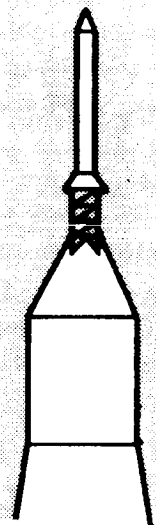
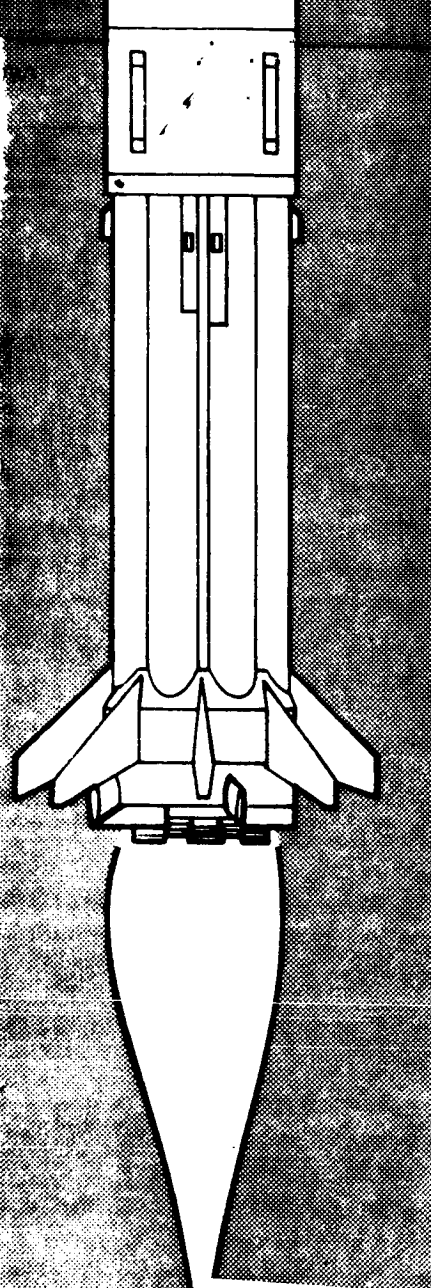


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PART IV

AS-204/LM-1 LAUNCH VEHICLE
OPERATIONAL FLIGHT
TRAJECTORY (REVISION I)



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AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)

JULY 25, 1967

by

AEROSPACE PHYSICS BRANCH

CHRYSLER CORPORATION SPACE DIVISION

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FOREWORD

This report documents the AS-204/IM-1 Launch Vehicle Operational Flight Trajectory (Revision I). The analysis and documentation were performed by Aerospace Physics Branch, Chrysler Corporation Space Division, within the scope of NAS 8-4016, Modification MSFC-1, Amendment 23, MCRR No. 101, BB Item 3.1.3-10-M01, Part IV.

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TABLE OF CONTENTS

	Page
FOREWORD	i
TABLE OF CONTENTS	ii
LIST OF TABLES	iv
LIST OF ILLUSTRATIONS	vi
DEFINITIONS AND SYMBOLS	viii
SUMMARY	1
1.0 INTRODUCTION	2
2.0 MISSION DESCRIPTION	3
2.1 Mission Objectives	3
2.2 Mission Ground Rules and Constraints	3
3.0 LAUNCH VEHICLE AND ENVIRONMENT DESCRIPTION	4
3.1 Configuration	4
3.2 Mass Characteristics	4
3.3 Aerodynamic Properties	4
3.4 Propulsion Systems	4
3.5 Environment Description	5
4.0 GUIDANCE AND CONTROL	6
4.1 Guidance	6
4.2 Control Systems	6
5.0 LAUNCH VEHICLE TRAJECTORY	7
5.1 S-IB Stage Powered Flight Phase	7
5.2 S-IVB Stage Powered Flight Phase.....	7

TABLE OF CONTENTS (Cont'd)

	Page
5.3 Orbital Flight Phase	8
5.4 Spent S-IB Stage Trajectory	8
5.5 Tracking Summary	8
5.6 Trajectory Dispersion Summary	8
5.7 Launch Vehicle Performance Characteristics	8
6.0 REFERENCES	9
APPENDIX A. "LAUNCH VEHICLE CHARACTERISTICS"	78
APPENDIX B. "GUIDANCE PRESETTINGS"	91
APPENDIX C. "LAUNCH VEHICLE TRAJECTORY LISTING, ENGLISH UNITS"	98
DISTRIBUTION	128

LIST OF TABLES

<u>Table</u>	<u>Description</u>	<u>Page</u>
1	Flight Sequence of Events	11
2	Launch Vehicle Trajectory Summary	13
3	S-IB Stage End Conditions of Flight	14
4	S-IVB Stage End Conditions of Flight	15
5	Trajectory Listing: S-IB Stage Flight Data	17
6	Trajectory Listing: S-IVB Stage Flight Data	22
7	Trajectory Listing: Orbital Flight Data	27
8	Trajectory Listing: S-IB Stage Re-entry Data	42
9	Tracking and Telemetry Sta. Coordinates: Launch Phase	46
10	Tracking and Telemetry Sta. Coordinates: Orbital Phase....	47
11	Trajectory Dispersion Envelope at S-IB/S-IVB Separation	48
12	Trajectory Dispersion Envelope at J-2 Engine Cutoff Signal	51
13	Launch Vehicle Performance Characteristics	54
Appendix A: "Launch Vehicle Characteristics"		
1A	Vehicle Weight Breakdown	79
2A	S-IB Stage Mass Characteristics	80
3A	S-IVB Stage Mass Characteristics	81
4A	S-IB Stage Aerodynamic Characteristics	82
5A	S-IB Stage Propulsion Characteristics	83
6A	S-IVB Stage Propulsion Characteristics	84
7A	Orbital Vent Sequence and Impulse History	85

LIST OF TABLES (Cont'd)

<u>Table</u>	<u>Description</u>	<u>Page</u>
Appendix B: "Guidance Presettings"		
1B	S-IB Stage Steering Program	92
2B	S-IB Pitch Attitude Command	93
3B	IGM Presettings	94
4B	Orbital Attitude Maneuvers	97
Appendix C: "Launch Vehicle Trajectory Listings, English Units"		
1C	S-IB Stage Flight Data	99
2C	S-IVB Stage Flight Data	104
3C	Orbital Flight Data	109
4C	S-IB Stage Re-entry Data	124

LIST OF ILLUSTRATIONS

<u>Figure</u>	<u>Description</u>	<u>Page</u>
1	Flight Profile: Altitude vs. Flight Time	55
2	Flight Profile: Altitude vs. Ground Range	56
3	Flight Profile: Velocity vs. Flight Time	57
4	Flight Profile: Space Fixed Path Angle vs. Flight Time	58
5	Flight Profile: Earth Fixed Path Angle vs. Flight Time	59
6	Pitch Attitude Steering Command: S-IB Stage Flight Data	60
7	Vehicle Pitch Attitude Rate: S-IB Stage Flight Data	61
8	Pitch Attitude Error: S-IB Stage Flight Data	62
9	Pitch Angle of Attack History: S-IB Stage Flight Data	63
10	Dynamic Pressure History: S-IB Stage Flight Data	64
11	Longitudinal Acceleration: S-IB Stage Flight Data	65
12	Pitch Attitude Steering Command: S-IVB Stage Flight Data	66
13	Yaw Attitude Steering Command: S-IVB Stage Flight Data	67
14	Longitudinal Acceleration: S-IVB Stage Flight Data	68
15	Vehicle Attitude Rate: S-IVB Stage Flight Data	69
16	Attitude Error: S-IVB Stage Flight Data	70
17	Pitch Angle of Attack: S-IVB Stage Flight Data	71
18	Dynamic Pressure: S-IVB Stage Flight Data	72
19	Altitude History: Orbital Flight	73

LIST OF ILLUSTRATIONS (Cont'd)

<u>Figure</u>	<u>Description</u>	<u>Page</u>
20	Space Fixed Velocity History: Orbital Flight	74
21	Pitch Attitude History: Orbital Flight	75
22	Tracking Summary: Launch Phase	76
23	Tracking and Telemetry Summary: Orbital Phase	77
Appendix A: "Launch Vehicle Characteristics"		
1A	Vehicle Profile	86
2A	H-1 Engine Thrust Decay	87
3A	J-2 Engine Thrust Buildup	88
4A	J-2 Engine Thrust Decay	89
5A	Mean Headwind/Tailwind Profile	90

DEFINITIONS AND SYMBOLS

Aerodynamic Heating Indicator

$$\int \frac{qV}{\pi/2 - |\alpha_t|} dt$$

q = dynamic pressure
 V_r = relative velocity
 α_t = total angle of attack

Aerodynamic Load Indicator

Product of dynamic pressure and angle of attack.

Altitude

Vehicle altitude above the referenced ellipsoid measured along the geocentric position vector.

Angle of Attack, Pitch

Angle between the pitch plane relative velocity component and the longitudinal axis of the vehicle, measured positive nose up.

Axial Force

Component of the resultant aerodynamic force along the vehicle longitudinal axis (X axis of PASCs 8a), measured positive toward the tail of the vehicle.

Central Range Angle

Angle between instantaneous space fixed position vector and space fixed position vector at Guidance Reference Release

Descending Node Argument

Angle measured in the equatorial plane between the orbit plane descending node and the space fixed meridian plane defined at Guidance Reference Release.

Drag

Component of the resultant aerodynamic force along the earth fixed velocity vector, measured positive opposite to the velocity vector.

Dynamic Pressure

$$\frac{1}{2} \times (\text{Density}) \times (\text{Relative Velocity})^2$$

Earth Fixed Position

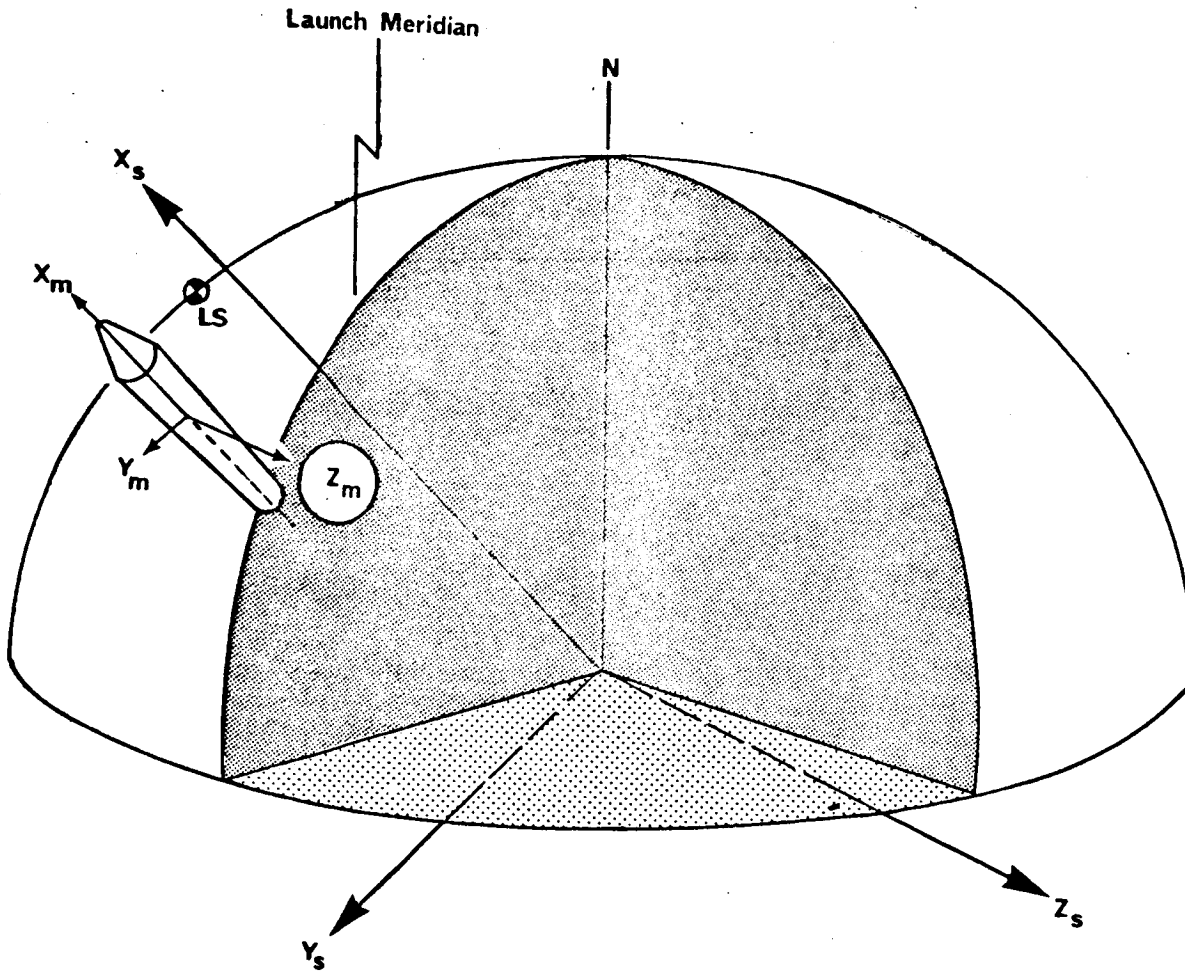
Position vector components in an earth-fixed pad-centered plumbline coordinate system. The X_e axis is coincident with the reference ellipsoid normal, positive upward. The Z_e axis is parallel to the earth-fixed aiming azimuth and is positive downrange. The Y_e axis completes a right handed system. (PASCs 10)

Earth Fixed Cross Range

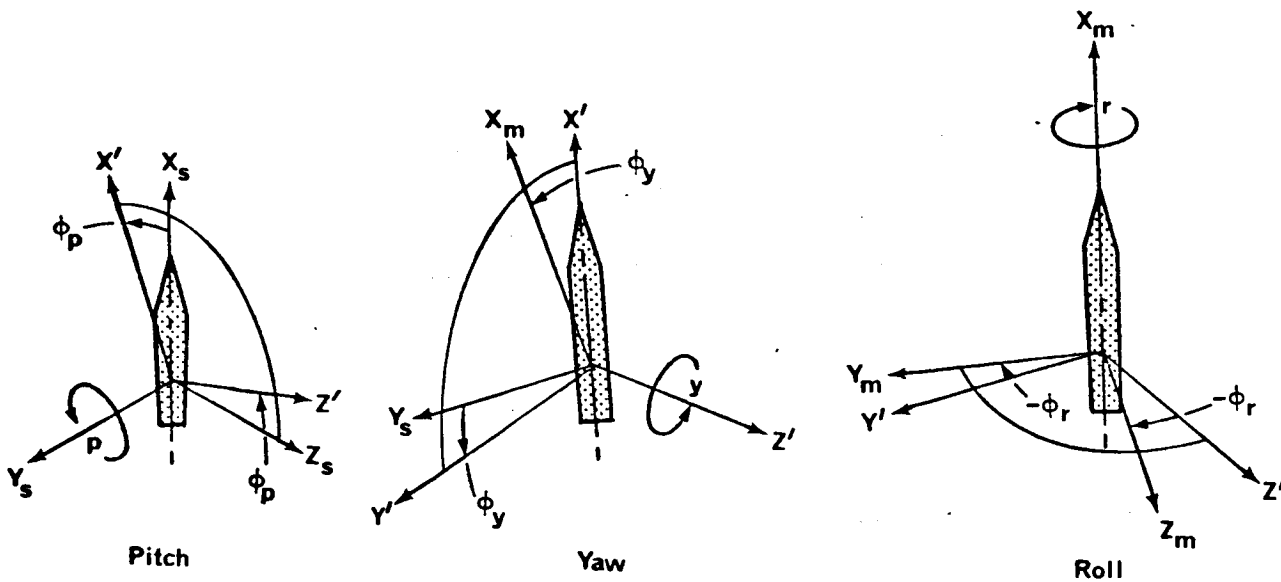
Y_e component of PASCs 10 position vector.

DEFINITIONS AND SYMBOLS (Cont'd)

Earth Fixed Flight Path Angle	Angle between the earth fixed velocity vector and the earth fixed geocentric position vector (PASCs 11), measured positive downrange from the position vector.
Earth Fixed Velocity	Velocity vector components in PASCs 10.
Earth Fixed Velocity Magnitude	$\sqrt{\dot{x}_e^2 + \dot{y}_e^2 + \dot{z}_e^2}$
Flight Azimuth	Angle defining orientation of the space fixed coordinate system downrange axis, Z_s , at Guidance Reference Release, measured positive east of north in plane normal to the space fixed X_s axis at Guidance Reference Release.
Geocentric Declination	Angle between the geocentric radius vector and the true equatorial plane, measured positive north of the equator.
Geodetic Latitude	Angle between the reference ellipsoid normal through the point of interest and the true equatorial plane, measured positive north of the equator.
Ground Range	Surface range measured from launch site to the sub vehicle point.
Inclination	Angle between the instantaneous flight plane and the equatorial plane.
Longitude	Angle between the Greenwich meridian plane and the projection of the geocentric position vector in the equatorial plane, measured positive east of Greenwich.
Longitudinal Acceleration	That part of the total measurable acceleration directed along the longitudinal axis of the vehicle.
Mach Number	$(\text{Relative Velocity}) \div (\text{Local Speed of Sound})$



$$\bar{x}_m = (-\phi_r)_1 (\phi_y)_3 (\phi_p)_2 \bar{x}_s$$



DEFINITIONS AND SYMBOLS (Cont'd)

Mass	Mass of the vehicle.
Normal Force	Component of the resultant aerodynamic force normal to the vehicle X axis, and in the X-Z plane (PASCS 8a), measured positive toward Position I.
Pitch, Yaw, Roll	Eulerian angle of vehicle attitude measured with respect to the space fixed coordinate system. Vehicle attitude is defined by the ordered rotation of pitch, yaw, and roll, respectively. (See illustration)
Radius	$\sqrt{X_s^2 + Y_s^2 + Z_s^2}$
Relative Velocity	Velocity relative to the atmosphere (includes wind velocity).
Space Fixed Position	Position vector components in a spaced fixed, earth centered, plumbline coordinate system defined at Guidance Reference Release. The Xs axis is parallel to the reference ellipsoid normal which passes through the launch site. The Zs axis is parallel to, and positive in the same direction as the earth-fixed firing azimuth. The Ys axis completes the right handed system. This is Project Apollo Standard Coordinate System 13. (PASCS 13.)
Space Fixed Cross Range	Ys component of PASCS 13 position vector.
Space Fixed Flight Path Angle	Angle between the space-fixed velocity vector and the radius vector (PASCS 13), measured positive downrange from radius vector.
Space Fixed Velocity	Velocity vector components in PASCS 13.
Space Fixed Velocity Magnitude	$\sqrt{\dot{X}_s^2 + \dot{Y}_s^2 + \dot{Z}_s^2}$
Time	Instantaneous flight time referenced to first motion.
Weight	Weight of vehicle in pounds.

SUMMARY

This report documents the AS-204/LM-1 Launch Vehicle Operational Flight Trajectory (Revision I). Trajectory data are tabulated for all phases of flight for which the Saturn IB Launch Vehicle has a functional requirement. A comprehensive summary of the launch vehicle characteristics is also presented.

The predicted S-IB and S-IVB stage end conditions are summarized below:

		<u>S-IB/S-IVB Separation</u>	<u>Guidance Cutoff Signal</u>
Flight Time	(sec)	143.523	598.152
Altitude	(m)	63,579.	163,193.
Space Fixed Velocity	(m/sec)	2,369.58	7,821.49
Space Fixed Path Angle	(deg)	62.854	90.004
Range	(m)	62,766.	1,796,200.

The nominal weight in orbit capability is predicted to be 70,205 pounds. This is 3,386 pounds in excess of the nominal propellant depletion weight. The 3-sigma flight performance reserve given in Reference 1, approximately 1,300 pounds, is considered reasonable for the AS-204/LM-1 configuration. Hence, from a performance standpoint, approximately 2,086 pounds of S-IVB propellant is available to compensate for S-IB stage early engine shutdown.

Summaries of the trajectory flight envelope at S-IB/S-IVB separation and S-IVB cutoff are presented in Tables 11 and 12. These data were taken from Reference 1, with the exceptions noted, and are considered applicable to this trajectory.

The supporting tracking and alternate mission trajectories are documented in References 2 and 3, respectively. Summaries of the tracking coverage are presented in Figures 22 and 23.

SECTION 1

INTRODUCTION

The AS-204/IM-1 Launch Vehicle Operational Flight Trajectory (Revision I) is presented in this document. By definition, the Launch Vehicle Operational Trajectory includes all phases of flight for which the S-IB stage and the S-IVB/IU stage have functional requirements.

In addition, comprehensive summaries of vehicle data, sub-systems characteristics, and the guidance and control modes are presented herein.

SECTION 2

MISSION DESCRIPTION

2.1 MISSION OBJECTIVES: The basic purpose of the Apollo Saturn 204/LM-1 Mission is to launch and test an unmanned LM for verification of crew safety items and to verify the launch vehicle's systems performance in preparation for subsequent operational manned space vehicle missions. An S-IVB stage propellant dump experiment is also planned after LM separation. The primary objective of the SA-204 Launch Vehicle is to insert the S-IVB/IU/Payload configuration in a near earth 85/120 nautical mile elliptic orbit. The payload consists of a Lunar Module (LM), Spacecraft LM Adapter (SIA), and a 25° Nose Cone. (See References 4 & 5.)

In the event of an S-IB engine premature shutdown, the desired orbit may be attained by using the remaining seven S-IB engines, S-IVB burn, and, if necessary, LM burn to orbit. The effects of S-IB engine premature shutdown on mission capability are documented in Reference 3. In the event of S-IVB engine failure, the inflight alternate mission is LM burn to orbit.

2.2 MISSION GROUND RULES AND CONSTRAINTS: The following mission criteria, vehicle constraints, and trajectory constraints have been imposed on this trajectory:

- 1) Launch from AFETR Pad 37B.
- 2) Pad oriented launch azimuth of 90 degrees east-of-north.
- 3) Flight azimuth of 72 degrees east-of-north.
- 4) S-IB stage tilt program defined in Table 1B.
- 5) S-IVB cutoff conditions for 85/120 nautical mile elliptic orbit insertion.
- 6) Commanded pitch and yaw attitude rate limit of one degree per second.
- 7) Average mean head/tailwind for September and October.

SECTION 3

LAUNCH VEHICLE AND ENVIRONMENT DESCRIPTION

3.1 CONFIGURATION: The SA-204/LM-1 Saturn IB Launch Vehicle consists of a S-IB first stage, a S-IVB second stage, an instrument unit, and a payload. The payload consists of a Lunar Module (LM), 25° Nose Cone, and a Spacecraft LM Adapter (SIA). An outboard profile of the complete configuration is shown in Figure 1A, Appendix A.

3.2 MASS CHARACTERISTICS: The SA-204 vehicle mass characteristics are defined in Reference 6. Table 1A presents a vehicle weight breakdown of the launch vehicle. These data are consistent with Reference 6 and the trajectory presented herein. Tables 2A and 3A present a time history of the vehicle mass and the associated center of gravity and moment of inertia data for the S-IB and S-IVB stages of flight, respectively.

3.3 AERODYNAMIC PROPERTIES: Aerodynamic data for the S-IB and S-IVB stages of powered flight were obtained from References 7-9. Flight time histories of the S-IB stage of flight aerodynamic data are presented in Table 4A. Orbital drag data was extracted from Reference 10.

3.4 PROPULSION SYSTEMS: The S-IB stage is powered by eight H-1 engines which have a nominally rated sea level thrust of 200,000 pounds each. The predicted nominal thrust magnitude history for each H-1 engine, including thrust decay and the associated turbine engine thrust, were obtained from Reference 11. The thrust magnitude time history for each H-1 engine is delineated in Table 5A. Figure 2A depicts the thrust decay histories.

The S-IVB stage is powered by a single J-2 engine which has a rated vacuum thrust of 200,000 pounds at a nominal mixture ratio of 5:1. However, the propellant utilization system produces a Programmed Mixture Ratio (PMR) shift which provides a high mixture ratio level and a corresponding high thrust level for approximately 325 seconds of flight. The predicted nominal J-2 engine thrust history from the 90% thrust level time point to the time of the guidance cut-off signal was obtained from Reference 12. The thrust buildup and thrust decay histories were obtained from Reference 13. Table 6A presents a summary of the J-2 engine thrust history. The J-2 thrust buildup and decay histories are depicted in Figures 3A and 4A.

Four solid propellant retro-motors (TE-M-29) mounted on the S-IB/S-IVB inter-stage provide thrust to decelerate the S-IB stage after separation. The retro-motors are rated at a nominal thrust level of 36,720 pounds each (Reference 14).

Three solid propellant ullage motors mounted on the S-IVB stage aft skirt provide a positive acceleration for the S-IVB stage to settle propellants for J-2 engine start. The ullage motors are rated at 3,460 pounds-thrust each (Reference 15).

The S-IVB Stage Auxiliary Propulsion System (APS) consists of two modules. Each module contains three 150 pound thrust (vacuum) hypergolic rocket engines. This system provides roll control during the J-2 burn phase and pitch, yaw and roll control after J-2 cutoff.

3.5 ENVIRONMENT DESCRIPTION: The 1963 Patrick Reference Atmosphere model defines the atmospheric properties incorporated in the trajectory simulation. The earth model and potential function are those of the Fischer Earth Model. The wind profile is an average of the September and October mean headwind/tailwind profiles defined in Reference 16. It is depicted in Figure 5A.

SECTION 4

GUIDANCE AND CONTROL

The Saturn IB inertial guidance system performs navigation evaluations, issues discrete commands, initiates guidance and control functions, and issues steering commands to guide the launch vehicle to the prespecified targeting conditions. These functions are accomplished by the AS-204/IM-1 Flight Program which is stored in the Launch Vehicle Digital Computer (LVDC). Inputs to the LVDC for navigation and steering command evaluations are the predetermined constants for the different guidance modes and the inertial velocity increments sensed by the stabilized platform accelerometers.

4.1 GUIDANCE: Guidance of the AS-204/IM-1 Launch Vehicle into orbit and throughout the orbital phases of active attitude control is divided into three distinct phases: (1) Pre-IGM; (2) IGM; and (3) Orbital.

The Pre-IGM phase guidance provides pitch, yaw and roll vehicle attitude commands as a function of the time from liftoff to the time of IGM initiation. The S-IB stage pitch program polynomials for this mission are delineated in Appendix B, Table IB. Also included in Table IB is a time history of the yaw and roll attitude commands. A history of the pitch attitude steering command generated by the polynomials is given in Table 2B.

In the Iterative Guidance Mode (IGM) phase, a two-stage three-dimensional formulation of the IGM equations and logic provides active guidance of the S-IVB stage in pitch and yaw from the time of IGM initiation, TB3 + 17.0 seconds, to J-2 cut-off. The commanded roll attitude is zero. The IGM equations and logic programmed for the LVDC Flight Program are defined in Reference 17. The IGM pre-settings for the mission are given in Appendix B, Table 3B.

The orbital guidance mode provides pitch, yaw and roll attitude commands for the planned maneuvers during the orbital phase of the mission. The specific guidance equations are defined in Reference 17. Table 4B presents a summary of the attitude maneuvers simulated during the orbital phase. (See Reference 18.)

4.2 CONTROL SYSTEMS: Pitch, yaw and roll attitude control are maintained by the four swivelable H-1 engines during the S-IB stage of powered flight. The control law, gains, and network characteristics for the S-IB stage control system are defined in Reference 19.

The J-2 engine provides pitch and yaw attitude control throughout the S-IVB stage of powered flight. Roll attitude control is maintained by the Auxiliary Propulsion System. The control law, gains and network characteristics of the S-IVB stage control systems are defined in Reference 19.

SECTION 5

LAUNCH VEHICLE TRAJECTORY

The nominal sequence of events for the AS-204/IM-1 Launch Vehicle Operational Flight Trajectory (Revision I) is summarized in Table 1. These data are consistent with Reference 20 and the mass and propulsion data referenced herein.

Table 2 provides a summary of trajectory parameters at pertinent events from liftoff to loss of attitude control. Convenient summaries of the end conditions of flight for the S-IB and S-IVB stages of powered flight are presented in Tables 3 and 4, respectively. Tabulated listings of the trajectory are presented in Tables 5 - 8. Corresponding tabular listings, in English units, are given in Appendix C. Graphical displays of the ascent trajectory profile are shown in Figures 1 through 5.

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

Trajectory Listing (Printout Tape):
CCSD/Slidell Reel No. 5634,
MSFC Copy was delivered 7-6-67.

Data Tape (B-7 Tape):
CCSD/Slidell Reel No. 6476,
MSFC Copy was transmitted 7-10-67.

5.1 S-IB STAGE POWERED FLIGHT PHASE: Tabulated listings of trajectory parameters for this phase are presented in Table 5. The phase is initiated at Guidance Reference Release (GRR), which is assumed to be 5 seconds prior to launch (first motion). The time of umbilical disconnect and the corresponding establishment of Time Base one (TBl) is assumed to be 0.2 seconds after first motion. The phase ends at S-IB/S-IVB physical separation, which is assumed to be 1.379 seconds after Outboard Engine Cutoff signal (OECO).

A time history of the S-IB stage pitch attitude steering command is depicted in Figure 6. Figures 7 and 8 present summaries of the resulting vehicle pitch attitude rate and attitude error. A summary of the pitch plane angle of attack is presented in Figure 9. Figure 10 presents a summary of the dynamic pressure history. The longitudinal acceleration history is depicted in Figure 11.

In order to establish a more realistic nominal trajectory prediction, a constant thrust 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.

5.2 S-IVB STAGE POWERED FLIGHT PHASE: Tabulated listings of the trajectory from S-IB/S-IVB separation to the time of orbit insertion are presented in Table 6.

Orbit insertion is defined to be at Guidance Cutoff Signal (GCS) plus 10 seconds. GCS occurs when the space fixed velocity magnitude equals a prespecified value of 7821.49 m/sec. This phase of the trajectory includes the ullage rocket burns, J-2 engine thrust buildup, mainstage burn with ullage case jettisoning and Engine Mixture Ratio (EMR) shift, J-2 thrust decay and LOX venting.

The pitch and yaw attitude angle steering commands during the S-IVB powered flight phase are depicted in Figures 12 and 13. The acceleration history is depicted in Figure 14. Trajectory parameters pertinent to an analysis of the trajectory from S-IB/S-IVB separation to the time of active control are depicted in Figures 15 - 18.

5.3 ORBITAL FLIGHT PHASE: Table 7 presents tabulated listings of trajectory parameters for the orbital flight phase of the Launch Vehicle trajectory from orbit insertion to loss of S-IVB/IU stage attitude control. Histories of altitude, velocity and pitch attitude for this phase are displayed in Figures 19 through 21.

5.4 SPENT S-IB STAGE TRAJECTORY: The re-entry trajectory for the spent S-IB stage is summarized in Table 8. This phase of the S-IB stage trajectory is initiated at S-IB/S-IVB separation and includes the retro-rocket burns.

5.5 TRACKING SUMMARY: Radar and telemetry coverage during ascent are provided by the stations listed in Tables 9 and 10. Summaries of the tracking and telemetry coverage for each station are presented in Figures 22 and 23.

5.6 TRAJECTORY DISPERSION SUMMARY: The predicted nominal performance characteristics of the launch vehicle and the predicted flight environment are subject to deviations. Therefore, to complement the nominal trajectory a flight envelope is required. Presented in Tables 11 and 12 are trajectory flight envelope summaries at S-IB/S-IVB separation and S-IVB cutoff, respectively. These data were taken from Reference 1, with exceptions noted, and are considered applicable to this trajectory. Based on current dispersion philosophy, two envelope components required updating. These components are the IMU and S-IB thrust misalignment deviations. Updating of the IMU error effects was necessitated by a revision of 3-sigma tolerances (Reference 21). An additional S-IB thrust misalignment was incorporated to determine a realistic envelope for vehicle roll attitude at S-IB/S-IVB stage separation.

5.7 LAUNCH VEHICLE PERFORMANCE CHARACTERISTICS: The predicted S-IB and S-IVB stage performance characteristics are presented in Table 13. These data are time averages of the detailed vehicle performance data referenced herein.

SECTION 6

REFERENCES

1. "AS-204 Launch Vehicle Operational Flight Trajectory Dispersion Analysis", TN-AP-66-72, 26 September 1966.
2. "AS-204/IM-1 Launch Vehicle Operational Flight Trajectory (Revision I) Tracking Analysis", BB-3.1.3-14-MO1 (TN-AP-67-260), 4 August 1967.
3. "AS-204/IM-1 L/V Operational Alternate Mission Trajectories", BB-3.1.3-11-MO1 (TN-AP-67-262), 31 July 1967.
4. "MSFC Flight Mission Directive Apollo-Saturn IB Missions (Updated Saturn I), Appendix D", 15 April 1967.
5. "SA-204/IM-1 Launch Vehicle Operational Flight Trajectory", TN-AP-67-212, 28 April 1967.
6. "AS-204 Final Predicted Mass Characteristics, Depletion Cutoff", R-P&VE-VAW-67-84, 8 June 1967.
7. "Saturn IB, SA-204/IM-1 Aerodynamic Axial Force Characteristics", TN-AP-67-234, 5 May 1967.
8. "Saturn IB/LEM AS-206, Aerodynamic Static Stability Characteristics", TB-AP-66-58, 6 October 1966.
9. "Aerodynamics of the Saturn IB/LEM, AS-206 Vehicle During First Stage Separation and Second Stage Flight ", TB-AP-66-68, 28 November 1966.
10. "Study of Drag Coefficients for Unusual Vehicle Configurations-January Progress Report", IMSC/HREC A782235, 15 February 1966; May Progress Report IMSC/HREC A782810, 15 June 1966; June Progress Report IMSC/HREC A 782929, 15 July 1966.
11. S-IB Stage Propulsion Prediction: CCSD B-5 Reel No. 7504 (B6 Reel No. 9741/1026).
12. S-IVB Stage Propulsion Prediction: CCSD B5 Reel No. 5483 (MSFC Reel No. 1147).
13. "Thrust Increase Envelope, Test No. 313-036, Engine S/N J-2025; "Saturn IB J-2 Engine Characteristics", R-P&VE-PPE-66-M-90, 11 May 1966.
14. "Data for use in S-IB-03 and Sub Vehicle Specifications and Future Separation Studies", R-P&VE-PPE-66-M-82, 21 June 1966.

15. "S-IVB Ullage Rocket Typical Thrust Versus Time (Vacuum 70°F)", R-P&VE-PPS-65-M-65, Figure 16, 5 May 1965.
16. "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; "Latest Wind Estimates From 80 km to 200 km Altitude Region at Mid-Latitudes", NASA TMX-53064, 16 June 1964.
17. "LVDC Equation Defining Document for the AS-206 Flight Program", MSFC No. III-4-423-7, IBM No. 66-207-003, 12 April 1966.
18. "S-IVB/CSM Orbital Attitude Timeline and Vent Schedule for the AS-206", NAS 80M92061 (Revised by datafax to R. D. Taylor CCSD, 5 April 1967); "Revised Venting Schedule for the AS-204 Vehicle (AS-206 Mission)", R-P&VE-PP-67-M-23, 21 March 1967; NASA letter, Mr. Harold Ledford to Mr. E. D. Murrah, 16 June 1967.
19. "Control Gains and Shaping Networks for AS-208 S-IB and S-IVB Stages", R-ASTR-F-66-237, 8 December 1966; "Control System Information for AS-204L", R-ASTR-NG-40-67, 5 June 1967.
20. "Interface Control Document, Definition of Saturn SA-204 Flight Sequence Program", 40M33604C, 13 December 1965 and IRN 13, 14 and 15.
21. "ST-124M Platform Hardware Errors to be Used in Performing a Hardware Error Analysis of the Saturn IB and Saturn V Launch Vehicle", R-ASTR-NG-168-66, 12 December 1966 (C).

TABLE 1

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
FLIGHT SEQUENCE OF EVENTS

<u>NOMINAL FLIGHT TIME</u> (HR: MIN: SEC)	<u>TIME</u> (SEC)	<u>PROGRAM</u> <u>TIME (SEC)</u>	<u>EVENT</u>
- 0:0:05.0	- 5.00	---	Guidance Reference Release (GRR).
- 0:0:03.1	- 3.10	---	Initiate S-IB Mainstage Ignition Sequence.
0:0:00.0	0.00	---	First Motion.
0:0:00.2	0.20	(0.0) ₁	Lift-off Signal; Initiate Time Base 1.
0:0:10.2	10.20	(10.0) ₁	Initiate Pitch and Roll Maneuvers.
0:0:40.2	40.20	(40.0) ₁	Control Gain Switch Point.
0:1:14.0	74.00	---	Maximum Dynamic Pressure.
0:1:40.2	100.20	(100.0) ₁	Control Gain Switch Point.
0:2:00.2	120.20	(120.0) ₁	Control Gain Switch Point.
0:2:12.5	132.50	(132.3) ₁	Enable S-IB Propellant Level Sensors.
0:2:13.2	133.20	(133.0) ₁	Tilt Arrest.
0:2:16.0	136.04	(0.0) ₂	Level Sensor Activation; Initiate Time Base 2.
0:2:19.1	139.14	(3.1) ₂	Inboard Engine Cutoff (IECO).
0:2:22.1	142.14	(0.0) ₃	Outboard Engine Cutoff (OECO); Initiate Time Base 3.
0:2:23.4	143.44	(1.3) ₃	Separation Signal.
0:2:23.5	143.52	---	S-IB/S-IVB Physical Separation; Control Gain Switch Point.
		(1.4) ₃	

TABLE 1 (Cont'd)
AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
FLIGHT SEQUENCE OF EVENTS

<u>NOMINAL FLIGHT TIME</u> <u>(HR: MIN: SEC)</u>	<u>TIME</u> <u>(SEC)</u>	<u>PROGRAM</u> <u>TIME (SEC)</u>	<u>EVENT</u>
0:2:24.8	144.84	(2.7) ₃	J-2 Engine Start Command.
0:2:27.2	147.19	---	Ullage Burn Out.
0:2:28.1	148.14	---	90% J-2 Thrust Level.
0:2:30.8	150.84	(8.7) ₃	Command PU System Activation.
0:2:35.4	155.44	(13.3) ₃	Jettison Ullage Rocket Motors.
0:2:39.1	159.14	(17.0) ₃	Command Active Guidance Initiation.
0:4:45.8	285.84	(143.7) ₃	Control Gain Switch Point.
0:7:55.8	475.75	---	EMR Shift Sensed by IGM.
0:9:58.2	598.15	---	Guidance Cutoff Signal (GCS).
0:9:58.4	598.35	(0.0) ₄	Initiate Time Base 4. (Reflects an approximate 0.2 second systems delay)
0:10:08.2	608.15	---	Orbital Insertion.
0:10:43.4	643.35	(45.0) ₄	Nose Cone Jettison.
0:19:58.4	1198.35	(600.0) ₄	SIA Panel Deployment.
0:53:55.0	3235.00	---	LM Separation.
4:30:00.0	16200.00	---	Loss of S-IVB/IU Attitude Control.

TABLE 2

AS-204/DM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
LAUNCH VEHICLE TRAJECTORY SUMMARY

Event	Flight Time (sec)	Altitude (km)	Velocity (m/s)	--- Space Fixed ---		Azimuth (deg)	Geodetic Lat. (deg)	Longitude (Pos. East) (deg)
				Flight Path Angle (deg)	Flight Path Angle (deg)			
Guidance Ref. Release	-5.0	0.03	408.93	90.000	90.00	28.53	- 80.56	
First Motion	0.0	0.03	408.93	90.000	90.00	28.53	- 80.56	
Max. Dyn. Pressure	74.0	12.34	745.54	57.854	83.40	28.54	- 80.53	
Tilt Arrest	133.2	52.62	2091.86	61.285	76.07	28.66	- 80.11	
Inboard Engine Cutoff	139.1	58.82	2309.91	62.154	75.71	28.69	- 80.03	
Outboard Engine Cutoff	142.1	62.08	2368.73	62.606	75.64	28.70	- 79.98	
S-IB/S-IVB Physical Sep.	143.5	63.58	2369.58	62.854	75.64	28.71	- 79.95	
J-2 Eng. Start Command	144.8	65.00	2364.15	63.102	75.66	28.71	- 79.93	
Ullage Case Jettison	155.4	75.97	2374.30	64.990	75.68	28.76	- 79.76	
Initiate IGM	159.3	79.76	2387.08	65.631	75.67	28.78	- 79.69	
EMR Shift Sensed by IGM	475.8	177.00	5483.43	91.465	81.53	30.73	- 69.88	
S-IB Stage Impact	563.4	0.00	412.55	102.667	90.10	29.87	- 75.41	
Guidance C/O Signal	598.2	163.19	7821.49	90.004	85.71	31.52	- 62.24	
Orbit Insertion	608.2	163.22	7828.60	89.992	86.13	31.57	- 61.48	
Jettison Nose Cone	643.4	163.33	7829.63	89.979	87.61	31.70	- 58.80	
IM Separation	3235.0	223.31	7758.22	90.008	94.58	-31.48	105.96	
Loss of S-IVB Att. Control	16200.0	148.11	7841.05	89.998	76.21	28.90	- 147.63	

TABLE 3

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IB STAGE END CONDITIONS OF FLIGHT

Flight Time (t):	OECO + 1.379 seconds	143.523	(sec)
Radius (R):		6436843.	(m)
Altitude:		63579.	(m)
Space Fixed Velocity (V):		2369.58	(m/s)
Space Fixed Path Angle (θ):		62.854	(deg)
Space Fixed Flight Azimuth (AZI):		75.644	(deg)
Earth Fixed Flight Azimuth (AZE):		72.221	(deg)
Geocentric Declination (δ):		28.546	(deg)
Geodetic Latitude (ϕ):		28.706	(deg)
Longitude (λ): (Pos. East)		- 79.955	(deg)

SPACE FIXED POSITION AND VELOCITY COMPONENTS

Xs	=	6435696.	(m)
Ys	=	35477.	(m)
Zs	=	116174.	(m)
\dot{X}_s	=	1042.34	(m/s)
\dot{Y}_s	=	118.28	(m/s)
\dot{Z}_s	=	2124.72	(m/s)

VEHICLE ATTITUDE AND ATTITUDE RATE

Pitch Attitude Angle (ϕ_p):	-59.460	(deg)
Yaw Attitude Angle (ϕ_y):	-0.084	(deg)
Roll Attitude Angle (ϕ_r):	-0.004	(deg)
Pitch Rate ($\dot{\phi}_p$):	-0.002	(deg/s)
Yaw Rate ($\dot{\phi}_y$):	0.000	(deg/s)
Roll Rate ($\dot{\phi}_r$):	-0.003	(deg/s)

TABLE 4

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION II)
S-IVB STAGE END CONDITION OF FLIGHT

Flight Time (t):	GCS	598.152	(sec)
Radius (R):		6535549.	(m)
Altitude:		163193.	(m)
Space Fixed Velocity (V):		7821.49	(m/s)
Space Fixed Flight Path Angle (θ):		90.004	(deg)
Space Fixed Flight Azimuth (AZI):		85.707	(deg)
Earth Fixed Flight Azimuth (AZE):		85.472	(deg)
Geocentric Declination (δ):		31.351	(deg)
Geodetic Latitude (ϕ):		31.518	(deg)
Longitude (λ): (Pos. East)		-62.240	(deg)
Inclination (i):		31.614	(deg)
Descending Node Argument (Θ):		119.055	(deg)

SPACE FIXED POSITION AND VELOCITY COMPONENTS

Xs	=	6206692.	(m)
Ys	=	142015.	(m)
Zs	=	2042110.	(m)
\dot{X}_s	=	-2450.10	(m/s)
\dot{Y}_s	=	411.04	(m/s)
\dot{Z}_s	=	7416.46	(m/s)

VEHICLE ATTITUDE ANGLES

Pitch Attitude Angle (ϕ_p)	=	-98.901	(deg)
Yaw Attitude Angle (ϕ_y)	=	3.396	(deg)
Roll Attitude Angle (ϕ_r)	=	-0.414	(deg)

OSCULATING CONIC PARAMETERS

*Perigee Altitude	=	157.38	(km)
*Apogee Altitude	=	197.38	(km)
Eccentricity	=	0.0031	
Semi-Major Axis	=	6555.54	(km)
True Anomaly	=	-1.26	(deg)
Period	=	88.04	(min)

* Referenced to Equatorial Radius (6378.16 km)

TABLE 4 (Cont'd)

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IVB STAGE END CONDITIONS OF FLIGHT

Flight Time (t): Orbit Insertion	608.152	(sec)
Radius (R):	6535557.	(m)
Altitude:	163218.	(m)
Space Fixed Velocity (V):	7828.60	(m/s)
Space Fixed Flight Path Angle (θ):	89.992	(deg)
Space Fixed Flight Azimuth (AZI):	86.125	(deg)
Earth Fixed Flight Azimuth (AZE):	85.913	(deg)
Geocentric Declination (δ):	31.400	(deg)
Geodetic Latitude (ϕ):	31.567	(deg)
Longitude (λ): (Pos. East)	-61.480	(deg)
Inclination (i):	31.614	(deg)
Descending Node Argument (Θ):	119.054	(deg)

SPACE FIXED POSITION AND VELOCITY COMPONENTS

Xs	=	6181739.	(m)
Ys	=	146120.	(m)
Zs	=	2116190.	(m)
.			
Xs	=	-2539.69	(m/s)
.			
Ys	=	409.49	(m/s)
.			
Zs	=	7393.86	(m/s)

VEHICLE ATTITUDE ANGLES

Pitch Attitude Angle (θ_P)	=	-98.903	(deg)
Yaw Attitude Angle (θ_Y)	=	3.380	(deg)
Roll Attitude Angle (θ_R)	=	-0.414	(deg)

OSCULATING CONIC PARAMETERS

* Perigee Altitude	=	157.38	(km)
* Apogee Altitude	=	221.42	(km)
Eccentricity	=	0.0049	
Semi-Major Axis	=	6567.57	(km)
True Anomaly	=	1.60	(deg)
Period	=	88.28	(min)

* Referenced to Equatorial Radius (6378.16 km)

TABLE 5
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IR STAGE FLIGHT DATA

FLIGHT TIME (SEC)	SPACE FIXED		PATH ANGLE		SPACE FIXED POSITION AND VELOCITY VECTOR COMPONENTS			---		
	RADIUS (M)	VELOCITY (M/S)	ANGLE (DEG)	ANGLE (DEG)	X (M)	Y (M)	Z (M)	DX (M/S)	DY (M/S)	DZ (M/S)
1) 5.00	6373352.	408.93	90.000	90.000	6373327.	17051.	-5540.	0.00	126.37	388.92
2) 0.00	6373352.	408.93	90.000	90.000	6373327.	17683.	-3556.	-0.13	126.30	388.94
5.00	6373385.	409.15	88.130	88.130	6373359.	18314.	-1651.	13.09	126.20	388.98
10.00	6373489.	409.86	86.009	86.009	6373461.	19945.	294.	28.14	126.10	388.96
15.00	6373673.	411.51	83.627	83.627	6373643.	19575.	2239.	45.16	126.03	389.13
20.00	6373950.	415.05	80.968	80.968	6373916.	20205.	4187.	64.50	125.95	390.18
25.00	6374329.	421.24	78.094	78.094	6374292.	20835.	6143.	86.12	125.87	392.66
30.00	6374823.	430.55	75.078	75.078	6374781.	21464.	8117.	110.04	125.76	397.23
35.00	6375442.	445.05	72.023	72.023	6375396.	22092.	10120.	136.28	125.63	404.61
40.00	6376200.	464.30	69.051	69.051	6376148.	22720.	12169.	164.76	125.51	415.54
45.00	6377106.	489.31	66.283	66.283	6377047.	23347.	14283.	195.39	125.39	430.73
50.00	6378171.	520.54	63.818	63.818	6378105.	23974.	16485.	228.04	125.27	450.85
55.00	6379406.	557.71	61.721	61.721	6379331.	24600.	18799.	262.34	125.14	475.98
60.00	6380813.	599.50	60.153	60.153	6380728.	25225.	21253.	296.19	125.01	506.02
65.00	6382387.	645.50	59.091	59.091	6382291.	25850.	23868.	329.06	124.87	541.11
70.00	6384132.	698.09	58.319	58.319	6384021.	26474.	26674.	363.68	124.72	582.67
75.00	6395658.	745.54	57.854	57.854	6385535.	26973.	29080.	393.34	124.58	620.96
80.00	6398182.	826.13	57.371	57.371	6388037.	27720.	32999.	441.36	124.35	687.19
85.00	6390518.	902.15	57.172	57.172	6390350.	28341.	36591.	484.24	124.17	750.98
90.00	6393077.	986.62	57.170	57.170	6392883.	28961.	40523.	529.13	123.97	823.45
95.00	6395870.	1079.55	57.340	57.340	6395644.	29581.	44840.	575.69	123.75	904.82
100.00	6398905.	1180.80	57.642	57.642	6398642.	30199.	49586.	623.70	123.51	995.00
105.00	6402192.	1290.46	58.038	58.038	6401884.	30815.	54805.	673.19	123.17	1094.04
110.00	6405740.	1408.80	58.489	58.489	6405377.	31430.	60542.	724.42	122.79	1202.03
115.00	6409559.	1536.47	58.982	58.982	6409131.	32043.	66842.	777.43	122.36	1319.61
120.00	6413561.	1674.08	59.518	59.518	6413154.	32654.	73755.	832.00	121.88	1447.57
125.00	6418154.	1822.42	60.114	60.114	6417452.	33262.	81337.	887.42	121.17	1587.14
130.00	6422743.	1982.57	60.791	60.791	6422028.	33866.	89648.	942.68	120.34	1739.96
135.00	6425399.	2091.86	61.285	61.285	6425100.	34250.	95384.	977.12	119.79	1845.75
140.00	6432037.	2309.91	62.154	62.154	6431102.	34958.	106975.	1044.24	118.67	2056.98
145.00	6435344.	2368.73	62.606	62.606	6434251.	35314.	113246.	1052.05	118.35	2118.96
150.00	6437575.	2369.83	62.839	62.839	6435614.	35468.	116007.	1043.00	118.28	2124.65
155.00	6436843.	2369.58	62.854	62.854	6435596.	35477.	116174.	1042.34	118.28	2124.72

- 1) GCR;
- 2) First Motion;
- 3) Maximum Dynamic Pressure;
- 4) Tilt Arrest;
- 5) IECCO;
- 6) OECCO;
- 7) Separation Signal;
- 8) Physical Separation.

AS-234/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	POSITION (M)	EARTH FIXED VELOCITY (M/S)		PATH ANGLE (DEG)	EARTH FIXED POSITION (M)			VELOCITY VECTOR COMPONENTS (M/S)			
		VELOCITY (M/S)	VELOCITY (M/S)		X	Y	Z	DX	DY	DZ	
1) 5.00	34.	0.00	N/A	N/A	34.	-0.	0.	-0.00	0.00	0.00	-0.00
2) 7.00	34.	0.00	N/A	N/A	34.	-0.	0.	-0.00	0.00	0.00	0.00
5.00	67.	13.35	0.298	0.298	67.	0.	0.	13.35	-0.03	-0.03	0.01
10.00	171.	24.53	0.309	0.309	171.	0.	0.	28.53	-0.07	-0.07	-0.05
15.00	355.	45.63	0.291	0.291	355.	-1.	-0.	45.68	-0.09	-0.09	0.05
20.00	632.	65.17	0.983	0.983	632.	-1.	2.	65.16	-0.12	-0.12	1.02
25.00	1011.	86.98	2.303	2.303	1011.	-2.	12.	86.91	-0.16	-0.16	3.40
30.00	1505.	111.25	4.095	4.095	1505.	-3.	39.	110.98	-0.23	-0.23	7.83
35.00	2127.	138.19	6.312	6.312	2124.	-4.	95.	137.37	-0.32	-0.32	15.06
40.00	2889.	168.02	8.886	8.886	2882.	-6.	196.	166.03	-0.40	-0.40	25.80
45.00	3805.	201.02	11.750	11.750	3788.	-8.	360.	196.84	-0.48	-0.48	40.76
50.00	4392.	237.59	14.833	14.833	4854.	-11.	612.	229.72	-0.55	-0.55	60.64
55.00	6166.	277.77	17.965	17.965	6089.	-14.	975.	264.29	-0.63	-0.63	85.47
60.00	7640.	319.90	21.143	21.143	7496.	-17.	1474.	298.44	-0.70	-0.70	115.18
65.00	9319.	363.98	24.358	24.358	9071.	-21.	2135.	331.66	-0.74	-0.74	149.93
70.00	11220.	413.51	27.550	27.550	10816.	-25.	2985.	366.70	-0.78	-0.78	191.10
74.00	12921.	458.12	30.015	30.015	12342.	-28.	3823.	396.75	-0.81	-0.81	229.05
80.00	15814.	534.12	33.490	33.490	14867.	-33.	5389.	445.45	-0.83	-0.83	294.70
85.00	18578.	606.01	36.192	36.192	17202.	-37.	7017.	489.00	-0.81	-0.81	357.96
90.00	21706.	686.03	38.767	38.767	19760.	-41.	8983.	534.67	-0.75	-0.75	429.84
95.00	25238.	774.31	41.202	41.202	22552.	-44.	11331.	582.13	-0.66	-0.66	510.57
100.00	29214.	870.89	43.476	43.476	25584.	-47.	14103.	631.17	-0.55	-0.55	600.06
105.00	33677.	976.01	45.580	45.580	28866.	-50.	17346.	681.84	-0.46	-0.46	698.35
110.00	38671.	1090.05	47.506	47.506	32406.	-52.	21102.	734.39	-0.34	-0.34	805.54
115.00	44243.	1213.63	49.279	49.279	36213.	-53.	25417.	788.89	-0.20	-0.20	922.25
120.00	50443.	1347.32	50.928	50.928	40298.	-54.	30341.	845.16	-0.01	-0.01	1049.28
125.00	57324.	1491.80	52.503	52.503	44666.	-54.	35929.	902.47	0.04	0.04	1187.86
130.00	64939.	1648.03	54.051	54.051	49322.	-53.	42242.	959.85	0.10	0.10	1339.65
135.00	70226.	1754.69	55.056	55.056	52452.	-53.	46695.	995.81	0.18	0.18	1444.75
140.00	80967.	1968.30	56.759	56.759	58574.	-51.	55899.	1066.02	0.39	0.39	1654.63
145.00	94301.	2025.09	57.441	57.441	61790.	-50.	60562.	1075.11	0.62	0.62	1716.14
148.44	99366.	2025.25	57.713	57.713	63184.	-49.	63195.	1066.43	0.73	0.73	1721.73
148.52	99522.	2024.94	57.729	57.729	63268.	-49.	63335.	1065.74	0.74	0.74	1721.80

- 1) GRR;
- 2) First Motion;
- 3) Maximum Dynamic Pressure;
- 4) Tilt Arrest;
- 5) IECCO;
- 6) OECCO;
- 7) Separation Signal;
- 8) Physical Separation.

TABLE 5 (Cont'd)
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	MASS (KG)	THRUST (TOTAL) (N)	DRAW (N)	LONGITUDINAL ACCELERATION (M/SEC ²)	DYNAMIC PRESSURE (N/M ²)	A.H.I. (KG-M/M ² -RAD)	MACH NO.	PITCH ANGLE OF ATTACK (DEG)
1) -5.00	589243.	0.	0.	0.000	C.	C.	0.00	0.000
2) 0.00	582886.	7007287.	5884.	12.117	0.	C.	0.00	0.000
5.00	568924.	7155103.	13100.	12.660	105.	114.	0.04	1.471
10.00	554904.	7186991.	27749.	13.011	476.	2109.	0.08	2.831
15.00	540920.	7253906.	39034.	13.452	1198.	12246.	0.13	1.554
20.00	526649.	7319856.	49118.	13.919	2377.	44603.	0.19	1.054
25.00	512425.	7380204.	70425.	14.380	4088.	125000.	0.25	0.813
30.00	498160.	7444858.	90516.	14.880	6376.	294514.	0.33	0.289
35.00	483867.	7509924.	117100.	15.397	9246.	612913.	0.41	-0.063
40.00	469554.	7579341.	152508.	15.937	12648.	1160467.	0.50	-0.299
45.00	455229.	7648604.	181931.	16.524	16481.	2037658.	0.60	-0.444
50.00	440898.	7719919.	216590.	17.142	20584.	3363223.	0.72	-0.435
55.00	426566.	7791182.	330464.	17.616	24695.	5265105.	0.85	-0.465
60.00	412245.	7851192.	670205.	17.548	28172.	7841383.	1.00	-0.528
65.00	397901.	7916879.	729419.	18.195	30630.	11101929.	1.16	-0.599
70.00	383500.	7981068.	661220.	19.222	32216.	15050034.	1.36	-0.670
74.00	371978.	8028967.	561369.	20.212	32693.	18695347.	1.53	-0.515
80.00	354699.	8085829.	437958.	21.702	31473.	24872558.	1.85	-0.179
85.00	340304.	8122106.	327217.	23.051	28079.	30385625.	2.12	0.079
90.00	325991.	8145237.	233460.	24.421	23025.	35732869.	2.37	0.093
95.00	311709.	8158376.	164457.	25.803	18279.	40621784.	2.64	0.091
100.00	297439.	8161401.	115734.	27.214	14075.	44931629.	2.93	-0.007
105.00	283189.	8157367.	79371.	28.698	10513.	48601875.	3.24	0.031
110.00	268961.	8149379.	50310.	30.295	7505.	51597051.	3.54	-0.131
115.00	254762.	8134658.	22697.	32.034	5225.	53943727.	3.87	-0.273
120.00	240598.	8113670.	8893.	33.890	3524.	55730525.	4.18	-0.808
125.00	226476.	8089775.	1896.	35.930	2356.	57051533.	4.54	-1.505
130.00	212403.	8060245.	-3523.	38.198	1563.	58022972.	4.95	-2.741
135.20	203436.	8037008.	-7359.	39.788	1219.	58496471.	5.33	-3.676
139.14	186844.	7975494.	-13428.	43.020	729.	59183684.	6.15	-2.079
142.14	181762.	3566980.	-13808.	19.701	515.	59422511.	6.46	-1.279
143.44	181025.	215184.	-11923.	1.255	430.	59502369.	6.52	-0.992
143.52	131012.	199782.	-11789.	1.169	425.	59506761.	6.52	-0.975

- 1) GBR;
2) First Motion;
3) Maximum Dynamic Pressure;
4) Tilt Arrest;
5) IRCO;
6) CECCO;
7) Separation Signal;
8) Physical Separation.

TABLE 5 (Cont'd)
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	ALTITUDE (KM)	RANGE (KM)	VELOCITY SPACE FIXED (DEG)	VELOCITY VECTOR EARTH FIXED (DEG)	AZIMUTH (DEG)	LONGITUDE (POS. EAST) (DEG)	GEOCENTRIC DECLINATION (DEG)	GEOGETIC LATITUDE (DEG)
1) 5.00	0.034	0.000	90.000	N/A	N/A	-80.565	28.371	28.532
2) 0.00	0.034	0.000	90.000	N/A	N/A	-80.565	28.371	28.532
5.00	0.067	0.000	89.990	N/A	N/A	-80.565	28.371	28.532
10.00	0.171	0.001	89.991	N/A	N/A	-80.565	28.371	28.532
15.00	0.355	-0.002	89.968	N/A	N/A	-80.565	28.371	28.532
20.00	0.631	0.004	89.914	56.743		-80.565	28.371	28.532
25.00	1.010	0.014	89.799	65.594		-80.565	28.371	28.532
30.00	1.504	0.041	89.594	68.224		-80.565	28.371	28.532
35.00	2.124	0.097	89.277	69.419		-80.564	28.371	28.532
40.00	2.882	0.199	88.835	70.135		-80.563	28.371	28.532
45.00	3.789	0.364	88.260	70.594		-80.561	28.372	28.533
50.00	4.854	0.616	87.558	70.902		-80.559	28.373	28.534
55.00	6.088	0.980	86.763	71.111		-80.556	28.374	28.535
60.00	7.496	1.480	85.913	71.266		-80.551	28.375	28.536
65.00	9.071	2.140	85.038	71.390		-80.544	28.377	28.538
70.00	10.816	2.989	84.133	71.488		-80.536	28.379	28.540
3) 74.00	12.343	3.827	83.403	71.550		-80.528	28.382	28.543
85.00	17.205	7.014	81.474	71.695		-80.497	28.391	28.552
90.00	19.766	9.973	80.662	71.751		-80.478	28.396	28.557
95.00	22.561	11.311	79.907	71.804		-80.455	28.403	28.564
100.00	25.599	14.070	79.215	71.852		-80.429	28.411	28.571
105.00	28.489	17.293	78.587	71.893		-80.397	28.420	28.580
110.00	32.440	21.023	78.022	71.934		-80.361	28.430	28.591
115.00	36.263	25.305	77.517	71.974		-80.319	28.442	28.603
120.00	40.369	30.186	77.065	72.016		-80.272	28.456	28.616
125.00	44.767	35.718	76.654	72.051		-80.218	28.471	28.631
130.00	49.461	41.960	76.284	72.089		-80.157	28.488	28.649
4) 133.20	52.621	46.359	76.069	72.117		-80.115	28.500	28.661
5) 137.14	56.817	50.439	75.714	72.172		-80.026	28.525	28.686
6) 142.14	62.070	60.429	75.640	72.206		-79.977	28.535	28.699
7) 143.44	63.494	62.632	75.644	72.220		-79.956	28.545	28.705
8) 143.52	63.576	62.765	75.644	72.221		-79.955	28.546	28.706

- 1) GRR;
- 2) First Motion;
- 3) Maximum Dynamic Pressure;
- 4) Tilt Arrest;
- 5) IECO;
- 6) OEEO;
- 7) Separation Signal;
- 8) Physical Separation.

TABLE 5 (Cont'd.)
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
S-IR STAGE FLIGHT DATA

FLIGHT TIME (SEC)	VEHICLE ATTITUDE ANGLE			VEHICLE ATTITUDE RATE			VEHICLE ATTITUDE ERROR			
	PITCH (DEG)	YAW (DEG)	ROLL (DEG)	PITCH (DEG/S)	YAW (DEG/S)	ROLL (DEG/S)	PITCH (DEG)	YAW (DEG)	ROLL (DEG)	
1) 5.00	0.000	0.000	18.000	-0.003	0.001	-0.002	0.000	0.000	0.000	0.000
2) 9.00	-0.017	0.006	17.990	-0.003	0.001	-0.002	-0.017	0.006	-0.010	-0.010
5.00	-0.013	-0.015	18.004	-0.007	-0.004	-0.003	-0.013	-0.015	0.004	0.004
10.00	-0.003	-0.019	18.001	-0.000	-0.000	0.000	-0.003	-0.019	0.001	0.001
15.00	-0.567	-0.001	14.384	-0.117	-0.013	-1.087	0.109	-0.001	1.184	1.184
20.00	-1.500	0.012	9.387	-0.229	-0.001	-1.062	0.195	0.012	1.187	1.187
25.00	-2.863	0.002	4.385	-0.313	-0.004	-1.000	0.267	0.002	1.185	1.185
30.00	-4.638	-0.022	-0.007	-0.394	-0.004	-0.169	0.323	-0.022	-0.007	-0.007
35.00	-6.800	-0.023	0.000	-0.469	-0.000	-0.001	0.365	-0.023	0.000	0.000
40.00	-9.312	-0.024	-0.002	-0.536	-0.000	-0.000	0.410	-0.024	-0.002	-0.002
45.00	-12.139	-0.027	-0.005	-0.595	-0.001	-0.001	0.476	-0.027	-0.005	-0.005
50.00	-15.057	-0.032	-0.008	-0.563	-0.001	0.001	0.529	-0.032	-0.008	-0.008
55.00	-18.088	-0.039	-0.010	-0.609	-0.001	-0.000	0.599	-0.039	-0.010	-0.010
60.00	-21.189	-0.041	-0.013	-0.625	-0.000	-0.001	0.651	-0.041	-0.013	-0.013
65.00	-24.280	-0.047	-0.016	-0.617	-0.001	-0.001	0.728	-0.047	-0.016	-0.016
70.00	-27.332	-0.051	-0.021	-0.595	-0.001	-0.001	0.824	-0.051	-0.021	-0.021
75.00	-29.627	-0.060	-0.018	-0.592	-0.000	0.003	1.007	-0.060	-0.018	-0.018
80.00	-33.374	-0.047	-0.008	-0.602	-0.000	0.003	0.866	-0.047	-0.008	-0.008
85.00	-36.424	-0.047	0.002	-0.606	0.000	0.001	0.679	-0.047	0.002	0.002
90.00	-39.325	-0.045	0.002	-0.547	0.001	-0.000	0.472	-0.045	0.002	0.002
95.00	-41.907	-0.040	0.002	-0.488	0.000	-0.000	0.379	-0.040	0.002	0.002
100.00	-44.303	-0.039	-0.002	-0.451	0.000	-0.000	0.325	-0.039	-0.000	-0.000
105.00	-46.357	-0.062	0.001	-0.395	0.002	-0.000	0.333	-0.062	0.001	0.001
110.00	-48.285	-0.063	-0.001	-0.382	-0.001	-0.001	0.309	-0.063	-0.001	-0.001
115.00	-50.185	-0.070	-0.002	-0.390	-0.001	-0.001	0.313	-0.070	-0.002	-0.002
120.00	-52.219	-0.074	-0.005	-0.431	-0.001	-0.001	0.342	-0.074	-0.005	-0.005
125.00	-54.534	-0.161	-0.005	-0.494	0.008	-0.000	0.409	-0.161	-0.005	-0.005
130.00	-57.267	-0.161	-0.007	-0.601	-0.000	-0.000	0.535	-0.161	-0.007	-0.007
133.00	-59.274	-0.163	-0.009	-0.505	-0.001	-0.005	0.155	-0.163	-0.009	-0.009
4) 133.14	-59.491	-0.170	-0.003	0.000	-0.001	0.001	-0.062	-0.170	-0.003	-0.003
5) 142.14	-59.460	-0.085	-0.002	0.002	0.003	0.001	-0.031	-0.085	-0.002	-0.002
6) 143.44	-59.460	-0.084	-0.004	-0.002	-0.000	-0.003	-0.031	-0.084	-0.004	-0.004
8) 143.52	-59.460	-0.084	-0.004	-0.002	-0.000	-0.003	-0.031	-0.084	-0.004	-0.004

- 1) GRR;
- 2) First Motion;
- 3) Maximum Dynamic Pressure;
- 4) Tilt Arrest;
- 5) IECCO;
- 6) OECCO;
- 7) Separation Signal;
- 8) Physical Separation.

TABLE 6
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	SPACE FIXED			PATH ANGLE			SPACE FIXED POSITION AND VELOCITY VECTOR COMPONENTS					
	RADIUS (M)	VELOCITY (M/S)	PATH ANGLE (DEG)	X (M)	Y (M)	Z (M)	DX (M/S)	DY (M/S)	DZ (M/S)			
1) 143.52	6436843.	2369.58	62.854	6435696.	35477.	116174.	1042.34	118.28	2124.72			
2) 144.84	6438263.	2364.15	63.102	6437065.	35633.	118981.	1029.81	118.23	2124.79			
3) 147.19	6440752.	2355.46	63.546	6439459.	35911.	123975.	1007.94	118.12	2125.63			
4) 148.14	6441746.	2355.74	63.719	6440413.	36021.	125996.	1000.97	118.06	2129.23			
5) 150.00	6441746.	2355.74	63.719	6440413.	36021.	125996.	1000.97	118.06	2129.23			
6) 150.00	6443672.	2359.63	64.048	6442260.	36242.	129957.	989.03	117.87	2129.11			
7) 150.94	6444542.	2361.58	64.196	6443092.	36342.	131764.	983.70	117.76	2143.72			
8) 155.44	6449214.	2374.30	64.990	6447552.	36882.	141684.	955.70	117.15	2170.30			
9) 159.25	6452998.	2387.08	65.631	6451147.	37327.	149989.	933.53	116.64	2193.87			
10) 170.00	6463293.	2427.15	67.489	6460836.	38585.	173943.	867.97	118.59	2263.54			
11) 190.00	6480827.	2515.94	70.866	6476943.	41023.	220572.	742.60	125.27	2400.59			
12) 210.00	6496302.	2621.21	73.978	6490542.	43603.	270008.	617.40	133.16	2543.98			
13) 230.00	6509793.	2741.55	76.794	6501641.	46360.	322369.	492.57	142.68	2693.16			
14) 250.00	6521380.	2876.80	79.323	6510242.	49313.	377781.	367.43	152.65	2849.16			
15) 270.00	6531141.	3026.52	81.569	6516335.	52469.	436383.	241.73	162.97	3012.44			
16) 290.00	6539160.	3190.21	83.542	6519905.	55834.	498329.	115.06	173.45	3183.41			
17) 310.00	6545520.	3368.36	85.263	6520925.	59403.	563781.	-13.27	183.91	3363.31			
18) 330.00	6550320.	3560.95	86.737	6519364.	63197.	632925.	-143.19	195.62	3552.69			
19) 350.00	6553663.	3768.40	87.984	6515183.	67231.	705958.	-275.42	207.87	3752.57			
20) 370.00	6555661.	3991.65	89.020	6508327.	71516.	783107.	-410.69	220.68	3964.33			
21) 390.00	6556438.	4230.94	89.856	6498733.	76062.	864614.	-549.29	234.07	4188.59			
22) 410.00	6556134.	4488.21	90.507	6486327.	80883.	950748.	-692.21	248.15	4427.57			
23) 430.00	6554905.	4765.76	90.984	6471010.	85994.	1041830.	-840.43	263.05	4683.69			
24) 450.00	6552926.	5065.05	91.293	6452669.	91411.	1138221.	-994.73	278.84	4958.58			
25) 470.00	6550407.	5388.30	91.443	6431175.	97154.	1240313.	-1156.07	295.61	5254.51			
26) 475.75	6549613.	5483.43	91.465	6424390.	98867.	1270777.	-1204.08	300.48	5341.15			
27) 490.00	6547551.	5712.43	91.494	6406377.	103332.	1348370.	-1324.97	311.99	5547.88			
28) 510.00	6544483.	6038.59	91.475	6378100.	109621.	1462219.	-1503.83	327.99	5839.14			
29) 530.00	6541457.	6385.81	91.301	6346197.	116356.	1582060.	-1688.60	344.72	6148.86			
30) 550.00	6538779.	6761.00	91.019	6310468.	123427.	1708330.	-1886.52	362.51	6482.34			
31) 570.00	6536753.	7170.34	90.638	6270624.	130865.	1841545.	-2101.44	381.60	6844.86			
32) 590.00	6535673.	7623.61	90.211	6226235.	138701.	1982367.	-2344.54	402.14	7242.98			
33) 598.15	6535549.	7821.49	90.004	6206697.	147015.	2042110.	-2450.10	411.04	7416.46			
34) 608.15	6535557.	7828.60	89.997	6181739.	146170.	2116190.	-2539.69	409.49	7392.86			

- 1) Separation Completed;
- 2) J-2 Start Command;
- 3) Terminate Ullage Burn;
- 4) 90% Thrust Level;
- 5) Command P.U. Activation;
- 6) Ullage Case Jettison;
- 7) I.G.M. Initiation;
- 8) E.M.R. Shift sensed by I.G.M.;
- 9) Guidance Cutoff Signal;
- 10) Orbit Insertion.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IVB STAGE FLIGHT DATA

TABLE 6 (Cont'd)

FLIGHT TIME (SEC)	EARTH FIXED VELOCITY		PATH ANGLE		EARTH FIXED POSITION AND VELOCITY VECTOR COMPONENTS				
	POSITION (M)	VELOCITY (M/S)	(DEG)	X (M)	Y (M)	Z (M)	DX (M/S)	DY (M/S)	DZ (M/S)
1) 143.52	89522.	2024.94	57.729	63268.	-49.	63335.	1065.74	0.74	1721.80
2) 144.84	92122.	2018.54	58.004	64668.	-48.	65610.	1053.52	0.84	1721.80
3) 147.19	96730.	2008.13	58.478	67118.	-45.	69656.	1032.22	1.03	1727.54
4) 148.14	98589.	2007.74	58.700	68095.	-44.	71294.	1025.50	1.09	1726.08
5) 150.00	102223.	2007.74	58.700	68095.	-44.	71294.	1025.50	1.09	1726.08
6) 150.84	103877.	2010.35	59.093	69988.	-42.	74506.	1014.10	1.16	1745.84
7) 155.44	112919.	2011.73	59.270	70842.	-41.	75973.	1009.01	1.18	1740.39
8) 159.25	120440.	2021.43	60.226	75421.	-36.	84038.	982.38	1.25	1766.67
9) 170.00	141897.	2031.82	61.004	79120.	-31.	90806.	961.36	1.32	1789.99
10) 182.79	182769.	2065.11	63.257	89126.	-3.	110414.	899.21	5.02	1859.05
11) 210.00	225143.	2142.65	67.364	105924.	199.	148945.	780.65	15.35	1995.32
12) 230.00	269338.	2238.89	71.147	120358.	621.	190271.	662.88	27.35	2138.34
13) 250.00	315676.	2352.20	74.557	132446.	1308.	234519.	546.10	41.49	2287.55
14) 270.00	364481.	2482.11	77.600	142203.	2287.	281823.	429.69	56.59	2443.98
15) 290.00	416079.	2627.88	80.278	149635.	3577.	323229.	313.43	72.59	2608.11
16) 310.00	470794.	2788.75	82.608	154740.	5196.	386200.	196.98	89.32	2780.35
17) 330.00	528958.	2964.94	84.617	157507.	7150.	443608.	79.69	106.64	2961.95
18) 350.00	590904.	3156.20	86.319	157923.	9473.	504745.	-38.29	125.87	3153.46
19) 370.00	656579.	3362.81	87.741	15967.	12193.	569818.	-157.63	146.32	3355.93
20) 390.00	727539.	3585.56	88.909	151604.	15335.	639064.	-278.97	168.09	3570.74
21) 410.00	802953.	3824.58	89.841	144794.	18926.	712734.	-402.51	191.24	3798.53
22) 430.00	883636.	4081.77	90.517	135484.	22995.	791106.	-529.11	215.96	4041.56
23) 450.00	970014.	4359.33	91.015	123604.	27576.	874514.	-659.64	242.48	4302.30
24) 470.00	1062622.	4658.68	91.406	109069.	32707.	963327.	-794.72	270.95	4582.40
25) 475.75	1050455.	4982.03	91.561	91781.	38428.	1057954.	-935.15	301.56	4884.18
26) 490.00	1161743.	5077.19	91.583	86284.	40188.	1086292.	-976.89	310.61	4972.63
27) 510.00	1267298.	5306.28	91.609	71619.	44772.	1158669.	-1082.09	332.64	5184.11
28) 530.00	1379562.	5632.57	91.582	48428.	51738.	1265315.	-1237.93	364.20	5482.76
29) 550.00	1499048.	5979.89	91.389	22087.	59353.	1378107.	-1397.93	397.72	5800.58
30) 570.00	1626353.	6355.16	91.084	-7564.	67663.	1497501.	-1569.05	433.77	6143.12
31) 598.15	1762242.	6764.54	90.677	-40771.	76724.	1624031.	-1754.82	472.84	6515.83
32) 608.15	1820283.	7217.82	90.222	-77913.	86601.	1758387.	-1966.02	515.45	6925.75
33) 608.15	1892522.	7415.70	90.004	-94315.	90878.	1815565.	-2057.71	533.98	7104.66
34) 608.15	1892522.	7422.79	89.992	-115301.	96245.	1886553.	-2138.98	539.00	7087.66

- 1) Separation Completed;
- 2) J-2 Start Command;
- 3) Terminate Ullage Burn;
- 4) 90% Thrust Level;
- 5) Command P.U. Activation;
- 6) Ullage Case Jettison;
- 7) I.G.M. Initiation;
- 8) E.M.R. Shift sensed by I.G.M.;
- 9) Guidance Cutoff Signal;
- 10) Orbit Insertion.

TABLE 6 (Cont'd)
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	MASS (KG)	THRUST (TOTAL) (N)	LONGITUDINAL ACCELERATION (M/S ²)	DYNAMIC PRESSURE (N/M ²)	CENTRAL RANGE ANGLE (DEG)	PITCH ATT. COMMAND (DEG)	PITCH ANGLE OF ATTACK (DEG)
1) 143.52	134360.	38915.	0.267	425.	1.096	-59.429	-0.975
2) 144.84	134326.	38364.	0.267	351.	1.121	-59.429	-0.765
3) 147.19	134211.	380886.	2.825	249.	1.165	-59.429	-0.647
4) 148.14	134101.	797977.	5.939	217.	1.182	-59.429	-0.535
5) 150.00	133719.	797977.	5.939	217.	1.182	-59.429	-0.535
6) 150.84	133545.	875236.	6.546	166.	1.233	-59.429	0.075
7) 155.44	132542.	980803.	7.396	74.	1.320	-59.429	1.540
8) 159.25	131549.	981603.	7.460	41.	1.393	-59.429	2.347
9) 170.00	129002.	990216.	7.676	7.	1.603	-64.534	-0.288
10) 190.00	124222.	997812.	8.032	0.	2.011	-66.132	3.317
11) 210.00	119426.	998925.	8.364	0.	2.443	-67.318	6.547
12) 230.00	114639.	938184.	8.707	0.	2.900	-68.518	8.839
13) 250.00	109856.	996845.	9.074	0.	3.382	-69.742	11.306
14) 270.00	105078.	997966.	9.497	0.	3.893	-71.178	13.026
15) 290.00	100310.	996431.	9.933	0.	4.433	-72.435	14.266
16) 310.00	95537.	997032.	10.436	0.	5.005	-73.693	15.532
17) 330.00	90771.	996407.	10.977	0.	5.609	-75.144	16.331
18) 350.00	86004.	997326.	11.596	0.	6.249	-76.717	16.796
19) 370.00	81235.	995759.	12.258	0.	6.927	-78.218	17.092
20) 390.00	76477.	993405.	12.989	0.	7.645	-79.751	17.184
21) 410.00	71718.	994567.	13.867	0.	8.407	-81.435	16.954
22) 430.00	66956.	994654.	14.855	0.	9.215	-83.104	16.571
23) 450.00	62200.	990684.	15.927	0.	10.074	-84.699	16.161
24) 470.00	57460.	982625.	17.101	0.	10.987	-86.419	15.472
25) 475.75	56139.	938665.	16.720	0.	11.261	-86.772	15.377
26) 490.00	53093.	864235.	16.277	0.	11.959	-87.956	14.931
27) 510.00	49068.	836211.	17.041	0.	12.986	-88.953	14.776
28) 530.00	45119.	828826.	18.369	0.	14.074	-90.868	13.908
29) 550.00	41217.	817157.	19.825	0.	15.225	-92.810	12.805
30) 570.00	37351.	814718.	21.812	0.	16.445	-95.463	11.000
31) 590.00	33506.	804375.	24.006	0.	17.741	-99.046	7.753
32) 598.15	31954.	801715.	25.089	0.	18.293	-98.060	9.367
33) 608.15	31845.	1603.	0.050	0.	18.979	-98.060	10.040

- 1) Separation Completed;
- 2) J-2 Start Command;
- 3) Terminate Ullage Burn;
- 4) 90% Thrust Level;
- 5) Command P.U. Activation;
- 6) Ullage Case Jettison;
- 7) I.G.M. Initiation;
- 8) E.M.R. Shift sensed by I.G.M.;
- 9) Guidance Cutoff Signal;
- 10) Orbit Insertion.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IVB STAGE FLIGHT DATA

TABLE 6 (Cont'd)

FLIGHT TIME (SEC)	ALTITUDE (KM)	RANGE (KM)	VELOCITY VECTOR SPACE FIXED (DEG)	VELOCITY VECTOR EARTH FIXED (DEG)	LONGITUDE (POS. EAST) (DEG)	GEOCENTRIC DECLINATION (DEG)	GEODETHIC LATITUDE (DEG)
1) 143.52	63.579	62.766	75.644	72.221	-79.955	28.546	28.706
2) 144.84	65.002	65.005	75.657	72.236	-79.933	28.552	28.712
3) 147.19	67.494	68.986	75.679	72.263	-79.894	28.563	28.723
4) 148.14	68.489	70.597	75.683	72.273	-79.878	28.567	28.727
5) 150.84	71.289	75.196	75.683	72.292	-79.848	28.576	28.736
6) 155.44	75.968	83.116	75.679	72.342	-79.834	28.580	28.740
7) 159.25	79.758	89.756	75.675	72.378	-79.691	28.619	28.779
170.00	90.069	108.958	75.753	72.589	-79.504	28.671	28.831
190.00	107.634	146.576	75.977	73.068	-79.135	28.771	28.931
210.00	123.142	186.796	76.235	73.565	-78.740	28.875	29.035
230.00	136.668	229.763	76.533	74.089	-78.316	28.983	29.142
250.00	148.289	275.632	76.843	74.607	-77.862	29.094	29.254
270.00	158.087	324.574	77.163	75.120	-77.376	29.209	29.369
290.00	166.144	376.776	77.492	75.626	-76.855	29.327	29.488
310.00	172.543	432.440	77.828	76.126	-76.298	29.449	29.610
330.00	177.383	491.791	78.193	76.647	-75.702	29.575	29.736
350.00	180.768	555.071	78.577	77.175	-75.064	29.704	29.865
370.00	182.808	622.553	78.980	77.713	-74.382	29.836	29.997
390.00	183.628	694.530	79.405	78.264	-73.651	29.970	30.132
410.00	183.370	771.324	79.853	78.831	-72.869	30.107	30.270
430.00	182.185	853.312	80.328	79.417	-72.032	30.247	30.410
450.00	180.253	940.913	80.833	80.025	-71.134	30.387	30.551
470.00	177.779	1034.582	81.369	80.659	-70.170	30.528	30.693
490.00	174.970	1134.651	81.941	81.319	-69.137	30.669	30.834
510.00	171.948	1241.040	82.547	82.006	-68.036	30.808	30.973
530.00	168.966	1354.023	83.190	82.725	-66.863	30.943	31.109
550.00	166.330	1474.101	83.873	83.480	-65.612	31.073	31.239
570.00	164.346	1601.864	84.601	84.276	-64.277	31.195	31.362
590.00	163.303	1738.068	85.376	85.115	-62.850	31.309	31.475
598.15	163.191	1796.200	85.707	85.472	-62.240	31.351	31.518
608.15	163.218	1868.548	86.125	85.913	-61.480	31.400	31.567

- 1) Separation Completed;
- 2) J-2 Start Command;
- 3) Terminate Ullage Burn;
- 4) 90% Thrust Level;
- 5) Command P.U. Activation;
- 6) Ullage Case Jettison;
- 7) I.G.M. Initiation;
- 8) E.M.R. Shift sensed by I.G.M.;
- 9) Guidance Cutoff Signal;
- 10) Orbit Insertion.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	VEHICLE ATTITUDE ANGLE			VEHICLE ATTITUDE RATE			VEHICLE ATTITUDE ERROR		
	PITCH (DEG)	YAW (DEG)	ROLL (DEG)	PITCH (DEG/S)	YAW (DEG/S)	ROLL (DEG/S)	PITCH (DEG)	YAW (DEG)	ROLL (DEG)
1) 142.52	-59.460	-0.084	-0.004	-0.002	-0.000	-0.003	-0.001	-0.084	-0.004
2) 144.84	-59.539	-0.090	-0.012	-0.109	-0.010	-0.008	-0.109	-0.090	-0.012
3) 147.19	-59.940	-0.145	-0.039	-0.186	-0.056	-0.018	-0.511	-0.145	-0.039
4) 148.14	-60.041	-0.233	-0.067	-0.010	-0.123	-0.041	-0.612	-0.233	-0.067
5) 148.14	-60.041	-0.233	-0.067	-0.010	-0.123	-0.041	-0.612	-0.233	-0.067
6) 150.00	-59.846	-0.458	-0.167	0.155	-0.088	-0.058	-0.416	-0.458	-0.167
7) 150.84	-59.725	-0.514	-0.212	0.127	-0.046	-0.052	-0.295	-0.514	-0.212
8) 155.44	-59.584	-0.506	-0.364	-0.015	0.008	-0.019	-0.154	-0.506	-0.364
9) 155.25	-59.609	-0.501	-0.412	0.003	-0.005	-0.007	-0.179	-0.501	-0.412
10) 170.00	-64.668	2.948	0.016	-0.027	-0.023	-0.004	-0.134	-0.498	0.016
11) 190.00	-66.272	3.074	-0.012	-0.054	0.004	-0.003	-0.140	-0.526	-0.012
12) 210.00	-67.446	3.699	-0.028	-0.066	0.018	-0.002	-0.128	-0.563	-0.028
13) 230.00	-68.654	3.807	-0.091	-0.075	0.001	-0.002	-0.137	-0.556	-0.091
14) 250.00	-69.898	3.803	-0.147	-0.061	-0.001	-0.003	-0.156	-0.572	-0.147
15) 270.00	-71.377	3.792	-0.193	-0.056	-0.000	-0.003	-0.199	-0.596	-0.193
16) 290.00	-72.888	3.118	-0.263	-0.120	-0.088	-0.003	-0.453	-1.358	-0.263
17) 310.00	-74.138	3.780	-0.281	-0.063	0.005	-0.002	-0.445	-1.275	-0.281
18) 330.00	-75.613	3.800	-0.323	-0.072	0.000	-0.002	-0.469	-1.309	-0.323
19) 350.00	-77.186	3.780	-0.361	-0.075	-0.003	-0.002	-0.470	-1.359	-0.361
20) 370.00	-78.719	3.760	-0.398	-0.079	-0.001	-0.002	-0.501	-1.405	-0.398
21) 390.00	-80.264	3.741	-0.433	-0.080	-0.001	-0.002	-0.512	-1.451	-0.433
22) 410.00	-81.964	3.719	-0.457	-0.083	0.000	-0.001	-0.529	-1.500	-0.457
23) 430.00	-83.568	3.698	-0.478	-0.081	-0.001	-0.001	-0.565	-1.547	-0.478
24) 450.00	-85.266	3.668	-0.503	-0.081	-0.002	-0.001	-0.566	-1.601	-0.503
25) 470.00	-87.023	3.646	-0.515	-0.085	-0.001	-0.001	-0.604	-1.655	-0.515
26) 475.75	-87.414	3.633	-0.525	-0.055	-0.002	-0.003	-0.642	-1.673	-0.525
27) 490.00	-88.585	3.610	-0.537	-0.109	-0.002	0.001	-0.620	-1.706	-0.537
28) 510.00	-89.743	3.572	-0.579	0.008	-0.003	-0.006	-0.790	-1.749	-0.579
29) 530.00	-91.508	3.535	-0.580	-0.106	-0.001	0.001	-0.640	-1.803	-0.580
30) 550.00	-93.461	3.495	-0.564	-0.110	-0.001	0.002	-0.651	-1.851	-0.564
31) 570.00	-96.035	3.454	-0.507	-0.145	-0.002	0.004	-0.621	-1.894	-0.507
32) 590.00	-100.182	3.351	-0.383	0.180	0.010	-0.004	-1.135	-1.950	-0.383
33) 598.15	-98.901	3.396	-0.414	0.004	-0.002	-0.000	-0.841	-1.949	-0.414
34) 608.15	-98.903	3.380	-0.414	-0.000	-0.001	0.000	-0.843	-1.965	-0.414

- 1) Separation Completed;
- 2) J-2 Start Command;
- 3) Terminate Ullage Burn;
- 4) 90% Thrust Level;
- 5) Command P.U. Activation;
- 6) Ullage Case Jettison;
- 7) I.G.M. Initiation;
- 8) E.M.R. Shift sensed by I.G.M.;
- 9) Guidance Cutoff Signal;
- 10) Orbit Insertion.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 TABLE 7-1
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	SPACE FIXED VELOCITY			PATH ANGLE * (DEG)	SPACE FIXED POSITION			VELOCITY VECTORS		
	RADIUS (M)	VELOCITY (M/S)	ANGLE * (DEG)		X (M)	Y (M)	Z (M)	DX (M/S)	DY (M/S)	DZ (M/S)
1) 608.15	6535557.	7828.60	0.008	6181739.	146120.	2116190.	-2539.69	409.49	7393.86	
638.60	6535612.	7829.65	0.019	6100331.	158495.	2339886.	-2806.96	403.32	7298.06	
638.60	6535612.	7829.65	0.019	6100331.	158495.	2339886.	-2806.96	403.32	7298.06	
643.35	6535625.	7829.63	0.021	6086900.	160409.	2374514.	-2848.30	402.30	7282.06	
643.35	6535625.	7829.63	0.021	6086900.	160409.	2374514.	-2848.30	402.30	7282.06	
688.35	6535799.	7829.40	0.036	5949988.	178285.	2698615.	-3235.18	391.99	7118.95	
688.35	6535799.	7829.40	0.036	5949988.	178285.	2698615.	-3235.18	391.99	7118.95	
724.46	6536004.	7829.15	0.048	5827663.	192277.	2953088.	-3538.89	382.90	6973.18	
724.46	6536004.	7829.15	0.048	5827663.	192277.	2953088.	-3538.89	382.90	6973.18	
800.00	6536623.	7828.45	0.072	5536972.	220416.	3467103.	-4152.20	361.50	6626.70	
992.00	6539305.	7825.58	0.131	4601690.	283696.	4637509.	-5547.36	294.66	5511.78	
1184.00	6543442.	7821.24	0.183	3425492.	332573.	5565252.	-6650.75	212.22	4110.27	
1198.35	6543803.	7820.86	0.186	3329557.	335571.	5623416.	-6719.79	205.55	3996.01	
1198.35	6543803.	7820.86	0.186	3329557.	335571.	5623416.	-6719.79	205.55	3996.01	
1376.00	6548786.	7815.59	0.223	2070183.	364469.	6202266.	-7405.08	118.55	2496.85	
1568.00	6555022.	7808.87	0.251	606777.	377688.	6515941.	-7772.07	18.51	757.08	
1760.00	6561791.	7801.36	0.264	-888340.	371503.	6490758.	-7734.29	-82.70	-1017.41	
1858.40	6565344.	7797.32	0.266	-1641605.	360863.	6346547.	-7558.56	-133.32	-1910.13	
1858.40	6565344.	7797.32	0.266	-1641605.	360863.	6346547.	-7558.56	-133.32	-1910.13	
1952.00	6568715.	7793.40	0.263	-2337506.	346191.	6128967.	-7295.89	-179.86	-2734.01	
2144.00	6575425.	7785.37	0.249	-3665882.	303016.	5450294.	-6481.89	-267.98	-4304.10	
2336.00	6581575.	7777.70	0.221	-4805310.	244154.	4490714.	-5336.52	-342.57	-5647.72	
2528.00	6586868.	7770.81	0.184	-5697749.	172578.	3300409.	-3920.38	-399.86	-6697.48	
2720.00	6591060.	7765.11	0.137	-6298094.	91902.	1941041.	-2307.01	-436.97	-7401.61	
2912.00	6593970.	7760.97	0.086	-6576289.	6195.	482528.	-578.94	-452.04	-7726.14	
3000.00	6594841.	7759.67	0.060	-6591760.	-33588.	-198734.	227.56	-451.33	-7743.19	
3000.00	6594841.	7759.67	0.060	-6591760.	-33588.	-198734.	227.56	-451.33	-7743.19	
3104.00	6595480.	7758.66	0.030	-6518660.	-80219.	-1000500.	1176.40	-444.29	-7656.08	
3235.00	6595676.	7758.22	-0.008	-6287589.	-137338.	-1987537.	2344.35	-426.03	-7383.26	
3235.00	6595676.	7758.22	-0.008	-6287589.	-137338.	-1987537.	2344.35	-426.03	-7383.26	
3296.00	6595535.	7758.34	-0.026	-6128459.	-162972.	-2432388.	2870.79	-414.05	-7195.76	
3403.40	6594931.	7759.05	-0.057	-5771903.	-206089.	-3183674.	3760.15	-387.81	-6775.97	
3403.40	6594931.	7759.05	-0.057	-5771903.	-206089.	-3183674.	3760.15	-387.81	-6775.97	
3415.00	6594839.	7759.16	-0.060	-5727747.	-210569.	-3261975.	3852.87	-384.59	-6723.99	
3415.00	6594839.	7759.16	-0.060	-5727747.	-210569.	-3261975.	3852.87	-384.59	-6723.99	

- 1) Orbit Insertion;
- 2) End LH Vent;
- 3) Nose Cone Jettison;
- 4) End LH₂ Vent;
- 5) LM Separation;
- 6) Start LH₂ Vent.

* Relative to local horizontal.

TABLE 7-1 (Cont'd)
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	RADIUS (M)	SPACE FIXED VELOCITY		PATH ANGLE* (DEG)	SPACE FIXED POSITION			VELOCITY VECTORS		
		(M/S)	(M/S)		X (M)	Y (M)	Z (M)	DX (M/S)	DY (M/S)	DZ (M/S)
3481.00	6594218.	7759.95	-0.079	-5456379.	-235316.	-3695439.	4366.29	-364.94	-6404.62	
3483.00	6594218.	7759.95	-0.079	-5456379.	-235316.	-3695439.	4366.29	-364.94	-6404.62	
3488.00	6594142.	7760.05	-0.081	-5425529.	-237863.	-3740145.	4419.26	-362.72	-6368.44	
3680.00	6591367.	7763.71	-0.132	-4445817.	-301062.	-4856974.	5743.80	-292.74	-5215.19	
3872.00	6587332.	7769.09	-0.177	-3238684.	-349294.	-5725545.	6776.99	-207.45	-3793.16	
4064.00	6582214.	7775.86	-0.214	-1865567.	-380008.	-6520856.	7465.18	-111.00	-2173.20	
4256.00	6576239.	7783.61	-0.242	-396546.	-391509.	-6520587.	7771.34	-8.16	-436.80	
4448.00	6569681.	7791.88	-0.258	1092975.	-383063.	-6466790.	7677.35	95.90	1327.60	
4603.40	6564160.	7798.62	-0.262	2260752.	-361776.	-6151936.	7309.10	177.38	2713.68	
4603.40	6564160.	7798.62	-0.262	2260752.	-361776.	-6151936.	7309.10	177.38	2713.68	
4640.00	6562853.	7800.18	-0.262	2526043.	-354945.	-6046830.	7185.41	195.87	3028.92	
4832.00	6556093.	7808.07	-0.252	3828137.	-308446.	-5313435.	6318.59	286.52	4578.14	
5024.00	6549756.	7815.14	-0.229	4931112.	-245825.	-4303837.	5120.06	363.05	5893.18	
5216.00	6544187.	7821.06	-0.194	5776905.	-170204.	-3065981.	3651.21	421.32	6903.63	
5408.00	6539701.	7825.59	-0.147	6320747.	-85416.	-1675874.	1988.53	458.10	7554.85	
5485.00	6538269.	7826.98	-0.125	6446933.	-49802.	-1087901.	1286.67	466.30	7706.41	
5485.00	6538269.	7826.98	-0.125	6446933.	-49802.	-1087901.	1286.67	466.30	7706.41	
5600.00	6536564.	7828.58	-0.091	6533677.	4195.	-194228.	219.44	471.30	7811.30	
5792.00	6534966.	7829.93	-0.030	6404187.	93998.	1297434.	-1562.51	460.07	7658.63	
5984.00	6535007.	7829.62	0.033	5938902.	179325.	2720955.	-3262.90	424.86	7104.64	
6148.40	6536345.	7828.07	0.086	5291654.	245447.	3829093.	-4585.71	376.95	6333.08	
6148.40	6536345.	7828.07	0.086	5291654.	245447.	3829093.	-4585.71	376.95	6333.08	
6176.00	6536684.	7827.70	0.094	5162234.	255720.	4001773.	-4791.72	367.42	6178.78	
6355.00	6539631.	7824.54	0.146	4193442.	315361.	5008230.	-5991.30	296.41	5023.93	
6355.00	6539631.	7824.54	0.146	4193442.	315361.	5008230.	-5991.30	296.41	5023.93	
6368.00	6539893.	7824.26	0.149	4115053.	319177.	5072935.	-6068.33	290.68	4930.51	
6560.00	6544437.	7819.46	0.196	2852447.	366358.	5878689.	-7025.95	198.61	3426.45	
6566.60	6544614.	7819.27	0.197	2805988.	367657.	5901121.	-7052.54	195.23	3371.14	
6566.60	6544614.	7819.27	0.197	2805988.	367657.	5901121.	-7052.54	195.23	3371.14	
6748.40	6549927.	7813.61	0.230	1468110.	394420.	6371078.	-7607.72	98.00	1779.19	
6748.40	6549927.	7813.61	0.230	1468110.	394420.	6371078.	-7607.72	98.00	1779.19	
6752.00	6550040.	7813.49	0.230	1440708.	394769.	6377424.	-7615.17	96.01	1746.61	
6944.00	6556369.	7806.58	0.251	-46270.	402893.	6543815.	-7806.55	-11.79	-20.17	
7136.00	6563063.	7799.02	0.258	-1530979.	390268.	6370054.	-7591.98	-119.19	-1781.12	
7328.00	6569752.	7791.17	0.252	-2936422.	357506.	5866111.	-6984.83	-220.64	-3444.67	

- 7) End LH₂ Vent;
- 8) Start LH₂ Vent;
- 9) End LH₂ Vent.

* Relative to local horizontal.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	SPACE FIXED			SPACE FIXED POSITION AND VELOCITY VECTORS					
	RADIUS (M)	VELOCITY (M/S)	PATH ANGLE* (DEG)	X (M)	Y (M)	Z (M)	DX (M/S)	DY (M/S)	DZ (M/S)
7520.00	6576083.	7783.43	0.232	-4190147.	306255.	5059026.	-6018.80	-310.95	-4925.35
7712.00	6581739.	7776.20	0.200	-5227956.	239110.	3991314.	-4745.69	-385.51	-6148.10
7904.00	6586451.	7765.92	0.160	-5997091.	159469.	2718603.	-3232.32	-440.56	-7051.92
8096.00	6590008.	7764.96	0.112	-6458773.	71362.	1306659.	-1556.80	-473.23	-7592.56
8288.00	6592259.	7761.66	0.060	-6589982.	-20757.	-172002.	195.49	-482.17	-7744.20
8438.35	6593052.	7760.37	0.018	-6457356.	-92677.	-1327512.	1563.98	-472.04	-7586.47
8438.35	6593052.	7760.37	0.018	-6457356.	-92677.	-1327512.	1563.98	-472.04	-7586.47
8480.00	6593117.	7760.23	0.006	-6384452.	-112228.	-1641758.	1936.11	-456.60	-7500.32
8647.00	6592706.	7760.61	-0.042	-5939751.	-187648.	-2854458.	3372.46	-433.72	-6976.06
8647.00	6592706.	7760.61	-0.042	-5939751.	-187648.	-2854458.	3372.46	-433.72	-6976.06
8672.00	6592553.	7760.80	-0.049	-5852869.	-198412.	-3027593.	3577.60	-427.32	-6873.73
8779.00	6591631.	7761.99	-0.078	-5424511.	-242506.	-3737041.	4418.52	-395.77	-6369.34
8779.00	6591631.	7761.99	-0.078	-5424511.	-242506.	-3737041.	4418.52	-395.77	-6369.34
8824.50	6590844.	7763.02	-0.177	-5215531.	-260158.	-4021167.	4765.19	-379.95	-6116.62
8824.50	6590844.	7763.02	-0.177	-5215531.	-260158.	-4021167.	4765.19	-379.95	-6116.62
8848.40	6590243.	7763.77	-0.192	-5099569.	-269137.	-4165725.	4937.89	-371.38	-5979.59
8848.40	6590243.	7763.77	-0.192	-5099569.	-269137.	-4165725.	4937.89	-371.38	-5979.59
8864.00	6589828.	7764.30	-0.200	-5021674.	-274885.	-4258293.	5048.25	-365.64	-5887.76
8899.40	6588833.	7765.55	-0.214	-4838621.	-287592.	-4462931.	5292.13	-352.16	-5672.14
8899.40	6588833.	7765.55	-0.214	-4838621.	-287592.	-4462931.	5292.13	-352.16	-5672.14
8909.20	6588547.	7765.91	-0.216	-4786435.	-291025.	-4518217.	5357.90	-348.32	-5610.79
8909.20	6588547.	7765.91	-0.216	-4786435.	-291025.	-4518217.	5357.90	-348.32	-5610.79
8978.40	6586395.	7768.64	-0.241	-4400067.	-314156.	-4890942.	5802.50	-319.85	-5155.63
8978.40	6586395.	7768.64	-0.241	-4400067.	-314156.	-4890942.	5802.50	-319.85	-5155.63
9056.00	6583740.	7772.03	-0.263	-3931910.	-337655.	-5269887.	6254.99	-285.35	-4604.13
9089.40	6582530.	7773.57	-0.271	-3719977.	-346926.	-5419513.	6433.90	-269.72	-4354.38
9089.40	6582530.	7773.57	-0.271	-3719977.	-346926.	-5419513.	6433.90	-269.72	-4354.38
9099.40	6582161.	7774.05	-0.273	-3655379.	-349599.	-5462676.	6485.50	-264.96	-4278.30
9099.40	6582161.	7774.05	-0.273	-3655379.	-349599.	-5462676.	6485.50	-264.96	-4278.30
9248.00	6576321.	7781.53	-0.304	-2640152.	-383488.	-6010868.	7143.37	-189.92	-3080.32
9348.40	6572075.	7786.96	-0.317	-1905964.	-399845.	-6276909.	7464.70	-135.51	-2212.85
9348.40	6572075.	7786.96	-0.317	-1905964.	-399845.	-6276909.	7464.70	-135.51	-2212.85
9398.35	6569905.	7789.74	-0.321	-1529973.	-405919.	-6376368.	7585.62	-107.60	-1768.28
9398.35	6569905.	7789.74	-0.321	-1529973.	-405919.	-6376368.	7585.62	-107.60	-1768.28
9440.00	6568077.	7792.06	-0.324	-1212289.	-409910.	-6442202.	7666.18	-83.99	-1392.39

- 10) Start J-2 LOX Purge;
- 11) End J-2 LOX Purge;
- 12) Start J-2 LH₂ Purge;
- 13) End J-2 LH₂ Purge;
- 14) Start J-2 LH₂ Vent; Start J-2 LOX Vent.

* Relative to local horizontal.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION J)
 TABLE 7-1 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SFC)	SPACE FIXED			SPACE FIXED POSITION AND VELOCITY VECTORS					
	RADIUS (M)	VELOCITY (M/S)	PATH ANGLE* (DEG)	X (M)	Y (M)	Z (M)	DX (M/S)	DY (M/S)	DZ (M/S)
9556.63	6562905.	7798.51	-0.327	-309414.	-415797.	-6542408.	7791.80	-16.75	-322.85
9556.62	6562905.	7758.51	-0.327	-309414.	-415797.	-6542408.	7791.80	-16.75	-322.85
9632.00	6559557.	7802.62	-0.325	278315.	-415406.	-6540471.	7793.59	27.14	374.32
9824.00	6551200.	7812.72	-0.311	1754477.	-399514.	-6299239.	7515.88	137.83	2128.66
10016.00	6543406.	7821.82	-0.281	3139162.	-362876.	-5729759.	6844.42	242.29	3778.37
10208.00	6536561.	7829.44	-0.238	4359581.	-307230.	-4860689.	5811.97	334.95	5235.35
10400.00	6531012.	7835.21	-0.182	5351192.	-235334.	-3736775.	4471.40	410.78	6420.93
10592.00	6527055.	7838.90	-0.117	6061339.	-150836.	-2416581.	2893.04	465.61	7270.61
10784.00	6524906.	7840.40	-0.045	6452237.	-58081.	-969361.	1160.74	496.39	7738.10
10976.00	6524684.	7839.75	0.029	6503115.	38120.	528721.	-632.96	501.33	7798.06
11168.00	6526401.	7837.06	0.102	6211376.	132748.	1998774.	-2392.24	480.07	7447.56
11360.00	6529952.	7822.53	0.168	5592697.	220854.	3363515.	-4023.45	433.68	6706.14
11552.00	6535121.	7826.42	0.225	4680095.	297822.	4551463.	-5440.45	364.56	5614.39
11646.40	6538164.	7822.93	0.248	4137848.	330324.	5051405.	-6035.48	323.30	4966.56
11646.40	6538164.	7822.93	0.248	4137848.	330324.	5051405.	-6035.48	323.30	4966.56
11656.20	6538496.	7822.55	0.250	4078418.	333470.	5099729.	-6092.93	318.78	4895.59
11656.20	6538496.	7822.55	0.250	4078418.	333470.	5099729.	-6092.93	318.78	4895.59
11744.00	6541597.	7815.11	0.258	3522030.	359619.	5500770.	-6569.32	276.34	4231.57
11936.00	6548996.	7810.97	0.295	2179655.	403008.	6162470.	-7352.17	173.65	2631.86
12128.00	6555890.	7802.23	0.306	723486.	425715.	6502933.	-7749.89	61.84	900.18
12320.00	6564833.	7793.30	0.300	-770434.	426540.	6505500.	-7744.12	-53.29	-872.51
12512.00	6572384.	7784.57	0.277	-2224572.	405418.	6171155.	-7337.74	-165.81	-2594.14
12704.00	6579141.	7776.46	0.240	-3563944.	363406.	5518273.	-6554.22	-269.96	-4176.45
12896.00	6584756.	7769.40	0.190	-4719225.	302629.	4581456.	-5435.94	-360.45	-5539.33
13088.00	6588959.	7763.78	0.132	-5633642.	226159.	3409591.	-4041.64	-432.74	-6614.70
13280.00	6591561.	7759.95	0.068	-6258811.	137856.	2063239.	-2443.11	-483.19	-7349.46
13472.00	6592459.	7758.16	0.002	-6563899.	42177.	611529.	-721.57	-509.25	-7707.73
13664.00	6591635.	7758.58	-0.064	-6533557.	-56045.	-871284.	1036.24	-509.55	-7672.17
13856.00	6589149.	7761.24	-0.126	-6169301.	-151832.	-2309450.	2742.07	-483.98	-7244.56
14048.00	6585137.	7766.03	-0.181	-5489427.	-240304.	-3629391.	4310.03	-433.64	-6445.68
14221.40	6580363.	7771.99	-0.223	-4632361.	-310124.	-4663287.	5541.19	-368.80	-5437.18
14221.40	6580363.	7771.99	-0.223	-4632361.	-310124.	-4663287.	5541.19	-368.80	-5437.18
14240.00	6579794.	7772.69	-0.227	-4528181.	-316910.	-4763281.	5660.46	-360.86	-5314.47
14432.00	6573369.	7780.66	-0.263	-3334224.	-377656.	-5652389.	6723.52	-269.10	-3906.48
14598.40	6567140.	7788.46	-0.296	-2157965.	-414953.	-6188565.	7368.61	-177.64	-2516.36

15) End J-2 LH₂ Vent; End J-2 LOX Vent;
 16) Start J-2 LOX Vent; Start J-2 EH₂ Vent.

* Relative to local horizontal.

TABLE 7-1 (Cont'd)
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	RADIUS (M)	SPACE FIXED VELOCITY (M/S)	PATH ANGLE* (DEG)	X (M)	SPACE FIXED POSITION AND VELOCITY VECTORS			DZ (M/S)	
					Y (M)	Z (M)	(M/S)		
14598.40	6567140.	7788.46	-0.286	-2157965.	-414953.	-6188565.	7368.61	-177.64	-2516.36
14624.00	6566142.	7789.74	-0.288	-1968360.	-419311.	-6250117.	7443.13	-162.81	-2292.01
14816.00	6558439.	7795.56	-0.299	-500605.	-439582.	-6524514.	7779.80	-47.28	-552.76
15008.00	6550615.	7805.35	-0.296	993206.	-437248.	-6460101.	7712.82	71.64	1221.93
15200.00	6543049.	7818.53	-0.279	2435262.	-412248.	-6058964.	7242.55	187.80	2939.30
15392.00	6536123.	7826.60	-0.247	3749896.	-365703.	-5340922.	6390.95	295.06	4508.25
15584.00	6530197.	7833.13	-0.202	4867687.	-299885.	-4342715.	5200.93	387.66	5844.48
15776.00	6525597.	7837.83	-0.146	5729321.	-218106.	-3116203.	3734.39	460.55	6875.60
15968.00	6522583.	7840.53	-0.082	6288936.	-124556.	-1725649.	2068.90	509.70	7545.44
16160.00	6521338.	7841.17	-0.012	6516718.	-24081.	-244253.	293.29	532.35	7817.58
17) 16200.00	6521311.	7841.05	0.002	6520950.	-2758.	68607.	-81.74	533.58	7822.44

17) Loss of S-IVB/III Attitude Control.

* Relative to local horizontal.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 TABLE 7-2
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	CHI* PITCH (DEG)	CHI* YAW (DEG)	PITCH ATTITUDE (LOCAL HORIZONTAL)	THRUST (N)	MASS (KG)	AXIAL FORCE (N)	NORMAL FORCE (N)
1) 608.15	-8.90	-3.38	10.08	1603.43	31844.50	3.39	-0.75
638.60	-8.90	-3.38	12.16	1217.73	31761.63	3.59	-0.95
2) 638.60	-8.90	-3.38	12.16	0.00	31761.63	3.59	-0.95
643.35	-8.90	-3.38	12.49	0.00	31759.88	3.63	-0.98
3) 643.35	-8.90	-3.38	12.49	0.00	31275.90	3.23	-0.76
688.35	-8.90	-3.38	15.58	0.00	31267.73	3.40	-1.01
724.46	-26.96	-2.80	-0.00	0.00	31261.18	2.66	-0.00
724.46	-26.96	-2.80	-0.00	0.00	31261.18	2.66	-0.00
800.00	-32.14	-2.65	0.00	0.00	31247.46	2.61	-0.01
992.00	-45.32	-2.15	0.00	0.00	31212.62	2.42	-0.03
1184.00	-58.47	-1.55	-0.00	0.00	31177.78	2.17	-0.05
1198.35	-59.45	-1.50	0.00	0.00	31175.17	2.15	-0.05
1198.35	-59.45	-1.50	0.00	0.00	31175.17	4.22	-0.09
1376.00	-71.59	-0.86	0.00	0.00	31142.94	3.73	-0.10
1568.00	-84.69	-0.12	-0.00	0.00	31108.10	3.20	-0.11
1760.00	-97.76	0.62	0.00	0.00	31073.26	2.68	-0.10
1858.40	-104.45	0.99	0.00	0.00	31055.40	2.43	-0.09
4) 1858.40	-104.45	0.99	0.00	0.00	31055.40	2.43	-0.09
1952.00	-110.81	1.34	0.00	0.00	31054.78	2.21	-0.09
2144.00	-123.83	1.98	-0.00	0.00	31054.78	1.84	-0.07
2336.00	-136.84	2.53	0.00	0.00	31054.78	1.53	-0.06
2528.00	-149.84	2.95	-0.00	0.00	31054.78	1.29	-0.04
2720.00	-162.83	3.23	-0.00	0.00	31054.78	1.12	-0.03
2912.00	-175.80	3.34	-0.00	0.00	31054.78	1.01	-0.02
3000.00	178.26	3.33	0.00	0.00	31054.78	0.98	-0.02
3000.00	178.26	3.33	0.00	0.00	31054.78	0.98	-0.02
3104.00	178.38	3.34	7.13	0.00	31054.78	0.97	-0.13
3235.00	178.54	3.36	16.12	0.00	31054.78	0.99	-0.30
5) 3235.00	178.54	3.36	16.12	0.00	16804.72	1.02	-0.33
3296.00	178.61	3.36	20.31	0.00	16804.72	1.04	-0.41
3403.40	178.74	3.37	21.67	0.00	16804.72	1.05	-0.58
6) 3403.40	178.74	3.37	21.67	0.00	16804.72	1.05	-0.58
3415.00	178.75	3.37	28.47	0.00	16802.83	1.05	-0.60
3415.00	178.75	3.37	28.47	0.00	16802.83	1.05	-0.60
3415.00	178.75	3.37	28.47	0.00	16802.83	1.05	-0.60

- 1) Orbit Insertion;
- 2) End LOX Vent;
- 3) Nose Cone Jettison;
- 4) End LH₂ Vent;
- 5) IM Separation;
- 6) Start LH₂ Vent.

* Referenced to the Z₀ axis (PASC-13) measured positive counter clockwise.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 TABLE 7-2 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	CHI PITCH (DEG)	CHI * YAW (DEG)	CHI * PITCH ATTITUDE (LOCAL HORIZONTAL)	THRUST (N)	MASS (KG)	AXIAL FORCE (N)	NORMAL FORCE (N)
3481.00	145.79	2.70	0.00	0.00	16790.85	1.00	-0.01
3481.00	145.79	2.70	0.00	0.00	16790.85	1.00	-0.01
3488.00	145.32	2.68	-0.00	0.00	16789.58	1.00	-0.01
3680.00	132.37	2.17	-0.00	0.00	16754.74	1.09	-0.02
3872.00	119.41	1.54	0.00	0.00	16719.90	1.25	-0.03
4064.00	106.45	0.83	0.00	0.00	16685.06	1.48	-0.05
4256.00	93.46	0.07	0.00	0.00	16650.22	1.79	-0.07
4448.00	80.45	-0.69	0.00	0.00	16615.38	2.20	-0.09
4603.40	69.89	-1.29	-0.00	0.00	16587.18	2.61	-0.11
4603.40	69.89	-1.29	-0.00	0.00	16587.18	2.61	-0.11
4640.00	67.40	-1.42	-0.00	0.00	16586.97	2.71	-0.11
4832.00	54.33	-2.09	-0.00	0.00	16586.97	3.32	-0.13
5024.00	41.21	-2.65	-0.00	0.00	16586.97	3.96	-0.15
5216.00	28.07	-3.08	0.00	0.00	16586.97	4.60	-0.15
5408.00	14.89	-3.35	0.00	0.00	16586.97	5.14	-0.13
5485.00	9.60	-3.41	0.00	0.00	16586.97	5.32	-0.12
5485.00	9.60	-3.41	0.00	0.00	16586.97	5.32	-0.12
5600.00	9.60	-3.42	7.89	0.00	16586.97	5.67	-0.93
5792.00	9.60	-3.44	21.06	0.00	16586.97	6.10	-2.52
5984.00	9.59	-3.46	34.23	0.00	16586.97	5.95	-4.11
6148.40	9.58	-3.47	45.51	0.00	16586.97	5.31	-5.33
6148.40	9.58	-3.47	45.51	0.00	16586.97	5.31	-5.33
6176.00	9.58	-3.47	47.40	0.00	16582.49	5.13	-5.51
6355.00	9.58	-3.48	59.68	0.00	16550.01	3.97	-6.18
6355.00	9.58	-3.48	59.68	0.00	16550.01	3.97	-6.18
6368.00	16.10	-3.40	67.07	0.00	16547.65	3.02	-6.51
6560.00	112.05	1.23	176.25	0.00	16512.81	-4.55	-0.39
6566.60	115.35	1.42	180.00	0.00	16511.61	-4.55	-0.12
6566.60	115.35	1.42	180.00	0.00	16511.61	-4.55	-0.12
6748.40	102.93	0.70	180.00	0.00	16478.63	-3.99	-0.13
6748.40	102.93	0.70	180.00	0.00	16478.63	-3.99	-0.13
6752.00	102.69	0.69	180.00	0.00	16478.46	-3.98	-0.13
6944.00	89.60	-0.10	180.00	0.00	16478.46	-3.38	-0.13
7136.00	76.54	-0.89	180.00	0.00	16478.46	-2.82	-0.11
7328.00	63.50	-1.64	180.00	0.00	16478.46	-2.33	-0.10

- 7) End LH₂ Vent;
- 8) Start LH₂ Vent;
- 9) End LH₂ Vent.

* Referenced to the Z₀ axis (PASC-13) measured positive counter clockwise.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 TABLE 7-2 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	CHI* PITCH (DEG)	CHI* YAW (DEG)	PITCH ATTITUDE (LOCAL HORIZONTAL)	THRUST (N)	MASS (KG)	AXIAL FORCE (N)	NORMAL FORCE (N)
7520.00	50.47	-2.30	180.00	0.00	16478.46	-1.94	-0.08
7712.00	37.46	-2.85	180.00	0.00	16478.46	-1.63	-0.06
7904.00	24.46	-3.25	180.00	0.00	16478.46	-1.40	-0.04
8096.00	11.47	-3.50	180.00	0.00	16478.46	-1.24	-0.03
8288.00	-1.51	-3.56	180.00	0.00	16478.46	-1.14	-0.02
8438.35	-11.67	-3.49	180.00	0.00	16478.46	-1.10	-0.01
8438.35	-11.67	-3.49	180.00	0.00	16478.46	-1.10	-0.01
8480.00	3.52	-3.58	-162.03	0.00	16478.46	-1.06	-0.41
8647.00	64.33	-1.63	-90.00	0.00	16478.46	-0.76	-1.42
8647.00	64.33	-1.63	-90.00	0.00	16478.46	-0.76	-1.42
8672.00	62.65	-1.72	-90.00	0.00	16478.46	-0.76	-1.42
8779.00	55.44	-2.11	-90.00	0.00	16478.46	-0.78	-1.46
8779.00	55.44	-2.11	-90.00	0.00	16478.46	-0.78	-1.46
8824.50	52.37	-2.26	-90.00	4136.85	16478.46	-0.80	-1.50
8824.50	52.37	-2.26	-90.00	4136.85	15554.31	-0.80	-1.50
8848.40	50.76	-2.34	-90.00	1112.95	15554.31	-0.80	-1.50
8848.40	50.76	-2.34	-90.00	489.30	15472.60	-0.81	-1.52
8848.40	50.76	-2.34	-90.00	489.30	15472.60	-0.81	-1.52
8864.00	49.70	-2.39	-90.00	489.30	15472.60	-0.81	-1.52
8864.00	49.70	-2.39	-90.00	407.67	15420.66	-0.82	-1.54
8899.40	47.31	-2.50	-90.00	222.41	15302.79	-0.84	-1.59
8899.40	47.31	-2.50	-90.00	0.00	15302.79	-0.84	-1.59
8909.20	46.65	-2.53	-90.00	0.00	15302.29	-0.85	-1.60
8909.20	46.65	-2.53	-90.00	0.00	15302.29	-0.85	-1.60
8978.40	41.98	-2.73	-90.00	337.18	15302.29	-0.85	-1.60
8978.40	41.98	-2.73	-90.00	177.93	15281.40	-0.91	-1.70
8978.40	41.98	-2.73	-90.00	177.93	15281.40	-0.91	-1.70
9056.00	36.73	-2.94	-90.00	177.93	15281.40	-0.91	-1.70
9056.00	36.73	-2.94	-90.00	128.17	15257.91	-0.98	-1.84
9089.40	34.47	-3.02	-90.00	106.76	15247.80	-1.02	-1.91
9089.40	34.47	-3.02	-90.00	0.00	15247.80	-1.02	-1.91
9099.40	33.79	-3.04	-90.00	0.00	15247.75	-1.03	-1.93
9099.40	33.79	-3.04	-90.00	0.00	15247.75	-1.03	-1.93
9099.40	33.79	-3.04	-90.00	155.69	15247.75	-1.03	-1.93
9248.00	23.71	-3.34	-90.00	86.67	15230.35	-1.23	-2.31
9348.40	16.89	-3.49	-90.00	40.03	15218.58	-1.40	-2.64
9348.40	16.89	-3.49	-90.00	13.59	15218.58	-1.40	-2.64
9398.35	13.49	-3.54	-90.00	13.59	15212.73	-1.50	-2.83
9398.35	13.49	-3.54	-90.00	13.59	15212.73	-1.50	-2.83
9440.00	-13.07	-3.53	-113.68	13.59	15207.85	-1.97	-3.02

- 10) Start J-2 LOX Purge;
- 11) End J-2 LOX Purge;
- 12) Start J-2 LH₂ Purge;
- 13) End J-2 LH₂ Purge;
- 14) Start J-2 LH₂ Vent; Start J-2 LOX Vent.

* Referenced to the Z₀ axis (PASC-13) measured positive counter clockwise.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 TABLE 7-2 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	CHI* PITCH (DEG)	CHI* YAW (DEG)	PITCH ATTITUDE (LOCAL HORIZONTAL)	THRUST (N)	MASS (KG)	AXIAL FORCE (N)	NORMAL FORCE (N)
9556.63	-87.30	-0.14	-180.00	13.59	15194.18	-2.75	-0.10
9556.63	-87.30	-0.14	180.00	13.59	15194.18	-2.75	-0.10
9632.00	-92.43	0.18	180.00	13.59	15185.35	-3.08	-0.12
9824.00	-105.50	0.99	180.00	13.59	15162.85	-4.09	-0.16
10016.00	-118.62	1.76	180.00	13.59	15140.35	-5.38	-0.22
10208.00	-131.77	2.44	180.00	13.59	15117.85	-6.87	-0.26
10400.00	-144.96	3.00	180.00	13.59	15095.35	-8.44	-0.29
10592.00	-158.18	3.40	180.00	13.59	15072.85	-9.58	-0.28
10784.00	-171.42	3.63	180.00	13.59	15050.35	-9.98	-0.22
10976.00	-175.33	3.67	180.00	13.59	15027.85	-9.58	-0.13
11168.00	-162.09	3.51	180.00	13.59	15005.35	-8.59	-0.04
11360.00	-148.87	3.17	180.00	13.59	14982.85	-7.30	-0.04
11552.00	-135.68	2.66	180.00	13.59	14960.35	-6.04	-0.09
11646.40	-129.20	2.36	180.00	13.59	14949.29	-5.49	-0.10
11646.40	129.20	2.36	180.00	13.59	14949.29	-5.49	-0.10
11656.20	128.53	2.32	180.00	13.59	14948.55	-5.43	-0.10
11656.20	128.53	2.32	180.00	0.00	14948.55	-5.43	-0.10
11744.00	122.52	2.01	180.00	0.00	14948.53	-4.95	-0.11
11936.00	109.40	1.26	180.00	0.00	14948.53	-4.03	-0.12
12128.00	96.32	0.43	180.00	0.00	14948.53	-3.27	-0.12
12320.00	83.27	-0.41	180.00	0.00	14948.53	-2.65	-0.10
12512.00	70.25	-1.24	180.00	0.00	14948.53	-2.17	-0.09
12704.00	57.25	-2.00	180.00	0.00	14948.53	-1.80	-0.07
12896.00	44.27	-2.67	180.00	0.00	14948.53	-1.53	-0.06
13088.00	31.29	-3.20	180.00	0.00	14948.53	-1.33	-0.04
13280.00	18.32	-3.57	180.00	0.00	14948.53	-1.21	-0.03
13472.00	5.35	-3.76	180.00	0.00	14948.53	-1.14	-0.02
13664.00	-7.63	-3.77	180.00	0.00	14948.53	-1.14	-0.01
13856.00	-20.61	-3.58	180.00	0.00	14948.53	-1.20	-0.00
14048.00	-32.59	-3.21	180.00	0.00	14948.53	-1.33	-0.01
14221.40	-45.32	-2.73	180.00	0.00	14948.53	-1.53	-0.02
14221.40	-45.32	-2.73	180.00	17.79	14948.53	-1.53	-0.02
14240.00	-46.58	-2.67	180.00	17.79	14948.24	-1.56	-0.03
14432.00	-59.58	-2.00	180.00	17.79	14945.14	-1.90	-0.05
14598.40	-70.86	-1.32	180.00	17.70	14942.46	-2.32	-0.07

15) End J-2 LH₂ Vent; End J-2 LOX Vent;

16) Start J-2 LOX Vent; Start J-2 LH₂ Vent.

* Referenced to the Z_s axis (FASCS-13) measured positive counter clockwise.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 TABLE 7-2 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	CHI * PITCH (DEG)	CHI * YAW (DEG)	PITCH ATTITUDE (LOCAL HORIZONTAL)	THRUST (N)	MASS (KG)	AXIAL FORCE (N)	NORMAL FORCE (N)
14598.40	-70.86	-1.32	180.00	0.00	14942.46	-2.32	-0.07
14624.00	-72.60	-1.22	180.00	0.00	14942.05	-2.40	-0.07
14816.00	-85.64	-0.37	180.00	0.00	14938.98	-3.13	-0.11
15008.00	-98.71	0.51	180.00	0.00	14935.90	-4.13	-0.16
15200.00	-111.81	1.36	180.00	0.00	14932.82	-5.45	-0.22
15392.00	-124.95	2.15	180.00	0.00	14929.75	-7.10	-0.28
15584.00	-138.13	2.83	180.00	0.00	14926.67	-8.99	-0.33
15776.00	-151.35	3.36	180.00	0.00	14923.60	-10.65	-0.34
15968.00	-164.58	3.73	180.00	0.00	14920.52	-11.70	-0.30
16160.00	-177.84	3.89	180.00	0.00	14917.44	-11.72	-0.21
16200.00	179.40	3.90	180.00	0.00	14916.80	-11.59	-0.18

17) Loss of S-IVB/III Attitude Control

* Referenced to the Z_s axis (FASCS-13) measured positive counter clockwise

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 TABLE 7-3
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	ALTITUDE (KM)	CENTRAL ANGLE (DEG)	VELOCITY SPACE FIXED (DEG)	VECTOR AZIMUTH EARTH FIXED (DEG)	LONGITUDE (POS. EAST) (DEG)	GEOCENTRIC DECLINATION (DEG)	GEOETIC LATITUDE (DEG)
1) 608.15	163.22	18.979	86.125	85.913	-61.480	31.400	31.567
638.60	163.31	21.069	87.405	87.263	-59.161	31.518	31.686
2) 638.60	163.31	21.069	87.405	87.263	-59.161	31.518	31.686
643.35	163.33	21.395	87.605	87.474	-58.799	31.532	31.700
3) 643.35	163.33	21.395	87.605	87.474	-58.799	31.532	31.700
688.35	163.53	24.484	89.507	89.480	-55.363	31.610	31.778
688.35	163.53	24.484	89.507	89.480	-55.363	31.610	31.778
724.46	163.73	26.962	91.036	91.093	-52.603	31.599	31.766
724.46	163.73	26.962	91.036	91.093	-52.603	31.599	31.766
800.00	164.27	32.146	94.216	94.447	-46.846	31.361	31.528
992.00	166.34	45.316	101.933	102.596	-32.515	29.499	29.660
1184.00	169.40	58.473	108.661	109.721	-18.970	26.007	26.155
1198.35	169.67	59.456	109.112	110.200	-17.997	25.689	25.836
1198.35	169.67	59.456	109.112	110.200	-17.997	25.689	25.836
1376.00	173.43	71.613	114.047	115.450	-6.417	21.199	21.326
1568.00	178.38	84.730	117.977	119.550	5.195	15.423	15.519
1760.00	184.15	97.822	120.469	122.325	16.078	9.008	9.066
1858.40	187.38	104.521	121.208	123.121	21.465	5.571	5.607
4) 1858.40	187.38	104.521	121.208	123.121	21.465	5.571	5.607
1952.00	190.58	110.887	121.581	123.525	26.520	2.253	2.267
2144.00	197.40	123.925	121.354	123.285	36.834	-4.575	-4.605
2336.00	204.22	136.937	119.789	121.607	47.336	-11.215	-11.287
2528.00	210.62	149.926	116.852	118.462	58.330	-17.400	-17.506
2720.00	216.13	162.895	112.504	113.824	70.076	-22.837	-22.971
2912.00	220.29	175.848	106.767	107.728	82.740	-27.212	-27.364
3000.00	221.65	178.218	103.714	104.493	88.857	-28.774	-28.931
3000.00	221.65	178.218	103.714	104.493	88.857	-28.774	-28.931
3104.00	222.75	171.208	99.818	100.370	96.308	-30.206	-30.368
3235.00	223.31	162.379	94.580	94.836	105.957	-31.315	-31.481
5) 3235.00	223.31	162.379	94.580	94.836	105.957	-31.315	-31.481
3296.00	223.25	158.268	92.065	92.180	110.513	-31.554	-31.720
3403.40	222.64	151.029	87.604	87.471	118.561	-31.533	-31.699
6) 3403.40	222.64	151.029	87.604	87.471	118.561	-31.533	-31.699
3415.00	222.53	150.247	87.124	86.964	119.428	-31.497	-31.663
3415.00	222.53	150.247	87.124	86.964	119.428	-31.497	-31.663

1) Orbit Insertion;
 2) End LOX Vent;
 3) Nose Cone Jettison;
 4) End I.H₂ Vent;
 5) IM Separation;
 6) Start I.H₂ Vent.

TABLE 7-3 (Cont'd)
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
ORBITAL FLIGHT DATA

FLIGHT TIME (SFC)	ALTITUDE (KM)	CENTRAL RANGE (DEG)	VELOCITY VECTOR SPACE FIXED (DEG)	AZIMUTH EARTH FIXED (DEG)	LONGITUDE (POS. EAST) (DEG)	GEOCENTRIC DECLINATION (DEG)	GEODETTIC LATITUDE (DEG)
3481.00	221.80	145.797	84.415	84.103	124.348	-31.168	-31.333
3481.00	221.80	145.797	84.415	84.103	124.348	-31.168	-31.333
3488.00	221.71	145.325	84.131	83.803	124.868	-31.121	-31.286
3680.00	218.23	132.374	76.693	75.939	138.826	-28.951	-29.108
3872.00	213.07	119.409	70.297	69.146	151.992	-25.246	-25.390
4064.00	206.63	106.424	65.204	63.737	164.224	-20.305	-20.427
4256.00	199.41	93.416	61.539	59.820	175.603	-14.452	-14.542
4448.00	191.93	80.383	59.273	57.393	-173.651	-7.993	-8.045
4603.40	186.04	69.814	58.437	56.497	-165.219	-2.515	-2.532
4603.40	186.04	69.814	58.437	56.497	-165.219	-2.515	-2.532
4640.00	184.70	67.322	58.368	56.423	-163.249	-1.209	-1.217
4832.00	178.14	54.234	59.802	56.895	-152.880	5.634	5.671
5024.00	172.56	41.120	60.600	58.828	-142.226	12.273	12.351
5216.00	168.17	27.983	62.813	62.269	-130.981	18.422	18.535
5408.00	165.02	14.827	68.489	67.253	-118.887	23.766	23.904
5485.00	164.11	9.547	70.772	69.678	-113.761	25.605	25.752
5485.00	164.11	9.547	70.772	69.678	-113.761	25.605	25.752
5600.00	163.12	1.657	74.589	73.726	-105.804	27.959	28.114
5792.00	162.38	11.521	81.887	81.440	-91.801	30.662	30.827
5984.00	162.74	24.702	89.899	89.883	-77.231	31.614	31.781
6148.40	163.86	35.986	96.775	97.147	-64.730	30.954	31.120
6148.40	163.86	35.986	96.775	97.147	-64.730	30.954	31.120
6176.00	164.12	37.880	97.899	98.334	-62.657	30.713	30.878
6355.00	166.29	50.156	104.756	105.582	-49.568	28.288	28.445
6355.00	166.29	50.156	104.756	105.582	-49.568	28.288	28.445
6368.00	166.48	51.047	105.218	106.071	-48.645	28.058	28.214
6560.00	169.80	64.200	111.350	112.577	-35.551	23.909	24.048
6566.60	169.93	64.652	111.536	112.775	-35.119	23.744	23.882
6566.60	169.93	64.652	111.536	112.775	-35.119	23.744	23.882
6748.40	173.97	77.088	115.987	117.520	-23.669	18.713	18.827
6748.40	173.97	77.088	115.987	117.520	-23.669	18.713	18.827
6752.00	174.06	77.234	116.062	117.600	-23.451	18.605	18.718
6944.00	179.21	90.445	119.316	121.085	-12.207	12.489	12.568
7126.00	185.12	103.530	121.157	123.066	-1.563	5.877	5.915
7328.00	191.59	116.589	121.640	123.590	8.785	-0.948	-0.954

- 7) End LH₂ Vent;
- 8) Start LH₂ Vent;
- 9) End LH₂ Vent.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 TABLE 7-3 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	ALTITUDE (KM)	CENTRAL ANGLE (DEG)		VELOCITY VECTOR (DEG)		AZIMUTH (DEG)		LONGITUDE (POS., EAST) (DEG)		GEOCENTRIC DECLINATION (DEG)		GEOGETIC LATITUDE (DEG)
		RANGE	ANGLE	SPACE FIXED	EARTH FIXED	(POS., EAST)	DECLINATION	LONGITUDE	DECLINATION	GEOGETIC		
7520.00	198.31	129.622		120.789		122.678		19.155	-7.724			-7.774
7712.00	204.86	142.631		118.585		120.316		29.858	-14.189			-14.278
7904.00	210.81	155.617		114.987		116.470		41.184	-20.065			-20.185
8096.00	215.69	168.587		109.973		111.131		53.358	-25.046			-25.190
8288.00	219.08	178.455		103.627		104.400		66.473	-28.812			-28.969
8438.35	220.48	168.315		97.900		98.342		77.325	-30.713			-30.876
8480.00	220.48	168.315		97.900		98.342		77.325	-30.713			-30.876
8647.00	220.66	165.507		96.228		96.576		80.399	-31.058			-31.223
8647.00	220.44	154.244		89.338		89.301		92.879	-31.608			-31.774
8647.00	220.44	154.244		89.338		89.301		92.879	-31.608			-31.774
8672.00	220.27	152.558		88.299		88.204		94.754	-31.573			-31.739
8779.00	219.18	145.340		83.899		83.558		102.739	-31.081			-31.246
10) 8779.00	219.18	145.340		83.899		83.558		102.739	-31.081			-31.246
8824.50	218.27	142.270		82.071		81.627		106.100	-30.706			-30.870
8824.50	218.27	142.270		82.071		81.627		106.100	-30.706			-30.870
8848.40	217.60	140.657		81.126		80.628		107.854	-30.470			-30.633
8848.40	217.60	140.657		81.126		80.628		107.854	-30.470			-30.633
8864.00	217.13	139.604		80.515		79.982		108.994	-30.302			-30.465
8899.40	215.99	137.214		79.148		78.537		111.565	-29.880			-30.041
11) 8899.40	215.99	137.214		79.148		78.537		111.565	-29.880			-30.041
8909.20	215.67	136.552		78.775		78.143		112.273	-29.754			-29.914
12) 8909.20	215.67	136.552		78.775		78.143		112.273	-29.754			-29.914
8978.40	213.19	131.877		76.212		75.430		117.215	-28.740			-28.898
8978.40	213.19	131.877		76.212		75.430		117.215	-28.740			-28.898
9056.00	210.11	126.631		73.504		72.562		122.630	-27.369			-27.521
9089.40	208.70	124.371		72.399		71.390		124.915	-26.706			-26.856
13) 9089.40	208.70	124.371		72.399		71.390		124.915	-26.706			-26.856
9099.40	208.27	123.695		72.076		71.047		125.594	-26.500			-26.649
14) 9099.40	208.27	123.695		72.076		71.047		125.594	-26.500			-26.649
9248.00	201.44	113.630		67.693		66.391		135.382	-23.028			-23.162
9348.40	196.50	106.818		65.203		63.739		141.681	-20.303			-20.425
9348.40	196.50	106.818		65.203		63.739		141.681	-20.303			-20.425
9398.35	193.98	103.426		64.109		62.573		144.726	-18.850			-18.965
9398.35	193.98	103.426		64.109		62.573		144.726	-18.850			-18.965
9440.00	191.88	100.596		63.271		61.678		147.223	-17.596			-17.704

- 10) Start J-2 LOX Purge;
- 11) End J-2 LOX Purge;
- 12) Start J-2 LH₂ Purge;
- 13) End J-2 LH₂ Purge;
- 14) Start J-2 LH₂ Vent; Start J-2 LOX Vent.

TABEL 7-3 (Cont'd)
 AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 11)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	ALTITUDE (KM)	CENTRAL RANGE ANGLE (DEG)		VELOCITY VECTOR SPACE FIXED (DEG)		AZIMUTH EARTH FIXED (DEG)		LONGITUDE (POS., EAST) (DEG)		GEOCENTRIC DECLINATION (DEG)		GEOPTIC LATITUDE (DEG)
9556.63	185.98	92.662	61.282	59.552	154.032	154.032	-13.900	-13.900	-13.987			
9556.62	185.98	92.662	61.282	59.552	154.032	154.032	-13.900	-13.900	-13.587			
9632.00	192.23	87.528	60.273	58.472	158.309	158.309	-11.392	-11.392	-11.464			
9824.00	173.18	74.425	58.664	56.750	168.898	168.898	-4.713	-4.713	-4.744			
10016.00	165.27	61.291	58.413	56.484	179.296	179.296	2.164	2.164	2.178			
10208.00	158.92	48.128	59.521	57.679	-170.180	-170.180	8.972	8.972	9.030			
10400.00	154.37	34.940	62.029	60.369	-159.212	-159.212	15.434	15.434	15.531			
10592.00	151.71	21.735	65.993	64.602	-147.512	-147.512	21.245	21.245	21.372			
10784.00	150.89	8.520	71.427	70.378	-134.870	-134.870	26.068	26.068	26.216			
10976.00	151.74	4.701	78.207	77.555	-121.242	-121.242	29.550	29.550	29.712			
11168.00	154.05	17.915	85.964	85.743	-106.848	-106.848	31.382	31.382	31.549			
11360.00	157.60	31.118	94.077	94.300	-92.173	-92.173	31.377	31.377	31.544			
11552.00	162.17	44.303	101.815	102.470	-77.815	-77.815	29.542	29.542	29.704			
11646.40	164.74	50.777	105.285	106.142	-71.027	-71.027	28.023	28.023	28.179			
11646.40	164.74	50.777	105.285	106.142	-71.027	-71.027	28.023	28.023	28.179			
11656.20	165.01	51.449	105.629	106.507	-70.335	-70.335	27.844	27.844	27.999			
11656.20	165.01	51.449	105.629	106.507	-70.335	-70.335	27.844	27.844	27.999			
11744.00	167.58	57.465	108.564	109.618	-64.250	-64.250	26.074	26.074	26.222			
11936.00	173.66	70.600	113.971	115.370	-51.686	-51.686	21.286	21.286	21.413			
12128.00	180.27	83.705	117.922	119.593	-40.071	-40.071	15.528	15.528	15.625			
12320.00	187.21	96.775	120.436	122.292	-29.193	-29.193	9.131	9.131	9.190			
12512.00	194.26	109.823	121.572	123.518	-18.764	-18.764	2.390	2.390	2.406			
12704.00	201.10	122.835	121.373	123.309	-8.470	-8.470	-4.427	-4.427	-4.456			
12896.00	207.38	135.830	119.841	121.666	2.005	2.005	-11.063	-11.063	-11.133			
13088.00	212.68	148.800	116.942	118.561	12.966	12.966	-17.253	-17.253	-17.358			
13280.00	216.50	161.756	112.635	113.565	24.678	24.678	-22.708	-22.708	-22.841			
13472.00	218.75	174.702	106.936	107.908	37.311	37.311	-27.113	-27.113	-27.264			
13664.00	218.88	172.347	100.013	100.576	50.860	50.860	-30.147	-30.147	-30.309			
13856.00	216.86	159.396	92.266	92.393	65.068	65.068	-31.541	-31.541	-31.707			
14048.00	212.71	146.431	84.315	83.998	79.452	79.452	-31.152	-31.152	-31.317			
14221.40	207.34	134.706	77.527	76.824	92.134	92.134	-29.292	-29.292	-29.452			
14221.40	207.34	134.706	77.527	76.824	92.134	92.134	-29.292	-29.292	-29.452			
14240.00	206.68	133.449	76.841	76.098	93.462	93.462	-29.013	-29.013	-29.171			
14432.00	199.13	120.440	70.389	65.259	106.692	106.692	-25.323	-25.323	-25.468			
14558.40	191.76	109.144	65.866	64.449	117.403	117.403	-21.100	-21.100	-21.226			

15) End J-2 LH₂ Vent; End J-2 LOX Vent;
 16) Start J-2 LOX Vent; Start J-2 LH₂ Vent.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 TABLE 7-3 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	ALTITUDE (KM)	CENTRAL RANGE ANGLE (DEG)	VELOCITY SPACE FIXED (DEG)	VECTOR EARTH FIXED (DEG)	AZIMUTH (POS, EAST) (DEG)	LONGITUDE (DEG)	GEOCENTRIC DECLINATION (DEG)	GEODETTIC LATITUDE (DEG)
14598.40	191.76	105.144	65.866	64.449	117.403	-21.100	-21.226	
14624.00	190.58	107.405	65.265	63.808	118.990	-20.380	-20.503	
14816.00	181.62	94.338	61.566	59.858	130.433	-14.509	-14.600	
15008.00	172.87	81.240	59.280	57.411	141.240	-8.021	-8.073	
15200.00	164.89	68.110	58.367	56.434	151.702	-1.202	-1.210	
15392.00	158.17	54.951	58.809	56.914	162.132	5.678	5.715	
15584.00	153.02	41.767	60.629	58.870	172.852	12.349	12.428	
15776.00	149.60	28.562	63.880	62.349	-175.831	18.521	18.634	
15968.00	147.93	15.344	68.607	67.384	-163.657	23.870	24.010	
16160.00	147.92	2.128	74.765	73.916	-150.491	28.049	28.205	
17) 16200.00	148.11	0.676	76.211	75.445	-147.625	28.740	28.898	

17) Loss of S-IVB/III Attitude Control

TABLE 8
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
S-1H STAGE RE-ENTRY DATA

FLIGHT TIME (SEC)	SPACE FIXED			SPACE FIXED POSITION AND VELOCITY VECTOR COMPONENTS					
	RADIUS (M)	VELOCITY (M/S)	PATH ANGLE (DEG)	X (M)	Y (M)	Z (M)	DX (M/S)	DY (M/S)	DZ (M/S)
1) 143.52	643684.	2369.58	62.854	6435656.	35477.	116174.	1042.34	118.28	2124.72
2) 145.08	6438502.	2341.73	63.331	6437295.	35657.	119470.	1011.50	112.75	2108.99
160.00	6453143.	2273.42	66.301	6451272.	37329.	150848.	864.28	111.76	2099.75
180.00	6469336.	2202.33	70.482	6466642.	39555.	192785.	673.04	110.87	2094.03
200.00	6482582.	2145.61	74.901	6478201.	41763.	234604.	482.98	109.91	2087.65
220.00	6491996.	2103.55	79.520	6485966.	43951.	276283.	293.64	108.90	2080.11
240.00	6497889.	2076.84	84.287	6489950.	46119.	317800.	104.79	107.83	2071.29
260.00	6500267.	2065.94	89.139	6490160.	48264.	359131.	-83.76	106.70	2061.49
3) 264.00	6500321.	2065.69	90.113	6489749.	48691.	367373.	-121.45	106.47	2059.36
280.00	6499132.	2071.07	94.003	6486600.	50387.	400252.	-272.20	105.51	2050.39
300.00	6494483.	2092.11	98.809	6479271.	52484.	441138.	-460.73	104.26	2038.08
320.00	6486315.	2128.69	103.488	6468169.	54557.	481767.	-649.55	102.94	2024.55
340.00	6474620.	2180.17	107.984	6453286.	56602.	522112.	-838.85	101.56	2009.76
360.00	6459386.	2245.56	112.253	6434611.	58618.	562148.	-1028.75	100.11	1992.53
380.00	6446609.	2319.91	116.260	6412143.	60606.	601827.	-1217.05	98.60	1972.57
400.00	6418536.	2335.59	119.869	6386167.	62563.	640748.	-1360.27	97.25	1896.11
420.00	6397647.	1448.72	120.239	6361774.	64515.	673465.	-857.84	98.99	1163.22
440.00	6389610.	595.08	112.066	6352073.	66521.	688378.	-281.68	100.74	514.42
460.00	6385725.	485.47	111.338	6347149.	68528.	697484.	-224.79	99.93	418.52
480.00	6382467.	448.81	109.550	6342959.	70521.	705535.	-195.84	99.42	391.41
500.00	6379685.	431.22	107.401	6339274.	72508.	713252.	-173.89	99.31	381.91
520.00	6377271.	422.27	105.557	6335961.	74493.	720953.	-158.25	99.22	378.72
540.00	6375131.	415.78	104.064	6332919.	76476.	728413.	-146.56	99.09	377.37
560.00	6373205.	412.75	102.853	6330084.	78457.	735948.	-137.43	98.93	376.42
4) 563.39	6372896.	412.55	102.657	6329621.	78792.	737224.	-136.18	98.88	376.66

- 1) Physical Separation;
- 2) Retro-Rocket Burnout;
- 3) S-1B Stage Apogee;
- 4) S-1VB Stage Impact.

TABLE 8 (Cont'd)
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IB STAGE RE-ENTRY DATA

FLIGHT TIME (SEC)	POSITION (M)	EARTH FIXED VELOCITY (M/S)		PATH ANGLE (DEG)	EARTH FIXED POSITION (M)			VELOCITY VECTOR COMPONENTS (M/S)		
		VELOCITY	(M/S)		X	Y	Z	DX	DY	DZ
1) 143.52	89522.	2024.94	57.729	63268.	-49.	63335.	1065.74	0.74	1721.80	
2) 145.08	92568.	1995.62	58.218	64903.	-52.	66004.	1035.11	-4.63	1706.18	
160.00	120554.	1916.43	61.523	79257.	-118.	91368.	891.29	-3.81	1696.55	
180.00	157324.	1831.81	66.316	95213.	-177.	125240.	704.65	-2.06	1690.85	
200.00	191903.	1763.33	71.520	107450.	-200.	159001.	519.17	-0.17	1685.17	
220.00	224864.	1711.97	77.085	115985.	-183.	192644.	334.37	1.86	1679.00	
240.00	256411.	1679.05	82.927	120828.	-124.	226158.	150.03	4.03	1672.33	
260.00	286773.	1665.50	88.931	121988.	-21.	259533.	-34.05	6.34	1665.14	
3) 264.00	292724.	1665.17	90.140	121778.	6.	266191.	-70.85	6.82	1663.65	
280.00	316197.	1671.75	94.961	119467.	130.	292760.	-218.07	8.78	1657.45	
300.00	344553.	1697.60	100.978	113265.	331.	325828.	-402.23	11.35	1649.22	
320.00	373324.	1742.28	106.557	103376.	585.	358725.	-586.73	14.05	1640.46	
340.00	401610.	1804.57	111.902	89792.	894.	391442.	-771.78	16.88	1631.12	
360.00	430122.	1882.81	116.851	72501.	1261.	423965.	-957.48	19.82	1621.05	
380.00	459162.	1971.34	121.377	51499.	1688.	456262.	-1141.75	22.84	1606.89	
400.00	488692.	2001.72	125.527	27061.	2170.	487938.	-1282.38	25.03	1536.80	
420.00	513452.	1123.91	130.477	4132.	2611.	513428.	-795.19	14.88	794.13	
440.00	520807.	269.24	146.132	-4521.	2760.	520780.	-234.93	3.04	131.48	
460.00	522290.	183.32	164.497	-8535.	2794.	522213.	-180.04	0.74	34.53	
480.00	522721.	151.48	172.716	-11834.	2799.	522580.	-151.32	-0.05	6.97	
500.00	522816.	129.19	176.628	-14627.	2796.	522604.	-129.15	-0.14	-2.88	
520.00	522792.	113.29	178.531	-17041.	2794.	522507.	-113.12	-0.08	-6.30	
540.00	522724.	101.28	179.708	-19176.	2793.	522365.	-100.98	-0.01	-7.80	
560.00	522629.	91.83	179.089	-21096.	2794.	522196.	-91.40	0.06	-8.86	
4) 563.39	522612.	90.47	179.153	-21403.	2794.	522166.	-90.06	0.06	-8.62	

- 1) Physical Separation;
- 2) Retro-Rocket Burnout;
- 3) S-IB Stage Apogee;
- 4) S-IBB Stage Impact.

TABLE 8 (Cont'd)
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IB STAGE RE-ENTRY DATA

FLIGHT TIME (SEC)	MASS (KG)	THRUST (TOTAL) (N)	DRAG (N)	LONGITUDINAL ACCELERATION (M/SEC ²)	DYNAMIC PRESSURE (N/M ²)	A.H.I. (KG-M/M ² -RAD)	MACH NO.
1) 143.52	46650.	0.	57896.	-1.241	425.	59513694.	6.52
2) 145.03	46018.	551580.	45285.	-12.120	332.	59588887.	6.49
160.00	46018.	0.	4850.	-0.105	36.	59840115.	6.36
180.00	46018.	0.	215.	-0.005	2.	59866114.	6.32
200.00	46018.	0.	25.	-0.001	0.	59867428.	5.61
220.00	46018.	0.	7.	-0.000	0.	59867604.	4.74
240.00	46018.	0.	2.	-0.000	0.	59867627.	4.04
260.00	46018.	0.	2.	-0.000	0.	59867627.	3.80
3) 264.00	46018.	0.	2.	-0.000	0.	59867627.	3.91
280.00	46018.	0.	3.	-0.000	0.	59867627.	4.44
300.00	46018.	0.	5.	-0.000	0.	59867723.	5.23
320.00	46018.	0.	14.	-0.000	0.	59868313.	5.98
340.00	46018.	0.	85.	-0.002	1.	59876392.	6.89
360.00	46018.	0.	1495.	-0.033	11.	60066021.	6.51
380.00	46018.	0.	31940.	-0.694	235.	63385659.	6.08
400.00	46018.	0.	520444.	-11.310	3797.	96888842.	3.79
420.00	46018.	0.	4010199.	-87.145	26855.	109679445.	0.94
440.00	46018.	0.	874796.	-19.010	5993.	11075965.	0.62
460.00	46018.	0.	527624.	-11.466	4888.	112137646.	0.49
480.00	46018.	0.	505156.	-10.977	5040.	113045572.	0.40
500.00	46018.	0.	492017.	-10.692	4582.	113821858.	0.34
520.00	46018.	0.	481307.	-10.459	4932.	114504966.	0.30
540.00	46018.	0.	474635.	-10.314	4906.	115115381.	0.27
560.00	46018.	0.	469513.	-10.203	4853.	115212151.	0.26
4) 563.39	46018.	0.	468651.	-10.184	4844.		

1 4 4 1

- 1) Physical Separation;
- 2) Retro-Rocket Burnout;
- 3) S-IB Stage Apogee;
- 4) S-IB Stage Impact.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IB STAGE RE-ENTRY DATA

FLIGHT TIME (SEC)	ALTITUDE (KM)	RANGE (KM)	VELOCITY VECTOR		LONGITUDE (POS. EAST) (DEG)	GEOCENTRIC DECLINATION (DEG)	GEODETTIC LATITUDE (DEG)
			SPACE FIXED (DEG)	EARTH FIXED (DEG)			
1) 143.52	63.579	62.766	75.644	72.221	-79.955	28.546	28.706
2) 145.08	65.241	65.392	75.536	72.054	-79.929	28.553	28.713
160.00	79.903	90.309	75.686	72.210	-79.686	28.622	28.782
180.00	96.424	123.465	75.889	72.441	-79.363	28.712	28.872
200.00	109.399	156.428	76.091	72.678	-79.040	28.801	28.961
220.00	118.841	189.247	76.293	72.919	-78.718	28.888	29.048
240.00	124.761	221.967	76.496	73.166	-78.397	28.974	29.134
260.00	127.166	254.632	76.699	73.418	-78.075	29.058	29.219
280.00	127.225	261.162	76.740	73.469	-78.011	29.075	29.236
300.00	126.057	287.286	76.903	73.675	-77.753	29.141	29.302
320.00	121.434	319.973	77.109	73.938	-77.430	29.223	29.385
340.00	113.292	352.736	77.315	74.206	-77.105	29.304	29.466
360.00	101.623	385.620	77.523	74.480	-76.779	29.384	29.546
380.00	86.413	418.669	77.733	74.759	-76.450	29.463	29.626
400.00	67.662	451.907	77.950	75.044	-76.118	29.541	29.704
420.00	45.613	484.981	78.248	75.332	-75.788	29.617	29.781
440.00	24.743	512.020	80.227	75.612	-75.517	29.678	29.843
460.00	16.712	520.015	86.207	75.928	-75.437	29.696	29.861
480.00	12.829	521.764	88.500	76.023	-75.419	29.699	29.865
500.00	9.571	522.395	89.360	75.765	-75.413	29.701	29.866
520.00	6.789	522.646	89.753	76.490	-75.410	29.701	29.867
540.00	4.375	522.744	89.928	79.909	-75.409	29.701	29.867
560.00	2.235	522.776	90.027	111.475	-75.409	29.701	29.867
580.00	0.309	522.763	90.102	240.607	-75.409	29.701	29.867
4) 563.39	0.000	522.758	90.096	239.775	-75.409	29.701	29.867

- 1) Physical Separation;
- 2) Retro-Rocket Burnout;
- 3) S-IB Stage Apogee;
- 4) S-IVB Stage Impact.

TABLE 9

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 TRACKING AND TELEMETRY STATION COORDINATES: LAUNCH PHASE

<u>STATION</u>	<u>GEODETTIC LATITUDE(1)</u> <u>(DEGREES NORTH)</u>	<u>LONGITUDE(1)</u> <u>(DEGREES EAST)</u>	<u>ALTITUDE ABOVE</u> <u>ELLIPSOID (METERS)</u>
<u>GLOTRAC</u>			
GLOTRAC 1	28.413386	-80.592263	10.95
Bassett Cove	26.614552	-78.323580	16.15
Atlantic	34.881507	-76.353404	2.92
Grand Turk	21.433765	-71.145032	21.00
Bermuda	32.254488	-64.838675	87.09
<u>Telemetry</u>			
Cape Tel 4	28.463713	-80.653029	0.00(4)
MILA-CIF	28.542366	-80.643533	0.00(4)
Vero Beach(2)	27.666667	-80.350000	0.00(4)
New Smyrna Beach(2)	29.066667	-80.916667	0.00(4)
Powered Flight Ship	31.000000	-63.000000	0.00(4)
Grand Bahama	26.628514	-78.299444	0.00(4)
Grand Turk	21.446016	-71.147500	0.00(4)
Bermuda	32.348102	-64.653800	18.00
<u>C-Band Radar</u>			
MILA	28.424862	-80.664404	12.02
Patrick A.F. Base	28.226553	-80.599293	15.51
Grand Bahama	26.615778	-78.347833	13.98
Grand Turk	21.462890	-71.132114	28.00
Bermuda	32.348103	-64.653801	24.31
Powered Flight Ship	31.000000	-63.000000	0.00(4)
<u>ODOP</u>			
Transmitter (3) (1.3.1.7)	28.444373	-80.579973	5.14

- Notes:
1. All coordinates are referenced to Fischer Ellipsoid of 1960.
 2. New Smyrna and Vero Beach receive signal strength only.
 3. ODOP tracks the S-IB stage during powered flight and after separation from the S-IVB until loss of track at an elevation of zero degrees.
 4. An altitude of zero meters is assumed whenever a value for the actual station altitude is not available.

TABLE 10

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 TRACKING AND TELEMETRY STATION COORDINATES: ORBITAL PHASE

<u>STATION</u>	<u>GEODETTIC LATITUDE(1)</u> <u>(DEGREES NORTH)</u>	<u>LONGITUDE(1)</u> <u>(DEGREES EAST)</u>	<u>ALTITUDE ABOVE(1)</u> <u>ELLIPSOID (METERS)</u>
<u>Telemetry</u>			
Cape Tel 4	28.463713	- 80.653029	0.00 (2)
MILA-CIF	28.542366	- 80.643533	0.00 (2)
Grand Bahama	26.628514	- 78.299444	0.00 (2)
Grand Turk	21.446016	- 71.147500	0.00 (2)
Bermuda	32.348102	- 64.653800	18.00
Antigua	17.137333	- 61.774955	41.20
Apollo Ship (3)	28.000000	- 41.000000	00.00 (2)
Canary Island	27.742797	- 15.598103	35.00
Ascension	- 7.974314	- 14.392221	29.98
Tananarive	-19.018056	47.304444	1375.00
Ship I	-27.000000	96.000000	0.00 (2)
Carnarvon	-24.897356	113.716067	64.00
Hawaii	22.125267	-159.667691	1142.00
Guaymas	27.958406	-110.720792	18.00
Corpus Christi	27.655400	- 97.380256	10.00
<u>C-Band Radar</u>			
MILA	28.424862	- 80.664404	12.02
Grand Bahama	26.615778	- 78.347833	13.98
Grand Turk	21.462890	- 71.132114	28.00
Bermuda	32.348103	- 64.653801	24.31
Antigua	17.144032	- 61.792859	49.37
Apollo Ship (3)	28.000000	- 41.000000	0.00 (2)
Canary Island	27.744861	- 15.602000	36.00
Ascension	- 7.951514	- 14.412606	152.43
Pretoria	-25.943731	+ 28.358490	1622.40
Tananarive	-19.018056	47.304444	1375.00
Carnarvon	-24.897403	113.716078	62.00
Woomera	-30.819728	-136.836989	151.00
Hawaii	22.122092	-159.665383	1140.00
Point Arguello	34.582903	-120.561150	646.00
White Sands	32.358222	-106.369564	1232.00

Notes:

1. All coordinates are referenced to Fischer Ellipsoid of 1960
2. A station altitude of zero is assumed when the actual value is unavailable.
3. The Apollo ship will track only on the first revolution immediately after insertion.

TABLE II

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 TRAJECTORY DISPERSION ENVELOPE AT S-IB/S-IVB SEPARATION
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION GROUP	FLIGHT TIME (SEC)	ALTITUDE (M)	SPACE-FIXED VELOCITY (M/S)	SPACE-FIXED PATH ANGLE (DEG)	FLIGHT RANGE (M)	EARTH-FIXED CROSS RANGE (M)	VEHICLE WEIGHT (LB)	
S-IB Propulsion	+RSS	4.94	1405.	14.05	1.868	4953.	17.	3796.
S-IB Propulsion	-RSS	2.48	1585.	19.18	1.127	2221.	10.	1507.
S-IB Non Propulsion	+RSS	0.00	1579.	30.40	1.652	3106.	3320.	310.
S-IB Non Propulsion	-RSS	0.00	1630.	29.71	1.657	2861.	3152.	310.
S-IVB Propulsion	+RSS	0.00	550.	13.37	0.120	324.	2.	3010.
S-IVB Propulsion	-RSS	0.00	547.	13.29	0.120	323.	2.	3010.
S-IVB Non Propulsion	+RSS	0.00	36.	0.88	0.008	21.	0.	200.
S-IVB Non Propulsion	-RSS	0.00	36.	0.88	0.008	21.	0.	200.
Combined Positive	RSS	4.94	2184.	36.07	2.497	5855.	3320.	4859.
Combined Negative	RSS	2.48	2339.	37.79	2.008	3636.	3152.	3386.

TABLE 11 (Cont'd)

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 TRAJECTORY DISPERSION ENVELOPE AT S-IB/S-IVB SEPARATION
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION GROUP	FLIGHT TIME (SEC)	SPACE FIXED POSITION VECTOR			SPACE FIXED VELOCITY VECTOR		
		X (M)	Y (M)	Z (M)	XDOT (M/S)	YDOT (M/S)	ZDOT (M/S)
S-IB Propulsion +RSS	4.94	1455.	595.	6911.	43.13	0.24	28.68
S-IB Propulsion -RSS	2.48	1682.	300.	3185.	75.05	0.20	25.55
S-IB Non Propulsion +RSS	0.00	1614.	3320.	3117.	52.57	74.68	51.31
S-IB Non Propulsion -RSS	0.00	1666.	3151.	2871.	54.64	73.79	52.51
S-IVB Propulsion +RSS	0.00	544.	2.	337.	9.93	0.07	10.18
S-IVB Propulsion -RSS	0.00	541.	2.	336.	9.85	0.07	10.13
S-IVB Non Propulsion +RSS	0.00	36.	0.	22.	0.65	0.00	0.67
S-IVB Non Propulsion -RSS	0.00	36.	0.	22.	0.65	0.00	0.67
Combined Positive	4.94	2240.	3373.	7589.	68.73	74.68	59.66
Combined Negative	2.48	2429.	3165.	4301.	93.36	73.79	59.27

TABLE 11 (Cont'd)

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 TRAJECTORY DISPERSION ENVELOPE AT S-IB/S-IVB SEPARATION
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION GROUP	FLIGHT TIME (SEC)	VEHICLE ATTITUDE			(1) VEHICLE ATTITUDE RATE		
		PITCH (DEG)	YAW (DEG)	ROLL (DEG)	PITCH (DEG/S)	YAW (DEG/S)	ROLL (DEG/S)
S-IB Propulsion +RSS	4.94	0.082	0.003	0.026	----	----	----
S-IB Propulsion -RSS	2.48	0.041	0.004	0.011	----	----	----
S-IB Non Propulsion +RSS	0.00	1.145	1.141	(2) 5.840	----	----	----
S-IB Non Propulsion -RSS	0.00	1.140	1.141	(2) 5.840	----	----	----
S-IVB Propulsion +RSS	0.00	0.001	0.000	0.000	----	----	----
S-IVB Propulsion -RSS	0.00	0.002	0.000	0.001	----	----	----
S-IVB Non Propulsion +RSS	0.00	0.000	0.000	0.000	----	----	----
S-IVB Non Propulsion -RSS	0.00	0.000	0.000	0.000	----	----	----
Combined Positive	4.94	1.148	1.141	5.840	----	----	----
Combined Negative	2.48	1.141	1.141	5.840	----	----	----

(1) The S-IB stage attitude rates have been omitted in order that more realistic values, reflecting conditions at physical separation, can be determined. These data will be determined prior to launch.

(2) Includes the effect of the H-1 thrust misalignment combination which produces a 3-sigma roll attitude deviation.

TABLE 12

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 TRAJECTORY DISPERSION ENVELOPE AT J-2 ENGINE CUTOFF SIGNAL
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION GROUP	FLIGHT TIME (SEC)	ALTITUDE (M)	SPACE-FIXED VELOCITY (M/S)	SPACE-FIXED PATH ANGLE (DEG)	FLIGHT GROUND RANGE (M)	EARTH-FIXED CROSS RANGE (M)	VEHICLE WEIGHT (LB)
S-IB Propulsion +RSS	6.20	6.	0.00	0.000	9220.	546.	359.
S-IB Propulsion -RSS	2.85	12.	0.00	0.000	6084.	416.	682.
S-IB Non Propulsion +RSS	1.38	5.	0.00	0.001	11024.	895.	520.
S-IB Non Propulsion -RSS	1.21	11.	0.00	0.001	11018.	903.	591.
S-IVB Propulsion +RSS	17.92	12.	0.00	0.003	71322.	5051.	837.
S-IVB Propulsion -RSS	16.88	7.	0.00	0.002	70803.	5002.	924.
S-IVB Non Propulsion +RSS	0.44	3.	0.00	0.000	1782.	130.	24.
S-IVB Non Propulsion -RSS	0.44	3.	0.00	0.000	1829.	135.	44.
(1) IMU Dispersions +RSS	0.03	601.	1.60	0.026	318.	----	----
(1) IMU Dispersions -RSS	0.03	601.	1.60	0.026	318.	----	----
Combined Positive	RSS	601.	1.60	0.026	72778.	5160.	1049.
Combined Negative	RSS	601.	1.60	0.026	71937.	5102.	1292.

(1) Based on the new 3-sigma tolerances defined in Reference 21.

TABLE 12 (Cont'd)

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 TRAJECTORY DISPERSION ENVELOPE AT J-2 ENGINE CUTOFF SIGNAL
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION GROUP	FLIGHT TIME (SEC)	SPACE FIXED POSITION VECTOR			SPACE FIXED VELOCITY VECTOR		
		X (M)	Y (M)	Z (M)	XDOT (M/S)	YDOT (M/S)	ZDOT (M/S)
S-IB Propulsion	+RSS	2178.	633.	11242.	8.18	0.17	2.61
S-IB Propulsion	-RSS	3629	383.	6791.	13.48	0.33	4.32
S-IB Non Propulsion	+RSS	3311.	588.	10439.	12.46	0.32	3.98
S-IB Non Propulsion	-RSS	3361	584.	10350.	12.54	0.36	4.02
S-IVB Propulsion	+RSS	23687.	4301.	76336.	90.80	1.95	28.35
S-IVB Propulsion	-RSS	24504.	4258.	75527.	91.97	1.98	29.41
S-IVB Non Propulsion	+RSS	612.	105.	1868.	2.26	0.10	0.72
S-IVB Non Propulsion	-RSS	602.	107.	1898.	2.22	0.11	0.71
IMU Dispersions	+RSS	654.	725.	207.	4.10	3.05	0.65
IMU Dispersions	-RSS	654.	725.	207.	4.10	3.05	0.65
Combined Positive	RSS	24033.	4448.	77885.	92.13	3.64	28.76
Combined Negative	RSS	25014.	4377.	76559.	93.91	3.67	30.01

(1) Based on the new 3-sigma tolerances defined in Reference 21.

TABLE 12 (Cont'd)

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 TRAJECTORY DISPERSION ENVELOPE AT J-2 ENGINE CUTOFF SIGNAL
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION	FLIGHT TIME (SEC)	VEHICLE ATTITUDE			VEHICLE ATTITUDE RATE		
		PITCH (DEG)	YAW (DEG)	*ROLL (DEG)	PITCH (DEG/S)	YAW (DEG/S)	*ROLL (DEG/S)
S-IB Propulsion +RSS	6.20	1.242	0.037	---	0.013	0.001	---
S-IB Propulsion -RSS	2.85	2.007	0.017	---	0.010	0.001	---
S-IB Non Propulsion +RSS	1.38	1.652	2.144	---	0.012	0.003	---
S-IB Non Propulsion -RSS	1.21	1.726	2.146	---	0.014	0.005	---
S-IVB Propulsion +RSS	17.92	2.347	0.116	---	0.000	0.003	---
S-IVB Propulsion -RSS	16.88	3.439	0.086	---	0.028	0.000	---
S-IVB Non Propulsion +RSS	0.44	0.321	0.358	---	0.002	0.000	---
S-IVB Non Propulsion -RSS	0.44	0.355	0.351	---	0.005	0.002	---
(1) IMU Dispersions +RSS	0.03	---	---	---	---	---	---
(1) IMU Dispersions -RSS	0.03	---	---	---	---	---	---
Combined Positive	RSS 19.02	3.144	2.177	---	0.018	0.004	---
Combined Negative	RSS 17.17	4.354	2.176	---	0.033	0.005	---

(1) Based on the new 3 sigma tolerances defined in Reference 21.

* Not Applicable

TABLE 13

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
LAUNCH VEHICLE PERFORMANCE CHARACTERISTICS

S-IB STAGE

Average Longitudinal Sea Level Thrust (lbs)

	<u>H-1 Engine</u>	<u>Turbine</u>	<u>Total</u>
Engine #1	203877.	591.	204468.
Engine #2	202227.	655.	202882.
Engine #3	202621.	630.	203251.
Engine #4	199535.	620.	200155.
Engine #5	202343.	590.	202933.
Engine #6	205170.	647.	205817.
Engine #7	202972.	607.	203579.
Engine #8	204036.	597.	<u>204633.</u>

Total Average Sea Level Thrust (F): 1,627,718.

Flight Time Interval: 0.0 - 139.144 seconds (IECO)

$$\dot{W} = [W_t (t=0) - W_t (t = 139.144) - *W_{aux}] / 139.144$$

$$= 6266.82 \text{ (lb/sec)}$$

*Waux:	Frost	1100 lbs
	Seal Purge	6 lbs
	Fuel Additive	<u>27 lbs</u>
	Total	<u>1133 lbs</u>

$$I_{sp} = F/\dot{W}$$

$$= 259.74 \text{ (sec)}$$

S-IVB STAGE

High Thrust Level Flight Time Interval: 150.84 - 475.75 seconds

Low Thrust Level Flight Time Interval: 475.75 - 598.15 seconds

AVERAGE VALUES

	<u>High Thrust Level</u>	<u>Low Thrust Level</u>
Vacuum Thrust (lbs)	223,397.	186,979.
Flowrate (lb/sec)	525.22	435.62
Specific Impulse (sec)	425.34	429.23

NOTE: The 0.7% S-IB stage bias, previously mentioned, is not included in these data.

Figure 1

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
FLIGHT PROFILE: ALTITUDE VS FLIGHT TIME

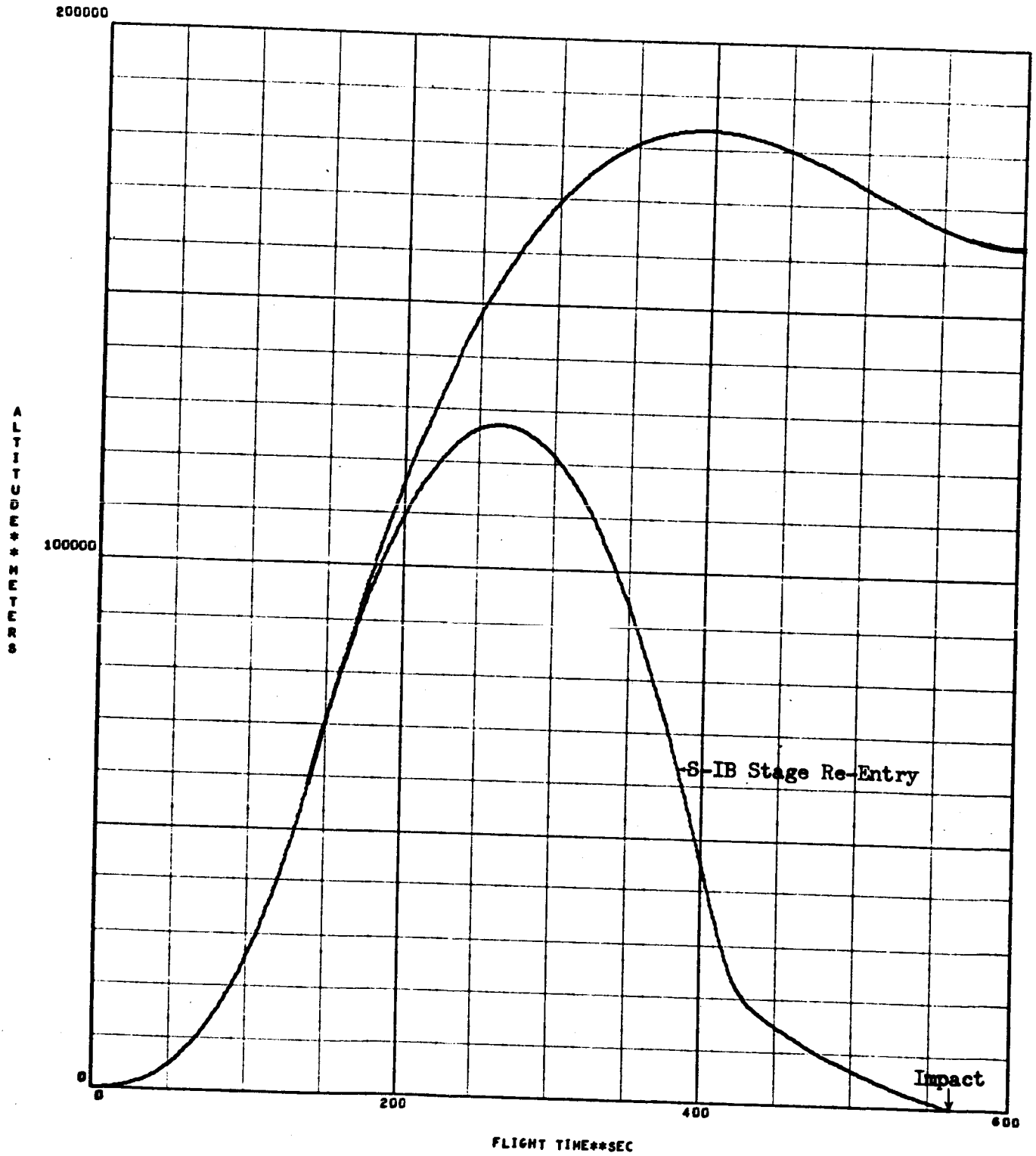


Figure 2

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
FLIGHT PROFILE: ALTITUDE VS GROUND RANGE

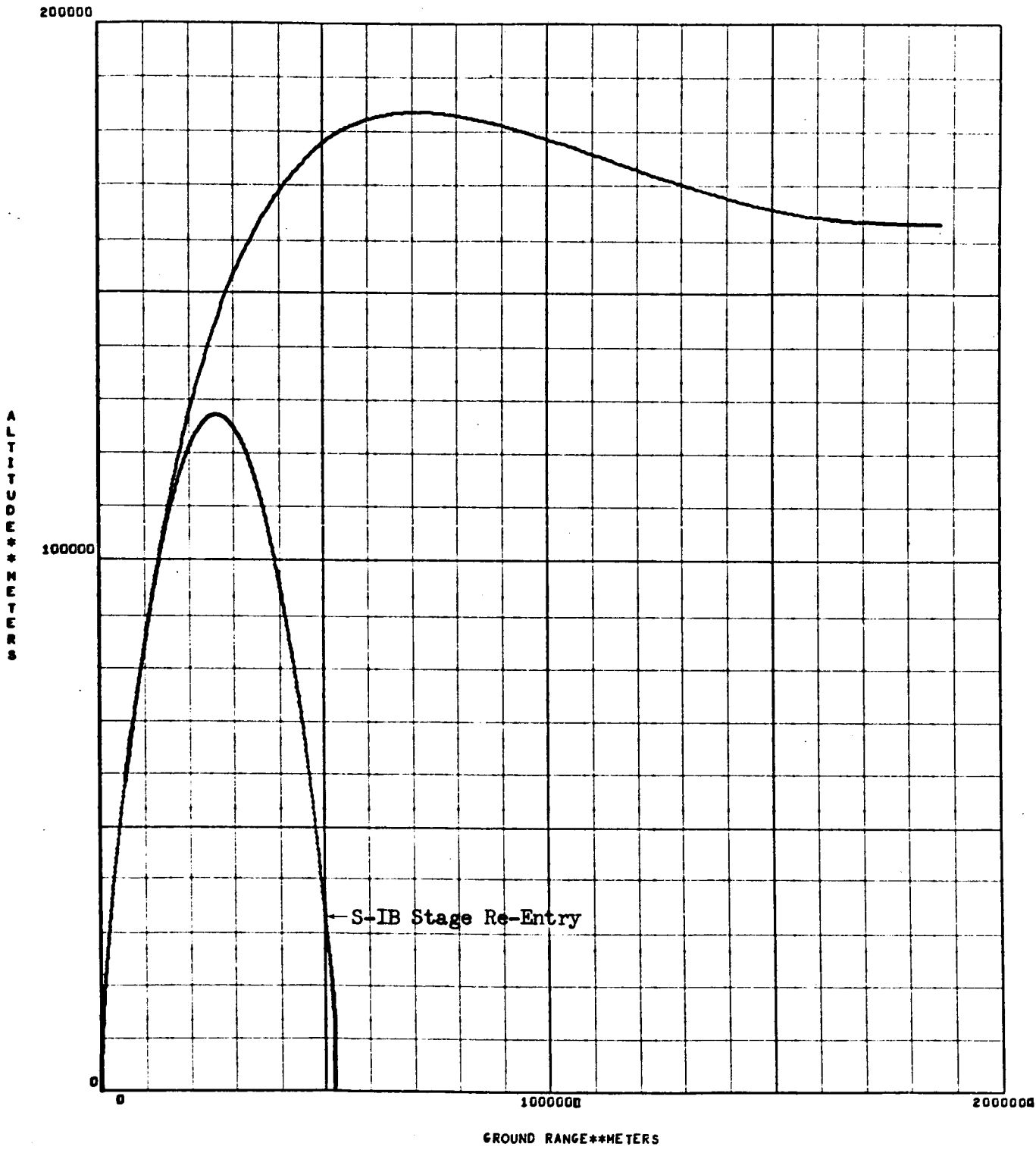


Figure 3

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
FLIGHT PROFILE: VELOCITY VS FLIGHT TIME

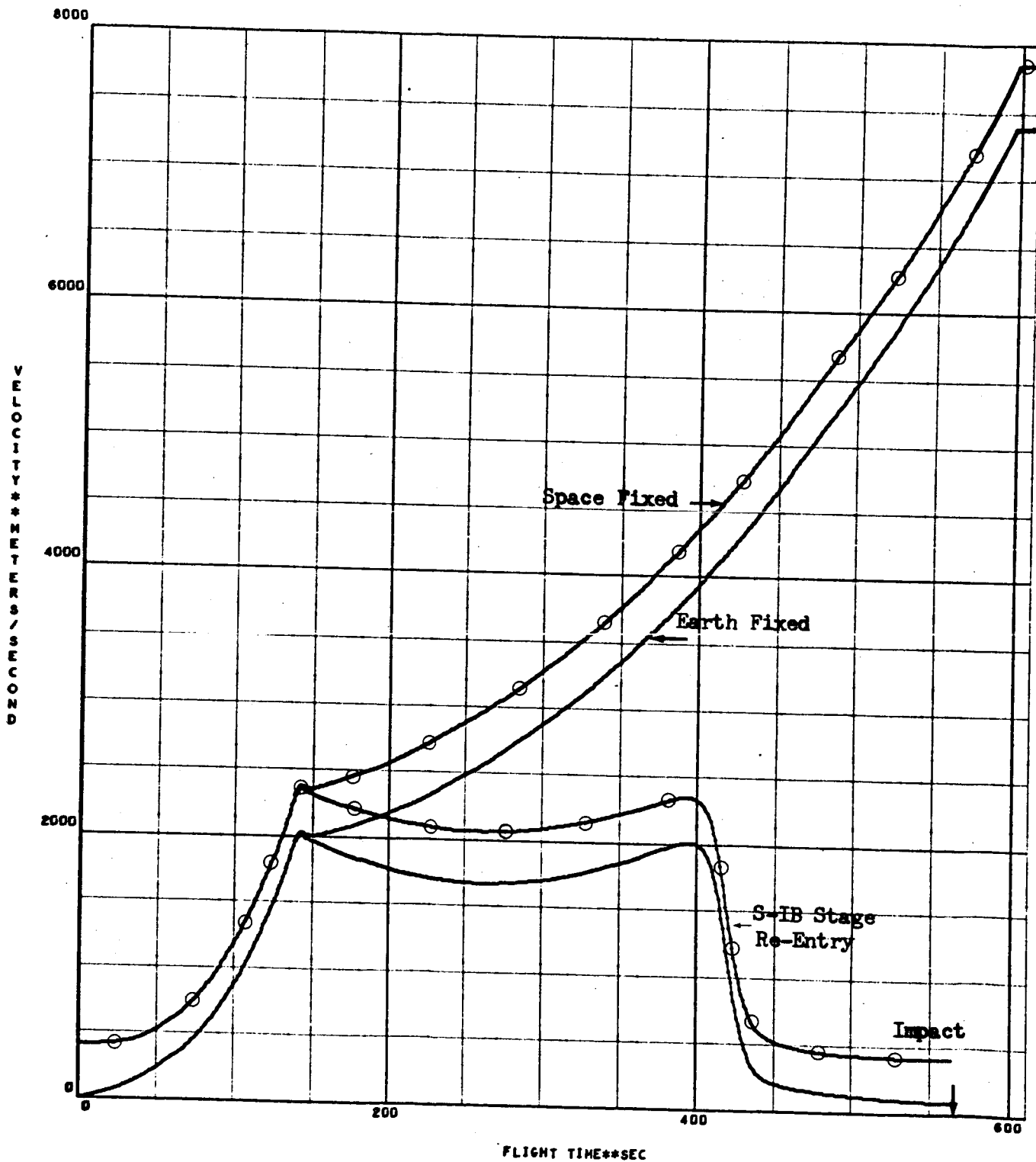


Figure 4

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
FLIGHT PROFILE: SPACE FIXED FLIGHT PATH ANGLE VS FLIGHT TIME

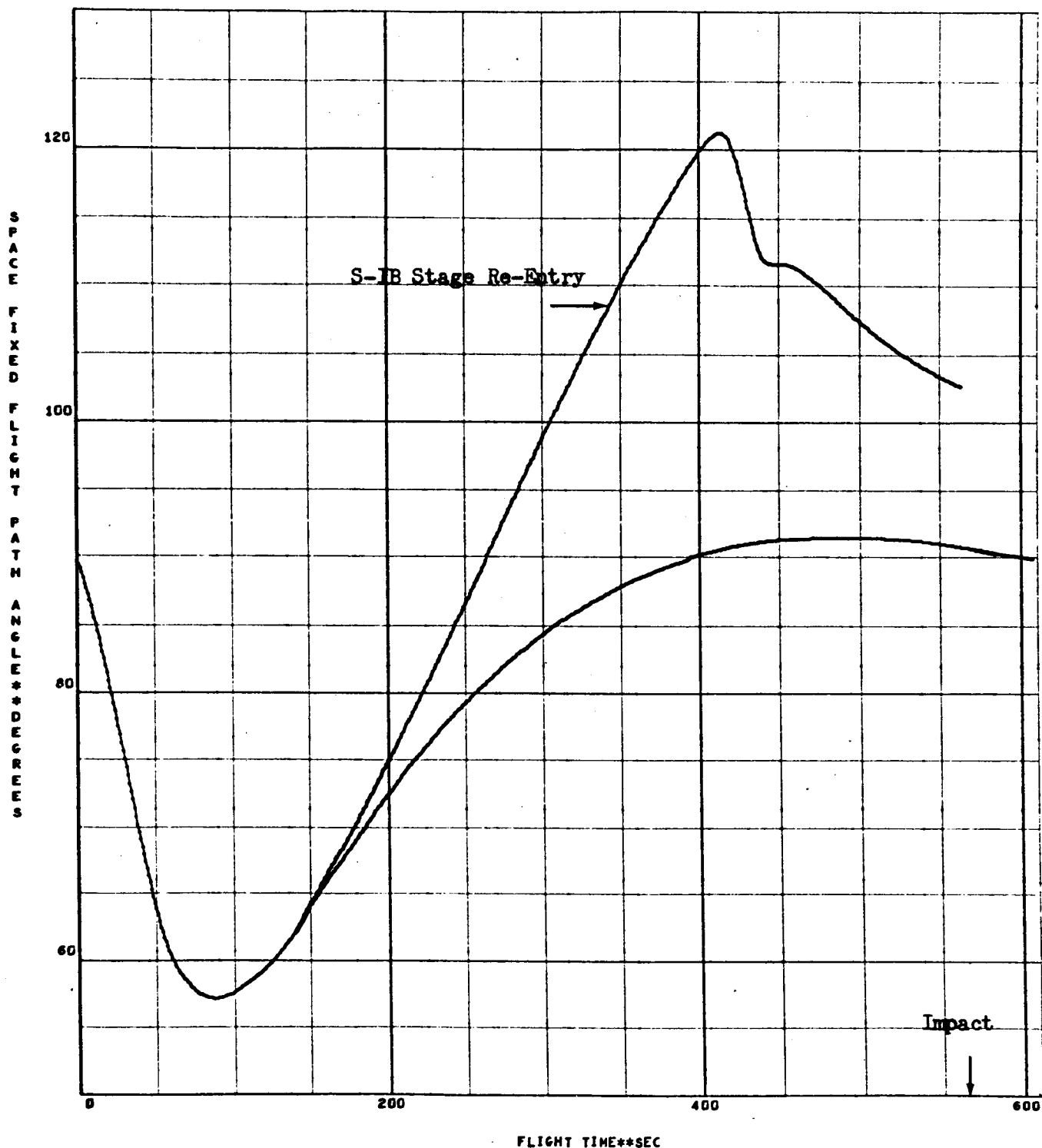


Figure 5

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
FLIGHT PROFILE: EARTH FIXED FLIGHT PATH ANGLE VS FLIGHT TIME

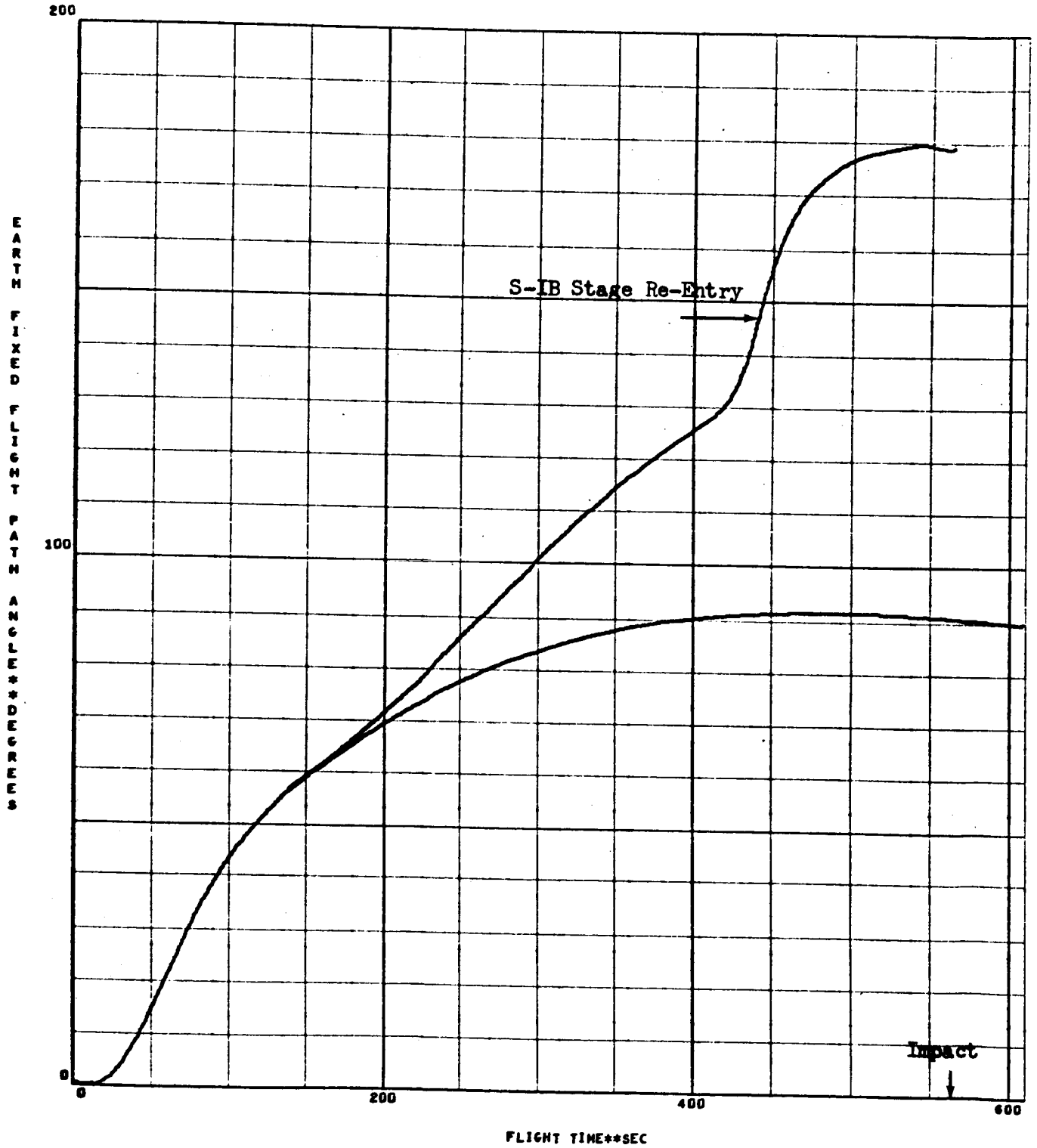


Figure 6

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
PITCH ATTITUDE STEERING COMMAND: S-IB STAGE FLIGHT DATA

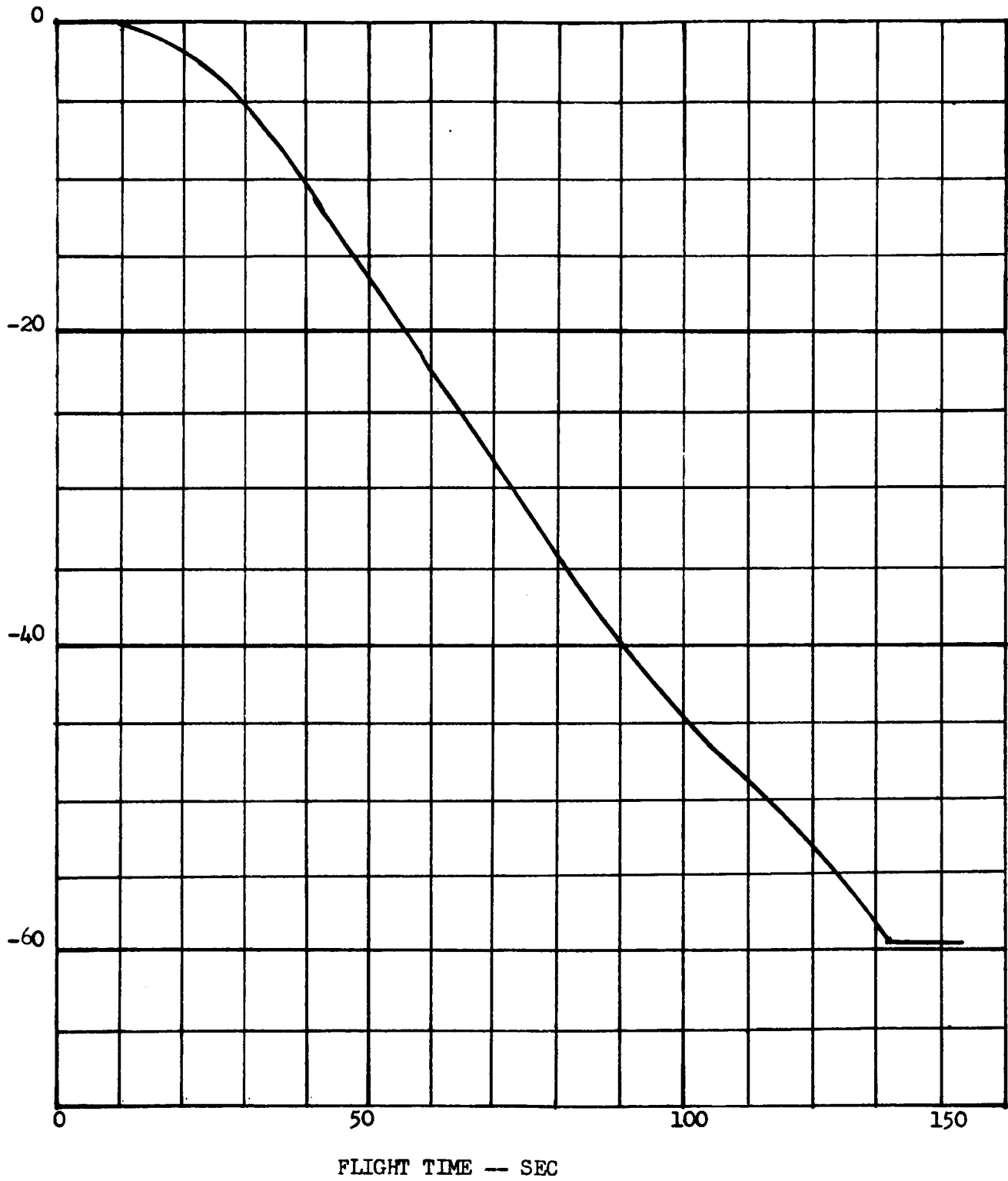


Figure 7

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
VEHICLE PITCH ATTITUDE RATE: S-IB STAGE FLIGHT DATA

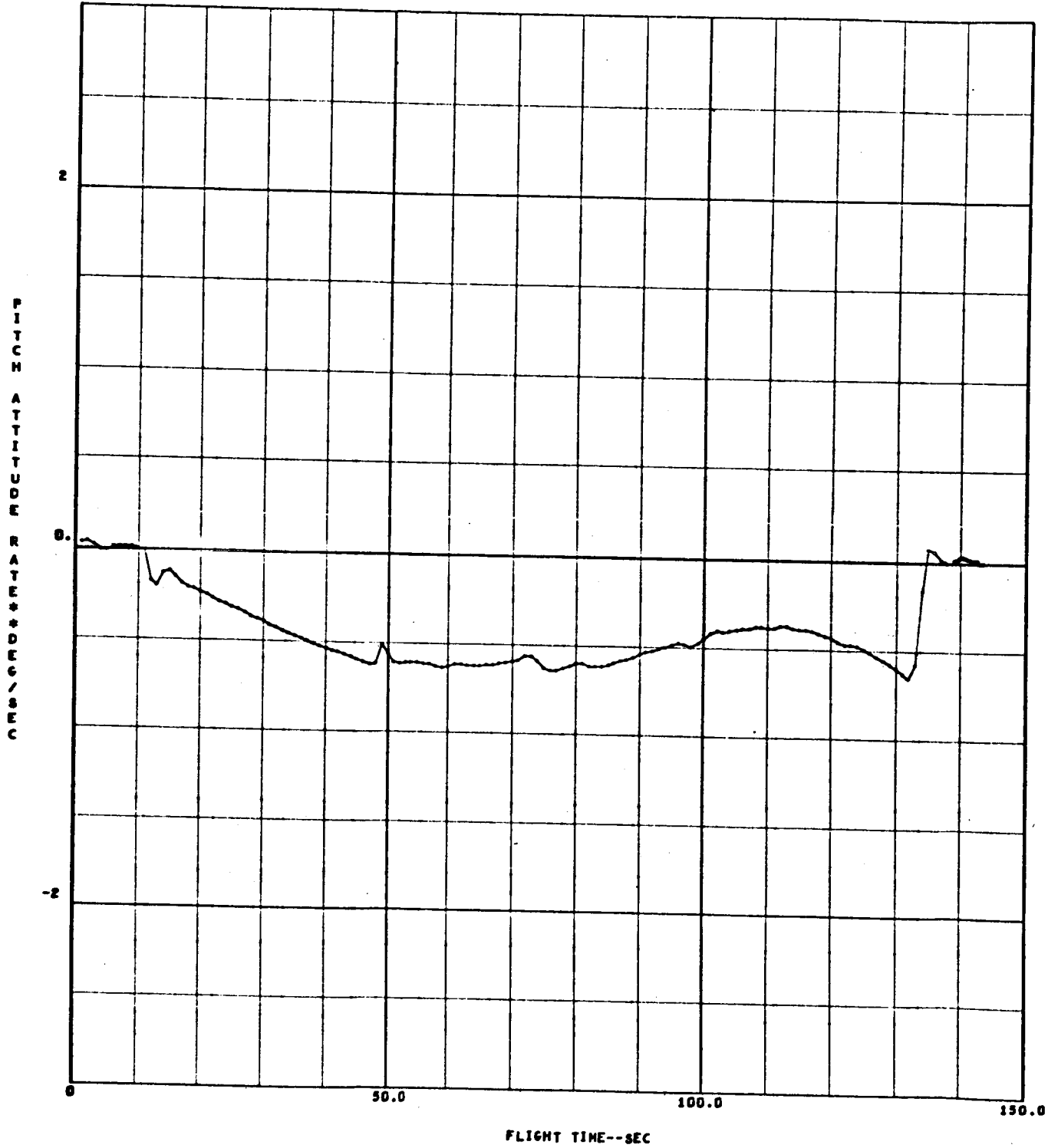


Figure 8

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
PITCH ATTITUDE ERROR: S-IB STAGE FLIGHT DATA

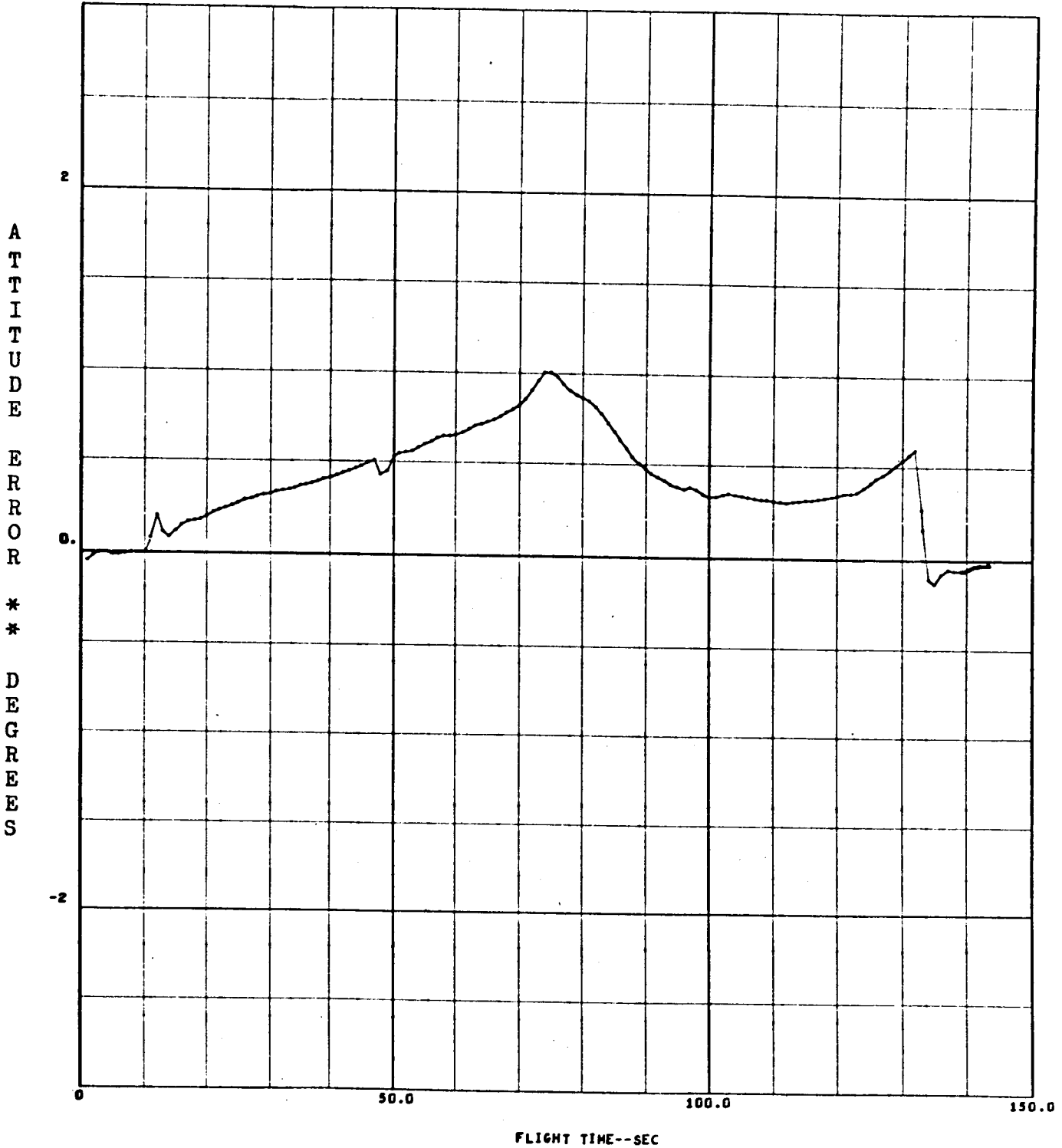


Figure 9

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
PITCH ANGLE OF ATTACK HISTORY: S-IB STAGE FLIGHT DATA

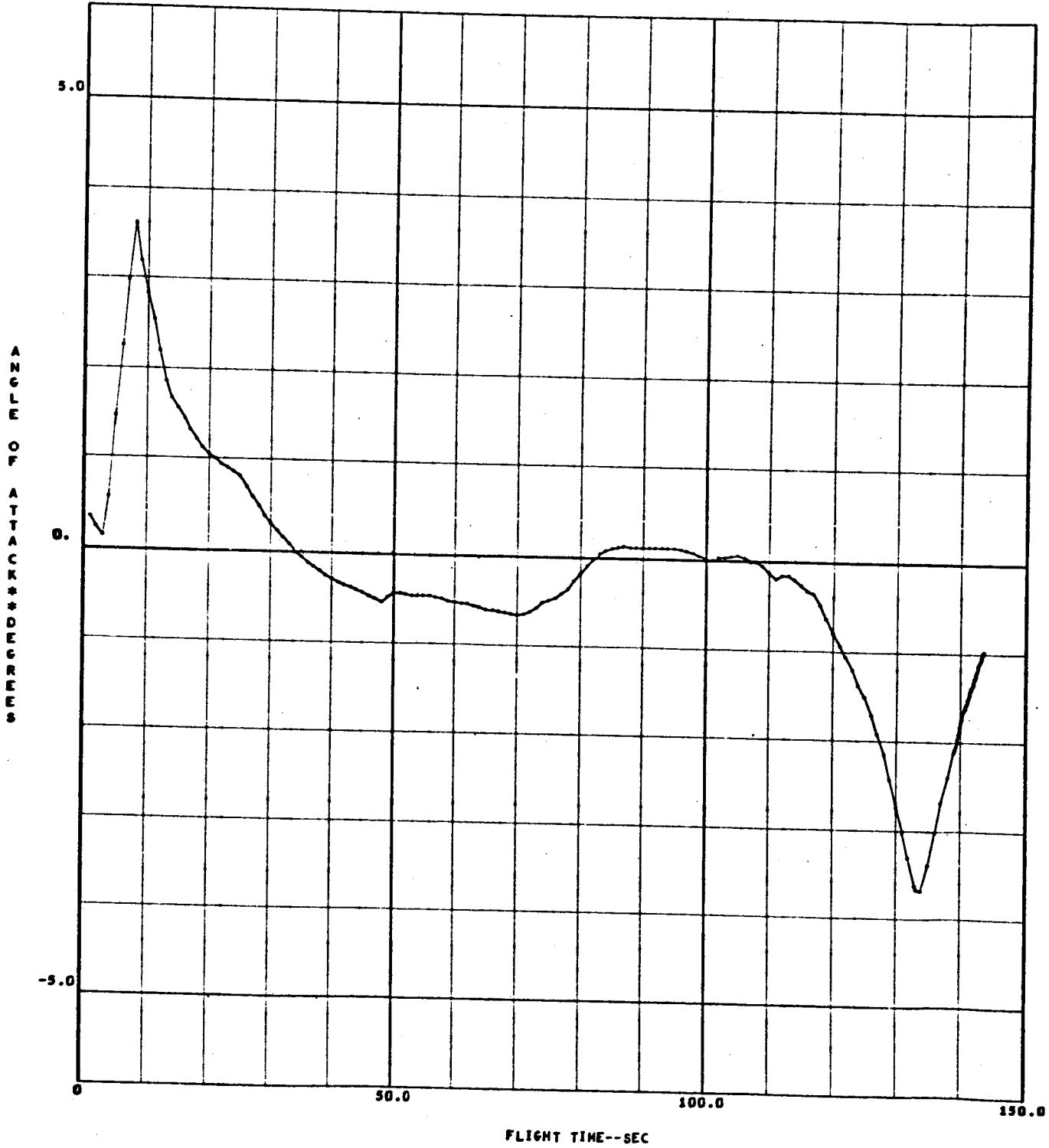


Figure 10

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
DYNAMIC PRESSURE HISTORY: S-IB STAGE FLIGHT DATA

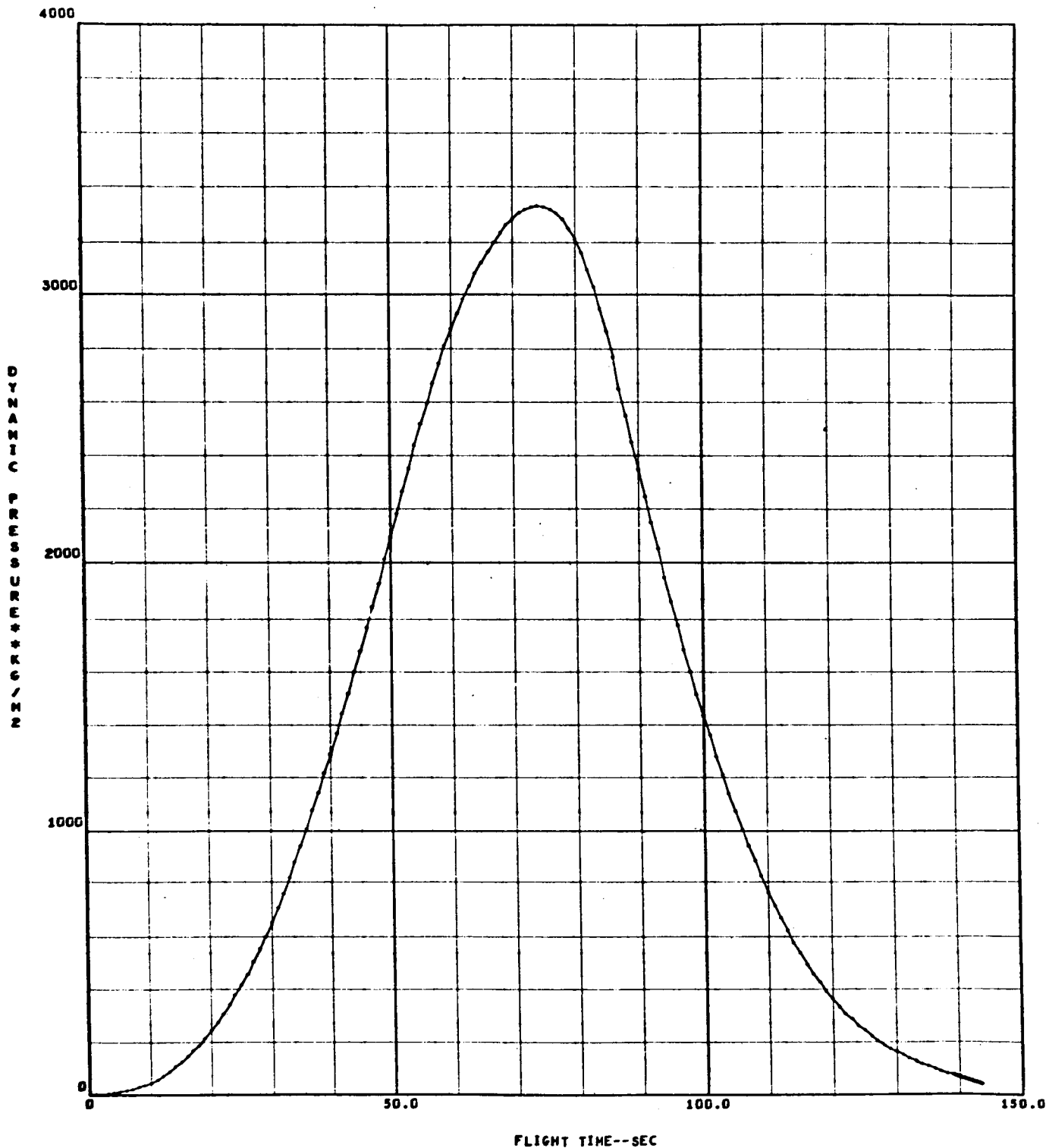


Figure 11

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
LONGITUDINAL ACCELERATION : S-IB STAGE FLIGHT DATA

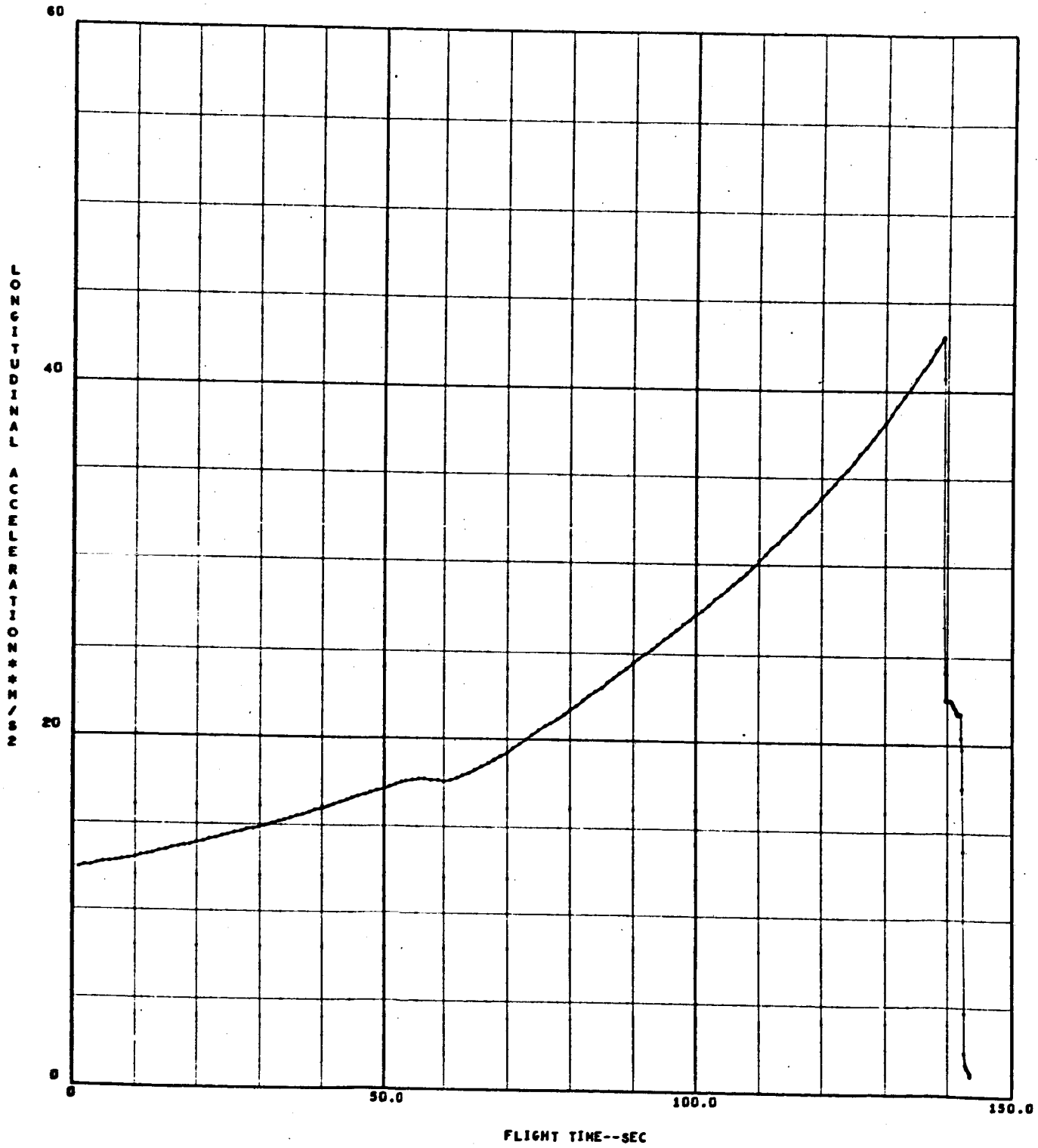


Figure 12

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
PITCH ATTITUDE STEERING COMMAND
S-IVB STAGE FLIGHT DATA

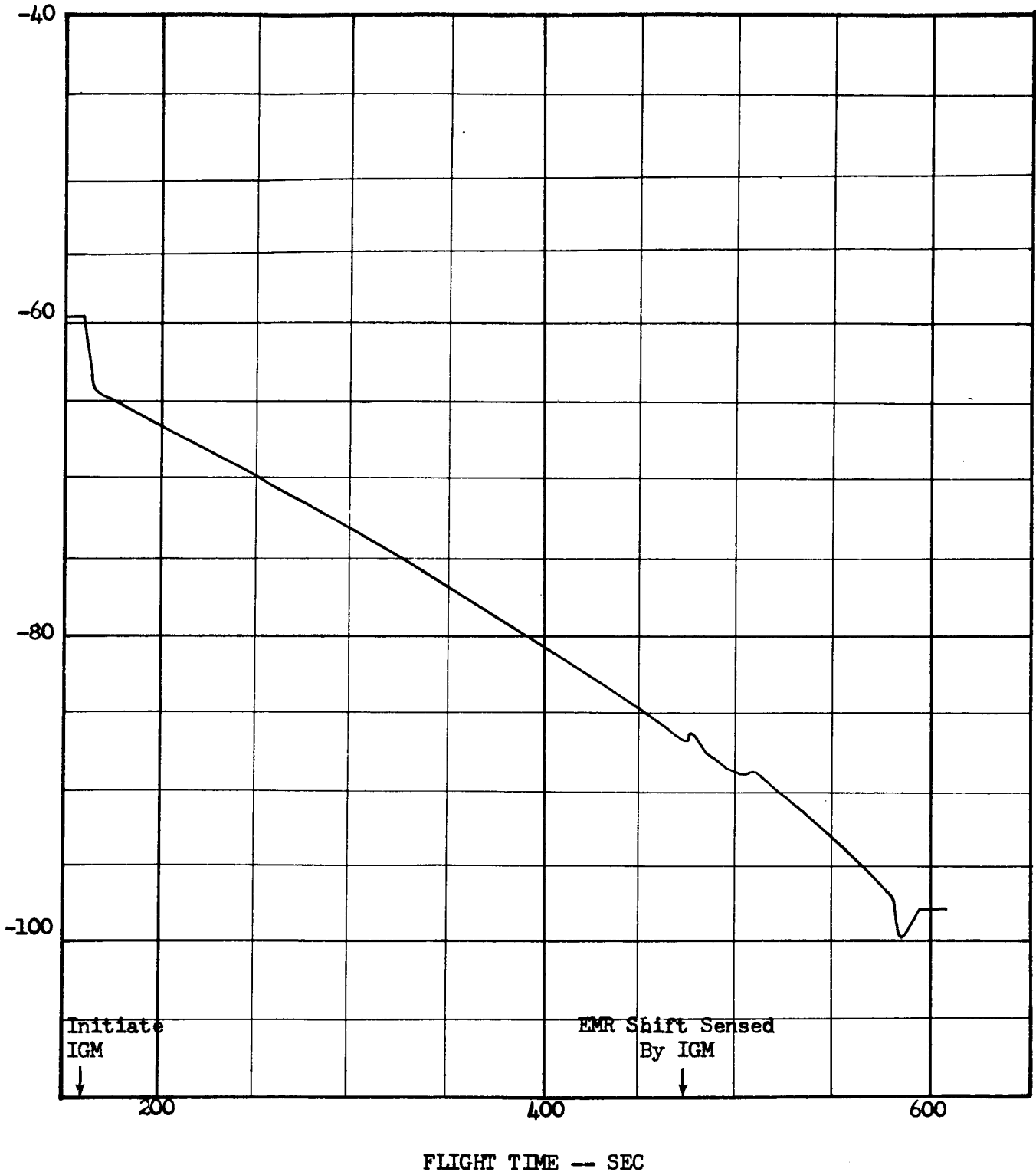


Figure 13

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
YAW ATTITUDE STEERING COMMAND: S-IVB STAGE FLIGHT DATA

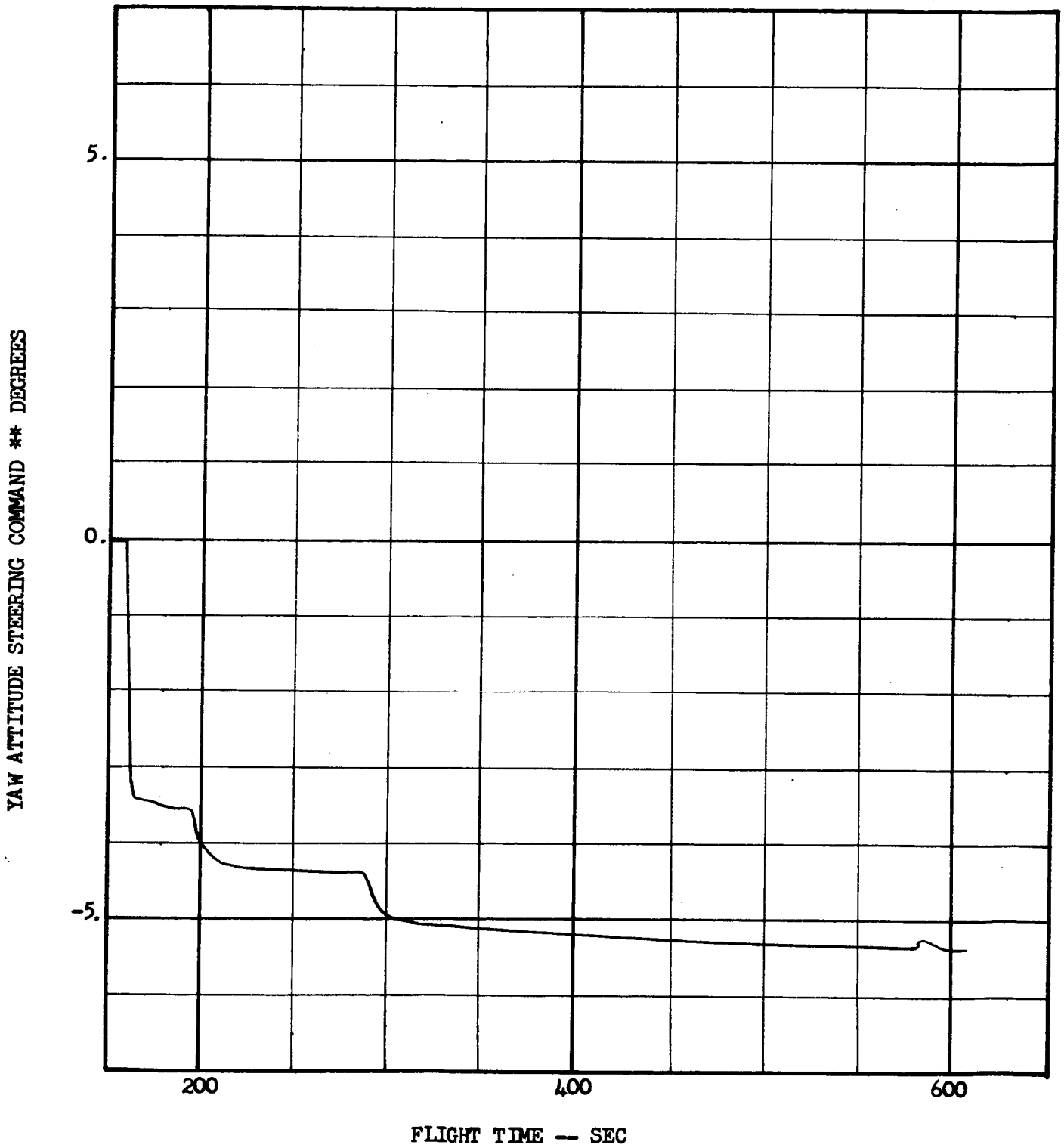


Figure 14

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
LONGITUDINAL ACCELERATION: S-IVB FLIGHT DATA

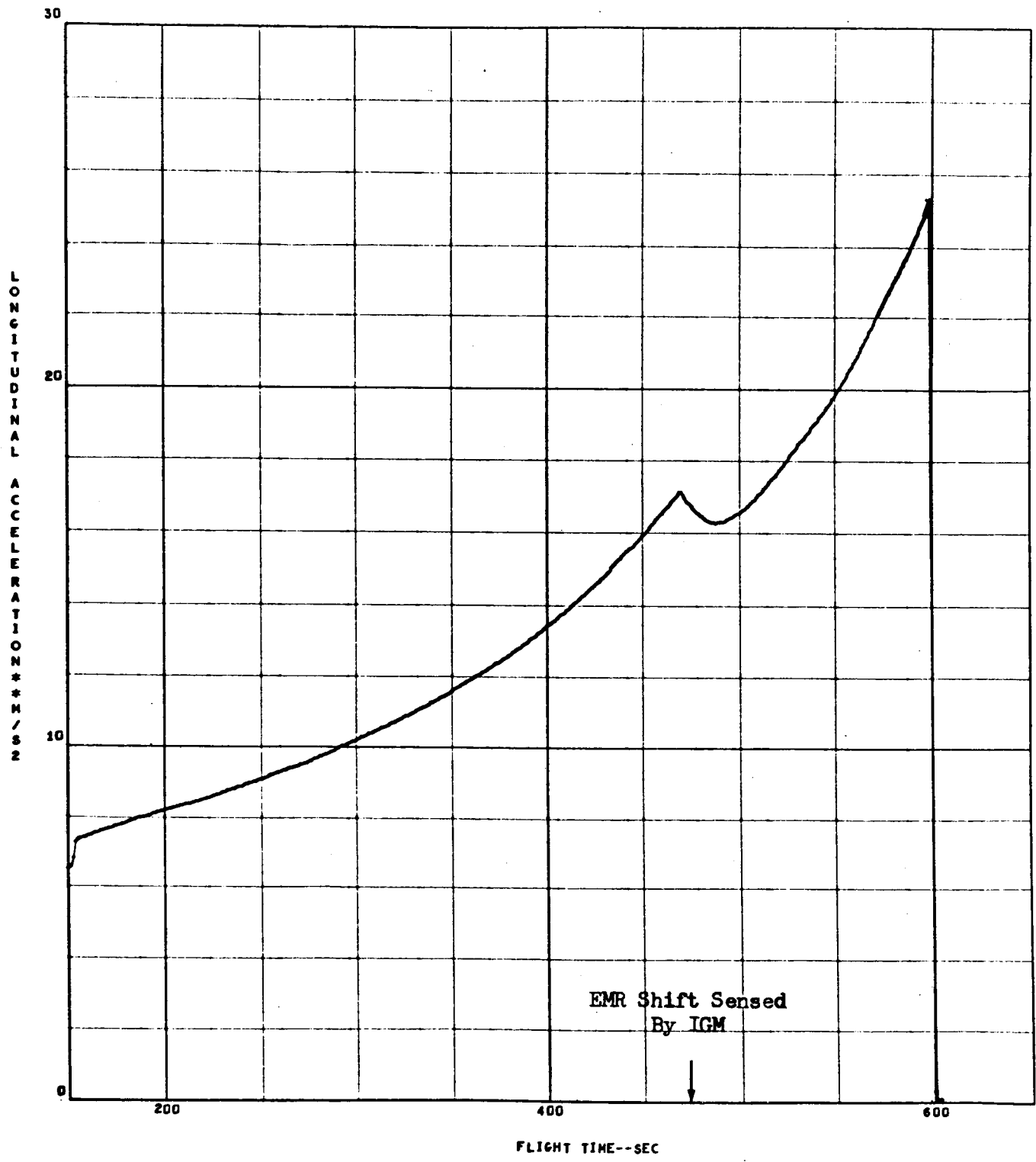


Figure 15

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
VEHICLE ATTITUDE RATE: S-IVB STAGE FLIGHT DATA

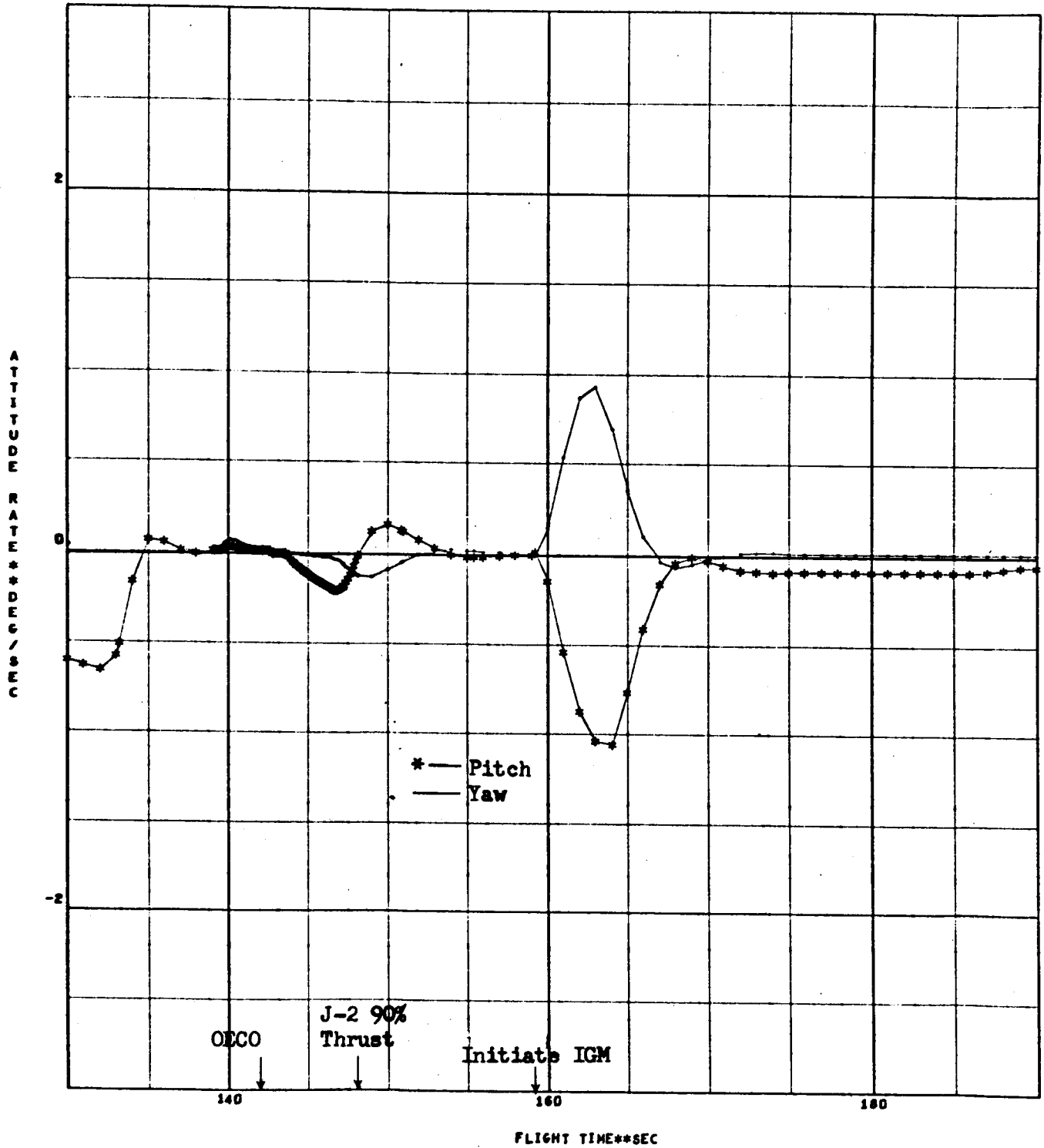


Figure 16

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
ATTITUDE ERROR: S-IVB STAGE FLIGHT DATA

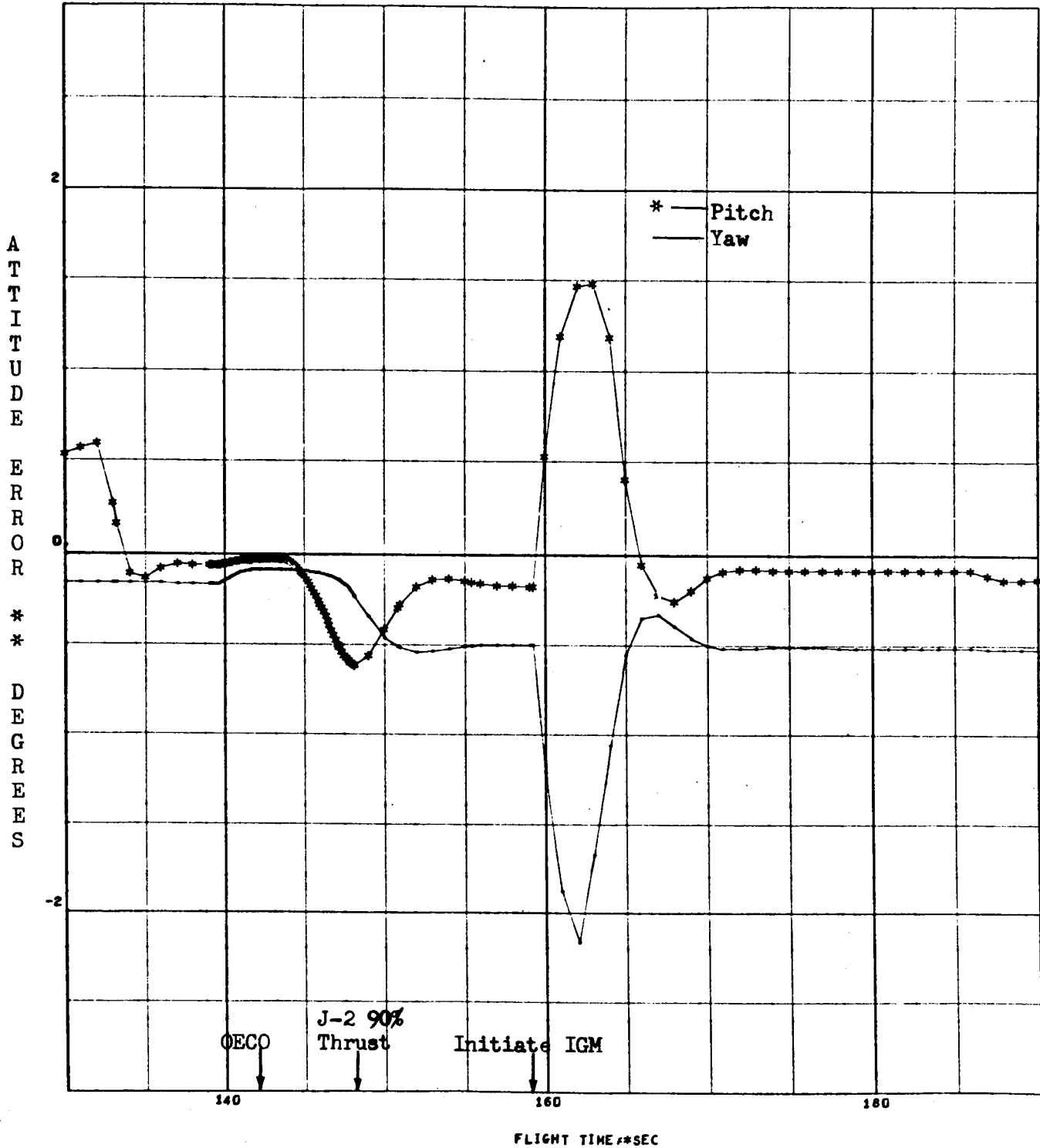


Figure 17

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
ANGLE OF ATTACK: S-IVB STAGE FLIGHT DATA

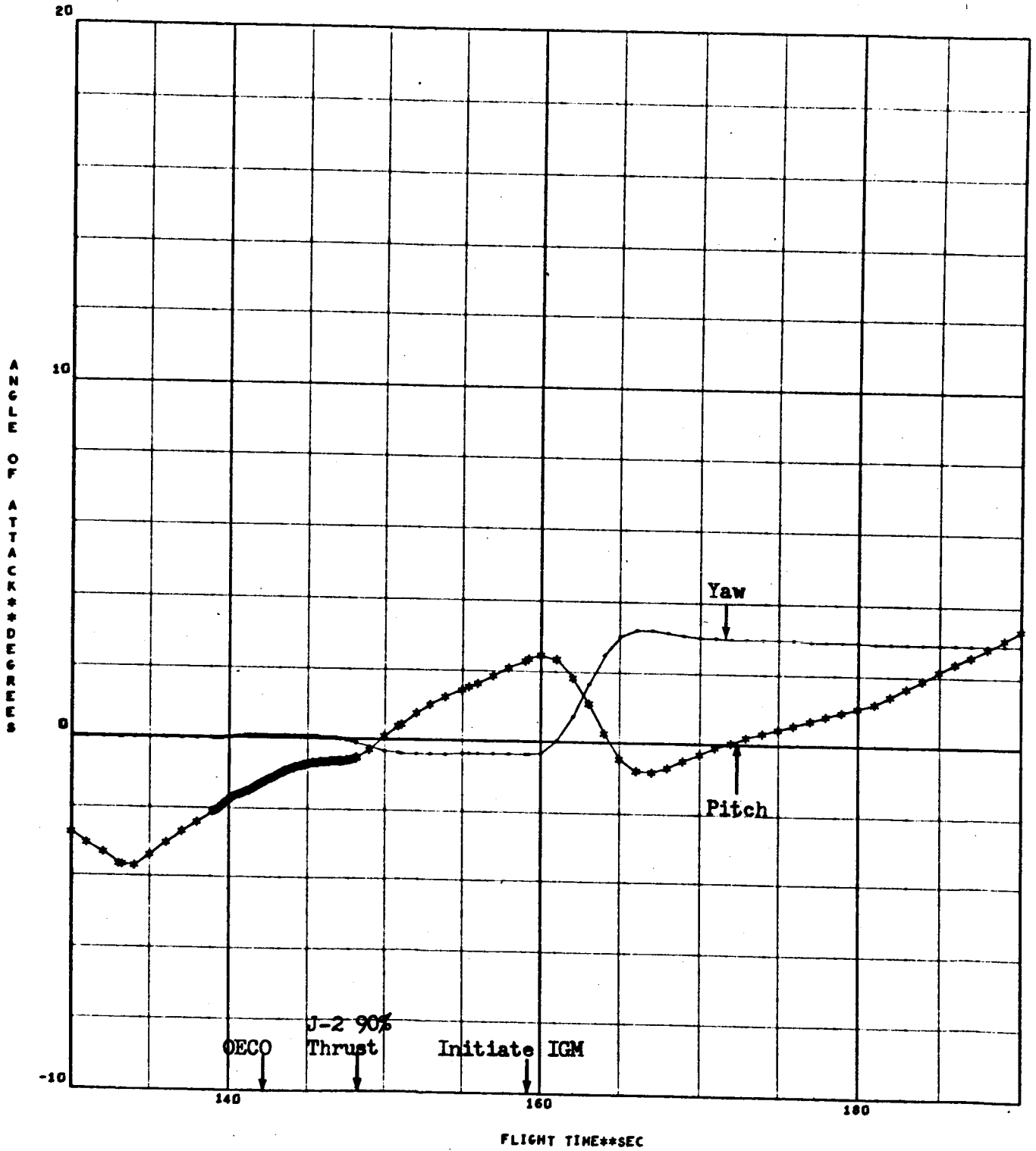


Figure 18

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
DYNAMIC PRESSURE: S-IVB STAGE FLIGHT DATA

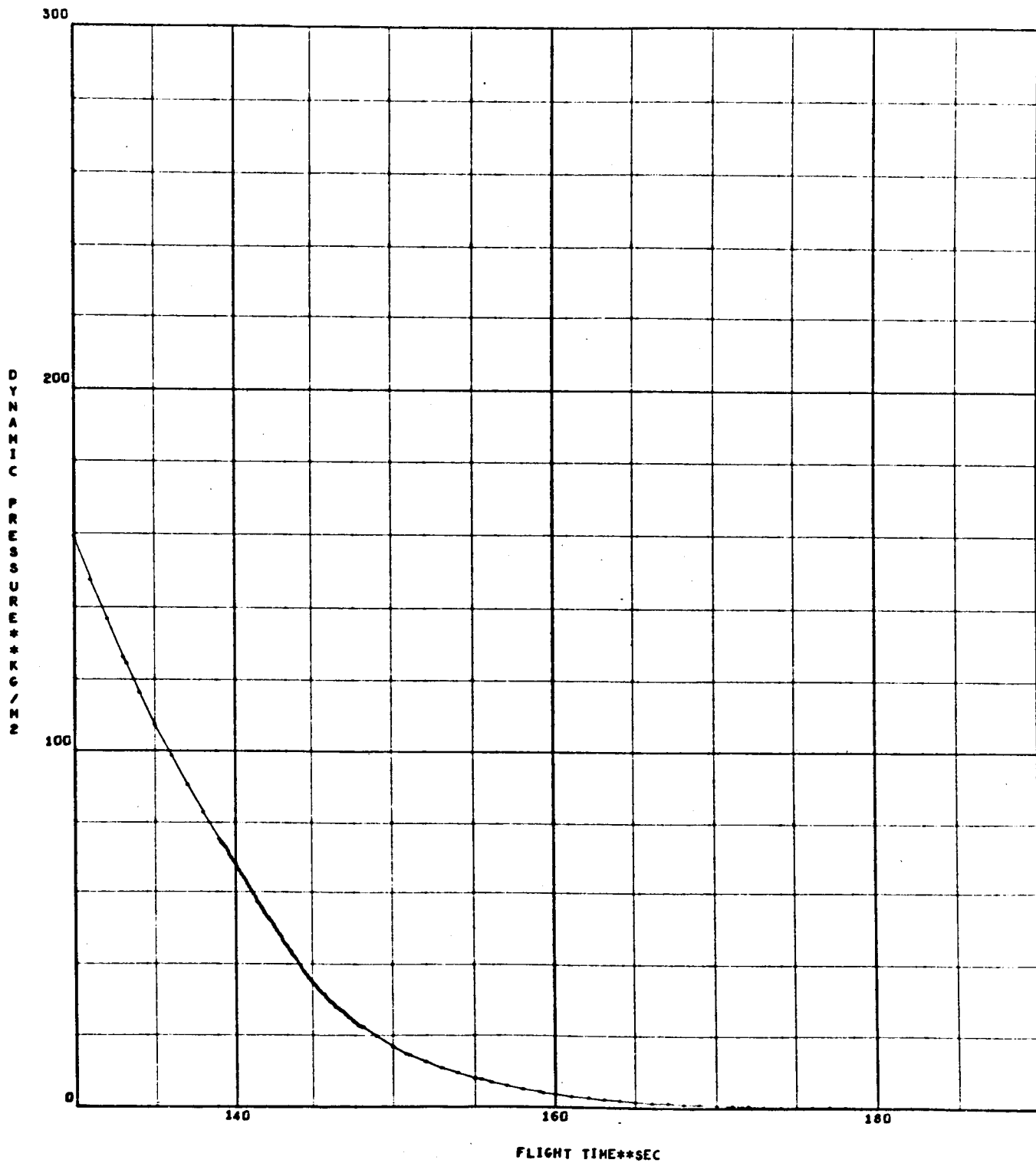


Figure 19

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
ALTITUDE HISTORY: ORBITAL FLIGHT

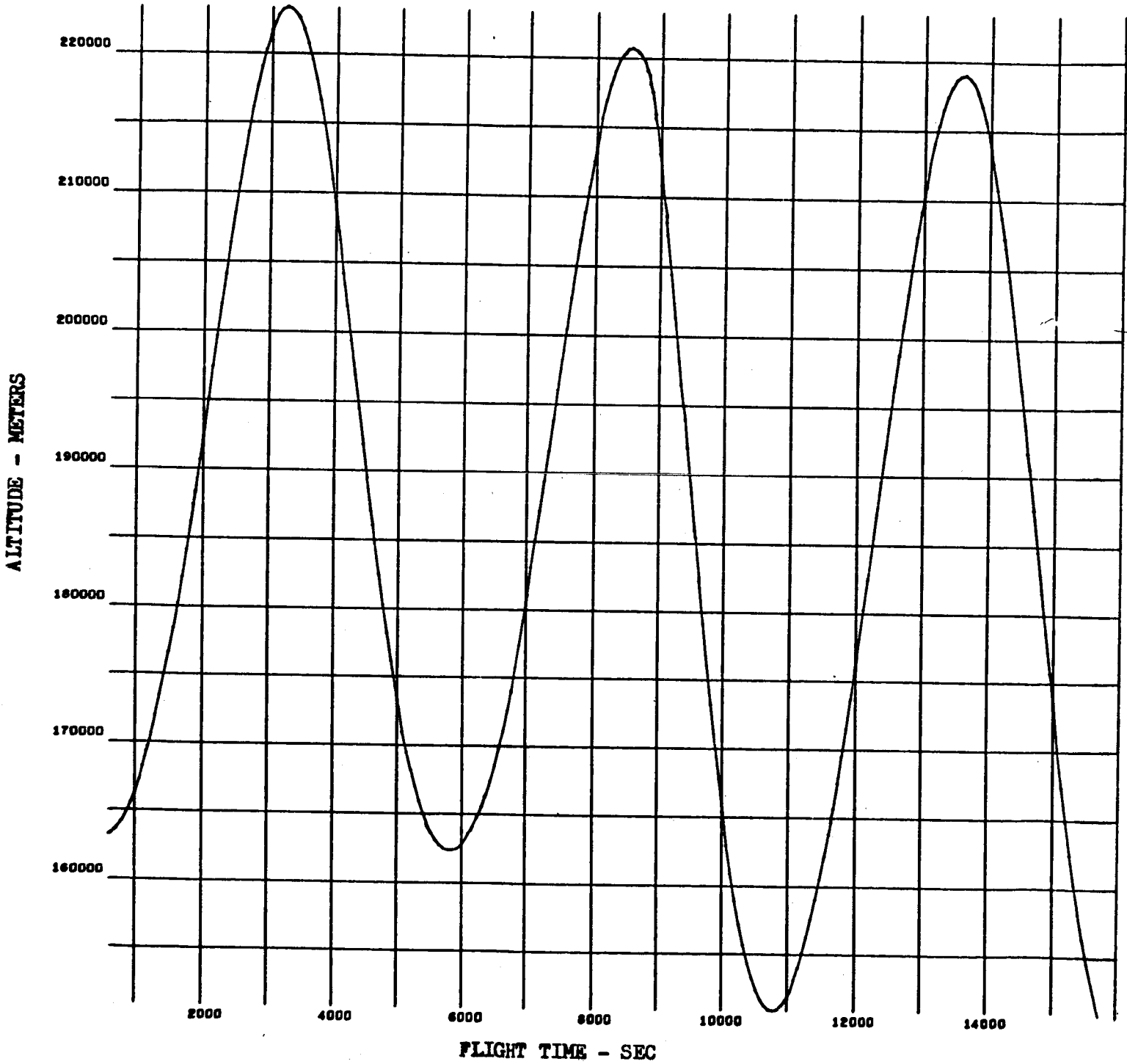


Figure 20

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
SPACE FIXED VELOCITY HISTORY: ORBITAL FLIGHT

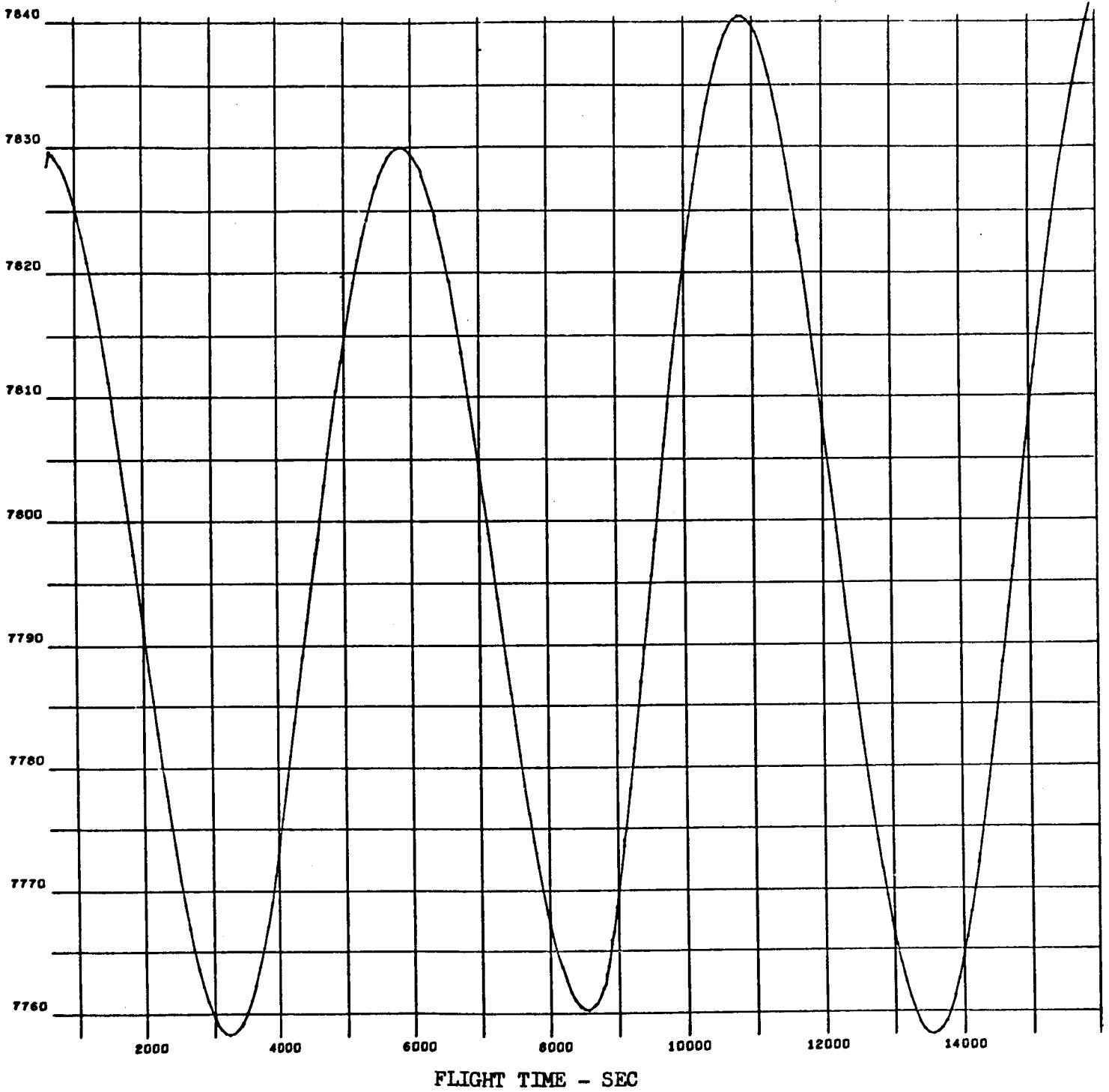


Figure 21

AS-20A/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
PITCH ATTITUDE HISTORY: ORBITAL FLIGHT

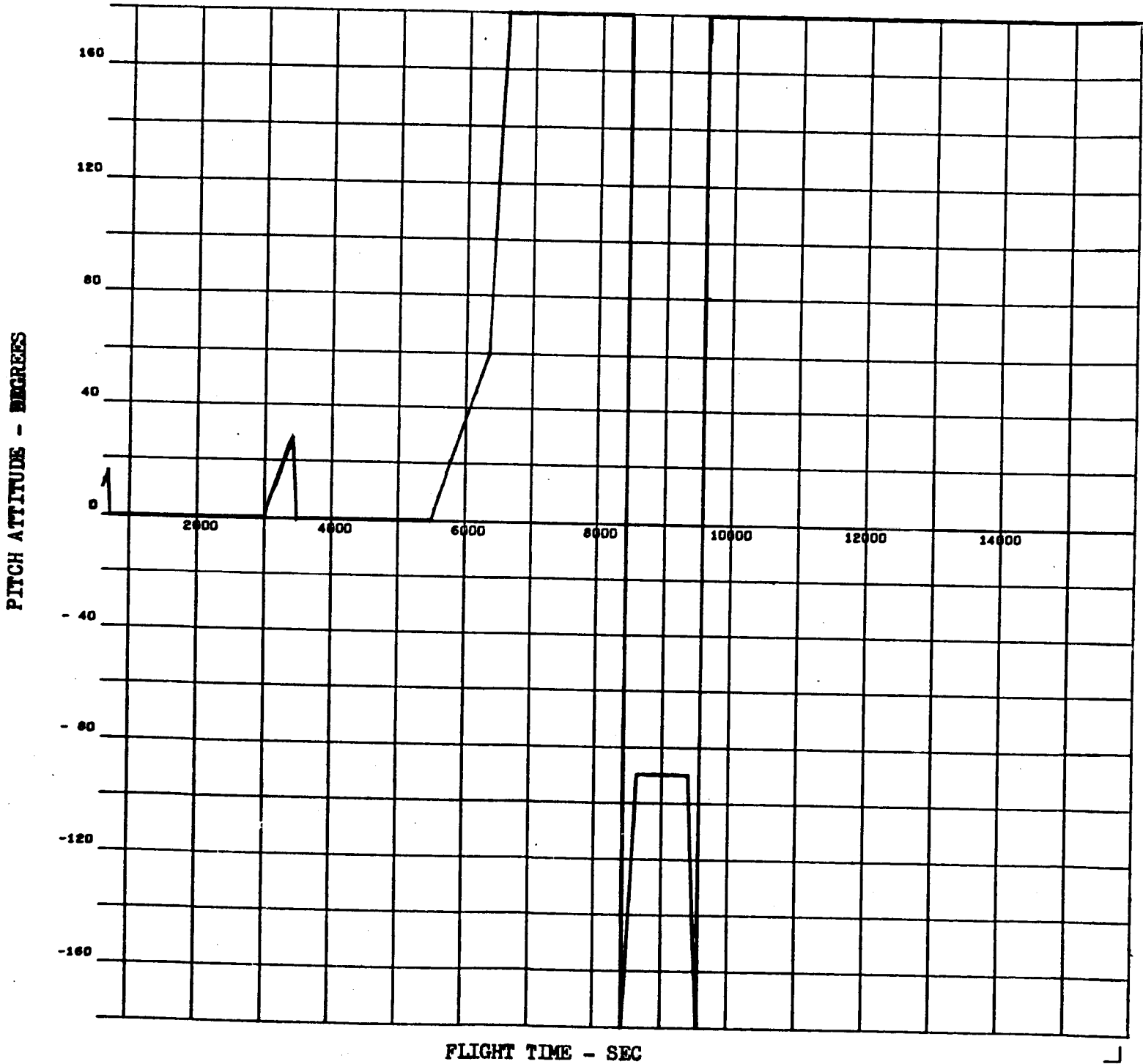


Figure 22

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
POWERED FLIGHT GROUND TRACE - TRACKING COVERAGE ABOVE 5° ELEVATION ANGLE

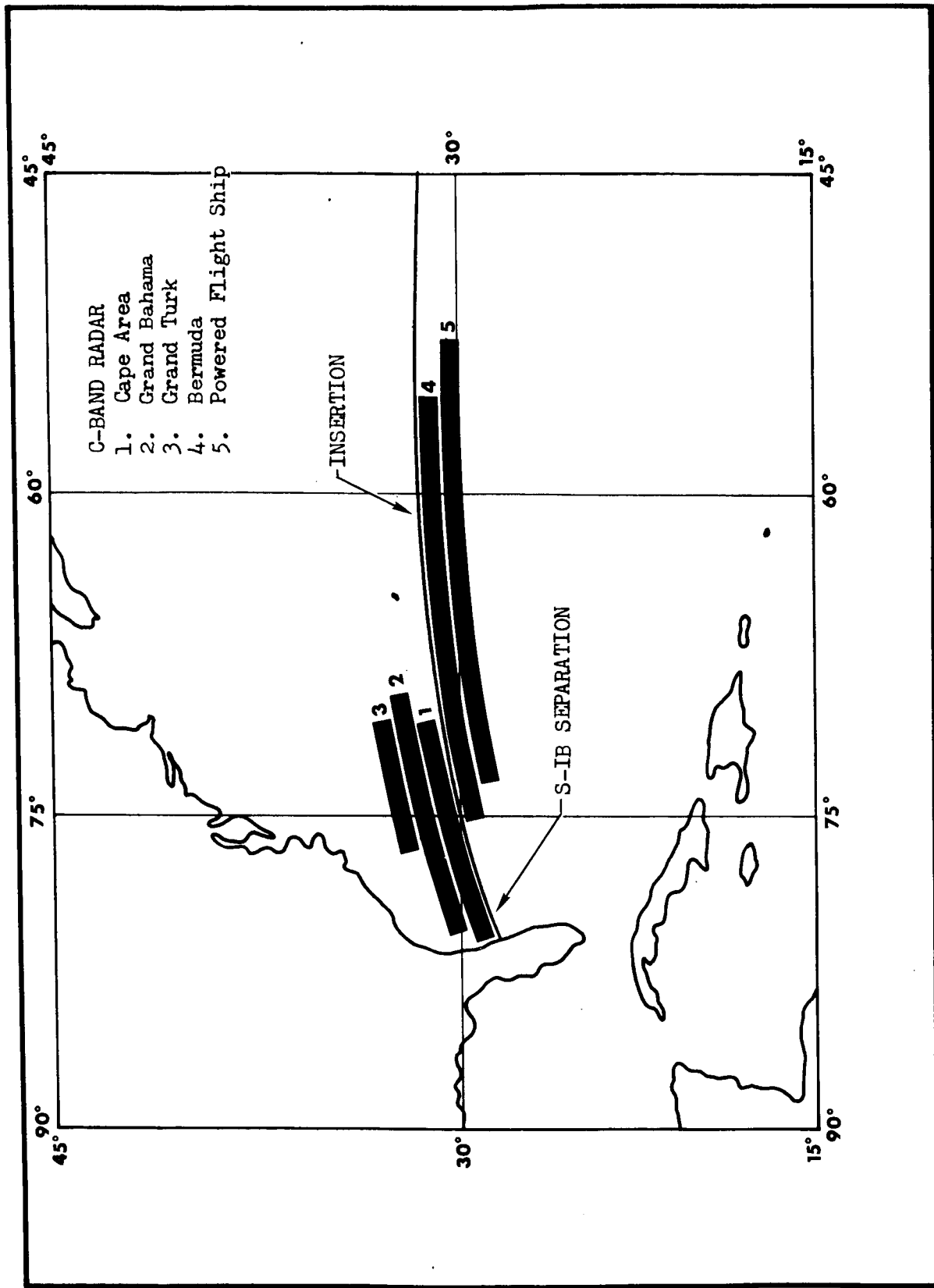
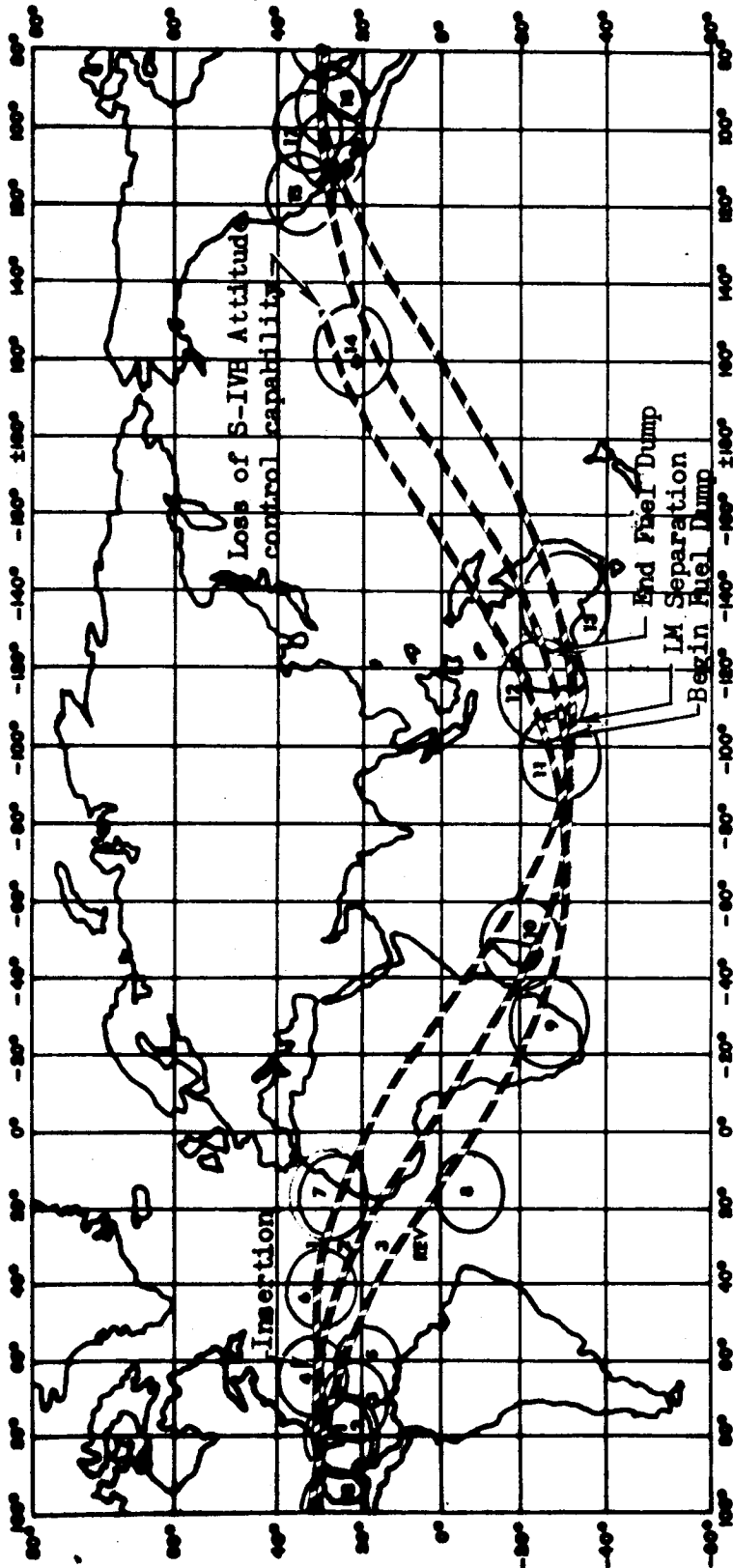


Figure 23

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 ORBITAL GROUND PROJECTION - TRACKING AND TELEMETRY COVERAGE ABOVE 5 DEG. ELEVATION ANGLE



STATION *

- | | | | |
|---------------------|-------------------------|----------------------|----------------------|
| 1. CAPE AREA-R/T | 6. APOLLO SHIP-R/T | 11. SHIP I-T | 16. GUAYMAS-T |
| 2. GRAND BAHAMA-R/T | 7. CANARY ISLAND-R/T | 12. CARNARVON-R/T | 17. WHITE SANDS-R |
| 3. GRAND TURK-R/T | 8. ASCENSION ISLAND-R/T | 13. WOOMERA-R | 18. CORPUS CHRISTI-T |
| 4. BERMUDA-R/T | 9. PRETORIA-R | 14. HAWAII-R/T | |
| 5. ANTIGUA-R/T | 10. TANANARIVE-R/T | 15. POINT ARGUELLO-R | |

* R denotes C-band radar stations; T denotes telemetry stations.

APPENDIX A: "LAUNCH VEHICLE CHARACTERISTICS"

TABLE 1A

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 VEHICLE WEIGHT BREAKDOWN
 (POUNDS)

Spacecraft *	36,342	
Instrument Unit	4,600	
S-IVB Stage Dry	23,427	
S-IVB Residuals	2,450	
Useable Reserve Propellant (Includes FPR)	<u>3,386</u>	
Injection Weight		70,205
J-2 Thrust Decay Propellant and LOX Venting	<u>241</u>	
S-IVB Cutoff Weight		70,446
S-IVB Propellant Consumed	224,976	
S-IVB APS Propellant Consumed	6	
Ullage Cases	<u>215</u>	
S-IVB "90% Thrust" Weight		295,643
S-IVB GH2 Start Tank	4	
S-IVB Buildup Propellant Consumed	390	
Ullage Propellant Consumed	176	
S-IVB Detonation Package	<u>5</u>	
S-IVB Stage Weight at Separation		296,218
S-IVB Aft Frame Hardware	31	
S-IB/S-IVB Interstage	6,654	
S-IB Dry Weight	85,317	
S-IB Residuals and Reserves	10,843	
S-IVB Frost Consumed	100	
S-IB Frost Consumed	1,000	
S-IB Seal Purge Consumed	6	
S-IB Fuel Additive Consumed	27	
S-IB Gearbox Lubricant Consumed	714	
Inboard Engine Thrust Decay Prpt Consumed	2,143	
Outboard Engine Thrust Decay Prpt Consumed		
To Separation	1,653	
S-IB Mainstage Propellant Consumed	<u>880,338</u>	
Vehicle Liftoff Weight		1,285,044
* SIA	3,950	
Lunar Module	31,325	
Nose Cone	<u>1,067</u>	
	36,342	

TABLE 2A
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IB STAGE MASS CHARACTERISTICS

FLIGHT TIME (SEC)	MASS (KG)	CENTER OF GRAVITY			MOMENT OF INERTIA		
		X-AXIS (M)	Y-AXIS (M)	Z-AXIS (M)	X-AXIS (KG-M-S2)	Y-AXIS (KG-M-S2)	Z-AXIS (KG-M-S2)
1) -5.00	589243.						
2) 7.00	582886.	15.8528	0.0066	-0.0023	216276.	614896.	6148696.
5.00	568924.	15.7672	0.0066	-0.0025	210670.	6125244.	6125244.
13.00	554934.	15.6915	0.0069	-0.0025	204542.	6106098.	6106098.
15.00	540820.	15.6262	0.0071	-0.0025	198383.	6090762.	6090762.
20.00	526649.	15.5714	0.0071	-0.0028	192266.	6078708.	6078708.
25.00	512475.	15.5290	0.0074	-0.0028	186153.	6069383.	6069383.
30.00	498160.	15.5003	0.0076	-0.0028	180016.	6062276.	6062276.
35.00	483867.	15.4866	0.0079	-0.0030	173831.	6056278.	6056278.
40.00	469554.	15.4832	0.0081	-0.0030	167630.	6050845.	6050845.
45.00	455229.	15.5087	0.0084	-0.0030	161431.	6044901.	6044901.
50.00	440898.	15.5486	0.0086	-0.0033	155234.	6037244.	6037244.
55.00	426566.	15.6093	0.0089	-0.0033	149052.	6026944.	6026944.
60.00	412245.	15.6941	0.0091	-0.0036	142881.	6012683.	6012683.
65.00	397901.	15.8064	0.0097	-0.0036	136707.	5992713.	5992713.
70.00	383500.	15.9500	0.0099	-0.0038	130531.	5964984.	5964984.
75.00	371978.	16.0910	0.0103	-0.0038	125594.	5935741.	5935741.
80.00	354699.	16.3397	0.0109	-0.0041	118196.	5881046.	5881046.
85.00	340304.	16.5950	0.0112	-0.0043	112037.	5820460.	5820460.
90.00	325991.	16.8946	0.0119	-0.0043	105898.	5745103.	5745103.
95.00	311709.	17.2464	0.0124	-0.0046	99766.	5651107.	5651107.
100.00	297435.	17.6584	0.0130	-0.0048	93635.	5534428.	5534428.
105.00	283139.	18.1401	0.0137	-0.0051	87510.	5390703.	5390703.
110.00	263961.	18.7015	0.0145	-0.0053	81395.	5214586.	5214586.
115.00	254762.	19.3562	0.0152	-0.0056	75286.	4999965.	4999965.
120.00	249598.	20.1193	0.0163	-0.0051	69187.	4739325.	4739325.
125.00	226476.	21.0097	0.0173	-0.0063	63109.	4423461.	4423461.
130.00	212403.	22.0522	0.0183	-0.0069	57055.	4041026.	4041026.
133.20	203436.	22.8362	0.0191	-0.0072	53194.	3744416.	3744416.
5) 133.14	136844.	24.4571	0.0211	-0.0076	46016.	3118606.	3118606.
6) 142.14	161762.	25.0517	0.0218	-0.0079	43793.	2876025.	2876025.
7) 143.44	181025.	25.1425	0.0218	-0.0079	43398.	2837945.	2837945.
8) 143.52	181012.	25.1444	0.0218	-0.0079	43392.	2837076.	2837076.

- 1) GRR;
- 2) First Motion;
- 3) Maximum Dynamic Pressure;
- 4) Tilt Arrest;
- 5) IECC;
- 6) OBCC;
- 7) Separation Signal;
- 8) Physical Separation.

TABLE 3A
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IVB STAGE MASS CHARACTERISTICS

FLIGHT TIME (SEC)	MASS (KG)	--- CENTER OF GRAVITY ---			---- MOMENT OF INERTIA ----		
		X-AXIS (M)	Y-AXIS (M)	Z-AXIS (M)	X-AXIS (KG-M-S2)	Y-AXIS (KG-M-S2)	Z-AXIS (KG-M-S2)
1) 143.52	134360.	6.3643	0.0216	-0.0091	14215.	371355.	371355.
2) 144.84	134326.	6.3643	0.0216	-0.0091	14215.	371355.	371355.
3) 147.19	134211.	6.3643	0.0216	-0.0091	14187.	371267.	371267.
4) 148.14	134101.	6.3643	0.0216	-0.0091	14153.	371162.	371162.
5) 150.00	133719.	6.3640	0.0217	-0.0091	14153.	371018.	371018.
6) 155.44	132542.	6.3643	0.0218	-0.0094	14153.	370952.	370952.
7) 159.25	131549.	6.3672	0.0221	-0.0094	14152.	370544.	370544.
170.00	129002.	6.3714	0.0224	-0.0095	14034.	370071.	370071.
190.00	124222.	6.3871	0.0232	-0.0099	14033.	369065.	369065.
210.00	119426.	6.4125	0.0241	-0.0103	14031.	367209.	367209.
230.00	114639.	6.4479	0.0250	-0.0107	14028.	365432.	365432.
250.00	109856.	6.4940	0.0260	-0.0112	14025.	363515.	363515.
270.00	105078.	6.5516	0.0273	-0.0117	14023.	361380.	361380.
290.00	100310.	6.6226	0.0284	-0.0122	14020.	359067.	359067.
310.00	95537.	6.7086	0.0298	-0.0128	14017.	356457.	356457.
330.00	90771.	6.8120	0.0312	-0.0135	14014.	353494.	353494.
350.00	86004.	6.9355	0.0330	-0.0141	14011.	350102.	350102.
370.00	81235.	7.0810	0.0347	-0.0150	14008.	346179.	346179.
390.00	76477.	7.2543	0.0368	-0.0158	14005.	341732.	341732.
410.00	71718.	7.4616	0.0391	-0.0169	14002.	336481.	336481.
430.00	66956.	7.7077	0.0417	-0.0181	13999.	330214.	330214.
450.00	62200.	8.0047	0.0448	-0.0194	13995.	322772.	322772.
470.00	57460.	8.3628	0.0484	-0.0210	13992.	313741.	313741.
475.75	56139.	8.4760	0.0496	-0.0215	13989.	302751.	302751.
490.00	53093.	8.7599	0.0522	-0.0227	13987.	299247.	299247.
510.00	49068.	9.1992	0.0564	-0.0246	13984.	290458.	290458.
530.00	45119.	9.7197	0.0612	-0.0266	13981.	276707.	276707.
550.00	41217.	10.3491	0.0669	-0.0291	13977.	260236.	260236.
570.00	37351.	11.1228	0.0736	-0.0320	13973.	240097.	240097.
590.00	33506.	12.0973	0.0819	-0.0357	13969.	214999.	214999.
5) 595.15	31954.	12.5653	0.0856	-0.0373	13964.	182501.	182501.
6) 608.15	31845.	12.6015	0.0859	-0.0375	13962.	166649.	166649.
					13962.	165407.	165407.

- 1) Separation Completed;
- 2) J-2 Start Command;
- 3) Terminate Ullage Burn;
- 4) 90% Thrust Level;
- 5) Command P.U. Activation;
- 6) Ullage Case Jettison;
- 7) I.G.M. Initiation;
- 8) E.M.R. Shift sensed by I.G.M.;
- 9) Guidance Cutoff Signal;
- 10) Orbit Insertion.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 S-1B STAGE AERODYNAMIC CHARACTERISTICS

FLIGHT TIME (SEC)	MACH NO.	CENTER OF PRESSURE (M)	AXIAL FORCE COEFFICIENT	NORMAL FORCE COEFFICIENT (1/RAD)
1) -5.00	0.00	19.3900	1.0000	5.7300
2) 0.00	0.00	19.3900	1.0000	5.7300
5.00	0.04	19.3630	1.0000	5.7454
10.00	0.08	19.3322	1.0000	5.7630
15.00	0.13	19.2812	0.8317	5.7894
20.00	0.19	19.1573	0.6137	5.8316
25.00	0.25	19.0495	0.5135	5.8516
30.00	0.33	18.8954	0.4241	5.8780
35.00	0.41	18.7840	0.3784	5.9048
40.00	0.50	18.6011	0.3601	5.9597
45.00	0.60	18.3384	0.3295	6.0013
50.00	0.72	18.2144	0.3140	6.0599
55.00	0.85	17.7792	0.3594	6.0893
60.00	1.00	19.6567	0.7103	6.0693
65.00	1.16	21.5122	0.7110	5.7159
70.00	1.36	21.5119	0.6125	6.1995
74.00	1.53	19.7402	0.5126	6.0190
3) 80.00	1.85	25.0303	0.4157	5.2573
85.00	2.12	28.5148	0.3482	4.8545
90.00	2.37	30.5154	0.3029	4.7188
95.00	2.64	30.9284	0.2688	4.6696
100.00	2.93	29.6859	0.2457	4.7100
105.00	3.24	28.3757	0.2256	4.8978
110.00	3.54	27.2262	0.2003	5.0856
115.00	3.87	26.7643	0.1297	5.0535
120.00	4.18	25.9741	0.0744	4.9998
125.00	4.54	24.8433	0.0206	4.9230
130.00	4.95	23.8184	-0.0785	4.8486
4) 133.20	5.33	23.8690	-0.2005	4.7880
5) 139.14	6.15	25.1644	-0.5570	4.6946
6) 142.14	6.46	25.8888	-0.8034	4.6638
7) 143.44	6.52	26.0344	-0.8300	4.6581
8) 143.52	6.52	26.0415	-0.8300	4.6579

- 1) GRR;
 2) First Motion;
 3) Maximum Dynamic Pressure;
 4) Tilt Arrest;
 5) IECC;
 6) OBCO;
 7) Separation Signal;
 8) Physical Separation.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
S-1VR STAGE PROPULSION CHARACTERISTICS

	FLIGHT TIME (SEC)	ALTITUDE (KM)	LONGITUDINAL ACCELERATION (M/S ²)	THRUST MAGNITUDE J-2 ENGINE (N)	APS IMPULSF (N-SEC)
1)	143.52	63.58	0.267	0.	0.000
2)	144.84	65.00	0.267	0.	0.000
3)	147.19	67.49	2.875	354651.	0.000
	148.14	68.49	5.939	797977.	0.000
4)	148.14	68.49	5.939	797978.	0.000
5)	150.00	70.42	6.537	875276.	0.000
6)	150.84	71.29	6.546	875236.	0.000
7)	155.44	75.97	7.396	980803.	0.000
	159.25	79.76	7.460	981603.	0.000
	170.00	90.07	7.676	990216.	0.000
	190.00	107.63	8.032	997812.	0.000
	210.00	123.14	8.364	998925.	0.000
	230.00	136.67	8.707	998184.	0.000
	250.00	148.29	9.074	996845.	0.000
	270.00	158.09	9.497	997966.	0.000
	290.00	166.14	9.933	996431.	0.000
	310.00	172.54	10.436	997032.	0.000
	330.00	177.38	10.977	996408.	0.000
	350.00	180.77	11.596	997326.	0.000
	370.00	182.81	12.258	995760.	0.000
	390.00	183.63	12.989	993405.	0.000
	410.00	183.37	13.867	994567.	0.000
	430.00	182.19	14.855	994654.	0.000
	450.00	180.25	15.927	990684.	0.000
	470.00	177.78	17.101	982625.	0.000
8)	475.75	177.00	16.720	938665.	0.000
	490.00	174.97	16.277	864235.	0.000
	510.00	171.95	17.041	836211.	0.000
	530.00	168.97	18.369	828827.	0.000
	550.00	166.33	19.825	817157.	0.000
	570.00	164.35	21.812	814718.	0.000
	590.00	163.30	24.006	804376.	0.000
9)	598.15	163.19	25.089	801715.	0.000
10)	608.15	163.22	0.050	1603.	0.000

- 1) Separation Completed;
 2) J-2 Start Command;
 3) Terminate Ullage Burn;
 4) 90% Thrust Level;
 5) Command P.U. Activation;
 6) Ullage Case Jettison;
 7) I.G.M. Initiation;
 8) E.M.R. Shift sensed by I.G.M.;
 9) Guidance Cutoff Signal;
 10) Orbit Insertion.

TABLE 5A
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
S-IB STAGE PROPUSSION CHARACTERISTICS

FLIGHT TIME (SEC)	ALTITUDE (KM)	LONG. ACCEL (M/S ²)	H-1 ENGINE THRUST MAGNITUDES										
			ENGINE 1 (N)	ENGINE 2 (N)	ENGINE 3 (N)	ENGINE 4 (N)	ENGINE 5 (N)	ENGINE 6 (N)	ENGINE 7 (N)	ENGINE 8 (N)			
1) -5.00	0.03	0.000	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.00	0.03	12.117	884481.	877231.	879148.	865023.	869994.	882825.	872992.	877634.			
2) 5.00	0.07	12.660	902879.	895631.	897544.	883447.	888517.	901254.	891410.	896134.			
10.00	0.17	13.011	906835.	899578.	901493.	887397.	892491.	905202.	895371.	900093.			
15.00	0.36	13.452	915107.	907881.	909759.	895708.	900828.	913509.	903673.	908423.			
20.00	0.63	13.919	923258.	916021.	917904.	903854.	909022.	921652.	911838.	916585.			
25.00	1.01	14.380	930674.	923435.	925315.	911276.	916467.	925069.	919263.	924016.			
30.00	1.50	14.880	938584.	931371.	933220.	919218.	924371.	936978.	927151.	931938.			
35.00	2.12	15.397	946501.	939260.	941134.	927109.	932273.	944898.	935045.	939862.			
40.00	2.88	15.937	954878.	947608.	949509.	935459.	940690.	953217.	943454.	948186.			
45.00	3.79	16.524	963216.	955916.	957846.	943771.	945005.	961555.	951767.	956527.			
50.00	4.85	17.142	971831.	964589.	966460.	952444.	957566.	970170.	960326.	965143.			
55.00	6.09	17.616	980415.	973174.	975044.	961030.	966212.	978755.	968972.	973727.			
60.00	7.50	17.548	987602.	980361.	982233.	968217.	973392.	986001.	976159.	980970.			
65.00	9.07	18.195	995547.	988249.	990179.	976105.	981337.	993888.	984107.	988855.			
70.00	10.82	19.222	1003340.	995984.	997972.	983839.	989015.	1001685.	991783.	996651.			
75.00	12.34	20.212	1009042.	1001810.	1003676.	989665.	994843.	1007451.	997610.	1002419.			
80.00	14.87	21.702	1015920.	1008692.	1010556.	996548.	1001665.	1014273.	1004433.	1009241.			
85.00	17.21	23.051	1020300.	1013013.	1014937.	1000867.	1006108.	1018595.	1008878.	1013560.			
90.00	19.77	24.421	1023226.	1015630.	1017863.	1003486.	1008846.	1021398.	1011619.	1016363.			
95.00	22.56	25.803	1024564.	1017345.	1019205.	1005196.	1010432.	1022991.	1013210.	1017951.			
100.00	25.60	27.214	1024979.	1017640.	1019622.	1005488.	1010719.	1023285.	1013504.	1018240.			
105.00	28.89	28.698	1024409.	1017196.	1019055.	1005043.	1010142.	1022717.	1012936.	1017668.			
110.00	32.44	30.295	1023390.	1016057.	1018039.	1003899.	1009236.	1021702.	1012041.	1016643.			
115.00	36.26	32.034	1021447.	1014242.	1016101.	1002082.	1007405.	1019886.	1010223.	1014820.			
120.00	40.37	33.890	1018914.	1011591.	1013573.	999427.	1004612.	1017356.	1007444.	1012278.			
125.00	44.77	35.930	1015805.	1008736.	1010471.	996565.	1001609.	1014375.	1004460.	1009284.			
130.00	49.46	38.198	1012244.	1004811.	1006917.	992637.	998023.	1010693.	1000897.	1005588.			
133.20	52.62	39.788	1009372.	1001994.	1004050.	989813.	995036.	1007776.	997926.	1002657.			
139.14	58.32	43.020	1001582.	994341.	996313.	982211.	987390.	1000110.	990264.	994997.			
142.14	62.08	19.701	820809.	968230.	816178.	956137.	-0.	-0.	-0.	-0.			
143.44	63.49	1.255	66092.	41781.	65731.	41249.	-0.	-0.	-0.	-0.			
143.52	63.58	1.169	59925.	40232.	59597.	39720.	-0.	-0.	-0.	-0.			

- 1) GRR;
- 2) First Motion;
- 3) Maximum Dynamic Pressure;
- 4) Tilt Arrest;
- 5) IECC;
- 6) OECC;
- 7) Separation Signal;
- 8) Physical Separation.

TABLE 7A

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 ORBITAL VENT SEQUENCE AND IMPULSE HISTORY

FLIGHT TIME (Hr:Min:Sec)			EFFECTIVE IMPULSE (lb-sec)
<u>Start</u>	<u>End</u>		
<u>LOX TANK</u>			
00:09:59	00:10:39	VENT	11800.
02:26:19	02:28:19	PURGE	50700.*
02:31:39	03:14:16	VENT	12592.
03:57:02	04:43:06	VENT	1508.
<u>HYDROGEN TANK</u>			
00:09:59	00:30:59	VENT	0.
00:56:43	01:16:43	VENT	0.
01:42:28	01:52:28	VENT	0.
02:28:29	02:31:29	PURGE	7560.*
02:31:39	03:14:16	VENT	0.
03:57:01	04:43:05	VENT	0.

* Propellant Dump Experiment

Figure 1A

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
VEHICLE PROFILE

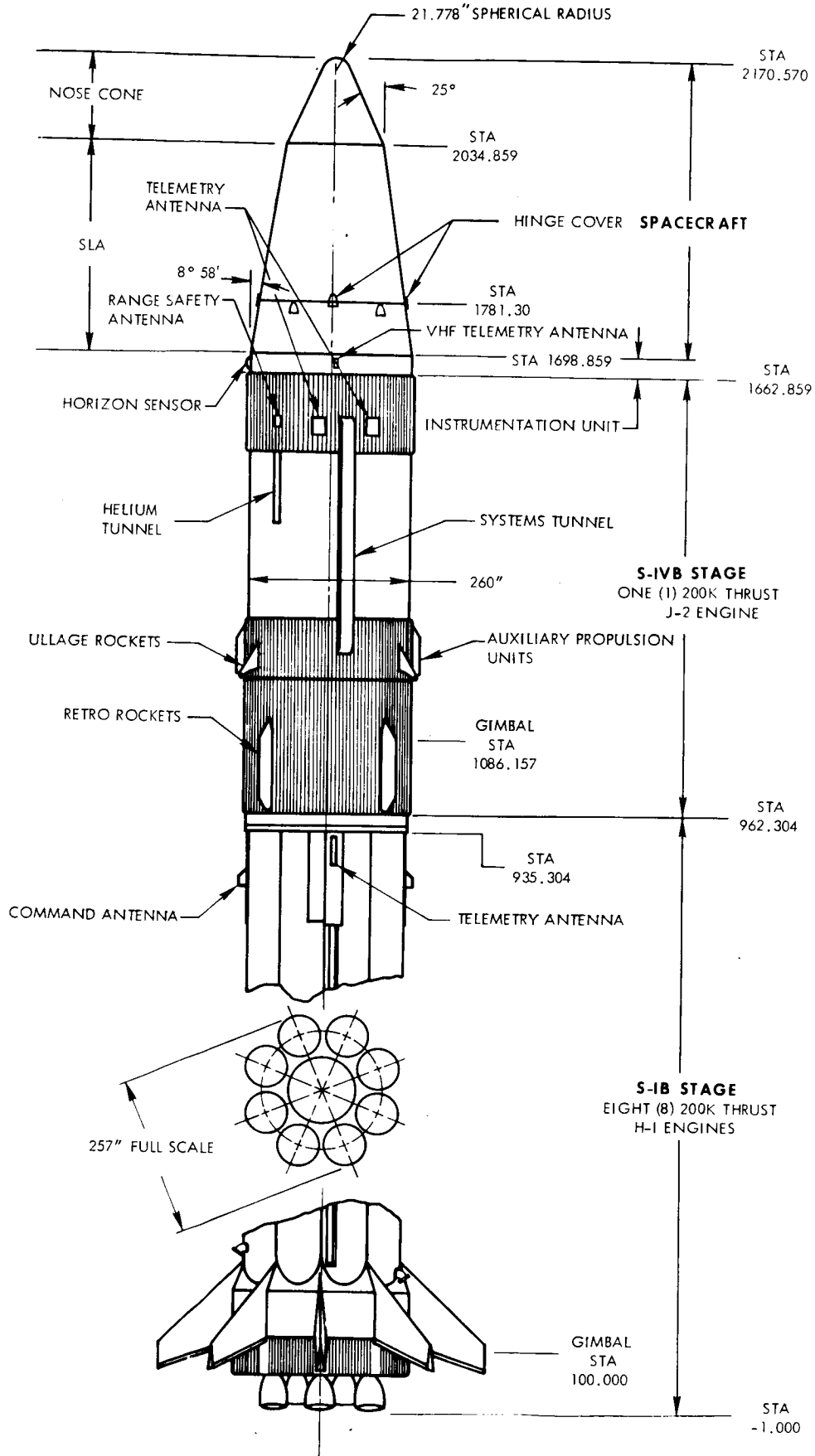


Figure 2A

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
H-1 ENGINE THRUST DECAY

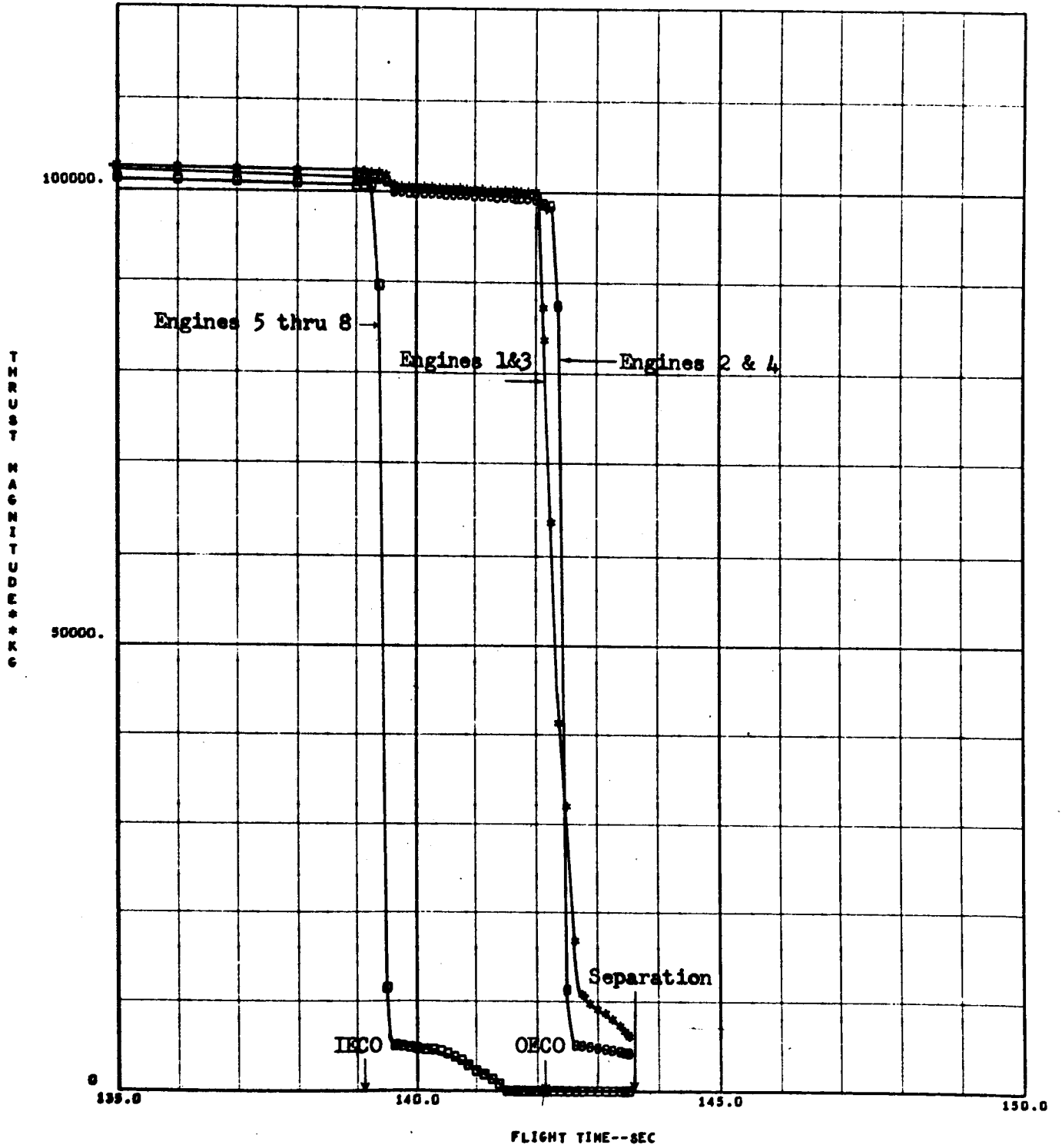


Figure 3A

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
J-2 ENGINE THRUST BUILDUP

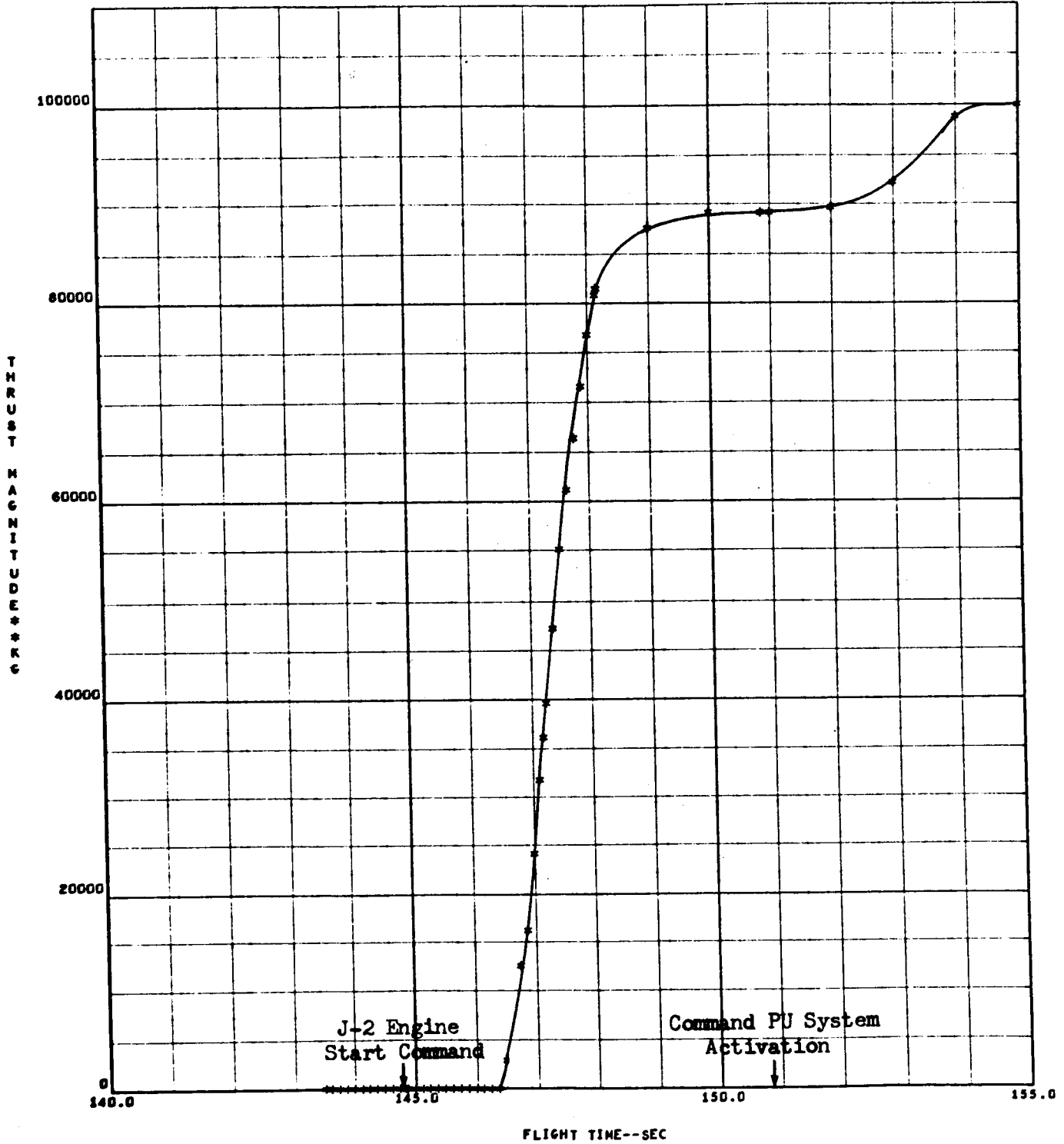


Figure 4A

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
J-2 ENGINE THRUST DECAY

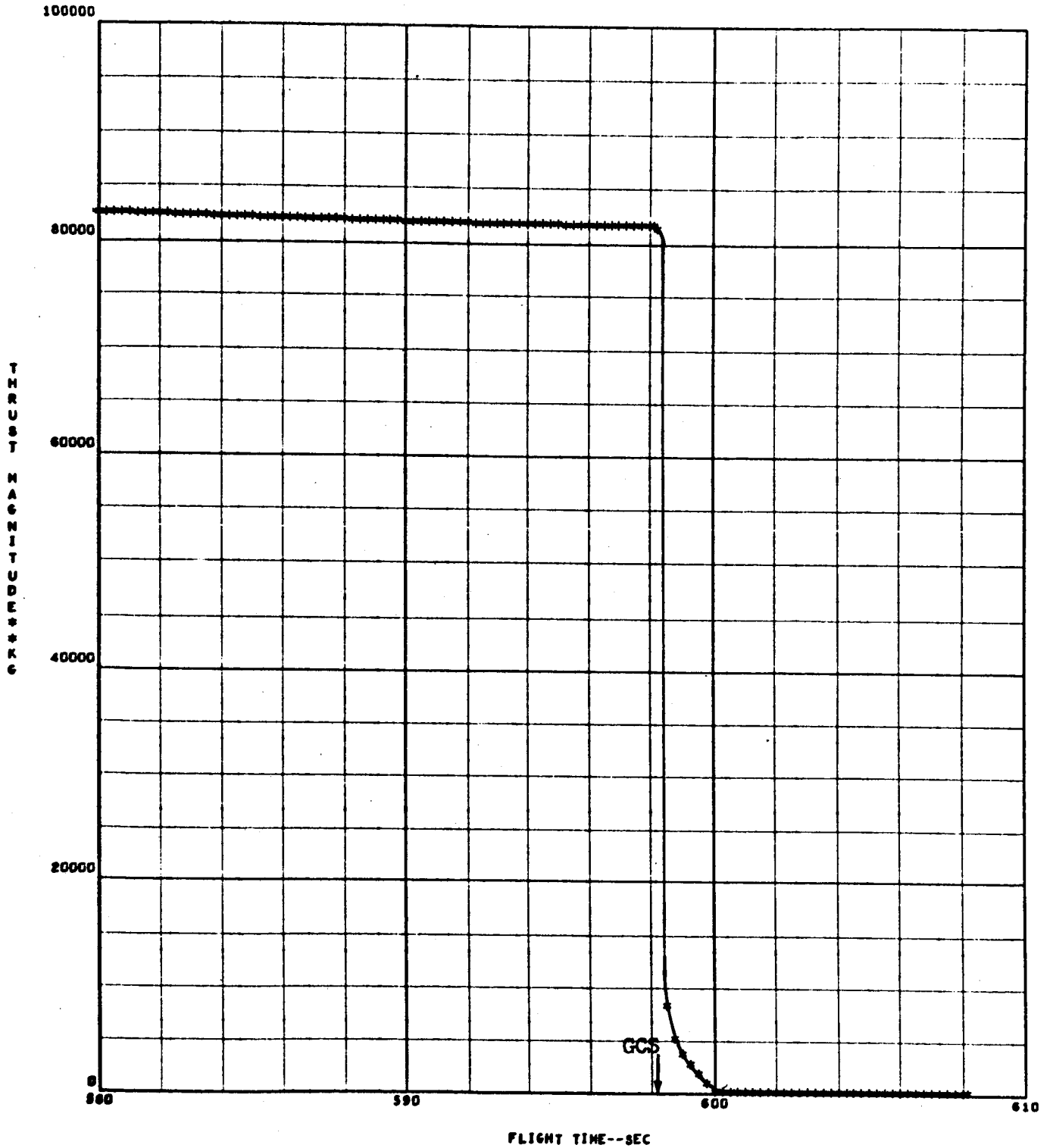
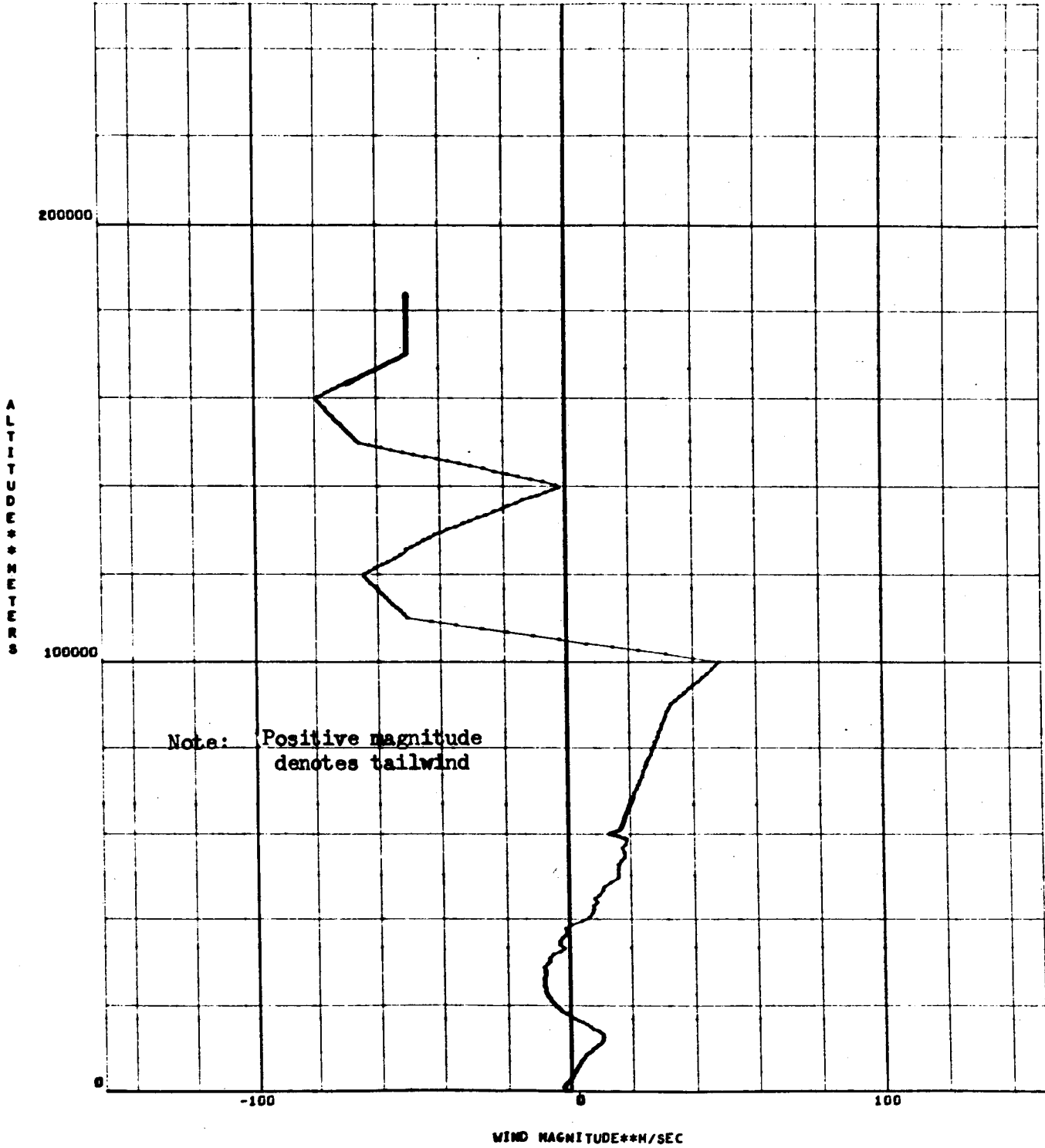


Figure 5A

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
AVERAGE MEAN HEADWIND/TAILWIND PROFILE
SEPTEMBER AND OCTOBER



APPENDIX B: "GUIDANCE PRESETTINGS"

TABLE 1E

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IB STAGE STEERING PROGRAM

For the time segment $t - T1 \leq 10$:

$$\begin{aligned} X_y &= 0. \\ X_z &= 0. \\ X_x &= -0.314159 \text{ rad. } (-18. \text{ degrees}) \end{aligned}$$

For the time segment $10 < t - T1 \leq 47$:

$$\begin{aligned} X_y &= A_0 + A_1xT + A_2xT^2 + A_3xT^3 \\ A_0 &= -.655727 \times 10^{-2} \text{ radians} \\ A_1 &= .225645 \times 10^{-2} \text{ radians/second} \\ A_2 &= -.174025 \times 10^{-3} \text{ radians/second}^2 \\ A_3 &= .472717 \times 10^{-6} \text{ radians/second}^3 \\ X_x &= X_z = 0. \end{aligned}$$

For the time segment $47 < t - T1 \leq 96$:

$$\begin{aligned} X_y &= B_0 + B_1xT + B_2xT^2 + B_3xT^3 \\ B_0 &= .774282 \times 10^{-1} \text{ radians} \\ B_1 &= -.945599 \times 10^{-3} \text{ radians/second} \\ B_2 &= -.161445 \times 10^{-3} \text{ radians/seconds}^2 \\ B_3 &= .858421 \times 10^{-6} \text{ radians/second}^3 \\ X_x &= X_z = 0. \end{aligned}$$

For the time segment $96 < t - T1 \leq 133$:

$$\begin{aligned} X_y &= C_0 + C_1xT + C_2xT^2 + C_3xT^3 \\ C_0 &= .489574 \times 10^{+1} \text{ radians} \\ C_1 &= -.142762 \times 10^{+0} \text{ radians/second} \\ C_2 &= .123205 \times 10^{-2} \text{ radians/second}^2 \\ C_3 &= -.371469 \times 10^{-5} \text{ radians/second}^3 \\ X_x &= X_z = 0. \end{aligned}$$

For the time segment $t - T1 > 133$:

$$\begin{aligned} X_y &= -1.037239 \text{ radians} \\ X_x &= X_z = 0. \end{aligned}$$

NOTE:

X_y : Pitch attitude angle measured negative downrange from inertial vertical

$T = t - T1 + \text{NGMDT}$

t : time from GRF

$T1$: time of liftoff (Time Base 1), approximately 0.2 seconds after first motion

NGMDT: Bias to account for system delays

TABLE 2B

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IB STAGE PITCH ATTITUDE COMMAND

<u>FLIGHT TIME (SEC)</u>	<u>PITCH ATTITUDE COMMAND, χ_c (DEG)</u>	<u>FLIGHT TIME (SEC)</u>	<u>PITCH ATTITUDE COMMAND, χ_c (DEG)</u>
0	0.0000	82	-35.4033
10	0.0000	84	-36.5426
12	-0.2712	86	-37.6564
14	-0.5231	88	-38.7425
16	-0.8443	90	-39.7971
18	-1.2367	92	-40.8194
20	-1.6956	94	-41.8070
22	-2.2200	96	-42.7558
24	-2.8115	98	-43.7211
26	-3.4658	100	-44.6279
28	-4.1816	102	-45.4819
30	-4.9606	104	-46.2958
32	-5.7985	106	-47.0794
34	-6.6942	108	-47.8419
36	-7.6489	110	-48.5944
38	-8.6587	112	-49.3468
40	-9.7225	114	-50.1096
42	-10.8413	116	-50.8927
44	-12.0113	118	-51.7058
46	-13.2314	120	-52.5610
48	-14.4068	122	-53.4666
50	-15.5864	124	-54.4323
52	-16.8176	126	-55.4717
54	-18.0611	128	-56.5918
56	-19.3141	130	-57.8021
58	-20.5742	132	-59.1178
60	-21.8394	134	-59.4294
62	-23.1071		
64	-24.3749		
66	-25.6405		
68	-26.9015		
70	-28.1558		
72	-29.4005		
74	-30.6337		
76	-31.8532		
78	-33.0558		
80	-34.2399		
		IGM Initiation	-59.4294

TABLE 3B

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
IGM PRESETTINGS

<u>LVDC SYMBOL</u>	<u>INITIAL VALUE</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
---	17.	sec	Time from time base 3 to initiate IGM guidance
T1i	316.8	sec	Time to gc for first IGM stage
T3i	111.7	sec	Time to gc for second IGM stage
T_3	271.0	sec	Average value of m/\dot{m} at initiation of second IGM stage
Vex1	4151.00	m/sec	Average exhaust velocity ($g_0 \times I_{sp}$) for 1st IGM stage phase of flight
Vex3	4221.00	m/sec	Average exhaust velocity ($g_0 \times I_{sp}$) for 2nd IGM stage phase of flight
VT	7821.494	m/sec	Guidance cutoff signal (GCS) criteria. Terminal velocity for IGM equations
XVT	6535586.	m	Desired terminal position vector components in IGM coordinate system
YVT	0.		
ZVT	0.		
$\dot{X}VT$	0.	m/sec	Desired cutoff velocity components in IGM coordinate system
$\dot{Y}VT$	0.		
$\dot{Z}VT$	7821.494		
$\ddot{X}VGT$	-9.332	m/sec ²	Terminal gravitation vector components in IGM coordinate system
$\ddot{Y}VGT$	0.		
$\ddot{Z}VGT$	0.		

TABLE 3B (Cont'd)

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
IGM PRESETTINGS

<u>LVDC SYMBOL</u>	<u>INITIAL VALUE</u>	<u>UNITS</u>	<u>DESCRIPTIONS</u>
ε	15.	sec	Value of T3i to initiate IGM ΔV guidance
---	3.	sec	Value of T3i to freeze IGM (ε')
Tr1	1.8	N/D	Mission dependent constant multiplier for terminal range angle equation
Tr2	0.	N/D	Mission dependent constants for N3 and N4 equations
Tr3	0.	N/D	
---	200.	sec	Time to initiate thrust misalignment correction
T2	0.	sec	Terminal steering time argument
ΔTNCM	R-ASTR	sec	Nominal computation cycle length
ILD	0.	N/D	IGM staging flag (Burn switch)
AP1	-.42666501	E+00	Transformation matrix from navigation coordinate system to the (X4, Y4, Z4) coordinate system Az = 72. φL = 28.531856 θN = 119.0548 i = 31.6143
AP2	+.49514778	E-01	
AP3	+.90305320	E+00	
AP4	-.41829534	E-02	
AP5	+.99838143	E+00	
AP6	-.56717968	E-01	
AP7	-.90440002	E+00	
AP8	-.27976999	E-01	
AP9	-.42576733	E+00	
---	257.	sec	Time from time base 3 to sample F/M for IGM staging (Approximately 70 sec. prior to nominal IGM staging)
FLAS	2.	N/D	Number of F/M decreases required for IGM staging criteria

TABLE 3B (Cont'd)

AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
IGM PRESETTINGS

<u>LVDC</u> <u>SYMBOL</u>	<u>INITIAL</u> <u>VALUE</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
ACC	0.01	m/sec ²	F/M comparison tolerance for IGM staging
T10	316.8	sec	} Constants for updating second stage time-to-go for perturbed EMR shift time
AC	495.8	sec	
A1	- 1.22	N/D	
PCO	60.	sec	Backup time for IGM staging
T10	555.888	sec	} Constants for artificial τ_3 mode
CC	35.	sec	
M02	130951.96	kg	
M1	242.264	kg/sec	
M3	199.427	kg/sec	

TABLE 4B

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
ORBITAL ATTITUDE MANEUVERS

<u>FLIGHT TIME</u> <u>(HR:MIN:SEC)</u>	<u>(SEC)</u>	<u>DESCRIPTION</u>
00:09:58	598	Maintain cutoff inertial attitude for 90 seconds after initiation of time base four (TB4).
00:10:43	643	Jettison nose cap.
00:11:28	688	Initiate pitch maneuver to align S-IVB/(IM) with local horizontal and maintain [(IM) forward/position I down] with respect to local reference.
00:19:58	1198	Deploy SIA panels.
00:50:00	3000	Initiate maneuver to attain separation inertial attitude. Inertial attitude specified by pitch +87.1°, yaw -0.9°, roll 0° with respect to GRR inertial reference.
00:53:55	3235	Nominal (IM) separation.
00:56:55	3415	Initiate maneuver to align S-IVB with local horizontal and maintain (SIA forward/position I down) with respect to local reference.
01:31:25	5485	Initiate inertial attitude hold using gimbal angles at specified initiate time. Maintain inertial attitude.
01:45:55	6355	Initiate pitch maneuver to place S-IVB in retro attitude with roll axis aligned along local horizontal. Maintain with respect to local reference.
02:20:38	8438	Initiate maneuver to pitch to 270° and maintain with local horizontal.
02:36:38	9398	Initiate maneuver to pitch to local horizontal (retro-attitude position I up) and maintain throughout remainder of flight.
04:30:00	16200	S-IVB loss of attitude control capability.

APPENDIX C: "LAUNCH VEHICLE TRAJECTORY LISTINGS, ENGLISH UNITS"

TABLE 1C
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-B STAGE FLIGHT DATA

FLIGHT TIME (SEC)	SPACE FIXED			SPACE FIXED POSITION AND VELOCITY VECTOR COMPONENTS			---		
	RADIUS (FT)	VELOCITY (FT/S)	PATH ANGLE (DEG)	X (FT)	Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)
1) 5.00	20909949.	1341.64	90.000	20909867.	55942.	-18177.	0.00	414.59	1275.97
2) 0.00	20909949.	1341.64	90.000	20909865.	58015.	-11797.	-0.43	414.37	1276.05
5.00	20910056.	1342.36	88.130	20909969.	60086.	-5416.	42.94	414.05	1276.18
10.00	20910397.	1344.69	86.008	20910304.	62155.	965.	92.32	413.71	1276.13
15.00	20911002.	1350.11	83.627	20910903.	64223.	7346.	148.15	413.48	1276.67
20.00	20911908.	1361.72	80.968	20911799.	66290.	13736.	211.63	413.23	1280.13
25.00	20913152.	1382.03	78.094	20913031.	68355.	20155.	282.54	412.96	1288.27
30.00	20914772.	1413.87	75.078	20914637.	70419.	26630.	361.03	412.60	1303.24
35.00	20916806.	1460.13	72.023	20916654.	72481.	33203.	447.11	412.18	1327.47
40.00	20919291.	1523.29	69.051	20919120.	74541.	39524.	540.56	411.78	1363.32
45.00	20922264.	1605.35	66.283	20922071.	76599.	46859.	641.04	411.40	1413.14
50.00	20925759.	1707.82	63.818	20925542.	78655.	54083.	748.17	411.00	1479.18
55.00	20929809.	1829.77	61.721	20929563.	80709.	61678.	860.71	410.57	1561.62
60.00	20934426.	1966.88	60.153	20934147.	82761.	69726.	971.74	410.12	1660.16
65.00	20939591.	2117.79	59.091	20939273.	84810.	78307.	1075.58	409.68	1775.31
70.00	20945315.	2290.31	58.319	20944952.	86858.	87515.	1193.17	409.19	1911.66
74.00	20950321.	2445.59	57.854	20949917.	88493.	95408.	1290.48	408.72	2037.28
80.00	20958603.	2710.41	57.371	20958127.	90943.	108265.	1448.04	407.98	2254.56
85.00	20966265.	2959.81	57.172	20965715.	92982.	120050.	1588.71	407.39	2463.84
90.00	20974661.	3236.94	57.170	20974025.	95017.	132951.	1736.00	406.74	2701.61
95.00	20983824.	3541.84	57.340	20983084.	97049.	147114.	1888.75	406.02	2968.57
100.00	20993784.	3874.00	57.642	20992920.	99077.	162685.	2046.25	405.20	3264.44
105.00	21004568.	4233.79	58.038	21003555.	101101.	179807.	2208.64	404.09	3589.37
110.00	21016207.	4622.06	58.489	21015016.	103118.	198627.	2376.70	402.84	3943.66
115.00	21028738.	5040.90	58.982	21027332.	105129.	219296.	2550.61	401.44	4329.42
120.00	21042194.	5492.39	59.518	21040531.	107132.	241978.	2729.67	399.88	4749.24
125.00	21056607.	5979.06	60.114	21054633.	109126.	266852.	2911.49	397.53	5207.14
130.00	21071390.	6504.51	60.791	21069645.	111107.	294122.	3092.77	394.83	5708.55
4) 133.20	21082346.	6863.07	61.285	21079724.	112368.	312919.	3205.78	393.00	6055.60
5) 133.14	21102646.	7578.44	62.154	21099416.	114693.	350966.	3425.98	389.35	6748.61
6) 142.14	21113334.	7771.43	62.606	21100747.	115859.	371543.	3451.75	388.28	6951.97
7) 143.44	21117970.	7775.03	62.839	21114219.	116364.	380599.	3422.10	388.07	6970.63
8) 143.52	21118259.	7774.20	62.854	21114490.	116395.	381150.	3419.76	388.06	6970.86

- 1) GRR;
- 2) First Motion;
- 3) Maximum Dynamic Pressure;
- 4) Tilt Arrest;
- 5) IECC;
- 6) OECO;
- 7) Separation Signal;
- 8) Physical Separation.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	EARTH FIXED			EARTH FIXED POSITION AND VELOCITY VECTOR COMPONENTS					
	POSITION (FT)	VELOCITY (FT/S)	PATH ANGLE (DEG)	X (FT)	Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)
1) 5.00	113.	0.00	N/A	113.	-0.	0.	-0.00	0.00	-0.00
2) 1.00	113.	0.00	N/A	113.	-0.	-0.	-0.00	0.00	0.00
5.00	220.	43.80	0.298	220.	-0.	0.	43.80	-0.10	0.03
10.00	561.	33.61	0.309	561.	-1.	0.	93.61	-0.25	-0.18
15.00	1166.	149.87	0.291	1166.	-3.	-1.	149.87	-0.30	0.16
21.00	2072.	213.81	0.983	2072.	-4.	6.	213.78	-0.39	3.35
25.00	3317.	295.35	2.303	3316.	-7.	40.	285.14	-0.52	11.15
31.00	4938.	365.00	4.095	4936.	-10.	129.	364.10	-0.74	25.70
35.00	6377.	453.39	6.312	6970.	-14.	312.	450.69	-1.04	49.41
40.00	9477.	551.25	8.886	9456.	-20.	642.	544.71	-1.32	84.64
45.00	12485.	659.52	11.750	12429.	-27.	1182.	645.82	-1.57	133.74
51.00	16051.	779.51	14.833	15925.	-36.	2007.	753.69	-1.82	198.94
55.00	20230.	911.31	17.965	19975.	-45.	3198.	867.09	-2.07	280.42
61.00	25055.	1049.52	21.143	24594.	-56.	4838.	979.13	-2.28	377.90
65.00	30574.	1194.16	24.358	29761.	-68.	7004.	1088.13	-2.43	491.90
70.00	36812.	1356.67	27.550	35485.	-81.	9792.	1203.10	-2.55	626.98
74.00	42391.	1503.02	30.015	40492.	-91.	12544.	1301.67	-2.67	751.48
80.00	51882.	1752.35	33.490	48776.	-107.	17681.	1461.46	-2.74	966.88
85.00	60952.	1983.23	36.192	56437.	-121.	23023.	1604.33	-2.64	1174.40
90.00	71215.	2250.75	38.767	64831.	-134.	29472.	1754.16	-2.47	1410.25
95.00	82802.	2540.39	41.202	73988.	-145.	37174.	1909.87	-2.18	1675.11
100.00	95847.	2857.24	43.476	83938.	-155.	46271.	2070.76	-1.80	1968.70
105.00	110488.	3202.14	45.580	94705.	-164.	56909.	2236.99	-1.50	2291.19
110.00	126872.	3576.29	47.506	106318.	-170.	69231.	2409.41	-1.12	2642.84
115.00	145153.	3981.72	49.279	118809.	-175.	83389.	2588.24	-0.64	3025.75
120.00	165496.	4420.35	50.928	132210.	-176.	99545.	2772.83	-0.03	3442.52
125.00	188060.	4894.36	52.503	146543.	-176.	117878.	2960.85	0.12	3897.19
130.00	213055.	5406.51	54.051	161819.	-175.	138589.	3149.13	0.32	4395.19
135.20	230399.	5756.86	55.056	172086.	-173.	153200.	3267.08	0.58	4740.00
139.14	265638.	6457.66	56.759	192172.	-168.	183394.	3497.43	1.28	5428.57
142.14	284781.	6644.00	57.441	202724.	-163.	200008.	3527.28	2.05	5630.37
145.44	293196.	6644.52	57.713	207295.	-160.	207346.	3498.80	2.40	5648.72
143.32	233707.	6643.51	57.729	207572.	-160.	207793.	3496.53	2.42	5648.94

- 1) GRR;
- 2) First Motion;
- 3) Maximum Dynamic Pressure;
- 4) Tilt Arrest;
- 5) IEEO;
- 6) OEEO;
- 7) Separation Signal;
- 8) Physical Separation.

TABLE 1C (Cont'd)
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	MASS (LB)	THRUST (TOTAL) (LB)	DRAW (LB)	LONGITUDINAL ACCELERATION (FT/SEC ²)	DYNAMIC PRESSURE (LB/FT ²)	A.H.I. (LB-FT/FT ² -RAD)	MACH NO.	PITCH ANGLE OF ATTACK (DEG)
1) -5.00	1299059.	0.	0.	0.000	0.	0.	0.00	0.000
2) 0.00	1285044.	1575301.	1323.	39.752	0.	0.	0.00	0.000
5.00	1254262.	1608531.	2945.	41.537	2.	77.	0.04	1.471
10.00	1223353.	1615700.	6238.	42.688	10.	1417.	0.08	2.831
15.00	1192304.	1630743.	8775.	44.134	25.	8229.	0.13	1.554
20.00	1161063.	1645569.	11042.	45.666	50.	29972.	0.19	1.054
25.00	1129704.	1659136.	15832.	47.179	85.	83996.	0.25	0.813
30.00	1098256.	1673671.	20349.	48.818	133.	197904.	0.33	0.289
35.00	1066743.	1688298.	26325.	50.515	193.	411858.	0.41	-0.063
40.00	1035188.	1703904.	34285.	52.287	264.	779798.	0.50	-0.299
45.00	1003609.	1719474.	40900.	54.213	344.	1369243.	0.60	-0.444
50.00	972014.	1735507.	48691.	56.240	430.	2259981.	0.72	-0.435
55.00	940417.	1751527.	74291.	57.796	516.	3537987.	0.85	-0.465
60.00	908844.	1765018.	150668.	57.572	588.	5269166.	1.00	-0.528
65.00	877221.	1779785.	163980.	59.695	640.	7460151.	1.16	-0.599
70.00	845473.	1794215.	148648.	63.064	673.	10113155.	1.36	-0.670
74.00	820072.	1804984.	126201.	66.313	683.	12562693.	1.53	-0.515
80.00	781977.	1817767.	98457.	71.200	657.	16713587.	1.85	-0.179
85.00	750242.	1825922.	73561.	75.625	586.	20418197.	2.12	0.079
90.00	718687.	1831122.	52484.	80.120	481.	24011379.	2.37	0.093
95.00	687200.	1834076.	36972.	84.655	382.	27296578.	2.64	0.091
100.00	655741.	1834756.	26018.	89.286	294.	30192660.	2.93	-0.007
105.00	624324.	1833849.	17843.	94.154	220.	32658952.	3.24	0.031
110.00	592957.	1832053.	11310.	99.392	157.	34671617.	3.54	-0.131
115.00	561653.	1828744.	5102.	105.099	109.	36248510.	3.87	-0.273
120.00	530427.	1824026.	1999.	111.189	74.	37449186.	4.18	-0.808
125.00	499294.	1818654.	426.	117.879	49.	38336859.	4.54	-1.505
130.00	468269.	1812015.	-792.	125.322	33.	38989636.	4.95	-2.741
4) 133.20	448500.	1806791.	-1654.	130.536	25.	39307813.	5.33	-3.676
5) 139.14	411921.	1792962.	-3019.	141.143	15.	39769595.	6.15	-2.079
6) 142.14	400716.	801889.	-3104.	64.635	11.	39930083.	6.46	-1.279
7) 143.44	399093.	48375.	-2680.	4.116	9.	39983745.	6.52	-0.992
8) 143.52	399063.	44913.	-2650.	3.835	9.	39986697.	6.52	-0.975

- 1) GRC;
- 2) First Motion;
- 3) Maximum Dynamic Pressure;
- 4) Tilt Arrest;
- 5) IBCO;
- 6) OBCO;
- 7) Separation Signal;
- 8) Physical Separation.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	ALTITUDE (FT)	RANGE (NM)	VELOCITY SPACE FIXED (DEG)	VELOCITY VECTOR EARTH FIXED (DEG)	AZIMUTH (DEG)	LONGITUDE (POS. EAST) (DEG)	DECLINATION (DEG)	GEOCENTRIC LATITUDE (DEG)
1) 5.00	112.	0.000	90.000	N/A	N/A	-80.565	28.371	28.532
2) 5.00	112.	0.000	90.000	N/A	N/A	-80.565	28.371	28.532
5.00	218.	0.000	89.990	N/A	N/A	-80.565	28.371	28.532
10.00	560.	0.000	89.981	N/A	N/A	-80.565	28.371	28.532
15.00	1165.	0.001	89.968	N/A	N/A	-80.565	28.371	28.532
20.00	2071.	0.002	89.914	56.743	56.743	-80.565	28.371	28.532
25.00	3315.	0.007	89.799	65.594	65.594	-80.565	28.371	28.532
30.00	4935.	0.022	89.594	68.224	68.224	-80.565	28.371	28.532
35.00	5969.	0.053	89.277	69.419	69.419	-80.564	28.371	28.532
40.00	9454.	0.107	88.835	70.135	70.135	-80.563	28.371	28.532
45.00	12428.	0.196	88.260	70.594	70.594	-80.561	28.372	28.533
50.00	15924.	0.333	87.558	70.902	70.902	-80.555	28.373	28.534
55.00	19975.	0.529	86.763	71.111	71.111	-80.556	28.374	28.535
60.00	24594.	0.799	85.913	71.266	71.266	-80.551	28.375	28.536
65.00	29760.	1.156	85.038	71.390	71.390	-80.544	28.377	28.538
70.00	35486.	1.614	84.133	71.488	71.488	-80.536	28.375	28.540
74.00	40495.	2.067	83.403	71.550	71.550	-80.528	28.382	28.543
3) 80.00	44782.	2.910	82.329	71.632	71.632	-80.513	28.386	28.547
85.00	55448.	3.787	81.474	71.695	71.695	-80.497	28.391	28.552
90.00	64950.	4.845	80.662	71.751	71.751	-80.478	28.396	28.557
95.00	74020.	6.107	79.907	71.804	71.804	-80.455	28.403	28.564
100.00	83988.	7.597	79.215	71.852	71.852	-80.429	28.411	28.571
105.00	94781.	9.337	78.587	71.893	71.893	-80.397	28.420	28.580
110.00	106431.	11.352	78.022	71.934	71.934	-80.361	28.430	28.591
115.00	118374.	13.664	77.517	71.974	71.974	-80.319	28.442	28.603
120.00	132445.	16.299	77.065	72.016	72.016	-80.272	28.456	28.616
125.00	145872.	19.286	76.654	72.051	72.051	-80.218	28.471	28.631
130.00	162274.	22.657	76.284	72.089	72.089	-80.157	28.488	28.649
4) 133.20	172642.	25.032	76.069	72.117	72.117	-80.115	28.500	28.661
5) 139.14	192968.	29.935	75.714	72.172	72.172	-80.026	28.525	28.686
6) 142.14	203670.	32.629	75.640	72.206	72.206	-79.977	28.539	28.699
7) 143.44	208312.	33.818	75.644	72.220	72.220	-79.956	28.545	28.705
8) 143.52	208593.	33.851	75.644	72.221	72.221	-79.955	28.546	28.706

- 1) GRR;
- 2) First Motion;
- 3) Maximum Dynamic Pressure;
- 4) Tilt Arrest;
- 5) IECO;
- 6) DECO;
- 7) Separation Signal;
- 8) Physical Separation.

TABLE 1C (Cont'd.)
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-1B STAGE FLIGHT DATA

FLIGHT TIME (SEC)	VEHICLE ATTITUDE ANGLE			VEHICLE ATTITUDE RATE			VEHICLE ATTITUDE ERROR		
	PITCH (DEG)	YAW (DEG)	ROLL (DEG)	PITCH (DEG/S)	YAW (DEG/S)	ROLL (DEG/S)	PITCH (DEG)	YAW (DEG)	ROLL (DEG)
1) -5.00	0.000	0.000	18.000	-0.003	0.001	-0.002	0.000	0.000	0.000
2) 0.00	-0.017	0.006	17.990	-0.003	0.001	-0.002	-0.017	0.006	-0.010
10.00	-0.003	-0.019	18.001	-0.000	-0.000	0.000	-0.003	-0.019	0.001
15.00	-0.567	-0.001	14.384	-0.117	-0.013	-1.087	0.109	-0.001	1.184
20.00	-1.500	0.012	9.387	-0.229	-0.001	-1.002	0.195	0.012	1.187
25.00	-2.863	0.002	4.385	-0.313	-0.004	-1.000	0.267	0.002	1.185
30.00	-4.638	-0.022	-0.007	-0.394	-0.004	-0.169	0.323	-0.022	-0.007
35.00	-6.800	-0.023	0.000	-0.469	-0.000	-0.001	0.365	-0.023	0.000
40.00	-9.312	-0.024	-0.002	-0.536	-0.000	0.000	0.410	-0.024	-0.002
45.00	-12.139	-0.027	-0.005	-0.595	-0.001	-0.001	0.476	-0.027	-0.005
50.00	-15.057	-0.032	-0.008	-0.563	-0.001	0.001	0.529	-0.032	-0.008
55.00	-18.088	-0.039	-0.010	-0.609	-0.001	-0.000	0.599	-0.039	-0.010
60.00	-21.189	-0.041	-0.013	-0.625	-0.000	-0.001	0.651	-0.041	-0.013
65.00	-24.280	-0.047	-0.016	-0.617	-0.001	-0.001	0.728	-0.047	-0.016
70.00	-27.332	-0.051	-0.021	-0.595	-0.001	-0.001	0.824	-0.051	-0.021
74.00	-29.627	-0.060	-0.018	-0.592	-0.000	0.003	1.007	-0.060	-0.018
80.00	-33.374	-0.047	-0.008	-0.602	-0.000	0.003	0.866	-0.047	-0.008
85.00	-36.424	-0.047	0.002	-0.606	0.000	0.001	0.679	-0.047	0.002
90.00	-39.325	-0.045	0.002	-0.547	0.001	-0.000	0.472	-0.045	0.002
95.00	-41.907	-0.040	0.002	-0.488	0.000	-0.000	0.379	-0.040	0.002
100.00	-44.303	-0.039	-0.000	-0.451	0.000	-0.000	0.325	-0.039	-0.000
105.00	-46.357	-0.062	0.001	-0.395	0.002	-0.000	0.333	-0.062	0.001
110.00	-48.285	-0.063	-0.001	-0.382	-0.001	-0.001	0.309	-0.063	-0.001
115.00	-50.185	-0.070	-0.002	-0.390	-0.001	-0.001	0.313	-0.070	-0.002
120.00	-52.219	-0.074	-0.005	-0.431	-0.001	-0.001	0.342	-0.074	-0.005
125.00	-54.534	-0.161	-0.005	-0.494	0.008	-0.000	0.409	-0.161	-0.005
130.00	-57.267	-0.161	-0.007	-0.601	-0.000	-0.000	0.535	-0.161	-0.007
133.20	-59.274	-0.163	-0.009	-0.505	-0.001	-0.005	0.155	-0.163	-0.009
139.14	-59.491	-0.170	-0.003	0.000	-0.001	0.001	-0.062	-0.170	-0.003
142.14	-59.460	-0.085	-0.002	0.002	0.003	0.001	-0.031	-0.085	-0.002
143.44	-53.460	-0.084	-0.004	-0.002	-0.000	-0.003	-0.031	-0.084	-0.004
143.52	-59.460	-0.084	-0.004	-0.002	-0.000	-0.003	-0.031	-0.084	-0.004

- 1) GRR;
- 2) First Motion;
- 3) Maximum Dynamic Pressure;
- 4) Tilt Arrest;
- 5) IECC;
- 6) OECO;
- 7) Separation Signal;
- 8) Physical Separation.

TABLE 2C
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	---- SPACE FIXED ----			--- SPACE FIXED POSITION AND VELOCITY VECTOR COMPONENTS ---					
	RADIUS (FT)	VELOCITY (FT/S)	PATH ANGLE (DEG)	X (FT)	Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)
1) 143.52	21118250.	7774.20	62.854	21114490.	116395.	381150.	3419.76	389.06	6970.86
2) 144.84	21122910.	7756.39	63.102	21118980.	116907.	390358.	3378.64	387.88	6971.08
3) 147.19	21131077.	7727.88	63.546	21126834.	117818.	406741.	3306.90	387.55	6973.84
4) 148.14	21134337.	7728.79	63.719	21129964.	118186.	413371.	3284.02	387.34	6985.66
5) 150.84	21140657.	7741.58	64.048	21136023.	118905.	426367.	3244.84	386.70	7018.08
6) 155.44	21158838.	7789.70	64.990	21138754.	119231.	432296.	3227.36	386.35	7033.19
7) 159.25	21171254.	7831.63	65.631	21165180.	122463.	492091.	3062.75	382.69	7197.75
170.00	21205028.	7963.09	67.489	21196970.	126593.	570678.	2847.67	389.08	7426.31
190.00	21269556.	8254.40	70.866	21249811.	134591.	724661.	2436.36	411.00	7875.94
210.00	21313326.	8599.77	73.978	21294428.	143054.	885851.	2025.61	436.87	8346.38
230.00	21357589.	8994.60	76.794	21330844.	152101.	1057640.	1616.05	468.12	8825.84
250.00	21395603.	9438.33	79.323	21359060.	161788.	1239439.	1205.49	500.82	9347.63
270.00	21427629.	9929.52	81.569	21379052.	172141.	1431704.	793.07	534.68	9883.34
290.00	21453936.	10466.56	83.542	21390765.	181183.	1634937.	377.51	569.06	10444.26
310.00	21474804.	11051.04	85.263	21394110.	194892.	1849675.	-43.53	603.38	11034.47
330.00	21490550.	11682.91	86.737	21388988.	207341.	2076524.	-469.77	641.80	11655.81
350.00	21501519.	12363.53	87.984	21375271.	220575.	2316134.	-903.60	681.97	12311.60
370.00	21508073.	13095.98	89.020	21352778.	234632.	2569248.	-1347.41	724.01	13006.34
390.00	21510622.	13881.02	89.856	21321303.	249548.	2836659.	-1802.14	767.93	13742.10
410.00	21509627.	14725.11	90.507	21280599.	265364.	3119252.	-2271.02	814.14	14526.13
430.00	21505593.	15635.70	90.984	21230348.	282132.	3418078.	-2757.32	863.03	15366.44
450.00	21499102.	16617.61	91.293	21170175.	299905.	3734320.	-3263.53	914.82	16268.30
470.00	21490835.	17678.15	91.443	21099655.	318746.	4069269.	-3792.88	969.83	17239.22
475.75	21488232.	17990.26	91.465	21077395.	324368.	4169215.	-3950.39	985.82	17523.47
490.00	21481466.	18741.58	91.494	21018296.	338688.	4423787.	-4347.02	1023.59	18201.77
510.00	21471401.	19811.66	91.475	20925524.	359482.	4797308.	-4933.83	1076.07	19157.28
530.00	21461473.	20950.83	91.301	20820854.	381746.	5190485.	-5540.02	1130.98	20173.41
550.00	21452686.	22181.77	91.019	20703634.	404944.	5604758.	-6189.38	1189.34	21267.53
570.00	21446040.	23524.73	90.638	20572914.	429348.	6041815.	-6894.48	1251.97	22456.88
590.00	21442496.	25011.84	90.211	20427280.	455057.	6503830.	-7692.07	1319.36	23763.07
598.15	21442090.	25661.07	90.004	20363162.	465930.	6698834.	-8038.39	1348.57	24332.21
608.15	21442117.	25684.37	89.992	20281297.	479995.	6942881.	-8332.33	1343.48	24258.08

- 1) Separation Completed;
- 2) J-2 Start Command;
- 3) Terminate Ullage Burn;
- 4) 90% Thrust Level;
- 5) Command P.U. Activation;
- 6) Ullage Case Jettison;
- 7) I.G.M. Initiation;
- 8) E.M.R. Shift sensed by I.G.M.;
- 9) Guidance Cutoff Signal;
- 10) Orbit Insertion.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	EARTH FIXED VELOCITY		PATH ANGLE		EARTH FIXED POSITION AND VELOCITY VECTOR COMPONENTS					
	POSITION (FT)	VELOCITY (FT/S)	(DEG)	X (FT)	Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)	
1) 143.52	293707.	6643.51	57.729	207572.	-160.	207793.	3496.53	2.42	5648.9.	
2) 144.84	302239.	6622.51	58.004	212164.	-156.	215255.	3456.43	2.77	5648.9.	
3) 147.19	317357.	6588.37	58.498	220203.	-149.	228530.	3386.55	3.38	5651.3.	
4) 148.14	323455.	6587.07	58.700	223410.	-146.	233904.	3364.52	3.59	5662.9.	
5) 150.00	323455.	6587.07	58.700	223410.	-146.	233904.	3364.52	3.59	5662.9.	
6) 150.84	340805.	6600.15	59.270	232420.	-136.	249257.	3310.40	3.87	5709.9.	
7) 155.44	370469.	6631.98	60.226	247443.	-117.	275715.	3223.02	4.11	5796.1.	
8) 159.25	395143.	6666.06	61.004	259579.	-101.	297921.	3154.06	4.35	5872.6.	
9) 170.00	465542.	6775.30	63.257	292409.	-9.	362252.	2950.16	16.48	6099.2.	
10) 190.00	599637.	7029.69	67.364	347521.	654.	488665.	2561.20	50.35	6546.3.	
11) 210.00	738659.	7345.45	71.147	394875.	2037.	624249.	2174.79	89.74	7015.5.	
12) 230.00	883654.	7717.19	74.557	434534.	4290.	769420.	1791.66	136.12	7505.0.	
13) 250.00	1035681.	8143.40	77.600	466546.	7503.	924616.	1409.74	185.66	8018.3.	
14) 270.00	1195803.	8621.66	80.278	490929.	11736.	1090320.	1028.33	238.15	8556.8.	
15) 290.00	1365090.	9149.44	82.608	507677.	17049.	1267061.	646.28	293.03	9121.8.	
16) 310.00	1544601.	9727.49	84.617	516755.	23459.	1455406.	261.46	349.88	9717.6.	
17) 330.00	1735427.	10355.00	86.319	518120.	31080.	1655986.	-125.63	412.95	10346.0.	
18) 350.00	1938661.	11032.84	87.741	511703.	40003.	1869483.	-517.16	480.05	11010.2.	
19) 370.00	2155444.	11763.64	88.909	497190.	50311.	2096667.	-915.24	551.48	11715.0.	
20) 390.00	2386938.	12547.85	89.841	475046.	62092.	2338365.	-1320.56	627.43	12462.3.	
21) 410.00	2624361.	13391.63	90.557	444502.	75443.	2595493.	-1735.93	708.55	13259.7.	
22) 430.00	2899068.	14302.26	91.075	405525.	90473.	2869139.	-2164.18	795.54	14115.1.	
23) 450.00	3182525.	15284.40	91.406	357837.	107307.	3160523.	-2607.33	888.93	15034.1.	
24) 470.00	3486254.	16345.26	91.561	301117.	126077.	3470977.	-3068.09	989.39	16024.2.	
25) 490.00	3811493.	17409.05	91.609	234972.	131852.	3563954.	-3205.04	1019.07	16314.4.	
26) 510.00	4157801.	18479.54	91.582	158884.	146889.	3801406.	-3550.16	1091.33	17008.2.	
27) 530.00	4526121.	19619.05	91.389	72464.	169743.	4151296.	-4061.44	1194.88	17988.0.	
28) 550.00	4918137.	20850.25	91.084	-24816.	194727.	4521350.	-4586.37	1304.87	19030.7.	
29) 570.00	5335805.	22191.36	90.677	-133762.	251718.	5328186.	-5757.27	1551.31	21377.3.	
30) 590.00	5781633.	23680.52	90.223	-255621.	284125.	5768987.	-6450.20	1691.11	22722.2.	
31) 598.15	5972056.	24329.73	90.004	-309432.	298156.	5956577.	-6751.01	1751.91	23308.6.	
32) 608.15	6209063.	24353.00	89.992	-378283.	315765.	6189480.	-7017.66	1768.30	23252.8.	

- 1) Separation Completed;
- 2) J-2 Start Command;
- 3) Terminate Ullage Burn;
- 4) 90% Thrust Level;
- 5) Command P.U. Activation;
- 6) Ullage Case Jettison;
- 7) I.G.M. Initiation;
- 8) E.M.R. Shift sensed by I.G.M.;
- 9) Guidance Cutoff Signal;
- 10) Orbit Insertion.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	MASS (LB)	THRUST (TOTAL) (LB)	LONGITUDINAL ACCELERATION (FT/S ²)	DYNAMIC PRESSURE (LB/FT ²)	CENTRAL RANGE ANGLE (DEG)	PITCH ATT. COMMAND (DEG)	PITCH ANGLE OF ATTACK (DEG)
1) 142.52	296213.	8749.	0.877	9.	1.096	-59.429	-0.975
2) 144.84	296139.	8625.	0.876	7.	1.121	-59.429	-0.765
3) 147.15	295886.	8567.	9.268	5.	1.155	-59.429	-0.647
4) 148.14	295643.	179392.	19.485	5.	1.182	-59.429	-0.535
5) 150.00	294800.	179392.	19.485	3.	1.217	-59.429	0.075
6) 155.44	292205.	196761.	21.477	3.	1.233	-59.429	0.384
7) 159.25	290017.	220493.	24.265	2.	1.320	-59.429	1.540
170.00	284401.	220673.	24.474	1.	1.393	-59.429	2.347
190.00	273863.	222609.	25.182	0.	1.603	-64.534	-0.288
210.00	263288.	224317.	26.753	0.	2.011	-66.132	3.317
230.00	252735.	224567.	27.442	0.	2.443	-67.318	6.547
250.00	242192.	224401.	28.567	0.	2.900	-68.518	8.839
270.00	231657.	224100.	29.770	0.	3.382	-69.742	11.306
290.00	221145.	224159.	31.159	0.	3.893	-71.178	13.026
310.00	210624.	224007.	32.590	0.	4.433	-72.435	14.266
330.00	200116.	224142.	34.239	0.	5.005	-73.693	15.532
350.00	189606.	224001.	36.014	0.	5.609	-75.144	16.331
370.00	179093.	224208.	38.045	0.	6.249	-76.717	16.796
390.00	168604.	223856.	40.215	0.	6.927	-78.218	17.092
410.00	158112.	223326.	42.616	0.	7.645	-79.751	17.184
430.00	147613.	223587.	45.497	0.	8.407	-81.435	16.954
450.00	137129.	223607.	48.737	0.	9.215	-83.104	16.571
470.00	126678.	222715.	52.254	0.	10.074	-84.699	16.161
490.00	117050.	220903.	56.104	0.	10.987	-86.419	15.472
510.00	108177.	211020.	54.855	0.	11.261	-86.772	15.377
530.00	99471.	194288.	53.404	0.	11.959	-87.966	14.931
550.00	90868.	197988.	55.910	0.	12.986	-88.953	14.776
570.00	82345.	186328.	60.266	0.	14.074	-90.868	13.908
590.00	73858.	183704.	65.043	0.	15.225	-92.810	12.805
608.15	70446.	183156.	71.561	0.	16.445	-95.463	11.000
702.05	70205.	180831.	78.760	0.	17.741	-98.046	7.753
		180233.	82.314	0.	18.293	-98.060	9.367
		360.	0.165	0.	18.979	-98.060	10.040

- 1) Separation Completed;
- 2) J-2 Start Command;
- 3) Terminate Ullage Burn;
- 4) 90% Thrust Level;
- 5) Command P.U. Activation;

- 6) Ullage Case Jettison;
- 7) I.G.M. Initiation;
- 8) E.M.R. Shift sensed by I.G.M.;
- 9) Guidance Cutoff Signal;
- 10) Orbit Insertion.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-1WB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	ALTITUDE (FT)	RANGE (NM)	SPACE FIXED (DEG)	VELOCITY VECTOR EARTH FIXED (DEG)	AZIMUTH (DEG)	LONGITUDE (POS. EAST) (DEG)	GEOCENTRIC DECLINATION (DEG)	GEOCENTRIC LATITUDE (DEG)
1) 143.52	208593.	33.891	75.644	72.221	-79.955	28.546	28.546	28.706
2) 144.84	213260.	35.100	75.657	72.236	-79.933	28.552	28.552	28.712
3) 147.19	221437.	37.249	75.679	72.263	-79.894	28.563	28.563	28.723
4) 148.14	224702.	38.119	75.683	72.273	-79.878	28.567	28.567	28.727
5) 150.00	231031.	39.824	75.683	72.292	-79.848	28.576	28.576	28.736
6) 155.44	249238.	44.879	75.679	72.342	-79.834	28.580	28.580	28.740
7) 159.25	261673.	48.464	75.675	72.378	-79.756	28.601	28.601	28.761
8) 170.00	295501.	58.833	75.753	72.589	-79.691	28.619	28.619	28.779
9) 190.00	353131.	79.145	75.977	73.068	-79.135	28.771	28.771	28.831
10) 210.00	404009.	100.862	76.235	73.565	-78.740	28.875	28.875	29.035
11) 230.00	448384.	124.062	76.533	74.089	-78.316	28.983	28.983	29.142
12) 250.00	486514.	148.830	76.843	74.607	-77.862	29.094	29.094	29.254
13) 270.00	518660.	175.256	77.163	75.120	-77.376	29.209	29.209	29.369
14) 290.00	545091.	203.443	77.492	75.626	-76.855	29.327	29.327	29.488
15) 310.00	566087.	233.499	77.828	76.126	-76.298	29.449	29.449	29.610
16) 330.00	581966.	265.546	78.193	76.647	-75.702	29.575	29.575	29.736
17) 350.00	593070.	299.714	78.577	77.175	-75.064	29.704	29.704	29.865
18) 370.00	599764.	336.152	78.980	77.713	-74.382	29.836	29.836	29.997
19) 390.00	602456.	375.016	79.405	78.264	-73.651	29.970	29.970	30.132
20) 410.00	601607.	416.481	79.853	78.831	-72.869	30.107	30.107	30.270
21) 430.00	597721.	460.751	80.328	79.417	-72.032	30.247	30.247	30.410
22) 450.00	591380.	508.052	80.833	80.025	-71.134	30.387	30.387	30.551
23) 470.00	583265.	558.630	81.369	80.659	-70.170	30.528	30.528	30.693
24) 475.75	580706.	573.812	81.530	80.846	-69.880	30.569	30.569	30.733
25) 490.00	574048.	612.662	81.941	81.319	-69.137	30.669	30.669	30.834
26) 510.00	564133.	670.108	82.547	82.006	-68.036	30.808	30.808	30.973
27) 530.00	554351.	731.174	83.190	82.725	-66.863	30.943	30.943	31.109
28) 550.00	545704.	795.951	83.873	83.480	-65.612	31.073	31.073	31.239
29) 570.00	539191.	864.937	84.601	84.276	-64.277	31.195	31.195	31.362
30) 590.00	535771.	938.481	85.376	85.115	-62.850	31.309	31.309	31.475
31) 598.15	535411.	969.870	85.707	85.472	-62.240	31.351	31.351	31.518
32) 608.15	535491.	1008.935	86.125	85.913	-61.480	31.400	31.400	31.567

- 1) Separation Completed;
- 2) J-2 Start Command;
- 3) Terminate Ullage Burn;
- 4) 90% Thrust Level;
- 5) Command P.U. Activation
- 6) Ullage Case Jettison;
- 7) I.G.M. Initiation;
- 8) E.M.R. Shift sensed by I.G.M.;
- 9) Guidance Cutoff Signal;
- 10) Orbit Insertion.

TABLE 2C (Cont'd)
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	VEHICLE ATTITUDE ANGLE			VEHICLE ATTITUDE RATE			VEHICLE ATTITUDE ERROR		
	PITCH (DEG)	YAW (DEG)	ROLL (DEG)	PITCH (DEG/S)	YAW (DEG/S)	ROLL (DEG/S)	PITCH (DEG)	YAW (DEG)	ROLL (DEG)
1) 143.52	-59.460	-0.084	-0.004	-0.002	-0.000	-0.003	-0.031	-0.084	-0.004
2) 144.84	-59.539	-0.090	-0.012	-0.109	-0.010	-0.008	-0.109	-0.090	-0.012
3) 147.19	-59.940	-0.145	-0.039	-0.186	-0.056	-0.018	-0.511	-0.145	-0.039
4) 148.14	-60.041	-0.233	-0.067	-0.010	-0.123	-0.041	-0.612	-0.233	-0.067
5) 148.14	-60.041	-0.233	-0.067	-0.010	-0.123	-0.041	-0.612	-0.233	-0.067
6) 150.00	-59.846	-0.458	-0.167	0.155	-0.088	-0.058	-0.416	-0.458	-0.167
7) 150.84	-59.725	-0.514	-0.213	0.127	-0.046	-0.052	-0.295	-0.514	-0.213
8) 155.44	-59.584	-0.506	-0.364	-0.005	0.008	-0.019	-0.154	-0.506	-0.364
9) 159.25	-59.609	-0.501	-0.412	0.003	-0.005	-0.007	-0.179	-0.501	-0.412
10) 170.00	-64.668	2.948	0.016	-0.027	-0.023	-0.004	-0.134	-0.498	0.016
11) 190.00	-66.272	3.024	-0.012	-0.054	0.004	-0.003	-0.140	-0.526	-0.012
12) 210.00	-67.446	3.699	-0.038	-0.066	0.018	-0.002	-0.128	-0.563	-0.038
13) 230.00	-68.654	3.807	-0.091	-0.075	0.001	-0.002	-0.137	-0.556	-0.091
14) 250.00	-69.898	3.803	-0.147	-0.061	-0.001	-0.003	-0.156	-0.573	-0.147
15) 270.00	-71.377	3.792	-0.193	-0.056	-0.000	-0.003	-0.199	-0.596	-0.193
16) 290.00	-72.888	3.118	-0.263	-0.120	-0.088	-0.003	-0.453	-1.358	-0.263
17) 310.00	-74.138	3.780	-0.281	-0.063	0.005	-0.002	-0.445	-1.275	-0.281
18) 330.00	-75.613	3.800	-0.323	-0.072	0.000	-0.002	-0.469	-1.309	-0.323
19) 350.00	-77.186	3.780	-0.361	-0.075	-0.003	-0.002	-0.470	-1.359	-0.361
20) 370.00	-78.719	3.760	-0.398	-0.079	-0.001	-0.002	-0.501	-1.405	-0.398
21) 390.00	-80.264	3.741	-0.433	-0.080	-0.001	-0.002	-0.512	-1.451	-0.433
22) 410.00	-81.964	3.719	-0.457	-0.083	0.000	-0.001	-0.529	-1.500	-0.457
23) 430.00	-83.668	3.698	-0.478	-0.081	-0.001	-0.001	-0.565	-1.547	-0.478
24) 450.00	-85.266	3.668	-0.503	-0.081	-0.002	-0.001	-0.566	-1.601	-0.503
25) 470.00	-87.023	3.646	-0.515	-0.085	-0.001	-0.001	-0.604	-1.655	-0.515
26) 475.75	-87.414	3.633	-0.525	-0.055	-0.002	-0.003	-0.642	-1.673	-0.525
27) 490.00	-88.585	3.610	-0.537	-0.109	-0.002	0.001	-0.620	-1.706	-0.537
28) 510.00	-89.743	3.572	-0.579	0.008	-0.003	-0.006	-0.790	-1.749	-0.579
29) 530.00	-91.508	3.535	-0.580	-0.106	-0.001	0.001	-0.640	-1.803	-0.580
30) 550.00	-93.461	3.495	-0.564	-0.110	-0.001	0.002	-0.651	-1.851	-0.564
31) 570.00	-96.085	3.454	-0.507	-0.145	-0.002	0.004	-0.621	-1.894	-0.507
32) 590.00	-100.182	3.351	-0.383	0.180	0.010	-0.004	-1.135	-1.950	-0.383
33) 598.15	-98.901	3.396	-0.414	0.004	-0.002	-0.000	-0.841	-1.949	-0.414
34) 608.15	-98.903	3.380	-0.414	-0.000	-0.001	0.000	-0.843	-1.965	-0.414

- 1) Separation Completed;
- 2) J-2 Start Command;
- 3) Terminate Ullage Burn;
- 4) 90% Thrust Level;
- 5) Command P.U. Activation;

- 6) Ullage Case Jettison;
- 7) I.G.M. Initiation;
- 8) E.M.R. Shift sensed by I.G.M.;
- 9) Guidance Outoff Signal;
- 10) Orbit Insertion.

TABLE 3C-1
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	SPACE FIXED VELOCITY			PATH ANGLE * (DEG)	SPACE FIXED POSITION			SPACE FIXED VELOCITY VECTORS		
	RADIUS (FT)	VELOCITY (FT/S)	X (FT)		Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)	
1) 608.15	21442117.	25684.37	0.008	20281297.	479395.	6942881.	-8332.33	1343.48	24258.08	
638.60	21442297.	25687.82	0.019	20014209.	519998.	7676792.	-9209.18	1323.23	23943.77	
643.35	21442339.	25687.76	0.021	19970143.	526275.	7790400.	-9344.80	1319.88	23891.28	
643.35	21442339.	25687.76	0.021	19970143.	526275.	7790400.	-9344.80	1319.88	23891.28	
688.35	21442909.	25687.01	0.036	19520958.	584923.	8853723.	-10614.09	1286.06	23356.15	
724.46	21443583.	25686.20	0.048	19119629.	630831.	9688607.	-11610.53	1256.24	22877.90	
800.00	21445514.	25683.90	0.072	18165917.	723151.	11375010.	-13622.70	1186.36	21741.15	
992.00	21454414.	25674.48	0.131	15097407.	930762.	15214923.	-18199.98	966.75	18083.27	
1184.00	21467986.	25660.24	0.183	11238494.	1091120.	18258700.	-21820.04	696.27	13485.14	
1198.35	21469171.	25659.00	0.186	10923744.	1100954.	18449527.	-22046.55	674.38	13110.25	
1198.35	21469171.	25659.00	0.186	10923744.	1100954.	18449527.	-22046.55	674.38	13110.25	
1376.00	21485518.	25641.71	0.223	6791939.	1195766.	20348641.	-24294.88	388.94	8191.76	
1568.00	21505977.	25619.67	0.251	1990738.	1239135.	21377759.	-25498.91	60.74	2483.84	
1760.00	21528185.	25595.03	0.264	-2914501.	1218841.	21295138.	-25374.98	-271.33	-3337.97	
1858.40	21539842.	25581.75	0.266	-5385842.	1183933.	20822004.	-24798.41	-437.42	-6266.84	
1952.00	21550904.	25568.90	0.263	-7668984.	1135797.	20108160.	-23936.64	-590.10	-8969.83	
2144.00	21572915.	25542.56	0.249	-12027171.	994147.	17881541.	-21266.06	-879.20	-14121.06	
2336.00	21593094.	25517.38	0.221	-15765454.	801030.	14733313.	-17508.28	-1123.91	-18529.27	
2528.00	21610459.	25494.78	0.184	-18693403.	566202.	10828114.	-12862.15	-1311.87	-21973.34	
2720.00	21624214.	25476.09	0.137	-20663039.	301517.	6368245.	-7568.93	-1433.62	-24283.48	
2912.00	21633761.	25462.51	0.086	-21575751.	20326.	1583096.	-1899.41	-1483.07	-25348.22	
3000.00	21636617.	25458.24	0.060	-21626510.	-110198.	-652015.	746.57	-1480.74	-25404.18	
3000.00	21636617.	25458.24	0.060	-21626510.	-110198.	-652015.	746.57	-1480.74	-25404.18	
3104.00	21638714.	25454.92	0.030	-21386679.	-263184.	-3282480.	3859.57	-1457.66	-25118.36	
3235.00	21639357.	25453.48	-0.008	-20628574.	-450584.	-6520790.	7691.42	-1397.75	-24223.30	
3235.00	21639357.	25453.48	-0.008	-20628574.	-450584.	-6520790.	7691.42	-1397.75	-24223.30	
3296.00	21638895.	25453.87	-0.026	-20106493.	-534684.	-7980277.	9418.61	-1358.44	-23608.13	
3403.40	21636914.	25456.20	-0.057	-18936691.	-676146.	-10445125.	12336.45	-1272.33	-22230.86	
3403.40	21636914.	25456.20	-0.057	-18936691.	-676146.	-10445125.	12336.45	-1272.33	-22230.86	
3415.00	21636912.	25456.57	-0.060	-18791821.	-690844.	-10702018.	12640.65	-1261.78	-22060.35	
3415.00	21636912.	25456.57	-0.060	-18791821.	-690844.	-10702018.	12640.65	-1261.78	-22060.35	

- 1) Orbit Insertion;
- 2) End LOX Vent;
- 3) Nose Cone Jettison;
- 4) End LH₂ Vent;
- 5) IM Separation;
- 6) Start LH₂ Vent.

* Relative to the local horizontal.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 TABLE 30-1 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	RADIUS (FT)	SPACE FIXED VELOCITY		PATH ANGLE * (DEG)	SPACE FIXED POSITION			VELOCITY VECTORS		
		(FT/S)	(FT/S)		X (FT)	Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)
3481.00	21634573.	25459.17	-0.079	-17901505.	-772035.	-12124143.	14325.10	-1197.32	-21012.55	
3481.00	21634573.	25459.17	-0.079	-17901505.	-772035.	-12124143.	14325.10	-1197.32	-21012.55	
3488.00	21634325.	25459.49	-0.081	-17800620.	-780391.	-12270816.	14498.88	-1190.04	-20893.82	
3680.00	21625220.	25471.48	-0.132	-14586012.	-987736.	-15934954.	18844.50	-960.43	-17110.20	
3872.00	21611982.	25489.13	-0.177	-10625605.	-1145978.	-18784595.	22234.23	-680.61	-12444.75	
4064.00	21555189.	25511.35	-0.214	-6120627.	-1246744.	-20672101.	24492.05	-364.19	-7129.93	
4256.00	21575587.	25536.79	-0.242	-1301002.	-1284480.	-21497987.	25496.53	-26.78	-1433.08	
4448.00	21554071.	25563.91	-0.258	3585875.	-1256769.	-21216504.	25188.15	314.65	4355.63	
4603.40	21535956.	25586.02	-0.262	7417164.	-1186930.	-20183516.	23979.99	581.95	8903.14	
4603.40	21535956.	25586.02	-0.262	7417164.	-1186930.	-20183516.	23979.99	581.95	8903.14	
4640.00	21531668.	25591.15	-0.262	8287543.	-1164517.	-19838681.	23574.19	642.62	9937.39	
4832.00	21509493.	25617.03	-0.252	12559502.	-1011961.	-17432530.	20730.27	940.04	15020.13	
5024.00	21488702.	25640.22	-0.229	16178188.	-806511.	-14120201.	16798.08	1191.12	19334.59	
5216.00	21470428.	25659.65	-0.194	18953100.	-558413.	-10072114.	11979.04	1382.27	22649.71	
5408.00	21455712.	25674.52	-0.147	20737358.	-280236.	-5498274.	6524.05	1502.96	24786.26	
5485.00	21451012.	25679.08	-0.125	21151355.	-163391.	-3569230.	4221.35	1529.87	25283.49	
5485.00	21451012.	25679.08	-0.125	21151355.	-163391.	-3569230.	4221.35	1529.87	25283.49	
5600.00	21445420.	25684.21	-0.091	21435946.	13762.	-637231.	719.96	1546.27	25627.61	
5792.00	21440178.	25688.73	-0.030	21011113.	308392.	4256672.	-5126.34	1509.42	25126.74	
5934.00	21440310.	25687.73	0.033	19484587.	588337.	8927017.	-10705.05	1393.91	23309.19	
6148.40	21444701.	25682.65	0.086	17361070.	805271.	12562642.	-15044.98	1236.70	20777.82	
6148.40	21444701.	25682.65	0.086	17361070.	805271.	12562642.	-15044.98	1236.70	20777.82	
6176.00	21445813.	25681.43	0.094	16936463.	828976.	13129175.	-16720.85	1205.44	20271.55	
6355.00	21452483.	25671.07	0.146	13758012.	1034648.	16431201.	-19655.50	972.46	16482.72	
6355.00	21452483.	25671.07	0.146	13758012.	1034648.	16431201.	-19655.50	972.46	16482.72	
6368.00	21456343.	25670.16	0.149	13500329.	1047163.	16643488.	-19909.23	953.67	16176.22	
6550.00	21471251.	25654.40	0.196	9358422.	1201961.	19287038.	-23051.01	651.62	11241.65	
6566.60	21471831.	25653.79	0.197	9205998.	1206225.	19360634.	-23138.26	640.53	11060.17	
6566.60	21471831.	25653.79	0.197	9205998.	1206225.	19360634.	-23138.26	640.53	11060.17	
6748.40	21489261.	25635.22	0.230	4816632.	1294027.	20902485.	-24959.72	321.53	5837.25	
6748.40	21489261.	25635.22	0.230	4816632.	1294027.	20902485.	-24959.72	321.53	5837.25	
6752.00	21489631.	25634.82	0.230	4726734.	1295173.	20923307.	-24994.15	315.90	5730.35	
6564.00	21510397.	25612.14	0.251	-151804.	1321828.	21469208.	-25612.03	-38.67	-66.17	
7136.00	21532358.	25587.35	0.258	-5022896.	1280407.	20899127.	-24908.07	-391.04	-5843.57	
7328.00	21554303.	25561.59	0.252	-9633329.	1172920.	19245770.	-22916.13	-723.90	-11301.42	

7) End LH₂ Vent.
 8) Start LH₂ Vent.
 9) End LH₂ Vent.

* Relative to the local horizontal.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 TABLE 30-1 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	SPACE FIXED VELOCITY			PATH ANGLE* (DEG)	SPACE FIXED POSITION			VELOCITY VECTORS		
	RADIUS (FT)	VELOCITY (FT/S)	X (FT)		Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)	
7520.00	21575075.	25536.17	0.232	-13747203.	1004775.	16597853.	-19746.73	-1020.18	-16159.27	
7712.00	21593631.	25512.47	0.200	-17152086.	784481.	13094864.	-15569.85	-1264.81	-20170.92	
7904.00	21609091.	25491.85	0.160	-19675496.	523193.	8919302.	-10604.72	-1445.41	-23136.23	
8096.00	21620760.	25475.60	0.112	-21190201.	234128.	4286940.	-5107.62	-1552.93	-24909.97	
9288.00	21628146.	25464.75	0.060	-21620676.	-68100.	-564312.	641.39	-1581.94	-25407.47	
8438.35	21630746.	25460.53	0.018	-21185552.	-304058.	-4355355.	5131.17	-1548.68	-24889.98	
8430.00	21630961.	25460.06	0.006	-20946365.	-368201.	-5386345.	6352.08	-1530.85	-24607.36	
8647.00	21629614.	25461.33	-0.042	-19487371.	-615643.	-9365018.	11064.52	-1422.96	-22887.35	
8672.00	21629110.	25461.95	-0.049	-19202325.	-650957.	-9933046.	11737.54	-1401.95	-22551.62	
8779.00	21626085.	25465.85	-0.078	-17796951.	-795622.	-12260632.	14496.47	-1298.45	-20896.79	
8824.50	21623505.	25469.21	-0.177	-17111321.	-853536.	-13192806.	15633.81	-1246.56	-20067.66	
8848.40	21621533.	25471.70	-0.192	-16730869.	-882994.	-13667078.	16200.43	-1218.45	-19618.08	
8848.40	21621533.	25471.70	-0.192	-16730869.	-882994.	-13667078.	16200.43	-1218.45	-19618.08	
8864.00	21620170.	25473.42	-0.200	-16475309.	-901855.	-13970776.	16562.52	-1199.61	-19316.80	
8899.40	21616905.	25477.53	-0.214	-15874741.	-943544.	-14642162.	17362.64	-1155.37	-18609.37	
8899.40	21616905.	25477.53	-0.214	-15874741.	-943544.	-14642162.	17362.64	-1155.37	-18609.37	
8909.20	21615966.	25478.72	-0.216	-15703528.	-954805.	-14823548.	17578.41	-1142.79	-18408.11	
8909.20	21615966.	25478.72	-0.216	-15703528.	-954805.	-14823548.	17578.41	-1142.79	-18408.11	
8978.40	21608907.	25487.68	-0.241	-14435917.	-1030697.	-16046396.	19037.06	-1049.39	-16914.81	
8978.40	21608907.	25487.68	-0.241	-14435917.	-1030697.	-16046396.	19037.06	-1049.39	-16914.81	
9056.00	21600197.	25498.78	-0.263	-12899966.	-1107793.	-17289655.	20521.63	-936.19	-15105.42	
9039.40	21596228.	25503.85	-0.271	-12204649.	-1138209.	-17780554.	21108.60	-884.91	-14286.02	
9039.40	21596228.	25503.85	-0.271	-12204649.	-1138209.	-17780554.	21108.60	-884.91	-14286.02	
9099.40	21595017.	25505.40	-0.273	-11992713.	-1146980.	-17922166.	21277.90	-869.28	-14036.40	
9099.40	21595017.	25505.40	-0.273	-11992713.	-1146980.	-17922166.	21277.90	-869.28	-14036.40	
9248.00	21575856.	25529.55	-0.304	-8661916.	-1259164.	-19720695.	23436.25	-623.08	-10106.04	
9348.40	21561924.	25547.78	-0.317	-6253162.	-1311829.	-20593534.	24490.48	-444.58	-7260.02	
9348.40	21561924.	25547.78	-0.317	-6253162.	-1311829.	-20593534.	24490.48	-444.58	-7260.02	
9398.35	21554805.	25556.88	-0.321	-5019595.	-1331755.	-20919841.	24887.20	-353.03	-5801.44	
9398.35	21554805.	25556.88	-0.321	-5019595.	-1331755.	-20919841.	24887.20	-353.03	-5801.44	
9440.00	21548809.	25564.49	-0.324	-3977326.	-1344849.	-21135832.	25151.52	-275.57	-4568.19	

- 10) Start J-2 LOX Purge;
- 11) End J-2 LOX Purge;
- 12) Start J-2 LH₂ Purge;
- 13) End J-2 LH₂ Purge;
- 14) Start J-2 LH₂ Vent; Start J-2 LOX Vent.

* Relative to local horizontal.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 11)
 TABLE 30-1 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	SPACE FIXED			PATH ANGLE * (DEG)	SPACE FIXED POSITION AND VELOCITY VECTORS						
	RADIUS (FT)	VELOCITY (FT/S)	FIXED		X (FT)	Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)	
9556.53	21531940.	25585.65	-0.327	-1015137.	-1364164.	-21464592.	25563.65	-54.95	-1059.21		
9556.62	21521840.	25585.65	-0.327	-1015137.	-1364164.	-21464592.	25563.65	-54.95	-1059.21		
9632.00	21520856.	25599.15	-0.325	913108.	-1362880.	-21458239.	25569.52	89.06	1228.07		
9824.00	21493437.	25632.28	-0.311	5756158.	-1310741.	-20666796.	24658.38	452.21	6983.78		
10016.00	21467867.	25662.13	-0.281	10299089.	-1190539.	-18798423.	22455.44	794.92	12396.22		
10208.00	21445409.	25687.13	-0.238	14303086.	-1007972.	-15947141.	19068.14	1098.91	17176.35		
10400.00	21427204.	25706.06	-0.182	17556403.	-772094.	-12259759.	14669.96	1347.70	21066.03		
10592.00	21414223.	25718.16	-0.117	19886284.	-498869.	-7928417.	9491.62	1527.61	23853.71		
10784.00	21407171.	25723.10	-0.045	21168757.	-190554.	-3180318.	3808.21	1628.56	25387.47		
10976.00	21406444.	25720.56	0.029	21335680.	125065.	1734648.	-2076.65	1644.77	25584.17		
11168.00	21412076.	25712.12	0.102	20378529.	435526.	6557659.	-7848.54	1575.03	24434.26		
11360.00	21423726.	25697.26	0.168	18348743.	724589.	11035155.	-13200.29	1422.92	22001.76		
11552.00	21440686.	25677.22	0.225	15354643.	977107.	14932622.	-17849.24	1196.05	18419.93		
11646.40	21450669.	25665.77	0.248	13575516.	1083739.	16572850.	-19801.43	1050.71	16294.48		
11646.40	21450669.	25665.77	0.248	13575516.	1083739.	16572850.	-19801.43	1060.71	16294.48		
11656.20	21451760.	25664.53	0.250	13380637.	1094061.	16731395.	-19989.94	1045.85	16061.65		
11656.20	21451760.	25664.53	0.250	13380637.	1094061.	16731395.	-19989.94	1045.85	16061.65		
11744.00	21461932.	25653.26	0.268	11555216.	1179853.	18047146.	-21552.90	906.63	13883.10		
11936.00	21486206.	25626.53	0.255	7151099.	1322206.	20218077.	-24121.28	569.72	8634.71		
12128.00	21512107.	25597.88	0.306	2373640.	1396703.	21335083.	-25426.13	202.88	2953.34		
12320.00	21538166.	25568.57	0.300	-2527670.	1399411.	21343503.	-25407.22	-174.85	-2862.55		
12512.00	21562939.	25539.92	0.277	-7298463.	1330110.	20246570.	-24073.95	-543.99	-8510.96		
12704.00	21585108.	25513.34	0.240	-11692730.	1192277.	18104569.	-21503.35	-885.68	-13702.26		
12896.00	21603530.	25490.17	0.190	-15485319.	992878.	15021022.	-17834.46	-1182.59	-18173.67		
13088.00	21617320.	25471.73	0.132	-18483077.	741951.	11186323.	-13259.96	-1419.76	-21701.77		
13280.00	21625857.	25459.15	0.068	-20534158.	452283.	6769156.	-8015.44	-1585.27	-24112.41		
13472.00	21628803.	25453.29	0.002	-21355102.	138175.	2006329.	-2367.36	-1670.76	-25287.83		
13664.00	21626098.	25454.67	-0.064	-21435556.	-183875.	-2858545.	3399.75	-1671.76	-25171.15		
13856.00	21617944.	25463.38	-0.126	-20240490.	-498138.	-7576935.	8995.29	-1587.85	-23768.24		
14048.00	21604730.	25479.10	-0.181	-18009930.	-788399.	-11907450.	14140.51	-1422.69	-21147.25		
14221.40	21589119.	25458.65	-0.223	-15193033.	-1017466.	-15299497.	18179.76	-1209.93	-17838.53		
14221.40	21589119.	25458.65	-0.223	-15193033.	-1017466.	-15299497.	18179.76	-1209.99	-17838.53		
14240.00	21587551.	25500.94	-0.227	-14856235.	-1037320.	-15627561.	18571.06	-1183.92	-17435.94		
14432.00	21566171.	25527.10	-0.263	-10929056.	-1239028.	-18544584.	22058.79	-882.86	-12815.52		
14598.40	21545736.	25552.68	-0.286	-7079937.	-1361393.	-20303691.	24175.24	-582.80	-8255.76		

15) End J-2 LH₂ Vent; End J-2 LOX Vent;
 16) Start J-2 LOX Vent; Start J-2 LH₂ Vent.

* Relative to local horizontal.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 TABLE 3C-1 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	SPACE FIXED VELOCITY		PATH ANGLE * (DEG)	SPACE FIXED POSITION AND VELOCITY VECTORS					
	RADIUS (FT)	(FT/S)		X (FT)	Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)
1459.40	21545736.	2552.68	-0.286	-7079937.	-1361393.	-20303691.	24175.24	-582.80	-8255.76
14624.00	21542461.	25556.88	-0.288	-6457975.	-1375691.	-20505633.	24419.72	-534.15	-7519.72
14816.00	21517187.	25589.11	-0.259	-1642404.	-1442197.	-21405885.	25524.29	-155.12	-1813.52
15008.00	21491517.	25621.21	-0.296	3258549.	-1434542.	-21194558.	25304.53	235.05	4008.96
15200.00	21466697.	25651.34	-0.279	7989705.	-1352519.	-19878490.	23761.66	616.14	9643.39
15392.00	21443972.	25677.81	-0.247	12302807.	-1199814.	-17522709.	20967.68	968.04	14790.84
15584.00	21424532.	25699.25	-0.202	15970101.	-983874.	-14247752.	17063.42	1271.85	19174.81
15776.00	21409438.	25714.67	-0.146	18796986.	-715571.	-10223762.	12251.94	1510.98	22557.73
15968.00	21399550.	25723.51	-0.082	20632990.	-408650.	-5661578.	6787.73	1672.24	24755.39
16160.00	21395466.	25725.61	-0.012	21380308.	-79005.	-801355.	962.24	1746.55	25648.21
1716200.00	21395377.	25725.21	0.002	21394191.	-9049.	225090.	-268.17	1750.60	25664.18

17) Loss of S-IVB/IU Attitude Control.

* Relative to local horizontal.

TABLE 30-2
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	CHI* PITCH (DEG)	CHI* YAW (DEG)	PITCH ATTITUDE (LOCAL HORIZONTAL) (DEG)	THRUST (POUNDS)	WEIGHT (PCUNDS)	AXIAL FORCE (POUNDS)	NORMAL FORCE (POUNDS)
1) 608.15	-8.90	-3.38	10.08	360.46	70205.10	0.76	-0.17
638.60	-8.90	-3.38	12.16	273.76	70022.41	0.81	-0.21
2) 638.60	-8.90	-3.38	12.16	0.00	70022.41	0.81	-0.21
643.35	-8.90	-3.38	12.49	0.00	70018.54	0.82	-0.22
3) 643.35	-8.90	-3.38	12.49	0.00	68951.54	0.73	-0.17
688.35	-8.90	-3.38	15.58	0.00	68933.53	0.76	-0.23
688.35	-8.90	-3.38	15.58	0.00	68933.53	0.76	-0.23
724.46	-26.96	-2.80	-0.00	0.00	68919.08	0.60	-0.00
724.46	-26.96	-2.80	-0.00	0.00	68919.08	0.60	-0.00
800.00	-32.14	-2.65	0.00	0.00	68888.85	0.59	-0.00
992.00	-45.32	-2.15	0.00	0.00	68812.03	0.54	-0.01
1184.00	-58.47	-1.55	-0.00	0.00	68735.22	0.49	-0.01
1198.35	-59.45	-1.50	0.00	0.00	68729.48	0.48	-0.01
1198.35	-59.45	-1.50	0.00	0.00	68729.48	0.48	-0.01
1376.00	-71.59	-0.86	0.00	0.00	68658.41	0.84	-0.02
1558.00	-84.69	-0.12	-0.00	0.00	68581.60	0.72	-0.02
1760.00	-97.76	0.62	0.00	0.00	68504.79	0.60	-0.02
1858.40	-104.45	0.99	0.00	0.00	68465.43	0.55	-0.02
4) 1858.40	-104.45	0.99	0.00	0.00	68465.43	0.55	-0.02
1952.00	-110.81	1.34	0.00	0.00	68464.07	0.50	-0.02
2144.00	-123.83	1.98	-0.00	0.00	68464.07	0.41	-0.02
2338.00	-136.84	2.53	0.00	0.00	68464.07	0.34	-0.01
2528.00	-149.84	2.95	-0.00	0.00	68464.07	0.29	-0.01
2720.00	-162.83	3.23	-0.00	0.00	68464.07	0.25	-0.01
2912.00	-175.80	3.34	-0.00	0.00	68464.07	0.23	-0.00
3000.00	178.26	3.23	0.00	0.00	68464.07	0.22	-0.00
3000.00	178.26	3.33	0.00	0.00	68464.07	0.22	-0.00
3104.00	178.38	3.34	7.13	0.00	68464.07	0.22	-0.03
3235.00	178.54	3.36	16.12	0.00	68464.07	0.22	-0.07
5) 3235.00	178.54	3.36	16.12	0.00	37048.07	0.23	-0.07
3295.00	179.61	3.36	20.31	0.00	37048.07	0.23	-0.09
3403.40	178.74	3.37	27.67	0.00	37048.07	0.24	-0.13
6) 3403.40	178.74	3.37	27.67	0.00	37048.07	0.24	-0.13
3415.00	178.75	3.37	28.47	0.00	37043.89	0.24	-0.13
3415.00	178.75	3.37	28.47	0.00	37043.89	0.24	-0.13

- 1) Orbit Insertion;
- 2) End LOX Vent;
- 3) Nose Cone Jettison;
- 4) End LH₂ Vent;
- 5) LM Separation;
- 6) Start LH₂ Vent.

* Referenced to the Z_g axis (FASCS-13) measured positive counter clockwise.

TABLE 3C-2 (Cont'd)
 AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	CHI * PITCH (DEG)	CHI * YAW (DEG)	PITCH ATTITUDE (LOCAL HORIZONTAL)	THRUST (POUNDS)	WEIGHT (POUNDS)	AXIAL FORCE (POUNDS)	NORMAL FORCE (POUNDS)
3481.00	145.79	2.70	0.00	0.00	37017.48	0.22	-0.00
3481.00	145.79	2.70	0.00	0.00	37017.48	0.22	-0.00
3488.00	145.32	2.68	-0.00	0.00	37014.68	0.23	-0.00
3680.00	132.37	2.17	-0.00	0.00	36937.87	0.25	-0.00
3872.00	119.41	1.54	0.00	0.00	36861.07	0.28	-0.01
4064.00	106.45	0.83	0.00	0.00	36784.26	0.33	-0.01
4256.00	93.46	0.07	0.00	0.00	36707.45	0.40	-0.01
4448.00	80.45	-0.69	0.00	0.00	36630.64	0.49	-0.02
4603.40	65.89	-1.29	-0.00	0.00	36568.47	0.59	-0.02
7) 4603.40	69.89	-1.29	-0.00	0.00	36568.47	0.59	-0.02
4640.00	67.40	-1.42	-0.00	0.00	36568.01	0.61	-0.03
4832.00	54.33	-2.09	-0.00	0.00	36568.01	0.75	-0.03
5024.00	41.21	-2.65	-0.00	0.00	36568.01	0.89	-0.03
5216.00	28.07	-3.08	0.00	0.00	36568.01	1.03	-0.03
5408.00	14.89	-3.35	0.00	0.00	36568.01	1.16	-0.03
5485.00	9.60	-3.41	0.00	0.00	36568.01	1.20	-0.03
5600.00	9.60	-3.42	7.89	0.00	36568.01	1.28	-0.21
5792.00	9.60	-3.44	21.06	0.00	36568.01	1.37	-0.57
5984.00	5.59	-3.46	34.23	0.00	36568.01	1.34	-0.92
6148.40	9.58	-3.47	45.51	0.00	36568.01	1.19	-1.20
8) 6148.40	9.58	-3.47	45.51	0.00	36568.01	1.19	-1.20
6176.00	9.58	-3.47	47.40	0.00	36558.13	1.15	-1.24
6355.00	9.58	-3.48	59.68	0.00	36486.52	0.89	-1.39
6355.00	9.58	-3.48	59.68	0.00	36486.52	0.89	-1.39
6368.00	16.10	-3.40	67.07	0.00	36481.32	0.68	-1.46
6560.00	112.05	1.23	176.25	0.00	36404.51	-1.02	-0.09
6566.60	115.35	1.42	180.00	0.00	36401.87	-1.02	-0.03
6566.60	115.35	1.42	180.00	0.00	36401.87	-1.02	-0.03
6748.40	102.93	0.70	180.00	0.00	36329.14	-0.90	-0.03
9) 6748.40	102.93	0.70	180.00	0.00	36329.14	-0.90	-0.03
6752.00	102.69	0.69	180.00	0.00	36328.78	-0.89	-0.03
6944.00	89.60	-0.10	180.00	0.00	36328.78	-0.76	-0.03
7136.00	76.54	-0.89	180.00	0.00	36328.78	-0.63	-0.03
7328.00	63.50	-1.64	180.00	0.00	36328.78	-0.52	-0.02

7) End LH₂ Vent;

8) Start LH₂ Vent;

9) End LH₂ Vent.

* Referenced to the Z_g axis (PASC-13) measured positive counter clockwise.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 TABLE 3C-2 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	CHI * PITCH (DEG)	CHI * YAW (DEG)	PITCH ATTITUDE (LOCAL HORIZONTAL)	THRUST (POUNDS)	WEIGHT (POUNDS)	AXIAL FORCE (POUNDS)	NORMAL FORCE (POUNDS)
7520.00	50.47	-2.30	180.00	0.00	36328.78	-0.44	-0.02
7712.00	37.46	-2.85	180.00	0.00	36328.78	-0.37	-0.01
7904.00	24.46	-3.25	180.00	0.00	36328.78	-0.31	-0.01
8096.00	11.47	-3.50	180.00	0.00	36328.78	-0.29	-0.01
8288.00	-1.51	-3.56	180.00	0.00	36328.78	-0.26	-0.00
8438.25	-11.67	-3.49	180.00	0.00	36328.78	-0.25	-0.00
8438.35	-11.67	-3.49	180.00	0.00	36328.78	-0.25	-0.00
8480.00	3.52	-3.58	-162.03	0.00	36328.78	-0.24	-0.09
8647.00	64.33	-1.63	-90.00	0.00	36328.78	-0.17	-0.32
8647.00	64.33	-1.63	-90.00	0.00	36328.78	-0.17	-0.32
8672.00	62.65	-1.72	-90.00	0.00	36328.78	-0.18	-0.33
8779.00	55.44	-2.11	-90.00	0.00	36328.78	-0.18	-0.33
10) 8779.00	55.44	-2.11	-90.00	930.00	36328.78	-0.18	-0.33
8824.50	52.37	-2.26	-90.00	930.00	34291.39	-0.18	-0.34
8824.50	52.37	-2.26	-90.00	250.20	34291.39	-0.18	-0.34
8848.40	50.76	-2.34	-90.00	110.00	34111.24	-0.18	-0.34
8848.40	50.76	-2.34	-90.00	110.00	34111.24	-0.18	-0.34
8864.00	49.70	-2.39	-90.00	91.65	33996.73	-0.18	-0.35
8864.00	49.70	-2.39	-90.00	91.65	33996.73	-0.18	-0.35
8893.40	47.31	-2.50	-90.00	50.00	33736.88	-0.19	-0.36
11) 8893.40	47.31	-2.50	-90.00	50.00	33736.88	-0.19	-0.36
8909.20	46.65	-2.53	-90.00	0.00	33735.77	-0.19	-0.36
8909.20	46.65	-2.53	-90.00	75.80	33735.77	-0.19	-0.36
8978.40	41.98	-2.73	-90.00	40.00	33689.72	-0.20	-0.38
8978.40	41.98	-2.73	-90.00	40.00	33689.72	-0.20	-0.38
9056.00	36.73	-2.94	-90.00	28.81	33637.93	-0.22	-0.41
9082.40	34.47	-3.02	-90.00	24.00	33615.64	-0.23	-0.43
13) 9082.40	34.47	-3.02	-90.00	24.00	33615.64	-0.23	-0.43
9099.40	33.79	-3.04	-90.00	0.00	33615.52	-0.23	-0.43
9099.40	33.79	-3.04	-90.00	35.00	33615.52	-0.23	-0.43
9248.00	23.71	-3.34	-90.00	19.48	33577.17	-0.28	-0.52
9348.40	16.89	-3.49	-90.00	9.00	33551.23	-0.32	-0.59
9348.40	16.89	-3.49	-90.00	9.00	33551.23	-0.32	-0.59
9398.25	13.49	-3.54	-90.00	3.06	33538.32	-0.34	-0.64
9398.25	13.49	-3.54	-90.00	3.06	33538.32	-0.34	-0.64
9440.00	-13.07	-3.53	-113.69	3.06	33527.56	-0.44	-0.68

- 10) Start J-2 LOX Purge;
- 11) End J-2 LOX Purge;
- 12) Start J-2 LH₂ Purge;
- 13) End J-2 LH₂ Purge;
- 14) Start J-2 LH₂ Vent; Start J-2 LOX Vent.

* Referenced to the Z_s axis (PASC-13) measured positive counter clockwise.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 TABLE 3C-2 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	CHI * PITCH (DEG)	CHI * YAW (DEG)	PITCH ATTITUDE (LOCAL HORIZONTAL)	THRUST (POUNDS)	WEIGHT (POUNDS)	AXIAL FORCE (POUNDS)	NORMAL FORCE (POUNDS)
9556.63	-87.30	-0.14	-180.00	3.06	33497.43	-0.62	-0.02
9556.63	-87.30	-0.14	180.00	3.06	33497.43	-0.62	-0.02
9632.00	-92.43	0.18	180.00	3.06	33477.96	-0.69	-0.03
9824.00	-105.50	0.99	180.00	3.06	33428.35	-0.92	-0.04
10016.00	-118.62	1.76	180.00	3.06	33378.75	-1.21	-0.05
10208.00	-131.77	2.44	180.00	3.06	33329.15	-1.55	-0.06
10400.00	-144.96	3.00	180.00	3.06	33279.54	-1.90	-0.07
10592.00	-158.18	3.40	180.00	3.06	33229.94	-2.15	-0.06
10784.00	-171.42	3.63	180.00	3.06	33180.33	-2.24	-0.05
10976.00	-175.33	3.67	180.00	3.06	33130.73	-2.15	-0.03
11168.00	-162.09	3.51	180.00	3.06	33081.13	-1.93	-0.01
11360.00	-148.87	3.17	180.00	3.06	33031.52	-1.64	-0.01
11552.00	-135.68	2.66	180.00	3.06	32981.92	-1.36	-0.02
11646.40	-129.20	2.36	180.00	3.06	32957.53	-1.23	-0.02
11646.40	129.20	2.36	180.00	3.06	32957.53	-1.23	-0.02
11656.20	128.53	2.32	180.00	3.06	32955.91	-1.22	-0.02
15) 11656.20	128.53	2.32	180.00	0.00	32955.91	-1.22	-0.02
11744.00	122.52	2.01	180.00	0.00	32955.87	-1.11	-0.03
11936.00	109.40	1.26	180.00	0.00	32955.87	-0.91	-0.03
12128.00	96.22	0.43	180.00	0.00	32955.87	-0.73	-0.03
12320.00	83.27	-0.41	180.00	0.00	32955.87	-0.59	-0.02
12512.00	70.25	-1.24	180.00	0.00	32955.87	-0.49	-0.02
12704.00	57.25	-2.00	180.00	0.00	32955.87	-0.40	-0.02
12896.00	44.27	-2.67	180.00	0.00	32955.87	-0.34	-0.01
13088.00	31.29	-3.20	180.00	0.00	32955.87	-0.30	-0.01
13280.00	18.32	-3.57	180.00	0.00	32955.87	-0.27	-0.01
13472.00	5.35	-3.76	180.00	0.00	32955.87	-0.26	-0.01
13664.00	-7.63	-3.77	180.00	0.00	32955.87	-0.26	-0.00
13856.00	-20.61	-3.58	180.00	0.00	32955.87	-0.27	-0.00
14048.00	-33.59	-3.21	180.00	0.00	32955.87	-0.30	-0.00
14221.40	-45.32	-2.73	180.00	0.00	32955.87	-0.34	-0.01
16) 14221.40	-45.32	-2.73	180.00	4.00	32955.87	-0.34	-0.01
14240.00	-46.58	-2.67	180.00	4.00	32955.22	-0.35	-0.01
14432.00	-59.58	-2.00	180.00	4.00	32948.40	-0.43	-0.01
14598.40	-70.86	-1.32	180.00	4.00	32942.49	-0.52	-0.02

15) End J-2 LH₂ Vent; End J-2 LOX Vent;
 16) Start J-2 LOX Vent; Start J-2 LH₂ Vent.

* Referenced to the Z_S axis (PASC-13) measured positive counter clockwise

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 TABLE 3C-2 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	CHI * PITCH (DEG)	CHI * YAW (DEG)	PITCH ATTITUDE (LOCAL HORIZONTAL) (DEG)	THRUST (POUNDS)	WEIGHT (POUNDS)	AXIAL FORCE (POUNDS)	NORMAL FORCE (POUNDS)
14598.4	-70.86	-1.32	180.00	0.00	32942.49	-0.52	-0.02
14624.0	-72.60	-1.22	180.00	0.00	32941.58	-0.54	-0.02
14816.0	-85.64	-0.37	180.00	0.00	32934.80	-0.70	-0.03
15008.0	-98.71	0.51	180.00	0.00	32928.02	-0.93	-0.04
15200.0	-111.81	1.36	180.00	0.00	32921.24	-1.22	-0.05
15392.0	-124.95	2.15	180.00	0.00	32914.45	-1.60	-0.06
15584.0	-138.13	2.83	180.00	0.00	32907.67	-2.02	-0.07
15776.0	-151.35	3.36	180.00	0.00	32900.89	-2.39	-0.08
15968.0	-164.58	3.73	180.00	0.00	32894.11	-2.63	-0.07
16160.0	-177.84	3.89	180.00	0.00	32887.33	-2.63	-0.05
17) 16200.0	179.40	3.90	180.00	0.00	32885.91	-2.61	-0.04

17) Loss of S-IVB/III Attitude Control.

* Referenced to the Z_s axis (PASC-13) measured positive counter clockwise.

TABLE 3C-3
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	ALTITUDE (FT)	CENTRAL RANGE ANGLE (DEG)	VELOCITY VECTOR SPACE FIXED (DEG)	EARTH FIXED (DEG)	LONGITUDE (POS. EAST) (DEG)	GEOCENTRIC DECLINATION (DEG)	GEODETTIC LATITUDE (DEG)
1) 608.15	535490.60	18.979	86.125	85.913	-61.480	31.400	31.567
638.60	535798.99	21.069	87.405	87.263	-59.161	31.518	31.686
2) 638.60	535798.99	21.069	87.405	87.263	-59.161	31.518	31.686
643.35	535855.41	21.395	87.605	87.474	-58.799	31.532	31.700
3) 643.35	535856.41	21.395	87.605	87.474	-58.799	31.532	31.700
688.35	536511.13	24.484	89.507	89.480	-55.363	31.610	31.778
688.35	536511.13	24.484	89.507	89.480	-55.363	31.610	31.778
724.46	537172.83	26.562	91.036	91.093	-52.603	31.599	31.766
724.46	537172.83	26.562	91.036	91.093	-52.603	31.599	31.766
800.00	538943.67	32.146	94.216	94.447	-46.846	31.361	31.528
992.00	545748.48	45.316	101.933	102.596	-32.515	29.499	29.660
1184.00	555789.80	58.473	108.661	109.721	-18.970	26.007	26.155
1184.35	556668.06	59.456	109.112	110.200	-17.997	25.689	25.836
1198.35	556668.06	59.456	109.112	110.200	-17.997	25.689	25.836
1376.00	568993.40	71.613	114.047	115.450	-6.417	21.199	21.326
1568.00	585224.91	84.730	117.977	119.650	5.195	15.423	15.519
1760.00	604177.41	97.822	120.469	122.325	16.078	9.008	9.066
1858.40	614770.82	104.521	121.208	123.121	21.465	5.571	5.607
4) 1858.40	614770.82	104.521	121.208	123.121	21.465	5.571	5.607
1952.00	625276.59	110.887	121.581	123.525	26.520	2.253	2.267
2144.00	647627.65	123.925	121.354	123.285	36.834	-4.575	-4.605
2336.00	670023.45	136.937	119.789	121.607	47.336	-11.215	-11.287
2528.00	691023.81	149.926	116.852	118.462	58.330	-17.400	-17.506
2720.00	709087.57	162.895	112.504	113.824	70.076	-22.837	-22.971
2912.00	722749.18	175.848	106.767	107.728	82.740	-27.212	-27.364
3000.00	727193.48	178.218	103.714	104.493	88.857	-28.774	-28.931
3000.00	727193.48	178.218	103.714	104.493	88.857	-28.774	-28.931
3104.00	730797.09	171.208	99.818	100.370	96.308	-30.206	-30.368
3235.00	732636.57	162.379	94.580	94.836	105.957	-31.315	-31.481
3296.00	732636.57	162.379	94.580	94.836	105.957	-31.315	-31.481
3403.40	73430.91	151.029	87.604	87.471	110.513	-31.554	-31.720
6) 3403.40	73430.91	151.029	87.604	87.471	110.513	-31.554	-31.720
3415.00	730090.13	150.247	87.124	86.964	118.561	-31.533	-31.699
3415.00	730090.13	150.247	87.124	86.964	118.561	-31.533	-31.699
3415.00	73090.13	150.247	87.124	86.964	119.428	-31.497	-31.663
3415.00	73090.13	150.247	87.124	86.964	119.428	-31.497	-31.663

- 1) Orbit Insertion;
- 2) End LOX Vent;
- 3) Nose Cone Jettison;
- 4) End LH₂ Vent;
- 5) IM Separation;
- 6) Start LH₂ Vent.

TABLE 3C-3 (Cont'd)
 AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	ALTITUDE (FT)	CENTRAL RANGE (DEG)	VELOCITY SPACE FIXED (DEG)	VELOCITY VECTOR EARTH FIXED (DEG)	LONGITUDE (POS. EAST) (DEG)	GEOCENTRIC DECLINATION (DEG)	GEODETTIC LATITUDE (DEG)
3481.00	727692.48	145.797	84.415	84.103	124.348	-31.168	-31.333
3481.00	727692.48	145.797	84.415	84.103	124.348	-31.168	-31.333
3488.00	727393.32	145.325	84.131	83.803	124.868	-31.121	-31.286
3580.00	715980.00	132.274	76.693	75.939	138.826	-28.951	-29.108
3872.00	699055.70	119.409	70.287	69.146	151.992	-25.246	-25.390
4064.00	677935.99	106.424	65.204	63.737	164.224	-20.305	-20.427
4256.00	654239.43	93.416	61.539	59.820	175.603	-14.452	-14.542
4448.00	629698.30	80.383	59.273	57.393	173.651	-7.993	-8.045
4603.40	610356.14	69.814	58.437	56.497	165.219	-2.515	-2.532
4603.40	610356.14	69.814	58.437	56.497	165.219	-2.515	-2.532
4640.00	605963.94	67.322	58.368	56.423	163.249	-1.209	-1.217
4832.00	584436.38	54.234	58.802	56.895	152.880	5.634	5.671
5024.00	566150.00	41.120	60.600	58.828	142.226	12.273	12.351
5216.00	551728.10	27.583	63.813	62.269	130.981	18.422	18.535
5408.00	541414.66	14.827	68.489	67.253	118.887	23.766	23.904
5485.00	538429.12	9.547	70.772	69.678	113.761	25.605	25.752
5485.00	538429.12	9.547	70.772	69.678	113.761	25.605	25.752
5485.00	538429.12	9.547	70.772	69.678	113.761	25.605	25.752
5600.00	535160.98	1.657	74.589	73.726	105.804	27.959	28.114
5792.00	532750.35	11.521	81.887	81.440	91.801	30.662	30.827
5884.00	533916.40	24.702	85.889	89.883	77.231	31.614	31.781
6148.40	537589.55	35.986	96.775	97.147	64.730	30.954	31.120
6148.40	537589.55	35.986	96.775	97.147	64.730	30.954	31.120
6176.00	538440.13	37.880	97.899	98.334	62.657	30.713	30.878
6355.00	545560.35	50.156	104.756	105.582	49.568	28.288	28.445
6355.00	545560.35	50.156	104.756	105.582	49.568	28.288	28.445
6368.00	546184.96	51.047	105.218	106.071	48.645	28.058	28.214
6560.00	557083.89	64.200	111.350	112.577	35.551	23.909	24.048
6566.60	557513.49	64.652	111.536	112.775	35.119	23.744	23.882
6566.60	557513.49	64.652	111.536	112.775	35.119	23.744	23.882
6748.40	570776.18	77.088	115.587	117.520	23.669	18.713	18.827
6748.40	570776.18	77.088	115.587	117.520	23.669	18.713	18.827
6752.00	571055.73	77.224	116.062	117.600	23.451	18.605	18.718
6944.00	587956.48	90.445	119.315	121.095	12.707	12.489	12.569
6944.00	587956.48	90.445	119.315	121.095	12.707	12.489	12.569
7126.00	607361.03	103.530	121.157	123.056	1.563	5.877	5.915
7328.00	628586.77	116.585	121.640	123.590	8.785	-0.948	-0.954

7) End LH₂ Vent;
 8) Start LH₂ Vent;
 9) End LH₂ Vent.

TABLE 3C-3 (Cont'd)
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	ALTITUDE (FT)	CENTRAL ANGLE RANGE (DEG)	VELOCITY SPACE FIXED (DEG)	EARTH FIXED (DEG)	LONGITUDE (POS. EAST) (DEG)	GEOCENTRIC DECLINATION (DEG)	GEODETTIC LATITUDE (DEG)
7520.00	650612.23	129.622	120.789	122.678	19.155	-7.724	-7.774
7712.00	672129.24	142.631	118.585	120.316	29.858	-14.189	-14.278
7904.00	691646.83	155.617	114.987	116.470	41.184	-20.065	-20.185
8096.00	707645.96	168.587	109.973	111.131	53.358	-25.046	-25.190
8288.00	718762.77	178.455	103.627	104.400	66.473	-28.812	-28.969
8438.25	723373.34	168.315	97.900	98.342	77.325	-30.713	-30.876
8438.35	723373.34	168.315	97.900	98.342	77.325	-30.713	-30.876
8480.00	723961.17	165.507	96.228	96.576	80.399	-31.058	-31.223
8647.00	723213.30	154.244	89.338	89.301	92.879	-31.608	-31.774
8647.00	723213.30	154.244	89.338	89.301	92.879	-31.608	-31.774
8672.00	722671.76	152.558	88.299	88.204	94.754	-31.573	-31.739
8779.00	719110.07	145.340	83.899	83.558	102.739	-31.081	-31.246
10) 8779.00	719110.07	145.340	83.899	83.558	102.739	-31.081	-31.246
8824.50	716124.76	142.270	82.071	81.627	106.100	-30.706	-30.870
8824.50	716124.76	142.270	82.071	81.627	106.100	-30.706	-30.870
8848.40	713898.54	140.657	81.126	80.628	107.854	-30.470	-30.633
8848.40	713898.54	140.657	81.126	80.628	107.854	-30.470	-30.633
8864.00	712355.95	139.604	80.515	79.982	108.994	-30.302	-30.465
8899.40	708641.70	137.214	79.148	78.537	111.565	-29.880	-30.041
11) 8899.40	708641.70	137.214	79.148	78.537	111.565	-29.880	-30.041
8909.20	707569.09	136.552	78.775	78.143	112.273	-29.754	-29.914
12) 8909.20	707569.09	136.552	78.775	78.143	112.273	-29.754	-29.914
8978.40	699449.37	131.877	76.212	75.430	117.215	-28.740	-28.898
8978.40	699449.37	131.877	76.212	75.430	117.215	-28.740	-28.898
9056.00	689341.51	126.631	73.504	72.562	122.630	-27.369	-27.521
9089.40	684714.19	124.371	72.399	71.390	124.915	-26.706	-26.856
13) 9089.40	684714.19	124.371	72.399	71.390	124.915	-26.706	-26.856
9099.40	683300.79	123.695	72.076	71.047	125.594	-26.500	-26.649
14) 9099.40	683300.79	123.695	72.076	71.047	125.594	-26.500	-26.649
9248.00	660898.08	113.630	67.693	66.391	135.382	-23.028	-23.162
9348.40	644669.38	106.818	65.203	63.739	141.681	-20.303	-20.425
9348.40	644669.38	106.818	65.203	63.739	141.681	-20.303	-20.425
9398.35	636423.59	103.426	64.109	62.573	144.726	-18.850	-18.965
9398.35	636423.59	103.426	64.109	62.573	144.726	-18.850	-18.965
9440.00	629511.22	100.596	63.271	61.678	147.223	-17.596	-17.704

- 10) Start J-2 LOX Purge;
- 11) End J-2 LOX Purge;
- 12) Start J-2 LH₂ Purge;
- 13) End J-2 LH₂ Purge;
- 14) Start J-2 LH₂ Vent; Start J-2 LOX Vent.

TABLE 30-3 (Cont'd)
 AS-204/IM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	ALTITUDE (FT)	CENTRAL RANGE (DEG)	VELOCITY VECTOR SPACE FIXED (DEG)	AZIMUTH EARTH FIXED (DEG)	LONGITUDE (POS. EAST) (DEG)	GEOCENTRIC DECLINATION (DEG)	GEODETTIC LATITUDE (DEG)
9556.63	610170.27	92.662	61.282	59.552	154.032	-13.900	-13.987
9556.63	610170.27	92.662	61.282	59.552	154.032	-13.900	-13.987
9632.00	597869.41	87.528	60.273	58.472	158.309	-11.392	-11.464
9824.00	568176.99	74.426	58.664	56.750	168.898	-4.713	-4.744
10016.00	542231.76	61.291	58.413	56.484	179.296	2.164	2.178
10208.00	521387.51	48.128	59.521	57.679	-170.180	8.972	9.030
10400.00	505459.43	34.940	62.029	60.369	-159.212	15.414	15.531
10592.00	437737.01	21.735	65.953	64.602	-147.512	21.245	21.372
10784.00	495033.76	8.520	71.427	70.378	-134.870	26.068	26.216
10976.00	497833.02	4.701	78.207	77.555	-121.242	29.550	29.712
11168.00	505429.63	17.915	85.964	85.743	-106.848	31.382	31.549
11360.00	517073.48	31.118	94.077	94.300	-92.173	31.377	31.544
11552.00	532066.81	44.303	101.815	102.470	-77.815	29.542	29.704
11646.40	540475.91	50.777	105.285	106.142	-71.027	28.023	28.179
11646.40	540475.91	50.777	105.285	106.142	-71.027	28.023	28.179
11656.20	541384.31	51.449	105.629	106.507	-70.335	27.844	27.999
11744.00	549800.23	57.465	108.564	109.618	-64.250	26.074	26.222
11936.00	569753.52	70.600	113.971	115.370	-51.686	21.286	21.413
12128.00	591420.75	83.705	117.922	119.593	-40.071	15.528	15.625
12320.00	614204.56	96.779	120.436	122.292	-29.193	9.131	9.190
12512.00	637325.88	109.823	121.572	123.518	-18.764	2.390	2.406
12704.00	659791.57	122.839	121.373	123.309	-8.470	-4.427	-4.455
12896.00	680589.26	135.830	119.841	121.656	2.005	-11.063	-11.133
13088.00	697781.32	148.800	116.942	118.561	12.966	-17.253	-17.358
13280.00	710616.37	161.756	112.635	113.965	24.678	-22.708	-22.841
13472.00	717691.38	174.702	106.936	107.908	37.311	-27.113	-27.264
13664.00	718118.75	172.347	100.013	100.576	50.860	-30.147	-30.309
13856.00	711470.31	159.396	92.266	92.393	65.068	-31.541	-31.707
14048.00	697882.09	146.431	84.315	83.998	79.452	-31.152	-31.317
14240.00	680236.15	134.706	77.527	76.824	92.134	-29.292	-29.452
14432.00	662036.15	124.706	77.527	76.824	92.134	-29.292	-29.452
14624.00	644836.15	113.448	76.841	76.098	93.462	-29.013	-29.171
14816.00	627636.15	102.440	70.289	69.259	106.692	-25.323	-25.468
15008.00	610436.15	109.144	65.366	64.449	117.403	-21.100	-21.226

15) End J-2 LH Vent; End J-2 LOX Vent;
 16) Start J-2 LOX Vent; Start J-2 LH Vent.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION 1)
 TABLE 30-3 (Cont'd)
 ORBITAL FLIGHT DATA

FLIGHT TIME (SEC)	ALTITUDE (FT)	CENTRAL RANGE ANGLE (DEG)	VELOCITY SPACE FIXED (DEG)	VELOCITY VECTOR EARTH FIXED (DEG)	LONGITUDE (POS. EAST) (DEG)	GEOCENTRIC DECLINATION (DEG)	GEODETTIC LATITUDE (DEG)
14598.40	629129.00	109.144	65.866	64.449	117.403	-21.100	-21.226
14624.00	625268.78	107.405	65.265	63.808	118.990	-20.380	-20.503
14816.00	595874.17	94.338	61.566	59.858	130.433	-14.509	-14.600
15008.00	567154.03	81.240	59.280	57.411	141.240	-8.021	-8.073
15200.00	540991.62	68.110	58.367	56.434	151.702	-1.202	-1.210
15392.00	518926.02	54.551	58.809	56.914	162.132	5.678	5.715
15584.00	502019.69	41.767	60.629	58.870	172.852	12.349	12.428
15776.00	490810.40	28.562	63.880	62.349	-175.831	18.521	18.634
15968.00	485347.93	15.344	68.607	67.384	-163.657	23.870	24.010
16160.00	485298.96	2.128	74.765	73.916	-150.491	28.049	28.205
16200.00	485919.38	0.676	76.211	75.445	-147.625	28.740	28.898

17) Loss of S-IVB/TU Attitude Control.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (PROVISION I)
S-1B STAGE RE-ENTRY DATA

TABLE 4C

FLIGHT TIME (SEC)	SPACE FIXED			SPACE FIXED POSITION AND VELOCITY VECTOR COMPONENTS					
	RADIUS (FT)	VELOCITY (FT/S)	PATH ANGLE (DEG)	X (FT)	Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)
1) 143.52	21118250.	7774.20	62.854	21114490.	116395.	281150.	3419.76	388.06	5970.86
2) 145.08	21123695.	7682.84	63.331	21119734.	116984.	291862.	3318.56	369.93	5919.27
160.00	21171738.	7458.74	66.301	21165589.	122470.	404907.	2825.56	366.65	6888.97
180.00	21225839.	7225.48	70.482	21216016.	120774.	627496.	2208.15	363.74	6870.18
200.00	21268313.	7039.40	74.901	21253930.	137018.	769697.	1584.60	360.61	6849.25
220.00	21259200.	6901.43	79.520	21270416.	144198.	906441.	963.38	357.30	6824.51
240.00	21318535.	6813.79	84.287	21292485.	151309.	1042651.	342.80	352.79	6705.90
260.00	21326336.	6778.03	89.139	21293174.	158248.	1178251.	-274.79	350.08	6763.41
3) 264.00	21326513.	6777.17	90.113	21291828.	159746.	1205291.	-398.45	349.31	6756.44
280.00	21322612.	6794.84	94.003	21281496.	165310.	1313162.	-893.02	345.17	6727.00
300.00	21307360.	6863.88	98.809	21257452.	172193.	1447305.	-1511.58	342.05	6686.62
320.00	21280562.	6983.89	103.488	21221027.	178991.	1580600.	-2131.07	337.72	6642.22
340.00	21242192.	7152.78	107.984	21172199.	185701.	1712966.	-2752.15	333.20	6593.70
360.00	21192211.	7367.31	112.253	21110929.	192318.	1844317.	-3375.17	328.44	6540.46
380.00	21130608.	7611.24	116.260	21037215.	198837.	1974497.	-3992.95	323.50	6471.48
400.00	21058188.	7662.71	119.869	20951931.	205260.	2102193.	-4462.82	319.06	6220.82
420.00	20585655.	4753.01	120.239	20871962.	211663.	2209532.	-2814.44	324.78	3816.35
440.00	20963288.	1952.36	112.066	20840134.	218245.	2258457.	-924.14	330.51	1687.74
460.00	20950542.	1592.75	111.338	20823981.	224830.	2288333.	-737.52	327.84	1373.11
480.00	20925852.	1472.49	109.560	20810234.	231266.	2314748.	-642.51	326.17	1284.14
500.00	20930724.	1414.77	107.401	20798143.	237886.	2340065.	-570.51	325.83	1252.97
520.00	20922804.	1385.40	105.557	20787275.	244400.	2365002.	-519.18	325.53	1242.51
540.00	20915784.	1367.38	104.064	20777293.	250906.	2380805.	-480.82	325.10	1238.08
560.00	20909464.	1354.18	102.853	20767991.	257403.	2414529.	-450.90	324.59	1234.97
4) 563.39	20908451.	1353.51	102.667	20766471.	258503.	2418713.	-446.80	324.41	1235.77

- 1) Physical Separation;
- 2) Retro-Rocket Burnout;
- 3) S-1B Stage Apogee;
- 4) S-10B Stage Impact.

TABLE 4C (Cont'd)
AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-1B STAGE RE-ENTRY DATA

FLIGHT TIME (SEC)	POSITION (FT)	EARTH FIXED		PATH ANGLE (DEG)	EARTH FIXED POSITION AND VELOCITY VECTOR COMPONENTS						
		VELOCITY (FT/S)	-----		X (FT)	Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)	
1) 143.52	293707.	6643.51	57.729	207572.	-160.	207793.	3496.53	2.42	5648.		
2) 145.08	303701.	6547.31	58.218	212936.	-170.	216547.	3396.01	-15.20	5597.		
160.00	356829.	6287.49	61.523	260029.	-387.	299763.	2924.17	-12.51	5566.		
180.00	516153.	6009.86	66.316	312380.	-580.	410893.	2311.86	-6.77	5547.		
200.00	629605.	5785.20	71.520	352527.	-655.	521657.	1703.32	-0.57	5528.		
220.00	737744.	5616.70	77.085	380528.	-600.	632033.	1097.02	6.11	5508.		
240.00	841244.	5508.69	82.927	396418.	-407.	741987.	492.23	13.23	5486.		
260.00	940855.	5464.25	88.931	400723.	-68.	851487.	-111.70	20.80	5463.		
3) 264.00	560381.	5463.15	90.140	399535.	18.	873329.	-232.44	32.37	5458.		
280.00	1037393.	5484.75	94.961	391952.	428.	960499.	-715.44	28.81	5437.		
300.00	1131735.	5569.55	100.878	371603.	1087.	1068988.	-1319.64	37.25	5410.		
320.00	1224816.	5716.15	106.557	339160.	1920.	1176920.	-1924.97	46.10	5382.		
340.00	1317617.	5920.52	111.902	294593.	2934.	1284258.	-2532.07	55.37	5351.		
360.00	1411160.	6177.20	116.851	237863.	4138.	1390963.	-3141.35	65.04	5318.		
380.00	1506437.	6467.66	121.377	168959.	5538.	1496922.	-3745.88	74.92	5271.		
400.00	1603321.	6567.34	125.527	88781.	7121.	1600845.	-4207.30	82.11	5042.		
420.00	1684552.	3687.38	130.477	-14832.	8567.	1684476.	-2608.88	48.83	2605.		
440.00	1708683.	883.32	146.132	-28003.	9054.	1708595.	-770.77	9.96	431.		
460.00	1713551.	601.45	164.497	-38825.	9166.	1713298.	-590.68	2.44	113.		
480.00	1714964.	496.98	172.716	-47989.	9182.	1714500.	-496.46	-0.16	22.		
500.00	1715276.	423.84	176.628	-55909.	9174.	1714580.	-423.74	-0.46	-9.		
520.00	1714973.	371.69	178.531	-62915.	9167.	1714260.	-371.11	-0.26	-20.		
540.00	1714663.	332.29	179.708	-69211.	9164.	1713795.	-331.31	-0.02	-25.		
560.00	1714663.	301.28	179.089	-70219.	9167.	1713241.	-299.88	0.21	-29.		
4) 563.35	1714606.	296.83	179.153		9167.	1713143.	-295.48	0.19	-28.		

- 1) Physical Separation;
- 2) Retro-Rocket Burnout;
- 3) S-1B Stage Apogee;
- 4) S-1B Stage Impact;

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
S-IB STAGE RE-ENTRY DATA

FLIGHT TIME (SEC)	MASS (LB)	THRUST (TOTAL) (LB)	DRAG (LB)	LONGITUDINAL ACCELERATION (FT/SEC ²)	DYNAMIC PRESSURE (LB/FT ²)	A.H.I.	MACH NO.
1) 143.52	102845.	0.	13015.	-4.072	9.	29991355.	6.52
2) 145.08	101452.	124000.	10181.	-39.764	7.	40041882.	6.49
146.00	101452.	0.	10900.	-0.246	1.	40210700.	6.86
180.00	101452.	0.	48.	-0.015	0.	40228171.	6.32
200.00	101452.	0.	6.	-0.002	0.	40229054.	5.61
220.00	101452.	0.	2.	-0.000	0.	40229172.	4.74
240.00	101452.	0.	1.	-0.000	0.	40229187.	4.04
260.00	101452.	0.	1.	-0.000	0.	40229187.	3.80
284.00	101452.	0.	1.	-0.000	0.	40229187.	3.80
280.00	101452.	0.	1.	-0.000	0.	40229187.	3.91
320.00	101452.	0.	1.	-0.000	0.	40229187.	4.44
340.00	101452.	0.	2.	-0.001	0.	40229252.	5.23
360.00	101452.	0.	19.	-0.006	0.	40229648.	5.98
380.00	101452.	0.	326.	-0.107	0.	40235077.	6.89
400.00	101452.	0.	7180.	-2.277	5.	40362502.	6.51
420.00	101452.	0.	117000.	-37.105	79.	42593195.	6.08
440.00	101452.	0.	901528.	-285.903	561.	65106295.	3.79
460.00	101452.	0.	196662.	-62.369	125.	73701183.	0.94
480.00	101452.	0.	118215.	-37.617	102.	74639601.	0.62
500.00	101452.	0.	113554.	-36.015	105.	75353018.	0.49
520.00	101452.	0.	110210.	-35.078	104.	75963116.	0.40
540.00	101452.	0.	102202.	-34.215	102.	76484756.	0.34
560.00	101452.	0.	105702.	-33.839	102.	76943783.	0.30
580.00	101452.	0.	105551.	-33.474	101.	77353962.	0.27
4) 583.39	101452.	0.	105257.	-33.412	101.	77419660.	0.26

- 1) Physical Separation;
- 2) Retro-Rocket Burnout;
- 3) S-IB Stage Apogee;
- 4) S-IBB Stage Impact.

AS-204/LM-1 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY (REVISION I)
 S-IB STAGE RE-ENTRY DATA
 TABLE 4C (Cont'd)

FLIGHT TIME (SEC)	ALTITUDE (FT)	RANGE (NM)	SPACE FIXED (DEG)	VELOCITY VECTOR EARTH FIXED (DEG)	LONGITUDE (POS. EAST) (DEG)	GEOCENTRIC DECLINATION (DEG)	GEOCENTRIC LATITUDE (DEG)
1) 143.52	208593.	33.891	75.644	72.221	-79.955	28.546	28.706
2) 145.08	214045.	35.309	75.536	72.054	-79.929	28.553	28.713
160.00	262150.	48.763	75.686	72.210	-79.686	28.622	28.782
180.00	316353.	66.666	75.889	72.441	-79.363	28.712	28.872
200.00	358919.	84.464	76.091	72.678	-79.040	28.801	28.961
220.00	383898.	102.185	76.293	72.919	-78.718	28.888	29.048
240.00	409321.	119.853	76.496	73.166	-78.397	28.974	29.134
260.00	417210.	137.490	76.699	73.418	-78.075	29.058	29.219
3) 264.00	417405.	141.016	76.740	73.469	-78.011	29.075	29.236
280.00	413573.	155.122	76.903	73.675	-77.753	29.141	29.302
300.00	398406.	172.772	77.109	73.938	-77.430	29.223	29.385
320.00	371694.	190.462	77.315	74.206	-77.105	29.304	29.466
340.00	333407.	208.218	77.523	74.480	-76.779	29.384	29.546
360.00	283508.	226.063	77.733	74.759	-76.450	29.463	29.626
380.00	221988.	244.010	77.950	75.044	-76.118	29.541	29.704
400.00	149648.	261.869	78.248	75.332	-75.788	29.617	29.781
420.00	81179.	276.469	80.227	75.612	-75.517	29.678	29.843
440.00	54831.	280.786	86.207	75.928	-75.437	29.696	29.861
460.00	47088.	281.730	88.500	76.023	-75.419	29.699	29.865
480.00	31400.	282.071	89.360	75.765	-75.413	29.701	29.866
500.00	22273.	282.206	89.753	76.490	-75.410	29.701	29.867
520.00	14354.	282.259	89.928	79.909	-75.409	29.701	29.867
540.00	7333.	282.276	90.027	111.475	-75.409	29.701	29.867
560.00	1013.	282.269	90.102	240.607	-75.409	29.701	29.867
4) 563.39	0.	282.267	90.096	239.775	-75.409	29.701	29.867

- 1) Physical Separation;
- 2) Retro-Rocket Burnout;
- 3) S-IB Stage Apogee;
- 4) S-IVB Stage Impact.

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