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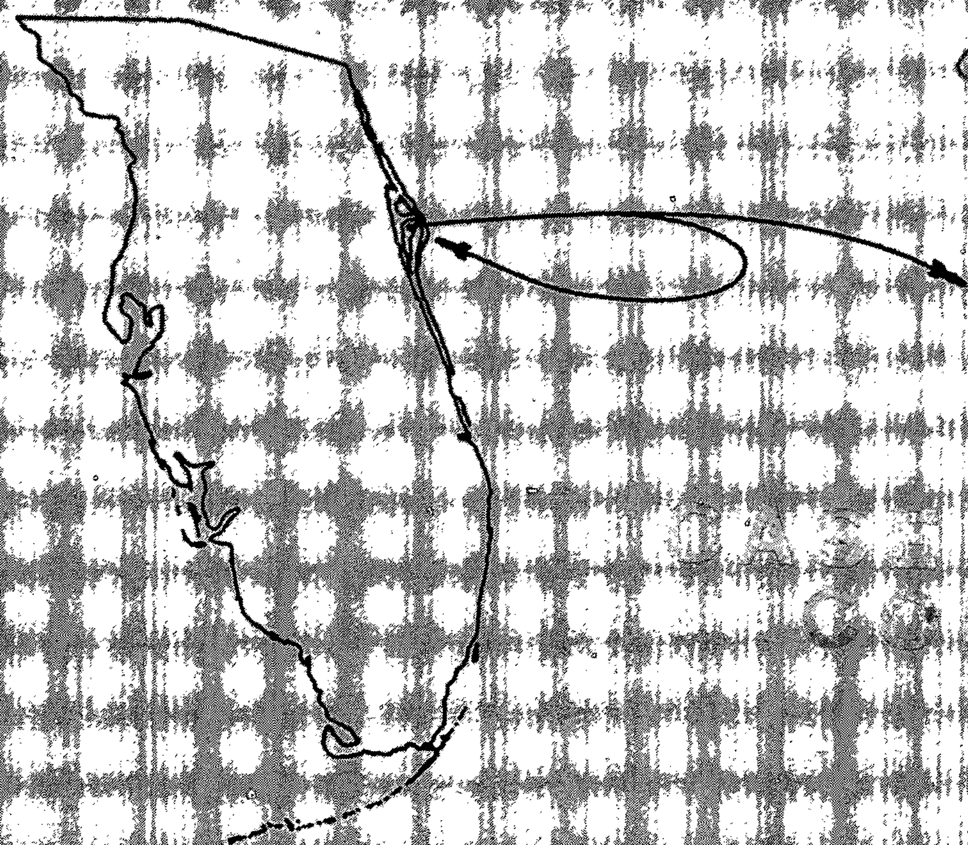

PERFORMANCE ANALYSIS AND DESIGN SYNTHESIS (PADS) COMPUTER PROGRAM

VOLUME III
User Manual
Final Report

MCDONNELL DOUGLAS ASTRONAUTICS COMPANY

MCDONNELL DOUGLAS
CORPORATION

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PREPARED UNDER CONTRACT NO. NAS9-12059
BY GUIDANCE AND FLIGHT MECHANICS DEPARTMENT
RESEARCH AND DEVELOPMENT
MCDONNELL DOUGLAS ASTRONAUTICS COMPANY—WEST
HUNTINGTON BEACH, CALIFORNIA
FOR
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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FOREWORD

This is the third of three volumes describing the Performance Analysis and Design Synthesis (PADS) computer program. This volume is the user manual. Volume I contains a complete program formulation and Volume II is devoted to programming and numerical techniques.

The PADS computer program and documentation were prepared under NASA Contract No. NAS9-12059 by McDonnell Douglas Astronautics Company, Huntington Beach, California, under the cognizance of Mr. Robert Abel, NASA, MSC, Houston, Texas. The key MDAC personnel who formulated and programmed PADS are Messrs. Murray H. Rosenberg, John W. Hensley, and Michael Beach. Valuable programming assistance was given by Larry Ong, Fred Gangloff, and Sheldon Herman.

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ABSTRACT

The Performance Analysis and Design Synthesis (PADS) computer program has a two-fold purpose. It can size launch vehicles in conjunction with calculus-of-variations optimal trajectories and can also be used as a general-purpose branched trajectory optimization program. In the former use, it has the Space Shuttle Synthesis Program as well as a simplified stage weight module for optimally sizing manned recoverable launch vehicles. For trajectory optimization alone or with sizing, PADS has two trajectory modules. The first trajectory module uses the method of steepest descent; the second employs the method of quasi-linearization, which requires a starting solution from the first trajectory module.

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CONTENTS

TABLES

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SYMBOLS

Symbols	Description	Unit
A	A matrix (steepest decent formulation)	
A_e	Net nozzle area	ft^2
A_{exit}	Nozzle area per engine	ft^2
a	Acceleration vector	
a^v	Component of a in $\dot{v}$ equation	
a^γ	Component of a in $\dot{\gamma}$ equation	
a^ψ	Component of a in $\dot{\psi}$ equation	
a^m	Component of a in $\dot{m}$ equation	
a_s	Semi-major axis	ft
a_o, a_1, a_2, a_3	Coefficient in booster-stage empty-weight equation	
B	B matrix	
b_o, b_1, b_2, b_3	Coefficients in orbiter-stage empty-weight equation	
C_D	Drag coefficient	
C_{D_o}	Zero-lift drag coefficient	
C_L	Lift coefficient	
C_{L_u}	Uncorrected lift coefficient	
C_{L_o}	Lift coefficient at $\alpha = 0$	
C_{L_α}	Lift coefficient slope	/rad
$C_{\mathcal{M}_o}$	Moment coefficient at $\alpha = 0$	
$C_{\mathcal{M}_\alpha}$	Moment coefficient slope	/rad
C_{u_L}	Constant lift term in governing equation	lb

Symbols	Description	Unit
GM	Gravitational constant times mass of earth	
G_j	Variable part of cut-off function for arc j	
g	Gravitational acceleration	ft/sec^2
g_{max}	Maximum total acceleration	
g_r	Reference gravitational acceleration	ft/sec^2
H	Momentum (ft/sec), or Hamiltonian, or matrix of homogeneous solutions to linearized state and co-state equations	
h	Altitude	ft
h_i	i^{th} homogeneous solution to linearized state and co-state equations	
I_{sp}	Vacuum specific impulse	
I_{sp_B}	Booster vacuum I_{sp}	
$I_{sp_{eff}}$	Effective I_{sp} (with throttling)	
I_{sp_o}	Orbiter vacuum I_{sp}	
i	Inclination angle	
i_ρ	Unit vector along latitude	
i_μ	Unit vector along longitude	
J	Functional to be minimized	
j	Control blend factor	
K	Vector of governing equations with elements K_1, K_2, K_3	
K'	Ratio of dual engine I_{sp}'s	
k	Induced drag coefficient	
k_γ	Expression used in vertical rise or pitchover control governing equation	

Symbols	Description	Unit
C_α	Constant angle of attack	rad
c_i	Multiplier for i^{th} homogeneous solution to linearized state and co-state equations	
D	Aerodynamic drag	lb
D ( )	Direction cosine matrix	
D'	Diagonal of A matrix	
D_b	Base drag	lb
$D_{\dot{y}}$	Partial derivative operator including effect of steering vector u	
$D^*_{\dot{y}}$	Partial derivative operator, steering vector u fixed	
d_{Ref}	Aerodynamic reference length	ft
$(dP)^2$	Metric of control and parameter changes	
E	Energy or eccentric anomaly	ft^2/sec^2 or rad
$E\{\delta u_i\}$	Unknown control functional	
E_R	Earth radius	ft
e	Orbit eccentricity	
F	Vector comprised of state and co-state differential equations in QL module	
F_{RATED}	Rated vacuum thrust (total)	lb
F_{VAC}	Vacuum thrust per engine	lb
f	Differential equations of motion	
$\bar{f}$	Nominal differential equations of motion	
G	Diagonal matrix of coefficients that multiplies acceleration vector	

Symbols	Description	Unit
k_ψ	Expression used in vertical rise or pitchover control governing equation	
L	Aerodynamic lift	lb
L_u	Uncorrected lift	lb
L_{max}	Maximum lift	lb
M	Mach number, or minor of A matrix, or Lagrange multipliers for state boundary conditions	
$\mathcal{M}$	Aerodynamic moment	ft-lb
$\mathcal{M}_{CG}$	Aerodynamic moment about center of gravity	ft-lb
m	Mass	slugs
N	Minor vector of A matrix	
N_1	Last subarc of trunk	
N_2	Last subarc of first branch	
N_3	Last subarc of second branch ($N_2 = N_3$ if no branches)	
PL	Payload	lb
p	Adjustable parameter, or propulsion vector, or particular solution to linearized state and co-state equations	
p_a	Atmospheric pressure	lb/ft^2
Q	Heating	Btu/ft^2
$\dot{Q}$	Heating rate	$Btu/ft^2/sec$
Q_{MULT}	Heating flag	
q	Dynamic pressure (lb/ft^2) or control variables that are not free to be optimized	
R	Radial distance to vehicle	ft

Symbols	Description	Unit
R'	Ratio of throttled dual engine thrust	
R_a	Apogee radius	ft
R_{ey}	Reynolds number (unit)	ft^{-1}
R_p	Perigee radius	ft
S_C	Cross-range	ft
S_D	Downrange	ft
SFC	Specific fuel consumption	lb/lb/hr
S_{Ref}	Aerodynamic reference area	ft^2
S_T	Total range	ft
S^{Ψ}	Matrix of adjustable parameter sensitivities	
s	Total solution to linearized state and co-state equations	
T	Thrust	lb
T_{MULT}	Number of engines	
Tol	Vector of constraint tolerances	
T_{VAC}	Total vacuum thrust	lb
t	Time (usually arc time)	sec
t_e	Elapsed time	sec
t_F	Trajectory end time	sec
t_o	Initial time	sec
$(\quad)^T$	Denotes transpose	
U	Control vector	
u	Steering vector	
V	Relative velocity	ft/sec

SYMBOLS (Continued)

Symbols	Description	Unit
V_A	Velocity at apogee	ft/sec
V_I	Inertial velocity	ft/sec
V_p	Velocity at perigee	ft/sec
W	Vehicle weight (lb), or control weighting matrix, or approximate solution to w	
W_{BO}	Booster burn-out weight	lb
W_{e_B}	Booster-stage empty weight	lb
W_{e_o}	Orbiter-stage empty weight	lb
$W_{L.O.}$	Lift-off weight	lb
W_o	Orbiter gross weight	lb
W_{p_B}	Booster propellant weight	lb
W_{p_o}	Orbiter propellant weight	lb
w	In-plane control vector (subset of U)	
X	Asymptotic injection parameter	ft
X_{CG}	Body x station instantaneous center-of-gravity	ft
X_{CGR}	Body x station reference center-of-gravity	ft
X_E	Body x station of engine thrust centroid	ft
X_T	Tail length body station	ft
x	Body station coordinate along axis (ft) or quasitime	
Y	Asymptotic injection parameter, or vector comprised of the QL module state and co-state vectors	
[Y]	Diagonal matrix of parameter weighting factors	
y	State vector	

SYMBOLS (Continued)

Symbols	Description	Unit
Z	Approximate solution to Y vector	
Z_{CG}	Body x-station center-of-gravity	ft
Z_{CGR}	Body z-station reference center-of-gravity	ft
Z_E	Body z-station of engine thrust centroid	ft
z	Body station coordinate normal to axis	ft
α	Angle of attack	deg or rad
α^*	Angle of attack, $\alpha^* > \alpha_{max}$	rad or deg
α_{max}	Maximum angle of attack	rad or deg
α_{OLD}	Angle of attack on last nominal trajectory	rad or deg
β_p	Argument of perigee	rad
γ	Relative flight path angle	rad
γ_I	Inertial flight path angle	rad
$\dot{\gamma}^*$	Pitchover rate	rad/sec
δ_E	Engine deflection angle	rad
ΔL_T	Aerodynamic tail trim force	lb
ΔV_{TOT}	Total characteristic velocity	ft/sec
$\Delta\mu$	Difference in longitude	rad
δ	Total variation operator	
E	Convergence tolerance on governing equations	
ϵ	Convergence tolerance on QL loops	
ζ	True anomaly	rad
$\bar{\zeta}$	True anomaly at impact	rad
θ	Asymptote (rad) or vector of transversality conditions.	rad

SYMBOLS (Continued)

Symbols	Description	Unit
θ_ℓ	Azimuth steering attitude	rad or deg
θ_p	Pitch steering attitude	rad or deg
θ_{pitch}	Relative pitch Euler angle	rad
θ_{roll}	Relative roll Euler angle	rad
θ_{yaw}	Relative yaw Euler angle	rad
$\Lambda^{\Psi_i \Omega_j}$	Matrix of impulse response functions	
λ	Lagrange multipliers for equations of motion in QL module	
λ^{Ψ_i}	Matrix of adjoints for constraint Ψ (arc duration fixed)	
$\lambda^{\Psi_i \Omega_j}$	Matrix of adjoints for constraint Ψ_i subject to cut-off function Ω_j during arc j (arc duration not fixed)	
λ^*_v	Adjoint influence function for velocity	
λ^*_γ	Adjoint influence function for path angle	
λ^*_h	Adjoint influence function for altitude	
λ^*_m	Adjoint influence function for mass	
λ^*_ψ	Adjoint influence function for azimuth	
λ^*_ρ	Adjoint influence function for latitude	
λ^*_μ	Adjoint influence function for longitude	
λ^*_Q	Adjoint influence function for heating	
μ	Longitude angle (rad) or adjoining constant	
μ_β	Booster mass ratio	
μ_r	Reference longitude	rad
μ_o	Orbiter mass ratio	
$\bar{\mu}$	Longitude increment to impact	rad

SYMBOLS (Continued)

Symbols	Description	Unit
ν	Atmospheric viscosity (slugs/ft/sec) or adjoining constant	
π	Constant 3.14159	
ρ	Latitude angle	rad
ρ_a	Atmospheric density	slugs/ft^3
ρ_b	Base atmospheric density (sea level)	slugs/ft^3
ρ_r	Reference latitude	deg or rad
σ	Subvector of steering angles that are free to be optimized	
σ_a	Density ratio	
τ	Arc duration or orbit period	sec
Φ	Payoff	
ϕ	Bank angle	deg or rad
Ψ	Constraint vector or state boundary-conditions vector	
ψ	Azimuth angle	rad
ψ_I	Inertial azimuth angle	rad
ψ_r	Reference azimuth	rad
Ω_j	Cut-off function for arc j	
Ω_j^*	Fixed or desired part of cut-off function for arc j	
ω	Earth rotation rate or adjustable arc cut-off parameter	rad/sec
Ω	Longitude of ascending node	rad

SPECIAL NOTATIONS

I	Inertial or subarc indicator	
IIP	Instantaneous impact conditions	

SYMBOLS (Continued)

Symbols	Description	Unit
i	i^{th} arc	
Δ	Incremental	
1, 2	Engine numbers	

Section 1
INTRODUCTION

The Performance Analysis and Design Synthesis (PADS) computer program has multiple uses in design and performances analysis of a wide variety of aerospace vehicles. The PADS program actually contains four merged computer programs, as indicated in the PADS overall flow chart shown in Figure 1-1.

The trajectory portion of PADS, called TABTOP (Three Dimensional Atmospheric Branched Trajectory Optimization Program), calculates calculus-of-variations optimal trajectories. It consists of two programs; a closed-loop steepest descent (direct) trajectory optimization algorithm plus a quasi-linearization indirect optimal trajectory program (generalized Newton-Raphson).

The sizing or design portion of PADS also contains two programs. The first is called Phase I and consists of a two-stage, launch-vehicle weights analysis based on tabular input or curve fit coefficients. The second is a modified version of SSSP (the Space Shuttle Synthesis Program) originally programmed by General Dynamics Corporation and described in a 1970 report (No. GDC-DBB70-001 to -004). The SSSP program is intended to size manned reusable two-stage launch vehicles such as the Space Shuttle.

By merging these programs, the launch vehicle design can be optimized from a performance and weight standpoint in PADS.

TABTOP, the trajectory portion of PADS, may be used separately. It affords a flexible and efficient trajectory optimization tool for a very wide variety of simulation models and mission constraints. It has several unique capabilities, some of which are itemized below.

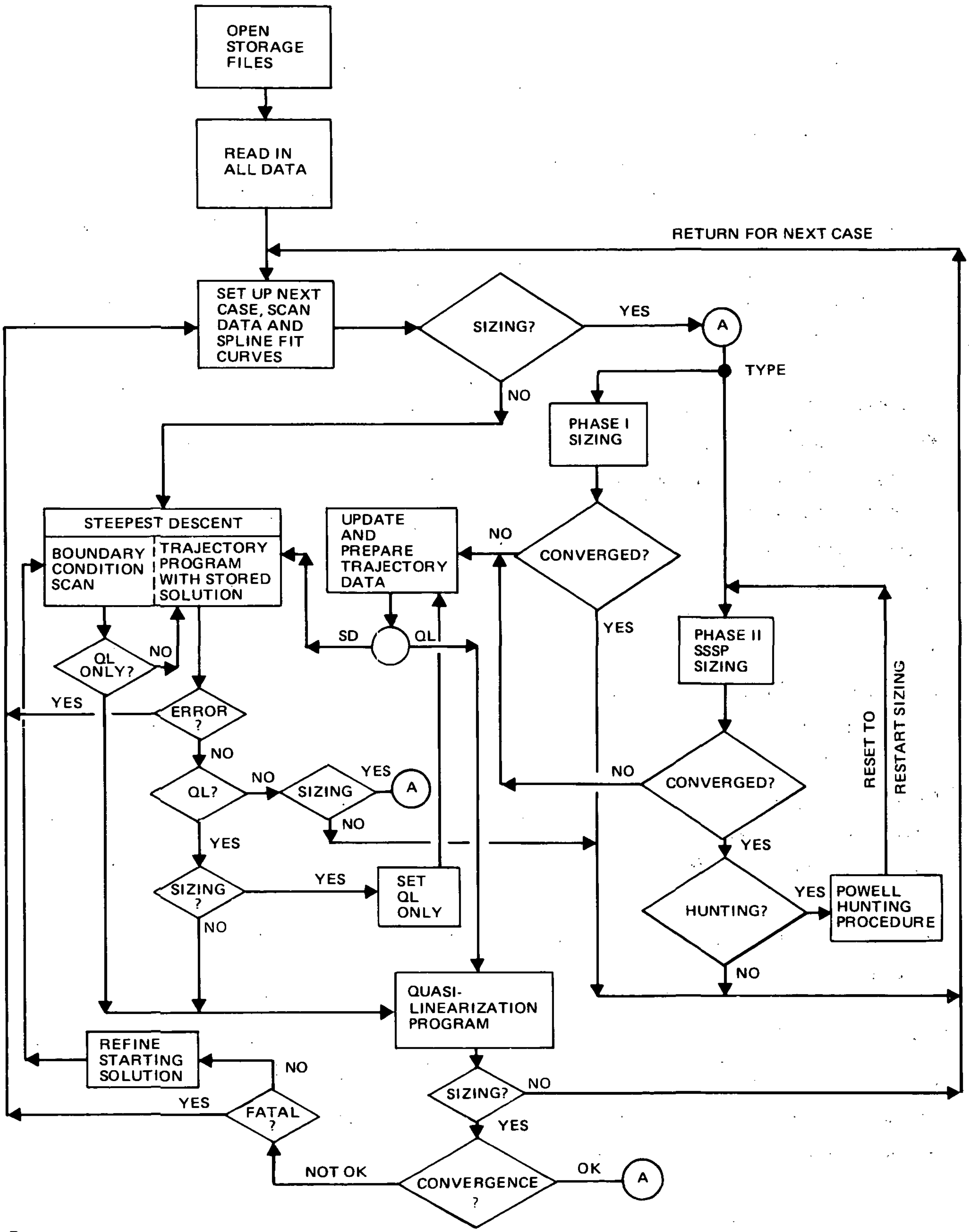

Figure 1-1. PADS Overall Flow Chart

A. The program can solve the three-dimensional atmospheric branched trajectory calculus-of-variations boundary value problem using the method of quasi-linearization.

B. The program can, as an option, solve the approximate optimal trajectory as a result of a steepest descent algorithm (direct solution).

C. The problem constraints and boundary conditions are handled in a generalized way in the indirect solution. This permits the user a general choice of problem boundary conditions and payoffs. There are 36 boundary conditions (targets) supplied in the program. These include a complete set of in-plane and out-of-plane orbital injection parameters plus atmospheric entry-trajectory conditions such as stagnation-point heating, total range, and down- and cross-range.

D. TABTOP also has the capability of constraining in-flight loads (lift and total acceleration), as well as trajectory-dependent in-flight functions including dynamic pressure, heating rate, and Reynolds number.

E. Steering (angle of attack and bank angle) may be optimal or may be governed by a choice of nonoptimal steering laws.

F. The TABTOP program structure is modular to facilitate modifications.

The input scheme chosen for PADS employs NAMELIST software. It is designed to be conversational and user-oriented. The input data for the SSSP portion of PADS remains in its original format, with the exception of trajectory data which, of course, had to be changed to accommodate TABTOP.

The remainder of this manual concisely describes the simulations, assumptions, and operational aspects of the program and concludes with input definitions, and output and error-message descriptions. For greater detail on trajectory program formulation or numerical techniques, see Volumes I and II of this report. For further data on SSSP, see General Dynamics Corporation Report No. GDC-DBB70-001 to -004.

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Section 2

TABTOP TRAJECTORY MODULE

The TABTOP trajectory module contains two parts, as shown in Figure 1-1. The first part is the closed-loop steepest descent SD algorithm which is used by itself for an approximate answer or to generate a starting solution for the quasi-linearization QL program. The QL algorithm may not be employed without a starting solution. This starting solution, usually on tape, may be generated by the SD program or may be a prior QL solution. Conversely, the starting solution tape, once generated, may be employed to give the SD program a starting guess for a control history. However, the SD program can also get a starting guess from input cards.

The interchangeability of starting solutions implies that the SD and QL programs are precisely compatible in all aspects of simulation modeling and trajectory structuring.

The key to structuring is the use of subarcs to divide the trajectory up into segments. The end of each subarc is termed a "corner point." The duration of each subarc is determined by an input arc time, or by an event or cut-off condition.

Each arc in the trajectory is a separate entity and, as such, may have a completely different simulation. This capability is retained even for launch-vehicle sizing problems.

In addition to the simulation changes and cut-off time determination, each arc is also characterized by initial conditions and terminal conditions called targets.

2.1 COORDINATE SYSTEMS

TABTOP uses a spherical, central-force gravitational field, rotating-Earth model. The equations of motion are cast in the Earth-relative flight-path coordinate system shown in Figure 2.1-1.

The initial conditions for the trajectory can be entirely arbitrary. Initial conditions specifications are given in Section 2.8.

2.2 EQUATIONS OF MOTION

$$\overset{\circ}{V} = R\omega^2 \cos\rho\,(\cos\rho \sin\gamma - \sin\rho \cos\psi \cos\gamma) - g \sin\gamma + a^V \qquad (2.2\text{-}1)$$

$$\overset{\circ}{\gamma} = \omega\cos\rho \left\{2 \sin\psi + \frac{R\omega}{V}(\cos\rho \cos\gamma + \sin\rho \cos\psi \sin\gamma)\right\}$$

$$+ \cos\gamma \left(\frac{V}{R} - \frac{g}{V}\right) + \frac{a^\gamma}{V} \cos\phi \qquad (2.2\text{-}2)$$

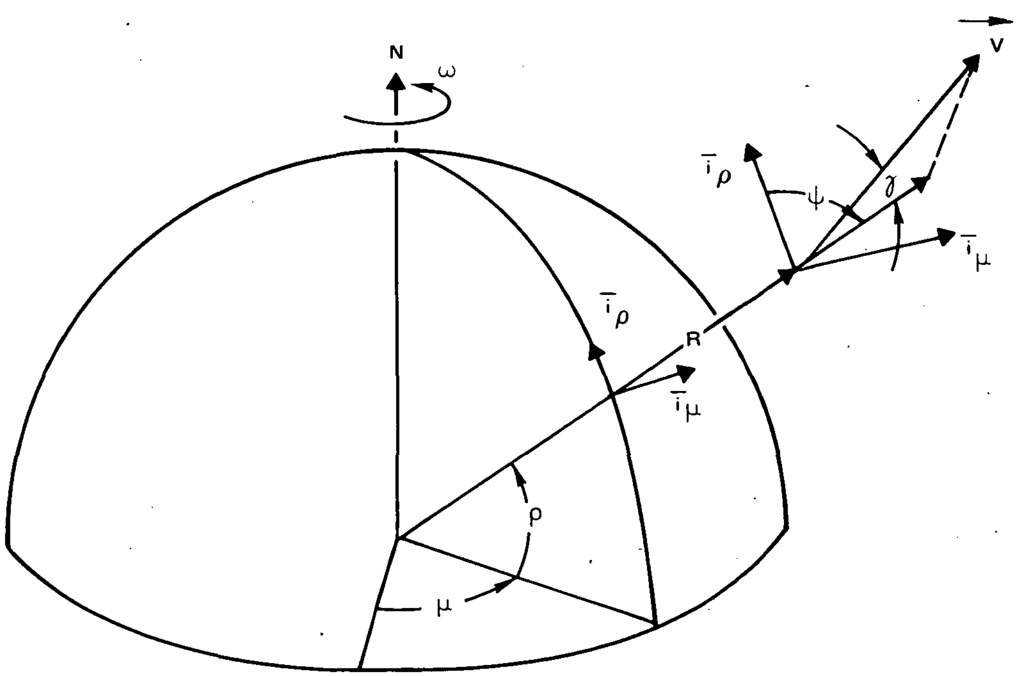


Figure 2.1-1. Earth-Relative Flight-Path Coordinates

$$\mathring{\psi} = \frac{\omega \cos\rho}{\cos\gamma}\left(\frac{R\omega \sin\rho \sin\psi}{V} - 2\cos\psi \sin\gamma\right) + \sin\rho\left(\frac{V\cos\gamma \sin\psi}{R\cos\rho} + 2\omega\right)$$

$$+ \frac{a^{\psi}}{V\cos\gamma}\sin\phi \qquad (2.2\text{-}3)$$

The terms a^V, a^γ, and a^ψ are the elements of the acceleration vector. The values of these elements depend on the type of simulation model employed.

The kinematic equations are:

$$\mathring{h} = \mathring{R} = V\sin\gamma \qquad (2.2\text{-}4)$$

$$\mathring{\rho} = \frac{V\cos\gamma\cos\psi}{R} \qquad (2.2\text{-}5)$$

$$\mathring{\mu} = \frac{V\cos\gamma\sin\psi}{R\cos\rho} \qquad (2.2\text{-}6)$$

The heating equation is included as a state derivative,

$$\mathring{Q} = \frac{17,600}{\sqrt{R_N}}\left(\sigma_d\right)^{1/2}\left(\frac{V}{26,200}\right)^{3.15} \qquad (2.2\text{-}7)$$

2.3 AERODYNAMIC MODELS

The TABTOP module contains several aerodynamic models which are explained below. The aerodynamic option flag, JAER, is associated with each one.

2.3.1 Asymmetric Linearized Lift with Quadratic Drag Polar, JAER = 1

The equations for the total lift and drag coefficients depend on coefficients that are input functions of Mach number.

$$C_L = C_{L_\alpha}\alpha + C_{L_o} \qquad (2.3\text{-}1)$$

$$C_D = C_{D_o} + kC_L^2 \qquad (2.3\text{-}2)$$

It should be noted that all functions of one variable (such as Mach number) are spline-fit before the program execution to ensure continuous first- and second-partial derivatives.

The lift and drag are calculated from these coefficients as:

$$L = C_L q\, S_{REF} \tag{2.3-3}$$

$$D = C_D q\, S_{REF} \tag{2.3-4}$$

2.3.2 Nonlinear Aerodynamics, JAER = 2

A nonlinear aerodynamic model is available in TABTOP. It employs the bivariate nonlinear tabular data

$$C_L = C_L\,(\alpha,\ M) \tag{2.3-5}$$

$$C_D = C_D\,(\alpha,\ M) \tag{2.3-6}$$

These data are curve-fit with a bicubic spline prior to execution. During execution, they are spline-interpolated to ensure continuous derivatives. This tabular input must be bounded, and the maximum angle of attack, ALFMAX, must be limited to less than the highest and lowest angles of attack in the table.

2.3.3 Base Drag

For all aerodynamic options, base drag as a function of altitude may be accounted for through a univariant tabular input of D_b vs altitude.

2.3.4 Static Moment Balance Aerodynamics, JAER = 3

The static moment balance model includes the effect of aerodynamic and propulsive moment balance trim on the overall applied loads. The distribution of the trim forces is accounted for through a blend factor. The moment balance diagram for this model is given in Figure 2.3-1.

The effect of base pressure may also be accounted for with this model.

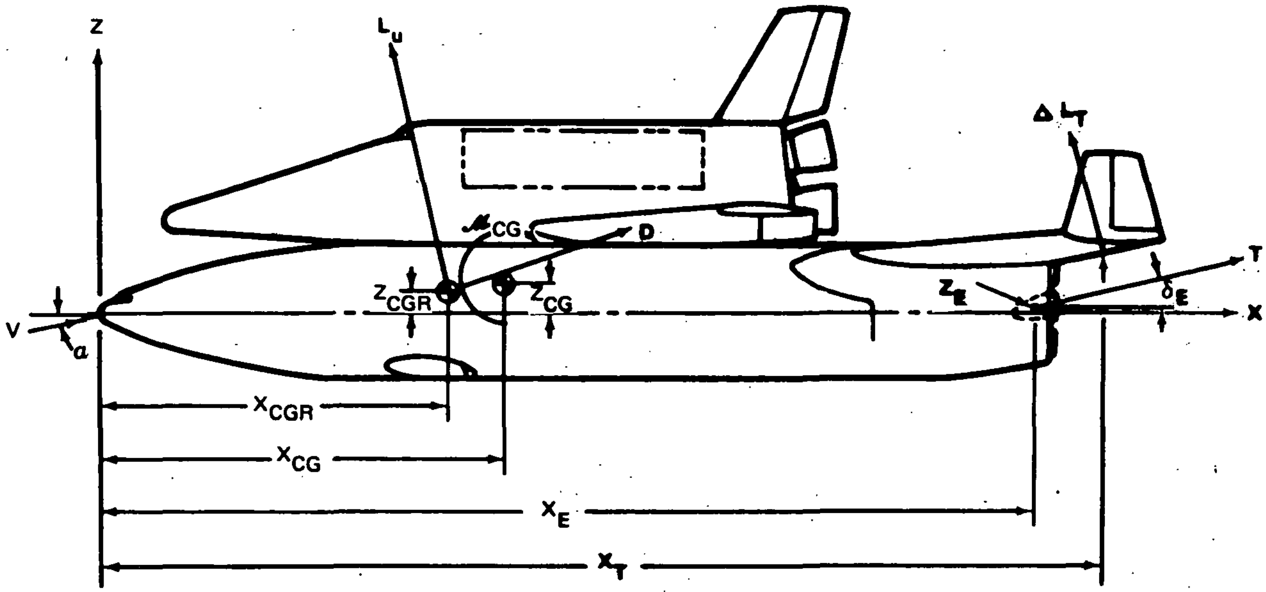


Figure 2.3-1. Moment Balance Diagram—Body Station Coordinate System

The moment balance model employs asymmetric linear aerodynamics. The equations for uncorrected lift, drag, and aerodynamic pitching moment follow.

$$C_{L_u} = C_{L_\alpha} \alpha + C_{L_o} \qquad (2.3\text{-}7)$$

$$L_u = \left(C_{L_\alpha} \alpha + C_{L_o}\right) q\, S_{Ref} \qquad (2.3\text{-}8)$$

$$D = C_{D_o} + k\left(C_{L_u}\right)^2 \qquad (2.3\text{-}9)$$

$$\mathcal{M} = \left(C_{\mathcal{M}_\alpha} \alpha + C_{\mathcal{M}_o}\right) q\, S_{Ref}\, d_{Ref} \qquad (2.3\text{-}10)$$

$$D_B = D_B(h) \qquad (2.3\text{-}11)$$

The base drag is centered at station Z_{BD} and acts parallel to the x axis.

The coefficients C_{L_α}, C_{L_o}, C_{D_o}, k, $C_{\mathcal{M}_\alpha}$, and $C_{\mathcal{M}_o}$ are all univariant functions of Mach number; $C_{\mathcal{M}_\alpha}$ and $C_{\mathcal{M}_o}$ are defined only for the moments about the reference center of gravity, X_{CGR}. The base drag in pounds is a function of altitude.

The actual center of gravity is an input function of instantaneous vehicle weight.

$$X_{CG} = X_{CG}(W), \; Z_{CG} = Z_{CG}(W) \tag{2.3-12}$$

The untrimmed moment about the vehicle center of gravity is therefore approximately

$$\begin{aligned}\mathcal{M}_{CG} = {} & (L_u \cos \alpha + D \sin \alpha) \left(X_{CG} - X_{CGR}\right) \\ & - (D \cos \alpha - L_u \sin \alpha) \left(Z_{CG} - Z_{CGR}\right) \\ & + \left(C_{\mathcal{M}_o} + C_{\mathcal{M}_\alpha} \alpha\right) q \, S_{Ref} \, d_{Ref} + D_B \,(Z_{BD} - Z_{CG})\end{aligned} \tag{2.3-13}$$

This moment is balanced by combining aerodynamic tail control and propulsive trim moments through an input blend-factor function of dynamic pressure

$$j = j\,(q) \tag{2.3-14}$$

The tail control contribution is

$$\left(X_T - X_{CG}\right) \Delta L_T = j \, \mathcal{M}_{CG} \tag{2.3-15}$$

or

$$\Delta L_T = \frac{j \, \mathcal{M}_{CG}}{\left(X_T - X_{CG}\right)} \tag{2.3-16}$$

The corrected lift becomes

$$L = L_u + \Delta L_T \tag{2.3-17}$$

The engine thrust contribution due to gimballing is:

$$\left[\left(X_E - X_{CG}\right) \sin \delta_E - \left(Z_E - Z_{CG}\right) \cos \delta_E\right] T = (1 - j) \mathcal{M}_{CG} \tag{2.3-18}$$

The engine deflection is calculated in an iterative fashion, as described in Volume I.

2.3.5 Parallel Burn Propulsion Model, JPRØ = 3, JAER = 3

The configuration of the parallel burn model is shown in Figure 2.3-2. In the equations, all aerodynamic coefficients are functions of Mach number, M.

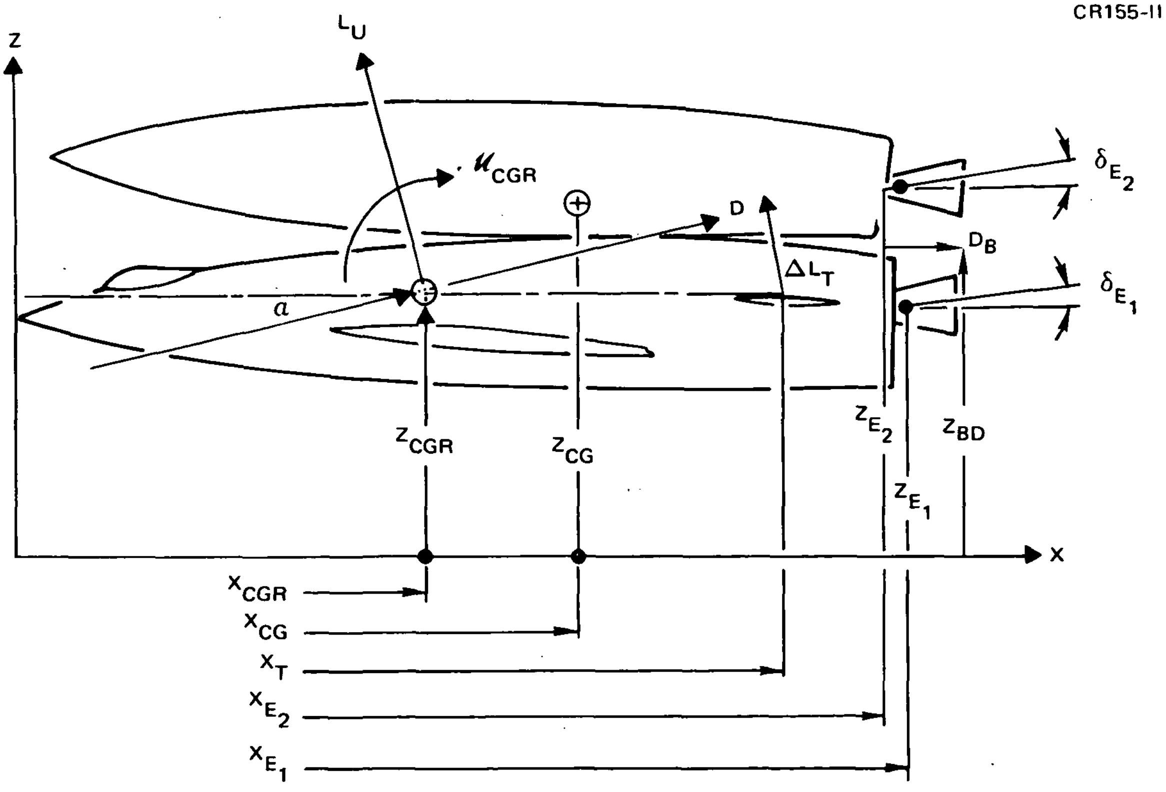


Figure 2.3-2. Parallel Burn Configuration

Aerodynamic lift (untrimmed):

$$L_u = \left(C_{L_\alpha} \alpha + C_{L_o}\right) q \, S_{Ref} \tag{2.3-19}$$

Drag coefficient:

$$C_D = C_{D_o} + k \left(C_{L_u}\right)^2 \tag{2.3-20}$$

Aerodynamic moment:

$$\mathcal{M}_a = \left(C_{\mathcal{M}_\alpha} \alpha + C_{\mathcal{M}_o}\right) q \, S_{Ref} \, d_{Ref} \tag{2.3-21}$$

Center-of-gravity dependency:

$$Z_{CG} = Z_{CG}\,(W) \tag{2.3-22}$$

where W is vehicle total weight

$$X_{CG} = X_{CG}\,(W) \tag{2.3-23}$$

For this model, base drag is centered at Z_{BD} and is parallel to the x axis.

The total untrimmed moment, $\mathcal{M}_{CG}$, about the instantaneous center of gravity depends on which engine is being gimballed or whether both engines are gimballed. Assume the β engine, having thrust T_β, is not gimballed but has fixed engine deflection, δ_{E_β}. Then

$$\begin{aligned}\mathcal{M}_{CG} = {} & \left(L_u \cos\alpha + D \sin\alpha\right)\left(X_{CG} - X_{CGR}\right) + D_B\left(Z_{BD} - Z_{CG}\right) \\ & - \left(D \cos\alpha - L_u \sin\alpha\right)\left(Z_{CG} - Z_{CGR}\right) + \mathcal{M}_a \\ & - \left(Z_E - Z_{CG}\right) T_\beta \cos\delta_{E_\beta} + \left(X_E - X_{CG}\right) T_\beta \sin\delta_{E_\beta}\end{aligned} \tag{2.3-24}$$

If both engines are gimballed, the last two terms involving T_β are excluded.

The tail contribution to balance the moment depends on the blend factor $j = j(q)$, where q is the dynamic pressure $\left(= \frac{\rho}{2} V^2\right)$

$$\Delta L_T = \frac{j \mathcal{M}_{CG}}{\left(X_T - X_{CG}\right)} \tag{2.3-25}$$

For one-engine fixed, the gimballable engine deflection for engine γ required to balance the remainder of the moment is:

$$\left[\left(X_{E_\gamma} - X_{CG}\right) \sin \delta_{E_\gamma} - \left(Z_{E_\gamma} - Z_{CG}\right) \cos \delta_{E_\gamma}\right] T_\gamma = (1-j) \mathcal{M}_{CG} \quad . \tag{2.3-26}$$

If both engines are gimballed, we have

$$\left[T_\beta \left(X_{E_\beta} - X_{CG}\right) + T_\gamma \left(X_{E_\gamma} - X_{CG}\right)\right] \sin \delta_E$$

$$- \left[T_\beta \left(Z_{E_\beta} - Z_{CG}\right) + T_\gamma \left(Z_{E_\gamma} - Z_{CG}\right)\right] \cos \delta_E = (1-j) \mathcal{M}_{CG} \tag{2.3-27}$$

This completes the governing equation for engine-deflection solution. It remains to describe the applied-load terms in the equation of motion. The general form is

$$\dot{y} = f(y) + G a \tag{2.3-28}$$

where f (y) are the applied-load independent terms, G is a diagonal matrix of applied-load independent multiplying factors, and a is the acceleration vector having elements

$$a = \begin{pmatrix} a^V \\ a^\gamma \\ a^\psi \\ a^m \end{pmatrix} \tag{2.3-29}$$

and

$$\text{diag}\ [G] = \left[1, \frac{1}{V}, \frac{1}{v \cos \gamma}, \frac{1}{g_r}\right] \tag{2.3-30}$$

The equations for the first three elements of a are

$$a^V = \frac{T_1 \cos\left(\alpha - \delta_{E_1}\right) + T_2 \cos\left(\alpha - \delta_{E_2}\right) - D - D_B \cos \alpha}{m} \tag{2.3-31}$$

let

$$a^x = \frac{T_1 \sin\left(\alpha - \delta_{E_1}\right) + T_2 \sin\left(\alpha - \delta_{E_2}\right) + L - D_B \sin \alpha}{m} \tag{2.3-32}$$

then

$$a^\gamma = a^x \cos \phi \tag{2.3-33}$$

$$a^\psi = a^x \sin \phi \tag{2.3-34}$$

The equation for a^m is given by

$$a^m = -\left(\frac{T_1}{ISP_1} + \frac{T_2}{ISP_2}\right) \tag{2.3-35}$$

where

T_1 and T_2 are functions of t

and

ISP_1 and ISP_2 are constants.

2.4 PROPULSION MODELS

Three propulsion models are available in TABTOP. The basic rocket model accommodates most liquid or solid rockets. The second model is used only for sizing with SSSP and simulates simultaneous thrusting of two engines with different specific impulses. The last option permits simulation of turbojet air-breather engines. Each of these models is described below.

2.4.1 Rocket Models JPRØ = 0

The vacuum thrust per engine may be input as a function of arc time or burn time. The total thrust then accounts for the number of engines and their respective nozzle areas

$$T = \left[F_{VAC} - A_{exit}\, p_a\right] \times T_{MULT} \qquad (2.4\text{-}1)$$

where T_{MULT} is the number of engines. In the event that the vacuum thrust is a constant, it may be entered as such in the table or may instead be input as a separate constant, thereby eliminating the need for table input.

Engine throttling to limit total acceleration is an option that may be triggered by inputting the acceleration limit value for the desired arc. Engine throttling may incur some loss in effective ISP. This can be accounted for by an input table of percent ISP loss versus percent maximum thrust. Maximum thrust may be an input constant or if omitted, the program will choose the first tabular vacuum thrust input. If vacuum thrust has already been input as a separate constant and throttling occurs, the same constant value is assumed to be the maximum thrust.

2.4.2 Dual Rocket Model, JPRØ = 1

In order to accommodate droppable solid boosters and dual-burn expendable tank options in SSSP, a simulation must be made which accounts for different ISP levels during throttling or time-varying thrust of one of the two engines. This option is automatic when either of these dual-engine sizing modes is chosen in SSSP except that the propulsion option flag (JPRØ) must be input as 1. The detailed description of this model is reserved for Section 5.

2.4.3 Air-Breather, JPRØ = 2

The air-breather option in TABTOP incorporates bivariate tables of thrust and specific fuel consumption as functions of velocity and altitude. This option may be used with both aerodynamic models JAER = 1 and JAER = 3, but cannot be used in conjunction with the bivariate (nonlinear) aerodynamic model, JAER = 2.

In most circumstances, air-breathers are not gimballed; however, for the moment balance model, this does not preclude the use of aerodynamic trim exclusively.

2.5 GEOPHYSICS AND ATMOSPHERIC MODELS

The program contains the rotating central-force field Earth model. The gravitational attraction at altitude h is

$$g = g_r \left(\frac{E_R}{E_R + h}\right)^2 \tag{2.5-1}$$

TABTOP includes both the 1962 Standard Atmosphere and the 1963 Patrick Air Force Base atmosphere as well as vacuum simulation. These atmospheric models are analytic and allow high-order continuous partial derivatives.

2.6 CONTROL MODES

The basic control variables in TABTOP are angle of attack, α, and bank angle, ϕ. The vehicle is assumed to have no yaw angle. This is accomplished by banking the vehicle around the relative velocity vector, as shown in Figure 2.6-1.

CR155-I

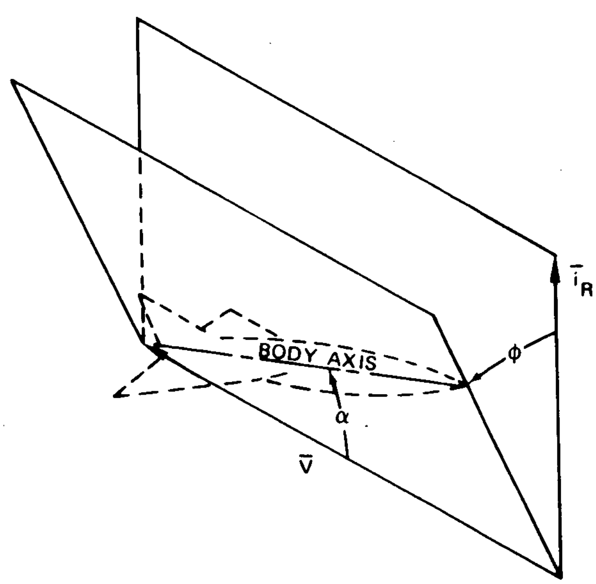


Figure 2.6-1. Vehicle Control Angles

The various control modes available in TABTOP are described in the following text. The prime control mode, of course, is optimal (IMØDE = 1). This is calculated in the steepest descent program by successive adjustments to the starting control history based on the local gradient. (See Volume I for a detailed description of this procedure.) During the indirect solution done by the quasi-linearization portion of TABTOP, the optimal control is solved as one of the necessary conditions of the calculus of variations (again, see Volume I).

A second optimal control mode is provided to fix the bank angle to zero and just optimize the angle of attack. This is control mode 2 (IMØDE = 2).

2.6.1 Vertical Rise, IMØDE = 3

The vertical rise control mode is available for ascent trajectories in TABTOP. Since the differential equations in relative coordinates are undefined at zero velocity or at a path angle of 90 degrees, special limit functions are used to define the control. These apply on the vertical rise

$$F = V\dot{\gamma}^{*} = \text{constant} \tag{2.6-1}$$

$$G = V \cos \gamma \dot{\psi} = 0 \tag{2.6-2}$$

Equation (2.6-2) implies $\dot{\psi}$ is zero and these two functions are used to define explicitly the angle of attack and bank angle on the vertical rise. This control mode is also used for a prescribed pitchover maneuver since $\dot{\gamma}^{*}$ need not be zero. $\dot{\gamma}^{*}$ is input as 0 for a vertical rise arc or at some negative pitch rate (deg per sec) for a pitchover arc.

2.6.2 Gravity Turn, IMØDE = 4

The gravity turn control mode results in no net applied load normal to the vehicle flight path. Bank angle is still optimized.

2.6.3 Zero Control, IMØDE = 5

Both angle of attack and bank angle can be set to zero using control mode IMØDE = 5.

2.7 INEQUALITY CONSTRAINTS

The capability for constraining various types of functions instantaneously on the trajectory is an important aspect of TABTOP. These functions fall into two categories; those that are explicit functions of control and those that are not.

The first category (functions of control) includes (1) maximum angle of attack, (2) maximum lift, and (3) maximum total acceleration. The second category includes (1) maximum dynamic pressure, (2) maximum heating rate, and (3) maximum Reynolds number.

Of the two types of inequality constraints, the first needs no explanation except a reminder that maximum total acceleration during rocket-powered arcs means throttling and not control modulation. There is, however, a special consideration for starting control histories where problems exist with total acceleration limits. This will be discussed in Section 2.9.

The second category is called a state inequality constraint. The method employed to solve this requires that the state function must reach the bounding value. The point where the bound is reached is then a corner point. After the corner point, the control is solved to drive the rate of change of the bounding functions to zero, thereby flying the boundary until the optimal control yields a negative rate of change of the bounding function. At that point, the bound is left "tangentially."

An important difference between the steepest descent and the QL solution should be noted. The steepest descent program treates the corner condition as an inequality. If the bounding value of the function is not reached before the time derivative of the function becomes zero, an artificial corner is supplied at approximately the time when the derivative hits zero. The boundary is then not flown. If, however, on the next iteration the boundary is hit, the corner point will precisely reflect hitting the boundary. At the end of the steepest descent solution, the status of the inequality corner will be either on or off and the QL program will respond accordingly, forcing the corner condition or treating the arc as just a fixed-time segment of the trajectory.

It should be also noted that once the vehicle stops flying the boundary, the program will not recognize secondary boundary violations. Fortunately, the likelihood of secondary boundary violations is quite small.

2.8 INITIAL CONDITIONS, TARGETS, AND MISSION CONSTRAINTS

2.8.1 Initial Conditions

The required trajectory initial conditions inputs for TABTOP are more extensive than those used in ordinary trajectory programs. This stems from the fact that in calculus-of-variations analyses, there are two types of boundary conditions that have to be matched. The first is the more familiar type comprising such items as arc cut-off functions and orbital parameters. The second arises from the necessary variational conditions that are called transversality relations.

Both the SD and QL modules can derive these transversality conditions or their equivalent in a completely general sense. However, to do so requires particular information on how the initial time condition for each arc should be determined. Also, information is needed on the nature of the state at the beginning of the trajectory and the weight at the beginning of key arcs. Likewise, branching problems have certain requirements. The ideas to keep in mind for setting up problem initial conditions are itemized below.

A. Trajectory Initial Point

At the initial point in the trajectory, the states are either specified to be known or they are free to be optimized. If any are to be optimized, a best guess of their value must be supplied as a starting point.

The time for the first arc is known if the arc is to have a fixed duration. If the arc duration is to be determined by a cut-off condition (see next section), the arc time must be specified as an unknown quantity.

The specification of an optimized arc time will be discussed in Item D.

B. Trajectory Intermediate Corner Point

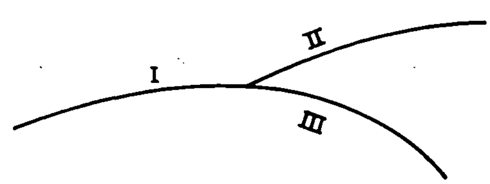
At intermediate corner points, the state will be continuous with only two exceptions. The continuous state condition need not be specified through input since it is a preset condition in the program. The two exceptions are arc time and weight. The arc time input specification rule for intermediate arcs as well as for the terminal arc is the same as for the initial arc.

The initial weight, however, at the beginning of each arc after the first may be specified in several ways. The simplest is continuity, the automatic condition which needs no specification. The second is known, which means that the weight is reinitialized to a new value independent of the weight at the end of the previous arc. The third is to specify a weight drop, which means the weight at the beginning of the new arc equals the weight at the end of the previous arc less a specified constant weight. The fourth method is to calculate a weight dropped as part of the Phase I sizing algorithm. The last method, used for branch problems, forces the sum of the weights of the two branch initial points to be the weight at the end of the "trunk." This is further explained in Item C. Data card setups are given in Section 3.6.

C. Initial Conditions for Branch Problems

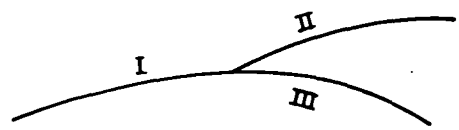
Trajectory initial conditions are also used to trigger branch problems. Input is used to specify the arc-end corner point to be tied to the second branch of the problem. The weights at the beginning of each branch may be continuous or may have any of the specifications described previously. Some examples are given below. Input data setups for these examples are given in Section 3.6.

Example 1. Continuity (no specification)



Result: $W_{III} = W_{II} = W_{I}$

Example 2. W_{II} and W_{III} specified as known



$W_{III} = W^{*}_{III}$ input known value

$W_{II} = W^{*}_{II}$ input known value

Example 3. W_{II} specified as known, and a weight drop, ΔW^{*}_{III}, specified for Arc III

Result: $W_{II} = W^{*}_{II}$

$W_{III} = W_{I} - \Delta W^{*}_{III}$ (input drop weight)

Example 4. W_{II} specified as known (W^{*}_{II} is known value)

W_{III} specified to be sum of parts

Result: $W_{II} = W^{*}_{II}$

$W_{III} = W_{I} - W^{*}_{II}$

Example 5. W_{II} result of weight drop, ΔW^{*}_{II}; W_{III} specified by sum of parts.

Result: $W_{II} = W_{I} - \Delta W^{*}_{II}$

$W_{III} = \Delta W^{*}_{II}$

The following type of situation is not permitted on sum-of-parts specifications. The sum-of-parts specification may not be placed on the initial weight of the first branch.

D. Arc Time Optimization

As a general rule, arc time optimization may be specified for any arc where there is no time-dependent weight discontinuity occurring at the end of the arc. If a time-dependent weight discontinuity does occur there, a special situation exists which can be handled only in a Phase I sizing problem (discussed in Section 4.4).

Some special consideration for simple arc-time optimization with no time-dependent weight discontinuities is given below.

First of all, no concurrent arc cut-off conditions may be specified. This is inconsistent with fundamental program operation and will cause immediate determination of execution. For example, if the arc time for, say, Arc II of the trajectory is to be optimized, an estimate of the arc time must be supplied. The trajectory program will then use the estimate of optimal arc time as a first guess and proceed to modify it iteratively to satisfy optimization criteria. No other specification (such as a cut-off conditions) that can determine the arc time is consistent with this optimization scheme.

Second, the user should carefully consider situations where vehicle control is being switched from nonoptimal to optimal control or vice versa at an optimized arc time. An example of poor choice of control switching from nonoptimal to optimal at an optimized arc time can occur when the duration of a pitchover arc is optimized prior to beginning optimal control. This is a bad setup because the optimal control will always be better than a fixed-rate pitchover and the pitchover arc duration will tend to be driven to zero. On the other hand, if the pitchover arc is followed by a gravity turn arc, the probability of a valid optimal arc time solution is quite good. Likewise, switching from an atmospheric model to a vacuum simulation or vice versa should be carefully considered. If an atmosphere arc is followed by a vacuum arc, the optimization of the corner point may tend to be artifically and incorrectly biased. Any situation which tends to eliminate an arc (make total arc duration less than three integration steps) is usually fatal to program execution.

2.8.2 Trajectory Targets

The targets fall into three categories: (1) arc cut-off functions, (2) problem constraints, and (3) the payoff function. The choices of these targets are itemized in Table 2.8-1.

The equations for the orbital parameter and range targets are presented in Volume I. Figures 2.8-1 through 2.8-4 illustrate the key parameters.

2.8.2.1 Cut-off Functions

The cut-off function use has been introduced in TABTOP as an alternative to requiring fixed arc times. The rules for using it are:

A. All arc cut-offs must be completed in proper sequence. There can be no null arcs of undefinable duration (cut-off never satisfied).

B. The arc cut-off must define an arc having at least three integration steps.

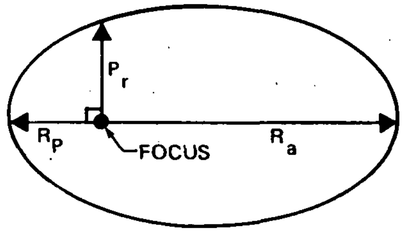
C. The direction in which the arc cut-off function is changing with arc time must be specified; that is, the rate of change of the arc cut-off function should be known a priori in the arc where it is used.

D. Whenever an arc cut-off function is specified, the corresponding arc-time initial condition must be flagged as an unknown.

E. When a state inequality condition exists in the following arc, precisely the same cut-off function must be input for the current arc. The state inequality condition will otherwise be ignored by the program.

2.8.2.2 Constraints

Problem constraints form the bulk of the boundary conditions to be satisfied by the trajectory program. Most times, the constraints will only be applied at the terminus of the trajectory; however, TABTOP has the capability of applying constraints on one intermediate corner point or in the case of branching, at the end of each branch. In any event, a maximum total of eight problem constraints is permitted.



P_r SEMI-LATUS RECTUM

R_P PERIGEE

R_a APOGEE

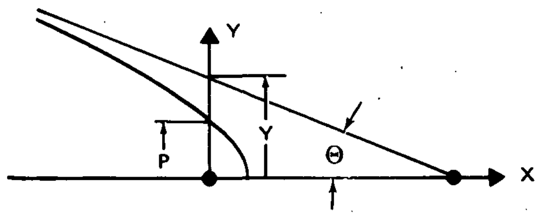
$a_S = \frac{R_P + R_a}{2}$ SEMI-MAJOR AXIS

$e = \frac{R_a - R_P}{R_a + R_P}$ ECCENTRICITY

$H = \sqrt{GMp}$

$E = 2\,GM/a$, TRUE ANOMALY $= \mathrm{TAN}^{-1}\left(\frac{\mathrm{TAN}\,\gamma_I}{1 - \frac{r}{p}}\right)$

Figure 2.8-1. Planar Elliptical Orbit Parameters

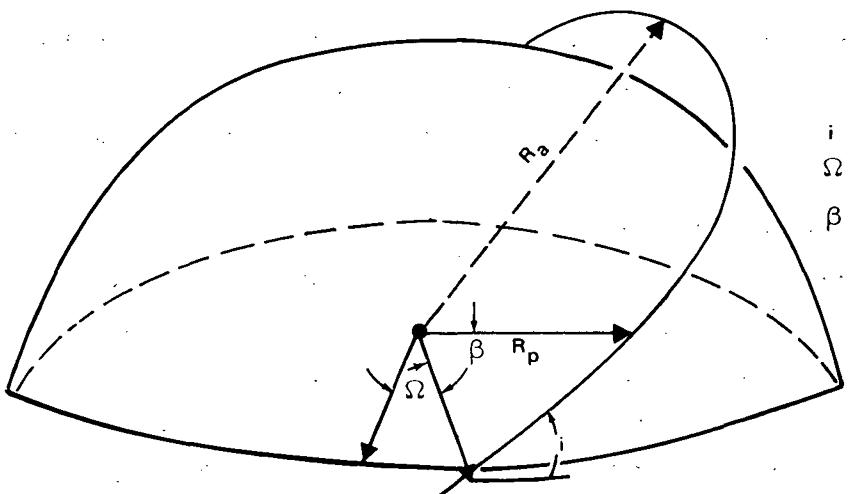


Θ ASYMPTOTE

Y NORMAL DISTANCE

X HYPERBOLA AXIS DISTANCE

Figure 2.8-2. Asymptotic Parameters

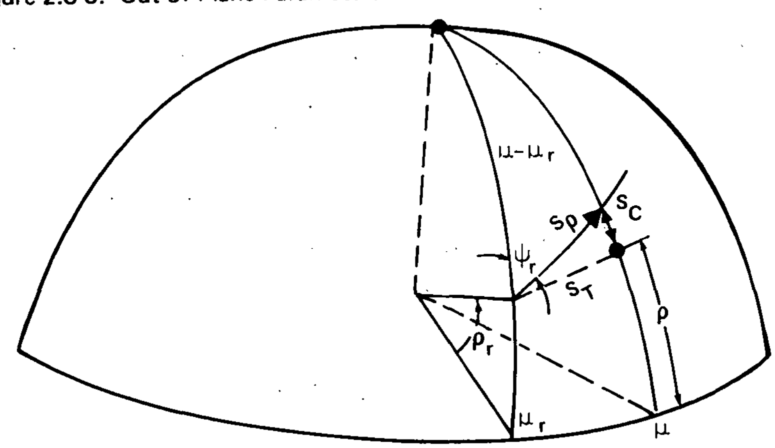


i INCLINATION

Ω LONGITUDE OF ASCENDING NODE

β ARGUMENT OF PERIGEE

Figure 2.8-3. Out-of Plane Parameters



μ_r = REFERENCE LONGITUDE

ρ_r = REFERENCE LATITUDE

ψ_r = REFERENCE AZIMUTH

μ = VEHICLE LONGITUDE

ρ = VEHICLE LATITUDE

S_D = DOWNRANGE

S_C = CROSS-RANGE

S_T = TOTAL RANGE

Figure 2.8-4. Range Targets

Table 2.8-1

TRAJECTORY TARGETS

Variable Code	Meaning	Units
1	Arc time	sec
2	Relative velocity	ft/sec
3	Relative path angle	deg
4	Altitude	ft
5	Weight	lb
6	Azimuth	deg
7	Latitude	deg
8	Relative longitude	deg
9	Elapsed time	sec
10	Heat load	Btu/ft^2
11	Penetration (not used)	
12	Inertial velocity	ft/sec
13	Inertial path angle	deg
14	Inertial azimuth	deg
15	Inertial longitude	deg
16	Semi-latus rectum	ft
17	Eccentricity	-
18	Inclination	deg
19	Argument of perigee	deg
20	Longitude of the ascending node	deg
21	Semi-major axis	ft
22	Apogee radius	ft
23	Perigee radius	ft
24	True anomaly	deg
25	Cap X	ft
26	Cap Y	ft
27	Outgoing asymptote	deg
28	Energy	ft^2/sec^2
29	Momentum	ft^2/sec^2
30	Downrange	ft
31	Cross-range	ft
32	Total range	ft
33	Dynamic pressure	lb/ft^2
34	Heating rate	Btu/ft^2/sec
35	Unit Reynolds number	ft^{-1}
36	Payload	lb

Following are some suggestions for choosing constraints.

A. Caution should be exercised to avoid overspecifying a problem by applying too many target constraints. The SD program will not recognize this fault; however, the QL algorithm will stop execution when this situation is detected.

B. Use relative state target constraints whenever possible since these are linear in behavior and permit more rapid program convergence than nonlinear function constraints. (A nonlinear constraint is a nonlinear relationship involving the relative states.)

If relative states cannot be used, give preference to the most linear-behaving functions. An example would be to avoid using orbit eccentricity as a constraint when it is to be very close to zero (less than about 0.005).

C. At the corner where target constraints are applied, choose the cut-off condition to complement the constraints that are to be satisfied.

D. If an inequality constraint is desired, use a two-pass approach to solving the problem. First, solve the problem without the constraint and if the solution shows it will be violated, resubmit it with the constraint imposed.

E. A branch problem must have at least one target constraint on the end of the first branch.

2.8.2.3 Payoff

The payoff function is the one quantity chosen from Table 2.8-1 which is to be maximized or minimized. It must be defined at the end of the terminal trajectory arc. This applies as well to branch problems where the payoff must be defined at the end of the second branch. In the event that there are intermediate arc constraints, the payoff can still be defined only at the end of the trajectory.

2.9 STEEPEST DESCENT STARTING SOLUTION

Normally, the steepest descent program requires an input of the starting guess of the control history. This guessed control history is used to generate the first nominal trajectory.

A number of input control options are available for this first nominal trajectory and it may be subdivided in a number of ways to permit changing the control option. These special trajectory subdivisions, called phases, are used only in the steepest descent program. The primary purpose of phasing is to aid in the construction of the first nominal control history. It It is also used during steepest descent trial and solution trajectories to permit spanning several optimal control arcs with the same phase.

For the first nominal control history, a control option with an associated set of tables is used for an entire phase; tables are interpolated as a function of phase time. This phase may be initiated at an arc corner point and end at a later arc corner point. It may also have its own cut-off function independent of the arc cut-offs in the trajectory. The last phase in the starting solution must terminate concurrently with the last trajectory arc. Examples of starting solution phasing and its associated input are given in Section 3.8.2.

The choice of the first nominal trajectory control history can be very important to the convergence of the steepest descent program. Of primary concern is the requirement that the choice will permit satisfying all the arc cut-off conditions. If this does not occur, the result will usually be an abortive execution error.

Another important factor occurs when total acceleration is limited during powered or unpowered flight. In unpowered flight, it is important that the total acceleration limit will not occur at zero aerodynamic lift at any point in the first nominal trajectory. When this happens, there is no instantaneous bounding control solution, and execution has to be terminated.

During rocket-powered flight, the engine will be throttled to limit total acceleration. Situations where aerodynamic loads are very high due to high angles of attack may require increased thrust to maintain the acceleration boundary. Increasing thrust beyond the maximum rated value is not permitted, and hence this situation will also stop execution.

When the fixed rate-of-change of flight-path angle control mode is employed, the force capability of the vehicle may sometimes be insufficient to satisfy the governing equations. In any situation where this or any nonoptimal or bounding control has no local solution on the first nominal trajectory, the result is a fatal execution error. Execution errors are catalogued and explained in Section 2.10.3.

2.10 TRAJECTORY ITERATION PROCESS

In this section, the trajectory iteration process will be described in terms of the typical output results at each stage of the process. For purposes of this discussion, sizing options will be assumed inactive. The consequences of sizing are described in Sections 3 and 4.

2.10.1 INPUT Scan

The first printout of the program is a dump of the input card images precisely as they are punched. After this, the input editor reads in the card images and breaks down input data into separate logical records that are stored on a FASTRAND drum or disc. If errors in card format or variable names are detected, the NAMELIST input software will terminate the execution at the point of the error and on many computers, print out the faulty card image.

After the file of input records (part cases) is created, the detailed input scan and interpretation is begun. The input scan involves many steps, each of which can detect faults in the input data and print out descriptive messages as to the nature of the error. The key processes that go on during the input scan are:

A. Univariant table spline fit
B. Bivariate table bicubic spline fit
C. Simulation model and arc-data scan
D. Initial and target condition table construction and interpretation
E. Steepest descent first nominal control-history phase-structure processing
F. Steepest descent solution-trajectory phase structuring
G. Update of preset tolerances and parameter weighting factors.

Key input scan-error messages and their meaning are itemized below.

1. INPUT ERROR IN PART-CASE $\boxed{N}$

   This error message implies all data for part-case N is missing. (The part-cases are the records in the file mentioned above.) To identify the data in each part-case, see the input data glossary in Section 6.

2. FATAL INPUT ERRØR

   TOO MANY TABLES AND/OR TOO MANY POINTS, THE SUM OF THE LARGEST TABLE .....

   This message is self-explanatory. The user is referred to Section 3. 2. 2 for rules on univariant table inputs.

3. FATAL INPUT ERROR

   TABLE NO. N, THE POINT X = ..., IS NOT DISTINCT

   This message means there are two or more identical arguments in the univariant table No. N.

4. *****FATAL INPUT ERRØR*****

   THE VALUE (I) IS AN ILLEGAL DATA SET FOR BIVARIATE DATA

   Set numbers (I) must be 6, 7, 8, or 9. (See Section 3. 4.)

5. *****FATAL INPUT ERRØR*****

   THE BIVARIATE DATA SET I WAS NOT INPUT

   A bivariate aerodynamic or air-breather propulsion option was called for, but no data for the set were input (See Section 3. 4 or 3. 5).

6. *****FATAL INPUT ERRØR****

   LESS THAN THREE TABLES OF BIVARIATE DATA WERE INPUT IN DATA SET I

   There must be a minimum of three arguments in each direction of the bivariate tables (see Section 3. 4 or 3. 5).

7. *****FATAL INPUT ERRØR*****

   LESS THAN SIX ENTRIES PER TABLE OF BIVARIATE DATA WERE INPUT IN DATA SET I

   See Item 6 for explanation.

8. *****FATAL INPUT ERRØR*****

   BIVARIATE DATA TABLE N IN DATA SET I IS TOO SHORT

   The number of first arguments and the number of table entries do not agree for the N^{th} second argument table.

9. *****FATAL INPUT ERRØR*****

BIVARIATE DATA TABLE N IN DATA SET I IS TOO LONG

See explanation for Item 8.

10. *****FATAL INPUT ERRØR*****

ARG 1 = ..., IS NOT UNIQUE IN DATA SET I

A first argument has been repeated within Set I.

11. *****FATAL INPUT ERRØR*****

ARG 2 = ..., IS NOT UNIQUE IN DATA SET I

A second argument has been repeated within Set I.

12. FATAL INPUT ERROR

NO INITIAL CONDITIONS FOR ARC 1

The state and arc-time initial condition data have not been input for arc 1.

13. FATAL INPUT ERROR

STARTING SOLUTION, FILE 11, IS NOT AVAILABLE FOR THIS CASE

Program tried to read file 11, the starting solution tape, and found an end-of-file.

14. FATAL INPUT ERROR

ARC I CONTROL MODE = J IS ILLEGAL

An illegal control mode has been chosen for Arc I (see Section 3.10).

15. FATAL INPUT ERROR

PAYOFF MULTIPLY DEFINED, ORIGINALLY IØP = ☐ VALØP = ☐ ....., NEW DATA IØP = ☐ VALOP = ...

There may be only one problem PAYØFF (performance index).

16. FATAL INPUT ERROR

INITIAL CONDITION CODE FOR ARC $\boxed{I}$ VARIABLE NUMBER $\boxed{J}$ = $\boxed{?}$ IS NOT INTERPRETABLE

The initial condition codes are described in Section 3.6. This error message indicates an illegal choice of these codes.

17. FATAL INPUT ERROR

STOPPING CONDITION FOR ARC ☐ IS UNDEFINED

This message means that no cut-off data have been input for arc ☐ (see Section 3.6).

18. FATAL INPUT ERROR

STOPPING CONDITION FOR ARC ☐ IS MULTIPLY DEFINED

Cut-off for Arc ☐ has been defined more than once. Program cannot pick one (see Section 3.6).

19. I IS AN ILLEGAL STOPPING VARIABLE CODE

Stopping or cut-off variable codes may be from 1 through 36 excluding 11 (see Table 2.8.1 and Section 3.6).

20. I IS AN ILLEGAL CONSTRAINT CODE

Constraint variable codes may be from 2 through 36 (Variable 1 corresponds to arc time which cannot be a constraint). See Table 2.8.1 and Section 3.6.

2.10.2 Steepest Descent Trajectory Sequence

On completion of the input scan, barring fatal errors the program is ready to integrate the first nominal trajectory. During this integration, it will print a standard block at all the corner points. Note that all print options are suppressed until the solution trajectory is integrated. At the end of the trajectory, it will print out the constraint misses in the DCØN array.

Next, the adjoint initial conditions are calculated for the constraint adjoint sets. It will then integrate them back to the initial time and print out their values and parameter sensitivities at that point. The next one or more trajectories will be corrected to reduce the constraint misses to less than input tolerance levels. When constraints are within tolerance, the next adjoint solution will contain the payoff set and the DCØN printout will contain the payoff improvement. For the first so-called optimization pass, the payoff improvement will be the input value DPAY.

Each new completed trajectory generated from corrected control and parameters is tested to determine the following: Did the payoff improve? Are the constraint misses still within tolerance?

If either test is not passed, the payoff improvement is scaled down. If scaling down several times does not solve the problem, a message is printed and the last good trajectory is integrated. Sometimes, if the payoff improvement or constraint errors are too large, the computed control correction or trajectory integration will exhibit divergence. If this happens, the integration will stop, and at that point an error message and a current print block will appear. Step-size scaling will then occur and a new trajectory will be integrated.

Certain special situations can arise during optimization passes. If constraint tolerances are permitted to be relatively large, it is possible that the restoration of the constraints will produce a net degradation of payoff. If this is predicted, a message will print out and the program will return to do a constraint restoration pass before starting optimization again. If the same thing happens anytime after optimization is renewed, the program will print out the last good trajectory as the solution.

Another special situation can occur with state inequality cut-off conditions. If during a trial trajectory, the arc time determined by an inequality cut-off changes radically, a potentially divergent situation can occur. To avoid this, the integration will stop and restart with a scaled down step size.

So far, several of the situations described will result in printing out a solution trajectory. Some of these will yield a properly optimized flight path. However, the way the program should normally determine the solution is when the predicted payoff improvement is less than an input minimum value (PMIN). If the number of iterations exceeds the input maximum value (NITER), the likelihood of a good solution is small unless the step size is close to PMIN. If the computed step size is still large, it is possible to restart the solution from the last trajectory and continue optimization until normal termination.

After the solution is achieved, the program, if flagged, will perform a transformation of the adjoints to get an approximation of the Euler-Lagrange multipliers and store these, the state, and the control on tape (or disc 6500).

2.10.3 Steepest Descent Execution Errors and Convergence Hints

A comprehensive survey of steepest descent convergence problems and system termination error remedies cannot be written because of the generality of the program. However, some of the more likely situations are listed below.

A. Computed GØTØ error or storage retrieval error on file 39 on first adjoint solution or on first trial trajectory.

   This will usually mean that an arc or phase cut-off has been specified incorrectly or cannot be satisfied on the first nominal trajectory (see examples in Sections 3.6 and 3.8).

B. Control divergence error (PADS generated error message).

   This error message causes step-size scaling to occur on trial trajectories, but can cause a fatal error on the first nominal trajectory.

   The conditions that can cause the fatal error are listed below with discrimination clues.

   1. Angle-of-attack divergence

      The print block magnitude of ALPHA will exceed 240 degrees.

   2. Integration divergence

      The print block values of key states are out of normal range.

      REL VELOCITY < 0

      |REL FLIGHT-PATH ANGLE| > 301 DEG

      |REL AZIMUTH ANGLE| > 301 DEG

   3. Bounded bivariate table limit exceeded

      If the second argument limit of the bivariate table is exceeded on a trajectory, the value of the argument should appear in the printout. For example, say M* is the largest Mach number argument in the table, then the print block output of Mach will be greater than M*.

4. Bank angle divergence

   Bank angle divergence is detected when the bank angle correction exceeds about 15 deg at any time. When this happens, angle of attack ALPHA is set to zero and will appear as such in the print block.

5. Storage buffers exceeded

   If the terminal trajectory cut-off is not satisfied on a trial trajectory, the integration may continue until all storage buffers on file 39 or 40 are used up. The print block at that point should have very large values for arc and elapsed time.

6. Excessive change in cut-off time

   During inequality cut-off situations, the arc duration may change radically. The print block will exhibit the data precisely at the inequality corner point.

C. Choice of time to switch from closed-loop to open-loop control (TOPEN1)

T∅PEN1 and T∅PEN2 are the input times to switch from closed-to open-loop control (see Section 3.7). Certain precautions should be taken in the choice of these inputs. Some important precautions are listed below according to type of trajectory solution.

1. Terminal arcs using non-optimal control

   When the terminal arc or arcs use non-optimal control, the closed-loop shut-off times should be less than the start time of the terminal non-optimal control arcs). This will prevent singular matrix errors. (The matrix is given in Equations (12.1-21) and (12.1-22) of Volume I.) Control divergence errors are also likely under these circumstances.

2. Long intermediate arcs using non-optimal control

   If intermediate arcs are very long followed by a relatively short terminal optimal control period, the closed-loop shut-off time should precede the non-optimal control period to avoid control divergence problems.

3. Intermediate arc cut-off on a function other than arc time

   In situations where arc cut-off times vary significantly between trial and nominal trajectories, caution dictates that the closed-loop shut-off time should precede termination of the variable arc. This is more important for problems having the characteristics of Items C. 1 and C. 2 as well. In problems having long terminal optimal control arcs, no special considerations for the choice of TØPENl1 or TØPEN2 are usually necessary.

4. Highly nonlinear or difficult linear constraints

   In general, when very nonlinear target constraints are imposed on the trajectory solution, convergence is usually slow. Once the constraints have been satisfied, the payoff improvement step size will generally tend to be small and the effect of shut-off time is nebulous. On the other hand, for difficult linear constraint problems e.g., (constrained relative states), the switching time, TOPEN1, should be as long as it can reasonably be made, since this helps to maintain the constraint during optimization.

5. Branching problems

   The purpose of the input TØPEN2 is to permit closed-loop control shut-off at a different point on the second branch of the trajectory than on the first. The feature is very helpful, especially when the elapsed time of one branch is significantly different than the other.

D. Initial payoff improvement, DPAY

If initial payoff improvement DPAY is chosen small, convergence may be degraded. DPAY should be an optimistic estimate.

E. Convergence problems associated with bivariate aerodynamics

When bivariate aerodynamics are employed and problem convergence is doubtful, the smoothness of curve fit of the aerodynamic coefficients with respect to angle of attack should be checked very carefully. This can be done by spotting computed C_L and C_D values from the trajectory printout on the table data. If anomalous jumps between input data points appear, the input data should be redone with more arguments or better placed arguments.

F. Integration accuracy

Integration interval can degrade program convergence only if it is too large. It is very difficult to tell whether the interval is too large, but if most other remedies fail, try reducing it using the most recent trial solution as a starting control and see if convergence can occur. The following types of arcs are known to require relatively small integration intervals.

- Arcs where state inequality constraints govern the control
- Arcs having rapid changes in α or ϕ
- Arcs having very high or rapidly changing accelerations
- Arcs where a highly nonlinear arc cut-off criterion is used (e.g., dynamic pressure cut-off during atmospheric entry).

To save computer time, it is advantageous to use large integration intervals. If the arc in question does not have any of the critical items above, the integration interval should be relatively large with a minimum of three intervals in an arc.

2.10.4 Steepest Descent Special Error Messages

Most TABTOP steepest descent error messages have been explained. But sometimes the program will terminate with a line of asterisks followed by a number. The most likely errors are explained in the following text:

** 2	j the control blend factor must be zero on a vacuum arc
** 3	Thrust table number less than zero in first arc of trajectory
** 4	Illegal choice of guidance option or matrix inversion error in MTX3A
** 6	SPLYNE interpolation error
** 8	Misalignment detected in GETIT of phase and stage data storage
** 11	Matrix inversion error in PAYØ2
** 41	Number of buffers for adjoint solution storage exceeded
** 88	Matrix inversion error in TRAN3

** 99 INPUT DATA ERROR

**111 Maximum angle of attack, ALFMAX, greater than largest angle of attack in bivariate aerodynamics table.

2.10.5 Output from the QL Trajectory Module of PADS

The first two pages of output from the QL module comprise the initialization phase of the module. The printout from a normal execution of this phase consists of

A. The maximum number of QL iterations (ITRMAX)

B. The desired accuracy (EPSLON)

C. The number of Adams - Moulton inner loops (INNER)

D. The state initial conditions

E. The costate initial conditions

F. The state target conditions

G. The costate target conditions.

Items A, B, and C are described in Section 3.2.1. The last four items, which can be categorized as boundary conditions, deserve a few words of explanation.

The state initial conditions array is a rectangular matrix whose rows correspond to the relative states V, γ, ψ, R, ρ, μ, m, τ, and Q, respectively, and whose columns correspond to subarc numbers. The entries in this matrix are the conditions of the respective states at the start of the respective subarcs—1 for known, 2, 3, or 4 for unknown, 0 for continuous, etc.

The costate initial conditions array is the costate's counterpart of the state initial conditions. This array is automatically derived for the user by the program.

The state target conditions array is a rectangular matrix whose columns correspond to subarc numbers. The non-zero entries are the code numbers for the target conditions that the state is to satisfy at the end of the respective subarcs.

The costate target conditions array is the costate's counterpart of the state target conditions. The nonzero entries are pointers that indicate to the program in which locations of a dimensioned variable the appropriate transversality conditions are to be found.

The following is a list of the abnormal terminations that are unique to this phase of execution.[1]

BCØND ERRØR NØ. 1
MAGIC ERRØR NØ. 1
MAGIC ERRØR NØ. 2
CØSTAI ERRØR NØ. 1
CØSTAB ERRØR NØ. 1
FETCH ERRØR NØ. 1
FETCH ERRØR NØ. 2
INARC ERRØR NØ. 1

The subsequent pages of output comprise the iterative phase of the module. Since the quantity of output depends on the number of subarcs in the problem and the number of iterations needed to converge, the number of pages is not fixed during this phase of execution.

For each QL iteration, the output from a normal execution consists of:

A. A printout at the first and last point of each subarc of the trajectory print block excluding optional print quantities
B. If the orbital elements option has not been turned off, a printout of the orbital elements at the last point of the last subarc
C. A printout of the c's for the next iteration together with the errors in state and costate target conditions resulting from those c's.
D. A printout of the error metric for the iteration.

Items A and B need no explanation. The c's in Item C are the multipliers for the homogeneous solutions. However, they can also be viewed as the

[1] See Table 2.10-1 for a complete list, including explanations and suggested recourses, of all error notes in this module of PADS.

perturbations to the unknown initial conditions that cause the target conditions to be satisfied. The error metric in Item D is simply defined as

$$E = \sum_{i=1}^{M} |c_i|,$$

where M is the total number of c's for the problem. The whole idea of the QL iterations is to drive the error metric to a smaller number than the desired accuracy (EPSLØN) mentioned above.

Following is a list of the abnormal terminations that are unique to this phase of the module's execution.

GRØPE ERRØR NØ. 3
GRØPE ERRØR NØ. 5
NEWCS ERRØR NØ. 1
NEWCS ERRØR NØ. 2
NEWCS ERRØR NØ. 3
BNDRY ERRØR NØ. 1
ENDPT ERRØR NØ. 1

Provided that the two phases have been executed normally, the remainder of the output from the QL trajectory module consists of a full printout of the converged trajectory. More precisely, it consists of a printout at each point of the user's print schedule of the trajectory print block with all options that have not been turned off.

2.10.6 Abnormal Terminations of the QL Trajectory Module of PADS

Table 2.10-1 is a complete list of the error notes that can occur in the QL module.

Table 2.10-1

QL MODULE ERROR MESSAGES

Error Note	Explanation	Severity*	Recourse
ALGCØN ERRØR NØ. 1	Could not converge the in-plane control after 20 iterations	F	
ALGCØN ERRØR NØ. 2	Matrix of partials of in-plane control constraints with respect to in-plane control variables is singular	F	
ARCIN ERRØR NØ. 1	Initial value of tabular vacuum thrust is negative or constant zero	W	
ARCIN ERRØR NØ. 2	ISP loss table active, but FRATE not input	W	
BCØND ERRØR NØ. 1	Payoff not specified at last point of last arc	VF	Check inputs to trajectory target conditions (Section 3.6.2)
BNDRY ERRØR NØ. 1	Number of target misses evaluated does not equal number of unknown initial conditions	VF	Should not happen
CØSTAB ERRØR NØ. 1	Matrix of partials of the boundary conditions at the branch point is singular	VF	Redundant boundary conditions. Check inputs to trajectory target conditions (Section 3.6.2)
CØSTAI ERRØR NØ. 1	Matrix of partials of the boundary conditions at an intermediate point is singular	VF	Same as above
ENDPT ERRØR NØ. 1	Matrix of partials of the boundary conditions at an end point is singular	VF	Same as above

Table 2.10-1 (Continued)

QL MODULE ERROR MESSAGES

Error Note	Explanation	Severity*	Recourse
FETCH ERRØR NØ. 1	Number of subarcs on initial arc file does not equal number input	VF	Starting solution must have same arc structure as the problem
FETCH ERRØR NØ. 2	Subroutine FETCH called for a point not on the initial arc file	VF	Bad tape
GRØPE ERRØR NØ. 3	Too many QL iterations	F	
GRØPE ERRØR NØ. 5	Too many QL iterations have diverged	F	
INARC ERRØR NØ. 1	End of file encountered while trying to read first record of initial arc file	VF	Bad tape or system fault
INARC ERRØR NØ. 4	Number of subarcs on initial arc file does not equal number input	VF	Bad tape or system fault
MAGIC ERRØR NØ. 1	Number of target conditions is less than number of unknown initial conditions	VF	Should not happen
MAGIC ERRØR NØ. 2	Number of target conditions is greater than number of unknown initial conditions	VF	Should not happen
NEWCS ERRØR NØ. 1	Too many divergent iterations in solving for the c's	F	
NEWCS ERRØR NØ. 2	Matrix of partials of the target conditions with respect to the c's is singular	VF	Target condition insensitive to state or costate. Make sure problem is physically reasonable

Table 2.10-1 (Continued)

QL MODULE ERROR MESSAGES

Error Note	Explanation	Severity*	Recourse
NEWCS ERRØR NØ. 3	Too many iterations for the c's	F	
SPLINE ERRØR NØ. 1	Illegal univariant table requested	VF	Check univariant table numbers
SPLINE ERRØR NØ. 2	Univariant table not input	VF	Same as above
STATEF ERRØR NØ. 1	Blend factor less than zero or greater than 1	VF	Correct inputs
STATEF ERROR NO. 2	Vacuum thrust less than zero	VF	Correct inputs

*F—Fatal to execution of QL module. If sizing module is in effect, the problem will be given to the steepest descent module for further refinement of the starting solution for QL. W—Warning only. VF—Very fatal error. Execution for this case will cease.

Section 3
TRAJECTORY DATA INPUT INSTRUCTIONS

This section of the user manual gives detailed instructions for inputting data to PADS. Included in the discussion are descriptions of data deck structure, data presets, and inputs.

3.1 DATA DECK STRUCTURE

The PADS data input routine, INEDIT, employs NAMELIST input software and has three NAMELIST sets. The first NAMELIST set is $XX, which includes input routine editing instructions and trajectory and Phase I sizing data as well as certain flags required for Phase II sizing. The two other NAMELIST sets are $DATA3 and $DATA2 which are the same as the NAMELIST sets employed in the SSSP program.* The NAMELIST input is described in most FORTRAN manuals; however, PADS imposes the restriction that card images use only Columns 2 through 78 rather than 2 through 80.

There are a number of ways to structure the PADS data deck depending on whether or not a Phase II sizing problem is to be run and also on how data for successive stacked runs or cases are to be interpreted.

For a Phase II sizing problem, the edit flag, SIZING, must be input followed by the trajectory and sizing data in the order given below.

```
$XX SIZING = 1
$END
$XX Trajectory data
$END
$DATA3 Orbiter data (see Section 5)
$END
```

*Space Shuttle Synthesis Program, General Dynamics Corporation, Rept. No. GDC-DBB70-001 to -004, 1970.

$DATA3 Booster data (see Section 5)
$END
$DATA2 Synthesis data (see Section 5)

The remaining EDIT flags are given below:*

Flag	Action
BD≠0	Creates basic deck for subsequent stacked cases
MØDCS=0	Permits sequence of stacked cases to modify previous case (no basic deck)
MAKEBD=0	Makes last case a new basic deck for subsequent cases
CS=N	Makes N the case number (optional).

The use of these flags is illustrated below:

Example 1. No Phase II sizing; independent cases. For this example no flags are input.

$XX	Trajectory data (first case)
$END	
$XX	Trajectory data (second case)
$END	

Example 2. No Phase II sizing; basic deck and dependent cases.

$XX	BD=1
$END	
$XX	Trajectory data (basic deck)
$END	
$XX	Case 1 data modifies or augments basic deck
$END	
$XX	Case 2 trajectory data modifies or augments basic deck (independent of Case 1 data).
$END	

*EDIT FLAGS are never input within trajectory data except for CS. They must always be a separate data set.

Example 3. No phase II sizing; each case modifies the previous case until a basic deck is created for remaining case

```
$XX        MØDCS = 1
$END
$XX        Case 1 trajectory data
$END
$XX        Case 2 trajectory data modifies Case 1
$END
$XX        Case 3 trajectory data modifies Case 2
$END
$XX        MAKEBD = 1 (This makes Case 3 a basic deck
$END                   for subsequent cases)
$XX        Trajectory data for Case 4 modifies and augments
           Case 3
$END
$XX        Trajectory data for Case 5 modifies and augments
           Case 3
$END
```

Example 4. Stacked cases with Phase II (SSSP) sizing.

```
$XX        SIZING = 1,  BD = 1 (sizing and trajectory basic
                                deck)
$END
$XX        Trajectory data and sizing flags
$END
$DATA3
$END
$DATA3
$END
$DATA2
$END
```

With the above basic deck, several types of stacked cases may arise.

Trajectory modification

```
$XX        Trajectory data modifications for Case 1
$END
$XX        SIZING = 1
$END
$XX        Trajectory data modifications for Case 2
$END
$DATA3  ⎫
$END    ⎪
$DATA3  ⎬  Sizing data modifications for Case 2
$END    ⎪
$DATA2  ⎪
$END    ⎭
```

When Phase II sizing data are being modified and no new data are required, the following type of input is permitted.

```
$XX        SIZING = 1
$END
$XX        NØDATA = 1
$END
$DATA3     NØDATA = 1
$END
$DATA3     DATA =    ,
$END
$DATA2     NØDATA = 1
$END
```

3.2 TRAJECTORY PROGRAM INPUT DATA

The branch trajectory optimization modules of PADS may be operated independently of the sizing function. The input data for trajectory runs may be placed in the following categories.

A. Global data (see Section 3.2.1)
B. Univariant tabular data and simulation models (Sections 3.2.2 to 3.5)
C. Integration and printout options
D. Convergence data (Section 3.7)

E. Starting control data

F. State and control inequality constraints (Section 3.9)

G. Boundary conditions (Section 3.6)

H. Solution control inputs

I. Atmosphere options

Since NAMELIST input is essentially free-form, the ordering of data cards is not significant. However, some ordering suggestions are made to help check for omissions.

The mnemonics that have been chosen for input names do not always correspond with the FORTRAN names used in the actual computational coding; wherever possible, the corresponding coding name is given. A complete alphabetic glossary of input names is given in Section 6.

3.2.1 Global Data

Input Name	Code Name	Meaning	Units	Preset
GR	GR	Reference gravity	ft/sec^2	None
ER	ER	Earth radius	ft	None
ØMGZ	ØMGZ	Earth rotation	rad/sec	0
RHØRF	XLAMRF	Reference latitude (uses initial latitude if not input)	deg	
YMURF	YMURF	Reference longitude (uses initial longitude if not input)	deg	
PSIRF	PSIRF	Reference azimuth (uses initial azimuth if not input)	deg	
NARC	NARC	Number of arcs in trajectory		None
PRCØ	LUM	Program control flag = 0 means steepest descent only = 1, steepest descent + writes TAPE11 (=TAPEI) starting solution for QL or sizing option restart		0

Input Name	Code Name	Meaning	Units	Preset
		= 2, steepest descent start + QL program solution (also used for QL sizing solutions)		
		= 3, QL program only must have starting solution on TAPE11 (= TAPEI)		
TPSØL	ITPSØL	≠ 0, use starting solution on TAPE11 (TAPEI) to start steepest descent program		0 (no starting solution available)
EPSLØN		QL convergence tolerance		0.05
INNER		QL integration inner corrector		1.
ITRMAX		Maximum number of QL iterations		10.

3.2.2 Univariant Tabular Data and Simulation Models

The univariant table data input corresponds to the type of simulation used in each arc of the trajectory. In certain problems, it will be necessary to switch from linearized aerodynamics to moment-balance for different arcs. Likewise, changes in thrust level should be quite common. On the other hand, a particular table may apply over several arcs of the trajectory before a change is necessary. To communicate these types of occurrences, the user must assign each table a distinct number ranging from 1 through 30. The table number is then associated with the arcs in which the corresponding table is to be used by an indexed flag input. An example of this is

TNCLA(1) = 3.,
TCLA(1, 3) = 0., .2, ...,

This means that the C_{L_α} versus Mach number table for arc 1 is table number 3. The TCLA table has as its second subscript the table number 3.

Suppose the fourth arc uses table number 6 for TCLA. The input would look like

TNCLA(4) = 6.,
TCLA(1, 6) = 0., .26, ...,

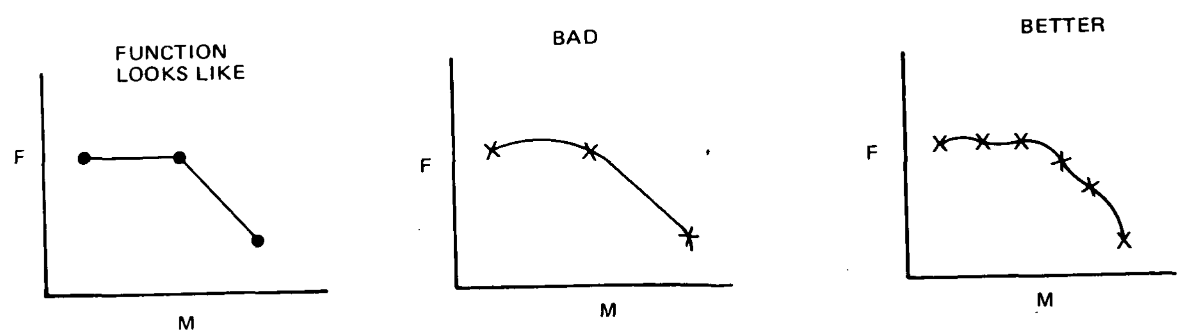
If TNCLA(2) and TNCLA(3) are not input, table 3 would automatically be used for arc 2 and arc 3.

Each univariant table may contain up to 35 data pairs. If a table number is set to zero, the corresponding table interpolation normally will return a zero. However, there are special cases where a different preset is used. These presets are noted where appropriate.

If a quantity is associated with, say, arc 1, it will also be used for all subsequent arcs until it is input again. For example, suppose 10 ft^2 is the aerodynamic reference area to be used for the first three arcs of the trajectory and thereafter it changes to 15 ft^2. The input would then be:

SREF(1) = 10., SREF(4) = 15.,

All univariant tables having three or more data points are spline-fit before execution. For this reason, care must be exercised in choosing data input points. The spline-fit behaves like a flexible elastic strip, pinned but free to rotate at each of the data points. The fitting equation is necessarily cubic and can produce anomalous results at abrupt changes in the function being fitted. An example of the right and wrong way to do it is given below.



3.2.3 Asymmetric Linear Aerodynamics Inputs

The asymmetric linear aerodynamic simulation is described in Section 2.3.1. In the definitions, the INPUT names have 0 = zero and Ø = letter.

In general, let i be the stage number and n be the generic table number.

Input Name	Code Name	Meaning	Units	Preset
JAER(i) = 1	JAER	Asymmetric linear aerodynamic option		None
SREF(i)	SREF	Aerodynamic reference area	ft^2	0
TNCLA(i)	MAEA	= n, table number for CLA vs. M		0
TCLA(1, n)		CLA vs. M table		
TNCLO(i)	MAEB	= n, table number for CLO vs. M		0
TCLO(1, n)		CLO vs. M table		
TNCDO(i)	MAEC	= n, table number for CDO vs. M		0
TCDO(1, n)		CDO vs. M table		
TNFK(i)	MAED	= n, table number for FK vs. M		0
TFK(1, n)		FK vs. M table		

3.2.4 Moment Balance Aerodynamics

The moment balance aerodynamics simulation is described in Section 2.3.4.

All of the above tables and data for linear aerodynamic simulation are required plus the following:

Input Name	Code Name	Meaning	Units	Preset
JAER(i)=3	JAER	3 is the moment balance option		None
DREF(i)	DREF	Reference length	ft	0
XCGR(i)	XCGR	Reference center of gravity, x station		0

Input Name	Code Name	Meaning	Units	Preset
ZCGR(i)	ZCGR	Reference center of gravity, z station	ft	0
XE(i)	XE	Engine x station	ft	0
ZE(i)	ZE	Engine z station	ft	0
XT(i)	XT	Aerodynamic control surface, x station	ft	0
TNCMO(i)	MAEE	= n, table number for CMO vs. M		0
TCMO(1, n)		CMO vs. M table		
TNCMA(i)	MAEF	= n, table number for CMA vs. M		0
TCMA(1, n)		CMA vs. M table		
TNBLDQ(i)	MAEG	= n, table number for control blend factor vs. dynamic pressure		0
TBLDQ(1, n)		Control blend factor vs. dynamic pressure table		
TNXCGW(1, n)	MXCG	= n, XCG vs. weight table number		0
TXCGW(1, n)		XCG vs. weight table		
TNZCGW(i)	MZCG	= n, ZCG vs weight table number		0
TZCGW(1, n)		ZCG vs. weight table		

3.2.5 Thrust, Base Drag, and ISP Loss Data Inputs, JPRØ = 0

The rocket propulsion option is described in Section 2.4.1. Also, see Section 3.3 for comments on thrust simulation, and Section 3.2.6 for a description of ISP loss input.

Input Name	Code Name	Meaning	Units	Preset
JPRØ(i)	JPRØ	Propulsion option 0 is the rocket option		0
AEXIT(i)	EJ	Nozzle exit area per engine	ft^2	0
TMULT(i)	TMULT	Number of engines		1
XISP(i)	XISP	Vacuum ISP	sec	None
TNFVAC(i)	MT	= n, vacuum thrust per engine vs. time table number		0
TFVAC(1, n)		Vacuum thrust per engine vs. time table	lb vs. sec	
TNISPL(i)	MISP	= n, % ISP vs. % FVAC/FRATE table number		0

Input Name	Code Name	Meaning	Units	Preset
TISPL(1, n)		% ISP vs. % FVAC/FRATE table		
FRATE(i)	FRATE	Rated vacuum thrust per engine	lb	0
TNDBH(i)	MDB	= n, base drag vs. altitude table number		0
TDBH(1, n)		Base drag vs. altitude table	lb vs. ft	
ZBD(L)	ZBD	Base drag Z station	ft	0

In order to use the parallel burn propulsion model with moment balance (JPRØ=3 and JAER=3), the following additional inputs are required:

Input Name	Code Name	Meaning	Units	Preset
JAER(i)	JAER	= 3, moment balance aerodynamic option		0
JPRØ(i)	JPRØ	= 3, parallel burn option		0
TMULT2	TMULT2	Number of secondary engines		1
AEXIT2(i)	EJA2	Nozzle exit area of second engine	ft^2	0
XISP2(i)	XISP2	Vaccum ISP of second engine	sec	0
TNFV2(i)	MT2	= n, vacuum thrust per engine table number vs. time for second engine		
TFV2(1, n)		Vacuum thrust vs. time table for second engine	lb	
FRAT2(i)	FRATE2	Rated vacuum thrust	lb	0
XE2(i)	XE2	Engine 2, x station	ft	0
ZE2(i)	ZE2	Engine 2, z station	ft	0
JENG(i)	MCND	Fixed engine flag 0 = both engines gimballed 1 = engine 1 gimballed, engine 2 fixed 2 = engine 2 gimballed, engine 1 fixed		
DLRF(i)	DLERF	Fixed engine reference deflection angle	deg	0

3.2.6 ISP Loss Table

When using the ISP loss table, several options are available. Examples 1 and 2 apply with or without throttling; Example 3 applies only with throttling.

Example 1

INPUT:
- Thrust table number
- Thrust vs. time table FVAC
- ISP loss table number
- ISP loss table %ISP = F(%T)
- FRATE
- TMULT
- XISP

Result: T = net vacuum thrust = TMULT * FVAC

(%ISP) = F (T/FRAME * TMULT) * 100.

ISP = (%ISP) * XISP * .01

Example 2. If FRATE is omitted, FRATE is interpolated at the first time point in the vacuum thrust table.

Example 3. If the thrust table is omitted and FRATE is input, the ISP loss table will be used only when throttling to limit maximum acceleration.

3.3 COMMENTS ON THRUST SIMULATION

The following comments refer to different thrust inputs that may be desired in the trajectory simulation.

3.3.1 Thrust vs. Time Table Used Over Several Arcs

To use the same thrust vs. time table for several arcs of the trajectory, define the curve number for the first arc during which the table is to be used and then input negative thrust table numbers for the remaining arcs during which the same table is to be used. For example, suppose the thrust vs. time table is number 8. It is to be used for arcs 1 through 4. In arc 5, a new table number, 9, is to be used. The input should look like:

TNFVAC(1) = 8., TFVAC(2) = -1., -1., -1.,
TFVAC(1, 8) = Time_1 thrust_1, time_2, thrust_2, etc.
TNFVAC(5) = 9.,

3.3.2 Constant Thrust in a Table

To input a constant thrust—say, T*—in a table, the value should appear as

TFVAC(1, n) = 0., T*,

3.3.3 Constant Thrust in FRATE

If a constant vacuum thrust is desired in a particular arc, input a zero thrust table number and FRATE equal to the desired thrust value. For example, assume arc 1 requires a thrust of 1. x 10^6 lb per engine and has three engines.

TNFVAC(1) = 0., (or omit input)

FRATE(1) = 1. E6.,

TMULT(1) = 3.,

3.4 BIVARIATE AERODYNAMICS, JAER = 2

The bivariate aerodynamic simulation option is described in Section 2.2. The following data are required for each arc using bivariate aerodynamic simulation.

Input Name	Code Name	Meaning	Preset
JAER(i)	JAER	JAER = 2, for bivariate aerodynamics	None
SREF(i)	SREF	Aerodynamic reference area	None
SNA(i)	MAEA	Permissible set number, let N be the table number $1 \leq N \leq 3$ SNA(i) = 5 + N (takes on values 6, 7, or 8)	
SNB(i)		SNB(i) < 0 means input CN and CA vs. α and M and convert to C_L and C_D	

A bivariate table may be used over several arcs of the trajectory.

TALFA1(1) Table of angle-of-attack arguments for bivariate aerodynamic table set 6

The angle-of-attack table should span both negative and positive angles since symmetry is not assumed. Also the magnitude of both the maximum and minimum angles of attack in the table should be less than or equal to the

	value of ALFMAX(I), where ALFMAX(I) is the magnitude of the maximum angle of attack for arc 1 (see Section 3. 8)
TALFA2(1)	As above for set 7
TALFA2(1)	As above for set 8
TMACH1(1)	Table of mach numbers for bivariate aerodynamic table set 6
TMACH2(1)	As above for set 7
TMACH3(1)	As above for set 8
TCLCD1(1, 1)	C_L and C_D table for α and M arguments input in TALF1(1) and TMACH1(1)

For p angles of attack and q Mach number arguments, the table input looks like: ($p \leq 31$, $q \leq 31$)

$$\text{TCLCD1(1, 1)} = C_{L_{\alpha_1 M_1}}, C_{D_{\alpha_1 M_1}}, \ldots\ldots C_{L_{\alpha_p M_1}}, C_{D_{\alpha_p M_1}}$$

$$\text{TCLCD1(1, 2)} = C_{L_{\alpha_1 M_2}}, C_{D_{\alpha_1 M_2}}, \ldots\ldots C_{L_{\alpha_p M_2}}, C_{D_{\alpha_p M_2}}$$

$$\text{TCLCD1(1, q)} = C_{L_{\alpha_1 M_q}}, C_{D_{\alpha_1 M_q}}, \ldots\ldots C_{L_{\alpha_p M_2}}, C_{D_{\alpha_p M_q}}$$

The TCLCD2 and TCLCD3 tables are input the same as above.

It should be noted that the argument tables TALF1 $\rightarrow$ TALF3 and TMACH1 $\rightarrow$ TMACH3 need not be in monotonic order. However, the order must agree with the coefficient data loaded in the table.

An additional restriction is that the minimum number of either α or M arguments is three. The user is also referred to Section 2. 10. 3, Item E for special hints on bivariate table input.

3. 5 AIR-BREATHER PROPULSION OPTION, JPRØ = 2

The air-breather propulsion simulation is described in Section 2. 4. 3. There can be only one air-breather propulsion table. The input of thrust and specific fuel consumption as function of velocity and altitude is handled as follows.

Input Name	Meaning
SNB(i)	= 9, air-breathing engine table set number
JPRØ(i)	= 2, air-breather option
TVELT(i)	Table of velocity arguments
TALT(i)	Table of altitude arguments

Let p be the number of velocity arguments $p \le 31$

and q be the number of altitude arguments $q \le 31$

$$\begin{array}{l}
THSF(1,1) = T_{v_1 h_1}, SFC_{v_1 h_1}, \ldots . T_{v_p h_1}, SFC_{v_p h_1}, \\
\quad \vdots \\
THSF(1,q) = T_{v_1 h_q}, SFC_{v_1 h_q}, \ldots . T_{v_p h_q}, SFC_{v_p h_q}
\end{array}$$

Note that the unit of T is pounds and the unit of SFC is pounds thrust per pounds of fuel per hour.

3.6 TRAJECTORY BOUNDARY CONDITIONS

Trajectory initial and target conditions are explained in Section 2.8. The inputs are presented below. Note that updates of data pairs for stacked cases must have both pieces of data present.

3.6.1 Trajectory Initial Conditions

See Section 2.8.1 for an explanation of trajectory initial conditions.

Input Name	Meaning	Units	Preset
T1(1)	Arc time option code: 1 = known 2 = optimized 4 = unknown		none
T1(2)	Value of arc time–if known or optimized option code is chosen	sec	none
T2 → T20	Same data pairs as above for arcs 2 through 20		

Input Name	Meaning	Units	Preset
V1(1)	Initial relative velocity code 1 = known 2 = optimized		
V2 → V20	Used for branching flag V_i = 10 + arc number to tack on branch Example: arc 6 ends first branch; arc 7 is tacked onto the end of arc 3 to start second branch: V7 = 13.,		
GAM1(1)	Code for initial relative flight path angle (1 or 2)		none
GAM1(2)	Value of initial relative flight path angle	deg	none
ALT1(1)	Code for initial altitude (1 or 2)		
ALT1(2)	Value of initial altitude	ft	0
W1(1)	Code for initial weight (1 or 2)		
W1(2)	Value of initial weight	lb	
W2(1) W20(1)	Codes for initial weights of arcs 2 through 20 1 = known, Wi(2)=known weight 5 = discontinuous, Wi(2) weight dropped 6 = discontinuous (computed weight drop for Phase I sizing only) 7 = sum of parts on branch problem Wi(2)=0 (See Section 2. 8. 1, Examples 1 through 5)	lb	
PSI1(1)	Code for initial azimuth (1 or 2)		
PSI1(2)	Value of initial azimuth	deg	none or 0
RHØ1(2)	Code for initial latitude (1 or 2)		
RHØ1(2)	Value of initial latitude	deg	none
MU1(1)	Code for initial longitude (1 or 2)		
MU1(2)	Value of initial longitude	deg	none
H1(1)	Code for initial heat load (1 or 2)		
H1(2)	Value of initial heat load		
TIM1(1)	Code for initial elapsed time (1 only)		
TIM1(2)	Value of initial elapsed time	sec	

3.6.2 Trajectory Target Conditions

Input Name	Meaning	Units	Preset
CT1(1)	Cut-off variable code; ± code from table of variables (Table 2.8-1) + means variable is increasing - means decreasing		
CT1(2)	Value of cut-off	external units	none
CT2 → CT20	Cut-off data pairs for arcs 2 through 20 Reminder: in any arc where a cut-off is defined, the corresponding arc time must be input as an unknown (code 4) Conversely, if the arc time has been input as known (code 1), a cut-off must not be input.	external units	none
CN1(1)	Arc number at which first terminal constraint is applied		none
CN1(2)	Variable number code of first constraint (see Table 2.8-1)		none
CN1(3)	Value of constraint	external units	none
CN2 → CN8	Constraint triplets for constraints 2 through 8 (a maximum of 8 constraints)		
PAYØFF(1)	Arc number where payoff is defined (terminus)		
PAYØFF(2)	± Variable code of pay-off (see Table 2.8-1) + means maximize - means minimize		
PAYØFF(3)	Optional guessed value of payoff	external units	none

3.7 CONVERGENCE DATA FOR STEEPEST DESCENT PROGRAM

As described in Section 2.10, the steepest descent program requires a number of inputs for its convergence process. These inputs are not required for QL-only solutions.

Input Name	Code Name	Meaning	Units	Preset
DPAY	DPAY	INITIAL PAYOFF IMPROVEMENT. This is an estimate of how much payoff improvement can be achieved on the first optimization pass. The units are the same as those used internally: distance mass angle The sign of DPAY should be in the direction that optimization should progress; minimization—negative and maximization—positive (see Section 2. 10-3, Item D)	internal ft slugs rad	none (must be input)
PMIN	PMIN	This is an estimate of the absolute value of the minimum payoff improvement. When the program predicts it can get only this amount or less, it has converged and will print the solution trajectory. PMIN is in internal units (see comments in Section 2. 10-2)	internal	none (must be input)
NITER	NITER	Maximum number of iterations permitted for steepest descent program		none
TØPEN1	WØRK(1)	Elapsed time at which to switch from closed-loop to open-loop optimized control. Should be about 50 to 85% of total flight time. (See Section 2. 10-3, Item C for a detailed discussion)	sec	0.
TØPEN2	WØRK(2)	Elapsed time at which to switch from closed-loop to open-loop optimized control on second branch of branched trajectory (see Section 2. 10-3, Item C for a detailed discussion)	sec	0.
PHIWT	WØRK(10)	Bank angle weighting factor. This factor may be used to weight bank angle differently than angle of attack during optimized control arcs		1. 0

The constraint tolerances are used to determine when constraints are essentially satisfied before starting optimization. After optimization has started, constraints must stay within tolerance values or else a step-size scaling occurs. The preset values supplied are derived from experience with the program and are not necessarily best for all types of problems. A general rule of thumb is if the performance is greatly influenced by a constraint violation, the corresponding tolerance should tend to be small and vice versa. It should be emphasized that the constraint tolerance values are not the expected error in satisfying the constraint on a converged steepest descent solution. Generally, on properly converged solutions, the constraint errors should be negligible.

Input Name	Code Name	Meaning	Units	Preset
TØF(2)		Tolerance on relative velocity constraint	ft/sec	20.
TØF(3)		Tolerance on relative path angle	rad	.01
TØF(4)		Constraint tolerance on altitude	ft	2000
TØF(5)		Constraint tolerance on weight	mass slugs	.2
TØF(6)		Constraint tolerance on relative azimuth	rad	.07
TØF(7)		Constraint tolerance on latitude	rad	.001
TØF(8)		Constraint tolerance on relative longitude	rad	.001
TØF(9)		Constraint tolerance on elapsed time	sec	.2
TØF(10)		Constraint tolerance on head load	Btu/ft^2	10.
TØF(11)		Constraint tolerance on dummy penetration		20.
TØF(12)		Constraint tolerance on inertial velocity	ft/sec	20.
TØF(13)		Constraint tolerance on inertial path angle	rad	.01
TØF(14)		Constraint tolerance on inertial azimuth	rad	.07
TØF(15)		Constraint tolerance on inertial longitude	rad	.001

Input Name	Code Name	Meaning	Units	Preset
TØF(16)		Constraint tolerance on semi-latus rectum	ft	10000
TØF(17)		Constraint tolerance on eccentricity		.00025
TØF(18)		Constraint tolerance on inclination	rad	.01
TØF(19)		Constraint tolerance on argument of perigee	rad	.01
TØF(20)		Constraint tolerance on longitude of ascending node	rad	.001
TØF(21)		Constraint tolerance on semi-major axis	ft	10000.
TØF(22)		Constraint tolerance on apogee radius	ft	10000.
TØF(23)		Constraint tolerance on perigee radius	ft	10000.
TØF(24)		Constraint tolerance on true anomaly	rad	.01
TØF(25)		Constraint tolerance on Cap X	ft	10000.
TØF(26)		Constraint tolerance on Cap Y	ft	10000.
TØF(27)		Constraint tolerance on outgoing asymptote	rad	.01
TØF(28)		Constraint tolerance on energy	ft^2/sec^2	100000.
TØF(29)		Constraint tolerance on momentum	ft/sec	100000.
TØF(30)		Constraint tolerance on down-range	ft	3000.
TØF(31)		Constraint tolerance on cross-range	ft	3000.
TØF(32)		Constraint tolerance on total range	ft	6000.
TØF(33)		Constraint tolerance on dynamic pressure	lb/ft^2	.5
TØF(34)		Constraint tolerance on heating rate	$Btu/ft^2/sec$	.1
TØF(35)		Constraint tolerance on unit Reynolds number	ft^{-1}	200.
TØF(36)		Constraint tolerance on payload	lb	30.

Input Name	Code Name	Meaning	Units	Preset
		The parameter weighting factors given below are used inversely; that is, the larger the factor, the smaller will be the effect of the parameter.		
WPTI(1)	WTPD(1)	Weighting factor for optimized arc times		1.
WPTI(2)	WTPD(2)	Weighting factor for optimized initial velocity		1.
WPTI(3)	WTPD(3)	Weighting factor for optimized initial flight-path angle		1.
WPTI(4)	WTPD(4)	Weighting factor for optimized initial altitude		.01
WPTI(5)	WTPD(5)	Weighting factor for optimized initial weight		1.
WPTI(6)	WTPD(6)	Weighting factor for optimized initial azimuth		2.
WPTI(7)	WTPD(7)	Weighting factor for optimized initial latitude		.1
WPTI(8)	WTPD(8)	Weighting factor for optimized initial longitude		none

3.8 STATE AND CONTROL INEQUALITY CONSTRAINTS AND CONTROL BOUNDS (i is the arc number)

Input Name	Code Name	Meaning	Units	Preset
QMAX(i)	QMAX	Maximum dynamic pressure. Is effective only if prior arc was cut off on same value	ft^{-1}	0
GMAX(i)	GMAX	Maximum total acceleration	g's	0
LFTMAX(i)	XLMAX	Maximum lift (untrimmed)	lb	0
HDMAX(i)		Maximum heating rate. Is effective only if prior arc was cut off on same value (HTFLG(i) must be = 1)	$Btu/ft^2/sec$	0
ALFMAX(i)	ALFMAX	Maximum angle of attack	deg	0
PHMAX(i)	PHMAX	If non-zero, the QL solution will yield only "belly-down" bank angles, has no effect on steepest descent solution	deg	0

Input Name	Code Name	Meaning	Units	Preset
HTFLG(i)		Turns on integration of stagnation heating in arc i if set equal to 1.		0
REMAX(i)	REMAX	Maximum unit Reynolds number. Is effective only if prior arc was cut off on same value.	ft^{-1}	0

3.9 SOLUTION CONTROL INPUTS

The basic control modes are described in Section 2.6.

Input Name	Internal Name	Meaning	Units	Preset
IMØDE(i)	IMØDE	Solution control option for each arc in trajectory IMØDE = 1; optimal control IMØDE = 2; optimal control, with = 0 IMØDE = 3; vertical rise or pitchover IMØDE = 4; gravity turn IMØDE = 5; $\alpha = \Phi = 0$		none
GMDØT(i)	GMDØT	Pitch rate for pitchover (IMØDE = 3)	deg/sec	0

3.10 STEEPEST DESCENT STARTING CONTROL HISTORY

This section describes the input cards for the steepest descent starting control history described in Section 2.9, and concludes with some examples and special rules for this type of input.

3.10.1 Input Data Description for Phase Sequencing

This input is not required for a QL-only solution. If omitted for a steepest descent run, the program will assume a tape starting solution has been supplied; likewise, if the starting solution flag TPSØL is input non-zero, this input will be ignored.

Input Name	Meaning	Units	Preset
PH1(1)	Arc number which terminates first phase of starting control history. If set to 0, see PH1(5) and PH1(6)		none
PH1(2)	Starting control option to be used for Phase 1 (see Table 3. 10-1)		none
PH1(3)	Table number for control table A		none
PH1(4)	Table number for control table B		none
PH1(5)	If PH1(1) is 0, this is the phase cut-off variable code PH1(5) = ± variable code (see Table 2. 8-1) + means cut-off increasing - means decreasing		none
PH1(6)	Value of cut-off	external	none
PH2→PH20	As above for Phases 2 through 20		none
TCØNA(1, N)	Control table N where N has been input, for example, in PH1(3) = N		none
TCØNB(1, P)	Control table P where P has been input, for example, in PH1(4) = P		none

The control table numbers N and P are not independent of each other but are independent of the table numbers used for the univariant tables described in Sections 3. 2. 3 through 3. 2. 5. There are a maximum of 20 control tables, i. e., $N \neq P$, $1 \leq N \leq 20$, $1 \leq P \leq 20$. Each table may have up to 15 phase-time points.

Table 3. 10-1

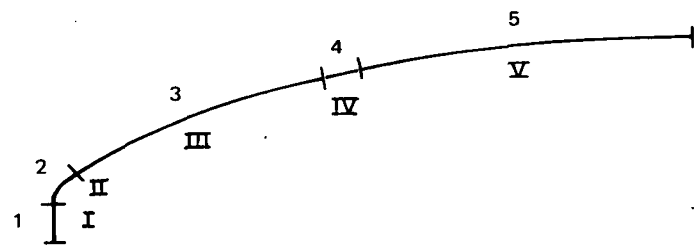
STARTING CONTROL OPTIONS

Starting Control Option	Type of Control	Control Table A	Control Table B
1	α, ϕ	α vs phase time, τ_p	ϕ vs phase time, τ_p
2	Steering pitch, θ_p; steering azimuth, θ_ℓ attitudes	θ_p vs τ_p	θ_ℓ vs τ_p
3	Steering pitch, θ_p; bank angle zero	θ_p vs τ_p	none
4	Not used		
5	Not used		
6	$\alpha = 0$, $\phi = 0$	none	none
7	Gravity turn	none	none
8	Vertical rise and pitchover	none	none

3.10.2 Examples of Phase Sequencing

The examples given in this section are intended to show how the starting control history is generated for the steepest descent program.

Example 1: Orbit injection trajectory



Arc No.	Description
I	Vertical rise control for 10 sec
II	Pitchover for 10 sec
III	Gravity turn to cut-off on weight decreasing to W*
IV	Coast for 10 sec no control
V	Optimal control arc cut-off on inertial velocity, V_I*

The data cards for this arc structure are

T1 = 1., 10.,
IMØDE(1) = 3., GMDØT(1) = 0.,
T2 = 1., 10.,
IMØDE(2) = 3., GMDØT(2) = -.3,
T3 = 4., 0.,
CT3 = -5., [W*],
IMØDE(3) = 4.,
T4 = 1., 10.,
IMØDE(4) = 5.,
T5 = 4., 0.,
CT5 = 12, V_I*, ...
IMØDE(5) = 1.,

The phase structuring for the starting solution is input as follows for the first four arcs:

PH1(1) = 1., 8.,
PH2(1) = 2., 8.,

PH3(1) = 3., 7.,
PH4(1) = 4., 6.,

Notice that the first four phases are tied directly to the first four arcs. In this case, there is no choice in the matter because the first four solution control options are non-optimal.† However, the fifth arc is an optimal control arc and a starting control history is needed. We may choose to use any of the eight options available in Table 3.10-1 to get a starting guess. Suppose we use option 2, steering elevation and steering azimuth attitude angles. The input for Phase 5 is

PH5(1) = 5., 2., 1., 2.,

This input is interpreted as:
Phase 5 ends at the end of arc V using starting control option 2; the steering elevation attitude versus phase time is in table 1; and the steering azimuth attitude history is in table 2.

The steering attitude tables would then be input, for example:

TCØNA(1, 1) = 0., 10., 100., 5., 400., 0.,
TCØNB(1, 2) = 0., 90., 100., 95.,

Suppose the fifth arc in this example were subdivided in order to change integration intervals and the trajectory would then have six arcs. The following changes in arc structure would be input:

T5 = 1., 150., (arc 5 cut-off on arc time)
IMØDE(5) = 1.,
T6 = 4., 0.,
CT6 = 12., $[V_I{*}]$
IMØDE(6) = 1.,

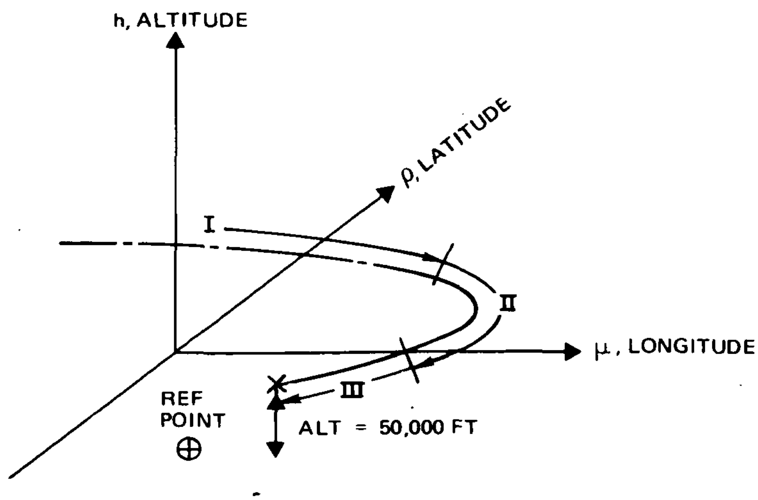
If the same control histories were to be used for this revised problem, all that is necessary to input is:

PH5(1) = 6., 2., 1., 2.,

†Non-optimal control arcs must always have corresponding starting solution phases.

This means that phase 5 ends at the end of arc 6 instead of arc 5, all else remaining the same.

Example 2. Atmospheric entry trajectory



Arc No.	Description
I	Large compute interval arc, cut-off on dynamic pressure = 5 psf, optimal control
II	Small compute interval arc cut-off on arc time of 20 sec, optimal control with bounded acceleration.
III	Moderate compute interval arc cut-off on altitude = 50, 000 ft, optimal control with bounded acceleration.

The payoff on this example is minimum range to a reference point, as shown in the preceding sketch. The inputs to effect this arc structure and payoff are:

T1 = 4.,
CT1 = 33., 5.,
IMØDE(1) = 1.,
T2 = 1., 20.,
T3 = 4.,
CT3 = -4., 50000.,
PAYØFF(1) = 3., -32.,

The control history for this example should start by maintaining a moderate descent rate to keep from exceeding acceleration limits. Once the dense atmosphere is encountered, a sharp turn back toward the reference point should be performed. Thereafter, the descent should be at approximately the maximum lift-to-drag ratio angle of attack with little or no bank angle modulation. After reviewing the arc structure, we conclude that if the sharp turn is performed during arc 2, there is no guarantee that the vehicle will be headed back toward the reference point. Therefore, we construct the phase sequence and starting control as follows:

PH1(1) = 1., 1., 1., 2.,
PH2(1) = 0.; 1., 3., 4., 6., 270.,
PH3(1) = 3., 1., 5., 2.,
TCØNA(1, 1) = 15.,
TCØNB(1. 2) = 0.,
TCØNA(1, 3) = 40., (note that constant control angles may
TCØNB(1, 4) = 45., be input as shown)
TCØNA(1, 5) = 12., ...

This input is interpreted as follows:
Phase I is tied to the end of arc 1 using angle of attack and bank angle control (option 1), which is stored in tables 1 and 2, respectively. Phase II is not tied to the end of any arc, but is cut off on relative azimuth at ψ = 270 deg (increasing). Phase II of the first nominal trajectory will also use the angle of attack and bank angle control supplied in tables 3 and 4.

It should be noted that the special cut-off for Phase II will not occur precisely at ψ = 270 deg, but at the end of the integration interval just prior to reaching the cut-off.

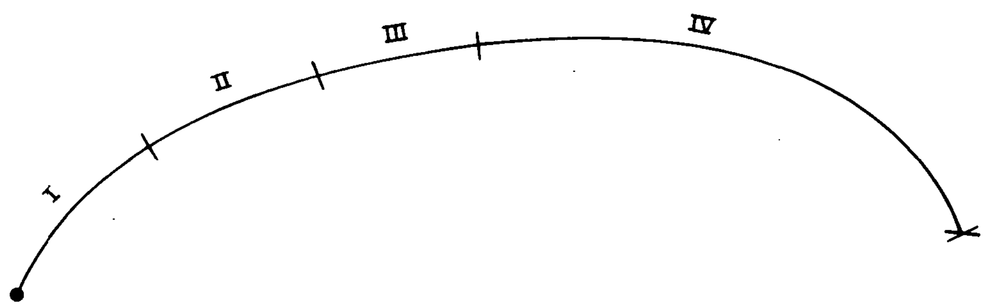
Phase III is, as it must be, tied to the terminal arc of the trajectory. Note also that the bank-angle-history curve for Phase III as the same as for Phase I.

Example 3. Troublesome phase sequencing

Important precaution for phase sequencing

on steepest descent trajectory

The most difficult trajectory for phase sequencing is one which has several arcs that use optimal control followed by an arc using non-optimal control.



Suppose the arc structure is

T1 = 1., 30.,
IMØDE(1) = 1.,
T2 = 1., 20.,
IMØDE(2) = 1.,
T3 = 1., 50.,
IMØDE(3) = 1.,
T4 = 4.,
CT4 = -4., 30000.,
IMØDE(4) = 4.

This structure is interpreted as having the the first three optimal control arcs each cutting off on arc time and the last (gravity turn) arc cut-off is on altitude. To set up the first nominal control, we run into the following difficult situation. We tie the first phase to the end of the third arc. The cut-off on arc 3 is on an arc time of 50 sec and the program logic will consequently interpret this as a cut-off on phase time of 50 sec. The 50-sec phase time will start from the problem initial time—not what was intended at all!

Therefore, instead of cutting off arc 3 on arc time, some other cut-off must be used. Usually a weight cut-off is the best to use on thrusting trajectories.

3.11 INTEGRATION AND PRINT OPTIONS

Input Name	Internal Name	Meaning	Unit	Preset
DTNC(i)	DTNC	Integration-compute interval (see Section 2.10.3, Item F)	sec	1.0
PFRQ(i)	DTPI	Print frequency; solution trajectory will print at intervals of PFRQ * DTNC		1.0
PFLG1	IPFLG1	If non-zero, will suppress printout of velocity losses and inertial Euler angles		0
PFLG2	IPFLG2	If non-zero, will suppress printout of orbital parameters		0
PFLG3	IPFLG3	If non-zero, will suppress printout of impact data		
PFLG4	IPFLG4	If non-zero, will suppress printout of Cartesian inertial coordinates		0

3.12 ATMOSPHERE OPTIONS

Input Name	Internal Name	Meaning	Preset
IATM(i)	IATM	ATMØSPHERE OPTION Flag for each arc. IATM = 0; 1962 standard atmosphere = 1; 1963 Patrick AFB atmosphere = 2; vacuum	0

Section 4

PHASE I SIZING INPUT INSTRUCTIONS

4.1 SCOPE OF DATA

The Phase I PADS sizing program is designed to solve basic sizing problems quickly. The types of problems include sizing one or both stages of the space shuttle or other two-stage launch vehicles or determining the optimum staging time. The primary difference between a Phase I and a Phase II (SSSP) sizing problem is the degree of complexity used in describing the vehicle. The following paragraphs will describe the input requirements and various sizing options.

4.1.1 Propulsion Data

The following propulsion parameters are required input data for all of the Phase I sizing options. The terms are defined in Table 4.1-1 and all Phase I inputs are included in the $XX NAMELIST set.

TVACB	TVACØ
NNB	NØ
ISPB	ISPØ
EXITA	

4.1.2 Mission Data

The mission is characterized by two parameters for purposes of sizing the vehicle. These parameters are the total characteristic velocity required and a choice between the estimate of the booster mass ratio or the booster staging velocity. The input names for these parameters are IDVEL, MUB, and VSTG, respectively.

Table 4. 1-1

PHASE I SIZING INPUT REQUIREMENTS SUMMARY

Parameter	Preset Value	Units	Definition	Sizing Option 1	2	3	4	5
JTYP		none	Sizing problem flag (must = 1)	X	X	X	X	X
PRFLG[1]	1	none	Iteration output flag					
IPSMAX[1]	4	none	Maximum number of iterations					
ISIZE		none	Option flag ($\neq 0$)	X	X	X	X	X
TOLWT[1]	0. 5	lb	Convergence tolerance for gross weight iteration					
MUB[2]		none	Booster mass ratio	X	X	X	X	X
VSTG[2]		fps	Booster characteristic velocity	X	X	X	X	X
BKi[3]		See Eq. (4. 1-1)	Coefficients in equation for booster-stage weight	X	X	X		X
ØKi[4]		See Eq. (4. 1-1)	Coefficients in equation for orbiter-stage weight	X	X		X	X
ITNBW[3]		none	Table name for tabular booster-stage weights	X	X	X		X
ITNØW[4]		none	Table name for tabular orbiter-stage weights	X	X		X	X
WLØ		lb	Gross lift-off weight	X				
WEB		lb	Fixed booster-stage weight				X	
WEØ		lb	Fixed orbiter-stage weight			X		
WPB		lb	Booster propellant weight				X	
WPØ		lb	Orbiter propellant weight			X		
XPL		lb	Payload weight		X	X	X	

[1]This parameter has a built-in value if not input

[2]MUB or VSTG may be input

[3]Either BKi or ITNBW must be input (ITNBW and ITNOW are univariant table numbers and may not conflict with other table numbers)

[4]Either OKi or ITNØW must be input

Table 4.1-1

PHASE I SIZING INPUT REQUIREMENTS SUMMARY (Continued)

Parameter	Preset Value	Units	Definition	Sizing Option 1	2	3	4	5
TWRATO		none	Lift-off thrust-to-weight ratio					X
TVACB		lb	Booster vacuum thrust per engine	X	X	X	X	X
TVACØ		lb	Orbiter vacuum thrust per engine	X	X	X	X	X
NNB		none	Number of booster engines	X	X	X	X	X
NØ		none	Number of orbiter engines	X	X	X	X	X
EXITA		ft^2	Exit area per booster engine	X	X	X	X	X
ISPB[1]	425	sec	Booster vacuum specific impulse	X	X	X	X	X
ISPØ[1]	460	sec	Orbiter vacuum specific impulse	X	X	X	X	X

[1] This parameter has a built-in value if not input

DEFINITION OF TERMS FOR TABLE 4.1-1

The following terms are inputs for PADS-1 Sizing problems:

JTYPE=1	Tells PADS that a Phase I sizing problem is to be solved
IPSMAX	Maximum number of iterations minus one between sizing program and trajectory program. Built-in value of 4
ISIZE	This flag determines the type of Phase I sizing problem to be solved. See Section 2
TVACB	Booster vacuum thrust per engine (lb)
TVACØ	Orbiter vacuum thrust per engine (lb)
NNB	Number of booster engines

NØ	Number of orbiter engines
EXITA	Booster engine exit area per engine (ft^2)
MUB	Booster mass ratio initial guess
VSTG	Booster staging characteristic velocity guess (fps)
IDVEL	Total characteristic velocity estimate (fps)
ISPB	Booster vacuum specific impulse (sec)
ISPØ	Orbiter vacuum specific impulse (sec)
BK1, . . ., BK4	Coefficients of booster-stage weight equation (see Section 1)
ØK1, . . ., ØK4	Coefficients of orbiter-stage velocity equation (see Section 1)
WLØ	Vehicle lift-off gross weight (lb)
XPL	Payload weight (lb)
WEØ	Orbiter-stage weight (lb)
WEB	Booster-stage weight (lb)
WPØ	Orbiter propellant weight (lb)
WPB	Booster propellant weight (lb)
PRFLG	Print flag: 1 = Print sizing data each iteration 0 = Do not print sizing data except for converged pass
TWRATØ	Lift-off thrust-to-weight ratio
TOLWT	Lift-off weight convergence tolerance (lb)

4.1.3 Vehicle Data

The Phase I sizing problem employs two vehicle models. The first is a simple table input of stage weight versus propellant weight. The second model consists of inputting the coefficients of an equation that relates the propellant weight to the stage weight. This equation is:

$$W_{stg} = A_1 + A_2 W_p + A_3 W_p^{1/3} + A_4 W_p^{2/3} \qquad (4.1\text{-}1)$$

The coefficients input for the equation to express the booster-stage weight are BKi and OKi for the orbiter. If both the coefficients and tabular data are input, the equation form for the stage weight will override the tabular input.

The table number for booster weight is ITNBW and for the orbiter, ITNOW. The tables are input in TWDRP(1,N), where N is table number. This table set is included with the remainder of univariate spline fit tables.

The other vehicle parameters that must be input are discussed under the various sizing options.

4.1.4 Miscellaneous Data

The miscellaneous data input consists of output flags, convergence tolerances, and problem identification. These parameters are: (1) an iteration print flag, PRFLG; (2) the tolerance that a gross weight iteration must converge to, TOLWT; and (3) two flags to identify the problem. The first flag indicates a Phase I sizing problem and must be input as JTYP=1.. The second flag identifies the sizing option being used and must be non-zero.

4.2 SIZING OPTIONS

There are five sizing options available. These options are:

1. Fixed lift-off weight
2. Fixed payload weight
3. Fixed orbiter
4. Fixed booster
5. Fixed lift-off thrust-to-weight ratio.

The following paragraphs will discuss these options and their input requirements. Table 4-1.1 summarizes the input requirements.

4.2.1 ISIZE = 1., Fixed Lift-Off Weight

The fixed lift-off weight sizing option will maximize the payload weight that can be delivered to the final conditions. The input requirements for this option are shown in Table 4.1-1.

4.2.2 ISIZE = 2., Fixed Payload Weight

This option will minimize the gross lift-off weight to place a fixed payload at the end conditions. The required inputs for this option are shown in Table 4.1-1.

4.2.3 ISIZE = 3., Fixed Orbiter

This option will size a booster stage to boost a fixed payload and orbiter stage to the desired end conditions.

4.2.4 ISIZE = 4., Fixed Booster

This option will size an orbiter stage with a fixed payload. The input requirements are similar to the previous option except the booster stage parameters WPB and WEB are substituted for the corresponding orbiter parameters.

4.2.5 ISIZE = 5., Fixed Lift-Off Thrust-to-Weight Ratio

This option is exercised if a gross weight is selected at lift-off based on an input thrust-to-weight ratio and thrust level. Given the gross weight, the program will maximize the payload utilizing the logic and equations designed for an Option 1 problem. Thus, the input data are identical to those used in an Option 1 type problem with two exceptions; ISIZE must equal five and the thrust-to-weight ratio, TWRATO, must be input. The gross weight, WLO, does not have to be input for this option.

Table 4.1-1 summarizes the input requirements for all of the pads Phase I sizing options. Some of these parameters are only estimates of the value and will be determined by the program.

4.3 OPTIMAL STAGING

PADS has the capability to determine the optimal staging velocity for a two-stage vehicle. The input requirements for this capability are discussed in the boundary conditions input, Section 2.9, and also in the following section. This capability is limited to a Phase I problem and only to Options 1, 2, or 5, since both stages must be permitted to vary in size.

The inputs required to permit this type of solution include the payload performance index, variable code 36, and the computed weight drop at the beginning of the arc following booster burnout. The arc duration determining the length of booster burn must be optimized. An example of these for an injection problem is given in Section 4.4.

4.4 SIZING INTERFACE INPUTS

The arc-structure of the trajectory module is tied to the sizing problem by several required inputs.

These are:

BECØ	The arc where booster thrust terminates
BSTG	The arc where booster case is dropped
ØRBI	The arc where orbiter thrusting is initiated

For a fixed staging problem, all cut-off conditions and initial conditions must be input the same as described previously except that cut-off weights, drop weight, and initial weight values need not be input since they are supplied by the sizing program.

The Phase I sizing program also automatically supplies the following data to the trajectory program:

A. Booster vacuum thrust
B. Booster vacuum ISP
C. Booster nozzle area
D. Number of booster engines
E. Orbiter vacuum thrust
F. Orbiter vacuum ISP
G. Number of orbiter engines.

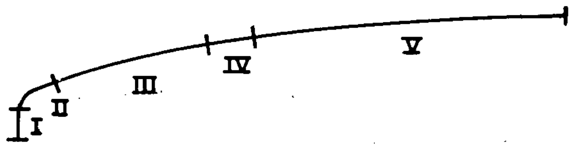
Note that the orbiter nozzle area is not supplied by the sizing program, but if desired may be supplied by the trajectory program input, AEXIT(i).

If optimal staging is desired, in a Phase I problem the trajectory boundary condition input must be handled in the following way:

> The last arc of the booster thrusting period must be cut off on optimized arc time. The initial weight of the orbiter must be governed by the calculated weight drop, Option 6. And finally, payload (variable Option 36) must be the payoff.

An example of the key input for this is illustrated below

Arc Structure



The trajectory shown has five arcs:

Arc No.	Description
I	Vertical rise for 10 sec
II	Optimal pitchover at 0. 2 deg/sec
III	Booster cut-off arc
IV	Coast arc
V	Orbiter injection arc

Key Data:

BECØ = 3.,
BSTG = 3.,
ØRBI = 5.,

T1	= 1., 10.,	10 sec, vertical rise
T2	= 2., 8.,	8 sec, estimate optimized pitchover
T3	= 2., 160.,	160 sec, optimized booster termination arc
T4	= 1., 10.,	Coast arc
T5	= 4., 0.,	Last arc time is unknown
CT5	= 12., 25000.,	Cut off last arc on inertial velocity
W4	= 6., 0.,	The initial weight of arc IV to be determined by a calculated weight-drop increment.

PAYØFF = 5., 36., 0., Payload to be maximized.

In conclusion, it is recommended that aerodynamic drag be included in upper-stage simulation on all optimal-stage Phase I sizing problems.

Section 5
PHASE II SIZING INPUT INSTRUCTIONS

The Phase II sizing module was written for NASA by General Dynamics Corporation and is published as that company's report No. GDC-DBB70-002. This program has three NAMELIST data packages required for input data.

The first NAMELIST package is for input of the orbiter data, the second for input of the booster data, and the third for input of the synthesis data and sizing options. These three packages must be present and in the order mentioned above for the Phase II sizing option to work.

5.1 VEHICLE DATA

The booster and orbiter data are both read in with the same NAMELIST name, $DATA3. These data are read in under identical input acronyms by the subroutine VEHDF and are stored in appropriate arrays in the subroutine STORE. The data are also stored on random file for ease of handling when transferring from one OVERLAY to another during the synthesis iteration process and to differentiate between orbiter and booster data. Volume II of the General Dynamics report, the Weight Volume Handbook, contains a complete description of the use of these input parameters in the general $DATA3 format and differentiates between the orbiter and booster input where necessary.

This section contains a complete list and brief description of the $DATA3 input in the general data format (orbiter or booster) and points to those input parameters which are either controlled by the synthesis driver input ($DATA2) or are computed internally during the synthesis process. In the first case, input for certain parameters is needed to parallel a particular synthesis option. In the second case, certain input parameters are internally computed, thereby overriding the $DATA3 input, or are recomputed during the synthesis process. The basic scaling coefficients are input in subscripted arrays and acronym names. The principal arrays and their internal dimensions are C(300) and K(30). These arrays are internally initialized at a value of 0, for both the orbiter and booster data. Therefore, if a parameter is not input, its value will be internally stored as 0. Where an array parameter is not shown in the $DATA3 input list, it has been reserved for future use in an expanded SSSP and also has an internally stored value of 0. The remaining $DATA3 input parameters are read in under acronym names and primarily are fixed items or initial estimates used in the WTSCH sizing process for each stage. These parameters are also internally initialized at a value of 0. for each stage. Since the data for both the orbiter and booster are input under the same parameter names, it is important to place the respective input in the proper $DATA3 inputdata block as outlined above. Misplacement of orbiter data to the booster $DATA3 and vice versa is one of the most frequent causes of aborted SSSP runs.

The brief descriptions following the $DATA3 input list are utilized in this volume only for reference. The numbers in parentheses preceding the terms in the list refer to the comments following the list.

5.2 BRANCHED TRAJECTORY BOOSTER TPS WEIGHT CALCULATION

If C(81) = 0.
and a branched trajectory problem is simulated, the following equation may be used to determine the TPS weight:

$$WTPS = Q^{C(81)} * t^{C(82)} * C(180) + C(26)$$

where C(I) are input coefficients, Q is the heat load (Btu/ft^2) generated on the branched leg of the trajectory (entry portion), and t is the heating time. A familiar configuration of this equation in thermal-protection-system design is obtained when C(81) = 1/8, C(82) = 3/8, and C(180) = 1. C(27) = 0.

The heat load and heating time are determined from an input threshold heating rate; that is, the heat rate is integrated from the time it exceeds the threshold value until it falls below this value again. This integral forms Q and the time of integration determines the heating time.

$DATA3 INPUT TERMS

Terms	Description	Units
C(1)	Wing weight coefficient (intercept)	--
C(2)	Wing weight coefficient F(gross area)	lb/ft^2
C(3)	Fixed wing weight	lb
C(4)	Vertical fin weight coefficient	lb/ft^2
C(5)	Fixed vertical fin weight	lb
C(6)	Horizontal stabilizer weight coefficient	--
C(7)	Fixed horizontal stabilizer weight	lb
C(8)	Unit weight of fairing or shroud	lb/ft^2
C(9)	Fixed weight of fairing or shroud	lb
C(10)	Integral fuel tank weight coefficient	lb/ft^2
C(11)	Fixed integral fuel tank weight	lb
C(12)	Wing weight coefficient (slope)	--
C(13)	Basic body weight coefficient F(area)	lb/ft^2
C(14)	Basic body weight coefficient F(vol)	lb/ft^3
C(15)	Fixed basic body weight	lb
C(16)	Not used	--
C(17)	Not used	--
C(18)	Not used	--
C(19)	Not used	--
C(20)	Not used	--
C(21)	Not used	--
C(22)	Not used	--
C(23)	Secondary structure weight coefficient	lb/ft^2
C(24)	Vertical fin weight coefficient F(fin area)	lb/ft^2
C(25)	Horizontal weight coefficient F(horiz area)	lb/ft^2
C(26)	Fixed insulation weight	lb
C(27)	Fixed cover panel weight	lb
C(28)	Gimbal system weight coefficient (intercept)	--
C(29)	Prime power source tankage weight coefficient	--
C(30)	Landing gear weight coefficient F(WLAND)	--
C(31)	Fixed landing gear weight	lb
C(32)	Rocket engine weight coefficient	--
C(33)	Fixed rocket engine weight	lb
C(34)	Not used	--
C(35)	Not used	--
C(36)	Nacelle, pods, and pylons weight coefficient	--
C(37)	Fixed Nacelle, pods, and pylons weight	lb
C(38)	Power source propellant weight coefficient	--
C(39)	Fuel tank weight coefficient (non-structural)	lb/ft^3
C(40)	Fixed fuel tank weight (non-structural)	lb
C(41)	Oxid tank weight coefficient (non-structural)	lb/ft^3
C(42)	Fixed oxid tank weight (non-structural)	lb
C(43)	Fuel tank insulation unit weight	lb/ft^2
C(44)	Fixed propellant tank insulation weight	lb
C(45)	Fuel system weight coefficient F(thrust)	--
C(46)	Fuel system weight coefficient F(length)	lb/ft
C(47)	Fixed fuel system weight	lb

$DATA3 INPUT TERMS (Continued)

Terms	Description	Units
C(48)	Oxid system weight coefficient F(thrust)	--
C(49)	Oxid system weight coefficient F(length)	lb/ft
C(50)	Fixed oxid system weight	lb
C(51)	Fuel tank pressure system weight coefficient	lb/ft^3
C(52)	Oxid tank pressure system weight coefficient	lb/ft^3
C(53)	Not used	--
C(54)	Not used	--
C(55)	Aerodynamic control system weight coefficient	--
C(56)	Fixed aerodynamic control system weight	lb
C(57)	Not used	--
C(58)	Not used	--
C(59)	Not used	--
C(60)	Fixed prime power source tankage weight	lb
C(61)	Not used	--
C(62)	Electrical system weight coefficient	--
C(63)	Electrical system weight coefficient	--
C(64)	Fixed electrical system weight	lb
C(65)	Hydraulic/pneumatic system weight coefficient	--
C(66)	Hydraulic/pneumatic system weight coefficient	--
C(67)	Fixed hydraulic/pneumatic system weight	lb
C(68)	Fixed guidance and navig system weight	lb
C(69)	Instrumentation system weight coefficient	lb/ft
C(70)	Fixed instrumentation system weight	lb
C(71)	Communication system weight coefficient	--
C(72)	Fixed communication system weight	lb
C(73)	Fixed ACS reserve propellant weight	lb
C(74)	Equipment ECS weight coefficient	--
C(75)	Crew provisions weight coefficient	--
C(76)	Fixed crew provisions weight	lb
C(77)	Oxid tank insulation unit weight	lb/ft^2
C(78)	Fixed ice and frost weight	lb
C(79)	Not used	--
C(80)	Not used	--
C(81)	TPS weight coefficient	--
C(82)	TPS weight coefficient	--
C(83)	Not used	--
C(84)	Not used	--
C(85)	Not used	--
C(86)	Not used	--
C(87)	Not used	--
C(88)	Not used	--
C(89)	Not used	--
C(90)	Not used	--
C(91)	Not used	--
C(92)	Not used	--
C(93)	Not used	--
C(94)	Not used	--
C(95)	Not used	--
C(96)	Contingency and growth coefficient	--

$DATA3 INPUT TERMS (Continued)

	Terms	Description	Units
	C(97)	Crew weight coefficient	--
	C(98)	Fixed crew weight	lb
	C(99)	Not used	--
	C(100)	Not used	--
	C(101)	Not used	--
	C(102)	Payload/cargo weight coefficient	--
(1)	C(103)	Fixed payload/cargo weight	lb
	C(104)	Passenger weight coefficient	--
(2)	C(105)	Fixed passenger weight	lb
	C(106)	Fuel tank gaseous weight coefficient	lb/ft^3
	C(107)	Oxid tank gaseous weight coefficient	lb/ft^3
	C(108)	Fixed pressure and purge gaseous weight	lb
	C(109)	Trapped fuel weight coefficient F(fuel weight)	--
	C(110)	Fixed trapped fuel weight	lb
	C(111)	Trapped oxid weight coefficient F(oxid weight)	--
	C(112)	Fixed trapped oxid weight	lb
	C(113)	Trapped service items weight coefficient	--
	C(114)	Fixed trapped service items weight	lb
	C(115)	Fuel reserve weight coefficient	--
	C(116)	Fixed reserve fuel weight	lb
	C(117)	Oxid reserve weight coefficient	--
	C(118)	Fixed reserve oxidizer weight	lb
	C(119)	Power source reserve propellant weight coefficient	--
	C(120)	Fixed reserve power source propellant	lb
	C(121)	Reserve service items weight coefficient	--
	C(122)	Fixed reserve service items	lb
	C(123)	Vented fuel weight coefficient F(total fuel)	--
	C(124)	Fixed vented fuel weight	lb
	C(125)	Vented oxid weight coefficient F(total oxid)	--
	C(126)	Fixed vented oxid weight	lb
	C(127)	Fixed power source propellant weight	lb
	C(128)	Not used	--
(3)	C(129)	Fixed main thrust per engine (vac)	lb
	C(130)	Service item losses weight coefficient	--
	C(131)	Fixed service item losses	lb
	C(132)	Fixed thrust build-up fuel weight	lb
	C(133)	Fixed thrust build-up oxid weight	lb
	C(134)	Fixed pre-ignition losses	lb
	C(135)	Vertical fin weight coefficient	--
	C(136)	Fixed secondary fuel system weight	lb
	C(137)	Fixed secondary oxid system weight	lb
	C(138)	Integral oxid tank weight coefficient	lb/ft^3
	C(139)	Fixed integral oxid tank weight	lb
	C(140)	Secondary rocket-engine weight coefficient	--
	C(141)	Fixed secondary rocket-engine weight	lb
	C(142)	Not used	--
	C(143)	Launch gear weight coefficient	--
	C(144)	Fixed launch gear weight	lb
	C(145)	Deployable aerodynamic devices weight coefficient	--

$DATA3 INPUT TERMS (Continued)

Terms	Description	Units
C(146)	Fixed deployable aerodynamic devices weight	lb
C(147)	Docking structure weight coefficient	--
C(148)	Fixed docking structure weight	lb
C(149)	Airbreathing engine thrust per engine	lb
C(150)	Not used	--
C(151)	Not used	--
C(152)	Not used	--
C(153)	Separation system weight coefficient	--
C(154)	Fixed separation system weight	lb
C(155)	ACS system weight coefficient	--
C(156)	ACS system weight coefficient	--
C(157)	Fixed ACS system weight	lb
C(158)	Fixed secondary thrust	lb
C(159)	Not used	--
C(160)	Gimbal system weight coefficient	--
C(161)	Fixed gimbal system weight	lb
C(162)	Fixed contingency and growth weight	lb
C(163)	Fixed thrust structure weight	lb
C(164)	ACS tank weight coefficient	--
C(165)	Fixed ACS tank weight	lb
C(166)	Thrust decay propellant weight coefficient	--
C(167)	Fixed thrust decay propellant weight	lb
C(168)	Thrust structure weight coefficient	--
C(169)	Fixed secondary structure weight	lb
C(170)	Secondary fuel system weight coefficient	lb/ft^3
C(171)	Secondary oxid system weight coefficient	lb/ft^3
C(172)	ACS reserve propellant weight coefficient	--
C(173)	ACS propellant weight coefficient F(WTO)	--
C(174)	ACS propellant weight coefficient F(WWAIT(4))	--
C(175)	Fixed ACS propellant weight	lb
C(176)	Horizontal stabilizer weight coefficient	--
C(177)	Not used	--
C(178)	Not used	--
C(179)	Not used	--
C(180)	Insulation unit weight	lb/ft^2
C(181)	Cover panel unit weight	lb/ft^2
C(182)	Landing gear weight coefficient F(WLAND)	--
C(183)	Engine mount weight coefficient	--
C(184)	Fixed engine mount weight	lb
C(185)	Aerodynamic control system weight coefficient	--
C(186)	Not used	--
C(187)	Fixed pressurization system weight	lb
C(188)	Not used	--
C(189)	Fuel tank weight coefficient (JP)	--
C(190)	Fixed fuel tank weight	lb
C(191)	Fuel dist system-Part 1 weight coefficient	--
C(192)	Not used	--
C(193)	Not used	--
C(194)	Not used	--

$DATA3 INPUT TERMS (Continued)

Terms	Description	Units
C(195)	Not used	--
C(196)	Not used	--
C(197)	Not used	--
C(198)	Not used	--
C(199)	Not used	--
C(200)	Not used	--
C(201)	Not used	--
C(202)	Not used	--
C(203)	Not used	--
C(204)	Not used	--
C(205)	Not used	--
C(206)	Not used	--
C(207)	Not used	--
C(208)	Not used	--
C(209)	Not used	--
C(210)	Air-breathing engine weight coefficient	--
C(211)	Fixed air-breathing engine weight	lb
C(212)	Air-breathing tankage plus system weight coefficient	--
C(213)	Fixed air-breathing tankage plus system weight	lb
(4) C(214)	Flyback mass ratio minus 1.0	--
C(215)	Fixed flyback propellant weight	lb
C(216)	Not used	--
C(217)	Not used	--
C(218)	Nozzle exit area per engine	ft^2
C(219)	Rocket engine weight coefficient F(thrust area)	--
C(220)	Rocket engine area ratio	--
C(221)	Rocket engine area ratio exponent	--
C(222)	Not used	--
C(223)	Not used	--
C(224)	Not used	--
C(225)	Trapped fuel weight coefficient F(propellant)	--
C(226)	Trapped fuel weight coefficient F(thrust)	--
C(227)	Trapped oxid weight coefficient F(propellant)	--
C(228)	Trapped oxid weight coefficient F(thrust)	--
C(229)	Vented fuel weight coefficient F(propellant)	--
C(230)	Vented oxid weight coefficient F(propellant)	--
ANENGS	Number of air-breathing engines	--
ANTANK	Number of air-breathing fuel tanks (JP)	--
ASRATO	Wing aspect ratio	--
ASWEEP	Wing leading edge sweep angle	deg
CBBODY	Body width or coefficient	ft
CFUEL (1)	Thrust build-up mixture ratio	--
CFUEL (2)	Not used	--
CFUEL (3)	Main impulse mixture ratio	--
CFUEL (4)	Main impulse reserve mixture ratio	--
CFUEL (5)	Secondary impulse mixture ratio	--

$DATA3 INPUT TERMS (Continued)

Terms	Description	Units
CFUEL (6)	Not used	--
CHBODY	Body height or coefficient	ft
CLBODY	Body length or coefficient	ft
CSBODY	Total body wetted area or coefficient	ft^2
CSFAIR	Fairing planform area or coefficient	ft^2
CSFUTK	Fuel tank surface area coefficient	--
CSHORZ	Horizontal stab planform area or coefficient	ft^2
CSOXTK	Oxid tank surface area coefficient	--
CSPLAN	Body planform area or coefficient	ft^2
CSVERT	Veritical fin planform area or coefficient	ft^2
(5) CSWING	Wing planform area	ft^2
(6) CTHRST	Vacuum thrust to lift-off weight ratio	--
CTHST2	Secondary propulsion T/W ratio	--
FXWOVS	Fixed wing loading	lb/ft^2
ISP(1)	Thrust build-up propellant ISP	sec
ISP(2)	Sea level ISP	--
ISP(3)	Main impulse propellant ISP (vac)	sec
(7) ISP(4)	Main impulse reserve propellant ISP	sec
ISP(5)	Secondary propulsion propellant ISP	sec
ISP(6)	Not used	--
ITPS	TPS flag	--
K(1)	Fuel tank ullage volume coefficient	--
K(2)	Oxidizer tank ullage volume coefficient	--
K(3)	Average fuel tank insulation thickness	ft
K(4)	Fixed propellant tank insulation volume	ft^3
K(5)	Crew volume coefficient	--
K(6)	Fixed crew volume	ft^3
K(7)	Fixed secondary fuel tank volume	ft^3
K(8)	Fixed secondary oxid tank volume	ft^3
K(9)	Fixed cargo bay volume	ft^3
K(10)	Average body structural depth	ft
K(11)	Fixed body structural volume	ft^3
K(12)	Landing gear bay volume coefficient	ft^3/lb
K(13)	Fixed landing gear bay volume	ft^3
K(14)	Not used	--
K(15)	Not used	--
K(16)	Propulsion bay volume coefficient	ft^3/lb
K(17)	Fixed propulsion bay volume	ft^3
K(18)	Miscellaneous volume coefficient	--
K(19)	Fixed miscellaneous volume	ft^3
K(20)	Not used	--
K(21)	Fixed fuel tank volume	ft^3
K(22)	Not used	--
K(23)	Body volume intercept (K(18) scaling)	ft^3
K(24)	Not used	--
K(25)	Average oxid tank insulation thickness	ft
K(26)	Not used	--
K(27)	Not used	--

	Terms	Description	Units
	K(28)	Main fuel tank volume for flyback	ft^3
	K(29)	Fixed oxidizer tank volume	ft^3
	K(30)	Not used	--
	KIN	Not used	--
	LF	Ultimate load factor	--
	MR(1)	Thrust build-up mass ratio or ΔV	--
	MR(2)	Not used	--
	MR(3)	Main impulse mass ratio	--
	MR(4)	Main impulse reserve mass ratio or ΔV	--
	MR(5)	Secondary impulse mass ratio or ΔV	--
	MR(6)	Not used	--
	NCREW	Number of crew members	--
	NENGS	Total number of engines per stage	--
	NLISTO	NAMELIST output flag	--
	NPASS	Number of passengers	--
	NWL	Wing loading flag	--
	PCHAM	Main rocket engine chamber pressure	psia
(9)	Q	Maximum dynamic pressure	psia
	RHOFU	Fuel density	lb/ft^3
	RHOFU2	Secondary fuel density	lb/ft^3
	RHOX	Oxidizer density	lb/ft^3
	RHOX2	Secondary oxidizer density	lb/ft^3
(10)	SBODY	Total body wetted area	ft^2
	TOL	Gross weight iteration tolerance	lb
	TOVERC	Wing thickness over chord ratio	--
	TPRATO	Wing taper ratio	--
	TYTAIL	Not used	--
(10)	VBODY	Total body volume	ft^3
(10)	WGROSS	Gross weight	lb

$DATA3 COMMENTS*

1. For the orbiter, this input is the fixed system payload or cargo for the mission excluding the weight of furnishings and support equipment for the passengers, if any. The weight of the passengers is handled separately. If a fixed booster gross weight (liftoff weight) is to be specified (see Section 4.3.5), this weight is used as the initial estimate for the system payload.
2. For the booster, this input is not available. Internally, this parameter is set equal to the gross weight of the orbiter and hence, the "payload" of the booster.
3. For the orbiter, this input is the vacuum thrust per engine (unit thrust). If a fixed vacuum thrust/gross weight is desired for the orbiter (see Section 4.3.1), this parameter must be input as 0. For the booster, this parameter is internally computed and the input value is ignored.
4. For the orbiter, this input is the fixed value of the cruise performance mass ratio minus 1, which is used to calculate the weight of air-breathing fuel, if any. Typically, the orbiter makes use of air-breathing engines only for a powered approach and landing with go-around capability. For the booster, this input is an initial estimate (see Section 4.3.4) since the booster also utilizes its air-breathing engines to perform the subsonic cruise to the landing site with the cruise range requirement being specified internally.
5. For the orbiter or the booster, this input is the fixed specified theoretical (gross) wing area and the wing loading is computed internally (set FXWOVS=0.,) at a selected design condition. If the wing is to be specified (FXWOVS) at a selected design condition, this input is used as an initial estimate for the theoretical wing area.
6. If CTHRST (vac T/W) is non-zero for the booster or orbiter, the corresponding stage thrust will be adjusted to match this gravity.

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*All section numbers in the comments refer to sections in the Space Shuttle Synthesis Program, General Dynamics Corporation, Report No. GDC-DBB70-002, 1970.

7. For the orbiter, this parameter is internally set equal to the $DATA2 input (I VACO) and therefore need not be input.
8. For the orbiter, this parameter is internally computed as an initial estimate to start the synthesis process (see Section 2.3.1), and therefore need not be input. For the booster, this input is the fixed main impulse mass ratio utilized during the synthesis process. If a fixed orbiter gross weight or fixed orbiter propellant weight is to be specified (see Sections 4.3.5.2 and 4.3.5.3), this input is used as the initial estimate for the booster main impulse mass ratio.
9. For the orbiter and the booster, this parameter is internally computed by the maximum dynamic pressure attained during simulation of the ascent trajectory and therefore need not be input. Internally, the initial estimate for this parameter is equal to the $DATA2 input estimate QMAX.
10. For the orbiter and the booster, this input is used as an initial estimate to start the synthesis process.

$DATA2 TERMS

The NAMELIST input data block $DATA2 primarily controls the basic operation of the SSSP. It contains the basic synthesis driver parameters and option flags. It also has estimates for the various synthesis options and control flags for printing output during the synthesis iterations. These inputs are read in from the subroutine VEHDF and are stored in subscripted arrays for ease of data handling when transferring from one to another during the basic synthesis iteration process. These subscripted arrays are also utilized to store computed data necessary to drive the synthesis iterations.

Input Parameter	Internal Parameter	Compiled Value	Description*
IDVEL	SV(2)		Total characteristic velocity estimate to parking orbit insertion (fps) (see Section 2.3.1)
COPIES	SV(15)	6.	No. of copies of summary sheet (see Section 5)
ISLB			Booster sea level specific impulse (sec)
IVACB	SE(1)	450.	Booster vacuum specific impulse (sec)
IVACO	SE(7)	450.	Orbiter vacuum specific impulse (sec)
TFCTRB	SE(9)	1.	Booster multiplicative thrust factor for ascent flight simulation
TFCTRO	SE(8)	1.	Orbiter multiplicative thrust factor for ascent flight simulation
FIRE	SE(2)	2.	Flag for stage ascent burn sequence (Section 4.3.2) = 1., for simultaneous stage burns = 2., for sequential stage burns

*Sections numbers refer to sections in the Space Shuttle Synthesis Program, General Dynamics Corporation, Report No. GDC-DBB70-002, 1970.

Input Parameter	Internal Parameter	Compiled Value	Description*
BOOTW**	SE(3)	0.	Flag for propulsion option (Section 4.3.1) = 0., for fixed booster thrust or fixed liftoff thrust/weight with common engines = 1., for fixed engines (noncommon engines)
QMXS	SE(4)	900.	Slope used for QMAX adjustment (psf) when liftoff thrust/weight varies during the synthesis iterations (see Section 2.3.2.1)
FBPAR	SE(5)	250.	Estimate of slope for adjusting the booster cruise parameter if WOREQ > 0. or WPOREQ > 0., (see Special Note, Section 2.3.4.2)*
QMAX	SE(6)	550.	Estimate of maximum dynamic pressure (psf) during ascent flight used for sizing of stage components. (See Volume II, Weight/Volume Handbook of General Dynamics Corporation Report.)
NXFOB	SE(10)	0.	Flag for cross-feed of propellants from booster tanks to orbiter engines at liftoff if FIRE = 1., (see Section 4.3.2.2) = 1., for no cross-feed
SYNIT	SW(4)	10.	Twice the number of allowable basic synthesis iterations (see Section 2.3.1)
TOLMU	SW(5)	.0005	Convergence tolerance for orbiter main impulse mass ratio during basic synthesis iteration process (see Section 2.3.1)
TRATIO	SW(6)	1.	Ratio of booster-to-orbiter engine vacuum thrust if BOOTW = 0.; common engines, see Section 4.3.1

* Sections numbers refer to sections in the Space Shuttle Synthesis Program, General Dynamics Corporation, Report No. GDC-DBB70-002, 1970.

** If BOOTW = 0, C(129) for the booster ≠ 0 or booster, tabular data must be input.

Input Parameter	Internal Parameter	Compiled Value	Description*
PERISP	SW(7)	.81	Parameter used to estimate the effective booster specific impulse in calculating the booster characteristic velocity requirement in sizing (see Section 2.3.1)
CLVG	SW(9)	1.0	Correlation factor used to adjust reference cruise range requirement if FLYBCK = 1., (see Section 2.3.4.1) (Adjustment not used if CLVG = 1.)
ALD SFC VCRUSE	SW(11) SW(12) SW(14)	6. .2 300.	Booster subsonic lift-drag ratio, specific fuel consumption (lb/lb-hr) and cruise velocity (fps) for determining cruise performance parameter if FBFUEL = 1., (see Section 2.3.4.2)
SLVOUT	SW(13)	0.	Flag for printout of weight sizing iterations during booster and orbiter weight synthesis (see Section 2.3.1.1 for iteration process) = 0., for no printout = 2., for printout of final iteration = 3., for printout of each iteration
WTOUT	SW(16)	0.	Flag for intermediate printout of weight data and trajectory simulation during basic synthesis iteration process (see Section 2.3.1 for iteration process) = 0., no printout = 1., for intermediate printout
TWLO	SW(17)	1.371	Desired liftoff thrust-to-weight ratio if BOOTW = 0., and TWLOI 0., (see Section 2.3.2.2)
TOLTW	SW(18)	.001	Tolerance on TWLO for iteration process (see Section 2.3.2.2)
TWLOI	SW(19)	-1.	Maximum allowable number of iterations to obtain TWLO (see Section 2.3.2.2)

*Sections numbers refer to sections in the Space Shuttle Synthesis Program, General Dynamics Corporation, Report No. GDC-DBB70-002, 1970.

Input Parameter	Internal Parameter	Compiled Value	Description*
WOREQ**	SQ(10, 1)	0.	Required orbiter gross weight (lb) (see Section 2.3.2.4). If WOREQ ≤ 0., the option is not used (also see Section 4.3.5.2)
DRNG	SQ(10, 3)	0.	Additive range increment (nmi) to bias results of booster cruise reference range requirement (see Section 2.3.4)
WPOREQ**	SQ(13, 1)	0.	Required orbiter total impulse propellants (lb) (see Section 2.3.2.5). If WPOREQ ≤ 0., the option is not used (also see Section 4.3.5.3)
GWREQ**	SQ(16, 1)	3500000.	Required booster gross weight (lb) (see Section 2.3.2.3). If GWREQ ≤ 0., the option is not used (also see Section 4.3.5.1)
FLYBCK	SQ(19, 5)	2.	Flag for desired method of calculating reference cruise range requirement for booster (see Sections 2.3.4.1 and 4.3.3) = 1., for parametric flyback range data = 2., for staging Q function range = 3., for constant range = 4., for ballistic impact range = 5., for entry trajectory simulation range
SOLID	SQ(20, 1)	0.	Required number of solid rocket strap-on motors, (see Section 2.3.3.3). If SOLID ≤ 0., the option is not used (also see Section 4.3.5.4)
AS BS SINERT SAE	SQ(20, 2) SQ(20, 3) SQ(20, 5) SQ(21, 1)	0. 0. 0. 0.	Constant (lb), slope (lb/sec), inert weight (lb), and exit area per solid rocket, if SOLID > 0., (see Section 2.3.3.3)

* Sections numbers refer to sections in the Space Shuttle Synthesis Program, General Dynamics Corporation, Report No. GDC-DBB70-002, 1970.

** If $\left\{\begin{array}{l}\text{GWREQ} = 0\\ \text{WPOREQ} = 0\\ \text{WOREQ} = 0\end{array}\right\}$, PADS will find the minimum gross weight required to place the payload specified by C(103) into orbit.

Input Parameter	Internal Parameter	Compiled Value	Description*
SISP TSBO	SQ(20, 4) SQ(21, 2)	0.	Constant vacuum specific impulse (sec) for solid rockets, if SOLID > 0., (see Section 2.3.3.3.)
FBFUEL	SQ(32, 1)	1.	Flag for desired method of calculating booster cruise performance parameter (see Section 2.3.4.2): = 1., for single segment cruise = 2., for four-segment cruise, option 1 = 3., for four-segment cruise, option 2
CA	SQ(32, 2)	0.	Percent of the current booster weight at initiation of idle descent and final descent, to be used as cruise fuel during these cruise flight phases when FBFUEL = 2., (see Section 2.3.4.2)
WFLYX	SQ(32, 4)	0.	Weight additive term (lb) used in calculating the booster cruise performance parameter (see Section 2.3.4.2)
RT R1 R3	SQ(32, 5) SQ(33, 1) SQ(33, 2)	0. 0. 0.	Range decrements (nmi) for transition, idle descent, and final descent, when FBFUEL = 2., or 3., (see Section 2.3.4.2)
ALD2 SFC2 VFLY2	SQ(34, 2) SQ(33, 4) SQ(34, 5)	1. 0. 1.	Booster subsonic lift-to-drag ratio, specific fuel consumption (lb/lb-hr) and cruise velocity (fps) for determining fuel expended during cruise phase when FBFUEL = 2., or 3., (see Section 2.3.4.2)
ALD1 SFC1 VFLY1	SQ(34, 1) WQ(33,3) SQ(34, 4)	1. 0. 1.	Booster subsonic lift-to-drag ratio, specific fuel consumption (lb/lb-hr) and cruise velocity (fps) for determining fuel expended during idle descent phase when FBFUEL = 3., (see Section 2.3.4.2)

*Sections numbers refer to sections in the Space Shuttle Synthesis Program, General Dynamics Corporation, Report No. GDC-DBB70-002, 1970.

Input Parameter	Internal Parameter	Compiled Value	Description*
ALD3 SFC3 VFLY3	SQ(34,3) SQ(33,5) SQ(35, 1)	1. 0. 1.	Booster subsonic lift-to-drag ratio, specific fuel consumption (lb/lb-hr), and cruise velocity (fps) for determining fuel expended during final descent phase when FBFUEL = 3., (see Section 2.3.4.2)

*Sections numbers refer to sections in the Space Shuttle Synthesis Program, General Dynamics Corporation, Report No. GDC-DBB70-002, 1970.

5.3 PHASE II INTERFACE WITH TRAJECTORY MODULE

5.3.1 Key Interface Inputs

Phase II (SSSP) sizing module interface inputs are similar to those used for Phase I sizing (Section 4). The main differences in input are concerned with solid motor strap-ons or expendable tank option.

The key interfacing inputs in the input are:

Input Name	Meaning
JTYP	= 2, SSSP sizing flag
BECØ	Boost engine cut-off arc no.
BSTG	Boost stage drop arc no.
ØRBI	Orbiter thrust initiation arc no.
	If a solid motor option is used:
SØCØ	SØLID MØTØR CUT-ØFF ARC NO.
SØSP	SØLID MØTØR CASE DRØP ARC NO.

The Phase II sizing option also does not currently permit optimal staging and its associated computer stage drop weights nor does it permit payload optimization. Most problems should use maximum injected weight as a payoff.

5.3.2 Dual Engine Simulation

In the event that the solid motor strap-on or expendable tank option is chosen in SSSP, a special dual-engine simulation is provided in the trajectory module to account for ISP differences between engines. In any arc where two engines are thrusting, JPRØ(i) = 1. must be input. It is assumed that one engine has fixed vacuum thrust whereas the other may be time-varying or throttleable. There are several ways that the required data may be input to the trajectory program. These are illustrated by examples.

Example 1. Solid strap-on ramp thrust history

A. Input in $DATA2 AS and BS, slope and intercept of the solid-motor ramp thrust history.

B. In $XX data, set up two-point thrust vs. time table to span from initial time to the end of the arc defined by SØCØ. The first time point should be zero and the second time point should be the time to cut off the solid. The thrust values need not be loaded.

Result: The interface routine will automatically add up the thrust of all engines over the solid-thrusting time period and load the values into the thrust vs. time table. The weight flow calculation will be based on a corrected ISP to account for the time-varying thrust.

Example 2. Solid strap-on with constant vacuum thrust and throttling

A. A thrust-time table should not be set up for this case.

B. JPRØ should be set equal to 1 for all arcs up to and including SØCØ.

C. The solid-engine thrust must be terminated on time. It is assumed that the liquid will continue to burn (ie BECØ > SØCØ).

D. The secondary engine set up in the sizing input is the one that is throttled.

E. After arc "SØCØ," JPRØ must be reset to 0.

Result: The solid and liquid net vacuum thrust and ISP will be calculated internally and used for all arcs up to and including SØCØ. If the total acceleration limit is reached, the secondary engine will be throttled and the effective ISP used for the net weight flow calculation that will be computed at each time point. After the arc corner point defined by SØCØ, the secondary engine will continue to burn until BECØ.

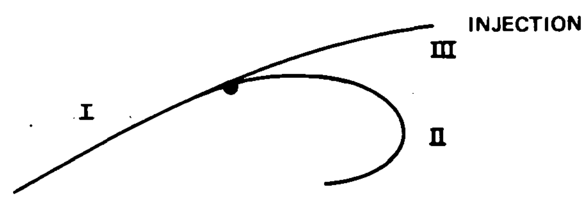
BECØ may be defined by any reasonable cut-off condition.

5.3.3 Branched Sizing Problems

The branched sizing trajectory interface is designed for the flyable booster only. The ground rules for branch problems described in Section 2 apply. The sizing program automatically picks up the flyback simulation flag when the trajectory input is set up for branching.

There are two basically different approaches to branched sizing problems. They are made distinct by the choice of the payoff quantity. These are listed below:

Example 1. Payoff defined at injection



If the payoff quantity is defined at the injection point, the orbiter injection branch must be the last branch in the trajectory; i.e., Segment III on the diagram. The atmosphere entry and flyback is indicated by Segment II on the diagram. The entry and flyback branch should have at least one constraint on its end point. The payoff should normally be injected weight at the insertion point (payload optimization is not available in Phase II sizing problems).

Example 2. Payoff defined at terminus of entry or flyback segment

It is conceivable that a fixed injected weight may be desired with some payoff quantity defined at the entry or flyback terminus. Payoffs such as minimum range or minimum heating may be desired. In such cases, the orbiter injection segment is the first branch in the trajectory and the entry segment is second, as shown in the diagram.

5.4 PARAMETER HUNTING PROCEDURE

The parameter hunting procedure employed in PADS is described in detail in Volume II of this report. The algorithm was developed originally by Powell. It requires no gradients and is set up to perform an unconstrained minimization of a function of up to 10 bounded independent variables. This hunting procedure may be used to vary any words in the Phase II sizing input to achieve any payoff. The inputs for hunting, described below, are all contained within the $DATA2 input with one exception, the hunting iteration counter, IHUNT, which is in the $XX NAMELIST set.

Let j be the independent variable number

RVAR	Numbered independent variables
PNDX(j)	Index code of independent variable (see Table 5.4-1)
PAYX	± index of payoff (see Table 5.4-1) + means maximize - means minimize
BUPP(j)	Upper bound of independent of j^{th} variable
BLØW(j)	Lower bound
STEP(j)	Step size for j^{th} independent variable
IHUNT	Maximum number of hunting iterations. If one independent variable is used, only one iteration is done Note that IHUNT is contained within the $XX NAMELIST set, whereas all others for hunting are within the $DATA2 set.

It is recommended that quasi-linearization sizing solutions be used when performing parameter hunting. There can be enough noise in steepest-descent solutions to slow parameter-hunting convergence.

Table 5.4-1

INDEXES FOR HUNTING PROCEDURE

Index	FORTRAN Name	Equivalent Name	Index	FORTRAN Name	Equivalent Name
1	TB1		32	TB20(8)	
2	TB2	CBBØDY*	33	(9)	
3	TB3		34	TB20(10)	
4	TB4(1)	CFUEL(1)*	35	TB21	
5	(2)	(2)*	41	TB27(1)	ISP(1)*
6	(3)	(3)*	42	(2)	(2)*
7	(4)	(4)*	43	(3)	(3)*
8	(5)	(5)*	44	(4)	(4)*
9	TB4(6)	CFUEL(6)*	45	(5)	(5)*
10	TB5	CHBØDY*	46	TB27(6)	ISP(6)*
11	TB6	CLBØDY*	52	TB33	
12	TB7	CSBØDY*	53	TB34(1)	MR(1)*
13	TB8		54	(2)	(2)*
14	TB9		55	(3)	(3)*
15	TB10	CSFAIR*	56	(4)	(4)*
16	TB11	CSFUTK	57	(5)	(5)*
17	TB12	CSØXTK*	58	TB34(6)	MR(6)*
18	TB13	CSHØRZ*	59	TB35	NCREW*
19	TB14		60	TB36	NENGS*
20	TB15	CSPLAN*	62	TB38	NPASS*
21	TB16	CSVERT*	63	TB39	
22	TB17	CSWING*	64	TB40	
23	TB18	CTHRST*	65	TB41	RHØFU*
24	TB19	CTHST2*	66	TB42	RHØFU2*
25	TB20(1)		67	TB43	RHØX*
26	(2)		68	TB44	RHØX2*
27	(3)		69	TB45	SWING
28	(4)		70	TB46	
29	(5)		71	TB47	TØVERC*
30	(6)		72	TB48(1)	
31	(7)		73	(2)	

* = Booster input

Table 5.4-1

INDEXES FOR HUNTING PROCEDURE (Continued)

Index	FORTRAN Name	Equivalent Name	Index	FORTRAN Name	Equivalent Name
74	TB48(3)		104	TB53	VFUTK2
75	(4)		105	TB54	VØXTK
76	(5)		106	TB55	VØXTK2
77	(6)		107	TB56	WGRØSS
78	(7)		108	TB57(1)	
79	(8)		109	(2)	
80	(9)		110	(3)	
81	TB48(10)		111	(4)	
82	TB49(1)		112	(5)	
83	(2)		113	TB57(6)	
84	(3)		114	SKB(1)	K(1)*
85	(4)		115	(2)	(2)*
86	(5)		116	(3)	(3)*
87	(6)		117	(4)	(4)*
88	(7)		118	(5)	(5)*
89	(8)		119	(6)	(6)*
90	(9)		120	(7)	(7)*
91	TB49(10)		121	(8)	(8)*
92	TB50(1)		122	(9)	(9)*
93	(2)		123	(10)	(10)*
94	(3)		124	(11)	(11)*
95	(4)		125	(12)	(12)*
96	(5)		126	(13)	(13)*
97	(6)		127	(14)	(14)*
98	(7)		128	(15)	(15)*
99	(8)		129	(16)	(16)*
100	(9)		130	(17)	(17)*
101	TB50(10)		131	(18)	(18)*
102	TB51	VBØDY*	132	(19)	(19)*
103	TB52	VFUTK	133	(20)	(20)*
			134	(21)	(21)*

* = Booster input

Table 5.4-1

INDEXES FOR HUNTING PROCEDURE (Continued)

Index	FORTRAN Name	Equivalent Name	Index	FORTRAN Name	Equivalent Name
135	SKB(22)	K(22)*	462	TB67	ANTANK*
136	(23)	(23)*	463	TB68	TYTAIL*
137	(24)	(24)*	464	TB69	NLISTØ*
138	(25)	(25)*	465	TB70	ASWEEP*
139	(26)	(26)*	466	TB71	WFRØST
140	(27)	(27)*	467	TB72	WFUTRP
141	(28)	(28)*	468	TB73	WØXTRP
142	(29)	(29)*	469	TB74	WSRTRP
143	SKB(30)	K(30)*	470	TB75	WDECAY
144	SCB(1)	INDEX → 143 + I	471	TB76	WFURES
443	SCB(300)	To get SCB(1)	472	TB77	WØXRES
		C(1) → C(300)*	473	TB78	WACSFØ
444	BWSAVE(1)	WWAIT(1)	474	TB79	WFULØS
445	(2)	(2)	475	TB80	WØXLØS
446	(3)	(3)	476	TB81	WPØWFØ
447	(4)	(4)	477	TB82	WGASPR
448	(5)	(5)	478	TB83	WACRES
449	(6)	(6)	479	TB84	WPØWRS
450	(7)	(7)	480	WGRØSØ	
451	(8)	(8)	481	ØTTØT	
452	(9)	(9)	482	WFUØXØ	
453	BWSAVE(10)	WWAIT(10)	483	TBTØ	
454	TB59	LF	484	BTTØT	
455	TB60	TPRATØ*	485	WØP	
456	TB61	ASRATØ*	486	WABFUB	
457	TB62	FXWØVS*	487	WFUØXB	
458	TB63	NWL*	488	WDRYB	
459	TB64	ITPS*	489	WGRØSB	
460	TB65	PHAMB*	490	WØTHB	
461	TB66	ANENGS*	491	VFUTUB	
			492	VØXTKB	

* = Booster input

Table 5.4-1

INDEXES FOR HUNTING PROCEDURE (Continued)

Index	FORTRAN Name	Equivalent Name	Index	FORTRAN Name	Equivalent Name
493	VØTHB		915	BBØDY	
494	VBØDYB		916	CRØØT	
495	VABFUB		917	CSPAN	
496	LBØDYB		918	CTIP	
497	SBØDYB		919	GAL	
498	SPLANB		920	GSPAN	
499	WØVRSB		921	HBØDY	
500	WPAYLØ		922	LBØDY	
501	WDRYØ		923	RTØD	
502	WØFHØ		924	SFAIR	
503	WABFUØ		925	SFUTK	
504	VFUTKØ		926	SHØRZ	
505	VØXTKØ		927	SØXTK	
506	VCARØ		928	SPLAN	
507	VØTHØ		929	STPS	
508	VBØDYØ		930	SVERT	
509	LBØDYØ		931	SWING	
510	SBØDYØ		932	SXPØS	
511	SPLANØ		933	TDEL	
512	WØVRSØ		934	TRØØT	
513	WØRBTØ		935	TTØT	
514	WØRBTB		936	TTØT2	
515	WRTRNØ		937	TTØTAL	
516	WRTRNB		938	VBØDYA	
517	WENTRØ		939	VBØDY1	
518	WENTRB		940	VBØDY2	
519	WLANDB		941	VCARGØ	
520	WLANDØ		942	VCREW	
521	WCØNTØ		943	VFUTK	
522	WCØNTB		944	VFUTK2	
			945	VINSTK	

Table 5.4-1

INDEXES FOR HUNTING PROCEDURE (Continued)

Index	FORTRAN Name	Equivalent Name	Index	FORTRAN Name	Equivalent Name
946	VLGBAY		976	WELCAD	
947	VØTHER		977	WEMPTY	
948	VØXTK		978	WENGMT	
949	VØXTK2		979	WENGS	
950	VPRØP		980	WENGS2	
951	VSTRUC		981	WFAIR	
952	ABFSYS		982	WFCØNT	
953	WABFTK		983	WFDCAY	
954	WABFU		984	WFRØST	
955	WABPR		985	WFU2(1)	
956	WACRES		986	WFU2(2)	
957	WACS		987	WFU2(3)	
958	WACSFØ		988	WFUEL(1)	
959	WACSTK		989	(2)	
960	WAERØ		990	(3)	
961	WAUXT		991	(4)	
962	WBASIC		992	(5)	
963	WBØDY		993	WFUEL(6)	
964	WBPUMP		994	WFUL	
965	WCARGØ		995	WFULØS	
966	WCØMM		996	WFUNCT	
967	WCØNT		997	WFUØX	
968	WCØVER		998	WFURES	
969	WDECAY		999	WFUSYS	
970	WDIST1		1000	WFUTK	
971	WDIST2		1001	WFUTK2	
972	WDØCK		1002	WFUTØT	
973	WDPLØY		1003	WFUTRP	
974	WDRANS		1004	WGASPR	
975	WDRY		1005	WGNAV	

Table 5.4-1

INDEXES FOR HUNTING PROCEDURE (Continued)

Index	FORTRAN Name	Equivalent Name	Index	FORTRAN Name	Equivalent Name
1006	WHØRZ		1036	WØX2(2)	
1007	WHYCAD		1037	WØX2(3)	
1008	WINFUT		1038	WØXID	
1009	WINØXT		1039	WØXLØS	
1010	WINSTK		1040	WØXRES	
1011	WINST		1041	WØXSYS	
1012	WINSUL		1042	WØXTK	
1013	WJET(1)		1043	WØXTK2	
1014	(2)		1044	WØXTØT	
1015	(3)		1045	WØXTRP	
1016	(4)		1046	WP	
1017	(5)		1047	WPASS	
1018	WJET(6)		1048	WPAYL	
1019	WLANCH		1049	WPERS	
1020	WLG		1050	WPØWCD	
1021	WLØSS		1051	WPØWER	
1022	WLRD		1052	WPØWFØ	
1023	WNACEL		1053	WPØWRS	
1024	WØDCAY		1054	WPØWTK	
1025	WØIL		1055	WPPRØV	
1026	WØILRS		1056	WPREIG	
1027	WØRSUL		1057	WPRØP	
1028	WØVERS		1058	WPRSYS	
1029	WØX(1)		1059	WREFUL	
1030	(2)		1060	WRESID	
1031	(3)		1061	WRESRV	
1032	(4)		1062	WSEAL	
1033	(5)		1063	WSECST	
1034	WØX(6)		1064	WSØRCE	
1035	WØX2(1)				

Table 5.4-1

INDEXES FOR HUNTING PROCEDURE (Continued)

Index	FORTRAN Name	Equivalent Name	Index	FORTRAN Name	Equivalent Name
1065	WSRTRP		1096	WMNFTP	
1066	WSTAB		1097	WABFUC	
1067	WSURF		1098	WACØRS	
1068	WTABC		1099	WACFRS	
1069	WTHRST		1100	WPWØRS	
1070	WTØ		1101	WPWFRS	
1071	WTPS		1102	ALD***	
1072	WVERT		1103	FBPAR***	
1073	WWAIT(1)		1104	IDVELØ***	
1074	(2)		1105	ISLB***	
1075	(3)		1106	ISLØ***	
1076	(4)		1107	IVACB***	
1077	(5)		1108	IVACØ***	
1078	(6)		1109	PERISP***	
1079	(7)		1110	QMXX***	
1080	(8)		1111	QMXS***	
1081	(9)		1112	SFC***	
1082	WWAIT(10)		1113	SLVØUT***	
1083	WWET		1114	CØPIES***	
1084	WWING		1115	SYNIT***	
1085	WZRØFU		1116	TFCTRB***	
1086	WABTRP		1117	TFCTRØ***	
1087	WABRES		1118	TØLMU***	
1088	WMNØTP		1119	TØLTW ***	
1089	WMNFTP		1120	TRATIØ***	
1090	WMNØRS		1121	TWLØ***	
1091	WMNFRS		1122	TWLØI***	
1092	WACØTP		1123	WTØUT***	
1093	WACFTP		1124	FIRE***	
1094	WPWØTP		1125	BØØTW ***	
1095	WPNØTP		1126	VCRUSE***	

*** = Synthesis input

Table 5. 4-1

INDEXES FOR HUNTING PROCEDURE (Continued)

Index	FORTRAN Name	Equivalent Name	Index	FORTRAN Name	Equivalent Name
1228	TØ20(2)		1269	TØ43	RHØX**
1229	(3)		1270	TØ44	RHØX2**
1230	(4)		1271	TØ45	SWING
1231	(5)		1272	TØ46	
1232	(6)		1273	TØ47	TØVERC**
1233	(7)		1274	TØ48(1)	
1234	(8)		1275	TØ48(2)	
1235	(9)		1276	(3)	
1236	TØ20(10)		1277	(4)	
1237	TØ21		1278	(5)	
1243	TØ27(1)	ISP(1)**	1279	(6)	
1244	(2)	(2)**	1280	(7)	
1245	(3)	(3)**	1281	(8)	
1246	(4)	(4)**	1282	(9)	
1247	(5)	(5)**	1283	TØ48(10)	
1248	TØ27(6)	ISP(6)**	1284	TØ49(1)	
1254	TØ33		1285	(2)	
1255	TØ34(1)	MR(1)**	1286	(3)	
1256	(2)	(2)**	1287	(4)	
1257	(3)	(3)**	1288	(5)	
1258	(4)	(4)**	1289	(6)	
1259	(5)	(5)**	1290	(7)	
1260	TØ34(6)	MR(6)**	1291	(8)	
1261	TØ35	NCREW**	1292	(9)	
1262	TØ36	NENGS**	1293	TØ49(10)	
1264	TØ38	NPASS*	1294	TØ50(1)	
1265	TØ39		1295	(2)	
1266	TØ40		1296	(3)	
1267	TØ41	RHØFU**	1297	(4)	
1268	TØ42	RHOFU2**	1298	(5)	

* = Booster input, ** = Orbiter input,

Table 5.4-1

INDEXES FOR HUNTING PROCEDURE (Continued)

Index	FORTRAN Name	Equivalent Name	Index	FORTRAN Name	Equivalent Name
1127	NXFØB***		1156	VFLY1***	
1128	PRNTX***		1157	VFLY2***	
1129	FSEC***		1158	VFLY3***	
1130	CLVG***		1159	TWØX(1)**	
1131	DRNG***		1203	TØ1	
1132	SØLID***		1204	TØ2	CBBØDY**
1133	AS***		1205	TØ3	
1134	BS***		1206	TØ4(1)	CFUEL(1)**
1135	SISP***		1207	(2)	(2)**
1136	SINERT***		1208	(3)	(3)**
1137	SAE***		1209	(4)	(4)**
1138	TSBØ***		1210	(5)	(5)**
1139	FLYBCK***		1211	TØ4(6)	CFUEL(6)**
1140	WPØREQ***		1212	TØ5	CHBØDY**
1141	WØREQ***		1213	TØ6	CLBØDY**
1142	GWREQ***		1214	TØ7	CSBØDY**
1143	FBFUEL***		1215	TØ8	
1144	CA***		1216	TØ9	
1145	CB***		1217	TØ10	CSFAIR**
1146	WFLYX***		1218	TØ11	CSFUTK**
1147	RT***		1219	TØ12	CSØXTK**
1148	R1***		1220	TØ13	CSHØRZ**
1149	R3***		1221	TØ14	
1150	SFC1***		1222	TØ15	CSPLAN**
1151	SFC2***		1223	TØ16	CSVERT**
1152	SFC3***		1224	TØ17	CSWING**
1153	ALD1***		1225	TØ18	CTHRST**
1154	ALD2***		1226	TØ19	CTHST2**
1155	ALD3***		1227	TØ20(1)	

** = Orbiter input, *** = Synthesis input

Table 5.4-1

INDEXES FOR HUNTING PROCEDURE (Continued)

Index	FORTRAN Name	Equivalent Name	Index	FORTRAN Name	Equivalent Name
1299	TØ50(6)		1329	SKØ(13)	K (13)**
1300	(7)		1330	(14)	(14)**
1301	(8)		1331	(15)	(15)**
1302	(9)		1332	(16)	(16)**
1303	TØ50(10)		1333	(17)	(17)**
1304	TØ51	VBØDY**	1334	(18)	(18)**
1305	TØ52	VFUTK	1335	(19)	(19)**
1306	TØ53	VFUTK2	1336	(20)	(20)**
1307	TØ54	VØXTK	1337	(21)	(21)**
1308	TØ55	VØXTK2	1338	(22)	(22)**
1309	TØ56	WGRØSS**	1339	(23)	(23)**
1310	TØ57(1)		1340	(24)	(24)**
1311	(2)		1341	(25)	(25)**
1312	(3)		1342	(26)	(26)**
1313	(4)		1343	(27)	(27)**
1314	(5)		1344	(28)	(28)**
1315	TØ57(6)		1345	(29)	(29)**
1316	TØ66	ANENGS**	1346	SKØ(30)	K(30)**
1317	SKØ(1)	K(1)**	1347	SCØ(1)	INDEX = 1346 + J
1318	(2)	(2)		SCØ(300)	to get C(J)**
1319	(3)	(3)	1647	ØWSAVE(1)	WWAIT(1)
1320	(4)	(4)	1648	(2)	(2)
1321	(5)	(5)	1649	(3)	(3)
1322	(6)	(6)	1650	(4)	(4)
1323	(7)	(7)**	1651	(5)	(5)
1324	(8)	(8)**	1652	(6)	(6)
1325	(9)	(9)**	1653	(7)	(7)
1326	(10)	(10)**	1654	(8)	(8)
1327	(11)	(11)**	1655	(9)	(9)
1328	(12)	(12)**	1656	ØWSAVE(10)	WWAIT(10)

** = Orbiter input

Table 5 4-1

INDEXES FOR HUNTING PROCEDURE (Continued)

Index	FORTRAN Name	Equivalent Name	Index	FORTRAN Name	Equivalent Name
1657	TØ59	LF**	1669	TØ72	WFUTRP
1658	TØ60	TPRATØ	1670	TØ73	WØXTRP
1659	TØ61	ASRATØ**	1671	TØ74	WSRTRP
1660	TØ62	FXNOVS**	1672	TØ75	WDECAY
1661	TØ63	NWL**	1673	TØ76	WFURES
1662	TØ64	ITPS**	1674	TØ77	WØXRES
1663	TØ65	PCHAM**	1675	TØ78	WACSFØ
1664	TØ67	ANTANK**	1676	TØ79	WFULØS
1665	TØ68	TNTAIL**	1677	TØ80	WØXLØS
1666	TØ69	NLISTØ**	1678	TØ81	WPØWFØ
1667	TØ70	NSWEEP**	1679	TØ82	WGASPR
1668	TØ71	WFRØST	1680	TØ83	WACRES
			1681	TØ84	WPØWRS

** = Oribiter input

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Section 6
GLOSSARY OF INPUTS

This section contains a complete glossary of inputs for the PADS. These are listed alphabetically in Table 6-1. All inputs to PADS are floating point numbers, F; however, if input in fixed point, I, the NAMELIST processor will automatically convert to floating point.

Table 6-1

INPUT NAME GLOSSARY $XX NAMELIST SET

Symbol	Input Units	Dimension	Interior Name	Interior Parent Common Block	Preset Value	Interior Type	Description (Section Reference)
AEXIT	ft^2	20	EJ	ARCDAT	0	F	Nozzle exit area (3. 2. 5)
AEXIT2	ft^2	20	EJA2	ARCDAT	0	F	Nozzle exit area engine 2 (3. 2. 5)
ALFMAX	deg	20	ALFMAX	ARCDAT	0	F	Maximum angle of attack (3. 8)
ALT1	ft	2	---	---	0	F	Initial altitude (3. 6. 1)
BECØ	---	1	BECØ	SIZING	0	I	Booster staging arc (4. 4, 5. 4. 1)
BK1	---	1	BK1	SIZING	0	F	Booster sizing coefficient (4. 1. 3)
BK2	---	1	BK2	SIZING	0	F	Booster sizing coefficient (4. 1. 3)
BK3	---	1	BK3	SIZING	0	F	Booster sizing coefficient (4. 1. 3)
BK4	---	1	BK4	SIZING	0	F	Booster sizing coefficient (4. 1. 3)
BSTG	---	1	BSTG	SIZING	0	I	Booster staging arc (4. 4, 5. 4. 1)
CN1	---	3	---	---	0	F	First constraint code (3. 6. 2)
CN2	---	3	---	---	0	F	2nd constraint code (3. 6. 2)
CN3	---	3	---	---	0	F	3rd constraint code (3. 6. 2)
CN4	---	3	---	---	0	F	4th constraint code (3. 6. 2)
CN5	---	3	---	---	0	F	5th constraint code (3. 6. 2)
CN6	---	3	---	---	0	F	6th constraint code (3. 6. 2)
CN7	---	3	---	---	0	F	7th constraint code (3. 6. 2)
CN8	---	3	---	---	0	F	8th constraint code (3. 6. 2)
CS	---	1	CS	---	0	I	Case number (3. 1)
CT1 → CT20	---	2 each	---	---	0	F	Arc cut-off codes (3. 6. 2)
DLRF	deg	20	DLERF	ARCDAT	0	F	Fixed engine reference deflection (3. 2. 5)
DPAY	INTERNAL	1	DPAY	STS	0	F	Initial payoff improvement (3. 7)
DREF	ft	20	DREF	ARCDAT	0	F	Reference length (3. 2. 4)
DTNC	sec	20	DTNC	ARCDAT	1	F	Integration interval (3. 11)
EPSLØN	---	1	EPSLØN	GLØBAL	0. 05	F	QL convergence tolerance (3. 2. 1)
ER	ft	1	ER	GLØBAL	---	F	Earth radius (3. 2. 1)
EXITA	ft^2	1	EXITA	SIZING	0.	F	Exit area per booster engine (4. 3)
FRATE	lb	20	FRATE	ARCDAT	0.	F	Rated thrust/engine (3. 2. 5)
FRAT2	lb	20	FRATE2	ARCDAT	0.	F	Rated thrust/engine No. 2 (3. 2. 5)

Table 6-1

INPUT NAME GLOSSARY $XX NAMELIST SET (Continued)

Symbol	Input Units	Dimension	Interior Name	Interior Parent Common Block	Preset Value	Interior Type	Description (Section Reference)
GAM1	deg	2	---	---	0.	F	Initial flight path angle (3.6.1)
GMAX	g's	20	GMAX	ARCDAT	0.	F	Maximum total acceleration (3.8)
GMDØT	deg/sec	20	GMDØT	ARCDAT	0.	F	Rate of change of flight path angle (3.9)
GR	ft/sec^2	1	GR	GLOBAL	0.	F	Reference gravity (3.2.1)
HDMAX	Btu/ft^2/sec	20		ARCDAT	0.	F	Maximum heating rate (3.8)
HTFLG	---	20	QMULT	ARCDAT	0.	F	Heating flag (3.8)
H1	Btu/ft^2	2	---	---	0.	F	Initial heat load (3.6.1)
IATM	---	20	IATM	ARCDAT	0.	I	Atmosphere flag (3.12)
IDVEL	ft/sec	1	IDVEL	SIZING	0.	F	Total characteristic velocity estimate (4.0)
IHUNT	---	1	IHUMT	SIZING	0.	I	Parameter hunting maximum iterations (5.5)
IMØDE	---	20	IMØDE	ARCDAT	0.	I	Solution control flag (3.9)
INNER	---	1	INNER	GLOBAL	1	I	QL integration inner corrector loops (3.2.1)
IPSMAX	---	1	IPSMAX	SIZING	5	I	Maximum sizing iterations (4.0)
ISIZE	---	1	ISIZE	SIZING	0.	I	Phase I sizing option (4.0)
ISPB	---		ISPB	SIZING	425.	F	Booster vac. spec impulse (4.0)
ISPØ	---		ISPØ	SIZING	460.	F	Orbiter vac. spec impulse (4.0)
ITNBW	---		ITNBW	SIZING	0.	I	Booster stage weight curve number (4.0)
ITNØW	---		ITNOW	SIZING	0.	I	Orbiter stage weight curve number (4.0)
ITRMAX	---		ITRMAX	GLOBAL	10.	I	Maximum QL iterations (3.2.1)
JAER	---	20	JAER	ARCDAT	0.	I	Aerodynamic option flag (3.2.3, 3.2.4)
JENG(i)	---	20	MCND	ARCDAT	0.	I	Fixed engine flag (3.2.5)
JPRØ	---	20	JPRØ	ARCDAT	0.	I	Propulsion option flag (3.2.5)
JTYP	---	1	JTYP	SIZING	0.	I	Sizing flag (4, 5)
LFTMAX	lb	20	XLMAX	ARCDAT	0.	F	Maximum lift (3.8)
MAKEBD	---	1	MAKEBD	---	0.	I	Make basic deck flag (3.1)
MØDCS	---	1	MØDCS	---	0.	I	Modify case flag (3.1)
MUB	---	1	MUB	SIZING	0.	F	Booster mass ratio (4)
MU1	deg	2	---	---	---	F	Initial longitude (3.6.1)
NARC	---	1	NARC	GLØBAL	---	I	Number of trajectory arcs (3.2.1)
NITER	---	1	NITER	STS	---	I	Maximum number of steepest descent iterations (3.7)

Table 6-1

INPUT NAME GLOSSARY $XX NAMELIST SET (Continued)

Symbol	Input Units	Dimension	Interior Name	Interior Parent Common Block	Preset Value	Interior Type	Description (Section Reference)
RHØ1	deg	2	---	---	---	F	Initial latitude (3.6.1)
SIZING	---	1	SIZING	---	0.	I	Data input flag (3.1)
SNA	---	20	MAEA	ARCDAT	0.	I	Bivariate aerodynamic table set number (3.4)
SNB	---	20	MWDB	ARCDAT	0.	I	Air-breather set or body axis aero flag (35, 3.4)
SREF	ft^2	20	SREF	ARCDAT	0.	F	Aerodynamic reference area (3.2.3, 3.4)
TALFA1	deg	31	---	---	0.	F	Angle-of-attack table for bivariate Set 6 (3.4)
TALFA2	deg	31	---	---	0.	F	Angle-of-attack table for bivariate Set 7 (3.4)
TALFA3	deg	31	---	---	0.	F	Angle-of-attack table for bivariate Set 8 (3.4)
TALT	ft	31	---	---	0.	F	Altitude table for bivariate Set 9 (3.5)
TBLDQ	---	(70, N)	---	---	0.	F	Blend factor vs. dynamic pressure table (3.2.4)
TCDO	---	(70, N)	---	---	0.	F	C_{D_O} vs Mach number table (3.2.3)
TCLA	---	(70, N)	---	---	0.	F	C_{L_α} vs Mach number table (3.2.3)
TCLCD1	---	(62, 31)	---	---	0.	F	Bivariate aerodynamic table, Set 6 (3.4)
TCLCD2	---	(62, 31)	---	---	0.	F	Bivariate aerodynamic table, Set 7 (3.4)
TCLCD3	---	(62, 31)	---	---	0.	F	Bivariate aerodynamic table, Set 8 (3.4)
TCLO	---	(70, N)	---	---	0.	F	C_{L_O} vs Mach number table (3.2.3)
TCMA	---	(70, N)	---	---	0.	F	$C_{\mathcal{M}_\alpha}$ vs Mach number table (3.2.4)
TCMO	---	(70, N)	---	---	0.	F	$C_{\mathcal{M}_O}$ vs Mach number table (3.2.4)
TCØNA	deg vs time	(30, P)	AR	STS	0.	F	Starting control table A (3.10)
TCØNB	deg vs time	(30, P)	AR	STS	0.	F	Starting control table B (3.10)
TDBH	---	(70, N)	---	---	0.	F	Base drag vs altitude table (3.2.5)
TFK		(70, N)	---	---	0.	F	Induced drag coefficient vs Mach number table (3.2.3)
TFVAC	lb vs sec	(70, N)	---	---	0.	F	Vacuum thrust vs burn time (3.2.5)
TFV2	---	(70, N)	---	---	0.	F	Vacuum thrust vs time (second engine) (3.2.5)
THSF	---	(62, 31)	---	---	0.	F	Air-breather engine table, Set 9 (3.5)
TIM1	sec	2	---	---	0.	F	Initial elapsed time (3.6.1)
TISPL	---	(70, N)	---	---	1.	F	Percent ISP loss vs percent rated thrust table (3.2.5)
TMACH1	---	31	---	---	0.	F	Table of Mach numbers for bivariate Set 6 (3.4)

Table 6-1

INPUT NAME GLOSSARY $XX NAMELIST SET (Continued)

Symbol	Input Units	Dimension	Interior Name	Interior Parent Common Block	Preset Value	Interior Type	Description (Section Reference)
NNB	---	1	NNB	SIZING	0.	I	No. of booster engines (4)
NØ	---	1	NØ	SIZING	0.	I	No. of orbiter engines (4.0)
NØDATA	---	1	NØDATA	---	---	---	Dummy data input (3.1)
ØK1	---	1	ØK1	SIZING	0.	F	Orbiter sizing coefficient (4)
ØK2	---	1	ØK2	SIZING	0.	F	Orbiter sizing coefficient (4)
ØK3	---	1	ØK3	SIZING	0.	F	Orbiter sizing coefficient (4)
ØK4	---	1	ØK4	SIZING	0.	F	Orbiter sizing coefficient (4)
ØMGZ	rad/sec	1	ØMGZ	GLØBAL	0.	F	Earth rotation rate (3.2.1)
ØRBI	---	1	ØRBI	SIZING	0.	I	Orbiter ignition arc (4.4, 5.4.1)
PAYØFF	---	3	---	---	0.	F	Payoff code (3.6.2)
PFLG1	---	1	IPFLG1	GLØBAL	0.	I	Print flag (3.11)
PFLG2	---	1	IPFLG2	GLØBAL	0.	I	Print flag (3.11)
PFLG3	---	1	IPFLG3	GLØBAL	0.	I	Print flag (3.11)
PFLG4	---	1	IPFLG3	GLØBAL	0.	I	Print flag (3.11)
PFRQ	---	20	DTPI	ARCDAT	1.	F	Print frequency (3.11)
PHIWT	---	1	WØRK(10)	STS	1.	F	Bank angle weighting factor (3.7)
PHMAX	deg	20	PHMAX	ARCDAT	0.	F	Belly-down flag; QL only (3.8)
PH1 → PH20	---	6 each	---	---	0.	F	Phase sequencing for first nominal (3.10)
PMIN	internal	1	PMIN	STS	0.	F	Minimum payoff improvement (3.7)
PRCØ	---	1	LUM	GLØBAL	0.	I	Program control flag (3.2.1)
PRFLG	---	1	PRFLG	SIZING	1	I	SIZING PRINT flag (4)
PSIRF	deg	1	PSIRF	GLØBAL	set to initial condition	F	Reference azimuth (3.2.1)
PSI1	deg	2	---	---	---	F	Initial azimuth (3.6.1)
QMAX	lb/ft^2	20	QMAX	ARCDAT	0.	F	Maximum dynamic pressure (3.8)
REMAX	ft^{-1}	20	REMAX	ARCDAT	0.	F	Maximum unit Reynolds number (3.8)
RHØRF	deg	1	XLAMRF	GLØBAL	set to initial condition	F	Reference latitude (3.2.1)

Table 6-1

INPUT NAME GLOSSARY $XX NAMELIST SET (Continued)

Symbol	Input Units	Dimension	Interior Name	Interior Parent Common Block	Preset Value	Interior Type	Description (Section Reference)
TMACH2	---	31	---	---	0.	F	Table of Mach numbers for bivariate, Set 7 (3.4)
TMACH3	---	31	---	---	0.	F	Table of Mach numbers for bivariate, Set 8 (2.4)
TMLT2	---	20	TMULT2	ARCDAT	1.	F	Second engine thrust multipler (3.2.5)
TMULT	---	20	TMULT	ARCDAT	1.	F	Thrust multipler (3.2.5)
TNBLDQ	---	20	MAEG	ARCDAT	0.	I	Control blending table number (3.2.4)
TNCDO	---	20	MAEC	ARCDAT	0.	I	C_{D_O} vs Mach table number (3.2.3)
TNCLA	---	20	MAEA	ARCDAT	0.	I	C_{L_α} vs Mach table number (3.2.3)
TNCLO	---	20	MAEB	ARCDAT	0.	I	C_{L_O} vs Mach table number (3.2.3)
TNCMA	---	20	MAEE	ARCDAT	0.	I	$C_{\mathcal{M}_\alpha}$ vs Mach table number (3.2.4)
TNCMO	---	20	MAEF	ARCDAT	0.	I	$C_{\mathcal{M}_O}$ vs Mach table number (3.2.4)
TNDBH	---	20	MDB	ARCDAT	0.	I	Base drag vs altitude table number (3.2.5)
TNFK	---	20	MAED	ARCDAT	0.	I	Induced drag coefficient vs Mach table number (3.2.3)
TNFVAC	---	20	MT	ARCDAT	0.	I	Vacuum thrust table number (3.2.5)
TNFV2	---	20	MT2	ARCDAT	0.	I	Second engine thrust table number (3.2.5)
TNISPL	---	20	MISP	ARCDAT	0.	I	ISP loss table number (3.2.5)
TNXCGW	---	20	MXCG	ARCDAT	0.	I	XCG vs weight table number (3.2.4)
TNZCGW	---	20	MZCG	ARCDAT	0.	I	ZCG vs weight table number (3.2.4)
TØF	---	40	TAL	---	See manual	I	Constraint tolerances (3.7)
TØLWT	lb	1	TØLWT	SIZING	0.5	F	Convergence tolerance for gross weight (4)
TØPEN1	sec	1	WØRK(1)	STS	0.	F	Open-loop control switch time (7)
TØPEN2	sec	1	WØRK(2)	STS	0.	F	Open-loop control switch time (second branch) (7)
TPSØL	---	1	ITPSØL	GLØBAL	0.	I	Starting solution on tape flag (3.2.1)
TVACB	lb	1	TVACB	SIZING	0.	F	Booster vacuum thrust (4)
TVACØ	lb	1	TVACØ	SIZING	0.	F	Orbiter vacuum thrust (4)
TWDRP		(70, N)	---	---	0.	F	Sizing tables for Phase I (4)
TWRATØ		1	TWRATØ	SIZING	0.	F	Thrust-to-weight ratio (4)
TXCGW	ft vs lb	(70, N)	---	---	0.	F	XCG vs weight table (3.2.4)
TZCGW	ft vs lb	(70, N)	---	---	0.	F	ZCG vs weight table (3.2.4)
T1 → T20	sec	2 each	---	---	---	F	Arc time input pairs (3.6.1)
VSTG	ft/sec	1	VSTG	SIZING	---	F	Booster characteristic velocity (4)

Table 6-1

INPUT NAME GLOSSARY $XX NAMELIST SET (Continued)

Symbol	Input Units	Dimension	Interior Name	Interior Parent Common Block	Preset Value	Interior Type	Description (Section Reference)
VSTG	ft/sec	1	VSTG	SIZING	---	F	Booster characteristic velocity (4)
V1	ft/sec	2	---	---	0.	F	Initial relative velocity (3. 6. 1)
V2 → V20		2 each	---	---	0.	F	Branching flags (3. 6. 1)
WEB	lb	1	WEB	SIZING	0.	F	Fixed booster stage weight (4)
WEØ	lb	1	WEØ	SIZING	0.	F	Fixed orbiter stage weight (4)
WLØ	lb	1	WLØ	SIZING	0.	F	Vehicle lift-off weight (4)
WPB	lb	1	WPB	SIZING	0.	F	Booster propellant weight (4)
WPØ	---	1	WPØ	SIZING	0.	F	Orbiter propellant weight (4)
WPTI	---	9	WTPD	PARAM	See presets	F	Parameter weighting factors (3. 7)
W1 → W20	lb	2 each	---	---	---	F	Arc initial weight inputs (3. 6. 1)
XCGR	ft	20	XCGR	ARCDAT	0.	F	Reference XCG x station (3. 2. 4)
XE	ft	20	XE	ARCDAT	0.	F	Engine x station (3. 2. 4)
XE2	ft	20	XE2	ARCDAT	0.	F	Second engine x station (3. 2. 5)
XISP	sec	20	XISP	ARCDAT	0.	F	Vacuum ISP (3. 2. 5)
XISP2	sec	20	XISP2	ARCDAT	0.	F	Second engine vacuum ISP (3. 2. 5)
XPL	lb	1	XPL	SIZING	0.	F	Payload weight (4)
XT	ft	20	XT	ARCDAT	0.	F	Aerodynamic trim device x station (3. 2. 4)
YMURF	deg	1	YMURF	GLOBAL	Set to initial condition	F	Reference longitude (3. 2. 1)
ZCGR	ft	20	ZCGR	ARCDAT	0.	F	Reference ZCG z station (3. 2. 4)
ZE	ft	20	ZE	ARCDAT	0.	F	Engine z station (3. 2. 4)
ZE2	ft	20	ZE2	ARCDAT	0.	F	Second engine z station (3. 2. 5)
ZDB	ft	20	ZDB	ARCDAT	0.	F	Base drag z station (3. 2. 5)

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Section 7
SAMPLE PROBLEM

This PADS sample problem exemplifies a Space Shuttle optimal orbital injection trajectory solution. The sample Space Shuttle configuration has a recoverable orbiter with an expendable external fuel tank and multiple solid booster rockets. Both orbiter and solid rockets thrust until the solid fuel is expended. At this point the solid motor cases are dropped. The orbiter engines continue to thrust until orbital injection is achieved. This configuration also carries abort engines which are dropped at a prescribed time during boost.

The simulation of this vehicle uses the parallel burn option while both solid booster and liquid orbiter engines are operating. The liquid engine is gimballed, whereas the solid motor is not. Aerodynamic, base drag, and fixed-engine moments are balanced by the gimballed engine. After the solid rockets have been dropped, the parallel burn simulation is no longer required and only the aerodynamic and base drag moments are resolved.

The aerodynamic coefficients required for this simulation include C_{L_α}, C_{L_o}, C_{D_o}, k, $C_{\mathcal{M}_\alpha}$, and $C_{\mathcal{M}_o}$. Additional tabular data include the solid rocket motor net vacuum thrust versus time and the base drag as a function of altitude. No aerodynamic trim is used; hence, the trim blend factor, j, is not input. Tables for center-of-gravity travel versus vehicle weight are also necessary for this simulation.

The trajectory is divided into 6 arcs. The characteristics of each are described below.

Arc	Characteristic
1	Vertical rise for 12 sec; initiation of parallel burn.
2	Optimal duration pitchover with an estimated arc time of 20 sec.
3	Gravity turn control initiated; arc ends at point where abort engines are dropped.
4	Dummy 30-sec arc where gravity turn control continues.
5	Gravity turn control continues to solid motor burnout, at which point the solid motor cases are dropped.
6	Optimal control orbiter injection arc.

The computer output for this sample problem follows. This has been notated by hand to indicate the meaning of the output as the solution progresses and also to show key input quantities.

① *Input card images*

```
***MARK TIME AT LOCATION 1 T=57,047   DT=57.047
 $XX  BD=1
 $END
 $XX  GR=32,14655, ER=20925738,2, NARC=6., PRCO=1.,OMGZ=7,292158E-5,
```

Global data

Aero coefficient tables

```
Y  TNCDO(1)= 1.,     TNFK(1)=2.,   TNCLO(1)= 3.,    TACLA(1)= 4.,
   TNCMO(1)= 5.,     TNCMA(1)=6.,
      TCDO(1,1)=0,,.0825,,2,,0835,,4,,085 ,.5,,0863,,6,,088,,7,,091,,8,
      .097,,85,,1009,,9,,116,.95,,15,1,,.24,1.13,,248,1.15,,2495,1.2,,2505,
      1.25,,2495,,3,,2475,1,5,,24,2,,.225,3.,.205,5,,,181,7.5,,165,50,,.165,
      TFK(1,2)= 0, ,.349,,2  ,,3485,,4 ,,346,.6  ,,341,,7  ,,336,,8  ,
      .329,,85,,32 ,,9  ,,3005,1, ,,29 ,1.1 ,.28 ,1,2 ,,2775,1.3,,278,
      1.4,,2886,1,5,,294,1,6 ,,299,1,7 ,,34 ,1,8 ,,375,1,9 ,,312,2.1 ,
      .336,2,3 ,,364,2,9,,41 ,4,  ,,456,5.  ,.484,7,  ,,519,50, ,,541,
      TCLO(1,3)= 0,,-,08,,2  ,-,081,,6 ,-.0855,.75,-,0905,,8,-,0955,
      .825,-,105,,85,-,115,,9,-,12,,95 ,-,122,,975,-,1227,1.,-,123,
      1.05,-,1225,1,075 ,-.121,1,1,-,119 ,1.2,-,104 ,1,3 ,-.093 ,1.5,
      -,077 ,1,6,-,0588 ,1,9 ,-,057, 2,1,-.053, 2,4,-,0503, 2,7,-,0508,
      2,9, -,0527, 3,1,-,055, 3,4,-,057, 3.6,-,0573,3,8,-,0572, 4,,-,057,
      4,5,-,0557, 5.,-,054,7,,-,0505,50.,-.046,
      TCLA(1,4) = 0.,,0555,,2,,0556 ,,5 ,.0563 , ,6,,0567 , .7 , .0574,
      .8, ,058 , ,85 ,,0605  ,,9 , ,063 , .95 ,,0654 , 1, , .0655 ,
      1.05 ,,0653 , 1,1 ,,0638 , 1,2  , .0615 , 1.4 , ,0578 , 1.7 ,
      .054 , 2, , ,0505 , 2,5 , ,0457  , 3, , .0418 , 4., ,0365 , 5.,
      .0325 , 7., ,028 , 50,, ,026,
      TCMO(1,5) = 0.,,0002,,2,,0003,,4,.0045,.6,,008,,7,,011,,8,,016,
      .85, ,025,,87,,045,,9,,05,,95,,053,1.,.054,1,05,,053,1.1,.049,
      1.2,,04,1.4,,02,1.7,,0045,1,9,-,001,2.,-,003,2,25,-,006,2.4,-.0067,
      2.5,-,0068,2,6,-,006,2,75,-,0038,2.8,-,002, 2,9,,0023, 3.,,005,
      3.25,,01,3,5,,0133,4.,,017,4,5,,019,5.,.02, 6.,,02,50.,.02,
      TCMA(1,6)= 0,,-,012,,2,-,0122,,4,-,0124,,6,-,0128,,8,-,0145,,9,
      -,0175,,95,-,0225,,97,-,0233,1,,-,024, 1,05,-,0232, 1.1,-,0225,
      1.15,-,0187,1,25,-,0149,1,4,-,0155,1.6,-,009,1,8,-,0065, 2.,-,0045,
      2.5,-,0013,3,,,0005,3,5,,001,4,,.0014,7.,,002,50,,,002,
   JAER(1)= 3.,  JPRO(1)= 3., SREF(1)= 3420.,  DREF(1)=69,7 ,
   XCGR(1)= 86,42, ZCGR(1)= 5.167,  XE(1)= 154,917, ZE(1)=24.028,
   TNXCGW(6)=8,,TNXCGW(4)= 9,, TNXCGW(1)= 10.,
   TNZCGW(6)=11,,TNZCGW(4)=12.,TNZCGW(1)=13.,
```

Center of gravity tables

```
      TXCGW(1,8) =            355600,,117.17,1544388,,67,42,
      TXCGW(1,9)=1916688,,73,17,3637717.,78.33,
      TXCGW(1,10)= 3720217,,80,,4422456.,80.53,5505835,81,25 ,
      TZCGW(1,11)=335600,,+18,5,1544388.,4.33,
      TZCGW(1,12)=1916688,,4,59,3637717.,4,83,
      TZCGW(1,13)=3720217,,5,25,4422456.,5.22,5505835,,5.17,
   AEXIT(1)=134,673,TMULT(1)=1,,XISP(1)= 450.648, FRATE(1)=1,395749689E6,
   TNDBH(1)=7,, ZBD(1)=10,,ZBD(6)=24,028,
```

Base drag table

```
      TDBH(1,7)= -10,,2000,,10000,,35000,,20000,,75000,,25000,,110000,,
      27500,,130000,,28500,,140000,,29000,,141000,,30000,,140000,,33000,,
      130000,,35000,,120000,,40000,,102000,,50000,,72000,,60000,,48000,,
      70000,,30000,,80000,,19000,,90000.,10000,,110000,,4000,,150000,,
      0.,160000,,0.,.170000,, 0.,2000000,, 0.,
   TMULT2(1)=1,,AEXIT2(1)=296.154,XISP2(1)=262., TNFV2(1)=14.,
```

```
(2)  INFV2(2) =-1., TNFV2(3)=15., TNFV2(4)=16., TNFV2(5)=-1.,          Solid rocket vacuum
        TFV2(1,14)= 0.,7247912., 40.,5321418.,                          thrust tables
        TFV2(1,15)=0.,6092016.,5.,5851204.125,11.,5562298.75,15.,
        5369580,375,15,3,5355131,662, 15,8,5331050,475,16,2,5321418.,
        16,7,5321418.,20.,5321418.,40.,5321418.,
        TFV2(1,16)= 0.,5321418.,30., 5321418., 59.,5321418., 59.5,5321418.,
        60.,5321418., 60.5, 5321418.,
        61,5,5286911,284    , 62.,5252404.57    ,  62.5,5217897.85       ,
        63.,5183391,14      , 67.,4907337.41    ,  72. ,4562270,25       ,
        73.,4493256,82      , 74.,4424243,34    ,  75. ,4386286,  ,
        77.,4386286,        , 90., 4386286.     ,
     XE2(1)= 150,7, ZE2(1)= 5,833, JENG(1)=1., CLRF(1)= .917,
     JPRO(6)=0., TNFV2(6)=0.,
     V1=1.,.1, GAM1=1.,90., W1=1.,5,505834772E6,PSI1=1.,90.,RHO1=1.,28.521,   Trajectory Initial
     T1 = 1.,12., MU1=1.,-80,561,TIM1=1.0,0.,ALT1(1)= 1., 0.,                 conditions
       T2=2.,20.,                       arc initial and
       T3=4.,0.,
       CT3=-5.,3,7205139E6,             target conditions
     T4=1.,30.,
     W4 = 5.,8,24994152E4,
     T5 = 4.,0.,
    CT5 = -5.,1,916687895E6,
     W6 = 1.,1,544387769E6 ,
     T6 =4., 0.,
    CT6 =2.,24482,198,
     CN1 = 6.,4.,303964.,
     CN2 = 6.,3.,0.,
     CN3 = 6.,18.,28,52,
     PAYOFF= 6.,5.,0.,                                    convergence data for
     DPAY =80., PMIN=1., NITER=10., TOPEN1=460.  ,       steepest descent program
     GMAX(5)= 3., Maximum total acceleration
      IMODE(1)= 3.,3.,4.,4.,4.,1., arc control modes
     GMDOT(1)= 0.,-,23,
     PH1(1)= 1.,8.,    steepest descent starting control
     PH2(1)= 2.,8.,
      PH3(1)=3.,7.,      phase sequencing
      PH4(1)=4.,7.,
      PH5(1)=5.,7.,
        PH6(1)= 6.,3.,2.,
     TCONA(1,1)=0.,99.,16.,75.,26.,57.,59.,54.5,60.,59,5,66.,45,5,78.,
         40,5,100.,37,6,122.,37.,
     TCONA(1,2)= 0.,46.,40.,42,7,90.,39.2,180.,34.2,200.,32.,220.,30.7,
       240.,30,3,270.,34.,290.,25.,310.,11.7,320.,18,5,340.,17.5,
         383.,11.3,
     DTNC(1)= 2., 2., 2.,2.,3., 5.,     compute interval
     PFRQ(1)= 2.,2.,4.,4., 2.,2.,       print frequency
     IATM(1)=1.,  Patrick atmosphere
                    PFLG3=1.,PFLG4=1.,
   $END
   $XX   DPAY=80., NITER= 25.,PRCO=2., PHMAX(1)=90.,     case data
   $END
    BD=  1(  1)
         1(  1          0(  0)  CS=  1(  0)
 ***MARK TIME AT LOCATION 2 T=58,496    DT= 1.449
 ***MARK TIME AT LOCATION 8 T=58,499    DT=  .003
```

(3)

GLOBAL DATA
THIS WILL BE A ST.D.+QLIN RUN

GRAVITY= 32.14655 EARTH RADIUS= 20925738.20 ROTAT RATE= 7.292158E-05 REF. LATIT = -0.0000 REF. LONG. = -0.0000
REF.AZIM= -0.0000

TABLE NO. 1

C_{D_0} table

X=	F(X)=	M(X)=
0.	8.2500000E-02	0.
2.0000000E-01	8.3500000E-02	2.7502055E+01
3.0000000E-01	2.4750000E-01	-6.6912327E+01
4.0000000E-01	8.5000000E-02	4.4247255E+01
5.0000000E-01	8.6300000E-02	-1.1796693E+01
6.0000000E-01	8.8000000E-02	3.1795167E+00
7.0000000E-01	9.1000000E-02	-1.4137379E-01
8.0000000E-01	9.7000000E-02	-8.1402151E-01
8.5000000E-01	1.0090000E-01	7.3268766E+00
9.0000000E-01	1.1600000E-01	-1.6134850E+00
9.5000000E-01	1.5000000E-01	4.4487063E+01
1.0000000E+00	2.4000000E-01	-4.1934769E+01
1.1300000E+00	2.4800000E-01	1.8779957E+01
1.1500000E+00	2.4950000E-01	-5.0848931E+00
1.2000000E+00	2.5050000E-01	1.2571795E-01
1.2500000E+00	2.4950000E-01	-2.1797871E-01
1.5000000E+00	2.4000000E-01	6.6005315E-02
2.0000000E+00	2.2500000E-01	6.9734094E-03
3.0000000E+00	2.0500000E-01	6.0771142E-03
5.0000000E+00	1.8100000E-01	2.2819526E-03
7.5000000E+00	1.6500000E-01	3.6327909E-04
5.0000000E+01	1.6500000E-01	0.

TABLE NO. 2

k table

X=	F(X)=	M(X)=
0.	3.4900000E-01	0.
2.0000000E-01	3.4850000E-01	-7.1008047E-02
4.0000000E-01	3.4600000E-01	-1.5967813E-02
6.0000000E-01	3.4100000E-01	-2.4012070E-01
7.0000000E-01	3.3600000E-01	-2.7340171E-02
8.0000000E-01	3.2900000E-01	-8.5051861E-01
8.5000000E-01	3.2000000E-01	-8.0422080E+00
9.0000000E-01	3.0050000E-01	7.8193565E+00
1.0000000E+00	2.9000000E-01	-2.3369475E+00
1.1000000E+00	2.8000000E-01	1.8284395E+00
1.2000000E+00	2.7750000E-01	-4.7681034E-01
1.3000000E+00	2.7800000E-01	1.8788019E+00
1.4000000E+00	2.8860000E-01	-9.7639724E-01
1.5000000E+00	2.9400000E-01	-1.0852129E+00
1.6000000E+00	2.9900000E-01	5.0792490E+00
1.7000000E+00	3.4000000E-01	2.3682171E+00
1.8000000E+00	3.7500000E-01	-1.8152117E+01
1.9000000E+00	3.1200000E-01	1.1440252E+01
2.1000000E+00	3.3600000E-01	-2.7446972E+00
2.3000000E+00	3.6400000E-01	1.3853692E-01
2.9000000E+00	4.1000000E-01	-8.7866060E-02
4.0000000E+00	4.5600000E-01	5.9377642E-03
5.0000000E+00	4.8400000E-01	-1.1195034E-02
7.0000000E+00	5.1900000E-01	-8.8377960E-04
5.0000000E+01	5.4100000E-01	0.

4

TABLE NC, 3

X	F(X)	M(X)
0.	-8,0000000E-02	0,
2.0000000E-01	-8,1000000E-02	3,3833191E-02
6.0000000E-01	-8,5500000E-02	-1,9524957E-01
7.5000000E-01	-9,0500000E-02	4,5827503E-01
8.0000000E-01	-9,5500000E-02	-1,1080452E+01
8.2500000E-01	-1,0500000E-01	-1,6338407E+00
8.5000000E-01	-1,1500000E-01	1,2815814E+01
9.0000000E-01	-1,2000000E-01	-1,6305231E+00
9.5000000E-01	-1,2200000E-01	9,0627797E-01
9.7500000E-01	-1,2270000E-01	7,0337842E-01
1.0000000E+00	-1,2300000E-01	1,2020834E-01
1.0500000E+00	-1,2250000E-01	1,9276858E+00
1.0750000E+00	-1,2100000E-01	1,9346874E-01
1.1000000E+00	-1,1900000E-01	2,0984393E+00
1.2000000E+00	-1,0400000E-01	-1,0944654E+00
1.3000000E+00	-9,3000000E-02	-1,2057764E-01
1.5000000E+00	-7,7000000E-02	8,9656129E-03
1.8000000E+00	-5,8800000E-02	-3,3616695E-01
1.9000000E+00	-5,7000000E-02	1,0243878E-01
2.1000000E+00	-5,3000000E-02	-7,9232873E-02
2.4000000E+00	-5,0300000E-02	-2,4182944E-02
2.7000000E+00	-5,0800000E-02	-3,7368683E-02
2.9000000E+00	-5,2700000E-02	-1,1882167E-02
3.1000000E+00	-5,5000000E-02	2,4897351E-02
3.4000000E+00	-5,7000000E-02	2,1596943E-02
3.6000000E+00	-5,7300000E-02	9,6692612E-03
3.8000000E+00	-5,7200000E-02	-2,7398751E-04
4.0000000E+00	-5,7000000E-02	6,4266888E-03
4.5000000E+00	-5,5700000E-02	1,3148664E-03
5.0000000E+00	-5,4000000E-02	-2,0861543E-03
7.0000000E+00	-5,0500000E-02	-6,3330939E-05
5.0000000E+01	-4,6000000E-02	0,

C_{L_0} table

TABLE NC, 4

X	F(X)	M(X)
0.	5,5500000E-02	0,
2.0000000E-01	5,5600000E-02	1,3396640E-02
5.0000000E-01	5,6300000E-02	-7,9887999E-03
6.0000000E-01	5,6700000E-02	1,2372048E-01
7.0000000E-01	5,7400000E-02	-3,0689312E-01
8.0000000E-01	5,8000000E-02	1,0438520E+00
8.5000000E-01	6,0500000E-02	-3,6932570E-01
9.0000000E-01	6,3000000E-02	4,3345080E-01
9.5000000E-01	6,5400000E-02	-1,6044775E+00
1.0000000E+00	6,5500000E-02	4,6445928E-01
1.0500000E+00	6,5300000E-02	-9,7335960E-01
1.1000000E+00	6,3800000E-02	3,0897911E-01
1.2000000E+00	6,1500000E-02	-2,0257533E-02
1.4000000E+00	5,7800000E-02	4,1283043E-02
1.7000000E+00	5,4000000E-02	-7,4384539E-03
2.0000000E+00	5,0500000E-02	8,4707730E-03
2.5000000E+00	4,5700000E-02	2,1565988E-03
3.0000000E+00	4,1800000E-02	4,5028317E-03
4.0000000E+00	3,6500000E-02	4,1320549E-04
5.0000000E+00	3,2500000E-02	1,6443464E-03
7.0000000E+00	2,8000000E-02	1,1035819E-04
5.0000000E+01	2,6000000E-02	0,

C_{L_α} table

5

TABLE NC. 5

X	F(X)	M(X)
0.	2,0000000E-04	0,
2.0000000E-01	3,0000000E-04	1,6046823E-01
4.0000000E-01	4,5000000E-03	-2,6672904E-02
6.0000000E-01	8,0000000E-03	-1,5797661E-01
7.0000000E-01	1,1000000E-02	1,7516055E+00
8.0000000E-01	1,6000000E-02	-5,6484453E+00
8.5000000E-01	2,5000000E-02	4,5987461E+01
8.7000000E-01	4,5000000E-02	-6,1791112E+01
9.0000000E-01	5,0000000E-02	8,6454007E+00
9.5000000E-01	5,3000000E-02	-3,3906147E+00
1.0000000E+00	5,4000000E-02	1,1705820E-01
1.0500000E+00	5,3000000E-02	-1,8776181E+00
1.1000000E+00	4,9000000E-02	1,9341416E-01
1.2000000E+00	4,0000000E-02	-2,4143343E-01
1.4000000E+00	2,0000000E-02	3,2759321E-01
1.7000000E+00	4,5000000E-03	3,5644929E-02
1.9000000E+00	-1,0000000E-03	5,5385546E-02
2.0000000E+00	-3,0000000E-03	4,6396865E-02
2.2500000E+00	-6,0000000E-03	3,9934560E-02
2.4000000E+00	-6,7000000E-03	3,0209050E-03
2.5000000E+00	-6,8000000E-03	1,4499363E-01
2.6000000E+00	-6,0000000E-03	-4,2995445E-02
2.7500000E+00	-3,8000000E-03	3,1332239E-01
2.8000000E+00	-2,0000000E-03	1,8240720E-01
2.9000000E+00	2,3000000E-03	-2,8388279E-01
3.0000000E+00	5,0000000E-03	-6,8760342E-03
3.2500000E+00	1,0000000E-02	-3,5193988E-02
3.5000000E+00	1,3300000E-02	-1,5548015E-02
4.0000000E+00	1,7000000E-02	-5,3589615E-03
4.5000000E+00	1,9000000E-02	-3,8161390E-03
5.0000000E+00	2,0000000E-02	-3,3764823E-03
6.0000000E+00	2,0000000E-02	3,7516470E-05
5.0000000E+01	2,0000000E-02	0,

C_{m_0} table

TABLE NC. 6

X	F(X)	M(X)
0.	-1,2000000E-02	0,
2.0000000E-01	-1,2200000E-02	-3,9957049E-03
4.0000000E-01	-1,2400000E-02	1,5982819E-02
6.0000000E-01	-1,2800000E-02	-8,9935573E-02
8.0000000E-01	-1,4500000E-02	1,4875947E-01
9.0000000E-01	-1,7500000E-02	-2,0026857E+00
9.5000000E-01	-2,2500000E-02	3,3185952E+00
9,7000000E-01	-2,3300000E-02	-2,2345199E-01
1.0000000E+00	-2,4000000E-02	1,8657765E+00
1.0500000E+00	-2,3200000E-02	-1,1164137E+00
1.1000000E+00	-2,2500000E-02	2,3598782E+00
1.1500000E+00	-1,8700000E-02	-8,8309898E-01
1.2500000E+00	-1,4500000E-02	-5,7064213E-01
1.4000000E+00	-1,5500000E-02	5,4420643E-01
1.6000000E+00	-9,0000000E-03	-3,0174089E-01
1.8000000E+00	-6,5000000E-03	6,2757139E-02
2.0000000E+00	-4,5000000E-03	-2,4287665E-02
2.5000000E+00	-1,3000000E-03	-2,9739380E-04
3.0000000E+00	5,0000000E-04	-8,1227599E-03
3.5000000E+00	1,0000000E-03	1,5884332E-03
4.0000000E+00	1,4000000E-03	-6,3097312E-04
7.0000000E+00	2,0000000E-03	7,5317321E-06
5.0000000E+01	2,0000000E-03	0,

C_{m_α} table

6

TABLE NC, 7

X=-1.0000000E+01	F(X)= 2,0000000E+03	M(X)= 0,
1.0000000E+04	3,5000000E+04	-7,4102330E-05
2.0000000E+04	7,5000000E+04	7,1853555E-04
2.5000000E+04	1,1000000E+05	-5,6300862E-04
2.7500000E+04	1,3000000E+05	4,3409806E-03
2.8500000E+04	1,4000000E+05	-1,6979343E-02
2.9000000E+04	1,4100000E+05	-2,8059049E-03
3.0000000E+04	1,4000000E+05	-1,0926140E-03
3.3000000E+04	1,3000000E+05	-8,1772761E-04
3.5000000E+04	1,2000000E+05	7,2755910E-04
4.0000000E+04	1,0200000E+05	-3,0074443E-05
5.0000000E+04	7,2000000E+04	8,6443777E-05
6.0000000E+04	4,8000000E+04	4,4299334E-05
7.0000000E+04	3,0000000E+04	9,6358888E-05
8.0000000E+04	1,9000000E+04	-9,7348868E-06
9.0000000E+04	1,0000000E+04	6,2580659E-05
1.1000000E+05	4,0000000E+03	-2,8745330E-06
1.5000000E+05	0,	7,3332696E-06
1.6000000E+05	0,	-1,8345637E-06
1.7000000E+05	0,	4,9852274E-09
2.0000000E+06	0,	0,

D_B versus altitude table

TABLE NC, 8

X= 3.5560000E+05	F(X)= 1,1717000E+02	M(X)= 0,
1.5443880E+06	6,7420000E+01	0,

X_{CG} versus weight for arc 6

TABLE NC, 9

X= 1.9166880E+06	F(X)= 7,3170000E+01	M(X)= 0,
3.6377170E+06	7,8330000E+01	0,

X_{CG} versus weight for arcs 4 and 5

TABLE NC, 10

X= 3.7202170E+06	F(X)= 8,0000000E+01	M(X)= 0,
4.4224560E+06	8,0530000E+01	-1,5144577E-13
5.5058350E+06	8,1250000E+01	0,

X_{CG} versus weight for arcs 1 through 3

TABLE NC, 11

X= 3.3560000E+05	F(X)= 1,8500000E+01	M(X)= 0,
1.5443880E+06	4,3300000E+00	0,

Z_{CG} versus weight for arc 6

TABLE NC, 12

X= 1.9166880E+06	F(X)= 4,5900000E+00	M(X)= 0,
3.6377170E+06	4,8300000E+00	0,

Z_{CG} versus weight for arcs 4 and 5

TABLE NC, 13

X= 3.7202170E+06	F(X)= 5,2500000E+00	M(X)= 0,
4.4224560E+06	5,2200000E+00	-5,7650669E-15
5.5058350E+06	5,1700000E+00	0,

Z_{CG} versus weight for arcs 1 through 3

7

TABLE NO. 14

X= 0.	F(X)= 7.2479120E+06	M(X)= 0.
4.0000000E+01	5.3214180E+06	0.

Solid rocket vacuum thrust for arcs 1 and 2

TABLE NO. 15

X= 0.	F(X)= 6.0920160E+06	M(X)= 0.
5.0000000E+00	5.8512041E+06	5.9361264E+01
1.1000000E+01	5.5622987E+06	-2.0617880E+02
1.5000000E+01	5.3695804E+06	8.9880523E+02
1.5300000E+01	5.3551317E+06	-2.2672358E+04
1.5800000E+01	5.3310505E+06	7.2012293E+04
1.6200000E+01	5.3214180E+06	6.5502925E+04
1.6700000E+01	5.3214180E+06	-4.4461158E+03
2.0000000E+01	5.3214180E+06	3.1485369E+02
4.0000000E+01	5.3214180E+06	0.

Solid rocket vacuum thrust for arc 3

TABLE NO. 16

X= 0.	F(X)= 5.3214180E+06	M(X)= 0.
3.0000000E+01	5.3214180E+06	-8.4777427E+00
5.9000000E+01	5.3214180E+06	3.4495643E+01
5.9500000E+01	5.3214180E+06	-3.5787767E+03
6.0000000E+01	5.3214180E+06	1.4280611E+04
6.0500000E+01	5.3214180E+06	-5.3543669E+04
6.1500000E+01	5.2869113E+06	-5.3549596E+04
6.2000000E+01	5.2524046E+06	1.4304369E+04
6.2500000E+01	5.2178978E+06	-3.6680227E+03
6.3000000E+01	5.1833911E+06	3.6796225E+02
6.7000000E+01	4.9073374E+06	-3.6943096E+02
7.2000000E+01	4.5622702E+06	1.0355823E+03
7.3000000E+01	4.4932568E+06	-1.0579820E+04
7.4000000E+01	4.4242433E+06	4.1283399E+04
7.5000000E+01	4.3862860E+06	3.1763064E+04
7.7000000E+01	4.3862860E+06	-2.1188709E+03
9.0000000E+01	4.3862860E+06	0.

solid rocket vacuum thrust vs time for arcs 4 and 5

(8) (Subarc data includes all inputs that are pertinent to each arc)

```
DATA FOR SUBARC  1
    SREF=3,420000E+03     NOZ,AREA=1,346730E+02          ISP=450,648          TH, MULT= 1,00            DELTA T=  2,00000
PRT MULT=  2,0            ATM,OPTN= 1               CNT,MODE=  3              AER,OPTN=  3              PRO OPTN=  3
    QMAX=  =0,00              GMAX==0,000           MAX LIFT==,                HEAT RT==,                  QMDOT= 0,
  ALFMAX= =0,000            PHIMAX= 90,000            XCGREF=  86,420          ZCGREF=  5,167               XENG= 154,917
    ZENG= 24,028              XTAIL=  =0,000              DREF= 69,700          REMAX= =0,                      FRATE=  1,39575+06
     XE2=  150,700              ZE2=     5,833        FRATE2= =0,             TMULT2= 1,00              GIMBL ANG=    ,9170
   ISP 2= 262,000         NOZ AR, 2=2,961540E+02    Z BASE D=    10,000             JENG=  1
 TABLE NUMBERS
   AERO A    4 AERO B    3 AERO C    1 AERO D    2 AERO E    6 AERO F    5 AERO G    0 THRUST    0 ISP LS    0    XCG  10    ZCG  13
   1 MWDA    0 AIRBRE    0 BASE D    7 THRST2   14

DATA FOR SUBARC  2
    SREF=3,420000E+03     NOZ,AREA=1,346730E+02          ISP=450,648          TH, MULT= 1,00            DELTA T=  2,00000
PRT MULT=  2,0            ATM,OPTN= 1               CNT,MODE=  3              AER,OPTN=  3              PRO OPTN=  3
    QMAX=  =0,00              GMAX==0,000           MAX LIFT==,                HEAT RT==,                  QMDOT==2,300000E=01
  ALFMAX= =0,000            PHIMAX= 90,000            XCGREF=  86,420          ZCGREF=  5,167               XENG= 154,917
    ZENG= 24,028              XTAIL=  =0,000              DREF= 69,700          REMAX= =0,                      FRATE=  1,39575+06
     XE2=  150,700              ZE2=     5,833        FRATE2= =0,             TMULT2= 1,00              GIMBL ANG=    ,9170
   ISP 2= 262,000         NOZ AR, 2=2,961540E+02    Z BASE D=    10,000             JENG=  1
 TABLE NUMBERS
   AERO A    4 AERO B    3 AERO C    1 AERO D    2 AERO E    6 AERO F    5 AERO G    0 THRUST    0 ISP LS    0    XCG  10    ZCG  13
   1 MWDA    0 AIRBRE    0 BASE D    7 THRST2   =1

DATA FOR SUBARC  3
    SREF=3,420000E+03     NOZ,AREA=1,346730E+02          ISP=450,648          TH, MULT= 1,00            DELTA T=  2,00000
PRT MULT=  4,0            ATM,OPTN= 1               CNT,MODE=  4              AER,OPTN=  3              PRO OPTN=  3
    QMAX=  =0,00              GMAX==0,000           MAX LIFT==,                HEAT RT==,                  QMDOT==2,300000E=01
  ALFMAX= =0,000            PHIMAX= 90,000            XCGREF=  86,420          ZCGREF=  5,167               XENG= 154,917
    ZENG= 24,028              XTAIL=  =0,000              DREF= 69,700          REMAX= =0,                      FRATE=  1,39575+06
     XE2=  150,700              ZE2=     5,833        FRATE2= =0,             TMULT2= 1,00              GIMBL ANG=    ,9170
   ISP 2= 262,000         NOZ AR, 2=2,961540E+02    Z BASE D=    10,000             JENG=  1
 TABLE NUMBERS
   AERO A    4 AERO B    3 AERO C    1 AERO D    2 AERO E    6 AERO F    5 AERO G    0 THRUST    0 ISP LS    0    XCG  10    ZCG  13
   1 MWDA    0 AIRBRE    0 BASE D    7 THRST2   15
```

9

```
DATA FOR SUBARC  4
    SREF=3.420000E+03     NOZ,AREA=1.346730E+02         ISP=450.648         TH, MULT= 1.00            DELTA T=  2.00000
 PRT MULT=  4.0           ATM,OPTN= 1              CNT,MODE=  4            AER,OPTN=  3             PRO OPTN=  3
     QMAX=  -0.00              GMAX=-0.000         MAX LIFT=*,              HEAT RT=*,                  GMDOT=-2.300000E-01
   ALFMAX= -0.000            PHIMAX= 90.000           XCGREF=  86.420        ZCGREF=  5.167              XENG= 154.917
     ZENG= 24.028             XTAIL=  -0.000            DREF= 69.700         REMAX= -0.                     FRATE=  1.3957E+06
      XE2=  150.700             ZE2=     5.833        FRATE2= -0.           THMULT2= 1.00              GIMBL ANG=    .9170
    ISP 2= 262.000        NOZ AR, 2=2.961540E+02   Z BASE D=    10.000             JENG=  1
  TABLE NUMBERS
    AERO A    4 AERO B    3 AERO C    1 AERO D    2 AERO E    6 AERO F    5 AERO G    0 THRUST    0 ISP LS    0    XCG    9    ZCG  12
    1 MWDA    0 AIRBRE    0 BASE D    7 THRST2   16

DATA FOR SUBARC  5
    SREF=3.420000E+03     NOZ,AREA=1.346730E+02         ISP=450.648         TH, MULT= 1.00            DELTA T=  3.00000
 PRT MULT=  2.0           ATM,OPTN= 1              CNT,MODE=  4            AER,OPTN=  3             PRO OPTN=  3
     QMAX=  -0.00              GMAX= 3.000         MAX LIFT=*,              HEAT RT=*,                  GMDOT=-2.300000E-01
   ALFMAX= -0.000            PHIMAX= 90.000           XCGREF=  86.420        ZCGREF=  5.167              XENG= 154.917
     ZENG= 24.028             XTAIL=  -0.000            DREF= 69.700         REMAX= -0.                     FRATE=  1.3957E+06
      XE2=  150.700             ZE2=     5.833        FRATE2= -0.           THMULT2= 1.00              GIMBL ANG=    .9170
    ISP 2= 262.000        NOZ AR, 2=2.961540E+02   Z BASE D=    10.000             JENG=  1
  TABLE NUMBERS
    AERO A    4 AERO B    3 AERO C    1 AERO D    2 AERO E    6 AERO F    5 AERO G    0 THRUST    0 ISP LS    0    XCG    9    ZCG  12
    1 MWDA    0 AIRBRE    0 BASE D    7 THRST2   -1

DATA FOR SUBARC  6
    SREF=3.420000E+03     NOZ,AREA=1.346730E+02         ISP=450.648         TH, MULT= 1.00            DELTA T=  5.00000
 PRT MULT=  2.0           ATM,OPTN= 1              CNT,MODE=  1            AER,OPTN=  3             PRO OPTN=  0
     QMAX=  -0.00              GMAX= 3.000         MAX LIFT=*,              HEAT RT=*,                  GMDOT=-2.300000E-01
   ALFMAX= -0.000            PHIMAX= 90.000           XCGREF=  86.420        ZCGREF=  5.167              XENG= 154.917
     ZENG= 24.028             XTAIL=  -0.000            DREF= 69.700         REMAX= -0.                     FRATE=  1.3957E+06
      XE2=  150.700             ZE2=     5.833        FRATE2= -0.           THMULT2= 1.00              GIMBL ANG=    .9170
    ISP 2= 262.000        NOZ AR, 2=2.961540E+02   Z BASE D=    24.028             JENG=  1
  TABLE NUMBERS
    AERO A    4 AERO B    3 AERO C    1 AERO D    2 AERO E    6 AERO F    5 AERO G    0 THRUST    0 ISP LS    0    XCG    8    ZCG  11
    1 MWDA    0 AIRBRE    0 BASE D    7 THRST2    0
```

(10)

PRELIMINARY SCAN OF BOUNDARY CONDITIONS

GOOD SCAN OF INPUT INITIAL CONDITIONS

GOOD SCAN OF TARGET CONDITIONS

KTAB

-0	-0	1	-0	1	5	-0

ITAB

9	1	1	2	1	2	-0

BNARR

1.00000000E+00	1.00000000E+00	1.20000000E+01	1.00000000E+00	2.00000000E+00	1.00000000E-01
1.00000000E+00	3.00000000E+00	9.00000000E+01	1.00000000E+00	4.00000000E+00	0.
1.00000000E+00	5.00000000E+00	5.50583477E+06	1.00000000E+00	6.00000000E+00	9.00000000E+01
1.00000000E+00	7.00000000E+00	2.85210000E+01	1.00000000E+00	8.00000000E+00	-8.05610000E+01
1.00000000E+00	9.00000000E+00	0.	2.00000000E+00	1.00000000E+00	2.00000000E+01
4.00000000E+00	1.00000000E+00	0.	1.00000000E+00	1.00000000E+00	3.00000000E+01
5.00000000E+00	5.00000000E+00	8.24994152E+04	4.00000000E+00	1.00000000E+00	0.
4.00000000E+00	1.00000000E+00	0.	1.00000000E+00	5.00000000E+00	1.54438777E+06
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.		

TARG

-5.00000100E+06	3.72051390E+06	-5.00000100E+06	1.91668790E+06	5.00000200E+06	0.
4.00000000E+06	3.03964000E+05	3.00000000E+06	0.	1.80000000E+07	2.85200000E+01
2.00000100E+06	2.44821980E+04	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0
0.	0.				

(11)

FIRST-SCAN INPUT BOUNDARY CONDITIONS

```
TRAJECTORY INITIAL CONDITIONS     (internal units - slugs, feet, radians)
  TIME=   0.            VELOCITY=   1.00000000E-01PATH ANGL=   1.57079633E+00 ALTITUDE=   0.
SLG.MASS=  1.71272960E+05 AZIMUTH=   1.57079633E+00 LATITUDE=   4.97785356E-01 LNGITUDE=  -1.40605470E+00

SOLUTION TRAJECTORY STOPPING CONDITION FOR ARC  1 AT      TIME= =   1.20000000E+01

SOLUTION TRAJECTORY STOPPING CONDITION FOR ARC  2 AT      TIME= =   2.00000000E+01
       THIS ARC TIME WILL BE OPTIMIZED

SOLUTION TRAJECTORY STOPPING CONDITION FOR ARC  3 AT       MASS =   1.15736025E+05

SOLUTION TRAJECTORY STOPPING CONDITION FOR ARC  4 AT      TIME= =   3.00000000E+01

WEIGHT DISCONTINUITY BEFORE  ARC  4 =   8.24994152E+04 POUNDS.

SOLUTION TRAJECTORY STOPPING CONDITION FOR ARC  5 AT       MASS =   5.96234400E+04

WEIGHT DISCONTINUITY BEFORE  ARC  6 =   3.72300126E+05 POUNDS.

CONSTRAINT FOR ARC  6  ALTITUDE =   3.03964000E+05 +OR-   2.00000000E+03 (Constraint tolerance, preset)

CONSTRAINT FOR ARC  6PATH ANGLE =   0.              +OR-   1.00000000E-02

CONSTRAINT FOR ARC  6INCLNATION =   4.97767903E-01 +OR-   1.00000000E-02

SOLUTION TRAJECTORY STOPPING CONDITION FOR ARC  6 AT   VELOCITY =   2.44821980E+04

TRAJECTORY HAS  6 ARCS,
      MASS IS TO BE MAXIMIZED , OPTIONAL GUESSED VALUE OF PAYOFF =   0.
```

(12)

```
*******************SOLUTION TRAJECTORY PHASE INPUT********************

ARC  1 CONTROL OPT,=  8,STOP OPT,=  2 AT    1.20000000E+01

ARC  2 CONTROL OPT,=  8,STOP OPT,=  2 AT    2.00000000E+01

ARC  3 CONTROL OPT,=  7,STOP OPT,= =6 AT    1.15736025E+05

ARC  4 CONTROL OPT,=  7,STOP OPT,=  2 AT    3.00000000E+01

ARC  5 CONTROL OPT,=  7,STOP OPT,= =6 AT    5.96234400E+04

ARC  6 CONTROL OPT,= 11,STOP OPT,=  3 AT    2.44821980E+04
*******************FIRST NOMINAL TRAJECTORY PHASE INPUT********************

ARC  1 CONTROL OPT,=  8,STOP OPT,=  2 AT    1.20000000E+01

ARC  2 CONTROL OPT,=  8,STOP OPT,=  2 AT    2.00000000E+01

ARC  3 CONTROL OPT,=  7,STOP OPT,= =6 AT    1.15736025E+05

ARC  4 CONTROL OPT,=  7,STOP OPT,=  2 AT    3.00000000E+01

ARC  5 CONTROL OPT,=  7,STOP OPT,= =6 AT    5.96234400E+04

ARC  6 CONTROL OPT,=  3,STOP OPT,=  3 AT    2.44821980E+04
 ICOR
       1         2         3         4         5         6         0         0         0         0

 STEEPEST DESCENT INPUT
 INITIAL PAYOFF IMPROVEMENT ,DPAY=   8.000000E+01 ,MINIMUM PAYOFF IMPROVEMENT,PMIN=   1.000000E+00
 MAXIMUM ITERATIONS,NITER= 25
 WORK ARRAY            TØPEN1
 4.600000E+02   =0.            =0.            =0.            =0.            =0.
 =0.            =0.            =0.            =0.            =0.            =0.
 =0.            =0.            =0.            =0.            =0.            =0.
 =0.            =0.       TØPEN2 (if input)         PHIWT (if input)
  IAD
       4         22        0
  INP
       20        46        0
```

(13)

First Nominal Trajectory (based on input nominal control)

CASE 1 SD ITERATION NO 1 PAGE 1 DATE 10293

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
1	0,	0,	1,0000000E-01	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	0,	5,5058348E+06	1,3407534E+03	4,2734018E-03	9,0000000E+01	-8,0561000E+01	-8,6656756E-08
3	0,	1,7127296E+05	0,	0,	0,	5,8060496E-04	-2,1505242E-07
4	5,8626290E+02	2,1241290E+03	2,2964064E-03	1,1416733E+03	8,7590730E-05	8,9955098E-02	8,5244220E-02
5	3,0622634E+00	8,9984272E+01	0,	1,1482032E-05	2,9787848E+06	3,5324062E-03	3,3474168E-03
6	1,1096869E+06	1,0000000E-01	1,5707963E+00	1,5707963E+00	0,	4,9778536E-01	-1,4060547E+00
7	6,6188427E+06	9,1700000E-01	-1,4060547E+00	1,7127296E+05	1,2789769E-13	9,0000840E+01	9,3062263E+01
8	1,6381766E+01	1,3950701E+00	-7,4632804E-02	1,3970650E+00	-8,6937737E+01	-1,5727705E-02	-1,8000000E+02
1	1,2000000E+01	9,1798502E+02	1,5222019E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	1,2000000E+01	5,1499383E+06	1,3494252E+03	6,4769635E+00	9,0000000E+01	-8,0510863E+01	-8,6656756E-08
3	1,2000000E+01	1,6020190E+05	0,	0,	0,	5,8060496E-04	-2,1505202E-07
4	8,8031072E+05	2,0573615E+03	2,2410577E-03	1,1337219E+03	1,3426590E-01	9,3002554E-02	1,8575257E-02
5	3,1288300E+00	6,7323797E+01	0,	2,5963758E+01	2,3865275E+06	8,2582597E+03	1,6494098E+03
6	1,1186786E+06	1,5222019E+02	1,5707963E+00	1,5707963E+00	9,1798502E+02	4,9778536E-01	-1,4060547E+00
7	6,0606680E+06	9,1700000E-01	-1,4060547E+00	1,6020190E+05	-1,1204975E-09	9,1205725E+01	9,2886793E+01
8	1,6041578E+01	1,3843047E+00	-7,5669876E-02	1,3863713E+00	-8,6871170E+01	-2,2676203E+01	-1,8000000E+02
	End of vertical rise						
1	1,2000000E+01	9,1798502E+02	1,5222019E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	0,	5,1499383E+06	1,3494252E+03	6,4769635E+00	9,0000000E+01	-8,0510863E+01	-8,6656756E-08
3	0,	1,6020190E+05	0,	0,	0,	5,8060496E-04	-2,1505202E-07
4	8,8031072E+05	2,0573615E+03	2,2410577E-03	1,1337219E+03	1,3426590E-01	5,3457270E-02	1,6554854E-02
5	2,4167411E+00	4,2343476E+00	0,	2,5963758E+01	2,6590227E+06	4,7467946E+03	1,4700097E+03
6	1,1186786E+06	1,5222019E+02	1,5707963E+00	1,5707963E+00	9,1798502E+02	4,9778536E-01	-1,4060547E+00
7	6,0606680E+06	9,1700000E-01	-1,4060547E+00	1,6020190E+05	1,3224781E-07	9,2410140E+01	9,0178390E+01
8	1,6090291E+01	1,3849830E+00	-5,8453378E-02	1,3862160E+00	-8,7583259E+01	-8,5765652E+01	-1,8000000E+02
1	3,2000000E+01	6,3880503E+03	3,9118135E+02	8,5400000E+01	9,0000000E+01	-8,0560216E+01	2,8521000E+01
2	2,0000000E+01	4,6156018E+06	1,4268465E+03	1,5859235E+01	9,0000000E+01	-8,0426517E+01	-2,2197036E-07
3	2,0000000E+01	1,4358001E+05	0,	0,	0,	4,1419765E-02	4,1414614E-08
4	1,9866762E+06	1,6914718E+03	1,9045331E-03	1,1099557E+03	3,5242970E-01	1,4342162E-01	1,8244382E-01
5	4,0193350E+00	-2,9513142E+00	0,	1,4571854E+02	6,4805553E+05	7,1475225E+04	9,0922080E+04
6	1,1679541E+06	3,9118135E+02	1,4905112E+00	1,5707963E+00	6,3880503E+03	4,9778536E-01	-1,4060410E+00
7	5,2057807E+06	9,1700000E-01	-1,4060410E+00	1,4358001E+05	-1,8626451E-08	8,9413995E+01	8,9793224E+01
8	1,4635560E+01	1,3468151E+00	-9,4635216E-02	1,3501358E+00	9,4019335E+01	-8,7048686E+01	-4,6000000E+00

End of pitchover start gravity turn

14

CASE 1 SD ITERATION NO 1 PAGE 2 DATE 10273

1	3,2000000E+01	6,3880503E+03	3,9118135E+02	8,5400000E+01	9,0000000E+01	-8,0560216E+01	2,8521000E+01
2	0,	4,6156018E+06	1,4268465E+03	1,5859235E+01	9,0000000E+01	-8,0426517E+01	-2,2197036E-07
3	0,	1,4358001E+05	0,	0,	0,	4,1419765E-02	4,1414614E-02
4	1,9866762E+06	1,6914718E+03	1,9045331E-03	1,1099557E+03	3,5242970E-01	8,6697572E-02	1,7791749E-01
5	3,0050636E+00	0,	0,	1,4571854E+02	1,4484889E+06	4,3206377E+04	8,8666498E+04
6	1,1679541E+06	3,9118135E+02	1,4905112E+00	1,5707963E+00	6,3880503E+03	4,9778536E-01	-1,4060410E+00
7	5,5910799E+06	9,1700000E-01	-1,4060410E+00	1,4358001E+05	2,6107907E-13	8,8405064E+01	9,0000000E+01
8	1,5148228E+01	1,4316433E+00	-7,5156116E-02	1,4336146E+00	8,8405064E+01	-8,9999993E+01	0,

1	6,9248538E+01	3,0380401E+04	1,0272931E+03	6,0980276E+01	9,1073897E+01	-8,0537232E+01	2,8520684E+01
2	3,7248538E+01	3,7205139E+06	2,0484690E+03	2,6010258E+01	9,0290685E+01	-8,0247904E+01	1,8866737E-02
3	3,7248538E+01	1,1573602E+05	0,	0,	0,	1,2554426E+00	1,2553007E+00
4	2,8363519E+06	6,5649807E+02	8,9374551E-04	1,0121727E+03	1,0149386E+00	6,3353069E-02	2,5872706E-01
5	2,8472123E+00	0,	0,	4,7159876E+02	1,0551674E+06	1,0218012E+05	4,1729253E+05
6	1,3073371E+06	1,0272931E+03	1,0643066E+00	1,5895394E+00	3,0380401E+04	4,9777984E-01	-1,4056399E+00
7	5,1241604E+06	9,1700000E-01	-1,4056399E+00	1,1573602E+05	-2,3336169E-13	6,3827489E+01	9,1073897E+01
8	1,4670141E+01	1,5689486E+00	-7,8030363E-02	1,5708878E+00	6,3827489E+01	-8,8926103E+01	0,

drop short engines

1	6,9248538E+01	3,0380401E+04	1,0272931E+03	6,0980276E+01	9,1073897E+01	-8,0537232E+01	2,8520684E+01
2	0,	3,6380145E+06	2,0484690E+03	2,6010258E+01	9,0290685E+01	-8,0247904E+01	1,8866737E-02
3	0,	1,1316967E+05	0,	0,	0,	1,2554426E+00	1,2553007E+00
4	2,8363519E+06	6,5649807E+02	8,9374551E-04	1,0121727E+03	1,0149386E+00	5,7038860E-02	2,5850738E-01
5	2,7507851E+00	0,	0,	4,7159876E+02	-5,8535090E+05	9,1996139E+04	4,1693823E+05
6	1,3073371E+06	1,0272931E+03	1,0643066E+00	1,5895394E+00	3,0380401E+04	4,9777984E-01	-1,4056399E+00
7	5,1269935E+06	9,1700000E-01	-1,4056399E+00	1,1316967E+05	2,8803026E-14	6,3731061E+01	9,1073897E+01
8	1,3747536E+01	1,6066330E+00	-7,7194182E-02	1,6084864E+00	6,3731061E+01	-8,8926103E+01	0,

1	9,9248538E+01	6,2995113E+04	2,0958477E+03	3,6830629E+01	9,1333554E+01	-8,0442706E+01	2,8518896E+01
2	3,0000000E+01	2,9357392E+06	3,2728966E+03	2,2573461E+01	9,0740184E+01	-8,0028036E+01	1,2338561E-01
3	3,0000000E+01	9,1323617E+04	0,	0,	0,	6,2488575E+00	6,2476392E+00
4	1,5191198E+06	1,3461925E+02	2,0994889E-04	9,4676472E+02	2,2136943E+00	6,7943058E-02	2,2182327E-01
5	2,4719432E+00	0,	0,	4,6110839E+02	-1,7667744E+06	1,0714557E+05	3,4981324E+05
6	1,3776201E+06	2,0958477E+03	6,4281574E-01	1,5940712E+00	6,2995113E+04	4,9774863E-01	-1,4039901E+00
7	5,2815500E+06	9,1700000E-01	-1,4039901E+00	9,1323617E+04	1,0198047E-14	3,9302572E+01	9,1333554E+01
8	1,2870634E+01	2,1245441E+00	-9,1717287E-02	2,1265230E+00	3,9302572E+01	-8,8666446E+01	0,

End of timed dummy arc

1	9,9248538E+01	6,2995113E+04	2,0958477E+03	3,6830629E+01	9,1333554E+01	-8,0442706E+01	2,8518896E+01
2	0,	2,9357392E+06	3,2728966E+03	2,2573461E+01	9,0740184E+01	-8,0028036E+01	1,2338561E-01
3	0,	9,1323617E+04	0,	0,	0,	6,2488575E+00	6,2476392E+00
4	1,5191198E+06	1,3461925E+02	2,0994889E-04	9,4676472E+02	2,2136943E+00	6,7943058E-02	2,2182327E-01
5	2,4719432E+00	0,	0,	4,6110839E+02	-1,7667744E+06	1,0714557E+05	3,4981324E+05
6	1,3776201E+06	2,0958477E+03	6,4281574E-01	1,5940712E+00	6,2995113E+04	4,9774863E-01	-1,4039901E+00
7	5,2815500E+06	9,1700000E-01	-1,4039901E+00	9,1323617E+04	1,0198047E-14	3,9302572E+01	9,1333554E+01
8	1,2870634E+01	2,1245441E+00	-9,1717287E-02	2,1265230E+00	3,9302572E+01	-8,8666446E+01	0,

15

CASE 1 SD ITERATION NO 1 PAGE 3 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
1	1.4382414E+02	1.2489612E+05	5.2989316E+03	1.5614374E+01	9.1770011E+01	-7.9995077E+01	2.8508078E+01
2	4.4575604E+01	1.9166879E+06	6.6075559E+03	1.2465640E+01	9.1399999E+01	-7.9394165E+01	7.0623685E-01
3	4.4575604E+01	5.9623440E+04	0.	0.	0.	2.9900290E+01	2.9891948E+01
4	1.6639734E+05	8.2010625E+00	1.0626086E-05	1.0402305E+03	5.0939976E+00	6.3689170E-02	1.8218810E-01
5	3.6472224E+00	0.	0.	1.4918322E+02	5.1750943E+05	3.2494635E+04	9.2953572E+04
6	1.3946452E+06	5.2989316E+03	2.7252223E-01	1.6016889E+00	1.2489812E+05	4.9755982E-01	-1.3961775E+00
7	4.3955332E+06	9.1700000E-01	-1.3961775E+00	5.9623440E+04	1.1715056E-14	1.9261596E+01	9.1770011E+01
8	1.3628560E+01	2.9516932E+00	-1.8814730E-01	2.9576836E+00	1.9261596E+01	-8.8229989E+01	0.
			End of solid booster burn, drop solid cases, start optimal control arc				
1	1.4382414E+02	1.2489612E+05	5.2989316E+03	1.5614374E+01	9.1770011E+01	-7.9995077E+01	2.8508078E+01
2	0.	1.5443678E+06	6.6075559E+03	1.2465640E+01	9.1399999E+01	-7.9394165E+01	7.0623685E-01
3	0.	4.8042100E+04	0.	0.	0.	2.9900290E+01	2.9891948E+01
4	1.6639734E+05	8.2010625E+00	1.0626086E-05	1.0402305E+03	5.0939976E+00	9.2437601E-01	5.9576640E-01
5	3.0385626E+01	0.	0.	1.4918322E+02	-7.7413115E+06	4.7162274E+05	3.0396395E+05
6	1.3946452E+06	5.2989316E+03	2.7252223E-01	1.6016889E+00	1.2489812E+05	4.9755982E-01	-1.3961775E+00
7	0.	0.	-1.3961775E+00	4.8042100E+04	0.	4.6000000E+01	9.1770011E+01
8	9.1390327E+00	8.7485167E-01	2.1955540E-01	9.0198116E-01	4.6000000E+01	-8.8229989E+01	0.
1	5.3904415E+02	1.6775004E+05	2.4482198E+04	1.7780264E-01	1.0042375E+02	-6.5071756E+01	2.7036384E+01
2	3.9522001E+02	3.2425523E+05	2.5830847E+04	1.6851940E-01	9.9873901E+01	-6.2819576E+01	3.6030697E+01
3	3.9522001E+02	1.0086781E+04	0.	0.	0.	8.2796486E+02	8.2719566E+02
4	1.2581351E+05	1.5357542E+00	1.8391490E-06	1.0790110E+03	2.2689479E+01	9.3170242E-02	1.2921417E-01
5	9.3602429E+00	0.	0.	5.5117275E+02	7.3733202E+06	1.7562691E+05	2.4357010E+05
6	1.2296224E+06	2.4482198E+04	3.1032415E-03	1.7527250E+00	1.6775004E+05	4.7187392E-01	-1.1357164E+00
7	0.	0.	-1.1357164E+00	1.0086781E+04	0.	9.5380455E+00	1.0042375E+02
8	1.7792237E+01	2.9576739E+00	-5.0216035E-01	3.0000000E+00	9.5380455E+00	-7.9576254E+01	0.

(25)

First Optimization Pass (note that only terminus prints)

CASE 1 SD ITERATION NO 4 PAGE 1 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
1	5.3605204E+02	3.0407012E+05	2.4482198E+04	8.7911524E-03	9.9054430E+01	-6.5509552E+01	2.7304396E+01
2	3.9222998E+02	3.4756215E+05	2.5841587E+04	8.3266963E-03	9.8574434E+01	-6.3269874E+01	2.2993165E+01
3	3.9222998E+02	1.0811803E+04	0.	0.	0.	8.0226694E+02	8.0194335E+02
4	3.5677607E+02	2.1694446E-03	3.9009197E-09	9.0419082E+02	2.7076362E+01	1.6650908E-01	1.4072925E+01
5	1.4725417E+01	-2.9790366E-01	0.	1.1690628E+00	2.6317266E+04	6.6573570E+02	5.6266292E+02
6	1.0428154E+06	7.4650298E-01	0.	0.	0.	0.	0.
7	0.	0.	0.	1.0000000E+00	0.	1.4734004E+01	9.8978707E+01
8	8.6537085E+00	2.9661819E+00	-4.4918232E-01	3.0000000E+00	1.6602921E+01	-8.0940666E+01	-1.8923014E+00

10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
10	3.5190995E+03	7.1383621E-03	2.8520016E+01	-1.3507431E+02	7.2715581E+01	3.5442201E+03	3.4939789E+03
11	1.1751611E+00	5.2362086E+03	1.3166467E+09	5.4861194E+11	3.5189202E+03	2.5475307E+04	2.5841626E+04

ADJ.IN.CND

-3.91727781E-02	0.	1.00000000E+00	0.	0.	0.
0.	0.	0.	-4.47025233E-06	1.00000000E+00	0.
0.	0.	0.	0.	0.	0.
5.98373906E-09	-3.37893688E-07	-1.03731540E-10	0.	2.62864441E-01	9.51133068E-01
0.	0.	0.	7.50665633E-01	0.	0.
1.00000000E+00	0.	0.	0.	0.	0.

DCON

-1.06119902E+02 -1.53434554E-04 -2.77855225E-07 8.00000000E+01

PAYOFF

1.08118026E+04 actual increase in mass is 10811.802 − 10733.451 = 78.351 slugs

ITCT

5

TIME

9.92464490E+01

TIME

3.20330424E+01

TIME

1.20000000E+01

(26)

PARAMETER SENSITIVITIES

4.89115500E+04	6.83765979E-03	1.83595084E-05	-4.09671564E+01

XL

6.54508595E+03	1.67511572E+07	5.31375231E+01	-1.10924275E+02	-2.45682280E+04	-1.52649152E+05
0.	0.	0.	9.23151701E-04	2.33251453E+00	7.45062946E-06
-1.54190561E-05	-3.85286570E-03	-3.74167934E-02	0.	0.	0.
7.27593433E-06	2.60497468E-02	6.15957562E-08	-1.14782284E-07	3.43895874E-02	1.00303665E+00
0.	0.	0.	-2.60174451E+00	-1.47704646E+04	-7.04373627E-04
1.18211158E-01	3.92873874E+01	1.44002677E+02	0.	0.	0.

DPSQ

-1.82694517E-01 (magnitude of $(DP)^2$ is scaled up)

DC

6.89469277E+01 (predicted improvement in payoff)

DCON

-1.06119902E+02 -1.53434554E-04 -2.77855225E-07 8.00000000E+01 "asked-for" larger than predicted improvement in payoff

Second Optimization Pass

CASE 1 SD ITERATION NO 5 PAGE 1 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST THC	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
1	5.3503665E+02	3.0462847E+05	2.4482198E+04	3.9325379E-02	9.9020259E+01	-6.5565948E+01	2.7313927E+01
2	3.9122996E+02	3.4988420E+05	2.5841628E+04	3.7256620E-02	9.8542089E+01	-6.3330503E+01	2.2797442E+01
3	3.9122996E+02	1.0884036E+04	0.	0.	0.	7.9920289E+02	7.9888353E+02
4	3.4459927E+02	2.1029950E-03	3.7770683E-09	9.0547469E+02	2.7037971E+01	9.4536325E+02	1.2882031E-01
5	9.6187506E+00	-2.5836717E-01	0.	1.1319459E+00	1.3062562E+04	3.6597421E+02	4.9869623E+02
6	1.0497838E+06	7.5066563E-01	0.	0.	0.	0.	0.
7	0.	0.	0.	1.0000000E+00	0.	9.6579772E+00	9.8977089E+01
8	8.6530260E+00	2.9660370E+00	-4.5013803E-01	3.0000000E+00	1.1285142E+01	-8.0975894E+01	-1.6474456E+00
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY

27

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10    3.5192972E+03   7.1959828E-03   2.8520115E+01   -1.3520550E+02   6.8732410E+01   3.5446220E+03   3.4939724E+03
11    5.2217475E+00   5.2366498E+03   1.3165727E+09    5.4862712E+11   3.5191149E+03   2.5473123E+04   2.5842389E+04
  ADJ.IN.CND
 -1.74290424E+01   0.               1.00000000E+00   0.                0.               0.
  0.               0.               0.               -6.00155647E-07   1.00000000E+00   0.
  0.               0.               0.               0.                0.               0.
  8.20817398E-10   -1.49997439E-06  -1.02938063E-10  0.                2.61856555E-01   9.51508689E-01
  0.               0.               0.               7.51624671E-01    0.               0.
  1.00000000E+00   0.               0.               0.                0.               0.
  DCON
 -6.64473923E+02   -6.86357346E-04  -2.01266075E-06  8.00000000E+01
  PAYOFF
  1.08840356E+04
  ITCT
      6
  TIME
  9.92330852E+01
  TIME
  3.22477736E+01
  TIME
  1.20000000E+01

   PARAMETER SENSITIVITIES
     5.82223388E+04      9.11433200E-03      1.09197225E-05      -7.18749432E+01
  XL
  7.81668325E+03   1.99255983E+07   6.40275214E+01   -1.32431362E+02   -2.88841130E+04   -1.69883893E+05
  0.               0.               0.               1.24646986E-03    3.10745290E+00   1.02799437E-05
 -2.05197612E-05   -4.82039684E-03  -4.13866067E-02  0.                0.               0.
  6.14715451E-06   2.29931054E-02   5.23295502E-08   -9.66512243E-08   3.42270313E-02   1.00302269E+00
  0.               0.               0.               -6.78167679E+00   -2.53232945E+04  -3.58694270E-02
  1.88433361E+01   5.37755932E+01   2.01684630E+02   0.                0.               0.
  DPSQ
 -1.82694517E+01
  DC
  5.97700270E+01
  DCON
 -6.64473923E+02   -6.86357346E-04  -2.01266075E-06  5.97700270E+01
```

actual increase in mass is 10884.035 − 10811.802 = 72.233 slugs

predicted payoff improvement

"asked-for" same as predicted payoff improvement

28

CASE 1 SD ITERATION NO 6 PAGE 1 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
1	5,3421736E+02	3,3391510E+05	2,4482198E+04	-6,3745235E-03	9,8988263E+01	-6,5614551E+01	2,7322629E+01
2	3,9042130E+02	3,5177096E+05	2,5841590E+04	-6,0391929E-03	9,8511828E+01	-6,3382538E+01	2,2598589E+01
3	3,9042130E+02	1,0942728E+04	0,	0,	0,	7,9655806E+02	7,9624317E+02
4	3,6022954E+02	2,1583017E-03	3,9360131E-09	9,0383819E+02	2,7086926E+01	1,1273232E-01	1,3122409E-01
5	1,0907775E+01	-3,2996699E-01	0,	1,1795799E+00	1,6869362E+04	4,5478060E+02	5,2937938E+02
6	1,0554645E+06	7,5162211E-01	-1,4374895E+01	2,1191695E-02	1,2909398E-06	5,3360349E-03	0,
7	0,	0,	0,	9,9593256E-01	0,	1,0901218E+01	9,8925824E+01
8	8,6734102E+00	2,9659187E+00	-4,5091696E-01	3,0000000E+00	1,2986585E+01	-8,1005768E+01	-2,1111189E+00
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
10	3,5190484E+03	7,1305017E-03	2,8520037E+01	-1,3532342E+02	7,3160320E+01	3,5441410E+03	3,4939598E+03
11	-8,5302207E-01	5,2360946E+03	1,3166658E+09	5,4860799E+11	3,5188695E+03	2,5475692E+04	2,5841610E+04

ADJ,IN,CND

2.82625096E-02	0,	1,00000000E+00	0,	0,	0,
0.	0,	0,	-1,70839508E-06	1,00000000E+00	0,
0.	0,	0,	0,	0,	0,
2.43470705E-09	2,41389170E-07	-1,02199739E-10	0,	2,60916401E-01	9,51858103E-01
0.	0,	0,	7,55974545E-01	0,	0,
1.00000000E+00	0,	0,	0,	0,	0,

DCON

4.89027282E+01 1,11256423E-04 -6,45397815E-07 5,97700270E+01

PAYOFF

1.09427283E+04 *actual payoff improvement = 10942.728 − 10884.035 = 58.693 slugs*

(29) ITCT 25 *Last adjoint solution*

```
TIME
9.90044938E+01
TIME
3.81785369E+01
TIME
1.20000000E+01

 PARAMETER SENSITIVITIES
   7.95228594E+04    1.584774096-02    -1.14562469E-05    -1.734756868+02
XL
1.16064797E+04   2.78526376E+07   1.06628337E+02  -2.05257768E+02  -3.79303438E+04  -2.27236009E+05
0.               0.               0.               2.32441639E-03   5.54834598E+00   2.13427204E-05
-4.08432127E-05  -7.91612959E-03  -5.77890628E-02  0.               0.               0.
1.49978084E-06   8.36057751E-03   1.38276166E-08  -2.29628795E-08   3.52876597E-02   1.00275796E+00
0.               0.               0.              -2.23749848E+01  -6.07584570E+04  -1.92613765E-01
4.65440853E-01   9.83457842E+01   4.17734303E+02  0.               0.               0.
DPSQ
-2.26266088E-01
DC
6.42256923E+00
DCON
4.77743514E+01   5.669663136-05   -1.98870238E-06   6.42256923E+00
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Last Optimization Pass

CASE 1 SD ITERATION NO 25 PAGE 1 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
1	5.3051672E+02	3.0392091E+05	2.4482198E+04	-3.1919497E-03	9.8881148E+01	-6.5985647E+01	2.7351885E+01
2	3.8693868E+02	3.6002298E+05	2.5841609E+04	-3.0240355E-03	9.8410469E+01	-6.3709096E+01	2.2878071E+01
3	3.8693868E+02	1.1199428E+04	0.	0.	0.	7.7987117E+09	7.7994127E+09
4	3.6009937E+02	2.1875908E-03	3.9346907E-09	9.0385139E+02	2.7086530E+01	1.4022495E-01	1.3562749E-01
5	1.2859107E+01	-1.6267029E+00	0.	1.1791835E+00	2.1500503E+04	5.6550027E+02	5.4695960E+08
6	1.0802143E+06	7.7698082E-01	0.	0.	0.	0.	0.
7	0.	0	0.	1.0000000E+00	0.	1.2850644E+01	9.8519164E+01
8	8.7442861E+00	7.9654076E+00	-4.5426639E-01	3.0000000E+00	2.3152640E+01	-8.0972370E+01	-1.0423060E+01

10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
10	3.5190558E+03	7.1317226E-03	2.8520122E+01	-1.3587075E+02	7.3784570E+01	3.5441527E+03	3.4939588E+03
11	-4.2705387E-01	5.2361110E+03	1.3166630E+09	5.4860856E+11	3.5188768E+03	2.5475634E+04	2.5841614E+04

```
TRIAL PAYOFF  DID NOT IMPROVE    1/2  DOWN
DCON
4.77743514E+01   5.669663136-05   -1.98870238E-06   4.54144366E+00
PAYOFF
1.11994284E+04
```

payoff improvement scaled down by $1/\sqrt{2}$, $(dP)^2$ is halved down.

(30)

CASE 1 SD ITERATION NO 25 PAGE 1 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL

1	5.3049221E+02	3.0394315E+05	2.4482198E+04	-1.0118232E-03	9.8877542E+01	-6.5927272E+01	2.7352792E+01
2	3.8691360E+02	3.6008358E+05	2.5841612E+04	-9.5859557E-04	9.8407056E+01	-6.3710823E+01	2.2834400E+01
3	3.8691360E+02	1.1201313E+04	0.	0.	0.	7.7977727E+02	7.7944860E+02
4	3.9960231E+02	2.1848764E-03	3.9296404E-09	9.0390186E+02	2.7085018E+01	1.4636694E-01	1.3674199E-01
5	1.3295144E+01	-1.5950166E+00	0.	1.1776700E+00	2.2550038E+04	5.8951211E+02	5.5074472E+02
6	1.0803933E+06	7.7698082E-01	0.	0.	0.	0.	0.
7	0.	0.	0.	1.0000000E+00	0.	1.3288887E+01	9.8510785E+01
8	8.7462041E+00	2.9654041E+00	-4.5428892E-01	3.0000000E+00	2.3398523E+01	-8.0981467E+01	-1.0228214E+01

10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
10	3.5190640E+03	7.1328308E-03	2.8520057E+01	-1.3587986E+02	7.4082898E+01	3.5441649E+03	3.4939631E+03
11	-1.3535074E-01	5.2361294E+03	1.3166599E+09	5.4860920E+11	3.5188850E+03	2.5475576E+04	2.5841613E+04

DCON

2.08531781E+01 1.76596458E-05 -9.97952117E-07 4.54144366E+00

(31) *Steepest Descent Solution Trajectory (includes all print options)*

CASE, 1 SD SOLUTION PAGE 1 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY

Note that costates are transformed adjoints used to start QL trajectory solution.

1	0.	0.	1.0000000E-01	9.0000000E+01	9.0000000E+01	-8.0561000E+01	2.8521000E+01
2	0.	5.5058348E+06	1.3407534E+03	4.2734018E-03	9.0000000E+01	-8.0561000E+01	-8.6656756E-08
3	0.	1.7127296E+05	0.	0.	0.	5.8060496E-04	-2.1505262E-07
4	5.8626290E+02	2.1241290E+03	2.2964064E-03	1.1416733E+03	8.7590730E-05	8.9955098E-02	8.5244220E-02
5	3.0622634E+00	8.9984272E+01	0.	1.1482032E-05	2.9787848E+06	3.5324062E-03	3.3474168E-03
6	1.1096869E+06	3.6090622E+00	1.5444087E+03	-1.3230640E+01	4.6081660E-02	-8.5364605E+02	0.
7	6.6188427E+06	9.1700000E-01	0.	6.3500931E-03	1.2789769E-13	9.0000840E+01	9.3062263E+01
8	1.6381786E+01	1.3950701E+00	-7.4632804E-02	1.3970650E+00	-8.6937737E+01	-1.5727705E-02	-1.8000000E+02
9	0.	0.	0.	0.	-8.9512867E+01	-3.0233468E+00	-9.9451435E+01
10	1.7242741E+03	9.9732772E-01	2.8521000E+01	-1.7056100E+02	-8.9999987E+01	3.4439405E+03	4.6077504E+00
11	1.7999999E+02	1.7958873E+03	2.6871659E+09	2.8056254E+10	9.2031876E+00	1.3407534E+03	1.0021104E+06

1	4.0000000E+00	1.0288307E+02	5.1262191E+01	9.0000000E+01	9.0000000E+01	-8.0561000E+01	2.8521000E+01
2	4.0000000E+00	5.3842614E+06	1.3417396E+03	2.1895621E+00	9.0000000E+01	-8.0544288E+01	-8.6656756E-08
3	4.0000000E+00	1.6749111E+05	0.	0.	0.	5.8060496E-04	-2.1505262E-07
4	3.0012712E+05	2.1165809E+03	2.2902920E-03	1.1406916E+03	4.4939571E-02	9.1899561E-02	4.6554443E-02
5	3.1020142E+00	8.1990282E+01	0.	3.0092286E+00	2.9080117E+06	9.4579001E+02	4.7911792E+02
6	1.1107034E+06	3.4301132E+00	1.5444432E+03	-1.3230640E+01	4.3717437E-02	-8.5233100E+02	0.
7	6.4284287E+06	9.1700000E-01	0.	1.0076044E-02	7.2759576E-11	9.0432031E+01	9.3071723E+01
8	1.6311331E+01	1.3913174E+00	-7.5400112E-02	1.3933590E+00	-8.6897986E+01	-8.0097176E+00	-1.8000000E+02
9	0.	0.	0.	0.	-9.7412682E+01	-4.3442936E+00	-9.8956931E+01
10	1.7242860E+03	9.9732768E-01	2.8521000E+01	-1.7054429E+02	-8.9994130E+01	3.4439642E+03	4.6078411E+00
11	1.7999413E+02	1.7959059E+03	2.6871474E+09	2.8056530E+10	9.2033686E+00	1.3407573E+03	1.0021006E+06

1	8.0000000E+00	4.0947780E+02	1.0196045E+02	9.0000000E+01	9.0000000E+01	-8.0561000E+01	2.8521000E+01
2	8.0000000E+00	5.2656293E+06	1.3446508E+03	4.3487244E+00	9.0000000E+01	-8.0527575E+01	-8.6656756E-08
3	8.0000000E+00	1.6380076E+05	0.	0.	0.	5.8060496E-04	-2.1505262E-07
4	5.9439366E+05	2.0941825E+03	2.2719261E-03	1.1379068E+03	8.9603511E-02	9.2896616E-02	2.0304311E-02
5	3.1240604E+00	7.4364453E+01	0.	1.1809395E+01	2.7758445E+06	3.7519207E+03	8.2005316E+02
6	1.1137199E+06	3.2599584E+00	1.5445598E+03	-1.3230640E+01	4.1429966E-02	-8.5108097E+02	0.
7	6.2424127E+06	9.1700000E-01	0.	1.3687903E-02	5.0931703E-10	9.0841602E+01	9.3008348E+01
8	1.6196629E+01	1.3877759E+00	-7.5743751E-02	1.3898414E+00	-8.6875940E+01	-1.5635547E+01	-1.8000000E+02
9	0.	0.	0.	0.	-1.0497526E+02	-5.5158502E+00	-9.8317876E+01
10	1.7243213E+03	9.9732758E-01	2.8521000E+01	-1.7052758E+02	-8.9988325E+01	3.4440346E+03	4.6081114E+00
11	1.7998832E+02	1.7959611E+03	2.6870923E+09	2.8057352E+10	9.2039080E+00	1.3407692E+03	1.0020712E+06

(32)

1	1,2000000E+01	9.1798502E+02	1,5222019E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2.8521000E+01
2	1,2000000E+01	5.1499383E+06	1,3494252E+03	6,4769635E+00	9,0000000E+01	-8,0510863E+01	-8.6656756E+08
3	1,2000000E+01	1.6020190E+05	0,	0,	0,	5,8060496E-04	-2.1509262E+07
4	8,8031072E+05	2,0573615E+03	2,2410577E-03	1,1337219E+03	1,3426590E-01	9,3002550E-02	1,8575297E-02
5	3,1288299E+00	6,7323668E+01	0,	2,5963758E+01	2,5865275E+06	8,2582594E+03	1,6494095E+03
6	1,1186786E+06	3,0992811E+00	1,5447947E+03	-1,3230640E+01	3,9229768E+02	-8,4989262E+02	0,
7	6,0606680E+06	9,1700000E-01	0,	1,7189429E-02	-1,3678800E+09	9,1205731E+01	9,2886750E+01
8	1,6041578E+01	1,3843047E+00	-7,5669875E-02	1,3863713E+00	-8,6871170E+01	-2,2676332E+01	-1,8000000E+02
9	0,	0,	0,	0,	-1,1198443E+02	-6,5015874E+00	-9.7597449E+01
10	1,7243798E+03	9,9732741E-01	2,8521000E+01	-1,7051086E+02	-8,9982569E+01	3,4441510E+03	4,6085597E+00
11	1,7998257E+02	1,7960524E+03	2,6870012E+09	2,8058716E+10	9,2048026E+00	1,3407890E+03	1,0020224E+06
1	1,2000000E+01	9,1798502E+02	1,5222019E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2.8521000E+01
2	0,	5,1499383E+06	1,3494252E+03	6,4769635E+00	9,0000000E+01	-8,0510863E+01	-8.6656756E+08
3	0,	1,6020190E+05	0,	0,	0,	5,8060496E-04	-2.1505262E+07
4	8,8031072E+05	2,0573615E+03	2,2410577E-03	1,1337219E+03	1,3426590E-01	5,3457270E-02	1.6554854E-02
5	2,4167411E+00	4,2343476E+00	0,	2,5963758E+01	2,6590227E+06	4,7467946E+03	1.4700057E+03
6	1,1186786E+06	3,0992811E+00	1,5447947E+03	-1,3230640E+01	3,9229768E-02	-8,4989262E+02	0,
7	6,0606680E+06	9,1700000E-01	0,	1,7189429E-02	1,3271347E+07	9,2410140E+01	9,0178390E+01
8	1,6090291E+01	1,3849830E+00	-5,8453378E-02	1,3862160E+00	-8,7583259E+01	-8,5765652E+01	-1,8000000E+02
9	0,	0,	0,	0,	-1,7570870E+02	-9,6414198E+00	-8.8298674E+01
10	1,7243798E+03	9,9732741E-01	2,8521000E+01	-1,7051086E+02	-8,9982569E+01	3,4441510E+03	4,6085597E+00
11	1,7998257E+02	1,7960524E+03	2,6870012E+09	2,8058716E+10	9,2048026E+00	1,3407890E+03	1.0020224E+06
1	1,6000000E+01	1,6265421E+03	2,0198511E+02	8,9080000E+01	9,0000000E+01	-8,0560981E+01	2,8521000E+01
2	4,0000000E+00	5,0371886E+06	1,3591888E+03	8,5451046E+00	9,0000000E+01	-8,0494132E+01	-8.4730099E+08
3	4,0000000E+00	1,5669453E+05	0,	0,	0,	1,1969478E-03	9,7981744E-04
4	1,1532428E+06	2,0067801E+03	2,1974232E-03	1,1286935E+03	1,7895478E-01	7,4479641E-02	5,2619686E-02
5	2,7965583E+00	8,2880371E+00	0,	4,4825217E+01	2,4058270E+06	1,1417896E+04	8,0667189E+03
6	1,1254906E+06	2,9564687E+00	1,5523031E+03	-1,3241819E+01	3,7123728E-02	-8,4876352E+02	0,
7	5,8829984E+06	9,1700000E-01	0,	2,0588363E-02	-1,0011718E-08	9,1847328E+01	9,0402964E+01
8	1,5891506E+01	1,3801583E+00	-6,7417896E-02	1,3818039E+00	-8,7203442E+01	-8,1711963E+01	1,7900000E+02
9	0,	0,	0,	0,	-1,7159822E+02	-9,8087651E+00	-8,9535348E+01
10	1,7244722E+03	9,9731423E-01	2,8521000E+01	-1,7049413E+02	-8,9976815E+01	3,4443129E+03	4,6319380E+00
11	1,7997682E+02	1,7961968E+03	2,6868572E+09	2,8128486E+10	9,2506367E+00	1,3440599E+03	9,9953034E+05
1	2,0000000E+01	2,5326169E+03	2,5103462E+02	8,8160000E+01	9,0000000E+01	-8,0560913E+01	2,8521000E+01
2	8,0000000E+00	4,9273801E+06	1,3721114E+03	1,0536429E+01	9,0000000E+01	-8,0477351E+01	-8,8332694E+08
3	8,0000000E+00	1,5327866E+05	0,	0,	0,	4,6629482E-03	4,6150321E-03
4	1,4066748E+06	1,9434077E+03	2,1410370E-03	1,1234125E+03	2,2345720E-01	9,1761118E-02	1,3509383E-01
5	3,1062040E+00	7,7092826E+01	0,	6,7462343E+01	2,0724530E+06	2,1171237E+04	3,1169944E+04
6	1,1340251E+06	2,8464913E+00	1,5624461E+03	-1,3258042E+01	3,5099802E-02	-8,4768126E+02	0,
7	5,7091170E+06	9,1700000E-01	0,	2,3901988E-02	-9,3787094E-09	8,8853517E+01	9,3027646E+01
8	1,5640400E+01	1,3719606E+00	-7,4451724E-02	1,3739793E+00	-8,6893796E+01	-1,2907174E+01	1,7816000E+02
9	0,	0,	0,	0,	-1,0226303E+02	-5,1086184E+00	-1,0046205E+02
10	1,7245923E+03	9,9729464E-01	2,8521000E+01	-1,7047735E+02	-8,9971090E+01	3,4445189E+03	4,6656473E+00
11	1,7997109E+02	1,7963844E+03	2,6866702E+09	2,8231735E+10	9,3186723E+00	1,3489127E+03	9,9586910E+05

(33)

CASE, 1 SD SOLUTION PAGE 3 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
1	2,4000000E+01	3,6320132E+03	2,9868148E+02	8,7240000E+01	9,0000000E+01	-8,0560774E+01	2,8521000E+01
2	1,2000000E+01	4,8205128E+06	1,3878661E+03	1,2421596E+01	9,0000000E+01	-8,0460500E+01	-9,7869594E-08
3	1,2000000E+01	1,4995428E+05	0,	0,	0,	1,1941281E-02	1,1923338E-02
4	1,6324831E+06	1,8685939E+03	2,0724858E-03	1,1183780E+03	2,6724848E-01	1,1218246E-01	2,2583885E-01
5	3,4694598E+00	-8,8895463E+00	0,	9,2567724E+01	1,6340397E+06	3,5514903E+04	7,1496429E+04
6	1,1441005E+06	2,7722750E+00	1,5749957E+03	-1,3280155E+01	3,3097440E-02	-8,4663291E+02	0,
7	5,5386240E+06	9,1700000E-01	0,	2,7159807E-02	-2,3748726E-08	9,0667735E+01	8,9464184E+01
8	1,5323219E+01	1,3597990E+00	-8,2441371E-02	1,3622958E+00	9,3469460E+01	-8,1110454E+01	-2,7600000E+00
9	0,	0,	0,	0,	1,7101813E+02	-8,8886405E+00	-8,7849432E+01
10	1,7247386E+03	9,9726881E-01	2,8521000E+01	-1,7046050E+02	-8,9965436E+01	3,4447671E+03	4,7105926E+00
11	1,7996544E+02	1,7966134E+03	2,6864419E+09	2,8367207E+10	9,4083196E+00	1,3552879E+03	9,9109637E+08
1	2,8000000E+01	4,9168197E+03	3,4535633E+02	8,6320000E+01	9,0000000E+01	-8,0560548E+01	2,8521000E+01
2	1,6000000E+01	4,7165867E+06	1,4061255E+03	1,4187864E+01	9,0000000E+01	-8,0443561E+01	-1,3162595E-07
3	1,6000000E+01	1,4672140E+05	0,	0,	0,	2,3886090E-02	2,3876493E-02
4	1,8254052E+06	1,7840260E+03	1,9930554E-03	1,1138854E+03	3,1004654E-01	1,2847034E-01	2,4871709E-01
5	3,7567179E+00	-4,4084849E+00	0,	1,1885685E+02	1,1545454E+06	5,2221964E+04	1,0110112E+05
6	1,1554896E+06	2,6934940E+00	1,5898628E+03	-1,3307811E+01	3,1060040E-02	-8,4560981E+02	0,
7	5,3710198E+06	9,1700000E-01	0,	3,0377993E-02	4,6566129E-08	9,0065987E+01	8,9711439E+01
8	1,4984649E+01	1,3493491E+00	-8,8599905E-02	1,3522548E+00	9,3756718E+01	-8,5591515E+01	-3,6800000E+00
9	0,	0,	0,	0,	1,7554307E+02	-9,2394862E+00	-8,9199145E+01
10	1,7249106E+03	9,9723694E-01	2,8521000E+01	-1,7044356E+02	-8,9959862E+01	3,4480551E+03	4,7660260E+00
11	1,7995986E+02	1,7968817E+03	2,6861744E+09	2,8533402E+10	9,5188832E+00	1,3631142E+03	9,8530795E+08
1	3,2000000E+01	6,3880502E+03	3,9118135E+02	8,5400000E+01	9,0000000E+01	-8,0560216E+01	2,8521000E+01
2	2,0000000E+01	4,6156018E+06	1,4268465E+03	1,5859235E+01	9,0000000E+01	-8,0426817E+01	-2,8197036E-07
3	2,0000000E+01	1,4358001E+05	0,	0,	0,	4,1419765E-02	4,1414614E-02
4	1,9866762E+06	1,6914718E+03	1,9045331E-03	1,1099557E+03	3,5242970E-01	1,4342257E-01	1,8244361E-01
5	4,0193520E+00	-2,9512590E+00	0,	1,4571854E+02	6,4804532E+05	7,1475699E+04	9,0922127E+04
6	1,1679541E+06	2,5624423E+00	1,6064279E+03	-1,3340497E+01	2,9062886E-02	-8,4462386E+02	0,
7	5,2057807E+06	9,1700000E-01	0,	3,3528083E-02	-1,0244548E-08	8,9414012E+01	8,9793227E+01
8	1,4635554E+01	1,3468151E+00	-9,4635615E-02	1,3501358E+00	9,4019352E+01	-8,7048741E+01	-4,6000000E+00
9	0,	0,	0,	0,	1,7701630E+02	-9,3539645E+00	-9,0089949E+01
10	1,7251072E+03	9,9719899E-01	2,8521000E+01	-1,7042652E+02	-8,9954274E+01	3,4453824E+03	4,8320445E+00
11	1,7995427E+02	1,7971890E+03	2,6858682E+09	2,8730076E+10	9,6505584E+00	1,3723794E+03	9,7854438E+08

34

CASE, 1 SD SOLUTION PAGE 4 DATE 10273

1	3,6000000E+01	8,0383061E+03	4,3727899E+02	8,4480000E+01	9,0000000E+01	-8,0559760E+01	2,8521000E+01
2	2,4000000E+01	4,5175581E+06	1,4501897E+03	1,7465650E+01	9,0000000E+01	-8,0409348E+01	-4,2508736E-07
3	2,4000000E+01	1,4053011E+05	0,	0,	0,	6,5499084E-02	6,5495391E-02
4	2,1200477E+06	1,5925393E+03	1,0088894E-03	1,1063300E+03	3,9525187E-01	1,5683480E-01	9,9999210E-02
5	4,2548320E+00	-2,2411127E+00	0,	1,7294150E+02	1,2258122E+05	9,2761497E+04	5,9145525E+04
6	1,1812776E+06	2,4056132E+00	1,6240168E+03	-1,3377563E+01	2,7263767E-02	-8,4369167E+02	0,
7	5,0424305E+06	9,1700000E-01	0,	3,6567466E-02	2,7939677E-09	8,8731572E+01	8,9833768E+01
8	1,4282302E+01	1,3485873E+00	-1,0033171E-01	1,3523144E+00	9,4254832E+01	-8,7758887E+01	-5,5200000E+00
9	0,	0,	0,	0,	1,7773452E+02	-9,4170592E+00	-9,0891058E+01
10	1,7253297E+03	9,9715460E-01	2,8521000E+01	-1,7040935E+02	-8,9948551E+01	3,4457502E+03	4,9092486E+00
11	1,7994855E+02	1,7975367E+03	2,6855218E+09	2,8958356E+10	9,8045284E+00	1,3831363E+03	9,7080885E+05

1	3,8274269E+01	9,0575609E+03	4,6364886E+02	8,3956918E+01	9,0000000E+01	-8,0559438E+01	2,8521000E+01
2	2,6274269E+01	4,4631253E+06	1,4646128E+03	1,8349246E+01	9,0000000E+01	-8,0309525E+01	-6,2338416E-07
3	2,6274269E+01	1,3883684E+05	0,	0,	0,	8,2483204E-02	8,2480627E-02
4	2,1838182E+06	1,5340158E+03	1,7521089E-03	1,1042244E+03	4,1988647E-01	1,6381616E-01	7,7128918E-02
5	4,3778880E+00	-1,9806136E+00	0,	1,8832566E+02	-1,8676848E+05	1,0550969E+05	4,9676711E+04
6	1,1891592E+06	2,3343369E+00	1,6338896E+03	-1,3399502E+01	2,6390713E-02	-8,4320705E+02	0,
7	4,9502283E+06	9,1700000E-01	0,	3,8172665E-02	1,8626451E-09	8,8332186E+01	8,9848841E+01
8	1,4078593E+01	1,3475042E+00	-1,0316170E-01	1,3514474E+00	9,4377888E+01	-8,8019386E+01	-6,0430819E+00
9	0,	0,	0,	0,	1,7799803E+02	-9,4435632E+00	-9,1333981E+01
10	1,7254679E+03	9,9712641E-01	2,8521000E+01	-1,7039952E+02	-8,9945226E+01	3,4459775E+03	4,9582789E+00
11	1,7994523E+02	1,7977527E+03	2,6853066E+09	2,9102400E+10	9,9023099E+00	1,3899245E+03	9,6599015E+05

1	3,8274269E+01	9,0575609E+03	4,6364886E+02	8,3956918E+01	9,0000000E+01	-8,0559438E+01	2,8521000E+01
2	0,	4,4631253E+06	1,4646128E+03	1,8349246E+01	9,0000000E+01	-8,0309525E+01	-6,2338416E-07
3	0,	1,3883684E+05	0,	0,	0,	8,2483204E-02	8,2480627E-02
4	2,1838182E+06	1,5340158E+03	1,7521089E-03	1,1042244E+03	4,1988647E-01	8,2278698E-02	7,0192550E-02
5	2,9245578E+00	0,	0,	1,8832566E+02	1,2863303E+06	5,2993549E+04	4,5209178E+04
6	1,1891592E+06	2,3343369E+00	1,6338896E+03	-1,3399502E+01	2,6390713E-02	-8,4320705E+02	0,
7	5,6377111E+06	9,1700000E-01	0,	3,8172665E-02	2,7167548E-13	8,6881476E+01	9,0000000E+01
8	1,5003997E+01	1,5036697E+00	-7,6818787E-02	1,5056307E+00	8,6881476E+01	-8,9999993E+01	0,
9	0,	0,	0,	0,	1,8000000E+02	-9,6004754E+00	-9,3118524E+01
10	1,7254679E+03	9,9712641E-01	2,8521000E+01	-1,7039952E+02	-8,9945226E+01	3,4459775E+03	4,9582789E+00
11	1,7994523E+02	1,7977527E+03	2,6853068E+09	2,9102400E+10	9,9023099E+00	1,3899245E+03	9,6599015E+05

1	4,6274269E+01	1,3256211E+04	5,9618845E+02	8,0266390E+01	9,0341308E+01	-8,0557625E+01	2,8520994E+01
2	8,0000000E+00	4,2582133E+06	1,5574950E+03	2,2165074E+01	9,0023851E+01	-8,0364286E+01	3,4661324E-04
3	8,0000000E+00	1,3246253E+05	0,	C,	0,	1,7826983E-01	1,7826852E-01
4	2,4997242E+06	1,3122576E+03	1,5375820E-03	1,0941912E+03	5,4486678E-01	7,6507991E-02	9,4716133E-02
5	2,8426805E+00	0,	C,	2,7325958E+02	6,8355148E+05	7,1500373E+04	8,8516752E+04
6	1,2190240E+06	2,0209504E+00	1,0579339E+03	-1,2500039E+01	2,3613706E-02	-8,4052001E+02	0,
7	5,3184514E+06	9,1700000E-01	0,	4,4334921E-02	-7,7339217E-14	8,3109071E+01	9,0341308E+01
8	1,4580269E+01	1,4953882E+00	-7,4253327E-02	1,4972306E+00	8,3109071E+01	-8,9658692E+01	0,
9	0,	0,	0,	0,	1,7965627E+02	-9,6764935E+00	-9,6833273E+01
10	1,7261754E+03	9,9690602E-01	2,8521003E+01	-1,7031433E+02	-8,9971429E+01	3,4470101E+03	5,3407555E+00
11	1,7992754E+02	1,7988586E+03	2,6842061E+09	3,0202348E+10	1,0664987E+01	1,4420257E+03	9,3070674E+05

(35)

CASE, 1 SD SOLUTION PAGE 5 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
1	5.4274269E+01	1.6441996E+04	7.2989687E+02	7.5771377E+01	9.0536897E+01	-8.0554195E+01	2.8520970E+01
2	1.6000000E+01	4.0650650E+06	1.6777998E+03	2.4941112E+01	9.0063313E+01	-8.0327431E+01	1.7802435E-03
3	1.6000000E+01	1.2645416E+05	0.	0.	0.	3.5941545E-01	3.5941064E-01
4	2.6826921E+06	1.0759901E+03	1.3112761E-03	1.0752600E+03	6.7880964E-01	7.1722150E-02	9.1096496E-02
5	2.7933424E+00	0.	0.	3.4929080E+02	3.8971614E+04	8.5677454E+04	1.0882156E+05
6	1.2508429E+06	1.7648623E+00	7.8644504E+02	-1.2115492E+01	2.1418155E-02	-8.3836414E+02	0.
7	5.0062003E+06	9.1700000E-01	0.	4.9928207E-02	-2.0989972E-13	7.8564719E+01	9.0536897E+01
8	1.4152962E+01	1.4877663E+00	-7.2590624E-02	1.4895361E+00	7.8564719E+01	-8.9463103E+01	0.
9	0.	0.	0.	0.	1.7946600E+02	-9.7786007E+00	-1.0134507E+02
10	1.7271047E+03	9.9655767E-01	2.8521035E+01	-1.7019483E+02	-9.0024430E+01	3.4482642E+03	5.9452647E+00
11	1.7990793E+02	1.8003114E+03	2.6827618E+09	3.1863030E+10	1.1870064E+01	1.5207625E+03	8.8204497E+05
1	6.2274269E+01	2.4577118E+04	8.7772852E+02	7.0564443E+01	9.0667635E+01	-8.0548407E+01	2.8520916E+01
2	2.4000000E+01	3.8778250E+06	1.8320168E+03	2.6859479E+01	9.0119303E+01	-8.0288219E+01	5.0160778E-03
3	2.4000000E+01	1.2062958E+05	0.	0.	0.	6.6511636E-01	6.6509715E-01
4	2.7924581E+06	8.4091995E+02	1.0833019E-03	1.0442687E+03	8.4051977E-01	6.0424566E-02	1.0055154E-01
5	2.8686215E+00	0.	0.	4.1729187E+02	2.8762917E+05	8.6234205E+04	1.4350094E+05
6	1.2825005E+06	1.5650670E+00	6.5157659E+02	-1.1999034E+01	1.9950166E-02	-8.3654588E+02	0.
7	5.0663310E+06	9.1700000E-01	0.	5.5205075E-02	-3.8602577E-15	7.3433065E+01	9.0667635E+01
8	1.4264700E+01	1.5633760E+00	-7.8338842E-02	1.5653375E+00	7.3433065E+01	-8.9332365E+01	0.
9	0.	0.	0.	0.	1.7935041E+02	-9.9015316E+00	-1.0645629E+02
10	1.7283093E+03	9.9602646E-01	2.8521145E+01	-1.7003836E+02	-9.0103718E+01	3.4497512E+03	6.8674666E+00
11	1.7988416E+02	1.8021952E+03	2.6808920E+09	3.4240648E+10	1.3707645E+01	1.6335373E+03	8.2057875E+05
1	6.9003009E+01	3.0496154E+04	1.0199553E+03	6.5796830E+01	9.0751167E+01	-8.0541018E+01	2.8520835E+01
2	3.0728739E+01	3.7205139E+06	1.9914822E+03	2.7848730E+01	9.0178378E+01	-8.0252717E+01	9.8219858E-03
3	3.0728739E+01	1.1573602E+05	0.	0.	0.	1.0553430E+00	1.0552971E+00
4	2.8076498E+06	6.5316596E+02	8.9016912E-04	1.0115492E+03	1.0083101E+00	6.3983537E-02	2.5201280E-01
5	2.8563538E+00	0.	0.	4.6302539E+02	1.0501658E+06	1.0132093E+05	3.9907406E+05
6	1.3077859E+06	1.5445633E+00	5.9549234E+02	-1.2048646E+01	1.9149569E-02	-8.3516468E+02	0.
7	5.1203409E+06	9.1700000E-01	0.	5.9688803E-02	-4.0234775E-15	6.8653184E+01	9.0751167E+01
8	1.4667098E+01	1.5729996E+00	-7.8483430E-02	1.5749563E+00	6.8653184E+01	-8.9248833E+01	0.
9	0.	0.	0.	0.	1.7928953E+02	-1.0019976E+01	-1.1122486E+02
10	1.7295858E+03	9.9538710E-01	2.8521346E+01	-1.6987914E+02	-9.0187868E+01	3.4511931E+03	7.9784105E+00
11	1.7985962E+02	1.8041921E+03	2.6789135E+09	3.6900506E+10	1.5920017E+01	1.7596970E+03	7.6118599E+05

(36)

CASE, 1 SD SOLUTION PAGE 6 DATE 10273

1	6,9003009E+01	3,0496154E+04	1,0199553E+03	6,5796830E+01	9,0751167E+01	-8,0541018E+01	2,8520835E+01
2	0,	3,6380145E+06	1,9914822E+03	2,7848730E+01	9,0178378E+01	-8,0252717E+01	9,8219858E-03
3	0,	1,1316967E+05	0,	0,	0,	1,0553430E+00	1,0552971E+00
4	2,8076498E+06	6,5316596E+02	8,9016912E-04	1,0115492E+03	1,0083101E+00	5,7555222E-02	2,5178662E-01
5	2,7581863E+00	0,	0,	4,6302539E+02	-5,9246961E+05	9,1141389E+04	3,9871591E+05
6	1,3077659E+06	1,5445633E+00	5,9549234E+02	-1,2048646E+01	1,9149589E-02	-8,3516468E+02	0,
7	5,1279803E+06	9,1700000E-01	0,	6,0522187E-02	6,9950207E-14	6,8555017E+01	9,0751167E+01
8	1,3743697E+01	1,6120987E+00	-7,7665520E-02	1,6139685E+00	6,8555017E+01	-8,9248833E+01	0,
9	0,	0,	0,	0,	1,7929001E+02	-1,0021175E+01	-1,1132311E+02
10	1,7295858E+03	9,9536710E-01	2,8521346E+01	-1,6987914E+02	-9,0187868E+01	3,4511931E+03	7,9784105E+00
11	1,7985962E+02	1,8041921E+03	2,6789135E+09	3,6900506E+10	1,5920017E+01	1,7596970E+03	7,6118899E+05

1	7,7003009E+01	3,8437607E+04	1,2212992E+03	5,9887631E+01	9,0833201E+01	-8,0528302E+01	2,8520680E+01
2	8,0000000E+00	3,4507458E+06	2,2229893E+03	2,8375653E+01	9,0261008E+01	-8,0206576E+01	1,9004845E-02
3	8,0000000E+00	1,0734420E+05	0,	0,	0,	1,7269898E+00	1,7268851E+00
4	2,6644080E+06	4,5458416E+02	6,6264012E-04	9,7388782E+02	1,2540450E+00	6,3641734E-02	2,5052823E-01
5	2,6614725E+00	0,	0,	4,9418762E+02	-1,3717074E+05	1,0756227E+05	4,2342319E+05
6	1,3345295E+06	1,4474706E+00	5,8007635E+02	-1,2260507E+01	1,5799261E-02	-8,3363790E+02	0,
7	5,1871061E+06	9,1700000E-01	0,	6,6358395E-02	-1,3014060E-14	6,2549103E+01	9,0833201E+01
8	1,3918252E+01	1,7262941E+00	-8,0246605E-02	1,7281583E+00	6,2549103E+01	-8,9166799E+01	0,
9	0,	0,	0,	0,	1,7924880E+02	-1,0176684E+01	-1,1732064E+02
10	1,7315049E+03	9,9430739E-01	2,8521774E+01	-1,6965995E+02	-9,0302957E+01	3,4531530E+03	9,8567787E+00
11	1,7982267E+02	1,8071958E+03	2,6759443E+09	4,1003799E+10	1,9657447E+01	1,9542635E+03	6,8464264E+05

1	8,5003009E+01	4,7414920E+04	1,4690401E+03	5,4007712E+01	9,0904729E+01	-8,0510065E+01	2,8520436E+01
2	1,6000000E+01	3,2634693E+06	2,5067590E+03	2,8304406E+01	9,0353885E+01	-8,0154914E+01	3,3322262E-02
3	1,6000000E+01	1,0151649E+05	0,	0,	0,	2,6902532E+00	2,6900468E+00
4	2,2809242E+06	2,9408856E+02	4,5119971E-04	9,4858287E+02	1,5486681E+00	6,4491098E-02	2,3927485E-01
5	2,4723899E+00	0,	0,	4,8686223E+02	-1,8715980E+06	1,0738212E+05	3,8840909E+05
6	1,3561439E+06	1,3640111E+00	5,9922325E+02	-1,2614735E+01	1,2683104E-02	-8,3222959E+02	0,
7	5,2348078E+06	9,1700000E-01	0,	7,2575792E-02	-2,7521761E-14	5,6480102E+01	9,0904729E+01
8	1,2925547E+01	1,8640033E+00	-8,0484207E-02	1,8657400E+00	5,6480102E+01	-8,9095271E+01	0,
9	0,	0,	0,	0,	1,7923328E+02	-1,0343824E+01	-1,2338551E+02
10	1,7339892E+03	9,9275009E-01	2,8522447E+01	-1,6941378E+02	-9,0425611E+01	3,4554072E+03	1,2571268E+01
11	1,7977442E+02	1,8110866E+03	2,6721104E+09	4,6288863E+10	2,5051395E+01	2,2047133E+03	6,0599951E+05

1	9,3003009E+01	5,7462744E+04	1,7697990E+03	4,8407972E+01	9,0971203E+01	-8,0484858E+01	2,8520073E+01
2	2,4000000E+01	3,0761917E+06	2,8457460E+03	2,7718043E+01	9,0452907E+01	-8,0096282E+01	5,4459046E-02
3	2,4000000E+01	9,5692748E+04	0,	0,	0,	4,0217453E+00	4,0213765E+00
4	1,7125318E+06	1,7772690E+02	2,7818850E-04	9,4258648E+02	1,8775985E+00	7,1606921E-02	2,2961983E-01
5	2,4836448E+00	0,	0,	4,3566940E+02	-1,7717042E+06	1,0669355E+05	3,4213110E+05
6	1,3718147E+06	1,2996432E+00	6,4527494E+02	-1,3110782E+01	9,9185047E-03	-8,3090686E+02	0,
7	5,2691497E+06	9,1700000E-01	0,	7,9328533E-02	2,9197277E-14	5,0891616E+01	9,0971203E+01
8	1,2917329E+01	2,0203176E+00	-8,7631176E-02	2,0222172E+00	5,0891616E+01	-8,9028797E+01	0,
9	0,	0,	0,	0,	1,7923353E+02	-1,0515458E+01	-1,2897252E+02
10	1,7371842E+03	9,9055234E-01	2,8523367E+01	-1,6914779E+02	-9,0545882E+01	3,4579561E+03	1,4412327E+01
11	1,7971249E+02	1,8160944E+03	2,6671959E+09	5,2860642E+10	3,2669597E+01	2,5158678E+03	5,3007474E+05

(37)

CASE, 1 SD SOLUTION PAGE 7 DATE 1027

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY

1	9,9003009E+01	6,5709472E+04	2,0336348E+03	4,4493862E+01	9,1019936E+01	-8,0460446E+01	2.8519700E+01
2	3,0000000E+01	2,9357392E+06	3,1378651E+03	2,7013877E+01	9,0529243E+01	-8,0046802E+01	7.5933929E-02
3	3,0000000E+01	9,1323617E+04	0,	0,	0,	5,3112023E+00	5.3106594E+00
4	1,2737755E+06	1,1757747E+02	1,8250573E-04	9,5008877E+02	2,1404682E+00	7,4679623E-02	2.2372432E-01
5	2,5917134E+00	0,	0,	3,7739178E+02	-1,5234611E+06	9,6387487E+04	2.8875649E+05
6	1,3799152E+06	1,2601449E+00	6,9486533E+02	-1,3579088E+01	8,1700503E-03	-8,2995444E+02	0.
7	5,2865970E+06	9,1700000E-01	0,	8,4842170E-02	-4,5891213E-14	4,7085575E+01	9.1019936E+01
8	1,2996845E+01	2,1492154E+00	-9,7283822E-02	2,1514160E+00	4,7085575E+01	-8,8980064E+01	0.
9	0,	0,	0,	0,	1,7923996E+02	-1,0646802E+01	-1.3277852E+02
10	1,7401528E+03	9,8836401E-01	2,8524198E+01	-1,6893846E+02	-9,0629406E+01	3,4600572E+03	2.0248408E+01
11	1,7965557E+02	1,8207516E+03	2,6626459E+09	5,8681868E+10	4,0261205E+01	2,7912293E+03	4.7696653E+05

1	9,9003009E+01	6,5709472E+04	2,0336348E+03	4,4493862E+01	9,1019936E+01	-8,0460446E+01	2.8519700E+01
2	0,	2,9357392E+06	3,1378651E+03	2,7013877E+01	9,0529243E+01	-8,0046802E+01	7.5933929E-02
3	0,	9,1323617E+04	0,	0,	0,	5,3112023E+00	5.3106594E+00
4	1,2737755E+06	1,1757747E+02	1,8250573E-04	9,5008877E+02	2,1404682E+00	7,4679623E-02	2.2372432E-01
5	2,5917134E+00	0,	0,	3,7739178E+02	-1,5234611E+06	9,6387487E+04	2.8875649E+05
6	1,3799152E+06	1,2601449E+00	6,9486533E+02	-1,3579088E+01	8,1700503E-03	-8,2995444E+02	0.
7	5,2865970E+06	9,1700000E-01	0,	8,4842170E-02	-5,0990237E-15	4,7085575E+01	9.1019936E+01
8	1,2996845E+01	2,1492154E+00	-9,7283822E-02	2,1514160E+00	4,7085575E+01	-8,8980064E+01	0.
9	0,	0,	0,	0,	1,7923996E+02	-1,0646802E+01	-1.3277852E+02
10	1,7401528E+03	9,8836401E-01	2,8524198E+01	-1,6893846E+02	-9,0629406E+01	3,4600572E+03	2.0248408E+01
11	1,7965557E+02	1,8207516E+03	2,6626459E+09	5,8681868E+10	4,0261205E+01	2,7912293E+03	4.7696653E+05

1	1,0500301E+02	7,4564067E+04	2,3323424E+03	4,0868057E+01	9,1068952E+01	-8,0430560E+01	2.8519221E+01
2	6,0000000E+00	2,7952981E+06	3,4635208E+03	2,6143448E+01	9,0606365E+01	-7,9991847E+01	1.0321083E-01
3	6,0000000E+00	8,6954841E+04	0,	0,	0,	6,8898676E+00	6.8890945E+00
4	9,0083331E+05	7,6163089E+01	1,1534562E-04	9,6408346E+02	2,4192528E+00	7,6788642E-02	2.1801813E-01
5	2,7381405E+00	0,	0,	3,1372977E+02	-1,1886619E+06	8,2390820E+04	2.3391324E+05
6	1,3854926E+06	1,2260706E+00	7,5563129E+02	-1,4134142E+01	6,7539414E-03	-8,2902459E+02	0.
7	5,2982541E+06	9,1700000E-01	0,	9,0820546E-02	1,0710417E-14	4,3606198E+01	9.1068952E+01
8	1,3116794E+01	2,2869777E+00	-1,0937695E-01	2,2895917E+00	4,3606198E+01	-8,8931048E+01	0.
9	0,	0,	0,	0,	1,7924952E+02	-1,0781317E+01	-1.3625839E+02
10	1,7437091E+03	9,8560355E-01	2,8525125E+01	-1,6872201E+02	-9,0704220E+01	3,4623150E+03	2.5103220E+01
11	1,7958849E+02	1,8263360E+03	2,6572153E+09	6,5293738E+10	4,9845042E+01	3,1037004E+03	4.2807213E+05

38

CASE, 1 SD SOLUTION PAGE 8 DATE 10273

1	1,1100301E+02	8,4019638E+04	2,6674101E+03	3,7544954E+01	9,1119131E+01	-8,0394504E+01	2,8518615E+01
2	1,2000000E+01	2,6548714E+06	3,8236421E+03	2,5157755E+01	9,0683857E+01	-7,9930722E+01	1,3724210E-01
3	1,2000000E+01	8,2586511E+04	0,	0,	0,	8,7945247E+00	8,7934538E+00
4	6,1876992E+05	4,8647340E+01	7,1225025E-05	9,8022965E+02	2,7212094E+00	7,6999702E-02	2,1227380E-01
5	2,9163115E+00	0,	0,	2,5338576E+02	-6,6569923E+05	6,6726347E+04	1,8395208E+05
6	1,3891982E+06	1,1964187E+00	8,2560680E+02	-1,4780751E+01	5,6492029E-03	-8,2810843E+02	0,
7	5,3058099E+06	9,1700000E-01	0,	9,7339180E-02	5,6384666E-15	4,0461265E+01	9,1119131E+01
8	1,3328386E+01	2,4338271E+00	-1,2398704E-01	2,4369832E+00	4,0461265E+01	-8,8880869E+01	0,
9	0,	0,	0,	0,	1,7926039E+02	-1,0919921E+01	-1,3940401E+02
10	1,7479555E+03	9,8215819E-01	2,8526125E+01	-1,6849862E+02	-9,0768470E+01	3,4647242E+03	3,1186697E+01
11	1,7951017E+02	1,8330114E+03	2,6507601E+09	7,2713391E+10	6,1816967E+01	3,4539860E+03	3,8372479E+05

1	1,1700301E+02	9,4066276E+04	3,0404145E+03	3,4522861E+01	9,1171210E+01	-8,0351567E+01	2,8517861E+01
2	1,8000000E+01	2,5144551E+06	4,2195024E+03	2,4102350E+01	9,0761692E+01	-7,9862717E+01	1,7904151E-01
3	1,8000000E+01	7,8218504E+04	0,	0,	0,	1,1062642E+01	1,1061193E+01
4	4,1928538E+05	3,0754440E+01	4,3449824E-05	9,9564397E+02	3,0537165E+00	7,4611951E-02	2,0644501E-01
5	3,1158966E+00	0,	0,	2,0082769E+02	9,9968928E+04	5,1245780E+04	1,4179278E+05
6	1,3916079E+06	1,1706698E+00	9,0294631E+02	-1,5524647E+01	4,7992599E-03	-8,2719809E+02	0,
7	5,3108509E+06	9,1700000E-01	0,	1,0448932E-01	3,8696705E-14	3,7638758E+01	9,1171210E+01
8	1,3697849E+01	2,5914272E+00	-1,4106779E-01	2,5952640E+00	3,7638758E+01	-8,8828790E+01	0,
9	0,	0,	0,	0,	1,7927125E+02	-1,1063912E+01	-1,4222717E+02
10	1,7530138E+03	9,7789770E-01	2,8527177E+01	-1,6826764E+02	-9,0820832E+01	3,4672821E+03	3,8745632E+01
11	1,7941933E+02	1,8409739E+03	2,6431113E+09	8,0960622E+10	7,6634896E+01	3,8429038E+03	3,4389506E+05

1	1,2300301E+02	1,0469370E+05	3,4531334E+03	3,1789906E+01	9,1225824E+01	-8,0301026E+01	2,8516931E+01
2	2,4000000E+01	2,3740377E+06	4,6527756E+03	2,3015350E+01	9,0840130E+01	-7,9787107E+01	2,2968874E-01
3	2,4000000E+01	7,3850466E+04	0,	0,	0,	1,3732575E+01	1,3730694E+01
4	2,8161832E+05	1,9255559E+01	2,6318094E-05	1,0102627E+03	3,4180549E+00	7,0392424E-02	2,0064979E-01
5	3,2452833E+00	0,	0,	1,5691019E+02	3,4900606E+05	3,7774887E+04	1,0767527E+05
6	1,3931565E+06	1,1477826E+00	9,8544810E+02	-1,6372285E+01	4,1796274E-03	-8,2628696E+02	0,
7	5,3146533E+06	9,1700000E-01	0,	1,1237921E-01	-6,3054617E-15	3,5035189E+01	9,1225824E+01
8	1,3725970E+01	2,7621091E+00	-1,5661580E-01	2,7665457E+00	3,5035189E+01	-8,8774176E+01	0,
9	0,	0,	0,	0,	1,7928261E+02	-1,1215790E+01	-1,4483143E+02
10	1,7590314E+03	9,7267094E-01	2,8528265E+01	-1,6802780E+02	-9,0860205E+01	3,4699901E+03	4,8072665E+01
11	1,7931440E+02	1,8504613E+03	2,6340694E+09	9,0061043E+10	9,4831550E+01	4,2715313E+03	3,0832847E+05

1	1,2900301E+02	1,1589384E+05	3,9079157E+03	2,9328575E+01	9,1283547E+01	-8,0242130E+01	2,8519797E+01
2	3,0000000E+01	2,2336013E+06	5,1258425E+03	2,1927569E+01	9,0919636E+01	-7,9703143E+01	2,9033857E-01
3	3,0000000E+01	6,9481836E+04	0,	0,	0,	1,6843966E+01	1,6841463E+01
4	1,8678979E+05	1,1932383E+01	1,5821168E-05	1,0261262E+03	3,8084162E+00	6,6965889E-02	1,9524856E-01
5	3,3235303E+00	0,	0,	1,2080890E+02	3,8125313E+05	2,7668057E+04	8,0670149E+04
6	1,3941427E+06	1,1274323E+00	1,0708392E+03	-1,7330859E+01	3,7198944E-03	-8,2536974E+02	0,
7	5,3178842E+06	9,1700000E-01	0,	1,2114420E-01	4,6812869E-12	3,2652105E+01	9,1283547E+01
8	1,3686024E+01	2,9501792E+00	-1,7132190E-01	2,9551495E+00	3,2652105E+01	-8,8716453E+01	0,
9	0,	0,	0,	0,	1,7929364E+02	-1,1376766E+01	-1,4721508E+02
10	1,7661905E+03	9,6629798E-01	2,8529378E+01	-1,6777736E+02	-9,0885328E+01	3,4728568E+03	5,9524187E+01
11	1,7919325E+02	1,8617696E+03	2,6233924E+09	1,0005342E+11	1,1704229E+02	4,7415456E+03	2,7663895E+05

(39)

CASE, 1 SD SOLUTION PAGE 9 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY

1	1,3500301E+02	1,2765356E+05	4,3946950E+03	2,7117042E+01	9,1344894E+01	-8,0174150E+01	2,8514427E+01
2	3,6000000E+01	2,0964464E+06	5,6288504E+03	2,0846834E+01	9,1000026E+01	-7,9610094E+01	3,6217438E-01
3	3,6000000E+01	6,5215285E+04	0,	0,	0,	2,0435338E+01	2,0432128E+01
4	1,2154418E+05	7,3244984E+00	9,4239774E-06	1,0447262E+03	4,2065518E+00	6,7797095E-02	1,9070623E-01
5	3,4939353E+00	0,	0,	9,1004259E+01	3,0755454E+05	2,1100799E+04	5,9354370E+04
6	1,3947633E+06	1,1093195E+00	1,1573428E+03	-1,8407626E+01	3,3688471E-03	-8,2444211E+02	0,
7	4,9742749E+06	9,1700000E-01	0,	1,3073227E-01	1,3798766E-12	3,0610977E+01	9,1344894E+01
8	1,3595669E+01	2,9905490E+00	-1,8259209E-01	2,9961181E+00	3,0610977E+01	-8,8655106E+01	0,
9	0,	0,	0,	0,	1,7930107E+02	-1,1546601E+01	-1,4925603E+02
10	1,7745200E+03	9,5874322E-01	2,8530486E+01	-1,6751599E+02	-9,0898112E+01	3,4758290E+03	7,3210974E+01
11	1,7905812E+02	1,8749555E+03	2,6110783E+09	1,1074838E+11	1,4340150E+02	5,2438932E+03	2,4896372E+08

1	1,4357861E+02	1,4527759E+05	5,1019984E+03	2,4324012E+01	9,1439458E+01	-8,0060578E+01	2,8512000E+01
2	4,4575604E+01	1,9166679E+06	6,3563835E+03	1,9305902E+01	9,1115513E+01	-7,9460692E+01	4,8584816E-01
3	4,4575604E+01	5,9623440E+04	0,	0,	0,	2,6435688E+01	2,6431223E+01
4	6,4239804E+04	3,6239072E+00	4,4651173E-06	1,0711808E+03	4,7629666E+00	7,1475630E-02	1,8551260E-01
5	3,7866932E+00	0,	0,	5,8114367E+01	1,6233131E+05	1,4205862E+04	3,6870840E+04
6	1,3952616E+06	1,0865624E+00	1,2802948E+03	-2,0156313E+01	3,0163346E-03	-8,2309038E+02	0,
7	4,3968887E+06	9,1700000E-01	0,	1,4526847E-01	1,4643820E-14	2,8110705E+01	9,1439458E+01
8	1,3454868E+01	2,9828861E+00	-1,9742727E-01	2,9894125E+00	2,8110705E+01	-8,8560542E+01	0,
9	0,	0,	0,	0,	1,7930715E+02	-1,1808186E+01	-1,5175502E+02
10	1,7879937E+03	9,4631914E-01	2,8531983E+01	-1,6712477E+02	-9,0909854E+01	3,4800064E+03	9,5981042E+01
11	1,7885737E+02	1,8963505E+03	2,5914020E+09	1,2640385E+11	1,8680974E+02	5,9779889E+03	2,1674530E+08

1	1,4357861E+02	1,4527759E+05	5,1019984E+03	2,4324012E+01	9,1439458E+01	-8,0060578E+01	2,8512000E+01
2	0,	1,5443878E+06	6,3563835E+03	1,9305902E+01	9,1115513E+01	-7,9460692E+01	4,8584816E-01
3	0,	4,8042100E+04	0,	0,	0,	2,6435688E+01	2,6431223E+01
4	6,4239804E+04	3,6239072E+00	4,4651173E-06	1,0711808E+03	4,7629666E+00	5,9809764E-01	3,8396826E-01
5	1,9579661E+01	-1,2960537E+00	0,	5,8114367E+01	-1,7728552E+06	1,1887258E+05	7,0351593E+04
6	1,3952616E+06	1,0865624E+00	1,2802948E+03	-2,0156313E+01	3,0163346E-03	-8,2309038E+02	0,
7	0,	0,	0,	1,7316530E-01	0,	4,3898459E+01	9,1005161E+01
8	1,1875591E+01	8,6686314E-01	-9,8130902E-02	8,7239979E-01	7,4796274E+01	-8,7700352E+01	-3,0907439E+01
9	0,	0,	0,	0,	1,7773829E+02	-1,1134233E+01	-1,3568508E+02
10	1,7879937E+03	9,4631914E-01	2,8531983E+01	-1,6712477E+02	-9,0909854E+01	3,4800064E+03	9,5981042E+01
11	1,7885737E+02	1,8963505E+03	2,5914020E+09	1,2640385E+11	1,8680974E+02	5,9779889E+03	2,1674530E+08

(40)

CASE, 1 SD SOLUTION PAGE 10 DATE 10273

1	1,5357861E+02	1,6565027E+05	5,2558171E+03	2,2055489E+01	9,1538622E+01	-7,9913433E+01	2,8508639E+01
2	1,0000000E+01	1,5134157E+06	6,5278317E+03	1,7597813E+01	9,1204463E+01	-7,9271766E+01	6,5071280E-01
3	1,0000000E+01	4,7078635E+04	2,9347911E+02	0,	0,	3,4210321E+01	3,4204132E+01
4	2,9128718E+04	1,6626683E+00	1,9913826E-06	1,0801073E+03	4,8660139E+00	7,1186996E-01	4,2566268E-01
5	2,3244365E+01	-1,1882542E+00	0,	2,7504591E+01	-9,4397575E+05	6,6962548E+04	4,0040259E+04
6	1,3955258E+06	1,0656350E+00	1,4264079E+03	-2,2375617E+01	2,7104130E-03	-8,2144857E+02	0,
7	0,	0,	0,	1,7982248E-01	0,	4,5294568E+01	9,1069701E+01
8	1,2203543E+01	8,9441181E-01	-1,4382322E-01	9,0590155E-01	7,4316219E+01	-8,7730185E+01	-2,9031155E+01
9	1,1254724E+01	1,2467039E+02	4,0174039E+00	6,9828864E-02	1,7777125E+02	-1,1333768E+01	-1,3428843E+02
10	1,7928360E+03	9,4216777E-01	2,8531938E+01	-1,6674949E+02	-9,1097252E+01	3,4819883E+03	1,0368370E+08
11	1,7888097E+02	1,9040593E+03	2,5844029E+09	1,3123787E+11	2,0137114E+02	6,2030703E+03	2,0831643E+09
1	1,6357861E+02	1,8476051E+05	5,4288623E+03	1,9912836E+01	9,1640799E+01	-7,9759401E+01	2,8504882E+01
2	2,0000000E+01	1,4824436E+06	6,7161796E+03	1,5980363E+01	9,1297063E+01	-7,9075953E+01	8,2740285E-01
3	2,0000000E+01	4,6115171E+04	5,9302679E+02	0,	0,	4,2349514E+01	4,2341431E+01
4	1,5372310E+04	8,0093228E-01	9,8389333E-07	1,0575511E+03	5,1334278E+00	7,7853098E-01	4,7523311E-01
5	2,5952927E+01	-1,1300882E+00	0,	1,4498921E+01	-4,9161280E+05	3,8604478E+04	2,3565056E+04
6	1,3956418E+06	1,0452100E+00	1,5764424E+03	-2,4669083E+01	2,5400563E-03	-8,1971306E+02	0,
7	0,	0,	0,	1,8675375E-01	0,	4,5860338E+01	9,1146262E+01
8	1,2363783E+01	9,1674591E-01	-1,7120902E-01	9,3259616E-01	7,3535468E+01	-8,7712624E+01	-2,7684922E+01
9	1,7903092E+01	2,3782295E+02	1,1007799E+01	1,0304510E-01	1,7776099E+02	-1,1564059E+01	-1,3371281E+02
10	1,7979882E+03	9,3765142E-01	2,8531903E+01	-1,6635965E+02	-9,1292721E+01	3,4838743E+03	1,1210202E+08
11	1,7890590E+02	1,9122729E+03	2,5769973E+09	1,3630290E+11	2,1721463E+02	6,4389856E+03	2,0010895E+09
1	1,7357861E+02	2,0264096E+05	5,6189059E+03	1,7905873E+01	9,1745680E+01	-7,9598178E+01	2,8500693E+01
2	3,0000000E+01	1,4514716E+06	6,9193675E+03	1,4457964E+01	9,1392962E+01	-7,8872949E+01	1,0165626E+00
3	3,0000000E+01	4,5151706E+04	8,9889932E+02	0,	0,	5,0869414E+01	5,0859956E+01
4	8,7801742E+03	3,8801770E-01	5,1353301E-07	1,0216072E+03	5,5000648E+00	8,1338188E-01	5,0475320E-01
5	2,7938698E+01	-1,1048764E+00	0,	8,1066387E+00	-2,5262443E+05	2,2550828E+04	1,3994168E+04
6	1,3956974E+06	1,0254896E+00	1,7260466E+03	-2,7038922E+01	2,4355360E-03	-8,1788040E+02	0,
7	0,	0,	0,	1,9392867E-01	0,	4,5838921E+01	9,1228041E+01
8	1,2426747E+01	9,3787442E-01	-1,8867934E-01	9,5666521E-01	7,2590966E+01	-8,7664658E+01	-2,6762414E+01
9	2,1910407E+01	3,4003485E+02	2,0894134E+01	1,1931485E-01	1,7772341E+02	-1,1817045E+01	-1,3371899E+02
10	1,8034456E+03	9,3277675E-01	2,8531861E+01	-1,6595568E+02	-9,1496239E+01	3,4856614E+03	1,2122987E+08
11	1,7893276E+02	1,9209860E+03	2,5691989E+09	1,4156518E+11	2,3431052E+02	6,6841486E+03	1,9218595E+09
1	1,8357861E+02	2,1932076E+05	5,8247775E+03	1,6033889E+01	9,1853285E+01	-7,9429489E+01	2,8496039E+01
2	4,0000000E+01	1,4204995E+06	7,1364529E+03	1,3028718E+01	9,1492131E+01	-7,8662480E+01	1,2187776E+00
3	4,0000000E+01	4,4188242E+04	1,2113696E+03	0,	0,	5,9784739E+01	5,9772316E+01
4	5,0559101E+03	1,8644876E-01	2,7011627E-07	9,8820492E+02	5,8943013E+00	8,3254555E-01	5,2271707E-01
5	2,9441123E+01	-1,0967102E+00	0,	4,5822569E+00	-1,2699988E+05	1,3047086E+04	8,1916657E+03
6	1,3957246E+06	1,0065836E+00	1,8728883E+03	-2,9487140E+01	2,3661660E-03	-8,1594977E+02	0,
7	0,	0,	0,	2,0134219E-01	0,	4,5469088E+01	9,1314249E+01
8	1,2436512E+01	9,5909742E-01	-2,0076835E-01	9,7988560E-01	7,1516798E+01	-8,7600034E+01	-2,6058836E+01
9	2,4312423E+01	4,3193472E+02	3,3448031E+01	1,2727053E-01	1,7767225E+02	-1,2089084E+01	-1,3406940E+02
10	1,8092234E+03	9,2753743E-01	2,8531803E+01	-1,6553736E+02	-9,1708203E+01	3,4873459E+03	1,3110098E+08
11	1,7896200E+02	1,9302250E+03	2,5609941E+09	1,4701611E+11	2,5270204E+02	6,9381669E+03	1,8459841E+09

(41)

CASE, 1 SD SOLUTION PAGE 11 DATE 10272

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY

1	1,9357861E+02	2,3482613E+05	6,0457486E+03	1,4293676E+01	9,1963743E+01	-7,9253064E+01	2,8490868E+01
2	5,0000000E+01	1,3895275E+06	7,3669306E+03	1,1689892E+01	9,1594648E+01	-7,8444274E+01	1,4340291E+00
3	5,0000000E+01	4,3224777E+04	1,5307285E+03	0,	0,	6,9109944E+01	6,9109984E+01
4	2,8687801E+03	8,9930231E-02	1,4048791E-07	9,5913004E+02	6,3033669E+00	8,4280864E-01	5,3319938E-01
5	3,0604579E+01	-1,0988046E+00	0,	2,5674922E+00	-6,2331935E+04	7,3979194E+03	4,6815783E+03
6	1,3957376E+06	9,8857069E-01	2,0155487E+03	-3,2015744E+01	2,3177129E-03	-8,1382182E+02	0,
7	0,	0,	0,	2,0900006E-01	0,	4,4892022E+01	9,1404356E+01
8	1,2416430E+01	9,8092044E-01	-2,0967864E-01	1,0030803E+00	7,0361387E+01	-8,7524382E+01	-2,8481383E+01
9	2,5712989E+01	5,1416759E+02	4,8437455E+01	1,3115052E-01	1,7761295E+02	-1,2377789E+01	-1,3468497E+02
10	1,8153455E+03	9,2190746E-01	2,8531725E+01	-1,6510425E+02	-9,1929069E+01	3,4889260E+03	1,4176494E+03
11	1,7899393E+02	1,9400305E+03	2,5523575E+09	1,5265506E+11	2,7245910E+02	7,2010247E+03	1,7722183E+05

1	2,0357861E+02	2,4918183E+05	6,2813115E+03	1,2681064E+01	9,2077222E+01	-7,9068630E+01	2,8485149E+01
2	6,0000000E+01	1,3585554E+06	7,6105014E+03	1,0438703E+01	9,1700637E+01	-7,8218059E+01	1,6640910E+00
3	6,0000000E+01	4,2261313E+04	1,8572866E+03	0,	0,	7,8859616E+01	7,8842047E+01
4	1,6224986E+03	4,4234127E-02	7,2700184E-08	9,3090650E+02	6,7475214E+00	8,4477010E-01	5,3700274E-01
5	3,1514243E+01	-1,1066594E+00	0,	1,4341883E+00	-3,0613354E+04	4,1435332E+03	2,6339574E+03
6	1,3957437E+06	9,7150822E-01	2,1531450E+03	-3,4626789E+01	2,2825058E-03	-8,1179812E+02	0,
7	0,	0,	0,	2,1691347E-01	0,	4,4188755E+01	9,1498786E+01
8	1,2379116E+01	1,0035948E+00	-2,1663407E-01	1,0267097E+00	6,9138453E+01	-8,7441034E+01	-2,4962721E+01
9	2,6499845E+01	5,8738101E+02	6,5644856E+01	1,3306703E-01	1,7754906E+02	-1,2682510E+01	-1,3530488E+02
10	1,8218410E+03	9,1586482E-01	2,8531624E+01	-1,6465582E+02	-9,2159283E+01	3,4904011E+03	1,5328092E+03
11	1,7902874E+02	1,9504523E+03	2,5432574E+09	1,5848458E+11	2,9366552E+02	7,4728547E+03	1,7016439E+05

1	2,1357861E+02	2,6241217E+05	6,5311094E+03	1,1191156E+01	9,2193910E+01	-7,8875910E+01	2,8478832E+01
2	7,0000000E+01	1,3275633E+06	7,8670002E+03	9,2722486E+00	9,1810244E+01	-7,7983557E+01	1,9095799E+00
3	7,0000000E+01	4,1297848E+04	2,1913760E+03	0,	0,	8,9048669E+01	8,9028196E+01
4	9,2607650E+02	2,2340353E-02	3,7980929E-08	9,0453154E+02	7,2204331E+00	8,4056397E-01	5,3519153E-01
5	3,2225822E+01	-1,1190356E+00	0,	8,1004567E-01	-1,5851753E+04	2,3286616E+03	1,4829712E+03
6	1,3957467E+06	9,5543130E-01	2,2849470E+03	-3,7322401E+01	2,2556341E-03	-8,0958078E+02	0,
7	0,	0,	0,	2,2509717E-01	0,	4,3410090E+01	9,1597203E+01
8	1,2331681E+01	1,0272726E+00	-2,2246032E-01	1,0510841E+00	6,7884179E+01	-8,7350875E+01	-2,4488222E+01
9	2,6923701E+01	6,5221549E+02	8,4668652E+01	1,3403756E-01	1,7748129E+02	-1,3002251E+01	-1,3609839E+02
10	1,8287442E+03	9,0938218E-01	2,8531498E+01	-1,6419146E+02	-9,2399283E+01	3,4917715E+03	1,6571681E+03
11	1,7906661E+02	1,9615485E+03	2,5336571E+09	1,6450923E+11	3,1641673E+02	7,7538839E+03	1,6337987E+05

42

1	2,2357861E+02	2,7454156E+05	6,7949072E+03	9,8184678E+00	9,2313989E+01	-7,8674616E+01	2,8471867E+01
2	8,0000000E+01	1,2966113E+06	8,1363673E+03	8,1874393E+00	9,1923618E+01	-7,7740483E+01	2,1699193E+00
3	8,0000000E+01	4,0334384E+04	2,5333523E+03	0,	0,	9,9692482E+01	9,9668870E+01
4	5,3319720E+02	1,1602362E-02	2,0267767E-08	8,8586506E+02	7,6703637E+00	8,3292170E-01	5,3018136E-01
5	3,2775914E+01	-1,1354781E+00	0,	4,6788914E-01	-9,3221103E+03	1,3328254E+03	8,4838608E+02
6	1,3957481E+06	9,4035411E-01	2,4104915E+03	-4,0104799E+01	2,2338958E-03	-8,0727229E+02	0,
7	0,	0,	0,	2,3356880E-01	0,	4,2587138E+01	9,1699321E+01
8	1,2278756E+01	1,0520648E+00	-2,2770988E-01	1,0764256E+00	6,6626476E+01	-8,7254223E+01	-2,4054692E+01
9	2,7137773E+01	7,0929664E+02	1,0592193E+02	1,3454330E-01	1,7740980E+02	-1,3336384E+01	-1,3685433E+02
10	1,8360939E+03	9,0242887E-01	2,8531347E+01	-1,6371037E+02	-9,2649490E+01	3,4930380E+03	1,7914975E+02
11	1,7910766E+02	1,9733855E+03	2,5235151E+09	1,7073512E+11	3,4081966E+02	8,0444139E+03	1,5684891E+05

1	2,3357861E+02	2,8559486E+05	7,0725725E+03	8,5571258E+00	9,2437639E+01	-7,8464453E+01	2,8464201E+01
2	9,0000000E+01	1,2656392E+06	8,4186281E+03	7,1810156E+00	9,2040913E+01	-7,7488538E+01	2,4463623E+00
3	9,0000000E+01	3,9370919E+04	2,8835969E+03	0,	0,	1,1080701E+02	1,1078002E+02
4	3,0836817E+02	6,2315286E-03	1,1135228E-08	8,8020378E+02	8,0351535E+00	8,2578638E-01	5,2519855E-01
5	3,3188062E+01	-1,1558435E+00	0,	2,7849918E-01	-6,6196118E+03	7,8653442E+02	5,0023439E+02
6	1,3957488E+06	9,2627179E-01	2,5294180E+03	-4,2976315E+01	2,2153265E-03	-8,0487537E+02	0,
7	0,	0,	0,	2,4234855E-01	0,	4,1737563E+01	9,1804973E+01
8	1,2221767E+01	1,0780685E+00	-2,3272236E-01	1,1029013E+00	6,5383443E+01	-8,7151186E+01	-2,3662574E+01
9	2,7230831E+01	7,5922896E+02	1,2862656E+02	1,3481520E-01	1,7733457E+02	-1,3684662E+01	-1,3767496E+02
10	1,8439340E+03	8,9497090E-01	2,8531169E+01	-1,6321253E+02	-9,2910318E+01	3,4942013E+03	1,9366673E+02
11	1,7915201E+02	1,9660386E+03	2,5127855E+09	1,7716965E+11	3,6699281E+02	8,3448061E+03	1,5055985E+05

1	2,4357861E+02	2,9559748E+05	7,3640628E+03	7,4010594E+00	9,2365029E+01	-7,8245112E+01	2,8455777E+01
2	1,0000000E+02	1,2346672E+06	8,7138810E+03	6,2496090E+00	9,2162278E+01	-7,7227416E+01	2,7395883E+00
3	1,0000000E+02	3,8407455E+04	3,2425196E+03	0,	0,	1,2240889E+02	1,2237824E+02
4	1,8015467E+02	3,5094949E-03	6,3472893E-09	8,8814619E+02	8,2914985E+00	8,2078319E-01	5,2165732E-01
5	3,3477869E+01	-1,1806978E+00	0,	1,7210491E-01	-5,6097219E+03	4,8311200E+02	3,0704687E+02
6	1,3957492E+06	9,1316344E-01	2,6414400E+03	-4,5939408E+01	2,1987833E-03	-8,0239286E+02	0,
7	0,	0,	0,	2,5145908E-01	0,	4,0870884E+01	9,1913771E+01
8	1,2161858E+01	1,1053808E+00	-2,3769633E-01	1,1306486E+00	6,4175411E+01	-8,7041497E+01	-2,3322497E+01
9	2,7252635E+01	8,0259148E+02	1,5280748E+02	1,3496745E-01	1,7725504E+02	-1,4046792E+01	-1,3851054E+02
10	1,8523141E+03	8,8697086E-01	2,8530962E+01	-1,6269671E+02	-9,3182172E+01	3,4952627E+03	2,0936546E+02
11	1,7919978E+02	1,9995926E+03	2,5014174E+09	1,8382123E+11	3,9506653E+02	8,6554708E+03	1,4449921E+05

1	2,5357861E+02	3,0457558E+05	7,6694178E+03	6,3441688E+00	9,2696329E+01	-7,8016271E+01	2,8446532E+01
2	1,1000000E+02	1,2036951E+06	9,0222901E+03	5,3898074E+00	9,2287864E+01	-7,6956794E+01	3,0503041E+00
3	1,1000000E+02	3,7443990E+04	3,6105613E+03	0,	0,	1,3451548E+02	1,3448091E+02
4	1,0830683E+02	2,1091926E-03	3,7886320E-09	9,0535217E+02	8,4711983E+00	8,1664641E-01	5,1859903E-01
5	3,3656324E+01	-1,2094223E+00	0,	1,1142361E-01	-5,3067442E+03	3,1119842E+02	1,9762188E+02
6	1,3957494E+06	9,0099613E-01	2,7463114E+03	-4,8996685E+01	2,1836249E-03	-7,9982768E+02	0,
7	0,	0,	0,	2,6092564E-01	0,	3,9991994E+01	9,2026089E+01
8	1,2099413E+01	1,1341049E+00	-2,4274622E-01	1,1597930E+00	6,2996568E+01	-8,6925507E+01	-2,3024366E+01
9	2,7230743E+01	8,3993499E+02	1,7828921E+02	1,3505771E-01	1,7717175E+02	-1,4423370E+01	-1,3935619E+02
10	1,8612894E+03	8,7838774E-01	2,8530723E+01	-1,6216244E+02	-9,3465468E+01	3,4962231E+03	2,2635560E+02
11	1,7925109E+02	2,0141437E+03	2,4893554E+09	1,9069916E+11	4,2518358E+02	8,9768610E+03	1,3865400E+05

43

CASE, 1 SD SOLUTION PAGE 13 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
1	2,6357861E+02	3,1255610E+05	7,9887552E+03	5,3804498E+00	9,2831711E+01	-7,7777594E+01	2,8436399E+01
2	1,2000000E+02	1,1727230E+06	9,3440819E+03	4,5982107E+00	9,2417831E+01	-7,6676337E+01	3,3792492E+00
3	1,2000000E+02	3,6480526E+04	3,9881975E+03	0,	0,	1,4714495E+02	1,4710616E+02
4	6,8570486E+01	1,3707137E-03	2,3899088E-09	9,2506665E+02	8,6358699E+00	8,1063073E-01	5,1383289E-01
5	3,3731867E+01	-1,2421513E+00	0,	7,6262239E-02	-5,2713057E+03	2,1142616E+02	1,3401628E+02
6	1,3957495E+06	8,8972838E-01	2,8438046E+03	-5,2150911E+01	2,1694956E-03	-7,9718278E+02	0,
7	0,	0,	0,	2,7077624E-01	0,	3,9103327E+01	9,2141973E+01
8	1,2034537E+01	1,1643533E+00	-2,4794028E-01	1,1904592E+00	6,1850437E+01	-8,6803137E+01	-2,2768689E+01
9	2,7180518E+01	8,7178053E+02	2,0489441E+02	1,3511531E-01	1,7708460E+02	-1,4814727E+01	-1,4020933E+02
10	1,8709221E+03	8,6917666E-01	2,8530450E+01	-1,6160905E+02	-9,3760640E+01	3,4970840E+03	2,4478027E+02
11	1,7930606E+02	2,0297997E+03	2,4765385E+09	1,9781362E+11	4,5750019E+02	9,3094705E+03	1,3301178E+05
1	2,7357861E+02	3,1956692E+05	8,3222697E+03	4,5040865E+00	9,2971352E+01	-7,7528730E+01	2,8425307E+01
2	1,3000000E+02	1,1417510E+06	9,6795456E+03	3,8714769E+00	9,2552342E+01	-7,6385692E+01	3,7271777E+00
3	1,3000000E+02	3,5517061E+04	4,3759419E+03	0,	0,	1,6031636E+02	1,6027306E+02
4	4,6511241E+01	9,6649125E-04	1,6033558E-09	9,4142318E+02	8,8400942E+00	8,0038059E-01	5,0549265E-01
5	3,3711532E+01	-1,2790608E+00	0,	5,5524351E-02	-5,3135818E+03	1,5198690E+02	9,5989659E+01
6	1,3957496E+06	8,7931302E-01	2,9336983E+03	-5,5405032E+01	2,1561955E-03	-7,9446113E+02	0,
7	0,	0,	0,	2,8104202E-01	0,	3,8206094E+01	9,2261499E+01
8	1,1967203E+01	1,1962504E+00	-2,5332267E-01	1,2227785E+00	6,0738960E+01	-8,6674284E+01	-2,2556415E+01
9	2,7110682E+01	8,9861897E+02	2,3244409E+02	1,3515522E-01	1,7699347E+02	-1,5221268E+01	-1,4106862E+02
10	1,8812824E+03	6,5928648E-01	2,8530142E+01	-1,6103583E+02	-9,4068139E+01	3,4978466E+03	2,6471810E+02
11	1,7936481E+02	2,0466831E+03	2,4629001E+09	2,0517562E+11	4,9218732E+02	9,6538344E+03	1,2756072E+05
1	2,8357861E+02	3,2563690E+05	8,6702321E+03	3,7095153E+00	9,3115427E+01	-7,7269311E+01	2,8413176E+01
2	1,4000000E+02	1,1107789E+06	1,0029034E+04	3,2063583E+00	9,2691563E+01	-7,6084492E+01	4,0948996E+00
3	1,4000000E+02	3,4553597E+04	4,7743505E+03	0,	0,	1,7404970E+02	1,7400156E+02
4	3,4003018E+01	7,3446937E-04	1,1459188E-09	9,5165746E+02	9,1106648E+00	7,8498273E-01	4,9293018E-01
5	3,3601513E+01	-1,3203764E+00	0,	4,3071032E-02	-5,3546960E+03	1,1563026E+02	7,2610060E+01
6	1,3957496E+06	8,6969951E-01	3,0157697E+03	-5,8762187E+01	2,1436077E-03	-7,9166569E+02	0,
7	0,	0,	0,	2,9175760E-01	0,	3,7300921E+01	9,2384758E+01
8	1,1897318E+01	1,2299343E+00	-2,5892549E-01	1,2568933E+00	5,9663338E+01	-8,6538809E+01	-2,2388142E+01
9	2,7026329E+01	9,2091132E+02	2,6075851E+02	1,3518520E-01	1,7689820E+02	-1,5643447E+01	-1,4193327E+02
10	1,8924491E+03	2,4866933E-01	2,8529794E+01	-1,6044203E+02	-9,4388432E+01	3,4985127E+03	2,8638559E+02
11	1,7942749E+02	2,0649329E+03	2,4483673E+09	2,1279712E+11	5,2943226E+02	1,0010532E+04	1,2228957E+05

(44)

1	2,9357861E+02	3,3079607E+05	9,0329912E+03	2,9914673E+00	9,3264116E+01	-7,6988950E+01	2,8399922E+01
2	1,5000000E+02	1,0798069E+06	1,0392966E+04	2,5997288E+00	9,2835666E+01	-7,5772349E+01	4,4832414E+00
3	1,5000000E+02	3,3590132E+04	5,1840265E+03	0,	0,	1,8836599E+02	1,8831268E+02
4	2,6682744E+01	5,9394917E-04	8,7011403E-10	9,5622874E+02	9,4464752E+00	7,6494027E-01	4,7669250E-01
5	3,3407437E+01	-1,3663815E+00	0,	3,5498446E-02	-5,3639113E+03	9,2867334E+01	5,7872703E+01
6	1,3957496E+06	8,6083569E-01	3,0897898E+03	-6,2225733E+01	2,1316605E-03	-7,8879942E+02	0,
7	0,	0,	0,	3,0296164E-01	0,	3,6388160E+01	9,2511851E+01
8	1,1824751E+01	1,2655593E+00	-2,6477520E-01	1,2929602E+00	5,8624516E+01	-8,6396536E+01	-2,2264493E+01
9	2,6930526E+01	9,3906964E+02	2,8965845E+02	1,3520939E-01	1,7679861E+02	-1,6081745E+01	-1,4280274E+02
10	1,9045120E+03	8,3726010E-01	2,8529404E+01	-1,5982691E+02	-9,4722005E+01	3,4990838E+03	3,0994010E+02
11	1,7949423E+02	2,0847078E+03	2,4328598E+09	2,2069107E+11	5,6944057E+02	1,0380189E+04	1,1718765E+05

1	3,0357861E+02	3,3507569E+05	9,4109752E+03	2,3449923E+00	9,3417603E+01	-7,6717241E+01	2,8385455E+01
2	1,6000000E+02	1,0468348E+06	1,0771830E+04	2,0486032E+00	9,2984829E+01	-7,5448860E+01	4,8930678E+00
3	1,6000000E+02	3,2626668E+04	5,6056259E+03	0,	0,	2,0328733E+02	2,0322890E+02
4	2,2261472E+01	5,0419545E-04	6,9815759E-10	9,5734984E+02	9,8302363E+00	7,4150643E-01	4,5794377E-01
5	3,3134491E+01	-1,4174265E+00	0,	3,0916671E-02	-5,3306598E+03	7,8403193E+01	4,8420692E+01
6	1,3957496E+06	8,5266924E-01	3,1555208E+03	-6,5799265E+01	2,1203065E-03	-7,8586523E+02	0,
7	0,	0,	0,	3,1469737E-01	0,	3,5468040E+01	9,2642884E+01
8	1,1749352E+01	1,3032977E+00	-2,7089615E-01	1,3311535E+00	5,7623470E+01	-8,6247249E+01	-2,2186241E+01
9	2,6825202E+01	9,5355824E+02	3,1896639E+02	1,3523005E-01	1,7669441E+02	-1,6536667E+01	-1,4367689E+02
10	1,9175727E+03	8,2499573E-01	2,8528968E+01	-1,5918964E+02	-9,5069370E+01	3,4995619E+03	3,3556341E+02
11	1,7956519E+02	2,1061891E+03	2,4162895E+09	2,2887150E+11	6,1243828E+02	1,0763484E+04	1,1224476E+05

1	3,1357861E+02	3,3850849E+05	9,8046955E+03	1,7654695E+00	9,3576076E+01	-7,6423759E+01	2,8369676E+01
2	1,7000000E+02	1,0178627E+06	1,1166189E+04	1,5501497E+00	9,3139236E+01	-7,5113597E+01	5,3252791E+00
3	1,7000000E+02	3,1663203E+04	6,0398636E+03	0,	0,	2,1883703E+02	2,1877232E+02
4	1,9546939E+01	4,4443721E-04	5,8833413E-10	9,5727806E+02	1,0242265E+01	7,1594929E-01	4,3783597E-01
5	3,2787487E+01	-1,4739368E+00	0,	2,8278884E-02	-5,2522582E+03	6,9242165E+01	4,2344773E+01
6	1,3957496E+06	8,4514870E-01	3,2127136E+03	-6,9486641E+01	2,1095119E-03	-7,8286601E+02	0,
7	0,	0,	0,	3,2701330E-01	0,	3,4540746E+01	9,2777965E+01
8	1,1670950E+01	1,3433431E+00	-2,7731259E-01	1,3716680E+00	5,6661357E+01	-8,6090682E+01	-2,2154394E+01
9	2,6711625E+01	9,6469524E+02	3,4850768E+02	1,3524849E-01	1,7658525E+02	-1,7008739E+01	-1,4455439E+02
10	1,9317476E+03	8,1180453E-01	2,8528482E+01	-1,5852940E+02	-9,5431062E+01	3,4999490E+03	3,6354614E+02
11	1,7964052E+02	2,1295860E+03	2,3985590E+09	2,3735369E+11	6,5867455E+02	1,1161154E+04	1,0745121E+05

1	3,2357861E+02	3,4112875E+05	1,0214751E+04	1,2486095E+00	9,3739731E+01	-7,6118055E+01	2,8352477E+01
2	1,8000000E+02	9,8689069E+05	1,1576684E+04	1,1016982E+00	9,3299079E+01	-7,4766112E+01	5,7808129E+00
3	1,8000000E+02	3,0699739E+04	6,4875207E+03	0,	0,	2,3503968E+02	2,3496860E+02
4	1,7922479E+01	4,0407646E-04	5,1784280E-10	9,5734122E+02	1,0669916E+01	6,8911787E-01	4,1715298E-01
5	3,2370903E+01	-1,5364214E+00	0,	2,7016152E-02	-5,1285858E+03	6,3671211E+01	3,8542950E+01
6	1,3957496E+06	8,3822422E-01	3,2611060E+03	-7,3292007E+01	2,0992508E-03	-7,7980461E+02	0,
7	0,	0,	0,	3,3996410E-01	0,	3,3606455E+01	9,2917204E+01
8	1,1589363E+01	1,3859135E+00	-2,8404988E-01	1,4147228E+00	5,5739596E+01	-8,5926521E+01	-2,2170235E+01
9	2,6590682E+01	9,7285421E+02	3,7811147E+02	1,3526554E-01	1,7647071E+02	-1,7498501E+01	-1,4543569E+02
10	1,9471703E+03	7,9760725E-01	2,8527942E+01	-1,5784531E+02	-9,5807644E+01	3,5002474E+03	3,9409315E+02
11	1,7972040E+02	2,1551402E+03	2,3795611E+09	2,4615428E+11	7,0842470E+02	1,1574001E+04	1,0279769E+05

(45)

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY

1	3,3357861E+02	3,4297255E+05	1.0641833E+04	7,9044892E-01	9,3908789E+01	-7,5799655E+01	2,8333745E+01
2	1,9000000E+02	9,5591663E+05	1,2004044E+04	7,0074450E-01	9,3464575E+01	-7,4405931E+01	6,2606474E+00
3	1,9000000E+02	2,9736274E+04	6,9494532E+03	0,	0,	2,5192123E+02	2,5184357E+02
4	1,7076345E+01	3,7771200E-04	4,7400674E-10	9,5783692E+02	1,1110276E+01	6,6138642E-01	3,9628162E-01
5	3,1868911E+01	-1,6027511E+00	0,	2,6840301E-02	-4,9597728E+03	6,0711193E+01	3,6376208E+01
6	1,3957496E+06	8,3184815E-01	3,3004211E+03	-7,7219826E+01	2,0895013E+03	-7,7668380E+02	0,
7	0,	0,	0,	3,5361152E-01	0,	3,2665414E+01	9,3062177E+01
8	1,1504389E+01	1,4312549E+00	-2,9113538E-01	1,4605651E+00	5,4825945E+01	-8,5755438E+01	-2,2201276E+01
9	2,6463035E+01	9,7836588E+02	4,0761155E+02	1,3528181E-01	1,7635263E+02	-1,8008010E+01	-1,4632050E+02
10	1,9639946E+03	7,8231605E-01	2,8527344E+01	-1,5713640E+02	-9,6199745E+01	3,5004595E+03	4,2753014E+02
11	1,7980500E+02	2,1831326E+03	2,3591766E+09	2,5529145E+11	7,6199383E+02	1,2002897E+04	9,8279302E+04

1	3,4357861E+02	3,4407799E+05	1,1086734E+04	3,8734058E-01	9,4083483E+01	-7,5468061E+01	2,8313353E+01
2	2,0000000E+02	9,2494657E+05	1,2449094E+04	3,4495164E-01	9,3635954E+01	-7,4032556E+01	6,7658111E+00
3	2,0000000E+02	2,8772610E+04	7,4266017E+03	0,	0,	2,6950920E+02	2,6942444E+02
4	1,6861018E+01	3,6254624E-04	4,4972910E-10	9,5844629E+02	1,1567402E+01	6,3284125E-01	3,7537976E-01
5	3,1345388E+01	-1,6758805E+00	0,	2,7639376E-02	-4,7451172E+03	5,9820374E+01	3,5483019E+01
6	1,3957496E+06	8,2597535E-01	3,3303657E+03	-8,1274914E+01	2,0802437E+03	-7,7350628E+02	0,
7	0,	0,	0,	3,6802567E-01	0,	3,1717802E+01	9,3211788E+01
8	1,1415814E+01	1,4796465E+00	-2,9859912E-01	1,5094752E+00	5,3953115E+01	-8,5576087E+01	-2,2280139E+01
9	2,6329223E+01	9,8153989E+02	4,3684709E+02	1,3529776E-01	1,7622840E+02	-1,8536604E+01	-1,4720781E+02
10	1,9824000E+03	7,6583332E-01	2,8526686E+01	-1,5640165E+02	-9,6608032E+01	3,5005879E+03	4,6421203E+02
11	1,7989452E+02	2,2138926E+03	2,3372733E+09	2,6478513E+11	8,1972106E+02	1,2448799E+04	9,3875494E+04

1	3,5357861E+02	3,4448539E+05	1,1550355E+04	3,5939527E-02	9,4264018E+01	-7,5122745E+01	2,8291169E+01
2	2,1000000E+02	8,9397451E+05	1,2912759E+04	3,2147607E-02	9,3813424E+01	-7,3645459E+01	7,2973780E+00
3	2,1000000E+02	2,7809345E+04	7,9200027E+03	0,	0,	2,8783273E+02	2,8774042E+02
4	1,7221199E+01	3,5706128E-04	4,4113145E-10	9,5874699E+02	1,2047345E+01	6,0351789E-01	3,5454551E-01
5	3,0743941E+01	-1,7593290E+00	0,	2,9425830E-02	-4,4824204E+03	6,0735832E+01	3,5680162E+01
6	1,3957496E+06	8,2056347E-01	3,3506285E+03	-8,5462472E+01	2,0714588E+03	-7,7027468E+02	0,
7	0,	0,	0,	3,8328641E-01	0,	3,0763817E+01	9,3364750E+01
8	1,1323402E+01	1,5314064E+00	-3,0647442E-01	1,5617721E+00	5,3155152E+01	-8,5386890E+01	-2,2440772E+01
9	2,6189719E+01	9,8266650E+02	4,6566317E+02	1,3531386E-01	1,7609482E+02	-1,9083436E+01	-1,4809633E+02
10	2,0025946E+03	7,4805018E-01	2,8525959E+01	-1,5564006E+02	-9,7033152E+01	3,5006358E+03	5,0455334E+02
11	1,7998917E+02	2,2478078E+03	2,3137038E+09	2,7465723E+11	8,8198455E+02	1,2912756E+04	8,9589849E+04

(46)

1	3,6357861E+02	3,4423763E+05	1,2033720E+04	-2,6680990E-01	9,4450607E+01	-7,4763148E+01	2.8267034E+01
2	2,2000000E+02	6,6300245E+05	1,3396086E+04	-2,3967549E-01	9,3997199E+01	-7,3244080E+01	7.8564628E+00
3	2,2000000E+02	2,6845881E+04	8,4308026E+03	0,	0,	3,0692277E+02	3.0682247E+02
4	1,8159654E+01	3,6039067E-04	4,4633838E-10	9,5855879E+02	1,2553972E+01	5,7355454E-01	3.3396644E-01
5	3,0087943E+01	-1,8514958E+00	0,	3,2317225E-02	-4,1673691E+03	6,3392064E+01	3.6911611E+01
6	1,3957496E+06	8,1557304E-01	3,3608784E+03	-8,9788137E+01	2,0631268E+03	-7,6699148E+02	0.
7	0,	0,	0,	3,9948515E-01	0,	2,9803803E+01	9.3522520E+01
8	1,1226900E+01	1,5868979E+00	-3,1479860E-01	1,6178205E+00	5,2403673E+01	-8,5188317E+01	-2.2654491E+01
9	2,6044982E+01	9,8201828E+02	4,9391136E+02	1,3533053E-01	1,7595320E+02	-1,9650497E+01	-1.4898577E+02
10	2,0248238E+03	7,2884483E-01	2,8525157E+01	-1,5485056E+02	-9,7297454E+01	3,5006062E+03	5.4904145E+02
11	-1,7991083E+02	2,2853382E+03	2,2883031E+09	2,8493193E+11	9,4920747E+02	1,3305925E+04	8.5410417E+04
1	3,7357861E+02	3,4338039E+05	1,2537986E+04	-5,2368881E-01	9,4643470E+01	-7,4388676E+01	2.8240801E+01
2	2,3000000E+02	8,3203039E+05	1,3900250E+04	-4,7236460E-01	9,4187508E+01	-7,2827827E+01	8.4442295E+00
3	2,3000000E+02	2,5882416E+04	8,9602735E+03	0,	0,	3,2681228E+02	3.2670350E+02
4	1,9725120E+01	3,7206620E-04	4,6488410E-10	9,5802931E+02	1,3087268E+01	5,4321855E-01	3.1386658E-01
5	2,9380520E+01	-1,9570064E+00	0,	3,6540145E-02	-3,7927732E+03	6,7884594E+01	3.9225598E+01
6	1,3957496E+06	8,1096754E-01	3,3607624E+03	-9,4258026E+01	2,0552262E+03	-7,6369906E+02	0.
7	0,	0,	0,	4,1672696E-01	0,	2,8838017E+01	9.3683490E+01
8	1,1126034E+01	1,6465390E+00	-3,2361364E-01	1,6780394E+00	5,1739410E+01	-8,4978329E+01	-2.2961928E+01
9	2,5895501E+01	9,7985164E+02	5,2145015E+02	1,3534823E-01	1,7579918E+02	-2,0236628E+01	-1.4987435E+02
10	2,0493782E+03	7,0608046E-01	2,8524270E+01	-1,5403204E+02	-9,7547181E+01	3,5005028E+03	5.9825392E+02
11	-1,7980525E+02	2,3270342E+03	2,2608861E+09	2,9563602E+11	1,0218652E+03	1,3899583E+04	8.1329280E+04
1	3,8357861E+02	3,4196256E+05	1,3064462E+04	-7,3721833E-01	9,4842844E+01	-7,3998698E+01	2.8212290E+01
2	2,4000000E+02	8,0105833E+05	1,4426576E+04	-6,6760907E-01	9,4384590E+01	-7,2396069E+01	9.0618713E+00
3	2,4000000E+02	2,4918952E+04	9,5098324E+03	0,	0,	3,4753641E+02	3.4741865E+02
4	2,2014822E+01	3,9197302E-04	4,9747538E-10	9,5749878E+02	1,3644364E+01	5,1283590E-01	2.9456639E-01
5	2,8624607E+01	-2,0735921E+00	0,	4,2454591E-02	-3,3475449E+03	7,4461056E+01	4.2769479E+01
6	1,3957496E+06	8,0671334E-01	3,3499040E+03	-9,8878787E+01	2,0477323E+03	-7,6027962E+02	0.
7	0,	0,	0,	4,3513332E-01	0,	2,7866914E+01	9.3849618E+01
8	1,1020507E+01	1,7108118E+00	-3,3296715E-01	1,7429125E+00	5,1125865E+01	-8,4757456E+01	-2.3326164E+01
9	2,5741830E+01	9,7640845E+02	5,4814544E+02	1,3536747E-01	1,7563457E+02	-2,0844369E+01	-1.5076172E+02
10	2,0766039E+03	6,8560281E-01	2,8523288E+01	-1,5318330E+02	-9,7804262E+01	3,5003294E+03	6.5287843E+02
11	-1,7969383E+02	2,3735595E+03	2,2312443E+09	3,0679928E+11	1,1004937E+03	1,4425148E+04	7.7338459E+04
1	3,9357861E+02	3,4003664E+05	1,3614630E+04	-9,0967710E-01	9,5048913E+01	-7,3592543E+01	2.8181313E+01
2	2,5000000E+02	7,7008627E+05	1,4976560E+04	-8,2694739E-01	9,4588644E+01	-7,1948133E+01	9.7106472E+00
3	2,5000000E+02	2,3955487E+04	1,0081064E+04	0,	0,	3,6913273E+02	3.6900547E+02
4	2,5189204E+01	4,2043767E-04	5,4597334E-10	9,5725640E+02	1,4222554E+01	4,8268276E-01	2.7620371E-01
5	2,7822884E+01	-2,2182487E+00	0,	5,0600308E-02	-2,8153694E+03	8,3529725E+01	4.7797895E+01
6	1,3957496E+06	8,0277968E-01	3,3279005E+03	-1,0365767E+02	2,0406155E+03	-7,5685518E+02	0.
7	0,	0,	0,	4,5484530E-01	0,	2,6890550E+01	9.4013770E+01
8	1,0909997E+01	1,7802764E+00	-3,4291332E-01	1,8130013E+00	5,0716895E+01	-8,4518778E+01	-2.3901486E+01
9	2,5584648E+01	9,7191742E+02	5,7387086E+02	1,3538882E-01	1,7544329E+02	-2,1466821E+01	-1.5164270E+02
10	2,1069178E+03	6,6123717E-01	2,8522191E+01	-1,5230317E+02	-9,8068877E+01	3,5000902E+03	7.1374546E+02
11	-1,7957629E+02	2,4257220E+03	2,1991416E+09	3,1845498E+11	1,1857005E+03	1,4974201E+04	7.3431016E+04

97

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
1	4.0357861E+02	3.3765917E+05	1.4190172E+04	-1.0431125E+00	9.5261878E+01	-7.3169492E+01	2.8147663E+01
2	2.6000000E+02	7.3911421E+05	1.5551894E+04	-9.5176897E-01	9.4799882E+01	-7.1483301E+01	1.0391816E+01
3	2.6000000E+02	2.2992023E+04	1.0675747E+04	0.	0.	3.9164154E+02	3.9150425E+02
4	2.9498619E+01	4.5840613E-04	6.1351455E-10	9.5731925E+02	1.4822821E+01	4.5291061E-01	2.5889323E-01
5	2.6977931E+01	-2.3779729E+00	0.	6.1768949E-02	-2.1730463E+03	9.5677278E+01	5.4691145E+01
6	1.3957496E+06	7.9913858E-01	3.2943211E+03	-1.0860259E+02	2.0338387E-03	-7.5338753E+02	0.
7	0.	0.	0.	4.7602782E-01	0.	2.5909705E+01	9.4183363E+01
8	1.0794155E+01	1.8555865E+00	-3.5351433E-01	1.8889610E+00	5.0361913E+01	-8.4266708E+01	-2.4536360E+01
9	2.5424817E+01	9.6659545E+02	5.9850824E+02	1.3541295E-01	1.7523680E+02	-2.2112211E+01	-1.5251914E+02
10	2.1408262E+03	6.3478473E-01	2.8520957E+01	-1.5139041E+02	-9.8341222E+01	3.4997900E+03	7.8186243E+02
11	-1.7945231E+02	2.4845157E+03	2.1643095E+09	3.3064047E+11	1.2781768E+03	1.5548513E+04	6.9598601E+04
1	4.1357861E+02	3.3489128E+05	1.4792999E+04	-1.1393474E+00	9.5482081E+01	-7.2728775E+01	2.8111114E+01
2	2.7000000E+02	7.0814215E+05	1.6154497E+04	-1.0433123E+00	9.5018651E+01	-7.1000802E+01	1.1106694E+01
3	2.7000000E+02	2.2028558E+04	1.1295892E+04	0.	0.	4.1510615E+02	4.1495826E+02
4	3.5321251E+01	5.0767645E-04	7.0470193E-10	9.5733857E+02	1.5452212E+01	4.2353638E-01	2.4263433E-01
5	2.6092122E+01	-2.5513974E+00	0.	7.7105950E-02	-1.3886482E+03	1.1168754E+02	6.3983242E+01
6	1.3957496E+06	7.9576473E-01	3.2487047E+03	-1.1372222E+02	2.0273540E-03	-7.4987819E+02	0.
7	0.	0.	0.	4.9887478E-01	0.	2.4924963E+01	9.4360236E+01
8	1.0672606E+01	1.9375101E+00	-3.6484189E-01	1.9715615E+00	5.0036010E+01	-8.4001105E+01	-2.5205382E+01
9	2.5263478E+01	9.6064899E+02	6.2194810E+02	1.3544071E-01	1.7501589E+02	-2.2783011E+01	-1.5339012E+02
10	2.1789504E+03	6.0601815E-01	2.8519580E+01	-1.5044343E+02	-9.8621718E+01	3.4994339E+03	8.5846692E+02
11	-1.7932156E+02	2.5511773E+03	2.1264415E+09	3.4339784E+11	1.3787135E+03	1.6150077E+04	6.5833787E+04
1	4.2357861E+02	3.3179936E+05	1.5425289E+04	-1.1999576E+00	9.5710549E+01	-7.2269564E+01	2.8071418E+01
2	2.8000000E+02	6.7717009E+05	1.6786557E+04	-1.1026372E+00	9.5245929E+01	-7.0499811E+01	1.1856779E+01
3	2.8000000E+02	2.1065094E+04	1.1943775E+04	0.	0.	4.3957328E+02	4.3941421E+02
4	4.3208816E+01	5.7107188E-04	8.2577259E-10	9.5667871E+02	1.6123792E+01	3.9451632E-01	2.2738643E-01
5	2.5168142E+01	-2.6163478E+00	0.	9.8241974E-02	-4.1970791E+02	1.3255257E+02	7.6399009E+01
6	1.3957496E+06	7.9263538E-01	3.1905581E+03	-1.1902603E+02	2.0210972E-03	-7.4632835E+02	0.
7	0.	0.	0.	5.2361579E-01	0.	2.3940123E+01	9.4598195E+01
8	1.0544944E+01	2.0269555E+00	-3.7697937E-01	2.0617134E+00	4.8708944E+01	-8.3770458E+01	-2.4871242E+01
9	2.5102168E+01	9.5427532E+02	6.4409069E+02	1.3547321E-01	1.7489780E+02	-2.3536735E+01	-1.5428861E+02
10	2.2220618E+03	5.7467605E-01	2.8518154E+01	-1.4945927E+02	-9.8911932E+01	3.4990275E+03	9.4509611E+02
11	-1.7918369E+02	2.6272647E+03	2.0851853E+09	3.5677478E+11	1.4882202E+03	1.6781147E+04	6.2128808E+04

(48)

CASE, 1 SD SOLUTION PAGE 18 DATE 10273

1	4,3357861E+02	3,2845591E+05	1,6089540E+04	-1,2262994E+00	9,5948654E+01	-7,1780968E+01	2,8028294E+01
2	2,9000000E+02	6,4619803E+05	1,7450574E+04	-1,1306429E+00	9,5483026E+01	-6,9979434E+01	1,2644118E+01
3	2,9000000E+02	2,0101629E+04	1,2621995E+04	0,	0,	4,6509347E+02	4,6492261E+02
4	5,3930972E+01	6,5252973E-04	9,8459028E-10	9,5464091E+02	1,6854024E+01	3,6582516E-01	2,1312000E+01
5	2,4207670E+01	-2,6354165E+00	0,	1,2744207E-01	7,8753220E+02	1,5944559E+02	9,2888752E+01
6	1,3957496E+06	7,8973020E-01	3,1193544E+03	-1,2452437E+02	2,0149800E+03	-7,4273884E+02	0,
7	0,	0,	0,	5,5052472E-01	0,	2,2954129E+01	9,4868332E+01
8	1,0410729E+01	2,1250050E+00	-3,9002451E-01	2,1605012E+00	4,6989890E+01	-8,3547410E+01	-2,4145441E+01
9	2,4942991E+01	9,4766395E+02	6,6484604E+02	1,3551194E-01	1,7482509E+02	-2,4344014E+01	-1,5519921E+02
10	2,2711306E+03	5,4045606E-01	2,8516841E+01	-1,4843421E+02	-9,9214028E+01	3,4985770E+03	1,0436843E+03
11	-1,7903830E+02	2,7147685E+03	2,0401339E+09	3,7082567E+11	1,6077498E+03	1,7444286E+04	5,8475707E+04
1	4,4357861E+02	3,2494034E+05	1,6788630E+04	-1,2195455E+00	9,6197850E+01	-7,1292023E+01	2,7981425E+01
2	3,0000000E+02	6,1522597E+05	1,8149428E+04	-1,1280947E+00	9,5731343E+01	-6,9438708E+01	1,3471338E+01
3	3,0000000E+02	1,9138165E+04	1,3333533E+04	0,	0,	4,9172166E+02	4,9153835E+02
4	6,8499690E+01	7,5692431E-04	1,1902345E-09	9,5073796E+02	1,7658525E+01	3,3756668E-01	1,9987026E+01
5	2,3212614E+01	-2,4957468E+00	0,	1,6773861E-01	2,2972143E+03	1,9365054E+02	1,1465878E+02
6	1,3957496E+06	7,8703105E-01	3,0345337E+03	-1,3022857E+02	2,0088802E+03	-7,3911005E+02	0,
7	0,	0,	0,	5,7993085E-01	0,	2,1969763E+01	9,5214428E+01
8	1,0269482E+01	2,2329581E+00	-4,0409291E-01	2,2692274E+00	4,4009566E+01	-8,3369815E+01	-2,2151603E+01
9	2,4788843E+01	9,4099766E+02	6,8413369E+02	1,3555890E-01	1,7491142E+02	-2,5252755E+01	-1,5615861E+02
10	2,3273953E+03	5,0300601E-01	2,8515834E+01	-1,4736426E+02	-9,9530294E+01	3,4980892E+03	1,1567015E+03
11	-1,7888496E+02	2,8162737E+03	1,9908138E+09	3,8561290E+11	1,7385293E+03	1,8142433E+04	5,4866229E+04
1	4,5357861E+02	3,2134007E+05	1,7525890E+04	-1,1806906E+00	9,6460091E+01	-7,0771682E+01	2,7930449E+01
2	3,1000000E+02	5,8425391E+05	1,8886454E+04	-1,0956240E+00	9,5992762E+01	-6,8876586E+01	1,4341989E+01
3	3,1000000E+02	1,8174700E+04	1,4081832E+04	0,	0,	5,1951778E+02	5,1932128E+02
4	8,8139232E+01	8,8950057E-04	1,4518432E-09	9,4490005E+02	1,8547878E+01	3,0998283E-01	1,8773058E-01
5	2,2183886E+01	-2,2003635E+00	0,	2,2297179E-01	4,1785105E+03	2,3638160E+02	1,4315649E+02
6	1,3957496E+06	7,8452185E-01	2,9355042E+03	-1,3615112E+02	2,0026275E+03	-7,3544151E+02	0,
7	0,	0,	0,	6,1223354E-01	0,	2,0985970E+01	9,5629452E+01
8	1,0120675E+01	2,3523697E+00	-4,1932270E-01	2,3894704E+00	3,9853590E+01	-8,3220026E+01	-1,8974558E+01
9	2,4643694E+01	9,3445362E+02	7,0188283E+02	1,3561679E-01	1,7516087E+02	-2,6257016E+01	-1,5717372E+02
10	2,3924627E+03	4,6191272E-01	2,8515440E+01	-1,4624434E+02	-9,9863835E+01	3,4975717E+03	1,2873538E+03
11	-1,7872316E+02	2,9351979E+03	1,9366699E+09	4,0120859E+11	1,8819988E+03	1,8878977E+04	5,1291709E+04
1	4,6357861E+02	3,1775129E+05	1,8305215E+04	-1,1107970E+00	9,6732819E+01	-7,0228803E+01	2,7874969E+01
2	3,2000000E+02	5,5328185E+05	1,9665554E+04	-1,0339504E+00	9,6264991E+01	-6,8291925E+01	1,5259958E+01
3	3,2000000E+02	1,7211236E+04	1,4870900E+04	0,	0,	5,4854754E+02	5,4833704E+02
4	1,1414466E+02	1,0547039E-03	1,7763501E-09	9,3752298E+02	1,9525084E+01	2,8351581E-01	1,7685695E-01
5	2,1128185E+01	-2,7159137E+00	0,	2,9761048E-01	6,4973025E+03	2,8897028E+02	1,8000992E+02
6	1,3957495E+06	7,8218885E-01	2,8216483E+03	-1,4230591E+02	1,9959874E+03	-7,3173328E+02	0,
7	0,	0,	0,	6,4792196E-01	0,	1,9992521E+01	9,5754171E+01
8	9,9637189E+00	2,4852264E+00	-4,3588067E-01	2,5231611E+00	4,2039207E+01	-8,2791388E+01	-2,2181571E+01
9	2,4512922E+01	9,2820374E+02	7,1803143E+02	1,3568913E-01	1,7458998E+02	-2,6970966E+01	-1,5790893E+02
10	2,4684590E+03	4,1668682E-01	2,8515166E+01	-1,4507784E+02	-1,0020980E+02	3,4970333E+03	1,4398847E+03
11	-1,7855195E+02	3,0761570E+03	1,8770458E+09	4,1769697E+11	2,0398656E+03	1,9657868E+04	4,7742864E+04

(49)

CASE, 1 SD SOLUTION PAGE 19 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	FE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST THC	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY

1	4,7357861E+02	3,1427671E+05	1,9131324E+04	-1,0130190E+00	9,7015014E+01	-6.9662124E+01	2.7814560E+01
2	3,3000000E+02	5,2230979E+05	2,0491459E+04	-9,4577283E-01	9,6547145E+01	-6.7683466E+01	1.6227487E+01
3	3,3000000E+02	1,6247771E+04	1,5705435E+04	0,	0,	5.7888347E+02	5.7865813E+02
4	1,4760283E+02	1,2543979E-03	2,1652190E-09	9,2934147E+02	2,0585893E+01	2.5726339E-01	1.6693620E-01
5	1,9962450E+01	-2,8490771E+00	0,	3,9624328E-01	9,2317761E+03	3.4863101E+02	2.2622393E+02
6	1,3957495E+06	7,6002683E-01	2,6923328E+03	-1,4870871E+02	1,9886472E+03	-7.2798271E+02	0.
7	0,	0,	0,	6,8759903E-01	0,	1.8923709E+01	9.6042681E+01
8	9,7978744E+00	2,6338507E+00	-4,5397174E-01	2,6726878E+00	4,1086221E+01	-8.2478008E+01	-2.2311425E+01
9	2,4403426E+01	9,2240955E+02	7,3238891E+02	1,3578036E-01	1,7441430E+02	-2.7887212E+01	-1.5885124E+02
10	2,5582732E+03	3,6673712E-01	2,8514744E+01	-1,4386512E+02	-1,0056169E+02	3.4964869E+03	1.6200594E+03
11	-1,7836613E+02	3,2455627E+03	1,8111477E+09	4,3517959E+11	2,2141954E+03	2.0483844E+04	4.4209176E+04

1	4,8357861E+02	3,1102786E+05	2,0009515E+04	-8,8575527E-01	9,7308651E+01	-6.9070252E+01	2.7748761E+01
2	3,4000000E+02	4,9133773E+05	2,1369463E+04	-8,2938193E-01	9,6841129E+01	-6.7049812E+01	1.7247650E+01
3	3,4000000E+02	1,5284307E+04	1,6590999E+04	0,	0,	6.1060610E+02	6.1036501E+02
4	1,8889176E+02	1,4851443E-03	2,6096879E-09	9,2121420E+02	2,1720806E+01	2.3381531E-01	1.5879158E-01
5	1,8839775E+01	-3,0015359E+00	0,	5,2243431E-01	1,2454882E+04	4.1776374E+02	2.8371694E+02
6	1,3957495E+06	7,7802025E-01	2,5469207E+03	-1,5537705E+02	1,9801970E+03	-7.2418728E+02	0.
7	0,	0,	0,	7,3202703E-01	0,	1.7927203E+01	9.6339783E+01
8	9,6224017E+00	2,3012490E+00	-4,7304606E-01	2,8410431E+00	4,0288415E+01	-8.2145165E+01	-2.2526109E+01
9	2,4324520E+01	9,1722510E+02	7,4505910E+02	1,3589564E-01	1,7421026E+02	-2.8833593E+01	-1.5970438E+02
10	2,6658747E+03	3,1136685E-01	2,8514449E+01	-1,4260061E+02	-1,0092239E+02	3.4959397E+03	1.8358097E+03
11	-1,7816483E+02	3,4524646E+03	1,7380451E+09	4,5377073E+11	2,4074200E+03	2.1362270E+04	4.0680255E+04

1	4,9357861E+02	3,0818366E+05	2,0942600E+04	-6,8349926E-01	9,7612538E+01	-6.8451660E+01	2.7677042E+01
2	3,5000000E+02	4,6039296E+05	2,2302406E+04	-6,4182366E-01	9,7145830E+01	-6.6389440E+01	1.8323786E+01
3	3,5000000E+02	1,4321691E+04	1,7533384E+04	0,	0,	6.4380394E+02	6.4354617E+02
4	2,3612723E+02	1,7296604E-03	3,0753516E-09	9,1405757E+02	2,2911686E+01	2.4410542E-01	1.6118981E-01
5	1,9913913E+01	-3,0520314E+00	0,	6,7441308E-01	1,8859499E+04	5.6302737E+02	3.7178312E+02
6	1,3810732E+06	7,7604665E-01	2,3847664E+03	-1,6233088E+02	1,9700450E+03	-7.2034308E+02	0.
7	0,	0,	0,	7,8210154E-01	0,	1.9200975E+01	9.6573427E+01
8	9,4393518E+00	2,9596220E+00	-4,9054805E-01	3,0000000E+00	4,1044766E+01	-8.1835660E+01	-2.2017433E+01
9	2,4294008E+01	9,1288404E+02	7,5876684E+02	1,3603997E-01	1,7384058E+02	-2.9643266E+01	-1.5820619E+02
10	2,7964106E+03	2,4993075E-01	2,8513904E+01	-1,4128476E+02	-1,0141526E+02	3.4953196E+03	2.0975016E+03
11	-1,7807301E+02	3,7091213E+03	1,6569136E+09	4,7353783E+11	2,6217318E+03	2.2296805E+04	3.7155892E+04

(50)

1	5,0357861E+02	3,0610986E+05	2,1896545E+04	-4,3543584E-01	9,7930124E+01	-6,7805249E+01	2,7598895E+01
2	3,6000000E+02	4,3074355E+05	2,3256245E+04	-4,0997720E-01	9,7463733E+01	-6,5701248E+01	1,9457751E+01
3	3,6000000E+02	1,3399371E+04	1,8497687E+04	0,	0,	6,7854370E+02	6,7826828E+02
4	2,8102444E+02	1,9373868E-03	3,4670729E-09	9,0897541E+02	2,4089260E+01	2,0963773E-01	1,5089483E-01
5	1,7724539E+01	-2,8189698E+00	0,	8,3115911E-01	2,0983610E+04	5,9590871E+02	4,2892823E+02
6	1,2922028E+06	7,7415009E-01	2,2055255E+03	-1,6958796E+02	1,9576740E+03	-7,1644669E+02	0,
7	0,	0,	0,	8,3603150E-01	0,	1,7266945E+01	9,7072228E+01
8	9,2501827E+00	2,9612528E+00	-4,8060582E-01	3,0000000E+00	3,6783563E+01	-8,1606975E+01	-1,9689885E+01
9	2,4320196E+01	9,0985599E+02	7,7221490E+02	1,3621634E-01	1,7415340E+02	-3,0906145E+01	-1,6019104E+02
10	2,9507258E+03	1,6435800E-01	2,8513592E+01	-1,3991111E+02	-1,0214013E+02	3,4947158E+03	2,4087399E+03
11	-1,7818563E+02	4,0203412E+03	1,5702613E+09	4,9376041E+11	2,8504370E+03	2,3253014E+04	3,3764883E+04

1	5,1357861E+02	3,0480606E+05	2,2855036E+04	-2,4404713E-01	9,8267392E+01	-6,7130946E+01	2,7513832E+01
2	3,7000000E+02	4,0300198E+05	2,4214627E+04	-2,3034442E-01	9,7800214E+01	-6,4985164E+01	2,0653978E+01
3	3,7000000E+02	1,2536399E+04	1,9462047E+04	0,	0,	7,1483827E+02	7,1454412E+02
4	3,1815973E+02	2,0823346E-03	3,7384999E-09	9,0588737E+02	2,5229446E+01	1,6973056E-01	1,4115240E-01
5	1,4991264E+01	-2,4461305E+00	0,	9,7640774E-01	2,0506658E+04	5,6678370E+02	4,7135227E+02
6	1,2090548E+06	7,7251766E-01	2,0099171E+03	-1,7715173E+02	1,9425216E+03	-7,1249629E+02	0,
7	0,	0,	0,	8,9359274E-01	0,	1,4733236E+01	9,7634827E+01
8	9,0598676E+00	2,9628344E+00	-4,7075722E-01	3,0000000E+00	3,1135856E+01	-8,1390734E+01	-1,6565450E+01
9	2,4387378E+01	9,0803262E+02	7,7993563E+02	1,3642420E-01	1,7474652E+02	-3,2289682E+01	-1,6290414E+02
10	3,1318812E+03	1,1572591E-01	2,8514881E+01	-1,3846839E+02	-1,0284382E+02	3,4943210E+03	2,7694414E+03
11	-1,7823952E+02	4,3962011E+03	1,4794337E+09	5,1408555E+11	3,0899375E+03	2,4212935E+04	3,0550482E+04

1	5,2357861E+02	3,0410734E+05	2,3816928E+04	-1,0508180E-01	9,8623048E+01	-6,6428845E+01	2,7421342E+01
2	3,8000000E+02	3,7704552E+05	2,5176409E+04	-9,9407566E-02	9,8154155E+01	-6,4241282E+01	2,1918197E+01
3	3,8000000E+02	1,1728958E+04	2,0426467E+04	0,	0,	7,5269285E+02	7,5237875E+02
4	3,4627925E+02	2,1649443E-03	3,8925411E-09	9,0427573E+02	2,6338126E+01	1,4043897E-01	1,3547817E-01
5	1,2910161E+01	-1,9777528E+00	0,	1,1040143E+00	1,9583432E+04	5,3025947E+02	5,1152884E+02
6	1,1312496E+06	7,7110304E-01	1,7990259E+03	-1,8502271E+02	1,9242590E+03	-7,0848920E+02	0,
7	0,	0,	0,	9,5501999E-01	0,	1,2797256E+01	9,8181256E+01
8	8,8707670E+00	2,9643696E+00	-4,6099119E-01	3,0000000E+00	2,5631141E+01	-8,1158262E+01	-1,2975184E+01
9	2,4492394E+01	9,0709492E+02	7,8339927E+02	1,3665984E-01	1,7541833E+02	-3,3657573E+01	-1,6506713E+02
10	3,3465968E+03	4,4076869E-02	2,8517677E+01	-1,3695872E+02	-1,0313353E+02	3,4941043E+03	3,1990893E+03
11	-1,7784350E+02	4,8559556E+03	1,3845142E+09	5,3449047E+11	3,3400951E+03	2,5175549E+04	2,7497199E+04

1	5,3049221E+02	3,0394311E+05	2,4482198E+04	-1,0122561E-03	9,8877542E+01	-6,5927272E+01	2,7352792E+01
2	3,8691359E+02	3,6008358E+05	2,5841612E+04	-9,5900569E-04	9,8407056E+01	-6,3710823E+01	2,2834400E+01
3	3,8691359E+02	1,1201313E+04	2,1093080E+04	0,	0,	7,7977727E+02	7,7944960E+02
4	3,5960316E+02	2,1848810E-03	3,9296490E-09	9,0390178E+02	2,7085020E+01	1,4636694E-01	1,3674159E-01
5	1,3295144E+01	-1,5950166E+00	0,	1,1776726E+00	2,2550093E+04	5,8951341E+02	5,5074594E+02
6	1,0803933E+06	7,7017801E-01	1,6447132E+03	-1,9065172E+02	1,9095380E+03	-7,0568030E+02	0,
7	0,	0,	0,	1,0000000E+00	0,	1,3288886E+01	9,8510785E+01
8	8,7462042E+00	2,9654041E+00	-4,5428892E-01	3,0000000E+00	2,3398522E+01	-8,0981467E+01	-1,0228214E+01
9	2,4593052E+01	9,0688165E+02	7,8510651E+02	1,3683626E-01	1,7566799E+02	-3,4500264E+01	-1,6463148E+02
10	3,5190640E+03	7,1328288E-03	2,8520057E+01	-1,3587986E+02	7,4082843E+01	3,5441649E+03	3,4939631E+03
11	-1,3540869E-01	5,2361294E+03	1,3166600E+09	5,4860920E+11	3,5188850E+03	2,5475576E+04	2,5841613E+04

End of Steepest Descent Trajectory Solution

51

MAXIMUM NUMBER OF ITERATIONS= 10 DESIRED ACCURACY= 5.000000E-02
ADAMS-MOULTON INNER LOOPS= 1

****BOUNDARY CONDITIONS****

STATE INITIAL CONDITIONS

1	0	0	0	0	0
1	0	0	0	0	0
1	0	0	0	0	0
1	0	0	0	0	0
1	0	0	0	0	0
1	0	0	0	0	0
1	0	0	5	0	1
1	2	4	1	4	4
1	0	0	0	0	0

See Section 2.10.5 of the User's Manual for a description of the QL output.

COSTATE INITIAL CONDITIONS

2	0	0	0	0	0
2	0	0	0	0	0
2	0	0	0	0	0
2	0	0	0	0	0
2	0	0	0	0	0
2	0	0	0	0	0
2	0	0	2	0	2
1	1	1	1	1	1
2	0	0	0	0	0

STATE TARGET CONDITIONS

0	0	9	0	5	4
0	0	0	0	0	3
0	0	0	0	0	18
0	0	0	0	0	2
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0

COSTATE TARGET CONDITIONS

0	9	7	0	8	1
0	0	0	0	0	2
0	0	0	0	0	3
0	0	0	0	0	4
0	0	0	0	0	5
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0

****INITIAL ARC DATA****

****THE INITIAL ARC IS ON UNIT 11****

THE ABOVE ITERATION TOOK 4.601 SECONDS.

(52)

CASE 1 CL ITERATION NO 1 PAGE 1 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
1	0,	0,	1,0000000E-01	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	0,	5,5058348E+06	1,3407534E+03	4,2734018E-03	9,0000000E+01	-8,0561000E+01	-9,2236069E-08
3	RRRRR	1,7127296E+05	RRRRR	0,	0,	5,0281868E-04	-2,2889924E-07
4	-4,3643312E-05	2,1241290E+03	2,2964064E-03	1,1416733E+03	8,7590730E-05	8,9955098E-02	8,5244220E-02
5	3,0622634E+00	8,9984272E+01	0,	1,1482032E-05	2,9787848E+06	3,5324062E-03	3,3474168E-03
6	1,1096869E+06	3,6090622E+00	1,5444087E+03	-1,3230640E+01	4,6081660E-02	-8,5364605E+02	0,
7	6,6188427E+06	9,1700000E-01	0,	6,3500931E-03	0,	9,0000840E+01	9,3062263E+01
8	1,6381786E+01	1,3949925E+00	-7,6082931E-02	1,3970658E+00	-8,6937737E+01	-1,5727705E-02	-1,8000000E+02
1	1,2000000E+01	9,1798502E+02	1,5222019E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	1,2000000E+01	5,1499383E+06	1,3494252E+03	6,4769635E+00	9,0000000E+01	-8,0510863E+01	-9,2236069E-08
3	RRRRR	1,6020190E+05	RRRRR	0,	0,	5,0281868E-04	-2,2889924E-07
4	-6,4832722E-02	2,0573615E+03	2,2410577E-03	1,1337219E+03	1,3426590E-01	9,3002554E-02	1,6575257E-02
5	3,1288300E+00	6,7323797E+01	0,	2,5963758E+01	2,5865275E+06	8,2582597E+03	1,6494095E+03
6	1,1106786E+06	3,0992811E+00	1,5447947E+03	-1,3230640E+01	3,9229768E-02	-8,4989262E+02	0,
7	6,0606680E+06	9,1700000E-01	0,	1,7189429E-02	0,	9,1205725E+01	9,2886753E+01
8	1,6041578E+01	1,3842188E+00	-7,7241462E-02	1,3863722E+00	-8,6871170E+01	-2,2676203E+01	-1,8000000E+02
1	1,2000000E+01	9,1798502E+02	1,5222019E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	0,	5,1499383E+06	1,3494252E+03	6,4769635E+00	9,0000000E+01	-8,0510863E+01	-9,2236069E-08
3	RRRRR	1,6020190E+05	RRRRR	0,	0,	5,0281868E-04	-2,2889924E-07
4	-6,4632722E-02	2,0573615E+03	2,2410577E-03	1,1337219E+03	1,3426590E-01	5,3457270E-02	1,6554854E-02
5	2,4167411E+00	4,2343476E+00	0,	2,5963758E+01	2,6590227E+06	4,7467946E+03	1,4700057E+03
6	1,1106786E+06	3,0992811E+00	1,5447947E+03	-1,3230640E+01	3,9229768E-02	-8,4989262E+02	0,
7	6,0606680E+06	9,1700000E-01	0,	1,7189429E-02	0,	9,2410140E+01	9,0178390E+01
8	1,6090291E+01	1,3841536E+00	-7,8104650E-02	1,3863555E+00	-8,7583259E+01	-8,5765652E+01	-1,8000000E+02
1	3,8274269E+01	9,0575609E+03	4,6364886E+02	8,3956918E+01	9,0000000E+01	-8,0559438E+01	2,8521000E+01
2	2,6274269E+01	4,4631253E+06	1,4646128E+03	1,8349246E+01	9,0000000E+01	-8,0399525E+01	-6,2895693E-07
3	RRRRR	1,3883684E+05	RRRRR	0,	0,	8,2482694E-02	8,2480613E-02
4	-1,5439003E-01	1,5340156E+03	1,7521089E-03	1,1042244E+03	4,1988647E-01	1,6381616E-01	7,7128918E-02
5	4,3778880E+00	-1,9806135E+00	0,	1,8832566E+02	-1,8676853E+05	1,0550969E+05	4,9676711E+04
6	1,1891592E+06	2,3343369E+00	1,6338896E+03	-1,3399502E+01	2,6390713E-02	-8,4320705E+02	0,
7	4,9502283E+06	9,1700000E-01	0,	3,8172665E-02	0,	8,8332186E+01	8,9848841E+01
8	1,4078593E+01	1,3509508E+00	-5,8142128E-02	1,3522014E+00	9,4377888E+01	-8,8019386E+01	-6,0430819E+00

(53)

CASE 1 GL ITERATION NO 1 PAGE 2 DATE 10273

1	3,8274269E+01	9,0575609E+03	4,6364886E+02	8,3956918E+01	9,0000000E+01	-8,0559438E+01	2,8521000E+01
2	0,	4,4631253E+06	1,4646128E+03	1,8349246E+01	9,0000000E+01	-8,0399525E+01	-6,2895693E-07
3	RRRRR	1,3883684E+05	RRRRR	0,	0,	8,2482694E-02	8,2480613E-02
4	-1,5439003E-01	1,5340158E+03	1,7521089E-03	1,1042244E+03	4,1988647E-01	8,2278698E-02	7,0192550E-02
5	2,9245578E+00	0,	0,	1,8832566E+02	1,2863303E+06	5,2993549E+04	4,5209178E+04
6	1,1891592E+06	2,3343369E+00	1,6338696E+03	-1,3399502E+01	2,6390713E-02	-8,4320705E+02	0,
7	5,6377111E+06	9,1700000E-01	0,	3,8172665E-02	0,	8,6881476E+01	9,0000000E+01
8	1,5003997E+01	1,5036697E+00	-7,6818787E-02	1,5056307E+00	8,6881476E+01	-8,9999993E+01	0,

1	6,9003009E+01	3,0496154E+04	1,0199553E+03	6,5796830E+01	9,0751167E+01	-8,0541018E+01	2,8520835E+01
2	3,0728739E+01	3,7205139E+06	1,9914822E+03	2,7848730E+01	9,0178378E+01	-8,0252717E+01	9,8219802E-03
3	RRRRR	1,1573602E+05	RRRRR	0,	0,	1,0553429E+00	1,0552971E+00
4	-1,7255304E-01	6,5316596E+02	8,9016912E-04	1,0115492E+03	1,0083101E+00	6,3983537E-02	2,5201280E-01
5	2,8563536E+00	0,	0,	4,6302539E+02	1,0501658E+06	1,0132093E+05	3,9907406E+01
6	1,3077859E+06	1,5445633E+00	5,9549234E+02	-1,2048646E+01	1,9149589E-02	-8,3516468E+02	0,
7	5,1203409E+06	9,1700000E-01	0,	5,9688803E-02	0,	6,8653184E+01	9,0751167E+01
8	1,4667098E+01	1,5729996E+00	-7,8483430E-02	1,5749563E+00	6,8653184E+01	-8,9248833E+01	0,

1	6,9003009E+01	3,0496154E+04	1,0199553E+03	6,5796830E+01	9,0751167E+01	-8,0541018E+01	2,8520835E+01
2	0,	3,6380145E+06	1,9914822E+03	2,7848730E+01	9,0178378E+01	-8,0252717E+01	9,8219802E-03
3	RRRRR	1,1316967E+05	RRRRR	0,	0,	1,0553429E+00	1,0552971E+00
4	-1,7255304E-01	6,5316596E+02	8,9016912E-04	1,0115492E+03	1,0083101E+00	5,7555222E-02	2,5178662E-01
5	2,7581863E+00	0,	0,	4,6302539E+02	-5,9246961E+05	9,1141389E+04	3,9871591E+05
6	1,3077859E+06	1,5445633E+00	5,9549234E+02	-1,2048646E+01	1,9149589E-02	-8,3516468E+02	0,
7	5,1279803E+06	9,1700000E-01	0,	6,0522187E-02	0,	6,8555017E+01	9,0751167E+01
8	1,3743697E+01	1,6120987E+00	-7,7665520E-02	1,6139685E+00	6,8555017E+01	-8,9248833E+01	0,

1	9,9003009E+01	6,5709472E+04	2,0336348E+03	4,4493862E+01	9,1019936E+01	-8,0460446E+01	2,8519700E+01
2	3,0000000E+01	2,9357392E+06	3,1378651E+03	2,7013877E+01	9,0529243E+01	-8,0046802E+01	7,5933923E-02
3	RRRRR	9,1323617E+04	RRRRR	0,	0,	5,3112022E+00	5,3106594E+00
4	-7,0537233E-02	1,1757747E+02	1,8250573E-04	9,5008877E+02	2,1404682E+00	7,4679623E-02	2,2372432E-01
5	2,5917134E+00	0,	0,	3,7739178E+02	-1,5234611E+06	9,6387487E+04	2,8875649E+05
6	1,3799152E+06	1,2601449E+00	6,9486533E+02	-1,3579088E+01	8,1700503E-03	-8,2995444E+02	0,
7	5,2865970E+06	9,1700000E-01	0,	8,4842170E-02	0,	4,7085575E+01	9,1019936E+01
8	1,2996845E+01	2,1492154E+00	-9,7283822E-02	2,1514160E+00	4,7085575E+01	-8,8980064E+01	0,

1	9,9003009E+01	6,5709472E+04	2,0336348E+03	4,4493862E+01	9,1019936E+01	-8,0460446E+01	2,8519700E+01
2	0,	2,9357392E+06	3,1378651E+03	2,7013877E+01	9,0529243E+01	-8,0046802E+01	7,5933923E-02
3	RRRRR	9,1323617E+04	RRRRR	0,	0,	5,3112022E+00	5,3106594E+00
4	-7,0537233E-02	1,1757747E+02	1,8250573E-04	9,5008877E+02	2,1404682E+00	7,4679623E-02	2,2372432E-01
5	2,5917134E+00	0,	0,	3,7739178E+02	-1,5234611E+06	9,6387487E+04	2,8875649E+05
6	1,3799152E+06	1,2601449E+00	6,9486533E+02	-1,3579088E+01	8,1700503E-03	-8,2995444E+02	0,
7	5,2865970E+06	9,1700000E-01	0,	8,4842170E-02	0,	4,7085575E+01	9,1019936E+01
8	1,2996845E+01	2,1492154E+00	-9,7283822E-02	2,1514160E+00	4,7085575E+01	-8,8980064E+01	0,

CASE 1 CL ITERATION NO 1 PAGE 3 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL

1	1,4357861E+02	1,4527759E+05	5,1019984E+03	2,4324012E+01	9,1439458E+01	-8,0060578E+01	2.8512000E+01
2	4,4575604E+01	1,9166879E+06	6,3563835E+03	1,9305902E+01	9,1115513E+01	-7,9460692E+01	4,8584816E-01
3	RRRRR	5,9623440E+04	RRRRR	0,	0,	2,6435688E+01	2,6431223E+01
4	-4,3295439E-03	3,3239072E+00	4,4651173E-06	1,0711808E+03	4,7629666E+00	7,1475630E-02	1,8551260E-01
5	3,7866932E+00	0,	0,	5,8114367E+01	1,6233131E+05	1,4205862E+04	3,6870840E+04
6	1,3952616E+06	1,0865624E+00	1,2802948E+03	-2,0156313E+01	3,0163346E-03	-8,2309038E+02	0.
7	4,3958887E+06	9,1700000E-01	0,	1,4526847E-01	0,	2,8110705E+01	9,1439458E+01
8	1,3454868E+01	2,9828861E+00	-1,9742727E-01	2,9894125E+00	2,8110705E+01	-8,8560542E+01	0.

1	1,4357861E+02	1,4527759E+05	5,1019984E+03	2,4324012E+01	9,1439458E+01	-8,0060578E+01	2.8512000E+01
2	0,	1,5443878E+06	6,3563835E+03	1,9305902E+01	9,1115513E+01	-7,9460692E+01	4.8584816E-01
3	RRRRR	4,8042100E+04	RRRRR	0,	0,	2,6435688E+01	2,6431223E+01
4	-4,3295439E-03	3,6239072E+00	4,4651173E-06	1,0711808E+03	4,7629666E+00	6,0707088E-01	3,8913463E-01
5	1,9848761E+01	-9,8981076E-01	0,	5,8114367E+01	-1,8069693E+06	1,2065603E+05	7,1378414E+04
6	1,3952616E+06	1,0865624E+00	1,2802948E+03	-2,0156313E+01	3,0163346E-03	-8,2309038E+02	0.
7	0,	0,	0,	1,7316530E-01	0,	4,4169687E+01	9.1103394E+01
8	1,1059970E+01	8,6709301E-01	-9,6498455E-02	8,7244612E-01	7,0192348E+01	-8,7944440E+01	-2.6030907E+01

1	5,3049221E+02	3,0394311E+05	2,4482198E+04	-1,0122364E-03	9,8877542E+01	-6,5987272E+01	2,7352792E+01
2	3,8691360E+02	3,6008358E+05	2,3841612E+04	-9,5898703E-04	9,8407056E+01	-6,3710823E+01	2,2834400E+01
3	RRRRR	1,1201313E+04	RRRRR	0,	0,	7,7977728E+02	7,7944861E+02
4	-1,8284080E-05	2,1848810E-03	3,9296490E-09	9,0390178E+02	2,7085020E+01	1,5270398E-01	1,3794164E-01
5	1,3744923E+01	-6,6120972E+00	0,	1,1776726E+00	2,3668770E+04	6,1503671E+02	5,5557931E+02
6	1,0803909E+06	7,7017801E-01	1,6447132E+03	-1,9065172E+02	1,9095380E-03	-7,0568030E+02	0.
7	0,	0,	0,	1,0000000E+00	0,	1,3650710E+01	9,7309798E+01
8	8,7477501E+00	2,9654044E+00	-4,5428722E-01	3,0000000E+00	5,0142024E+01	-7,8946595E+01	-3,6911955E+01

10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
10	3,5190640E+03	7,1328365E-03	2,8520057E+01	-1,3587986E+02	7,4082845E+01	3,5441649E+03	3,4939631E+03
11	-1,3540591E-01	5,2361294E+03	1,3166599E+09	5,4860920E+11	3,5188850E+03	2,5475576E+04	2,5841613E+04

SOLUTION FOR C#S FOLLOWS,

```
C=  -6.0850009E-01 -1,4474149E+03  1,4377137E+00 -5,6907728E-03  3,1138144E+01
C=   0.             1,0505773E-02  0,                            5,9457070E-01 -1,1994278E+00
C=  -6,3966129E-05  2,6720574E-03 -4,8155549E-02  2,1302930E-03
E=  -2.8421709E-14  0,                            -1,5987212E-14  0,                            1.7819080E-14
E=   1.1175871E-08  1,4072077E-14  1,8491875E-11 -1,1641532E-10 -1.3325887E-05
E=   0.             1,0067680E-10 -9,6589403E-14  0,
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ERROR METRIC= 1,4824625E+03

THE ABOVE ITERATION TOOK 83,797 SECONDS,

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(55)

CASE 1. CL ITERATION NO 2 PAGE 1 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
1	0,	0,	1,0000000E-01	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	0,	5,5058348E+06	1,3407534E+03	4,2734018E-03	9,0000000E+01	-8,0561000E+01	-9,2236069E-08
3	RRRRR	1,7127296E+05	RRRRR	0,	0,	5,0281868E-04	-2,2889924E-07
4	-4,3643312E-05	2,1241290E+03	2,2964064E-03	1,1416733E+03	8,7590730E-05	8,9955098E-02	8,5244220E-02
5	3,0622634E+00	8,9984272E+01	0,	1,1482032E-05	2,9787848E+06	3,5324062E-03	3,3474168E-03
6	1,1096869E+06	3,0005621E+00	9,6993735E+01	-1,1792926E+01	4,0390887E-02	-8,2250791E+02	0,
7	6,6188427E+06	9,1700000E-01	0,	1,6855866E-02	0,	9,0000840E+01	9,3062263E+01
8	1,6381786E+01	1,3949925E+00	-7,6082931E-02	1,3970658E+00	-8,6937737E+01	-1,5727705E-02	-1,8000000E+02
1	1,2000000E+01	9,1798658E+02	1,5222014E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	1,2000000E+01	5,1499383E+06	1,3494252E+03	6,4769614E+00	9,0000000E+01	-8,0510863E+01	-9,2217716E-08
3	RRRRR	1,6020190E+05	RRRRR	0,	0,	5,8060496E-04	-2,2877023E-07
4	-6,4832698E-02	2,0573614E+03	2,2410576E-03	1,1337219E+03	1,3426585E-01	9,3002558E-02	1,8575244E-02
5	3,1288301E+00	6,7323803E+01	0,	2,5963741E+01	2,5865278E+06	8,2582546E+03	1,6494073E+03
6	1,1186787E+06	2,5516778E+00	9,7312611E+01	-1,1792926E+01	3,4720040E-02	-8,1940134E+02	0,
7	6,0606680E+06	9,1700000E-01	0,	2,5826734E-02	-1,4263252E+01	9,1205725E+01	9,2886753E+0.
8	1,6041578E+01	1,3842188E+00	-7,7241464E-02	1,3863722E+00	-8,6871170E+01	-2,2676197E+01	-1,8000000E+02
1	1,2000000E+01	9,1798658E+02	1,5222014E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	0,	5,1499383E+06	1,3494252E+03	6,4769614E+00	9,0000000E+01	-8,0510863E+01	-9,2217716E-08
3	RRRRR	1,6020190E+05	RRRRR	0,	0,	5,8060496E-04	-2,2877023E-07
4	-6,4832698E-02	2,0573614E+03	2,2410576E-03	1,1337219E+03	1,3426585E-01	5,3457287E-02	1,6554841E-02
5	2,4167414E+00	4,2343489E+00	0,	2,5963741E+01	2,6590229E+06	4,7467929E+03	1,4700035E+03
6	1,1186787E+06	2,5516778E+00	9,7312611E+01	-1,1792926E+01	3,4720040E-02	-8,1940134E+02	0,
7	6,0606680E+06	9,1700000E-01	0,	2,5826734E-02	0,	9,2410141E+01	9,0178390E+01
8	1,6090291E+01	1,3841536E+00	-7,8104651E-02	1,3863555E+00	-8,7583259E+01	-8,5765651E+01	-1,8000000E+02
1	3,8868840E+01	9,3317194E+03	4,7054298E+02	8,3820167E+01	9,0000000E+01	-8,0559348E+01	2,8521000E+01
2	2,6868840E+01	4,4490190E+06	1,4685104E+03	1,8575860E+01	9,0000000E+01	-8,0396950E+01	-6,9262312E-07
3	RRRRR	1,3839802E+05	RRRRR	0,	0,	8,7257024E-02	8,7255260E-02
4	-1,5534787E-01	1,5186013E+03	1,7371490E-03	1,1036546E+03	4,2634986E-01	1,6557283E-01	7,4785105E-02
5	4,4089635E+00	-1,9232075E+00	0,	1,9231168E+02	-2,6915512E+05	1,0889824E+05	4,9186609E+04
6	1,1912351E+06	1,8381670E+00	1,7095373E+02	-1,1939293E+01	2,4044638E-02	-8,1382847E+02	0,
7	4,9261575E+06	9,1700000E-01	0,	4,3339202E-02	-2,8421709E-14	8,8226642E+01	8,9852181E+01
8	1,4024857E+01	1,3503283E+00	-5,7353818E-02	1,3515458E+00	9,4408963E+01	-8,8076792E+01	-6,1798332E+00

(56)

CASE 1 CL ITERATION NO 2 PAGE 2 DATE 10273

1	3,8868840E+01	9,3317194E+03	4,7054298E+02	8,3820167E+01	9,0000000E+01	-8,0559348E+01	2,8521000E+01
2	0,	4,4490190E+06	1,4685104E+03	1,8575860E+01	9,0000000E+01	-8,0396950E+01	-6,9262312E+07
3	RRRRR	1,3839802E+05	RRRRR	0,	0,	8,7297024E-02	8,7259260E-02
4	-1,5534787E-01	1,5186013E+03	1,7371490E-03	1,1036546E+03	4,2634986E-01	8,1889552E-02	6,7628855E-02
5	2,9178340E+00	0,	0,	1,9231168E+02	1,2730401E+06	5,3859245E+04	4,4479901E+04
6	1,1912351E+06	1,8381670E+00	1,7095373E+02	-1,1939293E+01	2,4044638E-02	-8,1382847E+02	0,
7	5,6422761E+06	9,1700000E-01	0,	4,3339202E-02	0,	8,6738001E+01	9,0000000E+01
8	1,4991856E+01	1,5099094E+00	-7,6959901E-02	1,5118694E+00	8,6738001E+01	-8,9999993E+01	0,

1	6,8992722E+01	3,0490612E+04	1,0193624E+03	6,6167619E+01	9,0726655E+01	-8,0541316E+01	2,8520845E+01
2	3,0123882E+01	3,7205139E+06	1,9869484E+03	2,7987821E+01	9,0170578E+01	-8,0253058E+01	9,2236189E-03
3	RRRRR	1,1573602E+05	RRRRR	0,	0,	1,0396148E+00	1,0399737E+00
4	-1,7248587E-01	6,5332520E+02	8,9034019E-04	1,0115790E+03	1,0076943E+00	6,4018628E-02	2,5130529E-01
5	2,8568114E+00	0,	0,	4,6257608E+02	1,0503543E+06	1,0127812E+05	3,9756794E+05
6	1,3077644E+06	1,4216467E+00	2,1442492E+02	-1,2176861E+01	1,8097675E-02	-8,0889613E+02	0,
7	5,1200955E+06	9,1700000E-01	0,	6,1490663E-02	3,3750780E-14	6,9024431E+01	9,0726655E+01
8	1,4667215E+01	1,5733285E+00	-7,8512434E-02	1,5752862E+00	6,9024431E+01	-8,9273345E+01	0,

1	6,8992722E+01	3,0490612E+04	1,0193624E+03	6,6167619E+01	9,0726655E+01	-8,0541316E+01	2,8520845E+01
2	0,	3,6380145E+06	1,9869484E+03	2,7987821E+01	9,0170578E+01	-8,0253058E+01	9,2236189E-03
3	RRRRR	1,1316967E+05	RRRRR	0,	0,	1,0396148E+00	1,0399737E+00
4	-1,7248587E-01	6,5332520E+02	8,9034019E-04	1,0115790E+03	1,0076943E+00	5,7584050E-02	2,5107874E-01
5	2,7585490E+00	0,	0,	4,6257608E+02	-5,9255662E+05	9,1098555E+04	3,9720914E+05
6	1,3077644E+06	1,4216467E+00	2,1442492E+02	-1,2176861E+01	1,8097675E-02	-8,0889613E+02	0,
7	5,1279331E+06	9,1700000E-01	0,	6,2241912E-02	0,	6,8926168E+01	9,0726655E+01
8	1,3743644E+01	1,6124898E+00	-7,7694593E-02	1,6143605E+00	6,8926168E+01	-8,9273348E+01	0,

1	9,8992722E+01	6,5883608E+04	2,0288077E+03	4,5101421E+01	9,0996364E+01	-8,0461861E+01	2,8519755E+01
2	3,0000000E+01	2,9357392E+06	3,1267626E+03	2,7362553E+01	9,0513799E+01	-8,0048260E+01	7,2688064E-02
3	RRRRR	9,1323617E+04	RRRRR	0,	0,	5,2364186E+00	5,2359141E+00
4	-6,9737696E-02	1,1656323E+02	1,8086634E-04	9,5032404E+02	2,1348589E+00	7,5137273E-02	2,2386694E-01
5	2,5997820E+00	0,	0,	3,7222843E+02	-1,5077904E+06	9,5651342E+04	2,8498685E+05
6	1,3800518E+06	1,2232365E+00	4,5434029E+02	-1,3850384E+01	7,7525328E-03	-8,0477936E+02	0,
7	5,2868973E+06	9,1700000E-01	0,	8,5366598E-02	-1,0943536E+00	4,7701202E+01	9,0996364E+01
8	1,3004953E+01	2,1507294E+00	-9,7655850E-02	2,1529454E+00	4,7701202E+01	-8,9003636E+01	0,

1	9,8992722E+01	6,5883608E+04	2,0288077E+03	4,5101421E+01	9,0996364E+01	-8,0461861E+01	2,8519755E+01
2	0,	2,9357392E+06	3,1267626E+03	2,7362553E+01	9,0513799E+01	-8,0048260E+01	7,2688064E-02
3	RRRRR	9,1323617E+04	RRRRR	0,	0,	5,2364186E+00	5,2359141E+00
4	-6,9737696E-02	1,1656323E+02	1,8086634E-04	9,5032404E+02	2,1348589E+00	7,5137273E-02	2,2386694E-01
5	2,5997820E+00	0,	0,	3,7222843E+02	-1,5077904E+06	9,5651342E+04	2,8498685E+05
6	1,3800518E+06	1,2232365E+00	4,5434029E+02	-1,3850384E+01	7,7525328E-03	-8,0477936E+02	0,
7	5,2868973E+06	9,1700000E-01	0,	8,5366598E-02	0,	4,7701202E+01	9,0996364E+01
8	1,3004953E+01	2,1507294E+00	-9,7655850E-02	2,1529454E+00	4,7701202E+01	-8,9003636E+01	0,

57

CASE 1 CL ITERATION NO 2 PAGE 3 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL

1	1,4357100E+02	1,4676588E+05	5,0856909E+03	2,5035900E+01	9,1414485E+01	-8,0066092E+01	2,8512282E+01
2	4,4578276E+01	1,9166879E+06	6,3346164E+03	1,9861716E+01	9,1093939E+01	-7,9466238E+01	4,7011557E-01
3	RRRRR	5,7623440E+04	RRRRR	0,	0,	2,6144138E+01	2,6139911E+01
4	-4,0595288E-03	3,4199143E+00	4,2000718E-06	1,0728877E+03	4,7401894E+00	7,1946989E-02	1,8574844E-01
5	3,7934732E+00	0,	0,	5,4315858E+01	1,4869193E+05	1,3364889E+04	3,4504673E+04
6	1,3952891E+06	1,0780001E+00	1,0914281E+03	-2,0264893E+01	2,8637210E-03	-7,9878869E+02	0,
7	4,3968562E+06	9,1700000E-01	0,	1,4495635E-01	-1,2895240E-13	2,8829374E+01	9,1414485E+01
8	1,3448201E+01	2,9841443E+00	-1,9786521E-01	2,9906969E+00	2,8829374E+01	-8,8585515E+01	0,

1	1,4357100E+02	1,4676588E+05	5,0856909E+03	2,5035900E+01	9,1414485E+01	-8,0066092E+01	2,8512282E+01
2	0,	1,5443878E+06	6,3346164E+03	1,9861716E+01	9,1093939E+01	-7,9466238E+01	4,7011557E-01
3	RRRRR	4,8042100E+04	RRRRR	0,	0,	2,6144138E+01	2,6139911E+01
4	-4,0595288E-03	3,4199143E+00	4,2000718E-06	1,0728877E+03	4,7401894E+00	5,6660284E-01	3,3644954E-01
5	1,8589865E+01	-1,1739844E+00	0,	5,4315858E+01	-1,5505465E+06	1,0525227E+05	6,2498944E+04
6	1,3952891E+06	1,0780001E+00	1,0914281E+03	-2,0264893E+01	2,8637210E-03	-7,9878869E+02	0,
7	0,	0,	0,	1,7488029E-01	0,	4,3621720E+01	9,1040252E+01
8	1,1977402E+01	8,6708951E-01	-1,0999423E-01	8,7403830E-01	7,2715827E+01	-8,7812708E+01	-2,9103193E+01

1	5,3043911E+02	3,0396400E+05	2,4482198E+04	-2,2899994E-12	9,8909734E+01	-6,5949822E+01	2,7344011E+01
2	3,8686811E+02	3,6019652E+05	2,5841608E+04	-2,1695328E-12	9,8437518E+01	-6,3733695E+01	2,3504108E+01
3	RRRRR	1,1204827E+04	RRRRR	0,	0,	7,7866049E+02	7,7831173E+02
4	-1,8262027E-05	2,1823337E-03	3,9249092E-09	9,0394924E+02	2,7083598E+01	1,6022039E-01	1,3943050E-01
5	1,4278515E+01	-5,3187735E+00	0,	1,1762521E+00	2,4962381E+04	6,4453174E+02	5,6089857E+02
6	1,0807260E+06	7,6963181E-01	1,8212132E+03	-1,8559500E+02	1,8331656E-03	-6,8373802E+02	0,
7	0,	0,	0,	1,0000000E+00	-8,7707619E-14	1,4203396E+01	9,7476933E+01
8	8,7504071E+00	2,9653977E+00	-4,5433067E-01	3,0000000E+00	4,7169055E+01	-7,9371362E+01	-3,3344264E+01

10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
10	3,5190699E+03	7,1334680E-03	2,8520000E+01	-1,3583639E+02	7,4158673E+01	3,5441731E+03	3,4939666E+03
11	-3,0630306E+10	5,2361425E+03	1,3166578E+09	5,4860965E+11	3,5188908E+03	2,5475538E+04	2,5841608E+04

SOLUTION FOR C*S FOLLOWS,

C=	-6.2288396E-03	-9,6809722E+00	4,3985361E-02	-1,0617804E-04	5,3786740E-01
C=	0,	1,3855225E-04	0,	5,2463043E-02	-1,0335417E-01
C=	-7.5106160E-05	-5,9149125E-09	1,8969219E-02	-2,9606735E-04	
E=	6.5862871E-12	0,	3,2407188E-10	0,	1.3638246E-10
E=	-2.7939677E-08	-1,0214052E-14	-2,8544386E-07	0,	-2.2323234E-02
E=	0,	2,9269387E-10	3,4740832E-10	0,	

ERROR METRIC= 1,0444456E+01

THE ABOVE ITERATION TOOK 73.163 SECONDS.

7

(58)

CASE 1 GL ITERATION NO 3 PAGE 1 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
1	0,	0,	1,0000000E-01	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	0,	5,5058348E+06	1,3407534E+03	4,2734018E-03	9,0000000E+01	-8,0561000E+01	-9,2236069E-08
3	RRRRR	1,7127296E+05	RRRRR	0,	0,	5,0281868E-04	-2,2889924E-07
4	-4,3643312E-05	2,1241290E+03	2,2964064E-03	1,1416733E+03	8,7590730E-05	8,9955098E-02	8,5244220E-02
5	3,0622634E+00	8,9984272E+01	0,	1,1482032E-05	2,9787848E+06	3,5324062E-03	3,3474168E+03
6	1,1096869E+06	2,9943333E+00	8,7312762E+01	-1,1748940E+01	4,0284709E-02	-8,2197004E+02	0,
7	6,6188427E+06	9,1700000E-01	0,	1,6994418E-02	0,	9,0000840E+01	9,3062263E+01
8	1,6381786E+01	1,3949925E+00	-7,6082931E-02	1,3970658E+00	-8,6937737E+01	-1,5727705E-02	-1,8000000E+02
1	1,2000000E+01	9,1798658E+02	1,5222014E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	1,2000000E+01	5,1499383E+06	1,3494252E+03	6,4769614E+00	9,0000000E+01	-8,0510863E+01	-9,2217716E-08
3	RRRRR	1,6020190E+05	RRRRR	0,	0,	5,8060496E-04	-2,2877023E-07
4	-6,4832698E-02	2,0573614E+03	2,2410576E-03	1,1337219E+03	1,3426585E+01	9,3002558E-02	1,8575244E-02
5	3,1288301E+00	6,7323803E+01	0,	2,5963741E+01	2,5865278E+06	8,2582546E+03	1,6494073E+03
6	1,1186787E+06	2,5466499E+00	8,7630999E+01	-1,1748940E+01	3,4625357E-02	-8,1886977E+02	0,
7	6,0606680E+06	9,1700000E-01	0,	2,5947103E-02	-1,4079023E+01	9,1205725E+01	9,2886753E+01
8	1,5041578E+01	1,3842188E+00	-7,7241464E-02	1,3863722E+00	-8,6871170E+01	-2,2676197E+01	-1,8000000E+02
1	1,2000000E+01	9,1798658E+02	1,5222014E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	0,	5,1499383E+06	1,3494252E+03	6,4769614E+00	9,0000000E+01	-8,0510863E+01	-9,2217716E-08
3	RRRRR	1,6020190E+05	RRRRR	0,	0,	5,8060496E-04	-2,2877023E-07
4	-6,4832698E-02	2,0573614E+03	2,2410576E-03	1,1337219E+03	1,3426585E+01	5,3457287E-02	1,6554841E-02
5	2,4167414E+00	4,2343489E+00	0,	2,5963741E+01	2,6590229E+06	4,7467929E+03	1,4700035E+03
6	1,1186787E+06	2,5466499E+00	8,7630999E+01	-1,1748940E+01	3,4625357E-02	-8,1886977E+02	0,
7	6,0606680E+06	9,1700000E-01	0,	2,5947103E-02	0,	9,2410141E+01	9,0178390E+01
8	1,6090291E+01	1,3841536E+00	-7,8104651E-02	1,3863555E+00	-8,7583259E+01	-8,5765651E+01	-1,8000000E+02
1	3,8921303E+01	9,3582691E+03	4,7114628E+02	8,3808100E+01	9,0000000E+01	-8,0559338E+01	2,8521000E+01
2	2,6921303E+01	4,4478125E+06	1,4688548E+03	1,8595588E+01	9,0000000E+01	-8,0396721E+01	-6,9990310E-07
3	RRRRR	1,3836049E+05	RRRRR	0,	0,	8,7784224E-02	8,7782268E-02
4	-1,5541797E-01	1,5171158E+03	1,7357074E-03	1,1035992E+03	4,2691793E+01	1,6573368E+01	7,4641014E-02
5	4,4118126E+00	-1,9182950E+00	0,	1,9264513E+02	-2,7624825E+05	1,0919303E+05	4,9176959E+04
6	1,1914352E+06	1,8359467E+00	1,6054549E+02	-1,1894993E+01	2,4002113E-02	-8,1332621E+02	0,
7	4,9240707E+06	9,1700000E-01	0,	4,3368454E-02	0,	8,8217436E+01	8,9852463E+01
8	1,4020243E+01	1,3502644E+00	-5,7285472E-02	1,3514790E+00	9,4411813E+01	-8,8081705E+01	-6,1918997E+00

59

CASE 1 CL ITERATION NO 3 PAGE 2 DATE 10273

1	3,8921303E+01	9,3582691E+03	4,7114628E+02	8,3808100E+01	9,0000000E+01	-8,0559338E+01	2,8521000E+01
2	0,	4,4478125E+06	1,4688548E+03	1,8595588E+01	9,0000000E+01	-8,0396721E+01	-6,9990310E-07
3	RRRRR	1,3836049E+05	RRRRR	0,	0,	8,7784224E-02	8,7782268E-02
4	-1,5541797E-01	1,5171158E+03	1,7357074E-03	1,1035992E+03	4,2691793E-01	8,1858758E-02	6,7464803E-02
5	2,9173076E+00	0,	0,	1,9264513E+02	1,2720295E+06	5,3932344E+04	4,4448939E+04
6	1,1914352E+06	1,8359467E+00	1,6054549E+02	-1,1894993E+01	2,4002113E-02	-8,1332621E+02	0,
7	5,6427161E+06	9,1700000E-01	0,	4,3368454E-02	0,	8,6725408E+01	9,0000000E+01
8	1,4990883E+01	1,5104517E+00	-7,6973628E-02	1,5124117E+00	8,6725408E+01	-8,9999993E+01	0,

1	6,8994294E+01	3,0488951E+04	1,0192685E+03	6,6190752E+01	9,0725017E+01	-8,0541336E+01	2,8520846E+01
2	3,0072991E+01	3,7205139E+06	1,9866202E+03	2,7995476E+01	9,0170063E+01	-8,0253071E+01	9,1924438E-03
3	RRRRR	1,1573602E+05	RRRRR	0,	0,	1,0385847E+00	1,0385438E+00
4	-1,7247992E-01	6,5337294E+02	8,9039146E-04	1,0115879E+03	1,0075926E+00	6,4023179E-02	2,5118701E-01
5	2,8568673E+00	0,	0,	4,6251753E+02	1,0504006E+06	1,0127250E+05	3,9733011E+05
6	1,3077580E+06	1,4168360E+00	1,9764295E+02	-1,2123095E+01	1,8057611E-02	-8,0841152E+02	0,
7	5,1200672E+06	9,1700000E-01	0,	6,1483627E-02	-4,4408921E-16	6,9047620E+01	9,0725017E+01
8	1,4667244E+01	1,5733818E+00	-7,8516636E-02	1,5753397E+00	6,9047620E+01	-8,9274983E+01	0,

1	6,8994294E+01	3,0488951E+04	1,0192685E+03	6,6190752E+01	9,0725017E+01	-8,0541336E+01	2,8520846E+01
2	0,	3,6380145E+06	1,9866202E+03	2,7995476E+01	9,0170063E+01	-8,0253071E+01	9,1924438E-03
3	RRRRR	1,1316967E+05	RRRRR	0,	0,	1,0385847E+00	1,0385438E+00
4	-1,7247992E-01	6,5337294E+02	8,9039146E-04	1,0115879E+03	1,0075926E+00	5,7587827E-02	2,5096042E-01
5	2,7585932E+00	0,	0,	4,6251753E+02	-5,9256418E+05	9,1082997E+04	3,8697168E+05
6	1,3077580E+06	1,4168360E+00	1,9764295E+02	-1,2123095E+01	1,8057611E-02	-8,0841152E+02	0,
7	5,1279190E+06	9,1700000E-01	0,	6,2251966E-02	0,	6,8949346E+01	9,0725017E+01
8	1,3743638E+01	1,6125483E+00	-7,7698660E-02	1,6144191E+00	6,8949346E+01	-8,9274983E+01	0,

1	9,8994294E+01	6,5890359E+04	2,0284705E+03	4,5140063E+01	9,0994811E+01	-8,0461955E+01	2,8519758E+01
2	3,0000000E+01	2,9357392E+06	3,1260250E+03	2,7384544E+01	9,0512788E+01	-8,0048347E+01	7,2509143E-02
3	RRRRR	9,1323617E+04	RRRRR	0,	0,	5,2314626E+00	5,2309600E+00
4	-6,9702463E-02	1,1652530E+02	1,8080502E-04	9,5033293E+02	2,1344840E+00	7,5160053E-02	2,2387563E-01
5	2,6001627E+00	0,	0,	3,7197852E+02	-1,5070886E+06	9,5616104E+04	2,8480708E+05
6	1,3800569E+06	1,2212668E+00	4,4478035E+02	-1,3805698E+01	7,7381759E-03	-8,0433807E+02	0,
7	5,2869086E+06	9,1700000E-01	0,	8,5323449E-02	-1,0909452E+00	4,7740226E+01	9,0994811E+01
8	1,3005316E+01	2,1507991E+00	-9,7673335E-02	2,1530157E+00	4,7740226E+01	-8,9005189E+01	0,

1	9,8994294E+01	6,5890359E+04	2,0264705E+03	4,5140063E+01	9,0994811E+01	-8,0461955E+01	2,8519758E+01
2	0,	2,9357392E+06	3,1260250E+03	2,7384544E+01	9,0512788E+01	-8,0048347E+01	7,2509143E-02
3	RRRRR	9,1323617E+04	RRRRR	0,	0,	5,2314626E+00	5,2309600E+00
4	-6,9702463E-02	1,1652530E+02	1,8080502E-04	9,5033293E+02	2,1344840E+00	7,5160053E-02	2,2387563E-01
5	2,6001627E+00	0,	0,	3,7197852E+02	-1,5070886E+06	9,5616104E+04	2,8480708E+05
6	1,3800569E+06	1,2212668E+00	4,4478035E+02	-1,3805698E+01	7,7381759E+03	-8,0433807E+02	0,
7	5,2869086E+06	9,1700000E-01	0,	8,5323449E-02	0,	4,7740226E+01	9,0994811E+01
8	1,3005316E+01	2,1507991E+00	-9,7673335E-02	2,1530157E+00	4,7740226E+01	-8,9005189E+01	0,

(60)

CASE 1   CL ITERATION NO 3   PAGE 3   DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL

1	1,4357257E+02	1,4684596E+05	5,0845858E+03	2,5083102E+01	9,1412834E+01	-8,0066480E+01	2,8512299E+01
2	4,4578276E+01	1,9166879E+06	6,3331430E+03	1,9898537E+01	9,1092512E+01	-7,9466620E+01	4,6919487E-01
3	RRRRR	5,9623440E+04	RRRRR	0,	0,	2,6123638E+01	2,6119424E+01
4	-4,0453429E-03	3,4092902E+00	4,1863045E-06	1,0729758E+03	4,7387702E+00	7,1974256E-02	1,8576304E-01
5	3,7938292E+00	0,	0,	5,4114291E+01	1,4796168E+05	1,3320339E+04	3,4379329E+04
6	1,3952905E+06	1,0771437E+00	1,0838805E+03	-2,0217621E+01	2,8576786E-03	-7,9838283E+02	0,
7	4 3968593E 06	9 1700000E 01	0	1 4485040E 01	4 4408921E 16	2 8876931E 01	9 1412834E 01
8	1,3447844E+01	2,9842133E+00	-1,9788841E-01	2,9907673E+00	2,8876931E+01	-8,8587166E+01	0,

1	1,4357257E+02	1,4684596E+05	5,0845858E+03	2,5083102E+01	9,1412834E+01	-8,0066480E+01	2,8512299E+01
2	0,	1,5443878E+06	6,3331430E+03	1,9898537E+01	9,1092512E+01	-7,9466620E+01	4,6919487E-01
3	RRRRR	4,3042100E+04	RRRRR	0,	0,	2,6123638E+01	2,6119424E+01
4	-4,0453429E-03	3,4092902E+00	4,1863045E-06	1,0729758E+03	4,7387702E+00	5,6524638E-01	3,3571745E-01
5	1,6546469E+01	-1,1796545E+00	0,	5,4114291E+01	-1,5403257E+06	1,0461064E+05	6,2131522E+04
6	1,3952905E+06	1,0771437E+00	1,0838805E+03	-2,0217621E+01	2,8576786E-03	-7,9838283E+02	0,
7	0,	0,	0,	1,7491435E-01	0,	4,3625495E+01	9,1037977E+01
8	1,1982083E+01	9,6711207E-01	-1,1054880E-01	8,7413064E-01	7,2809932E+01	-8,7808821E+01	-2,9193538E+01

1	5,3045965E+02	3,0396400E+05	2,4482198E+04	-1,2722219E-14	9,8908064E+01	-4,5951319E+01	2,7344464E+01
2	3,6688708E+02	3,6015070E+05	2,5841609E+04	-1,2052960E-14	9,8435938E+01	-6,3735006E+01	2,3486051E+01
3	RRRRR	1,1203401E+04	RRRRR	0,	0,	7,7858266E+02	7,7823440E+02
4	-1,8262027E-05	2,1823337E-03	3,9249092E-09	9,0394924E+02	2,7083598E+01	1,6053991E-01	1,3949540E-01
5	1,4301194E+01	-5,7918965E+00	0,	1,1762521E+00	2,5020385E+04	6,4581712E+02	5,6115964E+02
6	1,0805884E+06	7,6947396E-01	1,8285060E+03	-1,8547159E+02	1,8296294E-03	-6,8342616E+02	0,
7	0,	0,	0,	1,0000000E+00	8,8817842E-16	1,4226644E+01	9,7479642E+01
8	8,7501346E+00	2,9654006E+00	-4,5431219E-01	3,0000000E+00	4,7076272E+01	-7,9387330E+01	-3,3226617E+01

10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
10	3,5190699E+03	7,1335126E-03	2,8520000E+01	-1,3584114E+02	7,4161097E+01	3,5441733E+03	3,4939666E+03
11	-1,7016778E-12	5,2361427E+03	1,3166577E+09	5,4860966E+11	3,5188909E+03	2,5475537E+04	2,5841609E+04

SOLUTION FOR C≠S FOLLOWS,

```
C=  -2.2442480E-05 -5,3161928E-02  1,3146079E-04 -2,6963968E-07  1.3084711E-03
C=   0.             1,5175286E-07  0,             1,8606197E-04 -3.5939190E-04
C=   2.0243197E-07 -1,1223011E-12  3,5855904E-05 -4,4302482E-07
E=   6.4748554E-16 -4,6566129E-10 -9,5323055E-16 -2,3283064E-10  3.7947076E-17
E=   0.             7,5894152E-18 -1,7763568E-14 -1,1641532E-10 -2.1872645E-05
E=   0.             3,7658765E-13  2,6801478E-15  0,
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ERROR METRIC= 5,5206679E-02

THE ABOVE ITERATION TOOK 73.180 SECONDS.

(61)

CASE 1 CL ITERATION NO 4 PAGE 1 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL

1	0,	0.	1,0000000E-01	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2.8521000E+01
2	0,	5.5058348E+06	1,3407534E+03	4,2734018E-03	9,0000000E+01	-8,0561000E+01	-9,2236069E-08
3	RRRRR	1,7127296E+05	RRRRR	0,	0,	5,0281868E-04	-2,2889924E-07
4	-4,3643312E-05	2,1241290E+03	2,2964064E-03	1,1416733E+03	8,7590730E-05	8,9955098E-02	8,5244220E-02
5	3,0622634E+00	8,9984272E+01	0,	1,1482032E-05	2,9787848E+06	3,5324062E-03	3.3474168E-03
6	1,1096869E+06	2,9943109E+00	8,7259400E+01	-1,1748809E+01	4,0284439E-02	-8,2196873E+02	0,
7	6,6188427E+06	9,1700000E-01	0,	1,6994570E-02	0,	9,0000840E+01	9,3062263E+01
8	1,6381786E+01	1,3949925E+00	-7,6082931E-02	1,3970658E+00	-8,6937737E+01	-1,5727705E-02	-1,8000000E+02

1	1,2000000E+01	9,1798658E+02	1,5222014E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	1,2000000E+01	5,1499383E+06	1,3494252E+03	6,4769614E+00	9,0000000E+01	-8,0510863E+01	-9,2217716E-08
3	RRRRR	1,6020190E+05	RRRRR	0,	0,	5,8060496E-04	-2,2877023E-07
4	-6,4832698E-02	2,0573614E+03	2,2410576E-03	1,1337219E+03	1,3426585E-01	9,3002558E-02	1,8575244E-02
5	3,1288301E+00	6,7323803E+01	0,	2,5963741E+01	2,5865278E+06	6,2582546E+03	1,6494073E+03
6	1,1186787E+06	2,5466304E+00	8,7577835E+01	-1,1748809E+01	3,4625130E-02	-8,1886848E+02	0.
7	6,0606680E+06	9,1700000E-01	0,	2,5947187E-02	-1,4078670E+01	9,1205725E+01	9,2886793E+01
8	1,6041578E+01	1,3842188E+00	-7,7241464E-02	1,3863722E+00	-8,6871170E+01	-2,2676197E+01	-1,8000000E+02

1	1,2000000E+01	9,1798658E+02	1,5222014E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	0,	5,1499383E+06	1,3494252E+03	6,4769614E+00	9,0000000E+01	-8,0510863E+01	-9,2217716E-08
3	RRRRR	1,6020190E+05	RRRRR	0,	0,	5,8060496E-04	-2,2877023E-07
4	-6,4832698E-02	2,0573614E+03	2,2410576E-03	1,1337219E+03	1,3426585E-01	5,3457287E-02	1,6554841E-02
5	2,4167414E+00	4,2343489E+00	0,	2,5963741E+01	2,6590229E+06	4,7467929E+03	1,4700039E+03
6	1,1186787E+06	2,5466304E+00	8,7577835E+01	-1,1748809E+01	3,4625130E-02	-8,1886848E+02	0,
7	6,0606680E+06	9,1700000E-01	0,	2,5947187E-02	0,	9,2410141E+01	9,0178390E+01
8	1,6090291E+01	1,3841536E+00	-7,8104651E-02	1,3863555E+00	-8,7583259E+01	-8,5765651E+01	-1,8000000E+02

1	3,8921489E+01	9,3583718E+03	4,7114839E+02	8,3808058E+01	9,0000000E+01	-8,0559338E+01	2,8521000E+01
2	2,6921489E+01	4,4478083E+06	1,4688560E+03	1,8595657E+01	9,0000000E+01	-8,0396720E+01	-6,9993369E-07
3	RRRRR	1,3836036E+05	RRRRR	0,	0,	8,7786624E-02	8,7784532E-02
4	-1,5541816E-01	1,5171101E+03	1,7357018E-03	1,1035990E+03	4,2691993E-01	1,6573429E-01	7,4640529E-02
5	4,4118233E+00	-1,9182775E+00	0,	1,9264624E+02	-2,7627257E+05	1,0919406E+05	4,9176922E+04
6	1,1914359E+06	1,8359331E+00	1,6049554E+02	-1,1894866E+01	2,4001947E-02	-8,1332495E+02	0,
7	4,9240634E+06	9,1700000E-01	0,	4,3368466E-02	0,	8,8217403E+01	8,9852464E+01
8	1,4020228E+01	1,3502642E+00	-5,7285239E-02	1,3514788E+00	9,4411823E+01	-8,8081723E+01	-6,1919424E+00

(62)

CASE 1 CL ITERATION NO 4 PAGE 2 DATE 10273

1	3,8921489E+01	9,3583718E+03	4,7114839E+02	8,3808058E+01	9,0000000E+01	-8,0559338E+01	2,8521000E+01
2	0,	4,4478083E+06	1,4688560E+03	1,8595657E+01	9,0000000E+01	-8,0396720E+01	-6,9993369E-07
3	RRRRR	1,3836036E+05	RRRRR	0,	0,	8,7786624E-02	8,7784532E-02
4	-1,5541616E-01	1,5171101E+03	1,7357018E-03	1,1035990E+03	4,2691993E-01	8,1858663E-02	6,7464244E-02
5	2,9173060E+00	0,	0,	1,9264624E+02	1,2720265E+06	5,3932591E+04	4,4448826E+04
6	1,1914359E+06	1,8359331E+00	1,6049554E+02	-1,1894866E+01	2,4001947E+02	-8,1332495E+02	0,
7	5,6427178E+06	9,1700000E-01	0,	4,3368466E-02	0,	8,6725364E+01	9,0000000E+01
8	1,4990880E+01	1,5104536E+00	-7,6973683E-02	1,5124136E+00	8,6725364E+01	-8,9999993E+01	0,

1	6,8994307E+01	3,0488945E+04	1,0192681E+03	6,6190817E+01	9,0725013E+01	-8,0541336E+01	2,8520846E+01
2	3,0072818E+01	3,7205139E+06	1,9866191E+03	2,7995494E+01	9,0170061E+01	-8,0253071E+01	9,1923780E-03
3	RRRRR	1,1573602E+05	RRRRR	0,	0,	1,0385818E+00	1,0383409E+00
4	-1,7247988E-01	6,5337310E+02	8,9039163E-04	1,0115880E+03	1,0075921E+00	6,4023203E-02	2,5118646E-01
5	2,8568676E+00	0,	0,	4,6251721E+02	1,0504009E+06	1,0127247E+05	3,9732897E+05
6	1,3077580E+06	1,4168235E+00	1,9759861E+02	-1,2122975E+01	1,8057518E-02	-8,0841034E+02	0,
7	5,1200671E+06	9,1700000E-01	0,	6,1483455E-02	3,4694470E-18	6,9047684E+01	9,0725013E+01
8	1,4667244E+01	1,5733821E+00	-7,8516658E-02	1,5753400E+00	6,9047684E+01	-8,9274987E+01	0,

1	6,8994307E+01	3,0488945E+04	1,0192681E+03	6,6190817E+01	9,0725013E+01	-8,0541336E+01	2,8520846E+01
2	0,	3,6380145E+06	1,9866191E+03	2,7995494E+01	9,0170061E+01	-8,0253071E+01	9,1923780E-03
3	RRRRR	1,1316967E+05	RRRRR	0,	0,	1,0385818E+00	1,0383409E+00
4	-1,7247980E-01	6,5337310E+02	8,9039163E-04	1,0115880E+03	1,0075921E+00	5,7587848E-02	2,5099987E-01
5	2,7585935E+00	0,	0,	4,6251721E+02	-5,9256419E+05	9,1082968E+04	3,9497055E+05
6	1,3077580E+06	1,4168235E+00	1,9759861E+02	-1,2122975E+01	1,8057518E-02	-8,0841034E+02	0,
7	5,1279189E+06	9,1700000E-01	0,	6,2252056E-02	0,	6,8949410E+01	9,0725013E+01
8	1,3743638E+01	1,6125486E+00	-7,7698681E-02	1,6144194E+00	6,8949410E+01	-8,9274987E+01	0,

1	9,8994307E+01	6,5890369E+04	2,0284694E+03	4,5140169E+01	9,0994807E+01	-8,0461956E+01	2,8519758E+01
2	3,0000000E+01	2,9357392E+06	3,1260228E+03	2,7384603E+01	9,0512786E+01	-8,0048348E+01	7,2508732E-02
3	RRRRR	9,1323617E+04	RRRRR	0,	0,	5,2314484E+00	5,2309499E+00
4	-6,9702389E-02	1,1652524E+02	1,8080492E-04	9,5033294E+02	2,1344829E+00	7,5160108E-02	2,2387566E-01
5	2,6001636E+00	0,	0,	3,7197793E+02	-1,5070871E+06	9,5616022E+04	2,8480667E+05
6	1,3800569E+06	1,2212623E+00	4,4475546E+02	-1,3805602E+01	7,7381492E-03	-8,0433700E+02	0,
7	5,2869086E+06	9,1700000E-01	0,	8,5323412E-02	-1,0909333E+00	4,7740333E+01	9,0994807E+01
8	1,3005316E+01	2,1507992E+00	-9,7673374E-02	2,1530159E+00	4,7740333E+01	-8,9005193E+01	0,

1	9,8994307E+01	6,5890369E+04	2,0284694E+03	4,5140169E+01	9,0994807E+01	-8,0461956E+01	2,8519758E+01
2	0,	2,9357392E+06	3,1260228E+03	2,7384603E+01	9,0512786E+01	-8,0048348E+01	7,2508732E-02
3	RRRRR	9,1323617E+04	RRRRR	0,	0,	5,2314484E+00	5,2309499E+00
4	-6,9702389E-02	1,1652524E+02	1,6080492E-04	9,5033294E+02	2,1344829E+00	7,5160108E-02	2,2387566E-01
5	2,6001636E+00	0,	0,	3,7197793E+02	-1,5070871E+06	9,5616022E+04	2,8480667E+05
6	1,3800569E+06	1,2212623E+00	4,4475546E+02	-1,3805602E+01	7,7381492E-03	-8,0433700E+02	0,
7	5,2869086E+06	9,1700000E-01	0,	8,5323412E-02	0,	4,7740333E+01	9,0994807E+01
8	1,3005316E+01	2,1507992E+00	-9,7673374E-02	2,1530159E+00	4,7740333E+01	-8,9005193E+01	0,

(63)

CASE 1 CL ITERATION NO 4 PAGE 3 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	ELEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
1	1.4357258E+02	1.4684615E+05	5.0845826E+03	2.5083233E+01	9.1412830E+01	-8.0066481E+01	2.8512299E+01
2	4.4578276E+01	1.9166879E+06	6.3331388E+03	1.9898639E+01	9.1092508E+01	-7.9466621E+01	4.6919267E-01
3	RRRRR	5.9623440E+04	RRRRR	0.	0.	2.6123578E+01	2.6119364E+01
4	-4.0453082E-03	3.4092645E+00	4.1862712E-06	1.0729760E+03	4.7387663E+00	7.1974328E-02	1.8576308E-01
5	3.7938301E+00	0.	0.	5.4113793E+01	1.4795985E+05	1.3320229E+04	3.4379020E+04
6	1.3952906E+06	1.0771420E+00	1.0838607E+03	-2.0217517E+01	2.8576680E-03	-7.9838186E+02	0.
7	4.3968593E+06	9.1700000E-01	0.	1.4485023E-01	-3.0357661E-18	2.8877063E+01	9.1412830E+01
8	1.3447843E+01	2.9842135E+00	-1.9788847E-01	2.9907674E+00	2.8877063E+01	-8.8587170E+01	0.
1	1.4357258E+02	1.4684615E+05	5.0845826E+03	2.5083233E+01	9.1412830E+01	-8.0066481E+01	2.8512299E+01
2	0.	1.5443878E+06	6.3331388E+03	1.9898639E+01	9.1092508E+01	-7.9466621E+01	4.6919267E-01
3	RRRRR	4.6042100E+04	RRRRR	0.	0.	2.6123578E+01	2.6119364E+01
4	-4.0453082E-03	3.4092645E+00	4.1662712E-06	1.0729760E+03	4.7387663E+00	5.6524265E-01	3.3571544E-01
5	1.8546350E+01	-1.1798712E+00	0.	5.4113793E+01	-1.5402992E+06	1.0460899E+05	6.2130578E+04
6	1.3952906E+06	1.0771420E+00	1.0838607E+03	-2.0217517E+01	2.8576680E-03	-7.9838186E+02	0.
7	0.	0.	0.	1.7491449E-01	0.	4.3625508E+01	9.1037570E+01
8	1.1982095E+01	8.6711211E-01	-1.1055023E-01	8.7413086E-01	7.2810194E+01	-8.7808810E+01	-2.9193788E+01
1	5.3045970E+02	3.0396400E+05	2.4482196E+04	-1.3666446E-16	9.8908060E+01	-6.5951323E+01	2.7344465E+01
2	3.8688712E+02	3.6015062E+05	2.5841609E+04	-1.2947516E-16	9.8435934E+01	-6.3735010E+01	2.3486011E+01
3	RRRRR	1.1203399E+04	RRRRR	0.	0.	7.7858244E+02	7.7823418E+02
4	-1.8262027E-05	2.1823337E-03	3.9249092E-09	9.0394924E+02	2.7083598E+01	1.6054072E-01	1.3949557E-01
5	1.4301252E+01	-5.7918288E+00	0.	1.1762521E+00	2.5020531E+04	6.4582038E+02	5.6116030E+02
6	1.0005881E+06	7.6947365E-01	1.8285246E+03	-1.8547130E+02	1.8296207E-03	-6.8342544E+02	0.
7	0.	0.	0.	1.0000000E+00	-3.4694470E-18	1.4226703E+01	9.7478649E+01
8	8.7501341E+00	2.9654006E+00	-4.5431215E-01	3.0000000E+00	4.7076038E+01	-7.9387370E+01	-3.3226320E+01

10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
10	3.5190699E+03	7.1335127E-03	2.8520000E+01	-1.3584116E+02	7.4161769E+01	3.5441733E+03	3.4939666E+03
11	-1.8279742E-14	5.2361427E+03	1.3166577E+09	5.4860966E+11	3.5188909E+03	2.5475537E+04	2.5841609E+04

SOLUTION FOR C*S FOLLOWS,

```
C=  -2.3915818E-08 -1.3485169E-05  2.6680168E-08 -2.9292051E-10  1.5020021E-07
C=   0.            -9.0534730E-11  0.             9.0201323E-09 -1.7941468E-08
C=   4.7258311E-10  1.1223034E-12 -3.9793358E-10  6.0380551E-10
B=   2.1543382E-08  1.3178214E-07  6.2048104E-08  1.3248064E-07 -2.3498558E-07
B=   1.4690205E-02  6.1995036E-09  1.3091750E-11 -5.0547998E-05 -1.1794327E-08
B=   0.             6.1499392E-09 -5.8418724E-08  0.
```

ERROR METRIC= 1.3714786E-05

THE ABOVE ITERATION TOOK 62.579 SECONDS.

69

THE FOLLOWING ITERATE IS CONVERGED.

CASE, 1 OL SOLUTION PAGE 1 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST THG	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
1	0,	0,	1,0000000E-01	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2.8521000E+01
2	0,	5,5058348E+06	1,3407534E+03	4,2734018E-03	9,0000000E+01	-8,0561000E+01	-9.2236069E-08
3	RRRRR	1,7127296E+05	0,	0,	0,	5,0281868E-04	-2.2889924E-07
4	IIIII	2,1241290E+03	2,2964064E-03	1,1416733E+03	8,7590730E-05	8,9955098E-02	8.5244220E-02
5	3,0622634E+00	8,9984272E+01	0,	1,1482032E-05	2,9787848E+06	3,5324062E-03	3.3474168E-03
6	1,1096869E+06	2,9943108E+00	8,7259587E+01	-1,1748809E+01	4,0284439E-02	-8,2196873E+02	0,
7	6,6188427E+06	9,1700000E-01	0,	1,6994570E-02	0,	9,0000840E+01	9,3062263E+01
8	1,6381786E+01	1,3949925E+00	-7,6082931E-02	1,3970658E+00	-8,6937737E+01	-1,5727705E-02	-1,8000000E+02
9	0,	0,	0,	0,	-8,9512867E+01	-3,0233468E+00	-9,9451439E+01
10	1,7242741E+03	9,9732772E-01	2,8521000E+01	-1,7056100E+02	-8,9999987E+01	3,4439405E+03	4,6077504E+00
11	1,7999999E+02	1,7958873E+03	2,6871659E+09	2,8056254E+10	9,2031076E+00	1,3407534E+03	1.0021104E+06
1	4,0000000E+00	1,0288307E+02	5,1262191E+01	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2.8521000E+01
2	4,0000000E+00	5,3842614E+06	1,3417396E+03	2,1895621E+00	9,0000000E+01	-8,0544288E+01	-9.2236069E-08
3	RRRRR	1,6749111E+05	3,2963838E+01	0,	0,	5,0281868E-04	-2.2889924E-07
4	IIIII	2,1165809E+03	2,2902920E-03	1,1406916E+03	4,4939571E-02	9,1899561E-02	4.6554443E-02
5	3,1020142E+00	8,1990363E+01	0,	3,0092286E+00	2,9080117E+06	9,4579002E+02	4.7911792E+02
6	1,1107034E+06	2,8376302E+00	8,7288205E+01	-1,1748809E+01	3,8325695E-02	-8,2087922E+02	0,
7	6,4284287E+06	9,1700000E-01	0,	2,0081497E-02	-6,4449706E+00	9,0432027E+01	9,3071724E+01
8	1,6311331E+01	1,3912361E+00	-7,6864478E-02	1,3933598E+00	-8,6897986E+01	-8,0096369E+00	-1,8000000E+02
9	5,5324756E-02	1,2858578E+02	8,7970723E-01	6,5678752E+00	-9,7412602E+01	-4,3442810E+00	-9,8956937E+01
10	1,7242860E+03	9,9732768E-01	2,8521000E+01	-1,7054429E+02	-8,9994130E+01	3,4439642E+03	4,6078411E+00
11	1,7999413E+02	1,7959059E+03	2,6871474E+09	2,8056530E+10	9,2033686E+00	1,3407573E+03	1.0021006E+06
1	8,0000000E+00	4,0947780E+02	1,0196045E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2.8521000E+01
2	8,0000000E+00	5,2656293E+06	1,3446508E+03	4,3487244E+00	9,0000000E+01	-8,0527575E+01	-9.2236069E-08
3	RRRRR	1,6380076E+05	6,6671196E+01	0,	0,	5,0281868E-04	-2.2889924E-07
4	IIIII	2,0941825E+03	2,2719241E-03	1,1379068E+03	8,9603511E-02	9,2886617E-02	2.0304311E-02
5	3,1240604E+00	7,4364521E+01	0,	1,1809395E+01	2,7758445E+06	3,7519207E+03	8.2005316E+02
6	1,1137199E+06	2,6882241E+00	8,7384495E+01	-1,1748809E+01	3,6436301E-02	-8,1984671E+02	0,
7	6,2424127E+06	9,1700000E-01	0,	2,3064799E-02	-1,1081876E+01	9,0841598E+01	9,3008349E+01
8	1,6196629E+01	1,3876937E+00	-7,7249543E-02	1,3898422E+00	-8,6875940E+01	-1,5635479E+01	-1,8000000E+02
9	1,4067205E-01	2,5716904E+02	1,7626300E+00	1,3239697E+01	-1,0497519E+02	-5,5158405E+00	-9,8317882E+01
10	1,7243213E+03	9,9732758E-01	2,8521000E+01	-1,7052758E+02	-8,9988325E+01	3,4440346E+03	4,6081114E+00
11	1,7998832E+02	1,7959611E+03	2,6870923E+09	2,8057352E+10	9,2039080E+00	1,3407692E+03	1.0020712E+06

65

CASE, 1 GL SOLUTION PAGE 2 DATE 10273

1	1,2000000E+01	9,1798502E+02	1,5222019E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	1,2000000E+01	5,1499363E+06	1,3494252E+03	6,4769635E+00	9,0000000E+01	-8,0510863E+01	-9,2236069E-08
3	RRRRR	1,6020190E+05	1,0113691E+02	0,	0,	5,0281868E-04	-2,2889924E-07
4	IIIII	2,0573615E+03	2,2410577E-03	1,1337219E+03	1,3426590E-01	9,3002554E-02	1,8575257E-02
5	3,1268300E+00	6,7323797E+01	0,	2,5963758E+01	2,5865275E+06	8,2582597E+03	1,6494095E+03
6	1,1186786E+06	2,5466313E+00	8,7577816E+01	-1,1748809E+01	3,4625127E-02	-8,1886848E+02	0,
7	6,0606680E+06	9,1700000E-01	0,	2,5947199E-02	-1,4078708E+01	9,1205725E+01	9,2886753E+01
8	1,6041578E+01	1,3842188E+00	-7,7241462E-02	1,3863722E+00	-8,6871170E+01	-2,2676203E+01	-1,8000000E+02
9	2,7185206E-01	3,8574729E+02	2,6451964E+00	1,9969555E+01	-1,1198430E+02	-6,5015704E+00	-9,7597403E+01
10	1,7243798E+03	9,9732741E-01	2,8521000E+01	-1,7051086E+02	-8,9982569E+01	3,4441510E+03	4,6085597E+00
11	1,7998257E+02	1,7960524E+03	2,6870012E+09	2,8058716E+10	9,2048027E+00	1,3407890E+03	1,0020224E+06

1	1,2000000E+01	9,1798658E+02	1,5222014E+02	9,0000000E+01	9,0000000E+01	-8,0561000E+01	2,8521000E+01
2	0,	5,1499383E+06	1,3494252E+03	6,4769614E+00	9,0000000E+01	-8,0510863E+01	-9,2217716E-08
3	RRRRR	1,6020190E+05	1,0113691E+02	0,	0,	5,8060496E-04	-2,2877023E-07
4	IIIII	2,0573614E+03	2,2410576E-03	1,1337219E+03	1,3426585E-01	5,3457287E-02	1,6554841E-02
5	2,4167414E+00	4,2343489E+00	0,	2,5963741E+01	2,6590229E+06	4,7467929E+03	1,4700035E+03
6	1,1186787E+06	2,5466304E+00	8,7577821E+01	-1,1748809E+01	3,4625130E-02	-8,1886848E+02	0,
7	6,0606680E+06	9,1700000E-01	0,	2,5947187E-02	0,	9,2410141E+01	9,0178390E+01
8	1,6090291E+01	1,3841536E+00	-7,8104651E-02	1,3863555E+00	-8,7583259E+01	-8,5765651E+01	-1,8000000E+02
9	2,7105208E-01	3,8574729E+02	2,6451964E+00	1,9969555E+01	-1,7570870E+02	-9,6414199E+00	-8,8296674E+01
10	1,7243798E+03	9,9732741E-01	2,8521000E+01	-1,7051086E+02	-8,9982569E+01	3,4441510E+03	4,6085597E+00
11	1,7998257E+02	1,7960524E+03	2,6870012E+09	2,8058716E+10	9,2048027E+00	1,3407890E+03	1,0020224E+06

1	1,6000000E+01	1,6265435E+03	2,0198506E+02	8,9080000E+01	9,0000000E+01	-8,0560981E+01	2,8521000E+01
2	4,0000000E+00	5,0371686E+06	1,3591888E+03	8,5451027E+00	9,0000000E+01	-8,0494132E+01	-9,2254344E-08
3	RRRRR	1,5669453E+05	1,3637552E+02	0,	0,	1,1243367E-03	9,7980355E-04
4	IIIII	2,0067600E+03	2,1974231E-03	1,1286935E+03	1,7895475E-01	7,4480250E-02	5,2619668E-02
5	2,7965692E+00	8,2882722E+00	0,	4,4825196E+01	2,4058253E+06	1,1417984E+04	8,0687092E+03
6	1,1254906E+06	2,4196974E+00	9,3719814E+01	-1,1758011E+01	3,2897963E-02	-8,1794250E+02	0,
7	5,8829985E+06	9,1700000E-01	0,	2,8734643E-02	-1,6833055E+00	9,1847337E+01	9,0402979E+01
8	1,5891505E+01	1,3796643E+00	-7,7529657E-02	1,3818410E+00	-8,7203431E+01	-8,1711728E+01	1,7908000E+02
9	5,3044811E-01	5,1431253E+02	3,6025852E+00	2,6694419E+01	-1,7159798E+02	-9,8087723E+00	-8,9535377E+01
10	1,7244722E+03	9,9731423E-01	2,8521000E+01	-1,7049413E+02	-8,9976815E+01	3,4443129E+03	4,6315380E+00
11	1,7997682E+02	1,7961968E+03	2,6868372E+09	2,8128486E+10	9,2506367E+00	1,3440599E+03	9,9953034E+05

1	2,0000000E+01	2,5326181E+03	2,5103458E+02	8,8160000E+01	9,0000000E+01	-8,0560913E+01	2,8521000E+01
2	8,0000000E+00	4,9273801E+06	1,3721114E+03	1,0536428E+01	9,0000000E+01	-8,0477351E+01	-9,3807943E-08
3	RRRRR	1,5327866E+05	1,7240121E+02	0,	0,	4,6448396E-03	4,6150176E-03
4	IIIII	1,9434076E+03	2,1410369E-03	1,1234125E+03	2,2345717E-01	9,1761350E-02	1,3509347E-01
5	3,1062081E+00	7,7111299E+01	0,	6,7462319E+01	2,0724522E+06	2,1171282E+04	3,1169918E+04
6	1,1340252E+06	2,3195582E+00	1,0194575E+02	-1,1771391E+01	3,1245028E-02	-8,1705863E+02	0,
7	5,7091171E+06	9,1700000E-01	0,	3,1440863E-02	-2,6988436E+00	8,8882542E+01	9,3027874E+01
8	1,5640400E+01	1,3718789E+00	-7,5957489E-02	1,3739801E+00	-8,6893792E+01	-1,2888701E+01	1,7816000E+02
9	1,2247540E+00	6,4283471E+02	4,4981609E+00	3,3392269E+01	-1,0224460E+02	-5,1058527E+00	-1,0046368E+02
10	1,7245923E+03	9,9729464E-01	2,8521000E+01	-1,7047735E+02	-8,9971090E+01	3,4445189E+03	4,6656473E+00
11	1,7997109E+02	1,7963844E+03	2,6866702E+09	2,8231735E+10	9,3186723E+00	1,3489127E+03	9,9588510E+05

(66)

CASE, 1 QL SOLUTION PAGE 3 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
1	2,4000000E+01	3,6320143E+03	2,9888144E+02	8,7240000E+01	9,0000000E+01	-8,0560774E+01	2,8521000E+01
2	[illegible],2000000E+01	4,8205128E+06	1,3878661E+03	1,2421594E+01	9,0000000E+01	-8,0460500E+01	-1,0328975E+07
3	RRRRR	1,4995428E+05	2,0922771E+02	0,	0,	1,1937752E-02	1,1923323E-02
4	IIIII	1,8685939E+03	2,0724857E-03	1,1183780E+03	2,6724545E-01	1,1218280E-01	2,2583882E-01
5	3,4694659E+00	-6,8893839E+00	0,	9,2567696E+01	1,6340377E+06	3,5515001E+04	7,1496398E+04
6	1,1441005E+06	2,2483899E+00	1,1202685E+02	-1,1789637E+01	2,9617155E-02	-8,1620633E+02	0,
7	5,5386241E+06	9,1700000E-01	0,	3,4089414E-02	-3,0925243E+00	9,0667742E+01	8,9464192E+01
8	1,5323217E+01	1,3603801E+00	-7,2856957E-02	1,3623297E+00	9,3469466E+01	-8,1110616E+01	-2,7600000E+00
9	2,8931681E+00	7,7127829E+02	5,3252038E+00	4,0015341E+01	1,7101830E+02	-8,8886534E+00	-8,7849491E+01
10	1,7247388E+03	9,9726881E-01	2,8521000E+01	-1,7046050E+02	-8,9965436E+01	3,4447671E+03	4,7105926E+00
11	1,7996544E+02	1,7966134E+03	2,6864419E+09	2,8367207E+10	9,4083196E+00	1,3552879E+03	9,9109637E+09
1	2,8000000E+01	4,9188206E+03	3,4535628E+02	8,6320000E+01	9,0000000E+01	-8,0560548E+01	2,8521000E+01
2	1,6000000E+01	4,7165867E+06	1,4061255E+03	1,4187862E+01	9,0000000E+01	-8,0443561E+01	-1,3700326E+07
3	RRRRR	1,4472140E+05	2,4686819E+02	0,	0,	2,3882562E-02	2,3876436E-02
4	IIIII	1,7840259E+03	1,9930554E-03	1,1138854E+03	3,1004650E-01	1,2846910E-01	2,4871701E-01
5	3,7566957E+00	-4,4086394E+00	0,	1,1885682E+02	1,1545567E+06	5,2221445E+04	1,0110105E+05
6	1,1554896E+06	2,1733271E+00	1,2384664E+02	-1,1812465E+01	2,7968953E-02	-8,1537866E+02	0,
7	5,3710198E+06	9,1700000E-01	0,	3,6692875E-02	-2,8996344E+00	9,0065564E+01	8,9711431E+01
8	1,4984657E+01	1,3506285E+00	-6,9115274E-02	1,3523958E+00	9,3756696E+01	-8,5591361E+01	-3,6800000E+00
9	5,7385483E+00	8,9960788E+02	6,0862022E+00	4,6516149E+01	1,7554291E+02	-9,2394759E+00	-8,9195142E+01
10	1,7249106E+03	9,9723694E-01	2,8521000E+01	-1,7044356E+02	-8,9959862E+01	3,4450551E+03	4,7660260E+00
11	1,7995986E+02	1,7968617E+03	2,6861744E+09	2,8533401E+10	9,5188832E+00	1,3631142E+03	9,8530796E+09
1	3,2000000E+01	6,3880509E+03	3,9112131E+02	8,5400000E+01	9,0000000E+01	-8,0560216E+01	2,8521000E+01
2	2,0000000E+01	4,6156018E+06	1,4268465E+03	1,5859233E+01	9,0000000E+01	-8,0426517E+01	-2,2729252E+07
3	RRRRR	1,4358001E+05	2,8533517E+02	0,	0,	4,1417730E-02	4,1414595E-02
4	IIIII	1,6914718E+03	1,9045331E-03	1,1099557E+03	3,5242966E-01	1,4342164E-01	1,8244360E-01
5	4,0193353E+00	-2,9513136E+00	0,	1,4571851E+02	6,4805579E+05	7,1475217E+04	9,0922098E+04
6	1,1679541E+06	2,0560274E+00	1,3685788E+02	-1,1839452E+01	2,6361873E-02	-8,1458528E+02	0,
7	5,2057807E+06	9,1700000E-01	0,	3,9227663E-02	-2,1854399E+00	8,9413996E+01	8,9793224E+01
8	1,4635560E+01	1,3488663E+00	-6,5158929E-02	1,3504592E+00	9,4019335E+01	-8,7048686E+01	-4,6000000E+00
9	9,0513979E+00	1,0277881E+03	6,7828155E+00	5,2850679E+01	1,7701624E+02	-9,3539611E+00	-9,0089997E+01
10	1,7251072E+03	9,9719899E-01	2,8521000E+01	-1,7042652E+02	-8,9954274E+01	3,4453824E+03	4,8320445E+00
11	1,7995427E+02	1,7971890E+03	2,6858682E+09	2,8730076E+10	9,6505584E+00	1,3723794E+03	9,7854435E+09

67

CASE, 1 OL SOLUTION PAGE 4 DATE 10273

1	3.6000000E+01	8.0383066E+03	4.3727895E+02	8.4480000E+01	9.0000000E+01	-8.0559760E+01	2.8521000E+01
2	2.4000000E+01	4.5175581E+06	1.4501897E+03	1.7465648E+01	9.0000000E+01	-8.0409348E+01	-4.3036697E-07
3	RRRRR	1.4053011E+05	3.2464045E+02	0.	0.	6.5498441E-02	6.5495370E-02
4	IIIII	1.5925392E+03	1.8088893E-03	1.1063300E+03	3.9525183E-01	1.5683535E-01	9.9999321E-02
5	4.2548419E+00	-2.2410936E+00	0.	1.7294147E+02	1.2257469E+05	9.2761806E+04	5.9145580E+04
6	1.1812777E+06	1.9181738E+00	1.5047120E+02	-1.1870072E+01	2.4922624E-02	-8.1383958E+02	0.
7	5.0424305E+06	9.1700000E-01	0.	4.1658969E-02	-1.0498358E+00	8.8731581E+01	8.9833769E+01
8	1.4282298E+01	1.3515192E+00	-6.0923490E-02	1.3528916E+00	9.4254842E+01	-8.7758906E+01	-5.5200000E+00
9	1.1900336E+01	1.1557837E+03	7.4187128E+00	5.8978244E+01	1.7773454E+02	-9.4170604E+00	-9.0891091E+01
10	1.7253297E+03	9.9715460E-01	2.8521000E+01	-1.7040935E+02	-8.9948551E+01	3.4457502E+03	4.9092486E+00
11	1.7994855E+02	1.7975367E+03	2.6855218E+09	2.8958356E+10	9.8045284E+00	1.3831362E+03	9.7080886E+05

1	3.8921489E+01	9.3583476E+03	4.7114529E+02	8.3808058E+01	9.0000000E+01	-8.0559338E+01	2.8521000E+01
2	2.6921489E+01	4.4478083E+06	1.4688547E+03	1.8595547E+01	9.0000000E+01	-8.0396720E+01	-6.9986028E-07
3	RRRRR	1.3836036E+05	3.5388396E+02	0.	0.	8.7786144E-02	8.7784110E-02
4	IIIII	1.5171114E+03	1.7357031E-03	1.1035990E+03	4.2691710E-01	1.6573558E-01	7.4641462E-02
5	4.4118465E+00	-1.9182601E+00	0.	1.9264385E+02	-2.7625843E+05	1.0919356E+05	4.9176928E+04
6	1.1914357E+06	1.8357930E+00	1.6061541E+02	-1.1894661E+01	2.4001957E-02	-8.1332454E+02	0.
7	4.9240630E+06	9.1700000E-01	0.	4.3367636E-02	9.1259424E-04	8.8217427E+01	8.9852465E+01
8	1.4020236E+01	1.3502640E+00	-5.7285376E-02	1.3514787E+00	9.4411846E+01	-8.8081740E+01	-6.1919424E+00
9	1.3646333E+01	1.2491313E+03	7.8469665E+00	6.3301404E+01	1.7806110E+02	-9.4503467E+00	-9.1459161E+01
10	1.7255087E+03	9.9711801E-01	2.8521000E+01	-1.7039672E+02	-8.9944274E+01	3.4460445E+03	4.9729027E+00
11	1.7994427E+02	1.7978165E+03	2.6852433E+09	2.9145224E+10	9.9314736E+00	1.3919427E+03	9.6456673E+05

1	3.8921489E+01	9.3583718E+03	4.7114839E+02	8.3808058E+01	9.0000000E+01	-8.0559338E+01	2.8521000E+01
2	0.	4.4478083E+06	1.4688560E+03	1.8595657E+01	9.0000000E+01	-8.0396720E+01	-6.9993369E-07
3	RRRRR	1.3836036E+05	3.5388396E+02	0.	0.	8.7786624E-02	8.7784532E-02
4	IIIII	1.5171101E+03	1.7357018E-03	1.1035990E+03	4.2691993E-01	8.1858663E-02	6.7464244E-02
5	2.9173060E+00	0.	0.	1.9264624E+02	1.2720265E+06	5.3932591E+04	4.4448826E+04
6	1.1914359E+06	1.8359331E+00	1.6049554E+02	-1.1894866E+01	2.4001946E-02	-8.1332495E+02	0.
7	5.6427178E+06	9.1700000E-01	0.	4.3368466E-02	0.	8.6725364E+01	9.0000000E+01
8	1.4990880E+01	1.5104536E+00	-7.6973683E-02	1.5124136E+00	8.6725364E+01	-8.9999993E+01	0.
9	1.3646333E+01	1.2491313E+03	7.8469665E+00	6.3301404E+01	1.8000000E+02	-9.6032800E+00	-9.3274636E+01
10	1.7255087E+03	9.9711801E-01	2.8521000E+01	-1.7039672E+02	-8.9944273E+01	3.4460445E+03	4.9729052E+00
11	1.7994427E+02	1.7978165E+03	2.6852433E+09	2.9145231E+10	9.9314784E+00	1.3919430E+03	9.6456650E+05

1	4.6921489E+01	1.3621443E+04	6.0538294E+02	8.0100614E+01	9.0330282E+01	-8.0557459E+01	2.8520994E+01
2	8.0000000E+00	4.2428964E+06	1.5638761E+03	2.2416749E+01	9.0023777E+01	-8.0361416E+01	3.4643984E-04
3	RRRRR	1.3198606E+05	4.3652301E+02	0.	0.	1.8702871E-01	1.8702744E-01
4	IIIII	1.2943379E+03	1.5203477E-03	1.0931222E+03	5.5381084E-01	7.5946637E-02	9.4309362E-02
5	2.8352951E+00	0.	0.	2.7859498E+02	6.6213585E+05	7.2361563E+04	8.9857472E+04
6	1.2214373E+06	1.6766912E+00	1.3974750E+02	-1.1818747E+01	2.1771971E-02	-8.1182539E+02	0.
7	5.3237584E+06	9.1700000E-01	0.	4.8402552E-02	-6.4813523E-01	8.2935909E+01	9.0330282E+01
8	1.4563761E+01	1.5020197E+00	-7.4388531E-02	1.5038607E+00	8.2935909E+01	-8.9669718E+01	0.
9	1.9961881E+01	1.5034926E+03	9.6233121E+00	7.4277261E+01	1.7966749E+02	-9.6790423E+00	-9.7008302E+01
10	1.7262312E+03	9.9689180E-01	2.8521003E+01	-1.7031162E+02	-8.9970042E+01	3.4470970E+03	5.3654755E+00
11	1.7992629E+02	1.7989458E+03	2.6841194E+09	3.0272056E+10	1.0714274E+01	1.4453175E+03	9.2855698E+05

(68)

CASE, 1 QL SOLUTION PAGE 5 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
1	5,4921489E+01	1,8883304E+04	7,4095970E+02	7,5613099E+01	9,0521234E+01	-8,0553930E+01	2.8520970E+01
2	1,6000000E+01	4,0497481E+06	1,6864139E+03	2,5188100E+01	9,0062881E+01	-8,0324462E+01	1.7758424E-03
3	RRRRR	1,2597769E+05	5,2312943E+02	0,	0,	3,7341927E-01	3.7341498E-01
4	IIIII	1,0575726E+03	1,2936427E-03	1,0732890E+03	6,9036366E-01	7,1211252E-02	9.1950607E-02
5	2,7899725E+00	0,	0,	3,5511869E+02	4,5015521E+04	8,6486486E+04	1.1167456E+05
6	1,2533232E+06	1,5228227E+00	1,4859933E+02	-1,1851382E+01	1,9956462E-02	-8,1049223E+02	0.
7	5,0116547E+06	9,1700000E-01	0,	5,3180645E-02	-2,6875722E-02	7,8403071E+01	9.0521234E+01
8	1,4153917E+01	1,4940508E+00	-7,2809174E-02	1,4958239E+00	7,8403071E+01	-8,9478766E+01	0.
9	2,9552645E+01	1,7545174E+03	1,1370967E+01	8,3901635E+01	1,7948188E+02	-9,7799297E+00	-1.0150938E+02
10	1,7271785E+03	9,7653619E-01	2,8521034E+01	-1,7019277E+02	-9,0022012E+01	3,4483744E+03	5.9826161E+00
11	1,7990630E+02	1,3004268E+03	2,6826472E+09	3,1962792E+10	1,1944510E+01	1,5254752E+03	8.7928249E+03
1	6,2921489E+01	2,5105356E+04	8,9060963E+02	7,0440662E+01	9,0649787E+01	-8,0548007E+01	2.8520916E+01
2	2,4000000E+01	3,3625081E+06	1,8427026E+03	2,7092438E+01	9,0118096E+01	-8,0285115E+01	4.9936446E-03
3	RRRRR	1,2015311E+05	6,1387916E+02	0,	0,	6,8622434E-01	6.8620596E-01
4	IIIII	8,2267982E+02	1,0651486E-03	1,0413561E+03	8,5524022E-01	6,2601768E-02	1.0325648E-01
5	2,9455605E+00	0,	0,	4,2243020E+02	1,2437727E+06	9,0441480E+04	1.4917581E+05
6	1,2849569E+06	1,3956309E+00	1,7233939E+02	-1,1971023E+01	1,8708853E-02	-8,0928145E+02	0.
7	5,0717329E+06	9,1700000E-01	0,	5,7850279E-02	1,5424144E-02	7,3386243E+01	9.0649787E+01
8	1,4814537E+01	1,5684877E+00	-8,0707190E-02	1,5705627E+00	7,3386243E+01	-8,9350213E+01	0.
9	4,3705703E+01	1,9999545E+03	1,3172597E+01	9,1956519E+01	1.7936793E+02	-9,9000880E+00	-1.0650609E+02
10	1,7284036E+03	9,9599656E-01	2,8521140E+01	-1,7003778E+02	-9,0099439E+01	3,4498877E+03	6.0195675E+00
11	1,7988212E+02	1,8023427E+03	2,6807457E+09	3,4370030E+10	1,3811433E+01	1,6396449E+03	8.1747752E+03
1	6,8994307E+01	3,9488354E+04	1,0191406E+03	6,6190216E+01	9,0725025E+01	-8,0541336E+01	2.8520846E+01
2	3,0072818E+01	3,7205314E+06	1,9865256E+03	2,7992980E+01	9,0170051E+01	-8,0253071E+01	9.1923838E-03
3	RRRRR	1,1573657E+05	6,8575286E+02	0,	0,	1,0385611E+00	1.0385203E+00
4	IIIII	6,5339009E+02	8,9040989E-04	1,0115911E+03	1,0074630E+00	6,4031326E-02	2.5103582E-01
5	2,8509742E+00	0,	0,	4,6241107E+02	1,0505103E+06	1,0126208E+05	3.9699956E+05
6	1,3077557E+06	1,4139630E+00	1,9729415E+02	-1,2122549E+01	1,8108329E-02	-8,0841173E+02	0.
7	5,1200621E+06	9,1700000E-01	0,	6,1473894E-02	3,0565777E-02	6,9047190E+01	9.0725025E+01
8	1,4667310E+01	1,5734606E+00	-7,8523512E-02	1,5754188E+00	6,9047190E+01	-8,9274975E+01	0.
9	6,2258703E+01	2,1808607E+03	1,4790052E+01	9,6949078E+01	1,7931246E+02	-1,0005503E+01	-1.1083488E+02
10	1,7295597E+03	9,9542228E-01	2,8521310E+01	-1,6989693E+02	-9,0172770E+01	3,4512019E+03	7.0174441E+00
11	1,7985985E+02	1,8041513E+03	2,6789539E+09	3,6759573E+10	1,5798644E+01	1,7529719E+03	7.6411778E+03

(69)

CASE, 1 GL SOLUTION PAGE 6 DATE 10273

1	6,8994307E+01	3,0488945E+04	1,0192681E+03	6,6190817E+01	9,0725013E+01	-8,0541336E+01	2,8520846E+01
2	0,	3,6380145E+06	1,9866191E+03	2,7995494E+01	9,0170061E+01	-8,0253071E+01	9,1923780E-03
3	RRRRR	1,1316967E+05	6,8575286E+02	0,	0,	1,0385818E+00	1,0385409E+00
4	IIIII	6,5337310E+02	8,9039163E-04	1,0115880E+03	1,0075921E+00	5,7587848E-02	2,5095987E-01
5	2,7585935E+00	0,	0,	4,6251721E+02	-5,9256419E+05	9,1092968E+04	3,9697055E+05
6	1,3077580E+06	1,4168235E+00	1,9759861E+02	-1,2122975E+01	1,8057518E-02	-8,0841034E+02	0,
7	5,1279189E+06	9,1700000E-01	0,	6,2252056E-02	0,	6,8949410E+01	9,0725013E+01
8	1,3743638E+01	1,6125486E+00	-7,7698681E-02	1,6144194E+00	6,8949410E+01	-8,9274987E+01	0,
9	6,2258703E+01	2,1808607E+03	1,4790052E+01	9,6949078E+01	1,7931292E+02	-1,0006655E+01	-1,1093273E+02
10	1,7295602E+03	9,9542206E-01	2,8521310E+01	-1,6989691E+02	-9,0172767E+01	3,4512026E+03	7,9178217E+00
11	1,7985983E+02	1,8041521E+03	2,6789531E+09	3,6760448E+10	1,5799396E+01	1,7530132E+03	7,6409951E+05
1	7,6994307E+01	3,8453630E+04	1,2197925E+03	6,0364771E+01	9,0807612E+01	-8,0528820E+01	2,8520698E+01
2	8,0000000E+00	3,4507456E+06	2,2163768E+03	2,8578544E+01	9,0250267E+01	-8,0207131E+01	1,7934474E-02
3	RRRRR	1,0734420E+05	7,8704892E+02	0,	0,	1,6996134E+00	1,6995187E+00
4	IIIII	4,5423634E+02	6,6221219E-04	9,7382406E+02	1,2525800E+00	6,3740574E-02	2,5056587E-01
5	2,6643886E+00	0,	0,	4,9265070E+02	-1,2473348E+05	1,0739429E+05	4,2210976E+05
6	1,3345763E+06	1,3553086E+00	2,4594288E+02	-1,2417292E+01	1,4962574E-02	-8,0786797E+02	0,
7	5,1872091E+06	9,1700000E-01	0,	6,7665693E-02	-2,9925008E-01	6,3029159E+01	9,0807612E+01
8	1,3924970E+01	1,7267037E+00	-8,0353714E-02	1,7285723E+00	6,3029159E+01	-8,9192388E+01	0,
9	1,0179631E+02	2,4097365E+03	1,6686417E+01	1,0222634E+02	1,7926877E+02	-1,0158360E+01	-1,1684417E+02
10	1,7314682E+03	9,9436293E-01	2,8521704E+01	-1,6968300E+02	-9,0283441E+01	3,4531761E+03	9,7604002E+00
11	1,7982292E+02	1,8071384E+03	2,6760009E+09	4,0803410E+10	1,9465780E+01	1,9446999E+03	6,8802415E+05
1	8,4994307E+01	4,7470054E+04	1,4664456E+03	5,4558245E+01	9,0879454E+01	-8,0510863E+01	2,8520465E+01
2	1,6000000E+01	3,2634693E+06	2,4982822E+03	2,8569020E+01	9,0340835E+01	-8,0155748E+01	3,1617349E-02
3	RRRRR	1,0151849E+05	8,9399854E+02	0,	0,	2,6481251E+00	2,6479363E+00
4	IIIII	2,9328568E+02	4,5006533E-04	9,4848961E+02	1,5460851E+00	6,4586651E-02	2,3937794E-01
5	2,4762249E+00	0,	0,	4,8392436E+02	-1,8767730E+06	1,0689228E+05	3,9617599E+05
6	1,3562520E+06	1,2974635E+00	3,0647433E+02	-1,2816929E+01	1,2032875E-02	-8,0617408E+02	0,
7	5,2350456E+06	9,1700000E-01	0,	7,3538078E-02	-5,9944332E-01	5,7034470E+01	9,0879454E+01
8	1,2922894E+01	1,8648423E+00	-8,0645489E-02	1,8665852E+00	5,7034470E+01	-8,9120546E+01	0,
9	1,4055607E+02	2,6255320E+03	1,8507853E+01	1,0597329E+02	1,7925001E+02	-1,0321954E+01	-1,2283422E+02
10	1,7339388E+03	9,9283503E-01	2,8522330E+01	-1,6944195E+02	-9,0401784E+01	3,4554539E+03	1,2423626E+01
11	1,7977461E+02	1,8110075E+03	2,6721882E+09	4,6017224E+10	2,4758238E+01	2,1917459E+03	6,0960270E+05
1	9,2994307E+01	5,7579638E+04	1,7658664E+03	4,9019041E+01	9,0946062E+01	-8,0486024E+01	2,8520116E+01
2	2,4000000E+01	3,0761917E+06	2,8353762E+03	2,8045158E+01	9,0437800E+01	-8,0097484E+01	5,1878784E-02
3	RRRRR	9,5692748E+04	1,0072705E+03	0,	0,	3,9601279E+00	3,9597880E+00
4	IIIII	1,7668416E+02	2,7656146E-04	9,4263015E+02	1,8733396E+00	7,1994446E-02	2,2976139E-01
5	2,4898912E+00	0,	0,	4,3119863E+02	-1,7566022E+06	1,0617016E+05	3,3882896E+05
6	1,3719551E+06	1,2514077E+00	3,8033731E+02	-1,3333875E+01	9,4066665E-03	-8,0511476E+02	0,
7	5,2694585E+06	9,1700000E-01	0,	8,0007259E-02	-8,9910777E-01	5,1508933E+01	9,0946062E+01
8	1,2925248E+01	2,0216029E+00	-8,7907734E-02	2,0235132E+00	5,1508933E+01	-8,9053938E+01	0,
9	1,7505939E+02	2,8264311E+03	2,0415830E+01	1,0845240E+02	1,7924694E+02	-1,0490484E+01	-1,2835775E+02
10	1,7371172E+03	9,9067768E-01	2,8523194E+01	-1,6918062E+02	-9,0517986E+01	3,4580404E+03	1,6193964E+01
11	1,7971239E+02	1,8159894E+03	2,6672988E+09	5,2509467E+10	3,2236963E+01	2,4990928E+03	5,3369340E+05

(70)

CASE, 1 QL SOLUTION PAGE 7 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY

1	9.8994307E+01	6.5892621E+04	2.0285454E+03	4.5141627E+01	9.0994804E+01	-8.0461953E+01	2.8519798E+01
2	3.0000000E+01	2.9357392E+06	3.1260796E+03	2.7385928E+01	9.0512787E+01	-8.0048345E+01	7.2510585E+02
3	RRRRR	9.1323617E+04	1.0968458E+03	0.	0.	5.2315895E+00	5.2310869E+00
4	IIIII	1.1651220E+02	1.8078384E-04	9.5033600E+02	2.1345560E+00	7.5161040E-02	2.2387416E-01
5	2.6001989E+00	0.	0.	3.7196242E+02	-1.5069867E+06	9.5613223E+04	2.8479290E+05
6	1.3800586E+06	1.2220394E+00	4.4508691E+02	-1.3806241E+01	7.7377584E-03	-8.0433450E+02	0.
7	5.2869124E+06	9.1700000E-01	0.	8.5340419E-02	-1.1228081E+00	4.7741826E+01	9.0994804E+01
8	1.3005369E+01	2.1508070E+00	-9.7675056E-02	2.1530238E+00	4.7741826E+01	-8.9005196E+01	0.
9	1.9873317E+02	2.9667723E+03	2.1891654E+01	1.0968154E+02	1.7925091E+02	-1.0619783E+01	-1.3212441E+02
10	1.7400716E+03	9.8852829E-01	2.8523980E+01	-1.6897446E+02	-9.0598574E+01	3.4601816E+03	1.9961603E+01
11	1.7965501E+02	1.8206241E+03	2.6627701E+09	5.8267200E+10	3.9694213E+01	2.7714097E+03	4.8040064E+05

1	9.8994307E+01	6.5890369E+04	2.0284694E+03	4.5140169E+01	9.0994807E+01	-8.0461956E+01	2.8519798E+01
2	0.	2.9357392E+06	3.1260228E+03	2.7384603E+01	9.0512786E+01	-8.0048348E+01	7.2508732E+02
3	RRRRR	9.1323617E+04	1.0968458E+03	0.	0.	5.2314484E+00	5.2309459E+00
4	IIIII	1.1652524E+02	1.8080492E-04	9.5033294E+02	2.1344829E+00	7.5160108E-02	2.2387566E-01
5	2.6001636E+00	0.	0.	3.7197793E+02	-1.5070871E+06	9.5616022E+04	2.8480667E+05
6	1.3800569E+06	1.2212623E+00	4.4475546E+02	-1.3805602E+01	7.7381492E-03	-8.0433700E+02	0.
7	5.2869086E+06	9.1700000E-01	0.	8.5323412E-02	0.	4.7740333E+01	9.0994807E+01
8	1.3005316E+01	2.1507992E+00	-9.7673374E-02	2.1530159E+00	4.7740333E+01	-8.9005193E+01	0.
9	1.9873317E+02	2.9667723E+03	2.1891654E+01	1.0968154E+02	1.7925092E+02	-1.0619802E+01	-1.3212591E+02
10	1.7400709E+03	9.8852843E-01	2.8523980E+01	-1.6897446E+02	-9.0598595E+01	3.4601805E+03	1.9961351E+01
11	1.7965504E+02	1.8206231E+03	2.6627711E+09	5.8266833E+10	3.9693713E+01	2.7713891E+03	4.8040369E+05

1	1.0499431E+02	7.4831765E+04	2.3258924E+03	4.1543957E+01	9.1043768E+01	-8.0432468E+01	2.8519296E+01
2	6.0000000E+00	2.7952981E+06	3.4502626E+03	2.6556039E+01	9.0588718E+01	-7.9993791E+01	9.8760452E+02
3	RRRRR	8.6954841E+04	1.1908131E+03	0.	0.	6.7890611E+00	6.7883427E+00
4	IIIII	7.5185321E+01	1.1376289E-04	9.6454413E+02	2.4113903E+00	7.7415567E-02	2.1820364E-01
5	2.7479618E+00	0.	0.	3.0771585E+02	-1.1708226E+06	8.1471230E+04	2.2963494E+05
6	1.3856243E+06	1.1950293E+00	5.1730197E+02	-1.4356774E+01	6.3868145E-03	-8.0356273E+02	0.
7	5.2985436E+06	9.1700000E-01	0.	9.1139846E-02	-1.4822732E-01	4.4291919E+01	9.1043768E+01
8	1.3125910E+01	2.2887311E+00	-1.0985403E-01	2.2913660E+00	4.4291919E+01	-8.8956232E+01	0.
9	2.1802672E+02	3.0981901E+03	2.3433012E+01	1.1052270E+02	1.7925812E+02	-1.0752489E+01	-1.3557442E+02
10	1.7436113E+03	9.8581547E-01	2.8524862E+01	-1.6876090E+02	-9.0670476E+01	3.4624902E+03	2.4732314E+01
11	1.7958721E+02	1.8261822E+03	2.6573645E+09	6.4813037E+10	4.9113812E+01	3.0806947E+03	4.3129305E+05

(71)

CASE, 1		QL SOLUTION		PAGE 8			DATE 10273
1	1,1099431E+02	8,4398602E+04	2,6595512E+03	3,8244448E+01	9,1093838E+01	-8,0396869E+01	2.8518713E+01
2	1,2000000E+01	2,6548714E+06	3,8089534E+03	2,5608594E+01	9,0665155E+01	-7,9933124E+01	1.3156500E-01
3	RRRRR	8,2586511E+04	1,2696251E+03	0,	0,	8,6695306E+00	8.6685323E+00
4	IIIII	4,7797336E+01	6,9883212E-05	9,8085182E+02	2,7114710E+00	7,7693167E-02	2.1249227E-01
5	2,9253506E+00	0,	0,	2,4714942E+02	-6,6574475E+05	6,5670227E+04	1.7960930E+05
6	1,3893127E+06	1,1714147E+00	5,9673176E+02	-1,4992874E+01	5,3331064E-03	-8,0278824E+02	0.
7	5,3060617E+06	9,1700000E-01	0,	9,7514347E-02	-2,9600530E-01	4,1169799E+01	9.1093838E+01
8	1,3328391E+01	2,4357173E+00	-1,2446859E-01	2,4388954E+00	4,1169799E+01	-8,8906162E+01	0.
9	2,3382610E+02	3,2208820E+03	2,5050998E+01	1,1108920E+02	1,7926676E+02	-1,0889449E+01	-1.3869685E+02
10	1,7476395E+03	9,8242730E-01	2,8525817E+01	-1,6854018E+02	-9,0731660E+01	3,4649647E+03	3.0714261E+01
11	1,7950777E+02	1,8328290E+03	2,6509360E+09	7,2165433E+10	6,0888790E+01	3,4277193E+03	3.8669094E+05
1	1,1699431E+02	9,4585172E+04	3,0310310E+03	3,5240900E+01	9,1145757E+01	-8,0354451E+01	2.8517984E+01
2	1,8000000E+01	2,5144551E+06	4,2033569E+03	2,4587634E+01	9,0742046E+01	-7,9865637E+01	1.7191664E-01
3	RRRRR	7,8218504E+04	1,3938079E+03	0,	0,	1,0910256E+01	1.0908902E+01
4	IIIII	3,0048160E+01	4,2378217E-05	9,9638394E+02	3,0420312E+00	7,5315561E-02	2.0667839E-01
5	3,1238288E+00	0,	0,	1,9466749E+02	8,5205280E+04	5,0142301E+04	1.3759879E+05
6	1,3917030E+06	1,1503206E+00	6,8187140E+02	-1,5720390E+01	4,5266901E-03	-8,0200819E+02	0.
7	5,3110601E+06	9,1700000E-01	0,	1,0453446E-01	-4,4374078E-01	3,8364729E+01	9.1145757E+01
8	1,3650457E+01	2,5933053E+00	-1,4153012E-01	2,5971645E+00	3,8364729E+01	-8,8854243E+01	0.
9	2,4638938E+02	3,3352091E+03	2,6789886E+01	1,1146672E+02	1,7927551E+02	-1,1031909E+01	-1.4150220E+02
10	1,7528773E+03	9,7823493E-01	2,8526826E+01	-1,6831170E+02	-9,0780671E+01	3,4676032E+03	3.8151490E+01
11	1,7941531E+02	1,8407589E+03	2,6433171E+09	8,0344330E+10	7,5472611E+01	3,8132976E+03	3.4659204E+05
1	1,2299431E+02	1,0538415E+05	3,4421017E+03	3,2522341E+01	9,1200167E+01	-8,0304489E+01	2.8517084E+01
2	2,4000000E+01	2,3740377E+06	4,6351185E+03	2,3531310E+01	9,0819624E+01	-7,9790607E+01	2.2087327E-01
3	RRRRR	7,3850466E+04	1,5039790E+03	0,	0,	1,3549528E+01	1.3547728E+01
4	IIIII	1,8688120E+01	2,5492004E-05	1,0112024E+03	3,4039691E+00	7,0993510E-02	2.0088811E-01
5	3,2532432E+00	0,	0,	1,5101545E+02	3,3364422E+05	3,6666221E+04	1.0375326E+05
6	1,3932329E+06	1,1310401E+00	7,7098929E+02	-1,6546231E+01	3,9423316E-03	-8,0121788E+02	0.
7	5,3148214E+06	9,1700000E-01	0,	1,1230503E-01	-5,9207504E-01	3,5775584E+01	9.1200167E+01
8	1,3718319E+01	2,7638949E+00	-1,5710228E-01	2,7683562E+00	3,5775584E+01	-8,8799833E+01	0.
9	2,5629629E+02	3,4416422E+03	2,8636131E+01	1,1171640E+02	1,7928482E+02	-1,1182304E+01	-1.4409168E+02
10	1,7588710E+03	9,7308675E-01	2,8527872E+01	-1,6807423E+02	-9,0816242E+01	3,4704087E+03	4.7333422E+01
11	1,7930816E+02	1,8502063E+03	2,6343095E+09	8,9375361E+10	9,3393042E+01	4,2384986E+03	3.1075975E+05
1	1,2899431E+02	1,1679123E+05	3,8951307E+03	3,0072063E+01	9,1257646E+01	-8,0246236E+01	2.8515986E+01
2	3,0000000E+01	2,2336013E+06	5,1066184E+03	2,2470714E+01	9,0898333E+01	-7,9707285E+01	2.7957531E-01
3	RRRRR	6,9481836E+04	1,6208694E+03	0,	0,	1,6626925E+01	1.6624575E+01
4	IIIII	1,1490287E+01	1,5199673E-05	1,0274764E+03	3,7909684E+00	6,7488264E-02	1.9549708E-01
5	3,3307693E+00	0,	0,	1,1530505E+02	3,6360688E+05	2,6613543E+04	7.7092957E+04
6	1,3942023E+06	1,1134834E+00	8,6218497E+02	-1,7477827E+01	3,5102542E-03	-8,0041355E+02	0.
7	5,3180151E+06	9,1700000E-01	0,	1,2095861E-01	-7,4269620E-01	3,3402832E+01	9.1257646E+01
8	1,3677288E+01	2,9519091E+00	-1,7179658E-01	2,9569041E+00	3,3402832E+01	-8,8742354E+01	0.
9	2,6413559E+02	3,5407154E+03	3,0559013E+01	1,1188031E+02	1,7929389E+02	-1,1341836E+01	-1.4646464E+02
10	1,7660025E+03	9,6681038E-01	2,8528945E+01	-1,6782610E+02	-9,0836925E+01	3,4733920E+03	5.8612948E+01
11	1,7918403E+02	1,8614723E+03	2,6236717E+09	9,9297560E+10	1,1528056E+02	4,7050000E+03	2.7881739E+05

12

CASE, 1 QL SOLUTION PAGE 9 DATE 10293

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	FE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST INC	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
1	1,3499431E+02	1,2879672E+05	4,3800702E+03	2,7868937E+01	9,1318709E+01	-8,0178963E+01	2,8514656E+01
2	3,6000000E+01	2,0964464E+06	5,6080112E+03	2,1413535E+01	9,0977980E+01	-7,9614943E+01	3,4918078E-01
3	RRRRR	6,5215285E+04	1,7452983E+03	0,	0,	2,0180933E+01	2,0177918E+01
4	IIIII	6,9905929E+00	8,9682398E-06	1,0465991E+03	4,1850508E+00	6,8320127E-02	1,9097063E-01
5	3,5010184E+00	0,	0,	8,6027907E+01	2,8965932E+05	2,0100836E+04	5,6186508E+04
6	1,3948082E+06	1,0975440E+00	9,5394435E+02	-1,8522550E+01	3,1825228E-03	-7,9959205E+02	0,
7	4,9743738E+06	9,1700000E-01	0,	1,3044322E-01	-4,6385719E-01	3,1369955E+01	9,1318709E+01
8	1,3586860E+01	2,9921874E+00	-1,8306341E-01	2,9977821E+00	3,1369955E+01	-8,8681291E+01	0,
9	2,7324761E+02	3,6329903E+03	3,2536032E+01	1,1198709E+02	1,7929949E+02	-1,1510218E+01	-1,4849700E+02
10	1,7743004E+03	9,5936345E-01	2,8530015E+01	-1,6756699E+02	-9,0844510E+01	3,4764994E+03	7,2101441E+01
11	1,7904507E+02	1,8746075E+03	2,6114014E+09	1,0992337E+11	1,4127293E+02	5,2038253E+03	2,5091171E+05
1	1,4099431E+02	1,4132742E+05	4,8721582E+03	2,5880360E+01	9,1383674E+01	-8,0102317E+01	2,8513087E+01
2	4,2000000E+01	1,9686552E+06	6,1148540E+03	2,0352000E+01	9,1057907E+01	-7,9513229E+01	4,3050778E-01
3	RRRRR	6,1240016E+04	1,8778436E+03	0,	0,	2,4230238E+01	2,4226413E+01
4	IIIII	4,2308170E+00	5,2606823E-06	1,0660806E+03	4,5701592E+00	7,0874886E-02	1,8724203E-01
5	3,7059997E+00	0,	0,	6,2438842E+01	1,8887633E+05	1,5134683E+04	3,9983820E+04
6	1,3951799E+06	1,0829974E+00	1,0450998E+03	-1,9683210E+01	2,9396818E-03	-7,9875044E+02	0,
7	4,5610173E+06	9,1700000E-01	0,	1,4042200E-01	-9,1828269E-02	2,9586359E+01	9,1383674E+01
8	1,3487821E+01	2,9856817E+00	-1,9338933E-01	2,9919303E+00	2,9586359E+01	-8,8616326E+01	0,
9	2,7486596E+02	3,7190126E+03	3,4523061E+01	1,1205614E+02	1,7930241E+02	-1,1689245E+01	-1,5027947E+02
10	1,7835027E+03	9,5098346E-01	2,8531040E+01	-1,6729792E+02	-9,0847054E+01	3,4795843E+03	8,7421128E+01
11	1,7390055E+02	1,8892102E+03	2,5979274E+09	1,2078014E+11	1,7055718E+02	5,7127212E+03	2,2738090E+05
1	1,4357258E+02	1,4684853E+05	5,0848178E+03	2,5083621E+01	9,1412836E+01	-8,0066468E+01	2,8512298E+01
2	4,4578276E+01	1,9166348E+06	6,3333700E+03	1,9899141E+01	9,1092523E+01	-7,9466608E+01	4,6920613E-01
3	RRRRR	5,9621789E+04	1,9374007E+03	0,	0,	2,6124250E+01	2,6120036E+01
4	IIIII	3,4089503E+00	4,1858640E-06	1,0729786E+03	4,7389739E+00	7,1972040E-02	1,8576106E-01
5	3,7938289E+00	0,	0,	5,4113535E+01	1,4795038E+05	1,3319742E+04	3,4378482E+04
6	1,3952906E+06	1,0771184E+00	1,0838008E+03	-2,0217651E+01	2,8579010E-03	-7,9838199E+02	0,
7	4,3968594E+06	9,1700000E-01	0,	1,4485372E-01	5,8219646E-02	2,8877450E+01	9,1412836E+01
8	1,3447818E+01	2,9842966E+00	-1,9789392E-01	2,9908507E+00	2,8877450E+01	-8,8587164E+01	0,
9	2,7646001E+02	3,7541812E+03	3,5377206E+01	1,1207769E+02	1,7930309E+02	-1,1769760E+01	-1,5098775E+02
10	1,7877282E+03	9,4710432E-01	2,8531466E+01	-1,6717881E+02	-9,0847535E+01	3,4808934E+03	9,4563105E+01
11	1,7883733E+02	1,8959281E+03	2,5917869E+09	1,2549199E+11	1,8412423E+02	5,9333525E+03	2,1840830E+05

(73)

CASE, 1 QL SOLUTION PAGE 10 DATE 10273

1	1,4357258E+02	1,4684615E+05	5,0848826E+03	2,5083233E+01	9,1412830E+01	-8,0066481E+01	2,8512289E+01
2	0,	1,5443878E+06	6,3331386E+03	1,9898639E+01	9,1092508E+01	-7,9466621E+01	4,6919267E-01
3	RRRRR	4,8042100E+04	1,9374007E+03	0,	0,	2,6123578E+01	2,6119364E+01
4	IIIII	3,4092645E+00	4,1862712E-06	1,0729760E+03	4,7387663E+00	5,6524265E-01	3,3571544E-01
5	1,8546350E+01	-1,1798712E+00	0,	5,4113793E+01	-1,5402992E+06	1,0460899E+05	6,2130978E+04
6	1,3952906E+06	1,0771420E+00	1,0838607E+03	-2,0217516E+01	2,8576680E-03	-7,9838186E+02	0,
7	0,	0,	0,	1,7491449E-01	0,	4,3625508E+01	9,1037970E+01
8	1,1962095E+01	8,6711211E-01	-1,1055023E-01	8,7413086E-01	7,2810194E+01	-8,7808810E+01	-2,9193788E+01
9	2,7646001E+02	3,7541812E+03	3,5377206E+01	1,1207769E+02	1,7786627E+02	-1,1173690E+01	-1,3598176E+02
10	1,7877240E+03	9,4710783E-01	2,8531466E+01	-1,6717885E+02	-9,0847621E+01	3,4808914E+03	9,4556609E+01
11	1,7883745E+02	1,8959214E+03	2,5917931E+09	1,2548780E+11	1,8411191E+02	5,9331574E+03	2,1841600E+05

1	1,5357258E+02	1,6773953E+05	5,2371243E+03	2,2732145E+01	9,1514505E+01	-7,9920658E+01	2,8509024E+01
2	1,0000000E+01	1,5134157E+06	6,5044371E+03	1,8127553E+01	9,1183384E+01	-7,9279016E+01	6,2959833E-01
3	RRRRR	4,7078635E+04	2,2308798E+03	0,	0,	3,3828260E+01	3,3822400E+01
4	IIIII	1,5363652E+00	1,8398788E-06	1,0790175E+03	4,8536048E+00	6,7625982E-01	4,0180756E-01
5	2,2135475E+01	-1,1230359E+00	0,	2,5231611E+01	-8,1156170E+05	5,8355886E+04	3,4677999E+04
6	1,3955428E+06	1,0575945E+00	1,2371361E+03	-2,2367962E+01	2,5748395E-03	-7,9689689E+02	0,
7	0,	0,	0,	1,8148795E-01	-7,9595194E-06	4,4863144E+01	9,1091371E+01
8	1,2265088E+01	8,9436733E-01	-1,5153850E-01	9,0711456E-01	7,2855219E+01	-8,7793379E+01	-2,8001290E+01
9	2,8630557E+02	3,8824635E+03	3,8483093E+01	1,1214307E+02	1,7784930E+02	-1,1363959E+01	-1,3473408E+02
10	1,7925965E+03	9,4292605E-01	2,8531515E+01	-1,6680087E+02	-9,1038343E+01	3,4828824E+03	1,0231055E+02
11	1,7886084E+02	1,9036777E+03	2,5847483E+09	1,3039139E+11	1,9878184E+02	6,1614786E+03	2,0979065E+05

1	1,6357258E+02	1,8733299E+05	5,4091257E+03	2,0513415E+01	9,1618510E+01	-7,9767860E+01	2,8505352E+01
2	2,0000000E+01	1,4824436E+06	6,6926965E+03	1,6452447E+01	9,1277396E+01	-7,9084438E+01	8,0213451E-01
3	RRRRR	4,6115171E+04	2,5304275E+03	0,	0,	4,1902096E+01	4,1894418E+01
4	IIIII	7,2402438E-01	8,9659935E-07	1,0528254E+03	5,1377234E+00	7,4112700E-01	4,4755708E-01
5	2,4796482E+01	-1,0793957E+00	0,	1,3116639E+01	-4,1704826E+05	3,3246147E+04	2,0076920E+04
6	1,3956522E+06	1,0383353E+00	1,3935916E+03	-2,4592038E+01	2,4202132E-03	-7,9531278E+02	0,
7	0,	0,	0,	1,8833054E-01	-1,5731366E-05	4,5305200E+01	9,1165837E+01
8	1,2398970E+01	9,1664163E-01	-1,7610800E-01	9,3340554E-01	7,2154983E+01	-8,7761966E+01	-2,6899367E+01
9	2,9201884E+02	3,9988708E+03	4,4209257E+01	1,1217362E+02	1,7782530E+02	-1,1593580E+01	-1,3427990E+02
10	1,7977755E+03	9,3838366E-01	2,8531560E+01	-1,6640931E+02	-9,1236353E+01	3,4847787E+03	1,1077236E+02
11	1,7888572E+02	1,9119337E+03	2,5773021E+09	1,3551773E+11	2,1471932E+02	6,4002326E+03	2,0134441E+05

1	1,7357258E+02	2,0565991E+05	5,5984326E+03	1,8434753E+01	9,1725061E+01	-7,9607794E+01	2,8501246E+01
2	3,0000000E+01	1,4514716E+06	6,8959611E+03	1,4875790E+01	9,1374608E+01	-7,8882590E+01	9,8740712E-01
3	RRRRR	4,5151706E+04	2,8363000E+03	0,	0,	5,0360764E+01	5,0351084E+01
4	IIIII	3,4126595E-01	4,5886411E-07	1,0153349E+03	5,5138776E+00	7,7639666E-01	4,7569457E-01
5	2,6776143E+01	-1,0482667E+00	0,	7,1909621E+00	-2,1083300E+05	1,9093993E+04	1,1698799E+04
6	1,3957037E+06	1,0195875E+00	1,5491698E+03	-2,6891708E+01	2,3261852E-03	-7,9362660E+02	0,
7	0,	0,	0,	1,9541502E-01	-2,3667140E-05	4,5206058E+01	9,1252832E+01
8	1,2446777E+01	9,3778127E-01	-1,9187609E-01	9,5720956E-01	7,1009281E+01	-8,7715690E+01	-2,5813398E+01
9	2,9540196E+02	4,1039905E+03	5,2559445E+01	1,1218823E+02	1,7779301E+02	-1,1852502E+01	-1,3436458E+02
10	1,8032589E+03	9,3348557E-01	2,8531598E+01	-1,6600376E+02	-9,1442455E+01	3,4865751E+03	1,1994274E+02
11	1,7891276E+02	1,9206877E+03	2,5694649E+09	1,4083740E+11	2,3190755E+02	6,6480429E+03	1,9324973E+05

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94

CASE. 1 QL SOLUTION PAGE 11 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
1	1.8357258E+02	2.2274924E+05	5.8038879E+03	1.6495272E+01	9.1834418E+01	-7.9440187E+01	2.8496668E+01
2	4.0000000E+01	1.4204995E+06	7.1133175E+03	1.3395343E+01	9.1475181E+01	-7.8673203E+01	1.1860193E+00
3	RRRRR	4.4188242E+04	3.1487703E+03	0.	0.	5.9218728E+01	5.9206851E+01
4	IIIII	1.5927152E-01	2.3496980E-07	9.8172278E+02	5.9119418E+00	7.9724631E-01	4.9387016E-01
5	2.8301824E+01	-1.0276344E+00	0.	3.9574924E+00	-1.0396578E+05	1.0790429E+04	6.6843471E+03
6	1.3957282E+06	1.0014912E+00	1.7017459E+03	-2.9268797E+01	2.2640645E-03	-7.9163784E+02	0.
7	0.	0.	0.	2.0273798E-01	-3.1679035E-05	4.4792134E+01	9.1347220E+01
8	1.2447727E+01	9.5903100E-01	-2.0287078E-01	9.8025355E-01	6.9652413E+01	-8.7656649E+01	-2.4871092E+01
9	2.9738444E+02	4.1984603E+03	6.3389536E+01	1.1219518E+02	1.7775272E+02	-1.2132952E+01	-1.3476175E+02
10	1.8090626E+03	9.2821817E-01	2.8531628E+01	-1.6558359E+02	-9.1657407E+01	3.4882674E+03	1.2985783E+02
11	1.7894242E+02	1.9299676E+03	2.5612218E+09	1.4634325E+11	2.5039423E+02	6.9045882E+03	1.8547245E+05
1	1.9357258E+02	2.3862692E+05	6.0247468E+03	1.4691951E+01	9.1946801E+01	-7.9264775E+01	2.8491579E+01
2	5.0000000E+01	1.3895275E+06	7.3442570E+03	1.2008389E+01	9.1579267E+01	-7.8456009E+01	1.3989927E+00
3	RRRRR	4.3224777E+04	3.4681292E+03	0.	0.	6.8490257E+01	6.8475977E+01
4	IIIII	7.4756429E-02	1.1858316E-07	9.5186731E+02	6.3293977E+00	8.0899803E-01	5.0506862E-01
5	2.9505495E+01	-1.0156292E+00	0.	2.1521406E+00	-5.0218029E+04	3.9544850E+03	3.7174470E+03
6	1.3957396E+06	9.8415354E-01	1.8500473E+03	-3.1725143E+01	2.2208914E-03	-7.8994736E+02	0.
7	0.	0.	0.	2.1030596E-01	-3.9717758E-05	4.4192353E+01	9.1446616E+01
8	1.2422424E+01	9.8087818E-01	-2.1103216E-01	1.0033228E+00	6.8208721E+01	-8.7586683E+01	-2.4027966E+01
9	2.9850729E+02	4.2829377E+03	7.6534394E+01	1.1219847E+02	1.7770540E+02	-1.2430670E+01	-1.3534259E+02
10	1.8152109E+03	9.2256101E-01	2.8531651E+01	-1.6514822E+02	-9.1881802E+01	3.4898536E+03	1.4056809E+02
11	1.7897500E+02	1.9398147E+03	2.5525468E+09	1.5203514E+11	2.7025073E+02	7.1698756E+03	1.7800497E+05
1	2.0357258E+02	2.5331749E+05	6.2604756E+03	1.3020738E+01	9.2062396E+01	-7.9081266E+01	2.6482934E+01
2	6.0000000E+01	1.3585554E+06	7.5884672E+03	1.0712167E+01	9.1687007E+01	-7.8230740E+01	1.6257711E+00
3	RRRRR	4.2261313E+04	3.7946873E+03	0.	0.	7.8189782E+01	7.8172881E+01
4	IIIII	3.5843916E-02	5.9592766E-08	9.2248606E+02	6.7865260E+00	8.1303540E-01	5.1000499E-01
5	3.0466072E+01	-1.0107789E+00	0.	1.1678262E+00	-2.4683352E+04	3.2472353E+03	2.0369424E+03
6	1.3957449E+06	9.6765567E-01	1.9932167E+03	-3.4262633E+01	2.1895322E+03	-7.8795682E+02	0.
7	0.	0.	0.	2.1813061E-01	-4.7763854E-05	4.3481566E+01	9.1549223E+01
8	1.2382098E+01	1.0035704E+00	-2.1747962E-01	1.0268646E+00	6.6744855E+01	-8.7507194E+01	-2.3275772E+01
9	2.9911645E+02	4.3580866E+03	9.1828182E+01	1.1220005E+02	1.7765196E+02	-1.2743652E+01	-1.3603237E+02
10	1.8217332E+03	9.1648993E-01	2.8531666E+01	-1.6469708E+02	-9.2116121E+01	3.4913333E+03	1.5213307E+02
11	1.7901071E+02	1.9502791E+03	2.5434080E+09	1.5791582E+11	2.9156150E+02	7.4440482E+03	1.7083500E+05

(75)

CASE, 1 OL SOLUTION PAGE 12 DATE 10273

1	2,1357258E+02	2,6684516E+05	6,5106896E+03	1,1476739E+01	9,2181377E+01	-7,8889447E+01	2,8479686E+01
2	7,0000000E+01	1,3275833E+06	7,8457677E+03	9,5037564E+00	9,1798537E+01	-7,7997119E+01	1,8682219E+00
3	RRRRR	4,1297848E+04	4,1287767E+03	0,	0,	8,8332080E+01	8,8312326E+01
4	IIIII	1,7643376E-02	3,0299239E-08	8,9667459E+02	7,2609280E+00	8,1120050E-01	5,1001144E-01
5	3,1235445E+01	-1,0119635E+00	0,	6,4217842E-01	-1,3215024E+04	1,7815992E+03	1,1201132E+03
6	1,3957473E+06	9,5205264E-01	2,1306540E+03	-3,6883222E+01	2,1653914E-03	-7,8586839E+02	0,
7	0,	0,	0,	2,2622703E-01	-5,5813607E-05	4,2706764E+01	9,1656637E+01
8	1,2333229E+01	1,0272603E+00	-2,2297903E-01	1,0511819E+00	6,5298849E+01	-8,7419216E+01	-2,2605548E+01
9	2,9943039E+02	4,4245660E+03	1,0911101E+02	1,1220084E+02	1,7759310E+02	-1,3070810E+01	-1,3678414E+02
10	1,8286638E+03	9,0997744E-01	2,8531673E+01	-1,6422959E+02	-9,2360788E+01	3,4927066E+03	1,6462099E+02
11	1,7904973E+02	1,9614192E+03	2,5337685E+09	1,6398997E+11	3,1442238E+02	7,7273400E+03	1,6394830E+05
1	2,2357258E+02	2,7923435E+05	6,7751248E+03	1,0054385E+01	9,2303908E+01	-7,8688972E+01	2,8472785E+01
2	8,0000000E+01	1,2966113E+06	8,1160816E+03	8,3800122E+00	9,1913992E+01	-7,7754864E+01	2,1266381E+00
3	RRRRR	4,0334384E+04	4,4707530E+03	0,	0,	9,8932408E+01	9,8909554E+01
4	IIIII	8,9340398E-03	1,5765199E-08	8,8179042E+02	7,6833731E+00	8,0726987E-01	5,0802219E-01
5	3,1846927E+01	-1,0183397E+00	0,	3,6182957E-01	-8,3444943E+03	9,9896188E+02	6,2865569E+02
6	1,3957485E+06	9,3737492E-01	2,2619328E+03	-3,9588956E+01	2,1455712E-03	-7,8368455E+02	0,
7	0,	0,	0,	2,3461315E-01	-6,3866154E-05	4,1895691E+01	9,1766600E+01
8	1,2279265E+01	1,0520605E+00	-2,2802748E-01	1,0764887E+00	6,3889853E+01	-8,7323497E+01	-2,2008705E+01
9	2,9957809E+02	4,4830216E+03	1,2822922E+02	1,1220123E+02	1,7752939E+02	-1,3411724E+01	-1,3757019E+02
10	1,8360418E+03	9,0299283E-01	2,8531670E+01	-1,6374519E+02	-9,2616200E+01	3,4939743E+03	1,7810922E+02
11	1,7909218E+02	1,9733015E+03	2,5235867E+09	1,7026380E+11	3,3894058E+02	8,0200573E+03	1,5732972E+05
1	2,3357258E+02	2,9051000E+05	7,0536189E+03	8,7476492E+00	9,2430153E+01	-7,8479568E+01	2,8465175E+01
2	9,0000000E+01	1,2656392E+06	8,3994158E+03	7,3375911E+00	9,2033514E+01	-7,7503679E+01	2,4017403E+00
3	RRRRR	3,9370919E+04	4,8209976E+03	0,	0,	1,1000661E+02	1,0998040E+02
4	IIIII	4,7016956E-03	8,4660031E-09	8,8247830E+02	7,9929658E+00	8,0496484E-01	5,0700199E-01
5	3,2321610E+01	-1,0292816E+00	0,	2,1060681E-01	-6,4318228E+03	5,7979628E+02	3,6518101E+02
6	1,3957491E+06	9,2363092E-01	2,3867362E+03	-4,2381986E+01	2,1283725E-03	-7,8140798E+02	0,
7	0,	0,	0,	2,4330943E-01	-7,1920283E-05	4,1063410E+01	9,1879847E+01
8	1,2221866E+01	1,0780695E+00	-2,3291929E-01	1,1029439E+00	6,2525234E+01	-8,7220565E+01	-2,1477554E+01
9	2,9963181E+02	4,5340785E+03	1,4903043E+02	1,1220144E+02	1,7746128E+02	-1,3766418E+01	-1,3837544E+02
10	1,8439111E+03	8,9550206E-01	2,8531656E+01	-1,6324326E+02	-9,2882757E+01	3,4951373E+03	1,9268491E+02
11	1,7913818E+02	1,9860016E+03	2,5128167E+09	1,7674475E+11	3,6523464E+02	8,3225639E+03	1,5096410E+05
1	2,4357258E+02	3,0069771E+05	7,3460996E+03	7,5502680E+00	9,2560278E+01	-7,8260929E+01	2,8456798E+01
2	1,0000000E+02	1,2346672E+06	8,6958488E+03	6,3730223E+00	9,2157250E+01	-7,7243258E+01	2,6942794E+00
3	RRRRR	3,8407455E+04	5,1799203E+03	0,	0,	1,2157120E+02	1,2154135E+02
4	IIIII	2,6228104E-03	4,7386398E-09	8,9695348E+02	8,1900564E+00	8,0473423E-01	5,0739293E-01
5	3,2673510E+01	-1,0443357E+00	0,	1,2786077E-01	-5,7765256E+03	3,5189727E+02	2,2187473E+02
6	1,3957493E+06	9,1081075E-01	2,5048097E+03	-4,5264585E+01	2,1128495E-03	-7,7904146E+02	0,
7	0,	0,	0,	2,5233873E-01	-7,9975189E-05	4,0217674E+01	9,1996514E+01
8	1,2161768E+01	1,1053855E+00	-2,3782124E-01	1,1306795E+00	6,1206136E+01	-8,7110779E+01	-2,1005494E+01
9	2,9963084E+02	4,5783362E+03	1,7135934E+02	1,1220156E+02	1,7738915E+02	-1,4135171E+01	-1,3919212E+02
10	1,8523212E+03	8,8746778E-01	2,8531631E+01	-1,6272320E+02	-9,3160865E+01	3,4961966E+03	2,0844582E+02
11	1,7918787E+02	1,9996043E+03	2,5014078E+09	1,8344121E+11	3,9343477E+02	8,6352700E+03	1,4483668E+05

(76)

CASE, 1 CL SOLUTION PAGE 13 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
1	2,5357258E+02	3,0982391E+05	7,6525775E+03	6,4559237E+00	9,2694449E+01	-7,8032734E+01	2,8447591E+01
2	1,1000000E+02	1,2036951E+06	9,0055243E+03	5,4827794E+00	9,2285349E+01	-7,6973283E+01	3,0050385E+00
3	RRRRR	3,7443990E+04	5,5479620E+03	0,	0,	1,3364344E+02	1,3360967E+02
4	IIIII	1,5833588E-03	2,7973586E-09	9,1817213E+02	8,3345782E+00	8,0403048E-01	5,0721278E-01
5	3,2912751E+01	-1,0631858E+00	0,	8,1909376E-02	-5,6203624E+03	2,2523311E+02	1,4208555E+02
6	1,3957495E+06	8,9889060E-01	2,6159303E+03	-4,8239163E+01	2,0984902E-03	-7,7658782E+02	0,
7	0,	0,	0,	2,6172651E-01	-8,8030376E-05	3,9362291E+01	9,2116779E+01
8	1,2099241E+01	1,1341121E+00	-2,4282779E-01	1,1598170E+00	5,9930843E+01	-8,6994371E+01	-2,0587014E+01
9	2,9959642E+02	4,6163658E+03	1,9505571E+02	1,1220163E+02	1,7731331E+02	-1,4518408E+01	-1,4001639E+02
10	1,8613275E+03	6,7884906E-01	2,8531594E+01	-1,6218434E+02	-9,3450946E+01	3,4971534E+03	2,2550158E+02
11	1,7924137E+02	2,0142056E+03	2,4893044E+09	1,9036245E+11	4,2368343E+02	8,9586271E+03	1,3893336E+05
1	2,6357258E+02	3,1791592E+05	7,9731427E+03	5,4583852E+00	9,2832839E+01	-7,7794650E+01	2,8437485E+01
2	1,2000000E+02	1,1727230E+06	9,3286491E+03	4,6633438E+00	9,2417970E+01	-7,6693418E+01	3,3348347E+00
3	RRRRR	3,6480526E+04	5,9255982E+03	0,	0,	1,4624140E+02	1,4620340E+02
4	IIIII	1,0462842E-03	1,7598686E-09	9,3788915E+02	8,5011568E+00	7,9955858E-01	5,0384033E-01
5	3,3067407E+01	-1,0856273E+00	0,	5,5938309E-02	-5,6367936E+03	1,5296276E+02	9,6389198E+01
6	1,3957495E+06	8,8783648E-01	2,7198866E+03	-5,1308281E+01	2,0850181E-03	-7,7404991E+02	0,
7	0,	0,	0,	2,7150097E-01	-9,6085589E-05	3,8499102E+01	9,2240836E+01
8	1,2034333E+01	1,1643621E+00	-2,4799538E-01	1,1904793E+00	5,8696667E+01	-8,6871471E+01	-2,0217598E+01
9	2,9954016E+02	4,6487076E+03	2,1995428E+02	1,1220167E+02	1,7723397E+02	-1,4916626E+01	-1,4084635E+02
10	1,8709920E+03	8,6960113E-01	2,8531543E+01	-1,6162602E+02	-9,3753439E+01	3,4980088E+03	2,4397524E+02
11	1,7929880E+02	2,0299135E+03	2,4764459E+09	1,9751856E+11	4,5613639E+02	9,2931267E+03	1,3324073E+05
1	2,7357258E+02	3,2500208E+05	8,3079637E+03	4,5516117E+00	9,2975621E+01	-7,7546328E+01	2,8426406E+01
2	1,3000000E+02	1,1417510E+06	9,6654932E+03	3,9112561E+00	9,2555276E+01	-7,6403315E+01	3,6845221E+00
3	RRRRR	3,5517961E+04	6,3133426E+03	0,	0,	1,5938403E+02	1,5934147E+02
4	IIIII	7,5489575E-04	1,1862303E-09	9,5082233E+02	8,7376616E+00	7,8935592E-01	4,9573490E-01
5	3,3084428E+01	-1,1115478E+00	0,	4,0938148E-02	-5,6899074E+03	1,1051651E+02	6,9407083E+01
6	1,3957496E+06	8,7760733E-01	2,8164782E+03	-5,4474668E+01	2,0722793E-03	-7,7143060E+02	0,
7	0,	0,	0,	2,8169344E-01	-1,0414072E-04	3,7629015E+01	9,2368883E+01
8	1,1966989E+01	1,1962603E+00	-2,5336132E-01	1,2227963E+00	5,7500863E+01	-8,6742131E+01	-1,9893604E+01
9	2,9946653E+02	4,6758710E+03	2,4588584E+02	1,1220170E+02	1,7715130E+02	-1,5330365E+01	-1,4168102E+02
10	1,8813849E+03	8,5967503E-01	2,8531477E+01	-1,6104751E+02	-9,4068804E+01	3,4987644E+03	2,6400528E+02
11	1,7936031E+02	2,0468503E+03	2,4627660E+09	2,0492049E+11	4,9096403E+02	9,6393008E+03	1,2774609E+05

(77)

1	2,8357258E+02	3,3111186E+05	8,6572872E+03	3,7298246E+00	9,3122977E+01	-7,7287401E+01	2,8414275E+01
2	1,4000000E+02	1,1107789E+06	1,0016391E+04	3,2231557E+00	9,2697438E+01	-7,6102607E+01	4,0549932E+00
3	RRRRR	3,4553597E+04	6,7117512E+03	0,	0,	1,7309121E+02	1,7304379E+02
4	IIIII	5,0661357E-04	8,5586793E-10	9,5638454E+02	9,0520987E+00	7,7347264E-01	4,8302565E-01
5	3,3030070E+01	-1,1409139E+00	0,	3,2073061E-02	-5,7258271E+03	8,4842112E+01	5,2983020E+01
6	1,3957496E+06	8,6815753E-01	2,9054895E+03	-5,7741239E+01	2,0601844E-03	-7,6873275E+02	0,
7	0,	0,	0,	2,9233875E-01	-1,1219575E-04	3,6752510E+01	9,2501118E+01
8	1,1897103E+01	1,2299451E+00	-2,5895372E-01	1,2569096E+00	5,6341012E+01	-8,6606336E+01	-1,9612194E+01
9	2,9938524E+02	4,6983345E+03	2,7267887E+02	1,1220172E+02	1,7706538E+02	-1,5760187E+01	-1,4251983E+02
10	1,8925848E+03	8,4901707E-01	2,8531397E+01	-1,6044809E+02	-9,4397523E+01	3,4994217E+03	2,8574801E+02
11	1,7942604E+02	2,0651550E+03	2,4481918E+09	2,1258010E+11	5,2835295E+02	9,9977251E+03	1,2243744E+05
1	2,9357258E+02	3,3627598E+05	9,0214391E+03	2,9875538E+00	9,3275092E+01	-7,7017486E+01	2,8401005E+01
2	1,5000000E+02	1,0798069E+06	1,0381743E+04	2,5958110E+00	9,2844633E+01	-7,5790910E+01	4,4471822E+00
3	RRRRR	3,3590132E+04	7,1214273E+03	0,	0,	1,8738386E+02	1,8733113E+02
4	IIIII	4,3226096E-04	6,5724884E-10	9,5737015E+02	9,4231465E+00	7,5337678E-01	4,6701708E-01
5	3,2890090E+01	-1,1737624E+00	0,	2,6745547E-02	-5,7250322E+03	6,8911201E+01	4,2717948E+01
6	1,3957496E+06	8,5943894E-01	2,9867063E+03	-6,1111111E+01	2,0486776E-03	-7,6595921E+02	0,
7	0,	0,	0,	3,0347573E-01	-1,2025069E+04	3,5869869E+01	9,2637737E+01
8	1,1824538E+01	1,2655706E+00	-2,6479672E-01	1,2929757E+00	5,5215171E+01	-8,6464019E+01	-1,9371039E+01
9	2,9929240E+02	4,7165466E+03	3,0016110E+02	1,1220174E+02	1,7697623E+02	-1,6206675E+01	-1,4336238E+02
10	1,9046814E+03	8,3756635E-01	2,8531299E+01	-1,5982698E+02	-9,4740102E+01	3,4999822E+03	3,0938094E+02
11	1,7949614E+02	2,0849859E+03	2,4326434E+09	2,2051026E+11	5,6850789E+02	1,0369022E+04	1,1730341E+05
1	3,0357258E+02	3,4052659E+05	9,4008269E+03	2,3196642E+00	9,3432158E+01	-7,6736178E+01	2,8386503E+01
2	1,6000000E+02	1,0488348E+06	1,0762021E+04	2,0261389E+00	9,2997046E+01	-7,5467822E+01	4,8620669E+00
3	RRRRR	3,2626668E+04	7,5430267E+03	0,	0,	2,0228396E+02	2,0222559E+02
4	IIIII	4,1302208E-04	5,3314225E-10	9,5728032E+02	9,8203491E+00	7,3085659E-01	4,4926094E-01
5	3,2669825E+01	-1,2101960E+00	0,	2,3558369E-02	-5,6817692E+03	5,8884840E+01	3,6196789E+01
6	1,3957496E+06	8,5140242E-01	3,0599030E+03	-6,4587627E+01	2,0377216E-03	-7,6311278E+02	0,
7	0,	0,	0,	3,1514784E-01	-1,2830558E-04	3,4981294E+01	9,2778932E+01
8	1,1749140E+01	1,3033094E+00	-2,7091329E-01	1,3311684E+00	5,4121904E+01	-8,6315063E+01	-1,9168645E+01
9	2,9919163E+02	4,7309272E+03	3,2816103E+02	1,1220176E+02	1,7688384E+02	-1,6670425E+01	-1,4420834E+02
10	1,9177762E+03	8,2526408E-01	2,8531184E+01	-1,5918335E+02	-9,5097071E+01	3,5004479E+03	3,3510437E+02
11	1,7957076E+02	2,1065244E+03	2,4160331E+09	2,2872490E+11	6,1165397E+02	1,0753867E+04	1,1233322E+05
1	3,1357258E+02	3,4389742E+05	9,7959425E+03	1,7213681E+00	9,3594372E+01	-7,6443056E+01	2,8370669E+01
2	1,7000000E+02	1,0178627E+06	1,1157772E+04	1,5112194E+00	9,3154869E+01	-7,5132919E+01	5,3006720E+00
3	RRRRR	3,1663203E+04	7,9772643E+03	0,	0,	2,1781471E+02	2,1775029E+02
4	IIIII	3,6499445E-04	4,5359861E-10	9,5832698E+02	1,0221921E+01	7,0715615E-01	4,3084243E-01
5	3,2374239E+01	-1,2503819E+00	0,	2,1763772E-02	-5,5953171E+03	5,2635118E+01	3,2068507E+01
6	1,3957496E+06	8,4399904E-01	3,1248432E+03	-6,8174379E+01	2,0272894E-03	-7,6019625E+02	0,
7	0,	0,	0,	3,2740382E-01	-1,3636048E-04	3,4086958E+01	9,2924897E+01
8	1,1670740E+01	1,3433552E+00	-2,7732683E-01	1,3716826E+00	5,3060292E+01	-8,6159307E+01	-1,9003902E+01
9	2,9908356E+02	4,7418689E+03	3,5650919E+02	1,1220178E+02	1,7678810E+02	-1,7152051E+01	-1,4505738E+02
10	1,9319653E+03	8,1203286E-01	2,8531050E+01	-1,5851637E+02	-9,5468990E+01	3,5008209E+03	3,6314976E+02
11	1,7965008E+02	2,1299791E+03	2,3982639E+09	2,3723921E+11	6,5803930E+02	1,1152993E+04	1,0751661E+05

78

CASE, 1 QL SOLUTION PAGE 15 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY

1	3,2357258E+02	3,4642398E+05	1,0207367E+04	1,1882263E+00	9,3761941E+01	-7,6137672E+01	2,8353394E+01
2	1,8000000E+02	9,8689069E+05	1,1569624E+04	1,0483028E+00	9,3318306E+01	-7,4785753E+01	5,7640720E+00
3	RRRRR	3,0699739E+04	8,4249215E+03	0,	0,	2,3400058E+02	2,3392968E+02
4	IIIII	3,3161928E-04	4,0260041E-10	9,6088239E+02	1,0622909E+01	6,8269508E-01	4,1217399E-01
5	3,2007952E+01	-1,2945529E+00	0,	2,0973535E-02	-5,4663503E+03	4,8969370E+01	2,9565030E+01
6	1,3957496E+06	8,3718093E-01	3,1812777E+03	-7,1875229E+01	2,0173594E-03	-7,5721235E+02	0,
7	0,	0,	0,	3,4029852E-01	-1,4441544E-04	3,3187038E+01	9,3075822E+01
8	1,1589151E+01	1,3859258E+00	-2,8406221E-01	1,4147373E+00	5,2029922E+01	-8,5996547E+01	-1,8876251E+01
9	2,9896889E+02	4,7497391E+03	3,8503922E+02	1,1220179E+02	1,7668886E+02	-1,7652183E+01	-1,4590916E+02
10	1,9474422E+03	7,9779573E-01	2,8530896E+01	-1,5782512E+02	-9,5856447E+01	3,5011032E+03	3,9378113E+02
11	1,7973426E+02	2,1555916E+03	2,3792289E+09	2,4606972E+11	7,0793803E+02	1,1567196E+04	1,0284380E+05

1	3,3357258E+02	3,4814366E+05	1,0635774E+04	7,1614264E-01	9,3935077E+01	-7,5819556E+01	2,8334559E+01
2	1,9000000E+02	9,5591863E+05	1,1998289E+04	6,3481457E-01	9,3487566E+01	-7,4425856E+01	6,2533949E+00
3	RRRRR	2,9736274E+04	8,8668540E+03	0,	0,	2,5086741E+02	2,5078960E+02
4	IIIII	3,0979888E-04	3,7140814E-10	9,6400534E+02	1,1032900E+01	6,5729340E-01	3,9320308E-01
5	3,1575256E+01	-1,3430126E+00	0,	2,1006787E-02	-5,2954079E+03	4,7222069E+01	2,8248972E+01
6	1,3957496E+06	8,3090196E-01	3,2289429E+03	-7,5694344E+01	2,0079129E-03	-7,5416375E+02	0,
7	0,	0,	0,	3,5389397E-01	-1,5247054E-04	3,2281728E+01	9,3231898E+01
8	1,1504174E+01	1,4312674E+00	-2,9114649E-01	1,4609795E+00	5,1030898E+01	-8,5826538E+01	-1,8785633E+01
9	2,9884806E+02	4,7548815E+03	4,1358878E+02	1,1220180E+02	1,7658587E+02	-1,8171467E+01	-1,4676327E+02
10	1,9643006E+03	7,6246520E-01	2,8530721E+01	-1,5710867E+02	-9,6260061E+01	3,5012974E+03	4,2730372E+02
11	1,7982350E+02	2,1836425E+03	2,3580094E+09	2,5523452E+11	7,6165402E+02	1,1997348E+04	9,8305449E+04

1	3,4357258E+02	3,4909625E+05	1,1081942E+04	3,0135349E-01	9,4114003E+01	-7,5488211E+01	2,8314037E+01
2	2,0000000E+02	9,2494657E+05	1,2444579E+04	2,6835609E-01	9,3662871E+01	-7,4052731E+01	6,7698258E+00
3	RRRRR	2,8772810E+04	9,3640024E+03	0,	0,	2,6844258E+02	2,6835738E+02
4	IIIII	2,9795353E-04	3,5521222E-10	9,6635848E+02	1,1467734E+01	6,3059951E-01	3,7376243E-01
5	3,1080146E+01	-1,3961427E+00	0,	2,1811707E-02	-5,0821664E+03	4,7040225E+01	2,7881196E+01
6	1,3957496E+06	8,2511814E-01	3,2675597E+03	-7,9636223E+01	1,9989329E-03	-7,5105305E+02	0,
7	0,	0,	0,	3,6826048E-01	-1,6052585E-04	3,1371247E+01	9,3393316E+01
8	1,1415593E+01	1,4796592E+00	-2,9860951E-01	1,5094896E+00	5,0063843E+01	-8,5648988E+01	-1,8732491E+01
9	2,9872144E+02	4,7576179E+03	4,4200024E+02	1,1220182E+02	1,7647883E+02	-1,8710569E+01	-1,4761924E+02
10	1,9827390E+03	7,6594404E-01	2,8530522E+01	-1,5636602E+02	-9,6680487E+01	3,5014062E+03	4,4407189E+02
11	1,7991800E+02	2,2144606E+03	2,3368737E+09	2,6475346E+11	8,1952499E+02	1,2444401E+04	9,3892572E+04

(79)

CASE, 1 QL SOLUTION PAGE 16 DATE 10273

1	3,5357258E+02	3,4932390E+05	1,1546758E+04	-5,9585442E-02	9,4298952E+01	-7,5143114E+01	2.8291689E+01
2	2,1000000E+02	8,9397451E+05	1,2909409E+04	-5,3295906E-02	9,3844453E+01	-7,3665853E+01	7.3146110E+00
3	RRRRR	2,7809345E+04	9,8574034E+03	0,	0,	2,8675512E+02	2.8666203E+02
4	IIIII	2,9514491E-04	3,5144825E-10	9,6699560E+02	1,1940859E+01	6,0244853E-01	3.5383905E-01
5	3,0526320E+01	-1,4544139E+00	0,	2,3428879E-02	-4,8249425E+03	4,8272254E+01	2.8351979E+01
6	1,3957496E+06	8,1978794E-01	3,2968316E+03	-8,3705734E+01	1,9904021E-03	-7,4788276E+02	0.
7	0,	0,	0,	3,8347815E-01	-1,6858148E-04	3,0455851E+01	9.3560264E+01
8	1,1323173E+01	1,5314192E+00	-3,0648449E-01	1,5617866E+00	4,9129936E+01	-8,5463555E+01	-1.8717793E+01
9	2,9858936E+02	4,7582504E+03	4,7012130E+02	1,1220183E+02	1,7636732E+02	-1,9270173E+01	-1.4847683E+02
10	2,0029660E+03	7,4812377E-01	2,8530299E+01	-1,5559611E+02	-9,7082531E+01	3,5014324E+03	5.0449951E+02
11	-1,7998206E+02	2,2484331E+03	2,3132748E+09	2,7464836E+11	8,8192759E+02	1,2909402E+04	8.9596514E+04
1	3,6357258E+02	3,4887158E+05	1,2031231E+04	-3,6981414E-01	9,4490169E+01	-7,4783707E+01	2.8267364E+01
2	2,2000000E+02	8,6300245E+05	1,3393811E+04	-3,3219174E-01	9,4032556E+01	-7,3264665E+01	7.8890631E+00
3	RRRRR	2,6845881E+04	1,0366203E+04	0,	0,	3,0583584E+02	3.0573434E+02
4	IIIII	3,0073357E-04	3,5896662E-10	9,6575884E+02	1,2457801E+01	5,7302288E-01	3.3367139E-01
5	2,9917222E+01	-1,5184014E+00	0,	2,5980304E-02	-4,5201578E+03	5,0914595E+01	2.9647584E+01
6	1,3957496E+06	8,1487242E-01	3,3164431E+03	-8,7908156E+01	1,9823028E-03	-7,4465528E+02	0.
7	0,	0,	0,	3,9963865E-01	-1,7663752E-04	2,9535832E+01	9.3732931E+01
8	1,1226659E+01	1,5869109E+00	-3,1480866E-01	1,6178352E+00	4,8230954E+01	-8,5269843E+01	-1.8743076E+01
9	2,9845215E+02	4,7570628E+03	4,9780553E+02	1,1220184E+02	1,7625079E+02	-1,9850979E+01	-1.4933491E+02
10	2,0252263E+03	7,2888303E-01	2,8530049E+01	-1,5479782E+02	-9,7327455E+01	3,5013794E+03	5.4907322E+02
11	-1,7987643E+02	2,2860196E+03	2,2878484E+09	2,8494332E+11	9,4928337E+02	1,3393503E+04	8.5408889E+04
1	3,7357256E+02	3,4778740E+05	1,2536508E+04	-6,3218378E-01	9,4687896E+01	-7,4409402E+01	2.8240899E+01
2	2,3000000E+02	8,3203039E+05	1,3898951E+04	-5,7021185E-01	9,4227436E+01	-7,2848578E+01	8.4945659E+00
3	RRRRR	2,5882416E+04	1,0897674E+04	0,	0,	3,2571758E+02	3.2560713E+02
4	IIIII	3,1427031E-04	3,7765710E-10	9,6324662E+02	1,3014847E+01	5,4281179E-01	3.1368983E-01
5	2,9256050E+01	-1,5888052E+00	0,	2,9677055E-02	-4,1616066E+03	5,5092970E+01	3.1838115E+01
6	1,3957496E+06	8,1033535E-01	3,3260579E+03	-9,2249223E+01	1,9746154E-03	-7,4137289E+02	0.
7	0,	0,	0,	4,1684729E-01	-1,8469412E-04	2,8611528E+01	9.3911502E+01
8	1,1125777E+01	1,6465521E+00	-3,2362400E-01	1,6780544E+00	4,7369343E+01	-8,5067386E+01	-1.8810510E+01
9	2,9831016E+02	4,7543222E+03	5,2491281E+02	1,1220186E+02	1,7612855E+02	-2,0453708E+01	-1.5019242E+02
10	2,0498099E+03	7,0808547E-01	2,8529772E+01	-1,5396999E+02	-9,7579590E+01	3,5012505E+03	5.9836930E+02
11	-1,7976491E+02	2,3277697E+03	2,2604099E+09	2,9566506E+11	1,0220659E+03	1,3897979E+04	8.1321530E+04
1	3,8357258E+02	3,4612300E+05	1,3063885E+04	-8,4927210E-01	9,4892412E+01	-7,4019570E+01	2.8212116E+01
2	2,4000000E+02	8,0105833E+05	1,4426144E+04	-7,6907039E-01	9,4429364E+01	-7,2416966E+01	9.1325804E+00
3	RRRRR	2,4918952E+04	1,1447233E+04	0,	0,	3,4643534E+02	3.4631535E+02
4	IIIII	3,3550455E-04	4,0833674E-10	9,6046485E+02	1,3601628E+01	5,1243623E-01	2.9436988E-01
5	2,8545782E+01	-1,6664769E+00	0,	3,4844414E-02	-3,7394206E+03	6,1065948E+01	3.5079439E+01
6	1,3957496E+06	8,0614320E-01	3,3253164E+03	-9,6735175E+01	1,9673174E-03	-7,3803771E+02	0.
7	0,	0,	0,	4,3522577E-01	-1,9275145E-04	2,7683328E+01	9.4096155E+01
8	1,1020227E+01	1,7108252E+00	-3,3297807E-01	1,7429278E+00	4,6548313E+01	-8,4855644E+01	-1.8922992E+01
9	2,9816382E+02	4,7502806E+03	5,5130973E+02	1,1220187E+02	1,7599974E+02	-2,1079099E+01	-1.5104939E+02
10	2,0770627E+03	6,8557732E-01	2,8529464E+01	-1,5311134E+02	-9,7839279E+01	3,5010498E+03	6.5307562E+02
11	-1,7964725E+02	2,3743461E+03	2,2307515E+09	3,0684328E+11	1,1008094E+03	1,4424248E+04	7.7326438E+04

(80)

CASE, 1 OL SOLUTION PAGE 17 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
1	3,9357258E+02	3,4393397E+05	1,3614836E+04	-1,0233980E+00	9,5103994E+01	-7,3613543E+01	2,8180819E+01
2	2,5000000E+02	7,7008627E+05	1,4976874E+04	-9,3031880E-01	9,4638626E+01	-7,1969158E+01	9,8046518E+00
3	RRRRR	2,3955487E+04	1,2018464E+04	0,	0,	3,6802656E+02	3,6789643E+02
4	IIIII	3,6449799E-04	4,5281235E-10	9,5835046E+02	1,4206532E+01	4,8243490E-01	2,7608109E-01
5	2,7709197E+01	-1,7524562E+00	0,	4,1967500E-02	-3,2386594E+03	6,9243326E+01	3,9625602E+01
6	1,3957496E+06	8,0226509E-01	3,3138345E+03	-1,0137282E+02	1,9603815E-03	-7,3465168E+02	0,
7	0,	0,	0,	4,5491542E-01	-2,0080972E-04	2,6751677E+01	9,4287064E+01
8	1,0909687E+01	1,7802902E+00	-3,4292507E-01	1,8130170E+00	4,5771969E+01	-8,4633975E+01	-1,9084270E+01
9	2,9801368E+02	4,7451777E+03	5,7687002E+02	1,1220189E+02	1,7586324E+02	-2,1727903E+01	-1,5190436E+02
10	2,1074008E+03	6,6118442E-01	2,8529125E+01	-1,5222054E+02	-9,8106895E+01	3,5007814E+03	7,1402023E+02
11	-1,7952319E+02	2,4265561E+03	2,1986376E+09	3,1851122E+11	1,1861193E+03	1,4973888E+04	7,3415720E+04
1	4,0357258E+02	3,4128041E+05	1,4191032E+04	-1,1566353E+00	9,5322937E+01	-7,3190607E+01	2,8146797E+01
2	2,6000000E+02	7,3911421E+05	1,5552826E+04	-1,0553491E+00	9,4855525E+01	-7,1504441E+01	1,0512417E+01
3	RRRRR	2,2992023E+04	1,2613148E+04	0,	0,	3,9053138E+02	3,9039048E+02
4	IIIII	4,0185109E-04	5,1406857E-10	9,5736301E+02	1,4823042E+01	4,5310789E-01	2,5899960E-01
5	2,6968099E+01	-1,8480185E+00	0,	5,1762949E-02	-2,6375044E+03	8,0213366E+01	4,5850514E+01
6	1,3957496E+06	7,9867279E-01	3,2912006E+03	-1,0616960E+02	1,9537735E-03	-7,3121652E+02	0,
7	0,	0,	0,	4,7608133E-01	-2,0886921E-04	2,5817087E+01	9,4484388E+01
8	1,0793807E+01	1,8556008E+00	-3,5352713E-01	1,8889774E+00	4,5045490E+01	-8,4401619E+01	-1,9299120E+01
9	2,9706045E+02	4,7392398E+03	6,0147489E+02	1,1220191E+02	1,7571768E+02	-2,2400886E+01	-1,5275607E+02
10	2,1413297E+03	6,3470652E-01	2,8528751E+01	-1,5129617E+02	-9,8382843E+01	3,5004500E+03	7,8220950E+02
11	-1,7939248E+02	2,4853923E+03	2,1638006E+09	3,3070614E+11	1,2786845E+03	1,5548669E+04	6,9581537E+04
1	4,1357258E+02	3,3822748E+05	1,4794375E+04	-1,2508245E+00	9,5549553E+01	-7,2749996E+01	2,8109817E+01
2	2,7000000E+02	7,0814215E+05	1,6155912E+04	-1,1453968E+00	9,5080383E+01	-7,1022049E+01	1,1257613E+01
3	RRRRR	2,2028558E+04	1,3233292E+04	0,	0,	4,1399296E+02	4,1384061E+02
4	IIIII	4,4900645E-04	5,9653057E-10	9,5729098E+02	1,5454418E+01	4,2448168E-01	2,4311301E-01
5	2,6147339E+01	-1,9547396E+00	0,	6,5282379E-02	-1,9051309E+03	9,4772214E+01	5,4278804E+01
6	1,3957496E+06	7,9534054E-01	3,2569739E+03	-1,1113366E+02	1,9474484E-03	-7,2773370E+02	0,
7	0,	0,	0,	4,9891762E-01	-2,1693028E-04	2,4880148E+01	9,4688271E+01
8	1,0672210E+01	1,9375251E+00	-3,6485594E-01	1,9715789E+00	4,4375362E+01	-8,4157656E+01	-1,9573573E+01
9	2,9770512E+02	4,7326834E+03	6,2501352E+02	1,1220194E+02	1,7556126E+02	-2,3098817E+01	-1,5360301E+02
10	2,1794700E+03	6,0592288E-01	2,8528341E+01	-1,5033669E+02	-9,8667572E+01	3,5000607E+03	8,5887925E+02
11	-1,7925485E+02	2,5520699E+03	2,1259346E+09	3,4347011E+11	1,3792938E+03	1,6150583E+04	6,5816031E+04

(21)

CASE, 1 QL SOLUTION PAGE 18 DATE 10872

1	4,2357258E+02	3,3484608E+05	1,5427039E+04	-1,3075835E+00	9,5784175E+01	-7,2290887E+01	2,8049428E+01
2	2,8000000E+02	6,7717009E+05	1,6788311E+04	-1,2015425E+00	9,5313542E+01	-7,0521159E+01	1,2042088E+01
3	RRRRR	2,1065094E+04	1,3881175E+04	0,	0,	4,3845786E+02	4,3829336E+02
4	IIIII	5,0853428E-04	7,0631668E-10	9,5733542E+02	1,6114560E+01	3,9640044E-01	2,2830095E+01
5	2,5266851E+01	-2,0745836E+00	0,	8,4049398E-02	-9,9953192E+02	1,1394489E+02	6,5624867E+01
6	1,3957496E+06	7,9224502E-01	3,2106828E+03	-1,1627396E+02	1,9413450E-03	-7,2420438E+02	0,
7	0,	0,	0,	5,2365400E-01	-2,2499341E-04	2,3941543E+01	9,4898828E+01
8	1,0544487E+01	2,0269717E+00	-3,7699482E-01	2,0617322E+00	4,3769695E+01	-8,3900960E+01	-1,9915217E+01
9	2,9754906E+02	4,7257156E+03	6,4738348E+02	1,1220197E+02	1,7539172E+02	-2,3822463E+01	-1,5444330E+02
10	2,2225920E+03	5,7456666E-01	2,8527891E+01	-1,4934045E+02	-9,8961583E+01	3,4996192E+03	9,4554473E+02
11	-1,7911002E+02	2,6282050E+03	2,0846879E+09	3,5685083E+11	1,4888547E+03	1,6781886E+04	6,2111253E+04
1	4,3357258E+02	3,3121369E+05	1,6091514E+04	-1,3283160E+00	9,6027154E+01	-7,1812394E+01	2,8025942E+01
2	2,9000000E+02	6,4619803E+05	1,7452523E+04	-1,2247128E+00	9,5555369E+01	-7,0000885E+01	1,2867813E+01
3	RRRRR	2,0101629E+04	1,4559395E+04	0,	0,	4,6397646E+02	4,6379907E+02
4	IIIII	5,8427491E-04	8,5133144E-10	9,5643196E+02	1,6824525E+01	3,6869073E-01	2,1444308E+01
5	2,4349671E+01	-2,2100233E+00	0,	1,1022053E-01	1,3405573E+02	1,3807952E+02	8,0835220E+01
6	1,3957496E+06	7,8936520E-01	3,1518232E+03	-1,2160034E+02	1,9353781E-03	-7,2062933E+02	0,
7	0,	0,	0,	5,5056439E-01	-2,3305925E-04	2,3002070E+01	9,5116139E+01
8	1,0410200E+01	2,1250230E+00	-3,9004139E-01	2,1605219E+00	4,3238640E+01	-8,3630133E+01	-2,0333613E+01
9	2,9739417E+02	4,7105356E+03	6,6849132E+02	1,1220200E+02	1,7520614E+02	-2,4572568E+01	-1,5527465E+02
10	2,2716649E+03	5,4033801E-01	2,8527399E+01	-1,4830570E+02	-9,9265445E+01	3,4991318E+03	1,0441980E+03
11	-1,7895773E+02	2,7157264E+03	2,0396541E+09	3,7090270E+11	1,6084179E+03	1,7445143E+04	5,8459081E+04
1	4,4357258E+02	3,2741528E+05	1,6790671E+04	-1,3142174E+00	9,6278868E+01	-7,1313555E+01	2,7978459E+01
2	3,0000000E+02	6,1522597E+05	1,8151424E+04	-1,2156794E+00	9,5806256E+01	-6,9460265E+01	1,3736895E+01
3	RRRRR	1,9138165E+04	1,5270933E+04	0,	0,	4,9060351E+02	4,9041246E+02
4	IIIII	6,8120687E-04	1,0409492E-09	9,5367805E+02	1,7606226E+01	3,4131801E-01	2,0150194E+01
5	2,3397984E+01	-2,3642095E+00	0,	1,4673565E-01	1,5628739E+03	1,7128564E+02	1,0112091E+02
6	1,3957496E+06	7,8668222E-01	3,0798593E+03	-1,2712370E+02	1,9294264E-03	-7,1700890E+02	0,
7	0,	0,	0,	5,7997805E-01	-2,4112876E-04	2,2062666E+01	9,5340228E+01
8	1,0268871E+01	2,2329786E+00	-4,0411109E-01	2,2692508E+00	4,2794955E+01	-8,3343398E+01	-2,0840842E+01
9	2,9724315E+02	4,7113355E+03	6,8825317E+02	1,1220204E+02	1,7500072E+02	-2,5349838E+01	-1,5609418E+02
10	2,3279256E+03	5,0288528E-01	2,8526861E+01	-1,4723051E+02	-9,9579823E+01	3,4986052E+03	1,1572461E+03
11	-1,7879773E+02	2,8172363E+03	1,9903602E+09	3,8568818E+11	1,7392081E+03	1,8143298E+04	5,4851114E+04
1	4,5357258E+02	3,2354443E+05	1,7527837E+04	-1,2662784E+00	9,6539720E+01	-7,0793326E+01	2,7926837E+01
2	3,1000000E+02	5,8425391E+05	1,8888347E+04	-1,1750563E+00	9,6066625E+01	-6,8898255E+01	1,4651595E+01
3	RRRRR	1,8174700E+04	1,6019233E+04	0,	0,	5,1839875E+02	5,1819323E+02
4	IIIII	8,0488200E-04	1,2849145E-09	9,4868432E+02	1,8475943E+01	3,1446386E-01	1,8954721E+01
5	2,2413956E+01	-2,5412103E+00	0,	1,9737898E-01	3,3624316E+03	2,1227446E+02	1,2795121E+02
6	1,3957496E+06	7,8417933E-01	2,9942265E+03	-1,3285608E+02	1,9233174E-03	-7,1334289E+02	0,
7	0,	0,	0,	6,1229426E-01	-2,4920503E-04	2,1124440E+01	9,5571039E+01
8	1,0119978E+01	2,3524138E+00	-4,1934187E-01	2,3894974E+00	4,2454765E+01	-8,3038455E+01	-2,1452255E+01
9	2,9709972E+02	4,7043019E+03	7,0659556E+02	1,1220210E+02	1,7477047E+02	-2,6154895E+01	-1,5689822E+02
10	2,3829792E+03	4,6179587E-01	2,8526274E+01	-1,4611280E+02	-9,9905527E+01	3,4980471E+03	1,2879113E+03
11	-1,7862986E+02	2,9361484E+03	1,9362520E+09	4,0127942E+11	1,8826634E+03	1,8879743E+04	5,1278596E+04

(82)

CASE, 1 QL SOLUTION PAGE 19 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY
1	4,6357258E+02	3,1970467E+05	1,8306895E+04	-1,1852854E+00	9,6810144E+01	-7,0250566E+01	2,7870699E+01
2	3,2000000E+02	5,5328185E+05	1,9667178E+04	-1,1032945E+00	9,6336935E+01	-6,8313714E+01	1,5614347E+01
3	RRRRR	1,7211236E+04	1,6808300E+04	0,	0,	5,4742768E+02	5,4720683E+02
4	IIIII	9,6019982E-04	1,5909918E-09	9,4170581E+02	1,9440143E+01	2,8849480E-01	1,7871996E-01
5	2,1399782E+01	-2,7463584E+00	0,	2,6660441E-01	5,6052780E+03	2,6304583E+02	1,6295455E+02
6	1,3957496E+06	7,8184171E-01	2,6943367E+03	-1,3881087E+02	1,9168068E-03	-7,0963044E+02	0,
7	0,	0,	0,	6,4800196E-01	-2,5728404E-04	2,0188710E+01	9,5808404E+01
8	9,9629352E+00	2,4852553E+00	-4,3590035E-01	2,5231930E+00	4,2238591E+01	-8,2712255E+01	-2,2187493E+01
9	2,9696903E+02	4,6976168E+03	7,2345638E+02	1,1220216E+02	1,7450875E+02	-2,6988228E+01	-1,5768206E+02
10	2,4689475E+03	4,1658174E-01	2,8525633E+01	-1,4495029E+02	-1,0024360E+02	3,4974659E+03	1,4404291E+03
11	-1,7845407E+02	3,0770702E+03	1,8766744E+09	4,1776043E+11	2,0404855E+03	1,9658422E+04	4,7732071E+04
1	4,7357258E+02	3,1601110E+05	1,9132409E+04	-1,0718168E+00	9,7090610E+01	-6,9684022E+01	2,7809627E+01
2	3,3000000E+02	5,2230979E+05	2,0492485E+04	-1,0006734E+00	9,6617681E+01	-6,7705389E+01	1,6627782E+01
3	RRRRR	1,6247771E+04	1,7642836E+04	0,	0,	5,7776248E+02	5,7752541E+02
4	IIIII	1,1492538E-03	1,9609597E-09	9,3352209E+02	2,0494864E+01	2,6384671E-01	1,6916439E-01
5	2,0387736E+01	-2,9867653E+00	0,	3,5890373E-01	8,3388197E+03	3,2385884E+02	2,0764096E+02
6	1,3957495E+06	7,7965644E-01	2,7795905E+03	-1,4500298E+02	1,9095570E-03	-7,0586987E+02	0,
7	0,	0,	0,	6,8770638E-01	-2,6537439E-04	1,9257042E+01	9,6051986E+01
8	9,7970667E+00	2,6338872E+00	-4,5399025E-01	2,6727269E+00	4,2172760E+01	-8,2360652E+01	-2,3071895E+01
9	2,9685792E+02	4,6914587E+03	7,3878604E+02	1,1220224E+02	1,7420661E+02	-2,7850094E+01	-1,5843951E+02
10	2,5586978E+03	3,6666047E-01	2,8524934E+01	-1,4374050E+02	-1,0059550E+02	3,4968712E+03	1,6205249E+03
11	-1,7827062E+02	3,2463708E+03	1,8108471E+09	4,3522984E+11	2,2147067E+03	2,0483958E+04	4,4201593E+04
1	4,8357258E+02	3,1259235E+05	2,0009791E+04	-9,2623592E-01	9,7381630E+01	-6,9092309E+01	2,7743152E+01
2	3,4000000E+02	4,9133773E+05	2,1369686E+04	-8,6728873E-01	9,6909407E+01	-6,7071895E+01	1,7694758E+01
3	RRRRR	1,5284307E+04	1,8528400E+04	0,	0,	6,0948320E+02	6,0922897E+02
4	IIIII	1,3681313E-03	2,3849346E-09	9,2515757E+02	2,1628522E+01	2,4088739E-01	1,6096645E-01
5	1,9290214E+01	-3,2721038E+00	0,	4,7745405E-01	1,1548577E+04	3,9334330E+02	2,6284097E+02
6	1,3957495E+06	7,7761233E-01	2,6493937E+03	-1,5144910E+02	1,9011194E-03	-7,0205848E+02	0,
7	0,	0,	0,	7,3216577E-01	-2,7347800E-04	1,8331289E+01	9,6301204E+01
8	9,6215570E+00	2,8012950E+00	-4,7386361E-01	2,8410914E+00	4,2291360E+01	-8,1977847E+01	-2,4138476E+01
9	2,9677511E+02	4,6860040E+03	7,5254891E+02	1,1220235E+02	1,7385175E+02	-2,8740375E+01	-1,5916236E+02
10	2,6662036E+03	3,1133020E-01	2,8524170E+01	-1,4248066E+02	-1,0096356E+02	3,4962733E+03	1,8361339E+03
11	-1,7808054E+02	3,4531034E+03	1,7378308E+09	4,5380445E+11	2,4077778E+03	2,1361819E+04	4,0676095E+04

83

CASE, 1 QL SOLUTION PAGE 20 DATE 10273

1	4,9357258E+02	3,0959301E+05	2,0944677E+04	-7,4903498E-01	9,7683788E+01	-6,8473886E+01	2,7670731E+01
2	3,5000000E+02	4,6039299E+05	2,2304419E+04	-7,0336925E-01	9,7212716E+01	-6,6411691E+01	1,8818398E+01
3	RRRRR	1,4321692E+04	1,9470784E+04	0,	0,	6,4267918E+02	6,4240681E+02
4	IIIII	1,6030567E-03	2,8348942E-09	9,1758995E+02	2,2825748E+01	2,1983304E-01	1,5413041E-01
5	1,8200352E+01	-3,6158401E+00	0,	6,2180496E-01	1,5105828E+04	4,6749099E+02	3,2776997E+02
6	1,3810595E+06	7,7569908E-01	2,5031797E+03	-1,5816799E+02	1,8909438E-03	-6,9819230E+02	0,
7	0,	0,	0,	7,8223122E-01	-2,5602039E-04	1,7413820E+01	9,6555090E+01
8	9,4357059E+00	2,9596146E+00	-4,9059272E-01	3,0000000E+00	4,2639186E+01	-8,1555475E+01	-2,5430741E+01
9	2,9673089E+02	4,6814276E+03	7,6471502E+02	1,1220248E+02	1,7342689E+02	-2,9658303E+01	-1,5983927E+02
10	2,7970109E+03	2,4979299E-01	2,8523337E+01	-1,4116771E+02	-1,0135194E+02	3,4956847E+03	2,0983372E+03
11	-1,7788650E+02	3,7103157E+03	1,6565579E+09	4,7360604E+11	2,6224871E+03	2,2297688E+04	3,7146406E+04

1	5,0357258E+02	3,0715243E+05	2,1902476E+04	-5,5679233E-01	9,7998520E+01	-6,7827543E+01	2,7591891E+01
2	3,6000000E+02	4,3074391E+05	2,3262092E+04	-5,2424815E-01	9,7528190E+01	-6,5723567E+01	2,0001455E+01
3	RRRRR	1,3399382E+04	2,0435121E+04	0,	0,	6,7742311E+02	6,7713159E+02
4	IIIII	1,8296102E-03	3,2642522E-09	9,1150849E+02	2,4028822E+01	2,0113905E-01	1,4870317E-01
5	1,7115979E+01	-4,0366059E+00	0,	7,8296098E-01	1,8672916E+04	5,3859538E+02	3,9818644E+02
6	1,2921858E+06	7,7387829E-01	2,3407344E+03	-1,6517516E+02	1,8785210E-03	-6,9426735E+02	0,
7	0,	0,	0,	8,3607799E-01	-1,0974646E-04	1,6515422E+01	9,6811417E+01
8	9,2477123E+00	2,9612496E+00	-4,8062525E-01	3,0000000E+00	4,3280929E+01	-8,1081648E+01	-2,7004093E+01
9	2,9673571E+02	4,6778672E+03	7,7486171E+02	1,1220265E+02	1,7290710E+02	-3,0600481E+01	-1,6044647E+02
10	2,9519933E+03	1,8399343E-01	2,8522465E+01	-1,3979892E+02	-1,0174744E+02	3,4951407E+03	2,4088459E+03
11	-1,7767384E+02	4,0229318E+03	1,5695871E+09	4,9390077E+11	2,8520577E+03	2,3256797E+04	3,3744697E+04

1	5,1357258E+02	3,0536776E+05	2,2861255E+04	-3,5689986E-01	9,8326193E+01	-6,7153237E+01	2,7506140E+01
2	3,7000000E+02	4,0300274E+05	2,4220771E+04	-3,3686677E-01	9,7855785E+01	-6,5007480E+01	2,1245170E+01
3	RRRRR	1,2536423E+04	2,1399511E+04	0,	0,	7,1372603E+02	7,1341430E+02
4	IIIII	2,0184555E-03	3,6190651E-09	9,0720567E+02	2,5199638E+01	1,8466616E-01	1,4450483E-01
5	1,6052093E+01	-4,5596204E+00	0,	9,4572858E-01	2,1811543E+04	5,9728270E+02	4,6738523E+02
6	1,2090367E+06	7,7214405E-01	2,1627546E+03	-1,7247376E+02	1,8631771E-03	-6,9028218E+02	0,
7	0,	0,	0,	8,9363156E-01	3,6430682E-05	1,5643026E+01	9,7066636E+01
8	9,0614105E+00	2,9628363E+00	-4,7074513E-01	3,0000000E+00	4,4287478E+01	-8,0539764E+01	-2,8924331E+01
9	2,9679735E+02	4,6753734E+03	7,8296382E+02	1,1220285E+02	1,7225931E+02	-3,1560274E+01	-1,6095953E+02
10	3,1332903E+03	1,1533274E-01	2,8521569E+01	-1,3837406E+02	-1,0212264E+02	3,4946613E+03	2,7719194E+03
11	-1,7741479E+02	4,3991683E+03	1,4787484E+09	5,1422486E+11	3,0916124E+03	2,4217139E+04	3,0531443E+04

1	5,2357258E+02	3,0434038E+05	2,3820702E+04	-1,4709638E-01	9,8666467E+01	-6,6451143E+01	2,7413072E+01
2	3,8000000E+02	3,7704666E+05	2,5180150E+04	-1,3915480E-01	9,8195260E+01	-6,4263605E+01	2,2550461E+01
3	RRRRR	1,1728993E+04	2,2363960E+04	0,	0,	7,5158801E+02	7,5125502E+02
4	IIIII	2,1369955E-03	3,8404767E-09	9,0480962E+02	2,6326756E+01	1,6994032E-01	1,4127578E-01
5	1,5009801E+01	-5,2218668E+00	0,	1,0895928E+00	2,4029194E+04	6,3326689E+02	5,2645115E+02
6	1,1312352E+06	7,7051009E-01	1,9702567E+03	-1,8006501E+02	1,8445523E-03	-6,8623482E+02	0,
7	0,	0,	0,	9,5514711E-01	1,8254412E-04	1,4798954E+01	9,7315832E+01
8	8,8765333E+00	2,9643725E+00	-4,6097234E-01	3,0000000E+00	4,5743513E+01	-7,9903724E+01	-3,1276756E+01
9	2,9691792E+02	4,6739949E+03	7,8928764E+02	1,1220308E+02	1,7143587E+02	-3,2527889E+01	-1,6135074E+02
10	3,3475780E+03	4,3815436E-02	2,8520649E+01	-1,3689348E+02	-1,0232973E+02	3,4942536E+03	3,2009025E+03
11	-1,7696160E+02	4,8580915E+03	1,3841083E+09	5,3457498E+11	3,3411514E+03	2,5178453E+04	2,7485968E+04

(24)

CASE, 1 QL SOLUTION PAGE 21 DATE 10273

1	TIME	ALTITUDE	REL VELOCITY	REL PATH ANGLE	REL AZIMUTH	REL LONGITUDE	LATITUDE
2	ARC TIME	WEIGHT	INR VELOCITY	INR PATH ANGLE	INR AZIMUTH	INR LONGITUDE	CROSS RNG(NM)
3	PHASE TIME	MASS	IDEAL VELOCITY	HEAT LOAD	HEAT RATE	RANGE(NM)	DOWN RNG(NM)
4	RE NUMBER	AMB PRESSURE	ATMOS DENSITY	SPEED SOUND	MACH NUMBER	LIFT COEFF	DRAG COEFF
5	ALPHA	BANK ANGLE	BLEND FACTOR	DYNAMIC PRESS	AERO MOMENT	LIFT	DRAG
6	THRUST	COSTATE V	COSTATE GAMMA	COSTATE AZI	COSTATE ALT	COSTATE LAT	COSTATE LONG
7	THRUST TWO	GIMBAL ANG 2	COSTATE HEATING	COSTATE MASS	COSTATE TAU	STEERING ELEV	STEERING AZI
8	GIMBAL ANGLE	AXIAL ACC	NORMAL ACC	TOTAL ACC	REL PITCH	REL YAW	REL ROLL
9	DRAG LOSS	GRAVITY LOSS	ALPHA LOSS	BACK PRESS LOSS	INR PITCH	INR YAW	INR ROLL
10	SEMI AXIS(NM)	ECCENTRICITY	INCLINATION	ASCENDING NODE	ARG PERIGEE	APOGEE RAD(NM)	PERIGEE RAD(NM)
11	TRUE ANOMALY	PERIOD(MIN)	ENERGY	MOMENTUM	SEMI LAT REC(NM)	APOGEE VELOCITY	PERIGEE VELOCITY

1	5,3045970E+02	3,3413256E+05	2,4481711E+04	4,2237501E-03	9,8907963E+01	-6,5951550E+01	2.7344496E+01
2	3,8688712E+02	3,6014837E+05	2,5841132E+04	4,0015518E-03	9,8435830E+01	-6,3735237E+01	2.3485471E+01
3	RRRRR	1,1203329E+04	2,3028220E+04	0,	0,	7,7857018E+02	7.7822193E+02
4	IIIII	2,1619000E-03	3,8668727E-09	9,0433333E+02	2,7071557E+01	1,6058503E-01	1.3950076E-01
5	1,4305286E+01	-5,7874692E+00	0,	1,1648067E+00	2,4762107E+04	6,3971274E+02	5,5572064E+02
6	1,0805761E+06	7,6944658E-01	1,8298396E+03	-1,8546402E+02	1,8297932E-03	-6,8340959E+02	0,
7	0,	0,	0,	9,9995896E-01	2,8316686E-04	1,4235051E+01	9.7480229E+01
8	8,7497600E+00	2,9654008E+00	-4,5431064E-01	3,0000000E+00	4,7063766E+01	-7,9389453E+01	-3.3205444E+01
9	2,9703191E+02	4,6737248E+03	7,9274212E+02	1,1220325E+02	1,7073002E+02	-3,3191013E+01	-1.6152888E+02
10	3,5189946E+03	7,1047155E-03	2,8520000E+01	-1,3584161E+02	7,3594738E+01	3,5439961E+03	3,4939932E+03
11	5,6723539E-01	5,2359745E+03	1,3166859E+09	5,4860390E+11	3,5188170E+03	2,5476544E+04	2,5841141E+04

Appendix

CONTROL CARDS

Following is a list of control cards needed to run PADS on the Univac 1108 installation at MSC in Houston.

If the user simply wishes to run the steepest-descent module of PADS or the steepest-descent and quasilinearization modules without saving the solution on tape, then the following control cards should be used:

```
∇Z RUN (MSC run card)
∇   MSG     FILE REQ. TAPE 01 FH432 2 FSTRN 3
∇   ASG   Z = A10259 (Current tape No. - subject to change)
∇   ASG   A, H
∇   ASG   I
∇   CØM   03400000
∇   XQT   CUR
       TRW Z
       IN Z
       TRI Z
∇E  XQT   PADSA
Data Deck
∇    EØF
```

If the user wants to save either the steepest-descent solution or the quasi-linearization solution, he should use the following package:

```
∇Z RUN (MSC run card)
∇   MSG     FILE REQ. TAPE 02 FH432 2 FSTRN 2
∇   ASG   Z = A10259
∇   ASG   A, H
∇S  ASG I = SAVE
∇   CØM 03400000
```

```
∇   XQT CUR
       TRW Z
       IN Z
       TRI Z
∇E  XQT PADSA
 Data Deck
∇   EØF
```

When the user has a tape solution to start either the steepest-descent module or the quasilinearization module, then he should use the following control cards:

```
∇Z  RUN (MSC run card)
∇   MSG       FILE REQ. TAPE 03 FH432 2 FSTRN 2
∇   ASG   Z = A10259
∇   ASG   Y = (Tape No. of starting solution)
∇   ASG   A, H
∇S  ASG   I = SAVE
∇   XQT   TAPACK
       REWIND, 28
       REWIND, 11
       TAPE COPY, 28, 1, 1,, 11
       END FILE, 11
       RELEASE, 28
∇   CØM  03400000
∇   XQT   CUR
       TRW Z
       IN Z
       TRI Z
∇E  XQT PADSA
 Data Deck
∇   EØF
```

Next is a list of control cards needed to run PADS on the CDC 6500 installation at McDonnell Douglas in Huntington Beach.

Only the following control cards are needed if one simply wishes to run the steepest-descent module of PADS or the steepest-descent and quasilinearization modules without saving the solution of the disk:

```
P1551, p, cp, pp, pg, 7000, 160000.*
ID   necessary user description
BEGIN, P1551.
```

Should the user want either the steepest-descent solution or the quasilinearization solution saved on the disk, then the following control card package should be used:

```
P1551, p, cp, pp, pg, 7000, 160000.
ID   necessary user description
REQUEST, TAPE11, *PF.
BEGIN, P1551.
CATALØG, TAPE11, pfn, ID = HRdddgggg.**
```

When either the steepest-descent module or the quasilinearization module is to be started by a solution that is already on the disk, then the following control cards should be used:

```
P1551, p, cp, pp, pg, 7000, 160000.
ID   necessary user description
ATTACH, SØL, pfn.
CØPYBF, SØL, TAPE11.
BEGIN, P1551.
```

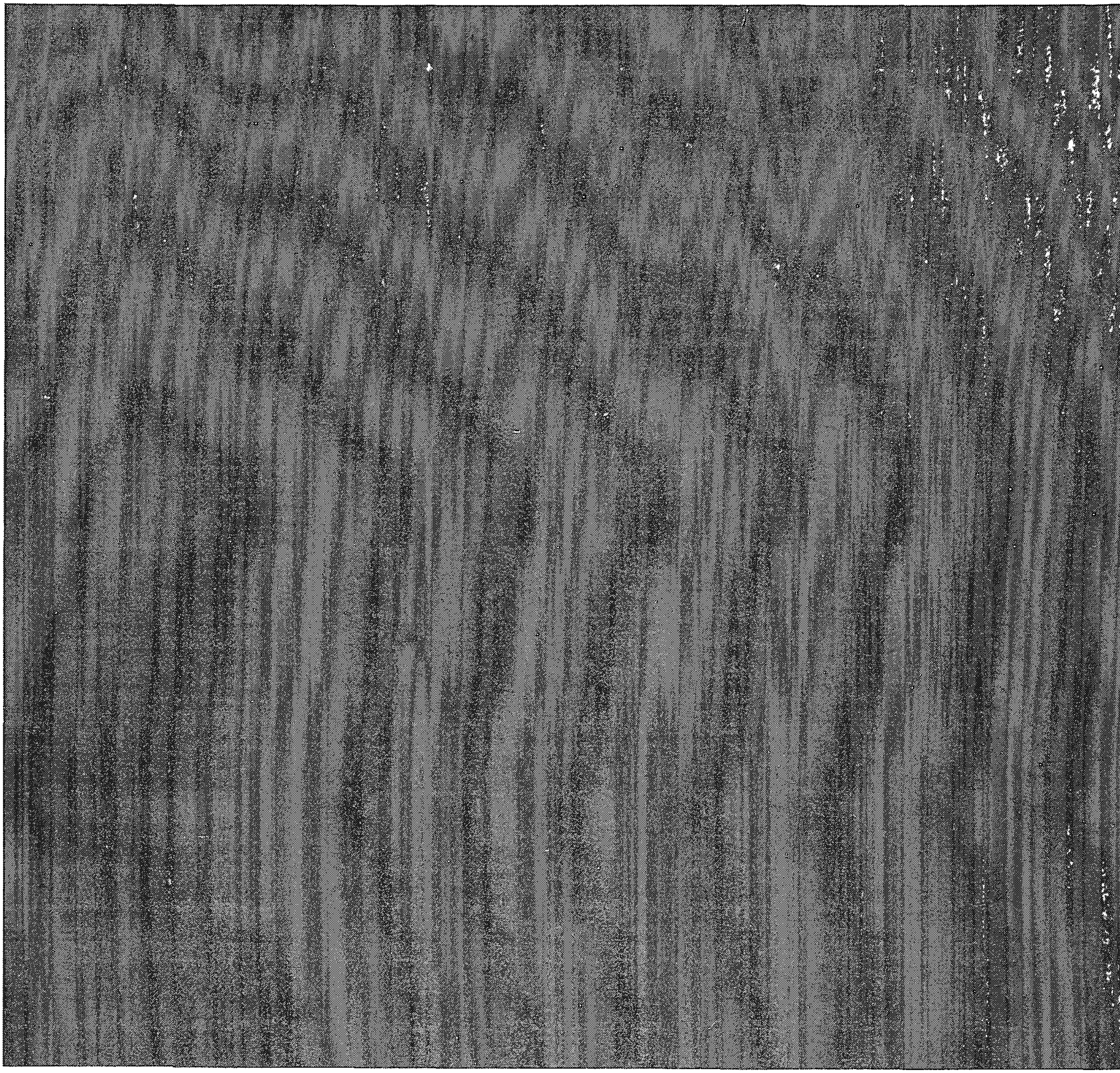
---

*p stands for priority—a value greater than 2 requires special authorization. cp stands for the decimal number of central processing records required by the job – figure on at least 240. pp stands for the decimal number of peripheral processing seconds required by the job – be generous. pg stands for the decimal number of pages of output required by the job – figure on at least 100.

**pfn stands for the permanent file name. ddd is the user's department number and gggg is his group number.

If the user wishes to start from a solution already on the disk and also wishes to save the new solution on the disk, then he should use the following control cards:

```
P1551, p, cp, pp, pg, 7000, 160000.
ID   necessary user description
REQUEST, TAPE11, *PF.
ATTACH, SØL, pfn.
CØPYBF, SØL, TAPE11.
BEGIN, P1551.
CATALØG, TAPE11, pfn, ID = HR dddgggg.
```



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