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ROTORCRAFT FLIGHT SIMULATION WITH AEROELASTIC ROTOR AND IMPROVED AERODYNAMIC REPRESENTATIONS. VOLUME III. PROGRAMMER'S MANUAL

P. Y. Hsieh, et al

Bell Helicopter Company

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Army Air Mobility Research and Development Laboratory

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The computer program resulting from this contract will be provided, upon request of qualified users, for use in the design and analysis of rotary-wing aircraft. Volume III of this report, a programmer's manual, has not been widely distributed, but will be provided with the computer program to aid in program installation.

The technical monitor for this contract was Mr. Edward E. Austin, Aeromechanics, Technology Applications Division.

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This report consists of three volumes and documents the current version in the C81 family of rotorcraft flight simulation programs developed by Bell Helicopter Company. This current version of the digital computer program is referred to as AGAJ73.

The new, revised, or alternate mathematical models incorporated into the program during the current contract are as follows:

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(3) External stores/aerodynamic brakes (new)

(4) Rotor blade airfoil section distribution (new)

(5) Rotor-induced velocity distribution (alternate)

(6) Rotor unsteady aerodynamics (alternate)

(7) Rotor wake effect at aerodynamic surfaces (alternate)

(8) Method for numerically integrating rotorcraft equations of motion (alternate)

This volume, the Programmer's Manual, contains the information necessary to set up and support the computer program. Specifically, it includes cross-references of FORTRAN COMMON BLOCK variables, a catalog of subroutines, and a discussion of programming considerations. The listings and related software for the computer program documented in this report are unpublished data which are on file at the Eustis Directorate, U. S. Army Air Mobility Research and Development Laboratory (USAAMRDL), Fort Eustis, Virginia. Volume I, The Engineer's Manual, documents the background and development of the current version of the program. Volume II, the User's Manual, contains the detailed information necessary for setting up an input data deck and interpreting the computed data.

PREFACE

This report and its accompanying computer program were developed under Contract DAAJ02-72-C-0098 awarded in June 1972 by the Eustis Directorate of the U. S. Army Air Mobility Research and Development Laboratory (USAAMRDL). In addition to the work performed under this contract, the report and computer program include the documentation and program features developed under USAAMRDL Contracts DAAJ02-70-C-0063 and DAAJ02-73-C-0086. The contractor and USAAMRDL have agreed that the computer program documented herein is the new master version of the program. Hence, this report supercedes all previous versions of the C81 program and documentation.

Technical program direction was provided by Mr. E. E. Austin of USAAMRDL. Principal Bell Helicopter personnel associated with the current contract were Messrs. B. L. Blankenship, J. M. Davis, and P. Y. Hsieh, and Dr. B. T. Waak. In addition, Dr. R. L. Bennett and Mr. B. J. Bird assisted in coordinating the work and documentation prepared under the two previous contracts noted above with that prepared under this contract.

TABLE OF CONTENTS

		Page
PREFACE		iii
LIST OF ILLUSTRATIONS		vi
LIST OF TABLES		vi
1.	INTRODUCTION	1-1
2.	OPERATING ENVIRONMENT AND PROCEDURES	2-1
3.	GENERAL PROGRAMMING AIDS	3-1
	3.1 Marco Flow Charts	3-1
	3.2 Fortran Subroutines in AGAJ73	3-1
	3.3 Assembly Language Subprograms in AGAJ73	3-10
	3.4 FORTRAN Subroutines in GDAJ07	3-12
	3.5 Labeled Commons in AGAJ73	3-13
	3.6 Labeled Commons in GDAJ07	3-15
4.	DETAILED PROGRAMMING AIDS	4-1
	4.1 Control Section Cross-Reference	4-1
	4.2 Program Listings	4-1
	4.3 Programming Option in Numerical Integration	4-2
	4.4 Reduction of Program Memory Requirements	4-2
	4.5 Switch for Diagnostic Data From STAB	4-4

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LIST OF ILLUSTRATIONS

Figure		Page
2-1	Job Control Language To Run AGAJ73 and GDAJ07	2-9
3-1	Flow Chart of System Structure	3-16
3-2	Flow Chart of Trim Process	3-17
3-3	Flow Chart of Stability Analysis	3-18
3-4	Flow Chart of Maneuver With Runge-Kutta Method	3-19
3-5	Flow Chart of Maneuver With Hamming's Method	3-20
3-6	Flow Chart of GDAJ07.	3-21
4-1	Job Control Language To Run AS812A Data	4-32

LIST OF TABLES

Table		Page
2-1	Linkage Editor Cards for OVERLAY of AGAJ73	2-3
2-2	Linkage Editor Data Cards for HIARCHY Support of AGAJ73 .	2-5
2-3	Linkage Editor Data Cards for OVERLAY of GDAJ07. . . .	2-6
2-4	Input/Output Units Used in AGAJ73	2-7
4-1	Control Section Cross-Reference for AGAJ73	4-5
4-2	Cross-Reference of Multiple Entry Subroutines in AGAJ73 .	4-25
4-3	Control Section Cross-Reference for GDAJ07	4-26
4-4	Reduction of AGAJ73 Storage Requirements	4-30
4-5	STAB Diagnostic Switch in AGAJ73.	4-31

1. INTRODUCTION

This manual documents the rotorcraft flight simulation program, designated AGAJ73, and its post processor for data reduction, designated GDAJ07. To the user, this system appears as a single program; to the programmer, the two programs are very different. This documentation is for the programs as they were written for, and are being used on, an IBM System/360 Model 65 Computer at Bell Helicopter Company.

The information in this volume is of two types. Section 2 contains the information necessary to get the programs operational on a computer compatible with the installation at Bell Helicopter Company. If the programs are to be modified in any way, the programmer will need the information in Sections 3 and 4 of this volume.

2. OPERATING ENVIRONMENT AND PROCEDURES

The System/360 environment under which this program system is maintained is Operating System/360 Option IV (MVT). Input on the system reader is controlled by Houston Automatic Spooling Program (HASP) II, as is system output destined for on-line printer or card punch. As delivered under this contract, the program requires approximately a 1000K region of memory (1K = 1024 bytes, 1000K ≈ 1 megabyte). Methods for reducing this large memory requirement are discussed below and in Section 4.4. The Basic Sequential Access Method routines are retained in a resident LINKPACK area. Scratch data sets are directed to a Telex 5312 Direct Access Storage Facility. Tape data sets are recorded on Telex 6420 Tape Drives. The recording format for the CALCOMP PLOTTAPE is 9 track, 800 bpi, NRZI.

All other tape data sets are recorded as 9 track, 1600 fci phase encoded. To run the program under OS/360, at least 262,144 (256K) bytes of main memory are required for operation with Option I (PCP) or Option II (MFT) systems. At least 524,288 (512K) bytes of main memory are required for Option IV (MVT).

The program has been maintained on the IBM System/360 FORTRAN H Compiler in USA FORTRAN. Compiler options used are SOURCE, EBCDIC, NOLIST, NODECK, LOAD, MAP, NOEDIT, ID, XREF, and OPT=2. Since the FORTRAN H Compiler performs essential optimization functions, compilation of this program under any other compiler or using optimization level less than "2" on the H Compiler will result in degraded performance in speed. Some FORTRAN language features peculiar to IBM FORTRAN definitions have been noted explicitly in individual routines.

AGAJ73 can be link-edited in several different ways. For example, with the OVERLAY structure shown in Table 2-1, the entire program can be loaded into either main or extended memory; with the HIARCHY support structure shown in Table 2-2, part of the program can be loaded into main memory and the rest into extended memory; or if neither OVERLAY nor HIARCHY structure is used, the entire program can be loaded into either main or extended memories. The best way to link-edit this program depends upon the facilities available at the local installation.

Although this program is quite large, it can be run in less than 300K if the OVERLAY structure shown in Table 2-1 is used and the size of several large arrays is reduced according to the procedure outlined in Section 4.4. If the region size available is greater than 300K, the OVERLAY shown in Table 2-1 can be relaxed to reduce the overhead time associated with OVERLAY. By using the HIARCHY support structure shown in Table 2-2 and also following the procedures in Section 4.4, the program can run in a 206K region of main memory and a 450K region of extended memory. It would need approximately another 300K if the reduction of array sizes mentioned above is not done. Since the buffers are in extended memory, the amount of extended memory used depends upon the units opened.

The input data for the linkage editor for GDAJ07 are shown in Table 2-3. This OVERLAY structure results in a program whose longest segment is 142K bytes. After a buffer allocation, the size of the region needed is 184K bytes.

The Job Control Linkage (JCL) used to run a typical set of data is shown in Figure 2-1. If other than HIARCHY structure is used, the REGION card in the first step should be changed accordingly from that shown in Figure 2-4. Tables 2-4 and 2-5 give the unit type, what it is used for, and which subroutines refer to it for AGAJ73 and GDAJ07, respectively.

The JCL has been prepared such that the job is in two steps: C81 and C81PLOT. The C81 step executes AGAJ73, and the C81PLOT step executes GDAJ07 even if the first step abends. This was done so that if a maneuver abends on the first step, the user will still get plots of what was run.

TABLE 2-1. LINKAGE EDITOR CARDS FOR OVERLAY OF AGAJ73

```
OVERLAY ALPHA  INITIALIZATION SEGMENT
INSERT  PDSRED,REDID,REDRWK,REDSWK,START,WKTABN,IHCNAMEL
OVERLAY BETA
INSERT  ERRCHK,JSTRED,LGCINT,LIZE,NPUTOT,RBDY,READIN
INSERT  REDATB,REDBMS,REDCL,XSTINT,ZERO
OVERLAY BETA
INSERT  FUSINT,INBLD,INRU,INRTR,INSCAS,JFBGIN,MODAL,PYLINT
INSERT  RTINIT,STBZIN,WRMDAL,XCONIN
OVERLAY BETA
INSERT  MNEM,TABFIX,TABOUT,TURN,YRINIT,YSINIT
OVERLAY ALPHA  HARMONIC ANALYSIS
INSERT  HARM,LOADT
OVERLAY ALPHA  STABILITY ANALYSIS SEGMENT
INSERT  ALLMAT,ALSTAB,INVERS,IOMAT,MDRDRS,MODES,PUNCH,WRMS
INSERT  IHCCLABS,IHCCLAS,IHCCLSQT,IHCCSABS,IHCCSAS,IHCFOPT
INSERT  IHCLSQRT
OVERLAY ALPHA  GENERAL PURPOSE SEGMENT
INSERT  ANAL,ANDDIT,AZMINT,AZMUTH,CDCL,CLCD,CMCALC,DIFFER
INSERT  DOTX,FOCUS,FORCMC,FUSFNM,HRESP,INTFRQ,ITROT,MBAL
INSERT  NSTED,RADBGN,RADIAL,RADOUT,RGUST,ROTAN,RTWAKE,SOLVE
INSERT  STBWAK,STBZFM,SWSRAT,TABINT,TRMANU,UNSTED,WING,WRFM
INSERT  WRTMNV,WSHDUF,XSTORE,IHCSASCN
OVERLAY BETA
INSERT  AJACOB,JACOBI,DAMPER,WRVP
OVERLAY GAMMA  STABILITY ANALYSIS SEGMENT
INSERT  WRINST
OVERLAY DELTA
INSERT  INSTAB
OVERLAY DELTA
INSERT  STAB,WRSTAB
OVERLAY GAMMA  TRIM SEGMENT
INSERT  TRIM,TVT
OVERLAY DELTA
INSERT  RPTPG
OVERLAY DELTA
INSERT  TRM1
OVERLAY DELTA
INSERT  WRTRIM
OVERLAY DELTA
INSERT  ITRIM,PDZ1
```

TABLE 2-1. Concluded.

```
OVERLAY BETA    MANEUVER SEGMENT
INSERT  DERIV,HAMMS,HPCG,MANU,MANUV,QUAN,RNGKTA,SAVEIC,WAG
OVERLAY GAMMA
INSERT  SCASIT
OVERLAY GAMMA
INSERT  VARI
OVERLAY DELTA
INSERT  VCNTRL
OVERLAY DELTA
INSERT  SUPERP
OVERLAY DELTA
INSERT  MTLT
OVERLAY DELTA
INSERT  GUST
OVERLAY DELTA
INSERT  EXTORS
OVERLAY DELTA
INSERT  CNTM
OVERLAY DELTA
INSERT  MOMB
OVERLAY ONE(REGION)
INSERT  INIT,RESTRT,SIVAR,TIMLP,TIVAR,WRMANU
OVERLAY ONE
INSERT  CONSTB,STBD
ENTRY MAIN
```

TABLE 2-2. LINKAGE EDITOR DATA CARDS FOR HIARCHY SUPPORT OF AGAJ73

```
HIARCHY 1,IHCCOMH2
HIARCHY 1,IHCECOMH
HIARCHY 1,IHCEFIOS
HIARCHY 1,IHCEFNTH
HIARCHY 1,IHCERRM
HIARCHY 1,IHCETRCH
HIARCHY 1,IHCFCVTH
HIARCHY 1,IHCFOPT
HIARCHY 1,IHCNAMEL
HIARCHY 1,IHCUATBL
HIARCHY 1,IHCUOPT
HIARCHY 1,ABDUMP
HIARCHY 1,AJACOB
HIARCHY 1,ALSTAB
HIARCHY 1,CGZARM
HIARCHY 1,CNTM
HIARCHY 1,CONSTB
HIARCHY 1,CONTRM
HIARCHY 1,DATE
HIARCHY 1,DAMPER
HIARCHY 1,DERIV
HIARCHY 1,ERRCHK
HIARCHY 1,EXTORS
HIARCHY 1,FOCUS
HIARCHY 1,FORWK
HIARCHY 1,FORWK1
HIARCHY 1,FORYYY
HIARCHY 1,FORYY1
HIARCHY 1,FOSWK
HIARCHY 1,FOSWK1
HIARCHY 1,FUSINT
HIARCHY 1,GUST
HIARCHY 1,HANMS
HIARCHY 1,HPCG
HIARCHY 1,INBLD
HIARCHY 1,INIT
HIARCHY 1,INRO
HIARCHY 1,INRTR
HIARCHY 1,INSCAS
HIARCHY 1,INSTAB
HIARCHY 1,INSTAR
HIARCHY 1,INVERS
HIARCHY 1,IOMAT
HIARCHY 1,JACOBI
HIARCHY 1,JFBGIN
HIARCHY 1,JSTRED
HIARCHY 1,LGCINT
HIARCHY 1,LIZE
HIARCHY 1,LOADT
HIARCHY 1,MAIN
HIARCHY 1,MANU
HIARCHY 1,MANUV
HIARCHY 1,MDRDRS
HIARCHY 1,MNEM
HIARCHY 1,MODAL
HIARCHY 1,MODES
HIARCHY 1,MOMB
HIARCHY 1,MTLT
HIARCHY 1,NOPS
HIARCHY 1,NPUTOT
HIARCHY 1,PDSRED
HIARCHY 1,PDZI
HIARCHY 1,PUNCH
HIARCHY 1,PYLINT
HIARCHY 1,QUAN
HIARCHY 1,RADOUT
HIARCHY 1,RBDY
HIARCHY 1,READSN
HIARCHY 1,REDATB
HIARCHY 1,REDBMS
HIARCHY 1,REDCL
HIARCHY 1,REDID
HIARCHY 1,REDRWK
HIARCHY 1,REDSWK
HIARCHY 1,RESTRT
HIARCHY 1,RNGKTA
HIARCHY 1,RPTPG
HIARCHY 1,RTINIT
HIARCHY 1,SAVEIC
HIARCHY 1,SAVOLD
HIARCHY 1,SCASIT
HIARCHY 1,SIVAR
HIARCHY 1,STAMAN
HIARCHY 1,STARAN
HIARCHY 1,START
HIARCHY 1,STBWAK
HIARCHY 1,STBZIN
HIARCHY 1,SUPERP
HIARCHY 1,SWSRAT
HIARCHY 1,TABFIX
HIARCHY 1,TABOUT
HIARCHY 1,TILT
HIARCHY 1,TINLP
HIARCHY 1,TIVAR
HIARCHY 1,TOPLOT
HIARCHY 1,TRIM
HIARCHY 1,TRMANU
HIARCHY 1,TRM1
HIARCHY 1,TURN
HIARCHY 1,VARI
HIARCHY 1,VCNTRL
HIARCHY 1,WAG
HIARCHY 1,WKTABN
HIARCHY 1,WRFM
HIARCHY 1,WRINST
HIARCHY 1,WRMANU
HIARCHY 1,WRMDAL
HIARCHY 1,WRMS
HIARCHY 1,WROT1
HIARCHY 1,WRSTAB
HIARCHY 1,WRTHNV
HIARCHY 1,WRTRIM
HIARCHY 1,WRVP
HIARCHY 1,XCONIN
HIARCHY 1,XSTINT
HIARCHY 1,YRINIT
HIARCHY 1,YSINIT
HIARCHY 1,ZERO
HIARCHY 1,ZLLCAL
ENTRY MAIN
```

TABLE 2-3. LINKAGE EDITOR DATA CARDS FOR OVERLAY OF GDAJ07

```
IEW0000      OVERLAY ALPHA
IEW0000      INSERT CURVET
IEW0000      INSERT IHCLATN2
IEW0000      INSERT IHCLSQRT
IEW0000      INSERT CBLL
IEW0000      INSERT TIMPTS
IEW0000      OVERLAY ALPHA
IEW0000      INSERT CALCOM
IEW0000      INSERT IHCFRXPI
IEW0000      INSERT LINE
IEW0000      INSERT NEXTTIME
IEW0000      INSERT NUMBER
IEW0000      INSERT SYMBOL
IEW0000      OVERLAY BETA
IEW0000      INSERT FSFT
IEW0000      INSERT HARM
IEW0000      INSERT IHCSSQRT
IEW0000      INSERT PLOTER
IEW0000      INSERT AXIS#
IEW0000      INSERT IHCFRXPR
IEW0000      INSERT IHCLSCN
IEW0000      INSERT IHCSEXP
IEW0000      INSERT IHCSLOG
IEW0000      INSERT SCALE#
IEW0000      OVERLAY BETA
IEW0000      INSERT SCALIT
IEW0000      INSERT CALCBI
IEW0000      INSERT PPLOT
IEW0000      INSERT SCLFIX
IEW0000      INSERT INPLOT
IEW0000      ENTRY MAIN
```

TABLE 2-4. INPUT/OUTPUT UNITS USED IN AGAJ73

Unit No.	Type	Used for	Used by Subroutine
1	direct access	Permanent data storage in partitioned data set (PDS)	JSTRED, REDATB, REDBMS, REDCL, REDID, REDRWK, REDSWK
2	tape	New restart tape	RESTRT
3	direct access	Utility storage of time-variant trim flapping history and storing maneuver time history to pass to GDAJ07	INIT, LOADT, MAIN, MANU, MANUV, RESTRT, TVT
4	tape	Old restart tape	RESTRT
5	card reader	Input data	MAIN
6	printer	Printed output	ALSTAB, AZMUTH, CDCL, CLCD, DAMPER, ERRCHK, EXTORS, FUSINT, HAMMS, HPCG, INRO, INSTAB, IOMAT, ITRIM, ITROT, JFBGIN, LIZE, LOADT, MAIN, MBAL, MNEM, NPUTOT, RADOUT, READIN, REDID, REDRWK, RPTPG, SIVAR, STAB, TABOUT, TIVAR, TRIM, TRM1, TURN, VIND, WAG, WRFM, WRINST, WRMANU, WRMDAL, WRMS, WROT1, WRSTAB, WRTMNV, WRTRIM, WRVP, XCONIN, YRINIT, YSINIT
7	card punch	Punched output	PUNCH
10	direct access	Utility storage of AGAJ73 input data	JSTRED, MAIN, READIN, REDATB, REDBMS, REDCL, REDID, REDRWK, REDSWK
11	direct access	Passing input data to GDAJ07	MAIN, READIN

TABLE 2-4. Continued.			
Unit No.	Type	Used for	Used by Subroutine
14	direct access	Stored and retrieved initial conditions when Hamming's method is used	SAVEIC

TABLE 2-5. INPUT/OUTPUT UNITS USED IN GDAJ07			
Unit No.	Type	Used for	Used by Subroutines
3	direct access	Maneuver time history from AGAJ73 or Tape 8	CURVET, C81L, FSFT, MAIN, SCALIT
6	printer	Printed output	CALC81, CURVET, C18L, FSFT, PPLOT, WROT1
8	tape	Old time history tape	C81L
9	tape	New time history tape	C81L
10	direct access	Input data from AGAJ73	CURVET, C81L, FSFT, MAIN, SCALIT
PLOT-TAPE	tape	Plot maneuver time history in GDAJ07	PLOTER

```
//E2712370 JOB (AGAJ7300,638,69109304,OP20,T,02),'PV              2841',*
//            MSGLEVEL=1,CLASS=C
//CBIPROC PROC PROG=AGAJ7306,LIB=ENGTEST,F3SP=100,BLK=7292,
//            RESTI=NULLFILE,RESTO=NULLFILE,THIN=NULLFILE,
//            THOUT=NULLFILE,THSER=0,SYSPLOT=NULLFILE,
//            GRAPH=GDAJ07,LIB1=ENGTEST
//*
//*           PARAMETERS ON THE EXEC STATEMENT:
//*      NAME        DEFAULT        USAGE
//*      ----        --------       ----------------------------------
//*      PROG        AGAJ73         PROGRAM NAME
//*      LIB         ENGR.PROD1     LIBRARY WHERE PROGRAM RESIDES
//*      F3SP        100            NO. OF CYLINDERS FOR FT03F001
//*      BLK         7292           BLOCKSIZE OF FT03F001, FT08F001, AND
//*                                 FT09F001
//*      RESTI       NULLFILE       DSNAME FOR RESTART TAPE INPUT
//*      RESTO       NULLFILE       DSNAME FOR RESTART TAPE OUTPUT
//*      THIN        NULLFILE       DSNAME FOR TIME HISTORY INPUT
//*      THOUT       NULLFILE       DSNAME FOR TIME HISTORY OUTPUT
//*      THSER       0              VOL=SER FOR TIME HISTORY INPUT TAPE
//*      SYSUT1      (TEMP)         DSNAME FOR FT03F001
//*      TPA                        ANY TAPE DRIVE
//*      DDT                        ANY DUAL DENSITY TAPE DRIVE
//*      SYSPLOT     NULLFILE       DSNAME FOR PLOT TAPE
//*
*  //CBI      EXEC PGM=&PROG,REGION=(206K,550K)
//STEPLIB    DD   DISP=SHR,DSN=&LIB
//FT01F001   DD   UNIT=2314,DSN=CBILI872(DUM),VOL=SER=JOBLBX,DISP=SHR,
//            DCB=HIARCHY=1,LABEL=(,,,IN)
//*           DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)
//FT02F001   DD   UNIT=(TPS,,DEFER),DISP=(,CATLG,DELETE),DSN=&RESTO,
//            DCB=HIARCHY=1
//FT03F001   DD   UNIT=SYSDA,SPACE=(CYL,(&F3SP)),DSN=&SYSUT1,
//            DCB=(RECFM=VBS,LRECL=3644,BLKSIZE=&BLK,HIARCHY=1),
//            DISP=(NEW,PASS)
//FT04F001   DD   UNIT=(TPS,,DEFER),DISP=OLD,DSN=&RESTI,
//            DCB=HIARCHY=1
//FT05F001   DD   DDNAME=IN
//FT06F001   DD   SYSOUT=A
//FT07F001   DD   SYSOUT=B
//FT10F001   DD   UNIT=SYSDA,SPACE=(TRK,(10)),DSN=&SYSIN1,
//            DCB=(RECFM=FB,LRECL=80,BLKSIZE=3600,HIARCHY=1),
//            DISP=(NEW,PASS)
//FT11F001   DD   DSN=&SYSIN2,UNIT=SYSDA,SPACE=(TRK,(10)),
//            DCB=(RECFM=F,BLKSIZE=80,HIARCHY=1),DISP=(NEW,PASS)
//FT14F001   DD   UNIT=SYSDA,SPACE=(TRK,(8,4)),DISP=(NEW,DELETE),
//            DCB=HIARCHY=1
//CBIPLOT EXEC PGM=&GRAPH,COND=((4,LE,CBI),EVEN)
//STEPLIB    DD   DISP=SHR,DSN=&LIB1
//FT03F001   DD   DISP=(OLD,DELETE),DSN=&SYSUT1,DCB=HIARCHY=1
//FT06F001   DD   SYSOUT=A
//FT08F001   DD   UNIT=(TPS,,DEFER),DISP=OLD,DSN=&THIN,VOL=SER=&THSER,
//            DCB=HIARCHY=1
//FT09F001   DD   UNIT=(TPS,,DEFER),DISP=(,KEEP,DELETE),DSN=&THOUT,
//            DCB=(RECFM=VBS,LRECL=3644,BLKSIZE=&BLK,HIARCHY=1)
//FT10F001   DD   DISP=(OLD,DELETE),DSN=&SYSIN2,DCB=HIARCHY=1
//PLOTTAPE   DD   UNIT=(DDT,,DEFER),DSN=&SYSPLOT,LABEL=(,NL),VOL=PRIVATE,
//            DCB=HIARCHY=1
//         PEND THIS IS THE END OF THE IN-STREAM PROCEDURE
//         EXEC CBIPROC
//IN DD *
//*
```

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*REGION size shown in for use with HIARCHY support. If OVERLAY is used or entire program is run only in main or only in extended memory, the REGION size must be changed accordingly.

Figure 2-1. Job Control Language To Run AGAJ73 and GDAJ07 Data.

3. GENERAL PROGRAMMING AIDS

3.1 MARCO FLOW CHARTS

The flow charts in Figures 3-1 through 3-6 describe the functional structure of the program without regard to flow by subroutine. Figure 3-1 shows the total program structure and is a composite of Figures 1-1 through 1-13 in Volume II. Figure 3-2 provides some detail of the trim process in Figure 3-1. Figure 3-3 amplifies the stability analysis shown in Figure 3-1. Figures 3-4 and 3-5 give some flow logics of Runge-Kutta Method and Hamming's Predictor-Corrector Method employed, respectively, in maneuver functions in Figure 3-1. Figure 3-6 details the data reduction program.

3.2 FORTRAN SUBROUTINES IN AGAJ73

The FORTRAN subroutines contained in AGAJ73 are listed in alphabetical order including the main program, which is called MAIN. A few remarks are made for each subroutine which indicate its general purpose or use in the program. In the case of subroutines with multiple entry points, the names of all the entries are given after the name of the subroutine in the order that they occur in the subroutine.

(1) AJACOB, AJACB1. This subroutine handles computation of quantities which depend upon variables which are changed in either subroutine TRIM or subroutine STAB in order to compute partial derivatives. These quantities are then calculated and used in the computation of forces and moments.

(2) ALLMAT, ALLVEC. The stability analysis uses this subroutine to compute eigenvalues and eigenvectors.

(3) ALSTAB. This subroutine calls ALLMAT and processes and prints out the results of the stability analysis.

(4) ANAL. Output of this subroutine consists of the total summation of forces and moments.

(5) AZMINT. It initializes some variables which will be used by subroutine AZMUTH.

(6) AZMUTH. This subroutine in the rotor analysis does the calculation and integration at each blade azimuth position.

(7) CDCL. This subroutine uses the local angle of attack and Mach number plus the airfoil aerodynamic inputs to compute the steady-state lift, drag, and pitching moment coefficients for each blade segment of the rotor.

(8) CGZARM, CGYARM, CGXARM. This subroutine calculates moment arms about the cg for the aerodynamic surfaces whenever cg is shifted.

(9) CLCD. This subroutine is similar to subroutine CDCL except that CLCD computes the three aerodynamic coefficients for the wing and stabilizing surfaces.

(10) CMC/LC. This subroutine interpolates on the Carta tables to produce the contribution of unsteady aerodynamics to the pitching moment. It is the major section of the BUNS unsteady aerodynamic model.

(11) CNTM, AUXJ, FLAP. Some of the forcing functions in a maneuver may be timed to start after the rotors have been stopped. This subroutine converts those relative times to absolute times. It also varies jet thrust and RPM dependent flapping stops during a maneuver.

(12) CONSTB. This is the control program for the stability analysis.

(13) CONTRM. This is the control program of the trim segment.

(14) DAMPER, RATI. This is the variable damper for TRIM. The purpose of this is to gradually dampen out oscillations of the trim iterations. This is accomplished by checking the errors generated in TRIM against an upper limit and, whenever all errors are less than this limit, reducing both the partial derivative increment and the maximum amount which one of the TRIM variables can change in one iteration. This second entry to this subroutine, RATI, limits and applies the corrections to the TRIM variables.

(15) DAT1. This block data contains C_L, C_D, and C_M tables for the NACA 0012 airfoil.

(16) DAT3. This block data subroutine contains the Carta tables used in subroutine CMCALC.

(17) DERIV. This subroutine evaluates the derivatives during a maneuver.

(18) DIFFER. This is a subroutine of numerical differential technique. Outputs from it are quantities of velocities and accelerations required for the calculation of unsteady aerodynamic effects.

(19) ERRCHK. This subroutine checks possible input errors in the program logic group which is the key input group.

(20) EXTORS. It recalculates cg location, inertias, and gross weight when any external store is dropped. It also updates aerodynamic brake locations if brake deployment during a maneuver is exercised.

(21) FOCUS. This subroutine is in the rotor analysis. It transforms fuselage quantities into rotor reference and calculates accelerations during a maneuver.

(22) FUSFNM. As the name implies, this subroutine computes fuselage aerodynamic forces and moments. It also calculates rotor nacelle drag contributions.

(23) FUSINT. This subroutine converts input array to mnemonics for the fuselage group. It also calculates cg location and inertias if external stores are included.

(24) GUST. This subroutine is entered only during a maneuver in which a gust is being generated. It calculates the distance of each part of the rotorcraft from the start of the gust and then calculates from that distance the magnitude of the gust velocity at each point on the ship.

(25) HAMMS. This is the core of Hamming's Predictor-Corrector Method. It does predictions, checks errors, and makes corrections. It also handles the integration of differential equations and calls other subroutines necessary to a maneuver.

(26) HARM, HARM1. The harmonic analysis for blade loads at the trim point is done by this subroutine.

(27) HPCG. This subroutine calculates the first three time points. It is used along with trim points to start Hamming's Predictor-Corrector cycles in subroutine HAMMS.

(28) HRESP. The elastic modes during the quasi-static trim procedure are handled by this subroutine.

(29) INBLD, INBLD1, INBLD2, INBLD3. This subroutine converts input array to mnemonics for blade related data.

(30) INIT. This subroutine initializes the arrays for the printout during a maneuver and also writes those arrays on disk for later plotting.

(31) INRO. The function of this subroutine is the initialization and calculation of problem constants from the rotor inputs only.

(32) INRTR. This subroutine initializes some of the rotor related data which are not done in subroutine INRO.

(33) INSCAS. Initialization of the SCAS inputs is done here.

(34) INSTAB. This subroutine initializes for a stability analysis. It calculates the partial derivatives needed for later computing the frequency response.

(35) INTFRQ. It interpolates blade natural frequency as a function of rotor rotational speed and blade collective pitch.

(36) INVERS. This subroutine calculates the inverse of the mass matrix before the call to ALLMAT.

(37) IOMAT. This subroutine prints the mass, damping, and stiffness matrices used in the stability analysis.

(38) ITRIM. Included in this subroutine is the iteration loop of the trim section of the program. The function here is to iterate to a trimmed flight condition.

(39) ITROT. This subroutine initializes variables for subroutine AZMUTH and, when specified by the input parameters, controls the iteration loops to balance the rotor flapping moments. It also calculates the trim conditions for an elastic blade.

(40) JACOBI. As the name of this subroutine implies, its function is to calculate the Jacobian for use in the Newton-Raphson iteration method in TRIM or to calculate the displacement derivatives for use in the stability analysis.

(41) JFBGIN, ATMINT. This subroutine converts input arrays to mnemonics for jets, flight constants, bobweight, and weapons groups.

(42) JSTRED. This subroutine reads most of the input data groups.

(43) LGCINT. The program logic group input array is converted to mnemonics in this subroutine.

(44) LIZE. Initialization of some numerical constants is done in this subroutine.

(45) LOADT. This subroutine computes and prints out the loads on an elastic blade at the trim point.

(46) MAIN. This subprogram reads the control cards which direct the flow of the whole problem. The path is selected and calls are initiated to begin working the problem. Upon return, possible errors are checked for and appropriate action is taken. If an error is detected, an error message may be printed out. Then the program either terminates execution or starts the next problem, depending on the severity of the error.

(47) MANU. This subroutine controls the time-variant maneuver segment if Runge-Kutta Method is used. It handles the integration of the differential equations and the calling of the other subroutines necessary to a maneuver.

(48) MANUV. It controls the time-variant maneuver segment if Hamming's Method is used.

(49) MATRIX. The function of this subroutine is to calculate the transformation matrix from a set of input Euler angles.

(50) MBAL. This subroutine calculates rotor flapping increments during each iteration.

(51) MDRDRS. Damping and stiffness matrices for a stability analysis are calculated here.

(52) MNEM. The function of this subroutine is to calculate problem constants from input data and to initialize for a problem.

(53) MODAL. The variables which are functions of mode shape, frequency, and mass and inertia distributions only are computed in this subroutine.

(54) MODES. This subroutine calculates the mass matrix for a stability analysis.

(55) MOMB, SUBA, SUBB. This subroutine simulates a servomechanism controlling the swashplate while the main rotor is being folded horizontally.

(56) MTLT, TTLT, FLAT, YAWP. This subroutine handles mast tilt during a maneuver, the flat tracking mechanism, and the yaw control servomechanism.

(57) NOPS, NOPS1. The inputs to this subroutine are the number of azimuth stations for use in the rotor analysis. The outputs are quantities which are functions of the number of azimuth stations.

(58) NPUTOT. This subroutine prints most of the input data.

(59) NSTED, NSTED1. This subroutine calculates some variables for unsteady aerodynamic effects.

(60) PDZ1, PDZ. Ths inputs of this subroutine are a trim partial derivative matrix (i.e., the Jacobian) and the type of helicopter or rotorcraft being flown. This subroutine then changes the partial derivative matrix to conditions which are known to hold. Essentially, this is an attempt to filter numerical "noise" in the matrix.

(61) PUNCH. It punches nonzero elements of mass, damping, and stiffness matrices used in the stability analysis. The form of the punched output cards is explained in Volume II.

(62) PYLINT. It converts input arrays to mnemonics for the dynamic pylon group.

(63) QUAN. This subroutine sets mnemonics from the integration array at the end of each time point.

(64) RADBGN. It calculates some variables used by subroutine RADIAL.

(65) RADIAL. This subroutine in the rotor analysis does the calculations and integration along the blade radius.

(66) RADOUT. It prints output from subroutine RADIAL and AZMUTH.

(67) RBDY. It initializes radial stations for a rigid blade.

(68) READIN. This subroutine contains the logic for reading and printing the input data.

(69) REDATB. It handles the read-in of airfoil data tables.

(70) REDBMS. It handles the read-in of aeroelastic blade data as well as blade mode shape data.

(71) REDCL. It reads the coefficients of lift, drag, and pitching moment of each airfoil data table.

(72) REDID. It handles the read-in of group ID cards.

(73) REDRWK, RWKOUT. It performs the read-in and printout of rotor-induced velocity distribution (RIVD) tables.

(74) REDSWK, SWKOUT. It performs the read-in and printout of rotor wake at aerodynamic surface (RWAS) tables.

(75) RESTRT, REST4, RESTO, REST1, REST2. Restart tapes are written or copied by this subroutine. For the first case of each run, it also initializes all variables in commons to zero.

(76) RGUST. Subroutine GUST carries wind gust calculations to the rotor hubs. This subroutine then carries the calculations to the blade elements.

(77) RNGKTA. This is a special Runge-Kutta routine being used as a starter in Hamming's Predictor-Corrector Method.

(78) ROTAN. This subroutine may be considered to be the outer section of the rotor analysis.

(79) RPTPG. It controls the optional trim page output.

(80) RTINIT. This is the control routine which handles the initialization of the rotor.

(81) RTWAKE. This routine calculates blade local induced velocity when rotor wake table option is used.

(82) SAVEIC, RESTOR, RESTR1. This routine saves initial conditions during calculation of the first three time points of Hamming's Method.

(83) SAVOLD. It saves the values of some variables at the previous time point for Hamming's Method.

(84) SCASIT. The highest derivatives in the differential equations for the SCAS are calculated here.

(85) SIVAR. This subroutine handles the initialization of the maneuver inputs for subroutine VARI which are not a function of the trim point.

(86) SOLVE. This subroutine solves systems of linear equations by Gaussian elimination.

(87) STAB. This subroutine computes the rate derivatives used in the stability analysis.

(88) START. The function of this subroutine is to change units of the input arrays and set them equal to mnemonics and to control the initialization segment.

(89) STBWAK. This subroutine calculates the effect of rotor wakes on each stabilizing surfaces when a surface uses RWAS tables.

(90) STBZFM. It calculates aerodynamic forces and moments at all stabilizing surfaces.

(91) STBZIN. The function of this routine is the initialization and calculation of problem constants for wing and stabilizing surfaces.

(92) SUPERP. This subroutine simulates an autopilot.

(93) SWAS. This subroutine performs the function of linking the controls to the swashplates with the appropriate linkage factors and phase factors.

(94) SWSRAT. It calculates some intermediate velocities and accelerations.

(95) TABFIX. This subroutine calculates arrays to be used in the method of calculated entry in subroutine TABINT.

(96) TABINT. As the name implies, this subroutine does a table interpolation for C_L, C_D, and C_M tables.

(97) TABOUT. When tables are used for C_L, C_D, and C_M, this subroutine prints the tables after the input data.

(98) TILT, HASF, TFFA. This subroutine controls cg shift calculations for several different manners of shifting cg. The primary function is in a mast tilt maneuver. It provides not only for cg shift but also for changes in control phasing as a function of the mast tilt angle. Secondary entries handle cg shift with folding of a rotor either when it is

being folded aft after being tilted forward and stopped or being folded horizontally after a stop.

(99) TIMLP. This subroutine contains the initialization necessary at the start of each time step.

(100) TIVAR. This subroutine handles the initialization of the maneuver inputs for subroutine VARI which are a function of the trim point.

(101) TRIM. As the name implies, this subroutine is the primary one of the section of the program for finding the trimmed flight condition.

(102) TRMANU. This routine sets up arrays for the outputs of trim as well as maneuver pages.

(103) TRM1. The primary function of this routine is to initialize variables used by time-variant trim.

(104) TURN. This subroutine handles a banked turn. Secondarily, it handles pushovers or pull-ups. It does so by checking input data, picking up proper inputs, and doing the appropriate initialization to find a trimmed flight condition.

(105) TVT. This subroutine controls the time-variant trim procedure.

(106) UNSTED. This is the major section of the UNSAN unsteady aerodynamic model mentioned in Volumes I and II.

(107) VARI. This subroutine produces the effects of input disturbances during a time-variant maneuver. The inputs to this subroutine are the user-supplied forcing functions. The results produced by these functions are the output of this subroutine.

(108) VCNTRL, VCNT1, VCNT2, ---, VCNT10. This is called by subroutine VARI. It calculates the effects of time-variant maneuver disturbance.

(109) VIND. This subroutine calculates the induced velocity of a rotor.

(110) WAG. The time-dependent lift change by the Wagner and Kussner Method is computed in this subroutine.

(111) WING. As the name implies, this routine computes aerodynamic forces and moments on wings.

(112) WKTABN. If the number of blade radial stations input to rotor wake table is not twenty, this subroutine interpolates the table into twenty blade radial stations. This is done outside the iteration loops so that a three-way interpolation can be reduced to two-way.

(113) WRFM. This is an output subroutine which writes out the rotor force and moment summary in shaft reference and the fuselage reference force and moment summary.

(114) WRINST, IOWRFM, IOWRF1. This subroutine prints output during the computation of partial derivatives for a stability analysis.

(115) WRMANU. This subroutine contains the write statements which produce part of the maneuver printout.

(116) WRMDAL, WRMDL1, WRMDL2. This subroutine prints the results of subroutine MODAL.

(117) WRMS. As a result of stability analysis, it prints out mode shapes associated with the rotorcraft characteristic roots.

(118) WROT1, WROT. This is another output subroutine which produces the heading for the printout of the input data and the trim page.

(119) WRSTAB. This subroutine prints the rate derivatives used in the stability analysis.

(120) WRTMNV. This subroutine defines the output arrays for trim as well as maneuver pages.

(121) WRTRIM. As the name implies, this routine writes trim page.

(122) WRVP. This is still another output subroutine which produces the printouts of the partial derivative matrices calculated and the independent variables used in the calculation of those derivatives.

(123) WSHDUF. It calculates fuselage effects on downwash and sidewash angles at wings and other stabilizing surfaces.

(124) XCONIN. Initialization of all control linkages is handled by this subroutine.

(125) XSTINT. This subroutine converts input array to mnemonics for external stores/aerodynamic brakes.

(126) XSTORE. It calculates aerodynamic forces and moments at each external store/aerodynamic brake.

(127) YRINIT. This subroutine conditions the aerodynamic inputs for the rotors.

(128) YSINIT. This subroutine conditions the aerodynamic inputs for the wing and stabilizing surfaces.

(129) ZERO. This is part of the initialization segment. Every variable in this routine is set to zero.

(130) ZLLCAL. This subroutine computes zero lift line increments at wings and other stabilizing surfaces.

3.3 ASSEMBLY LANGUAGE SUBPROGRAMS IN AGAJ73

AGAJ73 uses four assembly language subprograms which were written at Bell Helicopter Company: ABDUMP, DATE, DOTX, and PDSRED. The first three are available from the SHARE (an IBM user's organization) FORTRAN library. Although PDSRED itself is not available from SHARE, their library does include two routines (OPEN and CLOSE) which are generalizations of PDSRED and can be adapted to replace the single routine.

(1) ABDUMP. This diagnostic routine permits the program to terminate itself with a memory dump under OS/360. It does nothing except issue an ABEND macro with user code 0322. The routine is in System/360 Assembler Language. It was prepared at Bell Helicopter and is in the public domain.

(2) DATE. This routine with argument (NDATE) returns the current system date, NDATE, in Gregorian form: mm/dd/yy. NDATE must be at least eight bytes long. The routine is coded in System/360 Assembler Language for OS/360 only. It uses the macros peculiar to the MVT option of OS/360. It was prepared at Bell Helicopter and is in the public domain. It contains the following entry points:

ENTRY SETIME (TINT). This entry establishes an operating time interval against which to check program operation. This interval (TINT) is in minutes in floating point form. The routine does not cause execution to terminate at the end of the designated interval. This entry initializes TIMEX.

ENTRY TIMEX (TU, DT, TL). This entry checks the central processor time since the last call to SETIME or TIMEX. It returns three argument values in floating point minutes:

TU - Time since initial call to SETIME.

DT - Time since last call to TIMEX or SETIME.

TL - Time remaining in the SETIME interval.

(3) DOTX. This is a function subprogram with the following argument list: A, IA, B, IB, NP. It is a fast method of computing vector inner product using double precision accumulation of sum of products of single precision operands. The routine is physically small, about twice as fast as equivalent FORTRAN code, and quite flexible. It provides the improved accuracy of double precision vector products without the increase of storage and time required to do full double precision analysis. DOTX returns a double precision result if the calling program types it as such. The arguments are described as follows:

A and B are the first elements of the two single precision vectors to be multiplied.

IA is the number of words between successive elements of A. It is a full word integer greater than zero.

IB is the number of words between successive elements of B. It is a full word integer of any value.

NP is the number of element products to be formed, i.e., the number of elements used. It is a full word integer greater than zero.

The only validity check made on the arguments is that IA and NP be greater than zero. If either of them is out of range, the routine returns a zero result. There are no other error exits.

The computations of the subprogram can be represented by the following summation:

$$X = \sum_{i=0}^{NP} Y(NA + i*IA)*Z(NB + i*IB) \qquad (3\text{-}1)$$

where X is the output of the subprogram,

Y(NA) is the NA^{th} element in the Y array (A in the calling sequence),

Z(NB) is the NB^{th} element in the Z array (B in the calling sequence), and

NP, IA, and IB are as defined in the argument list.

For example, assume that the two arrays FORCE and DISP are dimensioned to 5 and 8 respectively. Using DOTX, the following statement could be programmed:

```
WORK = DOTX(FORCE(1),2,DISP(2),3,3)                    (3-2)
```

The equivalent FORTRAN statement would then be as follows:

```
WORK = FORCE(1)*DISP(2) + FORCE(3)*DISP(5) + FORCE(5)*DISP(8)
```

The routine is written in System /360 Assembler Language for any level of assembler. It was prepared at Bell Helicopter Company and is in the public domain.

(4) <u>PDSRED</u>. This routine is used to find a member of a partitional dataset and to make it accessible to a FORTRAN routine through normal sequential READ statements. The parameter list is as follows:

member — an 8-byte character string which identified the desired member

&sn — the symbol & is a standard punch. The symbol sn stands for a statement number. If the member is not found, the program goes to this statement in the calling routine rather than executing the statement following the call to PDSRED. This type of argument is an IBM FORTRAN language extension.

After returning from PDSRED, normal FORTRAN READ on unit 1 may be issued and an end of dataset is sensed as with any other dataset. Before another call to PDSRED can be issued for the same PDS, Rewind 1 must be issued.

This routine is coded in IBM System/360 Assembler Language using OS/360 macro facilities. This function is not duplicated in any other operating system. The routine is compatible with all OS/360 releases through and including the 21.6 release. It was prepared at Bell Helicopter and is in the public domain.

3.4 FORTRAN SUBROUTINES IN GDAJ07

The FORTRAN subroutines contained in GDAJ07 are listed in alphabetical order including the main program, which is called MAIN. A few remarks are made for each subroutine which indicate its general use or purpose in the program.

(1) CALC81. This subroutine is the interface between subroutine SCALIT and the CALCOMP plot routines.

(2) CONPLT. This subroutine controls the plotting of the time histories.

(3) CURVET. This subroutine analyzes the time history of selected variables during a maneuver. This analysis is accomplished by a least-squares curve fit followed by comparison of both the amplitude and phase angle of different variables. Then one variable is expressed as a linear function of two others.

(4) C81L. The function of this subroutine is the transfer to a disk of maneuver time history data which has been stored on a tape or the transfer to a tape of maneuver time history data which has been stored on a disk.

(5) DATP. This first block data subroutine contains part of the headings for plotted time histories.

(6) DAT1. This second block data subroutine contains part of the headings for plotted time histories.

(7) FSFT. This subroutine controls the harmonic analysis of a time history.

(8) HARM. This is the harmonic analysis subroutine used by subroutine FSFT.

(9) HEDING. This subroutine generates the labels for the time histories from the data stores in DATP or DAT1.

(10) MAIN. This is the control program for GADJ07.

(11) PLOTER. This subroutine does the CALCOMP plotting of the results of the harmonic analysis.

(12) PPLOT. This is the printer plot routine which produces plots of time histories.

(13) SCALIT. This subroutine sets up the arrays for the time history plots.

(14) SCLFIX. This subroutine calculates scale factors for the time history plots.

(15) WROT1, WROT. This subroutine prints the headings on the printer plots.

3.5 LABELED COMMONS IN AGAJ73

There are 21 labeled COMMONS, but no blank COMMON, in AGAJ73. Each of the COMMONS is listed below. Any special ordering of variables and the reason for doing so are given along with some general comments.

(1) ANDOIT. The first 9 variables, HFRC through YSHRN, in this COMMON are double precision. It is used only in the general purpose subroutines controlled by subroutine ANAL.

(2) FLEX. It contains most of the variables used in elastic blade modal analysis.

(3) FORCMC. This COMMON contains the Carta tables used by subroutine CMCALC. Since it is defined in block data format in subroutine DAT3, it is not marked as a COMMON block in Table 4-1.

(4) FORWK. This COMMON contains most of the variables used in computing the rotor-induced velocity distribution from the table stored in FORWK1.

(5) FORWK1. This is the set of rotor-induced velocity distribution (RIVD) tables used by subroutine RTWAKE.

(6) FORY. There is no special ordering of variables in this COMMON. It consists of the array "Y" operated upon by Runge-Kutta and is used in the initialization, trim, and maneuver segments.

(7) FORYYY. It contains most of the variables specifically used by Hamming's Predictor-Corrector Method.

(8) FORYY1. This COMMON has only one array. It retains all the values of previous time points and their derivatives used by Hamming's method.

(9) FOSWK. This COMMON contains most of the variables used in computing the effects of the rotor wake at the aerodynamic surfaces from the tables stored in FSWK1.

(10) FOSWK1. This is the set of rotor wake at the aerodynamic surfaces (RWAS) tables used by subroutine STBWAK.

(11) INSTAR. This block contains most of the input. It is used in the initialization segment.

(12) MANAL. The first 59 variables, XF through NQTR, in this COMMON are ordered to allow I/O and other manipulations to be done on an equivalent array. The next 11 variables, COLSTK through B1TR, are ordered for equivalencing to an array. Not more than 10 of these variables are used, and the array KVAR is used as a pointer vector to choose which ones and their order. The next 22 variables, A1M through PYLMD, are ordered for equivalencing to the array VAR in subroutine STAB for the calculation of derivatives. The variables TAXL and TAXR are equivalenced to an array in subroutine CNTM.

(13) STAMAN. Variables in this block are mostly used in initialization and maneuver segments. Arrays SHPGRP through SFTGRP are ordered to allow I/O and other manipulations to be done on an equivalent array.

(14) STARAD. Most of the variables here are used in the initialization and general-purpose segments.

(15) STARAN. This COMMON is used in the initialization and general-purpose segments.

(16) STBD. This COMMON is used only in the stability analysis.

(17) STRIAB. COMMON STRIAB is used in the initialization, trim, and stability analysis segments.

(18) STRIMA. The first 16 variables, TZM through TCLOCK, are ordered for equivalencing in subroutine MOMB. The next six arrays, SCASRF through SCASYC, are ordered for equivalencing in subroutine INSCAS. This COMMON is not used in the rotor analysis.

(19) TAB. This COMMON contains the C_D table for the NACA 0012 airfoil. Since it is defined in block data format in Subroutine DAT1, it is not marked as a COMMON block in Table 4-1.

(20) TAB1. This COMMON contains C_L and C_D tables for the NACA 0012 airfoil. Like TAB, it is block data in DAT1. Consequently, it is not identified as a COMMON block in Table 4-1.

(21) TOPLOT. This COMMON is used in all segments.

3.6 LABELED COMMONS IN GDAJ07

There are 6 labeled COMMONS, but no blank COMMONS, in GDAJ07. Each of the COMMONS is listed below, together with pertinent comments.

(1) INPLOT. This COMMON is used by subroutine SCALIT and the other subroutines in the segment for plotting time histories.

(2) MAXMIN. It contains the maximum and minimum values of the specified variable. It is primarily used to determine the scale of the plot.

(3) PLOTD. This COMMON contains the data in the block data subroutine DATP which is used by subroutine HEDING to furnish alphameric headings for time histories.

(4) PLOTD1. It has the data in the second block data subroutine DAT1 which is used by subroutine HEDING to supply headings for time histories.

(5) TIMPTS. This COMMON is chiefly used as local storage in subroutines CURVET and C81L.

(6) TOPLOT. This COMMON contains control variables and is not the same as COMMON TOPLOT in AGAJ73.

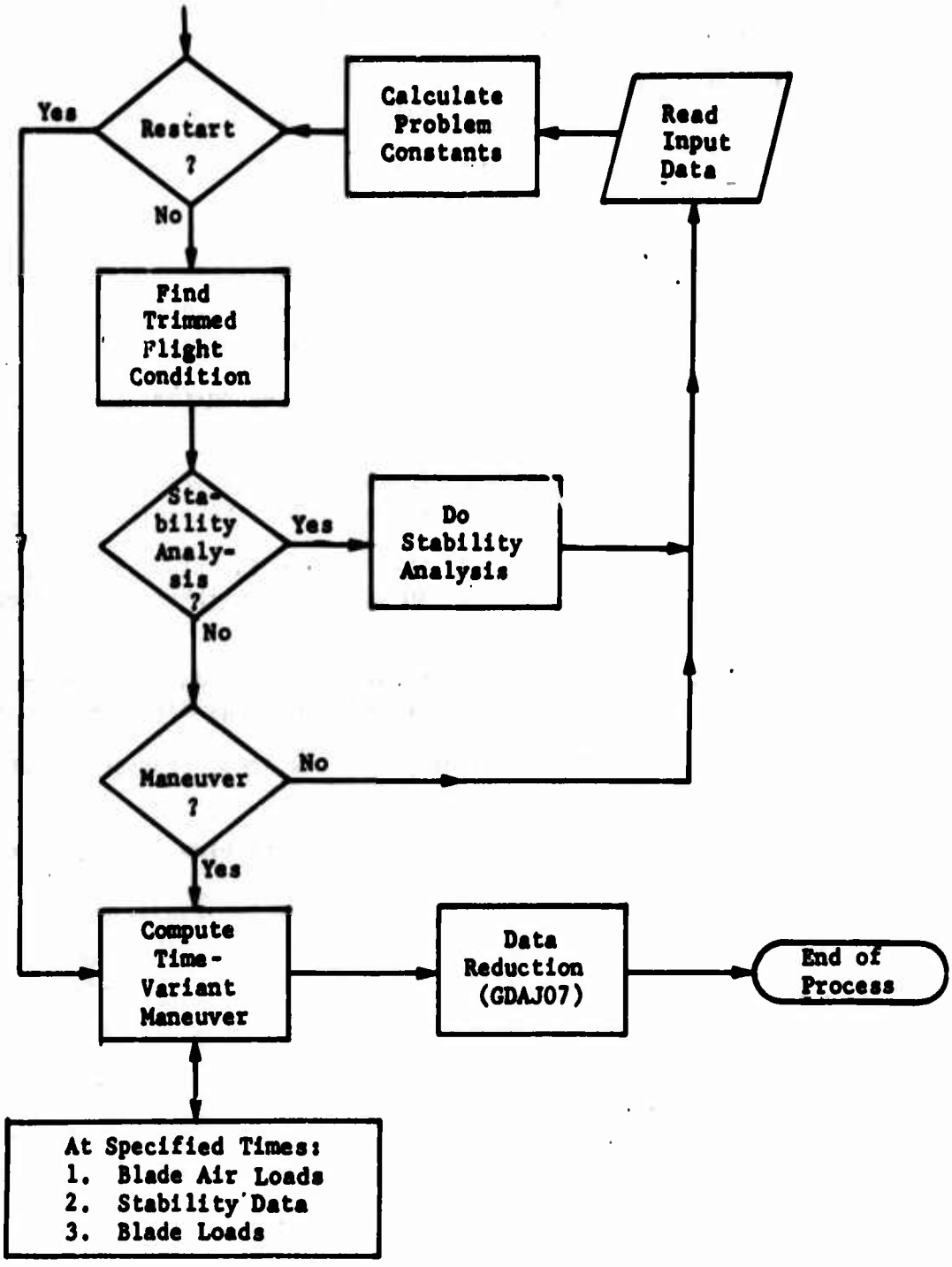

Figure 3-1. Flow Chart of System Structure.

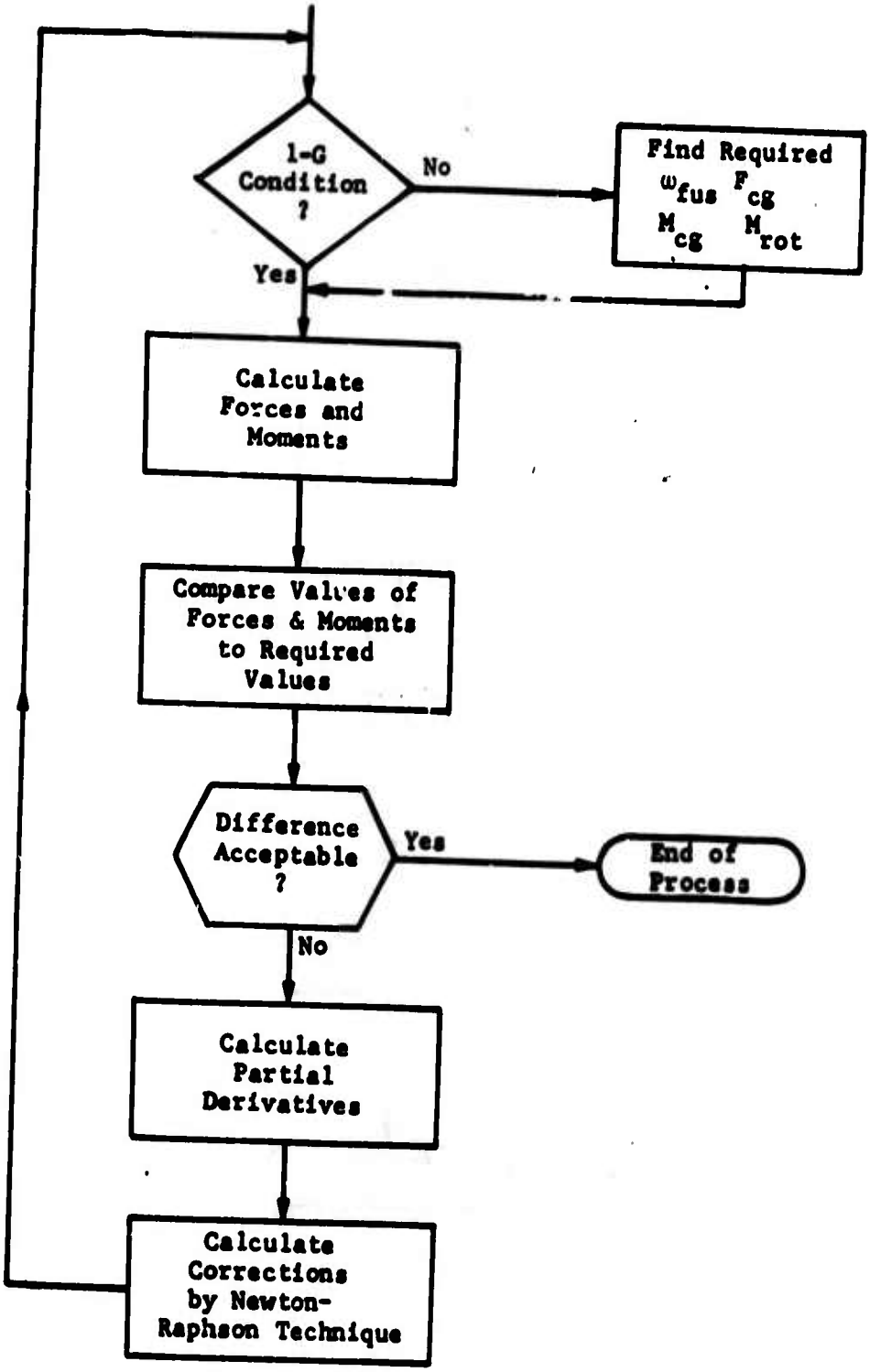

Figure 3-2. Flow Chart of Trim Process.

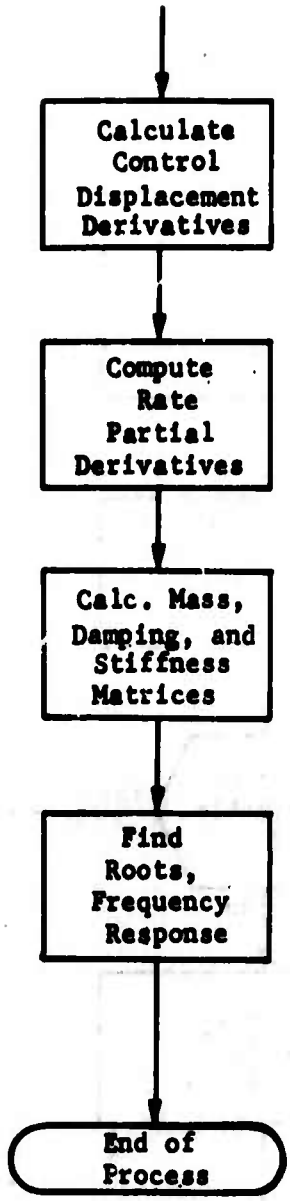

Figure 3-3. Flow Chart of Stability Analysis.

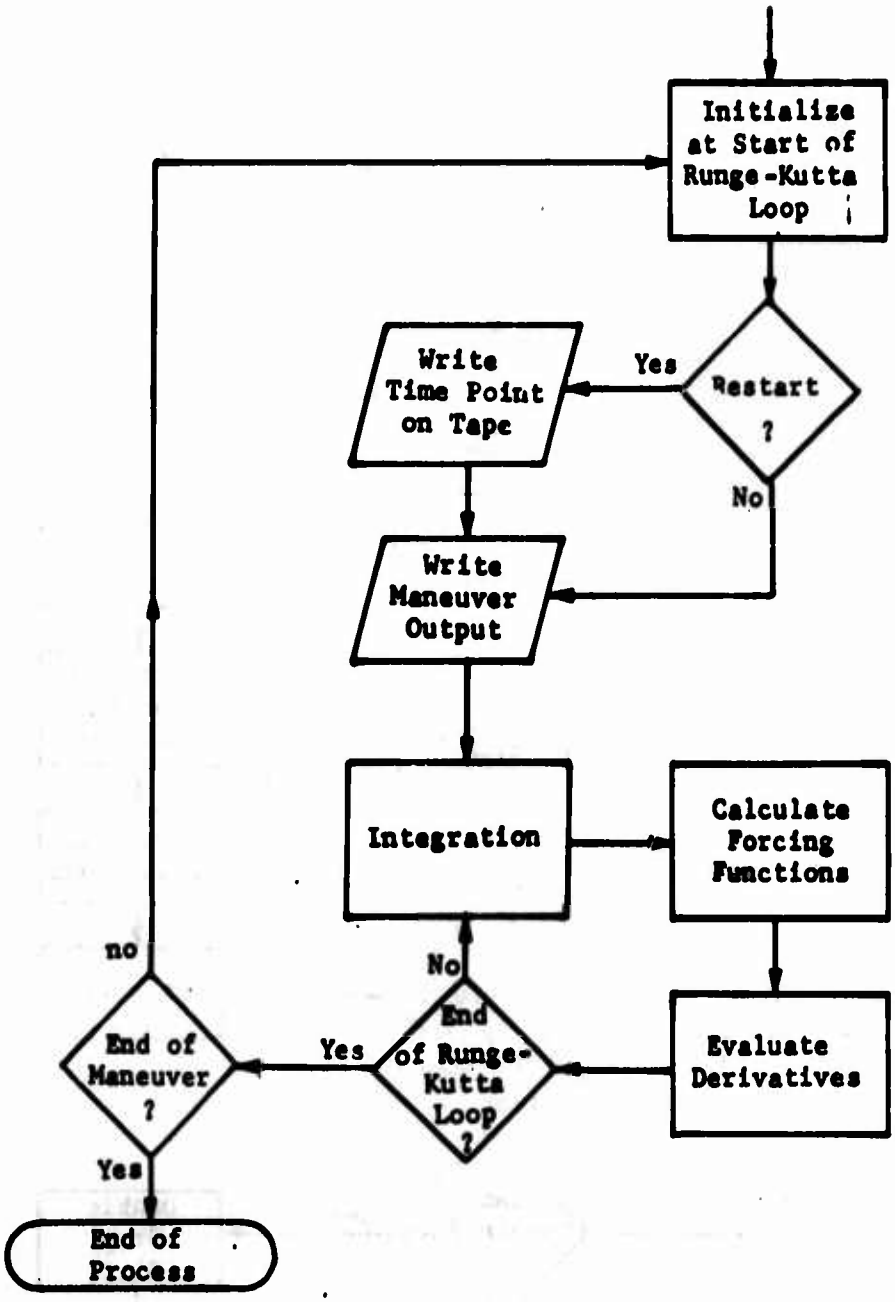

Figure 3-4. Flow Chart of Maneuver With Runge-Kutta Method.

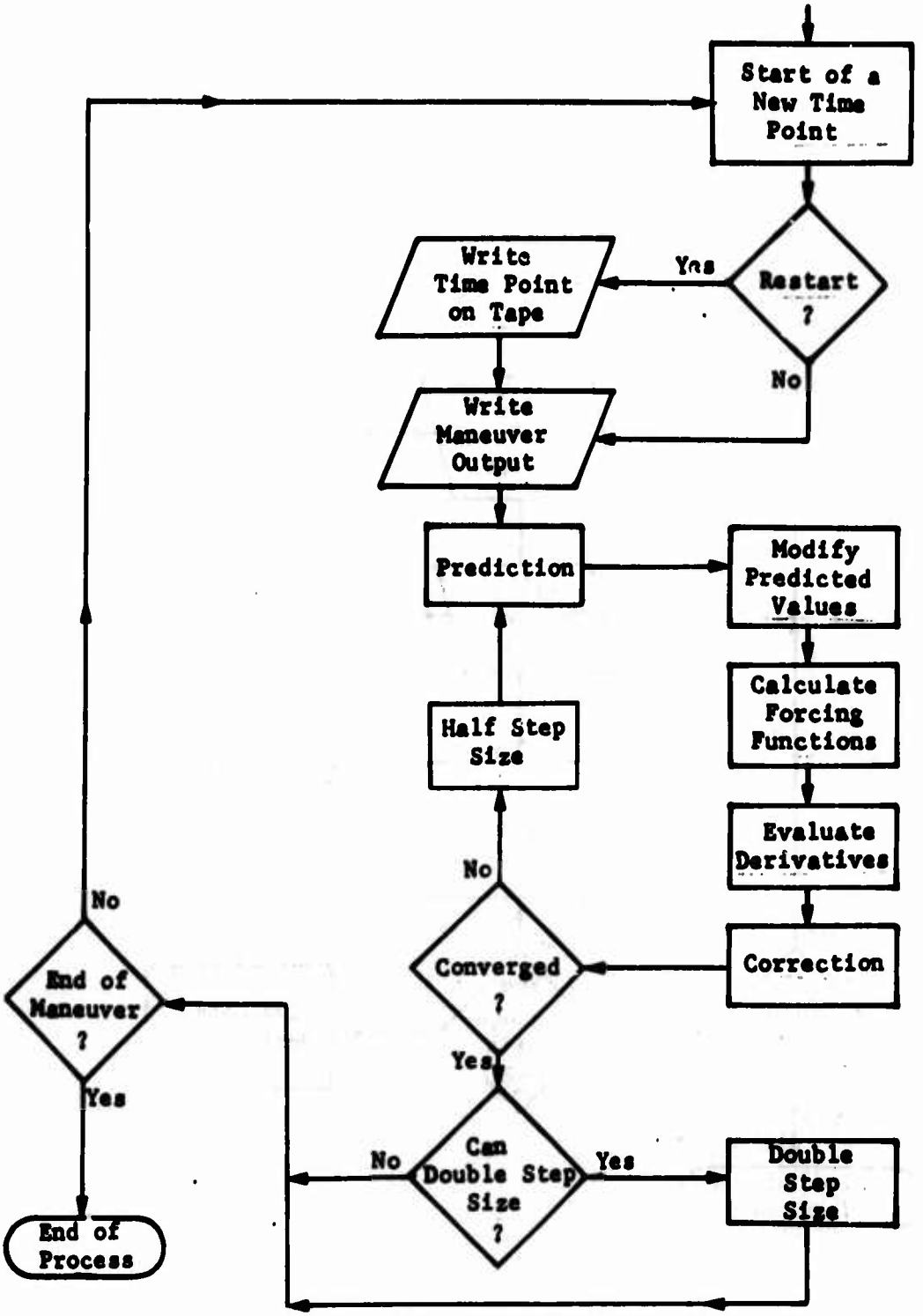

Figure 3-5. Flow Chart of Maneuver With Hamming's Method.

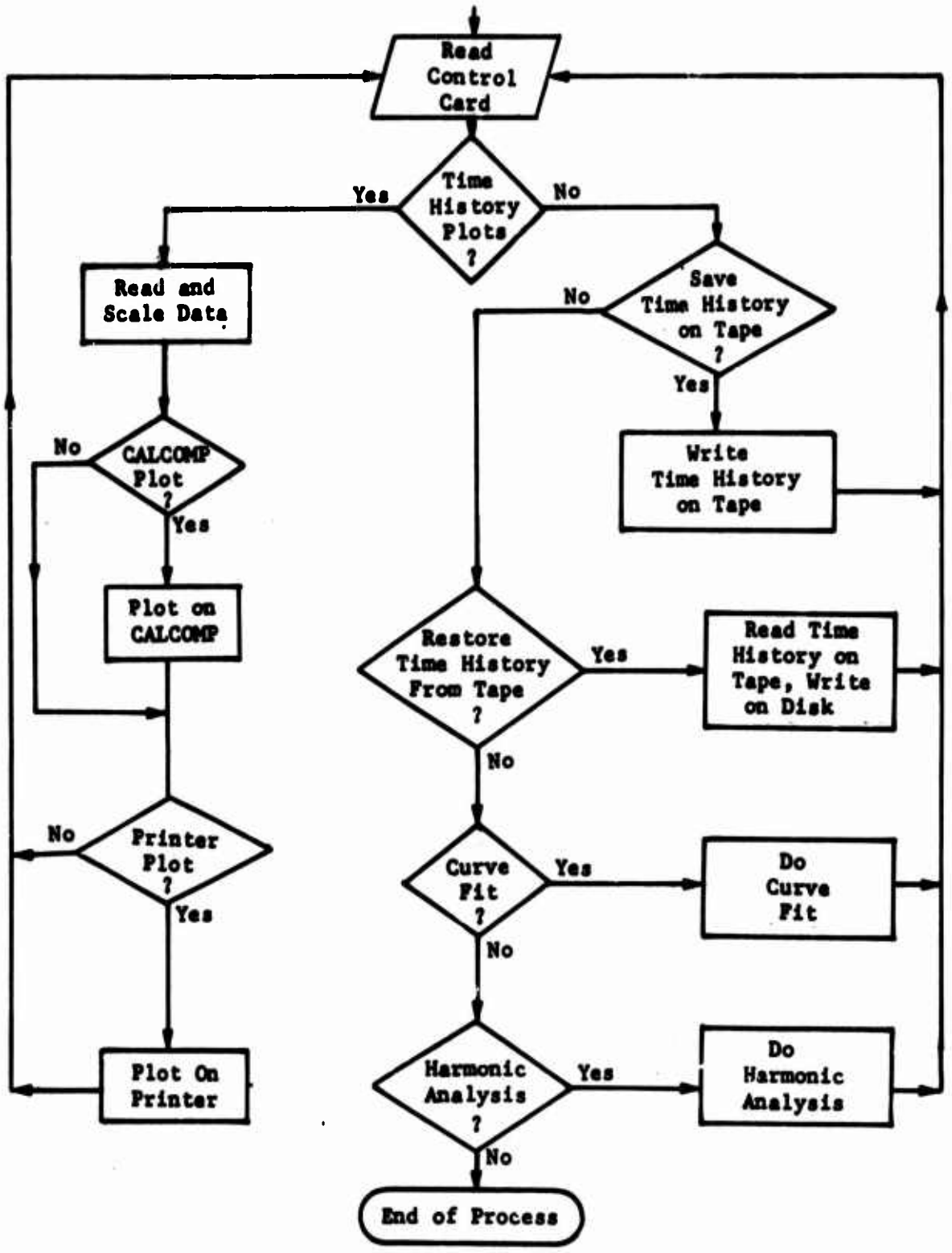

Figure 3-6. Flow Chart of GDAJ07.

4. DETAILED PROGRAMMING AIDS

4.1 CONTROL SECTION CROSS-REFERENCE

The Control Section Cross-Reference List for AGAJ73, Table 4-1, shows most of the control sections, including COMMONS, which are referenced by another control section. The exceptions are listed on the first page of the table. These exceptions are system routines, and their presence would not contribute to the cross-reference list. The remaining pages of Table 4-1 contain the control sections in alphabetical order in a column on the left side of the page. To the right of each control section name is the cross-reference information. "LENGTH" is the size of the subroutine or COMMON in hexadecimal bytes. "CALLED BY" gives the name of each control section referencing the control section whose name is in the column on the left. "IS USED BY" gives the name of each control section referencing a control section in the "CALLED BY" list or by another control section in the "IS USED BY" list. "CALLS" gives the name of each control section referenced by the control section whose name is in the column on the left. "USES" gives the name of each control section referenced by a control section in the "CALLS" list or by another control section in the "USES" list.

The information in the Control Section Cross-Reference List is sufficient to construct the sequence of subroutine calls from which an overlay structure can be made.

As noted in Section 3.2, several subroutines have multiple entry points. However, the Cross-Reference List (Table 4-1) includes only the primary names of subroutines; it does not include the names of any of these additional entry points. In the case where a call to a subroutine is actually a call to an additional entry point, the primary name of the subroutine which contains the specified entry point is used in the Cross-Reference List. For example, Table 4-1 indicates that subroutine AZMUTH calls RADOUT when AZMUTH actually calls AZMOUT (a second entry point to RADOUT). In Section 3.2 the names of any additional entry points follow the name of the subroutine; however, in reading the program listing, it is generally more useful to know the name of the subroutine which contains a particular entry point than to know the additional entry points of a subroutine. Hence, a cross-reference of the additional entry points to the subroutine which contains them is given in Table 4-2.

Table 4-3 contains the Control Section Cross-Reference List for GDAJ07. It is read and used in exactly the same manner as Table 4-1.

4.2 PROGRAM LISTINGS

Listings of the three programs supplied under this contract are on file at Eustis Directorate, USAAMRDL:

(1) AGAJ73
(2) GDAJ07
(3) AS812A

Note that Program AS812A is written in PL/1 rather than FORTRAN.

Program AS812A is independent of the AGAJ73/GDAJ07 combination. The purpose of the program is to perform least-squared-errors curve fits of wind tunnel data which provide inputs for the Nominal Angle Equations of AGAJ73. The card format for the wind tunnel data input to AS812A was chosen to be compatible with the format of data supplied by the LTV Low Speed Wind Tunnel, Dallas, Texas. The data is read in by the statement on CARD 500 for the sequenced source deck. The format may be changed by the programmer to read most any available data.

The printed output of AS812A lists the coefficients of the equation to which the data has been fitted. The output also lists the inputs to AGAJ73 in the proper sequence and format with the AGAJ73 card number. Punched card output, for direct input to AGAJ73, is an option in AS812A. The job control cards for AS812A are shown in Figure 4-1.

4.3 PROGRAMMING OPTION IN NUMERICAL INTEGRATION

As mentioned in Section 2 of Volume I, there are two methods of numerical integration techniques in AGAJ73. The first one is the Runge-Kutta method which is programmed as the default option. The second is Hamming's method which can be activated only by setting the logical variable HMG to TRUE. This variable is located in subroutine LIZE and is set to FALSE in the program delivered under this contract.

4.4 REDUCTION OF PROGRAM MEMORY REQUIREMENTS

There are several very large arrays in AGAJ73. The size of some can be easily reduced without any significant decrease in the capabilities of the program. The arrays which can be easily reduced in size are shown in Table 4-4. The table also includes the name of the COMMON to which each belongs, the full and reduced dimensions of each, and the approximate savings in memory requirements for reducing each array. Up to 330K of storage can be eliminated with minimal effort.

Referring to Table 4-3; arrays WKRTR, WKSTB, and AUX are independent of each other. Their sizes can be cut individually or concurrently. However, arrays CURVED, CURVEL, and CURVEM are dependent; if one of them is reduced, all of them must be reduced at the same time. If, after the program is link-edited in load-module form, the programmer wishes to reduce the size of any array noted in Table 4-4, it is necessary to include a REPLACE card, before the INCLUDE OLDLIB or SYSLMOD card in the linkage step. This REPLACE card must then contain the names of all arrays which have just been reduced in size.

In Table 4-4 there are two columns under the headings of array name and dimension. The "Outside RESTRT" column gives the name(s) and dimension(s) to be used in the associated COMMON block when it is included in any subroutine other than RESTRT. In subroutine RESTRT the information listed under "In RESTRT" must be used. The different names and single dimensions are in RESTRT simply to facilitate the task of setting the COMMON blocks to zero. Each array included in Table 4-4 is discussed in more detail below.

WKRTR contains the sets of coefficients for the Rotor-Induced Velocity Distribution (RIVD) tables discussed in Sections 2.3.3.1.3 and 2.3.3.2 of Volume II. If the size of this array is reduced as shown in Table 4-4, the input to IPL(5) must be equal to zero and in subroutine RESTRT FRK1(66000) and DO 34 I=1,66000 must be changed to FRK1(1) and DO 34 I=1,1, respectively.

WKSTB contains the sets of coefficients for the Rotor Wake at Aerodynamic Surface tables discussed in Section 2.3.4 of Volume II. If the size of this array is reduced as shown in Table 4-4, the input to IPL(37) must be equal to zero and the inputs to XWG(29) through XWG(32), XSTBi(29), and XSTBi(32) must all be less than or equal to 100. XSTBi stands for the ith stabilizing surface. In subroutine RESTRT, FSK1(9000) and DO 36 I=1,9000 must be changed to FSK1(1) and DO 36 I=1,1, respectively.

CURVED is the array where drag coefficients of the airfoil data tables are located. If the size of this array is reduced as shown in Table 4-4, the input to IPL(2) must be less than or equal to 2, TABL(6350) in subroutine RESTRT must be changed to TABL(3026), and TITLE(8,4) and CURVED(1100,4) in block data DAT1 must be changed to TITLE(8,1) and CURVED(1100,1), respectively.

CURVEL and CURVEM are the arrays for the airfoil lift and pitching moment coefficients respectively. If their sizes are reduced as shown in Table 4-4, the input to IPL(2) must be less than or equal to 2, TABL1(5375) in subroutine RESTRT must be changed to TABL1(2150), and CURVEL(1100,4) and CURVEM(575,4) in block data DAT1 must be changed to CURVEL(1100,1) and CURVEM(575,1), respectively.

AUX is an auxiliary array used in the Hamming's method. If this array is reduced as shown in Table 4-4, the default option of numerical integration in maneuver (the Runge-Kutta method) must be used. Also, in subroutine RESTRT, FYY1(3440) and DO 104 I=1,3440 must be changed to FYY1(1) and DO 104 I=1,1, respectively.

There are other large arrays which can be reduced if storage requirements are still excessive after taking the steps discussed above. However, the necessary steps for reducing them are more complicated and in some cases mean deletion of a major program option, and in most cases the savings is not worth the effort. The programmer should consult with the contractor before attempting any storage reductions beyond those outlined in this report.

4.5 SWITCH FOR DIAGNOSTIC DATA FROM STAB

In Section 3.2 of Volume II, IPL(34) is defined as a switch for obtaining diagnostic data during the stability analysis (STAB). Since the data generated by this switch are not of general interest to the user, but can be useful to the programmer, the function of IPL(34) is discussed in this Programmer's Manual rather than in Volume II. The function of the switch is described below.

In STAB there are up to 22 independent variables which may be incremented in the process of computing the stability (partial) derivatives. The number of variables actually incremented depends on the number of degrees of freedom which the user has activated. (See IPL(30) and (32) in Section 3.2 of Volume II). In each STAB case, IPL(34) can be used to print out the following data resulting from one of the variables being incremented:

(1) blade element aerodynamic data (α, C_L, C_D, C_M, etc.) at each blade station and each azimuth location for each rotor (i.e., IPRINT in subroutine RADIAL does not equal zero, which calls RADOUT)

(2) rotor and pylon moment data (i.e., COND1 in subroutine MBAL is greater than 1.5, which causes printout)

To generate this output for a particular increment, IPL(34) is set to the value shown in Table 4-5. Further information about the variables in this table can be found in Section 4.11.2.1 of Volume II. Note that locking out a degree of freedom does not change the correspondence shown in Table 4-5 between IPL(34) and the variables. Also, it is only possible to obtain this extra printout for one variable in each STAB case. To obtain the printout for more than one variable, the case must be rerun for each variable of interest with IPL(34) set to the appropriate value in each repeat run.

TABLE 4-1. CONTROL SECTION CROSS-REFERENCE FOR AGAJ73

PURG	IHCCLABS	CONTROL SECTION REMOVED
PURG	IHCCLAS	CONTROL SECTION REMOVED
PURG	IHCCLSQT	CONTROL SECTION REMOVED
PURG	IHCCOMH2	CONTROL SECTION REMOVED
PURG	IHCCSABS	CONTROL SECTION REMOVED
PURG	IHCCSAS	CONTROL SECTION REMOVED
PURG	IHCECOMH	CONTROL SECTION REMOVED
PURG	IHCEFIOS	CONTROL SECTION REMOVED
PURG	IHCEFNTH	CONTROL SECTION REMOVED
PURG	IHCERRM	CONTROL SECTION REMOVED
PURG	IHCETRCH	CONTROL SECTION REMOVED
PURG	IHCFCVTH	CONTROL SECTION REMOVED
PURG	IHCFOPT	CONTROL SECTION REMOVED
PURG	IHCFRXPR	CONTROL SECTION REMOVED
PURG	IHCLSQRT	CONTROL SECTION REMOVED
PURG	IHCNAMEL	CONTROL SECTION REMOVED
PURG	IHCSASCN	CONTROL SECTION REMOVED
PURG	IHCSATN2	CONTROL SECTION REMOVED
PURG	IHCSEXP	CONTROL SECTION REMOVED
PURG	IHCSLOG	CONTROL SECTION REMOVED
PURG	IHCSSCN	CONTROL SECTION REMOVED
PURG	IHCSSQRT	CONTROL SECTION REMOVED
PURG	IHCSTNCT	CONTROL SECTION REMOVED
PURG	IHCUATBL	CONTROL SECTION REMOVED
PURG	IHCUOPT	CONTROL SECTION REMOVED

TABLE 4-1. Continued.

```
ABDUMP   LENGTH      20
         CALLED BY   - MAIN

AJACOB   LENGTH     878
         CALLED BY   - INSTAB   ITRIM   JACOBI
         IS USED BY  - CONSTB   CONTRM  INSTAB  ITRIM   MAIN    TRIM
               CALLS - ANAL     FORV    FORYYY  FORYY1  MANAL   MATRIX  STARAN  STARAN  STRIAB  STRIMA  SWAS    TOPLOT
                       WRFM     WRVP    ZLLCAL
               USES  - ANDOIT   AZMINT  AZMUTH  CDCL    CLCD    CMCALC  DIFFER  DOTX    FLEX    FOCUS   FORCMC  FORWK
                       FORWK1   FORV    FORYYY  FORYY1  FOSWK   FOSWK1  FUSFNM  HRESP   INSTAR  INTFRQ  ITROT   MANAL
                       MATRIX   MBAL    NSTED   RADDGN  RADIAL  RADOUT  RGUST   ROTAN   RTWAKE  STARAN  STARAD  STARAN
                       STPWAK   STBZFM  STRIAB  STRIMA  SWSRAT  TAB     TABINT  TAB1    TOPLOT  TVT     UNSTED  VIND
                       WAG      WING    WSMOUF  XSTORE

ALLMAT   LENGTH    4588
         CALLED BY   - ALSTAB
         IS USED BY  - CONSTB   MAIN

ALSTAB   LENGTH    6A20
         CALLED BY   - CONSTB
         IS USED BY  - MAIN
               CALLS - ALLMAT   INVERS  MANAL   STBD    WRMS
               USES  - STARAN   STBD

ANAL     LENGTH     920
         CALLED BY   - AJACOB   DERIV   STAB
         IS USED BY  - CONSTB   CONTRM  MANMS   MPCG    INSTAB  ITRIM   JACOBI  MAIN    MANU    MANUV   RNGKTA  TRIM
               CALLS - ANDOIT   FUSFNM  MANAL   ROTAN   STARAN  STBZFM  STRIMA  TOPLOT  WING    XSTORE
               USES  - ANDOIT   AZMINT  AZMUTH  CDCL    CLCD    CMCALC  DIFFER  DOTX    FLEX    FOCUS   FORCMC  FORWK
                       FORWK1   FORV    FORYYY  FORYY1  FOSWK   FOSWK1  HRESP   INSTAR  INTFRQ  ITROT   MANAL   MATRIX
                       MBAL     NSTED   RADDGN  RADIAL  RADOUT  RGUST   RTWAKE  STARAN  STARAD  STARAN  STPWAK  STRIAB
                       STRIMA   SWSRAT  TAB     TABINT  TAB1    TOPLOT  TVT     UNSTED  VIND    WAG     WSMOUF

ANDOIT   LENGTH     4C0    THIS IS A 'COMMON' CONTROL SECTION
         CALLED BY   - ANAL     AZMINT  AZMUTH  CDCL    CLCD    CMCALC  FOCUS   FUSFNM  HRESP   INTFRQ  ITROT   MBAL
                       NSTED    RADDGN  RADIAL  RADOUT  RGUST   ROTAN   RPTPG   STBZFM  SWSRAT  TABINT  TVT     UNSTED
                       WING
         IS USED BY  - AJACOB   ANAL    AZMUTH  CDCL    CLCD    CONSTB  CONTRM  DERIV   FOCUS   MANMS   MPCG    INSTAB
                       ITRIM    ITROT   JACOBI  MAIN    MANU    MANUV   RADDGN  RADIAL  RNGKTA  ROTAN   STAB    STBZFM
                       TRIM     TVT     UNSTED  WING

AZMINT   LENGTH     7A0
         CALLED BY   - AZMUTH
         IS USED BY  - AJACOB   ANAL    CONSTB  CONTRM  DERIV   FOCUS   MANMS   MPCG    INSTAB  ITRIM   ITROT   JACOBI
                       MAIN     MANU    MANUV   RNGKTA  ROTAN   STAB    TRIM    TVT
               CALLS - ANDOIT   FLEX    FORWK   FORWK1  MANAL   STARAD  STARAN
                       AEO
AZMUTH   LENGTH
         CALLED BY   - ITROT
         IS USED BY  - AJACOB   ANAL    CONSTB  CONTRM  DERIV   FOCUS   MANMS   MPCG    INSTAB  ITRIM   JACOBI  MAIN
                       MANU     MANUV   RNGKTA  ROTAN   STAB    TRIM    TVT
               CALLS - ANDOIT   AZMINT  FLEX    INTFRQ  MANAL   RADIAL  RADOUT  STARAD  STARAN  TOPLOT
               USES  - ANDOIT   CDCL    CMCALC  DIFFER  DOTX    FLEX    FORCMC  FORWK   FORWK1  MANAL   NSTED   RADDGN
                       RADOUT   RGUST   RTWAKE  STARAN  STARAD  STARAN  STRIMA  TAB     TABINT  TAB1    TOPLOT  UNSTED
```

TABLE 4-1. Continued.

CDCL	LENGTH 898												
	CALLED BY -	RADIAL	UNSTED										
	IS USED BY -	AJACOB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	FOCUS	HAMMS	HPCG	INSTAB	ITRIM	ITROT
		JACOBI	MAIN	MANU	MANUV	RADIAL	RNGKTA	ROTAN	STAB	TRIM	TVT		
	CALLS -	ANDOIT	MANAL	STARAD	STARAN	TABINT							
	USES -	ANDOIT	TAB	TAB1									
CGZARM	LENGTH 7C0												
	CALLED BY -	EXTORS	TILT										
	IS USED BY -	DERIV	HAMMS	HPCG	MAIN	MANU	MANUV	MNEM	MOMB	MTLT	RNGKTA	START	VARI
	CALLS -	INSTAR	MANAL	STAMAN	STRIMA	TOPLOT							
CLCD	LENGTH EF8												
	CALLED BY -	STBZFM	WING										
	IS USED BY -	AJACOB	ANAL	CONSTB	CONTRM	DERIV	HAMMS	HPCG	INSTAB	ITRIM	JACOBI	MAIN	MANU
		MANUV	RNGKTA	STAB	TRIM								
	CALLS -	ANDOIT	MANAL	STARAN	STRIAB	TABINT	TOPLOT						
	USES -	ANDOIT	TAB	TAB1									
CMCALC	LENGTH 6E0												
	CALLED BY -	RADIAL											
	IS USED BY -	AJACOB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	FOCUS	HAMMS	HPCG	INSTAB	ITRIM	ITROT
		JACOBI	MAIN	MANU	MANUV	RNGKTA	ROTAN	STAB	TRIM	TVT			
	CALLS -	ANDOIT	FORCMC										
CNTM	LENGTH 610												
	CALLED BY -	VARI											
	IS USED BY -	DERIV	HAMMS	HPCG	MAIN	MANU	MANUV	RNGKTA					
	CALLS -	MANAL	STAMAN	STRIMA	TOPLOT								
CONSTB	LENGTH 260												
	CALLED BY -	MAIN											
	CALLS -	ALSTAB	INSTAB	MANAL	MODES	STAB	STARAN	STBD	STRIMA	TOPLOT			
	USES -	AJACOB	ALLMAT	ANAL	ANDOIT	AZMINT	AZMUTH	CDCL	CLCD	CMCALC	DAMPER	DATE	DIFFER
		DOTX	FLEX	FOCUS	FORCMC	FORWK	FORWK1	FORY	FORYYY	FORYY1	FOSWK	FOSWK1	FUSFNM
		HPESP	INSTAR	INTFRQ	INVERS	IOMAT	ITROT	JACOBI	MANAL	MATRIX	MBAL	MDRDRS	NSTED
		PUNCH	RADBGN	RADIAL	RADOUT	RGUST	ROTAN	RTWAKE	STAMAN	STARAD	STARAN	STBD	STBWAK
		STBZFM	STRIAB	STRIMA	SWAS	SWSRAT	TAB	TABINT	TAB1	TOPLOT	TVT	UNSTED	VIND
		WAG	WING	WRFM	WRINST	WRMS	WRSTAB	WRVP	WSHDUF	XSTORE	ZLLCAL		
CONTRM	LENGTH 110												
	CALLED BY -	MAIN											
	CALLS -	LOADT	STRIAB	TOPLOT	TRIM								
	USES -	AJACOB	ANAL	ANDOIT	AZMINT	AZMUTH	CDCL	CLCD	CMCALC	DAMPER	DATE	DIFFER	DOTX
		FLEX	FOCUS	FORCMC	FORWK	FORWK1	FORY	FORYYY	FORYY1	FOSWK	FOSWK1	FUSFNM	HARM
		HRESP	INSTAR	INTFRQ	ITRIM	ITROT	JACOBI	MANAL	MATRIX	MBAL	NOPS	NSTED	PCAL
		RADBGN	RADIAL	RADOUT	RGUST	ROTAN	RPTPG	RTWAKE	SOLVE	STAMAN	STARAD	STARAN	STBWAK
		STBZFM	STRIAB	STRIMA	SWAS	SWSRAT	TAB	TABINT	TAB1	TIVAR	TOPLOT	TRMANU	TRM1
		TVT	UNSTED	VIND	WAG	WING	WRFM	WROTI	WRTMNV	WRTRIM	WRVP	WSHDUF	XSTORE
		ZLLCAL											
DAMPER	LENGTH 368												
	CALLED BY -	INSTAB	ITRIM	TRIM									
	IS USED BY -	CONSTB	CONTRM	MAIN	TRIM								
	CALLS -	STARAN,	STRIAB	STRIMA									

TABLE 4-1. Continued.

DATE	LENGTH 1F0												
	CALLED BY -	ITRIM	MAIN	PUNCH	WRMANU	WROTI	WRTRIM						
	IS USED BY -	CONSTB	CONTRM	MANMS	MPCG	INIT	MAIN	MANU	MANUV	MODES	READIN	RPTPG	START
		TIMLP	TRIM	WRTRIM									
DERIV	LENGTH D30												
	CALLED BY -	MAMMS	MPCG	MANU	RNGKTA								
	IS USED BY -	MPCG	MAIN	MANUV									
	CALLS -	ANAL	FORV	FORVYY	FORVYI	MANAL	QUAN	ROTAN	SCASIT	STAMAN	STRIMA	TCPLOT	VARI
	USES -	ANDOIT	AZMINT	AZMUTH	CDCL	CGZARM	CLCD	CMCALC	CMTM	DIFFER	DOTX	EXTORS	FLEX
		FOCUS	FORCMC	FORMK	FORMKI	FORV	FORVYY	FORVYI	FOSMK	FOSMKI	FUSFMM	GUST	MRESP
		INSTAR	INTFRQ	ITROT	MANAL	MATRIX	MBAL	MDMB	MTLT	MOPS	NSTED	RADBGN	RADIAL
		RADOUT	RGUST	ROTAN	RTMAKE	SOLVE	STAMAN	STARAD	STARAN	STBMAK	STBZFR	STRIAB	STRIMA
		SUPERP	SWAS	SWSRAT	TAB	TABINT	TABI	TILT	TOPLOT	TVT	UNSTED	VCNTRL	VIND
		WAG	WING	WSMOUF	XSTORE	ZLLCAL							
DIFFER	LENGTH 3A8												
	CALLED BY -	NSTED											
	IS USED BY -	AJACOB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	FOCUS	MAMMS	MPCG	INSTAB	ITRIM	ITROT
		JACOBI	MAIN	MANU	MANUV	RADIAL	RNGKTA	ROTAN	STAB	TRIM	TVT		
DOTX	LENGTH 58												
	CALLED BY -	FOCUS	MRESP	RTMAKE	STBMAK								
	IS USED BY -	AJACOB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	FOCUS	MAMMS	MPCG	INSTAB	ITRIM	ITROT
		JACOBI	MAIN	MANU	MANUV	RADBGN	RADIAL	RNGKTA	ROTAN	STAB	STBZFR	TRIM	TVT
		WING											
EMMEMK	LENGTH 498												
	CALLED BY -	MPUTOT											
	IS USED BY -	MAIN	READIN	START									
	CALLS -	INSTAR	TOPLOT										
FXTORS	LENGTH 990												
	CALLED BY -	VARI											
	IS USED BY -	DERIV	MAMMS	MPCG	MAIN	MANU	MANUV	RNGKTA					
	CALLS -	CGZARM	INSTAR	MANAL	STAMAN	STRIMA	TOPLOT						
	USES -	INSTAR	MANAL	STAMAN	STRIMA	TCPLOT							
FLEX	LENGTH 1850	THIS IS A 'COMMON' CONTROL SECTION											
	CALLED BY -	AZMINT	AZMUTH	FOCUS	INIT	INRTR	LIZE	LOADT	MODAL	PVLINT	QUAN	RADBGN	RADIAL
		RESTRT	RPTPG	SWSRAT	TVT	VARI	VCNTRL	WRMDAL	ZERO				
	IS USED BY -	AJACOB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	FOCUS	MAMMS	MPCG	INIT	INRD	INSTAB
		ITRIM	ITROT	JACOBI	LIZE	MAIN	MANU	MANUV	MNEM	MODAL	RADIAL	RNGKTA	ROTAN
		RTINIT	STAB	START	TIMLP	TRIM	TVT	VARI					
FOCUS	LENGTH BE8												
	CALLED BY -	ROTAN	TVT										
	IS USED BY -	AJACOB	ANAL	CONSTB	CONTRM	DERIV	MAMMS	MPCG	INSTAB	ITRIM	JACOBI	MAIN	MANU
		MANUV	RNGKTA	ROTAN	STAB	TRIM							
	CALLS -	ANDOIT	DOTX	FLEX	FORV	FORVYY	FORVYI	ITROT	MANAL	STAMAN	STARAD	STARAN	SWSRAT
		TOPLOT											
	USES -	ANDOIT	AZMINT	AZMUTH	CDCL	CMCALC	DIFFER	DOTX	FLEX	FORCMC	FORMK	FORMKI	MRESP
		INTFRQ	MANAL	MATRIX	MBAL	NSTED	RADBGN	RADIAL	RADOUT	RGUST	RTMAKE	STAMAN	STARAD
		STARAN	STRIMA	TAB	TABINT	TABI	TOPLOT	UNSTED	VIND				

TABLE 4-1. Continued.

```
FORCMC   LENGTH   15A8
         CALLED BY   - CMCALC
         IS USED BY  - AJACOB   ANAL     AZMUTH   CONSTB   CONTRM   DERIV    FOCUS    MAMMS    MPCG     INSTAB   ITRIM    ITRMV
                       JACOBI   MAIN     MANU     MANUV    RADIAL   RNGKTA   ROTAN    STAB     TRIM     TVT

FORWK    LENGTH    230    THIS IS A *COMMON* CONTROL SECTION
         CALLED BY   - AZMINT   ITROT    LIZE     RADOGN   REDRWK   RESTRT   RTWAKE   START    STBWAK   SWSRAT   ZERO
         IS USED BY  - AJACOB   ANAL     AZMUTH   CONSTB   CONTRM   DERIV    FOCUS    MAMMS    MPCG     INIT     INSTAB   ITRIM
                       ITROT    JACOBI   JSTRED   LIZE     MAIN     MANU     MANUV    MNEM     RADOGN   RADIAL   READIN   RNGKTA
                       ROTAN    STAB     START    STBZFM   TIMLP    TRIM     TVT      WING

FORWK1   LENGTH  40740    THIS IS A *COMMON* CONTROL SECTION
         CALLED BY   - AZMINT   ITROT    LIZE     RADOGN   REDRWK   RESTRT   RTWAKE   START    STBWAK   SWSRAT   ZERO
         IS USED BY  - AJACOB   ANAL     AZMUTH   CONSTB   CONTRM   DERIV    FOCUS    MAMMS    MPCG     INIT     INSTAB   ITRIM
                       ITROT    JACOBI   JSTRED   LIZE     MAIN     MANU     MANUV    MNEM     RADOGN   RADIAL   READIN   RNGKTA
                       ROTAN    STAB     START    STBZFM   TIMLP    TRIM     TVT      WING

FORY     LENGTH   1A50    THIS IS A *COMMON* CONTROL SECTION
         CALLED BY   - AJACOB   DERIV    FOCUS    INIT     LIZE     MANU     MNEM     MOMB     QUAN     RESTRT   SCASIT   STBZFM
                       TIMLP    TRIM     TRMANU   TRM1     TVT      VARI     VCNTRL   WRMANU
         IS USED BY  - AJACOB   ANAL     CONSTB   CONTRM   DERIV    MAMMS    MPCG     INIT     INSTAB   ITRIM    JACOBI   MAIN
                       MANU     MANUV    MNEM     RNGKTA   ROTAN    STAB     START    TIMLP    TRIM     TVT      VARI     WRTRIM

FORYYY   LENGTH    708    THIS IS A *COMMON* CONTROL SECTION
         CALLED BY   - AJACOB   DERIV    FOCUS    MAMMS    MPCG     INIT     LIZE     MNEM     MOMB     QUAN     RESTRT   RNGKTA
                       SAVEIC   SAVOLD   SCASIT   TIMLP    TRIM     TRMANU   TRM1     VARI     VCNTRL   WRMANU
         IS USED BY  - AJACOB   ANAL     CONSTB   CONTRM   DERIV    MAMMS    MPCG     INIT     INSTAB   ITRIM    JACOBI   MAIN
                       MANU     MANUV    MNEM     RNGKTA   ROTAN    SAVEIC   STAB     START    TIMLP    TRIM     TVT      VARI
                       WRTRIM

FORYY1   LENGTH   35C0    THIS IS A *COMMON* CONTROL SECTION
         CALLED BY   - AJACOB   DERIV    FOCUS    MAMMS    MPCG     INIT     LIZE     MNEM     MOMB     QUAN     RESTRT   RNGKTA
                       SAVEIC   SAVOLD   SCASIT   TIMLP    TRIM     TRMANU   TRM1     VARI     VCNTRL   WRMANU
         IS USED BY  - AJACOB   ANAL     CONSTB   CONTRM   DERIV    MAMMS    MPCG     INIT     INSTAB   ITRIM    JACOBI   MAIN
                       MANU     MANUV    MNEM     RNGKTA   ROTAN    SAVEIC   STAB     START    TIMLP    TRIM     TVT      VARI
                       WRTRIM

FOSWK    LENGTH    610    THIS IS A *COMMON* CONTROL SECTION
         CALLED BY   - LIZE     REDSWK   RESTRT   STBWAK   STBZFM   STBZIN   WING
         IS USED BY  - AJACOB   ANAL     CONSTB   CONTRM   DERIV    MAMMS    MPCG     INIT     INSTAB   ITRIM    JACOBI   JSTRED
                       MAIN     MANU     MANUV    MNEM     READIN   RNGKTA   STAB     START    STBZFM   TIMLP    TRIM     WING

FOSWK1   LENGTH   8CA0    THIS IS A *COMMON* CONTROL SECTION
         CALLED BY   - LIZE     REDSWK   RESTRT   STBWAK   STBZFM   STBZIN   WING
         IS USED BY  - AJACOB   ANAL     CONSTB   CONTRM   DERIV    MAMMS    MPCG     INIT     INSTAB   ITRIM    JACOBI   JSTRED
                       MAIN     MANU     MANUV    MNEM     READIN   RNGKTA   STAB     START    STBZFM   TIMLP    TRIM     WING

FUSFMM   LENGTH    C30
         CALLED BY   - ANAL
         IS USED BY  - AJACOB   CONSTB   CONTRM   DERIV    MAMMS    MPCG     INSTAB   ITRIM    JACOBI   MAIN     MANU     MANUV
                       RNGKTA   STAB     TRIM
               CALLS - ANDDIT   MANAL    STAMAN   STARAN   USHOUP
               USES  - STARAN   STRIMA
```

TABLE 4-1. Continued.

FUSINT	LENGTH 880												
	CALLED BY - START												
	IS USED BY - MAIN												
	CALLS - INSTAR	MANAL	STAMAN	STARAN	STRINA								
GUST	LENGTH 870												
	CALLED BY - VARI												
	IS USED BY - DERIV	MANMS	MPCG	MAIN	MANU	MANUV	RNGKTA						
	CALLS - MANAL	STAMAN	STARAN	STRIAB	STRINA								
MANMS	LENGTH 820												
	CALLED BY - MPCG												
	IS USED BY - MAIN	MANUV											
	CALLS - DERIV	FORYYY	FORYY1	MANAL	QUAN	STRINA	TIMLP	TOPLOT					
	USES - ANAL	ANDOIT	AZMINT	AZMUTH	CDCL	CGZARM	CLCD	CMCALC	CNTM	DATE	DIFFER	DOTX	
	EXTORS	FLEX	FOCUS	FORCMC	FORMK	FORMK1	FORY	FORYYY	FORYY1	FOSMK	FOSMK1	FUSFRM	
	GUST	HRESP	INIT	INSTAR	INTFRO	ITROT	MANAL	MATRIX	MBAL	MOMB	MTLT	NOPS	
	NSTED	QUAN	RADDGN	RADIAL	RADOUT	RESTRT	RGUST	ROTAN	RTWAKE	SAVOLD	SCASIT	SIVAR	
	SOLVE	STAMAN	STARAD	STARAN	STBMAK	STBZFM	STRIAB	STRINA	SUPERP	SMAS.	SMSRAT	TAB	
	TABINT	TAB1	TILT	TIVAR	TOPLOT	TRMANU	TVT	UNSTED	VARI	VCNTRL	VIND	WAG	
	WING	WRFM	WRMANU	WRTMNV	WSMOUF	XSTORE	ZLLCAL						
MANU	LENGTH 378												
	CALLED BY - LOADT												
	IS USED BY - CONTRM	MAIN											
MPCG	LENGTH 968												
	CALLED BY - MANUV												
	IS USED BY - MAIN												
	CALLS - DERIV	FORYYY	FORYY1	MANMS	MANAL	RNGKTA	SAVEIC	SAVOLD	STRINA	TIMLP	TOPLOT		
	USES - ANAL	ANDOIT	AZMINT	AZMUTH	CDCL	CGZARM	CLCD	CMCALC	CNTM	DATE	DERIV	DIFFER	
	DOTX	EXTORS	FLEX	FOCUS	FORCMC	FORMK	FORMK1	FORY	FORYYY	FORYY1	FOSMK	FOSMK1	
	FUSFRM	GUST	HRESP	INIT	INSTAR	INTFRO	ITROT	MANAL	MATRIX	MBAL	MOMB	MTLT	
	NOPS	NSTED	QUAN	RADDGN	RADIAL	RADOUT	RESTRT	RGUST	ROTAN	RTWAKE	SAVOLD	SCASIT	
	SIVAR	SOLVE	STAMAN	STARAD	STARAN	STBMAK	STBZFM	STRIAB	STRINA	SUPERP	SMAS	SMSRAT	
	TAB	TABINT	TAB1	TILT	TIMLP	TIVAR	TOPLOT	TRMANU	TVT	UNSTED	VARI	VCNTRL	
	VIND	WAG	WING	WRFM	WRMANU	WRTMNV	WSMOUF	XSTORE	ZLLCAL				
HRESP	LENGTH 968												
	CALLED BY - ITROT												
	IS USED BY - AJACOB	ANAL	CONSTB	CONTRM	DERIV	FOCUS	MANMS	MPCG	INSTAR	ITRIM	JACOBI	MAIN	
	MANU	MANUV	RNGKTA	ROTAN	STAB	TRIM	TVT						
	CALLS - ANDOIT	DOTX	MANAL	STARAD	STARAN								
INBLD	LENGTH 628												
	CALLED BY - INRO												
	IS USED BY - MAIN	RTINIT	START										
	CALLS - INSTAR	MANAL	STARAD	STARAN									
INIT	LENGTH 000												
	CALLED BY - TIMLP												
	IS USED BY - MANMS	MPCG	MAIN	MANU	MANUV								
	CALLS - FLEX	FORY	FORYYY	FORYY1	MANAL	RESTRT	SAVOLD	STARAN	TOPLOT	TRMANU	WRMANU		
	USES - DATE	FLEX	FORMK	FORMK1	FORY	FORYYY	FORYY1	FOSMK	FOSMK1	INSTAR	MANAL	SIVAR	
	STAMAN	STARAD	STARAN	STRIAB	STRINA	TAB	TAB1	TIVAR	TOPLOT	WRFM	WRTMNV		

TABLE 4-1. Continued.

```
INRO      LENGTH    848
          CALLED BY   - RTINIT
          IS USED BY  - MAIN     START
                CALLS - INBLD    INRTR    INSTAR   MANAL    MODAL    PVLINT   STAMAN   STARAD   STARAN   TOPLOT
                USES  - FLEX     INSTAR   MANAL    MATRIX   STAMAN   STARAD   STARAN   STRIMA   WRMDAL

INRTR     LENGTH    658
          CALLED BY   - INRO
          IS USED BY  - MAIN     RTINIT   START
                CALLS - FLEX     INSTAR   MANAL    MATRIX   STARAD   STARAN   STRIMA

INSCAS    LENGTH    358
          CALLED BY   - JFBGIN
          IS USED BY  - MAIN     START
                CALLS - STAMAN   STRIMA

INSTAB    LENGTH    420
          CALLED BY   - CONSTB
          IS USED BY  - MAIN
                CALLS - AJACOB   DAMPER   JACOBI   MANAL    STARAD   STARAN   STBD     STRIAB   STRIMA   TOPLOT   WRINST
                USES  - AJACOB   ANAL     ANDOIT   AZMINT   AZMUTH   CDCL     CLCD     CMCALC   DIFFFR   DOTX     FLEX     FOCUS
                        FOPCMC   FORWK    FORWK1   FORY     FORYYY   FORYY1   FOSWK    FOSWK1   FUSFNM   HRESP    INSTAR   INTFRQ
                        ITROT    MANAL    MATRIX   MBAL     MSTED    RADBGN   RADIAL   RADOUT   RGUST    ROTAN    RTMAKE   STAMAN
                        STARAD   STARAN   STBD     STBWAK   STBZFM   STRIAB   STRIMA   SWAS     SWSRAT   TAB      TABINT   TABI
                        TOPLOT   TVT      UNSTED   VIND     WAG      WING     WRFM     WRVP     WSHDUF   XSTORE   ZLLCAL

INSTAR    LENGTH   2288    THIS IS A 'COMMON' CONTROL SECTION
          CALLED BY   - CGZARM   ERRCHK   EXTORS   FUSINT   INBLD    INRO     INRTR    JFBGIN   JSTRED   LGCINT   LIZE     MMEM
                        MODAL    MPUTOT   PUNCH    PVLINT   READIN   REDATB   REDID    REDRWK   REDSWK   RESTRT   RPTPG    RTINIT
                        SIVAR    START    STBZFM   STBZIN   TABOUT   TRMANU   TURN     WRMDAL   XCONIN   XSTINT
          IS USED BY  - AJACOB   ANAL     CONSTB   CONTRM   DERIV    EXTORS   HAMMS    HPCG     INIT     INRO     INSTAB   ITRIM
                        JACOBI   JSTRED   MAIN     MANU     MANUV    MMEM     MODAL    MODES    MOMB     MTLT     MPUTOT   READIN
                        REDATB   REDRWK   REDSWK   RESTRT   RNGKTA   RTINIT   STAB     START    TILT     TIMLP    TRIM     VARI
                        WRTRIM

INTFRQ    LENGTH    218
          CALLED BY   - AZMUTH
          IS USED BY  - AJACOB   ANAL     CONSTB   CONTRM   DERIV    FOCUS    HAMMS    HPCG     INSTAB   ITRIM    ITROT    JACOBI
                        MAIN     MANU     MANUV    RNGKTA   ROTAN    STAB     TRIM     TVT
                CALLS - ANDOIT   MANAL    STARAN

INVERS    LENGTH    680
          CALLED BY   - ALSTAB
          IS USED BY  - CONSTB   MAIN

IONAT     LENGTH   1348
          CALLED BY   - MODES
          IS USED BY  - CONSTB   MAIN
                CALLS - STBD
```

TABLE 4-1. Continued.

ITRIN	LENGTH 708												
	CALLED BY - TRIN												
	IS USED BY - CONTRN	MAIN											
	CALLS - AJACOB	DAMPER	DATE	JACOBI	MANAL	PDZI	SOLVE	S MAN	STARAN	STRIAB	STRINA	TOPLOT	
	WRVP												
	USES - AJACOB	ANAL	ANDOIT	AZMINT	AZMUTH	CDCL	CLCD	CMCALC	DIFFER	DOTX	FLEX	FOCUS	
	FORCMC	FORWK	FORWK1	FORY	FORYYY	FORYY1	FOSWK	FOSWK1	FUSFMM	HRESP	INSTAR	INTFRQ	
	ITROT	MANAL	MATRIX	MBAL	NSTED	RADOGN	RADIAL	RADOUT	RGUST	ROTAN	RTWAKE	STAMAN	
	STARAD	STARAN	STBWAK	STBZFM	STRIAB	STRINA	SWAS	SWSRAT	TAB	TABINT	TAB1	TOPLOT	
	TVT	UNSTED	VIND	WAG	WING	WRFM	WRVP	WSHDUF	XSTORE	ZLLCAL			
ITROT	LENGTH 1348												
	CALLED BY - FOCUS												
	IS USED BY - AJACOB	ANAL	CONSTB	CONTRN	DERIV	HANNS	MPCG	INSTAB	ITRIN	JACOBI	MAIN	MANU	
	MANUV	RNGKTA	ROTAN	STAB	TRIM	TVT							
	CALLS - ANDOIT	AZMUTH	FORWK	FORWK1	HRESP	MANAL	MBAL	STARAD	STARAN	TOPLOT	VIND		
	USES - ANDOIT	AZMINT	CDCL	CMCALC	DIFFER	DOTX	FLEX	FORCMC	FORWK	FORWK1	INTFRQ	MANAL	
	NSTED	RADOGN	RADIAL	RADOUT	RGUST	RTWAKE	STAMAN	STARAD	STARAN	STRINA	TAB	TABINT	
	TAB1	TOPLOT	UNSTED										
JACOBI	LENGTH 388												
	CALLED BY - INSTAB	ITRIN											
	IS USED BY - CONSTB	CONTRN	MAIN	TRIM									
	CALLS - AJACOB	MANAL	STARAN	STRIAB	STRINA	TOPLOT							
	USES - ANAL	ANDOIT	AZMINT	AZMUTH	CDCL	CLCD	CMCALC	DIFFER	DOTX	FLEX	FOCUS	FORCMC	
	FORWK	FORWK1	FORY	FORYYY	FORYY1	FOSWK	FOSWK1	FUSFMM	HRESP	INSTAR	INTFRQ	ITROT	
	MANAL	MATRIX	MBAL	NSTED	RADOGN	RADIAL	RADOUT	RGUST	ROTAN	RTWAKE	STAMAN	STARAD	
	STARAN	STBWAK	STBZFM	STRIAB	STRINA	SWAS	SWSRAT	TAB	TABINT	TAB1	TOPLOT	TVT	
	UNSTED	VIND	WAG	WING	WRFM	WRVP	WSHDUF	XSTORE	ZLLCAL				
JPBGIN	LENGTH 980												
	CALLED BY - START												
	IS USED BY - MAIN												
	CALLS - INSCAS	INSTAR	MANAL	MATRIX	STAMAN	STARAD	STARAN	STRIAB	STRINA	TOPLOT			
	USES - STAMAN	STRINA											
JOB	LENGTH 48												
	CALLED BY - MAIN												
JSTRED	LENGTH 078												
	CALLED BY - READIN												
	IS USED BY - MAIN	START											
	CALLS - INSTAR	MANAL	RBDY	REDATB	REDBMS	REDID	REDRWK	REDSWK	STAMAN	STARAD	STRINA	TOPLOT	
	USES - FORWK	FORWK1	FOSWK	FOSWK1	INSTAR	POSRED	REDCL	REDID	TAB	TAB1	TOPLOT	WKTABN	
LGCINT	LENGTH 450												
	CALLED BY - START												
	IS USED BY - MAIN												
	CALLS - INSTAR	MANAL	STARAD	STARAN	STRIAB	TOPLOT							
LIZE	LENGTH 968												
	CALLED BY - STARY												
	IS USED BY - MAIN												
	CALLS - FLEX	FORWK	FORWK1	FORY	FORYYY	FORYY1	FOSWK	FOSWK1	INSTAR	MANAL	STAMAN	STARAN	
	STRIAB	STRINA	TOPLOT	ZERO									
	USES - FLEX	FORWK	FORWK1	MANAL	STARAN	STRIAB	STRINA						

TABLE 4-1. Continued.

```
LOADT     LENGTH    9630
          CALLED BY   - CONTRM
          IS USED BY  - MAIN
                CALLS - FLEX     MARM     MANAL    STAMAN   STARAN   STRIAB

MAIN      LENGTH    6F8
                CALLS - ABDUMP   CONSTB   CONTRM   DATE     JOB      MANU     MANUV    READIN   RESTRT   START    TOPLOT   WROT1
                USES  - AJACOB   ALLMAT   ALSTAB   ANAL     ANDOIT   AZMINT   AZMUTH   CDCL     CGZARM   CLCD     CMCALC   CMTM
                        DAMPER   DATE     DERIV    DIFFER   DOTX     ERRCHK   EXTORS   FLEX     FOCUS    FORCMC   FORWK    FORWK1
                        FORY     FORYYY   FORYY1   FOSWK    FOSWK1   FUSFMM   FUSINT   GUST     HAMMS    HARM     HPCG     HRESP
                        INBLD    INIT     INRO     INRTR    INSCAS   INSTAB   INSTAR   INTFRQ   INVERS   IOMAT    ITRIM    ITROT
                        JACOBI   JFBGIN   JSTRED   LGCINT   LIZE     LOADT    MANAL    MATRIX   MBAL     MORDRS   MMEM     MODAL
                        MODES    MOMB     MTLT     MOPS     MPUTOT   MSTED    MDSRED   MDZI     PUNCH    PVLINT   QUAN     RADBGN
                        RADIAL   RADOUT   RBDY     READIN   REDATB   REDBMS   REDCL    REDID    REDRWK   REDSWK   RESTRT   RGUST
                        RNGKTA   ROTAN    RPTPG    RTINIT   RTWAKE   SAVEIC   SAVOLD   SCASIT   SIVAR    SOLVE    STAB     STAMAN
                        STARAD   STARAN   STBO     STBWAK   STBZFM   STBZIN   STRIAB   STRIMA   SUPERP   SWAS     SWSRAT   TAB
                        TABFIX   TABINT   TABOUT   TAB1     TILT     TIMLP    TIVAR    TOPLOT   TRIM     TRMANU   TRM1     TURN
                        TVT      UNSTED   VARI     VCNTRL   VIND     WAG      WING     WKTABM   WRFM     WRINST   WRMANU   WRMDAL
                        WRMS     WROT1    WRSTAB   WRTMNV   WRTRIM   WRVP     WSMDUF   XCONIN   XSTINT   XSTORE   YRINIT   YSINIT
                        ZERO     ZLLCAL

MANAL     LENGTH    D00    THIS IS A *COMMON* CONTROL SECTION
          CALLED BY   - AJACOB   ALSTAB   ANAL     AZMINT   AZMUTH   CDCL     CGZARM   CLCD     CMTM     CONSTB   DERIV    EXTORS
                        FOCUS    FUSFMM   FUSINT   GUST     HAMMS    HPCG     HRESP    INBLD    INIT     INRO     INRTR    INSTAB
                        INTFRQ   ITRIM    ITROT    JACOBI   JFBGIN   JSTRED   LGCINT   LIZE     LOADT    MANU     MANUV    MBAL
                        MORDRS   MMEM     MODAL    MODES    MOMB     MTLT     MOPS     MPUTOT   PVLINT   QUAN     RADBGN   RADIAL
                        RADOUT   READIN   RESTRT   RGUST    RNGKTA   ROTAN    RPTPG    RTINIT   RTWAKE   SAVEIC   SAVOLD   SCASIT
                        SIVAR    STAB     START    STBWAK   STBZFM   STBZIN   SUPERP   SWAS     SWSRAT   TILT     TIMLP    TIVAR
                        TRIM     TRMANU   TRM1     TVT      UNSTED   VARI     VCNTRL   VIND     WING     WRFM     WRINST   WRMANU
                        WRMDAL   WRTMNV   WRTRIM   WRVP     XCONIN   XSTORE   ZERO     ZLLCAL
          IS USED BY  - AJACOB   ANAL     AZMUTH   CONSTB   CONTRM   DERIV    EXTORS   FOCUS    HAMMS    HPCG     INIT     INRO
                        INSTAB   ITRIM    ITROT    JACOBI   LIZE     MAIN     MANU     MANUV    MMEM     MODAL    MODES    MOMB
                        MTLT     RADBGN   RADIAL   READIN   RESTRT   RNGKTA   ROTAN    RTINIT   SAVEIC   STAB     START    STBZFM
                        TILT     TIMLP    TRIM     TRM1     TVT      UNSTED   VARI     WING     WRINST   WRMANU   WRTRIM

MANU      LENGTH    558
          CALLED BY   - MAIN
                CALLS - DERIV    FORY     MANAL    QUAN     RESTRT   STAMAN   STRIMA   TIMLP    TOPLOT
                USES  - ANAL     ANDOIT   AZMINT   AZMUTH   CDCL     CGZARM   CLCD     CMCALC   CMTM     DATE     DIFFER   DOTX
                        EXTORS   FLEX     FOCUS    FORCMC   FORWK    FORWK1   FORY     FORYYY   FORYY1   FOSWK    FOSWK1   FUSFMM
                        GUST     HRESP    INIT     INSTAR   INTFRQ   ITROT    MANAL    MATRIX   MBAL     MOMB     MTLT     MOPS
                        MSTED    QUAN     RADBGN   RADIAL   RADOUT   RESTRT   RGUST    ROTAN    RTWAKE   SAVOLD   SCASIT   SIVAR
                        SOLVE    STAMAN   STARAD   STARAN   STBWAK   STBZFM   STRIAB   STRIMA   SUPERP   SWAS     SWSRAT   TAB
                        TABINT   TAB1     TILT     TIVAR    TOPLOT   TRMANU   TVT      UNSTED   VARI     VCNTRL   VIND     WAG
                        WING     WRFM     WRMANU   WRTMNV   WSMDUF   XSTORE   ZLLCAL

MANUV     LENGTH    1E8
          CALLED BY   - MAIN
                CALLS - HPCG     MANAL    RESTRT   STAMAN   TOPLOT
                USES  - ANAL     ANDOIT   AZMINT   AZMUTH   CDCL     CGZARM   CLCD     CMCALC   CMTM     DATE     DERIV    DIFFER
                        DOTX     EXTORS   FLEX     FOCUS    FORCMC   FORWK    FORWK1   FORY     FORYYY   FORYY1   FOSWK    FOSWK1
                        FUSFMM   GUST     HAMMS    HRESP    INIT     INSTAR   INTFRQ   ITROT    MANAL    MATRIX   MBAL     MOMB
                        MTLT     MOPS     MSTED    QUAN     RADBGN   RADIAL   RADOUT   RESTRT   RGUST    RNGKTA   ROTAN    RTWAKE
                        SAVEIC   SAVOLD   SCASIT   SIVAR    SOLVE    STAMAN   STARAD   STARAN   STBWAK   STBZFM   STRIAB   STRIMA
                        SUPERP   SWAS     SWSRAT   TAB      TABINT   TAB1     TILT     TIMLP    TIVAR    TOPLOT   TRMANU   TVT
                        UNSTED   VARI     VCNTRL   VIND     WAG      WING     WRFM     WRMANU   WRTMNV   WSMDUF   XSTORE   ZLLCAL
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TABLE 4-1. Continued.

MATRIX	LENGTH 2C8												
	CALLED BY -	AJACOB	INRTR	JFBGIN	MMEM	MTLT	GUAN	SWSRAT					
	IS USED BY -	AJACOB	ANAL	CONSTB	CONTRM	DERIV	FOCUS	MAMMS	MPCG	INRO	INSTAB	ITRIM	JACOBI
		MAIN	MANU	MANUV	RNGKTA	ROTAN	RTINIT	STAB	START	TRIM	TVT	VARI	
MBAL	LENGTH 4E0												
	CALLED BY -	ITRCT											
	IS USED BY -	AJACOB	ANAL	CONSTB	CONTRM	DERIV	FOCUS	MAMMS	MPCG	INSTAB	ITRIM	JACOBI	MAIN
		MANU	MANUV	RNGKTA	ROTAN	STAB	TRIM	TVT					
	CALLS -	ANDOIT	MANAL	STARAN	TOPLOT								
MORDRS	LENGTH 788												
	CALLED BY -	MODES											
	IS USED BY -	CONSTB	MAIN										
	CALLS -	MANAL	STARAN	STBD	STRIAB	STRIMA							
MMEM	LENGTH 800												
	CALLED BY -	START											
	IS USED BY -	MAIN											
	CALLS -	FCRV	FORVYY	FORVY1	INSTAR	MANAL	MATRIX	MOPS	RESTRT	SAVGLD	SIVAR	STARAN	STARAN
		STRIAB	STRIMA	SWAS	TILT	TOPLOT	TURN	VIND					
	USES -	CGZARM	FLEX	FORMK	FORMK1	FORV	FORVYY	FORVY1	FOSMK	FOSMK1	INSTAR	MANAL	SIVAR
		STARAN	STARAD	STARAN	STRIAB	STRIMA	TAB	TAB1	TIVAR	TOPLOT	ZLLCAL		
MODAL	LENGTH EA8												
	CALLED BY -	INRO											
	IS USED BY -	MAIN	RTINIT	START									
	CALLS -	FLEX	INSTAR	MANAL	STARAN	STARAD	STARAN	STRIMA	WRMDAL				
	USES -	FLEX	INSTAR	MANAL	STARAN	STARAN	STRIMA						
MODES	LENGTH 938												
	CALLED BY -	CONSTB											
	IS USED BY -	MAIN											
	CALLS -	IOMAT	MANAL	MORDRS	PUNCH	STARAN	STBD	STRIAB	STRIMA				
	USES -	DATE	INSTAR	MANAL	STARAN	STARAN	STPD	STRIAB	STRIMA	TOPLOT			
MOMB	LENGTH 878												
	CALLED BY -	VARI											
	IS USED BY -	DERIV	MAMMS	MPCG	MAIN	MANU	MANUV	RNGKTA					
	CALLS -	FORV	FORVYY	FORVY1	MANAL	MOPS	SOLVE	STARAN	STRIMA	TI.T	TOPLOT		
	USES -	CGZARM	INSTAR	MANAL	STARAN	STRIMA	TOPLOT	ZLLCAL					
MTLT	LENGTH 848												
	CALLED BY -	VARI											
	IS USED BY -	DERIV	MAMMS	MPCG	MAIN	MANU	MANUV	RNGKTA					
	CALLS -	MANAL	MATRIX	STARAN	STRIMA	TILT	TOPLOT						
	USES -	CGZARM	INSTAR	MANAL	STARAN	STRIMA	TOPLOT	ZLLCAL					
MOPS	LENGTH 508												
	CALLED BY -	MMEM	MOMB	TRM1									
	IS USED BY -	CONTRM	DERIV	MAMMS	MPCG	MAIN	MANU	MANUV	RNGKTA	START	TRIM	VARI	
	CALLS -	MANAL											

TABLE 4-1. Continued.

NPUTOT	LENGTH 680												
	CALLED BY -	READIN											
	IS USED BY -	MAIN	START										
	CALLS -	ERRCHK	INSTAR	MANAL	STAMAN	STARAD	STRIMA						
	USES -	INSTAR	TOPLOT										
NSTED	LENGTH 778												
	CALLED BY -	RADIAL											
	IS USED BY -	AJACOB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	FOCUS	MAMMS	MPCG	INSTAB	ITRIM	ITROT
		JACOBI	MAIN	MANU	MANUV	RNGKTA	ROTAN	STAB	TRIM	TVT			
	CALLS -	ANDOIT	DIFFER	STARAD	STARAN								
POSRED	LENGTH 218												
	CALLED BY -	REDID											
	IS USED BY -	JSTRED	MAIN	READIN	REDATB	REDMAK	REDSUK	START					
PDZ1	LENGTH 388												
	CALLED BY -	ITRIM	TRIM										
	IS USED BY -	CONTRM	MAIN	TRIM									
PUNCH	LENGTH 660												
	CALLED BY -	MODES											
	IS USED BY -	CONSTB	MAIN										
	CALLS -	DATE	INSTAR	STAMAN	STBD	STRIMA	TOPLOT						
PYLINT	LENGTH 618												
	CALLED BY -	INRO											
	IS USED BY -	MAIN	RTINIT	START									
	CALLS -	FLEX	INSTAR	MANAL	STAMAN	STARAD	STARAN						
QUAN	LENGTH 470												
	CALLED BY -	DERIV	MAMMS	MANU									
	IS USED BY -	MAMMS	MPCG	MAIN	MANU	MANUV	RNGKTA						
	CALLS -	FLEX	FORV	FORVVV	FORVV1	MANAL	MATRIX	STAMAN	STRIMA	TOPLOT			
RADBGN	LENGTH 920												
	CALLED BY -	RADIAL											
	IS USED BY -	AJACOB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	FOCUS	MAMMS	MPCG	INSTAB	ITRIM	ITROT
		JACOBI	MAIN	MANU	MANUV	RNGKTA	ROTAN	STAB	TRIM	TVT			
	CALLS -	ANDOIT	FLEX	FORWK	FORWK1	MANAL	RGUST	RTWAKE	STARAD	STARAN			
	USES -	ANDOIT	DOTX	FORWK	FORWK1	MANAL	STARAD	STARAN					
RADIAL	LENGTH 938												
	CALLED BY -	AZMUTH											
	IS USED BY -	AJACOB	ANAL	CONSTB	CONTRM	DERIV	FOCUS	MAMMS	MPCG	INSTAB	ITRIM	ITROT	JACOBI
		MAIN	MANU	MANUV	RNGKTA	ROTAN	STAB	TRIM	TVT				
	CALLS -	ANDOIT	CDCL	CNCALC	FLEX	MANAL	NSTED	RADBGN	RADOUT	STAMAN	STARAD	STARAN	STRIMA
		TOPLOT	UNSTED										
	USES -	ANDOIT	CDCL	DIFFER	DOTX	FLEX	FORCMC	FORWK	FORWK1	MANAL	RGUST	RTWAKE	STARAD
		STARAN	TAB	TABINT	TAB1	TOPLOT							
RADOUT	LENGTH 870												
	CALLED BY -	AZMUTH	RADIAL										
	IS USED BY -	AJACOB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	FOCUS	MAMMS	MPCG	INSTAB	ITRIM	ITROT
		JACOBI	MAIN	MANU	MANUV	RNGKTA	ROTAN	STAB	TRIM	TVT			
	CALLS -	ANDOIT	MANAL	STARAD	STARAN	TOPLOT							

TABLE 4-1. Continued.

RDDY	LENGTH 130												
	CALLED BY - JSTRED												
	IS USED BY - MAIN	READIN	START										
READIN	LENGTH D18												
	CALLED BY - MAIN	START											
	IS USED BY - MAIN												
	CALLS - INSTAR	JSTRED	MANAL	NPUTDT	STAMAN	STARAD	STRIAB	STRIM..	TOPLOT	WROTI			
	USES - DATE	ERRCHK	FORWK	FORWK1	FOSWK	FOSWK1	INSTAR	MANAL	PDSRED	RDDY	REDATB	REDBMS	
	REDCL	REDID	REDRWK	REDSWK	STAMAN	STARAD	STRIMA	TAB	TAB1	TOPLOT	WKTABN		
REDATB	LENGTH 2F8												
	CALLED BY - JSTRED												
	IS USED BY - MAIN	READIN	START										
	CALLS - INSTAR	REDCL	REDID	TAB	TAB1								
	USES - INSTAR	PDSRED											
REDBMS	LENGTH 1F0												
	CALLED BY - JSTRED												
	IS USED BY - MAIN	READIN	START										
REDCL	LENGTH 2C0												
	CALLED BY - REDATB												
	IS USED BY - JSTRED	MAIN	READIN	START									
REDID	LENGTH 640												
	CALLED BY - JSTRED	REDATB	REDRWK	REDSWK									
	IS USED BY - JSTRED	MAIN	READIN	START									
	CALLS - INSTAR	PDSRED											
REDRWK	LENGTH 1180												
	CALLED BY - JSTRED	START											
	IS USED BY - MAIN	READIN	START										
	CALLS - FORWK	FORWK1	INSTAR	REDID	TOPLOT	WKTABN							
	USES - INSTAR	PDSRED											
REDSWK	LENGTH CF8												
	CALLED BY - JSTRED	START											
	IS USED BY - MAIN	READIN	START										
	CALLS - FOSWK	FOSWK1	INSTAR	REDID	TOPLOT								
	USES - INSTAR	PDSRED											
RESTRT	LENGTH 1058												
	CALLED BY - INIT	MAIN	MANU	MANUV	MNEM								
	IS USED BY - MANMS	MPCG	MAIN	MANU	MANUV	START	TIMLP						
	CALLS - FLEX	FORWK	FORWK1	FORY	FORYYY	FORYY1	FOSWK	FOSWK1	INSTAR	MANAL	SIVAR	STAMAN	
	STARAD	STARAN	STRIAB	STRIMA	TAB	TAB1	TIVAR	TOPLOT					
	USES - INSTAR	MANAL	STAMAN	STARAN	STRIMA	TOPLOT							
RGUST	LENGTH 388												
	CALLED BY - RADBGN												
	IS USED BY - AJACOB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	FOCUS	MANMS	MPCG	INSTAB	ITRIN	ITRBT	
	JACOBI	MAIN	MANU	MANUV	RADIAL	RNGKTA	ROTAN	STAB	TRIN	TVT			
	CALLS - ANDOIT	MANAL	STARAD	STARAN									

TABLE 4-1. Continued.

RNGKTA	LENGTH 488												
	CALLED BY - MPCG												
	IS USED BY - MAIN	MANUV											
	CALLS - DERIV	FORYYY	FORYY1	MANAL	STRIMA								
	USES - ANAL	ANDOIT	AZMINT	AZMUTH	CDCL	CGZARM	CLCD	CMCALC	CNTM	DIFFER	DOTX	EXTORS	
	FLEX	FOCUS	FORCMC	FORWK	FORWK1	FORY	FORYYY	FORYY1	FOSWK	FOSWK1	FUSFNR	GUST	
	MRESP	INSTAR	INTFRQ	ITROT	MANAL	MATRIX	MBAL	MOMB	MTLT	MOPS	NSTED	QUAN	
	RADBGN	RADIAL	RADOUT	RGUST	ROTAN	RTWAKE	SCASIT	SOLVE	STAMAN	STARAD	STARAN	STBWAK	
	STBZFN	STRIAB	STRIMA	SUPERP	SWAS	SWSRAT	TAB	TABINT	TABI	TILT	TOPLOT	TVT	
	UNSTED	VARI	VCNTRL	VIND	WAG	WING	WSHDUF	XSTORE	ZLLCAL				
ROTAN	LENGTH 4A0												
	CALLED BY - ANAL	DERIV	TRIM										
	IS USED BY - AJACOB	CONSTB	CONTRM	DERIV	MAMMS	MPCG	INSTAB	ITRIM	JACOBI	MAIN	MANU	MANUV	
	RNGKTA	STAB	TRIM										
	CALLS - ANDOIT	FOCUS	MANAL	STARAN	TOPLOT	TVT							
	USES - ANDOIT	AZMINT	AZMUTH	CDCL	CMCALC	DIFFER	DOTX	FLEX	FOCUS	FORCMC	FORWK	FORWK1	
	FORY	FORYYY	FORYY1	MRESP	INTFRQ	ITROT	MANAL	MATRIX	MBAL	NSTED	RADBGN	RADIAL	
	RADOUT	RGUST	RTWAKE	STAMAN	STARAD	STARAN	STRIMA	SWSRAT	TAB	TABINT	TABI	TOPLOT	
	UNSTED	VIND											
RPYPG	LENGTH 1448												
	CALLED BY - TRIP												
	IS USED BY - CONTRM	MAIN											
	CALLS - ANDOIT	FLEX	INSTAR	MANAL	STAMAN	STARAD	STARAN	STRIAB	STRIMA	WROT1			
	USES - DATE	TOPLOT											
RTINIT	LENGTH 3A0												
	CALLED BY - START												
	IS USED BY - MAIN												
	CALLS - INRD	INSTAR	MANAL	STAMAN	STARAD	STARAN	STRIAB	STRIMA	TOPLOT				
	USES - FLEX	INBLD	INRTR	INSTAR	MANAL	MATRIX	MODAL	PVLINK	STAMAN	STARAD	STARAN	STRIMA	
	TOPLOT	WRMDAL											
RTWAKE	LENGTH 6A0												
	CALLED BY - RNDPGN												
	IS USED BY - AJACOB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	FOCUS	MAMMS	MPCG	INSTAB	ITRIM	ITROT	
	JACOBI	MAIN	MANU	MANUV	RADIAL	RNGKTA	ROTAN	STAB	TRIM	TVT			
	CALLS - DOTX	FORWK	FORWK1	MANAL									
SAVEIC	LENGTH A08												
	CALLED BY - MPCG												
	IS USED BY - MAIN	MANUV											
	CALLS - FORYYY	FORYY1	MANAL	SAVOLD	STAMAN	STRIMA							
	USES - FORYYY	FORYY1	MANAL	STAMAN	STRIMA								
SAVOLD	LENGTH 3E8												
	CALLED BY - MPCG	INIT	MMEN	SAVEIC									
	IS USED BY - MAMMS	MPCG	MAIN	MANU	MANUV	START	TIMLP						
	CALLS - FORYYY	FORYY1	MANAL	STAMAN	STRIMA								
SCASIT	LENGTH 618												
	CALLED BY - DERIV												
	IS USED BY - MAMMS	MPCG	MAIN	MANU	MANUV	RNGKTA							
	CALLS - FORY	FORYYY	FORYY1	MANAL	STAMAN	STRIMA	TOPLOT						

TABLE 4-1. Continued.

SIVAR	LENGTH 8E8												
	CALLED BY -	MNEM	RESTRT										
	IS USED BY -	MAMMS	MPCG	INIT	MAIN	MANU	MANUV	MNEM	START	TIMLP			
	CALLS -	INSTAR	MANAL	STAMAN	STARAN	STRIMA	TOPLOT						
SOLVE	LENGTH 428												
	CALLED BY -	ITRIM	MOMB	SUPERP									
	IS USED BY -	CONTRM	DERIV	MAMMS	MPCG	MAIN	MANU	MANUV	RNGKTA	TRIM	VARI		
	CALLS -	STRIMA	TOPLOT										
STAB	LENGTH 990												
	CALLED BY -	CONSTB											
	IS USED BY -	MAIN											
	CALLS -	ANAL	MANAL	STARAN	STBD	STRIAB	STRIMA	SWAS	TOPLOT	WRINST	WRSTAB	ZLLCAL	
	USES -	ANDDIT	AZMINT	AZMUTH	CDCL	CLCD	CMCALC	DIFFER	DOTX	FLEX	FOCUS	FORCMC	FORMK
		FORWK1	FORV	FORVVV	FORVV1	FOSWK	FOSWK1	FUSFNM	MRESP	INSTAR	INTFRQ	ITROT	MANAL
		MATRIX	MBAL	NSTED	RADBGN	RADIAL	RADOUT	RGUST	ROTAN	RTWAKE	STAMAN	STARAD	STARAN
		STBD	STBWAK	STBZFM	STRIAB	STRIMA	SWSRAT	TAB	TABINT	TABI	TOPLOT	TVT	UNSTED
		VIND	WAG	WING	WRFM	WSHOUF	XSTORE						
STAMAN	LENGTH 1D58	THIS IS A 'COMMON' CONTROL SECTION											
	CALLED BY -	AJACOB	CGZARM	CNTM	DERIV	EXTORS	FOCUS	FUSFNM	FUSINT	GUST	INIT	INRO	INSCAS
		ITRIM	JFBGIN	JSTRED	LIZE	LOADT	MANU	MANUV	MNEM	MODAL	MOMB	MTLT	MPUTOT
		PUNCH	PYLINT	QUAN	RADIAL	READIN	RESTRT	RPTPG	RTINIT	SAVEIC	SAVOLD	SCASIT	SIVAR
		START	STBZFM	SUPERP	SWAS	TILT	TIMLP	TRIM	TRMANU	TURN	TVT	VARI	VCNTRL
		WING	WRMANU	WRMODAL	WRTMNV	XCOWIN	ZLLCAL						
	IS USED BY -	AJACOB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	EXTORS	FOCUS	MAMMS	MPCG	INIT	INRO
		INSTAB	ITRIM	ITROT	JACOBI	JFBGIN	MAIN	MANU	MANUV	MNEM	MODAL	MODES	MOMB
		MTLT	READIN	RESTRT	RNGKTA	ROTAN	RTINIT	SAVEIC	STAB	START	TILT	TIMLP	TRIM
		TVT	VARI	WRMANU	WRTRIM								
STARAD	LENGTH 10C0	THIS IS A 'COMMON' CONTROL SECTION											
	CALLED BY -	AZMINT	AZMUTH	CDCL	FOCUS	MRESP	INBLD	INRO	INRTR	INSTAB	ITROT	JFBGIN	JSTRED
		LGCINT	MODAL	MPUTOT	NSTED	PYLINT	RADBGN	RADIAL	RADOUT	READIN	RESTRT	RGUST	RPTPG
		RTINIT	START	STBZFM	TRMANU	UNSTED	VIND	WING	WRTRIM				
	IS USED BY -	AJACOB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	FOCUS	MAMMS	MPCG	INIT	INRO	INSTAB
		ITRIM	ITROT	JACOBI	MAIN	MANU	MANUV	MNEM	RADBGN	RADIAL	READIN	RNGKTA	ROTAN
		RTINIT	STAB	START	TIMLP	TRIM	TVT	UNSTED	WRTRIM				
STARAN	LENGTH 86F0	THIS IS A 'COMMON' CONTROL SECTION											
	CALLED BY -	AJACOB	ANAL	AZMINT	AZMUTH	CDCL	CLCD	CONSTB	DAMPER	FOCUS	FUSFNM	FUSINT	GUST
		MRESP	INBLD	INRO	INRTR	INSTAB	INTFRQ	ITRIM	ITROT	JACOBI	JFBGIN	LGCINT	LIZE
		LOADT	MBAL	MORDRS	MNEM	MODAL	MODES	NSTED	PYLINT	RADBGN	RADIAL	RADOUT	RESTRT
		RGUST	ROTAN	RPTPG	RTINIT	SIVAR	STAB	START	STBZFM	STBZIN	SWSRAT	TRIM	TRMANU
		TRM1	TVT	UNSTED	VIND	WAG	WING	WRINST	WRMODAL	WRMS	WRTRIM	WSHOUF	ZERO
	IS USED BY -	AJACOB	ALSTAB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	FOCUS	FUSFNM	MAMMS	MPCG	INIT
		INRO	INSTAB	ITRIM	ITROT	JACOBI	LIZE	MAIN	MANU	MANUV	MNEM	MODAL	MODES
		RADBGN	RADIAL	RESTRT	RNGKTA	ROTAN	RTINIT	STAB	START	STBZFM	TIMLP	TRIM	TVT
		UNSTED	VARI	WING	WRTRIM								

TABLE 4-1. Continued.

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START     LENGTH    818
          CALLED BY   - MAIN
                CALLS - FORWK    FORWK1   FUSINT   INSTAR   JFBGIN   LGCINT   LIZE     MANAL    MNEM     READIN   REDRWK   REDSWK
                        RTINIT   STAMAN   STARAD   STARAN   STRZIN   STRIAB   STRIMA   TABOUT   TOPLOT   XCONIN   XSTINT   YRINIT
                        YSINIT
                USES  - CGZARM   DATE     ERRCHK   FLEX     FORWK    FORWK1   FORY     FORYYY   FORYY1   FOSWK    FOSWK1   INBLD
                        INPO     INRTR    INSCAS   INSTAR   JSTRED   MANAL    MATRIX   MODAL    MOPS     MPUTOT   PDSRED   PVLINT
                        RBDY     REDATB   REDBMS   REDCL    REDID    REDRWK   REDSWK   RESTRT   SAVOLD   SIVAR    STAMAN   STARAD
                        STARAN   STRIAB   STRIMA   SWAS     TAB      TABFIX   TABI     TILT     TIVAR    TOPLOT   TURN     VIND
                        WKTABN   WRMODAL  WROT1    ZERO     ZLLCAL

STBD      LENGTH   3800    THIS IS A *COMMON* CONTROL SECTION
          CALLED BY   - ALSTAB   CONSTB   INSTAB   IOMAT    MDRDRS   MODES    PUNCH    STAB     WRINST   WRMS     WRSTAB
          IS USED BY  - ALSTAB   CONSTB   INSTAB   MAIN     MODES    STAB

STBWAK    LENGTH .  7C3
          CALLED BY   - STBZFM   WING
          IS USED BY  - AJACOB   ANAL     CONSTB   CONTRM   DERIV    HAMMS    HPCG     INSTAB   ITRIM    JACOBI   MAIN     MANU
                        MANUV    RNGKTA   STAB     TRIM
                CALLS - DOTX     FORWK    FORWK1   FOSWK    FOSWK1   MANAL

STBZFM    LENGTH    D78
          CALLED BY   - ANAL
          IS USED BY  - AJACOB   CONSTB   CONTRM   DERIV    HAMMS    HPCG     INSTAB   ITRIM    JACOBI   MAIN     MANU     MANUV
                        RNGKTA   STAB     TRIM
                CALLS - ANDOIT   CLCD     FORY     FOSWK    FOSWK1   INSTAR   MANAL    STAMAN   STARAD   STARAN   STBWAK   STRIMA
                        TOPLOT
                USES  - ANDOIT   DOTX     FORWK    FORWK1   FOSWK    FOSWK1   MANAL    STARAN   STRIAB   TAB      TABINT   TABI
                        TOPLOT

STBZIN    LENGTH    780
          CALLED BY   - START
          IS USED BY  - MAIN
                CALLS - FOSWK    FOSWK1   INSTAR   MANAL    STARAN   STRIAB   STRIMA

STRIAB    LENGTH    448    THIS IS A *COMMON* CONTROL SECTION
          CALLED BY   - AJACOB   CLCD     CONTRM   DAMPER   GUST     INSTAB   ITRIM    JACOBI   JFBGIN   LGCINT   LIZE     LOADT
                        MDRDRS   MNEM     MODES    READIN   RESTRT   RPTPG    RTINIT   STAB     START    STBZIN   TRIM     TRM1
                        WRINST   WRTRIM   WRVP     ZERO
          IS USED BY  - AJACOB   ANAL     CONSTB   CONTRM   DERIV    HAMMS    HPCG     INIT     INSTAB   ITRIM    JACOBI   LIZE
                        MAIN     MANU     MANUV    MNEM     MODES    RNGKTA   STAB     START    STBZFM   TIMLP    TRIM     VARI
                        WING     WRTRIM

STRIMA    LENGTH   1210    THIS IS A *COMMON* CONTROL SECTION
          CALLED BY   - AJACOB   ANAL     CGZARM   CNTM     CONSTB   DAMPER   DERIV    EXTORS   FUSINT   GUST     HAMMS    HPCG
                        INRTR    INSCAS   INSTAB   ITRIM    JACOBI   JFBGIN   JSTRED   LIZE     MANU     MDRDRS   MNEM     MODAL
                        MODES    MOMB     MTLT     MPUTOT   PUNCH    QMAN     RADIAL   READIN   RESTRT   RNGKTA   RPTPG    RTINIT
                        SAVEIC   SAVOLD   SCASIT   SIVAR    SOLVE    STAB     START    STBZFM   STBZIN   SUPERP   SWAS     TILT
                        TIMLP    TIVAR    TRIM     TRMANU   TRM1     VARI     VCNTRL   WING     WRFM     WRINST   WRMANU   WRMODAL
                        WRTPNV   WRTRIM   WRVP     WSHDUF   XCONIN   XSTINT   XSTORE   ZERO     ZLLCAL
          IS USED BY  - AJACOB   ANAL     AZMUTH   CONSTB   CONTRM   DERIV    FXTORS   FOCUS    FUSFRM   HAMMS    HPCG     INIT
                        INRO     INSTAB   ITRIM    ITROT    JACOBI   JFBGIN   LIZE     MAIN     MANU     MANUV    MNEM     MODAL
                        MODES    MOMB     MTLT     READIN   RESTRT   RNGKTA   ROTAN    RTINIT   SAVEIC   STAB     START    SUPERP
                        TILT     TIMLP    TRIM     TVT      VARI     WRINST   WRMANU   WRTRIM
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TABLE 4-1. Continued.

SUPERP	LENGTH 840												
	CALLED BY -	VARI											
	IS USED BY -	DERIV	HAMMS	MPCG	MAIN	MANU	MANUV	RNGKTA					
	CALLS -	MANAL	SOLVE	STAMAN	STRIMA	TOPLOT							
	USES -	STRIMA	TOPLOT										
SWAS	LENGTH 470												
	CALLED BY -	AJACOB	MMEM	STAB	VARI								
	IS USED BY -	CONSTB	CONTRM	DERIV	HAMMS	MPCG	INSTAB	ITRIM	JACOBI	MAIN	MANU	MANUV	RNGKTA
		START	TRIM										
	CALLS -	MANAL	STAMAN	STRIMA									
SWSRAT	LENGTH 740												
	CALLED BY -	FOCUS											
	IS USED BY -	AJACOB	ANAL	CONSTB	CONTRM	DERIV	HAMMS	MPCG	INSTAB	ITRIM	JACOBI	MAIN	MANU
		MANUV	RNGKTA	ROTAN	STAB	TRIM	TVT						
	CALLS -	ANDOIT	FLEX	FORWK	FORWK1	MANAL	MATRIX	STARAN					
TAB	LENGTH 6338												
	CALLED BY -	REDATB	RESTRT	TABINT	TABOUT								
	IS USED BY -	AJACOB	ANAL	AZMUTH	CDCL	CLCD	CONSTB	CONTRM	DERIV	FOCUS	HAMMS	MPCG	INIT
		INSTAB	ITRIM	ITROT	JACOBI	JSTRED	MAIN	MANU	MANUV	MMEM	RADIAL	READIN	RNGKTA
		ROTAN	STAB	START	STBZFM	TIMLP	TRIM	TVT	UNSTED	WING			
TABFIX	LENGTH 308												
	CALLED BY -	TABOUT											
	IS USED BY -	MAIN	START										
TABINT	LENGTH 858												
	CALLED BY -	CDCL	CLCD										
	IS USED BY -	AJACOB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	FOCUS	HAMMS	MPCG	INSTAB	ITRIM	ITROT
		JACOBI	MAIN	MANU	MANUV	RADIAL	RNGKTA	ROTAN	STAB	STBZFM	TRIM	TVT	UNSTED
		WING											
	CALLS -	ANDOIT	TAB	TABI									
TABOUT	LENGTH 740												
	CALLED BY -	START											
	IS USED BY -	MAIN											
	CALLS -	INSTAR	TAB	TABFIX	TABI								
TABI	LENGTH 5400												
	CALLED BY -	REDATB	RESTRT	TABINT	TABOUT								
	IS USED BY -	AJACOB	ANAL	AZMUTH	CDCL	CLCD	CONSTB	CONTRM	DERIV	FOCUS	HAMMS	MPCG	INIT
		INSTAB	ITRIM	ITROT	JACOBI	JSTRED	MAIN	MANU	MANUV	MMEM	RADIAL	READIN	RNGKTA
		ROTAN	STAB	START	STBZFM	TIMLP	TRIM	TVT	UNSTED	WING			
TILT	LENGTH 508												
	CALLED BY -	MMEM	MONB	MTLT	VARI								
	IS USED BY -	DERIV	HAMMS	MPCG	MAIN	MANU	MANUV	RNGKTA	START	VARI			
	CALLS -	CGZARM	MANAL	STAMAN	STRIMA	TOPLOT	ZLLCAL						
	USES -	INSTAR	MANAL	STAMAN	STRIMA	TOPLOT							

TABLE 4-1. C ıtinued.

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TIMLP     LENGTH    6B8
          CALLED BY   - HAMMS    HPCG     MANU
          IS USED BY  - HPCG     MAIN     MANUV
                CALLS - FORY     FORYYY   FORYY1   INIT     MANAL    STAMAN   STRIMA   TOPLOT
                USES  - DATE     FLEX     FORWK    FORWK1   FORY     FORYYY   FORYY1   FOSWK    FOSWK1   INSTAR   MANAL    RESTRT
                        SAVOLD   SIVAR    STAMAN   STARAD   STARAN   STRIAB   STRIMA   TAB      TAB1     TIVAR    TOPLOT   TRMANU
                        WRFM     WRMANU   WRTMNV

TIVAR     LENGTH    320
          CALLED BY   - RESTRT   TRIM
          IS USED BY  - CONTRM   HAMMS    HPCG     INIT     MAIN     MANU     MANUV    MNEM     START    TIMLP
                CALLS - MANAL    STRIMA   TOPLOT

TOPLOT    LENGTH    118    THIS IS A 'COMMON' CONTROL SECTION
          CALLED BY   - AJACOB   ANAL     AZMUTH   CGZARM   CLCD     CNTM     CONSTB   CONTRM   DERIV    EXRCHK   EXTORS   FOCUS
                        HAMMS    HPCG     INIT     INRO     INSTAB   ITRIM    ITROT    JACOBI   JFBGIN   JSTRED   LGCINT   LIZE
                        MAIN     MANU     MANUV    MBAL     MNEM     MOMB     MTLT     PUNCH    QUAN     RADIAL   RADOUT   READIN
                        REDRWK   REDSWK   RESTRT   ROTAN    RTINIT   SCASIT   SIVAR    SOLVE    STAB     START    STBZFM   SUPERP
                        TILT     TIMLP    TIVAR    TRIM     TRMANU   TRM1     TVT      UNSTED   VARI     VCNTRL   WING     WRMANU
                        WROT1    WRTMNV   WRTRIM   XCONIN
          IS USED BY  - AJACOB   ANAL     AZMUTH   CONSTB   CONTRM   DERIV    EXTORS   FOCUS    HAMMS    HPCG     INIT     INSTAB
                        ITRIM    ITROT    JACOBI   JSTRED   MAIN     MANU     MANUV    MNEM     MODES    MOMB     MTLT     NPUTOT
                        RADIAL   READIN   RESTRT   RNGKTA   ROTAN    RPTPG    RTINIT   STAB     START    STBZFM   SUPERP   TILT
                        TIMLP    TRIM     TVT      VARI     WING     WRMANU   WRTRIM

TRIM      LENGTH    B18
          CALLED BY   - CONTRM
          IS USED BY  - MAIN
                CALLS - DAMPER   FORY     FORYYY   FORYY1   ITRIM    MANAL    PDZ1     ROTAN    RPTPG    STAMAN   STARAN   STRIAB
                        STRIMA   TIVAR    TOPLOT   TRM1     WRTRIM
                USES  - AJACOB   ANAL     ANDOIT   AZMINT   AZMUTH   CDCL     CLCD     CMCALC   DAMPER   DATE     DIFFER   DOTX
                        FLEX     FOCUS    FORCMC   FORWK    FORWK1   FORY     FORYYY   FORYY1   FOSWK    FOSWK1   FUSFNM   HRESP
                        INSTAR   INTFRQ   ITROT    JACOBI   MANAL    MATRIX   MBAL     NOPS     NSTED    PDZ1     RADBGN   RADIAL
                        RADOUT   RGUST    ROTAN    RTWAKE   SOLVE    STAMAN   STARAD   STARAN   STBWAK   STBZFM   STRIAB   STRIMA
                        SWAS     SWSRAT   TAB      TABINT   TAB1     TOPLOT   TRMANU   TVT      UNSTED   VIND     WAG      WING
                        WRFM     WROT1    WRTMNV   WRVP     WSHDUF   XSTORE   ZLLCAL

TRMANU    LENGTH    EB0
          CALLED BY   - INIT     WRTRIM
          IS USED BY  - CONTRM   HAMMS    HPCG     MAIN     MANU     MANUV    TIMLP    TRIM
                CALLS - FORY     FORYYY   FORYY1   INSTAR   MANAL    STAMAN   STARAD   STARAN   STRIMA   TOPLOT

TRM1      LENGTH    A20
          CALLED BY   - TRIM
          IS USED BY  - CONTRM   MAIN
                CALLS - FORY     FORYYY   FORYY1   MANAL    NOPS     STARAN   STRIAB   STRIMA   TOPLOT
                USES  - MANAL

TURN      LENGTH    228
          CALLED BY   - MNEM
          IS USED BY  - MAIN     START
                CALLS - INSTAR   STAMAN
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TABLE 4-1. Continued.

TVT	LENGTH 1300												
	CALLED BY - ROTAN												
	IS USED BY - AJACOB	ANAL	CONSTB	CONTRM	DERIV	HAMMS	HPCG	INSTAB	ITRIM	JACOBI	MAIN	MANU	
	MANUV	RNGKTA	STAB	TRIM									
	CALLS - ANDOIT	FLEX	FOCUS	FORY	MANAL	STAMAN	STARAN	TOPLOT					
	USES - ANDOIT	AZMINT	AZMUTH	CDCL	CMCALC	DIFFER	DOTX	FLEX	FORCMC	FORWK	FORWK1	FORY	
	FORYYY	FORYY1	HRESP	INTPRO	ITROT	MANAL	MATRIX	MBAL	MSTED	RADOGN	RADIAL	RADOUT	
	RGUST	RTWAKE	STAMAN	STARAD	STARAN	STRIMA	SWSRAT	TAB	TABINT	TABI	TOPLOT	UNSTED	
	VIND												
UNSTED	LENGTH C88												
	CALLED BY - RADIAL												
	IS USED BY - AJACOB	ANAL	AZMUTH	CONSTB	CONTRM	DERIV	FOCUS	HAMMS	HPCG	INSTAB	ITRIM	ITROT	
	JACOBI	MAIN	MANU	MANUV	RNGKTA	ROTAN	STAB	TRIM	TVT				
	CALLS - ANDOIT	CDCL	MANAL	STARAD	STARAN	TOPLOT							
	USES - ANDOIT	MANAL	STARAD	STARAN	TAB	TABINT	TABI						
VARI	LENGTH E08												
	CALLED BY - DERIV												
	IS USED BY - HAMMS	HPCG	MAIN	MANU	MANUV	RNGKTA							
	CALLS - CNTR	EXTORS	FLEX	FORY	FORYYY	FORYY1	GUST	MANAL	MOMB	MTLT	STAMAN	STRIMA	
	SUPERP	SWAS	TILT	TOPLOT	VCNTRL	ZLLCAL							
	USES - CGZARM	FLEX	FORY	FORYYY	FORYY1	INSTAR	MANAL	MATRIX	MOPS	SOLVE	STAMAN	STARAN	
	STRIAB	STRIMA	TILT	TOPLOT	ZLLCAL								
VCNTRL	LENGTH DE0												
	CALLED BY - VARI												
	IS USED BY - DERIV	HAMMS	HPCG	MAIN	MANU	MANUV	RNGKTA						
	CALLS - FLEX	FORY	FORYYY	FORYY1	MANAL	STAMAN	STRIMA	TOPLOT					
VIND	LENGTH 438												
	CALLED BY - ITROT	MMEM											
	IS USED BY - AJACOB	ANAL	CONSTB	CONTRM	DERIV	FOCUS	HAMMS	HPCG	INSTAB	ITRIM	JACOBI	MAIN	
	MANU	MANUV	RNGKTA	ROTAN	STAB	START	TRIM	TVT					
	CALLS - MANAL	STARAD	STARAN										
WAG	LENGTH 6D0												
	CALLED BY - WING												
	IS USED BY - AJACOB	ANAL	CONSTB	CONTRM	DERIV	HAMMS	HPCG	INSTAB	ITRIM	JACOBI	MAIN	MANU	
	MANUV	RNGKTA	STAB	TRIM									
	CALLS - STARAN												
WING	LENGTH C70												
	CALLED BY - ANAL												
	IS USED BY - AJACOB	CONSTB	CONTRM	DERIV	HAMMS	HPCG	INSTAB	ITRIM	JACOBI	MAIN	MANU	MANUV	
	RNGKTA	STAB	TRIM										
	CALLS - ANDOIT	CLCD	FOSWK	FOSWK1	MANAL	STAMAN	STARAD	STARAN	STBWAK	STRIMA	TOPLOT	WAG	
	USES - ANDOIT	DOTX	FORWK	FORWK1	FOSWK	FOSWK1	MANAL	STARAN	STRIAB	TAB	TABINT	TABI	
	TOPLOT												
WKTABN	LENGTH 520												
	CALLED BY - REDRWK												
	IS USED BY - JSTRED	MAIN	READIN	START									

TABLE 4-1. Continued.

WRFN	LENGTH 450												
	CALLED BY -	AJACOB	WRINST	WRMANU	WRTRIM								
	IS USED BY -	CONSTB	CONTRM	MANMS	MPCG	INIT	INSTAB	ITRIM	JACOBI	MAIN	MANU	MANUV	STAB
		TIMLP	TRIM										
	CALLS -	MANAL	STRIMA										
WRINST	LENGTH 13C8												
	CALLED BY -	INSTAB	STAB										
	IS USED BY -	CONSTB	MAIN										
	CALLS -	MANAL	STARAN	STBD	STRIAB	STRIMA	WRFN						
	USES -	MANAL	STRIMA										
WRMANU	LENGTH DA0												
	CALLED BY -	INIT											
	IS USED BY -	MANMS	MPCG	MAIN	MANU	MANUV	TIMLP						
	CALLS -	DATE	FORY	FORYYY	FORYY1	MANAL	STARAN	STRIMA	TOPLOT	WRFN	WRTMNV		
	USES -	MANAL	STARAN	STRIMA	TOPLOT								
WRMDAL	LENGTH 10E8												
	CALLED BY -	MMDAL											
	IS USED BY -	INRD	MAIN	RTINIT	START								
	CALLS -	FLEX	INSTAR	MANAL	STARAN	STARAN	STRIMA						
WRMS	LENGTH CF0												
	CALLED BY -	ALSTAB											
	IS USED BY -	CONSTB	MAIN										
	CALLS -	STARAN	STBD										
WROT1	LENGTH 1F8												
	CALLED BY -	MAIN	READIN	RPTPG	WRTRIM								
	IS USED BY -	CONTRM	MAIN	START	TRIM								
	CALLS -	DATE	TOPLOT										
WRSTAB	LENGTH 11D8												
	CALLED BY -	STAB											
	IS USED BY -	CONSTB	MAIN										
	CALLS -	STBD											
WRTMNV	LENGTH 1230												
	CALLED BY -	WRMANU	WRTRIM										
	IS USED BY -	CONTRM	MANMS	MPCG	INIT	MAIN	MANU	MANUV	TIMLP	TRIM			
	CALLS -	MANAL	STARAN	STRIMA	TOPLOT								
WRTRIM	LENGTH 488												
	CALLED BY -	TRIM											
	IS USED BY -	CONTRM	MAIN										
	CALLS -	DATE	MANAL	STARAD	STARAN	STRIAB	STRIMA	TOPLOT	TRMANU	WRFN	WROT1	WRTMNV	WRVP
	USES -	DATE	FORY	FORYYY	FORYY1	INSTAR	MANAL	STARAN	STARAD	STARAN	STRIAB	STRIMA	TOPLOT
WRVP	LENGTH 640												
	CALLED BY -	AJACOB	ITRIM	WRTRIM									
	IS USED BY -	CONSTB	CONTRM	INSTAB	ITRIM	JACOBI	MAIN	TRIM					
	CALLS -	MANAL	STRIAB	STRIMA									

TABLE 4-1. Concluded.

USMBUF	LENGTH 2A8												
	CALLED BY - FUSFNM												
	IS USED BY - AJACOB	ANAL	CONSTB	CONTRM	DERIV	HANNS	HPCG	INSTAB	ITRIM	JACOBI	MAIN	MANU	
	MANUV	RNGKTA	STAB	TRIM									
	CALLS - STARAN	STRIMA											
XCONIN	LENGTH 5C0												
	CALLED BY - START												
	IS USED BY - MAIN												
	CALLS - INSTAR	MANAL	STARAN	STRIMA	TOPLOT								
XSTINT	LENGTH 2D0												
	CALLED BY - START												
	IS USED BY - MAIN												
	CALLS - INSTAR	STRIMA											
XSTCRE	LENGTH 5A0												
	CALLED BY - ANAL												
	IS USED BY - AJACOB	CONSTB	CONTRM	DERIV	HANNS	HPCG	INSTAB	ITRIM	JACOBI	MAIN	MANU	MANUV	
	RNGKTA	STAB	TRIM										
	CALLS - MANAL	STRIMA											
YRINIT	LENGTH 8E0												
	CALLED BY - START												
	IS USED BY - MAIN												
YSINIT	LENGTH 85A												
	CALLED BY - START												
	IS USED BY - MAIN												
ZERO	LENGTH 5E0												
	CALLED BY - LIZE												
	IS USED BY - MAIN	START											
	CALLS - FLEX	FORWK	FORWK1	MANAL	STARAN	STRIAB	STRIMA						
ZLLCAL	LENGTH 368												
	CALLED BY - AJACOB	STAB	TILT	VARI									
	IS USED BY - CONSTB	CONTRM	DERIV	HANNS	HPCG	INSTAB	ITRIM	JACOBI	MAIN	MANU	MANUV	MDEM	
	MONB	MTLT	RNGKTA	START	TRIM	VARI							
	CALLS - MANAL	STARAN	STRIMA										

TABLE 4-2. CROSS-REFERENCE OF MULTIPLE ENTRY SUBROUTINES IN AGAJ73

Name of Additional Entry Point	Contained in Subroutine	Name of Additional Entry Point	Contained in Subroutine
AJACB1	AJACOB	RESTO	RESTRT
ALLVEC	ALLMAT	REST1	RESTRT
ATMINT	JFBGIN	REST2	RESTRT
ATRM	TRIM	REST4	RESTRT
AUXJ	CNTM	RWKOUT	REDRWK
AZMOUT	RADOUT	SUBA	MOMB
CGXARM	CGZARM	SUBB	MOMB
CGYARM	CGZARM	SWKOUT	REDSWK
FLAP	CNTM	TFFA	TILT
FLAT	MTLT	TTLT	MTLT
HARM1	HARM	VCNT1	VCNTRL
HSAF	TILT	VCNT2	VCNTRL
INBLD1	INBLD	VCNT3	VCNTRL
INBLD2	INBLD	VCNT4	VCNTRL
INBLD3	INBLD	VCNT5	VCNTRL
INBLD4	INBLD	VCNT6	VCNTRL
IOWRFM	WRINST	VCNT7	VCNTRL
IOWRF1	WRINST	VCNT8	VCNTRL
NOPS1	NOPS	VCNT9	VCNTRL
NSTED1	NSTED	VCNT10	VCNTRL
PDZ	PDZ1	WRMDL1	WRMDAL
RATI	DAMPER	WRMDL2	WRMDAL
RESTOR	SAVEIC	WROT	WROT1
RESTR1	SAVEIC	YAWP	MTLT

TABLE 4-3. CONTROL SECTION CROSS-REFERENCE FOR GDAJ07

PURG	IHCECOMH	CONTROL SECTION REMOVED
PURG	IHCUDPT	CONTROL SECTION REMOVED
PURG	IHCCOMH2	CONTROL SECTION REMOVED
PURG	IHCERRM	CONTROL SECTION REMOVED
PURG	IHCLSORT	CONTROL SECTION REMOVED
PURG	IHCFCVTH	CONTROL SECTION REMOVED
PURG	IHCSSORT	CONTROL SECTION REMOVED
PURG	IHCEFIOS	CONTROL SECTION REMOVED
PURG	IHCUATBL	CONTROL SECTION REMOVED
PURG	IHCEFNTH	CONTROL SECTION REMOVED
PURG	IHCSSCN	CONTROL SECTION REMOVED
PURG	IHCETRCH	CONTROL SECTION REMOVED
PURG	IHCLATN2	CONTROL SECTION REMOVED
PURG	IHCSLOG	CONTROL SECTION REMOVED
PURG	IHCSEXP	CONTROL SECTION REMOVED
PURG	IHCFRXPR	CONTROL SECTION REMOVED
PURG	IHCSATN2	CONTROL SECTION REMOVED
PURG	IHCIBERH	CONTROL SECTION REMOVED
PURG	IHCFRXPI	CONTROL SECTION REMOVED
PURG	IHCLSCN	CONTROL SECTION REMOVED

TABLE 4-3. Continued.

```
SPRIV001  LENGTH     30

SPRIV002  LENGTH     60

AXIS#     LENGTH    800
          CALLED BY   - PLOTER
          IS USED BY  - COMPLT   FSFT     MAIN
                CALLS - CALCOM   NUMBER   SYMBOL
                USES  - CALCOM   NEXTTIME SYMBOL

CALCOM    LENGTH    8F0
          CALLED BY   - AXIS#    CALC01   COMPLT   LINE     MAIN     PLOTER   SCALIT   SYMBOL
          IS USED BY  - AXIS#    CALC01   COMPLT   FSFT     LINE     MAIN     NUMBER   PLOTER   SCALIT

CALC91    LENGTH   1498
          CALLED BY   - SCALIT
          IS USED BY  - COMPLT   MAIN
                CALLS - CALCOM   HEDING   INPLOT   LINE     NUMBER   SYMBOL   TOPLOT
                USES  - CALCOM   NEXTTIME PLOTD    PLOTD1   SYMBOL

COMPLT    LENGTH    1A8
          CALLED BY   - MAIN
                CALLS - CALCOM   CURVET   CBIL     FSFT     SCALIT   TOPLOT
                USES  - AXIS#    CALCOM   CALC01   DATE     MARM     HEDING   INPLOT   LINE     MAXMIN   NEXTTIME NUMBER   PLOTD
                        PLOTD1   PLOTER   PPLOT    SCALE#   SCLFIX   SYMBOL   TIMPTS   TOPLOT   WROT1

CURVET    LENGTH   1090
          CALLED BY   - COMPLT
          IS USED BY  - MAIN
                CALLS - HEDING   TIMPTS   TOPLOT   WROT1
                USES  - DATE     PLOTD    PLOTD1   TOPLOT

CBIL      LENGTH    488
          CALLED BY   - COMPLT
          IS USED BY  - MAIN
                CALLS - MAXMIN   TIMPTS   TOPLOT

DATE      LENGTH    1F0
          CALLED BY   - WROT1
          IS USED BY  - COMPLT   CURVET    MAIN     PPLOT    SCALIT

FSFT      LENGTH  11BC0
          CALLED BY   - COMPLT
          IS USED BY  - MAIN
                CALLS - MARM     HEDING   PLOTER   TOPLOT
                USES  - AXIS#    CALCOM   LINE     NEXTTIME NUMBER   PLOTD    PLOTD1   SCALE#   SYMBOL
```

TABLE 4-3. Continued.

```
HARM       LENGTH     380
           CALLED BY   - FSFT
           IS USED BY  - COMPLT   MAIN

HEDING     LENGTH     840
           CALLED BY   - CALCB1   CURVET   FSFT     PPLOT
           IS USED BY  - COMPLT   MAIN     SCALIT
                 CALLS - PLOTD    PLOTD1

INPLOT     LENGTH    1900    THIS IS A 'COMMON' CONTROL SECTION
           CALLED BY   - CALCB1   PPLOT    SCALIT   SCLFIX
           IS USED BY  - COMPLT   MAIN     SCALIT

LINE       LENGTH     468
           CALLED BY   - CALCB1   PLOTER
           IS USED BY  - COMPLT   FSFT     MAIN     SCALIT
                 CALLS - CALCOM   SYMBOL
                 USES  - CALCOM   NEXTTIME

MAIN       LENGTH    1438
                 CALLS - CALCOM   COMPLT   MAXMIN   TOPLOT   WROT1
                 USES  - AXIS#    CALCOM   CALCB1   CURVET   CBIL     DATE     FSFT     HARM     HEDING   INPLOT   LINE     MAXMIN
                         NEXTTIME NUMBER   PLOTD    PLOTD1   PLOTER   PPLOT    SCALE#   SCALIT   SCLFIX   SYMBOL   TIMPTS   TOPLOT
                         WROT1

MAXMIN     LENGTH    2880    THIS IS A 'COMMON' CONTROL SECTION
           CALLED BY   - CBIL     MAIN     SCLFIX
           IS USED BY  - COMPLT   MAIN     SCALIT

NEXTTIME   LENGTH       8
           CALLED BY   - SYMBOL
           IS USED BY  - AXIS#    CALCB1   COMPLT   FSFT     LINE     MAIN     NUMBER   PLOTER   SCALIT

NUMBER     LENGTH     170
           CALLED BY   - AXIS#    CALCB1   PLOTER
           IS USED BY  - COMPLT   FSFT     MAIN     PLOTER   SCALIT
                 CALLS - SYMBOL
                 USES  - CALCOM   NEXTTIME

PLOTD      LENGTH    1468
           CALLED BY   - HEDING
           IS USED BY  - CALCB1   COMPLT   CURVET   FSFT     MAIN     PPLOT    SCALIT

PLOTD1     LENGTH     AA0
           CALLED BY   - HEDING
           IS USED BY  - CALCB1   COMPLT   CURVET   FSFT     MAIN     PPLOT    SCALIT

PLOTER     LENGTH     478
           CALLED BY   - FSFT
           IS USED BY  - COMPLT   MAIN
                 CALLS - AXIS#    CALCOM   LINE     NUMBER   SCALE#   SYMBOL
                 USES  - CALCOM   NEXTTIME NUMBER   SYMBOL
```

TABLE 4-3. Concluded.

```
PPLOT     LENGTH    780
          CALLED BY   - SCALIT
          IS USED BY  - COMPLT   MAIN
               CALLS  - HEDING   INPLOT   WROT1
               USES   - DATE     PLOTD    PLOTD1   TOPLOT

SCALE#    LENGTH    510
          CALLED BY   - PLOTER
          IS USED BY  - COMPLT   FSFT     MAIN

SCALIT    LENGTH  10740
          CALLED BY   - COMPLT
          IS USED BY  - MAIN
               CALLS  - CALCOM   CALC81   INPLOT   PPLOT    SCLFIX   TOPLOT
               USES   - CALCOM   DATE     HEDING   INPLOT   LINE     MAXMIN   NEXTTIME NUMBER   PLOTD    PLOTD1   SYMBOL   TOPLOT
                        WROT1

SCLFIX    LENGTH    438
          CALLED BY   - SCALIT
          IS USED BY  - COMPLT   MAIN
               CALLS  - INPLOT   MAXMIN   TOPLOT

SYMBOL    LENGTH    8C9
          CALLED BY   - AXIS#    CALC81   LINE     NUMBER   PLOTER
          IS USED BY  - AXIS#    CALC81   COMPLT   FSFT     MAIN     PLOTER   SCALIT
               CALLS  - CALCOM   NEXTTIME

TIMPTS    LENGTH   2C3D    THIS IS A 'COMMON' CONTROL SECTION
          CALLED BY   - CURVET   C81L
          IS USED BY  - COMPLT   MAIN

TOPLOT    LENGTH    108    THIS IS A 'COMMON' CONTROL SECTION
          CALLED BY   - CALC81   COMPLT   CURVET   C81L     FSFT     MAIN     SCALIT   SCLFIX   WROT1
          IS USED BY  - COMPLT   CURVET   MAIN     PPLOT    SCALIT

WROT1     LENGTH    20D
          CALLED BY   - CURVET   MAIN     PPLOT
          IS USED BY  - COMPLT   MAIN     SCALIT
               CALLS  - DATE     TOPLOT
```

TABLE 4-4. REDUCTION OF AGAJ73 STORAGE REQUIREMENTS

Array Name: Outside RESTRT	Array Name: In RESTRT	COMMON Name	Dimensions of Array: Outside RESTRT: Standard	Dimensions of Array: Outside RESTRT: Reduced	Dimensions of Array: In RESTRT: Standard	Dimensions of Array: In RESTRT: Reduced	Approx. Reduction of Storage Reqmts.**: Bytes($\times 10^{-3}$)	Approx. Reduction of Storage Reqmts.**: K
WKRTR	FRK1	FORWK1	(33,10,5,20,2)	(1,1,1,1,1)	(66000)	(1)	264	260
WKSTB	FSK1	FOSWK1	(15,10,5,12)	(1,1,1,1)	(9000)	(1)	36	34
CURVED	TABL	TAB	(1100,5)*	(1100,2)*	(6350)	(3050)	13	12
CURVEL	TABL1	TAB1	(500,5)*	(500,2)*	(5375)	(2150)	6	6
CURVEM			(575,5)*	(575,2)*			7	6
AUX	FYY1	FORYY1	(16,215)	(1,1)	(3440)	(1)	14	12

*In block data DAT1, the second subscript of the standard array is 4 rather than 5 and that of the reduced array is 1 rather than 2; the remaining entries of the COMMON block are filled with the block data (e.g., CL5A, CL5B, etc., for TAB). The block data in DAT1 are the data tables for an NACA 0012 airfoil. Also, if TAB and TAB1 are reduced, three statements near the end of subroutine TABOUT must be changed. The location of each statement is given with respect to the last call to subroutine TABFIX in TABOUT (i.e., the nth statement after the call).

Location	Standard	Reduced
1st	IF (K.EQ.5) RETURN	IF (K.EQ.2) RETURN
5th	K=5	K=2
7th	IF (YRR(18,I).EQ.5. .OR. YSTBZ(18,I).EQ.5.) GO TO 26	IF (YRR(18,I).EQ.2. .OR. YSTBZ(18,I).EQ.2) GO TO 26

**1K = 1024 bytes

TABLE 4-5. STAB DIAGNOSTIC SWITCH IN AGAJ73

IPL(34)	Variable
1	FUS. U
2	FUS. W
3	FUS. Q
4	FUS. V
5	FUS. P
6	FUS. R
7	M.R. F/A PYLON RATE
8	M.R. LAT PYLON RATE
9	T.R. F/A PYLON RATE
10	T.R. LAT PYLON RATE
11	M.R. F/A FLAP. RATE
12	M.R. LAT FLAP. RATE
13	T.R. F/A FLAP. RATE
14	T.R. LAT FLAP. RATE
15	M.R. F/A PYLON DISP
16	M.R. LAT PYLON DISP
17	T.R. F/A PYLON DISP
18	T.R. LAT PYLON DISP
19	M.R. F/A FLAP. DISP
20	M.R. LAT FLAP. DISP
21	T.R. F/A FLAP. DISP
22	T.R. LAT FLAP. DISP

```
//E2410480 JOB (AS812A00,G38,69109308,DP20,T,01),'PY                    2841',*
//              MSGLEVEL=1,CLASS=C
//JOBLIB    DD DSN=ENGTFST
//GO   EXEC PGM=AS812A
//SYSPRINT DD SYSOUT=A
//CARDS     DD SYSOUT=B,DCB=(LRECL=80,BLKSIZE=80,RECFM=F)
//SYSIN     DD *
/*
```

Figure 4-1. Job Control Language To Run AS812A.