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SIX-DEGREE-OF-FREEDOM PROGRAM TO OPTIMIZE SIMULATED TRAJECTORIES (6D POST)

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Prepared by

G. L. Brauer
and R. Stevenson

Approved

D. E. Cornick
Program Manager

MARTIN MARIETTA CORPORATION
P.O. BOX 179
Denver, Colorado 80201

FOREWORD

This final report describing the formulation of the Six-Degree-of-Freedom Program to Optimize Simulated Trajectories (6D POST) is provided in accordance with Part 3.0 of NASA Contract NAS1-14450. The report is presented in three volumes as follows:

Volume I - 6D POST - Formulation Manual;

Volume II - 6D POST - Utilization Manual;

Volume III - 6D POST - Programmer's Manual.

This work was conducted under the direction of Mr. Richard Powell of the Space Systems Division, National Aeronautics and Space Administration, Langley Research Center.

CONTENTS

		PAGE
I.	SUMMARY	1.0.0.1
II.	INTRODUCTION	2.0.0.1
III.	GENERAL INFORMATION	3.0.0.1
	A. PROCEDURES FOR NEW USERS	3.A.0.1
	B. NAMELIST INPUT FORMAT	3.B.0.1
	1. NAMELIST INPUT SEQUENCE	3.B.1.1
	C. HOLLERITH INPUT SYMBOLS	3.C.0.1
	D. COORDINATE SYSTEMS	3.D.0.1
	E. VEHICLE ATTITUDE ANGLES/RATES	3.E.0.1
IV.	OPERATIONAL CONTROLS	4.0.0.1
	A. INPUT/OUTPUT CONVERSION FACTORS	4.A.0.1
	B. MULTIPLE RUNS	4.B.0.1
V.	TARGETING/OPTIMIZATION INPUTS	5.0.0.1
	A. CONTROL (INDEPENDENT) VARIABLES	5.A.0.1
	B. CONSTRAINT (DEPENDENT) VARIABLES	5.B.0.1
	C. OPTIMIZATION VARIABLE	5.C.0.1
	D. TARGETING/OPTIMIZATION ALGORITHMS	5.D.0.1
	E. TARGETING/OPTIMIZATION OUTPUT	5.E.0.1
VI.	TRAJECTORY SIMULATION INPUTS	6.0.0.1
	A. GENERAL SIMULATION OPTIONS	6.A.0.1
	1. AERODYNAMIC INPUTS	6.A.1.1
	2. AEROHEATING CALCULATIONS	6.A.2.1
	3. ANALYTICAL IMPACT POINT CALCULATIONS	6.A.3.1
	4. ATMOSPHERE MODEL/WINDS INPUTS	6.A.4.1
	5. CONIC CALCULATION OPTION	6.A.5.1
	6. EVENT CRITERIA/PHASE DEFINITION INPUTS	6.A.6.1
	7. FUNCTIONAL INEQUALITIES	6.A.7.1
	8. GENERALIZED DEPENDENT VARIABLE OPTION	6.A.8.1
	9. GENERALIZED INTEGRATION VARIABLES	6.A.9.1
	10. GRAVITATIONAL INPUTS	6.A.10.1
	11. HOLD DOWN OPTION	6.A.11.1
	12. INITIAL POSITION AND VELOCITY	6.A.12.1
	13. INSTANTANEOUS VELOCITY ADDITIONS	6.A.13.1
	14. MONITOR VARIABLES	6.A.14.1
	15. NUMERICAL INTEGRATION METHODS	6.A.15.1
	16. PRINT VARIABLE REQUESTS	6.A.16.1
	17. PROFILE TAPE OPTION	6.A.17.1
	18. PROPULSION/THROTTLING INPUTS	6.A.18.1
	19. RANGE CALCULATIONS	6.A.19.1
	20. SPECIAL CALCULATIONS FEATURE	6.A.20.1
	21. STATIC TRIM INPUTS	6.A.21.1
	22. TIME REFERENCE INPUTS	6.A.22.1
	23. TRACKING STATIONS	6.A.23.1
	24. VEHICLE/PROPELLANT WEIGHT INPUTS	6.A.24.1
	25. VELOCITY LOSSES	6.A.25.1
	26. VELOCITY MARGIN CALCULATIONS	6.A.26.1

CONTENTS (CONTD)

	PAGE
27. WEIGHT CALCULATION OPTION	6.A.27.1
28. SUN-SHADOW AND SUN ANGLE OPTION	6.A.28.1
B. METHODS OF GUIDANCE (STEERING)	6.B.0.1
1. OPEN LOOP GUIDANCE MODEL	6.B.1.1
2. ASCENT GUIDANCE MODEL	6.B.2.1
3. REENTRY GUIDANCE MODEL	6.B.3.1
C. TABLE MULTIPLIER INPUT	6.C.0.1
D. TABLE DATA INPUT	6.D.0.1
E. SIX DEGREE OF FREEDOM MODULES	6.E.0.1
1. CONTROLS/AIRFRAME MODULES	6.E.1.1
2. MASS PROPERTIES MODULE	6.E.2.1
3. ROTATIONAL EQUATIONS MODULE	6.E.3.1
F. AUTOPILOT MODULE	6.F.0.1
1. ASCENT AUTOPILOT MODEL	6.F.1.1
2. REENTRY AUTOPILOT MODEL	6.F.2.1
VII. ERROR MESSAGES AND TROUBLE-SHOOTING	7.0.0.1
VIII. SAMPLE PROBLEM	8.0.0.1
A. SAMPLE PROBLEM INPUT	8.A.0.1
B. SAMPLE PROBLEM OUTPUT	8.B.0.1
IX. LISTS OF VARIABLES	9.0.0.1
A. INPUTS FOR NAMELIST SEARCH	9.A.0.1
B. INPUTS FOR NAMELIST GENDAT	9.B.0.1
C. INPUTS FOR NAMELIST TAB	9.C.0.1
D. OUTPUT VARIABLES	9.D.0.1
X. INDICES	10.0.0.1
A. SUBJECT INDEX	10.A.0.1
B. VARIABLE INDEX	10.B.0.1

ABBREVIATIONS

SEVERAL ABBREVIATIONS ARE USED IN THIS DOCUMENT TO SPECIFY THE UNITS OF THE INPUT AND OUTPUT VARIABLES. THIS SECTION PRESENTS THE LIST OF ABBREVIATIONS USED AND THE CORRESPONDING DEFINITIONS.

ABBREVIATION	DEFINITION
DEG	ANGULAR DEGREES
DEG K	DEGREES KELVIN
DEG R	DEGREES RANKINE
FT	FEET
FT2,FT**2	FEET SQUARED
FT3,FT**3	FEET CUBED
J	JOULE
KG	KILOGRAM
KM	KILOMETER
M	METER
M2	METER SQUARED
M3	METER CUBED
MHZ	MEGAHERTZ
N	NEWTON
N/D	NON-DIMENSIONAL
N.MI.	NAUTICAL MILE
RAD	RADIAN
S,SEC	SECOND
S2,SEC**2	SECOND SQUARED
SL	SLUG
T/O	TARGETING/OPTIMIZATION
W	WATT

1. SUMMARY

THE SIX DEGREE OF FREEDOM PROGRAM TO OPTIMIZE SIMULATED TRAJECTORIES (6D POST) IS A GENERALIZD 6D, DISCRETE PARAMETER TARGETING AND OPTIMIZATION PROGRAM. POST PROVIDES THE CAPABILITY TO TARGET AND OPTIMIZE 6D TRAJECTORIES FOR ASCENT OR REENTRY VEHICLES OPERATING NEAR AN ARBITRARY ROTATING, OBLATE PLANET. THE GENERALITY OF THE PROGRAM IS EVIDENCED BY ITS N-PHASE SIMULATION CAPABILITY WHICH FEATURES GENERALIZED PLANET AND VEHICLE MODELS.

2. INTRODUCTION

THE 6D PROGRAM TO OPTIMIZE SIMULATED TRAJECTORIES (6D POST) WAS DEVELOPED TO PROVIDE THE CAPABILITY TO SIMULATE AND OPTIMIZE ASCENT AND REENTRY TRAJECTORIES FOR SHUTTLE TYPE VEHICLES. HOWEVER, THE GENERALITY OF THE PROGRAM ALSO ALLOWS VARIOUS OTHER TYPES OF VEHICLES TO BE SIMULATED.

THE PROGRAM WAS WRITTEN ACCORDING TO GUIDLINES DESIGNED TO PROVIDE COMPLETE GENERALITY WHEREVER POSSIBLE WITHOUT SACRIFICING COMPUTATIONAL SPEED OR COMPUTER STORAGE. THE GUIDELINES ADHERED TO ARE -

1) COMPUTER CORE SIZE OF APPROXIMATELY 100000 OCTAL CELLS,
2) FORTRAN IV EXTENDED AND COMPASS ASSEMBLY LANGUAGES,
3) MINIMUM PROGRAM EXECUTION TIME,
4) MODULAR PROGRAM CONSTRUCTION,
5) GENERALIZED ROUTINES TO ALLOW SIMULATION OF VARIOUS TYPES OF VEHICLES,
6) GENERALITY OF INPUT, OUTPUT, TARGETING AND STOPPING VARIABLES,
7) COMPATIBILITY OF OPERATION ON BOTH 6500 AND 6600 CDC COMPUTERS UNDER SCOPE 3.4.3 AND NOS 1.1 OPERATING SYSTEMS

INFORMATION PERTINENT TO THE USER IS PRESENTED IN THE FOLLOWING SECTIONS OF THIS REPORT. INCLUDED ARE DESCRIPTIONS OF THE INPUT AND OUTPUT, A SAMPLE INPUT LISTING AND THE RESULTING COMPUTER RUN PRINTOUT.

3. GENERAL INFORMATION

THIS SECTION DISCUSSES PROCEDURES FOR NEW USERS, THE INPUT FORMAT, THE HOLLERITH INPUT SYMBOLS, AND DEFINITIONS OF THE VARIOUS COORDINATE SYSTEM USED IN THE PROGRAM.

3.A. PROCEDURES FOR NEW USERS

THE FOLLOWING DISCUSSION GIVES THE STEPS TO BE TAKEN IN FORMULATING A PROBLEM AS AN AID TO USERS WHO ARE NOT FAMILIAR WITH THE PROGRAM INPUT PROCEDURE.

1) DETERMINE THE SEQUENCE OF EVENTS WHICH WILL DESCRIBE THE PROBLEM ACCORDING TO THE INSTRUCTIONS IN THE SECTION ENTITLED EVENT CRITERIA/PHASE DEFINITION.

2) IF THIS IS NOT A TARGETING/OPTIMIZATION TYPE PROBLEM, GO TO STEP 3, OTHERWISE DEFINE THE CONTROL PARAMETERS, TARGET CONDITIONS, INEQUALITY CONSTRAINTS, AND OPTIMIZATION INPUTS ACCORDING TO THE INSTRUCTIONS IN THE SECTION ENTITLED TARGETING/OPTIMIZATION INPUTS.

3) SET UP THE PROPER NAMELIST INPUT SEQUENCE (EXCLUDING TABLES) ACCORDING TO THE SECTION ENTITLED NAMELIST INPUT SEQUENCE.

4) SPECIFY THE APPROPRIATE PARAMETERS IN THE FIRST PHASE FROM THE FOLLOWING SECTIONS -

   A) EVENT CRITERIA/PHASE DEFINITION INPUTS
   B) NUMERICAL INTEGRATION METHODS
   C) INITIAL POSITION AND VELOCITY
   D) VEHICLE/PROPELLANT WEIGHT INPUTS
   E) METHODS OF GUIDANCE (STEERING)
   F) PRINT VARIABLE REQUESTS
   G) ANY OTHER APPROPRIATE INPUTS FOR THE DESIRED OPTIONS DESCRIBED IN THE SECTION ENTITLED GENERAL SIMULATION OPTIONS.

5) DETERMINE THE TABLES TO BE INPUT (IF ANY) BASED ON THE OPTIONS SELECTED IN STEP 4. INCLUDE THE APPROPRIATE NAMELISTS FOR TABLES AS REQUIRED ACCORDING TO THE SECTION ENTITLED NAMELIST INPUT SEQUENCE.

6) DETERMINE THE INPUTS REQUIRED FOR PHASES AS IN STEPS 4 AND 5 ABOVE.

7) SET UP THE REQUIRED CONTROL CARDS ACCORDING TO THE PROCEDURES DICTATED BY THE COMPUTER AND OPERATING SYSTEM BEING USED.

3.A. PROCEDURES FOR NEW USERS (CONTD)

8) COMPARE THE RESULTING INPUT DECK WITH THAT IN THE SECTION ENTITLED SAMPLE INPUT/OUTPUT TO ENSURE THAT THE NAMELISTS ARE IN THE PROPER SEQUENCE, ETC.

9) SUBMIT THE JOB AND SEE WHETHER THERE ARE ANY INPUT ERRORS OR IF THE DESIRED TRAJECTORY SEQUENCE WAS OBTAINED. CORRECT ALL INPUT ERRORS AND RESUBMIT UNTIL THE DESIRED RESULTS ARE OBTAINED.

3.B. NAMELIST INPUT FORMAT

ALL PROGRAM INPUTS ARE MADE USING THE NAMELIST INPUT CAPABILITY.

THE NAMELIST INPUT FORMAT ALLOWS CARD COLUMNS 2 THRU 80 TO BE USED FOR INPUT. EACH VARIABLE INPUT MUST BE FOLLOWED BY A COMMA BEFORE THE NEXT VARIABLE IS INPUT. THE VARIABLES ARE INPUT AS FOLLOWS -

```
NAME1 = VALUE1, NAME2 = VALUE2, ETC.
```

VARIABLES MAY BE INPUT ONE TO A CARD OR SEVERAL TO A CARD DEPENDING ON USER PREFERENCE.

SUBSCRIPTED VARIABLES MAY BE INPUT AS AN ARRAY OR AS INDIVIDUAL ELEMENTS. THE FIRST ELEMENT OF THE ARRAY IS ASSUMED IF NO SUBSCRIPT IS PRESENT ON A SUBSCRIPTED INPUT VARIABLE. THE FOLLOWING EXAMPLE SHOWS VARIOUS METHODS OF INPUT WHICH ARE ALL EQUIVALENT -

```
EVENT = 1.0, 1.0,

      OR

EVENT(1) = 1.0, EVENT(2) = 1.0,

      OR

EVENT = 1.0, EVENT(2) = 1.0,
```

IN GENERAL, DECIMAL POINTS SHOULD NOT BE USED WITH INTEGER TYPE VARIABLES. IN ANY CASE, IF NO DECIMAL POINT IS INPUT FOR A VARIABLE, THE DECIMAL IS ASSUMED TO BE AFTER THE LAST DIGIT FOR THAT VARIABLE. AS A RESULT, IT IS BEST TO OMIT DECIMAL POINTS FOR ALL VARIABLES UNLESS REQUIRED.

3.B.1. NAMELIST INPUT SEQUENCE

ALL VARIABLES REQUIRED BY THE PROGRAM AS INPUT ARE INPUT VIA NAMELISTS ACCORDING TO THE TYPE OF INPUT BEING PROCESSED. THE FOUR (4) NAMELISTS USED IN THE INPUT PROCESS ARE -

1) SEARCH - READ ONCE PER PROBLEM. IT CONTAINS ALL INPUT REQUIRED FOR THE TARGETING/OPTIMIZATION OPTION PLUS ALL OTHER DATA CAPABLE OF BEING INPUT ONLY ONCE PER PROBLEM, SUCH AS CONVERSION CONSTANTS, ETC.

2) GENDAT - READ ONCE PER PHASE. IT CONTAINS ALL CONSTANT INPUT DATA REQUIRED TO DESCRIBE THE CURRENT PHASE. THESE INPUTS DESCRIBE SUCH THINGS AS THE PROGRAM CONTROLS TO BE USED, THE VEHICLE PHYSICAL CHARACTERISTICS, THE ATTITUDE CONTROL LAW (GUIDANCE) TO BE USED, ETC.

3) TBLMLT - READ ONCE PER PHASE PROVIDED THE VALUE OF THE VARIABLE ENDPHS IN NAMELIST GENDAT IS EQUAL TO ZERO. OTHERWISE IT IS NOT READ FOR THAT PHASE. IT CONTAINS ALL TABLE MULTIPLIERS ASSOCIATED WITH THE TABLES BEING INPUT. EVERY TABLE IN THE PROGRAM HAS ITS OWN NUMERIC TABLE MULTIPLIER. NOTE - THIS NAMELIST MUST BE INPUT IN A PHASE IF ANY TABLES ARE TO BE INPUT FOR THAT PHASE EVEN IF THERE ARE NO TABLE MULTIPLIERS TO BE INPUT. THIS NAMELIST IS INPUT AFTER NAMELIST GENDAT.

4) TAB - READ ONCE PER TABLE FOR EACH PHASE PROVIDED THE VALUE OF THE VARIABLE ENDPHS IN TBLMLT IS EQUAL TO ZERO IN THAT PHASE. OTHERWISE IT IS NOT READ FOR THAT PHASE. NOTE - IF TABLES ARE TO BE INPUT IN A PHASE, THE NAMELIST TBLMLT MUST BE INPUT IMMEDIATELY FOLLOWING NAMELIST GENDAT FOR THAT PHASE. THE TABLES ARE THEN INPUT IN NAMELIST TAB WITH AN INPUT OF NAMELIST TAB REQUIRED FOR EACH TABLE BEING INPUT.

3.B.1. NAMELIST INPUT SEQUENCE (CONTD)

THE SEQUENCE IN WHICH THE NAMELISTS ARE INPUT IS ALWAYS THE SAME AS FAR AS NAMELISTS SEARCH AND GENDAT ARE CONCERNED. NAMELIST SEARCH IS THE FIRST TO BE INPUT FOR A GIVEN PROBLEM FOLLOWED BY AN INPUT OF NAMELIST GENDAT FOR EACH PHASE OF THE PROBLEM. THE OTHER NAMELISTS (TBLMLT AND TAB) ARE ONLY REQUIRED IN A GIVEN PHASE IF TABLES OR TABLE MULTIPLIERS ARE TO BE INPUT FOR THAT PHASE. IF THE VARIABLE ENDPHS IS NOT INPUT IN NAMELIST GENDAT FOR A GIVEN PHASE, NAMELIST TBLMLT MUST THEN BE INPUT FOR THAT PHASE IMMEDIATELY AFTER NAMELIST GENDAT. FURTHER, IF THE VARIABLE ENDPHS IS NOT INPUT IN NAMELIST TBLMLT AN INPUT OF NAMELIST TAB MUST BE MADE FOR EACH TABLE BEING INPUT. THE LAST NAMELIST TAB THEN MUST CONTAIN THE VARIABLE ENDPHS=1. NAMELIST GENDAT IS THEN INPUT FOR THE NEXT PHASE UNLESS THE VARIABLE ENDPRB=1 IS INPUT IN THAT PHASE. IN THIS CASE, NAMELIST SEARCH IS THEN INPUT FOR THE NEXT PROBLEM.

AN EXAMPLE OF THE NAMELIST INPUT SEQUENCE IS SHOWN BELOW FOR A TYPICAL PROBLEM WHICH CONTAINS TWO PHASES. NOTICE THAT THERE ARE THREE EVENTS REQUIRED TO SIMULATE A TWO PHASE PROBLEM SINCE AN EVENT BEGINS THE CORRESPONDING PHASE.

```
P$SEARCH
 .        INPUT DATA FOR SEARCH/OPTIMIZATION
 .        (REQUIRED ONLY ONCE PER PROBLEM)
 .
 $
P$GENDAT
 .        GENERAL INPUT DATA FOR THE FIRST PHASE.  INPUT
 .        THE VARIABLE EVENT(1)=1.0, IN THIS NAMELIST.
 .
 $
P$TBLMLT
 .        TABLE MULTIPLIERS FOR THE FIRST PHASE.  THIS
 .        NAMELIST MUST BE INPUT SINCE TABLES ARE BEING
 .        INPUT IN THIS PHASE EVEN THOUGH THERE MAY NOT BE
 .        ANY MULTIPLIERS INPUT FOR THIS PHASE.
 $
P$TAB
 .        TABLE INPUT DATA FOR THE FIRST TABLE BEING INPUT
 .        FOR THIS PHASE.
 .
 $
```

3.B.1. NAMELIST INPUT SEQUENCE (CONTD)

```
P$TAB
 .        TABLE INPUT DATA FOR THE SECOND TABLE BEING
 .        INPUT FOR THIS PHASE.  ASSUME THAT THIS IS THE
 .        LAST TABLE TO BE INPUT FOR THIS PHASE.  IN THIS
 .        CASE, THE VARIABLE ENDPHS=1, WOULD BE INPUT IN
 .        THIS NAMELIST.
 $
P$GENDAT
 .        GENERAL INPUT DATA FOR THE SECOND PHASE.  ASSUME
 .        THAT THERE ARE NO NEW TABLES TO BE INPUT FOR
 .        THIS PHASE.  IN THIS CASE, THE VARIABLE ENDPHS=1,
 .        WOULD BE INPUT IN THIS NAMELIST.
 $
P$GENDAT
 .        GENERAL INPUT DATA FOR THE THIRD PHASE.  ASSUME
 .        THAT THIS IS THE LAST PHASE OF A SINGLE RUN JOB.
 .        IN THIS CASE, ENDPHS=1, ENDPRB=1, AND ENDJOB=1,
 .        WOULD BE INPUT IN THIS NAMELIST.
 $
```

3.C. HOLLERITH INPUT SYMBOLS

CERTAIN INPUT VARIABLES ARE USED WHICH REFER TO AN ALPHA-NUMERIC (MNEMONIC) NAME OF A VARIABLE. IN THESE INSTANCES THE HOLLERITH (BCD) NAME OF A VARIABLE BECOMES AN INPUT VALUE. ALL HOLLERITH (BCD) TYPE INPUT VARIABLES ARE INPUT AS FOLLOWS -

NAME1 = NHVALUE,

WHERE, N IS THE NUMBER OF LETTERS IN VALUE AND VALUE IS THE NAME OF THE VARIABLE BEING SPECIFIED. FOR EXAMPLE, IF THE OPTIMIZATION VARIABLE IS DESIRED TO BE CROSSRANGE, THE INPUT FOR OPTVAR WOULD BE -

OPTVAR = 5HCRRNG,

WHERE CRRNG IS THE HOLLERITH NAME ASSOCIATED WITH CROSSRANGE IN THE PROGRAM.

ALL HOLLERITH NAMES FOR INPUT VARIABLES ARE THE SAME AS THE NAMELIST INPUT SYMBOLS EXCEPT FOR VARIABLES THAT ARE SUB-SCRIPTED. ALL HOLLERITH NAMES OF INTERNALLY COMPUTED VARIABLES ARE THE SAME AS THEIR OUTPUT SYMBOLS.

THE HOLLERITH NAMES OF SUBSCRIPTED INPUT VARIABLES ARE -

HOLLERITH NAME	NAMELIST INPUT SYMBOL
DTIMRJ J=1,4	DTIMR(J) J=1,4
DEPI I=1,15	DEP(I) I=1,15
DEYI I=1,15	DEY(I) I=1,15
DEPOI I=1,15	DEPO(I) I=1,15
DEYOI I=1,15	DEYO(I) I=1,15
ETAPCI I=1,4	ETAPC(I) I=1,4

3.C. HOLLERITH INPUT SYMBOLS (CONTD)

HOLLERITH NAME	NAMELIST INPUT SYMBOL
FREFLI I=1,3	FREFL(I) I=1,3
GINTJ J=1,10	GINT(J) J=1,10
GXPI	GXP(I)
GYPI	GYP(I)
GZPI I=1,15	GZP(I) I=1,15
KPDPI I=1,15	KPDP(I) I=1,15
KRDPI I=1,15	KRDP(I) I=1,15
KRDYI I=1,15	KRDY(I) I=1,15
KYDYI I=1,15	KYDY(I) I=1,15
SPECIJ J=1,9	SPECI(J) J=1,9
TIMRFJ J=1,4	TIMRF(J) J=1,4
VXI	VXI(1)
VYI	VXI(2)
VZI	VXI(3)
XI	XI(1)
YI	XI(2)
ZI	XI(3)

3.D. COORDINATE SYSTEMS

THE COORDINATE SYSTEMS USED IN THE PROGRAM ARE DEFINED AS FOLLOWS -

(1) EARTH CENTERED INERTIAL (ECI) AXES (XI,YI,ZI). THIS SYSTEM IS AN EARTH CENTERED, CARTESIAN SYSTEM WITH ZI COINCIDENT WITH THE NORTH POLE, XI COINCIDENT WITH THE GREENWICH MERIDIAN AT TIME ZERO AND IN THE EQUATORIAL PLANE, AND YI COMPLETING A RIGHT-HAND SYSTEM. THE TRANSLATIONAL EQUATIONS OF MOTION ARE SOLVED WITH RESPECT TO THIS SYSTEM.

(2) EARTH CENTERED ROTATING (ECR) AXES (XR,YR,ZR). THIS SYSTEM IS SIMILAR TO THE ECI SYSTEM EXCEPT THAT IT ROTATES WITH THE EARTH SUCH THAT XR IS ALWAYS COINCIDENT WITH THE GREENWICH MERIDIAN.

(3) EARTH POSITION COORDINATES. THESE ARE THE FAMILIAR LATITUDE, LONGITUDE, AND AZIMUTH PARAMETERS. LATITUDE IS MEASURED POSITIVE IN THE NORTHERN HEMISPHERE. LONGITUDE IS MEASURED POSITIVE EAST OF GREENWICH. AZIMUTH IS MEASURED POSITIVE CLOCKWISE FROM TRUE NORTH, I.E., FROM NORTH TO EAST.

(4) INERTIAL LAUNCH (L) AXES (XL,YL,ZL). THIS IS AN INERTIAL CARTESIAN SYSTEM WHICH IS USED AS AN INERTIAL REFERENCE FROM WHICH THE INERTIAL ATTITUDE ANGLES OF THE VEHICLE ARE MEASURED. THIS COORDINATE SYSTEM IS AUTOMATICALLY LOCATED AT THE GEODETIC LATITUDE AND INERTIAL LONGITUDE OF THE VEHICLE AT THE BEGINNING OF THE SIMULATION UNLESS OVERRIDDEN BY USER INPUT OF LATL AND LONL. THE AZIMUTH ANGLE AZL IS ZERO UNLESS OVERRIDDEN BY USER INPUT. THE ORIENTATION OF THIS SYSTEM IS SUCH THAT XL IS ALONG THE POSITIVE RADIUS VECTOR IF LATL IS INPUT AS GEOCENTRIC LATITUDE, OR ALONG THE LOCAL VERTICAL IF LATL IS NOT INPUT OR IS INPUT AS THE GEODETIC LATITUDE, ZL IS IN THE LOCAL HORIZONTAL PLANE AND IS DIRECTED ALONG THE AZIMUTH SPECIFIED BY AZL, AND YL COMPLETES A RIGHT-HAND SYSTEM. THIS SYSTEM IS INTENDED FOR USE IN SIMULATING ASCENT PROBLEMS FOR LAUNCH VEHICLES WHICH USE EITHER INERTIAL PLATFORM OR STRAPDOWN TYPE ANGULAR COMMANDS. THE INERTIAL ANGLES (ROLI, YAWI, AND PITI) ARE ALWAYS MEASURED WITH RESPECT TO THIS SYSTEM AND ARE AUTOMATICALLY COMPUTED REGARDLESS OF THE STEERING OPTION (IGUID) BEING USED.

3.D. COORDINATE SYSTEMS (CONTD)

(5) GEOGRAPHIC (G) AXES (XG,YG,ZG). THIS SYSTEM IS LOCATED AT THE SURFACE OF THE PLANET AT THE CURRENT VEHICLE GEOCENTRIC LATITUDE AND LONGITUDE. THE XG AXIS IS IN THE LOCAL HORIZONTAL PLANE AND POINTS NORTH, THE YG AXIS IS IN THE LOCAL HORIZONTAL PLANE AND POINTS EAST, AND ZG COMPLETES A RIGHT-HAND SYSTEM. THIS SYSTEM IS USED TO CALCULATE PARAMETERS ASSOCIATED WITH AZIMUTH AND ELEVATION ANGLES.

(6) BODY (B) AXES (XB,YB,ZB). THE BODY AXES ARE A RIGHT-HAND CARTESIAN SYSTEM ALIGNED WITH THE AXES OF THE VEHICLE AND CENTERED AT THE VEHICLE CENTER-OF-GRAVITY. THE XB AXIS IS DIRECTED FORWARD ALONG THE LONGITUDINAL AXIS OF THE VEHICLE, YB POINTS RIGHT (OUT THE RIGHT WING), AND ZB POINTS DOWNWARD COMPLETING A RIGHT-HAND SYSTEM. ALL AERODYNAMIC AND THRUST FORCES ARE CALCULATED IN THE BODY SYSTEM. THESE FORCES ARE THEN TRANSFORMED TO THE INERTIAL (I) SYSTEM WHERE THEY ARE COMBINED WITH THE GRAVITATIONAL FORCES.

(7) BODY REFERENCE (BR) AXES (XBR,YBR,ZBR). THE BODY REFERENCE SYSTEM IS A RIGHT-HAND CARTESIAN SYSTEM ALIGNED WITH THE BODY AXES AS FOLLOWS. THE XBR AXIS IS DIRECTED ALONG THE NEGATIVE XB AXIS, THE YBR AXIS IS DIRECTED ALONG THE POSITIVE YB AXIS, AND THE ZBR AXIS IS DIRECTED ALONG THE NEGATIVE ZB AXIS. THIS SYSTEM IS USED TO LOCATE THE VEHICLE CENTER-OF-GRAVITY, AERODYNAMIC REFERENCE AND ENGINE GIMBAL LOCATIONS.

(8) ORBITAL ELEMENTS. THIS IS A NON-RECTANGULAR COORDINATE SYSTEM USED IN DESCRIBING ORBITAL MOTION. THE ORBITAL ELEMENTS ARE APOGEE ALTITUDE, PERIGEE ALTITUDE, INCLINATION, LONGITUDE OF THE ASCENDING NODE, TRUE ANOMALY, AND ARGUMENT OF PERIGEE. THE APOGEE AND PERIGEE ALTITUDES REPLACE THE STANDARD ORBITAL ELEMENTS SEMIMAJOR AXIS AND ECCENTRICITY.

3.E. VEHICLE ATTITUDE ANGLES/RATES

THE PROGRAM CALCULATES THE VEHICLE ATTITUDE WITH RESPECT TO SEVERAL COORDINATE SYSTEMS. THESE ATTITUDE ANGLES ARE DEFINED AS FOLLOWS -

1) AERODYNAMIC ANGLES. THESE ANGLES DEFINE THE VEHICLE ORIENTATION WITH RESPECT TO THE ATMOSPHERIC RELATIVE VELOCITY VECTOR. THESE ANGLES ARE USED TO CALCULATE THE AERODYNAMIC FORCES AND MOMENTS ACTING ON THE VEHICLE. THE AERODYNAMIC ANGLES ARE DEFINED AS FOLLOWS -

   ALPHA - ANGLE OF ATTACK. POSITIVE ALPHA IS NOSE UP (ABOVE THE ATMOSPHERIC RELATIVE VELOCITY VECTOR) WHEN FLYING THE VEHICLE UPRIGHT (BANK ANGLE BETWEEN -90 DEG AND +90 DEG). (THIRD EULER ROTATION ABOUT THE STABILITY (VELOCITY) AXES)

   BETA - ANGLE OF SIDESLIP. POSITIVE BETA IS NOSE LEFT WHEN FLYING THE VEHICLE UPRIGHT. (SECOND EULER ROTATION ABOUT THE STABILITY (VELOCITY) AXES)

   BNKANG - BANK ANGLE. POSITIVE BNKANG IS A BANK TO THE RIGHT, I.E., RIGHT WING DOWN. (FIRST EULER ROTATION ABOUT THE STABILITY (VELOCITY) AXES)

2) INERTIAL EULER ANGLES. THESE ANGLES DEFINE THE VEHICLE ORIENTATION WITH RESPECT TO THE LAUNCH (L) INERTIAL COORDINATE SYSTEM. THESE ANGLES ARE DEFINED AS FOLLOWS -

   ROLI - INERTIAL ROLL ANGLE. THIS IS THE ROLL ANGLE (FIRST EULER ROTATION) WITH RESPECT TO THE L COORDINATE SYSTEM.

   YAWI - INERTIAL YAW ANGLE. THIS IS THE YAW ANGLE (SECOND EULER ROTATION) WITH RESPECT TO THE L COORDINATE SYSTEM.

   PITI - INERTIAL PITCH ANGLE. THIS IS THE PITCH ANGLE (THIRD EULER ROTATION) WITH RESPECT TO THE L COORDINATE SYSTEM.

3.E. VEHICLE ATTITUDE ANGLES/RATES (CONTD)

3) RELATIVE EULER ANGLES. THESE ANGLES PROVIDE THE VEHICLE ORIENTATION WITH RESPECT TO THE LOCAL HORIZONTAL COORDINATE SYSTEM. THE LOCAL HORIZONTAL PLANE IS DEFINED TO BE PERPENDICULAR TO THE RADIUS VECTOR. THESE ANGLES ARE DEFINED BY A YAW, PITCH AND ROLL SEQUENCE. THESE ANGLES ARE DEFINED AS FOLLOWS -

YAWR - RELATIVE YAW ANGLE. THIS IS THE AZIMUTH ANGLE OF THE XB AXIS MEASURED CLOCKWISE FROM NORTH. THAT IS, FROM NORTH TO EAST. (FIRST EULER ROTATION ABOUT THE GEOGRAPHIC (G) COORDINATE SYSTEM)

PITR - RELATIVE PITCH ANGLE. THIS IS THE ELEVATION ANGLE OF THE XB AXIS ABOVE THE LOCAL HORIZONTAL PLANE. PITR IS POSITIVE WHEN XB IS ABOVE THE LOCAL HORIZONTAL AND RANGES FROM -90 DEG TO +90 DEG. WHEN PITCHING THE VEHICLE THROUGH + OR - 90 DEG, THE AZIMUTH ANGLE (YAWR) WILL GO THROUGH A 180 DEG DISCONTINUITY. (SECOND EULER ROTATION ABOUT THE GEOGRAPHIC (G) COORDINATE SYSTEM)

ROLR - RELATIVE ROLL ANGLE. THIS IS THE ROLL ANGLE ABOUT THE XB AXIS IN THE RIGHT-HAND SENSE. ZERO ROLL IMPLIES THAT THE YB AXIS IS IN THE LOCAL HORIZONTAL PLANE. (THIRD EULER ROTATION ABOUT THE GEOGRAPHIC (G) COORDINATE SYSTEM)

4) INERTIAL AERODYNAMIC ANGLES. THESE ANGLES ARE DEFINED IN EXACTLY THE SAME MANNER AS THE AERODYNAMIC ANGLES EXCEPT THAT THEY ARE MEASURED WITH RESPECT TO THE INERTIAL VELOCITY VECTOR. THESE ANGLES ARE DEFINED AS FOLLOWS -

ALPHI - INERTIAL ANGLE OF ATTACK. POSITIVE ALPHA IS NOSE UP (ABOVE THE INERTIAL VELOCITY VECTOR) WHEN FLYING THE VEHICLE UPRIGHT (BANKI BETWEEN -90 DEG AND +90 DEG).

BETAI - INERTIAL ANGLE OF SIDESLIP. POSITIVE BETAI IS NOSE LEFT WHEN FLYING THE VEHICLE UPRIGHT.

BANKI - INERTIAL BANK ANGLE. POSITIVE BANKI IS A BANK TO THE RIGHT WHEN FLYING THE VEHICLE UPRIGHT.

3.E. VEHICLE ATTITUDE ANGLES/RATES (CONTD)

THE PROGRAM CALCULATES THE VEHICLE BODY ATTITUDE BY INTEGRATING THE QUATERNION RATE EQUATIONS. THE RESULTING QUATERNION ELEMENTS ARE THEN USED TO DEFINE THE TRANSFORMATION MATRIX BETWEEN THE INERTIAL L-FRAME AND THE BODY FRAME.

THE INERTIAL BODY RATES ARE DEFINE AS -

ROLBD - ROLL BODY RATE. THE ANGULAR RATE ABOUT THE XB-AXIS IN DEG/SEC.

PITBD - PITCH BODY RATE. THE ANGULAR RATE ABOUT THE YB-AXIS IN DEG/SEC.

YAWBD - YAW BODY RATE. THE ANGULAR RATE ABOUT THE ZB-AXIS IN DEG/SEC.

THE NON-DIMENSIONAL BODY RATES CALCULATED FOR USE AS AERODYNAMIC TABLE MNEMONIC MULTIPLIERS ARE DEFINED AS -

PND - NON-DIMENSIONAL ROLL RATE

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PND = ROLBDR*DREFR/(2.*VELA)
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QND - NON-DIMENSIONAL PITCH RATE

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QND = PITBDR*DREFP/(2.*VELA)
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RND - NON-DIMENSIONAL YAW RATE

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RND = YAWBDR*DREFY/(2.*VELA)
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WHERE ROLBDR, PITBDR AND YAWBDR ARE THE VEHICLE ROLL, PITCH AND YAW RATES IN RADIANS, DREFR, DREFP AND DREFY ARE THE AERODYNAMIC REFERENCE DIAMETERS IN ROLL, PITCH AND YAW AND VELA IS THE VEHICLE VELOCITY RELATIVE TO THE ATMOSPHERE.

4. OPERATIONAL CONTROLS

THE INPUTS ASSOCIATED WITH GENERAL PROGRAM OPTIONS ARE DISCUSSED IN THIS SECTION. THESE OPTIONS CONCERN THE TYPE OF INPUT AND OUTPUT UNITS TO BE USED AND THE MULTIPLE RUN FEATURE OF THE PROGRAM.

4.A. INPUT/OUTPUT CONVERSION FACTORS

THE PROGRAM HAS THE CAPABILITY TO ACCEPT INPUT IN EITHER ENGLISH OR METRIC UNITS. THE ONLY RESTRICTION BEING THAT THE INPUT UNITS CANNOT BE MIXED. THE OUTPUT VARIABLES CAN ALSO BE PRINTED IN EITHER ENGLISH OR METRIC UNITS, BUT NOT BOTH.

THE PROGRAM ALSO HAS THE CAPABILITY TO PRINT THE TABLE DATA BEING USED BY THE PROGRAM. THIS FEATURE IS USEFUL IN THAT INPUT ERRORS IN THE TABLE FORMAT ARE EASILY DETECTED BY READING THIS PRINTOUT.

ALL OF THE ENGLISH TO METRIC CONVERSION CONSTANTS CAN BE CHANGED BY INPUT IF DESIRED. THE STORED VALUES OF THESE CONSTANTS WERE OBTAINED FROM THE FOLLOWING DOCUMENT -

THE INTERNATIONAL SYSTEM OF UNITS
PHYSICAL CONSTANTS AND CONVERSION FACTORS
F. A. MECHTLY, MARSHALL FLIGHT CENTER
NASA SP-7012, 1964

CARE MUST BE TAKEN WHEN USING METRIC SYSTEM INPUT AND OUTPUT. THE INPUT UNITS MUST BE OF THE SAME TYPE AS THE ENGLISH UNITS. FOR EXAMPLE, VALUES FOR WEIGHTS MUST BE INPUT IN UNITS OF FORCE (NEWTONS) RATHER THAN MASS (KG). VARIABLES OUTPUT IN NAUTICAL MILES IN ENGLISH UNITS WILL BE KILOMETERS IN METRIC.

ALL VARIABLES ASSOCIATED WITH THE INPUT/OUTPUT UNITS ARE INPUT IN NAMELIST SEARCH AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CDENS	SLUGS/FT3 PER KG/M3	.001940 31965	ATMOSPHERIC DENSITY CONVERSION CONSTANT.
CFORCE	NT/LB	4.4482216 152605	FORCE (THRUST AND AERODYNAMIC) CONVERSION CONSTANT.
CHEAT	JOULES/ BTU	1054.3502 6448888	AEROHEATING CONVERSION CONSTANT.
CMASS	KG/SLUG	14.5939 029	MASS CONVERSION CONSTANT.

4.A. INPUT/OUTPUT CONVERSION FACTORS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CMPFT	M/FT	.3048	LENGTH CONVERSION CONSTANT.
CPRES	LBS/FT2 PER NT/CM2	.02088 54347	ATMOSPHERIC PRESSURE CONVERSION CONSTANT.
CTEMP	DEG F PER DEG C	1.8	ATMOSPHERIC TEMPERATURE CONVERSION CONSTANT.
FTPNM	FT/NM	6076.1155	DISTANCE CONVERSION CONSTANT.
ICFLAG	INTEGER	0	INPUT/OUTPUT UNITS FLAG. = 0, ENGLISH/ENGLISH = 1, ENGLISH/METRIC = 2, METRIC /ENGLISH = 3, METRIC /METRIC
IPRC	INTEGER	0	CONTROLS PRINT OUT OF TRAJECTORIES DURING TARGETING/OPTIMIZATION. =-1, ONLY PRINT THE FINAL TRAJ-ECTORY GENERATED DURING TARGETING/OPTIMIZATION. = 0, SAME AS -1, AND FIRST NOMINAL = 1, SAME AS -1, AND ALL NOMINALS = 2, PRINT ALL TRAJECTORIES (NOMINALS, PERTURBED, AND TRIAL STEPS)
LISTIN	INTEGER	2	CONTROLS SUMMARY-OF-INPUT PRINTOUT =-1, NO SUMMARY. = 0, TABLE SUMMARY ONLY. = 1, TABLE AND NAMELIST SUMMARY. = 2, NAMELIST SUMMARY ONLY.

4.B. MULTIPLE RUNS

THE PROGRAM HAS THE CAPABILITY TO PERFORM MULTIPLE RUNS. THE WORD RUN IS THE SAME AS THE WORD PROBLEM INSOFAR AS THE PROGRAM IS CONCERNED. THE RUN NUMBERS ARE ASSIGNED AS INTEGERS BY THE PROGRAM BEGINNING WITH NUMBER ONE (1) ACCORDING TO THE ORDER IN WHICH THE INPUTS FOR THE RUNS ARE ARRANGED IN THE DATA DECK.

WHEN RUNNING NON-SEARCH/OPTIMIZATION TYPE MULTIPLE RUNS, I.E., IF SRCHM =0, THE USER ONLY NEEDS TO INPUT THE VARIABLE MULTRF WHICH INDICATES THE SOURCE OF THE INPUT DATA FOR THE CURRENT RUN.

THE SOURCE OF INPUT DATA FOR A MULTIPLE RUN CAN BE SPECIFIED IN ONE OF THREE WAYS AS FOLLOWS -

1. THE INPUTS FOR THE CURRENT RUN ARE THE SUMMATION OF THE INPUTS FROM ALL THE PREVIOUS RUNS.

2. THE INPUTS FOR THE CURRENT RUN ARE THE INPUTS FOR THE FIRST RUN PLUS ONLY THE INPUT CHANGES FOR THIS RUN.

3. THE INPUTS FOR THE CURRENT RUN ARE UNRELATED TO ANY PREVIOUS RUNS. I.E., THIS IS A COMPLETELY SEPARATE RUN.

THE MULTIPLE RUN CAPABILITY ALLOWS THE USER TO CHANGE THE INPUT DATA IN ANY OF THE NAMELISTS ASSOCIATED WITH THE BASIC DATA DECK. IN ADDITION, THE USER CAN ADD OR DELETE PHASES IN THE BASIC DATA DECK. THESE PROCEDURES ARE SUMMARIZED AS FOLLOWS -

1. CHANGES TO AN EXISTING PHASE - IDENTIFY THE PHASE TO BE CHANGED BY INPUTTING THE VARIABLE EVENT IN NAMELIST GENDAT ALONG WITH THE DESIRED CHANGES FOR THAT PHASE.

2. ADDING A NEW PHASE - A NEW PHASE IS ADDED BY MERELY INCLUDING THE DESIRED INPUTS FOR THAT PHASE. THE POSITION OF THE PHASE RELATIVE TO THE PHASES IN THE DECK BEING CHANGED IS DETERMINED BY THE INPUT VARIABLE EVENT.

3. DELETING A PHASE - A PHASE IS DELETED MERELY BY SETTING ITS EVENT NUMBER NEGATIVE, I.E., INPUT EVENT = -10, IN NAMELIST GENDAT TO DELETE PHASE 10.

4.B. MULTIPLE RUNS (CONTD)

THE NAMELIST INPUT SEQUENCE FOR A MULTIPLE RUN FOLLOWS THE SAME RULES AS THOSE PREVIOUSLY DISCUSSED IN THE SECTION ENTITLED NAMELIST INPUT SEQUENCE. A RUN CAN BE TERMINATED IN ANY OF THE NAMELISTS BY SETTING ENDPRB=1 IN THAT NAMELIST. THE END OF THE INPUT DATA FOR THE JOB IS SIGNIFIED BY SETTING ENDJOB=1 IN THE LAST NAMELIST IN THE DATA DECK.

THE TARGETING/OPTIMIZATION RESULTS FROM A GIVEN RUN ARE CARRIED OVER FROM THAT RUN TO THE NEXT RUN. THAT IS, THE VALUES OF THE INDEPENDENT VARIABLES ARE RETAINED FROM ONE RUN TO THE NEXT UNLESS OVERRIDDEN BY USER INPUT. THE NEXT RUN TO BE MADE DURING TARGETING/OPTIMIZATION CAN BE SPECIFIED AS A CONDITIONAL RUN. THAT IS, THE USER CAN INDICATE THAT THE CURRENT RUN IS TO BE MADE ONLY IF THE DESIGNATED RUNS HAVE TERMINATED ACCORDING TO ONE OF THE FOLLOWING CONDITIONS -

1. RUN THE CURRENT RUN ONLY IF ANY OF THE SPECIFIED RUNS IS SUCCESSFUL, I.E., IF *** PROBLEM SOLVED WAS OBTAINED.

2. RUN THE CURRENT RUN ONLY IF ANY OF THE SPECIFIED RUNS FAILED ON THE FIRST NOMINAL, I.E., IF *** UNUSABLE NOMINAL WAS OBTAINED.

3. RUN THE CURRENT RUN REGARDLESS OF THE CONDITION OF ANY OF THE PREVIOUS RUNS.

THE CONDITIONAL RUN CAPABILITY IS USEFUL IN RUNNING PROBLEMS THAT MAY OR MAY NOT WORK BECAUSE OF POOR INITIAL GUESSES. IN THIS CASE, THE USER COULD INPUT A MULTIPLE RUN WHICH WOULD PERFORM A REDUCED SEARCH (E.G., A 1X1) BASED ON THE USER SPECIFIED INITIAL GUESS, FOLLOWED BY A RUN WHICH WOULD REPEAT THE FIRST PROBLEM USING THE VALUES OBTAINED FROM THE 1X1 SEARCH.

THE FOLLOWING SEQUENCE OF RUNS SHOWS HOW THE CONDITIONAL RUN CAPABILITY CAN BE USED.

RUN NO. 1 - FIRST GUESS

RUN NO. 2 - RUN THIS PROBLEM ONLY IF RUN NO. 1 FAILS
(I.E., IF *** UNUSABLE NOMINAL WAS OBTAINED)
INPUTS REQUIRED - NXTRUN = 2,
IFRUNF(I) = 1,0,0,0,0,

4.B. MULTIPLE RUNS (CONTD)

RUN NO. 3 - RUN THIS PROBLEM ONLY IF RUN NO. 2 WORKS
(I.E., IF *** PROBLEM SOLVED WAS OBTAINED)
INPUTS REQUIRED - NXTRUN = 1,
IFRUNF(1) = 2,0,0,0,0,

RUN NO. 4 - RUN THIS PROBLEM ONLY IF RUN NO. 1 OR 3 WORKS
(I.E., IF *** PROBLEM SOLVED WAS OBTAINED)
INPUTS REQUIRED - NXTRUN = 1,
IFRUNF(1) = 1,3,0,0,0,

RUN NO. 5 - RUN THIS PROBLEM ONLY IF RUN NO. 4 WORKS
(I.E., IF *** PROBLEM SOLVED WAS OBTAINED)
INPUTS REQUIRED - NXTRUN = 1,
IFRUNF(1) = 4,0,0,0,0,

THE VARIABLES ASSOCIATED WITH MULTIPLE RUNS ARE INPUT IN NAMELIST SEARCH AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
IFRUNF(J) J=1,5	INTEGER	0	AN ARRAY CONTAINING THE RUN NUMBERS TO BE USED IN CONJUNCTION WITH THE VARIABLE NXTRUN TO DETERMINE WHICH RUN IS TO BE MADE NEXT. IF IFRUNF IS NOT INPUT OR IS ZERO, THE PREVIOUS RUN NUMBER WILL BE USED IN CONJUNCTION WITH NXTRUN.
MULTRF	INTEGER	1	A FLAG TO INDICATE HOW THE INPUT DATA FOR THE CURRENT RUN IS TO BE FORMED WHEN RUNNING MULTIPLE RUNS. = 1, THE INPUT DATA FOR THIS RUN THE DATA FOR THE FIRST RUN PLUS ALL INPUT CHANGES FOR THIS AND ALL PREVIOUS RUNS. = 2, THE INPUT DATA FOR THIS RUN IS THE DATA FOR THE FIRST RUN PLUS ONLY THE INPUT CHANGES FOR THIS RUN. = 3, THIS RUN IS A COMPLETELY INDEPENDENT RUN, I.E., THESE MULTIPLE RUNS ARE COMPLETELY SEPARATE PROBLEMS.

4.B. MULTIPLE RUNS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NXTRUN	INTEGER	1	A FLAG TO INDICATE WHETHER OR NOT THIS IS THE NEXT RUN WHEN USING THE SEARCH/OPTIMIZATION OPTION. = 1, PROCEED WITH THIS RUN ONLY IF ANY OF THE RUNS IN THE ARRAY IFRUNF(J) WAS SUCCESSFUL. I.E., IF *** PROBLEM SOLVED WAS OBTAINED ON ANY OF THE RUNS IN IFRUNF(J). = 2, PROCEED WITH THIS RUN ONLY IF THE FIRST NOMINAL TRAJECTORY ON ANY OF THE RUNS IN THE ARRAY IFRUNF(J) FAILED. I.E., IF *** UNUSABLE NOMINAL WAS OBTAINED ON ANY OF THE RUNS IFRUNF(J). = 3, PROCEED WITH THIS RUN REGARDLESS OF THE SUCCESS OR FAILURE OF ANY OF THE RUNS IN THE ARRAY IFRUNF(J).

5. TARGETING/OPTIMIZATION INPUTS

POST HAS THE CAPABILITY OF PERFORMING TARGETING WITH OR WITH OUT INEQUALITY CONSTRAINTS, UNCONSTRAINED OPTIMIZATION, AND CONSTRAINED (EQUALITY AND/OR INEQUALITY) OPTIMIZATION. THE GENERALITY OF POST ENABLES THE USER TO SELECT THE INDEPENDENT AND DEPENDENT VARIABLES FOR THE PROBLEM FROM A LIST OF OVER 400 PROGRAM VARIABLES.

ANY TYPE OF EVENT (PRIMARY, SECONDARY, OR ROVING) CAN BE USED IN TARGETING/OPTIMIZATION. HOWEVER, THE USER MUST INSURE THAT THE EVENTS SELECTED WILL ALWAYS OCCUR. THE ASSOCIATION OF AN EVENT NUMBER WITH THE DEFINITIONS OF THE TARGETING AND OPTIMIZATION VARIABLES ENABLES SUCH THINGS AS INTERMEDIATE TARGETING AND OPTIMIZATION TO BE PERFORMED WITH THE PROGRAM. THIS CORRESPONDENCE ALSO ENABLES THE PROGRAM TO REMEMBER THE STATE VARIABLES AT THE BEGINNING OF THE PHASES WHERE THE INDEPENDENT VARIABLES ARE INTRODUCED. THUS, WHEN INTEGRATING THE PERTURBED TRAJECTORIES AND THE TRIAL STEPS, ONLY THAT SEGMENT OF THE TRAJECTORY AFFECTED BY THE CONTROL PARAMETERS BEING CHANGED IS INTEGRATED, THEREBY REDUCING THE TIME REQUIRED TO GENERATE THE SENSITIVITY MATRIX.

FOR AN OPTIMIZATION PROBLEM, THE OPTIMIZATION VARIABLE MUST BE DEFINED IN NAMELIST SEARCH. THE VARIABLES OPTVAR, OPTPH, AND OPT ARE USED FOR THIS PURPOSE. FOR TARGETING (CONSTRAINED) PROBLEMS, THE DEPENDENT VARIABLES MUST BE DEFINED IN NAMELIST SEARCH. THE VARIABLES NDEPV, DEPVR, DEPPH, IDEPVR, DEPVAL, AND DEPTL ARE USED FOR THIS PURPOSE. BOTH SETS OF INPUTS ARE NEEDED FOR A CONSTRAINED OPTIMIZATION PROBLEM. IN ANY CASE, THE SEARCH MODE (SRCHM), THE NUMBER OF ITERATIONS (MAXITR), AND THE INDEPENDENT VARIABLES (NINDV, INDVR, INDPH, AND U) MUST BE DEFINED IN NAMELIST SEARCH.

IN ADDITION TO THE REQUIRED NAMELIST SEARCH INPUTS, THERE ARE SEVERAL OTHERS WHICH CAN BE USED TO FURTHER INCREASE THE RATE OF CONVERGENCE ON DIFFICULT OPTIMIZATION PROBLEMS. FOR THE MOST PART, THESE INPUTS ARE RELATED TO PROBLEM SCALING (MODEW AND WOPT), SEARCH DIRECTION STEPSIZE CONTROL (PCTCC), AND CONVERGENCE TOLERANCES (CONEPS(I)).

5.A. CONTROL (INDEPENDENT) VARIABLES

THE SEARCH/OPTIMIZATION OPTION ALLOWS THE USER TO SPECIFY AS MANY AS 25 CONTROL VARIABLES FOR EACH PROBLEM. THE INITIAL VALUE OF EACH CONTROL VARIABLE AND THE PHASE IN WHICH IT OCCURS ARE ALSO SPECIFIED BY INPUT. IF A CONTROL VARIABLE IS A GUIDANCE (STEERING) VARIABLE, SUCH AS A PITCH RATE OR ANGLE, THE APPROPRIATE GUIDANCE OPTION (IGUID) MUST BE REQUESTED IN NAMELIST GENDAT FOR THE CORRESPONDING PHASE.

THE VALUE OF A GIVEN CONTROL VARIABLE AS CALCULATED BY THE TARGETING/OPTIMIZATION ALGORITHM WILL BE CARRIED OVER FROM ONE PHASE TO THE NEXT UNTIL OVERRIDDEN BY USER INPUT OR BY A NEW CONTROL VARIABLE. FOR EXAMPLE, IF THE LINEAR TERM IN THE PITCH ANGLE POLYNOMIAL (HOLLERITH INPUT SYMBOL PITPC2) IS A CONTROL VARIABLE IN PHASE 1.0, AND IS NOT A CONTROL VARIABLE IN PHASE 2.0, THE CALCULATED VALUE OF THE PITCH RATE IN PHASE 1.0 WILL CONTINUE INTO PHASE 2.0 UNLESS THE COEFFICIENT PITPC(2) IS INPUT IN NAMELIST GENDAT FOR PHASE 2.0.

THE CONTROL VARIABLES CAN BE SELECTED FROM ALMOST ANY VARIABLE IN NAMELISTS GENDAT OR TBLMLT. EACH CONTROL VARIABLE HAS SEVERAL INPUTS ASSOCIATED WITH IT TO DESCRIBE ITS FUNCTION TO THE PROGRAM. THESE VARIABLES ARE INPUT IN NAMELIST SEARCH AND ARE AS FOLLOWS -

1) THE HOLLERITH NAME OF EACH CONTROL VARIABLE. THIS IS INPUT AS THE ARRAY INDVR(I), I=1,NINDV.

2) THE INITIAL VALUE OF EACH CONTROL VARIABLE. INPUT AS THE ARRAY U(I), I=1,NINDV. IF SRCHM IS NON-ZERO, U(I) OVERRIDES ANY VALUE INPUT FOR THAT VARIABLE IN NAMELIST GENDAT FOR PHASE INDPH(I).

3) THE PHASE NUMBER (EVENT) AT WHICH EACH INDVR IS INITIATED. INPUT AS THE ARRAY INDPH(I), I=1,NINDV. THE VARIABLE WHOSE HOLLERITH NAME APPEARS IN INDVR(I) IS SET EQUAL TO U(I) AT THE BEGINNING OF THE PHASE SPECIFIED BY INDPH(I).

5.A. CONTROL (INDEPENDENT) VARIABLES (CONTD)

4) THE PERTURBATION FOR EACH CONTROL VARIABLE TO BE USED TO GENERATE THE SENSITIVITIES. INPUT AS THE ARRAY PERT(I), I=1,NINDV. THE SENSITIVITY DE(J)/DU(I) IS DETERMINED BY FINITE DIFFERENCING U(I) BY PERT(I) AND CALCULATING THE CHANGE IN EACH E(J). FOR VARIABLES WHOSE NOMINAL VALUE IS GREATER THAN 10.0, THE VALUE OF PERT(I) SHOULD BE INPUT ROUGHLY SIX ORDERS OF MAGNITUDE LESS THAN THE NOMINAL VALUE OF THE VARIABLE. THE STORED VALUES FOR PERT(I) ARE 1.0E-4.

5) THE NUMBER OF CONTROL (INDEPENDENT) VARIABLES TO BE USED. INPUT AS THE VARIABLE NINDV. THE FIRST NINDV VARIABLES IN THE ARRAY INDVR(I) WILL BE USED AS CONTROL VARIABLES. THE NUMBER OF CONTROL VARIABLES MUST BE GREATER THAN OR EQUAL TO THE NUMBER OF TARGET VARIABLES PLUS THE OPTIMIZATION VARIABLE UNLESS SOME OF THE TARGET VARIABLES ARE INEQUALITY CONSTRAINTS.

IN ADDITION TO THE ABOVE REQUIRED INPUTS, THERE ARE SOME OTHERS ASSOCIATED WITH THE CONTROL VARIABLES WHICH COULD BE USED TO SPEED THE TARGETING/OPTIMIZATION PROCESS ON DIFFICULT PROBLEMS. IN MOST CASES, THE STORED VALUES WILL PROVIDE THE BEST RESULTS. NO USER INPUTS ARE REQUIRED IF THE STORED VALUES ARE TO BE USED. THESE INPUTS ARE INPUT IN NAMELIST SEARCH AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
MODEW	INTEGER	1	CONTROLS TYPE OF WEIGHTING TO BE USED FOR THE INDEPENDENT VARIABLES = 0, USE INPUT WEIGHTING, WVU(I). SEE INPUT INSTRUCTIONS FOR WVU(I). = 1, AUTOMATIC CONTROL WEIGHTING WVU(I) = 1.0/U(I)
NPAD(3)	DECIMAL	10.	THE LOWER BOUND ON THE PERCENTAGE CHANGE IN THE PERTURBATION OF THE CONTROL PARAMETERS WHEN COMPUTING THE SENSITIVITY MATRIX.

5.A. CONTROL (INDEPENDENT) VARIABLES (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
WVU(I) I=1,25	DECIMAL	0.0	INDEPENDENT VARIABLE WEIGHTING USED IF MODEW = 0. WVU(I) SHOULD BE INPUT AS THE RECIPROCAL OF THE MAXIMUM CHANGE ALLOWED IN U(I) PER ITERATION

5.B. CONSTRAINT (DEPENDENT) VARIABLES

THE DEPENDENT VARIABLES CAN BE EITHER EQUALITY CONSTRAINTS OR INEQUALITY CONSTRAINTS BASED ON USER INPUT. ANY CALCULATED OUTPUT OR INDEPENDENT VARIABLE CAN BE USED AS A DEPENDENT VARIABLE AND AS MANY AS 25 CAN BE SPECIFIED.

THE INEQUALITY CONSTRAINTS MAY BE EITHER FUNCTIONAL OR SINGLE VALUED. THESE TWO TYPES OF CONSTRAINTS ARE EXPLAINED IN SECTIONS 6.A.7 AND 6.A.14 OF THIS REPORT.

ALL INPUTS ASSOCIATED WITH THE DEPENDENT VARIABLES ARE INPUT IN NAMELIST SEARCH. THE REQUIRED VARIABLES ARE AS FOLLOWS -

1) THE HOLLERITH NAME OF EACH DEPENDENT VARIABLE. INPUT IN THE ARRAY DEPVR(I), I=1,NDEPV.

2) THE PHASE NUMBER (EVENT) ASSOCIATED WITH EACH DEPENDENT VARIABLE - DEPPH(I), I=1,NDEPV. THE VARIABLE SPECIFIED BY DEPVR(I) WILL BE SATISFIED AT THE PLUS SIDE OF THE EVENT SPECIFIED BY DEPPH(I). IF DEPPH(I) IS GREATER THAN FESN, THE LAST PHASE IS ASSUMED.

3) THE DESIRED VALUE OF EACH DEPENDENT VARIABLE - DEPVAL(I), I=1,NDEPV.

4) THE DESIRED ACCURACY TOLERANCE WITHIN WHICH DEPVR(I) IS CONSIDERED TO BE SATISIFIED - DEPTL(I), I=1,NDEPV.

5) THE NUMBER OF DEPENDENT VARIABLES TO BE USED - NDEPV. THE FIRST NDEPV VARIABLES IN THE ARRAY DEPVR(I) WILL BE USED AS DEPENDENT VARIABLES.

6) THE TYPE OF CONSTRAINT FOR EACH DEPVR(I) - IDEPVR(I), I=1,NDEPV. THE FOLLOWING VALUES FOR IDEPVR(I) CAN BE SPECIFIED -

```
IDEPVR(I) =  0, IF DEPVR(I) IS TO BE AN EQUALITY
                CONSTRAINT
          =  1, IF DEPVR(I) IS TO BE AN INEQUALITY
                CONSTRAINT WITH AN UPPER BOUND
          = -1, IF DEPVR(I) IS TO BE AN INEQUALITY
                CONSTRAINT WITH A LOWER BOUND
```

5.B. CONSTRAINT (DEPENDENT) VARIABLES (CONTD)

OTHER INPUTS WHICH ARE NOT REQUIRED BUT WHICH MAY HELP THE TARGETING/OPTIMIZATION PROCESS ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
IFDEG(I) I=1,25	INTEGER	0	CONTROLS 360 - 0 DEGREE DISCONTINUITY IN DEPVR(I). FOR EXAMPLE, IF DEPVR(I) = 6HTPUAN , AND DEPVAL = 359.95, A DISCONTINUITY EXISTS NEAR THE DESIRED VALUE, AND IFDEG SHOULD BE USED. = 0, NO CORRECTION MADE. = 1, IF ABS(E(I)) IS GREATER THAN 180.0, SET E(I) = E(I) PLUS OR MINUS 180.0.
NPAD(1) NPAD(2)	INTEGER	10 5	THE LOWER AND UPPER BOUNDS ON THE DESIRED NUMBER OF DIGITS DIFFERENCE BETWEEN THE NOMINAL AND PERTURBED VALUES OF THE DEPENDENT VARIABLES WHEN COMPUTING THE SENSITIVITY MATRIX.

5.C. OPTIMIZATION VARIABLE

THE PROGRAM HAS THE CAPABILITY TO EITHER MINIMIZE OR MAXIMIZE A SPECIFIED VARIABLE WITH OR WITHOUT SATIFYING SPECIFIED CONSTRAINTS.

THE FOLLOWING INPUTS ARE REQUIRED TO DEFINE THE OPTIMIZATION VARIABLE. ALL VARIABLES ASSOCIATED WITH THE OPTIMIZATION PROCESS ARE INPUT IN NAMELIST SEARCH.

1) THE HOLLERITH NAME OF THE OPTIMIZATION VARIABLE. INPUT AS THE VARIABLE OPTVAR. ANY OF THE OUTPUT VARIABLES CAN BE USED AS AN OPTIMIZATION VARIABLE, PROVIDED IT IS SENSITIVE TO AT LEAST ONE OF THE INDEPENDENT VARIABLES.

2) TYPE OF OPTIMIZATION DESIRED - OPT. IF NO OPTIMIZATION IS DESIRED, INPUT OPT AS 0. IF THE VARIABLE DEFINED BY OPTVAR IS TO BE MINIMIZED, INPUT OPT = -1. IF OPTVAR IS TO BE MAXIMIZED, INPUT OPT = +1.

3) THE PHASE NUMBER (EVENT) ASSOCIATED WITH THE OPTIMIZATION VARIABLE - OPTPH. THE VARIABLE SPECIFIED BY OPTVAR WILL BE OPTIMIZED AT THE PLUS SIDE OF THE EVENT SPECIFIED BY OPTPH.

4) THE WEIGHTING FOR THE OPTIMIZATION VARIABLE - WOPT. WOPT SHOULD BE INPUT AS APPROXIMATELY 1 OVER THE ANTICIPATED VALUE OF OPTVAR.

5) THE DECIMAL PERCENTAGE CHANGE TO BE MADE IN THE CONTROL VARIABLES FOR THE INITIAL TRIAL STEP ON EACH ITERATION - PCTCC.

5.D. TARGETING/OPTIMIZATION ALGORITHMS

POST CONTAINS FOUR (4) TARGETING/OPTIMIZATION ALGORITHMS. THESE ALGORITHMS ARE DIRECT METHODS BASED UPON FIRST ORDER GRADIENT INFORMATION. THE PRINCIPLE DIFFERENCE BETWEEN THESE TECHNIQUES IS THAT THREE OF THESE ALGORITHMS ARE UNCONSTRAINED METHODS WHILE THE FOURTH IS A CONSTRAINED METHOD. EFFICIENT UTILIZATION OF THESE ALGORITHMS REQUIRES A BASIC UNDERSTANDING OF TARGETING/OPTIMIZATION CONCEPTS AND NOMENCLATURE, AND A COMPLETE UNDERSTANDING OF POST INPUT PROCEDURES. FOR CONVENIENCE, A BRIEF SUMMARY OF THE KEY CONCEPTS AND TERMINOLOGY IS REVIEWED BELOW.

OPTIMIZATION VARIABLE

THE VARIABLE TO BE OPTIMIZED (I.E., MAXIMIZED OR MINIMIZED) IS INPUT AS OPTVAR, AND IS CALCULATED ON THE POSITIVE SIDE OF THE EVENT SPECIFIED BY OPTPH. SINCE ALL ALGORITHMS IN POST ARE FORMULATED AS MINIMIZATION ROUTINES, OPTVAR IS TRANSFORMED INTERNALLY TO A NEW FUNCTION

P1 = - OPT*WOPT*OPTVAR,

WHERE WOPT SCALES OPTVAR, AND OPT FLAGS MAXIMIZATION OR MINIMIZATION. CLEARLY, IF OPT =+1 (MAXIMIZATION), THEN

MIN(P1) = MIN(-WOPT*OPTVAR) = WOPT*MAX(OPTVAR),

AND IF OPT =-1 (MINIMIZATION) , THEN

MIN(P1) = MIN(+WOPT*OPTVAR) = WOPT*MIN(OPTVAR).

CONSTRAINTS

THE PROBLEM CONSTRAINTS ARE INPUT BY DEFINING THE NUMBER OF CONSTRAINTS (NDEPV), THEIR HOLLERITH NAMES (DEPVR), THE EVENTS AT WHICH THEY ARE CALCULATED (DEPPH), THEIR DESIRED VALUES (DEPVAL), THEIR TOLERANCES (DEPTL), AND THE TYPE OF CONSTRAINT (IDEPVR).

THE ACTUAL ERROR IN THE J-TH CONSTRAINT IS

E(J) = DEPVR(J) - DEPVAL(J),

AND THE WEIGHTED ERROR IS

WE(J) = (DEPVR(J) - DEPVAL(J))/ABS(DEPTL(J)) .

5.D. TARGETING/OPTIMIZATION ALGORITHMS (CONTD)

THE J-TH CONSTRAINT IS SAID TO BE AN EQUALITY CONSTRAINT IF IT IS OF THE FORM

DEPVR(J) = DEPVAL(J),

AND IS SAID TO BE AN INEQUALITY CONSTRAINT IF IT IS OF THE FORM

DEPVR(J) LE DEPVAL(J), (UPPER BOUND)

OR

DEPVR(J) GE DEPVAL(J), (LOWER BOUND) .

TYPICALLY, TARGET CONDITIONS (E.G., ALTITUDE, VELOCITY, ETC.) ARE FORMULATED AS EQUALITY CONSTRAINTS, AND ENVIRONMENT CONDITIONS (DYNAMIC PRESSURE LIMITS, ETC.) ARE FORMULATED AS INEQUALITY CONSTRAINTS. ONE MISTAKE THAT IS FREQUENTLY MADE IS THE USE OF EQUALITY CONSTRAINTS WITH LARGE TOLERANCES INSTEAD OF INEQUALITY CONSTRAINTS WITH SMALL TOLERANCES. THIS PRACTICE TENDS TO CONFUSE THE TARGETING LOGIC AND HENCE WASTE COMPUTER TIME. ANOTHER COMMON ERROR WHICH HAS A SIMILAR EFFECT, IS AN ATTEMPT TO HELP THE TARGETING ROUTINE BY USING EXTREMELY LARGE TOLERANCES. THE BEST GUIDE TO THE SELECTION OF THE TYPES OF CONSTRAINTS AND THEIR ASSOCIATED TOLERANCES IS THAT THEY MAKE GOOD PHYSICAL SENSE.

THE J-TH INEQUALITY CONSTRAINT IS SAID TO BE

VIOLATED IF

WE(J) LE -1.0 ,

NOT VIOLATED IF

WE(J) GE +1.0,

TIGHT IF

-1.0 GE WE(J) LE +1.0,

AND ACTIVE IF

A) P2 LE 1.0,

AND

B) R(J) = I(SMAT*T(SMAT))SMAT*G1(J) GE -1.0E-06

WHERE I(*) AND T(*) DENOTE INVERSE AND TRANSPOSE, RESPECTIVELY.

CLEARY, THE SET OF ACTIVE CONSTRAINTS IS A SUBSET OF THE SET OF TIGHT CONSTRAINTS, SINCE IF

R(J) LT -1.E-06,

THEN THE J-TH CONSTRAINT CAN BE DROPPED ON THAT PARTICULAR ITERATION. THE COMPLETE SET OF ACTIVE CONSTRAINTS FOR AN ITERATION IS THE UNION OF ALL EQUALITY CONSTRAINTS (THEY ARE ALWAYS ACTIVE) AND THE SET OF ACTIVE INEQUALITIES. THE TOTAL NUMBER OF ACTIVE CONSTRAINTS IS OUTPUT AS NAC, AND THEIR INDICES BY THE ARRAY IAC(J).

CONSTRAINT PENALTY FUNCTION (P2)

THE PENALTY FUNCTION FOR THE VIOLATED CONSTRAINTS IS CALCULATED AS

```
P2 =  SUM ( WE(I)**2 ) .
      I=1,NAC
```

A SUFFICIENT CONDITION WHICH INSURES THAT THE CONSTRAINTS ARE SATISFIED WITHIN THE TOLERANCE SPECIFIED BY DEPTL(I) IS THAT

P2 LE 1.0 .

WHEN UNCONSTRAINED METHODS ARE USED THIS SECOND PENALTY FUNCTION IS RECOMPUTED INTERNALLY AS

```
P2 = P1 + WCON*SUM( WE(I)**2 ) ,
                I=1,NAC
```

WHERE THE PENALTY CONSTANT IS INPUT AS WCON. IT CAN BE SHOWN THAT FOR A SUFFICIENTLY LARGE WEIGHTING CONSTANT, THE MINIMUM OF P2 CORRESPONDS TO THE CONSTRAINED MINIMUM.

INDEPENDENT VARIABLES AND WEIGHTING

THE INDEPENDENT VARIABLES ARE INPUT BY DEFINING THEIR HOLLERITH NAMES (INDVR), AND THE EVENTS AT WHICH THEY ARE TO BE ACTIVATED (INDPH). IT IS THESE VARIABLES THAT ARE INTERNALLY

ADJUSTED BY THE SELECTED ALGORITHM IN ORDER TO OPTIMIZE OPTVAR AND SIMULTANEOUSLY SATISFY THE CONSTRAINT EQUATIONS. THE INDEPENDENT VARIABLES ARE INTERNALLY WEIGHTED TO INSURE PROPER OVERALL SCALING. THIS IS ACCOMPLISHED BY PREMULTIPLYING THE THE ACTUAL VARIABLES BY A DIAGONAL WEIGHTING MATRIX. IN TERMS OF OUTPUT VARIABLES, THE SCALED INDEPENDENT VARIABLES ARE GIVEN BY

```
WU(I) = WVU(I)*U(I) , I = 1,NINDV.
```

NOMINALLY, THE WEIGHTING MATRIX IS GIVEN BY

```
WVU(I) = 1.0/ABS(U(I)) ,  I = 1,NINDV,
```

WHERE U(I) IS THE INPUT VALUES OF THE INDEPENDENT VARIABLES.

AS A CONSEQUENCE OF THE WEIGHTING OF BOTH THE DEPENDENT AND THE INDEPENDENT VARIABLES, THE FUNCTIONAL RELATIONSHIPS USED TO DETERMINE THE INDEPENDENT VARIABLE CORRECTIONS ARE ALSO SCALED. THUS, THE ACTUAL FUNCTIONAL RELATIONS USED INTERNALLY ARE

```
P1     = P1( WU(1),...,WU(NINDV) ) ,

WE(I) = WE( WU(1),...,WU(NINDV) ) ,
```

AND

```
P2     = P2( WE(1),...,WE(NAC) ) .
```

SENSITIVITY CALCULATIONS

THE COMPLEXITY OF THESE FUNCTIONS REQUIRES THAT THEIR DERIVATIVES BE APPROXIMATED BY FIRST DIFFERENCES. THESE APPROXIMATIONS TO THE SENSITIVITIES ARE THEN PROCESSED BY THE OPTIMIZATION ALGORITHM ORDER TO SOLVE THE PROBLEM FORMULATED IN NAMELIST SEARCH. THE GRADIENTS OF P1 AND P2 ARE DENOTED BY G1(I) AND G2(I), RESPECTIVELY AND THE GRADIENT OF THE CONSTRAINT VECTOR IS DENOTED BY SMAT(I,J). THE DIFFERENCE FORMULAE USED TO APPROXIMATE THESE PARTIAL DERIVATIVES ARE

```
G1(J) = (P1(U(1),.,U(J)+PERT(J),.,U(M))-P1(U(1),.,U(M)))/PERT(J),

SMAT(I,J) = ( WEI(U +PERT(J)) - WEI(U) )/PERT(J),
```

AND

```
G2(J) = 2*SUM(WE(I)*SMAT(I,J)) , J=1,NINDV .
          I=1,NAC
```

NOTE THAT THE GRADIENT OF P2 IS COMPUTED FROM SMAT AND NOT BY DIFFERENCING P2 DIRECTLY. THE REASON FOR THIS IS THAT IT REDUCES THE ERROR IN G2(I) AT P2 EQ 0.0.

THE UNSCALED GRADIENTS CAN BE COMPUTED FROM

```
GRAD(OPTVAR) = - WVU(I)*G1(I)/WOPT*OPT,
```

AND

```
GRAD(DEPVR(I)) = DEPTL(I)*WVU(J)*SMAT(I,J)
```

ESTIMATED NET COST FUNCTION

WHEN THE PROJECTED GRADIENT METHOD IS USED (I.E., SRCHM=4) AN ADDITIONAL PENALTY FUNCTION CAN BE DEFINED WHICH INCLUDES THE EFFECTS OF CONSTRAINT VIOLATION WITHOUT THE INTRODUCTION OF AN ARBITRARY WEIGHTING CONSTANT. THIS PENALTY FUNCTION IS CALLED THE ESTIMATED NET COST FUNCTION, AND IS COMPUTED AS

```
P1NET = P1 - T(G1)T(SMAT)*I(SMAT*T(SMAT))WE .
```

THE FIRST TERM THE P1NET IS THE ACTUAL WEIGHTED COST FUNCTION. THE SECOND TERM IS A LINEARIZED APPROXIMATION TO THE CHANGE IN P1 RESULTING FROM A MINIMUM NORM CORRECTION BACK TO THE SET OF ACTIVE CONSTRAINTS. THE SECOND TERM REPRESENTS THE INDUCED COST ASSOCIATED WITH THE CONSTRAINT VIOLATION WHICH RESULTS FROM DETERMINING THE DIRECTION OF SEARCH FROM A LINEARIZED APPROXIMATION TO THE NONLINEAR CONSTRAINTS. THE TERM ESTIMATED IS USED IN DESCRIBING P1NET BECAUSE THE SENSITIVITY MATRIX IS NOT RECOMPUTED AS A FUNCTION OF THE STEPSIZE TAKEN IN THE SEARCH DIRECTION.

DIRECTION OF SEARCH

THE FINAL KEY CONCEPT IS THE IDEA OF A DIRECTION OF SEARCH. HEURISTICALLY, THE DIRECTION OF SEARCH IS NOTHING MORE THAN A PARTICULAR LINE IN THE INDEPENDENT VARIABLE SPACE ALONG WHICH THE CONSTRAINT ERROR IS REDUCED, OR THE COST FUNCTION IS DECREASED.

5.D. TARGETING/OPTIMIZATION ALGORITHMS (CONTD)

IN A MORE PRECISE SENSE, THE DIRECTION OF SEARCH AT U(I) IS A HALF-RAY EMANATING FROM U(I). THUS, FOR ANY POSITIVE SCALAR, GAMAST, THE EQUATION

```
U(I) = U(I) + GAMAST*DU(I) , I = 1,NINDV
```

SETS THE LIMITS OF THIS HALF-RAY AND REPRESENTS MOVEMENT IN THE DIRECTION DU(I), FROM U(I).

THE VARIOUS MATHEMATICAL TECHNIQUES USED IN POST TO DETERMINE THE DIRECTION OF SEARCH ARE BASED UPON G1(I), SMAT(I,J), AND G2(I). THESE TECHNIQUES, WHICH ARE DISCUSSED IN DETAIL IN THE FORMULATION MANUAL, ARE SUMMARIZED ACCORDING TO THE SRCHM FLAG. IN ORDER TO SIMPLIFY THE NOTATION, THE ROW/COLUMN SUBSCRIPTS ARE REPLACED BY THE SUBSRIPT N, WHERE N DENOTES THE N-TH ELEMENT OF THE ITERATION SEQUENCE.

DIRECTION OF SEARCH EQUATIONS

```
SRCHM = 1, ( THE STEEPEST DESCENT METHOD APPLIED TO P2  )

 S(N) = - G2(N)

SRCHM = 2, ( THE CONJUGATE GRADIENT METHOD APPIED TO P2 )

 S(N) = - G2(N), IF N=0, OTHERWISE
 S(N) = - G2(N) + ( T(G2(N))G2(N)/T(G2(N-1))G2(N-1) )*G2(N-1)

SRCHM = 3, ( THE DAVIDON METHOD APPLIED TO P2 )

 S(N) = -G2(N), IF N=0, OTHERWISE
 S(N) = -H(N)G2(N), WHERE
 H(N) = H(N-1) + A(N) + B(N)
 D(N) = U(N) - U(N-1)
 G(N) = G2(N) - G2(N-1)
 A(N) = D(N)T(D(N))/T(D(N))G(N)
 B(N) = -H(N-1)G(N)T(H(N-1)G(N))/T(G(N))H(N-1)G(N)

SRCHM = 4, ( THE ACCELERATED PROJECTED GRADIENT METHOD )

  A) MINIMUM NORM CONSTRAINT CORRECTION

 S(N) = - T(SMAT)I(SMAT*T(SMAT))WE(N)
```

B) PROJECTED GRADIENT DIRECTION

```
 P(N) = I - T(SMAT)*I(SMAT*T(SMAT))*SMAT
PG(N) = P(N)G1(N)
 S(N) = -PG(N) , IF N=0 , OTHERWISE
 S(N) = -H(N)PG(N),
 H(N) = H(N-1) + A(N) + B(N), AS IN DAVIDONS METHOD
```

A UNIT VECTOR, DU(N), IN THE DIRECTION, S(N), IS THEN CALCULATED FROM THE EQUATION

```
DU(N)= S(N)/T(S(N))S(N).
```

AFTER DU(I) IS DETERMINED, THE MAGNITUDE OF THE CORRECTION TAKEN IN THAT DIRECTION IS CALCULATED BY MINIMIZING EITHER P1NET OR P2. THE RESULTS OF THESE ONE-DIMENSIONAL MINIMIZATIONS ARE INCLUDED IN THE ITERATION SUMMARY.

ONE DIMENSIONAL MINIMIZATION

THE MONOVARIANT MINIMIZATION IS PERFORMED EXCLUSIVELY BY POLYNOMIAL INTERPOLATION. FIRST THE ACTUAL FUNCTION, F, TO BE MINIMIZED IS APPROXIMATED BY ONE OR MORE QUADRATIC OR CUBIC POLYNOMIALS UNTIL A SUFFICIENTLY ACCURATE CURVEFIT, P, IS OBTAINED, THAT IS

```
P(GAMA)  =   SUM ( A(I)* GAMA**I )  =  F(GAMA)
             I=0,N
```

FOR ALL GAMA OF INTEREST. THEN THE INDEPENDENT VARIABLE VALUE, GAMA MINIMIZING F IS APPROXIMATED BY THE VALUE GAMAST MINIMIZING P(GAMA).

THE MINIMIZATION ROUTINE (GENMIN) MAKES USE OF ALL THE INFORMATION IT ACCUMULATES ABOUT F TO OBTAIN A GOOD CURVEFIT. FIRST, F IS FIT WITH A QUADRATIC POLYNOMIAL, P1, BASED ON

1) F(0)
2) DFDS(0)
3) F(GAMA(1)), WHERE GAMA(1) IS AN INITIAL ESTIMATE OF THE GAMAST VALUE MINIMIZING F.

THE INDEPENDENT VARIABLE VALUE MINIMIZING THE QUADRATIC IS

```
GAMA(2) = -A(1)/(2*A(2)) .
```

IF ABS((GAMA(2)-GAMA(1))/GAMA(1)) LE CONSEX(I), THEN GAMAST IS TAKEN TO BE GAMA(2) AND THE MINIMIZATION PROCEDURE IS CONSIDERED COMPLETE. SIMILARLY, IF ABS((P1(GAMA(2))- F(GAMA(2)))/F(GAMA(2))) LT FITERR(I), GAMAST IS TAKEN EQUAL TO GAMA(2) AND THE PROCESS IS TERMINATED. OTHERWISE F IS FIT WITH A CUBIC POLYNOMIAL, P2, BASED ON

1) F(0)
2) DFDS(0)
3) F(GAMA(1))
4) F(GAMA(2))

THE INDEPENDENT VARIABLE VALUE GAMA(3) MINIMIZING THE CUBIC IS

GAMA(3) =(-A(2)+SQRT(A(2)**2-3A(1)*A(3)))/3.0*A(3).

IF ABS((GAMA(3)-GAMA(2))/GAMA(2)) LE CONSEX(I), THEN GAMAST IS TAKEN TO BE GAMA(3) AND THE MINIMIZATION IS STOPPED. SIMILARLY, IF ABS((P2(GAMA(3)-F(GAMA(3))/F(GAMA(3)))) LE FITERR(I), THEN GAMAST IS TAKEN EQUAL TO GAMA(3) AND THE PROCEDURE IS STOPPED. IF NONE OF THESE STOPPING CONDITIONS ARE MET, THE ACCUMULATED SET OF FUNCTION VALUES IS SEARCHED FOR A NONMONOTONIC SEQUENCE (I.E., UP-DOWN-UP SEQUENCE OF FUNCTION VALUES). IF THE MINIMUM HAS BEEN BRACKETED, THEN THE BRACKETING POINTS ARE ARRANGED IN THE ORDER OF ASCENDING ABSCISSA VALUES. THEN THE FIRST POINT WHOSE ORDINATE VALUE IS LESS THAN THAT OF THE FOLLOWING POINT IS SELECTED. FOR SIMPLICITY OF NOTATION, RELABEL THIS POINT (GAMA(2),F(GAMA(2)), THE PRECEDING POINT (GAMA(1),F(GAMA(1)), AND THE FOLLOWING POINT (GAMA(3),F(GAMA(3)). A QUADRATIC, P3, IS THEN FIT TO

1) F(GAMA(1)) , GAMA(1)
2) F(GAMA(2)) , GAMA(2)
3) F(GAMA(3)) , GAMA(3)

AGAIN THE INDEPENDENT VARIABLE VALUE, GAMA(4), MINIMIZING THE QUADRATIC IS

GAMA(4) = -A(1)/(2.0*A(2)).

SIMILARLY, IF ABS((GAMA(4)-GAMA(3))/GAMA(3)) LE CONSEX(I) OR IF ABS((P3(GAMA(4)-F(GAMA(4)))/F(GAMA(4))) LE FITERR(I), THEN GAMAST IS TAKEN TO BE GAMA(4) AND THE PROCESS IS TERMINATED. IF NEITHER OF THESE STOPPING CONDITIONS IS MET, THEN A FINAL CUBIC, P4, IS FIT TO

1) F(GAMA(1)) , GAMA(1)
2) F(GAMA(2)) , GAMA(2)
3) F(GAMA(3)) , GAMA(3)
4) F(GAMA(4)) , GAMA(4).

THE INDEPENDENT VARIABLE VALUE, GAMA(5), MINIMIZING THE CUBIC IS

GAMA(5) = (-A(2)+SQRT(A(2)**2-3A(1)*A(3))/3*A(3).

IF ABS((GAMA(5)-GAMA(4))/GAMA(4)) LE CONSEX(I) OR IF ABS(P4(GAMA(5))-F(GAMA(5))/F(GAMA(5))) LE FITERR(I), THEN GAMAST IS TAKEN TO BE GAMA(5). IF NONE OF THESE STOPPING CONDITIONS ARE SATISFIED, THE ACCUMULATED SET OF SAMPLE POINTS IS SEARCHED FOR THE POINT WITH MINIMUM ORDINATE VALUE. THE ABSCISSA VALUE OF THIS POINT IS TAKEN TO BE GAMAST, AND THE MINIMIZATION IS CONSIDERED COMPLETE.

THIS PROCEDURE MAY BE SUMMARIZED AS FOLLOWS

STEP 1.0 - APPROXIMATE F BY A QUADRATIC POLYNOMIAL BASED UPON F(0), DFDS(0), F(GAMA(1)).

STEP 2.0 - APPROXIMATE F BY A CUBIC POLYNOMIAL BASED UPON F(0), DFDS(0), F(GAMA(1)).

STEP 3.0 - APPROXIMATE F BY A QUADRATIC POLYNOMIAL BASED UPON F(GAMA(I)),F(GAMA(J)),F(GAMA(K)),WHERE I,J, AND K ARE DETERMINED TO BRACKET THE MINIMUM.

STEP 4.0 - APPROXIMATE F BY A CUBIC POLYNOMIAL BASED UPON F(GAMA(I)), F(GAMA(J)), F(GAMA(K), F(GAMA(4)) .

STEP 5.0 - DETERMINE THE MINIMUM ORDINATE VALUE BY DIRECTLY SEARCHING THE SET OF ACCUMULATED VALUES.

CONVERGENCE TESTS

THE FINAL CONSIDERATION IS THAT OF DETERMINING WHEN AND IF THE SOLUTION TO THE PROBLEM HAS BEEN COMPUTED. CONVERGENCE OR CONVERGENCE FAILURE IS DETECTED AUTOMATICALLY IN SUBROUTINE TEST AND DEPENDS CRITICALLY UPON THE TOLERANCES CONEPS(J). THE STORED VALUES FOR THESE TOLERANCES ARE SMALLER THAN GENERALLY REQUIRED. THUS, ADEQUATE CONVERGENCE MAY BE ACHIEVED BEFORE ALL OF THE CONVERGENCE TESTS ARE SATISFIED WITHIN THE TOLERANCES SPECIFIED IN

THE ARRAY CONEPS(J). THIS CAN BE DETERMINED FROM ANALYSIS OF THE ITERATION SUMMARY PRINTOUT BY MAKING A FEW SIMPLE CHECKS. THE CONSTRAINTS (EQUALITY AND INEQUALITY) ARE SATISFIED WITHIN THE INPUT TOLERANCES IF

P2 LE 1.0 .

THUS, ON TARGETING PROBLEMS IF P2 LE 1.0, THEN A SOLUTION HAS BEEN COMPUTED. NOTE THAT THIS CONDITION IS SUFFICIENT BUT NOT NECESSARY, SINCE IF P2 LE NAC THE CONSTRAINTS MAY BE SATISFIED. ON OPTIMIZATION PROBLEMS, THE FOLLOWING ADDITIONAL TESTS MUST BE MADE

A) CTHA GE CONEPS(1),

AND

B) R(J) GE 0.0, FOR ALL J = 1,NAC,

WHERE CTHA IS THE ANGLE BETWEEN THE COST GRADIENT AND THE PROJECTION OF THE COST GRADIENT ONTO THE INTERSECTION OF THE LINEARIZED ACTIVE CONSTRAINTS, AND R(J) ARE THE COEFFICIENTS OF THE EXPANSION OF THE COST GRADIENT IN TERMS OF THE INDIVIDUAL ACTIVE CONSTRAINT GRADIENTS. CONDITION B IS A MATHEMATICAL STATEMENT OF THE FACT THAT, AT THE OPTIMUM, NO FEASIBLE DIRECTION CAN HAVE AN ANGLE OF LESS THAN 90 DEGREES BETWEEN IT AND -G1(I).

IN ADDITION, POST ALSO CONTAINS SEVERAL ITERATION CREEP TESTS. THESE TESTS ARE DESIGNED TO PREVENT THE ITERATION FROM PROCEEDING WHEN NO PROGRESS IS BEING MADE. THESE TESTS ARE

A) ABS(UMAG-OLDU)/UMAG LE CONEPS(2)

B) ABS((P1NOM-OLDP1)/P1NOM) LE CONEPS(3)

C) ABS((P2NOM-OLDP2)/P2NOM) LE CONEPS(4)

D) ABS((G2MAG-OLDG2)/G2MAG) LE CONEPS(5)

IF ALL OF THESE CHECKS ARE SATISFIED ON TWO SUCCESSIVE ITERATIONS, THEN THE MESSAGE

*** NO CHANGE IN STATE DURING 2 CONSECUTIVE ITERATIONS

IS PRINTED AND THE ITERATION IS TERMINATED BECAUSE NONE OF THE PARAMETERS ARE CHANGING. IN GENERAL, THIS MEANS THAT THE PROGRAM HAS CONVERGED BUT NOT TO THE DESIRED SOLUTION. IF THIS MESSAGE APPEARS , THEN THE PROBLEM SET-UP SHOULD BE CHECKED BEFORE ADDITIONAL ITERATIONS ARE ATTEMPTED.

SUMMARY

BASED UPON THESE DEFINITIONS AND CONCEPTS, THE BASIC POST TARGETING AND OPTIMIZATION MACROLOGIC CAN BE OUTLINE AS FOLLOWS -

STEP 1.0 - READ IN THE INITIAL VALUES OF U(I).

STEP 2.0 - PROPAGATE THE NOMINAL TRAJECTORY AND CALCULATE P1, WE(I), AND P2.

STEP 3.0 - COMPUTE G1(I), SMAT(I,J), AND G2(I).

STEP 4.0 - COMPUTE THE DIRECTION OF SEARCH DU(I) BASED ON SRCHM.

STEP 5.0 - IF P2 GT 1.0, DETERMINE GAMAST SUCH THAT P2(U(I)+GAMAST*DU(I)) IS MINIMIZED, WHERE

0.0 GE GAMAST LE MIN(GAMAX,STPMAX).

STEP 6.0 - IF P2 LE 1.0, DETERMINE GAMAST SUCH THAT P1NET(U(I)+GAMAST*DU(I)) IS MINIMIZE, WHERE

0.0 GE GAMAST LE MIN(PCTCC*UMAG,STPMAX),

THEN A RETARGETING STEP IS TAKEN AS IN STEP 5.0 WITHOUT RECOMPUTING THE SENSITIVITY MATRIX.

STEP 7.0 - UPDATE THE INDEPENDENT VARIABLES

U(I) = U(I) + GAMAST*DU(I)

STEP 8.0 - TEST FOR CONVERGENCE. IF CONVERGED, THEN EXIT. IF NOT CONVERGED AND ITERATION COUNTER LE MAXITR, THEN RETURN TO STEP 2.0.

5.D. TARGETING/OPTIMIZATION ALGORITHMS (CONTD)

THERE ARE SEVERAL INPUT VARIABLES ASSOCIATED WITH THE TARGETING/OPTIMIZATION ALGORITHM. THESE VARIABLES ARE INPUT IN NAMELIST SEARCH AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CONEPS(1)	DEG	89.9	CONVERGENCE TOLERANCE ON THE ANGLE BETWEEN THE OPTIMIZATION VARIABLE GRADIENT AND ITS PROJECTION ONTO THE PLANE TANGENT TO THE INTER-SECTION OF THE CONSTRAINT (DEPENDENT VARIABLE) SURFACES. IF CTHA IS GREATER THAN OR EQUAL TO CONEPS(1), THE VARIABLE IS OPTIMIZED FOR THE GIVEN CONTROL PARAMETERS.
CONEPS(2)	N/D	0.10	THE MINIMUM ALLOWABLE RELATIVE CHANGE IN THE MAGNITUDE OF THE CONTROL PARAMETERS BETWEEN SUCCESSIVE ITERATIONS.
CONEPS(3)	N/D	0.10	THE MINIMUM ALLOWABLE RELATIVE CHANGE IN P1 ON SUCCESSIVE ITERATIONS.
CONEPS(4)	N/D	0.10	THE MINIMUM ALLOWABLE RELATIVE CHANGE IN P2 ON SUCCESSIVE ITERATIONS.
CONEPS(5)	N/D	0.10	THE MINIMUM RELATIVE CHANGE IN THE VALUES OF G2MAG ON SUCCESSIVE ITERATIONS.
CONSEX(1)	DECIMAL	1.0E-6	RELATIVE DIFFERENCE BETWEEN TWO CONSECUTIVE OPTIMIZATION TRIAL STEPS BEFORE CURVE FIT PROCESS IS TERMINATED. IF ABS((GAMA(I)-GAMA(I-1))/GAMA(I)) IS LESS THAN CONSEX(1), THEN NO MORE TRIAL STEPS ARE TAKEN TO MINIMIZE P1.

5.D. TARGETING/OPTIMIZATION ALGORITHMS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CONSEX(2)	DECIMAL	.001	RELATIVE DIFFERENCE BETWEEN TWO CONSECUTIVE TARGETING TRIAL STEPS BEFORE CURVE FIT PROCESS IS TERMINATED. IF ABS((GAMA(I)-GAMA(I-1))/GAMA(I)) IS LESS THAN CONSEX(2), THEN NO MORE TRIAL STEPS ARE TAKEN TO MINIMIZE P2.
FITERR(1)	DECIMAL	1.0E-6	RELATIVE DIFFERENCE BETWEEN TWO CONSECUTIVE OPTIMIZATION TRIAL VALUES BEFORE CURVE FIT PROCESS IS TERMINATED. IF ABS((P1TRY(I)-P1TRY(I-1))/P1TRY(I) IS LESS THAN FITERR(1), THEN NO MORE TRIAL STEPS ARE TAKEN TO MINIMIZE P1.
FITERR(2)	DECIMAL	.001	RELATIVE DIFFERENCE BETWEEN TWO CONSECUTIVE TARGETING TRIAL VALUES BEFORE CURVE FIT PROCESS IS TERMINATED. IF ABS((P2TRY(I)-P2TRY(I-1))/P2TRY(I) IS LESS THAN FITERR(2), THEN NO MORE TRIAL STEPS ARE TAKEN TO MINIMIZE P2.
MAXITR	INTEGER	10	MAXIMUM NUMBER OF ITERATIONS DURING SEARCH/OPTIMIZATION. IF MAXITR IS INPUT AS ZERO AND SRCHM AS NONZERO, THEN A SINGLE TRAJECTORY WILL BE RUN USING THE INPUT U(I) VALUES FOR THE VARIABLES SPECIFIED BY INDVR(I).

5.D. TARGETING/OPTIMIZATION ALGORITHMS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
P2MIN	DECIMAL	1.0	THE PROBLEM IS CONSIDERED TARGETED IF P2 (THE MAGNITUDE OF THE ERROR VECTOR E(I)) IS LESS THAN P2MIN. HENCE IF OPT = 0.0, AND P2 IS LESS THAN P2MIN, THE PROBLEM IS SOLVED AND THE SEARCH IS TERMINATED. NOTE THAT NO OPTIMIZATION IS ATTEMPTED UNLESS P2 IS LESS THAN P2MIN. IT SHOULD BE NOTED THAT ALL DEPENDENT VARIABLES WILL BE WITHIN THE SPECIFIED TOLERENCES WHEN P2 IS LESS THAN 1.0. THEREFORE, P2MIN SHOULD GENERALLY INPUT EQUAL TO 1.0, EXCEPT FOR UNCONSTRAINED OPTIMIZATION TYPE PROBLEMS, IN WHICH CASE IT SHOULD BE INPUT LESS THAN THE ESTIMATED MINIMUM OF THE VARIABLE SPECIFIED BY OPTVAR.
SRCHM	INTEGER	0	CONTROLS THE TECHNIQUE USED FOR SEARCH/OPTIMIZATION. = 0, NO SEARCH/OPTIMIZATION. IGNORE ALL SEARCH/OPTIMIZATON INPUT. = 1, USE STEEPEST DESCENT METHOD TO MINIMIZE P2. = 2, USE CONJUGATE GRADIENT METHOD TO MINIMIZE P2. = 3, USE DAVIDON METHOD TO MINIMIZE P2. = 4, USE PROJECTED GRADIENT METHOD TO MINIMIZE P2. IF OPT IS NON-ZERO, OPTVAR WILL BE OPTIMIZED SUBJECT TO P2 LESS THAN P2MIN. THIS TECHNIQUE SHOULD BE USED FOR ALL SEARCH/OPTIMIZATION. = 5, USE ACCELERATED PROJECTED PROJECTED GRADIENT METHOD.

5.D. TARGETING/OPTIMIZATION ALGORITHMS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
STMINP	DECIMAL	.1	MAXIMUM RELATIVE CHANGE THAT A TRIAL STEP IS ALLOWED TO BE REDUCED BY BASED UPON THE CURVE FIT. ONLY VERY UNUSUAL PROBLEMS REQUIRE CHANGING THIS PARAMETER. SOMETIMES A QUADRATIC CURVE FIT MIGHT PREDICT A MINIMUM AT 1.0E-10 TIMES THE PREVIOUS STEP IF THE FUNCTION INCREASED TOO RAPIDLY ON THAT PREVIOUS STEP, WHEN IN FACT A STEP OF .1 TIMES THE PREVIOUS STEP WOULD PRODUCE A MUCH MORE REALISTIC VALUE.
STPMAX	DECIMAL	1.E10	MAXIMUM ABSOLUTED CHANGE ALLOWED IN MAGNITUDE OF WEIGHTED CONTROL VECTOR.
WCON	DECIMAL	100.0	WEIGHTING CONSTANT FOR P2 WHEN OPT IS NONZERO AND SRCHM IS NOT EQUAL TO FOUR. P2 IS SET EQUAL TO WOPT*P1 + WCON*P2. THEREFORE, TO MINIMIZE THE AUGMENTED P2 IS EQUIVALENT TO SIMULTANEOUSLY MINIMIZING P2 AND OPTIMIZING P1.

5.E. TARGETING/OPTIMIZATION OUTPUT

THE PROGRAM PRINTS VARIOUS AMOUNTS OF INFORMATION FOR EACH ITERARION BASED ON THE VALUE OF IDEB WHICH IS INPUT IN NAMELIST SEARCH. THE VARIOUS OPTIONS ASSOCIATED WITH IDEB ARE SUMMARIZED AS FOLLOWS -

IDEB = 0, PRINT ONLY THE ITERATION SUMMARIES. THAT IS, DO NOT PRINT THE TRIAL STEP SUMMARIES.

IDEB = 1, PRINT THE CENTRAL PROCESSOR (CP) TIME REQUIRED FOR EACH TRAJECTORY, THE TRIAL STEP SUMMARIES, AND THE ITERATION SUMMARIES.

THE TRIAL STEP SUMMARIES CONTAIN THE FOLLOWING PARAMETERS -

*** TRIAL STEP
GAMAS
DU
WU(I)
INDVR
INDPH
U(I)
WE(I)
DEPVR
DEPPH
E(I)
P1
OPTVAR
OPTPH
OPTVL
P2

THE ITERATION SUMMARIES CONTAIN THE FOLLOWING PARAMETERS -

*** ITERATION NUMBER I

CP/ITR
DU
PERT
SMAT
G1(I)
G1MAG
G2(I)
G2MAG

5.E. TARGETING/OPTIMIZATION OUTPUT (CONTD)

PG1(I)	
PG1MAG	
NAC	
IAC	
CTHA	(OBTAINED ONLY ON OPTIMIZATION STEPS)
DP1DS	
DP2DS	
STPMAX	
UMAG	
DUMAG	
PCTCC	(OBTAINED ONLY ON OPTIMIZATION STEPS)
STEP	
P1TRY	
P2TRY	
YES	
INDVR	
INDPH	
U(I)	
WE(I)	
DEPVR	
DEPPH	
E(I)	
P1	
OPTVAR	
OPTPH	
OPTVL	
P2	
DFDC	(OBTAINED ONLY ON THE LAST ITERATION)

OUTPUT SYMBOL	UNITS	DEFINITION
CP/ITR	SEC	THE AMOUNT OF CENTRAL PROCESSOR (CP) TIME REQUIRED FOR THE CURRENT ITERATION.
CTHA	DEG	THE ANGLE BETWEEN THE UNCONSTRAINED GRADIENT AND THE PROJECTED GRADIENT FOR P1. THIS ANGLE GOES TO 90 DEG AS P1 IS OPTIMIZED.

5.E. TARGETING/OPTIMIZATION OUTPUT (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
DFDC(I) I=1,25	OPTVAR/ DEPVR(I)	THE PARTIALS OF THE PERFORMANCE INDEX (OPTVAR) WITH RESPECT TO THE ACTIVE CONSTRAINTS.
DP1DS DP2DS	N/D	THE TOTAL DERIVATIVES OF P1 AND P2 WITH RESPECT TO THE STEPSIZE PARAMETER (GAMAS).
DU(I) I=1,25	N/D INDVR(I)	A UNIT VECTOR IN THE DIRECTION OF SEARCH. OBTAINED ONLY IF IDEB = 1.
E(I) I=1,25	SAME AS DEPVR(I)	THE TARGET ERRORS (ACTUAL - DESIRED).
G1(I) I=1,25	N/D	THE WEIGHTED GRADIENT COMPONENTS FOR P1.
G1MAG	N/D	THE MAGNITUDE OF THE WEIGHTED GRADIENT OF P1.
G2(I) I=1,25	N/D	THE WEIGHTED GRADIENT COMPONENTS FOR P2.
G2MAG	N/D	THE MAGNITUDE OF THE WEIGHTED GRADIENT OF P2.
IAC(I) I=1,25	INTEGER	THE INDICES OF THE ACTIVE CONSTRAINTS.
NAC	INTEGER	THE NUMBER OF ACTIVE CONSTRAINTS.
OPTVL	SAME AS VARIABLE IN OPTVAR	THE VALUE OF THE OPTIMIZATION VARIABLE.
PCTCC	N/D	THE MAXIMUM STEPSIZE ALLOWED FOR OPTIMIZATION.
PERT(I) I=1,25	SAME AS INDVR(I)	THE PERTURBATIONS IN THE CONTROL PARAMETERS USED TO GENERATE THE SENSITIVITY MATRIX (SMAT) BY MEANS OF FIRST DIFFERENCES.

5.E. TARGETING/OPTIMIZATION OUTPUT (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
PG1(I) I=1,25	N/D	THE WEIGHTED PROJECTED GRADIENT COMPONENTS P1.
PG1MAG	N/D	THE MAGNITUDE OF THE WEIGHTED PROJECTED GRADIENT OF P1.
P1	N/D	THE VALUE OF THE WEIGHTED OPTIMIZATION PENALTY FUNCTION.
P1TRY(I) P2TRY(I) I=1,6	N/D	THE VALUES OF P1 AND P2 FOR EACH TRIAL STEP.
P2	N/D	THE VALUE OF THE TARGETING PENALTY FUNCTION (WEIGHTED). THE PROBLEM IS WITHIN THE USER SPECIFIED TOLERANCES IF P2 IS LESS THAN 1.
RATIO(I) I=1,4	N/D	THE DECIMAL PERCENTAGE CHANGE IN UMAG, P1, P2, AND GMAG, RESPECTIVELY, SINCE THE LAST ITERATION.
SMAT(I,J) I=1,25 J=1,25	DEPVR(I)/ INDVR(J)	THE ELEMENTS OF THE SENSITIVITY MATRIX FOR EACH TARGET (DEPENDENT) VARIABLE.
STEP(I) I=1,6	N/D	THE VALUE OF GAMAS FOR EACH TRIAL STEP.
STPMAX	N/D	THE MAXIMUM STEPSIZE ALLOWED FOR TARGETING.
U(I) I=1,25	SAME AS INDVR(I)	THE VALUES OF THE CONTROL PARAMETERS.
UMAG	N/D	THE MAGNITUDE OF THE WEIGHTED CONTROL PARAMETER VECTOR (WU(I),I=1,NINDV).
WE(I) I=1,25	N/D	THE WEIGHTED ERRORS. WE(I) IS EQUAL TO E(I) DIVIDED BY DEPTL(I).
YES(I) I=1,6	N/D	THE VALUE OF P1 (OR P2) OBTAINED FROM THE CURVE FIT ROUTINE FOR EACH TRIAL STEP.

6. TRAJECTORY SIMULATION INPUTS

THIS SECTION DESCRIBES THE TRAJECTORY SIMULATION INPUTS. THE PROGRAM HAS FOUR BASIC CATEGORIES OF INPUT WHICH DEFINE THE SPECIFIC COMPUTATIONAL OPTIONS, THE BASIC VEHICLE INPUTS, THE TYPE OF STEERING COMMANDS, AND THE TABLE DATA USED TO DEFINE TIME VARYING VEHICLE CHARACTERISTICS.

THESE CATAGORIES OF INPUT ARE CLASSIFIED AS (1) GENERAL SIMULATION OPTIONS, (2) METHODS OF GUIDANCE (STEERING), (3) TABLE MULTIPLIERS, AND (4) TABLE INPUT FORMAT.

6.A. GENERAL SIMULATION OPTIONS

THE SELECTION OF GENERAL SIMULATION OPTIONS IS ACCOMPLISHED BY THE USER ASSIGNING PARTICULAR VALUES TO THE PROGRAM CONTROL ARRAY, NPC(I). THE ELEMENTS OF THIS ARRAY ARE USED INTERNALLY TO SELECT THE APPROPRIATE CALCULATIONS FOR THE OPTIONS SELECTED. THUS, ALTHOUGH THE PROGRAM CONTAINS NUMEROUS OPTIONS, ANY USER WHO DOES NOT INTEND TO USE ALL OF THE PROGRAM CAPABILITIES IS NOT PENALIZED IN TERMS OF RUN TIME. THE INPUTS CORRESPONDING TO THE OPTIONS SELECTED VIA THE NPC ARRAY MUST BE SPECIFIED AS INPUT IN NAMELIST GENDAT UNLESS THE STORED VALUES ARE TO BE USED, IN WHICH CASE THE VARIABLES NEED NOT BE INPUT.

ALL CONSTANT VALUED INPUT ASSOCIATED WITH THE SIMULATION AND THE AUXILARY CALCULATION OPTIONS ARE PRESENTED IN THIS SECTION.

INPUTS ARE GENERALLY REQUIRED FOR THE FOLLOWING OPTIONS IN ORDER TO PRODUCE MEANINGFUL SIMULATIONS. THE SECTIONS FOR EACH OF THESE OPTIONS SHOULD BE REVIEWED TO SEE WHICH OPTIONS ARE REQUIRED AND THE INPUTS REQUIRED FOR THOSE OPTIONS.

1. AERODYNAMIC INPUTS
2. AEROHEATING CALCULATIONS
3. ATMOSPHERE MODEL/WINDS INPUTS
4. EVENT CRITERIA/PHASE DEFINITION INPUTS
5. GRAVITATIONAL INPUTS
6. METHODS OF GUIDANCE (STEERING)
7. INITIAL POSITION AND VELOCITY
8. NUMERICAL INTEGRATION METHODS
9. PROPULSION/THROTTLING INPUTS
10. VEHICLE/PROPELLANT WEIGHT INPUTS

ALL OPTIONS WHICH ARE NOT LISTED ABOVE SHOULD BE REVIEWED ONLY IF THEY ARE DESIRED. OTHERWISE THE INPUTS FOR THE ABOVE LIST ARE ALL THAT ARE REQUIRED TO PRODUCE MEANINGFUL SIMULATION FOR MOST PROBLEMS.

6.A.1. AERODYNAMIC INPUTS

THIS SECTION PRESENTS THE INPUT ASSOCIATED WITH THE AERODYNAMIC CHARACTERISTICS OF THE VEHICLE.

THE AERODYNAMIC FORCE COEFFICIENTS IN PITCH CAN OPTIONALLY BE INPUT AS AXIAL AND NORMAL FORCE COEFFICIENTS IF NPC(8)=1 OR AS LIFT AND DRAG FORCE COEFFICIENTS IF NPC(8)=2.

THE AERODYNAMIC MOMENTS CAN OPTIONALLY BE CALCULATED BASE ON DIFFERENT CENTER OF PRESSURE LOCATIONS FOR THE AXIAL, SIDE, AND NORMAL FORCES. THIS OPTION IS OBTAINED WHEN THE FLAG IAEROM IS INPUT EQUAL TO 1 IN NAMELIST GENDAT. THE AERODYNAMIC MOMENTS FOR THIS OPTION ARE COMPUTED AS FOLLOWS -

```
AMXB = QSREF*DREFR*CLL + FAZB*(CPNYR-YCG) + FAYB*(CPYZR-ZCG)
AMYB = QSREF*DREFP*CM  - FAXB*(CPAZR-ZCG) + FAZB*(CPNXR-XCG)
AMZB = QSREF*DREFY*CW  - FAYB*(CPYXR-XCG) - FAXB*(CPAYR-YCG)

WHERE - CPNYR = GENTAB(CPNYRT)
        CPYZR = GENTAB(CPYZRT)
        CPYXR = GENTAB(CPYXRT)
        CPAYR = GENTAB(CPAYRT)
        CPNXR = GENTAB(CPNXRT)
        CPAZR = GENTAB(CPAZRT)
```

THE FOLLOWING RELATIONSHIPS APPLY WHEN THERE IS A SINGLE CENTER OF PRESSURE FOR ALL FORCES -

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CPAYRT = YREFT, CPAZRT = ZREFT,
CPNXRT = XREFT, CPNYRT = YREFT,
CPYXRT = XREFT, CPYZRT = ZREFT,
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ALL OF THE AERODYNAMIC COEFFICIENTS ARE INPUT AS TABLES IN NAMELIST TAB.

ALL CONSTANT INPUT VARIABLES FOR THE AERODYNAMIC OPTIONS ARE INPUT IN NAMELIST GENDAT. THESE VARIABLES ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(8)	INTEGER	1	AERODYNAMIC COEFFICIENT FLAG. = 0, NO AERODYNAMIC COEFFICIENTS. = 1, INPUT TABLES OF AXIAL FORCE AND NORMAL FORCE COEFFICIENTS. = 2, INPUT TABLES OF DRAG FORCE AND LIFT FORCE COEFFICIENTS. = 4, SAME AS OPTION NPC(8)=2, EXCEPT THAT VISCOUS AERO CORRECTIONS ARE ADDED TO CL AND CD.

6.A.1. AERODYNAMIC INPUTS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
AEXP	N/D	.64	AXIAL EXPONENT. USED IN CALCULATION OF VISCOUS CORRECTIONS IF NPC(8)=4.
CINF	N/D	1.0	CHAPMAN-RUBESIN VISCOSITY COEFFICIENT. USED IF NPC(8)=4.
DREFP DREFP DREFY	FT (M)	0.0	THE AERODYNAMIC REFERENCE DIAMETER FOR ROLL, PITCH AND YAW, RESPECTIVELY. USED TO CALCULATE THE AERODYNAMIC MOMENTS IN ROLL, PITCH AND YAW, RESPECTIVELY.
IAEROM	INTEGER	0	FLAG CONTROLLING THE CALCULATIONS OF AERODYNAMIC MOMENTS. = 0, USE XREFT, YREFT, AND ZREFT. = 1, USE CPRYRT, CPRZRT, CPPXRT, CPPYRT, CPYXRT, AND CPYZRT.
LREF	FT (M)	0.	REFERENCE LENGTH USED IN THE CALCULATION OF REYNOLDS NUMBER.
SREF	FT**2 (M2)	0.	THE AERODYNAMIC REFERENCE AREA USED TO COMPUTE THE AERODYNAMIC FORCES WHEN NPC(8)=1,2.
VINFI	N/D	.007	INVISCID VALUE OF RAREFACTION PARAMETER. USED IF NPC(8)=4.

ALL AERODYNAMIC COEFFICIENTS CAN BE INPUT AS CONSTANT, MONOVARIANT, BIVARIANT, OR TRIVARIANT TABLES. THIS CAPABILITY COUPLED WITH THE MNEMONIC MULTIPLIERS GIVES THE USER A GREAT DEAL OF FLEXIBILITY CONCERNING HOW THE AERODYNAMIC COEFFICIENTS ARE TO BE INPUT. THE COEFFICIENTS CAN BE INPUT DIRECTLY AS COEFFICIENTS OR AS COEFFICIENT SLOPES. THIS IS ACCOMPLISHED BY USE OF THE MNEMONIC MULTIPLIER FOR A GIVEN TABLE.

6.A.1. AERODYNAMIC INPUTS (CONTD)

THE MNEMONIC MULTIPLIER IS INPUT AS THE NAME OF ANY COMPUTED VARIABLE IN THE OUTPUT VARIABLE LIST. THE COEFFICIENT FOR A GIVEN TABLE IS THEN THE TABLE LOOK-UP VALUE FOR THAT TABLE MULTIPLIED BY THE VALUE OF THE VARIABLE DEFINED AS THE MNEMONIC MULTIPLIER. ANY MNEMONIC MULTIPLIER WHICH IS INPUT AS 3HONE, IS DEFINED TO BE 1.0 WITHIN THE PROGRAM. THE TABLES FOR THE ZERO ALPHA AND BETA CONDITIONS DO NOT HAVE MNEMONIC MULTIPLIERS.

THE MNEMONIC MULTIPLIERS ARE INPUT IN NAMELIST TBLMLT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CADANM	HOLLERITH	DELA	THE MNEMONIC MULTIPLIERS FOR THE
CADENM		DELE	CADAT, CADET AND CADRT TABLES.
CADRNM		DELR	
CAFIN I=1,3	HOLLERITH	DELFI	THE MNEMONIC MULTIPLIER FOR TABLE CAFIT.
CANM	HOLLERITH	ONE	THE MNEMONIC MULTIPLIER FOR TABLE CAT.
CDDANM	HOLLERITH	DELA	THE MNEMONIC MULTIPLIERS FOR THE
CDDENM		DELE	CDDAT, CDDET AND CDDRT TABLES.
CDDRNM		DELR	
CDFIN I=1,3	HOLLERITH	DELFI	THE MNEMONIC MULTIPLIER FOR TABLE CDFIT.
CDNM	HOLLERITH	ONE	THE MNEMONIC MULTIPLIER FOR TABLE CDT.
CLDANM	HOLLERITH	DELA	THE MNEMONIC MULTIPLIERS FOR THE
CLDENM		DELE	CLDAT, CLDET AND CLDRT TABLES.
CLDRNM		DELR	
CLFIN I=1,3	HOLLERITH	DELFI	THE MNEMONIC MULTIPLIER FOR TABLE CLFIT.
CLLBNM	HOLLERITH	ONE	THE MNEMONIC MULTIPLIER FOR THE CLLBT TABLE.
CLLDAN	HOLLERITH	DELA	THE MNEMONIC MULTIPLIERS FOR THE
CLLDEN		DELE	CLLDAT, CLLDET AND CLLDRT TABLES.
CLLDRN		DELR	

6.A.1. AERODYNAMIC INPUTS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CLLFIN I=1,3	HOLLERITH	DELFI	THE MNEMONIC MULTIPLIER FOR TABLE CLLFIT.
CLLPNM	HOLLERITH	PND	THE MNEMONIC MULTIPLIER FOR TABLE CLLPT.
CLLRNM	HOLLERITH	RND	THE MNEMONIC MULTIPLIER FOR TABLE CLLRT.
CLNM	HOLLERITH	ONE	THE MNEMONIC MULTIPLIER FOR TABLE CLT.
CMANM	HOLLERITH	ONE	THE MNEMONIC MULTIPLIER FOR TABLE CMAT.
CMDANM CMDENM CMDRNM	HOLLERITH	DELA DELE DELR	THE MNEMONIC MULTIPLIERS FOR THE CMDAT, CMDET AND CMDRT TABLES.
CMFIN I=1,3	HOLLERITH	DELFI	THE MNEMONIC MULTIPLIER FOR TABLE CMFIT.
CMQNM	HOLLERITH	QND	THE MNEMONIC MULTIPLIER FOR TABLE CMQT.
CNANM	HOLLERITH	ONE	THE MNEMONIC MULTIPLIER FOR TABLE CNAT.
CNDANM CNDENM CNDRNM	HOLLERITH	DELA DELE DELR	THE MNEMONIC MULTIPLIERS FOR THE CNDAT, CNDET AND CNDRT TABLES.
CNFIN I=1,3	HOLLERITH	DELFI	THE MNEMONIC MULTIPLIER FOR TABLE CNFIT.
CWBNM	HOLLERITH	ONE	THE MNEMONIC MULTIPLIER FOR TABLE CWBT.
CWDANM CWDENM CWDRNM	HOLLERITH	DELA DELE DELR	THE MNEMONIC MULTIPLIERS FOR THE CWDAT, CWDET AND CWDRT TABLES.
CWFIN I=1,3	HOLLERITH	DELFI	THE MNEMONIC MULTIPLIER FOR TABLE CWFIT.

6.A.1. AERODYNAMIC INPUTS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CWPNM	HOLLERITH	PND	THE MNEMONIC MULTIPLIER FOR TABLE CWPT.
CWRNM	HOLLERITH	RND	THE MNEMONIC MULTIPLIER FOR TABLE CWRT.
CYBNM	HOLLERITH	ONE	THE MNEMONIC MULTIPLIER FOR TABLE CYBT.
CYDANM CYDENM CYDRNM	HOLLERITH	DELA DELE DELR	THE MNEMONIC MULTIPLIERS FOR THE CYDAT, CYDET AND CYDRT TABLES.
CYFIN I=1,3	HOLLERITH	DELFI	THE MNEMONIC MULTIPLIER FOR TABLE CYFIT.

THE TABLES FOR THE AERODYNAMICS MODULE ARE INPUT IN NAMELIST TAB AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CADAT CADET CADRT	N/D	0.0	AXIAL FORCE COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES. USED IF NPC(8)=1.
CAFIT I=1,3	N/D	0.0	THE AXIAL FORCE COEFFICIENT TABLE FOR FLAP I. USED IF NPC(8)=1.
CAIOT	N/D	0.	TABLE OF INVISCID AXIAL COEFFICIENT AT MAXIMUM L/D. USED IF NPC(8)=4.
CAOT	N/D	0.	AXIAL FORCE COEFFICIENT TABLE FOR ZERO ALPHA. USED IF NPC(8)=1.
CAT	N/D	0.	AXIAL FORCE COEFFICIENT TABLE. USED IF NPC(8)=1.

6.A.1. AERODYNAMIC INPUTS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CDDAT CDDET CDDRT	N/D	0.0	DRAG FORCE COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES. USED IF NPC(8)=2.
CDFIT I=1,3	N/D	0.0	THE DRAG FORCE COEFFICIENT FOR FLAP I. USED IF NPC(8)=2.
CDOT	N/D	0.	DRAG FORCE COEFFICIENT TABLE FOR ZERO ALPHA. USED IF NPC(8)=2.
CDT	N/D	0.	DRAG FORCE COEFFICIENT TABLE. USED IF NPC(8)=2.
CLDAT CLDET CLDRT	N/D	0.0	LIFT FORCE COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES. USED IF NPC(8)=2.
CLFIT I=1,3	N/D	0.0	THE LIFT FORCE COEFFICIENT FOR FLAP I. USED IF NPC(8)=2.
CLLBT	N/D	0.0	THE ROLLING MOMENT COEFFICIENT PER DEGREE BETA.
CLLDAT CLLDET CLLDRT	N/D	0.0	ROLLING MOMENT COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES.
CLLFIT I=1,3	N/D	0.0	THE ROLLING MOMENT COEFFICIENT FOR FLAP I.
CLLOT	N/D	0.0	THE ROLLING MOMENT COEFFICIENT FOR ZERO ALPHA AND BETA.
CLLPT	N/D	0.0	THE ROLLING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL ROLL RATE.

6.A.1. AERODYNAMIC INPUTS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CLLRT	N/D	0.0	THE ROLLING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL YAW RATE.
CLOT	N/D	0.	LIFT FORCE COEFFICIENT TABLE FOR ZERO ALPHA. USED IF NPC(8)=2.
CLT	N/D	0.	LIFT FORCE COEFFICIENT TABLE. USED IF NPC(8)=2.
CMAT	N/D	0.0	THE PITCHING MOMENT COEFFICIENT TABLE PER DEGREE ALPHA.
CMDAT CMDET CMDRT	N/D	0.0	PITCHING MOMENT COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES.
CMFIT I=1,3	N/D	0.0	THE PITCHING MOMENT COEFFICIENT TABLE FOR FLAP I.
CMOT	N/D	0.0	THE PITCHING MOMENT COEFFICIENT FOR ZERO ALPHA.
CMQT	N/D	0.0	THE PITCHING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL PITCH RATE.
CNAT	N/D	0.	NORMAL FORCE COEFFICIENT TABLE. THE NORMAL FORCE COEFFICIENT SLOPE CAN BE INPUT AS CNAT IF THE MNEMONIC MULTIPLIER CNANM = 5HALPHA, IS INPUT IN NAMELIST TBLMLT. USED IF NPC(8) =1.
CNDAT CNDET CNDRT	N/D	0.0	NORMAL FORCE COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES. USED IF NPC(8)=1.
CNFIT I=1,3	N/D	0.0	THE NORMAL FORCE COEFFICIENT TABLE FOR FLAP I. USED IF NPC(8)=1.
CNOT	N/D	0.	NORMAL FORCE COEFFICIENT TABLE FOR ZERO ALPHA. USED IF NPC(8)=1.

6.A.1. AERODYNAMIC INPUTS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CPAYRT	FT (M)	0.0	THE LOCATION OF THE AXIAL FORCE CENTER OF PRESSURE ALONG THE YR AXIS.
CPAZRT	FT (M)	0.0	THE LOCATION OF THE AXIAL FORCE CENTER OF PRESSURE ALONG THE ZR AXIS.
CPNXRT	FT (M)	0.0	THE LOCATION OF THE NORMAL FORCE CENTER OF PRESSURE ALONG THE XR AXIS.
CPNYRT	FT (M)	0.0	THE LOCATION OF THE NORMAL FORCE CENTER OF PRESSURE ALONG THE YR AXIS.
CPYXRT	FT (M)	0.0	THE LOCATION OF THE SIDE FORCE CENTER OF PRESSURE ALONG THE XR AXIS.
CPYZRT	FT (M)	0.0	THE LOCATION OF THE SIDE FORCE CENTER OF PRESSURE ALONG THE ZR AXIS.
CWBT	N/D	0.0	THE YAWING MOMENT COEFFICIENT TABLE PER DEGREE BETA.
CWDAT CWDET CWDRT	N/D	0.0	YAWING MOMENT COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES.
CWFIT I=1,3	N/D	0.0	THE YAWING MOMENT COEFFICIENT FOR FLAP I.
CWOT	N/D	0.0	THE YAWING MOMENT COEFFICIENT FOR ZERO BETA.
CWPT	N/D	0.0	THE YAWING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL ROLL RATE.
CWRT	N/D	0.0	THE YAWING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL YAW RATE.
CYBT	N/D	0.	SIDE FORCE COEFFICIENT TABLE. THE SIDE FORCE COEFFICIENT SLOPE CAN BE INPUT AS CYBT IF THE MNEMONIC MULTIPLIER CYBNM = 4HBETA, IS INPUT IN NAMELIST TBLMLT.

6.A.1. AERODYNAMIC INPUTS (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION	
CYDAT CYDET CYDRT	N/D	0.0	SIDE FORCE COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES.
CYFIT I=1,3	N/D	0.0	THE SIDE FORCE COEFFICIENT FOR FLAP I.
CYOT	N/D	0.	SIDE FORCE COEFFICIENT TABLE FOR ZERO BETA.
XREFT YREFT ZREFT	FT (M)	0.	TABLES OF THE AERODYNAMIC REFERENCE LOCATION ALONG THE XBR, YBR, AND ZBR AXES, RESPECTIVELY.
ZLALPT	DEG	0.	ZERO-LIFT ANGLE OF ATTACK TABLE. USED IF NPC(8)=4.

THE OUTPUTS ASSOCIATED WITH THE AERODYNAMIC CALCULATIONS ARE AS FOLLOWS -

AMXB AMYB AMZB	FT-LBS (N-M)	THE TOTAL AERODYNAMIC MOMENTS ABOUT THE VEHICLE ROLL, PITCH AND YAW BODY AXES.
CA CY CN	N/D	AERODYNAMIC AXIAL, SIDE, AND NORMAL FORCE COEFFICIENTS. CALCULATED IF NPC(8)=1,2.
CAA	N/D	TABLE LOOK-UP OF CAT TIMES CANM.
CADA CADE CADR	N/D	THE AXIAL FORCE COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.
CAFI I=1,3	N/D	THE AXIAL FORCE COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CAO	N/D	TABLE LOOK-UP OF CAOT.
CD CL	N/D	AERODYNAMIC DRAG AND LIFT FORCE COEFFICIENTS. CALCULATED IF NPC(8)=2.
CDA	N/D	TABLE LOOK-UP OF CDT TIMES CDNM.
CDDA CDDE CDDR	N/D	THE DRAG FORCE COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.

6.A.1. AERODYNAMIC INPUTS (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
CDFI I=1,3	N/D	THE DRAG FORCE COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CDO	N/D	TABLE LOOK-UP OF CDOT.
CLA	N/D	TABLE LOOK-UP OF CLT TIMES CLNM.
CLDA CLDE CLDR	N/D	THE LIFT FORCE COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.
CLFI I=1,3	N/D	THE LIFT FORCE COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CLL CM CW	N/D	THE AERODYNAMIC ROLLING, PITCHING AND YAWING MOMENT COEFFICIENTS, RESPECTIVELY.
CLLB	N/D	TABLE LOOK-UP OF CLLBT TIMES CLLBNM.
CLLDA CLLDE CLLDR	N/D	THE ROLLING MOMENT COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.
CLLFI I=1,3	N/D	THE ROLLING MOMENT COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CLLO	N/D	TABLE LOOK-UP OF CLLOT.
CLLP	N/D	THE ROLLING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL ROLL RATE.
CLLR	N/D	THE ROLLING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL YAW RATE.
CLO	N/D	TABLE LOOK-UP OF CLOT.
CMA	N/D	TABLE LOOK-UP OF CMAT TIMES CMANM.
CMDA CMDE CMDR	N/D	THE PITCHING MOMENT COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.

6.A.1. AERODYNAMIC INPUTS (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
CMFI I=1,3	N/D	THE PITCHING MOMENT COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CMO	N/D	TABLE LOOK-UP OF CMOT.
CMQ	N/D	THE PITCHING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL PITCH RATE.
CNA	N/D	TABLE LOOK-UP OF CNAT TIMES CNANM.
CNFI I=1,3	N/D	THE NORMAL FORCE COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CNDA CNDE CNDR	N/D	THE NORMAL FORCE COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.
CNFI I=1,3	N/D	THE NORMAL FORCE COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CNO	N/D	TABLE LOOK-UP OF CNOT.
CPAYR	FT (M)	THE TABLE LOOK-UP OF TABLE CPAYRT
CPAZR	FT (M)	THE TABLE LOOK-UP OF TABLE CPAZRT
CPNXR	FT (M)	THE TABLE LOOK-UP OF TABLE CPNXRT
CPNYR	FT (M)	THE TABLE LOOK-UP OF TABLE CPNYRT
CPYXR	FT (M)	THE TABLE LOOK-UP OF TABLE CPYXRT
CPYZR	FT (M)	THE TABLE LOOK-UP OF TABLE CPYZRT
CWB	N/D	TABLE LOOK-UP OF CWBT TIMES CWBNM.
CWDA CWDE CWDR	N/D	THE YAWING MOMENT COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.

6.A.1. AERODYNAMIC INPUTS (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
CWFI I=1,3	N/D	THE YAWING MOMENT COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CWO	N/D	TABLE LOOK-UP OF CWOT.
CWP	N/D	THE YAWING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL ROLL RATE.
CWR	N/D	THE YAWING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL YAW RATE.
CYB	N/D	TABLE LOOK-UP OF CYBT TIMES CYBNM.
CYDA CYDE CYDR	N/D	THE SIDE FORCE COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.
CYFI I=1,3	N/D	THE SIDE FORCE COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CYO	N/D	TABLE LOOK-UP OF CYOT.
DCDV	N/D	DELTA CD DUE TO VISCOUS EFFECTS. CALCULATED IF NPC(8)=4.
DCLV	N/D	DELTA CL DUE TO VISCOUS EFFECTS. CALCULATED IF NPC(8)=4.
DRAG	LBS (N)	AERODYNAMIC DRAG FORCE. CALCULATED IF NPC(5)=1,2,3 AND NPC(8)=1,2.
FAXB FAYB FAZB	LBS (N)	AERODYNAMIC FORCES IN THE BODY COORDINATE SYSTEM. CALCULATED IF NPC(5)=1,2,3 AND NPC(8)=1,2.
LIFT	LBS (N)	AERODYNAMIC LIFT FORCE. CALCULATED IF NPC(5)=1,2,3 AND NPC(8)=1,2.
QALPHA	LB-DEG/ FT**2 (N-DEG/ M2)	PRODUCT OF DYNAMIC PRESSURE AND ANGLE OF ATTACK. USED AS AN AIRLOADS INDICATOR IN THE PITCH PLANE.

6.A.1. AERODYNAMIC INPUTS (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
QALTOT	LB-DEG/ FT**2 (N-DEG/ M2)	PRODUCT OF DYNAMIC PRESSURE AND THE TOTAL ANGLE OF ATTACK. USED AS AN AIRLOADS INDICATOR.
VINV	N/D	RAREFATION PARAMETER USED TO COMPUTE VISCOUS EFFECTS.
XREF YREF ZREF	FT (M)	THE AERODYNAMIC REFERENCE LOCATION ALONG THE XBR, YBR, AND ZBR AXES, RESPECTIVELY.

6.A.2. AEROHEATING CALCULATIONS

THE AEROHEATING CALCULATIONS ARE SELECTED BY THE INPUT VARIABLE NPC(15). SEVERAL OPTIONS ARE AVAILABLE TO THE USER

THE FOLLOWING VARIABLES ARE INPUT IN NAMELIST GENDAT FOR VARIOUS HEATING CALCULATION OPTIONS.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(15)	INTEGER	0	AEROHEATING RATE OPTION FLAG. = 0, DO NOT CALCULATE AEROHEATING RATE. = 1, CALCULATE AEROHEATING RATE (HEATRT) AND TOTAL HEAT(TLHEAT) USING CHAPMANS EQUATION FOR STAGNATION POINT HEATING. = 2, OBTAIN THE HEATING RATE USING HTRTT AS A TABLE LOOK-UP. = 3, CALCULATE HEATING RATE AS THE PRODUCT OF OPTIONS 1 AND 2 ABOVE. = 4, ONLY CALCULATE THE TURBULENT HEATING RATE (HTURBD) AND THE TURBULENT HEAT (HTURB) USING THE TABLE LOOK-UP OF HTRTT AS A MULTIPLIER. = 5, CALCULATE BOTH HEATRT AND HTURBD AS IN THE OPTIONS 3 AND 4 ABOVE TO YIELD THE LAMINAR HEATING (TLHEAT) AND THE TURBULENT HEATING (HTURB). = 6, CALCULATE HEATRT AS THE MAXIMUM CENTERLINE HEAT RATE.
HEATK(I) I=1,3	DECIMAL	1. 17600. 26000.	COEFFICIENTS USED IN COMPUTING CHAPMANS HEATING RATE. USED IF NPC(15)=1,3,4.
RHOSL	SLUGS/ FT**3 (KG/M3)	.0023769	SEA LEVEL DENSITY USED IN COMPUTING CHAPMANS HEATING RATE. USED IF NPC(15)=1,3,4.
RN	FT (M)	1.0	NOSE RADIUS USED IN COMPUTING CHAPMAN HEATING RATE. USED IF NPC(15)=1,3,4.

6.A.2 AEROHEATING CALCULATIONS (CONTD)

THE FOLLOWING TABLES ARE INPUT IN NAMELIST TAP FOR THE VARIOUS HEATING CALCULATION OPTIONS.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
HTRTT	BTU/ FT**2-SEC (W/M2)	0.	THE TABLE OF AEROHEATING RATE AS A FUNCTION OF THE INPUT ARGUMENTS IF NPC(15)=2, OR A MULTIPLIER TO BE USED IN CALCULATING HEATING RATE IF NPC(15)=3,4,5. WHEN USING NPC(15)=2, THE DATA FOR HTRTT IS USUALLY GIVEN AS A TRIVARIANT FUNCTION OF ATMOS-PHERIC RELATIVE VELOCITY (VELA), OBLATE ALTITUDE (ALTITO), AND ANGLE OF ATTACK (ALPHA).

THE OUTPUTS ASSOCIATED WITH THE AEROHEATING CALCULATIONS ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
HEATRT	BTU/ FT**2-SEC (W/M2)	AERODYNAMIC HEATING RATE. CALCULATED IF NPC(15)=1,2,3,4,5.
HTURB	BTU/FT**2 (J/M2)	THE STAGNATION POINT HEATING FOR TURBULENT FLOW. CALCULATED IF NPC(15)=4,5.
HTURBD	BTU/ FT**2/SEC (W/M2)	THE DERIVATIVE OF HTURB. CALCULATED IF NPC(15)=4,5.
TLHEAT	BTU/FT**2 (J/M2)	TOTAL HEAT. CALCULATED IF NPC(15)=1,2,3,4,5.

6.A.3. ANALYTICAL IMPACT POINT CALCULATIONS

THIS OPTION IS NOT AVAILABLE IN 6D POST. THE POINT MASS VERSION OF POST MUST BE USED TO OBTAIN THIS OPTION.

6.A.4. ATMOSPHERE MODEL/WINDS INPUTS

THE PROGRAM HAS THE CAPABILITY TO SIMULATE ANY ATMOSPHERE WHICH CAN BE DESCRIBED BY TABLES OF ATMOSPHERIC DENSITY, PRESSURE, TEMPERATURE, AND SPEED OF SOUND. THE PROGRAM ALSO HAS TWO SPECIFIC ATMOSPHERE MODELS STORED IN THE PROGRAM FOR USER CONVENIENCE. ATMOSPHERIC WINDS CAN ALSO SELECTED BY USER INPUT. THE ATMOSPHERE MODEL IS SELECTED BY THE VARIABLE NPC(5). THE ATMOSPHERIC WINDS ARE SELECTED BY THE VARIABLE NPC(6).

THE FOLLOWING VARIABLES ARE INPUT IN NAMELIST GENDAT.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(5)	INTEGER	2	ATMOSPHERE MODEL FLAG. = 0, NO ATMOSPHERE. = 1, GENERAL ATMOSPHERE USING INPUT TABLES PREST, ATEMT, CST, DENST, AND CONSTANTS ATMOSK(I), I=1,2. = 2, 1962 STANDARD ATMOSPHERE. = 3, 1963 PATRICK AFB ATMOSPHERE.
NPC(6)	INTEGER	0	ATMOSPHERIC WINDS FLAG. = 0, NO WINDS. = 1, WINDS DEFINED BY TABLES OF WIND SPEED (VWT), WIND AZIMUTH (AZWT), AND VERTICAL COMPONENT (VWWT). = 2, WINDS DEFINED BY TABLES OF NORTHERLY (VWUT), EASTERLY (VWVT), AND VERTICAL (VWWT) COMPONENTS.
ATMOSK(I) I=1,2	DECIMAL	1.	ATMOSPHERIC CONSTANTS USED TO COMPUTE THE SPEED OF SOUND (CS) AND THE ATMOSPHERIC DENSITY (DENS), RESPECTIVELY, WHEN USING THE TABLE LOOK-UP ATMOSPHERE OPTION, I.E., WHEN NPC(5)=1.
AZWB	DEG	180.	WIND AZIMUTH BIAS. USED IF NPC(6) =1. IF AZWB = 180., THE WIND AZIMUTH TABLE (AZWT) MUST BE INPUT IN METEOROLOGICAL TERMS.

6.A.4. ATMOSPHERE MODEL/WINDS INPUTS (CONTD)

THE FOLLOWING TABLES ASSOCIATED WITH THE ATMOSPHERE MODEL AND ATMOSPHERIC WINDS OPTIONS ARE INPUT IN NAMELIST TAB.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
ATEMT	DEG R (DEG K)	0.	ATMOSPHERIC TEMPERATURE TABLE. USED IF NPC(5)=1.
AZWT	DEG	0.	WIND AZIMUTH TABLE. USED IN CONJUNCTION WITH VWT WHEN NPC(6)=1.
CST	FT/SEC (M/S)	0.	SPEED OF SOUND TABLE. USED IF NPC(5)=1.
DENKT	DECIMAL	0.	A DENSITY MULTIPLIER TABLE WHICH IS USED TO SIMULATE DENSITY DISPERSIONS. THE DENSITY FROM THE ATMOSPHERE MODEL BEING USED WILL BE MULTIPLIED BY THE TABLE LOOK-UP VALUE OF DENKT WHICH MUST BE INPUT AS THE DESIRED DECIMAL PERCENTAGE CHANGE IN DENSITY. DENS = DENS*(1.0 + DENKT)
DENST	SLUGS/ FT**3 (KG/M3)	0.	ATMOSPHERIC DENSITY TABLE. USED IF NPC(5)=1.
PREST	LB/FT**2 (N/M2)	0.	ATMOSPHERIC PRESSURE TABLE. USED IF NPC(5)=1.
VWT	FT/SEC (M/S)	0.	WIND SPEED TABLE. USED IN CONJUNCTION WITH AZWT WHEN NPC(6)=1.
VWUT VWVT VWWT	FT/SEC (M/S)	0.	TABLES OF WIND SPEED COMPONENTS IN THE NORTH, EAST, AND VERTICAL DIRECTIONS. USED IF NPC(6)=2.

6.A.4. ATMOSPHERE MODEL/WINDS INPUTS (CONTD)

THE OUTPUTS ASSOCIATED WITH THE ATMOSPHERE MODEL/WINDS OPTIONS ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
ATEM	DEG R (DEG K)	ATMOSPHERIC TEMPERATURE. CALCULATED IF NPC(5) =1,2,3.
CS	FT/SEC (M/S)	SPEED OF SOUND. CALCULATED IF NPC(5)=1,2,3.
DENS	SLUGS/ FT**3 (KG/M3)	ATMOSPHERIC DENSITY. CALCULATED IF NPC(5) =1,2,3. DENS = DENS*(1.0 + DENKT)
DYNP	LB/FT**2 (N/M2)	DYNAMIC PRESSURE. CALCULATED IF NPC(5)=1,2,3.
MACH	N/D	MACH NUMBER. CALCULATED IF NPC(5)=1,2,3.
MACHDT	1/SEC	RATE OF CHANGE OF MACH WITH RESPECT TO TIME.
PRES	LB/FT**2 (N/M2)	ATMOSPHERIC PRESSURE. CALCULATED IF NPC(5) =1,2,3.
REYNO	N/D	REYNOLDS NUMBER BASED ON THE REFERENCE LENGTH LREF. CALCULATED IF NPC(5)=1,2,3.
UW VW WW	FT/SEC (M/S)	COMPONENTS OF THE WIND VELOCITY VECTOR IN THE GEOGRAPHIC (G) COORDINATE SYSTEM IN THE NORTH, EAST, AND DOWN DIRECTIONS, RESPECTIVELY. CALCULATED IF NPC(6)=1,2.
VMU	LB-SEC/ FT**2 (N-S/M2)	ATMOSPHERIC VISCOSITY. USED TO CALCULATE REYNOLDS NUMBER. CALCULATED IF NPC(5)=1,2,3.

6.A.5. CONIC CALCULATION OPTION

THE PROGRAM HAS THE CAPABILITY TO CALCULATE KEPLERIAN CONIC CONDITIONS FOR BOTH ELLIPTICAL AND HYPERBOLIC ORBITS. THIS OPTION MUST BE REQUESTED IF ANY CONIC PARAMETERS ARE TO BE USED FOR TARGETING/OPTIMIZATION.

THE VARIABLES ASSOCIATED WITH THE CONIC CALCULATIONS ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(1)	INTEGER	0	CONIC CALCULATION FLAG. = 0, DO NOT CALCULATE CONIC PARAMETERS. = 1, CALCULATE CONIC AT THE END OF EACH INTEGRATION STEP BUT DO NOT PRINT CONIC PRINT BLOCK. = 2, CALCULATE AND PRINT CONIC BLOCK ONLY AT PHASE CHANGES. = 3, CALCULATE CONIC AT THE END OF EACH INTEGRATION STEP AND PRINT CONIC BLOCK WITH EACH PRINTOUT.

THE CONIC OUTPUT VARIABLES MUST BE REQUESTED INDIVIDUALLY IN THE REGULAR PRINT BLOCK IF NPC(1)=1, AS DESCRIBED IN SECTION 6.A.16. THE OUTPUTS ASSOCIATED WITH THE CONIC CALCULATIONS ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
ALTA	N.MI. (KM)	ALTITUDE OF APOGEE ABOVE THE OBLATE PLANET. CALCULATED IF NPC(1)=1,2,3.
ALTP	N.MI. (KM)	ALTITUDE OF PERIGEE ABOVE THE OBLATE PLANET. CALCULATED IF NPC(1)=1,2,3.
ANGMOM	FT**2/ SEC**2 (M2/S2)	ORBITAL ANGULAR MOMENTUM. CALCULATED IF NPC(1)=1,2,3.
APORAD	FT (M)	GEOCENTRIC RADIUS OF APOGEE. CALCULATED IF NPC(1)=1,2,3.

6.A.5. CONIC CALCULATION OPTION (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
APVEL	FT/SEC	INERTIAL VELOCITY AT APOGEE. CALCULATED IF NPC(1)=1,2,3.
ARGP	DEG	ARGUMENT OF PERIGEE. CALCULATED IF NPC(1) =1,2,3.
ARGV	DEG	ARGUMENT OF THE VEHICLE. CALCULATED IF NPC(1) =1,2,3. ARGV IS THE ANGLE BETWEEN THE ASCENDING NODE AND THE VEHICLE IN THE ORBIT PLANE MEASURED POSITIVE IN THE DIRECTION OF THE VEHICLE MOTION.
DECLIN	DEG	DECLINATION OF THE OUTGOING ASYMPTOTE. CALCULATED IF NPC(1)=1,2,3.
DVCIR	FT/SEC (M/S)	THE DELTA VELOCITY REQUIRED TO CIRCULARIZE THE CURRENT ORBIT. CALCULATED IF NPC(1)=1,2,3.
ECCAN	DEG	ECCENTRIC ANOMALY. CALCULATED IF NPC(1)=1,2,3.
ECCEN	N/D	ORBITAL ECCENTRICITY. CALCULATED IF NPC(1) =1,2,3.
ENERGY	FT**2/ SEC**2 (M2/S2)	ORBITAL ENERGY. CALCULATED IF NPC(1)=1,2,3.
HYPVEL	FT/SEC (M/S)	HYPERBOLIC EXCESS VELOCITY. CALCULATED IF NPC(1)=1,2,3.
INC	DEG	ORBIT INCLINATION ANGLE. CALCULATED IF NPC(1)=1,2,3.
LAN	DEG	LONGITUDE OF THE ASCENDING NODE EAST OF THE PRIME MERIDIAN AT TIME=0. CALCULATED IF NPC(1)=1,2,3.
LANVE	DEG	THE LONGITUDE OF THE ASCENDING NODE WITH RESPECT TO THE VERNAL EQUINOX. THIS VARIABLE IS COMPUTED ONLY IF NPC(1) AND NPC(31) ARE BOTH INPUT NON-ZERO.

6.A.5. CONIC CALCULATION OPTION (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
MEAAN	DEG	MEAN ANOMALY. CALCULATED IF NPC(1)=1,2,3.
PERIOD	MIN	ORBITAL PERIOD. CALCULATED IF NPC(1)=1,2,3.
PGCLAT	DEG	GEOCENTRIC LATITUDE OF PERIGEE. CALCULATED IF NPC(1)=1,2,3. POSITIVE IN THE NORTHERN HEMISPHERE.
PGERAD	FT (M)	GEOCENTRIC RADIUS OF PERIGEE. CALCULATED IF NPC(1)=1,2,3.
PGLON	DEG	INERTIAL LONGITUDE OF PERIGEE MEASURED POSITIVE EAST OF THE XI AXIS. CALCULATED IF NPC(1) =1,2,3.
PGVEL	FT/SEC (M/S)	INERTIAL VELOCITY AT PERIGEE. CALCULATED IF NPC(1)=1,2,3.
RTASC	DEG	RIGHT ASCENSION OF THE OUTGOING ASYMPTOTE. CALCULATED IF NPC(1)=1,2,3.
SEMJAX	FT (M)	SEMI-MAJOR AXIS. CALCULATED IF NPC(1)=1,2,3.
TIMSP	MIN	TIME SINCE PERIGEE PASSAGE. CALCULATED IF NPC(1)=1,2,3.
TIMTP	MIN	TIME TO PERIGEE PASSAGE. CALCULATED IF NPC(1)=1,2,3.
TRUAN	DEG	TRUE ANOMALY. CALCULATED IF NPC(1)=1,2,3.
TRUNMX	DEG	MAXIMUM TRUE ANOMALY FOR HYPERBOLIC ORBITS. CALCULATED IF NPC(1)=1,2,3.
VCIRC	FT/SEC (M/SEC)	THE CIRCULAR VELOCITY AT THE CURRENT RADIUS. COMPUTED IF NPC(1)=1,2,3.

6.A.6. EVENT CRITERIA/PHASE DEFINITION INPUT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
EVENT(2)	DECIMAL	0.	THE TYPE OF EVENT. THE EVENTS ARE ASSUMED TO BE NON-ROVING (ORDERED) UNLESS OVERRIDDEN BY THIS INPUT. = 0., NON-ROVING (ORDERED) EVENT = 1., PRIMARY ROVING EVENT
MDL	INTEGER	1	THE EVENT CRITERIA MODEL TO BE USED. = 1, IGNORE THE SIGN OF THE DERIVATIVE = 2, INITIATE THE EVENT ONLY IF THE DERIVATIVE OF CRITR IS POSITIVE = 3, INITIATE THE EVENT ONLY IF THE DERIVATIVE OF CRITR IS NEGATIVE
TOL	SAME AS THE CRITERIA VARIABLE	1.E-6	THE DESIRED ACCURACY TOLERANCE FOR THE SPECIFIED CRITERIA VARIABLE (CRITR). THE EVENT WILL OCCUR WHEN THE ACTUAL VALUE OF CRITR IS WITHIN THIS TOLERANCE OF THE DESIRED VALUE.
VALUE	DECIMAL	1.E10	THE VALUE OF THE CRITERIA VARIABLE (CRITR) AT WHICH THE EVENT IS TO OCCUR.

THERE ARE OTHER INPUTS CONCERNING THE PHASE/DEFINITION PROCESS WHICH ACT AS TERMINATION PARAMETERS. THESE VARIABLES ARE DEFINED AS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
ALTMAX	FT (M)	1.E20	MAXIMUM ALTITUDE, I.E., THE TRAJECTORY WILL TERMINATE IF THE VALUE OF OBLATE ALTITUDE (ALTITO) EXCEEDS THIS VALUE.
ALTMIN	FT (M)	-5000.	MINIMUM ALTITUDE, I.E., THE TRAJECTORY WILL TERMINATE IF THE VALUE OF OBLATE ALTITUDE (ALTITO) BECOMES LESS THAN THIS VALUE.

6.A.6. EVENT CRITERIA/PHASE DEFINITION INPUT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
ENDJOB	INTEGER	0	END-OF-JOB FLAG. = 0, NOT THE END OF THE JOB = 1, END OF THE JOB BEING PROCESSED (REQUIRED INPUT FOR EACH JOB)
ENDPHS	INTEGER	0	END-OF-PHASE FLAG. = 0, NOT THE END OF THE PHASE BEING INPUT = 1, END OF THE PHASE BEING INPUT (REQUIRED INPUT FOR EACH PHASE)
ENDPRB	INTEGER	0	END-OF-PROBLEM FLAG. = 0, NOT THE END OF THE PROBLEM BEING INPUT = 1, END OF THE PROBLEM BEING INPUT (REQUIRED INPUT FOR EACH PROBLEM)
FESN	DECIMAL	100.	THE FINAL EVENT SEQUENCE NUMBER FOR THE CURRENT PROBLEM. THE PROBLEM WILL TERMINATE UPON REACHING THE EVENT DESIGNATED BY FESN. FESN MUST BE INPUT LESS THAN OR EQUAL TO THE LAST EVENT SEQUENCE NUMBER INPUT.
MAXTIM	SEC	1.E10	MAXIMUM TRAJECTORY TIME. THE TRAJECTORY WILL TERMINATE IF THE VALUE OF TIME EXCEEDS THIS VALUE. THIS IS A PSUEDO ABORT MODE AND SHOULD ONLY BE USED AS A BACK-UP TRAJECTORY TERMINATION PROCEDURE IN CASE THE DESIGNATE FINAL EVENT (FESN) DOES NOT OCCUR.
NPC(18)	INTEGER	0	TRAJECTORY TERMINATION FLAG. = 0, DO NOT TERMINATE TRAJECTORY. = 1, TERMINATE THE TRAJECTORY UPON REACHING THE CURRENT EVENT. THIS OPTION PROVIDES THE USER WITH A PSUEDO ABORT CAPABILITY WHICH CAN BE USED IN CONJUNCTION WITH ROVING OR SECONDARY EVENTS.

6.A.6. EVENT CRITERIA/PHASE DEFINITION INPUTS (CONTD)

THE PROGRAM MONITORS AS MANY AS TEN (10) EVENTS AT A TIME, DEPENDING ON THE EVENT TYPES, TO DETERMINE WHICH EVENT IS TO OCCUR NEXT. THIS PROVIDES THE USER WITH A POWERFUL TOOL TO ENABLE THE SIMULATION OF COMPLEX PROBLEMS.

THE MULTIPLE EVENT MONITORING IS DONE IN THE FOLLOWING SEQUENCE -

1) THE NEXT PRIMARY EVENT IS MONITORED.

2) AS MANY AS NINE (9) PRIMARY ROVING EVENTS ARE MONITORED PROVIDED THERE ARE NO SECONDARY EVENTS. A ROVING PRIMARY EVENT IS ADDED TO THE LIST OF THOSE BEING MONITORED AS SOON AS THE PRIMARY EVENT IMMEDIATELY PRECEEDING THAT ROVING EVENT HAS OCCURRED.

3) AS MANY AS NINE (9) SECONDARY EVENTS ARE MONITORED, PROVIDED THERE ARE NO PRIMARY ROVING EVENTS.
   NOTE - CAUTION MUST BE EXERCISED WHEN USING SECONDARY EVENTS BECAUSE OF THEIR NATURE. SINCE AS MANY AS NINE (9) SECONDARIES ARE MONITORED AT A TIME, ANY ONE OF THOSE NINE WILL OCCUR AS SOON AS ITS CRITERIA HAS BEEN MET. BECAUSE THEY ARE SECONDARY EVENTS, THE EVENT WHICH OCCURS WILL CANCEL THE SECONDARIES WITH SMALLER EVENT NUMBERS.

4) A TOTAL OF NINE (9) PRIMARY ROVING AND SECONDARY EVENTS ARE MONITORED.

SINCE THE PROGRAM CAN ONLY MONITOR NINE (9) EVENTS IN ADDITION TO THE NEXT PRIMARY EVENT, THE SUM OF PRIMARY ROVING AND SECONDARY EVENTS MUST BE LESS THAN OR EQUAL TO NINE (9) OR A FATAL ERROR WILL RESULT.

THE METHOD BY WHICH THE PROGRAM MONITORS THE EVENT CRITERIA REQUIRES THAT THE DESIRED CUTOFF VARIABLE BE CONTINUOUS. THE PROGRAM CHECKS THE VALUES OF THE CRITERIA BEING MONITORED AT EACH INTEGRATION STEP. IF NONE OF THE CRITERIA VALUES HAVE BRACKETED THE DESIRED CUT-OFF CONDITION, THE PROGRAM TAKES ANOTHER INTEGRATION STEP. IF A CRITERIA VARIABLE WAS BRACKETED ON A GIVEN STEP, THE PROGRAM BACKS UP TO THE PREVIOUS STEP, COMPUTES A NEW STEP SIZE BASED ON THE SLOPE OF THE CRITERIA VARIABLE AND TAKES A NEW STEP. THIS PROCESS IS REPEATED UNTIL THE CRITERIA VARIABLE VALUE IS WITHIN THE SPECIFIED TOLERANCE OF THE DESIRED VALUE.

6.A.6. EVENT CRITERIA/PHASE DEFINITION INPUTS (CONTD)

IF THE DESIRED CONDITIONS CANNOT BE ACHIEVED IN 20 ITERATIONS, THE PROGRAM PRINTS AN ERROR MESSAGE AND STOPS. GENERALLY THIS SITUATION IS CAUSED BY AN INPUT ERROR.

THE INPUT DATA REQUIRED TO DESCRIBE THE EVENTS AND THEIR ASSOCIATED CRITERIA ARE AS FOLLOWS -

1) EVENT SEQUENCE NUMBER - EVENT(1)
2) TYPE OF EVENT - EVENT(2)
3) EVENT CRITERIA VARIABLE NAME - CRITR
4) EVENT CRITERIA VARIABLE VALUE - VALUE
5) EVENT CRITERIA MODEL - MDL

FOR MOST PROBLEMS, THE USER ONLY NEEDS TO INPUT VALUES FOR THE ABOVE VARIABLES, HOWEVER, THE CAPABILITY EXISTS TO ALLOW THE ACCURACY TOLERANCE (TOL) TO BE INPUT AS WELL.

THE SAMPLE INPUT LISTING SECTION OF THIS REPORT ILLUSTRATES THE USE AND DESIGNATION OF EVENTS.

ALL INPUT VARIABLES ASSOCIATED WITH EVENT CRITERIA/ PHASE DEFINITION ARE INPUT IN NAMELIST GENDAT. THE INPUT VARIABLES ARE -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CRITR	HOLLERITH	TIME	THE NAME OF THE EVENT CRITERIA VARIABLE. THIS IS THE VARIABLE TO BE MONITORED TO INITIATE THE CORRESPONDING PHASE. ANY APPROPRIATE VARIABLE FROM THE LIST OF OUTPUT VARIABLES CAN BE USED FOR THIS PURPOSE.
EVENT(1)	DECIMAL	0.	THE EVENT SEQUENCE NUMBER FOR THE CURRENT PHASE. THIS VARIABLE MUST BE INPUT FOR EACH PHASE. = XXX.0, DENOTES PRIMARY EVENTS = XXX.X, DENOTES SECONDARY EVENTS

6.A.6. EVENT CRITERIA/PHASE DEFINITION INPUTS

THE USER MUST DEFINE A SEQUENCE OF EVENTS WHICH WILL DESCRIBE THE PROBLEM BEING SIMULATED FROM BEGINNING TO END. AN EVENT IS DEFINED AS AN INTERRUPTION IN THE TRAJECTORY SIMULATION WHEN A USER SPECIFIED VARIABLE REACHES THE DESIRED VALUE. AN EVENT MUST BE CREATED ANY TIME THE USER WISHES TO CHANGE ANY INPUT DATA FOR THE PROBLEM OR TO CAUSE ANY CHANGE IN THE METHOD OF SIMULATING THE PROBLEM. ALL EVENTS EXCEPT FOR THE FIRST EVENT MUST HAVE A USER SPECIFIED PARAMETER WHICH IS REFERRED TO AS THE EVENT CRITERIA. A GIVEN EVENT WILL OCCUR WHEN THE EVENT CRITERIA VARIABLE FOR THAT EVENT REACHES THE USER SPECIFIED VALUE. IN THIS WAY, THE USER CAN SET UP HIS PROBLEM TO SUIT HIS OWN PARTICULAR NEEDS BY THE APPROPRIATE INPUTS. THERE IS NO LIMIT TO THE NUMBER OF EVENTS THAT CAN BE USED. THE ONLY LIMIT IMPOSED IS THE SIZE OF THE DATA REGION ALLOCATED FOR INPUT WHICH IS 2500 CELLS FOR CONSTANTS AND 24000 CELLS FOR TABLES.

AS AN EXAMPLE, THE FOLLOWING SERIES OF EVENTS COULD BE USED TO DESCRIBE AN ASCENT PROBLEM FOR A TWO STAGE VEHICLE WITH FOUR PITCH RATES IN THE FIRST STAGE AND TWO PITCH RATES IN THE SECOND STAGE.

EVENT NUMBER	DESCRIPTION
1	LIFT-OFF.
2	INITIATE PITCH RATE 1 AT TIME = 20 SEC.
3	INITIATE PITCH RATE 2 AT TIME = 30 SEC.
4	INITIATE PITCH RATE 3 AT TIME = 60 SEC.
5	INITIATE PITCH RATE 4 AT TIME = 90 SEC.
6	JETTISON STAGE 1 WHEN WPROP = 0.
7	INITIATE PITCH RATE 5 AT 20 SEC AFTER EVENT 6.
8	INITIATE PITCH RATE 6 AT 100 SEC AFTER EVENT 7.
9	ORBIT INJECTION AT INERTIAL VELOCITY = 25568.

THE FIRST EVENT FOR THIS PROBLEM IS EVENT NUMBER 1 AND THE LAST EVENT IS EVENT NUMBER 9. EACH OF THE 6 PITCH RATES COULD BE USED AS CONTROL PARAMETERS (INDEPENDENT VARIABLES) TO SATISFY SPECIFIED TARGETS (DEPENDENT VARIABLES) IF DESIRED.

THE EVENT NUMBERS FOR A GIVEN PROBLEM ARE SPECIFIED AS REAL NUMBERS BY THE USER IN MONOTONIC INCREASING ORDER. THESE EVENT NUMBERS ARE USED BY THE PROGRAM TO DETERMINE THE ORDER IN WHICH

6.A.6. EVENT CRITERIA/PHASE DEFINITION INPUTS (CONTD)

THE EVENTS ARE TO OCCUR. THE PROGRAM REQUIRES THAT EACH PROBLEM HAVE A MINIMUM OF TWO (2) EVENTS, AN INITIAL EVENT AND A FINAL EVENT. A PHASE IS INITIATED BY THE CORRESPONDING EVENT, THEREFORE, THE EVENT CRITERIA FOR A GIVEN EVENT SPECIFIES THE CONDITIONS AT WHICH THE CORRESPONDING PHASE WILL BEGIN. A PROBLEM IS TERMINATED BY SPECIFYING THE LAST EVENT WHICH IS TO OCCUR. THE PROBLEM CAN ALSO BE TERMINATED IN A PSUEDO-ABORT MODE BY SPECIFYING THE MAXIMUM TRAJECTORY TIME, MAXIMUM ALTITUDE, OR MINIMUM ALTITUDE. ALTHOUGH EVENT NUMBERS MUST BE MONOTONIC INCREASING, THEY NEED NOT BE CONSECUTIVE. THIS ALLOWS THE USER TO EASILY ADD OR DELETE EVENTS FROM AN INPUT DECK.

EACH EVENT MUST HAVE A UNIQUE NUMBER ASSIGNED TO IT. EVENTS ARE SPECIFIED AS BEING ONE OF THREE TYPES, PRIMARY, SECONDARY, OR PRIMARY ROVING.

THE EVENT TYPES ARE DESIGNED TO PROVIDE FLEXIBILITY IN THE SETUP OF A GIVEN PROBLEM. THE EVENT TYPES ARE DEFINED AS FOLLOWS -

1) PRIMARY EVENTS - USED TO DESCRIBE THE MAIN SEQUENTIAL EVENTS OF THE TRAJECTORY BEING SIMULATED. THESE EVENTS MUST OCCUR AND MUST OCCUR IN ASCENDING ORDER ACCORDING TO THE EVENT NUMBER. MOST PROBLEMS WILL USUALLY BE SIMULATED BY A SERIES OF PRIMARY EVENTS.

2) SECONDARY EVENTS - USED TO DESCRIBE EVENTS WHICH MAY OR MAY NOT OCCUR DURING THE SPECIFIED TRAJECTORY SEGMENT.
SECONDARY EVENTS MUST OCCUR IN ASCENDING ORDER IN THE INTERVAL BOUNDED BY THE PRIMARY EVENTS ON EITHER SIDE OF THE SECONDARY EVENT. A PRIMARY EVENT OCCURANCE WILL NULLIFY THE SECONDARY EVENTS FOR THE THE PREVIOUS PRIMARY EVENT IF THEY HAVE NOT OCCURRED.

3) ROVING PRIMARY EVENTS - THESE EVENTS CAN OCCUR ANY TIME AFTER OCCURRENCE OF ALL PRIMARY EVENTS WITH SMALLER EVENT NUMBERS. THESE EVENTS CAN BE USED TO INTERRUPT THE TRAJECTORY ON THE SPECIFIED CRITERIA REGARDLESS OF THE STATE OF THE TRAJECTORY OR VEHICLE.

6.A.7. FUNCTIONAL INEQUALITIES

THIS OPTION PROVIDES THE CAPABILITY TO DETERMINE WHETHER A VARIABLE HAS CROSSED OVER SOME BOUNDARY (UPPER OR LOWER) DURING THE COURSE OF A TRAJECTORY. THE USER CAN USE THIS FEATURE IN CONJUCTION WITH THE TARGETING/OPTIMIZATION OPTION TO TARGET TO SOME DESIRED END CONDITIONS WHILE ADHERING TO A TIME VARYING CONSTRAINT. AN EXAMPLE WOULD BE SATISFYING A TRACKER LOOK ANGLE VERSUS SLANT RANGE DISTANCE CONSTRAINT.

THE GENERALIZED FUNCTIONAL INEQUALITIES CAN ONLY BE SATISFIED WHEN USING THE TARGETINF/OPTIMIZATION OPTION. THAT IS, SOME CONTROL PARAMETERS MUST BE SPECIFIED WHICH WILL AFFECT THE SPECIFIED FUNCTIONAL INEQUALITY VARIABLES. THE FUNCTIONAL INEQUALITIES WILL BE SATISFIED WHEN THE VALUE OF THE CONSTRAINT VIOLATION FVALJ IS DRIVEN TO ZERO BY THE TARGETING/OPTIMIZATION ALGORITHM.

THREE (3) GENERALIZED FUNCTIONAL INEQUALITY CONSTRAINTS ARE AVAILABLE. THE FUNCTIONAL INEQUALITY OPTION IS OBTAINED IF NPC(11)=1 IS INPUT. IT IS NOT ACTIVE IF NPC(11)=0. THE FOLLOWING VARIABLES ASSOCIATED WITH FUNCTIONAL INEQUALITIES ARE INPUT IN NAMELIST GENDAT.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(11)	INTEGER	0	FUNCTIONAL INEQUALITY CONSTRAINTS OPTION FLAG. = 0, NO FUNCTIONAL INEQUALITY CONSTRAINTS. = 1, COMPUTE FUNCTIONAL INEQUALITY CONSTRAINTS FVALI, I=1,2,3, BASED ON THE TABLE INPUT OF THE INEQUALITY BOUNDARY (FLIT, I=1, 2,3).
MONF(J) J=1,2,3	HOLLERITH	0.	THE NAME OF THE VARIABLE TO BE USED AS THE FUNCTIONAL INEQUALITY.

6.A.7. FUNCTIONAL INEQUALITIES (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NEQS(J) J=1,3	INTEGER	0	THE TYPE OF BOUNDARY TO BE CONSIDERED FOR THE FUNCTIONAL INEQUALITY WHEN USING NPC(11)=1. =-1, LOWER BOUND. = 1, UPPER BOUND.

THE FOLLOWING VARIABLES ASSOCIATED WITH FUNCTIONAL INEQUALITIES ARE INPUT IN NAMELIST TAB.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
FLJT J=1,2,3	SAME AS THE VARIABLE IN MONE(J)	0.	THE VALUE OF THE BOUNDARY OF THE FUNCTIONAL INEQUALITY AS A FUNCTION OF THE TABLE ARGUMENT.

THE FOLLOWING OUTPUTS ARE ASSOCIATED WITH THE FUNCTIONAL INEQUALITIES.

OUTPUT SYMBOL	UNITS	DEFINITION
DFVALJ J=1,2,3	DECIMAL	THE INSTANTANEOUS VALUE OF THE CONSTRAINT VIOLATION SQUARED. CALCULATED IF NPC(11)=1.
FVALJ J=1,2,3	DECIMAL	THE VALUE OF THE INEQUALITY CONSTRAINT VIOLATION PARAMETER (INTEGRAL OF DFVALJ). IF FVALJ IS ZERO, THE CONSTRAINT WAS NOT VIOLATED. THEREFORE, SPECIFY FVALJ AS AN EQUALITY CONSTRAINT, I.E., INPUT DEPVR(I)= 6HFVALJ , IN NAMELIST SEARCH WITH A DESIRED VALUE (DEPVAL) OF ZERO TO SATISFY THE FUNCTIONAL INEQUALITY. CALCULATED IF NPC(11)=1.

6.A.8. GENERALIZED DEPENDENT VARIABLE OPTION

THE PROGRAM HAS THE CAPABILITY TO CALCULATE AN ARBITRARY DEPENDENT VARIABLE WHICH IS DEFINED AS THE DIFFERENCE BETWEEN TWO GENERALIZED TABLE INPUTS. THIS OPTION IS USEFUL IN THAT THE GENERALIZED VARIABLE, DGENV, CAN BE USED AS A TARGET, CONSTRAINT, EVENT CRITERIA, OR AN OPTIMIZATION VARIABLE. THE VARIABLE DGENV IS CALCULATED AS -

```
DGENV = GENV2T - GENV1T,
```

WHERE THE TABLES GENV1T AND GENV2T ARE INPUT IN NAMELIST TAB PRIOR TO THE PHASE IN WHICH DGENV IS TO BE USED. TYPICAL APPLICATIONS OF THIS VARIABLE ARE -

1) EVENT CRITERIA -

```
CRITR = 5HDGENV,
```

2) TARGET AND/OR CONSTRAINT -

```
DEPVR = 5HDGENV,
```

3) OPTIMIZATION VARIABLE -

```
OPTVAR = 5HDGENV,
```

AN EXAMPLE OF HOW THIS VARIABLE COULD BE USED IS OUTLINED AS FOLLOWS -

INTERRUPT ON AN ALTITUDE-VELOCITY (H-V) PROFILE. SUPPOSE IT IS DESIRED TO INTERRUPT THE SIMULATION WHEN THE TRACE OF THE ACTUAL TRAJECTORY IN THE H-V SPACE INTERSECTS AN INPUT H-V PROFILE. IN THIS CASE, THE EVENT CRITERIA (CRITR) IS NOT CONSTANT BUT IS A SET OF ORDERED PAIRS OF ALTITUDE AND VELOCITY (I.E., A FUNCTION). THE INPUT FOR THIS EXAMPLE WOULD BE AS FOLLOWS -

THE EVENT CRITERIA WOULD BE

```
CRITR = 5HDGENV,  VALUE = 0.,
```

THE TABLES TO DEFINE THE VARIABLE DGENV WOULD BE INPUT IN THE PRECEDING PHASE AS -

```
P$TAB
 TABLE = 6HGENV1T,1,6HALTITD,2,1,1,1,
         0.,0., 1.0E6,1.0E6,
 $
```

6.A.8. GENERALIZED DEPENDENT VARIABLE OPTION (CONTD)

```
P$TAB
 TABLE = 6HGENV2T,1,6HVELA  ,4,1,1,1,
         1000.,49000., 1500.,71000.,
         3000.,80000., 5000.,95000.,
 $
```

THE PROGRAM WILL THEN INTERRUPT WHEN DGENV EQUALS 0, WHICH IS THE CONDITION WHEN THE ACTUAL H-V PROFILE INTERSECTS THE INPUT CURVE.

THE FOLLOWING TABLES ASSOCIATED WITH THE GENERALIZED DEPENDENT VARIABLE OPTION ARE INPUT IN NAMELIST TAB.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
GENV1T I=1,2	DECIMAL	0.	THE TABLES USED TO CALCULATE THE GENERALIZED DEPENDENT VARIABLE (DGENV) AS FOLLOWS - DGENV = GENV2T - GENV1T

THE OUTPUT VARIABLE ASSOCIATED WITH THE GENERALIZED DEPENDENT VARIABLE OPTION IS AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
DGENV	DECIMAL	THE GENERALIZED DEPENDENT VARIABLE. THIS VARIABLE IS CALCULATED AS THE DIFFERENCE BETWEEN TWO INPUT TABLES AS FOLLOWS - DGENV = GENV2T - GENV1T

6.A.9. GENERAL INTEGRATION VARIABLES

THE PROGRAM CAN OPTIONALLY COMPUTE THE INTEGRALS OF TEN USER SPECIFIED VARIABLES. THIS FEATURE ENABLES THE USER TO COMPUTE INTEGRALS OF VARIABLES WHICH ARE NOT INCLUDED IN THE NORMAL INTERGRATION LIST. FOR EXAMPLE, SUPPOSE THE TOTAL IMPULSE IS REQUIRED FOR INFORMATION PURPOSES. THIS WOULD BE OBTAINED BY INTEGRATING THRST BY SETTING GDERV(1)=5HTHRST, AND BY REQUESTING GINT1 AS A PRINT VARIABLE.

THE INPUT PROCEDURE FOR USING THIS OPTION IS -

1) INPUT NPC(24) = 1,
2) INPUT THE HOLLERITH NAMES OF THE DERIVATIVES GDERV(I).
3) INCLUDE THE INTEGRAL NAMES, GINTJ, IN THE PRINT BLOCK.

THE VARIABLES FOR THIS OPTION ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(24)	INTEGER	0	GENERAL INTEGRATION VARIABLE FLAG. = 0, NOT USED. = 1, INTEGRATE THE VARIABLES SPECIFIED BY GDERV(I), I=1,10, TO FORM THE INTEGRALS GINTJ, J=1,10.
GDERV(J) J=1,10	HOLLERITH	0	THE NAME OF GENERAL INTEGRATION VARIABLE J. THE INTEGRAL OF THE VARIABLE SPECIFIED BY GDERV(J) IS CONTAINED IN GINTJ. THE INTEGRATION OF VARIABLE J IS TURNED OFF IF GDERV(J)=0., IS INPUT.
GINT(J) J=1,10	DECIMAL	0.	THE VALUE OF THE INTEGRAL OF GENERAL INTEGRATION VARIABLE J. THIS INPUT ALLOWS THE USER TO RESET THE INTEGRALS AT ANY PHASE.

6.A.9. GENERAL INTEGRATION VARIABLES (CONTD)

THE OUTPUTS ASSOCIATED WITH THIS OPTION ARE -

OUTPUT SYMBOL	UNITS	DEFINITION
GINTJ J=1,10	DECIMAL	THE VALUE OF THE INTEGRAL FOR THE GENERAL INTEGRATION VARIABLE SPECIFIED BY GDERV(J). CALCULATED IF NPC(24)=1.

6.A.10. GRAVITATIONAL INPUTS

THE GRAVITY MODEL IS SELECTED FOR EITHER AN OBLATE OR SPHERICAL PLANET BY THE VALUE OF NPC(16). THE GRAVITY MODEL FOR THE OBLATE PLANET MODEL INCLUDES THE SECOND, THIRD, AND FOURTH HARMONICS WHICH REPRESENT THE VARIATION IN THE GRAVITY ACCELERATION AS A FUNCTION OF OBLATENESS AND LATITUDE.

ALL INPUT VARIABLES ASSOCIATED WITH THE GRAVITY MODEL ARE INPUT IN NAMELIST GENDAT. THESE VARIABLES ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(16)	INTEGER	0	GRAVITY MODEL OPTION FLAG = 0, USE GRAVITY MODEL FOR AN OBLATE PLANET. INPUT J2,J3,J4,RE,RP, MU, AND OMEGA. = 1, USE GRAVITY MODEL FOR A SPHERICAL PLANET OF RADIUS RE. INPUT RE AND MU.
J2	DECIMAL	1.0823E-3	SECOND, THIRD, AND FOURTH HARMONICS IN THE GRAVITY POTENTIAL FUNCTION. USED IF NPC(16)=0.
J3		0.	
J4		0.	
MU	FT**3/ SEC**2 (M3/S2)	1.40765 39E+16	GRAVITATIONAL CONSTANT OF THE ATTRACTING PLANET.
OMEGA	RAD/SEC	7.29211 E-5	ROTATION RATE OF THE ATTRACTING PLANET.
RE	FT (M)	20925741.	EQUATORIAL RADIUS OF THE ATTRACTING PLANET.
RP	FT (M)	20855590.	POLAR RADIUS OF THE ATTRACTING PLANET. USED IF NPC(16)=0.

6.A.10. GRAVITATIONAL INPUTS

THE OUTPUTS ASSOCIATED WITH THE GRAVITY CALCULATIONS ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
GXI GYI GZI	FT/SEC**2 (M/S2)	THE GRAVITY ACCELERATION VECTOR COMPONENTS ALONG THE XI, YI, AND ZI AXES.

6.A.11. HOLD DOWN OPTION

THE PROGRAM HAS THE CAPABILITY TO SIMULATE HOLD DOWN. THAT IS, THE EQUATIONS OF MOTION ARE INTEGRATED ASSUMING THE VEHICLE IS RIGIDLY ATTACHED AT THE INPUT INITIAL CONDITIONS. RELEASE OF THE VEHICLE IS ACHIEVED BY MAKING THE NEXT EVENT OCCUR AT A GIVEN VALUE OF AXIAL ACCELERATION (AXB), TIME, ETC, AND BY SETTING NPC(14)=0, IN THAT PHASE.

WHEN USING THE HOLD-DOWN OPTION, THE RELATIVE POSITION AND VELOCITY COMPONENTS REMAIN CONSTANT WHILE THE INERTIAL POSITION CHANGES BY THE EARTH ROTATION RATE TIMES TIME. THE INERTIAL VELOCITY MAGNITUDE ALSO REMAINS CONSTANT.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(14)	INTEGER	0	HOLD DOWN OPTION FLAG. = 0, NO HOLD DOWN OPTION. = 1, INTEGRATE THE EQUATIONS OF MOTION BASED ON HOLDING THE VEHICLE DOWN.

6.A.12. INITIAL POSITION AND VELOCITY

THE INITIAL POSITION AND VELOCITY STATES CAN BE INPUT IN SEVERAL WAYS DEPENDING ON USER PREFERENCE. THE OPTIONS FOR THE VELOCITY VECTOR INPUT ARE SELECTED BY THE VALUE OF NPC(3). THE OPTIONS FOR THE POSITION VECTOR INPUT ARE SELECTED BY THE VALUE OF NPC(4). THE OPTIONS ARE SUMMARIZED AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(3)	INTEGER	4	VELOCITY VECTOR INITIALIZATION FLAG. = 1, INPUT EARTH CENTERED INERTIAL COMPONENTS, VXI(J), J=1,3. = 2, INPUT INERTIAL COMPONENTS IN THE LOCAL HORIZONTAL (G) FRAME, GAMMAI, VELI, AND AZVELI. = 3, INPUT ATMOSPHERIC RELATIVE COMPONENTS IN THE LOCAL HORIZONTAL (G) FRAME, GAMMAA, VELA, AND AZVELA. = 4, INPUT EARTH RELATIVE COMPONENTS IN THE LOCAL HORIZONTAL (G) FRAME, GAMMAR, VELR, AND AZVELR. = 5, INPUT ORBITAL PARAMETERS, INC, ALTP, ALTA, TRUAN, ARGP, LAN, AND PGCLAT. NPC(4) IS NOT USED IF NPC(3)=5.
NPC(4)	INTECER	2	POSITION VECTOR INITIALIZATION FLAG. = 1, INPUT EARTH CENTERED INERTIAL COMPONENTS, XI(J), J=1,3. = 2, INPUT SPHERICAL COORDINATES, GEOCENTRIC OR GEODETIC LATITUDE, GCLAT OR GDLAT, RELATIVE OR INERTIAL LONGITUDE, LONG OR LONGI, AND OBLATE ALTITUDE OR GEOCENTRIC RADIUS, ALTITO OR GCRAD.

THE FOLLOWING LIST DEFINES THE INPUT VARIABLES FOR THE VARIOUS OPTIONS DEFINED ABOVE FOR NPC(3) AND NPC(4). ALL VARIABLES IN THIS LIST ARE INPUT IN NAMELIST GENDAT.

6.A.12. INITIAL POSITION AND VELOCITY (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
ALTA	N.MI. (KM)	0.	INITIAL APOGEE ALTITUDE. USED IF NPC(3)=5.
ALTITO	FT (M)	0.	INITIAL ALTITUDE ABOVE THE OBLATE PLANET. USED IF NPC(4)=2 AND IF GCRAD IS NOT INPUT.
ALTP	N.MI. (KM)	0.	INITIAL PERIGEE ALTITUDE. USED IF NPC(3)=5.
ARGP	DEG	0.	INITIAL ARGUMENT OF PERIGEE. USED IF NPC(3)=5.
AZVELA	DEG	0.	INITIAL AZIMUTH ANGLE OF THE VELOCITY RELATIVE TO THE ATMOSPHERE. USED IF NPC(3)=3.
AZVELI	DEG	0.	INITIAL AZIMUTH ANGLE OF THE INERTIAL VELOCITY VECTOR. USED IF NPC(3)=2.
AZVELR	DEG	0.	INITIAL AZIMUTH ANGLE OF THE RELATIVE VELOCITY VECTOR. USED IF NPC(3)=4.
GAMMAA	DEG	0.	INITIAL ATMOSPHERIC RELATIVE FLIGHT PATH ANGLE. USED IF NPC(3)=3.
GAMMAI	DEG	0.	INITIAL VALUE OF INERTIAL FLIGHT PATH ANGLE. USED IF NPC(3)=2.
GAMMAR	DEG	0.	INITIAL RELATIVE FLIGHT PATH ANGLE. USED IF NPC(3)=4.
INC	DEG	0.	INITIAL INCLINATION ANGLE. USED IF NPC(3)=5.
LAN	DEG	0.	INITIAL LONGITUDE OF THE ASCENDING NODE MEASURED EAST OF THE XI AXIS. USED IF NPC(3)=5.
GCLAT	DEG	0.	INITIAL GEOCENTRIC LATITUDE. USED IF NPC(4)=2 AND IF GDLAT IS NOT INPUT

6.A.12. INITIAL POSITION AND VELOCITY (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
GCRAD	FT (M)	0.	INITIAL GEOCENTRIC RADIUS. USED IF NPC(4)=2 AND IF ALTITC IS NOT INPUT.
GDLAT	DEG	0.	INITIAL GEODETIC LATITUDE. USED IF NPC(4)=2 AND IF GCLAT IS NOT INPUT.
LONG	DEG	0.	INITIAL EAST LONGITUDE RELATIVE TO THE PRIME MERIDIAN. USED IF NPC(4)=2 AND IF LONGI IS NOT INPUT.
LONGI	DEG	0.	INITIAL LONGITUDE EAST OF THE XI AXIS. USED IF NPC(4)=2, AND LONG IS NOT INPUT.
PGCLAT	DEG	0.	INITIAL GEOCENTRIC LATITUDE OF PERIGEE. MEASURED POSITIVE IN THE NORTHERN HEMISPHERE. USED IF NPC(3) =5.
TRUAN	DEG	0.	INITIAL TRUE ANOMALY. USED IF NPC(3)=5.
VELA	FT/SEC (M/S)	0.	INITIAL ATMOSPHERIC RELATIVE VELOCITY USED IF NPC(3)=3.
VELI	FT/SEC (M/S)	0.	INITIAL VALUE OF INERTIAL VELOCITY. USED IF NPC(3)=2.
VELR	FT/SEC (M/S)	0.	INITIAL RELATIVE VELOCITY. USED IF NPC(3)=4.
VXI(J) J=1,3	FT/SEC (M/S)	0.	THE INITIAL VALUES OF THE INERTIAL VELOCITY VECTOR COMPONENTS ALONG THE XI, YI, AND ZI AXES. USED IF NPC(3)=1.
XI(J) J=1,3	FT (M)	0.	THE INITIAL VEHICLE POSITION VECTOR COMPONENTS ALONG THE XI, YI, AND ZI AXES. USED IF NPC(4)=1.

6.A.13. INSTANTANEOUS VELOCITY ADDITIONS

THIS OPTION IS NOT AVAILABLE IN 6D POST. THE POINT MASS VERSION OF POST MUST BE USED TO OBTAIN THIS OPTION.

6.A.14. MONITOR VARIABLES

THE PROGRAM HAS THE CAPABILITY TO CALCULATE EITHER THE MAXIMUM OR MINIMUM VALUE ATTAINED BY USER SPECIFIED VARIABLES DURING THE COURSE OF A TRAJECTORY. THIS FEATURE IS USEFUL IN PROVIDING INFORMATION SUCH AS MAXIMUM DYNAMIC PRESSURE, ACCELERATION, ETC., AS WELL AS THE TIME OF OCCURRENCE OF THESE CONDITIONS.

THIS FEATURE IS ALSO USEFUL IN CONTROLLING THE MAXIMUM OR MINIMUM VALUES ATTAINED BY USER SPECIFIED VARIABLES BY MEANS OF THE TARGETING/OPTIMIZATION OPTION. FOR EXAMPLE, SUPPOSE THE USER WISHES TO TARGET TO SOME END CONDITIONS WHILE MAINTAINING AN UPPER BOUND ON THE MAXIMUM DYNAMIC PRESSURE. IN THIS CASE, THE VARIABLE MONX(1)=4HDYNP, WOULD BE INPUT IN NAMELIST GENDAT AND THE VARIABLE XMAX1 WOULD BE USED AS A DEPENDENT VARIABLE WITH AN UPPER BOUND, I.E., INPUT DEPVR(I)=5HXMAX1, IDEPVR(I)=1, AND DEPVAL(I)=UPPER BOUND VALUE, IN NAMELIST SEARCH.

ALL GENERALIZED MONITOR VARIABLES ARE INPUT IN NAMELIST GENDAT. TEN (10) GENERALIZED MONITOR VARIABLES ARE AVAILABLE. ANY COMPUTED PARAMETER WHICH IS LISTED IN THE SECTION ENTITLED OUTPUT VARIABLES CAN BE USED AS A GENERALIZED MONITOR VARIABLE.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
MONX(I) I=1,10	HOLLERITH	0.	THE NAME OF THE VARIABLE TO BE MONITORED FOR MAXIMUM AND MINIMUM VALUES. THE FIRST N MONX VARIABLES THAT ARE NONZERO WILL BE USED.
MONY(I) I=1,10	HOLLERITH	0.	THE NAME OF THE VARIABLE WHOSE VALUE IS TO BE DETERMINED WHEN MONX(I) REACHES THE MAXIMUM AND MINIMUM VALUES.
XMAX(I) I=1,10	DECIMAL	-1.0E20	THE INITIAL VALUE OF XMAX(1). THIS VARIABLE CAN BE INPUT IN ANY PHASE TO REINITIALIZE THE SEARCH FOR ANOTHER MAXIMUM OF THE VARIABLE INPUT AS MONX(I).

6.A.14. MONITOR VARIABLES (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
XMIN(I) I=1,10	DECIMAL	+1.0E20	THE INITIAL VALUE OF XMIN(I). THIS VARIABLE CAN BE INPUT IN ANY PHASE TO REINITIALIZE THE SEARCH FOR ANOTHER MINIMUM OF THE VARIABLE INPUT AS MONX(I).
YXMN(I) I=1,10	DECIMAL	+1.0E20	THE INITIAL VALUE OF YXMN(I). THIS VARIABLE CAN BE INPUT IN ANY PHASE TO REINITIALIZE THE SEARCH FOR ANOTHER MINIMUM OF THE VARIABLE INPUT AS MONY(I).
YXMX(I) I=1,10	DECIMAL	-1.0E20	THE INITIAL VALUE OF YXMX(I). THIS VARIABLE CAN BE INPUT IN ANY PHASE TO REINITIALIZE THE SEARCH FOR ANOTHER MAXIMUM OF THE VARIABLE INPUT AS MONY(I).

THE FOLLOWING OUTPUTS ARE ASSOCIATED WITH THE GENERALIZED MONITOR VARIABLES.

OUTPUT SYMBOL	UNITS	DEFINITION
XMAXJ J=1,10	DECIMAL	THE MAXIMUM VALUE OF MONX(J).
XMINJ J=1,10	DECIMAL	THE MINIMUM VALUE OF MONX(J).
YXMNJ J=1,10	DECIMAL	THE VALUE OF MONY(J) AT XMINJ.
YXMXJ J=1,10	DECIMAL	THE VALUE OF MONY(J) AT XMAXJ.

6.A.15. NUMERICAL INTEGRATION METHODS

THE PROGRAM CONTAINS THE FOLLOWING NUMERICAL INTEGRATION METHODS -

1) SECOND ORDER RUNGE-KUTTA
2) FOURTH ORDER RUNGE-KUTTA
3) FOURTH ORDER PREDICTOR-CORRECTOR

RUNGE-KUTTA SHOULD BE USED FOR PROBLEMS THAT HAVE A LARGE NUMBER OF EVENTS, AND PREDICTOR-CORRECTOR SHOULD BE USED FOR PROBLEMS THAT HAVE ONLY A FEW EVENTS. THIS IS BECAUSE PREDICTOR-CORRECTOR HAS TO BE RESTARTED AT EVERY EVENT.

THE INTEGRATION STEPSIZE IS INPUT AS A CONSTANT IN NAMELIST GENDAT. THE INTEGRATION STEPSIZE CAN ALSO BE COMPUTED FROM THE ARGUMENT OF A MONOVARIANT TABLE, PROVIDED THE ARGUMENT IS A TIME VARIABLE. THIS WILL INSURE THAT EVERY TABLE POINT IS EXACTLY INCLUDED IN THE INTEGRATION.

THE VARIABLES FOR THIS OPTION ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
DT	SEC	1.0	THE INTEGRATION INTERVAL (STEPSIZE)
NPC(2)	INTEGER	1	INTEGRATION METHOD FLAG. = 1, FOURTH ORDER RUNGE-KUTTA. = 2, FOURTH ORDER PREDICTOR-CORRECTOR. = 3, SECOND ORDER RUNGE-KUTTA
NPC(20)	INTEGER	0	FLAG TO SPECIFY THE TYPE OF SPECIAL INTEGRATION STEP SIZE (DT) PREDICTION TO BE USED. = 0, NONE. = 1, USE THE ARGUMENT VALUES OF THE MONOVARIANT TYPE TABLES WHICH HAVE TABLE(2)=-1, AS INTEGRATION TIMES. THE ARGUMENTS FOR THESE TABLES MUST BE A TIME PARAMETER, E.G., TIME, TIMES, TDUPP, TIMREJ, ETC.

6.A.16. PRINT VARIABLE REQUESTS

THE PROGRAM HAS THE CAPABILITY TO PRINT AS MANY AS 240 OUTPUT VARIABLES AT EACH PRINT TIME. A NOMINAL PRINT BLOCK IS OBTAINED AUTOMATICALLY WITHOUT USER INPUT IF DESIRED. HOWEVER THE USER CAN CHANGE PART OR ALL OF THE PRINT BLOCK IF DESIRED BY OVERRIDDING THE STORED VALUES WITH THE DESIRED NAMES BY MEANS OF THE ARRAY PRNT. THE ARRAY OF PRINT VARIABLES CAN BE TERMINATED AT ANY POINT BY INPUTTING PRNT(I)=5HPSTOP. THE PRINT REQUEST ARRAY PRNT(I) MUST BE INPUT SEQUENTIALLY WITH NO GAPS. SINCE THERE ARE 114 VARIABLES IN THE NOMINAL PRINT BLOCK, THE USER WOULD ADD TO THIS LIST BY BEGINNING THE INPUT OF THE ARRAY PRNT(I) WITH ELEMENT 115. FOR EXAMPLE, THE VARIABLE TIMREF1 WOULD BE ADDED TO THE NOMINAL BLOCK AS FOLLOWS -

```
PRNT(115)=6HTIMREF1,
```

THE VARIABLES WHICH ARE PRINTED IN THE NOMINAL PRINT BLOCK ARE AS FOLLOWS-

TIME	TIMES	TDURP	DENS	PRES	ATEM
ALTITD	GCRAD	GDLAT	GCLAT	LONG	LONGI
VELI	GAMMAI	AZVELI	XI	VXI	AXI
VELR	GAMMAR	AZVELR	YI	VYI	AYI
VELA	GAMMAA	AZVELA	ZI	VZI	AZI
GAMAD	AZVAD	DWNRNG	CRRNG	DPRNG1	DPRNG2
THRUST	WEIGHT	WDOT	WEICON	WPRCP	ASMG
FTXB	FAXB	AXB	TMXB	AMXB	TTMXB
FTYB	FAYB	AYB	TMYB	AMYB	TTMYB
FTZB	FAZB	AZB	TMZB	AMZB	TTMZB
CA	CLL	CD	DRAG	DYNP	ASXI
CY	CM	CL	LIFT	MACH	ASYI
CN	CW	HEATRT	TLHEAT	REYND	ASZI
ROLBD	ROLBDD	ROLI	YAWR	ALPHA	ALPTOT
PITBD	PITBDD	YAWI	PITR	BETA	QALPHA
YAWBD	YAWBDD	PITI	ROLR	BNKANG	QALTOT
ROLBER	ROLAC	XREF	XCG	IXX	IXY
PITBER	PITAC	YREF	YCG	IYY	IXZ
YAWBER	YAWAC	ZREF	ZCG	IZZ	IYZ

OTHER SPECIAL PRINT BLOCKS CAN BE REQUESTED IN ADDITION TO THE MAIN PRINT BLOCK DESCRIBED ABOVE. ANY OF THE VARIABLES LISTED IN THE SPECIAL PRINT BLOCKS MAY BE PRINTED INDIVIDUALLY USING THE PRNT ARRAY. THESE SPECIAL PRINT BLOCKS ARE SUMMARIZED AS FOLLOWS-

6.A.16. PRINT VARIABLE REQUESTS (CONTD)

CONIC PRINT BLOCK. OBTAINED IF NPC (1)=2 OR 3.

*** ELLIPTIC ORBIT ***

ALTP	ALTA	ECCEN	INC	PERIOD	ARGP
ENERGY	SEMJAX	TRUAN	LAN	ANGMOM	PGERAD
APORAD	PGCLAT	PGLON	ARGV	TIMTP	TIMSP
ECCAN	MEAAN	PGVEL	APVEL	DVCIR	VCIRC
LANVE					

*** HYPERBOLIC ORBIT ***

HYPVEL	SEMJAX	ECCEN	DECLIN	RTASC	PERIOD
TRUAN	TRUNMX	INC	ENERGY	ANGMOM	ALTP
PGERAD	PGCLAT	PGLON	ARGV	TIMTP	TIMSP
ECCAN	MEAAN	PGVEL	DVCIR	VCIRC	LANVE

VELOCITY LOSSES PRINT BLOCK. OBTAINED IF NPC(25)=2 OR 3.

*** VELOCITY LOSSES ***

DLR	TVLR	ATL	GLR	VIDEAL

THE FOLLOWING VARIABLES ASSOCIATED WITH THE PRINT VARIABLE REQUESTS ARE INPUT IN NAMELIST GENDAT.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(19)	INTEGER	1	FLAG TO CONTROL PRINTING OF INPUT CONDITIONS FOR EACH PHASE. = 0, DO NOT PRINT INPUT CONDITION SUMMARIES. = 1, PRINT INPUT CONDITION SUMMARIES FOR EACH PHASE.
PINC	SEC	0.	PRINT INTERVAL. IF PINC IS INPUT EQUAL TO ZERO, PRINTOUTS WILL OCCUR AT THE END OF EACH INTEGRATION STEP OTHERWISE, PINC MUST BE INPUT AS MULTIPLE OF THE INTEGRATION INTERVAL (DT).

6.A.16. PRINT VARIABLE REQUESTS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
PRNT(I) I=1,240	HOLLERITH	0.	PRINT VARIABLE NAMES. THESE CAN BE ANY OF THE VARIABLES CONTAINED IN THE LIST OF OUTPUT VARIABLES. A NOMINAL PRINT BLOCK IS OBTAINED UNLESS OVERRIDDEN BY THIS INPUT. THE PRINT LIST CAN BE TERMINATED AT ANY POINT BY INPUT OF PRNT(I)=5HPSTOP.
TITLE(I) I=1,10	HOLLERITH	0.	A 10 WORD TITLE TO BE USED FOR PROBLEM/PHASE IDENTIFICATION. EACH WORD CONTAINS 10 CHARACTERS, THEREBY PROVIDING A TOTAL OF 100 CHARACTERS FOR THE TITLE. THIS TITLE IS PRINTED AT THE TOP OF EACH PAGE OF PRINTOUT.

6.A.17. PROFILE TAPE OPTION

THE PROGRAM HAS THE CAPABILITY TO WRITE THE CONTENTS OF THE PRINT BLOCK ON A TAPE AT A USER SPECIFIED INTERVAL (PRNC). THIS TAPE WHICH CONTAINS THE TIME HISTORY OF THE TRAJECTORY PRINT BLOCK IS REFERRED TO AS A PROFILE TAPE AND IS WRITTEN ON LOGICAL UNIT PROFIL. THE CONTENTS OF PROFIL MUST BE COPIED TO A PHYSICAL TAPE AT THE CONCLUSION OF THE PROGRAM EXECUTION VIA CONTROL CARDS IF IT IS TO BE SAVED FOR LATER USE.

THE PROFILE TAPE CAN BE READ BY PROGRAMS CONTAINING THE NECESSARY PROFILE TAPE READ ROUTINES. THESE PROGRAMS CAN BE USED TO GENERATE A WIDE VARIETY OF DATA FROM THE PROFILE TAPE SUCH AS PLOTS, PUNCHED CARDS, ETC.

THE CONTENTS OF THE PROFILE TAPE CONSISTS OF TWO IDENTIFYING BINARY RECORDS FOLLOWED BY AS MANY 500 WORD RECORDS AS REQUIRED TO WRITE THE DATA FOR A TRAJECTORY PHASE. THIS SEQUENCE OF RECORDS IS REPEATED FOR EACH PHASE IN THE TRAJECTORY. ADDITIONAL TRAJECTORIES ARE WRITTEN AS SEPARATE BINARY FILES FOR EACH TRAJECTORY PRINTED WHILE USING THIS OPTION. THE VARIABLES ARE ACCESSED FROM THE PROFILE TAPE BY NAME AND THE NAMES ARE THE SAME AS THOSE IN THE PRNT ARRAY.

THE VARIABLES ASSOCIATED WITH THE PROFILE TAPE OPTION ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
FID(J) J=1,2	HOLLERITH	UD265 FILE I.D. 0000	THE TWO WORD (20 CHARACTERS) FILE IDENTIFICATION TO BE WRITTEN ON THE PROFILE TAPE WHEN USING THE PROFILE TAPE OPTION, I. E., IF PRNC IS INPUT GREATER THAN OR EQUAL TO ZERO.

6.A.17. PROFILE TAPE OPTION (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
PRNC	SEC	1HU	PROFILE TAPE WRITE INTERVAL. THIS VARIABLE ACTIVATES THE PROFILE TAPE WRITE OPTION IN ADDITION TO SPECIFYING THE WRITE INTERVAL. IF PRNC=0, THE PRINT BLOCK WILL BE WRITTEN ON THE PROFILE TAPE AT THE END OF EACH INTEGRATION STEP. IF PRNC IS INPUT GREATER THAN ZERO, IT MUST BE A MULTIPLE OF DT.

6.A.18. PROPULSION/THROTTLING INPUTS

THE TYPE OF ENGINES TO BE USED (ROCKET OR JET) IS SPECIFIED BY NPC(9). THE THRUST AND FLOWRATE (OR SPECIFIC FUEL CONSUMPTION FOR JETS) ARE INPUT AS TABLES VIA NAMELIST TAB. THE CONSTANT INPUT VARIABLES ARE INPUT VIA NAMELIST GENDAT.

THE PROGRAM CAN SIMULATE AS MANY AS 15 ENGINES PER PHASE. THE THRUST FOR EACH ENGINE IS SPECIFIED BY TABLE INPUT OF TVCIT. THE FLOWRATE CAN EITHER BE SPECIFIED BY TABLE INPUT OF WDIT OR CAN BE COMPUTED BASED ON ISPV DEPENDING ON THE VALUE OF NPC(21). THE ENGINES TO BE USED ARE SPECIFIED BY THE ARRAY ENGF(I), I=1,15. THE ENGINES DEFLECT IN PITCH AND YAW PLANES WHICH ARE PARALLEL TO THE BODY AXES PITCH AND YAW PLANES UNLESS THE ENGINES ARE DESIGNATED AS ROLL ENGINES BY THE ARRAY RENG(I), I=1,15, AND THE ROLL ORIENTATION ANGLE ENGROL(I), I=1,15. IF RENG(I) SPECIFIES ENGINE I AS A ROLL ENGINE, THEN THE PITCH AND YAW PLANES OF THE ENGINE ARE THOSE RESULTING FROM THE ROLL ANGLE ENGROL(I) IF IT IS INPUT OR IN A PLANE NORMAL TO THE RADIAL POSITION OF THE ENGINE LOCATION IF ENGROL(I) IS NOT INPUT.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(9)	INTEGER	0	PROPULSION TYPE FLAG. = 0, NO THRUST. = 1, NENG ROCKET ENGINES. INPUT A THRUST TABLE (TVCIT) FOR EACH ENGINE AND EITHER A FLOWRATE TABLE (WDIT) OR VACUUM SPECIFIC IMPULSE (ISPV(I)) BASED ON THE VALUE OF NPC(21). = 2, NENG JET ENGINES. INPUT A TABLE OF NET THRUST (TVCIT) AND SPECIFIC FUEL CONSUMPTION (WDIT) FOR EACH ENGINE.
NPC(21)	INTEGER	0	FLAG TO INDICATE THE METHOD BY WHICH FLOWRATE IS TO BE COMPUTED FOR ROCKET ENGINES. = 0, FLOWRATE IS A TABLE LOOK-UP OF THE INPUT FLOWRATE TABLE (WDIT, I=1,15). = 1, COMPUTE FLOWRATE USING VACUUM THRUST AND THE INPUT VACUUM SPECIFIC IMPULSE (ISPV(I), I=1,15).

6.A.18. PROPULSION/THROTTLING INPUTS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(22)	INTEGER	0	THROTTLING PARAMETER INPUT OPTION FLAG. = 0, THE THROTTLING PARAMETER (ETA) IS OBTAINED BY EVALUATING A CUBIC POLYNOMIAL WHERE THE CONSTANT TERM IS SET EQUAL TO THE VALUE OF ETA AT THE TIME NPC(22)=0 IS REQUESTED. THE COEFFICIENTS ARE INPUT AS ETAPC(I), I=2,4. = 1, THE THROTTLING PARAMETER (ETA) IS OBTAINED BY EVALUATING A CUBIC POLYNOMIAL AS WHEN NPC(22)=0 EXCEPT THAT THE CONSTANT TERM IS INPUT AS ETAPC(1). = 2, THE THROTTLING PARAMETER (ETA) IS A TABLE LOOK-UP OF THE INPUT TABLE ETAT. = 3, THE THROTTLING PARAMETER (ETA) IS A PIECEWISE LINEAR FUNCTION OF THE EVENT SPECIFIED BY DESNE. INPUT THE INITIAL VALUE OF ETA IN THE FIRST PHASE AS ETA. THE DESIRED VALUE OF ETA AT EVENT DESNE IS INPUT AS DETA.
NPC(27)	INTEGER	0	ACTIVATION FLAG FOR THE OPTION TO INTEGRATE THE FLOWRATE OF SPECIFIED ENGINES. IWPF(I) MUST ALSO BE INPUT. = 0, INACTIVE. = 1, ACTIVE.

6.A.18. PROPULSION/THROTTLING INPUTS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
DESNE	DECIMAL	THE NEXT PRIMARY EVENT NUMBER	THE EVENT NUMBER AT WHICH THE VALUE OF THE THROTTLING PARAMETER (ETA) IS TO ATTAIN THE DESIRED VALUE (DETA) AS A LINEAR FUNCTION OF THE CRITERIA VARIABLE (CRITR) FOR THE EVENT SPECIFIED BY DESNE. USED IF NPC(22)=3.
DETA	DECIMAL	0.	THE DESIRED VALUE OF THE THROTTLING PARAMETER (ETA) AT THE EVENT SPECIFIED BY DESNE. USED IF NPC(22) =3.
FNGF(I) I=1,15	INTEGER	0	A FLAG TO INDICATE THAT ENGINE I IS ON OR OFF. = 0, ENGINE I IS OFF. = 1, ENGINE I IS ON.
ENGROL(I) I=1,15	DEG	0.0	THE ROLL ANGLE OF ENGINE I ABOUT THE VEHICLE XB AXIS.
ETA	DECIMAL	1.0	THE INITIAL VALUE OF THE THROTTLING PARAMETER WHEN USING NPC(22)=3.
ETAARG	HOLLERITH	TIMES	THE NAME OF THE VARIABLE TO BE USED AS THE ARGUMENT FOR THE ETA POLYNOMIAL. USED IF NPC(22)=0,1.
ETAPC(I) I=1,4	DECIMAL	1.0,3*0.	THROTTLING PARAMETER (ETA) POLYNOMIAL COEFFICIENTS. USED IF NPC(22)=0 OR 1.
GXP(I) GYP(I) GZP(I) I=1,15	FT (M)	0.	LOCATION OF THE ENGINE GIMBAL IN BODY REFERENCE (XBR,YBR,ZBR) SYSTEM FOR ENGINE I.
ISPV(I) I=1,15	SEC	0.	VACUUM SPECIFIC IMPULSE FOR ENGINE I. USED IF NPC(21)=1.

6.A.18. PROPULSION/THROTTLING INPUTS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
IWPF(I) I=1,15	INTEGER	0	FLAG TO INDICATE WHICH ENGINES ARE TO BE INCLUDED IN THE SPECIFIC FLOWRATE INTEGRATION OBTAINED WHEN NPC(27) = 1. = 0, DO NOT INCLUDE ENGINE I. = 1, INCLUDE ENGINE I.
PSL	LB/FT**2 (N/M2)	VARIES BASED ON NPC(5)	SEA LEVEL ATMOSPHERIC PRESSURE USED IN COMPUTING JET ENGINE THRUST AND FLOWRATE. USED IF NPC(9)=2. IF NOT INPUT, PSL WILL BE SET EQUAL TO THE ATMOSPHERIC PRESSURE AT ALTITO=0.
PWPROP	LBS (N)	0.	THE VALUE OF THE PROPELLANT CONSUMED BY THE ENGINES SPECIFIED BY IWPF(I) WHEN USING THE SPECIAL PROPELLANT FLOWRATE INTEGRATION OPTION. USED IF NPC(27)=1. THIS INPUT ALLOWS THE USER TO RESET THE VALUE OF PWPROP AT ANY PHASE.
RENG(I) I=1,15	INTEGER	0	A FLAG TO INDICATE THAT ENGINE I IS A ROLL ENGINE. = 0 , ENGINE I IS NOT A ROLL ENGINE. = 1 , ENGINE I IS A ROLL ENGINE.
TSL	DEG R (DEG K)	VARIES BASED ON NPC(5)	SEA LEVEL ATMOSPHERIC TEMPERATURE USED IN COMPUTING JET ENGINE THRUST AND FLOWRATE. USED IN NPC(9)=2. IF NOT INPUT, TSL WILL BE SET EQUAL TO THE ATMOSPHERIC TEMPERATURE AT ZERO ALTITUDE.

6.A.18. PROPULSION/THROTTLING INPUTS (CONTD)

THE FOLLOWING TABLE INPUTS ASSOCIATED WITH THE PROPULSION OPTIONS ARE INPUT IN NAMELIST TAB.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
AEIT I=1,15	FT**2 (M2)	0.	TABLE OF EXIT AREA FOR ENGINE I WHEN USING ROCKET ENGINES, I.E., IF NPC(9)=1.
ETAT	N/D	0.	TABLE OF THE THROTTLING PARAMETER. USED IF NPC(22)=2.
TVCIT I=1,15	LBS (N)	0.	VACUUM THRUST TABLE FOR ENGINE I WHEN USING ROCKET ENGINES, I.E., IF NPC(9)=1, OR NET THRUST OVER THE ATMOSPHERIC PRESSURE RATIO WHEN USING JET ENGINES, I.E., IF NPC(9)=2.
WDIT I=1,15	LB/SEC OR LB/SEC/LB (N/S OR N/S/N)	0.	FLOWRATE TABLE FOR ENGINE I WHEN USING ROCKET ENGINES, I.E., IF NPC(9)=1 AND NPC(21)=0. OR SPECIFIC FUEL CONSUMPTION WHEN USING JET ENGINES, I.E., IF NPC(9)=2.

THE OUTPUT VARIABLES ASSOCIATED WITH THE PROPULSION OPTIONS ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
AEJ J=1,15	FT**2 (M2)	TABLE LOOK-UP VALUE OF EXIT AREA FOR ENGINE J. CALCULATED IF NPC(9)=1.
FTXB FTYB FTZB	LBS (N)	THRUST FORCES IN THE BODY COORDINATE SYSTEM. CALCULATED IF NPC(9)=1,2.

6.A.18. PROPULSION/THROTTLING INPUTS (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
PWDOT	LB/SEC (N/S)	THE FLOWRATE RESULTING FROM THE SUMMATION OF INDIVIDUAL FLOWRATES OF THE ENGINES INCLUDED IN THE SPECIAL FLOWRATE INTEGRATION OPTION. ACTIVATED BY NPC(27) = 1, AND IWPF(I) = 1.
PWPROP	LB (N)	THE PROPELLANT CONSUMED BY THE SPECIFIED ENGINES FOR THE SPECIAL FLOWRATE INTEGRATION OPTION. ACTIVATED BY NPC(27) = 1, AND IWPF(I) = 1.
THRJ J=1,15	LBS (N)	VALUE OF NET THRUST FOR ENGINE J. CALCULATED IF NPC(9)=1,2.
THRUST	LBS (N)	NET THRUST (VACUUM THRUST CORRECTED FOR ATMOSPHERIC BACKPRESSURE EFFECTS). CALCULATED IF NPC(9)=1,2.
TMXB TMYB TMZB	FT-LBS (N-M)	THE TOTAL THRUST MOMENTS ABOUT THE VEHICLE ROLL, PITCH AND YAW BODY AXES.
TVAC	LBS (N)	VACUUM THRUST. CALCULATED IF NPC(9)=1.
WDJ J=1,15	LB/SEC (N/S)	TABLE LOOK-UP VALUE OF FLOWRATE FOR ENGINE J. CALCULATED IF NPC(9)=1,2.
WDOT	LB/SEC (N/S)	TOTAL WEIGHT FLOWRATE.
WEICON	LBS (N)	THE AMOUNT OF PROPELLANT CONSUMED SINCE IT WAS ZEROED OUT BY INPUT.
WPROP	LBS (N)	WEIGHT OF THE REMAINING PROPELLANT.

6.A.19 RANGE CALCULATIONS

THE PROGRAM HAS THE CAPABILITY TO CALCULATE DOWNRANGE, CROSSRANGE, AND DOT PRODUCT (NON-DIRECTIONAL) RANGE BASED ON SEVERAL DEFINITIONS OF THESE PARAMETERS. THE DESIRED OPTION IS SELECTED BY THE APPROPRIATE INPUT OF NPC(12). THE DOT PRODUCT RANGE IS CALCULATED REGARDLESS OF THE SPECIFIC OPTION SELECTED FOR DOWNRANGE AND CROSSRANGE.

THE VARIABLES ASSOCIATED WITH THE RANGE CALCULATIONS ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(12)	INTEGER	0	CROSSRANGE AND DOWNRANGE OPTION FLAG. = 0, DO NOT CALCULATE CROSSRANGE AND DOWNRANGE. = 1, COMPUTE CROSSRANGE (CRRNG) AND DOWNRANGE (DWNRNG) BASED ON RELATIVE GREAT CIRCLES. = 2, COMPUTE CRRNG AND DWNRNG BASED ON INERTIAL GREAT CIRCLES. = 3, COMPUTE CRRNG AND DWNRNG RELATIVE TO THE GROUND TRACK OF THE REFERENCE CIRCULAR ORBIT DEFINED BY ALTREF AND AZREF. = 4, ZERO OUT CRRNG AND COMPUTE DWNRNG USING THE BREGUET RANGE EQUATION FOR CRUISE FLIGHT.
ALTREF	N.MI. (KM)	100.	ALTITUDE OF THE REFERENCE CIRCULAR ORBIT FOR USE IN COMPUTING THE CROSSRANGE RELATIVE TO THE GROUND TRACK OF THE REFERENCE ORBIT. USED IF NPC(12)=3.
AZREF	DEG	0.	THE AZIMUTH REFERENCE FOR USE IN COMPUTING DWNRNG AND CRRNG. USED IF NPC(12)=1,2,3.
CLCDMX	DECIMAL	0.	THE VALUE OF THE MAXIMUM LIFT TO DRAG RATIO FOR CRUISE FLIGHT USED TO COMPUTE DOWNRANGE (DWNRNG) BY MEANS OF THE BREGUET EQUATION. USED IF NPC(12)=4.

6.A.19. RANGE CALCULATIONS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
LATREF LONREF	DEG	0.	REFERENCE LATITUDE AND LONGITUDE FOR USE IN COMPUTING THE VARIOUS RANGE PARAMETERS. USED IF NPC(12) =1,2,3,4.
TIMREF	DECIMAL	0.	THE REFERENCE TIME TO BE USED FOR THE INERTIAL RANGE CALCULATIONS. USED IF NPC(12)=2.

THE OUTPUTS ASSOCIATED WITH THE RANGE CALCULATIONS ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
CRRNG	N.MI. (KM)	CROSSRANGE DISTANCE. CALCULATED IF NPC(12) =1,2,3.
DPRNG1 DPRNG2	N.MI. (KM)	THE DOT PRODUCT (NON-DIRECTIONAL) RANGE FROM THE REFERENCE POINT (SPECIFIED BY LATREF AND LONREF) TO THE CURRENT VEHICLE POSITION (GCLAT AND LONG). THE AVERAGE RADIUS TO THE SURFACE OF THE OBLATE PLANET BETWEEN THE INITIAL AND CURRENT VEHICLE LOCATIONS IS USED IN THE CALCULATION OF DPRNG1 AND DPRNG2. DPRNG1 IS ALWAYS LESS THAN HALF THE EARTHS CIRCUMFERENCE, WHEREAS DPRNG2 WILL BE GREATER THAN HALF THE EARTHS CIRCUMFERENCE IF THE VEHICLE TRAVELS MORE THAN HALF THE EARTHS CIRCUMFERENCE. CALCULATED IF NPC(12)=1,2,3,4.
DWNRNG	N.MI. (KM)	DOWNRANGE DISTANCE. CALCULATED IF NPC(12) =1,2,3,4.
RS	FT (M)	RADIUS TO THE SURFACE OF THE OBLATE PLANET. USED TO COMPUTE ALTITD AND IN THE RANGE CALCULATIONS IF NPC(12)=1,2,3.
RSO	FT (M)	RADIUS TO THE SURFACE OF THE OBLATE AT THE LATITUDE SPECIFIED BY LATREF. USED IN THE RANGE CALCULATIONS IF NPC(12)=1,2,3.

6.A.20 SPECIAL CALCULATIONS FEATURE

THE PROGRAM HAS A FEATURE THAT ALLOWS THE PROGRAM TO BE MODIFIED QUICKLY TO CALCULATE SPECIAL VARIABLES OF A TEMPORARY NATURE. THIS IS ACCOMPLISHED THROUGH THE USE OF SPECIAL INPUT VARIABLES (NSPEC AND SPECI) AND OUTPUT VARIABLES SPECVJ, J=1,9.

THE DESIRED CALCULATIONS ARE PROGRAMMED INTO SUBROUTINE CALSPEC USING THE SPECIAL VARIABLES (NSPEC, SPECI, SPECV) AND ANY OF THE REGULAR PROGRAM VARIABLES. IN THIS MANNER, THE INPUT/OUTPUT AND INTERNAL PROGRAM INTERFACES ARE ALWAYS AVAILABLE.

THE STEPS REQUIRED TO UTILIZE THIS FEATURE ARE AS FOLLOWS -

1. DETERMINE THE EQUATIONS TO BE PROGRAMMED.

2. DEFINE ANY FLAGS TO BE USED AS THE INPUT ARRAY NSPEC(J), J=1,5. THESE FLAGS ARE PRESET TO ZERO IF NOT INPUT.

3. DEFINE ANY INPUT VARIABLES TO BE USED AS THE ARRAY SPECI(J), J=1,9. THESE VARIABLES ARE PRESET TO ZERO IF NOT INPUT.

4. DEFINE THE DESIRED OUTPUT VARIABLES AS THE ARRAY SPECV(J) J=1,9. THE OUTPUT SYMBOL FOR THIS ARRAY IS SPECVJ, J=1,9.

5. CODE THE DESIRED EQUATIONS INTO SUBROUTINE CALSPEC. THE ARRAYS TEMP(I) AND STEMP(I), I=1,25 SHOULD BE USED FOR ANY INTERMEDIATE CALCULATIONS TO MINIMIZE THE CORE REQUIREMENTS.

6. THE VARIABLES SPECVJ CAN BE USED AS DEPENDENT VARIABLES, OPTIMIZATION VARIABLE, TABLE ARGUMENTS, ETC. THE INPUT VARIABLES SPECIJ CAN BE USED AS INDEPENDENT VARIABLES, DEPENDENT VARIABLES, TABLE ARGUMENTS, ETC.

6.A.20. SPECIAL CALCULATIONS FEATURE (CONTD)

THE VARIABLES ASSOCIATED WITH THIS OPTION ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NSPEC(J) J=1,5	INTEGER	0	THE ARRAY OF INPUT FLAGS FOR USE IN THE SPECIAL CALCULATIONS ROUTINE (CALSPEC).
SPECI(J) J=1,9	DECIMAL	0.	THE CONSTANT VALUED INPUT VARIABLES FOR USE IN THE SPECIAL CALCULATIONS ROUTINE (CALSPEC).

THE OUTPUTS ASSOCIATED WITH THIS OPTION ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
SPECVJ J=1,9	DECIMAL	THE OUTPUT VARIABLES ASSOCIATED WITH THE SPECIAL CALCULATIONS ROUTINE (CALSPEC).

6.A.21. STATIC TRIM INPUTS

THIS OPTION IS NOT AVAILABLE IN 6D POST. THE POINT MASS VERSION OF POST MUST BE USED TO OBTAIN THIS OPTION.

6.A.22. TIME REFERENCE INPUTS

THERE ARE SEVERAL TIME REFERENCES AVAILABLE WHICH ALLOW THE USER TO INITIATE EVENTS OR INPUT TABLE DATA AS FUNCTIONS OF ANY OF THESE TIME REFERENCES.

THE VARIOUS TIMES ARE SUMMARIZED AS-

1) TRAJECTORY TIME (TIME),

2) TIME SINCE THE LAST EVENT (TIMES),

3) TIME SINCE THE LAST PRIMARY EVENT (TDURP), AND

4) FOUR TIMES WHICH CAN BE REFERENCED FROM ANY ARBITRARY POINT (TIMREFJ, J=1,4).

INITIAL VALUES OF TIME AND TIMREFJ CAN BE INPUT. THESE INPUTS ARE CALLED TIMEO AND TIMREF(J), RESPECTIVELY, AND THE INPUTS ARE MADE VIA NAMELIST GENDAT. THE PHASE TIMES, TIMES AND TDURP, ARE STRICTLY OUTPUT VARIABLES AND CANNOT BE CHANGED BY INPUT. THE FOUR REFERENCE TIMES ARE INTEGRATED WHEN THEIR DERIVATIVES, DTIMR(J), ARE INPUT NONZERO. THESE ARE THE DERIVATIVES OF TIMREFJ WITH RESPECT TO TIME. IF TIMREFJ IS TO BE SECONDS, THE DERIVATIVE DTIMR(J) SHOULD BE INPUT AS 1. IF TIMREFJ IS TO BE MINUTES, THEN DTIMR(J) SHOULD BE INPUT AS 1/60. IF TIMREFJ IS TO BE HOURS, THEN DTIMR(J) SHOULD BE INPUT AS 1/3600, ETC. ANOTHER USE OF TIMREFJ IS THAT OF SIMULATING TIMER ERRORS. IN THIS CASE, DTIMR(J) WOULD BE INPUT DIFFERENT FROM 1. FOR EXAMPLE, A PLUS 2 PERCENT TIMER ERROR FOR REFERENCE TIME 1 WOULD BE SIMULATED BY INPUTTING DTIMR(1)=1.02.

THE INPUTS FOR THE REFERENCE TIMES ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
TIME	SEC	0.	THE INITIAL VALUE OF TRAJECTORY TIME.
DTIMR(J) J=1,4	SEC	0.	THE DERIVATIVE OF TIME REFERENCE J. THIS INPUT ACTIVATES THE INTEGRATION OF TIMREF(J) WHEN INPUT NONZERO. IT ALSO IS THE DERIVATIVE OF TIMREF(J) WITH RESPECT TO TIME AND SHOULD BE INPUT EQUAL TO 1 EXCEPT WHEN SIMULATING TIMER ERRORS.

6.A.22. TIME REFERENCE INPUTS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
TIMRF(J) J=1,4	SEC	0.	TIME REFERENCE J. THESE TIMES ARE ACTIVATED WHEN THEIR DERIVATIVES ARE INPUT NONZERO. THE DERIVATIVES ARE INPUT AS DTIMR(J). TIMRF(J) ACCUMULATES UNTIL IT IS RESET BY INPUT, OR UNTIL THE DERIVATIVE DTIMR(J) IS INPUT EQUAL TO ZERO.

THE OUTPUTS ASSOCIATED WITH THE TIME REFERENCES ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
TIME	SEC	CURRENT TRAJECTORY (PROBLEM) TIME.
TIMRFJ J=1,4	SEC	REFERENCE TIMES. THESE WILL BE CALCULATED IF THE DERIVATIVES (DTIMR(J),J=1,4) ARE INPUT GREATER THAN ZERO.
TDURP	SEC	THE TIME SINCE THE OCCURRENCE OF THE LAST PRIMARY EVENT.
TIMES	SEC	THE TIME SINCE THE BEGINNING OF THE CURRENT PHASE.

6.A.23. TRACKING STATIONS

THIS OPTION IS NOT AVAILABLE IN 6D POST. THE POINT MASS VERSION OF POST MUST BE USED TO OBTAIN THIS OPTION.

6.A.24. VEHICLE/PROPELLANT WEIGHT INPUTS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(17)	INTEGER	0	WEIGHT JETTISON OPTION FLAG BASED FMASST. = 0, NOT USED. = 1, COMPUTE WJETTM USING THE MASS FRACTION TABLE FMASST AS FOLLWS - WJETTM = WPROPI/FMASST - WPROPI = 2, SET WJETT EQUAL TO WJETTM. = 3, SET WJETTM EQUAL TO THE TABLE LOOK-UP OF FMASST.
GO	FT/SEC**2 (M/S**2)	32.174	WEIGHT TO MASS CONVERSION CONSTANT.
PWPROP	LBS (N)	0.	THE VALUE OF THE PROPELLANT CONSUMED BY THE ENGINES SPECIFIED BY IWPF(I) WHEN USING THE SPECIAL PROPELLANT FLOWRATE INTEGRATION OPTION. USED IF NPC(27)=1. THIS INPUT ALLOWS THE USER TO RESET THE VALUE OF PWPROP AT ANY PHASE.
WEICON	LBS (N)	0.	THE INITIAL VALUE OF THE AMOUNT OF PROPELLANT CONSUMED. THIS CAN BE INPUT IN ANY PHASE TO RESET THE AMOUNT OF PROPELLANT CONSUMED.
WGTSG	LBS (N)	0.	THE VEHICLE GROSS WEIGHT (EXCLUDING WPLD) AT THE BEGINNING OF THE PHASE IN WHICH WGTSG IS INPUT. IF WGTSG IS NOT INPUT (OR EQUAL TO ZERO) IN A PHASE OTHER THAN THE FIRST, THE INITIAL WEIGHT WILL BE COMPUTED USING WEIGHT, WJETT, WPLD, AND WPROP BASED ON THE VALUES OF NPC(13) AND NPC(17). IF NPC(5)=1.
WJETT	LBS (N)	0.	THE WEIGHT TO BE JETTISONED AT THE BEGINNING OF THE PHASE IN WHICH WJETT IS INPUT.

6.A.24. VEHICLE/PROPELLANT WEIGHT INPUTS

THE GROSS WEIGHT OF THE VEHICLE AT THE BEGINNING OF EACH PHASE CAN BE SPECIFIED AS THE SUM OF THE GROSS WEIGHT WITHOUT PAYLOAD (WGTSG) AND THE PAYLOAD WEIGHT (WPLD). FOR PHASES OTHER THAN THE FIRST, THE GROSS WEIGHT CAN OPTIONALLY BE COMPUTED INTERNALLY BY SUBTRACTING THE INPUT JETTISON WEIGHT (WJETT) AND THE REMAINING PROPELLANT (WPROP), IF DESIRED, FROM THE VEHICLE WEIGHT AT THE END OF THE PREVIOUS PHASE.

THE TWO ABOVE OPTIONS ARE OBTAINED AUTOMATICALLY BASED ON THE PARAMETERS BEING INPUT AS FOLLOWS -

1) IF WGTSG AND WPLD ARE INPUT IN A GIVEN PHASE, THE GROSS WEIGHT FOR THAT PHASE WILL BE THE SUM OF WGTSG AND WPLD.

2) IF WGTSG IS NOT INPUT (OR EQUAL TO ZERO) IN A PHASE OTHER THAN THE FIRST, THEN THE GROSS WEIGHT FOR THAT PHASE WILL BE COMPUTED BY SUBTRACTING THE INPUT JETTISON WEIGHT (WJETT) AND THE REMAINING PROPELLANT (WPROP) BASED ON THE VALUE OF NPC(13).

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(13)	INTEGER	0	PROPELLANT JETTISION OPTION FLAG. = 0, DO NOT JETTISON THE REMAINING PROPELLANT (WPROP). = 1, JETTISON THE REMAINING PROPELLANT (WPROP) AT THE BEGINNING OF THE CURRENT PHASE. = 2, SAVE THE AMOUNT OF PROPELLANT REMAINING AT THE END OF THE PREVIOUS PHASE TO BE JETTISONED AT A LATER TIME. = 3, JETTISION THE AMOUNT OF PROPELLANT SAVED BY NPC(13)=2 ABOVE.

6.A.24. VEHICLE/PROPELLANT WEIGHT INPUTS (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
WPLD	LBS (N)	0.	THE PAYLOAD WEIGHT. THIS PARAMETER CAN ONLY BE INPUT IN A PHASE IF WGTSG IS ALSO INPUT FOR THAT PHASE. IN THIS CASE, WGTSG MUST BE INPUT AS THE GROSS WEIGHT WITHOUT ANY PAYLOAD WEIGHT. THE VALUE OF WPLD WILL BE CARRIED OVER FROM ONE PHASE TO THE NEXT UNLESS OVERRIDDEN BY LATER INPUT.
WPROPI	LBS (N)	0.	THE INITIAL WEIGHT OF PROPELLANT. THIS PARAMETER IS NOT USED TO COMPUTE THE GROSS WEIGHT OF THE VEHICLE BUT IS USED ONLY AS AN INDICATOR OF THE AVAILABLE PROPELLANT FOR A GIVEN STAGE SO THAT THE REMAINING PROPELLANT (WPROP) CAN BE COMPUTED FOR USE AS A CRITERIA VARIABLE OR AS PART OF THE WEIGHT TO BE JETTISONED BASED ON THE VALUE OF NPC (13).

THE TABLE INPUTS ASSOCIATED WITH THE VEHICLE/PROPELLANT WEIGHT CALCULATIONS ARE INPUT IN NAMELIST TAB AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
FMASST	DECIMAL	0.	A TABLE WHICH IS USED IN CONJUNCTION WITH NPC(17) TO DETERMINE THE VALUE OF WJETTM AS FOLLOWS - IF NPC(17)=1, COMPUTE WJETTM AS WJETTM = WPROPI/FMASST-WPROPI IF NPC(17)=3, COMPUTE WJETTM AS WJETTM = FMASST

6.A.24. VEHICLE/PROPELLANT WEIGHT INPUTS (CONTD)

THE OUTPUTS ASSOCIATED WITH THE VEHICLE/PROPELLANT WEIGHT PARAMETERS ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
DMASS	SLUGS/SEC (KG/S)	RATE OF CHANGE IN VEHICLE MASS.
MASS	SLUGS (KG)	VEHICLE MASS.
PJETTS	LBS (N)	THE PROPELLANT WEIGHT TO BE JETTISONED. CALCULATED INTERNALLY BY THE PROGRAM BASED ON THE VALUE OF NPC(13).
PWDOT	LB/SEC (N/S)	THE FLOWRATE RESULTING FROM THE SUMMATION OF INDIVIDUAL FLOWRATES OF THE ENGINES INCLUDED IN THE SPECIAL FLOWRATE INTEGRATION OPTION. ACTIVATED BY NPC(27) = 1, AND IWPF(I) = 1.
PWPROP	LB (N)	THE PROPELLANT CONSUMED BY THE SPECIFIED ENGINES FOR THE SPECIAL FLOWRATE INTEGRATION OPTION. ACTIVATED BY NPC(27) = 1, AND IWPF(I) = 1.
WDOT	LB/SEC (N/S)	TOTAL WEIGHT FLOWRATE.
WEICON	LBS (N)	THE AMOUNT OF PROPELLANT CONSUMED SINCE IT WAS ZEROED OUT BY INPUT.
WEIGHT	LBS (N)	CURRENT VEHICLE WEIGHT.
WJETTM	LBS (N)	THE JETTISON WEIGHT CALCULATED INTERNALLY BY THE PROGRAM BASED ON THE VALUE OF NPC(17).
WPROP	LBS (N)	WEIGHT OF THE REMAINING PROPELLANT.

6.A.25. VELOCITY LOSSES

THIS OPTION IS NOT AVAILABLE IN 6D POST. THE POINT MASS VERSION OF POST MUST BE USED TO OBTAIN THIS OPTION.

6.A.26. VELOCITY MARGIN CALCULATIONS

THIS OPTION IS NOT AVAILABLE IN 6D POST. THE POINT MASS VERSION OF POST MUST BE USED TO OBTAIN THIS OPTION.

6.A.27. WEIGHT CALCULATION OPTION

THE PROGRAM CAN OPTIONALLY COMPUTE THE WEIGHT OR THE RATE OF CHANGE OF WEIGHT THROUGH A WEIGHT CALCULATION OPTION THAT ALLOWS THE WEIGHT AND FLOW RATE TO BE SPECIFIED AS A SUM OF TWO TABLES. THIS OPTION CAN BE USED TO SIMULATE ABLATION DURING ASCENT OR REENTRY.

THE FOLLOWING VARIABLES ASSOCIATED WITH THE WEIGHT CALCULATION OPTION ARE INPUT IN NAMELIST GENDAT -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(30)	INTEGER	0	A FLAG TO SPECIFY THE WEIGHT CALCULATION OPTION TO BE USED. = 0, DO NOT USE WEIGHT CALCULATION OPTION. = 1, CALCULATE WEIGHT AS THE SUM OF TABLES WGT1T AND WGT2T. WEIGHT = WGT1T + WGT2T = 2, CALCULATE FLOW RATE AS THE SUM OF TABLES WGTD1T AND WGTD2T. WDOT = WGTD1T + WGTD2T
WGTJT J=1,2	LBS (N)	0.	TABLES USED TO COMPUTE WEIGHT WHEN NPC(30)=1.
WGTDJT J=1,2	LB/SEC (N/S)	0.	TABLES USED TO COMPUTE FLOW RATE WHEN NPC(30)=2.

6.A.28. SUN-SHADOW AND SUN ANGLE OPTION

THIS OPTION IS NOT AVAILABLE IN 6D POST. THE POINT MASS VERSION OF POST MUST BE USED TO OBTAIN THIS OPTION.

6.B. METHODS OF GUIDANCE (STEERING)

THE GUIDANCE (STEERING) OPTIONS CONTROL THE ATTITUDE OF THE VEHICLE DURING THE TRAJECTORY SIMULATION.

THE ADDITION OF GUIDANCE AND AUTOPILOT MODULES REQUIRES KNOWLEDGE OF THE PROGRAM CALLING SEQUENCE AND THE INTERACTION OF RELATED SUBROUTINES. THE CORRECT SIMULATION OF GUIDANCE AND AUTOPILOT FUNCTIONS REQUIRES THAT THE GUIDANCE AND AUTOPILOT ROUTINES BE ISOLATED FROM THE TRAJECTORY SIMULATOR WITH PROPER INTERFACES. FOR EXAMPLE, THE GUIDANCE SYSTEM MUST OBTAIN ALL ITS INFORMATION FROM THE SENSOR MODEL. OTHERWISE, ONLY IDEAL GUIDANCE SITUATIONS CAN BE SIMULATED.

THE OUTER-LOOP SUBROUTINES ARE CALLED FROM SUBROUTINE PHZXM IN THE FOLLOWING SEQUENCE -

SUBROUTINE	FUNCTION
CYCXM1	COMPUTE REFERENCE TIMES (ATIME, GTIME, AND TREF).
TGOEM	COMPUTE TIME TO GO TO NEXT EVENT (TGO).
CLGM	COMPUTE GUIDANCE AND AUTOPILOT COMMANDS.
CYCXM2	COMPUTE INTEGRATION INTERVAL (DELT).
INFXM	PRINT OUTPUT.
DYNXM	COMPUTE EQUATIONS OF MOTION (INNER-LOOP CALCULATIONS).
AUXFM	COMPUTE AUXILIARY VARIABLES.
CALSPE	COMPUTE SPECIAL VARIABLES.

THE GUIDANCE ROUTINE CLGM CALLS THE FOLLOWING ROUTINES SEQUENTIALLY -

SUBROUTINE	FUNCTION
GSENSR	CONVERT SIMULATOR (REAL WORLD) PARAMETERS TO GUIDANCE SENSED PARAMETERS.
GNAV	COMPUTE NAVIGATION EQUATIONS.

6.B. METHODS OF GUIDANCE (STEERING) (CONTD)

SUBROUTINE	FUNCTION
GGUID	COMPUTE GUIDANCE COMMANDS.
GCNTRL	COMPUTE AUTOPILOT COMMANDS.

THE EQUATIONS OF MOTION ARE INTEGRATED IN THE INNER-LOOP VIA SUBROUTINE DYNXM. SUBROUTINE MOTION IS THE MAIN ROUTINE IN THE CALCULATION OF THE EQUATIONS OF MOTION AND IS CALLED INDIRECTLY BY DYNXM. THIS ROUTINE, IN TURN, SEQUENTIALLY CALLS THE FOLLOWING SUBROUTINES -

SUBROUTINE	FUNCTION
MASSP	COMPUTE VEHICLE WEIGHT AND MASS PROPERTIES.
ATMOS	COMPUTE ATMOSPHERIC PARAMETERS.
WINDS	COMPUTE WIND VELOCITY.
IBMTRX	COMPUTE VEHICLE DIRECTION COSINES (IB MATRIX).
OLGM	COMPUTE OPEN-LOOP STEERING ERROR COMMANDS (ROLBER, PITBER, YAWBER).
HINGM	COMPUTE CONTROL SURFACE HINGE MOMENTS.
AUTOPM	COMPUTE AUTOPILOT COMMANDS (ROLAC, PITAC, YAWAC) GIVEN THE BODY ATTITUDE ERRORS (ROLBER, PITBER, YAWBER).
CONTM	COMPUTE SURFACE DEFLECTIONS OR ENGINE DEFLECTIONS GIVEN THE AUTOPILOT COMMANDS (ROLAC, PITAC, YAWAC) AND THE INPUT MIXING GAINS.
AERO	COMPUTE AERODYNAMIC FORCES AND MOMENTS GIVEN THE CONTROL SURFACE DEFLECTIONS (DELA, DELE, DELR).
AEROHI	COMPUTE AEROHEATING PARAMETERS.
PROP	COMPUTE THRUST FORCES AND MOMENTS GIVEN THE ENGINE DEFLECTIONS IN PITCH AND YAW (DEP(I), DEY(I)).

6.B. METHODS OF GUIDANCE (STEERING) (CONTD)

SUBROUTINE	FUNCTION
AIRFM	COMPUTE TOTAL EXTERNAL FORCES AND MOMENTS.
TMOTM	COMPUTE TRANSLATIONAL ACCELERATIONS.
RMOTM	COMPUTE ROTATIONAL ACCELERATIONS.

THE PROGRAM CAN SIMULATE EITHER OPEN-LOOP OR CLOSED LOOP GUIDANCE SYSTEMS. IN GENERAL, GUIDANCE SYSTEMS ARE VEHICLE AND MISSION DEPENDENT. AS A RESULT, SPECIFIC SYSTEMS CAN ONLY BE SIMULATED ACCURATELY BY PROGRAMMING THE EQUATIONS REQUIRED TO MODEL THE SPECIFIC SYSTEM TO THE DEGREE OF COMPLEXITY REQUIRED FOR THE APPLICATION BEING STUDIED.

SPECIFIC GUIDANCE MODELS CAN BE ADDED TO THE PROGRAM BY MEANS OF THE FOLLOWING PROCEDURE -

1. DETERMINE THE EQUATIONS TO BE PROGRAMMED.

2. DEFINE ANY FLAGS TO BE USED AS THE INPUT ARRAY IGF(J), J=1,6. THESE FLAGS ARE PRESET TO ZERO IF NOT INPUT.

3. DEFINE ANY INPUT VARIABLES TO BE USED AS THE ARRAY GVRI(J),J=1,10. THESE FLAGS ARE PRESET TO ZERO IF NOT INPUT.

4. DEFINE ANY OUTPUT VARIABLES TO BE USED AS THE ARRAY GVRC(J), J=1,10. THE OUTPUT SYMBOL FOR THIS ARRAY IS GVRCJ, J=1,10.

5. INPUT THE VARIABLE IGUID(14)=1, FOR OPEN-LOOP GUIDANCE OR =2, FOR CLOSED-LOOP GUIDANCE.

6. CODE THE DESIRED EQUATIONS INTO SUBROUTINE OLGM FOR OPEN-LOOP GUIDANCE OR INTO ROUTINES GSENSR, GNAV, GGUID, AND GCNTRL FOR CLOSED-LOOP GUIDANCE. THE OUTPUTS OF THE GUIDANCE MUST BE THE BODY ATTITUDE ERRORS (ROLBER, PITBER, YAWBER) WHICH ARE OPERATED ON BY THE AUTOPILOT. THE USER CAN SUPPLY HIS OWN AUTOPILOT BY ADDING THE APPROPRIATE CODING IN SUBROUTINE AUTOP.

7. THE VARIABLES GVRIJ, J=1,10 CAN BE USED AS INDEPENDENT VARIABLES FOR THE TARGETING/OPTIMIZATION OPTION AND THE VARIABLES GVRCJ, J=1,10 CAN BE USED AS DEPENDENT VARIABLES OR AS AN OPTIMIZATION VARIABLE.

6.B. METHODS OF GUIDANCE (STEERING) (CONTD)

THE SPECIFIC OPEN AND CLOSED-LOOP GUIDANCE MODELS AVAILABLE IN THE PROGRAM ARE SUMMARIZED BELOW. THE OPEN-LOOP MODELS AVAILABLE ARE -

1. COMMAND BODY RATES AS OBTAINED FROM TABLE LOOK-UPS OF ROLT, PITT, AND YAWT. THESE TABLES CAN BE INPUT AS STEP FUNCTIONS.

2. COMMAND INERTIAL EULER ANGLES OBTAINED FROM TABLE LOOK-UPS OF ROLT, YAWT, AND PITT. THESE EULER ANGLES ARE MEASURED WITH RESPECT TO THE LAUNCH INERTIAL (L) COORDINATE SYSTEM IN A ROLL, YAW, PITCH ROTATION SEQUENCE.

THE CLOSED-LOOP GUIDANCE MODELS AVAILABLE ARE -

1. AN ASCENT MODEL WHICH FOLLOWS AN INPUT ALTITUDE PROFILE.

2. A REENTRY MODEL FOR THE SHUTTLE VEHICLE.

THE PROGRAM CONTAINS A GUIDANCE TIME CHANNEL WHICH CAN BE USED TO SIMULATE GUIDANCE CYCLE TIMES WHICH ARE INDEPENDENT OF THE SIMULATOR CYCLE TIMES. THERE ARE THREE BASIC OPTIONS INHERENT IN THE GUIDANCE TIME CHANNEL AS FOLLOWS -

1) DTG NOT INPUT AND GDT NOT COMPUTED. THE GUIDANCE ROUTINE WILL BE CALLED ONCE EVERY SIMULATOR INTEGRATION STEP.

2) DTG INPUT AND GDT NOT COMPUTED. THE GUIDANCE ROUTINE WILL BE CALLED ONLY EVERY DTG SECONDS STARTING FROM GTIME.

3) DTG INPUT AND GDT COMPUTED. GDT OVERRIDES DTG IF GDT IS NOT EQUAL TO ZERO. THERE IS CURRENTLY NO LOGIC IN THE PROGRAM TO CALCULATE GDT. AS A RESULT, THIS LOGIC MUST BE SUPPLIED BY THE USER.

THE INPUT VARIABLES ASSOCIATED WITH THE GUIDANCE MODULE ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

6.B. METHODS OF GUIDANCE (STEERING) (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
IGUID(14)	INTEGER	0	A FLAG TO SELECT THE TYPE OF GUIDANCE TO BE USED. = 0, NO GUIDANCE. = 1, USE OPEN-LOOP GUIDANCE. = 2, USE CLOSED-LOOP GUIDANCE.
IGUID(16)	INTEGER	0	A FLAG TO SELECT THE OPEN-LOOP GUIDANCE OPTION TO BE USED. = 1, COMMAND BODY RATES AS TABLES. = 2, COMMAND INERTIAL ANGLES AS TABLES.
IGUID(17)	INTEGER	0	A FLAG TO SELECT THE CLOSED-LOOP GUIDANCE OPTION TO BE USED. = 1, USE THE ASCENT GUIDANCE. = 2, USE THE REENTRY GUIDANCE.
DTG	SEC	1.0E300	THE GUIDANCE CYCLE TIME. DTG IS USED IF GDT IS ZERO.
GTIME	SEC	TIME/DTG	THE TIME AT WHICH THE GUIDANCE WAS LAST ENTERED.
GVRI(J) J=1,10	DECIMAL	0.	THE CONSTANT VALUED INPUT VARIABLES FOR USE WITH THE GENERAL GUIDANCE OPTIONS.
IGF(J) J=1,6	INTEGER	0	THE ARRAY OF INPUT FLAGS FOR USE WITH THE GENERAL GUIDANCE OPTIONS.

THE OUTPUTS ASSOCIATED WITH THIS OPTION ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
GDT	SEC	THE GUIDANCE COMPUTED CYCLE TIME. IF GDT IS GREATER THAN ZERO, IT OVERRIDES DTG.
GTIME	SEC	THE TIME AT WHICH THE GUIDANCE WAS LAST ENTERED.

6.B. METHODS OF GUIDANCE (STEERING) (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
GVRCJ J=1,10	DECIMAL	THE OUTPUT VARIABLES ASSOCIATED WITH THE GENERAL GUIDANCE OPTIONS.
ROLBER PITBER YAWBER	DEG	THE ATTITUDE ERRORS ABOUT THE VEHICLE ROLL, PITCH AND YAW BODY AXES.
TIMEG	SEC	THE TIME AT WHICH THE GUIDANCE IS TO BE REENTERED.

6.B.1. OPEN-LOOP GUIDANCE MODEL

COMMAND BODY RATES

THIS OPTION IS OBTAINED WHEN IGUID(14)=1, AND IGUID(16)=1, ARE INPUT IN NAMELIST GENDAT.

WHEN THIS OPTION IS USED, THE COMMANDED RATES ARE OBTAINED FROM TABLE INTERPOLATION AS FOLLOWS -

```
ROLBDC = ROLM*ROLT
PITBDC = PITM*PITT
YAWBDC = YAWM*YAWT
```

WHERE THE TABLE MULTIPLIER IS INPUT IN NAMELIST TBLMLT, AND THE TABLE IS INPUT IN NAMELIST TAB. THIS OPTION IS GENERAL BECAUSE THESE TABLES CAN BE MONOVARIANT, BIVARIANT, OR TRIVARIANT FUNCTIONS OF ANY INTERNALLY COMPUTED VARIABLES (SEE SECTION ON TABLE INPUTS).

THE COMMANDED BODY RATES ARE INTEGRATED TO YIELD THE COMMANDED BODY ANGLES. THE BODY ERRORS ARE THEN COMPUTED AS -

```
ROLBER = ROLB - ROLBC
PITBER = PITB - PITBC
YAWBER = YAWB - YAWBC
```

COMMAND INERTIAL EULER ANGLES

THIS OPTION IS OBTAINED WHEN IGUID(14)=1, AND IGUID(16)=2, ARE INPUT IN NAMELIST GENDAT.

WHEN THIS OPTION IS USED, THE COMMANDED ANGLES ARE OBTAINED FROM TABLE INTERPOLATION AS FOLLOWS -

```
ROLIGC = ROLM*ROLT
YAWIGC = YAWM*YAWT
PITIGC = PITM*PITT
```

THE INERTIAL ATTITUDE ERRORS ARE COMPUTED AS -

```
YAWIER = YAWI - YAWIGC
PITIER = PITI - PITIGC
ROLIER = ROLI - ROLIGC
```

6.B.1. OPEN-LOOP GUIDANCE MODEL (CONTD)

WHICH ARE THEN TRANSFORMED INTO BODY ERRORS.

THE INPUT PROCEDURE FOR THIS OPTION IS -

1) INPUT IGUID(14)=1,
2) INPUT IGUID(16)= TO THE DESIRED VALUE.
3) INPUT IGUID(12)= THE DESIRED VALUE,
4) INPUT THE VALUE OF THE TABLE MULTIPLIER IN NAMELIST TBLMLT.
5) INPUT THE TABLES ROLT, YAWT, AND PITT .

THE CONSTANT VALUED INPUT VARIABLES FOR THIS MODULE ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
IGUID(14)	INTEGER	0	A FLAG TO SELECT THE TYPE OF GUIDANCE TO BE USED. = 0, NO GUIDANCE. = 1, USE OPEN-LOOP GUIDANCE. = 2, USE CLOSED-LOOP GUIDANCE.
IGUID(16)	INTEGER	0	A FLAG TO SELECT THE OPEN-LOOP GUIDANCE OPTION TO BE USED. = 1, COMMAND BODY RATES AS TABLES. = 2, COMMAND INERTIAL ANGLES AS TABLES.

THE TABLES FOR THIS MODEL ARE INPUT IN NAMELIST TAB AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
ROLT YAWT PITT	DEG	0.0	TABLES OF ROLL, YAW AND PITCH ANGLES OR RATES.

6.B.1. OPEN-LOOP GUIDANCE MODEL (CONTD)

THE OUTPUT VARIABLES FOR THIS MODULE ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
ROLBC PITBC YAWBC	DEG	THE COMMANDED ROLL, PITCH AND YAW BODY ANGLES. CALCULATED IF IGUID(16)=1.
ROLBDC PITBDC YAWBDC	DEG/SEC	THE COMMANDED ROLL, PITCH AND YAW BODY RATES. CALCULATED IF IGUID(16)=1.
ROLBER PITBER YAWBER	DEG	THE ATTITUDE ERRORS ABOUT THE VEHICLE ROLL, PITCH AND YAW BODY AXES.
ROLIER YAWIER PITIER	DEG	THE INERTIAL ROLL, YAW AND PITCH ATTITUDE ERRORS. CALCULATED IF IGUID(16)=2.
ROLIGC YAWIGC PITIGC	DEG	THE COMMANDED ROLL, YAW AND PITCH INERTIAL EULER ANGLES. CALCULATED IF IGUID(16)=2.

6.B.2. ASCENT GUIDANCE MODEL

THIS OPTION IS OBTAINED WHEN IGUID(14)=2, AND IGUID(16)=1, ARE INPUT IN NAMELIST GENDAT.

THE ASCENT GUIDANCE MODEL IS AN ALTITUDE PROFILE MODEL. THE ALTITUDE PROFILE CAN BE INPUT AS A FUNCTION OF ANY COMPUTED VARIABLE IN THE LIST OF OUTPUT VARIABLES.

THE EQUATIONS AND LOGIC FOR THIS MODEL ARE SUMMARIZED AS FOLLOWS -

1) IF IGSTRT = 0, SET COMMANDS TO ZERO AND RETURN.

2) IF IGINIT = 1, INITIALIZE GUIDANCE CALCULATIONS.

3) COMPUTE VELOCITY RELATIVE TO L FRAME ALONG THE YL (OUT-OF-PLANE) AXIS (VBN).

4) SUM THE OUT-OF-PLANE VELOCITY TO OBTAIN OUT-OF-PLANE POSITION COMPONENT (VBNS).

5) IF TIME SINCE INITIALIZATION (XNL) IS LESS THAN GTIME1, USE TABLE LOOK-UPS OF ROLT, YAWT, AND PITT AS COMMANDS.

6) IF XNL IS GREATER THAN GTIME1 AND LESS THAN GTIME2, COMPUTE ROLL AND YAW COMMANDS TO NULL OUT-OF-PLANE ERROR AND COMPUTE PITCH COMMANDS FROM TABLE LOOK-UP OF PITT. THE ROLL AND YAW COMMANDS ARE GIVEN BY -

```
FSC    = (YAWPK(1)*VBN+YAWPK(2)*VBNS)*TR
ROLIGC = SIN(ROLI)*FSC + GENTAB(ROLT)
YAWIGC = -COS(YAWI)*FSC
```

WHERE TR IS THE TIME SINCE INITIALIZATION AND YAWPK(I), I=1,2 ARE INPUT GAINS.

7) IF XNL IS GREATER THAN GTIME2, COMPUTE ROLL AND YAW COMMANDS AS IN STEP 6 AND COMPUTE THE PITCH COMMAND AS FOLLOWS -

```
PITIGC = GENTAB(PITT) - GENTAB(KHT)*(ALTITC-HP)
                      - GENTAB(KHDT)*(-V(3)-HDP)
```

WHERE HP = GENTAB(HPT) ABD HDP = GENTAB(HDPT), KHT AND KHDT ARE THE INPUT GAIN TABLES FOR ALTITUDE AND ALTITUDE RATE ERRORS AND HPT AND HDPT ARE THE INPUT ALTITIDE AND ALTITUDE RATE TABLES.

8) LIMIT THE COMMANDED ANGLES AND RATES TO THE INPUT LIMIT VALUES.

6.B.2. ASCENT GUIDANCE MODEL (CONTD)

9) COMPUTE THE INERTIAL ATTITUDE ERRORS (ROLIER, YAWIER, PITIER) ABD CONVERT TO BODY ATTITUDE ERRORS (ROLBER, PITBER, YAWBER) AND RETURN.

THE CONSTANT VALUED INPUT VARIABLES FOR THIS MODULE ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
IGUID(14)	INTEGER	0	A FLAG TO SELECT THE TYPE OF GUIDANCE TO BE USED. = 0, NO GUIDANCE. = 1, USE OPEN-LOOP GUIDANCE. = 2, USE CLOSED-LOOP GUIDANCE.
IGUID(17)	INTEGER	0	A FLAG TO SELECT THE CLOSED-LOOP GUIDANCE OPTION TO BE USED. = 1, USE THE ASCENT GUIDANCE. = 2, USE THE REENTRY GUIDANCE.
GTIME1 GTIME2	SEC	0.0	THE TIMES TO BEGIN THE OPEN LOOP ATTITUDE COMMANDS AND CLOSED LOOP ALTITUDE-VELOCITY PROFILE COMMANDS RESPECTIVELY, FOR THE ASCENT GUIDANCE.
IGINIT	INTEGER	0	A FLAG TO INDICATE THAT THE SHUTTLE ASCENT GUIDANCE EQUATIONS ARE TO BE INITIALIZED. = 0, DO NOT INITIALIZE THE ASCENT GUIDANCE. = 1, INITIALIZE THE ASCENT GUIDANCE.
IGSTRT	INTEGER	0	A FLAG TO INDICATE THAT THE SHUTTLE ASCENT GUIDANCE COMMANDS ARE TO BE USED. = 0, ZERO OUT THE COMMANDS. = 1, USE THE CALCULATED COMMANDS.

6.8.2. ASCENT GUIDANCE MODEL (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
ROLIDL YAWIDL PITIDL	DEG/SEC	1.0E20	THE INERTIAL EULER ANGLE RATE LIMITS FOR THE SHUTTLE ASCENT GUIDANCE.
ROLINL YAWINL PITINL	DEG	-1.0E20	THE INERTIAL EULER ANGLE NEGATIVE LIMIT FOR THE SHUTTLE ASCENT GUIDANCE.
ROLIPL YAWIPL PITIPL	DEG	1.0E20	THE INERTIAL EULER ANGLE POSITIVE LIMIT FOR THE SHUTTLE ASCENT GUIDANCE.
YAWPK(I) I=1,2	N/D	0.0	THE YAW GAINS FOR THE VELOCITY AND POSITION ERRORS, RESPECTIVELY, FOR THE ASCENT GUIDANCE.

THE TABLES FOR THIS MODEL ARE INPUT IN NAMELIST TAB AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
HDPT	FT/SEC	0.0	THE ALTITUDE RATE PROFILE TABLE FOR THE ASCENT GUIDANCE.
HPT	FT	0.0	THE ALTITUDE PROFILE TABLE FOR THE ASCENT GUIDANCE.
KHDT	N/D	0.0	THE ALTITUDE RATE ERROR GAIN TABLE FOR THE ASCENT GUIDANCE.
KHT	N/D	0.0	THE ALTITUDE ERROR GAIN TABLE FOR THE ASCENT GUIDANCE.
ROLT YAWT PITT	DEG	0.0	THE INERTIAL ROLL, YAW AND PITCH ANGLE COMMAND TABLES TO BE USED FROM START OF GUIDANCE UNTIL GTIME2 SECONDS LATER.

6.B.2. ASCENT GUIDANCE MODEL (CONTD)

THE OUTPUT VARIABLES FOR THIS MODULE ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
HDP	FT/SEC	THE PROGRAMMED ALTITUDE RATE FROM TABLE HDPT.
HP	FT	THE PROGRAMMED ALTITUDE FROM TABLE HPT.
ROLBER PITBER YAWBER	DEG	THE ATTITUDE ERRORS ABOUT THE VEHICLE ROLL, PITCH AND YAW BODY AXES.
ROLIER YAWIER PITIER	DEG	THE INERTIAL ATTITUDE ERRORS IN ROLL, YAW AND PITCH. COMPUTED AS THE ACTUAL MINUS THE COMMANDED INERTIAL ATTITUDES.
ROLIGC YAWIGC PITIGC	DEG	INERTIAL ROLL, YAW AND PITCH ANGLE GUIDANCE COMMANDS.

6.B.3. REENTRY GUIDANCE MODEL

THIS OPTION IS OBTAINED WHEN IGUID(14)=2, AND IGUID(16)=2, ARE INPUT IN NAMELIST GENDAT.

THE REENTRY GUIDANCE MODEL IS THE SHUTTLE DRAG PROFILE MODEL. THIS MODEL CALCULATES THE ANGLE OF ATTACK (ALPGC) AND RELATIVE ROLL ANGLE (ROLRGC) REQUIRED TO LIMIT THE AERODYNAMIC HEATING AND ACCELERATION LEVELS TO SPECIFIED VALUES WHILE SATISFYING THE RANGING REQUIREMENTS FOR TARGETING TO A SPECIFIED LANDING SITE.

THIS MODEL WAS OBTAINED FROM THE FOLLOWING DOCUMENT -

ANALYTICAL DRAG CONTROL ENTRY GUIDANCE SYSTEM
JON C. HARPOLD, JOHNSON SPACE CENTER
JSC INTERNAL NOTE NO. 74-FM-25, APRIL 15, 1974

THE CONSTANT VALUED INPUT VARIABLES FOR THIS MODULE ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
IGUID(14)	INTEGER	0	A FLAG TO SELECT THE TYPE OF GUIDANCE TO BE USED. = 0, NO GUIDANCE. = 1, USE OPEN-LOOP GUIDANCE. = 2, USE CLOSED-LOOP GUIDANCE.
IGUID(17)	INTEGER	0	A FLAG TO SELECT THE CLOSED-LOOP GUIDANCE OPTION TO BE USED. = 1, USE THE ASCENT GUIDANCE. = 2, USE THE REENTRY GUIDANCE.
ISTRT	INTEGER	0	GUIDANCE INITIALIZATION FLAG. = 0, INITIALIZE. = 1, DO NOT INITIALIZE.
ITRANS	INTEGER	0	TRANSITION PHASE FLAG. = 0, START AT REENTRY INTERFACE. = 1, START AT TRANSITION PHASE.
ISLECT	INTEGER	0	GUIDANCE PHASE SELECTOR. = 1, CONSTANT HEAT RATE PHASE. = 2, EQUILIBRIUM GLIDE RANGING PHASE. = 3, CONSTANT G RANGING PHASE. = 4, TRANSITION PHASE.

6.B.3. REENTRY GUIDANCE MODEL (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
RAZD	DEG	-44.	THE RUNWAY AZIMUTH OF THE TARGET (LANDING SITE).
TLATCD	DEG	0.0	THE GEOCENTRIC LATITUDE OF THE TARGET.
TLONGD	DEG	0.0	THE LONGITUDE OF THE TARGET MEASURED EAST OF THE GREENWICH MERIDIAN.

THE OUTPUT VARIABLES FOR THIS MODULE ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
ALDREF	N/D	L/D REFERENCE USED IN CONTROLLER.
ALPGC	DEG	THE ANGLE OF ATTACK GUIDANCE COMMAND.
DELAZ	RAD	AZIMUTH ERROR.
DRAGGC	FT/SEC**2	GUIDANCE COMPUTED DRAG ACCELERATION LEVEL.
DRAGRP	FT/SEC**2	DRAG REFERENCE USED IN CONTROLLER.
LOD1	N/D	DESIRED VERTICAL L/D.
RDTREF	FT/SEC	ALTITUDE RATE REFERENCE.
RK2ROL	N/D	ROLL DIRECTION INDICATOR FLAG. = +1, ROLL RIGHT. = -1, ROLL LEFT.
ROLRGC	DEG	THE RELATIVE ROLL ANGLE GUIDANCE COMMAND.
SLECT	N/D	PRINTOUT VALUE OF ISLECT.
TRANGE	N.MI.	RELATIVE GREAT CIRCLE RANGE TO TARGET.

6.C. TABLE MULTIPLIER INPUT

EACH TABLE HAS ITS OWN NUMERIC MULTIPLIER. ALL NUMERIC TABLE MULTIPLIERS ARE INPUT IN NAMELIST TBLMLT. THE INPUT SYMBOL FOR A NUMERIC MULTIPLIER IS ALWAYS FORMED BY REPLACING THE T AT THE END OF THE TABLE NAME BY AN M WHICH DENOTES MULTIPLIER. FOR EXAMPLE, THE MULTIPLIER FOR TABLE PREST IS PPESM. ALL NUMERIC MULTIPLIERS ARE PRESET TO 1.0 IN THE PROGRAM UNLESS OVERRIDDEN BY INPUT.

IN ADDITION TO THE NUMERIC TABLE MULTIPLIERS, THERE ARE SOME SPECIAL PURPOSE MULTIPLIERS FOR CERTAIN AERODYNAMIC TABLES WHICH ARE SPECIFIED BY HOLLERITH NAMES. THESE ARE CALLED MNEMONIC MULTIPLIERS AND CAN BE ANY INTERNALLY COMPUTED VARIABLE WHICH IS IN THE OUTPUT VARIABLE LIST. THESE MULTIPLIERS ARE USED TO MULTIPLY TABLE LOOK-UP VALUES OF THE CORRESPONDING AERODYNAMIC COEFFICIENT TABLES. ALL MNEMONIC MULTIPLIERS ARE INPUT IN NAMELIST TBLMLT. THE LIST OF MNEMONIC MULTIPLIERS IS PRESENTED IN SECTION 6.A.1.

SOME EXAMPLES OF HOW THESE MNEMONIC TABLE MULTIPLIERS ARE USED ARE AS FOLLOWS -

1) ASSUME THAT THE NORMAL FORCE COEFFICIENT SLOPE IS GIVEN PER DEGREE ALPHA. IN THIS CASE, CNAT WOULD BE INPUT AS THE COEFFICIENT SLOPE WITH CNANM INPUT AS

   CNANM = 5HALPHA,

   THE CNAT TABLE LOOK-UP VALUE WOULD THEN BE MULTIPLIED BY THE VALUE OF ALPHA TO OBTAIN THE VALUE OF THE NORMAL FORCE COEFFICIENT.

2) ASSUME THAT THE NORMAL FORCE COEFFICIENT IS GIVEN AS A BIVARIANT FUNCTION OF ALPHA AND MACH. IN THIS CASE, THE MNEMONIC MULTIPLIER CNANM WOULD BE INPUT AS

   CNANM = 3HONE,

   THE NORMAL FORCE COEFFICIENT WOULD THEN BE THE ACTUAL TABLE LOOK-UP VALUE.

6.D. TABLE DATA INPUT

THE TABLE INPUTS FOR POST ARE GENERALIZED TO INCLUDE -

1) ALLOWABLE SIZE FOR EACH TABLE OF 2500 ENTRIES. THIS VALUE CAN BE CHANGED BY A SIMPLE PROGRAM MODIFICATION TO SATISFY USER REQUIREMENTS. THE NUMBER OF CURVES OF A BIVARIANT TABLE OR SURFACES OF A TRIVARIANT TABLE TO BE RESIDENT IN MEMORY AT ANY TIME CAN BE USER SPECIFIED FOR EACH TABLE.
   THE TOTAL SIZE OF ALL MEMORY RESIDENT TABLES IS LIMITED BY THE FIELD LENGTH REQUESTED ON THE JOB CARD.

2) GENERALIZED ARGUMENT SPECIFICATION. THE ARGUMENT TO BE USED FOR EACH TABLE IS SPECIFIED BY INPUT AND CAN BE ANY COMPUTED OUTPUT VARIABLE.

3) CONSTANT VALUED, MONOVARIANT, BIVARIANT, OR TRIVARIANT TABLE TYPES.

4) LINEAR INTERPOLATION CAPABILITY. A MONOVARIANT TABLE CAN ALSO BE INPUT AS A STEP TABLE.

EACH TABLE IS INPUT IN NAMELIST TAB AS THE ARRAY TABLE. AS A RESULT, EACH TABLE BEING INPUT REQUIRES A SEPARATE INPUT OF NAMELIST TAB. TERMINATION OF THE TABLE INPUT DATA FOR A GIVEN PHASE IS INDICATED BY THE PRESENCE OF ENDPHS=1, IN THE LAST INPUT OF NAMELIST TAB FOR THAT PHASE.

THE ELEMENTS OF THE TABLE ARRAY ARE DIFFERENT DEPENDING ON THE TYPE OF TABLE BEING INPUT.

TABLE POINTERS ARE USED BY THE TABLE LOOK-UP ROUTINES FOR ALL TABLES (EXCEPT CONSTANT VALUED TABLES) TO PROVIDE EFFICIENT OPERATION OF THE TABLE LOOK-UP ROUTINES. THESE POINTERS SHOULD ALWAYS BE INPUT AS 1. THE NUMBER OF POINTERS FOR A GIVEN TABLE DEPENDS ON THE TABLE TYPE, I.E., MONOVARIANT, BIVARIANT, OR TRIVARIANT. FOR EXAMPLE, A MONOVARIANT TABLE HAS 1 POINTER WHICH IS INPUT AS TABLE(7), A BIVARIANT TABLE HAS 5 POINTERS WHICH ARE INPUT AS TABLE(10) THROUGH TABLE(14), AND A TRIVARIANT TABLE HAS 21 POINTERS WHICH ARE INPUT AS TABLE(13) THROUGH TABLE(33).

TABLE DISK OPTION

PORTIONS OF BIVARIANT OR TRIVARIANT TABLES CAN BE STORED ON MASS STORAGE (DISK) BY USE OF THE DISK OPTION. THIS ALLOWS A CONSIDERABLE REDUCTION OF REQUIRED MEMORY WHEN LARGE BIVARIANT AND TRIVARIANT TABLES ARE REQUIRED. THE INPUT 'DISK' ALLOWS THE

USER TO SPECIFY HOW MANY CURVES OF A BIVARIANT TABLE OR HOW MANY SURFACES FOR A TRIVARIANT TABLE ARE TO BE MAINTAINED RESIDENT IN MEMORY FOR INTERPOLATION. IF THE Y AXIS OF A BIVARIANT TABLE OR THE Z AXIS OF A TRIVARIANT TABLE IS CHANGING SLOWLY DURING THE SIMULATION THEN ONLY 2 CURVES OR SURFACES MAY BE REQUIRED. IF THESE PARAMETERS ARE CHANGING RAPIDLY THEN MORE MEMORY RESIDENT CURVES OR SURFACES MAY BE REQUIRED. THE VALUE OF DISK USED SHOULD BE DETERMINED BY USER JUDGEMENT AND EXPERIENCE TO OBTAIN MINIMUM MEMORY REQUIREMENTS WITHIN ACCEPTABLE I/O OVERHEAD. IF 'DISK' IS NOT INPUT OR IT IS INPUT AS ZERO, THE ENTIRE TABLE WILL BE MEMORY RESIDENT. AT LEAST TWO SURFACES OR CURVES ARE ALWAYS MEMORY RESIDENT.

CONSTANT VALUED TABLES

THE TABLE ELEMENTS FOR CONSTANT VALUED TABLES ARE -

TABLE(1) THE HOLLERITH NAME OF THE TABLE.

TABLE(2) THE TABLE TYPE.
= 0, CONSTANT VALUED TABLE.

TABLE(3) THE TABLE VALUE. A TYPICAL CONSTANT VALUED TABLE WOULD BE INPUT AS FOLLOWS -

```
TABLE=6HTVC1T ,0,2000000.,
```

MONOVARIANT TABLES

MONOVARIANT TABLES ARE FORMED BY A SERIES OF ORDERED PAIRS OF X AND F(X) WHICH REPRESENT A CURVE. THE CURVE IS A SERIES OF LINE SEGMENTS IF LINEAR INTERPOLATION IS USED AND IS A SERIES OF SMOOTH LINES IF CUBIC INTERPOLATION IS USED.

THE SIZE OF A MONOVARIANT TABLE IS OBTAINED BY -

$$N = 7 + 2*NX$$

6.D. TABLE DATA INPUT (CONTD)

THE TABLE ELEMENTS FOR MONOVARIANT TABLES ARE -

TABLE(1) THE HOLLERITH NAME OF THE TABLE.

TABLE(2) THE TABLE TYPE.
=-1, MONOVARIANT TABLE WHERE THE X VALUES ARE TO BE USED AS INTEGRATION POINTS. THE TABLE ARGUMENT MUST BE SOME FORM OF TIME, I.E., TIME, TDURP, TIMES, ETC., AND NPC(20) MUST BE INPUT AS 1.
= 1, MONOVARIANT TABLE.

TABLE(3) THE HOLLERITH NAME OF THE X ARGUMENT.

TABLE(4) THE NUMBER OF X VALUES IN THE CURVE.

TABLE(5) THE INTERPOLATION TYPE.
= 0, STEP TABLE, I.E., NO INTERPOLATION.
= 1, LINEAR INTERPOLATION.

TABLE(6) THE TYPE OF X VALUES.
=-1, DECREASING VALUES.
= 1, INCREASING VALUES.

TABLE(7) THE INITIAL VALUE OF THE X POINTER.

TABLE(8) THE FIRST TABLE VALUE (X1). A TYPICAL MONOVARIANT TABLE WOULD BE INPUT AS FOLLOWS -

```
TABLE=6HALPHAT,1,6HMACH  ,L,1,1,1,
X1,F(X1),X2,F(X2),...,XL,F(XL),
```

BIVARIANT TABLES

BIVARIANT TABLES ARE FORMED BY A FAMILY OF MONOVARIANT CURVES, WHERE A MONOVARIANT CURVE IS INPUT FOR EACH VALUE OF Y. AS A RESULT, THE ARGUMENTS ARE X AND Y AND THE FUNCTION IS F(X,Y). THE X ARGUMENTS IN EACH CURVE DO NOT NEED TO BE THE SAME VALUE, HOWEVER, THERE MUST BE THE SAME NUMBER OF X VALUES IN EACH CURVE.

THE SIZE OF A BIVARIANT TABLE IS OBTAINED BY -

$$N = 14 + NY*(2*NX+1)$$

6.D. TABLE DATA INPUT (CONTD)

THE TABLE ELEMENTS FOR BIVARIANT TABLES ARE -

TABLE(1)	THE HOLLERITH NAME OF THE TABLE.
TABLE(2)	THE TABLE TYPE. = 2, BIVARIANT TABLE.
TABLE(3)	THE HOLLERITH NAME OF THE X ARGUMENT.
TABLE(4)	THE HOLLERITH NAME OF THE Y ARGUMENT.
TABLE(5)	THE NUMBER OF X VALUES IN EACH CURVE.
TABLE(6)	THE NUMBER OF Y VALUES (CURVES) IN THE FAMILY.
TABLE(7)	THE INTERPOLATION TYPE. = 1, LINEAR INTERPOLATION.
TABLE(8)	THE TYPE OF X VALUES. =-1, DECREASING VALUES. = 1, INCREASING VALUES.
TABLE(9)	THE TYPE OF Y VALUES. =-1, DECREASING VALUES. = 1, INCREASING VALUES.
TABLE(10)	THE INITIAL VALUE OF THE YL CURVE POINTER (INPUT = 1).
TABLE(11)	THE INITIAL VALUE OF THE X POINTER ON THE YL CURVE (INPUT = 1).
TABLE(12)	THE INITIAL VALUE OF THE X POINTER ON THE YL+1 CURVE (INPUT = 1).
TABLE(13)	THE INITIAL VALUE OF THE X POINTER ON THE YL+2 CURVE (INPUT = 1).
TABLE(14)	THE INITIAL VALUE OF THE X POINTER ON THE YL+3 CURVE (INPUT = 1).

TABLE(15) THE FIRST TABLE VALUE (Y1). A TYPICAL BI-VARIANT TABLE WOULD BE INPUT AS FOLLOWS -

```
TABLE=6HCDT   ,2,6HMACH  ,6HALPHA ,L,M,
1,1,1,1,1,1,1,1,
Y1,X1,F(X1,Y1),X2,F(X2,Y1),...,XL,F(XL,Y1),
Y2,X1,F(X1,Y2),X2,F(X2,Y2),...,XL,F(XL,Y2),
.
.
.
YM,X1,F(X1,YN),X2,F(X2,YN),...,XL,F(XL,YM),
```

TRIVARIANT TABLES

TRIVARIANT TABLES ARE FORMED BY A FAMILY OF BIVARIANT TABLES, WHERE A BIVARIANT TABLE IS INPUT FOR EACH VALUE OF Z. AS A RESULT, THE ARGUMENTS ARE X,Y,Z AND THE FUNCTION IS F(X,Y,Z). THE Y ARGUMENTS IN EACH BIVARIANT TABLE NEED NOT BE THE SAME VALUE, HOWEVER, THERE MUST BE THE SAME NUMBER OF Y VALUES IN EACH BIVARIANT TABLE.

THE SIZE OF A TRIVARIANT TABLE IS OBTAINED BY -

$$N = 33 + NZ*(NY*(2*NX+1)+1)$$

THE TABLE ELEMENTS FOR TRIVARIANT TABLES ARE -

TABLE(1) THE HOLLERITH NAME OF THE TABLE.

TABLE(2) THE TABLE TYPE.
= 3, TRIVARIANT TABLE.

TABLE(3) THE HOLLERITH NAME OF THE X ARGUMENT.

TABLE(4) THE HOLLERITH NAME OF THE Y ARGUMENT.

TABLE(5) THE HOLLERITH NAME OF THE Z ARGUMENT.

TABLE(6) THE NUMBER OF X VALUES IN EACH CURVE.

TABLE(7) THE NUMBER OF Y VALUES (CURVES) IN EACH FAMILY.

TABLE(8) THE NUMBER OF Z VALUES (FAMILIES) IN THE TABLE.

6.D. TABLE DATA INPUT (CONTD)

TABLE(9)	THE INTERPOLATION TYPE. = 1, LINEAR INTERPOLATION.
TABLE(10)	THE TYPE OF X VALUES. =-1, DECREASING VALUES. = 1, INCREASING VALUES
TABLE(11)	THE TYPE OF Y VALUES. =-1, DECREASING VALUES. = 1, INCREASING VALUES
TABLE(12)	THE TYPE OF Z VALUES. =-1, DECREASING VALUES. = 1, INCREASING VALUES
TABLE(13)	THE INITIAL VALUE OF THE ZL FAMILY POINTER (INPUT = 1).
TABLE(14)	THE INITIAL VALUE OF THE YL POINTER IN THE ZL FAMILY (INPUT = 1).
TABLE(15)	THE INITIAL VALUE OF THE YL POINTER IN THE ZL+1 FAMILY (INPUT = 1).
TABLE(16)	THE INITIAL VALUE OF THE YL POINTER IN THE ZL+2 FAMILY (INPUT = 1).
TABLE(17)	THE INITIAL VALUE OF THE YL POINTER IN THE ZL+3 FAMILY (INPUT = 1).
TABLE(18)	THE INITIAL VALUE OF THE X POINTER ON THE YL CURVE OF THE ZL FAMILY (INPUT = 1).
TABLE(19)	THE INITIAL VALUE OF THE X POINTER ON THE YL+1 CURVE OF THE ZL FAMILY (INPUT = 1).
TABLE(20)	THE INITIAL VALUE OF THE X POINTER ON THE YL+2 CURVE OF THE ZL FAMILY (INPUT = 1).
TABLE(21)	THE INITIAL VALUE OF THE X POINTER ON THE YL+3 CURVE OF THE ZL FAMILY (INPUT = 1).
TABLE(22)	THE INITIAL VALUE OF THE X POINTER ON THE YL CURVE OF THE ZL+1 FAMILY (INPUT = 1).

6.D. TABLE DATA INPUT (CONTD)

TABLE(23)	THE INITIAL VALUE OF THE X POINTER ON THE YL+1 CURVE OF THE ZL+1 FAMILY (INPUT = 1).
TABLE(24)	THE INITIAL VALUE OF THE X POINTER ON THE YL+2 CURVE OF THE ZL+1 FAMILY (INPUT = 1).
TABLE(25)	THE INITIAL VALUE OF THE X POINTER ON THE YL+3 CURVE OF THE ZL+1 FAMILY (INPUT = 1).
TABLE(26)	THE INITIAL VALUE OF THE X POINTER ON THE YL CURVE OF THE ZL+2 FAMILY (INPUT = 1).
TABLE(27)	THE INITIAL VALUE OF THE X POINTER ON THE YL+1 CURVE OF THE ZL+2 FAMILY (INPUT = 1).
TABLE(28)	THE INITIAL VALUE OF THE X POINTER ON THE YL+2 CURVE OF THE ZL+2 FAMILY (INPUT = 1).
TABLE(29)	THE INITIAL VALUE OF THE X POINTER ON THE YL+3 CURVE OF THE ZL+2 FAMILY (INPUT = 1).
TABLE(30)	THE INITIAL VALUE OF THE X POINTER ON THE YL CURVE OF THE ZL+3 FAMILY (INPUT = 1).
TABLE(31)	THE INITIAL VALUE OF THE X POINTER ON THE YL+1 CURVE OF THE ZL+3 FAMILY (INPUT = 1).
TABLE(32)	THE INITIAL VALUE OF THE X POINTER ON THE YL+2 CURVE OF THE ZL+3 FAMILY (INPUT = 1).
TABLE(33)	THE INITIAL VALUE OF THE X POINTER ON THE YL+3 CURVE OF THE ZL+3 FAMILY (INPUT = 1).

6.D. TABLE DATA INPUT (CONTD)

TABLE(34)

THE FIRST TABLE VALUE (Z1). A TYPICAL TRI-VARIANT TABLE WOULD BE INPUT AS FOLLOWS -

```
TABLE=5HHTRTT,3,6HALTITO,4HVELA,5HALPHA,L,M,N,
1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,
1,1,1,
Z1,Y1,X1,F(X1,Y1,Z1),...,XL,F(XL,Y1,Z1),
   .
   .
   .
   YM,X1,F(X1,YM,Z1),...,XL,F(XL,YM,Z1),
Z2,Y1,X1,F(X1,Y1,Z2),...,XL,F(XL,Y1,Z2),
   .
   .
   .
   YM,X1,F(X1,YM,Z2),...,XL,F(XL,YM,Z2),
.
.
.
ZN,Y1,X1,F(X1,Y1,ZN),...,XL,F(XL,Y1,ZN),
   .
   .
   .
   YM,X1,F(X1,YM,ZN),...,XL,F(XL,YM,ZN),
```

6.E. SIX DEGREE OF FREEDOM MODULES

THIS SECTION DESCRIBES THE MODULES WHICH ARE PECULIAR TO THE SIX DEGREE OF FREEDOM CAPABILITY.

6.E.1. CONTROLS/AIRFRAME MODULES

THE CONTROLS MODULE ACCEPTS THE AUTOPILOT COMMANDS AND CONVERTS THEM INTO CONTROL SURFACE AND/OR ENGINE DEFLECTIONS BASED ON A SIMPLE MIXING LOGIC.

THE MIXING OF THE COMMANDS IS DONE BASED ON THE VALUE OF THE GAINS SPECIFIED BY USER INPUT. THE PROGRAM CURRENTLY DOES NOT ALLOW THE MIXING OF CONTROL SURFACE DEFLECTIONS AND ENGINE DEFLECTIONS. THE CONTROLS MODULE CURRENTLY USES ENGINE DEFLECTIONS TO IMPLEMENT THE ASCENT AUTOPILOT COMMANDS AND CONTROL SURFACE DEFLECTIONS TO IMPLEMENT THE REENTRY AUTOPILOT COMMANDS.

THE SIGN CONVENTIONS FOR THE MIXING GAINS DEPEND DIRECTLY ON THE SIGN CONVENTIONS FOR THE ATTITUDE ERRORS. THE ATTITUDE ERRORS FOR THE ASCENT AUTOPILOT ARE CALCULATED AS -

ERROR = ACTUAL ANGLE - COMMANDED ANGLE.

THE SIGN CONVENTIONS FOR THE ATTITUDE ERRORS FOR THE ASCENT AUTOPILOT RESULT IN THE FOLLOWING RELATIONSHIPS -

AUTOPILOT COMMAND	REQUIRED VEHICLE MOTION
POSITIVE ROLL ERROR (+ROLAC)	NEGATIVE ROLL (ROLL LEFT)
POSITIVE PITCH ERROR (+PITAC)	NEGATIVE PITCH (PITCH DOWN)
POSITIVE YAW ERROR (+YAWAC)	NEGATIVE YAW (YAW LEFT)

THE ASCENT AUTOPILOT CONVERTS THE ATTITUDE ERRORS INTO ROLL, PITCH AND YAW COMMANDS (ROLAC, PITAC, YAWAC). THESE COMMANDS ARE THEN MIXED AS FOLLOWS TO PRODUCE THE REQUIRED PITCH AND YAW ENGINE DEFLECTIONS -

```
DEP(I) = DEPO(I) + KRDP(I)*ROLAC + KPDP(I)*PITAC

DEY(I) = DEYO(I) + KRDY(I)*ROLAC + KYDY(I)*YAWAC
```

THE SIGN CONVENTIONS FOR THE ENGINE DEFLECTIONS ARE SUMMARIZED AS FOLLOWS FOR THE CASE WHERE THE ENGINE GIMBAL IS

AFT OF THE VEHICLE CENTER-OF-GRAVITY, I.E., WHERE GXP IS GREATER THAN XCG -

ENGINE DEFLECTION	VEHICLE RESPONSE	RESULTANT FORCES AND MOMENTS
POSITIVE PITCH (+DEP(I))	NEGATIVE PITCH (-ALPHA)	-FTZB,-TMYB
POSITIVE YAW (+DEY(I))	NEGATIVE YAW (+BETA)	+FTYB,-TMZB

THE MIXING GAINS FOR AN ASCENT VEHICLE WITH TWO CONTROLLING ENGINES IN THE PITCH PLANE WOULD BE -

```
ROLL  - KRDP(1)=0,  KRDP(2)=0,

        KRDY(1)=-1, KRDY(2)=+1,
        IF GZP(1).GT.ZCG.GT.GZP(2), OR

        KRDY(1)=+1, KRDY(2)=-1,
        IF GZP(2).GT.ZCG.GT.GZP(1).

PITCH - KPDP(1)=+1, KPDP(2)=+1,

YAW   - KYDY(1)=+1, KYDY(2)=+1,
```

THE MIXING GAINS FOR AN ASCENT VEHICLE WITH TWO CONTROLLING ENGINES IN THE YAW PLANE WOULD BE -

```
ROLL  - KRDP(1)=-1, KRDP(2)=+1,
        IF GYP(1).LT.YCG.LT.GYP(2), OR

        KRDP(1)=+1, KRDP(2)=-1,
        IF GYP(2).LT.YCG.LT.GYP(1),

        KRDY(1)=0,  KRDY(2)=0,.

PITCH - KPDP(1)=+1, KPDP(2)=+1,

YAW   - KYDY(1)=+1, KYDY(2)=+1,
```

THE ATTITUDE ERRORS FOR THE REENTRY AUTOPILOT ARE CALCULATED AS -

ERROR = COMMANDED ANGLE - ACTUAL ANGLE.

6.E.1. CONTROLS/AIRFRAME MODULES (CONTD)

THE SIGN CONVENTIONS FOR THE ATTITUDE ERRORS FOR THE REENTRY AUTOPILOT RESULT IN THE FOLLOWING RELATIONSHIPS -

AUTOPILOT COMMAND	REQUIRED VEHICLE MOTION
POSITIVE ROLL ERROR (+ROLAC)	POSITIVE ROLL (ROLL RIGHT)
POSITIVE PITCH ERROR (+PITAC)	POSITIVE PITCH (PITCH UP)
POSITIVE YAW ERROR (+YAWAC)	POSITIVE YAW (YAW RIGHT)

THE REENTRY AUTOPILOT CONVERTS THE ATTITUDE ERRORS INTO ROLL, PITCH AND YAW RATE COMMANDS (ROLAC, PITAC, YAWAC). THESE COMMANDS ARE THEN MIXED AS FOLLOWS TO PRODUCE THE REQUIRED AILERON, ELEVATOR AND RUDDER RATES -

```
DELAD = KPDA*ROLAC + KPDA*PITAC + KYDA*YAWAC

DELED = KRDE*ROLAC + KPDE*PITAC + KYDE*YAWAC

DELRD = KRDR*ROLAC + KPDR*PITAC + KYDR*YAWAC
```

THE SIGN CONVENTIONS FOR THE AERODYNAMIC SURFACES ARE SUMMARIZED AS FOLLOWS -

SURFACE DEFLECTION	VEHICLE RESPONSE	RESULTANT FORCES AND MOMENTS
POSITIVE AILERON (+DELA)	POSITIVE ROLL (+BNKANG)	+CLL
POSITIVE ELEVATOR (+DELE)	NEGATIVE PITCH (-ALPHA)	+CL,-CM
POSITIVE RUDDER (+DELR)	NEGATIVE YAW (+BETA)	+CY,-CW

6.E.1. CONTROLS/AIRFRAME MODULES (CONTD)

THE MIXING GAINS FOR A REENTRY VEHICLE USING AILERON, ELEVATOR, AND RUDDER CONTROL SURFACES WOULD BE :-

ROLL - KRDA=+1, KRDE=0, KRDR=0,

PITCH - KPDA=0, KPDE=+1, KPDR=0,

YAW - KYDA=0, KYDE=0, KYDR=+1,.

THE AIRFRAME MODULE CALCULATES THE TOTAL FORCES AND MOMENTS ACTING ON THE VEHICLE BY SUMMING THE THRUST AND AERODYNAMIC MOMENTS.

THE CONSTANT VALUED INPUT VARIABLES ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
DELA DELE DELR	DEG	0.0	THE INITIAL VALUES OF THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACE DEFLECTION ANGLES.
DEPMAX(I) DEYMAX(I) I=1,15	DEG	1.0E20	THE MAXIMUM ALLOWABLE PITCH AND YAW DEFLECTIONS FOR ENGINE I.
DEPO(I) DEYO(I) I=1,15	DEG	0.0	THE ZERO DEFLECTION (NULL) VALUES OF ENGINE I IN PITCH AND YAW.
KPDA KPDE KPDR	N/D	0.0	THE PITCH MIXING GAINS FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES.
KPDP(I) I=1,15	N/D	0.0	THE PITCH MIXING GAIN FOR THE PITCH DEFLECTION OF ENGINE I.
KRDA KRDE KRDR	N/D	0.0	THE ROLL MIXING GAINS FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES.

6.E.1. CONTROLS/AIRFRAME MODULES (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
KRDP(I) I=1,15	N/D	0.0	THE ROLL MIXING GAIN FOR THE PITCH DEFLECTION OF ENGINE I.
KRDY(I) I=1,15	N/D	0.0	THE ROLL MIXING GAIN FOR THE YAW DEFLECTION OF ENGINE I.
KYDA KYDE KYDR	N/D	0.0	THE YAW MIXING GAINS FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES.
KYDY(I) I=1,15	N/D	0.0	THE YAW MIXING GAIN FOR THE YAW DEFLECTION OF ENGINE I.

THE OUTPUTS FOR THE CONTROLS/AIRFRAME MODULES ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
DELA DELE DELR	DEG	THE AILERON, ELEVATOR AND RUDDER DEFLECTION ANGLES WITH RESPECT TO THE VEHICLE BODY AXES.
DELAD DELED DELRD	DEG/SEC	THE RATES OF CHANGE IN THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACE DEFLECTION ANGLES.
DEP(I) DEY(I) I=1,15	DEG	THE PITCH AND YAW DEFLECTIONS WITH RESPECT TO THE VEHICLE BODY AXES FOR ENGINE I.
FTTXB FTTYB FTTZB	LBS	THE TOTAL FORCES ALONG THE VEHICLE ROLL, PITCH AND YAW BODY AXES, RESPECTIVELY.
TTMXB TTMYB TTMZB	FT-LBS (N-M)	THE TOTAL MOMENTS ABOUT THE VEHICLE ROLL, PITCH AND YAW BODY AXES.

6.E.3. ROTATIONAL EQUATIONS MODULE

THE ROTATIONAL EQUATIONS MODULE CALCULATES THE VEHICLE ANGULAR ACCELERATIONS WHICH ARE INTEGRATED TO YIELD THE VEHICLE BODY RATES. THE BODY RATES ARE USED TO CALCULATE THE QUATERNION RATES WHICH ARE INTEGRATED TO YIELD THE VEHICLE DIRECTION COSINE MATRIX WITH RESPECT TO THE EARTH-CENTERED INERTIAL COORDINATE SYSTEM. THE VEHICLE BODY RATES ARE INTEGRATED TO YIELD THE BODY ANGLES WHICH ARE USED TO COMPUTE ATTITUDE ERRORS FOR THE AUTOPILOT.

THE DIRECTION COSINE MATRIX IS INITIALIZED VIA THE QUATERNIONS BASED ON THE VALUE OF IGUID(12). THE USER CAN INITIALIZE THE QUATERNIONS, AND THUS THE VEHICLE ATTITUDE, IN ANY ONE OF THREE WAYS AS FOLLOWS -

1) INPUT IGUID(12)=1, AND ALPHA, BETA AND BNKANG AS THE DESIRED ANGLES.

2) INPUT IGUID(12)=2, AND ROLI, YAWI AND PITI AS THE DESIRED ANGLES WITH RESPECT TO THE L FRAME DEFINED BY LATL, LONL AND AZL.

3) INPUT IGUID(12)=3, AND YAWR, PITR AND ROLR AS THE DESIRED ANGLES.

THE VEHICLE BODY RATES AND BODY ANGLES (INTEGRATED BODY RATES) ARE ALSO INPUT IN NAMELIST GENDAT TO COMPLETE THE INITIALIZATION OF THE ROTATIONAL EQUATIONS MODULE.

THE CONSTANT VALUED INPUT VARIABLES FOR THIS MODULE ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
IGUID(12)	INTEGER	1	A FLAG TO SPECIFY THE OPTION TO BE USED FOR VEHICLE BODY ATTITUDE INITIALIZATION. = 1, INITIALIZE BODY RATES USING ALPHA, BETA, AND BNKANG. = 2, INITIALIZE BODY RATES USING ROLI, YAWI, AND PITI. = 3, INITIALIZE BODY RATES USING YAWR, PITR, AND ROLR.

6.E.3. ROTATIONAL EQUATIONS MODULE (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
IGUID(18)	INTEGER	0	ATTITUDE RATE INITIALIZATION FLAG. = 0, USE BODY RATES. (ROLBD,PITBD,YAWBD) = 2, USE INERTIAL EULER RATES. (ROLID,YAWID,PITID) = 3, USE RELATIVE EULER RATES. (YAWRD,PITRD,ROLRD)
ALPHA BETA BNKANG	DEG	0.	INITIAL VALUES OF ANGLE OF ATTACK, SIDESLIP, AND BANK, RESPECTIVELY. USED IF IGUID(12)=1.
AZL	DEG	0.	THE AZIMUTH OF THE LAUNCH CENTERED INERTIAL (L) COORDINATE SYSTEM MEASURED FROM NORTH TO EAST.
LATL	DEG	GDLAT	LATITUDE OF THE LAUNCH CENTERED INERTIAL (L) COORDINATE SYSTEM. THIS CAN BE INPUT AS EITHER GEODETIC OR GEOCENTRIC LATITUDE. IF GEODETIC LATITUDE IS INPUT, THE L FRAME BECOMES A PLUMB LINE SYSTEM. IF LATL IS NOT INPUT, IT IS SET EQUAL TO GDLAT.
LONL	DEG	LONGI	INERTIAL EAST LONGITUDE OF THE LAUNCH CENTERED INERTIAL (L) COORDINATE SYSTEM. IF LONL IS NOT INPUT, IT IS SET EQUAL TO LONGI.
ROLB PITB YAWB	DEG	0.0	THE INITIAL VALUE OF THE INTEGRATED ROLL, PITCH AND YAW BODY RATES, RESPECTIVELY.
ROLBD PITBD YAWBD	DEG/SEC	0.0	THE INITIAL VALUE OF THE VEHICLE ROLL, PITCH AND YAW BODY RATES WITH RESPECT TO INERTIAL SPACE.
ROLI YAWI PITI	DEG	0.	THE INITIAL VALUES OF THE INERTIAL EULER ATTITUDE ANGLES OF THE VEHICLE WITH RESPECT TO THE LAUNCH PAD (L) COORDINATE SYSTEM. USED IF IGUID(12)=2.

6.E.2. MASS PROPERTIES MODULE

THE PROGRAM ACCEPTS COMPOSITE MASS PROPERTIES DATA AS TABLE INPUTS. THE CENTER OF GRAVITY POSITION COMPONENTS ARE INPUT WITH RESPECT TO THE BODY REFERENCE SYSTEM AS THE XCGT, YCGT, AND ZCGT TABLES. THE MOMENTS AND PRODUCTS OF INERTIA ARE INPUT WITH RESPECT TO THE BODY AXIS SYSTEM WHICH IS LOCATED AT THE VEHICLE CENTER OF GRAVITY. THE MOMENTS OF INERTIA ARE INPUT AS THE IXXT, IYYT, AND IZZT TABLES. THE PRODUCTS OF INERTIA ARE INPUT AS THE IXYT, IXZT, AND IYZT TABLES.

THE TABLE INPUTS FOR THE MASS PROPERTIES MODULE ARE INPUT IN NAMELIST TAB AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
IXXT IYYT IZZT	SLUG-FT2 (KG-M2)	0.0	THE VEHICLE MOMENTS OF INERTIA TABLES ABOUT THE VEHICLE ROLL, PITCH AND YAW AXES, RESPECTIVELY.
IXYT IXZT IYZT	SLUG-FT2 (KG-M2)	0.0	THE VEHICLE PRODUCTS OF INERTIA TABLES.
XCGT YCGT ZCGT	FT (M)	0.	TABLES OF CENTER-OF-GRAVITY LOCATION ALONG THE XBR,YBR, AND ZBR AXES, RESPECTIVELY.

THE OUTPUT VARIABLES FOR THE MASS PROPERTIES MODULE ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
IXX IYY IZZ	SLUG-FT2 (KG-M2)	THE VEHICLE MOMENTS OF INERTIA ABOUT THE VEHICLE ROLL, PITCH AND YAW AXES, RESPECTIVELY.
IXXD IYYD IZZD	SL-FT2/S (KG-M2/S)	THE RATES OF CHANGE IN THE MOMENTS OF INERTIA ABOUT THE VEHICLE ROLL, PITCH AND YAW AXES, RESPECTIVELY.

6.E.2. MASS PROPERTIES MODULE (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
IXY IXZ IYZ	SLUG-FT2 (KG-M2)	THE VEHICLE PRODUCTS OF INERTIA.
IXYD IXZD IYZD	SL-FT2/S (KG-M2/S)	THE RATES OF CHANGE IN THE VEHICLE PRODUCTS OF INERTIA.
XCG YCG ZCG	FT (M)	VEHICLE CENTER-OF-GRAVITY LOCATION ALONG THE XBR, YBR, AND ZBR, RESPECTIVELY.

6.E.3. ROTATIONAL EQUATIONS MODULE (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
YAWR PITR ROLR	DEG	0.	THE INITIAL VALUES OF THE RELATIVE EULER ANGLES OF THE VEHICLE WITH RESPECT TO THE LOCAL GEOGRAPHIC (G) COORDINATE SYSTEM. USED IF IGUID(12)=3.

THE OUTPUT VARIABLES FOR THIS MODULE ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
ALPHA BETA BNKANG	DEG	ANGLE OF ATTACK, SIDESLIP, AND BANK. SEE THE SECTION ON VEHICLE ATTITUDE ANGLES/RATES FOR THE SPECIFIC DEFINITIONS.
DEJ J=0,3	N/D	RATE OF CHANGE IN THE QUATERNIONS.
FJ J=0,3	N/D	THE VALUES OF THE QUATERNIONS.
IB1J IB2J IB3J. J=1,3	N/D	THE DIRECTION COSINES OF THE VEHICLE ROLL, PITCH AND YAW AXES WITH RESPECT TO THE EARTH-CENTERED INERTIAL COORDINATES.
PND QND RND	N/D	THE NON-DIMENSIONAL VEHICLE ROLL, PITCH AND YAW RATES ABOUT THE VEHICLE BODY AXES. THESE RATES ARE USED AS TABLE MULTIPLIERS FOR THE AERODYNAMIC DAMPING DERIVATIVE COEFFICIENTS.
ROLB PITB YAWB	DEG	THE INTEGRATED VEHICLE BODY RATES ABOUT THE VEHICLE ROLL, PITCH AND YAW AXES.
ROLBD PITBD YAWBD	DEG/SEC	THE VEHICLE ROLL, PITCH AND YAW RATES ABOUT THE VEHICLE BODY AXES.

6.E.3. ROTATIONAL EQUATIONS MODULE (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
ROLBDD PITBDD YAWBDD	DEG/S**2	VEHICLE ROLL, PITCH AND YAW ANGULAR ACCELERATIONS.
ROLBDR PITBDR YAWBDR	RAD/SEC	THE ANGULAR RATES OF THE VEHICLE ABOUT THE ROLL, PITCH AND YAW BODY AXES.
ROLI YAWI PITI	DEG	INERTIAL VEHICLE ATTITUDE ANGLES MEASURED WITH RESPECT TO THE LAUNCH PAD INERTIAL (L) COORD-INATE SYSTEM. AT LAUNCH, ALL THREE ANGLES ARE ZERO WHEN THE VEHICLE IS VERTICAL, I.E., WHEN XB IS IN THE RADIAL (OR LOCAL VERTICAL) DIRECTION, ZB IS ALONG THE AZIMUTH SPECIFIED BY AZL, AND YB COMPLETES A RIGHT-HAND SYSTEM.
YAWR PITR ROLR	DEG	VEHICLE ATTITUDE ANGLES RELATIVE TO THE LOCAL GEOGRAPHIC (G) SYSTEM. YAWR IS THE AZIMUTH OF THE XB AXIS MEASURED CLOCKWISE FROM NORTH, PITR IS THE PITCH ANGLE MEASURED POSITIVE ABOVE THE LOCAL HORIZONTAL PLANE, AND ROLR IS THE BANK ANGLE ABOUT THE XB AXIS MEASURED POSITIVE IN THE RIGHT-HAND SENSE.
ALPHI BETAI BANKI	DEG	INERTIAL ANGLE OF ATTACK, SIDESLIP, AND BANK.

6.F. AUTOPILOT MODULE

THE PROGRAM CAN SIMULATE EITHER AN UNCONTROLLED VEHICLE WITHOUT AN AUTOPILOT OR A CONTROLLED VEHICLE WITH AN AUTOPILOT. THE AUTOPILOT MODELS AVAILABLE ARE -

1. NONE.

2. AN ASCENT AUTOPILOT.

3. A REENTRY AUTOPILOT WHICH USES AERODYNAMIC CONTROL SURFACES AND REACTION CONTROL JETS SIMULTANEOUSLY.

THE AUTOPILOT MODULE SUPPLIES THE ROLL, PITCH AND YAW COMMANDS TO THE CONTROLS MODULE . AS A RESULT, ANY NEW AUTOPILOT MODELS WHICH MAY BE ADDED IN THE FUTURE ALSO MUST SUPPLY THESE SAME COMMANDS. THESE COMMANDS ARE DEFINED AS ROLAC, PITAC, AND YAWAC.

THE PROCEDURE FOR ADDING NEW AUTOPILOT MODELS IS THE SAME AS THAT FOR ADDING NEW GUIDANCE MODELS. SECTION 6.B SHOWS THE RELATED SUBROUTINES AND INTERACTIONS. THE AUTOPILOT PECULIAR INSTRUCTIONS ARE AS FOLLOWS -

1. DETERMINE THE EQUATIONS TO BE PROGRAMMED.

2. DEFINE ADDITIONAL VALUES FOR THE AUTOPILOT MODEL FLAG NAUTOP.

3. IF THE AUTOPILOT IS TO BE CALLED ONCE PER INTEGRATION STEP, THE MODEL SHOULD BE CALLED FROM SUBROUTINE GCNTRL. IF THE AUTOPILOT IS TO BE CALLED ONCE PER INTERGATION PASS, THE MODEL SHOULD BE CALLED FROM SUBROUTINE AUTOPM.

4. IF THE AUTOPILOT IS TO BE CALLED BASED ON THE AUTOPILOT TIME CHANNEL, THIS LOGIC MUST BE ADDED TO THE ROUTINE USING THE VARIABLES ATIME, TIMEA, AND DTA.

THE PROGRAM CONTAINS AN AUTOPILOT TIME CHANNEL WHICH CAN BE USED TO SIMULATE AUTOPILOT CYCLE TIMES WHICH ARE INDEPENDENT OF THE SIMULATOR CYCLE TIMES. THERE ARE THREE BASIC OPTIONS INHERENT IN THE AUTOPILOT TIME CHANNEL AS FOLLOWS -

1) DTA NOT INPUT AND ADT NOT COMPUTED. THE AUTOPILOT ROUTINE WILL BE CALLED ONCE EVERY SIMULATOR INTEGRATION STEP.

2) DTA INPUT AND ADT NOT COMPUTED. THE AUTOPILOT ROUTINE WILL BE CALLED ONLY EVERY DTA SECONDS STARTING FROM ATIME.

6.F. AUTOPILOT MODULE (CONTD)

3) DTA INPUT AND ADT COMPUTED. ADT OVERRIDES DTA IF ADT IS NOT EQUAL TO ZERO. THERE IS CURRENTLY NO LOGIC IN THE PROGRAM TO CALCULATE ADT. AS A RESULT, THIS LOGIC MUST BE SUPPLIED BY THE USER.

THE INPUT VARIABLES ASSOCIATED WITH THE AUTOPILOT MODULE ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NAUTOP	INTEGER	0	A FLAG TO INDICATE WHICH AUTOPILOT MODEL IS TO BE USED. = 0, NO AUTOPILOT. = 1, USE THE ASCENT AUTOPILOT. = 2, USE THE REENTRY AUTOPILOT.
ATIME	SEC	TIME/DTA	THE TIME AT WHICH THE AUTOPILOT WAS LAST ENTERED.
DTA	SEC	1.0E300	THE AUTOPILOT CYCLE TIME. DTA IS USED IF ADT IS ZERO.

THE OUTPUT VARIABLES FOR THIS MODULE ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
ADT	SEC	THE AUTOPILOT COMPUTED CYCLE TIME. IF ADT IS GREATER THAN ZERO, IT OVERRIDES DTA.
ATIME	SEC	THE TIME AT WHICH THE AUTOPILOT WAS LAST ENTERED.
ROLAC PITAC YAWAC	DEG	ROLL, PITCH, AND YAW AUTOPILOT COMMANDS.
TIMEA	SEC	THE TIME AT WHICH THE AUTOPILOT IS TO BE REENTERED.

6.F.1. ASCENT AUTOPILOT MODEL

THE ASCENT AUTOPILOT IS USED IF NAUTOP=1, IS INPUT IN NAMELIST GENDAT.

THE ASCENT AUTOPILOT MODEL IN THE PROGRAM IS THE SHUTTLE ASCENT AUTOPILOT. THIS AUTOPILOT UTILIZES ATTITUDE ERROR, RATE ERROR, AND PITCH AND YAW ACCELERATION ERROR LOOPS.

THIS MODEL WAS OBTAINED FROM THE FOLLOWING DOCUMENT -

DIGITAL FLIGHT CONTROL SOFTWARE DESIGN REQUIREMENTS
GUIDANCE AND CONTROL SYSTEMS BRANCH
JOHNSON SPACE CENTER
NASA SPACE SHUTTLE PROGRAM WORKING PAPER
JULY 6, 1973

THE ASCENT AUTOPILOT CAN BE USED WITH EITHER THE OPEN LOOP GUIDANCE OR CLOSED LOOP ASCENT GUIDANCE MODELS.

THE ASCENT AUTOPILOT MODEL INCLUDES A LOAD RELIEF OPTION. THE LOAD RELIEF OPTION IS OBTAINED IF LDRLF = 1 IS INPUT IN NAMELIST GENDAT. THE LOAD RELIEF FEATURE REDUCES THE ANGLES OF ATTACK AND SIDESLIP BY USING MEASURED LATERAL ACCELERATIONS IN PITCH AND YAW FEEDBACK LOOPS.

THE PITCH AND YAW LOAD RELIEF ACCELEROMETERS ARE ASSUMED TO BE COINCIDENT WITH THE VEHICLE YAW AND PITCH BODY AXES, RESPECTIVELY. MISALIGNMENT ANGLES FOR THESE ACCELEROMETERS ARE PROVIDED SO THAT MISALIGNMENT ERRORS CAN BE SIMULATED.

THE ACCELEROMETER MISALIGNMENT ANGLES ARE DEFINED AS FOLLOWS -
PITCH ACCELEROMETER LOCATION -

1) ROTATE ABOUT THE XB AXIS THROUGH AN ANGLE OF DPHP DEGREES FROM THE ZB AXIS.
2) ROTATE ABOUT THE ONCE ROTATED YB AXIS THROUGH AN ANGLE OF DTHP DEGREES.

YAW ACCELEROMETER LOCATION -

1) ROTATE ABOUT THE XB AXIS THROUGH AN ANGLE OF DPHY DEGREES FROM THE YB AXIS.
2) ROTATE ABOUT THE ONCE ROTATED ZB AXIS THROUGH AN ANGLE OF DPSY DEGREES.

6.F.1. ASCENT AUTOPILOT MODEL (CONTD)

THE MEASURED ACCELERATION AT THE ACCELEROMETER LOCATION ALONG AXES THAT ARE PARALLEL TO THE XB, YB, AND ZB AXES IS GIVEN BY -

```
TEMP(I) = AXB(I) + ROLBDD(I) CROSS DAXB(I)
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THE MEASURED ACCELERATION FOR THE MISALIGNED YAW AND PITCH ACCELEROMETERS IS GIVEN BY -

```
AYBM = TEMP(I) DOT MISSY(I)
AZBM = TEMP(I) DOT MISSP(I)

WHERE - MISSY(1) = -SIN(DPSY)
        MISSY(2) = COS(DPSY) * COS(DPHY)
        MISSY(3) = COS(DPSY) * SIN(DPHY)
        MISSP(1) = SIN(DTHP)
        MISSP(2) = -COS(DTHP) * SIN(DPHP)
        MISSP(3) = COS(DTHP) * COS(DPHP)
```

THE AUTOPILOT COMMANDS ARE COMPUTED AS FOLLOWS -

```
ROLAC = DISR + RATR
PITAC = DISP + RATP + PLDRL + ANGAP + DSPINT
YAWAC = DISY + RATY + YLDRL + ANGAY + DSYINT
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THE CONSTANT VALUED INPUT VARIABLES FOR THIS MODULE ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
AAFFP(I) AAFFY(I) I=1,3	RAD/SEC	0.0	PITCH AND YAW ANGULAR ACCELERATION FILTER FREQUENCIES.
AFFP AFFY	RAD/SEC	0.0	THE AUTOPILOT ACCELERATION FILTER FREQUENCIES IN PITCH AND YAW FOR THE ASCENT AUTOPILOT.
APRLIM APPLIM APYLIM	DEG	0.0	THE AUTOPILOT ROLL, PITCH AND YAW ATTITUDE ERROR LIMITS FOR THE ASCENT AUTOPILOT.
ASFFP ASFFY	RAD/S**2	0.0	THE AUTOPILOT FILTER FREQUENCIES IN PITCH AND YAW FOR THE SUM OF THE ATTITUDE AND ACCELERATION ERRORS FOR THE ASCENT AUTOPILOT.
AXRB AYRB AZRB	FT (M)	0.0	THE POSITION COMPONENTS OF THE AUTOPILOT ACCELEROMETER IN THE VEHICLE BODY REFERENCE SYSTEM.

6.F.1. ASCENT AUTOPILOT MODEL (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
DFFR DFFP DFFY	RAD/SEC	0.0	THE AUTOPILOT DISPLACEMENT FILTER FREQUENCIES IN ROLL, PITCH AND YAW FOR THE ASCENT AUTOPILOT.
DPHP DPHY	DEG	0.0	THE ROLL MISALIGNMENTS ANGLE FOR THE PITCH AND YAW ACCELEROMETERS.
DPSY	DEG	0.0	THE YAW MISALIGNMENT ANGLE FOR THE YAW ACCELEROMETER.
DTHP	DEG	0.0	THE PITCH MISALIGNMENT ANGLE FOR PITCH ACCELEROMETER.
LDRLF	INTEGER	0	LOAD RELIEF OPTION CONTROL FLAG = 0, DO NOT USE LOAD RELIEF OPTION. = 1, USE LOAD RELIEF OPTION.
RFFR RFFP RFFY	RAD/SEC	0.0	THE AUTOPILOT RATE FILTER FREQUENCIES IN ROLL, PITCH AND YAW FOR THE ASCENT AUTOPILOT.
TAUINT	N/D	0.0	THE INTEGRATION CONSTANT FOR THE FORWARD INTEGRATION LOOP IN THE ASCENT AUTOPILOT.
TAULP TAULY	SEC	0.0	PITCH AND YAW LOAD RELIEF INTEGRATION TIME CONSTANTS.

THE TABLES FOR THIS MODEL ARE INPUT IN NAMELIST TAB AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
AYBCT AZBCT	DEG/S**2	0.0	THE PITCH AND YAW BODY ACCELERATION COMMAND TABLES FOR THE ASCENT AUTOPILOT ACCELERATION ERROR FEEDBACK LOOP.
CKAAPT CKAAYT	SEC**2	0.0	PITCH AND YAW ANGULAR ACCELERATION GAINS.
CKAPT CKAYT	SEC**2	0.0	THE AUTOPILOT ACCELERATION GAIN TABLES FOR PITCH AND YAW, RESPECTIVELY, FOR THE ASCENT AUTOPILOT.

6.F.1. ASCENT AUTOPILOT MODEL (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CKASPT CKASYT	SEC**2	0.0	THE AUTOPILOT GAINS IN PITCH AND YAW FOR THE SUM OF THE ATTITUDE AND ACCELERATION ERRORS FOR THE ASCENT AUTOPILOT.
CKDRT CKDPT CKDYT	N/D	0.0	THE AUTOPILOT DISPLACEMENT GAIN TABLES FOR ROLL, PITCH AND YAW, RESPECTIVELY, FOR THE ASCENT AUTOPILOT.
CKLAPT CKLAYT	RAD/FT/ SEC**2	0.0	PITCH AND YAW LOAD RELIEF ACCELERATION GAINS.
CKLVPT CKLVYT	RAD/FT/ SEC	0.0	PITCH AND YAW LOAD RELIEF VELOCITY GAINS.
CKRRT CKRPT CKRYT	SEC	0.0	THE AUTOPILOT RATE GAIN TABLES FOR ROLL, PITCH AND YAW, RESPECTIVELY, FOR THE ASCENT AUTOPILOT.
RBDCT PBDCT YBDCT	DEG/SEC	0.0	THE ROLL, PITCH AND YAW BODY RATE COMMAND TABLES FOR THE ASCENT AUTOPILOT RATE ERROR FEEDBACK LOOP.

THE OUTPUT VARIABLES FOR THIS MODULE ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
ACCELP ACCELY	DEG	ACCELERATION CONTRIBUTION TO THE AUTOPILOT PITCH AND YAW COMMANDS.
ANGAP ANGAY	DEG	ANGULAR ACCELERATION CONTRIBUTION TO THE AUTOPILOT PITCH AND YAW COMMANDS.
AXBM AYBM AZBM	FPSS (MPSS)	THE ACCELERATION COMPONENTS ALONG THE VEHICLE BODY SYSTEM MEASURED BY THE ASCENT AUTOPILOT ACCELEROMETER.
AYBC AZBC	DEG/S**2	THE PITCH AND YAW BODY ACCELERATION COMMANDS FOR THE ASCENT AUTOPILOT ACCELERATION ERROR FEEDBACK LOOP.

6.F.1. ASCENT AUTOPILOT MODEL (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
CKAAP CKAAY	SEC**2	TABLE LOOK-UPS OF TABLES CKAAPT AND CKAAYT.
CKLAP CKLAY	RAD/FT/ SEC**2	TABLE LOOK-UPS OF TABLES CKLAPT AND CKLAYT.
CKLVP CKLVY	RAD/FT/ SEC	TABLE LOOK-UPS OF TABLES CKLVPT AND CKLVYT.
DAXB DAYB DAZB	FT (M)	THE DELTA POSITION VECTOR FROM THE VEHICLE CENTER OF GRAVITY TO THE ASCENT AUTOPILOT ACCELEROMETER.
DISP DISR DISY	DEG	DISPLACEMENT CONTRIBUTION TO THE AUTOPILOT PITCH, ROLL AND YAW COMMANDS.
DSPD DSYD	N/D	THE RATES FOR THE FORWARD LOOP INTEGRATOR IN PITCH AND YAW FOR THE ASCENT AUTOPILOT.
DSPINT DSYINT	N/D	THE INTEGRALS OF THE FORWARD LOOP INTEGRATOR IN PITCH AND YAW FOR THE ASCENT AUTOPILOT.
PACCER YACCER	FT/SEC**2 (M-S2)	THE PITCH AND YAW ACCELERATION ERRORS FOR THE ASCENT AUTOPILOT.
PLDRL YLDRL	DEG	LOAD RELIEF CONTRIBUTIONS TO THE AUTOPILOT PITCH AND YAW COMMANDS.
RATP RATR RATY	DEG	RATE CONTRIBUTIONS TO THE AUTOPILOT PITCH, ROLL AND YAW COMMANDS.
RBDC PBDC YBDC	DEG/SEC	THE ROLL, PITCH AND YAW BODY RATE COMMANDS FOR THE ASCENT AUTOPILOT RATE ERROR FEEDBACK LOOP.
ROLAC PITAC YAWAC	DEG	ROLL, PITCH, AND YAW AUTOPILOT COMMANDS.
RRATER PRATER YRATER	DEG/SEC	THE ROLL, PITCH AND YAW RATE ERRORS FOR THE ASCENT AUTOPILOT.

6.F.2. REENTRY AUTOPILOT MODEL

THE REENTRY AUTOPILOT IS USED IF NAUTOP=2, IS INPUT IN NAMELIST GENDAT.

THE REENTRY AUTOPILOT MODEL IN THE PROGRAM IS THE SHUTTLE SYSTEM X REENTRY AUTOPILOT. THIS AUTOPILOT UTILIZES BOTH AERODYNAMIC CONTROL SURFACES (AILERON, ELEVATOR AND RUDDER) AND REACTION CONTROL SYSTEM (RCS) JETS FOR ATTITUDE CONTROL. THE BLENDING OF THESE TWO TYPES OF CONTROL ELEMENTS IS A FUNCTION OF THE FLIGHT REGIME.

THIS MODEL WAS OBTAINED FROM THE FOLLOWING DOCUMENT WITH LATER MODIFICATIONS INCLUDED -

DIGITAL FLIGHT CONTROL SOFTWARE DESIGN REQUIREMENTS
GUIDANCE AND CONTROL SYSTEMS BRANCH
JOHNSON SPACE CENTER
NASA SPACE SHUTTLE PROGRAM WORKING PAPER
JULY 6, 1973

THE REENTRY AUTOPILOT CAN ONLY BE USED WITH THE SHUTTLE REENTRY GUIDANCE MODEL.

THE CONSTANT VALUED INPUT VARIABLES FOR THIS MODULE ARE INPUT IN NAMELIST GENDAT AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
AREFL EREFL RREFL	FT**3 (M**3)	0.0	THE PRODUCTS OF THE AILERON, ELEVATOR AND RUDDER AREAS AND REFERENCE LENGTHS USED TO COMPUTE THE HINGE MOMENTS.
DADMAX DEDMAX DRDMAX	DEG/SEC	1.0E20	THE MAXIMUM ALLOWABLE AILERON, ELEVATOR AND RUDDER RATES.
DAMAX DEMAX DRMAX	DEG	1.0E20	THE MAXIMUM ALLOWABLE AILERON, ELEVATOR AND RUDDER DEFLECTION ANGLES.
DAMIN DEMIN DRMIN	DEG	-1.0E20	THE MINIMUM ALLOWABLE AILERON, ELEVATOR AND RUDDER DEFLECTION ANGLES.
DELECI	DEG	0.0	THE INITIAL VALUE OF DELEC.
FREFL(I) I=1,3	FT**3 (M**3)	0.0	THE PRODUCT OF THE AREA AND REFERENCE LENGTH FOR FLAP I USED TO COMPUTE THE HINGE MOMENT FOR FLAP I.

6.F.2. REENTRY AUTOPILOT MODEL (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
HMAMX HMEMX HMRMX	FT-LBS (N-M)	1.0E20	THE MAXIMUM ALLOWABLE AILERON, ELEVATOR AND RUDDER HINGE MOMENTS.
THRSJ	LBS (N)	0.0	THE THRUST OF EACH RCS JET. USED TO COMPUTE WDOTJ.
TISPJ	SEC	1.0E20	THE SPECIFIC IMPULSE OF THE RCS JETS.
WPCONJ	LBS (N)	0.0	THE WEIGHT OF PROPELLANT CONSUMED BY THE RCS JETS.

THE TABLES FOR THIS MODEL ARE INPUT IN NAMELIST TAB AND ARE AS FOLLOWS -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CHAT CHET CHRT	N/D	0.0	THE AILERON, ELEVATOR AND RUDDER HINGE MOMENT COEFFICIENT TABLES.
CHFIT I=1,3	N/D	0.0	THE HINGE MOMENT COEFFICIENT TABLE FOR FLAP I.
CKAT CKET CKRT	N/D	0.0	THE AILERON, ELEVATOR AND RUDDER GAIN TABLES FOR THE REENTRY AUTOPILOT.
DELFIT I=1,3	DEG	0.0	THE DEFLECTION ANGLE TABLE FOR FLAP I.
FXBPJT FYBPJT FZBPJT	LBS (N)	0.0	THE FORCE PER JET ALONG THE VEHICLE ROLL, PITCH AND YAW BODY AXES.
PNPJIT PPPJIT	N/D	0.0	THE PITCH MOMENT INTERFERENCE COEFFICIENTS DUE TO THE NEGATIVE AND POSITIVE PITCH JETS, RESPECTIVELY.
PRJIT PYJIT	N/D	0.0	THE PITCH MOMENT INTERFERENCE COEFFICIENTS DUE TO THE ROLL AND YAW JETS, RESPECTIVELY.

6.F.2. REENTRY AUTOPILOT MODEL (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
RMPJT PMPJT YMPJT	FT-LBS (N-M)	0.0	THE ROLL, PITCH AND YAW MOMENT PER JET TABLES FOR THE REENTRY AUTOPILOT.
RRJIT RYJIT	N/D	0.0	THE ROLL MOMENT INTERFERENCE COEFFICIENTS DUE TO THE ROLL AND YAW JETS, RESPECTIVELY.
YRJIT YYJIT	N/D	0.0	THE YAW MOMENT INTERFERENCE COEFFICIENTS DUE TO THE ROLL AND YAW JETS, RESPECTIVELY.

THE OUTPUT VARIABLES FOR THIS MODULE ARE AS FOLLOWS -

OUTPUT SYMBOL	UNITS	DEFINITION
ALPERR	DEG	THE ANGLE OF ATTACK ERROR (COMMANDED - ACTUAL).
CHA CHE CHR	N/D	THE AILERON, ELEVATOR AND RUDDER HINGE MOMENT COEFFICIENTS.
CKA CKE CKR	N/D	THE AILERON, ELEVATOR AND RUDDER GAINS FOR THE REENTRY AUTOPILOT.
DADMX DEDMX DRDMX	DEG/SEC	THE COMPUTED AILERON, ELEVATOR AND RUDDER MAXIMUM RATES BASED ON HINGE MOMENTS.
DELAC DELEC DELRC	DEG	THE COMMANDED AILERON, ELEVATOR AND RUDDER DEFLECTION ANGLES FROM THE REENTRY AUTOPILOT.
DELADC DELEDC DELRDC	DEG/SEC	THE COMMANDED AILERON, ELEVATOR AND RUDDER DEFLECTION ANGLE RATES FROM THE REENTRY AUTOPILOT.
DELFI I=1,3	DEG	THE DEFLECTION ANGLE OF FLAP I. OBTAINED AS THE TABLE LOOK-UP OF DELFIT.

6.F.2. REENTRY AUTOPILOT MODEL (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
HMA HME HMR	FT-LBS (N-M)	THE CALCULATED AILERON, ELEVATOR AND RUDDER HINGE MOMENTS.
HMFI I=1,3	FT-LBS (N-M)	THE CALCULATED HINGE MOMENT FOR FLAP I.
RCSFXB RCSFYB RCSFZB	LBS (N)	THE FORCES ALONG THE VEHICLE ROLL, PITCH AND YAW BODY AXES DUE TO THE REACTION CONTROL SYSTEM (RCS) JETS.
RCSMXB RCSMYB RCSMZB	FT-LBS (N-M)	THE MOMENTS ABOUT THE VEHICLE ROLL, PITCH AND YAW BODY AXES DUE TO THE REACTION CONTROL SYSTEM (RCS) JETS.
ROLBER PITBER YAWBER	DEG	THE ATTITUDE ERRORS ABOUT THE VEHICLE ROLL, PITCH AND YAW BODY AXES.
ROLN PITN YAWN	DECIMAL	THE NUMBER OF NEGATIVE ROLL, PITCH AND YAW JETS ON IN THE REENTRY AUTOPILOT.
ROLP PITP YAWP	DECIMAL	THE NUMBER OF POSITIVE ROLL, PITCH AND YAW JETS ON IN THE REENTRY AUTOPILOT.
ROLRER	DEG	THE RELATIVE ROLL ANGLE ERROR (COMMANDED - ACTUAL).
TONT	SEC	THE TOTAL ON TIME OF ALL JETS IN THE REENTRY AUTOPILOT.
TROLN TPITN TYAWN	SEC	THE TOTAL ON TIME OF THE NEGATIVE ROLL, PITCH AND YAW JETS IN THE REENTRY AUTOPILOT.
TROLP TPITP TYAWP	SEC	THE TOTAL ON TIME OF THE POSITIVE ROLL, PITCH AND YAW JETS IN THE REENTRY AUTOPILOT.
WDOTJ	LBS/SEC (N/SEC)	THE PROPELLANT FLOWRATE OF THE RCS JETS.

7. ERROR MESSAGES AND TROUBLE-SHOOTING

THE PROGRAM PRINTS OUT ERROR MESSAGES WHENEVER A SITUATION ARISES WHICH PREVENTS THE PROGRAM FROM CONTINUING (FATAL ERROR) OR WHENEVER A SITUATION ARISES WHICH THE USER SHOULD BE AWARE OF (NON-FATAL ERROR) BUT WHICH WILL NOT IN ITSELF CAUSE THE PROGRAM TO TERMINATE.

THERE ARE CIRCUMSTANCES WHICH CAN ARISE DUE TO INPUT ERRORS WHICH WILL PRODUCE CONDITIONS THAT CANNOT EASILY BE DIAGNOSED INTERNALLY BY THE PROGRAM. THESE CASES WILL INVARIABLY CAUSE THE PROGRAM TO TERMINATE WITH A CORE DUMP. DIAGNOSIS IN THESE CASES CAN USUALLY BE MADE BY CHECKING THE INPUT AND THE TRAJECTORY PRINTOUT UP TO THE TIME OF THE DUMP. IN CERTAIN CASES, THE CORE DUMP MUST BE EXAMINED TO DETERMINE THE PROGRAM LOGIC THAT CAUSED THE DUMP. FOR EXAMPLE, AN INPUT ERROR IN A THRUST TABLE COULD PRODUCE INFINITE THRUST. THE PROGRAM WOULD THEN DUMP AS SOON AS IT ATTEMPTED TO USE THAT VALUE. THESE TYPES OF INPUT ERRORS CANNOT GENERALLY BE ACCOMODATED BY AN ERROR MESSAGE. AS A RESULT, ONLY THE MOST PROBABLE INPUT ERRORS HAVE BEEN INCLUDED IN THE LIST OF ERROR MESSAGES.

ERROR MESSAGES ARE USUALLY CAUSED BY INPUT ERRORS OR BY INVALID PROBLEM DEFINITION. AS A RESULT, THE FIRST COURSE OF ACTION TO BE TAKEN WHEN AN ERROR MESSAGE (OR DUMP) IS OBTAINED IS TO REVIEW ALL INPUT DATA AND THE PROBLEM FORMULATION.

THE SELECTION AND PLACEMENT OF CONTROL PARAMETERS IS VERY IMPORTANT TO THE SUCCESSFUL OPERATION OF THE SEARCH/OPTIMIZATION ALGORITHMS. CASES WHICH SHOW POOR CONVERGENCE SHOULD BE EXAMINED TO ENSURE THAT THE SELECTION OF CONTROL PARAMETERS AND PROBLEM SETUP CAN PRODUCE A SOLUTION. POOR CONVERGENCE IS SOMETIMES CAUSED BY UNEQUAL WEIGHTING OF THE TARGET VARIABLES. THAT IS, THE DESIRED TOLERANCES FOR THE TARGET VARIABLES ARE NOT OF THE SAME PERCENTAGE. THIS CAUSES THE ALGORITHM TO TRY TO SATISFY THE TARGET VARIABLE WHICH HAS THE LARGEST WEIGHTED ERROR EVEN THOUGH THE ACTUAL ERROR MAY BE SMALL. CONTROL PARAMETER WEIGHTING IS ALSO IMPORTANT. THE AUTOMATIC WEIGHTING PROCESS GENERALLY PROVIDES THE BEST WEIGHTING FOR MOST PROBLEMS. HOWEVER, PROBLEMS WHICH ENCOMPASS DIFFERENT FLIGHT REGIMES IN THE SAME RUN USUALLY MUST BE WEIGHTED MANUALLY OR BY SOME SPECIFIC WEIGHTING METHOD IN ORDER TO PRODUCE A SOLUTION.

THE TROUBLE SHOOTING LIST SHOULD BE REVIEWED IF AN ERROR MESSAGE OR UNEXPECTED RESULTS WERE OBTAINED FROM THE TRAJECTORY SIMULATION.

7. ERROR MESSAGES AND TROUBLE-SHOOTING (CONTD)

TROUBLE SHOOTING

1) CHECK THE SEQUENCE OF NAMELISTS TO SEE THAT THEY ARE IN THE PROPER ORDER.

2) CHECK TO SEE THAT EACH NAMELIST IS TERMINATED BY A $ IN COLUMNS 2 THROUGH 80.

3) CHECK TO SEE THAT EACH PHASE IS TERMINATED BY ENDPHS = 1, IN NAMELISTS GENDAT, TBLMLT, OR TAB AS THE CASE MAY BE.

4) CHECK TO SEE THAT THE PHASE (EVENT) NUMBERS ARE ASSIGNED IN ASCENDING ORDER.

5) CHECK TO SEE THAT THE LAST PHASE CONTAINS ENDPRB=1, AND ENDJOB=1.

6) CHECK TO SEE THAT THE FINAL EVENT SEQUENCE NUMBER (FESN) IS LESS THAN OR EQUAL TO THE LAST PHASE OF THE PROBLEM.

7) CHECK TO SEE THAT THE EVENT CRITERIA FOR EACH PRIMARY EVENT CAN BE ATTAINED IN THE PRESCRIBED ORDER OF OCCURRANCE.

8) IF SERCH ERRORS HAVE OCCURRED, CHECK ALL HOLLERITH INPUT VARIABLES TO BE SURE THAT THE NAMES ARE VALID.

ERROR MESSAGES

MESSAGE	SOURCE/TYPE	CONDITION/CORRECTIVE ACTION
DATA BUFFER	READAT/FATAL	THE CONSTANT VALUED INPUT DATA EXCEEDS 2500 CELLS OR THE TABLE DATA EXCEEDS 24000 CELLS. REDUCE THE AMOUNT OF INPUT DATA OR CHECK THE TABLE INPUTS FOR THE CORRECT FORMAT.

7. ERROR MESSAGES AND TROUBLE-SHOOTING (CONTD)

MESSAGE	SOURCE/TYPE	CONDITION/CORRECTIVE ACTION
DIMENSION TABLE NAME	READAT/FATAL	THE INDICATED TABLE IS INPUT INCORRECTLY. CHECK TABLE INPUT.
-DINPT-ESN= I NOT FOUND	DINPT/FATAL	DATA FOR EVENT I DOES NOT EXIST. MACHINE ERROR, RERUN THE JOB.
TARGETING UPHILL	TRYIT2/FATAL	THE TARGET ERRORS CANNOT BE REDUCED ANY FURTHER WITH THE GIVEN SET OF CONTROLS. CHECK THE PROBLEM FORMULATION OR THE SIZE OF THE PERTURBATIONS (PERT).
END FILE TAPE 1 -DINPT - ESN = I	DINPT/FATAL	END OF FILE WAS ENCOUNTERED TRYING TO READ DATA FOR EVENT I. MACHINE ERROR, RERUN THE JOB.
EOF ENCOUNT-ERED BY INPUTN	SYSTEM/FATAL	THE SYSTEM ENCOUNTERED AN END OF FILE WHILE READING INPUT. CHECK TO SEE THAT ALL NAMELISTS ARE INPUT AND ARE TERMINATED BY A $ AND THAT EACH PHASE IS TERMINATED BY ENDPHS=1.
EOF READAT	READAT/FATAL	AN END OF FILE WAS ENCOUNTERED TRYING TO READ PREVIOUSLY PROCESSED INPUT DATA. MACHINE ERROR, RERUN THE JOB.
FATAL SERCH ERRORS	READAT/FATAL	THE HOLLERITH INPUT NAMES SHOWN ARE INCORRECT. CHECK ALL VARIABLES CONTAINING HOLLERITH INPUTS TO SEE THAT THE NAMES ARE VALID AND SPELLED CORRECTLY.
G1MAG=0,CK INPUTS	GMAG/FATAL	THE GRADIENT OF THE OPTIMIZATION VARIABLE (OPTVAR) WITH RESPECT TO THE CONTROLS IS ZERO. AT LEAST ONE CONTROL PARAMETER MUST BE USED WHICH WILL AFFECT THE VARIABLE SPECIFIED BY OPTVAR.

7. ERROR MESSAGES AND TROUBLE-SHOOTING (CONTD)

MESSAGE	SOURCE/TYPE	CONDITION/CORRECTIVE ACTION
C2MAG=0,CK INPUTS	CMAG/FATAL	THE GRADIENT OF THE TARGET VARIABLES (DEPVR) WITH RESPECT TO THE CONTROLS IS ZERO. CHECK THE INPUTS FOR NAMELIST SEARCH.
CORAD = 0 SEE NPC(4)	MOTIAL/FATAL	SELF-EXPLANATORY.
GENTAB, I XS=ARGUMENT VALUE X=TABLE VALUE	TAB/NON-FATAL	THE TABLE ARGUMENT (XS) OF TABLE I EXCEEDS THE TABLE VALUE (X). EXTRAPOLATION IS USED TO OBTAIN THE TABLE VALUE CORRESPONDING TO XS.
ILLEGAL CNTRL CRITR	READAT/FATAL	THE FIRST PHASE OF A PHASE THAT DOES NOT EXIST WAS SPECIFIED AS A CONTROL PARAMETER. CHECK THE INPUTS INDVR AND INDPH IN NAMELIST SEARCH.
INVERSION OF A SINGULAR MATRIX WAS ATTEMPTED	INVM/FATAL	ONE OF THE TARGET VARIABLES (DEPVR) IS NOT AFFECTED BY ANY OF THE CONTROL PARAMETERS. CHECK THE INPUTS FOR NAMELIST SEARCH.
***ITERATION LIMIT	ITERC/FATAL	THE SPECIFIED ITERATION LIMIT WAS REACHED. CHECK MAXITR IN NAMELIST SEARCH.
MASS .LE.0	MOTIAL/FATAL	THE VEHICLE MASS IS LESS THAN OR EQUAL TO ZERO. CHECK TO SEE THAT WGTSG IS INPUT CORRECTLY.
MISSING CNTRL CRITR	READAT/FATAL	A CRITERIA FOR A PHASE THAT DOES NOT EXIST WAS REQUESTED AS A CONTROL.
MISSING TARGT CRITR	READAT/FATAL	A CRITERIA FOR A PHASE THAT DOES NOT EXIST WAS REQUESTED AS A TARGET.
NAMELIST ERROR	RGENDAT/FATAL RSEARCH/FATAL RTAB/FATAL RTELMLT/FATAL	A NAMELIST ERROR HAS OCURRED. CHECK INPUT DATA.

7. ERROR MESSAGES AND TROUBLE-SHOOTING (CONTD)

MESSAGE	SOURCE/TYPE	CONDITION/CORRECTIVE ACTION
***NO CHANGE IN STATE DURING LAST TWO ITERATIONS	ITERC/FATAL	THE CONTROL PARAMETERS COULD NOT IMPROVE THE TARGET ERRORS OR THE OPTIMIZATION VARIABLE DURING THE LAST TWO ITERATIONS.
NO EVENT NO.	READAT/FATAL	A PHASE WAS INPUT WITH NO EVENT NUMBER (EVENT) OR IT IS ZERO. INPUT THE EVENT NUMBER AS EVENT(1).
NO PHASE = OPTPH	TRAJ/FATAL	THE PHASE SPECIFIED IN OPTPH DID NOT OCCUR OR DOES NOT EXIST.
PARITY ERR TAPE 1 -DINPT- ESN=I	DINPT/FATAL	A READ PARITY ERROR OCURRED TRYING TO READ DATA FOR EVENT I. MACHINE ERROR, RERUN THE JOB.
PCTGO .LT. 50 PERCENT	TGOEM/NON-FATAL	THE TIME TO GO WAS REDUCED BY MORE THAN 50 PERCENT TRYING TO HIT THE SEPCIFIED EVENT.
***PROBLEM SOLVED	ITERO/NOT AN ERROR	THE PROBLEM HAS BEEN TARGETED AND OPTIMIZED TO THE SPECIFIED TOLERANCES.
SERCH I	SERCH/FATAL	THE HOLLERITH INPUT VARIABLE I IS NOT VALID OR IT IS MISSPELLED. THIS IS A NON-FATAL ERROR IF THE MISSPELLED VARIABLE IS A PRINT VARIABLE. CHECK THE HOLLERITH NAME IN QUESTION.
SETIC, PHASE I DOES NOT EXIST	SETIC/FATAL	PHASE NUMBER I WAS REQUESTED AS A CONTROL PARAMETER PHASE BUT DOES NOT EXIST. CHECK THE PHASE NUMBERS INPUT IN INDPH.
SETIC PARITY	SETIC/FATAL	A PARITY ERROR OCCURRED TRYING TO READ THE INITIAL CONDITIONS FOR A PHASE DURING SEARCH/ OPTIMIZATION. MACHINE ERROR, RERUN THE JOB.

7. ERROR MESSAGES AND TROUBLE-SHOOTING (CONTD)

MESSAGE	SOURCE/TYPE	CONDITION/CORRECTIVE ACTION
TGOMI	TGOEMI/FATAL	NO EVENT CRITERIA HAVE BEEN INPUT. CHECK THE VALUE OF CRITR.
TIME LIMIT INSUFFICIENT FOR ANOTHER ITERATION	ITERO/FATAL	SELF EXPLANATORY. CHECK CP TIME ESTIMATE.
NO CONVERG-ENCE IN TIME TO GO. RUN TERMINATED	CYCXM2/FATAL	THE CONDITIONS FOR THE SPECIFIED EVENT COULD NOT BE MET. CHECK EVENT CRITERIA INPUTS.
TOO MANY CRASHES	FGAMA/FATAL	SIX SUCCESSIVE TRAJECTORIES CRASHED IN TRYING TO GENERATE A SUCCESSFUL TRIAL STEP. CHECK PROBLEM SETUP.
TRAJECTORY TERMINATED BY ALTMAX = XXX	PHZXM/FATAL	SELF-EXPLANATORY. CHECK THE PROBLEM SETUP OR REDUCE THE INTEGRATION STEPSIZE.
TRAJECTORY TERMINATED BY ALTMIN = XXX	PHZXM/FATAL	SELF-EXPLANATORY. CHECK THE PROBLEM SETUP OR REDUCE THE INTEGRATION STEPSIZE.
TRAJECTORY TERMINATED BY MASS .LE. 0	PHZXM/FATAL	SELF-EXPLANATORY. CHECK THE PROBLEM SETUP.
TRAJECTORY TERMINATED BY MAXTIM = XXX	PHZXM/FATAL	SELF-EXPLANATORY. CHECK THE PROBLEM SETUP OR THE EVENT CRITERIA AND MODEL TO SEE THAT THE DESIRED CONDITIONS CAN BE ATTAINED.
UNUSABLE NOMINAL	NOMINL/FATAL	THE NOMINAL TRAJECTORY DURING SEARCH/OPTIMIZATION DID NOT REACH THE FINAL EVENT (FESN). CHECK THE PROBLEM SETUP.

8. SAMPLE PROBLEM

THIS SECTION PRESENTS A SAMPLE INPUT LISTING AND ASSOCIATED OUTPUT OF A PORTION OF A REENTRY TRAJECTORY FOR A SHUTTLE ORBITER VEHICLE WHICH BEGINS AT 1500 SEC AND ENDS AT 1510 SEC.

THE SAMPLE TRAJECTORY REQUIRED LESS THAN 100000 OCTAL CELLS OF COMPUTER MEMORY AND APPROXIMATELY 1/2 MINUTE OF CENTRAL PROCESSOR (CP) TIME ON THE MARTIN MARIETTA CORPORATION CDC 6500 COMPUTER.

8.A. SAMPLE PROBLEM INPUT

THIS SECTION PRESENTS A LISTING OF THE INPUT DATA DECK USED TO GENERATE THE TRAJECTORY PRINTOUT IN THE NEXT SECTION.

```
P$SEARCH
 $
P$GENDAT
 TITLE(1)   = 50H6D POST REENTRY CHECK CASE                          ,
 EVENT      = 1.,
 FESN       = 10.,
 MAXTIM     = 2000.,
 DT         = .0625,
 DTG        = .0625,
 TIME       = 1500.,
 TIMRF(1)   = 1500.,
 DTIMR(1)   = 1.,
 DTIMR(2)   = 1.,
 NPC(3)     = 4,
 NPC(4)     = 2,
 ALTITO     = 152488.89,
 GCLAT      = 39.500882,
 LONG       = -121.21400,
 VELR       = 8734.5313,
 GAMMAR     = -.52896275,
 AZVELR     = 153.94194,
 AZL        = 153.94194,
C     ATMOSPHERE
 NPC(5)     = 2,
 NPC(8)     = 2,
 SREF       = 2690.,
 DREFR      = 78.05666667,
 DREFP      = 39.5666667,
 DREFY      = 78.05666667,
 LREF       = 110.7,
 WGTSG      = 182986.,
C     PROPULSION
 NPC(9)     = 0,
C     RANGE CALCULATION
 NPC(12)    = 1,
 LATREF     = 34.55577617,
 LONREF     = -120.5338,
 AZREF      = 154.,
C     GRAVITY
 NPC(16)    = 1,
 MU         = 1.407662686E16,
 OMEGA      = 7.29211515E-5,
 RE         = 20902910.,
C     AUTOPILOT
 NAUTOP     = 2,
```

B.A. SAMPLE PROBLEM INPUT (CONTD)

```
C       GUIDANCE
C       INITIALIZE QUATERNIONS
 IGUID(12) = 3,
 YAWR      = 178.88212,
 PITR      = 17.370592,
 ROLR      = 56.46,
 ROLBD     = 0.,
 PITBD     = 0.,
 YAWBD     = 0.,
C       USE CLOSED LOOP REENTRY GUIDANCE
 IGUID(14) = 2,
 IGUID(17) = 2,
C       TLATGD = TARGET GEOCENTRIC LATITUDE
 TLATGD    = 34.55577617,
C       TLONGD  = TARGET LONGITUDE
 TLONGD    = -120.5338,
 ITRANS = 1,
C       CONTROLS
 KRDA      = 1.,     KRDE      = 0.,     KRDR      = 0.,
 KPDA      = 0.,     KPDE      = 1.,     KPDR      = 0.,
 KYDA      = 0.,     KYDE      = 0.,     KYDR      = 1.,
 DAMAX     = 15.,
 DAMIN     = -15.,
 DEMAX     = 15.,
 DEMIN     = -40.,
 DRMAX     = 22.8,
 DRMIN     = -22.8,
 DELECI    = -5.,
 DELE      = -5.,
 EREFL     = 19047.,
C       PRINTOUT
PINC      = 1.0,
 PRNT(115) =
            6HTIMREF1,6HTIMREF2,6HGTIME ,6HATIME ,6HDELT  ,6H*     ,
            6HDELAZ ,6HLOD1  ,6HRDTREF,6HRK2RCL,6HTRANGE,6HDRAGGC,
           6HSLECT ,6HGASM  ,6HGLOD  ,6HGRDOT ,6HDRAGRP,6HALDREF,
            6HALPGC ,6HALPEFR,6HROLRCC,6HROLREF,6HALPERI,6HDELECI,
            6HTROLN ,6HTROLP ,6HTPITN ,6HTPITP ,6HTYAWN ,6HTYAWP ,
            6HTONT  ,6HWDOTJ ,6HWPCONJ,6HRCSMXB,6HRCSMYB,6HRCSMZB,
            6HDELAC ,6HDELEC ,6HDELRC ,6HDELAD ,6HDELED ,6HDELRD ,
            6HDELA  ,6HDELE  ,6HDELR  ,6HDELF1 ,6HDELF2 ,6HUDCTR ,
            6HCKA   ,6HCKE   ,6HCKR   ,6HHMA   ,6HHME   ,6HHMR   ,
            6HCLA   ,6HCDA   ,6HCMA   ,6HCYB   ,6HCWB   ,6HCLLB  ,
            6HCYDR  ,6HCLLDR ,6HCWDR  ,6HCLDE  ,6HCDDE  ,6HCMDE  ,
```

8.A. SAMPLE PROBLEM INPUT (CONTD)

```
                6HCYDA  ,6HCLLDA ,6HCWDA  ,6HCLF1  ,6HCDF1  ,6HCMF1  ,
                6HCYF1  ,6HCWF1  ,6HCLLF1 ,6HCHF   ,6HCMQ   ,6HCWR   ,
                6HCLLR  ,6HCWP   ,6HCLLP  ,6HCLF2  ,6HCDF2  ,6HCMF2  ,
 $
P$TBLMLT
 CYBNM      = 6HBETA  ,
 CWBNM      = 6HBETA  ,
 CLLBNM     = 6HBETA  ,
 CYDRNM     = 6HDELR  ,
 CLLDRN     = 6HDELR  ,
 CWDRNM     = 6HDELR  ,
 CLDENM     = 6HDELE  ,
 CDDENM     = 6HDELE  ,
 CMDENM     = 6HDELE  ,
 CYDANM     = 6HDELA  ,
 CLLDAN     = 6HDELA  ,
 CWDANM     = 6HDELA  ,
 CLF1N      = 6HONE   ,
 CDF1N      = 6HONE   ,
 CMF1N      = 6HONE   ,
 CYF1N      = 6HBETA  ,
 CWF1N      = 6HBETA  ,
 CLLF1N     = 6HBETA  ,
 CLF2N      = 6HONE   ,
 CDF2N      = 6HONE   ,
 CMF2N      = 6HONE   ,
 $
P$TAB
 TABLE      = 6HCLT   ,0,.672662268,
 $
P$TAB
 TABLE      = 6HCDT   ,0,.456788181,
 $
P$TAB
 TABLE      = 6HCMAT  ,0,-.0304227747,
 $
P$TAB
 TABLE      = 6HCYBT  ,0,-.0054,
 $
P$TAB
 TABLE      = 6HCWBT  ,0,-.00184,
 $
P$TAB
 TABLE      = 6HCLLBT ,0,-.00162,
 $
P$TAB
 TABLE      = 6HCYDRT ,0,.0004,
 $
```

8.A. SAMPLE PROBLEM INPUT (CONTD)

```
P$TAB
 TABLE      = 6HCLLDRT,0,.00015,
 $
P$TAB
 TABLE      = 6HCWDRT ,0,-.00028,
 $
P$TAB
 TABLE      = 6HCLDET ,0,2.366278E-3,
 $
P$TAB
 TABLE      = 6HCDDET ,0,1.58043E-3,
 $
P$TAB
 TABLE      = 6HCMDET ,0,-2.84346E-3,
 $
P$TAB
 TABLE      = 6HCYDAT ,0,1.323394E-4,
 $
P$TAB
 TABLE      = 6HCLLDAT,0,1.07534E-3,
 $
P$TAB
 TABLE      = 6HCWDAT ,0,-3.5084E-4,
 $
P$TAB
 TABLE      = 6HCLFIT ,0,0.,
 $
P$TAB
 TABLE      = 6HCDFIT ,0,0.,
 $
P$TAB
 TABLE      = 6HCMFIT ,0,0.,
 $
P$TAB
 TABLE      = 6HCYFIT ,0,0.,
 $
P$TAB
 TABLE      = 6HCWFIT ,0,0.,
 $
P$TAB
 TABLE      = 6HCLLFIT,0,0.,
 $
P$TAB
 TABLE      = 6HCHET  ,0,.046,
 $
P$TAB
 TABLE      = 6HCMGT  ,0,-2.8,
 $
```

8.A. SAMPLE PROBLEM INPUT (CONTD)

```
P$TAB
 TABLE      = 6HCWRT  ,0,-.05,
 $
P$TAB
 TABLE      = 6HCLLRT ,0,.05,
 $
P$TAB
 TABLE      = 6HCWPT  ,0,-.022,
 $
P$TAB
 TABLE      = 6HCLLPT ,0,-.251,
 $
P$TAB
 TABLE      = 6HCLF2T ,0,-1.0195E-2,
 $
P$TAB
 TABLE      = 6HCDF2T ,0,-6.312E-3,
 $
P$TAB
 TABLE      = 6HCMF2T ,0,1.6234E-2,
 $
P$TAB
C      DELF1 = SPEED BRAKE DEFLECTION
 TABLE      = 6HDELF1T,1,6HMACH  ,5,1,1,1,
              0.,55., 4.,55., 5.,85., 8.,55., 10.,55.,
 $
P$TAB
C      DELF2 = BODY FLAP DEFLECTION
C      BODY FLAP DEFLECTION FOR FWD CG CONDITION
 TABLE      = 6HDELF2T,0,-11.7,
 $
P$TAB
 TABLE      = 6HRMPJT ,0,9952.,
 $
P$TAB
 TABLE      = 6HPMPJT ,0,33622.,
 $
P$TAB
 TABLE      = 6HYMPJT ,0,34072.,
 $
P$TAB
 TABLE      = 6HPNPJIT,1,6HDYNP  ,6,1,1,1,
              0.,.78, 5.,.62, 10.,.53, 15.,.50, 20.,.48, 200.,.48,
 $
P$TAB
 TABLE      = 6HPYJIT ,1,6HDYNP  ,6,1,1,1,
              0.,0.,  5.,.1,  10.,.16, 15.,.18, 20.,.19, 200.,.19,
 $
```

8.A. SAMPLE PROBLEM INPUT (CONTD)

```
P$TAB
 TABLE      = 6HPRJIT ,1,6HDYNP  ,6,1,1,1,
              0.,.14, 5.,.23, 10.,.26, 15.,.27, 20.,.28, 200.,.28,
 $
P$TAB
 TABLE      = 6HRRJIT ,1,6HDYNP  ,6,1,1,1,
              0.,.77, 5.,.59, 10.,.50, 15.,.45, 20.,.42, 200.,.42,
 $
P$TAB
 TABLE      = 6HRYJIT ,1,6HDYNP  ,6,1,1,1,
              0.,-.70, 5.,-.32, 10.,-.32, 15.,-.30, 20.,-.28,200.,-.28,
 $
P$TAB
 TABLE      = 6HYRJIT ,1,6HDYNP  ,6,1,1,1,
              0.,-.11, 5.,-.12, 10.,-.12, 15.,-.13, 20.,-.13,200.,-.13,
 $
P$TAB
 TABLE      = 6HYYJIT ,0,1.0,
 $
P$TAB
 TABLE      = 6HPPPJIT,0,1.0,
 $
P$TAB
 TABLE      = 6HCKFT  ,1,6HMACH  ,4,1,1,1,
              0.,6., 10.,6., 12.,2., 100.,2.,
 $
P$TAB
 TABLE      = 6HCKRT  ,1,6HMACH  ,4,1,1,1,
              0.,2., 2.,2., 2.01,4., 30.,4.,
 $
P$TAB
 TABLE      = 6HCKAT  ,1,6HDYNP  ,4,1,1,1,
              0.,10., 10.,10., 30.,2.5, 200.,2.5,
 $
P$TAB
 TABLE      = 6HYCGT  ,0,0.125,
 $
P$TAB
 TABLE      = 6HIXXT  ,0,759000.,
 $
P$TAB
 TABLE      = 6HIYYT  ,0,5765000.,
 $
P$TAB
 TABLE      = 6HIZZT  ,0,5912000.,
 $
P$TAB
 TABLE      = 6HIXZT  ,0,131000.,
```

8.A. SAMPLE PROBLEM INPUT (CONTD)

```
 ENDPHS     = 1,
 $
P$GENDAT
 EVENT      = 10.,
 CRITR      = 6HTIMREF1,
VALUE      = 1510.,
 MDL        = 1,
 ENDPHS     = 1,
 ENDPRB     = 1,
 ENDJOB     = 1,
 $
```

8.B. SAMPLE PROBLEM OUTPUT

THE SAMPLE OUTPUT SHOWS THE TIME HISTORY OF THE REENTRY TRAJECTORY AT 1 SECOND INTERVALS.

THE ANSWERS SHOWN WERE OBTAINED ON THE MARTIN MARIETTA CDC 6500 COMPUTER. ANSWERS OBTAINED ON OTHER COMPUTERS AND OPERATING SYSTEMS WILL PROBABLY DIFFER SLIGHTLY FROM THESE RESULTS DUE TO NUMERICAL ACCURACY DIFFERENCES BETWEEN THE COMPUTERS AND OPERATING SYSTEMS.

```
6D POST REENTRY CHECK CASE                                                                                    PROBLEM NO.    1

*** INPUT SUMMARY FOR PROBLEM NO.   1 ***

INPUT UNITS = ENGLISH, OUTPUT UNITS = ENGLISH

INITIAL CONDITIONS
        TIME    =  1.50000000E+03
        GCLAT   =  3.95008820E+01 GDLAT   =  3.95008820E+01 LONG    = -1.21214000E+02 LONGI   = -1.14946889E+02
        GCRAD   =  2.10553989E+07 ALTITO  =  1.52488890E+05
        VELR    =  8.73453130E+03 GAMMAR  = -5.28962750E-01 AZVELR  =  1.53941940E+02

PROGRAM TERMINATION PARAMETERS
        FESN    =   10.00         MAXTIM  =  2.00000000E+03 ALTMIN  = -5.00000000E+03 ALTMAX  =  1.00000000E+20

INITIAL ORIENTATION ANGLES
        YAWR    =  1.78882120E+02 PITR    =  1.73705920E+01 ROLR    =  5.64600000E+01

THE LAUNCH PAD INERTIAL (L) FRAME IS DEFINED BY
        LATL    =  3.95008820E+01 LONL    = -1.14946889E+02 AZL     =  1.53941940E+02

ATTRACTING PLANET MODEL
        RE      =  2.09029100E+07 RP      =  2.09029100E+07 OMEGA   =  7.29211515E-05 MU      =  1.40766269E+16
        J2      =  0.             J3      =  0.             J4      =  0.
```

```
6D POST REENTRY CHECK CASE                                                                                    PROBLEM NO.     1

BEGIN PHASE   1.0

1962 U.S. STANDARD ATMOSPHERE MODEL

COMPUTE DOWN AND CROSS RANGE BASED ON RELATIVE GREAT CIRCLES
        LATREF =  3.45557762E+01 LONREF = -1.20533800E+02 AZREF  =  1.54000000E+02

AERODYNAMIC COEFFICIENTS SPECIFIED BY DRAG AND LIFT COEFFICIENTS CORRECTED FOR VISCOUS EFFECTS
        SREF   =  2.69000000E+03 DREFR  =  7.80566667E+01 DREFP  =  3.95666667E+01 DREFY  =  7.80566667E+01
        LREF   =  1.10700000E+02

VEHICLE WEIGHT PARAMETERS
        WGTSG  =  1.82986000E+05 WPLD   =  0.             WPROP  =  0.             WJETT  =  0.
        GO     =  3.21740000E+01

INTEGRATION SCHEME = FOURTH ORDER RUNGE-KUTTA
        DT     =  6.25000000E-02 PINC   =  1.00000000E+00

CLOSED-LOOP REENTRY GUIDANCE OPTION
        DTG    =  6.25000000E-02

REENTRY AUTOPILOT

THE NEXT EVENT TO OCCUR WILL BE ONE OF THE FOLLOWING
        ESN    =   10.0          TYPE   = PRIMRY          CRITR  = TIMRF1          VALUE  =  1.51100000E+03
        TOL    =  1.00000000E-06 MDL    =  1

TABLES AND MULTIPLIERS FOR THIS PHASE
        CDT    , 1.00000000E+00  CLT    , 1.00000000E+00  CYRT   , 1.00000000E+00  CMAT   , 1.00000000E+00  CWRT   , 1.00000000E+00
        YCGT   , 1.00000000E+00  IXXT   , 1.00000000E+00  IXZT   , 1.00000000E+00  IYYT   , 1.00000000E+00  IZZT   , 1.00000000E+00
        CDDET  , 1.00000000E+00  CDF1T  , 1.00000000E+00  CDF2T  , 1.00000000E+00  CLDET  , 1.00000000E+00  CLF1T  , 1.00000000E+00
        CLF2T  , 1.00000000E+00  CLLRT  , 1.00000000E+00  CLLDAT, 1.00000000E+00  CLLDRT, 1.00000000E+00  CLLF1T, 1.00000000E+00
        CLLPT  , 1.00000000E+00  CLLRT  , 1.00000000E+00  CMDET  , 1.00000000E+00  CMF1T  , 1.00000000E+00  CMF2T  , 1.00000000E+00
        CMDT   , 1.00000000E+00  CNDAT  , 1.00000000E+00  CNDRT  , 1.00000000E+00  CNF1T  , 1.00000000E+00  CNRT   , 1.00000000E+00
        CNRT   , 1.00000000E+00  CYDAT  , 1.00000000E+00  CYDRT  , 1.00000000E+00  CYF1T  , 1.00000000E+00  CKAT   , 1.00000000E+00
        CKET   , 1.00000000E+00  CKRT   , 1.00000000E+00  RMPJT  , 1.00000000E+00  PMPJT  , 1.00000000E+00  YMPJT  , 1.00000000E+00
        RRJIT  , 1.00000000E+00  RYJIT  , 1.00000000E+00  PPPJIT, 1.00000000E+00  PNPJIT, 1.00000000E+00  PYJIT  , 1.00000000E+00
        PRJIT  , 1.00000000E+00  YYJIT  , 1.00000000E+00  YRJIT  , 1.00000000E+00  CHET   , 1.00000000E+00  DELF1T, 1.00000000E+00
        DELF2T, 1.00000000E+00

PROGRAM CONTROL FLAGS
        NPC  ( 1) =  0 NPC  ( 2) =  1 NPC  ( 3) =  4 NPC  ( 4) =  2 NPC  ( 5) =  2 NPC  ( 6) =  0 NPC  ( 7) =  0
        NPC  ( 8) =  4 NPC  ( 9) =  0 NPC  (10) =  0 NPC  (11) =  0 NPC  (12) =  1 NPC  (13) =  0 NPC  (14) =  0
        NPC  (15) =  0 NPC  (16) =  1 NPC  (17) =  0 NPC  (18) =  0 NPC  (19) =  1 NPC  (20) =  0 NPC  (21) =  0
        NPC  (22) =  0 NPC  (23) =  0 NPC  (24) =  0 NPC  (25) =  0 NPC  (26) =  0 NPC  (27) =  0 NPC  (28) =  0
        NPC  (29) =  0 NPC  (30) =  0 NPC  (31) =  0 NPC  (32) =  0 NPC  (33) =  0 NPC  (34) =  0 NPC  (35) =  0
```

60 POST REENTRY CHECK CASE PROBLEM NO. 1

GUIDANCE CONTROL FLAGS

```
IGUID ( 1) =  0 IGUID ( 2) =  0 IGUID ( 3) =  0 IGUID ( 4) =  0 IGUID ( 5) =  1 IGUID ( 6) =  0 IGUID ( 7) =  0
IGUID ( 8) =  0 IGUID ( 9) =  0 IGUID (10) =  0 IGUID (11) =  0 IGUID (12) =  3 IGUID (13) =  1 IGUID (14) =  2
IGUID (15) =  0 IGUID (16) =  0 IGUID (17) =  2 IGUID (18) =  0 IGUID (19) =  0 IGUID (20) =  0 IGUID (21) =  0
IGUID (22) =  0 IGUID (23) =  0 IGUID (24) =  0 IGUID (25) =  0
```

60 POST REENTRY CHECK CASE PROBLEM NO. 1

*** PHASE 1.0 ***

TIME	1.50000000E+03	TIMES	0.	TOURP	0.	DENS	3.11587060E-06	PRES	2.58252533E+00	ATEM	4.82845705E+02
ALTITO	1.52488890E+05	GCRAD	2.10553989E+07	GOLAT	3.95009820E+01	GCLAT	3.95008820E+01	LONG	2.38786000E+02	LONGT	2.45053111E+02
VELI	9.31593324E+03	GAMMAI	-4.95949643E-01	AZVELI	1.47381625E+02	XI	-6.85249198E+06	VXI	2.47413484E+03	AXI	-2.79647049E+01
VELR	8.73453130E+03	GAMMAR	-5.28962750E-01	AZVELR	1.53941940E+02	YI	-1.47308303E+07	VYI	-6.58684313E+03	AYI	2.75579998E+01
VELA	8.73453130E+03	GAMMAA	-5.28962750E-01	AZVELA	1.53941940E+02	ZI	1.33931308E+07	VZI	-6.10563399E+03	AZI	1.28696854E+00
GAMAD	-3.58533343E-02	AZVAD	2.04906517E-01	DWNRNG	2.13343873E+04	CRRNG	-1.01735846E+02	DRRNG1	2.98698296E+02	DRRNG2	2.13165684E+04
THRUST	0.	WEIGHT	1.82986000E+05	WDOT	0.	WEICON	0.	WPROP	0.	ASMG	1.37492214E+00
FTXB	0.	FAXB	-1.68239217E+04	AXB	-2.95811077E+00	TMXB	0.	AMXB	3.13785720E+04	TTMXB	3.69516920E+04
FTYB	0.	FAYB	1.12922043E-03	AYB	1.98548194E-07	TMYB	0.	AMYB	3.60861536E+02	TTMYB	1.31372215E+04
FTZB	0.	FAZB	-2.51028364E+05	AZB	-4.41377296E+01	TMZB	0.	AMZB	-2.10296018E+03	TTMZB	-7.02469602E+04
CA	5.26194531E-02	CLL	1.05954418E-09	CD	4.42574031E-01	DRAG	1.41503387E+05	DYNP	1.18858058E+02	ASXI	-3.82984104E+01
CY	3.53181395E-09	CM	2.85253000E-05	CL	6.50635878E-01	LIFT	2.08026622E+05	MACH	8.10854636E+00	ASYI	5.34355796E+00
CN	7.85130570E-01	CW	1.20343290E-09	HEATRT	0.	TLHEAT	0.	REYNO	8.52701386E+06	ASZI	2.14841277E+01
ROL30	0.	ROL30D	2.68218401E+00	ROLI	-6.94433811E-01	YAWR	1.78882120E+02	ALPHA	3.03900006E+01	ALPTOT	3.03900006E+01
PITR0	0.	PITR0D	1.30565021E-01	YAWI	5.27013181E+01	PITR	1.73705920E+01	BETA	-6.54039620E-07	DALPHA	3.61209644E+03
YAW90	0.	YAW90D	-5.21361339E-01	PITI	-6.04829406E+01	ROLR	5.64600000E+01	RNKANG	5.27045237E+01	DALTOT	3.61209644E+03
ROLBER	0.	ROLAC	-9.44005422E+00	XREF	0.	XCG	0.	IXX	7.59000000E+05	IXY	0.
PITBER	0.	PITAC	-1.05599458E+01	YREF	0.	YCG	1.25000000E-01	IYY	5.76500000E+06	IXZ	1.31000000E+05
YAWBER	-1.67201322E+00	YAWAC	0.	ZREF	0.	ZCG	0.	IZZ	5.91200000E+06	IYZ	0.
TIMRF1	1.50000000E+03	TIMRF2	0.	GTIME	1.50000000E+03	ATIME	0.	DELT	6.25000000E-02	*	0.
DELAZ	-3.11032010E-01	LOD1	9.95036497E-01	RDTREF	-7.35979472E+01	RK2ROL	1.00000000E+00	TRANGE	3.09520273E+02	DRAGGC	2.56792870E+01
SLECT	4.00000000E+00	GASM	4.57100319E+01	GLOD	1.47259123E+00	GRDOT	-8.06372843E+01	DRAGRP	2.66609975E+01	ALDREF	1.05178846E+00
ALPGC	3.05000000E+01	ALPERR	6.59996611E-01	ROLPGC	4.74911185E+01	ROLRER	-8.96888147E+00	ALPERI	0.	DELECI	-5.00000000E+00
TROLN	0.	TROLP	0.	TPITN	0.	TPITP	0.	TYAWN	0.	TYAWP	0.
TONT	0.	WDOTJ	0.	WPCONJ	0.	RCSMXB	5.57712000E+03	RCSMYB	1.27763600E+04	RCSMZB	-6.81440000E+04
DELAC	-6.84642532E-01	DELEC	-5.65999661E+00	DELRC	0.	DELAD	-9.44005422E+00	DELSD	-1.05599458E+01	DELRD	0.
DELA	0.	DELE	-5.00000000E+00	DELR	0.	DELF1	5.50000000E+01	DELF2	-1.17000000E+01	UDCTP	-2.00000000E+00
CKA	2.50000000E+00	CKE	6.00000000E+00	CKR	0.	HMA	0.	HME	1.04138913E+05	HMR	0.
CLA	6.72662268E-01	CDA	4.56788181E-01	CMA	-3.04227747E-02	CYB	3.53181395E-09	CNB	1.20343290E-09	CLLB	1.05954418E-09
CYDR	0.	CLLDR	0.	CNDR	0.	CLDE	-1.19313900E-02	CDDE	-7.90215000E-03	CMDE	1.42173000E-02
CYDA	0.	CLLDA	0.	CNDA	0.	CLF1	0.	CDF1	0.	CMF1	0.
CYF1	0.	CNF1	0.	CLLF1	0.	CHE	4.60000000E-02	CNO	0.	CNR	0.
CLLR	0.	CNR	0.	CLLP	0.	CLF2	-1.01950000E-02	CDF2	-6.31200000E-03	CMF2	1.62340000E-02

60 POST REENTRY CHECK CASE PROBLEM NO. 1

*** PHASE 1.0 ***

TIME	1.50100000E+03	TIMES	1.00000000E+00	TOURP	1.00000000E+00	DENS	3.12663148E-06	PRES	2.59076757E+00	ATEM	4.82719621E+02
ALTITO	1.52435613E+05	GCRAD	2.10553156E+07	GDLAT	3.94795420E+01	GCLAT	3.94795420E+01	LONG	2.38799460E+02	LONGT	2.45070750E+02
VELI	9.28422643E+03	GAMMAI	-5.29865502E-01	AZVELI	1.47553137E+02	XI	-6.85002178E+06	VXI	2.44626653E+03	AXI	-2.78074385E+01
VELR	8.71004235E+03	GAMMAR	-5.65039776E-01	AZVELR	1.54146654E+02	YI	-1.47374934E+07	VYI	-6.55929435E+03	AYI	2.74767357E+01
VELA	8.71004235E+03	GAMMAA	-5.65039776E-01	AZVELA	1.54146654E+02	ZI	1.33870258E+07	VZI	-6.10430896E+03	AZI	1.48173527E+02
GAMAD	-3.54422955E-02	AZVAD	2.04423185E-01	DWNRNG	2.13358129E+04	CRRNG	-1.01726367E+02	DPRNG1	2.97354436E+02	DPRNG2	2.13179123E+04
THRUST	0.	WEIGHT	1.82986000E+05	WDOT	0.	WEICON	0.	WPROP	0.	ASMG	1.37307801E+00
FTXB	0.	FAXB	-1.68030019E+04	AXB	-2.95443249E+00	TMXB	0.	AMXB	-1.48276888E+04	TTMXB	-1.20411288E+04
FTYB	0.	FAYB	-6.21118005E+02	AYB	-1.09209725E-01	TMYB	0.	AMYB	-8.03563435E+03	TTMYB	-1.64742435E+03
FTZB	0.	FAZB	-2.50690790E+05	AZB	-4.40783747E+01	TMZB	0.	AMZB	-5.32200480E+03	TTMZB	-4.03940048E+04
CA	5.26680649E-02	CLL	-1.85376326E-03	CD	4.42933629E-01	DRAG	1.41311716E+05	DYNP	1.18600695E+02	ASXT	-3.81375566E+01
CY	-1.94685947E-03	CM	-6.36574981E-04	CL	6.51174281E-01	LIFT	2.07747953E+05	MACH	8.08686840E+00	ASYT	5.25211789E+00
CN	7.85776199E-01	CW	-1.69523772E-04	HEATRT	0.	TLHEAT	0.	REYNO	8.53423694E+06	ASZT	2.16699274E+01
ROLBO	-7.65666259E-01	ROLBOD	-9.80020869E-01	ROLI	-4.18557661E-01	YAWR	1.78822819E+02	ALPHA	3.03992137E+01	ALPTOT	3.03908360E+01
PITBO	1.63276103E-01	PITBOD	-9.71361777E-03	YAWI	5.23879594E+01	PITR	1.77062810E+01	BETA	3.30180021E-01	DALPHA	3.60418187E+03
YAWBO	-5.66331994E-01	YAWBOD	-4.11308288E-01	PITI	-6.01492415E+01	ROLR	5.62621656E+01	RNKANG	5.23905097E+01	DALTOT	3.60437427E+03
ROLBER	0.	ROLAC	8.74303004E-01	XREF	0.	XCG	0.	IXX	7.59000000E+05	IYY	0.
PITBER	0.	PITAC	2.00132299E-01	YREF	0.	YCG	1.25000000E-01	IYY	5.76500000E+06	IXZ	1.31000000E+05
YAWBER	-8.02526162E-01	YAWAC	0.	ZREF	0.	ZCG	0.	IZZ	5.91200000E+06	IYZ	0.
TIMRF1	1.50100000E+03	TIMRF2	1.00000000E+00	GTIME	1.50100000E+03	ATIME	0.	DELT	5.25000000E-02	*	0.
DELAZ	-3.09340711E-01	LOD1	1.01141059E+00	RDTREF	-7.36877378E+01	RK2ROL	1.00000000E+00	TRANGE	3.08164126E+02	DRAGCO	2.56237454E+01
SLECT	4.00000000E+00	GASM	4.56111660E+01	GLOD	1.47259123E+00	GRDOT	-8.58953426E+01	DRAGRP	2.66224638E+01	ALDREF	1.05406230E+00
ALPGC	3.05000000E+01	ALPERR	6.64717659E-01	ROLRGC	4.66207982E+01	ROLPER	-9.64136742E+00	ALPERT	7.48990954E-01	DFLECT	-5.00000000E+00
TROLN	0.	TROLP	0.	TPITN	0.	TPITP	0.	TYAWN	1.75000000E+00	TYAWP	0.
TONT	1.75000000E+00	WDOTJ	0.	WPCONJ	0.	RCSMXB	2.78656000E+03	RCSMYB	6.38818000E+03	RCSMZB	-3.40720000E+04
DELAC	-1.18374282E+00	DELEC	-4.75996014E+00	DELRC	0.	DELAD	8.74303004E-01	DELED	2.00132299E-01	DELRD	0.
DELA	-1.23838675E+03	DELE	-4.77246841E+00	DELR	0.	DELF1	5.50000000E+01	DELF2	-1.17000000E+01	UDCTR	-2.00000000E+00
CKA	2.50000000E+00	CKE	6.00000000E+00	CKR	0.	HMA	0.	HME	1.03913422E+05	HMR	0.
CLA	6.72662268E-01	CDA	4.56788181E-01	CMA	-3.04227747E-02	CYB	-1.78297211E-03	CNB	-6.07531238E-04	CLLB	-5.34891633E-04
CYDR	0.	CLLDR	0.	CNDR	0.	CLDE	-1.12929870E-02	CDDE	-7.54255224E-03	CMDE	1.35703230E-02
CYDA	-1.63887363E-04	CLLDA	-1.33168681E-03	CNDA	4.34475609E-04	CLF1	0.	CDF1	0.	CMF1	0.
CYF1	0.	CNF1	0.	CLLF1	0.	CHE	4.60000000E-02	CMO	-1.81232978E-05	CNR	2.21451287E-06
CLLR	-2.21451287E-06	CNR	1.31734432E-06	CLLP	1.50297011E-05	CLF2	-1.01950000E-02	CDF2	-6.31200000E-03	CMF2	1.62340000E-02

60 POST REENTRY CHECK CASE

PROBLEM NO. 1

*** PHASE 1.0 ***

TIME	1.50200000E+03	TIMES	2.00000000E+00	TOURP	2.00000000E+00	DENS	3.13809559E-06	PRES	2.59954608E+00	ATEM	4.82585810E+02
ALTITO	1.52317233E+05	GCRAD	2.10552272E+07	GDLAT	3.94582252E+01	GCLAT	3.94582252E+01	LONG	2.38812781E+02	LONGI	2.45088248E+02
VELI	9.26057651E+03	GAMMAI	-5.61524887E-01	AZVELI	1.47722868E+02	XI	-6.84754937E+06	VXI	2.41864089E+03	AXI	-2.73957368E+01
VELR	8.68558648E+03	GAMMAR	-5.98699418E-01	AZVELR	1.54349563E+02	YI	-1.47439490E+07	VYI	-6.53205428E+03	AYI	2.69342509E+01
VELA	8.68558648E+03	GAMMAA	-5.98699418E-01	AZVELA	1.54349563E+02	ZI	1.33809223E+07	VZI	-6.10251755E+03	AZI	2.16993290E+00
GAMAD	-3.13662583E-02	AZVAD	2.00882587E-01	DWNRNG	2.13372345E+04	CRRNG	-1.01712047E+02	DPRNG1	2.96014304E+02	DPRNG2	2.13192524E+04
THRUST	0.	WEIGHT	1.82986000E+05	WDOT	0.	WEICON	0.	WPROP	0.	ASMG	1.37057821E+00
FTXB	0.	FAXB	-1.65619987E+04	AXB	-2.91205745E+00	TMXB	0.	AMXB	-7.41189492E+03	TTMXB	-1.01984549E+04
FTYB	0.	FAYB	-9.78922708E+02	AYB	-1.72121688E-01	TMYB	0.	AMYB	-9.32327151E+03	TTMYB	-2.93509161E+03
FTZB	0.	FAZB	-2.50247254E+05	AZB	-4.40003889E+01	TMZB	0.	AMZB	-2.16352669E+04	TTMZB	1.24367331E+04
CA	5.20146877E-02	CLL	-1.55680216E-03	CD	4.42993454E-01	DRAG	1.41057562E+05	DYNP	1.18369044E+02	ASXI	-3.77223167E+01
CY	-3.07440907E-03	CM	-7.40034764E-04	CL	6.51263854E-01	LIFT	2.07368948E+05	MACH	8.06528020E+00	ASYI	4.69948195E+00
CN	7.85927656E-01	CW	-7.87197091E-04	HEATRT	0.	TLHEAT	0.	REYNO	8.54335332E+06	ASZI	2.23491749E+01
ROLBD	-1.67277158E+00	ROLBDD	-7.51617717E-01	ROLI	-3.06320500E-01	YAWR	1.78502647E+02	ALPHA	3.04373065E+01	ALPTOT	3.04418584E+01
PITBD	1.25299677E-01	PITBDD	-4.72720323E-03	YAWI	5.39369793E+01	PITR	1.84610352E+01	BETA	5.53631056E-01	DALPHA	3.60280442E+03
YAWBD	-9.65041020E-01	YAWBDD	1.07019565E-01	PITI	-5.99102625E+01	ROLR	5.49494900E+01	BNKANG	5.09409255E+01	DALTOT	3.60334322E+03
ROLBER	0.	ROLAC	4.96241603E-01	XREF	0.	XCG	0.	IXX	7.59000000E+05	IXY	0.
PITPER	0.	PITAC	-2.68255166E-01	YREF	0.	YCG	1.25000000E-01	IYY	5.76500000E+06	IXZ	1.31000000E+05
YAWBER	2.29103412E-01	YAWAC	0.	ZREF	0.	ZCG	0.	IZZ	5.91200000E+06	IYZ	0.
TIMRF1	1.50200000E+03	TIMRF2	2.00000000E+00	GTIME	1.50200000E+03	ATIME	0.	DELT	6.25000000E-02	*	0.
DELAZ	-3.07072827E-01	LOD1	1.02702392E+00	RDTREF	-7.37786904E+01	RK2ROL	1.00000000E+00	TRANGE	3.06810930E+02	DRAGCC	2.55735923E+01
SLECT	4.00000000E+00	GASM	4.55218917E+01	GLOD	1.47259123E+00	GROOT	-9.07564393E+01	DRAGPP	2.65839402E+01	ALPREF	1.05633898E+00
ALPGC	3.05000000E+01	ALPERR	3.76161299E-01	ROLRGC	4.57791175E+01	ROLRER	-9.17037251E+00	ALPERI	1.27017274E+00	DELECI	-5.00000000E+00
TROLN	0.	TROLP	0.	TPITN	0.	TPITP	0.	TYAWN	2.50000000E+00	TYAWP	0.
TONT	2.50000000E+00	WDOTJ	0.	WPCONJ	0.	RCSMX3	-2.78656000E+03	RCSMY3	6.38818000E+03	RCSMZ3	3.40720000E+04
DELAC	-6.09771905E-01	DELEC	-4.75138050E+00	DELPC	0.	DELAD	4.96241603E-01	DELED	-2.68255166E-01	DELPD	0.
DELA	-6.40787005E-01	DELE	-4.73461455E+00	DELP	0.	DELF1	5.50000000E+01	DELF2	-1.17000000E+01	WDOTE	-1.00000000E+00
CKA	2.50000000E+00	CKE	6.00000000E+00	CKR	0.	HMA	0.	HME	1.03709582E+05	HMR	0.
CLA	6.72662268E-01	CDA	4.56788181E-01	CYA	-3.04227747E-02	CYB	-2.98960770E-03	CNB	-1.01868114E-03	CLLB	-8.96882311E-04
CYDR	0.	CLLDR	0.	CNDR	0.	CLDE	-1.12034143E-02	CNDE	-7.48272688E-03	CMDE	1.34626871E-02
CYDA	-8.48013678E-05	CLLDA	-6.89063898E-04	CNDA	2.24813713E-04	CLF1	0.	CDF1	0.	CMF1	0.
CYF1	0.	CNF1	0.	CLLF1	0.	CNE	4.60000000E-02	CNR	-1.39471564E-05	CNP	3.78419931E-06
CLLP	-3.78419931E-06	CNP	2.88614101E-06	CLLP	3.29282452E-05	CLF2	-1.01950000E-02	CDF2	-6.31200000E-03	CMF2	1.62340000E-02

60 POST REENTRY CHECK CASE PROBLEM NO. 1

*** PHASE 1.0 ***

TIME	1.50300000E+03	TIMES	3.00000000E+00	TDURP	3.00000000E+00	DENS	3.15018883E-06	PRES	2.60880371E+00	ATEM	4.82445225E+02
ALTITO	1.52224379E+05	GCRAD	2.10551344E+07	GDLAT	3.94369325E+01	GCLAT	3.94369325E+01	LONG	2.38825963E+02	LONGT	2.45105608E+02
VELI	9.23306228E+03	GAMMAI	-5.88284637E-01	AZVELI	1.47888244E+02	XI	-6.84518433E+06	VXI	2.39151831E+03	AXI	-2.68431425E+01
VELR	8.66119328E+03	GAMMAR	-6.27128566E-01	AZVELR	1.54547879E+02	YI	-1.47504677E+07	VYI	-6.50550107E+03	AYI	2.61748567E+01
VELA	8.66119328E+03	GAMMAA	-6.27128566E-01	AZVELA	1.54547879E+02	ZI	1.33749210E+07	VZI	-6.09987993E+03	AZI	3.10214617E+00
GAMAD	-2.55226151E-02	AZVAD	1.95714147E-01	DWNRNG	2.13386520E+04	CRRNG	-1.01692993E+02	DPRNG1	2.94677925E+02	DPRNG2	2.13205888E+04
THRUST	0.	WEIGHT	1.82986000E+05	WDOT	0.	WEICON	0.	WPROP	0.	ASMG	1.36840440E+00
FTXB	0.	FAXB	-1.63980139E+04	AXB	-2.88322440E+00	TMXB	0.	AMXB	3.68270040E+03	TTMXB	8.96140399E+02
FTYB	0.	FAYB	-1.06975286E+03	AYB	-1.88092142E-01	TMYB	0.	AMYB	-1.11639794E+04	TTMYB	-4.77579936E+03
FTZB	0.	FAZB	-2.49859047E+05	AZB	-4.39321313E+01	TMZB	0.	AMZB	-2.90932064E+04	TTMZB	4.97879356E+03
CA	5.15913531E-02	CLL	-1.11043267E-03	CD	4.43076468E-01	DRAG	1.40829299E+05	DYNP	1.18157707E+02	ASXI	-3.71662320E+01
CY	-3.36565135E-03	CM	-8.87718413E-04	CL	6.51388146E-01	LIFT	2.07039964E+05	MACH	8.04380085E+00	ASYI	3.92996289E+00
CN	7.86105340E-01	CW	-1.09002846E-03	HEATRT	0.	TLHEAT	0.	REYNO	8.55416351E+06	ASZI	2.32724539E+01
ROLBD	-1.73581460E+00	ROLBDD	7.65194803E-02	ROLI	-4.34800662E-01	YAWR	1.78046075E+02	ALPHA	3.04687894E+01	ALPTOT	3.04744937E+01
PITBD	1.09958915E-01	PITBDD	-2.41503632E-02	YAWI	4.89496840E+01	PITR	1.93017553E+01	BETA	6.20157203E-01	DALPHA	3.60012228E+03
YAWBD	-8.93390378E-01	YAWBDD	5.28059715E-02	PITI	-5.98884641E+01	ROLR	5.30494290E+01	BNKANG	4.89559944E+01	DALTOT	3.60079629E+03
ROLBER	0.	ROLAC	5.64084770E-02	XREF	0.	XCG	0.	IXX	7.59000000E+05	IXY	0.
PITBER	0.	PITAC	-1.21180557E-02	YREF	0.	YCG	1.25000000E-01	IYY	5.76500000E+06	IXZ	1.31000000E+05
YAWBER	6.03614486E-01	YAWAC	0.	ZREF	0.	ZCG	0.	IZZ	5.91200000E+06	IYZ	0.
TIMRF1	1.50300000E+03	TIMRF2	3.00000000E+00	GTIME	1.50300000E+03	ATIME	0.	DELT	6.25000000E-02	*	0.
DELAZ	-3.05177227E-01	LOD1	1.04051753E+00	RDTREF	-7.38726482E+01	RK2ROL	1.00000000E+00	TRANGE	3.05460708E+02	DRAGGC	2.55281926E+01
SLECT	4.00000000E+00	GASM	4.54410786E+01	GLOD	1.47259123E+00	GROOT	-9.47988370E+01	DRAGRP	2.65457346E+01	ALDREF	1.05860487E+00
ALPGC	3.05000000E+01	ALPERR	1.87263524E-01	ROLRGC	4.50418975E+01	ROLRER	-8.00753152E+00	ALPERI	1.55335482E+00	DELECT	-5.00000000E+00
TROLN	0.	TROLP	0.	TPITN	0.	TPITP	0.	TYAWN	2.50000000E+00	TYAWP	1.00000000E+00
TONT	3.50000000E+00	WDOTJ	0.	WPCONJ	0.	RCSMXB	-2.78656000E+03	RCSMYB	6.38818000E+03	RCSMZB	3.40720000E+04
DELAC	-1.23439311E-01	DELEC	-4.68284551E+00	DELRC	0.	DELAD	5.64084770E-02	DELED	-1.21180557E-02	DELRD	0.
DELA	-1.26964941E-01	DELE	-4.68208814E+00	DELR	0.	DELF1	5.50000000E+01	DELF2	-1.17000000E+01	UDCTR	-1.00000000E+00
CKA	2.50000000E+00	CKE	6.00000000E+00	CKR	0.	HMA	0.	HME	1.03525292E+05	HMR	0.
CLA	6.72662268E-01	CDA	4.56788181E-01	CMA	-3.04227747E-02	CYB	-3.34884890E-03	CNB	-1.14108925E-03	CLLB	-1.00465467E-03
CYDR	0.	CLLDR	0.	CNDR	0.	CLDE	-1.10791221E-02	CNDE	-7.39971255E-03	CMDE	1.33133303E-02
CYDA	-1.68024508E-05	CLLDA	-1.36530372E-04	CNDA	4.45443447E-05	CLF1	0.	CDF1	0.	CMF1	0.
CYF1	0.	CNF1	0.	CLLF1	0.	CHE	4.60000000E-02	CMO	-1.22740414E-05	CNR	3.51310328E-06
CLLR	-3.51310328E-06	CNP	3.00334802E-06	CLLP	3.42654706E-05	CLF2	-1.01950000E-02	CDF2	-6.31200000E-03	CMF2	1.62340000E-02

60 POST REENTRY CHECK CASE PROBLEM NO. 1

*** PHASE 1.0 ***

TIME	1.50400000E+03	TIMES	4.00000000E+00	TOURP	4.00000000E+00	DENS	3.16280401E-06	PRES	2.61845802E+00	ATEM	4.82299189E+02		
ALTITO	1.52127926E+05	GCRAD	2.10550379E+07	GOLAT	3.94156650E+01	GCLAT	3.94156650E+01	LONG	2.38839010E+02	LONGI	2.45122833E+02		
VELI	9.20568752E+03	GAMMAI	-6.09769250E-01	AZVELI	1.48048707E+02	XI	-6.84280614E+06	VXI	2.36496045E+03	AXI	-2.62808711E+01		
VELR	8.63685540E+03	GAMMAR	-6.49930945E-01	AZVELR	1.54741010E+02	YI	-1.47569603E+07	VYI	-6.47968508E+03	AYI	2.54728450E+01		
VELA	8.63685540E+03	GAMMAA	-6.49930945E-01	AZVELA	1.54741010E+02	ZI	1.33687228E+07	VZI	-6.09633710E+03	AZI	3.97009158E+00		
GAMAD	-2.01860360E-02	AZWAD	1.90635881E-01	DWNRNG	2.13400655E+04	CRRNG	-1.01669355E+02	DPRNG1	2.93342875E+02	DPRNG2	2.13219238E+04		
THRUST	0.	WEIGHT	1.82986000E+05	WDOT	0.	WEICON	0.	WPROP	0.	ASMG	1.36624960E+00		
FTXB	0.	FAXB	-1.62955324E+04	AXB	-2.86520531E+00	TMXB	0.	AMXB	4.48969137E+03	TTMXB	-1.08342863E+03		
FTYB	0.	FAYB	-1.16960253E+03	AYB	-2.05648474E-01	TMYB	0.	AMYB	-1.16567020E+04	TTMYB	1.11965805E+03		
FTZB	0.	FAZB	-2.49470163E+05	AZB	-4.38637548E+01	TMZB	0.	AMZB	-3.29971883E+04	TTMZB	3.51468117E+04		
CA	5.13526302E-02	CLL	-1.07770297E-03	CD	4.43099912E-01	DRAG	1.40607189E+05	DYNP	1.17965111E+02	ASXI	-3.66005160E+01		
CY	-3.68580569E-03	CM	-9.28411189E-04	CL	6.51423247E-01	LIFT	2.06713631E+05	MACH	8.02241212E+00	ASYI	3.21785409E+00		
CN	7.86163269E-01	CW	-1.24993823E-03	HEATRT	0.	TLHEAT	0.	REYNO	8.56633906E+06	ASZI	2.41314799E+01		
ROLBD	-1.57933501E+00	ROLBDD	-2.28824364E-02	ROLI	-5.59051228E-01	YAWR	1.77579695E+02	ALPHA	3.04863633E+01	ALPTOT	3.04932683E+01		
PITBD	9.63692923E-02	PITBDD	3.05576457E-02	YAWI	4.70770453E+01	PITR	2.00698430E+01	BETA	6.82556610E-01	QALPHA	3.59632724E+03		
YAWBD	-8.17980630E-01	YAWBDD	3.42395881E-01	PITI	-5.98809851E+01	ROLR	5.12387859E+01	BNKANG	4.70858593E+01	QALTOT	3.59714178E+03		
ROLBER	0.	ROLAC	-2.50068161E-01	XREF	0.	XCG	0.	IXX	7.59000000E+05	IXY	0.		
PITBER	0.	PITAC	-7.91316477E-02	YREF	0.	YCG	1.25000000E-01	IYY	5.76500000E+06	IXZ	1.31000000E+05		
YAWBER	1.02403537E+00	YAWAC	0.	ZREF	0.	ZCG	0.	IZZ	5.91200000E+06	IYZ	0.		
TIMRF1	1.50400000E+03	TIMRF2	4.00000000E+00	GTIME	1.50400000E+03	ATIME	0.	DELT	6.25000000E-02	*	0.		
DELAZ	-3.03364646E-01	LOD1	1.05166444E+00	RDTREF	-7.39695987E+01	RK2ROL	1.00000000E+00	TRANGE	3.04113492E+02	DRAGGC	2.54866278E+01		
SLECT	4.00000000E+00	GASM	4.53670917E+01	GLOD	1.47259123E+00	GRDOT	-9.79695059E+01	DRAGRP	2.65078036E+01	ALDPEF	1.06086185E+00		
ALPGC	3.05000000E+01	ALPERR	8.18204590E-02	ROLRGC	4.44256725E+01	ROLRER	-6.81311332E+00	ALPERT	1.68595332E+00	DELECI	-5.00000000E+00		
TROLN	0.	TROLP	0.	TPITN	0.	TPITP	0.	TYAWN	2.50000000E+00	TYAWP	2.12500000E+00		
TONT	4.62500000E+00	WDOTJ	0.	WPCONJ	0.	RCSMXB	-5.57312000E+03	RCSMYB	1.27763600E+04	RCSMZB	6.81440000E+04		
DELAC	-1.56292600E-02	DELEC	-4.67220004E+00	DELRC	0.	DELAD	-2.50068161E-01	DELED	-7.91316477E-02	DELRD	0.		
DELA	0.	DELE	-4.66725431E+00	DELR	0.	DELF1	5.50000000E+01	DELF2	-1.17000000E+01	UDCTR	1.00000000E+00		
CKA	2.50000000E+00	CKE	6.00000000E+00	CKR	0.	HMA	0.	HME	1.03356548E+05	HMR	0.		
CLA	6.72662268E-01	CDA	4.56788181E-01	CMA	-3.04227747E-02	CYB	-3.68580569E-03	CWB	-1.25590416E-03	CLLB	-1.10574171E-03		
CYDR	0.	CLLDR	0.	CWDR	0.	CLDE	-1.10440212E-02	CDDE	-7.37626873E-03	CMDF	1.32711509E-02		
CYDA	0.	CLLDA	0.	CWDA	0.	CLF1	0.	CDF1	0.	CMF1	0.		
CYF1	0.	CWF1	0.	CLLF1	0.	CHE	4.60000000E-02	CMQ	-1.07874275E-05	CWR	3.22563148E-06		
CLLR	-3.22563148E-06	CWP	2.74030352E-06	CLLP	3.12643720E-05	CLF2	-1.01950000E-02	CDF2	-6.31200000E-03	CMF2	1.62340000E-02		

60 POST REENTRY CHECK CASE PROBLEM NO. 1

*** PHASE 1.0 ***

TIME	1.50500000E+03	TIMES	5.00000000E+00	TOURP	5.00000000E+00	DENS	3.17583883E-06	PRES	2.62843042E+00	ATEM	4.82148952E+02
ALTITO	1.52028700E+05	GCRAD	2.10549387E+07	GDLAT	3.93944240E+01	GCLAT	3.93944240E+01	LONG	2.38851925E+02	LONGI	2.45139927E+02
VELI	9.17843497E+03	GAMMAI	-6.26528931E-01	AZVELI	1.48234545E+02	XI	-6.84045423E+06	VXI	2.33894744E+03	AXI	-2.57534557E+01
VELR	8.61256051E+03	GAMMAR	-6.67695814E-01	AZVELR	1.54929274E+02	YI	-1.47634273E+07	VYI	-6.45452938E+03	AYI	2.48654145E+01
VELA	8.61256051E+03	GAMMAA	-6.67695814E-01	AZVELA	1.54929274E+02	ZI	1.33626286E+07	VZI	-6.09196552E+03	AZI	4.73919364E+00
GAMAD	-1.55866529E-02	AZVAD	1.86035619E-01	DWNRNG	2.13414750E+04	CRRNG	-1.01641280E+02	DPRNG1	2.92011651E+02	DPRNG2	2.13232550E+04
THRUST	0.	WEIGHT	1.82986000E+05	WDOT	0.	WEICON	0.	WPROP	0.	ASMG	1.36451617E+00
FTXB	0.	FAXB	-1.61948873E+04	AXB	-2.84750912E+00	TMXB	0.	AMXB	1.00418011E+04	TTMXB	7.25524114E+03
FTYB	0.	FAYB	-1.10992234E+03	AYB	-1.95155046E-01	TMYB	0.	AMYB	-1.41248440E+04	TTMYB	-7.73666397E+03
FTZB	0.	FAZB	-2.49159124E+05	AZB	-4.38090655E+01	TMZB	0.	AMZB	-3.30864188E+04	TTMZB	9.85581193E+02
CA	5.11131467E-02	CLL	-8.53278348E-04	CO	4.43210408E-01	DRAG	1.40428502E+05	DYNP	1.17785826E+02	ASXI	-3.60696995E+01
CY	-3.50305762E-03	CM	-1.12670153E-03	CL	6.51588685E-01	LIFT	2.06451882E+05	MACH	8.00109189E+00	ASYI	2.60035580E+00
CN	7.86378234E-01	CW	-1.25595741E-03	HEATRT	0.	TLHEAT	0.	REYNO	8.57956384E+06	ASZI	2.48916762E+01
ROLBD	-1.27793699E+00	ROLBDD	5.51561034E-01	ROLI	-8.06637960E-01	YAWR	1.77215950E+02	ALPHA	3.05046347E+01	ALPTOT	3.05109470E+01
PITBD	9.15518849E-02	PITBDD	-6.67029622E-02	YAWI	4.54320258E+01	PITR	2.06752954E+01	BETA	6.52841280E-01	QALPHA	3.59301359E+03
YAWBD	-5.37774347E-01	YAWBDD	2.35214682E-02	PITI	-5.99619838E+01	ROLR	4.96105239E+01	BNKANG	4.54440521E+01	QALTOT	3.59375709E+03
ROLBER	0.	ROLAC	5.54263168E-01	XREF	0.	XCG	0.	IXX	7.59000000E+05	IXY	0.
PITBER	0.	PITAC	5.24676166E-02	YREF	0.	YCG	1.25000000E-01	IYY	5.76500000E+06	IXZ	1.31000000E+05
YAWBER	9.89818311E-01	YAWAC	0.	ZREF	0.	ZCG	0.	IZZ	5.91200000E+06	IYZ	0.
TIMRF1	1.50500000E+03	TIMRF2	5.00000000E+00	GTIME	1.50500000E+03	ATIME	0.	DELT	6.25000000E-02	*	0.
DELAZ	-3.01629913E-01	LOD1	1.06068233E+00	RDTREF	-7.40691292E+01	RK2ROL	1.00000000E+00	TRANGE	3.02769318E+02	DPAGGC	2.54478704E+01
SLECT	4.00000000E+00	GASM	4.52981024E+01	GLOD	1.47259123E+00	GRDOT	-1.00364119E+02	DRAGRP	2.64700527E+01	ALDREF	1.06311413E+00
ALPGC	3.05000000E+01	ALPERR	-2.78081535E-02	ROLRGC	4.39221553E+01	ROLRER	-5.68836866E+00	ALPERI	1.71179484E+00	DELECT	-5.00000000E+00
TROLN	0.	TROLP	0.	TPITN	0.	TPITP	0.	TYAWN	2.50000000E+00	TYAWP	3.93750000E+00
TONT	6.43750000E+00	WDOTJ	0.	WPCONJ	0.	RCSMXB	-2.78656000E+03	RCSMYB	6.38818000E+03	RCSMZB	3.40720000E+04
DELAC	2.03036453E-01	DELEC	-4.59406002E+00	DELRC	0.	DELAD	5.54263168E-01	DELED	5.24676166E-02	DELRD	0.
DELA	1.68395005E-01	DELE	-4.59733925E+00	DELR	0.	DELF1	5.50000000E+01	DELF2	-1.17000000E+01	UDCTR	4.00000000E+00
CKA	2.50000000E+00	CKE	6.00000000E+00	CKR	0.	HMA	0.	HME	1.03199465E+05	HMR	0.
CLA	6.72662268E-01	CDA	4.56788181E-01	CMA	-3.04227747E-02	CYB	-3.52534291E-03	CNB	-1.20122796E-03	CLLB	-1.05760287E-03
CYDR	0.	CLLDR	0.	CNDR	0.	CLDE	-1.08785827E-02	CDDE	-7.26577287E-03	CMDE	1.30723503E-02
CYDA	2.22852939E-05	CLLDA	1.81081885E-04	CNDA	-5.90797036E-05	CLF1	0.	CDF1	0.	CMF1	0.
CYF1	0.	CNF1	0.	CLLF1	0.	CME	4.60000000E-02	CMO	-1.02770832E-05	CNR	2.12664585E-06
CLLR	-2.12664585E-06	CNP	2.22360278E-06	CLLP	2.53692862E-05	CLF2	-1.01950000E-02	CDF2	-6.31200000E-03	CMF2	1.62340000E-02

60 POST REENTRY CHECK CASE PROBLEM NO. 1

*** PHASE 1.0 ***

TIME	1.50600000E+03	TIMES	6.00000000E+00	TOURP	6.00000000E+00	DENS	3.18920713E-06	PRES	2.63865473E+00	ATEM	4.81995559E+02
ALTITO	1.51927390E+05	GCRAD	2.10548374E+07	GDLAT	3.93732106E+01	GCLAT	3.93732106E+01	LONG	2.38864711E+02	LONGI	2.45156890E+02
VELI	9.15129630E+03	GAMMAI	-6.39756580E-01	AZVELI	1.48356542E+02	XI	-6.83812808E+06	VXI	2.31342187E+03	AXI	-2.53103148E+01
VELR	8.58831468E+03	GAMMAR	-6.81695852E-01	AZVELR	1.55113512E+02	YI	-1.47698695E+07	VYI	-6.42988605E+03	AYI	2.44425749E+01
VELA	8.58831468E+03	GAMMAA	-6.81695852E-01	AZVELA	1.55113512E+02	ZI	1.33565391E+07	VZI	-6.08694247E+03	AZI	5.28240828E+00
GAMAD	-1.25848183E-02	AZVAD	1.82587178E-01	DWNRNG	2.13428803E+04	CRRNG	-1.01608903E+02	DPRNG1	2.90683466E+02	DPRNG2	2.13245832E+04
THRUST	0.	WEIGHT	1.82986000E+05	WDOT	0.	WEICON	0.	WPROP	0.	ASMG	1.36196903E+00
FTXB	0.	FAXB	-1.61758305E+04	AXB	-2.84415841E+00	TMXB	0.	AMXB	2.33383757E+03	TTMXB	-4.52722431E+02
FTYB	0.	FAYB	-1.07678202E+03	AYB	-1.89328062E-01	TMYB	0.	AMYB	-9.83553284E+03	TTMYB	-3.44732284E+03
FTZB	0.	FAZB	-2.48693430E+05	AZB	-4.37271836E+01	TMZB	0.	AMZB	-2.90492887E+04	TTMZB	5.02271134E+03
CA	5.11264549E-02	CLL	-1.16425967E-03	CD	4.43022172E-01	DRAG	1.40167191E+05	DYNP	1.17616602E+02	ASXI	-3.56231993E+01
CY	-3.40335215E-03	CM	-7.85680899E-04	CL	6.51306851E-01	LIFT	2.06066101E+05	MACH	7.97983692E+00	ASYI	2.16747910E+00
CN	7.86037750E-01	CN	-1.09438948E-03	HEATRT	0.	TLHEAT	0.	REYNO	8.59358896E+06	ASZI	2.54259979E+01
ROLBD	-1.02819798E+00	ROLBDD	-2.58184006E-02	ROLI	-1.04124235E+00	YAWR	1.76984416E+02	ALPHA	3.05022709E+01	ALPTOT	3.05080830E+01
PITBD	7.04068473E-02	PITBDD	-2.88380731E-02	YAWI	4.42572603E+01	PITR	2.10838599E+01	BETA	6.26409939E-01	QALPHA	3.58757345E+03
YAWBD	-3.61021635E-01	YAWBDD	4.91848879E-02	PITI	-6.00479863E+01	ROLR	4.84348090E+01	BNKANG	4.42726807E+01	QALTOT	3.58825706E+03
ROLBER	0.	ROLAC	-2.02899260E-04	XREF	0.	XCG	0.	IXX	7.59000000E+05	IXY	0.
PITBER	0.	PITAC	-2.49244994E-01	YREF	0.	YCG	1.25000000E-01	IYY	5.76500000E+06	IXZ	1.31000000E+05
YAWBER	9.82414298E-01	YAWAC	0.	ZREF	0.	ZCG	0.	IZZ	5.91200000E+06	IYZ	0.
TIMRF1	1.50600000E+03	TIMRF2	6.00000000E+00	GTIME	1.50600000E+03	ATIME	0.	DELT	6.25000000E-02	*	0.
DELAZ	-2.99958686E-01	LOD1	1.06810182E+00	RDTREF	-7.41714174E+01	RK2ROL	1.00000000E+00	TRANGE	3.01428214E+02	DRAGGC	2.54112903E+01
SLECT	4.00000000E+00	GASM	4.52329885E+01	GLOD	1.47259123E+00	GROOT	-1.02179958E+02	DRAGRP	2.64325637E+01	BLDREF	1.06535803E+00
ALPGC	3.05000000E+01	ALPERR	-1.36253179E-02	ROLRGC	4.35044149E+01	ROLRER	-4.93039403E+00	ALPEPI	1.68088115E+00	DELECI	-5.00000000E+00
TROLN	0.	TROLP	0.	TPITN	0.	TPITP	0.	TYAWN	2.50000000E+00	TYAWP	5.37500000E+00
TONT	7.87500000E+00	WDOTJ	0.	WPCONJ	0.	RCSMXB	-2.78656000E+03	RCSMYB	6.38818000E+03	RCSMZB	3.40720000E+04
DELAC	-1.56719421E-01	DELEC	-4.73202171E+00	DELRC	0.	DELAD	-2.02899260E-04	DELED	-2.49244994E-01	DELRD	0.
DELA	-1.56706740E-01	DELE	-4.71644390E+00	DELR	0.	DELF1	5.52016308E+01	DELF2	-1.17000000E+01	UDCTP	1.00000000E+01
CKA	2.50000000E+00	CKE	6.00000000E+00	CKR	0.	HMA	0.	HME	1.03051197E+05	HMR	0.
CLA	6.72662268E-01	CDA	4.56788181E-01	CMA	-3.04227747E-02	CYB	-3.38261367E-03	CWB	-1.15259429E-03	CLLB	-1.01478410E-03
CYDR	0.	CLLDR	0.	CWDR	0.	CLDE	-1.11604174E-02	CDDE	-7.45400944E-03	CMDE	1.34110196E-02
CYDA	-2.07384759E-05	CLLDA	-1.68513026E-04	CWDA	5.49789927E-05	CLF1	0.	CDF1	0.	CMF1	0.
CYF1	0.	CWF1	0.	CLLF1	0.	CHE	4.60000000E-02	CMQ	-7.92577641E-06	CWR	1.43170208E-06
CLLR	-1.43170208E-06	CWP	1.79410910E-06	CLLP	2.04691539E-05	CLF2	-1.01950000E-02	CDF2	-6.31200000E-03	CMF2	1.62340000E-02

60 POST REENTRY CHECK CASE PROBLEM NO. 1

*** PHASE 1.0 ***

TIME	1.50700000E+03	TIMES	7.00000000E+00	TOURP	7.80000000E+00	DENS	3.20284904E-06	PRES	2.64908496E+00	ATEM	4.81839738E+02
ALTITO	1.51824477E+05	GCRAD	2.10547345E+07	GOLAT	3.93520255E+01	GCLAT	3.93520255E+01	LONG	2.38877369E+02	LONGI	2.45173727E+02
VELI	9.12426249E+03	GAMMAI	-6.50456531E-01	AZVELI	1.48505453E+02	XI	-6.83582724E+06	VXI	2.28832114E+03	AXI	-2.49075450E+01
VELR	8.56412286E+03	GAMMAR	-6.93001893E-01	AZVELR	1.55294533E+02	YI	-1.47762872E+07	VYI	-6.40562856E+03	AYI	2.40899506E+01
VELA	8.56412286E+03	GAMMAA	-6.93001893E-01	AZVELA	1.55294533E+02	ZI	1.33504549E+07	VZI	-6.08142048E+03	AZI	5.74537444E+00
GAMAD	-1.01390236E-02	AZVAD	1.79633528E-01	DWNRNG	2.13442816E+04	CRRNG	-1.01572334E+02	DPRNG1	2.89358344E+02	DPRNG2	2.13259083E+04
THRUST	0.	WEIGHT	1.82986000E+05	WDOT	0.	WEICON	0.	WPROP	0.	ASMG	1.35951602E+00
FTXB	0.	FAXB	-1.62131762E+04	AXB	-2.85072482E+00	TMXB	0.	AMXB	4.41859743E+03	TTMXB	1.63203743E+03
FTYB	0.	FAYB	-9.80465386E+02	AYB	-1.72392933E-01	TMYB	0.	AMYB	-5.60969396E+03	TTMYB	7.78486377E+02
FTZB	0.	FAZB	-2.48241572E+05	AZB	-4.36477345E+01	TMZB	0.	AMZB	-2.65091064E+04	TTMZB	7.56289361E+03
CA	5.13149100E-02	CLL	-1.07903726E-03	CD	4.42834992E-01	DRAG	1.39915704E+05	DYNP	1.17455201E+02	ASXI	-3.52171107E+01
CY	-3.10318548E-03	CM	-4.48730070E-04	CL	6.51026598E-01	LIFT	2.05694777E+05	MACH	7.95864562E+00	ASYI	1.80484912E+00
CN	7.85687751E-01	CN	-9.92705687E-04	HEATRT	0.	TLHEAT	0.	REYNO	8.60824204E+06	ASZI	2.58800834E+01
ROLBD	-7.81424143E-01	ROLBDD	1.36417910E-01	ROLI	-1.30846300E+00	YAWR	1.76814330E+02	ALPHA	3.04871405E+01	ALPTOT	3.04919698E+01
PITBD	6.85866235E-02	PITBDD	1.11608294E-02	YAWI	4.32567411E+01	PITR	2.13960706E+01	BETA	5.70818644E-01	DALPHA	3.58087320E+03
YAWBD	-2.97835480E-01	YAWBDD	7.71160677E-02	PITI	-6.01664882E+01	ROLR	4.74167667E+01	BNKANG	4.32760401E+01	DALTOT	3.58144043E+03
ROLBER	0.	ROLAC	-1.95021446E-04	XREF	0.	XCG	0.	IXX	7.59000000E+05	IXY	0.
PITBER	0.	PITAC	-2.67146863E-02	YREF	0.	YCG	1.25000000E-01	IYY	5.76500000E+06	IXZ	1.31000000E+05
YAWBER	8.67116530E-01	YAWAC	0.	ZREF	0.	ZCG	0.	IZZ	5.91200000E+06	IYZ	0.
TIMRF1	1.50700000E+03	TIMRF2	7.00000000E+00	GTIME	1.50700000E+03	ATIME	0.	DELT	6.25000000E-02	*	0.
DELAZ	-2.98337118E-01	LOD1	1.07436864E+00	RDTREF	-7.42765788E+01	RK2ROL	1.00000000E+00	TRANGE	3.00090203E+02	DRAGCC	2.53763820E+01
SLECT	4.00000000E+00	GASM	4.51708505E+01	GLOD	1.47259123E+00	GRDOT	-1.03581951E+02	DRAGPP	2.63954017E+01	ALDREF	1.06759055E+00
ALPGC	3.05000000E+01	ALPERR	7.71570701E-02	ROLRGC	4.31490588E+01	ROLRER	-4.26770793E+00	ALPERI	1.70912137E+00	DELECI	-5.00000000E+00
TROLN	0.	TROLP	0.	TPITN	0.	TPITP	0.	TYAWN	2.50000000E+00	TYAWP	6.37500000E+00
TONT	8.87500000E+00	WDOTJ	0.	WPCONJ	0.	RCSMXB	-2.78656000E+03	RCSMYB	6.38818000E+03	RCSMZB	3.40720000E+04
DELAC	-1.56917881E-01	DELEC	-4.83654947E+00	DELRC	0.	DELAD	-1.95021446E-04	DELED	-2.67146863E-02	DELRD	0.
DELA	-1.56905692E-01	DELE	-4.83487980E+00	DELR	0.	DELF1	5.54135438E+01	DELF2	-1.17000000E+01	UDCTR	1.00000000E+01
CKA	2.50000000E+00	CKE	6.00000000E+00	CKR	0.	HMA	0.	HME	1.02909784E+05	HMR	0.
CLA	6.72662268E-01	CDA	4.56788181E-01	CMA	-3.04227747E-02	CYB	-3.08242068E-03	CNB	-1.05030631E-03	CLLB	-9.24726203E-04
CYDR	0.	CLLDR	0.	CNDR	0.	CLDE	-1.14406697E-02	CNDE	-7.64118908E-03	CMDE	1.37477873E-02
CYDA	-2.07648051E-05	CLLDA	-1.68726967E-04	CNDA	5.50487930E-05	CLF1	0.	CDF1	0.	CMF1	0.
CYF1	0.	CNF1	0.	CLLF1	0.	CME	4.60000000E-02	CMQ	-7.74268164E-06	CNR	1.18446142E-06
CLLR	-1.18446142E-06	CNP	1.36736352E-06	CLLP	1.56003747E-05	CLF2	-1.01950000E-02	CDF2	-6.31200000E-03	CMF2	1.62340000E-02

6D POST REENTRY CHECK CASE PROBLEM NO. 1

*** PHASE 1.0 ***

TIME	1.50800000E+03	TIMES	8.00000000E+00	TOURP	8.00000000E+00	DENS	3.21671854E-06	PRES	2.65968575E+00	ATEM	4.81682047E+02
ALTITO	1.51720330E+05	GCRAD	2.10546303E+07	GOLAT	3.93308695E+01	GCLAT	3.93308695E+01	LONG	2.38889903E+02	LONGI	2.45190439E+02
VELI	9.09731025E+03	GAMMAI	-6.59213938E-01	AZVELI	1.48651914E+02	XI	-6.83355132E+06	VXI	2.26357550E+03	AXI	-2.45912437E+01
VELR	8.53997358E+03	GAMMAR	-7.02237717E-01	AZVELR	1.55473027E+02	YI	-1.47826408E+07	VYI	-6.38166896E+03	AYI	2.38385453E+01
VELA	8.53997358E+03	GAMMAA	-7.02237717E-01	AZVELA	1.55473027E+02	ZI	1.33443764E+07	VZI	-6.07549018E+03	AZI	6.10529040E+00
GAMAD	-8.39958565E-03	AZVAD	1.77458969E-01	DWNRNG	2.13456789E+04	CRRNG	-1.01531665E+02	DPRNG1	2.88036304E+02	DPRNG2	2.13272304E+04
THRUST	0.	WEIGHT	1.82986000E+05	WDOT	0.	WEICON	0.	WPROP	0.	ASMG	1.35774236E+00
FTXB	0.	FAXB	-1.62249795E+04	AXB	-2.85280017E+00	TMXB	0.	AMXB	4.11703790E+03	TTMXB	1.33047790E+03
FTYB	0.	FAYB	-9.89355407E+02	AYB	-1.73956045E-01	TMYB	0.	AMYB	-5.82362459E+03	TTMYB	5.64555406E+02
FTZB	0.	FAZB	-2.47915515E+05	AZB	-4.35904046E+01	TMZB	0.	AMZB	-2.67598499E+04	TTMZB	7.31215011E+03
CA	5.14204362E-02	CLL	-1.09105860E-03	CD	4.42844154E-01	DRAG	1.39733107E+05	DYNP	1.17299489E+02	ASXI	-3.48975299E+01
CY	-3.13547925E-03	CM	-4.66461180E-04	CL	6.51040316E-01	LIFT	2.05426413E+05	MACH	7.93750263E+00	ASYI	1.54347031E+00
CN	7.85697382E-01	CN	-1.00414412E-03	HEATRT	0.	TLHEAT	0.	REYNO	8.62337537E+06	ASZI	2.62311306E+01
ROLBD	-6.57759936E-01	ROLBDD	1.13136258E-01	ROLI	-1.48757441E+00	YAWR	1.76697677E+02	ALPHA	3.04795134E+01	ALPTOT	3.04844459E+01
PITBD	7.94130457E-02	PITBDD	7.74069009E-03	YAWI	4.25049027E+01	PITR	2.16587941E+01	BETA	5.76794259E-01	OALPHA	3.57523135E+03
YAWBD	-2.22367868E-01	YAWBDD	7.41509429E-02	PITI	-6.02139914E+01	ROLR	4.66633607E+01	BNKANG	4.25275486E+01	OALTOT	3.57580992E+03
ROLBER	0.	ROLAC	-1.89505238E-04	XREF	0.	XCG	0.	IXX	7.59000000E+05	IXY	0.
PITBER	0.	PITAC	2.05681638E-02	YREF	0.	YCG	1.25000000E-01	IYY	5.76500000E+06	IXZ	1.31000000E+05
YAWBER	7.17151304E-01	YAWAC	0.	ZREF	0.	ZCG	0.	IZZ	5.91200000E+06	IYZ	0.
TIMRF1	1.50800000E+03	TIMRF2	8.00000000E+00	GTIME	1.50800000E+03	ATIME	0.	DELT	6.25000000E-02	*	0.
DELAZ	-2.96753356E-01	LOD1	1.07975328E+00	RDTREF	-7.43840894E+01	RK2ROL	1.00000000E+00	TRANGE	2.98755302E+02	DRAGGC	2.53427441E+01
SLECT	4.00000000E+00	GASM	4.51109739E+01	GLOD	1.47259123E+00	GRDOT	-1.04666373E+02	DRAGPP	2.63584670E+01	ALDREF	1.06981612E+00
ALPGC	3.05000000E+01	ALPERR	1.22919507E-01	ROLRGC	4.28418376E+01	ROLRER	-3.82152312E+00	ALPERI	1.81756042E+00	DELECI	-5.00000000E+00
TROLN	0.	TROLP	0.	TPITN	0.	TPITP	0.	TYAWN	2.50000000E+00	TYAWP	7.37500000E+00
TONT	9.87500000E+00	WDOTJ	0.	WPCONJ	0.	RCSMXB	-2.78656000E+03	RCSMYB	6.38818000E+03	RCSMZB	3.40720000E+04
DELAC	-1.57109821E-01	DELEC	-4.82779728E+00	DELRC	0.	DELAD	-1.89505238E-04	DELED	2.05681638E-02	DELRD	0.
DELA	-1.57097977E-01	DELE	-4.82908279E+00	DELR	0.	DELF1	5.56249737E+01	DELF2	-1.17000000E+01	UDCTR	1.00000000E+01
CKA	2.50000000E+00	CKE	6.00000000E+00	CKR	0.	HMA	0.	HME	1.02773355E+05	HMR	0.
CLA	6.72662268E-01	CDA	4.56788181E-01	CMA	-3.04227747E-02	CYB	-3.11468900E-03	CNB	-1.08130144E-03	CLLB	-9.34406700E-04
CYDR	0.	CLLDR	0.	CNDR	0.	CLDE	-1.14269524E-02	CDDE	-7.63202731E-03	CMDE	1.37313037E-02
CYDA	-2.07902521E-05	CLLDA	-1.68933739E-04	CNDA	5.51162544E-05	CLF1	0.	CDF1	0.	CMF1	0.
CYF1	0.	CNF1	0.	CLLF1	0.	CHE	4.60000000E-02	CMQ	-8.99021739E-06	CNR	8.86835118E-07
CLLR	-8.86835118E-07	CNP	1.15422624E-06	CLLP	1.31686721E-05	CLF2	-1.01950000E-02	CDF2	-6.31200000E-03	CMF2	1.62340000E-02

60 POST REENTRY CHECK CASE PROBLEM NO. 1

*** PHASE 1.0 ***

TIME	1.50900000E+03	TIMES	9.00000000E+00	TOURP	9.00000000E+00	DENS	3.23078172E-06	PRES	2.67043103E+00	ATEM	4.81522899E+02
ALTITC	1.51615223E+05	GCRAD	2.10545252E+07	GDLAT	3.93097434E+01	GCLAT	3.93097434E+01	LONG	2.38902312E+02	LONGI	2.45207026E+02
VELI	9.07042233E+03	GAMMAI	-6.66526093E-01	AZVELI	1.48796467E+02	XI	-6.83129999E+06	VXI	2.23912596E+03	AXI	-2.43137473E+01
VELR	8.51585979E+03	GAMMAR	-7.09933189E-01	AZVELR	1.55649584E+02	YI	-1.47890506E+07	VYI	-6.35793430E+03	AYI	2.36389808E+01
VELA	8.51585979E+03	GAMMAA	-7.09933189E-01	AZVELA	1.55649584E+02	ZI	1.33383040E+07	VZI	-6.06922958E+03	AZI	6.40618908E+00
GAMAD	-7.05654946E-03	AZVAD	1.75719791E-01	OWNRNG	2.13470721E+04	CRRNG	-1.01486972E+02	DPRNG1	2.86717360E+02	DPRNG2	2.13285493E+04
THRUST	0.	WEIGHT	1.82986000E+05	WDOT	0.	WEICON	0.	WPROP	0.	ASMG	1.35606516E+00
FTXB	0.	FAXB	-1.62027702E+04	AXB	-2.84889515E+00	TMXB	0.	AMXB	4.10849758E+03	TTMXB	1.32193758E+03
FTYB	0.	FAYB	-9.86104056E+02	AYB	-1.73384368E-01	TMYB	0.	AMYB	-6.38015371E+03	TTMYB	8.02629481E+00
FTZB	0.	FAZB	-2.47609418E+05	AZB	-4.35365843E+01	TMZB	0.	AMZB	-2.66827442E+04	TTMZB	7.38925575E+03
CA	5.14164830E-02	CLL	-1.09126182E-03	CD	4.42869026E-01	DRAG	1.39560402E+05	DYNP	1.17147932E+02	ASXI	-3.46167923E+01
CY	-3.12921814E-03	CM	-9.11699238E-04	CL	6.51077555E-01	LIFT	2.05172727E+05	MACH	7.91639790E+00	ASYI	1.33396489E+00
CN	7.85742516E-01	CW	-1.00242142E-03	HEATRT	0.	TLHEAT	0.	REYNO	8.63888113E+06	ASZI	2.65231723E+01
ROLBD	-5.47265177E-01	ROLBDD	1.12603324E-01	ROLI	-1.67404442E+00	YAWR	1.76638954E+02	ALPHA	3.04799873E+01	ALPTOT	3.04848998E+01
PITBD	8.34949769E-02	PITBDD	1.23569694E-03	YAWI	4.18898876E+01	PITR	2.18714076E+01	BETA	5.75630198E-01	OALPHA	3.57066748E+03
YAWBD	-1.48283663E-01	YAWBDD	7.47876930E-02	PITI	-6.02572048E+01	ROLR	4.60459876E+01	BNKANG	4.19160537E+01	OALTOT	3.57124297E+03
ROLBER	0.	ROLAC	-1.85494383E-04	XREF	0.	XCG	0.	IXX	7.59000000E+05	IYY	0.
PITBER	0.	PITAC	8.19534644E-03	YREF	0.	YCG	1.25000000E-01	IYY	5.76500000E+06	IXZ	1.31000000E+05
YAWBER	5.68084134E-01	YAWAC	0.	ZREF	0.	ZCG	0.	IZZ	5.91200000E+06	IYZ	0.
TIMRF1	1.50900000E+03	TIMRF2	9.00000000E+00	GTIME	1.50900000E+03	ATIME	0.	DELT	6.25000000E-02	*	0.
DELAZ	-2.95197255E-01	LOD1	1.08447777E+00	ROTREF	-7.44936016E+01	RK2ROL	1.00000000E+00	TRANGE	2.97423525E+02	DRAGGC	2.53099992E+01
SLECT	4.00000000E+00	GASM	4.50526868E+01	GLOD	1.47259123E+00	GRDOT	-1.05514522E+02	DRAGRP	2.63216996E+01	ALDREF	1.07203741E+00
ALPGC	3.05000000E+01	ALPERR	1.20075949E-01	ROLRGC	4.25708110E+01	ROLRER	-3.47517661E+00	ALPERI	1.93726908E+00	DELECT	-5.00000000E+00
TROLN	0.	TROLP	0.	TPITN	0.	TPITP	0.	TYAWN	2.50000000E+00	TYAWP	8.37500000E+00
TONT	1.08750000E+01	WDOTJ	0.	WPCONJ	0.	RCSMXB	-2.78656000E+03	RCSMYB	6.38818000E+03	RCSMZB	3.40720000E+04
DELAC	-1.57297392E-01	DELEC	-4.81283299E+00	DELRC	0.	DELAD	-1.85494383E-04	DELED	8.19534644E-03	DELRD	0.
DELA	-1.57285499E-01	DELE	-4.81334520E+00	DELR	0.	DELF1	5.58360210E+01	DELF2	-1.17000000E+01	UDCTR	1.00000000E+01
CKA	2.50000000E+00	CKE	6.00000000E+00	CKR	0.	HMA	0.	HME	1.02640566E+05	HMR	0.
CLA	6.72662268E-01	CDA	4.56788181E-01	CMA	-3.04227747E-02	CYB	-3.10840307E-03	CNB	-1.05915956E-03	CLLB	-9.72520921E-04
CYDR	0.	CLLDR	0.	CNDR	0.	CLDE	-1.13897129E-02	CDDE	-7.60715516E-03	CNDE	1.36865546E-02
CYDA	-2.08150686E-05	CLLDA	-1.69135388E-04	CNDA	5.51820445E-05	CLF1	0.	CDF1	0.	CMF1	0.
CYF1	0.	CNF1	0.	CLLF1	0.	CNE	4.60000000E-02	CND	-9.47909148E-06	CNR	5.93051190E-07
CLLR	-5.93051190E-07	CNP	9.63051176E-07	CLLP	1.09875384E-05	CLF2	-1.01950000E-02	CDF2	-6.31200000E-03	CMF2	1.62340000E-02

*** PHASE 1.0 ***

TIME	1.51000000E+03	TIMES	1.00000000E+01	TOURP	1.00000000E+01	DENS	3.24501297E-06	PRES	2.68130113E+00	ATEM	4.81362607E+02
ALTITO	1.51509360E+05	GCRAD	2.10544194E+07	GDLAT	3.92886476E+01	GCLAT	3.92886476E+01	LONG	2.38914600E+02	LONGT	2.45223492E+02
VELI	9.04359105E+03	GAMMAI	-6.72764166E-01	AZVELI	1.48939477E+02	XI	-6.82907298E+06	VXI	2.21493552E+03	AXI	-2.40740325E+01
VELR	8.49178062E+03	GAMMAR	-7.16483742E-01	AZVELR	1.55824600E+02	YI	-1.47953968E+07	VYI	-6.33437423E+03	AYI	2.34900257E+01
VELA	8.49178062E+03	GAMMAA	-7.16483742E-01	AZVELA	1.55824600E+02	ZI	1.33322380E+07	VZI	-6.06269765E+03	AZI	6.64727833E+00
GAMAD	-6.11416604E-03	AZVAD	1.74384465E-01	DWNRNG	2.13484612E+04	CRRNG	-1.01438319E+02	DPRNG1	2.85401525E+02	DPRNG2	2.13298652E+04
THRUST	0.	WEIGHT	1.82986000E+05	WDOT	0.	WEICON	0.	WPROP	0.	ASMG	1.35436006E+00
FTXB	0.	FAXB	-1.61730459E+04	AXB	-2.84366880E+00	TMXB	0.	AMXB	4.39830336E+03	TTMXB	1.61174336E+03
FTYB	0.	FAYB	-9.69834405E+02	AYB	-1.70523713E-01	TMYB	0.	AMYB	-6.47040391E+03	TTMYB	-8.22239074E+01
FTZB	0.	FAZB	-2.47298748E+05	AZB	-4.34819600E+01	TMZB	0.	AMZB	-2.62592841E+04	TTMZB	7.81271588E+03
CA	5.13872724E-02	CLL	-1.07926888E-03	CD	4.42873394E-01	DRAG	1.39384937E+05	DYNP	1.16999491E+02	ASXI	-3.43738741E+01
CY	-3.08149406E-03	CM	-5.19595851E-04	CL	6.51084095E-01	LIFT	2.04914806E+05	MACH	7.89532798E+00	ASYI	1.17510191E+00
CN	7.85752309E-01	CN	-9.86607282E-04	HEATRT	0.	TLHEAT	0.	REYNO	8.65468219E+06	ASZI	2.67554161E+01
RCLBD	-4.24525950E-01	ROLBDD	1.35257921E-01	ROLI	-1.86953263E+00	YAWR	1.76635841E+02	ALPHA	3.04821499E+01	ALPTOT	3.04869122E+01
PITBD	8.35884987E-02	PITBDD	-4.13300346E-04	YAWI	4.14115761E+01	PITR	2.20306277E+01	BETA	5.66787895E-01	DALPHA	3.56639603E+03
YAWBD	-7.14706042E-02	YAWBDD	7.92402744E-02	PITI	-6.03034154E+01	ROLR	4.55637652E+01	BNKANG	4.14414610E+01	DALTCT	3.56695321E+03
ROLBER	0.	ROLAC	-1.82543543E-04	XREF	0.	XCG	0.	IXX	7.59000000E+05	IXY	0.
PITBER	0.	PITAC	-1.65392630E-03	YREF	0.	YCG	1.25000000E-01	IYY	5.76500000E+06	IXZ	1.31000000E+05
YAWBER	4.12753486E-01	YAWAC	0.	ZREF	0.	ZCG	0.	IZZ	5.91200000E+06	IYZ	0.
TIMRF1	1.51000000E+03	TIMRF2	1.00000000E+01	GTIME	1.51000000E+03	ATIME	0.	DELT	6.25000000E-02	*	0.
DELAZ	-2.93662035E-01	LOD1	1.08870604E+00	RDTREF	-7.46050425E+01	RK2ROL	1.00000000E+00	TRANGE	2.96094881E+02	DRAGGC	2.52779227E+01
SLECT	4.00000000E+00	GASM	4.49955894E+01	GLOD	1.47259123E+00	GRDOT	-1.06186952E+02	DRAGRP	2.62850983E+01	ALDREF	1.07425444E+00
ALPGC	3.05000000E+01	ALPERR	1.07100408E-01	ROLRGC	4.23270619E+01	ROLRER	-3.23670331E+00	ALPERT	2.05115242E+00	DELECI	-5.00000000E+00
TROLN	0.	TROLP	0.	TPITN	0.	TPITP	0.	TYAWN	2.50000000E+00	TYAWP	9.37500000E+00
TONT	1.18750000E+01	WDOTJ	0.	WPCONJ	0.	RCSMXB	-2.78656000E+03	RCSMYB	6.38818000E+03	RCSMZB	3.40720000E+04
DELAC	-1.57480946E-01	DELEC	-4.81068466E+00	DELRC	0.	DELAD	-1.82543543E-04	DELED	-1.65392630E-03	DELRD	0.
DELA	-1.57469537E-01	DELE	-4.81058129E+00	DELR	0.	DELF1	5.60467202E+01	DELF2	-1.17000000E+01	UDCTR	1.00000000E+01
CKA	2.50000000E+00	CKE	6.00000000E+00	CKR	0.	HMA	0.	HME	1.02510508E+05	HMR	0.
CLA	6.72662288E-01	CDA	4.56788181E-01	CMA	-3.04227747E-02	CYB	-3.06065463E-03	CNB	-1.04288973E-03	CLLB	-9.18196390E-04
CYDR	0.	CLLDR	0.	CNDR	0.	CLDE	-1.13831727E-02	CDDE	-7.60278698E-03	CMDE	1.36786955E-02
CYDA	-2.08394241E-05	CLLDA	-1.69333292E-04	CNDA	5.52466124E-05	CLF1	0.	CDF1	0.	CMF1	0.
CYF1	0.	CNF1	0.	CLLF1	0.	CNE	4.60000000E-02	CMD	-9.51661779E-06	CNR	2.86652719E-07
CLLR	-2.86652719E-07	CNP	7.49178888E-07	CLLP	8.54745004E-06	CLF2	-1.01950000E-02	CDF2	-6.31200000E-03	CMF2	1.62340000E-02

9. LISTS OF VARIABLES

THIS SECTION PRESENTS A LIST OF ALL INPUT VARIABLES AND ALL TRAJECTORY OUTPUT VARIABLES USED IN THE PROGRAM. THE TARGETING/ OPTIMIZATION OUTPUTS ARE PRESENTED IN SECTION 4.F.

THE INPUT VARIABLES ARE LISTED ACCORDING TO THE NAMELIST IN WHICH THEY APPEAR AS INPUT. THE INPUTS FOR NAMELIST TBLMLT ARE NOT INCLUDED SINCE THE MULTIPLIERS WHICH ARE INPUT IN THAT NAMELIST FOLLOW THE RULES GIVEN IN THE TABLE MULTIPLIER SECTION OF THIS REPORT.

THE OUTPUT VARIABLES ARE PRESENTED IN ALPHABETICAL ORDER AT END OF THIS SECTION. THIS LIST SHOULD BE CONSULTED WHEN LOOKING FOR HOLLERITH (PCD) NAMES OF TARGETING/OPTIMIZATION VARIABLES, TABLE ARGUMENTS, EVENT CRITERIA, PRINT REQUESTS, ETC.

9.A. INPUTS FOR NAMELIST SEARCH

THIS SECTION CONTAINS A LIST OF ALL INPUT VARIABLES FOR NAMELIST SEARCH. IT IS INTENDED ONLY AS A SUMMARY OF ALL THE INPUTS FOR THE BENEFIT OF USERS WHO ARE FAMILIAR WITH THE VARIOUS OPTIONS. MORE DETAILED INSTRUCTIONS ON HOW TO INPUT VARIABLES SUCH AS CONTROL PARAMETERS, ETC., ARE FOUND IN THE SPECIFIC SECTIONS THAT DISCUSS THE TOPIC IN QUESTION.

THE INPUT VARIABLES FOR NAMELIST SEARCH IN ALPHABETICAL ORDER ARE -

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CDENS	SLUGS/FT3 PER KG/M3	.001940 31965	ATMOSPHERIC DENSITY CONVERSION CONSTANT.
CFORCE	NT/LB	4.4482216 152605	FORCE (THRUST AND AERODYNAMIC) CONVERSION CONSTANT.
CHEAT	JOULES/ BTU	1054.3502 6448888	AEROHEATING CONVERSION CONSTANT.
CMASS	KG/SLUG	14.5939 029	MASS CONVERSION CONSTANT.
CMPFT	M/FT	.3048	LENGTH CONVERSION CONSTANT.
CONEPS(1)	DEG	89.9	CONVERGENCE TOLERANCE ON THE ANGLE BETWEEN THE OPTIMIZATION VARIABLE GRADIENT AND ITS PROJECTION ONTO THE PLANE TANGENT TO THE INTERSECTION OF THE CONSTRAINT (DEPENDENT VARIABLE) SURFACES.
CONEPS(2)	N/D	0.10	THE MINIMUM ALLOWABLE PERCENTAGE CHANGE IN THE MAGNITUDE OF THE CONTROL PARAMETERS BETWEEN SUCCESSIVE ITERATIONS.
CONEPS(3)	N/D	0.10	THE MINIMUM ALLOWABLE PERCENTAGE CHANGE IN P1 ON SUCCESSIVE ITERATIONS.

9.A. INPUTS FOR NAMELIST SEARCH (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CONEPS(4)	N/D	0.10	THE MINIMUM ALLOWABLE PERCENTAGE CHANGE IN P2 ON SUCCESSIVE ITERATIONS.
CONEPS(5)	N/D	0.10	THE MINIMUM PERCENTAGE CHANGE IN THE VALUES OF G2MAG ON SUCCESSIVE ITERATIONS.
CONSEX(1)	DECIMAL	1.0E-6	PERCENTAGE DIFFERENCE BETWEEN TWO CONSECUTIVE OPTIMIZATION TRIAL STEPS BEFORE CURVE FIT PROCESS IS TERMINATED.
CONSEX(2)	DECIMAL	.001	PERCENTAGE DIFFERENCE BETWEEN TWO CONSECUTIVE TARGETING TRIAL STEPS BEFORE CURVE FIT PROCESS IS TERMINATED.
CPRES	LBS/FT2 PER NT/CM2	.02068 54347	ATMOSPHERIC PRESSURE CONVERSION CONSTANT.
CTEMP	DEG F PER DEG C	1.8	ATMOSPHERIC TEMPERATURE CONVERSION CONSTANT.
DEPPH(I) I=1,25	DECIMAL	9000	THE EVENT AT WHICH DEPENDENT VARIABLE (TARGET) I IS TO BE SATISFIED.
DEPTL(I) I=1,25	SAME AS DEPVAL	1.0	THE DESIRED ACCURACY LEVEL WITHIN WHICH DEPVR(I) IS CONSIDERED TO BE SATISFIED.
DEPVAL(I) I=1,25	SAME AS THE VARIABLE IN DEPVR(I)	0.0	THE DESIRED VALUE OF DEPVR(I). THE VALUES OF DEPVAL ARE INPUT IN ENGLISH UNITS IF IOFLAG=0 OR 1, AND IN METRIC UNITS IF IOFLAG=2 OR 3.
DEPVR(I) I=1,25	HOLLERITH	0.0	THE HOLLERITH NAME OF DEPENDENT VARIABLE I.

9.A. INPUTS FOR NAMELIST SEARCH (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
ENDJOB	INTEGER	0	END-OF-JOB FLAG.
ENDPRB	INTEGER	0	END-OF-PROBLEM FLAG.
FITERR(1)	DECIMAL	1.0E-6	PERCENTAGE DIFFERENCE BETWEEN TWO CONSECUTIVE OPTIMIZATION TRIAL VALUES BEFORE CURVE FIT PROCESS IS TERMINATED.
FITERR(2)	DECIMAL	.001	PERCENTAGE DIFFERENCE BETWEEN TWO CONSECUTIVE TARGETING TRIAL VALUES BEFORE CURVE FIT PROCESS IS TERMINATED.
FTPNM	FT/NM	6076.1155	DISTANCE CONVERSION CONSTANT.
IDEB	INTEGER	0	CONTROLS TRIAL STEP PRINTOUT. USED PRIMARILY FOR DEBUGGING PROBLEMS THAT FAIL TO CONVERGE.
IDEPVR(I) I=1,25	INTEGER	0	FLAG TO INDICATE THE TYPE OF CONSTRAINT DESIRED FOR DEPVR(I).
IFDEG(I) I=1,25	INTEGER	0	CONTROLS 360 - 0 DEGREE DISCONTINUITY IN DEPVR(I). FOR EXAMPLE, IF DEPVR(I) = 6HTRUAN , AND DEPVAL = 359.95, A DISCONTINUITY EXISTS NEAR THE DESIRED VALUE, AND IFDEG SHOULD BE USED.
IFRUNF(J) J=1,5	INTEGER	0	AN ARRAY CONTAINING THE RUN NUMBERS TO BE USED IN CONJUNCTION WITH THE VARIABLE NXTRUN TO DETERMINE WHICH RUN IS TO BE MADE NEXT.
INDPH(I) I=1,25	DECIMAL	0.0	PHASE AT WHICH INDVR(I) IS TO BE INITIATED.
INDVR(I) I=1,25	HOLLERITH	0.0	HOLLERITH NAME OF THE ITH INDEPENDENT VARIABLE USED FOR THE SEARCH PROCESS.
IOFLAG	INTEGER	0	INPUT/OUTPUT UNITS FLAG.

9.A. INPUTS FOR NAMELIST SEARCH (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
IPRC	INTEGER	0	CONTROLS PRINT OUT OF TRAJECTORIES DURING SEARCH/OPTIMIZATION.
ISENS	INTEGER	0	FLAG TO CONTROL HOW SENSITIVITIES ARE TO BE COMPUTED. = 0, USE FIRST DIFFERENCES = 1, USE SYMMETRIC DIFFERENCES = 2, USE USER SUPPLIED ANALYTICAL PARTIALS IN SUBROUTINE ANPART
LISTIN	INTEGER	2	CONTROLS SUMMARY-OF-INPUT PRINTOUT
MAXITR	INTEGER	10	MAXIMUM NUMBER OF ITERATIONS DURING SEARCH/OPTIMIZATION.
MODEW	INTEGER	1	CONTROLS TYPE OF WEIGHTING TO BE USED FOR THE INDEPENDENT VARIABLES
MULTRF	INTEGER	1	A FLAG TO INDICATE HOW THE INPUT DATA FOR THE CURRENT RUN IS TO BE FORMED WHEN RUNNING MULTIPLE RUNS.
NDEPV	INTEGER	0	NUMBER OF DEPENDENT VARIABLES TO BE SATISFIED FOR THE SEARCH/OPTIMIZATION.
NINDV	INTEGER	0	NUMBER OF INDEPENDENT VARIABLES TO BE USED FOR CONTROL IN THE SEARCH/OPTIMIZATION PROCESS.
NPAD(1) NPAD(2)	INTEGER	10 5	THE LOWER AND UPPER BOUNDS ON THE DESIRED NUMBER OF DIGITS DIFFERENCE BETWEEN THE NOMINAL AND PERTURBED VALUES OF THE DEPENDENT VARIABLES WHEN COMPUTING THE SENSITIVITY MATRIX.
NPAD(3)	DECIMAL	10.	THE LOWER BOUND ON THE PERCENTAGE CHANGE IN THE PERTURBATION OF THE CONTROL PARAMETERS WHEN COMPUTING THE SENSITIVITY MATRIX.

9.A. INPUTS FOR NAMELIST SEARCH (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NXTRUN	INTEGER	1	A FLAG TO INDICATE WHETHER OR NOT THIS IS THE NEXT RUN WHEN USING THE SEARCH/OPTIMIZATION OPTION.
OPT	DECIMAL	0.0	FLAGS THE TYPE OF OPTIMIZATION TO BE PERFORMED.
OPTPH	DECIMAL	900.0	PHASE AT WHICH THE VARIABLE SPECIFIED BY OPTVAR IS TO BE OPTIMIZED.
OPTVAR	HOLLERITH	0.0	HOLLERITH NAME OF THE VARIABLE TO BE OPTIMIZED.
PCTCC	DECIMAL	.3	MAXIMUM PERCENTAGE CHANGE IN THE MAGNITUDE OF THE CONTROL VECTOR, U(I) DURING AN OPTIMIZATION STEP (NOT USED FOR TARGETING).
PERT(I) I=1,25	SAME AS THE VAR. SPECIFIED BY INDVR(I)	1.0E-4	PERTURBATION ON THE INDEPENDENT VARIABLE, INDVR(I) WHOSE VALUE IS CURRENTLY U(I). USED TO DETERMINE THE SENSITIVITY DE(J)/DU(I).
P2MIN	DECIMAL	1.0	THE PROBLEM IS CONSIDERED TARGETED IF P2 (THE MAGNITUDE OF THE ERROR VECTOR E(I)) IS LESS THAN P2MIN.
SRCHM	INTEGER	0	CONTROLS THE TECHNIQUE USED FOR SEARCH/OPTIMIZATION.
STMINP	DECIMAL	.1	MAXIMUM PERCENTAGE THAT A TRIAL STEP IS ALLOWED TO BE REDUCED BY BASED UPON THE CURVE FIT.
STPMAX	DECIMAL	1.E10	MAXIMUM ABSOLUTE CHANGE ALLOWED IN MAGNITUDE OF WEIGHTED CONTROL VECTOR.
U(I) I=1,25	SAME AS THE VAR. SPECIFIED BY INDVR(I)	0.0	INITAL VALUES TO BE USED FOR THE VARIABLES SPECIFIED BY INDVR(I) AT PHASE INDPH(I).

9.A. INPUTS FOR NAMELIST SEARCH (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
WCON	DECIMAL	100.0	WEIGHTING CONSTANT FOR P2 WHEN OPT IS NONZERO AND SRCHM IS NOT EQUAL TO FOUR.
WOPT	DECIMAL	1.0	WEIGHTING FOR THE OPTIMIZATION VARIABLE. SHOULD BE APPROXIMATELY ONE OVER THE NORMAL VALUE OF OPTVAR.
WVU(I) I=1,25	SAME AS THE VAR. SPECIFIED BY INDVR(I)	0.0	INDEPENDENT VARIABLE WEIGHTING USED IF MODFW = 0. WVU(I) SHOULD BE INPUT AS THE RECIPROCAL OF THE MAXIMUM CHANGE ALLOWED IN U(I) PER ITERATION

9.B. INPUTS FOR NAMELIST GENDAT

THIS SECTION CONTAINS A LIST OF ALL INPUT VARIABLES FOR NAMELIST GENDAT. IT IS INTENDED ONLY AS A SUMMARY OF ALL THE INPUTS FOR THE BENEFIT OF USERS WHO ARE FAMILIAR WITH THE VARIOUS OPTIONS. MORE DETAILED INSTRUCTIONS ON THE USE OF THESE VARIABLES CAN BE FOUND IN THE SECTIONS THAT DISCUSS THE SPECIFIC OPTIONS.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
AAFFP(I) AAFFY(I)	RAD/SEC	0.0	PITCH AND YAW ANGULAR ACCELERATION FILTER FREQUENCIES.
AEXP	N/D	.64	AXIAL EXPONENT. USED IN CALCULATION OF VISCOUS CORRECTIONS IF NPC(8)=4.
AFFP AFFY	RAD/SEC	0.0	THE AUTOPILOT ACCELERATION FILTER FREQUENCIES IN PITCH AND YAW FOR THE ASCENT AUTOPILOT.
ALPHA BETA BNKANG	DEG	0.	INITIAL VALUES OF ANGLE OF ATTACK, SIDESLIP, AND BANK, RESPECTIVELY.
ALTA	N.MI. (KM)	0.	INITIAL APOGEE ALTITUDE. USED IF NPC(3)=5.
ALTITO	FT (M)	0.	INITIAL ALTITUDE ABOVE THE OBLATE PLANET. USED IF NPC(4)=2 AND IF GCRAD IS NOT INPUT.
ALTMAX	FT (M)	1.E20	MAXIMUM ALTITUDE, I.E., THE TRAJECTORY WILL TERMINATE IF THE VALUE OF OBLATE ALTITUDE (ALTITO) EXCEEDS THIS VALUE.
ALTMIN	FT (M)	-5000.	MINIMUM ALTITUDE, I.E., THE TRAJECTORY WILL TERMINATE IF THE VALUE OF OBLATE ALTITUDE (ALTITO) BECOMES LESS THAN THIS VALUE.
ALTP	N.MI. (KM)	0.	INITIAL PERIGEE ALTITUDE. USED IF NPC(3)=5.
APRLIM APPLIM APYLIM	DEG	0.0	THE AUTOPILOT ROLL, PITCH AND YAW ATTITUDE ERROR LIMITS FOR THE ASCENT AUTOPILOT.

9.B. INPUTS FOR NAMELIST GENDAT (CONT)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
AREFL FREFL RREFL	FT**3 (M**3)	0.0	THE PRODUCTS OF THE AILERON, ELEVATOR AND RUDDER AREAS AND REFERENCE LENGTHS USED TO COMPUTE THE HINGE MOMENTS.
ARGP	DEG	0.	INITIAL ARGUMENT OF PERIGEE. USED IF NPC(3)=5.
ARP(I) I=1,10	FT**2 (M2)	0.	THE SURFACE AREA OF PANEL I. USED IF NPC(26)=1.
ASFFP ASFFY	RAD/S**2	0.0	THE AUTOPILOT FILTER FREQUENCIES IN PITCH AND YAW FOR THE SUM OF THE ATTITUDE AND ACCELERATION ERRORS FOR THE ASCENT AUTOPILOT.
ATIME	SEC	TIME/DTA	THE TIME AT WHICH THE AUTOPILOT WAS LAST ENTERED.
ATMOSK(I) I=1,2	DECIMAL	1.	ATMOSPHERIC CONSTANTS USED TO COMPUTE THE SPEED OF SOUND (CS) AND THE ATMOSPHERIC DENSITY (DENS), RESPECTIVELY.
AXRB AYRB AZRB	FT (M)	0.0	THE POSITION COMPONENTS OF THE AUTOPILOT ACCELEROMETER IN THE VEHICLE BODY REFERENCE SYSTEM.
AZL	DEG	0.	THE AZIMUTH OF THE LAUNCH CENTERED INERTIAL (L) COORDINATE SYSTEM MEASURED CLOCKWISE FROM NORTH.
AZREF	DEG	0.	THE AZIMUTH REFERENCE FOR USE IN COMPUTING DWNRNG AND CRRNG. USED IF NPC(12)=1,2,3.
AZVELA	DEG	0.	INITIAL AZIMUTH ANGLE OF THE VELOCITY RELATIVE TO THE ATMOSPHERE. USED IF NPC(3)=3.
AZVELI	DEG	0.	INITIAL AZIMUTH ANGLE OF THE INERTIAL VELOCITY VECTOR. USED IF NPC(3)=2.

9.B. INPUTS FOR NAMELIST GENDAT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
AZVELR	DEG	0.	INITIAL AZIMUTH ANGLE OF THE RELATIVE VELOCITY VECTOR. USED IF NPC(3)=4.
AZWB	DEG	180.	WIND AZIMUTH BIAS. USED IF NPC(6) =1.
CINF	N/D	1.0	CHAPMAN-RUBESIN VISCOSITY COEFF-ICIENT. USED IF NPC(8)=4.
CLCDMX	DECIMAL	0.	THE VALUE OF THE MAXIMUM LIFT TO DRAG RATIO FOR CRUISE FLIGHT USED TO COMPUTE DOWNRANGE (DWNRNG) BY MEANS OF THE BREGUET EQUATION. USED IF NPC(12)=4.
CRITR	HOLLERITH	TIME	THE NAME OF THE EVENT CRITERIA VARIABLE.
DADMAX DEDMAX DRDMAX	DEG/SEC	1.0E20	THE MAXIMUM ALLOWABLE AILERON, ELEVATOR AND RUDDER RATES.
DAMAX DEMAX DRMAX	DEG	1.0E20	THE MAXIMUM ALLOWABLE AILERON, ELEVATOR AND RUDDER DEFLECTION ANGLES.
DAMIN DEMIN DRMIN	DEG	-1.0E20	THE MINIMUM ALLOWABLE AILERON, ELEVATOR AND RUDDER DEFLECTION ANGLES.
DELA DELE DELR	DEG	0.0	THE INITIAL VALUES OF THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACE DEFLECTION ANGLES.
DELECI	DEG	0.0	THE INITIAL VALUE OF DELEC.
DEPMAX(I) DEYMAX(I) I=1,15	DEG	1.0E20	THE MAXIMUM ALLOWABLE PITCH AND YAW DEFLECTIONS FOR ENGINE I.
DEPO(I) DEYO(I)	DEG	0.0	THE ZERO DEFLECTION (NULL) VALUES OF ENGINE I IN PITCH AND YAW.

9.B. INPUTS FOR NAMELIST GENDAT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
DESNE	DECIMAL	THE NEXT PRIMARY EVENT NUMBER	THE EVENT NUMBER AT WHICH THE VALUE OF THE THROTTLING PARAMETER (ETA) IS TO ATTAIN THE DESIRED VALUE.
DETA	DECIMAL	0.	THE DESIRED VALUE OF THE THROTTLING PARAMETER (ETA) AT THE EVENT SPECIFIED BY DESNE. USED IF NPC(22) =3.
DFFR DFFP DFFY	RAD/SEC	0.0	THE AUTOPILOT DISPLACEMENT FILTER FREQUENCIES IN ROLL, PITCH AND YAW FOR THE ASCENT AUTOPILOT.
DPHP DPHY	DEG	0.0	THE ROLL MISALIGNMENT ANGLE FOR THE PITCH AND YAW ACCELEROMETERS.
DPSY	DEG	0.0	THE YAW MISALIGNMENT ANGLE FOR THE YAW ACCELEROMETER.
DREFR DREFP DREFY	FT (M)	0.0	THE AERODYNAMIC REFERENCE DIAMETER FOR ROLL, PITCH AND YAW, RESPECTIVELY. USED TO CALCULATE THE AERODYNAMIC MOMENTS IN ROLL, PITCH AND YAW, RESPECTIVELY.
DT	SEC	1.0	THE INTEGRATION INTERVAL (STEPSIZE).
DTA	SEC	1.0E300	THE AUTOPILOT CYCLE TIME. DTA IS USED IF ADT IS ZERO.
DTG	SEC	1.0E300	THE GUIDANCE CYCLE TIME. DTG IS USED IF GDT IS ZERO.
DTIMR(J) J=1,4	SEC	0.	THE DERIVATIVE OF TIME REFERENCE J. THIS INPUT ACTIVATES THE INTEGRATION OF TIMRF(J) WHEN INPUT NONZERO.
DTM	DECIMAL	1.	A MULTIPLIER ON THE INTEGRATION INTERVAL (DT) TO BE USED IN COMPUTING THE INTEGRATION INTERVAL FOR THE PERTURBED TRAJECTORIES AND THE TRIAL STEP TRAJECTORIES.

9.B INPUTS FOR NAMELIST GENDAT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
DTHP	DEG	0.0	THE PITCH MISALIGNMENT ANGLE FOR THE PITCH ACCELEROMETER.
ENDJOB	INTEGER	0	END-OF-JOB FLAG.
ENDPHS	INTEGER	0	END-OF-PHASE FLAG.
ENDPRB	INTEGER	0	END-OF-PROBLEM FLAG.
ENGF(I) I=1,15	INTEGER	0	A FLAG TO INDICATE THAT ENGINE I IS ON OR OFF. = 0, ENGINE I IS OFF. = 1, ENGINE I IS ON.
ENGROL(I) I=1,15	DEG	0.0	THE ROLL ANGLE OF ENGINE I ABOUT THE VEHICLE XB AXIS.
ETA	DECIMAL	1.0	THE INITIAL VALUE OF THE THROTTLING PARAMETER WHEN USING NPC(22)=3.
ETAARG	HOLLERITH	TIMES	THE NAME OF THE VARIABLE TO BE USED AS THE ARGUMENT FOR THE ETA POLYNOMIAL. USED IF NPC(22)=0,1.
ETAPC(I) I=1,4	DECIMAL	1.0,3*0.	THROTTLING PARAMETER (ETA) POLYNOMIAL COEFFICIENTS. USED IF NPC(22)=0 OR 1.
EVENT(1)	DECIMAL	0.	THE EVENT SEQUENCE NUMBER FOR THE CURRENT PHASE.
EVENT(2)	DECIMAL	0.	THE TYPE OF EVENT.
FESN	DECIMAL	100.	THE FINAL EVENT SEQUENCE NUMBER FOR THE CURRENT PROBLEM.
FID(J) J=1,2	HOLLERITH	UD265 FILE I.D. 0000	THE TWO WORD (20 CHARACTERS) FILE IDENTIFICATION TO BE WRITTEN ON THE PROFILE TAPE.
FREFL(I) I=1,3	FT**3 (M**3)	0.0	THE PRODUCT OF THE AREA AND REFERENCE LENGTH FOR FLAP I USED TO COMPUTE THE HINGE MOMENT FOR FLAP I.

9.B INPUTS FOR NAMELIST GENDAT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
GAMMAA	DEG	0.	INITIAL ATMOSPHERIC RELATIVE FLIGHT PATH ANGLE. USED IF NPC(3)=3.
GAMMAI	DEG	0.	INITIAL VALUE OF INERTIAL FLIGHT PATH ANGLE. USED IF NPC(3)=2.
GAMMAR	DEG	0.	INITIAL RELATIVE FLIGHT PATH ANGLE. USED IF NPC(3)=4.
GCLAT	DEG	0.	INITIAL GEOCENTRIC LATITUDE. USED IF NPC(4)=2 AND IF GDLAT IS NOT INPUT.
GCRAD	FT (M)	0.	INITIAL GEOCENTRIC RADIUS. USED IF NPC(4)=2 AND IF ALTITO IS NOT INPUT.
GDERV(J) J=1,10	HOLLERITH	0	THE NAME OF GENERAL INTEGRATION VARIABLE J.
GDLAT	DEG	0.	INITIAL GEODETIC LATITUDE. USED IF NPC(4)=2 AND IF GCLAT IS NOT INPUT.
GINT(J) J=1,10	DECIMAL	0.	THE VALUE OF THE INTEGRAL OF GENERAL INTEGRATION VARIABLE J.
GTIME	SEC	TIME/DTG	THE TIME AT WHICH THE GUIDANCE WAS LAST ENTERED.
GTIME1 GTIME2	SEC	0.0	THE TIMES TO BEGIN THE OPEN LOOP ATTITUDE COMMANDS AND CLOSED LOOP ALTITUDE-VELOCITY PROFILE COMMANDS RESPECTIVELY, FOR THE ASCENT GUIDANCE.
GVRI(J) J=1,10	DECIMAL	0.	THE CONSTANT VALUED INPUT VARIABLES FOR USE WITH THE GENERAL GUIDANCE OPTIONS.
GXP(I) GYP(I) GZP(I) I=1,15	FT (M)	0.	LOCATION OF THE ENGINE GIMBAL IN BODY REFERENCE (XBR,YBR,ZBR) SYSTEM FOR ENGINE I.
HEATK(I) I=1,3	DECIMAL	1. 17600. 26000.	COEFFICIENTS USED IN COMPUTING CHAPMANS HEATING RATE. USED IF NPC(15)=1,3,4.

9.E. INPUTS FOR NAMELIST GENDAT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
HMAMX HMEMX HMRMX	FT-LBS (N-M)	1.0E20	THE MAXIMUM ALLOWABLE AILERON, ELEVATOR AND RUDDER HINGE MOMENTS.
HRAT(I) I=1,10	DECIMAL	0.	THE HEAT RATIO FOR PANEL I WITH RESPECT TO THE REFERENCE TOTAL HEAT (TLHEAT).
IAEROM	INTEGER	0	FLAG CONTROLLING HOW THE AERODYNAMIC MOMENTS ARE CALCULATED. = 0, USE XREFT, YREFT AND ZREFT. = 1, USE CPRYRT, CPRZRT, CPPXRT, CPPYRT, CPYXRT AND CPYZRT.
IGF(J) J=1,6	INTEGER	0	THE ARRAY OF INPUT FLAGS FOR USE WITH THE GENERAL GUIDANCE OPTIONS.
IGINIT	INTEGER	0	A FLAG TO INDICATE THAT THE SHUTTLE ASCENT GUIDANCE EQUATIONS ARE TO BE INITIALIZED. = 0, DO NOT INITIALIZE THE ASCENT GUIDANCE. = 1, INITIALIZE THE ASCENT GUIDANCE.
IGSTRT	INTEGER	0	A FLAG TO INDICATE THAT THE SHUTTLE ASCENT GUIDANCE COMMANDS ARE TO BE USED. = 0, ZERO OUT THE COMMANDS. = 1, USE THE CALCULATED COMMANDS.
IGUID(12)	INTEGER	1	A FLAG TO SPECIFY THE OPTION TO BE USED FOR VEHICLE BODY ATTITUDE INITIALIZATION.
IGUID(14)	INTEGER	0	GENERAL OPEN OR CLOSED LOOP GUIDANCE OPTION.
IGUID(16)	INTEGER	0	A FLAG TO SELECT THE OPEN-LOOP GUIDANCE OPTION TO BE USED.
IGUID(17)	INTEGER	0	A FLAG TO SELECT THE CLOSED-LOOP GUIDANCE OPTION TO BE USED.

9.B INPUTS FOR NAMELIST GENDAT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
IGUID(18)	INTEGER	0	ATTITUDE RATE INITIALIZATION FLAG.
INC	DEG	0.	INITIAL INCLINATION ANGLE. USED IF NPC(3)=5.
ISLECT	INTEGER	0	GUIDANCE PHASE SELECTOR.
ISTRT	INTEGER	0	GUIDANCE INITIALIZATION FLAG.
ITRANS	INTEGER	0	TRANSITION PHASE FLAG.
IWPF(I) I=1,15	INTEGER	0	FLAG TO INDICATE WHICH ENGINES ARE TO BE INCLUDED IN THE SPECIFIC FLOWRATE INTEGRATION OBTAINED WHEN NPC(27) = 1.
J2 J3 J4	DECIMAL	1.0823E-3 0. 0.	SECOND, THIRD, AND FOURTH HARMONICS IN THE GRAVITY POTENTIAL FUNCTION. USED IF NPC(16)=0.
KPDA KPDE KPDR	N/D	0.0	THE PITCH MIXING GAINS FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES.
KPDP(I) I=1,15	N/D	0.0	THE PITCH MIXING GAIN FOR THE PITCH DEFLECTION OF ENGINE I.
KRDA KRDE KRDR	N/D	0.0	THE ROLL MIXING GAINS FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES.
KRDP(I) I=1,15	N/D	0.0	THE ROLL MIXING GAIN FOR THE PITCH DEFLECTION OF ENGINE I.
KRDY(I) I=1,15	N/D	0.0	THE ROLL MIXING GAIN FOR THE YAW DEFLECTION OF ENGINE I.
KYDA KYDE KYDR	N/D	0.0	THE YAW MIXING GAINS FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES.
KYDY(I) I=1,15	N/D	0.0	THE YAW MIXING GAIN FOR THE YAW DEFLECTION OF ENGINE I.

9.B INPUTS FOR NAMELIST GENDAT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
LAN	DEG	0.	INITIAL LONGITUDE OF THE ASCENDING NODE MEASURED EAST OF THE XI AXIS. USED IF NPC(3)=5.
LATL	DEG	GDLAT	LATITUDE OF THE LAUNCH CENTERED INERTIAL (L) COORDINATE SYSTEM.
LATREF LONREF	DEG	0.	REFERENCE LATITUDE AND LONGITUDE FOR USE IN COMPUTING THE VARIOUS RANGE PARAMETERS. USED IF NPC(12) =1,2,3,4.
LDRLF	INTEGER	0	A FLAG TO ACTIVATE THE LOAD RELIEF OPTION.
LONG	DEG	0.	INITIAL EAST LONGITUDE RELATIVE TO THE PRIME MERIDIAN. USED IF NPC(4)=2 AND IF LONGI IS NOT INPUT.
LONGI	DEG	0.	INITIAL LONGITUDE EAST OF THE XI AXIS. USED IF NPC(4)=2, AND LONG IS NOT INPUT.
LONL	DEG	LONGI	INERTIAL EAST LONGITUDE OF THE LAUNCH CENTERED INERTIAL (L) COORDINATE SYSTEM.
LREF	FT (M)	0.	REFERENCE LENGTH USED IN THE CALCULATION OF REYNOLDS NUMBER.
MAXTIM	SEC	1.E10	MAXIMUM TRAJECTORY TIME.
MDL	INTEGER	1	THE EVENT CRITERIA MODEL TO BE USED.
MONF(J) J=1,2,3	HOLLERITH	0.	THE NAME OF THE VARIABLE TO BE USED AS THE FUNCTIONAL INEQUALITY.
MONX(I) I=1,10	HOLLERITH	0.	THE NAME OF THE VARIABLE TO BE MONITORED FOR MAXIMUM AND MINIMUM VALUES.
MONY(I) I=1,10	HOLLERITH	0.	THE NAME OF THE VARIABLE WHOSE VALUE IS TO BE DETERMINED WHEN MONX(I) REACHES THE MAXIMUM AND MINIMUM VALUES.

9.B INPUTS FOR NAMELIST GENDAT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
MU	FT**3/ SEC**2 (M3/S2)	1.40765 39E+16	GRAVITATIONAL CONSTANT OF THE ATTRACTING PLANET.
NAUTOP	INTEGER	0	A FLAG TO INDICATE WHICH AUTOPILOT MODEL IS TO BE USED. = 0, NO AUTOPILOT. = 1, USE THE ASCENT AUTOPILOT. = 2, USE THE REENTRY AUTOPILOT.
NEQS(J) J=1,3	INTEGER	0	THE TYPE OF BOUNDARY TO BE CONSIDERED FOR THE FUNCTIONAL INEQUALITY WHEN USING NPC(11)=1.
NPC(1)	INTEGER	0	CONIC CALCULATION FLAG.
NPC(3)	INTEGER	4	VELOCITY VECTOR INITIALIZATION FLAG.
NPC(4)	INTEGER	2	POSITION VECTOR INITIALIZATION FLAG.
NPC(5)	INTEGER	2	ATMOSPHERE MODEL FLAG.
NPC(6)	INTEGER	0	ATMOSPHERIC WINDS FLAG.
NPC(7)	INTEGER	0	NOT APPLICABLE TO 6D POST
NPC(8)	INTEGER	1	AERODYNAMIC COEFFICIENT TYPE FLAG.
NPC(9)	INTEGER	0	PROPULSION TYPE FLAG.
NPC(10)	INTEGER	0	NOT APPLICABLE TO 6D POST.
NPC(11)	INTEGER	0	FUNCTIONAL INEQUALITY CONSTRAINTS OPTION FLAG.
NPC(12)	INTEGER	0	CROSSRANGE AND DOWNRANGE OPTION FLAG.
NPC(13)	INTEGER	0	PROPELLANT JETTISION OPTION FLAG.
NPC(14)	INTEGER	0	HOLD DOWN OPTION FLAG.
NPC(15)	INTEGER	0	AEROHEATING RATE OPTION FLAG.

9.B INPUTS FOR NAMELIST GENDAT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
NPC(16)	INTEGER	0	GRAVITY MODEL OPTION FLAG.
NPC(17)	INTEGER	0	WEIGHT JETTISON OPTION FLAG BASED FMASST.
NPC(18)	INTEGER	0	TRAJECTORY TERMINATION FLAG.
NPC(19)	INTEGER	1	FLAG TO CONTROL PRINTING OF INPUT CONDITIONS FOR EACH PHASE.
NPC(20)	INTEGER	0	FLAG TO SPECIFY THE TYPE OF SPECIAL INTEGRATION STEP SIZE (DT) PREDICTION TO BE USED.
NPC(21)	INTEGER	0	FLAG TO INDICATE THE METHOD BY WHICH FLOWRATE IS TO BE COMPUTED FOR ROCKET ENGINES.
NPC(22)	INTEGER	0	THROTTLING PARAMETER INPUT OPTION FLAG.
NPC(24)	INTEGER	0	GENERAL INTEGRATION VARIABLE FLAG.
NPC(27)	INTEGER	0	ACTIVATION FLAG FOR THE OPTION TO INTEGRATE THE FLOWRATE OF SELECTED ENGINES.
NPC(29)	INTEGER	0	NOT APPLICABLE TO 6D POST.
NPC(30)	INTEGER	0	WEIGHT CALCULATION OPTION FLAG.
NPC(I) I=32,35	INTEGER	0	NOT USED.
NSPEC(J) J=1,5	INTEGER	0	THE ARRAY OF INPUT FLAGS FOR USE IN THE SPECIAL CALCULATIONS ROUTINE (CALSPEC).
OMEGA	RAD/SEC	7.29211 E-5	ROTATION RATE OF THE ATTRACTING PLANET.
PGCLAT	DEG	0.	INITIAL GEOCENTRIC LATITUDE OF PERIGEE. MEASURED POSITIVE IN THE NORTHERN HEMISPHERE. USED IF NPC(3) =5.

9.B INPUTS FOR NAMELIST GENDAT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
PINC	SEC	0.	PRINT INTERVAL.
PRNC	SEC	1HU	PROFILE TAPE WRITE INTERVAL.
PRNT(I) I=1,240	HOLLERITH	0.	PRINT VARIABLE NAMES.
PSL	LB/FT**2 (N/M2)	VARIES BASED ON NPC(5)	SEA LEVEL ATMOSPHERIC PRESSURE USED IN COMPUTING JET ENGINE THRUST AND FLOWRATE.
PWPROP	LBS (N)	0.	THE VALUE OF THE PROPELLANT CONSUMED BY THE ENGINES SPECIFIED BY IWPF(I).
RAZD	DEG	-44.	THE RUNWAY AZIMUTH OF THE TARGET (LANDING SITE).
RE	FT (M)	20925741.	EQUATORIAL RADIUS OF THE ATTRACTING PLANET.
RENG(I) I=1,15	INTEGER	0	A FLAG TO INDICATE THAT ENGINE I IS A ROLL ENGINE. = 0 , ENGINE I IS NOT A ROLL ENGINE. = 1 , ENGINE I IS A ROLL ENGINE.
RFFR RFFP RFFY	RAD/SEC	0.0	THE AUTOPILOT RATE FILTER FREQUENCIES IN ROLL, PITCH AND YAW FOR THE ASCENT AUTOPILOT.
RHOSL	SLUGS/ FT**3 (KG/M3)	.0023769	SEA LEVEL DENSITY USED IN COMPUTING CHAPMANS HEATING RATE. USED IF NPC(15)=1,3,4.
RN	FT (M)	1.0	NOSE RADIUS USED IN COMPUTING CHAPMAN HEATING RATE. USED IF NPC(15)=1,3,4.
ROLB PITB YAWB	DEG	0.0	THE INITIAL VALUE OF THE INTEGRATED ROLL, PITCH AND YAW BODY RATES, RESPECTIVELY.

9.B INPUTS FOR NAMELIST GENDAT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
ROLBD PITBD YAWBD	DEG/SEC	0.0	THE INITIAL VALUE OF THE VEHICLE ROLL, PITCH AND YAW BODY RATES WITH RESPECT TO INERTIAL SPACE.
ROLI YAWI PITI	DEG	0.	THE INITIAL VALUES OF THE INERTIAL EULER ATTITUDE ANGLES OF THE VEHICLE WITH RESPECT TO THE LAUNCH PAD (L) COORDINATE SYSTEM.
ROLIDL YAWIDL PITIDL	DEG/SEC	1.0E20	THE INERTIAL EULER ANGLE RATE LIMITS FOR THE SHUTTLE ASCENT GUIDANCE.
ROLINL YAWINL PITINL	DEG	-1.0E20	THE INERTIAL EULER ANGLE NEGATIVE LIMIT FOR THE SHUTTLE ASCENT GUIDANCE.
ROLIPL YAWIPL PITIPL	DEG	1.0E20	THE INERTIAL EULER ANGLE POSITIVE LIMIT FOR THE SHUTTLE ASCENT GUIDANCE.
RP	FT (M)	20855590.	POLAR RADIUS OF THE ATTRACTING PLANET. USED IF NPC(16)=0.
SPECI(J) J=1,9	DECIMAL	0.	THE CONSTANT VALUED INPUT VARIABLES FOR USE IN THE SPECIAL CALCULATIONS ROUTINE (CALSPEC).
SREF	FT**2 (M2)	0.	THE AERODYNAMIC REFERENCE AREA USED TO COMPUTE THE AERODYNAMIC FORCES AND MOMENTS.
TAUINT	N/D	0.0	THE INTEGRATION CONSTANT FOR THE FORWARD INTEGRATION LOOP IN THE ASCENT AUTOPILOT.
TAULP TAULY	SEC	0.0	PITCH AND YAW LOAD RELIEF INTEGRATION TIME CONSTANTS.
THRSJ	LBS (N)	0.0	THE THRUST OF EACH RCS JET. USED TO COMPUTE WDOTJ.
TIME	SEC	0.	THE INITIAL VALUE OF TRAJECTORY TIME.

9.B INPUTS FOR NAMELIST GENDAT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
TIMREF	DECIMAL	0.	THE REFERENCE TIME TO BE USED FOR THE INERTIAL RANGE CALCULATIONS. USED IF NPC(12)=2.
TIMRF(J) J=1,4	SEC	0.	TIME REFERENCE J.
TISPJ	SEC	1.0E20	THE SPECIFIC IMPULSE OF THE RCS JETS.
TITLE(I) I=1,10	HOLLERITH	0.	A 10 WORD TITLE TO BE USED FOR PROBLEM/PHASE IDENTIFICATION.
TLATCD	DEG	0.0	THE GEOCENTRIC LATITUDE OF THE TARGET.
TLONGD	DEG	0.0	THE LONGITUDE OF THE TARGET MEASURED EAST OF THE GREENWICH MERIDIAN.
TOL	SAME AS THE CRITERIA VARIABLE	1.E-6	THE DESIRED ACCURACY TOLERANCE FOR THE SPECIFIED CRITERIA VARIABLE (CRITR).
TRUAN	DEG	0.	INITIAL TRUE ANOMALY. USED IF NPC(3)=5.
TSL	DEG R (DEG K)	VARIES BASED ON NPC(5)	SEA LEVEL ATMOSPHERIC TEMPERATURE USED IN COMPUTING JET ENGINE THRUST AND FLOWRATE.
VALUE	DECIMAL	1.E10	THE VALUE OF THE CRITERIA VARIABLE (CRITR) AT WHICH THE EVENT IS TO OCCUR.
VELA	FT/SEC (M/S)	0.	INITIAL ATMOSPHERIC RELATIVE VELOCITY USED IF NPC(3)=3.
VELI	FT/SEC (M/S)	0.	INITIAL VALUE OF INERTIAL VELOCITY. USED IF NPC(3)=2.
VELP	FT/SEC (M/S)	0.	INITIAL RELATIVE VELOCITY. USED IF NPC(3)=4.

9.B INPUTS FOR NAMELIST GENDAT (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
VINFI	N/D	.007	INVISCID VALUE OF RAREFACTION PARAMETER. USED IF NPC(8)=4.
VXI(J) J=1,3	FT/SEC (M/S)	0.	THE INITIAL VALUES OF THE INERTIAL VELOCITY VECTOR COMPONENTS ALONG THE XI, YI, AND ZI AXES. USED IF NPC(3)=1.
WEICON	LBS (N)	0.	THE INITIAL VALUE OF THE AMOUNT OF PROPELLANT CONSUMED.
WGTSG	LBS (N)	0.	THE VEHICLE GROSS WEIGHT (EXCLUDING WPLD) AT THE BEGINNING OF THE PHASE I WHICH WGTSG IS INPUT.
WJETT	LBS (N)	0.	THE WEIGHT TO BE JETTISONED AT THE BEGINNING OF THE PHASE IN WHICH WJETT IS INPUT.
WPCONJ	LBS (N)	0.0	THE WEIGHT OF PROPELLANT CONSUMED BY THE RCS JETS.
WPLD	LBS (N)	0.	THE PAYLOAD WEIGHT.
WPROPI	LBS (N)	0.	THE INITIAL WEIGHT OF PROPELLANT.
XI(J) J=1,3	FT (M)	0.	THE INITIAL VEHICLE POSITION VECTOR COMPONENTS ALONG THE XI, YI, AND ZI AXES. USED IF NPC(4)=1.
XMAX(I) I=1,10	DECIMAL	-1.0E20	THE INITIAL VALUE OF XMAX(I). THIS VARIABLE CAN BE INPUT IN ANY PHASE TO REINITIALIZE THE SEARCH FOR ANOTHER MAXIMUM OF THE VARIABLE INPUT AS MONX(I).
XMIN(I) I=1,10	DECIMAL	+1.0E20	THE INITIAL VALUE OF XMIN(I). THIS VARIABLE CAN BE INPUT IN ANY PHASE TO REINITIALIZE THE SEARCH FOR ANOTHER MINIMUM OF THE VARIABLE INPUT AS MONX(I).

9.B INPUTS FOR NAMELIST GENDAT (CONTD)

YAWPK(I) I=1,2	N/D	0.0	THE YAW GAINS FOR THE VELOCITY AND POSITION ERRORS, RESPECTIVELY, FOR THE ASCENT GUIDANCE.
YAWR PITR ROLR	DEG	0.	THE INITIAL VALUES OF THE RELATIVE EULER ANGLES OF THE VEHICLE WITH RESPECT TO THE LOCAL GEOGRAPHIC (G) COORDINATE SYSTEM.
YXMN(I) I=1,10	DECIMAL	+1.0E20	THE INITIAL VALUE OF YXMN(I). THIS VARIABLE CAN BE INPUT IN ANY PHASE TO REINITIALIZE THE SEARCH FOR ANOTHER MINIMUM OF THE VARIABLE INPUT AS MONY(I).
YXMX(I) I=1,10	DECIMAL	-1.0E20	THE INITIAL VALUE OF YXMX(I). THIS VARIABLE CAN BE INPUT IN ANY PHASE TO REINITIALIZE THE SEARCH FOR ANOTHER MAXIMUM OF THE VARIABLE INPUT AS MONY(I).

9.C. INPUTS FOR NAMELIST TAB

THIS SECTION SUMMARIZES ALL THE TABLE INPUTS FOR THE PROGRAM. ALL TABLES ARE INPUT IN NAMELIST TAB WITH A NEW INPUT OF NAMELIST TAB BEING REQUIRED FOR EACH TABLE. SEE THE SECTION ON NAMELIST INPUT SEQUENCE FOR DETAILS ON THE USE OF NAMELIST TAB.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
AEIT I=1,15	FT**2 (M2)	0.	TABLE OF EXIT AREA FOR ENGINE I WHEN USING ROCKET ENGINES, I.E., IF NPC(9)=1.
ATEMT	DEG R (DEG K)	0.	ATMOSPHERIC TEMPERATURE TABLE. USED IF NPC(5)=1.
AYBCT AZBCT	DEG/S**2	0.0	THE PITCH AND YAW BODY ACCELERATION COMMAND TABLES FOR THE ASCENT AUTOPILOT ACCELERATION ERROR FEEDBACK LOOP.
AZWT	DEG	0.	WIND AZIMUTH TABLE. USED IN CONJUNCTION WITH VWT WHEN NPC(6)=1.
CADAT CADET CADRT	N/D	0.0	AXIAL FORCE COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES. USED IF NPC(8)=1.
CAFIT I=1,3	N/D	0.0	THE AXIAL FORCE COEFFICIENT TABLE FOR FLAP I. USED IF NPC(8)=1.
CAIOT	N/D	0.	TABLE OF INVISCID AXIAL COEFFICIENT AT MAXIMUM L/D. USED IF NPC(8)=4.
CAOT	N/D	0.	AXIAL FORCE COEFFICIENT TABLE FOR ZERO ALPHA. USED IF NPC(8)=1.
CAT	N/D	0.	AXIAL FORCE COEFFICIENT TABLE. USED IF NPC(8)=1.
CDDAT CDDET CDDRT	N/D	0.0	DRAG FORCE COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES. USED IF NPC(8)=2.

9.C. INPUTS FOR NAMELIST TAB (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CDFIT I=1,3	N/D	0.0	THE DRAG FORCE COEFFICIENT FOR FLAP I. USED IF NPC(8)=2.
CDOT	N/D	0.	DRAG FORCE COEFFICIENT TABLE FOR ZERO ALPHA. USED IF NPC(8)=2.
CDT	N/D	0.	DRAG FORCE COEFFICIENT TABLE. USED IF NPC(8)=2.
CHAT CHET CHRT	N/D	0.0	THE AILERON, ELEVATOR AND RUDDER HINGE MOMENT COEFFICIENT TABLES.
CHFIT I=1,3	N/D	0.0	THE HINGE MOMENT COEFFICIENT TABLE FOR FLAP I.
CKAAPT CKAAYT	SEC**2	0.0	PITCH AND YAW ANGULAR ACCELERATION GAINS.
CKAPT CKAYT	SEC**2	0.0	THE AUTOPILOT ACCELERATION GAIN TABLES FOR PITCH AND YAW, RESPECTIVELY, FOR THE ASCENT AUTOPILOT.
CKASPT CKASYT	SEC**2	0.0	THE AUTOPILOT GAINS IN PITCH AND YAW FOR THE SUM OF THE ATTITUDE AND ACCELERATION ERRORS FOR THE ASCENT AUTOPILOT.
CKAT CKET CKRT	N/D	0.0	THE AILERON, ELEVATOR AND RUDDER GAIN TABLES FOR THE REENTRY AUTOPILOT.
CKDRT CKDPT CKDYT	N/D	0.0	THE AUTOPILOT DISPLACEMENT GAIN TABLES FOR ROLL, PITCH AND YAW, RESPECTIVELY, FOR THE ASCENT AUTOPILOT.
CKLAPT CKLAYT	RAD/FT/ SEC**2	0.0	PITCH AND YAW LOAD RELIEF ACCELERATION GAIN.
CKLVPT CKLVYT	RAD/FT/ SEC	0.0	PITCH AND YAW LOAD RELIEF VELOCITY GAIN.

9.C. INPUTS FOR NAMELIST TAB (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CKRRT CKRPT CKRYT	SEC	0.0	THE AUTOPILOT RATE GAIN TABLES FOR ROLL, PITCH AND YAW, RESPECTIVELY, FOR THE ASCENT AUTOPILOT.
CLDAT CLDET CLDRT	N/D	0.0	LIFT FORCE COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES. USED IF NPC(8)=2.
CLFIT I=1,3	N/D	0.0	THE LIFT FORCE COEFFICIENT FOR FLAP I. USED IF NPC(8)=2.
CLLBT	N/D	0.0	THE ROLLING MOMENT COEFFICIENT PER DEGREE BETA.
CLLDAT CLLDET CLLDRT	N/D	0.0	ROLLING MOMENT COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES.
CLLFIT I=1,3	N/D	0.0	THE ROLLING MOMENT COEFFICIENT FOR FLAP I.
CLLOT	N/D	0.0	THE ROLLING MOMENT COEFFICIENT FOR ZERO ALPHA AND BETA.
CLLPT	N/D	0.0	THE ROLLING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL ROLL RATE.
CLLRT	N/D	0.0	THE ROLLING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL YAW RATE.
CLOT	N/D	0.	LIFT FORCE COEFFICIENT TABLE FOR ZERO ALPHA. USED IF NPC(8)=2.
CLT	N/D	0.	LIFT FORCE COEFFICIENT TABLE. USED IF NPC(8)=2.
CMAT	N/D	0.0	THE PITCHING MOMENT COEFFICIENT TABLE PER DEGREE ALPHA.

9.C. INPUTS FOR NAMELIST TAB (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CMOT	N/D	0.0	THE PITCHING MOMENT COEFFICIENT FOR ZERO ALPHA.
CMDAT CMDET CMDRT	N/D	0.0	PITCHING MOMENT COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES.
CMFIT I=1,3	N/D	0.0	THE PITCHING MOMENT COEFFICIENT TABLE FOR FLAP I.
CMQT	N/D	0.0	THE PITCHING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL PITCH RATE.
CNAT	N/D	0.	NORMAL FORCE COEFFICIENT TABLE. THE NORMAL FORCE COEFFICIENT SLOPE CAN BE INPUT AS CNAT IF THE MNEMONIC MULTIPLIER CNANM = 5HALPHA, IS INPUT IN NAMELIST TBLMLT. USED IF NPC(8)=1.
CNDAT CNDET CNDRT	N/D	0.0	NORMAL FORCE COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES. USED IF NPC(8)=1.
CNFIT I=1,3	N/D	0.0	THE NORMAL FORCE COEFFICIENT TABLE FOR FLAP I. USED IF NPC(8)=1.
CNOT	N/D	0.	NORMAL FORCE COEFFICIENT TABLE FOR ZERO ALPHA. USED IF NPC(8)=1.
CPAYRT	FT (M)	0.0	THE LOCATION OF THE AXIAL FORCE CENTER OF PRESSURE ALONG THE YR AXIS.
CPAZRT	FT (M)	0.0	THE LOCATION OF THE AXIAL FORCE CENTER OF PRESSURE ALONG THE ZR AXIS.
CPNXRT	FT (M)	0.0	THE LOCATION OF THE NORMATL FORCE CENTER OF PRESSURE ALONG THE XR AXIS
CPNYRT	FT (M)	0.0	THE LOCATION OF THE NORMAL FORCE CENTER OF PRESSURE ALONG THE YR AXIS.

9.C. INPUTS FOR NAMELIST TAB (CONTD)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CPYXRT	FT (M)	0.0	THE LOCATION OF THE SIDE FORCE CENTER OF PRESSURE ALONG THE XR AXIS.
CPYZRT	FT (M)	0.0	THE LOCATION OF THE SIDE FORCE CENTER OF PRESSURE ALONG THE ZR AXIS.
CST	FT/SEC (M/S)	0.	SPEED OF SOUND TABLE. USED IF NPC(5)=1.
CWBT	N/D	0.0	THE YAWING MOMENT COEFFICIENT TABLE PER DEGREE BETA.
CWDAT CWDET CWDRT	N/D	0.0	YAWING MOMENT COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES.
CWFIT I=1,3	N/D	0.0	THE YAWING MOMENT COEFFICIENT FOR FLAP I.
CWOT	N/D	0.0	THE YAWING MOMENT COEFFICIENT FOR ZERO BETA.
CWPT	N/D	0.0	THE YAWING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL ROLL RATE.
CWRT	N/D	0.0	THE YAWING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL YAW RATE.
CYBT	N/D	0.	SIDE FORCE COEFFICIENT TABLE. THE SIDE FORCE COEFFICIENT SLOPE CAN BE INPUT AS CYBT IF THE MNEMONIC MULTIPLIER CYBNM = 4HBETA, IS INPUT IN NAMELIST TBLMLT.
CYDAT CYDET CYDRT	N/D	0.0	SIDE FORCE COEFFICIENT TABLES FOR THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACES.
CYFIT I=1,3	N/D	0.0	THE SIDE FORCE COEFFICIENT FOR FLAP I.

9.C.

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
CYOT	N/D	0.	SIDE FORCE COEFFICIENT TABLE FOR ZERO BETA.
DELFIT I=1,3	DEG	0.0	THE DEFLECTION ANGLE TABLE FOR FLAP I.
DENKT	DECIMAL	0.	A DENSITY MULTIPLIER TABLE WHICH IS USED TO SIMULATE DENSITY DISPERSIONS. THE DENSITY FROM THE ATMOSPHERE MODEL BEING USED WILL BE MULTIPLIED BY THE TABLE LOOK-UP VALUE OF DENKT WHICH MUST BE INPUT AS THE DESIRED DECIMAL PERCENTAGE CHANGE IN DENSITY.
DENST	SLUGS/ FT**3 (KG/M3)	0.	ATMOSPHERIC DENSITY TABLE. USED IF NPC(5)=1.
DISK	INTEGER	0	PARAMETER WHICH CONTROLS WHETHER BIVARIANT AND TRIVARIANT CURVES AND SURFACES ARE STORED ON DISK AND HOW MANY ARE MAINTAINED IN MEMORY.
ETAT	N/D	0.	TABLE OF THE THROTTLING PARAMETER. USED IF NPC(22)=2.
FLJT J=1,2,3	SAME AS THE VARIABLE IN MONF(J)	0.	THE VALUE OF THE BOUNDARY OF THE FUNCTIONAL INEQUALITY AS A FUNCTION OF THE TABLE ARGUMENT.
FMASST	DECIMAL	0.	A TABLE WHICH IS USED IN CONJUNCTION WITH NPC(17) TO DETERMINE THE VALUE OF WJETTM.
FXBPJT FYBPJT FZBPJT	LBS (N)	0.0	THE FORCE PER JET ALONG THE VEHICLE ROLL, PITCH AND YAW BODY AXES.
GENVIT I=1,2	DECIMAL	0.	THE TABLES USED TO CALCULATE THE GENERALIZED DEPENDENT VARIABLE (DGENV).
HDPT	FT/SEC	0.0	THE ALTITUDE RATE PROFILE TABLE FOR THE ASCENT GUIDANCE.

9.C. INPUTS FOR NAMELIST TAB (COND)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
HPT	FT	0.0	THE ALTITUDE PROFILE TABLE FOR THE ASCENT GUIDANCE.
HTRTT	BTU/ FT**2-SEC (W/M2)	0.	THE TABLE OF AEROHEATING RATE AS A FUNCTION OF THE INPUT ARGUMENTS IF NPC(15)=2, OR A MULTIPLIER TO BE USED IN CALCULATING HEATING RATE IF NPC(15)=3,4,5.
IXXT IYYT IZZT	SLUG-FT2 (KG-M2)	0.0	THE VEHICLE MOMENTS OF INERTIA TABLES ABOUT THE VEHICLE ROLL, PITCH AND YAW AXES, RESPECTIVELY.
IXYT IXZT IYZT	SLUG-FT2 (KG-M2)	0.0	THE VEHICLE PRODUCTS OF INERTIA TABLES.
KHDT	N/D	0.0	THE ALTITUDE RATE ERROR GAIN TABLE FOR THE ASCENT GUIDANCE.
KHT	N/D	0.0	THE ALTITUDE ERROR GAIN TABLE FOR THE ASCENT GUIDANCE.
PNPJIT PPPJIT	N/D	0.0	THE PITCH MOMENT INTERFERENCE COEFFICIENTS DUE TO THE NEGATIVE AND POSITIVE PITCH JETS, RESPECTIVELY.
PREST	LB/FT**2 (N/M2)	0.	ATMOSPHERIC PRESSURE TABLE. USED IF NPC(5)=1.
PRJIT PYJIT	N/D	0.0	THE PITCH MOMENT INTERFERENCE COEFFICIENTS DUE TO THE ROLL AND YAW JETS, RESPECTIVELY.
RBDCT PBDCT YBDCT	DEG/SEC	0.0	THE ROLL, PITCH AND YAW BODY RATE COMMAND TABLES FOR THE ASCENT AUTOPILOT RATE ERROR FEEDBACK LOOP.
RMPJT PMPJT YMPJT	FT-LBS (N-M)	0.0	THE ROLL, PITCH AND YAW MOMENT PER JET TABLES FOR THE REENTRY AUTOPILOT.

9.C. INPUTS FOR NAMELIST TAB (COND)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
ROLT YAWT PITT	DEG	0.0	TABLES OF ROLL, YAW AND PITCH ANGLES OR RATES.
RRJIT RYJIT	N/D	0.0	THE ROLL MOMENT INTEFERENCE COEFFICIENTS DUE TO THE ROLL AND YAW JETS, RESPECTIVELY.
TVCIT I=1,15	LBS (N)	0.	VACUUM THRUST TABLE FOR ENGINE I WHEN USING ROCKET ENGINES, I.E., IF NPC(9)=1, OR NET THRUST OVER THE ATMOSPHERIC PRESSURE RATIO WHEN USING JET ENGINES, I.E., IF NPC(9)=2.
VWT	FT/SEC (M/S)	0.	WIND SPEED TABLE. USED IN CON-JUNCTION WITH AZWT WHEN NPC(6)=1.
VWUT VWVT VWWT	FT/SEC (M/S)	0.	TABLES OF WIND SPEED COMPONENTS IN THE NORTH, EAST, AND VERTICAL DIRECTIONS. USED IF NPC(6)=2.
WDIT I=1,15	LB/SEC OR LB/SEC/LB (N/S OR N/S/N)	0.	FLOWRATE TABLE FOR ENGINE I WHEN USING ROCKET ENGINES, I.E., IF NPC(9)=1 AND NPC(21)=0. OR SPECIFIC FUEL CONSUMPTION WHEN USING JET ENGINES, I.E., IF NPC(9)=2.
WGTJT J=1,2	LBS (N)	0.	TABLES USED TO COMPUTE WEIGHT WHEN NPC(30)=1.
WGTDJT J=1,2	LB/SEC (N/S)	0.	TABLES USED TO COMPUTE FLOW RATE WHEN NPC(30)=2.
XCGT YCGT ZCGT	FT (M)	0.	TABLES OF CENTER-OF-GRAVITY LOCATION ALONG THE XBR, YBR, AND ZBR AXES, RESPECTIVELY.
XREFT YREFT ZREFT	FT (M)	0.	TABLES OF THE AERODYNAMIC REFERENCE LOCATION ALONG THE XBR, YBR, AND ZBR AXES, RESPECTIVELY.

9.C. INPUTS FOR NAMELIST TAB (COND)

INPUT SYMBOL	UNITS	STORED VALUE	DEFINITION
YRJIT YYJIT	N/D	0.0	THE YAW MOMENT INTERFERENCE COEFFICIENTS DUE TO THE ROLL AND YAW JETS, RESPECTIVELY.
ZLALPT	DEG	0.	ZERO-LIFT ANGLE OF ATTACK TABLE. USED IF NPC(8)=4.

9.D. OUTPUT VARIABLES

THIS SECTION PRESENTS AN ALPHABETICAL LIST OF THE OUTPUT VARIABLES. THIS LIST SHOULD ALSO BE USED TO DETERMINE THE NAMES OF INTERNALLY COMPUTED VARIABLES WHICH ARE TO BE USED AS TARGETS, EVENT CRITERIA VARIABLES, OPTIMIZATION VARIABLES, AND TABLE ARGUMENTS.

OUTPUT SYMBOL	UNITS	DEFINITION
ACCELP ACCELY	DEG	ACCELERATION CONTRIBUTIONS TO THE AUTOPILOT PITCH AND YAW COMMANDS.
ADT	SEC	THE AUTOPILOT COMPUTED CYCLE TIME. IF ADT IS GREATER THAN ZERO, IT OVERRIDES DTA.
AEJ J=1,15	FT**2 (M2)	TABLE LOOK-UP VALUE OF EXIT AREA FOR ENGINE J. CALCULATED IF NPC(9)=1.
ALDREF	N/D	L/D REFERENCE USED IN CONTROLLER.
ALPDOT BETDOT BNKDOT	DEG/SEC	RATE OF CHANGE IN ANGLE OF ATTACK, SIDESLIP, AND BANK.
ALPERR	DEG	THE ANGLE OF ATTACK ERROR (COMMANDED - ACTUAL).
ALPGC	DEG	THE ANGLE OF ATTACK GUIDANCE COMMAND.
ALPHA BETA BNKANG	DEG	ANGLE OF ATTACK, SIDESLIP, AND BANK. SEE THE SECTION ON VEHICLE ATTITUDE ANGLES/RATES FOR THE SPECIFIC DEFINITIONS.
ALPHI BETAI BANKI	DEG	INERTIAL ANGLE OF ATTACK, SIDESLIP, AND BANK. THE SECTION ON VEHICLE ATTITUDE ANGLES/RATES OPTIONS FOR THE SPECIFIC DEFINITIONS.
ALPTOT	DEG	TOTAL ANGLE OF ATTACK.
ALTA	N.MI. (KM)	ALTITUDE OF APOGEE ABOVE THE OBLATE PLANET. CALCULATED IF NPC(1)=1,2,3.
ALTITO	FT (M)	ALTITUDE OF THE VEHICLE ABOVE THE OBLATE PLANET.
ALTP	N.MI. (KM)	ALTITUDE OF PERIGEE ABOVE THE OBLATE PLANET. CALCULATED IF NPC(1)=1,2,3.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
AMXB AMYB AMZB	FT-LBS (N-M)	THE TOTAL AERODYNAMIC MOMENTS ABOUT THE VEHICLE ROLL, PITCH AND YAW BODY AXES.
ANGAP ANGAY	DEG	ANGULAR ACCELERATION CONTRIBUTIONS TO THE AUTOPILOT PITCH AND YAW COMMANDS.
ANGMOM	FT**2/ SEC**2 (M2/S2)	ORBITAL ANGULAR MOMENTUM. CALCULATED IF NPC(1)=1,2,3.
APORAD	FT (M)	GEOCENTRIC RADIUS OF APOGEE. CALCULATED IF NPC(1)=1,2,3.
APVEL	FT/SEC (M/S)	INERTIAL VELOCITY AT APOGEE. CALCULATED IF NPC(1)=1,2,3.
ARGP	DEG	ARGUMENT OF PERIGEE. CALCULATED IF NPC(1) =1,2,3.
ARGV	DEG	ARGUMENT OF THE VEHICLE. CALCULATED IF NPC(1) =1,2,3. ARGV IS THE ANGLE BETWEEN THE ASCENDING NODE AND THE VEHICLE IN THE ORBIT PLANE MEASURED POSITIVE IN THE DIRECTION OF THE VEHICLE MOTION.
ASM	FT/SEC**2 (M/S2)	MEASURABLE (SENSED) ACCELERATION MAGNITUDE.
ASMG	G-S	MEASURABLE (SENSED) ACCELERATION IN G-S.
ASXI ASYI ASZI	FT/SEC**2 (M/S2)	COMPONENTS OF MEASURABLE (SENSED) VEHICLE ACCELERATION IN THE EARTH CENTERED INERTIAL COORDINATE SYSTEM.
ATEM	DEG R (DEG K)	ATMOSPHERIC TEMPERATURE. CALCULATED IF NPC(5) =1,2,3.
ATIME	SEC	THE TIME AT WHICH THE AUTOPILOT WAS LAST ENTERED.
AXB AYB AZB	FT/SEC**2 (M/S2)	COMPONENTS OF MEASURABLE (SENSED) ACCELERATION IN THE BODY COORDINATE SYSTEM.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
AXBM AYBM AZBM	FPSS (MPSS)	THE ACCELERATION COMPONENTS ALONG THE VEHICLE BODY SYSTEM MEASURED BY THE ASCENT AUTOPILOT ACCELEROMETER.
AXI AYI AZI	FT/SEC**2 (M/S2)	COMPONENTS OF TOTAL VEHICLE ACCELERATION IN THE EARTH CENTERED INERTIAL SYSTEM.
AYBC AZBC	DEG/S**2	THE PITCH AND YAW BODY ACCELERATION COMMANDS FOR THE ASCENT AUTOPILOT ACCELERATION ERROR FEEDBACK LOOP.
AZVAD	DEG/SEC	RATE OF CHANGE IN THE AZIMUTH ANGLE OF THE VELOCITY VECTOR RELATIVE TO THE ATMOSPHERE.
AZVELA	DEG	AZIMUTH (HEADING) ANGLE OF THE VELOCITY VECTOR RELATIVE TO THE ATMOSPHERE.
AZVELI	DEG	AZIMUTH (HEADING) ANGLE OF THE INERTIAL VELOCITY VECTOR.
AZVELR	DEG	AZIMUTH (HEADING) ANGLE OF THE VELOCITY VECTOR RELATIVE TO THE ROTATING PLANET.
CA CY CN	N/D	AERODYNAMIC AXIAL, SIDE, AND NORMAL FORCE COEFFICIENTS. CALCULATED IF NPC(8)=1,2.
CAA	N/D	TABLE LOOK-UP OF CAT TIMES CANM.
CADA CADE CADR	N/D	THE AXIAL FORCE COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.
CAFI I=1,3	N/D	THE AXIAL FORCE COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CAO	N/D	TABLE LOOK-UP OF CADT.
CD CL	N/D	AERODYNAMIC DRAG AND LIFT FORCE COEFFICIENTS. CALCULATED IF NPC(8)=2.
CDA	N/D	TABLE LOOK-UP OF CDT TIMES CDNM.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
CDDA CDDE CDDR	N/D	THE DRAG FORCE COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.
CDFI I=1,3	N/D	THE DRAG FORCE COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CDO	N/D	TABLE LOOK-UP OF CDOT.
CHA CHE CHR	N/D	THE AILERON, ELEVATOR AND RUDDER HINGE MOMENT COEFFICIENTS.
CKA CKE CKR	N/D	THE AILERON, ELEVATOR AND RUDDER GAINS FOR THE REENTRY AUTOPILOT.
CKAAP CKAAY	SEC**2	TABLE LOOK-UPS OF TABLES CKAAPT AND CKAAYT.
CKLAP CKLAY	RAD/FT	TABLE LOOK-UPS OF TABLES CKLAPT AND CKLAYT.
CKLVP CKLVY	RAD/FT	TABLE LOOK-UPS OF TABLES CKLVPT AND CKLVYT.
CLA	N/D	TABLE LOOK-UP OF CLT TIMES CINM.
CLDA CLDE CLDR	N/D	THE LIFT FORCE COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.
CLFI I=1,3	N/D	THE LIFT FORCE COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CLL CM CW	N/D	THE AERODYNAMIC ROLLING, PITCHING AND YAWING MOMENT COEFFICIENTS, RESPECTIVELY.
CLLDA CLLDE CLLDR	N/D	THE ROLLING MOMENT COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
CLLFI I=1,3	N/D	THE ROLLING MOMENT COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CLLO	N/D	TABLE LOOK-UP OF CLLOT.
CLLP	N/D	THE ROLLING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL
CLLR	N/D	THE ROLLING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL YAW RATE.
CLO	N/D	TABLE LOOK-UP OF CLOT.
CMA	N/D	TABLE LOOK-UP OF CMAT TIMES CMANM.
CMDA CMDE CMDR	N/D	THE PITCHING MOMENT COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.
CMFI I=1,3	N/D	THE PITCHING MOMENT COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CMO	N/D	TABLE LOOK-UP OF CMOT.
CMQ	N/D	THE PITCHING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL PITCH RATE.
CNA	N/D	TABLE LOOK-UP OF CNAT TIMES CNANM.
CNDA CNDE CNDR	N/D	THE NORMAL FORCE COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.
CNFI I=1,3	N/D	THE NORMAL FORCE COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CNO	N/D	TABLE LOOK-UP OF CNOT.
CPAYR	FT (M)	THE TABLE LOOK-UP OF TABLE CPAYRT.
CPAZR	FT (M)	THE TABLE LOOK-UP OF TABLE CPAZRT.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
CPNXR	FT (M)	THE TABLE LOOK-UP OF TABLE CPNXRT.
CPNYR	FT (M)	THE TABLE LOOK-UP OF TABLE CPNYRT.
CPYXR	FT (M)	THE TABLE LOOK-UP OF TABLE CPYXRT.
CPYZR	FT (M)	THE TABLE LOOK-UP OF TABLE CPYZRT.
CRRNG	N.MI. (KM)	CROSSRANGE DISTANCE. CALCULATED IF NPC(12) =1,2,3.
CS	FT/SEC (M/S)	SPEED OF SOUND. CALCULATED IF NPC(5)=1,2,3.
CWB	N/D	TABLE LOOK-UP OF CWBT TIMES CWBNM.
CWDA CWDE CWDR	N/D	THE YAWING MOMENT COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.
CWFI I=1,3	N/D	THE YAWING MOMENT COEFFICIENT DUE TO FLAP DEFLECTION DELFI.
CWO	N/D	TABLE LOOK-UP OF CWOT.
CWP	N/D	THE YAWING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL ROLL RATE.
CWR	N/D	THE YAWING MOMENT DAMPING DERIVATIVE COEFFICIENT DUE TO THE NON-DIMENSIONAL YAW RATE.
CYB	N/D	TABLE LOOK-UP OF CYBT TIMES CYBNM.
CYDA CYDE CYDR	N/D	THE SIDE FORCE COEFFICIENT DUE TO THE AILERON, ELEVATOR AND RUDDER DEFLECTIONS, RESPECTIVELY.
CYFI I=1,3	N/D	THE SIDE FORCE COEFFICIENT DUE TO FLAP DEFLECTION DELFI.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
CYO	N/D	TABLE LOOK-UP OF CYOT.
DADMX DEDMX DRDMX	DEG/SEC	THE COMPUTED AILERON, ELEVATOR AND RUDDER MAXIMUM RATES BASED ON HINGE MOMENTS.
DAXB DAYB DAZB	FT (M)	THE DELTA POSITION VECTOR FROM THE VEHICLE CENTER OF GRAVITY TO THE ASCENT AUTOPILOT ACCELEROMETER.
DCDV	N/D	DELTA CD DUE TO VISCOUS EFFECTS. CALCULATED IF NPC(8)=4.
DCLV	N/D	DELTA CL DUE TO VISCOUS EFFECTS. CALCULATED IF NPC(8)=4.
DECLIN	DEG	DECLINATION OF THE OUTGOING ASYMPTOTE. CALCULATED IF NPC(1)=1,2,3.
DELA DELE DELR	DEG	THE AILERON, ELEVATOR AND RUDDER DEFLECTION ANGLES WITH RESPECT TO THE VEHICLE BODY AXES.
DELAC DELEC DELRC	DEG	THE COMMANDED AILERON, ELEVATOR AND RUDDER DEFLECTION ANGLES FROM THE REENTRY AUTOPILOT.
DELAD DELED DELRD	DEG/SEC	THE RATES OF CHANGE IN THE AILERON, ELEVATOR AND RUDDER CONTROL SURFACE DEFLECTION ANGLES.
DELADC DELEDC DELRDC	DEG/SEC	THE COMMANDED AILERON, ELEVATOR AND RUDDER DEFLECTION ANGLE RATES FROM THE REENTRY AUTOPILOT.
DELAZ	RAD	AZIMUTH ERROR.
DELFI I=1,3	DEG	THE DEFLECTION ANGLE OF FLAP I. OBTAINED AS THE TABLE LOOK-UP OF DELFIT.
DENS	SLUGS/ FT**3 (KG/M3)	ATMOSPHERIC DENSITY. CALCULATED IF NPC(5) =1,2,3.

9.D OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
DEJ J=0,3	N/D	RATE OF CHANGE IN THE QUATERNIONS.
DEP(I) DEY(I) I=1,15	DEG	THE PITCH AND YAW DEFLECTIONS WITH RESPECT TO THE VEHICLE BODY AXES FOR ENGINE I.
DFVALJ J=1,2,3	DECIMAL	THE INSTANTANEOUS VALUE OF THE CONSTRAINT VIOLATION SQUARED. CALCULATED IF NPC(11)=1.
DGENV	DECIMAL	THE GENERALIZED DEPENDENT VARIABLE. THIS VARIABLE IS CALCULATED AS THE DIFFERENCE BETWEEN TWO INPUT TABLES AS FOLLOWS - DGENV = GENV2T - GENV1T
DISP DISR DISY	DEG	DISPLACEMENT CONTRIBUTIONS TO THE AUTOPILOT PITCH, ROLL AND YAW COMMANDS.
DMASS	SLUGS/SEC (KG/S)	RATE OF CHANGE IN VEHICLE MASS.
DPRNG1 DPRNG2	N. MI. (KM)	THE DOT PRODUCT (NON-DIRECTIONAL) RANGE FROM THE REFERENCE POINT (SPECIFIED BY LATREF AND LONREF) TO THE CURRENT VEHICLE POSITION (GCL AND LONG).
DRAG	LBS (N)	AERODYNAMIC DRAG FORCE. CALCULATED IF NPC(5) =1,2,3 AND NPC(8)=1,2.
DRAGGC	FT/SEC**2	GUIDANCE COMPUTED DRAG ACCELERATION LEVEL.
DRAGRP	FT/SEC**2	DRAG REFERENCE USED IN CONTROLLER.
DSPD DSYD	N/D	THE RATES FOR THE FORWARD LOOP INTEGRATOR IN PITCH AND YAW FOR THE ASCENT AUTOPILOT.
DSPINT DSYINT	N/D	THE INTEGRALS OF THE FORWARD LOOP INTEGRATOR IN PITCH AND YAW FOR THE ASCENT AUTOPILOT.
DUA DVA DWA	FT/SEC**2 (M/S2)	VEHICLE ACCELERATION COMPONENTS RELATIVE TO THE ATMOSPHERE.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
DVCIR	FT/SEC (M/S)	THE DELTA VELOCITY REQUIRED TO CIRCULARIZE THE CURRENT ORBIT. CALCULATED IF NPC(1)=1,2,3.
DWNRNG	N.MI. (KM)	DOWNRANGE DISTANCE. CALCULATED IF NPC(12) =1,2,3,4.
DYNP	LB/FT**2 (N/M2)	DYNAMIC PRESSURE. CALCULATED IF NPC(5)=1,2,3.
FJ J=0,3	N/D	THE VALUES OF THE QUATERNIONS.
ECCAN	DEG	ECCENTRIC ANOMALY. CALCULATED IF NPC(1)=1,2,3.
ECCEN	N/D	ORBITAL ECCENTRICITY. CALCULATED IF NPC(1) =1,2,3.
ENERGY	FT**2/ SEC**2 (M2/S2)	ORBITAL ENERGY. CALCULATED IF NPC(1)=1,2,3.
FAXB FAYB FAZB	LBS (N)	AERODYNAMIC FORCES IN THE BODY COORDINATE SYSTEM. CALCULATED IF NPC(5)=1,2,3 AND NPC(8) =1,2.
FTTXB FTTYB FTTZB	LBS	THE TOTAL FORCES ALONG THE VEHICLE ROLL, PITCH AND YAW BODY AXES, RESPECTIVELY.
FTXB FTYB FTZB	LBS (N)	THRUST FORCES IN THE BODY COORDINATE SYSTEM. CALCULATED IF NPC(9)=1,2.
FVALJ J=1,2,3	DECIMAL	THE VALUE OF THE INEQUALITY CONSTRAINT VIOLATION PARAMETER (INTEGRAL OF DFVALJ).
GAMAD	DEG/SEC	RATE OF CHANGE IN THE FLIGHT PATH ANGLE OF THE VELOCITY VECTOR RELATIVE TO THE ATMOSPHERE.
GAMMAA	DEG	FLIGHT PATH ANGLE OF THE VELOCITY VECTOR RELATIVE TO THE ATMOSPHERE. POSITIVE WHEN VELA IS ABOVE THE LOCAL HORIZONTAL PLANE.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
GAMMAI	DEG	FLIGHT PATH ANGLE OF THE INERTIAL VELOCITY VECTOR. POSITIVE WHEN VELI IS ABOVE THE LOCAL HORIZONTAL PLANE.
GAMMAR	DEG	FLIGHT PATH ANGLE OF THE VELOCITY VECTOR RELATIVE TO THE ROTATING PLANET. POSITIVE WHEN VELR IS ABOVE THE LOCAL HORIZONTAL PLANE.
GCLAT	DEG	GEOCENTRIC LATITUDE OF THE VEHICLE. POSITIVE WHEN IN THE NORTHERN HEMISPHERE.
GCRAD	FT (M)	GEOCENTRIC RADIUS TO THE VEHICLE.
GDLAT	DEG	GEODETIC LATITUDE OF THE VEHICLE. POSITIVE WHEN IN THE NORTHERN HEMISPHERE.
GDT	SEC	THE GUIDANCE COMPUTED CYCLE TIME. IF GDT IS GREATER THAN ZERO, IT OVERRIDES DTG.
GINTJ J=1,10	DECIMAL	THE VALUE OF THE INTEGRAL FOR THE GENERAL INTEGRATION VARIABLE SPECIFIED BY GDERV(J). CALCULATED IF NPC(24)=1.
GTIME	SEC	THE TIME AT WHICH THE GUIDANCE WAS LAST ENTERED.
GVRCJ J=1,10	DECIMAL	THE OUTPUT VARIABLES ASSOCIATED WITH THE GENERAL GUIDANCE OPTIONS.
GXI GYI GZI	FT/SEC**2 (M/S2)	THE GRAVITY ACCELERATION VECTOR COMPONENTS ALONG THE XI, YI, AND ZI AXES.
HDP	FT/SEC	THE PROGRAMMED ALTITUDE RATE FROM TABLE HDPT.
HEATRT	BTU/ FT**2-SEC (W/M2)	AERODYNAMIC HEATING RATE. CALCULATED IF NPC(15)=1,2,3,4,5.
HMA HME HMR	FT-LBS (N-M)	THE CALCULATED AILERON, ELEVATOR AND RUDDER HINGE MOMENTS.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
HMFI I=1,3	FT-LBS (N-M)	THE CALCULATED HINGE MOMENT FOR FLAP I.
HP	FT	THE PROGRAMMED ALTITUDE FROM TABLE HPT.
HTURB	BTU/FT**2 (J/M2)	THE STAGNATION POINT HEATING FOR TURBULENT FLOW. CALCULATED IF NPC(15)=4,5.
HTURBD	BTU/ FT**2/SEC (W/M2)	THE DERIVATIVE OF HTURB. CALCULATED IF NPC(15)=4,5.
HYPVEL	FT/SEC (M/S)	HYPERBOLIC EXCESS VELOCITY. CALCULATED IF NPC(1)=1,2,3.
IB1J IB2J IB3J J=1,3	N/D	THE DIRECTION COSINES OF THE VEHICLE ROLL, PITCH AND YAW AXES WITH RESPECT TO THE EARTH-CENTERED INERTIAL COORDINATES.
INC	DEG	ORBIT INCLINATION ANGLE. CALCULATED IF NPC(1)=1,2,3.
IXX IYY IZZ	SLUG-FT2 (KG-M2)	THE VEHICLE MOMENTS OF INERTIA ABOUT THE VEHICLE ROLL, PITCH AND YAW AXES, RESPECTIVELY.
IXXD IYYD IZZD	SL-FT2/S (KG-M2/S)	THE RATES OF CHANGE IN THE MOMENTS OF INERTIA ABOUT THE VEHICLE ROLL, PITCH AND YAW AXES, RESPECTIVELY.
IXY IXZ IYZ	SLUG-FT2 (KG-M2)	THE VEHICLE PRODUCTS OF INERTIA.
IXYD IXZD IYZD	SL-FT2/S (KG-M2/S)	THE RATES OF CHANGE IN THE VEHICLE PRODUCTS OF INERTIA.
LAN	DEG	LONGITUDE OF THE ASCENDING NODE EAST OF THE PRIME MERIDIAN AT TIME=0. CALCULATED IF NPC(1)=1,2,3.
LIFT	LBS (N)	AERODYNAMIC LIFT FORCE. CALCULATED IF NPC(5)=1,2,3 AND NPC(8)=1,2.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
LOD1	N/D	DESIRED VERTICAL L/D.
LONG	DEG	LONGITUDE OF THE VEHICLE MEASURED EAST OF THE PRIME MERIDIAN.
LONGI	DEG	INERTIAL LONGITUDE OF THE VEHICLE MEASURED EAST OF THE XI AXIS.
MACH	N/D	MACH NUMBER. CALCULATED IF NPC(5)=1,2,3.
MACHDT	1/SEC	RATE OF CHANGE OF MACH WITH RESPECT TO TIME.
MASS	SLUGS (KG)	VEHICLE MASS.
MEAAN	DEG	MEAN ANOMALY. CALCULATED IF NPC(1)=1,2,3.
PACCER YACCER	FT/SEC**2 (M-S2)	THE PITCH AND YAW ACCELERATION ERRORS FOR THE ASCENT AUTOPILOT.
PERIOD	MIN	ORBITAL PERIOD. CALCULATED IF NPC(1)=1,2,3.
PGCLAT	DEG	GEOCENTRIC LATITUDE OF PERIGEE. CALCULATED IF NPC(1)=1,2,3. POSITIVE IN THE NORTHERN HEMISPHERE.
PGERAD	FT (M)	GEOCENTRIC RADIUS OF PERIGEE. CALCULATED IF NPC(1)=1,2,3.
PGLON	DEG	INERTIAL LONGITUDE OF PERIGEE MEASURED POSITIVE EAST OF THE XI AXIS. CALCULATED IF NPC(1) =1,2,3.
PGVEL	FT/SEC (M/S)	INERTIAL VELOCITY AT PERIGEE. CALCULATED IF NPC(1)=1,2,3.
PJETTS	LBS (N)	THE PROPELLANT WEIGHT TO BE JETTISONED. CALCULATED INTERNALLY BY THE PROGRAM BASED ON THE VALUE OF NPC(13).
PLDRL YLDRL	DEG	LOAD RELIEF CONTRIBUTIONS TO THE AUTOPILOT PITCH AND YAW COMMANDS.
PND QND RND	N/D	THE NON-DIMENSIONAL VEHICLE ROLL, PITCH AND YAW RATES ABOUT THE VEHICLE BODY AXES. THESE RATES ARE USED AS TABLE MULTIPLIERS FOR THE AERODYNAMIC DAMPING DERIVATIVE COEFFICIENTS.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
PRES	LB/FT**2 (N/M2)	ATMOSPHERIC PRESSURE. CALCULATED IF NPC(5) =1,2,3.
PWDOT	LB/SEC (N/S)	THE FLOWRATE RESULTING FROM THE SUMMATION OF INDIVIDUAL FLOWRATES OF THE ENGINES INCLUDED IN THE SPECIAL FLOWRATE INTEGRATION OPTION. ACTIVATED BY NPC(27) = 1, AND IWPF(I) = 1.
PWPROP	LB (N)	THE PROPELLANT CONSUMED BY THE SPECIFIED ENGINES FOR THE SPECIAL FLOWRATE INTEGRATION OPTION. ACTIVATED BY NPC(27) = 1, AND IWPF(I) = 1.
QALPHA	LB-DEG/ FT**2 (N-DEG/ M2)	PRODUCT OF DYNAMIC PRESSURE AND ANGLE OF ATTACK. USED AS AN AIRLOADS INDICATOR IN THE PITCH PLANE.
QALTOT	LB-DEG/ FT**2 (N-DEG/ M2)	PRODUCT OF DYNAMIC PRESSURE AND THE TOTAL ANGLE OF ATTACK. USED AS AN AIRLOADS INDICATOR.
RBDC PBDC YBDC	DEG/SEC	THE ROLL, PITCH AND YAW BODY RATE COMMANDS FOR THE ASCENT AUTOPILOT RATE ERROR FEEDBACK LOOP.
RATP RATR RATY	DEG	RATE CONTRIBUTIONS TO THE AUTOPILOT PITCH, ROLL AND YAW COMMANDS.
RDTREF	FT/SEC	ALTITUDE RATE REFERENCE.
REYNO	N/D	REYNOLDS NUMBER BASED ON THE REFERENCE LENGTH LREF. CALCULATED IF NPC(5)=1,2,3.
RCSFXB RCSFYB RCSFZB	LBS (N)	THE FORCES ALONG THE VEHICLE ROLL, PITCH AND YAW BODY AXES DUE TO THE REACTION CONTROL SYSTEM (RCS) JETS.
RCSMXB RCSMYB RCSMZB	FT-LBS (N-M)	THE MOMENTS ABOUT THE VEHICLE ROLL, PITCH AND YAW BODY AXES DUE TO THE REACTION CONTROL SYSTEM (RCS) JETS.
RK2ROL	N/D	ROLL DIRECTION INDICATOR FLAG. = +1, ROLL RIGHT. = -1, ROLL LEFT.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
ROLAC PITAC YAWAC	DEG	ROLL, PITCH, AND YAW AUTOPILOT COMMANDS.
ROLB PITB YAWB	DEG	THE INTEGRATED VEHICLE BODY RATES ABOUT THE VEHICLE ROLL, PITCH AND YAW AXES.
ROLBC PITBC YAWBC	DEG	THE COMMANDED ROLL, PITCH AND YAW BODY ANGLES. CALCULATED IF IGUID(16)=1.
ROLBD PITBD YAWBD	DEG/SEC	VEHICLE BODY RATES WITH RESPECT TO THE LAUNCH PAD INERTIAL (L) COORDINATE SYSTEM.
ROLBDC PITBDC YAWBDC	DEG/SEC	THE COMMANDED ROLL, PITCH AND YAW BODY RATES. CALCULATED IF IGUID(16)=1.
ROLBDD PITBDD YAWBDD	DEG/S**2	VEHICLE ROLL, PITCH AND YAW ANGULAR ACCELERATIONS.
ROLBDR PITBDR YAWBDR	RAD/SEC	THE ANGULAR RATES OF THE VEHICLE ABOUT THE ROLL, PITCH AND YAW BODY AXES.
ROLBER PITBER YAWBER	DEG	THE ATTITUDE ERRORS ABOUT THE VEHICLE ROLL, PITCH AND YAW BODY AXES.
ROLI YAWI PITI	DEG	INERTIAL VEHICLE ATTITUDE ANGLES MEASURED WITH RESPECT TO THE LAUNCH PAD INERTIAL (L) COORDINATE SYSTEM. AT LAUNCH, ALL THREE ANGLES ARE ZERO WHEN THE VEHICLE IS VERTICAL, I.E., WHEN XB IS IN THE RADIAL (OR LOCAL VERTICAL) DIRECTION, ZB IS ALONG THE AZIMUTH SPECIFIED BY AZL, AND YB COMPLETES A RIGHT-HAND SYSTEM.
ROLID YAWID PITID	DEG/SEC	THE INERTIAL EULER RATES WITH RESPECT TO THE LAUNCH CENTERED (L) INERTIAL COORDINATE SYSTEM.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
ROLIER YAWIER PITIER	DEG	THE INERTIAL ROLL, YAW AND PITCH ATTITUDE ERRORS. CALCULATED IF IGUID(16)=2.
ROLIGC YAWIGC PITIGC	DEG	THE COMMANDED ROLL, YAW AND PITCH INERTIAL EULER ANGLES. CALCULATED IF IGUID(16)=2.
ROLN PITN YAWN	DECIMAL	THE NUMBER OF NEGATIVE ROLL, PITCH AND YAW JETS ON IN THE REENTRY AUTOPILOT.
ROLP PITP YAWP	DECIMAL	THE NUMBER OF POSITIVE ROLL, PITCH AND YAW JETS ON IN THE REENTRY AUTOPILOT.
ROLRER	DEG	THE RELATIVE ROLL ANGLE ERROR (COMMANDED - ACTUAL).
ROLRGC	DEG	THE RELATIVE ROLL ANGLE GUIDANCE COMMAND.
RRATER PRATER YRATER	DEG/SEC	THE ROLL, PITCH AND YAW RATE ERRORS FOR THE ASCENT AUTOPILOT.
RS	FT (M)	RADIUS TO THE SURFACE OF THE OBLATE PLANET. USED TO COMPUTE ALTITO AND IN THE RANGE CALCULATIONS IF NPC(12)=1,2,3.
RSO	FT (M)	RADIUS TO THE SURFACE OF THE OBLATE AT THE LATITUDE SPECIFIED BY LATREF. USED IN THE RANGE CALCULATIONS IF NPC(12)=1,2,3.
RTASC	DEG	RIGHT ASCENSION OF THE OUTGOING ASYMPTOTE. CALCULATED IF NPC(1)=1,2,3.
SEMJAX	FT (M)	SEMI-MAJOR AXIS. CALCULATED IF NPC(1)=1,2,3.
SLECT	N/D	PRINTOUT VALUE OF ISLECT.
SPECVJ J=1,9	DECIMAL	THE OUTPUT VARIABLES ASSOCIATED WITH THE SPECIAL CALCULATIONS ROUTINE (CALSPEC).

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
TDURP	SEC	THE TIME SINCE THE OCCURRENCE OF THE LAST PRIMARY EVENT.
THRJ J=1,15	LBS (N)	VALUE OF NET THRUST FOR ENGINE J. CALCULATED IF NPC(9)=1,2.
THRUST	LBS (N)	NET THRUST (VACUUM THRUST CORRECTED FOR ATMOSPHERIC BACKPRESSURE EFFECTS). CALCULATED IF NPC(9)=1,2.
TIME	SEC	CURRENT TRAJECTORY (PROBLEM) TIME.
TIMEA	SEC	THE TIME AT WHICH THE AUTOPILOT IS TO BE REENTERED.
TIMEG	SEC	THE TIME AT WHICH THE GUIDANCE IS TO BE REENTERED.
TIMES	SEC	THE TIME SINCE THE BEGINNING OF THE CURRENT PHASE.
TIMREFJ J=1,4	SEC	REFERENCE TIMES. THESE WILL BE CALCULATED IF THE DERIVATIVES (DTIMR(J),J=1,4) ARE INPUT GREATER THAN ZERO.
TIMSP	MIN	TIME SINCE PERIGEE PASSAGE. CALCULATED IF NPC(1)=1,2,3.
TIMTP	MIN	TIME TO PERIGEE PASSAGE. CALCULATED IF NPC(1)=1,2,3.
TLHEAT	BTU/FT**2 (J/M2)	TOTAL HEAT. CALCULATED IF NPC(15)=1,2,3,4,5
TMXB TMYB TMZB	FT-LBS (N-M)	THE TOTAL THRUST MOMENTS ABOUT THE VEHICLE ROLL, PITCH AND YAW BODY AXES.
TONT	SEC	THE TOTAL ON TIME OF ALL JETS IN THE REENTRY AUTOPILOT.
TRANGE	N.MI.	RELATIVE GREAT CIRCLE RANGE TO TARGET.
TROLN TPITN TYAWN	SEC	THE TOTAL ON TIME OF THE NEGATIVE ROLL, PITCH AND YAW JETS IN THE REENTRY AUTOPILOT.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
TROLP TPITP TYAWP	SEC	THE TOTAL ON TIME OF THE POSITIVE ROLL, PITCH AND YAW JETS IN THE REENTRY AUTOPILOT.
TRUAN	DEG	TRUE ANOMALY. CALCULATED IF NPC(1)=1,2,3.
TRUNMX	DEG	MAXIMUM TRUE ANOMALY FOR HYPERBOLIC ORBITS. CALCULATED IF NPC(1)=1,2,3.
TTMXB TTMYB TTMZB	FT-LBS (N-M)	THE TOTAL MOMENTS ABOUT THE VEHICLE ROLL, PITCH AND YAW BODY AXES.
TVAC	LBS (N)	VACUUM THRUST. CALCULATED IF NPC(9)=1.
U V W	FT/SEC (M/S)	VEHICLE INERTIAL VELOCITY COMPONENTS IN THE GEOGRAPHIC (G) COORDINATE SYSTEM.
UA VA WA	FT/SEC (M/S)	COMPONENTS OF VEHICLE VELOCITY RELATIVE TO THE ATMOSPHERE IN THE GEOGRAPHIC (G) COORDINATE SYSTEM.
UB VB WB	FT/SEC (M/S)	COMPONENTS OF VEHICLE VELOCITY RELATIVE TO THE ATMOSPHERE IN THE BODY SYSTEM.
UR VR WR	FT/SEC (M/S)	COMPONENTS OF VEHICLE VELOCITY RELATIVE TO THE ROTATING PLANET IN THE GEOGRAPHIC (G) COORDINATE SYSTEM.
UW VW WW	FT/SEC (M/S)	COMPONENTS OF THE WIND VELOCITY VECTOR IN THE GEOGRAPHIC (G) COORDINATE SYSTEM IN THE NORTH, EAST, AND DOWN DIRECTIONS, RESPECTIVELY. CALCULATED IF NPC(6)=1,2.
VELA	FT/SEC (M/S)	VEHICLE VELOCITY RELATIVE TO THE ATMOSPHERE.
VELAD	FT/SEC**2 (M/S)	RATE OF CHANGE IN VEHICLE VELOCITY RELATIVE TO THE ATMOSPHERE.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
VELI	FT/SEC (M/S)	INERTIAL VEHICLE VELOCITY.
VELR	FT/SEC (M/S)	VEHICLE VELOCITY RELATIVE TO THE ROTATING PLANET.
VINV	N/D	RAREFATION PARAMETER USED TO COMPUTE VISCOUS EFFECTS.
VMU	LB-SEC/ FT**2 (NS/M2)	ATMOSPHERIC VISCOSITY. USED TO CALCULATE REYNOLDS NUMBER. CALCULATED IF NPC(5)=1,2,3.
VXI VYI VZI	FT/SEC (M/S)	COMPONENTS OF THE INERTIAL VEHICLE VELOCITY VECTOR IN THE EARTH-CENTERED INERTIAL (I) COORDINATE SYSTEM.
WDJ J=1,15	LB/SEC (N/S)	TABLE LOOK-UP VALUE OF FLOWRATE FOR ENGINE J. CALCULATED IF NPC(9)=1,2.
WDOT	LB/SEC (N/S)	TOTAL WEIGHT FLOWRATE.
WDOTJ	LBS/SEC (N/SEC)	THE PROPELLANT FLOWRATE OF THE RCS JETS.
WEICON	LBS (N)	THE AMOUNT OF PROPELLANT CONSUMED SINCE IT WAS ZEROED OUT BY INPUT.
WEIGHT	LBS (N)	CURRENT VEHICLE WEIGHT.
WJETTM	LBS (N)	THE JETTISON WEIGHT CALCULATED INTERNALLY BY THE PROGRAM BASED ON THE VALUE OF NPC(17).
WPROP	LBS (N)	WEIGHT OF THE REMAINING PROPELLANT.
XCG YCG ZCG	FT (M)	VEHICLE CENTER-OF-GRAVITY LOCATION ALONG THE XBR, YBR, AND ZBR AXES, RESPECTIVELY.

9.D. OUTPUT VARIABLES (CONTD)

OUTPUT SYMBOL	UNITS	DEFINITION
XI YI ZI	FT (M)	COMPONENTS OF THE VEHICLE POSITION VECTOR IN THE EARTH-CENTERED INERTIAL (I) COORDINATE SYSTEM.
XMAXJ J=1,10	DECIMAL	THE MAXIMUM VALUE OF MONX(J).
XMINJ J=1,10	DECIMAL	THE MINIMUM VALUE OF MONX(J).
XREF YREF ZREF	FT (M)	THE AERODYNAMIC REFERENCE LOCATION ALONG THE XBR, YBR, AND ZBR AXES, RESPECTIVELY.
YAWR PITR ROLR	DEG	VEHICLE ATTITUDE ANGLES RELATIVE TO THE LOCAL GEOGRAPHIC (G) SYSTEM. YAWR IS THE AZIMUTH OF THE XB AXIS MEASURED CLOCKWISE FROM NORTH, PITR IS THE PITCH ANGLE MEASURED POSITIVE ABOVE THE LOCAL HORIZONTAL PLANE, AND ROLR IS THE BANK ANGLE ABOUT THE XB AXIS MEASURED POSITIVE IN THE RIGHT-HAND SENSE.
YAWRD PITRD ROLRD	DEG/SEC	THE RELATIVE EULER RATES WITH RESPECT TO THE GEOGRAPHIC (G) COORDINATE SYSTEM.
YXMNJ J=1,10	DECIMAL	THE VALUE OF MONY(J) AT XMINJ.
YXMXJ J=1,10	DECIMAL	THE VALUE OF MONY(J) AT XMAXJ.

10. INDICES

THIS SECTION PRESENTS A SUBJECT INDEX AND A VARIABLE INDEX AS AN AIDE TO THE USER IN LOCATING PROGRAM INPUT AND OUTPUT VARIABLES.

THE SUBJECT INDEX CONTAINS A LIST OF COMMONLY USED TRAJECTORY PARAMETERS. THE VARIABLE NAME CORRESPONDING TO A GIVEN PARAMETER IS PRESENTED ACCORDING TO GENERALLY ACCEPTED DEFINITIONS.

THE VARIABLE INDEX CONTAINS A LIST OF ALL INPUT AND OUTPUT VARIABLES AND THE SECTION NUMBER WHERE THE VARIABLE IS DEFINED OR DISCUSSED.

THE USE OF THESE INDICES IS OUTLINED AS FOLLOWS -

1. LOCATE THE DEFINITION OF THE DESIRED PARAMETER IN THE SUBJECT INDEX.

2. LOOK UP THE VARIABLES ASSOCIATED WITH THE DESIRED PARAMETER IN THE VARIABLE INDEX TO DETERMINE THE SECTIONS IN WHICH THE VARIABLES ARE DEFINED.

3. LOOK UP THE VARIABLE DEFINITIONS IN THE INDICATED SECTIONS.

10.A. SUBJECT INDEX

A --

ACCELERATION
ASM ASMG ASMAX ASXI ASYI
ASZI AXB AYB AZB AXI
AYI AZI GXI GYI GZI

AERODYNAMIC COEFFICIENTS
CA CD CL CLL CM
CN CW CY

AERODYNAMIC FORCES
DRAG FAXB FAYB FAZB LIFT

AERODYNAMIC MOMENTS
AMXB AMYB AMZB

AERODYNAMIC REFERENCES
DREFP DREFR DREFY LREF SREF
XREF XREFT YREF YREFT ZREF
ZREFT

AIRLOADS INDICATOR
QALPHA QALTOT

ALGORITHMS
SEE SEARCH ALGORITHMS

ALTITUDE
ALTA ALTITO ALTMAX ALTMIN ALTP
ALTREF

ANGLE OF ATTACK
ALPHA ALPTOT DALPHA

ANGLE OF SIDESLIP
BETA

ANGULAR MOMENTUM
ANGMOM

ANGULAR RATES
SEE ATTITUDE RATES

10.A. SUBJECT INDEX (CONTD)

APOGEE
ALTA APORAD

ARGUMENT OF PERIGEE
ARGP

ATMOSPHERIC DENSITY
DENS

ATMOSPHERIC TEMPERATURE
ATEM

ATTITUDE ANGLES
ALPHA BETA BNKANG ROLI YAWI
PITI YAWR ROLR PITR

ATTITUDE RATES
ALPDOT BETDOT BNKDOT ROLBD PITBD
YAWBD

AZIMUTH ANGLES
AZVAD AZVELA AZVELI AZVELR AZL
AZREF AZWB

B --

BANK ANGLE
BNKANG

BODY ACCELERATIONS
ROLBDD PITBDD YAWBDD

BODY RATES
ROLBD PITBD YAWBD

BURN TIME
TIMES TDURP TIMRFJ

C --

CENTER OF GRAVITY
XCG XCGT YCG YCGT ZCG
ZCGT

10.A. SUBJECT INDEX (CONTD)

CONSTRAINTS
SEE DEPENDENT VARIABLES

CONTROL PARAMETERS
INDVR U

CONVERGENCE TOLERANCES
CONEPS CONSEX DEPTL TOL FITERR

CONVERSION FACTORS
CDENS CFORCE CHEAT CMASS CMPFT
CPRES CTEMP FTPNM GO

CROSSRANGE
CRRNG

D --

DECLINATION OF OUTGOING ASYMPTOTE
DECLIN

DENSITY
DENS

DEPENDENT PHASE
DEPPH

DEPENDENT TOLERANCES
DEPTL

DEPENDENT VARIABLE
DEPVR

DOWNRANGE
DPRNG1 DPRNGE DWNRNG

DRAG FORCE
DRAG

DYNAMIC PRESSURE
DYNP

10.A. SUBJECT INDEX (CONTD)

E --

ECCENTRICITY
ECCEN

ECCENTRIC ANOMALY
ECCAN

ENERGY
ENERGY

ENGINE GIMBAL LOCATION
GXP GYP GZP

EVENT CRITERIA
CRITR

EVENT SEQUENCE NUMBER
DEPPH ESN EVENT FESN INDPH
OPTPH

EXIT AREA
AEIT

F --

FLAP DEFLECTION ANGLE
DELA DELE DELR DELFI

FLIGHT PATH ANGLE
GAMAD GAMMAA GAMMAI GAMMAR

FLOWRATE
DMASS PWDOT WDOT

G --

GIMBAL POINT LOCATION
SEE ENGINE GIMBAL LOCATION

GRADIENTS
G1 G1MAG G2 G2MAG

10.A. SUBJECT INDEX (CONTD)

GRAVITATIONAL PARAMETERS
J2 J3 J4 MU RE
RP

H --

HEADING ANGLES
SEE AZIMUTH ANGLES

HEATING INTEGRAL
HTURB TLHEAT

HEATING RATE
HEATRT HTURBD

HYPERBOLIC EXCESS VELOCITY
HYPVEL

I --

INCIDENCE ANGLES
SEE THRUST VECTOR INCIDENCE ANGLES

INCLINATION ANGLE
INC

INEQUALITY CONSTRAINTS
FVALJ XMAXJ XMINJ YXMXJ YXMNJ

INDEPENDENT VARIABLE
INDVR

INTEGRATION INTERVAL
DT DTA DTG

J --

JETTISON WEIGHT
PJETTS WJETT WJETTM

10.A. SUBJECT INDEX (CONTD)

L --

LATITUDE
GCLAT GDLAT LATL LATREF PGCLAT

LIFT FORCE
LIFT

LONGITUDE
LONG LONGI LONL LONREF

LONGITUDE OF THE ASCENDING NODE
LAN

M --

MACH NUMBER
MACH

MASS
MASS

MEAN ANOMALY
MEAAN

MOMENTS OF INERTIA
IXX IXXT IXY IXYT IXZ
IXZT IYY IYYT IYZ IYZT
IZZ IZZT

N --

NOSE RADIUS
RN

O --

ONE DIMENSIONAL MINIMIZATION
P1TRY P2TRY GAMAST YPRED

OPTIMIZATION OPTIONS
OPT SRCHM

10.A. SUBJECT INDEX (CONTD)

OPTIMIZATION VARIABLE
OPTVAR

OUTPUT VARIABLE REQUESTS
PRNT

P --

PENALTY FUNCTIONS
P1 P2

PERIGEE
ALTP PGCLAT PGERAD PGLON

PERIOD
PERIOD

PHASE
DEPPH DESN ESN EVENT FESN
INDPH OPTPH

PITCH ANGLE
ALPHA PITI PITR

POSITION VECTOR
XI YI ZI

PRESSURE
PRES PSL

PRINT INTERVAL
PINC PRNC

PRINT REQUESTS
PRNT

PROGRAM CONTROL FLAGS
NPC

PROJECTED GRADIENT
CTHA PG1 PG1MAG PG2 PG2MAG

PROPELLANT WEIGHT
PWPROP WEICON WPROP WPROPI

10.A. SUBJECT INDEX (CONTD)

R --

RADIUS
APORAD GCRAD PGERAD RE RP
RS RSO

RANGE CALCULATIONS
CRRNG DPRNG1 DPRNG2 DWNRNG

REYNOLDS NUMBER
REYNO

REFERENCE AREA
SREF

REFERENCE LENGTH
DREFP DREFR DREFY LREF

RIGHT ASCENSION OF OUTGOING ASYMPTOTE
RTASC

ROLL ANGLE
BNKANG ROLI ROLR

ROTATION RATE
OMEGA

S --

SEARCH ALGORITHMS
SRCHM

SEMI-MAJOR AXIS
SEMJAX

SENSITIVITY MATRIX
SMAT

SIDESLIP ANGLE
SEE ANGLE OF SIDESLIP

SPECIFIC FUEL CONSUMPTION
WDIT WDOT

10.A. SUBJECT INDEX (CONTD)

SPECIFIC IMPULSE
ISPV TTLISP

SPEED OF SOUND
CS

STEERING OPTIONS
IGUID

STEPSIZE CONTROL
PCTCC GAMAST GAMAX

STOPPING PARAMETERS
CRITR

T --

TARGET ERRORS
E WE

TARGET VARIABLES
DEPVR

TEMPERATURE
ATEM TSL

THROTTLING PARAMETER
ETA

THRUST
THRUST TVAC TVCIT

THRUST APPLICATION POINT
GXP GYP GZP

THRUST FORCES
FTXB FTYB FTZB

THRUST MOMENTS
TMXB TMYB TMZB

THRUST VECTOR DEFLECTION ANGLES
DEPJ DEYJ

10.A. SUBJECT INDEX (CONTD)

TIME REFERENCES
TDURP TIME TIMES TIMRFJ TIMSP
TIMTP

TRUE ANOMALY
TRUAN

V --

VELOCITY
APVEL DVCIR DVELA PGVEL VELA
VELI VELR VIDEAL VXI VYI
VZI

VISCOSITY
VMU

W --

WEIGHT
PJETTS PWPROP WEICON WEIGHT WGTSG
WJETT WJETTM WPLD WPROP WPROPI

WEIGHTING CONSTANTS
WU

WIND AZIMUTH
AZWB AZWT

WIND VELOCITY
UW VW WW VWT

Y --

YAW ANGLE
BETA YAWI YAWR

10.B. INDEX OF VARIABLES

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
AAFFP(I)	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
AAFFY(I)	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
ACCELP	OUTPUT	AUTP1	6.F.1	,9.D	
ACCELY	OUTPUT	AUTP1	6.F.1	,9.D	
ADT	OUTPUT	AUTOPM	6.F	,9.D	
AEIT	INPUT/TAB	PROP	6.A.18	,9.C	
AEJ	OUTPUT	PROP	6.A.18	,9.D	
AEXP	INPUT/GENDAT	AERO4	6.A.1	,9.B	
AFFP	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
AFFY	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
ALDREF	OUTPUT	GGUID2	6.B.3	,9.D	
ALPERI	OUTPUT	BLKDAT	6.F.2	,9.D	
ALPERR	OUTPUT	AUTP2	6.F.2	,9.D	
ALPGC	OUTPUT	GGUID2	6.B.3	,9.D	
ALPHA	INPUT/GENDAT	IBMTXI	6.A.1	,6.B	,9.B
		MOTION	,9.D		
ALPHI	OUTPUT	AUXFM	6.E.3	,9.D	
ALTA	INPUT/GENDAT	ORBTR	6.A.5	,6.A.12	,9.B
		CONIC	,9.D		
ALTITO	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	,9.D
		MOTION			
ALTMAX	INPUT/GENDAT	PHZXM	6.A.6	,9.B	
ALTMIN	INPUT/GENDAT	PHZXM	6.A.6	,9.B	
ALTP	INPUT/GENDAT	ORBTR	6.A.5	,6.A.12	,9.B
		CONIC	,9.D		
AMXB	OUTPUT	AERO	6.A.1	,9.D	
AMYB	OUTPUT	AERO	6.A.1	,9.D	
AMZB	OUTPUT	AERO	6.A.1	,9.D	
ANGAP	OUTPUT	AUTP1	6.F.1	,9.D	
ANGAY	OUTPUT	AUTP1	6.F.1	,9.D	
ANGMOM	OUTPUT	CONIC	6.A.5	,9.D	
APORAD	OUTPUT	CONIC	6.A.5	,9.D	
APPLIM	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
APRLIM	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
APVEL	OUTPUT	CONIC	6.A.5	,9.D	
APYLIM	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
AREFL	INPUT/GENDAT	HINGEM	6.F.2	,9.B	
ARGP	INPUT/GENDAT	ORBTR	6.A.5	,6.A.12	,9.B
		CONIC	,9.D		
ARGV	OUTPUT	CONIC	6.A.5	,9.D	
ARP(I)	INPUT/GENDAT	HSWGT	6.A.2	,9.B	
ASFFP	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
ASFFY	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
ASM	OUTPUT	TMOTM	9.D		
ASMG	OUTPUT	AUXFM	9.D		

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
ASXI	OUTPUT	TMOTM	9.D		
ASYI	OUTPUT	TMOTM	9.D		
ASZI	OUTPUT	TMOTM	9.D		
ATEM	OUTPUT	ATMOS1	6.A.4	,9.D	
		ATMOS2			
		ATMOS3			
ATEMT	INPUT/TAB	ATMOS1	6.A.4	,9.C	
ATIME	INPUT/GENDAT	AUTOPM	6.F	,9.B	
ATMOSK(I)	INPUT/GENDAT	ATMOS1	6.A.4	,9.B	
AXB	OUTPUT	TMOTM	9.D		
AXBM	OUTPUT	AUTP1	6.F.1	,9.D	
AXI	OUTPUT	TMOTM	9.D		
AXRB	INPUT/GENDAT	AUTP1	6.F.1	.9.B	
AYB	OUTPUT	TMOTM	9.D		
AYBC	OUTPUT	AUTP1	6.F.1	,9.D	
AYBCT	INPUT/TAB	AUTP1	6.F.1	,9.C	
AYBM	OUTPUT	AUTP1	6.F.1	,9.D	
AYI	OUTPUT	TMOTM	9.D		
AYRB	INPUT/GENDAT	AUTP1	6.F.1	.9.B	
AZB	OUTPUT	TMOTM	9.D		
AZBC	OUTPUT	AUTP1	6.F.1	,9.D	
AZBCT	INPUT/TAB	AUTP1	6.F.1	,9.C	
AZBM	OUTPUT	AUTP1	6.F.1	,9.D	
AZI	OUTPUT	TMOTM	9.D		
AZL	INPUT/GENDAT	MOTIAL	6.B	,9.B	
AZRB	INPUT/GENDAT	AUTP1	6.F.1	.9.B	
AZREF	INPUT/GENDAT	AUXFMI	6.A.19	,9.B	
		XRNGE1			
AZVAD	OUTPUT	DGAMLA	9.D		
AZVELA	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	,9.D
		GAMLAM			
AZVELI	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	,9.D
		AUXFM			
AZVELR	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	,9.D
		AUXFM			
AZWB	INPUT/GENDAT	WINDS	6.A.4	,9.B	
AZWT	INPUT/TAB	WINDS	6.A.4	,9.C	
BETA	INPUT/GENDAT	IBMTXI	6.B	,9.B	,8.D
		MOTION			
BETAI	OUTPUT	AUXFM	6.E.3	,9.D	
BNKANG	INPUT/GENDAT	IBMTXI	6.B	,9.B	,9.D
		AUXFM			
BANKI	OUTPUT	AUXFM	6.E.3	,9.D	
CA	OUTPUT	AERO	6.A.1	,9.D	
CAA	OUTPUT	AERO	6.A.1	,9.D	
CADA	OUTPUT	AERO	6.A.1	,9.D	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION	
CADANM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CADAT	INPUT/TAB	AERO	6.A.1	,9.C
CADE	OUTPUT	AERO	6.A.1	,9.D
CADENM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CADET	INPUT/TAB	AERO	6.A.1	,9.C
CADR	OUTPUT	AERO	6.A.1	,9.D
CADRNM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CADRT	INPUT/TAB	AERO	6.A.1	,9.C
CAFJ	OUTPUT	AERO	6.A.1	,9.D
CAFJN	INPUT/TBLMLT	AERO	6.A.1	,6.C
CAFJT	INPUT/TAB	AERO	6.A.1	,9.C
CANM	INPUT/TBLMLT	AERO	6.C	
CAO	OUTPUT	AERO	6.A.1	,9.D
CAIOT	INPUT/TAB	AERO4	6.A.1	,9.C
CAOT	INPUT/TAB	AERO	6.A.1	,9.C
CAT	INPUT/TAB	AERO	6.A.1	,9.C
CD	OUTPUT	AERO	6.A.1	,9.D
CDA	OUTPUT	AERO	6.A.1	,9.D
CDDA	OUTPUT	AERO	6.A.1	,9.D
CDDANM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CDDAT	INPUT/TAB	AERO	6.A.1	,9.C
CDDE	OUTPUT	AERO	6.A.1	,9.D
CDDENM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CDDET	INPUT/TAB	AERO	6.A.1	,9.C
CDDR	OUTPUT	AERO	6.A.1	,9.D
CDDRNM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CDDRT	INPUT/TAB	AERO	6.A.1	,9.C
CDENS	INPUT/SEARCH	CONVO	4.A	,9.A
CDFJ	OUTPUT	AERO	6.A.1	,9.D
CDFJN	INPUT/TBLMLT	AERO	6.A.1	,6.C
CDFJT	INPUT/TAB	AERO	6.A.1	,9.C
CDNM	INPUT/TBLMLT	AERO	6.C	
CDO	OUTPUT	AERO	6.A.1	,9.D
CDOT	INPUT/TAB	AERO	6.A.1	,9.C
CDT	INPUT/TAB	AERO	6.A.1	,9.C
CFORCE	INPUT/SEARCH	CONVO	4.A	,9.A
CHA	OUTPUT	HINGEM	6.F.2	,9.D
CHAT	INPUT/TAB	HINGEM	6.F.2	,9.C
CHE	OUTPUT	HINGEM	6.F.2	,9.D
CHEAT	INPUT/SEARCH	CONVO	4.A	,9.A
CHET	INPUT/TAB	HINGEM	6.F.2	,9.C
CHFJ	OUTPUT	HINGEM	6.F.2	,9.D
CHFJT	INPUT/TAB	HINGEM	6.F.2	,9.C
CHR	OUTPUT	HINGEM	6.F.2	,9.D
CHRT	INPUT/TAB	HINGEM	6.F.2	,9.C
CINF	INPUT/GENDAT	AERO4	6.A.1	,9.B

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION	
CKA	OUTPUT	AUTP2	6.F.2	,9.D
CKAAP	OUTPUT	AUTP1	6.F.1	,9.D
CKAAPT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKAAY	OUTPUT	AUTP1	6.F.1	,9.D
CKAAYT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKAPT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKASPT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKASYT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKAT	INPUT/TAB	AUTP2	6.F.2	,9.C
CKAYT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKDPT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKDRT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKDYT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKE	OUTPUT	AUTP2	6.F.2	,9.D
CKET	INPUT/TAB	AUTP2	6.F.2	,9.C
CKLAP	OUTPUT	AUTP1	6.F.1	,9.D
CKLAPT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKLAY	OUTPUT	AUTP1	6.F.1	,9.D
CKLAYT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKLVP	OUTPUT	AUTP1	6.F.1	,9.D
CKLVPT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKLVY	OUTPUT	AUTP1	6.F.1	,9.D
CKLVYT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKR	OUTPUT	AUTP2	6.F.2	,9.D
CKRPT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKRRT	INPUT/TAB	AUTP1	6.F.1	,9.C
CKPT	INPUT/TAB	AUTP2	6.F.2	,9.C
CKRYT	INPUT/TAB	AUTP1	6.F.1	,9.C
CL	OUTPUT	AERO	6.A.1	,9.D
CLA	OUTPUT	AERO	6.A.1	,9.D
CLCDMX	INPUT/GENDAT	AUXFM	6.A.19	,9.B
CLDA	OUTPUT	AERO	6.A.1	,9.D
CLDANM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CLDAT	INPUT/TAB	AERO	6.A.1	,9.C
CLDE	OUTPUT	AERO	6.A.1	,9.D
CLDENM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CLDET	INPUT/TAB	AERO	6.A.1	,9.C
CLDR	OUTPUT	AERO	6.A.1	,9.D
CLDRNM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CLDRT	INPUT/TAB	AERO	6.A.1	,9.C
CLFJ	OUTPUT	AERO	6.A.1	,9.D
CLFJN	INPUT/TBLMLT	AERO	6.A.1	,6.C
CLFJT	INPUT/TAB	AERO	6.A.1	,9.C
CLL	OUTPUT	AERO	6.A.1	,9.D
CLLB	OUTPUT	AERO	6.A.1	,9.D
CLLBNM	INPUT/TBLMLT	AERO	6.A.1	,6.C

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION	
CLLBT	INPUT/TAB	AERO	6.A.1	,9.C
CLLDA	OUTPUT	AERO	6.A.1	,9.D
CLLDAN	INPUT/TBLMLT	AERO	6.A.1	,6.C
CLLDAT	INPUT/TAB	AERO	6.A.1	,9.C
CLLDE	OUTPUT	AERO	6.A.1	,9.D
CLLDEN	INPUT/TBLMLT	AERO	6.A.1	,6.C
CLLDET	INPUT/TAB	AERO	6.A.1	,9.C
CLLDR	OUTPUT	AERO	6.A.1	,9.D
CLLDRN	INPUT/TBLMLT	AERO	6.A.1	,6.C
CLLDRT	INPUT/TAB	AERO	6.A.1	,9.C
CLLFJ	OUTPUT	AERO	6.A.1	,9.D
CLLFJN	INPUT/TBLMLT	AERO	6.A.1	,6.C
CLLFJT	INPUT/TAB	AERO	6.A.1	,9.C
CLLO	OUTPUT	AERO	6.A.1	,9.D
CLLOT	INPUT/TAB	AERO	6.A.1	,9.C
CLLP	OUTPUT	AERO	6.A.1	,9.D
CLLPNM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CLLPT	INPUT/TAB	AERO	6.A.1	,9.C
CLLR	OUTPUT	AERO	6.A.1	,9.D
CLLRNM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CLLRT	INPUT/TAB	AERO	6.A.1	,9.C
CLNM	INPUT/TBLMLT	AERO	6.C	
CLOT	INPUT/TAB	AERO	6.A.1	
CLT	INPUT/TAB	AERO	6.A 1	,9.C
CM	OUTPUT	AERO	6.A.1	,9.D
CMA	OUTPUT	AERO	6.A.1	,9.D
CMANM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CMAT	INPUT/TAB	AERO	6.A.1	,9.C
CMANM	INPUT/TBLMLT	AERO	6.C	
CMASS	INPUT/SEARCH	CONVO	4.A	,9.A
CMAT	INPUT/TAB	AERO	6.A.1	,9.C
CMDA	OUTPUT	AERO	6.A.1	,9.D
CMDANM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CMDAT	INPUT/TAB	AERO	6.A.1	,9.C
CMDE	OUTPUT	AERO	6.A.1	,9.D
CMDENM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CMDET	INPUT/TAB	AERO	6.A.1	,9.C
CMDR	OUTPUT	AERO	6.A.1	,9.D
CMDRNM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CMDRT	INPUT/TAB	AERO	6.A.1	,9.C
CMFJ	OUTPUT	AERO	6.A.1	,9.D
CMFJN	INPUT/TBLMLT	AERO	6.A.1	,6.C
CMFJT	INPUT/TAB	AERO	6.A.1	,9.C
CMO	OUTPUT	AERO	6.A.1	,9.D
CMOT	INPUT/TAB	AERO	6.A.1	,9.C
CMPFT	INPUT/SEARCH	CONVO	4.A	,9.A

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
CMQ	OUTPUT	AERO	6.A.1	,9.D	
CMQNM	INPUT/TBLMLT	AERO	6.A.1	,6.C	
CMQT	INPUT/TAB	AERO	6.A.1	,9.C	
CN	OUTPUT	AERO	6.A.1	,9.D	
CNA	OUTPUT	AERO	6.A.1	,9.D	
CNANM	INPUT/TBLMLT	AERO	6.C		
CNAT	INPUT/TAB	AERO	6.A.1	,9.C	
CNDA	OUTPUT	AERO	6.A.1	,9.D	
CNDANM	INPUT/TBLMLT	AERO	6.A.1	,6.C	
CNDAT	INPUT/TAB	AERO	6.A.1	,9.C	
CNDE	OUTPUT	AERO	6.A.1	,9.D	
CNDENM	INPUT/TBLMLT	AERO	6.A.1	,6.C	
CNDET	INPUT/TAB	AERO	6.A.1	,9.C	
CNDR	OUTPUT	AERO	6.A.1	,9.D	
CNDRNM	INPUT/TBLMLT	AERO	6.A.1	,6.C	
CNDRT	INPUT/TAB	AERO	6.A.1	,9.C	
CNEJ	OUTPUT	AERO	6.A.1	,9.D	
CNEJN	INPUT/TBLMLT	AERO	6.A.1	,6.C	
CNEJT	INPUT/TAB	AERO	6.A.1	,9.C	
CNO	OUTPUT	AERO	6.A.1	,9.D	
CNOT	INPUT/TAB	AERO	6.A.1	,9.C	
CONEPS(I)	INPUT/SEARCH	MINMYS TEST	5.D	,9.A	
CONSEX(I)	INPUT/SEARCH	TRYIT1	5.D	,9.A	
CPAYR	OUTPUT	AERO	6.A.1	,9.D	
CPAYRT	INPUT/TAB	AERO	6.A.1	,9.C	
CPAZR	OUTPUT	AERO	6.A.1	,9.D	
CPAZRT	INPUT/TAB	AERO	6.A.1	,9.C	
CPNXR	OUTPUT	AERO	6.A.1	,9.D	
CPNXRT	INPUT/TAB	AERO	6.A.1	,9.C	
CPNYR	OUTPUT	AERO	6.A.1	,9.D	
CPNYRT	INPUT/TAB	AERO	6.A.1	,9.C	
CPRES	INPUT/SEARCH	CONVO	4.A	,9.A	
CPYXR	OUTPUT	AERO	6.A.1	,9.D	
CPYXRT	INPUT/TAB	AERO	6.A.1	,9.C	
CPYZR	OUTPUT	AERO	6.A.1	,9.D	
CPYZRT	INPUT/TAB	AERO	6.A.1	,9.C	
CP/ITR	T/O OUTPUT	ITERO	5.E		
CRITP	INPUT/GENDAT	READAT	3.D ,9.B	,5.A	,6.A.8
CRRNG	OUTPUT	AUXFM XRNGE1	6.A.19	,9.D	
CS	OUTPUT	ATMOS1 ATMOS2 ATMOS3	6.A.4	,9.D	
CST	INPUT/TAB	ATMOS1	6.A.4	,9.C	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION	
CTEMP	INPUT/SEARCH	CONVO	4.A	,9.A
CTHA	INPUT/SEARCH	TEST	5.D	,5.E
CW	OUTPUT	AERO	6.A.1	,9.D
CWB	OUTPUT	AERO	6.A.1	,9.D
CWBNM	INPUT/TBLMLT	AERO	6.C	
CWBT	INPUT/TAB	AERO	6.A.1	,9.C
CWDA	OUTPUT	AERO	6.A.1	,9.D
CWDANM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CWDAT	INPUT/TAB	AERO	6.A.1	,9.C
CWDE	OUTPUT	AERO	6.A.1	,9.D
CWDENM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CWDET	INPUT/TAB	AERO	6.A.1	,9.C
CWDR	OUTPUT	AERO	6.A.1	,9.D
CWDRNM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CWDRT	INPUT/TAB	AERO	6.A.1	,9.C
CWFJ	OUTPUT	AERO	6.A.1	,9.D
CWFJN	INPUT/TBLMLT	AERO	6.A.1	,6.C
CWFJT	INPUT/TAB	AERO	6.A.1	,9.C
CWO	OUTPUT	AERO	6.A.1	,9.D
CWOT	INPUT/TAB	AERO	6.A.1	,9.C
CWP	OUTPUT	AERO	6.A.1	,9.D
CWPNM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CWPT	INPUT/TAB	AERO	6.A.1	,9.C
CWR	OUTPUT	AERO	6.A.1	,9.D
CWRNM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CWRT	INPUT/TAB	AERO	6.A.1	,9.C
CY	OUTPUT	AERO	6.A.1	,9.D
CYB	OUTPUT	AERO	6.A.1	,9.D
CYBNM	INPUT/TBLMLT	AERO	6.C	
CYBT	INPUT/TAB	AERO	6.A.1	,9.C
CYDA	OUTPUT	AERO	6.A.1	,9.D
CYDANM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CYDAT	INPUT/TAB	AERO	6.A.1	,9.C
CYDE	OUTPUT	AERO	6.A.1	,9.D
CYDENM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CYDET	INPUT/TAB	AERO	6.A.1	,9.C
CYDR	OUTPUT	AERO	6.A.1	,9.D
CYDRNM	INPUT/TBLMLT	AERO	6.A.1	,6.C
CYDRT	INPUT/TAB	AERO	6.A.1	,9.C
CYFJ	OUTPUT	AERO	6.A.1	,9.D
CYFJN	INPUT/TBLMLT	AERO	6.A.1	,6.C
CYFJT	INPUT/TAB	AERO	6.A.1	,9.C
CYO	OUTPUT	AERO	6.A.1	,9.D
CYOT	INPUT/TAB	AERO	6.A.1	,9.C
DADMAX	INPUT/GENDAT	AUTP2	6.F.2	,9.B
DADMX	OUTPUT	AUTP2	6.F.2	,9.D

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION	
DAMAX	INPUT/GENDAT	AUTP2	6.F.2	,9.B
DAMIN	INPUT/GENDAT	AUTP2	6.F.2	,9.B
DAXB	OUTPUT	AUTP1	6.F.1	,9.D
DAYB	OUTPUT	AUTP1	6.F.1	,9.D
DAZB	OUTPUT	AUTP1	6.F.1	,9.D
DCDV	OUTPUT	AERO4	6.A.1	,9.D
DCLV	OUTPUT	AERO4	6.A.1	,9.D
DECLIN	OUTPUT	CONIC	6.A.5	,9.D
DEDMAX	INPUT/GENDAT	AUTP2	6.F.2	,9.B
DEDMX	OUTPUT	AUTP2	6.F.2	,9.D
DEJ	OUTPUT	DQUAT	6.E.3	,9.D
DELA	OUTPUT	BLKDAT	6.F.2	,9.D
DELAC	OUTPUT	AUTP2	6.F.2	,9.D
DELAD	OUTPUT	CONTM	6.E.1	,9.D
DELADC	OUTPUT	AUTP2	6.F.2	,9.D
DELAZ	OUTPUT	GGUID2	6.B.3	,9.D
DELF	OUTPUT	BLKDAT	6.F.2	,9.D
DELFC	OUTPUT	AUTP2	6.F.2	,9.D
DELFCI	INPUT/GENDAT	AUTP2	6.F.2	,9.B
DELFD	OUTPUT	CONTM	6.E.1	,9.D
DELFDC	OUTPUT	AUTP2	6.F.2	,9.D
DELFJ	OUTPUT	HINGEM	6.F.2	,9.D
DELFJT	INPUT/TAB	HINGEM	6.F.2	,9.C
DELR	OUTPUT	BLKDAT	6.F.2	,9.D
DELRC	OUTPUT	AUTP2	6.F.2	,9.D
DELRD	OUTPUT	CONTM	6.E.1	,9.D
DELRDC	OUTPUT	AUTP2	6.F.2	,9.D
DEMAX	INPUT/GENDAT	AUTP2	6.F.2	,9.B
DEMIN	INPUT/GENDAT	AUTP2	6.F.2	,9.B
DENKT	INPUT/TAB	ATMOS	6.A.4	,9.C
DENS	OUTPUT	ATMOS1	6.A.4	,9.D
		ATMOS2		
		ATMOS3		
DENST	INPUT/TAB	ATMOS1	6.A.4	,9.C
DEPJ	OUTPUT	CONTM	6.E.1	,9.D
DEPMAX(I)	INPUT/GENDAT	CONTM	6.E.1	,9.B
DEPO(I)	INPUT/GENDAT	CONTM	6.E.1	,9.B
DEPPH(I)	INPUT/SEARCH	CALE	5.B	,9.A
DEPTL(I)	INPUT/SEARCH	CALE	5.B	,9.A
DEPVAL(I)	INPUT/SEARCH	CALE	5.B	,9.A
DEPVR(I)	INPUT/SEARCH	CALE	5.B	,9.A
DESNE	INPUT/GENDAT	MOTIAL	6.A.18	,9.B
DETA	INPUT/GENDAT	MOTIAL	6.A.18	,9.B
DEYJ	OUTPUT	CONTM	6.E.1	,9.D
DEYMAX(I)	INPUT/GENDAT	CONTM	6.E.1	,9.B
DEYO(I)	INPUT/GENDAT	CONTM	6.E.1	,9.B

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION	
DFDC(I)	T/O OUTPUT	ITERO REVISE	5.E	
DFFP	INPUT/GENDAT	AUTP1	6.F.1	,9.B
DFFR	INPUT/GENDAT	AUTP1	6.F.1	,9.B
DFFY	INPUT/GENDAT	AUTP1	6.F.1	,9.B
DFVALJ	OUTPUT	MOTION	6.A.7	,9.D
DGENV	OUTPUT	AUXFM	6.A.8	,9.D
DISK	INPUT/TAB	RTAB	6.D	,9.B
DISP	OUTPUT	AUTP1	6.F.1	,9.D
DISR	OUTPUT	AUTP1	6.F.1	,9.D
DISY	OUTPUT	AUTP1	6.F.1	,9.D
DMASS	OUTPUT	PROP	6.A.24	,9.D
DPHP	INPUT/GENDAT	AUTP1	6.F.1	,9.B
DPHY	INPUT/GENDAT	AUTP1	6.F.1	,9.B
DPRNG1	OUTPUT	DPRNG	6.A.19	,9.D
DPRNG2	OUTPUT	DPRNG	6.A.19	,9.D
DPSY	INPUT/GENDAT	AUTP1	6.F.1	,9.B
DP1DS	T/O OUTPUT	TRYIT1	5.E	
DP2DS	T/O OUTPUT	TRYIT1	5.E	
DRAG	OUTPUT	AUXFM	6.A.1	,9.D
DRAGGC	OUTPUT	GGUID2	6.B.3	,9.D
DRAGRP	OUTPUT	GGUID2	6.B.3	,9.D
DRDMAX	INPUT/GENDAT	AUTP2	6.F.2	,9.B
DRDMX	OUTPUT	AUTP2	6.F.2	,9.D
DREFP	INPUT/GENDAT	AERO	6.A.1	,9.B
DREFR	INPUT/GENDAT	AERO	6.A.1	,9.B
DREFY	INPUT/GENDAT	AERO	6.A.1	,9.B
DRMAX	INPUT/GENDAT	AUTP2	6.F.2	,9.B
DRMIN	INPUT/GENDAT	AUTP2	6.F.2	,9.B
DSPD	OUTPUT	AUTP1	6.F.1	,9.D
DSPINT	OUTPUT	BLKDAT	6.F.1	,9.D
DSYD	OUTPUT	AUTP1	6.F.1	,9.D
DSYINT	OUTPUT	BLKDAT	6.F.1	,9.D
DT	INPUT/GENDAT	CYCXMI	6.A.15	,9.B
DTA	INPUT/GENDAT	AUTOPM	6.F	,9.B
DTG	INPUT/GENDAT	GGUID	6.B	,9.B
DTHP	INPUT/GENDAT	AUTP1	6.F.1	,9.B
DTIMR(J)	INPUT/GENDAT	MOTIAL	6.A.22	,9.B
DTIMRJ	HOLLERITH	BLKDAT	6.A.22	,9.D
DU(I)	T/O OUTPUT	GRAD UNITDU	5.D	,5.E
DUA	OUTPUT	DGAMLA	9.D	
DUMAG	T/O OUTPUT	UNITDU	5.D	,6.E
DVA	OUTPUT	DGAMLA	9.D	
DVCIR	OUTPUT	CONIC	6.A.5	,9.D
DVPCT	INPUT/GENDAT	AUXFM	6.A.26	,9.B

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
DWA	OUTPUT	DGAMLA	9.D		
DWNRNG	OUTPUT	AUXFM	6.A.19	,9.D	
		XRNGE1			
DYNP	OUTPUT	MOTION	9.D		
E(I)	T/D OUTPUT	CALE	5.D	,5.E	
		GRAD			
ECCAN	OUTPUT	CONIC	6.A.5	,9.D	
ECCEN	OUTPUT	CONIC	6.A.5	,9.D	
EJ	OUTPUT	BLKDAT	6.B.1	,9.D	
ENDJOB	INPUT/ALL	READAT	3.B	,3.D	,6.A.6
			,9.A	,9.B	
ENDPHS	INPUT/ALL	READAT	3.B	,3.D	,6.A.6
			,9.A	,9.B	
ENDPRB	INPUT/ALL	READAT	3.B	,3.D	,6.A.6
			,9.A	,9.B	
ENERGY	OUTPUT	CONIC	6.A.5	,9.D	
ENGF(I)	INPUT/GENDAT	CONTM	6.A.18	,6.E.1	,9.B
ENGROL(I)	INPUT/GENDAT	PROP	6.A.18	,9.B	
EREFL	INPUT/GENDAT	HINGEM	6.F.2	,9.B	
ETA	INPUT/GENDAT	PROP	6.A.18	,9.B	
ETAARG	INPUT/GENDAT	PROP	6.A.18	,9.B	
ETAPC(I)	INPUT/GENDAT	PROP	6.A.18	,9.B	
ETAPCI	HOLLERITH	PROP	3.C		
ETAT	INPUT/TAB	PROP	6.A.18	,9.C	
EVENT(I)	INPUT/GENDAT	READAT	3.D	,6.A.6	,9.B
FAXB	OUTPUT	AERO	6.A.1	,9.D	
FAYB	OUTPUT	AERO	6.A.1	,9.D	
FAZB	OUTPUT	AERO	6.A.1	,9.D	
FESN	INPUT/GENDAT	TRAJ	6.A.6	,9.B	
		TRAJX			
FID(J)	INPUT/GENDAT	INFXMI	6.A.17	,9.B	
FITERR(I)	INPUT/SEARCH	TRYIT1	5.D	,9.A	
		TRYIT2			
FLJT	INPUT/TAB	MOTION	6.A.7	,9.C	
FMASST	INPUT/TAB	WGTINI	6.A.24	,9.C	
FREFL	INPUT/GENDAT	AUTP2	6.F.2	,9.B	
FTPNM	INPUT/SEARCH	CONVO	4.A	,9.A	
FTTXB	OUTPUT	AIRFM	6.E.1	,9.D	
FTTYB	OUTPUT	AIRFM	6.E.1	,9.D	
FTTZB	OUTPUT	AIRFM	6.E.1	,9.D	
FTXB	OUTPUT	PROP	6.A.18	,9.D	
FTYB	OUTPUT	PROP	6.A.18	,9.D	
FTZB	OUTPUT	PROP	6.A.18	,9.D	
FVALJ	OUTPUT	BLKDAT	6.A.12	,9.D	
FXBPJT	INPUT/TAB	AUTP2	6.F.2	,9.C	
FYBPJT	INPUT/TAB	AUTP2	6.F.2	,9.C	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
FZBPJT	INPUT/TAB	AUTP2	6.F.2	,9.C	
G1(I)	T/O OUTPUT	GRAD	5.D	,5.E	
G1MAG	T/O OUTPUT	GMAG	5.D	,5.E	
G2(I)	T/O OUTPUT	GRAD	5.D	,5.E	
G2MAG	T/O OUTPUT	GMAG	5.D	,5.E	
GALPHA	OUTPUT	GSENSR	6.B	,9.D	
GALTIT	OUTPUT	GSENSR	6.B	,9.D	
GAMAD	OUTPUT	DGAMLA	9.D		
GAMAST(I)	T/O OUTPUT	FGAMA	5.D	,5.E	
		TRYIT1			
GAMMAA	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	,9.D
		GAMLAM			
GAMMAI	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	,9.D
		AUXFM			
GAMMAR	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	,9.D
		AUXFM			
GASM	OUTPUT	GSENSR	6.B	,9.D	
GAZVR	OUTPUT	GSENSR	6.B	,9.D	
GBANK	OUTPUT	GSENSR	6.B	,9.D	
GBETA	OUTPUT	GSENSR	6.B	,9.D	
GCLAT	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	,9.D
		AUXFM			
GCRAD	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	,9.D
		MOTION			
GDERV(J)	INPUT/GENDAT	DYSI1	6.A.15	,9.B	
GDLAT	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	,9.D
		AUXFM			
GDT	OUTPUT	GGUID	6.B	,9.D	
GENVIT	INPUT/TAB	AUXFM	6.A.8	,9.C	
GGAMAR	OUTPUT	GSENSR	6.B	,9.D	
GGCLAT	OUTPUT	GSENSR	6.B	,9.D	
GGCRAD	OUTPUT	GSENSR	6.B	,9.D	
GINT(J)	INPUT/GENDAT	BLKDAT	6.A.9	,9.B	
GINTJ	HOLLERITH	BLKDAT	6.A.15	,9.D	
GLOD	OUTPUT	GSENSR	6.B	,9.D	
GLONG	OUTPUT	GSENSR	6.B	,9.D	
GO	INPUT/GENDAT	MASSP	4.A	,6.A.24	,9.B
		PROP			
GPASXI	OUTPUT	GSENSR	6.B	,9.D	
GPASYI	OUTPUT	GSENSR	6.B	,9.D	
GPASZI	OUTPUT	GSENSR	6.B	,9.D	
GPAXI	OUTPUT	GSENSR	6.B	,9.D	
GPAYI	OUTPUT	GSENSR	6.B	,9.D	
GPAZI	OUTPUT	GSENSR	6.B	,9.D	
GPITI	OUTPUT	GSENSR	6.B	,9.D	
GPITR	OUTPUT	GSENSR	6.B	,9.D	

10.B. INDEX OF VARIABLES (CONTD)

GPVXI	OUTPUT	GSENSR	6.B	,9.D
GPVYI	OUTPUT	GSENSR	6.B	,9.D
GPVZI	OUTPUT	GSENSR	6.B	,9.D
GPXI	OUTPUT	GSENSR	6.B	,9.D
GPYI	OUTPUT	GSENSR	6.B	,9.D
GPZI	OUTPUT	GSENSR	6.B	,9.D
GRDOT	OUTPUT	GSENSR	6.B	,9.D
GROLI	OUTPUT	GSENSR	6.B	,9.D
GROLR	OUTPUT	GSENSR	6.B	,9.D
GTHRST	OUTPUT	GSENSR	6.B	,9.D
GTIME	INPUT/GENDAT	GGUID	6.B	,9.B
GTIME1	INPUT/GENDAT	GGUID1	6.B.2	,9.B
GTIME2	INPUT/GENDAT	GGUID1	6.B.2	,9.B
GVELI	OUTPUT	GSENSR	6.B	,9.D
GVELR	OUTPUT	GSENSR	6.B	,9.D
GVRI(J)	INPUT/GENDAT	GGUID	6.B	,9.B
		OLGM		
GVRCJ	OUTPUT	GGUID	6.B	,9.D
		OLGM		
GWDOT	OUTPUT	GSENSR	6.B	,9.D
GWGT	OUTPUT	GSENSR	6.B	,9.D
GXI	OUTPUT	GRAV	9.D	
GXP(I)	INPUT/GENDAT	MASSP	6.A.21	,9.B
GXR	OUTPUT	GSENSR	6.B	,9.D
GYAWI	OUTPUT	GSENSR	6.B	,9.D
GYAWR	OUTPUT	GSENSR	6.B	,9.D
GYI	OUTPUT	GRAV	9.D	
GYP(I)	INPUT/GENDAT	MASSP	6.A.21	,9.B
GYR	OUTPUT	GSENSR	6.B	,9.D
GZI	OUTPUT	GRAV	9.D	
GZP(I)	INPUT/GENDAT	MASSP	6.A.21	,9.B
GZR	OUTPUT	GSENSR	6.B	,9.D
HDP	OUTPUT	GGUID1	6.B.2	,9.D
HDPT	INPUT/TAB	GGUID1	6.B.2	,9.C
HEATK(I)	INPUT/GENDAT	MOTIAL	6.A.2	,9.B
		AEROHI		
HEATRT	OUTPUT	BLKDAT	6.A.2	,9.D
HMA	OUTPUT	HINGEM	6.F.2	,9.D
HMAMX	INPUT/GENDAT	AUTP2	6.F.2	,9.B
HME	OUTPUT	HINGEM	6.F.2	,9.D
HMEMX	INPUT/GENDAT	AUTP2	6.F.2	,9.B
HMFJ	OUTPUT	HINGEM	6.F.2	,9.D
HMR	OUTPUT	HINGEM	6.F.2	,9.D
HMRMX	INPUT/GENDAT	AUTP2	6.F.2	,9.B
HP	OUTPUT	GGUID1	6.B.2	,9.D
HPT	INPUT/TAB	GGUID1	6.B.2	,9.C

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
HTURB	OUTPUT	BLKDAT	6.A.2	,9.D	
HTURBD	OUTPUT	AEROHI	6.A.2	,9.D	
HYPVEL	OUTPUT	CONIC	6.A.5	,9.D	
IAC(I)	T/O OUTPUT	UPDATS	5.E		
IAEROM	INPUT/GENDAT	AERO	6.A.1	,9.B	
IBJK	OUTPUT	IBMTRX	9.D		
IDEB	INPUT/SEARCH	ITERO	9.A		
IDEPVR(I)	INPUT/SEARCH	CALE	5.B	,9.A	
IFDEG(I)	INPUT/SEARCH	CALE	5.B		
IFRUNF(J)	INPUT/SEARCH	READAT	4.B	,9.A	
IGF(J)	INPUT/GENDAT	GGUID	6.B	,9.B	
		OLGM			
IGINIT	INPUT/GENDAT	GGUID1	6.B.2	,9.B	
IGSTRT	INPUT/GENDAT	GGUID1	6.B.2	,9.B	
IGUID(I)	INPUT/GENDAT	MOTION	6.B	,9.B	
INC	INPUT/GENDAT	ORBTR	6.A.5	,6.A.12	,9.B
		CONIC	,9.D		
		SETIV			
INDVR(I)	INPUT/SEARCH	SETIV	5.A	,9.A	
IOFLAG	INPUT/SEARCH	CONVO	4.A	,9.A	
		INFXM			
		TSPXM			
IPRO	INPUT/SEARCH	MINMYS	4.A	,9.A	
ISENS	INPUT/SEARCH	GRAD	9.A		
ISLECT	INPUT/GENDAT	GGUID2	6.B.3	,9.B	
ISTRT	INPUT/GENDAT	GGUID2	6.B.3	,9.B	
ISPV(I)	INPUT/GENDAT	PROP	6.A.13	,6.A.18	,9.B
ITRANS	INPUT/GENDAT	GGUID2	6.B.3	,9.B	
IWPF(I)	OUTPUT	PROP	6.A.18	,9.D	
IXX	OUTPUT	MASSP	6.E.2	,9.D	
IXXD	OUTPUT	MASSP	6.E.2	,9.D	
IXXT	INPUT/TAB	MASSP	6.E.2	,9.C	
IXY	OUTPUT	MASSP	6.E.2	,9.D	
IXYD	OUTPUT	MASSP	6.E.2	,9.D	
IXYT	INPUT/TAB	MASSP	6.E.2	,9.C	
IXZ	OUTPUT	MASSP	6.E.2	,9.D	
IXZD	OUTPUT	MASSP	6.E.2	,9.D	
IXZT	INPUT/TAB	MASSP	6.E.2	,9.C	
IYY	OUTPUT	MASSP	6.E.2	,9.D	
IYYD	OUTPUT	MASSP	6.E.2	,9.D	
IYYT	INPUT/TAB	MASSP	6.E.2	,9.C	
IYZ	OUTPUT	MASSP	6.E.2	,9.D	
IYZD	OUTPUT	MASSP	6.E.2	,9.D	
IYZT	INPUT/TAB	MASSP	6.E.2	,9.C	
IZZ	OUTPUT	MASSP	6.E.2	,9.D	
IZZD	OUTPUT	MASSP	6.E.2	,9.D	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
IZZT	INPUT/TAB	MASSP	6.E.2	,9.C	
J2	INPUT/GENDAT	MOTIAL	6.A.10	,9.B	
J3	INPUT/GENDAT	MOTIAL	6.A.10	,9.B	
J4	INPUT/GENDAT	MOTIAL	6.A.10	,9.B	
KHDT	INPUT/TAB	GGUID1	6.B.2	,9.C	
KHT	INPUT/TAB	GGUID1	6.B.2	,9.C	
KPDA	INPUT/GENDAT	CONTM	6.E.1	,9.B	
KPDE	INPUT/GENDAT	CONTM	6.E.1	,9.B	
KPDP(I)	INPUT/GENDAT	CONTM	6.E.1	,9.B	
KPDR	INPUT/GENDAT	CONTM	6.E.1	,9.B	
KRDA	INPUT/GENDAT	CONTM	6.E.1	,9.B	
KRDE	INPUT/GENDAT	CONTM	6.E.1	,9.B	
KRDP(I)	INPUT/GENDAT	CONTM	6.E.1	,9.B	
KRDR	INPUT/GENDAT	CONTM	6.E.1	,9.B	
KRDY(I)	INPUT/GENDAT	CONTM	6.E.1	,9.B	
KYDA	INPUT/GENDAT	CONTM	6.E.1	,9.B	
KYDE	INPUT/GENDAT	CONTM	6.E.1	,9.B	
KYDR	INPUT/GENDAT	CONTM	6.E.1	,9.B	
KYDY	INPUT/GENDAT	CONTM	6.E.1	,9.B	
LAN	INPUT/GENDAT	ORBTR	6.A.5	,6.A.12	,9.B
		CONIC	,9.D		
LATREF	INPUT/GENDAT	AUXFMI	6.A.19	,9.B	
		XRNGE1			
LATL	INPUT/GENDAT	MOTIAL	6.B	,9.B	
LDRLF	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
LIFT	OUTPUT	AUXFM	6.A.1	,9.D	
LISTIN	INPUT/SEARCH	INPUTX	4.A	,9.B	
LOD1	OUTPUT	GGUID2	6.B.3	,9.D	
LONG	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	,9.D
		AUXFM			
LONGI	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	,9.D
		AUXFM			
LONL	INPUT/GENDAT	MOTIAL	6.B	,9.B	
LONREF	INPUT/GENDAT	AUXFMI	6.A.19	,9.B	
		XRNGE1			
LREF	INPUT/GENDAT	AUXFM	6.A.1	,9.B	
MACH	OUTPUT	MOTION	6.A.4	,9.D	
MACHDT	OUTPUT	AUXFM	6.A.4	,9.D	
MASS	OUTPUT	BLKDAT	6.A.24	,9.D	
		MASSP			
MAXITR	INPUT/SEARCH	NOMINL	5.D	,9.A	
MAXTIM	INPUT/GENDAT	PHZXM	6.A.6	,9.B	
MDL	INPUT/GENDAT	READAT	6.A.6	,9.B	
MEAAN	OUTPUT	CONIC	6.A.5	,9.D	
MODEW	INPUT/SEARCH	WUCAL	5.A	,9.A	
MONF(J)	INPUT/GENDAT	MOTION	6.A.7	,9.B	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
MONX(I)	INPUT/GENDAT	MONITR	6.A.14	,9.B	
MONY(I)	INPUT/GENDAT	MONITR	6.A.14	,9.B	
MU	INPUT/GENDAT	GRAV	6.A.10	,9.B	
MULTRF	INPUT/SEARCH	READAT	4.B	,9.A	
NAC	T/O OUTPUT	UPDATS	5.D	,5.E	
NAUTOP	INPUT/GENDAT	AUTOPM	6.A.1	,9.B	
NDEPV	INPUT/SEARCH	CALE	5.B	,5.D	,9.A
		GRAD			
NEQS(J)	INPUT/GENDAT	MOTION	6.A.7	,9.B	
NINDV	INPUT/SEARCH	GRAD	5.A	,5.D	,9.A
NPAD(I)	INPUT/SEARCH	PAD	5.A	,5.B	,9.A
NPC(1)	INPUT/GENDAT	AUXFM	6.A.6	,9.B	
NPC(2)	INPUT/GENDAT	DERIV	6.A.15	,9.B	
		DYNXM			
NPC(3)	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	
NPC(4)	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	
NPC(5)	INPUT/GENDAT	MOTION	6.A.4	,9.B	
		ATMOS			
NPC(6)	INPUT/GENDAT	MOTION	6.A.4	,9.B	
		WINDS			
NPC(8)	INPUT/GENDAT	MOTION	6.A.1	,9.B	
		AERO			
NPC(9)	INPUT/GENDAT	MOTION	6.A.18	,9.B	
		PROP			
NPC(11)	INPUT/GENDAT	MOTION	6.A.11	,9.B	
NPC(12)	INPUT/GENDAT	AUXFM	6.A.19	,9.B	
NPC(13)	INPUT/GENDAT	WGTINI	6.A.24	,9.B	
NPC(14)	INPUT/GENDAT	TMOTM	6.A.10	,9.B	
NPC(15)	INPUT/GENDAT	MOTION	6.A.2	,9.B	
		AEROHI			
NPC(16)	INPUT/GENDAT	MOTIAL	6.A.10	,9.B	
NPC(17)	INPUT/GENDAT	WGTINI	6.A.24	,9.B	
NPC(18)	INPUT/GENDAT	PHZXM	6.A.6	,9.B	
NPC(19)	INPUT/GENDAT	PRNTIC	4.A.	,9.B	
NPC(20)	INPUT/GENDAT	CYCXM	6.A.15	,9.B	
NPC(21)	INPUT/GENDAT	PROP	6.A.18	,9.B	
NPC(22)	INPUT/GENDAT	PROP	6.A.18	,9.B	
NPC(24)	INPUT/GENDAT	DYSI1	6.A.15	,9.B	
NPC(25)	INPUT/GENDAT	MOTION	6.A.25	,9.B	
NPC(26)	INPUT/GENDAT	MOTION	6.A.2	,9.B	
		AEROHI			
NPC(27)	INPUT/GENDAT	PROP	6.A.18	,9.B	
NPC(30)	INPUT/GENDAT	MASSP	6.A.27	,9.B	
NSPEC(J)	INPUT/GENDAT	CALSPE	6.A.20	,9.B	
NXTRUN	INPUT/SEARCH	READAT	4.B	,9.A	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
OMEGA	INPUT/GENDAT	MOTIAL	6.A.10	,9.B	
		MOTION			
		AUXFM			
OPT	INPUT/SEARCH	CALE	5.C	,9.A	
OPTPH	INPUT/SEARCH	CALE	5.C	,9.A	
OPTVAR	INPUT/SEARCH	CALE	5.C	,9.A	
PACCER	OUTPUT	AUTP1	6.F.1	,9.D	
PBDC	OUTPUT	AUTP1	6.F.1	,9.D	
PBDCT	INPUT/TAB	AUTP1	6.F.1	,9.C	
PCTCC	INPUT/SEARCH	TRYIT1	5.C	,9.A	
PERIOD	OUTPUT	CONIC	6.A.5	,9.D	
PERT(I)	INPUT/SEARCH	GRAD	5.A	,9.A	
PGCLAT	INPUT/GENDAT	ORBTR	6.A.5	,9.B	
		CONIC			
PGERAD	OUTPUT	CONIC	6.A.5	,9.D	
PGLON	OUTPUT	CONIC	6.A.5	,9.D	
PGVEL	OUTPUT	CONIC	6.A.5	,9.D	
PGI(I)	T/O OUTPUT	UPDATS	5.D	,5.E	
PGIMAG	T/O OUTPUT	UPDATS	5.E		
PSTOP	HOLLERITH	INFXMI	6.A.16		
P1	T/O OUTPUT	GRAD	5.D	,5.E	
P1TRY(I)	T/O OUTPUT	FGAMA	5.D	,5.E	
		TRYIT1			
P2	T/O OUTPUT	GRAD	5.D	,5.E	
		TRAJ			
P2MIN	T/O OUTPUT	TEST	5.D	,9.A	
P2TRY(I)	T/O OUTPUT	FGAMA	5.D	,5.E	
PINC	INPUT/GENDAT	INFXM	6.A.16	,9.B	
PITAC	OUTPUT	AUTP1	6.F.1	,9.D	
PITB	OUTPUT	BLKDAT	6.E.3	,9.D	
PITBC	OUTPUT	BLKDAT	6.B.1	,9.D	
PITBD	OUTPUT	BLKDAT	6.B	,9.D	
PITBDC	OUTPUT	OLGM	6.B.1	,9.D	
PITBDD	OUTPUT	RMOTM		,9.D	
PITBDR	OUTPUT	MOTION	6.E.3	,9.D	
PITBER	OUTPUT	AUTP1	6.B.1	,6.B.2	,6.F.2
		AUTP2	,9D		
		GGUID1			
		OLGM			
PITI	INPUT/GENDAT	IBMTXI	6.B	,9.B	,9.D
		BACKOI			
PITID	INPUT/GENDAT	RMOTI	9.B		
PITIDL	OUTPUT	GGUID1	6.B.2	,9.D	
PITIER	OUTPUT	GGUID1	6.B.1	,6.B.2	,9.D
		OLGM			
PITIGC	OUTPUT	GGUID1	6.B.1	,6.B.2	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
PITINL	OUTPUT	GGUID1	6.B.2	,9.D	
PITIPL	OUTPUT	GGUID1	6.B.2	,9.D	
PITN	OUTPUT	AUTP2	6.F.2	,9.D	
PITP	OUTPUT	AUTP2	6.F.2	,9.D	
PITR	INPUT/GENDAT	IBMTXI	6.B	,9.B	,9.D
		BACKOR			
PITRD	INPUT/GENDAT	RMOTI	9.B		
PITT	INPUT/TAB	OLGM	6.B	,9.C	
		GGUID1			
PJETTS	INPUT/GENDAT	WGTINI	6.A.24	,9.B	
PLDRL	OUTPUT	AUTP1	6.F.1	,9.D	
PMPJT	INPUT/TAB	AUTP2	6.F.2	,9.C	
PND	OUTPUT	MOTION	6.E.3	,9.D	
PNPJIT	INPUT/TAB	AUTP2	6.F.2	,9.C	
PPPJIT	INPUT/TAB	AUTP2	6.F.2	,9.C	
PRATER	OUTPUT	AUTP1	6.F.1	,9.D	
PRES	OUTPUT	ATMOS1	6.A.4	,9.D	
		ATMOS2			
		ATMOS3			
PREST	INPUT/TAB	ATMOS1	6.A.4	,9.C	
PRJIT	INPUT/TAB	AUTP2	6.F.2	,9.C	
PRNC	INPUT/GENDAT	INFXM	6.A.16	,9.B	
PRNT(I)	INPUT/GENDAT	READAT	6.A.16	,9.B	
PSL	INPUT/GENDAT	PROP	6.A.18	,9.B	
PWDOT	OUTPUT	PROP	6.A.18	,6.A.24	,9.D
PWPROP	INPUT/GENDAT	BLKDAT	6.A.18	,6.A.24	,9.B
			,9.D		
PYJIT	INPUT/TAB	AUTP2	6.F.2	,9.C	
QALPHA	OUTPUT	MOTION	6.A.1	,9.D	
QALTOT	OUTPUT	AUXFM	6.A.1	,9.D	
QND	OUTPUT	MOTION	6.E.3	,9.D	
RATIO(I)	T/O OUTPUT	TEST	5.E		
RATP	OUTPUT	AUTP1	6.F.1	,9.D	
RATR	OUTPUT	AUTP1	6.F.1	,9.D	
RATY	OUTPUT	AUTP1	6.F.1	,9.D	
RAZD	INPUT/GENDAT	GGUID2	6.B.3	,9.B	
RBDC	OUTPUT	AUTP1	6.F.1	,9.D	
RBDCT	INPUT/TAB	AUTP1	6.F.1	,9.C	
RCSFXB	OUTPUT	AUTP2	6.F.2	,9.D	
RCSFYB	OUTPUT	AUTP2	6.F.2	,9.D	
RCSFZB	OUTPUT	AUTP2	6.F.2	,9.D	
RCSMXB	OUTPUT	AUTP2	6.F.2	,9.D	
RCSMYB	OUTPUT	AUTP2	6.F.2	,9.D	
RCSMZB	OUTPUT	AUTP2	6.F.2	,9.D	
RDTREF	OUTPUT	GGUID2	6.B.3	,9.D	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
RE	INPUT/GENDAT	MOTIAL	6.A.10	,9.B	
		GRAV			
RENG(I)	INPUT/GENDAT	PROP	6.A.18	,9.B	
REYNO	OUTPUT	AUXFM	6.A.4	,9.D	
RFFP	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
RFFR	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
RFFY	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
RHOSL	INPUT/GENDAT	MOTIAL	6.A.2	,9.B	
		AEROHI			
RK2ROL	OUTPUT	GGUID2	6.B.3	,9.D	
RMPJT	INPUT/TAB	AUTP2	6.F.2	,9.C	
RN	INPUT/GENDAT	AUXFM	6.A.2	,9.B	
RND	OUTPUT	MOTION	6.E.3	,9.D	
ROLAC	OUTPUT	AUTP1	6.F.1	,9.D	
ROLB	OUTPUT	BLKDAT	6.E.3	,9.D	
ROLBC	OUTPUT	BLKDAT	6.B.1	,9.D	
ROLBD	OUTPUT	BLKDAT	6.B	,9.D	
ROLBDC	OUTPUT	OLGM	6.B.1	,9.D	
ROLBDD	OUTPUT	RMOTM	6.E.3	,9.D	
ROLBDR	OUTPUT	MOTION	6.E.3	,9.D	
ROLBER	OUTPUT	AUTP1	6.B.1	,6.B.2	,6.F.2
		AUTP2	,9D		
		GGUID1			
		OLGM			
ROLI	INPUT/GENDAT	IBMTXI	6.B	,9.B	,9.D
		BACKOI			
ROLID	INPUT/GENDAT	RMOTI	9.B		
ROLIDL	OUTPUT	GGUID1	6.B.2	,9.D	
ROLIER	OUTPUT	GGUID1	6.B.1	,6.B.2	,9.D
		OLGM			
ROLIGC	OUTPUT	GGUID1	6.B.1	,6.B.2	,9.D
		OLGM			
ROLINL	OUTPUT	GGUID1	6.B.2	,9.D	
ROLIPL	OUTPUT	GGUID1	6.B.2	,9.D	
ROLN	OUTPUT	AUTP2	6.F.2	,9.D	
ROLP	OUTPUT	AUTP2	6.F.2	,9.D	
ROLR	INPUT/GENDAT	IBMTXI	6.B	,9.B	,9.D
		BACKOR			
ROLRD	INPUT/GENDAT	RMOTI	9.B		
ROLRER	OUTPUT	AUTP2	6.F.2	,9.D	
ROLRGC	OUTPUT	GGUID2	6.B.3	,9.D	
ROLT	INPUT/TAB	OLGM	6.B	,9.C	
		GGUID1			
RP	INPUT/GENDAT	MOTIAL	6.A.10	,9.B	
RRATER	OUTPUT	AUTP1	6.F.1	,9.D	
RREFL	INPUT/GENDAT	HINGEM	6.F.2	,9.B	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
RRJIT	INPUT/TAB	AUTP2	6.F.2	,9.C	
RS	OUTPUT	MOTION	9.D		
RSO	OUTPUT	MOTIAL	9.D		
RTASC	OUTPUT	CONIC	6.A.5	,9.D	
RYJIT	INPUT/TAB	AUTP2	6.F.2	,9.C	
SEMJAX	OUTPUT	CONIC	6.A.5	,9.D	
SLECT	OUTPUT	GGUID2	6.B.3	,9.D	
SMAT(I,J)	T/O OUTPUT	ITERO	5.D	,5.E	
		UPDATS			
SPECI(J)	INPUT/GENDAT	CALSPE	6.A.20	,9.B	
SPECIJ	HOLLERITH	CALSPE	3.C		
SPECVJ	OUTPUT	CALSPE	6.A.20	,9.D	
SRCHM	INPUT/SEARCH	GRAD	5.D	,9.A	
		TSPXM			
SREF	INPUT/GENDAT	AERO	6.A.1	,9.B	
STMINP	INPUT/SEARCH	TRYIT1	5.D	,9.A	
		TRYIT2			
STPMAX	INPUT/SEARCH	TRYIT1	5.D	,9.A	
		TRYIT2			
TAUINT	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
TAULP	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
TAULY	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
TDURP	OUTPUT	DERIV	6.A.22	,9.D	
THRJ	OUTPUT	PROP	6.A.18	,9.D	
THRSJ	INPUT/GENDAT	AUTP2	6.F.2	,9.B	
THRUST	OUTPUT	PROP	6.A.18	,9.D	
THTP	OUTPUT	HSWGT	6.A.2	,9.D	
THTPL	OUTPUT	HSWGT	6.A.2	,9.D	
TIME	INPUT/GENDAT	BLKDAT	6.A.22	,9.B	,9.D
TIMEA	OUTPUT	AUTOPM	6.F	,9.D	
TIMEG	OUTPUT	GGUID	6.B	,9.D	
TIMES	OUTPUT	DERIV	6.A.22	,9.D	
TIMREF	INPUT/GENDAT	AUXFMI	6.A.19	,9.B	
TIMRF(J)	INPUT/GENDAT	BLKDAT	6.A.22	,9.B	
TIMRFJ	OUTPUT	BLKDAT	6.A.22	,9.D	
TIMSP	OUTPUT	CONIC	6.A.5	,9.D	
TIMTP	OUTPUT	CONIC	6.A.5	,9.D	
TISPJ	INPUT/GENDAT	AUTP2	6.F.2	,9.B	
TITLE(I)	INPUT/GENDAT	PAGER	6.A.16	,9.B	
TLATCD	INPUT/GENDAT	GGUID2	6.B.3	,9.B	
TLHEAT	OUTPUT	BLKDAT	6.A.2	,9.D	
TLONGD	INPUT/GENDAT	GGUID2	6.B.3	,9.B	
TLPWT	OUTPUT	HSWGT	6.A.2	,9.D	
TMXB	OUTPUT	PROP	6.A.18	,9.D	
TMYB	OUTPUT	PROP	6.A.18	,9.D	
TMZB	OUTPUT	PROP	6.A.18	,9.D	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
TOL	INPUT/GENDAT	READAT	6.A.6	,9.B	
TONT	OUTPUT	BLKDAT	6.F.2	,9.D	
TONTD	OUTPUT	AUTP2	6.F.2	,9.D	
TPITN	OUTPUT	BLKDAT	6.F.2	,9.D	
TPITND	OUTPUT	AUTP2	6.F.2	,9.D	
TPITP	OUTPUT	BLKDAT	6.F.2	,9.D	
TPITPD	OUTPUT	AUTP2	6.F.2	,9.D	
TRANGE	OUTPUT	GGUID2	6.B.3	,9.D	
TROLN	OUTPUT	BLKDAT	6.F.2	,9.D	
TROLND	OUTPUT	AUTP2	6.F.2	,9.D	
TROLP	OUTPUT	BLKDAT	6.F.2	,9.D	
TROLPD	OUTPUT	AUTP2	6.F.2	,9.D	
TRUAN	INPUT/GENDAT	ORBTR	6.A.5	,6.A.12	,9.B
		CONIC	,9.D		
TRUNMX	OUTPUT	CONIC	6.A.5	,9.D	
TSL	INPUT/GENDAT	PROP	6.A.18	,9.B	
TTMXB	OUTPUT	AIRFM	6.E.1	,9.D	
TTMYB	OUTPUT	AIRFM	6.E.1	,9.D	
TTMZB	OUTPUT	AIRFM	6.E.1	,9.D	
TVAC	INPUT/GENDAT	PROP	6.A.18	,9.B	
TVCIT	INPUT/TAB	PROP	6.A.18	,9.C	
TYAWN	OUTPUT	BLKDAT	6.F.2	,9.D	
TYAWND	OUTPUT	AUTP2	6.F.2	,9.D	
TYAWP	OUTPUT	BLKDAT	6.F.2	,9.D	
TYAWPD	OUTPUT	AUTP2	6.F.2	,9.D	
U	OUTPUT	DGAMLA	9.D		
U(I)	INPUT/SEARCH	GRAD	5.A	,9.A	
		UPNOM			
UA	OUTPUT	GAMLAM	9.D		
UB	OUTPUT	MOTION	9.D		
UDCTR	OUTPUT	AUTP2	6.F.2	,9.D	
UMAG	T/D OUTPUT	WUCAL	5.D	,5.E	
UNX	OUTPUT	AUXFM	9.D		
UNY	OUTPUT	AUXFM	9.D		
UNZ	OUTPUT	AUXFM	9.D		
UR	OUTPUT	AUXFM	9.D		
URX	OUTPUT	AUXFM	9.D		
URY	OUTPUT	AUXFM	9.D		
URZ	OUTPUT	AUXFM	9.D		
UTX	OUTPUT	AUXFM	9.D		
UTY	OUTPUT	AUXFM	9.D		
UTZ	OUTPUT	AUXFM	9.D		
UW	OUTPUT	WINDS	6.A.4	,9.D	
V	OUTPUT	DGAMLA	9.D		
VA	OUTPUT	GAMLAM	9.D		
VALUE	INPUT/GENDAT	READAT	6.A.6	,9.B	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
RRJIT	INPUT/TAB	AUTP2	6.F.2	,9.C	
RS	OUTPUT	MOTION	9.D		
RSO	OUTPUT	MOTIAL	9.D		
RTASC	OUTPUT	CONIC	6.A.5	,9.D	
RYJIT	INPUT/TAB	AUTP2	6.F.2	,9.C	
SEMJAX	OUTPUT	CONIC	6.A.5	,9.D	
SLECT	OUTPUT	GGUID2	6.B.3	,9.D	
SMAT(I,J)	T/O OUTPUT	ITERO	5.D	,5.E	
		UPDATS			
SPECI(J)	INPUT/GENDAT	CALSPE	6.A.20	,9.B	
SPECIJ	HOLLERITH	CALSPE	3.C		
SPECVJ	OUTPUT	CALSPE	6.A.20	,9.D	
SRCHM	INPUT/SEARCH	GRAD	5.D	,9.A	
		TSPXM			
SREF	INPUT/GENDAT	AERO	6.A.1	,9.B	
STMINP	INPUT/SEARCH	TRYIT1	5.D	,9.A	
		TRYIT2			
STPMAX	INPUT/SEARCH	TRYIT1	5.D	,9.A	
		TRYIT2			
TAUINT	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
TAULP	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
TAULY	INPUT/GENDAT	AUTP1	6.F.1	,9.B	
TDURP	OUTPUT	DERIV	6.A.22	,9.D	
THRJ	OUTPUT	PROP	6.A.18	,9.D	
THRSJ	INPUT/GENDAT	AUTP2	6.F.2	,9.B	
THRUST	OUTPUT	PROP	6.A.18	,9.D	
THTP	OUTPUT	HSWGT	6.A.2	,9.D	
THTPL	OUTPUT	HSWGT	6.A.2	,9.D	
TIME	INPUT/GENDAT	BLKDAT	6.A.22	,9.B	,9.D
TIMEA	OUTPUT	AUTOPM	6.F	,9.D	
TIMEG	OUTPUT	GGUID	6.B	,9.D	
TIMES	OUTPUT	DERIV	6.A.22	,9.D	
TIMREF	INPUT/GENDAT	AUXFMI	6.A.19	,9.B	
TIMRF(J)	INPUT/GENDAT	BLKDAT	6.A.22	,9.B	
TIMRFJ	OUTPUT	BLKDAT	6.A.22	,9.D	
TIMSP	OUTPUT	CONIC	6.A.5	,9.D	
TIMTP	OUTPUT	CONIC	6.A.5	,9.D	
TISPJ	INPUT/GENDAT	AUTP2	6.F.2	,9.B	
TITLE(I)	INPUT/GENDAT	PAGER	6.A.16	,9.B	
TLATCD	INPUT/GENDAT	GGUID2	6.B.3	,9.B	
TLHEAT	OUTPUT	BLKDAT	6.A.2	,9.D	
TLONGD	INPUT/GENDAT	GGUID2	6.B.3	,9.B	
TLPWT	OUTPUT	HSWGT	6.A.2	,9.D	
TMXB	OUTPUT	PROP	6.A.18	,9.D	
TMYB	OUTPUT	PROP	6.A.18	,9.D	
TMZB	OUTPUT	PROP	6.A.18	,9.D	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
TOL	INPUT/GENDAT	READAT	6.A.6	,9.B	
TONT	OUTPUT	BLKDAT	6.F.2	,9.D	
TONTD	OUTPUT	AUTP2	6.F.2	,9.D	
TPITN	OUTPUT	BLKDAT	6.F.2	,9.D	
TPITND	OUTPUT	AUTP2	6.F.2	,9.D	
TPITP	OUTPUT	BLKDAT	6.F.2	,9.D	
TPITPD	OUTPUT	AUTP2	6.F.2	,9.D	
TRANGE	OUTPUT	GGUID2	6.B.3	,9.D	
TROLN	OUTPUT	BLKDAT	6.F.2	,9.D	
TROLND	OUTPUT	AUTP2	6.F.2	,9.D	
TROLP	OUTPUT	BLKDAT	6.F.2	,9.D	
TROLPD	OUTPUT	AUTP2	6.F.2	,9.D	
TRUAN	INPUT/GENDAT	ORBTR	6.A.5	,6.A.12	,9.B
		CONIC	,9.D		
TRUNMX	OUTPUT	CONIC	6.A.5	,9.D	
TSL	INPUT/GENDAT	PROP	6.A.18	,9.B	
TTMXB	OUTPUT	AIRFM	6.E.1	,9.D	
TTMYB	OUTPUT	AIRFM	6.E.1	,9.D	
TTMZB	OUTPUT	AIRFM	6.E.1	,9.D	
TVAC	INPUT/GENDAT	PROP	6.A.18	,9.B	
TVCIT	INPUT/TAB	PROP	6.A.18	,9.C	
TYAWN	OUTPUT	BLKDAT	6.F.2	,9.D	
TYAWND	OUTPUT	AUTP2	6.F.2	,9.D	
TYAWP	OUTPUT	BLKDAT	6.F.2	,9.D	
TYAWPD	OUTPUT	AUTP2	6.F.2	,9.D	
U	OUTPUT	DGAMLA	9.D		
U(I)	INPUT/SEARCH	GRAD	5.A	,9.A	
		UPNOM			
UA	OUTPUT	GAMLAM	9.D		
UB	OUTPUT	MOTION	9.D		
UDCTR	OUTPUT	AUTP2	6.F.2	,9.D	
UMAG	T/O OUTPUT	WUCAL	5.D	,5.E	
UNX	OUTPUT	AUXFM	9.D		
UNY	OUTPUT	AUXFM	9.D		
UNZ	OUTPUT	AUXFM	9.D		
UR	OUTPUT	AUXFM	9.D		
URX	OUTPUT	AUXFM	9.D		
URY	OUTPUT	AUXFM	9.D		
URZ	OUTPUT	AUXFM	9.D		
UTX	OUTPUT	AUXFM	9.D		
UTY	OUTPUT	AUXFM	9.D		
UTZ	OUTPUT	AUXFM	9.D		
UW	OUTPUT	WINDS	6.A.4	,9.D	
V	OUTPUT	DGAMLA	9.D		
VA	OUTPUT	GAMLAM	9.D		
VALUE	INPUT/GENDAT	READAT	6.A.6	,9.B	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
VAXI	OUTPUT	MOTION	9.D		
VAYI	OUTPUT	MOTION	9.D		
VAZI	OUTPUT	MOTION	9.D		
VB	OUTPUT	MOTION	9.D		
VELA	INPUT/GENDAT	MOTION	6.A.12	,9.B	,9.D
VELAD	OUTPUT	DGAMLA	9.D		
VELI	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	,9.D
		AUXFM			
VELR	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	,9.D
		AUXFM			
VINFI	INPUT/GENDAT	AERO4	6.A.1	,9.B	
VMU	OUTPUT	AUXFM	6.A.4	,9.D	
VR	OUTPUT	AUXFM	9.D		
VRXI	OUTPUT	MOTION	9.D		
VRYI	OUTPUT	MOTION	9.D		
VRZI	OUTPUT	MOTION	9.D		
VW	OUTPUT	WINDS	6.A.4	,9.D	
VWT	INPUT/TAB	WINDS	6.A.4	,9.C	
VWUT	INPUT/TAB	WINDS	6.A.4	,9.C	
VWVT	INPUT/TAB	WINDS	6.A.4	,9.C	
VWWT	INPUT/TAB	WINDS	6.A.4	,9.C	
VXI	OUTPUT	BLKDAT	9.D		
VXI(J)	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	
VYI	OUTPUT	BLKDAT	9.D		
VZI	OUTPUT	BLKDAT	9.D		
W	OUTPUT	DGAMLA	9.D		
WA	OUTPUT	GAMLAM	9.D		
WB	OUTPUT	MOTION	9.D		
WCON	INPUT/SEARCH	GRAD	5.D	,9.A	
WDIT	INPUT/TAB	PROP	6.A.18	,9.C	
WDJ	OUTPUT	PROP	6.A.18	,6.A.24	,9.D
WDOT	OUTPUT	PROP	6.A.18	,6.A.24	,9.D
		MASSP			
WDOTJ	OUTPUT	AUTP2	6.F.2	,9.D	
WE(I)	T/O OUTPUT	ITERO	5.D	,5.E	
WEICON	OUTPUT	PROP	6.A.18	,6.A.24	,9.D
WEIGHT	OUTPUT	MASSP	6.A.24	,9.D	
WGTDJT	INPUT/TAB	MASSP	6.A.27	,9.C	
WGTJT	INPUT/TAB	MASSP	6.A.27	,9.C	
WGTSG	INPUT/GENDAT	WGTINI	6.A.24	,9.B	
WJETT	INPUT/GENDAT	WGTINI	6.A.24	,9.B	
WJETTM	OUTPUT	WGTINI	6.A.24	,9.D	
WOPT	INPUT/SEARCH	CALE	5.C	,9.A	
WPCONJ	OUTPUT	BLKDAT	6.F.2	,9.D	
WPLD	INPUT/GENDAT	WGTINI	6.A.24	,9.B	
WPROP	OUTPUT	PROP	6.A.24	,9.D	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION		
WPROPI	INPUT/GENDAT	WGTINI	6.A.24	,9.B	
WR	OUTPUT	AUXFM	9.D		
WVU(I)	INPUT/SEARCH	WUCAL	5.A	,9.A	
WU(I)	T/O OUTPUT	WUCAL	9.A		
WW	OUTPUT	WINDS	6.A.4	,9.D	
XCG	OUTPUT	MASSP	6.E.2	,9.D	
XCGT	INPUT/TAB	MASSP	6.E.2	,9.C	
XI	OUTPUT	BLKDAT	9.D		
XI(J)	INPUT/GENDAT	MOTIAL	6.A.12	,9.B	
XMAXJ	OUTPUT	MONITR	6.A.7	,9.D	
XMINJ	OUTPUT	MONITR	6.A.7	,9.D	
XR	OUTPUT	AUXFM	9.D		
XREF	OUTPUT	MASSP	6.A.1	,9.D	
XREFT	INPUT/TAB	MASSP	6.A.1	,9.C	
YACCER	OUTPUT	AUTP1	6.F.1	,9.D	
YAWAC	OUTPUT	AUTP1	6.F.1	,9.D	
YAWB	OUTPUT	BLKDAT	6.E.3	,9.D	
YAWBC	OUTPUT	BLKDAT	6.B.1	,9.D	
YAWBD	OUTPUT	BLKDAT	6.B	,9.D	
YAWBDC	OUTPUT	OLGM	6.B.1	,9.D	
YAWBDD	OUTPUT	RMOTM		,9.D	
YAWBDR	OUTPUT	MOTION	6.E.3	,9.D	
YAWBER	OUTPUT	AUTP1	6.B.1	,6.B.2	,6.F.2
		AUTP2	,9D		
		GGUID1			
		OLGM			
YAWI	INPUT/GENDAT	IBMTXI	6.B	,9.B	,9.D
		BACKOI			
YAWID	INPUT/GENDAT	RMOTI	9.B		
YAWIDL	OUTPUT	GGUID1	6.B.2	,9.D	
YAWIER	OUTPUT	GGUID1	6.B.1	,6.B.2	,9.D
		OLGM			
YAWIGC	OUTPUT	GGUID1	6.B.1	,6.B.2	
YAWINL	OUTPUT	GGUID1	6.B.2	,9.D	
YAWIPL	OUTPUT	GGUID1	6.B.2	,9.D	
YAWN	OUTPUT	AUTP2	6.F.2	,9.D	
YAWP	OUTPUT	AUTP2	6.F.2	,9.D	
YAWPK(I)	INPUT/GENDAT	GGUID1	6.B.2	,9.B	
YAWR	INPUT/GENDAT	IBMTXI	6.B	,9.B	,9.D
		BACKOR			
YAWRD	INPUT/GENDAT	RMOTI	9.B		
YAWT	INPUT/TAB	OLGM	6.B	,9.C	
		GGUID1			
YBDC	OUTPUT	AUTP1	6.F.1	,9.D	
YBDCT	INPUT/TAB	AUTP1	6.F.1	,9.C	
YCG	OUTPUT	MASSP	6.E.2	,9.D	

10.B. INDEX OF VARIABLES (CONTD)

VARIABLE	TYPE/NAMELIST	ROUTINE	SECTION	
YCGT	INPUT/TAB	MASSP	6.E.2	,9.C
YI	OUTPUT	BLKDAT	9.D	
YLDRL	OUTPUT	AUTP1	6.F.1	,9.D
YMPJT	INPUT/TAB	AUTP2	6.F.2	,9.C
YPRED(I)	I/O OUTPUT	ITERO	5.E	
		TPYIT1		
		TRYIT2		
YR	OUTPUT	AUXFM	9.D	
YRATER	OUTPUT	AUTP1	6.F.1	,9.D
YREF	OUTPUT	MASSP	6.A.1	,9.D
YREFT	INPUT/TAB	MASSP	6.A.1	,9.C
YRJIT	INPUT/TAB	AUTP2	6.F.2	,9.C
YXMNJ	OUTPUT	MONITR	6.A.7	,9.D
YXMXJ	OUTPUT	MONITR	6.A.7	,9.D
YYJIT	INPUT/TAB	AUTP2	6.F.2	,9.C
ZCG	OUTPUT	MASSP	6.E.2	,9.D
ZCGT	INPUT/TAB	MASSP	6.E.2	,9.C
ZI	OUTPUT	BLKDAT	9.D	
ZLALPT	INPUT/TAB	AERO4	6.A.1	,9.C
ZR	OUTPUT	AUXFM	9.D	
ZREF	OUTPUT	MASSP	6.A.1	,9.D
ZREFT	INPUT/TAB	MASSP	6.A.1	,9.C