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GENERIC TILT-ROTOR SIMULATION (GTRSIM) USER'S AND PROGRAMMER'S GUIDE

VOLUME 1: USER'S GUIDE

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GTRSIM TILT ROTOR SIMULATION USER'S MANUAL

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1. GENERAL DESCRIPTION

1.1 PURPOSE OF THE USER'S MANUAL

This User's Manual provides a reference in order for the reader to (a) understand the capabilities of the Generic Tilt Rotor Simulation Program (GTRSIM), (b) assemble an input data deck, and (c) understand the output after successfully executing the program. Computer program GTRSIM simulates the tilt-rotor aircraft mathematical model documented in Ref. 1. This mathematical model and the GTRSIM program were developed from the XV-15 mathematical model developed by Bell Helicopter Textron (BHT) which is described in Ref. 2. Additional information concerning the operation of Program GTRSIM is included in the Programmer's Manual, Ref. 3.

1.2 ACKNOWLEDGEMENTS

Systems Technology, Inc., would like to acknowledge the help of Messrs. M. Landry and M. Schramm of BHT. The excellent job they did in preparing the IFHC80 user's and programmer's guides (Refs. 4 and 5) simplified the job of preparing this document considerably.

1.3 REFERENCES

1. Ferguson, Samuel W., A Mathematical Model for Real Time Flight Simulation of a Generic Tilt Rotor Aircraft, NASA CR-166536, October 1983, September 1988, Rev. A (Final).

2. Harendra, P. B., M. M. Joglekar, T. M. Gaffey, and R. L. Marr, V/STOL Tilt Rotor Study. Volume 5: A Mathematical Model for Real Time Flight Simulation of the Bell Model 301 Tilt Rotor Research Aircraft, NASA CR-114614, April 1973.

3. Hanson, Gregory D., and Samuel W. Ferguson, Generic Tilt-Rotor Simulation (GTRSIM) User's and Programmer's Guide. Volume 2: Programmer's Guide, NASA CR-166535, October 1983, September 1988, Rev. A (Final).

4. Schramm, M., and L. M. Landry, Jr., IFHC80 XV-15 Tilt Rotor Simulation Users' Manual, Bell Helicopter Co. (Draft) Report prepared under Contract NAS2-10349.

5. Schramm, M., and L. M. Landry, Jr., IFHC80 XV-15 Tilt Rotor Simulation Programmer's Manual, Bell Helicopter Co. (Draft) Report prepared under Contract NAS2-10349.

2. GTRSIM SUMMARY

2.1 GTRSIM APPLICATION

The simulation program GTRSIM represents the major subsystems of the Tilt-Rotor Research Vehicle including the following modules:

1. Two distinct rotors represented by algebraic equations
2. Aerodynamic tables and equations for each component of the airframe (fuselage, wing, pylon, horizontal and vertical stabilizers, control surfaces, and wake effects)
3. The entire control system including phasing and mixing
4. The engine, drive system, and controls
5. Rotor collective governor
6. Stability and control augmentation system (SCAS)
7. Landing gear aerodynamics.

The basic input data deck for GTRSIM consists of between eighty and one hundred card images. This deck allows the user to specify most of the configuration constants and variables for the tilt rotor, and the aerodynamic data tables. Input data switch options permit varying degrees of stability analyses and the amount of printout (both formal and diagnostic).

Following the basic input data deck are run-type option cards. Program GTRSIM has six run-type options as listed in Table 2-1. The DTPT, MANU, and TUNL options are designed mainly for checkout and diagnostics. Trims are performed with TRMS and maneuvers are accomplished using MANS. The END option is used to terminate a run.

TABLE 2-1. GTRSIM EXECUTION OPTIONS

Run Type	Description
DTPT (data point)	Data point fixes the airframe in space according to a set of initial input conditions while the rotor thrust/induced velocity loop is closed.
TRMS (trim sweep)	Trim sweep of any two of eleven flight variables.
MANS (maneuver)	Trim followed by a maneuver.
MANU (maneuver)	Start in maneuver without first trimming.
TUNL (tunnel)	Tabulation of airframe forces and moments versus angle of attack and sideslip.
END (end of run)	End of execution.

Maneuver capabilities include options for pulse inputs, time history input of control position, or a sum-of-sines driven control input on any four of the controls for a user-specified period of time. The aircraft flies rotor free for one second, fuselage and rotor free for another second, followed by stick inputs for the specified run length. The run is completed at any chosen time (up to 120.0 seconds), and data can be printed out in several formats at any time increment desired.

2.2 GTRSIM CONFIGURATION

Program GTRSIM, a significantly revised version of Program IFHC80 developed by BHT on an IBM 370/168 (Refs. 4 and 5), is available at NASA Ames Research Center (ARC) and is installed on a VAX 11/785 computer. Versions of the program on the VAX include a stand-alone version, which is executed as described in this documentation, and a version that runs under the TRENDS flight test data base menu. The TRENDS version uses the same input data as the stand-alone version; however, the user interface is modified. Information on the use of the latest version of TRENDS, as developed and maintained by Analytical Mechanics Associates of Mountain View, California, can be obtained through the NASA ARC XV-15 Project Office. The VAX 11/785 installation required that FORTRAN versions of several IBM assembly language routines be written and that the NAMELIST and COMPLEX*16 usage be modified, i.e., all NAMELIST writes were modified to formatted writes, a restricted simulated NAMELIST read was also developed, and the double precision complex was replaced with single precision complex. The single precision complex deteriorates the accuracy and ability to separate stability roots.

Program IFHC80 at BHT has Calcomp plotting capabilities for the MANS, MANU, TUNL, and TABL run-type options. This feature is not supported by GTRSIM. A capability is provided in the program to printout a graphics output data file to be picked up by some other type of user specified graphics routine. Details on this option are discussed in the programmer's guide in Section 4.4, and the format can be changed by the user through modification of subroutine IFHB43 in GTRSIM or the utility

MATOUT source code (also discussed in Section 4.4 of the programmer's guide).

The file GTRSIM.DOC, supplied with the GTRSIM code, is the text file for the Input Guide which forms Appendices A through G of this User's Manual. The file can be updated easily in order to reflect future changes or additional comments. Column 1 is used for print carriage control. If GTRSIM.DOC is modified, the utility GTRDOC.EXE should be run to format the text file for printing by typing "@GTRDOC" on the VAX.

2.3 GTRSIM ORGANIZATION

2.3.1 Basic Input Data

The format of the input data is specified in Appendix A. The basic deck consists of approximately eighty to one-hundred card images, followed by run-type option data cards. Multiple runs can be made, but most executions will consist of the basic input data deck followed by a single run-type option.

Once a basic input data deck has been constructed, only changes to the switch options are required for most investigations. Values input with run-type data cards at the end of the input data deck override values input in the flight configuration data group in situations where a variable can be specified in both locations (i.e., airspeed and gross weight).

2.3.2 DTPT Run-Type Option

The data point run-type fixes the airframe in space according to a set of initial input conditions while the rotor thrust/induced velocity loop is closed. The DTPT option is used mainly for checkout and diagnostic purposes. The three data cards of the DTPT option specify the controls, attitudes, rates, and conditions for the "data point" and override the input from the basic deck. The DTPT option executes quickly and

is often used in multiple runs. NAMELIST CHANGE can be used to modify the configuration for multiple DTPT runs.

2.3.3 TRMS Run-Type Option

TRMS is the most often used option. The trim sweep option gives a sweep of any two of eleven flight variables. The variables are velocity along with X-, Y-, or Z-ground axis, total velocity, rate of descent, gross weight, mast tilt angle, flaps switch setting, reference RPM, and center of gravity station line or water line. The data card for TRMS allows the user to specify the two flight variables, their starting value, the increment changed between trims, and the displacement of the second variable as the first variable increments. The second variable is swept through its range, the first variable is then incremented, and the starting value of the second variable is displaced. Figure 2-1 shows the matrix of trims obtained by a single TRMS run in which airspeed is swept and the starting airspeed is displaced as the mast tilt is incremented.

The starting control positions and attitudes for the trim iterations are internally computed in the program. In the sweep of the second variable, the control positions and attitudes of the previous case are used as starting values if the force and moment summation successfully converged to zero in the previous case. When a sweep is complete and the first variable is incremented before starting over on a sweep, the internally computed starting points are used.

For most trims, the starting control positions and attitudes are satisfactorily computed and tend to minimize computation time. However difficulty will occasionally be encountered in trimming at a point which should trim. For instance, when trimming at a specified rate of descent, it may be necessary to trim level and then sweep to the specified rate of descent.

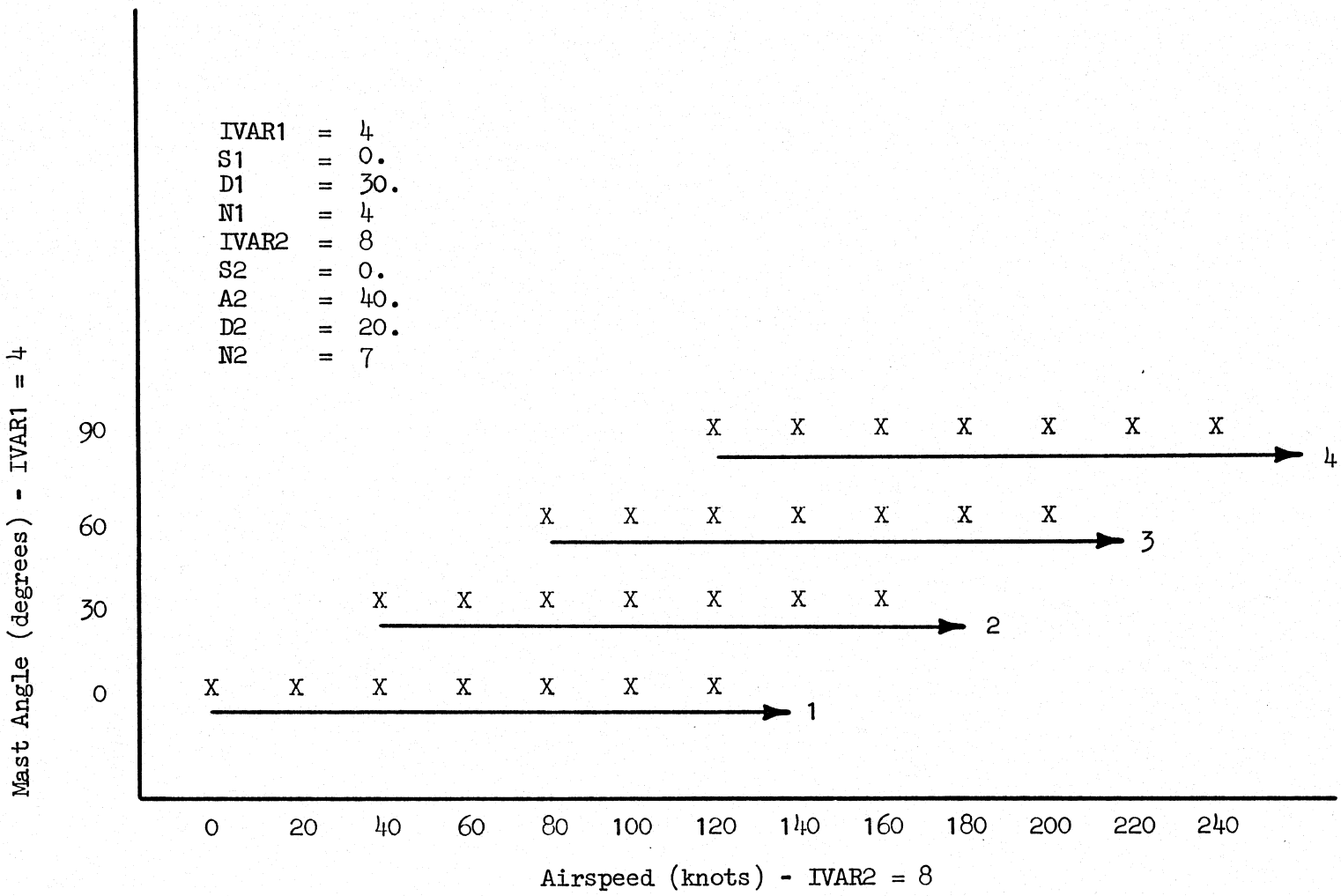

Figure 2-1. Example of TRMS Trims

2.3.4 MANS Run-Type Option

The MANS maneuver option is composed of a trim followed by a maneuver. This sequence automatically insures that the initial conditions for the maneuver are trim values in order to minimize any starting transients. Following the trim, the rotors fly free for one second with the fuselage frozen in space (no integration of forces and accelerations). From 1.0 to 2.0 seconds, both the rotors and the fuselage are released. The specified type of control input begins at 2.0 seconds and remains for PTIME seconds, as specified on the first MANS group data card (following the run-type card). The maneuver executes for RTIME seconds (120.0 = maximum) after the inputs are entered (at 2.0 seconds). This yields a maximum elapsed maneuver time of potentially 122.0 seconds. The user may also specify the PRTDEL print increment on the first MANS group data card. Pulse- or step-gusts are simulated using data specified on the fourth MANS group data card.

User selectable options that are available for inputting pilot control positions during a maneuver are:

1. A pure pulse or step (requires four data cards for the MANS group)
2. A user-specified time history of the control positions (requires thirty-two data cards for the MANS group)
3. A sum-of-sines driven input (requires four data cards for the MANS group).

The pure pulse or step input option is utilized by setting ICONT1 equal to 1 on input data card one and inputting the value of the pulse or step (in percent control authority) on card four for the desired control axis. The more flexible time history input data format (which accepts steps or pulses also) is utilized by setting ICONT2 equal to 1 on card one. Twenty-eight additional data cards are then added behind the fourth card to define the time history of the pilot control inputs. This group of cards includes a comment card for each control axis and the capability

for inputting twenty-one time breakpoints for twenty-one control positions on each axis. Using this option, almost any flight test maneuver can be broken up and correlated.

The sum-of-sines driven control input option is implemented using the same positions on input data card four that are used with the pure pulse or step option. The specified control position values are used as scale factors for the magnitude of the sum-of-sines input (to insure that the magnitude of the input does not cause the tilt-rotor to be driven out of control during a run). Since this option is normally used for one axis at a time, a scale factor of 0.0 on the other axes prevents them from being driven by the sum-of-sines input. Time history outputs for this option are automatically run for 81.92 seconds. A graphics output file is generated so that the results can be plotted and input into a Fast-Fourier Transform (FFT) program where describing functions can be derived from the data (i.e., for use in demonstrating compliance with handling qualities specification requirements).

An option is provided on input data card two to specify a time during the maneuver at which one of the axes of the SCAS may be failed. This option provides for the capability to study transient conditions at various points in a maneuver following a SCAS failure.

2.3.5 MANU Run-Type Option

The maneuver option starts a maneuver without first trimming. The user must therefore be careful to specify all initial (trim?) conditions in order to establish a stabilized flight path at 2.0 seconds. MANU probably should be used only if MANS has been unsuccessful in trimming. Trim initial conditions can be obtained from a previous TRMS sweep. All other characteristics of the MANU option are identical to the MANS option.

2.3.6 TUNL Run-Type Option

The tunnel option "simulates" a wind tunnel by tabulating airframe forces and moments versus angle of attack and sideslip and is normally used for dignostic checks. On the first TUNL data card, the user specifies the minimum value for angle of attack and sideslip, the sweep (step) increment, and the number of points in the sweep. The second data card has a print switch for the tabulation of the data.

2.4 AERODYNAMIC DATA TABLES

2.4.1 Specific Aerodynamic Data Tables

The aerodynamic data tables used in GTRSIM are read into the program from individual data table files at the beginning of program execution. To facilitate the reading of each data table file in the correct order, a master list containing each data table file name and its directory location is required. Appendix E presents an example of the file that contains the list of file names, a brief description of each file, and the VAX VMS directory in which the file is stored. There are 306 data tables (hence 306 files) which need to be read and stored in the program. It is extremely important that the order of this list not be changed, as the order in which the files are found in the list relates to the way the files are stored in the program and referenced from within the program. Thus any changes in this list will result, without question, in erroneous results.

Although the order of the list of tables cannot be changed, the name of the data table itself and the directory under which the file is stored can be changed. The description of the data table can also be changed to reflect any additional information. However, there are a few restrictions or requirements which must be adhered to when making any changes in this list.

1. All file names begin in the first column, except those preceeded by a "$". If changing a file name preceeded by a "$", the "$" is in the first column, and the file name starts in the second column. The "$" is a signal to the program that a new section of tables is being read.

2. The description begins with a "!" and is limited to a length of 50 characters. The only characters which cannot be used in the description are the right and left square brackets (i.e., [and]), as these are reserved for the directory information.

3. The directory must begin with a "[" and end with a "]". The limit on the length of the directory is 30 characters including the square brackets. The directory should also begin at least 50 spaces after the "!" starting the description of the table.

4. The total length of a line is limited to 120 characters.

The directory and name of the file which contains the list of the data files to be read is specified on the last card in the flight configuration group of the input data deck. The directory is specified first, enclosed in square brackets, followed by the file name. Thus the operator of the program specifies which data file list is to be used, which further specifies from which directories the data files are to be read.

2.4.2 Aerodynamic Data Table Files

The individual aerodynamic data tables are read into the program (as compared to IFHC80 where the data tables were compiled with the program) to provide the user the option to modify the tables as desired without affecting the executable program. The following section describes an example data table file and how to make changes within a file. Figure 2-2 presents the example data table file. The data table file contains a description, the independent data (i.e., break points), and the dependent data (i.e., table data). Data table files are read such that blank lines are ignored and any line containing a "!" is treated as a

```
!  EXAMPLE.TAB
!  ALL COMMENT LINES START WITH A "!"
!  ALL LINES WITH A "!" AND BLANK LINES ARE IGNORED
!
!  THE INDEPENDENT DATA BEGINS WITH A LINE CONTAINING ONLY A "1"
!
 1
   -40.    -36.    -32.    -28.    -24.    -20.    -19.5
   -16.    -15.5   -13.    -12.    -11.    -8.     -4.
     0.      4.      8.     11.     12.     13.     16.
    17.     20.     24.     28.     32.     36.     40.
!
!  THE DEPENDENT DATA IS SEPARATED FROM THE INDEPENDENT DATA
!  BY A LINE WITH A "$"
 $
   -.93    -.84    -.84    -.89    -1.     -1.15   -1.15
   -.95    -.91    -.75    -.67    -.59    -.33    -.04
    .38     .72    1.04    1.28    1.37    1.42    1.57
   1.57    1.38    1.22    1.2     1.27    1.4     1.46
!
```

Figure 2-2. Example of a Data Table File

comment line that is also ignored. Comment lines may be placed anywhere within the data table file and must begin with an "!".

A line in the file with a 1 and nothing else on the line signals the beginning of the independent data. This data should be stored in the file from the smallest value to the largest (i.e., negative to positive). The end of the independent and beginning of the dependent data is signaled with a "$" on a line with nothing else contained on that line. The dependent data follows with the data being presented in the order corresponding directly to the independent data.

The length of each line of a data file is limited to 80 characters; however, the only required input format is that the data points are separated by at least one space. (Tabs are not allowed.) It is important to note that the number of data points per line is not restricted, only that they fit in 80 columns, nor does the number of data points per line of dependent data have to equal the number of data points per line of

independent data. The only restriction is that there be an equal number of data points. Also, the number of data points contained in a table is not predetermined (i.e., the program determines the number of data points contained in the file as it reads the data points). Thus the data files and the program are dynamically dimensional in that the data files can change size, and the program will adjust itself to that size.

To change a data file, merely edit the file making sure that all descriptions begin with an "!" and that a 1 preceeds the independent data, and the independent and dependent data are separated by a "$".

3. INPUT DATA DECK

3.1 GENERAL DESCRIPTION

The basic input data deck for Program GTRSIM consists of approximately eighty to one-hundred card images. The last card of the input data deck is an END OF DATA card. Following the END OF DATA card is a run-type option card and its associated data cards (at least one run-type card must be specified). Ordinarily only one run type is executed per job, but multiple runs can be made. Following the associated run-type data cards must be NAMELIST CHANGE cards. The NAMELIST CHANGE cards signify the start of a new run and represent changes of data from the basic input data deck. For multiple runs, the input data is always restored back to the data of the basic input data. This means that the NAMELIST CHANGE data and the run-type data represent data changes to the original input data as opposed to the previous case run.

3.2 INPUT FORMAT

The format of the input data deck is specified in Appendix A. The basic data deck begins with four comment cards followed by groups of data cards for each subgroup. The first card of each subgroup is also a comment card. Appendix I provides a cross reference for the input data deck, the associated VAX/VMS FORTRAN 77 input data variable names, and the mathematical model equations as described in Ref. 1. As a convenience to the user, Appendix J provides a cross reference similar to Appendix I for use with the NASA Sigma 8/VMS version of the generic tilt-rotor program (not revised for Revision A).

The input data switch options are explained in Appendix B. Notes on the use of NAMELIST CHANGE is in Appendix C, and an example of an input data deck is given in Appendix D. A data table list file is given in Appendix E, and an example of a data table file is given in Appendix F. Sign conventions for input data are provided in Appendix G.

4. OUTPUT GUIDE

4.1 REFERENCE SYSTEMS

Earth, body, wind, and mast axes systems are used in the mathematical model. The rotor flapping, forces, and moments are calculated in a "wind-mast" axis system, while the airframe aerodynamic forces and moments are calculated in a wind axis system. Forces and moments from the rotor and airframe are resolved into the body axis system for solution of the aircraft equations of motion. The flight path of the aircraft is described with reference to earth-fixed axes with the aircraft orientation given by the Euler angles Ψ, Θ, and Φ, in that order of rotation.

The control position/force-force and moment sign convention is shown in Fig. 4-1. Sign conventions are in accordance with Ref. 1.

4.2 INPUT DATA PRINTOUT

As the program begins execution, the first printout obtained is a listing of the input data cards through the END OF DATA card. Figure 4-2 presents this printout. This printout is strictly an echo of the input card images without regard to any illegal characters, input format errors, or program logic. This listing can be useful in locating input data errors that may be found in the following formatted input data printout.

The formatted print is separated into subsystem groups as shown in Fig. 4-3. In each subsystem, a line is used to print the variable name, description, input data value, and units. For execution on a computer terminal, NTSOSW can be set to eliminate the formatted print by subgroup with the exception of the Flight Configuration Group.

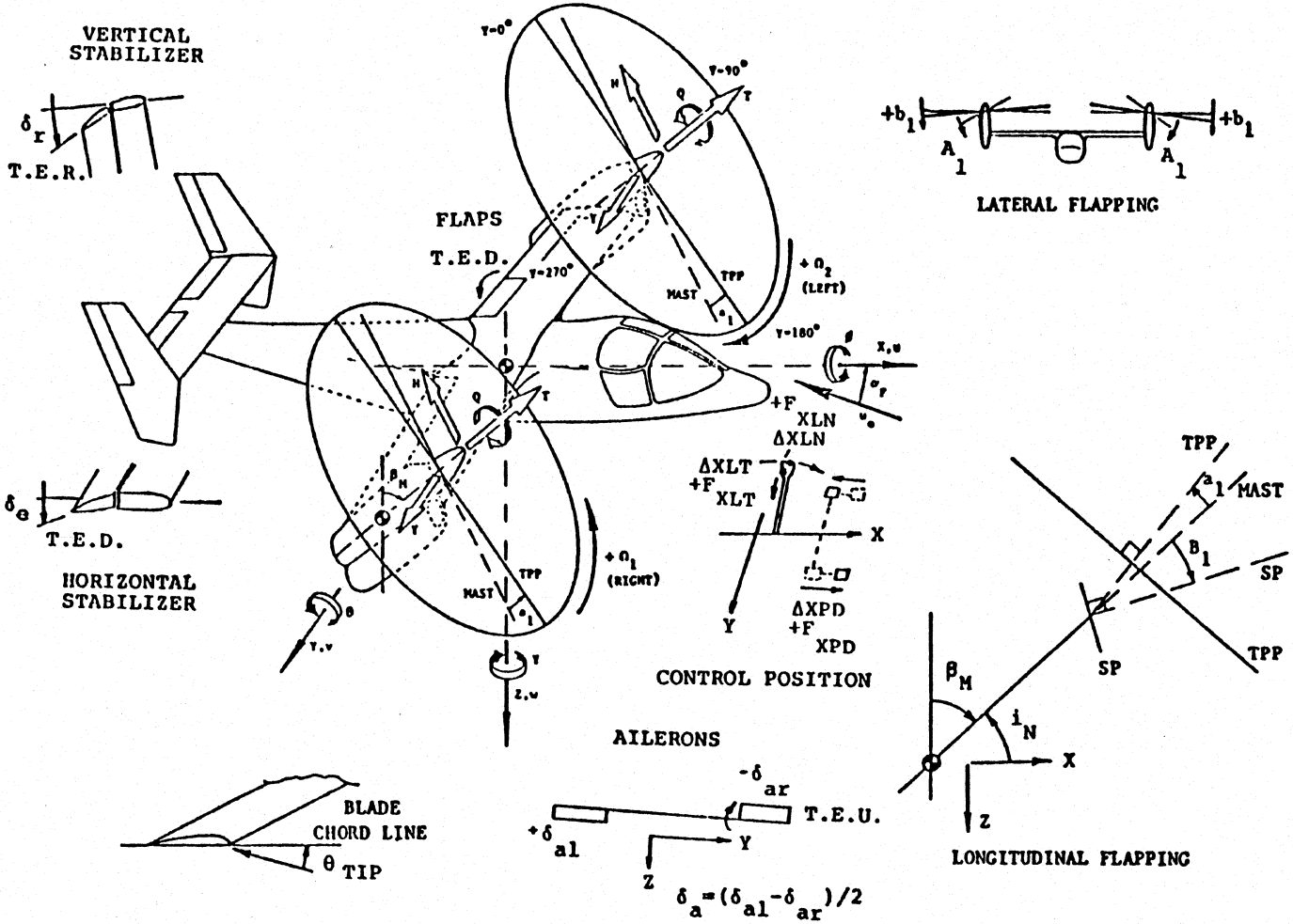

Figure 4-1. Control Position/Force-Force and Moment Sign Convention

```
                XV-15 TILT ROTOR DIGITAL FLIGHT SIMULATION
                G.W. = VARIABLE LBS, 299.9 AFT C.G.
                FLAPS 0/0, GEAR UP, 10-11-88
                EXAMPLE CASE FOR DOCUMENTATION
     ***** SUBSYSTEM 1 - ROTOR GROUP *****
3.0       12.5      14.0      4.667     -15.0     102.5     225.0
300.0     193.0     100.0     0.97      0.015     -0.068    0.81
291.7     193.0     118.0     3986.0    90.0      1.0       10.0
1.0       0.6       0.5333    0.4667    0.4       0.3333    0.2667
0.2000    0.1333    0.0667    0.0
0.0       10.2      12.3      14.5      17.75     21.90     26.15
30.65     34.65     38.00     40.90
1.6       0.0       0.0       0.0       0.0       338.19    3.0
4.95      8.0       -30.0     8.0       1.0
2.5       180000.   0.01      0.85      0.35      0.20
1.0       0.11      -0.08     1.5629083 -2.911932 54.0
17.807    -0.561    6.0       0.1067    0.5733    1.0       5.5
     ***** SUBSYSTEM 3 - FUSELAGE GROUP *****
293.0     84.0
-7.23     -1.56     66.5      0.0       -0.5      1.15
     ***** SUBSYSTEM 4 - WING-PYLON GROUP *****
291.17    95.85     181.0     32.17     5.225     -6.5      5.7
0.0       0.0       0.0       -0.774    0.27      -0.0016   0.006
-0.0315   0.057     -0.016    -0.32     -0.06     1.0       -0.45
1.4000    -0.0035   0.26      0.0806    .00003341 .000007386
24.05
     ***** SUBSYSTEM 5 - HORIZONTAL STABILIZER GROUP *****
560.0     103.0               50.25     3.92                -0.00422
0.0       0.518     0.8       0.24      1.0       0.0       0.0
     ***** SUBSYSTEM 6 - VERTICAL STABILIZER GROUP *****
2.0
570.02    -77.0     115.69    25.25     0.0       3.02522
0.27      0.25      -0.1      0.0       1.0       0.24
570.02    77.0      115.69    25.25     0.0       3.02522
0.27      0.25      -0.1      0.0       1.0       0.24
     ***** SUBSYSTEM 7 - LANDING GEAR GROUP *****
324.0     7.4       139.0     4.95      10.0      7.0
     ***** SUBSYSTEM 8 - CONTROL SYSTEM GROUP *****
4.8       4.8       2.5       4.8       4.8       2.5
4.167     3.93      8.0       0.0       1.0       1.0       1.0
0.0
0.0
0.0
                              0.0       1.5
9.6       9.6       5.0       10.0      90.0      -5.0
     ***** SUBSYSTEM 14 - IGE MOMENT GROUP *****
-7506.0   23366.0   -20134.0  5290.0    -0.1      1.6386    0.5
-0.9      -2.6      -0.08
     ***** SUBSYSTEMS 17,18, &19 - POWER MANAGEMENT GROUP *****
11.3      0.0       6.0       6.0       824.0     35.133    0.93
-0.94     1.94      0.0       13100.0   235.0     475.0     288.16
0.0032    0.875     0.00125   0.0       0.0       42.0      1400.0
1.0       1.0       10.0      -5.0      33.5
```

Figure 4-2. Listing of Input Data

```
     ***** SUBSYSTEM 20 - SCAS GROUP *****
1.0       1.078
0.3       3.0       0.3
0.6       -1.0      0.921     0.386     0.107     0.0
-7.5      -7.5      0.2       0.2       0.0       0.0
0.092     0.059
1.0       1.617
0.3       3.0       0.3
1.0       1.0       0.535     0.803     0.064     0.057
10.0      10.0      0.2       0.2       0.0       0.0
0.15      0.15
1.0       0.4
2.7       2.7       0.0
2.94      0.0       0.16      0.08      0.0       0.0
0.0       0.0       0.0       0.0       0.0       0.0
0.0       0.0
    *****  TABLES NOT READ IN FROM OUTSIDE FILES  *****
0.057     0.0575    0.057     0.0563
0.0799    0.080     0.080     0.08
0.0799    0.0837    0.0915    0.0988
0.2126    0.2512    0.256     0.442
0.0177    0.0419    0.058     0.243
0.0177    0.0178    0.0179    0.0405
0.00316   0.00396   0.00476   0.0
0.000     15.0      30.0      60.0
***** FLIGHT CONFIGURATION GROUP *****
12690.0   7432.0    0.0       8.6
299.9     0.0       81.65     52795.0   21360.0   66335.0   1234.0
20.5      11.24     9.26      1.76
4.9       4.8       2.5       6.96      516.5     516.5     0.01
150.0     0.0       0.0       0.0       1.0       0.0
0.0       3.0       0.0       0.0       0.0       0.0
0.0       0.0       7500.0    0.0       0.0       0.0
1.0       1.0       0.0
        0         1         0         1         0
        0         0         1         0         1
        0         0         0         1         1         0
        4         7        10
[SAM.AEROTAB]TABLIS.DAT
END OF DATA
TRMS
10    12690.0 -144.0     1    1   140.0       0.0     20.0       7
 &CHANGE
 &END
/*
```

Figure 4-2 (Concluded)

SUBSYSTEM NO. 1 ROTOR GROUP

NAME	DESCRIPTION	VALUE	UNITS
XBLADS	NUMBER OF ROTOR BLADES	3.0000	-ND-
RADIUS	RADIUS OF ROTOR DISC	12.500	FT
CHORD	BLADE CHORD	14.000	IN
LMAST	MAST LENGTH	4.6670	FT
DEL3	PITCH FLAP COUPLING	-15.000	DEG
IBLADE	BLADE FLAPPING INERTIA	102.50	SLG-FT2
KH	FLAPPING HUB SPRING RATE	225.00	FT-LB/DEG
SLSP	S.L. OF SHAFT PIVOT POINT	300.00	IN
BLSP	B.L. OF SHAFT PIVOT POINT	193.00	IN
WLSP	W.L. OF SHAFT PIVOT POINT	100.00	IN
BTLOSS	BLADE TIP LOSS FACTOR	0.97000	-ND-
DEL0	CONST IN CDF EQUATION	0.15000E-01	-ND-
DEL1	CONST IN CDF EQUATION	-0.68000E-01	1/RAD
DEL2	CONST IN CDF EQUATION	0.81000	1/RAD2
SLPYL	S.L. OF PYLON C.G.	291.70	IN
WLPYL	W.L. OF PYLON C.G.	118.00	IN
PYLWT	WEIGHT OF TWO PYLONS	3986.0	LBS
BETAD	MAST TILT ANGLE	0.00000E+00	DEG
PHIM	MAST DIHEDRAL ANGLE	1.0000	DEG
NSEGMT	NUMBER OF BLADE SEGMENTS	10	-ND-
X(1)	BLADE STATION / R	1.0000	-ND-
X(2)	BLADE STATION / R	0.60000	-ND-
X(3)	BLADE STATION / R	0.53330	-ND-
X(4)	BLADE STATION / R	0.46670	-ND-
X(5)	BLADE STATION / R	0.40000	-ND-
X(6)	BLADE STATION / R	0.33330	-ND-
X(7)	BLADE STATION / R	0.26670	-ND-
X(8)	BLADE STATION / R	0.20000	-ND-
X(9)	BLADE STATION / R	0.13330	-ND-
X(10)	BLADE STATION / R	0.66700E-01	-ND-
X(11)	BLADE STATION / R	0.00000E+00	-ND-
THETA(1)	BLADE TWIST	0.00000E+00	DEG
THETA(2)	BLADE TWIST	10.200	DEG
THETA(3)	BLADE TWIST	12.300	DEG
THETA(4)	BLADE TWIST	14.500	DEG
THETA(5)	BLADE TWIST	17.750	DEG
THETA(6)	BLADE TWIST	21.900	DEG
THETA(7)	BLADE TWIST	26.150	DEG
THETA(8)	BLADE TWIST	30.650	DEG
THETA(9)	BLADE TWIST	34.650	DEG
THETA(10)	BLADE TWIST	38.000	DEG
THETA(11)	BLADE TWIST	40.900	DEG
K0	CONST-WING VELOCITY EQU	1.6000	-ND-
K1	CONST-WING VELOCITY EQU	0.00000E+00	-ND-
K2	CONST-WING VELOCITY EQU	0.00000E+00	-ND-
K3	CONST-WING VELOCITY EQU	0.00000E+00	-ND-
K4	CONST-WING VELOCITY EQU	0.00000E+00	-ND-

Printout from Subroutine SIMINIT if NTSOSW=0

Figure 4-3. Formatted Print of Input Data

SLWTE	STA LINE WING TRAIL EDGE	338.19	IN
KRW	SKEW ANGLE VEL.DIST.FACT.	3.0000	-ND-
NASEGS	NUMBER OF AERO. SEGMENTS	8	-ND-
BDALP0	CONST-BLADE ZERO LIFT	1.0000	DEG
A0BAR	PRECONE ANGLE	2.5000	DEG
KHUB	CONING HUB SPRING	0.18000E+06	FT-LB/DEG
RSLC0	CONST-SLOPE OF LIFT CURVE	4.9500	-ND-
RSLC1	CONST-SLOPE OF LIFT CURVE	8.0000	-ND-
RSLC2	CONST-SLOPE OF LIFT CURVE	-30.000	-ND-
CDALPH	DRAG COEF. SLOPE W/ALPHA	0.10000E-01	-ND-
CDLIM	ONSET - PROFILE DRAG RISE	0.85000	-ND-
CDMACH	LOWER LIMIT - MACH EFFECT	0.35000	-ND-
CDFACT	DRAG COEFFICIENT FACTOR	0.20000	-ND-
CTMAXM	CT MAX MULT. FACTOR	1.0000	-ND-
CDMAX	MAX. DRAG COEFFICIENT	0.11000	-ND-
GEWASH	A/S WASHOUT IGE	-0.80000E-01	SEC/FT
GECON1	CONST. IN IGE EQUATION	1.5629	-ND-
GECON2	CONST. IN IGE EQUATION	-2.9119	-ND-
SFWASH	A/S WASHOUT ROTOR SIDE FX	54.000	FPS
KMU1	INDUCED VEL. DISTR. EQN.	17.807	-ND-
KMU2	INDUCED VEL. DISTR. EQN.	-0.56100	-ND-
KMUSF	SIDEWARD FLT CORR. FACTOR	6.0000	-ND-
MUL0	INDUCED VEL. DISTR. EQN.	0.10670	-ND-
MUH1	INDUCED VEL. DISTR. EQN.	0.57330	-ND-
SDBM90	SPINNER DRAG AT BETAD=90	1.0000	FT2
SDBM	SPINNER DRAG EQU. CONST.	5.5000	FT2

SUBSYSTEM NO. 1 ROTOR GROUP TABLES

TABLE NAME	DESCRIPTION	DIRECTORY
TBAR	MAX THRUST COEFFICIENT VS MU	[SAM.AEROTAB]
CTL15	THRUST COEF END LIMIT,BM=15.	[SAM.AEROTAB]
CTL30	THRUST COEF END LIMIT,BM=30.	[SAM.AEROTAB]
CTL60	THRUST COEF END LIMIT,BM=60.	[SAM.AEROTAB]
TXSF	SIDEWASH EFFECT	[SAM.AEROTAB]
TXSS	SIDEWASH EFFECT	[SAM.AEROTAB]

Figure 4-3 (Concluded)

4.3 OPTIONAL PRINTOUT

4.3.1 Individual Trim Page Printout

If TRMPAG=1 for the TRMS and MANS run-type options, the individual trim page will be printed. As shown in Fig. 4-4, the individual trim page consists of the header, the aircraft trim values, and the trim flight conditions. In the standard header are:

Airspeed
Nacelle Incidence
Mode of Flight (helicopter, conversion, or airplane)
Gross Weight
Center of Gravity
Rotor RPM
Mast angle
Flap setting

The TRMS option will also provide a summary trim page at the end of the run.

4.3.2 Rotor Derivative Matrix Printout

If RDERMX=1 for the TRMS and MANS run-type options, the rotor derivative matrix will be printed. As shown in Fig. 4-5, the rotor derivative matrix gives the derivative of the rotor terms as a function of aircraft linear and angular rates, control inputs, and rotor rotation speed.

4.3.3 Force and Moment Summary Printout

If FAMSUM=1 for the TRMS, DTPT, MANS, and MANU run-type options, the force and moment summary page will be printed. As shown in Fig. 4-6, the force and moment summary page consists of the header and a tabulation in body axis of individual and total airframe and rotor X, Y, and Z forces

```
************        AIRCRAFT TRIM FLIGHT CONDITIONS        ************

*********************************************************************
*** VT =  0.10 KTS *** NACELLE INCIDENCE = 90.0 DEG  ***  HELICOPTER  ***
*** GW = 13000.0      RPM =  589.00   SLCG =  299.80   WLCG =   81.65 ***
***   MAST ANGLE =   0.00 DEG   *****   FLAP SETTING =    40/25  DEG  ***
*********************************************************************
```

Printed from Subroutine IFHB42 if TRMPAG = 1

```
                                  ----- EARTH REFERENCE -----
                                     UE          VE          WE
                RATE    (FPS)   0.1688      0.0000E+00   0.5821E-10
                ACCEL  (FPS2)   0.1749E-04  -.7575E-13   0.4655E-03

                              --------------- BODY REFERENCE ---------------
                        UB          VB          WB          P           Q           R
RATE  (FT OR DEG/SEC)  0.1688     0.0000E+00  0.7131E-03  0.0000E+00  0.0000E+00  0.0000E+00
ACCEL(FT OR DEG/SEC2)                                     -.9890E-14  0.1776E-02  -.4231E-12

----- ATMOSPHERIC CONDITIONS -----  ----- FLIGHT PATH CONDITIONS -----  ----- INERTIAS -----  ----- CENTER OF GRAVITY -----
ALTITUDE      (FT)          1000.00  CAL. AIRSPEED  (KNOTS)       0.00     (SLUGS-FT2)                 (IN)
DENSITY ALT. (FT)           1815.95  RATE OF DECENT (FPS)         0.00
PRESSURE ALT.(FT)           1000.00  G-LEVEL        (G S)         1.00  IXX      0.5280E+05     S.L.      299.8
AMBIENT TEMP (DEG-R)         293.16  DYN PRES (SLUGS/FT-SEC2)     0.00  IXZ       1234.         B.L.     0.0000E+00
OUTSIDE AIR TEMP (DEG-C)      20.00  ANGLE OF ATTACK  (DEG)       0.242  IYY      0.2136E+05     W.L.       81.65
AIR DENSITY (SLUGS/FT3) 0.2253E-02   FLIGHT PATH ANGLE(DEG)       0.000  IZZ      0.6634E+05
                                     SIDESLIP ANGLE   (DEG)       0.000
THETES (ND)                1.01735  ROLL ANGLE       (DEG)       0.000
DELSTD (ND)                0.96439  PITCH ANGLE      (DEG)       0.242
SIGMA PRIME (ND)           0.94794  YAW ANGLE        (DEG)       0.000

----- CONTROL DISPLACEMENTS -----  --------------- POWER/TORQUE ---------------  ---------- BLADE ----------
        (+)        (IN)      (PER)          POWER       TORQUE     GOV. PITCH   TIP SPEED       TIP MACH NO.
COLL    (UP)      7.6518     76.52          (SHP)      (FT-LBS)      (DEG)       (FPS)            (ND)
LONG    (FWD)     4.9047     51.09  LEFT    1014.       9040.       3.248       771.2           0.6848
LAT     (RT)      4.8000     50.00  RIGHT   1014.       9040.       3.248       771.2           0.6848
PEDAL   (RT)      2.5000     50.00  ENGINE  1100.

----- SWASH PLATE ANGLE (DEG) ----                   ----------- ROTOR -----------
        LEFT ROTOR   RIGHT ROTOR  ------------ FLAPPING ------------  ---- FORCES - MAST AXIS ------  -- JET --
THETA0    47.6909     47.6909            A0        LONG       LAT      THRUST     H-FORCE    Y-FORCE   THRUST
B1         0.2199      0.2199          (DEG)      (DEG)      (DEG)     (LBS)      (LBS)      (LBS)     (LBS)
A1         0.0000      0.0000  LEFT    3.0917    -0.2132    -0.0242   7328.35    -27.63     -5.21     101.11
                               RIGHT   3.0917    -0.2132    -0.0242   7328.35    -27.63     -5.21     101.11

------- SURFACE POSITIONS -------          PROP      ADVANCE   INDUCED   INFLOW    COEFF     COEFF     COEFF
          (DEG)                           EFFIC.     RATIO   VELOCITY   RATIO     POWER     THRUST    DRAG
                                           (ND)       (ND)     (FPS)     (ND)      (ND)      (ND)      (ND)
     ELEVATOR          0.4363   LEFT     0.0000     0.0002   54.0268   0.0700   0.001100  0.011146  0.028295
     AILERON           0.0000   RIGHT    0.0000     0.0002   54.0268   0.0700   0.001100  0.011146  0.028295
     RUDDER            0.0000
                                         CDRISE      CTEL     CDALPHA   CDLIM    CDMACH    CDFACT
                                          (ND)       (ND)      (ND)     (ND)      (ND)      (ND)
                                  LEFT  -0.03127   0.01601   0.01000   0.85000   0.35000   0.20000
                                  RIGHT -0.03127   0.01601

   TIME USED FOR THIS TRIM =   0.0820 MIN
```

Figure 4-4. Individual Trim Page Printout.

ROTOR DERIVATIVE MATRIX

	U	V	W	P	Q	R	THETO	B1	OMEGA
FAFLPL	0.8877E-02	-.1311	0.2287E-02	-2.753	-4.586	0.2261	-.1985E-03	-.9766	0.1019E-03
FAFLPR	0.8877E-02	0.1311	0.2287E-02	2.753	-4.586	-.2261	-.1985E-03	-.9766	0.1019E-03
LTFLPL	0.1312	0.8935E-02	0.7231E-04	4.585	-2.716	2.150	0.8094E-03	-.2104	-.7334E-03
LTFLPR	0.1312	-.8936E-02	0.7231E-04	-4.585	-2.716	-2.150	0.8094E-03	-.2104	-.7334E-03
HL	1.677	-7.453	-.1448E-01	-352.0	-389.2	33.56	-2.412	-127.0	-.8770
HR	1.677	7.453	-.1448E-01	352.0	-389.2	-33.56	-2.412	-127.0	-.8770
YL	7.474	1.719	-.3435E-01	389.6	-352.3	125.7	-.3804	-29.39	-.2202
YR	7.474	-1.719	-.3435E-01	-389.6	-352.3	-125.7	-.3804	-29.39	-.2202
TL	9.473	-4.213	39.14	-658.8	-30.04	268.8	628.9	0.4043	237.6
TR	9.473	4.209	39.14	658.8	-30.04	-268.6	628.9	0.4043	237.6
HPL	1.453	-.1511E-01	-.3186E-01	2.050	-11.68	53.74	127.4	0.9192E-01	49.31
HPR	1.453	0.1605E-01	-.3186E-01	-2.059	-11.68	-53.78	127.4	0.9192E-01	49.31
XROT	-3.353	-.1144E-04	0.2896E-01	-.5722E-03	778.3	0.8011E-03	4.824	253.9	1.754
YROT	0.0000E+00	-3.291	0.0000E+00	-756.2	0.0000E+00	-260.7	0.0000E+00	0.0000E+00	0.0000E+00
ZROT	-18.68	0.3906E-02	-78.26	-.1953E-01	47.76	-.2051	-1258.	-1.834	-475.1
LROT	0.0000E+00	-161.5	0.0000E+00	-.2826E+05	0.0000E+00	6033.	0.0000E+00	0.0000E+00	0.0000E+00
MROT	24.00	-.3052E-04	-.4448	0.3052E-02	-6881.	-.1831E-02	-90.59	-2013.	-28.97
NROT	0.0000E+00	242.3	0.0000E+00	0.1138E+05	-.9766E-02	-1747.	0.0000E+00	0.0000E+00	0.0000E+00
QREQL	12.96	-.1348	-.2847	18.28	-106.7	332.5	1136.	0.8193	293.1
QREQR	12.96	0.1431	-.2847	-18.35	-106.7	-332.9	1136.	0.8193	293.1
QLPT	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	-.9155E-04	-.9155E-04	-4.866
QRPT	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	-.9155E-04	-.9155E-04	-4.866

Printed from Subroutine STABDV if RDERMX = 1

TIME USED IN STABDV = 0.0318 MIN

Figure 4-5. Rotor Derivative Matrix Printout

********** FORCE AND MOMENT SUMMARY (BODY AXIS) **********

```
*********************************************************************
*** VT =  0.10 KTS *** NACELLE INCIDENCE = 90.0 DEG  ***  HELICOPTER  ***
*** GW = 13000.0      RPM =  589.00   SLCG =  299.80   WLCG =   81.65 ***
***   MAST ANGLE =   0.00 DEG   *****   FLAP SETTING =    40/25  DEG  ***
*********************************************************************
```

Printed from Subroutine FAMPRT if FAMSUM = 1

	X-FORCE LBS	Y-FORCE LBS	Z-FORCE LBS	ROLL FT-LBS	PITCH FT-LBS	YAW FT-LBS
FUSELAGE	0.000	0.000	0.000	0.000	-0.002	0.000
WING						
LEFT WING	-0.041	0.000	869.381	-9376.809	500.447	-0.439
RIGHT WING	-0.041	0.000	869.381	9376.809	500.447	0.439
FREESTREAM	-0.001	0.000	-0.002	0.000	-0.001	0.000
TOTAL	-0.082	0.000	1738.761	0.000	1000.893	0.000
ENGINE PYLONS	-0.222	0.000	113.798	0.000	2.236	0.000
HORIZ. STAB.	0.000	0.000	0.000	0.000	0.000	0.000
VERT. STAB.						
FIN NO. 1	0.000	0.000	0.000	0.000	0.000	0.000
FIN NO. 2	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.000	0.000	0.000	0.000	0.000	0.000
LANDING GEAR						
MAIN AERO.	0.000	0.000	0.000	0.000	0.000	0.000
NOSE AERO.	0.000	0.000	0.000	0.000	0.000	0.000
DYNAMIC	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.000	0.000	0.000	0.000	0.000	0.000
JET THRUST						
LEFT ENG	0.000	0.000	-101.275	1628.834	-1.688	0.000
RIGHT ENG	0.000	0.000	-101.275	-1628.834	-1.688	0.000
TOTAL	0.000	0.000	-202.549	0.000	-3.376	0.000
GROUND EFFECT						
FUSE-HOR STAB	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL AIRFRAME	-0.304	0.000	1650.010	0.000	999.751	0.000
ROTOR						
LEFT ROTOR	27.667	-122.860	-7337.244	117849.211	-499.748	-8606.591
RIGHT ROTOR	27.667	122.860	-7337.244	-117849.211	-499.748	8606.591
HUB SPINNER	-0.021	0.000	6.585	0.000	0.237	0.000
TOTAL ROTOR	55.313	0.000	-14667.901	0.000	-999.259	0.000
TOTAL AIRCRAFT (BODY AXIS)	55.009	0.000	-13017.893	0.000	0.492	0.000
TOTAL AIRCRAFT (INERTIAL AXIS)	0.084	0.000	-18.008	0.000	0.492	0.000

Figure 4-6. Force and Moment Summary Printout

and roll, pitch, and yaw moments. The total aircraft summation is given both in body and in inertial axis.

4.3.4 Stability Derivative Matrix Printout

If STBMTX=1 for the TRMS and MANS run-type options, the stability derivative matrix will be printed. For the DTPT case, this matrix is printed even if STBMTX=0. If SRTSPT=1 (for printing SCAS-off roots) or SCSRTS=1 (for printing SCAS-on roots), STBMTX is turned on internally in the program. As shown in Fig. 4-7 (for dimensional stability derivatives, NDIMSW=0), the stability derivative matrix page consists of the header and then a tabulation of the derivatives of the X-, Y-, and Z-body forces; the L-, M-, and N-body moments; and torque as a function of linear and angular aircraft rates, rpm, and control positions. By varying the value of NDIMSW (see Pages A-27 and B-2), the user can specify the units of the output on the printout. If NDIMSW=0, the stability derivatives are in dimensional units. If NDIMSW=1, the dimensional units are presented as divided by mass and the appropriate axis inertia. Non-dimensional derivatives are printed out if NDIMSW=2.

4.3.5 SCAS-Off Root Printout

If SRTSPT=1 for the TRMS and MANS run-type options, the longitudinal and lateral SCAS-off stability roots will be printed. The solution method invoked using this switch is a determinant (non-matrix) stability analysis solution. As shown in Fig. 4-8, the total printout appears on two pages. On the first page is the matrix data, coefficients of characteristic equations, and longitudinal and lateral roots. On the second page of printout, the roots are identified as longitudinal phugoid, longitudinal short period, dutch roll, roll mode, and spiral mode. These roots may not be identified using the classical terms if the airspeed approaches too close to hover; however, the roots will be calculated. Time to half or double amplitude and damping is also printed. (In general, the suggested method for obtaining SCAS-OFF roots is chosen with the

```
***************     STABILITY DERIVATIVE MATRIX     ***************

*********************************************************************
*** VT =  0.10 KTS *** NACELLE INCIDENCE = 90.0 DEG  ***  HELICOPTER  ***
*** GW = 13000.0      RPM =  589.00   SLCG =  299.80   WLCG =   81.65 ***
***   MAST ANGLE =   0.00 DEG   *****   FLAP SETTING =    40/25  DEG  ***
*********************************************************************
```

Printed from Subroutine HANDLE if STBMTX = 1

		XBODY	YBODY	ZBODY	LBODY	MBODY	NBODY	TORQUE
			UNITS =	(LBS OR FT-LB)	/	(FT/SEC OR RAD/SEC)		
P	TOTAL	0.0000	-757.9852	0.0000	-22360.4121	0.0000	11398.4580	0.0000
	ROTOR	0.0000	-757.6395	0.0000	-28275.1563	0.0000	11390.5078	0.0000
	AIRFRM	0.0000	-0.3457	0.0000	5914.7446	0.0000	7.9501	0.0000
Q	TOTAL	780.2933	0.0000	-78.8477	0.0000	-6941.5117	0.0000	-350.0195
	ROTOR	780.1481	0.0000	-90.4297	0.0000	-6891.5356	0.0000	-350.0195
	AIRFRM	0.1452	0.0000	11.5796	0.0000	-49.9762	0.0000	0.0000
R	TOTAL	-0.0001	-258.1416	0.0195	5467.7905	0.0018	-1823.9417	0.0195
	ROTOR	-0.0001	-261.3074	0.0195	6037.2656	0.0000	-1752.4609	0.0195
	AIRFRM	0.0000	3.1658	0.0049	-569.4751	0.0018	-71.4807	0.0000
U	TOTAL	-5.0090	0.0000	-17.1162	0.0000	30.9249	0.0000	25.7056
	ROTOR	-3.3407	0.0000	-15.5347	0.0000	23.9260	0.0000	25.7056
	AIRFRM	-1.6683	0.0000	-1.5817	0.0000	6.9989	0.0000	0.0000
V	TOTAL	0.0000	-8.6709	0.0000	-196.7278	0.0000	88.8709	0.0000
	ROTOR	0.0000	-8.0627	0.0000	-200.4453	0.0000	85.0854	0.0000
	AIRFRM	0.0000	-0.6082	0.0000	3.7175	0.0000	3.7854	0.0000
W	TOTAL	0.0821	0.0000	-83.3013	0.0000	-9.0323	0.0000	-2.2593
	ROTOR	0.0091	0.0000	-77.7974	0.0000	-0.2449	0.0000	-2.2593
	AIRFRM	0.0731	0.0000	-5.5041	0.0000	-8.7873	0.0000	0.0000
RPM	TOTAL	1.7508	0.0000	-423.7712	0.0000	3.3638	0.0000	865.3047
	ROTOR	1.7561	0.0000	-475.7688	0.0000	-29.0139	0.0000	865.3047
	AIRFRM	-0.0053	0.0000	51.9973	0.0000	32.3777	0.0000	0.0000

CONTROL DERIVATIVE MATRIX

		XBODY	YBODY	ZBODY	LBODY	MBODY	NBODY	TORQUE
			UNITS =	(LBS OR FT-LB)	/	(INCH OR DEG(XTHEG)		
XCOL	TOTAL	7.6973	0.0000	-1807.0566	0.0000	-17.3708	0.0000	-361.3154
	ROTOR	7.7189	0.0000	-2012.2471	0.0000	-145.0208	0.0000	-361.3154
	AIRFRM	-0.0216	0.0000	205.1901	0.0000	127.6500	0.0000	0.0000
XTHEG	TOTAL	4.6852	0.0000	-1129.5127	0.0000	-9.9886	0.0000	2274.7969
	ROTOR	4.6988	0.0000	-1257.7627	0.0000	-89.7744	0.0000	2274.7969
	AIRFRM	-0.0137	0.0000	128.2505	0.0000	79.7858	0.0000	0.0000
XLN	TOTAL	533.9872	0.0000	-3.7236	0.0000	-4231.0894	0.0000	3.4121
	ROTOR	533.9872	0.0000	-3.8799	0.0000	-4231.1787	0.0000	3.4121
	AIRFRM	0.0000	0.0000	0.1563	0.0000	0.0891	0.0000	0.0000
XLT	TOTAL	0.0000	-13.2464	0.0000	11868.9863	0.0000	-1372.6200	0.0000
	ROTOR	0.0000	-13.2464	0.0000	12625.2656	0.0000	-1372.5977	0.0000
	AIRFRM	0.0000	0.0000	0.0000	-756.2792	0.0000	-0.0223	0.0000
XPD	TOTAL	0.0000	94.1416	0.0000	781.3130	0.0000	6584.8760	0.0000
	ROTOR	0.0000	94.1419	0.0000	782.4688	0.0000	6584.8701	0.0000
	AIRFRM	0.0000	-0.0003	0.0000	-1.1558	0.0000	0.0059	0.0000

TIME USED IN HANDLE = 0.1833 MIN

Figure 4-7. Stability Derivative Matrix Printout

```
COEFFICIENTS OF CHARACTERISTIC EQUATION
LAMBDA **0  COEFF IS 0.79189089E+00
LAMBDA **1  COEFF IS 0.22894875E+01
LAMBDA **2  COEFF IS 0.63848149E+01
LAMBDA **3  COEFF IS 0.28381273E+01
LAMBDA **4  COEFF IS 0.10000000E+01
NORMALIZATION FACTOR= 0.10000000E+01


     2.8381      6.3848      2.2895      0.7919
                -6.3848      3.3303      8.6039
                            -10.2583     -3.5885
ROOT(1)=   -0.17981 ,    0.34031*I  ,Q=   0.38490
ROOT(2)=   -0.17981 ,   -0.34031*I  ,Q=   0.38490
ROOT(3)=   -1.23925 ,    1.95182*I  ,Q=   2.31200
ROOT(4)=   -1.23925 ,   -1.95182*I  ,Q=   2.31200


COEFFICIENTS OF CHARACTERISTIC EQUATION
MATRIX EXPANSION RESULTS IN A ZERO ROOT
LAMBDA **0  COEFF IS 0.18267846E+00
LAMBDA **1  COEFF IS 0.26875928E+01
LAMBDA **2  COEFF IS 0.36294506E+01
LAMBDA **3  COEFF IS 0.18613762E+01
LAMBDA **4  COEFF IS 0.10000000E+01
NORMALIZATION FACTOR= 0.13823591E+13


     1.8614      3.6295      2.6876      0.1827
                -3.6295      4.2719     -5.2040
                             -0.1191     -3.5773
ROOT(1)=   -0.44365 ,    1.58133*I  ,Q=   1.64238
ROOT(2)=   -0.44365 ,   -1.58133*I  ,Q=   1.64238
ROOT(3)=   -0.07536 ,    0.00000*I  ,Q=   0.07536
ROOT(4)=   -0.89871 ,    0.00000*I  ,Q=   0.89871
RETURNED FROM AS2014, LATERAL MODES
RETURNED FROM AS2005, NUMBER 1
RETURNED FROM AS2005, NUMBER 2
                        LONGITUDINAL NORMAL MODES
  REAL              IMAG.             VEL/THETA         PHASE             ALPHA/THETA       PHASE
  -0.17981142E+00   0.34031451E+00    0.81648433E+02    0.10750738E+03    0.10769203E+03    0.97926029E+02
  -0.12392523E+01   0.19518186E+01    0.11338513E+02   -0.15520202E+03    0.34580852E+03    0.24412333E+02
                                 LATERAL NORMAL MODE
  REAL              IMAG.             BETA/PHI          PHASE             PSI/PHI           PHASE
  -0.44364989E+00   0.15813282E+01    0.22442721E+01   -0.17904838E+03    0.80153903E+00   -0.28371317E+03
  -0.75362235E-01   0.00000000E+00    0.15055505E+00    0.00000000E+00    0.16470360E+02    0.00000000E+00

  -0.89871418E+00   0.00000000E+00    0.36026663E+02    0.00000000E+00    0.23160485E-01    0.00000000E+00
```

Printed from Subroutine SROOTS if SRTSPT = 1

Figure 4-8. SCAS OFF Root Printout

```
************************
* LONGITUDINAL PHUGOID *
************************

  REAL                        -.17981142
  DAMPED NATURAL FREQUENCY    0.34031451
  UNDAMPED FREQUENCY (RPS)    0.38489753
  UNDAMPED FREQUENCY (CPS)    0.61258394E-01
  PERIOD IN SEC                18.462862
  DAMPING                     0.46716699
  TIME TO HALF                 3.8548553

*****************************
* LONGITUDINAL SHORT PERIOD *
*****************************

  REAL                        -1.2392523
  DAMPED NATURAL FREQUENCY     1.9518186
  UNDAMPED FREQUENCY (RPS)     2.3119996
  UNDAMPED FREQUENCY (CPS)    0.36796644
  PERIOD IN SEC                3.2191415
  DAMPING                     0.53600889
  TIME TO HALF                0.55932677

**************
* DUTCH ROLL *
**************

  REAL                        -.44364989
  DAMPED NATURAL FREQUENCY     1.5813282
  UNDAMPED FREQUENCY (RPS)     1.6423836
  UNDAMPED FREQUENCY (CPS)    0.26139367
  PERIOD IN SEC                3.9733562
  DAMPING                     0.27012563
  TIME TO HALF                 1.5623739

*************
* ROLL MODE *
*************
  REAL                        -.89871418
  TIME TO HALF                0.77126523

***************
* SPIRAL MODE *
***************
  REAL                        -.75362235E-01
  TIME TO HALF                 9.1975377
```

Figure 4-8 (Concluded)

SCSRTS switch, Section 4.3.6. This method does not, however, assign the classical mode names with the roots. Therefore, it may be desirable to use both methods and compare the results.)

4.3.6 Matrix Method Root Printout

If SCSRTS=1 for the TRMS and MANS run-type options, then a SCAS-OFF stability analysis printout is provided. This analysis is based on a matrix solution technique. In the baseline printout, an example of which is provided in Fig. 4-9, a listing of the input mass, damping, and stiffness matrices is provided. This is followed by an output of the calculated SCAS-OFF roots and parameters associated with the roots. The baseline switch setting provides SCAS-OFF roots for a 6 × 6 rigid body degree-of-freedom analysis and a 7 × 7 analysis where the rpm degree-of-freedom is added to the 6 × 6 rigid body degrees-of-freedom. If a larger value than 1 is used for SCSRTS, other types of printout may also be obtained. The various options available for this switch are summarized in Table 4-1. (The options where SCAS ON roots are printed should be used with extreme caution, because the SCAS ON configuration may not be up to date unless the user has modified subroutine SCASRT.FOR. XV-15 ships 702 and 703 do not have the same SCAS systems, see Ref. 1.)

4.4 RUN-TYPE PRINTOUT

For each run-type, a heading page is printed. These pages typically contain a printout of the time of day and date and the run-type, as well as information and input data specific to the chosen run-type. Figure 4-10 provides an example header page for the MANS run-type. The Programmer's Manual provides examples for each of the run-type printouts with a reference to which subroutine in the program produced the printout.

*** RPM COUPLED STABILITY ROOTS - SCAS-OFF - FLAPPING ALLOWED TO CHANGE - 7 X 7 MATRIX ***

MASS MATRIX--

0.40407E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.40542E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.29606E+02	0.20348E+05	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.40407E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.50950E+05	-0.10756E+04	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	-0.10756E+04	0.67168E+05	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.82400E+03	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.10000E+01	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.10000E+01

DAMPING MATRIX--

0.14391E+03	-0.40253E+02	0.62373E+04	0.50226E-05	0.00000E+00	-0.91426E-04	-0.83003E+03	0.12982E+05	0.00000E+00
0.10950E+03	0.39309E+03	-0.11939E+06	0.00000E+00	0.91426E-04	0.00000E+00	-0.24519E+03	0.69306E+03	0.18135E-03
-0.44178E+03	0.28221E+03	0.22056E+05	0.00000E+00	0.80361E-02	0.00000E+00	0.23581E+04	0.00000E+00	0.00000E+00
0.40452E-06	0.24967E-05	0.25110E-03	0.10070E+03	-0.62161E+04	0.11937E+06	0.91073E-05	0.96819E-05	-0.12982E+05
0.80730E-04	0.30597E-06	-0.80157E-02	0.33282E+03	0.38590E+05	0.32188E+04	0.46598E-03	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	-0.57459E+03	0.11545E+05	0.57064E+05	0.00000E+00	0.00000E+00	0.00000E+00
-0.74333E+03	0.47116E+00	0.87280E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.47368E+04	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	-0.10000E+01	0.00000E+00	0.00000E+00	0.13970E-07	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	-0.74583E-09	0.00000E+00	-0.10000E+01	-0.53388E-01	0.00000E+00	0.00000E+00	0.00000E+00

STIFFNESS MATRIX--

0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

Printed from Subroutines SCASRT, MPRINT, MAINDG, and OUT if SCSRTS > 0

Figure 4-9. Matrix Method SCAS ON/OFF Printout

NO. OF EIGENVALUES CALCULATED 18

EIGENVALUES,(COMPLEX-VALUED) REAL	IMAG	FREQUENCIES DAMPED RPS	UNDAMPED RPS	UNDAMPED CPS	DAMPING RATIO	PERIOD SEC	TIME TO HALF AMPL SEC
0.0000000E+00	0.0000000E+00	0.0000000E+00	0.0000000E+00	0.0000000E+00	0.9999900E+38	0.9999900E+38	0.9999900E+38
0.1258183E-15	0.0000000E+00	0.0000000E+00	0.1258183E-15	0.2002460E-16	-1.000000	0.9999900E+38	0.5509112E+16
-0.1527745E-08	0.0000000E+00	0.0000000E+00	0.1527745E-08	0.2431482E-09	1.000000	0.9999900E+38	0.4537060E+09
0.2480169E-11	0.0000000E+00	0.0000000E+00	0.2480169E-11	0.3947312E-12	-1.000000	0.9999900E+38	0.2794757E+12
0.2478601E-11	0.0000000E+00	0.0000000E+00	0.2478601E-11	0.3944816E-12	-1.000000	0.9999900E+38	0.2796525E+12
0.6307231E-07	0.0000000E+00	0.0000000E+00	0.6307231E-07	0.1003827E-07	-1.000000	0.9999900E+38	0.1098972E+08
0.2240528E-06	0.0000000E+00	0.0000000E+00	0.2240528E-06	0.3565911E-07	-1.000000	0.9999900E+38	3093678.
0.2524561E-05	0.0000000E+00	0.0000000E+00	0.2524561E-05	0.4017964E-06	-1.000000	0.9999900E+38	274561.4
-0.2264264E-06	0.0000000E+00	0.0000000E+00	0.2264264E-06	0.3603687E-07	1.000000	0.9999900E+38	3061247.
-0.7535509E-01	0.0000000E+00	0.0000000E+00	0.7535509E-01	0.1199313E-01	1.000000	0.9999900E+38	9.198410
-0.8987213	0.0000000E+00	0.0000000E+00	0.8987213	0.1430359	1.000000	0.9999900E+38	0.7712591
-0.2712594E-01	0.1839980	0.1839980	0.1859868	0.2960071E-01	0.1458488	34.14812	25.55292
-0.2712593E-01	-0.1839979	-0.1839979	0.1859867	0.2960069E-01	0.1458488	-34.14814	25.55293
-0.4436502	1.581331	1.581331	1.642386	0.2613939	0.2701253	3.973352	1.562373
-0.4436503	-1.581331	-1.581331	1.642387	0.2613940	0.2701253	-3.973351	1.562373
-1.247340	1.899457	1.899457	2.272398	0.3616634	0.5489091	3.307885	0.5557001
-6.037715	0.0000000E+00	0.0000000E+00	6.037715	0.9609323	1.000000	0.9999900E+38	0.1148029
-1.247341	-1.899461	-1.899461	2.272402	0.3616640	0.5489085	-3.307878	0.5556999

TIME REQD FOR THIS PROBLEM 0.033 MIN

Figure 4-9 (Concluded)

TABLE 4-1. CONDITIONS FOR STABILITY DERIVATIVES

Matrix Size	SCSRTS =	Roots	SCAS	Flapping
6 × 6	1	Longitudinal plus Lateral	OFF	Allowed to change
7 × 7	1	Longitudinal plus Lateral	OFF	Allowed to change
3 × 3	2	Longitudinal	OFF	Allowed to change
5 × 5	2	Longitudinal	OFF	Rotor as degree of freedom
7 × 7	2	Longitudinal	ON	Allowed to change
9 × 9	2	Longitudinal	ON	Rotor as degree of freedom
3 × 3	3	Lateral	OFF	Allowed to change
5 × 5	3	Lateral	OFF	Rotor as degree of freedom
8 × 8	3	Lateral	ON	Allowed to change
10 × 10	3	Lateral	ON	Rotor as degree of freedom

DATE: 11OCT'87 RUNTYPE: MANS

AFTER AIRCRAFT TRIM, A MANEUVER WILL BE RUN FOR 3.50 SEC

CONTROLS REMAIN LOCKED FOR THE FIRST 2.0 SECONDS OF THE MANEUVER

CONTROLS WILL THEN BE MOVED FOR 1.50 SEC AS SHOWN BELOW

	TIME(SEC)	DXLN(PCT)	TIME(SEC)	DXLT(PCT)	TIME(SEC)	DXPD(PCT)	TIME(SEC)	DXCOL(PCT)
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.01	-10.00	20.00	0.00	20.00	0.00	1.00	0.00
3	20.00	-10.00	0.00	0.00	0.00	0.00	3.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	20.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PITCH SCAS WILL BE TURNED OFF AT 50.00 SECONDS
ROLL SCAS WILL BE TURNED OFF AT 50.00 SECONDS
YAW SCAS WILL BE TURNED OFF AT 50.00 SECONDS

DATA WILL BE PRINTED AT 0.10 SECOND INCREMENTS

A WIND GUST WILL BE ENCOUNTERED AFTER 0.00 SEC AND WILL STOP AT 0.00 SEC INTO RUN

TIME INCREMENT TSTEP =0.01000 SECONDS

Figure 4-10. MANS Run-Type Heading Printout

DATE: 11OCT'87 RUNTYPE: DTPT

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - INPUTS

U	=0.1688	V	=0.0000E+00	W	=0.0000E+00	P	=0.0000E+00	Q	=0.0000E+00	R	=0.0000E+00
RHO	=0.2253E-02	MN	=0.1499E-03	BETAD	=0.0000E+00	OMEGL	= 589.0	OMEGR	= 589.0		
A1L	=0.0000E+00	A1R	=0.0000E+00	B1L	=0.0000E+00	B1R	=0.0000E+00	THTOLD	= 45.20	THTORD	= 45.20
CPM	=0.9998	SPM	=0.1745E-01	CBM	= 1.000	SBM	=0.0000E+00				
LXH	=-.1667E-01	LYH	= 16.16	LZH	= 6.195						

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - RIGHT ROTOR

FAFLPR	=0.1331E-04	LTFLPR	=0.3397E-03	AOR	=0.4549E-01	TR	= 5783.	HR	=0.1723	YR	=0.8504
A1RBD	=0.1668E-09	B1RBD	=0.0000E+00	MUR	=0.2189E-03	QREQR	= 6466.	OMEGAR	= 61.68	OMGRP	= 61.68
THETOR	=0.7889	THORG	= 1.000	WIR	= 47.99	LAMDAR	=0.6221E-01	LAMDIR	=0.6225E-01	LAMDOR	=0.0000E+00
A11	=-.4773E+05	A12	=0.2227E+06	A21	=-.2227E+06	A22	=-.4773E+05	B1	= 75.02	B2	=-19.18
C11	= 3611.	C12	=0.1902E+05	C21	=-.1902E+05	C22	= 3611.	ARS	= 4.952	DWR	=0.6575E+06
GEFR	= 1.000	CHIRD	= 2.515								

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - LEFT ROTOR

FAFLPL	=0.1331E-04	LTFLPL	=0.3397E-03	AOL	=0.4549E-01	TL	= 5783.	HL	=0.1723	YL	=0.8504
A1LBD	=0.1668E-09	B1LBD	=0.0000E+00	MUL	=0.2189E-03	QREQL	= 6466.	OMEGAL	= 61.68	OMGLP	= 61.68
THETOL	=0.7889	THOLG	= 1.000	WIL	= 47.99	LAMDAL	=0.6221E-01	LAMDIL	=0.6225E-01	LAMDOL	=0.0000E+00
A11	=-.4773E+05	A12	=0.2227E+06	A21	=-.2227E+06	A22	=-.4773E+05	B1	= 75.02	B2	=-19.18
C11	= 3611.	C12	=0.1902E+05	C21	=-.1902E+05	C22	= 3611.	ALS	= 4.952	DWL	=0.6575E+06
GEFL	= 1.000	CHILD	= 2.515								

Figure 4-11. Subsystems 1 and 10B DTPT Run-Type Printout

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - VARIABLES IN WIND AXIS

HL	=0.1723	HR	=0.1723	YL	=0.8504	YR	=0.8504	HPL	= 725.1	HPR	= 725.1
AOL	=0.4549E-01	AOR	=0.4549E-01	FAFLPL	=0.1331E-04	FAFLPR	=0.1331E-04	LTFLPL	=0.3397E-03	LTFLPR	=0.3397E-03

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - OUTPUTS

A1L	=0.0000E+00	A1R	=0.0000E+00	B1L	=0.0000E+00	B1R	=0.0000E+00	TL	= 5783.	TR	= 5783.
HL	=0.1723	HR	=0.1723	YL	=0.8504	YR	=0.8504	WIL	= 47.99	WIR	= 47.99
HPL	= 725.1	HPR	= 725.1	QREQL	= 6466.	QREQR	= 6466.				
MA1L	=0.1716	MA1R	=0.1716	LB1L	= 4.379	LB1R	= 4.379				
XROT	=-.3446	YROT	=0.0000E+00	ZROT	=-.1156E+05	LROT	=0.0000E+00	MROT	=-415.9	NROT	=0.0000E+00
GECONS= 1.000											

Figure 4-11 (Concluded)

4.4.1 DTPT Run-Type Printout

The DTPT run-type provides three pages of printout for the various tilt-rotor components or subsystems, with the inputs and outputs of the subsystems being printed. Figure 4-11 shows the inputs and outputs for Subsystems 1 and 10b. Also included in the DTPT print is a short force and moment summary for the rotor, airframe, total in body axis, and total in inertial axis. If FAMSUM=1, a complete force and moment summary page is obtained. For the DTPT option, the stability derivative matrix is always printed out even if STBMTX=0.

4.4.2 TRMS Run-Type Printout

On the heading page for the TRMS run-type, the variables to be swept, their starting values, incrementing values, and final values are printed. For each trim case specified, the trim iteration information of Fig. 4-12 is listed. If a minimum printout is desired, this is the only information printed as each individual trim is performed. At the conclusion of the TRMS run, a summary page like Fig. 4-13 is printed for each of the values of the first variable of the sweep. Table 4-2 provides a list of the available optional print for the TRMS run-type.

4.4.3 MANS Run-Type Printout

The MANS run-type header page provides a wealth of information to the user. An example of this printout is provided in Fig. 4-10. A description of the chosen control input option is provided first. This is followed by a tabular listing of the control positions to be input as a function of time, unless a pure step or the sum-of-sines option was chosen. The printout is simplified if these alternative options are chosen. For SCAS failure investigations, a tabulation is provided which identifies the time at which the failure will occur. Lastly, information is provided on any user-input gust profile, and a note on the frequency of printout is provided. All of the print options available with the TRMS

DATE: 11OCT'87 RUNTYPE: TRMS

SWEEP GW STARTING WITH 0.1300E+05 , INCREMENTING BY -150.0 , ENDING WITH 0.1300E+05

SWEEP U STARTING WITH 0.1000 , INCREMENTING BY 10.00 , ENDING WITH 20.10

TOTAL TIME USED SINCE BEGINNING OF RUN 1.3275 MIN

GW / U SWEEP --- ITERATION 1 / 1

ITER	ERROR	ROLL	PITCH	YAW	XLN	XLT	XPD	THOLG	FAFLPL	LTFLPL
1	0.3311	0.000	1.512	0.000	5.370	4.800	2.500	7.153	-1.168	-0.230
2	0.0655	0.000	0.512	0.000	5.003	4.800	2.500	7.247	-0.416	-0.068
3	0.0005	0.000	0.242	0.000	4.905	4.800	2.500	7.269	-0.213	-0.024

Figure 4-12. TRMS Run-Type Header and Iteration Summary Printout

XV-15 TILT ROTOR DIGITAL FLIGHT SIMULATION DATE: 11OCT'87
G.W. = 13000 LBS, 299.8 AFT C.G. PAGE 1

CONFIGURATION:

NACELLE INCIDENCE	90.0 DEG	GEAR	0.0 % DOWN	ALTITUDE	
FLAP SETTING	40/25 DEG	STAB INCIDENCE	0.000 DEG	PRES(MSL)	1000.0 FT
ROTOR RPM	589.0 RPM	INERTIA, SLUG-FT2		DENSITY	1816.0 FT
GROSS WEIGHT	13000.0 LB	IXX 52795.	IXZ 1234.0	HEIGHT(AGL)	1000.0 FT (OGE)
C.G. F.S.	299.800 IN	IYY 21360.	IZZ 66335.	TEMP(OAT)	20.00 DEG-C
W.L.	81.650 IN	SIGMAP	0.94794 -ND-	VSOUND	667.19 KTS
		RHO	0.0022532 SLG/FT3	WIND-V	0.00 KTS

U/VKCAS -KTS NOTE: SYMBOL INDICATES A TRIM PROBLEM

	0.10	10.10	20.10	0.00	0.00	0.00	0.00	0.00
	0.00	9.83	19.57	0.00	0.00	0.00	0.00	0.00
AIRCRAFT CONTROL SETTINGS:								
XLN,%	51.0907	52.2458	52.7916	0.0000	0.0000	0.0000	0.0000	0.0000
XLT,%	50.0000	50.0000	50.0000	0.0000	0.0000	0.0000	0.0000	0.0000
XPD,%	50.0000	50.0000	50.0000	0.0000	0.0000	0.0000	0.0000	0.0000
XCOL,%	76.5176	76.8619	74.2551	0.0000	0.0000	0.0000	0.0000	0.0000
A1,DEG	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
B1,DEG	0.2199	0.4528	0.5628	0.0000	0.0000	0.0000	0.0000	0.0000
THETO,DEG	47.6909	47.5955	46.9895	0.0000	0.0000	0.0000	0.0000	0.0000
THOG,DEG	3.2481	3.0976	2.9087	0.0000	0.0000	0.0000	0.0000	0.0000
ELEVATOR,DEG	0.4363	0.8984	1.1167	0.0000	0.0000	0.0000	0.0000	0.0000
AILERON,DEG	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
RUDDER,DEG	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ROTOR:								
FAFLP,DEG	-0.2132	-0.3164	-0.3312	0.0000	0.0000	0.0000	0.0000	0.0000
LTFLP,DEG	-0.0242	2.1919	4.2550	0.0000	0.0000	0.0000	0.0000	0.0000
THRUST,LB	7328.3	7328.4	7135.3	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
CT	0.0111	0.0111	0.0109	0.0000	0.0000	0.0000	0.0000	0.0000
H-FORCE,LB	-27.633	-31.614	-22.521	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
Y-FORCE,LB	-5.2050	116.56	226.86	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
HORSEPOWER	1013.8	1023.0	961.04	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
Q,FT-LB	9040.1	9122.0	8569.6	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
CP	0.0011	0.0011	0.0010	0.0000	0.0000	0.0000	0.0000	0.0000
RPM,ROTOR	589.00	589.00	589.00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
WI,FT/SEC	54.0268	55.6262	53.4910	0.0000	0.0000	0.0000	0.0000	0.0000
MU	0.0002	0.0221	0.0440	0.0000	0.0000	0.0000	0.0000	0.0000
LAMDA	0.0700	0.0720	0.0695	0.0000	0.0000	0.0000	0.0000	0.0000
AIRCRAFT ATTITUDES:								
ALPHAF,DEG	0.2421	0.1633	-0.3276	0.0000	0.0000	0.0000	0.0000	0.0000
PITCH,DEG	0.2421	0.1633	-0.3276	0.0000	0.0000	0.0000	0.0000	0.0000
GAMMA,DEG	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BETAF,DEG	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ROLL,DEG	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Figure 4-13. TRMS Summary Page Printout

YAW,DEG	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FLIGHT CONDITIONS:

DYNAMIC PRES	0.0000	0.3274	1.2966	0.0000	0.0000	0.0000	0.0000	0.0000
MACH NUMBER	0.0001	0.0151	0.0301	0.0000	0.0000	0.0000	0.0000	0.0000
VT,KNOTS	0.1000	10.1000	20.1000	0.0000	0.0000	0.0000	0.0000	0.0000
VKCAS,KNOTS	0.0000	9.8326	19.5718	0.0000	0.0000	0.0000	0.0000	0.0000
HP-ENG	1100.0	1109.9	1043.4	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

SYMBOL DEFINITIONS:

++++ FORCES AND MOMENTS UNBALANCED
**** CONTROLS OUT OF LIMITS
ROTOR ENDURANCE LIMIT EXCEEDED
@@@@ ROTOR STALLED
//// WING STALLED

CPU TIME SINCE TIMEX CALLED = 0.0083 MIN TOTAL TIME USED IN THIS RUN = 2.2138 MIN

Figure 4-13 (Concluded)

TABLE 4-2. PRINT OPTIONS AVAILABLE FOR TRMS AND MANS RUN-TYPES

Print Switch	Print Option
TRMPAG=1	Individual Trim Page
RDERMX=1	Rotor Derivative Matrix
STBMTX=1	Stability Derivative Matrix
SRTSPT=1	Determinant Method SCAS-Off Root Analysis
SCSRTS>0	Matrix Method Root Analysis
FAMSUM=1	Force and Moment Summary

run-type are also available for MANS, since MANS begins from a trim. When the maneuver results are printed out, a snapshot page is printed at each printout time increment (user specified). An example is provided in Fig. 4-14. When this snapshot page is printed, the force and moment summary is also obtained if FAMSUM=1.

4.4.4 MANU Run-Type Printout

The MANU run-type immediately initiates the maneuver with a snapshot print like that of Fig. 4-14. When the maneuver snapshot is printed, the force and moment summary is obtained if FAMSUM=1.

4.4.5 TUNL Run-Type Printout

The TUNL run-type provides a printout as shown in Fig. 4-15. None of the print switch options are operative for the TUNL run-type.

4.5 GRAPHICS DATA FILE

A graphics data file is output at the request of the user when the MANS or MANU option is specified. This data file contains unformatted (not ASCII) data for pickup by other user specified graphics programs. Since graphics programs are usually unique to the site where they are used, the format of the output data file may need to be modified. This can be accomplished in one of several ways, each of which is described in the programmer's guide. Appendix H herein presents a list of the parameters presently output to the default data file. The data contained in this file can be viewed online (at a terminal) or printed by executing the MATOUT.COM utility that is also described in the programmer's guide.

```
******** TIME =   0.000 SECONDS INTO RUN          KTAS =  180.00 KNOTS

 *****    ROTOR DATA

FAFLPL(DEG) = -.8126          LTFLPL(DEG) = -.1706          AOL   (DEG) =  1.199
FAFLPR(DEG) = -.8126          LTFLPR(DEG) = -.1706          AOR   (DEG) =  1.199

THETOL(DEG) =  66.66          A1L   (DEG) = 0.0000E+00      B1L   (DEG) =  1.500
THETOR(DEG) =  66.66          A1R   (DEG) = 0.0000E+00      B1R   (DEG) =  1.500

THOLG (DEG) =  10.86          WIL   (F/S) =  1.089          OMEGAL(RPM) =  517.0
THORG (DEG) =  10.86          WIR   (F/S) =  1.089          OMEGAR(RPM) =  517.0

TL    (LB)  =  704.2          HL    (LB)  =  65.13          YL    (LB)  = -44.92
TR    (LB)  =  704.2          HR    (LB)  =  65.13          YR    (LB)  = -44.92

QREQL(FT-LB)=  5449.          HPL   (SHP) =  536.4          TIPSPL(F/S) =  741.8
QREQR(FT-LB)=  5449.          HPR   (SHP) =  536.4          TIPSPR(F/S) =  741.8

 *****    CONTROLS DATA

XLN   (IN)  =  5.070          XLN   (PCT) =  52.82          ELEV  (DEG) =  1.148
XLT   (IN)  =  4.800          XLT   (PCT) =  50.00          AILR  (DEG) = 0.0000E+00
XPD   (IN)  =  2.500          XPD   (PCT) =  50.00          RUDD  (DEG) = 0.0000E+00
PWRLEV (IN) =  4.338          PWRLEV(PCT) =  43.38          BM    (DEG) =  90.00

ESAS  (IN)  = 0.5085E-02      ESAS  (PCT) = 0.4717E-02      ENGINE(SHP) =  586.8
ASAS  (IN)  = 0.0000E+00      ASAS  (PCT) = 0.0000E+00      HPENAV(SHP) =  536.4
RSAS  (IN)  = 0.0000E+00      RSAS  (PCT) = 0.0000E+00

 *****    STATE DATA

UB    (F/S) =  303.4          QB    (D/S) = 0.0000E+00      KCAS  (KTS) =  175.4
VB    (F/S) = 0.2263E-06      PB    (D/S) = 0.0000E+00      KTAS  (KTS) =  180.0
WB    (F/S) =  16.20          RB    (D/S) = 0.0000E+00      VT    (F/S) =  303.8

AX   (F/S2) = -.3589E-03      PITCH (DEG) =  3.056          ALPHA (DEG) =  3.056
AY   (F/S2) = 0.3825E-06      ROLL  (DEG) = 0.8004E-06
AZ   (F/S2) = -.8202E-02      YAW   (DEG) = 0.0000E+00      BETA  (DEG) = 0.4267E-07

 *****    OTHER DATA

RODESC(F/S) = 0.0000E+00      UGND  (F/S) =  303.8          NZ     (G)  =  1.000
                              VGND  (F/S) = 0.1421E-13      DYNP(S/F-S2)=  104.0
HEIGHT (FT) =  1000.          WGND  (F/S) = 0.0000E+00
NORTHG (FT) = 0.0000E+00                                    PRSALT (FT) =  1000.
EASTG  (FT) = 0.0000E+00                                    RHO (S/FT3) = 0.2253E-02
```

Figure 4-14. MANS Run-Type Printout

DATE: 11OCT'87 RUNTYPE: TUNL

&TUNNEL IN MAIN
ALPLOW=-10.00000 ,DELALP= 1.000000 ,NALPHA= 21,BETLOW=-20.00000 ,DELBET= 2.000000 ,NBETA = 21
&END

```
*************************************************************
*****            TUNNEL  NON-DIMENSIONAL              *****
*****          FORCE AND MOMENT COEFFICIENTS          *****
*****        VT=  303.804 FPS   VKTS=  180.000 KNOTS   *****
***** MAST ANGLE=  90.0 DEG    FLAP SETTING=     0/0 DEG *****
*************************************************************
```

WIND AXES						BODY AXES						
CD	CY	CL	CROLL	CM	CN	X	Y	Z	L	M	N	ALPHA
0.11089	0.00000	-0.69280	0.00000	0.30684	0.00000	0.01110	0.00000	0.70153	0.00000	0.30684	0.00000	-10.000
0.10042	0.00000	-0.58082	0.00000	0.27696	0.00000	-0.00833	0.00000	0.58938	0.00000	0.27696	0.00000	-9.000
0.09009	0.00000	-0.46884	0.00000	0.24553	0.00000	-0.02396	0.00000	0.47681	0.00000	0.24553	0.00000	-8.000
0.08505	0.00000	-0.37598	0.00000	0.23322	0.00000	-0.03859	0.00000	0.38355	0.00000	0.23322	0.00000	-7.000
0.08014	0.00000	-0.28312	0.00000	0.21971	0.00000	-0.05011	0.00000	0.28995	0.00000	0.21971	0.00000	-6.000
0.07536	0.00000	-0.19025	0.00000	0.20500	0.00000	-0.05849	0.00000	0.19609	0.00000	0.20500	0.00000	-5.000
0.07071	0.00000	-0.09737	0.00000	0.18911	0.00000	-0.06375	0.00000	0.10207	0.00000	0.18911	0.00000	-4.000
0.07036	0.00000	0.02191	0.00000	0.17599	0.00000	-0.07141	0.00000	-0.01820	0.00000	0.17599	0.00000	-3.000
0.07020	0.00000	0.14119	0.00000	0.16144	0.00000	-0.07508	0.00000	-0.13865	0.00000	0.16144	0.00000	-2.000
0.07053	0.00000	0.26046	0.00000	0.14568	0.00000	-0.07506	0.00000	-0.25919	0.00000	0.14568	0.00000	-1.000
0.07098	0.00000	0.37976	0.00000	0.12829	0.00000	-0.07098	0.00000	-0.37976	0.00000	0.12829	0.00000	0.000
0.07672	0.00000	0.48292	0.00000	0.11003	0.00000	-0.06828	0.00000	-0.48419	0.00000	0.11003	0.00000	1.000
0.08258	0.00000	0.58612	0.00000	0.09037	0.00000	-0.06208	0.00000	-0.58864	0.00000	0.09037	0.00000	2.000
0.08857	0.00000	0.68931	0.00000	0.06946	0.00000	-0.05237	0.00000	-0.69300	0.00000	0.06946	0.00000	3.000
0.09483	0.00000	0.79249	0.00000	0.04737	0.00000	-0.03932	0.00000	-0.79717	0.00000	0.04737	0.00000	4.000
0.10410	0.00000	0.89238	0.00000	0.02482	0.00000	-0.02592	0.00000	-0.89806	0.00000	0.02482	0.00000	5.000
0.11349	0.00000	0.99226	0.00000	0.00107	0.00000	-0.00914	0.00000	-0.99869	0.00000	0.00107	0.00000	6.000
0.12300	0.00000	1.09214	0.00000	-0.02389	0.00000	0.01101	0.00000	-1.09899	0.00000	-0.02389	0.00000	7.000
0.13264	0.00000	1.19200	0.00000	-0.05005	0.00000	0.03454	0.00000	-1.19886	0.00000	-0.05005	0.00000	8.000
0.14855	0.00000	1.29525	0.00000	-0.09364	0.00000	0.05590	0.00000	-1.30254	0.00000	-0.09364	0.00000	9.000
0.16494	0.00000	1.39845	0.00000	-0.13835	0.00000	0.08041	0.00000	-1.40585	0.00000	-0.13835	0.00000	10.000

Figure 4-15. TUNL Run-Type Printout

```
*****************************************************************
*****              TUNNEL  NON-DIMENSIONAL                  *****
*****            FORCE AND MOMENT COEFFICIENTS              *****
*****         VT=  303.804 FPS   VKTS=  180.000 KNOTS       *****
***** MAST ANGLE=  90.0 DEG    FLAP SETTING=     0/0 DEG    *****
*****************************************************************
```

WIND AXES						BODY AXES						
CD	CY	CL	CROLL	CM	CN	X	Y	Z	L	M	N	BETA
0.23115	0.41735	0.33984	0.06735	0.06396	-0.12343	-0.07447	0.47124	-0.33984	0.05974	0.20192	-0.12343	-20.000
0.20772	0.38739	0.34536	0.06113	0.08957	-0.11789	-0.07785	0.43262	-0.34536	0.05364	0.20150	-0.11789	-18.000
0.18435	0.35273	0.35088	0.05429	0.11140	-0.10935	-0.07998	0.38988	-0.35088	0.04720	0.19922	-0.10935	-16.000
0.15986	0.31242	0.35640	0.04708	0.12792	-0.09694	-0.07953	0.34181	-0.35640	0.04065	0.19424	-0.09694	-14.000
0.13538	0.26979	0.36192	0.03993	0.13837	-0.08318	-0.07633	0.29204	-0.36192	0.03439	0.18646	-0.08318	-12.000
0.11669	0.22494	0.36744	0.03282	0.14673	-0.06890	-0.07586	0.24179	-0.36744	0.02818	0.17959	-0.06890	-10.000
0.10078	0.18011	0.36991	0.02579	0.14945	-0.05471	-0.07473	0.19239	-0.36991	0.02216	0.17010	-0.05471	-8.000
0.09271	0.13507	0.37237	0.01885	0.14512	-0.04114	-0.07808	0.14402	-0.37237	0.01628	0.15645	-0.04114	-6.000
0.08459	0.09004	0.37483	0.01215	0.13399	-0.02744	-0.07810	0.09572	-0.37483	0.01060	0.13889	-0.02744	-4.000
0.07782	0.04502	0.37729	0.00596	0.12766	-0.01374	-0.07620	0.04771	-0.37729	0.00523	0.12887	-0.01374	-2.000
0.07098	0.00000	0.37976	0.00000	0.12829	0.00000	-0.07098	0.00000	-0.37976	0.00000	0.12829	0.00000	0.000
0.07782	-0.04502	0.37729	-0.00596	0.12766	0.01374	-0.07620	-0.04771	-0.37729	-0.00523	0.12887	0.01374	2.000
0.08459	-0.09004	0.37483	-0.01215	0.13399	0.02744	-0.07810	-0.09572	-0.37483	-0.01060	0.13889	0.02744	4.000
0.09271	-0.13507	0.37237	-0.01885	0.14512	0.04114	-0.07808	-0.14402	-0.37237	-0.01628	0.15645	0.04114	6.000
0.10078	-0.18011	0.36991	-0.02579	0.14945	0.05471	-0.07473	-0.19239	-0.36991	-0.02216	0.17010	0.05471	8.000
0.11669	-0.22494	0.36744	-0.03282	0.14673	0.06890	-0.07586	-0.24179	-0.36744	-0.02818	0.17959	0.06890	10.000
0.13538	-0.26979	0.36192	-0.03993	0.13837	0.08318	-0.07633	-0.29204	-0.36192	-0.03439	0.18646	0.08318	12.000
0.15986	-0.31242	0.35640	-0.04708	0.12792	0.09694	-0.07953	-0.34181	-0.35640	-0.04065	0.19424	0.09694	14.000
0.18435	-0.35273	0.35088	-0.05429	0.11140	0.10935	-0.07998	-0.38988	-0.35088	-0.04720	0.19922	0.10935	16.000
0.20772	-0.38739	0.34536	-0.06113	0.08957	0.11789	-0.07785	-0.43262	-0.34536	-0.05364	0.20150	0.11789	18.000
0.23115	-0.41735	0.33984	-0.06735	0.06396	0.12343	-0.07447	-0.47124	-0.33984	-0.05974	0.20192	0.12343	20.000

CPU TIME SINCE TIMEX CALLED = 0.0338 MIN TOTAL TIME USED IN THIS RUN = 2.2477 MIN

Figure 4-15 (Concluded)

5. DIAGNOSTIC PRINT OPTIONS

Diagnostic print can be obtained through the use of DGPTSW or TABSW. For TABSW=1, table lookup diagnostic print is obtained. DGPTSW is used to set internal print switch CHECKS. CHECKS is a logical array dimensioned 20.

For 21 < DGPTSW < 40 CHECKS(DGPTSW-20) =.TRUE.
and set DGPTSW=1.

For 3 < DGPTSW < 20 CHECKS(DGPTSW)=.TRUE.
and set DGPTSW=0

For 1 < DGPTSW < 2 CHECKS(DGPTSW)=.TRUE.
and leave DGPTSW unchanged

The Data Dependent Switch Options described in Appendix B provide for utilization of CHECKS. Examples of diagnostic print options are given in Figs. 5-1 to 5-11.

```
TOTAL TIME USED SINCE BEGINNING OF RUN  1.2293 MIN

          GW  /  U    SWEEP  ---  ITERATION  1 / 1


 ITER   ERROR     ROLL      PITCH     YAW       XLN     XLT     XPD     THOLG   FAFLPL  LTFLPL
  1     0.3311    0.000     1.512     0.000     5.370   4.800   2.500   7.153  -1.168  -0.230
  2     0.0655    0.000     0.512     0.000     5.003   4.800   2.500   7.247  -0.416  -0.068
  3     0.0005    0.000     0.242     0.000     4.905   4.800   2.500   7.269  -0.213  -0.024
&AT IN ACTRIM
VTK   =0.1000000    ,U     =0.1687785    ,V     =0.0000000E+00,W     =0.7130913E-03,P     =0.0000000E+00,Q     =0.0
R     =0.0000000E+00,ROLLD =0.0000000E+00,PITCHD=0.2420739    ,YAWD  =0.0000000E+00,XLN   = 4.904711    ,XLT   = 4.8
XPD   = 2.500000    ,XCOL  = 5.138950    ,THOLG = 7.268573    ,
B      (  )=
 0.7074493E-02-.3060583E-100.1880692    -.9113424E-110.6618042    -.4899019E-09
XROT  = 55.25748    ,YROT  =0.0000000E+00,ZROT  =-14654.64    ,LROT  =0.0000000E+00,MROT  =-998.0661    ,NROT  =0.0
&END

       SUBSYSTEM NO. 4 - WING/PYLON - RIGHT WING

U     =0.1688       V     =0.0000E+00   W     =0.7131E-03   RWR   = 10.71       DEL   =-.3408E-04   SIWR  = 55.36
XIWR  =-.5756       XBAR  =-.5316       XTE   =-3.155       YIWR  = 10.79       YBAR  = 5.298       YTIP  =-.5066E-06
UDW   =-.1953E-02   VDW   =0.1746E-01   XLE   = 2.070       YTE1  =-10.24       YTE2  = 10.24       YLE1  =-10.51
YLE2  = 10.51       XTIP1 =-10.71       XTIP2 = 10.71       RWX   = 10.71       RWY   = 10.72       XA    =-29.43
YA    = 293.3       G     =0.0000E+00   WW    = 86.43

       SUBSYSTEM NO. 4 - WING/PYLON - LEFT WING

U     =0.1688       V     =0.0000E+00   W     =0.7131E-03   RWL   = 10.71       DEL   =-.3408E-04   SIWL  = 55.36
XIWL  =-.5756       XBAR  =-.5316       XTE   =-3.155       YIWL  =-10.79       YBAR  = 5.298       YTIP  =-.5066E-06
UDW   =-.1953E-02   VDW   =0.1746E-01   XLE   = 2.070       YTE1  =-10.24       YTE2  = 10.24       YLE1  =-10.51
YLE2  = 10.51       XTIP1 =-10.71       XTIP2 = 10.71       RWX   = 10.71       RWY   = 10.72       XA    =-29.43
YA    = 293.3       G     =0.0000E+00   WW    = 86.43


   SUBSYSTEM NO. 2 - INDUCED VELOCITIES ----- INPUTS

TR    = 7328.       TL    = 7328.       HR    =-27.63       HL    =-27.63       YR    =-5.205       YL    =-5.205
WIR   = 54.03       WIL   = 54.03       BETAD =0.0000E+00

   SUBSYSTEM NO. 2 - INDUCED VELOCITIES ----- OUTPUTS

URIWR =0.1688       URIWL =0.1688       WRIWR =-86.44       WRIWL =-86.44       RWR   = 10.71       RWL   = 10.71
URH   =0.0000E+00   WRH   =0.0000E+00   UVR   =0.1688       WVR   =0.1688       CRFR  =0.0000E+00   CRFLD =0.0000E+00


   SUBSYSTEM NO. 2 - INDUCED VELOCITIES ----- INPUTS

TR    =0.1645E-01   TL    =0.1645E-01   HR    =0.0000E+00   HL    =0.0000E+00   YR    =0.1115E-01   YL    =0.1115E-01
WIR   =


   SUBSYSTEM NO. 3 - FUSELAGE CHARACTERISTICS - INPUTS
```

Figure 5-1. DGPTSW = 1 Diagnostic Printout

```
VTK   =0.1000       ALPFD =0.2421       BETFD =0.0000E+00

   SUBSYSTEM NO. 3 - FUSELAGE CHARACTERISTICS - OUTPUTS

QF    =0.3209E-04   LF    =-.2392E-03   DF    =-.3347E-04   FLIFT =-.2391E-03   FDRAG =-.3448E-04   FROLLM=0.0000E+00
FPTCHM=-.1987E-02   FYAWM =-.4897E-09   FHIGEM=0.0000E+00


   SUBSYSTEM NO. 4 - WING/PYLON VARIABLES - INPUTS

URIWL =0.1688       URIWR =0.1688       RWR   = 10.71       BETAD =0.0000E+00   XFLAPS =          3 DELA  =0.0000E+00
VTK   =0.1000       ALPFD =0.2421       BETFD =0.0000E+00   UWAKE =0.1688       VWAKE =0.0000E+00   WWAKE =0.7131E-03
P     =0.0000E+00   Q     =0.0000E+00   R     =0.0000E+00   RHO   =0.2253E-02   VSOUND= 1126.

   SUBSYSTEM NO. 4 - WING/PYLON VARIABLES - OUTPUTS

EWHM  = 5.780       ALPWDL=-89.89       ALPWDR=-89.89       WWLIFL= 1.654       WWLIFR= 1.654
WWDRGL=-868.3       WWDRGR=-868.3       ALPW  =-.1654E-01   WFLIFT=-.2054E-02   WFDRAG=-.7579E-03   WMPOWP=-.3339E-02
YWP   =0.0000E+00   LPWP  =0.0000E+00   NPWP  =0.0000E+00


   SUBSYSTEM NO. 4 - PYLON/SPINNER DRAG VARIABLES

FXPYLN=-.2219       FZPYLN= 113.6       PYLAPP=-1.569       FXSD  =-.2055E-01   FYSD  =0.0000E+00   FZSD  = 6.577
FXPYLB=0.0000E+00   FYPYLB=0.0000E+00   FZPYLB=0.0000E+00   FMLSD =0.0000E+00   FMMSD =0.2369       FMNSD =0.0000E+00
FMLPYL=0.0000E+00   FMMPYL= 2.233       FMNPYL=0.0000E+00   DPYLN =-113.6       GPYLD =0.1790       QPYL  = 3.288
ALFPYL=-1.568       BETPYL=0.0000E+00   SPYLB =0.0000E+00   KPYLB =0.7160E-03   DPYBET=0.0000E+00   SGPYL =0.3124E-02
SD    = 6.577


   SUBSYSTEM NO. 4 - WING/PYLON VARIABLES - OTHERS

PP    =0.0000E+00   RP    =0.0000E+00   CNR   =0.0000E+00   CNB   =0.0000E+00   CLR   =0.0000E+00   CLP   =0.0000E+00
CNP   =0.0000E+00   CYR   =0.0000E+00   CYP   =0.0000E+00   CYB   =0.0000E+00   CLDA  =0.0000E+00   CNDA  =0.0000E+00
SWINF = 70.28       URIWL =0.1688       URIWR =0.1688       WRIWL =-86.44       WRIWR =-86.44       VTIWL = 86.44
VTIWR = 86.44       QIWPL = 8.418       QIWPR = 8.418


   SUBSYSTEM NO. 5 - HORIZONTAL STABILIZER - INPUTS

AXH   = 21.68       AZH   = 1.779       Q     =0.0000E+00   UH    =0.1688       VH    =0.0000E+00   WH    =0.1645E-01
UWH   =0.1696       UWAKE =0.1688       VWAKE =0.0000E+00   WWAKE =0.7131E-03   EWHM  = 5.780       BETH  =0.0000E+00
HNU   = 1.005       QH    =0.2581E-04   DELE  =0.4363       XIH   =0.0000E+00   BETFD =0.0000E+00   MN    =0.1499E-03
RHO   =0.2253E-02

   SUBSYSTEM NO. 5 - HORIZONTAL STABILIZER - OUTPUTS

ALPHST=-.3709E-02   ALPHL =-.2125       ALPHD  =0.1352E-01  LHO   =0.3519E-05   DH    =0.1138E-04   PHM   =0.0000E+00

   SUBSYSTEM NO. 5 - HORIZONTAL STABILIZER - OTHERS

CLWD  =0.2808E-01   LH    =-.7897E-03   BHS   =0.0000E+00   PEPA  =0.3900
```

Figure 5-1 (Continued)

```
   SUBSYSTEM NO. 6 - VERTICAL STABILIZER - INPUTS

UWAKE =0.1688       VWAKE =0.0000E+00   WWAKE =0.7131E-03   P     =0.0000E+00   Q     =0.0000E+00   R     =0.0000E+00
I     =         1   UVR(I)=0.1688       VVR(I)=0.0000E+00   WVR(I)=0.1645E-01   UWTSQ(I)=0.1696
MN    =0.1499E-03   RHO   =0.2253E-02   DELR  =0.0000E+00   BETAD =0.0000E+00   XFLAPS =         3
BETFD =0.0000E+00   ALPHD =0.1352E-01   SLCG  = 24.98       WLCG  = 6.804

   SUBSYSTEM NO. 6 - VERTICAL STABILIZER - OUTPUTS

BETVS(I)=0.0000E+00 BETVSD(I)=0.0000E+00QV(I) =0.3226E-04   VSYF(I) =0.0000E+00 VSDGR(I) =-.7035E-05


   SUBSYSTEM NO. 6 - VERTICAL STABILIZER - OTHERS

AXV(I)= 22.52       AYV(I)=-6.417       AZV(I)= 2.837
CYVT(I)=0.0000E+00  CDVT(I)=0.8636E-02
VFBF(1)=-.7035E-05  VFBF(2)=0.0000E+00  VFBF(3)=0.0000E+00


   SUBSYSTEM NO. 6 - VERTICAL STABILIZER - INPUTS

UWAKE =0.1688       VWAKE =0.0000E+00   WWAKE =0.7131E-03   P     =0.0000E+00   Q     =0.0000E+00   R     =0.0000E+00
I     =         2   UVR(I)=0.1688       VVR(I)=0.0000E+00   WVR(I)=0.1645E-01   UWTSQ(I)=0.1696
MN    =0.1499E-03   RHO   =0.2253E-02   DELR  =0.0000E+00   BETAD =0.0000E+00   XFLAPS =         3
BETFD =0.0000E+00   ALPHD =0.1352E-01   SLCG  = 24.98       WLCG  = 6.804

   SUBSYSTEM NO. 6 - VERTICAL STABILIZER - OUTPUTS

BETVS(I)=0.0000E+00 BETVSD(I)=0.0000E+00QV(I) =0.3226E-04   VSYF(I) =0.0000E+00 VSDGR(I) =-.7035E-05


   SUBSYSTEM NO. 6 - VERTICAL STABILIZER - OTHERS

AXV(I)= 22.52       AYV(I)= 6.417       AZV(I)= 2.837
CYVT(I)=0.0000E+00  CDVT(I)=0.8636E-02
VFBF(1)=-.7035E-05  VFBF(2)=0.0000E+00  VFBF(3)=0.0000E+00


   SUBSYSTEM NO. 18 - ENGINE - INPUTS

XTHROR= 87.21       VTK   =0.1000       DELSTD=0.9644       AMBTMP= 293.2       OMGRPT= 2167.       OMGLPT= 2167.


   SUBSYSTEM NO. 18 - ENGINE - OUTPUTS

QRPT  = 257.3       QLPT  = 257.3

   SUBSYSTEM NO. 18 - ENGINE - OTHERS

HPROC = 1132.       HP    = 1100.       HPENAV = 1014.      HPAVTR= 1014.       HPLREQ= 1014.       HPRREQ= 1014.
```

Figure 5-1 (Continued)

SUBSYSTEM NO. 8A - CONTROLS GROUP - INPUTS

THOLG = 3.248	THORG = 3.248	XLN = 4.905	XLT = 4.800	XPD = 2.500	XCOL = 7.652
ESAS =0.0000E+00	RSAS =0.0000E+00	ASAS =0.0000E+00	VTK =0.1000		

SUBSYSTEM NO. 8A - CONTROLS GROUP - OUTPUTS

THETOL=0.8324	THETOR=0.8324	B1L =0.3838E-02	B1R =0.3838E-02	DELE =0.4363	DELR =0.0000E+00
DELA =0.0000E+00	IROT = 55.26	BETAD =0.0000E+00	A1L =0.0000E+00	A1R =0.0000E+00	

SUBSYSTEM NO. 9 - C.G. AND INERTIAS - INPUTS

BETAD =0.0000E+00

SUBSYSTEM NO. 9 - C.G. AND INERTIAS - OUTPUTS

SLCG = 24.98	WLCG = 6.804	IXX =0.5280E+05	IYY =0.2136E+05	IZZ =0.6634E+05	IXZ = 1234.

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - INPUTS

U =0.1688	V =0.0000E+00	W =0.7131E-03	P =0.0000E+00	Q =0.0000E+00	R =0.0000E+00
RHO =0.2253E-02	MN =0.1499E-03	BETAD =0.0000E+00	OMEGL = 589.0	OMEGR = 589.0	
A1L =0.0000E+00	A1R =0.0000E+00	B1L =0.3838E-02	B1R =0.3838E-02	THTOLD= 47.69	THTORD= 47.69
CPM =0.9998	SPM =0.1745E-01	CBM = 1.000	SBM =0.0000E+00		
LXH =-.1667E-01	LYH = 16.16	LZH = 6.195			

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - RIGHT ROTOR

FAFLPR=-.3721E-02	LTFLPR=-.4219E-03	AOR =0.5396E-01	TR = 7328.	HR =-27.63	YR =-5.205
A1RBD =-.3997E-08	B1RBD =0.3331E-09	MUR =0.2189E-03	QREQR = 9040.	OMEGAR= 61.68	OMGRP = 61.68
THETOR=0.8324	THORG = 3.248	WIR = 54.03	LAMDAR=0.7003E-01	LAMDIR=0.7007E-01	LAMDOR=-.9248E-06
A11 =-.4754E+05	A12 =0.2207E+06	A21 =-.2207E+06	A22 =-.4754E+05	B1 = 83.79	B2 = 841.4
C11 = 3578.	C12 =0.1904E+05	C21 =-.1904E+05	C22 = 3578.	ARS = 4.952	DNR =0.6575E+06
GEFR = 1.000	CHIRD = 2.655				

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - LEFT ROTOR

FAFLPL=-.3721E-02	LTFLPL=-.4219E-03	AOL =0.5396E-01	TL = 7328.	HL =-27.63	YL =-5.205
A1LBD =-.3997E-08	B1LBD =0.3331E-09	MUL =0.2189E-03	QREQL = 9040.	OMEGAL= 61.68	OMGLP = 61.68
THETOL=0.8324	THOLG = 3.248	WIL = 54.03	LAMDAL=0.7003E-01	LAMDIL=0.7007E-01	LAMDOL=-.9248E-06
A11 =-.4754E+05	A12 =0.2207E+06	A21 =-.2207E+06	A22 =-.4754E+05	B1 = 83.79	B2 = 841.4
C11 = 3578.	C12 =0.1904E+05	C21 =-.1904E+05	C22 = 3578.	ALS = 4.952	DNL =0.6575E+06
GEFL = 1.000	CHILD = 2.655				

Figure 5-1 (Continued)

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - VARIABLES IN WIND AXIS

HL	=-27.63	HR	=-27.63	YL	=-5.207	YR	=-5.207	HPL	= 1014.	HPR	= 1014.
AOL	=0.5396E-01	AOR	=0.5396E-01	FAFLPL	=-.3721E-02	FAFLPR	=-.3721E-02	LTFLPL	=-.4219E-03	LTFLPR	=-.4219E-03

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - OUTPUTS

A1L	=0.0000E+00	A1R	=0.0000E+00	B1L	=0.3838E-02	B1R	=0.3838E-02	TL	= 7328.	TR	= 7328.
HL	=-27.63	HR	=-27.63	YL	=-5.205	YR	=-5.205	WIL	= 54.03	WIR	= 54.03
HPL	= 1014.	HPR	= 1014.	QREQL	= 9040.	QREQR	= 9040.				
MA1L	=-47.98	MA1R	=-47.98	LB1L	=-5.436	LB1R	=-5.436				
XROT	= 55.26	YROT	=0.0000E+00	ZROT	=-.1465E+05	LROT	=0.0000E+00	MROT	=-998.1	NROT	=0.0000E+00

GECONS= 1.000

TIME USED FOR THIS TRIM = 0.0875 MIN

Figure 5-1 (Concluded)

```
TIME USED FOR THIS TRIM =   0.0785 MIN

CHECKS(2) IN STABDV, VALUES FOR SAVE(I,J)

2.000
   -0.19546850    -0.21322268

   -0.19546850    -0.21322268

    0.23820496    -0.24159350E-01

    0.23820496    -0.24159350E-01

   -24.279463     -27.632921

   -24.279463     -27.632921

    9.7437553     -5.2050409

    9.7437553     -5.2050409

    7347.2847      7328.3394

    7347.2847      7328.3394

    1016.7183      1013.8118

    1016.7183      1013.8118

    48.551529      55.257427

   0.00000000E+00 0.00000000E+00

   -14691.991     -14654.628

   0.00000000E+00 0.00000000E+00

   -950.05914     -998.06610

   0.00000000E+00 0.00000000E+00
```

Figure 5-2. DGPTSW, CHECKS(2) Diagnostic Printout

*** COUPLED STABILITY ROOTS - SCAS-OFF - FLAPPING ALLOWED TO CHANGE - 6 X 6 MATRIX ***

MASS MATRIX--

0.40407E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.40407E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.78974E-03	0.21360E+05	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.40407E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.52795E+05	-0.12340E+04	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	-0.12340E+04	0.66335E+05	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.10000E+01	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.10000E+01

DAMPING MATRIX--

0.50090E+01	-0.82136E-01	-0.78001E+03	0.00000E+00	0.00000E+00	0.76294E-04	0.13000E+05	0.00000E+00
0.17116E+02	0.83301E+02	0.10649E+02	0.00000E+00	0.00000E+00	-0.19531E-01	0.54925E+02	0.00000E+00
-0.30925E+02	0.90323E+01	0.69415E+04	0.00000E+00	0.00000E+00	-0.18311E-02	0.00000E+00	0.00000E+00
0.46602E-08	0.42991E-08	0.00000E+00	0.86709E+01	0.75770E+03	0.32634E+03	0.00000E+00	-0.13000E+05
0.00000E+00	0.00000E+00	0.00000E+00	0.19673E+03	0.22360E+05	-0.54678E+04	0.00000E+00	0.00000E+00
0.74564E-07	0.27820E-08	0.00000E+00	-0.88871E+02	-0.11398E+05	0.18239E+04	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	-0.10000E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	-0.10000E+01	-0.42250E-02	0.00000E+00	0.00000E+00

STIFFNESS MATRIX--

0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

Figure 5-2 (Continued)

MATRIX T (INVERSE OF BM)

0.24748E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.24748E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	-0.91501E-10	0.46816E-04	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.24748E-02	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.18949E-04	0.35251E-06	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.35251E-06	0.15082E-04	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.10000E+01	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.10000E+01

IDENTITY MATRIX = (M-INVERSE) * (M)

0.100000E+01	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.100000E+01	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.100000E+01	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.100000E+01	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.100000E+01	0.433681E-18	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.100000E+01	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.100000E+01	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.100000E+01

MATRIX PRODUCT -- (M-INV)* (BK)

0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

Figure 5-2 (Continued)

MATRIX PRODUCT -- (M-INV)* (BD)

0.12396E-01	-0.20327E-03	-0.19304E+01	0.00000E+00	0.00000E+00	0.18881E-06	0.32172E+02	0.00000E+00
0.42359E-01	0.20615E+00	0.26354E-01	0.00000E+00	0.00000E+00	-0.48336E-04	0.13593E+00	0.00000E+00
-0.14478E-02	0.42285E-03	0.32498E+00	0.00000E+00	0.00000E+00	-0.85722E-07	-0.50257E-08	0.00000E+00
0.11533E-10	0.10639E-10	0.00000E+00	0.21459E-01	0.18752E+01	0.80763E+00	0.00000E+00	-0.32172E+02
0.26284E-13	0.98068E-15	0.00000E+00	0.36966E-02	0.41970E+00	-0.10297E+00	0.00000E+00	0.00000E+00
0.11245E-11	0.41957E-13	0.00000E+00	-0.12710E-02	-0.16402E+00	0.25580E-01	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	-0.10000E+01	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	-0.10000E+01	-0.42250E-02	0.00000E+00	0.00000E+00

MATRIX (A) PRIOR TO CALLING EIGENVALUE ROUTINE.--

ROW, 1

-0.123964E-01	0.000000E+00	0.203271E-03	0.000000E+00	0.193036E+01	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	-0.188813E-06	0.000000E+00
-0.321722E+02	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

ROW, 2

-0.423593E-01	0.000000E+00	-0.206155E+00	0.000000E+00	-0.263543E-01	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.483361E-04	0.000000E+00
-0.135928E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

Figure 5-2 (Continued)

ROW, 3

0.144780E-02	0.000000E+00	-0.422851E-03	0.000000E+00	-0.324977E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.857217E-07	0.000000E+00
0.502567E-08	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

ROW, 4

-0.115332E-10	0.000000E+00	-0.106394E-10	0.000000E+00	0.000000E+00	0.000000E+00
-0.214589E-01	0.000000E+00	-0.187515E+01	0.000000E+00	-0.807629E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.321722E+02	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

ROW, 5

-0.262843E-13	0.000000E+00	-0.980684E-15	0.000000E+00	0.000000E+00	0.000000E+00
-0.369655E-02	0.000000E+00	-0.419699E+00	0.000000E+00	0.102969E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

ROW, 6

-0.112454E-11	0.000000E+00	-0.419572E-13	0.000000E+00	0.000000E+00	0.000000E+00
0.127096E-02	0.000000E+00	0.164024E+00	0.000000E+00	-0.255804E-01	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

Figure 5-2 (Continued)

ROW, 7

0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.100000E+01	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

ROW, 8

0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.100000E+01	0.000000E+00	0.422501E-02	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

ROW, 9

0.100000E+01	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

ROW,10

0.000000E+00	0.000000E+00	0.100000E+01	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

Figure 5-2 (Continued)

ROW,11

0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.100000E+01	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

ROW,12

0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.100000E+01	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

ROW,13

0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.100000E+01	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

ROW,14

0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.100000E+01	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

Figure 5-2 (Continued)

ROW,15

0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.100000E+01	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

ROW,16

0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.100000E+01	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
0.000000E+00	0.000000E+00				

NO. OF EIGENVALUES CALCULATED 16

Figure 5-2 (Concluded)

```
&DIAGHN IN HANDLE
XLN   = 4.904711    ,XLT   = 4.800000    ,XPD   = 2.500000    ,XCOL  = 7.651763    ,XAERO =-.3249382    ,YAERO =-.3060583E-10,
ZAERO = 1654.572    ,LAERO =0.0000000E+00,MAERO = 998.7281    ,NAERO =-.4896889E-09,XROT  = 55.25748    ,YROT  =0.0000000E+00,
ZROT  =-14654.64    ,LROT  =0.0000000E+00,MROT  =-998.0660    ,NROT  =0.0000000E+00,HPL   = 1013.810    ,HPR   = 1013.810    ,
TL    = 7328.347    ,HL    =-27.63295    ,QREQL = 9040.148    ,QREQR = 9040.148    ,U     =0.1687785    ,V     =0.0000000E+00,
W     =0.7130913E-03,P     =0.0000000E+00,Q     =0.0000000E+00,R     =0.0000000E+00,PITCH =0.4224988E-02,ROLL  =0.0000000E+00,
&END



&HANDL IN HANDLE
ICOUNT=            1,VT    =0.1687800    ,DELVEL= 4.000000    ,DELRAT=0.1000000    ,AOL   =0.5396080E-01,AOR   =0.5396080E-01,
FAFLPL=-.3721439E-02,FAFLPR=-.3721439E-02,LTFLPL=-.4216607E-03,LTFLPR=-.4216607E-03,LAMDAL=0.7003480E-01,LAMDAR=0.7003480E-01,
LAMDOL=-.9247522E-06,LAMDOR=-.9247522E-06,MUL   =0.2189089E-03,MUR   =0.2189089E-03,XLN   = 4.904711    ,XCOL  = 7.651763    ,
THOLG = 3.248075    ,THORG = 3.248075    ,MFA   =0.0000000E+00,MLAT  =-.6103516E-04,MFALL =0.0000000E+00,MFARR =0.0000000E+00,
MLATLL=-.6103516E-04,MLATRR=-.6103516E-04
EL    (  )=
 0.5396080E-01-.3721407E-02-.4219351E-03
ER    (  )=
 0.5396080E-01-.3721407E-02-.4219351E-03
&END


&PARTLS IN HANDLE
A11   =-47540.71    ,A12   = 220705.7    ,A21   =-220705.7    ,A22   =-47540.71    ,C11   = 3578.243    ,C12   = 19039.05    ,
C21   =-19039.05    ,C22   = 3578.243    ,MFAU  =-503.7500    ,MFAV  =-433.1523    ,MFAW  = 79.75000    ,MFAP  =-24124.32    ,
MFAQ  =-4980.000    ,MFAR  =-1663.621    ,MLATU = 144.0000    ,MLATV =-.3248596E-01,MLATW = 17.00002    ,MLATP =-1649.078    ,
MLATQ = 36760.00    ,MLATR =-16807.19    ,XROTA1=-10653.97    ,YROTA1=-3797.650    ,ZROTA1= 101.1628    ,XROTB1= 3798.272    ,
YROTB1=-10653.90    ,ZROTB1= 191.8624    ,LROTA1=-25143.88    ,MROTA1= 91760.71    ,NROTA1=-174150.7    ,LROTB1=-94844.17    ,
MROTB1=-23538.94    ,NROTB1= 60864.88
&END

     TIME USED IN HANDLE =   0.2498 MIN
```

Figure 5-3. CHECKS(3) Diagnostic Printout

```
TOTAL TIME USED SINCE BEGINNING OF RUN  1.5098 MIN

     GW  /  U    SWEEP  ---  ITERATION  1 / 1


 ITER   ERROR     ROLL      PITCH      YAW       XLN      XLT      XPD     THOLG   FAFLPL  LTFLPL
  1     0.3311   0.000     1.512     0.000     5.370    4.800    2.500    7.153  -1.168  -0.230
  2     0.0655   0.000     0.512     0.000     5.003    4.800    2.500    7.247  -0.416  -0.068
  3     0.0005   0.000     0.242     0.000     4.905    4.800    2.500    7.269  -0.213  -0.024

      TIME USED FOR THIS TRIM =   0.0785 MIN

&FT09 IN MAIN
USAVE =0.1687800    ,VSAVE =0.0000000E+00,WSAVE =0.0000000E+00,BETAD =0.0000000E+00,NZ    = 1.000000    ,OMEGAR= 61.67990    ,
SLCG  = 24.98333    ,VT    =0.1687800    ,WLCG  = 6.804167    ,GW    = 13000.00    ,RODESC=0.0000000E+00,IVAR1 =          10,
N1    =           1,I1    =           1,IVAR2 =           1,N2    =           1,I2    =           1,IGUESS=           1,
ARAY1 (  )=
 0.2253160E-02 1126.090     293.1600    0.0000000E+000.0000000E+000.0000000E+000.1687800    0.0000000E+000.0000000E+000.9643888
  1.017352    0.9479406    0.0000000E+00 1000.000     1815.955     20.00000
ARAY2 (  )=
 0.4224988E-020.0000000E+000.0000000E+000.1687785    0.0000000E+000.7130913E-030.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+00 1000.000    0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+000.0000000E+000.0000000E+000.1946092E-04-.7574943E-13-.4653931E-03-.1726191E-150.3099763E-04-.7385270E-140.1687800
 0.0000000E+000.5820766E-100.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
ARAY3 (  )=
 0.0000000E+000.6621094    -.4896889E-09 54.93254    -.3060583E-10-13000.07    -.8526855    0.3446467E-010.1894943E-040.3525076E-06
 0.6338952    0.5777154E-010.4681648E-040.4745237    0.1508156E-040.0000000E+000.0000000E+000.0000000E+00
```

Figure 5-4. CHECKS(4) Diagnostic Printout

```
 0.0000000E+00 24.98333     6.804167    -.1666641E-01 16.16478     6.195457     52795.00     1234.000     21360.00     66335.00
  13000.00     3986.000
&END
&FT0901 IN GETDAT
SWPVAR(  )=
 0.1687800    0.0000000E+000.0000000E+000.0000000E+00 1.000000     61.67990     24.98333    0.1687800     6.804167     13000.00
 0.0000000E+00
SWPCON(  )=
 0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
ARAY1 (  )=
 0.2253160E-02 1126.090     293.1600    0.0000000E+000.0000000E+000.0000000E+000.1687800    0.0000000E+000.0000000E+000.9643888
  1.017352    0.9479406    0.0000000E+00 1000.000     1815.955     20.00000
ARAY4 (  )=
 0.5396080E-01-.3721439E-02-.4216606E-030.5396080E-01-.3721439E-02-.4216606E-030.1114646E-010.1114646E-010.2189089E-030.2189089E-03
 0.1114654E-010.1114654E-01 54.02678     54.02678    0.7003481E-010.7003481E-01-.9247522E-06-.9247522E-060.1100010E-020.1100010E-02
 0.1601422E-010.1601422E-01
ARAY5 (  )=
 0.0000000E+000.0000000E+000.3837862E-020.3837862E-020.0000000E+000.0000000E+00 1.000000    0.0000000E+000.0000000E+000.4363309
 0.0000000E+000.8323635    0.8323635
ARAY6 (  )=
  4.904711     4.800000     2.500000     7.651763    0.0000000E+000.0000000E+000.0000000E+00 589.0000    0.0000000E+00 87.21411
  20693.34    0.0000000E+00 1.000000     1.000000    0.0000000E+00 10.00000
ARAY7 (  )=
  7328.347    -27.63295    -5.205046     1013.810     9040.148     27.62874    -122.6931    -7327.322     7328.347    -27.63295
 -5.205046     1013.810     9040.148     27.62874     122.6931    -7327.322     55.25748    0.0000000E+00-14654.64    0.0000000E+00
 -998.0660    0.0000000E+00
ARAY8 (  )=
  61.67990     61.67990     61.67990     696.9829     2167.000     2167.000
ARAY9 (  )=
 -.3249382    -.3060583E-10 1654.572    0.0000000E+00 998.7281    -.4896889E-09
ARAY10(  )=
  3.248075     3.248075     257.2945     257.2945    0.0000000E+00 1131.607     2000.000     1131.607     1100.043    0.0000000E+00
  3.248075     1013.740
ARAY11(  )=
```

Figure 5-4 (Continued)

```
ARAY2 (  )=
 0.4224988E-020.0000000E+000.0000000E+000.1687785    0.0000000E+000.7130913E-030.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+00 1000.000    0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+000.0000000E+000.0000000E+000.1946092E-04-.7574943E-13-.4653931E-03-.1726191E-150.3099763E-04-.7385270E-140.1687800
 0.0000000E+000.5820766E-100.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
 0.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+000.0000000E+00
ARAY3 (  )=
 0.0000000E+000.6621094    -.4896889E-09 54.93254    -.3060583E-10-13000.07    -.8526855    0.3446467E-010.1894943E-040.3525076E-06
 0.6338952    0.5777154E-010.4681648E-040.4745237    0.1508156E-040.0000000E+000.0000000E+000.0000000E+00
ARAY4 (  )=
 0.5396080E-01-.3721439E-02-.4216606E-030.5396080E-01-.3721439E-02-.4216606E-030.1114646E-010.1114646E-010.2189089E-030.2189089E-03
 0.1114654E-010.1114654E-01 54.02678     54.02678    0.7003481E-010.7003481E-01-.9247522E-06-.9247522E-060.1100010E-020.1100010E-02
 0.1601422E-010.1601422E-01
ARAY5 (  )=
 0.0000000E+000.0000000E+000.3837862E-020.3837862E-020.0000000E+000.0000000E+00 1.000000    0.0000000E+000.0000000E+000.4363309
 0.0000000E+000.8323635    0.8323635
ARAY6 (  )=
  4.904711     4.800000     2.500000     7.651763    0.0000000E+000.0000000E+000.0000000E+00 589.0000    0.0000000E+00 87.21411
  20693.34    0.0000000E+00 1.000000     1.000000    0.0000000E+00 10.00000
ARAY7 (  )=
  7328.347    -27.63295    -5.205046     1013.810     9040.148     27.62874    -122.6931    -7327.322     7328.347    -27.63295
 -5.205046     1013.810     9040.148     27.62874     122.6931    -7327.322     55.25748    0.0000000E+00-14654.64    0.0000000E+00
 -998.0660    0.0000000E+00
ARAY8 (  )=
  61.67990     61.67990     61.67990     696.9829     2167.000     2167.000
ARAY9 (  )=
 -.3249382    -.3060583E-10 1654.572    0.0000000E+00 998.7281    -.4896889E-09
ARAY10(  )=
  3.248075     3.248075     257.2945     257.2945    0.0000000E+00 1131.607     2000.000     1131.607     1100.043    0.0000000E+00
  3.248075     1013.740
ARAY11(  )=
 0.0000000E+00 24.98333     6.804167    -.1666641E-01 16.16478     6.195457     52795.00     1234.000     21360.00     66335.00
  13000.00     3986.000
&END
```

Figure 5-4 (Concluded)

```
TOTAL TIME USED SINCE BEGINNING OF RUN  1.6057 MIN

     GW  /  U    SWEEP  ---  ITERATION  1 / 1

&AT IN ACTRIM
VTK   =0.1000000    ,U     =0.1687800    ,V     =0.0000000E+00,W     =0.0000000E+00,P     =0.0000000E+00,Q     =0.0000000E+00,
R     =0.0000000E+00,ROLLD =0.0000000E+00,PITCHD=0.2420739    ,YAWD  =0.0000000E+00,XLN   = 4.900000    ,XLT   = 4.800000    ,
XPD   = 2.500000    ,XCOL  = 7.600000    ,THOLG = 3.248075    ,
B      (  )=
 0.7074493E-02-.3060583E-100.1880692    -.9113424E-110.6618042    -.4899019E-09
XROT  = 55.25748    ,YROT  =0.0000000E+00,ZROT  =-14654.64    ,LROT  =0.0000000E+00,MROT  =-998.0660    ,NROT  =0.0000000E+00
&END
&AT IN ACTRIM
VTK   =0.1000000    ,U     =0.1687800    ,V     =0.0000000E+00,W     =0.0000000E+00,P     =0.0000000E+00,Q     =0.0000000E+00,
R     =0.0000000E+00,ROLLD =0.0000000E+00,PITCHD=0.2420739    ,YAWD  =0.0000000E+00,XLN   = 5.370242    ,XLT   = 4.800000    ,
XPD   = 2.500000    ,XCOL  = 5.138950    ,THOLG = 7.153279    ,
B      (  )=
 0.7074493E-02-.3060583E-100.1880692    -.9113424E-110.6618042    -.4899019E-09
XROT  = 300.4109    ,YROT  =0.0000000E+00,ZROT  =-14514.23    ,LROT  =0.0000000E+00,MROT  =-2939.543    ,NROT  =0.0000000E+00
&END


 ITER   ERROR     ROLL      PITCH      YAW       XLN     XLT     XPD    THOLG   FAFLPL  LTFLPL

ROLL= 0.0000E+00     NZ=   1.00     RADTRN= 0.0000E+00     P= 0.0000E+00     Q= 0.0000E+00     R= 0.0000E+00
```

Figure 5-5. CHECKS(5) Diagnostic Printout

```
&AT IN ACTRIM
VTK   =0.1000000    ,U     =0.1687212    ,V     =0.0000000E+00,W     =0.4454875E-02,P     =0.0000000E+00,Q     =0.0000000E+00,
R     =0.0000000E+00,ROLLD =0.0000000E+00,PITCHD=0.2420739    ,YAWD  =0.0000000E+00,XLN   = 5.370242    ,XLT   = 4.800000    ,
XPD   = 2.500000    ,XCOL  = 5.138950    ,THOLG = 7.153279    ,
B      (  )=
 0.7074493E-02-.3060583E-100.1880692    -.9113424E-110.6618042    -.4899019E-09
XROT  = 300.4109    ,YROT  =0.0000000E+00,ZROT  =-14514.23    ,LROT  =0.0000000E+00,MROT  =-2939.543    ,NROT  =0.0000000E+00
&END
&AT IN ACTRIM
VTK   =0.1000000    ,U     =0.1687212    ,V     =0.0000000E+00,W     =0.4454875E-02,P     =0.0000000E+00,Q     =0.0000000E+00,
R     =0.0000000E+00,ROLLD =0.0000000E+00,PITCHD=0.2420739    ,YAWD  =0.0000000E+00,XLN   = 5.370242    ,XLT   = 4.800000    ,
XPD   = 2.500000    ,XCOL  = 5.138950    ,THOLG = 7.153279    ,
B      (  )=
 0.7074493E-02-.3060583E-100.1880692    -.9113424E-110.6618042    -.4899019E-09
XROT  = 300.3871    ,YROT  =-46.45738    ,ZROT  =-14516.24    ,LROT  =-456.9531    ,MROT  =-2939.484    ,NROT  =-3246.168
&END
&AT IN ACTRIM
VTK   =0.1000000    ,U     =0.1687212    ,V     =0.0000000E+00,W     =0.4454875E-02,P     =0.0000000E+00,Q     =0.0000000E+00,
R     =0.0000000E+00,ROLLD =0.0000000E+00,PITCHD=0.2420739    ,YAWD  =0.0000000E+00,XLN   = 5.370242    ,XLT   = 4.800000    ,
XPD   = 2.500000    ,XCOL  = 5.138950    ,THOLG = 7.153279    ,
B      (  )=
 -.9857029E-01-.7574944E-13-.3026263    -.1725605E-15-.9128477E-01-.7382765E-14
XROT  = 300.4126    ,YROT  =0.0000000E+00,ZROT  =-14514.36    ,LROT  =0.0000000E+00,MROT  =-2939.559    ,NROT  =0.0000000E+00
&END
  1     0.3311    0.000     1.512     0.000     5.370   4.800   2.500   7.153  -1.168  -0.230

ROLL= 0.1434E-14     NZ=   1.00     RADTRN= 0.0000E+00     P= 0.0000E+00     Q= 0.0000E+00     R= 0.0000E+00
```

Further data in the above format deleted to shorten figure

```
  3     0.0005    0.000     0.242     0.000     4.905   4.800   2.500   7.269  -0.213  -0.024

        TIME USED FOR THIS TRIM =   0.0840 MIN
```

Figure 5-5 (Concluded)

M	X(M) KS0 K01	X(M-1) KC0 K02	THETA(M) KS1 K11	THETA(M-1) KC1 K12	T1M KS2 K21	TM1 KC2 K22	TXM KS3 K31	T1M1 KC3 K32
1	0.600	1.00	0.178	0.000E+00	-0.445	-2.25	-0.267	-0.445
	-0.139	0.374	-0.114	0.299	-0.945E-01	0.243	-0.801E-01	0.202
	-0.228	0.328	-0.184	0.261	-0.152	0.212	-0.128	0.176
2	0.533	0.600	0.215	0.178	-0.550	-1.82	-0.293	-0.330
	-0.204E-01	0.635E-01	-0.116E-01	0.360E-01	-0.658E-02	0.204E-01	-0.374E-02	0.116E-01
	-0.260	0.387	-0.202	0.294	-0.162	0.231	-0.134	0.186
3	0.467	0.533	0.253	0.215	-0.577	-1.73	-0.269	-0.307
	-0.189E-01	0.638E-01	-0.948E-02	0.319E-01	-0.475E-02	0.160E-01	-0.239E-02	0.801E-02
	-0.290	0.446	-0.217	0.324	-0.170	0.246	-0.137	0.194
4	0.400	0.467	0.310	0.253	-0.850	-1.18	-0.340	-0.397
	-0.240E-01	0.622E-01	-0.104E-01	0.270E-01	-0.454E-02	0.117E-01	-0.198E-02	0.509E-02
	-0.317	0.507	-0.229	0.350	-0.175	0.257	-0.140	0.199
5	0.333	0.400	0.382	0.310	-1.09	-0.921	-0.362	-0.434
	-0.259E-01	0.615E-01	-0.950E-02	0.225E-01	-0.350E-02	0.828E-02	-0.129E-02	0.305E-02
	-0.339	0.570	-0.237	0.373	-0.178	0.266	-0.141	0.202
6	0.267	0.333	0.456	0.382	-1.11	-0.898	-0.297	-0.371
	-0.218E-01	0.629E-01	-0.658E-02	0.189E-01	-0.199E-02	0.568E-02	-0.604E-03	0.172E-02
	-0.358	0.634	-0.243	0.393	-0.180	0.272	-0.141	0.204
7	0.200	0.267	0.535	0.456	-1.18	-0.849	-0.236	-0.314
	-0.181E-01	0.642E-01	-0.425E-02	0.150E-01	-0.100E-02	0.351E-02	-0.239E-03	0.831E-03
	-0.371	0.699	-0.246	0.408	-0.180	0.275	-0.141	0.205
8	0.133	0.200	0.605	0.535	-1.05	-0.955	-0.140	-0.209
	-0.116E-01	0.657E-01	-0.195E-02	0.109E-01	-0.334E-03	0.185E-02	-0.579E-04	0.316E-03
	-0.379	0.765	-0.247	0.419	-0.181	0.277	-0.141	0.205

TWIST AT 3/4 RADIUS IS 34.5000

TIME OF DAY - 09:38:40

Figure 5-6. CHECKS(6) Diagnostic Printout

```
TOTAL TIME USED SINCE BEGINNING OF RUN  1.7897 MIN

GW  /  U   SWEEP  ---  ITERATION  1 / 1


RSPHR = 0.6000E-05   VTK = 0.1000      HPROC =  666.3      HP =  618.4      HPEREQ = 0.0000E+00   HPENG = 0.0000E+00


ITER   ERROR     ROLL     PITCH     YAW      XLN     XLT     XPD     THOLG   FAFLPL  LTFLPL

RSPHR = 0.6000E-05   VTK = 0.1000      HPROC =  666.3      HP =  618.4      HPEREQ = 0.0000E+00   HPENG = 0.0000E+00


RSPHR = 0.6000E-05   VTK = 0.1000      HPROC =  666.3      HP =  618.4      HPEREQ = 0.0000E+00   HPENG = 0.0000E+00
```

Figure 5-7. CHECKS(7) Diagnostic Printout

```
RSPHR = 0.6000E-05   VTK = 0.1000      HPROC =  666.3      HP =  618.4      HPEREQ = 0.0000E+00   HPENG = 0.0000E+00

3    0.0005    0.000    0.242    0.000    4.905   4.800   2.500   7.269  -0.213  -0.024

RSPHR = 0.6000E-05   VTK = 0.1000      HPROC =  666.3      HP =  618.4      HPEREQ = 0.0000E+00   HPENG = 0.0000E+00
```

Intervening lines deleted in the interest of shortening the figure.

```
RSPHR = 0.6000E-05   VTK = 0.1000      HPROC =  1132.      HP =  1100.      HPEREQ = 0.0000E+00   HPENG = 0.0000E+00

RSPHR = 0.6000E-05   VTK = 0.1000      HPROC =  1132.      HP =  1100.      HPEREQ = 0.0000E+00   HPENG = 0.0000E+00

TIME USED FOR THIS TRIM =   0.0925 MIN
```

Figure 5-7 (Concluded)

```
TOTAL TIME USED SINCE BEGINNING OF RUN  1.8930 MIN

     GW  /  U    SWEEP  ---  ITERATION  1 / 1


ITER   ERROR     ROLL     PITCH    YAW      XLN      XLT      XPD      THOLG    FAFLPL   LTFLPL
 1     0.3311    0.000    1.512    0.000    5.370    4.800    2.500    7.153   -1.168   -0.230
 2     0.0655    0.000    0.512    0.000    5.003    4.800    2.500    7.247   -0.416   -0.068
 3     0.0005    0.000    0.242    0.000    4.905    4.800    2.500    7.269   -0.213   -0.024

A=ANGLE OF ATTACK, B=SIDESLIP ANGLE, IN DEG
 FUSELAGE A=    0.24, B=    0.00, DA/DT=  -0.003 RAD/SEC


      FXB   -.3347E-04-.3061E-10-.2392E-03

      FMB   0.2069E-11-.1987E-02-.4897E-09

  FDRAG = -.3448E-04     FYFORC= -.3061E-10     FLIFT = -.2391E-03

  FROLLM= 0.0000E+00     FPTCHM= -.1987E-02     FYAWM = -.4897E-09

      SCAB   0.4225E-02 1.000    0.0000E+00 1.000


 WING WAKE LEFT  A= -89.89, AREA=  55.36, CENTROID AT( -0.576,-10.785)
 WING WAKE RIGHT A= -89.89, AREA=  55.36, CENTROID AT ( -0.576, 10.785)
   FREE STREAM A=   -0.95, B=    0.00,  AILERON ANGLE =  0.00 DEG

      PEPA = 0.3900              PCPC =  1.000


 HORIZ STAB  A(ROTATION)=   -0.21, A(LIFT)=   -0.21, A(DRAG)=    0.01, DELE ANGLE =  0.44 DEG


  VERTICAL STABILIZER - PRELOOP CALC.

BLTIP(1)=-28.58     BLTIP(2)=-3.583     BLTIP(3)= 3.583     BLTIP(4)= 28.58
UVRPNT  =0.0000E+00 WVRPNT  =0.1574E-01 UVEL  =0.0000E+00   SUW2    =0.0000E+00 VTSVEL  =0.0000E+00
BETDOT  =0.0000E+00
```

Figure 5-8. CHECKS(8) Diagnostic Printout

```
VERTICAL STABILIZER - INIT. LOOP CALC.

I =          1       AXV(I) = 22.52      AYV(I) =-6.417      AZV(I) = 2.837      LXRV = 22.50
GAMRV(1)=-44.57      GAMRV(2)= 7.177     GAMRV(3)= 23.96     GAMRV(4)= 57.26     BETFD =  0.0000E+00


VERTICAL STABILIZER - PRE A-O-A CALC.

UWAKE =0.1688        VWAKE =0.0000E+00   WWAKE =0.7131E-03   P     =0.0000E+00   Q     =0.0000E+00   R     =0.0

I =          1       UVR(I) =0.1688      VVR(I) =0.0000E+00  WVR(I) =0.1645E-01  UVRI =0.1688        WVRI =0.1645
UWTSQ(I)=0.1696      ABETF =0.0000E+00   ALPFD =0.2421       TDSDB = 1.216       TKBET = 1.000       DSDBK = 1.216


VERTICAL STABILIZER - POST A-O-A CALC.

I =          1       BPR =0.0000E+00     DSDBL =0.0000E+00   XIV(I) =0.0000E+00
BETVS(I)=0.0000E+00 BETVSD(I)=0.0000E+00VWU2 = 1.003        KVWU(I)= 1.000      QV(I) =0.3226E-04


VERTICAL STABILIZER - FINAL CALC.

I =          1       CYV =0.0000E+00     CYVR =0.0000E+00    CYVT(I)=0.0000E+00  CDVT(I)=0.8636E-02
CRCV(I)=0.2500       SV(I) = 25.25       AV(I) = 3.025       TAURUD(I)=0.2700
VSVF(I)=0.0000E+00   VSDRG(I)=-.7035E-05
VVL(1)=-.7035E-05    VVL(2) =0.0000E+00  VVL(3) =0.0000E+00


VERTICAL STABILIZER - INIT. LOOP CALC.

I =          2       AXV(I) = 22.52      AYV(I) = 6.417      AZV(I) = 2.837      LXRV = 22.50
GAMRV(1)=-57.26      GAMRV(2)=-23.96     GAMRV(3)=-7.177     GAMRV(4)= 44.57     BETFD =  0.0000E+00


VERTICAL STABILIZER - PRE A-O-A CALC.

UWAKE =0.1688        VWAKE =0.0000E+00   WWAKE =0.7131E-03   P     =0.0000E+00   Q     =0.0000E+00   R     =0.000
I =          2       UVR(I) =0.1688      VVR(I) =0.0000E+00  WVR(I) =0.1645E-01  UVRI =0.1688        WVRI =0.1645
UWTSQ(I)=0.1696      ABETF =0.0000E+00   ALPFD =0.2421       TDSDB = 1.216       TKBET = 1.000       DSDBK = 1.216
```

Figure 5-8 (Continued)

```
VERTICAL STABILIZER - POST A-O-A CALC.

I =          2        BPR =0.0000E+00     DSDBL =0.0000E+00   XIV(I) =0.0000E+00
BETVS(I)=0.0000E+00 BETVSD(I)=0.0000E+00VNU2 = 1.003        XVNU(I)= 1.000      QV(I) =0.3226E-04


VERTICAL STABILIZER - FINAL CALC.

I =          2        CYV =0.0000E+00     CYVR =0.0000E+00    CYVT(I)=0.0000E+00  CDVT(I)=0.8636E-02
CRCV(I)=0.2500        SV(I) = 25.25       AV(I) = 3.025       TAURUD(I)=0.2700
VSVF(I)=0.0000E+00  VSDRG(I)=-.7035E-05
VVL(1)=-.7035E-05   VVL(2) =0.0000E+00  VVL(3) =0.0000E+00

 LANDING GEAR   0.0 PERCENT DOWN


  JT =    202.21        JTL =    101.11        JTR =    101.11        SD =    6.5766


        TIME USED FOR THIS TRIM =   0.0815 MIN
```

Figure 5-8 (Concluded)

TOTAL TIME USED SINCE BEGINNING OF RUN 1.9857 MIN

GW / U SWEEP --- ITERATION 1 / 1

ITER	ERROR	ROLL	PITCH	YAW	XLN	XLT	XPD	THOLG	FAFLPL	LTFLPL
1	0.3311	0.000	1.512	0.000	5.370	4.800	2.500	7.153	-1.168	-0.230
2	0.0655	0.000	0.512	0.000	5.003	4.800	2.500	7.247	-0.416	-0.068
3	0.0005	0.000	0.242	0.000	4.905	4.800	2.500	7.269	-0.213	-0.024

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - INPUTS

U	=0.1688	V	=0.0000E+00	W	=0.7131E-03	P	=0.0000E+00	Q	=0.0000E+00	R	=0.0000E+00
RHO	=0.2253E-02	MN	=0.1499E-03	BETAD	=0.0000E+00	OMEGL	= 589.0	OMEGR	= 589.0		
A1L	=0.0000E+00	A1R	=0.0000E+00	B1L	=0.3838E-02	B1R	=0.3838E-02	THTOLD	= 47.69	THTORD	= 47.69
CPM	=0.9998	SPM	=0.1745E-01	CBM	= 1.000	SBM	=0.0000E+00				
LXH	=-.1667E-01	LYH	= 16.16	LZH	= 6.195						

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - RIGHT ROTOR

FAFLPR	=-.3721E-02	LTFLPR	=-.4219E-03	AOR	=0.5396E-01	TR	= 7328.	HR	=-27.63	YR	=-5.205
A1RBD	=-.3997E-08	B1RBD	=0.3331E-09	MUR	=0.2189E-03	QREQR	= 9040.	OMEGAR	= 61.68	OMGRP	= 61.68
THETOR	=0.8324	THORG	= 3.248	WIR	= 54.03	LAMDAR	=0.7003E-01	LAMDIR	=0.7007E-01	LAMDOR	=-.9248E-06
A11	=-.4754E+05	A12	=0.2207E+06	A21	=-.2207E+06	A22	=-.4754E+05	B1	= 83.79	B2	= 841.4
C11	= 3578.	C12	=0.1904E+05	C21	=-.1904E+05	C22	= 3578.	ARS	= 4.952	DNR	=0.6575E+06
GEFR	= 1.000	CHIRD	= 2.655								

Figure 5-9. CHECKS(9) Diagnostic Printout

```
&ROVALR IN ALGROT
UHMR  =0.1687785    ,VHMR  =0.1244516E-04,WHMR  =0.7129827E-03,STOR  =0.7395244    ,CTOR  =0.6731298    ,CCOR  =0.7957474    ,
CC1R  =0.4649775    ,CC2R  =0.3200430    ,CC3R  =0.2426001    ,CSOR  =0.3106350    ,CS1R  =0.1431927    ,CS2R  =0.8325564E-01,
CS3R  =0.5635009E-01,CTR   =0.1114646E-01,CTELR =0.1601422E-01,ALPHRR=0.1767942    ,034RR = 578.2491    ,OMEGR = 589.0000    ,
DMQR  = 921637.3    ,GAMMR = 3.100711    ,TIPSDR= 770.9988    ,TIPVR = 771.1675    ,TIPMMR=0.6848186    ,CDCR  =0.2829550E-01,
CDRISR=-.3126835E-01,CDR   =0.2829550E-01,CDFR  =0.1904747E-02,DEL0  =0.1500000E-01,DEL1  =-.6800000E-01,DEL2  =0.8100000    ,
KR    =0.3898111E-02,CRFR  =0.1114654E-01,Q6R   = 145079.5    ,QPR   =0.0000000E+00,PPR   =0.0000000E+00,A1R   =-.2829912E-06,
B1R   =0.3837862E-02,SIGMA =0.8912684E-01,XSS   = 1.000000    ,EVBAR =0.0000000E+00,XSFR  =0.0000000E+00,Q6RADR= 1813494.    ,
CTW34R=0.9736152    ,STW34R=0.2281963    ,PRPEFR=0.8363016E-05,MFARR =-.1525879E-04,MLATRR=-.6103516E-04,A1RBDP=-.3996917E-08,
B1RBDP=0.0000000E+00,GOVM  = 3.248075
ER    (  )=
 0.5396080E-01-.3721407E-02-.4219351E-03
PHMR  =0.0000000E+00,QHMR  =0.0000000E+00,PWMR  =0.0000000E+00,QWMR  =0.0000000E+00,CEWHMR= 1.000000    ,SEWHMR=0.7373666E-04
&END


   SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - LEFT ROTOR

FAFLPL=-.3721E-02   LTFLPL=-.4219E-03   AOL   =0.5396E-01   TL    = 7328.       HL    =-27.63       YL    =-5.205
A1LBD =-.3997E-08   B1LBD =0.3331E-09   MUL   =0.2189E-03   QREQL = 9040.       OMEGAL= 61.68       OMGLP = 61.68
THETOL=0.8324       THOLG = 3.248       WIL   = 54.03       LAMDAL=0.7003E-01   LAMDIL=0.7007E-01   LAMDOL=-.9248E-06
A11   =-.4754E+05   A12   =0.2207E+06   A21   =-.2207E+06   A22   =-.4754E+05   B1    = 83.79       B2    = 841.4
C11   = 3578.       C12   =0.1904E+05   C21   =-.1904E+05   C22   = 3578.       ALS   = 4.952       DWL   =0.6575E+06
GEFL  = 1.000       CHILD = 2.655
```

Figure 5-9 (Continued)

```
&ROVALL IN ALGROT
UHML  =0.1687785    ,VHML  =0.1244516E-04,WHML  =0.7129827E-03,STOL  =0.7395244    ,CTOL  =0.6731298    ,CCOL  =0.7957474    ,
CC1L  =0.4649775    ,CC2L  =0.3200430    ,CC3L  =0.2426001    ,CSOL  =0.3106350    ,CS1L  =0.1431927    ,CS2L  =0.8325564E-01,
CS3L  =0.5635009E-01,CTL   =0.1114646E-01,CTELL =0.1601422E-01,ALPHRL=0.1767942    ,034RL = 578.2491    ,OMEGL = 589.0000    ,
DNQL  = 921637.3    ,GAMML = 3.100711    ,TIPSDL= 770.9988    ,TIPVL = 771.1675    ,TIPMNL=0.6848186    ,CDCL  =0.2829550E-01,
CDRISL=-.3126835E-01,CDL   =0.2829550E-01,CDFL  =0.1904747E-02,DEL0  =0.1500000E-01,DEL1  =-.6800000E-01,DEL2  =0.8100000    ,
KL    =0.3898111E-02,CRFL  =0.1114654E-01,Q6L   = 145079.5    ,QPL   =0.0000000E+00,PPL   =0.0000000E+00,A1L   =-.2829912E-06,
B1L   =0.3837862E-02,SIGMA =0.8912684E-01,XSS   = 1.000000    ,EVBAR =0.0000000E+00,XSFL  =0.0000000E+00,Q6RADL= 1813494.    ,
CTW34L=0.9736152    ,STW34L=0.2281963    ,PRPEFL=0.8363016E-05,MFALL =-.1525879E-04,MLATLL=-.6103516E-04,A1LBDP=-.3996917E-08,
B1LBDP=0.0000000E+00,GOVN  = 3.248075
EL    (  )=
 0.5396080E-01-.3721407E-02-.4219351E-03
PHML  =0.0000000E+00,QHML  =0.0000000E+00,PWML  =0.0000000E+00,QWML  =0.0000000E+00,CEWHML= 1.000000    ,SEWHML=0.7373666E-04
&END


   SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - VARIABLES IN WIND AXIS

HL    =-27.63       HR    =-27.63       YL    =-5.207       YR    =-5.207       HPL   = 1014.       HPR   = 1014.
AOL   =0.5396E-01   AOR   =0.5396E-01   FAFLPL=-.3721E-02   FAFLPR=-.3721E-02   LTFLPL=-.4219E-03   LTFLPR=-.4219E-03


   SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - OUTPUTS

A1L   =0.0000E+00   A1R   =0.0000E+00   B1L   =0.3838E-02   B1R   =0.3838E-02   TL    = 7328.       TR    = 7328.
HL    =-27.63       HR    =-27.63       YL    =-5.205       YR    =-5.205       WIL   = 54.03       WIR   = 54.03
HPL   = 1014.       HPR   = 1014.       QREQL = 9040.       QREQR = 9040.
MA1L  =-47.98       MA1R  =-47.98       LB1L  =-5.436       LB1R  =-5.436
XROT  = 55.26       YROT  =0.0000E+00   ZROT  =-.1465E+05   LROT  =0.0000E+00   MROT  =-998.1       NROT  =0.0000E+00
GECONS= 1.000


          TIME USED FOR THIS TRIM =   0.0828 MIN
```

Figure 5-9 (Concluded)

```
TOTAL TIME USED SINCE BEGINNING OF RUN  2.0792 MIN

      GW  /  U    SWEEP  ---  ITERATION  1 / 1


 ITER   ERROR     ROLL      PITCH     YAW       XLW     XLT     XPD     THOLG   FAFLPL  LTFLPL
  1     0.3311    0.000     1.512     0.000     5.370   4.800   2.500   7.153  -1.168  -0.230
  2     0.0655    0.000     0.512     0.000     5.003   4.800   2.500   7.247  -0.416  -0.068
  3     0.0005    0.000     0.242     0.000     4.905   4.800   2.500   7.269  -0.213  -0.024
&HPDIGW IN TRMPHS
HP    = 618.4381    ,COLERR= 447.9624    ,XCOL  = 5.138950
&END
&HPDIGW IN TRMPHS
HP    = 660.9745    ,COLERR= 408.4036    ,XCOL  = 5.388950
&END
```

Repetitive printout deleted to shorten figure

```
&HPDIGW IN TRMPHS
HP    = 1099.999    ,COLERR=0.1109009    ,XCOL  = 7.651605
&END
&POWERD IN TRMPHS
XLW   = 4.904711    ,XLT   = 4.800000    ,XPD   = 2.500000    ,XCOL  = 7.651763    ,MASTSW=           0,XFLAPS=           3,
XLGEAR=           0,RPMSEL= 589.0000    ,XTHROL=0.0000000E+00,XTHROR= 87.21411    ,RPMNII= 20693.34    ,BFTRIM=            1,
ENGINL= 1.000000    ,ENGINR= 1.000000    ,TL    = 7328.348    ,HL    =-27.63295    ,YL    =-5.205046    ,HPL   = 1013.810    ,
QREQL = 9040.148    ,XFRL  = 27.62874    ,YFRL  =-122.6931    ,ZFRL  =-7327.322    ,TR    = 7328.348    ,HR    =-27.63295    ,
YR    =-5.205046    ,HPR   = 1013.810    ,QREQR = 9040.148    ,XFRR  = 27.62874    ,YFRR  = 122.6931    ,ZFRR  =-7327.322    ,
XROT  = 55.25748    ,YROT  =0.0000000E+00,ZROT  =-14654.64    ,LROT  =0.0000000E+00,MROT  =-998.0661    ,NROT  =0.0000000E+00,
OMEGAL= 61.67990    ,OMEGAR= 61.67990    ,OMEGRO= 61.67990    ,OMGINT= 696.9829    ,OMGLPT= 2167.000    ,OMGRPT= 2167.000    ,
EP    =0.0000000E+00,ES    =0.7319450E-04,THOLG = 3.248075    ,THORG =0.0000000E+00,QRPT  = 257.2945    ,QLPT  = 257.2945    ,
EMODED=0.0000000E+00,HPROC = 1131.607    ,HPRPTG= 2000.000    ,HPROTH= 1131.607    ,HP    = 1100.043    ,FORCE1=0.0000000E+00,
&END

      TIME USED FOR THIS TRIM =   0.0812 MIN
```

Figure 5-10. CHECKS(10) Diagnostic Printout

```
&INPVAR IN DYNPHS
XLGEAR=          0,XFLAPS=          3,BFTRIM=          1,ENGINL= 1.000000    ,ENGINR= 1.000000    ,XLN    4.903619    ,
XLT   = 4.800000    ,XPD   = 2.500000    ,XCOL  = 7.652671    ,XTHROR= 87.22137    ,RPMSEL= 589.0000    ,RPMNII 20693.34    ,
MASTSW=          0,PITCH =0.4243558E-02,ROLL  =0.0000000E+00,U     =0.1687785E-01,V     =0.0000000E+00,W     0.7162256E-04,
P     =0.0000000E+00,Q     =0.0000000E+00,R     =0.0000000E+00,BETAD =0.0000000E+00,ASAS  =0.0000000E+00,ESAS  0.0000000E+00,
RSAS  =0.0000000E+00,TIME  =0.0000000E+00
&END
```

Figure 5-11. CHECKS(11) Diagnostic Printout

```
TOTAL TIME USED SINCE BEGINNING OF RUN  1.1095 MIN

      GW  /  U    SWEEP  ---  ITERATION  1 / 1


&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2=0.0000000E+00,RSIDEW= 1.228000
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1001754    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2=0.0000000E+00,RSIDEW= 1.228000
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1001754    ,RSIDEW= 1.000000
&END


 ITER   ERROR     ROLL     PITCH      YAW       XLN     XLT     XPD    THOLG   FAFLPL  LTFLPL
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 1.512472    ,RSIDEW= 1.154969
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 1.512472    ,RSIDEW= 1.154969
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 1.512472    ,RSIDEW= 1.154969
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 1.512472    ,RSIDEW= 1.154969
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 1.512472    ,RSIDEW= 1.154969
&END
```

Figure 5-12. TABSW = 1 Diagnostic Printout

```
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 1.512472    ,RSIDEW= 1.154969
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 1.512472    ,RSIDEW= 1.154969
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 1.512472    ,RSIDEW= 1.154969
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.1319711E-01,ARGMT2= 1.512414    ,RSIDEW= 1.154972
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.1319711E-01,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.1319711E-01,ARGMT2= 1.512414    ,RSIDEW= 1.154972
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.1319711E-01,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.1319711E-01,ARGMT2= 1.512414    ,RSIDEW= 1.154972
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.1319711E-01,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.1319711E-01,ARGMT2= 1.512414    ,RSIDEW= 1.154972
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.1319711E-01,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 2.012472    ,RSIDEW= 1.130826
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 2.012472    ,RSIDEW= 1.130826
&END
```

Figure 5-12 (Continued)

```
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 1.512472    ,RSIDEW= 1.154969
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 1.512472    ,RSIDEW= 1.154969
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 1.512472    ,RSIDEW= 1.154969
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 1.512472    ,RSIDEW= 1.154969
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 1.512472    ,RSIDEW= 1.154969
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.0000000E+00,ARGMT2= 1.512472    ,RSIDEW= 1.154969
&END
&RSIDW IN RSIDEW
IXXKEY=          27,ARGMT1=0.0000000E+00,ARGMT2=0.1000000    ,RSIDEW= 1.000000
&END
  1     0.3311    0.000     1.512     0.000     5.370    4.800    2.500    7.153   -1.168   -0.230
&RSIDW IN RSIDEW
IXXKEY=          13,ARGMT1=0.7350902E-15,ARGMT2=0.5124722    ,RSIDEW= 1.203255
&END
```

Figure 5-12 (Concluded)

APPENDIX A

INPUT GUIDE

XV-15 TILT ROTOR DIGITAL FLIGHT SIMULATION INPUT GUIDE

THE INPUT DATA DECK MUST ADHERE TO THE FORMAT PRESCRIBED ON THE SUCCEEDING PAGES. THE BASIC DATA DECK IS TERMINATED WITH AN 'END OF DATA' CARD FOLLOWING CARD 12D. 'END OF D' MUST BE IN COLUMNS 1 TO 8. FOLLOWING THE 'END OF DATA' CARD MUST BE A RUN TYPE OPTION CARD AND ITS ASSOCIATED DATA CARDS. THE RUN TYPE IS IN COLUMNS 1 TO 4.

RUN TYPE	FUNCTION	DESCRIPTION
DTPT	DATA POINT	DATA POINT FIXES THE AIRFRAME IN SPACE ACCORDING TO A SET OF INITIAL INPUT CONDITIONS WHILE THE ROTOR THRUST/INDUCED VELOCITY LOOP IS CLOSED.
TRMS	TRIM SWEEP	TRIM SWEEP OF ANY TWO OF ELEVEN FLIGHT VARIABLES.
MANS	MANEUVER SWEEP	TRIM FOLLOWED BY A MANEUVER (SUPPORTS SEVERAL TYPES OF CONTROL INPUT).
MANU	MANEUVER	START IN MANEUVER WITHOUT TRIMMING (SEVERAL TYPES OF CONTROL INPUT).
TUNL	TUNNEL	TABULATION OF AIRFRAME FORCES AND MOMENTS VERSUS ANGLE OF ATTACK AND SIDESLIP.
END	END OF RUN	TERMINATE EXECUTION.

AFTER THE RUN TYPE DATA CARDS MUST BE A NAMELIST &CHANGE AND &END WITH NO PUNCHES IN COLUMN 1. THE NAMELIST &CHANGE CARD REPRESENTS THE BEGINNING OF A NEW RUN. ADDITIONAL SETS OF RUN TYPE OPTION CARDS, RUN TYPE DATA CARDS, AND NAMELIST &CHANGE AND &END CARDS MAY BE INSERTED FOR MULTIPLE RUNS BEFORE THE 'END OF RUN' CARD. AT THE BEGINNING OF EACH NEW RUN, THE ORIGINAL INPUT DATA IS RESTORED BY THE PROGRAM. THIS MEANS THAT THE NAMELIST CHANGE DATA AND THE RUN TYPE DATA REPRESENT CHANGES TO THE ORIGINAL INPUT DATA AS OPPOSED TO THE PREVIOUS CASE RUN.

AN EXAMPLE OF A DATA DECK IS LISTED AT THE END OF THE USER'S GUIDE.

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
1	1-80	20A4			COMMENTS	
2	1-80	20A4			COMMENTS	
3	1-80	20A4			COMMENTS	
4	1-80	20A4			COMMENTS	

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
10	1-80	20A4			SUBSYS. 1 - ROTOR GROUP	
11	1-10	F		XBLADS	NUMBER OF ROTOR BLADES	-ND-
	11-20	F		RADIUS	RADIUS OF ROTOR DISC	FT
	21-30	F		CHORD	BLADE CHORD	IN
	31-40	F		LMAST	MAST LENGTH	FT
	41-50	F		DEL3	PITCH FLAP COUPLING	DEG
	51-60	F		IBLADE	BLADE FLAPPING INERTIA	SLG-FT2
	61-70	F		KH	FLAPPING SPRING RATE	FT-LB/DEG
12	1-10	F		SLSP	S.L. OF SHAFT PIVOT POINT	IN
	11-20	F		BLSP	B.L. OF SHAFT PIVOT POINT	IN
	21-30	F		WLSP	W.L. OF SHAFT PIVOT POINT	IN
	31-40	F		BTLOSS	BLADE TIP LOSS FACTOR	-ND-
	41-50	F		DEL0	CONST IN CDF EQUATION	-ND-
	51-60	F		DEL1	CONST IN CDF EQUATION	1/RAD
	61-70	F		DEL2	CONST IN CDF EQUATION	1/RAD2
13	1-10	F		SLPYL	S.L. OF PYLON C.G.	IN
	11-20	F		BLPYL	B.L. OF PYLON C.G.	IN
	21-30	F		WLPYL	W.L. OF PYLON C.G.	IN
	31-40	F		PYLWT	WEIGHT OF TWO PYLONS	LBS
	41-50	F		BETAD	MAST TILT ANGLE(90 TO -10)	DEG
	51-60	F		PHIM	MAST DIHEDRAL ANGLE (LATERAL NACELLE TILT)	DEG
	61-70	F		XSEGMT	NO. OF BLADE SEG.(10 MAX)	-ND-

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
14	1-10	F		BLDSTA(1)	BLADE STATION / R	-ND-
	11-20	F		BLDSTA(2)	BLADE STATION / R	-ND-
	21-30	F		BLDSTA(3)	BLADE STATION / R	-ND-
	31-40	F		BLDSTA(4)	BLADE STATION / R	-ND-
	41-50	F		BLDSTA(5)	BLADE STATION / R	-ND-
	51-60	F		BLDSTA(6)	BLADE STATION / R	-ND-
	61-70	F		BLDSTA(7)	BLADE STATION / R	-ND-
15	1-10	F		BLDSTA(8)	BLADE STATION / R	-ND-
	11-20	F		BLDSTA(9)	BLADE STATION / R	-ND-
	21-30	F		BLDSTA(10)	BLADE STATION / R	-ND-
	31-40	F		BLDSTA(11)	BLADE STATION / R	-ND-
16	1-10	F		THETA(1)	BLADE TWIST	DEG
	11-20	F		THETA(2)	BLADE TWIST	DEG
	21-30	F		THETA(3)	BLADE TWIST	DEG
	31-40	F		THETA(4)	BLADE TWIST	DEG
	41-50	F		THETA(5)	BLADE TWIST	DEG
	51-60	F		THETA(6)	BLADE TWIST	DEG
	61-70	F		THETA(7)	BLADE TWIST	DEG
17	1-10	F		THETA(8)	BLADE TWIST	DEG
	11-20	F		THETA(9)	BLADE TWIST	DEG
	21-30	F		THETA(10)	BLADE TWIST	DEG
	31-40	F		THETA(11)	BLADE TWIST	DEG

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
18	1-10	F		K0	CONST IN WING VELOCITY EQU	-ND-
	11-20	F		K1	CONST IN WING VELOCITY EQU	-ND-
	21-30	F		K2	CONST IN WING VELOCITY EQU	-ND-
	31-40	F		K3	CONST IN WING VELOCITY EQU	-ND-
	41-50	F		K4	CONST IN WING VELOCITY EQU	-ND-
	51-60	F		SLWTE	STA LINE WING TRAIL EDGE	IN
	61-70	F		KRW	SKEW ANGLE VEL.DIST.FACT.	-ND-
19	1-10	F		RSLC0	CONST-SLOPE OF LIFT CURVE	-ND-
	11-20	F		RSLC1	CONST-SLOPE OF LIFT CURVE	-ND-
	21-30	F		RSLC2	CONST-SLOPE OF LIFT CURVE	-ND-
	31-40	F		XNASEG	NUMBER OF AERO. SEGMENTS (MAX = NSEGMT)	-ND-
	41-50	F		BDALP0	CONSTANT - BLADE ZERO LIFT	DEG
1A	1-10	F		A0BAR	PRECONE ANGLE	DEG
	11-20	F		KHUB	CONING HUB SPRING	FT-LB/DEG
	21-30	F		CDALPH	DRAG COEF. SLOPE W/ALPHA (IF 0, DEFAULT TO 0.01)	-ND-
	31-40	F		CDLIM	ONSET - PROFILE DRAG RISE (IF 0, DEFAULT TO 0.85)	-ND-
	41-50	F		CDMACH	LOWER LIMIT - MACH EFFECT (IF 0, DEFAULT TO 0.35)	-ND-
	51-60	F		CDFACT	DRAG COEFFICIENT FACTOR (IF 0, DEFAULT TO 0.20)	-ND-

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
1B	1-10	F		CTMAXM	CT MAX. MULT. FACTOR	-ND-
	11-20	F		CDMAX	MAX. DRAG COEFF.	-ND-
	21-30	F		GEWASH	AIR SPEED WASHOUT (IGE)	1/FPS
	31-40	F		GECON1	CONST. IN IGE EQU.	-ND-
	41-50	F		GECON2	CONST. IN IGE EQU.	-ND-
	51-60	F		SFWASH	A/S WASHOUT ROTOR SIDEFORCE	FPS
1C	1-10	F		KMU1	INDUCED VEL. DISTR. FACTOR	-ND-
	11-20	F		KMU2	INDUCED VEL. DISTR. FACTOR	-ND-
	21-30	F		KMUSF	SIDEWARD FLT. CORR. FACTOR	-ND-
	31-40	F		MULO	LOW ADV. RATIO BREAKPOINT	-ND-
	41-50	F		MUH1	HIGH ADV. RATIO BREAKPOINT	-ND-
	51-60	F		SDBM90	SPINNER DRAG @ MAST ANGLE=0	FT2
	61-70	F		SDBM	CONST. SPINNER DRAG EQU.	FT2

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
20	1-80	20A4			SUBSYS. 3 - FUSELAGE GROUP	
21	1-10	F		SLF	STA LINE FUSE C OF PRESS	IN
	11-20	F		WLF	WATER LN FUSE C OF PRESS	IN
22	1-10	F		LBFO	LIFT @ ZERO SIDESLIP	FT2
	11-20	F		DBFO	DRAG @ ZERO SIDESLIP	FT2
	21-30	F		MBFO	PITCH MOM. @ ZERO SIDESLIP	FT3
	31-40	F		LLANG	ADDITIONAL FUSELAGE LIFT	FT2
	41-50	F		DLANG	ADDITIONAL FUSELAGE DRAG	FT2
	51-60	F		DPOD	ADDITIONAL GEAR POD DRAG	FT2

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
30	1-80	20A4			SUBSYS. 4 - WING-PYLON GROUP	
31	1-10	F		SLW	STA. LINE WING C OF PRESS	IN
	11-20	F		WLW	WATER LINE WING C.P.	IN
	21-30	F		SW	WING AREA	FT2
	31-40	F		BW	WING SPAN	FT
	41-50	F		CW	WING CHORD	FT
	51-60	F		CCLAM	WING SWEEP ANGLE AT C/4	DEG
	61-70	F		ARW	WING ASPECT RATIO	-ND-
32	1-10	F		CYBM	CONST USED IN Y FORCE EQU	1/RAD
	11-20	F		CYPCL	CONST USED IN Y FORCE EQU	1/RAD
	21-30	F		CYRM	CONST USED IN Y FORCE EQU	1/RAD
	31-40	F		CLPC	CONST IN ROLL MOMENT EQU	1/RAD
	41-50	F		CLRCL	CONST IN ROLL MOMENT EQU	1/RAD
	51-60	F		CLRDF	CONST IN ROLL MOMENT EQU	1/DEG
	61-70	F		CLDAF	CONST IN ROLL MOMENT EQU	1/DEG
33	1-10	F		CNBCL	CONST IN YAW MOMENT EQU	1/RAD
	11-20	F		CNBCL2	CONST IN YAW MOMENT EQU	1/RAD
	21-30	F		CNCL2	CONST IN YAW MOMENT EQU	1/RAD
	31-40	F		CNCD	CONST IN YAW MOMENT EQU	1/RAD
	41-50	F		CNPCL	CONST IN YAW MOMENT EQU	1/RAD
	51-60	F		KNP	CONST IN YAW MOMENT EQU	-ND-
	61-70	F		PAPF	PART.(ALFAW)/PART.(DELF)	-ND-

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
34	1-10	F		KFWO	CONST IN DOWNLOAD W/FLAPS	-ND-
	11-20	F		KFWDF	SLOPE DOWNLOAD W/FLAPS	1/DEG
	21-30	F		KXRW	CONST ROTOR FLOW ON WING	-ND-
	31-40	F		XRWO	CONST ROTOR FLOW ON WING	-ND-
	41-50	F		XRW1	CONST ROTOR FLOW ON WING	-ND-
	51-60	F		XRW2	CONST ROTOR FLOW ON WING	-ND-
35	1-10	F		SPYL	LATERAL PYLON DRAG COEFF.	FT2

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
40	1-80	20A4			SUBSYS. 5 - HORIZONTL STABILIZER GROUP	
41	1-10	F		SLH	STA. LINE CENTER OF PRESS	IN
	11-20	F		WLH	WATER LN CENTER OF PRESS	IN
	21-30	F		SLHLE	NOT USED	
	31-40	F		SH	AREA	FT2
	41-50	F		CH	CHORD	FT
	51-60	F		ENUH	NOT USED	
	61-70	F		CLHB	CONST IN LIFT EQUATION	1/DEG
42	1-10	F		XIH	TAIL INCIDENCE	DEG
	11-20	F		TAUELE	ELEVATOR EFFECTIVENESS	-ND-
	21-30	F		KHNU	Q-LOSS MULT. HOR. STAB.	-ND-
	31-40	F		DKEDDE	ELEV. EFF. MULTIPLIER	-ND-
	41-50	F		DMPWB	WING/BODY DAMPING FACTOR	-ND-
	51-60	F		CMHO	AIRFOIL PITCH MOM. COEFF.	-ND-
	61-70	F		CMHA	AIRFOIL PITCH MOM. SLOPE	1/DEG

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
50	1-80	20A4			SUBSYS. 6 - VERTICAL STABILIZER GROUP	
51	1-10	F		XFINS	NUMBER OF VERTICAL FINS	-ND-
52	1-10	F		SLVT	STA. LINE CENTER OF PRESS	IN
	11-20	F		BLVT	BUTT LINE CENTER OF PRESS	IN
	21-30	F		WLVT	WATER LINE CENTER OF PRESS	IN
	31-40	F		SV	AREA	FT2
	41-50	F		XIV	STABILIZER INCIDENCE	DEG
	51-60	F		AV	STAB. LIFT CURVE SLOPE	1/RAD
53	1-10	F		TAURUD	RUDDER EFFECTIVENESS	-ND-
	11-20	F		CRCV	RUDDER CHORD/ STAB. CHORD	-ND-
	21-30	F		PSGPP	CONST IN SIDESLIP ANG EQU	-ND-
	31-40	F		PSGPR	CONST IN SIDESLIP ANG EQU	-ND-
	41-50	F		KVNU	Q-LOSS MULTIPLIER	-ND-
	51-60	F		DKRDDE	RUDDER EFF. MULTIPLIER	-ND-
54	****	F		**** REPEAT CARD 52 FOR NEXT FIN(S)....		
55	****	F		**** REPEAT CARD 53 FOR NEXT FIN(S)....		

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
60	1-80	20A4			SUBSYS. 7 - LANDING GEAR GROUP	
61	1-10	F		SLMG	STA. LINE MAIN GEAR	IN
	11-20	F		WLMG	WATER LINE MAIN GEAR	IN
	21-30	F		SLNG	STA. LINE NOSE GEAR	IN
	31-40	F		WLNG	WATER LINE NOSE GEAR	IN
	41-50	F		GEARUP	GEAR RETRACTION TIME	SEC
	51-60	F		GEARDN	GEAR EXTENTION TIME	SEC

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
70	1-80	20A4			SUBSYS. 8 - CONTROL SYSTEM GROUP	
71	1-10	F	*	XLNTR	LONG. CYC. FORCE NEUTRAL	IN
	11-20	F	*	XLTTR	LAT. CYC. FORCE NEUTRAL	IN
	21-30	F	*	XPDTR	PEDALS FORCE NEUTRAL	IN
	31-40	F		XLNN	LONG. CYCLIC NEUTRAL POS.	IN
	41-50	F		XLTN	LAT. CYC. NEUTRAL POSITION	IN
	51-60	F		XPDN	PEDALS NEUTRAL POSITION	IN
72	1-10	F		DEDXLN	D(ELEVATOR)/D(XLN)	DEG/IN
	11-20	F		DADXLT	D(AILERON)/D(XLT)	DEG/IN
	21-30	F		DRDXPD	D(RUDDER)/D(XPD)	DEG/IN
	31-40	F		A1SWCH	A1 CONTROLLER SWITCH	-ND-
	41-50	F		DCYCN2	DIFFERENTIAL CYCLIC CONST	-ND-
	51-60	F		DCYCN3	DIFFERENTIAL CYCLIC CONST	-ND-
	61-70	F		DCYCN4	DIFFERENTIAL CYCLIC CONST	-ND-
73	1-10	F		FLN0	NOT USED	
	11-20	F		FLN1	NOT USED	
	21-30	F		KLN	NOT USED	
	31-40	F		FLNLIM	NOT USED	
74	1-10	F		FLT0	NOT USED	
	11-20	F		FLT1	NOT USED	
	21-30	F		KLT	NOT USED	
	31-40	F		FLTLIM	NOT USED	

* KNOWN TRIM POSITIONS USED IN COMPUTING PILOT FORCES. FORCES AT NEW TRIM POSITIONS ARE COMPUTED FROM THESE INPUT TRIM POSITIONS.

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
75	1-10	F		FPD0	NOT USED	
	11-20	F		FPD1	NOT USED	
	21-30	F		KPD	NOT USED	
	31-40	F		FPDLIM	NOT USED	
76	1-10	F		FCOL0	NOT USED	
	11-20	F		KCOL	NOT USED	
	21-30	F		FCOLIM	NOT USED	
	31-40	F		F4	CONST. IN COL. FFS EQU	LB/IN
	41-50	F		DB1	B1 RIGGING OFFSET CONSTANT	DEG
77	1-10	F		LTRNJ	LATERAL STICK RANGE	IN
	11-20	F		LNRNJ	LONITUDINAL STICK RANGE	IN
	21-30	F		PDRNJ	PEDAL RANGE	IN
	31-40	F		COLRNJ	COLLECTIVE RANGE	IN
	41-50	F		PBMMAX	MAX. FWD MAST TILT ANGLE	DEG
	51-60	F		PBMIN	MIN. AFT MAST TILE ANGLE	DEG

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
80	1-80	20A4			SUBSYS. 14 - IGE MOMENT GROUP	
81	1-10	F		LG0	CONST-IGE ROLL MOMENT EQU	FT*LB/DEG
	11-20	F		LG1	CONST-IGE ROLL MOMENT EQU	FT*LB/DEG
	21-30	F		LG2	CONST-IGE ROLL MOMENT EQU	FT*LB/DEG
	31-40	F		LG3	CONST-IGE ROLL MOMENT EQU	FT*LB/DEG
	41-50	F		LG4	CONST-IGE ROLL MOMENT EQU	1/FPS
	51-60	F		GEULIM	Z/D ROLL IGE UPPER LIMIT	-ND-
	61-70	F		GELLIM	Z/D ROLL IGE LOWER LIMIT	-ND-
82	1-10	F		MG1	CONST-IGE PITCH MOMENT EQU	FT
	11-20	F		MG2	CONST-IGE PITCH MOMENT EQU	-ND-
	21-30	F		MG3	CONST-IGE PITCH MOMENT EQU	1/FPS

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
90	1-80	20A4		SUBSYS.	17,18,&19 POWER MANAGEMENT GROUP	
91	1-10	F		THINT1	ROTOR-INTERCONN GEAR RATIO	-ND-
	11-20	F		TD	ROTOR GOVERNOR DELAY TIME	SEC
	21-30	F		PCTMXS	MAX % HP/SEC PWR TURB GOV	%/SEC
	31-40	F		PCTMXP	MAX % HP/SEC THROTTLE	%/SEC
	41-50	F		DRIVEI	DRIVE SYSTEM INERTIA	SLUG*FT2
	51-60	F		THRPT1	ROTOR-TURBINE GEAR RATIO	-ND-
	61-70	F		TRNEFF	TRANSMISSION EFFICIENCY	-ND-
92	1-10	F		HPK1	CONST IN DRIVE SYST EQNS	-ND-
	11-20	F		HPK2	CONST IN DRIVE SYST EQNS	-ND-
	21-30	F		HPK3	CONST IN DRIVE SYST EQNS	-ND-
	31-40	F		HPK4	CONST IN DRIVE SYST EQNS	RPM
	41-50	F		HPK5	CONST IN DRIVE SYST EQNS	RPM/S(HP)
	51-60	F		HPK6	CONST IN DRIVE SYST EQNS	HP
	61-70	F		HPK7	CONST IN DRIVE SYST EQNS	DEG K
93	1-10	F		HPK11	CONST IN DRIVE SYST EQNS	1/DEG K
	11-20	F		HPK12	CONST IN DRIVE SYST EQNS	1/DEG K
	21-30	F		HPK13	CONST IN DRIVE SYST EQNS	1/DEG K
	31-40	F		HPK14	CONST IN DRIVE SYST EQNS	DEG K
	41-50	F		HPK15	CONST IN DRIVE SYST EQNS	1/KNOTS
	51-60	F		HPK17	CONST IN DRIVE SYST EQNS	DEG K
	61-70	F		HPK18	CONST IN DRIVE SYST EQNS	-ND-

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
94	1-10	F		REP	RATED POWER OF ONE ENGINE	HP
	11-20	F		RPME	100% POWER TURBINE SPEED	RPM
	21-30	F		SHPACC	SHAFT HP REQD BY ACCESSORY	HP
	31-40	F		THOGMN	MINIMUM PITCH-GOVENOR	DEG
	41-50	F		THOGMX	MAXIMUM PITCH-GOVENOR	DEG

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
100	1-80	20A4			SUBSYS. 20 - SCAS GROUP	
101	1-10	F		XPSCAS	PITCH SCAS ON/OFF SWITCH	-ND-
	11-20	F		XLMSLT	PITCH SCAS LIMIT TRAVEL	IN
102	1-10	F		T1P	PITCH SCAS TIME CONSTANT	SEC
	11-20	F		T2P	PITCH SCAS TIME CONSTANT	SEC
	21-30	F		T3P	PITCH SCAS TIME CONSTANT	SEC
103	1-10	F		K1P-0	PITCH GAIN @ BETAD=0	IN/IN
	11-20	F		K1P-90	PITCH GAIN @ BETAD=90	IN/IN
	21-30	F		K2P-0	PITCH GAIN @ BETAD=0	IN/DG/SC
	31-40	F		K2P-90	PITCH GAIN @ BETAD=90	IN/DG/SC
	41-50	F		K3P-0	PITCH GAIN @ BETAD=0	IN/DG/SC
	51-60	F		K3P-90	PITCH GAIN @ BETAD=90	IN/DG/SC
104	1-10	F		K4P-0	PITCH GAIN @ BETAD=0	DG/SC/IN
	11-20	F		K4P-90	PITCH GAIN @ BETAD=90	DG/SC/IN
	21-30	F		K5P-0	PITCH GAIN @ BETAD=0	IN/DEG
	31-40	F		K5P-90	PITCH GAIN @ BETAD=90	IN/DEG
	41-50	F		K6P-0	PITCH GAIN @ BETAD=0	-ND-
	51-60	F		K6P-90	PITCH GAIN @ BETAD=90	-ND-
105	1-10	F		K7P-0	PITCH GAIN @ BETAD=0	IN/DG/SC
	11-20	F		K7P-90	PITCH GAIN @ BETAD=90	IN/DG/SC

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
106	1-10	F		XRSCAS	ROLL SCAS ON/OFF SWITCH	-ND-
	11-20	F		XLTSLT	ROLL SCAS LIMIT TRAVEL	IN
107	1-10	F		T1R	ROLL SCAS TIME CONSTANT	SEC
	11-20	F		T2R	ROLL SCAS TIME CONSTANT	SEC
	21-30	F		T3R	ROLL SCAS TIME CONSTANT	SEC
108	1-10	F		K1R-0	ROLL GAIN @ BETAD=0	IN/IN
	11-20	F		K1R-90	ROLL GAIN @ BETAD=90	IN/IN
	21-30	F		K2R-0	ROLL GAIN @ BETAD=0	IN/DG/SC
	31-40	F		K2R-90	ROLL GAIN @ BETAD=90	IN/DG/SC
	41-50	F		K3R-0	ROLL GAIN @ BETAD=0	IN/DG/SC
	51-60	F		K3R-90	ROLL GAIN @ BETAD=90	IN/DG/SC
109	1-10	F		K4R-0	ROLL GAIN @ BETAD=0	DG/SC/IN
	11-20	F		K4R-90	ROLL GAIN @ BETAD=90	DG/SC/IN
	21-30	F		K5R-0	ROLL GAIN @ BETAD=0	IN/DEG
	31-40	F		K5R-90	ROLL GAIN @ BETAD=90	IN/DEG
	41-50	F		K6R-0	ROLL GAIN @ BETAD=0	-ND-
	51-60	F		K6R-90	ROLL GAIN @ BETAD=90	-ND-
10A	1-10	F		K7R-0	ROLL GAIN @ BETAD=0	IN/DG/SC
	11-20	F		K7R-90	ROLL GAIN @ BETAD=90	IN/DG/SC

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
10B	1-10	F		XYSCAS	YAW SCAS ON/OFF SWITCH	-ND-
	11-20	F		XPDSLT	YAW SCAS LIMIT TRAVEL	IN
10C	1-10	F		T1Y	YAW SCAS TIME CONSTANT	SEC
	11-20	F		T2Y	YAW SCAS TIME CONSTANT	SEC
	21-30	F		T3Y	YAW SCAS TIME CONSTANT	SEC
10D	1-10	F		K1Y-0	YAW GAIN @ BETAD=0	IN/IN
	11-20	F		K1Y-90	YAW GAIN @ BETAD=90	IN/IN
	21-30	F		K2Y-0	YAW GAIN @ BETAD=0	IN/DG/SC
	31-40	F		K2Y-90	YAW GAIN @ BETAD=90	IN/DG/SC
	41-50	F		K3Y-0	YAW GAIN @ BETAD=0	-ND-
	51-60	F		K3Y-90	YAW GAIN @ BETAD=90	-ND-
10E	1-10	F		K4Y-0	YAW GAIN @ BETAD=0	-ND-
	11-20	F		K4Y-90	YAW GAIN @ BETAD=90	-ND-
	21-30	F		K5Y-0	YAW GAIN @ BETAD=0	-ND-
	31-40	F		K5Y-90	YAW GAIN @ BETAD=90	-ND-
	41-50	F		K6Y-0	YAW GAIN @ BETAD=0	-ND-
	51-60	F		K6Y-90	YAW GAIN @ BETAD=90	-ND-
10F	1-10	F		K7Y-0	YAW GAIN @ BETAD=0	-ND-
	11-20	F		K7Y-90	YAW GAIN @ BETAD=90	-ND-

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
110	1-80	20A4			INDEX ARRAYS NOT READ IN USING TABLE READ FUNCTION	
111	1-10	F	PCOPAW(1,1)		PARTIAL OF CL WRT AOA MN<.2,FX=F1,BETAD=0.	
	11-20	F	PCOPAW(2,1)		PARTIAL OF CL WRT AOA MN<.2,FX=F2,BETAD=0.	
	21-30	F	PCOPAW(3,1)		PARTIAL OF CL WRT AOA MN<.2,FX=F3,BETAD=0.	
	31-40	F	PCOPAW(4,1)		PARTIAL OF CL WRT AOA MN<.2,FX=F4,BETAD=0.	
	41-50	F	PCOPAW(5,1)		PARTIAL OF CL WRT AOA MN<.2,FX=F5,BETAD=0.	
112	1-10	F	PCOPAW(1,2)		PARTIAL OF CL WRT AOA MN<.2,FX=F1,BETAD=90.	
	11-20	F	PCOPAW(2,2)		PARTIAL OF CL WRT AOA MN<.2,FX=F2,BETAD=90.	
	21-30	F	PCOPAW(3,2)		PARTIAL OF CL WRT AOA MN<.2,FX=F3,BETAD=90.	
	31-40	F	PCOPAW(4,2)		PARTIAL OF CL WRT AOA MN<.2,FX=F4,BETAD=90.	
	41-50	F	PCOPAW(5,2)		PARTIAL OF CL WRT AOA MN<.2,FX=F5,BETAD=90.	
113	1-10	F	PCOPWA(1)		PARTIAL OF CL WRT AOA MN=.2,FX=F1,BETAD=90.	
	11-20	F	PCOPWA(2)		PARTIAL OF CL WRT AOA MN=.4,FX=F1,BETAD=90.	
	21-30	F	PCOPWA(3)		PARTIAL OF CL WRT AOA MN=.5,FX=F1,BETAD=90.	
	31-40	F	PCOPWA(4)		PARTIAL OF CL WRT AOA MN=.6,FX=F1,BETAD=90.	
	41-50	F	PCOPWA(5)		PARTIAL OF CL WRT AOA MN>.6,FX=F1,BETAD=90.	
114	1-10	F	CDCLO(1,1)		WING CD @ CL=0. MN<.2,FX=F1,BETAD=0.	
	11-20	F	CDCLO(2,1)		WING CD @ CL=0. MN<.2,FX=F2,BETAD=0.	
	21-30	F	CDCLO(3,1)		WING CD @ CL=0. MN<.2,FX=F3,BETAD=0.	
	31-40	F	CDCLO(4,1)		WING CD @ CL=0. MN<.2,FX=F4,BETAD=0.	
	41-50	F	CDCLO(5,1)		WING CD @ CL=0. MN<.2,FX=F5,BETAD=0.	

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
115	1-10	F	CDCLO(1,2)	WING CD @ CL=0.	MN<.2,FX=F1,BETAD=90.	
	11-20	F	CDCLO(2,2)	WING CD @ CL=0.	MN<.2,FX=F2,BETAD=90.	
	21-30	F	CDCLO(3,2)	WING CD @ CL=0.	MN<.2,FX=F3,BETAD=90.	
	31-40	F	CDCLO(4,2)	WING CD @ CL=0.	MN<.2,FX=F4,BETAD=90.	
	41-50	F	CDCLO(5,2)	WING CD @ CL=0.	MN<.2,FX=F5,BETAD=90.	
116	1-10	F	CDCLM(1)	WING CD @ CL=0.	MN=.2,FX=F1,BETAD=90.	
	11-20	F	CDCLM(2)	WING CD @ CL=0.	MN=.4,FX=F1,BETAD=90.	
	21-30	F	CDCLM(3)	WING CD @ CL=0.	MN=.5,FX=F1,BETAD=90.	
	31-40	F	CDCLM(4)	WING CD @ CL=0.	MN=.6,FX=F1,BETAD=90.	
	41-50	F	CDCLM(5)	WING CD @ CL=0.	MN>.6,FX=F1,BETAD=90.	
	51-60	F	CDCLM(6)	WING CD @ CL=0.	NOT USED	
117	1-10	F	CLWDA(1)	LIFT COEFF. DUE TO AILERONS	FX=F1	
	11-20	F	CLWDA(2)	LIFT COEFF. DUE TO AILERONS	FX=F2	
	21-30	F	CLWDA(3)	LIFT COEFF. DUE TO AILERONS	FX=F3	
	31-40	F	CLWDA(4)	LIFT COEFF. DUE TO AILERONS	FX=F4	
	41-50	F	CLWDA(5)	LIFT COEFF. DUE TO AILERONS	FX=F5	
118	1-10	F	DELF(1)	CONST. IN CLR AND KFW EQU.	FX=F1	
	11-20	F	DELF(2)	CONST. IN CLR AND KFW EQU.	FS=F2	
	21-30	F	DELF(3)	CONST. IN CLR AND KFW EQU.	FS=F3	
	31-40	F	DELF(4)	CONST. IN CLR AND KFW EQU.	FS=F4	
	41-50	F	DELF(5)	CONST. IN CLR AND KFW EQU.	FS=F5	

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
120	1-80	20A4			FLIGHT CONFIGURATION GROUP	
121	1-10	F		GW	A/C GROSS WEIGHT	LB
	11-20	F		PRSALT	PRESSURE ALTITUDE	FT
	21-30	F	*	DELTAT	DEGREES ABOVE STANDARD DAY	DEG C
	31-40	F	*	OAT	OUTSIDE AIR TEMPERATURE	DEG C
122	1-10	F		SLCGO	A/C C.G. S.L. @ BETAD=0	IN
	11-20	F		BLCG	A/C C.G. B.L. @ BETAD=0	IN
	21-30	F		WLCGO	A/C C.G. W.L. @ BETAD=0	IN
	31-40	F		IXXO	A/C ROLL INERTIA @ BETAD=0	SLG-FT2
	41-50	F		IYYO	A/C PTCH INERTIA @ BETAD=0	SLG-FT2
	51-60	F		IZZO	A/C YAW INERTIA @ BETAD=0	SLG-FT2
	61-70	F		IXZO	A/C CROS INERTIA @ BETAD=0	SLG-FT2
123	1-10	F		KI1	CONSTANT IN IXX EQUATION	1/DEG
	11-20	F		KI2	CONSTANT IN IYY EQUATION	1/DEG
	21-30	F		KI3	CONSTANT IN IZZ EQUATION	1/DEG
	31-40	F		KI4	CONSTANT IN IXZ EQUATION	1/DEG
124	1-10	F		XLN	LONG. CYCLIC STICK INPUT	IN
	11-20	F		XLT	LATERAL CYCLIC STICK INPUT	IN
	21-30	F		XPD	PEDALS POSITION INPUT	IN
	31-40	F		XCOL	COLLECTIVE STICK POAITION	IN
	41-50	F	*	OMEGRO	REFERENCE ROTOR RPM	RPM
	51-60	F	@	RPMSEL	RPM SELECTION	RPM
	61-70	F		TSTEP	INTEGRATION STEP SIZE	SEC

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
125	1-10	F		U	VELOCITY ALONG X-GND AXIS	KNOTS
	11-20	F		V	VELOCITY ALONG Y-GND AXIS	KNOTS
	21-30	F	$	W	VELOCITY ALONG Z-GND AXIS	KNOTS
	31-40	F	$	RODESC	RATE OF DESCENT (+ DOWN)	FT/MIN
	41-50	F		NZ	G-LEVEL FOR COORD. TURN	-ND-
	51-60	F		XNTURN	TURN CONTROL(1=COORD TURN)	-ND-

* TS(STANDARD TEMP.) = 288.16 - .0019812 * PRSALT.
  IF OAT > 0 AND DELTAT = 0, AMBTMP(AMBIENT TEMP.) = OAT + 273.16
  AND DELTAT = AMBTMP - TS
  OTHERWISE, AMBTMP = TS + DELTAT AND OAT = AMBTMP - 273.16

ROTOR RPM FOR TRIM OR INITIAL RPM FOR MANU

@ IF RPMSEL = OMEGRO, ROTOR RPM WILL BE MAINTAINED AT TRIM RPM
  THROUGHOUT MANEUVER.

$ W INPUT IGNORED IF RODESC IS NONZERO

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
126	1-10	F		ROLL	EULER ROLL ANGLE	DEG
	11-20	F		PITCH	EULER PITCH ANGLE	DEG
	21-30	F		YAW	EULER YAW ANGLE	DEG
	31-40	F		P	A/C ROLL RATE (X-BODY)	DEG/SEC
	41-50	F		Q	A/C PITCH RATE (Y-BODY)	DEG/SEC
	51-60	F		R	A/C YAW RATE (Z-BODY)	DEG/SEC
127	1-10	F		NORTHG	A/C POSITION GROUND AXIS N	FT
	11-20	F		EASTG	A/C POSITION GROUND AXIS E	FT
	21-30	F		HEIGHT	A/C POSITION GROUND AXIS Z	FT
	31-40	F		VWIND	VELOCITY OF AIR MASS	FT/SEC
	41-50	F		THWIND	WIND AZIMUTH ANGLE	DEG
	51-60	F		PSWIND	WIND ELEVATION ANGLE	DEG
128	1-10	F		ENGINL	LEFT ENGINE OPERATING IND	-ND-
	11-20	F		ENGINR	RIGHT ENGINE OPERATING IND	-ND-
	21-30	F		XENGSL	NOT USED	
129	1-10	I		MASTSW	MAST TILT ACTUATOR SW	-ND-
	11-20	I		XFLAPS	FLAPS SWITCH SETTING	-ND-
	21-30	I		XLGEAR	LANDING GEAR SELECTOR SW	-ND-
	31-40	I		BFTRIM	FORCE FEEL TRIM SWITCH	-ND-
	41-50	I		DFLPSW	DEL FLAP SWITCH	-ND-

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
12A	1-10	I		DGPTSW	DIAGNOSTIC PRINT SWITCH	-ND-
	11-20	I		TABSW	PRINT TABLE LOOKUP DIAG.	-ND-
	21-30	I		STBPSW	BYPASS THOG IN DERIVATIVES	-ND-
	31-40	I		NDIMSW	STAB. DERIV. FORMAT SWITCH	-ND-
	41-50	I		NTSOSW	PRINT FLT CONFIG DATA ONLY	-ND-
12B	1-10	I		STBMTX	PRINT STABILITY MATRIX	-ND-
	11-20	I		SRTSPT	PRINT STABILITY ROOTS	-ND-
	21-30	I		RDERMX	PRINT ROTOR DERIV MATRIX	-ND-
	31-40	I		TRMPAG	PRINT INDIVIDUAL TRIM PAGE	-ND-
	41-50	I		FAMSUM	PRINT FORCE & MOM SUMMARY	-ND-
	51-60	I		SCSRTS	PRINT SCAS-ON ROOTS	-ND-
12C	1-10	I		IR	READ DEVICE NUMBER	-ND-
	11-20	I		IW	WRITE DEVICE NUMBER	-ND-
	21-30	I		IUNIT	LISTING FILE DEVICE NUMBER	-ND-
12D	1-50	50A1		DIRNAM	DIRECTORY AND NAME OF FILE WHICH CONTAINS THE LIST OF TABLE DATA FILES TO BE USED	

CARD

130 END OF D IN COLUMNS 1 TO 8 TERMINATES BASIC DATA DECK

FORMAT FOR RUN TYPES

FOLLOWING THE 'END OF D' CARD ARE THE RUN TYPE OPTION CARD AND ITS ASSOCIATED RUN TYPE DATA CARDS. THE FORMATS FOR THE RUN TYPE DATA CARDS ARE GIVEN ON THE SUCCEEDING PAGES.

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
200	1-4	A4		DTPT	DATA POINT	
201	1-10	F		U	VELOCITY ALONG X-BODY AXIS	KNOTS
	11-20	F		V	VELOCITY ALONG Y-BODY AXIS	KNOTS
	21-30	F		W	VELOCITY ALONG Z-BODY AXIS	KNOTS
	31-40	F		P	A/C ROLL RATE (X-BODY)	DEG/SEC
	41-50	F		Q	A/C PITCH RATE (Y-BODY)	DEG/SEC
	51-60	F		R	A/C YAW RATE (Z-BODY)	DEG/SEC
202	1-10	F		XLN	LONG CYCLIC STICK INPUT	IN
	11-20	F		XLT	LATERAL CYCLIC INPUT	IN
	21-30	F		XPD	PEDALS POSITION INPUT	IN
	31-40	F		XCOL	COLLECTIVE STICK POSITION	IN
	41-50	F		FLAPS	FLAPS SWITCH SETNG(XFLAPS=)	-ND-
	51-60	F		GEAR	LAND. GEAR SEL. SW(XLGEAR=)	-ND-
	61-70	F		THOLG	LEFT GOV. COLL. PITCH	DEG
203	1-10	F		ROLL	EULER ROLL ANGLE	DEG
	11-20	F		PITCH	EULER PITCH ANGLE	DEG
	21-30	F		YAW	EULER YAW ANGLE	DEG
	31-40	F		OMEGRO	REFERENCE ROTOR RPM	RPM
	41-50	F		BETAD	MAST TILE ANGLE	DEG

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
200	1-4	A4		TRMS	TRIM SWEEP	
201	1-2	I		IVAR1	FIRST VARIABLE CODE NO.	-ND-
	5-14	F		S1	FIRST VARIABLE START VALUE	STD
	15-24	F		D1	FIRST VARIABLE INCREMENT	STD
	25-26	I		N1	NO. OF VALUES OF 1ST VAR.	-ND-
	30-31	I		IVAR2	SECOND VARIABLE CODE NO.	-ND-
	35-44	F		S2	2ND VARIABLE START VALUE	STD
	45-54	F		A2	DISPLACEMENT WITH 1ST VAR.	STD
	55-64	F		D2	2ND VARIABLE INCREMENT	STD
	65-66	I		N2	NO. OF VALUES OF 2ND VAR.	-ND-

IVAR1 AND IVAR2 CODE NUMBERS

CODE NO.	NAME	DESCRIPTION	UNITS
1	U	VELOCITY ALONG X-GND AXIS	KNOTS
2	V	VELOCITY ALONG Y-GND AXIS	KNOTS
3	W	VELOCITY ALONG Z-GND AXIS	KNOTS
4	BETAD	MAST TILT ANGLE	DEG
5	NZ	G-LEVEL FOR COORDINATED TURN	-ND-
6	OMEGRO	REFERENCE ROTOR RPM	RPM
7	SLCGO	A/C C.G. STA. LINE @ BETAD = 0	IN
8	VT	TOTAL VELOCITY	KNOTS
9	WLCGO	A/C C.G. WATER LINE @ BETAD = 0	IN
10	GW	A/C GROSS WEIGHT	LB
11	RODESC	RATE OF DESCENT (+ DOWN)	FT/MIN

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
200	1-4	A4	*	MANS	MANEUVER FOLLOWING TRIM	
201	1-10	F		RTIME	MANEUVER RUN TIME	SEC
	11-20	F		PTIME	TIME CONTROLS MOVE	SEC
	21-30	F		PRTDEL	PRINT TIME INCREMENT	SEC
	31-35	I		ICONT1	STEP CONT. INPUT SWITCH	-ND-
	36-40	I		ICONT2	TIME HIST. INPUT SWITCH	-ND-
	41-45	I		ICONT3	SUM-OF-SINES INPUT SWITCH	-ND-
	46-50	I		IGRAP	GRAPHICS FILE SWITCH	-ND-
202	1-10	F		XISCAS	AFCS/SCAS ON/OFF SWITCH	-ND-
	11-20	F		TIMPSC	TIME FOR PITCH SCAS FAILURE	SEC
	21-30	F		TIMRSC	TIME FOR ROLL SCAS FAILURE	SEC
	31-35	F		TIMYSC	TIME FOR YAW SCAS FAILURE	SEC

***** PUT VALUES IN CARD 203 IF ICONT1 OR ICONT3 SWITCH IS ON *****

203	1-10	F	#	DXLN	DELTA CHANGE LONG	PCT
	11-20	F	#	DXLT	DELTA CHANGE LATERAL	PCT
	21-30	F	#	DXPD	DELTA CHANGE PEDALS	PCT
	31-40	F	#	DXCOL	DELTA CHANGE COLLECTIVE	PCT
204	1-10	F		GSTIN	TIME GUST ENCOUNTERED	SEC
	11-20	F		GSTOUT	TIME GUST STOPS	SEC
	21-30	F		DUGND	DELTA CHANGE UGND VEL.	FT/SEC
	31-40	F		DVGND	DELTA CHANGE VGND VEL.	FT/SEC
	41-50	F		DWGND	DELTA CHANGE WGND VEL.	FT/SEC

* IN A MANEUVER THE FUSELAGE IS FROZEN IN SPACE FROM 0 TO 1 SECONDS AS THE ROTOR REACHES STEADY STATE. INTEGRATION OF FUSELAGE ACCELLERATIONS AND RATES BEGINS AT 1 SECOND. CONTROL INPUTS BEGIN AT 2 SECONDS FOR 'PTIME' SECONDS. TOTAL MANEUVER TIME IS RTIME SECONDS.

\# STEP SIZE IF ICONT1 = 1, SCALAR GAIN FOR SUM-OF-SINES IF ICONT3 = 1

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
***** PUT VALUES IN CARDS 205-211 IF ICONT2 IS SWITCH ON ***** CARDS NOT INPUT IF ICONT2 SWITCH = 0						
205	1-4	A4		LONGITUDINAL CONTROL INPUT COMMENT CARD		
206	1-10	F		PHTIME(1)		SEC
	11-20	F		PHTIME(2)		SEC
	21-30	F		PHTIME(3)		SEC
	31-40	F		PHTIME(4)		SEC
	41-50	F		PHTIME(5)		SEC
	51-60	F		PHTIME(6)		SEC
	61-70	F		PHTIME(7)		SEC
207	1-10	F		PHTIME(8)		SEC
	11-20	F		PHTIME(9)		SEC
	21-30	F		PHTIME(10)		SEC
	31-40	F		PHTIME(11)		SEC
	41-50	F		PHTIME(12)		SEC
	51-60	F		PHTIME(13)		SEC
	61-70	F		PHTIME(14)		SEC
208	1-10	F		PHTIME(15)		SEC
	11-20	F		PHTIME(16)		SEC
	21-30	F		PHTIME(17)		SEC
	31-40	F		PHTIME(18)		SEC
	41-50	F		PHTIME(19)		SEC
	51-60	F		PHTIME(20)		SEC
	61-70	F		PHTIME(21)		SEC

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
209	1-10	F		PHPCT(1)		PCT
	11-20	F		PHPCT(2)		PCT
	21-30	F		PHPCT(3)		PCT
	31-40	F		PHPCT(4)		PCT
	41-50	F		PHPCT(5)		PCT
	51-60	F		PHPCT(6)		PCT
	61-70	F		PHPCT(7)		PCT
210	1-10	F		PHPCT(8)		PCT
	11-20	F		PHPCT(9)		PCT
	21-30	F		PHPCT(10)		PCT
	31-40	F		PHPCT(11)		PCT
	41-50	F		PHPCT(12)		PCT
	51-60	F		PHPCT(13)		PCT
	61-70	F		PHPCT(14)		PCT
211	1-10	F		PHPCT(15)		PCT
	11-20	F		PHPCT(16)		PCT
	21-30	F		PHPCT(17)		PCT
	31-40	F		PHPCT(18)		PCT
	41-50	F		PHPCT(19)		PCT
	51-60	F		PHPCT(20)		PCT
	61-70	F		PHPCT(21)		PCT

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS

***** PUT VALUES IN CARDS 212-218 IF ICONT2 IS SWITCH ON *****

212	1-4	A4		LATERAL CONTROL INPUT COMMENT CARD		
213	1-10	F		RLTIME(1)		SEC
	11-20	F		RLTIME(2)		SEC
	21-30	F		RLTIME(3)		SEC
	31-40	F		RLTIME(4)		SEC
	41-50	F		RLTIME(5)		SEC
	51-60	F		RLTIME(6)		SEC
	61-70	F		RLTIME(7)		SEC
214	1-10	F		RLTIME(8)		SEC
	11-20	F		RLTIME(9)		SEC
	21-30	F		RLTIME(10)		SEC
	31-40	F		RLTIME(11)		SEC
	41-50	F		RLTIME(12)		SEC
	51-60	F		RLTIME(13)		SEC
	61-70	F		RLTIME(14)		SEC
215	1-10	F		RLTIME(15)		SEC
	11-20	F		RLTIME(16)		SEC
	21-30	F		RLTIME(17)		SEC
	31-40	F		RLTIME(18)		SEC
	41-50	F		RLTIME(19)		SEC
	51-60	F		RLTIME(20)		SEC
	61-70	F		RLTIME(21)		SEC

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
216	1-10	F		RLPCT(1)		PCT
	11-20	F		RLPCT(2)		PCT
	21-30	F		RLPCT(3)		PCT
	31-40	F		RLPCT(4)		PCT
	41-50	F		RLPCT(5)		PCT
	51-60	F		RLPCT(6)		PCT
	61-70	F		RLPCT(7)		PCT
217	1-10	F		RLPCT(8)		PCT
	11-20	F		RLPCT(9)		PCT
	21-30	F		RLPCT(10)		PCT
	31-40	F		RLPCT(11)		PCT
	41-50	F		RLPCT(12)		PCT
	51-60	F		RLPCT(13)		PCT
	61-70	F		RLPCT(14)		PCT
218	1-10	F		RLPCT(15)		PCT
	11-20	F		RLPCT(16)		PCT
	21-30	F		RLPCT(17)		PCT
	31-40	F		RLPCT(18)		PCT
	41-50	F		RLPCT(19)		PCT
	51-60	F		RLPCT(20)		PCT
	61-70	F		RLPCT(21)		PCT

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
***** PUT VALUES IN CARDS 219-225 IF ICONT2 IS SWITCH ON *****						
219	1-4	A4			PEDAL CONTROL INPUT COMMENT CARD	
220	1-10	F			YWTIME(1)	SEC
	11-20	F			YWTIME(2)	SEC
	21-30	F			YWTIME(3)	SEC
	31-40	F			YWTIME(4)	SEC
	41-50	F			YWTIME(5)	SEC
	51-60	F			YWTIME(6)	SEC
	61-70	F			YWTIME(7)	SEC
221	1-10	F			YWTIME(8)	SEC
	11-20	F			YWTIME(9)	SEC
	21-30	F			YWTIME(10)	SEC
	31-40	F			YWTIME(11)	SEC
	41-50	F			YWTIME(12)	SEC
	51-60	F			YWTIME(13)	SEC
	61-70	F			YWTIME(14)	SEC
222	1-10	F			YWTIME(15)	SEC
	11-20	F			YWTIME(16)	SEC
	21-30	F			YWTIME(17)	SEC
	31-40	F			YWTIME(18)	SEC
	41-50	F			YWTIME(19)	SEC
	51-60	F			YWTIME(20)	SEC
	61-70	F			YWTIME(21)	SEC

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
223	1-10	F		YWPCT(1)		PCT
	11-20	F		YWPCT(2)		PCT
	21-30	F		YWPCT(3)		PCT
	31-40	F		YWPCT(4)		PCT
	41-50	F		YWPCT(5)		PCT
	51-60	F		YWPCT(6)		PCT
	61-70	F		YWPCT(7)		PCT
224	1-10	F		YWPCT(8)		PCT
	11-20	F		YWPCT(9)		PCT
	21-30	F		YWPCT(10)		PCT
	31-40	F		YWPCT(11)		PCT
	41-50	F		YWPCT(12)		PCT
	51-60	F		YWPCT(13)		PCT
	61-70	F		YWPCT(14)		PCT
225	1-10	F		YWPCT(15)		PCT
	11-20	F		YWPCT(16)		PCT
	21-30	F		YWPCT(17)		PCT
	31-40	F		YWPCT(18)		PCT
	41-50	F		YWPCT(19)		PCT
	51-60	F		YWPCT(20)		PCT
	61-70	F		YWPCT(21)		PCT

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS

***** PUT VALUES IN CARDS 226-232 IF ICONT2 IS SWITCH ON *****

226	1-4	A4			COLLECTIVE CONTROL INPUT COMMENT CARD	
227	1-10	F			CETIME(1)	SEC
	11-20	F			CETIME(2)	SEC
	21-30	F			CETIME(3)	SEC
	31-40	F			CETIME(4)	SEC
	41-50	F			CETIME(5)	SEC
	51-60	F			CETIME(6)	SEC
	61-70	F			CETIME(7)	SEC
228	1-10	F			CETIME(8)	SEC
	11-20	F			CETIME(9)	SEC
	21-30	F			CETIME(10)	SEC
	31-40	F			CETIME(11)	SEC
	41-50	F			CETIME(12)	SEC
	51-60	F			CETIME(13)	SEC
	61-70	F			CETIME(14)	SEC
229	1-10	F			CETIME(15)	SEC
	11-20	F			CETIME(16)	SEC
	21-30	F			CETIME(17)	SEC
	31-40	F			CETIME(18)	SEC
	41-50	F			CETIME(19)	SEC
	51-60	F			CETIME(20)	SEC
	61-70	F			CETIME(21)	SEC

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
230	1-10	F		CEPCT(1)		PCT
	11-20	F		CEPCT(2)		PCT
	21-30	F		CEPCT(3)		PCT
	31-40	F		CEPCT(4)		PCT
	41-50	F		CEPCT(5)		PCT
	51-60	F		CEPCT(6)		PCT
	61-70	F		CEPCT(7)		PCT
231	1-10	F		CEPCT(8)		PCT
	11-20	F		CEPCT(9)		PCT
	21-30	F		CEPCT(10)		PCT
	31-40	F		CEPCT(11)		PCT
	41-50	F		CEPCT(12)		PCT
	51-60	F		CEPCT(13)		PCT
	61-70	F		CEPCT(14)		PCT
232	1-10	F		CEPCT(15)		PCT
	11-20	F		CEPCT(16)		PCT
	21-30	F		CEPCT(17)		PCT
	31-40	F		CEPCT(18)		PCT
	41-50	F		CEPCT(19)		PCT
	51-60	F		CEPCT(20)		PCT
	61-70	F		CEPCT(21)		PCT

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
200	1-4	A4	*	MANU	MANEUVER WITHOUT TRIMMING (SUGGESTED USE ONLY IF MANS OPTION CANNOT BE USED)	
201	1-10	F		RTIME	MANEUVER RUN TIME	SEC
	11-20	F		PTIME	TIME CONTROLS MOVE	SEC
	21-30	F		PRTDEL	PRINT TIME INCREMENT	SEC
	31-35	I		ICONT1	STEP CONT. INPUT SWITCH	-ND-
	36-40	I		ICONT2	TIME HIST. INPUT SWITCH	-ND-
	41-45	I			NOT USED	
	46-50	I		IGRAP	GRAPHICS FILE SWITCH	-ND-
202	1-10	F		XISCAS	AFCS/SCAS ON/OFF SWITCH	-ND-
	11-20	F		TIMPSC	TIME FOR PITCH SCAS FAILURE	SEC
	21-30	F		TIMRSC	TIME FOR ROLL SCAS FAILURE	SEC
	31-35	F		TIMYSC	TIME FOR YAW SCAS FAILURE	SEC

***** PUT VALUES IN CARD 203 IF ICONT1 SWITCH IS ON *****

203	1-10	F		DXLN	DELTA CHANGE LONG.	PCT
	11-20	F		DXLT	DELTA CHANGE LATERAL	PCT
	21-30	F		DXPD	DELTA CHANGE PEDALS	PCT
	31-40	F		DXCOL	DELTA CHANGE COLLECTIVE	PCT
	41-50	F		THOLG	LEFT GOV. COLL. PITCH	DEG
	51-60	F		THORG	RIGHT GOV. COLL. PITCH	DEG

204	1-10	F	GSTIN	TIME GUST ENCOUNTERED	SEC
	11-20	F	GSTOUT	TIME GUST STOPS	SEC
	21-30	F	DUGND	DELTA CHANGE UGND VEL.	FT/SEC
	31-40	F	DVGND	DELTA CHANGE VGND VEL.	FT/SEC
	41-50	F	DWGND	DELTA CHANGE WGND VEL.	FT/SEC

***** FOR DETAILS ON CARDS 205 THROUGH 232, SEE MANS OPTION *****

* FOR MANU U,V, AND W FROM INPUT DATA ARE IN BODY AXIS AND NOT GROUND AXIS. VARIABLE RODESC MUST BE ZERO FOR MANU.
FOR A MANEUVER THE FUSELAGE IS NOT ALLOWED TO MOVE FROM 0 TO 1 SECONDS WHILE THE ROTOR REACHES STEADY STATE. INTEGRATION OF FUSELAGE ACCELERATIONS AND RATES STARTS AT 1 SECOND. THE CONTROL INPUTS START AT 2 SECONDS AND ARE IN FOR PTIME SECONDS. THE TOTAL MANEUVER RUN TIME IS RTIME SECONDS.

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
200	1-4	A4		TUNL	TUNNEL	
201	1-10	F		ALPLOW	MINIMUM VALUE OF ALPHA	DEG
	11-20	F		DELALP	DELTA VALUE OF ALPHA	DEG
	23-25	I		NALPHA	NUMBER OF ALPHA VALUES	-ND-
	31-40	F		BETLOW	MINIMUM VALUE OF BETA	DEG
	41-50	F		DELBET	DELTA VALUE OF BETA	DEG
	53-55	I		NBETA	NUMBER OF BETA VALUES	-ND-
202	1-10	I		XPRINT	FULL PRINTOUT IF XPRINT=1	-ND-

CARD	COL.	FMT.	SYMBOL	NAME	DESCRIPTION	UNITS
200	1-4	A4		END	END OF RUN - TERMINATES EXECUTION	

NO DATA CARDS REQUIRED

APPENDIX B

SWITCH OPTIONS

INPUT DATA SWITCH OPTIONS

NAME	VALUE	FUNCTION
A1SWCH	1.0	TURNS ON A1 CONTROLLER
	0.0	TURNS OFF A1 CONTROLLER
BFTRIM	0	COMPUTES STICK FORCE
	1	SETS STICK FORCE TO ZERO
DFLPSW	0	COMPUTES DYNAMIC FLAPPING IN MANEUVER
	1	COMPUTES DIFFERENTIAL FLAPPING
DGPTSW	0	SUPPRESSES DIAGNOSTIC PRINTOUT
	1	GIVES GENERAL DIAGNOSTIC PRINTOUT
	>1	SETS CHECKS(I) DIAGNOSTIC SWITCH (SEE DATA DEPENDENT SWITCH OPTIONS)
	>20	SETS CHECKS(I) DIAGNOSTIC SWITCH & SETS DGPTSW = 1 (SEE DATA DEPENDENT SWITCH OPTIONS)
ENGINL	0.0	INDICATES LEFT ENGINE OFF
	1.0	INDICATES LEFT ENGINE ON
ENGINR	0.0	INDICATES RIGHT ENGINE OFF
	1.0	INDICATES RIGHT ENGINE ON
FAMSUM	1	PRINTS FORCE AND MOMENT SUMMARY
	0	SUPPRESSES FORCE AND MOMENT SUMMARY PRINT
MASTSW	-1	TILTS NACELLE DOWN DURING A MANEUVER
	0	LOCKS NACELLE DURING MANEUVER
	1	TILTS NACELLE UP DURING A MANEUVER
NDIMSW	0	PRINTS DIMENSIONAL STABILITY DERIVATIVES
	1	PRINTS STAB. DERIV. DIVIDED BY MASS OR INERTIA
	2	PRINTS NON-DIMENSIONAL STAB. DERIV.(ABOVE U=40 FT/SEC)
NTSOSW	1	PRINTS ONLY FLIGHT CONF. GROUP OF INPUT DATA
	0	PRINTS ALL OF THE INPUT DATA
NTURN	0	TRIMS IN 1 G LEVEL FLIGHT
	1	TRIMS IN NZ G COORDINATED TURN
	2	TRIMS IN NZ G PULLUP OR PUSHOVER

INPUT DATA SWITCH OPTIONS (CONTINUED)

NAME	VALUE	FUNCTION
RDERMX	1	PRINTS ROTOR DERIVATIVE MATRIX
	0	SUPPRESSES ROTOR DERIVATIVE MATRIX PRINTOUT
SCSRTS	0	SUPPRESSES SCAS ROOT PRINTOUT
	1	SCAS-OFF 7X7 COUPLED EQUATION ROOTS
	2	PRINTS SCAS ON/OFF ROOTS(MAKES STBMTX=1)
SRTSPT	1	PRINTS SCAS-OFF ROOTS(MAKES STBMTX=1)
	0	SUPPRESSES ROOT PRINTOUT
STBMTX	1	PRINTS TOTAL AIRCRAFT STABILITY & CONTROL MATRIX
	0	SUPPRESSES A/C S&C MATRIX PRINTOUT
STBPSW	0	TURNS GOVERNOR ON
	1	BYPASSES THOG (GOVERNOR) IN DERIVATIVES, TURNS OFF GOVERNOR IN MANEUVERS
TABSW	1	PRINTS TABLE LOOKUP DIAGNOSTICS
	0	SUPPRESSES TABLE LOOKUP PRINTOUT
TRMPAG	1	PRINTS INDIVIDUAL TRIM PAGE
	0	SUPPRESSES TRIM PAGE PRINT
XFLAPS	1	SETS FLAPS @ F1 (0 DEG / 0 DEG)
	2	SETS FLAPS @ F2 (20 DEG / 12.5 DEG)
	3	SETS FLAPS @ F3 (40 DEG / 25 DEG)
	4	SETS FLAPS @ F4 (75 DEG / 47 DEG)
XLGEAR	0	SETS GEAR UP
	1	SETS GEAR DOWN

SCAS DEPENDENT SWITCH OPTIONS

XISCAS	0	SCAS CANNOT BE USED IN MANEUVER
	1	SCAS CAN BE USED IN MANEUVER
IPSCAS	0	PITCH SCAS TURNED OFF
	1	PITCH SCAS TURNED ON
IRSCAS	0	ROLL SCAS TURNED OFF
	1	ROLL SCAS TURNED ON
IYSCAS	0	YAW SCAS TURNED OFF
	1	YAW SCAS TURNED ON

MANEUVER DEPENDENT SWITCH OPTIONS

ICONT1	0	TURNS OFF PURE STEP CONTROL INPUT OPTION
	1	TURNS ON PURE STEP CONTROL INPUT OPTION
ICONT2	0	TURNS OFF TIME HISTORY CONTROL INPUT OPTION
	1	TURNS ON TIME HISTORY CONTROL INPUT OPTION
ICONT3	0	TURNS OFF SUM-OF-SINES CONTROL INPUT OPTION
	1	TURNS ON SUM-OF-SINES CONTROL INPUT OPTION
IGRAP	0	TURNS OFF GRAPHICS OUTPUT TO AN INDIVIDUAL FILE
	1	TURNS ON GRAPHICS OUTPUT TO AN INDIVIDUAL FILE

DATA DEPENDENT SWITCH OPTIONS

SWITCH NAME	TO TURN SWITCH ON	FUNCTION
CHECKS(2)	DGPTSW=2 OR DGPTSW=22	DIAGNOSTIC PRINT FROM HANDLE, STABDV, INIT & MAINDG
CHECKS(3)	DGPTSW=3 OR DGPTSW=23	DIAGNOSTIC PRINT FROM HANDLE
CHECKS(4)	DGPTSW=4 OR DGPTSW=24	DIAGNOSTIC PRINT FROM MAIN & GETDAT FOR TRIM SUMMARY INFORMATION
CHECKS(5)	DGPTSW=5 OR DGPTSW=25	DIAGNOSTIC PRINT FROM ACTRIM FOR NZ, TURN RADIUS, P, Q, R
CHECKS(7)	DGPTSW=7 OR DGPTSW=27	DIAGNOSTIC PRINT FROM COMMIX FOR HORSEPOWER
CHECKS(8)	DGPTSW=8 OR DGPTSW=28	DIAGNOSTIC PRINT FROM AEROPQ
CHECKS(9)	DGPTSW=9 OR DGPTSW=29	DIAGNOSTIC PRINT FROM ALGROT
CHECKS(10)	DGPTSW=10 OR DGPTSW=30	DIAGNOSTIC PRINT FROM IFHB42(TRMPHS) FOR HORSEPOWER CONVERGENCE IN TRIM LOOP
CHECKS(11)	DGPTSW=11 OR DGPTSW=31	DIAGNOSTIC PRINT FROM IFHB43(DYNPHS) FOR MANEUVER

INTERNAL SWITCHES

NAME	VALUE	FUNCTION
IGUESS	0	WHEN NOT TRIMMED
	1	WHEN TRIMMED
	2	CONTROLS OUT OF LIMITS
	3	ROTOR STALLED
	4	WING STALLED
INITSW	0	DURING MANEUVER
	1	DURING INITIALIZATION OF RUN
ISTART	0	AFTER COMPLETING A RUN TYPE
	1	ON ENTERING PROGRAM TO READ INPUT DATA CARDS
PRNTSW	FALSE	BRANCH AROUND PRINTOUT
	TRUE	GIVE PRINTOUT
SNAPSW	0	BRANCH AROUND PRINTOUT
	1	GIVE PRINTOUT FOR DTPT RUN TYPE
STABSW	0	GOVERNOR ON
	1	GOVERNOR OFF
	2	GOVERNOR ON AND LOCK FLAPPING FOR STAB. DERIV.
	3	GOVERNOR OFF AND LOCK FLAPPING FOR STAB. DERIV.

APPENDIX C

USE OF NAMELIST

NOTES ON THE USE OF NAMELIST

VALID VARIABLE NAMES TO BE USED FOR NAMELIST CHANGE ARE:

```
U     ,V     ,W     ,BETAD ,GW    ,PRSALT,DELTAT,
OAT   ,SLCGO ,BLCG  ,WLCGO ,IXXO  ,IYYO  ,IZZO  ,
IXZO  ,XLN   ,XLT   ,XPD   ,XCOL  ,OMEGRO,RPMSEL,
TSTEP ,RODESC,NZ    ,NTURN ,ROLL  ,PITCH ,YAW   ,
P     ,Q     ,R     ,VWIND ,THWIND,PSWIND,XFLAPS,
MASTSW,XLGEAR,DFLPSW,DGPTSW,TABSW ,STBPSW,NDIMSW,
NTSOSW,STBMTX,SRTSPT,RDERMX,TRMPAG,FAMSUM,SCSRTS,
CHORD,RADIUS,HEIGHT
```

NO NAMELIST VARIABLES CAN APPEAR IN COLUMN 1. THE NAMELIST STARTS WITH '&CHANGE' AND ENDS WITH '&END'. SEVERAL VARIABLES AND THEIR VALUES, SEPARATED BY COMMAS, MAY BE PLACED ON A SINGLE CARD. THE LAST VARIABLE VALUE AT THE END OF A CARD OR BEFORE &END HAS AN OPTIONAL COMMA FOLLOWING IT. ALL INTEGER VALUES MUST HAVE A COMMA IMMEDIATELY FOLLOWING IT. NAMELIST READS DATA THROUGH COLUMN 80.

THE FOLLOWING ARE SAMPLES OF VALID NAMELIST CHANGE CARDS:

```
COL.
 2

 &CHANGE , &END

 &CHANGE
  BETAD = 30., XFLAPS = 2, DGPTSW = 0,
 &END

 &CHANGE STBMTX = 1, &END

 &CHANGE
  RPMSEL = 565.
  DGPTSW = 1,
  OMEGRO = 565.,
  BETAD = 30.
 &END
```

FOR COMPUTERS WHICH DO NOT SUPPORT NAMELIST, A RESTRICTED SIMULATED NAMELIST READ IS PROVIDED. '&CHANGE' AND '&END' MUST BE ON SEPARATE CARDS AND MUST START IN COLUMN 2. ONLY ONE VARIABLE MAY BE PLACED ON A CARD. THE VARIABLE NAME MUST START IN COLUMN 3 AND END IN COLUMN 8. IF THE VARIABLE IS AN INTEGER, THE I2 INTEGER VALUE MUST BE IN COLUMNS 10 & 11. FLOATING POINT VALUES MUST BE IN COLUMNS 12 TO 25.

THE FOLLOWING ARE SAMPLES OF RESTRICTED NAMELIST CHANGE CARDS:

```
COL.
 2

 &CHANGE
 &END

 &CHANGE
  BETAD =  30.
  XFLAPS= 2
  DGPTSW= 0
 &END

 &CHANGE
  STBMTX= 1
 &END

 &CHANGE
  RPMSEL=  565.
  DGPTSW= 1
  OMEGRO=  565.
  BETAD =  30.
 &END
```

EXAMPLE OF SETS OF MULTIPLE RUNS

EXAMPLE 1 - TUNL & TRMS

```
TUNL
-10.      0.5          50     -15.      1.0          30
         1
 &CHANGE STBMTX=1, SRTSPT=1, FAMSUM=1,SCSRTS=1, &END
TRMS
 4  0.0       30.0       2    8   0.0       20.0      20.0       6
 &CHANGE
 &END
END OF RUN
```

EXAMPLE 2 - TRMS & MANU

```
TRMS
 4  0.0       30.0       2    8   0.0       20.0      20.0       6
 &CHANGE
  U=120.,BETAD=30.,XCOL=4.249,XLN=6.994,W=-2.6,PITCH=-1.242
 &END
MANU
6.0       2.0       0.25          1    6    8
0.5       0.0       0.0       0.0
3.81      3.81
 &CHANGE  &END
END OF RUN
```

EXAMPLE 3 - DTPT

```
DTPT
40.       0.        -1.368    0.0       0.0       0.0
5.454     4.8       2.5       4.308     2.0       0.0       4.56
0.0       -1.96     0.0       565.      0.0
 &CHANGE   &END
DTPT
120.      20.       -20.      11.46     11.46     11.46
8.0       4.8       2.5       6.5       2.0       0.0       6.75
5.0       5.0       5.0       565.      30.0
 &CHANGE    &END
DTPT
200.      0.0       9.42      0.0       0.0       0.0
5.215     4.8       2.5       2.982     1.0       0.0       17.03
0.0       2.669     0.0       458.      90.0
/*
```

```
EXAMPLE 4 - TRMS & MANS

TRMS
 4  0.0      30.0      2    8   0.0       20.0      20.0       6
 &CHANGE
  U=250.,XFLAPS=1,OMEGRO=458.,RPMSEL=458.,BETAD=90.
 &END
MANS
4.0       4.0       0.1           0    1    0    8
1.0       50.0      50.0      50.0
0.0       0.0       0.0       0.0
0.0       0.0       0.0       0.0       0.0
LONG CONT. INPUT
0.0       0.01      20.0      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       -10.0     -10.0     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
LAT CONT. INPUT
0.0       20.0      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       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
PED CONT. INPUT
0.0       20.0      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       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
COL CONT. INPUT
0.0       1.0       3.0       20.0      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       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
 &CHANGE
 &END
/*
```

APPENDIX D

EXAMPLE OF INPUT DATA DECK

EXAMPLE OF INPUT DATA DECK

```
XV-15 TILT ROTOR DIGITAL FLIGHT SIMULATION
G.W. = VARIABLE LBS, 299.9 AFT C.G.
FLAPS 0/0, GEAR UP, 10-11-88
EXAMPLE CASE FOR DOCUMENTATION
***** SUBSYSTEM 1 - ROTOR GROUP *****
3.0       12.5      14.0      4.667     -15.0     102.5     225.0
300.0     193.0     100.0     0.97      0.015     -0.068    0.81
291.7     193.0     118.0     3986.0    90.0      1.0       10.0
1.0       0.6       0.5333    0.4667    0.4       0.3333    0.2667
0.2000    0.1333    0.0667    0.0
0.0       10.2      12.3      14.5      17.75     21.90     26.15
30.65     34.65     38.00     40.90
1.6       0.0       0.0       0.0       0.0       338.19    3.0
4.95      8.0       -30.0     8.0       1.0
2.5       180000.   0.01      0.85      0.35      0.20
1.0       0.11      -0.08     1.5629083 -2.911932 54.0
17.807    -0.561    6.0       0.1067    0.5733    1.0       5.5
***** SUBSYSTEM 3 - FUSELAGE GROUP *****
293.0     84.0
-7.23     -1.56     66.5      0.0       -0.5      1.15
***** SUBSYSTEM 4 - WING-PYLON GROUP *****
291.17    95.85     181.0     32.17     5.225     -6.5      5.7
0.0       0.0       0.0       -0.774    0.27      -0.0016   0.006
-0.0315   0.057     -0.016    -0.32     -0.06     1.0       -0.45
1.4000    -0.0035   0.26      0.0806    .00003341 .000007386
24.05
***** SUBSYSTEM 5 - HORIZONTAL STABILIZER GROUP *****
560.0     103.0                50.25     3.92                -0.00422
0.0       0.518     0.8       0.24      1.0       0.0       0.0
***** SUBSYSTEM 6 - VERTICAL STABILIZER GROUP *****
2.0
570.02    -77.0     115.69    25.25     0.0       3.02522
0.27      0.25      -0.1      0.0       1.0       0.24
570.02    77.0      115.69    25.25     0.0       3.02522
0.27      0.25      -0.1      0.0       1.0       0.24
***** SUBSYSTEM 7 - LANDING GEAR GROUP *****
324.0     7.4       139.0     4.95      10.0      7.0
***** SUBSYSTEM 8 - CONTROL SYSTEM GROUP *****
4.8       4.8       2.5       4.8       4.8       2.5
4.167     3.93      8.0       0.0       1.0       1.0       1.0
0.0
0.0
0.0
                              0.0       1.5
9.6       9.6       5.0       10.0      90.0      -5.0
***** SUBSYSTEM 14 - IGE MOMENT GROUP *****
-7506.0   23366.0   -20134.0  5290.0    -0.1      1.6386    0.5
-0.9      -2.6      -0.08
***** SUBSYSTEMS 17,18, &19 - POWER MANAGEMENT GROUP *****
11.3      0.0       6.0       6.0       824.0     35.133    0.93
-0.94     1.94      0.0       13100.0   235.0     475.0     288.16
0.0032    0.875     0.00125   0.0       0.0       42.0      1400.0
1.0       1.0       10.0      -5.0      33.5
```

```
     ***** SUBSYSTEM 20 - SCAS GROUP *****
1.0       1.078
0.3       3.0       0.3
0.6       -1.0      0.921     0.386     0.107     0.0
-7.5      -7.5      0.2       0.2       0.0       0.0
0.092     0.059
1.0       1.617
0.3       3.0       0.3
1.0       1.0       0.535     0.803     0.064     0.057
10.0      10.0      0.2       0.2       0.0       0.0
0.15      0.15
1.0       0.4
2.7       2.7       0.0
2.94      0.0       0.16      0.08      0.0       0.0
0.0       0.0       0.0       0.0       0.0       0.0
0.0       0.0
    *****  TABLES NOT READ IN FROM OUTSIDE FILES  *****
0.057     0.0575    0.057     0.0563
0.0799    0.080     0.080     0.08
0.0799    0.0837    0.0915    0.0988
0.2126    0.2512    0.256     0.442
0.0177    0.0419    0.058     0.243
0.0177    0.0178    0.0179    0.0405
0.00316   0.00396   0.00476   0.0
0.000     15.0      30.0      60.0
***** FLIGHT CONFIGURATION GROUP *****
12690.0   7432.0    0.0       8.6
299.9     0.0       81.65     52795.0   21360.0   66335.0   1234.0
20.5      11.24     9.26      1.76
4.9       4.8       2.5       6.96      516.5     516.5     0.01
150.0     0.0       0.0       0.0       1.0       0.0
0.0       3.0       0.0       0.0       0.0       0.0
0.0       0.0       7500.0    0.0       0.0       0.0
1.0       1.0       0.0
          0         1         0         1         0
          0         0         1         0         1
          0         0         0         1         1         0
          4         7         10
[GTRS.XV15]TABLIS.DAT
END OF DATA
TRMS
10    13316.0 -150.0    1    1   0.1        0.0     10.0       4
 &CHANGE
  XFLAPS= 3
  BETAD =  0.0
 &END
TRMS
 1     0.1    20.0      1    2   0.0        0.0     10.0       4
 &CHANGE
  XFLAPS= 3
  BETAD =  20.0
 &END
```

```
TRMS
 1     70.0   20.0       1    2   0.0         0.0     5.0        4
 &CHANGE
  XFLAPS= 1
  RPMSEL=  517.0
  OMEGRO=  517.0
  BETAD =  90.0
 &END
TRMS
 1    185.0   20.0       1    2   0.0         0.0     7.0        3
 &CHANGE
  XFLAPS= 1
  RPMSEL=  517.0
  OMEGRO=  517.0
  BETAD =  90.0
 &END
MANS
4.0       4.0       0.1           0    1    0    8
1.0       50.0      50.0      50.0
0.0       0.0       0.0       0.0
0.0       0.0       0.0       0.0       0.0
LONG CONT. INPUT
0.0       0.01      20.0      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       -10.0     -10.0     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
LAT CONT. INPUT
0.0       20.0      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       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
PED CONT. INPUT
0.0       20.0      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       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
COL CONT. INPUT
0.0       1.0       3.0       20.0      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       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
 &CHANGE
 &END
/*
```

APPENDIX E

EXAMPLE OF TABLE NAME FILE

EXAMPLE OF 'TABLIS.DAT' INPUT TABLE FILE LISTING

```
$BK0.TAB        1   !ROTOR SIDEWASH VS A/S, BV = 0                        [SAM.AEROTAB]
BK5.TAB             !ROTOR SIDEWASH VS A/S, BV = 5                        [SAM.AEROTAB]
BK10.TAB            !ROTOR SIDEWASH VS A/S, BV = 10                       [SAM.AEROTAB]
BK15.TAB            !ROTOR SIDEWASH VS A/S, BV = 15                       [SAM.AEROTAB]
BK20.TAB            !ROTOR SIDEWASH VS A/S, BV = 20                       [SAM.AEROTAB]
BK25.TAB            !ROTOR SIDEWASH VS A/S, BV = 25                       [SAM.AEROTAB]
BK30.TAB            !ROTOR SIDEWASH VS A/S, BV = 30                       [SAM.AEROTAB]
BFBLK.TAB           !INDEX FOR BF IN THE DP ARRAY                         [SAM.AEROTAB]
BMBLK.TAB           !INDEX FOR BM IN THE DP ARRAY                         [SAM.AEROTAB]
$CDH2.TAB       2   !HOR STAB DRAG COEF VS ANG OF ATT, M<.2, DELE=0.      [SAM.AEROTAB]
CDH4.TAB            !HOR STAB DRAG COEF VS ANG OF ATT, M<.4, DELE=0.      [SAM.AEROTAB]
CDH5.TAB            !HOR STAB DRAG COEF VS ANG OF ATT, M<.5, DELE=0.      [SAM.AEROTAB]
CDH6.TAB            !HOR STAB DRAG COEF VS ANG OF ATT, M<.6, DELE=0.      [SAM.AEROTAB]
$CDV0.TAB       3   !VERT STAB DRAG COEF VS BV, M<.2, DELR=0.             [SAM.AEROTAB]
CDV4.TAB            !VERT STAB DRAG COEF VS BV, M<.4, DELR=0.             [SAM.AEROTAB]
CDV5.TAB            !VERT STAB DRAG COEF VS BV, M<.5, DELR=0.             [SAM.AEROTAB]
CDV6.TAB            !VERT STAB DRAG COEF VS BV, M<.6, DELR=0.             [SAM.AEROTAB]
$CDW01.TAB      4   !WING PYLON DRAG COEF, M=.2,BM=0., FX = F1            [SAM.AEROTAB]
CDW02.TAB           !WING PYLON DRAG COEF, M=.2,BM=0., FX = F2            [SAM.AEROTAB]
CDW03.TAB           !WING PYLON DRAG COEF, M=.2,BM=0., FX = F3            [SAM.AEROTAB]
CDW04.TAB           !WING PYLON DRAG COEF, M=.2,BM=0., FX = F4            [SAM.AEROTAB]
$CDW91.TAB      5   !WING PYLON DRAG COEF, M=.2,BM=90.,FX = F1            [SAM.AEROTAB]
CDW92.TAB           !WING PYLON DRAG COEF, M=.2,BM=90.,FX = F2            [SAM.AEROTAB]
CDW93.TAB           !WING PYLON DRAG COEF, M=.2,BM=90.,FX = F3            [SAM.AEROTAB]
CDW94.TAB           !WING PYLON DRAG COEF, M=.2,BM=90.,FX = F4            [SAM.AEROTAB]
$CDW914.TAB     6   !WING PYLON DRAG COEF, M=.4,BM=90.,FX = F1            [SAM.AEROTAB]
CDW915.TAB          !WING PYLON DRAG COEF, M=.5,BM=90.,FX = F1            [SAM.AEROTAB]
CDW916.TAB          !WING PYLON DRAG COEF, M=.6,BM=90.,FX = F1            [SAM.AEROTAB]
$CLB01.TAB      7   !WING PYLON ROLLING MOMENT @ CL=0., FX = F1           [SAM.AEROTAB]
CLB02.TAB           !WING PYLON ROLLING MOMENT @ CL=0., FX=F2,3,4         [SAM.AEROTAB]
$CLBCL1.TAB     8   !CLBETA/CLWP FOR FX = F1                              [SAM.AEROTAB]
CLBCL2.TAB          !CLBETA/CLWP FOR FX = F2,3,4                          [SAM.AEROTAB]
$CLDA01.TAB     9   !AILERON EFFECTIVENESS IN ROLL,BM=0., FX = F1         [SAM.AEROTAB]
CLDA02.TAB          !AILERON EFFECTIVENESS IN ROLL,BM=0., FX = F2         [SAM.AEROTAB]
CLDA03.TAB          !AILERON EFFECTIVENESS IN ROLL,BM=0., FX = F3         [SAM.AEROTAB]
CLDA04.TAB          !AILERON EFFECTIVENESS IN ROLL,BM=0., FX = F4         [SAM.AEROTAB]
$CLDA91.TAB     10  !AILERON EFFECTIVENESS IN ROLL,BM=90., FX = F1        [SAM.AEROTAB]
CLDA92.TAB          !AILERON EFFECTIVENESS IN ROLL,BM=90., FX = F2        [SAM.AEROTAB]
CLDA93.TAB          !AILERON EFFECTIVENESS IN ROLL,BM=90., FX = F3        [SAM.AEROTAB]
CLDA94.TAB          !AILERON EFFECTIVENESS IN ROLL,BM=90., FX = F4        [SAM.AEROTAB]
$CKNDA1.TAB     11  !AILERON YAW MOMENT EQN, FX = F1                      [SAM.AEROTAB]
CKNDA2.TAB          !AILERON YAW MOMENT EQN, FX = F2                      [SAM.AEROTAB]
CKNDA3.TAB          !AILERON YAW MOMENT EQN, FX = F3                      [SAM.AEROTAB]
CKNDA4.TAB          !AILERON YAW MOMENT EQN, FX = F4                      [SAM.AEROTAB]
$CLFALP.TAB     12  !FUS. LIFT/Q VS ANG OF ATTACK                         [SAM.AEROTAB]
$CLFBET.TAB     13  !FUS. LIFT/Q VS SIDESLIP                              [SAM.AEROTAB]
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$CLHM20.TAB    14   !HOR STAB LIFT COEF VS ANG OF ATT, M<.2, DELE=-20.   [SAM.AEROTAB]
CLHM15.TAB          !HOR STAB LIFT COEF VS ANG OF ATT, M<.2, DELE=-15.   [SAM.AEROTAB]
CLHM10.TAB          !HOR STAB LIFT COEF VS ANG OF ATT, M<.2, DELE=-10.   [SAM.AEROTAB]
CLH0.TAB            !HOR STAB LIFT COEF VS ANG OF ATT, M<.2, DELE= 0.    [SAM.AEROTAB]
CLH10.TAB           !HOR STAB LIFT COEF VS ANG OF ATT, M<.2, DELE= 10.   [SAM.AEROTAB]
CLH15.TAB           !HOR STAB LIFT COEF VS ANG OF ATT, M<.2, DELE= 15.   [SAM.AEROTAB]
CLH20.TAB           !HOR STAB LIFT COEF VS ANG OF ATT, M<.2, DELE= 20.   [SAM.AEROTAB]
$CHLM2.TAB     15   !HOR STAB LIFT COEF VS ANG OF ATT, M<.2, DELE=0.     [SAM.AEROTAB]
CHLM4.TAB           !HOR STAB LIFT COEF VS ANG OF ATT, M<.4, DELE=0.     [SAM.AEROTAB]
CHLM5.TAB           !HOR STAB LIFT COEF VS ANG OF ATT, M<.5, DELE=0.     [SAM.AEROTAB]
CHLM6.TAB           !HOR STAB LIFT COEF VS ANG OF ATT, M<.6, DELE=0.     [SAM.AEROTAB]
$CLVM20.TAB    16   !VERT STAB LIFT COEF VS SIDESLIP, M<.2, DELR=-20.   [SAM.AEROTAB]
CLVM15.TAB          !VERT STAB LIFT COEF VS SIDESLIP, M<.2, DELR=-15.   [SAM.AEROTAB]
CLV0.TAB            !VERT STAB LIFT COEF VS SIDESLIP, M<.2, DELR=0.     [SAM.AEROTAB]
CLV15.TAB           !VERT STAB LIFT COEF VS SIDESLIP, M<.2, DELR= 15.   [SAM.AEROTAB]
CLV20.TAB           !VERT STAB LIFT COEF VS SIDESLIP, M<.2, DELR= 20.   [SAM.AEROTAB]
CYV4.TAB            !VERT STAB LIFT COEF VS SIDESLIP, M<.4, DELR= 0.    [SAM.AEROTAB]
CYV5.TAB            !VERT STAB LIFT COEF VS SIDESLIP, M<.5, DELR= 0.    [SAM.AEROTAB]
CYV6.TAB            !VERT STAB LIFT COEF VS SIDESLIP, M<.6, DELR= 0.    [SAM.AEROTAB]
$CLW01.TAB     17   !WING PYLON LIFT COEF, M=.2,BM=0., FX=F1             [SAM.AEROTAB]
CLW02.TAB           !WING PYLON LIFT COEF, M=.2,BM=0., FX=F2             [SAM.AEROTAB]
CLW03.TAB           !WING PYLON LIFT COEF, M=.2,BM=0., FX=F3             [SAM.AEROTAB]
CLW04.TAB           !WING PYLON LIFT COEF, M=.2,BM=0., FX=F4             [SAM.AEROTAB]
$CLW91.TAB     18   !WING PYLON LIFT COEF, M=.2,BM=90., FX=F1            [SAM.AEROTAB]
CLW92.TAB           !WING PYLON LIFT COEF, M=.2,BM=90., FX=F2            [SAM.AEROTAB]
CLW93.TAB           !WING PYLON LIFT COEF, M=.2,BM=90., FX=F3            [SAM.AEROTAB]
CLW94.TAB           !WING PYLON LIFT COEF, M=.2,BM=90., FX=F4            [SAM.AEROTAB]
$CLW914.TAB    19   !WING PYLON LIFT COEF, M=.4,BM=90., FX=F1            [SAM.AEROTAB]
CLW915.TAB          !WING PYLON LIFT COEF, M=.5,BM=90., FX=F1            [SAM.AEROTAB]
CLW916.TAB          !WING PYLON LIFT COEF, M=.6,BM=90., FX=F1            [SAM.AEROTAB]
$CMOWP1.TAB    20   !WING PYLON PITCH MOMENT, FX = F1                    [SAM.AEROTAB]
CMOWP2.TAB          !WING PYLON PITCH MOMENT, FX = F2                    [SAM.AEROTAB]
CMOWP3.TAB          !WING PYLON PITCH MOMENT, FX = F3                    [SAM.AEROTAB]
CMOWP4.TAB          !WING PYLON PITCH MOMENT, FX = F4                    [SAM.AEROTAB]
$CNDA1.TAB     21   !AILERON YAW MOMENT EQN, FX = F1                     [SAM.AEROTAB]
CNDA2.TAB           !AILERON YAW MOMENT EQN, FX = F2                     [SAM.AEROTAB]
CNDA3.TAB           !AILERON YAW MOMENT EQN, FX = F3                     [SAM.AEROTAB]
CNDA4.TAB           !AILERON YAW MOMENT EQN, FX = F4                     [SAM.AEROTAB]
$CTL15.TAB     22   !THRUST COEF END LIMIT,BM=15.                        [SAM.AEROTAB]
CTL30.TAB           !THRUST COEF END LIMIT,BM=30.                        [SAM.AEROTAB]
CTL60.TAB           !THRUST COEF END LIMIT,BM=60.                        [SAM.AEROTAB]
$DALPF.TAB     23   !FUS. DRAG/Q VS ANG. OF ATTACK                       [SAM.AEROTAB]
$DBETA.TAB     24   !FUS. DRAG/Q VS SIDE SLIP                            [SAM.AEROTAB]
$DOMGD.TAB     25   !MAIN GEAR DRAG @ EXTENSION                          [SAM.AEROTAB]
$DONGD.TAB     26   !NOSE GEAR DRAG @ EXTENSION                          [SAM.AEROTAB]
$DP100.TAB     27   !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=0,BF=0          [SAM.AEROTAB]
DP104.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=0,BF=4          [SAM.AEROTAB]
DP108.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=0,BF=8          [SAM.AEROTAB]
DP1012.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=0,BF=12         [SAM.AEROTAB]
DP1016.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=0,BF=16         [SAM.AEROTAB]
DP1020.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=0,BF=20         [SAM.AEROTAB]
DP1050.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=0,BF=50         [SAM.AEROTAB]
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$DP130.TAB     28   !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=30, BF=0        [SAM.AEROTAB]
DP134.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=30, BF=4        [SAM.AEROTAB]
DP138.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=30, BF=8        [SAM.AEROTAB]
DP1312.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=30, BF=12       [SAM.AEROTAB]
DP1316.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=30, BF=16       [SAM.AEROTAB]
DP1320.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=30, BF=20       [SAM.AEROTAB]
DP1350.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=30, BF=50       [SAM.AEROTAB]
$DP160.TAB     29   !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=60, BF=0        [SAM.AEROTAB]
DP164.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=60, BF=4        [SAM.AEROTAB]
DP168.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=60, BF=8        [SAM.AEROTAB]
DP1612.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=60, BF=12       [SAM.AEROTAB]
DP1616.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=60, BF=16       [SAM.AEROTAB]
DP1620.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=60, BF=20       [SAM.AEROTAB]
DP1650.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=60, BF=50       [SAM.AEROTAB]
$DP190.TAB     30   !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=90, BF=0        [SAM.AEROTAB]
DP194.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=90, BF=4        [SAM.AEROTAB]
DP198.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=90, BF=8        [SAM.AEROTAB]
DP1912.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=90, BF=12       [SAM.AEROTAB]
DP1916.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=90, BF=16       [SAM.AEROTAB]
DP1920.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=90, BF=20       [SAM.AEROTAB]
DP1950.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F1,BM=90, BF=50       [SAM.AEROTAB]
$DP200.TAB     31   !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=0, BF=0         [SAM.AEROTAB]
DP204.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=0, BF=4         [SAM.AEROTAB]
DP208.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=0, BF=8         [SAM.AEROTAB]
DP2012.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=0, BF=12        [SAM.AEROTAB]
DP2016.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=0, BF=16        [SAM.AEROTAB]
DP2020.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=0, BF=20        [SAM.AEROTAB]
DP2050.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=0, BF=50        [SAM.AEROTAB]
$DP230.TAB     32   !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=30, BF=0        [SAM.AEROTAB]
DP234.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=30, BF=4        [SAM.AEROTAB]
DP238.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=30, BF=8        [SAM.AEROTAB]
DP2312.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=30, BF=12       [SAM.AEROTAB]
DP2316.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=30, BF=16       [SAM.AEROTAB]
DP2320.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=30, BF=20       [SAM.AEROTAB]
DP2350.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=30, BF=50       [SAM.AEROTAB]
$DP260.TAB     33   !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=60, BF=0        [SAM.AEROTAB]
DP264.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=60, BF=4        [SAM.AEROTAB]
DP268.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=60, BF=8        [SAM.AEROTAB]
DP2612.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=60, BF=12       [SAM.AEROTAB]
DP2616.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=60, BF=16       [SAM.AEROTAB]
DP2620.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=60, BF=20       [SAM.AEROTAB]
DP2650.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=60, BF=50       [SAM.AEROTAB]
$DP290.TAB     34   !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=90, BF=0        [SAM.AEROTAB]
DP294.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=90, BF=4        [SAM.AEROTAB]
DP298.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=90, BF=8        [SAM.AEROTAB]
DP2912.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=90, BF=12       [SAM.AEROTAB]
DP2916.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=90, BF=16       [SAM.AEROTAB]
DP2920.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=90, BF=20       [SAM.AEROTAB]
DP2950.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F2,BM=90, BF=50       [SAM.AEROTAB]
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$DP300.TAB     35   !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=0, BF=0        [SAM.AEROTAB]
DP304.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=0, BF=4        [SAM.AEROTAB]
DP308.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=0, BF=8        [SAM.AEROTAB]
DP3012.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=0, BF=12       [SAM.AEROTAB]
DP3016.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=0, BF=16       [SAM.AEROTAB]
DP3020.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=0, BF=20       [SAM.AEROTAB]
DP3050.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=0, BF=50       [SAM.AEROTAB]
$DP330.TAB     36   !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=30, BF=0       [SAM.AEROTAB]
DP334.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=30, BF=4       [SAM.AEROTAB]
DP338.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=30, BF=8       [SAM.AEROTAB]
DP3312.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=30, BF=12      [SAM.AEROTAB]
DP3316.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=30, BF=16      [SAM.AEROTAB]
DP3320.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=30, BF=20      [SAM.AEROTAB]
DP3350.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=30, BF=50      [SAM.AEROTAB]
$DP360.TAB     37   !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=60, BF=0       [SAM.AEROTAB]
DP364.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=60, BF=4       [SAM.AEROTAB]
DP368.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=60, BF=8       [SAM.AEROTAB]
DP3612.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=60, BF=12      [SAM.AEROTAB]
DP3616.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=60, BF=16      [SAM.AEROTAB]
DP3620.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=60, BF=20      [SAM.AEROTAB]
DP3650.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=60, BF=50      [SAM.AEROTAB]
$DP390.TAB     38   !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=90, BF=0       [SAM.AEROTAB]
DP394.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=90, BF=4       [SAM.AEROTAB]
DP398.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=90, BF=8       [SAM.AEROTAB]
DP3912.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=90, BF=12      [SAM.AEROTAB]
DP3916.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=90, BF=16      [SAM.AEROTAB]
DP3920.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=90, BF=20      [SAM.AEROTAB]
DP3950.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F3,BM=90, BF=50      [SAM.AEROTAB]
$DP400.TAB     39   !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=0, BF=0        [SAM.AEROTAB]
DP404.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=0, BF=4        [SAM.AEROTAB]
DP408.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=0, BF=8        [SAM.AEROTAB]
DP4012.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=0, BF=12       [SAM.AEROTAB]
DP4016.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=0, BF=16       [SAM.AEROTAB]
DP4020.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=0, BF=20       [SAM.AEROTAB]
DP4050.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=0, BF=50       [SAM.AEROTAB]
$DP430.TAB     40   !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=30, BF=0       [SAM.AEROTAB]
DP434.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=30, BF=4       [SAM.AEROTAB]
DP438.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=30, BF=8       [SAM.AEROTAB]
DP4312.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=30, BF=12      [SAM.AEROTAB]
DP4316.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=30, BF=16      [SAM.AEROTAB]
DP4320.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=30, BF=20      [SAM.AEROTAB]
DP4350.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=30, BF=50      [SAM.AEROTAB]
$DP460.TAB     41   !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=60, BF=0       [SAM.AEROTAB]
DP464.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=60, BF=4       [SAM.AEROTAB]
DP468.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=60, BF=8       [SAM.AEROTAB]
DP4612.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=60, BF=12      [SAM.AEROTAB]
DP4616.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=60, BF=16      [SAM.AEROTAB]
DP4620.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=60, BF=20      [SAM.AEROTAB]
DP4650.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=60, BF=50      [SAM.AEROTAB]
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$DP490.TAB      42  !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=90, BF=0        [SAM.AEROTAB]
DP494.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=90, BF=4        [SAM.AEROTAB]
DP498.TAB           !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=90, BF=8        [SAM.AEROTAB]
DP4912.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=90, BF=12       [SAM.AEROTAB]
DP4916.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=90, BF=16       [SAM.AEROTAB]
DP4920.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=90, BF=20       [SAM.AEROTAB]
DP4950.TAB          !SIDE WASH FACTOR VS FLAPS, FX=F4,BM=90, BF=50       [SAM.AEROTAB]
$EF1.TAB        43  !ELEV/RUDDER EFFECTIVENESS                           [SAM.AEROTAB]
$EW00.TAB       44  !Q RATIO AT HOR STAB,BM=0., V = 0. KTS               [SAM.AEROTAB]
EW020.TAB           !Q RATIO AT HOR STAB,BM=0., V = 20. KTS              [SAM.AEROTAB]
EW040.TAB           !Q RATIO AT HOR STAB,BM=0., V = 40. KTS              [SAM.AEROTAB]
EW060.TAB           !Q RATIO AT HOR STAB,BM=0., V = 60. KTS              [SAM.AEROTAB]
EW080.TAB           !Q RATIO AT HOR STAB,BM=0., V = 80. KTS              [SAM.AEROTAB]
EW0100.TAB          !Q RATIO AT HOR STAB,BM=0., V = 100. KTS             [SAM.AEROTAB]
$EW10.TAB       45  !Q RATIO AT HOR STAB,BM=15., V = 0. KTS              [SAM.AEROTAB]
EW120.TAB           !Q RATIO AT HOR STAB,BM=15., V = 20. KTS             [SAM.AEROTAB]
EW140.TAB           !Q RATIO AT HOR STAB,BM=15., V = 40. KTS             [SAM.AEROTAB]
EW160.TAB           !Q RATIO AT HOR STAB,BM=15., V = 60. KTS             [SAM.AEROTAB]
EW180.TAB           !Q RATIO AT HOR STAB,BM=15., V = 80. KTS             [SAM.AEROTAB]
EW1100.TAB          !Q RATIO AT HOR STAB,BM=15., V = 100. KTS            [SAM.AEROTAB]
$EW30.TAB       46  !Q RATIO AT HOR STAB,BM=30.                          [SAM.AEROTAB]
EW60.TAB            !Q RATIO AT HOR STAB,BM=60.                          [SAM.AEROTAB]
EW90.TAB            !Q RATIO AT HOR STAB,BM=90.                          [SAM.AEROTAB]
$EWH01.TAB      47  !WING WAKE DEFL. ON HOR. STAB.,BM=0., FX = F1        [SAM.AEROTAB]
EWH02.TAB           !WING WAKE DEFL. ON HOR. STAB.,BM=0., FX = F2        [SAM.AEROTAB]
EWH03.TAB           !WING WAKE DEFL. ON HOR. STAB.,BM=0., FX = F3        [SAM.AEROTAB]
EWH04.TAB           !WING WAKE DEFL. ON HOR. STAB.,BM=0., FX = F4        [SAM.AEROTAB]
$EWH151.TAB     48  !WING WAKE DEFL. ON HOR. STAB.,BM=15., FX = F1       [SAM.AEROTAB]
EWH152.TAB          !WING WAKE DEFL. ON HOR. STAB.,BM=15., FX = F2       [SAM.AEROTAB]
EWH153.TAB          !WING WAKE DEFL. ON HOR. STAB.,BM=15., FX = F3       [SAM.AEROTAB]
EWH154.TAB          !WING WAKE DEFL. ON HOR. STAB.,BM=15., FX = F4       [SAM.AEROTAB]
$EWH31.TAB      49  !WING WAKE DEFL. ON HOR. STAB.,BM=30., FX = F1       [SAM.AEROTAB]
EWH32.TAB           !WING WAKE DEFL. ON HOR. STAB.,BM=30., FX = F2       [SAM.AEROTAB]
EWH33.TAB           !WING WAKE DEFL. ON HOR. STAB.,BM=30., FX = F3       [SAM.AEROTAB]
EWH34.TAB           !WING WAKE DEFL. ON HOR. STAB.,BM=30., FX = F4       [SAM.AEROTAB]
$EWH61.TAB      50  !WING WAKE DEFL. ON HOR. STAB.,BM=60., FX = F1       [SAM.AEROTAB]
EWH62.TAB           !WING WAKE DEFL. ON HOR. STAB.,BM=60., FX = F2       [SAM.AEROTAB]
EWH63.TAB           !WING WAKE DEFL. ON HOR. STAB.,BM=60., FX = F3       [SAM.AEROTAB]
EWH64.TAB           !WING WAKE DEFL. ON HOR. STAB.,BM=60., FX = F4       [SAM.AEROTAB]
$EWH91.TAB      51  !WING WAKE DEFL. ON HOR. STAB.,BM=90., FX = F1       [SAM.AEROTAB]
EWH92.TAB           !WING WAKE DEFL. ON HOR. STAB.,BM=90., FX = F2       [SAM.AEROTAB]
EWH93.TAB           !WING WAKE DEFL. ON HOR. STAB.,BM=90., FX = F3       [SAM.AEROTAB]
EWH94.TAB           !WING WAKE DEFL. ON HOR. STAB.,BM=90., FX = F4       [SAM.AEROTAB]
$FLBETA.TAB     52  !FUS. ROLLING MOMENT/Q VS SIDESLIP                   [SAM.AEROTAB]
$FMALPH.TAB     53  !FUS. PITCHING MOMENT/Q VS ANG OF ATTACK             [SAM.AEROTAB]
$FMBETA.TAB     54  !FUS. PITCHING MOMENT/Q VS SIDESLIP                  [SAM.AEROTAB]
$FNBETA.TAB     55  !FUS. YAWING MOMENT/Q VS SIDESLIP                    [SAM.AEROTAB]
$KHB0.TAB       56  !INDUCED VEL FACTOR VS SIDESLIP,BM=0.                [SAM.AEROTAB]
KHB15.TAB           !INDUCED VEL FACTOR VS SIDESLIP,BM=15.               [SAM.AEROTAB]
KHB30.TAB           !INDUCED VEL FACTOR VS SIDESLIP,BM=30.               [SAM.AEROTAB]
KHB60.TAB           !INDUCED VEL FACTOR VS SIDESLIP,BM=60.               [SAM.AEROTAB]
KHB90.TAB           !INDUCED VEL FACTOR VS SIDESLIP,BM=90.               [SAM.AEROTAB]
$PCPM.TAB       57  !MACH NUMBER EFFECT ON dEWH/dALPHA WING (HOR. STAB.) [SAM.AEROTAB]
$TB1DXL.TAB     58  !CYCLIC/LONG STICK GRADIENT VS BM                    [SAM.AEROTAB]
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$TBDXP0.TAB     59   !DIFF CYCLIC/PEDAL GRADIENT VS BM, U<60 KTS          [SAM.AEROTAB]
TBDXP1.TAB           !DIFF CYCLIC/PEDAL GRADIENT VS BM, U=80 KTS          [SAM.AEROTAB]
TBDXP2.TAB           !DIFF CYCLIC/PEDAL GRADIENT VS BM, U>100 KTS         [SAM.AEROTAB]
$TTODXL.TAB     60   !DIFF COLL/LAT STICK GRADIENT VS BM                  [SAM.AEROTAB]
$TTDXCO.TAB     61   !BLADE PITCH/ PWR LEVER GRADIENT VS BM               [SAM.AEROTAB]
$THEREF.TAB     62   !MIN BLADE PITCH @ .75R VS BM                        [SAM.AEROTAB]
$TETAMD.TAB     63   !PYLON CONVERSION RATE VS BM                         [SAM.AEROTAB]
$THROR.TAB      64   !THROTTLE VS PWR LEVER                               [SAM.AEROTAB]
$TA1BM.TAB      65   !LAT FLAP CONTROLLER VS BM                           [SAM.AEROTAB]
$TA1VT.TAB      66   !LAT FLAP CONTROLLER VS A/S                          [SAM.AEROTAB]
$RSHPWR.TAB     67   !SHAFT HORSEPOWER VS THROTTLE                        [SAM.AEROTAB]
$TABALT.TAB     68   !ALTITUDE INDEX VS ALTITUDE                          [SAM.AEROTAB]
$THPRO1.TAB     69   !ENGINE ACCL VS HP @ ALT INDEX 1                     [SAM.AEROTAB]
THPRO2.TAB           !ENGINE ACCL VS HP @ ALT INDEX 2                     [SAM.AEROTAB]
THPRO3.TAB           !ENGINE ACCL VS HP @ ALT INDEX 3                     [SAM.AEROTAB]
THPRO4.TAB           !ENGINE ACCL VS HP @ ALT INDEX 4                     [SAM.AEROTAB]
$RSHPRT.TAB     70   !RAM EFFECT                                          [SAM.AEROTAB]
$TBAR.TAB       71   !MAX THRUST COEFFICIENT VS MU                        [SAM.AEROTAB]
$THINTL.TAB     72   !CONSTANT JET THRUST EQN                             [SAM.AEROTAB]
$THSLOP.TAB     73   !SLOPE - JET THRUST EQN                              [SAM.AEROTAB]
$TKPROG.TAB     74   !PROPORTIONAL GOVERNOR GAIN VS BM                    [SAM.AEROTAB]
$TKINTG.TAB     75   !INTEGRAL GOVERNOR GAIN VS BM                        [SAM.AEROTAB]
$TXSF.TAB       76   !SIDEWARD FLIGHT ROTOR EFFECT                        [SAM.AEROTAB]
$TXSS.TAB       77   !SIDE-BY-SIDE ROTOR EFFECT                           [SAM.AEROTAB]
$W00.TAB        78   !IND VEL RATIO ON HOR STAB,BM=0., VT = 0 KTS         [SAM.AEROTAB]
W020.TAB             !IND VEL RATIO ON HOR STAB,BM=0., VT = 20 KTS        [SAM.AEROTAB]
W040.TAB             !IND VEL RATIO ON HOR STAB,BM=0., VT = 40 KTS        [SAM.AEROTAB]
W060.TAB             !IND VEL RATIO ON HOR STAB,BM=0., VT = 60 KTS        [SAM.AEROTAB]
W080.TAB             !IND VEL RATIO ON HOR STAB,BM=0., VT = 80 KTS        [SAM.AEROTAB]
W0100.TAB            !IND VEL RATIO ON HOR STAB,BM=0., VT = 100 KTS       [SAM.AEROTAB]
W0120.TAB            !IND VEL RATIO ON HOR STAB,BM=0., VT = 120 KTS       [SAM.AEROTAB]
W0140.TAB            !IND VEL RATIO ON HOR STAB,BM=0., VT = 140 KTS       [SAM.AEROTAB]
$W150.TAB       79   !IND VEL RATIO ON HOR STAB,BM=15., VT = 0 KTS        [SAM.AEROTAB]
W1520.TAB            !IND VEL RATIO ON HOR STAB,BM=15., VT = 20 KTS       [SAM.AEROTAB]
W1540.TAB            !IND VEL RATIO ON HOR STAB,BM=15., VT = 40 KTS       [SAM.AEROTAB]
W1560.TAB            !IND VEL RATIO ON HOR STAB,BM=15., VT = 60 KTS       [SAM.AEROTAB]
W1580.TAB            !IND VEL RATIO ON HOR STAB,BM=15., VT = 80 KTS       [SAM.AEROTAB]
W15100.TAB           !IND VEL RATIO ON HOR STAB,BM=15., VT = 100 KTS      [SAM.AEROTAB]
W15120.TAB           !IND VEL RATIO ON HOR STAB,BM=15., VT = 120 KTS      [SAM.AEROTAB]
W15140.TAB           !IND VEL RATIO ON HOR STAB,BM=15., VT = 140 KTS      [SAM.AEROTAB]
$W300.TAB       80   !IND VEL RATIO ON HOR STAB,BM=30., VT = 0 KTS        [SAM.AEROTAB]
W3020.TAB            !IND VEL RATIO ON HOR STAB,BM=30., VT = 20 KTS       [SAM.AEROTAB]
W3040.TAB            !IND VEL RATIO ON HOR STAB,BM=30., VT = 40 KTS       [SAM.AEROTAB]
W3060.TAB            !IND VEL RATIO ON HOR STAB,BM=30., VT = 60 KTS       [SAM.AEROTAB]
W3080.TAB            !IND VEL RATIO ON HOR STAB,BM=30., VT = 80 KTS       [SAM.AEROTAB]
W30100.TAB           !IND VEL RATIO ON HOR STAB,BM=30., VT = 100 KTS      [SAM.AEROTAB]
W30120.TAB           !IND VEL RATIO ON HOR STAB,BM=30., VT = 120 KTS      [SAM.AEROTAB]
W30140.TAB           !IND VEL RATIO ON HOR STAB,BM=30., VT = 140 KTS      [SAM.AEROTAB]
```

$XMTAB.TAB	81	!CLWP INDEX	[SAM.AEROTAB]
$YBETA.TAB	82	!FUS. SIDE FORCE/Q VS SIDESLIP	[SAM.AEROTAB]
$DLRTAB.TAB	83	!RUDDER ANGLE INDEX	[SAM.AEROTAB]
$DELTAB.TAB	84	!ELEVATOR ANGLE INDEX	[SAM.AEROTAB]
$TKPYL.TAB	85	!PYLON DRAG IN SIDEWARD FLIGHT	[SAM.AEROTAB]
$TDPYL.TAB	86	!PYLON INTERFERENCE DRAG IN FORWARD FLIGHT	[SAM.AEROTAB]
$KHBET.TAB	87	!HORIZONTAL STABILIZER Q-LOSS WITH SIDESLIP	[SAM.AEROTAB]
$KVBET.TAB	88	!VERTICAL STABILIZER Q-LOSS WITH SIDESLIP	[SAM.AEROTAB]

APPENDIX F

EXAMPLE OF TABLE DATA FILE

```
!  EXAMPLE.TAB
!  ALL COMMENT LINES START WITH A "!"
!  ALL LINES WITH A "!" AND BLANK LINES ARE IGNORED
!
!  THE INDEPENDENT DATA BEGINS WITH A LINE CONTAINING ONLY A "1"
!
 1
   -40.    -36.    -32.    -28.    -24.    -20.    -19.5
   -16.    -15.5   -13.    -12.    -11.    -8.     -4.
     0.      4.      8.     11.     12.     13.     16.
    17.     20.     24.     28.     32.     36.     40.
!
!  THE DEPENDENT DATA IS SEPARATED FROM THE INDEPENDENT DATA
!  BY A LINE WITH A "$"
 $
   -.93    -.84    -.84    -.89    -1.     -1.15   -1.15
   -.95    -.91    -.75    -.67    -.59    -.33    -.04
    .38     .72    1.04    1.28    1.37    1.42    1.57
   1.57    1.38    1.22    1.2     1.27    1.4     1.46
!
```

APPENDIX G

SIGN CONVENTIONS FOR INPUT DATA

SIGN CONVENTIONS FOR INPUT DATA

NAME	DESCRIPTION	POSITIVE
XLN	LONGITUDINAL CYCLIC STICK INPUT	FORWARD
XLT	LATERAL CYCLIC STICK INPUT	RIGHT
XPD	PEDAL POSITION INPUT	RIGHT
XCOL	COLLECTIVE STICK POSITION	UP
U	VELOCITY ALONG X-GND AXIS	FORWARD
	VELOCITY ALONG X-BODY AXIS	FORWARD
V	VELOCITY ALONG Y-GND AXIS	RIGHT
	VELOCITY ALONG Y-BODY AXIS	RIGHT
W	VELOCITY ALONG Z-GND AXIS	UP
	VELOCITY ALONG Z-BODY AXIS	DOWN
ROLL	EULER ROLL ANGLE	RIGHT
PITCH	EULER PITCH ANGLE	UP
YAW	EULER YAW ANGLE	RIGHT
BETAD	MAST TILT ANGLE (90 TO -10)	FORWARD

APPENDIX H

DESCRIPTION OF THE DEFAULT PARAMETERS IN THE GRAPHICS OUTPUT FILE

DEFAULT PARAMETERS OUTPUT TO THE GRAPHICS DATA FILE

Note: This list can be modified or made a different size by modifying subroutine IFHB43.FOR.

OUTPUT PARAMETER	DESCRIPTION	UNITS
Time	Maneuver time	sec
VKCASK	Calibrated airpseed	knots
VTK	True airspeed	knots
RODESC	Rate-of-descent	ft/min
HEIGHT	Height above ground	ft
PRSALT	Pressure altitude	ft
OAT	Outside air temperature	deg C
XLNP	Longitudinal stick position	percent
XLTP	Lateral stick position	percent
XPDP	Pedal position	percent
XCOLP	Power lever position	percent
DELE	Elevator deflection	deg
DELA	Aileron deflection	deg
DELR	Rudder deflection	deg
ESASP	Pitch SCAS actuator position	percent
ASASP	Roll SCAS actuator position	percent
RSASP	Yaw SCAS actuator position	percent
BETAD	Mast angle	deg
PITCHD	Pitch attitude	deg
ROLLD	Roll attitude	deg
YAWD	Yaw attitude	deg
QDEG	Pitch rate	deg/sec
PDEG	Roll rate	deg/sec
RDEG	Yaw rate	deg/sec
ALPFD	Angle of attack	deg
BETFD	Sideslip angle	deg

OUTPUT PARAMETER	DESCRIPTION	UNITS
OMEGLD	Left rotor speed	rpm
OMEGRD	Right rotor speed	rpm
QREQL	Left rotor torque	inch-pounds
QREQR	Right rotor torque	inch-pounds
QREQAVE	Total rotor torque	inch-pounds
HPL	Left rotor power	SHP
HPR	Right rotor power	SHP
HPTOT	Total rotor power	SHP
FAFPLD	Left rotor fore-and-aft flapping	deg
FAFPRD	Right rotor fore-and-aft flapping	deg
LTFPLD	Left rotor lateral flapping	deg
LTFPRD	Right rotor lateral flapping	deg
FLAPLTOT	Left rotor gimbal (total) flapping	deg
FLAPRTOT	Right rotor gimbal (total) flapping	deg

APPENDIX I

VAX 11/785
GENERIC TILT ROTOR MATHEMATICAL MODEL
INPUT DATA REQUIREMENTS

TABLE OF SUBSYSTEMS

SUBSYSTEM NO. 1—ROTOR GROUP

VAX Name	Equation Name	Description	Value	Units
XBLADS	n_b	Number of rotor blades	3.0	-ND-
RADIUS	R	Radius of rotor disc	12.5	ft
CHORD	c_b	Blade chord	14.0	in
LMAST	l_m	Mast length	4.667	ft
DEL3	δ_3	Pitch flap coupling	-15.0	deg
IBLADE	I_b	Blade flapping inertia	102.5	slug-ft^2
KH	K_H	Flapping hub spring rate	225.0	ft-lb/deg
SLSP	SL_{SP}	S.L. of shaft pivot point	300.0	in
BLSP	BL_{SP}	B.L. of shaft pivot point	193.0	in
WLSP	WL_{SP}	W.L. of shaft pivot point	100.0	in
BTLOSS	B	Blade tip loss factor	0.97	-ND-
DELO	δ_o	Const in CDF equation	0.015	-ND-
DEL1	δ_1	Const in CDF equation	-0.068	1/rad
DEL2	δ_2	Const in CDF equation	0.81	1/rad^2
SLPYL	SL_p	S.L. of pylon c.g.	291.7	in
WLPYL	WL_p	W.L. of pylon c.g.	118.0	in
PYLWT	W_p	Weight of two pylons	3986.0	lbs
BETAD	β_m	Mast tilt angle	0.0	deg
PHIM	ϕ_M	Mast dihedral angle	1.0	deg
XSEGMT	m	Number of blade segments	10.0	-ND-
X(1)	X_{m-9}	Blade station/R	1.0	-ND-
X(2)	X_{m-8}	Blade station/R	0.6	-ND-
X(3)	X_{m-7}	Blade station/R	0.5333	-ND-
X(4)	X_{m-6}	Blade station/R	0.4667	-ND-
X(5)	X_{m-5}	Blade station/R	0.4	-ND-
X(6)	X_{m-4}	Blade station/R	0.3333	-ND-
X(7)	X_{m-3}	Blade station/R	0.2667	-ND-
X(8)	X_{m-2}	Blade station/R	0.2	-ND-
X(9)	X_{m-1}	Blade station/R	0.1333	-ND-

SUBSYSTEM NO. 1—ROTOR GROUP (Continued)

VAX Name	Equation Name	Description	Value	Units
X(10)	X_m	Blade station/R	0.0667	-ND-
X(11)	X_{m+1}	Blade station/R	0.0	-ND-
THETA(1)	θ_{m-9}	Blade twist	0.0	deg
THETA(2)	θ_{m-8}	Blade twist	10.2	deg
THETA(3)	θ_{m-7}	Blade twist	12.3	deg
THETA(4)	θ_{m-6}	Blade twist	14.5	deg
THETA(5)	θ_{m-5}	Blade twist	17.75	deg
THETA(6)	θ_{m-4}	Blade twist	21.9	deg
THETA(7)	θ_{m-3}	Blade twist	26.15	deg
THETA(8)	θ_{m-2}	Blade twist	30.65	deg
THETA(9)	θ_{m-1}	Blade twist	34.65	deg
THETA(10)	θ_m	Blade twist	38.0	deg
THETA(11)	θ_{m+1}	Blade twist	40.9	deg
KO	K_0	Const-wing velocity equ	1.6	-ND-
K1	K_1	Const-wing velocity equ	0.0	-ND-
K2	K_2	Const-wing velocity equ	0.0	-ND-
K3	K_3	Const-wing velocity equ	0.0	-ND-
K4	K_4	Const-wing velocity equ	0.0	-ND-
SLWTE	SL_{WTE}	Sta line wing trail edge	338.1	in
KRW	K_{RW}	Skew angle vel dist fact	3.0	-ND-
XNASEG	ℓ	No. of aero segments	8.0	-ND-
BDALPO	α_{0_L}	Const-blade zero lift	1.0	deg
AOBAR	$\bar{a}_o$	Precone angle	2.5	deg
KHUB	K_{HUB}	Coning hub spring	180000.0	ft-lb/deg
RSLCO	a_o	Const-slope of lift curve	4.95	-ND-
RSLC1	a_1	Const-slope of lift curve	8.0	-ND-
RSLC2	a_2	Const-slope of lift curve	-30.0	-ND-
CDALPH	CDALPH	Drag coef slope w/alpha	0.01	-ND-
CDLIM	CDLIM	Onset-profile drag rise	0.85	-ND-
CDMACH	CDMACH	Lower limit-mach effect	0.35	-ND-
CDFACT	CDFACT	Drag coefficient factor	0.2	-ND-

SUBSYSTEM NO. 1—ROTOR GROUP (Continued)

VAX Name	Equation Name	Description	Value	Units
CTMAXM	CTMAXM	CT max multiplier factor	1.0	-ND-
CDMAX	CDMAX	Max drag coefficient	0.11	-ND-
GEWASH	GEWASH	A/S washout IGE	-0.08	sec/ft
GECON1	GECON1	Const in IGE equation	1.5629	-ND-
GECON2	GECON2	Const in IGE equation	-2.9119	-ND-
SFWASH	SFWASH	A/S washout for rotor X_{SF} effect	54.0	fps
KMU1	KMU1	Induced vel dist equ	17.807	-ND-
KMU2	KMU2	Induced vel dist equ	-0.561	-ND-
KMUSF	KMUSF	Sideward flt correction factor	6.0	-ND-
MUL0	MUL0	Induced vel dist equ	0.1067	-ND-
MUH1	MUH1	Induced vel dist equ	0.5733	-ND-
SDBM90	SDBM90	Spinner drag, β_m=90	1.0	ft^2
SDBM	SDBM	Spinner drag equ const	5.5	ft^2

SUBSYSTEM NO. 1—ROTOR GROUP TABLES

VAX Name	Equation Name	Description
	C_T^-	Maximum available rotor thrust coefficient,=f(μ,β_m)
		VAX Subtable Titles
TBAR		Max thrust coefficient vs MU
CTL15		Thrust coef end limit, β_m=15.
CTL30		Thrust coef end limit, β_m=30.
CTL60		Thrust coef end limit, β_m=60.
TXSS	X_{SS}	Side-by-side rotor effect,=f($\bar{u}$)
TXSF	X_{SF}	Sidewash effect,=f($\lvert\bar{v}\rvert$)

SUBSYSTEM NO. 2—ROTOR INDUCED VELOCITIES GROUP TABLES

VAX Name	Equation Name	Description
	$\frac{W_i\|_{R/H}}{W_i}$	Ratio of the induced z-axis rotor wake velocity on the horizontal stabilizer to the mean induced velocity at the rotor (for both right and left rotor),=f(α_F, β_m, V_T) (non-dimensional)
		VAX Subtable Titles
W00		Ind vel ratio on hor stab, β_m=0., VT=0 kts
W020		Ind vel ratio on hor stab, β_m=0., VT=20 kts
W040		Ind vel ratio on hor stab, β_m=0., VT=40 kts
W060		Ind vel ratio on hor stab, β_m=0., VT=60 kts
W080		Ind vel ratio on hor stab, β_m=0., VT=80 kts
W0100		Ind vel ratio on hor stab, β_m=0., VT=100 kts
W0120		Ind vel ratio on hor stab, β_m=0., VT=120 kts
W0140		Ind vel ratio on hor stab, β_m=0., VT=140 kts
W150		Ind vel ratio on hor stab, β_m=15., VT=0 kts
W1520		Ind vel ratio on hor stab, β_m=15., VT=20 kts
W1540		Ind vel ratio on hor stab, β_m=15., VT=40 kts
W1560		Ind vel ratio on hor stab, β_m=15., VT=60 kts
W1580		Ind vel ratio on hor stab, β_m=15., VT=80 kts
W15100		Ind vel ratio on hor stab, β_m=15., VT=100 kts
W15120		Ind vel ratio on hor stab, β_m=15., VT=120 kts
W15140		Ind vel ratio on hor stab, β_m=15., VT=140 kts
W300		Ind vel ratio on hor stab, β_m=30., VT=0 kts
W3020		Ind vel ratio on hor stab, β_m=30., VT=20 kts
W3040		Ind vel ratio on hor stab, β_m=30., VT=40 kts
W3060		Ind vel ratio on hor stab, β_m=30., VT=60 kts
W3080		Ind vel ratio on hor stab, β_m=30., VT=80 kts
W30100		Ind vel ratio on hor stab, β_m=30., VT=100 kts
W30120		Ind vel ratio on hor stab, β_m=30., VT=120 kts
W30140		Ind vel ratio on hor stab, β_m=30., VT=140 kts

SUBSYSTEM NO. 2—ROTOR INDUCED VELOCITIES GROUP TABLES (Concluded)

VAX Name	Equation Name	Description
	K_{H_β}	Rotor wake on the horizontal stabilizer (constant), $= f(\beta_m, \beta_F)$ (non-dimensional)
		VAX Subtable Titles
KHB0		Induced vel factor vs sideslip, β_m=0
KHB15		Induced vel factor vs sideslip, β_m=15.
KHB30		Induced vel factor vs sideslip, β_m=30.
KHB60		Induced vel factor vs sideslip, β_m=60.
KHB90		Induced vel factor vs sideslip, β_m=90.

SUBSYSTEM NO. 3—FUSELAGE GROUP

VAX Name	Equation Name	Description	Value	Units
SLF	SL_F	Sta line fuse center of press	293.0	in
WLF	WL_F	Water line fuse center of press	84.0	in
LBF0	LBF0	Lift (zero sideslip)	-7.23	ft^2
DBF0	DBF0	Drag (zero sideslip)	-1.56	ft^2
MBF0	MBF0	Pitch moment (zero sideslip)	66.5	ft^3
LLANG	LLANG	Extra fuselage lift	0.0	ft^2
DLANG	DLANG	Extra fuselage drag	-0.5	ft^2
DPOD	DPOD	Drag/q land gear pod	1.15	ft^2

SUBSYSTEM NO. 3—FUSELAGE GROUP TABLES

VAX Name	Equation Name	Description
CLFALP	L_α	Fuselage lift/q vs angle of attack,=f(α)
DALPF	D_α	Fuselage drag/q vs angle of attack,=f(α)
FMALPH	M_α	Fuselage pitching moment/q vs angle of attack,=f(α)

SUBSYSTEM NO. 3—FUSELAGE GROUP TABLES (Concluded)

VAX Name	Equation Name	Description
CLFBET	L_β	Fuselage lift/q vs sideslip,=f(β)
DBETA	D_β	Fuselage drag/q vs sideslip,=f(β)
FMBETA	M_β	Fuselage pitching moment/q vs sideslip,=f(β)
YBETA	Y_β	Fuselage side force/q vs sideslip,=f(β)
FLBETA	l_β	Fuselage rolling moment/q vs sideslip,=f(β)
FNBETA	N_β	Fuselage yawing moment/q vs sideslip,=f(β)

SUBSYSTEM NO. 4—WING/PYLON GROUP

VAX Name	Equation Name	Description	Value	Units
SLW	SL_W	Sta line wing center of press	291.17	in
WLW	WL_W	Water line wing center of press	95.85	in
SW	S_W	Wing area	181.0	ft^2
BW	b_W	Wing span	32.17	ft
CW	c_W	Wing chord	5.225	ft
CCLAM	$(\Lambda_{c/4})_W$	Wing sweep angle at C/4	-6.5	deg
ARW	AR_W	Wing aspect ratio	5.7	-ND-
CYBM	$C_{Y_\beta}\Big\vert_{M_N=0}$	Const used in Y force equ	0.0	1/rad
CYPCL	$\dfrac{C_{Y_p}}{C_{L_{WP}}}\Bigg\vert_{M_N=0}$	Const used in Y force equ	0.0	1/rad
CYRM	$C_{Y_r}\Big\vert_{M_N=0}$	Const used in Y force equ	0.0	1/rad
CLPC	$C_{l_p}\Big\vert_{\substack{C_L=0\\M_N=0}}$	Const in roll moment equ	-0.774	1/rad

SUBSYSTEM NO. 4—WING/PYLON GROUP (Continued)

VAX Name	Equation Name	Description	Value	Units
CLRCL	$\left.\frac{C_{l_r}}{C_{L_{WP}}}\right\|_{M_N=0}$	Const in roll moment equ	0.27	1/rad
CLRDF	$\frac{\Delta C_{l_r}}{(\partial\alpha/\partial\delta_F)}(\delta_F)$	Const in roll moment equ	-0.0016	1/deg
CLDAF	$C_{l_{\delta_a}}\Big\|_{\alpha_W^{F_1} < 8\ \mathrm{deg}}$	Const in roll moment equ	0.006	1/deg
CNBCL	$C_{n_\beta}\Big\|_{\substack{C_L=0\\ M_N=0}}$	Const in yaw moment equ	-0.0315	1/rad
CNBCL2	$\left.\left(\frac{C_{n_\beta}}{C_{L_{WP}}^2}\right)\right\|_{M_N=0}$	Const in yaw moment equ	0.057	1/rad
CNCL2	$\left(\frac{C_{n_r}}{C_{L_{WP}}^2}\right)$	Const in yaw moment equ	-0.016	1/rad
CNCD	$\left(\frac{C_{n_r}}{C_{D_{o_{WP}}}}\right)$	Const in yaw moment equ	-0.32	1/rad
CNPCL	$\left.\frac{C_{n_p}}{C_{L_{WP}}}\right\|_{M_N=0}$	Const in yaw moment equ	-0.06	1/rad
KNP	K_{np}	Const in yaw moment equ	1.0	-ND-
PAPF	PAPF	Partial (ALPHA)/Partial (DELF)	-0.45	1/deg
KFWO	KFWO	Const download with flaps	1.4	-ND-
KFWDF	KFWDF	Slope download with flaps	-0.0035	1/deg
KXRW	KXRW	Const rotor flow on wings	0.26	-ND-
XRWO	XRWO	Const rotor flow on wings	0.0806	-ND-

SUBSYSTEM NO. 4—WING/PYLON GROUP (Concluded)

VAX Name	Equation Name	Description	Value	Units
XRW1	XRW1	Const rotor flow on wings	0.33410E-04	1/deg
XRW2	XRW2	Const rotor flow on wings	0.73860E-05	$1/deg^2$
SPYL	SPYL	Lateral pylon drag coefficient	24.05	ft^2

SUBSYSTEM NO. 4—WING/PYLON GROUP TABLES

VAX Name	Equation Name	Description
	$C_{M_{o_{WP}}}$	Wing-pylon pitching moment coefficient,=f(δ_F,β_m) (non-dimensional)
		VAX Subtable Titles
CMOWP1		Wing pylon pitch moment, δ_F=F1
CMOWP2		Wing pylon pitch moment, δ_F=F2
CMOWP3		Wing pylon pitch moment, δ_F=F3
CMOWP4		Wing pylon pitch moment, δ_F=F4
	$C_{L_{WP}}$	Wing-pylon lift coefficient,=f(α_W,β_m,δ_F,M_N) (non-dimensional)
		VAX Subtable Titles
CLWO1		Wing pylon lift coef, M<.2, β_m=0., δ_F=F1
CLWO2		Wing pylon lift coef, M<.2, β_m=0., δ_F=F2
CLWO3		Wing pylon lift coef, M<.2, β_m=0., δ_F=F3
CLWO4		Wing pylon lift coef, M<.2, β_m=0., δ_F=F4
CLW91		Wing pylon lift coef, M<.2, β_m=90., δ_F=F1
CLW92		Wing pylon lift coef, M<.2, β_m=90., δ_F=F2
CLW93		Wing pylon lift coef, M<.2, β_m=90., δ_F=F3
CLW94		Wing pylon lift coef, M<.2, β_m=90., δ_F=F4
CLW914		Wing pylon lift coef, M<.4, β_m=90., δ_F=F1
CLW915		Wing pylon lift coef, M<.5, β_m=90., δ_F=F1
CLW916		Wing pylon lift coef, M<.6, β_m=90., δ_F=F1

VAX Name	Equation Name	Description
	$C_{D_{WP}}$	Wing-pylon drag coefficient,=f(α_W,β_m,δ_F,M_N) (non-dimensional)
		VAX Subtable Titles
CDW01		Wing pylon drag coef, M<.2, β_m=0., δ_F=F1
CDW02		Wing pylon drag coef, M<.2, β_m=0., δ_F=F2
CDW03		Wing pylon drag coef, M<.2, β_m=0., δ_F=F3
CDW04		Wing pylon drag coef, M<.2, β_m=0., δ_F=F4
CDW91		Wing pylon drag coef, M<.2, β_m=90., δ_F=F1
CDW92		Wing pylon drag coef, M<.2, β_m=90., δ_F=F2
CDW93		Wing pylon drag coef, M<.2, β_m=90., δ_F=F3
CDW94		Wing pylon drag coef, M<.2, β_m=90., δ_F=F4
CDW914		Wing pylon drag coef, M≤.4, β_m=90., δ_F=F1
CDW915		Wing pylon drag coef, M≤.5, β_m=90., δ_F=F1
CDW916		Wing pylon drag coef, M≤.6, β_m=90., δ_F=F1
	$\varepsilon_{W/H}$	Wing wake deflection at the horizontal stabilizer, = f(α_W,β_m,δ_F) (non-dimensional)
		VAX Subtable Titles
EWH01		Wing wake defl on hor stab, β_m=0., δ_F=F1
EWH02		Wing wake defl on hor stab, β_m=0., δ_F=F2
EWH03		Wing wake defl on hor stab, β_m=0., δ_F=F3
EWH04		Wing wake defl on hor stab, β_m=0., δ_F=F4
EWH151		Wing wake defl on hor stab, β_m=15., δ_F=F1
EWH152		Wing wake defl on hor stab, β_m=15., δ_F=F2
EWH153		Wing wake defl on hor stab, β_m=15., δ_F=F3
EWH154		Wing wake defl on hor stab, β_m=15., δ_F=F4
EWH31		Wing wake defl on hor stab, β_m=30., δ_F=F1
EWH32		Wing wake defl on hor stab, β_m=30., δ_F=F2
EWH33		Wing wake defl on hor stab, β_m=30., δ_F=F3
EWH34		Wing wake defl on hor stab, β_m=30., δ_F=F4
EWH61		Wing wake defl on hor stab, β_m=60., δ_F=F1

VAX Name	Equation Name	Description
EWH62		Wing wake defl on hor stab, β_m=60., δ_F=F2
EWH63		Wing wake defl on hor stab, β_m=60., δ_F=F3
EWH64		Wing wake defl on hor stab, β_m=60., δ_F=F4
EWH91		Wing wake defl on hor stab, β_m=90., δ_F=F1
EWH92		Wing wake defl on hor stab, β_m=90., δ_F=F2
EWH93		Wing wake defl on hor stab, β_m=90., δ_F=F3
EWH94		Wing wake defl on hor stab, β_m=90., δ_F=F4
	$C_{l_\beta}\Big\vert_{\substack{C_L=0\\M_N=0}}$	Wing-pylon rolling moment coefficient,=f(δ_F,β_F,β_m) (1/rad)
		VAX Subtable Titles
CLB01		Wing pylon rolling moment at CL=0., δ_F=1
CLB02		Wing pylon rolling moment at CL=0., δ_F=F2, 3, 4
	$\dfrac{C_{l_\beta}}{C_{L_{WP}}}\Big\vert_{M_N=0}$	Aerodynamic coefficient in the wing rolling moment equation,=f(δ_F,β_F,β_m) (1/rad)
		VAX Subtable Titles
CLBCL1		CLBETA/CLWP for δ_F=F1
CLBCL2		CLBETA/CLWP for δ_F=F2, 3, 4
	$K_{l_{\delta_a}}$	Aileron effectiveness in roll,=f(α_w,β_m,δ_F)
		VAX Subtable Titles
CLDA01		Aileron effectiveness in roll, β_m=0., δ_F=F1
CLDA02		Aileron effectiveness in roll, β_m=0., δ_F=F2
CLDA03		Aileron effectiveness in roll, β_m=0., δ_F=F3
CLDA04		Aileron effectiveness in roll, β_m=0., δ_F=F4
CLDA91		Aileron effectiveness in roll, β_m=90., δ_F=F1
CLDA92		Aileron effectiveness in roll, β_m=90., δ_F=F2
CLDA93		Aileron effectiveness in roll, β_m=90., δ_F=F3
CLDA94		Aileron effectiveness in roll, β_m=90., δ_F=F4

VAX Name	Equation Name	Description
	$K_{no_{\delta_a}}$	Yawing moment equation coefficient,=f(δ_F,β_m) (1/deg)
		VAX Subtable Titles
CKNDA1		Aileron yaw moment equ, δ_F=F1
CKNDA2		Aileron yaw moment equ, δ_F=F2
CKNDA3		Aileron yaw moment equ, δ_F=F3
CKNDA4		Aileron yaw moment equ, δ_F=F4
	$K_{n_{\delta_a}}$	Yawing moment equation coefficient,=f(δ_F,β_m) (non-dimensional)
		VAX Subtable Titles
CNDA1		Aileron yaw moment equ, δ_F=F1
CNDA2		Aileron yaw moment equ, δ_F=F2
CNDA3		Aileron yaw moment equ, δ_F=F3
CNDA4		Aileron yaw moment equ, δ_F=F4
TDPYL	D_{PYINT}	Pylon interference drag in forward flight,=f(β_m)
TKPYL	K_{PLAT}	Pylon drag factor in sideward flight,=f(α_{PYL})
XMTAB		Mach number index

—Date Tables Not Read in Using The Standard Table Input Format—
(These tables are read in following the SCAS group in the input data array)

PCOPAW	$\left.\frac{\partial C_{L_{WP}}}{\partial \alpha_W}\right\|_{C_{L_{WP}}=0}$	Partial of wing coefficient of lift with respect to angle of attack for $M_N < 0.2$, = f(δ_F, β_m)
PCOPWA	$\left.\frac{\partial C_{L_{WP}}}{\partial \alpha_W}\right\|_{C_{L_{WP}}=0}$	Partial of wing coefficient of lift with respect to angle of attack for β_m = 90, δ_F = 0, = f(M_N)
CDCLO	$C_{D_{O_{WP}}}\Big\|_{C_{L_{WP}}=0}$	Wing coefficient of drag at wing coefficient of lift equal to zero for $M_N < 0.2$, = f(δ_F, β_m)

SUBSYSTEM NO. 4—WING/PYLON GROUP TABLES (Concluded)

VAX Name	Equation Name	Description
CDCLM	$C_{D_{O_{WP}}}\Big\vert_{C_{L_{WP}}=0}$	Wing coefficient of drag at wing coefficient of lift equal to zero for $\beta_m = 90$, $\delta_F = 0$, $= f(M_N)$
CLWDA	$C_{L_{\delta_A}}$	Wing lift coefficient due to aileron deflection, $= f(\delta_F)$
DELF	δ_F	Constant in the CLR and KFW equation, $= f(\delta_F)$

SUBSYSTEM NO. 5—HORIZONTAL STABILIZER GROUP

VAX Name	Equation Name	Description	Value	Units
SLH	SL_H	Sta line center of pressure	560.0	in
WLH	WL_H	Water line center of pressure	103.0	in
SH	S_H	Area	50.25	ft^2
CH	c_H	Chord	3.92	ft
CLHB	$C_{LH\beta}$	Constant in lift equation	-0.00422	1/deg
XIH	i_H	Horizontal stabilizer incidence	0.0	deg
TAUELE	τ_e	Elevator effectiveness	0.518	-ND-
KHNU	K_{HNU}	Q-loss multiplier	1.0	-ND-
DKEDDE	D_{Ke}	Elevator effectiveness factor	0.24	-ND-
DMPWB	D_{WB}	Wing/body damping factor	1.0	-ND-
CMHØ	$C_{MH\emptyset}$	Stabilizer pitching mom. coeff.	0.0	-ND-
CMHA	C_{MHA}	Stabilizer pitching mom. slope	0.0	1/deg

SUBSYSTEM NO. 5—HORIZONTAL STABILIZER GROUP TABLES

VAX Name	Equation Name	Description
	C_{LH}	Horizontal stabilizer lift coefficient,=f(α_H,δ_e,M_N) (non-dimensional)
		VAX Subtable Titles
CLHO		Hor stab lift coef vs angle of attack, M<.2,DELE=0.
CLH10		Hor stab lift coef vs angle of attack,M<.2,DELE=10.
CLH15		Hor stab lift coef vs angle of attack,M<.2,DELE=15.
CLH20		Hor stab lift coef vs angle of attack,M<.2,DELE=20.
CLHM10		Hor stab lift coef vs angle of attack,M<.2,DELE=-10.
CLHM15		Hor stab lift coef vs angle of attack,M<.2,DELE=-15.
CLHM20		Hor stab lift coef vs angle of attack,M<.2,DELE=-20.
CLHM2		Hor stab lift coef vs angle of attack,M<.2,DELE=0.
CLHM4		Hor stab lift coef vs angle of attack,M<.4,DELE=0.
CLHM5		Hor stab lift coef vs angle of attack,M<.5,DELE=0.
CLHM6		Hor stab lift coef vs angle of attack,M<.6,DELE=0.
	C_{DH}	Horizontal stabilizer drag coefficient,=f(α_H,M_N) (non-dimensional)
		VAX Subtable Titles
CDH2		Hor stab drag coef vs angle of attack,M<.2,DELE=0.
CDH4		Hor stab drag coef vs angle of attack,M<.4,DELE=0.
CDH5		Hor stab drag coef vs angle of attack,M<.5,DELE=0.
CDH6		Hor stab drag coef vs angle of attack,M<.6,DELE=0.
EF1	X_{Ke}, X_{Kr}	Elev/rudder effectiveness,=f(M_N) (non-dimensional)
	η_H,η_V	Dynamic pressure ratio at the horizontal tail, = f(α_F,β_m,V_T) (non-dimensional)
		VAX Subtable Titles
EN00		Q ratio at hor stab, β_m=0., V=0. kts
EN020		Q ratio at hor stab, β_m=0., V=20. kts
EN040		Q ratio at hor stab, β_m=0., V=40. kts
EN060		Q ratio at hor stab, β_m=0., V=60. kts
EN080		Q ratio at hor stab, β_m=0., V=80. kts
EN0100		Q ratio at hor stab, β_m=0., V=100. kts

SUBSYSTEM NO. 5—HORIZONTAL STABILIZER GROUP TABLES (Concluded)

VAX Name	Equation Name	Description
EN10		Q ratio at hor stab, β_m=15., V=0. kts
EN120		Q ratio at hor stab, β_m=15., V=20. kts
EN140		Q ratio at hor stab, β_m=15., V=40. kts
EN160		Q ratio at hor stab, β_m=15., V=60. kts
EN180		Q ratio at hor stab, β_m=15., V=80. kts
EN1100		Q ratio at hor stab, β_m=15. V=100. kts
EN30		Q ratio at hor stab, β_m=30.
EN60		Q ratio at hor stab, β_m=60.
EN90		Q ratio at hor stab, β_m=90.
DELTAB		Elevator angle index
PCPM	PCPM	Mach number effect $\partial\varepsilon_{W/H}/\partial\alpha_W$ at the hor stab, = $f(M_N)$
KHBET	$K_{\beta HS}$	Horizontal stabilzer Q-loss with sideslip, =$f(\beta_F)$

SUBSYSTEM NO. 6—VERTICAL STABILIZER GROUP*

VAX Name	Equation Name	Description	Value	Units
XFINS	NFINS	No. of vertical stabilizers	2.0	-ND-
SLVT(L)	SL_V	Sta line center of pressure	570.02	in
BLVT(L)	BL_V	Buttline center of pressure	77.0	in
WLVT(L)	WL_V	Water line center of pressure	115.69	in
SV(L)	S_V	Area	50.5	ft^2
XIV(L)	i_V	Stabilizer incidence	0.0	deg
AV(L)	a_V	Stabilizer lift curve slope	3.0252	1/rad
CRCV(L)	CRCV	Rudder chord/stabilizer chord	0.25	-ND-
TAURUD(L)	τ_r	Rudder effectiveness	0.27	-ND-
PSGPP(L)	$\partial\sigma/\partial\hat{p}$	Const in sideslip angle equ	-0.1	-ND-
PSGPR(L)	$\partial\sigma/\partial\hat{r}$	Const in sideslip angle equ	0.0	-ND-
KVNU(L)	K_{VNU}	Q-loss multiplier	1.0	-ND-
DKRDDE(L)	D_{Kr}	Rudder effectiveness factor	0.24	-ND-

*Subscript (L) denotes the requirement that "L" values for "L" vertical stabilizers will be needed.

SUBSYSTEM NO. 6—VERTICAL STABILIZER GROUP TABLES

VAX Name	Equation Name	Description
	C_{Y_V}	Vertical fin side force (lift) coefficient, $= f(\beta_V, \delta_r, M_N)$ (non-dimensional)
		VAX Subtable Titles
CLV0		Vert stab lift coef vs sideslip,M<.2,DELR=0.
CLV15		Vert stab lift coef vs sideslip,M<.2,DELR=15.
CLV20		Vert stab lift coef vs sideslip,M<.2,DELR=20.
CLVM15		Vert stab lift coef vs sideslip,M<.2,DELR= -15.
CLVM20		Vert stab lift coef vs sideslip,M<.2,DELR= -20.
CLV4		Vert stab lift coef vs sideslip,M<.4,DELR=0.
CLV5		Vert stab lift coef vs sideslip,M<.5,DELR=0.
CLV6		Vert stab lift coef vs sideslip,M<.6,DELR=0.
	C_{D_V}	Vertical fin drag coefficient,$=f(\beta_V, \delta_r, M_N)$ (non-dimensional)
		VAX Subtable Titles
CDV0		Vert stab drag coef vs BV,M<.2,DELR=0.
CDV4		Vert stab drag coef vs BV,M<.4,DELR=0.
CDV5		Vert stab drag coef vs BV,M<.5,DELR=0.
CDV6		Vert stab drag coef vs BV,M<.6,DELR=0.
	$(1 - \frac{\partial\sigma}{\partial\beta_F})$	Vertical stabilizer sidewash factor,$=f(\beta_F, \beta_m, \delta_F, \alpha_F)$ (non-dimensional)
		VAX Subtable Titles
DP100		Sidewash factor vs flaps, δ_F=F1, β_m=0., BF=0
DP104		Sidewash factor vs flaps, δ_F=F1, β_m=0., BF=4
DP108		Sidewash factor vs flaps, δ_F=F1, β_m=0., BF=8
DP1012		Sidewash factor vs flaps, δ_F=F1, β_m=0., BF=12
DP1016		Sidewash factor vs flaps, δ_F=F1, β_m=0., BF=16
DP1020		Sidewash factor vs flaps, δ_F=F1, β_m=0., BF=20
DP1050		Sidewash factor vs flaps, δ_F=F1, β_m=0., BF=50
DP130		Sidewash factor vs flaps, δ_F=F1, β_m=30., BF=0
DP134		Sidewash factor vs flaps, δ_F=F1, β_m=30., BF=4
DP138		Sidewash factor vs flaps, δ_F=F1, β_m=30., BF=8

SUBSYSTEM NO. 6—VERTICAL STABILIZER GROUP TABLES (Continued)

VAX Name	Equation Name	Description
DP1312		Sidewash factor vs flaps, δ_F=F1, β_m=30., BF=12
DP1316		Sidewash factor vs flaps, δ_F=F1, β_m=30., BF=16
DP1320		Sidewash factor vs flaps, δ_F=F1, β_m=30., BF=20
DP1350		Sidewash factor vs flaps, δ_F=F1, β_m=30., BF=50
DP160		Sidewash factor vs flaps, δ_F=F1, β_m=60., BF=0
DP164		Sidewash factor vs flaps, δ_F=F1, β_m=60., BF=4
DP168		Sidewash factor vs flaps, δ_F=F1, β_m=60., BF=8
DP1612		Sidewash factor vs flaps, δ_F=F1, β_m=60., BF=12
DP1616		Sidewash factor vs flaps, δ_F=F1, β_m=60., BF=16
DP1620		Sidewash factor vs flaps, δ_F=F1, β_m=60., BF=20
DP1650		Sidewash factor vs flaps, δ_F=F1, β_m=60., BF=50
DP190		Sidewash factor vs flaps, δ_F=F1, β_m=90., BF=0
DP194		Sidewash factor vs flaps, δ_F=F1, β_m=90., BF=4
DP198		Sidewash factor vs flaps, δ_F=F1, β_m=90., BF=8
DP1912		Sidewash factor vs flaps, δ_F=F1, β_m=90., BF=12
DP1916		Sidewash factor vs flaps, δ_F=F1, β_m=90., BF=16
DP1920		Sidewash factor vs flaps, δ_F=F1, β_m=90., BF=20
DP1950		Sidewash factor vs flaps, δ_F=F1, β_m=90., BF=50
DP200		Sidewash factor vs flaps, δ_F=F2, β_m=0., BF=0
DP204		Sidewash factor vs flaps, δ_F=F2, β_m=0., BF=4
DP208		Sidewash factor vs flaps, δ_F=F2, β_m=0., BF=8
DP2012		Sidewash factor vs flaps, δ_F=F2, β_m=0., BF=12
DP2016		Sidewash factor vs flaps, δ_F=F2, β_m=0., BF=16
DP2020		Sidewash factor vs flaps, δ_F=F2, β_m=0., BF=20
DP2050		Sidewash factor vs flaps, δ_F=F2, β_m=0., BF=50
DP230		Sidewash factor vs flaps, δ_F=F2, β_m=30., BF=0
DP234		Sidewash factor vs flaps, δ_F=F2, β_m=30., BF=4
DP238		Sidewash factor vs flaps, δ_F=F2, β_m=30., BF=8
DP2312		Sidewash factor vs flaps, δ_F=F2, β_m=30., BF=12
DP2316		Sidewash factor vs flaps, δ_F=F2, β_m=30., BF=16
DP2320		Sidewash factor vs flaps, δ_F=F2, β_m=30., BF=20

SUBSYSTEM NO. 6—VERTICAL STABILIZER GROUP TABLES (Continued)

VAX Name	Equation Name	Description
DP2350		Sidewash factor vs flaps, δ_F=F2, β_m=30., BF=50
DP260		Sidewash factor vs flaps, δ_F=F2, β_m=60., BF=0
DP264		Sidewash factor vs flaps, δ_F=F2, β_m=60., BF=4
DP268		Sidewash factor vs flaps, δ_F=F2, β_m=60., BF=8
DP2612		Sidewash factor vs flaps, δ_F=F2, β_m=60., BF=12
DP2616		Sidewash factor vs flaps, δ_F=F2, β_m=60., BF=16
DP2620		Sidewash factor vs flaps, δ_F=F2, β_m=60., BF=20
DP2650		Sidewash factor vs flaps, δ_F=F2, β_m=90., BF=50
DP290		Sidewash factor vs flaps, δ_F=F2, β_m=90., BF=0
DP294		Sidewash factor vs flaps, δ_F=F2, β_m=90., BF=4
DP298		Sidewash factor vs flaps, δ_F=F2, β_m=90., BF=8
DP2912		Sidewash factor vs flaps, δ_F=F2, β_m=90., BF=12
DP2916		Sidewash factor vs flaps, δ_F=F2, β_m=90., BF=16
DP2920		Sidewash factor vs flaps, δ_F=F2, β_m=90., BF=20
DP2950		Sidewash factor vs flaps, δ_F=F2, β_m=90., BF=50
DP300		Sidewash factor vs flaps, δ_F=F3, β_m=0., BF=0
DP304		Sidewash factor vs flaps, δ_F=F3, β_m=0., BF=4
DP308		Sidewash factor vs flaps, δ_F=F3, β_m=0., BF=8
DP3012		Sidewash factor vs flaps, δ_F=F3, β_m=0., BF=12
DP3016		Sidewash factor vs flaps, δ_F=F3, β_m=0., BF=16
DP3020		Sidewash factor vs flaps, δ_F=F3, β_m=0., BF=20
DP3050		Sidewash factor vs flaps, δ_F=F3, β_m=0., BF=50
DP330		Sidewash factor vs flaps, δ_F=F3, β_m=30., BF=0
DP334		Sidewash factor vs flaps, δ_F=F3, β_m=30., BF=4
DP338		Sidewash factor vs flaps, δ_F=F3, β_m=30., BF=8
DP3312		Sidewash factor vs flaps, δ_F=F3, β_m=30., BF=12
DP3316		Sidewash factor vs flaps, δ_F=F3, β_m=30., BF=16
DP3320		Sidewash factor vs flaps, δ_F=F3, β_m=30., BF=20
DP3350		Sidewash factor vs flaps, δ_F=F3, β_m=30., BF=50
DP360		Sidewash factor vs flaps, δ_F=F3, β_m=60. BF=0
DP364		Sidewash factor vs flaps, δ_F=F3, β_m=60. BF=8

VAX Name	Equation Name	Description
DP368		Sidewash factor vs flaps, δ_F=F3, β_m=60. BF=4
DP3612		Sidewash factor vs flaps, δ_F=F3, β_m=60. BF=12
DP3616		Sidewash factor vs flaps, δ_F=F3, β_m=60. BF=16
DP3620		Sidewash factor vs flaps, δ_F=F3, β_m=60. BF=20
DP3650		Sidewash factor vs flaps, δ_F=F3, β_m=60. BF=50
DP390		Sidewash factor vs flaps, δ_F=F3, β_m=90., BF=0
DP394		Sidewash factor vs flaps, δ_F=F3, β_m=90., BF=4
DP398		Sidewash factor vs flaps, δ_F=F3, β_m=90., BF=8
DP3912		Sidewash factor vs flaps, δ_F=F3, β_m=90., BF=12
DP3916		Sidewash factor vs flaps, δ_F=F3, β_m=90., BF=16
DP3920		Sidewash factor vs flaps, δ_F=F3, β_m=90., BF=20
DP3950		Sidewash factor vs flaps, δ_F=F3, β_m=90., BF=50
DP400		Sidewash factor vs flaps, δ_F=F4, β_m=0., BF=0
DP404		Sidewash factor vs flaps, δ_F=F4, β_m=0., BF=4
DP408		Sidewash factor vs flaps, δ_F=F4, β_m=0., BF=8
DP4012		Sidewash factor vs flaps, δ_F=F4, β_m=0., BF=12
DP4016		Sidewash factor vs flaps, δ_F=F4, β_m=0., BF=16
DP4020		Sidewash factor vs flaps, δ_F=F4, β_m=0., BF=20
DP4050		Sidewash factor vs flaps, δ_F=F4, β_m=0., BF=50
DP430		Sidewash factor vs flaps, δ_F=F4, β_m=30., BF=0
DP434		Sidewash factor vs flaps, δ_F=F4, β_m=30., BF=4
DP438		Sidewash factor vs flaps, δ_F=F4, β_m=30., BF=8
DP4312		Sidewash factor vs flaps, δ_F=F4, β_m=30., BF=12
DP4316		Sidewash factor vs flaps, δ_F=F4, β_m=30., BF=16
DP4320		Sidewash factor vs flaps, δ_F=F4, β_m=30., BF=20
DP4350		Sidewash factor vs flaps, δ_F=F4, β_m=30., BF=50
DP460		Sidewash factor vs flaps, δ_F=F4, β_m=60., BF=0
DP464		Sidewash factor vs flaps, δ_F=F4, β_m=60., BF=4
DP468		Sidewash factor vs flaps, δ_F=F4, β_m=60., BF=8
DP4612		Sidewash factor vs flaps, δ_F=F4, β_m=60., BF=12
DP4616		Sidewash factor vs flaps, δ_F=F4, β_m=60., BF=16

SUBSYSTEM NO. 6—VERTICAL STABILIZER GROUP TABLES (Concluded)

VAX Name	Equation Name	Description
DP4620		Sidewash factor vs flaps, δ_F=F4, β_m=60., BF=20
DP4650		Sidewash factor vs flaps, δ_F=F4, β_m=60., BF=50
DP490		Sidewash factor vs flaps, δ_F=F4, β_m=90., BF=0
DP494		Sidewash factor vs flaps, δ_F=F4, β_m=90., BF=4
DP498		Sidewash factor vs flaps, δ_F=F4, β_m=90., BF=8
DP4912		Sidewash factor vs flaps, δ_F=F4, β_m=90., BF=12
DP4916		Sidewash factor vs flaps, δ_F=F4, β_m=90., BF=16
DP4920		Sidewash factor vs flaps, δ_F=F4, β_m=90., BF=20
DP4950		Sidewash factor vs flaps, δ_F=F4, β_m=90., BF=50
	$K_{\beta R}$	Rotor sidewash factor on dynamic pressure,=f(β_v,V_T) (non-dimensional)
		VAX Subtable Titles
BK0		Rotor sidewash vs A/S, BV=0
BK5		Rotor sidewash vs A/S, BV=5
BK10		Rotor sidewash vs A/S, BV=10
BK15		Rotor sidewash vs A/S, BV=15
BK20		Rotor sidewash vs A/S, BV=20
BK25		Rotor sidewash vs A/S, BV=25
BK30		Rotor sidewash vs A/S, BV=30
KVBET	$K_{\beta VS}$	Ver stab Q-loss with sideslip
BFBLK		Index for BF in the DP array
BMBLK		Index for β_m in the DP array
DLRTAB		Rudder angle index

SUBSYSTEM NO. 7A—LANDING GEAR GROUP

VAX Name	Equation Name	Description	Value	Units
SLMG	$SL_{G2,3}$	Station line main gear	324.0	in
WLMG	$WL_{G2,3}$	Water line main gear	7.4	in
SLNG	SL_{G1}	Station line nose gear	139.0	in
WLNG	WL_{G1}	Water line nose gear	4.95	in
GEARUP	GEARUP	Gear retraction time	10.0	sec
GEARDN	GEARDN	Gear extension time	7.0	sec

SUBSYSTEM NO. 7A—LANDING GEAR GROUP TABLES

VAX Name	Equation Name	Description
DOMGD		Main gear drag for extension and retraction
		VAX Subtable Titles
	$D_{o_{MGD}}$	Main gear drag during extension/retraction,=f(t) (ft^2)
DONGD		Nose gear drag for extension and retraction
		VAX Subtable Titles
	$D_{o_{NGD}}$	Nose gear drag during extension/retraction,=f(t) (ft^2)

SUBSYSTEM NO. 8—CONTROL SYSTEM GROUP

VAX Name	Equation Name	Description	Value	Units
XLNN	X_{LNN}	Long cyclic neutral	4.8	in
XLTN	X_{LTN}	Lat cyc neutral position	4.8	in
XPDN	X_{PDN}	Pedals neutral position	2.5	in
DEDXLN	$\partial\delta_e/\partial X_{LN}$	D(elevator)/D(XLN)	4.167	deg/in
DADXLT	$\partial\delta_a/\partial X_{LT}$	D(aileron)/D(XLT)	3.93	deg/in

SUBSYSTEM NO. 8—CONTROL SYSTEM GROUP (Concluded)

VAX Name	Equation Name	Description	Value	Units
DRDXPD	$\partial\delta_r/\partial X_{PD}$	D(rudder)/D(XPD)	8.0	deg/in
A1SWCH	--	A1 contr switch	0.0	-ND-
DCYCN2	--	Diff cyclic const	1.0	-ND-
DCYCN3	--	Diff cyclic const	1.0	-ND-
DCYDN4	--	Diff cyclic const	1.0	-ND-
DB1	DB1	B1 rigging offset constant	1.5	deg
LTRNJ	X_{LT}	Lateral control range	9.6	in
LNRNJ	X_{LN}	Longitudinal control range	9.6	in
PDRNJ	X_{PD}	Pedal control range	5.0	in
COLRNJ	X_{COL}	Power lever control range	10.0	in
PBMMAX	PBMMAX	Max fwd mast tilt	90.0	deg
PBMMIN	PBMMIN	Max aft mast tilt	-5.0	deg

SUBSYSTEM NO. 8—CONTROL SYSTEM GROUP TABLES

VAX Name	Equation Name	Description
TB1DXL	$\partial B_1/\partial X_{LN}$	Cyclic/longitudinal stick gradient vs β_m
	$\partial B_1/\partial X_{PD}$	Differential cyclic pitch control gearing ratio,=f(β_m,V_T) (deg/in)
		VAX Subtable Titles
TBDXP0		Diff cyclic/pedal gradient vs β_m, U < 60 kts
TBDXP1		Diff cyclic/pedal gradient vs β_m, U=80 kts
TBDXP2		Diff cyclic/pedal gradient vs β_m, U > 100 kts
TTODXL	$\partial\theta_o/\partial X_{LT}$	Diff coll/lat stick gradient vs β_m
TTDXCO	$\partial\theta_o/\partial X_{COL}$	Blade pitch/power lever gradient vs β_m
THEREF	$\theta_{o_{LL}}$	Min blade pitch at 0.75R vs β_m
TETAMD	$\dot{\beta}_m$	Pylon conversion rate vs β_m
THROR	$X_{THR,L}$	Throttle vs power lever
TA1BM	$A_{1_{\beta_m}}$	Lateral flap controller vs β_m
TA1VT	$A_{1_{V_T}}$	Lateral flap controller vs A/S

SUBSYSTEM NO. 14—IGE MOMENT GROUP

VAX Name	Equation Name	Description	Value	Units
LG0	L_{G0}	Const-IGE roll moment equ	-7506.0	ft-lb/deg
LG1	L_{G1}	Const-IGE roll moment equ	23366.0	ft-lb/deg
LG2	L_{G2}	Const-IGE roll moment equ	-20134.0	ft-lb/deg
LG3	L_{G3}	Const-IGE roll moment equ	5290.0	ft-lb/deg
LG4	L_{G4}	Const-IGE roll moment equ	-0.1	sec/ft
GEULIM	GEULIM	IGE up limit--roll moment equ	1.6386	-ND-
GELLIM	GELLIM	IGE low limit--roll moment equ	0.5	-ND-
MG1	M_{G1}	Const-IGE pitch moment equ	-0.9	ft
MG2	M_{G2}	Const-IGE pitch moment equ	-2.6	-ND-
MG3	M_{G3}	Const-IGE pitch moment equ	-0.08	sec/ft

SUBSYSTEM NOS. 17, 18, AND 19—POWER MANAGEMENT GROUP

VAX Name	Equation Name	Description	Value	Units
THINT1	θ_{INT_1}	Rotor-interconn gear ratio	11.3	-ND-
TD	t_D	Rotor governor delay time	0.0	sec
PCTMXS	pctmxs	Max % HP/sec power turb gov	6.0	%/sec
PCTMXP	pctmxp	Max % HP/sec throttle	6.0	%/sec
DRIVEI	I_1	Drive system inertia	824.0	slug-ft^2
THRPT1	θ_{RPT_1}	Rotor-turbine gear ratio	35.133	-ND-
TRNEFF	--	Trans efficiency	0.93	-ND-
HPK1	K_1	Const in drive syst equs	-0.94	-ND-
HPK2	K_2	Const in drive syst equs	1.94	-ND-
HPK3	K_3	Const in drive syst equs	0.0	-ND-
HPK4	K_4	Const in drive syst equs	13100.0	RPM
HPK5	K_5	Const in drive syst equs	235.0	RPM/$\sqrt{SHP}$
HPK6	K_6	Const in drive syst equs	475.0	HP
HPK7	K_7	Const in drive syst equs	288.16	deg K
HPK11	K_{11}	Const in drive syst equs	0.0032	1/deg K

SUBSYSTEM NOS. 17, 18, AND 19—POWER MANAGEMENT GROUP (Concluded)

VAX Name	Equation Name	Description	Value	Units
HPK12	K_{12}	Const in drive syst equs	0.875	1/deg K
HPK13	K_{13}	Const in drive syst equs	0.00125	1/deg K
HPK14	K_{14}	Const in drive syst equs	0.0	deg K
HPK15	K_{15}	Const in drive syst equs	0.0	1/kts
HPK17	K_{17}	Const in drive syst equs	42.0	deg
HPK18	K_{18}	Const in drive syst equs	1400.0	-ND-
REP	--	Rated pwr of one eng	1.0	SHP
RPME	--	100% pwr turb speed	1.0	RPM
SHPACC	--	SHP reqd by accessory	10.0	SHP
THOGMN	THOGMN	Minimum pitch-governor	-5.0	deg
THOGMX	THOGMX	Maximum pitch-governor	33.5	deg

SUBSYSTEM NO. 17—POWER MANAGEMENT GROUP TABLES

VAX Name	Equation Name	Description
TKPROP	K_{PROP}	Coll governor proportional gain vs β_m
TKINTG	K_{INTG}	Coll governor integral gain vs β_m

SUBSYSTEM NO. 18—POWER PLANT GROUP TABLES

VAX Name	Equation Name	Description
RSHPWR	RSHP	Shaft horsepower vs throttle,=f(X_{THR})
THINTL	K_{JT_1}	Constant jet thrust equ,=f(V_T) (lb)
THSLOP	K_{JT_2}	Slope-jet thrust equ,=f(V_T) (lb/SHP)

SUBSYSTEM NO. 18—POWER PLANT GROUP TABLES (Concluded)

VAX Name	Equation Name	Description
	$\frac{dHP_{ROT}}{dt_{TH}}$	Engine acceleration characteristics,=f(SHP,h_p)
		VAX Subtable Titles
TABALT		Altitude index vs altitude
THPRO1		Engine acceleration vs HP at altitude index 1
THPRO2		Engine acceleration vs HP at altitude index 2
THPRO3		Engine acceleration vs HP at altitude index 3
THPRO4		Engine acceleration vs HP at altitude index 4
RSHPRT	$\frac{RSHP}{RSHP_{V=0}}$	Ram effect,=f(V_T)

SUBSYSTEM NO. 20—SCAS GROUP

VAX Name	Equation Name	Description	Value	Units
NASA ARC Roll SCAS				
XLTSLT	XLTSLT	Roll SCAS limit travel	1.617	inches
T1R	T1R	Roll time constant	0.3	sec
T2R	T2R	Roll time constant	3.0	sec
T3R	T3R	Roll time constant	0.3	sec
K1R-0	K_{1R}, $\beta_m = 0$	Roll gain at BETAD = 0	1.0	in/in
K1R-90	K_{1R}, $\beta_m = 90$	Roll gain at BETAD = 90	1.0	in/in
K2R-0	K_{2R}, $\beta_m = 0$	Roll gain at BETAD = 0	0.535	in/deg/sec
K2R-90	K_{2R}, $\beta_m = 90$	Roll gain at BETAD = 90	0.803	in/deg/sec
K3R-0	K_{3R}, $\beta_m = 0$	Roll gain at BETAD = 0	0.064	in/deg/sec
K3R-90	K_{3R}, $\beta_m = 90$	Roll gain at BETAD = 90	0.057	in/deg/sec
K4R-0	K_{4R}, $\beta_m = 0$	Roll gain at BETAD = 0	10.0	deg/sec/in
K4R-90	K_{4R}, $\beta_m = 90$	Roll gain at BETAD = 90	10.0	deg/sec/in
K5R-0	K_{5R}, $\beta_m = 0$	Roll gain at BETAD = 0	0.2	in/deg
K5R-90	K_{5R}, $\beta_m = 90$	Roll gain at BETAD = 90	0.2	in/deg

VAX Name	Equation Name	Description	Value	Units
NASA ARC Roll SCAS (Concluded)				
K6R-0	K_{6R}, $\beta_m = 0$	Roll gain at BETAD = 0	0.0	deg/in
K6R-90	K_{6R}, $\beta_m = 90$	Roll gain at BETAD = 90	0.0	deg/in
K7R-0	K_{7R}, $\beta_m = 0$	Roll gain at BETAD = 0	0.15	in/deg/sec
K7R-90	K_{7R}, $\beta_m = 90$	Roll gain at BETAD = 90	0.15	in/deg/sec
NASA ARC Pitch SCAS				
XLNSLT	XLNSLT	Pitch SCAS limit travel	1.078	inches
T1P	T1P	Pitch time constant	0.3	sec
T2P	T2P	Pitch time constant	3.0	sec
T3P	T3P	Pitch time constant	0.3	sec
K1P-0	K_{1P}, $\beta_m = 0$	Pitch gain at BETAD = 0	0.6	in/in
K1P-90	K_{1P}, $\beta_m = 90$	Pitch gain at BETAD = 90	-1.0	in/in
K2P-0	K_{2P}, $\beta_m = 0$	Pitch gain at BETAD = 0	0.921	in/deg/sec
K2P-90	K_{2P}, $\beta_m = 90$	Pitch gain at BETAD = 90	0.386	in/deg/sec
K3P-0	K_{3P}, $\beta_m = 0$	Pitch gain at BETAD = 0	0.107	in/deg/sec
K3P-90	K_{3P}, $\beta_m = 90$	Pitch gain at BETAD = 90	0.0	in/deg/sec
K4P-0	K_{4P}, $\beta_m = 0$	Pitch gain at BETAD = 0	-7.5	deg/sec/in
K4P-90	K_{4P}, $\beta_m = 90$	Pitch gain at BETAD = 90	-7.5	deg/sec/in
K5P-0	K_{5P}, $\beta_m = 0$	Pitch gain at BETAD = 0	0.2	in/deg
K5P-90	K_{5P}, $\beta_m = 90$	Pitch gain at BETAD = 90	0.2	in/deg
K6P-0	K_{6P}, $\beta_m = 0$	Pitch gain at BETAD = 0	0.0	deg/in
K6P-90	K_{6P}, $\beta_m = 90$	Pitch gain at BETAD = 90	0.0	deg/in
K7P-0	K_{7P}, $\beta_m = 0$	Pitch gain at BETAD = 0	0.092	in/deg/sec
K7P-90	K_{7P}, $\beta_m = 90$	Pitch gain at BETAD = 90	0.059	in/deg/sec

SUBSYSTEM NO. 20—SCAS GROUP (Concluded)

VAX Name	Equation Name	Description	Value	Units
NASA ARC Yaw SCAS				
XPDSLT	XPDSLT	Yaw SCAS limit travel	0.4	inches
T1Y	T1Y	Yaw time constant	2.7	sec
T2Y	T2Y	Yaw time constant	2.7	sec
T3Y	T3Y	Yaw time constant	0.0	sec
K1Y-0	K_{1Y}, $\beta_m = 0$	Yaw gain at BETAD = 0	2.94	in/in
K1Y-90	K_{1Y}, $\beta_m = 90$	Yaw gain at BETAD = 90	0.0	in/in
K2Y-0	K_{2Y}, $\beta_m = 0$	Yaw gain at BETAD = 0	0.16	in/deg/sec
K2Y-90	K_{2Y}, $\beta_m = 90$	Yaw gain at BETAD = 90	0.08	in/deg/sec
K3Y-0	K_{3Y}, $\beta_m = 0$	Yaw gain at BETAD = 0	0.0	in/deg/sec
K3Y-90	K_{3Y}, $\beta_m = 90$	Yaw gain at BETAD = 90	0.0	in/deg/sec
K4Y-0	K_{4Y}, $\beta_m = 0$	Yaw gain at BETAD = 0	0.0	deg/sec/in
K4Y-90	K_{4Y}, $\beta_m = 90$	Yaw gain at BETAD = 90	0.0	deg/sec/in
K5Y-0	K_{5Y}, $\beta_m = 0$	Yaw gain at BETAD = 0	0.0	in/deg
K5Y-90	K_{5Y}, $\beta_m = 90$	Yaw gain at BETAD = 90	0.0	in/deg
K6Y-0	K_{6Y}, $\beta_m = 0$	Yaw gain at BETAD = 0	0.0	deg/in
K6Y-90	K_{6Y}, $\beta_m = 90$	Yaw gain at BETAD = 90	0.0	deg/in
K7Y-0	K_{7Y}, $\beta_m = 0$	Yaw gain at BETAD = 0	0.0	in/deg/sec
K7Y-90	K_{7Y}, $\beta_m = 90$	Yaw gain at BETAD = 90	0.0	in/deg/sec

FLIGHT CONFIGURATION GROUP

***** Most of the following variables are user input variables *****

VAX Name	Equation Name	Description	Value	Units
GW	GW	A/C gross weight	13000.0	lb
PRSALT	h_p	Pressure altitude	0.0	ft
DELTAT	ΔT	Degrees above standard day	0.0	deg C
DAT	OAT	Outside air temperature	0.0	deg C
SLCG0	$SL_{CG}\big\vert_{\beta_m=0}$	A/C c.g. S.L. at $\beta_m=0$	300.0	in
BLCG	BL_{CG}	A/C c.g. B.L. at $\beta_m=0$	0.0	in
WLCG0	$WL_{CG}\big\vert_{\beta_m=0}$	A/C c.g. W.L. at $\beta_m=0$	81.65	in
IXX0	$I_{XX}\big\vert_{\beta_m=0}$	A/C roll inertia at $\beta_m=0$	52795.0	slug-ft^2
IYY0	$I_{YY}\big\vert_{\beta_m=0}$	A/C pitch inertia at $\beta_m=0$	21360.0	slug-ft^2
IZZ0	$I_{ZZ}\big\vert_{\beta_m=0}$	A/C yaw inertia at $\beta_m=0$	66335.0	slug-ft^2
IXZ0	$I_{XZ}\big\vert_{\beta_m=0}$	A/C cross inertia at $\beta_m=0$	1234.0	slug-ft^2
KI1	K_{I1}	Constant in IXX equation	20.5	1/deg
KI2	K_{I2}	Constant in IYY equation	11.24	1/deg
KI3	K_{I3}	Constant in IZZ equation	9.26	1/deg
KI4	K_{I4}	Constant in IXZ equation	1.76	1/deg
XLN	X_{LN}	Longitudinal stick position	4.8	in
XLT	X_{LT}	Lateral stick position	4.8	in
XPD	X_{PD}	Pedal position input	2.5	in
XCOL	X_{COL}	Collective stick position	6.96	in
OMEGRO	$\Omega_{R,L}$	Center rotor RPM	589.0	RPM
RPMSEL	--	RPM selection	589.0	RPM
TSTEP	--	Integration step size	0.02	sec
U	U	Velocity along X-gnd axis	200.0	kts
V	V	Velocity along Y-gnd axis	0.0	kts
W	W	Velocity along Z-gnd axis	0.0	kts
ROLL	ϕ	Euler roll angle	0.0	deg
PITCH	θ	Euler pitch angle	-3.0	deg
YAW	ψ	Euler yaw angle	0.0	deg

FLIGHT CONFIGURATION GROUP (Concluded)

VAX Name	Equation Name	Description	Value	Units
P	p	A/C roll rate (X-body)	0.0	deg/sec
Q	q	A/C pitch rate (Y-body)	0.0	deg/sec
R	r	A/C yaw rate (Z-body)	0.0	deg/sec
NORTHG	N_N'	A/C position ground axis N	0.0	ft
EASTG	E	A/C position ground axes E	0.0	ft
HEIGHT	h	A/C position ground axis Z	5000.0	ft
VWIND	U_W	Velocity of air mass	0.0	ft/sec
THWIND	θ_W	Wind azimuth angle	0.0	deg
PSWIND	ψ_W	Wind elevation angle	0.0	deg
RODESC	--	Rate of descent (+ down)	0.0	ft/min
NZ	--	G-level for coord. turn	1.0	-ND-
NTURN	--	Turn control (1=coord turn)	0	-ND-
MASTSW	--	Mast tilt actuator SW	0	-ND-
XFLAPS	X_{FL}	Flaps switch setting	1	-ND-
XLGEAR	X_{LG}	Landing gear selector SW.	0	-ND-
SCSRTS	--	Print SCAS-ON roots	1	-ND-
SCASON	--	1=SCAS ON, 0=SCAS OFF	0	-ND-
TABPRT	--	Print table directory	1	-ND-
BFTRIM	--	Force feel trim switch	1	-ND-
DFLPSW	--	Del flap switch	0	-ND-
ENGINL	--	Left engine operating ind.	1.0	-ND-
ENGINR	--	Right engine operating ind	1.0	-ND-
DGPTSW	--	Diagnostic print switch	0	-ND-
TABSW	--	Print table lookup diag.	0	-ND-
STBPSW	--	Bypass thog in derivatives	1	-ND-
NDIMSW	--	Non-dimensional derivs	0	-ND-
NTSOSW	--	Print flt config data only	0	-ND-
STBMTX	--	Print stability matrix	1	-ND-
SRTSPT	--	Print stability roots	1	-ND-
RDERMX	--	Print rotor deriv matrix	1	-ND-
TRMPAG	--	Print individual trim page	1	-ND-
FAMSUM	--	Print force and moment summary	1	-ND-

APPENDIX J

SIGMA 8/VMS
GENERIC TILT ROTOR MATHEMATICAL MODEL
INPUT DATA REQUIREMENTS

TABLE OF SUBSYSTEMS

SUBSYSTEM NO. 1—ROTOR GROUP

Sigma 8 Name	Equation Name	Description	Value	Units
NUMB	n_b	Number of rotor blades	3	-ND-
RBLADE	R	Radius of rotor disc	12.5	ft
CHORDB	c_b	Blade chord	1.167	ft
XMASTL	l_m	Mast length	4.667	ft
DELTA3	δ_3	Pitch flap coupling	-0.261799	rad
XIB	I_b	Blade flapping inertia	102.5	slug-ft^2
XKFA,XKLT	K_H	Flapping hub spring rate	225.0	ft-lb/deg
SLSP	SL_{SP}	S.L. of shaft pivot point	300.0	in
BLSPR	BL_{SP}	B.L. of shaft pivot point	193.0	in
WLSP	WL_{SP}	W.L. of shaft pivot point	100.0	in
BTIPLS	B	Blade tip loss factor	0.97	-ND-
DELBPD(1)	δ_o	Const in CDF equation	0.015	-ND-
DELBPD(2)	δ_1	Const in CDF equation	-0.068	1/rad
DELBPD(3)	δ_2	Const in CDF equation	0.81	1/rad^2
SLP	SL_p	S.L. of pylon c.g.	291.7	in
WLP	WL_p	W.L. of pylon c.g.	118.0	in
WAITP	W_p	Weight of two pylons	3986.0	lbs
BETMIC	β_m	Mast tilt angle	0.0	deg
PHIM	M	Mast dihedral angle	1.0	deg
ISTN	m	Number of blade segments	10	-ND-
XBTD(1)	X_{m-9}	Blade station/R	1.0	-ND-
XBTD(2)	X_{m-8}	Blade station/R	0.6	-ND-
XBTD(3)	X_{m-7}	Blade station/R	0.5333	-ND-
XBTD(4)	X_{m-6}	Blade station/R	0.4667	-ND-
XBTD(5)	X_{m-5}	Blade station/R	0.4	-ND-
XBTD(6)	X_{m-4}	Blade station/R	0.3333	-ND-
XBTD(7)	X_{m-3}	Blade station/R	0.2667	-ND-
XBTD(8)	X_{m-2}	Blade station/R	0.2	-ND-
XBTD(9)	X_{m-1}	Blade station/R	0.1333	-ND-

SUBSYSTEM NO. 1—ROTOR GROUP (Continued)

Sigma 8 Name	Equation Name	Description	Value	Units
XBTD(10)	X_m	Blade station/R	0.0667	-ND-
XBTD(11)	X_{m+1}	Blade station/R	0.0	-ND-
THTBT(1)	θ_{m-9}	Blade twist	0.0	deg
THTBT(2)	θ_{m-8}	Blade twist	10.2	deg
THTBT(3)	θ_{m-7}	Blade twist	12.3	deg
THTBT(4)	θ_{m-6}	Blade twist	14.5	deg
THTBT(5)	θ_{m-5}	Blade twist	17.75	deg
THTBT(6)	θ_{m-4}	Blade twist	21.9	deg
THTBT(7)	θ_{m-3}	Blade twist	26.15	deg
THTBT(8)	θ_{m-2}	Blade twist	30.65	deg
THTBT(9)	θ_{m-1}	Blade twist	34.65	deg
THTBT(10)	θ_m	Blade twist	38.0	deg
THTBT(11)	θ_{m+1}	Blade twist	40.9	deg
XK0	K_0	Const-wing velocity equ	1.6	-ND-
XK1	K_1	Const-wing velocity equ	0.0	-ND-
XK2	K_2	Const-wing velocity equ	0.0	-ND-
XK3	K_3	Const-wing velocity equ	0.0	-ND-
XK4	K_4	Const-wing velocity equ	0.0	-ND-
SLWTE	SL_{WTE}	Sta line wing trail edge	338.1	in
RKRW	K_{RW}	Skew angle vel dist fact	3.0	-ND-
NHI	ℓ	No. of aero segments	8	-ND-
ALFOL	α_{0_L}	Const-blade zero lift	1.0	deg
AOBAR	$\bar{a}_o$	Precone angle	0.0436325	rad
HUBK	K_{HUB}	Coning hub spring	180000.0	ft-lb/deg
ABLO	a_o	Const-slope of lift curve	4.95	-ND-
ABL1	a_1	Const-slope of lift curve	8.0	-ND-
ABL2	a_2	Const-slope of lift curve	30.0	-ND-
CDALPH	CDALPH	Drag coef slope w/alpha	0.01	-ND-
CDLIM	CDLIM	Onset-profile drag rise	0.85	-ND-
CDMACH	CDMACH	Lower limit-mach effect	0.35	-ND-
CDFACT	CDFACT	Drag coefficient factor	0.2	-ND-

SUBSYSTEM NO. 1—ROTOR GROUP (Concluded)

Sigma 8 Name	Equation Name	Description	Value	Units
CDMAX	CDMAX	Max drag coefficient	0.11	-ND-
GEWASH	GEWASH	A/S washout IGE	-0.08	sec/ft
GECON1	GECON1	Const in IGE equation	1.5629	-ND-
GECON2	GECON2	Const in IGE equation	-2.9119	-ND-
SFWASH	SFWASH	A/S washout for rotor X_{SF} effect	54.0	fps
XKR1	KMU1	Induced vel dist equ	17.807	-ND-
XKR2	KMU2	Induced vel dist equ	-0.561	-ND-
XMULL	MUL0	Induced vel dist equ	0.1067	-ND-
XMUUL	MUH1	Induced vel dist equ	0.5733	-ND-
SDQAXL	SDBM90	Spinner drag, $\beta_m = 90$	1.0	ft^2
SDQRDL	SDBM	Spinner drag equ const	5.5	ft^2

SUBSYSTEM NO. 1—ROTOR GROUP TABLES

Sigma 8 Name	Equation Name	Description
TCT	C_T^-	Maximum available rotor thrust coefficient, = $f(\mu)$, Size (9)
CTINS	CTEL	Maximum available rotor thrust coefficient, = $f(\mu, \beta_m)$, Size (9 x 3)
XSS	X_{SS}	Side-by-side rotor effect, = $f(\bar{u})$, Size (10)
XSF	X_{SF}	Sidewash effect, = $f(\lvert\bar{v}\rvert)$, Size (8)

SUBSYSTEM NO. 2—ROTOR INDUCED VELOCITIES GROUP TABLES

Sigma 8 Name	Equation Name	Description
WKH	$\frac{W_{i\|R/H}}{W_{i_{L,R}}}$	Ratio of the induced z-axis rotor wake velocity on the horizontal stabilizer to the mean induced velocity at the rotor (for both right and left rotor), $= f(\alpha_F, V_T, \beta_m)$, Size (16 x 8 x 3), (non-dimensional)
XKHB	K_{H_β}	Rotor wake on the horizontal stabilizer (constant), $= f(\beta_F, \beta_m)$, Size (10 x 5), (non-dimensional)

SUBSYSTEM NO. 3—FUSELAGE GROUP

Sigma 8 Name	Equation Name	Description	Value	Units
SLF	SL_F	Sta line fuse center of press	293.0	in
WLF	WL_F	Water line fuse center of press	84.0	in
[illegible]	LBFO	Lift (zero sideslip)	-7.23	ft^2
TDC	DBFO	Drag (zero sideslip)	-1.56	ft^2
TMC	MBFO	Pitch moment (zero sideslip)	66.5	ft^3
XFUSL	LLANG	Extra fuselage lift	0.0	ft^2
XFUSD	DLANG	Extra fuselage drag	-0.5	ft^2
XDPOD	DPOD	Drag/q land gear pod	1.15	ft^2

SUBSYSTEM NO. 3—FUSELAGE GROUP TABLES

Sigma 8 Name	Equation Name	Description
TLA	L_α	Fuselage lift/q vs angle of attack, $= f(\alpha)$, Size (61)
TDA	D_α	Fuselage drag/q vs angle of attack, $= f(\alpha)$, Size (61)
TMA	M_α	Fuselage pitching moment/q vs angle of attack, $= f(\alpha)$, Size (61)

SUBSYSTEM NO. 3—FUSELAGE GROUP TABLES (Concluded)

Sigma 8 Name	Equation Name	Description
TLB	L_β	Fuselage lift/q vs sideslip, = f(β), Size (37)
TDB	D_β	Fuselage drag/q vs sideslip, = f(β), Size (37)
TMB	M_β	Fuselage pitching moment/q vs sideslip, = f(β), Size (37)
TYB	Y_β	Fuselage side force/q vs sideslip, = f(β), Size (37)
TLLB	l_β	Fuselage rolling moment/q vs sideslip, = f(β), Size (37)
TNB	N_β	Fuselage yawing moment/q vs sideslip, = f(β), Size (37)

SUBSYSTEM NO. 4—WING/PYLON GROUP

Sigma 8 Name	Equation Name	Description	Value	Units
SLW	SL_W	Sta line wing center of press	291.17	in
WLW	WL_W	Water line wing center of press	95.85	in
AREA	S_W	Wing area	181.0	ft^2
SPAN	b_W	Wing span	32.17	ft
CHORD	c_W	Wing chord	5.225	ft
CSWEP	$(\Lambda_{c/4})_W$	Wing sweep angle at C/4	-6.5	deg
ARW	AR_W	Wing aspect ratio	5.7	-ND-
CYBM	$C_{Y_\beta}\Big\vert_{M_N=0}$	Const used in Y force equ	0.0	1/rad
CYPM	$\dfrac{C_{Y_p}}{C_{L_{WP}}}\Bigg\vert_{M_N=0}$	Const used in Y force equ	0.0	1/rad
CYRM	$C_{Y_r}\Big\vert_{M_N=0}$	Const used in Y force equ	0.0	1/rad
CLPM	$C_{l_p}\Big\vert_{\substack{C_L=0\\M_N=0}}$	Const in roll moment equ	-0.774	1/rad

SUBSYSTEM NO. 4—WING/PYLON GROUP (Continued)

Sigma 8 Name	Equation Name	Description	Value	Units
CLRM	$\left.\frac{C_{l_r}}{C_{L_{WP}}}\right\|_{M_N=0}$	Const in roll moment equ	0.27	1/rad
CLRAF	$\frac{\Delta C_{l_r}}{(\partial\alpha/\partial\delta_F)}(\delta_F)$	Const in roll moment equ	-0.0016	1/deg
CLDA	$C_{l_{\delta_a}}\Big\|_{\alpha_W^{F_1} < 8 \text{ deg}}$	Const in roll moment equ	0.006	1/deg
CNBO	$C_{n_\beta}\Big\|_{M_N=0}^{C_L=0}$	Const in yaw moment equ	-0.0315	1/rad
CNBM	$\left.\left(\frac{C_{n_\beta}}{C_{L_{WP}}^2}\right)\right\|_{M_N=0}$	Const in yaw moment equ	0.057	1/rad
CNRL	$\left(\frac{C_{n_r}}{C_{L_{WP}}^2}\right)$	Const in yaw moment equ	-0.016	1/rad
CNRD	$\left(\frac{C_{n_r}}{C_{D_{o_{WP}}}}\right)$	Const in yaw moment equ	-0.32	1/rad
CNPL	$\left.\frac{C_{n_p}}{C_{L_{WP}}}\right\|_{M_N=0}$	Const in yaw moment equ	-0.06	1/rad
FKNP	K_{np}	Const in yaw moment equ	1.0	-ND-
XKFWB	KFWO	Const download with flaps	1.4	-ND-
XKFWS	KFWDF	Slope download with flaps	-0.0035	1/deg
CXRW	KXRW	Const rotor flow on wings	0.26	-ND-
XRWO	XRWO	Const rotor flow on wings	0.0806	-ND-

SUBSYSTEM NO. 4—WING/PYLON GROUP (Concluded)

Sigma 8 Name	Equation Name	Description	Value	Units
XRW1	XRW1	Const rotor flow on wings	0.33410E-04	1/deg
XRW2	XRW2	Const rotor flow on wings	0.73860E-05	$1/deg^2$
DQP90	CPYLN1	Const in pylon drag equation	1.0	ft^2
DQP0	CPYLN2	Const in pylon drag equation	13.5	ft^2

SUBSYSTEM NO. 4—WING/PYLON GROUP TABLES

Sigma 8 Name	Equation Name	Description
CMOWP	$C_{M_{o_{WP}}}$	Wing-pylon pitching moment coefficient, = $f(\beta_m, F_X)$ Size (5 x 4), (non-dimensional)
CLWP1	$C_{L_{WP}}$	Wing-pylon lift coefficient for F_X = 0 deg, = $f(\alpha'_{F/W}/\alpha_W, \beta_m, M_N)$, Size (28 x 2 x 4), (non-dimensional)
CLWP2	$C_{L_{WP}}$	Wing-pylon lift coefficient for F_X = 20 deg, = $f(\alpha'_{F/W}/\alpha_W, \beta_m)$, Size (55 x 2), (non-dimensional)
CLWP3	$C_{L_{WP}}$	Wing-pylon lift coefficient for F_X = 40 deg, = $f(\alpha'_{F/W}/\alpha_W, \beta_m)$, Size (32 x 2), (non-dimensional)
CLWP4	$C_{L_{WP}}$	Wing-pylon lift coefficient for F_X = 75 deg, = $f(\alpha'_{F/W}/\alpha_W, \beta_m)$, Size (32 x 2), (non-dimensional)
CDWP1	$C_{D_{WP}}$	Wing-pylon drag coefficient for F_X = 0 deg, = $f(\alpha'_{F/W}/\alpha_W, \beta_m, M_N)$, Size (21 x 2 x 4), (non-dimensional)
CDWP2	$C_{D_{WP}}$	Wing-pylon drag coefficient for F_X = 20 deg, = $f(\alpha'_{F/W}/\alpha_W, \beta_m)$, Size (49 x 2), (non-dimensional)
CDWP3	$C_{D_{WP}}$	Wing-pylon drag coefficient for F_X = 40 deg = $f(\alpha'_{F/W}/\alpha_W, \beta_m)$, Size (26 x 2), (non-dimensional)
CDWP4	$C_{D_{WP}}$	Wing-pylon drag coefficient for F_X = 75 deg, = $f(\alpha'_{F/W}/\alpha_W, \beta_m)$, Size (26 x 2), (non-dimensional)
EWH	$\varepsilon_{W/H}$	Wing wake deflection at the horizontal stabilizer, = $f(\alpha_W, F_X, \beta_m)$, Size (12 x 4 x 5), (non-dimensional)
CLB	$C_{l_\beta}\Big\vert_{\substack{C_L=0 \\ M_N=0}}$	Wing-pylon rolling moment coefficient, = $f(\beta_m, F_X)$ Size (4 x 4), (1/rad)

SUBSYSTEM NO. 4—WING/PYLON GROUP TABLES (Concluded)

Sigma 8 Name	Equation Name	Description
CLBL	$\left.\frac{C_{l_\beta}}{C_{L_{WP}}}\right\|_{M_N=0}$	Aerodynamic coefficient in the wing rolling moment equation, = $f(\beta_m, F_X)$, Size (4 x 4), (1/rad)
FKLDA	$K_{l_{\delta_a}}$	Aileron effectiveness in roll, = $f(\alpha_w, \beta_m, F_X)$, Size (2 x 2 x 4)
FKNOA	$K_{no_{\delta_a}}$	Yawing moment equation coefficient, = $f(\beta_m, F_X)$, Size (3 x 4), (1/deg)
FKNDA	$K_{n_{\delta_a}}$	Yawing moment equation coefficient, = $f(\beta_m, F_X)$, Size (3 x 4), (non-dimensional)
CDO	$C_{D_{o_{WP}}}\Big\|_{C_{L_{WP}}=0}$	Wing coefficient of drag at wing coefficient of lift equal to zero, = $f(M_N, \beta_m, F_X)$, Size (4 x 2 x 4)
CLDAI	$C_{l_{\delta_A}}$	Wing lift coefficient due to aileron deflection, = $f(F_X)$, Size (4)
LA1	$\left.\frac{\partial C_{L_{WP}}}{\partial \alpha_W}\right\|_{C_{L_{WP}}=0}$	Partial of wing coefficient of lift with respect to angle of attack, = $f(M_N, \beta_m)$, Size (4 x 2)

SUBSYSTEM NO. 5—HORIZONTAL STABILIZER GROUP

Sigma 8 Name	Equation Name	Description	Value	Units
SLH	SL_H	Sta line center of pressure	560.0	in
WLH	WL_H	Water line center of pressure	103.0	in
SH	S_H	Area	50.25	ft^2
CLHB	$C_{L_{H\beta}}$	Const in lift equation	-0.00422	1/deg
XIH	i_H	Horizontal stab incidence	0.0	deg
HTEL,HTED	τ_e	Elevator effectiveness	0.518	-ND-
XKHNU	KHNU	Q-loss multiplier	1.0	-ND-

SUBSYSTEM NO. 5—HORIZONTAL STABILIZER GROUP TABLES

Sigma 8 Name	Equation Name	Description
CLH	C_{L_H}	Horizontal stabilizer lift coefficient, = $f(\alpha_H, \delta_e)$, Size (56 x 7), (non-dimensional)
CLHM	C_{L_H}	Horizontal stabilizer lift coefficient, = $f(\alpha_H, M_N)$, Size (17 x 4), (non-dimensional)
CDH	C_{D_H}	Horizontal stabilizer drag coefficient, = $f(\alpha_M, M_N)$, Size (49 x 4), (non-dimensional)
HKE	K_e	Elev/rudder effectiveness, = $f(M_N)$, Size (4), (non-dimensional)
ETAH	η_H	Dynamic pressure ratio at the horizontal tail, = $f(\alpha_F, V_T, \beta_m)$, Size (18 x 6 x 5), (non-dimensional)

SUBSYSTEM NO. 6—VERTICAL STABILIZER GROUP

Sigma 8 Name	Equation Name	Description	Value	Units
SLV	SL_V	Sta line center of pressure	570.02	in
WLV	WL_V	Water line center of pressure	115.69	in
BLV	BL_V	Buttline center of pressure	77.0	in
SF	S_V	Area	50.5	ft^2
DSIGP	$\partial\sigma/\partial\hat{p}$	Const in sideslip angle equ	-0.1	-ND-
DSIGR	$\partial\sigma/\partial\hat{r}$	Const in sideslip angle equ	0.0	-ND-
HTRL,HTRD	τ_r	Rudder effectiveness	0.27	-ND-
BETWK1	BETWK1	Sideslip wake off fin	5.0	deg
BETWK2	BETWK2	Sideslip opp wake on fin	28.0	deg
BETWK3	BETWK3	Sideslip opp wake off fin	60.0	deg
XKVNU	KVNU	Q-loss multiplier	1.0	-ND-

SUBSYSTEM NO. 6—VERTICAL STABILIZER GROUP TABLES

Sigma 8 Name	Equation Name	Description
CYV1	C_{Y_V}	Vertical fin side force (lift) coefficient, $= f(\beta_V, \delta_r)$, Size (50 x 5), (non-dimensional)
CYV2	C_{Y_V}	Vertical fin side force (lift coefficient, $= f(\beta_V, M_N)$, Size (19 x 4), (non-dimensional)
CDV	C_{D_V}	Vertical fin drag coefficient, $= f(\beta_V, M_N)$, Size (47 x 4), (non-dimensional)
DSIG1	$(1 - \frac{\partial\sigma}{\partial\beta_F})$	Vertical stabilizer sidewash factor for $F_X = 0$ deg, $= f(\beta_F, \alpha_F, \beta_m)$, Size (6 x 6 x 4), (non-dimensional)
DSIG2	$(1 - \frac{\partial\sigma}{\partial\beta_F})$	Vertical stabilizer sidewash factor for $F_X = 20$ deg, $= f(\beta_F, \alpha_F, \beta_m)$, Size (6 x 6 x 4), (non-dimensional)
DSIG3	$(1 - \frac{\partial\sigma}{\partial\beta_F})$	Vertical stabilizer sidewash factor for $F_X = 40$ deg, $= f(\beta_F, \alpha_F, \beta_m)$, Size (6 x 6 x 4), (non-dimensional)
DSIG4	$(1 - \frac{\partial\sigma}{\partial\beta_F})$	Vertical stabilizer sidewash factor for $F_X = 75$ deg, $= f(\beta_F, \alpha_F, \beta_m)$, Size (6 x 6 x 4), (non-dimensional)
XKB	K_β	Rotor sidewash factor on dynamic pressure, $= f(V_T, \beta_v)$ Size (8 x 7), (non-dimensional)

SUBSYSTEM NO. 7A—LANDING GEAR GROUP

Sigma 8 Name	Equation Name	Description	Value	Units
SLNG	SL_{G1}	Station line nose gear	139.0	in
WLNG	WL_{G1}	Water line nose gear	4.95	in
BLNG	BL_{G1}	Butt line nose gear	0.0	in
SLMG	$SL_{G2,3}$	Station line main gear	324.0	in
WLMG	$WL_{G2,3}$	Water line main gear	7.4	in
BLMG	$BL_{G2,3}$	Butt line main gear	51.25	in
DBMIN	$\delta_{B_{n_{MIN}}}$	Brake threshold deflection	5.73	deg
XKBRK	K_{B_n}	Brake sensitivity	-0.1745	ft/sec^2-deg

SUBSYSTEM NO. 7A—LANDING GEAR GROUP (Concluded)

Sigma 8 Name	Equation Name	Description	Value	Units
AMAX	A_{MAX}	Maximum braking deceleration	-5.0	ft/sec^2
GA1	G_{A_1}	Nose gear linear damping term	100.0	lb-sec/ft
GA2,GA3	$G_{A_{2,3}}$	Main gear linear damping term	775.0	lb-sec/ft
GB1,GB2,GB3	G_{B_n}	Landing gear nonlinear damping term	0.0	$lb\text{-}sec/ft^3$
GC1	G_{C_1}	Nose gear nonlinear stiffness term	175.0	lb/ft^4
GC2,GC3	$G_{C_{2,3}}$	Main gear nonlinear stiffness term	325.0	lb/ft^4
US1,US2,US3	μ_{S_n}	Landing gear side force slope	0.03	-ND-
UG	μ_{G_n}	Landing gear maximum side force coefficient	0.5	-ND-
UR	μ_{RF}	Coefficient of rolling friction	0.015	-ND-

SUBSYSTEM NO. 7A—LANDING GEAR GROUP TABLES

Sigma 8 Name	Equation Name	Description
DOMGD	$D_{o_{MGD}}$	Drag of main landing gear during extension, = f(t), Size (21), (ft^2)
DOMGU	$D_{o_{MGU}}$	Drag of main landing gear during retraction, = f(t), Size (21), (ft^2)
DONGD	$D_{o_{NGD}}$	Drag of nose landing gear during extension, = f(t) Size (21), (ft^2)
DONGU	$D_{o_{NGU}}$	Drag of nose landing gear during retraction, = f(t) Size (21), (ft^2)

SUBSYSTEM NO. 8—CONTROL SYSTEM GROUP

Sigma 8 Name	Equation Name	Description	Value	Units
XLNN	X_{LNN}	Long cyclic neutral	4.8	in
XLTN	X_{LTN}	Lat cyc neutral position	4.8	in
XPDN	X_{PDN}	Pedals neutral position	2.5	in
DEXLN	$\partial\delta_e/\partial X_{LN}$	D(elevator)/D(XLN)	4.16	deg/in
DAXLT	$\partial\delta_a/\partial X_{LT}$	D(aileron)/D(XLT)	3.93	deg/in
DRXPD	$\partial\delta_r/\partial X_{PD}$	D(rudder)/D(XPD)	8.0	deg/in
DB1	DB1	B1 rigging offset constant	1.5	deg
LTRNJ	X_{LT}	Lateral control range	9.6	in
LNRNJ	X_{LN}	Longitudinal control range	9.6	in
PDRNJ	X_{PD}	Pedal control range	5.0	in
COLRNJ	X_{COL}	Power lever control range	10.0	in
BETMAX	PBMMAX	Max fwd mast tilt	90.0	deg
BETMIN	PBMMIN	Max aft mast tilt	-5.0	deg
[illegible]LOW	$\dot{\beta}_m$	Pylon conversion rate--low	1.5	deg/sec
[illegible]HIGH	$\dot{\beta}_m$	Pylon conversion rate--high	7.5	deg/sec
GLNO	G_{LNO}	Longitudinal force feel system gradient	3.5	lb/in
GLN1	G_{LN1}	Longitudinal force feel system gradient	0.108	lb/in/psf
AKLN	K_{LN}	Longitudinal force feel system constant (system off)	11.25	lb/in
ZENFFS	ζ_{LN}	Longitudinal force feel system viscous damping coefficient	0.85	-ND-
HLN	H_{LN}	Longitudinal force feel system hysteresis force	2.85	lb
GLTO	G_{LTO}	Lateral force feel system gradient	1.0	lb/in
GLT1	G_{LT1}	Lateral force feel system gradient	0.023	lb/in/psf
AKLT	K_{LT}	Lateral force feel system constant (system off)	3.5	lb/in
ZETFFS	ζ_{LT}	Lateral force feel system viscous damping coefficient	0.85	-ND-

SUBSYSTEM NO. 8—CONTROL SYSTEM GROUP (Concluded)

Sigma 8 Name	Equation Name	Description	Value	Units
HLT	H_{LT}	Lateral force feel system hysteresis force	3.75	lb
GPDO	G_{PDO}	Pedal force feel system gradient	5.0	lb/in
GPD1	G_{PD1}	Pedal force feel system hysteresis	0.167	lb/in/psf
ZEDFFS	ζ_{PD}	Pedal force feel system viscous damping coefficient	0.85	-ND-
HPD	H_{PD}	Pedal force feel system hysteresis force	8.8	lb
HRUD	H_{RUD}	Rudder force feel constant	0.37	ft^2/in
FARUDL	$F_{ACT_{RUD_{LIM}}}$	Rudder force feel actuator limit	45.0	lb
XDLNTO	$\dot{X}_{LNTO}$	Longitudinal trim rate force feel system constant	1.0	in/sec
XDLNT1	$\dot{X}_{LNT1}$	Longitudinal trim rate force feel system constant	-0.00262	in/sec/psf
XDLTTO	$\dot{X}_{LTTO}$	Lateral trim rate force feel system constant	1.0	in/sec
XDLTT1	$\dot{X}_{LTT1}$	Lateral trim rate force feel system constant	-0.00262	in/sec/psf
XDLPDO	$\dot{X}_{PDTO}$	Pedal trim rate force feel system constant	0.5	in/sec
XDLPD1	$\dot{X}_{PDT1}$	Pedal trim rate force feel system constant	-0.00131	in/sec/psf

SUBSYSTEM NO. 8—CONTROL SYSTEM GROUP TABLES

Sigma 8 Name	Equation Name	Description
C1	$\partial B_1/\partial X_{LN}$	Cyclic/longitudinal stick gradient vs β_m, Size (10)
C2	$\partial B_1/\partial X_{PD}$	Differential cyclic pitch control gearing ratio, $= f(\beta_m, V_T)$, Size (10 x 3), (deg/in)
C3	$\partial \theta_o/\partial X_{LT}$	Diff coll/lat stick gradient vs β_m, Size (10)

SUBSYSTEM NO. 8—CONTROL SYSTEM GROUP TABLES (Concluded)

Sigma 8 Name	Equation Name	Description
C4	$\partial\theta_o/\partial X_{COL}$	Blade pitch/power lever gradient vs β_m, Size (10)
C5	$\theta_{o_{LL}}$	Min blade pitch at 0.75R vs β_m, Size (10)
THP	$X_{THR,L}$	Throttle vs power lever, Size (21)
AIB	$A_{1_{\beta_m}}$	Lateral flap controller vs β_m, Size (7)
AIV	$A_{1_{V_T}}$	Lateral flap controller vs A/S, Size (7)

SUBSYSTEM NO. 11—AIRCRAFT ACCELERATIONS AND VELOCITIES GROUP

Sigma 8 Name	Equation Name	Description	Value	Units
SLPA	SL_{PA}	Station line of the pilot	215.25	in
BLPA	BL_{PA}	Butt line of the pilot	16.5	in
WLPA	WL_{PA}	Water line of the pilot	82.0	in

SUBSYSTEM NO. 14—IGE MOMENT GROUP

Sigma 8 Name	Equation Name	Description	Value	Units
XLG0	L_{G0}	Const-IGE roll moment equ	-7506.0	ft-lb/deg
XLG1	L_{G1}	Const-IGE roll moment equ	23366.0	ft-lb/deg
XLG2	L_{G2}	Const-IGE roll moment equ	-20134.0	ft-lb/deg
XLG3	L_{G3}	Const-IGE roll moment equ	5290.0	ft-lb/deg
XLG4	L_{G4}	Const-IGE roll moment equ	-0.1	sec/ft
XH2	GEULIM	IGE up limit--roll moment equ	1.6386	-ND-
XH1	GELLIM	IGE low limit--roll moment equ	0.5	-ND-
GEM1	M_{G1}	Const-IGE pitch moment equ	-0.9	ft
GEM2	M_{G2}	Const-IGE pitch moment equ	-2.6	-ND-
GEM3	M_{G3}	Const-IGE pitch moment equ	-0.08	sec/ft

SUBSYSTEM NOS. 17, 18, AND 19—POWER MANAGEMENT GROUP

Sigma 8 Name	Equation Name	Description	Value	Units
THINT1	θ_{INT_1}	Rotor-interconn gear ratio	11.3	-ND-
TD	t_D	Rotor governor delay time	0.0	sec
PCTMXS	pctmxs	Max % HP/sec power turb gov	6.0	%/sec
PCTMXP	pctmxp	Max % HP/sec throttle	6.0	%/sec
XI1	I_1	Drive system inertia	824.0	slug-ft^2
THRPT1	θ_{RPT_1}	Rotor-turbine gear ratio	35.133	-ND-
EK1	K_1	Const in drive syst equs	-0.94	-ND-
EK2	K_2	Const in drive syst equs	1.94	-ND-
EK3	K_3	Const in drive syst equs	0.0	-ND-
EK4	K_4	Const in drive syst equs	13100.0	RPM
EK5	K_5	Const in drive syst equs	235.0	RPM/$\sqrt{SHP}$
EK6	K_6	Const in drive syst equs	475.0	HP
EK7	K_7	Const in drive syst equs	288.16	deg K
EK11	K_{11}	Const in drive syst equs	0.0032	1/deg K
EK12	K_{12}	Const in drive syst equs	0.875	1/deg K
EL13	K_{13}	Const in drive syst equs	0.00125	1/deg K
EK14	K_{14}	Const in drive syst equs	0.0	deg K
THTMX	THOGMN	Minimum pitch-governor	-5.0	deg
THTMU	THOGMX	Maximum pitch-governor	33.5	deg
PRGK	K_{PRG}	Coll. governor proportional gain at β_m=90	0.1	-ND-
TK1G1	K_{1G}	Coll. governor integral gain at β_m=90	0.05	-ND-

SUBSYSTEM NO. 18—POWER PLANT GROUP TABLES

Sigma 8 Name	Equation Name	Description
RSPN	RSHP	Shaft horsepower vs throttle, = $f(X_{THR})$, Size (14)
TJET1	K_{JT_1}	Constant jet thrust equ, = $f(V_T)$, Size (4), (1b)

SUBSYSTEM NO. 18—POWER PLANT GROUP TABLES (Concluded)

Sigma 8 Name	Equation Name	Description
TJET2	K_{JT_2}	Slope-jet thrust equ, = $f(V_T)$, Size (4), (lb/SHP)
DHPR	$\frac{dHP_{ROT}}{dt_{TH}}$	Engine acceleration characteristics, = f(SHP), Size (19)
RSHP	$\frac{RSHP}{RSHP_{V=0}}$	Ram effect, = $f(V_T)$, Size (7)

SUBSYSTEM NO. 20—SCAS GROUP

Sigma 8 Name	Equation Name	Description	Value	Units
Bell Roll SCAS				
ST1RF	τ_{1R}	Roll time constant	0.5	sec
ST2RF	τ_{2R}	Roll time constant	3.0	sec
ST3RF	τ_{3R}	Roll time constant	3.0	sec
ST4RF	τ_{4R}	Roll time constant	3.0	sec
ST5RF	τ_{5R}	Roll time constant	3.0	sec
SK1R0F	$K_{1R,\beta_m} = 0$	Roll gain	30.0	deg/sec/in
SK1R90F	$K_{1R,\beta_m} = 90$	Roll gain	30.0	deg/sec/in
SK2R0F	$K_{2R,\beta_m} = 0$	Roll gain	0.8	in/deg/sec
SK2R90F	$K_{2R,\beta_m} = 90$	Roll gain	0.8	in/deg/sec
SK3R0F	$K_{3R,\beta_m} = 0$	Roll gain	0.3	in/deg/sec
SK3R90F	$K_{3R,\beta_m} = 90$	Roll gain	0.3	in/deg/sec
SK4R0F	$K_{4R,\beta_m} = 0$	Roll gain	10.0	deg/sec/in
SK4R90F	$K_{4R,\beta_m} = 90$	Roll gain	10.0	deg/sec/in
SK5R0F	$K_{5R,\beta_m} = 0$	Roll gain	0.15	in/deg
SK5R90F	$K_{5R,\beta_m} = 90$	Roll gain	0.15	in/deg

SUBSYSTEM NO. 20—SCAS GROUP (Continued)

Sigma 8 Name	Equation Name	Description	Value	Units
Bell Pitch SCAS				
ST1PF	τ_{1P}	Pitch time constant	0.5	sec
ST2PF	τ_{2P}	Pitch time constant	3.15	sec
ST3PF	τ_{3P}	Pitch time constant	3.15	sec
ST4PF	τ_{4P}	Pitch time constant	3.15	sec
ST5PF	τ_{5P}	Pitch time constant	3.15	sec
ST6PF	τ_{6P}	Pitch time constant	1.0	sec
SK1POF	$K_{1P,\beta_m = 0}$	Pitch gain at $\beta_m = 0$	7.5	deg/sec/in
SK1P90F	$K_{1P,\beta_m = 90}$	Pitch gain at $\beta_m = 90$	4.5	deg/sec/in
SK2POF	$K_{2P,\beta_m = 0}$	Pitch gain at $\beta_m = 0$	0.47	in/deg/sec
SK2P90F	$K_{2P,\beta_m = 90}$	Pitch gain at $\beta_m = 90$	1.105	in/deg/sec
SK3POF	$K_{3P,\beta_m = 0}$	Pitch gain at $\beta_m = 0$	0.1	in/deg/sec
SK3P90F	$K_{3P,\beta_m = 90}$	Pitch gain at $\beta_m = 90$	0.06	in/deg/sec
SK4POF	$K_{4P,\beta_m = 0}$	Pitch gain at $\beta_m = 0$	10.0	deg/sec/in
SK4P90F	$K_{4P,\beta_m = 90}$	Pitch gain at $\beta_m = 90$	10.0	deg/sec/in
SK5POF	$K_{5P,\beta_m = 0}$	Pitch gain at $\beta_m = 0$	0.2	in/deg/sec
SK5P90F	$K_{5P,\beta_m = 90}$	Pitch gain at $\beta_m = 90$	0.1	in/deg/sec
SK6POF	$K_{6P,\beta_m = 0}$	Pitch gain at $\beta_m = 0$	0.0	in/deg/sec
SK6P90F	$K_{6P,\beta_m = 90}$	Pitch gain at $\beta_m = 90$	0.6	in/deg/sec
Bell Yaw SCAS				
ST1YF	τ_{1Y}	Yaw time constant	2.7	sec
ST2YF	τ_{2Y}	Yaw time constant	2.7	sec
SK1YOF	$K_{1Y,\beta_m = 0}$	Yaw gain at $\beta_m = 0$	12.0	in/in
SK1Y90F	$K_{1Y,\beta_m = 90}$	Yaw gain at $\beta_m = 90$	0.0	in/in
SK2YOF	$K_{2Y,\beta_m = 0}$	Yaw gain at $\beta_m = 0$	0.6	in/deg/sec
SK2Y90F	$K_{2Y,\beta_m = 90}$	Yaw gain at $\beta_m = 90$	0.3	in/deg/sec
SK3YOF	$K_{3Y,\beta_m = 0}$	Yaw gain at $\beta_m = 0$	0.0	in/in
SK3Y90F	$K_{3Y,\beta_m = 90}$	Yaw gain at $\beta_m = 90$	0.0	in/in

SUBSYSTEM NO. 20—SCAS GROUP (Continued)

Sigma 8 Name	Equation Name	Description	Value	Units
Modified Roll SCAS				
ST1RN	τ_{1R}	Roll time constant	0.4	sec
ST2RN	τ_{2R}	Roll time constant	3.0	sec
STPRN	τ_P	Roll time constant	0.4	sec
SK1RON	$K_{1R,\beta_m} = 0$	Roll gain at $\beta_m = 0$	1.0	in/in
SK1R90N	$K_{1R,\beta_m} = 90$	Roll gain at $\beta_m = 90$	0.5	in/in
SK2RON	$K_{2R,\beta_m} = 0$	Roll gain at $\beta_m = 0$	1.03	in/deg/sec
SK2R90N	$K_{2R,\beta_m} = 90$	Roll gain at $\beta_m = 90$	1.03	in/deg/sec
SK3RON	$K_{3R,\beta_m} = 0$	Roll gain at $\beta_m = 0$	0.064	in/deg/sec
SK3R90N	$K_{3R,\beta_m} = 90$	Roll gain at $\beta_m = 90$	0.064	in/deg/sec
SK4RON	$K_{4R,\beta_m} = 0$	Roll gain at $\beta_m = 0$	10.0	deg/sec/in
SK4R90N	$K_{4R,\beta_m} = 90$	Roll gain at $\beta_m = 90$	10.0	deg/sec/in
SK5RON	$K_{5R,\beta_m} = 0$	Roll gain at $\beta_m = 0$	TBD	in/deg
SK5R90N	$K_{5R,\beta_m} = 90$	Roll gain at $\beta_m = 90$	TBD	in/deg
SK6RON	$K_{6R,\beta_m} = 0$	Roll gain at $\beta_m = 0$	TBD	deg/in
SK6R90N	$K_{6R,\beta_m} = 90$	Roll gain at $\beta_m = 90$	TBD	deg/in
SK7RON	$K_{7R,\beta_m} = 0$	Roll gain at $\beta_m = 0$	0.135	in/deg/sec
SK7R90N	$K_{7R,\beta_m} = 90$	Roll gain at $\beta_m = 90$	0.135	in/deg/sec
Modified Pitch SCAS				
ST1PN	τ_{1P}	Pitch time constant	0.3	sec
ST2PN	τ_{2P}	Pitch time constant	3.15	sec
STQPN	τ_q	Pitch time constant	0.4	sec
SK1PON	$K_{1P,\beta_m} = 0$	Pitch gain at $\beta_m = 0$	0.6	in/in
SK1P90N	$K_{1P,\beta_m} = 90$	Pitch gain at $\beta_m = 90$	-1.0	in/in
SK2PON	$K_{2P,\beta_m} = 0$	Pitch gain at $\beta_m = 0$	1.04	in/deg/sec
SK2P90N	$K_{2P,\beta_m} = 90$	Pitch gain at $\beta_m = 90$	0.48	in/deg/sec
SK3PON	$K_{3P,\beta_m} = 0$	Pitch gain at $\beta_m = 0$	0.107	in/deg/sec
SK3P90N	$K_{3P,\beta_m} = 90$	Pitch gain at $\beta_m = 90$	0.107	in/deg/sec

SUBSYSTEM NO. 20—SCAS GROUP (Concluded)

Sigma 8 Name	Equation Name	Description	Value	Units
Modified Pitch SCAS (Concluded)				
SK4PON	$K_{4P,\beta_m} = 0$	Pitch gain at $\beta_m = 0$	-7.5	deg/sec/in
SK4P90N	$K_{4P,\beta_m} = 90$	Pitch gain at $\beta_m = 90$	-7.5	in/deg/sec
SK5PON	$K_{5P,\beta_m} = 0$	Pitch gain at $\beta_m = 0$	TBD	in/deg
SK5P90N	$K_{5P,\beta_m} = 90$	Pitch gain at $\beta_m = 90$	TBD	in/deg
SK6PON	$K_{6P,\beta_m} = 0$	Pitch gain at $\beta_m = 0$	TBD	deg/in
SK6P90N	$K_{6P,\beta_m} = 90$	Pitch gain at $\beta_m = 90$	TBD	deg/in
SK7PON	$K_{7P,\beta_m} = 0$	Pitch gain at $\beta_m = 0$	0.133	in/deg/sec
SK7P90N	$K_{7P,\beta_m} = 90$	Pitch gain at $\beta_m = 90$	0.1	in/deg/sec
Modified Yaw SCAS				
ST1YN	τ_{1Y}	Yaw time constant	2.7	sec
ST2YN	τ_{2Y}	Yaw time constant	2.7	sec
SK1YON	$K_{1Y,\beta_m} = 0$	Yaw gain at $\beta_m = 0$	2.94	in/in
SK1Y90N	$K_{1Y,\beta_m} = 90$	Yaw gain at $\beta_m = 90$	0.0	in/in
SK2YON	$K_{2Y,\beta_m} = 0$	Yaw gain at $\beta_m = 0$	0.125	in/deg/sec
SK2Y90N	$K_{2Y,\beta_m} = 90$	Yaw gain at $\beta_m = 90$	0.026	in/deg/sec

FLIGHT CONFIGURATION GROUP

***** Most of the following variables are user input variables *****

Sigma 8 Name	Equation Name	Description	Value	Units
WAITIC	GW	A/C gross weight	13000.0	lb
SLCGBO	$SL_{CG}\|_{\beta_m=0}$	A/C c.g. S.L. at $\beta_m = 0$	300.0	in
BLCG	BL_{CG}	A/C c.g. B.L. at $\beta_m = 0$	0.0	in
WLCGBO	$WL_{CG}\|_{\beta_m=0}$	A/C c.g. W.L. at $\beta_m = 0$	81.65	in

IGHT CONFIGURATION GROUP (Concluded)

Sigma 8 Name	Equation Name	Description	Value	Units
XIXXBO	$I_{XX}\|_{\beta_m=0}$	A/C roll inertia at $\beta_m = 0$	48668.0	slug-ft^2
XIYYBO	$I_{YY}\|_{\beta_m=0}$	A/C pitch inertia at $\beta_m = 0$	17907.0	slug-ft^2
XIZZBO	$I_{ZZ}\|_{\beta_m=0}$	A/C yaw inertia at $\beta_m = 0$	60254.0	slug-ft^2
XIXZBO	$I_{XZ}\|_{\beta_m=0}$	A/C cross inertia at $\beta_m = 0$	1234.0	slug-ft^2
XKI1	K_{I1}	Constant in IXX equation	20.5	1/deg
XKI2	K_{I2}	Constant in IYY equation	11.24	1/deg
XKI3	K_{I3}	Constant in IZZ equation	9.26	1/deg
XKI4	K_{I4}	Constant in IXZ equation	1.76	1/deg
DCXTRM	X_{LN}	Longitudinal stick position	4.8	in
DWXTRM	X_{LT}	Lateral stick position	4.8	in
DPXTRM	X_{PD}	Pedal position input	2.5	in
COLSTK	X_{COL}	Collective stick position	6.96	in
BETMIC	β_m	Initial mast angle	0.0	deg
IPIC	$\Omega_{R,L}$	Center rotor RPM	589.0	RPM
VEQIC	U	Velocity along X-gnd axis	200.0	kts
VEQIC	V	Velocity along Y-gnd axis	0.0	kts
VEQIC	W	Velocity along Z-gnd axis	0.0	kts
PHIIC	ϕ	Euler roll angle	0.0	deg
THETIC	θ	Euler pitch angle	-3.0	deg
PSIIC	ψ	Euler yaw angle	0.0	deg
PBIC	p	A/C roll rate (X-body)	0.0	deg/sec
QBIC	q	A/C pitch rate (Y-body)	0.0	deg/sec
RBIC	r	A/C yaw rate (Z-body)	0.0	deg/sec
HIC	h	A/C position ground axis Z	5000.0	ft
VNW	U_W	Velocity of air mass	0.0	ft/sec
VEW	V_W	Velocity of air mass	0.0	ft/sec
VDW	W_W	Velocity of air mass	0.0	ft/sec
GAMVIC	--	Rate of descent (+ down)	0.0	ft/min
XIFLAP	X_{FL}	Flaps switch setting	1	-ND-
IWEELC	X_{LG}	Landing gear selector SW.	0	-ND-
RR	--	1=SCAS ON, 0=SCAS OFF	1	-ND-
NSYS	--	Governor engaged	1	-ND-

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16. Abstract

This report provides documentation for use with the VAX 11/780 version of the Generic Tilt-Rotor Simulation (GTRSIM) program. Volume I, the user's guide, provides a reference to enable the reader to (a) understand the capabilities of the GTRSIM program, (b) assemble an input data deck, and (c) understand the program output following execution of the program. Volume II, the programmer's guide, provides a reference for operating and modifying the GTRSIM program. Detailed structural information is provided for the purpose of describing the order of execution of program subroutines. The tilt-rotor mathematical model, which has been programmed as GTRSIM, is described in NASA CR-166536, which is entitled "A Mathematical Model for Real Time Flight Simulation of a Generic Tilt-Rotor Aircraft."

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1. GENERAL DESCRIPTION

1.1 PURPOSE OF THE PROGRAMMER'S MANUAL

The Programmer's Manual provides a reference for operating and modifying the computer program, GTRSIM. The mathematical model for this program is described in Ref. 1, and the user's guide is presented in Ref. 2. Details concerning the program structure are included in the Programmer's Manual in order to provide an understanding of present program operation.

1.2 PROGRAM HISTORY

In 1973, Bell Helicopter Textron (BHT) developed a computer program to evaluate the mathematical model of a tilt-rotor aircraft under NASA Contract NAS2-6599 and documented this model in Ref. 3; refinements resulted in a second version, called IFHB76, in 1976. In 1980, under NASA Contract NAS2-10349, BHT made minor corrections, and documentary comments were added to Program IFHB76. The program was renamed IFHC80, and Refs. 4 and 5 were provided as draft user's and programmer's guides, respectively. Systems Technology, Inc., (STI), under NASA Contract NAS2-11317 in 1982-83, developed Program GTRSIM from Program IFHC80 by making minor corrections and additions to the mathematical model, changing input/output formats, and extensively altering the manner in which the aerodynamic tables are incorporated into the program. Further program mathematical model development and correlation conducted between 1983 and 1987 have resulted in Revision A to this document.

1.3 OPERATING ENVIRONMENT

Program GTRSIM is available at NASA Ames Research Center (ARC) and is installed on an ARC VAX 11/785 computer (any model of VAX installation is supported). Due to the changes incorporated into this program, the use

of FORTRAN 77 and VAX-11 file handling is required; thus, for this program to be compatible with any other computer, modifications to the file handling routines may be required.

Program GTRSIM has been maintained with the VAX FORTRAN compiler. The entire program can be loaded to main memory without overlay structure.

1.4 PROGRAM SOURCE

The FORTRAN program source code is supplied to NASA ARC and installed on the VAX 11/785. The program files, Common blocks, and data table files, are listed in Table 1-1. A brief description of the contents of these files is also provided in Table 1-1.

1.5 ACKNOWLEDGEMENTS

STI would like to acknowledge the help of Messrs. M. Landry and M. Schramm of BHT. Their excellent job in preparation of the IFHC80 user's and programmer's guides (Refs. 4 and 5) simplified the job of preparing this document considerably.

1.6 REFERENCES

1. Ferguson, Samuel W., A Mathematical Model for Real Time Flight Simulation of a Generic Tilt Rotor Aircraft, NASA CR-166536, October 1983, September 1988, Rev. A (Final).

2. Hanson, Gregory D., and Samuel W. Ferguson, Generic Tilt-Rotor Simulation (GTRSIM) User's and Programmer's Guide. Volume 1: User's Guide, NASA CR-166535, October 1983, September 1988, Rev. A (Final).

3. Harendra, P. B., M. M. Joglekar, T. M. Gaffey, and R. L. Marr, V/STOL Tilt Rotor Study. Volume 5: A Mathematical Model for Real Time Flight Simulation of the Bell Model 301 Tilt Rotor Research Aircraft, NASA CR-114614, April 1973.

TABLE 1-1. CONTENTS OF SOURCE FILES

File	Description
*.FOR	Source card images for the main program and subroutines specifically for the VAX 11/785.
DATBUF.CMM	Include Common file containing aerodynamic table data storage arrays
SIMIN.CMM	Include Common file containing labeled Common blocks for SIMINIT.FOR (program initialization subroutine)
IFHB.CMM	Include Common file containing labeled common blocks for IFHB40.FOR (program data read subroutine)
SSNAME.CMM	Include Common file containing aerodynamic table file names, description, and directories
"OTHER"*.CMM	Include Common files used by recently added subroutines (Rev. A) that are included at compilation time
*.TAB	The 306 aerodynamic tables used by Program GTRSIM
GTRUN.COM	Job control language file used to execute GTRSIM
GTREX.DAT	Sample set of input data for GTRSIM
GTRSIM.DOC	Card images for an input user's guide (online user's guide)
FORTLI.COM	FORTRAN compiling, linking, and library updating job control file for maintaining GTRSIM
GTRMAIN.OBJ	Object code for the mainline program that is linked with GTRLIB.OLB
GTRLIB.OLB	Object code library of the FORTRAN 77 subroutines

4. Schramm, M., and L. M. Landry, Jr., IFHC80 XV-15 Tilt Rotor Simulation Users' Manual, Bell Helicopter Co. (Draft) Report prepared under Contract NAS2-10349.

5. Schramm, M., and L. M. Landry, Jr., IFHC80 XV-15 Tilt Rotor Simulation Programmer's Manual, Bell Helicopter Co. (Draft) Report prepared under Contract NAS2-10349.

2. SYSTEM DESCRIPTION

2.1 GENERAL DESCRIPTION OF SIMULATION

As currently installed on the VAX 11/785, the Tilt-Rotor Simulation Program GTRSIM represents the major subsystems of the Tilt-Rotor Research Vehicle including the following modules:

1. Two distinct rotors represented by algebraic equations.
2. Aerodynamic tables and equations for each component of the airframe (fuselage, wing, pylon, horizontal and vertical stabilizers, control surfaces, and wake effects).
3. The entire control system, including phasing and mixing.
4. The engine, drive system, and controls.
5. Rotor collective governor.
6. Stability and control augmentation system (SCAS)
7. Landing gear aerodynamics.

The basic input data deck for Program GTRSIM consists of between 80 and 100 card images that are stored on disk (usually to be run with the command file GTRUN.COM). The input data deck allows the user to specify most aircraft variables and the aerodynamic data table file locations. Input data switch options permit varying degrees of stability analyses and amounts of printout.

Following the basic input data deck are run-type option cards. Program GTRSIM has six run-type options listed in Table 2-1. The DTPT, MANU, and TUNL options are designed for checkout and diagnostics. Trims are performed with TRMS, and maneuvers are done with MANS and MANU (for most applications, the user should always use the MANS option). The END option is used to terminate a run. Figure 2-1 presents the program functional flow for the run-type options.

Maneuver options in the program provide a capability for pure pulse inputs, time history input of control position, or a sum-of-sines driven control input on any four of the main controls for a user specified length of time. The aircraft flies rotor free for one second, fuselage and rotor free for another second, followed by stick inputs for the specified run length. The run is completed at any chosen time (up to 120.0 seconds), and data can be printed out in several formats at any time increment desired. The 120.0 second time limit can easily be increased by a FORTRAN code modification in Subroutine IFHB43 if the user requires an extremely long run time.

2.2 DETAILED DESCRIPTION

2.2.1 Labeled Common Description

As programmed at NASA ARC, some labeled Common blocks are maintained in external files, and an "INCLUDE" feature inserts appropriate Commons in specified subroutines in the source code at compilation time. The external files containing the majority of labeled Common blocks are SIMIN.CMM, IFHB.CMM, SSNAME.CMM, and DATBUF.CMM. With development of Revision A, other .CMM files are also included with the program. At the present time, these files are mostly related to the SCAS implementation. (The long-term goal for the program's development is to move all commons out of the program and into .CMM files to simplify programming changes.)

IFHB.CMM and SIMIN.CMM contain the labeled Common blocks used in Subroutines IFHB40 and SIMINIT, respectively. SSNAME.CMM contains the labeled Common blocks for the data table file names, descriptions, and directories. DATBUF.CMM contains the data table arrays which are referenced from within the program to obtain the input aerodynamic data tables.

In general, the name used for a Common is indicative of its contents. A description of the Commons is provided in Table 2-2.

TABLE 2-1. GTRSIM EXECUTION OPTIONS

Run Type	Description
DTPT (data point)	Data point fixes the airframe in space according to a set of initial input conditions while the rotor thrust/induced velocity loop is closed.
TRMS (trim sweep)	Trim sweep of any two of eleven flight variables
MANS (maneuver)	Trim followed by a maneuver.
MANU (maneuver)	Executes a maneuver without first trimming.
TUNL (tunnel)	Tabulation of airframe forces and moments versus angle of attack and sideslip.
END (end of run)	End of execution.

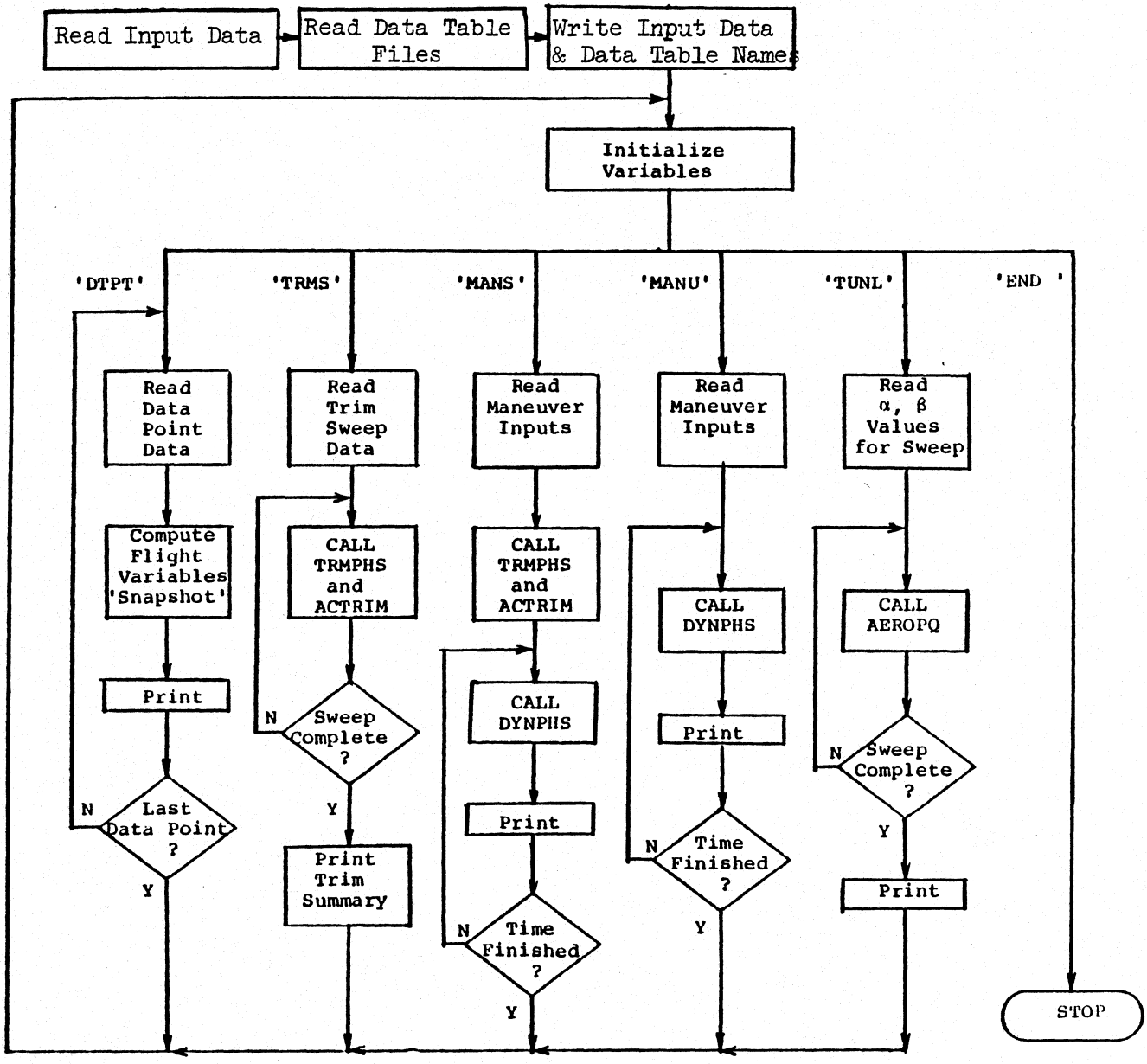

Figure 2-1. Program functional flow.

TABLE 2-2. LABELED COMMON DESCRIPTION

Common	Description
ABC	Matrices for ALLMAT
CDCLØM	Drag coefficient at zero lift (used in WING1)
CLWDLF	$C_{L_{\delta_A}}$ and δ_F (used in AEROPQ)
CMPLXH	Matrix for ALLMAT
COMARO	Aerodynamic force and moment summation data
COMFUS	Subsystem 3 (fuselage) inputs
COMHSB	Subsystem 5 (horizontal stabilizer) inputs
COMLGR	Subsystem 7 (landing gear) inputs
COMMOM	Subsystem 14 (IGE moment) inputs
COMVSB	Subsystem 6 (vertical stabilizer) inputs
COMWKE	Subsystem 1 (rotor wake) inputs
COMWNG	Subsystem 4 (wing-pylong) inputs
CONFLC	Initialization data
CONTLC	Initialization and limiting constants (not used)
CPUTIM	Time and date inputs
CTFORC	Force feel data
DECMAL	Decimal data constants
DEV	Degrees of freedom retained
DIFROT	Mast axes velocities
DRIVST	Subsystems 17, 18, and 19 (power management) inputs
DYNAM	Time and date data
ENVOUT	Environmental data
EXLK	Matrix print data
FANDM	Force and moment data
FLAGS	Diagnostic switches and title information
FREQDA	Arrays used in the sum-of-sines control input option
FUELST	Engine and power turbine terms
FUSDYN	SV and SVD state vectors
FUSIPT	Body axis forces and moments and inertia shifts
GSTDAT	Gust data
HANCON	Torque saved in HANDLE
INDVEL	Induced velocity data
IO	Input/output device numbers
JETTHR	Jet thrust related forces and moments
MANDAT	Maneuver data
MASTER	Start control variable
MIXCON	Subsystem 8 (control system) inputs

TABLE 2-2 (Concluded)

Common	Description
MIXIN	Flight configuration group inputs
MIXOUT	Control system variables
PARTS	Parts of matrices solved for stability roots
PASTV	Saved past values for Subsystem 18
PCØP	Partial of wing C_L with respect to angle of attack
PHYSCN	Physical constants
PROSYS	Engine variables
ROTCON	Subsystem 1 (rotor) inputs
ROTOUT	Rotor outputs
SCASLC	SCAS limits
SCASSW	Subsystem 20 SCAS switches
SCSCOM	Data for root locus plot
SCSCON	Subsystem 20 (SCAS) inputs
SCSOUT	SCAS outputs
SCSPCH	Subsystem 20 pitch SCAS inputs
SCSROL	Subsystem 20 roll SCAS inputs
SCSYAW	Subsystem 20 yaw SCAS inputs
SHFTIN	Flight configuration group inputs
SHIFTS	Shifted c.g.'s and inertias
SMODES	Stability mode data
SOMEGA	RPM DOF derivatives for stability analysis
STATLC	Rotor blade constants
SWITCH	Switch variables
SWPCOM	Sweep variables
SYSCHR	Input data table array identification
SYSINT	Input data table array printout formatting parameters
SYST19	RPM variables
TAB	Tab character
TABBUFFER	Aerodynamic table arrays
TABCON	Sweep variables
TABVAL	Table partials
TIPSPD	Tip speed variables
TRIMAT	Trim matrix
TURNS	Coordinated turn data
WAKE1	Wake variables
WHISTL	Print switches for maximum limits
WINGS	Subsystem 4 (wing-pylon) inputs

2.2.2 Subroutine Description

Subroutines are written in FORTRAN 77 and use VAX VMS time and date routines. A subroutine functional flow chart is given in Fig. 2-2. An individual description of each subroutine is presented in Tables 2-3 through 2-69. Flow charts follow subroutine descriptions for major subroutines.

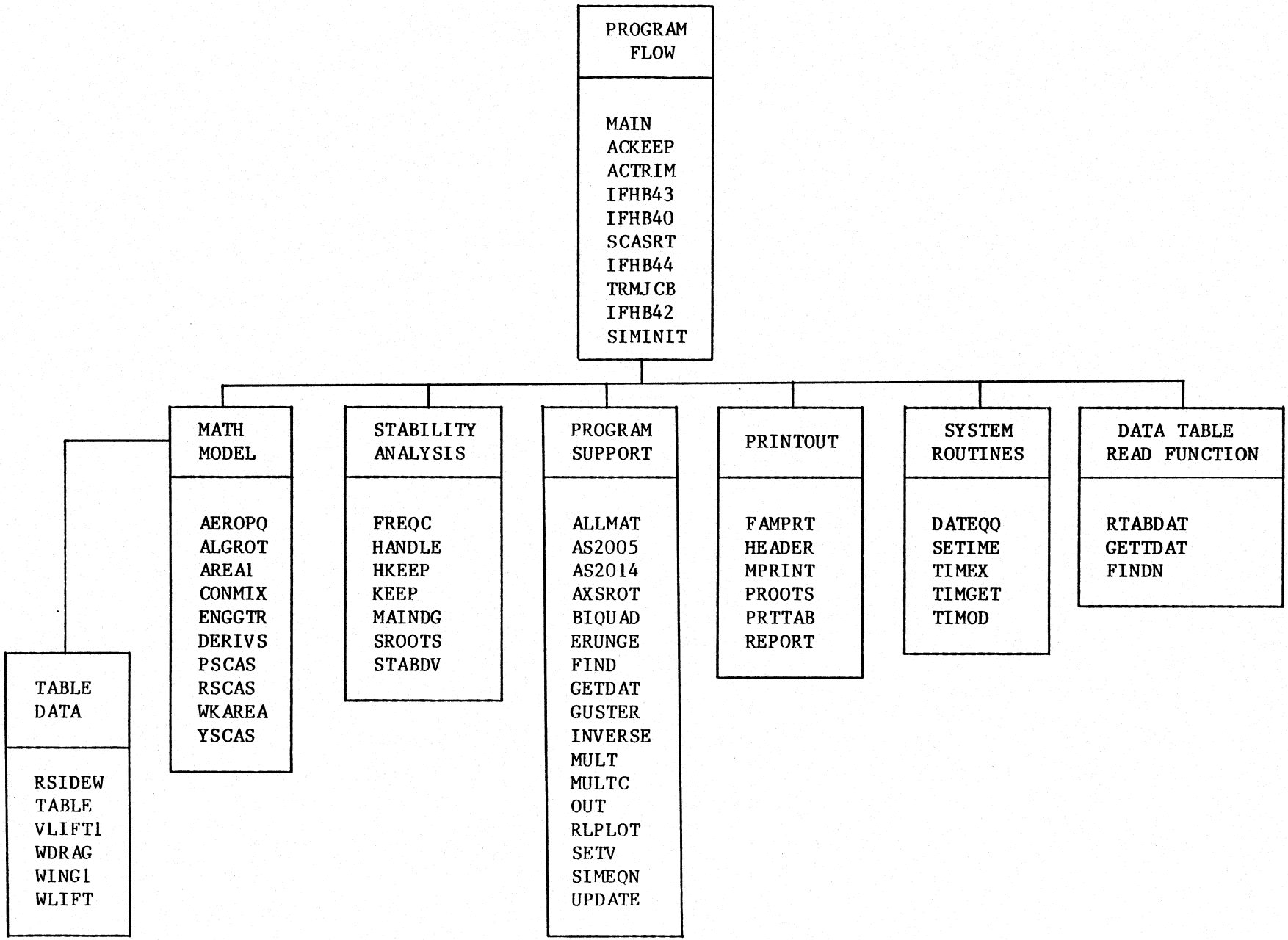

Figure 2-2. Subroutine Functional Flow Chart

TABLE 2-3. DESCRIPTION OF SUBROUTINE ACKEEP

CALLING SEQUENCE:

CALL ACKEEP(A)

FUNCTIONS:

Is used by ACTRIM and TRMJCB to compute and return a column of the derivative matrix

INPUTS:

Data from Common

OUTPUTS:

A(1) - X ground acceleration (ft/sec^2)
A(2) - Y ground acceleration (ft/sec^2)
A(3) - Z ground acceleration (ft/sec^2)
A(4) - roll acceleration (rad/sec^2)
A(5) - pitch acceleration (rad/sec^2)
A(6) - yaw acceleration (rad/sec^2)

CALLED BY:

ACTRIM, IFHB42(TRMPHS), TRMJCB

CALLS:

AEROPQ, ALGROT, CONMIX, DERIVS

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Uses SVD array from DERIVS

TABLE 2-4. DESCRIPTION OF SUBROUTINE ACTRIM

CALLING SEQUENCE:

CALL ACTRIM(IGUESS)

FUNCTIONS:

Is used to compute the aircraft six-degrees-of-freedom trim

INPUTS:

Initial guesses for stick positions, pitch attitude, and rotor collective governor setting come from data statements

OUTPUTS:

XLN, XLT, XPD, THØLG, ROLL, PITCH, YAW

CALLED BY:

IFHB42(TRMPHS)

CALLS:

ACKEEP, FIND, SIMEQN, TRMJCB

DIAGNOSTIC PRINT OPTIONS:

CHECKS(5) or DGPTSW=1 prints NAMELIST AT

COMMENTS:

The following procedure is used to trim:

Step	Process
1.	Make initial guess on stick positions, aircraft attitudes, and rotor collective governor setting.
2.	Calls ACKEEP which in turn calls CONMIX, ALGROT(4), and AEROPQ. ACKEEP returns a set of six accelerations ($\dot{u}$, $\dot{v}$, $\dot{w}$, $\dot{p}$, $\dot{q}$, and $\dot{r}$).

TABLE 2-4 (Concluded)

Step	Process
3.	Calls TRMJCB to get control and attitude partial derivatives. TRMJCB returns acceleration partials for all stick motions and roll, pitch, and yaw changes.
4.	Call ACKEEP four (4) times and check the resulting accelerations to see if they are within tolerance. "Trim" is defined as: $\dot{u}, \dot{v}, \dot{w} < 0.125$ ft/sec $\dot{p}, \dot{q}, \dot{r} < 0.001$ rad/sec
5.	If accelerations are not within trim tolerances, SIMEQN is called using the partials previously computed, and a set of deltas (Δ's) are found to modify stick positions (XLN, XLT, XPD), collective governor setting, pitch attitude, and roll attitude. The deltas are then limited so that over-corrections are not made when the controls are changed.
6.	The program then goes back to Step 2 for another iteration. This continues for up to one hundred (100) attempts at trim or until the sum of the squares of the six A/C accelerations is not decreasing after twenty iterations.

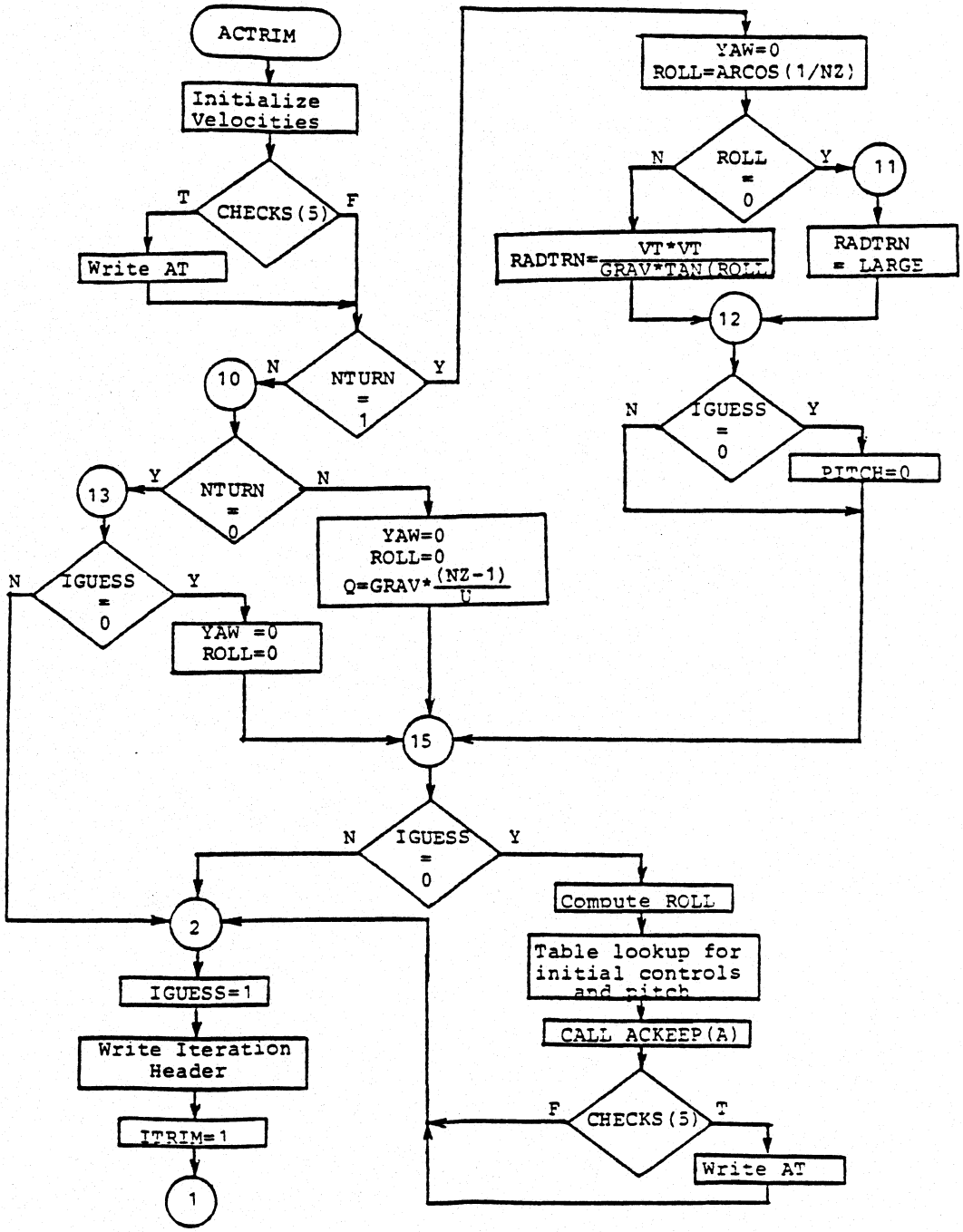

Figure 2-3. Flow Chart of Subroutine ACTRIM

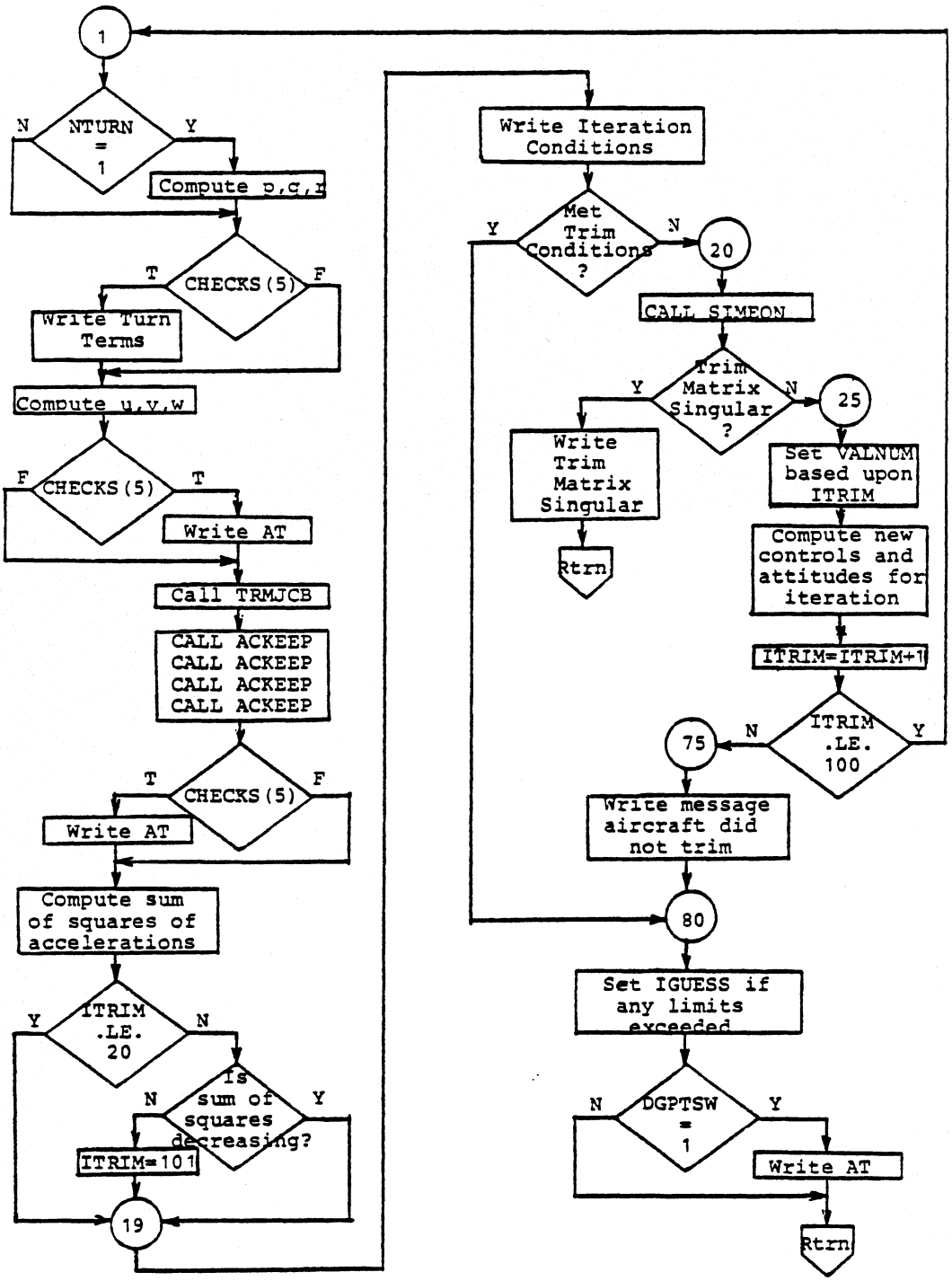

Figure 2-3. Concluded.

TABLE 2-5. DESCRIPTION OF SUBROUTINE AEROPQ

CALLING SEQUENCE:

CALL AEROPQ

FUNCTIONS:

Computes aerodynamic forces and moments for wings, horizontal stabilizer, vertical stabilizers, landing gear (when extended), and jet thrust

INPUTS:

U, V, W, P, Q, R (state variables)
Rudder, elevator, aileron angles (from neutral positions)
Wake data (from WKAREA subroutine)

OUTPUTS:

XAERO, YAERO, ZAERO (forces in body axis)
LAERO, MAERO, NAERO (moments in body axis)

CALLED BY:

ACKEEP, HKEEP, IFHB42(TRMPHS), IFHB43(DYNPHS), MAIN

CALLS:

AXSROT, FIND, RSIDEW, TABLE, VLIFT1, WDRAG, WING1, WKAREA, WLIFT

DIAGNOSTIC PRINT OPTIONS:

CHECKS(8) gives many prints if PRNTSW is TRUE.

COMMENTS:

Uses "TABLE" function subroutines for aerodynamic data, and is called after CONMIX, ALGROT

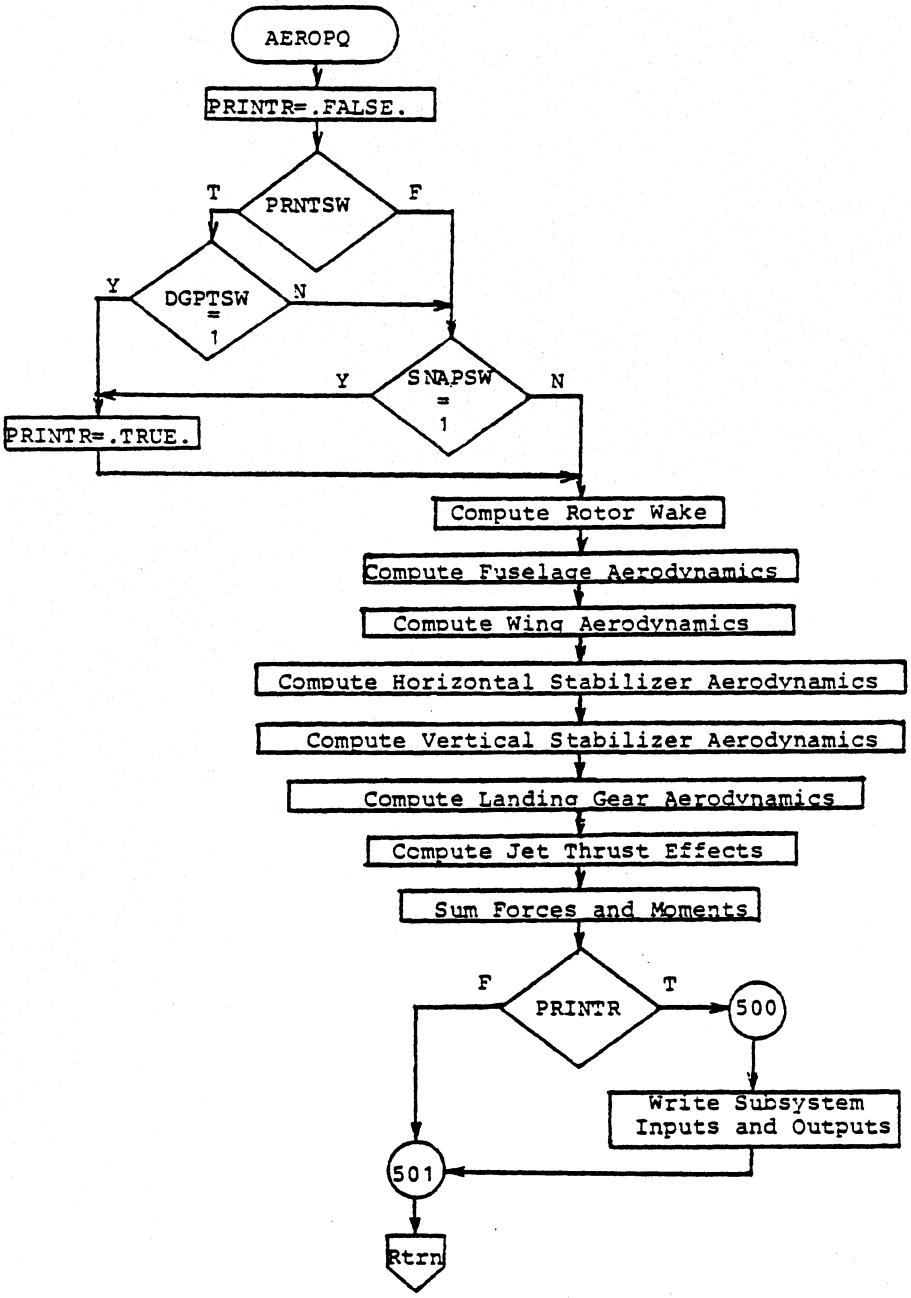

Figure 2-4. Flow chart of subroutine AEROPQ

TABLE 2-6. DESCRIPTION OF SUBROUTINE ALGROT

CALLING SEQUENCE:

CALL ALGROT

FUNCTIONS:

Computes rotor forces and moments, flapping, coning, induced velocity, H-force, Y-force, and thrust

INPUTS:

A_1, B_1, collective pitch on blades, collective governor setting, rotor RPM, mast angle, U, V, W, P, Q, R, air density, Mach number

OUTPUTS:

XROT, YROT, ZROT (forces in body axis)

LROT, MROT, NROT (moments in body axis)

F/A flapping, lateral flapping, induced velocity, horsepower and torque required, thrust, H-force, Y-force (a right- and left-rotor value is computed for each variable)

CALLED BY:

ACKEEP, HANDLE, HKEEP, IFHB42(TRMPHS), IFHB43(DYNPHS), KEEP, MAIN, STABDV

CALLS:

FIND

DIAGNOSTIC PRINT OPTIONS:

CHECKS(9) gives diagnostic printout

TABLE 2-6 (Concluded)

COMMENTS:

Has two loops for converging to steady state:

(1) Inner loop--induced velocity (λ); twenty (20) iterations or until values are within tolerance limits (0.1% + 0.0001)

(2) Outer loop--thrust; five (5) iterations or until values are within tolerance limits (0.1%)

- No message printed if inner loop goes to twenty (20) iterations or outer loop goes to five (5) iterations
- No convergence loop for flapping
- Uses average C_L, C_D values over entire blade
- Blade stall done by limiting thrust and printing message on output
- Endurance limit checked and prints message if exceeded
- No flapping limits
- Induced velocity constant over disk
- Has side-by-side rotor effects, tandem rotor effects, and ground effects
- Computation done in wind-axis, then converted to body axis

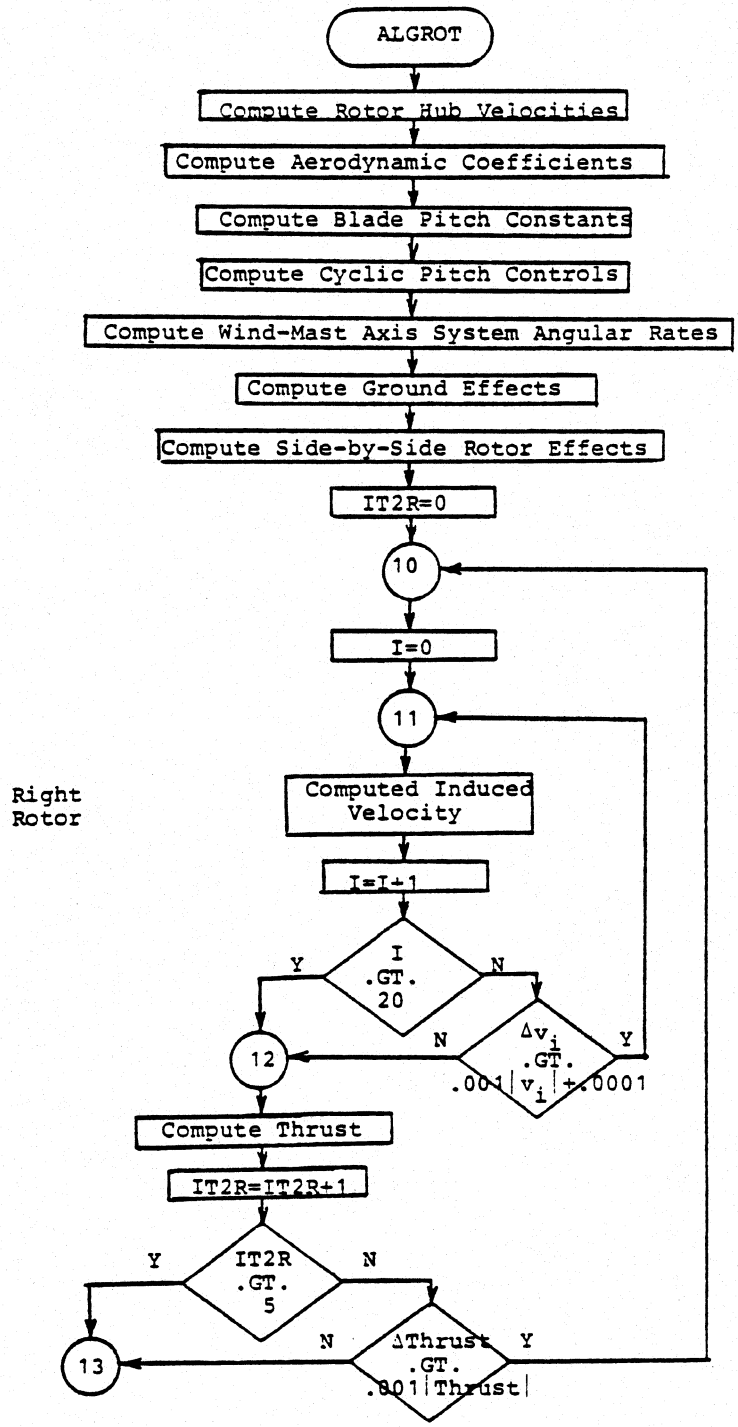

Figure 2-5. Flow chart of subroutine ALGROT.

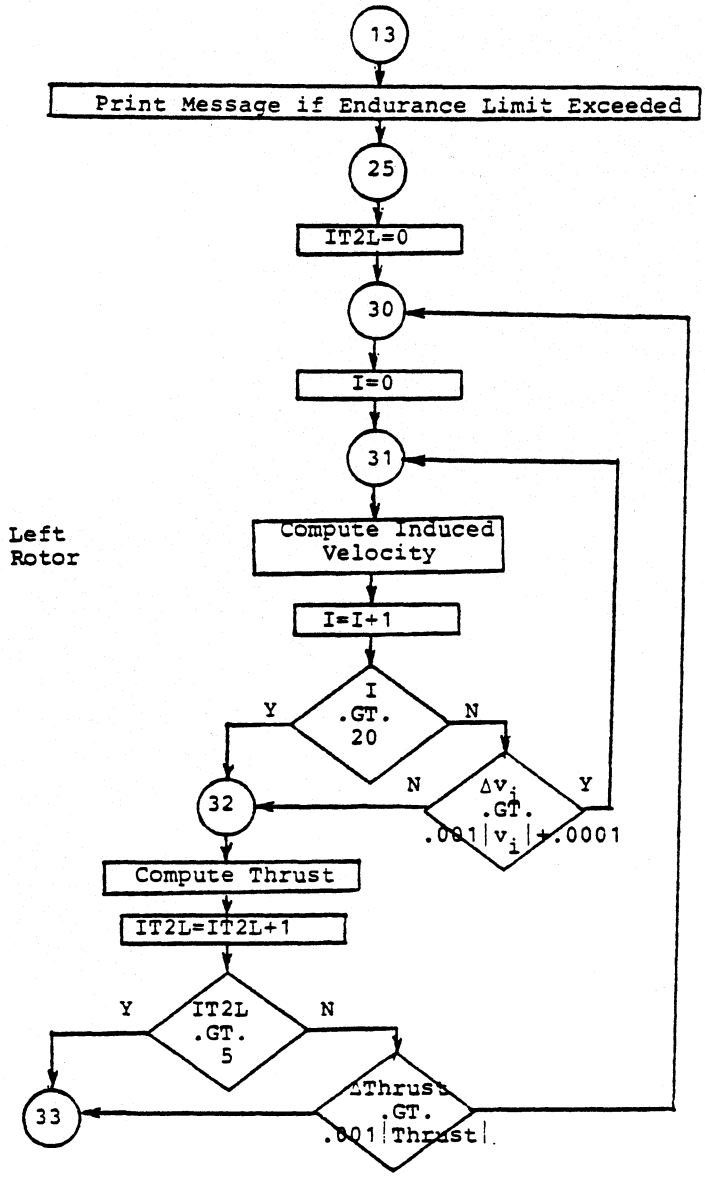

Figure 2-5. Continued.

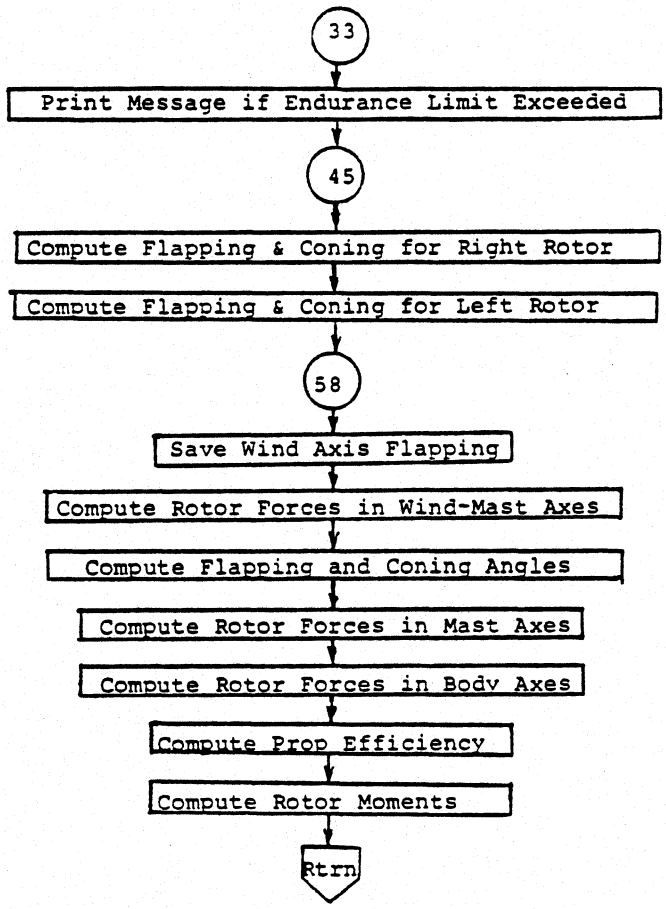

Figure 2-5. Concluded.

TABLE 2-7. DESCRIPTION OF SUBROUTINE ALLMAT

CALLING SEQUENCE:

```
CALL ALLMAT(M,NCAL)
CALL ALLVEC(L)
```

FUNCTIONS:

Gives Eigenvalues and Eigenvectors of a complex matrix

INPUTS:

M - order of matrix
L - index of matrix

OUTPUTS:

NCAL--number of Eigenvalues returned

CALLED BY:

MAINDG, OUT

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

General routine

TABLE 2-8. DESCRIPTION OF SUBROUTINE AREA1

CALLING SEQUENCE:

```
CALL AREA1(X1,X2)
CALL AERA2(X1,X2)
```

FUNCTIONS:

Computes wing area affected by wake of rotor

INPUTS:

X1
X2

OUTPUTS:

SIW
XA
YA

CALLED BY:

WKAREA

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Includes equations for subsystem 4

TABLE 2-9. DESCRIPTION OF SUBROUTINE AS2ØØ5

CALLING SEQUENCE:

CALL AS2ØØ5(A,B,C,H,K,NORD)

FUNCTIONS:

Matrix expansion routine

INPUTS:

A,B,C,H - input matrices
K - index of array

OUTPUTS:

H - output matrix
NORD - return code

CALLED BY:

SROOTS

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Used in IFHB44(STBPHS)--double precision

TABLE 2-10. DESCRIPTION OF SUBROUTINE AS2Ø14

CALLING SEQUENCE:

CALL AS2Ø14(FH,FXR,FXI,FM,LL)

FUNCTIONS:

Sets up for BIQUAD which extracts the roots

INPUTS:

FH - real*8 data array
LL - index of array

OUTPUTS:

FXR - real*8 array of real part of roots
FXI - real*8 array of imaginary part of roots
FM - return code

CALLED BY:

SROOTS

CALLS:

BIQUAD

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Used by IFHB44(STBPHS)--double precision

TABLE 2-11. DESCRIPTION OF SUBROUTINE AXSROT

CALLING SEQUENCE:

CALL AXSROT(VOUT,X,Y,Z,SCARAY)

FUNCTIONS:

Performs coordinate axes rotational transformations

INPUTS:

X,Y,Z - components of the input vector
SCARAY - array of sines and cosines of alpha and beta

OUTPUTS:

VOUT - output transformed vector array of three elements

CALLED BY:

AEROPQ

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

All arguments real*4; the order of sines and cosines is
sin(alpha)
cos(alpha)
sin(beta)
cos(beta)

TABLE 2-12. DESCRIPTION OF SUBROUTINE BIQUAD

CALLING SEQUENCE:

CALL BIQUAD(A,B,C,D,FXR,FXI)

FUNCTIONS:

Computes the roots of a quartic $X^4 + AX^3 + BX^2 + CX + D = 0$

INPUTS:

A - coefficient of third cubic term
B - coefficient of second-order term
C - coefficient of first-order term
D - coefficient of zeroth-order term

OUTPUTS:

FXR - array of real part of roots
FXI - array of imaginary part of roots

CALLED BY:

AS2Ø14

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

General routine--double precision

TABLE 2-13. DESCRIPTION OF SUBROUTINE CONMIX

CALLING SEQUENCE:

CALL CONMIX

FUNCTIONS:

Mixes flight controls given stick and SCAS inputs

INPUTS:

V_T, stick positions, SCAS inputs, mast switch, weights, inertias

OUTPUTS:

A_1, B_1, mast angle, collective governor setting, and elevator, rudder, and aileron positions

CALLED BY:

ACKEEP, HKEEP, IFHB42(TRMPHS), IFHB43(DYNPHS), MAIN, SIMINIT, STABDV

CALLS:

ENGGTR, FIND, PSCAS, RSCAS, YSCAS

DIAGNOSTIC PRINT OPTIONS:

DGPTSW=1 gives general diagnostic print when PRNTSW is TRUE

COMMENTS:

- Computes blade pitch.
- Computes control surface positions
- Computes A_1 and B_1 for rotor inputs
- Computes differential collective with pedal (optional)
- Controls collective pitch governor
- Computes c.g. and inertia shifts with pylon tilt
- Calls engine module

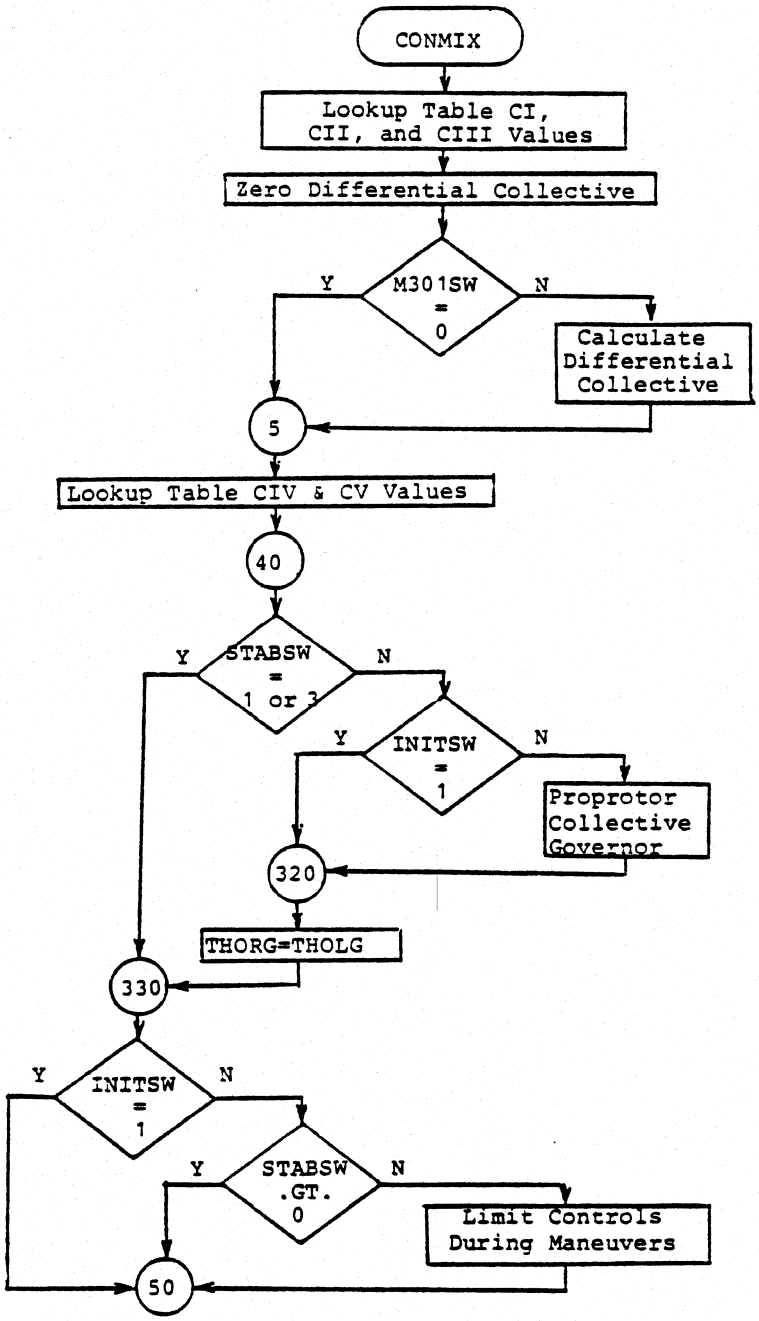

Figure 2-6. Flow chart of subroutine CONMIX.

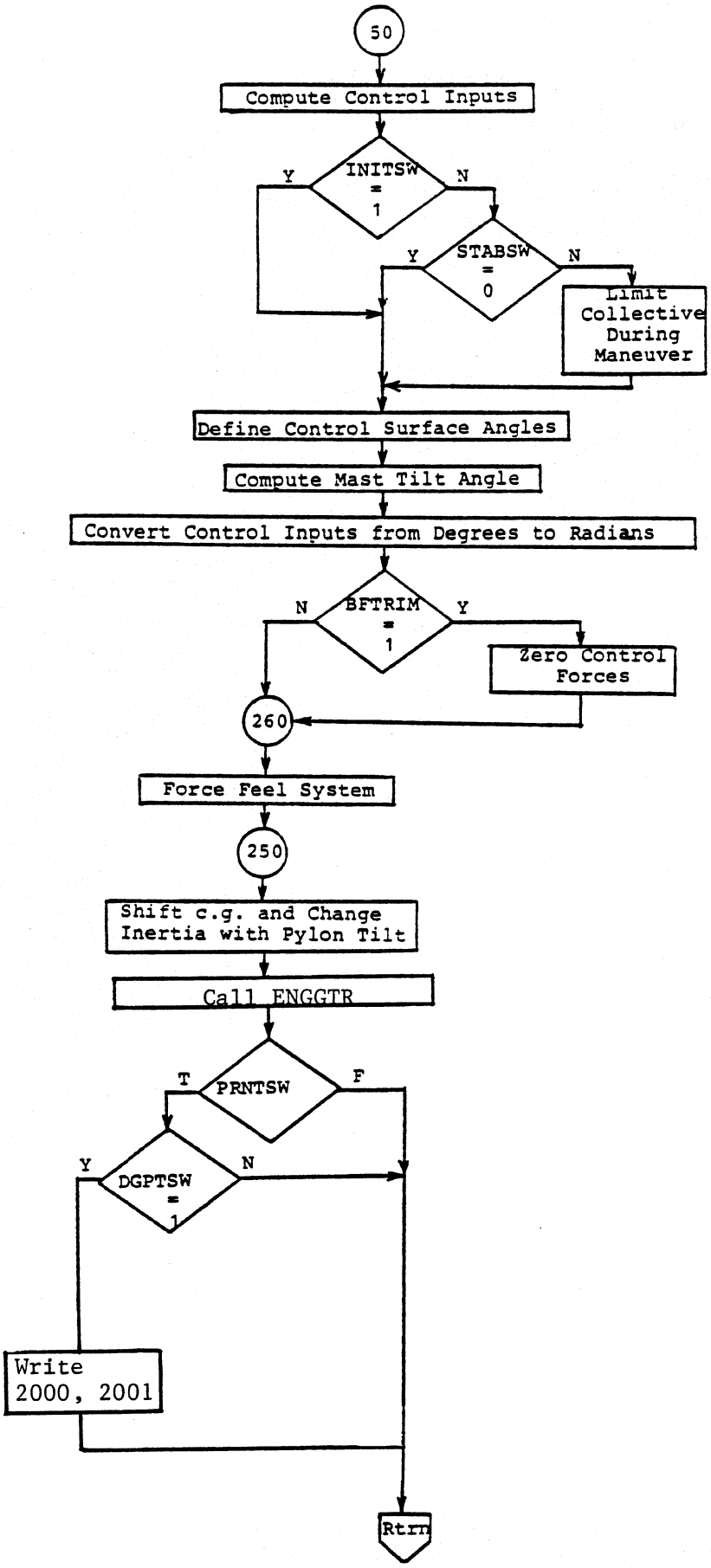

Figure 2-6 (Concluded)

TABLE 2-14. DESCRIPTION OF SUBROUTINE DATEQQ

CALLING SEQUENCE:

CALL DATEQQ(NDATE)

FUNCTIONS:

Gives date

INPUTS:

None

OUTPUTS:

NDATE - logical*1(8) date ddmmm'yy (e.g., 01FEB'83)

CALLED BY:

IFHB40(INIT), MAINDG, SIMINIT

CALLS:

DATE

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Special VAX VMS system routine by BHT

TABLE 2-15. DESCRIPTION OF SUBROUTINE DERIVS

CALLING SEQUENCE:

```
CALL DERIVS(SV,SVD)
```

FUNCTIONS:

Computes the derivative of the fuselage state vector

INPUTS:

SV - STATE VECTOR

```
SV(1) = ETHET, PITCH
SV(2) = EPSI, YAW
SV(3) = EPHI, ROLL
SV(4) = U
SV(5) = V
SV(6) = W
SV(7) = P
SV(8) = Q
SV(9) = R
SV(10) = NORTHG
SV(11) = EASTG
SV(12) = HEIGHT
```

OUTPUTS:

SVD - STATE VECTOR DERIVATIVES

```
SVD(1) = ETHETD
SVD(2) = EPSID
SVD(3) = EPHID
SVD(4) = UDOT
SVD(5) = VDOT
SVD(6) = WDOT
SVD(7) = PDOT
SVD(8) = QDOT
SVD(9) = RDOT
SVD(10) = UGND
SVD(11) = VGND
SVD(12) = WGND
```

TABLE 2-15 (Concluded)

CALLED BY:

ACKEEP, ERUNGE, FAMPRT, IFHB42(TRMPHS), MAIN

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Equations from Subsystems 10c, 12, 11, and 10d

TABLE 2-16. DESCRIPTION OF SUBROUTINE IFHB43(DYNPHS)

CALLING SEQUENCE:

CALL IFHB43

FUNCTIONS:

Dynamic run phase which accepts pulse, time history, and sum-of-sines inputs at 2.0 seconds into run, holds the new input for PTIME (input in seconds) if a pulse only, and runs the maneuver for RTIME (input in seconds) with printed output at PRTDEL (input in seconds)

INPUTS:

Data for maneuver is obtained from MANS or MANU run-type option data cards

OUTPUTS:

Flight conditions at PRTDEL seconds (in both a formal printout and an optional graphics output file format)

CALLED BY:

MAIN

CALLS:

AEROPQ, ALGROT, CONMIX, ERUNGE, FAMPRT, GUSTER, PSCAS, RSCAS, YSCAS

DIAGNOSTIC PRINT OPTIONS:

CHECKS(11) gives diagnostic printout during maneuvers
DGPTSW=1 gives additional printout

COMMENTS:

- Called by MANS and MANU options in MAIN
- PSCAS, RSCAS, and YSCAS are called for initialization purposes

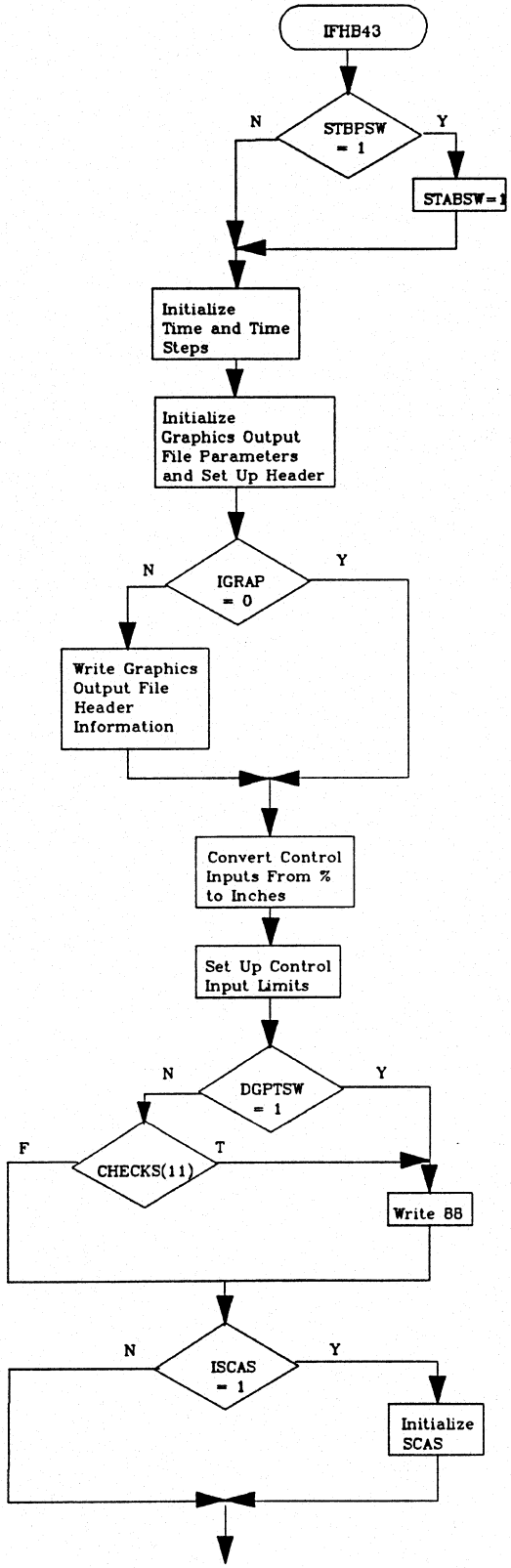

Figure 2-7. Flow Chart of Subroutine IFHB43(DYNPHS)

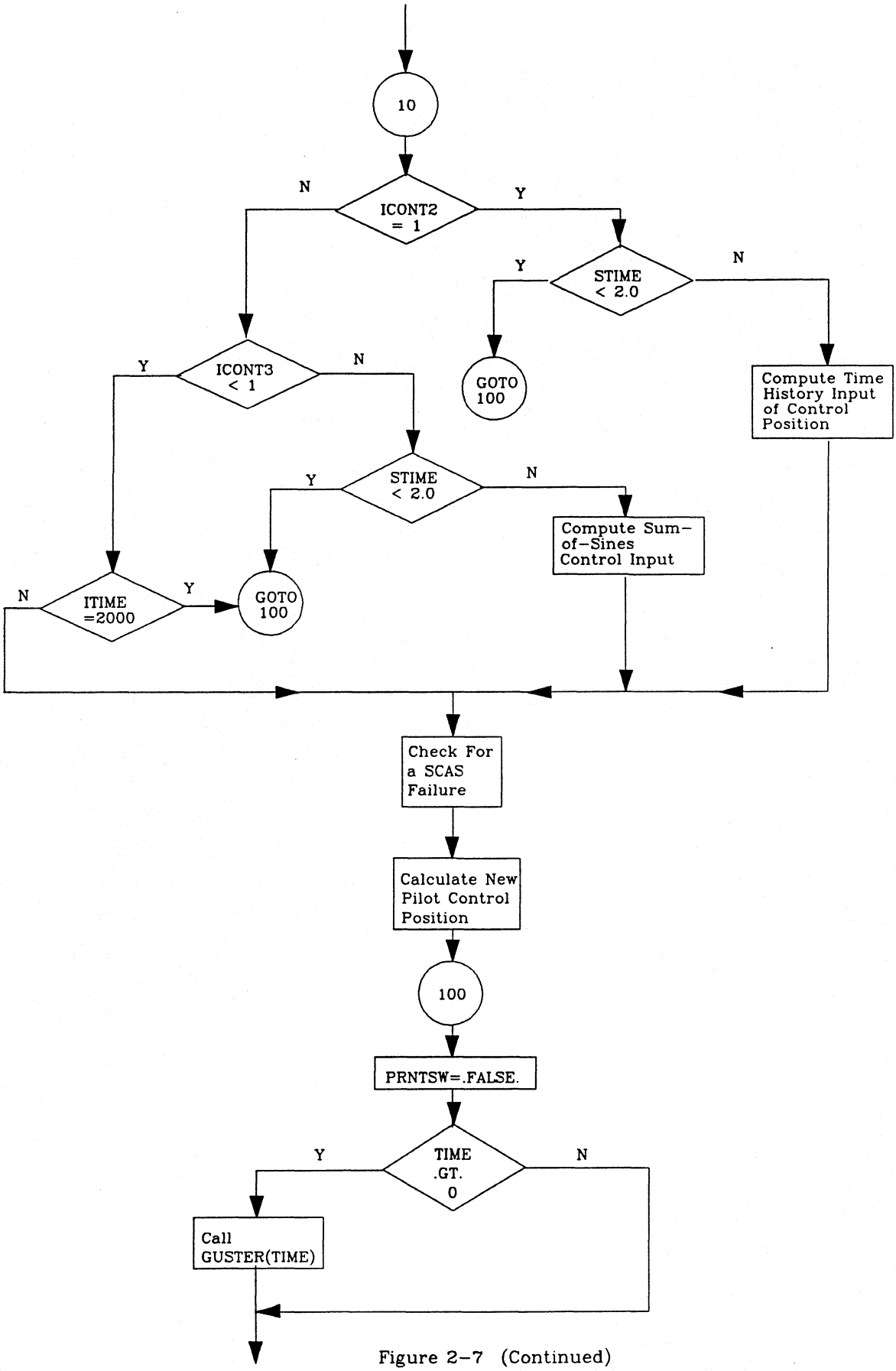

Figure 2-7 (Continued)

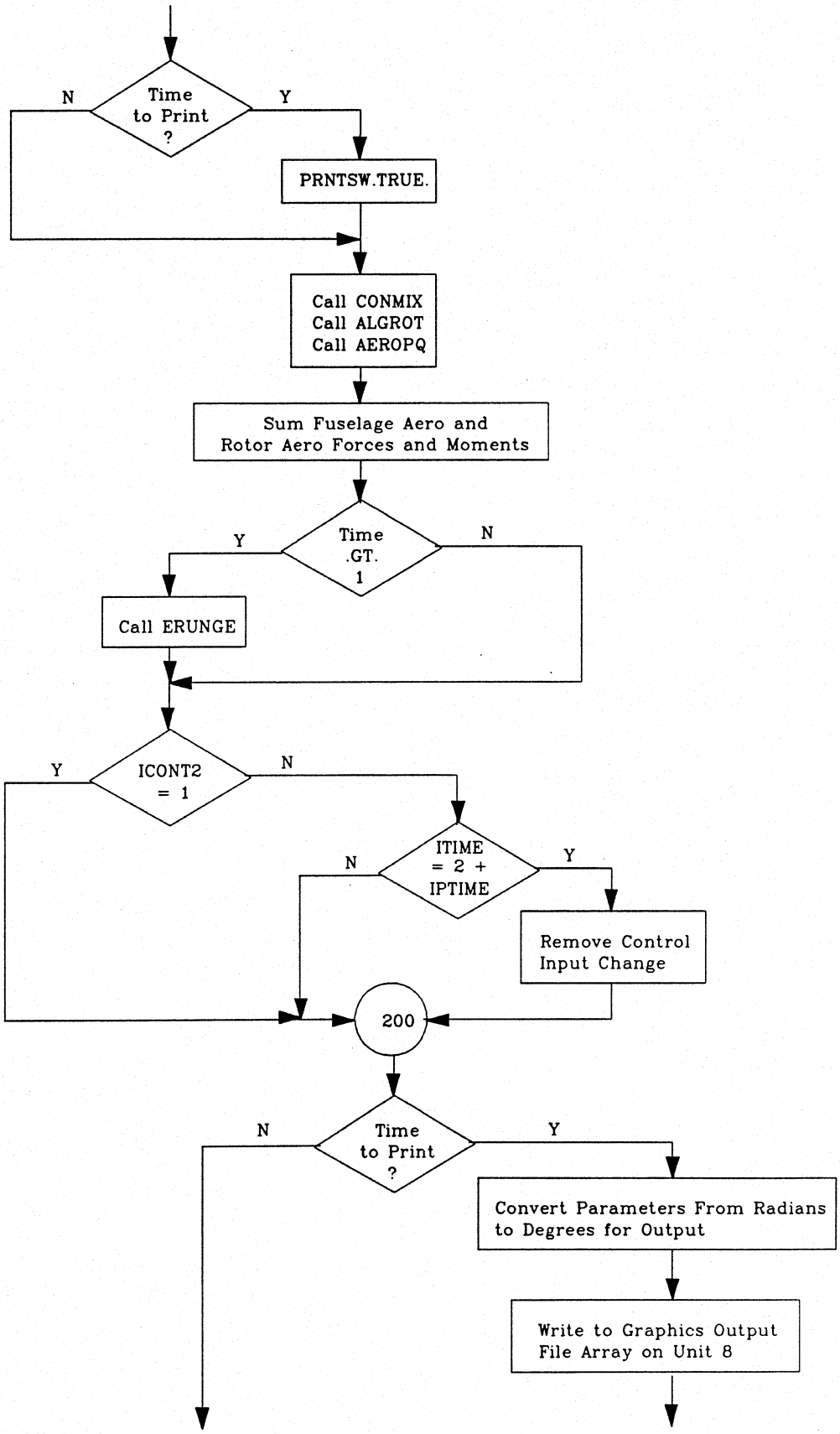

Figure 2-7 (Continued)

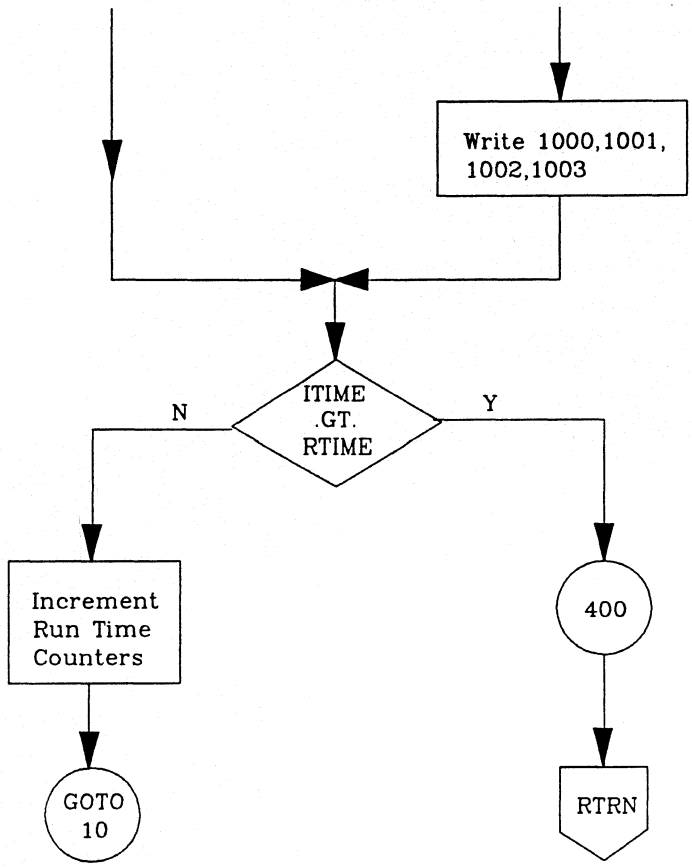

Figure 2-7 (Concluded)

TABLE 2-17. DESCRIPTION OF SUBROUTINE ENGGTR

CALLING SEQUENCE:

CALL ENGGTR

FUNCTIONS:

Calculates inputs for engine controls, engine performance, and all engine and power train dynamics

INPUTS:

V_T, power level (collective) position, atmospheric conditions, engine and drive train inertias, and other engine and power-train related constants

OUTPUTS:

Engine performance, rotor RPM (changes during maneuver), and drive train dynamics

CALLED BY:

CONMIX

CALLS:

FIND

DIAGNOSTIC PRINT OPTIONS:

CHECKS(7) gives horsepower printout
DGPTSW=1 gives general diagnostic print when PRNTSW is true

COMMENTS:

- Computes throttle as a function of collective
- Computes horsepower, torque, and RPM of engine and drive train components
- Computes jet ram recovery coefficient

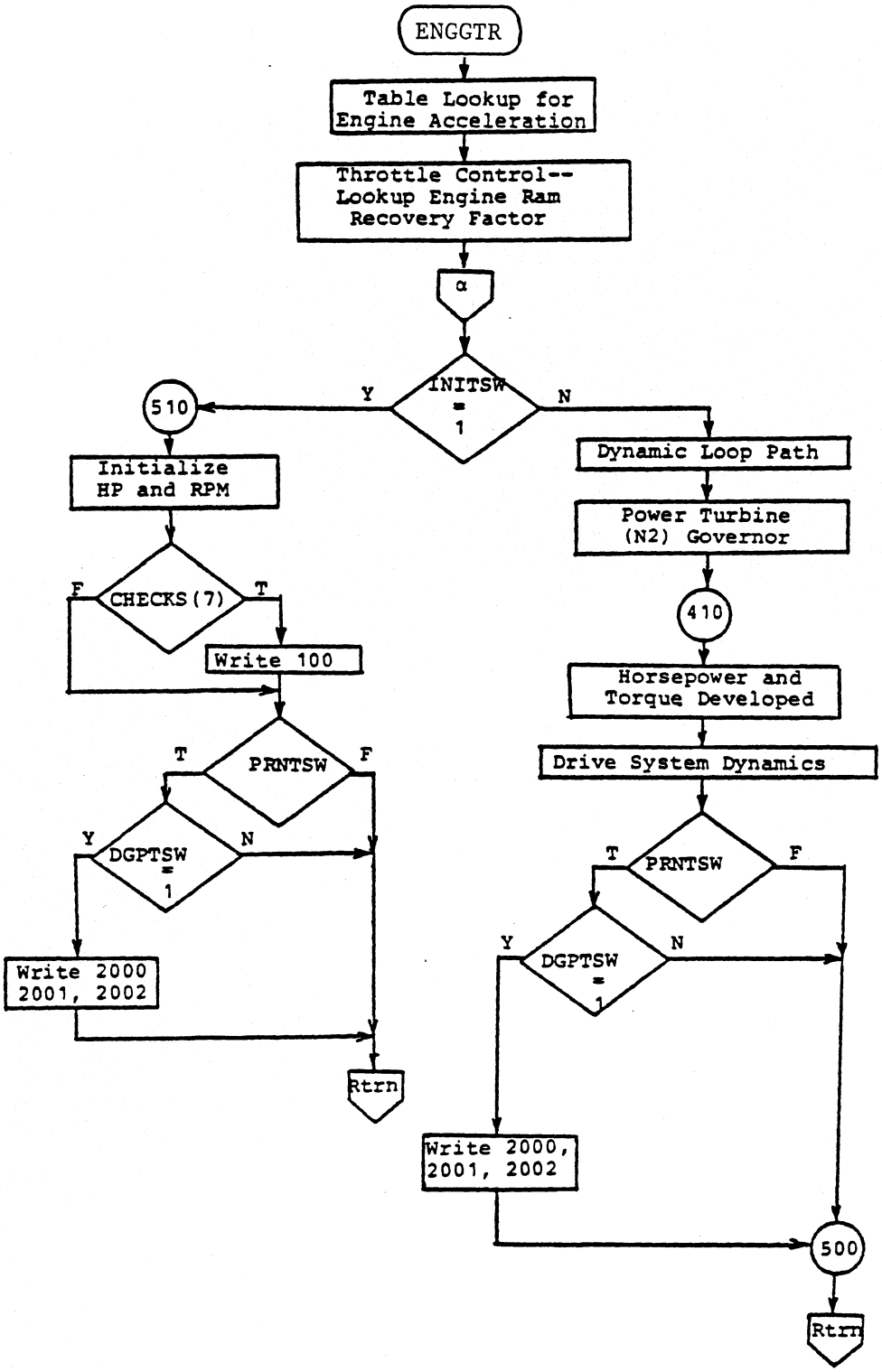

Figure 2-8. Flow Chart of Subroutine ENGGTR

TABLE 2-18. DESCRIPTION OF SUBROUTINE ERUNGE

CALLING SEQUENCE:

CALL ERUNGE(SV,SVDOT,H,NEQNS)

FUNCTIONS:

Integration of fuselage equations using Runge-Kutta (Simpson) order 4

INPUTS:

SVDOT - state vector derivatives
H - time step
NEQNS - number of equations

OUTPUTS:

SV - state vectors

CALLED BY:

IFHB43(DYNPHS)

CALLS:

DERIVS

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

General routine

TABLE 2-19. DESCRIPTION OF SUBROUTINE FAMPRT

CALLING SEQUENCE:

CALL FAMPRT

FUNCTIONS:

Prints force and moment summary

INPUTS:

Variables in Common to be printed

OUTPUTS:

Printout of variables

CALLED BY:

IFHB43(DYNPHS), MAIN

CALLS:

DERIVS, HEADER

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Printout routine

TABLE 2-20. DESCRIPTION OF SUBROUTINE FIND

CALLING SEQUENCE:

```
OUT = FIND(XVAL,TABLE,NSIZE,IER)
OUT = PARTAL(1)
```

FUNCTIONS:

Function routine FIND returns interpolated value Y=f(X) with table of Y versus X input

Entry PARTAL returns partial of Y with respect to X for last call to FIND

INPUTS:

XVAL - value of X
TABLE - 3*NSIZE dimensioned array of data
NSIZE - number of table values
IER - error code

OUTPUTS:

Function routine

CALLED BY:

ACTRIM, AEROPQ, ALGROT, CONMIX, ENGGTR, RSIDEW, TABLE, VLIFT1, WDRAG, WING1, WLIFT

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

TABSW=1 gives printout when XVAL is outside the X table limits

COMMENTS:

Table contains the X table values, the Y values corresponding to the previous X values, and the slope between break points; a complete description is included as comments in FIND

TABLE 2-21. DESCRIPTION OF SUBROUTINE FINDN

CALLING SEQUENCE:

CALL FINDN(I,IST,IEND,LNBUF)

FUNCTIONS:

Searches for the next number in a data file and returns the starting character index (IST), the ending character index (IEND), and updates the current character pointer (I)

INPUTS:

I - current character pointer
LNBUF - one line of aerodynamic table file

OUTPUTS:

IST - starting character index
IEND - ending character index
I - new current character pointer

CALLED BY:

GETTDAT

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

This subroutine requires a FORTRAN compatible with IF,THEN,ELSE and DO,WHILE functions

TABLE 2-22. DESCRIPTION OF SUBROUTINE FREQC

CALLING SEQUENCE:

CALL FREQC

FUNCTIONS:

Sets up the sum-of-sines frequency data arrays for use in driving the position of the controls in IFHB43

INPUTS:

None (see comments)

OUTPUTS:

Frequencies, periods, and phase angles used to drive controls

CALLED BY:

MAIN

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

- Several potential user specifiable variables are now explicitly defined in the subroutine
- Data used in IFHB43 is provided through common

TABLE 2-23. DESCRIPTION OF SUBROUTINE GETDAT

CALLING SEQUENCE:

CALL GETDAT(A,B)

FUNCTIONS:

Reads and sorts the records (get data)

INPUTS:

From FORTRAN Unit 9

OUTPUTS:

A - array of right-hand rotor values
B - array of left-hand rotor values

CALLED BY:

REPORT

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

CHECKS(4) prints out information from FTØ9FØØ1 (trim summary information)

COMMENTS:

Data for PRTTAB

TABLE 2-24. DESCRIPTION OF SUBROUTINE GETTDAT

CALLING SEQUENCE:

CALL GETTDAT(FILEN,K)

FUNCTIONS:

Reads the data from the aerodynamic table files and stores data in data table arrays

INPUTS:

FILEN - directory and file name of data file
K - DATA table number

OUTPUTS:

Data table arrays, DATBUF, and BRKPNT

CALLED BY:

RTABDAT

CALLS:

FINDN

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

This subroutine requires a FORTRAN compatible with character strings and DO/WHILE and IF/THEN/ELSE functions

TABLE 2-25. DESCRIPTION OF SUBROUTINE GUSTER

CALLING SEQUENCE:

CALL GUSTER(RTIME)

FUNCTIONS:

Computes wind gusts acting on the aircraft

INPUTS:

RTIME - maneuver time
GSTIN - time that gust starts
GSTOUT - time that gust is removed
DUGND - U gust velocity
DVGND - V gust velocity
GWGND - W gust velocity

OUTPUTS:

U, V, W, UWINDE, VWINDE, WWINDE velocities

CALLED BY:

IFHB43(DYNPHS)

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

GUSTER provides a step gust; and DU, DV, and DW are computed when entering the gust at GSTIN and leaving the gust at GSTOUT

TABLE 2-26. DESCRIPTION OF SUBROUTINE HANDLE

CALLING SEQUENCE:

CALL HANDLE

FUNCTIONS:

Computes and prints the aircraft handling qualities stability derivative matrix

INPUTS:

Data from Common and HKEEP

OUTPUTS:

Prints stability derivatives

CALLED BY:

IFHB44(STBPHS), MAIN

CALLS:

ALGROT, DATE, HEADER, HKEEP

DIAGNOSTIC PRINT OPTIONS:

CHECKS(2) - prints out STABDV diagnostics
CHECKS(3) - prints out DERIVS diagnostics and makes DGPTSW=1 during HANDLE and makes PRNTSW TRUE during calls to ALGROT
NDIMSW=1 gives printout of nondimensional derivative matrix
STBPSW=1 locks RPM governor when obtaining stability derivatives
(in HANDLE STBPSW=1 makes STABSW=0 and;
in IFHB43 STBPSW=1 makes STABSW=1)

COMMENTS:

HANDLE is a long driver routine

TABLE 2-27. DESCRIPTION OF SUBROUTINE HEADER

CALLING SEQUENCE:

CALL HEADER

FUNCTIONS:

Prints heading printout for each data page

INPUTS:

Airspeed, nacelle incidence, mode of flight, gross weight, rotor rpm, flap position, and c.g.

OUTPUTS:

Printout of inputs

CALLED BY:

FAMPRT, HANDLE, IFHB42(TRMPHS)

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Mode of flight is helicopter, conversion, or airplane

TABLE 2-28. DESCRIPTION OF SUBROUTINE HKEEP

CALLING SEQUENCE:

CALL HKEEP(A,B,C)

FUNCTIONS:

Computes a row of the stability derivative matrix for HANDLE

INPUTS:

Variables from Common

OUTPUTS:

A,B,C - arrays used in HANDLE

CALLED BY:

HANDLE

CALLS:

AEROPQ, ALGROT, CONMIX

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Calls ALGROT four times in succession to ensure convergence of iterative loops in ALGROT

TABLE 2-29. DESCRIPTION OF SUBROUTINE IFHB40(INIT)

CALLING SEQUENCE:

CALL IFHB40

FUNCTIONS:

Reads input data

INPUTS:

Reads input data from FORTRAN Unit 10

OUTPUTS:

Input data to appropriate commons throughout the program for use by other subroutines

CALLED BY:

MAIN

CALLS:

SIMINIT, DATEQQ, TIMOD

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

IFHB4Ø(INIT) reads input data through the END OF DATA card from FORTRAN Unit 4 and writes it to FORTRAN Unit 10 from where it is read again; cards after END OF DATA remain on FORTRAN Unit 4; and NAMELIST CHANGE must appear before the END OF RUN card

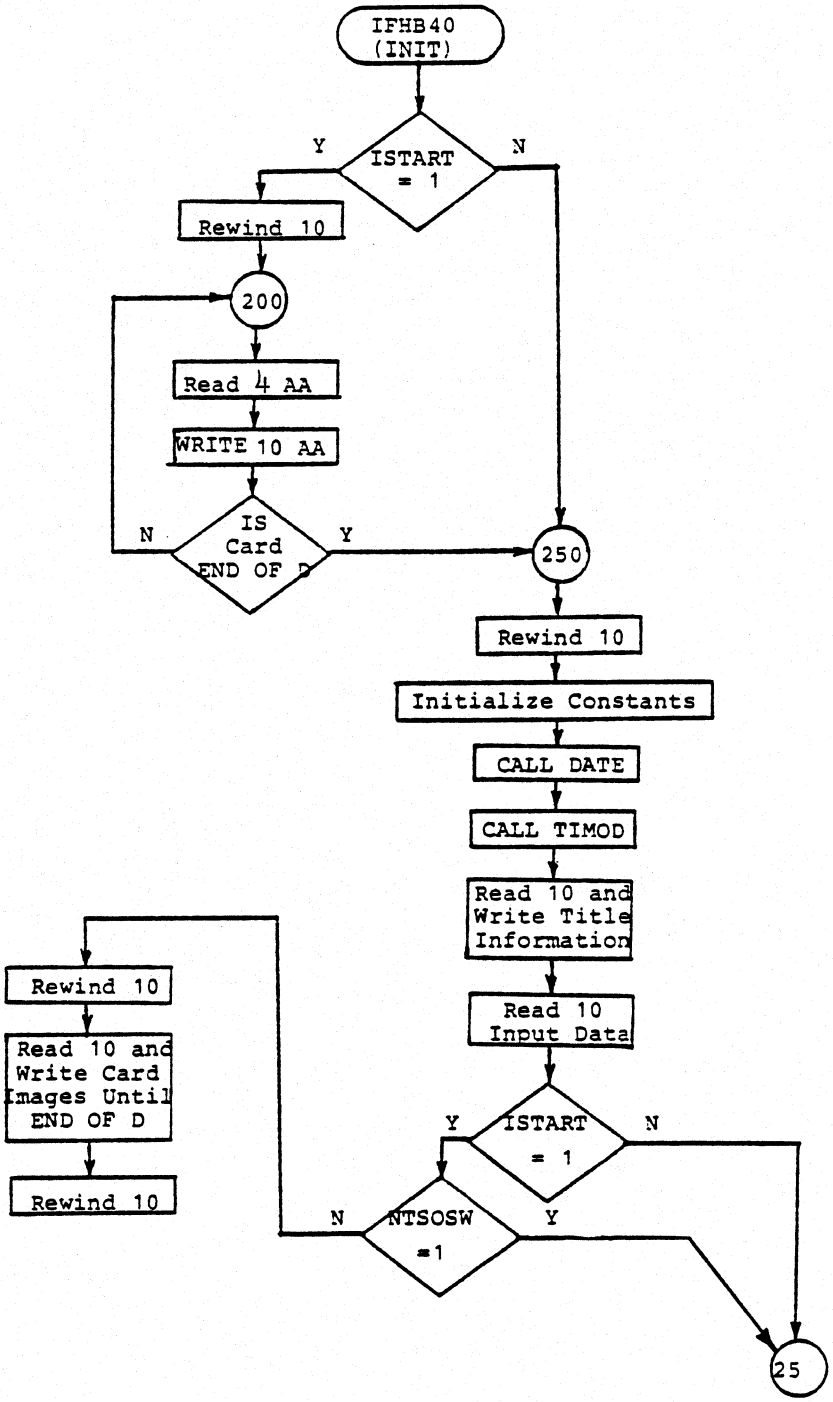

Figure 2-9. Flow chart of subroutine IFHB40(INIT)

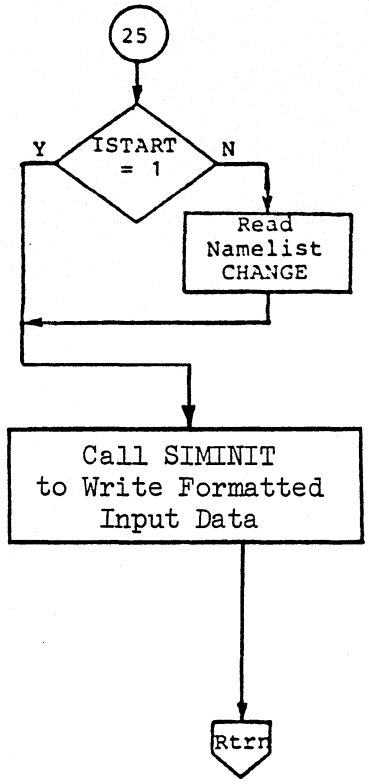

Figure 2- 9 Concluded.

TABLE 2-30. DESCRIPTION OF SUBROUTINE INVERS

CALLING SEQUENCE:

CALL INVERS(STIFF,N,IGOOFD)

FUNCTIONS:

Calculates mass matrix inverse for ALLMAT

INPUTS:

STIFF - 10 × 10 stiffness matrix
N - order of the matrix

OUTPUTS:

IGOOFD - error return code

CALLED BY:

MAINDG

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

General routine

TABLE 2-31. DESCRIPTION OF SUBROUTINE KEEP

CALLING SEQUENCE:

CALL KEEP(SAVE,I)

FUNCTIONS:

Computes a column of stability derivative matrix for STABDV

INPUTS:

I - column of matrix

OUTPUTS:

SAVE - matrix column computed

CALLED BY:

STABDV

CALLS:

ALGROT

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Calls ALGROT three times in succession to ensure convergence of iterative loops in ALGROT

TABLE 2-32. DESCRIPTION OF MAIN

CALLING SEQUENCE:

Root phase or mainline driver program

FUNCTIONS:

Controls program flow and branches to specified run-type option

INPUTS:

Calls IFHB40(INIT) to read input data

OUTPUTS:

Desired run-type option

CALLED BY:

None

CALLS:

AEROPQ, ALGROT, AXSROT, CONMIX, DERIVS, FAMPRT, FREQC, HANDLE, IFHB4Ø(INIT), IFHB42(TRMPHS), IFHB43(DYNPHS), IFHB44(STBPHS), REPORT, SCASRT, SETIME, SETV, TIMEX, UPDATE

DIAGNOSTIC PRINT OPTIONS:

CHECKS(4) prints out information from FTØ9FØØ1 (trim summary information) for TRMS option

COMMENTS:

MAIN permits TRMS, MANS, MANU, TUNL, and DTPT run type options

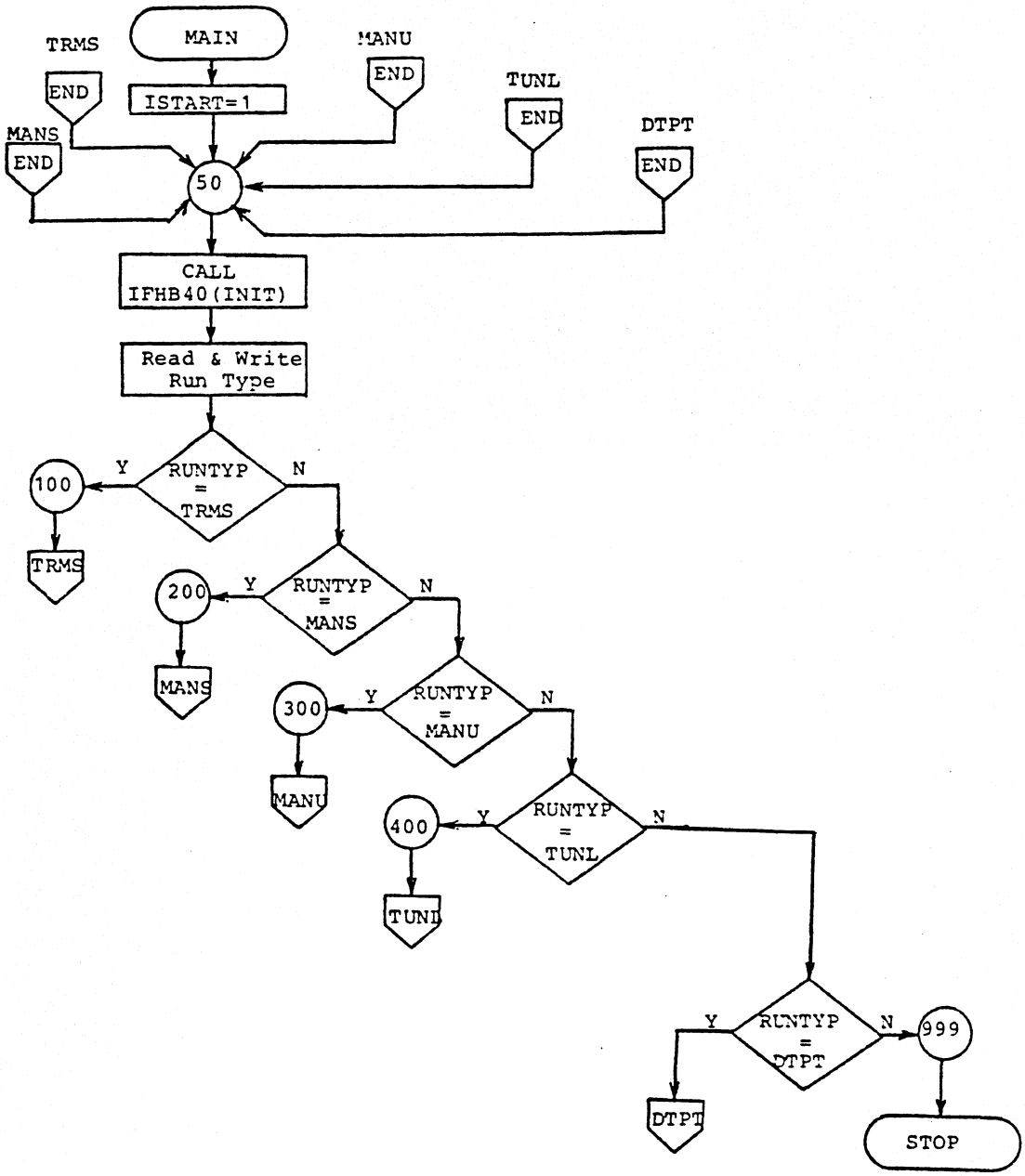

Figure 2-10. Flow Chart of MAIN

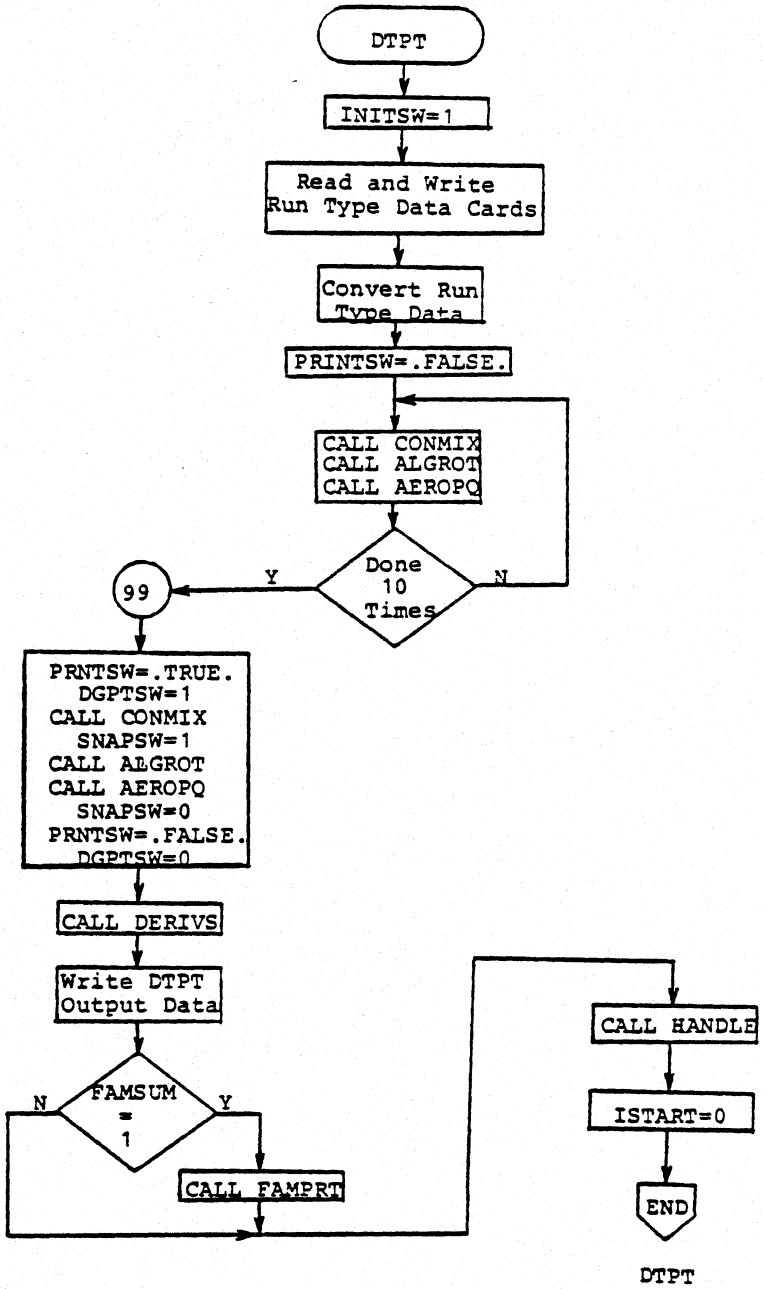

Figure 2-10 Continued.

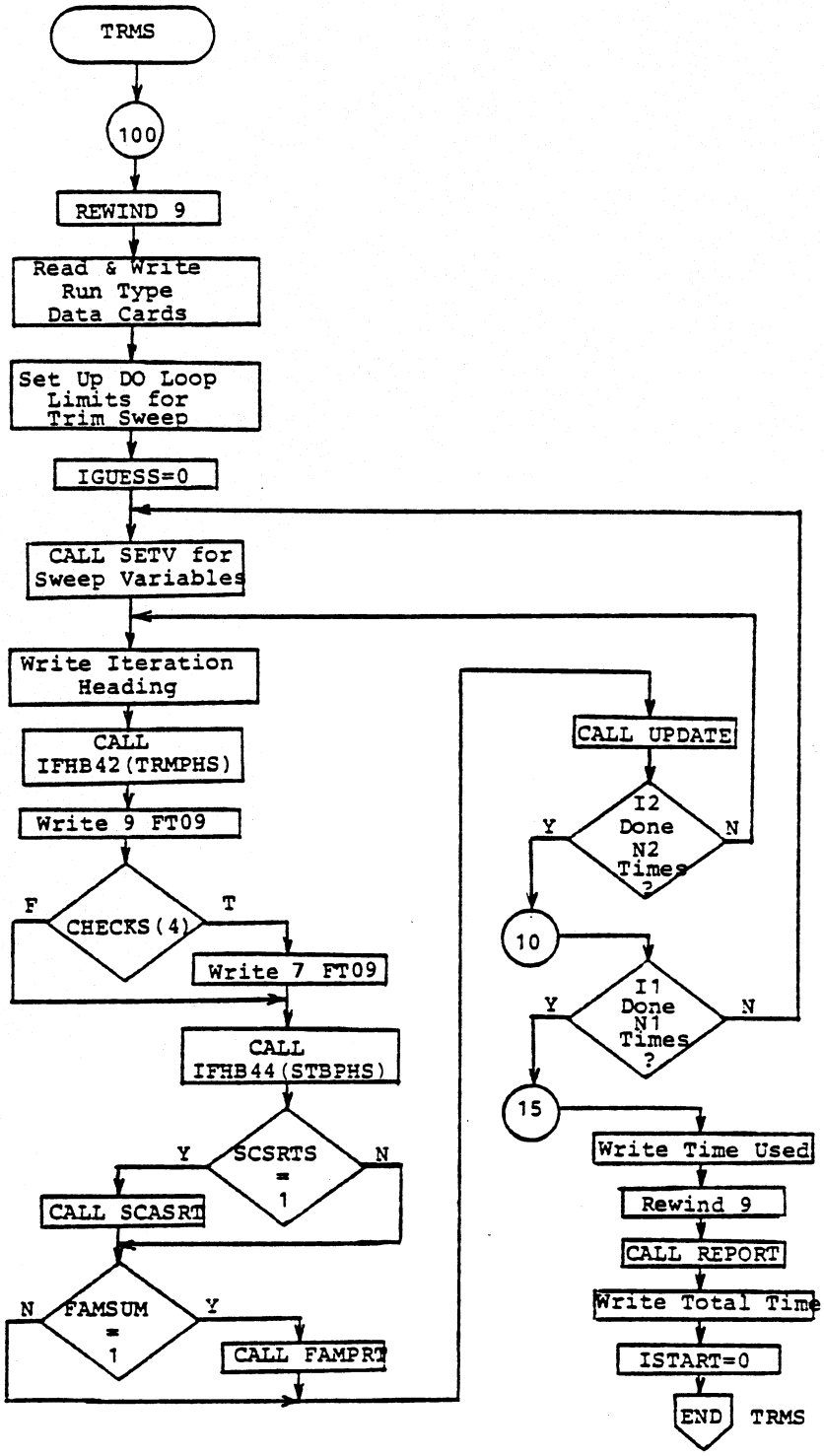

Figure 2- 10 Continued.

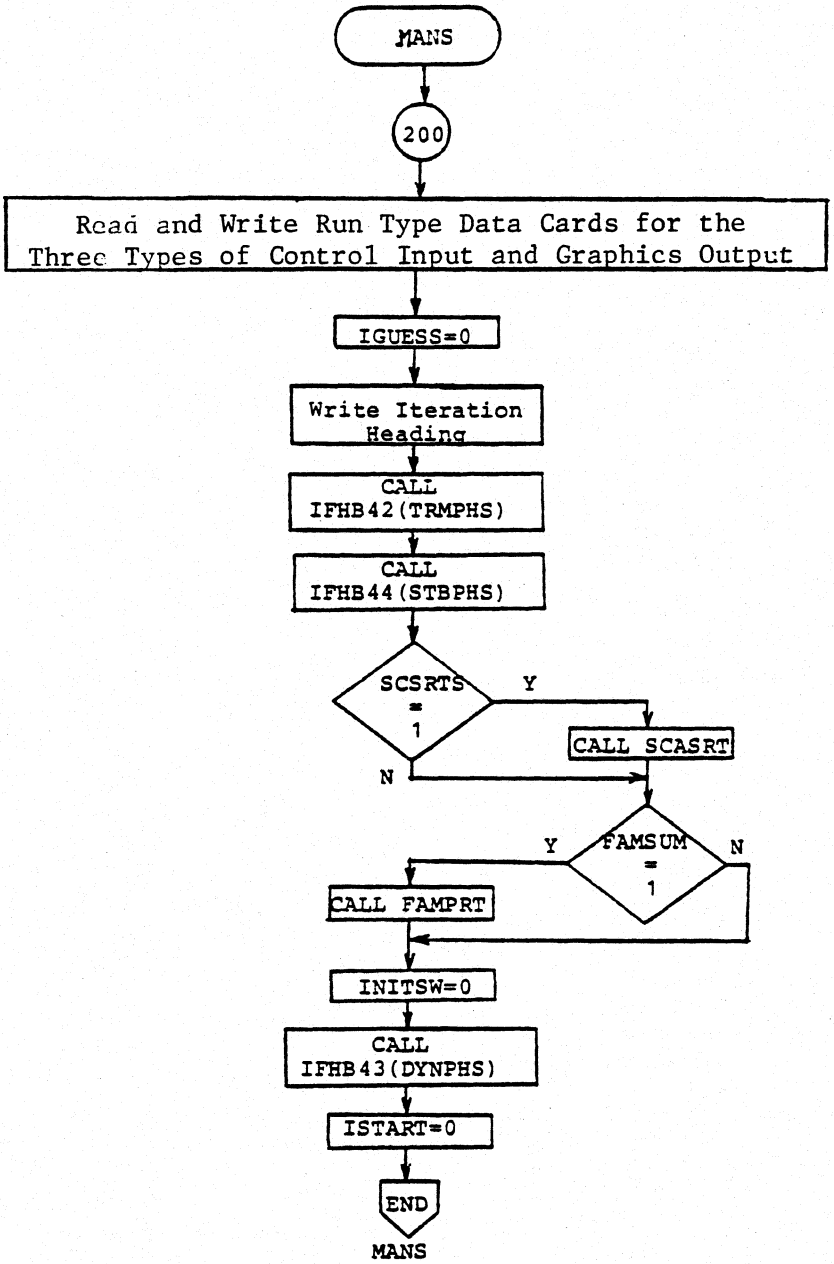

Figure 2-10 (Continued)

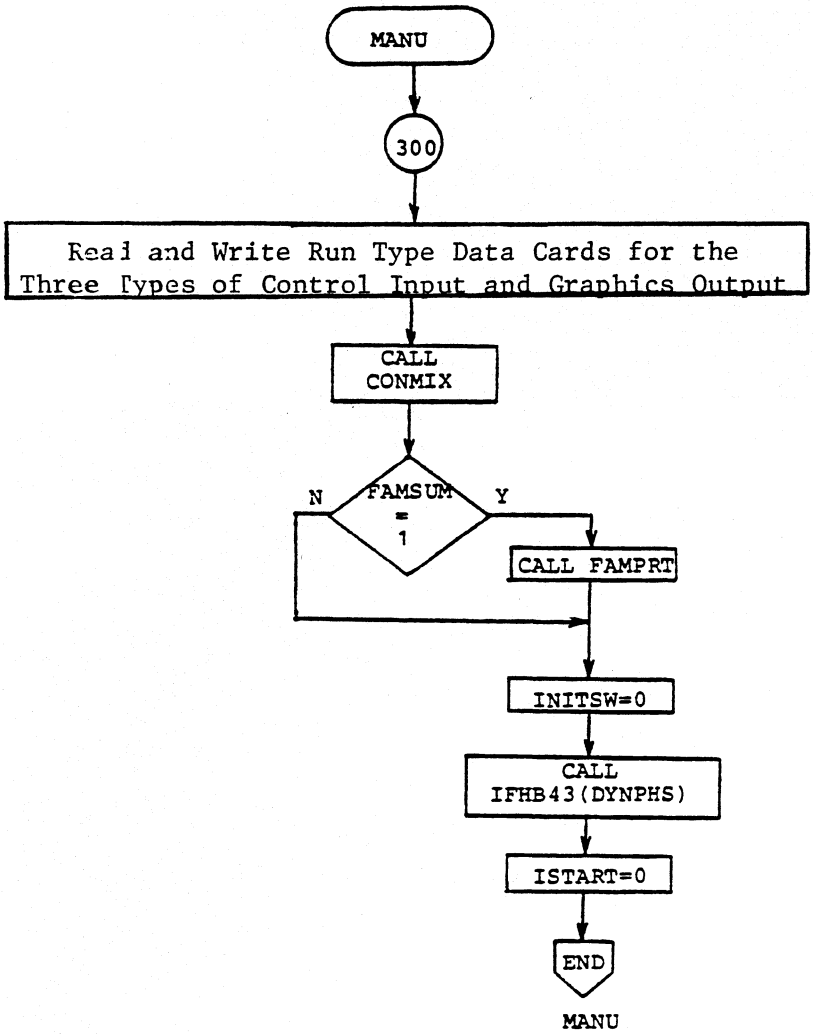

Figure 2-10 (Continued)

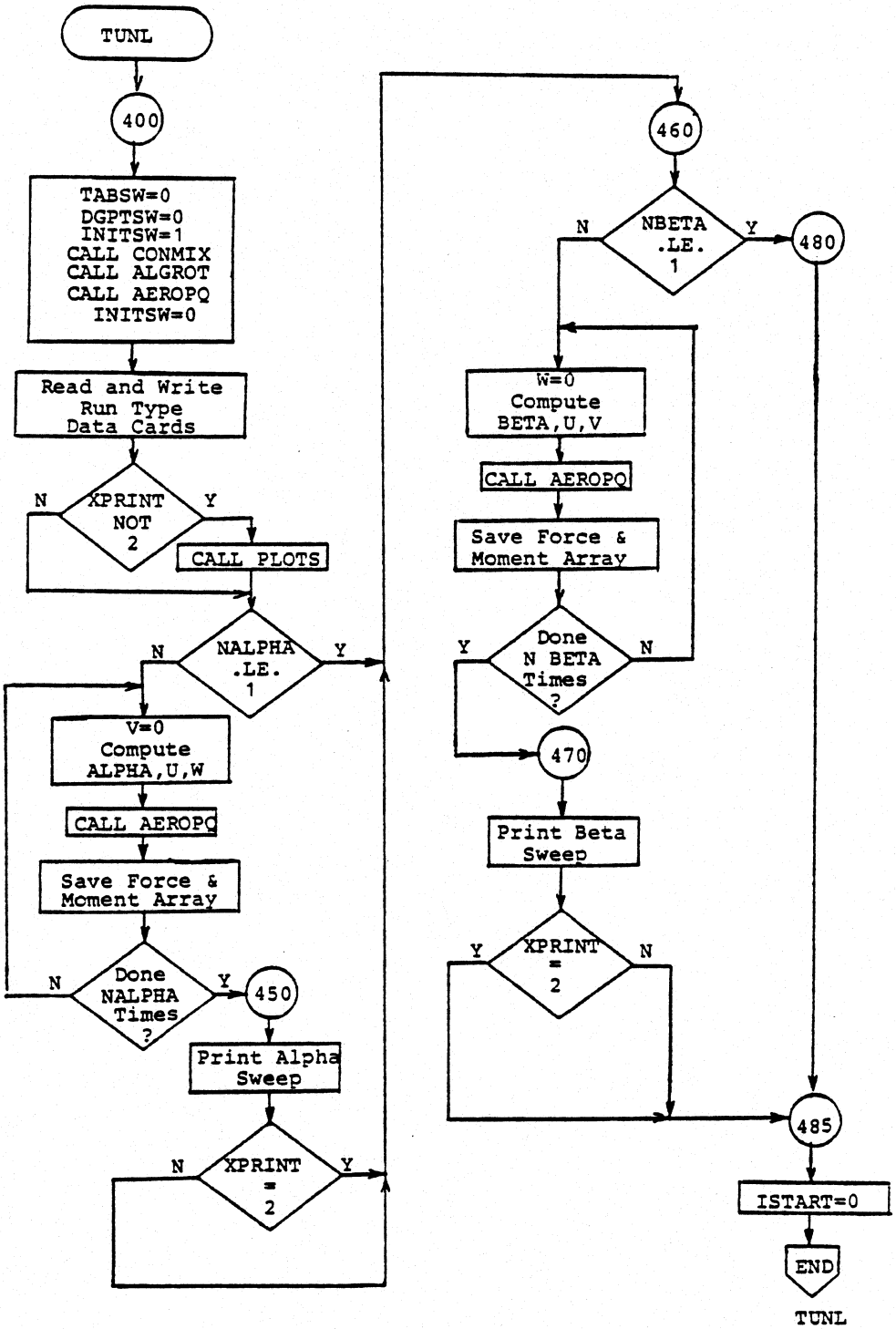

Figure 2-10 Continued.

TABLE 2-33. DESCRIPTION OF SUBROUTINE MAINDG

CALLING SEQUENCE:

CALL MAINDG(NEQ)

FUNCTIONS:

Calls other subroutines for root calculations, printing, and plotting

INPUTS:

NEQ - number of equations

OUTPUTS:

Printout

CALLED BY:

SCASRT

CALLS:

ALLMAT, DATEQQ, INVERS, MPRINT, MULT, OUT, SETIME, TIMEX

DIAGNOSTIC PRINT OPTIONS:

DGPTSW=2 for MAINDG matrix printout

COMMENTS:

Main driver for root calculations which was extracted from another program and modified

TABLE 2-34. DESCRIPTION OF SUBROUTINE MPRINT

CALLING SEQUENCE:

CALL MPRINT(NN)

FUNCTIONS:

Printout of mass, damping, and stiffness matrices in row order

INPUTS:

NN - order of matrices

OUTPUTS:

Printout

CALLED BY:

MAINDG

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Used because of ALLMAT

TABLE 2-35. DESCRIPTION OF SUBROUTINE MULT

CALLING SEQUENCE:

CALL MULTI(A,M1,N1,B,M2,N2,C)

FUNCTIONS:

Matrix multiplication routine; Matrix B is multiplied by Matrix A

INPUTS:

A - 10 × 10 real*8 matrix
M1 - rows of Matrix A
N1 - columns of Matrix A
B - 10 × 10 matrix
M2 - rows of Matrix B (=N1)
N2 - columns of Matrix B

OUTPUTS:

C = M1 × N2 real*8 output matrix

CALLED BY:

MAINDG

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Used because of ALLMAT

TABLE 2-36. DESCRIPTION OF SUBROUTINE MULTC

CALLING SEQUENCE:

CALL MULTC(DUM,DXR,DXI,DREAL,DIMG,L,P)

FUNCTIONS:

Matrix manipulation routine

INPUTS:

DUM - complex matrix
DXR - real part of input vector
DXI - imaginary part of input vector
L - array index
P - array index

OUTPUTS:

DREAL - real part of output vector
DIMG - imaginary part of output vector

CALLED BY:

SROOTS

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Used in IFHB44(STBPHS)--double precision

TABLE 2-37. DESCRIPTION OF SUBROUTINE OUT

CALLING SEQUENCE:

CALL OUT(NCAL,OMEGA,JJJ)

FUNCTIONS:

Printout of Eigenvalues and Eigenvectors

INPUTS:

NCAL - number of Eigenvalues calculated
OMEGA - rotor speed

OUTPUTS:

JJJ - number of points

CALLED BY:

MAINDG

CALLS:

ALLVEC

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Used because of ALLMAT

TABLE 2-38. DESCRIPTION OF SUBROUTINE PROOTS

CALLING SEQUENCE:

CALL PROOTS(XR,XI)

FUNCTIONS:

Prints frequency and damping of roots

INPUTS:

XR - real root
XI - imaginary root

OUTPUTS:

None

CALLED BY:

SROOTS

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Print from IFHB44(STBPHS)

TABLE 2-39. DESCRIPTION OF SUBROUTINE PRTTAB

CALLING SEQUENCE:

CALL PRTTAB(A,B)

FUNCTIONS:

Prints the tabular data generated by a trim sweep

INPUTS:

A - array of right-hand rotor values
B - array of left-hand rotor values

OUTPUTS:

Printout

CALLED BY:

REPORT

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Data from GETDAT

TABLE 2-40. DESCRIPTION OF SUBROUTINE PSCAS

CALLING SEQUENCE:

CALL PSCAS (Q, THE, XLN, BETAD, ILNDET, DELT, IC, XLNSAS)

FUNCTIONS:

Calculates the pitch SCAS and attitude retention system control inputs that are added to the pilot control input in CONMIX

INPUTS:

Pitch rate and attitude, longitudinal stick position, mast angle, longitudinal stick detente switch setting, integration step size or cycle time, initial conditions switch setting, and SCAS/attitude block diagram parameters through commons.

OUTPUTS:

Longitudinal SCAS actuator position

CALLED BY:

CONMIX, IFHB43

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

- Call from IFHB43 is to initialize pitch SCAS/attitude system before a maneuver is run
- A pitch SCAS failure capabaility is programmed to investigate the transient due to SCAS actuator centering upon failure at a time specified by the user

TABLE 2-41. DESCRIPTION OF SUBROUTINE REPORT

CALLING SEQUENCE:

CALL REPORT(IVAR1,S1,D1,N1,IVAR2,S2,A2,D2,N2)

FUNCTIONS:

Generates the printed trim sweep reports

INPUTS:

N1 - number of values of first sweep variable
N2 - number of values of second sweep variable

OUTPUTS:

Trim summary page

CALLED BY:

MAIN

CALLS:

GETDAT, PRTTAB

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Called after the completion of a trim sweep of two variables

TABLE 2-42. DESCRIPTION OF SUBROUTINE RSCAS

CALLING SEQUENCE:

CALL RSCAS (P, PHI, XLT, BETAD, ILTDET, DELT, IC, XLTSAS)

FUNCTIONS:

Calculates the roll SCAS and attitude retention system control inputs that are added to the pilot control input in CONMIX

INPUTS:

Roll rate and attitude, lateral stick position, mast angle, lateral stick detente switch setting, integration step size or cycle time, initial conditions switch setting, and SCAS/attitude block diagram parameters through commons

OUTPUTS:

Lateral SCAS actuator position

CALLED BY:

CONMIX, IFHB43

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

- Call from IFHB43 is to initialize roll SCAS/attitude system before a maneuver is run
- A roll SCAS failure capability is programmed to investigate the transient due to SCAS actuator centering upon failure at a time specified by the user

TABLE 2-43. DESCRIPTION OF SUBROUTINE RSIDEW

CALLING SEQUENCE:

OUT = RSIDEW(KEY,ANG,VM)

FUNCTIONS:

Performs rudder sidewash factor table lookup and interpolation for functions of two variables

INPUTS:

KEY - code number for table (13, 14, or 27)
ANG - first argument
VM - second argument

OUTPUTS:

Function routine

CALLED BY:

AEROPQ

CALLS:

FIND

DIAGNOSTIC PRINT OPTIONS:

Writes NAMELIST RSIDW if TABSW=1 and PRINTSW is TRUE

COMMENTS:

Function routine with tables for Subsystem 6; originally was a part of function routine TABLE

TABLE 2-44. DESCRIPTION OF SUBROUTINE RTABDAT

CALLING SEQUENCE:

CALL RTABDAT

FUNCTIONS:

Obtains file name and directory location for aerodynamic data tables

INPUTS:

Master file listing aerodynamic table names, DIRNAME

OUTPUTS:

File name, directory, and description of aerodynamic data table files

CALLED BY:

SIMINIT

CALLS:

GETTDAT

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

This subroutine requires a FORTRAN compatible with the use of character strings

TABLE 2-45. DESCRIPTION OF SUBROUTINE SCASRT

CALLING SEQUENCE:

CALL SCASRT

FUNCTIONS:

Sets up mass, damping, and stiffness matrices to be solved for stability roots

INPUTS:

Data from Common

OUTPUTS:

Six pages of printout from subroutine MAINDG

CALLED BY:

MAIN

CALLS:

MAINDG

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

In MAIN, for TRMS and MANS options, SCASRT is called if SCSRTS=1

TABLE 2-46. DESCRIPTION OF SUBROUTINE SETIME

CALLING SEQUENCE:

CALL SETIME(TMIN)

FUNCTIONS:

Limits maximum computation time

INPUTS:

TMIN - large time value used to initialize TIMEX

OUTPUTS:

None

CALLED BY:

MAIN, MAINDG

CALLS:

TIMGET

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Special VAX VMS system routine written by BHT

TABLE 2-47. DESCRIPTION OF SUBROUTINE SETV

CALLING SEQUENCE:

CALL SETV(IVAR,S,A,N)

FUNCTIONS:

Initializes sweep variables

INPUTS:

IVAR - code number of sweep variable
S - variable starting value
A - displacement with first variable increment
N - (i-1)th case of sweep

OUTPUTS:

State variable for next trim case

CALLED BY:

MAIN

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Used in outer DO loop for two variable sweep with UPDATE in inner DO loop

TABLE 2-48. DESCRIPTION OF SUBROUTINE SIMEQN

CALLING SEQUENCE:

CALL SIMEQN(A,B,N,KS)

FUNCTIONS:

Obtains the solution to a set of simultaneous linear equations

$$[A]\ [X] = [B]$$

INPUTS:

A - N×N matrix of coefficients
B - vector of constants; length is N
N - number of equations and variables

OUTPUTS:

B - vector of final solution values, X(i)
KS - output error code

CALLED BY:

ACTRIM

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

The A matrix is destroyed in the computation; the X(i) solution is placed in the B input array

TABLE 2-49. DESCRIPTION OF SUBROUTINE SIMINIT

CALLING SEQUENCE:

CALL SIMINIT

FUNCTIONS:

Writes formatted input data and initializes program variables

INPUTS:

Input data from IFHB40 by labeled Common blocks

OUTPUTS:

Initialized variables to labeled Commons

CALLED BY:

IFHB40

CALLS:

CONMIX, DATEQQ, RTABDAT, SETTHR, TIMOD

DIAGNOSTIC PRINT OPTIONS:

DGPTSW=1 writes NAMELIST CHANGE

COMMENTS:

Prints table file names used by subsystem

TABLE 2-50. DESCRIPTION OF SUBROUTINE SROOTS

CALLING SEQUENCE:

CALL SROOTS

FUNCTIONS:

Determination of longitudinal and lateral modes

INPUTS:

Data from Common

OUTPUTS:

Printout of stability roots

CALLED BY:

IFHB44(STBPHS)

CALLS:

AS2ØØ5, AS2Ø14, MULTC, PROOTS

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Used in IFHB44(STBPHS)--double precision

TABLE 2-51. DESCRIPTION OF SUBROUTINE STABDV

CALLING SEQUENCE:

CALL STABDV

FUNCTIONS:

Computes the stability derivatives

INPUTS:

Data from Common and KEEP

OUTPUTS:

Prints rotor derivative matrix

CALLED BY:

IFHB44(STBPHS)

CALLS:

ALGROT, CONMIX, TIMEX, KEEP

DIAGNOSTIC PRINT OPTIONS:

CHECKS(2) prints part of SAVE matrix
INITSW is saved, set to zero while CONMIX is called for stability derivatives, and then restored to its original value

COMMENTS:

Calls ALGROT four times in succession to ensure convergence of iterative loops in ALGROT

TABLE 2-52. DESCRIPTION OF SUBROUTINE IFHB44(STBPHS)

CALLING SEQUENCE:

CALL IFHB44

FUNCTIONS:

Driver to compute handling qualities and stability derivative matrices

INPUTS:

Switches from Common

OUTPUTS:

Printout from routines called

CALLED BY:

MAIN

CALLS:

HANDLE, SROOTS, STABDV

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Called by TRMS and MANS options in MAIN

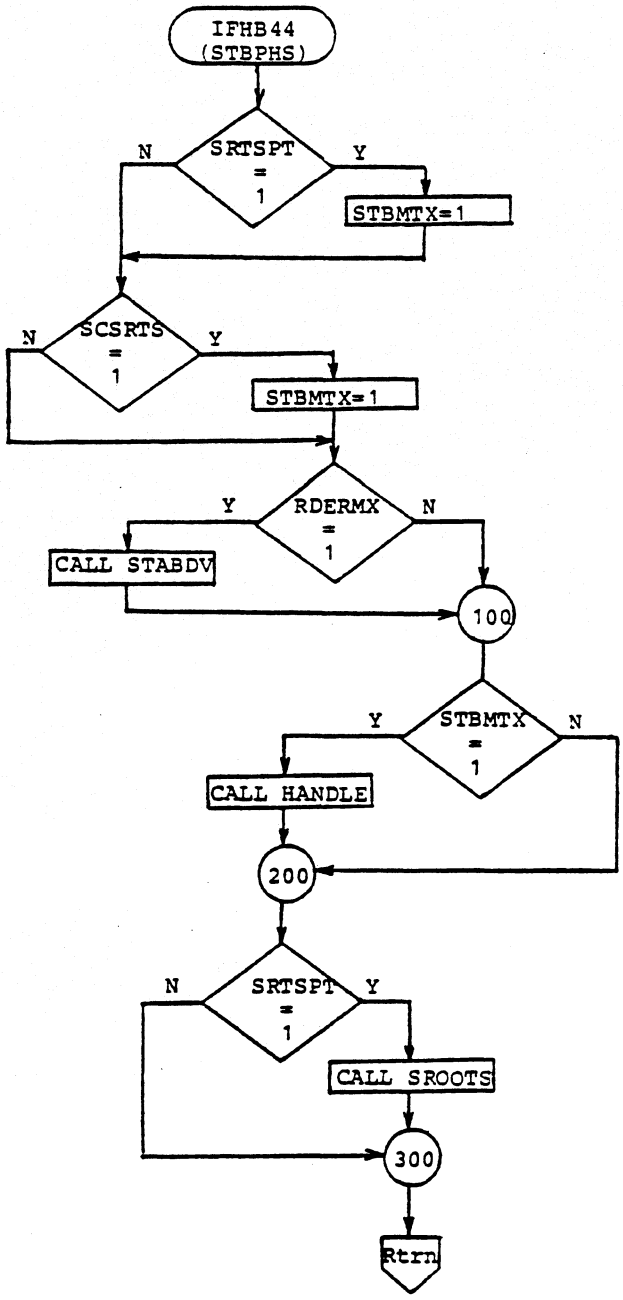

Figure 2-11. Flow chart of subroutine IFHB44(STBPHS)

TABLE 2-53. DESCRIPTION OF SUBROUTINE TABLE

CALLING SEQUENCE:

```
OUT = TABLE(KEY)
OUT = TABLE(KEY,ANG)
OUT = TABLE(KEY,ANG,VM)
```

FUNCTIONS:

Performs table lookup and interpolation for functions of one or two variables

INPUTS:

KEY - code number for table (3, 4, 5, 6, 7, 8, 9, 11, 16, 20, 21, 22, 23, 24, 25, or 26)
ANG - first argument
VM - second argument

OUTPUTS:

Function routine

CALLED BY:

AEROPO

CALLS:

FIND

DIAGNOSTIC PRINT OPTIONS:

Writes NAMELIST TABLES if TABSW=1 and PRNTSW is TRUE.

COMMENTS:

Function routine with tables for Subsystems 2, 3, 4, 5, and 6

TABLE 2-54. DESCRIPTION OF SUBROUTINE TIMEX

CALLING SEQUENCE:

CALL TIMEX(TM1,TM2,TM3)

FUNCTIONS:

Gives elapsed time

INPUTS:

None

OUTPUTS:

TM1 - time used since call to SETIME
TM2 - time used since most recent call to TIMEX or SETIME
TM3 - time remaining in interval set by SETIME

CALLED BY:

HANDLE, IFHB42(TRMPHS), MAIN, MAINDG, and STABDV

CALLS:

TIMGET

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Special VAX VMS system routine written by BHT

TABLE 2-55. DESCRIPTION OF SUBROUTINE TIMGET

CALLING SEQUENCE:

CALL TIMGET(N)

FUNCTIONS:

Gets total accumulated CPU time in 10 millisecond tics

INPUTS:

None

OUTPUTS:

N - 10 millisecond tics used by the current process

CALLED BY:

TIMEX, SETIME

CALLS:

SYS$GETJPI

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Special VAX VMS system routine written by BHT

TABLE 2-56. DESCRIPTION OF SUBROUTINE TIMOD

CALLING SEQUENCE:

CALL TIMOD(TIME)

FUNCTIONS:

Sets argument to a character string giving the current value of the system time of day clock in the form hh.mm.ss.th

INPUTS:

None

OUTPUTS:

TIME(3)

CALLED BY:

IFHB40(INIT), SIMINIT

CALLS:

TIME

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Special VAX VMS system routine written by BHT

TABLE 2-57. DESCRIPTION OF SUBROUTINE TRMJCB

CALLING SEQUENCE:

CALL TRMJCB(UEB,VEB,WEB)

FUNCTIONS:

Computes the aircraft trim Jacobian (partial derivative) matrix

INPUTS:

UEB - U ground velocity
VEB - V ground velocity
WEB - W ground velocity

OUTPUTS:

A(6,6) - trim matrix

CALLED BY:

ACTRIM

CALLS:

ACKEEP

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Computes partials by small perturbations of F/A stick, lateral stick, collective, pedals, pitch, and roll or yaw

TABLE 2-58. DESCRIPTION OF SUBROUTINE IFHB42(TRMPHS)

CALLING SEQUENCE:

CALL IFHB42(IGUESS)

FUNCTIONS:

Trim phase routine

INPUTS:

IGUESS - initialized to zero

OUTPUTS:

IGUESS - indicates that aircraft has trimmed or why it was unsuccessful

CALLED BY:

MAIN

CALLS:

ACKEEP, ACTRIM, AEROPQ, ALGROT, CONMIX, DERIVS, HEADER, TIMEX

DIAGNOSTIC PRINT OPTIONS:

CHECKS(10) prints out information about horsepower convergence in trim loop

COMMENTS:

Called by TRMS and MANS options in MAIN

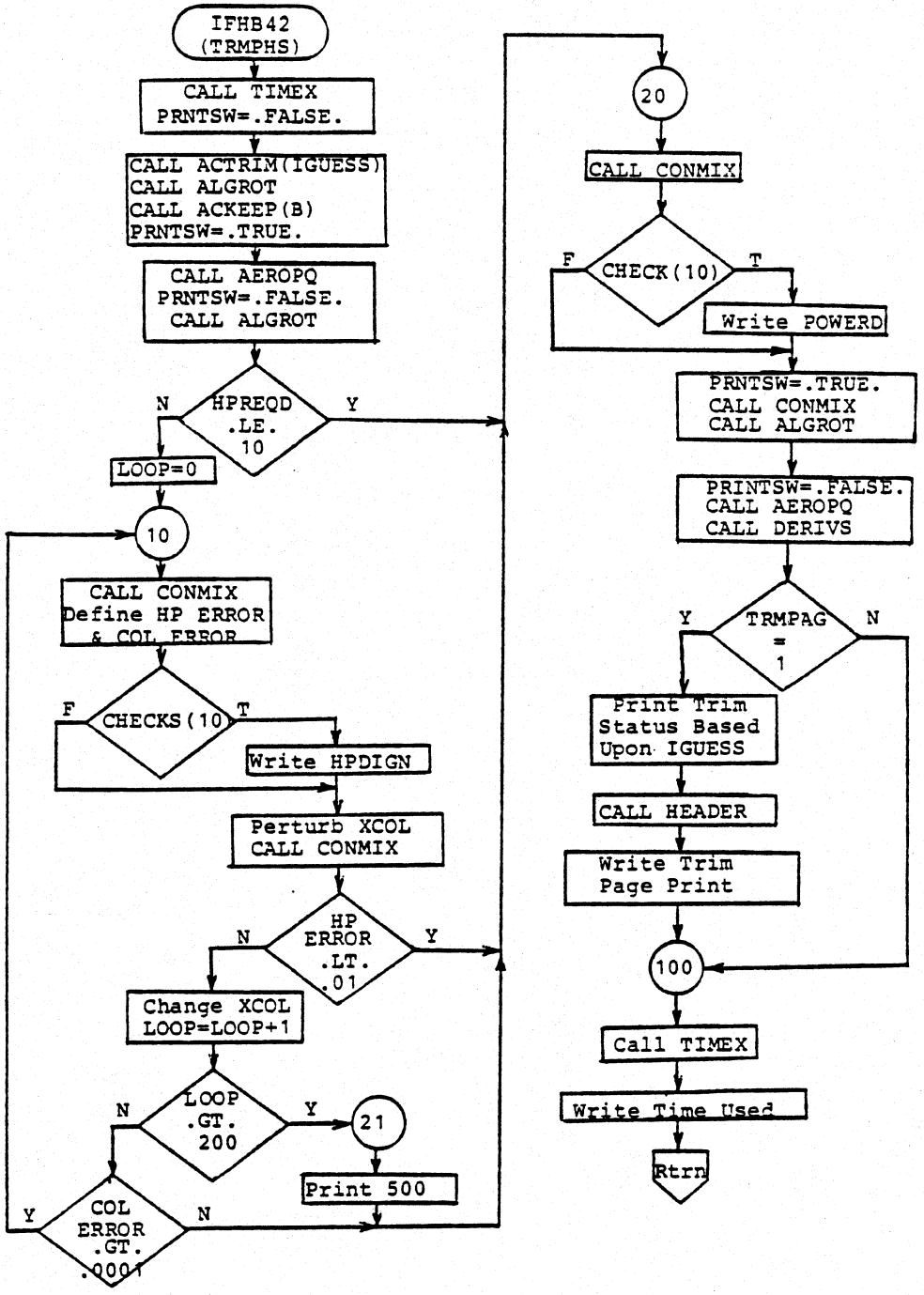

Figure 2-12. Flow chart of subroutine IFHB42(TRMPHS)

TABLE 2-59. DESCRIPTION OF SUBROUTINE UPDATE

CALLING SEQUENCE:

CALL UPDATE(IVAR,DELT)

FUNCTIONS:

Increments sweep variables

INPUTS:

IVAR - code number of second variable of sweep
DELT - second variable increment

OUTPUTS:

State variables for next trim case

CALLED BY:

MAIN

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

Used in inner DO loop for two variable sweep with SETV in outer DO loop

TABLE 2-60. DESCRIPTION OF SUBROUTINE VLIFT1

CALLING SEQUENCE:

OUT = VLIFT1(KEY,ANG,VM)

FUNCTIONS:

Performs vertical stabilizer lift table lookup and interpolation for functions of two variables

INPUTS:

KEY - code number for table (15)
ANG - first argument
VM - second argument

OUTPUTS:

Function routine

CALLED BY:

AEROPQ

CALLS:

FIND

DIAGNOSTIC PRINT OPTIONS:

Writes NAMELIST VLIFT if TABSW=1 and PRNTSW is TRUE

COMMENTS:

Function routine with tables for Subsystem 6; originally was a part of function routine TABLE

TABLE 2-61. DESCRIPTION OF SUBROUTINE WDRAG

CALLING SEQUENCE:

OUT = WDRAG(KEY,ANG,VM)

FUNCTIONS:

Performs wing drag table lookup and interpolation for functions of two variables

INPUTS:

KEY - code number for table (2)
ANG - first argument
VM - second argument

OUTPUTS:

Function routine

CALLED BY:

AEROPQ

CALLS:

FIND

DIAGNOSTIC PRINT OPTIONS:

Writes NAMELIST WDRG if TABSW=1 and PRNTSW is TRUE

COMMENTS:

Function routine with tables for Subsystem 4; originally was a part of function routine TABLE

TABLE 2-62. DESCRIPTION OF SUBROUTINE WING1

CALLING SEQUENCE:

OUT = WING1(KEY,ANG,VM)

FUNCTIONS:

Performs wing table lookup and interpolation for functions of two variables

INPUTS:

KEY - code number for table (10, 12, 17, 18, or 19)
ANG - first argument
VM - second argument

OUTPUTS:

Function routine

CALLED BY:

AEROPQ

CALLS:

FIND

DIAGNOSTIC PRINT OPTIONS:

Writes NAMELIST WNG1 if TABSW=1 and PRNTSW is TRUE

COMMENTS:

Function routine with tables for Subsystem 4; originally was a part of function routine TABLE

TABLE 2-63. DESCRIPTION OF SUBROUTINE WKAREA

CALLING SEQUENCE:

CALL WKAREA

FUNCTIONS:

Calculates area of wing influenced by rotor wake and calculates centroid of this area relative to c.g.

INPUTS:

Data from Common

OUTPUTS:

SIWR,SIWL - right and left wing areas
XIWR,XIWL - X coordinate of centroid
YIWR,YIWL - Y coordinate of centroid

CALLED BY:

AEROPQ

CALLS:

AREA1

DIAGNOSTIC PRINT OPTIONS:

Print if PRNTSW is TRUE and DGPTSW=1 or SNAPSW=1

COMMENTS:

Includes equations for Subsystem 4

TABLE 2-64. DESCRIPTION OF SUBROUTINE WLIFT

CALLING SEQUENCE:

OUT = WLIFT(KEY,ANG,VM)

FUNCTIONS:

Performs wing lift table lookup and interpolation for functions of two variables

INPUTS:

KEY - code number for table (1)
ANG - first argument
VM - second argument

OUTPUTS:

Function routine

CALLED BY:

AEROPQ

CALLS:

FIND

DIAGNOSTIC PRINT OPTIONS:

Write NAMELIST WLFT if TABSW=1 and PRNTSW is TRUE

COMMENTS:

Function routine with tables for Subsystem 4; originally was a part of function routine TABLE

TABLE 2-65. DESCRIPTION OF SUBROUTINE YSCAS

CALLING SEQUENCE:

CALL YSCAS (R, PSI, XPD, BETAD, IPDDET, DELT, IC, XPDSAS)

FUNCTIONS:

Calculates the yaw SCAS control input that is added to the pilot control input in CONMIX (no heading hold is presently modeled)

INPUTS:

Yaw rate and attitude, pedal position, mast angle, pedal detente switch setting, integration step size or cycle time, initial conditions switch setting, and SCAS block diagram parameters through commons

OUTPUTS:

Yaw SCAS actuator position

CALLED BY:

CONMIX, IFHB43

CALLS:

None

DIAGNOSTIC PRINT OPTIONS:

None

COMMENTS:

- Call from IFHB43 is to initialize yaw SCAS before a maneuver is run
- A yaw SCAS failure capability is programmed to investigate the transient due to SCAS actuator centering upon failure at a time specified by the user

3. INPUT/OUTPUT DESCRIPTIONS

3.1 GENERAL DESCRIPTION

The initialization subroutines IFHB4Ø and SIMINIT read the input data, store it on a disk, process the data into constants to be used throughout the program, and convert all program values into a common set of units that are used for every calculation. The standard units are feet, seconds, radians, and pounds. Variables, once computed, are converted back into common engineering units for printout (knots, degrees, etc.). The input deck values, along with a brief description of the variable name, is printed out before the run begins.

A list of the device units used in Program GTRSIM is given in Table 3-1. The Input/Output Data Flow is shown in Fig. 3-1.

3.2 INPUT DATA FLOW

The input data flow is illustrated in the sequence of runs shown in Fig. 3-1. The MAIN program calls subroutine IFHB4Ø, which does a read 4 and write 10 of the input data through the END OF DATA card. Unit 10 is rewound, and the input data is read from 10. In IFHB4Ø, when the write 10 is performed, a write 7 of the input data card images (through the END OF DATA card) is done, followed by a call to SIMINIT which prints the formatted input data with a variable description. On the first pass through IFHB4Ø, no NAMELIST CHANGE cards are read. After returning to MAIN from IFHB4Ø, the run-type control data is read from 4 and then written out on 7. MAIN then branches to the designated run type to read from 4 the associated data cards. Information from the data cards is printed on 7 for some run-type options before executing the run-type code. At the completion of the run, a branch is made in MAIN back to Statement 50. On succeeding runs, Unit 10 is rewound and read for the original input data, NAMELIST CHANGE provides changes to the original

TABLE 3-1. INPUT/OUTPUT DEVICE UNITS USED IN GTRSIM

Unit	Type	Used For	Subroutine
3	Direct Access	Input data table	RTABDAT names and directories
4	Input Data File	Input Data	IFHB4Ø, MAIN
5	Input from Terminal		
6	Output to Terminal		
7	Output List File	Printed Output	*
8	Output Data	Graphics Tabular Output	IFHB43
9	Direct Access	Summary Data in	GETDAT, MAIN TRMS run type
10	Direct Access	Input Data Card	IFHB4Ø(INIT) Image
16	Direct Access	Aerodynamic Table	GETTDAT Files

*ACTRIM, AEROPQ, ALGROT, MPRINT, MULT, OUT, BIQUAD, CONMIX, IFHB43, FAMPRT, GETDAT, GUSTER, HANDLE, HEADER, IFHB4Ø, MAIN, MAINDG, PRTTAB, RSIDEW, SCASRT, SIMINIT, STABDV, IFHB44, SROOTS, PROOTS, TABLE, IFHB42, VLIFT1, WDRAG, WING1, WKAREA, WLIFT

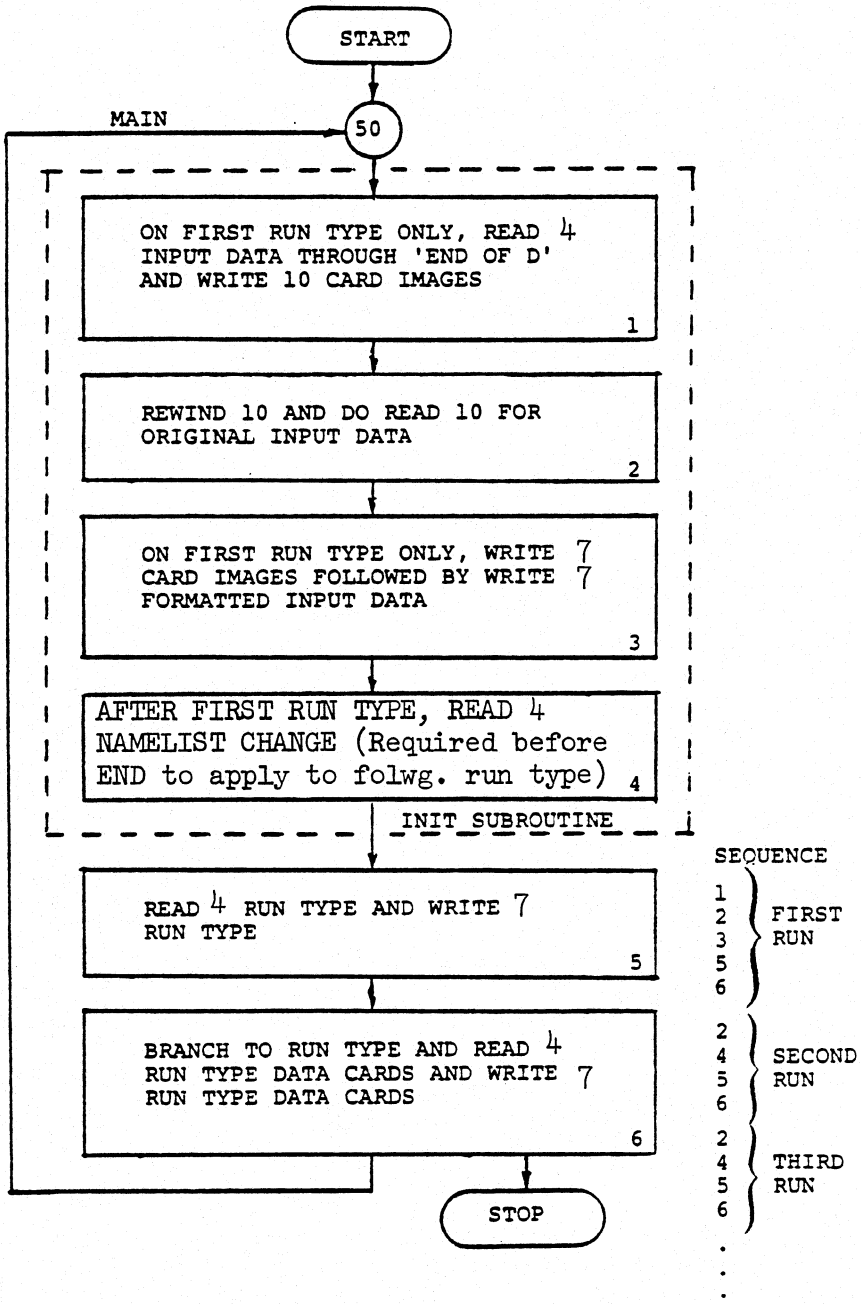

Figure 3-1. Input/output data flow.

data, the run type is read, and then a branch is made to perform the designated run type.

3.3 TABLES

Additional program tabular data appears in table data files. Most of the aerodynamic coefficients are input in this manner. Subroutines RTABDAT, GETTDAT, and FINDN are used to extract and store each table data file in a suitable manner for referencing within the program. Function routine FIND is used to obtain the interpolated values. A KEY is used to branch to the desired table lookup. TABLE has been modified so that some values of KEY call other function routines. The table organization by subsystem is given in Table 3-2. Table 3-3 gives the routine and function for each of the KEY values.

3.4 OUTPUT DATA FLOW

Upon execution of the program, the input data card images through the END OF DATA card are printed out. Following this is a formatted print of the data variable name, description, value, and units. The program then branches to the specified run-type and provides the printout associated with that run-type. At the end of a TRMS trim sweep, a summary page is printed. Figures 3-2 through 3-8 provide examples of printout for several more common run types and switch combinations with notations identifying which subroutine provided the printout. (The example printouts are not all inclusive of the many possible types of printouts or combinations of printouts. For example, the Stability Derivative matrix printout in Fig. 3-5 can be obtained in both dimensional and nondimensional formats, see user's guide for details.)

3.5 DIAGNOSTICS

The program provides optional diagnostic printout through DGPTSW. General diagnostic printout is obtained for DGPTSW = 1. For specific diagnostic printout, DGPTSW > 1. The Input Data Switch Options and Data Dependent Switch Options of the User's Guide give permissible values of DGPTSW.

TABLE 3-2. ORGANIZATION OF THE INPUT DATA TABLE ROUTINE

TILT-ROTOR INPUT DATA TABLES

Subsystem	Table*	Routine	Key	VAX File Name
1	1-I	ALGROT		TBAR, CTL15, CTL3Ø, CTL6Ø
1	1-II	ALGROT		TXSF
1	1-III	ALGROT		TXSS
2	2-I	TABLE	24	WØØ-W3Ø14Ø
2	2-II	TABLE	25	KHBØ-KHB9Ø
3	3-I	TABLE	20	CLFALP
3	3-II	TABLE	20	CLFBET
3	3-III	TABLE	9	DALPF
3	3-IV	TABLE	9	DBETA
3	3-V	TABLE	22	FMALPH
3	3-VI	TABLE	22	FMBETA
3	3-VII	TABLE	11	YBETA
3	3-VIII	TABLE	21	FLBETA
3	3-IX	TABLE	23	FNBETA
4	4-I	WLIFT	1	CLWØ1,CLW91,CLW914-CLW916
4	4-II	WLIFT	1	CLWØ2-CLWØ4,CLW92-CLW94
4	4-III	WDRAG	2	CDWØ1,CDW91,CDW914-CDW916
4	4-IV	WDRAG	2	CDWØ2-CDWØ4,CDW92-CDW94

*Appendix B of Ref. 1.

TABLE 3-2 (Continued)

Subsystem	Table	Routine	Key	VAX File Name
4	4-V	TABLE	8	EWHØ1-EWH94
4	4-VI	WING1	17	CLBØ1, CLBØ2
4	4-VII	WING1	17	CLBCL1,CLBCL2
4	4-VIII	AEROPQ		CMØWP1-CMØWP4
4	4-XI	WING1	12	CLDAØ1-CLDA94
4	4-XIII	AEROPQ		CKNDA1-CKNDA4
4	4-XIV	AEROPQ		CNDA1-CNDA4
4	4-XV	AEROPQ		TDPYL
4	4-XVI	AEROPQ		TKPYL
5	5-I	TABLE	6	CLHØ-CLH2Ø,CLHM1Ø-CLHM2Ø
5	5-II	TABLE	6	CHLM2-CHLM6
5	5-III	TABLE	7	CDH2-CDH6
5	5-IV	TABLE RSIDEW	4 14	EF1
5	5-V	TABLE	26	ENØØ-EN9Ø
5	5-VI	AEROPQ		KHBET, KVBET
5	5-VII	AEROPQ		PCPM
6	6-I	VLIFT1	15	CLVØ-CLV2Ø,CLVM15,CLVM2Ø
6	6-II	VLIFT1	15	CYV4-CYV6
6	6-III	TABLE	16	CDVØ-CDV6
6	6-IV	RSIDEW	13	DP1ØØ-DP195Ø
6	6-V	RSIDEW	13	DP2ØØ-DP295Ø
6	6-VI	RSIDEW	13	DP3ØØ-DP395Ø

TABLE 3-2 (Continued)

Subsystem	Table	Routine	Key	VAX File Name
6	6-VII	RSIDEW	13	DP4ØØ-DP495Ø
6	6-VIII	RSIDEW	27	BKØ-BK3Ø
7	7A-I	AEROPQ		DOMGD
7	7A-II	AEROPQ		DONGD
8	8a-I	CONMIX		TB1DXL
8	8a-II	CONMIX		TBDXPØ-TBDXP2
8	8a-III	CONMIX		TTØDXL
8	8a-IV	CONMIX		TTDXCØ,THEREF
8	8a-V	CONMIX		TETAMD
8	8a-VI	CONMIX		THROR
8	8a-VII	CONMIX		TA1BM
8	8a-VIII	CONMIX		TA1VT
17	17-I	CONMIX		TKPROP
17	17-II	CONMIX		TKINTG
18	18-I	CONMIX		RSHPWR
18	18-II	CONMIX		RSPHRT
18	18-III	CONMIX		THPRØ1-THPRØ4
18	18-IV	AEROPQ		THINTL, THSLOP

TABLE 3-2 (Continued)

INDEXING TABLES

Subsystem	Description	VAX File Name
4	Mach Number Index	XMTAB
5	Elevator Angle Index	DELTAB
6	Rudder Angle Index	DLRTAB
6	Mast Angle Index for DP Arrays	BMBLK
6	Sideslip Angle Index for DP Array	BFBLK
18	Altitude Index	TABALT

TABLE 3-2 (Concluded)

TABLES NOT READ IN USING TABLE ROUTINE

Subsystem	Table	Description	VAX Table Identification*
4	4-XII	Wing lift coefficient due to aileron deflection	CLWDA
4	4-X	Wing coefficient of drag at wing coefficient of lift equal to zero for $M_N < 0.2$	CDCLØ
4	4-X	Wing coefficient of drag at wing coefficient of lift equal to zero for $\beta_m = 90$, $F_X = 0$	CDCLM
4	4SP-III	Constant in the CLR and KFW equation	DELF
4	4-IX	Partial of wing coefficient of lift with respect to angle of attack for $M_N < 0.2$	PCOPAW
4	4-IX	Partial of wing coefficient of lift with respect to angle of attack for $\beta_m = 90$, $F_X = 0$	PCOPWA

*These tables are read in from the constant and coefficients input data array before the flight configuration group. See Ref. 2.

TABLE 3-3. FUNCTION ROUTINE TABLE LOOKUP

Key	Routine	Function
1	WLIFT	Wing lift
2	WDRAG	Wing drag
3	TABLE	Horizontal stabilizer downwash
4	TABLE	Elevator effectiveness
5	TABLE	Partial of stabilizer C_L with respect to angle of attack
6	TABLE	Horizontal stabilizer lift
7	TABLE	Horizontal stabilizer drag
8	TABLE	Partial of wing C_L with respect to angle of attack
9	TABLE	Fuselage drag
10	WING1	Partial of wing C_L with respect to angle of attack divided by partial of C_L at $C_L = 0$
11	TABLE	Fuselage Y force
12	WING1	Aileron effectiveness
13	RSIDEW	Rudder sidewash factor
14	RSIDEW	Rudder effectiveness
15	VLIFT1	Rudder side force
16	TABLE	Rudder drag
17	WING1	Wing dihedral stability at C_L (wing) = 0
18	WING1	Wing dihedral stability as a function of wing loading

TABLE 3-3 (Concluded)

Key	Routine	Function
19	WING1	Wing drag at C_L (wing) = 0
20	TABLE	Fuselage lift
21	TABLE	Fuselage rolling moment
22	TABLE	Fuselage pitching moment
23	TABLE	Fuselage yawing moment
24	TABLE	Rotor wake on horizontal tail ($W_i \mid R/H/W_{i_R}$)
25	TABLE	Rotor wake horizontal tail (K_{H_β})
26	TABLE	Dynamic pressure ratio at horizontal tail
27	RSIDEW	Rotor sidewash factor (K_β)

```
*****   VERIFICATION OF INPUT DATA FILE*****

                XV-15 TILT ROTOR DIGITAL FLIGHT SIMULATION
                G.W. = 13000.0 LBS, 299.8 AFT C.G.
                FLAPS 0/0, GEAR UP, 9-1-88
                EXAMPLE CASE FOR DOCUMENTATION
     ***** SUBSYSTEM 1 - ROTOR GROUP *****
3.0       12.5      14.0      4.667     -15.0     102.5     225.0
300.0     193.0     100.0     0.97      0.015     -0.068    0.81
291.7     193.0     118.0     3986.0    90.0      1.0       10.0
1.0       0.6       0.5333    0.4667    0.4       0.3333    0.2667
0.2000    0.1333    0.0667    0.0
0.0       10.2      12.3      14.5      17.75     21.90     26.15
30.65     34.65     38.00     40.90
1.6       0.0       0.0       0.0       0.0       338.19    3.0
4.95      8.0       -30.0     8.0       1.0
2.5       180000.   0.01      0.85      0.35      0.20
1.0       0.11      -0.08     1.5629083 -2.911932 54.0
17.807    -0.561    6.0       0.1067    0.5733    1.0       5.5
     ***** SUBSYSTEM 3 - FUSELAGE GROUP *****
293.0     84.0
-7.23     -1.56     66.5      0.0       -0.5      1.15
     ***** SUBSYSTEM 4 - WING-PYLON GROUP *****
291.17    95.85     181.0     32.17     5.225     -6.5      5.7
0.0       0.0       0.0       -0.774    0.27      -0.0016   0.006
-0.0315   0.057     -0.016    -0.32     -0.06     1.0       -0.45
1.4000    -0.0035   0.26      0.0806    .00003341 .000007386
24.05
     ***** SUBSYSTEM 5 - HORIZONTAL STABILIZER GROUP *****
560.0     103.0               50.25     3.92                -0.00422
0.0       0.518     0.8       0.24      1.0       0.0       0.0
     ***** SUBSYSTEM 6 - VERTICAL STABILIZER GROUP *****
2.0
570.02    -77.0     115.69    25.25     0.0       3.02522
0.27      0.25      -0.1      0.0       1.0       0.24
570.02    77.0      115.69    25.25     0.0       3.02522
0.27      0.25      -0.1      0.0       1.0       0.24
     ***** SUBSYSTEM 7 - LANDING GEAR GROUP *****
324.0     7.4       139.0     4.95      10.0      7.0
     ***** SUBSYSTEM 8 - CONTROL SYSTEM GROUP *****
4.8       4.8       2.5       4.8       4.8       2.5
4.167     3.93      8.0       0.0       1.0       1.0       1.0
0.0
0.0
0.0
                              0.0       1.5
9.6       9.6       5.0       10.0      90.0      -5.0
     ***** SUBSYSTEM 14 - IGE MOMENT GROUP *****
-7506.0   23366.0   -20134.0  5290.0    -0.1      1.6386    0.5
-0.9      -2.6      -0.08
     ***** SUBSYSTEMS 17,18, &19 - POWER MANAGEMENT GROUP *****
11.3      0.0       6.0       6.0       824.0     35.133    0.93
-0.94     1.94      0.0       13100.0   235.0     475.0     288.16
0.0032    0.875     0.00125   0.0       0.0       42.0      1400.0
1.0       1.0       10.0      -5.0      33.5
```

Figure 3-2. Printout Summary of Input Data

```
     ***** SUBSYSTEM 20 - SCAS GROUP *****
1.0       1.078
0.3       3.0       0.3
0.6       -1.0      0.921     0.386     0.107     0.0
-7.5      -7.5      0.2       0.2       0.0       0.0
0.092     0.059
1.0       1.617
0.3       3.0       0.3
1.0       1.0       1.07      1.07      0.064     0.057
10.0      10.0      0.2       0.2       0.0       0.0
0.2       0.2
1.0       0.4
2.7       2.7       0.0
2.94      0.0       0.16      0.08      0.0       0.0
0.0       0.0       0.0       0.0       0.0       0.0
0.0       0.0
    *****  TABLES NOT READ IN FROM OUTSIDE FILES  *****
0.057     0.0575    0.057     0.0563
0.0799    0.080     0.080     0.08
0.0799    0.0837    0.0915    0.0988
0.2126    0.2512    0.256     0.442
0.0177    0.0419    0.058     0.243
0.0177    0.0178    0.0179    0.0405
0.00316   0.00396   0.00476   0.0
0.000     15.0      30.0      60.0
***** FLIGHT CONFIGURATION GROUP *****
13000.0   1000.0    0.0       0.0
299.8     0.0       81.65     52795.0   21360.0   66335.0   1234.0
20.5      11.24     9.26      1.76
4.9       4.8       2.5       6.96      517.0     517.0     0.01
180.0     0.0       0.0       0.0       1.0       0.0
0.0       3.0       0.0       0.0       0.0       0.0
0.0       0.0       1000.0    0.0       0.0       0.0
1.0       1.0       0.0
          0         1         0         1         0
          0         0         1         0         1
          1         0         0         1         1         0
          4         7         10
[SAM.AEROTAB]TABLIS.DAT
END OF DATA


   *****     END OF VERIFICATION     *****
BEGINNING TABLE DATA READ FUNCTION
TABLE DATA READ FUNCTION COMPLETE
  THERE WERE  306  DATA TABLES READ IN
```

Figure 3-2 (Continued)

SUBSYSTEM NO. 1 ROTOR GROUP

NAME	DESCRIPTION	VALUE	UNITS
XBLADS	NUMBER OF ROTOR BLADES	3.0000	-ND-
RADIUS	RADIUS OF ROTOR DISC	12.500	FT
CHORD	BLADE CHORD	14.000	IN
LMAST	MAST LENGTH	4.6670	FT
DEL3	PITCH FLAP COUPLING	-15.000	DEG
IBLADE	BLADE FLAPPING INERTIA	102.50	SLG-FT2
KH	FLAPPING HUB SPRING RATE	225.00	FT-LB/DEG
SLSP	S.L. OF SHAFT PIVOT POINT	300.00	IN
BLSP	B.L. OF SHAFT PIVOT POINT	193.00	IN
WLSP	W.L. OF SHAFT PIVOT POINT	100.00	IN
BTLOSS	BLADE TIP LOSS FACTOR	0.97000	-ND-
DEL0	CONST IN CDF EQUATION	0.15000E-01	-ND-
DEL1	CONST IN CDF EQUATION	-0.68000E-01	1/RAD
DEL2	CONST IN CDF EQUATION	0.81000	1/RAD2
SLPYL	S.L. OF PYLON C.G.	291.70	IN
WLPYL	W.L. OF PYLON C.G.	118.00	IN
PYLWT	WEIGHT OF TWO PYLONS	3986.0	LBS
BETAD	MAST TILT ANGLE	0.00000E+00	DEG
PHIM	MAST DIHEDRAL ANGLE	1.0000	DEG
NSEGMT	NUMBER OF BLADE SEGMENTS	10	-ND-
X(1)	BLADE STATION / R	1.0000	-ND-
X(2)	BLADE STATION / R	0.60000	-ND-
X(3)	BLADE STATION / R	0.53330	-ND-
X(4)	BLADE STATION / R	0.46670	-ND-
X(5)	BLADE STATION / R	0.40000	-ND-
X(6)	BLADE STATION / R	0.33330	-ND-
X(7)	BLADE STATION / R	0.26670	-ND-
X(8)	BLADE STATION / R	0.20000	-ND-
X(9)	BLADE STATION / R	0.13330	-ND-
X(10)	BLADE STATION / R	0.66700E-01	-ND-
X(11)	BLADE STATION / R	0.00000E+00	-ND-
THETA(1)	BLADE TWIST	0.00000E+00	DEG
THETA(2)	BLADE TWIST	10.200	DEG
THETA(3)	BLADE TWIST	12.300	DEG
THETA(4)	BLADE TWIST	14.500	DEG
THETA(5)	BLADE TWIST	17.750	DEG
THETA(6)	BLADE TWIST	21.900	DEG
THETA(7)	BLADE TWIST	26.150	DEG
THETA(8)	BLADE TWIST	30.650	DEG
THETA(9)	BLADE TWIST	34.650	DEG
THETA(10)	BLADE TWIST	38.000	DEG
THETA(11)	BLADE TWIST	40.900	DEG
K0	CONST-WING VELOCITY EQU	1.6000	-ND-
K1	CONST-WING VELOCITY EQU	0.00000E+00	-ND-
K2	CONST-WING VELOCITY EQU	0.00000E+00	-ND-
K3	CONST-WING VELOCITY EQU	0.00000E+00	-ND-
K4	CONST-WING VELOCITY EQU	0.00000E+00	-ND-
SLWTE	STA LINE WING TRAIL EDGE	338.19	IN

(Printed if NTSOSW = 0 in INIT)

Figure 3-2 (Continued)

KRW	SKEW ANGLE VEL.DIST.FACT.	3.0000	-ND-
NASEGS	NUMBER OF AERO. SEGMENTS	8	-ND-
BDALPO	CONST-BLADE ZERO LIFT	1.0000	DEG
AOBAR	PRECONE ANGLE	2.5000	DEG
KHUB	CONING HUB SPRING	0.18000E+06	FT-LB/DEG
RSLCO	CONST-SLOPE OF LIFT CURVE	4.9500	-ND-
RSLC1	CONST-SLOPE OF LIFT CURVE	8.0000	-ND-
RSLC2	CONST-SLOPE OF LIFT CURVE	-30.000	-ND-
CDALPH	DRAG COEF. SLOPE W/ALPHA	0.10000E-01	-ND-
CDLIM	ONSET - PROFILE DRAG RISE	0.85000	-ND-
CDMACH	LOWER LIMIT - MACH EFFECT	0.35000	-ND-
CDFACT	DRAG COEFFICIENT FACTOR	0.20000	-ND-
CTMAXM	CT MAX MULT. FACTOR	1.0000	-ND-
CDMAX	MAX. DRAG COEFFICIENT	0.11000	-ND-
GEWASH	A/S WASHOUT IGE	-0.80000E-01	SEC/FT
GECON1	CONST. IN IGE EQUATION	1.5629	-ND-
GECON2	CONST. IN IGE EQUATION	-2.9119	-ND-
SFWASH	A/S WASHOUT ROTOR SIDE FX	54.000	FPS
KMU1	INDUCED VEL. DISTR. EQN.	17.807	-ND-
KMU2	INDUCED VEL. DISTR. EQN.	-0.56100	-ND-
KMUSF	SIDEWARD FLT CORR. FACTOR	6.0000	-ND-
MULO	INDUCED VEL. DISTR. EQN.	0.10670	-ND-
MUH1	INDUCED VEL. DISTR. EQN.	0.57330	-ND-
SDBM90	SPINNER DRAG AT BETAD=90	1.0000	FT2
SDBM	SPINNER DRAG EQU. CONST.	5.5000	FT2

SUBSYSTEM NO. 1 ROTOR GROUP TABLES

TABLE NAME	DESCRIPTION	DIRECTORY
TBAR	MAX THRUST COEFFICIENT VS MU	[SAM.AEROTAB]
CTL15	THRUST COEF END LIMIT,BM=15.	[SAM.AEROTAB]
CTL30	THRUST COEF END LIMIT,BM=30.	[SAM.AEROTAB]
CTL60	THRUST COEF END LIMIT,BM=60.	[SAM.AEROTAB]
TXSF	SIDEWASH EFFECT	[SAM.AEROTAB]
TXSS	SIDEWASH EFFECT	[SAM.AEROTAB]

(Printed if NTSOSW = 0 in INIT)

Figure 3-2 (Continued)

SUBSYSTEM NO. 2 ROTOR INDUCED VELOCITIES GROUP TABLES

TABLE NAME	DESCRIPTION	DIRECTORY
W00	IND VEL RATIO ON HOR STAB,BM=0., VT = 0 KTS	[SAM.AEROTAB]
W020	IND VEL RATIO ON HOR STAB,BM=0., VT = 20 KTS	[SAM.AEROTAB]
W040	IND VEL RATIO ON HOR STAB,BM=0., VT = 40 KTS	[SAM.AEROTAB]
W060	IND VEL RATIO ON HOR STAB,BM=0., VT = 60 KTS	[SAM.AEROTAB]
W080	IND VEL RATIO ON HOR STAB,BM=0., VT = 80 KTS	[SAM.AEROTAB]
W0100	IND VEL RATIO ON HOR STAB,BM=0., VT = 100 KTS	[SAM.AEROTAB]
W0120	IND VEL RATIO ON HOR STAB,BM=0., VT = 120 KTS	[SAM.AEROTAB]
W0140	IND VEL RATIO ON HOR STAB,BM=0., VT = 140 KTS	[SAM.AEROTAB]
W150	IND VEL RATIO ON HOR STAB,BM=15., VT = 0 KTS	[SAM.AEROTAB]
W1520	IND VEL RATIO ON HOR STAB,BM=15., VT = 20 KTS	[SAM.AEROTAB]
W1540	IND VEL RATIO ON HOR STAB,BM=15., VT = 40 KTS	[SAM.AEROTAB]
W1560	IND VEL RATIO ON HOR STAB,BM=15., VT = 60 KTS	[SAM.AEROTAB]
W1580	IND VEL RATIO ON HOR STAB,BM=15., VT = 80 KTS	[SAM.AEROTAB]
W15100	IND VEL RATIO ON HOR STAB,BM=15., VT = 100 KTS	[SAM.AEROTAB]
W15120	IND VEL RATIO ON HOR STAB,BM=15., VT = 120 KTS	[SAM.AEROTAB]
W15140	IND VEL RATIO ON HOR STAB,BM=15., VT = 140 KTS	[SAM.AEROTAB]
W300	IND VEL RATIO ON HOR STAB,BM=30., VT = 0 KTS	[SAM.AEROTAB]
W3020	IND VEL RATIO ON HOR STAB,BM=30., VT = 20 KTS	[SAM.AEROTAB]
W3040	IND VEL RATIO ON HOR STAB,BM=30., VT = 40 KTS	[SAM.AEROTAB]
W3060	IND VEL RATIO ON HOR STAB,BM=30., VT = 60 KTS	[SAM.AEROTAB]
W3080	IND VEL RATIO ON HOR STAB,BM=30., VT = 80 KTS	[SAM.AEROTAB]
W30100	IND VEL RATIO ON HOR STAB,BM=30., VT = 100 KTS	[SAM.AEROTAB]
W30120	IND VEL RATIO ON HOR STAB,BM=30., VT = 120 KTS	[SAM.AEROTAB]
W30140	IND VEL RATIO ON HOR STAB,BM=30., VT = 140 KTS	[SAM.AEROTAB]
KHB0	INDUCED VEL FACTOR VS SIDESLIP,BM=0.	[SAM.AEROTAB]
KHB15	INDUCED VEL FACTOR VS SIDESLIP,BM=15.	[SAM.AEROTAB]
KHB30	INDUCED VEL FACTOR VS SIDESLIP,BM=30.	[SAM.AEROTAB]
KHB60	INDUCED VEL FACTOR VS SIDESLIP,BM=60.	[SAM.AEROTAB]
KHB90	INDUCED VEL FACTOR VS SIDESLIP,BM=90.	[SAM.AEROTAB]

***** Printout deleted here to shorten figure *****
(Printed if NTSOSW = 0 in INIT)

NAME	DESCRIPTION	VALUE	UNITS
GW	A/C GROSS WEIGHT	13000.	LBS
PRSALT	PRESSURE ALTITUDE	1000.0	FT
DELTAT	DEGREES ABOVE STANDARD DAY	0.00000E+00	DEG C
OAT	OUTSIDE AIR TEMPERATURE	20.000	DEG C
SLCG0	A/C C.G. S.L. @BETAD=0	299.80	IN
BLCG	A/C C.G. B.L. @BETAD=0	0.00000E+00	IN
WLCG0	A/C C.G. W.L. @BETAD=0	81.650	IN
IXX0	A/C ROLL INERTIA @BETAD=0	52795.	SLG-FT2
IYY0	A/C PTCH INERTIA @BETAD=0	21360.	SLG-FT2
IZZ0	A/C YAW INERTIA @BETAD=0	66335.	SLG-FT2
IXZ0	A/C CROS INERTIA @BETAD=0	1234.0	SLG-FT2

Figure 3-2 (Continued)

KI1	CONSTANT IN IXX EQUATION	20.500	1/DEG
KI2	CONSTANT IN IYY EQUATION	11.240	1/DEG
KI3	CONSTANT IN IZZ EQUATION	9.2600	1/DEG
KI4	CONSTANT IN IXZ EQUATION	1.7600	1/DEG
XLN	LONG CYCLIC STICK INPUT	4.9000	IN
XLT	LATERAL CYCLIC STICK INPUT	4.8000	IN
XPD	PEDALS POSITION INPUT	2.5000	IN
XCOL	COLLECTIVE STICK POSITION	7.6000	IN
OMEGRO	CENTER ROTOR RPM	589.00	RPM
RPMSEL	RPM SELECTION	589.00	RPM
TSTEP	INTEGRATION STEP SIZE	0.10000E-01	SEC
U	VELOCITY ALONG X-GND AXIS	0.10000E-01	KNOTS
V	VELOCITY ALONG Y-GND AXIS	0.00000E+00	KNOTS
W	VELOCITY ALONG Z-GND AXIS	0.00000E+00	KNOTS
ROLL	EULER ROLL ANGLE	0.00000E+00	DEG
PITCH	EULER PITCH ANGLE	0.20000	DEG
YAW	EULER YAW ANGLE	0.00000E+00	DEG
P	A/C ROLL RATE (X-BODY)	0.00000E+00	DEG/SEC
Q	A/C PITCH RATE (Y-BODY)	0.00000E+00	DEG/SEC
R	A/C YAW RATE (Z-BODY)	0.00000E+00	DEG/SEC
NORTHG	A/C POSITION GROUND AXIS N	0.00000E+00	FT
EASTG	A/C POSITION GROUND AXES E	0.00000E+00	FT
HEIGHT	A/C POSITION GROUND AXIS Z	1000.0	FT
VWIND	VELOCITY OF AIR MASS	0.00000E+00	FT/SEC
THWIND	WIND AZIMUTH ANGLE	0.00000E+00	DEG
PSWIND	WIND ELEVATION ANGLE	0.00000E+00	DEG
RODESC	RATE OF DESCENT (+ DOWN)	0.00000E+00	FT/MIN
NZ	G-LEVEL FOR COORD. TURN	1.0000	-ND-
NTURN	TURN CONTROL(1=COORD TURN)	0	-ND-
MASTSW	MAST TILT ACTUATOR SW	0	-ND-
XFLAPS	FLAPS SWITCH SETTING	3	-ND-
XLGEAR	LANDING GEAR SELECTOR SW.	0	-ND-
BFTRIM	FORCE FEEL TRIM SWITCH	1	-ND-
DFLPSW	DEL FLAP SWITCH	0	-ND-
ENGINL	LEFT ENGINE OPERATING IND.	1.0000	-ND-
ENGINR	RIGHT ENGINE OPERATING IND	1.0000	-ND-
DGPTSW	DIAGNOSTIC PRINT SWITCH	0	-ND-
TABSW	PRINT TABLE LOOKUP DIAG.	0	-ND-
STBPSW	BYPASS THOG IN DERIVATIVES	1	-ND-
NDIMSW	NON-DIMENSIONAL DERIVS	0	-ND-
NTSOSW	PRINT FLT CONFIG DATA ONLY	0	-ND-
STBMTX	PRINT STABILITY MATRIX	0	-ND-
SRTSPT	PRINT STABILITY ROOTS	0	-ND-
RDERMX	PRINT ROTOR DERIV MATRIX	0	-ND-
TRMPAG	PRINT INDIVIDUAL TRIM PAGE	1	-ND-
FAMSUM	PRINT FORCE & MOM SUMMARY	1	-ND-
SCSRTS	PRINT SCAS-ON ROOTS	0	-ND-

I/O ASSIGNMENTS

IR = 4 IW = 7 IUNIT = 10

Figure 3-2 (Concluded)

```
&PTINPT IN MAIN
U     =0.1000000    ,V     =0.0000000E+00,W     =0.0000000E+00,P     =0.0000000E+00,Q     =0.0000000E+00,R     =0.0000
XLN   = 4.800000    ,XLT   = 4.800000    ,XPD   = 2.500000    ,XCOL  = 7.500000    ,XFLAPS=            3,XLGEAR=
THOLG = 1.000000    ,ROLL  =0.0000000E+00,PITCH =0.0000000E+00,YAW   =0.0000000E+00,OMEGRO= 589.0000    ,BETAD =0.0000
&END
```

From CONMIX

```
   SUBSYSTEM NO. 18 - ENGINE - INPUTS

XTHROR= 86.00       VTK   =0.1000       DELSTD=0.9644       AMBTMP= 293.2       OMGRPT= 2167.       OMGLPT= 2167.


   SUBSYSTEM NO. 18 - ENGINE - OUTPUTS

QRPT  = 247.2       QLPT  = 247.2

   SUBSYSTEM NO. 18 - ENGINE - OTHERS

HPROC = 1089.       HP    = 1057.       HPENAV = 973.9      HPAVTR= 973.9       HPLREQ= 725.1       HPRREQ= 725.1



   SUBSYSTEM NO. 8A - CONTROLS GROUP - INPUTS

THOLG = 1.000       THORG = 1.000       XLN   = 4.800       XLT   = 4.800       XPD   = 2.500       XCOL  = 7.500
ESAS  =0.0000E+00   RSAS  =0.0000E+00   ASAS  =0.0000E+00   VTK   =0.1000

   SUBSYSTEM NO. 8A - CONTROLS GROUP - OUTPUTS

THETOL=0.7889       THETOR=0.7889       B1L   =0.0000E+00   B1R   =0.0000E+00   DELE  =0.0000E+00   DELR  =0.0000E+00
DELA  =0.0000E+00   XROT  =-.3446       BETAD =0.0000E+00   A1L   =0.0000E+00   A1R   =0.0000E+00



   SUBSYSTEM NO. 9 - C.G. AND INERTIAS - INPUTS

BETAD =0.0000E+00

   SUBSYSTEM NO. 9 - C.G. AND INERTIAS - OUTPUTS

SLCG  = 24.98       WLCG  = 6.804       IXX   =0.5280E+05   IYY   =0.2136E+05   IZZ   =0.6634E+05   IXZ   = 1234.
```

From ALGROT

```
   SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - INPUTS

U     =0.1688       V     =0.0000E+00   W     =0.0000E+00   P     =0.0000E+00   Q     =0.0000E+00   R     =0.0000E+00
RHO   =0.2253E-02   MN    =0.1499E-03   BETAD =0.0000E+00   OMEGL = 589.0       OMEGR = 589.0
A1L   =0.0000E+00   A1R   =0.0000E+00   B1L   =0.0000E+00   B1R   =0.0000E+00   THTOLD= 45.20       THTORD= 45.20
CPM   =0.9998       SPM   =0.1745E-01   CBM   = 1.000       SBM   =0.0000E+00
LXH   =-.1667E-01   LYH   = 16.16       LZH   = 6.195


   SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - RIGHT ROTOR

FAFLPR=0.1331E-04   LTFLPR=0.3397E-03   AOR   =0.4549E-01   TR    = 5783.       HR    =0.1723       YR    =0.8504
A1RBD =0.1668E-09   B1RBD =0.0000E+00   MUR   =0.2189E-03   QREQR = 6466.       OMEGAR= 61.68       OMGRP = 61.68
THETOR=0.7889       THORG = 1.000       WIR   = 47.99       LAMDAR=0.6221E-01   LAMDIR=0.6225E-01   LAMDOR=0.0000E+00
```

Figure 3-3 . Option DTPT Print

```
A11   =-.4773E+05   A12   =0.2227E+06   A21   =-.2227E+06   A22   =-.4773E+05   B1    = 75.02      B2    =-19.18
C11   = 3611.       C12   =0.1902E+05   C21   =-.1902E+05   C22   = 3611.       ARS   = 4.952      DNR   =0.6575E+06
GEFR  = 1.000       CHIRD = 2.515
```

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - LEFT ROTOR

```
FAFLPL=0.1331E-04   LTFLPL=0.3397E-03   AOL   =0.4549E-01   TL    = 5783.      HL    =0.1723      YL    =0.8504
A1LBD =0.1668E-09   B1LBD =0.0000E+00   MUL   =0.2189E-03   QREQL = 6466.      OMEGAL= 61.68      OMGLP = 61.68
THETOL=0.7889       THOLG = 1.000       WIL   = 47.99       LAMDAL=0.6221E-01  LAMDIL=0.6225E-01  LAMDOL=0.0000E+00
A11   =-.4773E+05   A12   =0.2227E+06   A21   =-.2227E+06   A22   =-.4773E+05   B1    = 75.02      B2    =-19.18
C11   = 3611.       C12   =0.1902E+05   C21   =-.1902E+05   C22   = 3611.       ALS   = 4.952      DNL   =0.6575E+06
GEFL  = 1.000       CHILD = 2.515
```

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - VARIABLES IN WIND AXIS

```
HL    =0.1723       HR    =0.1723       YL    =0.8504       YR    =0.8504       HPL   = 725.1     HPR   = 725.1
AOL   =0.4549E-01   AOR   =0.4549E-01   FAFLPL=0.1331E-04   FAFLPR=0.1331E-04   LTFLPL=0.3397E-03  LTFLPR=0.3397E-03
```

SUBSYSTEMS 1,10B - ROTOR CHARACTERISTICS - OUTPUTS

```
A1L   =0.0000E+00   A1R   =0.0000E+00   B1L   =0.0000E+00   B1R   =0.0000E+00   TL    = 5783.      TR    = 5783.
HL    =0.1723       HR    =0.1723       YL    =0.8504       YR    =0.8504       WIL   = 47.99      WIR   = 47.99
HPL   = 725.1       HPR   = 725.1       QREQL = 6466.       QREQR = 6466.
MA1L  =0.1716       MA1R  =0.1716       LB1L  = 4.379       LB1R  = 4.379
XROT  =-.3446       YROT  =0.0000E+00   ZROT  =-.1156E+05   LROT  =0.0000E+00   MROT  =-415.9      NROT  =0.0000E+0
GECONS= 1.000
```

From AEROPQ

SUBSYSTEM NO. 4 - WING/PYLON - RIGHT WING

```
U     =0.1688       V     =0.0000E+00   W     =0.1000E-01   RWR   = 10.87      DEL   =-.3837E-04   SIWR  = 56.18
XIWR  =-.5760       XBAR  =-.5285       XTE   =-3.152       YIWR  = 10.71      YBAR  = 5.377      YTIP  =-.1042E-04
UDW   =-.2199E-02   VDW   =0.1746E-01   XLE   = 2.073       YTE1  =-10.41      YTE2  = 10.41      YLE1  =-10.67
YLE2  = 10.67       XTIP1 =-10.87       XTIP2 = 10.87       RWX   = 10.87      RWY   = 10.87      XA    =-29.69
YA    = 302.1       G     =0.0000E+00   WW    = 76.77
```

SUBSYSTEM NO. 4 - WING/PYLON - LEFT WING

```
U     =0.1688       V     =0.0000E+00   W     =0.1000E-01   RWL   = 10.87      DEL   =-.3837E-04   SIWL  = 56.18
XIWL  =-.5760       XBAR  =-.5285       XTE   =-3.152       YIWL  =-10.71      YBAR  = 5.377      YTIP  =-.1042E-04
UDW   =-.2199E-02   VDW   =0.1746E-01   XLE   = 2.073       YTE1  =-10.41      YTE2  = 10.41      YLE1  =-10.67
YLE2  = 10.67       XTIP1 =-10.87       XTIP2 = 10.87       RWX   = 10.87      RWY   = 10.87      XA    =-29.69
YA    = 302.1       G     =0.0000E+00   WW    = 76.77
```

SUBSYSTEM NO. 2 - INDUCED VELOCITIES ----- INPUTS

```
TR    = 5783.       TL    = 5783.       HR    =0.1723       HL    =0.1723       YR    =0.8504       YL    =0.8504
WIR   = 47.99       WIL   = 47.99       BETAD =0.0000E+00
```

SUBSYSTEM NO. 2 - INDUCED VELOCITIES ----- OUTPUTS

```
URIWR =0.1688       URIWL =0.1688       WRIWR =-76.78       WRIWL =-76.78       RWR   = 10.87      RWL   = 10.87
URH   =0.0000E+00   WRH   =0.0000E+00   UVR   =0.1688       WVR   =0.1688       CRFR  =0.0000E+00  CRFLD =0.0000E+00
```

Figure 3-3 (Continued)

SUBSYSTEM NO. 2 - INDUCED VELOCITIES ----- INPUTS

```
TR    =0.2442E-01   TL    =0.2442E-01   HR    =0.0000E+00   HL    =0.0000E+00   YR    =0.8796E-02   YL    =0.8796E-02
WIR   =
```

SUBSYSTEM NO. 3 - FUSELAGE CHARACTERISTICS - INPUTS

```
VTK   =0.1002       ALPFD =0.0000E+00   BETFD =0.0000E+00
```

SUBSYSTEM NO. 3 - FUSELAGE CHARACTERISTICS - OUTPUTS

```
QF    =0.3221E-04   LF    =-.2328E-03   DF    =-.3414E-04   FLIFT =-.2328E-03   FDRAG =-.3414E-04   FROLLM=0.0000E+00
FPTCHM=-.2142E-02   FYAWM =0.0000E+00   FHIGEM=0.0000E+00
```

SUBSYSTEM NO. 4 - WING/PYLON VARIABLES - INPUTS

```
URIWL =0.1688       URIWR =0.1688       RWR   = 10.87       BETAD =0.0000E+00   XFLAPS =          3 DELA  =0.0000E+00
VTK   =0.1002       ALPFD =0.0000E+00   BETFD =0.0000E+00   UWAKE =0.1688       VWAKE =0.0000E+00   WWAKE =0.1000E-01
P     =0.0000E+00   Q     =0.0000E+00   R     =0.0000E+00   RHO   =0.2253E-02   VSOUND= 1126.
```

SUBSYSTEM NO. 4 - WING/PYLON VARIABLES - OUTPUTS

```
EWHM  = 5.784       ALPWDL=-89.87       ALPWDR=-89.87       WWLIFL= 1.491       WWLIFR= 1.491
WWDRGL=-695.1       WWDRGR=-695.1       ALPW  =-.1638E-01   WFLIFT=-.2014E-02   WFDRAG=-.7429E-03   WMPOWP=-.3350E-02
YWP   =0.0000E+00   LPWP  =0.0000E+00   NPWP  =0.0000E+00
```

SUBSYSTEM NO. 4 - PYLON/SPINNER DRAG VARIABLES

```
FXPYLN=-.1971       FZPYLN= 89.66       PYLAPP=-1.569       FXSD  =-.1825E-01   FYSD  =0.0000E+00   FZSD  = 5.190
FXPYLB=0.0000E+00   FYPYLB=0.0000E+00   FZPYLB=0.0000E+00   FMLSD =0.0000E+00   FMMSD =0.1996       FMNSD =0.0000E+00
FMLPYL=0.0000E+00   FMMPYL= 1.796       FMNPYL=0.0000E+00   DPYLN =-89.66       GPYLD =0.2015       QPYL  = 2.595
ALFPYL=-1.567       BETPYL=0.0000E+00   SPYLB =0.0000E+00   KPYLB =0.8060E-03   DPYBET=0.0000E+00   SGPYL =0.3517E-02
SD    = 5.190
```

SUBSYSTEM NO. 4 - WING/PYLON VARIABLES - OTHERS

```
PP    =0.0000E+00   RP    =0.0000E+00   CNR   =0.0000E+00   CNB   =0.0000E+00   CLR   =0.0000E+00   CLP   =0.0000E+00
CNP   =0.0000E+00   CYR   =0.0000E+00   CYP   =0.0000E+00   CYB   =0.0000E+00   CLDA  =0.0000E+00   CNDA  =0.0000E+00
SWINF = 68.63       URIWL =0.1688       URIWR =0.1688       WRIWL =-76.78       WRIWR =-76.78       VTIWL = 76.78
VTIWR = 76.78       QIWPL = 6.641       QIWPR = 6.641
```

SUBSYSTEM NO. 5 - HORIZONTAL STABILIZER - INPUTS

```
AXH   = 21.68       AZH   = 1.779       Q     =0.0000E+00   UH    =0.1688       VH    =0.0000E+00   WH    =0.2442E-01
UWH   =0.1705       UWAKE =0.1688       VWAKE =0.0000E+00   WWAKE =0.1000E-01   EWHM  = 5.784       BETH  =0.0000E+00
HNU   = 1.005       QH    =0.2590E-04   DELE  =0.0000E+00   XIH   =0.0000E+00   BETFD =0.0000E+00   MN    =0.1501E-03
RHO   =0.2253E-02
```

SUBSYSTEM NO. 5 - HORIZONTAL STABILIZER - OUTPUTS

Figure 3-3 (Continued)

```
ALPHST=0.4276E-01   ALPHL = 2.450       ALPHD  = 2.450      LHO   =0.2264E-03   DH    =0.1637E-04   PHM   =0.0000E+00

   SUBSYSTEM NO. 5 - HORIZONTAL STABILIZER - OTHERS

CLWD  =0.2808E-01   LH    =-.7926E-03   BHS   =0.0000E+00   PEPA  =0.3900


   SUBSYSTEM NO. 6 - VERTICAL STABILIZER - INPUTS

UWAKE =0.1688       VWAKE =0.0000E+00   WWAKE =0.0000E+00   P     =0.0000E+00   Q     =0.0000E+00   R     =0.0000E+00
I     =         1   UVR(I)=0.1688       VVR(I)=0.0000E+00   WVR(I)=0.2442E-01   UWTSQ(I)=0.1705
MN    =0.1501E-03   RHO   =0.2253E-02   DELR  =0.0000E+00   BETAD =0.0000E+00   XFLAPS =         3
BETFD =0.0000E+00   ALPHD = 2.450       SLCG  = 24.98       WLCG  = 6.804

   SUBSYSTEM NO. 6 - VERTICAL STABILIZER - OUTPUTS

BETVS(I)=0.0000E+00 BETVSD(I)=0.0000E+00QV(I) =0.3238E-04   VSYF(I) =0.0000E+00 VSDGR(I) =-.7128E-05


   SUBSYSTEM NO. 6 - VERTICAL STABILIZER - OTHERS

AXV(I)= 22.52       AYV(I)=-6.417       AZV(I)= 2.837
CYVT(I)=0.0000E+00  CDVT(I)=0.8719E-02
VFBF(1)=-.7128E-05  VFBF(2)=0.0000E+00  VFBF(3)=0.0000E+00


   SUBSYSTEM NO. 6 - VERTICAL STABILIZER - INPUTS

UWAKE =0.1688       VWAKE =0.0000E+00   WWAKE =0.0000E+00   P     =0.0000E+00   Q     =0.0000E+00   R     =0.0000E+00
I     =         2   UVR(I)=0.1688       VVR(I)=0.0000E+00   WVR(I)=0.2442E-01   UWTSQ(I)=0.1705
MN    =0.1501E-03   RHO   =0.2253E-02   DELR  =0.0000E+00   BETAD =0.0000E+00   XFLAPS =         3
BETFD =0.0000E+00   ALPHD = 2.450       SLCG  = 24.98       WLCG  = 6.804

   SUBSYSTEM NO. 6 - VERTICAL STABILIZER - OUTPUTS

BETVS(I)=0.0000E+00 BETVSD(I)=0.0000E+00QV(I) =0.3238E-04   VSYF(I) =0.0000E+00 VSDGR(I) =-.7128E-05


   SUBSYSTEM NO. 6 - VERTICAL STABILIZER - OTHERS

AXV(I)= 22.52       AYV(I)= 6.417       AZV(I)= 2.837
CYVT(I)=0.0000E+00  CDVT(I)=0.8719E-02
VFBF(1)=-.7128E-05  VFBF(2)=0.0000E+00  VFBF(3)=0.0000E+00
```

****

	X	Y	Z	L	M	N
ROTOR	-0.34	0.00	-11564.08	0.00	-415.94	0.00
AERO	-0.29	0.00	1331.41	0.00	800.28	0.00
TOTAL,BODY AXIS	-0.63	0.00	-10232.67	0.00	384.35	0.00
TOTAL,INER AXIS	-0.63	0.00	2767.33	0.00	384.35	0.00

****

Figure 3-3 (Continued)

********** FORCE AND MOMENT SUMMARY (BODY AXIS) **********

****
*** VT = 0.10 KTS *** NACELLE INCIDENCE = 90.0 DEG *** HELICOPTER ***
*** GW = 13000.0 RPM = 589.00 SLCG = 299.80 WLCG = 81.65 ***
*** MAST ANGLE = 0.00 DEG ***** FLAP SETTING = 40/25 DEG ***
****

	X-FORCE LBS	Y-FORCE LBS	Z-FORCE LBS	ROLL FT-LBS	PITCH FT-LBS	YAW FT-LBS
FUSELAGE	0.000	0.000	0.000	0.000	-0.002	0.000
WING						
LEFT WING	-0.037	0.000	695.144	-7442.363	400.430	-0.393
RIGHT WING	-0.037	0.000	695.144	7442.363	400.430	0.393
FREESTREAM	-0.001	0.000	-0.002	0.000	-0.001	0.000
TOTAL	-0.074	0.000	1390.287	0.000	800.859	0.000
ENGINE PYLONS	-0.197	0.000	89.657	0.000	1.796	0.000
HORIZ. STAB.	0.000	0.000	0.000	0.000	-0.005	0.000
VERT. STAB.						
FIN NO. 1	0.000	0.000	0.000	0.000	0.000	0.000
FIN NO. 2	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.000	0.000	0.000	0.000	0.000	0.000
LANDING GEAR						
MAIN AERO.	0.000	0.000	0.000	0.000	0.000	0.000
NOSE AERO.	0.000	0.000	0.000	0.000	0.000	0.000
DYNAMIC	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.000	0.000	0.000	0.000	0.000	0.000
JET THRUST						
LEFT ENG	0.000	0.000	-76.859	1236.154	-1.281	0.000
RIGHT ENG	0.000	0.000	-76.859	-1236.154	-1.281	0.000
TOTAL	0.000	0.000	-153.719	0.000	-2.562	0.000
GROUND EFFECT						
FUSE-HOR STAB	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL AIRFRAME	-0.271	0.000	1326.224	0.000	800.085	0.000
ROTOR						
LEFT ROTOR	-0.172	-101.776	-5782.041	92830.500	-207.968	-6465.744
RIGHT ROTOR	-0.172	101.776	-5782.041	-92830.500	-207.968	6465.744
HUB SPINNER	-0.018	0.000	5.190	0.000	0.200	0.000
TOTAL ROTOR	-0.363	0.000	-11558.892	0.000	-415.736	0.000
TOTAL AIRCRAFT (BODY AXIS)	-0.634	0.000	-10232.667	0.000	384.349	0.000
TOTAL AIRCRAFT (INERTIAL AXIS)	-0.634	0.000	2767.333	0.000	384.349	0.000

Figure 3-3 (Concluded)

```
                                    DATE: 11OCT'87     RUNTYPE: TUNL

&TUNNEL IN MAIN
ALPLOW=-10.00000    ,DELALP= 1.000000    ,NALPHA=          21,BETLOW=-20.00000    ,DELBET= 2.000000    ,NBETA =          21
&END
```

Figure 3-4. Option TUNL Print

```
*************************************************************
*****              TUNNEL  NON-DIMENSIONAL              *****
*****           FORCE AND MOMENT COEFFICIENTS           *****
*****         VT=  303.804 FPS   VKTS=  180.000 KNOTS   *****
***** MAST ANGLE=  90.0 DEG    FLAP SETTING=     0/0 DEG *****
*************************************************************
```

WIND AXES						BODY AXES						
CD	CY	CL	CROLL	CM	CN	X	Y	Z	L	M	N	ALPHA
0.11089	0.00000	-0.69280	0.00000	0.30684	0.00000	0.01110	0.00000	0.70153	0.00000	0.30684	0.00000	-10.000
0.10042	0.00000	-0.58082	0.00000	0.27696	0.00000	-0.00833	0.00000	0.58938	0.00000	0.27696	0.00000	-9.000
0.09009	0.00000	-0.46884	0.00000	0.24553	0.00000	-0.02396	0.00000	0.47681	0.00000	0.24553	0.00000	-8.000
0.08505	0.00000	-0.37598	0.00000	0.23322	0.00000	-0.03859	0.00000	0.38355	0.00000	0.23322	0.00000	-7.000
0.08014	0.00000	-0.28312	0.00000	0.21971	0.00000	-0.05011	0.00000	0.28995	0.00000	0.21971	0.00000	-6.000
0.07536	0.00000	-0.19025	0.00000	0.20500	0.00000	-0.05849	0.00000	0.19609	0.00000	0.20500	0.00000	-5.000
0.07071	0.00000	-0.09737	0.00000	0.18911	0.00000	-0.06375	0.00000	0.10207	0.00000	0.18911	0.00000	-4.000
0.07036	0.00000	0.02191	0.00000	0.17599	0.00000	-0.07141	0.00000	-0.01820	0.00000	0.17599	0.00000	-3.000
0.07020	0.00000	0.14119	0.00000	0.16144	0.00000	-0.07508	0.00000	-0.13865	0.00000	0.16144	0.00000	-2.000
0.07053	0.00000	0.26046	0.00000	0.14568	0.00000	-0.07506	0.00000	-0.25919	0.00000	0.14568	0.00000	-1.000
0.07098	0.00000	0.37976	0.00000	0.12829	0.00000	-0.07098	0.00000	-0.37976	0.00000	0.12829	0.00000	0.000
0.07672	0.00000	0.48292	0.00000	0.11003	0.00000	-0.06828	0.00000	-0.48419	0.00000	0.11003	0.00000	1.000
0.08258	0.00000	0.58612	0.00000	0.09037	0.00000	-0.06208	0.00000	-0.58864	0.00000	0.09037	0.00000	2.000
0.08857	0.00000	0.68931	0.00000	0.06946	0.00000	-0.05237	0.00000	-0.69300	0.00000	0.06946	0.00000	3.000
0.09483	0.00000	0.79249	0.00000	0.04737	0.00000	-0.03932	0.00000	-0.79717	0.00000	0.04737	0.00000	4.000
0.10410	0.00000	0.89238	0.00000	0.02482	0.00000	-0.02592	0.00000	-0.89806	0.00000	0.02482	0.00000	5.000
0.11349	0.00000	0.99226	0.00000	0.00107	0.00000	-0.00914	0.00000	-0.99869	0.00000	0.00107	0.00000	6.000
0.12300	0.00000	1.09214	0.00000	-0.02389	0.00000	0.01101	0.00000	-1.09899	0.00000	-0.02389	0.00000	7.000
0.13264	0.00000	1.19200	0.00000	-0.05005	0.00000	0.03454	0.00000	-1.19886	0.00000	-0.05005	0.00000	8.000
0.14855	0.00000	1.29525	0.00000	-0.09364	0.00000	0.05590	0.00000	-1.30254	0.00000	-0.09364	0.00000	9.000
0.16494	0.00000	1.39845	0.00000	-0.13835	0.00000	0.08041	0.00000	-1.40585	0.00000	-0.13835	0.00000	10.000

Figure 3-4 (Continued)

```
*****************************************************************
*****              TUNNEL  NON-DIMENSIONAL                  *****
*****            FORCE AND MOMENT COEFFICIENTS              *****
*****          VT=  303.804 FPS   VKTS=  180.000 KNOTS      *****
***** MAST ANGLE=  90.0 DEG    FLAP SETTING=      0/0 DEG   *****
*****************************************************************
```

WIND AXES						BODY AXES						
CD	CY	CL	CROLL	CM	CN	X	Y	Z	L	M	N	BETA
0.23115	0.41735	0.33984	0.06735	0.06396	-0.12343	-0.07447	0.47124	-0.33984	0.05974	0.20192	-0.12343	-20.000
0.20772	0.38739	0.34536	0.06113	0.08957	-0.11789	-0.07785	0.43262	-0.34536	0.05364	0.20150	-0.11789	-18.000
0.18435	0.35273	0.35088	0.05429	0.11140	-0.10935	-0.07998	0.38988	-0.35088	0.04720	0.19922	-0.10935	-16.000
0.15986	0.31242	0.35640	0.04708	0.12792	-0.09694	-0.07953	0.34181	-0.35640	0.04065	0.19424	-0.09694	-14.000
0.13538	0.26979	0.36192	0.03993	0.13837	-0.08318	-0.07633	0.29204	-0.36192	0.03439	0.18646	-0.08318	-12.000
0.11669	0.22494	0.36744	0.03282	0.14673	-0.06890	-0.07586	0.24179	-0.36744	0.02818	0.17959	-0.06890	-10.000
0.10078	0.18011	0.36991	0.02579	0.14945	-0.05471	-0.07473	0.19239	-0.36991	0.02216	0.17010	-0.05471	-8.000
0.09271	0.13507	0.37237	0.01885	0.14512	-0.04114	-0.07808	0.14402	-0.37237	0.01628	0.15645	-0.04114	-6.000
0.08459	0.09004	0.37483	0.01215	0.13399	-0.02744	-0.07810	0.09572	-0.37483	0.01060	0.13889	-0.02744	-4.000
0.07782	0.04502	0.37729	0.00596	0.12766	-0.01374	-0.07620	0.04771	-0.37729	0.00523	0.12887	-0.01374	-2.000
0.07098	0.00000	0.37976	0.00000	0.12829	0.00000	-0.07098	0.00000	-0.37976	0.00000	0.12829	0.00000	0.000
0.07782	-0.04502	0.37729	-0.00596	0.12766	0.01374	-0.07620	-0.04771	-0.37729	-0.00523	0.12887	0.01374	2.000
0.08459	-0.09004	0.37483	-0.01215	0.13399	0.02744	-0.07810	-0.09572	-0.37483	-0.01060	0.13889	0.02744	4.000
0.09271	-0.13507	0.37237	-0.01885	0.14512	0.04114	-0.07808	-0.14402	-0.37237	-0.01628	0.15645	0.04114	6.000
0.10078	-0.18011	0.36991	-0.02579	0.14945	0.05471	-0.07473	-0.19239	-0.36991	-0.02216	0.17010	0.05471	8.000
0.11669	-0.22494	0.36744	-0.03282	0.14673	0.06890	-0.07586	-0.24179	-0.36744	-0.02818	0.17959	0.06890	10.000
0.13538	-0.26979	0.36192	-0.03993	0.13837	0.08318	-0.07633	-0.29204	-0.36192	-0.03439	0.18646	0.08318	12.000
0.15986	-0.31242	0.35640	-0.04708	0.12792	0.09694	-0.07953	-0.34181	-0.35640	-0.04065	0.19424	0.09694	14.000
0.18435	-0.35273	0.35088	-0.05429	0.11140	0.10935	-0.07998	-0.38988	-0.35088	-0.04720	0.19922	0.10935	16.000
0.20772	-0.38739	0.34536	-0.06113	0.08957	0.11789	-0.07785	-0.43262	-0.34536	-0.05364	0.20150	0.11789	18.000
0.23115	-0.41735	0.33984	-0.06735	0.06396	0.12343	-0.07447	-0.47124	-0.33984	-0.05974	0.20192	0.12343	20.000

CPU TIME SINCE TIMEX CALLED = 0.0338 MIN TOTAL TIME USED IN THIS RUN = 2.2477 MIN

Figure 3-4 (Concluded)

DATE: 11OCT'87 RUNTYPE: TRMS

SWEEP GW STARTING WITH 0.1300E+05 , INCREMENTING BY -150.0 , ENDING WITH 0.1300E+05

SWEEP U STARTING WITH 0.1000 , INCREMENTING BY 10.00 , ENDING WITH 20.10

From MAIN Program

TOTAL TIME USED SINCE BEGINNING OF RUN 1.3275 MIN

GW / U SWEEP --- ITERATION 1 / 1

ITER	ERROR	ROLL	PITCH	YAW	XLN	XLT	XPD	THOLG	FAFLPL	LTFLPL
1	0.3311	0.000	1.512	0.000	5.370	4.800	2.500	7.153	-1.168	-0.230
2	0.0655	0.000	0.512	0.000	5.003	4.800	2.500	7.247	-0.416	-0.068
3	0.0005	0.000	0.242	0.000	4.905	4.800	2.500	7.269	-0.213	-0.024

Trim Iteration Printout
From Subroutine IFHB42

Figure 3-5. Option TRMS Print

```
************        AIRCRAFT TRIM FLIGHT CONDITIONS        ************

*********************************************************************
*** VT =  0.10 KTS *** NACELLE INCIDENCE = 90.0 DEG  ***  HELICOPTER  ***
*** GW = 13000.0      RPM =  589.00   SLCG =  299.80   WLCG =   81.65 ***
***   MAST ANGLE =   0.00 DEG   *****   FLAP SETTING =    40/25  DEG  ***
*********************************************************************
```

From Subroutine HEADER if TRMPAG = 1

From Subroutine IFHB42 if TRMPAG = 1

```
                                  ----- EARTH REFERENCE -----
                                    UE          VE          WE
                RATE    (FPS)   0.1688      0.0000E+00   0.5821E-10
                ACCEL   (FPS2)  0.1749E-04  -.7575E-13   0.4655E-03

                          --------------- BODY REFERENCE ---------------
                      UB          VB          WB          P           Q           R
RATE  (FT OR DEG/SEC)  0.1688     0.0000E+00  0.7131E-03  0.0000E+00  0.0000E+00  0.0000E+00
ACCEL(FT OR DEG/SEC2)                                     -.9890E-14  0.1776E-02  -.4231E-12

----- ATMOSPHERIC CONDITIONS -----  ----- FLIGHT PATH CONDITIONS -----  ----- INERTIAS -----  ----- CENTER OF GRAVITY -----
ALTITUDE      (FT)          1000.00  CAL. AIRSPEED  (KNOTS)      0.00     (SLUGS-FT2)              (IN)
DENSITY ALT. (FT)           1815.95  RATE OF DECENT (FPS)        0.00
PRESSURE ALT.(FT)           1000.00  G-LEVEL        (G S)        1.00  IXX     0.5280E+05     S.L.      299.8
AMBIENT TEMP (DEG-R)         293.16  DYN PRES (SLUGS/FT-SEC2)    0.00  IXZ      1234.         B.L.     0.0000E+00
OUTSIDE AIR TEMP (DEG-C)      20.00  ANGLE OF ATTACK  (DEG)      0.242  IYY     0.2136E+05     W.L.       81.65
AIR DENSITY (SLUGS/FT3) 0.2253E-02   FLIGHT PATH ANGLE(DEG)      0.000  IZZ     0.6634E+05
                                     SIDESLIP ANGLE   (DEG)      0.000
THETES (ND)                 1.01735  ROLL ANGLE       (DEG)      0.000
DELSTD (ND)                 0.96439  PITCH ANGLE      (DEG)      0.242
SIGMA PRIME (ND)            0.94794  YAW ANGLE        (DEG)      0.000

----- CONTROL DISPLACEMENTS -----  --------------- POWER/TORQUE ---------------  ---------- BLADE ----------
        (+)       (IN)      (PER)          POWER       TORQUE     GOV. PITCH   TIP SPEED       TIP MACH NO.
COLL    (UP)     7.6518     76.52          (SHP)      (FT-LBS)      (DEG)       (FPS)            (ND)
LONG    (FWD)    4.9047     51.09  LEFT    1014.        9040.       3.248       771.2          0.6848
LAT     (RT)     4.8000     50.00  RIGHT   1014.        9040.       3.248       771.2          0.6848
PEDAL   (RT)     2.5000     50.00  ENGINE  1100.

----- SWASH PLATE ANGLE (DEG) ----                  ----------- ROTOR -------------
        LEFT ROTOR   RIGHT ROTOR  ------------- FLAPPING ------------  ---- FORCES - MAST AXIS ------  -- JET --
THETA0    47.6909     47.6909                 A0        LONG       LAT      THRUST     H-FORCE    Y-FORCE   THRUST
B1         0.2199      0.2199               (DEG)      (DEG)      (DEG)     (LBS)      (LBS)      (LBS)    (LBS)
A1         0.0000      0.0000       LEFT    3.0917    -0.2132    -0.0242   7328.35    -27.63     -5.21    101.11
                                    RIGHT    3.0917    -0.2132    -0.0242   7328.35    -27.63     -5.21    101.11

------- SURFACE POSITIONS -------          PROP      ADVANCE   INDUCED   INFLOW    COEFF     COEFF     COEFF
          (DEG)                          EFFIC.      RATIO   VELOCITY   RATIO     POWER     THRUST    DRAG
                                          (ND)       (ND)      (FPS)     (ND)      (ND)      (ND)      (ND)
     ELEVATOR          0.4363       LEFT    0.0000    0.0002   54.0268    0.0700   0.001100  0.011146  0.028295
     AILERON           0.0000       RIGHT   0.0000    0.0002   54.0268    0.0700   0.001100  0.011146  0.028295
     RUDDER            0.0000
                                          CDRISE      CTEL     CDALPHA   CDLIM     CDMACH    CDFACT
                                           (ND)       (ND)      (ND)      (ND)      (ND)      (ND)
                                    LEFT  -0.03127   0.01601   0.01000   0.85000   0.35000   0.20000
                                    RIGHT -0.03127   0.01601

   TIME USED FOR THIS TRIM =   0.0820 MIN
```

Figure 3-5 (Continued)

From Subroutine STABDV if RDERMX = 1

ROTOR DERIVATIVE MATRIX

	U	V	W	P	Q	R	THETO	B1	OMEGA
FAFLPL	0.8877E-02	-.1311	0.2287E-02	-2.753	-4.586	0.2261	-.1985E-03	-.9766	0.1019E-03
FAFLPR	0.8877E-02	0.1311	0.2287E-02	2.753	-4.586	-.2261	-.1985E-03	-.9766	0.1019E-03
LTFLPL	0.1312	0.8935E-02	0.7231E-04	4.585	-2.716	2.150	0.8094E-03	-.2104	-.7334E-03
LTFLPR	0.1312	-.8936E-02	0.7231E-04	-4.585	-2.716	-2.150	0.8094E-03	-.2104	-.7334E-03
HL	1.677	-7.453	-.1448E-01	-352.0	-389.2	33.56	-2.412	-127.0	-.8770
HR	1.677	7.453	-.1448E-01	352.0	-389.2	-33.56	-2.412	-127.0	-.8770
YL	7.474	1.719	-.3435E-01	389.6	-352.3	125.7	-.3804	-29.39	-.2202
YR	7.474	-1.719	-.3435E-01	-389.6	-352.3	-125.7	-.3804	-29.39	-.2202
TL	9.473	-4.213	39.14	-658.8	-30.04	268.8	628.9	0.4043	237.6
TR	9.473	4.209	39.14	658.8	-30.04	-268.6	628.9	0.4043	237.6
HPL	1.453	-.1511E-01	-.3186E-01	2.050	-11.68	53.74	127.4	0.9192E-01	49.31
HPR	1.453	0.1605E-01	-.3186E-01	-2.059	-11.68	-53.78	127.4	0.9192E-01	49.31
XROT	-3.353	-.1144E-04	0.2896E-01	-.5722E-03	778.3	0.8011E-03	4.824	253.9	1.754
YROT	0.0000E+00	-3.291	0.0000E+00	-756.2	0.0000E+00	-260.7	0.0000E+00	0.0000E+00	0.0000E+00
ZROT	-18.68	0.3906E-02	-78.26	-.1953E-01	47.76	-.2051	-1258.	-1.834	-475.1
LROT	0.0000E+00	-161.5	0.0000E+00	-.2826E+05	0.0000E+00	6033.	0.0000E+00	0.0000E+00	0.0000E+00
MROT	24.00	-.3052E-04	-.4448	0.3052E-02	-6881.	-.1831E-02	-90.59	-2013.	-28.97
NROT	0.0000E+00	242.3	0.0000E+00	0.1138E+05	-.9766E-02	-1747.	0.0000E+00	0.0000E+00	0.0000E+00
QREQL	12.96	-.1348	-.2847	18.28	-106.7	332.5	1136.	0.8193	293.1
QREQR	12.96	0.1431	-.2847	-18.35	-106.7	-332.9	1136.	0.8193	293.1
QLPT	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	-.9155E-04	-.9155E-04	-4.866
QRPT	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	-.9155E-04	-.9155E-04	-4.866

TIME USED IN STABDV = 0.0318 MIN

Figure 3-5 (Continued)

********** STABILITY DERIVATIVE MATRIX **********

```
*************************************************************************
*** VT =  0.10 KTS *** NACELLE INCIDENCE = 90.0 DEG  ***  HELICOPTER  ***
*** GW = 13000.0      RPM =  589.00   SLCG =  299.80   WLCG =   81.65 ***
***   MAST ANGLE =   0.00 DEG   *****   FLAP SETTING =    40/25  DEG  ***
*************************************************************************
```

		XBODY	YBODY	ZBODY	LBODY	MBODY	NBODY	TORQUE
			UNITS =	(LBS OR FT-LB)	/	(FT/SEC OR RAD/SEC)		
P	TOTAL	0.0000	-757.9852	0.0000	-22360.4121	0.0000	11398.4580	0.0000
	ROTOR	0.0000	-757.6395	0.0000	-28275.1563	0.0000	11390.5078	0.0000
	AIRFRM	0.0000	-0.3457	0.0000	5914.7446	0.0000	7.9501	0.0000
Q	TOTAL	780.2933	0.0000	-78.8477	0.0000	-6941.5117	0.0000	-350.0195
	ROTOR	780.1481	0.0000	-90.4297	0.0000	-6891.5356	0.0000	-350.0195
	AIRFRM	0.1452	0.0000	11.5796	0.0000	-49.9762	0.0000	0.0000
R	TOTAL	-0.0001	-258.1416	0.0195	5467.7905	0.0018	-1823.9417	0.0195
	ROTOR	-0.0001	-261.3074	0.0195	6037.2656	0.0000	-1752.4609	0.0195
	AIRFRM	0.0000	3.1658	0.0049	-569.4751	0.0018	-71.4807	0.0000
U	TOTAL	-5.0090	0.0000	-17.1162	0.0000	30.9249	0.0000	25.7056
	ROTOR	-3.3407	0.0000	-15.5347	0.0000	23.9260	0.0000	25.7056
	AIRFRM	-1.6683	0.0000	-1.5817	0.0000	6.9989	0.0000	0.0000
V	TOTAL	0.0000	-8.6709	0.0000	-196.7278	0.0000	88.8709	0.0000
	ROTOR	0.0000	-8.0627	0.0000	-200.4453	0.0000	85.0854	0.0000
	AIRFRM	0.0000	-0.6082	0.0000	3.7175	0.0000	3.7854	0.0000
W	TOTAL	0.0821	0.0000	-83.3013	0.0000	-9.0323	0.0000	-2.2593
	ROTOR	0.0091	0.0000	-77.7974	0.0000	-0.2449	0.0000	-2.2593
	AIRFRM	0.0731	0.0000	-5.5041	0.0000	-8.7873	0.0000	0.0000
RPM	TOTAL	1.7508	0.0000	-423.7712	0.0000	3.3638	0.0000	865.3047
	ROTOR	1.7561	0.0000	-475.7688	0.0000	-29.0139	0.0000	865.3047
	AIRFRM	-0.0053	0.0000	51.9973	0.0000	32.3777	0.0000	0.0000

CONTROL DERIVATIVE MATRIX

		XBODY	YBODY	ZBODY	LBODY	MBODY	NBODY	TORQUE
			UNITS =	(LBS OR FT-LB)	/	(INCH OR DEG(XTHEG)		
XCOL	TOTAL	7.6973	0.0000	-1807.0566	0.0000	-17.3708	0.0000	-361.3154
	ROTOR	7.7189	0.0000	-2012.2471	0.0000	-145.0208	0.0000	-361.3154
	AIRFRM	-0.0216	0.0000	205.1901	0.0000	127.6500	0.0000	0.0000
XTHEG	TOTAL	4.6852	0.0000	-1129.5127	0.0000	-9.9886	0.0000	2274.7969
	ROTOR	4.6988	0.0000	-1257.7627	0.0000	-89.7744	0.0000	2274.7969
	AIRFRM	-0.0137	0.0000	128.2505	0.0000	79.7858	0.0000	0.0000
XLN	TOTAL	533.9872	0.0000	-3.7236	0.0000	-4231.0894	0.0000	3.4121
	ROTOR	533.9872	0.0000	-3.8799	0.0000	-4231.1787	0.0000	3.4121
	AIRFRM	0.0000	0.0000	0.1563	0.0000	0.0891	0.0000	0.0000
XLT	TOTAL	0.0000	-13.2464	0.0000	11868.9863	0.0000	-1372.6200	0.0000
	ROTOR	0.0000	-13.2464	0.0000	12625.2656	0.0000	-1372.5977	0.0000
	AIRFRM	0.0000	0.0000	0.0000	-756.2792	0.0000	-0.0223	0.0000
XPD	TOTAL	0.0000	94.1416	0.0000	781.3130	0.0000	6584.8760	0.0000
	ROTOR	0.0000	94.1419	0.0000	782.4688	0.0000	6584.8701	0.0000
	AIRFRM	0.0000	-0.0003	0.0000	-1.1558	0.0000	0.0059	0.0000

TIME USED IN HANDLE = 0.1833 MIN From Subroutine HANDLE if STBMTX = 1

Figure 3-5 (Continued)

```
************************
* LONGITUDINAL PHUGOID *
************************

  REAL                        -.17981142
  DAMPED NATURAL FREQUENCY    0.34031451
  UNDAMPED FREQUENCY (RPS)    0.38489753
  UNDAMPED FREQUENCY (CPS)    0.61258394E-01
  PERIOD IN SEC                18.462862
  DAMPING                     0.46716699
  TIME TO HALF                 3.8548553
```

SCAS OFF Roots From Subroutine SROOTS if SRTSPT = 1

```
****************************
* LONGITUDINAL SHORT PERIOD *
****************************

  REAL                        -1.2392523
  DAMPED NATURAL FREQUENCY     1.9518186
  UNDAMPED FREQUENCY (RPS)     2.3119996
  UNDAMPED FREQUENCY (CPS)    0.36796644
  PERIOD IN SEC                3.2191415
  DAMPING                     0.53600889
  TIME TO HALF                0.55932677

**************
* DUTCH ROLL *
**************

  REAL                        -.44364989
  DAMPED NATURAL FREQUENCY     1.5813282
  UNDAMPED FREQUENCY (RPS)     1.6423836
  UNDAMPED FREQUENCY (CPS)    0.26139367
  PERIOD IN SEC                3.9733562
  DAMPING                     0.27012563
  TIME TO HALF                 1.5623739

*************
* ROLL MODE *
*************
  REAL                        -.89871418
  TIME TO HALF                0.77126523

***************
* SPIRAL MODE *
***************
  REAL                        -.75362235E-01
  TIME TO HALF                 9.1975377
```

Figure 3-5 (Continued)

*** COUPLED STABILITY ROOTS - SCAS-OFF - FLAPPING ALLOWED TO CHANGE - 6 X 6 MATRIX ***

MASS MATRIX--

0.40407E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.40542E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.29606E+02	0.20348E+05	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.40407E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.50950E+05	-0.10756E+04	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	-0.10756E+04	0.67168E+05	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.10000E+01	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.10000E+01

DAMPING MATRIX--

0.14391E+03	-0.40253E+02	0.62373E+04	0.50226E-05	0.00000E+00	-0.91426E-04	0.12982E+05	0.00000E+00
0.10950E+03	0.39309E+03	-0.11939E+06	0.00000E+00	0.91426E-04	0.00000E+00	0.69306E+03	0.18135E-03
-0.44178E+03	0.28221E+03	0.22056E+05	0.00000E+00	0.80361E-02	0.00000E+00	0.00000E+00	0.00000E+00
0.40452E-06	0.24967E-05	0.25110E-03	0.10070E+03	-0.62161E+04	0.11937E+06	0.96819E-05	-0.12982E+05
0.80730E-04	0.30597E-06	-0.80157E-02	0.33282E+03	0.38590E+05	0.32188E+04	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	-0.57459E+03	0.11545E+05	0.57064E+05	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	-0.10000E+01	0.00000E+00	0.00000E+00	0.13970E-07	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	-0.74583E-09	0.00000E+00	-0.10000E+01	-0.53388E-01	0.00000E+00	0.00000E+00

STIFFNESS MATRIX--

0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

SCAS OFF Roots From
Subroutines MPRINT, OUT, MAINDG, and SCASRT
if SCSRTS = 1

Figure 3-5 (Continued)

NO. OF EIGENVALUES CALCULATED 16

EIGENVALUES,(COMPLEX-VALUED) REAL	IMAG	FREQUENCIES DAMPED RPS	UNDAMPED RPS	UNDAMPED CPS	DAMPING RATIO	PERIOD SEC	TIME TO HALF AMPL SEC
0.0000000E+00	0.0000000E+00	0.0000000E+00	0.0000000E+00	0.0000000E+00	0.9999900E+38	0.9999900E+38	0.9999900E+38
0.2960550E-15	0.0000000E+00	0.0000000E+00	0.2960550E-15	0.4711861E-16	-1.000000	0.9999900E+38	0.2341278E+16
-0.3466490E-12	0.0000000E+00	0.0000000E+00	0.3466490E-12	0.5517090E-13	1.000000	0.9999900E+38	0.1999564E+13
0.7228549E-07	0.0000000E+00	0.0000000E+00	0.7228549E-07	0.1150459E-07	-1.000000	0.9999900E+38	9589019.
0.7111136E-09	0.0000000E+00	0.0000000E+00	0.7111136E-09	0.1131772E-09	-1.000000	0.9999900E+38	0.9747345E+09
0.1262603E-07	0.0000000E+00	0.0000000E+00	0.1262603E-07	0.2009495E-08	-1.000000	0.9999900E+38	0.5489826E+08
0.1426413E-05	0.0000000E+00	0.0000000E+00	0.1426413E-05	0.2270207E-06	-1.000000	0.9999900E+38	485937.1
-0.2688680E-06	0.0000000E+00	0.0000000E+00	0.2688680E-06	0.4279166E-07	1.000000	0.9999900E+38	2578020.
-0.7535622E-01	0.0000000E+00	0.0000000E+00	0.7535622E-01	0.1199332E-01	1.000000	0.9999900E+38	9.198272
-0.8987209	0.0000000E+00	0.0000000E+00	0.8987209	0.1430359	1.000000	0.9999900E+38	0.7712594
-0.4436504	1.581330	1.581330	1.642386	0.2613938	0.2701256	3.973355	1.562372
-0.4436507	-1.581329	-1.581329	1.642385	0.2613937	0.2701259	-3.973357	1.562371
-0.1798109	0.3403157	0.3403157	0.3848984	0.6125848E-01	0.4671646	18.46281	3.854866
-0.1798115	-0.3403141	-0.3403141	0.3848972	0.6125829E-01	0.4671675	-18.46290	3.854854
-1.239253	-1.951819	-1.951819	2.312000	0.3679662	0.5360090	-3.219144	0.5593266
-1.239252	1.951818	1.951818	2.311999	0.3679660	0.5360091	3.219146	0.5593268

TIME REQD FOR THIS PROBLEM 0.024 MIN

SCAS OFF Roots From
Subroutines MPRINT, OUT, MAINDG, and SCASRT
if SCSRTS = 1

Figure 3-5 (Continued)

*** RPM COUPLED STABILITY ROOTS - SCAS-OFF - FLAPPING ALLOWED TO CHANGE - 7 X 7 MATRIX ***

MASS MATRIX--

0.40407E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.40542E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.29606E+02	0.20348E+05	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.40407E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.50950E+05	-0.10756E+04	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	-0.10756E+04	0.67168E+05	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.82400E+03	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.10000E+01	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.10000E+01

DAMPING MATRIX--

0.14391E+03	-0.40253E+02	0.62373E+04	0.50226E-05	0.00000E+00	-0.91426E-04	-0.83003E+03	0.12982E+05	0.00000E+00
0.10950E+03	0.39309E+03	-0.11939E+06	0.00000E+00	0.91426E-04	0.00000E+00	-0.24519E+03	0.69306E+03	0.18135E-03
-0.44178E+03	0.28221E+03	0.22056E+05	0.00000E+00	0.80361E-02	0.00000E+00	0.23581E+04	0.00000E+00	0.00000E+00
0.40452E-06	0.24967E-05	0.25110E-03	0.10070E+03	-0.62161E+04	0.11937E+06	0.91073E-05	0.96819E-05	-0.12982E+05
0.80730E-04	0.30597E-06	-0.80157E-02	0.33282E+03	0.38590E+05	0.32188E+04	0.46598E-03	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	-0.57459E+03	0.11545E+05	0.57064E+05	0.00000E+00	0.00000E+00	0.00000E+00
-0.74333E+03	0.47116E+00	0.87280E+03	0.00000E+00	0.00000E+00	0.00000E+00	0.47368E+04	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	-0.10000E+01	0.00000E+00	0.00000E+00	0.13970E-07	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	-0.74583E-09	0.00000E+00	-0.10000E+01	-0.53388E-01	0.00000E+00	0.00000E+00	0.00000E+00

STIFFNESS MATRIX--

0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

SCAS OFF Roots From
Subroutines MPRINT, OUT, MAINDG, and SCASRT
if SCSRTS = 1

Figure 3-5 (Continued)

NO. OF EIGENVALUES CALCULATED 18

EIGENVALUES,(COMPLEX-VALUED) REAL	IMAG	FREQUENCIES DAMPED RPS	UNDAMPED RPS	UNDAMPED CPS	DAMPING RATIO	PERIOD SEC	TIME TO HALF AMPL SEC
0.0000000E+00	0.0000000E+00	0.0000000E+00	0.0000000E+00	0.0000000E+00	0.9999900E+38	0.9999900E+38	0.9999900E+38
0.1258183E-15	0.0000000E+00	0.0000000E+00	0.1258183E-15	0.2002460E-16	-1.000000	0.9999900E+38	0.5509112E+16
-0.1527745E-08	0.0000000E+00	0.0000000E+00	0.1527745E-08	0.2431482E-09	1.000000	0.9999900E+38	0.4537060E+09
0.2480169E-11	0.0000000E+00	0.0000000E+00	0.2480169E-11	0.3947312E-12	-1.000000	0.9999900E+38	0.2794757E+12
0.2478601E-11	0.0000000E+00	0.0000000E+00	0.2478601E-11	0.3944816E-12	-1.000000	0.9999900E+38	0.2796525E+12
0.6307231E-07	0.0000000E+00	0.0000000E+00	0.6307231E-07	0.1003827E-07	-1.000000	0.9999900E+38	0.1098972E+08
0.2240528E-06	0.0000000E+00	0.0000000E+00	0.2240528E-06	0.3565911E-07	-1.000000	0.9999900E+38	3093678.
0.2524561E-05	0.0000000E+00	0.0000000E+00	0.2524561E-05	0.4017964E-06	-1.000000	0.9999900E+38	274561.4
-0.2264264E-06	0.0000000E+00	0.0000000E+00	0.2264264E-06	0.3603687E-07	1.000000	0.9999900E+38	3061247.
-0.7535509E-01	0.0000000E+00	0.0000000E+00	0.7535509E-01	0.1199313E-01	1.000000	0.9999900E+38	9.198410
-0.8987213	0.0000000E+00	0.0000000E+00	0.8987213	0.1430359	1.000000	0.9999900E+38	0.7712591
-0.2712594E-01	0.1839980	0.1839980	0.1859868	0.2960071E-01	0.1458488	34.14812	25.55292
-0.2712593E-01	-0.1839979	-0.1839979	0.1859867	0.2960069E-01	0.1458488	-34.14814	25.55293
-0.4436502	1.581331	1.581331	1.642386	0.2613939	0.2701253	3.973352	1.562373
-0.4436503	-1.581331	-1.581331	1.642387	0.2613940	0.2701253	-3.973351	1.562373
-1.247340	1.899457	1.899457	2.272398	0.3616634	0.5489091	3.307885	0.5557001
-6.037715	0.0000000E+00	0.0000000E+00	6.037715	0.9609323	1.000000	0.9999900E+38	0.1148029
-1.247341	-1.899461	-1.899461	2.272402	0.3616640	0.5489085	-3.307878	0.5556999

TIME REQD FOR THIS PROBLEM 0.033 MIN

SCAS OFF Roots From
Subroutines MPRINT, OUT, MAINDG, and SCASRT
if SCASRTS = 1

Figure 3-5 (Continued)

********** FORCE AND MOMENT SUMMARY (BODY AXIS) **********

```
*********************************************************************
*** VT =  0.10 KTS *** NACELLE INCIDENCE = 90.0 DEG  ***  HELICOPTER  ***
*** GW = 13000.0      RPM =  589.00   SLCG =  299.80   WLCG =   81.65 ***
***   MAST ANGLE =   0.00 DEG   *****   FLAP SETTING =    40/25  DEG  ***
*********************************************************************
```

	X-FORCE LBS	Y-FORCE LBS	Z-FORCE LBS	ROLL FT-LBS	PITCH FT-LBS	YAW FT-LBS
FUSELAGE	0.000	0.000	0.000	0.000	-0.002	0.000
WING						
LEFT WING	-0.041	0.000	869.381	-9376.809	500.447	-0.439
RIGHT WING	-0.041	0.000	869.381	9376.809	500.447	0.439
FREESTREAM	-0.001	0.000	-0.002	0.000	-0.001	0.000
TOTAL	-0.082	0.000	1738.761	0.000	1000.893	0.000
ENGINE PYLONS	-0.222	0.000	113.798	0.000	2.236	0.000
HORIZ. STAB.	0.000	0.000	0.000	0.000	0.000	0.000
VERT. STAB.						
FIN NO. 1	0.000	0.000	0.000	0.000	0.000	0.000
FIN NO. 2	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.000	0.000	0.000	0.000	0.000	0.000
LANDING GEAR						
MAIN AERO.	0.000	0.000	0.000	0.000	0.000	0.000
NOSE AERO.	0.000	0.000	0.000	0.000	0.000	0.000
DYNAMIC	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	0.000	0.000	0.000	0.000	0.000	0.000
JET THRUST						
LEFT ENG	0.000	0.000	-101.275	1628.834	-1.688	0.000
RIGHT ENG	0.000	0.000	-101.275	-1628.834	-1.688	0.000
TOTAL	0.000	0.000	-202.549	0.000	-3.376	0.000
GROUND EFFECT						
FUSE-HOR STAB	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL AIRFRAME	-0.304	0.000	1650.010	0.000	999.751	0.000
ROTOR						
LEFT ROTOR	27.667	-122.860	-7337.244	117849.211	-499.748	-8606.591
RIGHT ROTOR	27.667	122.860	-7337.244	-117849.211	-499.748	8606.591
HUB SPINNER	-0.021	0.000	6.585	0.000	0.237	0.000
TOTAL ROTOR	55.313	0.000	-14667.901	0.000	-999.259	0.000
TOTAL AIRCRAFT (BODY AXIS)	55.009	0.000	-13017.893	0.000	0.492	0.000
TOTAL AIRCRAFT (INERTIAL AXIS)	0.084	0.000	-18.008	0.000	0.492	0.000

From Subroutine FAMPRT if FAMSUM = 1

Figure 3-5 (Continued)

From Subroutine PRTTAB

XV-15 TILT ROTOR DIGITAL FLIGHT SIMULATION — DATE: 11OCT'87
G.W. = 13000 LBS, 299.8 AFT C.G. — PAGE 1

CONFIGURATION:

NACELLE INCIDENCE	90.0 DEG	GEAR	0.0 % DOWN	ALTITUDE	
FLAP SETTING	40/25 DEG	STAB INCIDENCE	0.000 DEG	PRES(MSL)	1000.0 FT
ROTOR RPM	589.0 RPM	INERTIA, SLUG-FT2		DENSITY	1816.0 FT
GROSS WEIGHT	13000.0 LB	IXX 52795.	IXZ 1234.0	HEIGHT(AGL)	1000.0 FT (OGE)
C.G. F.S.	299.800 IN	IYY 21360.	IZZ 66335.	TEMP(OAT)	20.00 DEG-C
W.L.	81.650 IN	SIGMAP	0.94794 -ND-	VSOUND	667.19 KTS
		RHO	0.0022532 SLG/FT3	WIND-V	0.00 KTS

U/VKCAS -KTS — NOTE: SYMBOL INDICATES A TRIM PROBLEM

	0.10	10.10	20.10	0.00	0.00	0.00	0.00	0.00
	0.00	9.83	19.57	0.00	0.00	0.00	0.00	0.00
AIRCRAFT CONTROL SETTINGS:								
XLN,%	51.0907	52.2458	52.7916	0.0000	0.0000	0.0000	0.0000	0.0000
XLT,%	50.0000	50.0000	50.0000	0.0000	0.0000	0.0000	0.0000	0.0000
XPD,%	50.0000	50.0000	50.0000	0.0000	0.0000	0.0000	0.0000	0.0000
XCOL,%	76.5176	76.8619	74.2551	0.0000	0.0000	0.0000	0.0000	0.0000
A1,DEG	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
B1,DEG	0.2199	0.4528	0.5628	0.0000	0.0000	0.0000	0.0000	0.0000
THETO,DEG	47.6909	47.5955	46.9895	0.0000	0.0000	0.0000	0.0000	0.0000
THOG,DEG	3.2481	3.0976	2.9087	0.0000	0.0000	0.0000	0.0000	0.0000
ELEVATOR,DEG	0.4363	0.8984	1.1167	0.0000	0.0000	0.0000	0.0000	0.0000
AILERON,DEG	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
RUDDER,DEG	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ROTOR:								
FAFLP,DEG	-0.2132	-0.3164	-0.3312	0.0000	0.0000	0.0000	0.0000	0.0000
LTFLP,DEG	-0.0242	2.1919	4.2550	0.0000	0.0000	0.0000	0.0000	0.0000
THRUST,LB	7328.3	7328.4	7135.3	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
CT	0.0111	0.0111	0.0109	0.0000	0.0000	0.0000	0.0000	0.0000
H-FORCE,LB	-27.633	-31.614	-22.521	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
Y-FORCE,LB	-5.2050	116.56	226.86	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
HORSEPOWER	1013.8	1023.0	961.04	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
Q,FT-LB	9040.1	9122.0	8569.6	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
CP	0.0011	0.0011	0.0010	0.0000	0.0000	0.0000	0.0000	0.0000
RPM,ROTOR	589.00	589.00	589.00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00
WI,FT/SEC	54.0268	55.6262	53.4910	0.0000	0.0000	0.0000	0.0000	0.0000
MU	0.0002	0.0221	0.0440	0.0000	0.0000	0.0000	0.0000	0.0000
LAMDA	0.0700	0.0720	0.0695	0.0000	0.0000	0.0000	0.0000	0.0000
AIRCRAFT ATTITUDES:								
ALPHAF,DEG	0.2421	0.1633	-0.3276	0.0000	0.0000	0.0000	0.0000	0.0000
PITCH,DEG	0.2421	0.1633	-0.3276	0.0000	0.0000	0.0000	0.0000	0.0000
GAMMA,DEG	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BETAF,DEG	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ROLL,DEG	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Figure 3-5 (Continued)

YAW,DEG	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FLIGHT CONDITIONS:

DYNAMIC PRES	0.0000	0.3274	1.2966	0.0000	0.0000	0.0000	0.0000	0.0000
MACH NUMBER	0.0001	0.0151	0.0301	0.0000	0.0000	0.0000	0.0000	0.0000
VT,KNOTS	0.1000	10.1000	20.1000	0.0000	0.0000	0.0000	0.0000	0.0000
VKCAS,KNOTS	0.0000	9.8326	19.5718	0.0000	0.0000	0.0000	0.0000	0.0000
HP-ENG	1100.0	1109.9	1043.4	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00

SYMBOL DEFINITIONS:

++++ FORCES AND MOMENTS UNBALANCED
**** CONTROLS OUT OF LIMITS
ROTOR ENDURANCE LIMIT EXCEEDED
@@@@ ROTOR STALLED
//// WING STALLED

CPU TIME SINCE TIMEX CALLED = 0.0083 MIN

TOTAL TIME USED IN THIS RUN = 2.2138 MIN

TIME: 21:55:11
DATE: 11OCT'87

TWIST AT 3/4 RADIUS IS 34.5000

TIME OF DAY - 21:55:11

Figure 3-5 (Concluded)

DATE: 11OCT'87 RUNTYPE: MANS

AFTER AIRCRAFT TRIM, A MANEUVER WILL BE RUN FOR 3.50 SEC

CONTROLS REMAIN LOCKED FOR THE FIRST 2.0 SECONDS OF THE MANEUVER

CONTROLS WILL THEN BE MOVED FOR 1.50 SEC AS SHOWN BELOW

	TIME(SEC)	DXLN(PCT)	TIME(SEC)	DXLT(PCT)	TIME(SEC)	DXPD(PCT)	TIME(SEC)	DXCOL(PCT)
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.01	-10.00	20.00	0.00	20.00	0.00	1.00	0.00
3	20.00	-10.00	0.00	0.00	0.00	0.00	3.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	20.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PITCH SCAS WILL BE TURNED OFF AT 50.00 SECONDS
ROLL SCAS WILL BE TURNED OFF AT 50.00 SECONDS
YAW SCAS WILL BE TURNED OFF AT 50.00 SECONDS

DATA WILL BE PRINTED AT 0.10 SECOND INCREMENTS

A WIND GUST WILL BE ENCOUNTERED AFTER 0.00 SEC AND WILL STOP AT 0.00 SEC INTO RUN

TIME INCREMENT TSTEP =0.01000 SECONDS

********** Printout from MAIN Program

Figure 3-6. Option MANS Print

TOTAL TIME USED SINCE BEGINNING OF RUN 2.2578 MIN

ITER	ERROR	ROLL	PITCH	YAW	XLN	XLT	XPD	THOLG	FAFLPL	LTFLPL
1	32.2205	0.000	-3.161	0.000	6.736	4.800	2.500	8.825	-2.870	-0.756
2	26.4166	0.000	-2.161	0.000	6.470	4.800	2.500	9.186	-2.573	-0.711
3	20.5574	0.000	-1.161	0.000	6.212	4.800	2.500	9.540	-2.263	-0.646
4	14.6740	0.000	-0.161	0.000	5.945	4.800	2.500	9.882	-1.939	-0.562
5	9.7765	0.000	0.839	0.000	5.673	4.800	2.500	10.213	-1.601	-0.461
6	5.3922	0.000	1.839	0.000	5.403	4.800	2.500	10.524	-1.251	-0.341
7	0.9772	0.000	2.839	0.000	5.124	4.800	2.500	10.803	-0.892	-0.203
8	0.0042	0.000	3.056	0.000	5.068	4.800	2.500	10.860	-0.813	-0.171
9	0.0001	0.000	3.056	0.000	5.070	4.800	2.500	10.860	-0.813	-0.171

Trim Iteration Printout (Prior to Running Maneuver)
From IFHB42

Figure 3-6 (Continued)

```
************      AIRCRAFT TRIM FLIGHT CONDITIONS      ************

*********************************************************************
*** VT =180.00 KTS *** NACELLE INCIDENCE =  0.0 DEG ***   AIRPLANE   ***
*** GW = 13000.0      RPM =  517.00   SLCG =  296.83   WLCG =   73.59 ***
***   MAST ANGLE =  90.00 DEG   *****   FLAP SETTING =      0/0  DEG  ***
*********************************************************************
```

From Subroutine HEADER if TRMPAG = 1

```
                                  ----- EARTH REFERENCE -----
                                    UE          VE          WE
                RATE    (FPS)    303.8       0.1421E-13  0.0000E+00
                ACCEL   (FPS2)   -.8422E-04  0.4216E-06  -.2360E-04
```

From Subroutine IFHB42 if TRMPAG = 1

```
                          --------------- BODY REFERENCE ---------------
                     UB          VB          WB          P           Q           R
RATE  (FT OR DEG/SEC)   303.4     0.2263E-06  16.20       0.0000E+00  0.0000E+00  0.0000E+00
ACCEL(FT OR DEG/SEC2)                                     0.1049E-05  0.9115E-03  0.1680E-07

----- ATMOSPHERIC CONDITIONS -----  ----- FLIGHT PATH CONDITIONS -----  ----- INERTIAS -----  ----- CENTER OF GRAVITY -----
ALTITUDE      (FT)          1000.00  CAL. AIRSPEED  (KNOTS)     175.41     (SLUGS-FT2)                 (IN)
DENSITY ALT.  (FT)          1815.95  RATE OF DECENT (FPS)         0.00
PRESSURE ALT.(FT)           1000.00  G-LEVEL        (G S)         1.00  IXX      0.5095E+05     S.L.      296.8
AMBIENT TEMP (DEG-R)         293.16  DYN PRES (SLUGS/FT-SEC2)   103.98  IXZ       1076.         B.L.     0.0000E+00
OUTSIDE AIR TEMP (DEG-C)      20.00  ANGLE OF ATTACK  (DEG)       3.056  IYY      0.2035E+05     W.L.      73.59
AIR DENSITY (SLUGS/FT3) 0.2253E-02   FLIGHT PATH ANGLE(DEG)       0.000  IZZ      0.6717E+05
                                     SIDESLIP ANGLE   (DEG)       0.000
THETES (ND)                 1.01735  ROLL ANGLE       (DEG)       0.000
DELSTD (ND)                 0.96439  PITCH ANGLE      (DEG)       3.056
SIGMA PRIME (ND)            0.94794  YAW ANGLE        (DEG)       0.000

----- CONTROL DISPLACEMENTS -----  --------------- POWER/TORQUE ---------------  ---------- BLADE ----------
        (+)        (IN)      (PER)          POWER       TORQUE     GOV. PITCH   TIP SPEED       TIP MACH NO.
COLL    (UP)      4.3379     43.38          (SHP)      (FT-LBS)      (DEG)       (FPS)            (ND)
LONG    (FWD)     5.0705     52.82  LEFT    536.4       5449.        10.86       741.8           0.6588
LAT     (RT)      4.8000     50.00  RIGHT   536.4       5449.        10.86       741.8           0.6588
PEDAL   (RT)      2.5000     50.00  ENGINE  586.8

----- SWASH PLATE ANGLE (DEG) ----                  ----------- ROTOR -----------
        LEFT ROTOR   RIGHT ROTOR  ------------- FLAPPING ------------  ---- FORCES - MAST AXIS ------  -- JET --
THETA0    66.6595      66.6595            A0        LONG       LAT      THRUST    H-FORCE   Y-FORCE   THRUST
B1         1.5000       1.5000          (DEG)      (DEG)      (DEG)     (LBS)     (LBS)     (LBS)     (LBS)
A1         0.0000       0.0000   LEFT   1.1991    -0.8126    -0.1706    704.24     65.13    -44.92    -22.93
                                 RIGHT  1.1991    -0.8126    -0.1706    704.24     65.13    -44.92    -22.93

------- SURFACE POSITIONS -------          PROP      ADVANCE   INDUCED   INFLOW    COEFF     COEFF     COEFF
          (DEG)                           EFFIC.     RATIO   VELOCITY   RATIO     POWER     THRUST    DRAG
                                           (ND)      (ND)      (FPS)     (ND)      (ND)      (ND)      (ND)
     ELEVATOR          1.1271   LEFT    0.7259    0.0239    1.0893    0.4498   0.000861  0.001390  0.014018
     AILERON           0.0000   RIGHT   0.7259    0.0239    1.0893    0.4498   0.000861  0.001390  0.014018
     RUDDER            0.0000
                                        CDRISE     CTEL     CDALPHA   CDLIM     CDMACH    CDFACT
                                         (ND)      (ND)      (ND)      (ND)      (ND)      (ND)
                                 LEFT  -0.03806   0.01426   0.01000   0.85000   0.35000   0.20000
                                 RIGHT -0.03806   0.01426

   TIME USED FOR THIS TRIM =   0.2028 MIN
```

Figure 3-6 (Continued)

********** STABILITY DERIVATIVE MATRIX **********

```
*************************************************************************
*** VT =180.00 KTS *** NACELLE INCIDENCE =  0.0 DEG ***   AIRPLANE   ***
*** GW = 13000.0      RPM =  517.00   SLCG =  296.83   WLCG =   73.59 ***
***   MAST ANGLE =  90.00 DEG   *****   FLAP SETTING =      0/0  DEG  ***
*************************************************************************
```

		XBODY	YBODY	ZBODY	LBODY	MBODY	NBODY	TORQUE
			UNITS =	(LBS OR FT-LB)	/	(FT/SEC OR RAD/SEC)		
P	TOTAL	0.0000	-328.4382	0.0000	-38589.6016	-0.0080	-11545.0439	0.0000
	ROTOR	0.0000	-70.0362	0.0010	-9641.7314	-0.0080	-14519.5049	0.0000
	AIRFRM	0.0000	-258.4020	0.0000	-28947.8672	0.0000	2974.4612	0.0000
Q	TOTAL	307.2832	-0.0003	-3192.5103	0.0080	-22055.9063	0.0000	872.8032
	ROTOR	341.6557	-0.0003	-2075.8167	0.0080	6135.9370	0.0000	872.8032
	AIRFRM	-34.3725	0.0000	-1116.6835	0.0000	-28191.8438	0.0000	0.0000
R	TOTAL	0.0000	3212.6543	0.0000	-3218.7510	0.0000	-57064.4453	0.0000
	ROTOR	0.0000	2063.4795	0.0000	-11310.6973	0.0000	-29880.5859	0.0000
	AIRFRM	0.0000	1149.1748	0.0000	8091.9468	0.0000	-27183.8574	0.0000
U	TOTAL	-143.9136	0.0000	-109.5029	-0.0001	441.7828	0.0000	-743.3271
	ROTOR	-138.5606	0.0000	-3.4780	-0.0001	319.0989	0.0000	-743.3271
	AIRFRM	-5.3530	0.0000	-106.0249	0.0000	122.6839	0.0000	0.0000
V	TOTAL	0.0000	-100.7015	0.0000	-332.8211	0.0000	574.5879	0.0000
	ROTOR	0.0000	-20.0378	0.0000	-26.2387	0.0000	-141.3572	0.0000
	AIRFRM	0.0000	-80.6637	0.0000	-306.5824	0.0000	715.9451	0.0000
W	TOTAL	40.2534	0.0000	-393.0934	0.0000	-282.2138	0.0000	0.4712
	ROTOR	2.9004	0.0000	-20.1285	0.0000	112.1972	0.0000	0.4712
	AIRFRM	37.3530	0.0000	-372.9648	0.0000	-394.4110	0.0000	0.0000
RPM	TOTAL	830.0350	0.0000	245.1886	-0.0005	-2358.1189	0.0000	4736.7739
	ROTOR	836.0443	0.0000	20.0195	-0.0005	-1930.0360	0.0000	4736.7739
	AIRFRM	-6.0093	0.0000	225.1691	0.0000	-428.0828	0.0000	0.0000

CONTROL DERIVATIVE MATRIX

		XBODY	YBODY	ZBODY	LBODY	MBODY	NBODY	TORQUE
			UNITS =	(LBS OR FT-LB)	/	(INCH OR DEG(XTHEG)		
XCOL	TOTAL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-3034.5352
	ROTOR	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-3034.5352
	AIRFRM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
XTHEG	TOTAL	1670.9714	0.0000	498.1953	0.0000	-4684.3940	0.0000	9343.5234
	ROTOR	1688.2030	0.0000	12.2450	0.0000	-3769.9094	0.0000	9343.5234
	AIRFRM	-17.2316	0.0000	485.9512	0.0000	-914.4846	0.0000	0.0000
XLN	TOTAL	-6.6400	0.0000	-652.9629	0.0000	-14303.9648	0.0000	0.0000
	ROTOR	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	AIRFRM	-6.6400	0.0000	-652.9629	0.0000	-14303.9648	0.0000	0.0000
XLT	TOTAL	0.0000	2.2458	0.0000	15498.5996	-0.0002	3803.8015	0.0000
	ROTOR	0.0000	2.2458	0.0001	1060.5112	-0.0002	3313.9160	0.0000
	AIRFRM	0.0000	0.0000	0.0000	14438.0879	0.0000	489.8855	0.0000
XPD	TOTAL	0.0000	-591.5510	0.0000	-2075.5544	0.0000	13467.3584	0.0000
	ROTOR	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	AIRFRM	0.0000	-591.5510	0.0000	-2075.5544	0.0000	13467.3584	0.0000

TIME USED IN HANDLE = 0.1680 MIN From Subroutine HANDLE if STABMTX = 1

Figure 3-6 (Continued)

********** FORCE AND MOMENT SUMMARY (BODY AXIS) **********

```
*********************************************************************
*** VT =180.00 KTS *** NACELLE INCIDENCE =  0.0 DEG  ***   AIRPLANE   ***
*** GW = 13000.0      RPM =  517.00   SLCG =  296.83   WLCG =   73.59 ***
***   MAST ANGLE =  90.00 DEG   *****   FLAP SETTING =      0/0  DEG  ***
*********************************************************************
```

	X-FORCE LBS	Y-FORCE LBS	Z-FORCE LBS	ROLL FT-LBS	PITCH FT-LBS	YAW FT-LBS
FUSELAGE	-73.690	0.000	-1044.766	0.000	-480.089	0.000
WING						
LEFT WING	0.000	0.000	0.000	0.000	0.000	0.000
RIGHT WING	0.000	0.000	0.000	0.000	0.000	0.000
FREESTREAM	-91.959	0.000	-11771.330	0.000	3260.260	0.000
TOTAL	-91.959	0.000	-11771.330	0.000	3260.260	0.000
ENGINE PYLONS	-105.027	0.000	-5.575	0.000	229.707	0.000
HORIZ. STAB.	-36.955	0.000	-12.079	0.000	-174.336	0.000
VERT. STAB.						
FIN NO. 1	-17.290	0.000	0.000	0.000	60.665	-110.944
FIN NO. 2	-17.290	0.000	0.000	0.000	60.665	110.945
TOTAL	-34.580	0.000	0.000	0.000	121.330	0.000
LANDING GEAR						
MAIN AERO.	-119.407	0.000	-6.375	0.000	-673.024	0.000
NOSE AERO.	0.000	0.000	0.000	0.000	0.000	0.000
DYNAMIC	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	-119.407	0.000	-6.375	0.000	-673.024	0.000
JET THRUST						
LEFT ENG	-22.930	0.000	0.000	0.000	50.473	-368.793
RIGHT ENG	-22.930	0.000	0.000	0.000	50.473	368.793
TOTAL	-45.860	0.000	0.000	0.000	100.946	0.000
GROUND EFFECT						
FUSE-HOR STAB	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL AIRFRAME	-507.478	0.000	-12840.125	0.000	2384.794	0.000
ROTOR						
LEFT ROTOR	704.916	43.776	-65.122	6598.400	-1447.130	11629.095
RIGHT ROTOR	704.916	-43.776	-65.122	-6598.399	-1447.130	-11629.095
HUB SPINNER	-209.328	0.000	-11.136	0.000	509.790	0.000
TOTAL ROTOR	1200.505	0.000	-141.379	0.001	-2384.470	0.000
TOTAL AIRCRAFT (BODY AXIS)	693.026	0.000	-12981.504	0.001	0.324	0.000
TOTAL AIRCRAFT (INERTIAL AXIS)	-0.034	0.000	0.008	0.001	0.324	0.000

Figure 3-6 (Continued)

Note Time = 0 seconds

```
******** TIME =   0.000 SECONDS INTO RUN          KTAS =  180.00 KNOTS

 *****    ROTOR DATA

FAFLPL(DEG) = -.8126          LTFLPL(DEG) = -.1706          AOL   (DEG) =  1.199
FAFLPR(DEG) = -.8126          LTFLPR(DEG) = -.1706          AOR   (DEG) =  1.199

THETOL(DEG) =  66.66          A1L   (DEG) = 0.0000E+00      B1L   (DEG) =  1.500
THETOR(DEG) =  66.66          A1R   (DEG) = 0.0000E+00      B1R   (DEG) =  1.500

THOLG (DEG) =  10.86          WIL   (F/S) =  1.089          OMEGAL(RPM) =  517.0
THORG (DEG) =  10.86          WIR   (F/S) =  1.089          OMEGAR(RPM) =  517.0

TL    (LB)  =  704.2          HL    (LB)  =  65.13          YL    (LB)  = -44.92
TR    (LB)  =  704.2          HR    (LB)  =  65.13          YR    (LB)  = -44.92

QREQL(FT-LB)=  5449.          HPL   (SHP) =  536.4          TIPSPL(F/S) =  741.8
QREQR(FT-LB)=  5449.          HPR   (SHP) =  536.4          TIPSPR(F/S) =  741.8

 *****    CONTROLS DATA

XLN   (IN)  =  5.070          XLN   (PCT) =  52.82          ELEV  (DEG) =  1.148
XLT   (IN)  =  4.800          XLT   (PCT) =  50.00          AILR  (DEG) = 0.0000E+00
XPD   (IN)  =  2.500          XPD   (PCT) =  50.00          RUDD  (DEG) = 0.0000E+00
PWRLEV (IN) =  4.338          PWRLEV(PCT) =  43.38          BM    (DEG) =  90.00

ESAS  (IN)  = 0.5085E-02      ESAS  (PCT) = 0.4717E-02      ENGINE(SHP) =  586.8
ASAS  (IN)  = 0.0000E+00      ASAS  (PCT) = 0.0000E+00      HPENAV(SHP) =  536.4
RSAS  (IN)  = 0.0000E+00      RSAS  (PCT) = 0.0000E+00

 *****    STATE DATA

UB    (F/S) =  303.4          QB    (D/S) = 0.0000E+00      KCAS  (KTS) =  175.4
VB    (F/S) = 0.2263E-06      PB    (D/S) = 0.0000E+00      KTAS  (KTS) =  180.0
WB    (F/S) =  16.20          RB    (D/S) = 0.0000E+00      VT    (F/S) =  303.8

AX   (F/S2) = -.3589E-03      PITCH (DEG) =  3.056          ALPHA (DEG) =  3.056
AY   (F/S2) = 0.3825E-06      ROLL  (DEG) = 0.8004E-06
AZ   (F/S2) = -.8202E-02      YAW   (DEG) = 0.0000E+00      BETA  (DEG) = 0.4267E-07

 *****    OTHER DATA

RODESC(F/S) = 0.0000E+00      UGND  (F/S) =  303.8          NZ     (G)  =  1.000
                              VGND  (F/S) = 0.1421E-13      DYNP(S/F-S2)=  104.0
HEIGHT (FT) =  1000.          WGND  (F/S) = 0.0000E+00
NORTHG (FT) = 0.0000E+00                                    PRSALT (FT) =  1000.
EASTG  (FT) = 0.0000E+00                                    RHO (S/FT3) = 0.2253E-02
```

Figure 3-6 (Continued)

Force and Moment Summary for Time = 2.6 seconds
(Prior time prints delted to shorten this figure)

********** FORCE AND MOMENT SUMMARY (BODY AXIS) **********

****
*** VT =180.22 KTS *** NACELLE INCIDENCE = 0.0 DEG *** AIRPLANE ***
*** GW = 13000.0 RPM = 517.39 SLCG = 296.83 WLCG = 73.59 ***
*** MAST ANGLE = 90.00 DEG ***** FLAP SETTING = 0/0 DEG ***
****

	X-FORCE LBS	Y-FORCE LBS	Z-FORCE LBS	ROLL FT-LBS	PITCH FT-LBS	YAW FT-LBS
FUSELAGE	-65.008	0.000	-1094.815	0.000	507.756	0.000
WING						
LEFT WING	0.000	0.000	0.000	0.000	0.000	0.000
RIGHT WING	0.000	0.000	0.000	0.000	0.000	0.000
FREESTREAM	4.371	0.000	-12602.493	0.000	3467.181	0.000
TOTAL	4.371	0.000	-12602.493	0.000	3467.181	0.000
ENGINE PYLONS	-105.261	0.000	-6.495	0.000	229.978	0.000
HORIZ. STAB.	-36.903	0.000	-39.718	0.000	-780.607	0.000
VERT. STAB.						
FIN NO. 1	-17.097	0.000	0.000	0.000	59.989	-109.709
FIN NO. 2	-17.097	0.000	0.000	0.000	59.989	109.709
TOTAL	-34.195	0.000	0.000	0.000	119.979	0.000
LANDING GEAR						
MAIN AERO.	-119.643	0.000	-7.426	0.000	-676.708	0.000
NOSE AERO.	0.000	0.000	0.000	0.000	0.000	0.000
DYNAMIC	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	-119.643	0.000	-7.426	0.000	-676.708	0.000
JET THRUST						
LEFT ENG	-22.848	0.000	0.000	0.000	50.291	-367.466
RIGHT ENG	-22.848	0.000	0.000	0.000	50.291	367.466
TOTAL	-45.695	0.000	0.000	0.000	100.583	0.000
GROUND EFFECT						
FUSE-HOR STAB	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL AIRFRAME	-402.334	0.000	-13750.946	0.000	2968.161	0.000
ROTOR						
LEFT ROTOR	722.340	54.380	-163.578	8249.624	-1089.924	11981.859
RIGHT ROTOR	722.340	-54.380	-163.578	-8249.624	-1089.924	-11981.859
HUB SPINNER	-209.874	0.000	-12.979	0.000	519.104	0.000
TOTAL ROTOR	1234.807	0.000	-340.134	0.000	-1660.743	0.000
TOTAL AIRCRAFT (BODY AXIS)	832.472	0.000	-14091.080	0.000	1307.418	0.000
TOTAL AIRCRAFT (INERTIAL AXIS)	-392.691	0.000	7446.446	0.000	1307.418	0.000

Figure 3-6 (Continued)

Note Time = 2.6 seconds
(Maneuver could run up to 120 seconds)

```
******** TIME =   2.600 SECONDS INTO RUN          KTAS =  180.22 KNOTS

 *****    ROTOR DATA

FAFLPL(DEG) = -.9826          LTFLPL(DEG) = -.2763          AOL   (DEG) =  1.204
FAFLPR(DEG) = -.9826          LTFLPR(DEG) = -.2763          AOR   (DEG) =  1.204

THETOL(DEG) =  66.66          A1L   (DEG) = 0.0000E+00      B1L   (DEG) =  1.500
THETOR(DEG) =  66.66          A1R   (DEG) = 0.0000E+00      B1R   (DEG) =  1.500

THOLG (DEG) =  10.86          WIL   (F/S) =  1.114          OMEGAL(RPM) =  517.4
THORG (DEG) =  10.86          WIR   (F/S) =  1.114          OMEGAR(RPM) =  517.4

TL    (LB)  =  721.5          HL    (LB)  =  163.6          YL    (LB)  = -57.24
TR    (LB)  =  721.5          HR    (LB)  =  163.6          YR    (LB)  = -57.24

QREQL(FT-LB)=  5486.          HPL   (SHP) =  540.4          TIPSPL(F/S) =  742.4
QREQR(FT-LB)=  5486.          HPR   (SHP) =  540.4          TIPSPR(F/S) =  742.4

 *****    CONTROLS DATA

XLN   (IN)  =  4.110          XLN   (PCT) =  42.82          ELEV  (DEG) = -.7776E-01
XLT   (IN)  =  4.800          XLT   (PCT) =  50.00          AILR  (DEG) = 0.5068E-07
XPD   (IN)  =  2.500          XPD   (PCT) =  50.00          RUDD  (DEG) = 0.1478E-07
PWRLEV (IN) =  4.338          PWRLEV(PCT) =  43.38          BM    (DEG) =  90.00

ESAS  (IN)  = 0.6709          ESAS  (PCT) = 0.6223          ENGINE(SHP) =  586.7
ASAS  (IN)  = 0.1289E-07      ASAS  (PCT) = 0.7974E-08      HPENAV(SHP) =  536.3
RSAS  (IN)  = 0.1847E-08      RSAS  (PCT) = 0.4619E-08

 *****    STATE DATA

UB    (F/S) =  303.6          QB    (D/S) =  3.996          KCAS  (KTS) =  175.6
VB    (F/S) = 0.9488E-06      PB    (D/S) = -.1146E-07      KTAS  (KTS) =  180.2
WB    (F/S) =  19.03          RB    (D/S) = -.8146E-07      VT    (F/S) =  304.2

AX   (F/S2) = -.9719          PITCH (DEG) =  3.038          ALPHA (DEG) =  3.552
AY   (F/S2) = 0.6431E-06      ROLL  (DEG) = 0.7489E-06
AZ   (F/S2) =  18.43          YAW   (DEG) = -.3759E-07      BETA  (DEG) = 0.1775E-06

 *****    OTHER DATA

RODESC(F/S) = 0.0000E+00      UGND  (F/S) =  304.2          NZ     (G)  =  1.000
                              VGND  (F/S) = 0.5006E-06      DYNP(S/F-S2)=  104.2
HEIGHT (FT) =  997.7          WGND  (F/S) = -2.911
NORTHG (FT) =  486.3                                        PRSALT (FT) =  1000.
EASTG  (FT) = 0.4323E-06                                    RHO (S/FT3) = 0.2253E-02
```

Figure 3-6 (Concluded)

4. PROGRAM COMPILATION, LINKING, AND MAINTENANCE PROCEDURES

4.1 FORTRAN SOURCE ROUTINES

As delivered to NASA ARC, the program GTRSIM is separated into the individual subroutines and the main program; thus, a total of 59 FORTRAN source files make up the complete program (i.e., one main routine and 58 subroutines). This structure makes editing and program development much easier and less time-consuming, because only the routines which are affected are recompiled, thereby eliminating the recompilation of the entire program for each change. (The compilation of the entire program requires approximately 15 to 30 minutes of total time--not CPU time.)

The use of this structure requires a different linking procedure in order to combine each subroutine with the main program in a suitable and acceptable manner. This is accomplished by defining a library, which contains the compiled object files of each subroutine, and then linking the main program with this library. The file name of this library is GTRLIB.OLB, where GTRLIB infers that this is a Generic Tilt Rotor object module LIBrary, and the designator, .OLB, infers that it is an Object file LiBrary (required to be .OLB for VMS library utility and FORTLI.COM utility).

4.2 LIBRARY MAINTENANCE

To aid in the updating and general library maintenance, a command procedure was written to perform the necessary tasks. This command procedure file is FORTLI.COM. This command procedure performs the compilation, the updating of library GTRLIB.OLB, and will link the program into an executable version.

Figure 4-1 is a listing of the command procedure, FORTLI.COM, used to perform the necessary compilation and library maintenance. To use this command procedure, type:

@FORTLI

The computer will respond:

FORTRAN PROGRAM/SUBROUTINE YOU WISH TO COMPILE:

Enter the name of the routine you wish to have compiled and updated in the library.

When this has been accomplished, the computer will respond

DO YOU WISH TO DELETE "FILENAME".OBJ FILE (Y OR N)?:

(Once the library has been updated, the object file can be erased, unless it needs to be saved for some other purpose. When recompiling the main program, do not erase the main program object code, as it is needed to link with the library.)

After this, the computer will respond:

DO YOU WISH TO COMPILE AND UPDATE ANY MORE FILES (Y OR N)?:

Here the operator can repeat the above sequence if there is more than one file to be compiled and updated, thus eliminating the need for individual calls to this routine for multiple subroutine updates.

After completing the necessary updating, the computer then responds:

EXECUTABLE FILE NAME:

Here the operator enters the name to be given to the executable file. The program is linked and stored in this file.

Upon completion of linking the program, the command procedure terminates, and the program is ready to be executed.

```
$ WRITE SYS$OUTPUT "     "
$ WRITE SYS$OUTPUT "  GTR PROGRAM COMPILER AND LINKER PROCEDURE"
$ WRITE SYS$OUTPUT "  PERFORMS FORTRAN COMPILING, LINKING "
$ WRITE SYS$OUTPUT "  AND LIBRARY UPDATING"
$ WRITE SYS$OUTPUT "     "
$ WRITE SYS$OUTPUT "  WRITTEN 2/4/83  BY G. HANSON (STI)"
$ WRITE SYS$OUTPUT "     "
$ START:
$ INQUIRE P1 "  FORTRAN PROGRAM/SUBROUTINE TO COMPILE"
$ IF P1.EQS."" THEN GOTO START
$ NAME = F$EXTRACT(0,F$LOCATE(".",P1),P1)
$ FORTRAN/LIST/CROSS/SHOW=INCLUDE   'P1'
$ IF NAME.NES. "GTRMAIN" THEN LIBRARY  GTRLIB/REPLACE  'NAME'.OBJ
$ INQUIRE P2 "  DO YOU WISH TO DELETE "'NAME'".OBJ FILE (Y OR N) ?"
$ IF P2.EQS."Y" THEN DELETE 'NAME'.OBJ;
$ INQUIRE P4 "  DO YOU WISH TO COMPILE AND UPDATE ANY MORE FILES (Y OR N )?"
$ IF P4.EQS."Y" THEN GOTO START
$ LINKER:
$ INQUIRE P3 "  EXECUTABLE FILE NAME"
$ IF P3.EQS."" THEN GOTO LINKER
$ LINK/MAP/EXE='P3'  GTRMAIN,GTRLIB/LIBRARY
$ WRITE SYS$OUTPUT "  COMPILAION AND LINKING COMPLETE"
$ WRITE SYS$OUTPUT "     "
```

Figure 4-1. Listing of the Command Procedure FORTLI.COM

4.3 JOB CONTROL LANGUAGE

Figure 4-2 is a listing of the job control required to run the executable version of the program at NASA ARC. To use this command procedure, type:

@GTRUN

When the computer responds:

INPUT FILE NAME:

enter the name of the file containing the input data deck to be used.

When the computer responds:

OUTPUT FILE NAME:

enter the name to be given to the file which will contain the output of the program.

After completing the necessary input/output responses, the computer responds with:

DO YOU WISH TO OUTPUT A GRAPHICS MATRIX FILE (Y OR N)?:

This question is responded to with a Yes or a No. If a graphics output file is desired (the MANS or MANU option is to be run), the computer responds:

GRAPHICS MATRIX FILE:

At this prompt, the user enters the desired filename for the graphics matrix output file. (The output file with the given name is not an ASCII file, see Section 4.4.)

```
$ WRITE SYS$OUTPUT "  COMMAND PROCEDURE TO RUN GTRSIM PROGRAM"
$ WRITE SYS$OUTPUT "  WRITTEN 1/24/85 BY  S. FERGUSON (STI)"
$ WRITE SYS$OUTPUT "  MODIFIED 4/10/86 FOR PROGRAM TT: INTERACTION"
$ DEFINE FOR022 TT:
$ IF P1 .EQS. "" THEN INQUIRE P1 "INPUT DATA FILE "
$ ASSIGN/USER 'P1' FOR004
$ ASSIGN/USER FOR007: FOR$PRINT:
$ ASSIGN/USER XV15F10.DAT FOR010
$ IF P2 .EQS. "" THEN INQUIRE P2 "OUTPUT FILE "
$ ASSIGN/USER 'P2'  FOR007
$ INQUIRE P3 "DO YOU WISH TO OUTPUT A GRAPHICS MATRIX FILE (Y OR N)?"
$ IF P3.EQS."N" THEN GOTO SKIP
$ IF P4 .EQS. "" THEN INQUIRE P4 "GRAPHICS MATRIX FILE"
$ ASSIGN/USER 'P4'  FOR008
$ SKIP:
$ ASSIGN/USER SYS$COMMAND SYS$INPUT
$ IF P5 .EQS. "" THEN INQUIRE P5 "PROGRAM FILE "
$  RUN 'P5'
$ DEL XV15F10.DAT;*
$ DEL FOR009.DAT;*
$ DEASSIGN FOR022
$ EXIT
```

Figure 4-2. Listing of the Command Procedure for Executing Program GTRSIM at NASA Ames Research Center

When the computer responds:

EXECUTABLE FILE NAME:

enter the name of the executable version of the program. This will usually be the name given to the program in Section 4.2.

The program will then be executed. Upon completion of execution of the program, the command procedure terminates and job control is returned to the terminal. The notation associated with unit "FOR022" in Fig. 4-2 has been used to print diagnostic output to the screen when it is inserted by the user into a FORTRAN subroutine temporarily using a "WRITE(22,*)..." statement format.

4.4 GRAPHICS OUTPUT FILE CONVERSION

The user named graphics output file specified in the program job control language prompt is output to the disk as an unformatted file (this file format is described and can be modified by the user in the subroutine IFHB43 source code). If the user desires to convert the file to a formatted ASCII file for viewing on the screen or for printout, a simple command file must be executed after the GTRS program execution is completed. This command file is envoked by typing:

@ MATOUT

The computer responds with the output:

INPUT DATA FILE:

The user responds to this prompt by typing in the name of the previously named graphics output file. The next prompt:

OUTPUT FILE:

asks for a filename for the to-be-created ASCII file that will be viewed or printed out eventually.

The final prompt then asks:

PROGRAM FILE:

Normally, this prompt will be responded to with "MATOUT.EXE" which is the name of the output format executable file provided with GTRSIM. If the user decides to modify the ASCII output format for another application, another program file would probably be used. The ASCII format file that can be customized by the user for post processing is presented in Fig. 4-4, which follows the listing of the "MATOUT.COM" file which is presented in Fig. 4-3. If the user does not desire to use the post processing approach, the format of the output file must be modified in Subroutine IFHB43.

```
$ WRITE SYS$OUTPUT "  COMMAND PROCEDURE TO RUN MATOUT PROGRAM"
$ WRITE SYS$OUTPUT "  WRITTEN  3/8/85   BY  S. FERGUSON (STI)"
$ WRITE SYS$OUTPUT "  "
$ IF P1 .EQS. "" THEN INQUIRE P1 "INPUT DATA FILE "
$ ASSIGN/USER 'P1' FOR008
$ IF P2 .EQS. "" THEN INQUIRE P2 "OUTPUT FILE "
$ ASSIGN/USER 'P2'  FOR006
$ ASSIGN/USER SYS$COMMAND SYS$INPUT
$ IF P3 .EQS. "" THEN INQUIRE P3 "PROGRAM FILE "
$  RUN 'P3'
$ EXIT
```

Figure 4-3. Listing of the Command Procedure MATOUT.COM

```
C
C     THIS PROGRAM CONVERTS A GTRS .MAT FILE TO A FORMATTED
C     FILE THAT CAN BE SCANNED PRIOR TO PLOTTING IF NEED BE.
C
      CHARACTER*20 HEADER(10)
      CHARACTER*8  COLN(40)
      INTEGER*4    COL(40),FRAME
      DIMENSION    GRAOUT(40)
C
      OPEN(UNIT=8,TYPE='OLD',DISP='SAVE',FORM='UNFORMATTED')
C
      READ(UNIT=8) (HEADER(L),L=1,10)
      READ(UNIT=8) ((COLN(L),COL(L)),L=1,40),FRAME
C
      WRITE(6,10)
   10 FORMAT(///)
C
      DO 20 L=1,10
      WRITE(6,21) HEADER(L)
   21 FORMAT(T5,A20)
   20 CONTINUE
C
      WRITE(6,10)
C
      WRITE(6,22) FRAME
   22 FORMAT(T5,I4)
C
      WRITE(6,10)
```

Figure 4-4. Listing of the MATOUT.FOR Graphics Output File Conversion Program FORTRAN Source Code

```
C
      WRITE(6,30) ((COL(L),COLN(L)),L=1,40)
C
   30 FORMAT(T4,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,
     *          I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,/,
     *       T4,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,
     *          I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,/,
     *       T4,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,
     *          I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,/,
     *       T4,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,
     *          I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,/,
     *       T4,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,
     *          I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,2X,I4,2X,A8,///)
C
      DO 40 L=1,FRAME
      READ(UNIT=8) (GRAOUT(J),J=1,40)
      WRITE(6,41)  (GRAOUT(J),J=1,40)
C
   41 FORMAT(T4,G12.4,4X,G12.4,4X,G12.4,4X,G12.4,4X,
     *          G12.4,4X,G12.4,4X,G12.4,4X,G12.4,/,
     *       T4,G12.4,4X,G12.4,4X,G12.4,4X,G12.4,4X,
     *          G12.4,4X,G12.4,4X,G12.4,4X,G12.4,/,
     *       T4,G12.4,4X,G12.4,4X,G12.4,4X,G12.4,4X,
     *          G12.4,4X,G12.4,4X,G12.4,4X,G12.4,/,
     *       T4,G12.4,4X,G12.4,4X,G12.4,4X,G12.4,4X,
     *          G12.4,4X,G12.4,4X,G12.4,4X,G12.4,/,
     *       T4,G12.4,4X,G12.4,4X,G12.4,4X,G12.4,4X,
     *          G12.4,4X,G12.4,4X,G12.4,4X,G12.4,///)
C
   40 CONTINUE
C
      CLOSE(UNIT=8)

      STOP
      END
```

Figure 4-4 (Concluded)

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16. Abstract

This report provides documentation for use with the VAX 11/780 version of the Generic Tilt-Rotor Simulation (GTRSIM) program. Volume I, the user's guide, provides a reference to enable the reader to (a) understand the capabilities of the GTRSIM program, (b) assemble an input data deck, and (c) understand the program output following execution of the program. Volume II, the programmer's guide, provides a reference for operating and modifying the GTRSIM program. Detailed structural information is provided for the purpose of describing the order of execution of program subroutines. The tilt-rotor mathematical model, which has been programmed as GTRSIM, is described in NASA CR-166536, which is entitled "A Mathematical Model for Real Time Flight Simulation of a Generic Tilt-Rotor Aircraft."

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