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AS-206A PRELIMINARY L/V OPERATIONAL TRAJECTORY AND GUIDANCE PRESETTINGS

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by

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FOREWORD

This report presents the guidance presettings and the associated Preliminary Launch Vehicle Operational Flight Trajectory for the AS-206A Mission. The analyses and documentation were performed by the Aerospace Physics Branch, Chrysler Corporation Space Division, within the scope of NAS8-4016, Modification MSFC-1, Amendment 16, BB Item 3.1.3-10.

TABLE OF CONTENTS

	Page
FOREWORD	i
TABLE OF CONTENTS	ii
LIST OF TABLES	iii
LIST OF ILLUSTRATIONS	iv
SUMMARY	1
1.0 INTRODUCTION	2
1.1 Mission Description	2
1.2 Vehicle and Environment Description	2
1.3 Trajectory Groundrules	2
2.0 DISCUSSION	3
2.1 Preliminary Launch Vehicle Operational Trajectory	3
2.2 Guidance and Control	3
2.3 S-IB Stage Pitch Program	4
2.4 IGM Presettings	5
3.0 RESULTS	7
4.0 REFERENCES	8
APPENDIX A. "Launch Vehicle Characteristics"	48
DISTRIBUTION	54

LIST OF TABLES

Table	Description	Page
1.	S-IB Stage Steering Program	9
2.	S-IB Stage Pitch Attitude Command	10
3.	IGM Presettings	11
4.	Programmed Sequence of Events	14
5.	Vehicle Weight Breakdown	15
6.	S-IB Stage End Conditions of Flight	16
7.	S-IVB Stage End Conditions of Flight	17
8.	S-IB Stage Flight Data (Metric Units)	19
9.	S-IVB Stage Flight Data (Metric Units)	24
10.	S-IB Stage Flight Data (English Units)	29
11.	S-IVB Stage Flight Data (English Units)	33
12.	Reference Trajectory Comparison	37
APPENDIX A:	"Launch Vehicle Characteristics"	
1A.	S-IB Stage Mass Characteristics	49
2A.	S-IVB Stage Mass Characteristics	50
3A.	S-IB Stage Aerodynamic Characteristics	51
4A.	S-IB Stage Propulsion Characteristics	52
5A.	S-IVB Stage Propulsion Characteristics	53

LIST OF ILLUSTRATIONS

Figure		Page
1.	S-IB Stage Tilt Program	38
2.	S-IB Stage Vehicle Pitch Attitude Rate History	39
3.	S-IVB Stage Pitch and Yaw Attitude Steering History	40
4.	S-IVB Stage Vehicle Attitude Rate History	41
5.	S-IB Stage Angle of Attack History	42
6.	S-IB Stage Dynamic Pressure History	43
7.	Angle of Attack and Dynamic Pressure History: S-IB/S-IVB Separation -- IGM Initiation	44
8.	Vehicle Attitude Rate: S-IB/S-IVB Separation -- IGM Initiation	45
9.	Targeting Plane Parameters: Performance Effects	46
10.	Targeting Plane Parameters: Yaw Attitude Histories	47

SUMMARY

This document presents the S-IB stage steering program and the Iterative Guidance Mode (IGM) presettings for the AS-206A Mission. In addition, the associated AS-206A Preliminary Launch Vehicle Operational Trajectory and a summary of the SA-206 Launch Vehicle performance characteristics are presented for review and critique.

The S-IB stage tilt program was derived to provide a near zero angle of attack history throughout the high dynamic pressure region of flight assuming a zero wind profile. However, the AS-206A Preliminary L/V Operational Trajectory was generated using a mean April head/tail wind profile. A summary of the end conditions of flight are presented below:

	S-IB/S-IVB Separation	S-IVB Guidance Cutoff Signal
Flight Time (sec)	143.34	580.46
Altitude (km)	61.18	163.19
Space Fixed Velocity (m/s)	2462.50	7821.99
Space Fixed Path Angle (deg)	66.35	90.00
Space Fixed Flight Azimuth (deg)	75.46	85.54
Longitude-Positive West (deg)	79.88	62.48
Geodetic Latitude (deg)	28.73	31.50

The nominal SA-206 Launch Vehicle weight in orbit capability is predicted to be 6,857 pounds in excess of the propellant depletion weight. Based on an FPR of 1,330 pounds, approximately 5,527 pounds of S-IVB propellant can be allocated for an inflight alternate mission.

SECTION 1

INTRODUCTION

1.1 MISSION DESCRIPTION: The basic purpose of the Apollo-Saturn 206A Mission is to launch and test a complete, fully loaded LEM for verification of LEM subsystems operation and LEM staging fire-in-the-hole abort capability. The primary objective of the SA-206 Launch Vehicle is to insert the S-IVB/IU/Payload configuration in a near earth 85/120 nautical mile elliptical orbit. The payload consists of a Lunar Excursion Module (LEM), Special LEM Adapter (SLA), and a 25° Nose Cone. (See References 1, 2, and 13.)

The preplanned alternate mission for the AS-206 Mission is to perform a dual AS-206/207 launch. The inflight alternate mission capability during S-IB stage powered flight is for one engine out. The alternate mission is then seven engine S-IB burn, S-IVB burn and LEM DPS burn to orbit. The inflight alternate mission during S-IVB stage powered flight is for loss of thrust. The alternate mission is then LEM DPS burn to orbit. (See Reference 1.)

1.2 VEHICLE AND ENVIRONMENT DESCRIPTION: The SA-206 Launch Vehicle, for the purpose of this analysis, is defined by the subsystem characteristics and data in References 4 and 7-11. A summary of the data is presented in Appendix A. Revisions and updates will be incorporated in the AS-206A Launch Vehicle Operational Flight Trajectory.

The atmospheric properties incorporated in the trajectory simulations are as defined by the 1963 Patrick Reference Atmosphere. The Fischer earth model and potential function are utilized.

The April mean head/tail wind profiles defined in References 5 and 6 are included in the Preliminary L/V Operational Trajectory simulation.

1.3 TRAJECTORY GROUNDRULES: The following mission criteria, trajectory constraints, and vehicle constraints have been imposed on the SA-206 Launch Vehicle trajectory: (a) Launch from AFETR Pad 37B; (b) Launch azimuth (fin 1/pad orientation) 90 degrees east of North; (c) Flight azimuth 72 degrees east of North; (d) Orbit insertion conditions for an 85/120 nautical mile elliptical orbit; (e) One degree per second limit on commanded vehicle attitude rates.

SECTION 2

DISCUSSION

2.1 PRELIMINARY LAUNCH VEHICLE OPERATIONAL TRAJECTORY: The AS-206A Preliminary L/V Operational Trajectory presented herein was generated using the guidance presettings presented in Tables 1-3. The SA-206 vehicle flight sequence of events and weight statement are summarized in Tables 4 and 5, respectively. The sequence of events is consistent with the propulsion data in Reference 7, the J-2 engine firing sequence in References 8 and 9, and the vehicle mass data defined in Reference 10. The weight statement is consistent with the referenced mass data and the L/V trajectory defined herein.

In order to establish a more realistic nominal trajectory prediction, a constant force bias equal to + 0.7 per cent of the vehicle sea level longitudinal thrust has been included in the S-IB stage trajectory. This action is an attempt to minimize the effects of an apparent systematic shift in the ground to flight test performance level. (See Reference 4.) In addition, the L/V trajectory simulation incorporated the April mean head/tail wind profile defined in References 5 and 6.

Summaries of the S-IB and S-IVB stage end conditions of flight are given in Tables 6 and 7. Tabular listings of pertinent L/V trajectory parameters, in metric units, are given in Tables 8 and 9 for the S-IB and S-IVB stages of powered flight, respectively. The corresponding listings for English units are given in Tables 10 and 11. Figures 1 and 2 depict the S-IB stage tilt program and the resulting vehicle pitch attitude rate history. The S-IVB stage pitch and yaw attitude steering histories are depicted in Figures 3 and 4. Flight time histories of the S-IB stage angle of attack and dynamic pressure are presented in Figures 5 and 6. Figures 7 and 8 present trajectory parameter histories pertinent to an analysis of the phase of flight from S-IB/S-IVB separation to IGM initiation.

A comparison of pertinent trajectory parameters from the Preliminary L/V Operational Trajectory with those of the two previously published Reference Trajectories is given in Table 12.

The coordinate systems for the trajectory data presented herein are consistent with the Project Apollo Coordinate Systems Standards defined in Reference 12.

2.2 GUIDANCE AND CONTROL: Guidance of the SA-206 Launch Vehicle is separated into the following three guidance modes:

1) Pre-IGM: An open loop guidance mode in the sense that the steering commands are prespecified functions of time.

2) IGM: An active closed loop guidance mode with the steering commands provided by a two-stage, three-dimensional formulation of the Iterative Guidance Mode (IGM).

3) Orbital: An active guidance mode during the S-IVB/IU orbital phases of flight in which a series of vehicle attitude maneuvers are executed.

The Pre-IGM guidance mode provides pitch, yaw, and roll attitude angle steering commands from liftoff through the S-IB stage powered phases of flight and the S-IVB stage phases of flight subsequent to IGM initiation. The Pre-IGM guidance mode is divided into five consecutive time segments. During each time segment the pitch attitude steering angle is obtained as a function of time using a third degree polynomial. The flight time segments, the yaw and roll commands, and the polynomial coefficients derived for the AS-206A Mission are delineated in Table 1. Derivation of the S-IB stage guidance presettings is discussed in subsequent paragraphs.

The IGM guidance mode is initiated approximately 3 seconds after jettisoning the ullage rocket cases. The IGM provides pitch and yaw attitude angle steering commands throughout the S-IVB stage phases of powered flight to the time of orbital insertion. The commanded roll attitude angle is zero. The IGM equations and logic for the SA-206 LVDC Flight Program are defined in Reference 3. The set of IGM presettings derived for the AS-206A Mission is presented in Table 3.

The orbital guidance mode provides pitch, yaw and roll attitude commands for the prespecified L/V maneuvers planned for the orbital phase of the AS-206A Mission. (See Reference 3.)

During the S-IB stage of powered flight, vehicle pitch, yaw, and roll control are maintained by the four outboard H-1 engines. During the S-IVB phases of powered flight, pitch and yaw attitude control are maintained by the J-2 engine with roll attitude control provided by the Auxillary Propulsion System (APS). Pitch, yaw, and roll attitude control are maintained by the APS during the orbital phases of S-IVB/IU flight. (See Reference 11.)

2.3 S-IB STAGE PITCH PROGRAM: A trajectory simulation technique which commands a prespecified vehicle pitch angle of attack (α_p) history throughout the S-IB stage of flight was utilized to shape the S-IB stage tilt program. It is noted that all trajectory simulations incorporated the vehicle data referenced herein and the guidance and control modes discussed above. A family of launch vehicle trajectories was generated in the absence of any wind profile for a series of α_p histories. From this family, the trajectory which collectively best satisfied each of the following criteria was chosen:

1) S-IB/S-IVB Stage Separation Conditions:
   Dynamic Pressure: ≤ 75 kg/m^2
   Pitch Angle of Attack: ~ -0.5 deg.
   Vehicle Attitude Rate: $\sim$ 0. deg/sec.

2) Near zero pitch angle of attack throughout the high dynamic pressure region of flight.

3) Commanded vehicle attitude rates less than one degree per second.

4) Aerodynamic Heating:
Aerodynamic heating indicator (AHI) at S-IB staging comparable to the Reference Trajectory value.

$$AHI = \int \frac{q \ V_R}{\pi/2 - |\alpha|} \ dt \left(\frac{kg\text{-}m}{m^2 - rad} \right)$$

5) L/V Weight in Orbit Capability:
Useable S-IVB propellant of at least 1500 pounds referenced to the S-IVB stage propellant data in Reference 10.

From the selected trajectory, the commanded pitch attitude angle data were fitted to a third degree polynomial, for three time intervals, using the method of least squares. The selected tilt program coefficients and the corresponding time interval for the LVDC Flight Program are presented in Table 1.

Table 2 presents a time history of the pitch attitude command (X_c) to the control system subroutine utilized in the trajectory simulation program. The L/V trajectory profile and the data in Table 2 are a result of simulating the X_y polynomial in Table 1 as follows:

$$X_y = f(T)$$

where

$$T = t - T_1 + NGMDT$$

with

t = time from GRR

T_1 = time base # 1. (0.2 second after first motion; T_1 = 5.2 sec.)

NGMDT = 1. sec. (Approximation of LVDC major loop cycle time.)

The pitch attitude command (X_c) to the control system subroutine was then implemented using a pitch attitude angle rate derived from successive values of X_y.

2.4 <u>IGM PRESETTINGS</u>: A set of IGM presettings for the AS-206A Mission was derived for the AS-206 Launch Vehicle and is presented in Table 3. The terminology used to define the IGM parameters is consistent with Reference 3. It is noted that the IGM presettings are strongly dependent on the proposed flight sequence of events and the S-IVB stage propulsion characteristics defined for the SA-206 Launch Vehicle. If these data change significantly prior to flight, then the presettings are subject to change. A review of the presettings will be made concurrently with generation of the AS-206A Launch Vehicle Operational Trajectory.

An investigation of the L/V orbital plane targeting conditions is summarized in Figures 9 and 10. The orbital plane targeting conditions determined for the Reference Trajectory

Argument of Descending Node (θ_N): 119.0548 (deg)

Inclination (i): 31.6143 (deg)

were used as the base point for the data presented in Figure 9. It is noted that the Reference Trajectory values yield a near optimum L/V weight in orbit capability for the SA-206 vehicle considered herein. Therefore, from a performance standpoint the above IGM parameters are applicable for the Preliminary L/V Operational Trajectory. Figure 10 depicts the vehicle yaw attitude angle history for the family of S-IVB stage trajectories considered. It is concluded that the Reference Trajectory targeting parameters provide a more desirable vehicle yaw attitude angle flight history.

SECTION 3

RESULTS

An examination of the AS-206A Preliminary L/V Operational Trajectory reveals that the S-IB stage tilt program and IGM presettings presented herein satisfy the stated mission objectives and vehicle constraints. The S-IB stage tilt program was shaped to provide a near zero angle of attack profile through the maximum dynamic pressure region of flight. However, the predicted nominal S-IB stage flight trajectory was generated using a mean April head/tail wind profile. The resulting angle of attack profile depicted in Figure 5 is deemed acceptable. It is noted that the IGM presettings are uniquely related to the S-IVB stage propulsion system characteristics defined for this analysis. If these data change significantly prior to flight, the IGM presettings presented herein are subject to change.

Table 12 presents a convenient comparison of the AS-206A Preliminary L/V Operational Trajectory with the two previously published Reference Trajectories. The revised Reference Trajectory reflects the substitution of a 25° nose cone for the boilerplate Apollo CSM and incorporation of a three second interval between inboard and outboard engines cutoff. This configuration is consistent with the L/V trajectory documented herein. It is noted that the Preliminary L/V Operational Trajectory aerodynamic heating indicator (AHI) is approximately 8.5% less than the revised Reference Trajectory.

The SA-206 Launch Vehicle performance capability is summarized in Table 5. It is noted that for the nominal predicted flight approximately 6,857 pounds of S-IVB stage burnable propellants remain in the tanks. Reference trajectory analyses indicate that the FPR requirement for the AS-206A Mission will be approximately 1,330 pounds. Hence, approximately 5,527 pounds of propellants can be allocated for an inflight alternate mission, i.e., early S-IB stage engine out.

The magnetic tapes required for distribution by MSFC, R-AERO-F, are identified as follows:

Trajectory Listing (Printout Tape):
CCSD/Slidell Reel No. 7178
MSFC Copy: (Transmitted 11/1/66)

Data Tape (B-7 Tape):
CCSD/Slidell Reel No. 4546
MSFC Copy: (Transmitted 11/1/66)

SECTION 4

REFERENCES

1. "MSFC Flight Mission Directive Apollo-Saturn 206A Mission", 1 March 1966.

2. "AS-206 A/BP-30/LEM-1 Joint Reference Trajectory", Document No. 66-FMF-3 9 May 1966.

3. "LVDC Equation Defining Document for The AS-206 Flight Program", MSFC No. III-4-423-7, IBM No. 66-207-0003; 12 April 1966.

4. "First Data Package for AS-206", R-AERO-FM-71-66, 12 August 1966; Data-Fax, November 1966.

5. "Cape Kennedy Wind Component Statistics 0 - 60 km Altitude For 72 Degree Flight Azimuth For Monthly and Annual Reference Periods", R-AERO-Y-90-66, 23 March 1966.

6. "Latest Wind Estimates From 80 km to 200 km Attitude Region at Mid-Latitudes", NASA TMX-53064, 16 June 1964.

7. "CCSD/Slidell Propulsion Tape Reel No. 7324 (Copy: 2035)", Data Transmission 6 September 1966: Transmit Reel No. 5940 (MSFC), Data Received on Reel No. 7324 Comment: Data consistent with CCSD/P&VE B-5 Tapes No. 1396 and 1608.

8. "Saturn IB/SA-206 Flight Sequence", Drawing No. 10M30156, 29 March 1966.

9. "Interface Control Document Definition of Saturn SA-206 Flight Sequence Program", 40M33606, 31 May 1966.

10. "Preliminary Predicted Mass Characteristics Saturn IB Vehicle AS-206, Part I, Depletion Cutoff", CCSD WG-66-II-1-103, 13 September 1966.

11. "Control Gains and Shaping Networks for Saturn AS-206, S-IB and S-IVB Stages", R-ASTR-F-66-162, 6 September 1966.

12. "Project Apollo Coordinate System Standards", SE008-001-1, June 1965.

13. "AS-206 Revised Reference Trajectory", R-AERO-DAP-66-66, 22 July 1966. (C)

TABLE 1

PRELIMINARY AS-206 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
S-IB STAGE STEERING PROGRAM

For the time segment $t - T_1 \leq 10$:

$$\chi_y = 0.$$
$$\chi_z = 0.$$
$$\chi_x = -.314159 \text{ rad. } (-18. \text{ degrees})$$

For the time segment $10 < t - T_1 \leq 47$:

$$\chi_y = A_0 + A_1T + A_2T^2 + A_3T^3$$

A_0	=	$-.609233 \times 10^{-2}$	rad.
A_1	=	$+.272268 \times 10^{-2}$	rad./sec.
A_2	=	$-.240269 \times 10^{-3}$	rad./sec.^{2}
A_3	=	$+.119946 \times 10^{-5}$	rad./sec.^{3}

$$\chi_x = \chi_z = 0.$$

For the time segment $47 < t - T_1 \leq 96$:

$$\chi_y = B_0 + B_1T + B_2T^2 + B_3T^3$$

B_0	=	$+.790477 \times 10^{-1}$	rad.
B_1	=	$-.175372 \times 10^{-2}$	rad./sec.
B_2	=	$-.173903 \times 10^{-3}$	rad./sec.^{2}
B_3	=	$+.992527 \times 10^{-6}$	rad./sec.^{3}

$$\chi_x = \chi_z = 0.$$

For the time segment $96 < t - T_1 \leq 132$:

$$\chi_y = C_0 + C_1T + C_2T^2 + C_3T^3$$

C_0	=	$+.949293 \times 10^{0}$	rad.
C_1	=	$-.355815 \times 10^{-1}$	rad./sec.
C_2	=	$+.252675 \times 10^{-3}$	rad./sec.^{2}
C_3	=	$-.763656 \times 10^{-6}$	rad./sec.^{3}

$$\chi_x = \chi_z = 0.$$

For the time segment $t - T_1 > 132$:

$$\chi_y = -1.110029 \text{ rad.}$$
$$\chi_x = \chi_z = 0.$$

NOTE:

χ_y: Pitch attitude angle measured negative downrange from inertial vertical

$T = t - T_1 + NGMDT$

t: time from GRR

T_1: time of liftoff (Time Base 1), approximately 0.2 second after first motion

NGMDT: Bias to account for system delays

TABLE 2

PRELIMINARY AS-206 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
S-IB STAGE PITCH ATTITUDE COMMAND

FLIGHT TIME (SEC)	PITCH ATTITUDE COMMAND, X_c (DEG)	FLIGHT TIME (SEC)	PITCH ATTITUDE COMMAND, X_c (DEG)
0	0.0000	82	-39.2352
10	0.0000	84	-40.3968
12	-0.3122	86	-41.5238
14	-0.6374	88	-42.6134
16	-1.0499	90	-43.6629
18	-1.5465	92	-44.6695
20	-2.1238	94	-45.6306
22	-2.7787	96	-46.5433
24	-3.5077	98	-47.4478
26	-4.3076	100	-48.3664
28	-5.1750	102	-49.2740
30	-6.1068	104	-50.1726
32	-7.0995	106	-51.0645
34	-8.1499	108	-51.9516
36	-9.2547	110	-52.8361
38	-10.4105	112	-53.7200
40	-11.6142	114	-54.6056
42	-12.8623	116	-55.4948
44	-14.1517	118	-56.3899
46	-15.4789	120	-57.2928
48	-16.8407	122	-58.2057
50	-18.1623	124	-59.1306
52	-19.5073	126	-60.0698
54	-20.8613	128	-61.0252
56	-22.2216	130	-61.9990
58	-23.5854	132	-62.9933
60	-24.9501	134	-63.6000
62	-26.3129	136	-63.6000
64	-27.6710	↓	↓
66	-29.0217		
68	-30.3624		
70	-31.6903		
72	-33.0026		
74	-34.2966		
76	-35.5696		
78	-36.8188		
80	-38.0416	IGM Initiation	-63.6000

TABLE 3

PRELIMINARY AS-206 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
IGM PRESETTINGS

LVDC SYMBOL	INITIAL VALUE	UNITS	DESCRIPTION
---	17.	sec	Time from time base 3 to initiate IGM guidance
T_{1_i}	290.	sec	Time to go for first IGM stage
T_{3_i}	130.8	sec	Time to go for second IGM stage
τ_3	292.953	sec	Average value of $m/\dot{m}$ at initiation of second IGM stage
Vex_1	4143.80	m/sec	Average exhaust velocity (go x I_{sp}) for 1st IGM stage phase of flight
Vex_3	4211.17	m/sec	Average exhaust velocity (go x I_{sp}) for 2nd IGM stage phase of flight
V_T	7821.9877	m/sec	Guidance cutoff signal (GCS) criteria. Terminal velocity for IGM equations
X_{VT}	6535586.	m	Desired terminal position vector components in IGM coordinate system
Y_{VT}	0.	m	
Z_{VT}	0.	m	
$\dot{X}_{VT}$	0.	m/sec	Desired cutoff velocity components in IGM coordinate system
$\dot{Y}_{VT}$	0.	m/sec	
$\dot{Z}_{VT}$	7821.9877	m/sec	
$\ddot{X}_{VGT}$	- 9.332	m/sec^2	Terminal gravitation vector components in IGM coordinate system
$\ddot{Y}_{VGT}$	0.	m/sec^2	
$\ddot{Z}_{VGT}$	0.	m/sec^2	
ϵ	15.	sec	Value of T_{3_i} to initiate IGM $\Delta\bar{V}$
---	3.	sec	Value of T_{3_i} to freeze IGM (ϵ')

TABLE 3 (Cont'd)

PRELIMINARY AS-206 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
IGM PRESETTINGS

LVDC SYMBOL	INITIAL VALUE	UNITS	DESCRIPTION
T_{r_1}	1.8	N/D	Mission dependent constant multiplier for terminal range angle equation
T_{r_2}	0.	N/D	Mission dependent constants for N_3 and N_4 equations
T_{r_3}	0.	N/D	
---	200.	sec	Time to initiate thrust misalignment correction
$\tilde{T}_2$	0.	sec	Terminal steering time argument
ΔT_{NOM}	R-ASTR	sec	Nominal computation cycle length
TLD	0.	N/D	IGM staging flag (Burn switch)
AP1	-.42666501	E+00	Transformation matrix from navigation coordinate system to the (X_4, Y_4, Z_4) coordinate system
AP2	+.49514778	E-01	
AP3	+.90305328	E+00	
AP4	-.41829534	E-02	A_z = 72.
AP5	+.99838143	E+00	ϕL = 28.531856
AP6	-.56717968	E-01	θN = 119.0548
AP7	-.90440002	E+00	i = 31.6143
AP8	-.27976999	E-01	
AP9	-.42576733	E+00	
---	236.	sec	Time from time base 3 to sample F/M for IGM staging (Approximately 70 sec. prior to nominal IGM staging)
FLAG	2.	N/D	Number of F/M decreases required for IGM staging criteria
ACC	0.01	m/sec^2	F/M comparison tolerance for IGM staging
T_{1_0}	290.	sec	Constants for updating second stage time-to-go for perturbed EMR shift time
A_0	477.25	sec	
A_1	-1.20	N/D	

TABLE 3 (Cont'd)

PRELIMINARY AS-206 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
IGM PRESETTINGS

LVDC SYMBOL	INITIAL VALUE	UNITS	DESCRIPTION
PCO	60.	sec	Backup time for IGM staging
τ_{1_0}	544.656	sec	Constants for artificial τ_3 mode
C_0	35.	sec	
M_{0_2}	130571.11	kg	
$\dot{M}_1$	245.2375	kg/sec	
$\dot{M}_3$	204.3284	kg/sec	

TABLE 4

PRELIMINARY AS-206 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
PROGRAMMED SEQUENCE OF EVENTS

NOMINAL FLIGHT TIME (MIN:SEC)	(SEC)	PROGRAM TIME (SEC)	EVENT
- 0:05.0	- 5.00	-----	Guidance Reference Release (GRR).
- 0:03.1	- 3.10	-----	Initiate S-IB Mainstage Ignition Sequence.
0:00.0	0.00	-----	First Motion.
0:00.2	0.20	$(0.0)_1$	Lift-off Signal. Initiate Time Base 1.
0:10.2	10.20	$(10.0)_1$	Initiate Pitch and Roll Maneuvers.
2:13.8	133.76	$(133.56)_1$	Enable S-IB Propellant Level Sensors.
2:15.8	135.76	$(0.0)_2$	Level Sensor Activation. Initiate Time Base 2.
2:19.0	138.96	$(3.2)_2$	Inboard Engine Cutoff (IECO).
2:22.0	141.96	$(0.0)_3$	Outboard Engine Cutoff (OECO). Initiate Time Base 3.
2:23.3	143.26	$(1.3)_3$	Separation Signal.
2:24.7	144.66	$(2.7)_3$	J-2 Engine Start Command.
2:29.1	149.06	$(7.1)_3$	Activate PU System.
2:35.7	155.69	$(13.7)_3$	Jettison Ullage Rocket Motors.
2:39.0	158.96	$(17.0)_3$	Initiate Active Guidance.
9:40.5	580.46	-----	Guidance Cutoff Signal (GCS).
9:40.7	580.66	$(0.0)_4$	Initiate Time Base 4.
9:50.7	590.66	$(10.0)_4$	Orbit Insertion.

NOTE: Above data consistent with References 4, 7, 8, 9, 10.

TABLE 5

PRELIMINARY AS-206 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
VEHICLE WEIGHT BREAKDOWN

Spacecraft	37,313	
Instrument Unit	4,200	
S-IVB Stage Inert	23,213	
Useable Reserve Propellant (Includes FPR)	6,857	
Injection Weight		71,583
J-2 Thrust Decay Propellant Consumed	153	
S-IVB Cutoff Weight		71,736
S-IVB Mass Depleted	221,485	
Ullage Cases	220	
S-IVB "90% Thrust" Weight		293,441
S-IVB Thrust Buildup Prpt. Consumed	445	
S-IVB GH_2 Start Tank	4	
Ullage Propellant Consumed	182	
S-IVB Stage Weight at Separation		294,072
S-IVB Aft Frame Hardware	30	
S-IVB Separation and Ullage Components	4	
S-IB/S-IVB Interstage	6,411	
S-IB Dry Weight	83,777	
S-IB Residuals and Reserves	10,813	
S-IVB Frost Consumed	100	
S-IB Frost Consumed	1,000	
S-IB Seal Purge Consumed	5	
S-IB Lubricant (Oronite)	26	
S-IB Gearbox Lubricant Consumed	713	
Inboard Engine Thrust Decay Prpt. Consumed	2,182	
Outboard Engine Thrust Decay Prpt. Consumed To Separation	1,768	
S-IB Mainstage Propellant Consumed	883,271	
Vehicle Liftoff Weight		1,284,172

NOTE: Above data consistent with Reference 10, adjusted to account for 1.3 second separation signal.

TABLE 6

PRELIMINARY AS-206 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
S-IB STAGE END CONDITIONS OF FLIGHT

Flight Time (t): OECO + 1.379 seconds	143.339	(sec)
Radius (R):	6434433.	(m)
Altitude:	61175.	(m)
Space Fixed Velocity (V):	2462.50	(m/s)
Space Fixed Path Angle (θ):	66.348	(deg)
Space Fixed Flight Azimuth (AZI):	75.457	(deg)
Earth Fixed Flight Azimuth (AZE):	72.267	(deg)
Geodetic Latitude (ϕ):	28.727	(deg)
Longitude (λ): (Pos West)	79.884	(deg)
Range:	69.97	(km)

POSITION AND VELOCITY COMPONENTS (PACSS NO. 13)

X	=	6433153.	(m)
Y	=	35424.	(m)
Z	=	123333.	(m)
$\dot{X}$	=	943.90	(m/s)
$\dot{Y}$	=	116.90	(m/s)
$\dot{Z}$	=	2271.41	(m/s)

VEHICLE ATTITUDE AND ATTITUDE RATE

Pitch Attitude Angle (ϕ_p):	-63.649	(deg)
Yaw Attitude Angle (ϕ_y):	- 0.109	(deg)
Roll Attitude Angle (ϕ_r):	- 0.005	(deg)
Pitch Rate (ϕ_p):	- 0.0004	(deg/s)
Yaw Rate (ϕ_y):	0.010	(deg/s)
Roll Rate (ϕ_r):	- 0.002	(deg/s)

TABLE 7

PRELIMINARY AS-206 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
S-IVB STAGE END CONDITIONS OF FLIGHT

Flight Time (t): GCS	580.464	(sec)
Radius (R):	6535556.	(m)
Altitude:	163193.	(m)
Space Fixed Velocity (V):	7821.99	(m/s)
Space Fixed Flight Path Angle (θ):	90.005	(deg)
Space Fixed Flight Azimuth (AZI):	85.544	(deg)
Earth Fixed Flight Azimuth (AZE):	85.299	(deg)
Geodetic Latitude (ϕ):	31.502	(deg)
Longitude (λ): (Pos West)	62.479	(deg West)
Inclination (i):	31.614	(deg)
Descending Node (θ_N):	119.056	(deg)

POSITION AND VELOCITY COMPONENTS (PACSS NO. 13)

X	=	6216193.	(m)
Y	=	140410.	(m)
Z	=	2013138.	(m)
$\dot{X}$	=	- 2415.64	(m/s)
$\dot{Y}$	=	411.76	(m/s)
$\dot{Z}$	=	7428.23	(m/s)

VEHICLE ATTITUDE ANGLES

Pitch Attitude Angle (ϕ_p)	=	- 99.016	(deg)
Yaw Attitude Angle (ϕ_y)	=	3.098	(deg)
Roll Attitude Angle (ϕ_r)	=	0.416	(deg)

OSCULATING CONIC PARAMETERS

*Perigee Altitude	=	157.38	(km)
*Apogee Altitude	=	199.06	(km)
Eccentricity	=	0.0032	
Semi-Major Axis	=	6556.39	(km)
True Anomaly	=	- 1.50	(deg)
Period	=	88.66	(min)

* Referenced to Equatorial Radius (6378.16)

TABLE 7 (Cont'd)

PRELIMINARY AS-206 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
S-IVB STAGE END CONDITIONS OF FLIGHT

Flight Time (t): GCS + 10.2 seconds:	590.664	(sec)
Radius (R):	6535563.	(m)
Altitude:	163218.	(m)
Space Fixed Velocity (V):	7828.81	(m/s)
Space Fixed Flight Path Angle (θ):	89.994	(deg)
Space Fixed Flight Azimuth (AZI):	85.970	(deg)
Earth Fixed Flight Azimuth (AZE):	85.749	(deg)
Geodetic Latitude (ϕ):	31.554	(deg)
Longitude (λ): (Pos West)	61.704	(deg West)
Inclination (i):	31.614	(deg)
Descending Node (θ_N):	119.055	(deg)

POSITION AND VELOCITY COMPONENTS (PACSS NO. 13)

X	=	6191083.	(m)
Y	=	144603.	(m)
Z	=	2088821.	(m)
$\dot{X}$	=	- 2507.12	(m/s)
$\dot{Y}$	=	410.14	(m/s)
$\dot{Z}$	=	7405.16	(m/s)

VEHICLE ATTITUDE ANGLES

Pitch Attitude Angle (ϕ_p)	=	- 99.025	(deg)
Yaw Attitude Angle (ϕ_y)	=	3.076	(deg)
Roll Attitude Angle (ϕ_r)	=	- 0.210	(deg)

OSCULATING CONIC PARAMETERS

*Perigee Altitude	=	157.39	(km)
*Apogee Altitude	=	222.17	(km)
Eccentricity	=	0.0049	
Semi-Major Axis	=	6567.94	(km)
True Anomaly	=	1.271	(deg)
Period	=	88.29	(min)

* Referenced to Equatorial Radius (6378.16)

TABLE 8
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	RANGE (KM)	ALTITUDE (KM)	SPACE FIXED VELOCITY (M/SEC)	SPACE FIXED PATH ANGLE (DEG)	LONGITUDINAL ACCELERATION (M/SEC2)	WEIGHT (KG)	THRUST (TOTAL) (N)	DYNAMIC PRESSURE (KG/M2)	MACH NO.	PITCH ANGLE OF ATTACK (DEG)
-5.00	0.00	0.03	408.93	90.000	0.000	588967.	0.	0.	0.00	0.000
0.00	0.00	0.03	408.93	90.000	12.255	582491.	7082616.	0.	0.00	0.000
5.00	0.00	0.07	409.15	88.048	12.757	568480.	7204615.	12.	0.04	1.330
10.00	0.00	0.18	409.92	85.834	13.169	554412.	7269073.	53.	0.09	2.262
15.00	-0.00	0.37	411.75	83.336	13.625	540243.	7348717.	133.	0.14	0.654
20.00	0.00	0.66	415.89	80.572	14.110	525985.	7415114.	264.	0.20	-0.117
25.00	0.02	1.05	423.23	77.609	14.577	511673.	7473414.	453.	0.27	-0.565
30.00	0.06	1.57	434.73	74.563	15.064	497330.	7534135.	702.	0.34	-0.983
35.00	0.13	2.21	451.27	71.553	15.585	482967.	7595628.	1011.	0.42	-1.183
40.00	0.26	3.00	473.53	68.778	16.137	468588.	7661069.	1373.	0.52	-1.369
45.00	0.48	3.94	502.03	66.148	16.725	454204.	7731225.	1774.	0.62	-1.548
50.00	0.80	5.03	537.04	63.965	17.329	439815.	7805580.	2197.	0.74	-1.538
55.00	1.25	6.30	578.08	62.204	17.800	425426.	7872689.	2613.	0.88	-1.420
60.00	1.87	7.73	623.69	61.003	17.734	411038.	7935045.	2949.	1.03	-1.494
65.00	2.68	9.32	673.85	60.264	18.482	396580.	8004659.	3194.	1.20	-1.354
70.00	3.70	11.08	730.89	59.808	19.538	382121.	8066270.	3334.	1.39	-1.559
75.00	4.98	13.00	795.32	59.531	20.735	367663.	8121711.	3356.	1.62	-1.289
80.00	6.55	15.12	867.44	59.404	22.009	353202.	8167803.	3267.	1.90	-0.430
85.00	8.45	17.43	947.34	59.395	23.329	338778.	8202692.	2965.	2.20	0.249
90.00	10.71	19.95	1035.53	59.533	24.722	324423.	8224457.	2488.	2.48	0.512
95.00	13.39	22.68	1132.36	59.842	26.126	310078.	8237108.	2000.	2.76	0.392
100.00	16.52	25.64	1237.78	60.277	27.580	295745.	8239083.	1558.	3.06	0.331
105.00	20.15	28.83	1351.85	60.796	29.095	281431.	8234722.	1178.	3.38	0.078
110.00	24.33	32.24	1474.97	61.384	30.741	267138.	8227741.	859.	3.70	-0.241
115.00	29.10	35.90	1607.73	62.028	32.517	252875.	8213778.	613.	4.04	-0.588
120.00	34.52	39.80	1750.87	62.717	34.456	238644.	8192668.	429.	4.40	-0.986
125.00	40.64	43.94	1905.15	63.446	36.577	224456.	8169996.	296.	4.78	-1.518
130.00	47.53	48.32	2071.55	64.216	38.934	210314.	8141724.	203.	5.21	-2.229
135.00	55.25	52.96	2251.37	65.035	41.559	196236.	8102608.	141.	5.80	-2.914
1) 138.96	62.00	56.81	2403.98	65.632	43.813	185149.	8057606.	104.	6.37	-1.735
140.00	63.86	57.85	2428.27	65.793	22.033	182752.	3972441.	94.	6.48	-1.438
2) 141.96	67.43	59.80	2463.58	66.099	18.418	181020.	3311239.	76.	6.67	-0.903
143.26	69.83	61.10	2462.80	66.334	0.102	179225.	14276.	65.	6.72	-0.599
3) 143.34	69.97	61.18	2462.50	66.348	0.090	179218.	12169.	64.	6.72	-0.582

1) IECO; 2) OECO; 3) Physical Separation

TABLE 8 (Cont'd)
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	* SPACE FIXED POSITION AND VELOCITY VECTORS X (M)	Y (M)	Z (M)	DX (M/S)	DY (M/S)	DZ (M/S)	SPACE FIXED MAGNITUDE RADIUS (M)	VELOCITY (M/S)	PATH ANGLE (DEG)
-5.00	6373327.	17651.	-554.	0.00	126.37	388.92	6373352.	408.93	90.000
0.00	6373327.	17683.	-3596.	-0.13	126.30	388.94	6373352.	408.93	90.000
5.00	6373359.	18314.	-1651.	13.68	126.19	388.97	6373386.	409.15	88.048
10.00	6373466.	18945.	294.	29.38	126.07	388.94	6373494.	409.92	85.834
15.00	6373657.	19575.	2239.	47.26	126.02	389.13	6373687.	411.75	83.336
20.00	6373943.	20205.	4187.	67.47	125.93	390.58	6373976.	415.89	80.572
25.00	6374335.	20834.	6148.	90.02	125.85	393.93	6374372.	423.23	77.609
30.00	6374847.	21463.	8131.	114.78	125.73	400.01	6374888.	434.73	74.563
35.00	6375487.	22091.	10154.	141.71	125.56	409.63	6375533.	451.27	71.553
40.00	6376267.	22719.	12235.	170.69	125.44	423.51	6376319.	473.53	68.708
45.00	6377197.	23346.	14397.	201.55	125.32	442.39	6377256.	502.03	66.148
50.00	6378285.	23972.	16668.	234.03	125.19	466.86	6378352.	537.04	63.965
55.00	6379539.	24598.	19075.	267.65	125.06	496.91	6379615.	578.08	62.204
60.00	6380960.	25223.	21646.	300.05	124.92	532.31	6381046.	623.69	61.003
65.00	6382538.	25847.	24407.	331.55	124.78	573.22	6382637.	673.85	60.264
70.00	6384277.	26470.	27390.	364.39	124.62	621.29	6384391.	730.89	59.808
75.00	6386186.	27093.	30631.	399.52	124.41	676.34	6386317.	795.32	59.531
80.00	6388276.	27715.	34166.	437.03	124.24	738.93	6388428.	867.44	59.474
85.00	6390560.	28335.	38033.	476.96	124.07	809.05	6390736.	947.34	59.395
90.00	6393049.	28955.	42271.	518.64	123.90	887.69	6393254.	1035.53	59.533
95.00	6395748.	29574.	46926.	561.17	123.69	975.72	6395989.	1132.36	59.842
100.00	6398662.	30191.	52044.	604.42	123.30	1073.11	6398944.	1237.78	60.277
105.00	6401793.	30807.	57672.	648.41	122.97	1179.81	6402127.	1351.85	60.796
110.00	6405147.	31421.	63858.	692.93	122.58	1296.28	6405542.	1474.97	61.384
115.00	6408723.	32033.	70652.	737.85	122.13	1423.19	6409193.	1607.73	62.028
120.00	6412526.	32642.	78109.	783.02	121.63	1561.29	6413084.	1750.87	62.717
125.00	6416554.	33249.	86285.	828.14	121.73	1711.50	6417220.	1905.15	63.446
130.00	6420806.	33849.	95246.	872.75	119.59	1874.92	6421602.	2071.55	64.216
135.00	6425279.	34444.	105059.	916.16	118.39	2053.12	6426230.	2251.37	65.035
1) 138.96	6428977.	34911.	113486.	952.51	117.37	2204.10	6430074.	2403.98	65.632
140.00	6429970.	35033.	115793.	955.07	117.19	2229.48	6431108.	2428.27	65.793
2) 141.96	6431842.	35263.	120201.	955.29	116.96	2267.81	6433062.	2463.58	66.099
143.26	6433078.	35415.	123153.	944.66	116.96	2271.42	6434354.	2462.80	66.334
3) 143.34	6433153.	35424.	123333.	943.90	116.9	2271.41	6434433.	2462.50	66.348

* PACSS No 13: Launch Vehicle Navigation Coordinates
1) IECO; 2) OECO: 3) Physical Separation

TABLE 8 (Cont'd)
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	*EARTH FIXED POSITION X (M)	Y (M)	Z (M)	*EARTH FIXED VELOCITY DX (M/S)	DY (M/S)	DZ (M/S)	EARTH FIXED MAGNITUDE POSITION (M)	VELOCITY (M/S)	PATH ANGLE (DEG)
-5.00	34.	-0.	-0.	-0.00	0.00	-0.00	34.	0.00	N/A
0.00	34.	-0.	-0.	-0.00	0.00	0.00	34.	0.00	N/A
5.00	68.	-0.	0.	13.94	-0.05	-0.00	68.	13.94	0.356
10.00	176.	-0.	-0.	29.78	-0.11	-0.08	176.	29.78	0.378
15.00	369.	-1.	-1.	47.79	-0.10	0.05	369.	47.79	0.294
20.00	658.	-2.	2.	68.13	-0.14	1.41	658.	68.14	1.264
25.00	1054.	-2.	17.	90.82	-0.18	4.65	1054.	90.94	2.993
30.00	1570.	-4.	53.	115.72	-0.26	10.60	1571.	116.21	5.288
35.00	2215.	-5.	129.	142.81	-0.38	20.06	2219.	144.21	8.050
40.00	3001.	-7.	261.	171.98	-0.47	33.75	3013.	175.26	11.153
45.00	3938.	-10.	474.	203.05	-0.54	52.40	3967.	209.70	14.519
50.00	5035.	-13.	794.	235.78	-0.61	76.62	5097.	247.91	18.047
55.00	6298.	-16.	1250.	269.64	-0.67	106.37	6421.	289.87	21.569
60.00	7729.	-19.	1867.	302.43	-0.72	141.45	7952.	333.87	25.100
65.00	9321.	-23.	2673.	334.32	-0.75	182.02	9697.	380.66	28.592
70.00	11075.	-27.	3699.	367.63	-0.76	229.61	11676.	433.45	32.005
75.00	13001.	-31.	4981.	403.32	-0.79	284.33	13923.	493.47	35.189
80.00	15112.	-35.	6555.	441.46	-0.76	346.45	16472.	561.17	38.116
85.00	17420.	-38.	8458.	482.12	-0.66	416.06	19365.	636.83	40.767
90.00	19936.	-41.	10730.	524.65	-0.53	494.13	22640.	720.71	43.238
95.00	22668.	-44.	13415.	568.17	-0.48	581.56	26340.	813.03	45.597
100.00	25619.	-46.	16561.	612.54	-0.34	678.30	30506.	913.94	47.818
105.00	28795.	-47.	20213.	657.80	-0.17	784.29	35181.	1023.63	49.882
110.00	32199.	-47.	24420.	703.76	0.02	900.02	40411.	1142.51	51.808
115.00	35834.	-47.	29231.	750.31	0.25	1026.14	46244.	1271.19	53.614
120.00	39703.	-45.	34700.	797.30	0.52	1163.41	52729.	1410.40	55.316
125.00	43807.	-42.	40885.	844.47	0.50	1312.74	59922.	1560.90	56.932
130.00	48147.	-40.	47849.	891.38	0.38	1475.26	67880.	1723.64	58.481
135.00	52719.	-38.	55662.	937.36	0.34	1652.51	76665.	1899.85	59.990
1)138.96	56506.	-37.	62501.	975.95	0.35	1802.70	84257.	2049.93	61.062
140.00	57524.	-36.	64391.	979.00	0.39	1827.92	86343.	2073.58	61.303
2)141.96	59443.	-35.	68011.	980.05	0.56	1866.01	90327.	2107.72	61.735
143.26	60712.	-35.	70441.	969.78	0.69	1869.55	92994.	2106.11	62.005
3)143.34	60788.	-35.	70589.	969.05	0.69	1869.54	93156.	2105.76	62.022

* PACSS No 10: Earth Fixed Launch Site Coordinates
1) IECO; 2) OECO; 3) Physical Separation

TABLE 8 (Cont'd)
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	RANGE (KM)	ALTITUDE (KM)	LONGITUDE (POS.WEST) (DEG)	GEODETIC LATITUDE (DEG)	GEOCENTRIC LATITUDE (DEG)
-5.00	0.00	0.03	80.565	28.532	28.371
0.00	0.00	0.03	80.565	28.532	28.371
5.00	0.00	0.07	80.565	28.532	28.371
10.00	0.00	0.18	80.565	28.532	28.371
15.00	-0.00	0.37	80.565	28.532	28.371
20.00	0.00	0.66	80.565	28.532	28.371
25.00	0.02	1.05	80.565	28.532	28.371
30.00	0.06	1.57	80.564	28.532	28.371
35.00	0.13	2.21	80.564	28.532	28.371
40.00	0.26	3.00	80.562	28.533	28.372
45.00	0.48	3.94	80.560	28.533	28.372
50.00	0.80	5.03	80.557	28.534	28.373
55.00	1.25	6.30	80.553	28.536	28.374
60.00	1.87	7.73	80.547	28.537	28.376
65.00	2.68	9.32	80.539	28.540	28.379
70.00	3.70	11.08	80.529	28.543	28.381
75.00	4.98	13.00	80.517	28.546	28.385
80.00	6.55	15.12	80.502	28.551	28.390
85.00	8.45	17.43	80.483	28.556	28.395
90.00	10.71	19.95	80.461	28.562	28.401
95.00	13.39	22.68	80.435	28.570	28.409
100.00	16.52	25.64	80.405	28.579	28.417
105.00	20.15	28.83	80.369	28.589	28.428
110.00	24.33	32.24	80.329	28.601	28.439
115.00	29.10	35.90	80.282	28.614	28.452
120.00	34.52	39.80	80.230	28.629	28.467
125.00	40.64	43.94	80.170	28.646	28.484
130.00	47.53	48.32	80.103	28.665	28.503
135.00	55.25	52.96	80.028	28.686	28.525
1) 138.96	62.00	56.81	79.962	28.705	28.543
140.00	63.86	57.85	79.944	28.710	28.548
2) 141.96	67.43	59.80	79.909	28.720	28.558
143.26	69.83	61.10	79.886	28.727	28.565
3) 143.34	69.97	61.18	79.884	28.727	28.565

1) IECO; 2) OECO; 3) Physical Separation

TABLE 8 (Cont'd)
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	VEHICLE ATTITUDE ANGLE PITCH (DEG)	YAW (DEG)	ROLL (DEG)	VEHICLE ATTITUDE RATE PITCH (DEG/S)	YAW (DEG/S)	ROLL (DEG/S)	ATTITUDE ERROR COMMAND PITCH (DEG)	YAW (DEG)	ROLL (DEG)
-5.00	0.000	0.000	18.000	-0.003	0.001	-0.002	0.000	0.000	-0.000
0.00	-0.017	0.000	17.990	-0.003	0.001	-0.002	-0.017	0.006	-0.010
5.00	-0.007	-0.018	18.007	-0.002	-0.002	0.007	-0.007	-0.018	0.007
10.00	-0.001	-0.020	18.000	0.000	0.000	-0.003	-0.001	-0.020	-0.000
15.00	-0.647	0.000	14.889	-0.218	-0.025	-1.335	0.186	0.060	1.689
20.00	-1.882	0.014	9.287	-0.285	0.008	-0.898	0.241	0.014	1.087
25.00	-3.584	0.007	4.387	-0.389	-0.007	-1.022	0.315	0.007	1.187
30.00	-5.771	-0.049	-0.244	-0.593	-0.033	-0.413	0.336	-0.049	-0.244
35.00	-8.277	-0.012	0.073	-0.546	-0.002	-0.002	0.418	-0.012	0.073
40.00	-11.145	-0.024	-0.037	-0.596	0.001	0.007	0.470	-0.024	-0.037
45.00	-14.240	-0.027	-0.052	-0.639	-0.001	-0.007	0.570	-0.027	-0.052
50.00	-17.466	-0.032	-0.067	-0.626	-0.001	-0.002	0.696	-0.032	-0.067
55.00	-20.644	-0.039	-0.072	-0.643	-0.001	-0.001	0.897	-0.039	-0.072
60.00	-23.956	-0.041	-0.099	-0.644	-0.002	-0.008	0.994	-0.041	-0.099
65.00	-27.172	-0.046	-0.098	-0.659	-0.000	0.001	1.176	-0.046	-0.098
70.00	-30.412	-0.051	-0.132	-0.607	-0.002	-0.013	1.278	-0.051	-0.132
75.00	-33.376	-0.052	-0.089	-0.684	0.003	0.006	1.560	-0.052	-0.089
80.00	-36.701	-0.041	-0.055	-0.642	0.001	0.021	1.341	-0.041	-0.055
85.00	-39.961	-0.036	0.011	-0.637	0.001	0.008	1.004	-0.036	0.011
90.00	-43.058	-0.032	0.041	-0.594	0.000	-0.003	0.605	-0.032	0.041
95.00	-45.772	-0.063	0.050	-0.516	0.012	-0.009	0.321	-0.063	0.050
100.00	-48.072	-0.046	0.024	-0.459	-0.001	0.003	0.295	-0.046	0.024
105.00	-50.331	-0.052	0.003	-0.439	-0.002	-0.004	0.288	-0.052	0.003
110.00	-52.528	-0.060	-0.008	-0.439	-0.002	-0.004	0.308	-0.060	-0.008
115.00	-54.732	-0.069	-0.017	-0.446	-0.001	-0.001	0.317	-0.069	-0.017
120.00	-56.950	-0.073	-0.019	-0.449	-0.000	-0.000	0.342	-0.073	-0.019
125.00	-59.185	-0.256	-0.016	-0.456	0.010	-0.000	0.414	-0.256	-0.016
130.00	-61.518	-0.238	-0.018	-0.482	-0.002	0.000	0.481	-0.238	-0.018
135.00	-63.755	-0.242	-0.029	-0.113	-0.002	-0.009	-0.155	-0.242	-0.029
1) 138.96	-63.699	-0.242	-0.006	0.002	0.001	0.001	-0.099	-0.242	-0.006
140.00	-63.686	-0.206	-0.006	0.025	0.067	-0.001	-0.086	-0.206	-0.006
2) 141.96	-63.652	-0.122	-0.005	0.006	0.013	0.002	-0.052	-0.122	-0.005
143.26	-63.649	-0.110	-0.005	-0.000	0.010	-0.002	-0.049	-0.110	-0.005
3) 143.34	-63.649	-0.109	-0.005	-0.000	0.010	-0.002	-0.049	-0.109	-0.005

1) IECO; 2) OECO; 3) Physical Separation

TABLE 9
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	RANGE (KM)	ALTITUDE (KM)	SPACE FIXED VELOCITY (M/SEC)	SPACE FIXED PATH ANGLE (DEG)	LONGITUDINAL ACCELERATION (M/SEC2)	WEIGHT (KG)	THRUST (TOTAL) (N)	DYNAMIC PRESSURE (KG/M2)	PITCH ATTITUDE COMMAND (DEG)
143.34	69.97	61.19	2462.50	66.348	1.415	133389.	191268.	64.	63.600
144.66	72.41	62.47	2459.27	66.591	1.390	133360.	187536.	54.	63.600
1) 148.06	78.69	65.76	2456.57	67.215	6.563	133103.	875025.	35.	63.600
155.69	92.94	72.86	2482.08	68.528	7.732	131394.	1016481.	13.	63.600
160.00	101.15	76.73	2500.36	69.234	7.802	130243.	1016451.	8.	63.100
180.00	140.71	93.59	2591.93	72.072	8.106	125342.	1016008.	0.	59.510
200.00	182.73	108.73	2697.58	74.673	8.444	120438.	1017053.	0.	61.993
220.00	227.38	122.19	2817.84	77.090	8.797	115530.	1016275.	0.	64.220
240.00	274.86	134.00	2952.41	79.300	9.190	110622.	1016672.	0.	66.514
260.00	325.35	144.20	3101.27	81.300	9.617	105717.	1016708.	0.	68.639
280.00	379.07	152.85	3264.57	83.092	10.068	100811.	1015025.	0.	70.596
300.00	436.24	160.01	3442.74	84.684	10.597	95906.	1016339.	0.	72.317
320.00	497.11	165.72	3636.10	86.070	11.173	90999.	1016787.	0.	74.392
340.00	561.94	170.09	3845.54	87.264	11.813	86090.	1016951.	0.	76.369
360.00	631.03	173.18	4071.52	88.273	12.520	81183.	1016425.	0.	78.278
380.00	704.70	175.12	4315.58	89.105	13.333	76274.	1017016.	0.	80.212
400.00	783.29	176.01	4579.01	89.766	14.236	71366.	1015960.	0.	82.060
420.00	867.21	176.01	4863.63	90.262	15.288	66461.	1016105.	0.	83.925
440.00	956.93	175.28	5172.49	90.598	16.494	61555.	1015281.	0.	85.759
460.00	1052.71	173.98	5484.78	90.850	15.559	57016.	887141.	0.	88.256
480.00	1154.56	172.13	5796.34	91.050	16.235	52883.	858570.	0.	89.909
500.00	1262.69	169.97	6129.99	91.113	17.591	48807.	858611.	0.	91.584
520.00	1377.65	167.55	6493.31	91.038	19.132	44733.	855875.	0.	93.182
540.00	1500.04	165.47	6888.84	90.820	20.885	40686.	849748.	0.	94.836
560.00	1630.56	163.83	7323.63	90.468	23.165	36661.	849291.	0.	96.888
580.00	1770.07	163.19	7810.07	90.018	25.969	32632.	847469.	0.	98.116
2) 580.46	1773.42	163.19	7821.99	90.005	26.040	32539.	847350.	0.	98.116
3) 590.66	1847.23	163.22	7828.81	89.994	-0.000	32469.	0.	0.	98.116

1) 90% J-2 Thrust; 2) GCS; 3) Orbit Insertion

TABLE 9 (Cont'd)
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	*SPACE FIXED POSITION AND VELOCITY VECTORS X (M)	Y (M)	Z (M)	DX (M/S)	DY (M/S)	DZ (M/S)	SPACE FIXED MAGNITUDE RADIUS (M)	VELOCITY (M/S)	PATH ANGLE (DEG)
143.34	6433153.	35424.	123333.	943.90	116.90	2271.41	6434433.	2462.50	66.348
144.66	6434392.	35578.	126334.	932.00	116.84	2272.82	6435730.	2459.27	66.591
1) 148.06	6437510.	35975.	134071.	903.43	116.57	2281.44	6439006.	2456.57	67.215
155.69	6444207.	36859.	151651.	853.40	115.29	2327.90	6446097.	2482.08	68.528
160.00	6447829.	37355.	161746.	827.02	114.63	2356.84	6449965.	2500.36	69.234
180.00	6463245.	39699.	210195.	716.63	121.22	2487.94	6466784.	2591.93	72.072
200.00	6476484.	42208.	261314.	606.87	129.72	2625.23	6481891.	2697.58	74.673
220.00	6487503.	44911.	315258.	494.72	140.91	2770.49	6495314.	2817.84	77.090
240.00	6496259.	47844.	372187.	380.44	152.48	2923.83	6507088.	2952.41	79.300
260.00	6502705.	51012.	432267.	263.72	164.39	3085.66	6517256.	3101.27	81.300
280.00	6506789.	54422.	495675.	144.23	176.65	3256.59	6525868.	3264.57	83.092
300.00	6508451.	58075.	562597.	21.32	188.39	3437.51	6532980.	3442.74	84.684
320.00	6507626.	61979.	633243.	-104.62	201.77	3628.99	6538657.	3636.10	86.070
340.00	6504241.	66151.	707835.	-234.62	215.44	3832.33	6542978.	3845.54	87.264
360.00	6498213.	70600.	786619.	-368.96	229.52	4048.27	6546031.	4071.52	88.273
380.00	6489449.	75336.	869862.	-508.35	244.13	4278.57	6547922.	4315.58	89.105
400.00	6477842.	80369.	957867.	-653.40	259.34	4524.73	6548771.	4579.01	89.766
420.00	6463271.	85714.	1050968.	-804.87	275.19	4788.67	6548721.	4863.63	90.262
440.00	6445597.	91382.	1149553.	-963.87	291.82	5073.51	6547942.	5172.49	90.598
460.00	6424652.	97383.	1253906.	-1133.20	307.98	5357.60	6546595.	5484.78	90.850
480.00	6400187.	103695.	1363822.	-1314.81	323.29	5635.99	6544704.	5796.34	91.050
500.00	6372000.	110317.	1479468.	-1505.55	339.06	5932.55	6542429.	6129.99	91.113
520.00	6339887.	117263.	1601295.	-1707.70	355.66	6254.62	6540036.	6493.31	91.038
540.00	6303613.	124549.	1729838.	-1922.05	373.05	6604.74	6537843.	6888.84	90.820
560.00	6262899.	132192.	1865710.	-2152.77	391.54	6989.12	6536226.	7323.63	90.468
580.00	6217312.	140219.	2009695.	-2409.60	411.28	7417.67	6535557.	7810.07	90.018
2) 580.46	6216193.	140410.	2013138.	-2415.64	411.76	7428.23	6535556.	7821.99	90.005
3) 590.66	6191083.	144603.	2088821.	-2507.12	410.14	7405.16	6535563.	7828.81	89.994

* PACSS No 13: Launch Vehicle Navigation Coordinates
1) 90% J-2 Thrust; 2) GCS; 3) Orbit Insertion

TABLE 9 (Cont'd)
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IVB STAGE FLIGHT DATA

	FLIGHT TIME (SEC)	*EARTH FIXED POSITION X (M)	Y (M)	Z (M)	*EARTH FIXED VELOCITY DX (M/S)	DY (M/S)	DZ (M/S)	EARTH FIXED MAGNITUDE POSITION (M)	VELOCITY (M/S)	PATH ANGLE (DEG)
	143.34	60788.	-35.	70589.	969.05	0.69	1869.54	93156.	2105.76	62.022
	144.66	62061.	-34.	73059.	957.49	0.82	1870.90	95860.	2101.68	62.296
1)	148.06	65267.	-30.	79429.	929.87	1.05	1879.38	102805.	2096.84	63.018
	155.69	72175.	-23.	93940.	882.25	1.02	1925.44	118465.	2117.95	64.597
	160.00	75924.	-18.	102300.	857.30	1.11	1954.18	127396.	2133.96	65.453
	180.00	92014.	91.	142686.	753.78	11.32	2084.36	169782.	2216.50	68.902
	200.00	106069.	442.	185727.	651.49	23.91	2221.07	213881.	2314.77	72.059
	220.00	118061.	1074.	231585.	547.45	39.66	2366.11	259945.	2428.94	74.978
	240.00	127958.	2032.	280427.	441.95	56.31	2519.64	308248.	2558.72	77.630
	260.00	135728.	3332.	332429.	334.75	73.85	2682.05	359085.	2703.87	80.010
	280.00	141334.	4992.	387774.	225.55	92.32	2853.98	412757.	2864.37	82.121
	300.00	144733.	7026.	446658.	113.77	110.89	3036.34	469574.	3040.49	83.979
	320.00	145876.	9454.	509298.	-0.12	131.77	3229.69	529862.	3232.37	85.578
	340.00	144710.	12307.	575927.	-117.08	153.66	3435.36	593956.	3440.79	86.942
	360.00	141172.	15609.	646798.	-237.30	176.72	3654.13	662209.	3666.09	88.082
	380.00	135192.	19385.	722191.	-361.41	201.16	3887.79	734991.	3909.73	89.012
	400.00	126686.	23665.	802419.	-489.89	227.10	4137.84	812702.	4172.93	89.744
	420.00	115563.	28480.	887826.	-623.37	254.70	4406.28	895768.	4457.44	90.286
	440.00	101712.	33865.	978813.	-762.78	284.20	4696.25	984666.	4766.27	90.649
	460.00	84995.	39850.	1075678.	-911.45	314.09	4986.25	1079767.	5078.59	90.918
	480.00	65178.	46428.	1178235.	-1071.47	343.95	5271.45	1180949.	5390.23	91.129
	500.00	42088.	53619.	1286664.	-1238.99	375.48	5575.65	1288469.	5723.98	91.192
	520.00	15555.	61463.	1401437.	-1415.92	409.27	5906.26	1402870.	6087.39	91.107
	540.00	-14613.	70005.	1523106.	-1602.84	445.43	6265.91	1524784.	6482.99	90.871
	560.00	-48648.	79299.	1652306.	-1803.57	484.54	6660.99	1654923.	6917.83	90.496
	580.00	-86926.	89411.	1789849.	-2027.28	527.21	7101.80	1794188.	7404.28	90.019
2)	580.46	-87867.	89655.	1793146.	-2032.52	528.24	7112.66	1797534.	7416.20	90.005
3)	590.66	-109025.	95071.	1865638.	-2115.48	533.30	7095.17	1871238.	7423.01	89.993

* PACSS No 10: Earth Fixed Launch Site Coordinates
1) 90% J-2 Thrust; 2) GCS; 3) Orbit Insertion

TABLE 9 (Cont'd)
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IVB STAGE FLIGHT DATA

	FLIGHT TIME (SEC)	RANGE (KM)	ALTITUDE (KM)	LONGITUDE (POS.WEST) (DEG)	GEODETIC LATITUDE (DEG)	GEOCENTRIC LATITUDE (DEG)
	143.34	69.97	61.18	79.884	28.727	28.565
	144.66	72.41	62.47	79.861	28.734	28.572
1)	148.06	78.68	65.76	79.799	28.751	28.589
	155.69	92.94	72.86	79.660	28.790	28.628
	160.00	101.15	76.73	79.580	28.812	28.650
	180.00	140.71	93.59	79.193	28.919	28.756
	200.00	182.73	108.73	78.780	29.028	28.865
	220.00	227.38	122.19	78.340	29.141	28.978
	240.00	274.86	134.00	77.870	29.257	29.094
	260.00	325.35	144.20	77.368	29.377	29.212
	280.00	379.07	152.85	76.833	29.499	29.334
	300.00	436.24	160.01	76.260	29.624	29.459
	320.00	497.11	165.72	75.649	29.753	29.588
	340.00	561.94	170.09	74.995	29.885	29.719
	360.00	631.03	173.18	74.296	30.019	29.853
	380.00	704.70	175.12	73.548	30.156	29.989
	400.00	783.29	176.01	72.747	30.295	30.128
	420.00	867.21	176.01	71.889	30.436	30.268
	440.00	956.90	175.28	70.969	30.578	30.410
	460.00	1052.71	173.98	69.983	30.721	30.552
	480.00	1154.56	172.13	68.931	30.862	30.693
	500.00	1262.69	169.90	67.811	31.001	30.831
	520.00	1377.65	167.55	66.616	31.135	30.965
	540.00	1500.04	165.40	65.340	31.265	31.094
	560.00	1630.56	163.83	63.976	31.387	31.216
	580.00	1770.07	163.19	62.514	31.500	31.329
2)	580.46	1773.42	163.19	62.479	31.502	31.331
3)	590.66	1847.23	163.22	61.704	31.554	31.383

1) 90% J-2 Thrust; 2) GCS; 3) Oribt Insertion

TABLE 9 (Cont'd)

PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY

S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	VEHICLE ATTITUDE ANGLE PITCH (DEG)	YAW (DEG)	ROLL (DEG)	VEHICLE ATTITUDE RATE PITCH (DEG/S)	YAW (DEG/S)	ROLL (DEG/S)	ATTITUDE ERROR COMMAND PITCH (DEG)	YAW (DEG)	ROLL (DEG)
143.34	-63.649	-0.109	-0.005	-0.000	0.010	-0.002	-0.049	-0.109	-0.005
144.66	-63.866	-0.135	-0.014	-0.313	-0.052	-0.011	-0.266	-0.135	-0.014
1) 148.06	-65.726	-0.715	-0.168	-0.034	-0.178	-0.072	-2.126	-0.715	-0.168
155.69	-63.433	-0.591	-0.178	-0.046	0.016	0.146	0.167	-0.591	-0.178
160.00	-63.567	-0.546	0.319	0.058	0.078	-0.021	-0.467	-1.046	0.319
180.00	-59.507	3.470	0.421	-0.132	0.001	-0.021	0.004	-0.538	0.421
200.00	-62.029	3.608	0.350	-0.130	0.093	0.008	-0.036	-0.774	0.350
220.00	-64.315	4.237	0.461	-0.100	-0.003	0.005	-0.095	-0.590	0.461
240.00	-66.622	4.261	0.580	-0.104	-0.004	0.006	-0.108	-0.600	0.580
260.00	-68.744	4.225	0.701	-0.112	-0.003	0.006	-0.105	-0.621	0.701
280.00	-70.713	4.180	0.821	-0.106	-0.003	0.006	-0.117	-0.643	0.821
300.00	-72.789	4.302	0.704	-0.043	0.137	-0.088	-0.471	-1.434	0.704
320.00	-74.848	4.160	-0.314	-0.089	0.021	0.038	-0.456	-1.400	-0.314
340.00	-76.856	4.052	0.426	-0.090	0.000	0.037	-0.487	-1.440	0.426
360.00	-78.780	3.984	0.211	-0.101	-0.002	-0.064	-0.501	-1.492	0.211
380.00	-80.749	3.916	-0.427	-0.096	-0.004	0.044	-0.538	-1.549	-0.427
400.00	-82.618	3.853	0.450	-0.094	-0.005	0.044	-0.559	-1.600	0.450
420.00	-84.505	3.779	0.061	-0.094	-0.004	-0.058	-0.583	-1.655	0.061
440.00	-86.373	3.727	-0.319	-0.093	-0.004	0.063	-0.614	-1.709	-0.319
460.00	-88.928	3.654	0.445	-0.097	-0.010	-0.044	-0.673	-1.763	0.445
480.00	-90.606	3.573	-0.452	-0.077	-0.008	-0.045	-0.697	-1.816	-0.452
500.00	-92.279	3.489	-0.049	-0.092	-0.006	0.056	-0.695	-1.875	-0.049
520.00	-93.921	3.394	0.365	-0.074	-0.007	-0.060	-0.739	-1.922	0.365
540.00	-95.570	3.303	-0.638	-0.089	-0.006	0.041	-0.734	-1.982	-0.638
560.00	-97.610	3.216	0.199	-0.115	-0.004	0.043	-0.722	-2.034	0.199
580.00	-99.017	3.099	0.445	0.006	-0.001	-0.062	-0.901	-2.087	0.445
2) 580.46	-99.016	3.098	0.416	-0.000	-0.002	-0.062	-0.900	-2.088	0.416
3) 590.66	-99.025	3.076	-0.210	0.000	-0.002	-0.061	-0.909	-2.110	-0.210

1) 90% J-2 Thrust; 2) GCS; 3) Orbit Insertion

TABLE 10
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	RANGE (NM)	ALTITUDE (FT)	SPACE FIXED VELOCITY (FT/SEC)	SPACE FIXED PATH ANGLE (DEG)	LONGITUDINAL ACCELERATION (FT/SEC2)	WEIGHT (LB)	THRUST (TOTAL) (LB)	DYNAMIC PRESSURE (LB/FT2)	MACH NO.	PITCH ANGLE OF ATTACK (DEG)
-5.00	0.000	110.	1341.64	90.000	0.000	1298449.	0.	0.	0.00	0.000
0.00	0.000	110.	1341.64	90.000	40.206	1284173.	1592235.	0.	0.00	0.000
5.00	0.000	221.	1342.37	88.048	41.855	1253283.	1619662.	2.	0.04	1.330
10.00	0.001	577.	1344.87	85.834	43.206	1222269.	1634153.	11.	0.09	2.262
15.00	-0.001	1210.	1350.89	83.336	44.702	1191032.	1652057.	27.	0.14	0.654
20.00	0.002	2157.	1364.46	80.572	46.293	1159598.	1666984.	54.	0.20	-0.117
25.00	0.010	3458.	1388.54	77.609	47.825	1128045.	1680090.	93.	0.27	-0.565
30.00	0.030	5149.	1426.27	74.563	49.423	1096426.	1693741.	144.	0.34	-0.983
35.00	0.071	7266.	1480.54	71.553	51.133	1064759.	1707565.	207.	0.42	-1.183
40.00	0.143	9846.	1553.58	68.708	52.944	1033059.	1722277.	281.	0.52	-1.369
45.00	0.258	12919.	1647.09	66.148	54.873	1001347.	1738049.	363.	0.62	-1.548
50.00	0.431	16517.	1761.93	63.965	56.854	969625.	1754764.	450.	0.74	-1.538
55.00	0.677	20662.	1896.58	62.204	58.400	937903.	1769851.	535.	0.88	-1.420
60.00	1.011	25359.	2046.22	61.003	58.184	906185.	1783869.	604.	1.03	-1.494
65.00	1.446	30581.	2210.80	60.264	60.637	874309.	1799519.	654.	1.20	-1.354
70.00	1.999	36338.	2397.92	59.808	64.100	842433.	1813370.	683.	1.39	-1.559
75.00	2.690	42660.	2609.33	59.531	68.028	810557.	1825833.	687.	1.62	-1.289
80.00	3.538	49590.	2845.92	59.404	72.208	778678.	1836195.	669.	1.90	-0.430
85.00	4.563	57170.	3108.07	59.395	76.538	746878.	1844039.	607.	2.20	0.249
90.00	5.785	65437.	3397.42	59.533	81.109	715231.	1848931.	510.	2.48	0.512
95.00	7.229	74416.	3715.08	59.842	85.716	683605.	1851776.	410.	2.76	0.392
100.00	8.918	84123.	4060.96	60.277	90.485	652005.	1852219.	319.	3.06	0.331
105.00	10.879	94576.	4435.21	60.796	95.455	620448.	1851239.	241.	3.38	0.078
110.00	13.135	105790.	4839.13	61.384	100.857	588939.	1849670.	176.	3.70	-0.241
115.00	15.712	117782.	5274.71	62.028	106.682	557493.	1846531.	126.	4.04	-0.588
120.00	18.639	130565.	5744.32	62.717	113.046	526121.	1841785.	88.	4.40	-0.986
125.00	21.946	144150.	6250.50	63.446	120.004	494840.	1836688.	61.	4.78	-1.518
130.00	25.669	158546.	6796.44	64.216	127.738	463662.	1830332.	42.	5.21	-2.229
135.00	29.833	173753.	7386.38	65.035	136.348	432626.	1821539.	29.	5.80	-2.914
1) 138.56	33.477	186382.	7887.07	65.632	143.743	408183.	1811422.	21.	6.37	-1.735
140.00	34.483	189781.	7966.76	65.793	72.287	402900.	893040.	19.	6.48	-1.438
2) 141.56	36.410	196202.	8082.61	66.099	60.428	396876.	744396.	16.	6.67	-0.903
143.26	37.703	200449.	8080.05	66.334	0.334	395123.	3209.	13.	6.72	-0.599
3) 143.34	37.782	200706.	8079.07	66.348	0.295	395107.	2736.	13.	6.72	-0.582

1) IECO; 2) OECO; 3) Physical Separation

TABLE 10 (Cont'd)
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	*SPACE FIXED POSITION AND VELOCITY VECTORS X (FT)	Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)	SPACE FIXED MAGNITUDE RADIUS (FT)	VELOCITY (FT/S)	PATH ANGLE (DEG)
-5.00	20909865.	55942.	-18177.	0.00	414.59	1275.97	20909947.	1341.64	90.000
0.00	20909864.	58015.	-11797.	-0.43	414.37	1276.05	20909947.	1341.64	90.000
5.00	20909972.	60086.	-5416.	44.87	414.00	1276.15	20910058.	1342.37	88.048
10.00	20910222.	62155.	964.	96.40	413.60	1276.06	20910414.	1344.87	85.834
15.00	20910948.	64222.	7345.	155.06	413.46	1276.68	20911047.	1350.89	83.336
20.00	20911885.	66289.	13738.	221.36	413.17	1281.42	20911995.	1364.46	80.572
25.00	20913174.	68354.	20170.	295.36	412.89	1292.41	20913295.	1388.54	77.609
30.00	20914851.	70417.	26677.	376.57	412.49	1312.36	20914986.	1426.27	74.563
35.00	20916951.	72478.	33313.	464.91	411.95	1343.93	20917103.	1480.54	71.553
40.00	20919511.	74537.	40140.	560.01	411.55	1389.47	20919682.	1553.58	68.708
45.00	20922562.	76594.	47235.	661.25	411.15	1451.41	20922755.	1647.09	66.148
50.00	20926132.	78649.	54685.	767.82	410.74	1531.71	20926351.	1761.93	63.965
55.00	20930246.	80701.	62582.	877.97	410.29	1630.30	20930495.	1896.58	62.204
60.00	20934907.	82752.	71017.	984.41	409.84	1746.42	20935190.	2046.22	61.003
65.00	20940085.	84800.	80077.	1087.75	409.37	1880.65	20940410.	2210.80	60.264
70.00	20945791.	86845.	89862.	1195.50	408.85	2038.05	20946164.	2397.92	59.808
75.00	20952053.	88888.	100496.	1310.77	408.18	2218.98	20952483.	2609.33	59.531
80.00	20958911.	90927.	112094.	1433.82	407.60	2424.31	20959408.	2845.92	59.404
85.00	20966405.	92964.	124780.	1564.83	407.07	2654.37	20966982.	3108.07	59.395
90.00	20974569.	94998.	138684.	1701.57	406.50	2912.36	20975243.	3397.42	59.533
95.00	20983425.	97028.	153955.	1841.12	405.51	3201.19	20984214.	3715.08	59.842
100.00	20992984.	99053.	170748.	1983.01	404.53	3520.72	20993912.	4060.96	60.277
105.00	21003259.	101073.	189213.	2127.32	403.44	3870.77	21004354.	4435.21	60.796
110.00	21014260.	103087.	209508.	2273.39	402.17	4252.90	21015557.	4839.13	61.384
115.00	21025995.	105095.	231799.	2420.78	400.70	4669.25	21027535.	5274.71	62.028
120.00	21038469.	107094.	256262.	2568.95	399.06	5122.35	21040302.	5744.32	62.717
125.00	21051685.	109083.	283089.	2716.98	396.09	5615.15	21053870.	6250.50	63.446
130.00	21065636.	111094.	312486.	2863.35	392.36	6151.33	21068246.	6796.44	64.216
135.00	21080311.	113006.	344683.	3005.76	388.41	6735.96	21083432.	7386.38	65.035
1) 138.56	21092445.	114538.	372330.	3125.02	385.09	7231.31	21096042.	7887.07	65.632
140.00	21095703.	114938.	379900.	3133.45	384.47	7314.57	21099436.	7966.76	65.793
2) 141.56	21101845.	115691.	394360.	3134.15	383.74	7440.32	21105847.	8082.61	66.099
143.26	21105900.	116190.	404046.	3099.28	383.53	7452.16	21110087.	8080.05	66.334
3) 143.34	21106145.	116220.	404635.	3096.79	383.52	7452.13	21110343.	8079.07	66.348

* PACSS No 13: Launch Vehicle Navigation Coordinates
1) IECO; 2) OECO; 3) Physical Separation

TABLE 10 (Cont'd)
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	* EARTH FIXED POSITION X (FT)	Y (FT)	Z (FT)	* EARTH FIXED VELOCITY DX (FT/S)	DY (FT/S)	DZ (FT/S)	EARTH FIXED MAGNITUDE POSITION (FT)	VELOCITY (FT/S)	PATH ANGLE (DEG)
-5.00	111.	-0.	-0.	-0.00	0.00	-0.00	111.	0.00	N/A
0.00	111.	-0.	-0.	-0.00	0.00	0.00	111.	0.00	N/A
5.00	222.	-0.	0.	45.73	-0.16	-0.01	222.	45.73	0.356
10.00	578.	-2.	-0.	97.69	-0.36	-0.25	578.	97.69	0.378
15.00	1211.	-4.	-2.	156.78	-0.33	0.16	1211.	156.78	0.294
20.00	2159.	-5.	8.	223.51	-0.46	4.62	2159.	223.56	1.264
25.00	3459.	-6.	55.	297.97	-0.59	15.26	3460.	298.36	2.993
30.00	5150.	-12.	175.	379.67	-0.85	34.76	5153.	381.25	5.288
35.00	7268.	-17.	422.	468.54	-1.26	65.81	7280.	473.14	8.050
40.00	9847.	-24.	857.	564.24	-1.53	110.72	9884.	575.00	11.153
45.00	12921.	-32.	1556.	666.17	-1.77	171.92	13014.	688.00	14.519
50.00	16518.	-42.	2606.	773.55	-1.99	251.36	16722.	813.37	18.047
55.00	20663.	-52.	4100.	884.06	-2.20	348.99	21065.	951.01	21.569
60.00	25359.	-64.	6126.	992.22	-2.36	464.07	26085.	1095.38	25.100
65.00	30580.	-76.	8770.	1096.86	-2.45	597.16	31813.	1248.86	28.592
70.00	36335.	-88.	12136.	1206.14	-2.50	753.32	38309.	1422.06	32.005
75.00	42655.	-101.	16342.	1323.21	-2.59	932.85	45678.	1618.99	35.189
80.00	49580.	-114.	21506.	1448.35	-2.48	1136.65	54044.	1841.11	38.116
85.00	57152.	-125.	27749.	1581.77	-2.18	1365.02	63533.	2089.33	40.787
90.00	65408.	-135.	35202.	1721.31	-1.75	1621.16	74280.	2364.54	43.238
95.00	74371.	-143.	44012.	1864.08	-1.56	1907.99	86418.	2667.44	45.597
100.00	84053.	-150.	54333.	2009.65	-1.13	2225.38	100085.	2998.50	47.818
105.00	94472.	-154.	66317.	2158.14	-0.57	2573.13	115425.	3356.36	49.862
110.00	105639.	-156.	80118.	2308.93	0.07	2952.83	132584.	3748.38	51.808
115.00	117564.	-153.	95902.	2461.65	0.81	3366.59	151719.	4170.57	53.614
120.00	130258.	-147.	113845.	2615.82	1.71	3816.96	172996.	4627.28	55.316
125.00	143724.	-138.	134137.	2770.58	1.65	4306.89	196594.	5121.08	56.932
130.00	157962.	-131.	156986.	2924.48	1.26	4840.08	222703.	5655.00	58.481
135.00	172963.	-125.	182619.	3075.34	1.13	5421.61	251527.	6233.11	59.990
1) 138.56	185367.	-120.	205055.	3201.95	1.16	5914.36	276435.	6725.48	61.062
140.00	188726.	-119.	211256.	3211.95	1.28	5997.12	283278.	6803.10	61.303
2) 141.96	195024.	-116.	223133.	3215.39	1.85	6122.07	296349.	6915.09	61.735
143.26	199186.	-113.	231105.	3161.71	2.26	6133.69	305098.	6909.81	62.005
3) 143.34	199437.	-113.	231590.	3179.29	2.28	6133.66	305629.	6908.66	62.022

* PACSS No 10: Earth Fixed Launch Site Coordinates
1) IECO; 2) OECO; 3) Physical Separation

TABLE 10 (Cont'd)
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	RANGE (NM)	ALTITUDE (FT)	LONGITUDE (POS.WEST) (DEG)	GEODETIC LATITUDE (DEG)	GEOCENTRIC LATITUDE (DEG)
-5.00	0.00	110.	80.565	28.532	28.371
0.00	0.00	110.	80.565	28.532	28.371
5.00	0.00	221.	80.565	28.532	28.371
10.00	0.00	577.	80.565	28.532	28.371
15.00	-0.00	1210.	80.565	28.532	28.371
20.00	0.00	2157.	80.565	28.532	28.371
25.00	0.01	3458.	80.565	28.532	28.371
30.00	0.03	5149.	80.564	28.532	28.371
35.00	0.07	7266.	80.564	28.532	28.371
40.00	0.14	9846.	80.562	28.533	28.372
45.00	0.26	12919.	80.560	28.533	28.372
50.00	0.43	16517.	80.557	28.534	28.373
55.00	0.68	20662.	80.553	28.536	28.374
60.00	1.01	25359.	80.547	28.537	28.376
65.00	1.45	30581.	80.539	28.540	28.379
70.00	2.00	36338.	80.529	28.543	28.381
75.00	2.69	42660.	80.517	28.546	28.385
80.00	3.54	49590.	80.502	28.551	28.390
85.00	4.56	57170.	80.483	28.556	28.395
90.00	5.79	65437.	80.461	28.562	28.401
95.00	7.23	74416.	80.435	28.570	28.409
100.00	8.92	84123.	80.405	28.579	28.417
105.00	10.88	94576.	80.369	28.589	28.428
110.00	13.13	105790.	80.329	28.601	28.439
115.00	15.71	117782.	80.282	28.614	28.452
120.00	18.64	130565.	80.230	28.629	28.467
125.00	21.95	144150.	80.170	28.646	28.484
130.00	25.66	158546.	80.103	28.665	28.503
135.00	29.83	173753.	80.028	28.686	28.525
1) 138.96	33.48	186382.	79.962	28.705	28.543
140.00	34.48	189781.	79.944	28.710	28.548
2) 141.96	36.41	196202.	79.909	28.720	28.558
143.26	37.70	200449.	79.886	28.727	28.565
3) 143.34	37.78	200706.	79.884	28.727	28.565

1) IECO; 2) OECO; 3) Physical Separation

TABLE 11
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IVB STAGE FLIGHT DATA

	FLIGHT TIME (SEC)	RANGE (NM)	ALTITUDE (FT)	SPACE FIXED VELOCITY (FT/SEC)	SPACE FIXED PATH ANGLE (DEG)	LONGITUDINAL ACCELERATION (FT/SEC2)	WEIGHT (LB)	THRUST (TOTAL) (LB)	DYNAMIC PRESSURE (LB/FT2)	PITCH ATTITUDE COMMAND (DEG)
	143.34	37.782	200706.	8079.07	66.348	4.643	294072.	42999.	13.	63.600
	144.66	39.096	204970.	8068.46	66.591	4.562	294008.	42160.	11.	63.600
1)	148.06	42.482	215736.	8059.62	67.215	21.532	293441.	196714.	7.	63.600
	155.69	50.186	239039.	8143.29	68.528	25.368	289675.	228514.	3.	63.600
	160.00	54.618	251753.	8203.29	69.234	25.597	287138.	228507.	2.	63.100
	180.00	75.979	307043.	8503.72	72.072	26.593	276333.	228408.	0.	59.510
	200.00	98.666	356719.	8850.34	74.673	27.705	265521.	228643.	0.	61.993
	220.00	122.776	400875.	9244.87	77.090	28.860	254700.	228468.	0.	64.220
	240.00	148.411	439625.	9686.40	79.300	30.152	243881.	228557.	0.	66.514
	260.00	175.675	473109.	10174.78	81.300	31.552	233066.	228565.	0.	68.639
	280.00	204.681	501491.	10710.53	83.092	33.033	222251.	228187.	0.	70.596
	300.00	235.551	524955.	11295.07	84.684	34.768	211436.	228482.	0.	72.317
	320.00	268.418	543715.	11929.47	86.070	36.658	200619.	228583.	0.	74.392
	340.00	303.426	558029.	12616.60	87.264	38.755	189795.	228620.	0.	76.369
	360.00	340.731	568190.	13358.00	88.273	41.076	178979.	228501.	0.	78.278
	380.00	380.507	574538.	14158.72	89.105	43.745	168155.	228634.	0.	80.212
	400.00	422.945	577471.	15023.01	89.766	46.705	157336.	228397.	0.	82.060
	420.00	468.256	577457.	15956.79	90.262	50.159	146521.	228430.	0.	83.923
	440.00	516.684	575052.	16970.13	90.598	54.113	135705.	228244.	0.	85.759
	460.00	568.419	570787.	17994.70	90.850	51.047	125700.	199437.	0.	88.256
	480.00	623.411	564733.	19016.88	91.050	53.264	116587.	193014.	0.	89.909
	500.00	681.799	557419.	20111.53	91.113	57.715	107602.	193023.	0.	91.584
	520.00	743.872	549711.	21303.51	91.038	62.770	98620.	192408.	0.	93.182
	540.00	809.959	542657.	22601.17	90.820	68.519	89698.	191031.	0.	94.836
	560.00	880.432	537484.	24027.65	90.468	76.002	80823.	190928.	0.	96.888
	580.00	955.763	535411.	25623.59	90.018	85.202	71942.	190519.	0.	98.116
2)	580.46	957.572	535411.	25662.69	90.005	85.434	71736.	190492.	0.	98.116
3)	590.66	997.422	535492.	25685.09	89.994	-0.000	71583.	0.	0.	98.116

1) 90% J-2 Thrust; 2) GCS; 3) Orbit Insertion

TABLE 11 (Cont'd)
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	*SPACE FIXED POSITION AND VELOCITY VECTORS X (FT)	Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)	SPACE FIXED MAGNITUDE RADIUS (FT)	VELOCITY (FT/S)	PATH ANGLE (DEG)
143.34	21106145.	116220.	474635.	3096.79	383.52	7452.13	21110343.	8079.07	66.348
144.66	21110211.	116726.	414482.	3057.73	383.33	7456.77	21114601.	8068.46	66.591
1) 148.06	21120439.	118029.	439865.	2964.03	382.44	7485.05	21125349.	8059.62	67.215
155.69	21142412.	120930.	497541.	2799.86	378.26	7637.46	21148611.	8143.29	68.528
160.00	21154293.	122556.	530663.	2713.33	376.10	7732.42	21161303.	8203.29	69.234
180.00	21204872.	130246.	689617.	2351.14	397.69	8162.55	21216483.	8503.72	72.072
200.00	21248306.	138477.	857328.	1991.03	425.59	8612.97	21266045.	8850.34	74.673
220.00	21284459.	147347.	1034311.	1623.09	462.31	9089.53	21310084.	9244.87	77.090
240.00	21313186.	156970.	1221085.	1248.16	500.25	9592.61	21348714.	9686.40	79.300
260.00	21334334.	167363.	1418198.	865.23	539.33	10123.57	21382074.	10174.78	81.300
280.00	21347732.	178550.	1626229.	473.18	579.56	10684.36	21410328.	10713.53	83.092
300.00	21353187.	190535.	1845792.	69.95	618.07	11277.93	21433661.	11295.07	84.684
320.00	21350479.	203343.	2077569.	-343.25	661.99	11906.15	21452286.	11929.47	86.070
340.00	21339373.	217032.	2322295.	-759.76	706.84	12573.25	21466462.	12616.60	87.264
360.00	21319535.	231528.	2580771.	-1210.48	753.03	13281.70	21476480.	13358.00	88.273
380.00	21290844.	247165.	2853878.	-1667.81	800.97	14037.32	21482684.	14156.72	89.105
400.00	21252762.	263579.	3142609.	-2143.70	850.84	14844.91	21485469.	15023.01	89.766
420.00	21204957.	281212.	3448358.	-2647.66	902.85	15710.85	21485[illegible]6.	15956.79	90.262
440.00	21146972.	299810.	3771499.	-3162.30	957.03	16645.37	21482749.	16970.13	90.598
460.00	21078254.	319499.	4113865.	-3717.86	1014.42	17577.42	21478331.	17994.76	90.850
480.00	20997987.	340248.	4474483.	-4313.68	1066.66	18490.78	21472126.	19016.88	91.050
500.00	20905510.	361934.	4853897.	-4939.48	1112.41	19463.75	21464663.	20111.53	91.113
520.00	20802155.	384722.	5253592.	-5612.69	1166.87	20520.42	21456810.	21303.51	91.038
540.00	20681146.	408625.	5675320.	-6305.93	1223.92	21669.11	21449615.	22601.17	90.820
560.00	20547568.	433772.	6121095.	-7062.89	1284.56	22930.19	21444310.	24027.65	90.468
580.00	20398604.	461035.	6593489.	-7905.51	1349.36	24336.19	21442115.	25623.59	90.018
2) 580.46	20394334.	466661.	6654783.	-7925.34	1350.92	24370.83	21442113.	25662.69	90.005
3) 590.66	20311951.	474418.	6853088.	-8225.47	1345.61	24295.16	21442136.	25685.09	89.994

* PACSS No 13: Launch Vehicle Navigation Coordinates
1) 90% J-2 Thrust; 2) GCS; 3) Orbit Insertion

TABLE 11 (Cont'd)
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	*EARTH FIXED POSITION X (FT)	Y (FT)	Z (FT)	*EARTH FIXED VELOCITY DX (FT/S)	DY (FT/S)	DZ (FT/S)	EARTH FIXED MAGNITUDE POSITION (FT)	VELOCITY (FT/S)	PATH ANGL (DEG)
143.34	199437.	-113.	231590.	3179.29	2.28	6133.66	305629.	6908.66	62.022
144.66	203612.	-110.	239695.	3141.37	2.69	6138.12	314502.	6895.27	62.296
1) 148.06	214131.	-99.	260594.	3050.74	3.43	6165.94	337285.	6879.38	63.018
155.69	236795.	-74.	308201.	2894.53	3.35	6317.08	388664.	6948.65	64.597
160.00	249094.	-59.	335630.	2812.65	3.63	6411.34	417966.	7001.17	65.453
180.00	301883.	300.	468131.	2473.04	37.15	6838.44	557028.	7271.98	68.902
200.00	347996.	1450.	609339.	2137.43	78.43	7286.97	701711.	7594.38	72.059
220.00	387340.	3525.	759793.	1796.08	130.13	7762.84	852837.	7968.98	74.978
240.00	419811.	6667.	920037.	1449.97	184.75	8266.52	1011313.	8394.76	77.630
260.00	445303.	10932.	1090645.	1098.25	242.29	8799.39	1178101.	8870.97	80.010
280.00	463695.	16379.	1272223.	739.98	302.88	9363.45	1354191.	9397.53	82.121
300.00	474847.	23051.	1465412.	373.28	363.82	9961.74	1540598.	9975.37	83.979
320.00	478595.	31017.	1670924.	-0.39	432.32	10596.09	1738391.	10604.90	85.578
340.00	474769.	40377.	1889523.	-384.12	504.12	11270.86	1948675.	11288.67	86.942
360.00	463161.	51209.	2122042.	-778.56	579.79	11988.61	2172603.	12027.85	88.082
380.00	443542.	63599.	2369393.	-1185.74	659.96	12755.20	2411389.	12827.19	89.012
400.00	415637.	77640.	2632607.	-1607.26	745.08	13575.60	2666346.	13690.70	89.744
420.00	379143.	93437.	2912814.	-2045.19	835.63	14456.28	2938871.	14624.13	90.286
440.00	333701.	111106.	3211329.	-2502.54	932.42	15407.64	3230531.	15637.38	90.649
460.00	278854.	130742.	3529128.	-2990.31	1030.48	16359.09	3542541.	16662.05	90.918
480.00	213839.	152324.	3865599.	-3515.33	1128.44	17294.79	3874504.	17684.48	91.129
500.00	138083.	175915.	4221339.	-4064.93	1231.89	18292.80	4227259.	18779.45	91.192
520.00	51033.	201649.	4597890.	-4645.40	1342.75	19377.51	4602592.	19971.74	91.107
540.00	-47944.	229676.	4997067.	-5258.67	1461.39	20557.46	5002572.	21269.66	90.871
560.00	-159608.	260168.	5420952.	-5917.22	1589.70	21853.63	5429538.	22696.30	90.496
580.00	-285190.	293342.	5872209.	-6651.19	1729.68	23299.87	5886444.	24292.27	90.019
2) 580.46	-288279.	294145.	5883023.	-6668.36	1733.08	23335.49	5897422.	24331.37	90.005
3) 590.66	-357694.	311914.	6120861.	-6940.56	1749.68	23278.13	6139232.	24353.72	89.993

* PACSS No 10: Earth Fixed Launch Site Coordinates
1) 90% J-2 Thrust; 2) GCS; 3) Orbit Insertion

TABLE 11 (Cont'd)
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	RANGE (NM)	ALTITUDE (FT)	LONGITUDE (POS.WEST) (DEG)	GEODETIC LATITUDE (DEG)	GEOCENTRIC LATITUDE (DEG)
143.34	37.78	20(706.	79.884	28.727	28.565
144.66	39.10	204970.	79.861	28.734	28.572
1) 148.06	42.48	215736.	79.799	28.751	28.589
155.69	50.19	239039.	79.660	28.790	28.628
160.00	54.62	251753.	79.580	28.812	28.650
180.00	75.98	307043.	79.193	28.919	28.756
200.00	98.67	356719.	78.780	29.028	28.865
220.00	122.78	400875.	78.340	29.141	28.978
240.00	148.41	439625.	77.870	29.257	29.094
260.00	175.67	473109.	77.368	29.377	29.212
280.00	204.68	501491.	76.833	29.499	29.334
300.00	235.55	524955.	76.260	29.624	29.459
320.00	268.42	543715.	75.649	29.753	29.588
340.00	303.43	558029.	74.995	29.885	29.719
360.00	340.73	568190.	74.296	30.019	29.853
380.00	380.51	574538.	73.548	30.156	29.989
400.00	422.94	577471.	72.747	30.295	30.128
420.00	468.26	577457.	71.889	30.436	30.268
440.00	516.68	575052.	70.969	30.578	30.410
460.00	568.42	570787.	69.983	30.721	30.552
480.00	623.41	564733.	68.931	30.862	30.693
500.00	681.80	557419.	67.811	31.001	30.831
520.00	743.87	549711.	66.616	31.135	30.965
540.00	809.96	542657.	65.340	31.265	31.094
560.00	880.43	537484.	63.976	31.387	31.216
580.00	955.76	535411.	62.514	31.500	31.329
2) 580.46	957.57	535411.	62.479	31.502	31.331
3) 590.65	997.42	535492.	61.704	31.554	31.383

1) 90% J-2 Thrust; 2) GCS; 3) Orbit Insertion

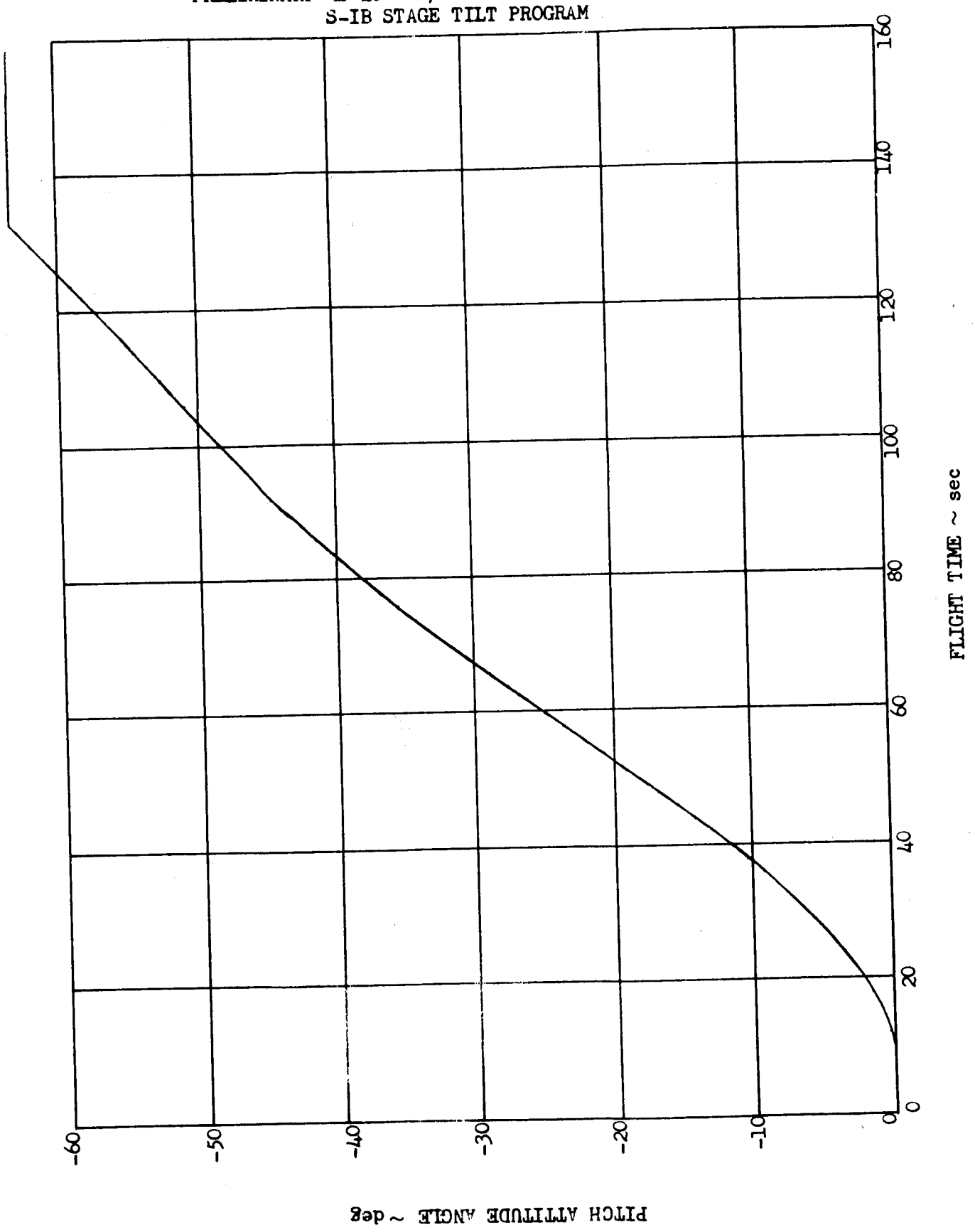
TABLE 12

PRELIMINARY AS-206 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
REFERENCE TRAJECTORY COMPARISON

Description	Preliminary Operational Trajectory	Revised Reference Trajectory (R-AERO-DAP-66-66)	Preliminary Reference Trajectory (Reference 2)
Max. Dynamic Pressure			
Time (sec)	73.00	75.20	76.00
Altitude (km)	12.21	12.78	12.70
Space-Fixed Velocity (m/s)	768.7	790.6	768.0
Path Angle (deg)	59.63	66.21	59.28
Angle of Attack (deg)	- 1.30	0.03	- 0.40
Dynamic Pressure (kg/m^2)	3364.	3613.	3426.
Longitudinal Acceleration (m/s^2)	20.24	20.29	20.28
Heating Indicator ($kg\text{-}m/m^2\text{-}rad$)	18.8×10^6	22.1×10^6	20.0×10^6
O.E.C.O			
Time (sec)	141.96	141.15	143.56
Altitude (km)	59.80	55.62	57.52
Space-Fixed Velocity (m/s)	2463.6	2417.8	2352.8
Path Angle (deg)	66.10	67.39	66.89
Angle of Attack (deg)	- 0.90	2.12	1.61
Dynamic Pressure (kg/m^2)	76.	119.	91.
Heating Indicator ($kg\text{-}m/m^2\text{-}rad$)	65.7×10^6	71.8×10^6	65.1×10^6
Geocentric Latitude	28.56	28.56	28.55
Longitude (deg-W)	79.91	79.92	79.93
GCS			
Time (sec)	580.46	600.90	603.53
Altitude (km)	163.19	163.23	163.22
Space-Fixed Velocity (m/s)	7822.0	7828.8	7828.8
Path Angle (deg)	90.00	90.00	90.00
Longitudinal Acceleration (m/s^2)	26.04	25.83	26.51
Geocentric Latitude	31.33	31.38	31.54
Longitude (deg-W)	62.48	61.77	62.02

Figure 1

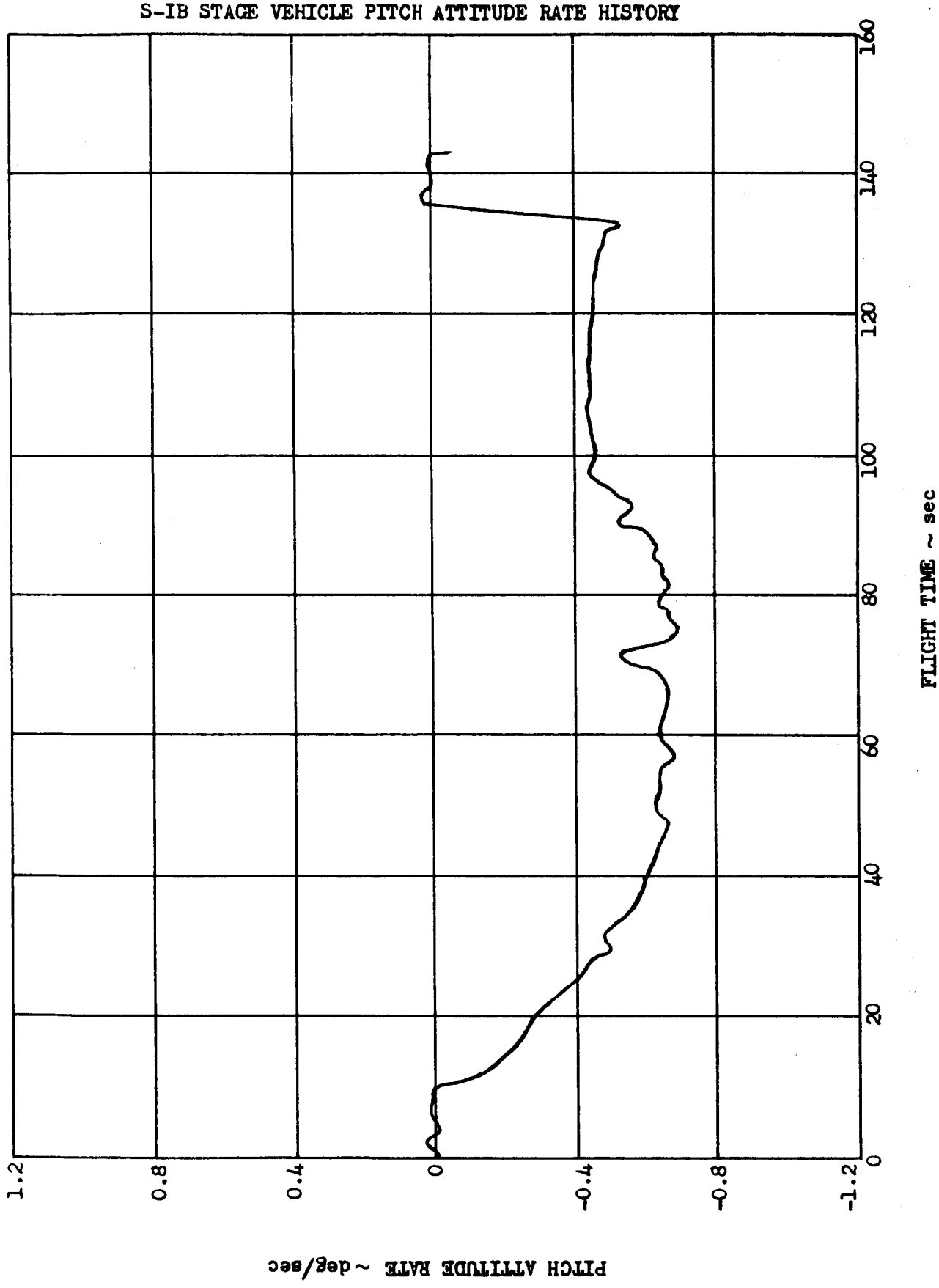
PRELIMINARY S-206A L/V OPERATIONAL TRAJECTORY
S-IB STAGE TILT PROGRAM



JAN 66

Figure 2

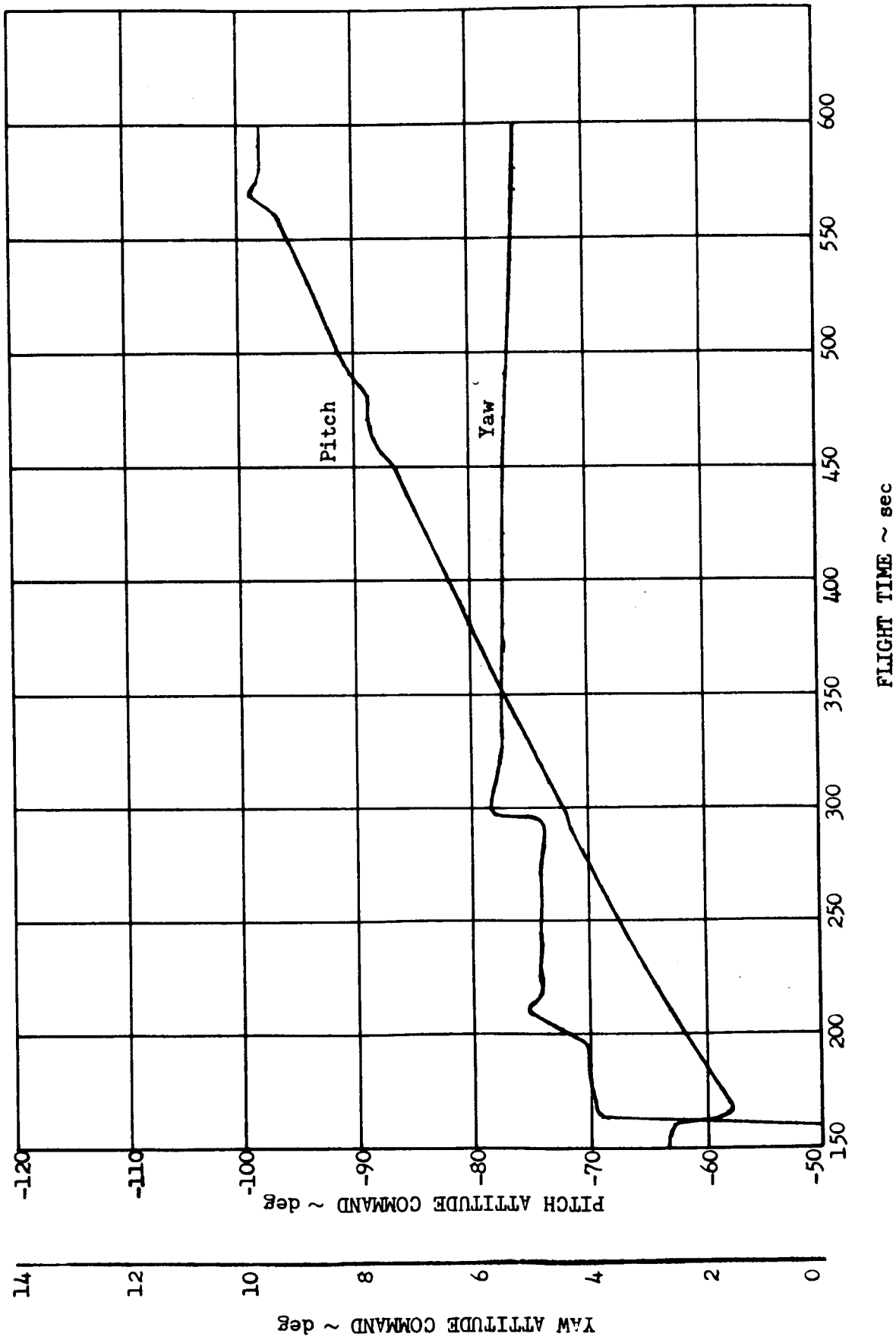
PRELIMINARY AS-206A L/V OPERATIONAL TRAJECTORY
S-IB STAGE VEHICLE PITCH ATTITUDE RATE HISTORY



84-431-62618C
JAN 66

Figure 3

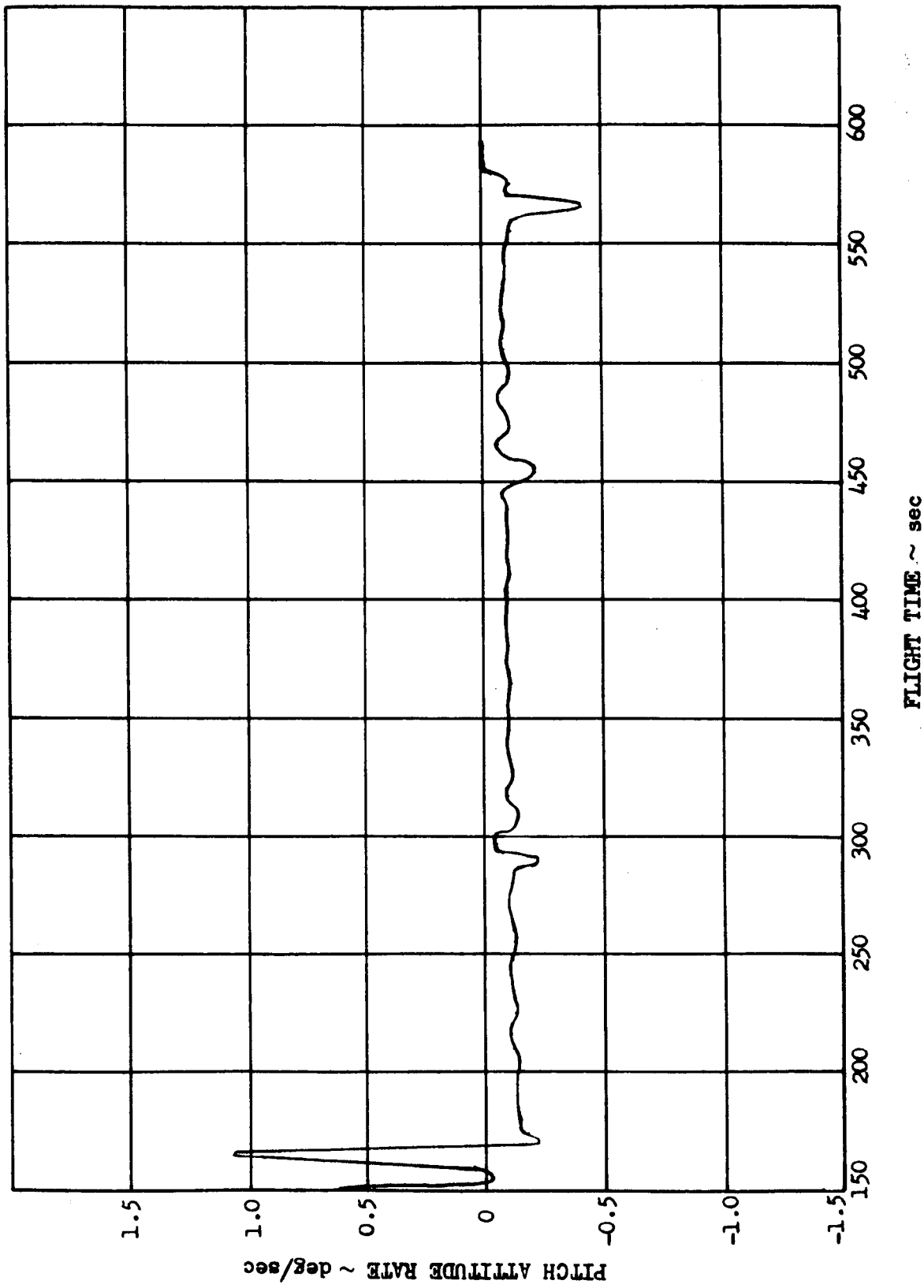
PRELIMINARY AS-206A L/V OPERATIONAL TRAJECTORY
S-IVB STAGE PITCH AND YAW ATTITUDE STEERING HISTORY



JAN 66

Figure 4

PRELIMINARY AS-206A L/V OPERATIONAL TRAJECTORY
S-IVB STAGE VEHICLE ATTITUDE RATE HISTORY



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JAN 66

Figure 5

PRELIMINARY AS-206A L/V OPERATIONAL TRAJECTORY
S-IB STAGE ANGLE OF ATTACK HISTORY

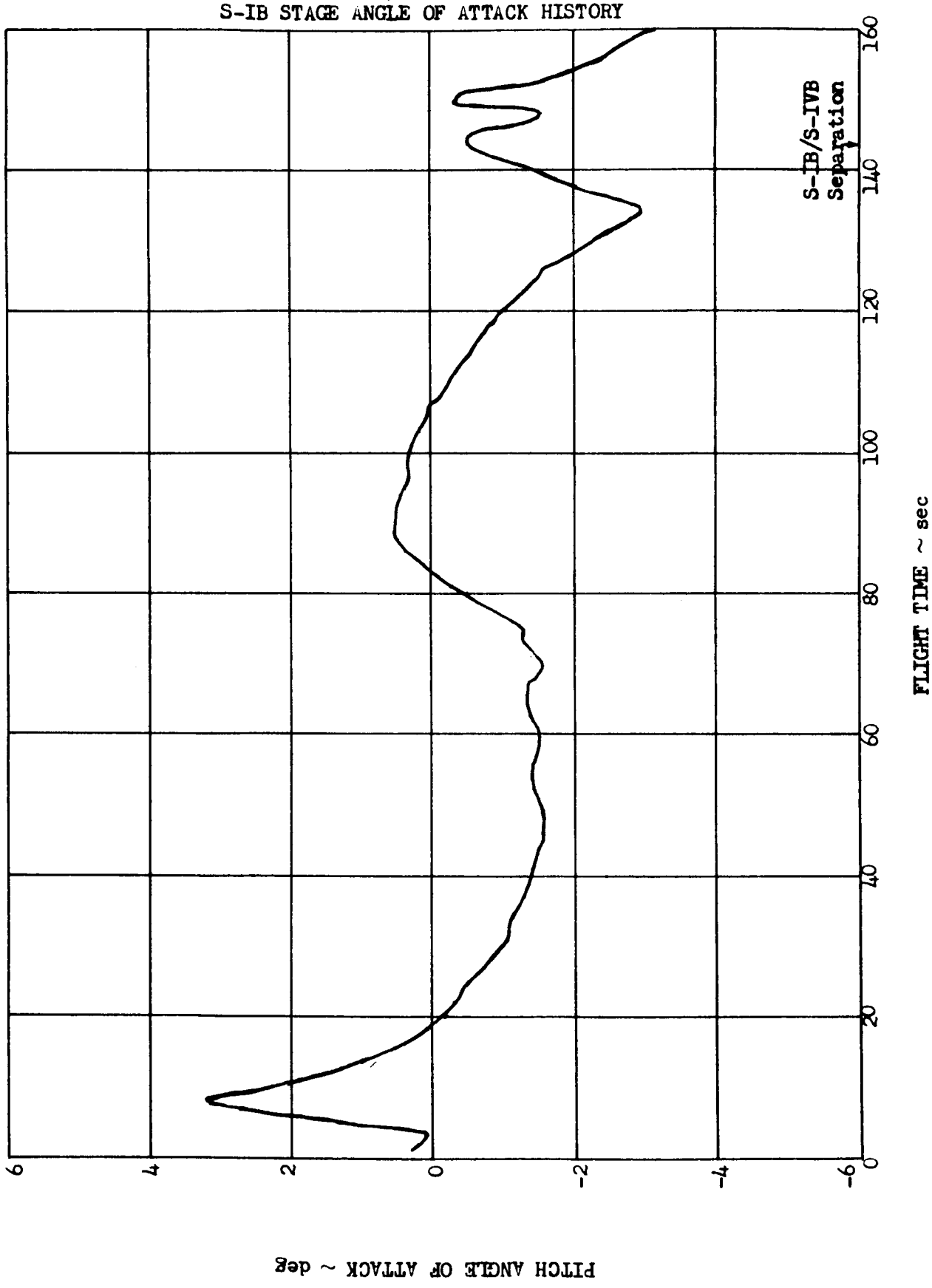
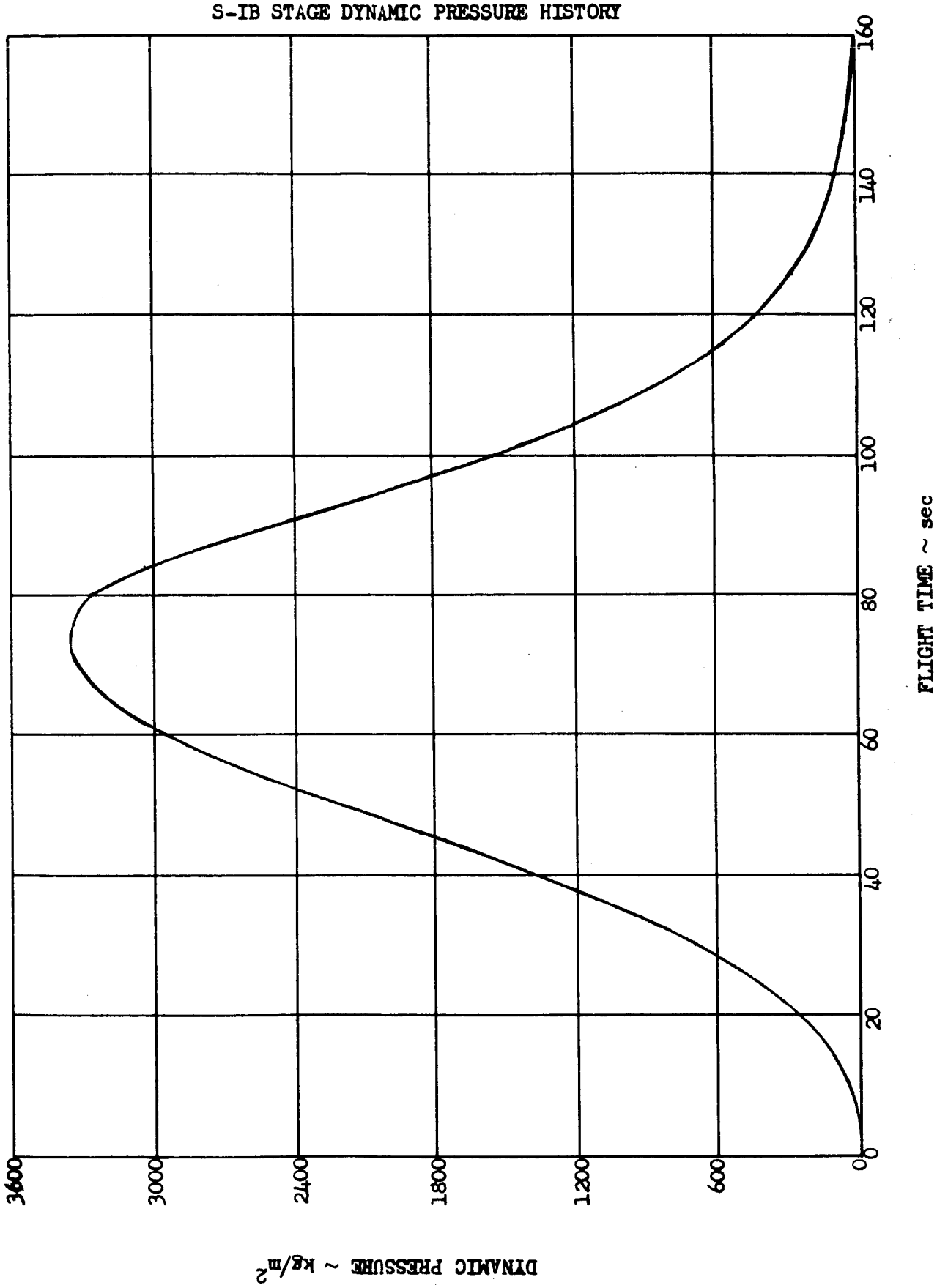


Figure 6

PRELIMINARY AS-206A L/V OPERATIONAL TRAJECTORY
S-IB STAGE DYNAMIC PRESSURE HISTORY



84-431.62818C
JAN 66

Figure 7

PRELIMINARY AS-206A L/V OPERATIONAL TRAJECTORY
ANGLE OF ATTACK AND DYNAMIC PRESSURE HISTORY
S-IB/S-IVB SEPARATION - IGM INITIATION

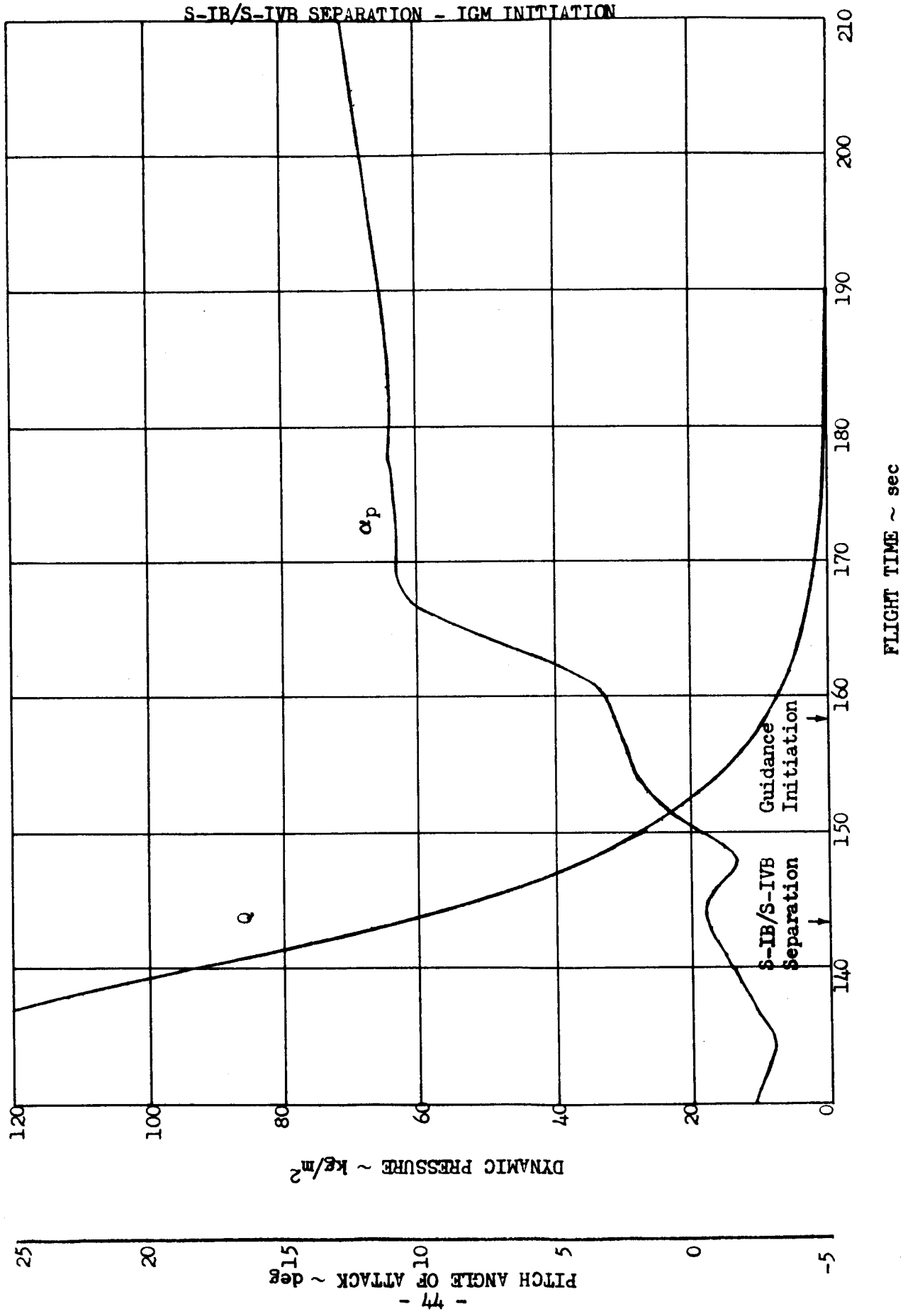
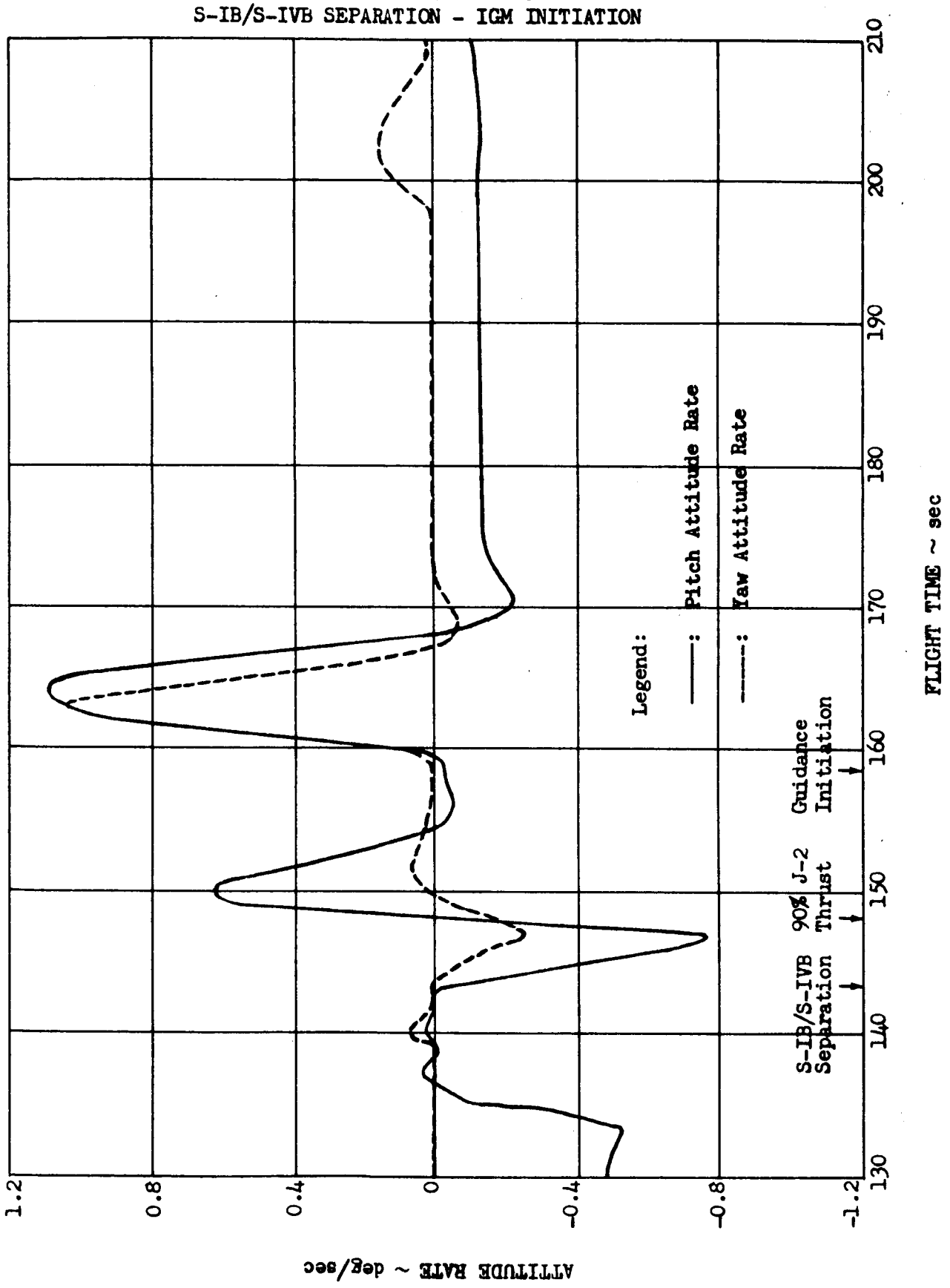


Figure 8

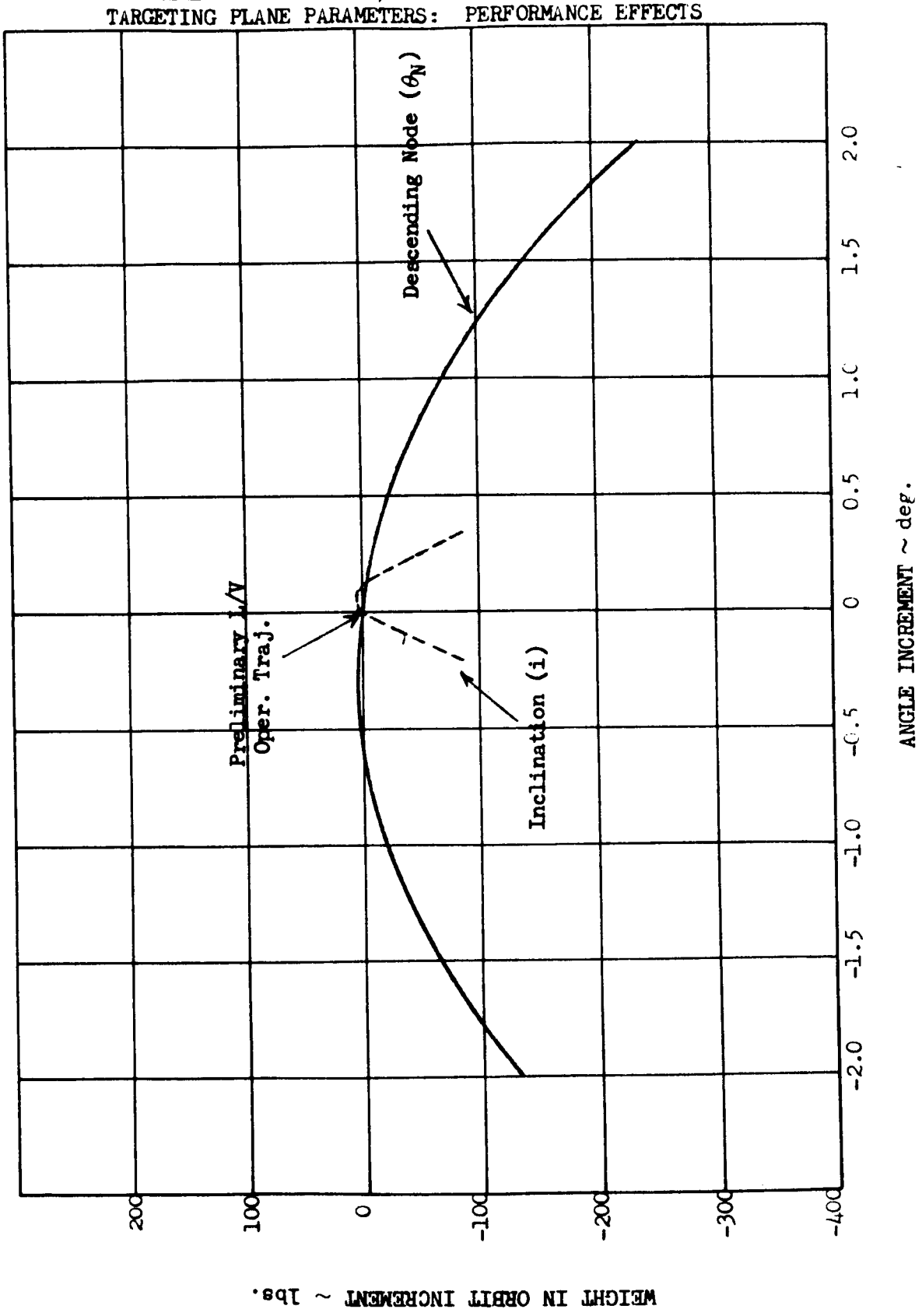
PRELIMINARY AS-206A L/V OPERATIONAL TRAJECTORY
VEHICLE ATTITUDE RATE
S-IB/S-IVB SEPARATION - IGM INITIATION



84431 62618C
JAN 66

Figure 9

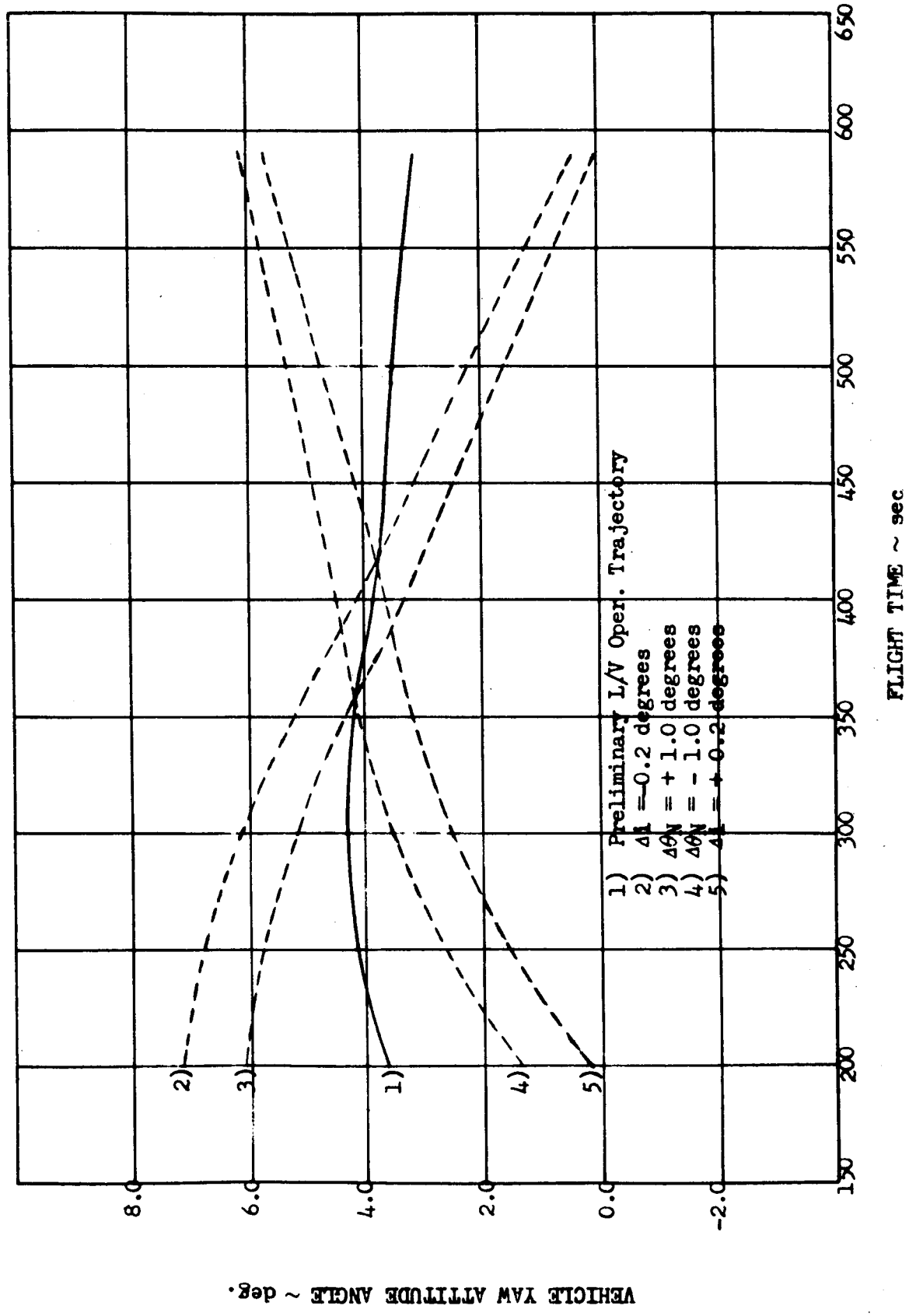
PRELIMINARY AS-206A L/V OPERATIONAL TRAJECTORY
TARGETING PLANE PARAMETERS: PERFORMANCE EFFECTS



847431-62616A
JAN 66

Figure 10

PRELIMINARY AS-206A L/V OPERATIONAL TRAJECTORY
TARGETING PLANE PARAMETERS: YAW ATTITUDE HISTORIES



64-431-926118A
JAN 66

A P P E N D I X A.

"LAUNCH VEHICLE CHARACTERISTICS"

TABLE 1A
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IB STAGE MASS CHARACTERISTICS

FLIGHT TIME (SEC)	WEIGHT (KG)	CENTER OF GRAVITY X-AXIS (M)	CENTER OF GRAVITY Y-AXIS (M)	CENTER OF GRAVITY Z-AXIS (M)	MOMENT OF INERTIA X-AXIS (KG-M-S2)	MOMENT OF INERTIA Y-AXIS (KG-M-S2)	MOMENT OF INERTIA Z-AXIS (KG-M-S2)
0.00	582491.	15.8332	0.0064	-0.0023	216249.	6094787.	6094787.
5.00	568480.	15.7444	0.0065	-0.0023	210509.	6072821.	6072821.
10.00	554412.	15.6648	0.0066	-0.0025	204449.	6055422.	6055422.
15.00	540243.	15.5959	0.0069	-0.0025	198312.	6044729.	6044729.
20.00	525985.	15.5375	0.0071	-0.0025	192161.	6032428.	6032428.
25.00	511673.	15.4918	0.0072	-0.0025	185962.	6026361.	6026361.
30.00	497330.	15.4591	0.0074	-0.0028	179739.	6020537.	6020537.
35.00	482967.	15.4422	0.0076	-0.0028	173502.	6016490.	6016490.
40.00	468588.	15.4409	0.0079	-0.0028	167264.	6014230.	6014230.
45.00	454204.	15.4585	0.0081	-0.0030	161049.	6009655.	6009655.
50.00	439815.	15.4957	0.0084	-0.0030	154847.	6005593.	6005593.
55.00	425426.	15.5551	0.0086	-0.0032	148652.	5996581.	5996581.
60.00	411038.	15.6373	0.0091	-0.0033	142475.	5985578.	5985578.
65.00	396580.	15.7477	0.0094	-0.0034	136295.	5963453.	5963453.
70.00	382121.	15.8906	0.0097	-0.0036	130100.	5938224.	5938224.
75.00	367663.	16.0685	0.0100	-0.0037	123909.	5902608.	5902608.
80.00	353202.	16.2823	0.0104	-0.0038	117719.	5856868.	5856868.
85.00	338778.	16.5392	0.0109	-0.0041	111540.	5797431.	5797431.
90.00	324423.	16.8385	0.0114	-0.0043	105379.	5723518.	5723518.
95.00	310078.	17.1932	0.0121	-0.0044	99216.	5629776.	5629776.
100.00	295745.	17.6068	0.0124	-0.0046	93055.	5513863.	5513863.
105.00	281431.	18.0941	0.0132	-0.0050	86896.	5369698.	5369698.
110.00	267138.	18.6591	0.0140	-0.0051	80743.	5193914.	5193914.
115.00	252875.	19.3229	0.0147	-0.0055	74605.	4978079.	4978079.
120.00	238644.	20.0932	0.0155	-0.0058	68482.	4716876.	4716876.
125.00	224456.	20.9990	0.0165	-0.0062	62379.	4397718.	4397718.
130.00	210314.	22.0548	0.0178	-0.0066	56293.	4013504.	4013504.
135.00	196236.	23.3056	0.0191	-0.0070	50230.	3543473.	3543473.
138.96	185149.	24.4584	0.0201	-0.0076	45361.	3097044.	3097044.
140.00	182752.	24.7247	0.0203	-0.0076	44541.	2988393.	2988393.
141.96	180020.	25.0557	0.0206	-0.0079	43191.	2854758.	2854758.
143.26	179225.	25.1440	0.0021	-0.0079	42782.	2817336.	2817336.
143.34	179218.	25.1440	0.0021	-0.0079	42782.	2817336.	2817336.

TABLE 2A
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IVB STAGE MASS CHARACTERISTICS

FLIGHT TIME (SEC)	WEIGHT (KG)	CENTER OF GRAVITY X-AXIS (M)	CENTER OF GRAVITY Y-AXIS (M)	CENTER OF GRAVITY Z-AXIS (M)	MOMENT OF INERTIA X-AXIS (KG-M-S2)	MOMENT OF INERTIA Y-AXIS (KG-M-S2)	MOMENT OF INERTIA Z-AXIS (KG-M-S2)
143.34	133389.	6.3484	0.0229	-0.0099	14101.	370154.	370154.
144.66	133360.	6.3484	0.0229	-0.0099	14101.	370154.	370154.
148.06	133103.	6.3451	0.0231	-0.0099	14030.	369825.	369825.
155.69	131394.	6.3451	0.0234	-0.0099	14029.	369169.	369169.
160.00	130243.	6.3476	0.0235	-0.0100	13909.	368661.	368661.
180.00	125342.	6.3592	0.0244	-0.0104	13906.	366936.	366936.
200.00	120438.	6.3807	0.0252	-0.0108	13903.	365346.	365346.
220.00	115530.	6.4126	0.0263	-0.0113	13901.	363606.	363606.
240.00	110622.	6.4566	0.0274	-0.0117	13898.	361610.	361610.
260.00	105717.	6.5122	0.0285	-0.0123	13896.	359414.	359414.
280.00	100811.	6.5817	0.0299	-0.0128	13893.	356943.	356943.
300.00	95906.	6.6674	0.0313	-0.0135	13890.	354052.	354052.
320.00	90999.	6.7702	0.0330	-0.0141	13887.	350790.	350790.
340.00	86090.	6.8940	0.0347	-0.0148	13884.	346963.	346963.
360.00	81183.	7.0412	0.0368	-0.0158	13882.	342548.	342548.
380.00	76274.	7.2181	0.0391	-0.0169	13879.	337293.	337293.
400.00	71366.	7.4300	0.0417	-0.0179	13876.	331014.	331014.
420.00	66461.	7.6838	0.0445	-0.0191	13872.	323491.	323491.
440.00	61555.	7.9922	0.0479	-0.0208	13869.	314276.	314276.
460.00	57016.	8.3351	0.0517	-0.0223	13866.	303956.	303956.
480.00	52883.	8.7076	0.0555	-0.0241	13862.	292620.	292620.
500.00	48807.	9.1504	0.0602	-0.0261	13859.	279008.	279008.
520.00	44733.	9.6879	0.0654	-0.0284	13855.	262283.	262283.
540.00	40686.	10.3464	0.0718	-0.0310	13851.	241607.	241607.
560.00	36661.	11.1687	0.0795	-0.0344	13846.	215203.	215203.
580.00	32632.	12.2260	0.0892	-0.0387	13841.	180414.	180414.
580.46	32539.	12.2542	0.0895	-0.0388	13841.	179477.	179477.
590.66	32469.	12.2752	0.0897	-0.0389	13841.	178775.	178775.

TABLE 3A
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IB STAGE AERODYNAMIC CHARACTERISTICS

FLIGHT TIME (SEC)	MACH NO.	CENTER OF PRESSURE (M)	AXIAL FORCE COEFFICIENT	NORMAL FORCE COEFFICIENT (1/RAD)
0.00	0.00	19.3900	1.0000	5.7300
5.00	0.04	19.3618	1.0000	5.7461
10.00	0.09	19.3297	1.0000	5.7644
15.00	0.14	19.2739	1.0000	5.7931
20.00	0.20	19.1350	0.6155	5.8385
25.00	0.27	19.0199	0.4977	5.8562
30.00	0.34	18.8771	0.4374	5.8822
35.00	0.42	18.7503	0.3803	5.9149
40.00	0.52	18.5504	0.3470	5.9676
45.00	0.62	18.3251	0.3280	6.0124
50.00	0.74	18.1317	0.3323	6.0725
55.00	0.88	17.6905	0.4139	6.0838
60.00	1.03	20.0040	0.7240	6.0340
65.00	1.20	21.8471	0.6958	5.6168
70.00	1.39	21.2725	0.5994	6.4132
75.00	1.62	20.5254	0.5001	5.7894
80.00	1.90	25.8268	0.4144	5.0952
85.00	2.20	29.1322	0.3588	4.8127
90.00	2.48	31.3532	0.3108	4.6620
95.00	2.76	30.4092	0.2825	4.6865
100.00	3.06	29.1245	0.2582	4.7652
105.00	3.38	27.7879	0.2486	5.0019
110.00	3.70	26.9972	0.2308	5.0697
115.00	4.04	26.4286	0.2022	5.0305
120.00	4.40	25.2586	0.1376	4.9515
125.00	4.78	24.2418	0.0986	4.8793
130.00	5.21	23.8105	0.0429	4.8060
135.00	5.80	24.4745	-0.0675	4.7297
138.96	6.37	25.6707	-0.1381	4.6732
140.00	6.48	25.9371	-0.1483	4.6618
141.96	6.67	26.4666	-0.1770	4.6431
143.26	6.72	26.6047	-0.1847	4.6383
143.34	6.72	26.6103	-0.1850	4.6381

TABLE 4A
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IB STAGE PROPULSION CHARACTERISTICS

FLIGHT TIME (SEC)	ALTITUDE (KM)	LONG. ACCEL (M/S2)	*** H-1 THRUST MAGNITUDE *** ENGINE 1 (N)	ENGINE 2 (N)	ENGINE 3 (N)	ENGINE 4 (N)	ENGINE 5 (N)	ENGINE 6 (N)	ENGINE 7 (N)	ENGINE 8 (N)
0.00	0.03	12.255	887707.	884379.	884868.	883661.	888427.	885971.	885350.	882467.
5.00	0.07	12.757	902901.	899567.	900060.	898847.	903627.	901177.	900578.	897696.
10.00	0.18	13.169	910947.	907584.	908080.	906841.	911638.	909190.	908583.	905718.
15.00	0.37	13.625	920797.	917499.	917903.	916744.	921517.	919094.	918453.	915627.
20.00	0.66	14.110	929020.	925690.	926100.	924926.	929736.	927275.	926659.	923810.
25.00	1.05	14.577	936174.	932844.	933236.	932075.	936886.	934421.	933799.	930956.
30.00	1.57	15.064	943578.	940312.	940626.	939537.	944224.	941820.	941129.	938354.
35.00	2.21	15.585	951046.	947716.	948080.	946937.	951626.	949281.	948521.	945812.
40.00	3.00	16.136	958919.	955527.	955948.	954747.	959566.	957029.	956457.	953561.
45.00	3.94	16.723	967428.	963975.	964456.	963194.	968015.	965540.	964907.	962071.
50.00	5.03	17.326	976419.	973094.	973444.	972312.	976885.	974534.	973775.	971065.
55.00	6.30	17.797	984465.	981141.	981488.	980359.	985062.	982582.	981948.	979112.
60.00	7.73	17.728	991934.	988613.	988959.	987832.	992535.	990181.	989422.	986709.
65.00	9.32	18.476	1000408.	996964.	997434.	996182.	1001017.	998534.	997903.	995062.
70.00	11.08	19.526	1007944.	1004376.	1004969.	1003594.	1008309.	1006075.	1005195.	1002604.
75.00	13.00	20.729	1014543.	1011104.	1011571.	1010322.	1015167.	1012554.	1012056.	1009084.
80.00	15.12	22.008	1020060.	1016750.	1017091.	1015969.	1020567.	1018204.	1017459.	1014735.
85.00	17.43	23.328	1024285.	1020851.	1021317.	1020070.	1024926.	1022308.	1021818.	1018840.
90.00	19.95	24.721	1027203.	1023143.	1024240.	1022364.	1027475.	1024982.	1024372.	1021514.
95.00	22.68	26.126	1028253.	1024950.	1025294.	1024173.	1029038.	1026543.	1025936.	1023074.
100.00	25.64	27.580	1028627.	1025077.	1025673.	1024301.	1029170.	1026673.	1026070.	1023205.
105.00	28.83	29.095	1027977.	1024681.	1025033.	1023908.	1028530.	1026032.	1025435.	1022564.
110.00	32.24	30.741	1027079.	1023534.	1024138.	1022764.	1027892.	1025141.	1024796.	1021670.
115.00	35.90	32.517	1025127.	1021836.	1022198.	1021069.	1026201.	1023449.	1023110.	1019977.
120.00	39.80	34.456	1022664.	1019128.	1019745.	1018365.	1023248.	1020996.	1020162.	1017523.
125.00	43.94	36.577	1019572.	1016538.	1016667.	1015779.	1020418.	1018164.	1017337.	1014689.
130.00	48.32	38.934	1016280.	1012505.	1013390.	1011754.	1017139.	1014635.	1014065.	1011159.
135.00	52.96	41.559	1011262.	1007988.	1008394.	1007243.	1012138.	1009634.	1009072.	1006156.
138.96	56.81	43.813	1005287.	1002108.	1002464.	1001358.	1006525.	1004605.	1003490.	1001136.
140.00	57.85	22.033	991259.	988236.	988443.	987506.	2067.	2062.	2061.	2055.
141.96	59.80	18.418	674535.	978196.	672524.	977554.	-0.	-0.	-0.	-0.
143.26	61.10	0.102	4562.	1820.	4549.	1818.	-0.	-0.	-0.	-0.
143.34	61.18	0.090	3703.	1678.	3692.	1676.	-0.	-0.	-0.	-0.

TABLE 5A
PRELIMINARY AS-206 L/V OPERATIONAL TRAJECTORY
S-IVB STAGE PROPULSION CHARACTERISTICS

FLIGHT TIME (SEC)	ALTITUDE (KM)	LONGITUDINAL ACCELERATION (M/S2)	THRUST MAGNITUDE J-2 ENGINE (N)	APS IMPULSE (N-SEC)
143.34	61.18	1.415	0.	0.000
144.66	62.47	1.390	0.	0.000
148.06	65.76	6.563	875026.	*166.808
155.69	72.86	7.732	1016481.	74.657
160.00	76.73	7.802	1016451.	259.490
180.00	93.59	8.106	1016008.	470.793
200.00	108.73	8.444	1017053.	470.793
220.00	122.19	8.797	1016275.	470.793
240.00	134.00	9.190	1016672.	470.793
260.00	144.20	9.617	1016708.	470.793
280.00	152.85	10.068	1015025.	470.793
300.00	160.01	10.597	1016339.	537.916
320.00	165.72	11.173	1016788.	625.508
340.00	170.09	11.813	1016952.	625.508
360.00	173.18	12.520	1016425.	694.342
380.00	175.12	13.333	1017016.	767.310
400.00	176.01	14.236	1015960.	767.310
420.00	176.01	15.288	1016106.	836.687
440.00	175.28	16.494	1015281.	918.134
460.00	173.98	15.559	887142.	991.022
480.00	172.13	16.235	858570.	991.022
500.00	169.90	17.591	858611.	1058.340
520.00	167.55	19.132	855875.	1136.649
540.00	165.40	20.885	849748.	1203.482
560.00	163.83	23.165	849291.	1203.482
580.00	163.19	25.969	847469.	1271.495
580.46	163.19	26.040	847351.	1271.495
590.66	163.22	-0.000	0.	*1271.495

*** Total Impulse = 1438 (N-Sec)**

DISTRIBUTION

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