at the far right side of the output line to signify the FM tolerance was exceeded.

- The **FMHI** tolerance signifies the highest acceptable positive deviation. For example, a calculated deviation of 18.4% would be rejected if **FMHI**=15.0.

- The **FMLO** tolerance signifies the lowest acceptable negative deviation. A calculated deviation of -16.0% would be rejected if **FMLO**=-15.0. **FMLO** can be input as a positive number, but the program will always make a negative number from it.

The default is 15.0% and -15.0%. Examples:

FMHI=15.0	default
FMLO=-15.0	default
FMLO=10.0	will be reset by program to FMLO=-10.0

3.3.4.18 GRAVITY

The value assigned to this keyword is the user-desired option for the gravity effect adjustment to the weight calculation. The options are NO or YES. By choosing NO, the user specifies no adjustments are to be made to the book performance for gravity effects (see section 4 Algorithm and Analysis for calculation details). Selecting YES will adjust the book performance for gravity effects except when the "WEIGHT=DMU" option is selected. The gravity correction includes adjustments for gravitational variation with latitude, altitude, Coriolis force, and centrifugal force. The default is NO.

3.3.4.19 INPUT

The value assigned to this keyword specifies the **CRZFIL** format. The choices are: ACMS (which indicates DSIRF) or MANUAL (which indicates MSIRF). The default is ACMS.

3.3.4.20 INSTR

The value assigned to this keyword specifies to the program which instrument source to use. The choices are: C for captain's, FO for first officer's or BOTH for the average. The selection dictates what signal(s) will be used to obtain the following parameters: altitude, TAT, IAS/CAS, Mach, heading, drift angle, true track, latitude, longitude, ground speed, initial gross weight and CG, and zero fuel weight. If one FMC is inoperative and it is specified as the desired instrument, the program will attempt to recover by switching to the other channel. If both signals in the DSIRF are zero, the program will terminate.

The parameters checked are: Mach, gross weight and altitude. If used with the manual input option, only Mach, IAS/CAS, and altitude are available for the right instrument source. The other items are set equal to the left instrument. The default value is C for captain's.

3.3.4.21 LHEATV

The value assigned to this keyword specifies whether the fuel lower heating value (LHV) adjustment is considered in the fuel flow calculation. The options are NO, YES or DMU. By choosing NO, the user specifies no adjustments are to be made to the book performance for LHV effects (see section 4.1.7.3 Algorithm and Analysis for LHV calculation details). Selecting YES or DMU will adjust the book performance for LHV effects. The DMU option instructs the program to anticipate a DMU/DFDAU calculated LHV in the DSIRF. If the DMU option is selected and the DSIRF does not contain the LHV, an error will result. If the value of LHV is known, it should be included in the **CONFIG** section of the database as a scalar (see Appendix A for details). The default is NO. Examples:

`LHEATV=YES`	Optional input
`LHEATV=DMU`	(use "DMU" if aircraft is equipped with a DFDAU)
`LHEATV=NO`	default

3.3.4.22 LHVB LHVM

The: values assigned to these keywords are the coefficients to the equation of a line to describe the **LHV** equation. **LHVM** is the slope of the line and **LHVB** is the y-intercept (see section 4 Algorithm and Analysis). The reference **LHV** value is contained in the database and in most cases is 18580 BTU/Lb. The default values are -5220 for **LHVM**, and 22777 for **LHVB**.

3.3.4.23 MASFIL

Specifies the output file name for the master file output option (see **MASTER**). The maximum length of the filename is 16 characters. The default filename is **MASTER** with no extension. File names with spaces can be used provided the file name is enclosed in dollar signs ($). Examples of filenames:

`MASFIL=MASTER.OUT`	Filename with extension
`MASFIL=$MAR 2004.MAS$`	Filename with spaces
`MASFIL=MASTER`	default

3.3.4.24 MASTER

This option provides the **MASTER** output to the user. The output contains all the deviations, the entire DSIRF (or MSIRF put into DSIRF sequence), and some of the critical parameters in the deviation calculations. The purpose of this file is for subsequent use by a postprocessor program. The choices are: NO, and YES. The default is NO.

3.3.4.25 OUTFIL

The value assigned to this keyword specifies the output file name for the normal output option (see **OUTPUT**). The default filename is **APMOUT** with no extension. File names with spaces can be used provided the file name is enclosed in dollar signs ($). Examples of filenames:

`OUTFIL=OUTPUT.DAT`	Filename with extension
`OUTFIL=$TEST RUN.OUT$`	Filename with spaces
`OUTFIL=APMOUT.`	default

3.3.4.26 OUTPUT

The value assigned to this keyword specifies the user desired output option. There are three output formats: BRIEF, DETAIL and DETAIL2.

- The BRIEF output option writes an 80-column file, which contains the performance analysis information in a summary type format.

- The DETAIL option writes a 132-column file containing more information than the BRIEF option.

- DETAIL2 output is similar to the DETAIL option except that it lists the individual engine fuel flow deviations in lieu of the input parameters LAT through DHP/DT.

Samples of each output are given in Section 5. The default is BRIEF.

3.3.4.27 OVERRIDE

The value assigned to this keyword instructs the program to ignore any pneumatic bleed discrete values in the DSIRF or MSIRF cruise data file. The default (NO) is to either reject non-normal bleed values or adjust fuel flow to account for them depending on model and specific bleed parameter. See model specific appendix for more details. Examples:

`OVERRIDE=BLEED`	option
`OVERRIDE=NO`	default

3.3.4.28 PAGEBRK

The value assigned to this keyword instructs the program to insert either an ANSI page break character or the traditional FORTRAN carriage control to indicate a form feed in the APM output and debug files. **PAGEBRK**=FORTRAN will insert a '1' in the first column of a line to indicate a form feed which is properly interpreted by many older technology line printers. The default is ANSI. Examples:

3.3.4.29 POWERX

The value assigned to this keyword specifies whether the power is extraction adjustment for off-nominal generator loads will be used in the fuel flow calculation. The options are NO or YES. By choosing NO, the user specifies no adjustments are to be made to the book performance for actual generator load (see section 4 Algorithm and Analysis for details). Selecting YES will adjust the book performance for actual generator load. The default is NO.

3.3.4.30 QUALTOL

This is the tolerance to be applied to the analysis for the stability criteria or quality factor (see section 3.1.6 DSIRF Data Quality Factor section). The tolerance is used to identify those points, which do not meet tolerance criteria. If a cruise data point quality factor does not meet the tolerance input, then the point is rejected from the analysis, and not included in the average deviation calculation. This point is displayed on the output, but with asterisks (*) where the deviations are presented. A "Q" flag will appear at the far right side of the output line to signify the quality tolerance was exceeded. For example, a stability "quality" number of 84.3 would be rejected if **QUALTOL**=50. A quality factor of zero would be perfect and a factor of 99.9 implies minimum acceptable stable cruise conditions as determined by the DMU or DFDAU. Check with the DMU/DFDAU vendor for quality factor calculation details. The default tolerance is 95. Examples:

`QUALTOL=95`	Default; quality factor of 95
`QUALTOL=50.`	Quality factor of 50

3.3.4.31 REYNLD

The value assigned to this keyword determines if the effects of off-nominal Reynolds Number are to be considered in the drag calculation. The options are: NO, or YES. By choosing NO, the user specifies no adjustments are to be made to the book performance for Reynolds Number effects (seesection 4.1.5.3 Algorithm and Analysis section for Reynolds Number calculation details). Selecting YES will adjust the book performance for these effects. The default is YES, because for some airplanes, the Operations Manual level (book) is calculated with Reynolds Number corrections. This is the only parameter with a default value equal YES.

3.3.4.32 SPDFIL

The value assigned to this keyword specifies the output file name for the spreadsheet output option (see **SPDSHT**). If the computing system needs a file extension, then one must be provided. Some systems do not use file extensions. If the computing system supports default extensions, they may be used to advantage. The default filename is SPREAD.CSV to be easily opened with a spreadsheet application. The exact content of the data is user selectable (See **SPDPRM**). File names with spaces can be used provided the file name is enclosed in dollar signs ($). Examples of filenames:

`SPDFIL=SPREADSHEET.CSV`	Filename with extentions
`SPDFIL=$TEST RUN.CSV$`	Filename with spaces
`SPDFIL=SPREAD.CSV`	default

3.3.4.33 SPDPRM

The value assigned to this keyword specifies the desired input or output parameters to be written to the spreadsheet output file (see **SPDSHT** and **SPDFIL**). The order in which the values are presented in the output file will follow the order in the *parameter list*. Examples of parameter lists are as follows:

```
SPDPRM=AC,DATE,GW,FL,M,PDEV,TDEV,WFDEV,FMDEV,QLT
```

Default: If no parameter list is specified, the following default parameter list is used.

```
SPDPRM=AC,DATE,TDEV,PDEV,WFDV1,WFDV2,WFDV3,WFDV4,WFDEV,FMDEV,WFDE
PR,DSIRF
```

These parameters can be listed all in one line of the APMINP file or separated into several lines by adding a plus (+) sign at the end of each line as a continuation character.

```
SPDPRM=AC,DATE,GW,FL,M,+
PDEV,TDEV,WFDEV,FMDEV,+
QLT
```

Another option for the **SPDPRM** keyword is to specify a file name (bracketed by the Ampersand symbol, &). The specified file would then contain the desired output parameters as in the following example.

```
SPDPRM=&PARAM.TXT&
```

The file PARAM.TXT would contain lines like this:

```
AC,DATE,GW,FL,M,+
PDEV,TDEV,WFDEV,FMDEV,+
QLT
```

Valid **SPDPRM** values and their definition are as follows:

Table 6: SPDPRM Options and Definitions

SPDPRM VALUE	DEFINITION
AC	Aircraft identification
CAS	Calibrated airspeed
CG	Center of gravity (%MAC)
DATE	YYY/MM/DD
DEPDST	Departure and destination
DH	Rate of climb/descent
DSIRF	Entire input DSIRF record. Always in last column of output.
DV	Horizontal acceleration
FL	Flight level
FM	Actual fuel mileage
FMBK	Book value of fuel mileage
FMDEV	Fuel mileage deviation
FN	Flight number
FN1…FN4	Thrust for each engine (up to 4)
FNB	Book thrust per engine
FNOD1…FNOD4	Thrust / δ for each engine 1 (up to 4)
FNODB	Book thrust / δ per engine
GEN	Generator load (% of Max)
GS	Ground speed
GW	Gross weight (1,000 LB or KG)
LAT	Latitude
LHV	Fuel heating value
M	Mach number
PAVG	Power setting (average)
PDEV	Power setting deviation
QLT	DFDAU calculated quality factor
SN1…SN4	Serial number of each engine (up to 4)
TAS	True airspeed

SPDPRM VALUE	DEFINITION
TAT	Total air temperature
TDEV	Thrust deviation
TIME	HHMMSS
WF	Total observed fuel flow
WFBK1…WFBK4	Book value of fuel flow for each engine (up to 4)
WFBKT	Book value of total fuel flow
WFDEPR	Fuel flow deviations due to EPR/N1 deviation
WFDEV	Fuel flow deviation
WFDV1…WFDV4	Fuel flow deviation for each engine (up to 4)
WOD	Weight / δ

3.3.4.34 SPDSHT

The value assigned to this keyword activates the spreadsheet output option. This output option creates a comma delimited file which can be opened directly with a spreadsheet application. The file name is specified by the **SPDFIL** keyword. This file is customizable as to content and order of output parameters (see **SPDPRM**).

`SPDSHT=NO`	default
`SPDSHT=YES`	Creates a new spreadsheet file overwriting any existing files of the same name.
`SPDSHT=APPEND`	Appends the current output to the end of a previously created spreadsheet. NOTE: It is important to use the same parameter list as in previously run data to ensure that the columns match.

3.3.4.35 SPEED

The value assigned to this keyword specifies which speed parameter to use, Mach, calibrated airspeed CAS, or indicated airspeed IAS. The choices are: MACH, CAS, or IAS. The default value is MACH. The Boeing Company suggests using MACH.

3.3.4.36 TAILID

This keyword specifies the airplane tail identifications associated with the weight adjustments provided by the keyword **TWTADJ**. (also see **ADJUSTWT**). For this keyword to be used, the keyword **ADJUSTWT** must be set to APMINP. A maximum limit of 999 tail identification/weight pairs can be used. An example is shown below.

```
TAILID=TAILID1,TAILID2,TAILID4,TAILID5,TAILID6,TAILID7
```

3.3.4.37 TITLE

The value assigned to this keyword is a character string that specifies the title to be displayed on the input specification (first) page of the output. The length allotted for the text is 16 characters. Any characters can be used except the dollar sign ($), which must be used to delimit character strings with embedded blanks or spaces. The default is MONTHLY AVERAGE. Example:

`TITLE=$MARCH THRU APRIL$`	embedded spaces
`TITLE=SAMPLE`	

3.3.4.38 TEMPUNTIN TEMPUNTOUT

TEMPUNTIN specifies the input temperature units for the MANUAL input option (the DSIRF units are fixed and cannot be changed). The choices are: C for Centigrade, and F for Fahrenheit. This should be used in conjunction with the **TEMPUNTOUT** keyword, which controls the output temperature units. The choices are the same for it. The default is C.

3.3.4.39 TRQDHI TRQDLO

The value assigned to these keywords specifies the tolerances to be applied to the analysis for the thrust required deviation calculation. The tolerances are used to identify those points that do not meet the tolerance criteria. If the computed thrust required deviation does not meet the tolerance input, then the data point is rejected from the analysis, and not included in the average deviation calculation. This point is displayed on the output, but with asterisks (*) where the deviations are presented. A "THR" flag will appear at the far right side of the output line to signify the thrust required tolerance was exceeded. The **TRQDHI** tolerance specifies the highest positive deviation. For example, a calculated deviation of 18.4% would be rejected if **TRQDHI**=15.0. The **TRQDLO** tolerance specifies the lowest negative deviation. A calculated deviation of - 16.0% would be rejected if **TRQDLO**=-15.0. **TRQDLO** can be input as a positive number, but the program will always make a negative number from it. The defaults are 15.0% and -15.0%. Examples:

`TRQDLO=-15.0`	default
`TRQDLO=10.0`	will be reset by program to TRQDLO=-10.0
`TRQDHI=15.0`	default
`TRQDHI=10.0`	

3.3.4.40 TWTADJ

This keyword specifies the weight adjustments associated with the airplane tail identifications provided by the keyword **TAILID**. (also see section 3.3.4.1 ADJUSTWT). For this keyword to be used, the keyword **ADJUSTWT** must be set to APMINP. A maximum limit of 999 tail identification/weight pairs can be used. An example is shown below.

```
TWTADJ=1500,-1400,500.,-1200,1000.,800
```

3.3.4.41 TWTFIL

This keyword specifies the name of the input file that contains the weight adjustments by airplane tail number (see section 3.3.4.1 **ADJUSTWT**). For the case where tail identification and weight adjustments are to be read from a file (**ADJUSTWT**=FILE), the format of the file can be either space or comma delimited. The first line of the file is always a comment line used to describe the contents of the file. **No data should be put in the first line of the file**. All subsequent lines may contain value pairs beginning with the tail identification first and the weight adjustment second. A line is up to 80 characters long and as many tail identification/weight adjustment values as can fit on one line are acceptable. More value pairs may be continued onto the next line until the 80 character line limit is reached after which another line can be added and so on. As many lines as necessary to include all the desired data is acceptable up to a maximum limit of 200 tail identification/weight pairs.. File names with spaces can be used provided the file name is enclosed in dollar signs ($). An example of acceptable file contents is shown below.

```
7X7 APM cruise weight adjustment file (Description Line)
TAILID1 2000 TAILID2 1500 TAILID4 1875 TAILID5 -500 TAILID6 1100 TAILID7 1900
TAILID8 350 TAILID9 -1120 TAILID10 1900 TAILID11 -450
```

3.3.4.42 WFHI WFLO

The value assigned to these keywords specifies the tolerances to be applied to the analysis for the fuel flow deviation calculation. The tolerances are used to identify those points that do not meet the tolerance criteria. If the computed fuel flow deviation does not meet the tolerance input, then the data point is rejected from the analysis, and not included in the average deviation calculation. This point is displayed on the output, but with asterisks (*) where the deviations are presented. A “WF” flag will appear at the far right side of the output line to signify the fuel flow tolerance was exceeded. The **WFHI** tolerance specifies the highest positive deviation. For example, a calculated deviation of 15.4% would be rejected if **WFHI**=12.0. The **WFLO** tolerance specifies the lowest negative deviation. A calculated deviation of -14.0% would be rejected if **WFLO**=-10.0. **WFLO** can be input as a positive number, but the program will always make a negative number from it. The default is 15.0% and -15.0%. Examples:

`WFLO=-15.0`	default
`WFLO=10.0`	will be reset by program to WFLO=-10.0
`WFHI=15.0`	default
`WFHI=10.0`	

3.3.4.43 WEIGHT

The value assigned to this keyword specifies the user desired option for the gross weight calculation. The options are:

A. FMC gross weight

B. FMC gross weight minus APU fuel burn

C. Zero fuel weight (ZFW) plus fuel tank quantities

D. Initial gross weight minus fuel used

E. Option D minus APU fuel burn

DMU Use DMU/DFDAU calculated gross weight (DSIRF field number 118)

The options are chosen by the letter designator A, B, C, D, E or DMU. The default value is A. APU fuel burn is calculated from APU time (in minutes) multiplied by the APU fuel flow. The manual input option will only run correctly with options A, B, and C, provided the required data is included in the MSIRF.

3.3.4.44 WFFAC

The value assigned to this keyword is a factor to be applied to the book calculation of fuel flow (i.e. total fuel flow equals calculated fuel flow multiplied by **WFFAC**). This factor is simply a multiplication constant. A **WFFAC**=1.0 is the default. A **WFFAC**=0.95 would result in the fuel flow calculations for all airplanes in this run to be multiplied by 0.95 to yield the book fuel flow. Examples:

`WFFAC=1.008`	0.8% higher fuel flow
`WFFAC=1.0`	default
`WFFAC=0.992`	0.8% lower fuel flow

3.3.4.45 WTUNITIN WTUNITOUT

WTUNITIN specifies the input units to be used for weight and fuel flow. The choices are: KG for kilograms, and LB for pounds. This should be used in conjunction with the **WTUNITOUT** keyword which controls the output weight units. The choices are the same for it. These parameters will be applied to airplane weight, fuel weight, and fuel flow. The default is LB. Examples:

`WTUNITIN=LB`	default
`WTUNITIN=KG`	This requires fuel density in KG/Liter
`WTUNITOUT=KG`	This does not affect the MASTER file
`WTUNITOUT=LB`	default

3.3.4.46 APM Input Summary Sheet

KEYWORD	DESCRIPTION	DEFAULT	OPTIONS
DATBAS	Database Filename	DATBAS	Valid filename
CONFIG##	Configuration Number	None	Valid Config Spec
/CASE	Case Block Delimiter	N/A	
APM	APM Analysis Flag	N/A	
AIR-ENG	Airplane/Engine Combination	747-400	Text
CG	Toggle for CG Calculation	NO	NO, YES or DMU
CGMOM	Delta CG moment	0	Valid Constant
CRZFIL	Cruise Data Point Filename	CRZFIL	Valid Filename
DATE	Date Format	DD-MM-YY	MM-DD-YY, YY-MM-DD
DEBUG	Toggle for DEBUG Output	NO	NO or YES,
DEBFIL	DEBUG Output Filename	DEBUG	Valid Filename
DRGFAC	Drag Factor	1.00	Valid Constant
ELASTIC	Toggle for Elasticity Correction	NO	NO or YES
ENERGY	Toggle for Energy Calculation	NO	NO or YES
EPRHI	Power Setting Deviation Tolerance	0.15/ 15%N1	Valid Tolerance
EPRLO	Power Setting Deviation Tolerance	-0.15/-15%N1	Valid Tolerance
FFCAL	Toggle for fuel flow bias correction	NO	NO or YES
FFA0	Polynomial constant for fuel flow bias	N/A	Valid constant
FFA1	Polynomial constant for fuel flow bias	N/A	Valid constant
FFA2	Polynomial constant for fuel flow bias	N/A	Valid constant
FFA3	Polynomial constant for fuel flow bias	N/A	Valid constant
FLEETAVG	Toggle for Fleet Avg Calculation	TAIL	TAIL or ALL
FMHI	Fuel Mileage Deviation Tolerance	15	Valid Tolerance
FMLO	Fuel Mileage Deviation Tolerance	-15	Valid Tolerance
GRAVITY	Toggle for Gravity Calculation	NO	NO or YES
INPUT	Cruise Data Input Format	ACMS	ACMS or MANUAL
INSTR	Instrument Source	C	C, FO, BOTH
LHEATV	Toggle for Fuel Lower Heat Value	NO	NO, YES or DMU
LHVB	Y-intercept of LHV Equation	22777	Valid Coefficient

KEYWORD	DESCRIPTION	DEFAULT	OPTIONS
LHVM	Slope of LHV Equation	-5220	Valid Coefficient
MASFIL	MASTER Output Filename	MASTER	Valid Filename
MASTER	Toggle for MASTER Output	NO	NO or YES
OUTPUT	Output Option	BRIEF	BRIEF or DETAIL
OUTFIL	Output Filename	APMOUT	Valid Filename
OVERRIDE	Toggle to ignore bleed discrete values	NO	NO or BLEED
PAGEBRK	Toggle for type of output page break	ANSI	ANSI or FORTRAN
POWERX	Toggle for Power Extraction	NO	NO or YES
QUALTOL	Quality Factor Tolerance	95	Valid Tolerance
REYNLD	Toggle for Reynolds # Calculation	YES	NO or YES
SPDSHT	Toggle for spreadsheet output	NO	NO, YES or APPEND
SPDFIL	Spreadsheet filename	SPREAD.CSV	Valid filename
SPDPRM	Spreadsheet parameter list	See detailed description earlier in this section	
SPEED	Speed Parameter	MACH	IAS, CAS or MACH
TEMPUNTIN	Input Temperature Units	C	F or C
TEMPUNTOUT	Output Temperature Units	C	F or C
TITLE	Output Title	Monthly Avg	Text
TRQDHI	Thrust Req’d Deviation Tolerance	15	Valid Tolerance
TRQDL0	Thrust Req’d Deviation Tolerance	-15	Valid Tolerance
WEIGHT	Weight Calculation Option	A	A, B, C, D, E or DMU
WFFAC	Fuel Flow Factor	1.00	Valid Constant
WFHI	Fuel Flow Deviation Tolerance	15	Valid Tolerance
WFLO	Fuel Flow Deviation Tolerance	-15	Valid Tolerance
WTUNITIN	Input Weight Units	LB	KG or LB
WTUNITOUT	Output Weight Units	LB	KG or LB
ADJUSTWT	Toggles weight adjustment option	NO	NO, APMINP or FILE
TWTFIL	Weight adjustment filename	TWTFIL	Valid filename
TAILID	Airplane ID for weight adjustment	N/A	Valid tail identification
TWTADJ	Weight adjustment for airplane ID	N/A	Valid weight increment

3.3.5 User Input File Samples

This section shows several sample User-Input files. The samples range from the very short, taking advantage of all program defaults, to a complete definition using every keyword. The very last sample will show how to stack inputs for multiple cases for the same execution. Note that these sample do not correspond to the examples given in Appendix C Sample Input and Output.

3.3.5.1 Sample 1

This sample makes maximum use of the available defaults. The default name for a database is DATBAS. Also, the standard analysis tolerances, output filenames, and algorithm switches are assumed. The ACMS cruise data file is called CRZFIL, and the brief tabular output file is APMOUT. This APMINP will contain:

```
CONFIG50
/CASE
APM
```

3.3.5.2 Sample 2

This sample builds upon SAMPLE 1 by overriding the default cruise data input file and output filenames. Also, text for a title and engine-airframe are added. This APMINP would look like:

```
CONFIG50
/CASE
APM
CRZFIL=SAMPLE.CRZ
OUTFIL=SAMPLE.OUT
TITLE=OCTOBER
AIR-ENG=7X7-ABC
```

3.3.5.3 Sample 3

This sample builds upon SAMPLE 2 by specifying a database filename (7X7ABC.DAT) and overriding default tolerances for fuel flow, thrust required, and fuel mileage. Finally, a quality factor tolerance (**QUALTOL**) of 70.0 is applied. This input file will appear as:

```
7X7ABC.DAT CONFIG50
/CASE
APM
CRZFIL=SAMPLE.CRZ
OUTFIL=SAMPLE.OUT
TITLE=OCTOBER
AIR-ENG=7X7-ABC
WFHI=12.
WFLO=-12.
TRQDHI=12.
TRQDLO=-12.
FMHI=10.
FMLO=-10.
QUALTOL=70.
```

3.3.5.4 Sample 4

For a manual cruise input file, it is necessary to override the default **INPUT**=ACMS by including **INPUT**=MANUAL. Also, in this example, the **CRZFIL** name is changed to MANUAL.CRZ. The User- Input file will appear as:

```
7X7ABC.DAT CONFIG50
/CASE
APM
INPUT=MANUAL
CRZFIL=MANUAL.CRZ
OUTFIL=SAMPLE.OUT
TITLE=OCTOBER
AIR-ENG=7X7-ABC
WFHI=12.
WFLO=-12.
TRQDHI=12.
TRQDLO=-12.
FMHI=10.
FMLO=-10.
QUALTOL=70.
```

3.3.5.5 Sample 5

The following example explicitly defines all keywords.

```
DATABAS.DAT CONFIG50
/CASE APM
AIR-ENG=7X7-ABC CG=NO CRZFIL=SAMPLE.CRZ DATE=DD-MM-YY DEBFIL=DEBUG.DAT
DEBUG=YES DRGFAC=1.00 ELASTIC=NO ENERGY=NO EPRHI=0.15
EPRLO=-0.15 FLTAVG=ALL FMHI=10.FMLO=-10.
GRAVITY=YES INPUT=ACMS INSTR=C LHEATV=YES LHVB=22777. LHVM=-5220.
MASFIL=MASTER.OUT MASTER=YES OUTFIL=SAMPLE.OUT OUTPUT=BRIEF
POWERX=NO QUALTOL=70.
REYNLD=YES SPEED=MACH TITLE=OCTOBER
TEMPUNTIN=C TEMPUNTOUT=C TRQDHI=12. TRQDLO=-12.
WFHI=12. WFLO=-12. WEIGHT=A WFFAC=1.00 WTUNITIN=KG WTUNITOUT=KG
```

3.3.5.6 Sample 6

A final sample shows how to stack inputs so the APM program can run multiple cases in one execution. One important note: **the program resets all keywords to their default values at each new /CASE line.**

```
DATABAS.DAT CONFIG50
/CASE APM
AIR-ENG=7X7-ABC CRZFIL=SAMPLE.CRZ INPUT=ACMS OUTFIL=SAMPLE.OUT
REYNLD=YES TRQDHI=12.
TRQDLO=-12.
WFHI=12.
/CASE APM
CRZFIL=SAMPLE2.CRZ INPUT=ACMS OUTFIL=SAMPLE2.OUT REYNLD=YES TRQDHI=12.
TRQDLO=-12.
WFHI=12.
/CASE AIPM
AIR-ENG=7X7-ABC CRZFIL=MANUAL.CRZ INPUT=MANUAL OUTFIL=SAMPLE.OUT
REYNLD=YES DEBUG=YES DEBFIL=MANDEB.DAT
```

3.3.6 Database

The term "database" is used in this document to identify a collection of fundamental aerodynamic, propulsion and other data that can be used by a computer program to model several configurations for a specific airframe/engine combination. This computer model can then be used in the calculation of relevant APM performance parameters.

To facilitate data preparation and to preserve its original nature, a tabular rather than a polynomial coefficient storage method is used. This method of data storage is ideally suited to straightforward interpolation techniques.

Within Boeing, the tabular data structure is known as **PRIME** (PRopulsion Interface MEthod) format. The details regarding **PRIME** format, database structure and contents are contained in Appendix A. Appendix B contains a sample database that should be used to test the APM program after installation. This sample database is generic and should **NOT** be used for production purposes. Rather, a database specific to an operator's model is furnished for the production environment.

The production database(s) supplied is (are) self-contained and the user does not need to read the material in Appendices A and B to use the APM program. However, it is essential that the integrity of the database be maintained to ensure consistent results when used with the program and to facilitate any related inquiries in its use.

As stated above, the details regarding database structure and content are contained in Appendices A. After studying Appendix A, one may have the notion that a furnished database must include at least one of each listed table type. This is not the case. Furnished databases contain only the complement of tables necessary for APM calculations and for generating a major portion of the inflight performance data contained in the Boeing Operations Manual.

To use a database, two questions must be addressed: 1) how is the database made available to the APM program and 2) how does the program know what portions of data within the database represent a unique airplane/engine configuration. The answers to these questions follow.

1. The database is made available to the APM program as a file identified by a name. The name is made available to the program via the User-Input file. As stated previously in this section, the very first entry in the User-Input file contains the database filename unless the default filename **DATBAS** applies and exists.

2. Contained within a database are unique collections of data, each called a CONFIG block. The beginning of each block is identified by a delimiter of the form **/CONFIGij** (the "ij" representing a two-digit extension ranging from 01 to 99). The end of each block is identified by the delimiter **/ENDCONFIG**. Within these delimiters are parameters that specify which portions of data are loaded from the database to represent a specific airframe/engine configuration. Hence, the matter of indicating the unique configuration is resolved simply by an entry in the User-Input file (APMINP) such as **CONFIG50**.

This in turn raises the question as to what two-digit extension applies to the APM program and to other applications. CONFIG information is furnished with the shipment of the program materials. As a backup source, the beginning of the database will contain comment lines, which clearly identify the available "configurations" or CONFIG's contained within the database along with any restrictions regarding their use.

4 ALGORITHM AND ANALYSIS

This section describes in detail the algorithms that are implemented in the APM program. These algorithms calculate the four performance deviations that can be used to assess airplane/engine condition by tracking these parameters over extended periods of time.

The organization of the material presented is arranged in sub-sections. In the sub-section descriptions, frequent reference is made to the word "book" as it relates to a parameter. This word, book, implies the theoretical level as used in calculating the operations Manual level of performance.

4.1 Overview

4.1.1 Thrust Required Deviation

Book thrust available is calculated based upon observed power setting parameter (EPR or %N1) and generalized thrust. Book thrust required is calculated based upon the drag model. The deviation is expressed as a percentage difference between thrust available and thrust required. Negative numbers represent “better than book” results.

1. Correct W for Gravity Effect.
2. Calculate C_L using M,W_{corr} (Eq. 1)
3. Lookup C_d using C_L,M (Table 1 Drag Polar)
4. Calculate R_n correction to C_d (Eq. 3)
5. Calculate aeroelastic correction to C_d using Table 14 and Equation 4, then apply to C_d corrected for R_n, i.e. sum of Steps 3 and 4.
6. Calculate CG correction to C_d.
7. Calculate C_{dtot} (Sum of steps 5 and 6).
8. Calculate D_{tot}/δusing C_{dtot}, M (Eq. 2)
9. Calculate Energy Correction to D_{tot}/δ.
10. Calculate $D_{tot,corr}/\delta$(Sum of steps 8, 9, and 10)
11. Lookup $(Fn/\delta)_i$ using EPR/%$N1_{obs}$,M for each engine (Table 2 Generalized Fn).
12. Calculate $Fn_{tot}/\delta = \Sigma(Fn/\delta)_i$
13. Calculate Thrust Required Deviation, percent

$$\%\Delta Fn_{Req'd\text{-}Dev} = \left[\frac{Fn_{Total\text{-}Observed} / \delta - D_{Total\text{-}Correct} / \delta}{D_{Total\text{-}Correct} / \delta}\right] * 100$$

4.1.2 Power Setting (EPR/%N1) Required Deviation

Book power setting is determined by finding the average power setting required, to produce a book thrust available (equal to book drag) for the observed conditions. The deviation is the difference between observed and book power settings. This is a pure deviation, not a percentage. Power setting, as used in this documentation, is equivalent to thrust setting. Negative numbers represent "better than book" results.

1. Correct W for Gravity Effect.
2. Calculate C_L using M, W_{corr} (Eq. 1)
3. Lookup C_d using C_L, M (Table 1 Drag Polar)
4. Calculate R_n correction to C_d (Eq. 3)*
5. Calculate aeroelastic correction to C_d using Table 14 and Equation 4, then apply to C_d corrected for R_n, i.e. sum of Steps 3 and 4.
6. Calculate CG correction to C_d.
7. Calculate C_{dtot} (Sum of steps 5 and 6)
8. Calculate D_{tot}/δ using C_{dtot}, M (Eq. 2)
9. Calculate Energy Correction to D_{tot}/δ.
10. Calculate $D_{tot,\ corr}/\delta$ (Sum of steps 8, 9, and 10)
11. Set $Fn/\delta = (D_{tot,corr}/\delta)$/(Number of engines)
12. Lookup $EPR/\%N1_{Book}$ using Fn/δ, M (Table 2 Generalized Fn)
13. Calculate average power setting $EPR/\%N1_{obs,avg}$
14. Calculate EPR/%N1 Deviation

$$\Delta EPR_{Req'dDev} = [EPR_{Observed} - EPR_{Book}]$$

$$\text{Or} \quad \Delta N1_{Req'dDev} = [N1_{Observed} - N1_{Book}]$$

4.1.3 Fuel Flow Deviation

This deviation should be considered as a measurement related only to engine performance. Book fuel flow is calculated based upon observed power setting, generalized engine thrust model and fuel flow model. The deviation is expressed as a percentage difference between observed fuel flow and book fuel flow. Negative numbers represent “better than book” results.

1. Lookup Fn_{obs}/δ using EPR_{obs}, M (Table 2 Generalized Fn)
2. Lookup Corrected Wf_{Book} using Fn_{obs}/δ, M (Table 3 WFTAB)
3. Calculate Wf_{Book} (Eq. 5)*
4. Calculate LHV correction to Wf_{Book} (Section 5.7.4)
5. Correct $Wf_{Book,corr}$ for Power Extraction (Section 5.7.6)
6. Calculate %Wf Deviation

$$\%\Delta Wf_{Req'dDev} = \left[\frac{Wf_{Observed} - Wf_{Book}}{Wf_{Book}}\right] * 100$$

4.1.4 Fuel Mileage Deviation

This deviation provides a performance measurement combining airframe and engine effects. Observed fuel mileage is determined from the quotient of true airspeed and observed fuel flow. Book fuel mileage is determined from the quotient of true airspeed and book fuel flow as determined from the drag model (thrust required). The deviation is expressed as a percentage difference between observed and book fuel mileages. Positive numbers represent “better than book” results.

1. Correct W for Gravity Effect.
2. Calculate C_L using M,W_{corr} (Eq. 1)
3. Lookup C_d using C_L,M (Table 1 Drag Polar)
4. Calculate R_n correction to C_d (Eq. 3)
5. Calculate aeroelastic correction to C_d using Table 14 and Equation 4, then apply to C_d corrected for R_n, i.e. sum of Steps 3 and 4.
6. Calculate CG correction to C_d.
7. Calculate C_{dtot} (Sum of steps 5 and 6)
8. Calculate D_{tot}/δ using C_{dtot},M (Eq. 2)

9. Calculate Energy Correction to D_{tot}/δ.

10. Calculate $D_{tot,corr}/\delta$ (Sum of steps 8, 9, and 10)

11. Set $Fn/\delta = (D_{tot,corr}/\delta)/$ (Number of engines)

12. Lookup Corrected Wf_{Book} using Fn/δ, M (Table 3 WFTAB)

13. Calculate Wf_{Book} (Eq. 5)

14. Calculate LHV correction to average Wf_{Book} to obtain $Wf_{Book,corr}$.

15. Correct $Wf_{Book,corr}$ for Power Extraction.

16. Calculate $FM_{obs} = TAS/Wf_{obs}$

17. Calculate FM_{Book} $TAS/Wf_{Book,corr}$

18. Calculate %FM Deviation

$$\%\Delta FM_{Req'dDev} = \left[\frac{FM_{Observed} - FM_{Book}}{FM_{Book}}\right] * 100$$

4.1.5 Equations

The fundamental lift, drag and fuel flow equations are presented for easy reference.

4.1.5.1 Lift

$$C_L = \frac{W_{Corr}}{\delta * 1481.4 * M^2 * S}$$

4.1.5.2 Drag

$$D / \delta = 1481.4 * Cd * M^2 * S$$

4.1.5.3 Reynolds Number Correction to C_d

1. $[(1/M)(Re/FT)] = 5.13435 * 10^6 * [\delta * (\theta + 0.38290) / \theta^2]$

2. $C_{DP} = [A + B * LOG_{10} [(1/M)(Re/FT)]] * 0.0001$

   where A and B are coefficients contained in the database (see Appendix A, Scalars ACDF and BCDF).

3. $\Delta C_d = C_{DP\ Off\text{-}reference} - C_{DP\ Reference}$

For Off-reference calculation in equation 1, use δ and θ corresponding to actual pressure altitude

For Reference calculation in equation 1, use δ and θ from Table 4 at reference altitude as determined from actual W_{corr}/δ.

4.1.5.4 Aerolastic Correction to Cd

$$\%\Delta C_{dELAS} = f(W,M)$$

$$\%\Delta Cd = (\%\Delta C_{dELAS\ Off\text{-}reference}) - (\%\Delta C_{dELAS\ Reference})$$

For reference conditions, use Table 4 reference altitude to determine δ_{Ref} for computing reference weight, i.e.

$$W_{Ref} = W * (\delta_{Ref} / \delta)$$

4.1.5.5 Corrected Fuel Flow to Actual Fuel FLow

$$Wf = Wfcorr\ (\delta_{delrat})^{edelta} * (\delta_{delrat})^{etheta}$$

1. $\delta_t = \delta_{test}\ (1 + 0.2M^2)^{3.5}$
2. $\theta_t = \theta_{test}\ (1 + 0.2M^2)$
3. delrat – either ambient or total

NOTES:

- edelta = exponent of delta
- etheta = exponent of theta

4.1.6 Tables

The list provided identifies those database tables used in the algorithms.

1. High Speed Drag Polar

   $C_d = f(M, C_L)$

2. Generalized Thrust

   $EPR/\%Nl = f(F_n/(\delta, M)$

3. Corrected Fuel Flow - WFTAB

   $Wf_{corr} = f\ (F_n/\delta, M, Altitude)$

4. Reference Reynolds Number

Reference Altitude = f(W/δ)

5. Delta C_d Trim correction for Center of Gravity

ΔC_d Trim @ Reference CG = f(M, C_L)

6. Trim correction for Center of Gravity

KTrim = f(CG MAC)

7-11. Fuel Moment Arm for Center of Gravity

Balance Arm = f(Fuel Weight)

12. Fuel Flow correction for Off-Nominal Power Extraction

Wf* = f(EPR/%$N1_{corr}$, M)

13. APU Fuel Flow

APU W_f = f(M, Altitude)

14. Aeroelastic correction to drag

%$\Delta C_{d\ ELAS}$ = f(W, M)

4.1.7 Specific Corrections

Many algorithm refinements have been developed and included in the APM program to account for various factors that influence the calculated book parameters mentioned above. Among the effects accounted for are the following: Earths' gravitational variation, Coriolis force, fuel lower heating value (LHV), horizontal/vertical accelerations, center of gravity (CG) and power extraction (generator load). The analytical methods used to account for these effects are presented on the following pages contained in this section. Listed below are the additional input data required to exercise these optional corrections.

DESCRIPTION	CORRECTION	ADDITIONAL INPUT DATA REQUIRED
CG correction	CG=YES	Initial Gross Weight Initial Zero Fuel Weight Initial CG Position Initial Fuel Quantities Inflight Fuel Quantities
Energy correction	ENERGY=YES	dHp/dt dVg/dt
Fuel heating value correction	LHEATV=YES	Fuel Temperature Fuel Density
Gravitational correction	GRAVITY=YES	Latitude

DESCRIPTION	CORRECTION	ADDITIONAL INPUT DATA REQUIRED
		True Track Ground Speed
Power extraction	POWERX=YES	Generator Load

4.1.7.1 Center of Gravity Correction to Cd

NOTE: If user has specified **CG**=DMU, the computation of CG position in steps 1 through 8 is not applicable.

<u>Inputs: Scalars</u>

- TOW = Takeoff Gross Weight [Lb]
- GWCGMAC = Initial (Takeoff) Center of Gravity Position [as % MAC]
- GWCGBS = (GWCGMAC * MAC)/100 + LEMAC
- ZFW = Zero Fuel Weight [Lb]
- W = Condition Weight [Lb] as determined by FMC
- Initial Fuel Quantities [Lb]
- Flight Condition Fuel Quantities [Lb]
- MAC = Mean Aerodynamic Chord [Inches]
- LEMAC = Leading Edge of Aerodynamic Chord Body Station [Inches]

<u>Tables</u>

- Table 5. ΔCd Trim @ Reference C.G. Versus Mach and C_L
- Table 6. K_{Trim} Versus C.G. as MAC to adjust test C.G. to nominal.
- Table 7-11. Fuel Weight [Lb] Versus Balance Arm [Inches]

<u>Algorithm</u>

Step 1. With Initial Tank Quantities □ Table 7-11 lookup = Tank Body Station

Step 2. With Flight Tank Quantities □ Table 7-11 lookup = Tank Body Station

Step 3. ZFW = W - [Sum of Initial Tank Quantities]

Step 4. Initial Moment = Initial Fuel * Tank Body Station

Step 5. ZFWCGBS = [(TOW * GWCGBS) - (Sum of Initial Moments)] / ZFW

Step 6. ZFWCGMAC = [(ZFWCGBS - LEMAC) / MAC] * 100

Step 7. WTCGBS = [(ZFW * ZFWCGBS) + (Sum of Flight Moments)] / W

Step 8. WTCGMAC = [(WTCGBS - LEMAC)/MAC] * 100

Step 9. With M and C_L go to Table 5. Look up = $\Delta Cd_{Trim\ @\ Reference\ CG}$

Step 10. With WTCGMAC go to Table 6. look up = K_{Trim}

Step 11. $\Delta Cd_{Trim\ @\ Cond} = \Delta Cd_{Trim\ @\ Reference\ CG} * K_{Trim}$

Step 12. $Cd_{corr} = Cd - \Delta Cd_{Trim\ @\ Cond}$

4.1.7.2 Energy Correction to Drag/δ (Acceleration/Deceleration)

Method as taken from the Boeing document D6-33468, entitled “The Determination of Cruise Fuel Mileage by Flight Testing Model 747 Production Airplanes, Revision D," approved for issue February 1979.

Inputs: Scalars

- TAS = True Airspeed [Knots]
- dV_g/dt = rate of change of INS ground speed [Knots/Sec]
- dH_t/dt = Tapeline rate of climb [Ft/Sec]
- dH_p/dt = rate of change of pressure altitude [Ft/Sec]
- T_{amb} = Ambient Temperature [C]

Algorithm

Step 1. $$\left(\frac{\Delta D}{\delta}\right)_{Vg} = (0.052459) * \left(\frac{W}{\delta}\right) * \left(\frac{dVg}{dt}\right)$$

Step 2. $$\left(\frac{\Delta D}{\delta}\right)_{Hp} = \frac{\left[(0.592484) * \frac{W}{\delta} * \left(\frac{dH_t}{dt}\right)\right]}{TAS}$$

NOTE: $$\frac{dH_t}{dt} = \frac{\left[\left(\frac{dHp}{dt}\right) * (T_{amb} + 273.16)\right]}{288.16}$$

Step 3. $$\frac{\Delta D}{\delta} = \left(\frac{\Delta D}{\delta}\right)_{Vg} + \left(\frac{\Delta D}{\delta}\right)_{Hp}$$

4.1.7.3 Fuel Lower Heating Value Correction to Fuel Flow

Method as taken from the Boeing document D6-33468, entitled "The Determination of Cruise Fuel Mileage by Flight Testing Model 747 Production Airplanes, Revision D," approved for issue February 1979.

Purpose: To correct fuel lower heating value to a nominal value of 18,580 BTU/Lb. The user may alter the relationship between specific gravity and fuel lower heat value. The relationship exists as the equation of a line given as:

$$y = mx + b,$$

where x is the specific gravity, in is the slope and b is the y- intercept. The slope and y-intercept may be input in the User-Input file as **LHVM** and **LHVB** respectively. If no slope or y-intercept are input the default values of -5220 and 22777 are used. If the actual value of **LHV** is known, it may be placed in the **CONFIG** section of the database, see Appedix 2 for details.

Inputs: Scalars

- T_{Fuel} = Fuel Temperature [Deg C]
- ρ_{Fuel} = Fuel Density [Lb/Gal]
- LHV_{ref} = Reference LHV (18580 BTU/Lb)
- M = LHV Equation Slope (default -5220)
- B = LHV equation y-intercept (default 22777)

From LHV = M(x) + B where x = Specific Gravity

Algorithm

Step 1. $\text{S.G.} = \frac{\left[\left[(0.0063)*(T_{Fuel}-15.56)\right]+\rho_{Fuel}\right]}{8.3282}$

Step 2. LHV = −5220 * (S.G.) + 22777

or LHV = M * (S.G.) + B

Step 3. $Wf_{Corr} = WF_{Calc} * (LVH_{ref} / LHV)$

4.1.7.4 Gravitational Variation Corrections to Gross Weight

Method as taken from the Engineering Sciences Data Unit, Item Number 79018, entitled "Example of performance analysis using data obtained concurrently in air-path, body and Earth axes," approved for issue November 1,979.

There are 4 different corrections encompassed into the gravity correction:

1. Gravitational variation with latitude
2. Gravitational variation with altitude
3. Gravitational variation *due* to Coriolis force
4. Gravitational variation due to centrifugal force

Inputs: Scalars

- Φ = Latitude [degrees]
- Z = Altitude [Ft]
- TTR = True Track [Degrees]
- GS = Ground Speed [Ft/Sec]
- W = Condition Gross Weight [Lb]

Algorithms

Step 1. Gravitational Variation with Latitude

$g\Phi,sl$ = gravity at Φ latitude and sea level

$$g\Phi,sl = 32.174\ [(l - 0.0026373\ \mathrm{Cos}(2\Phi) + 0.0000059\ \mathrm{Cos}^2(2\Phi))]$$

Step 2. Gravitational Variation with Altitude and Latitude

$$g\Phi,Z = [g\Phi,sl + \omega_e^2 * r_e * \mathrm{Cos}^2\Phi] * [r_e /(r_e + Z)]^2 - \omega_e\ (r_e + Z)\mathrm{Cos}\ (\Phi)$$

where $r_e = [(a^4 + b^4\mathrm{Tan}^2\ \Phi)/(a^2 + b^2\ \mathrm{Tan}^2\ \Phi)]^{0.5}$

Step 3. Gravitational variation due to Coriolis and Centrifugal force

$$Z_{\ Cent,Cori} = [(GS)^2 /(r_e + Z)] + [\ 2\ \omega_e\ (GS)\mathrm{Cos}\Phi\ (\mathrm{Sin}\ TTR)]$$

$$g_{actual} = g\Phi,z - Z_{Cent,Cori}$$

Step 4. The gravitational variations are computed for reference conditions defined as:

a. Latitude = 45 degrees N, TTR = 0 degrees, Wind = 0 kts (Vg=VT)

b. Altitude = Standard altitude from the Reynolds Number correction

$$\Delta W = [(g_{actual} – g_{ref}) / g_0] * W$$

Corrected Condition Weight, Wcorr = W + ΔW

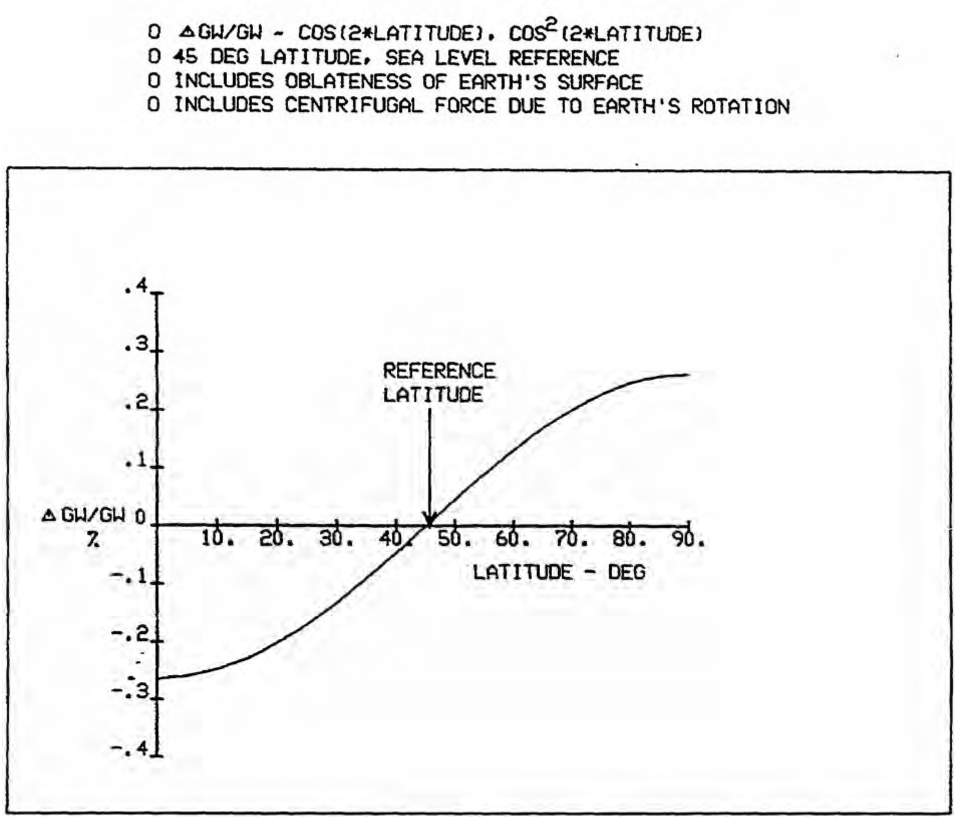


Figure 7: Latitude Correction to Gross Weight

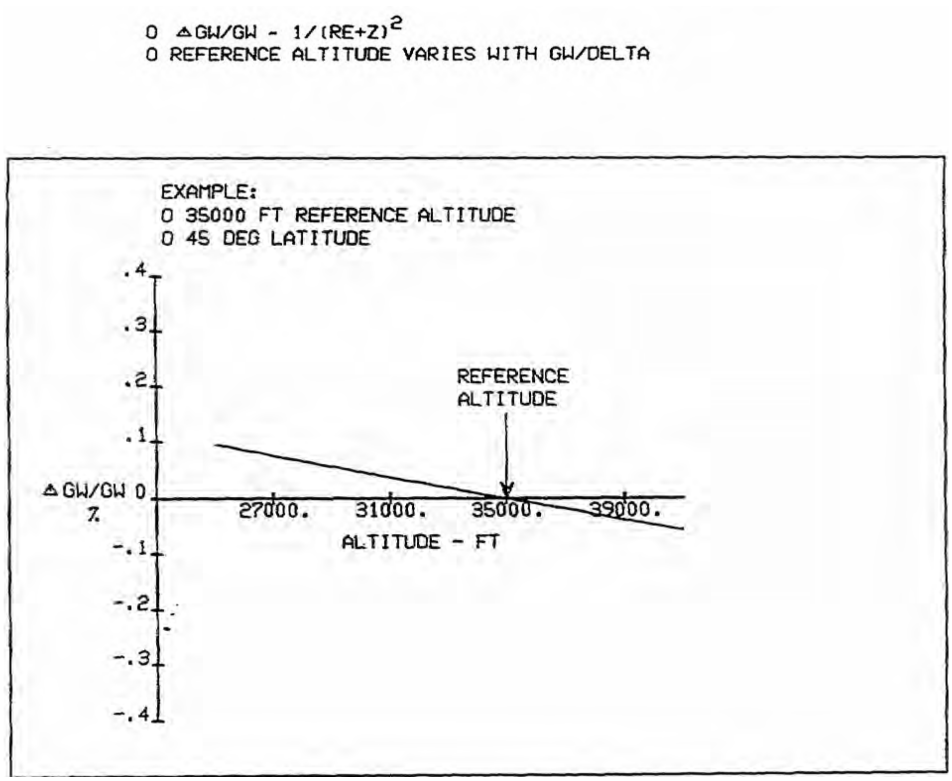


Figure 8: Altitude Correction to Gross Weight

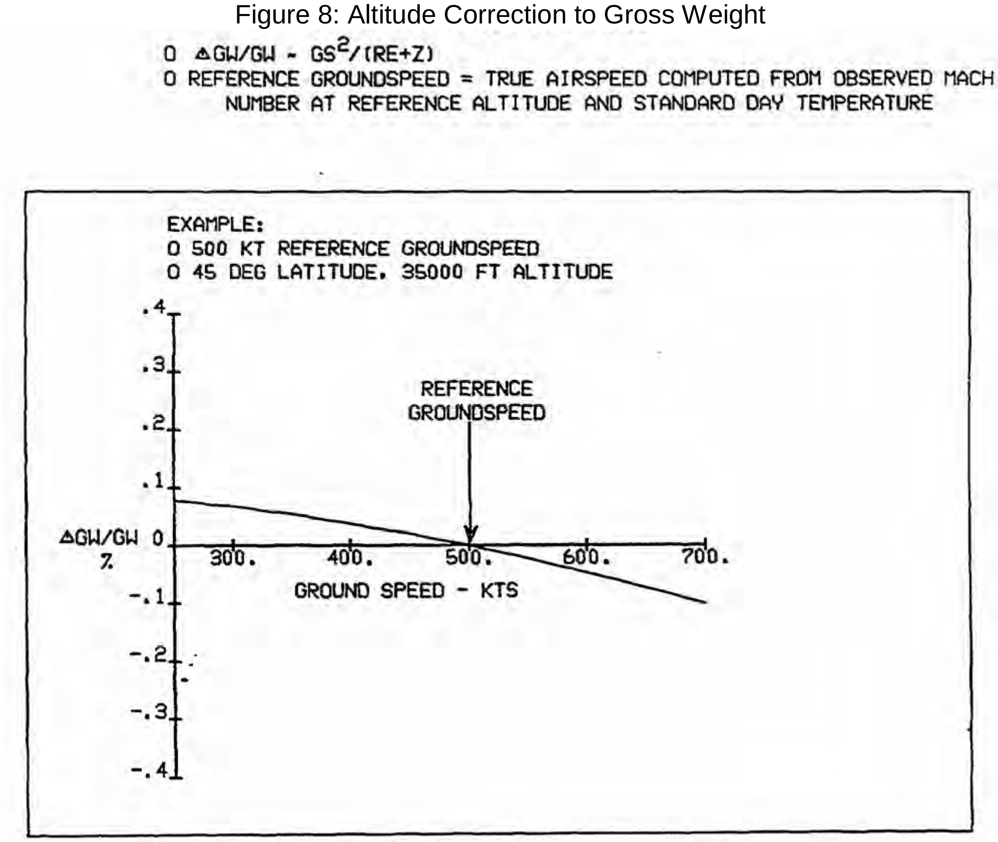


Figure 9: Centrifugal Correction to Gross Weight Due to Ground Speed

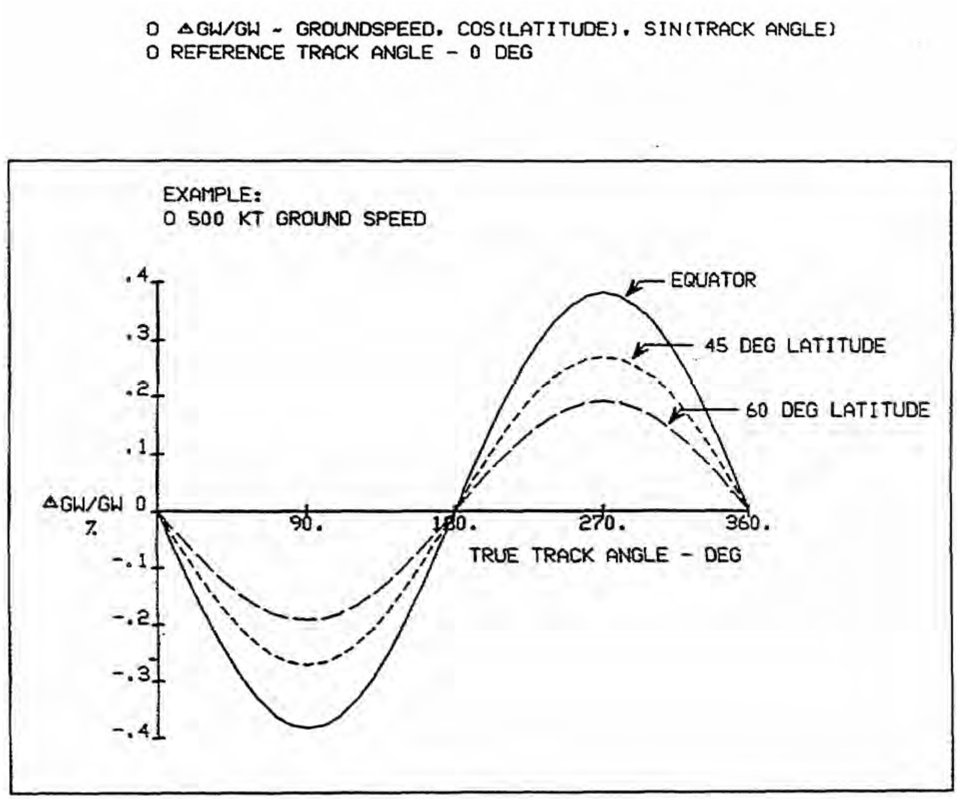


Figure 10: Coriolis Correction to Gross Weight

4.1.7.5 Off-Nominal Engine Power Extraction Correction to Fuel Flow

<u>Inputs: Scalar</u>

- GENLOD = Average Generator Electrical Load [% of Maximum]
- Wf = Fuel Flow not corrected for power extraction
- Nom HP = Nominal Power Extraction per Engine [Horsepower]
- A_0 = Incremental Engine Load
- A_1 = Factor Engine Load
- δ_t = Delta Total - Pressure Ratio
- θ_t = Theta Total - Temperature Ratio

<u>Tables</u>

Table 12. Wf_{Star} - Fuel Flow Ratio to determine the percent fuel flow correction or a power extraction of 100 corrected horsepower [$HP/\delta_t(\theta_t)^{0.5}$] per engine.

Algorithms

Test HP = A1 (GENLOD) + AO

$$Wfcorr = Wf / [1 + \left[\frac{(NomHP - TestHP)}{\delta_t {\theta_t}^{0.5}}\right] * \left(\frac{\frac{Wf_{Star}}{100}}{100}\right)]$$

5 OUTPUT OPTIONS

The possible types of output from APM are as follows: BRIEF, DETAIL, DETAIL2, SPDSHT, MASTER, DEBUG and ERROR. BRIEF, DETAIL and DETAIL2 are sent to the main output file specified by the keyword OUTFIL. The remaining output types are written to their own specific output files. A description of each follows.

Subsequent executions of the APM program will overwrite existing files if the user does not change the output filenames in the User-Input file. If the APM program is to be executed repeatedly, it is suggested that the user change the output filenames so the files are not overwritten.

5.1 BRIEF Tabular Output Description

The BRIEF output consists of the basic input parameters and four deviation results. If large amounts of cruise data are run, this may be the output option of choice. The results can be checked from the BRIEF output and consideration given to running other outputs.

The analysis produces three types of output pages in the following order: input specification pages, page(s) of deviation results, and the fleet summary. The input specification pages describe the User-Input variables and database. These pages can be very useful for debugging and verifying what the analysis is based upon. A sample of the input specification pages is included. These pages are written to both the TABULAR and DEBUG output files.

Date and flight number (FLT #) as shown in the sample output are read from the DSIRF header. Flight level (FLT LVL) is actually altitude divided by 100. TAT is the total air temperature, and GW stands for gross weight. The quality number (QUAL) is a DMU/DFDAU calculated variable to quantify the data point's stability.

If one of the deviation tolerance ranges has been exceeded or a non-normal system configuration is indicated, then asterisks (*) will be printed in all the deviation columns and a code will denote which tolerance was exceeded. The codes are:

Table 7: Deviation Tolerance Codes

CODE	DESCRIPTION
EPR/N1/TPR	Signifies the power setting deviation tolerance (EPRHI/EPRLO) has been exceeded.
THR	Signifies the thrust required deviation tolerance (TRQDHI/TRQDLO) has been exceeded.
WF	Signifies the fuel flow deviation tolerance (WFHI/WFLO) has been exceeded.
FM	Signifies the fuel mileage deviation tolerance (FMHI/FMLO) has been exceeded.
QLT	Signifies the quality tolerance (QUALTOL) has been exceeded.
TAI	Non-normal anti-ice bleed configuration
EAI	Non-normal engine cowl anti-ice bleed configuration
WAI	Non-normal wing anti-ice bleed configuration

CODE	DESCRIPTION
ISO	Non-normal isolation valve configuration
ECS	Non-normal configuration of the Environmental Control System packs
A/C	Non-normal Environmental Control System pack flow
BLD	Non-normal configuration of the engine bleeds
CGO	Invalid cargo heat indication

Subsequently, this data point will not be used in the calculation of "average deviation from book" or the standard deviation. The actual deviation may be seen on the DEBUG output option. The code "BLD" is used to indicate that the airplane bleed configuration is not compatible with the database and therefore will result in the point being rejected.

A sample of the normal BRIEF output is shown on the following pages. Figure 13 is a sample of output for an EPR engine, and Figure 14 is for an N1 engine.

```
              BOEING AIRPLANE PERFORMANCE MONITORING (APM) PROGRAM
                         VERSION
                            VARIABLES USED FOR ANALYSIS
DATABASE:
  AIRFRAME=7X7-XXX          ENGINE  =XXX-XX-A         CONFIG #=CONFIG50
  DATABASE=DATBAS           VERSION =1.0              REV DATE=12/9/89

          USER INPUTS ARE AS FOLLOWS:

REPORT TITLE:
  AIR-ENG =7X7-XXX          TITLE   =MONTHLY AVERAGE
FILE NAMES:
  CRZFIL  =MONTH.DAT        DEBFIL  =DEBUG,OUT        MASFIL  =MASTER.DAT
  OUTFIL  =MONTH.OUT        SPDFIL  =SPREAD.CSV       TWTFIL  =TWTFIL.DAT
OPTION SWITCHES:
  CG      =NO               DATE    =DD-MM-YY         DEBUG   =NO
  ELASTIC =NO               ENERGY  =NO               FFCAL   =NO
  FLEETAVG=TAIL             GRAVITY =NO               INPUT   =ACMS
  INSTR   =C                LHEATV  =NO
  MASTER  =NO               OUTPUT  =BRIEF            POWERX  =YES
  REYNLD  =YES              SPDSHT  =NO               SPEED   =MACH
  TMPTYP  =TAT              WEIGHT  =A                ADJUSTWT=NO
  PAGEBRK =ANSI
  SPDPRM =AC    ,DATE  ,TDEV  ,PDEV  ,WFDV1 ,WFDV2 ,WFDV3 ,WFDV4 ,WFDEV ,FMDEV ,
          WFDEPR,DSIRF ,
UNITS:
  TEMPUNITIN =C             TEMPUNITOUT=C
  WTUNITIN   =LB            WTUNITOUT  =LB
TOLERANCES:
  EPRHI   = 15.00           FMHI    = 15.0            QUALTOL = 95.0
  EPRLO   =-15.00           FMLO    =-15.0
  TRQDHI  = 15.0            WFHI    = 15.0
  TRQDLO  =-15.0            WFLO    =-15.0
CONSTANTS:
  CGMOM   =         0.      DRGFAC  = 1.000           FFA0    = 0.00000E+00
  FFA1    = 0.00000E+00     FFA2    = 0.00000E+00     FFA3    = 0.00000E+00
  LHVB    = 22777.0         LHVM    =-5220.0          WFFAC   = 1.000

          THE FOLLOWING TABLES HAVE BEEN READ IN:

AERO CLASS TABLES:
  TABLE CDBASE     WAS READ IN.
  TABLE REYNREF    WAS READ IN.
  TABLE CDELAS     WAS READ IN.
FLOE CLASS TABLES:
  TABLE APUWF      WAS READ IN.
  TABLE FNGEN1     WAS READ IN.
  TABLE FBATABCW   WAS READ IN.
  TABLE FBATABM14  WAS READ IN.
  TABLE FBATABM23  WAS READ IN.
  TABLE FBATABR23  WAS READ IN.
  TABLE FBATABTT   WAS READ IN.
  TABLE WFSTAR     WAS READ IN.
  TABLE CGTRIM     WAS READ IN.
  TABLE KTRIM      WAS READ IN.
PROP CLASS TABLES:
  TABLE WFTAB1     WAS READ IN.
```

Figure 11: BRIEF Output Sample (pg1)

```
            THE FOLLOWING VARIABLES HAVE BEEN SET TO:


  REAL VARIABLES:
    ACDF       =   133.6200  APUWF     =   1.0       A0        =  15.00
    A1         =  1.40       BCDF      =   -43.6000  CDBASE    =   1.0
    CDCORR     =   0.0       CDELAS    =   1.0       CDREYN    =   0.0
    CGCORR     =   0.0       DEGCOR    =  -2.0       DEGCRGO   =   1.0
    DEGECSBLD=    1.0        DEGECSFN  =   1.0       DEGECSWF  =   1.0
    DEGELS     =   1.0       DEGRN     =   2.0       DEGTHAEXP=    1.0
    DFACT      =   1.000     DEGBASE   =   6.0       EDELT1    =   1.000
    EDELT2     =   0.000     ETHET1    =   0.620     ETHET2    =   0.000
    FACWF1     =  0.9925     FFFAC1    =  1.0025     FFFAC2    =  1.0050
    FFFAC3     =  1.0070     FNBLDC    =   0.0       FNGEN1    =   1.0
    FNGEN2     =   0.0       FNGEN31   =   0.0       FNGEN32   =   0.0
    FNGNA1     =   0.0       FNGNA2    =   0.0       FNSURGA   =   0.0
    FNSURGB    =   0.0       LEMAC     =  1258.0     MAC       =  327.8
    NOMHP      =  55.0       REFCG     =  0.200      REYNREF   =   1.0
    SPAN       =  195.7      SW        =  5500.0     TBCORE    =   0.0
    TBCR1D     =   0.0       TBCR2D    =   0.0       WFLAM1    =   0.0
    WFLAM2     =   0.0       WFTAB1    =   1.0       WFTAB2    =   0.0
    WTFULL1    =        0.   WTFULL2   =       0.    ZNE1      =   4.0
    ZNE2       =   0.0
  CHARACTER VARIABLES:
    BLDORD     = CDEABFG     CRTYPC    =             CRTYPD    =
    CRTYPE     =             CRTYPF    =             DCDCOR    = NO
    DELRAT1    = TOTAL       DELRAT2   = TOTAL       DOSURGA   = NO
    DOSURGB    = NO          DOBLDC    = NO          DOBLDD    = NO
    DOBLDE     = NO          DOBLDF    = NO          DOECSBLD  = NO
    DOELAS     = YES         DORNCOR   = CURVE       DOTHAEXP  = NO
 THE FOLLOWING VARIABLES HAVE BEEN SET TO:
```

Figure 12: BRIEF Output Sample (pg2)

BOEING AIRPLANE PERFORMANCE MONITORING PROGRAM
REPORT TITLE MONTHLY AVERAGE

PERFORMANCE ANALYSIS FOR AIRPLANE ACFT00201
MODEL 7X7-XXX ENGINE XXX-XX-A
SPEED PARAMETER TO BASE ANALYSIS - MACH
INSTRUMENTS USED FOR ANALYSIS - C

DATE DD-MM-YY	FLT#	FLT LVL	CAS	TAT C	GW LB	MACH	EPR AVG	FUEL FLOW	EPR REQ'D	%THRST REQ'D	%FUEL FLOW	%FM	QUAL
18-05-88	BOEINGXX	330	286	-14	571.0	.803	1.141	4902	0.001	0.1	0.6	-0.7	32
18-05-88	BOEINGXX	340	297	-14	667.5	.848	1.358	5777	0.117	14.9	-11.9	-0.9	86
18-05-88	BOEINGXX	350	280	-18	684.7	.820	1.510	5063	*	*	*	*	WF
18-05-88	BOEINGXX	356	284	-19	708.3	.841	1.312	6171	-.063	-6.4	8.8	-1.8	46
18-05-88	BOEINGXX	334	318	-8	635.7	.740	1.063	6755	*	*	*	*	EPR
18-05-88	BOEINGXX	324	324	-6	585.9	.889	1.321	6516	0.098	12.9	-9.5	-2.0	84
18-05-88	BOEINGXX	303	342	1	559.5	.893	1.211	7007	0.015	2.3	-0.9	-1.3	79
18-05-88	BOEINGXX	305	301	-8	550.7	.801	1.090	5629	-.002	-0.5	12.8	-11.0	92
18-05-88	BOEINGXX	308	240	-19	544.3	.653	1.267	4440	*	*	*	*	THR
18-05-88	BOEINGXX	273	345	5	540.5	.851	1.110	6306	0.029	6.3	-4.2	-0.9	57
18-05-88	BOEINGXX	279	235	-15	524.3	.603	1.096	4056	0.013	4.2	-0.4	-2.5	87
18-05-88	BOEINGXX	336	318	-13	635.7	.739	1.173	6592	*	*	*	*	FM
18-05-88	BOEINGXX	302	345	2	559.5	.897	1.211	7034	-.007	-1.0	-1.7	2.7	74
18-05-88	BOEINGXX	305	302	-8	550.7	.807	1.110	5632	*	*	*	*	QLT
AVERAGE DEVIATION FROM BOOK PERFORMANCE									0.022	3.6	-0.7	-2.0	
STANDARD DEVIATION									0.055	6.8	7.8	3.7	

* - DENOTES NOT USED IN AVERAGE CALCULATION
(ACCEPTABLE TOLERANCE RANGE EXCEEDED)

Figure 13: BRIEF Output Sample EPR Engine

DATE DD-MM-YY	FLT#	FLT LVL	CAS	TAT C	GW LB	MACH	%N1 AVG	FUEL FLOW	%N1 REQ'D	%THRST REQ'D	%FUEL FLOW	%FM	QUAL
18-05-88	BOEINGXX	410	257	-25	551.2	.859	97.8	5259	2.76	9.4	-1.0	-7.9	27
18-05-88	BOEINGXX	450	233	-21	396.8	.856	93.4	3773	0.94	4.0	1.4	-5.0	84
18-05-88	BOEINGXX	450	232	-21	390.0	.855	92.8	3700	*	*	*	*	BLD
18-05-88	BOEINGXX	420	246	-26	418.9	.856	90.9	3921	1.11	5.2	-0.8	-3.8	78
18-05-88	BOEINGXX	450	234	-25	485.0	.859	101.8	4965	3.71	9.8	0.2	-10.0	40
18-05-88	BOEINGXX	390	253	-28	396.8	.815	86.3	3495	0.62	3.3	-3.5	0.9	60
18-05-88	BOEINGXX	390	269	-25	639.3	.859	100.3	6248	3.34	9.7	-0.3	-9.4	31
18-05-88	BOEINGXX	354	300	-19	617.3	.840	90.5	5617	*	*	*	*	QLT
18-05-88	BOEINGXX	390	269	-25	617.3	.859	98.4	5875	2.91	9.5	-0.8	-8.2	87
18-05-88	BOEINGXX	290	306	-14	551.2	.789	85.5	5148	0.31	1.6	2.0	-3.3	64
18-05-88	BOEINGXX	290	297	-15	507.1	.768	83.8	4768	0.43	2.1	1.8	-3.5	82
18-05-88	BOEINGXX	290	285	-17	463.0	.740	81.9	4361	0.69	3.4	1.3	-3.9	73
18-05-88	BOEINGXX	290	271	-20	418.9	.705	79.7	3961	1.00	5.1	1.1	-4.6	70
AVERAGE DEVIATION FROM BOOK PERFORMANCE									1.62	5.7	0.1	-5.3	
STANDARD DEVIATION									1.28	3.3	1.6	3.2	

Figure 14: BRIEF Output Sample %N1 Engine

```
                   BOEING APM PROGRAM
                      FLEET SUMMARY

 MODEL = 7X7-XXX        ENGINE = XXX-XX-A

AIRCRAFT    #PTS DATE      DATE         EPR     %THRST    %FUEL    %FM
IDENT.           FROM      TO           REQD     REQD      FLOW    REQD
NUMBER            (DD-MM-YY)
-----------------------------------------------------------------------
ACFT00201    4   01-01-88  01-03-88     0.002    0.5       1.6     -2.0
ACFT00202    3   01-01-88  01-06-88     0.003   -0.1       1.0     -0.9
ACFT00203    3   01-01-88  01-01-88    -0.001   -0.2       0.8     -0.7
ACFT00204    1   15-01-88  15-01-88     0.012    2.9       0.5     -2.5
                                       --------------------------------
FLEET AVERAGE  (AIRCRAFT AVG.)          0.004    0.8       1.0     -1.5
                                       --------------------------------
FLEET STANDARD DEVIATION                0.010    1.0       1.4      1.8
```

Figure 15: APM Fleet Summary Page

5.2 DETAIL Tabular Output Description

As with the BRIEF output option, three types of output pages are produced: input specification pages, page(s) of deviation results, and the fleet summary. Only the point-by-point deviation results pages differ in format and content from the BRIEF output. A sample of this point-by-point deviations page is shown on the following page.

The DETAIL output includes the parameters of the BRIEF output along with several additional input parameters. The LAT as stated on the sample DETAIL output is shown as a "north" or "south" latitude. The DSIRF gives latitude as +/- 90 degrees, not north or south. The program assigns a value of north if the latitude is positive. The tolerance handling characteristics of the DETAIL output are the same as for the BRIEF.

PERFORMANCE ANALYSIS FOR AIRPLANE ACFT00201
MODEL 7X7-XXX ENGINE XXX-XX-A
SPEED PARAMETER TO BASE ANALYSIS - MACH
INSTRUMENTS USED FOR ANALYSIS - C

DATE DD-MM-YY	FLT#	DEPTDEST	FLT LVL	CAS	TAT C	GW LB	MACH	EPR AVG	FUEL FLOW	LAT	CG %MAC	GEN LOAD	LHV CALC	DVG/DT	DHP/DT	EPR REQ'D	%THRST REQ'D	%FUEL FLOW	%FM	QUAL
18-05-88	BOEINGXX	DEPTDEST	330	286	-14	571.0	.803	1.141	4902	29N	20.0	30.5	18580.	-0.007	-0.298	0.001	0.1	0.6	-0.7	32
18-05-88	BOEINGXX	DEPTDEST	340	297	-14	667.5	.848	1.358	5777	29N	20.0	32.2	18580.	0.002	0.104	0.117	14.9	-11.9	-0.9	86
18-05-88	BOEINGXX	DEPTDEST	350	280	-18	684.7	.820	1.510	5763	30N	20.0	32.2	18580.	-0.002	-0.086	*	*	*	*	THR
18-05-88	BOEINGXX	DEPTDEST	356	284	-19	708.3	.841	1.312	6171	30N	20.0	29.5	18580.	0.003	0.120	-.063	-6.4	8.8	-1.8	46
18-05-88	BOEINGXX	DEPTDEST	334	318	-8	635.7	.740	1.163	6755	29N	20.0	32.2	18580.	0.002	0.122	*	*	*	*	FM
18-05-88	BOEINGXX	DEPTDEST	324	324	-6	585.9	.889	1.321	6516	30N	20.0	30.2	18580.	-0.001	-0.065	0.098	12.9	-9.5	-2.0	84
18-05-88	BOEINGXX	DEPTDEST	303	342	1	559.5	.893	1.211	7007	30N	20.0	32.5	18580.	-0.005	-0.237	0.015	2.3	-0.9	-1.3	79
18-05-88	BOEINGXX	DEPTDEST	305	301	-8	550.7	.801	1.090	5629	29N	20.0	33.0	18580.	-0.011	-0.471	-.002	-0.5	12.8	-11.0	92
18-05-88	BOEINGXX	DEPTDEST	308	240	-19	544.3	.653	1.267	4440	29N	20.0	33.2	18580.	-0.002	-0.056	*	*	*	*	THR
18-05-88	BOEINGXX	DEPTDEST	273	345	5	540.5	.851	1.110	6306	30N	20.0	28.5	18580.	-0.005	-0.227	0.029	6.3	-4.2	-0.9	57
18-05-88	BOEINGXX	DEPTDEST	279	235	-15	524.3	.603	1.096	4056	30N	20.0	28.5	18580.	0.003	0.300	0.013	4.2	-0.4	-2.5	87
18-05-88	BOEINGXX	DEPTDEST	336	318	-13	635.7	.739	1.173	6592	29N	20.0	32.2	18580.	0.002	0.122	*	*	*	*	FM
18-05-88	BOEINGXX	DEPTDEST	302	345	2	559.5	.897	1.211	7034	30N	20.0	32.5	18580.	-0.005	-0.237	-.007	-1.0	-1.7	2.7	74
18-05-88	BOEINGXX	DEPTDEST	305	302	-8	550.7	.807	1.110	5632	29N	20.0	33.0	18580.	-0.011	-0.471	*	*	*	*	QLT
AVERAGE DEVIATION FROM BOOK PERFORMANCE																0.022	3.6	-0.7	-2.0	
STANDARD DEVIATION																0.055	6.8	7.8	3.7	

* - DENOTES NOT USED IN AVERAGE CALCULATION
(ACCEPTABLE TOLERANCE RANGE EXCEEDED)

DATE DD-MM-YY	FLT#	DEPTDEST	FLT LVL	CAS	TAT C	GW LB	MACH	%N1 AVG	FUEL FLOW	LAT	CG %MAC	GEN LOAD	LHV CALC	DVG/DT	DHP/DT	%N1 REQ'D	%THRST REQ'D	%FUEL FLOW	%FM	QUAL
18-05-88	BOEINGXX	DEPTDEST	410	25.	-25	551.2	.859	97.8	5259	45N	20.0	94.5	18580.	0.020	0.500	2.76	9.4	-1.0	-7.9	27
18-05-88	BOEINGXX	DEPTDEST	450	233	-21	396.8	.856	93.4	3773	47N	20.0	94.5	18580.	0.020	0.500	0.94	4.0	1.4	-5.0	84
18-05-88	BOEINGXX	DEPTDEST	420	246	-26	418.9	.856	90.9	3921	49N	20.0	94.5	18580.	0.020	0.500	1.11	5.2	-0.8	-3.8	78
18-05-88	BOEINGXX	DEPTDEST	450	234	-25	485.0	.859	101.8	4965	52N	20.0	94.5	18580.	0.020	0.500	3.71	9.8	0.2	-10.0	40
18-05-88	BOEINGXX	DEPTDEST	390	253	-28	396.8	.815	86.3	3495	43N	20.0	94.5	18580.	0.020	0.500	0.62	3.3	-3.5	0.9	60
18-05-88	BOEINGXX	DEPTDEST	390	269	-25	639.3	.859	100.3	6248	47N	20.0	94.5	18580.	0.020	0.500	3.34	9.7	-0.3	-9.4	31
18-05-88	BOEINGXX	DEPTDEST	354	300	-19	617.3	.840	90.5	5617	46N	20.0	94.5	18580.	0.020	0.500	*	*	*	*	QLT
18-05-88	BOEINGXX	DEPTDEST	390	269	-25	617.3	.859	98.4	5875	57N	20.0	94.5	18580.	0.020	0.500	2.91	9.5	-0.8	-8.2	87
18-05-88	BOEINGXX	DEPTDEST	290	306	-14	551.2	.789	85.5	5148	45N	20.0	94.5	18580.	0.020	0.500	0.31	1.6	2.0	-3.3	64
18-05-88	BOEINGXX	DEPTDEST	290	297	-15	507.1	.768	83.8	4768	47N	20.0	94.5	18580.	0.020	0.500	0.43	2.1	1.8	-3.5	82
18-05-88	BOEINGXX	DEPTDEST	290	285	-17	463.0	.740	81.9	4361	49N	20.0	94.5	18580.	0.020	0.500	0.69	3.4	1.3	-3.9	73
18-05-88	BOEINGXX	DEPTDEST	290	271	-20	418.9	.705	79.7	3961	52N	20.0	94.5	18580.	0.020	0.500	1.00	5.1	1.1	-4.6	70
AVERAGE DEVIATION FROM BOOK PERFORMANCE																1.62	5.7	0.1	-5.3	
STANDARD DEVIATION																1.28	3.3	1.6	3.2	

Figure 16: DETAIL Output Sample

5.3 DETAIL2 Tabular Output Description

As with the BRIEF and DETAIL output options, three types of output pages are produced: input specification pages, page(s) of deviation results, and the fleet summary. The point-by-point deviation pages and the fleet summary page differ in format and content from the BRIEF and DETAIL output formats. A sample of the DETAIL2 point-by-point deviations page as well as the fleet summary page is shown on the following two pages.

The DETAIL2 is the same as the DETAIL output except that it includes the individual engine fuel flow deviations in lieu of the following parameters:

LAT, CG %MAC, GEN LOAD, LHV CALC, DVG/DT, DHP/DT

In addition to the point-by-point deviation page difference, the summary page includes the averages of the individual engine deviations.

```
                                                                                    BOEING AIRPLANE PERFORMANCE MONITORING
PROGRAM
                                        REPORT TITLE   MONTHLY AVERAGE

                                        PERFORMANCE ANALYSIS FOR AIRPLANE ACFT000XX
                                        MODEL 7X7-XXX          ENGINE XXX-XX-A          ENG SERIAL NUMBERS
                                        SPEED PARAMETER TO BASE ANALYSIS - MACH          000001    000002
                                        INSTRUMENTS USED FOR ANALYSIS    - C             000003    000004

  DATE    FLT#      DEPTDEST FLT CAS TAT  GW    MACH  %N1   FUEL  %N1   %THRST %FUEL  %FM    %FF   %FF   %FF   %FF QUAL
DD-MM-YY                     LVL      C   KG          AVG   FLOW  REQ'D  REQ'D  FLOW         ENG1  ENG2  ENG3  ENG4
--------------------------------------------------------------------------------------------------------------------------
18-10-02 XX0981              290 306   2 272.5 .790  93.8  2656   0.08   0.4   5.2  -5.2    5.4   3.5   3.6   8.2  90
19-10-02 XX0981              370 277 -17 252.0 .848  96.8  2372  -0.01   0.0   4.6  -4.4    5.1   3.2   4.4   5.7  90
02-10-03 XX0984              390 269 -21 250.5 .860  98.5  2358  -1.30  -4.2   5.0  -0.7    6.5   3.7   4.7   5.1  90
03-10-03 XX0985              370 281 -16 283.7 .858 100.3  2652  -1.18  -3.7   3.8   0.0    3.5   3.8   3.9   3.9  90
03-10-03 XX0980              390 269 -22 257.7 .859  99.4  2412  -1.06  -3.3   4.0  -0.6    5.4   3.2   2.3   4.9  90
03-10-03 XX0981              330 305  -6 310.7 .851  99.4  2978   0.21   0.8   3.8  -4.3    4.4   3.1   3.9   3.6  90
04-10-03 XX0981              370 279 -16 258.0 .853  97.4  2399  -0.53  -1.9   3.5  -1.7    2.9   3.2   3.5   4.4  90
04-10-03 XX0984              310 318   0 324.0 .849  99.3  3141   0.37   1.4   3.3  -4.4    4.5   4.2   2.9   1.7  90
05-10-03 XX0984              350 294 -18 304.3 .857  99.9  2888   0.09   0.3   3.6  -3.7    3.0   4.1   2.7   4.4  90
05-10-03 XX0984              330 304  -7 306.0 .849  98.9  2908   0.42   1.6   2.8  -4.1   -0.1   4.2   3.1   3.8  90
06-10-03 XX0980              350 285 -11 253.2 .833  95.3  2331  -0.16  -0.7   2.9  -2.2    4.7   1.6   0.1   5.2  90
07-10-03 XX0981              370 281 -14 260.3 .858  98.3  2464  -0.69  -2.4   3.4  -1.1    4.6   3.1   1.8   4.1  90
07-10-03 XX0981              410 255 -27 248.5 .854 100.4  2313  -1.47  -3.8   4.7  -0.6    5.1   4.3   5.1   4.5  90
07-10-03 XX0982              350 292  -9 286.4 .852  99.4  2742   0.12   0.4   3.6  -3.9    1.9   3.2   3.1   6.3  90
                                                               ------------------------------------------------
                    AVERAGE DEVIATION FROM BOOK PERFORMANCE   -0.36  -1.1   3.9  -2.6    4.1   3.5   3.2   4.7
                    STANDARD DEVIATION                         0.66   2.1   0.8   1.8    1.7   0.7   1.3   1.5
```

Figure 17: DETAIL2 Output Sample

```
                    BOEING APM PROGRAM
                       FLEET SUMMARY

MODEL = 7X7-XXX             ENGINE = XXX-XX-A

AIRCRAFT   #PTS   DATE      DATE       %N1     %THRST  %FUEL   %FM     %FF   %FF   %FF   %FF
IDENT.            FROM      TO         REQD    REQD    FLOW            ENG1  ENG2  ENG3  ENG4
NUMBER              (DD-MM-YY)
----------------------------------------------------------------------------------------------
ACFT000XX    14   18-10-02 07-10-03   -0.36    -1.1     3.9    -2.6    4.1   3.5   3.2   4.7
                                     ------------------------------
FLEET AVERAGE    (AIRCRAFT AVG.)      -0.36    -1.1     3.9    -2.6
                                     ------------------------------
FLEET STANDARD DEVIATION              99.00    99.0    99.0    99.0
```

Figure 18: DEATIL2 Output Sample (pg2)

5.4 Spreadsheet Output Description

This output option creates a comma delimited file which can be opened directly with a spreadsheet application. One can sort and/or plot the data in any way desired using the spreadsheet application of their choice. This file is customizable as to content and order of output parameters. The default file name is SPREAD.CSV. The CSV extension allows the user to open the file in a spreadsheet application.

To invoke the spreadsheet option the following keywords and values are required in the APMINP file:

`SPDSHT=YES` *or* `APPEND`

`SPDPRM=`{ *parameter list* }

`SPDFIL=`{ *spreadsheet file name* } Recommend using CSV file extension

Setting `SPDSHT=YES` will create a new spreadsheet file overwriting any existing files of the same name. If `SPDSHT=APPEND,` the program will append the new data points to the bottom of any previously run data in the spreadsheet file. It is important to use the same parameter list as in previously run data to ensure that the columns match.

The parameter list specifies the desired input or output values to be included in the spreadsheet file. The order in which the values are presented in the output file is entirely up to the user and will follow the order in the parameter list.

Table 8: SPDPRM Parameter Descriptions

SPDPRM PARAMETERS	DESCRIPTION
AC	Aircraft Identification
DATE	YYYY/MM/DD
TIME	HHMMSS
FN	Flight Number
DEPDST	Departure & Destination
FL	Flight Level
CAS	Calibrated Airspeed
TAS	True Airspeed
GS	Ground Speed
TAT	Total Air Temperature
GW	Gross Weight (1000 LB or KG)
M	Mach Number
PAVG	Power Setting (Average)
LAT	Latitude

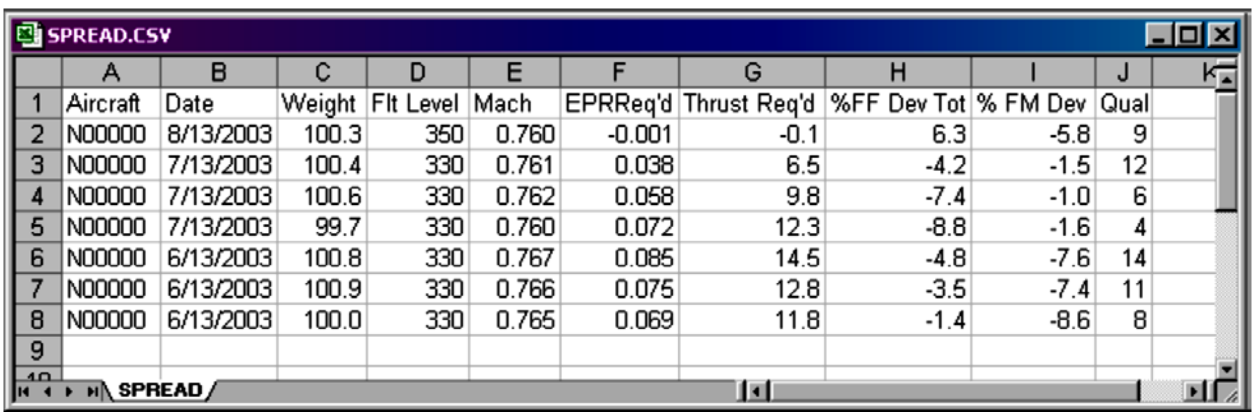
SPDPRM PARAMETERS	DESCRIPTION
CG	Center of Gravity (%MAC)
GEN	Generator Load (% of Max)
LHV	Fuel heating value
DV	Horizontal Acceleration
DH	Rate of climb / descent
PDEV	Power setting deviation
TDEV	Thrust deviation
WFDEPR	Fuel flow deviation due to EPR/N1deviation
FNB	Book thrust per engine
FNODB	Book thrust / δ per engine
FNOD1	Thrust / δ for engine 1
FNOD2	Thrust / δ for engine 2
FNOD3	Thrust / δ for engine 3
FNOD4	Thrust / δ for engine 4
FN1	Thrust for engine 1
FN2	Thrust for engine 2
FN3	Thrust for engine 3
FN4	Thrust for engine 4
WFBK1	Book value of fuel flow for engine 1
WFDV1	Fuel flow deviation for engine 1
WFBK2	Book value of fuel flow for engine 2
WFDV2	Fuel flow deviation for engine 2
WFBK3	Book value of fuel flow for engine 3
WFDV3	Fuel flow deviation for engine 3
WFBK4	Book value of fuel flow for engine 4
WFDV4	Fuel flow deviation for engine 4
WF	Total observed fuel flow
WFBKT	Book value of total fuel flow
WFDEV	Fuel flow deviation

SPDPRM PARAMETERS	DESCRIPTION
FM	Actual fuel mileage
FMBK	Book value of fuel mileage
FMDEV	Fuel mileage deviation
QLT	DFDAU calculated quality factor
WOD	Weight / δ
SN1	Serial number of engine 1
SN2	Serial number of engine 2
SN3	Serial number of engine 3
SN4	Serial number of engine 4
DSIRF	Entire input DSIRF recordAlways in last column of output

These parameters can be listed all in one line of the APMINP file or separated into several lines by adding a plus (+) sign at the end of each line as a continuation character.

```
SPDPRM=AC,DATE,GW,FL,M,+
PDEV,TDEV,WFDEV,FMDEV,+
QLT
```

This would result in the following spreadsheet:


SPREAD.CSV

	A	B	C	D	E	F	G	H	I	J
1	Aircraft	Date	Weight	Flt Level	Mach	EPRReq'd	Thrust Req'd	%FF Dev Tot	% FM Dev	Qual
2	N00000	8/13/2003	100.3	350	0.760	-0.001	-0.1	6.3	-5.8	9
3	N00000	7/13/2003	100.4	330	0.761	0.038	6.5	-4.2	-1.5	12
4	N00000	7/13/2003	100.6	330	0.762	0.058	9.8	-7.4	-1.0	6
5	N00000	7/13/2003	99.7	330	0.760	0.072	12.3	-8.8	-1.6	4
6	N00000	6/13/2003	100.8	330	0.767	0.085	14.5	-4.8	-7.6	14
7	N00000	6/13/2003	100.9	330	0.766	0.075	12.8	-3.5	-7.4	11
8	N00000	6/13/2003	100.0	330	0.765	0.069	11.8	-1.4	-8.6	8
9										

SPREAD

Another option for the SPDPRM keyword is to specify a file name (bracketed by “&”). The specified file would then contain the desired output parameters as in the following example.

```
SPDPRM=&PARAM.TXT&
```

The file PARAM.TXT would contain lines like this:

```
AC,DATE,GW,FL,M,+
PDEV,TDEV,WFDEV,FMDEV,+
QLT
```

Note: If the spreadsheet option is invoked, but no parameter list is specified, the following default parameter list is used.

```
AC,DATE,TDEV,PDEV,WFDV1,WFDV2,WFDV3,WFDV4,WFDEV,FMDEV,WFDEPR,DSIRF
```

5.5 MASTER Output Description

The tabular output formats (BRIEF, DETAIL and DETAIL2) may not satisfy the desires of all airline customers. Certain operators may wish to produce a "customized" output report or use some post-process with APM data. To accommodate this, an option of writing output data to a MASTER file containing all the deviation results, pertinent input parameters, and some intermediate computation results has been provided. The User Input keyword MASTER=YES will turn on this option.

Care should be taken as the MASTER option can generate very large files (i.e. each cruise data point will generate 31 lines of data). The sequence of data is: error code, error text, model and engine, deviations, DSIRF, and calculated parameters. A list of the parameters according to their sequence is shown on the pages that follow. The format for each line and associated parameter sequence number is presented on Section 5.5.2. A sample of a generic MASTER file is shown beginning on Section 5.5.3. Readers should refer to the specific model appendices (Appendix D and subsequent) for the definition of the MASTER file for specific airplanes.

A temporary file named APMTMP is created when program execution is started. If the program terminates normally, the file is deleted. If however, the program is terminated by the system, or abnormally, the file will remain. The contents of this file are identical to the MASTER file, as this is the temporary MASTER file. It is rewound and copied to the MASTER filename when the program is finished. If the program terminates abnormally, and the user wishes to look at the MASTER file contents, inspect the APMTMP file.

If the program has trouble loading the database or reading the APMINP, a MASTER file is generated and given the default filename MASTER. This was done to cover the contingency of execution termination prior to having read APMINP. If an error occurs in the database and input controller, the resulting MASTER file will reveal the source of the error. This error will also be written to the error file (or the screen depending on computing system). If the user does not want to use the MASTER file, it may be disregarded.

To summarize, the table below explains the different scenarios:

MODULE WHERE ERROR OCCURRED	NORMAL TERMINATION	ABNORMAL TERMINATION
Database and Input Controller	MASTER	APMTMP
APM Option Routines	as specified in APMINP or default filename	APMTMP

5.5.1 List of Parameters Contained in MASTER File

NOTE: This list is for a **generic** Master File. See specific model appendices for specific airplanes. The error code and text:

1	Error Code
2	Error Text
3	Model
4	Engine

The Deviations are as follows:

5	Thrust Deviation
6	Power Setting Deviation
7	Fuel Flow Deviation Engine 1
8	Fuel Flow Deviation Engine 2
9	Fuel Flow Deviation Engine 3
10	Fuel Flow Deviation Engine 4
11	Average Fuel Flow Deviation
12	Fuel Mileage Deviation
13	Fuel flow Deviation Due To Power Deviation

The Header is as follows:

14	Airplane Identification Number
15	Airplane Serial Number
16	Flight Number
17	Depart/Destination
18	Day
19	Month
20	Year
21	Time - Hrs
22	Time - Min
23	Time - Sec

24	Variable Header 1
25	Variable Header 2

The following are parameters used by the program for analysis:

26	Mach, ADC L
27	Mach, ADC R
28	Mach, ADC C
29	IAS/CAS, ADC L
30	IAS/CAS, ADC R
31	IAS/CAS, ADC C
32	TAT, ADC L
33	TAT, ADC R
34	TAT, ADC C
35	Pressure Alt, ADC L
36	Pressure Alt, ADC R
37	Pressure Alt, ADC C
38	Gross Weight FMC L
39	Gross Weight FMC R
40	Gross Weight FMC C
41	Fuel Flow Engine 1
42	Fuel Flow Engine 2
43	Fuel Flow Engine 3
44	Fuel Flow Engine 4
45	Power Setting Engine 1
46	Power Setting Engine 2
47	Power Setting Engine 3
48	Power Setting Engine 4
49	Calculated Quality Factor
50	Ground Speed FMC L
51	Ground Speed FMC R
52	Ground Speed FMC C
53	Bleed Config. Discrete 1
54	Bleed Config. Discrete 2
55	Bleed Config. Discrete 3
56	Bleed Config. Discrete 4
57	Bleed Config. Discrete 5
58	Bleed Config. Discrete 6
59	Bleed Config. Discrete 7
60	Bleed Config. Discrete 8
61	Bleed Config. Discrete 9

62	Bleed Config. Discrete 10
63	Bleed Config. Discrete 11
64	Bleed Config. Discrete 12
65	Bleed Config. Discrete 13
66	Bleed Config. Discrete 14
67	Present Position Latitude FMC L
68	Present Position Latitude FMC R
69	Present Position Latitude FMC C
70	Present Position Longitude FMC L
71	Present Position Longitude FMC R
72	Present Position Longitude FMC C
73	True Heading FMC L
74	True Heading FMC R
75	True Heading FMC C
76	Drift Angle FMC L
77	Drift Angle FMC R
78	Drift Angle FMC C
79	True Track Angle FMC L
80	True Track Angle FMC R
81	True Track Angle FMC C
82	Calculated dHp/dt
83	Calculated dVg/dt
84	Inertial Vertical Velocity IRU L
85	Inertial Vertical Velocity IRU R
86	Inertial Vertical Velocity IRU C
87	Fuel Density
88	Fuel Temperature
89	Fuel Quantity Tank 1
90	Fuel Quantity Tank 2
91	Fuel Quantity Tank 3
92	Fuel Quantity Tank 4
93	Fuel Quantity Tank 5
94	Fuel Quantity Tank 6
95	Fuel Quantity Tank 7
96	Fuel Quantity Tank 8
97	Fuel Used Engine 1
98	Fuel Used Engine 2
99	Fuel Used Engine 3
100	Fuel Used Engine 4
101	APU Operating Time

102	Generator Load Engine 1
103	Generator Load Engine 2
104	Generator Load Engine 3
105	Generator Load Engine 4
106	Initial Gross Weight FMC L
107	Initial Gross Weight FMC R
108	Initial Gross Weight FMC C
109	Initial CG FMC L
110	Initial CG FMC R
111	Initial CG FMC C
112	Initial zero Fuel Weight FMC L
113	Initial Zero Fuel Weight FMC R
114	Initial Zero Fuel Weight FMC C
115	Initial Fuel Quantity Tank 1
116	Initial Fuel Quantity Tank 2
117	Initial Fuel Quantity Tank 3
118	Initial Fuel Quantity Tank 4
119	Initial Fuel Quantity Tank 5
120	Initial Fuel Quantity Tank 6
121	Initial Fuel Quantity Tank 7
122	Initial Fuel Quantity Tank 8
123	Serial Number Engine 1
124	Serial Number Engine 2
125	Serial Number Engine 3
126	Serial Number Engine 4
127	Calculated Gross Weight
128	Calculated Center of Gravity Position
129	Calculated Fuel Lower Heat Value
130	%N1 Engine 1
131	%N1 Engine 2
132	%N1 Engine 3
133	%N1 Engine 4
134	%N2 Engine 1
135	%N2 Engine 2
136	%N2 Engine 3
137	%N2 Engine 4
138	%N3 Engine 1 (RR Only)
139	%N3 Engine 2 (RR Only)
140	%N3 Engine 3 (RR Only)
141	%N3 Engine 4 (RR Only)

142	EGT Engine 1
143	EGT Engine 2
144	EGT Engine 3
145	EGT Engine 4
146	Turb. Case Cool Eng 1 (P&W Only)
147	Turb. Case Cool Eng 2 (P&W Only)
148	Turb. Case Cool Eng 3 (P&W Only)
149	Turb. Case Cool Eng 4 (P&W Only)
150	SAT, ADC L
151	SAT, ADC R
152	SAT, ADC C
153	Indicated Angle of Attack, ADC L
154	Indicated Angle of Attack, ADC R
155	Indicated Angle of Attack, ADC C
156	Roll Angle, ADC L
157	Roll Angle, ADC R
158	Roll Angle, ADC C
159	Pitch Attitude, ADC L
160	Pitch Attitude, ADC R
161	Pitch Attitude, ADC C
162	Stabilizer Position
163	Spoiler Position Left
164	Spoiler Position Right
165	HS Aileron Left
166	HS Aileron Right
167	LS Aileron Left
168	LS Aileron Right
169	Rudder Upper
170	Rudder Lower
171	Inboard Elevator Position Left
172	Inboard Elevator Position Right
173	Outboard Elevator Position Left
174	Outboard Elevator Position Right
175	Trailing Edge Flap Left Outboard
176	Trailing Edge Flap Right Outboard
177	Trailing Edge Flap Left Inboard
178	Trailing Edge Flap Right Inboard
179	Along TK Horiz Accel IRU L
180	Along TK Horiz Accel IRU R
181	Along TK Horiz Accel IRU C

182	Flight Path Accel IRU L
183	Flight Path Accel IRU R
184	Flight Path Accel IRU C
185	Vertical Accel IRU L
186	Vertical Accel IRU R
187	Vertical Accel IRU C
188	Calculated dIVV/dt
189	Fuel Imbalance Roll Moment
190	Angle of Sideslip
191 to 219.	Open for DSIRF expansion

The following parameters are calculated variables in the program and are presented in the MASTER file for inspection or subsequent analysis.

220	Corrected Gross weight
221	Lift Coefficient
222	Cd Basic
223	Cd Reynolds
224	CG Position
225	Cd Center of Gravity
226	Cd Elasticity
227	Cd Total
228	Delta Drag - Acceleration
229	Total Drag
230	Drag/Delta
231	Thrust Engine 1
232	Thrust Engine 2
233	Thrust Engine 3
234	Thrust Engine 4
235	Total Thrust
236	Book Power Setting (Eng. Type 1)
237	Book Power Setting (Eng. Type 2)
238	Average Power Setting
239	Corrected Book Fuel Flow Engine 1
240	Corrected Book Fuel Flow Engine 2
241	Corrected Book Fuel Flow Engine 3
242	Corrected Book Fuel Flow Engine 4
243	Fuel Flow Factor
244	LHV Ratio Fuel Flow Factor
245	Power Extraction Fuel Flow Factor
246	Observed Fuel Flow Total

247	Book Fuel Flow Total
248	True Airspeed (TAS)
249	Book Fuel Mileage
250	Observed Fuel Mileage
251	Instrument Source
252	Speed Type

5.5.2 MASTER File Format and Contents

The first character of each line was reserved for FORTRAN carriage control.

LINE #	PARAMETERS	FORMAT
1	1-4	(1X,I7,1X,A80,1X,A16,1X,A16/
2	5-13	1X,9(F13.5,1X)/
3	14-23	1X,A54/
4	24-25	1X,2A40/
5	26-34	1X,9(F13.5,1X)/
6	35-43	1X,9(F13.5,1X)/
7	44-52	1X,9(F13.5,1X)/
8	53-61	1X,9(F13.5,1X)/
9	62-70	1X,9(F13.5,1X)/
10	71-79	1X,9(F13.5,1X)/
11	80-88	1X,9(F13.5,1X)/
12	89-97	1X,9(F13.5,1X)/
13	98-106	1X,9(F13.5,1X)/
14	107-115	1X,9(F13.5,1X)/
15	116-122	1X,7(F13.5,1X)/
16	123-126	1X,4(A8,1X)/
17	127-135	1X,9(F13.5,1X)/
18	136-144	1X,9(F13.5,1X)/
19	145-153	1X,9(F13.5,1X)/
20	154-162	1X,9(F13.5,1X)/
21	163-171	1X,9(F13.5,1X)/
22	172-180	1X,9(F13.5,1X)/
23	181-189	1X,9(F13.5,1X)/

24	190-198	1X,9(F13.5,1X)/
25	199-207	1X,9(F13.5,1X)/
26	208-216	1X,9(F13.5,1X)/
27	217-219	1X,3(F13.5,1X)/
28	220-228	1X,9(F13.5,1X)/
29	229-237	1X,9(F13.5,1X)/
30	238-246	1X,9(F13.5,1X)/
31	247-253	1X,5(F13.5,1X),A16,1X,A16)

5.5.3 MASTER Output Sample

Several sample MASTER files are presented here to clarify the different forms the MASTER file can take.

The first page contains a MASTER file from an APM run where the first point runs successfully and the second is rejected by the EPR deviation tolerance (as denoted by the error code 123053 and error text EPR). Note that the deviations and calculated variables are left out of the rejected point's MASTER output.

The next page contains a sample from a more critical error. In this case a fuel balance arm table was requested, but not loaded. This appears as an error code 105005 and error text of CENTER WING FUEL BALANCE ARM TABLE - NOT FOUND. This error terminates the program.

```
         0                                                                    7X7-XXX       XXX-XX-A
         0.36422     0.00262     4.01685     4.28359     3.09517     2.59380     3.49768      -3.70353
APM          AC001       BCA800   SEA-LAX 10111990
VARIABLE HEADER ONE HERE               VARIABLE HEADER TWO HERE
         0.85900     0.86000     0.00000   289.00000   289.00000     0.00000   -13.10000   -13.10000     0.00000
     35635.00000 35636.00000     0.00000620885.00000620885.00000     0.00000  5616.00000  5616.00000  5552.00000
      5525.00000     1.24900     1.24700     1.24700     1.24700     0.00000   516.50000   516.50000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     8.89800     8.89800     0.00000     0.00000
         0.00000     0.00000   140.00000   140.00000     0.00000     2.00000     2.00000     0.00000   142.00000
       142.00000     0.00000     0.00300    -0.00800     0.00000     0.00000     0.00000     6.74400   -18.00000
         0.00000 27600.00000 35800.00000 36100.00000 27400.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000    33.00000    33.00000    33.00000    33.00000812525.00000
    812525.00000     0.00000     9.10000     9.10000     0.00000485125.00000485125.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
     111111    222222    333333    444444
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
    617639.87500     0.45003     0.02455     0.00025     0.00000     0.00000     0.02481     0.00000 -1127.96594
     34044.25391148005.37500 37213.25391 37110.39063 37110.39063 37110.39063148544.43750     1.24488     1.24750
      5399.12549  5385.31543  5385.31543  5385.31543     1.00000     0.99451     0.99977 22309.00000 21555.07227
       503.88907     0.02346     0.02259 C               MACH
    123053 EPR                                                                 7X7-XXX       XXX-XX-A

APM          AC001       BCA800   SEA-LAX 10111990
VARIABLE HEADER ONE HERE               VARIABLE HEADER TWO HERE
         0.84500     0.84600     0.00000   285.00000   285.00000     0.00000   -14.30000   -14.30000     0.00000
     35635.00000 35636.00000     0.00000606125.00000606125.00000     0.00000  5398.00000  5384.00000  5319.00000
      5303.00000     1.22900     1.22900     1.23000     1.22900     0.00000   522.09998   522.09998     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000    12.82800    12.82800     0.00000     0.00000
         0.00000     0.00000   140.00000   140.00000     0.00000     2.00000     2.00000     0.00000   142.00000
       142.00000     0.00000     0.00200     0.01500     0.00000     0.00000     0.00000     6.75900   -19.00000
         0.00000 27500.00000 29400.00000 28800.00000 27300.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000    33.00000    34.00000    34.00000    33.00000812525.00000
    812525.00000     0.00000     9.10000     9.10000     0.00000485125.00000485125.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
     111111    222222    333333    444444
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
         0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
```

Figure 19: MASTER Output Sample (pg1)

```
105005 CENTER WING FUEL BALANCE ARM TABLE - NOT FOUND                                              7X7-XXX         XXX-XX-A

APM        AC001       BCA800  SEA-LAX 10111990
VARIABLE HEADER ONE HERE              VARIABLE HEADER TWO HERE
     0.85900      0.86000      0.00000    289.00000    289.00000      0.00000    -13.10000    -13.10000      0.00000
 35635.00000  35636.00000      0.00000 620885.00000 620885.00000      0.00000   5616.00000   5616.00000   5552.00000
  5525.00000      1.24900      1.24700      1.24700      1.24700      0.00000    516.50000    516.50000      0.00000
     0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
     0.00000      0.00000      0.00000      0.00000      0.00000      8.89800      8.89800      0.00000      0.00000
     0.00000      0.00000    140.00000    140.00000      0.00000      2.00000      2.00000      0.00000    142.00000
   142.00000      0.00000      0.00300     -0.00800      0.00000      0.00000      0.00000      6.74400    -18.00000
     0.00000  27600.00000  35800.00000  36100.00000  27400.00000      0.00000      0.00000      0.00000      0.00000
     0.00000      0.00000      0.00000      0.00000     33.00000     33.00000     33.00000     33.00000 812525.00000
812525.00000      0.00000      9.10000      9.10000      0.00000 485125.00000 485125.00000      0.00000  50000.00000
 50000.00000  50000.00000  30000.00000  30000.00000  10000.00000  10000.00000  10000.00000
 111111    222222    333333    444444
     0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
     0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
     0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
     0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
     0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
     0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
     0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
     0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
     0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
```

Figure 20: MASTER Output Sample (pg2)

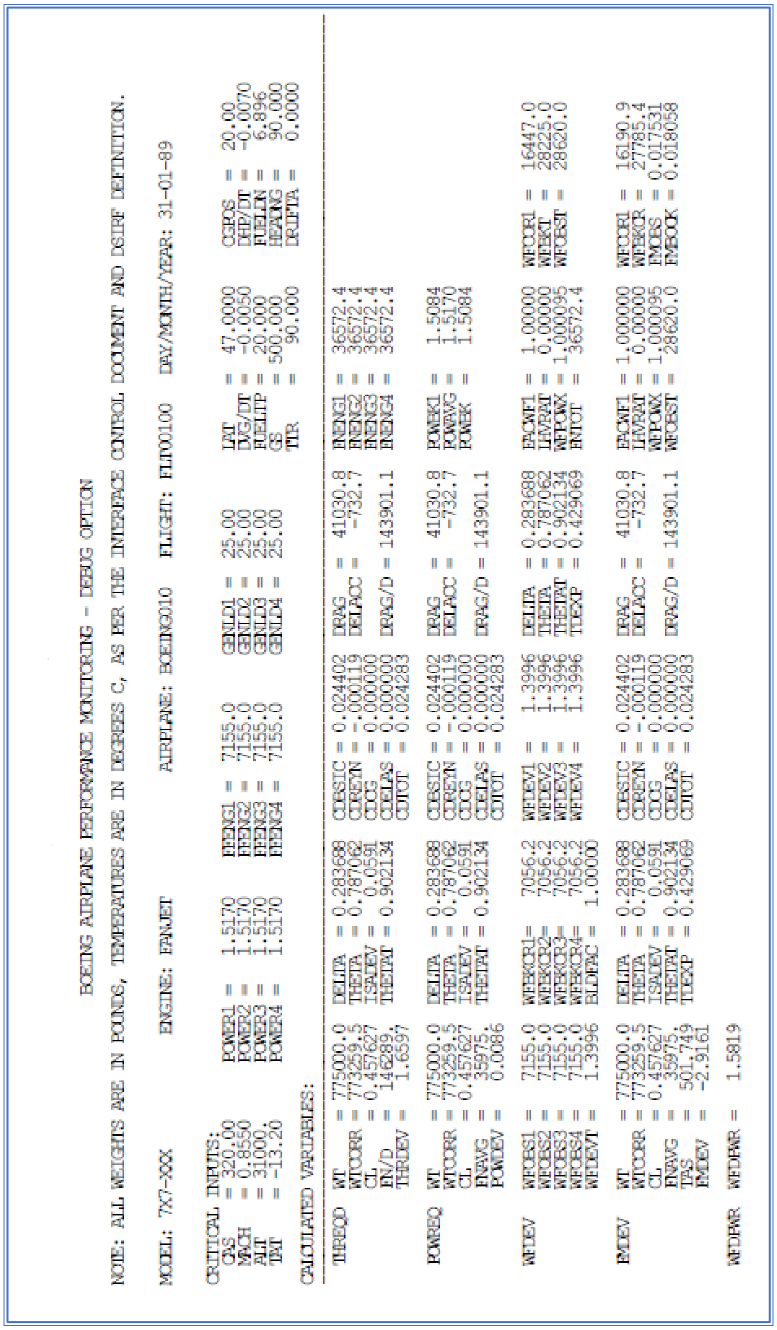
5.6 DEBUG Output Description

The DEBUG output option provides a 132-column format and is intended for analysis of calculated variables for each deviation calculation. Each cruise data point produces one page of output, and the input specification page is also written. When the DSIRF variables are also needed, the user can specify DEBUG=YESFULL, and this will instruct the program to append a listing of the DSIRF variables to the DEBUG output for that data point. A descriptive list of titles is given below:

Table 9: DEBUG Output Titles

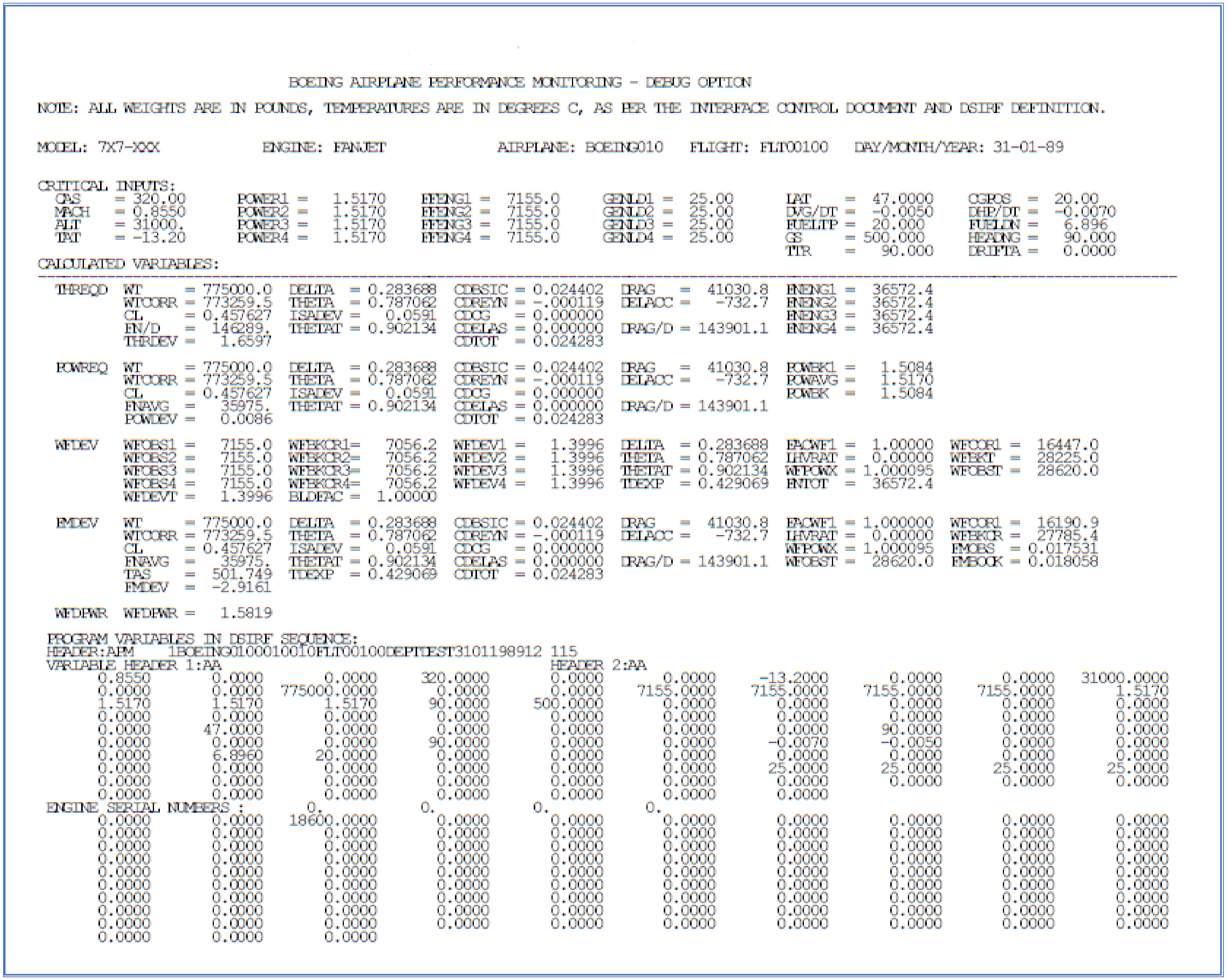
TITLES	DESCRIPTION
BLDFAC	Database Bleed Correction to Fuel Flow
CDBSIC	Cd Basic
CDCG	Cd Correction for Center of Gravity
CDELAS	Cd Correction for Aeroelasticity
CDREYN	Cd Correction for Reynolds Number
CDTOT	Cd Total
DELACC	Delta Drag due to Acceleration (Energy)
DHP/DT	Rate of Change of Pressure Altitude
DRAG	Drag Divided by Number of Engines
DRAG/D	Drag Divided by Delta
DVG/DT	Rate of Change of Ground Speed
FACWF1	Database Fuel Flow Correction Factor
FNAVG	Average Thrust (Fn)
FMBOOK	Book Fuel Mileage
FMOBS	Observed Fuel Mileage
FNENG#	Thrust for Engine Number
FN/D	Total Thrust Divided By Delta
GENLD#	Generator Load for Engine Number
LHVRAT	Fuel Lower Heat Value Fuel Flow Correction Factor
POWER#	Power Setting Parameter for Engine Number
POWAVG	Average Power Setting
POWBK	Book Power Setting
POWBK1	Book Power Setting (Uncorrected for %N1 Engines)
TDEXP	Fuel Flow Correction Factor (Theta * Delta to an Exponent)

TITLES	DESCRIPTION
THETAT	Theta Total
WFBKCR#	Corrected Book Fuel Flow for Engine Number
WFBKT	Total Book Fuel Flow
WFLOW1	Uncorrected Fuel Flow
WFOBS#	Observed Fuel Flow for Engine Number
WFOBST	Total Observed Fuel Flow
WFPOWX	Power Extraction Fuel Flow Correction Factor



```
                     BOEING AIRPLANE PERFORMANCE MONITORING - DEBUG OPTION
NOTE: ALL WEIGHTS ARE IN POUNDS, TEMPERATURES ARE IN DEGREES C, AS PER THE INTERFACE CONTROL DOCUMENT AND DSIRF DEFINITION.

MODEL: 7X7-XXX          ENGINE: FANJET          AIRPLANE: BOEING010   FLIGHT: FLT00100   DAY/MONTH/YEAR: 31-01-89

CRITICAL INPUTS:
  CAS    = 320.00    POWER1 =   1.5170   FFENG1 =  7155.0   GENLD1 =  25.00   LAT     =  47.0000   CGPOS  =  20.00
  MACH   = 0.8550    POWER2 =   1.5170   FFENG2 =  7155.0   GENLD2 =  25.00   DVG/DT  =  -0.0050   DHP/DT =  -0.0070
  ALT    = 31000.    POWER3 =   1.5170   FFENG3 =  7155.0   GENLD3 =  25.00   FUELTP  =  20.000    FUELDN =   6.896
  TAT    = -13.20    POWER4 =   1.5170   FFENG4 =  7155.0   GENLD4 =  25.00   GS      = 500.000    HEADNG =  90.000
                                                                              TTR     =   90.000   DRIFTA =   0.0000
CALCULATED VARIABLES:
---------------------------------------------------------------------------------------------------------------------
 THREQD  WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =   41030.8  FNENG1 =  36572.4
         WTCORR = 773259.5  THETA  = 0.787062  CDREYN = -.000119  DELACC =    -732.7  FNENG2 =  36572.4
         CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000                      FNENG3 =  36572.4
         FN/D   =  146289.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.1   FNENG4 =  36572.4
         THRDEV =   1.6597                     CDTOT  = 0.024283

 POWREQ  WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =   41030.8  POWBK1 =   1.5084
         WTCORR = 773259.5  THETA  = 0.787062  CDREYN = -.000119  DELACC =    -732.7  POWAVG =   1.5170
         CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000                      POWBK  =   1.5084
         FNAVG  =   35975.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.1
         POWDEV =   0.0086                     CDTOT  = 0.024283

 WFDEV   WFOBS1 =   7155.0  WFBKCR1=   7056.2  WFDEV1 =   1.3996  DELTA  = 0.283688   FACWF1 =  1.00000   WFCOR1 =  16447.0
         WFOBS2 =   7155.0  WFBKCR2=   7056.2  WFDEV2 =   1.3996  THETA  = 0.787062   LHVRAT =  0.00000   WFBKT  =  28225.0
         WFOBS3 =   7155.0  WFBKCR3=   7056.2  WFDEV3 =   1.3996  THETAT = 0.902134   WFPOWX = 1.000095   WFOBST =  28620.0
         WFOBS4 =   7155.0  WFBKCR4=   7056.2  WFDEV4 =   1.3996  TDEXP  = 0.429069   FNTOT  =  36572.4
         WFDEVT =   1.3996  BLDFAC =  1.00000

 FMDEV   WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =   41030.8  FACWF1 = 1.000000   WFCOR1 =  16190.9
         WTCORR = 773259.5  THETA  = 0.787062  CDREYN = -.000119  DELACC =    -732.7  LHVRAT =  0.00000   WFBKCR =  27785.4
         CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000                      WFPOWX = 1.000095   FMOBS  = 0.017531
         FNAVG  =   35975.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.1   WFOBST =  28620.0   FMBOOK = 0.018058
         TAS    =  501.749  TDEXP  = 0.429069  CDTOT  = 0.024283
         FMDEV  =  -2.9161

 WFDPWR  WFDPWR =   1.5819
```

Figure 21: DEBUG Output Sample



```
                    BOEING AIRPLANE PERFORMANCE MONITORING - DEBUG OPTION
NOTE: ALL WEIGHTS ARE IN POUNDS, TEMPERATURES ARE IN DEGREES C, AS PER THE INTERFACE CONTROL DOCUMENT AND DSIRF DEFINITION.

MODEL: 7X7-XXX        ENGINE: FANJET        AIRPLANE: BOEING010   FLIGHT: FLT00100   DAY/MONTH/YEAR: 31-01-89

CRITICAL INPUTS:
  CAS   = 320.00     POWER1 =   1.5170   FFENG1 = 7155.0   GENLD1 = 25.00   LAT    =  47.0000   CGPOS  =  20.00
  MACH  = 0.8550     POWER2 =   1.5170   FFENG2 = 7155.0   GENLD2 = 25.00   DVG/DT =  -0.0050   DHP/DT =  -0.0070
  ALT   = 31000.     POWER3 =   1.5170   FFENG3 = 7155.0   GENLD3 = 25.00   FUELTP =  20.000    FUELDN =   6.896
  TAT   = -13.20     POWER4 =   1.5170   FFENG4 = 7155.0   GENLD4 = 25.00   GS     = 500.000    HEADNG =  90.000
                                                                            TTR    =  90.000    DRIFTA =   0.0000
CALCULATED VARIABLES:
-------------------------------------------------------------------------------------------------------------------
 THREQD  WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  FNENG1 =  36572.4
         WTCORR = 773259.5  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  FNENG2 =  36572.4
         CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000                     FNENG3 =  36572.4
         FN/D   =  146289.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.1  FNENG4 =  36572.4
         THRDEV =   1.6597                     CDTOT  = 0.024283

 POWREQ  WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  POWBK1 =   1.5084
         WTCORR = 773259.5  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  POWAVG =   1.5170
         CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000                     POWBK  =   1.5084
         FNAVG  =   35975.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.1
         POWDEV =   0.0086                     CDTOT  = 0.024283

 WFDEV   WFOBS1 =   7155.0  WFBKCR1=   7056.2  WFDEV1 =   1.3996  DELTA  = 0.283688  FACWF1 = 1.00000   WFCOR1 =  16447.0
         WFOBS2 =   7155.0  WFBKCR2=   7056.2  WFDEV2 =   1.3996  THETA  = 0.787062  LHVRAT = 0.00000   WFBKT  =  28225.0
         WFOBS3 =   7155.0  WFBKCR3=   7056.2  WFDEV3 =   1.3996  THETAT = 0.902134  WFPOWX = 1.000095  WFOBST =  28620.0
         WFOBS4 =   7155.0  WFBKCR4=   7056.2  WFDEV4 =   1.3996  TDEXP  = 0.429069  FNTOT  =  36572.4
         WFDEVT =   1.3996  BLDFAC =  1.00000

 FMDEV   WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  FACWF1 = 1.000000  WFCOR1 =  16190.9
         WTCORR = 773259.5  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  LHVRAT = 0.00000   WFBKCR =  27785.4
         CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000                     WFPOWX = 1.000095  FMOBS  = 0.017531
         FNAVG  =   35975.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.1  WFOBST =  28620.0  FMBOOK = 0.018058
         TAS    =  501.749  TDEXP  = 0.429069  CDTOT  = 0.024283
         FMDEV  =  -2.9161

 WFDPWR  WFDPWR =   1.5819

PROGRAM VARIABLES IN DSIRF SEQUENCE:
HEADER:APM     1BOEING0100010010FLT00100DEPTTEST3101198912 115
VARIABLE HEADER 1:AA                                    HEADER 2:AA
    0.8550     0.0000      0.0000   320.0000     0.0000     0.0000   -13.2000     0.0000     0.0000  31000.0000
    0.0000     0.0000 775000.0000     0.0000     0.0000  7155.0000  7155.0000  7155.0000  7155.0000     1.5170
    1.5170     1.5170      1.5170    90.0000   500.0000     0.0000     0.0000     0.0000     0.0000     0.0000
    0.0000     0.0000      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
    0.0000    47.0000      0.0000     0.0000     0.0000     0.0000     0.0000    90.0000     0.0000     0.0000
    0.0000     0.0000      0.0000    90.0000     0.0000     0.0000    -0.0070    -0.0050     0.0000     0.0000
    0.0000     6.8960     20.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
    0.0000     0.0000      0.0000     0.0000     0.0000     0.0000    25.0000    25.0000    25.0000    25.0000
    0.0000     0.0000      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
    0.0000     0.0000      0.0000     0.0000     0.0000     0.0000     0.0000
ENGINE SERIAL NUMBERS :        0.          0.         0.         0.
    0.0000     0.0000  18600.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
    0.0000     0.0000      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
    0.0000     0.0000      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
    0.0000     0.0000      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
    0.0000     0.0000      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
    0.0000     0.0000      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
    0.0000     0.0000      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
    0.0000     0.0000      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
    0.0000     0.0000      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
    0.0000     0.0000      0.0000
```

Figure 22: DEBUG Full Output Sample

5.7 ERROR Output

Errors are reported to the user using the FORTRAN logical unit 6, or standard output. This means for some computing systems the error messages will be written directly to the screen (such as the PC). For batch environments, the user should allocate unit 6 to a file and save the file for reference. PC and UNIX environments can redirect standard output to a file.

6 TROUBLESHOOTING GUIDE

6.1 Error Codes

Error messages for the APM program are divided into two classes: error codes and error text. The error codes are a seven digit number which follow the convention:

- digits 1-2 define the module (e.g. Database and Input Controller)
- digits 3-4 define the subroutine in that module
- digits 5-7 define the error number

Error text is intended to assist the error code in explaining the problem. Not all error codes have associated text. An example of error text may be "ERROR OPENING CRZFIL - MANUAL INPUT OPTION". Error codes and text are passed through the program to the MASTER file when that option is selected.

6.2 Troubleshooting

The purpose of this section is to provide guidance information to assist users in troubleshooting the program, in the event that problems are experienced. An attempt has been made to group possible problems into one of five categories:

1. Program runs, but does not yield desired results or terminates abnormally.
2. Hardware/software system problems, or program terminates fatally (abnormally).
3. Database problems.
4. Output files not found.
5. Cannot duplicate results by hand.

The problems are listed by category and subject. For other difficulties that are not related to the ones listed, please contact The Boeing Company.

6.2.1 Program Runs, But Does Not Yield Desired Results or Terminates Abnormally.

6.2.1.1 Program runs but produces an error code and error text

Error text is similar to:

```
ITERR = XXXXX
ERROR NUMBER X OCCURRED IN SUBROUTINE AAAAAA IN MODULE DATABASE AND INPUT CONTROLLER
ERROR READING MESSAGE OR LAST LINE READ WAS: BBBBBBBBBBB
```

This type of error means the program has had difficulty processing the data. Verify the inputs, revise if necessary, and rerun. If the error text does not reveal the problem and the problem is persistent, contact Boeing.

6.2.1.2 Program runs but no output

Verify output filenames in the APMINP, or if using the program defaults, check the default filenames. If this is unsuccessful, look for error codes. If no output is found, revise the inputs to write a MASTER file. The MASTER file contains all the error codes and error text as well as the analysis results.

6.2.1.3 Program does not run and prints a message

Messgae text is similar to:

```
ITERR =13001
ERROR NUMBER 1 OCCURED IN SUBROUTINE INPCNT IN MODULE DATABASE AND INPUT CONTROLLER
ERROR READING FROM INPUT
ERROR MESSAGE OR LAST LINE READ WAS ERROR OPENING INPUT FILE
```

The program was unable to open the APM input file named APMINP. Verify that the APMINP file has no file extension.

6.2.1.4 Program printst asterisks (*) for analysis and a code

The output code and asterisks signal the cruise data either exceeded a deviation tolerance or the cruise record contains a point which has an incompatible bleed, A/C, or TAI configuration. See "Output Options" section of this manual.

6.2.1.5 Program prints first page (input specification page), but nothing else.

The program encountered a fatal problem in calculating the deviations. Check for error codes to indicate what the problem was, correct the inputs and rerun the analysis.

6.2.1.6 Program message XXXXX - TABLE NOT FOUND

Program has tried to load a database table, that was requested in the /CONFIG, but was not available in the database. This error indicates that the two-digit extension (of **CONFIGxx**) is incorrect or that the database is corrupted. Check the two-digit extension and revise if necessary. Otherwise, recreate the database from a backup copy.

6.2.1.7 Program screens the input cruise data and prints an error message

Message text such as:

```
MACH IS LESS THAN 0.3 OR GREATER THAN 0.95
```

The APM input record contains a point which is out of bounds. The error text will indicate which input is out of bounds and what those bounds are. The program will continue processing the rest of the **CRZFIL**.

6.2.1.8 No APM records found.

The program is unable to find any cruise input data (APM input records) in **CRZFIL**. If possible, type **CRZFIL** to the screen and verify the header contains the "APM" signifier in the DSIRF dataset title.

6.2.1.9 The program has trouble reading APMINP and prints a message

Message text such as:

```
ITERR =       21003
ERROR NUMBER  3 OCCURRED IN SUBROUTINE VARIBL IN MODULE DATABASE AND INPUT CONTROLLER
ERROR READING FROM INPUT
ERROR MESSAGE OR LAST LINE READ WAS :
ERRORS FOUND IN APMINP FILE - SEE "ERRORS" FILE FOR FURTHER INFORMATION.
```

The ERRORS file will contain the following text:

```
THE VALID INPUT KEYWORDS ARE:
             AIR-ENG        CG             CGMOM          CRZFIL   DATE
             DEBFIL         DEBUG          DRGFAC         ELASTIC  ENERGY
             EPRHI          EPRLO          FFA0           FFA1     FFA2
             FFA3           FFCAL          FLEETAVG       FMHI     FMLO
             GRAVITY        INPUT          INSTR          LHEATV
             LHVB           LHVM           MASFIL         MASTER   OUTFIL
             OUTPUT         POWERX         QUALTOL        REYNLD   SPDFIL
             SPDSHT         SPEED          TITLE          TEMPUNTIN       TEMPUNTOUT
             TRQDHI         TRQDLO         WFHI           WFLO     WEIGHT
             WFFAC          WTUNITIN       WTUNITOUT      TWTFIL   ADJUSTWT
             TAILID         TWTADJ         PAGEBRK        SPDPRM
ERRORS HAVE BEEN DETECTED IN AMPINP, THE PROBLEM LINE IS XXXX=XXX
INVALID KEYWORD, INPUT WAS XXXX
```

Verify the spelling of the indicated problem input. This step does not screen the value of the keyword, just the keyword itself. Correct the APMINP, and rerun the analysis.

6.2.1.10 Program terminated abnormally, and no MASFIL was found.

If the program terminated abnormally, it will dump the **MASTER** file contents into a file named **APMTMP**. Check the folder containing the APM program for this file. If the APM cannot open a file called **APMTMP**, no **MASTER** file records will be written.

6.2.2 Category 2: Hardware/Software System Problems, or Program Terminates Fatally (Abnormally).

6.2.2.1 Program terminates fatally with no apparent solution.

Contact Boeing and include a listing of the operating system error and any pertinent information. Be as specific as possible as an attempt will be made to duplicate the problem. Please include listings of APMINP if possible. The DSIRF may be printed by pressing CNTL-PRINT SCREEN and typing the DSIRF to the screen. This command will allow the user to visually inspect the DSIRF and the printer will capture whatever is displayed on the screen.

6.2.3 Category 3: Database Won't Load.

The database as provided from Boeing should load properly. If it does not - return it to Boeing, with a listing of the error.

6.2.4 Category 4: Output Files Not Found

Check the APMINP or default filenames. If unable to locate, check the directory for files created recently.

The program overwrites output files if the APMINP contains the same output filenames for successive runs.

6.2.5 Category 5: Can Not Duplicate Results by Hand Calculation.

Run the **DEBUG** output option and compare the results of hand calculations with the results printed on the **DEBUG** output. Consult the algorithm section of the documentation for algorithm questions. If the discrepancy is still not evident, please included the **DEBUG** output and the hand calculation, and return them to Boeing.

7 GLOSSARY

TERM or ACRONYM	DEFINITION
a	Radius of the Earth at the equator, (20,925,780 ft)
ACARS	Aircraft Communications Addressing and Reporting System
ACM	Airplane Condition Monitoring
ADC	Air Data Computer
ADL	Airborne Data Loader
ACMS	Airplane Condition Monitoring System
APM	Airplane Performance Monitoring
APU	Auxiliary Power Unit
A0	Incremental Engine Load
A1	Factor Engine Load
/AER0	One of the data type categories of the database
b	Radius of the Earth at the Pole, (20,855,636 ft)
B0	LHV Equation Slope, (default = -5220)
B1	LHV Equation Y-Intercept, (default = 22,777)
Cd	Drag Coefficient
CG	Center of Gravity, %MAC
CG_{init}	Initial Center of Gravity, %MAC
CL	Lift Coefficient
/CONFIG	One of the data type categories of the database
D	Airplane Drag, lbs
dHt/dt	Tapeline Rate of Climb, ft/sec
dHp/dt	Pressure Altitude Rate of Climb, ft/sec
DFDAU	Digital Flight Data Acquisition Unit
DMU	Data Management Unit
DSIRF	Digital Standard Input Record Format
dVg/dt	Inertial Acceleration, knots/sec
ECM	Engine Condition Monitoring
EGT	Exhaust Gas Temperature, deg C
ECS	Environmental Control System (Monitoring)

TERM or ACRONYM	DEFINITION
FM	Fuel Mileage, nm/lb
FMC	Flight Management Computer
Fn	Engine Thrust, lbs
/FLOE	One of the data type categories of the database
F77	FORTRAN 77, a computer language
go	Standard Gravity at Sea Level, (32.174 ft/sec^2)
GENLOD	Average Generator Electrical Load, % Maximum
GS	Ground Speed, knots
GSE	Ground Support Equipment
HDG	Heading, deg
Hp	Pressure Altitude, ft
Ht	Tapeline Altitude, ft
IRU	Inertial Reference Unit
K_{Trim}	CG Adjustment Factor
L	Airplane Lift, lbs
LHV	Fuel Lower Heat Value, (default 18,580 BTU/lb)
M	Mach Number
MAC	Mean Aerodynamic Chord, inches
MSIRF	Manual Standard Input Record Format
Nom HP	Nominal Power Extraction per Engine, horsepower
QAR	Quick Access Recorder
Power Setting	synonymous with thrust setting
/PROP	One of the sections of the database
Ref ArmCG	Reference Balance Arm for Nominal CG, inches
Rn	Reynolds Number
S	Reference Wing Area, ft^2
Tamb	Ambient Temperature, deg C
TAI	Thermal Anti-Ice
TAS	True Airspeed, knots
T_{Fuel}	Fuel Temperature, deg C

TERM or ACRONYM	DEFINITION
TOW	Takeoff Gross Weight, lbs
TTR	True Track, (Heading - Drift Angle), deg
V_{Wind}	Wind Velocity, knots
W	Condition Gross Weight, lbs
Wf	Fuel Flow, lbs

8 REFERENCES

D6-33468, entitled “The Determination of Cruise Fuel Mileage by Flight Testing Model 747 Production Airplanes, Revision D," approved for issue February 1979.

Appendix A DATABASE TABLE AND SCALAR DEFINITIONS

This appendix identifies all possible tables and scalars contained in a database suitable for use with the Boeing program(s) described in this document.

The user will note that the contents of the database(s) furnished (either as sample or production databases) do not incorporate the entire complement of data described in this appendix. Databases will be supplied with only the set of tables and scalars necessary to allow the user to perform the functions and options described in this document for the Boeing program(s) provided.

A.1 Database Tables

Table 10: Terminology

TERM	DEFINITION
α	Body Angle of Attack
ALT	Pressure Altitude
CD	Drag Coefficient
CL	Lift Coefficient
CN	Yawing Moment Coefficient
CEGT	Corrected EGT (degrees K)
C%N1	Corrected %N1
C%N2	Corrected %N2
C%N3	Corrected %N3
Drag Cts	CD/.0001
HR	Hours
KEAS	Equivalent Airspeed (knots)
KIAS	Indicated Airspeed (knots)
LB	Pounds
FN	Net Thrust (lb/engine)
FN/δ	Net Thrust / Delta (lb/engine)
RNFTM	Reynolds Number/Ft Mach Number
NM	Nautical Mile
∆T	ISA Deviation (degrees F)
GEN FN	Generalized Thrust (C%N1 or EPR)
WT	Weight (lb)
CG	Center of Gravity
WF	Fuel Flow (lb/hour/engine)
MAC	Mean Aerodynamic Chord (%)
CGBS	Body Station Center of Gravity

Table 11: Variables and Dimensions

VARIABLES	DESCRIPTION
X	Independent Variable for First Dimension
Y	Independent Variable for Second Dimension
Z	Independent Variable for Third Dimension
F	Dependent Variable
Ij	Two Digit Extensions for Database Tables: i = 0 - 9 j = 1 - 9 NOTE: An extension of 00 is not allowed. All configuration scalars which identify data base tables are initialized to 00 (ie., default value) to indicate that no database tables are loaded at the start of program execution.
TYPE	Degree of Table and Skewed Dimensions: SKEWxy x = Number of Independent Variables y = Number of Skewed Dimensions

DESCRIPTION	NAME	TYPE	X	Y	Z	F
Basic Drag	**CDBASEij**	SKEW21	CL(25,30)	MACH(30)	-	CD (25,30)
Drag Correction	**CDCORRij**	SKEW21	CL(25,30)	MACH(30)	-	CD (25,30)
Landing Gear Drag	**CDLGij**	SKEW20	CL(10)	MACH(10)	-	CD (10,10)
Yaw Drag	**CDPSIij**	SKEW10	CN(25)	-	-	CD (25)
Reynolds Drag	**CDREYNij**	SKEW10	RNFTM(10)	-	-	Drag Cts (10)
Spoiler Drag	**CDSPOILij**	SKEW10	KEAS(10)	-	-	CD (10)
Windmilling Drag	**CDWMij**	SKEW21	CL(25,30)	MACH(30)	-	CD (25,30)
Buffet Boundary	**CLBUFFij**	SKEW10	MACH(20)	-	-	CL (20)
Pod Drag	**DODPODij**	SKEW10	MACH(20)	-	-	DRAG/ δ (20)
Windmilling Drag	**DODWMij**	SKEW10	MACH(20)	-	-	DRAG/ δ (20)
Position Error	**IASij**	SKEW21	KIAS(10)	ALT(10)	-	ΔVP (KIAS) (10,10)
Reference altitude for Reynolds Number Correction	**REYNREFij**	SKEW10	WT(15)/δ *10E-6	-	-	REF ALT (15)
Stall Speed	**VSTALLij**	SKEW10	WT(10)	-	-	SPEED (10)
Aeroelastic Drag	**CDELASij**	SKEW21	WT(20,10)	MACH(10)	-	CD (20,10)
GammaZ Compressibility Correction	**CMPGAMZij**	SKEW21	MACH(20,10)	SPEED(10)		ΔGammaZ (20,10)
Aeroelastic Drag 2 (787)	**CDELAS2ij**	SKEW32	CL(20,20)	MACH(20,20)	ALT(20)	ΔCD (20,20,20)
Buffet Boundary with weight effect	**CLBUFFWij**	SKEW21	MACH(50,30)	WT(30)	-	CL (50,30)
Environmental Control System (ECS) DRAG	**CDECSij**	SKEW32	MACH(20,10)	ALT(20,10)	ΔT(10)	ΔCD (20,20,10)
APU Door Drag	**CDDOORij**	SKEW21	CL(25,30)	MACH(30)	-	CD (25,30)
Ice Drag	**CDICEij**	SKEW21	CL(25,30)	MACH(30)	-	ΔCD (25,30)
Drag Increment for Trailing Edge Variable Camber - Load Aleviation	**TEVCLAij**	SKEW42	CL(20,20)	MACH(20,20)	ALT(20) / WT(20)	ΔCD(20,20,20,20)

DESCRIPTION	NAME	TYPE	X	Y	Z	F
Boundary Speed for TEVC-LA Drag Increment	**TEVCLASPDij**	SKEW10	ALT(20)			SPD (20)

DESCRIPTION	NAME	TYPE	X	Y	Z	F
Off-Nominal ECS Bleed Correction to Corrected Fuel Flow	**ECSCORWFij**	SKEW32	FN/ δ (25,40)	MACH (14,40)	ALT (40)	ΔWF (25,14,40)
Off-Nominal ECS Bleed Correction to FN/ δ	**ECSFNODij**	SKEW32	C%N1/EPR (25,40)	MACH (14,40)	ALT (40)	ΔFN/ δ (25,14,40)
Low Pressure High Pressure Bleed Switch	**FNBLDFij**	SKEW21	MACH (14,40)	ALT (40)	-	FN/ δ (14,40)
Service Bleed Thrust	**FNBLDCij**	SKEW21	MACH (14,40)	ALT (40)	-	FN/ δ (14,40)
Max Climb Thrust	**FNCLB1ij** **FNCLB2ij**	SKEW31	MACH (40,40)	ALT (40)	ΔT (40)	FN/ δ (40,40,40)
Max Continuous Thrust	**FNCNT1ij** **FNCNT2ij**	SKEW31	MACH (40,40)	ALT (40)	ΔT (40)	FN/ δ (40,40,40)
Max Cruise Thrust	**FNCRU1ij** **FNCRU2ij**	SKEW31	MACH (40,40)	ALT (40)	ΔT (40)	FN/ δ (40,40,40)
Idle Thrust	**FNIDL1ij** **FNIDL2ij**	SKEW31	MACH (40,40)	ALT (40)	ΔT (40)	FN/ δ (40,40,40)
Surge Bleed A Thrust	**FNSURGAij**	SKEW21	MACH (14,40)	ALT (40)	-	FN/ δ (14,40)
Surge Bleed B Thrust	**FNSURGBij**	SKEW21	MACH (14,40)	ALT (40)	-	FN/ δ (14,40)
Climb Thrust Increment	**INCCLB1ij** **INCCLB2ij**	SKEW10	ALT (5)	-	-	ΔFN/ δ (5)
Continuous Thrust Increment	**INCCNT1ij** **INCCNT2ij**	SKEW10	ALT (5)	-	-	ΔFN/ δ (5)
Cruise Thrust Increment	**INCCRU1ij** **INCCRU2ij**	SKEW10	ALT (5)	-	-	ΔFN/ δ (5)
Idle Thrust Increment	**INCIDL1ij** **INCIDL2ij**	SKEW10	ALT (5)	-	-	ΔFN/ δ (5)
Service Bleed Correction	**TABCORCij**	SKEW10	FN/ δ (50)	-	-	ΔWF (50)
Automatic Clearance Bleed Correction	**TABCOREij**	SKEW32	FN/ δ (50,40)	MACH (14,40)	ALT(40)	ΔWF (50,14,40)

DESCRIPTION	NAME	TYPE	X	Y	Z	F
Fuel Flow Correction for Bleed Switch	**TABCORFij**	SKEW32	FN/ δ (50,40)	MACH (14,40)	ALT(40)	ΔWF (50,14,40)
Off-Temp Fuel Flow Correction	**TABCORGij**	SKEW42	FN/ δ (35,20)	MACH (10,20)	ALT(20)/ ΔT(10)	ΔWF (35,10,20,10)
2.5 Stage Bleed Modulation	**TABCR1Dij**	SKEW32	FN/ δ (50,40)	MACH (14,40)	ALT (40)	ΔWF (50,14,40)
2.5 Stage Bleed Open Full	**TABCR2Dij**	SKEW32	FN/ δ (50,40)	MACH (14,40)	ALT (40)	ΔWF (50,14,40)
Exponent of Theta	**THETAEXPij**	SKEW20	RN1 (40)	PTOTAL (20)	-	THAEXP (40,20)
Idle Fuel Flow	**WFIDL1ij** **WFIDL2ij**	SKEW31	MACH (40,40)	ALT (40)	ΔT (40)	WF (40,40,40)
Lambda Correction to Fuel Flow	**WFLAM1ij** **WFLAM2ij**	SKEW20	ΔT (10)	MACH (5)	-	LAMBDA (10,5)
Fuel Flow - Actual or Corrected	**WFTAB1ij** **WFTAB2ij**	SKEW32	FN/ δ (50,40)	MACH (40,40)	ALT (40)	WF (50,40,40)

DESCRIPTION	NAME	TYPE	X	Y	Z	F
APU Fuel Flow	**APUWFij**	SKEW20	ALT (10), (ALT or ALT * 1000)	MACH (10)	-	WF (10,10)
Body Angle of Attack	**CLALPHAij**	SKEW21	CL (10, 10)	MACH (10)	-	α (10,10)
Climb Mach	**CLBMACHij**	SKEW10	WT (10), (WT, WT * 1000 or WT/□□□* 10E-6)	-	-	MACH (10)
Climb Speed	**CLBSPDij**	SKEW10	WT (10), (WT, WT * 1000 or WT/□□□* 10E-6)	-	-	AIRSPEED (10)
Driftdown Speed	**DDSPDij**	SKEW21	WT (50,20), (WT, WT * 1000 or WT/□□* 10E-6)	ALT (20), (ALT or ALT * 1000)	-	MACH/ AIRSPEED (50, 20)
Derated Thrust 1	**DERATE11ij** **DERATE12ij**	SKEW31	MACH (40, 40)	ALT (40)	□T (40)	FN/□□ (40, 40, 40)
Derated Thrust 2	**DERATE21ij** **DERATE22ij**	SKEW31	MACH (40, 40)	ALT (40)	□T (40)	FN/□□ (40, 40, 40)
Derated Thrust 3	**DERATE31ij** **DERATE32ij**	SKEW31	MACH (40, 40)	ALT (40)	□T (40)	FN/□□ (40, 40, 40)
Corrected Exhaust Gas Temperature	**EGTGEN1ij** **EGTGEN2ij**	SKEW30	N1/EPR (25)	MACH (15)	ALT (15)	CEGT (25, 15, 15)
Generalized Thrust (C%N1 or EPR)	**FNGEN1ij** **FNGEN2ij**	SKEW20	FN/□□□(50)	MACH (25)	-	C%N1 / EPR (50, 25)
Generalized Thrust Altitude Dependence	**FNGENA1ij** **FNGENA2ij**	SKEW20	ALT (25)	N1/EPR (25)	-	%□ THRUST (25, 25)
Minimum Fuel Flow Speed	**MINWFij**	SKEW21	WT (50, 20) (WT, WT * 1000 or WT/□□* 10E-6)	ALT (20), (ALT or ALT * 1000)	-	MACH/ AIRSPEED (50, 20)
MMO	**MMOij**	SKEW10	ALT (10), (ALT or ALT * 1000)	-	-	MACH (10)

DESCRIPTION	NAME	TYPE	X	Y	Z	F
Corrected N1	**N1GEN1ij N1GEN2ij**	SKEW20	EPR (25)	MACH (15)	-	C%N1 (25, 15)
Corrected N2	**N2GEN1ij N2GEN2ij**	SKEW20	N1/EPR (25)	MACH (15)	-	C%N2 (25, 15)
Corrected N3	**N3GEN1ij N3GEN2ij**	SKEW20	N1/EPR (25)	MACH (15)	-	C%N3 (25, 15)
Approach Distance	**TABAPPDij**	SKEW10	WT (10), (WT or WT * 1000)	-	-	DIST (NM) (10)
Approach Fuel	**TABAPPFij**	SKEW10	WT (10), (WT or WT * 1000)	-	-	FUEL (LB) (10)
Approach Time	**TABAPPTij**	SKEW10	WT (10), (WT or WT * 1000)	-	-	TIME (HR) (10)
Climbout Distance	**TABCLODij**	SKEW30	WT (10), (WT or WT * 1000)	MACH/ AIRSPEED (5)	ALT (5) (ALT or ALT * 1000)	DIST (NM) (10, 5, 5)
Climbout Fuel	**TABCLOFij**	SKEW30	WT (10), (WT or WT * 1000)	MACH/ AIRSPEED (5)	ALT (5), (ALT or ALT * 1000)	FUEL (10, 5, 5)
Climbout Time	**TABCLOTij**	SKEW30	WT (10), (WT or WT * 1000)	MACH/ AIRSPEED (5)	ALT (5), (ALT or ALT * 1000)	TIME (10, 5, 5)
LRC Speed	**TABLRCij**	SKEW21	WT (50,50), (WT, WT * 1000 or WT/□□* 10E-6)	ALT (50), (ALT or ALT * 1000)	-	MACH/ AIRSPEED (50, 50)
Missed Approach Distance	**TABMAPDij**	SKEW30	WT (10), (WT or WT * 1000)	MACH/ AIRSPEED (5)	ALT (5), (ALT or ALT * 1000)	DIST (10, 5, 5)
Missed Approach Fuel	**TABMAPFij**	SKEW30	WT (10), (WT or WT * 1000)	MACH/ AIRSPEED (5)	ALT (5), (ALT or ALT * 1000)	FUEL (10, 5, 5)
Missed Approach Time	**TABMAPTij**	SKEW30	WT (10), (WT or WT * 1000)	MACH/ AIRSPEED (5)	ALT (5), (ALT or ALT * 1000)	TIME (HR) (10, 5, 5)

DESCRIPTION	NAME	TYPE	X	Y	Z	F
MRC Speed	**TABMRCij**	SKEW21	WT (50,50), (WT, WT * 1000 or WT/□□* 10E-6)	ALT (50), (ALT or ALT * 1000)	-	MACH/ AIRSPEED (50, 50)
Taxi Fuel Flow	**TAXITABij**	SKEW20	WT (10), (WT or WT * 1000)	ALT (5), (ALT or ALT * 1000)	-	WF (10, 5)
Minimum Drag Speed	**VMDij**	SKEW21	WT (50,20), (WT, WT * 1000 or WT/□□* 10E-6)	ALT (20), (ALT or ALT * 1000)	-	MACH/ AIRSPEED (50, 20)
VMO Speed	**VMOij**	SKEW10	ALT (10), (ALT or ALT * 1000)	-	-	MACH/ AIRSPEED (10)
VREF Speed	**VREFij**	SKEW10	WT (30), (WT, WT * 1000 or WT/□)	-	-	MACH/ AIRSPEED (30)
Fuel Balance Arm center wing tank	**FBATABCWij**	SKEW10	FUEL (LB) (99)	-	-	CGBS (99)
Fuel Balance Arm main tanks 1 and 4	**FBATABM14ij**	SKEW10	FUEL (LB) (99)	-	-	CGBS (99)
Fuel Balance Arm main tanks 2 and 3	**FBATABM23ij**	SKEW10	FUEL (LB) (99)	-	-	CGBS (99)
Fuel Balance Arm reserve tanks 2 and 3	**FBATABR23ij**	SKEW10	FUEL (LB) (99)	-	-	CGBS (99)
Fuel Balance Arm tail tanks	**FBATABTTij**	SKEW10	FUEL (LB) (99)	-	-	CGBS (99)
Power Extraction Fuel Flow Correction factor	**WFSTARij**	SKEW20	EPR/N1 (50)	MACH(25)	-	WF (50, 25) (FACTOR)
Delta CD trim	**CGTRIMij**	SKEW20	MACH (50)	CL(50)	-	□CD (50,50) CDtrim
Multiplicative factor to apply to CDtrim	**KTRIMij**	SKEW10	CG MAC (50)	-	-	FACTOR (50)
Fractional Fuel	**FRACFUELij**	SKEW10	FUEL (50)	-	-	FRACTION (50)
Fuel Balance Arm reserve tanks 1 and 4	**FBATABR14ij**	SKEW10	FUEL (99)	-	-	CGBS (99)

DESCRIPTION	NAME	TYPE	X	Y	Z	F
Economy Climb Speed	**ECONCLSPDij**	SKEW21	WT (30, 50)	COST INDEX (50)	-	SPEED (30, 50)
Economy Cruise Speed	**ECONCRSPDij**	SKEW21	WT (30, 50)	COST INDEX (50)	-	SPEED (30, 50)
Economy Descent Speed	**ECONDSSPDij**	SKEW21	WT (30, 50)	COST INDEX (50)	-	SPEED (30, 50)
Climb Thrust Rating Limits	**FNCLBLIMij**	SKEW31	MACH (10, 50)	ALT (50)	□T (50)	FN/□□ (10, 50, 50)
Max Continuous Thrust Rating Limits	**FNCNTLIMij**	SKEW31	MACH (10, 50)	ALT (50)	□T (50)	FN/□□ (10, 50, 50)
Cruise Thrust Rating Limits	**FNCRULIMij**	SKEW31	MACH (10, 50)	ALT (50)	□T (50)	FN/□□ (10, 50, 50)
Engine Bleed Level for Cargo Heat	**CARGOBLDij**	SKEW10	ALT (11)	-	-	CRGBD (11)
Standard Engine Bleed Level for Normal Passenger Load	**ECSBLDWFij**	SKEW10	ALT (11)	-	-	ECSBLD (11)
Generalized Thrust (C%N1 or EPR)	**FNGEN31ij**	SKEW32	FN/□□□(45, 40)	MACH (18, 40)	ALTS (40)	C%N1 / EPR (45, 18, 40)
Generalized Thrust (C%N1 or EPR)	**FNGEN32ij**	SKEW32	FN/□□□(45, 40)	MACH (18, 40)	ALTS (40)	C%N1 / EPR (45, 18, 40)
Temperature Correction to Economy Climb Speed	**ECLSPDTij**	SKEW10	□T (10)	--	-	□SPEED (10, 10)
Wind Correction to Economy Climb Speed	**ECLSPDWij**	SKEW10	□T (10)	-	-	□SPEED (10, 10)
Corrected Cost Function for Economy Cruise MACH	**CCFij**	SKEW21	WT/δ * 10E-6 (30, 40)	CCI (40)	-	CCF (30, 40)
Optimum Wt/δ as a function of Mach	**TABOPTMij**	SKEW10	MACH (20)	-	-	W/δ * 10E-6 (20)
Optimum Wt/δ as a function of Cost Index	**TABOPTEij**	SKEW10	CI / WT (20)	-	-	W/δ * 10E-6 (20)
Optimum Wt/δ as a function of CAS	**TABOPTCij**	SKEW10	CAS^2 / WT (20)	-	-	W/δ * 10E-6 (20)

DESCRIPTION	NAME	TYPE	X	Y	Z	F
Maximum Angle of Climb Speed	**MANGij**	SKEW10	WT (30)	-	-	SPEED (30)
Maximum Rate of Climb Speed	**MROCij**	SKEW10	WT (30)	-	-	SPEED (30)
Short Trip Optimum Altitude	**STOAij**	SKEW10	Distance, NM (30)	-	-	ALT (30)
Short Trip Optimum Cruise Time	**STCTij**	SKEW10	Distance, NM (30)	-	-	TIME, min (30)
Chemical Oxygen System Maximum Altitude Envelope	**COXYALTij**	SKEW10	TIME (20)			ALT (20)
Crew Oxygen Pressure (for chem pax oxy sys)	**CRWOXP1ij**	SKEW30	TEMP (20)	CREW(5)	Number or Size of crew cylinders (10)	PRESS (20, 5, 10)
Additional Crew Oxygen Pressure Required (for more extensive use)	**CRWOXP2ij**	SKEW20	Flow Rate (2) 1=Normal (diluted) 100 = 100% flow	Number or Size of crew cylinders (10)		□PRESS (2, 10)
Gaseous Passenger Oxygen Required (FPPM Table 1)	**GOXYLij**	SKEW30	ALT (10)	TIME (10)	PAX (10)	VOL (10, 10, 10)
Gaseous Passenger System - Additional Oxygen Required (intermediate alts) (FPPM Table 2)	**GOXYALij**	SKEW20	ALT (10)	PAX (10)		VOL (10, 10)
Minimum Crew Oxygen Required, FPPM Table 1 (gas pax oxy sys)	**CROXMINLij**	SKEW10	CREW (5)			VOL (5)
Supplemental Crew Oxygen Required, FPPM Table 2 (level off @ 14000ft) (gas pax oxy sys)	**CROXS14ij**	SKEW20	TIME (10)	CREW (5)		VOL (10, 5)
Supplemental Crew Oxygen Required at alt's other than 14000 ft, normal flow, FPPM table 3 (gas pax sys)	**CROXSUPNij**	SKEW20	ALT (10) intermediate	CREW (5)		VOL (10, 5) (Liters required for each minute above 14000 ft)

DESCRIPTION	NAME	TYPE	X	Y	Z	F
Supplemental Crew Oxygen Required at alt's other than 14000 ft, 100% flow, FPPM table 3 (gas pax sys)	**CROXSUPFij**	SKEW20	ALT(10) intermediate	CREW (5)		VOL (10, 5) (Liters required for each minute above 14000 ft)
Oxygen Cylinder Volume to Pressure Conversion	**OXYPRESSij**	SKEW20	CYL (30)	PRESS (30)		VOL (30, 30)
Temperature Correction to Oxygen Cylinder Pressure	**OXYPRESTCij**	SKEW10	PRESS (20)			∆P(20) pressure corr for each 5° C
Minimum Cylinder Pressure	**OXYPRSMINij**	SKEW10	TEMP (20)			PRESS (20)
Maximum Cylinder Pressure	**OXYPRSMAXij**	SKEW10	TEMP (20)			PRESS (20)
Gaseous Pulse Oxygen system flow rate	**GOXFLWij**	SKEW10	ALT (50)			FLOW (50)
Gaseous Pulse Oxygen system size	**GOXSIZij**	SKEW10	SIZE (10)			VOL (10)
Recommended Maneuver Speed	**VMANij**	SKEW20	WEIGHT (30)	ALT(10)		AIRSPEED (30, 10)
Speed Increment to Buffet Boundary	**BUFSPDINCij**	SKEW10	ALT (10)			∆ AIRSPEED (10)

A.2 Database Scalars

TERM	DEFINITION
TYPE	Type of data in scalar (real or character)
CONFIG?	Is the scalar found after a /CONFIG? Y = The scalar must be between a /CONFIG and /ENDCONFIG N = The scalar must be in the general database following a /AERO, /FLOE or a /PROP
Ij	Two digit extension identifier. Associates the scalar with a specific database table i = 0 – 9 j = 1 - 9 NOTE: An extension of 00 is not allowed
ALLOWABLE VALUES	Many of the database scalars have a specific set of input values that are recognized by the program (especially the character scalars). In the case of character scalars correct spelling is essential.
DEFAULT	Every database scalar is assigned a particular value within the program. If the value desired by the user is the same as the default value, the scalar need not appear in the database. If a different value is desired then the value appearing in the database will override the default. Note that it is possible to have multiple entries for some scalars in the database. If a scalar requires a two digit extension then the scalar may appear more than once with different values as long as the extensions (ie., ij) differ. If the extensions are identical then the last entry read will be assigned to the scalar.
RULES FOR SCALAR USEAGE	All Configuration scalars must appear between a /CONFIG and /ENDCONFIG but not following a /AERO, /PROP or /FLOE input. These scalars include all table names as well as the scalars OPTWOD, LHV, ENGINE and MODEL. Scalars of other classes (ie., AERODYNAMICS, PROPULSION and FLOE) that appear in a CONFIG must be between a /CONFIG and /ENDCONFIG and must follow the appropriate class delimiter (ie., /AERO, /PROP or /FLOE). AERODYNAMIC, PROPULSION and FLOE scalars not appearing in a CONFIG must be in the general database and also must follow the appropriate class delimiter.

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
First coefficient for Reynold's Number curve fitting	**ACDFij**	N	REAL	0.	
Second coefficient for Reynold's Number curve fitting	**BCDFij**	N	REAL	0.	
Increment of total drag coefficient	**CDIN**	Y	REAL	0.	
Degree of interpolation for table CDBASEij	**DEGBASEij**	N	REAL	-2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table CLBUFFij	**DEGBUFFij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table CDREYNij	**DEGCDRNij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table CDCORRij	**DEGCORij**	N	REAL	-2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table CDWMij	**DEGCDWM**	N	REAL	2	** Refer to discussion on SKEW routines **
Degree of interpolation for table CDLGij	**DEGLGij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table DODPODij	**DEGPODij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table REYNREFij	**DEGRNij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table CDSPOILij	**DEGSPij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table DODWMij	**DEGWMij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table CDPSIij	**DEGYAWij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Multiplication factor on total drag coefficient	**DFACT**	Y	REAL	1.	

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Number of engines out	**EOUT**	Y	REAL	0.	
Wing span	**SPAN**	N	REAL	0.	
Wing reference area	**SW**	N	REAL	0.	
Summation of moment arms of all engines out	**XLEOUT**	Y	REAL	0.	
Summation of moment arms of all external pods	**XLPOD**	Y	REAL	0.	
Incompressible Mach Number associated with table CDBASE	**ZMINCij**	N	REAL	0.7	
Number of external pods	**ZNPOD**	Y	REAL	0.	
Degree of interpolation for table CDELASij	**DEGELSij**	N	REAL	1.	** Refer to discussion on SKEW routines
Degree of interpolation for table IASij	**DEGIASij**	N	REAL	2.	** Refer to discussion on SKEW routines
Degree of interpolation for table VSTALLij	**DEGVSTALLij**	N	REAL	1.	** Refer to discussion on SKEW routines
Switch to use table CDCORR	**DOCDCOR**	Y	CHAR*16	NO	YES, NO
Switch to calculate Reynold's drag	**DORNCOR**	Y	CHAR*16	NO	TABLE, CURVE, NO
Switch to calculate Yaw Drag	**DOYAW**	Y	CHAR*16	NO	YES, NO
Speed units for Stall Speed table VSTALL	**SVUNITij**	N	CHAR*16	EAS	CAS,TAS,IAS,EAS
Switch to calculate Aeroelastic drag	**DOELAS**	Y	CHAR*16	NO	YES, NO
Reference Airspeed at WTREEF (GammaZ)	**VEWREF**	Y	REAL	0	** Refer to discussion on SKEW routines
Reference Weight (GammaZ Calc)	**WTREF**	Y	REAL	0	** Refer to discussion on SKEW routines
Induced Drag Efficiency Factor	**EFFGAMZ**	Y	REAL	0	** Refer to discussion on SKEW routines
Thrust over Weight Ratio 1	**FNWTR1**	Y	REAL	0	** Refer to discussion on SKEW routines
Thrust over Weight Ratio 2	**FNWTR2**	Y	REAL	0	** Refer to discussion on SKEW routines

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
GammaZ corresponding to FNWTR1	**GAMMAZ1**	Y	REAL	0	** Refer to discussion on SKEW routines
GammaZ corresponding to FNWTR2	**GAMMAZ2**	Y	REAL	0	** Refer to discussion on SKEW routines
Switch for performing GammaZ Drag Calculation	**DOGAMMAZ**	Y	CHAR*16	NO	YES, NO
Enroute Mach Number for High Speed GammaZ Calculation	**ENRTMACH**	Y	REAL	0	** Refer to discussion on SKEW routines
Degree of interpolation for table CMPGAMZij	**DEGCMPGAMZ**	N	REAL	0	** Refer to discussion on SKEW routines
Degree of interpolation with respect to MACH for table CLBUFFWij	**DEGBUFM**	N	REAL	-2	** Refer to discussion on SKEW routines
Degree of interpolation with respect to Weight for table CLBUFFWij	**DEGBUFW**	N	REAL	1	** Refer to discussion on SKEW routines
Degree of interpolation for table CDDOORij	**DEGDOOR**	N	REAL	1	** Refer to discussion on SKEW routines
Degree of interpolation for table CDICEij	**DGICEDRAG**	N	REAL	2	** Refer to discussion on SKEW routines
Degree of interpolation for table CDELAS2ij	**DEGELAS2**	N	REAL	1	** Refer to discussion on SKEW routines
Degree of interpolation for table CDECSij	**DEGCDECS**	N	REAL	1	** Refer to discussion on SKEW routines
Degree of interpolation for table TEVCLAij	**DEGTEVCLA**	N	REAL	1	** Refer to discussion on SKEW routines
Degree of interpolation for table TEVCLASPDij	**DGTVCLASPD**	N	REAL	1	** Refer to discussion on SKEW routines
Speed units for TEVC-LA Boundary Speed table TEVCLASPDij	**TEVCSPDTYPij**	N	CHAR*16	MACH	MACH, EAS, CAS, IAS, TAS

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Degree of interpolation for table TABCR1Dij	**DEGBL1Dij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table TABCR2Dij	**DEGBL2Dij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table TABCORCij	**DEGBLCCij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNBLDCij	**DEGBLDCij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table TABCOREij	**DEGBLDEij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNBLDFij	**DEGBLDFij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNCLB1ij	**DEGCLB1ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNCLB2ij	**DEGCLB2ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNCNT1ij	**DEGCNT1ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNCNT2ij	**DEGCNT2ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNCRU1ij	**DEGCRU1ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNCRU2ij	**DEGCRU2ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNIDL1ij	**DEGIDL1ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNIDL2ij	**DEGIDL2ij**	N	REAL	2.	** Refer to discussion on SKEW routines **

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Degree of interpolation for table WFLAM1ij	**DEGLAM1ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table WFLAM2ij	**DEGLAM2ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNSURGAij	**DEGSRGAij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNSURGBij	**DEGSRGBij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table WFTAB1ij	**DEGWF1ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table WFTAB2ij	**DEGWF2ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table WFIDL1ij	**DEGWFI1ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table WFIDL2ij	**DEGWFI2ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table INCCLB1ij	**DEGINCLB1ij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table INCCLB2ij	**DEGINCLB2ij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table INCCNT1ij	**DEGINCNT1ij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table INCCNT2ij	**DEGINCNT2ij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table INCCRU1ij	**DEGINCRU1ij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table INCCRU2ij	**DEGINCRU2ij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table INCIDL1ij	**DEGINIDL1ij**	N	REAL	1.	** Refer to discussion on SKEW routines **

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Degree of interpolation for table INCIDL2ij	**DEGINIDL2ij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table TABCORF	**DEGCORF**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table TABCORG	**DEGCORG**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table ECSFNODij	**DEGECSFNij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table ECSCORWFij	**DEGECSWFij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table THETAEXPij	**DEGTHAEXPij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Exponent of Delta used in fuel flow tables WFTAB1 and WFTAB2	**EDELTA1ij** **EDELTA2ij**	N	REAL	0.	
Exponent of Theta used in fuel flow tables WFTAB1 and WFTAB2	**ETHETA1ij** **ETHETA2ij**	N	REAL	0.	
Thrust factor for table FNCLB1	**FACCLB1**	Y	REAL	1.	
Thrust factor for table FNCLB2	**FACCLB2**	Y	REAL	1.	
Thrust factor for table FNCNT1	**FACCNT1**	Y	REAL	1.	
Thrust factor for table FNCNT2	**FACCNT2**	Y	REAL	1.	
Thrust factor for table FNCRU1	**FACCRU1**	Y	REAL	1.	
Thrust factor for table FNCRU2	**FACCRU2**	Y	REAL	1.	
Thrust factor for table FNIDL1	**FACIDL1**	Y	REAL	1.	
Thrust factor for table FNIDL2	**FACIDL2**	Y	REAL	1.	
Fuel flow factor for tables WFTAB1 and WFIDL1	**FACWF1**	Y	REAL	1.	
Fuel flow factor for tables WFTAB2 and WFIDL2	**FACWF2**	Y	REAL	1.	

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Thrust factor for table FNSURGA	**SRGFACA**	Y	REAL	1.	
Thrust factor fortable FNSURGB	**SRGFACB**	Y	REAL	1.	
Increment of corrected fuel flow for table FNSURGA	**SRGINCA**	Y	REAL	0.	
Increment of corrected fuel flow for table FNSURGB	**SRGINCB**	Y	REAL	0.	
Number of engines operating at thrust 1	**ZNE1**	Y	REAL	0.	
Number of engines operating at thrust 2	**ZNE2**	Y	REAL	0.	
Switch to declare in what order to apply the bleeds	**BLDORDR**	Y	CHAR*16	CDEAB	Any combination of: A, B, C, D, E, F, and G
Type of fuel flow correction to apply (Service Bleed Correction)	**CORTYPC**	Y	CHAR*16	' '	FAC or INC
Type of fuel flow correction to apply (2.5 Stage Bleed)	**CORTYPD**	Y	CHAR*16	' '	FAC or INC
Type of fuel flow correction to apply (Auto Clearance Control)	**CORTYPE**	Y	CHAR*16	' '	FAC or INC
Type of fuel flow correction to apply	**CORTYPF**	Y	CHAR*16	' '	FAC or INC
Type of Off-Temp fuel flow correction to apply	**CORTYPG**	Y	CHAR*16	' '	FAC or INC
Ambient/Total pressure and temperature ratio option for tables WFTAB1 and WFTAB2	**DELRAT1ij** **DELRAT2ij**	N	CHAR*16	TOTAL	AMBIENT
Switch for checking Service Bleed correction	**DOBLDC**	Y	CHAR*16	NO	YES = Correction from TABCORE applied to WFTAB and WFIDL WFTAB = Same as YES but applied only to WFTAB

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Switch for checking 2.5 Stage Bleed correction	**DOBLDD**	Y	CHAR*16	NO	YES = Correction is lower of TABCR1D and 2D Applied to WFTAB and WFIDL if > 0. WFTAB = Same as YES but applied only to WFTAB
Switch for checking Auto Clearance Control correction	**DOBLDE**	Y	CHAR*16	NO	YES = Correction from TABCORE applied to WFTAB and WFIDL WFTAB = Same as YES but applied only to WFTAB
Switch for checking High Stage Offtake correction	**DOBLDF**	Y	CHAR*16	NO	YES = Correction from TABCORF applied to WFTAB
Switch for checking Off-Temp fuel flow correction	**DOBLDG**	Y	CHAR*16	NO	YES = Correction from TABCORG applied to WFTAB
Switch for checking Surge Bleed Valve "A"'s position.If open apply a fuel flow correction	**DOSURGA**	Y	CHAR*16	NO	YES = Check thrust to determine valve position. If open apply the correction to WFTAB and WFIDL1 Input SRGFACA or SRGINCA and table FNSURGA WFTAB = same as YES but applied only to WFTAB
Switch for checking Surge Bleed Valve "B"'s position.If open apply a fuel flow correction	**DOSURGB**	Y	CHAR*16	NO	YES = Check thrust to determine valve position. If open apply the correction to WFTAB and WFIDL1 Input SRGFACB or SRGINCB and table FNSURGB WFTAB = same as YES but applied only to WFTAB
Switch for checking variable exponent of theta	**DOTHAEXP**	Y	CHAR*16	NO	YES = Use variable exponent of theta from table THETAEXP to calculate physical %N1 and corrected thrust

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Altitude to which tables TABAPPD, F and T are valid	**APPALTij**	N	REAL	1500.	
Altitude to which tables TABCLOD, F and T are valid	**CLOALTij**	N	REAL	1500.	
Degree of interpolation for table TABCLODij	**DEGCLDij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table TABCLOFij	**DEGCLFij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table TABCLOTij	**DEGCLTij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table DDSPDij	**DEGDDSPDij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table EGTGEN1ij	**DEGEGT1ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table EGTGEN2ij	**DEGEGT2ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNGEN1ij	**DEGFNGEN1ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNGEN2ij	**DEGFNGEN2ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNGEN31ij	**DEGFNGEN31ij**	N	REAL.	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNGEN32ij	**DEGFNGEN32ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNGENA1ij	**DEGFNGENA1ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNGENA2ij	**DEGFNGENA2ij**	N	REAL		** Refer to discussion on SKEW routines **
Degree of interpolation for table TABLRCij	**DEGLRCij**	N	REAL	2.	** Refer to discussion on SKEW routines **

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Degree of interpolation for table MINWFij	**DEGMINWFij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table TABMRCij	**DEGMRCij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table N1GEN1ij	**DEGN11ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table N1GEN2ij	**DEGN12ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table N2GEN1ij	**DEGN21ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table N2GEN2ij	**DEGN22ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table N3GEN1ij	**DEGN31ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table N3GEN2ij	**DEGN32ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table VMDij	**DEGVMDij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table DERATE11ij	**DGDERATE11ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table DERATE12ij	**DGDERATE12ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table DERATE21ij	**DGDERATE21ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table DERATE22ij	**DGDERATE22ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table DERATE31ij	**DGDERATE31ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table DERATE32ij	**DGDERATE32ij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Exponent of Theta used with values from table N1GEN1ij	**EXTHETA11ij**	N	REAL	0.	

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Exponent of Theta used with values from table N1GEN2ij	**EXTHETA12ij**	N	REAL	0.	
Exponent of Theta used with values from table N2GEN1ij	**EXTHETA21ij**	N	REAL	0.	
Exponent of Theta used with values from table N2GEN2ij	**EXTHETA22ij**	N	REAL	0.	
Exponent of Theta used with values from table N3GEN1ij	**EXTHETA31ij**	N	REAL	0.	
Exponent of Theta used with values from table N3GEN2ij	**EXTHETA32ij**	N	REAL	0.	
Exponent of Theta used with values from table EGTGEN1ij	**EXTHETAG1ij**	N	REAL	0.	
Exponent of Theta used with values from table EGTGEN2ij	**EXTHETAG2ij**	N	REAL	0.	
Exponent of Delta used with values from table APUWFij	**ADELTAij**	N	REAL	0.	
Exponent of Theta used with values from table APUWFij	**ATHETAij**	N	REAL	0.	
Exponent of Delta used with values from tables ECONCLSPDij, ECONCRSPDij and ECONDSSPDij	**ECDELTAij**	N	REAL	0.	
Exponent of Theta used with values from table ECON speed tables	**ECTHETAij**	N	REAL	0.	
Reference Fuel Heating Value for table WFIDL1ij (BTU/lb)	**LHVID1ij**	N	REAL	18580.	
Reference Fuel Heating Value for table WFIDL2ij (BTU/lb)	**LHVID2ij**	N	REAL	18580	
Reference Fuel Heating Value for table WFLAM1ij (BTU/lb)	**LHVLM1ij**	N	REAL	18580.	
Reference Fuel Heating Value for table WFLAM2ij (BTU/lb)	**LHVLM2ij**	N	REAL	18580.	
Reference Fuel Heating Value for table WFTAB1ij (BTU/lb)	**LHVTB1ij**	N	REAL	18580.	
Reference Fuel Heating Value for table WFTAB2ij (BTU/lb)	**LHVTB2ij**	N	REAL	18580.	
Reference CG position	**REFCG**	Y	REAL	0.	
Mean Aerodynamic Chord (inches)	**MAC**	N	REAL	0.	

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Location of leading edge of MAC (inches)	**LEMACij**	N	REAL	0.	
Sum of fuel capacities for 737 main tanks 1 and 2 (pounds)	**WTFULL1**	N	REAL	0.	
Fuel Capacity for 737 center tank (pounds)	**WTFULL2**	N	REAL	0.	
Y-intercept of a linear equation relating horsepower to electrical load	**A0**	N	REAL	0.	
Slope of a linear equation relating horsepower to electrical load	**A1**	N	REAL	0.	
Nominal horsepower extracted	**NOMHP**	N	REAL	0.	
Bleed configuration fuel flow factor	**FFFAC1**	N	REAL	1.	
Bleed configuration fuel flow factor	**FFFAC2**	N	REAL	1.	
Bleed configuration fuel flow factor	**FFFAC3**	N	REAL	1.	
Denotes type of speed used in table CLBSPDij	**CLBSPDTYPij**	N	CHAR*16	IAS	CAS, EAS, TAS
Denotes type of speed used in table TABCLODij	**CLDTYPij**	N	CHAR*16	CAS	IAS, EAS, TAS
Denotes type of speed used in table TABCLOFij	**CLFTYPij**	N	CHAR*16	CAS	IAS, EAS, TAS
Denotes type of speed used in table TABCLOTij	**CLTTYPij**	N	CHAR*16	CAS	IAS, EAS, TAS
Denotes type of speed used in table DDSPDij	**DDSPDTYPij**	N	CHAR*16	MACH	IAS, CAS, EAS, TAS
Denotes type of speed used in table TABLRCij	**LRCSPDTYPij**	N	CHAR*16	MACH	IAS, CAS, EAS, TAS
Denotes type of speed used in table MINWFij	**MINWFSPDij**	N	CHAR*16	MACH	IAS, CAS, EAS, TAS
Denotes type of speed used in table TABMRCij	**MRCSPDTYPij**	N	CHAR*16	MACH	IAS, CAS, EAS, TAS
Denotes type of speed used in table ECONCLSPDij	**ECLSPDTYPij**	N	CHAR*16	CAS	MACH, IAS, EAS, TAS
Denotes type of speed used in table ECONCRSPDij	**ECRSPDTYPij**	N	CHAR*16	MACH	IAS, CAS, EAS, TAS
Denotes type of speed used in table ECONDSSPDij	**EDSSPDTYPij**	N	CHAR*16	CAS	MACH, IAS, EAS, TAS
Denotes type of speed used in table VMDij	**VMDSPDij**	N	CHAR*16	MACH	IAS, CAS, EAS, TAS
Denotes type of speed used in table VMOij	**VMOSPDij**	N	CHAR*16	IAS	MACH, CAS, EAS, TAS
Denotes type of speed used in table VREFij	**VREFSPDij**	N	CHAR*16	IAS	MACH, CAS, EAS, TAS
Degree of interpolation for table FBATABCWij	**DEGFCWij**	N	REAL	1.	** Refer to discussion on SKEW routines **

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Degree of interpolation for table FBATABM14ij	**DEGFM14ij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FBATABM23ij	**DEGFM23ij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FBATABR23ij	**DEGFR23ij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FBATABTTij	**DEGFTTij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table WFSTARij	**DEGWFSTRij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table CGTRIMij	**DEGCGTRIMij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table KTRIMij	**DEGKTRIMij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table APUWFij	**DEGAPUWFij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table CLALPHAij	**DEGALPHAij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table CLBMACHij	**DEGCLBMCHij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table CLBSPDij	**DEGCLBSPDij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table MMOij	**DEGMMOij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table TABAPPDij	**DEGAPPDij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table TABAPPFij	**DEGAPPFij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table TABAPPTij	**DEGAPPTij**	N	REAL	2.	** Refer to discussion on SKEW routines **

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Degree of interpolation for table TABMAPDij	**DEGMAPDij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table TABMAPFij	**DEGMAPFij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table TABMAPTij	**DEGMAPTij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table TAXITABij	**DEGTAXIij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table VMOij	**DEGVMOij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table VREFij	**DEGVREFij**	N	REAL	2.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FRACFUELij	**DEGFACij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FBATABR14ij	**DEGFR14ij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNCLBLIMij	**DEGCLBLIMij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNCNTLIMij	**DEGCNTLIMij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table FNCRULIMij	**DEGCRULIMij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table ECONCLSPDij	**DEGECLij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table ECONCRSPDij	**DEGECRij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table ECONDSSPDij	**DEGEDSij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Degree of interpolation for table CARGOBLDij	**DEGCRGOBLDij**	N	REAL	1.	** Refer to discussion on SKEW routines **

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Degree of interpolation for table ECSBLDWFij	**DEGECSBLDij**	N	REAL	1.	** Refer to discussion on SKEW routines **
Ambient/Total pressure and temperature ratio option for table APUWFij	**ADELRATij**	N	CHAR*16	TOTAL	AMBIENT
Ambient/Total pressure and temperature ratio option for tables ECONCLSPDij, ECONCRSPDij AND ECONDSSPDij	**ECDELRATij**	N	CHAR*16	AMBIENT	TOTAL
Degree of interpolation for table ECLSPDTij	**DEGECLST**	N	REAL	1	** Refer to discussion on SKEW routines
Degree of interpolation for table ECLSPDWij	**DEGECLSW**	N	REAL	1	** Refer to discussion on SKEW routines
Degree of interpolation for table CCFij	**DEGCCF**	N	REAL	6	** Refer to discussion on SKEW routines
Degree of interpolation for table TABOPTMij	**DEGOPTMij**	N	REAL	1	** Refer to discussion on SKEW routines
Degree of interpolation for table TABOPTEij	**DEGOPTEij**	N	REAL	1	** Refer to discussion on SKEW routines
Degree of interpolation for table TABOPTCij	**DEGOPTCij**	N	REAL	1	** Refer to discussion on SKEW routines
Degree of interpolation for table MANGij	**DEGMANGij**	N	REAL	1	** Refer to discussion on SKEW routines
Degree of interpolation for table MROCij	**DEGMROCij**	N	REAL	1	** Refer to discussion on SKEW routines
Degree of interpolation for table STOAij	**DEGSTOAij**	N	REAL	1	** Refer to discussion on SKEW routines
Degree of interpolation for table STCTij	**DEGSTCTij**	N	REAL	1	** Refer to discussion on SKEW routines
Correction to Equivalent Trip Distance in Short Trip Optimum Altitude Calculation for Origin Airport Pressure Altitude	**STOAKORIG**	N	REAL	0	

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Correction to Equivalent Trip Distance in Short Trip Optimum Altitude Calculation for Destination Airport Pressure Altitude	**STOAKDEST**	N	REAL	0	
Correction to Equivalent Trip Distance in Short Trip Optimum Altitude Calculation for ISA Deviation below STOAKFRij	**STOAKT1**	N	REAL	0	
Correction to Equivalent Trip Distance in Short Trip Optimum Altitude Calculation for ISA Deviation above STOAKFRij	**STOAKT2**	N	REAL	0	
Climb Thrust Flat Rating Temperature Deviation from ISA	**STOAKFR**	N	REAL	0	
Correction to Equivalent Trip Distance in Short Trip Optimum Altitude Calculation for Cruise Tailwind Component	**STOAKW**	N	REAL	0	
Correction to Equivalent Trip Distance in Short Trip Optimum Altitude Calculation for Anti-Ice ON during Descent	**STOAKAI**	N	REAL	0	
Correction to Equivalent Trip Distance in Short Trip Optimum Altitude Calculation for Derate 1 Climb with Fast Taper	**STOAKD1FT**	N	REAL	0	
Correction to Equivalent Trip Distance in Short Trip Optimum Altitude Calculation for Derate 2 Climb with Fast Taper	**STOAKD2FT**	N	REAL	0	
Correction to Equivalent Trip Distance in Short Trip Optimum Altitude Calculation for Derate 1 Climb with Slow Taper	**STOAKD1ST**	N	REAL	0	
Correction to Equivalent Trip Distance in Short Trip Optimum Altitude Calculation for Derate 2 Climb with Slow Taper	**STOAKD2ST**	N	REAL	0	
Slope of TAS Vs. Altitude used in correcting Short Trip Opt ALT for Minimum Time.	**STOAB0**	N	REAL	0	
Slope of ALT Vs. Distance used in correcting Short Trip Opt ALT for Minimum Time.	**STOAB1**	N	REAL	0	

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Reference TAS @SL used in correcting Short Trip Opt ALT for Minimum Time.	**STOAVG0**	N	REAL	0	
Correction to Short Trip Optimum Altitude for Weight	**STOAKGW**	N	REAL	0	
Reference Weight used in Short Trip Optimum Altitude Calculation	**STOAWREF**	N	REAL	0	
Degree of interpolation for table COXYALTij	**DGCOXYALTij**	N	REAL		** Refer to discussion on SKEW routines
Degree of interpolation for table CRWOXP1ij	**DGCRWOXP1ij**	N	REAL		** Refer to discussion on SKEW routines
Degree of interpolation for table GOXYLij	**DGGOXYLij**	N	REAL		** Refer to discussion on SKEW routines
Degree of interpolation for table GOXYALij	**DGGOXYALij**	N	REAL		** Refer to discussion on SKEW routines
Degree of interpolation for table CROXMINLij	**DGCROXMINLij**	N	REAL		** Refer to discussion on SKEW routines
Degree of interpolation for table CROXS14ij	**DGCROXS14ij**	N	REAL		** Refer to discussion on SKEW routines
Degree of interpolation for table CROXSUPNij	**DGCROXSUPNij**	N	REAL		** Refer to discussion on SKEW routines
Degree of interpolation for table CROXSUPFij	**DGCROXSUPFij**	N	REAL		** Refer to discussion on SKEW routines
Degree of interpolation for table OXYPRESSij	**DGOXYPRESSij**	N	REAL		** Refer to discussion on SKEW routines
Degree of interpolation for table OXYPRESTCij	**DOXYPRESTCij**	N	REAL		** Refer to discussion on SKEW routines
Oxygen Cylinder reference temperature	**CYLREFTEMP**	N	REAL	21	
Degree of interpolation for table VMANij	**DEGVMAN**	N	REAL		** Refer to discussion on SKEW routines
Emergency Rate of Descent for pulse oxygen system calculations	**EMROD**	N	REAL	8200	

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Degree of interpolation for table GOXFLWij	**DGGOXF**	N	REAL		** Refer to discussion on SKEW routines
Degree of interpolation for table GOXSIZij	**DGGOXS**	N	REAL		** Refer to discussion on SKEW routines
Degree of interpolation for table BUFSPDINCij	**DEGBFSPDij**	N	REAL		** Refer to discussion on SKEW routines
Degree of interpolation for table OXYPRSMINij	**DGOXPRSMN**	N	REAL	1	** Refer to discussion on SKEW routines
Degree of interpolation for table OXYPRSMAXij	**DGOXPRSMX**	N	REAL	1	** Refer to discussion on SKEW routines

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Two digit extension identifier for table APUWFij	**APUWF**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CARGOBLDij	**CARGOBLD**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CDBASEij	**CDBASE**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CDCORRij	**CDCORR**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CDLGij	**CDLG**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CDPSIij	**CDPSI**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CDREYNij	**CDREYN**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CDSPOILij	**CDSPOIL**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CDWMij	**CDWM**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CLALPHAij	**CLALPHA**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CLBMACHij	**CLBMACH**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CLBSPDij	**CLBSPD**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CLBUFFij	**CLBUFF**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table DDSPDij	**DDSPD**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table DERATE11ij	**DERATE11**	Y	REAL	0	ij = 01 to 99

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Two digit extension identifier for table DERATE12ij	**DERATE12**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table DERATE21ij	**DERATE21**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table DERATE22ij	**DERATE22**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table DERATE31ij	**DERATE31**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table DERATE32ij	**DERATE32**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table DODPODij	**DODPOD**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table DODWMij	**DODWM**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table ECSBLDWFij	**ECSBLDWF**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table ECSCORWFij	**ECSCORWF**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table ECSFNODij	**ECSFNOD**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table EGTGEN1ij	**EGTGEN1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table EGTGEN2ij	**EGTGEN2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNBLDCij	**FNBLDC**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNBLDFij	**FNBLDF**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNCLB1ij	**FNCLB1**	Y	REAL	0	ij = 01 to 99

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Two digit extension identifier for table FNCLB2ij	**FNCLB2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNCNT1ij	**FNCNT1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNCNT2ij	**FNCNT2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNCRU1ij	**FNCRU1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNCRU2ij	**FNCRU2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNGEN1ij	**FNGEN1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNGEN2ij	**FNGEN2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNGEN31ij	**FNGEN31**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNGEN32ij	**FNGEN32**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNGENA1ij	**FNGENA1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNGENA2ij	**FNGENA2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNIDL1ij	**FNIDL1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNIDL2ij	**FNIDL2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNSURGAij	**FNSURGA**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNSURGBij	**FNSURGB**	Y	REAL	0	ij = 01 to 99

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Two digit extension identifier for table IASij	**IAS**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table INCCLB1ij	**INCCLB1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table INCCLB2ij	**INCCLB2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table INCCNT1ij	**INCCNT1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table INCCNT2ij	**INCCNT2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table INCCRU1ij	**INCCRU1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table INCCRU2ij	**INCCRU2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table INCIDL1ij	**INCIDL1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table INCIDL2ij	**INCIDL2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table MINWFij	**MINWF**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table MMOij	**MMO**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table N1GEN1ij	**N1GEN1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table N1GEN2ij	**N1GEN2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table N2GEN1ij	**N2GEN1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table N2GEN2ij	**N2GEN2**	Y	REAL	0	ij = 01 to 99

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Two digit extension identifier for table N3GEN1ij	**N3GEN1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table N3GEN2ij	**N3GEN2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table REYNREFij	**REYNREF**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for tables TABAPPDij, TABAPPFij and TABAPPTij	**TABAPP**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for tables TABCLODij, TABCLOFij and TABCLOT	**TABCLO**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table TABCORCij	**TABCORC**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table TABCOREij	**TABCORE**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table TABCORFij	**TABCORF**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table TABCR1Dij	**TABCR1D**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table TABCR2Dij	**TABCR2D**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table TABLRCij	**TABLRC**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for tables TABMAPDij, TABMAPFij and TABMAPTij	**TABMAP**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table TABMRCij	**TABMRC**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table TAXITABij	**TAXITAB**	Y	REAL	0	ij = 01 to 99

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Two digit extension identifier for table THETAEXPij	**THETAEXP**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table VMDij	**VMD**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table VMOij	**VMO**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table VREFij	**VREF**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table VSTALLij	**VSTALL**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table WFIDL1ij	**WFIDL1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table WFIDL2ij	**WFIDL2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table WFLAM1ij	**WFLAM1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table WFLAM2ij	**WFLAM2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table WFTAB1ij	**WFTAB1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table WFTAB2ij	**WFTAB2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FBATABCWij	**FBATABCW**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FBATABM14ij	**FBATABM14**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FBATABM23ij	**FBATABM23**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FBATABR23ij	**FBATABR23**	Y	REAL	0	ij = 01 to 99

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Two digit extension identifier for table FBATABTTij	**FBATABTT**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table WFSTARij	**WFSTAR**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CGTRIMij	**CGTRIM**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table KTRIMij	**KTRIM**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CDELASij	**CDELAS**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNCLBLIMij	**FNCLBLIM**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNCNTLIMij	**FNCNTLIM**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FNCRULIMij	**FNCRULIM**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FRACFUELij	**FRACFUEL**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table FBATABR14ij	**FBATABR14**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table ECONCLSPDij	**ECONCLSPD**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table ECONCRSPDij	**ECONCRSPD**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table ECONDSSPDij	**ECONDSSPD**	Y	REAL	0	ij = 01 to 99
Fuel Heating Value to be used where fuel burn = fuel burn *(LHVREF / LHV)	**LHV**	Y	REAL	18580	
Optimum W/δ * 1.0E+06 lb	**OPTWOD**	Y	REAL	0.	
16 character engine identifier	**ENGINE**	Y	CHAR*16	' '	

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
16 character airplane identifier	**MODEL**	Y	CHAR*16	' '	
Two digit extension identifier for table CMPGAMZij	**CMPGAMZ**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CLBUFFWij	**CLBUFFW**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table ECLSPDTij	**ECLSPDT**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table ECLSPDWij	**ECLSPDW**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CCFij	**CCF**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CDDOORij	**CDDOOR**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for tables TABOPTMij, TABOPTEij & TABOPTCij	**TABOPT**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table MANGij	**MANG**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table MROCij	**MROC**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table STOAij	**STOA**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table COXYALTij	**COXYALT**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CRWOXP1ij	**CRWOXP1**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CRWOXP2ij	**CRWOXP2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table GOXYLij	**GOXYL**	Y	REAL	0	ij = 01 to 99

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Two digit extension identifier for table GOXYALij	**GOXYAL**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CROXMINLij	**CROXMINL**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CROXS14ij	**CROXS14**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CROXSUPNij	**CROXSUPN**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CROXSUPFij	**CROXSUPF**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table OXYPRESSij	**OXYPRESS**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table OXYPRESTCij	**OXYPRESTC**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CDICEij	**CDICE**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CDELAS2ij	**CDELAS2**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table CDECSij	**CDECS**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table VMANij	**VMAN**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table GOXFLWij	**GOXFLW**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table GOXSIZij	**GOXSIZ**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table BUFSPDINCij	**BUFSPDINC**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table TEVCLAij	**TEVCLA**	Y	REAL	0	ij = 01 to 99

DESCRIPTION	NAME	CONFIG?	TYPE	DEFAULT	ALLOWABLE VALUES
Two digit extension identifier for table OXYPRSMINij	**OXYPRSMIN**	Y	REAL	0	ij = 01 to 99
Two digit extension identifier for table OXYPRSMAXij	**OXYPRSMAX**	Y	REAL	0	ij = 01 to 99

Appendix B SAMPLE DATABASE CONTENTS

This appendix contains a listing of the generic database that is provided with the program. The database is fictitious and therefore not representative of any specific airplane or engine, although, it assumes a four-engine configuration. It is intended that the program installation tests be made with this database to verify program operation using the sample input/output contained in Appendix C. Technical information on database structure can be found in Appendix A.

The generic database is applicable to aircraft operating in the high speed environment and therefore can serve two functions; (1) Inflight Performance, and (2) Airplane Performance Monitoring. Specific applications are controlled by the user through the configuration definition ("CONFIG") specified in the User-Input file. The generic database contains the specific configurations itemized below. It should be noted that the user can select either EPR or %N1 as the primary power setting parameter.

CONFIG01: Inflight Performance
Four Engines/Clean Configuration
EPR Used for Power Setting

CONFIG02: Inflight Performance
Three Engines/Clean Configuration
EPR Used for Power Setting

CONFIG03: Inflight Performance
Four Engines/Clean Configuration
%N1 Used for Power Setting

CONFIG04: Inflight Performance
Three Engines/Clean Configuration
%N1 Used for Power Setting

CONFIG10: Airplane Performance Monitoring
Four Engines/Clean Configuration
EPR Used for Power Setting

CONFIG11: Airplane Performance Monitoring
Four Engines/Clean Configuration
%N1 Used for Power Setting

```
H THIS IS THE SAMPLE DATABASE USED FOR THE SAMPLE INPUT/OUTPUT
H PROVIDED WITH THE PROGRAM. THE FOLLOWING CONFIGURATIONS ARE
H CONTAINED WITHIN THE SAMPLE DATABASE.
H
H      CONFIG01: INFLIGHT PERFORMANCE/FOUR ENGINES/CLEAN
H      CONFIGURATION/EPR POWER SETTINGS
H
H      CONFIG02: INFLIGHT PERFORMANCE/THREE ENGINES/CLEAN
H      CONFIGURATION/EPR POWER SETTINGS
H
H      CONFIG03: INFLIGHT PERFORMANCE/FOUR ENGINES/CLEAN
```

```
H       CONFIGURATION/%N1 POWER SETTINGS
H
H      CONFIG04: INFLIGHT PERFORMANCE/THREE ENGINES/CLEAN
H      CONFIGURATION/%N1 POWER SETTINGS
H
H      CONFIG10: AIRPLANE PERFORMANCE MONITORING
H      FOUR ENGINES/CLEAN CONFIGURATION
H      EPR POWER SETTINGS
H
H      CONFIG11: AIRPLANE PERFORMANCE MONITORING
H      FOUR ENGINES/CLEAN CONFIGURATION
H      %N1 POWER SETTINGS
H
H
H      FOUR ENGINE CLEAN CONFIGURATION (EPR FOR POWER SETTING)
H
/CONFIG01
MODEL = 7X7-XXX
ENGINE = FANJET
CDBASE = 1
CLBUFF = 1
CLALPHA = 1
FNCLB1 = 1    FNCRU1 = 1    FNCNT1 = 1    FNIDL1 = 1
WFTAB1 = 1    WFIDL1 = 1
FNGEN1 = 1
N1GEN1 = 1    N2GEN1 = 1    N3GEN1 = 1    EGTGEN1 = 1
MINWF = 1
TABLRC = 1
REYNREF = 1
TABAPP = 1    TABCLO = 1
ECONCRSPD = 1 ECONCLSPD = 1 ECONDSSPD = 1
VMO = 1
MMO = 1
IAS = 1
OPTWOD = 2.7
/AERO
DORNCOR = CURVE
/PROP
ZNE1 = 4
/ENDCONFIG
H
H      THREE ENGINE CLEAN CONFIGURATION (EPR FOR POWER SETTING)
H
/CONFIG02
MODEL = 7X7-XXX
ENGINE = FANJET
CDBASE = 1
CLBUFF = 1
CLALPHA = 1
FNCLB1 = 1    FNCRU1 = 1    FNCNT1 = 1    FNIDL1 = 1
WFTAB1 = 1    WFIDL1 = 1
FNGEN1 = 1
MINWF = 2
TABLRC = 2
REYNREF = 1
TABAPP = 1    TABCLO = 1
VMO = 1
MMO = 1
IAS = 1
CDPSI = 1     DODWM = 1
/AERO
DORNCOR = CURVE
/PROP
```

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ZNE1 = 3
/AERO
DOYAW = YES
EOUT = 1.0
XLEOUT = 69.50
/ENDCONFIG
H
H      FOUR ENGINE CLEAN CONFIGURATION (N1 FOR POWER SETTING)
H
/CONFIG03
MODEL = 7X7-XXX
ENGINE = FANJET
CDBASE = 1
CLBUFF = 1
CLALPHA = 1
FNCLB1 = 1    FNCRU1 = 1    FNCNT1 = 1    FNIDL1 = 1
WFTAB1 = 1    WFIDL1 = 1
FNGEN1 = 2
N1GEN1 = 1    N2GEN1 = 2    EGTGEN1 = 2
MINWF = 1
TABLRC = 1
REYNREF = 1
TABAPP = 1    TABCLO = 1
ECONCRSPD = 1 ECONCLSPD = 1 ECONDSSPD = 1
VMO = 1
MMO = 1
IAS = 1
/AERO
DORNCOR = CURVE
/PROP
ZNE1 = 4
/ENDCONFIG
H
H      THREE ENGINE CLEAN CONFIGURATION (N1 FOR POWER SETTING)
H
/CONFIG04
MODEL = 7X7-XXX
ENGINE = FANJET
CDBASE = 1
CLBUFF = 1
CLALPHA = 1
FNCLB1 = 1    FNCRU1 = 1    FNCNT1 = 1    FNIDL1 = 1
WFTAB1 = 1    WFIDL1 = 1
FNGEN1 = 2
N1GEN1 = 1    N2GEN1 = 2    EGTGEN1 = 2
MINWF = 2
TABLRC = 2
REYNREF = 1
TABAPP = 1    TABCLO = 1
VMO = 1
MMO = 1
IAS = 1
CDPSI = 1     DODWM = 1
/AERO
DORNCOR = CURVE
/PROP
ZNE1 = 3
/AERO
DOYAW = YES
EOUT = 1.0
XLEOUT = 69.50
/ENDCONFIG
H
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H      APM: FOUR ENGINE CLEAN CRUISE CONFIG. (EPR FOR POWER SETTING)
H
/CONFIG10
MODEL = 7X7-XXX
ENGINE = FANJET
CDBASE = 1
FNGEN1 = 1
LHV = 18600.
WFTAB1 = 1
WFSTAR = 1
CGTRIM = 1
KTRIM = 1
FBATABCW = 1
FBATABM14 = 1
FBATABM23 = 1
FBATABR23 = 1
FBATABTT = 1
REYNREF = 1
APUWF = 1
/FLOE
REFCG = 0.200
/AERO
DORNCOR = CURVE
/PROP
ZNE1 = 4
/ENDCONFIG
H
H      APM: FOUR ENGINE CLEAN CRUISE CONFIG. (N1 FOR POWER SETTING)
H
/CONFIG11
MODEL = 7X7-XXX
ENGINE = FANJET
CDBASE = 1
FNGEN1 = 2
LHV = 18600.
WFTAB1 = 1
WFSTAR = 2
CGTRIM = 1
KTRIM = 1
FBATABCW = 1
FBATABM14 = 1
FBATABM23 = 1
FBATABR23 = 1
FBATABTT = 1
REYNREF = 1
APUWF = 1
/FLOE
REFCG = 0.200
/AERO
DORNCOR = CURVE
/PROP
ZNE1 = 4
/ENDCONFIG
H
/FLOE
  DBNAME = $SAMPLE DATABASE$     VERSION = 3.00     REVDATE = 25-JANUARY-91
H      ALL ENGINE LRC SPEEDS
  DEGLRC01   1.0000
/TBLU
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1.700001.760001.800001.860001.900001.960002.000002.100002.200002.26000
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 .63590 .64750 .66470 .67550 .69060 .70050 .71500 .72450 .74800 .76850
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 .83400 .83800 .84050 .84390 .84600 .84880 .85050 .85300 .85430 .85580
 .85660 .85720 .85750 .85780 .85780 .85750 .85750 .85750 .85750 .85750
 .40750 .44600 .48400 .51950 .54120 .55500 .57430 .58700 .60580 .61800
 .63590 .64750 .66470 .67550 .69060 .70050 .71500 .72450 .74800 .76850
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 .85660 .85720 .85750 .85780 .85780 .85750 .85750 .85750 .85750 .85750
/AERO
H      INITIAL BUFFET BOUNDARY CL (CG = 20% MAC)
H      CL = F(MACH)
  DEGBUFF01     =     2.0000
/TBLU
CLBUFF01
.3     .5     .7     .8     .825   .85    .875   .9     .925            1
.818   .802   .758   .714   .701   .677   .629   .56    .47
/AERO
H      LANDING GEAR DRAG FLAPS UP
H      FLAPS UP GEAR DOWN DRAG
H      CD = F(CL,MACH)
  DEGLG01      =     2.0000
/TBLU
CDLG01
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0.00000 .90000                                                         11
 .02670 .02710 .02670 .02620 .02380
 .02670 .02710 .02670 .02620 .02380
/AERO
H      STANDARD REFERENCE REYNOLDS NUMBER CURVE
H      REFERENCE ALTITUDE = F(WEIGHT/DELTA)
  DEGRN01      =     2.0000
  ACDF01       =     133.62
  BCDF01       =     -39.83
  SW         =     5500.0
H  AR         =     6.9600
H  E          =     1.0000
  SPAN       =     195.67
  ZMINC      =     .30000
/TBLU
REYNREF01
3.1    2.3    2.21   2.2    2.18   2.16   2.14   2.12   2.10   2.0
1.9    1.6    1.273  .886   .528                                    1
33.000 33.000 33.000 33.000 32.940 32.900 32.850 32.750 32.650 31.950
31.000 27.000 21.638 13.618 1.500
/AERO
H      DRAG POLAR
H      CD = F (CL,M)
  DEGBASE01    =     6.0000
/TBLU
CDBASE01
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.650000.675000.700000.750000.800000                                    1 CL
.300000.350000.400000.450000.500000.550000.600000.650000.700000.720000   MACH
.740000.760000.780000.800000.810000.820000.830000.840000.850000.860000   MACH
.870000.880000.885000.890000.895000.900000.905000.910000.915000.920000 1 MACH
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/PROPULSION
H      CORR WF  ALL ENGINE NORMAL BLEED,ETHETA=.62,LHV=18580,55HPX
H      WF/(THETA TOTAL**.62*DELTA TOTAL**1.)= F (FN/DELTA,MACH,ALT)
  ETHETA101     =     .62000
  EDELTA101     =     1.0000
  DELRAT101     = TOTAL
  DEGWF101     =     6.0000
/TBLU
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 44000. 48000. 50000. 52000.                                          1
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  44375  40729  38147  36017  34310  32817  31839  31407  30540  29563  10   0
  48391  44978  42261  39840  37902  36564  35550  35044  34650  34232  15   0
  51658  48224  45503  43518  41907  40524  39462  39019  38633  38337  20   0
  54463  51159  48615  46778  45562  44724  43952  43438  43087  42865  25   0
  56137  53281  51270  49972  49326  48946  48907  48963  49005  49050  31   0
  56614  53848  51972  50835  50347  50096  50177  50298  50430  50630  32   0
  56154  53561  52033  51212  51064  51105  51447  51699  51976  52380  34   0
  55678  53218  51757  51203  51242  51457  51953  52272  52626  53110  35   0
  55192  52913  51648  51308  51595  52031  52724  53128  53563  54139  36   0
  54498  52223  50956  50481  50836  51253  51915  52313  52743  53313  40   0
  53476  51214  49933  49446  49592  49921  50490  50848  51232  52127  45   0
  36398  33477  31228  29183  27356  25345  23984  23101  21720  20367   0  18
  44373  40727  38146  36016  34309  32817  31839  31409  30542  29566  10  18
  48388  44975  42259  39838  37900  36564  35550  35045  34652  34234  15  18
  51654  48220  45498  43515  41905  40523  39463  39020  38636  38341  20  18
  54457  51154  48610  46775  45560  44723  43953  43439  43089  42868  25  18
  56167  53275  51266  49968  49323  48945  48908  48965  49008  49055  31  18
  56645  53841  51968  50831  50344  50095  50178  50300  50433  50635  32  18
  56183  53615  52028  51208  51060  51104  51448  51701  51980  52384  34  18
  55669  53273  51840  51198  51239  51456  51954  52274  52629  53114  35  18
  55185  52905  51729  51303  51592  52029  52724  53129  53566  54144  36  18
  54489  52216  51036  50594  50832  51250  51915  52313  52744  53316  40  18
  53468  51206  49925  49559  49744  50121  50752  51140  51561  52127  45  18
  34673  31811  29549  27435  25569  23423  22000  21017  19776  18490   0  27
  41987  38784  36301  34266  32553  31000  29943  29348  28312  27169  10  27
  46547  43057  40108  37780  36034  34655  33641  33155  32679  31903  15  27
  50034  46610  43930  41813  39862  38470  37445  36972  36538  36256  20  27
  53134  49732  47068  45098  43798  42697  41577  41120  40747  40518  25  27
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  55654  52538  50250  48690  47723  47130  46828  46693  46423  46182  31  27
  55898  52862  50669  49206  48352  47835  47639  47585  47464  47251  32  27
  56770  53908  51967  50757  50198  49886  49910  50000  50088  50232  34  27
  56554  53802  51990  50924  50508  50325  50467  50620  50789  51043  35  27
  55993  53368  51709  50798  50551  50515  50792  51016  51262  51623  36  27
  55271  52693  51015  50088  49816  49759  50025  50243  50490  50845  40  27
  54248  51619  49989  49066  48732  48668  48919  49135  49376  49709  45  27
/AERO
H      YAW DRAG FOR ONE ENGINE OUT       CDPSI = F(CN)
  DEGYAW01     =     1.0000
/TBLU
CDPSI01
0.00000 .00200 .00300 .00400 .00500 .00600 .00800 .01000 .01500 .0250011
0.00000 .00020 .00030 .00040 .00050 .00060 .00085 .00150 .00200 .00450
/FLOE
H      GENERALIZED EPR
H      EPR = F(FN/DELTA,MACH)
  DEGFNGEN101    =     1.0000
/TBLU
FNGEN101
  3000.  6000.  9000. 12000. 15000. 18000. 21000. 24000. 27000. 30000.
 33000. 36000. 39000. 42000. 45000. 48000. 51000. 54000. 57000. 60000.
 63000.                                                                  11
0.00000 .10000 .20000 .30000 .40000 .50000 .55000 .60000 .70000 .80000
 .85000 .90000 .95000                                                    11
 1.0331 1.0698 1.1060 1.1402 1.1760 1.2126 1.2496 1.2882 1.3273 1.3670
 1.4073 1.4488 1.4908 1.5335 1.5765 1.6197 1.6633 1.7072 1.7516 1.7963
 1.8413
 1.0457 1.0858 1.1260 1.1663 1.2067 1.2473 1.2885 1.3301 1.3722 1.4147
 1.4577 1.5010 1.5450 1.5893 1.6342 1.6798 1.7259 1.7726 1.8198 1.8674
 1.9151
 1.0509 1.0974 1.1420 1.1861 1.2296 1.2730 1.3167 1.3607 1.4052 1.4504
 1.4964 1.5415 1.5869 1.6327 1.6800 1.7289 1.7783 1.8278 1.8777 1.9277
 1.9777
 1.0502 1.1029 1.1510 1.1951 1.2416 1.2879 1.3343 1.3806 1.4270 1.4736
 1.5204 1.5677 1.6155 1.6638 1.7128 1.7633 1.8141 1.8637 1.9129 1.9622
 2.0114
 1.0511 1.1044 1.1541 1.1998 1.2484 1.2966 1.3445 1.3918 1.4394 1.4875
 1.5363 1.5848 1.6332 1.6821 1.7328 1.7827 1.8317 1.8804 1.9289 1.9774
 2.0259
 1.0497 1.1023 1.1520 1.1983 1.2472 1.2978 1.3469 1.3947 1.4428 1.4916
 1.5406 1.5890 1.6385 1.6876 1.7351 1.7825 1.8300 1.8772 1.9242 1.9712
 2.0182
 1.0447 1.0980 1.1472 1.1965 1.2451 1.2946 1.3429 1.3913 1.4400 1.4888
 1.5377 1.5864 1.6358 1.6837 1.7304 1.7778 1.8249 1.8710 1.9168 1.9627
 2.0085
 1.0412 1.0941 1.1443 1.1929 1.2408 1.2897 1.3385 1.3868 1.4348 1.4830
 1.5313 1.5802 1.6288 1.6755 1.7214 1.7681 1.8147 1.8600 1.9046 1.9493
 1.9939
 1.0293 1.0807 1.1311 1.1796 1.2278 1.2761 1.3239 1.3713 1.4184 1.4651
 1.5120 1.5590 1.6056 1.6509 1.6956 1.7399 1.7839 1.8272 1.8696 1.9114
 1.9531
 1.0186 1.0685 1.1177 1.1653 1.2120 1.2585 1.3041 1.3496 1.3947 1.4395
 1.4843 1.5291 1.5735 1.6172 1.6598 1.7007 1.7428 1.7848 1.8257 1.8656
 1.9049
 1.0112 1.0601 1.1086 1.1554 1.2010 1.2473 1.2923 1.3368 1.3811 1.4245
 1.4674 1.5107 1.5540 1.5973 1.6401 1.6799 1.7199 1.7608 1.8007 1.8395
 1.8770
 1.0046 1.0520 1.0994 1.1450 1.1896 1.2342 1.2785 1.3221 1.3650 1.4075
 1.4494 1.4913 1.5335 1.5755 1.6172 1.6579 1.6962 1.7360 1.7749 1.8125
 1.8490
  .9983 1.0440 1.0898 1.1342 1.1775 1.2208 1.2640 1.3064 1.3483 1.3896
 1.4305 1.4714 1.5124 1.5534 1.5943 1.6346 1.6724 1.7090 1.7467 1.7830
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 1.8184
/FLOE
H      GENERALIZED N1      (N1 ENGINES)
H      N1/SQRT THETA = F(FN/DELTA,MACH)
  DEGFNGEN102    =     1.0000
/TBLU
FNGEN102
6000.  8000.  10000. 12000. 15000. 20000. 25000. 30000. 35000. 40000.   FN/D
42000. 44000. 45000. 46000. 48000. 50000. 52000. 54000. 55000.        11FN/D
.3     .4     .5     .6     .7     .75    .8     .85    .9     .92    11MACH
57.480063.510668.579872.949778.455986.584193.080898.4414103.569109.104   .3N1
111.318113.969115.455117.058120.320124.545131.304139.840144.792          .3N1
60.713866.890071.697075.892281.136288.973194.9745100.073105.317110.706   .4
112.950115.950117.698119.650124.050129.206138.733151.114158.339          .4
64.209869.366373.648977.581983.029990.284095.9068100.947105.958111.435   .5
113.649116.795118.718120.874125.885131.828145.725164.545175.819          .5
67.006671.493175.659179.155184.282690.954196.4312101.238105.987111.143   .6
113.270116.271118.135120.204125.069130.808142.229157.320166.205          .6
69.482973.561577.057580.378785.302391.274696.3729100.976105.404110.066   .7
111.901114.552116.154117.961122.185127.167134.887144.501150.036          .7
70.386074.144277.494580.757585.302391.041596.1398100.510104.647109.279   .75
111.056113.416114.843116.417120.029124.253130.692138.645143.190          .75
70.939574.464777.698580.786685.302390.895995.644699.9272103.860108.376   .8
110.095112.280113.562114.931118.048121.631126.875133.285136.926          .8
71.347474.435577.407180.349684.690590.313294.974599.0823103.044107.269   .85
109.017110.998112.076113.212115.659118.369122.476127.516130.371          .85
71.551374.406477.232380.058384.195289.701494.246298.3540102.345106.336   .9
107.968109.716110.648111.610113.649115.805118.718122.098123.962          .9
71.376574.144276.911979.679583.816589.380993.954898.0626101.996105.958   .92
107.531109.192110.066110.940112.804114.727117.465120.699122.505          .92
/FLOE
H      INITIAL CLIMB FUEL: INCLUDES ALLOWANCES FROM BRAKE RELEASE TO 1500'
    DEGCLF01 = 1.0
/TBLU
TABCLOF01
400000.500000.600000.700000.750000.800000.850000.900000.              11
250.   375.                                                           11
0.     4000.  8000.                                                   11
1400.  1600.  1900.  2425.  2710.  3010.  3370.  3760.
1400.  1600.  1900.  2425.  2710.  3010.  3370.  3760.
1400.  1650.  2020.  2560.  2910.  3260.  3675.  4190.
1400.  1650.  2020.  2560.  2910.  3260.  3675.  4190.
1400.  1725.  2220.  2830.  3200.  3630.  4110.  4650.
1400.  1725.  2220.  2830.  3200.  3630.  4110.  4650.
/FLOE
H      INITIAL CLIMB TIME: INCLUDES ALLOWANCES FROM BRAKE RELEASE TO 1500'
    DEGCLT01 = 1.0
/TBLU
TABCLOT01
400000.500000.600000.700000.750000.800000.850000.900000.              11
250.   375.                                                           11
0.     4000.  8000.                                                   11
.019   .0205  .0268  .033   .036   .041   .045   .0505
.019   .0205  .0268  .033   .036   .041   .045   .0505
.022   .024   .029   .0375  .0425  .043   .053   .0605
.022   .024   .029   .0375  .0425  .043   .053   .0605
.025   .0285  .0355  .0458  .054   .061   .07    .08
.025   .0285  .0355  .0458  .054   .061   .07    .08
/FLOE
H      INITIAL CLIMB DIST.:  INCLUDES ALLOWANCES FROM 35' TO 1500'
    DEGCLD01 = 1.0
/TBLU
TABCLOD01
```

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400000.500000.600000.700000.750000.800000.850000.900000.                 11
250.   375.                                                               11
0.     4000.  8000.                                                       11
3.     3.3    3.9    5.5    6.4    7.4    8.5    10.0
3.     3.3    3.9    5.5    6.4    7.4    8.5    10.0
3.5    4.0    5.0    6.8    7.9    8.2    10.7   12.5
3.5    4.0    5.0    6.8    7.9    8.2    10.7   12.5
4.0    4.6    6.5    8.7    10.2   11.8   13.5   16.0
4.0    4.6    6.5    8.7    10.2   11.8   13.5   16.0
/FLOE
H      ENGINE OUT LRC SPEEDS
  DEGLRC02            1.0000
/TBLU
TABLRC02
.40000 .50000 .60000 .70000 .75000 .80000 .85000 .90000 .95000 1.00000
1.050001.100001.150001.200001.250001.300001.350001.400001.500001.60000
1.700001.750001.800001.850001.900001.950002.000002.100002.200002.25000
2.300002.350002.400002.450002.500002.550002.600002.650002.700002.75000
2.800002.850002.900003.000003.100003.200003.300003.400003.500003.6000011
0.      45000.                                                             1
 .36720 .38913 .41522 .44540 .46155 .47872 .49683 .51510 .53210 .54740
 .55947 .56967 .57825 .58582 .59373 .60010 .60690 .61327 .62620 .63920
 .65170 .65739 .66300 .66827 .67320 .67788 .68264 .69156 .69972 .70346
 .70686 .71018 .71324 .71621 .71952 .72208 .72488 .72743 .72956 .73109
 .73202 .73236 .73236 .73202 .73168 .73134 .73092 .73049 .73015 .72973
 .36720 .38913 .41522 .44540 .46155 .47872 .49683 .51510 .53210 .54740
 .55947 .56967 .57825 .58582 .59373 .60010 .60690 .61327 .62620 .63920
 .65170 .65739 .66300 .66827 .67320 .67788 .68264 .69156 .69972 .70346
 .70686 .71018 .71324 .71621 .71952 .72208 .72488 .72743 .72956 .73109
 .73202 .73236 .73236 .73202 .73168 .73134 .73092 .73049 .73015 .72973
/FLOE
H      ALL ENGINE LRC SPEEDS FOR GEAR DOWN
  DEGLRC03            1.0000
/TBLU
TABLRC03
.40000 .50000 .60000 .70000 .75000 .80000 .85000 .90000 .95000 1.00000
1.050001.100001.150001.200001.250001.300001.350001.400001.500001.60000
1.700001.750001.800001.850001.900001.950002.000002.100002.200002.25000
2.300002.350002.400002.450002.500002.550002.600002.650002.700002.75000
2.800002.850002.900003.000003.100003.200003.300003.400003.500003.6000011
0.      45000.                                                             1
 .32400 .34335 .36637 .39300 .40725 .42240 .43838 .45450 .46950 .48300
 .49365 .50265 .51022 .51690 .52387 .52950 .53550 .54112 .55252 .56400
 .57503 .58005 .58500 .58965 .59400 .59813 .60233 .61020 .61740 .62070
 .62370 .62663 .62933 .63195 .63487 .63713 .63960 .64185 .64372 .64507
 .64590 .64620 .64620 .64590 .64560 .64530 .64492 .64455 .64425 .64388
 .32400 .34335 .36637 .39300 .40725 .42240 .43838 .45450 .46950 .48300
 .49365 .50265 .51022 .51690 .52387 .52950 .53550 .54112 .55252 .56400
 .57503 .58005 .58500 .58965 .59400 .59813 .60233 .61020 .61740 .62070
 .62370 .62663 .62933 .63195 .63487 .63713 .63960 .64185 .64372 .64507
 .64590 .64620 .64620 .64590 .64560 .64530 .64492 .64455 .64425 .64388
/FLOE
H      HOLDING SPEEDS
  DEGMINWF01            2.0000
/TBLU
MINWF01
.40000 .50000 .60000 .70000 .80000 .90000 1.000001.100001.200001.30000
1.400001.500001.600001.700001.800001.900002.000002.100002.200002.30000
2.400002.500002.600002.700002.800002.862582.900003.000003.100003.20000
3.30000                                                                   11
0.      45000.                                                             1
.3103  .3469  .3800  .4104  .4388  .4654  .4906  .5145  .5374  .5593
.5805  .6008  .6205  .6396  .6582  .6762  .6938  .7109  .7276  .7440
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.7600  .7757  .7910  .8061  .8209  .83    .83    .83    .83    .83
.83
.3103  .3469  .3800  .4104  .4388  .4654  .4906  .5145  .5374  .5593
.5805  .6008  .6205  .6396  .6582  .6762  .6938  .7109  .7276  .7440
.7600  .7757  .7910  .8061  .8209  .83    .83    .83    .83    .83
.83
/AERO
H      ENGINE INOPERATIVE WINDMILLING DRAG
  DEGWM01      =     1.0000
/TBLU
DODWM01
 .15000 .20000 .30000 .40000 .50000 .60000 .70000 .80000 .90000 .9500011
 .00097 .00094 .00092 .00090 .00089 .00088 .00084 .00078 .00072 .00700
/AERO
H      POSITION ERROR IS ZERO
/TBLU
IAS01
  80.00 120.00 160.00 200.00 240.00 280.00 320.00 360.00 400.00       11
 15000. 20000. 25000. 30000. 45000.                                   11
    .0     .0    .0     .0    .0     .0     .0     .0     .0
    .0     .0    .0     .0    .0     .0     .0     .0     .0
    .0     .0    .0     .0    .0     .0     .0     .0     .0
    .0     .0    .0     .0    .0     .0     .0     .0     .0
    .0     .0    .0     .0    .0     .0     .0     .0     .0
/FLOE
H      FUEL BURN DURING FINAL APPROACH
/TBLU
TABAPPF01
400000.700000.                                                         1
780.   900.
/FLOE
H      TIME DURING FINAL APPROACH
/TBLU
TABAPPT01
400000.700000.                                                         1
.08    .061
/FLOE
H      DISTANCE TRAVELED DURING FINAL APPROACH
/TBLU
TABAPPD01
400000.700000.                                                         1
12.    12.
/FLOE
H      VMO/MMO
   VMOSPD01 = CAS
/TBLU
VMO01
0.     10000. 20000. 25000. 28740. 30000. 35000. 40000. 45000.        11
370.   370.   370.   370.   370.   360.   320.   290.   260.
MMO01
 28000. 45000.                                                        11
   .90    .90
/FLOE
H      MAC AND LEADING EDGE OF MAC IN INCHES
MAC = 327.8
LEMAC = 1258.0
/FLOE
H      FUEL BALANCE ARM FOR CENTER WING TANK
/TBLU
FBATABCW01
    670   2010   3350   4690   6030   7370   8710  10050  11390  12730  WEIGHT
  14070  15410  16750  18090  19430  20770  22110  23450  24790  26130  WEIGHT
  27470  28810  30150  31490  32830  34170  35510  36850  38190  39530  WEIGHT
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  40870  42210  43550  44890  46230  47570  48910  50250  51590  52930  WEIGHT
  54270  55610  56950  58290  59630  60970  62310  63650  64990  66330  WEIGHT
  67670  69010  70350  71690  73030  74370  75710  77050  78390  79730  WEIGHT
  81070  82410  83750  85090  86430  87770  89110  90450  91790  93130  WEIGHT
  94470  95810  97150  98490  99830 101170 102510 103850 105190 106530  WEIGHT
 107870 109210 110550 111890 113230 114570 114999                      1WEIGHT
1147.131145.081143.031140.981138.931136.881134.831132.781130.731128.69
1127.841127.101126.351125.611124.861124.181123.851123.521123.191122.86
1122.531122.251122.071121.891121.701121.521121.341121.201121.081120.97
1120.851120.741120.631120.551120.471120.391120.321120.241120.171120.11
1120.061120.011119.961119.901119.861119.821119.781119.741119.711119.67
1119.641119.611119.581119.551119.531119.501119.481119.461119.431119.41
1119.391119.371119.241119.111118.981118.851118.721118.491118.211117.93
1117.651117.371116.981116.561116.151115.741115.251114.711114.181113.63
1112.971112.321111.641110.861110.071109.151108.85
/FLOE
H      FUEL BALANCE ARM FOR MAIN TANKS #1 OR #4
/TBLU
FBATABM1401
  670.0 1340.0 2010.0 2680.0 3350.0 4020.0 4690.0 5360.0 6030.0 6700.0  WEIGHT
 7370.0 8040.0 8710.0 9380.010050.010720.011390.012060.012730.013400.0  WEIGHT
14070.014740.015410.016080.016750.017420.018090.018760.019430.020100.0  WEIGHT
20770.021440.022110.022780.023450.024120.024790.025460.026130.026800.0  WEIGHT
27470.028140.028810.029480.030150.030190.0                             1WEIGHT
1423.491420.621419.161419.821420.471421.661422.901424.151425.421426.70
1427.981429.261430.411431.521432.631433.741434.831435.881436.931437.98
1439.031440.381441.931443.471445.021446.671448.651450.631452.611454.69
1456.951459.221461.491463.971466.481468.991471.601474.251476.901479.71
1482.511485.401488.351491.311494.311494.49
/FLOE
H      FUEL BALANCE ARM FOR MAIN TANKS #2 OR #3
/TBLU
FBATABM2301
  670.0 1340.0 2010.0 2680.0 3350.0 4020.0 4690.0 5360.0 6030.0 6700.0  WEIGHT
 8040.0 9380.010720.012060.013400.014740.016080.017420.018760.020100.0  WEIGHT
21440.022780.024120.025460.026800.028140.029480.030820.032160.033500.0  WEIGHT
34840.036180.037520.038860.040200.041540.042880.044220.045560.046900.0  WEIGHT
48240.049580.050920.052260.053600.054940.056280.057620.058960.060300.0  WEIGHT
61640.062980.064320.065660.067000.068340.069680.071020.072360.073700.0  WEIGHT
75040.076380.077720.079060.080400.081740.083080.083750.084058.0        1WEIGHT
1150.321148.621148.711148.811149.481150.191150.891151.711152.591153.48
1155.251157.031158.811160.551162.231163.911165.591167.141168.701170.25
1171.791173.211174.641176.061177.491178.851180.161181.481182.801184.12
1185.391186.611187.831189.051190.271191.491192.621193.711194.811195.90
1197.001198.101199.141200.151201.151202.151203.151204.161205.151205.94
1206.721207.511208.291209.081209.861210.491211.091211.691212.291212.89
1213.451213.921214.381214.851215.321215.841216.391216.661216.78
/FLOE
H      FUEL BALANCE ARM FOR RESERVE TANKS #2 OR #3
/TBLU
FBATABR2301
 670.001340.002010.002680.003350.004020.004690.005360.006030.006700.00  WEIGHT
7370.008040.008697.00                                                  1WEIGHT
1673.401678.011681.131684.251687.981692.331697.151702.261707.651713.36
1719.281725.381731.64
/FLOE
H      FUEL BALANCE ARM FOR TAIL TANK
/TBLU
FBATABTT01
  670.0 1340.0 2010.0 2680.0 3350.0 4020.0 4690.0 5360.0 6030.0 6700.0  WEIGHT
 7370.0 8040.0 8710.0 9380.010050.010720.011390.012060.012730.013400.0  WEIGHT
14070.014740.015410.016080.016750.017420.018090.018760.019430.020100.0  WEIGHT
20770.021440.022110.0                                                  1WEIGHT
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2505.312512.062516.332519.522521.422523.182524.562525.892527.042528.19
2529.202530.202531.132531.942532.762533.502534.222534.932535.632536.32
2537.012537.642538.252538.852539.522540.212540.912541.782542.672543.70
2544.802546.022547.36
/FLOE
H      POWER EXTRACTION COEFFICIENTS AND CONSTANT
A0 = 15.0
A1 = 1.4
NOMHP = 55.0
/FLOE
H      NON-STANDARD BLEED FUEL FLOW FACTORS
FFFAC1 = 1.00
FFFAC2 = 1.00
FFFAC3 = 1.00
/FLOE
H      FUEL FLOW CORRECTION TABLE  (100 HPX)
H      EPR ENGINES
  DEGWFSTR01     =    1.
/TBLU
WFSTAR01
 0.9500 1.0000 1.0500 1.1000 1.2000 1.4000 1.6000 1.8000               1EPR
 .30000 .50000 .60000 .70000 .80000 .90000                             1MACH
 1.6055 1.0925 0.7885 0.4845 0.3230 0.1710 0.0950 0.0570                .300
 0.7790 0.5985 0.4180 0.3610 0.2565 0.1710 0.0950 0.0570                .500
 0.5605 0.4655 0.3610 0.3230 0.2280 0.1615 0.0950 0.0570                .600
 0.4655 0.3895 0.3135 0.2850 0.2185 0.1425 0.0855 0.0570                .700
 0.3135 0.2660 0.2185 0.1995 0.1520 0.1140 0.0760 0.0570                .800
 0.1995 0.1710 0.1425 0.1330 0.1140 0.0855 0.0665 0.0570                .900
/FLOE
H      FUEL FLOW CORRECTION TABLE  (100 HPX)
H      N1 ENGINES
H      THIS WFSTAR TABLE WAS CONVERTED FROM REFFERED N1 (RPM) TO
H      A PERCENT N1 (%N1) TO BE USED IN THE APM PROGRAM.
  DEGWFSTR02     =    1.
/TBLU
WFSTAR02
   25.0   27.5   30.0   32.5   35.0   37.5   40.0   42.5   45.0   47.5  RN1
   50.0   52.5   55.0   57.5   60.0   62.5   65.0   67.5   70.0   72.5  RN1
   75.0   77.5   80.0   82.5   85.0   87.5   90.0   92.5   95.0   97.5  RN1
  100.0  102.5  105.0  107.5  110.0                                    1RN1
 .00000 .10000 .20000 .30000 .40000 .50000 .60000 .70000 .80000 .90000 1MACH
 3.7043 3.1892 2.4953 2.2054 2.0880 1.8527 1.6594 1.4984 1.3623 1.2478  .000
 1.1359 1.0250 0.9273 0.8449 0.7687 0.6977 0.6373 0.5796 0.5228 0.4729  .000
 0.4295 0.3916 0.3602 0.3277 0.2933 0.2625 0.2365 0.2146 0.2036 0.1940  .000
 0.1774 0.1594 0.1414 0.1234 0.1054                                     .000
 3.7576 3.2196 2.6521 2.3342 2.1278 1.8870 1.6893 1.5249 1.3861 1.2699  .100
 1.1543 1.0391 0.9383 0.8532 0.7746 0.7021 0.6411 0.5823 0.5252 0.4756  .100
 0.4320 0.3938 0.3621 0.3282 0.2925 0.2603 0.2368 0.2200 0.2080 0.1945  .100
 0.1750 0.1544 0.1338 0.1131 0.0925                                     .100
 3.7909 3.2501 2.8089 2.4631 2.1676 1.9213 1.7193 1.5514 1.4100 1.2919  .200
 1.1725 1.0532 0.9491 0.8615 0.7806 0.7065 0.6448 0.5851 0.5275 0.4781  .200
 0.4344 0.3959 0.3639 0.3289 0.2918 0.2582 0.2371 0.2252 0.2123 0.1948  .200
 0.1728 0.1499 0.1269 0.1040 0.0810                                     .200
 3.7056 3.3770 3.0485 2.7198 2.3949 2.1068 1.8681 1.6728 1.5102 1.3754  .300
 1.2397 1.1075 0.9951 0.9009 0.8129 0.7329 0.6662 0.6016 0.5406 0.4889  .300
 0.4435 0.4042 0.3709 0.3362 0.3018 0.2711 0.2479 0.2298 0.2125 0.1959  .300
 0.1801 0.1645 0.1490 0.1334 0.1178                                     .300
 3.9520 3.6188 3.2858 2.9527 2.6196 2.2924 2.0169 1.7941 1.6103 1.4589  .400
 1.3067 1.1618 1.0410 0.9403 0.8452 0.7593 0.6875 0.6182 0.5538 0.4997  .400
 0.4526 0.4125 0.3778 0.3434 0.3116 0.2840 0.2585 0.2343 0.2128 0.1973  .400
 0.1873 0.1790 0.1706 0.1623 0.1539                                     .400
 3.4114 3.1933 2.9752 2.7572 2.5392 2.3211 2.1031 1.8850 1.6801 1.4914  .500
 1.3340 1.2045 1.0791 0.9640 0.8683 0.7829 0.6997 0.6258 0.5636 0.5080  .500
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 0.4599 0.4194 0.3809 0.3462 0.3168 0.2878 0.2605 0.2376 0.2160 0.1966  .500
 0.1799 0.1641 0.1482 0.1323 0.1165                                     .500
 3.6727 3.4399 3.2072 2.9745 2.7417 2.5089 2.2762 2.0434 1.8107 1.5789  .600
 1.3817 1.2221 1.0922 0.9878 0.8895 0.8002 0.7202 0.6503 0.5938 0.5370  .600
 0.4810 0.4337 0.3915 0.3530 0.3205 0.2903 0.2596 0.2315 0.2087 0.1935  .600
 0.1805 0.1641 0.1493 0.1396 0.1308                                     .600
 3.9512 3.6980 3.4447 3.1914 2.9382 2.6849 2.4316 2.1783 1.9251 1.6728  .700
 1.4571 1.2844 1.1400 1.0188 0.9134 0.8211 0.7363 0.6619 0.6001 0.5421  .700
 0.4854 0.4367 0.3934 0.3544 0.3209 0.2901 0.2612 0.2329 0.2100 0.1916  .700
 0.1748 0.1584 0.1444 0.1342 0.1248                                     .700
 4.2286 3.9549 3.6812 3.4076 3.1340 2.8603 2.5866 2.3129 2.0393 1.7666  .800
 1.5325 1.3468 1.1878 1.0497 0.9375 0.8421 0.7526 0.6734 0.6065 0.5470  .800
 0.4897 0.4399 0.3954 0.3556 0.3211 0.2898 0.2628 0.2345 0.2114 0.1898  .800
 0.1690 0.1526 0.1395 0.1290 0.1190                                     .800
 4.6983 4.3879 4.0774 3.7670 3.4566 3.1461 2.8357 2.5253 2.2148 1.9056  .900
 1.6360 1.4212 1.2549 1.1526 1.0170 0.8853 0.7940 0.7172 0.6447 0.5788  .900
 0.5200 0.4678 0.4196 0.3756 0.3356 0.3002 0.2690 0.2405 0.2165 0.1940  .900
 0.1764 0.1510 0.1368 0.1264 0.1169                                     .900
H      TRIM DRAG CORRECTION    DELTA CD = F(M.CL)
/TBLU
CGTRIM01
 .30000 .40000 .50000 .60000 .69900 .70000 .80000 .84000 .88000        1MACH
 .36000 .38000 .40000 .42000 .44000 .46000 .48000 .50000               1CL
 .00007 .00007 .00007 .00007 .00007 .00007 .00009 .00014 .00043         .360
 .00008 .00008 .00008 .00008 .00008 .00008 .00011 .00016 .00051         .380
 .00009 .00009 .00009 .00009 .00009 .00009 .00013 .00018 .00059         .400
 .00011 .00011 .00011 .00011 .00011 .00011 .00014 .00022 .00066         .420
 .00014 .00014 .00014 .00014 .00014 .00014 .00017 .00026 .00085         .440
 .00016 .00016 .00016 .00016 .00016 .00016 .00021 .00031 .00100         .460
 .00019 .00019 .00019 .00019 .00019 .00019 .00025 .00037 .00123         .480
 .00023 .00023 .00023 .00023 .00023 .00023 .00030 .00043 .00142         .500
H      TRIM DRAG FACTOR   CGK = F(CGT)
/TBLU
KTRIM01
.082200.100000.120000.140000.160000.180000.190000.250000.270000.290000 1CGT
1.06500.880000.660000.460000.280000.130000.065000.000000-.11000-.19000  CGK
/FLOE
H      GENERALIZED ENGINE N1
H      PERCENT CN1 = F(IEPR2T,MACH)
H      REFERENCE CN1 = 3900.
  DEGN1101     =     1.0000
  EXTHETA1101  =     .50000
/TBLU
N1GEN101
 1.1000 1.1500 1.2000 1.2500 1.3000 1.3500 1.4000 1.4500 1.5000 1.5500
 1.6000 1.6500 1.7000 1.7500 1.8000                                  11
  .1000  .2000  .3000  .4000  .5000  .6000  .7000  .8000  .9000 1.000011
  49.00  56.40  62.70  68.20  72.90  77.20  80.90  84.20  87.20  89.90
  92.60  95.40  98.40 101.70 105.40
  50.00  57.30  63.70  69.00  73.50  77.60  81.30  84.50  87.50  90.10
  92.70  95.50  98.40 101.70 105.40
  51.50  58.60  64.80  69.90  74.40  78.40  81.80  85.00  87.80  90.40
  93.00  95.60  98.60 101.90 105.50
  53.50  60.50  66.30  71.40  75.70  79.40  82.50  85.50  88.10  90.70
  93.20  95.80  98.70 102.10 105.70
  56.40  62.70  68.10  72.70  76.70  80.20  83.20  85.90  88.50  91.00
  93.50  96.10  99.00 102.30 106.00
  59.60  65.00  69.60  73.70  77.50  80.80  83.70  86.30  88.80  91.40
  93.80  96.40  99.30 102.50 106.30
  61.20  66.00  70.40  74.40  78.10  81.30  84.20  86.80  89.30  91.70
  94.10  96.70  99.50 102.80 106.60
  61.90  66.70  71.00  74.90  78.40  81.60  84.50  87.10  89.60  91.90
  94.30  96.90  99.70 103.00 106.80
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  62.40  67.10  71.30  75.20  78.70  81.90  84.70  87.40  89.80  92.10
  94.50  97.00  99.90 103.20 107.00
  62.80  67.40  71.50  75.40  78.90  82.10  84.90  87.50  89.90  92.20
  94.60  97.10 100.00 103.30 107.20
/FLOE
H      GENERALIZED ENGINE N2
H      PERCENT CN2 = F(IEPR2T,MACH)
H      REFERENCE CN2 = 7000.
  DEGN2101     =     1.0000
  EXTHETA2101  =     .50000
/TBLU
N2GEN101
 1.1000 1.1500 1.2000 1.2500 1.3000 1.3500 1.4000 1.4500 1.5000 1.5500
 1.6000 1.6500 1.7000 1.7500 1.8000                                    11
  .1000  .2000  .3000  .4000  .5000  .6000  .7000  .8000  .9000 1.000011
  78.40  81.20  83.60  95.90  87.90  89.70  91.40  93.00  94.50  95.90
  97.30  98.70 100.10 101.50 102.90
  79.10  81.70  84.00  86.10  88.10  89.80  91.50  93.10  94.50  95.90
  97.30  98.70 100.10 101.50 102.90
  79.80  82.20  84.50  86.40  88.30  90.10  91.70  93.20  94.60  96.00
  97.30  98.70 100.10 101.50 102.90
  80.50  82.80  84.90  86.90  88.70  90.40  91.90  93.30  94.70  96.00
  97.30  98.70 100.10 101.50 102.90
  81.10  83.30  85.40  87.30  89.00  90.60  92.00  93.40  94.70  96.00
  97.40  98.70 100.10 101.50 102.90
  81.80  83.90  85.80  87.60  89.20  90.70  92.20  93.50  94.70  96.00
  97.40  98.70 100.10 101.50 102.90
  82.40  84.40  86.20  87.80  89.40  90.80  92.30  93.60  94.80  96.10
  97.40  98.70 100.10 101.50 102.90
  82.90  84.70  86.30  88.00  89.50  90.90  92.30  93.60  94.80  96.10
  97.40  98.70 100.10 101.50 102.90
  83.20  84.90  86.50  88.10  89.60  91.00  92.40  93.70  94.90  96.10
  97.40  98.70 100.10 101.50 102.90
  83.40  85.10  86.70  88.20  89.70  91.10  92.40  93.70  94.90  96.20
  97.40  98.70 100.10 101.50 102.90
/FLOE
H      GENERALIZED ENGINE N3
H      PERCENT CN3 = F(IEPR2T,MACH)
H      REFERENCE CN3 = 10611.
  DEGN3101     =     1.0000
  EXTHETA3101  =     .48700
/TBLU
N3GEN101
 1.1000 1.1500 1.2000 1.2500 1.3000 1.3500 1.4000 1.4500 1.5000 1.5500
 1.6000 1.6500 1.7000 1.7500 1.8000                                    11
  .1000  .2000  .3000  .4000  .5000  .6000  .7000  .8000  .9000 1.000011
 74.600 77.000 79.200 81.100 82.900 84.500 85.900 87.300 88.600 89.800
 91.000 92.100 93.300 94.500 95.900
 75.000 77.300 79.400 81.300 83.000 84.600 86.000 87.400 88.600 89.800
 91.000 92.100 93.300 94.500 95.900
 75.400 77.700 79.700 81.500 83.200 84.700 86.100 87.400 88.600 89.800
 91.000 92.100 93.300 94.500 95.900
 75.800 78.000 79.900 81.700 83.300 84.800 86.200 87.500 88.600 89.800
 91.000 92.100 93.300 94.500 95.900
 76.200 78.300 80.200 81.900 83.500 84.900 86.200 87.500 88.700 89.800
 91.000 92.100 93.300 94.500 95.900
 76.600 78.600 80.400 82.000 83.600 85.000 86.300 87.500 88.700 89.800
 91.000 92.100 93.300 94.500 95.900
 76.900 78.800 80.600 82.100 83.600 85.000 86.300 87.500 88.700 89.800
 91.000 92.100 93.300 94.500 95.900
 77.100 78.900 80.700 82.200 83.700 85.000 86.300 87.500 88.700 89.800
 91.000 92.100 93.300 94.500 95.900
 77.200 79.000 80.700 82.200 83.700 85.000 86.300 87.500 88.700 89.800
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 91.000 92.100 93.300 94.500 95.900
 77.200 79.000 80.700 82.200 83.700 85.000 86.300 87.500 88.700 89.800
 91.000 92.100 93.300 94.500 95.900
/FLOE
H      GENERALIZED ENGINE EGT
H      CORRECTED EGT = F(IEPR2T,MACH,ALT)
  DEGEGT101    =     1.0000
  EXTHETAG101  =     .97000
/TBLU
EGTGEN101
 1.1000 1.1500 1.2000 1.2500 1.3000 1.3500 1.4000 1.4500 1.5000 1.5500
 1.6000 1.6500 1.7000 1.7500 1.8000                                     11
  .1000  .2000  .3000  .4000  .5000  .6000  .7000  .8000  .9000 1.000011
 0.     45000.                                                          11
 668.05 701.85 733.55 763.15 790.55 816.95 842.05 866.15 891.55 915.85
 940.55 966.25 992.751020.051049.05
 669.05 704.25 736.65 766.55 793.75 819.65 844.55 868.85 894.05 918.45
 943.05 968.95 995.351022.751052.15
 668.75 703.55 735.85 765.65 792.85 818.95 843.85 868.15 893.35 917.75
 942.35 968.15 994.651022.051051.35
 670.65 706.05 738.65 768.55 795.65 821.45 846.15 870.65 895.75 920.25
 944.75 970.45 997.051024.351054.05
 673.35 708.85 741.55 771.35 798.35 823.95 848.65 873.35 898.45 922.85
 947.25 972.75 999.451026.751056.75
 678.65 712.65 744.35 773.75 800.85 826.55 851.25 876.05 901.15 925.75
 950.05 975.451001.851029.451059.85
 682.75 715.95 747.05 776.25 803.55 829.35 854.05 878.95 904.15 928.65
 952.75 978.151004.551032.151063.15
 694.65 725.75 755.65 784.45 811.95 838.35 864.25 889.65 914.45 938.75
 962.95 987.851014.251041.951074.85
 690.25 722.25 752.75 781.65 808.95 834.95 860.45 885.85 910.65 935.05
 959.15 984.251010.651038.151070.55
 685.45 718.45 749.45 778.65 805.85 831.75 856.65 881.95 906.95 931.25
 955.35 980.651007.051034.551066.25
 668.05 701.85 733.55 763.15 790.55 816.95 842.05 866.15 891.55 915.85
 940.55 966.25 992.751020.051049.05
 669.05 704.25 736.65 766.55 793.75 819.65 844.55 868.85 894.05 918.45
 943.05 968.95 995.351022.751052.15
 668.75 703.55 735.85 765.65 792.85 818.95 843.85 868.15 893.35 917.75
 942.35 968.15 994.651022.051051.35
 670.65 706.05 738.65 768.55 795.65 821.45 846.15 870.65 895.75 920.25
 944.75 970.45 997.051024.351054.05
 673.35 708.85 741.55 771.35 798.35 823.95 848.65 873.35 898.45 922.85
 947.25 972.75 999.451026.751056.75
 678.65 712.65 744.35 773.75 800.85 826.55 851.25 876.05 901.15 925.75
 950.05 975.451001.851029.451059.85
 682.75 715.95 747.05 776.25 803.55 829.35 854.05 878.95 904.15 928.65
 952.75 978.151004.551032.151063.15
 694.65 725.75 755.65 784.45 811.95 838.35 864.25 889.65 914.45 938.75
 962.95 987.851014.251041.951074.85
 690.25 722.25 752.75 781.65 808.95 834.95 860.45 885.85 910.65 935.05
 959.15 984.251010.651038.151070.55
 685.45 718.45 749.45 778.65 805.85 831.75 856.65 881.95 906.95 931.25
 955.35 980.651007.051034.551066.25
/FLOE
H      GENERALIZED ENGINE N2
H      PERCENT RN2 = F(PERCENT RN1,MACH)
H      REFERENCE RN2 = 9827.
  DEGN2102     =     1.0000
  EXTHETA2102  =     .50000
/TBLU
N2GEN102
  50.00  55.00  60.00  65.00  70.00  75.00  80.00  85.00  90.00  95.00
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 100.00 105.00 110.00 115.00 120.00                                        11
  .1000  .2000  .3000  .4000  .5000  .6000  .7000  .8000  .9000 1.000011
  83.93  85.99  88.04  90.00  91.93  93.84  95.73  97.68  99.54 101.59
 103.64 105.57 107.43 109.10 110.71
  83.86  85.89  87.93  89.95  91.90  93.79  95.68  97.67  99.49 101.49
 103.50 105.40 107.21 108.88 110.51
  83.84  85.87  87.91  89.91  91.84  93.73  95.62  97.60  99.46 101.43
 103.42 105.32 107.12 108.78 110.42
  83.22  85.31  87.39  89.40  91.46  93.52  95.48  97.45  99.25 101.16
 103.10 105.03 106.91 108.59 110.18
  82.57  84.73  86.88  89.07  91.17  93.19  95.18  97.18  99.08 100.97
 102.95 104.97 106.88 108.59 110.10
  81.98  84.21  86.44  88.53  90.68  92.82  94.86  96.91  98.95 100.87
 102.91 105.05 106.97 108.67 110.11
  80.85  83.29  85.72  88.07  90.23  92.29  94.43  96.65  98.71 100.66
 102.68 104.75 106.59 108.10 109.57
  80.10  82.63  85.16  87.61  89.89  92.03  94.16  96.45  98.47 100.46
 102.54 104.69 106.73 108.20 109.60
  78.89  81.83  84.76  87.09  89.43  91.77  93.93  96.10  98.24 100.34
 102.57 104.79 106.54 107.97 109.15
  77.69  81.02  84.35  86.56  88.97  91.51  93.69  95.76  98.01 100.22
 102.58 104.85 106.37 107.74 108.72
/FLOE
H      GENERALIZED ENGINE EGT
H      CORRECTED EGT = F(PRCT RN1,MACH,ALT)
  DEGEGT102    =     1.0000
  EXTHETAG102  =     .84000
/TBLU
EGTGEN102
  50.00  55.00  60.00  65.00  70.00  75.00  80.00  85.00  90.00  95.00
 100.00 105.00 110.00 115.00 120.00                                        11
  .1000  .2000  .3000  .4000  .5000  .6000  .7000  .8000  .9000 1.000011
 0.     45000.                                                             11
  693.9  722.2  750.5  783.4  819.0  856.9  897.2  941.7  989.2 1038.0
 1086.4 1132.3 1173.8 1213.7 1255.6
  708.8  736.4  764.0  789.5  821.4  859.3  899.6  944.1  991.6 1040.5
 1089.0 1134.9 1176.0 1215.9 1257.7
  702.9  732.5  762.0  787.8  819.7  858.0  899.3  943.8  991.3 1040.2
 1088.7 1134.7 1175.8 1215.5 1257.4
  689.7  720.2  750.8  784.1  815.8  850.2  892.7  938.8  987.3 1036.6
 1085.3 1131.8 1174.5 1216.0 1258.1
  672.7  704.5  736.2  764.3  799.3  840.9  885.0  932.3  981.8 1031.7
 1081.0 1128.5 1173.0 1215.4 1257.6
  659.0  691.8  724.5  760.7  795.2  829.3  867.5  916.0  966.2 1017.0
 1071.9 1127.6 1173.6 1215.9 1258.2
  650.9  686.3  721.8  760.0  801.0  843.8  884.4  910.9  958.4 1011.1
 1064.4 1117.4 1171.8 1207.4 1242.5
  635.2  676.5  717.9  759.9  802.5  845.9  888.9  924.7  963.8 1012.3
 1065.0 1118.9 1173.4 1209.0 1244.2
  591.8  631.8  671.9  715.8  761.3  809.0  857.5  893.9  945.3 1002.2
 1059.7 1115.8 1170.9 1206.4 1241.7
  548.4  587.2  625.9  671.7  720.1  772.0  827.3  873.4  929.5  992.1
 1058.7 1121.4 1168.4 1203.8 1239.1
  693.9  722.2  750.5  783.4  819.0  856.9  897.2  941.7  989.2 1038.0
 1086.4 1132.3 1173.8 1213.7 1255.6
  708.8  736.4  764.0  789.5  821.4  859.3  899.6  944.1  991.6 1040.5
 1089.0 1134.9 1176.0 1215.9 1257.7
  702.9  732.5  762.0  787.8  819.7  858.0  899.3  943.8  991.3 1040.2
 1088.7 1134.7 1175.8 1215.5 1257.4
  689.7  720.2  750.8  784.1  815.8  850.2  892.7  938.8  987.3 1036.6
 1085.3 1131.8 1174.5 1216.0 1258.1
  672.7  704.5  736.2  764.3  799.3  840.9  885.0  932.3  981.8 1031.7
 1081.0 1128.5 1173.0 1215.4 1257.6
```

```
  659.0  691.8  724.5  760.7  795.2  829.3  867.5  916.0  966.2 1017.0
 1071.9 1127.6 1173.6 1215.9 1258.2
  650.9  686.3  721.8  760.0  801.0  843.8  884.4  910.9  958.4 1011.1
 1064.4 1117.4 1171.8 1207.4 1242.5
  635.2  676.5  717.9  759.9  802.5  845.9  888.9  924.7  963.8 1012.3
 1065.0 1118.9 1173.4 1209.0 1244.2
  591.8  631.8  671.9  715.8  761.3  809.0  857.5  893.9  945.3 1002.2
 1059.7 1115.8 1170.9 1206.4 1241.7
  548.4  587.2  625.9  671.7  720.1  772.0  827.3  873.4  929.5  992.1
 1058.7 1121.4 1168.4 1203.8 1239.1
/FLOE
H      CL ALPHA CURVE
/TBLU
CLALPHA01
.35    .6                                                            1
.265   .562                                                          1
.242   .6                                                            1
.18    .638                                                          1
.18    .636                                                          1
.214   .56                                                           1
.228   .535                                                          1
.236   .572                                                          1
.249   .401                                                          11
.4     .5     .6     .7     .75    .8     .82    .84    .86          11
2.     4.65
1.     4.1
.75    4.25
.1     4.25
.07    3.9
.25    2.9
.25    2.55
.25    2.6
.25    1.25
/FLOE
H      APU FUEL FLOW  (LBS/HR)
/TBLU
APUWF01            APU FUEL FLOW  (LBS/HR)
0.     20000. 40000. 55000.                                          11 ALT
.1     .9                                                            11MACH
690.   690.   690.   690.
690.   690.   690.   690.
/FLOE
H      COST INDEX SPEEDS
ECTHETA01 = .62
DEGECR01 = 6.
ECLSPDTYP = CAS
ECRSPDTYP = MACH
EDSSPDTYP = CAS
/TBLU
ECONCRSPD01          ECON CRUISE SPEED
 0.3000 0.5000 0.7000 0.9000 1.1000 1.3000 1.5000 1.6000 1.7000 1.8000  WEIGHTD
 1.9000 2.0000 2.1000 2.2000 2.3000 2.4000 2.5000 2.6000 2.7000 2.8000  WEIGHTD
 2.9000 3.0000 3.1000 3.2000 3.3000 3.4000 3.5000 3.6000               1WEIGHTD
      0    150    250    350    450    550    650    750    850    950  CCI
   1050   1550   2050   2550   3050   3550   4050   4550   5050   5550  CCI
   6050   6550   7050   8050   9050  10050  12050  14050  16050  18050  CCI
  30000  40000                                                         1CCI
 .386   .472   .540   .591   .629   .663   .681   .698   .715   .731
 .745   .759   .771   .782   .792   .801   .809   .817   .823   .828
 .832   .835   .837   .839   .841   .842   .843   .843
 .463   .527   .583   .628   .665   .696   .711   .725   .738   .751
 .762   .773   .784   .793   .802   .811   .819   .825   .831   .835
 .837   .840   .841   .843   .843   .844   .844   .844
```

.533	.574	.615	.655	.691	.721	.734	.745	.756	.766
.775	.785	.793	.802	.810	.818	.825	.831	.836	.839
.841	.843	.844	.844	.845	.845	.845	.845		
.591	.613	.643	.677	.713	.740	.752	.761	.770	.778
.786	.794	.802	.809	.817	.824	.830	.835	.839	.842
.844	.845	.845	.846	.846	.846	.846	.846		
.632	.645	.668	.698	.730	.756	.766	.775	.782	.789
.796	.803	.809	.816	.823	.829	.834	.839	.842	.845
.846	.847	.847	.847	.847	.847	.847	.847		
.661	.673	.694	.719	.747	.770	.779	.786	.793	.799
.805	.811	.817	.823	.828	.833	.839	.843	.846	.848
.848	.849	.849	.849	.849	.849	.849	.849		
.687	.700	.719	.741	.763	.782	.789	.796	.802	.807
.813	.818	.823	.828	.833	.838	.843	.847	.849	.851
.851	.851	.851	.851	.850	.850	.850	.850		
.712	.723	.739	.758	.778	.794	.800	.805	.809	.814
.818	.823	.828	.833	.838	.842	.847	.851	.853	.854
.853	.853	.853	.852	.852	.853	.851	.851		
.732	.742	.756	.773	.790	.804	.809	.812	.816	.819
.823	.828	.832	.837	.842	.847	.851	.854	.855	.855
.855	.855	.854	.854	.853	.853	.853	.852		
.749	.758	.771	.785	.800	.812	.816	.819	.822	.825
.828	.832	.837	.841	.846	.851	.854	.856	.857	.857
.856	.856	.855	.855	.854	.854	.853	.853		
.764	.772	.782	.795	.808	.818	.822	.825	.827	.830
.833	.837	.841	.845	.850	.853	.856	.858	.858	.858
.857	.856	.856	.855	.855	.855	.854	.854		
.813	.817	.822	.827	.834	.840	.843	.846	.849	.851
.853	.855	.857	.858	.860	.861	.862	.863	.862	.862
.860	.859	.858	.857	.856	.856	.855	.855		
.839	.841	.843	.847	.851	.856	.858	.860	.862	.863
.864	.864	.865	.865	.865	.865	.866	.866	.866	.865
.863	.862	.860	.859	.858	.857	.856	.856		
.852	.853	.855	.857	.861	.865	.866	.867	.868	.869
.870	.870	.869	.869	.869	.869	.869	.868	.867	.866
.865	.863	.862	.860	.859	.858	.857	.856		
.860	.861	.862	.863	.866	.869	.870	.872	.873	.874
.874	.874	.874	.873	.873	.872	.871	.870	.869	.868
.866	.865	.863	.861	.860	.859	.858	.857		
.865	.866	.867	.868	.869	.872	.874	.876	.878	.879
.879	.879	.878	.877	.876	.875	.874	.872	.871	.869
.868	.866	.864	.863	.861	.860	.859	.858		
.870	.870	.871	.872	.874	.877	.879	.881	.882	.883
.883	.882	.881	.880	.879	.877	.875	.874	.872	.870
.869	.867	.866	.864	.863	.861	.860	.859		
.875	.876	.876	.878	.880	.883	.884	.885	.886	.886
.885	.885	.883	.882	.880	.878	.876	.875	.873	.872
.870	.869	.867	.866	.864	.863	.861	.860		
.881	.881	.882	.883	.885	.887	.888	.888	.888	.887
.887	.886	.885	.883	.882	.880	.878	.876	.874	.873
.871	.870	.868	.867	.865	.864	.862	.861		
.885	.885	.886	.887	.888	.889	.889	.889	.889	.889
.888	.887	.886	.885	.883	.881	.879	.877	.875	.874
.872	.871	.869	.868	.866	.865	.863	.861		
.887	.888	.888	.889	.889	.889	.890	.890	.890	.890
.889	.889	.888	.886	.884	.882	.880	.879	.877	.875
.874	.872	.870	.869	.867	.865	.864	.862		
.888	.889	.889	.889	.890	.890	.890	.891	.891	.891
.891	.890	.889	.888	.886	.884	.882	.880	.878	.876
.875	.873	.871	.869	.868	.866	.864	.863		
.890	.890	.890	.891	.891	.891	.892	.892	.892	.892
.892	.891	.890	.889	.887	.885	.883	.882	.880	.878
.876	.874	.872	.870	.869	.867	.865	.863		

```
 .895   .895   .896   .896   .897   .897   .897   .896   .896   .895
 .895   .894   .893   .892   .890   .889   .887   .885   .882   .880
 .878   .876   .877   .872   .870   .868   .866   .864
 .898   .899   .899   .899   .899   .899   .899   .899   .899   .898
 .898   .897   .896   .895   .894   .893   .892   .890   .888   .886
 .884   .881   .879   .876   .874   .871   .868   .866
 .901   .901   .901   .901   .901   .901   .901   .901   .901   .901
 .900   .900   .899   .898   .897   .896   .895   .894   .892   .890
 .888   .886   .883   .880   .877   .873   .870   .867
 .904   .904   .903   .903   .903   .903   .903   .903   .903   .903
 .903   .902   .902   .901   .901   .900   .898   .897   .896   .894
 .892   .889   .886   .883   .879   .876   .873   .869
 .906   .906   .906   .906   .906   .906   .906   .906   .906   .906
 .905   .905   .905   .904   .904   .903   .902   .900   .899   .897
 .895   .892   .889   .885   .882   .878   .875   .872
 .909   .909   .909   .909   .909   .909   .908   .908   .908   .908
 .908   .908   .908   .907   .906   .906   .904   .903   .901   .899
 .897   .894   .891   .887   .884   .881   .877   .874
 .911   .911   .911   .911   .911   .911   .911   .911   .911   .911
 .910   .910   .910   .910   .909   .908   .907   .905   .903   .901
 .898   .895   .892   .889   .886   .883   .880   .876
 .918   .918   .918   .918   .918   .918   .918   .918   .918   .918
 .918   .918   .917   .917   .916   .914   .913   .911   .908   .906
 .903   .900   .897   .894   .891   .888   .885   .882
 .923   .923   .923   .923   .923   .923   .923   .923   .922   .922
 .922   .922   .921   .920   .920   .919   .917   .915   .914   .911
 .909   .906   .903   .900   .897   .894   .891   .888
ECONDSSPD01         ECON DESCENT SPEED
 300000 500000 750000 900000                                        1GW
    0.0   60.0  130.0  210.0  270.0  350.0 9999.0                   1CI
 250.00 250.00 250.00 290.00
 250.00 250.00 278.00 310.00
 265.00 280.00 295.00 315.00
 315.00 320.00 325.00 330.00
 335.00 336.00 338.80 340.00
 350.00 350.00 350.00 350.00
 355.00 355.00 355.00 355.00
ECONCLSPD01          ECON CLIMB SPEED
 300000 500000 750000 900000                                        1GW
    0.0   60.0  130.0  210.0  270.0  350.0  400.0 9999.0            1CI
 290.0  300.0  320.0  350.0
 290.0  310.0  330.0  355.0
 300.0  316.0  337.0  358.0
 304.0  320.0  340.0  360.0
 310.0  325.0  345.0  366.0
 312.0  328.0  349.0  370.0
 316.0  332.0  353.0  374.0
 318.0  334.0  355.0  376.0
H      END OF DATA
```

Appendix C SAMPLE INPUT AND OUTPUT

This appendix contains several sample executions of the program APM. The input files (APMINP), Sample database (Sample.dat), and output files are included in the APM package in the folder SampleCases. It is intended that this appendix be used as a means of verifying that the programs are executing properly. It is recommended that the user try to reproduce the sample outputs contained in this appendix by using the files contained in SampleCases folder of the APM package. Except for minor differences related to computer word size/accuracy, the output results should agree with the sample output provided in this appendix.

C.1 Digital Standard Input Record Format Input (DSIRF) with EPR Setting (DSIRF-EPR)

Selecting the user-input option of "INPUT=ACMS" specifies that the input data file is to be in the DSIRF format. Two sample DSIRF's are included with the APM program. They are:

`ACMSEPR.TXT` - Provides primary power setting data in terms of EPR.

`ACMSN1.TXT` - Provides primary power setting data in terms of %N1.

C.1.1 DSIRF-EPR Sample Case

This section contains the sample case execution resulting from the using the DSIRF input file named `ACMSEPR.TXT` and the APM input file shown below. Both these files are available in the Sample Cases/DSIRF-EPR folder of the APM package.

The sample output provided is representative of a typical four engine airplane where EPR is used for setting thrust. Examples of three possible APM output files are provided is section C.1.1.2.

- the standard tabular output, brief and detail formats are shown,
- the debug output, and
- the master file.

C.1.1.1 APM Input File – APMINP

```
SAMPLE.DAT
CONFIG10
/CASE
APM
AIR-ENG=7X7-XXX/FANJET
DEBUG=YES
DEBFIL=DEBFIL1.OUT
INPUT=ACMS
CRZFIL=ACMSEPR.TXT
OUTPUT=BRIEF
OUTFIL=OUTFIL1.OUT
MASTER=YES
MASFIL=MASTER1.DAT
GRAVITY=YES
ENERGY=YES
POWERX=YES
```

C.1.1.2 Output DSIRF-EPR

C.1.1.2.1 Tabular Brief Output

This output is a result of the “`OUTPUT=BRIEF`” parameter on line 10 of the AMPINP. This report shows both the brief performance analysis and a summary with averages and fleet standard deviation. For morinformation on the Brief Tabular output, see section 5.1.

```
           BOEING AIRPLANE PERFORMANCE MONITORING PROGRAM
           REPORT TITLE   MONTHLY AVERAGE

           PERFORMANCE ANALYSIS FOR AIRPLANE BOEING010
           MODEL 7X7-XXX           ENGINE FANJET-EPR       ENG SERIAL NUMBERS
           SPEED PARAMETER TO BASE ANALYSIS - MACH                0         0
           INSTRUMENTS USED FOR ANALYSIS    - C                   0         0

  DATE    FLT#      FLT CAS TAT    GW    MACH  EPR    FUEL  EPR  %THRST %FUEL %FM QUAL
DD-MM-YY            LVL      C     LB          AVG    FLOW REQ'D  REQ'D  FLOW
--------------------------------------------------------------------------------
31-01-04 FLT00100 310 320 -13  775.0 .855 1.517  7155 0.009   1.7   1.4  -2.9  90
31-01-04 FLT00100 310 318 -14  735.0 .851 1.484  6704 0.006   1.3   1.5  -2.7  90
31-01-04 FLT00100 330 307 -18  715.0 .856 1.527  6605 0.008   1.5   1.7  -3.0  90
31-01-04 FLT00100 330 305 -18  675.0 .852 1.491  6158 0.006   1.3   1.7  -2.9  90
31-01-04 FLT00100 350 294 -22  655.0 .857 1.535  6049 0.008   1.5   1.6  -3.0  90
31-01-04 FLT00100 350 292 -23  615.0 .852 1.495  5609 0.007   1.5   1.9  -3.1  90
31-01-04 FLT00100 370 280 -25  595.0 .857 1.538  5512 0.008   1.5   1.9  -3.2  90
31-01-04 FLT00100 370 278 -25  555.0 .851 1.495  5071 0.009   1.7   2.0  -3.5  90
                                                     --------------------------
              AVERAGE DEVIATION FROM BOOK PERFORMANCE  0.008   1.5   1.7  -3.0
              STANDARD DEVIATION                       0.001   0.1   0.2   0.2

 * - DENOTES NOT USED IN AVERAGE CALCULATION
     (ACCEPTABLE TOLERANCE RANGE EXCEEDED)
                    BOEING APM PROGRAM
                       FLEET SUMMARY

 MODEL = 7X7-XXX          ENGINE = FANJET-EPR

AIRCRAFT    #PTS    DATE     DATE      EPR    %THRST  %FUEL    %FM
IDENT.              FROM     TO        REQD    REQD    FLOW
NUMBER                (DD-MM-YY)
--------------------------------------------------------------------
BOEING010      8  31-01-04 31-01-04   0.008     1.5     1.7    -3.0
                                     -------------------------------
FLEET AVERAGE  (AIRCRAFT AVG.)        0.008     1.5     1.7    -3.0
                                     -------------------------------
FLEET STANDARD DEVIATION             99.000    99.0    99.0    99.0
```

C.1.1.2.2 Tabular Detail output

This output is a result of changing "`OUTPUT=BRIEF`" parameter on line 10 of the AMPINP to "`OUTPUT=DETAIL`". For more information on the Detail Tabular output, see section 5.2.

```
+                                         BOEING AIRPLANE PERFORMANCE MONITORING PROGRAM
                                          REPORT TITLE   MONTHLY AVERAGE

                                          PERFORMANCE ANALYSIS FOR AIRPLANE BOEING010
                                          MODEL 7X7-XXX           ENGINE FANJET-EPR                    ENG SERIAL NUMBERS
                                          SPEED PARAMETER TO BASE ANALYSIS - MACH                             0         0
                                          INSTRUMENTS USED FOR ANALYSIS    - C                                0         0

  DATE    FLT#      DEPTDEST FLT CAS TAT   GW    MACH  EPR    FUEL LAT  CG  GEN   LHV   DVG/DT DHP/DT EPR    %THRST %FUEL %FM QUAL
DD-MM-YY                     LVL      C    LB          AVG    FLOW     %MAC LOAD  CALC                 REQ'D  REQ'D  FLOW
-------------------------------------------------------------------------------------------------------------------------------
31-01-04 FLT00100 DEPTDEST 310 320 -13  775.0 .855 1.517  7155 47N 20.0 25.0 18600. -0.005 -0.007 0.009   1.7   1.4  -2.9  90
31-01-04 FLT00100 DEPTDEST 310 318 -14  735.0 .851 1.484  6704 47N 20.0 25.0 18600. -0.005 -0.007 0.006   1.3   1.5  -2.7  90
31-01-04 FLT00100 DEPTDEST 330 307 -18  715.0 .856 1.527  6605 47N 20.0 25.0 18600. -0.005 -0.007 0.008   1.5   1.7  -3.0  90
31-01-04 FLT00100 DEPTDEST 330 305 -18  675.0 .852 1.491  6158 47N 20.0 25.0 18600. -0.005 -0.007 0.006   1.3   1.7  -2.9  90
31-01-04 FLT00100 DEPTDEST 350 294 -22  655.0 .857 1.535  6049 47N 20.0 25.0 18600. -0.005 -0.007 0.008   1.5   1.6  -3.0  90
31-01-04 FLT00100 DEPTDEST 350 292 -23  615.0 .852 1.495  5609 47N 20.0 25.0 18600. -0.005 -0.007 0.007   1.5   1.9  -3.1  90
31-01-04 FLT00100 DEPTDEST 370 280 -25  595.0 .857 1.538  5512 47N 20.0 25.0 18600. -0.005 -0.007 0.008   1.5   1.9  -3.2  90
31-01-04 FLT00100 DEPTDEST 370 278 -25  555.0 .851 1.495  5071 47N 20.0 25.0 18600. -0.005 -0.007 0.009   1.7   2.0  -3.5  90
                                                                                ------------------------
                                                          AVERAGE DEVIATION FROM BOOK PERFORMANCE  0.008   1.5   1.7  -3.0
                                                          STANDARD DEVIATION                       0.001   0.1   0.2   0.2

 * - DENOTES NOT USED IN AVERAGE CALCULATION
     (ACCEPTABLE TOLERANCE RANGE EXCEEDED)
+                  BOEING APM PROGRAM
                      FLEET SUMMARY

 MODEL = 7X7-XXX          ENGINE = FANJET-EPR

AIRCRAFT   #PTS    DATE     DATE      EPR    %THRST  %FUEL    %FM
IDENT.             FROM     TO        REQD    REQD    FLOW
NUMBER               (DD-MM-YY)
-------------------------------------------------------------------
BOEING010     8  31-01-04 31-01-04   0.008     1.5     1.7    -3.0
                                    -------------------------------
FLEET AVERAGE  (AIRCRAFT AVG.)       0.008     1.5     1.7    -3.0
                                    -------------------------------
FLEET STANDARD DEVIATION            99.000    99.0    99.0    99.0
```

C.1.1.2.3 Debug output

This output is a result of the "`DEBUG=YES`" parameter on line 6 of the AMPINP. For more information on the Debug output, see section 5.6.

```
                              BOEING AIRPLANE PERFORMANCE MONITORING - DEBUG OPTION

 NOTE: ALL WEIGHTS ARE IN POUNDS, TEMPERATURES ARE IN DEGREES C, AS PER THE INTERFACE CONTROL DOCUMENT AND DSIRF DEFINITION.


 MODEL: 7X7-XXX          ENGINE: FANJET-EPR        AIRPLANE: BOEING010   FLIGHT: FLT00100   DAY/MONTH/YEAR: 31-01-04


 CRITICAL INPUTS:
   CAS    = 320.00      POWER1 =   1.5170    FFENG1 =  7155.0     GENLD1 =  25.00      LAT    =  47.0000    CGPOS  =  20.00
   MACH   = 0.8550      POWER2 =   1.5170    FFENG2 =  7155.0     GENLD2 =  25.00      DVG/DT =  -0.0050    DHP/DT =  -0.0070
   ALT    = 31000.      POWER3 =   1.5170    FFENG3 =  7155.0     GENLD3 =  25.00      FUELTP =  20.000     FUELDN =   6.896
   TAT    = -13.20      POWER4 =   1.5170    FFENG4 =  7155.0     GENLD4 =  25.00      GS     = 500.000     HEADNG =   90.000
                                                                                       TTR    =   90.000    DRIFTA =   0.0000
 CALCULATED VARIABLES:
 -----------------------------------------------------------------------------------------------------------------------------------
   THREQD  WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  FNENG1 =  36572.4
           WTCORR = 773259.4  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  FNENG2 =  36572.4
           CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000  CDCORR = 0.000000  FNENG3 =  36572.4
           FN/D   =  146289.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.0  FNENG4 =  36572.4
           THRDEV =   1.6597                     CDTOT  = 0.024283

   POWREQ  WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  POWBK1 =   1.5084
           WTCORR = 773259.4  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  POWAVG =   1.5170
           CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000  CDCORR = 0.000000  POWBK  =   1.5084
           FNAVG  =   35975.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.0
           POWDEV =   0.0086                     CDTOT  = 0.024283

   WFDEV   WFOBS1 =   7155.0  WFBKCR1=   7056.2  WFDEV1 =   1.3996  DELTA  = 0.283688  FACWF1 =  1.00000  WFCOR1 =  16447.0
           WFOBS2 =   7155.0  WFBKCR2=   7056.2  WFDEV2 =   1.3996  THETA  = 0.787062  LHVRAT =  1.00000  WFBKT  =  28225.0
           WFOBS3 =   7155.0  WFBKCR3=   7056.2  WFDEV3 =   1.3996  THETAT = 0.902134  WFPOWX = 1.000095  WFOBST =  28620.0
           WFOBS4 =   7155.0  WFBKCR4=   7056.2  WFDEV4 =   1.3996  TDEXP  = 0.429068  FNTOT  =  36572.4
           WFDEVT =   1.3996  BLDFAC =  1.00000

   FMDEV   WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  FACWF1 = 1.000000  WFCOR1 =  16190.9
           WTCORR = 773259.4  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  LHVRAT =  1.00000  WFBKCR =  27785.4
           CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000  CDCORR = 0.000000  WFPOWX = 1.000095  FMOBS  = 0.017531
           FNAVG  =   35975.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.0  WFOBST =  28620.0  FMBOOK = 0.018058
           TAS    =  501.749  TDEXP  = 0.429068  CDTOT  = 0.024283
           FMDEV  =  -2.9161

   WFDPWR  WFDPWR =   1.5820
```

C.1.1.2.4 Master File Output

This output is a result of the “MASTER=YES” parameter on line 12 of the AMPINP. Formore information on the Master output, see section 5.5.

```
         0                                                                                  7X7-XXX       FANJET-EPR
       1.65975       0.00860       1.39962       1.39962       1.39962       1.39962       1.39962      -2.91613       1.58196
APM     1BOEING0100010010FLT00100DEPTDEST31012004120115
AA                                                    AA
       0.85500       0.00000       0.00000     320.00000       0.00000       0.00000     -13.20000       0.00000       0.00000
   31000.00000       0.00000       0.00000  775000.00000       0.00000       0.00000    7155.00000    7155.00000    7155.00000
    7155.00000       1.51700       1.51700       1.51700       1.51700      90.00000     500.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000      47.00000       0.00000       0.00000       0.00000
       0.00000       0.00000      90.00000       0.00000       0.00000       0.00000       0.00000       0.00000      90.00000
       0.00000       0.00000      -0.00700      -0.00500       0.00000       0.00000       0.00000       6.89600      20.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000      25.00000      25.00000      25.00000      25.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
          0           0           0           0
       0.00000       0.00000   18600.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000
  773259.37500       0.45763       0.02440      -0.00012      20.00000       0.00000       0.00000       0.02428
    -732.68146   41030.80078  143901.03125   36572.35547   36572.35547   36572.35547   36572.35547  146289.42188       1.50840
       0.00000       1.51700    7056.23975    7056.23975    7056.23975    7056.23975       1.00000       1.00000       1.00009
   28620.00000   28224.95898     501.74881       0.01806       0.01753 C                MACH
         0                                                                                  7X7-XXX       FANJET-EPR
       1.29827       0.00632       1.53805       1.53805       1.53805       1.53805       1.53805      -2.66812       1.18498
APM     2BOEING0100010010FLT00100DEPTDEST31012004120215
AA                                                    AA
       0.85100       0.00000       0.00000     318.00000       0.00000       0.00000     -13.60000       0.00000       0.00000
   31000.00000       0.00000       0.00000  735000.00000       0.00000       0.00000    6704.00000    6704.00000    6704.00000
    6704.00000       1.48400       1.48400       1.48400       1.48400      90.00000     500.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000      47.00000       0.00000       0.00000       0.00000
       0.00000       0.00000      90.00000       0.00000       0.00000       0.00000       0.00000       0.00000      90.00000
       0.00000       0.00000      -0.00700      -0.00500       0.00000       0.00000       0.00000       6.89600      20.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000      25.00000      25.00000      25.00000      25.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
          0           0           0           0
       0.00000       0.00000   18600.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
```

C.1.2 DSIRF-N1 Sample Case

This section contains the sample case execution resulting from the using the DSIRF input file named `ACMSN1.TXT` and the APM input file shown below. Both these files are available in the Sample Cases/DSIRF-N1 folder of the APM package.

The sample output provided is representative of a typical four engine airplane where N1 is used for setting thrust. Examples of possible APM output files are provided is section C.1.2.2.

- the standard tabular output detail format is shown,
- the debug output, and
- the master file.

C.1.2.1 APM Input File – APMINP

```
SAMPLE.DAT
CONFIG11
/CASE
APM
AIR-ENG=7X7-XXX/FANJET
DEBUG=YES
DEBFIL=DEBFIL2.OUT
INPUT=ACMS
CRZFIL=ACMSN1.TXT
OUTPUT=DETAIL
OUTFIL=OUTFIL2.OUT
MASTER=YES
MASFIL=MASTER2.DAT
GRAVITY=YES
ENERGY=YES
POWERX=YES
```

C.1.2.2 Output DSIRF-N1

C.1.2.2.1 Detail output

This output is a result of the "`OUTPUT=DETAIL`" parameter on line 10 of the APMINP For more information on the Detail Tabular output, see section 5.2.

```
+                                         BOEING AIRPLANE PERFORMANCE MONITORING PROGRAM
                                          REPORT TITLE   MONTHLY AVERAGE

                                          PERFORMANCE ANALYSIS FOR AIRPLANE BOEING010
                                          MODEL 7X7-XXX          ENGINE FANJET-N1                  ENG SERIAL NUMBERS
                                          SPEED PARAMETER TO BASE ANALYSIS - MACH                         0         0
                                          INSTRUMENTS USED FOR ANALYSIS    - C                            0         0

  DATE    FLT#     DEPTDEST FLT CAS TAT   GW    MACH  %N1    FUEL LAT  CG  GEN   LHV   DVG/DT DHP/DT %N1    %THRST %FUEL %FM QUAL
DD-MM-YY                    LVL      C    LB          AVG    FLOW     %MAC LOAD  CALC                REQ'D  REQ'D  FLOW
---------------------------------------------------------------------------------------------------------------------------
31-01-04 FLT00100 DEPTDEST 310 320 -13  775.0 .855  99.0  7155 47N 20.0 25.0 18600. -0.005 -0.007  0.42   1.4   1.6  -2.9  90
31-01-04 FLT00100 DEPTDEST 310 318 -14  735.0 .851  97.2  6704 47N 20.0 25.0 18600. -0.005 -0.007  0.37   1.4   1.4  -2.7  90
31-01-04 FLT00100 DEPTDEST 330 307 -18  715.0 .856  98.8  6605 47N 20.0 25.0 18600. -0.005 -0.007  0.49   1.7   1.5  -3.0  90
31-01-04 FLT00100 DEPTDEST 330 305 -18  675.0 .852  96.7  6158 47N 20.0 25.0 18600. -0.005 -0.007  0.37   1.4   1.6  -2.9  90
31-01-04 FLT00100 DEPTDEST 350 294 -22  655.0 .857  98.3  6049 47N 20.0 25.0 18600. -0.005 -0.007  0.41   1.4   1.7  -3.0  90
31-01-04 FLT00100 DEPTDEST 350 292 -23  615.0 .852  96.0  5609 47N 20.0 25.0 18600. -0.005 -0.007  0.34   1.3   2.0  -3.1  90
31-01-04 FLT00100 DEPTDEST 370 280 -25  595.0 .857  98.0  5512 47N 20.0 25.0 18600. -0.005 -0.007  0.45   1.5   1.9  -3.2  90
31-01-04 FLT00100 DEPTDEST 370 278 -25  555.0 .851  95.5  5071 47N 20.0 25.0 18600. -0.005 -0.007  0.39   1.5   2.2  -3.5  90
                                                                                                 ------------------------
                                                        AVERAGE DEVIATION FROM BOOK PERFORMANCE     0.40   1.5   1.7  -3.0
                                                        STANDARD DEVIATION                          0.05   0.1   0.3   0.2

  * - DENOTES NOT USED IN AVERAGE CALCULATION
      (ACCEPTABLE TOLERANCE RANGE EXCEEDED)
+                   BOEING APM PROGRAM
                       FLEET SUMMARY

  MODEL = 7X7-XXX          ENGINE = FANJET-N1

 AIRCRAFT   #PTS    DATE     DATE     %N1    %THRST  %FUEL    %FM
 IDENT.             FROM     TO       REQD    REQD    FLOW
 NUMBER               (DD-MM-YY)
-------------------------------------------------------------------
 BOEING010     8  31-01-04 31-01-04    0.40     1.5     1.7    -3.0
                                     ------------------------------
 FLEET AVERAGE  (AIRCRAFT AVG.)        0.40     1.5     1.7    -3.0
                                     ------------------------------
 FLEET STANDARD DEVIATION             99.00    99.0    99.0    99.0
```

C.1.2.2.2 Debug output

This output is a result of the “DEBUG=YES” parameter on line 6 of the AMPINP. Formore information on the Debug output, see section 5.6.

```
                              BOEING AIRPLANE PERFORMANCE MONITORING - DEBUG OPTION

NOTE: ALL WEIGHTS ARE IN POUNDS, TEMPERATURES ARE IN DEGREES C, AS PER THE INTERFACE CONTROL DOCUMENT AND DSIRF DEFINITION.


MODEL: 7X7-XXX           ENGINE: FANJET-N1         AIRPLANE: BOEING010   FLIGHT: FLT00100   DAY/MONTH/YEAR: 31-01-04


CRITICAL INPUTS:
  CAS    = 320.00      POWER1 =  99.0000    FFENG1 =  7155.0     GENLD1 =  25.00      LAT    =  47.0000    CGPOS  =  20.00
  MACH   = 0.8550      POWER2 =  99.0000    FFENG2 =  7155.0     GENLD2 =  25.00      DVG/DT =  -0.0050    DHP/DT =  -0.0070
  ALT    = 31000.      POWER3 =  99.0000    FFENG3 =  7155.0     GENLD3 =  25.00      FUELTP =  20.000     FUELDN =   6.896
  TAT    = -13.20      POWER4 =  99.0000    FFENG4 =  7155.0     GENLD4 =  25.00      GS     = 500.000     HEADNG =   90.000
                                                                                      TTR    =   90.000    DRIFTA =   0.0000
CALCULATED VARIABLES:
-----------------------------------------------------------------------------------------------------------------------------------
  THREQD  WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  FNENG1 =  36496.5
          WTCORR = 773259.4  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  FNENG2 =  36496.5
          CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000  CDCORR = 0.000000  FNENG3 =  36496.5
          FN/D   =  145986.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.0  FNENG4 =  36496.5
          THRDEV =   1.4489                     CDTOT  = 0.024283

  POWREQ  WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  POWBK1 = 103.7936
          WTCORR = 773259.4  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  POWAVG =  99.0000
          CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000  CDCORR = 0.000000  POWBK  =  98.5840
          FNAVG  =   35975.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.0
          POWDEV =   0.4160                     CDTOT  = 0.024283

  WFDEV   WFOBS1 =   7155.0  WFBKCR1=   7041.7  WFDEV1 =   1.6083  DELTA  = 0.283688  FACWF1 =  1.00000  WFCOR1 =  16414.4
          WFOBS2 =   7155.0  WFBKCR2=   7041.7  WFDEV2 =   1.6083  THETA  = 0.787062  LHVRAT =  1.00000  WFBKT  =  28167.0
          WFOBS3 =   7155.0  WFBKCR3=   7041.7  WFDEV3 =   1.6083  THETAT = 0.902134  WFPOWX = 1.000164  WFOBST =  28620.0
          WFOBS4 =   7155.0  WFBKCR4=   7041.7  WFDEV4 =   1.6083  TDEXP  = 0.429068  FNTOT  =  36496.5
          WFDEVT =   1.6083  BLDFAC =  1.00000

  FMDEV   WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  FACWF1 = 1.000000  WFCOR1 =  16190.9
          WTCORR = 773259.4  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  LHVRAT =  1.00000  WFBKCR =  27783.5
          CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000  CDCORR = 0.000000  WFPOWX = 1.000164  FMOBS  = 0.017531
          FNAVG  =   35975.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.0  WFOBST =  28620.0  FMBOOK = 0.018059
          TAS    =  501.749  TDEXP  = 0.429068  CDTOT  = 0.024283
          FMDEV  =  -2.9228

  WFDPWR  WFDPWR =   1.3803
```

C.1.2.2.3 Master File Output

This output is a result of the “`MASTER=YES`” parameter on line 12 of the AMPINP. Formore information on the Master output, see section 5.5.

```
        0                                                                                     7X7-XXX          FANJET-N1
        1.44891       0.41603       1.60832       1.60832       1.60832       1.60832       1.60832      -2.92281       1.38030
APM    1BOEING0100010010FLT00100DEPTDEST31012004120115
AA                                      AA
        0.85500       0.00000       0.00000     320.00000       0.00000       0.00000     -13.20000       0.00000       0.00000
    31000.00000       0.00000       0.00000  775000.00000       0.00000       0.00000    7155.00000    7155.00000    7155.00000
     7155.00000      99.00000      99.00000      99.00000      99.00000      90.00000     500.00000       0.00000       0.00000
        0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
        0.00000       0.00000       0.00000       0.00000       0.00000      47.00000       0.00000       0.00000       0.00000
        0.00000       0.00000      90.00000       0.00000       0.00000       0.00000       0.00000       0.00000      90.00000
        0.00000       0.00000      -0.00700      -0.00500       0.00000       0.00000       0.00000       6.89600      20.00000
        0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
        0.00000       0.00000       0.00000       0.00000      25.00000      25.00000      25.00000      25.00000       0.00000
        0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
        0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
         0         0         0         0
        0.00000       0.00000   18600.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
        0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
        0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
        0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
        0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
        0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
        0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
        0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
        0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
        0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
        0.00000       0.00000       0.00000
   773259.37500       0.45763       0.02440      -0.00012      20.00000       0.00000       0.00000       0.02428
     -732.68146   41030.80078  143901.03125   36496.50781   36496.50781   36496.50781   36496.50781  145986.03125      98.58397
        0.00000      99.00000    7041.74609    7041.74609    7041.74609    7041.74609       1.00000       1.00000       1.00016
    28620.00000   28166.98438     501.74881       0.01806       0.01753 C                  MACH
```

C.2 Manual Standard Input Record Format Input (MSIRF)

Using an input data file in the MSIRF format (`INPUT=MANUAL`), is normally used whenever cruise data is recorded manually through the use of the Performance Log form. Two sample versions of the MSIRF input file are provided:

`MANEPR.TXT` - Provides primary power setting data in terms of EPR.

`MANN1.TXT` - Provides primary power setting data in terms of %N1.

C.2.1 MSIRF-EPR Sample Case

This section contains the sample case execution resulting from the using the MSIRF input file named `MANEPR.TXT` and the APM input file (APMINP) shown below. Both these files are available in the Sample Cases/MSIRF-EPR folder of the APM package.

The sample output provided is representative of a typical four engine airplane where EPR is used for setting thrust. Examples of the three possible APM output files are provided is section C.2.1.2.

- the standard tabular output, brief and detail formats are shown,
- the debug output, and

- the master file.

C.2.1.1 APM INPUT FILE – APMINP

```
SAMPLE.DAT
CONFIG10
/CASE
APM
AIR-ENG=7X7-XXX/FANJET
DEBUG=YES
DEBFIL=DEBFIL3.OUT
INPUT=MANUAL
CRZFIL=MANEPR.TXT
OUTPUT=DETAIL
OUTFIL=OUTFIL3.OUT
MASTER=N0
MASFIL=MASTER3.DAT
GRAVITY=YES
ENERGY=YES
POWERX=YES
```

C.2.1.2 Output MSIRF-EPR

C.2.1.2.1 Tabular Detail Output

This output is a result of "`OUTPUT=DETAIL`" parameter on line 10 of the AMPINP. For more information on the Detail Tabular output, see section 5.2.

```
+                                        BOEING AIRPLANE PERFORMANCE MONITORING PROGRAM
                                         REPORT TITLE   MONTHLY AVERAGE

                                         PERFORMANCE ANALYSIS FOR AIRPLANE AC0000100
                                         MODEL 7X7-XXX          ENGINE FANJET-EPR                 ENG SERIAL NUMBERS
                                         SPEED PARAMETER TO BASE ANALYSIS - MACH                     11111     22222
                                         INSTRUMENTS USED FOR ANALYSIS    - C                        33333     44444

   DATE    FLT#      DEPTDEST FLT CAS TAT   GW    MACH  EPR    FUEL LAT  CG  GEN   LHV   DVG/DT DHP/DT EPR   %THRST %FUEL %FM QUAL
 DD-MM-YY                     LVL       C   LB          AVG    FLOW     %MAC LOAD  CALC                REQ'D  REQ'D  FLOW
 -----------------------------------------------------------------------------------------------------------------------------
 31-01-04   GBL100   ROUTE  310 320 -13  775.0 .855 1.517  7155 47N 20.0 25.0 18600. -0.005 -0.007 0.009   1.7   1.4  -2.9   0
 31-01-04   GBL100   ROUTE  310 318 -14  735.0 .851 1.484  6704 47N 20.0 25.0 18600. -0.005 -0.007 0.006   1.3   1.5  -2.7   0
 31-01-04   GBL100   ROUTE  330 307 -18  715.0 .856 1.527  6605 47N 20.0 25.0 18600. -0.005 -0.007 0.008   1.5   1.7  -3.0   0
 31-01-04   GBL100   ROUTE  330 305 -18  675.0 .852 1.491  6158 47N 20.0 25.0 18600. -0.005 -0.007 0.006   1.3   1.7  -2.9   0
 31-01-04   GBL100   ROUTE  350 294 -22  655.0 .857 1.535  6049 47N 20.0 25.0 18600. -0.005 -0.007 0.008   1.5   1.6  -3.0   0
 31-01-04   GBL100   ROUTE  350 292 -23  615.0 .852 1.495  5609 47N 20.0 25.0 18600. -0.005 -0.007 0.007   1.5   1.9  -3.1   0
 31-01-04   GBL100   ROUTE  370 280 -25  595.0 .857 1.538  5512 47N 20.0 25.0 18600. -0.005 -0.007 0.008   1.5   1.9  -3.2   0
 31-01-04   GBL100   ROUTE  370 278 -25  555.0 .851 1.495  5071 47N 20.0 25.0 18600. -0.005 -0.007 0.009   1.7   2.0  -3.5   0
                                                                                               ------------------------
                                                         AVERAGE DEVIATION FROM BOOK PERFORMANCE   0.008   1.5   1.7  -3.0
                                                         STANDARD DEVIATION                        0.001   0.1   0.2   0.2

  * - DENOTES NOT USED IN AVERAGE CALCULATION
      (ACCEPTABLE TOLERANCE RANGE EXCEEDED)
+                   BOEING APM PROGRAM
                       FLEET SUMMARY

  MODEL = 7X7-XXX          ENGINE = FANJET-EPR

 AIRCRAFT    #PTS    DATE     DATE         EPR    %THRST  %FUEL     %FM
 IDENT.              FROM     TO           REQD    REQD    FLOW
 NUMBER                (DD-MM-YY)
 -------------------------------------------------------------------
 AC0000100     8  31-01-04 31-01-04   0.008      1.5      1.7     -3.0
                                     ------------------------------
 FLEET AVERAGE  (AIRCRAFT AVG.)       0.008      1.5      1.7     -3.0
                                     ------------------------------
 FLEET STANDARD DEVIATION            99.000     99.0     99.0     99.0
```

C.2.1.2.2 Sample Debug Output

This output is a result of the "`DEBUG=YES`" parameter on line 6 of the AMPINP. For more information on the Debug output, see section 5.6.

```
                              BOEING AIRPLANE PERFORMANCE MONITORING - DEBUG OPTION

 NOTE: ALL WEIGHTS ARE IN POUNDS, TEMPERATURES ARE IN DEGREES C, AS PER THE INTERFACE CONTROL DOCUMENT AND DSIRF DEFINITION.


 MODEL: 7X7-XXX           ENGINE: FANJET            AIRPLANE: AC0000100   FLIGHT:   GBL100   DAY/MONTH/YEAR: 31-01-04


 CRITICAL INPUTS:
   CAS     = 320.00      POWER1 =   1.5170    FFENG1 =  7155.0     GENLD1 =  25.00      LAT    =  47.0000    CGPOS  =  20.00
   MACH    = 0.8550      POWER2 =   1.5170    FFENG2 =  7155.0     GENLD2 =  25.00      DVG/DT =  -0.0050    DHP/DT =  -0.0070
   ALT     = 31000.      POWER3 =   1.5170    FFENG3 =  7155.0     GENLD3 =  25.00      FUELTP =  20.000     FUELDN =   6.900
   TAT     = -13.20      POWER4 =   1.5170    FFENG4 =  7155.0     GENLD4 =  25.00      GS     = 500.000     HEADNG =  90.000
                                                                                        TTR    =   90.000    DRIFTA =   0.0000
 CALCULATED VARIABLES:
 ----------------------------------------------------------------------------------------------------------------------------
---
   THREQD  WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  FNENG1 =  36572.4
           WTCORR = 773259.5  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  FNENG2 =  36572.4
           CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000                     FNENG3 =  36572.4
           FN/D   =  146289.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.1  FNENG4 =  36572.4
           THRDEV =   1.6597                     CDTOT  = 0.024283

   POWREQ  WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  POWBK1 =   1.5084
           WTCORR = 773259.5  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  POWAVG =   1.5170
           CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000                     POWBK  =   1.5084
           FNAVG  =   35975.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.1
           POWDEV =   0.0086                     CDTOT  = 0.024283

   WFDEV   WFOBS1 =   7155.0  WFBKCR1=   7056.2  WFDEV1 =   1.3996  DELTA  = 0.283688  FACWF1 =  1.00000  WFCOR1 =  16447.0
           WFOBS2 =   7155.0  WFBKCR2=   7056.2  WFDEV2 =   1.3996  THETA  = 0.787062  LHVRAT =  0.00000  WFBKT  =  28225.0
           WFOBS3 =   7155.0  WFBKCR3=   7056.2  WFDEV3 =   1.3996  THETAT = 0.902134  WFPOWX = 1.000095  WFOBST =  28620.0
           WFOBS4 =   7155.0  WFBKCR4=   7056.2  WFDEV4 =   1.3996  TDEXP  = 0.429069  FNTOT  =  36572.4
           WFDEVT =   1.3996  BLDFAC =  1.00000

   FMDEV   WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  FACWF1 = 1.000000  WFCOR1 =  16190.9
           WTCORR = 773259.5  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  LHVRAT =  0.00000  WFBKCR =  27785.4
           CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000                     WFPOWX = 1.000095  FMOBS  = 0.017531
           FNAVG  =   35975.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.1  WFOBST =  28620.0  FMBOOK = 0.018058
           TAS    =  501.749  TDEXP  = 0.429069  CDTOT  = 0.024283
           FMDEV  =  -2.9161

   WFDPWR  WFDPWR =   1.5819
```

C.2.2 MSIRF-N1 Sample Case

This section contains the sample case execution resulting from the using the MSIRF input file named `MANN1.TXT` and the APM input file shown below. Both these files are available in the Sample Cases/MSIRF-N1 folder of the APM package.

The sample output provided is representative of a typical four engine airplane where N1 is used for setting thrust. Examples of the possible APM output files are provided is section C.2.2.2.

- the standard tabular output detail format is shown,
- the debug output, and
- the master file.

C.2.2.1 APM Input File – APMINP

```
SAMPLE.DAT
CONFIG11
/CASE
APM
AIR-ENG=7X7-XXX/FANJET
DEBUG=YES
DEBFIL=DEBFIL4.OUT
INPUT=MANUAL
CRZFIL=MANN1.TXT
OUTPUT=DETAIL
OUTFIL=OUTFIL4.OUT
MASTER=YES
MASFIL=MASTER4.DAT
GRAVITY=YES
ENERGY=YES
POWERX=YES
```

C.2.2.2 Output MSIRF-N1

C.2.2.2.1 Tabular Detail Output

This output is a result of "`OUTPUT=DETAIL`" parameter on line 10 of the AMPINP. For more information on the Detail Tabular output, see section 5.2.

```
+                                       BOEING AIRPLANE PERFORMANCE MONITORING PROGRAM
                                        REPORT TITLE   MONTHLY AVERAGE

                                        PERFORMANCE ANALYSIS FOR AIRPLANE AC0000100
                                        MODEL 7X7-XXX           ENGINE FANJET-N1                      ENG SERIAL NUMBERS
                                        SPEED PARAMETER TO BASE ANALYSIS - MACH                          11111     22222
                                        INSTRUMENTS USED FOR ANALYSIS    - C                             33333     44444

  DATE    FLT#      DEPTDEST FLT CAS TAT   GW    MACH  %N1    FUEL LAT  CG   GEN   LHV   DVG/DT DHP/DT %N1   %THRST %FUEL %FM QUAL
DD-MM-YY                     LVL       C   LB          AVG    FLOW     %MAC LOAD  CALC                 REQ'D  REQ'D  FLOW
-------------------------------------------------------------------------------------------------------------------------------
31-01-04   GBL100   ROUTE  310 320 -13  775.0 .855  99.0  7155 47N 20.0 25.0 18600. -0.005 -0.007  0.42   1.4   1.6  -2.9   0
31-01-04   GBL100   ROUTE  310 318 -14  735.0 .851  97.2  6704 47N 20.0 25.0 18600. -0.005 -0.007  0.37   1.4   1.4  -2.7   0
31-01-04   GBL100   ROUTE  330 307 -18  715.0 .856  98.8  6605 47N 20.0 25.0 18600. -0.005 -0.007  0.49   1.7   1.5  -3.0   0
31-01-04   GBL100   ROUTE  330 305 -18  675.0 .852  96.7  6158 47N 20.0 25.0 18600. -0.005 -0.007  0.37   1.4   1.6  -2.9   0
31-01-04   GBL100   ROUTE  350 294 -22  655.0 .857  98.3  6049 47N 20.0 25.0 18600. -0.005 -0.007  0.41   1.4   1.7  -3.0   0
31-01-04   GBL100   ROUTE  350 292 -23  615.0 .852  96.0  5609 47N 20.0 25.0 18600. -0.005 -0.007  0.34   1.3   2.0  -3.1   0
31-01-04   GBL100   ROUTE  370 280 -25  595.0 .857  98.0  5512 47N 20.0 25.0 18600. -0.005 -0.007  0.45   1.5   1.9  -3.2   0
31-01-04   GBL100   ROUTE  370 278 -25  555.0 .851  95.5  5071 47N 20.0 25.0 18600. -0.005 -0.007  0.39   1.5   2.2  -3.5   0
                                                                                              ------------------------
                                                        AVERAGE DEVIATION FROM BOOK PERFORMANCE    0.40   1.5   1.7  -3.0
                                                        STANDARD DEVIATION                         0.05   0.1   0.3   0.2

 * - DENOTES NOT USED IN AVERAGE CALCULATION
     (ACCEPTABLE TOLERANCE RANGE EXCEEDED)
+                  BOEING APM PROGRAM
                      FLEET SUMMARY

 MODEL = 7X7-XXX          ENGINE = FANJET-N1

AIRCRAFT   #PTS    DATE     DATE       %N1    %THRST  %FUEL    %FM
IDENT.             FROM     TO         REQD    REQD    FLOW
NUMBER               (DD-MM-YY)
-------------------------------------------------------------------
AC0000100     8  31-01-04 31-01-04     0.40     1.5     1.7    -3.0
                                     ------------------------------
FLEET AVERAGE  (AIRCRAFT AVG.)         0.40     1.5     1.7    -3.0
                                     ------------------------------
FLEET STANDARD DEVIATION              99.00    99.0    99.0    99.0
```

C.2.2.2.2 Sample Debug Output

This output is a result of the "`DEBUG=YES`" parameter on line 6 of the AMPINP. For more information on the Debug output, see section 5.6.

```
                              BOEING AIRPLANE PERFORMANCE MONITORING - DEBUG OPTION

   NOTE: ALL WEIGHTS ARE IN POUNDS, TEMPERATURES ARE IN DEGREES C, AS PER THE INTERFACE CONTROL DOCUMENT AND DSIRF DEFINITION.


   MODEL: 7X7-XXX          ENGINE: FANJET           AIRPLANE: AC0000100   FLIGHT:   GBL100   DAY/MONTH/YEAR: 31-01-04


   CRITICAL INPUTS:
     CAS    = 320.00      POWER1 =  99.0000    FFENG1 =  7155.0     GENLD1 =  25.00      LAT    =  47.0000    CGPOS  =  20.00
     MACH   = 0.8550      POWER2 =  99.0000    FFENG2 =  7155.0     GENLD2 =  25.00      DVG/DT =  -0.0050    DHP/DT =  -0.0070
     ALT    = 31000.      POWER3 =  99.0000    FFENG3 =  7155.0     GENLD3 =  25.00      FUELTP =  20.000     FUELDN =   6.900
     TAT    = -13.20      POWER4 =  99.0000    FFENG4 =  7155.0     GENLD4 =  25.00      GS     = 500.000     HEADNG =  90.000
                                                                                         TTR    =   90.000    DRIFTA =   0.0000
   CALCULATED VARIABLES:
   ------------------------------------------------------------------------------------------------------------------------
  ---
     THREQD  WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  FNENG1 =  36496.5
             WTCORR = 773259.5  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  FNENG2 =  36496.5
             CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000                     FNENG3 =  36496.5
             FN/D   =  145986.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.1  FNENG4 =  36496.5
             THRDEV =   1.4489                     CDTOT  = 0.024283

     POWREQ  WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  POWBK1 = 103.7936
             WTCORR = 773259.5  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  POWAVG =  99.0000
             CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000                     POWBK  =  98.5840
             FNAVG  =   35975.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.1
             POWDEV =   0.4160                     CDTOT  = 0.024283

     WFDEV   WFOBS1 =   7155.0  WFBKCR1=   7041.7  WFDEV1 =   1.6083  DELTA  = 0.283688  FACWF1 =  1.00000  WFCOR1 =  16414.4
             WFOBS2 =   7155.0  WFBKCR2=   7041.7  WFDEV2 =   1.6083  THETA  = 0.787062  LHVRAT =  0.00000  WFBKT  =  28167.0
             WFOBS3 =   7155.0  WFBKCR3=   7041.7  WFDEV3 =   1.6083  THETAT = 0.902134  WFPOWX = 1.000164  WFOBST =  28620.0
             WFOBS4 =   7155.0  WFBKCR4=   7041.7  WFDEV4 =   1.6083  TDEXP  = 0.429069  FNTOT  =  36496.5
             WFDEVT =   1.6083  BLDFAC =  1.00000

     FMDEV   WT     = 775000.0  DELTA  = 0.283688  CDBSIC = 0.024402  DRAG   =  41030.8  FACWF1 = 1.000000  WFCOR1 =  16190.9
             WTCORR = 773259.5  THETA  = 0.787062  CDREYN = -.000119  DELACC =   -732.7  LHVRAT =  0.00000  WFBKCR =  27783.5
             CL     = 0.457627  ISADEV =   0.0591  CDCG   = 0.000000                     WFPOWX = 1.000164  FMOBS  = 0.017531
             FNAVG  =   35975.  THETAT = 0.902134  CDELAS = 0.000000  DRAG/D = 143901.1  WFOBST =  28620.0  FMBOOK = 0.018059
             TAS    =  501.749  TDEXP  = 0.429069  CDTOT  = 0.024283
             FMDEV  =  -2.9228

     WFDPWR  WFDPWR =   1.3803
```

C.2.2.2.3 Master File Output

This output is a result of the “`MASTER=YES`” parameter on line 12 of the AMPINP. Formore information on the Master output, see section 5.5.

```
       0                                                                           7X7-XXX           FANJET-N1
       1.44891       0.41603       1.60832       1.60832       1.60832       1.60832       1.60832      -2.92281       1.38030
 APM     AC0000100          GBL100   ROUTE 31012004

       0.85500       0.85500       0.00000     320.00000     320.00000       0.00000     -13.20000     -13.20000       0.00000
   31000.00000   31000.00000       0.00000  775000.00000  775000.00000       0.00000    7155.00000    7155.00000    7155.00000
    7155.00000      99.00000      99.00000      99.00000      99.00000       0.00000     500.00000     500.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000      47.00000      47.00000       0.00000       0.00000
       0.00000       0.00000      90.00000      90.00000       0.00000       0.00000       0.00000       0.00000      90.00000
      90.00000       0.00000      -0.00700      -0.00500       0.00000       0.00000       0.00000       6.90000      20.00000
   50000.00000   50000.00000   50000.00000   50000.00000   50000.00000   12500.00000   12500.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000      25.00000      25.00000      25.00000      25.00000  825000.00000
  825000.00000       0.00000      20.00000      20.00000       0.00000  500000.00000  500000.00000       0.00000   60000.00000
   60000.00000   60000.00000   60000.00000   60000.00000   12500.00000   12500.00000       0.00000
    11111     22222     33333     44444
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000
  773259.37500       0.45763       0.02440      -0.00012      20.00000       0.00000       0.00000       0.02428
    -732.68146   41030.80078  143901.03125   36496.50781   36496.50781   36496.50781   36496.50781  145986.03125      98.58397
       0.00000      99.00000    7041.74609    7041.74609    7041.74609    7041.74609       1.00000       1.00000       1.00016
   28620.00000   28166.98438     501.74881       0.01806       0.01753 C                 MACH
```

Appendix D 717/MD-90/MD-80 MODEL SPECIFIC INFORMATION

A generalized definition of the DSIRF for the 717 / MD-90 / MD-80 is provided in this section for those operators that have an ACMS system for data collection. The availability of some parameters will depend on customized ACMS programming and in some cases manual input by the flight crew prior to departure. It is recommended that the default values be used for the input options during the first trial run of the APM Program. To use one of the data correction algorithms contained in the program, it is recommended that the reader consult Section 4 Algorithm and Analysis to determine what data are required for that specific correction.

D.1 Bleed Configuration

To be eligible for analysis by the APM program, each candidate DSIRF or MSIRF data record is checked to determine if the bleed configuration is compatible with the airplane database. The status of the following bleeds are used to define this configuration. NOTE: The discrete values shown below represent the convention adopted for the APM program and do not necessarily agree with the actual airplane discrete values.

Table 12: 717/MD-90/MD-80 Bleed Configurations

BLEED	STATUS	
	ZERO STATE	ONE STATE
ECS PACKS	ON	OFF
ECS PACK FLOW RATE	LOW	HIGH
ENGINE BLEEDS	ON	OFF
ISOLATION VALVE	CLOSED	OPEN
ENGINE ANTI-ICE BLEEDS	OFF	ON
WING ANTI-ICE BLEED	OFF	ON

The zero state represents the "normal" bleed configuration of the 717/MD-90/MD-80 during cruise. The one state is indicative of a "non-normal" bleed configuration and with the exception of pack flow rate will cause the APM program to reject the data point for analysis.

The APM program will analyze data for situations where both ECS packs are in high flow. If data input is to be via **MSIRF**, then a **zero (0)** or a **two (2)** must be placed in the position labeled "**Bleed**" on the Performance Log to indicate the number of ECS pack in high flow. The same value should be entered for both engines.

D.2 717/MD-90/MD-80 Performance Log

Please see the manual performance log on the next page. This log is appropriate for use with the 717 and other Boeing models as noted.

717/MD-90/MD-80/737/757/767
Performance Log

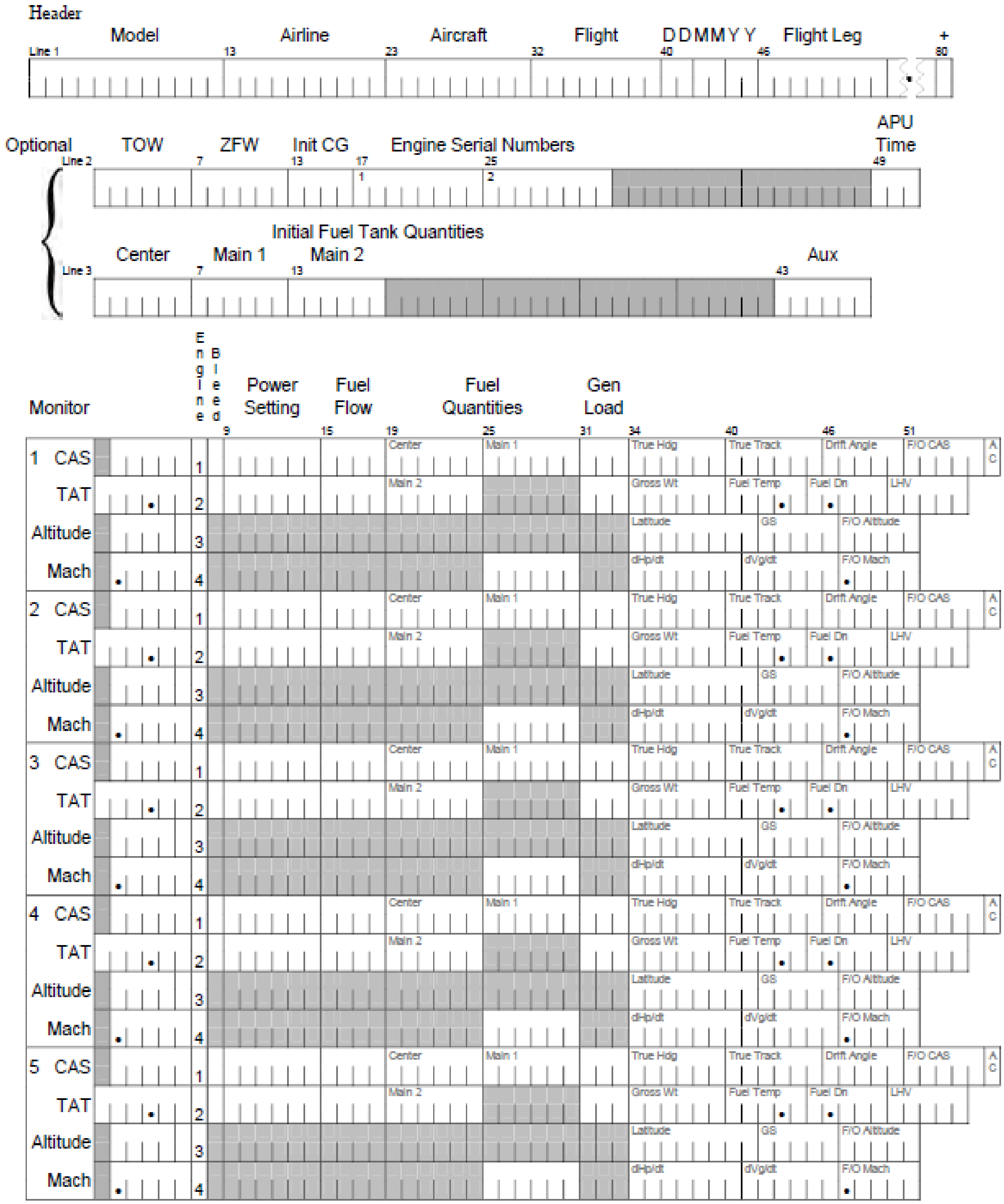

Figure 23: 717/MD-90/MD-80 Performance Log

D.2.1 Recommended Recording Procedures

1. Record Model, Airline, Aircraft, Flight Number and Date.

2. If desired record takeoff gross weight, ZFW, initial center of gravity, engine serial numbers, APU operating time, and initial fuel tank quantities.

3. Wait until the airplane is stabilized in cruise:

    a. Smooth air

    b. No thrust lever movement (auto-throttles off) for more than five minutes

    c. Anti-ice and fuel heat off for more than five minutes

    d. Less than one degree variation in indicated temperature during the preceding three minutes

    e. Less than .005 Mach (two knots CAS) variation in speed during the preceding three minutes

4. Quickly record Mach, EPR or %N1 and Fuel Flow.

5. Record TAT, Altitude, CAS, FMC Gross Weight (see Note 4).

6. Recheck Mach. If the Mach has changed more than .005 (two knots CAS) discard the point.

7. Record Individual Tank Fuel Quantities and Bleed Code (see Note 5).

8. The rest of the parameters on the Log form are optional, record those now if necessary.

9. Wait at least thirty minutes before recording the next data point in order to obtain data over a range of weights.

<u>Notes</u>

- Data can be taken at any stabilized speed. There is no need to return the airplane to a published speed schedule before recording data.

- The airplane identification number should be entered under aircraft. (Data sorting is done using this variable along with date.)

- All gross weight data and fuel quantities must be specified in the same units.

- If the FMC or total gross weight is known, it can be entered in the box labeled "Gross Wt".

- Bleed Config: Record a zero (0) if both ECS Packs are in LOW flow. Record a two (2) if both ECS Packs are in HIGH flow. The bleed code should be the same for both engines.

- If acceleration data (dHp/dt and dVg/dt) are desired, a separate time history must be kept for ground speed and altitude

D.3 717/MD-90/MD-80 DSIRF

Table 13: Standard DSIRF Dataset Header

Field	Parameter Name [3]	Columns	Format [1,2]	Units	Resolution
1	DSIRF Dataset Title	1-5	APM [4]	N/A	N/A
2	Subcategory	6	N	N/A	N/A
3	Dataset Sequence Number	7-8	NN	N/A	N/A
4	Aircraft ID Number	9-17	AAAAAAAAA	alphanum	N/A
5	Aircraft Serial Number	18-22	NNNNN	N/A	N/A
6	Aircraft Type Code	23-24	NN	N/A	N/A
7	Flight Number	25-32	AAAAAAAA	N/A	N/A
8	Depart/Destin Airports	33-40	AAAAAAAA	N/A	N/A
9	Day	41-42	NN	day	I day
10	Month	43-44	NN	month	1 month
11	Year	45-46	NN	year	1 year
12	Time - Hours	47-48	NN	hours	1 hour
13	Time - Minutes	49-50	NN	minutes	1 minute
14	Time - Seconds	51-52	NN,	seconds	1 second
15	Variable Header 1	N/A	A. . .A,[5]	N/A	N/A
16	Variable Header 2	N/A	A. . .A,[5]	N/A	N/A
17-181	First DSIRF Data Field	See DSIRF datasets continued on the following pages			

NOTES on dataset and header fields:

1. NNN denotes only numeric data, AAA denotes alphanumeric characters in data.
2. The first fourteen (14) data fields in the header are fixed, and no data delimiters (commas) are specified. The 15th and 16th header fields are variable, as are data fields in the DSIRF dataset body. The variable fields are separated by commas, such that no data available/required may be denoted by ",," for a specific data field (i.e. blanks/zeros are not required).
3. Fields that contain parameters that are not applicable to the 737 are labeled "Not Used". Availability of the parameters contained in the 737 DSIR is dependent upon the aircraft's ACMS configuration. The airline or operator will have to verify as to whether or not a specific parameter is available.
4. DSIRF dataset title for Airplane Performance Monitoring (APM) is "APM " (the letters APM plus two blanks).
5. The maximum field size is to be 40 characters.

6. Standard input units for DSIRF parameters are given in the DSIRF definition. However, the APM Program will accept units of kilograms for the following selected parameters; (1) gross weight, (2) fuel flow, (3) fuel quantity, (4) fuel used and (5) initial gross weight, zero fuel weight, and fuel quantity. if weight units of kilograms are used, then fuel density must be in kilograms per liter.

7. Due to the fact that the DSIRF can be a variable length record (maximum record length is 1200), it is recommended that the ASCII character string of a carriage return followed by a line feed be used to indicate the end of a DSIRF record.

Table 15 below has the 717/MD-90/MD-80 DSIRF details. Fields 121 through 181 are not used in the performance calculations in APM. They are included in the DSIRF as supplemental information. They will be included in the MASTER file for possible use by post- processing.

Table 14: 717/MD-90/MD-80 DSIRF Dataset

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
17	Mach, Left	.NNN	MACH	0.001 M
18	Mach, Right	.NNN	MACH	0.001 M
19	Not Used	,	N/A	N/A
20	CAS, Left	NNN.N,	Kt	0.1 Kt
21	CAS, Right	NNN.N,	Kt	0.1 Kt
22	Not Used	,	N/A	N/A
23	TAT, Left	+/-NN.NN,	Deg C	0.25 Deg
24	TAT, Right	+/-NN.NN,	Deg C	0.25 Deg
25	Not Used	,	N/A	N/A
26	Altitude(29.92), Left	NNNNN,	Ft	1 Ft
27	Altitude(29.92), Right	NNNNN,	Ft	1 Ft
28	Not Used		N/A	N/A
29	Gross weight, Left	NNNNNN,	Pounds	40 Lbs
30	Gross weight, Right	NNNNNN,	Pounds	40 Lbs
31	Not Used	,	N/A	N/A
32	Fuel Flow Engine 1	NNNN,	Lbs/Hr	1 Lb/Hr
33	Fuel Flow Engine 2	NNNN,	Lbs/Hr	1 Lb/Hr
34	Not Used	,	N/A	N/A
35	Not Used	,	N/A	N/A
36	Power Setting Engine 1	N.NNN / NNN.NN,	EPR / %N1	.001 EPR / .01%N1
37	Power Setting Engine 2	N.NNN / NNN.NN,	EPR / %N1	.001 EPR / .01%N1
38	Not Used	,	N/A	N/A
39	Not Used	,	N/A	N/A
40	DFDAU Calc Quality Factor	NN.N,	N/A	0.1
41	Ground Speed, Left	NNN.N,	Kt	0.1 Kt
42	Ground Speed, Right	NNN.N,	Kt	0.1 Kt
43	Not Used	,	N/A	N/A

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
44	ECS Discrete Pack 1	N,	Discrete	N/A
45	ECS Discrete Pack 2	N,	Discrete	N/A
46	Not Used	,	N/A	N/A
47	ECS High Flow Discrete Pack 1	N,	Discrete	N/A
48	ECS High Flow Discrete Pack 2	N,	Discrete	N/A
49	Not Used	,	N/A	N/A
50	Engine Anti-Ice Discrete Eng 1	N,	Discrete	N/A
51	Engine Anti-Ice Discrete Eng 2	N,	Discrete	N/A
52	Wing Anti-Ice Discrete	N,	Discrete	N/A
53	Isolation Valve Position	N,	Discrete	N/A
54	Engine Bleed Discrete Eng 1	N,	Discrete	N/A
55	Engine Bleed Discrete Eng 2	N,	Discrete	N/A
56	Not Used	,	N/A	N/A
57	Not Used	,	N/A	N/A
58	Present Pos Latitude, Left	+/-NN.NNNN,	Degrees	0.0001 Deg
59	Present Pos Latitude, Right	+/-NN.NNNN,	Degrees	0.0001 Deg
60	Not Used	,	N/A	N/A
61	Not Used	,	N/A	N/A
62	Not Used	,	N/A	N/A
63	Not Used	,	N/A	N/A
64	True Heading, Left	+/-NNN.N,	Degrees	0.1 Deg
65	True Heading, Right	+/-NNN.N,	Degrees	0.1 Deg
66	Not Used	,	N/A	N/A
67	Drift Angle, Left	+/-NN.N,	Degrees	0.1 Deg
68	Drift Angle, Right	+/-NN.N,	Degrees	0.1 Deg
69	Not Used	,	N/A	N/A
70	True Track Angle, Left	+/-NNN.N,	Degrees	0.1 Deg
71	True Track Angle, Right	+/-NNN.N,	Degrees	0.1 Deg
72	Not Used	,	N/A	N/A
73	DFDAU Calculated dHp/dt	+/-NN.NNN,	Ft/Sec	0.001 Ft/Sec
74	DFDAU Calculated dVg/dt	+/-N.NNN,	Kt/Sec	0.001 Kt/Sec
75	Not Used	,	N/A	N/A
76	Not Used	,	N/A	N/A
77	Not Used	,	N/A	N/A
78	Fuel Density	N.NNN,	Lbs/USgal	.001 Lb
79	Fuel Temperature	+/-NNN	Degrees C	1 Deg C
80	Fuel Quantity Center	NNNNN,	Pounds	100 Lbs
81	Fuel Quantity Left Main	NNNNN,	Pounds	100 Lbs
82	Fuel Quantity Right Main	NNNNN,	Pounds	100 Lbs

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
83	Not Used	,	N/A	N/A
84	Not Used	,	N/A	N/A
85	Not Used	,	N/A	N/A
86	Not Used	,	N/A	N/A
87	Not Used	,	N/A	N/A
88	Fuel Used Engine 1	NNNNN,	Pounds	1 Lb
89	Fuel Used Engine 2	NNNNN,	Pounds	1 Lb
90	Not Used	,	N/A	N/A
91	Not Used	,	N/A	N/A
92	APU Operating Time	NN.N,	minutes	0.1 Minute
93	Generator Load Engine 1	NNN,	%	1 %
94	Generator Load Engine 2	NNN,	%	1 %
95	Not Used	,	N/A	N/A
96	Not Used	,	N/A	N/A
97	Initial Gross Weight, Left	NNNNNN,	Pounds	40 Lbs.
98	Initial Gross Weight, Right	NNNNNN,	Pounds	40 Lbs
99	Not Used	,	N/A	N/A '
100	Initial CG, Left	NN.NN,	% MAC	0.05 %
101	Initial CG, Right	NN.NN,	% MAC	0.05 %
102	Not Used	,	N/A	N/A
103	Initial ZFW, Left	NNNNNN,	Pounds	40 Lbs
104	Initial ZFW, Right	NNNNNN,	Pounds	40 Lbs
105	Not Used	,	N/A	N/A
106	Init. Fuel Qty Center	NNNNN,	Pounds	100 Lbs
107	Init. Fuel Qty Left Main	NNNNN,	Pounds	100 Lbs
108	Init. Fuel Qty Right Main	NNNNN,	Pounds	100 Lbs
109	Not Used	,	N/A	N/A
110	Not Used	,	N/A	N/A
111	Not Used	,	N/A	N/A
112	Not Used	,	N/A	N/A
113	Not Used	,	N/A	N/A
114	Serial Number Engine 1	AAAAAAAA,	N/A	N/A
115	Serial Number Engine 2	AAAAAAAA,	N/A	N/A
116	Not Used	,	N/A	N/A
117	Not Used	,	N/A	N/A
118	DFDAU Calc Gross Weight	NNNNNN,	Pounds	40 Lbs
119	DFDAU Calc CG Position	NN.NN,	% MAC	0.1 %
120	DFDAU Calc LHV	NNNNN,	BTU/Lb	1.0 BTU/Lb
121	N1 Engine 1	NNN.N,	% RPM	0.1 %

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
122	N1 Engine 2	NNN.N,	% RPM	0.1 %
123	Not Used	,	N/A	N/A
124	Not Used	,	N/A	N/A
125.	N2 Engine 1	NNN.N,	% RPM	0.1 %
126.	N2 Engine 2	NNN.N,	% RPM	0.1 %
127.	Not Used	,	N/A	N/A
128.	Not Used	,	N/A	N/A
129.	Not Used	,	N/A	N/A
130.	Not Used	,	N/A	N/A
131.	Not Used	,	N/A	N/A
132.	Not Used	,	N/A	N/A
133.	EGT Engine 1	NNN.N,	Degrees C	0.5 Deg C
134.	EGT Engine 2	NNN.N,	Degrees C	0.5 Deg C
135.	Not Used	,	N/A	N/A
136.	Not Used	,	N/A	N/A
137.	Not Used	,	N/A	N/A
138.	Not Used	,	N/A	N/A
139.	Not Used	,	N/A	N/A
140.	Not Used	,	N/A	N/A
141.	SAT, Left	+/-NN. N,	Deg C	0.5 Deg
142.	SAT, Right	+/-NN.N,	Deg C	0.5 Deg
143.	Not Used	,	N/A	N/A
144.	Indicated AOA, Left	+/-NN.N,	Degrees	0.05 Deg
145.	Indicated AOA, Right	+/-NN.N,	Degrees	0.05 Deg
146.	Not Used	,	N/A	N/A
147.	Roll Angle, Left	+/-NN.N,	Degrees	0.1 Deg
148.	Roll Angle, Right	+/-NN.N,	Degrees	0.1 Deg
145.	Not Used	,	N/A	N/A
150.	Pitch Angle, Left	+/-NN.N,	Degrees	0.1 Deg
151.	Pitch Angle, Right	+/-NN.N,	Degrees	0.1 Deg
152.	Not Used	,	N/A	N/A
153.	Stabilizer Position	+/-NN.N,	Units	0.05 Unit
154.	Left spoilerPosition	NN.N,	Degrees	0.1 Deg
155.	Right Spoiler Position	NN.N,	Degrees	0,1 Deg
156.	Left Aileron Position	+/-NN.N,	Degrees	0.1 Deg
157.	Right Aileron Position	+/-NN.N,	Degrees	0.1 Deg
158.	Not Used	,	N/A	N/A
159.	Not Used	,	N/A	N/A
160.	Rudder Position	+/-NN.N,	Degrees	0.1 Deg

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
161.	Not Used	,	N/A	N/A
162.	Left Elevator Position	+/-NN.N,	Degrees	0.1 Deg
163.	Right Elevator Position	+/-NN.N,	Degrees	0.1 Deg
164.	Not Used	,	N/A	N/A
165.	Not Used	,	N/A	N/A
166.	TE Flap Position Left	NN.N,	Degrees	0.1 Deg
167.	TE Flap Position Right	NN.N,	Degrees	0.1 Deg
168.	Not Used	,	N/A	N/A
169.	Not Used	,	N/A	N/A
170.	Along TK Horiz Accel, Left	+/-N.NN,	G's	0.01 G
171.	Along TK Horiz Accel, Right	+/-N.NN,	G's	0.01 G
172.	Not Used	,	N/A	N/A
173.	Flight Path Accel, Left	+/-N.NN,	G's	0.01 G
174.	Flight Path Accel, Right	+/-N.NN,	G's	0.01 G
175.	Not Used	,	N/A	N/A
176.	Vertical Accel, Left	+/-N.NN,	G's	0.01 G
177.	Vertical Accel, Right	+/-N.NN,	G's	0.01 G
178.	Not Used	,	N/A	N/A
179.	DFDAU Calculated dIVV/dt	+/-NN.NNN,	Ft/Sec2	0.001
180.	Fuel Imbal. Roll Moment	+/-NN.NN,	106 In-Lb	0.0lx106 In-Lb
181.	Angle of Sideslip	+/-N.NN,	Degrees	0.01 Deg

D.4 717/MD-90/MD-80 MASTER File

The first character of each line is the FORTRAN carriage control. Parameters 220 – 252 are calculated variables in the program and are presented in the MASTER file for inspection or subsequent analysis.

Table 15: 717/MD-90/MD-80 Master File

Line	Parameters	Format
1	Error code and text: 1. Error code 2. Error test 3. Model 4. Engine	1X,I7,1X,A80,1X,A16,1X,A16/

Line	Parameters	Format
2	Deviations: 5. Thrust deviation 6. Power setting deviation 7. Fuel flow deviation engine 1 8. Fuel flow deviation engine 2 9. Not Used 10. Not Used 11. Average fuel flow deviation 12. Fuel mileage deviation 13. Fuel flow deviation due to power setting deviation	1X,9(F13.5,1X)/
3	Header: 14. Airplane Identification Number 15. Airplane Serial Number 16. Flight Number 17. Departure/Destination 18. Day 19. Month 20. Year 21. Time - Hrs 22. Time - Min 23. Time - Sec	1X,A54/
4	Variable Header 24. Variable Header 1 25. Variable Header 2	1X,2A40/
5	Analysis Parameters: 26. Mach, Left 27. Mach, Right 28. Not Used 29. CAS, Left 30. CAS, Right 31. Not Used 32. TAT, Left 33. TAT, Right 34. Not Used	1X,9(F13.5,1X)/
6	35. Pressure Altitude, Left 36. Pressure Altitude, Right 37. Not Used 38. Gross Weight, Left 39. Gross Weight, Right 40. Not Used 41. Fuel Flow Engine 1 42. Fuel Flow Engine 2 43. Not Used	1X,9(F13.5,1X)/

Line	Parameters	Format
7	44. Not Used 45. Power Setting Engine 1 46. Power Setting Engine 2 47. Not Used 48. Not Used 49. DFDAU Calculated Quality Factor 50. Ground Speed, Left 51. Ground Speed, Right 52. Not Used	1X,9(F13.5,1X)/
8	53. ECS Discrete Pack 1 54. ECS Discrete Pack 2 55. Not Used 56. ECS High Flow Discrete Pack 1 57. ECS High Flow Discrete Pack 2 58. Not Used 59. Engine Anti-Ice Discrete Eng 1 60. Engine Anti-Ice Discrete Eng 2 61. Wing Anti-Ice Discrete	1X,9(F13.5,1X)/
9	62. Isolation Valve Position 63. Engine Bleed Discrete Eng 1 64. Engine Bleed Discrete Eng 2 65. Not Used 66. Not Used 67. Present Position Latitude, Left 68. Present Position Latitude, Right 69. Not Used 70. Not Used	1X,9(F13.5,1X)/
10	71. Not Used 72. Not Used 73. True Heading, Left 74. True Heading, Right 75. Not Used 76. Drift Angle, Left 77. Drift Angle, Right 78. Not Used 79. True Track Angle, Left	1X,9(F13.5,1X)/
11	80. True Track Angle, Right 81. Not Used 82. DFDAU Calculated dHp/dt 83. DFDAU Calculated dVg/dt 84. Not Used 85. Not Used 86. I Not Used 87. Fuel Density 88. Fuel Temperature	1X,9(F13.5,1X)/

Line	Parameters	Format
12	89. Fuel Quantity Center 90. Fuel Quantity Left Main 91. Fuel Quantity Right Main 92. Not Used 93. Not Used 94. Not Used 95. Not Used 96. Not Used 97. Fuel Used Engine 1	1X,9(F13.5,1X)/
13	98. Fuel Used Engine 2 99. Not Used 100. Not Used 101. APU Operating Time 102. Generator Load Engine 1 103. Generator Load Engine 2 104. Not Used 105. Not Used 106. Initial Gross Weight, Left	1X,9(F13.5,1X)/
14	107. Initial Gross Weight, Right 108. Not Used 109. Initial CG Position, Left 110. Initial CG Position, Right 111. Not Used 112. Initial Zero Fuel Weight, Left 113. Initial Zero Fuel Weight, Right 114. Not Used 115. Initial Fuel Quantity Center	1X,9(F13.5,1X)/
15	116. Initial Fuel Quantity Left Main 117. Initial Fuel Quantity Right Main 118. Not Used 119. Not Used 120. Not Used 121. Not Used 122. Not Used	1X,7(F13.5,1X)/
16	123. Serial Number Engine 1 124. Serial Number Engine 2 125. Not Used 126. Not Used	1X,4(A8,1X)/

Line	Parameters		Format
17	127.	DFDAU Calculated Gross Weight	1X,9(F13.5,1X)/
	128.	DFDAU Calculated Center of Gravity Position	
	129.	DFDAU Calculated Fuel Lower Heat Value	
	130.	%N1 Engine 1	
	131.	%N1 Engine 2	
	132.	Not Used	
	133.	Not Used	
	134.	%N2 Engine 1	
	135.	%N2 Engine 2	
18	136.	Not Used	1X,9(F13.5,1X)/
	137.	Not Used	
	138.	Not Used	
	139.	Not Used	
	140.	Not Used	
	141.	Not Used	
	142.	EGT Engine 1	
	143.	EGT Engine 2	
	144.	Not Used	
19	145.	Not Used	1X,9(F13.5,1X)/
	146.	Not Used	
	147.	Not Used	
	148.	Not Used	
	149.	Not Used	
	150.	SAT, Left	
	151.	SAT, Right	
	152.	Not Used	
	153.	Indicated Angle of Attack, Left	
20	154.	Indicated Angle of Attack, Right	1X,9(F13.5,1X)/
	155.	Not Used	
	156.	Roll Angle, Left	
	157.	Roll Angle, Right	
	158.	Not Used	
	159.	Pitch Angle, Left	
	160.	Pitch Angle, Right	
	161.	Not Used	
	162.	Stabilizer Position	
21	163.	Left Spoiler Position	1X,9(F13.5,1X)/
	164.	Right Spoiler Position	
	165.	Left Aileron Position	
	166.	Right Aileron Position	
	167.	Not Used	
	168.	Not Used	
	169.	Rudder Position	
	170.	Not Used	
	171.	Left Elevator Position	

Line	Parameters		Format
22	172.	Right Elevator Position	1X,9(F13.5,1X)/
	173.	Not Used	
	174.	Not Used	
	175.	Trailing Edge Flap Position Left	
	176.	Trailing Edge Flap Position Right	
	177.	Not Used	
	178.	Not Used	
	179.	Along TK Horizontal Acceleration, Left	
	180.	Along TK Horizontal Acceleration, Right	
23	181.	Not Used	1X,9(F13.5,1X)/
	182.	Flight Path Acceleration, Left	
	183.	Flight Path Acceleration, Right	
	184.	Not Used	
	185.	Vertical Accel, Left	
	186.	Vertical Accel, Right	
	187.	Not Used	
	188.	DFDAU Calculated dIVV/dt	
	189.	Fuel Imbal. Roll Moment	
24	190.	Angle of Sideslip	1X,9(F13.5,1X)/
	191-198	Open for DSIRF expansion	
25	199-207	Open for DSIRF expansion	1X,9(F13.5,1X)/
26	208-216	Open for DSIRF expansion	1X,9(F13.5,1X)/
27	217-219	Open for DSIRF expansion	1X,3(F13.5,1X)/
28	220.	Corrected Gross weight	1X,9(F13.5,1X)/
	221.	Lift Coefficient	
	222.	Cd Basic	
	223.	Cd Reynolds	
	224.	CG Position	
	225.	Cd Center of Gravity	
	226.	Cd Elasticity	
	227.	Cd Total	
	228.	Delta Drag - Acceleration	
29	229.	Total Drag	1X,9(F13.5,1X)/
	230.	Drag/Delta	
	231.	Thrust Engine 1	
	232.	Thrust Engine 2	
	233.	Not Used	
	234.	Not Used	
	235.	Total Thrust	
	236.	Book Power Setting (Eng. Type 1)	
	237.	Book Power Setting (Eng. Type 2)	

Line	Parameters		Format
30	238.	Average Power Setting	1X,9(F13.5,1X)/
	239.	Corrected Book Fuel Flow Engine 1	
	240.	Corrected Book Fuel Flow Engine 2	
	241.	Not Used	
	242.	Not Used	
	243.	Fuel Flow Factor	
	244.	LHV Ratio Fuel Flow Factor	
	245.	Power Extraction Fuel Flow Factor	
	246.	Observed Fuel Flow Total	
31	247.	Book Fuel Flow Total	1X,5(F13.5,1X),A16,1X,A16/
	248.	True Airspeed (TAS)	
	249.	Book Fuel Mileage	
	250.	Observed Fuel Mileage	
	251.	Instrument Source	
	252.	Speed Type	

Appendix E MD-11 MODEL SPECIFIC INFORMATION

A generalized definition of the DSIRF for the MD-11 is provided in this section for those operators that have an ACMS system for data collection. The availability of some parameters will depend on customized ACMS programming and in some cases manual input by the flight crew prior to departure. It is recommended that the default values be used for the input options during the first trial run of the APM Program. To use one of the data correction algorithms contained in the program, it is recommended that the reader consult Section 4 Algorithm and Analysis to determine what data are required for that specific correction.

E.1 Bleed Configuration

To be eligible for analysis by the APM program, each candidate DSIRF or MSIRF data record is checked to determine if the bleed configuration is compatible with the airplane database. The status of the following bleeds are used to define this configuration. NOTE: The discrete values shown below represent the convention adopted for the APM program and do not necessarily agree with the actual airplane discrete values.

Table 16: MD-11 Bleed Configurations

BLEED	STATUS	
	ZERO STATE	ONE STATE
ECS PACKS	ON	OFF
ENGINE BLEEDS	ON	OFF
ISOLATION VALVE	CLOSED	OPEN
ENGINE ANTI-ICE BLEEDS	OFF	ON
WING ANTI-ICE BLEED	OFF	ON

The zero state represents the "normal" bleed configuration of the MD-11 during cruise. The one state is indicative of a "non-normal" bleed configuration and with the exception of pack flow rate will cause the APM program to reject the data point for analysis.

The APM program will analyze data for situations where both ECS packs are in high flow. If data input is to be via **MSIRF**, then a **zero (0)** or a **two (2)** must be placed in the position labeled "**Bleed**" on the Performance Log to indicate the number of ECS pack in high flow. The same value should be entered for both engines.

E.2 MD-11 Performance Log

Please see the manual performance log on the next page. This log is appropriate for use with the MD-11 and other Boeing models as noted.

717/MD-90/MD-80/737/757/767
Performance Log

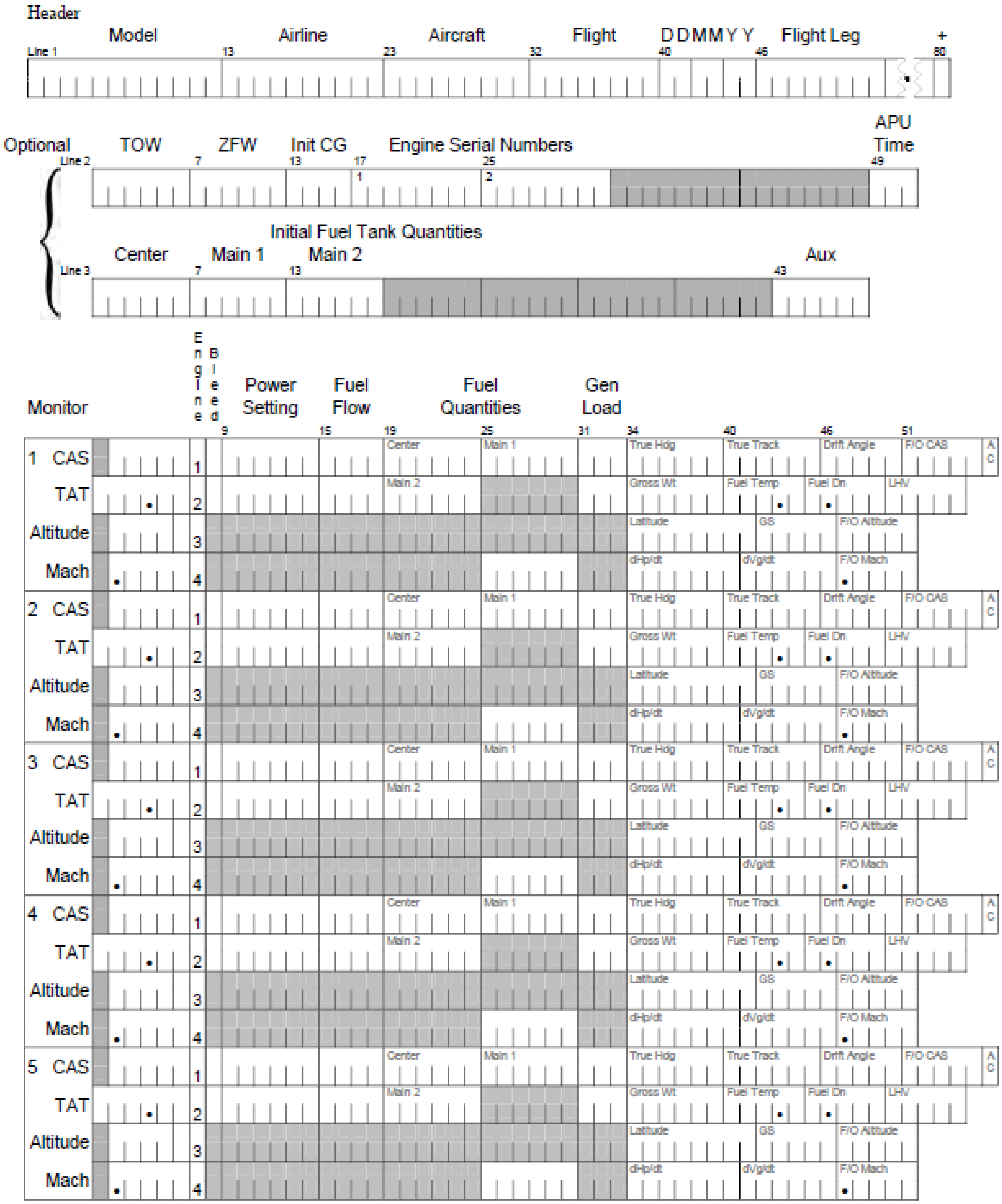

Figure 24: MD-11 Performance Log

E.2.1 Recommended Recording Procedures

1. Record Model, Airline, Aircraft, Flight Number and Date.

2. If desired record takeoff gross weight, ZFW, initial center of gravity, engine serial numbers, APU operating time, and initial fuel tank quantities.

3. Wait until the airplane is stabilized in cruise:

    a. Smooth air

    b. No thrust lever movement (auto-throttles off) for more than five minutes

    c. Anti-ice and fuel heat off for more than five minutes

    d. Less than one degree variation in indicated temperature during the preceding three minutes

    e. Less than .005 Mach (two knots CAS) variation in speed during the preceding three minutes

4. Quickly record Mach, EPR or %N1 and Fuel Flow.

5. Record TAT, Altitude, CAS, FMC Gross Weight (see Note 4).

6. Recheck Mach. If the Mach has changed more than .005 (two knots CAS) discard the point.

7. Record Individual Tank Fuel Quantities and Bleed Code (see Note 5).

8. The rest of the parameters on the Log form are optional, record those now if necessary.

9. Wait at least thirty minutes before recording the next data point in order to obtain data over a range of weights.

<u>Notes</u>

- Data can be taken at any stabilized speed. There is no need to return the airplane to a published speed schedule before recording data.

- The airplane identification number should be entered under aircraft. (Data sorting is done using this variable along with date.)

- All gross weight data and fuel quantities must be specified in the same units.

- If the FMC or total gross weight is known, it can be entered in the box labeled "Gross Wt".

- Bleed Config: Record a zero (0) if both ECS Packs are in LOW flow. Record a two (2) if both ECS Packs are in HIGH flow. The bleed code should be the same for both engines.

- If acceleration data (dHp/dt and dVg/dt) are desired, a separate time history must be kept for ground speed and altitude

E.3 MD-11 DSIRF

Table 17: Standard DSIRF Dataset Header

Field	Parameter Name [3]	Columns	Format [1,2]	Units	Resolution
1	DSIRF Dataset Title	1-5	APM [4]	N/A	N/A
2	Subcategory	6	N	N/A	N/A
3	Dataset Sequence Number	7-8	NN	N/A	N/A
4	Aircraft ID Number	9-17	AAAAAAAAA	alphanum	N/A
5	Aircraft Serial Number	18-22	NNNNN	N/A	N/A
6	Aircraft Type Code	23-24	NN	N/A	N/A
7	Flight Number	25-32	AAAAAAAA	N/A	N/A
8	Depart/Destin Airports	33-40	AAAAAAAA	N/A	N/A
9	Day	41-42	NN	day	I day
10	Month	43-44	NN	month	1 month
11	Year	45-46	NN	year	1 year
12	Time - Hours	47-48	NN	hours	1 hour
13	Time - Minutes	49-50	NN	minutes	1 minute
14	Time - Seconds	51-52	NN,	seconds	1 second
15	Variable Header 1	N/A	A. . .A,[5]	N/A	N/A
16	Variable Header 2	N/A	A. . .A,[5]	N/A	N/A
17-181	First DSIRF Data Field	See DSIRF datasets continued on the following pages			

<u>NOTES on dataset and header fields:</u>

1. NNN denotes only numeric data, AAA denotes alphanumeric characters in data.
2. The first fourteen (14) data fields in the header are fixed, and no data delimiters (commas) are specified. The 15th and 16th header fields are variable, as are data fields in the DSIRF dataset body. The variable fields are separated by commas, such that no data available/required may be denoted by ",," for a specific data field (i.e. blanks/zeros are not required).
3. Fields that contain parameters that are not applicable to the 737 are labeled "Not Used". Availability of the parameters contained in the 737 DSIR is dependent upon the aircraft's ACMS configuration. The airline or operator will have to verify as to whether or not a specific parameter is available.
4. DSIRF dataset title for Airplane Performance Monitoring (APM) is "APM " (the letters APM plus two blanks).
5. The maximum field size is to be 40 characters.

6. Standard input units for DSIRF parameters are given in the DSIRF definition. However, the APM Program will accept units of kilograms for the following selected parameters; (1) gross weight, (2) fuel flow, (3) fuel quantity, (4) fuel used and (5) initial gross weight, zero fuel weight, and fuel quantity. if weight units of kilograms are used, then fuel density must be in kilograms per liter.

7. Due to the fact that the DSIRF can be a variable length record (maximum record length is 1200), it is recommended that the ASCII character string of a carriage return followed by a line feed be used to indicate the end of a DSIRF record.

Table 19 below has the MD-11 DSIRF details. Fields 121 through 181 are not used in the performance calculations in APM. They are included in the DSIRF as supplemental information. They will be included in the MASTER file for possible use by post- processing.

Table 18: MD-11 DSIRF Dataset

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
17	Mach, Left	.NNN	MACH	0.001 M
18	Mach, Right	.NNN	MACH	0.001 M
19	Not Used	,	N/A	N/A
20	CAS, Left	NNN.N,	Kt	0.1 Kt
21	CAS, Right	NNN.N,	Kt	0.1 Kt
22	Not Used	,	N/A	N/A
23	TAT, Left	+/-NN.NN,	Deg C	0.25 Deg
24	TAT, Right	+/-NN.NN,	Deg C	0.25 Deg
25	Not Used	,	N/A	N/A
26	Altitude(29.92), Left	NNNNN,	Ft	1 Ft
27	Altitude(29.92), Right	NNNNN,	Ft	1 Ft
28	Not Used		N/A	N/A
29	Gross weight, Left	NNNNNN,	Pounds	40 Lbs
30	Gross weight, Right	NNNNNN,	Pounds	40 Lbs
31	Not Used	,	N/A	N/A
32	Fuel Flow Engine 1	NNNN,	Lbs/Hr	1 Lb/Hr
33	Fuel Flow Engine 2	NNNN,	Lbs/Hr	1 Lb/Hr
34	Fuel Flow Engine 3	NNNN,	Lbs/Hr	1 Lb/Hr
35	Not Used	,	N/A	N/A
36	Power Setting Engine 1	N.NNN,	EPR	.001 EPR
37	Power Setting Engine 2	N.NNN,	EPR	.001 EPR
38	Power Setting Engine 3	N.NNN,	EPR	.001 EPR
39	Not Used	,	N/A	N/A
40	DFDAU Calc Quality Factor	NN.N,	N/A	0.1
41	Ground Speed, Left	NNN.N,	Kt	0.1 Kt
42	Ground Speed, Right	NNN.N,	Kt	0.1 Kt
43	Not Used	,	N/A	N/A

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
44	ECS Discrete Pack 1	N,	Discrete	N/A
45	ECS Discrete Pack 2	N,	Discrete	N/A
46	ECS Discrete Pack 3	N,	Discrete	N/A
47	Not Used	,	N/A	N/A
48	Not Used	,	N/A	N/A
49	Not Used	,	N/A	N/A
50	Engine Anti-Ice Discrete Eng 1	N,	Discrete	N/A
51	Engine Anti-Ice Discrete Eng 2	N,	Discrete	N/A
52	Engine Anti-Ice Discrete Eng 3	N,	Discrete	N/A
53	Wing Anti-Ice Discrete	N,	Discrete	N/A
54	Engine Bleed Discrete Eng 1	N,	Discrete	N/A
55	Engine Bleed Discrete Eng 2	N,	Discrete	N/A
56	Engine Bleed Discrete Eng 3	N,	Discrete	N/A
57	Isolation Valve Position	N,	Discrete	N/A
58	Present Pos Latitude, Left	+/-NN.NNNN,	Degrees	0.0001 Deg
59	Present Pos Latitude, Right	+/-NN.NNNN,	Degrees	0.0001 Deg
60	Not Used	,	N/A	N/A
61	Not Used	,	N/A	N/A
62	Not Used	,	N/A	N/A
63	Not Used	,	N/A	N/A
64	True Heading, Left	+/-NNN.N,	Degrees	0.1 Deg
65	True Heading, Right	+/-NNN.N,	Degrees	0.1 Deg
66	Not Used	,	N/A	N/A
67	Drift Angle, Left	+/-NN.N,	Degrees	0.1 Deg
68	Drift Angle, Right	+/-NN.N,	Degrees	0.1 Deg
69	Not Used	,	N/A	N/A
70	True Track Angle, Left	+/-NNN.N,	Degrees	0.1 Deg
71	True Track Angle, Right	+/-NNN.N,	Degrees	0.1 Deg
72	Not Used	,	N/A	N/A
73	DFDAU Calculated dHp/dt	+/-NN.NNN,	Ft/Sec	0.001 Ft/Sec
74	DFDAU Calculated dVg/dt	+/-N.NNN,	Kt/Sec	0.001 Kt/Sec
75	Not Used	,	N/A	N/A
76	Not Used	,	N/A	N/A
77	Not Used	,	N/A	N/A
78	Fuel Density	N.NNN,	Lbs/USgal	.001 Lb
79	Fuel Temperature	+/-NNN	Degrees C	1 Deg C
80	Fuel Quantity Center	NNNNN,	Pounds	100 Lbs
81	Fuel Quantity Left Main	NNNNN,	Pounds	100 Lbs
82	Fuel Quantity Right Main	NNNNN,	Pounds	100 Lbs

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
83	Not Used	,	N/A	N/A
84	Not Used	,	N/A	N/A
85	Not Used	,	N/A	N/A
86	Not Used	,	N/A	N/A
87	Not Used	,	N/A	N/A
88	Fuel Used Engine 1	NNNNN,	Pounds	1 Lb
89	Fuel Used Engine 2	NNNNN,	Pounds	1 Lb
90	Fuel Used Engine 3	NNNNN,	Pounds	1 Lb
91	Not Used	,	N/A	N/A
92	APU Operating Time	NN.N,	minutes	0.1 Minute
93	Generator Load Engine 1	NNN,	%	1 %
94	Generator Load Engine 2	NNN,	%	1 %
95	Generator Load Engine 3	NNN,	%	1 %
96	Not Used	,	N/A	N/A
97	Initial Gross Weight, Left	NNNNNN,	Pounds	40 Lbs.
98	Initial Gross Weight, Right	NNNNNN,	Pounds	40 Lbs
99	Not Used	,	N/A	N/A '
100	Initial CG, Left	NN.NN,	% MAC	0.05 %
101	Initial CG, Right	NN.NN,	% MAC	0.05 %
102	Not Used	,	N/A	N/A
103	Initial ZFW, Left	NNNNNN,	Pounds	40 Lbs
104	Initial ZFW, Right	NNNNNN,	Pounds	40 Lbs
105	Not Used	,	N/A	N/A
106	Init. Fuel Qty Center	NNNNN,	Pounds	100 Lbs
107	Init. Fuel Qty Left Main	NNNNN,	Pounds	100 Lbs
108	Init. Fuel Qty Right Main	NNNNN,	Pounds	100 Lbs
109	Not Used	,	N/A	N/A
110	Not Used	,	N/A	N/A
111	Not Used	,	N/A	N/A
112	Not Used	,	N/A	N/A
113	Not Used	,	N/A	N/A
114	Serial Number Engine 1	AAAAAAAA,	N/A	N/A
115	Serial Number Engine 2	AAAAAAAA,	N/A	N/A
116	Serial Number Engine 3	AAAAAAAA,	N/A	N/A
117	Not Used	,	N/A	N/A
118	DFDAU Calc Gross Weight	NNNNNN,	Pounds	40 Lbs
119	DFDAU Calc CG Position	NN.NN,	% MAC	0.1 %
120	DFDAU Calc LHV	NNNNN,	BTU/Lb	1.0 BTU/Lb
121	Not Used	,	N/A	N/A

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
122	Not Used	,	N/A	N/A
123	Not Used	,	N/A	N/A
124	Not Used	,	N/A	N/A
125.	N2 Engine 1	NNN.N,	% RPM	0.1 %
126.	N2 Engine 2	NNN.N,	% RPM	0.1 %
127.	N2 Engine 3	NNN.N,	% RPM	0.1 %
128.	Not Used	,	N/A	N/A
129.	Not Used	,	N/A	N/A
130.	Not Used	,	N/A	N/A
131.	Not Used	,	N/A	N/A
132.	Not Used	,	N/A	N/A
133.	EGT Engine 1	NNN.N,	Degrees C	0.5 Deg C
134.	EGT Engine 2	NNN.N,	Degrees C	0.5 Deg C
135.	EGT Engine 3	NNN.N,	Degrees C	0.5 Deg C
136.	Not Used	,	N/A	N/A
137.	Not Used	,	N/A	N/A
138.	Not Used	,	N/A	N/A
139.	Not Used	,	N/A	N/A
140.	Not Used	,	N/A	N/A
141.	SAT, Left	+/-NN. N,	Deg C	0.5 Deg
142.	SAT, Right	+/-NN.N,	Deg C	0.5 Deg
143.	Not Used	,	N/A	N/A
144.	Indicated AOA, Left	+/-NN.N,	Degrees	0.05 Deg
145.	Indicated AOA, Right	+/-NN.N,	Degrees	0.05 Deg
146.	Not Used	,	N/A	N/A
147.	Roll Angle, Left	+/-NN.N,	Degrees	0.1 Deg
148.	Roll Angle, Right	+/-NN.N,	Degrees	0.1 Deg
145.	Not Used	,	N/A	N/A
150.	Pitch Angle, Left	+/-NN.N,	Degrees	0.1 Deg
151.	Pitch Angle, Right	+/-NN.N,	Degrees	0.1 Deg
152.	Not Used	,	N/A	N/A
153.	Stabilizer Position	+/-NN.N,	Units	0.05 Unit
154.	Left SpoilerPosition	NN.N,	Degrees	0.1 Deg
155.	Right Spoiler Position	NN.N,	Degrees	0,1 Deg
156.	Left Aileron Position	+/-NN.N,	Degrees	0.1 Deg
157.	Right Aileron Position	+/-NN.N,	Degrees	0.1 Deg
158.	Not Used	,	N/A	N/A
159.	Not Used	,	N/A	N/A
160.	Rudder Position	+/-NN.N,	Degrees	0.1 Deg

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
161.	Not Used	,	N/A	N/A
162.	Left Elevator Position	+/-NN.N,	Degrees	0.1 Deg
163.	Right Elevator Position	+/-NN.N,	Degrees	0.1 Deg
164.	Not Used	,	N/A	N/A
165.	Not Used	,	N/A	N/A
166.	TE Flap Position Left	NN.N,	Degrees	0.1 Deg
167.	TE Flap Position Right	NN.N,	Degrees	0.1 Deg
168.	Not Used	,	N/A	N/A
169.	Not Used	,	N/A	N/A
170.	Along TK Horiz Accel, Left	+/-N.NN,	G's	0.01 G
171.	Along TK Horiz Accel, Right	+/-N.NN,	G's	0.01 G
172.	Not Used	,	N/A	N/A
173.	Flight Path Accel, Left	+/-N.NN,	G's	0.01 G
174.	Flight Path Accel, Right	+/-N.NN,	G's	0.01 G
175.	Not Used	,	N/A	N/A
176.	Vertical Accel, Left	+/-N.NN,	G's	0.01 G
177.	Vertical Accel, Right	+/-N.NN,	G's	0.01 G
178.	Not Used	,	N/A	N/A
179.	DFDAU Calculated dIVV/dt	+/-NN.NNN,	Ft/Sec2	0.001
180.	Fuel Imbal. Roll Moment	+/-NN.NN,	106 In-Lb	0.0lx106 In-Lb
181.	Angle of Sideslip	+/-N.NN,	Degrees	0.01 Deg

E.4 MD-11 MASTER File

The first character of each line is the FORTRAN carriage control. Parameters 220 – 252 are calculated variables in the program and are presented in the MASTER file for inspection or subsequent analysis.

Table 19: MD-11 Master File

Line	Parameters	Format
1	Error code and text: 1. Error code 2. Error test 3. Model 4. Engine	1X,I7,1X,A80,1X,A16,1X,A16/

Line	Parameters	Format
2	Deviations: 5. Thrust deviation 6. Power setting deviation 7. Fuel flow deviation engine 1 8. Fuel flow deviation engine 2 9. Not Used 10. Not Used 11. Average fuel flow deviation 12. Fuel mileage deviation 13. Fuel flow deviation due to power setting deviation	1X,9(F13.5,1X)/
3	Header: 14. Airplane Identification Number 15. Airplane Serial Number 16. Flight Number 17. Departure/Destination 18. Day 19. Month 20. Year 21. Time - Hrs 22. Time - Min 23. Time - Sec	1X,A54/
4	Variable Header 24. Variable Header 1 25. Variable Header 2	1X,2A40/
5	Analysis Parameters: 26. Mach, Left 27. Mach, Right 28. Not Used 29. CAS, Left 30. CAS, Right 31. Not Used 32. TAT, Left 33. TAT, Right 34. Not Used	1X,9(F13.5,1X)/
6	35. Pressure Altitude, Left 36. Pressure Altitude, Right 37. Not Used 38. Gross Weight, Left 39. Gross Weight, Right 40. Not Used 41. Fuel Flow Engine 1 42. Fuel Flow Engine 2 43. Fuel Flow Engine 3	1X,9(F13.5,1X)/

Line	Parameters	Format
7	44. Not Used 45. Power Setting Engine 1 46. Power Setting Engine 2 47. Power Setting Engine 3 48. Not Used 49. DFDAU Calculated Quality Factor 50. Ground Speed, Left 51. Ground Speed, Right 52. Not Used	1X,9(F13.5,1X)/
8	53. ECS Discrete Pack 1 54. ECS Discrete Pack 2 55. ECS Discrete Pack 3 56. Not Used 57. Not Used 58. Not Used 59. Engine Anti-Ice Discrete Eng 1 60. Engine Anti-Ice Discrete Eng 2 61. Engine Anti-Ice Discrete Eng 3	1X,9(F13.5,1X)/
9	62. Wing Anti-Ice Discrete 63. Engine Bleed Discrete Eng 1 64. Engine Bleed Discrete Eng 2 65. Engine Bleed Discrete Eng 3 66. Isolation Valve Position 67. Present Position Latitude, Left 68. Present Position Latitude, Right 69. Not Used 70. Not Used	1X,9(F13.5,1X)/
10	71. Not Used 72. Not Used 73. True Heading, Left 74. True Heading, Right 75. Not Used 76. Drift Angle, Left 77. Drift Angle, Right 78. Not Used 79. True Track Angle, Left	1X,9(F13.5,1X)/
11	80. True Track Angle, Right 81. Not Used 82. DFDAU Calculated dHp/dt 83. DFDAU Calculated dVg/dt 84. Not Used 85. Not Used 86. Not Used 87. Fuel Density 88. Fuel Temperature	1X,9(F13.5,1X)/

Line	Parameters	Format
12	89. Fuel Quantity Center 90. Fuel Quantity Left Main 91. Fuel Quantity Right Main 92. Not Used 93. Not Used 94. Not Used 95. Not Used 96. Not Used 97. Fuel Used Engine 1	1X,9(F13.5,1X)/
13	98. Fuel Used Engine 2 99. Fuel used Engine 3 100. Not Used 101. APU Operating Time 102. Generator Load Engine 1 103. Generator Load Engine 2 104. Generator Load Engine 3 105. Not Used 106. Initial Gross Weight, Left	1X,9(F13.5,1X)/
14	107. Initial Gross Weight, Right 108. Not Used 109. Initial CG Position, Left 110. Initial CG Position, Right 111. Not Used 112. Initial Zero Fuel Weight, Left 113. Initial Zero Fuel Weight, Right 114. Not Used 115. Initial Fuel Quantity Center	1X,9(F13.5,1X)/
15	116. Initial Fuel Quantity Left Main 117. Initial Fuel Quantity Right Main 118. Not Used 119. Not Used 120. Not Used 121. Not Used 122. Not Used	1X,7(F13.5,1X)/
16	123. Serial Number Engine 1 124. Serial Number Engine 2 125. Not Used 126. Not Used	1X,4(A8,1X)/

Line	Parameters		Format
17	127. 128. 129. 130. 131. 132. 133. 134. 135.	DFDAU Calculated Gross Weight DFDAU Calculated Center of Gravity Position DFDAU Calculated Fuel Lower Heat Value Not Used Not Used Not Used Not Used %N2 Engine 1 %N2 Engine 2	1X,9(F13.5,1X)/
18	136. 137. 138. 139. 140. 141. 142. 143. 144.	%N2 Engine 3 Not Used Not Used Not Used Not Used Not Used EGT Engine 1 EGT Engine 2 EGT Engine 3	1X,9(F13.5,1X)/
19	145. 146. 147. 148. 149. 150. 151. 152. 153.	Not Used Not Used Not Used Not Used Not Used SAT, Left SAT, Right Not Used Indicated Angle of Attack, Left	1X,9(F13.5,1X)/
20	154. 155. 156. 157. 158. 159. 160. 161. 162.	Indicated Angle of Attack, Right Not Used Roll Angle, Left Roll Angle, Right Not Used Pitch Angle, Left Pitch Angle, Right Not Used Stabilizer Position	1X,9(F13.5,1X)/
21	163. 164. 165. 166. 167. 168. 169. 170. 171.	Left Spoiler Position Right Spoiler Position Left Aileron Position Right Aileron Position Not Used Not Used Rudder Position Not Used Left Elevator Position	1X,9(F13.5,1X)/

Line	Parameters		Format
22	172.	Right Elevator Position	1X,9(F13.5,1X)/
	173.	Not Used	
	174.	Not Used	
	175.	Trailing Edge Flap Position Left	
	176.	Trailing Edge Flap Position Right	
	177.	Not Used	
	178.	Not Used	
	179.	Along TK Horizontal Acceleration, Left	
	180.	Along TK Horizontal Acceleration, Right	
23	181.	Not Used	1X,9(F13.5,1X)/
	182.	Flight Path Acceleration, Left	
	183.	Flight Path Acceleration, Right	
	184.	Not Used	
	185.	Vertical Accel, Left	
	186.	Vertical Accel, Right	
	187.	Not Used	
	188.	DFDAU Calculated dIVV/dt	
	189.	Fuel Imbal. Roll Moment	
24	190.	Angle of Sideslip	1X,9(F13.5,1X)/
	191-198	Open for DSIRF expansion	
25	199-207	Open for DSIRF expansion	1X,9(F13.5,1X)/
26	208-216	Open for DSIRF expansion	1X,9(F13.5,1X)/
27	217-219	Open for DSIRF expansion	1X,3(F13.5,1X)/
28	220.	Corrected Gross weight	1X,9(F13.5,1X)/
	221.	Lift Coefficient	
	222.	Cd Basic	
	223.	Cd Reynolds	
	224.	CG Position	
	225.	Cd Center of Gravity	
	226.	Cd Elasticity	
	227.	Cd Total	
	228.	Delta Drag - Acceleration	
29	229.	Total Drag	1X,9(F13.5,1X)/
	230.	Drag/Delta	
	231.	Thrust Engine 1	
	232.	Thrust Engine 2	
	233.	Not Used	
	234.	Not Used	
	235.	Total Thrust	
	236.	Book Power Setting (Eng. Type 1)	
	237.	Book Power Setting (Eng. Type 2)	

Line	Parameters		Format
30	238.	Average Power Setting	1X,9(F13.5,1X)/
	239.	Corrected Book Fuel Flow Engine 1	
	240.	Corrected Book Fuel Flow Engine 2	
	241.	Not Used	
	242.	Not Used	
	243.	Fuel Flow Factor	
	244.	LHV Ratio Fuel Flow Factor	
	245.	Power Extraction Fuel Flow Factor	
	246.	Observed Fuel Flow Total	
31	247.	Book Fuel Flow Total	1X,5(F13.5,1X),A16,1X,A16/
	248.	True Airspeed (TAS)	
	249.	Book Fuel Mileage	
	250.	Observed Fuel Mileage	
	251.	Instrument Source	
	252.	Speed Type	

Appendix F 737 MODEL SPECIFIC INFORMATION

A generalized definition of the DSIRF for the 737 model (737 Classic, 737 NG, and 737 MAX) is provided in this section for those operators that have an ACMS system for data collection. The availability of some parameters will depend on customized ACMS programming and in some cases manual input by the flight crew prior to departure. It is recommended that the default values be used for the input options during the first trial run of the APM Program. To use one of the data correction algorithms contained in the program, it is recommended that the reader consult Section 4 Algorithm and Analysis to determine what data are required for that specific correction.

F.1 Bleed Configuration

To be eligible for analysis by the APM program, each candidate DSIRF or MSIRF data record is checked to determine if the bleed configuration is compatible with the airplane database. The status of the following bleeds is used to define this configuration.

NOTE: The discrete values shown below represent the convention adopted for the APM program and do not necessarily agree with the actual airplane discrete values.

Table 20: 737 Bleed Configuration

BLEED	STATUS	
	ZERO STATE	ONE STATE
ECS PACKS	ON	OFF
ECS PACK FLOW RATE	LOW	HIGH
ENGINE BLEEDS	ON	OFF
ISOLATION VALVE	CLOSED	OPEN
ENGINE ANTI-ICE BLEEDS	OFF	ON
WING ANTI-ICE BLEED	OFF	ON

The zero state represents the "normal" bleed configuration of the 737 during cruise. The one state is indicative of a "non-normal" bleed configuration and with the exception of pack flow rate, will cause the APM program to reject the data point for analysis. The APM program will analyze data for situations where both ECS packs are in high flow. If data input is to be via MSIRF, then a **zero (0)** or a **two (2)** must be placed in the position labeled **"Bleed"** on the Performance Log to indicate the number of ECS pack in high flow. The same value should be entered for both engines.

F.2 737 Performance Log

Please see the manual performance log on the next page. This log is appropriate for use with the 737 and other Boeing models as noted.

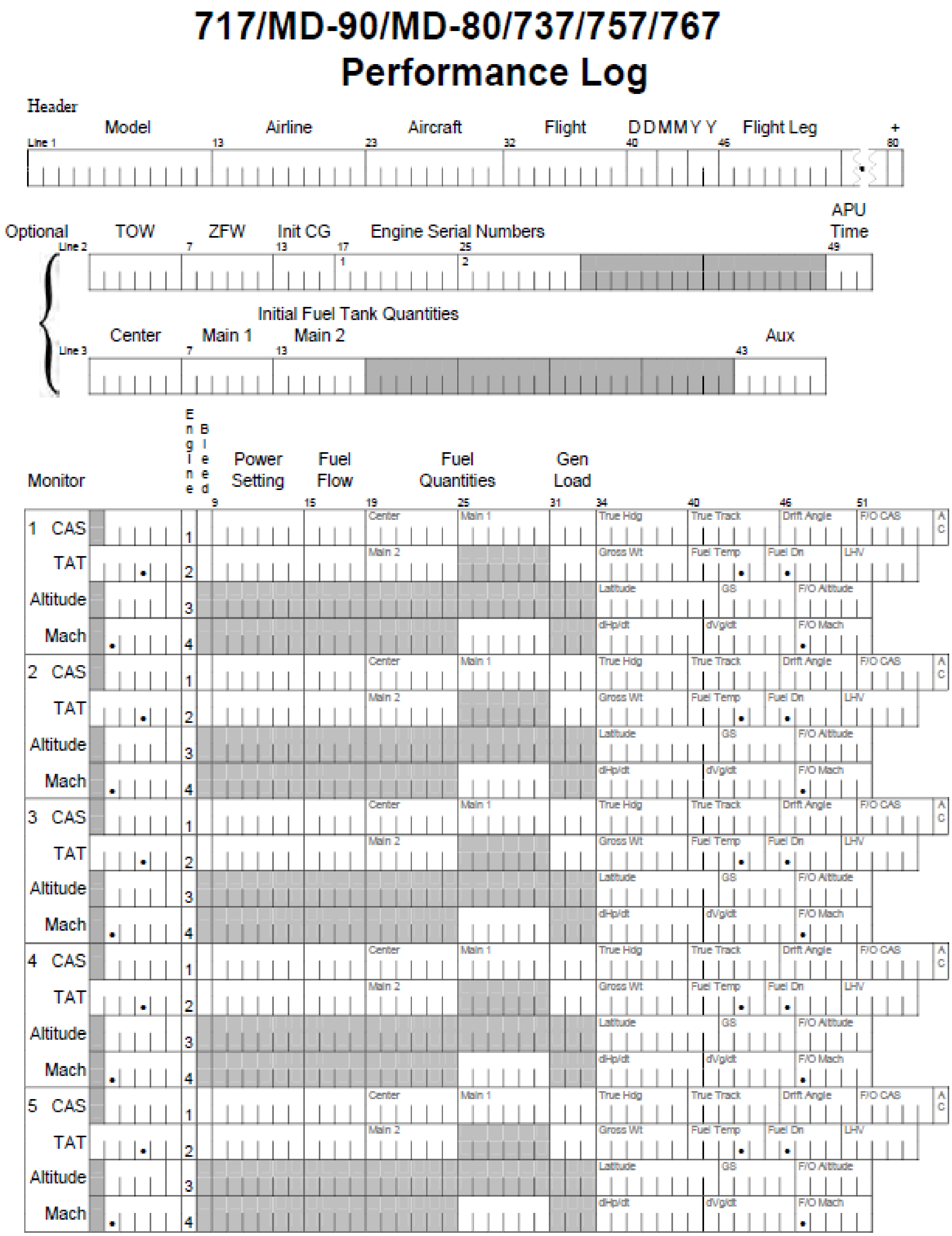

Figure 25: 737 Performance Log

F.2.1 Recommended Recording Procedures

1. Record Model, Airline, Aircraft, Flight Number and Date.

2. If desired record takeoff gross weight, ZFW, initial center of gravity, engine serial numbers, APU operating time, and initial fuel tank quantities.

3. Wait until the airplane is stabilized in cruise:

    a. Smooth air

    b. No thrust lever movement (auto-throttles off) for more than five minutes

    c. Anti-ice and fuel heat off for more than five minutes

    d. Less than one degree variation in indicated temperature during the preceding three minutes

    e. Less than .005 Mach (two knots CAS) variation in speed during the preceding three minutes

4. Quickly record Mach, EPR or %N1 and Fuel Flow.

5. Record TAT, Altitude, CAS, FMC Gross Weight (see Note 4).

6. Recheck Mach. If the Mach has changed more than .005 (two knots CAS) discard the point.

7. Record Individual Tank Fuel Quantities and Bleed Code (see Note 5).

8. The rest of the parameters on the Log form are optional, record those now if necessary.

9. Wait at least thirty minutes before recording the next data point in order to obtain data over a range of weights.

<u>Notes</u>

- Data can be taken at any stabilized speed. There is no need to return the airplane to a published speed schedule before recording data.

- The airplane identification number should be entered under aircraft. (Data sorting is done using this variable along with date.)

- All gross weight data and fuel quantities must be specified in the same units.

- If the FMC or total gross weight is known, it can be entered in the box labeled "Gross Wt".

- Bleed Config: Record a zero (0) if both ECS Packs are in LOW flow. Record a two (2) if both ECS Packs are in HIGH flow. The bleed code should be the same for both engines.

- If acceleration data (dHp/dt and dVg/dt) are desired, a separate time history must be kept for ground speed and altitude

F.3 737 DSIRF

Table 21: Standard DSIRF Dataset Header

Field	Parameter Name [3]	Columns	Format [1,2]	Units	Resolution
1	DSIRF Dataset Title	1-5	APM [4]	N/A	N/A
2	Subcategory	6	N	N/A	N/A
3	Dataset Sequence Number	7-8	NN	N/A	N/A
4	Aircraft ID Number	9-17	AAAAAAAAA	alphanum	N/A
5	Aircraft Serial Number	18-22	NNNNN	N/A	N/A
6	Aircraft Type Code	23-24	NN	N/A	N/A
7	Flight Number	25-32	AAAAAAAA	N/A	N/A
8	Depart/Destin Airports	33-40	AAAAAAAA	N/A	N/A
9	Day	41-42	NN	day	I day
10	Month	43-44	NN	month	1 month
11	Year	45-46	NN	year	1 year
12	Time - Hours	47-48	NN	hours	1 hour
13	Time - Minutes	49-50	NN	minutes	1 minute
14	Time - Seconds	51-52	NN,	seconds	1 second
15	Variable Header 1	N/A	A. . .A,[5]	N/A	N/A
16	Variable Header 2	N/A	A. . .A,[5]	N/A	N/A
17-181	First DSIRF Data Field	See DSIRF datasets continued on the following pages			

<u>NOTES on dataset and header fields:</u>

1. NNN denotes only numeric data, AAA denotes alphanumeric characters in data.
2. The first fourteen (14) data fields in the header are fixed, and no data delimiters (commas) are specified. The 15th and 16th header fields are variable, as are data fields in the DSIRF dataset body. The variable fields are separated by commas, such that no data available/required may be denoted by ",," for a specific data field (i.e. blanks/zeros are not required).
3. Fields that contain parameters that are not applicable to the 737 are labeled "Not Used". Availability of the parameters contained in the 737 DSIR is dependent upon the aircraft's ACMS configuration. The airline or operator will have to verify as to whether or not a specific parameter is available.
4. DSIRF dataset title for Airplane Performance Monitoring (APM) is "APM " (the letters APM plus two blanks).
5. The maximum field size is to be 40 characters.

6. Standard input units for DSIRF parameters are given in the DSIRF definition. However, the APM Program will accept units of kilograms for the following selected parameters; (1) gross weight, (2) fuel flow, (3) fuel quantity, (4) fuel used and (5) initial gross weight, zero fuel weight, and fuel quantity. if weight units of kilograms are used, then fuel density must be in kilograms per liter.

7. Due to the fact that the DSIRF can be a variable length record (maximum record length is 1200), it is recommended that the ASCII character string of a carriage return followed by a line feed be used to indicate the end of a DSIRF record.

Table 22: 737 DSIRF Dataset

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
17	Mach, Left	.NNN,	MACH	0.001 M
18	Mach, Right	.NNN,	MACH	0.001 M
19	Not Used	NNN.N,	Kt	0.1 Kt
20	CAS, Left	NNN.N,	Kt	0.1 Kt
21	CAS, Right	NNN.N,	Kt	0.1 Kt
22	Not Used	NNN.N,	Kt	0.1 Kt
23	TAT, Left	+/-NN.NN,	Deg C	0.25 Deg
24	TAT, Right	+/-NN.NN,	Deg C	0.25 Deg
25	Not Used	,	N/A	N/A
26	Altitude (29.92), Left	NNNNN,	Ft	1 Ft
27	Altitude(29.92), Right	NNNNN,	Ft	1 Ft
28	Not Used	,	NIA	N/A
29	Gross Weight, Left	NNNNNN,	Pounds	40 Lbs
30	Gross Weight, Right	NNNNNN,	Pounds	40 Lbs
31	Not Used	,	N/A	N/A
32	Fuel Flow Engine 1	NNNN,	Lbs/Hr	1 Lb/Hr
33	Fuel Flow Engine 2	NNNN,	Lbs/Hr	1 Lb/Hr
34	Not Used	,	N/A	N/A
35	Not Used	,	N/A	N/A
36	Power Setting Engine 1	NNN.NN,	%N1	.01% N1
37	Power Setting Engine 2	NNN.NN,	%N1	.01% N1
38	Not Used	,	N/A	N/A
39	Not Used	,	NIA	N/A
40	DFDAU Calc Quality Factor	NN.N,	N/A	0.1
41	Ground Speed, Left	NNN.N,	Kt	0.1 Kt
42	Ground Speed, Right	NNN.N,	Kt	0.1 Kt
43	Not Used	,	N/A	N/A
44	ECS Discrete Pack 1	N,	Discrete	N/A
45	ECS Discrete Pack 2	N,	Discrete	N/A
46	Not Used	,	N/A	N/A

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
47	ECS High Flow Discrete Pack 1	N,	Discrete	N/A
48	ECS High Flow Discrete Pack 2	N,	Discrete	N/A
49	Not Used	,	N/A	N/A
50	Engine Anti-Ice Discrete Eng 1	N,	Discrete	N/A
51	Engine Anti-Ice Discrete Eng 2	N,	Discrete	N/A
52	Wing Anti-Ice Discrete	N,	Discrete	N/A
53	Isolation Valve Position	N,	Discrete	NIA
54	Engine Bleed Discrete Eng 1	N,	Discrete	N/A
55	Engine Bleed Discrete Eng 2	N,	Discrete	N/A
56	Not Used	,	N/A	N/A
57	Not Used	,	N/A	N/A
58	Present Pos Latitude, Left	+/-NN.NNNN,	Degrees	0.0001 Deg
59	Present Pos Latitude, Right	+/-NN.NNNN,	Degrees	0.0001 Deg
60	Not Used	,	N/A	N/A
61	Present Pos Longitude, Left	+/-NNN.NNNN,	Degrees	0.0001 Deg
62	Present Pos Longitude, Right	+/-NNN.NNNN,	Degrees	0.0001 Deg
63	Not Used	,	N/A	N/A
64	True Heading, Left	+/-NNN.N,	Degrees	0.1 Deg
65	True Heading, Right	+/-NNN.N,	Degrees	0.1 Deg
66	Not Used	,		
67	Drift Angle, Left	+/-NN.N,	Degrees	0.1 Deg
68	Drift Angle, Right	+/-NN.N,	Degrees	0.1 Deg
69	Not Used	,		
70	True Track Angle, Left	+/-NNN.N,	Degrees	0.1 Deg
71	True Track Angle, Right	+/-NNN.N,	Degrees	0.1 Deg
72	Not Used	,	N/A	N/A
73	DFDAU Calculated dHp/dt	+/-NN.NNN,	Ft/Sec	0.001 Ft/Sec
74	DFDAU Calculated dVg/dt	+/-N.NNN,	Kt/Sec	0.001 Kt/Sec
75	Not Used	,	N/A	N/A
76	Not Used	,	N/A	N/A
77	Not Used	,	N/A	N/A
78	Fuel Density	N. NNN,	Lbs/USgal	.001 Lb
79	Fuel Temperature	+/-NNN,	Degrees C	1 Deg C
80	Total Fuel Quantity	NNNNN,	Pounds	100 Lbs
81	Left Main Fuel Tank Quantity	NNNNN,	Pounds	100 Lbs
82	Right Main Fuel Tank Quantity	NNNNN,	Pounds	100 Lbs
83	Center Fuel Tank Quantity	NNNNN,	Pounds	100 Lbs
84	Not Used	,	N/A	N/A
85	Fwd Aux Fuel Tank Quantity	NNNNN,	Pounds	100 Lbs

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
86	Aft Aux Fuel Tank Quantity	NNNNN,	Pounds	100 Lbs
87	Not Used	,	N/A	N/A
88	Fuel Used Engine 1	NNNNN,	Pounds	1 Lb
89	Fuel Used Engine 2	NNNNN,	Pounds	1 Lb
90	Not Used	,	N/A	N/A
91	Not Used	,	N/A	N/A
92	APU Operating Time	NN.N,	Minutes	0.1 minute
93	Generator Load Engine 1	NNN,	1 %	1 %
94	Generator Load Engine 2	NNN,	1 %	1 %
95	Not Used	,	Volts	
96	Not Used	,	Amps	N/A
97	Initial Gross Weight, Left	NNNNNN,	Pounds	40 Lbs
98	Initial Gross Weight, Right	NNNNNN,	Pounds	40 Lbs
99	Not Used	,	N/A	N/A
100	Initial CG, Left	NN.NN,	% MAC	0.05 %
101	Initial CG, Right	NN.NN,	% MAC	0.05 %
102	Not Used	,	N/A	N/A
103	Initial ZFW, Left	NNNNNN,	Pounds	40 Lbs
104	Initial ZFW, Right	NNNNNN,	Pounds	40 Lbs
105	Not Used	,	N/A	N/A
106	Init. Total Fuel Quantity	NNNNN,	Pounds	100 Lbs
107	Init. Right Main Fuel Quantity	NNNNN,	Pounds	100 Lbs
108	Init. Left Main Fuel Quantity	NNNNN,	Pounds	100 Lbs
109	Init. Center Fuel Quantity	NNNNN,	Pounds	100 Lbs
110	Not Used	,	N/A	N/A
111	Init. Fwd Aux Fuel Quantity	NNNNN,	Pounds	100 Lbs
112	Init. Aft Aux Fuel Quantity	NNNNN,	Pounds	100 Lbs
113	Not Used	,	N/A	N/A
114	Serial Number Engine 1	AAAAAAAA,	N/A	N/A
115	Serial Number Engine 2	AAAAAAAA,	N/A	N/A
116	Not Used	,	N/A	N/A
117	Not Used	,	N/A	N/A
118	DFDAU Calc Gross Weight	NNNNNN,	Pounds	40 Lbs
119	DFDAU Calc CG Position	NN.NN,	% MAC	0.1 %
120	DFDAU Calc LHV	NNNNN,	BTU/Lb	1.0 BTU/Lb
121	Not Used	,	N/A	N//A
122	Not Used	,	N/A	N//A
123	Not Used	,	N/A	N//A
124	Not Used	,	N/A	N//A

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
125.	N2 Engine 1	NNN.N,	% RPM	0.1 %
126.	N2 Engine 2	NNN.N,	% RPM	0.1 %
127.	Not Used	,	N/A	N/A
128.	Not Used	,	N/A	N/A
129.	Not Used	NNNN,		
130.	Not Used	NNNN,		
131.	Not Used	NNN,		
132.	Not Used	,	N/A	N/A
133.	EGT Engine 1	NNN.N,	Degrees C	0.5 Deg C
134.	EGT Engine 2	NNN.N,	Degrees C	0.5 Deg C
135.	Not Used	,		
136.	Not Used	,		
137.	Not Used	,		
138.	Not Used	,		
139.	Not Used	,		
140.	Not Used	,	N/A	N/A
141.	SAT, Left	+/-NN.N,	Deg C	0.5 Deg
142.	SAT, Right	+/-NN.N,	Deg C	0.5 Deg
143.	Not Used	,	N/A	N/A
144.	Indicated AOA, Left	+/-NN.N,	Degrees	0.05 Deg
145.	Indicated AOA, Right	+/-NN.N,	Degrees	0.05 Deg
146.	Not Used	,	N/A	N/A
147.	Roll Angle, Left	+/-NN.N,	Degrees	0.1 Deg
148.	Roll Angle, Right	+/-NN.N,	Degrees	0.1 Deg
145.	Not Used	,	N/A	N/A
150.	Pitch Angle, Left	+/-NN.N,	Degrees	0.1 Deg
151.	Pitch Angle, Right	+/-NN.N,	Degrees	0.1 Deg
152.	Not Used	,	N/A	N/A
153.	Stabilizer Position	+/-NN.N,	Units	0.05 Unit
154.	Left Spoiler Position	NN.N,	Degrees	0.1 Deg
155.	Right Spoiler Position	NN.N,	Degrees	0.1 Deg
156.	Left Aileron Position	+/-NN.N,	Degrees	0.1 Deg
157.	Right Aileron Position	+/-NN.N,	Degrees	0.1 Deg
158.	Not Used	,	N/A	N/A
159.	Not Used	,	N/A	N/A
160.	Rudder Position	+/-NN.N,	Degrees	0.1 Deg
161.	Not Used	,	N/A	N/A
162.	Left Elevator Position	+/-NN.N,	Degrees	0.1 Deg
163.	Right Elevator Position	+/-NN.N,	Degrees	0.1 Deg

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
164.	Not Used	,	Discreet	N/A
165.	Not Used	,	N/A	N/A
166.	TE Flap Position, Left	NN.N,	Degrees	0.1 Deg
167.	TE Flap Position, Right	NN.N,	Degrees	0.1 Deg
168.	Not Used	,	N/A	N/A
169.	Not Used	,	N/A	NIA
170.	Along TK Horiz Accel Left	+/-N.NN,	G's	0.01 G
171.	Along TK Horiz Accel, Right	+/-N.NN,	G's	0.01 G
172.	Not Used	,	N/A	N/A
173.	Flight Path Accel, Left	+/-N.NN,	GIs	0.01 G
174.	Flight Path Accel, Right	+/-N.NN,	GIs	0.01 G
175.	Not Used	,	N/A	N/A
176.	Vertical Accel, Left	+/-N.NN,	G's	0.01 G
177.	Vertical Accel, Right	+/-N.NN,	G's	0.01 G
178.	Not Used	,	N/A	N/A
179.	DFDAU Calculated dIVV/dt	+/-NN.NNN,	Ft/Sec2	0.001
180.	Fuel Imbal. Roll Moment	+/-NN.NN,	10^6in-Lb	0.01xl0^{6}In-Lb
181.	Angle of Sideslip	+/-N.NN,	Degrees	0.01 Deg

F.4 737 MASTER File

The first character of each line is the FORTRAN carriage control. Parameters 220 – 252 are calculated variables in the program and are presented in the MASTER file for inspection or subsequent analysis.

Table 23: 737 Master File

Line	Parameters	Format
1	Error code and text: 1. Error code 2. Error test 3. Model 4. Engine	1X,I7,1X,A80,1X,A16,1X,A16/

Line	Parameters	Format
2	Deviations: 5. Thrust deviation 6. Power setting deviation 7. Fuel flow deviation engine 1 8. Fuel flow deviation engine 2 9. Not used 10. Not used 11. Average fuel flow deviation 12. Fuel mileage deviation 13. Fuel flow deviation due to power setting deviation	1X,9(F13.5,1X)/
3	Header: 14. Airplane Identification Number 15. Airplane Serial Number 16. Flight Number 17. Departure/Destination 18. Day 19. Month 20. Year 21. Time - Hrs 22. Time - Min 23. Time - Sec	1X,A54/
4	Variable Header 24. Variable Header 1 25. Variable Header 2	1X,2A40/
5	Analysis Parameters: 26. Mach, Left 27. Mach, Right 28. Not Used 29. CAS, Left 30. CAS, Right 31. Not Used 32. TAT, Left 33. TAT, Right 34. Not Used	1X,9(F13.5,1X)/
6	35. Pressure Altitude, Left 36. Pressure Altitude, Right 37. Not Used 38. Gross Weight, Left 39. Gross Weight, Right 40. Not Used 41. Fuel Flow Engine 1 42. Fuel Flow Engine 2 43. Not Used	1X,9(F13.5,1X)/

Line	Parameters	Format
7	44. Not Used 45. Power Setting Engine 1 46. Power Setting Engine 2 47. Not Used 48. Not Used 49. DFDAU Calculated Quality Factor 50. Ground Speed, Left 51. Ground Speed, Right 52. Not Used	1X,9(F13.5,1X)/
8	53. ECS Discrete Pack 1 54. ECS Discrete Pack 2 55. Not Used 56. ECS High Flow Discrete Pack 1 57. ECS High Flow Discrete Pack 2 58. Not Used 59. Engine Anti-Ice Discrete Eng 1 60. Engine Anti-Ice Discrete Eng 2 61. Wing Anti-Ice Discrete	1X,9(F13.5,1X)/
9	62. Isolation Valve Position 63. Engine Bleed Discrete Eng 1 64. Engine Bleed Discrete Eng 2 65. Not Used 66. Not Used 67. Present Position Latitude, Left 68. Present Position Latitude, Right 69. Not Used 70. Not Used	1X,9(F13.5,1X)/
10	71. Not Used 72. Not Used 73. True Heading, Left 74. True Heading, Right 75. Not Used 76. Drift Angle, Left 77. Drift Angle, Right 78. Not Used 79. True Track Angle, Left	1X,9(F13.5,1X)/
11	80. True Track Angle, Right 81. Not Used 82. DFDAU Calculated dHp/dt 83. DFDAU Calculated dVg/dt 84. Not Used 85. Not Used 86. Not Used 87. Fuel Density 88. Fuel Temperature	1X,9(F13.5,1X)/

Line	Parameters	Format
12	89. Total Fuel Quantity 90. Not Used 91. Not Used 92. Not Used 93. Not Used 94. Not Used 95. Not Used 96. Not Used 97. Fuel Used Engine 1	1X,9(F13.5,1X)/
13	98. Fuel Used Engine 2 99. Not Used 100. Not Used 101. APU Operating Time 102. Generator Load Engine 1 103. Generator Load Engine 2 104. Not Used 105. Not Used 106. Initial Gross Weight, Left	1X,9(F13.5,1X)/
14	107. Initial Gross Weight, Right 108. Not Used 109. Initial CG Position, Left 110. Initial CG Position, Right 111. Not Used 112. Initial Zero Fuel Weight, Left 113. Initial Zero Fuel Weight, Right 114. Not Used 115. Initial Total Fuel Quantity	1X,9(F13.5,1X)/
15	116. Not Used 117. Not Used 118. Not Used 119. Not Used 120. Not Used 121. Not Used 122. Not Used	1X,7(F13.5,1X)/
16	123. Serial Number Engine 1 124. Serial Number Engine 2 125. Not Used 126. Not Used	1X,4(A8,1X)/

Line	Parameters		Format
17	127.	DFDAU Calculated Gross Weight	1X,9(F13.5,1X)/
	128.	DFDAU Calculated Center of Gravity Position	
	129.	DFDAU Calculated Fuel Lower Heat Value	
	130.	Not Used	
	131.	Not Used	
	132.	Not Used	
	133.	Not Used	
	134.	%N2 Engine 1	
	135.	%N2 Engine 2	
18	136.	Not Used	1X,9(F13.5,1X)/
	137.	Not Used	
	138.	Not Used	
	139.	Not Used	
	140.	Not Used	
	141.	Not Used	
	142.	EGT Engine 1	
	143.	EGT Engine 2	
	144.	Not Used	
19	145.	Not Used	1X,9(F13.5,1X)/
	146.	Not Used	
	147.	Not Used	
	148.	Not Used	
	149.	Not Used	
	150.	SAT, Left	
	151.	SAT, Right	
	152.	Not Used	
	153.	Indicated Angle of Attack, Left	
20	154.	Indicated Angle of Attack, Right	1X,9(F13.5,1X)/
	155.	Not Used	
	156.	Roll Angle, Left	
	157.	Roll Angle, Right	
	158.	Not Used	
	159.	Pitch Angle, Left	
	160.	Pitch Angle, Right	
	161.	Not Used	
	162.	Stabilizer Position	
21	163.	Left Spoiler Position	1X,9(F13.5,1X)/
	164.	Right Spoiler position	
	165.	Left Aileron Position	
	166.	Right Aileron Position	
	167.	Not Used	
	168.	Not Used	
	169.	Rudder Position	
	170.	Not Used	
	171.	Left Elevator Position	

Line	Parameters		Format
22	172.	Right Elevator Position	1X,9(F13.5,1X)/
	173.	Not Used	
	174.	Not Used	
	175.	Trailing Edge Flap Position, Left	
	176.	Trailing Edge Flap Position, Right	
	177.	Not Used	
	178.	Not Used	
	179.	Along TK Horizontal Acceleration, Left	
	180.	Along TK Horizontal Acceleration, Right	
23	181.	Not Used	1X,9(F13.5,1X)/
	182.	Flight Path Acceleration, Left	
	183.	Flight Path Acceleration, Right	
	184.	Not Used	
	185.	Vertical Accel, Left	
	186.	Vertical Accel, Right	
	187.	Not Used	
	188.	DFDAU Calculated dIVV/dt	
	189.	Fuel Imbalance Roll Moment	
24	190.	Angle of Sideslip	1X,9(F13.5,1X)/
	191-198	Open for DSIRF expansion	
25	199-207	Open for DSIRF expansion	1X,9(F13.5,1X)/
26	208-216	Open for DSIRF expansion	1X,9(F13.5,1X)/
27	217-219	Open for DSIRF expansion	1X,3(F13.5,1X)/
28	220.	Corrected Gross weight	1X,9(F13.5,1X)/
	221.	Lift Coefficient	
	222.	Cd Basic	
	223.	Cd Reynolds	
	224.	CG Position	
	225.	Cd Center of Gravity	
	226.	Cd Elasticity	
	227.	Cd Total	
	228.	Delta Drag - Acceleration	
29	229.	Total Drag	1X,9(F13.5,1X)/
	230.	Drag/Delta	
	231.	Thrust Engine 1	
	232.	Thrust Engine 2	
	233.	Not Used	
	234.	Not Used	
	235.	Total Thrust	
	236.	Book Power Setting (Eng. Type 1)	
	237.	Book Power Setting (Eng. Type 2)	

Line	Parameters		Format
30	238. 239. 240. 241. 242. 243. 244. 245. 246.	Average Power Setting Corrected Book Fuel Flow Engine 1 Corrected Book Fuel Flow Engine 2 Not Used Not Used Fuel Flow Factor LHV Ratio Fuel Flow Factor Power Extraction Fuel Flow Factor Observed Fuel Flow Total	1X,9(F13.5,1X)/
31	247. 248. 249. 250. 251. 252.	Book Fuel Flow Total True Airspeed (TAS) Book Fuel Mileage Observed Fuel Mileage Instrument Source Speed Type	1X,5(F13.5,1X),A16,1X,A16/

Appendix G 747-100/200/300 MODEL SPECIFIC INFORMATION

A generalized definition of the DSIRF for the 747 is provided in this section for those operators that have an AIDS system for data collection. Whether or not this data input mode can be used will depend upon the availability of the required parameters contained in this DSIRF. It is recommended that the default values be used for the input options during the first trial run of the APM Program. To use one of the data correction algorithms contained in the program, it is recommended that the reader consult Section 4 Algorithm and Analysis to determine what data are required for that specific correction. Additionally, the 747- 100/200/300 databases may not contain the necessary data to allow the use of User Input Options; CG=YES/DMU or POWERX=YES. Therefore, these options may or may not be used to correct for the effects of CG position or generator load. Consult the configuration notes within the database to make this determination.

G.1 Bleed Configuration

To be eligible for analysis by the APM program, each candidate DSIRF or MSIRF data record is checked to determine if the bleed configuration is compatible with the airplane database. The status of the following bleeds are used to define this configuration. NOTE: The discrete values shown below represent the convention adopted for the APM program and do not necessarily agree with the actual airplane discrete values.

Table 24: 747 Classic Bleed Configurations

BLEED	STATUS	
	ZERO STATE	ONE STATE
ECS PACKS	ON	OFF
ECS PACK FLOW RATE	FULL	HALF
ENGINE BLEEDS	ON	OFF
ENGINE ANTI-ICE BLEEDS	OFF	ON

The zero state represents the "normal" bleed configuration of the 747-400 during cruise. The one state for engine bleed or engine anti-ice is indicative of a "non-normal" bleed configuration and will cause the APM program to reject the data point for analysis.

The APM program will analyze data for the following pack configurations; (1) one pack at full flow, (2) two packs at half flow, (3) two packs at full flow, and (4) three packs at full flow. If data input is to be via MSIRF, then use the position labeled "**Bleed**" on the Performance Log to indicate the ECS Pack configuration as follows. The same value should be entered for all four engines.

PACK CONFIGURATION	VALUE TO USE IN MSIRF
One pack @ FULL flow	ONE
Two packs @ HALF flow	ONE
Two packs @ FULL flow	TWO
Three packs @ FULL flow	THREE

G.2 747-100/200/300 Performance Log

Please see the manual performance log below. This log is appropriate for use with the 747 Boeing models as noted.

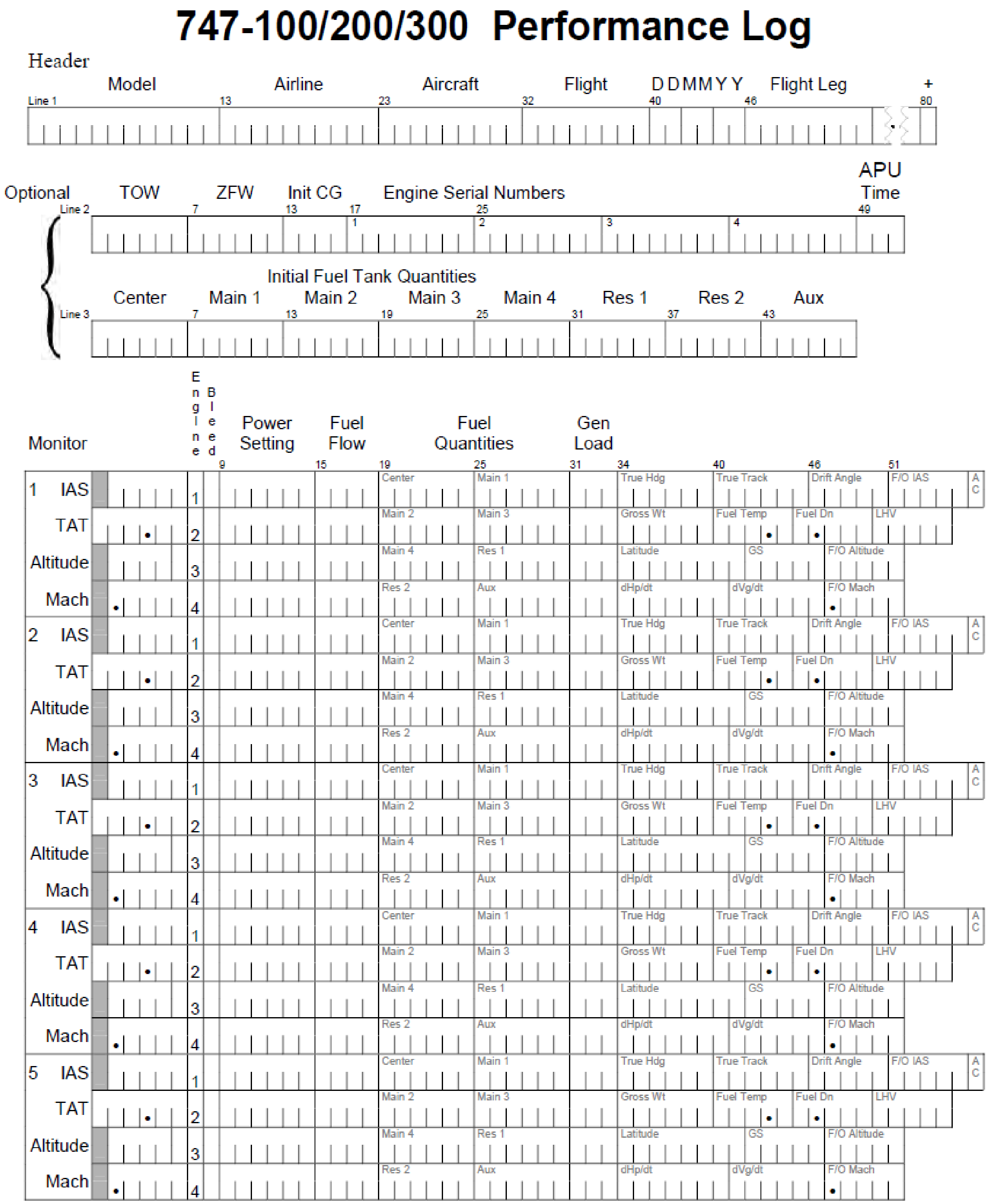

Figure 26: 747 Classic Performance Log

G.2.1 Recommended Recording Procedures

1. Record Model, Airline, Aircraft, Flight Number and Date.

2. If desired record takeoff gross weight, ZFW, initial center of gravity, engine serial numbers, APU operating time, and initial fuel tank quantities.

3. Wait until the airplane is stabilized in cruise:

    a. Smooth air

    b. No thrust lever movement (auto-throttles off) for more than five minutes

    c. Anti-ice and fuel heat off for more than five minutes

    d. Less than one degree variation in indicated temperature during the preceding three minutes

    e. Less than .005 Mach (two knots CAS) variation in speed during the preceding three minutes

4. Quickly record Mach, EPR or %N1 and Fuel Flow.

5. Record TAT, Altitude, CAS, FMC Gross Weight (see Note 4).

6. Recheck Mach. If the Mach has changed more than .005 (two knots CAS) discard the point.

7. Record Individual Tank Fuel Quantities and Bleed Code (see Note 5).

8. The rest of the parameters on the Log form are optional, record those now if necessary.

9. Wait at least thirty minutes before recording the next data point in order to obtain data over a range of weights.

Notes:

- Data can be taken at any stabilized speed. There is no need to return the airplane to a published speed schedule before recording data.

- The airplane identification number should be entered under aircraft. (Data sorting is done using this variable along with date.)

- All gross weight data and fuel quantities must be specified in the same units.

- If the FMC or total gross weight is known, it can be entered in the box labeled "Gross Wt".

- Bleed Config: Record a zero (0) if both ECS Packs are in LOW flow. Record a two (2) if both ECS Packs are in HIGH flow. The bleed code should be the same for both engines.

- If acceleration data (dHp/dt and dVg/dt) are desired, a separate time history must be kept for ground speed and altitude

G.3 747-100/200/300 DSIRF

Table 25: Standard DSIRF Dataset Header

Field	Parameter Name [3]	Columns	Format [1,2]	Units	Resolution
1	DSIRF Dataset Title	1-5	APM [4]	N/A	N/A
2	Subcategory	6	N	N/A	N/A
3	Dataset Sequence Number	7-8	NN	N/A	N/A
4	Aircraft ID Number	9-17	AAAAAAAAA	alphanum	N/A
5	Aircraft Serial Number	18-22	NNNNN	N/A	N/A
6	Aircraft Type Code	23-24	NN	N/A	N/A
7	Flight Number	25-32	AAAAAAAA	N/A	N/A
8	Depart/Destin Airports	33-40	AAAAAAAA	N/A	N/A
9	Day	41-42	NN	day	I day
10	Month	43-44	NN	month	1 month
11	Year	45-46	NN	year	1 year
12	Time - Hours	47-48	NN	hours	1 hour
13	Time - Minutes	49-50	NN	minutes	1 minute
14	Time - Seconds	51-52	NN,	seconds	1 second
15	Variable Header 1	N/A	A. . .A,[5]	N/A	N/A
16	Variable Header 2	N/A	A. . .A,[5]	N/A	N/A
17-181	First DSIRF Data Field	See DSIRF datasets continued on the following pages			

NOTES on dataset and header fields:

1. NNN denotes only numeric data, AAA denotes alphanumeric characters in data.
2. The first fourteen (14) data fields in the header are fixed, and no data delimiters (commas) are specified. The 15th and 16th header fields are variable, as are data fields in the DSIRF dataset body. The variable fields are separated by commas, such that no data available/required may be denoted by ",," for a specific data field (i.e. blanks/zeros are not required).
3. Fields that contain parameters that are not applicable to the 737 are labeled "Not Used". Availability of the parameters contained in the 737 DSIR is dependent upon the aircraft's ACMS configuration. The airline or operator will have to verify as to whether or not a specific parameter is available.
4. DSIRF dataset title for Airplane Performance Monitoring (APM) is "APM " (the letters APM plus two blanks).
5. The maximum field size is to be 40 characters.

6. Standard input units for DSIRF parameters are given in the DSIRF definition. However, the APM Program will accept units of kilograms for the following selected parameters; (1) gross weight, (2) fuel flow, (3) fuel quantity, (4) fuel used and (5) initial gross weight, zero fuel weight, and fuel quantity. if weight units of kilograms are used, then fuel density must be in kilograms per liter.

7. Due to the fact that the DSIRF can be a variable length record (maximum record length is 1200), it is recommended that the ASCII character string of a carriage return followed by a line feed be used to indicate the end of a DSIRF record.

Table 27 below has the 747 Classic DSIRF details. Fields 121 through 181 are not used in the performance calculations in APM. They are included in the DSIRF as supplemental information. They will be included in the MASTER file for possible use by post- processing.

Table 26: 747 Classic DSIRF Dataset

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
17	Mach, Left	.NNN,	MACH	0.001 M
18	Mach, Right	.NNN,	MACH	0.001 M
19	Not Used	,	N/A	N/A
20	IAS/CAS, Left	NNN.N,	Kt	0.1 Kt
21	IAS/CAS, Right	NNN.N,	Kt	0.1 Kt
22	Not Used	,	N/A	N/A
23	TAT, Left	+I-NN.NN,	Deg C	0.25 Deg
24	TAT, Right	+I-NN.NN,	Deg C	0.25 Deg
25	Not Used	,	N/A	N/A
26	Altitude(29.92), Left	NNNNN,	Ft	1 Ft
27	Altitude(29.92), Right	NNNNN,	Ft	1 Ft
28	Not Used	,	N/A	N/A
29	Gross Weight	NNNNNN,	Pounds	40 Lbs
30	Not Used	,	N/A	N/A
31	Not Used	,	N/A	N/A
32	Fuel Flow Engine 1	NNNN,	Lbs/Hr	1 Lb/Hr
33	Fuel Flow Engine 2	NNNN,	Lbs/Hr	1 Lb/Hr
34	Fuel Flow Engine 3	NNNN,	Lbs/Hr	1 Lb/Hr
35	Fuel Flow Engine 4	NNNN,	Lbs/Hr	1 Lb/Hr
36	Power Setting Eng 1	N.NNN / NNN.NN,	EPR / %N1	.001EPR/.0l% N1
37	Power Setting Eng 2	N.NNN / NNN.NN,	EPR / %N1	.001EPR/.0l% N1
38	Power Setting Eng 3	N.NNN / NNN.NN,	EPR / %N1	.001EPR/.0l% N1
39	Power Setting Eng 4	N.NNN / NNN.NN,	EPR / %N1	.001EPR/.0l% N1
40	DMU Calc Quality Factor	NN.N,	N/A	0.1
41	Ground Speed, Left	NNN.N,	Kt	0.1 Kt
42	Ground Speed, Right	NNN.N,	Kt	0.1 Kt
43	Ground Speed, Center	NNN.N,	Kt	0.1 Kt

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
44	ECS Discrete Pack 1	N,	Discrete	N/A
45	ECS Discrete Pack 2	N,	Discrete	N/A
46	ECS Discrete Pack 3	N,	Discrete	N/A
47	ECS Flow Discrete Pack 1	N,	Discrete	N/A
48	ECS Flow Discrete Pack 2	N,	Discrete	N/A
49	ECS Flow Discrete Pack 3	N,	Discrete	N/A
50	TAI Discrete Engine 1	N,	Discrete	N/A
51	TAI Discrete Engine 2	N,	Discrete	N/A
52	TAI Discrete Engine 3	N,	Discrete	N/A
53	TAI Discrete Engine 4	N,	Discrete	N/A
54	Engine Bleed Discrete Eng 1	N,	Discrete	N/A
55	Engine Bleed Discrete Eng 2	N,	Discrete	N/A
56	Engine Bleed Discrete Eng 3	N,	Discrete	N/A
57	Engine Bleed Discrete Eng 4	N,	Discrete	N/A
58	Present Pos Latitude, Left	+/-NN.NNNN,	Degrees	0.0001 Deg
59	Present Pos Latitude, Right	+/-NN.NNNN,	Degrees	0.0001 Deg
60	Present Pos Latitude, Center	+/-NN.NNNN,	Degrees	0.0001 Deg
61	Not Used	,	N/A	N/A
62	Not Used	,	N/A	N/A
63	Not Used	,	N/A	N/A
64	True Heading, Left	+/-NNN.N,	Degrees	0.1 Deg
65	True Heading, Right	+/-NNN.N,	Degrees	0.1 Deg
66	True Heading, Center	+/-NNN.N,	Degrees	0.1 Deg
67	Drift Angle, Left	+/-NN.N,	Degrees	0.1 Deg
68	Drift Angle, Right	+/-NN.N,	Degrees	0.1 Deg
69	Drift Angle, Center	+/-NN.N,	Degrees	0.1 Deg
70	True Track Angle, Left	+/-NNN.N,	Degrees	0.1 Deg
71	True Track Angle, Right	+/-NNN.N,	Degrees	0.1 Deg
72	True Track Angle, Center	+/-NNN.N,	Degrees	0.1 Deg
73	DMU Calculated dHp/dt	+/-NN.NNN,	Ft/Sec	0.001 Ft/Sec
74	DMU Calculated dVg/dt	+/-N.NNN,	Kt/Sec	0.001 Kt/Sec
75	Not Used	,	N/A	N/A
76	Not Used	,	N/A	N/A
77	Not Used	,	N/A	N/A
78	Fuel Density	N.NNN,	Lbs/USgal	.001 Lb/Gal
79	Fuel Temperature	+/-NNN,	Degrees C	1 Deg
80	Fuel Quantity Center	NNNNN,	Pounds	100 Lbs
81	Fuel Quantity Main 1	NNNNN,	Pounds	100 Lbs
82	Fuel Quantity Main 2	NNNNN,	Pounds	100 Lbs

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
83	Fuel Quantity Main 3	NNNNN,	Pounds	100 Lbs
84	Fuel Quantity Main 4	NNNNN,	Pounds	100 Lbs
85	Fuel Quantity Res 1	NNNNN,	Pounds	100 Lbs
86	Fuel Quantity Res 2	NNNNN,	Pounds	100 Lbs
87	Fuel Quantity Aux Tank	NNNNN,	Pounds	100 Lbs
88	Fuel Used Engine 1	NNNNN,	Pounds	1 Lb
89	Fuel Used Engine 2	NNNNN,	Pounds	1 Lb
90	Fuel Used Engine 3	NNNNN,	Pounds	1 Lb
91	Fuel Used Engine 4	NNNNN,	Pounds	1 Lb
92	APU Operating Time	NN.N,	Minutes	0.1 Minute
93	Gen Load Eng 1	NNN,	%	1 %
94	Gen Load Eng 2	NNN,	%	1 %
95	Gen Load Eng 3	NNN,	%	1 %
96	Gen Load Eng 4	NNN,	%	1 %
97	Initial Gross Weight	NNNNNN,	Pounds	40 Lbs
98	Not Used	,	N/A	N/A
99	Not Used	,	N/A	N/A
100	Initial CG Position	NN.NN,	% MAC	0.05 %
101	Not Used	,	N/A	N/A
102	Not Used	,	N/A	N/A
103	Initial Zero Fuel Weight	NNNNNN,	Pounds	40 Lbs
104	Not Used	,	N/A	N/A
105	Not Used	,	N/A	N/A
106	Init. Fuel Qty Center	NNNNN,	Pounds	100 Lbs
107	Init. Fuel Qty Main 1	NNNNN,	Pounds	100 Lbs
108	Init. Fuel Oty Main 2	NNNNN,	Pounds	100 Lbs
109	Init. Fuel Oty Main 3	NNNNN,	Pounds	100 Lbs
110	Init. Fuel Qty main 4	NNNNN,	Pounds	100 Lbs
111	Init. Fuel Qty Res 1	NNNNN,	Pounds	100 Lbs
112	Init. Fuel Qty Res 2	NNNNN,	Pounds	100 Lbs
113	Init. Fuel Qty Aux Tank	NNNNN,	Pounds	100 Lbs
114	Serial Number Engine 1	AAAAAAAA,	N/A	N/A
115	Serial Number Engine 2	AAAAAAAA,	N/A	N/A
116	Serial Number Engine 3	AAAAAAAA,	N/A	N/A
117	Serial Number Engine 4	AAAAAAAA,	N/A	N/A
118	DMU Calc Gross Weight	NNNNNN,	Pounds	40 Lbs
119	DMU Calc CG Position	NN.NN,	% MAC	0.1 %
120	DMU Calc LHV	NNNNN,	BTU/Lb	1.0 BTU/Lb
121	N1 Engine 1	NNN.N,	% RPM	0.1 %

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
122	N1 Engine 2	NNN.N,	% RPM	0.1 %
123	N1 Engine 3	NNN.N,	% RPM	0.1 %
124	N1 Engine 4	NNN.N,	% RPM	0.1 %
125.	N2 Engine 1	NNN.N,	% RPM	0.1 %
126.	N2 Engine 2	NNN.N,	% RPM	0.1 %
127.	N2 Engine 3	NNN.N,	% RPM	0.1 %
128.	N2 Engine 4	NNN.N,	% RPM	0.1 %
129.	N3 Engine 1 (RR only)	NNN.N,	% RPM	0.1 %
130.	N3 Engine 2 (RR only)	NNN.N,	% RPM	0.1 %
131.	N3 Engine 3 (RR only)	NNN.N,	% RPM	0.1 %
132.	N3 Engine 4 (RR only)	NNN.N,	% RPM	0.1 %
133.	EGT Engine 1	NNN.N,	Degrees C	0.5 Deg
134.	EGT Engine 2	NNN.N,	Degrees C	0.5 Deg
135.	EGT Engine 3	NNN.N,	Degrees C	0.5 Deg
136.	EGT Engine 4	NNN.N,	Degrees C	0.5 Deg
137.	Turb Case Cool Eng 1 (P&W)	NNN.N,	%	0.1 %
138.	Turb Case Cool Eng 2 (P&W)	NNN.N,	%	0.1 %
139.	Turb Case Cool Eng 3 (P&W)	NNN.N,	%	0.1 %
140.	Turb Case Cool Eng 4 (P&W)	NNN.N,	%	0.1 %
141.	SAT, Left	+/-NN.N,	Degrees C	0.5 Deg
142.	SAT, Right	+/-NN.N,	Degrees C	0.5 Deg
143.	Not Used	,	N/A	N/A
144.	Indicated AOA, Left	+/-NN.N,	Degrees	0.05 Deg
145.	Indicated AOA, Right	+/-NN.N,	Degrees	0.05 Deg
146.	Indicated AOA, Center	+/-NN.N,	Degrees	0.05 Deg
147.	Roll Angle, Left	+/-NN.N,	Degrees	0.1 Deg
148.	Roll Angle, Right	+/-NN.N,	Degrees	0.1 Deg
145.	Roll Angle, Center	+/-NN.N,	Degrees	0.1 Deg
150.	Pitch Angle, Left	+/-NN.N,	Degrees	0.1 Deg
151.	Pitch Angle, Right	+/-NN.N,	Degrees	0.1 Deg
152.	Pitch Angle, Center	+/-NN.N,	Degrees	0.1 Deg
153.	Stabilizer Position	+/-NN.N,	Units	0.05 Unit
154.	Left spoiler Position	NN.N,	Degrees	0.1 Deg
155.	Right Spoiler Position	NN.N,	Degrees	0.1 Deg
156.	Left HS Aileron Position	+/-NN.N,	Degrees	0.1 Deg
157.	Right HS Aileron Position	+/-NN.N,	Degrees	0.1 Deg
158.	Left LS Aileron Position	+/-NN.N,	Degrees	0.1 Deg
159.	Right LS Aileron Position	+/-NN.N,	Degrees	0.1 Deg
160.	Upper Rudder Position	+/-NN.N,	Degrees	0.1 Deg

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
161.	Lower Rudder Position	+/-NN.N,	Degrees	0.1 Deg
162.	L Inbd Elevator Position	+/-NN.N,	Degrees	0.1 Deg
163.	R Inbd Elevator Position	+/-NN.N,	Degrees	0.1 Deg
164.	L Outbd Elevator Position	+/-NN.N,	Degrees	0.1 Deg
165.	R Outbd Elevator Position	+/-NN.N,	Degrees	0.1 Deg
166.	L Outbd TE Flap Position	NN.N,	Degrees	0.1 Deg
167.	R Outbd TE Flap Position	NN.N,	Degrees	0.1 Deg
168.	L Inbd TE Flap Position	NN.N,	Degrees	0.1 Deg
169.	R Inbd TE Flap Position	NN.N,	Degrees	0.1 Deg
170.	Along TK Horiz Accel, Left	+/-N.NN,	G's	0.01 G
171.	Along TK Horiz Accel, Right	+/-N.NN,	G's	0.01 G
172.	Along TR Horiz Accel, Center	+/-N.NN,	G's	0.01 G
173.	Flight Path Accel, Left	+/-N.NN,	G's	0.01 G
174.	Flight Path Accel, Right	+/-N.NN,	G's	0.01 G
175.	Flight Path ACcel, Center	+/-N.NN,	G's	0.01 G
176.	Vertical Accel, Left	+/-N.NN,	G's	0.01 G
177.	Vertical Accel, Right	+/-N.NN,	G's	0.01 G
178.	Vertical Accel, Center	+/-N.NN,	G's	0.01 G
179.	DMU Calculated dIVV/dt	+/-NN.NNN,	Ft/Sec2	0.001 Ft/Sec2
180.	Fuel Imbal. Roll Moment	+/-NN.NN,	106 In-Lbs	0.0lxl06 In-Lb
181.	Angle of Sideslip	+/-N.NN,	Degrees	0.01 Deg

G.4 747-100/200/300 MASTER File

The first character of each line is the FORTRAN carriage control. Parameters 220 – 252 are calculated variables in the program and are presented in the MASTER file for inspection or subsequent analysis.

Table 27: 747 Classic Master File

Line	Parameters	Format
1	Error code and text: 1. Error code 2. Error test 3. Model 4. Engine	1X,I7,1X,A80,1X,A16,1X,A16/

Line	Parameters	Format
2	Deviations: 5. Thrust deviation 6. Power setting deviation 7. Fuel flow deviation engine 1 8. Fuel flow deviation engine 2 9. Fuel flow deviation engine 3 10. Fuel flow deviation engine 4 11. Average fuel flow deviation 12. Fuel mileage deviation 13. Fuel flow deviation due to power setting deviation	1X,9(F13.5,1X)/
3	Header: 14. Airplane Identification Number 15. Airplane Serial Number 16. Flight Number 17. Departure/Destination 18. Day 19. Month 20. Year 21. Time - Hrs 22. Time - Min 23. Time - Sec	1X,A54/
4	Variable Header 24. Variable Header 1 25. Variable Header 2	1X,2A40/
5	Analysis Parameters: 26. Mach, Left 27. Mach, Right 28. Not Used 29. CAS, Left 30. CAS, Right 31. Not Used 32. TAT, Left 33. TAT, Right 34. Not Used	1X,9(F13.5,1X)/
6	35. Pressure Altitude, Left 36. Pressure Altitude, Right 37. Not Used 38. Gross Weight, Left 39. Not Used 40. Not Used 41. Fuel Flow Engine 1 42. Fuel Flow Engine 2 43. Fuel Flow Engine 3	1X,9(F13.5,1X)/

Line	Parameters	Format
7	44. Fuel Flow Engine 4 45. Power Setting Engine 1 46. Power Setting Engine 2 47. Power Setting Engine 3 48. Power Setting Engine 4 49. DMU Calculated Quality Factor 50. Ground Speed, Left 51. Ground Speed, Right 52. Ground Speed Center	1X,9(F13.5,1X)/
8	53. ECS Discrete Pack 1 54. ECS Discrete Pack 2 55. ECS Discrete Pack 3 56. ECS Flow Discrete Pack 1 57. ECS Flow Discrete Pack 2 58. ECS Flow Discrete Pack 3 59. TAI Discrete Engine 1 60. TAI Discrete Engine 2 61. TAI Discrete Engine 3	1X,9(F13.5,1X)/
9	62. TAI Discrete Engine 4 63. Engine Bleed Discrete Engine 1 64. Engine Bleed Discrete Engine 2 65. Engine Bleed Discrete Engine 3 66. Engine Bleed Discrete Engine 4 67. Present Position Latitude, Left 68. Present Position Latitude, Right 69. Present Position Latitude, Center 70. Not Used	1X,9(F13.5,1X)/
10	71. Not Used 72. Not Used 73. True Heading, Left 74. True Heading, Right 75. True Heading, Center 76. Drift Angle, Left 77. Drift Angle, Right 78. Drift Angle, Center 79. True Track Angle, Left	1X,9(F13.5,1X)/
11	80. True Track Angle, Right 81. True Track Angle, Center 82. DMU Calculated dHp/dt 83. DMU Calculated dVg/dt 84. Not Used 85. Not Used 86. Not Used 87. Fuel Density 88. Fuel Temperature	1X,9(F13.5,1X)/

Line	Parameters	Format
12	89. Fuel Quantity Center Tank 90. Fuel Quantity Main Tank 1 91. Fuel Quantity Main Tank 2 92. Fuel Quantity Main Tank 3 93. Fuel Quantity Main Tank 4 94. Fuel Quantity Reserve Tank 1 95. Fuel Quantity Reserve Tank 2 96. Fuel Quantity Aux Tank 97. Fuel Used Engine 1	1X,9(F13.5,1X)/
13	98. Fuel Used Engine 2 99. Fuel Used Engine 3 100. Fuel Used Engine 4 101. APU Operating Time 102. Generator Load Engine 1 103. Generator Load Engine 2 104. Generator Load Engine 3 105. Generator Load Engine 4 106. Initial Gross Weight	1X,9(F13.5,1X)/
14	107. Not Used 108. Not Used 109. Initial CG Position 110. Not Used 111. Not Used 112. Initial Zero Fuel Weight 113. Not Used 114. Not Used 115. Initial Fuel Quantity Center Tank	1X,9(F13.5,1X)/
15	116. Initial Fuel Quantity Main Tank 1 117. Initial Fuel Quantity Main Tank 2 118. Initial Fuel Quantity Main Tank 3 119. Initial Fuel Quantity Main Tank 4 120. Initial Fuel Quantity Res Tank 1 121. Initial Fuel Quantity Res Tank 2 122. Initial Fuel Quantity Aux Tank	1X,7(F13.5,1X)/
16	123. Serial Number Engine 1 124. Serial Number Engine 2 125. Serial Number Engine 3 126. Serial Number Engine 4	1X,4(A8,1X)/

Line	Parameters		Format
17	127.	DMU Calculated Gross Weight	1X,9(F13.5,1X)/
	128.	DMU Calculated Center of Gravity Position	
	129.	DMU Calculated Fuel Lower Heat Value	
	130.	%N1 Engine 1	
	131.	%N1 Engine 2	
	132.	%N1 Engine 3	
	133.	%N1 Engine 4	
	134.	%N2 Engine 1	
	135.	%N2 Engine 2	
18	136.	%N2 Engine 3	1X,9(F13.5,1X)/
	137.	%N2 Engine 4	
	138.	%N3 Engine 1 (RR Only)	
	139.	%N3 Engine 2 (RR Only)	
	140.	%N3 Engine 3 (RR Only)	
	141.	%N3 Engine 4 (RR Only)	
	142.	EGT Engine 1	
	143.	EGT Engine 2	
	144.	EGT Engine 3	
19	145.	EGT Engine 4	1X,9(F13.5,1X)/
	146.	Turb Case Cool Engine 1 (P&W Only)	
	147.	Turb Case Cool Engine 2 (P&W Only)	
	148.	Turb Case Cool Engine 3 (P&W Only)	
	149.	Turb Case Cool Engine 4 (P&W Only	
	150.	SAT, Left	
	151.	SAT, Right	
	152.	Not Used	
	153.	Indicated Angle of Attack, Left	
20	154.	Indicated Angle of Attack, Right	1X,9(F13.5,1X)/
	155.	Indicated Angle of Attack, Center	
	156.	Roll Angle, Left	
	157.	Roll Angle, Right	
	158.	Roll Angle, Center	
	159.	Pitch Angle, Left	
	160.	Pitch Angle, Right	
	161.	Pitch Angle, Center	
	162.	Stabilizer Position	
21	163.	Left Spoiler Position	1X,9(F13.5,1X)/
	164.	Right Spoiler position	
	165.	Left HS Aileron Position	
	166.	Right HS Aileron Position	
	167.	Left LS Aileron Position	
	168.	Right LS Aileron Position	
	169.	Upper Rudder Position	
	170.	Lower Rudder Position	
	171.	Left Inboard Elevator Position	

Line	Parameters		Format
22	172.	Right Inboard Elevator Position	1X,9(F13.5,1X)/
	173.	Left Outboard Elevator Position	
	174.	Right Outboard Elevator Position	
	175.	Left Outboard Trailing Edge Flap	
	176.	Right Outboard Trailing Edge Flap	
	177.	Left Inboard Trailing Edge Flap	
	178.	Right Inboard Trailing Edge Flap	
	179.	Along TK Horiz Accel, Left	
	180.	Along TK Horiz Accel, Right	
23	181.	Along TK Horiz Accel, Center	1X,9(F13.5,1X)/
	182.	Flight Path Accel, Left	
	183.	Flight Path Accel, Right	
	184.	Flight Path Accel, Center	
	185.	Vertical Accel, Left	
	186.	Vertical Accel, Right	
	187.	Vertical Accel, Center	
	188.	DMU Calculated dIVV/dt	
	189.	Fuel Imbal. Roll Moment	
24	190.	Angle of Sideslip	1X,9(F13.5,1X)/
	191-198	Open for DSIRF expansion	
25	199-207	Open for DSIRF expansion	1X,9(F13.5,1X)/
26	208-216	Open for DSIRF expansion	1X,9(F13.5,1X)/
27	217-219	Open for DSIRF expansion	1X,3(F13.5,1X)/
28	220.	Corrected Gross weight	1X,9(F13.5,1X)/
	221.	Lift Coefficient	
	222.	Cd Basic	
	223.	Cd Reynolds	
	224.	CG Position	
	225.	Cd Center of Gravity	
	226.	Cd Elasticity	
	227.	Cd Total	
	228.	Delta Drag - Acceleration	
29	229.	Total Drag	1X,9(F13.5,1X)/
	230.	Drag/Delta	
	231.	Thrust Engine 1	
	232.	Thrust Engine 2	
	233.	Thrust Engine 3	
	234.	Thrust Engine 4	
	235.	Total Thrust	
	236.	Book Power Setting (Eng. Type 1)	
	237.	Book Power Setting (Eng. Type 2)	

Line	Parameters		Format
30	238.	Average Power Setting	1X,9(F13.5,1X)/
	239.	Corrected Book Fuel Flow Engine 1	
	240.	Corrected Book Fuel Flow Engine 2	
	241.	Corrected Book Fuel Flow Engine 3	
	242.	Corrected Book Fuel Flow Engine 4	
	243.	Fuel Flow Factor	
	244.	LHV Ratio Fuel Flow Factor	
	245.	Power Extraction Fuel Flow Factor	
	246.	Observed Fuel Flow Total	
31	247.	Book Fuel Flow Total	1X,5(F13.5,1X),A16,1X,A16/
	248.	True Airspeed (TAS)	
	249.	Book Fuel Mileage	
	250.	Observed Fuel Mileage	
	251.	Instrument Source	
	252.	Speed Type	

Appendix H 747-400 MODEL SPECIFIC INFORMATION

A generalized definition of the DSIRF for the 747-400 is provided in this section for those operators that have an ACMS system for data collection. Whether or not this data input mode can be used will depend upon the availability of the required parameters contained in this DSIRF. It is recommended that the default values be used for the input options during the first trial run of the APM Program. To use one of the data correction algorithms contained in the program, it is recommended that the reader consult Section 4 Algorithm and Analysis to determine what data are required for that specific correction.

H.1 Bleed Configuration

To be eligible for analysis by the APM program, each candidate DSIRF or MSIRF data record is checked to determine if the bleed configuration is compatible with the airplane database. The status of the following bleeds are used to define this configuration. NOTE: The discrete values shown below represent the convention adopted for the APM program and do not necessarily agree with the actual airplane discrete values.

Table 28: 747-400 Bleed Configurations

BLEED	STATUS	
	ZERO STATE	ONE STATE
ECS PACKS	ON	OFF
ECS PACK FLOW RATE	NORMAL	HIGH
ENGINE BLEEDS	ON	OFF
ENGINE ANTI-ICE BLEEDS	OFF	ON

The zero state represents the "normal" bleed configuration of the 747-400 during cruise. The one state for engine bleed or engine anti-ice is indicative of a "non-normal" bleed configuration and will cause the APM program to reject the data point for analysis.

The APM program will analyze data for the following pack configurations; (1) one or more ECS Packs are in high flow, (2) one ECS Pack is turned off, the remaining two packs are in high flow. If data input is to be via MSIRF, then use the position labeled "**Bleed**" on the Performance Log to indicate the ECS Pack configuration as follows. The same value should be entered for all four engines.

PACK CONFIGURATION	VALUE TO USE IN MSIRF
Two packs operating	ZERO
Three packs operating	Number of packs in high flow (0, 1, 2, 3)

H.2 747-400 Performance Log

Please see the manual performance log on the next page. This log is appropriate for use with the 747-400.

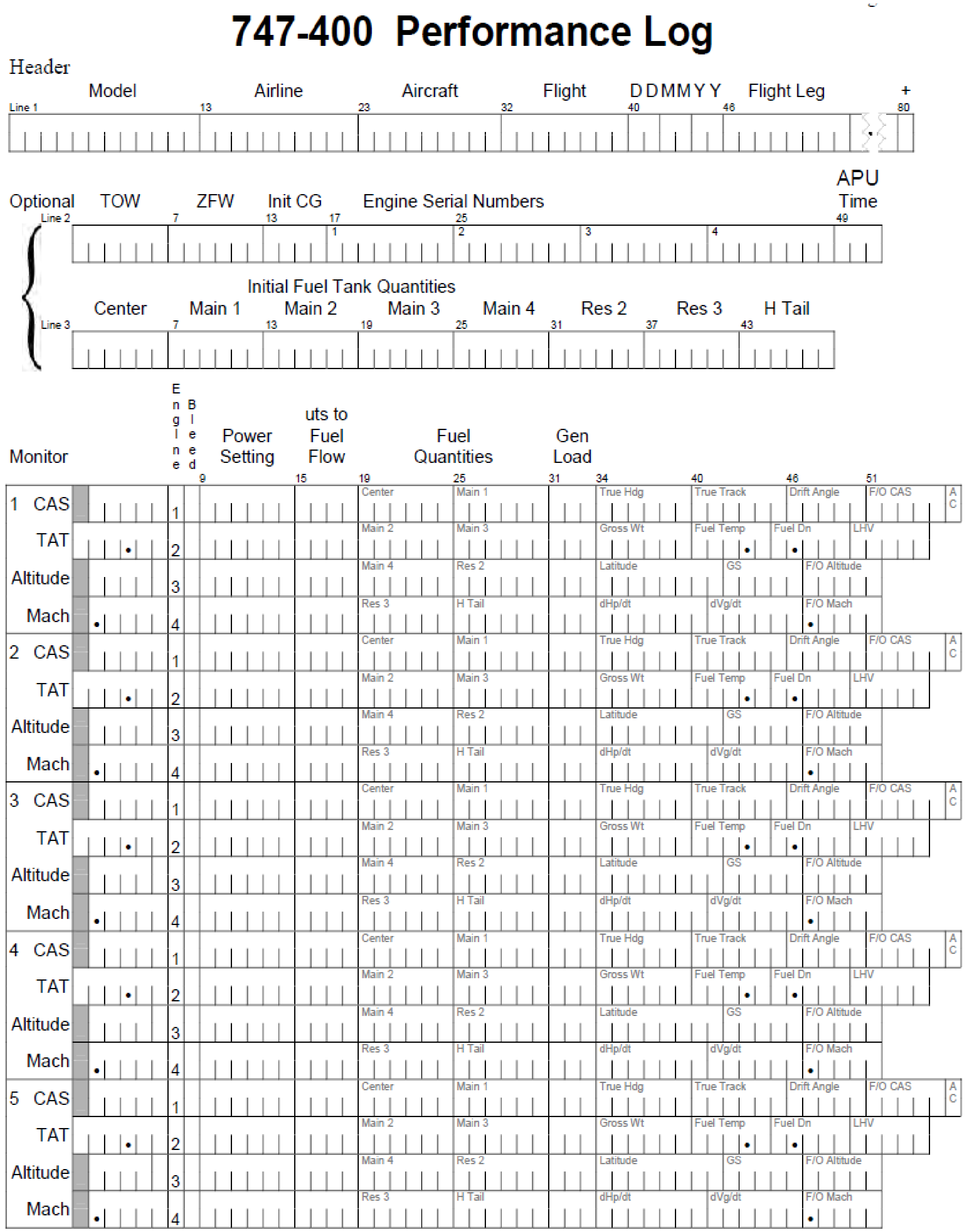

Figure 27: 747-400 Performance Log

H.2.1 Recommended Recording Procedures

1. Record Model, Airline, Aircraft, Flight Number and Date.

2. If desired record takeoff gross weight, ZFW, initial center of gravity, engine serial numbers, APU operating time, and initial fuel tank quantities.

3. Wait until the airplane is stabilized in cruise:

    a. Smooth air

    b. No thrust lever movement (auto-throttles off) for more than five minutes

    c. Anti-ice and fuel heat off for more than five minutes

    d. Less than one degree variation in indicated temperature during the preceding three minutes

    e. Less than .005 Mach (two knots CAS) variation in speed during the preceding three minutes

4. Quickly record Mach, EPR or %N1 and Fuel Flow.

5. Record TAT, Altitude, CAS, FMC Gross Weight (see Note 4).

6. Recheck Mach. If the Mach has changed more than .005 (two knots CAS) discard the point.

7. Record Individual Tank Fuel Quantities and Bleed Code (see Note 5).

8. The rest of the parameters on the Log form are optional, record those now if necessary.

9. Wait at least thirty minutes before recording the next data point in order to obtain data over a range of weights.

Notes

- Data can be taken at any stabilized speed. There is no need to return the airplane to a published speed schedule before recording data.

- The airplane identification number should be entered under aircraft. (Data sorting is done using this variable along with date.)

- All gross weight data and fuel quantities must be specified in the same units.

- If the FMC or total gross weight is known, it can be entered in the box labeled "Gross Wt".

- Bleed Config: Record a zero (0) if both ECS Packs are in LOW flow. Record a two (2) if both ECS Packs are in HIGH flow. The bleed code should be the same for both engines.

- If acceleration data (dHp/dt and dVg/dt) are desired, a separate time history must be kept for ground speed and altitude

H.3 747-400 DSIRF

Table 29: Standard DSIRF Dataset Header

Field	Parameter Name [3]	Columns	Format [1,2]	Units	Resolution
1	DSIRF Dataset Title	1-5	APM [4]	N/A	N/A
2	Subcategory	6	N	N/A	N/A
3	Dataset Sequence Number	7-8	NN	N/A	N/A
4	Aircraft ID Number	9-17	AAAAAAAAA	alphanum	N/A
5	Aircraft Serial Number	18-22	NNNNN	N/A	N/A
6	Aircraft Type Code	23-24	NN	N/A	N/A
7	Flight Number	25-32	AAAAAAAA	N/A	N/A
8	Depart/Destin Airports	33-40	AAAAAAAA	N/A	N/A
9	Day	41-42	NN	day	I day
10	Month	43-44	NN	month	1 month
11	Year	45-46	NN	year	1 year
12	Time - Hours	47-48	NN	hours	1 hour
13	Time - Minutes	49-50	NN	minutes	1 minute
14	Time - Seconds	51-52	NN,	seconds	1 second
15	Variable Header 1	N/A	A. . .A,[5]	N/A	N/A
16	Variable Header 2	N/A	A. . .A,[5]	N/A	N/A
17-181	First DSIRF Data Field	See DSIRF datasets continued on the following pages			

<u>NOTES on dataset and header fields:</u>

1. NNN denotes only numeric data, AAA denotes alphanumeric characters in data.

2. The first fourteen (14) data fields in the header are fixed, and no data delimiters (commas) are specified. The 15th and 16th header fields are variable, as are data fields in the DSIRF dataset body. The variable fields are separated by commas, such that no data available/required may be denoted by ",," for a specific data field (i.e. blanks/zeros are not required).

3. Fields that contain parameters that are not applicable to the 737 are labeled "Not Used". Availability of the parameters contained in the 737 DSIR is dependent upon the aircraft's ACMS configuration. The airline or operator will have to verify as to whether or not a specific parameter is available.

4. DSIRF dataset title for Airplane Performance Monitoring (APM) is "APM " (the letters APM plus two blanks).

5. The maximum field size is to be 40 characters.

6. Standard input units for DSIRF parameters are given in the DSIRF definition. However, the APM Program will accept units of kilograms for the following selected parameters; (1) gross weight, (2) fuel flow, (3) fuel quantity, (4) fuel used and (5) initial gross weight, zero fuel weight, and fuel quantity. if weight units of kilograms are used, then fuel density must be in kilograms per liter.

7. Due to the fact that the DSIRF can be a variable length record (maximum record length is 1200), it is recommended that the ASCII character string of a carriage return followed by a line feed be used to indicate the end of a DSIRF record.

Table 31 below has the 747-400 DSIRF details. Fields 121 through 181 are not used in the performance calculations in APM. They are included in the DSIRF as supplemental information. They will be included in the MASTER file for possible use by post- processing.

Table 30: 747-400 DSIRF Dataset

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
17	Mach, ADC L	.NNN,	MACH	0.001 M
18	Mach, ADC R	.NNN,	MACH	0.001 M
19	Mach, ADC C	.NNN,	MACH	0.001 M
20	CAS, ADC L	NNN.N,	Kt	0.1 Kt
21	CAS, ADC R	NNN.N,	Kt	0.1 Kt
22	CAS, ADC C	NNN.N,	Kt	0.1 Kt
23	TAT, ADC L	+/-NN.NN,	Deg C	0.25 Deg
24	TAT, ADC R	+/-NN.NN,	Deg C	0.25 Deg
25	TAT, ADC C	+/-NN.NN,	Deg C	0.25 Deg
26	Altitude(29.92), ADC L	NNNNN,	Ft	1 Ft
27	Altitude(29.92), ADC R	NNNNN,	Ft	1 Ft
28	Altitude(29.92), ADC C	NNNNN,	Ft	1 Ft
29	Gross Weight FMC L	NNNNNN,	Pounds	40 Lbs
30	Gross Weight FMC R	NNNNNN,	Pounds	40 Lbs
31	Gross Weight FMC C	NNNNNN,	Pounds	40 Lbs
32	Fuel Flow Engine 1	NNNN,	Lbs/Hr	1 Lb/Hr
33	Fuel Flow Engine 2	NNNN,	Lbs/Hr	1 Lb/Hr
34	Fuel Flow Engine 3	NNNN,	Lbs/Hr	1 Lb/Hr
35	Fuel Flow Engine 4	NNNN,	Lbs/Hr	1 Lb/Hr
36	Power Setting Eng 1	N.NNN/NNN.NN,	EPR/%N1	.001EPR/.01% N1
37	Power Setting Eng 2	N.NNN/NNN.NN,	EPR/%N1	.001EPR/.01% N1
38	Power Setting Eng 3	N.NNN/NNN.NN,	EPR/%N1	.001EPR/.01% N1
39	Power Setting Eng 4	N.NNN/NNN.NN,	EPR/%N1	.001EPR/.01% N1
40	DMU Calc Quality Factor	NN.N,	N/A	0.1
41	Ground Speed FMC L	NNN.N,	Kt	0.1 Kt
42	Ground Speed FMC R	NNN.N,	Kt	0.1 Kt
43	Ground Speed FMC C	NNN.N,	Kt	0.1 Kt

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
44	ECS Pack 1	N,	Discrete	N/A
45	ECS Pack 2	N,	Discrete	N/A
46	ECS Pack 3	N,	Discrete	N/A
47	ECS Pack 1 High Flow	N,	Discrete	N/A
48	ECS Pack 2 High Flow	N,	Discrete	N/A
49	ECS Pack 3 High Flow	N,	Discrete	N/A
50	TAI Discrete Engine 1	N,	Discrete	N/A
51	TAI Discrete Engine 2	N,	Discrete	N/A
52	TAI Discrete Engine 3	N,	Discrete	N/A
53	TAI Discrete Engine 4	N,	Discrete	N/A
54	Bleed Engine 1	N,	Discrete	N/A
55	Bleed Engine 2	N,	Discrete	N/A
56	Bleed Engine 3	N,	Discrete	N/A
57	Bleed Engine 4	N,	Discrete	N/A
58	Present Pos Lat FMC L	+/-NN.NNNN,	Degrees	0.0001 Deg
59	Present Pos Lat FMC R	+/-NN.NNNN,	Degrees	0.0001 Deg
60	Present Pos Lat FMC C	+/-NN.NNNN,	Degrees	0.0001 Deg
61	Present Pos Long FMC L	+/-NNN.NNNN,	Degrees	0.0001 Deg
62	Present Pos Long FMC R	+/-NNN.NNNN,	Degrees	0.0001 Deg
63	Present Pos Long FMC C	+/-NNN.NNNN,	Degrees	0.0001 Deg
64	True Heading FMC L	+/-NNN.N,	Degrees	0.1 Deg
65	True Heading FMC R	+/-NNN.N,	Degrees	0.1 Deg
66	True Heading FMC C	+/-NNN.N,	Degrees	0.1 Deg
67	Drift Angle FMC L	+/-NN.N,	Degrees	0.1 Deg
68	Drift Angle FMC R	+/-NN.N,	Degrees	0.1 Deg
69	Drift Angle FMC C	+/-NN.N,	Degrees	0.1 Deg
70	True Track Angle FMC L	+/-NNN.N,	Degrees	0.1 Deg
71	True Track Angle FMC R	+/-NNN.N,	Degrees	0.1 Deg
72	True Track Angle FMC C	+/-NNN.N,	Degrees	0.1 Deg
73	DMU Calculated dHp/dt	+/-NN.NNN,	Ft/Sec	0.001 Ft/Sec
74	DMU Calculated dVg/dt	+/-N.NNN,	Kt/Sec	0.001 Kt/Sec
75	Inertial Vert Spd IRU L	+/-NNNN,	Ft/Min	1 Ft/Min
76	Inertial Vert Spd IRU R	+/-NNNN,	Ft/Min	1 Ft/Min
77	Inertial Vert Spd IRU C	+/-NNNN,	Ft/Min	1 Ft/Min
78	Fuel Density Main 1	N.NNN,	Lbs/USgal	.001 Lb/Gal
79	Fuel Temp Main 1	+/-NNN,	Degrees C	1 Deg
80	Fuel Quantity Center	NNNNN,	Pounds	100 Lbs
81	Fuel Quantity Main 1	NNNNN,	Pounds	100 Lbs
82	Fuel Quantity Main 2	NNNNN,	Pounds	100 Lbs

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
83	Fuel Quantity Main 3	NNNNN,	Pounds	100 Lbs
84	Fuel Quantity Main 4	NNNNN,	Pounds	100 Lbs
85	Fuel Quantity Res 2	NNNNN,	Pounds	100 Lbs
86	Fuel Quantity Res 3	NNNNN,	Pounds	100 Lbs
87	Fuel Quantity H Tank	NNNNN,	Pounds	100 Lbs
88	Fuel Used Engine 1	NNNNN,	Pounds	1 Lb
89	Fuel Used Engine 2	NNNNN,	Pounds	1 Lb
90	Fuel Used Engine 3	NNNNN,	Pounds	1 Lb
91	Fuel Used Engine 4	NNNNN,	Pounds	1 Lb
92	APU Operating Time	NN.N,	Minutes	0.1 Minute
93	Gen Load Engine 1	NNN,	%	1 %
94	Gen Load Engine 2	NNN,	%	1 %
95	Gen Load Engine 3	NNN,	%	1 %
96	Gen Load Engine 4	NNN,	%	1 %
97	Initial GW FMC L	NNNNNN,	Pounds	40 Lbs
98	Initial GW FMC R	NNNNNN,	Pounds	40 Lbs
99	Initial GW FMC C	NNNNNN,	Pounds	40 Lbs
100	Initial CG FMC L	NN.NN,	% MAC	0.05 %
101	Initial CG FMC R	NN.NN,	% MAC	0.05 %
102	Initial CG FMC C	NN.NN,	% MAC	0.05 %
103	Initial ZFW FMC L	NNNNNN,	Pounds	40 Lbs
104	Initial ZFW FMC R	NNNNNN,	Pounds	40 Lbs,
105	Initial ZFW FMC C	NNNNNN,	Pounds	40 Lbs
106	Init. Fuel Qty Center	NNNNN,	Pounds	100 Lbs
107	Init. Fuel Qty Main 1	NNNNN,	Pounds	100 Lbs
108	Init. Fuel Qty Main 2	NNNNN,	Pounds	100 Lbs
109	Init. Fuel Qty Main 3	NNNNN,	Pounds	100 Lbs
110	Init. Fuel Qty Main 4	NNNNN,	Pounds	100 Lbs
111	Init. Fuel Qty Res 2	NNNNN,	Pounds	100 Lbs
112	Init. Fuel Qty Res 3	NNNNN,	Pounds	100 Lbs
113	Init. Fuel Qty H Tail	NNNNN,	Pounds	100 Lbs
114	Serial Number Engine 1	AAAAAAAA,	N/A	N/A
115	Serial Number Engine 2	AAAAAAAA,	N/A	N/A
116	Serial Number Engine 3	AAAAAAAA,	N/A	N/A
117	Serial Number Engine 4	AAAAAAAA,	N/A	N/A
118	DMU Calc Gross Weight	NNNNNN,	Pounds	40 Lbs
119	DMU Calc CG Position	NN.NN,	% MAC	0.1 %
120	DMU Calc LHV	NNNNN,	BTU/Lb	1.0 BTU/Lb
121	N1 Engine 1	NNN.N,	% RPM	0.1 %

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
122	N1 Engine 2	NNN.N,	% RPM	0.1 %
123	N1 Engine 3	NNN.N,	% RPM	0.1 %
124	N1 Engine 4	NNN.N,	% RPM	0.1 %
125.	N2 Engine 1	NNN.N,	% RPM	0.1 %
126.	N2 Engine 2	NNN.N,	% RPM	0.1 %
127.	N2 Engine 3	NNN.N,	% RPM	0.1 %
128.	N2 Engine 4	NNN.N,	% RPM	0.1 %
129.	N3 Engine 1 (RR only)	NNN.N,	% RPM	0.1 %
130.	N3 Engine 2 (RR only)	NNN.N,	% RPM	0.1 %
131.	N3 Engine 3 (RR only)	NNN.N,	% RPM	0.1 %
132.	N3 Engine 4 (RR only)	NNN.N,	% RPM	0.1 %
133.	EGT Engine 1	NNN.N,	Degrees C	0.5 Deg
134.	EGT Engine 2	NNN.N,	Degrees C	0.5 Deg
135.	EGT Engine 3	NNN.N,	Degrees C	0.5 Deg
136.	EGT Engine 4	NNN.N,	Degrees C	0.5 Deg
137.	Turb Case Cool Eng 1 (P&W)	NNN.N,	%	0.1 %
138.	Turb Case Cool Eng 2 (P&W)	NNN.N,	%	0.1 %
139.	Turb Case Cool Eng 3 (P&W)	NNN.N,	%	0.1 %
140.	Turb Case Cool Eng 4 (P&W)	NNN.N,	%	0.1 %
141.	SAT, ADC L	+/-NN.N,	Degrees C	0.5 Deg
142.	SAT, ADC R	+/-NN.N,	Degrees C	0.5 Deg
143.	SAT, ADC C	,	N/A	N/A
144.	Indicated AOA, ADC L	+/-NN.N,	Degrees	0.05 Deg
145.	Indicated AOA, ADC R	+/-NN.N,	Degrees	0.05 Deg
146.	Indicated AOA, ADC C	+/-NN.N,	Degrees	0.05 Deg
147.	Roll Angle IRU L	+/-NN.N,	Degrees	0.1 Deg
148.	Roll Angle IRU R	+/-NN.N,	Degrees	0.1 Deg
145.	Roll Angle IRU C	+/-NN.N,	Degrees	0.1 Deg
150.	Pitch Angle IRU L	+/-NN.N,	Degrees	0.1 Deg
151.	Pitch Angle IRU R	+/-NN.N,	Degrees	0.1 Deg
152.	Pitch Angle IRU C	+/-NN.N,	Degrees	0.1 Deg
153.	Stabilizer Position	+/-NN.N,	Units	0.05 Unit
154.	Spoiler Position #4	NN.N,	Degrees	0.1 Deg
155.	Spoiler Position #12	NN.N,	Degrees	0.1 Deg
156.	HS Aileron Position L	+/-NN.N,	Degrees	0.1 Deg
157.	HS Aileron Position R	+/-NN.N,	Degrees	0.1 Deg
158.	LS Aileron Position L	+/-NN.N,	Degrees	0.1 Deg
159.	LS Aileron Position R	+/-NN.N,	Degrees	0.1 Deg
160.	Rudder Position Upper	+/-NN.N,	Degrees	0.1 Deg

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
161.	Rudder Position Lower	+/-NN.N,	Degrees	0.1 Deg
162.	Elevator Position L Inbd	+/-NN.N,	Degrees	0.1 Deg
163.	Elevator Position R Inbd	+/-NN.N,	Degrees	0.1 Deg
164.	Elevator Position L Outbd	+/-NN.N,	Degrees	0.1 Deg
165.	Elevator Position R Outbd	+/-NN.N,	Degrees	0.1 Deg
166.	TE Flap Position L Outbd	NN.N,	Degrees	0.1 Deg
167.	TE Flap Position R Outbd	NN.N,	Degrees	0.1 Deg
168.	TE Flap Position L Inbd	NN.N,	Degrees	0.1 Deg
169.	TE Flap Position R Inbd	NN.N,	Degrees	0.1 Deg
170.	Along TK Horiz Accel IRU L	+/-N.NN,	G's	0.01 G
171.	Along TK Horiz Accel IRU R	+/-N.NN,	G's	0.01 G
172.	Along TK Horiz Accel IRU C	+/-N.NN,	G's	0.01 G
173.	Flight Path Accel IRU L	+/-N.NN,	G's	0.01 G
174.	Flight Path Accel IRU R	+/-N.NN,	G's	0.01 G
175.	Flight Path Accel IRU C	+/-N.NN,	G's	0.01 G
176.	Vertical Accel IRU L	+/-N.NN,	G's	0.01 G
177.	Vertical Accel IRU R	+/-N.NN,	G's	0.01 G
178.	Vertical Accel IRU C	+/-N.NN,	G's	0.01 G
179.	DMU Calculated dIVV/dt	+/-NN.NNN,	Ft/Sec2	0.001 Ft/Sec2
180.	Fuel Imbal. Roll Moment	+/-NN.NN,	106 In-Lbs	0.0lxl06 In-Lb
181.	Angle of Sideslip	+/-N.NN,	Degrees	0.01 Deg

H.4 747-400 MASTER File

The first character of each line is the FORTRAN carriage control. Parameters 220 – 252 are calculated variables in the program and are presented in the MASTER file for inspection or subsequent analysis.

Table 31: 747-400 Master File

Line	Parameters	Format
1	Error code and text: 1. Error code 2. Error test 3. Model 4. Engine	1X,I7,1X,A80,1X,A16,1X,A16/

Line	Parameters	Format
2	Deviations: 5. Thrust deviation 6. Power setting deviation 7. Fuel flow deviation engine 1 8. Fuel flow deviation engine 2 9. Fuel flow deviation engine 3 10. Fuel flow deviation engine 4 11. Average fuel flow deviation 12. Fuel mileage deviation 13. Fuel flow deviation due to power setting deviation	1X,9(F13.5,1X)/
3	Header: 14. Airplane Identification Number 15. Airplane Serial Number 16. Flight Number 17. Departure/Destination 18. Day 19. Month 20. Year 21. Time - Hrs 22. Time - Min 23. Time - Sec	1X,A54/
4	Variable Header 24. Variable Header 1 25. Variable Header 2	1X,2A40/
5	Analysis Parameters: 26. Mach, ADC L 27. Mach, ADC R 28. Mach, ADC C 29. CAS, ADC L 30. CAS, ADC R 31. CAS, ADC C 32. TAT, ADC L 33. TAT, ADC R 34. TAT, ADC C	1X,9(F13.5,1X)/
6	35. Pressure Altitude, ADC L 36. Pressure Altitude, ADC R 37. Pressure Altitude, ADC C 38. Gross Weight, FMC L 39. Gross Weight, FMC R 40. Gross Weight, FMC C 41. Fuel Flow Engine 1 42. Fuel Flow Engine 2 43. Fuel Flow Engine 3	1X,9(F13.5,1X)/

Line	Parameters	Format
7	44. Fuel Flow Engine 4 45. Power Setting Engine 1 46. Power Setting Engine 2 47. Power Setting Engine 3 48. Power Setting Engine 4 49. DMU Calculated Quality Factor 50. Ground Speed, FMC L 51. Ground Speed, FMC R 52. Ground Speed, FMC C	1X,9(F13.5,1X)/
8	53. ECS Pack 1 Discrete 54. ECS Pack 2 Discrete 55. ECS Pack 3 Discrete 56. ECS Pack 1 High Flow Discrete 57. ECS Pack 2 High Flow Discrete 58. ECS Pack 3 High Flow Discrete 59. TAI Engine 1 Discrete 60. TAI Engine 2 Discrete 61. TAI Engine 3 Discrete	1X,9(F13.5,1X)/
9	62. TAI Engine 4 Discrete 63. Bleed Engine 1 Discrete 64. Bleed Engine 2 Discrete 65. Bleed Engine 3 Discrete 66. Bleed Engine 4 Discrete 67. Present Position Latitude, FMC L 68. Present Position Latitude, FMC R 69. Present Position Latitude, FMC C 70. Present Position Longitude, FMC L	1X,9(F13.5,1X)/
10	71. Present Position Longitude, FMC R 72. Present Position Longitude, FMC C 73. True Heading, FMC L 74. True Heading, FMC R 75. True Heading, FMC C 76. Drift Angle, FMC L 77. Drift Angle, FMC R 78. Drift Angle, FMC C 79. True Track Angle, FMC L	1X,9(F13.5,1X)/
11	80. True Track Angle, FMC R 81. True Track Angle, FMC C 82. DMU Calculated dHp/dt 83. DMU Calculated dVg/dt 84. Inertial Vertical Velocity, IRU L 85. Inertial Vertical Velocity, IRU R 86. Inertial Vertical Velocity, IRU C 87. Fuel Density Main Tank 88. Fuel Temperature Main Tank	1X,9(F13.5,1X)/

Line	Parameters	Format
12	89. Fuel Quantity Center Tank 90. Fuel Quantity Main Tank 1 91. Fuel Quantity Main Tank 2 92. Fuel Quantity Main Tank 3 93. Fuel Quantity Main Tank 4 94. Fuel Quantity Reserve Tank 1 95. Fuel Quantity Reserve Tank 2 96. Fuel Quantity H Tail Tank 97. Fuel Used Engine 1	1X,9(F13.5,1X)/
13	98. Fuel Used Engine 2 99. Fuel Used Engine 3 100. Fuel Used Engine 4 101. APU Operating Time 102. Generator Load Engine 1 103. Generator Load Engine 2 104. Generator Load Engine 3 105. Generator Load Engine 4 106. Initial Gross Weight, FMC L	1X,9(F13.5,1X)/
14	107. Initial Gross Weight, FMC R 108. Initial Gross Weight, FMC C 109. Initial CG Position, FMC L 110. Initial CG Position, FMC R 111. Initial CG Position, FMC C 112. Initial Zero Fuel Weight, FMC L 113. Initial Zero Fuel Weight, FMC R 114. Initial Zero Fuel Weight, FMC C 115. Initial Fuel Quantity Center Tank	1X,9(F13.5,1X)/
15	116. Initial Fuel Quantity Main Tank 1 117. Initial Fuel Quantity Main Tank 2 118. Initial Fuel Quantity Main Tank 3 119. Initial Fuel Quantity Main Tank 4 120. Initial Fuel Quantity Res Tank 1 121. Initial Fuel Quantity Res Tank 2 122. Initial Fuel Quantity H Tail Tank	1X,7(F13.5,1X)/
16	123. Serial Number Engine 1 124. Serial Number Engine 2 125. Serial Number Engine 3 126. Serial Number Engine 4	1X,4(A8,1X)/

Line	Parameters		Format
17	127.	DMU Calculated Gross Weight	1X,9(F13.5,1X)/
	128.	DMU Calculated Center of Gravity Position	
	129.	DMU Calculated Fuel Lower Heat Value	
	130.	%N1 Engine 1	
	131.	%N1 Engine 2	
	132.	%N1 Engine 3	
	133.	%N1 Engine 4	
	134.	%N2 Engine 1	
	135.	%N2 Engine 2	
18	136.	%N2 Engine 3	1X,9(F13.5,1X)/
	137.	%N2 Engine 4	
	138.	%N3 Engine 1 (RR Only)	
	139.	%N3 Engine 2 (RR Only)	
	140.	%N3 Engine 3 (RR Only)	
	141.	%N3 Engine 4 (RR Only)	
	142.	EGT Engine 1	
	143.	EGT Engine 2	
	144.	EGT Engine 3	
19	145.	EGT Engine 4	1X,9(F13.5,1X)/
	146.	Turb Case Cool Engine 1 (P&W Only)	
	147.	Turb Case Cool Engine 2 (P&W Only)	
	148.	Turb Case Cool Engine 3 (P&W Only)	
	149.	Turb Case Cool Engine 4 (P&W Only	
	150.	SAT, ADC L	
	151.	SAT, ADC R	
	152.	SAT, ADC C	
	153.	Indicated Angle of Attack, ADC L	
20	154.	Indicated Angle of Attack, ADC R	1X,9(F13.5,1X)/
	155.	Indicated Angle of Attack, ADC C	
	156.	Roll Angle, IRU L	
	157.	Roll Angle, IRU R	
	158.	Roll Angle, IRU C	
	159.	Pitch Angle, IRU L	
	160.	Pitch Angle, IRU R	
	161.	Pitch Angle, IRU C	
	162.	Stabilizer Position	
21	163.	Spoiler Position #4	1X,9(F13.5,1X)/
	164.	Spoiler Position #12	
	165.	HS Aileron Position Left	
	166.	HS Aileron Position Right	
	167.	LS Aileron Position Left	
	168.	LS Aileron Position Right	
	169.	Rudder Position Upper	
	170.	Rudder Position Lower	
	171.	Inboard Elevator Position Left	

Line	Parameters		Format
22	172.	Inboard Elevator Position Right	1X,9(F13.5,1X)/
	173.	Outboard Elevator Position Left	
	174.	Outboard Elevator Position Right	
	175.	Outboard Trailing Edge Flap Left	
	176.	Outboard Trailing Edge Flap Right	
	177.	Inboard Trailing Edge Flap Left	
	178.	Inboard Trailing Edge Flap Right	
	179.	Along TK Horiz Accel, IRU L	
	180.	Along TK Horiz Accel, IRU R	
23	181.	Along TK Horiz Accel, IRU C	1X,9(F13.5,1X)/
	182.	Flight Path Accel, IRU L	
	183.	Flight Path Accel, IRU R	
	184.	Flight Path Accel, IRU C	
	185.	Vertical Accel, IRU L	
	186.	Vertical Accel, IRU R	
	187.	Vertical Accel, IRU C	
	188.	DMU Calculated dIVV/dt	
	189.	Fuel Imbal. Roll Moment	
24	190.	Angle of Sideslip	1X,9(F13.5,1X)/
	191-198	Open for DSIRF expansion	
25	199-207	Open for DSIRF expansion	1X,9(F13.5,1X)/
26	208-216	Open for DSIRF expansion	1X,9(F13.5,1X)/
27	217-219	Open for DSIRF expansion	1X,3(F13.5,1X)/
28	220.	Corrected Gross weight	1X,9(F13.5,1X)/
	221.	Lift Coefficient	
	222.	Cd Basic	
	223.	Cd Reynolds	
	224.	CG Position	
	225.	Cd Center of Gravity	
	226.	Cd Elasticity	
	227.	Cd Total	
	228.	Delta Drag - Acceleration	
29	229.	Total Drag	1X,9(F13.5,1X)/
	230.	Drag/Delta	
	231.	Thrust Engine 1	
	232.	Thrust Engine 2	
	233.	Thrust Engine 3	
	234.	Thrust Engine 4	
	235.	Total Thrust	
	236.	Book Power Setting (Eng. Type 1)	
	237.	Book Power Setting (Eng. Type 2)	

Line	Parameters		Format
30	238. 239. 240. 241. 242. 243. 244. 245. 246.	Average Power Setting Corrected Book Fuel Flow Engine 1 Corrected Book Fuel Flow Engine 2 Corrected Book Fuel Flow Engine 3 Corrected Book Fuel Flow Engine 4 Fuel Flow Factor LHV Ratio Fuel Flow Factor Power Extraction Fuel Flow Factor Observed Fuel Flow Total	1X,9(F13.5,1X)/
31	247. 248. 249. 250. 251. 252.	Book Fuel Flow Total True Airspeed (TAS) Book Fuel Mileage Observed Fuel Mileage Instrument Source Speed Type	1X,5(F13.5,1X),A16,1X,A16/

Appendix I 747-8 MODEL SPECIFIC INFORMATION

A generalized definition of the DSIRF for the 747-8 is provided in this section. Whether or not this data input mode can be used will depend upon the availability of the required parameters contained in this DSIRF. It is recommended that the default values be used for the input options during the first trial run of the APM Program. To use one of the data correction algorithms contained in the program, it is recommended that the reader consult Section 4 Algorithm and Analysis to determine what data are required for that specific correction.

I.1 Bleed Configuration

To be eligible for analysis by the APM program, each candidate DSIRF or MSIRF data record is checked to determine if the bleed configuration is compatible with the airplane database. The status of the following bleeds are used to define this configuration. NOTE: The discrete values shown below represent the convention adopted for the APM program and do not necessarily agree with the actual airplane discrete values.

Table 32: 747-8 Bleed Configurations

BLEED	STATUS	
ECS PACK FLOW RATE	Numeric Value	
ENGINE BLEED FLOW RATE	Numeric Value	
	ZERO STATE	**ONE STATE**
ENGINE ANTI-ICE BLEEDS	OFF	ON

For the 747-8, the APM Program will use measured ECS Pack flow rate to correct for the effects of ECS bleed on cruise performance. If data input is to be via MSIRF, record the actual ECS Pack mass flow (Lbs/Min) in the location provided on the Performance Log otherwise nominal bleed flow will be used.

The zero state represents the "normal" bleed configuration of the 747-8 during cruise. The one state for engine bleed or engine anti-ice is indicative of a "non-normal" bleed configuration and will cause the APM program to reject the data point for analysis.

I.2 747-8 Performance Log

Please see the manual performance log on the next page. This log is appropriate for use with the 747-8 and 747-8F.

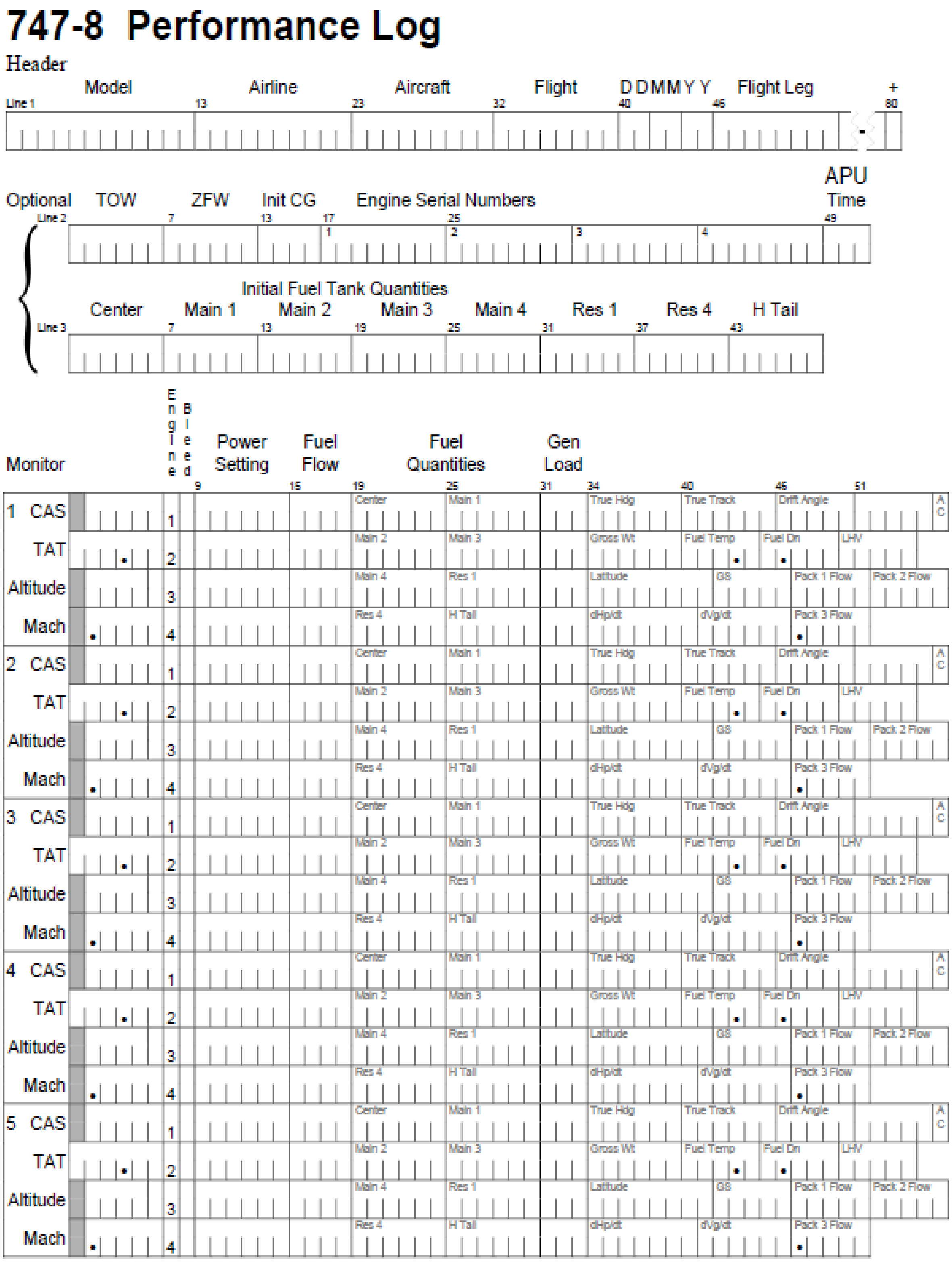

Figure 28: 747-8 Performance Log

I.2.1 Recommended Recording Procedures:

1) Record Model, Airline, Aircraft, Flight Number and Date.

2) If desired record takeoff gross weight, ZFW, initial center of gravity, engine serial numbers, APU operating time, and initial fuel tank quantities. Note; Some of these parameters may not be used by the program depending on the database capability and options selected by user.

3) Wait until the airplane is stabilized in cruise:

   a) Smooth air

   b) No thrust lever movement (auto-throttles off) for more than five minutes

   c) Anti-ice and fuel heat off for more than five minutes

   d) Less than one degree variation in indicated temperature during the preceding three minutes

   e) Less than .005 Mach (two knots CAS) variation in speed during the preceding three minutes

4) Quickly record Mach, EPR or %N1 and Fuel Flow.

5) Record TAT, Altitude, CAS, FMC Gross Weight (see Note 4).

6) Recheck Mach. If the Mach has changed more than .005 (two knots CAS) discard the point.

7) Record Individual Tank Fuel Quantities and Bleed Code (see Note 5).

8) The rest of the parameters on the Log form are optional, record those now if necessary.

9) Wait at least thirty minutes before recording the next data point in order to obtain data over a range of weights.

<u>NOTES:</u>

- Data can be taken at any stabilized speed. There is no need to return the airplane to a published speed schedule before recording data.

- The airplane identification number should be entered under aircraft. (Data sorting is done using this variable along with date.)

- All gross weight data and fuel quantities must be specified in the same units.

- If the FMC or total gross weight is known, it can be entered in the box labeled "Gross Wt".

- Bleed Config: For 3 ECS Packs operating, record the number of ECS Packs in HIGH flow, i.e., 0, 1, 2, or 3. For only 2 ECS Packs operating, record a zero (0) to indicate a 2

ECS Packs/High Flow configuration. The bleed code should be the same for all four engines.

- If acceleration data (dHp/dt and dVg/dt) are desired, a separate time history must be kept for ground speed and altitude.

I.3 747-8 DSIRF

Table 33: Standard DSIRF Dataset Header

Field	Parameter Name [3]	Columns	Format [1,2]	Units	Resolution
1	DSIRF Dataset Title	1-5	APM [4]	N/A	N/A
2	Subcategory	6	N	N/A	N/A
3	Dataset Sequence Number	7-8	NN	N/A	N/A
4	Aircraft ID Number	9-17	AAAAAAAAA	alphanum	N/A
5	Aircraft Serial Number	18-22	NNNNN	N/A	N/A
6	Aircraft Type Code	23-24	NN	N/A	N/A
7	Flight Number	25-32	AAAAAAAA	N/A	N/A
8	Depart/Destin Airports	33-40	AAAAAAAA	N/A	N/A
9	Day	41-42	NN	day	I day
10	Month	43-44	NN	month	1 month
11	Year	45-46	NN	year	1 year
12	Time - Hours	47-48	NN	hours	1 hour
13	Time - Minutes	49-50	NN	minutes	1 minute
14	Time - Seconds	51-52	NN,	seconds	1 second
15	Variable Header 1	N/A	A. . .A,[5]	N/A	N/A
16	Variable Header 2	N/A	A. . .A,[5]	N/A	N/A
17-181	First DSIRF Data Field	See DSIRF datasets continued on the following pages			

<u>NOTES on dataset and header fields:</u>

1. NNN denotes only numeric data, AAA denotes alphanumeric characters in data.

2. The first fourteen (14) data fields in the header are fixed, and no data delimiters (commas) are specified. The 15th and 16th header fields are variable, as are data fields in the DSIRF dataset body. The variable fields are separated by commas, such that no data available/required may be denoted by ",," for a specific data field (i.e. blanks/zeros are not required).

3. Fields that contain parameters that are not applicable to the 737 are labeled "Not Used". Availability of the parameters contained in the 737 DSIR is dependent upon the aircraft's ACMS configuration. The airline or operator will have to verify as to whether or not a specific parameter is available.

4. DSIRF dataset title for Airplane Performance Monitoring (APM) is "APM " (the letters APM plus two blanks).

5. The maximum field size is to be 40 characters.

6. Standard input units for DSIRF parameters are given in the DSIRF definition. However, the APM Program will accept units of kilograms for the following selected parameters; (1) gross weight, (2) fuel flow, (3) fuel quantity, (4) fuel used and (5) initial gross weight, zero fuel weight, and fuel quantity. if weight units of kilograms are used, then fuel density must be in kilograms per liter.

7. Due to the fact that the DSIRF can be a variable length record (maximum record length is 1200), it is recommended that the ASCII character string of a carriage return followed by a line feed be used to indicate the end of a DSIRF record.

Table 35 below has the 747-8 DSIRF details.

Table 34: 747-8 DSIRF Dataset

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
17	Mach, ADC L	.NNN,	MACH	0.001 M
18	Mach, ADC R	.NNN,	MACH	0.001 M
19	Mach, ADC C	.NNN,	MACH	0.001 M
20	CAS, ADC L	NNN.N,	Kt	0.1 Kt
21	CAS, ADC R	NNN.N,	Kt	0.1 Kt
22	CAS, ADC C	NNN.N,	Kt	0.1 Kt
23	TAT, ADC L	+/-NN.NN,	Deg C	0.25 Deg
24	TAT, ADC R	+/-NN.NN,	Deg C	0.25 Deg
25	TAT, ADC C	+/-NN.NN,	Deg C	0.25 Deg
26	Altitude,ADC L	NNNNN,	Ft	1 Ft
27	Altitude, ADC R	NNNNN,	Ft	1 Ft
28	Altitude, ADC C	NNNNN,	Ft	1 Ft
29	Gross Weight FMC L	NNNNNN,	Pounds	40 Lbs
30	Gross Weight FMC R	NNNNNN,	Pounds	40 Lbs
31	Not Used	,	N/A	N/A
32	Fuel Flow Engine 1	NNNN,	Lbs/Hr	1 Lb/Hr
33	Fuel Flow Engine 2	NNNN,	Lbs/Hr	1 Lb/Hr
34	Fuel Flow Engine 3	NNNN,	Lbs/Hr	1 Lb/Hr
35	Fuel Flow Engine 4	NNNN,	Lbs/Hr	1 Lb/Hr
36	Power Setting Eng 1	N.NNN/NNN.NN,	EPR/%N1	.001EPR/.01% N1
37	Power Setting Eng 2	N.NNN/NNN.NN,	EPR/%N1	.001EPR/.01% N1
38	Power Setting Eng 3	N.NNN/NNN.NN,	EPR/%N1	.001EPR/.01% N1
39	Power Setting Eng 4	N.NNN/NNN.NN,	EPR/%N1	.001EPR/.01% N1
40	DMU Calc Quality Factor	NN.N,	N/A	0.1
41	Ground Speed IRU avg	NNN.N,	Kt	0.1 Kt

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
42	Ground Speed GPS avg	NNN.N,	Kt	0.1 Kt
43	Not Used	,	N/A	N/A
44	ECS Pack Flow Rate Pack 1	N,	Discrete	N/A
45	ECS Pack Flow Rate Pack 2	N,	Discrete	N/A
46	ECS Pack Flow Rate Pack 3	N,	Discrete	N/A
47	ECS Pack 1 High Flow	N,	Discrete	N/A
48	ECS Pack 2 High Flow	N,	Discrete	N/A
49	ECS Pack 3 High Flow	N,	Discrete	N/A
50	TAI Discrete Engine 1	N,	Discrete	N/A
51	TAI Discrete Engine 2	N,	Discrete	N/A
52	TAI Discrete Engine 3	N,	Discrete	N/A
53	TAI Discrete Engine 4	N,	Discrete	N/A
54	Bleed Flow Engine 1	NNN.N,	Lbs/Min	0.1Lbs/Min
55	Bleed Flow Engine 2	NNN.N,	Lbs/Min	0.1Lbs/Min
56	Bleed Flow Engine 3	NNN.N,	Lbs/Min	0.1Lbs/Min
57	Bleed Flow Engine 4	NNN.N,	Lbs/Min	0.1Lbs/Min
58	Present Pos Latitude	+/-NN.NNNN,	Degrees	0.0001 Deg
59	Not Used	,	N/A	N/A
60	Not Used	,	N/A	N/A
61	Present Pos Longitude	+/-NNN.NNNN,	Degrees	0.0001 Deg
62	Not Used	,	N/A	N/A
63	Not Used	,	N/A	N/A
64	True Heading	+/-NNN.N,	Degrees	0.1 Deg
65	Not Used	,	N/A	N/A
66	Not Used	,	N/A	N/A
67	Drift Angle	+/-NN.N,	Degrees	0.1 Deg
68	Not Used	,	N/A	N/A
69	Not Used	,	N/A	N/A
70	True Track Angle	+/-NNN.N,	Degrees	0.1 Deg
71	Not Used	,	N/A	N/A
72	Not Used	,	N/A	N/A
73	DMU Calculated dHp/dt	+/-NN.NNN,	Ft/Sec	0.001 Ft/Sec
74	DMU Calculated dVg/dt	+/-N.NNN,	Kt/Sec	0.001 Kt/Sec
75	Inertial Vert Spd IRU	+/-NNNN,	Ft/Min	1 Ft/Min
76	Not Used	,	N/A	N/A
77	Not Used	,	N/A	N/A
78	Fuel Density Main 1	N.NNN,	Lbs/USgal	.001 Lb/Gal
79	Fuel Temp Main 1	+/-NNN,	Degrees C	1 Deg
80	Fuel Quantity Center	NNNNN,	Pounds	100 Lbs

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
81	Fuel Quantity Main 1	NNNNN,	Pounds	100 Lbs
82	Fuel Quantity Main 2	NNNNN,	Pounds	100 Lbs
83	Fuel Quantity Main 3	NNNNN,	Pounds	100 Lbs
84	Fuel Quantity Main 4	NNNNN,	Pounds	100 Lbs
85	Fuel Quantity Res 1	NNNNN,	Pounds	100 Lbs
86	Fuel Quantity Res 4	NNNNN,	Pounds	100 Lbs
87	Fuel Quantity Horiz Stab Tank	NNNNN,	Pounds	100 Lbs
88	Fuel Used Engine 1	NNNNN,	Pounds	1 Lb
89	Fuel Used Engine 2	NNNNN,	Pounds	1 Lb
90	Fuel Used Engine 3	NNNNN,	Pounds	1 Lb
91	Fuel Used Engine 4	NNNNN,	Pounds	1 Lb
92	APU Operating Time	NN.N,	Minutes	0.1 Minute
93	Gen (AC) Load Engine 1	NNN,	%	1 %
94	Gen (AC) Load Engine 2	NNN,	%	1 %
95	Gen (AC) Load Engine 3	NNN,	%	1 %
96	Gen (AC) Load Engine 4	NNN,	%	1 %
97	Initial GW	NNNNNN,	Pounds	40 Lbs
98	Not Used	,	N/A	N/A
99	Not Used	,	N/A	N/A
100	Initial CG	NN.NN,	% MAC	0.05 %
101	Not Used	,	N/A	N/A
102	Not Used	,	N/A	N/A
103	Initial ZFW	NNNNNN,	Pounds	40 Lbs
104	Not Used	,	N/A	N/A
105	Not Used	,	N/A	N/A
106	Init. Fuel Qty Center	NNNNN,	Pounds	100 Lbs
107	Init. Fuel Qty Main 1	NNNNN,	Pounds	100 Lbs
108	Init. Fuel Qty Main 2	NNNNN,	Pounds	100 Lbs
109	Init. Fuel Qty Main 3	NNNNN,	Pounds	100 Lbs
110	Init. Fuel Qty Main 4	NNNNN,	Pounds	100 Lbs
111	Init. Fuel Qty Res 1	NNNNN,	Pounds	100 Lbs
112	Init. Fuel Qty Res 4	NNNNN,	Pounds	100 Lbs
113	Init. Fuel Qty Horiz Stab Tail	NNNNN,	Pounds	100 Lbs
114	Serial Number Engine 1	AAAAAAAA,	N/A	N/A
115	Serial Number Engine 2	AAAAAAAA,	N/A	N/A
116	Serial Number Engine 3	AAAAAAAA,	N/A	N/A
117	Serial Number Engine 4	AAAAAAAA,	N/A	N/A
118	Not Used	,	N/A	N/A
119	Not Used	,	N/A	N/A

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
120	Not Used	,	N/A	N/A
121	Not Used	,	N/A	N/A
122	Not Used	,	N/A	N/A
123	Not Used	,	N/A	N/A
124	Not Used	,	N/A	N/A
125.	N2 Engine 1	NNN.N,	% RPM	0.1 %
126.	N2 Engine 2	NNN.N,	% RPM	0.1 %
127.	N2 Engine 3	NNN.N,	% RPM	0.1 %
128.	N2 Engine 4	NNN.N,	% RPM	0.1 %
129.	Not Used	,	N/A	N/A
130.	Not Used	,	N/A	N/A
131.	Not Used	,	N/A	N/A
132.	Not Used	,	N/A	N/A
133.	EGT Engine 1	NNN.N,	Degrees C	0.5 Deg
134.	EGT Engine 2	NNN.N,	Degrees C	0.5 Deg
135.	EGT Engine 3	NNN.N,	Degrees C	0.5 Deg
136.	EGT Engine 4	NNN.N,	Degrees C	0.5 Deg
137.	Forward Cargo A/C (FCAC)	N,	Discrete	N/A
138.	Aft Cargo A/C (ACAC)	N,	Discrete	N/A
139.	Aft Bulk Cargo Heat Duration	NNNN,	%	1%
140.	Not Used	,	N/A	N/A
141.	SAT, ADC	+/-NN.N,	Degrees C	0.5 Deg
142.	Not Used	,	N/A	N/A
143.	Not Used	,	N/A	N/A
144.	Indicated AOA, ADC	+/-NN.N,	Degrees	0.05 Deg
145.	Not Used	,	N/A	N/A
146.	Not Used	,	N/A	N/A
147.	Roll Angle IRU	+/-NN.N,	Degrees	0.1 Deg
148.	Not Used	,	N/A	N/A
145.	Not Used	,	N/A	N/A
150.	Pitch Angle IRU	+/-NN.N,	Degrees	0.1 Deg
151.	Not Used	,	N/A	N/A
152.	Not Used	,	N/A	N/A
153.	Stabilizer Position	+/-NN.N,	Units	0.05 Unit
154.	Spoiler Position #4	NN.N,	Degrees	0.1 Deg
155.	Spoiler Position #12	NN.N,	Degrees	0.1 Deg
156.	Aileron Position L Inbd	+/-NN.N,	Degrees	0.1 Deg
157.	Aileron Position R Inbd	+/-NN.N,	Degrees	0.1 Deg
158.	Aileron Position L Outbd	+/-NN.N,	Degrees	0.1 Deg

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
159.	Aileron Position R Outbd	+/-NN.N,	Degrees	0.1 Deg
160.	Rudder Position Upper	+/-NN.N,	Degrees	0.1 Deg
161.	Rudder Position Lower	+/-NN.N,	Degrees	0.1 Deg
162.	Elevator Position L Inbd	+/-NN.N,	Degrees	0.1 Deg
163.	Elevator Position R Inbd	+/-NN.N,	Degrees	0.1 Deg
164.	Elevator Position L Outbd	+/-NN.N,	Degrees	0.1 Deg
165.	Elevator Position R Outbd	+/-NN.N,	Degrees	0.1 Deg
166.	TE Flap Position L Outbd	NN.N,	Degrees	0.1 Deg
167.	TE Flap Position R Outbd	NN.N,	Degrees	0.1 Deg
168.	TE Flap Position L Inbd	NN.N,	Degrees	0.1 Deg
169.	TE Flap Position R Inbd	NN.N,	Degrees	0.1 Deg
170.	Along TK Horiz Accel IRU	+/-N.NN,	G's	0.01 G
171.	Not Used	,	N/A	N/A
172.	Not Used	,	N/A	N/A
173.	Flight Path Accel IRU	+/-N.NN,	G's	0.01 G
174.	Not Used	,	N/A	N/A
175.	Not Used	,	N/A	N/A
176.	Vertical Accel IRU	+/-N.NN,	G's	0.01 G
177.	Not Used	,	N/A	N/A
178.	Not Used	,	N/A	N/A
179.	Not Used	,	N/A	N/A
180.	Not Used	,	N/A	N/A
181.	Not Used	,	N/A	N/A

I.4 747-8 MASTER File

The first character of each line is the FORTRAN carriage control. Parameters 220 – 252 are calculated variables in the program and are presented in the MASTER file for inspection or subsequent analysis.

Table 35: 747-8 Master File

Line	Parameters	Format
1	Error code and text: 1. Error code 2. Error test 3. Model 4. Engine	1X,I7,1X,A80,1X,A16,1X,A16/

Line	Parameters	Format
2	Deviations: 5. Thrust deviation 6. Power setting deviation 7. Fuel flow deviation engine 1 8. Fuel flow deviation engine 2 9. Fuel flow deviation engine 3 10. Fuel flow deviation engine 4 11. Average fuel flow deviation 12. Fuel mileage deviation 13. Fuel flow deviation due to power setting deviation	1X,9(F13.5,1X)/
3	Header: 14. Airplane Identification Number 15. Airplane Serial Number 16. Flight Number 17. Departure/Destination 18. Day 19. Month 20. Year 21. Time - Hrs 22. Time - Min 23. Time - Sec	1X,A54/
4	Variable Header 24. Variable Header 1 25. Variable Header 2	1X,2A40/
5	Analysis Parameters: 26. Mach, ADC L 27. Mach, ADC R 28. Mach, ADC C 29. CAS, ADC L 30. CAS, ADC R 31. CAS, ADC C 32. TAT, ADC L 33. TAT, ADC R 34. TAT, ADC C	1X,9(F13.5,1X)/
6	35. Altitude, ADC L 36. Altitude, ADC R 37. Altitude, ADC C 38. Gross Weight, FMC L 39. Gross Weight, FMC R 40. Gross Weight, FMC C 41. Fuel Flow Engine 1 42. Fuel Flow Engine 2 43. Fuel Flow Engine 3	1X,9(F13.5,1X)/

Line	Parameters	Format
7	44. Fuel Flow Engine 4 45. Power Setting Engine 1 46. Power Setting Engine 2 47. Power Setting Engine 3 48. Power Setting Engine 4 49. DMU Calculated Quality Factor 50. Ground Speed, FMC L 51. Ground Speed, FMC R 52. Ground Speed, FMC C	1X,9(F13.5,1X)/
8	53. ECS Pack 1 54. ECS Pack 2 55. ECS Pack 3 56. ECS Pack 1 High Flow Discrete 57. ECS Pack 2 High Flow Discrete 58. ECS Pack 3 High Flow Discrete 59. TAI Discrete Engine 1 60. TAI Discrete Engine 2 61. TAI Discrete Engine 3	1X,9(F13.5,1X)/
9	62. TAI Discrete Engine 4 63. Bleed Engine 1 64. Bleed Engine 2 65. Bleed Engine 3 66. Bleed Engine 4 67. Present Position Latitude, FMC L 68. Present Position Latitude, FMC R 69. Present Position Latitude, FMC C 70. Present Position Longitude, FMC L	1X,9(F13.5,1X)/
10	71. Present Position Longitude, FMC R 72. Present Position Longitude, FMC C 73. True Heading, FMC L 74. True Heading, FMC R 75. True Heading, FMC C 76. Drift Angle, FMC L 77. Drift Angle, FMC R 78. Drift Angle, FMC C 79. True Track Angle, FMC L	1X,9(F13.5,1X)/
11	80. True Track Angle, FMC R 81. True Track Angle, FMC C 82. DMU Calculated dHp/dt 83. DMU Calculated dVg/dt 84. Inertial Vertical Speed, IRU L 85. Inertial Vertical Speed, IRU R 86. Inertial Vertical Speed, IRU C 87. Fuel Density Main Tank 1 88. Fuel Temperature Main Tank 1	1X,9(F13.5,1X)/

Line	Parameters	Format
12	89. Fuel Quantity Center Tank 90. Fuel Quantity Main Tank 1 91. Fuel Quantity Main Tank 2 92. Fuel Quantity Main Tank 3 93. Fuel Quantity Main Tank 4 94. Fuel Quantity Reserve Tank 2 95. Fuel Quantity Reserve Tank 3 96. Fuel Quantity Horiz Tail Tank 97. Fuel Used Engine 1	1X,9(F13.5,1X)/
13	98. Fuel Used Engine 2 99. Fuel Used Engine 3 100. Fuel Used Engine 4 101. APU Operating Time 102. Generator Load Engine 1 103. Generator Load Engine 2 104. Generator Load Engine 3 105. Generator Load Engine 4 106. Initial Gross Weight, FMC L	1X,9(F13.5,1X)/
14	107. Initial Gross Weight, FMC R 108. Initial Gross Weight, FMC C 109. Initial CG Position, FMC L 110. Initial CG Position, FMC R 111. Initial CG Position, FMC C 112. Initial Zero Fuel Weight, FMC L 113. Initial Zero Fuel Weight, FMC R 114. Initial Zero Fuel Weight, FMC C 115. Initial Fuel Quantity Center Tank	1X,9(F13.5,1X)/
15	116. Initial Fuel Quantity Main Tank 1 117. Initial Fuel Quantity Main Tank 2 118. Initial Fuel Quantity Main Tank 3 119. Initial Fuel Quantity Main Tank 4 120. Initial Fuel Quantity Res Tank 2 121. Initial Fuel Quantity Res Tank 3 122. Initial Fuel Quantity Horz Tail Tank	1X,7(F13.5,1X)/
16	123. Serial Number Engine 1 124. Serial Number Engine 2 125. Serial Number Engine 3 126. Serial Number Engine 4	1X,4(A8,1X)/

Line	Parameters		Format
17	127. 128. 129. 130. 131. 132. 133. 134. 135.	Not Used Not Used Not Used Not Used DMU Calculated Gross Weight DMU Calculated CG Position DMU Calculated Fuel Lower Heat Value %N1 Engine 1 %N1 Engine 2	1X,9(F13.5,1X)/
18	136. 137. 138. 139. 140. 141. 142. 143. 144.	%N1 Engine 3 %N1 Engine 4 %N2 Engine 1 %N2 Engine 2 %N2 Engine 3 %N2 Engine 4 EGT Engine 1 EGT Engine 2 EGT Engine 3	1X,9(F13.5,1X)/
19	145. 146. 147. 148. 149. 150. 151. 152. 153.	EGT Engine 4 Not Used Not Used Not Used Not Used SAT, ADC L SAT, ADC R SAT, ADC C Indicated Angle of Attack, ADC L	1X,9(F13.5,1X)/
20	154. 155. 156. 157. 158. 159. 160. 161. 162.	Indicated Angle of Attack, ADC R Indicated Angle of Attack, ADC C Roll Angle, IRU L Roll Angle, IRU R Roll Angle, IRU C Pitch Angle, IRU L Pitch Angle, IRU R Pitch Angle, IRU C Stabilizer Position	1X,9(F13.5,1X)/
21	163. 164. 165. 166. 167. 168. 169. 170. 171.	Spoiler Position #4 Spoiler Position #12 HS Aileron Position Left HS Aileron Position Right LS Aileron Position Left LS Aileron Position Right Rudder Position Upper Rudder Position Lower Inboard Elevator Position Left	1X,9(F13.5,1X)/

Line	Parameters		Format
22	172.	Inboard Elevator Position Right	1X,9(F13.5,1X)/
	173.	Outboard Elevator Position Left	
	174.	Outboard Elevator Position Right	
	175.	Outboard Trailing Edge Flap Left	
	176.	Outboard Trailing Edge Flap Right	
	177.	Inboard Trailing Edge Flap Left	
	178.	Inboard Trailing Edge Flap Right	
	179.	Along TK Horiz Accel, IRU L	
	180.	Along TK Horiz Accel, IRU R	
23	181.	Along TK Horiz Accel, IRU C	1X,9(F13.5,1X)/
	182.	Flight Path Accel, IRU L	
	183.	Flight Path Accel, IRU R	
	184.	Flight Path Accel, IRU C	
	185.	Vertical Accel, IRU L	
	186.	Vertical Accel, IRU R	
	187.	Vertical Accel, IRU C	
	188.	DMU Calculated dlVV/dt	
	189.	Fuel Imbalance Roll Moment	
24	190.	Angle of Sideslip	1X,9(F13.5,1X)/
	191-198	Open for DSIRF expansion	
25	199-207	Open for DSIRF expansion	1X,9(F13.5,1X)/
26	208-216	Open for DSIRF expansion	1X,9(F13.5,1X)/
27	217-219	Open for DSIRF expansion	1X,3(F13.5,1X)/
28	220.	Corrected Gross weight	1X,9(F13.5,1X)/
	221.	Lift Coefficient	
	222.	Cd Basic	
	223.	Cd Reynolds	
	224.	CG Position	
	225.	Cd Center of Gravity	
	226.	Cd Elasticity	
	227.	Cd Total	
29	228.	Delta Drag – Acceleration	1X,9(F13.5,1X)/
	229.	Total Drag	
	230.	Drag/Delta	
	231.	Thrust Engine 1	
	232.	Thrust Engine 2	
	233.	Thrust Engine 3	
	234.	Thrust Engine 4	
	235.	Total Thrust	
	236.	Book Power Setting (Eng. Type 1)	

Line	Parameters		Format
30	237. 238. 239. 240. 241. 242. 243. 244. 245.	Book Power Setting (Eng. Type 2) Average Power Setting Corrected Book Fuel Flow Engine 1 Corrected Book Fuel Flow Engine 2 Corrected Book Fuel Flow Engine 3 Corrected Book Fuel Flow Engine 4 Fuel Flow Factor LHV Ratio Fuel Flow Factor Power Extraction Fuel Flow Factor	1X,9(F13.5,1X)/
31	246. 247. 248. 249. 250. 251. 252.	Observed Fuel Flow Total Book Fuel Flow Total True Airspeed (TAS) Book Fuel Mileage Observed Fuel Mileage Instrument Source Speed Type	1X,5(F13.5,1X),A16,1X,A16/

Appendix J 757 MODEL SPECIFIC INFORMATION

A generalized definition of the DSIRF for the 757 is provided in this section for those operators that have an ACMS system for data collection. Whether or not this data input mode can be used will depend upon the availability of the required parameters contained in this DSIRF. It is recommended that the default values be used for the input options during the first trial run of the APM Program. To use one of the data correction algorithms contained in the program, it is recommended that the reader consult Section 4 Algorithm and Analysis to determine what data are required for that specific correction.

J.1 Bleed Configuration

To be eligible for analysis by the APM program, each candidate DSIRF or MSIRF data record is checked to determine if the bleed configuration is compatible with the airplane database. The status of the following bleeds are used to define this configuration. NOTE: The discrete values shown below represent the convention adopted for the APM program and do not necessarily agree with the actual airplane discrete values.

Table 36: 757 Bleed Configurations

BLEED	STATUS	
	ZERO STATE	ONE STATE
ECS PACKS	ON	OFF
ECS PACK FLOW RATE	LOW	HIGH
ENGINE BLEEDS	ON	OFF
ISOLATION VALVE	CLOSED	OPEN
ENGINE ANTI-ICE BLEEDS	OFF	ON
WING ANTI-ICE BLEED	OFF	ON

The zero state represents the "normal" bleed configuration of the 757 during cruise. The one state for engine bleed or engine anti-ice is indicative of a "non-normal" bleed configuration and will cause the APM program to reject the data point for analysis.

The APM program will analyze data for situations where both ECS packs are in high flow. If data input is to be via **MSIRF**, then a **zero (0)** or a **two (2)** must be placed in the position labeled "**Bleed**" on the Performance Log to indicate the number of ECS pack in high flow. The same value should be entered for both engines.

J.2 757 Performance Log

Please see the manual performance log on the next page. This log is appropriate for use with the 757 and other Boeing models as noted.

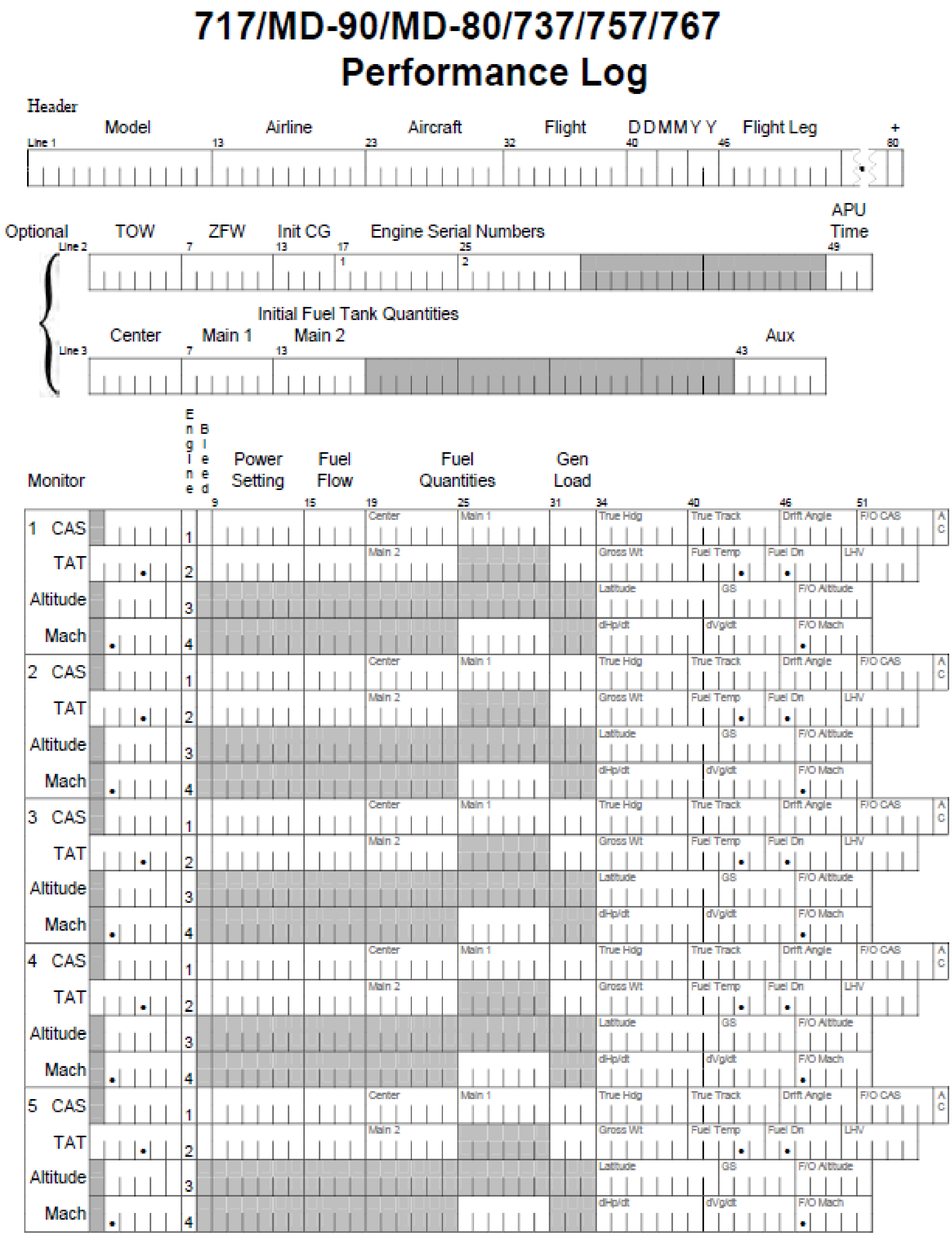

Figure 29: 757 Performance Log

J.2.1 Recommended Recording Procedures

1. Record Model, Airline, Aircraft, Flight Number and Date.

2. If desired record takeoff gross weight, ZFW, initial center of gravity, engine serial numbers, APU operating time, and initial fuel tank quantities.

3. Wait until the airplane is stabilized in cruise:

    a. Smooth air

    b. No thrust lever movement (auto-throttles off) for more than five minutes

    c. Anti-ice and fuel heat off for more than five minutes

    d. Less than one degree variation in indicated temperature during the preceding three minutes

    e. Less than .005 Mach (two knots CAS) variation in speed during the preceding three minutes

4. Quickly record Mach, EPR or %N1 and Fuel Flow.

5. Record TAT, Altitude, CAS, FMC Gross Weight (see Note 4).

6. Recheck Mach. If the Mach has changed more than .005 (two knots CAS) discard the point.

7. Record Individual Tank Fuel Quantities and Bleed Code (see Note 5).

8. The rest of the parameters on the Log form are optional, record those now if necessary.

9. Wait at least thirty minutes before recording the next data point in order to obtain data over a range of weights.

<u>Notes</u>

- Data can be taken at any stabilized speed. There is no need to return the airplane to a published speed schedule before recording data.

- The airplane identification number should be entered under aircraft. (Data sorting is done using this variable along with date.)

- All gross weight data and fuel quantities must be specified in the same units.

- If the FMC or total gross weight is known, it can be entered in the box labeled "Gross Wt".

- Bleed Config: Record a zero (0) if both ECS Packs are in LOW flow. Record a two (2) if both ECS Packs are in HIGH flow. The bleed code should be the same for both engines.

- If acceleration data (dHp/dt and dVg/dt) are desired, a separate time history must be kept for ground speed and altitude

J.3 757 DSIRF

Table 37: Standard DSIRF Dataset Header

Field	Parameter Name [3]	Columns	Format [1,2]	Units	Resolution
1	DSIRF Dataset Title	1-5	APM [4]	N/A	N/A
2	Subcategory	6	N	N/A	N/A
3	Dataset Sequence Number	7-8	NN	N/A	N/A
4	Aircraft ID Number	9-17	AAAAAAAAA	alphanum	N/A
5	Aircraft Serial Number	18-22	NNNNN	N/A	N/A
6	Aircraft Type Code	23-24	NN	N/A	N/A
7	Flight Number	25-32	AAAAAAAA	N/A	N/A
8	Depart/Destin Airports	33-40	AAAAAAAA	N/A	N/A
9	Day	41-42	NN	day	I day
10	Month	43-44	NN	month	1 month
11	Year	45-46	NN	year	1 year
12	Time - Hours	47-48	NN	hours	1 hour
13	Time - Minutes	49-50	NN	minutes	1 minute
14	Time - Seconds	51-52	NN,	seconds	1 second
15	Variable Header 1	N/A	A. . .A,[5]	N/A	N/A
16	Variable Header 2	N/A	A. . .A,[5]	N/A	N/A
17-181	First DSIRF Data Field	See DSIRF datasets continued on the following pages			

NOTES on dataset and header fields:

1. NNN denotes only numeric data, AAA denotes alphanumeric characters in data.
2. The first fourteen (14) data fields in the header are fixed, and no data delimiters (commas) are specified. The 15th and 16th header fields are variable, as are data fields in the DSIRF dataset body. The variable fields are separated by commas, such that no data available/required may be denoted by ",," for a specific data field (i.e. blanks/zeros are not required).
3. Fields that contain parameters that are not applicable to the 737 are labeled "Not Used". Availability of the parameters contained in the 737 DSIR is dependent upon the aircraft's ACMS configuration. The airline or operator will have to verify as to whether or not a specific parameter is available.
4. DSIRF dataset title for Airplane Performance Monitoring (APM) is "APM " (the letters APM plus two blanks).
5. The maximum field size is to be 40 characters.

6. Standard input units for DSIRF parameters are given in the DSIRF definition. However, the APM Program will accept units of kilograms for the following selected parameters; (1) gross weight, (2) fuel flow, (3) fuel quantity, (4) fuel used and (5) initial gross weight, zero fuel weight, and fuel quantity. if weight units of kilograms are used, then fuel density must be in kilograms per liter.

7. Due to the fact that the DSIRF can be a variable length record (maximum record length is 1200), it is recommended that the ASCII character string of a carriage return followed by a line feed be used to indicate the end of a DSIRF record.

Table 39 below has the 757 DSIRF details. Fields 121 through 181 are not used in the performance calculations in APM. They are included in the DSIRF as supplemental information. They will be included in the MASTER file for possible use by post- processing.

Table 38: 757 DSIRF Dataset

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
17	Mach, Left	.NNN	MACH	0.001 M
18	Mach, Right	.NNN	MACH	0.001 M
19	Not Used	,	N/A	N/A
20	CAS, Left	NNN.N,	Kt	0.1 Kt
21	CAS, Right	NNN.N,	Kt	0.1 Kt
22	Not Used	,	N/A	N/A
23	TAT, Left	+/-NN.NN,	Deg C	0.25 Deg
24	TAT, Right	+/-NN.NN,	Deg C	0.25 Deg
25	Not Used	,	N/A	N/A
26	Altitude(29.92), Left	NNNNN,	Ft	1 Ft
27	Altitude(29.92), Right	NNNNN,	Ft	1 Ft
28	Not Used		N/A	N/A
29	Gross weight, Left	NNNNNN,	Pounds	40 Lbs
30	Gross weight, Right	NNNNNN,	Pounds	40 Lbs
31	Not Used	,	N/A	N/A
32	Fuel Flow Engine 1	NNNN,	Lbs/Hr	1 Lb/Hr
33	Fuel Flow Engine 2	NNNN,	Lbs/Hr	1 Lb/Hr
34	Not Used	,	N/A	N/A
35	Not Used	,	N/A	N/A
36	Power Setting Engine 1	N.NNN,	EPR	.001 EPR
37	Power Setting Engine 2	N.NNN,	EPR	.001 EPR
38	Not Used	,	N/A	N/A
39	Not Used	,	N/A	N/A
40	DFDAU Calc Quality Factor	NN.N,	N/A	0.1
41	Ground Speed, Left	NNN.N,	Kt	0.1 Kt
42	Ground Speed, Right	NNN.N,	Kt	0.1 Kt
43	Not Used	,	N/A	N/A

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
44	ECS Discrete Pack 1	N,	Discrete	N/A
45	ECS Discrete Pack 2	N,	Discrete	N/A
46	Not Used	,	N/A	N/A
47	ECS High Flow Discrete Pack 1	N,	Discrete	N/A
48	ECS High Flow Discrete Pack 2	N,	Discrete	N/A
49	Not Used	,	N/A	N/A
50	Engine Anti-Ice Discrete Eng 1	N,	Discrete	N/A
51	Engine Anti-Ice Discrete Eng 2	N,	Discrete	N/A
52	Wing Anti-Ice Discrete	N,	Discrete	N/A
53	Isolation Valve Position	N,	Discrete	N/A
54	Engine Bleed Discrete Eng 1	N,	Discrete	N/A
55	Engine Bleed Discrete Eng 2	N,	Discrete	N/A
56	Not Used	,	N/A	N/A
57	Not Used	,	N/A	N/A
58	Present Pos Latitude, Left	+/-NN.NNNN,	Degrees	0.0001 Deg
59	Present Pos Latitude, Right	+/-NN.NNNN,	Degrees	0.0001 Deg
60	Not Used	,	N/A	N/A
61	Not Used	,	N/A	N/A
62	Not Used	,	N/A	N/A
63	Not Used	,	N/A	N/A
64	True Heading, Left	+/-NNN.N,	Degrees	0.1 Deg
65	True Heading, Right	+/-NNN.N,	Degrees	0.1 Deg
66	Not Used	,	N/A	N/A
67	Drift Angle, Left	+/-NN.N,	Degrees	0.1 Deg
68	Drift Angle, Right	+/-NN.N,	Degrees	0.1 Deg
69	Not Used	,	N/A	N/A
70	True Track Angle, Left	+/-NNN.N,	Degrees	0.1 Deg
71	True Track Angle, Right	+/-NNN.N,	Degrees	0.1 Deg
72	Not Used	,	N/A	N/A
73	DFDAU Calculated dHp/dt	+/-NN.NNN,	Ft/Sec	0.001 Ft/Sec
74	DFDAU Calculated dVg/dt	+/-N.NNN,	Kt/Sec	0.001 Kt/Sec
75	Not Used	,	N/A	N/A
76	Not Used	,	N/A	N/A
77	Not Used	,	N/A	N/A
78	Fuel Density	N.NNN,	Lbs/USgal	.001 Lb
79	Fuel Temperature	+/-NNN	Degrees C	1 Deg C
80	Fuel Quantity Center	NNNNN,	Pounds	100 Lbs
81	Fuel Quantity Left Main	NNNNN,	Pounds	100 Lbs
82	Fuel Quantity Right Main	NNNNN,	Pounds	100 Lbs

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
83	Not Used	,	N/A	N/A
84	Not Used	,	N/A	N/A
85	Not Used	,	N/A	N/A
86	Not Used	,	N/A	N/A
87	Fuel Quantity Aux Tank	NNNNN,	Pounds	100 Lbs
88	Fuel Used Engine 1	NNNNN,	Pounds	1 Lb
89	Fuel Used Engine 2	NNNNN,	Pounds	1 Lb
90	Not Used	,	N/A	N/A
91	Not Used	,	N/A	N/A
92	APU Operating Time	NN.N,	minutes	0.1 Minute
93	Generator Load Engine 1	NNN,	%	1 %
94	Generator Load Engine 2	NNN,	%	1 %
95	Not Used	,	N/A	N/A
96	Not Used	,	N/A	N/A
97	Initial Gross Weight, Left	NNNNNN,	Pounds	40 Lbs.
98	Initial Gross Weight, Right	NNNNNN,	Pounds	40 Lbs
99	Not Used	,	N/A	N/A '
100	Initial CG, Left	NN.NN,	% MAC	0.05 %
101	Initial CG, Right	NN.NN,	% MAC	0.05 %
102	Not Used	,	N/A	N/A
103	Initial ZFW, Left	NNNNNN,	Pounds	40 Lbs
104	Initial ZFW, Right	NNNNNN,	Pounds	40 Lbs
105	Not Used	,	N/A	N/A
106	Init. Fuel Qty Center	NNNNN,	Pounds	100 Lbs
107	Init. Fuel Qty Left Main	NNNNN,	Pounds	100 Lbs
108	Init. Fuel Qty Right Main	NNNNN,	Pounds	100 Lbs
109	Not Used	,	N/A	N/A
110	Not Used	,	N/A	N/A
111	Not Used	,	N/A	N/A
112	Not Used	,	N/A	N/A
113	Init. Fuel Qty Aux Tank	NNNNN,	Pounds	100 Lbs
114	Serial Number Engine 1	AAAAAAAA,	N/A	N/A
115	Serial Number Engine 2	AAAAAAAA,	N/A	N/A
116	Not Used	,	N/A	N/A
117	Not Used	,	N/A	N/A
118	DFDAU Calc Gross Weight	NNNNNN,	Pounds	40 Lbs
119	DFDAU Calc CG Position	NN.NN,	% MAC	0.1 %
120	DFDAU Calc LHV	NNNNN,	BTU/Lb	1.0 BTU/Lb
121	N1 Engine 1	NNN.N,	% RPM	0.1 %

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
122	N1 Engine 2	NNN.N,	% RPM	0.1 %
123	Not Used	,	N/A	N/A
124	Not Used	,	N/A	N/A
125.	N2 Engine 1	NNN.N,	% RPM	0.1 %
126.	N2 Engine 2	NNN.N,	% RPM	0.1 %
127.	Not Used	,	N/A	N/A
128.	Not Used	,	N/A	N/A
129.	N3 Engine 1 (RR only)	NNN.N,	% RPM	0.1 %
130.	N3 Engine 2 (RR only)	NNN.N,	% RPM	0.1 %
131.	Not Used	,	N/A	N/A
132.	Not Used	,	N/A	N/A
133.	EGT Engine 1	NNN.N,	Degrees C	0.5 Deg C
134.	EGT Engine 2	NNN.N,	Degrees C	0.5 Deg C
135.	Not Used	,	N/A	N/A
136.	Not Used	,	N/A	N/A
137.	Not Used	,	N/A	N/A
138.	Not Used	,	N/A	N/A
139.	Not Used	,	N/A	N/A
140.	Not Used	,	N/A	N/A
141.	SAT, Left	+/-NN. N,	Deg C	0.5 Deg
142.	SAT, Right	+/-NN.N,	Deg C	0.5 Deg
143.	Not Used	,	N/A	N/A
144.	Indicated AOA, Left	+/-NN.N,	Degrees	0.05 Deg
145.	Indicated AOA, Right	+/-NN.N,	Degrees	0.05 Deg
146.	Not Used	,	N/A	N/A
147.	Roll Angle, Left	+/-NN.N,	Degrees	0.1 Deg
148.	Roll Angle, Right	+/-NN.N,	Degrees	0.1 Deg
145.	Not Used	,	N/A	N/A
150.	Pitch Angle, Left	+/-NN.N,	Degrees	0.1 Deg
151.	Pitch Angle, Right	+/-NN.N,	Degrees	0.1 Deg
152.	Not Used	,	N/A	N/A
153.	Stabilizer Position	+/-NN.N,	Units	0.05 Unit
154.	Spoiler Handle Position	NN.N,	Degrees	0.1 Deg
155.	Not Used	,	N/A	N/A
156.	Left Aileron Position	+/-NN.N,	Degrees	0.1 Deg
157.	Right Aileron Position	+/-NN.N,	Degrees	0.1 Deg
158.	Not Used	,	N/A	N/A
159.	Not Used	,	N/A	N/A
160.	Rudder Position	+/-NN.N,	Degrees	0.1 Deg

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
161.	Not Used	,	N/A	N/A
162.	Left Elevator Position	+/-NN.N,	Degrees	0.1 Deg
163.	Right Elevator Position	+/-NN.N,	Degrees	0.1 Deg
164.	Not Used	,	N/A	N/A
165.	Not Used	,	N/A	N/A
166.	TE Flap Position	NN.N,	Degrees	0.1 Deg
167.	Not Used	,	N/A	N/A
168.	Not Used	,	N/A	N/A
169.	Not Used	,	N/A	N/A
170.	Along TK Horiz Accel, Left	+/-N.NN,	G's	0.01 G
171.	Along TK Horiz Accel, Right	+/-N.NN,	G's	0.01 G
172.	Not Used	,	N/A	N/A
173.	Flight Path Accel, Left	+/-N.NN,	G's	0.01 G
174.	Flight Path Accel, Right	+/-N.NN,	G's	0.01 G
175.	Not Used	,	N/A	N/A
176.	Vertical Accel, Left	+/-N.NN,	G's	0.01 G
177.	Vertical Accel, Right	+/-N.NN,	G's	0.01 G
178.	Not Used	,	N/A	N/A
179.	DFDAU Calculated dIVV/dt	+/-NN.NNN,	Ft/Sec2	0.001
180.	Fuel Imbal. Roll Moment	+/-NN.NN,	106 In-Lb	0.0lx106 In-Lb
181.	Angle of Sideslip	+/-N.NN,	Degrees	0.01 Deg

J.4 757 MASTER File

The first character of each line is the FORTRAN carriage control. Parameters 220 – 252 are calculated variables in the program and are presented in the MASTER file for inspection or subsequent analysis.

Table 39: 757 Master File

Line	Parameters	Format
1	Error code and text: 1. Error code 2. Error test 3. Model 4. Engine	1X,I7,1X,A80,1X,A16,1X,A16/

Line	Parameters	Format
2	Deviations: 5. Thrust deviation 6. Power setting deviation 7. Fuel flow deviation engine 1 8. Fuel flow deviation engine 2 9. Not Used 10. Not Used 11. Average fuel flow deviation 12. Fuel mileage deviation 13. Fuel flow deviation due to power setting deviation	1X,9(F13.5,1X)/
3	Header: 14. Airplane Identification Number 15. Airplane Serial Number 16. Flight Number 17. Departure/Destination 18. Day 19. Month 20. Year 21. Time - Hrs 22. Time - Min 23. Time - Sec	1X,A54/
4	Variable Header 24. Variable Header 1 25. Variable Header 2	1X,2A40/
5	Analysis Parameters: 26. Mach, Left 27. Mach, Right 28. Not Used 29. CAS, Left 30. CAS, Right 31. Not Used 32. TAT, Left 33. TAT, Right 34. Not Used	1X,9(F13.5,1X)/
6	35. Pressure Altitude, Left 36. Pressure Altitude, Right 37. Not Used 38. Gross Weight, Left 39. Gross Weight, Right 40. Not Used 41. Fuel Flow Engine 1 42. Fuel Flow Engine 2 43. Not Used	1X,9(F13.5,1X)/

Line	Parameters	Format
7	44. Not Used 45. Power Setting Engine 1 46. Power Setting Engine 2 47. Not Used 48. Not Used 49. DFDAU Calculated Quality Factor 50. Ground Speed, Left 51. Ground Speed, Right 52. Not Used	1X,9(F13.5,1X)/
8	53. ECS Discrete Pack 1 54. ECS Discrete Pack 2 55. Not Used 56. ECS High Flow Discrete Pack 1 57. ECS High Flow Discrete Pack 2 58. Not Used 59. Engine Anti-Ice Discrete Eng 1 60. Engine Anti-Ice Discrete Eng 2 61. Wing Anti-Ice Discrete	1X,9(F13.5,1X)/
9	62. Isolation Valve Position 63. Engine Bleed Discrete Eng 1 64. Engine Bleed Discrete Eng 2 65. Not Used 66. Not Used 67. Present Position Latitude, Left 68. Present Position Latitude, Right 69. Not Used 70. Not Used	1X,9(F13.5,1X)/
10	71. Not Used 72. Not Used 73. True Heading, Left 74. True Heading, Right 75. Not Used 76. Drift Angle, Left 77. Drift Angle, Right 78. Not Used 79. True Track Angle, Left	1X,9(F13.5,1X)/
11	80. True Track Angle, Right 81. Not Used 82. DFDAU Calculated dHp/dt 83. DFDAU Calculated dVg/dt 84. Not Used 85. Not Used 86. I Not Used 87. Fuel Density 88. Fuel Temperature	1X,9(F13.5,1X)/

Line	Parameters	Format
12	89. Fuel Quantity Center 90. Fuel Quantity Left Main 91. Fuel Quantity Right Main 92. Not Used 93. Not Used 94. Not Used 95. Not Used 96. Fuel Quantity Auxiliary Tank 97. Fuel Used Engine 1	1X,9(F13.5,1X)/
13	98. Fuel Used Engine 2 99. Not Used 100. Not Used 101. APU Operating Time 102. Generator Load Engine 1 103. Generator Load Engine 2 104. Not Used 105. Not Used 106. Initial Gross Weight, Left	1X,9(F13.5,1X)/
14	107. Initial Gross Weight, Right 108. Not Used 109. Initial CG Position, Left 110. Initial CG Position, Right 111. Not Used 112. Initial Zero Fuel Weight, Left 113. Initial Zero Fuel Weight, Right 114. Not Used 115. Initial Fuel Quantity Center	1X,9(F13.5,1X)/
15	116. Initial Fuel Quantity Left Main 117. Initial Fuel Quantity Right Main 118. Not Used 119. Not Used 120. Not Used 121. Not Used 122. Initial Fuel Quantity Auxiliary Tank	1X,7(F13.5,1X)/
16	123. Serial Number Engine 1 124. Serial Number Engine 2 125. Not Used 126. Not Used	1X,4(A8,1X)/

Line	Parameters		Format
17	127. 128. 129. 130. 131. 132. 133. 134. 135.	DFDAU Calculated Gross Weight DFDAU Calculated Center of Gravity Position DFDAU Calculated Fuel Lower Heat Value %N1 Engine 1 %N1 Engine 2 Not Used Not Used %N2 Engine 1 %N2 Engine 2	1X,9(F13.5,1X)/
18	136. 137. 138. 139. 140. 141. 142. 143. 144.	Not Used Not Used %N3 Engine 1 (RR Only) %N3 Engine 2 (RR Only) Not Used Not Used EGT Engine 1 EGT Engine 2 Not Used	1X,9(F13.5,1X)/
19	145. 146. 147. 148. 149. 150. 151. 152. 153.	Not Used Not Used Not Used Not Used Not Used SAT, Left SAT, Right Not Used Indicated Angle of Attack, Left	1X,9(F13.5,1X)/
20	154. 155. 156. 157. 158. 159. 160. 161. 162.	Indicated Angle of Attack, Right Not Used Roll Angle, Left Roll Angle, Right Not Used Pitch Angle, Left Pitch Angle, Right Not Used Stabilizer Position	1X,9(F13.5,1X)/
21	163. 164. 165. 166. 167. 168. 169. 170. 171.	Spoiler Handle Position Not Used Left Aileron Position Right Aileron Position Not Used Not Used Rudder Position Not Used Left Elevator Position	1X,9(F13.5,1X)/

Line	Parameters		Format
22	172. 173. 174. 175. 176. 177. 178. 179. 180.	Right Elevator Position Not Used Not Used Trailing Edge Flap Position Not Used Not Used Not Used Along TK Horizontal Acceleration, Left Along TK Horizontal Acceleration, Right	1X,9(F13.5,1X)/
23	181. 182. 183. 184. 185. 186. 187. 188. 189.	Not Used Flight Path Acceleration, Left Flight Path Acceleration, Right Not Used Vertical Accel, Left Vertical Accel, Right Not Used DFDAU Calculated dIVV/dt Fuel Imbal. Roll Moment	1X,9(F13.5,1X)/
24	190. 191-198	Angle of Sideslip Open for DSIRF expansion	1X,9(F13.5,1X)/
25	199-207	Open for DSIRF expansion	1X,9(F13.5,1X)/
26	208-216	Open for DSIRF expansion	1X,9(F13.5,1X)/
27	217-219	Open for DSIRF expansion	1X,3(F13.5,1X)/
28	220. 221. 222. 223. 224. 225. 226. 227. 228.	Corrected Gross weight Lift Coefficient Cd Basic Cd Reynolds CG Position Cd Center of Gravity Cd Elasticity Cd Total Delta Drag - Acceleration	1X,9(F13.5,1X)/
29	229. 230. 231. 232. 233. 234. 235. 236. 237.	Total Drag Drag/Delta Thrust Engine 1 Thrust Engine 2 Not Used Not Used Total Thrust Book Power Setting (Eng. Type 1) Book Power Setting (Eng. Type 2)	1X,9(F13.5,1X)/

Line	Parameters		Format
30	238.	Average Power Setting	1X,9(F13.5,1X)/
	239.	Corrected Book Fuel Flow Engine 1	
	240.	Corrected Book Fuel Flow Engine 2	
	241.	Not Used	
	242.	Not Used	
	243.	Fuel Flow Factor	
	244.	LHV Ratio Fuel Flow Factor	
	245.	Power Extraction Fuel Flow Factor	
	246.	Observed Fuel Flow Total	
31	247.	Book Fuel Flow Total	1X,5(F13.5,1X),A16,1X,A16/
	248.	True Airspeed (TAS)	
	249.	Book Fuel Mileage	
	250.	Observed Fuel Mileage	
	251.	Instrument Source	
	252.	Speed Type	

Appendix K 767 MODEL SPECIFIC INFORMATION

A generalized definition of the DSIRF for the 767 is provided in this section for those operators that have an ACMS system for data collection. Whether or not this data input mode can be used will depend upon the availability of the required parameters contained in this DSIRF. It is recommended that the default values be used for the input options during the first trial run of the APM Program. To use one of the data correction algorithms contained in the program, it is recommended that the reader consult Section 4 Algorithm and Analysis to determine what data are required for that specific correction.

K.1 Bleed Configuration

To be eligible for analysis by the APM program, each candidate DSIRF or MSIRF data record is checked to determine if the bleed configuration is compatible with the airplane database. The status of the following bleeds are used to define this configuration. NOTE: The discrete values shown below represent the convention adopted for the APM program and do not necessarily agree with the actual airplane discrete values.

Table 40: 767 Bleed Configurations

BLEED	STATUS	
	ZERO STATE	ONE STATE
ECS PACKS	ON	OFF
ECS PACK FLOW RATE	LOW	HIGH
ENGINE BLEEDS	ON	OFF
ISOLATION VALVE	CLOSED	OPEN
ENGINE ANTI-ICE BLEEDS	OFF	ON
WING ANTI-ICE BLEED	OFF	ON

The zero state represents the "normal" bleed configuration of the 767 during cruise. The one state for engine bleed or engine anti-ice is indicative of a "non-normal" bleed configuration and will cause the APM program to reject the data point for analysis.

The APM program will analyze data for situations where both ECS packs are in high flow. If data input is to be via **MSIRF**, then a **zero (0)** or a **two (2)** must be placed in the position labeled "**Bleed**" on the Performance Log to indicate the number of ECS pack in high flow. The same value should be entered for both engines.

K.2 767 Performance Log

Please see the manual performance log on the next page. This log is appropriate for use with the 767 and other Boeing models as noted.

717/MD-90/MD-80/737/757/767
Performance Log

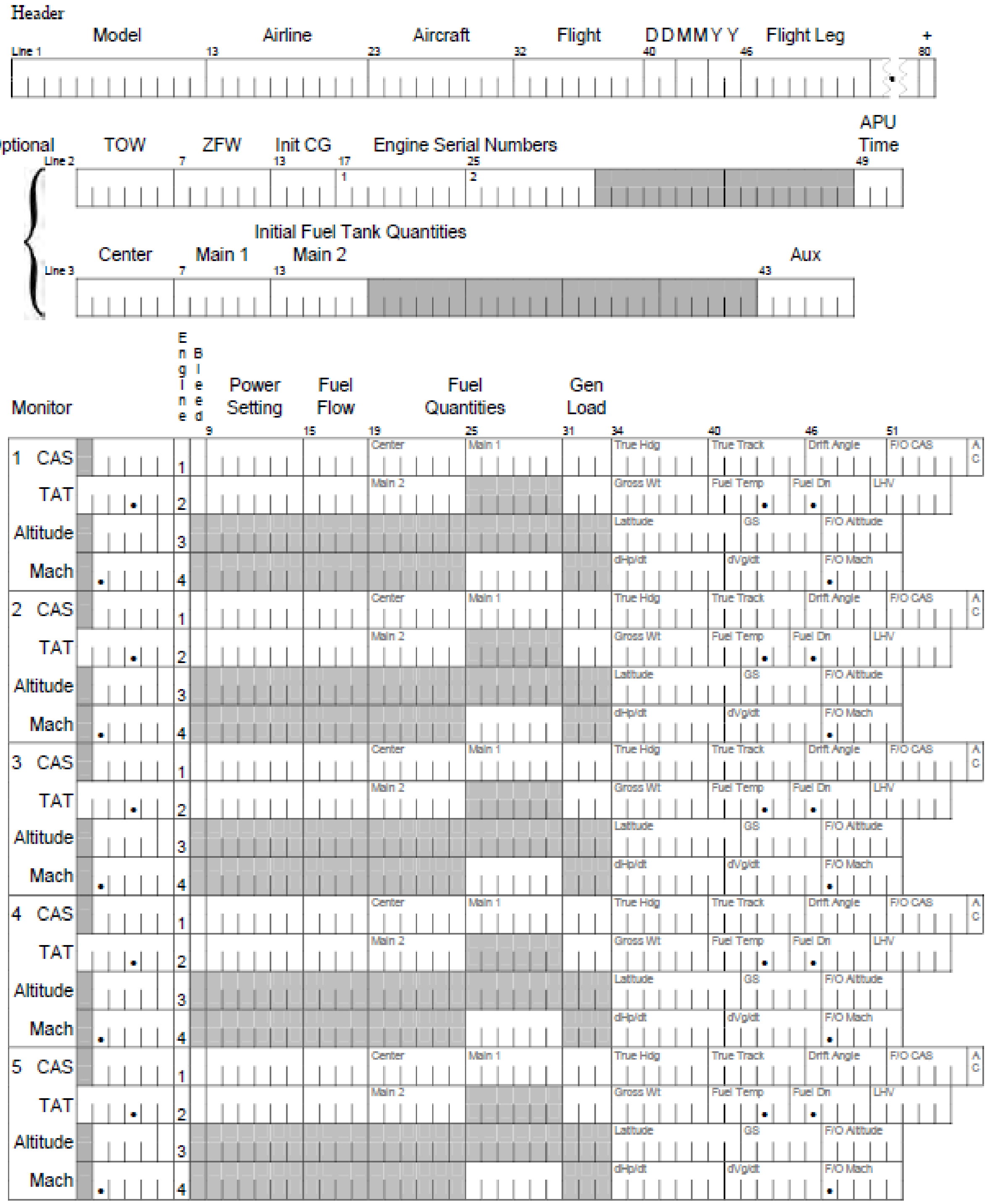

Figure 30: 767 Performance Log

K.2.1 Recommended Recording Procedures

1. Record Model, Airline, Aircraft, Flight Number and Date.
2. If desired record takeoff gross weight, ZFW, initial center of gravity, engine serial numbers, APU operating time, and initial fuel tank quantities.
3. Wait until the airplane is stabilized in cruise:
   a. Smooth air
   b. No thrust lever movement (auto-throttles off) for more than five minutes
   c. Anti-ice and fuel heat off for more than five minutes
   d. Less than one degree variation in indicated temperature during the preceding three minutes
   e. Less than .005 Mach (two knots CAS) variation in speed during the preceding three minutes
4. Quickly record Mach, EPR or %N1 and Fuel Flow.
5. Record TAT, Altitude, CAS, FMC Gross Weight (see Note 4).
6. Recheck Mach. If the Mach has changed more than .005 (two knots CAS) discard the point.
7. Record Individual Tank Fuel Quantities and Bleed Code (see Note 5).
8. The rest of the parameters on the Log form are optional, record those now if necessary.
9. Wait at least thirty minutes before recording the next data point in order to obtain data over a range of weights.

Notes

- Data can be taken at any stabilized speed. There is no need to return the airplane to a published speed schedule before recording data.
- The airplane identification number should be entered under aircraft. (Data sorting is done using this variable along with date.)
- All gross weight data and fuel quantities must be specified in the same units.
- If the FMC or total gross weight is known, it can be entered in the box labeled "Gross Wt".
- Bleed Config: Record a zero (0) if both ECS Packs are in LOW flow. Record a two (2) if both ECS Packs are in HIGH flow. The bleed code should be the same for both engines.

- If acceleration data (dHp/dt and dVg/dt) are desired, a separate time history must be kept for ground speed and altitude

K.3 767 DSIRF

Table 41: Standard DSIRF Dataset Header

Field	Parameter Name [3]	Columns	Format [1,2]	Units	Resolution
1	DSIRF Dataset Title	1-5	APM [4]	N/A	N/A
2	Subcategory	6	N	N/A	N/A
3	Dataset Sequence Number	7-8	NN	N/A	N/A
4	Aircraft ID Number	9-17	AAAAAAAAA	alphanum	N/A
5	Aircraft Serial Number	18-22	NNNNN	N/A	N/A
6	Aircraft Type Code	23-24	NN	N/A	N/A
7	Flight Number	25-32	AAAAAAAA	N/A	N/A
8	Depart/Destin Airports	33-40	AAAAAAAA	N/A	N/A
9	Day	41-42	NN	day	I day
10	Month	43-44	NN	month	1 month
11	Year	45-46	NN	year	1 year
12	Time - Hours	47-48	NN	hours	1 hour
13	Time - Minutes	49-50	NN	minutes	1 minute
14	Time - Seconds	51-52	NN,	seconds	1 second
15	Variable Header 1	N/A	A. . .A,[5]	N/A	N/A
16	Variable Header 2	N/A	A. . .A,[5]	N/A	N/A
17-181	First DSIRF Data Field	See DSIRF datasets continued on the following pages			

NOTES on dataset and header fields:

1. NNN denotes only numeric data, AAA denotes alphanumeric characters in data.
2. The first fourteen (14) data fields in the header are fixed, and no data delimiters (commas) are specified. The 15th and 16th header fields are variable, as are data fields in the DSIRF dataset body. The variable fields are separated by commas, such that no data available/required may be denoted by ",," for a specific data field (i.e. blanks/zeros are not required).
3. Fields that contain parameters that are not applicable to the 737 are labeled "Not Used". Availability of the parameters contained in the 737 DSIR is dependent upon the aircraft's ACMS configuration. The airline or operator will have to verify as to whether or not a specific parameter is available.
4. DSIRF dataset title for Airplane Performance Monitoring (APM) is "APM " (the letters APM plus two blanks).
5. The maximum field size is to be 40 characters.

6. Standard input units for DSIRF parameters are given in the DSIRF definition. However, the APM Program will accept units of kilograms for the following selected parameters; (1) gross weight, (2) fuel flow, (3) fuel quantity, (4) fuel used and (5) initial gross weight, zero fuel weight, and fuel quantity. if weight units of kilograms are used, then fuel density must be in kilograms per liter.

7. Due to the fact that the DSIRF can be a variable length record (maximum record length is 1200), it is recommended that the ASCII character string of a carriage return followed by a line feed be used to indicate the end of a DSIRF record.

Table 43 below has the 767 DSIRF details. Fields 121 through 181 are not used in the performance calculations in APM. They are included in the DSIRF as supplemental information. They will be included in the MASTER file for possible use by post- processing.

Table 42: 767 DSIRF Dataset

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
17	Mach, Left	.NNN	MACH	0.001 M
18	Mach, Right	.NNN	MACH	0.001 M
19	Not Used	,	N/A	N/A
20	CAS, Left	NNN.N,	Kt	0.1 Kt
21	CAS, Right	NNN.N,	Kt	0.1 Kt
22	Not Used	,	N/A	N/A
23	TAT, Left	+/-NN.NN,	Deg C	0.25 Deg
24	TAT, Right	+/-NN.NN,	Deg C	0.25 Deg
25	Not Used	,	N/A	N/A
26	Altitude(29.92), Left	NNNNN,	Ft	1 Ft
27	Altitude(29.92), Right	NNNNN,	Ft	1 Ft
28	Not Used		N/A	N/A
29	Gross weight, Left	NNNNNN,	Pounds	40 Lbs
30	Gross weight, Right	NNNNNN,	Pounds	40 Lbs
31	Not Used	,	N/A	N/A
32	Fuel Flow Engine 1	NNNN,	Lbs/Hr	1 Lb/Hr
33	Fuel Flow Engine 2	NNNN,	Lbs/Hr	1 Lb/Hr
34	Not Used	,	N/A	N/A
35	Not Used	,	N/A	N/A
36	Power Setting Engine 1	N.NNN / NNN.NN,	EPR / %N1	.001 EPR / .01%N1
37	Power Setting Engine 2	N.NNN / NNN.NN,	EPR / %N1	.001 EPR / .01%N1
38	Not Used	,	N/A	N/A
39	Not Used	,	N/A	N/A
40	DMU Calc Quality Factor	NN.N,	N/A	0.1
41	Ground Speed, Left	NNN.N,	Kt	0.1 Kt
42	Ground Speed, Right	NNN.N,	Kt	0.1 Kt
43	Not Used	,	N/A	N/A

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
44	ECS Discrete Pack 1	N,	Discrete	N/A
45	ECS Discrete Pack 2	N,	Discrete	N/A
46	Not Used	,	N/A	N/A
47	ECS High Flow Discrete Pack 1	N,	Discrete	N/A
48	ECS High Flow Discrete Pack 2	N,	Discrete	N/A
49	Not Used	,	N/A	N/A
50	Engine Anti-Ice Discrete Eng 1	N,	Discrete	N/A
51	Engine Anti-Ice Discrete Eng 2	N,	Discrete	N/A
52	Wing Anti-Ice Discrete	N,	Discrete	N/A
53	Not Used	,	N/A	N/A
54	Engine Bleed Discrete Eng 1	N,	Discrete	N/A
55	Engine Bleed Discrete Eng 2	N,	Discrete	N/A
56	Isolation Valve Position, Left	N,	Discrete	N/A
57	Isolation Valve Position, Right	N,	Discrete	N/A
58	Present Pos Latitude, Left	+/-NN.NNNN,	Degrees	0.0001 Deg
59	Present Pos Latitude, Right	+/-NN.NNNN,	Degrees	0.0001 Deg
60	Not Used	,	N/A	N/A
61	Not Used	,	N/A	N/A
62	Not Used	,	N/A	N/A
63	Not Used	,	N/A	N/A
64	True Heading, Left	+/-NNN.N,	Degrees	0.1 Deg
65	True Heading, Right	+/-NNN.N,	Degrees	0.1 Deg
66	Not Used	,	N/A	N/A
67	Drift Angle, Left	+/-NN.N,	Degrees	0.1 Deg
68	Drift Angle, Right	+/-NN.N,	Degrees	0.1 Deg
69	Not Used	,	N/A	N/A
70	True Track Angle, Left	+/-NNN.N,	Degrees	0.1 Deg
71	True Track Angle, Right	+/-NNN.N,	Degrees	0.1 Deg
72	Not Used	,	N/A	N/A
73	DMU Calculated dHp/dt	+/-NN.NNN,	Ft/Sec	0.001 Ft/Sec
74	DMU Calculated dVg/dt	+/-N.NNN,	Kt/Sec	0.001 Kt/Sec
75	Not Used	,	N/A	N/A
76	Not Used	,	N/A	N/A
77	Not Used	,	N/A	N/A
78	Fuel Density	N.NNN,	Lbs/USgal	.001 Lb
79	Fuel Temperature	+/-NNN	Degrees C	1 Deg C
80	Fuel Quantity Center	NNNNN,	Pounds	100 Lbs
81	Fuel Quantity Left Main	NNNNN,	Pounds	100 Lbs
82	Fuel Quantity Right Main	NNNNN,	Pounds	100 Lbs

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
83	Not Used	,	N/A	N/A
84	Not Used	,	N/A	N/A
85	Not Used	,	N/A	N/A
86	Not Used	,	N/A	N/A
87	Fuel Quantity Aux Tank	NNNNN,	Pounds	100 Lbs
88	Fuel Used Engine 1	NNNNN,	Pounds	1 Lb
89	Fuel Used Engine 2	NNNNN,	Pounds	1 Lb
90	Not Used	,	N/A	N/A
91	Not Used	,	N/A	N/A
92	APU Operating Time	NN.N,	minutes	0.1 Minute
93	Generator Load Engine 1	NNN,	%	1 %
94	Generator Load Engine 2	NNN,	%	1 %
95	Not Used	,	N/A	N/A
96	Not Used	,	N/A	N/A
97	Initial Gross Weight, Left	NNNNNN,	Pounds	40 Lbs.
98	Initial Gross Weight, Right	NNNNNN,	Pounds	40 Lbs
99	Not Used	,	N/A	N/A '
100	Initial CG, Left	NN.NN,	% MAC	0.05 %
101	Initial CG, Right	NN.NN,	% MAC	0.05 %
102	Not Used	,	N/A	N/A
103	Initial ZFW, Left	NNNNNN,	Pounds	40 Lbs
104	Initial ZFW, Right	NNNNNN,	Pounds	40 Lbs
105	Not Used	,	N/A	N/A
106	Init. Fuel Qty Center	NNNNN,	Pounds	100 Lbs
107	Init. Fuel Qty Left Main	NNNNN,	Pounds	100 Lbs
108	Init. Fuel Qty Right Main	NNNNN,	Pounds	100 Lbs
109	Not Used	,	N/A	N/A
110	Not Used	,	N/A	N/A
111	Not Used	,	N/A	N/A
112	Not Used	,	N/A	N/A
113	Init. Fuel Qty Aux Tank	NNNNN,	Pounds	100 Lbs
114	Serial Number Engine 1	AAAAAAAA,	N/A	N/A
115	Serial Number Engine 2	AAAAAAAA,	N/A	N/A
116	Not Used	,	N/A	N/A
117	Not Used	,	N/A	N/A
118	DMU Calc Gross Weight	NNNNNN,	Pounds	40 Lbs
119	DMU Calc CG Position	NN.NN,	% MAC	0.1 %
120	DMU Calc LHV	NNNNN,	BTU/Lb	1.0 BTU/Lb
121	N1 Engine 1	NNN.N,	% RPM	0.1 %

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
122	N1 Engine 2	NNN.N,	% RPM	0.1 %
123	Not Used	,	N/A	N/A
124	Not Used	,	N/A	N/A
125.	N2 Engine 1	NNN.N,	% RPM	0.1 %
126.	N2 Engine 2	NNN.N,	% RPM	0.1 %
127.	Not Used	,	N/A	N/A
128.	Not Used	,	N/A	N/A
129.	N3 Engine 1 (RR only)	NNN.N,	% RPM	0.1 %
130.	N3 Engine 2 (RR only)	NNN.N,	% RPM	0.1 %
131.	Not Used	,	N/A	N/A
132.	Not Used	,	N/A	N/A
133.	EGT Engine 1	NNN.N,	Degrees C	0.5 Deg C
134.	EGT Engine 2	NNN.N,	Degrees C	0.5 Deg C
135.	Not Used	,	N/A	N/A
136.	Not Used	,	N/A	N/A
137.	Turb Case Cool Eng 1 (P&W)	NNN.N,	%	0.031%
138.	Turb Case Cool Eng 2 (P&W)	NNN.N,	%	0.031%
139.	Not Used	,	N/A	N/A
140.	Not Used	,	N/A	N/A
141.	SAT, Left	+/-NN. N,	Deg C	0.5 Deg
142.	SAT, Right	+/-NN.N,	Deg C	0.5 Deg
143.	Not Used	,	N/A	N/A
144.	Indicated AOA, Left	+/-NN.N,	Degrees	0.05 Deg
145.	Indicated AOA, Right	+/-NN.N,	Degrees	0.05 Deg
146.	Not Used	,	N/A	N/A
147.	Roll Angle, Left	+/-NN.N,	Degrees	0.1 Deg
148.	Roll Angle, Right	+/-NN.N,	Degrees	0.1 Deg
145.	Not Used	,	N/A	N/A
150.	Pitch Angle, Left	+/-NN.N,	Degrees	0.1 Deg
151.	Pitch Angle, Right	+/-NN.N,	Degrees	0.1 Deg
152.	Not Used	,	N/A	N/A
153.	Stabilizer Position	+/-NN.N,	Units	0.05 Unit
154.	Spoiler Handle Position	NN.N,	Degrees	0.1 Deg
155.	Not Used	,	N/A	N/A
156.	Left Aileron Position	+/-NN.N,	Degrees	0.1 Deg
157.	Right Aileron Position	+/-NN.N,	Degrees	0.1 Deg
158.	Not Used	,	N/A	N/A
159.	Not Used	,	N/A	N/A
160.	Rudder Position	+/-NN.N,	Degrees	0.1 Deg

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
161.	Not Used	,	N/A	N/A
162.	Left Elevator Position	+/-NN.N,	Degrees	0.1 Deg
163.	Right Elevator Position	+/-NN.N,	Degrees	0.1 Deg
164.	Not Used	,	N/A	N/A
165.	Not Used	,	N/A	N/A
166.	TE Flap Position Left Outbd	NN.N,	Degrees	0.1 Deg
167.	TE Flap Position Right Outbd	NN.N,	Degrees	0.1 Deg
168.	TE Flap Position Left Inbd	NN.N,	Degrees	0.1 Deg
169.	TE Flap Position Right Inbd	NN.N,	Degrees	0.1 Deg
170.	Along TK Horiz Accel, Left	+/-N.NN,	G’s	0.01 G
171.	Along TK Horiz Accel, Right	+/-N.NN,	G’s	0.01 G
172.	Not Used	,	N/A	N/A
173.	Flight Path Accel, Left	+/-N.NN,	G’s	0.01 G
174.	Flight Path Accel, Right	+/-N.NN,	G’s	0.01 G
175.	Not Used	,	N/A	N/A
176.	Vertical Accel, Left	+/-N.NN,	G’s	0.01 G
177.	Vertical Accel, Right	+/-N.NN,	G’s	0.01 G
178.	Not Used	,	N/A	N/A
179.	DMU Calculated dIVV/dt	+/-NN.NNN,	Ft/Sec2	0.001
180.	Fuel Imbal. Roll Moment	+/-NN.NN,	106 In-Lb	0.0lx106 In-Lb
181.	Angle of Sideslip	+/-N.NN,	Degrees	0.01 Deg

K.4 767 MASTER File

The first character of each line is the FORTRAN carriage control. Parameters 220 – 252 are calculated variables in the program and are presented in the MASTER file for inspection or subsequent analysis.

Table 43: 767 Master File

Line	Parameters	Format
1	Error code and text: 1. Error code 2. Error test 3. Model 4. Engine	1X,I7,1X,A80,1X,A16,1X,A16/

Line	Parameters	Format
2	Deviations: 5. Thrust deviation 6. Power setting deviation 7. Fuel flow deviation engine 1 8. Fuel flow deviation engine 2 9. Not Used 10. Not Used 11. Average fuel flow deviation 12. Fuel mileage deviation 13. Fuel flow deviation due to power setting deviation	1X,9(F13.5,1X)/
3	Header: 14. Airplane Identification Number 15. Airplane Serial Number 16. Flight Number 17. Departure/Destination 18. Day 19. Month 20. Year 21. Time - Hrs 22. Time - Min 23. Time - Sec	1X,A54/
4	Variable Header 24. Variable Header 1 25. Variable Header 2	1X,2A40/
5	Analysis Parameters: 26. Mach, Left 27. Mach, Right 28. Not Used 29. CAS, Left 30. CAS, Right 31. Not Used 32. TAT, Left 33. TAT, Right 34. Not Used	1X,9(F13.5,1X)/
6	35. Pressure Altitude, Left 36. Pressure Altitude, Right 37. Not Used 38. Gross Weight, Left 39. Gross Weight, Right 40. Not Used 41. Fuel Flow Engine 1 42. Fuel Flow Engine 2 43. Not Used	1X,9(F13.5,1X)/

Line	Parameters	Format
7	44. Not Used 45. Power Setting Engine 1 46. Power Setting Engine 2 47. Not Used 48. Not Used 49. DMU Calculated Quality Factor 50. Ground Speed, Left 51. Ground Speed, Right 52. Not Used	1X,9(F13.5,1X)/
8	53. ECS Discrete Pack 1 54. ECS Discrete Pack 2 55. Not Used 56. ECS High Flow Discrete Pack 1 57. ECS High Flow Discrete Pack 2 58. Not Used 59. Engine Anti-Ice Discrete Eng 1 60. Engine Anti-Ice Discrete Eng 2 61. Wing Anti-Ice Discrete	1X,9(F13.5,1X)/
9	62. Not Used 63. Engine Bleed Discrete Eng 1 64. Engine Bleed Discrete Eng 2 65. Isolation Valve Position, Left 66. Isolation Valve Position, Right 67. Present Position Latitude, Left 68. Present Position Latitude, Right 69. Not Used 70. Not Used	1X,9(F13.5,1X)/
10	71. Not Used 72. Not Used 73. True Heading, Left 74. True Heading, Right 75. Not Used 76. Drift Angle, Left 77. Drift Angle, Right 78. Not Used 79. True Track Angle, Left	1X,9(F13.5,1X)/
11	80. True Track Angle, Right 81. Not Used 82. DMU Calculated dHp/dt 83. DMU Calculated dVg/dt 84. Not Used 85. Not Used 86. I Not Used 87. Fuel Density 88. Fuel Temperature	1X,9(F13.5,1X)/

Line	Parameters	Format
12	89. Fuel Quantity Center 90. Fuel Quantity Left Main 91. Fuel Quantity Right Main 92. Not Used 93. Not Used 94. Not Used 95. Not Used 96. Fuel Quantity Auxiliary Tank 97. Fuel Used Engine 1	1X,9(F13.5,1X)/
13	98. Fuel Used Engine 2 99. Not Used 100. Not Used 101. APU Operating Time 102. Generator Load Engine 1 103. Generator Load Engine 2 104. Not Used 105. Not Used 106. Initial Gross Weight, Left	1X,9(F13.5,1X)/
14	107. Initial Gross Weight, Right 108. Not Used 109. Initial CG Position, Left 110. Initial CG Position, Right 111. Not Used 112. Initial Zero Fuel Weight, Left 113. Initial Zero Fuel Weight, Right 114. Not Used 115. Initial Fuel Quantity Center	1X,9(F13.5,1X)/
15	116. Initial Fuel Quantity Left Main 117. Initial Fuel Quantity Right Main 118. Not Used 119. Not Used 120. Not Used 121. Not Used 122. Initial Fuel Quantity Auxiliary Tank	1X,7(F13.5,1X)/
16	123. Serial Number Engine 1 124. Serial Number Engine 2 125. Not Used 126. Not Used	1X,4(A8,1X)/

Line	Parameters		Format
17	127.	DMU Calculated Gross Weight	1X,9(F13.5,1X)/
	128.	DMU Calculated Center of Gravity Position	
	129.	DMU Calculated Fuel Lower Heat Value	
	130.	%N1 Engine 1	
	131.	%N1 Engine 2	
	132.	Not Used	
	133.	Not Used	
	134.	%N2 Engine 1	
	135.	%N2 Engine 2	
18	136.	Not Used	1X,9(F13.5,1X)/
	137.	Not Used	
	138.	%N3 Engine 1 (RR Only)	
	139.	%N3 Engine 2 (RR Only)	
	140.	Not Used	
	141.	Not Used	
	142.	EGT Engine 1	
	143.	EGT Engine 2	
	144.	Not Used	
19	145.	Not Used	1X,9(F13.5,1X)/
	146.	Turb Case Cool Engine 1 (P&W)	
	147.	Turb Case Cool Engine 2 (P&W)	
	148.	Not Used	
	149.	Not Used	
	150.	SAT, Left	
	151.	SAT, Right	
	152.	Not Used	
	153.	Indicated Angle of Attack, Left	
20	154.	Indicated Angle of Attack, Right	1X,9(F13.5,1X)/
	155.	Not Used	
	156.	Roll Angle, Left	
	157.	Roll Angle, Right	
	158.	Not Used	
	159.	Pitch Angle, Left	
	160.	Pitch Angle, Right	
	161.	Not Used	
	162.	Stabilizer Position	
21	163.	Spoiler Handle Position	1X,9(F13.5,1X)/
	164.	Not Used	
	165.	Left Aileron Position	
	166.	Right Aileron Position	
	167.	Not Used	
	168.	Not Used	
	169.	Rudder Position	
	170.	Not Used	
	171.	Left Elevator Position	

Line	Parameters		Format
22	172. 173. 174. 175. 176. 177. 178. 179. 180.	Right Elevator Position Not Used Not Used Trailing Edge Flap Position Left Outboard Trailing Edge Flap Position Right Outboard Trailing Edge Flap Position Left Inboard Trailing Edge Flap Position Right Inboard Along TK Horizontal Acceleration, Left Along TK Horizontal Acceleration, Right	1X,9(F13.5,1X)/
23	181. 182. 183. 184. 185. 186. 187. 188. 189.	Not Used Flight Path Acceleration, Left Flight Path Acceleration, Right Not Used Vertical Accel, Left Vertical Accel, Right Not Used DMU Calculated dIVV/dt Fuel Imbal. Roll Moment	1X,9(F13.5,1X)/
24	190. 191-198	Angle of Sideslip Open for DSIRF expansion	1X,9(F13.5,1X)/
25	199-207	Open for DSIRF expansion	1X,9(F13.5,1X)/
26	208-216	Open for DSIRF expansion	1X,9(F13.5,1X)/
27	217-219	Open for DSIRF expansion	1X,3(F13.5,1X)/
28	220. 221. 222. 223. 224. 225. 226. 227. 228.	Corrected Gross weight Lift Coefficient Cd Basic Cd Reynolds CG Position Cd Center of Gravity Cd Elasticity Cd Total Delta Drag - Acceleration	1X,9(F13.5,1X)/
29	229. 230. 231. 232. 233. 234. 235. 236. 237.	Total Drag Drag/Delta Thrust Engine 1 Thrust Engine 2 Not Used Not Used Total Thrust Book Power Setting (Eng. Type 1) Book Power Setting (Eng. Type 2)	1X,9(F13.5,1X)/

Line	Parameters		Format
30	238.	Average Power Setting	1X,9(F13.5,1X)/
	239.	Corrected Book Fuel Flow Engine 1	
	240.	Corrected Book Fuel Flow Engine 2	
	241.	Not Used	
	242.	Not Used	
	243.	Fuel Flow Factor	
	244.	LHV Ratio Fuel Flow Factor	
	245.	Power Extraction Fuel Flow Factor	
	246.	Observed Fuel Flow Total	
31	247.	Book Fuel Flow Total	1X,5(F13.5,1X),A16,1X,A16/
	248.	True Airspeed (TAS)	
	249.	Book Fuel Mileage	
	250.	Observed Fuel Mileage	
	251.	Instrument Source	
	252.	Speed Type	

Appendix L 777 MODEL SPECIFIC INFORMATION

For the 777, the Air Data Inertial Reference Unit (ADIRU) is considered to be the primary source for Mach, CAS, TAT and altitude data. For this reason, only the user input option "INSTR = C" can be used for the 777 even though the DSIRF contains similar data from the Secondary Attitude Air Data Reference Unit (SAARU). The SAARU data are provided for informational purposes only and cannot be used by the program. Similar to the 747-400, the aeroelastic correction ("ELASTIC = YES") should be used for cruise performance analysis.

L.1 Bleed Configuration

To be eligible for analysis by the APM program, each candidate DSIRF data record is checked to determine if the bleed configuration is compatible with the airplane database. The status of the following bleeds are used to define this configuration.

Table 44: 777 Bleed Configurations

BLEED	STATUS	
	ZERO STATE	ONE STATE
ECS PACK SCHEDULE	1 OR 2	1 OR 2
ENG BLD (PRSOV) VALVE	OPEN	1
ENG BLD (HPSOV) VALVE	CLOSED	0
ENGINE ANTI-ICE BLEEDS	OFF	0
WING ANTI-ICE BLEEDS	OFF	0
CENTER ISOLATION VALVE	CLOSED	0

For the 777, the APM Program will use measured ECS Pack mass flow rate to correct for the effects of ECS bleed on cruise performance. If data input is to be via MSIRF, record the actual ECS Pack mass flow (Lbs/Min) in the location provided on the Performance Log otherwise nominal bleed flow will be used. The program will also correct for the effects of aft cargo heat provided the system is either on or off for the entire data sample. For MSIRF input, enter a "**1**" in the column labeled "**Bleed**" (for engine # 1) on the Performance Log to indicate that the cargo heat was on during the sample period.

L.2 777 Performance Log

Please see the manual performance log on the next page. This log is appropriate for use with the 777.

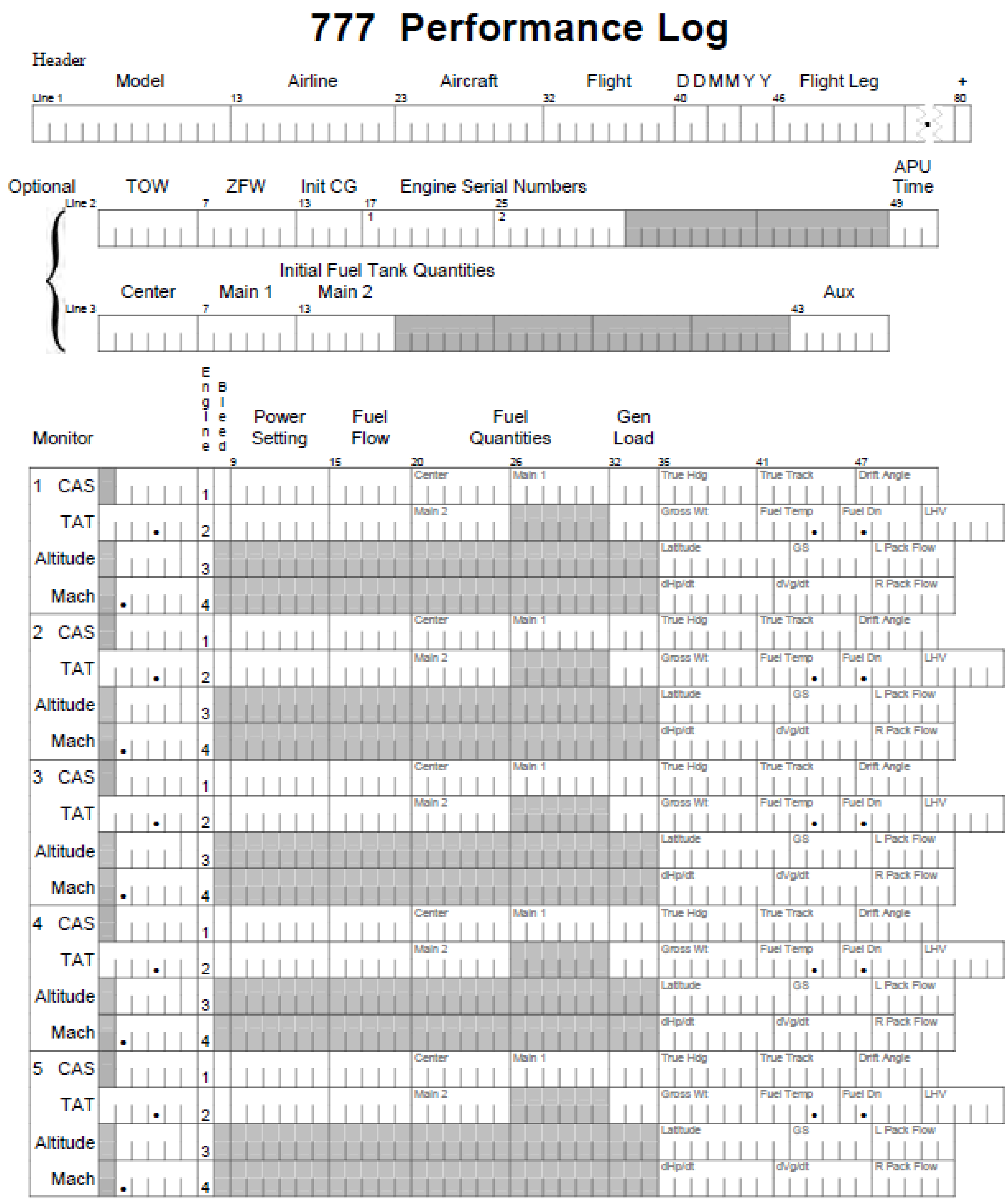

Figure 31: 777 Performance Log

L.2.1 Recommended Recording Procedures:

1. Record Model, Airline, Aircraft, Flight Number and Date.

2. If desired, record takeoff gross weight, ZFW, initial center of gravity, engine serial numbers, APU operating time, and initial fuel tank quantities.

3. Wait until the airplane is stabilized in cruise:

    a. Smooth air

    b. No thrust lever movement (auto-throttles off) for more than five minutes

    c. Anti-ice and fuel heat off for more than five minutes

    d. Less than one degree variation in indicated temperature during the preceding three minutes

    e. Less than .005 Mach (two knots CAS) variation in speed during the preceding three minutes

4. Quickly record Mach, EPR or %N1 and Fuel Flow.

5. Record TAT, Altitude, CAS, FMC Gross Weight (see Note 4).

6. Recheck Mach. If the Mach has changed more than .005 (two knots CAS) discard the point.

7. Record Individual Tank Fuel Quantities and Bleed Code (see Note 5).

8. The rest of the parameters on the Log form are optional, record those now if necessary.

9. Wait at least thirty minutes before recording the next data point in order to obtain data over a range of weights.

NOTES:

- Data can be taken at any stabilized speed. There is no need to return the airplane to a published speed schedule before recording data.

- The airplane identification number should be entered under aircraft. (Data sorting is done using this variable along with date.)

- All gross weight data and fuel quantities must be specified in the same units.

- If the FMC or total gross weight is known, it can be entered in the box labeled "Gross Wt".

- Bleed Config: Record flow rate in Lbs/Min in location provided. Record a one (1) in the box labeled "Bleed" for engine 1, if cargo heat is on, otherwise, bleed code should be zero (0).

- If acceleration data (dHp/dt and dVg/dt) are desired, a separate time history must be kept for ground speed and altitude

L.3 777 DSIRF

Table 45: Standard DSIRF Dataset Header

Field	Parameter Name [3]	Columns	Format [1,2]	Units	Resolution
1	DSIRF Dataset Title	1-5	APM [4]	N/A	N/A
2	Subcategory	6	N	N/A	N/A
3	Dataset Sequence Number	7-8	NN	N/A	N/A
4	Aircraft ID Number	9-17	AAAAAAAAA	alphanum	N/A
5	Aircraft Serial Number	18-22	NNNNN	N/A	N/A
6	Aircraft Type Code	23-24	NN	N/A	N/A
7	Flight Number	25-32	AAAAAAAA	N/A	N/A
8	Depart/Destin Airports	33-40	AAAAAAAA	N/A	N/A
9	Day	41-42	NN	day	I day
10	Month	43-44	NN	month	1 month
11	Year	45-46	NN	year	1 year
12	Time - Hours	47-48	NN	hours	1 hour
13	Time - Minutes	49-50	NN	minutes	1 minute
14	Time - Seconds	51-52	NN,	seconds	1 second
15	Variable Header 1	N/A	A. . .A,[5]	N/A	N/A
16	Variable Header 2	N/A	A. . .A,[5]	N/A	N/A
17-181	First DSIRF Data Field	See DSIRF datasets continued on the following pages			

NOTES on dataset and header fields:

1. NNN denotes only numeric data, AAA denotes alphanumeric characters in data.

2. The first fourteen (14) data fields in the header are fixed, and no data delimiters (commas) are specified. The 15th and 16th header fields are variable, as are data fields in the DSIRF dataset body. The variable fields are separated by commas, such that no data available/required may be denoted by ",," for a specific data field (i.e. blanks/zeros are not required).

3. Fields that contain parameters that are not applicable to the 737 are labeled "Not Used". Availability of the parameters contained in the 737 DSIR is dependent upon the aircraft's ACMS configuration. The airline or operator will have to verify as to whether or not a specific parameter is available.

4. DSIRF dataset title for Airplane Performance Monitoring (APM) is "APM " (the letters APM plus two blanks).

5. The maximum field size is to be 40 characters.

6. Standard input units for DSIRF parameters are given in the DSIRF definition. However, the APM Program will accept units of kilograms for the following selected parameters; (1) gross weight, (2) fuel flow, (3) fuel quantity, (4) fuel used and (5) initial gross weight, zero fuel weight, and fuel quantity. If weight units of kilograms are used, then fuel density must be in kilograms per liter.

7. Due to the fact that the DSIRF can be a variable length record (maximum record length is 1200), it is recommended that the ASCII character string of a carriage return followed by a line feed be used to indicate the end of a DSIRF record.

Table 47 below has the 777 DSIRF details. Fields 123 through 184 are not used in the performance calculations in APM. They are included in the DSIRF as supplemental information. They will be included in the MASTER file for possible use by post- processing. Also, fields 152-155 show a discrete signal (N) for GE engines.

Table 46: 777 DSIRF Dataset

FIELD	PARAMETER NAME	FORMAT	UNITS	RESOLUTION
17	Mach, D ADIRU	.NNN,	MACH	0.001 M
18	Mach, C SAARU	.NNN,	MACH	0.001 M
19	Not Used	,	N/A	N/A
20	CAS, D ADIRU	NNN.N,	Kts	0.1 Kt
21	CAS, C SAARU	NNN.N,	Kts	0.1 Kt
22	Not Used	,	N/A	N/A
23	TAT, D ADIRU	+/-NN.NN,	Deg C	0.13 Deg
24	TAT, C SAARU	+/-NN.NN,	Deg C	0.13 Deg
25	Not Used	,	N/A	N/A
26	Altitude(29.92), D ADIRU	NNNNN,	Ft	1 Ft
27	Altitude(29.92), C SAARU	NNNNN,	Ft	1 Ft
28	Not Used	,	N/A	N/A
29	Gross Weight, Mstr FMCF	NNNNNN,	Pounds	40 Lbs
30	Not Used	,	N/A	N/A
31	Not Used	,	N/A	N/A
32	Fuel Flow, Engine 1	NNNNN,	Lbs/Hr	1 Lb/Hr
33	Fuel Flow, Engine 2	NNNNN,	Lbs/Hr	1 Lb/Hr
34	Not Used	,	N/A	N/A
35	Not Used	,	N/A	N/A
36	Power Setting, Engine 1	N.NNN / NNN.NN,	EPR / %N1	.001EPR /.01%N1
37	Power Setting, Engine 2	N.NNN / NNN.NN,	EPR / %N1	.001EPR /.01%N1
38	Not Used	,	N/A	N/A
39	Not Used	,	N/A	N/A
40	Calculated Quality Factor	NN.NNN,	N/A	0.1
41	Ground Speed, Mstr FMCF	NNN.N,	Kts	0.1 Kt

FIELD	PARAMETER NAME	FORMAT	UNITS	RESOLUTION
42	Not Used	,	N/A	N/A
43	Not Used	,	N/A	N/A
44	ECS Pack Schedule, Pack 1	N,	Numeric	N/A
45	ECS Pack Schedule, Pack 2	N,	Numeric	N/A
46	Eng Bld (PRSOV) Valve, Eng 1	N,	Discrete	N/A
47	Eng Bld (PRSOV) Valve, Eng 2	N,	Discrete	N/A
48	ECS Pack Flow Rate, Pack 1	NNN.N,	Lbs/Min	0.1 Lbs/Min
49	ECS Pack Flow Rate, Pack 2	NNN.N,	Lbs/Min	0.1 Lbs/Min
50	Engine Anti-Ice, Engine 1	N,	Discrete	N/A
51	Engine Anti-Ice, Engine 2	N,	Discrete	N/A
52	Wing Anti-Ice, Left	N,	Discrete	N/A
53	Wing Anti-Ice, Right	N,	Discrete	N/A
54	Eng Bld (HPSOV) Valve, Eng 1	N,	Discrete	N/A
55	Eng Bld (HPSOV) Valve, Eng 2	N,	Discrete	N/A
56	Isolation Valve, Center	N,	Discrete	N/A
57	Aft Cargo Heat Duration	NNN,	Percent	1 %
58	Present Pos Latitude, Mstr FMCF	+/-NN.NNNN,	Degrees	0.0001 Deg
59	Not Used	,	N/A	N/A
60	Not Used	,	N/A	N/A
61	Present Pos Longitude, Mst FMCF	+/-NNN.NNNN,	Degrees	0.0001 Deg
62	Not Used	,	N/A	N/A
63	Not Used	,	N/A	N/A
64	True Heading, Mstr FMCF	+/-NNN.N,	Degrees	0.1 Deg
65	Not Used	,	N/A	N/A
66	Not Used	,	N/A	N/A
67	Drift Angle, Mstr FMCF	+/-NN.N,	Degrees	0.1 Deg
68	Not Used	,	N/A	N/A
69	Not Used	,	N/A	N/A
70	True Track Angle, Mstr FMCF	+/-NNN.N,	Degrees	0.1 Deg
71	Not Used	,	N/A	N/A
72	Not Used	,	N/A	N/A
73	AIMS Calculated dHp/dt	+/-NN.NNN,	Ft/Sec	0.001 Ft/Sec
74	AIMS Calculated dVg/dt	+/-N.NNN,	Kts/Sec	0.001 Kt/Sec
75	Inertial Vert Speed, D ADIRU	+/-NNNN,	Ft/Min	1 Ft/Min
76	Not Used	,	N/A	N/A
77	Not Used	,	N/A	N/A
78	Fuel Density, Left Main	N.NNN,	Lbs/US Gal	.001 Lb/Gal
79	Fuel Temperature, Left Main	+/-NNN,	Degrees C	1 Deg
80	Fuel Quantity, Center	NNNNNN,	Pounds	100 Lbs

FIELD	PARAMETER NAME	FORMAT	UNITS	RESOLUTION
81	Fuel Quantity, Left Main	NNNNN,	Pounds	100 Lbs
82	Fuel Quantity, Right Main	NNNNN,	Pounds	100 Lbs
83	Not Used	,	N/A	N/A
84	Not Used	,	N/A	N/A
85	Not Used	,	N/A	N/A
86	Not Used	,	N/A	N/A
87	Not Used	,	N/A	N/A
88	Fuel Used, Engine 1	NNNNNN,	Pounds	40 Lbs
89	Fuel Used, Engine 2	NNNNNN,	Pounds	40 Lbs
90	Not Used	,	N/A	N/A
91	Not Used	,	N/A	N/A
92	APU Operating Time	NNN.N,	minutes	0.1 minute
93	Generator Load, Engine 1	NNN,	% MAX KVA	1 %
94	Generator Load, Engine 2	NNN,	% MAX KVA	1 %
95	Not Used	,	N/A	N/A
96	Not Used	,	N/A	N/A
97	Initial Gross Wt, Mstr FMCF	NNNNNN,	Pounds	40 Lbs
98	Not Used	,	N/A	N/A
99	Not Used	,	N/A	N/A
100	Initial CG, Mstr FMCF	NN.NN,	% MAC	0.01%
101	Not Used	,	N/A	N/A
102	Not Used	,	N/A	N/A
103	Initial ZFW, Mstr FMCF	NNNNNN,	Pounds	40 Lbs
104	Not Used	,	N/A	N/A
105	Not Used	,	N/A	N/A
106	Init. Fuel Qty, Center	NNNNNN,	Pounds	100 Lbs
107	Init. Fuel Qty, Left Main	NNNNN,	Pounds	100 Lbs
108	Init. Fuel Qty, Right Main	NNNNN,	Pounds	100 Lbs
109	Not Used	,	N/A	N/A
110	Not Used	,	N/A	N/A
111	Not Used	,	N/A	N/A
112	Not Used	,	N/A	N/A
113	Not Used	,	N/A	N/A
114	Serial Number, Engine 1	AAAAAA,	N/A	N/A
115	Serial Number, Engine 2	AAAAAA,	N/A	N/A
116	Not Used	,	N/A	N/A
117	Not Used	,	N/A	N/A
118	AIMS Calc Gross Weight*	NNNNNN,	Pounds	40 Lbs

FIELD	PARAMETER NAME	FORMAT	UNITS	RESOLUTION
119	AIMS Calc CG Position*	NN.NN,	% MAC	0.01 %
120	AIMS Calc LHV*	NNNNN,	BTU/Lb	1.0 BTU/Lb
121	Acft Total Pressure, ADIRU	NNNN.N,	MilBar Hg	0.1 MilBar Hg
122	Acft Total Pressure, SAARU	NNNN.N,	MilBar Hg	0.1 MilBar Hg
123	True Heading Min/Max Diff	NN.N,	Degrees	N/A
124	APU Door Position	N,	Discrete	N/A
125.	Mach Min/Max Diff	.NNN,	MACH	N/A
126.	Altitude Min/Max Diff	NNNN,	Ft	N/A
127.	Ground Speed Min/Max Diff	NN.N,	Kts	N/A
128.	SAT Min/Max Diff	NN.N,	Degrees C	N/A
129.	Roll Angle Min/Max Diff	NN.N,	Degrees	N/A
130.	Power Setting Min/Max Dif,Eng 1	.NNN /.NNNN,	EPR/%N1	N/A
131.	Power Setting Min/Max Dif,Eng 2	.NNN /.NNNN,	EPR/%N1	N/A
132.	Drift Angle Min/Max Dif	NN.N,	Degrees	N/A
133.	CAS Min/Max Diff	NN.N,	Kts	N/A
134.	Pack 1 Flow Rate Min/Max Diff	NNN.N,	Lbs/Min	N/A
135.	Pack 2 Flow Rate Min/Max Diff	NNN.N,	lbs/Min	N/A
136.	Compartment Case Cooling Valve Position, Eng 1 (GE Only)	N,	Discrete	N/A
137.	Compartment Case Cooling Valve Position, Eng 2 (GE Only)	N,	Discrete	N/A
138.	Altitude, GPS	NNNNN,	Ft	1 Ft
139.	SAT, D ADIRU	+/-NN.N,	Degrees C	0.1 Deg
140	TAS, D ADIRU	NNN.N,	Kts	0.1 Kt
141.	Throttle Resolver Angle, Eng 1	NN.N,	Degrees	0.1 Deg
142.	Throttle Resolver Angle, Eng 2	NN.N,	Degrees	0.1 Deg
143.	Autothrottle Mode	N,	Numeric	N/A
144.	N1, Engine 1 (PW/RR only)	NNN.N,	% RPM	0.1 %
145.	N1, Engine 2 (PW/RR only)	NNN.N,	% RPM	0.1 %
146.	N2, Engine 1	NNN.N,	% RPM	0.1 9.
147.	N2, Engine 2	NNN.N,	% RPM	0.1 %
148.	N3, Engine 1 (RR only)	NNN.N,	% RPM	0.1 %
149.	N3, Engine 2 (RR only)	NNN.N,	% RPM	0.1 %
150.	EGT, Engine 1	NNN.N,	Degrees C	0.5 Deg
151.	EGT, Engine 2	NNN.N,	Degrees C	0.5 Deg
152.	HPT Case Cooling Valve Position, Eng 1 (PW/GE only)	+/-NNN.N,	% Open	0.1 %
153.	HPT Case Cooling Valve Position, Eng 2 (PW/GE only)	+/-NNN.N,	% Open	0.1 %

FIELD	PARAMETER NAME	FORMAT	UNITS	RESOLUTION
154.	LPT Case Cooling Valve Position, Eng 1 (PW/GE only*)	+/-NNN.N,	% Open	0.1 %
155.	LPT Case Cooling Valve Position, Eng 2 (PW/GE only*)	+/-NNN.N,	% Open	0.1 %
156.	Fan Air Valve, Engine 1	N,	Discrete	N/A
157.	Fan Air Valve, Engine 2	N,	Discrete	N/A
158.	IDG Oil Inlet Temp., Eng 1	NNN,	Degrees C	1 Deg
159.	IDG Oil Inlet Temp., Eng 2	NNN,	Degrees C	1 Deg
160.	IDG Oil Outlet Temp., Eng 1	NNN,	Degrees C	1 Deg
161.	IDG Oil Outlet Temp., Eng 2	NNN,	Degrees C	1 Deg
162.	Precooler Out Air Temp., Eng 1	NNN,	Degrees C	1 Deg
163.	Precooler Out Air Temp., Eng 2	NNN,	Degrees C	1 Deg
164.	Manifold Flow Rate, Eng 1	NNN,	Lbs/Min	1 Lb/Min
165.	Manifold Flow Rate, Eng 2	NNN,	Lbs/Min	1 Lb/Min
166.	Vane AOA, Left AIMS	+/-NN.N,	Degrees	0.1 Deg
167.	Vane AOA, Right AIMS	+/-NN.N,	Degrees	0.1 Deg
168.	Roll Angle, D ADIRU	+/-NN.N,	Degrees	0.1 Deg
169.	Pitch Angle, D ADIRU	+/-NN.N,	Degrees	0.1 Deg
170.	Stabilizer Position	+/-NN.N,	Units	0.1 Unit
171.	Spoiler Position, #1	+/-N.NN,	Inches LVDT	0.01 Inches
172.	Spoiler Position, #2	+/-N.NN,	Inches LVDT	0.01 Inches
173.	Spoiler Position, #3	+/-N.NN,	Inches LVDT	0.01 Inches
174.	Spoiler Position, #4	+/-N.NN,	Inches LVDT	0.01 Inches
175.	Spoiler Position, #5	+/-N.NN,	Inches LVDT	0.01 Inches
176.	Spoiler Position, #6	+/-N.NN,	Inches LVDT	0.01 Inches
177.	Spoiler Position, #7	+/-N-NN,	Inches LVDT	0.01 Inches
178.	Spoiler Position, #8	+/-N.NN,	Inches LVDT	0.01 Inches
179.	Spoiler Position, #9	+/-N.NN,	Inches LVDT	0.01 Inches
180	Spoiler Position, #10	+/-N.NN,	Inches LVDT	0.01 Inches
181	Spoiler Position, #11	+/-N.NN,	Inches LVDT	0.01 Inches
182	Spoiler Position, #12	+/-N.NN,	Inches LVDT	0.01 Inches

FIELD	PARAMETER NAME	FORMAT	UNITS	RESOLUTION
183	Spoiler Position, #13	+/-N.NN,	Inches LVDT	0.01 Inches
184	Spoiler Position, #14	+/-N.NN,	Inches LVDT	0.01 Inches
185.	Aileron Position, Left	+/-N.NN,	Inches LVDT	0.01 Inches
186.	Aileron Position, Right	+/-N.NN,	Inches LVDT	0.01 Inches
187.	Flaperon Position, Left	+/-N.NN,	Inches LVDT	0.01 Inches
188.	Flaperon Position, Right	+/-N.NN,	Inches LVDT	0.01 Inches
189.	Rudder Position	+/-N.NN,	Inches LVDT	0.01 Inches
190.	Elevator Position, Left	+/-N.NN,	Inches LVDT	0.01 Inches
191.	Elevator Position, Right	+/-N.NN,	Inches LVDT	0.01 Inches
192.	TE Flap Position, Left Inbd	NN.N,	Degrees	0.1 Deg
193.	TE Flap Position, Right Inbd	NN.N,	Degrees	0.1 Deg
194.	Outflow Valve, Fore	N.NN,	% Open/100.	0.01
195.	Outflow Valve, Aft	N.NN,	% Open/100.	0.01
196.	Along TK Horiz Accel, ADIRU	+/-N.NN,	G's	0.01 G
197.	Flight Path Accel, ADIRU	+/-N.NN,	G's	0.01 G
198.	Lateral Accel, ADIRU	+/-N.NN,	G's	0.01 G
199.	Vertical Accel, ADIRU	+/-N.NN,	G's	0.01 G
200.	Angle of Sideslip Δ Pressure	+/-N.NN,	Lbs/In^2	0.01 Lbs/In^2
201.	Primary Flight Control Mode	N,	Discrete	N/A
202 - 210	Available for DSIRF expansion			

L.4 777 MASTER File

The first character of each line is the FORTRAN carriage control. Parameters 220 – 252 are calculated variables in the program and are presented in the MASTER file for inspection or subsequent analysis.

Table 47: 777 Master File

Line	Parameters	Format
1	Error code and text: 1. Error code 2. Error test 3. Model 4. Engine	1X,I7,1X,A80,1X,A16,1X,A16/
2	Deviations: 5. Thrust deviation 6. Power setting deviation 7. Fuel flow deviation engine 1 8. Fuel flow deviation engine 2 9. Not Used 10. Not Used 11. Average fuel flow deviation 12. Fuel mileage deviation 13. Fuel flow deviation due to power setting deviation	1X,9(F13.5,1X)/
3	Header: 14. Airplane Identification Number 15. Airplane Serial Number 16. Flight Number 17. Departure/Destination 18. Day 19. Month 20. Year 21. Time - Hrs 22. Time - Min 23. Time - Sec	1X,A54/
4	Variable Header 24. Variable Header 1 25. Variable Header 2	1X,2A40/
5	Analysis Parameters: 26. Mach, D ADIRU 27. Mach, C SAARU 28. Not Used 29. CAS, D ADIRU 30. CAS, C SAARU 31. Not Used 32. TAT, D ADIRU 33. TAT, C SAARU 34. Not Used	1X,9(F13.5,1X)/

Line	Parameters	Format
6	35. Pressure Altitude, D ADIRU 36. Pressure Altitude, C SAARU 37. Not Used 38. Gross Weight, Mstr FMCF 39. Not Used 40. Not Used 41. Fuel Flow Engine 1 42. Fuel Flow Engine 2 43. Not Used	1X,9(F13.5,1X)/
7	44. Not Used 45. Power Setting Engine 1 46. Power Setting Engine 2 47. Not Used 48. Not Used 49. Calculated Quality Factor 50. Ground Speed, Mstr FMCF 51. Not Used 52. Not Used	1X,9(F13.5,1X)/
8	53. ECS Pack Schedule, Pack 1 54. ECS Pack Schedule, Pack 2 55. Eng Bld (PRSOV) Valve Discrete, Engine 1 56. Eng Bld (PRSOV) Valve Discrete, Engine 2 57. ECS Pack Mass Flow Rate, Pack 1 58. ECS Pack Mass Flow Rate, Pack 2 59. Engine Anti-Ice Discrete, Engine 1 60. Engine Anti-Ice Discrete, Engine 2 61. Wing Anti-Ice Discrete, Left	1X,9(F13.5,1X)/
9	62. Wing Anti-Ice Discrete, Right 63. Eng Bld (HPSOV) Valve Discrete, Engine 1 64. Eng Bld (HPSOV) Valve Discrete, Engine 2 65. Isolation Valve Discrete, Center 66. Aft Cargo Heat Duration 67. Present Position Latitude, Mstr FMCF 68. Not Used 69. Not Used 70. Present Position Longitude, Mstr FMCF	1X,9(F13.5,1X)/
10	71. Not Used 72. Not Used 73. True Heading, Mstr FMCF 74. Not Used 75. Not Used 76. Drift Angle, Mstr FMCF 77. Not Used 78. Not Used 79. True Track Angle, Mstr FMCF	1X,9(F13.5,1X)/

Line	Parameters	Format
11	80. Not Used 81. Not Used 82. AIMS Calculated dHp/dt 83. AIMS Calculated dVg/dt 84. Inertial Vertical Velocity, D ADIRU 85. Not Used 86. Not Used 87. Fuel Density, Left Main Tank 88. Fuel Temperature, Left Main Tank	1X,9(F13.5,1X)/
12	89. Fuel Quantity Center Tank 90. Fuel Quantity Left Main Tank 91. Fuel Quantity Right Main Tank 92. Not Used 93. Not Used 94. Not Used 95. Not Used 96. Not Used 97. Fuel Used Engine 1	1X,9(F13.5,1X)/
13	98. Fuel Used Engine 2 99. Not Used 100. Not Used 101. APU Operating Time 102. Generator Load Engine 1 103. Generator Load Engine 2 104. Not Used 105. Not Used 106. Initial Gross Weight, Mstr FMCF	1X,9(F13.5,1X)/
14	107. Not Used 108. Not Used 109. Initial CG Position, Mstr FMCF 110. Not Used 111. Not Used 112. Initial Zero Fuel Weight, FMCF 113. Not Used 114. Not Used 115. Initial Fuel Quantity, Center Tank	1X,9(F13.5,1X)/
15	116. Initial Fuel Quantity, Left Main Tank 117. Initial Fuel Quantity, Right Main Tank 118. Not Used 119. Not Used 120. Not Used 121. Not Used 122. Not Used	1X,7(F13.5,1X)/

Line	Parameters		Format
16	123.	Serial Number Engine 1	1X,4(A8,1X)/
	124.	Serial Number Engine 2	
	125.	Not Used	
	126.	Not Used	
17	127.	AIMS Calculated Gross Weight	1X,9(F13.5,1X)/
	128.	AIMS Calculated Center of Gravity Position	
	129.	AIMS Calculated Fuel Lower Heat Value	
	130.	Aircraft Total Pressure Pto, ADIRU	
	131.	Aircraft Total Pressure Pto, SAARU	
	132.	True Heading Min/Max Difference	
	133.	APU Door Position	
	134.	Mach Min/Max Difference	
	135.	Altitude Min/Max Difference	
18	136.	Ground Speed Min/Max Difference	1X,9(F13.5,1X)/
	137.	SAT Min/Max Difference	
	138.	Roll Angle Min/Max Difference	
	139.	Power Setting Min/Max Difference, Engine 1	
	140.	Power Setting Min/Max Difference, Engine 2	
	141.	Drift Angle Min/Max Difference	
	142.	CAS Min/Max Difference	
	143.	Pack 1 Flow Rate Min/Max Difference	
	144.	Pack 2 Flow Rate Min/Max Difference	
19	145.	Compartment Case Cooling Valve Position, Engine 1 (GE only)	1X,9(F13.5,1X)/
	146.	Compartment Case Cooling Valve Position, Engine 2 (GE only)	
	147.	GPS Altitude	
	148.	SAT, D ADIRU	
	149.	TAS, D ADIRU	
	150.	Throttle Resolver Angle, Engine 1	
	151.	Throttle Resolver Angle, Engine 2	
	152.	Autothrottle Mode	
	153.	N1, Engine 1 (PW / RR Engines only)	
20	154.	N1, Engine 2 (PW / RR Engines only)	1X,9(F13.5,1X)/
	155.	N2, Engine 1	
	156.	N2, Engine 2	
	157.	N3, Engine 1 (RR Engines only)	
	158.	N3, Engine 2 (RR Engines only)	
	159.	EGT, Engine 1	
	160.	EGT, Engine 2	
	161.	HPT Case Cooling Valve Position, Engine 1 (PW / GE only)	
	162.	HPT Case Cooling Valve Position, Engine 2 (PW / GE only)	

Line	Parameters		Format
21	163.	LPT Case Cooling Valve Position, Engine 1 (PW / GE only)	1X,9(F13.5,1X)/
	164.	LPT Case Cooling Valve Position, Engine 2 (PW / GE only)	
	165.	Fan Air Valve, Engine 1	
	166.	Fan Air Valve, Engine 2	
	167.	IDG Oil Inlet Temp., Engine 1	
	168.	IDG Oil Inlet Temp., Engine 2	
	169.	IDG Oil Outlet Temp., Engine 1	
	170.	IDG Oil Outlet Temp., Engine 2	
	171.	Precooler Out Air Temp., Engine 1	
22	172.	Precooler Out Air Temp., Engine 2	1X,9(F13.5,1X)/
	173.	Manifold Flow Rate, Engine 1	
	174.	Manifold Flow Rate, Engine 2	
	175.	Vane AOA, Left AIMS	
	176.	Vane AOA, Right AIMS	
	177.	Roll Angle, D ADIRU	
	178.	Pitch Angle, D ADIRU	
	179.	Stabilizer Position	
	180.	Spoiler Position, #1	
23	181.	Spoiler Position, #2	1X,9(F13.5,1X)/
	182.	Spoiler Position, #3	
	183.	Spoiler Position, #4	
	184.	Spoiler Position, #5	
	185.	Spoiler Position, #6	
	186.	Spoiler Position, #7	
	187.	Spoiler Position, #8	
	188.	Spoiler Position, #9	
	189.	Spoiler Position, #10	
24	190.	Spoiler Position, #11	1X,9(F13.5,1X)/
	191.	Spoiler Position, #12	
	192.	Spoiler Position, #13	
	193.	Spolier Position, #14	
	194.	Aileron Position, Left	
	195.	Aileron Position, Right	
	196.	Flaperon Position, Left	
	197.	Flaperon Position, Right	
	198.	Rudder Position	
25	199.	Elevator Position, Left	1X,9(F13.5,1X)/
	200.	Elevator Position, Right	
	201.	TE Flap Position, Left Inboard	
	202.	TE Flap Position, Right Inboard	
	203.	Outflow Valve Position, Foreward	
	204.	Outflow Valve Position, Aft	
	205.	Along Track Horizontal Acceleration, ADIRU	
	206.	Flight Path Acceleration, ADIRU	
	207.	Lateral Acceleration, ADIRU	

Line	Parameters		Format
26	208.	Vertical Acceleration, ADIRU	1X,9(F13.5,1X)/
	209.	Angle of Slideslip Delta Pressure	
	210.	Primary Flight Control Mode	
	211-216	Open for DSIRF expansion	
27	217-220	Open for DSIRF expansion	1X,4(F13.5,1X)/
28	221.	Corrected Gross weight	1X,9(F13.5,1X)/
	222.	Lift Coefficient	
	223.	Cd Basic	
	224.	Cd Reynolds	
	225.	CG Position	
	226.	Cd Center of Gravity	
	227.	Cd Elasticity	
	228.	Cd Total	
	229.	Delta Drag - Acceleration	
29	230.	Total Drag	1X,9(F13.5,1X)/
	231.	Drag/Delta	
	232.	Thrust Engine 1	
	233.	Thrust Engine 2	
	234.	Not Used	
	235.	Not Used	
	236.	Total Thrust	
	237.	Book Power Setting (Eng. Type 1)	
	238.	Book Power Setting (Eng. Type 2)	
30	239.	Average Power Setting	1X,9(F13.5,1X)/
	240.	Book Fuel Flow Engine 1	
	241.	Book Fuel Flow Engine 2	
	242.	Not Used	
	243.	Not Used	
	244.	Fuel Flow Factor	
	245.	LHV Ratio Fuel Flow Factor	
	246.	Power Extraction Fuel Flow Factor	
	247.	Observed Fuel Flow Total	
31	248.	Book Fuel Flow Total	1X,4(F13.5,1X), A16,1X,A16/
	249.	True Airspeed (TAS)	
	250.	Book Fuel Mileage	
	251.	Observed Fuel Mileage	
	252.	Instrument Source	
	253.	Speed Type	

Appendix M 787 MODEL SPECIFIC INFORMATION

A generalized definition of the DSIRF for the 787 is provided in this section for data collection. Whether or not this data input mode can be used will depend upon the availability of the required parameters contained in this DSIRF. It is recommended that the default values be used for the input options during the first trial run of the APM Program. To use one of the data correction algorithms contained in the program, it is recommended that the reader consult Section 4 Algorithm and Analysis to determine what data are required for that specific correction.

M.1 Bleed Configuration

To be eligible for analysis by the APM program, each candidate DSIRF or MSIRF data record is checked to determine if the bleed configuration is compatible with the airplane database. The status of the following bleeds are used to define this configuration. NOTE: The discrete values shown below represent the convention adopted for the APM program and do not necessarily agree with the actual airplane discrete values.

Table 48: 787 Bleed Configurations

BLEED	STATUS	
	ZERO STATE	ONE STATE
ENGINE ANTI-ICE BLEEDS	OFF	0

The zero state represents the "normal" bleed configuration of the 787 during cruise. The one state is indicative of a "non-normal" bleed configuration and will cause the APM program to reject the data point for analysis.

M.2 787 Performance Log

For your convenience, a manual log for recording 787 performance is on the following page.

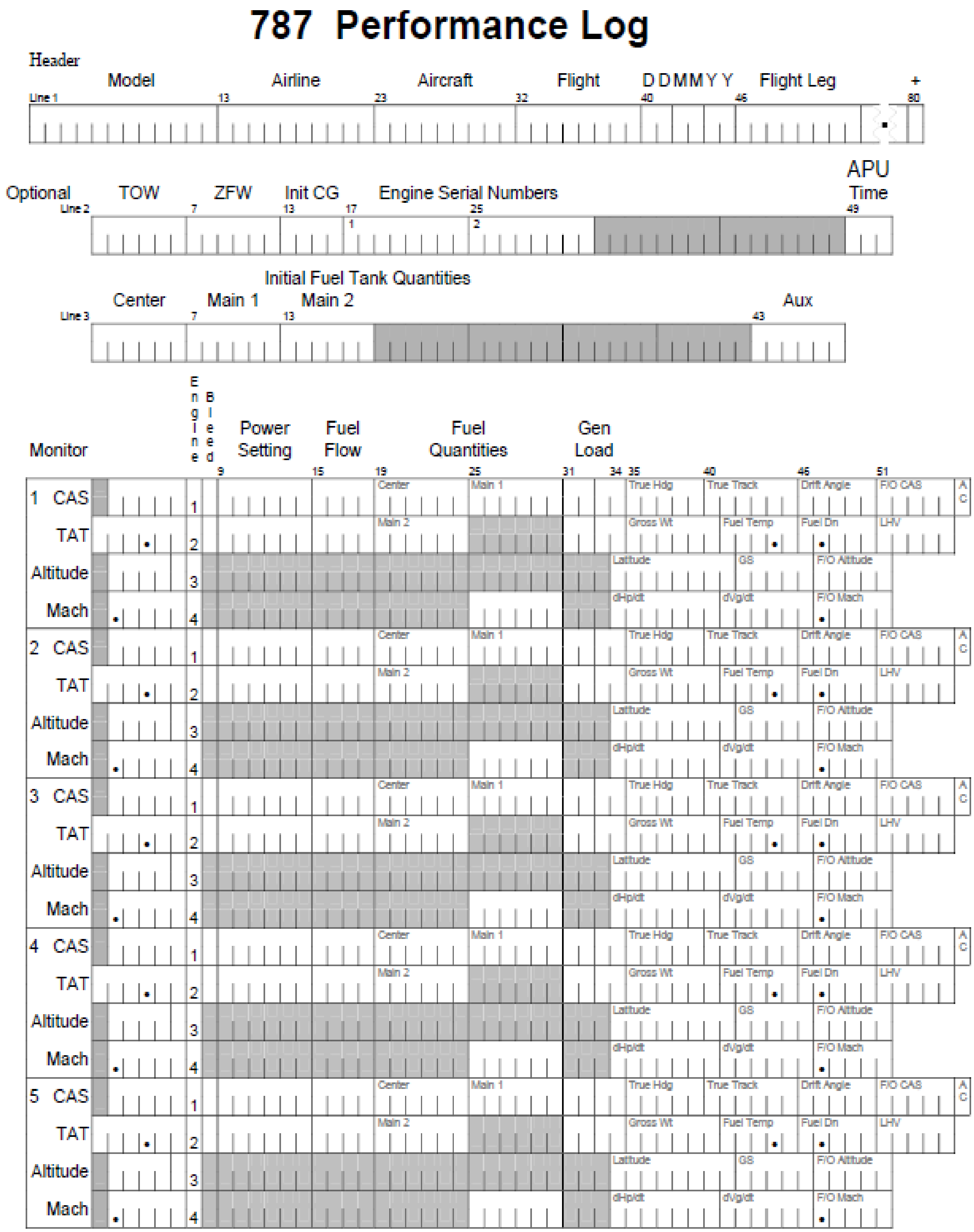

Figure 32: 787 Performance Log

M.2.1 Recommended Recording Procedures:

1. Record Model, Airline, Aircraft, Flight Number and Date.
2. If desired, record takeoff gross weight, ZFW, initial center of gravity, engine serial numbers, APU operating time, and initial fuel tank quantities.
3. Wait until the airplane is stabilized in cruise:
    a. Smooth air
    b. No thrust lever movement (auto-throttles off) for more than five minutes
    c. Anti-ice and fuel heat off for more than five minutes
    d. Less than one degree variation in indicated temperature during the preceding three minutes
    e. Less than .005 Mach (two knots CAS) variation in speed during the preceding three minutes
4. Quickly record Mach, EPR or %N1 and Fuel Flow.
5. Record TAT, Altitude, CAS, FMC Gross Weight (see Note 4).
6. Recheck Mach. If the Mach has changed more than .005 (two knots CAS) discard the point.
7. Record Individual Tank Fuel Quantities and Bleed Code (see Note 5).
8. The rest of the parameters on the Log form are optional, record those now if necessary.
9. Wait at least thirty minutes before recording the next data point in order to obtain data over a range of weights.

NOTES:

- Data can be taken at any stabilized speed. There is no need to return the airplane to a published speed schedule before recording data.
- The airplane identification number should be entered under aircraft. (Data sorting is done using this variable along with date.)
- All gross weight data and fuel quantities must be specified in the same units.
- If the FMC or total gross weight is known, it can be entered in the box labeled "Gross Wt".
- Bleed Config: Record a zero (0) if both ECS Packs are in LOW flow. Record a two (2) if both ECS Packs are in HIGH flow. The bleed code should be the same for both engines.

- If acceleration data (dHp/dt and dVg/dt) are desired, a separate time history must be kept for ground speed and altitude

M.3 787 DSIRF

Table 49: Standard DSIRF Dataset Header

Field	Parameter Name [3]	Columns	Format [1,2]	Units	Resolution
1	DSIRF Dataset Title	1-5	APM [4]	N/A	N/A
2	Subcategory	6	N	N/A	N/A
3	Dataset Sequence Number	7-8	NN	N/A	N/A
4	Aircraft ID Number	9-17	AAAAAAAAA	alphanum	N/A
5	Aircraft Serial Number	18-22	NNNNN	N/A	N/A
6	Aircraft Type Code	23-24	NN	N/A	N/A
7	Flight Number	25-32	AAAAAAAA	N/A	N/A
8	Depart/Destin Airports	33-40	AAAAAAAA	N/A	N/A
9	Day	41-42	NN	day	I day
10	Month	43-44	NN	month	1 month
11	Year	45-46	NN	year	1 year
12	Time - Hours	47-48	NN	hours	1 hour
13	Time - Minutes	49-50	NN	minutes	1 minute
14	Time - Seconds	51-52	NN,	seconds	1 second
15	Variable Header 1	N/A	A. . .A,[5]	N/A	N/A
16	Variable Header 2	N/A	A. . .A,[5]	N/A	N/A
17-181	First DSIRF Data Field	See DSIRF datasets continued on the following pages			

<u>NOTES on dataset and header fields:</u>

1. NNN denotes only numeric data, AAA denotes alphanumeric characters in data.

2. The first fourteen (14) data fields in the header are fixed, and no data delimiters (commas) are specified. The 15th and 16th header fields are variable, as are data fields in the DSIRF dataset body. The variable fields are separated by commas, such that no data available/required may be denoted by ",," for a specific data field (i.e. blanks/zeros are not required).

3. Fields that contain parameters that are not applicable to the 737 are labeled "Not Used". Availability of the parameters contained in the 737 DSIR is dependent upon the aircraft's ACMS configuration. The airline or operator will have to verify as to whether or not a specific parameter is available.

4. DSIRF dataset title for Airplane Performance Monitoring (APM) is "APM " (the letters APM plus two blanks).

5. The maximum field size is to be 40 characters.

6. Standard input units for DSIRF parameters are given in the DSIRF definition. However, the APM Program will accept units of kilograms for the following selected parameters; (1) gross weight, (2) fuel flow, (3) fuel quantity, (4) fuel used and (5) initial gross weight, zero fuel weight, and fuel quantity. if weight units of kilograms are used, then fuel density must be in kilograms per liter.

7. Due to the fact that the DSIRF can be a variable length record (maximum record length is 1200), it is recommended that the ASCII character string of a carriage return followed by a line feed be used to indicate the end of a DSIRF record.

Table 51 below has the 787 DSIRF details. Fields 121 through 181 are not used in the performance calculations in APM. They are included in the DSIRF as supplemental information. They will be included in the MASTER file for possible use by post- processing.

Table 50: 787 DSIRF Dataset

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
17	Mach, ADRF	.NNN,	MACH	0.001 M
18	Not Used	,	N/A	N/A
19	Not Used	,	N/A	N/A
20	CAS, ADRF	NNN.N,	Kt	0.1 Kt
21	Not Used	,	N/A	N/A
22	Not Used	,	N/A	N/A
23	TAT, ADRF	SNN.NN,	Deg C	0.25 Deg
24	Not Used	,	N/A	N/A
25	Not Used	,	N/A	N/A
26	Altitude(29.92), ADRF	NNNNN,	Ft	1 Ft
27	Not Used	,	N/A	N/A
28	Not Used	,	N/A	N/A
29	Gross weight	NNNNNN,	Pounds	40 Lbs
30	Not Used	,	N/A	N/A
31	Not Used	,	N/A	N/A
32	Fuel Flow Engine 1	NNNN,	Lbs/Hr	1 Lb/Hr
33	Fuel Flow Engine 2	NNNN,	Lbs/Hr	1 Lb/Hr
34	Not Used	,	N/A	N/A
35	Not Used	,	N/A	N/A
36	Power Setting Engine 1	NNN.NN,	TPR / %N1	.01
37	Power Setting Engine 2	NNN.NN,	TPR / %N1	.01
38	Not Used	,	N/A	N/A
39	Not Used	,	N/A	N/A
40	Calculated Quality Factor	NNN.NNN,	N/A	0.1
41	Ground Speed	NNN.N,	Kt	0.1 Kt
42	Not Used	,	N/A	N/A
43	Not Used	,	N/A	N/A

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
44	ECS Pack 1 RAM Inlet Door position	TBD,	TBD	TBD
45	ECS Pack 2 RAM Inlet Door position	TBD,	TBD	TBD
46	ECS Pack 1 RAM Exit Door position	TBD,	TBD	TBD
47	ECS Pack 2 RAM Exit Door position	TBD,	TBD	TBD
48	Not Used	,	N/A	N/A
49	Not Used	,	N/A	N/A
50	Engine Anti-Ice Discrete Eng 1	N,	Discrete	N/A
51	Engine Anti-Ice Discrete Eng 2	N,	Discrete	N/A
52	Wing Anti-Ice Discrete	N,	Discrete	N/A
53	Not Used	,	N/A	N/A
54	Not Used	,	N/A	N/A
55	Not Used	,	N/A	N/A
56	Not Used	,	N/A	N/A
57	Not Used	,	N/A	N/A
58	Present Pos Latitude	SNN.NNNN,	Degrees	0.0001 Deg
59	Not Used	,	N/A	N/A
60	Not Used	,	N/A	N/A
61	Present Pos Longitude	SNNN.NNNN,	Degrees	0.0001 Deg
62	Not Used	,	N/A	N/A
63	Not Used	,	N/A	N/A
64	True Heading	SNNN.N,	Degrees	0.1 Deg
65	Not Used	,	N/A	N/A
66	Not Used	,	N/A	N/A
67	Drift Angle	SNN.N,	Degrees	0.1 Deg
68	Not Used	,	N/A	N/A
69	Not Used	,	N/A	N/A
70	True Track Angle	SNNN.N,	Degrees	0.1 Deg
71	Not Used	,	N/A	N/A
72	Not Used	,	N/A	N/A
73	Calculated dHp/dt	SNNN.NNN,	Ft/Sec	0.001 Ft/Sec
74	Calculated dVg/dt	SN.NNN,	Kt/Sec	0.001 Kt/Sec
75	Inertial Vertical Speed, ADIRU	SNNNN,	Ft/Min	1 Ft/Min
76	Not Used	,	N/A	N/A
77	Not Used	,	N/A	N/A
78	Fuel Density	NN.NNN,	Lbs/USgal	.001 Lb
79	Fuel Temperature	SNNN	Degrees C	1 Deg C
80	Fuel Quantity Center	NNNNN,	Pounds	100 Lbs
81	Fuel Quantity Left Main	NNNNN,	Pounds	100 Lbs
82	Fuel Quantity Right Main	NNNNN,	Pounds	100 Lbs

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
83	Not Used	,	N/A	N/A
84	Not Used	,	N/A	N/A
85	Not Used	,	N/A	N/A
86	Not Used	,	N/A	N/A
87	Not Used	,	N/A	N/A
88	Fuel Used Engine 1	NNNNN,	Pounds	1 Lb
89	Fuel Used Engine 2	NNNNN,	Pounds	1 Lb
90	Not Used	,	N/A	N/A
91	Not Used	,	N/A	N/A
92	APU Operating Time	NN.N,	minutes	0.1 Minute
93	Left Engine Generator 1 Load	NNN,	%	1 %
94	Left Engine Generator 2 Load	NNN,	%	1 %
95	Right Engine Generator 1 Load	NNN,	%	1 %
96	Right Engine Generator 2 Load	NNN,	%	1 %
97	Initial Gross Weight, FMF	NNNNNN,	Pounds	40 Lbs.
98	Not Used	,	N/A	N/A
99	Not Used	,	N/A	N/A
100	Initial CG, FMF	NN.NN,	% MAC	0.05 %
101	Not Used	,	N/A	N/A
102	Not Used	,	N/A	N/A
103	Initial ZFW, FMF	NNNNNN,	Pounds	40 Lbs
104	Not Used	,	N/A	N/A
105	Not Used	,	N/A	N/A
106	Init. Fuel Qty Center	NNNNN,	Pounds	100 Lbs
107	Init. Fuel Qty Left Main	NNNNN,	Pounds	100 Lbs
108	Init. Fuel Qty Right Main	NNNNN,	Pounds	100 Lbs
109	Not Used	,	N/A	N/A
110	Not Used	,	N/A	N/A
111	Not Used	,	N/A	N/A
112	Not Used	,	N/A	N/A
113	Not Used	,	N/A	N/A
114	Serial Number Engine 1	AAAAAAAA,	N/A	N/A
115	Serial Number Engine 2	AAAAAAAA,	N/A	N/A
116	Not Used	,	N/A	N/A
117	Not Used	,	N/A	N/A
118	Average FMF Gross Weight	NNNNNN,	Pounds	40 Lbs
119	Average FMF CG Position	NN.NN,	% MAC	0.1 %
120	Not Used	,	N/A	N/A
121	N1 Engine 1	NNN.N,	% RPM	0.1 %

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
122	N1 Engine 2	NNN.N,	% RPM	0.1 %
123	Not Used	,	N/A	N/A
124	Not Used	,	N/A	N/A
125.	N2 Engine 1	NNN.N,	% RPM	0.1 %
126.	N2 Engine 2	NNN.N,	% RPM	0.1 %
127.	Not Used	,	N/A	N/A
128.	Not Used	,	N/A	N/A
129.	N3 Engine 1 (RR only)	NNN.N,	% RPM	0.1 %
130.	N3 Engine 2 (RR only)	NNN.N,	% RPM	0.1 %
131.	Not Used	,	N/A	N/A
132.	Not Used	,	N/A	N/A
133.	EGT Engine 1	NNN.N,	Degrees C	0.5 Deg C
134.	EGT Engine 2	NNN.N,	Degrees C	0.5 Deg C
135.	Not Used	,	N/A	N/A
136.	Not Used	,	N/A	N/A
137.	Not Used	,	N/A	N/A
138.	Not Used	,	N/A	N/A
139.	Not Used	,	N/A	N/A
140	Not Used	,	N/A	N/A
141.	Average SAT	SNN. N,	Deg C	0.5 Deg
142.	Not Used	,	N/A	N/A
143.	Not Used	,	N/A	N/A
144.	Average AOA	SNN.N,	Degrees	0.05 Deg
145.	Not Used	,	N/A	N/A
146.	Not Used	,	N/A	N/A
147.	Roll Angle, FCE source selected	SNN.N,	Degrees	0.1 Deg
148.	Not Used	,	N/A	N/A
149.	Not Used	,	N/A	N/A
150.	Pitch Angle, FCE source selected	SNN.N,	Degrees	0.1 Deg
151.	Not Used	,	N/A	N/A
152.	Not Used	,	N/A	N/A
153.	Horizontal Stabilizer Position	SNN.N,	Units	0.05 Unit
154.	Spoiler Handle Position	NN.N,	Degrees	0.1 Deg
155.	Not Used	,	N/A	N/A
156.	Left Aileron Position	SNN.N,	Degrees	0.1 Deg
157.	Right Aileron Position	SNN.N,	Degrees	0.1 Deg
158.	Not Used	,	N/A	N/A
159.	Not Used	,	N/A	N/A
160.	Rudder Position	SNN.N,	Degrees	0.1 Deg

FIELD	PERAMETER NAME	FORMAT	UNITS	RESOLUTION
161.	Not Used	,	N/A	N/A
162.	Left Elevator Position	SNN.N,	Degrees	0.1 Deg
163.	Right Elevator Position	SNN.N,	Degrees	0.1 Deg
164.	Not Used	,	N/A	N/A
165.	Not Used	,	N/A	N/A
166.	Average Left TE Flap Position	NN.N,	Degrees	0.1 Deg
167.	Average Right TE Flap Position	NN.N,	Degrees	0.1 Deg
168.	Not Used	,	N/A	N/A
169.	Not Used	,	N/A	N/A
170.	Along TK Horiz Accel, FCE	SN.NN,	G's	0.01 G
171.	Not Used	,	N/A	N/A
172.	Not Used	,	N/A	N/A
173.	Flight Path Accel, FCE	SNN.N,	G's	0.01 G
174.	Not Used	,	N/A	N/A
175.	Not Used	,	N/A	N/A
176.	Vertical Accel, FCE	SN.NN,	G's	0.01 G
177.	Not Used	,	N/A	N/A
178.	Not Used	,	N/A	N/A
179.	Not Used	,	N/A	N/A
180	Not Used	,	N/A	N/A
181	Sideslip Angle	SNN.N	Degrees	0.1 Deg
182	Spoiler Position, #12	+/-N.NN,	Inches LVDT	0.01 Inches
183	Spoiler Position, #13	+/-N.NN,	Inches LVDT	0.01 Inches
184	Spoiler Position, #14	+/-N.NN,	Inches LVDT	0.01 Inches

M.4 777 MASTER File

The first character of each line is the FORTRAN carriage control. Parameters 220 – 252 are calculated variables in the program and are presented in the MASTER file for inspection or subsequent analysis.

Table 51: 787 Master File

Line	Parameters	Format
1	Error code and text: 1. Error code 2. Error test 3. Model 4. Engine	1X,I7,1X,A80,1X,A16,1X,A16/

Line	Parameters	Format
2	Deviations: 5. Thrust deviation 6. Power setting deviation 7. Fuel flow deviation engine 1 8. Fuel flow deviation engine 2 9. Not Used 10. Not Used 11. Average fuel flow deviation 12. Fuel mileage deviation 13. Fuel flow deviation due to power setting deviation	1X,9(F13.5,1X)/
3	Header: 14. Airplane Identification Number 15. Airplane Serial Number 16. Flight Number 17. Departure/Destination 18. Day 19. Month 20. Year 21. Time - Hrs 22. Time - Min 23. Time - Sec	1X,A54/
4	Variable Header 24. Variable Header 1 25. Variable Header 2	1X,2A40/
5	Analysis Parameters: 26. Mach, ADRF 27. Not Used 28. Not Used 29. CAS, ADRF 30. Not Used 31. Not Used 32. TAT, ADRF 33. Not Used 34. Not Used	1X,9(F13.5,1X)/
6	35. Altitude(29.92), ADRF 36. Not Used 37. Not Used 38. Gross Weight 39. Not Used 40. Not Used 41. Fuel Flow Engine 1 42. Fuel Flow Engine 2 43. Not Used	1X,9(F13.5,1X)/

Line	Parameters	Format
7	44. Not Used 45. Power Setting Engine 1 46. Power Setting Engine 2 47. Not Used 48. Not Used 49. Calculated Quality Factor 50. Ground Speed 51. Not Used 52. Not Used	1X,9(F13.5,1X)/
8	53. Not Used 54. Not Used 55. Not Used 56. Not Used 57. Not Used 58. Not Used 59. Engine Anti-Ice Discrete, Engine 1 60. Engine Anti-Ice Discrete, Engine 2 61. Left Wing Anti-Ice Discrete	1X,9(F13.5,1X)/
9	62. Right Wing Anti-Ice Discrete 63. Not Used 64. Not Used 65. Not Used 66. Not Used 67. Present Position Latitude 68. Not Used 69. Not Used 70. Not Used	1X,9(F13.5,1X)/
10	71. Not Used 72. Not Used 73. True Heading 74. Not Used 75. Not Used 76. Drift Angle 77. Not Used 78. Not Used 79. True Track Angle	1X,9(F13.5,1X)/
11	80. Not Used 81. Not Used 82. DFDAU Calculated dHp/dt 83. DFDAU Calculated dVg/dt 84. Not Used 85. Not Used 86. Not Used 87. Fuel Density 88. Fuel Temperature	1X,9(F13.5,1X)/

Line	Parameters	Format
12	89. Fuel Quantity Center 90. Fuel Quantity Left Main 91. Fuel Quantity Right Main 92. Not Used 93. Not Used 94. Not Used 95. Not Used 96. Not Used 97. Fuel Used Engine 1	1X,9(F13.5,1X)/
13	98. Fuel Used Engine 2 99. Not Used 100. Not Used 101. APU Operating Time 102. Left Engine Generator 1 Load 103. Left Engine Generator 2 Load 104. Right Engine Generator 1 Load 105. Right Engine Generator 2 Load 106. Initial Gross Weight, FMF	1X,9(F13.5,1X)/
14	107. Not Used 108. Not Used 109. Initial CG Position, FMF 110. Not Used 111. Not Used 112. Initial Zero Fuel Weight, FMF 113. Not Used 114. Not Used 115. Initial Fuel Quantity, Center	1X,9(F13.5,1X)/
15	116. Initial Fuel Quantity, Left Main 117. Initial Fuel Quantity, Right Main 118. Not Used 119. Not Used 120. Not Used 121. Not Used 122. Not Used	1X,7(F13.5,1X)/
16	123. Serial Number Engine 1 124. Serial Number Engine 2 125. Not Used 126. Not Used	1X,4(A8,1X)/

Line	Parameters		Format
17	127.	Average FMF Gross Weight	1X,9(F13.5,1X)/
	128.	Average FMF Center of Gravity Position	
	129.	Not Used	
	130.	Not Used	
	131.	Not Used	
	132.	Not Used	
	133.	Not Used	
	134.	%N2 Engine 1	
	135.	%N2 Engine 2	
18	136.	Not Used	1X,9(F13.5,1X)/
	137.	Not Used	
	138.	%N3 Engine 1 (RR Only)	
	139.	%N3 Engine 2 (RR Only)	
	140.	Not Used	
	141.	Not Used	
	142.	EGT Engine 1	
	143.	EGT Engine 2	
	144.	Not Used	
19	145.	Not Used	1X,9(F13.5,1X)/
	146.	Not Used	
	147.	Not Used	
	148.	Not Used	
	149.	Not Used	
	150.	Average SAT	
	151.	Not Used	
	152.	Not Used	
	153.	Average AOA	
20	154.	Not Used	1X,9(F13.5,1X)/
	155.	Not Used	
	156.	Roll Angle, FCE source selected	
	157.	Not Used	
	158.	Not Used	
	159.	Pitch Angle, FCE source selected	
	160.	Not Used	
	161.	Not Used	
	162.	Horizontal Stabilizer Position	
21	163.	Spoiler Handle Position	1X,9(F13.5,1X)/
	164.	Not Used	
	165.	Left Aileron Position	
	166.	Right Aileron Position	
	167.	Not Used	
	168.	Not Used	
	169.	Rudder Position	
	170.	Not Used	
	171.	Left Elevator Position	

Line	Parameters		Format
22	172.	Right Elevator Position2	1X,9(F13.5,1X)/
	173.	Not Used	
	174.	Not Used	
	175.	Average Left TE Flap Position	
	176.	Average Right TE Flap Position	
	177.	Not Used	
	178.	Not Used	
	179.	Along TK Horizontal Acceleration, FCE	
	180.	Not Used	
23	181.	Not Used	1X,9(F13.5,1X)/
	182.	Flight Path Acceleration, Left	
	183.	Not Used	
	184.	Not Used	
	185.	Vertical Acceleration, FCE	
	186.	Not Used	
	187.	Not Used	
	188.	Not Used	
	189.	Not Used	
24	190.	Angle of Sideslip	1X,9(F13.5,1X)/
	191-198	Open for DSIRF expansion	
25	199-207	Open for DSIRF expansion	1X,9(F13.5,1X)/
26	208-216	Open for DSIRF expansion	1X,9(F13.5,1X)/
27	217-219	Open for DSIRF expansion	1X,3(F13.5,1X)/
28	220.	Corrected Gross weight	1X,8(F13.5,1X)/
	221.	Lift Coefficient	
	222.	Cd Basic	
	223.	Cd Reynolds	
	224.	CG Position	
	225.	Cd Center of Gravity	
	226.	Cd Elasticity	
	227.	Cd Total	
29	228.	Delta Drag - Acceleration	1X,9(F13.5,1X)/
	229.	Total Drag	
	230.	Drag/Delta	
	231.	Thrust Engine 1	
	232.	Thrust Engine 2	
	233.	Not Used	
	234.	Not Used	
	235.	Total Thrust	
	236.	Book Power Setting (Eng. Type 1)	

Line	Parameters		Format
30	237. 238. 239. 240. 241. 242. 243. 244. 245.	Book Power Setting (Eng. Type 2) Average Power Setting Book Fuel Flow Engine 1 Book Fuel Flow Engine 2 Not Used Not Used Fuel Flow Factor LHV Ratio Fuel Flow Factor Power Extraction Fuel Flow Factor	1X,9(F13.5,1X)/
31	246. 247. 248. 249. 250. 251. 252.	Observed Fuel Flow Total Book Fuel Flow Total True Airspeed (TAS) Book Fuel Mileage Observed Fuel Mileage Instrument Source Speed Type	1X,5(F13.5,1X),A16,1X,A16/

Revision Record

Release/Revision	**4.0.0**
Description of Change	• Changed formatting • Removed references to HISTORY program as that program is obsolete. • Added references to 737 MAX airplanes in Appendix F.
Authorization for Release	

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	Organization Number	Date