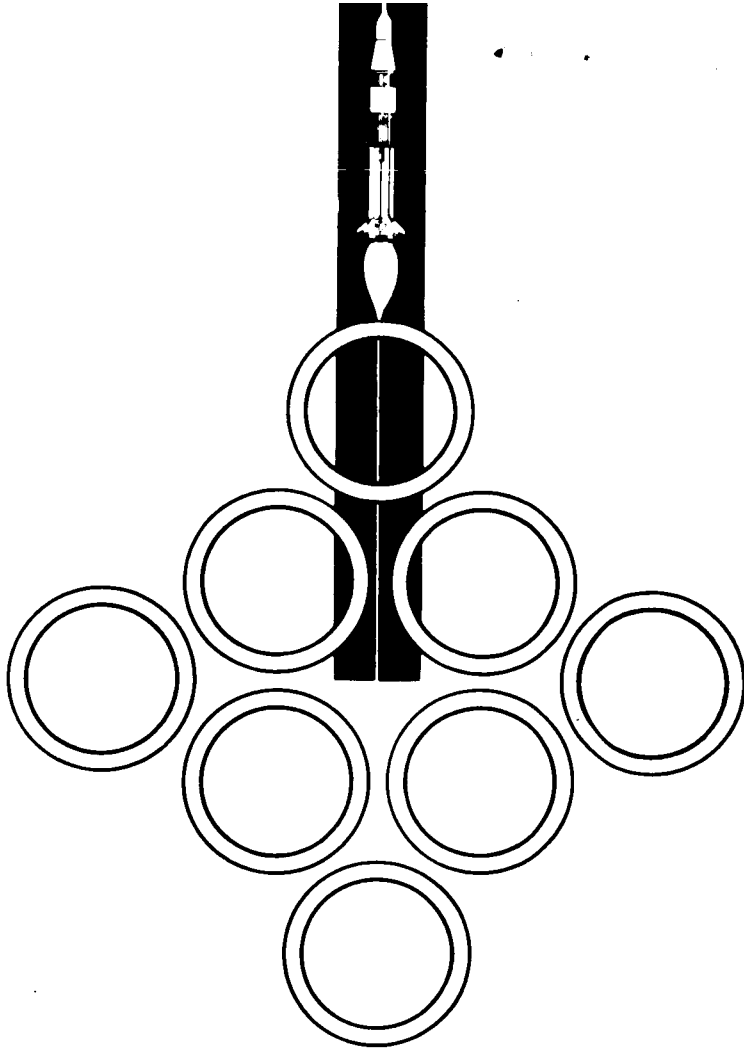


ENGINEERING DEPARTMENT
TECHNICAL NOTE

TN-AP-67-158



**AS-205 REVISED LAUNCH VEHICLE
REFERENCE TRAJECTORY**

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AS-205 REVISED LAUNCH VEHICLE REFERENCE TRAJECTORY /


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by


AEROSPACE PHYSICS BRANCH

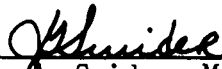
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FOREWORD

This report documents the AS-205 Revised Launch Vehicle Reference Trajectory. The analysis documented herein was performed by the Aerospace Physics Branch, Chrysler Corporation Space Division, under NAS8-4016, Modification MSFC-1, Amendments 19 and 21, as called out in BB Item 3.1.3-10.

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SUMMARY

This report documents the AS-205 Revised Launch Vehicle Reference Trajectory for the AS-205/208 rendezvous mission. Trajectory data are presented for the Saturn IB launch vehicle phases of flight from guidance reference release to orbit insertion. Comprehensive summaries of the launch vehicle characteristics are also presented.

The predicted nominal end conditions of flight at S-IB/S-IVB separation and orbit insertion are summarized below:

	<u>S-IB/S-IVB Separation</u>	<u>Orbit Insertion</u>
Flight Time (sec)	147.26	603.11
Altitude (km)	61.26	197.50
Space Fixed Velocity (m/s)	2324.84	7788.65
Space Fixed Path Angle (deg)	64.40	90.00
Ground Range (km)	62.26	1778.87

The SA-205 Launch Vehicle nominal weight in orbit capability is predicted to be 67,635 pounds for the orbit insertion conditions assumed herein. This orbit insertion weight is 1,471 pounds in excess of the propellant depletion weight.]

SECTION 1

INTRODUCTION

The AS-205 Revised Launch Vehicle Reference Trajectory and the associated guidance presettings are documented herein. The objectives of this analysis are to evaluate the performance capability of the SA-205 Launch Vehicle for the AS-205/208 rendezvous mission and to derive the S-IB stage tilt program. In addition, the Iterative Guidance Mode (IGM) presettings are presented for the Revised Reference Trajectory targeting conditions. The analysis is based on the "best available" vehicle data.

A final set of launch vehicle targeting conditions is not available at the present time. However, the data presented herein provides a realistic evaluation of the performance capability of the SA-205 vehicle for a prescribed orbit.

For information purposes, summaries of vehicle data, subsystems characteristics, and the guidance and control modes for the SA-205 Launch Vehicle are presented.

SECTION 2

MISSION DESCRIPTION

2.1 MISSION OBJECTIVES: The basic AS-205/208 mission plan is to insert the AS-205/CSM in a near earth circular orbit followed some twenty-four hours later by the AS-208/LM for rendezvous exercises.

The specific launch vehicle targeting conditions for the AS-205/208 mission are not finalized at this time. The targeting conditions considered herein for the AS-205 Revised L/V Reference Trajectory, will insert the AS-205/CSM into a 104 nautical mile circular orbit, referenced to an equatorial radius of 6378.166 km, with an orbital plane inclination of 28.896 degrees. The launch vehicle targeting conditions for the AS-208/LM will be a function of the AS-205 orbit achieved and the predicted orbit decay. The AS-208 L/V trajectory will be the subject of a subsequent report.

2.2 MISSION GROUND RULES AND CONSTRAINTS: The following mission criteria, vehicle constraints and trajectory constraints were imposed on the AS-205 Revised Launch Vehicle Reference Trajectory:

- 1) Launch from AFETR Pad 34;
- 2) Pad orientated launch azimuth of 100 degrees east of North;
- 3) Flight azimuth of approximately 82.82 degrees east of North. Flight azimuth is a free variable for optimization of L/V payload capability;
- 4) S-IB stage tilt program which: (a) Provides a near zero angle of attack profile throughout the high dynamic pressure region of flight; (b) Provides acceptable conditions at S-IB/S-IVB stage separation; and (c) Provides acceptable flight conditions throughout the region of flight from S-IVB stage separation to LES jettisoning;
- 5) Orbit insertion conditions at S-IVB cutoff for a 104 nautical mile circular orbit, equatorial reference, in an orbit plane inclined 28.896 degrees with the equatorial plane. The targeting parameter θ_N , argument of descending node, is a free variable for optimization of L/V performance capability and flight profile;
- 6) Commanded vehicle attitude rate limits of one degree per second in pitch, yaw and roll.

SECTION 3

LAUNCH VEHICLE AND ENVIRONMENT DESCRIPTION

3.1 CONFIGURATION: The SA-205 Saturn IB Launch Vehicle consists of a S-IB first stage, a S-IVB second stage, an Instrument Unit, and a payload. The AS-205 mission payload consists of the Launch Escape System (LES), Command Module (CM), Service Module (SM), and a Spacecraft-LM Adapter (SLA). An outboard profile of the complete configuration is shown in Figure 1A, Appendix A.

3.2 MASS CHARACTERISTICS: The SA-205 vehicle mass characteristics used for this analysis are defined in Reference 7. Table 1A presents a vehicle weight breakdown of the SA-205 Launch Vehicle. These data are consistent with Reference 7 and the L/V 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 Reference 6. A flight time history of the S-IB stage of flight aerodynamic data is presented in Table 4A.

3.4 PROPULSION SYSTEMS: The S-IB stage is powered by eight H-1 engines which are rated at 200,000 pounds thrust (sea level) 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 8. 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 is rated at 200,000 pound-thrust (vacuum) at a nominal mixture ratio of 5:1. However, the propellant utilization system is utilized to obtain a programmed mixture ratio (PMR) shift which provides a high mixture ratio level and a corresponding high thrust level for approximately 316 seconds of flight. The predicted nominal J-2 engine thrust history from the 90% thrust level time point to the time of the guidance cutoff signal was obtained from Reference 8. The thrust buildup and thrust decay histories were obtained from Reference 9. Table 6A presents a time history of the J-2 engine thrust magnitude. 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 interstage 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 10).

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 5).

The S-IVB Stage Auxiliary Propulsion Systems (APS) consists of two modules. Each module contains three 150-pound thrust (vacuum) hypergolic rocket engines.

3.5 ENVIRONMENT DESCRIPTION: The 1963 Patrick Reference Atmosphere model defines the atmospheric properties incorporated in the Revised L/V Trajectory simulation. The earth model and potential function is the Fischer Earth Model.

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 pre-specified targeting conditions. These functions are accomplished by the AS-205 Flight Program which is stored in the Launch Vehicle Digital Computer (LVDC). Inputs to the LVDC for navigation and steering command evaluations are the pre-specified constants for the different guidance modes and the inertial velocity increments sensed by the stabilized platform accelerometers. (See References 2 and 3.)

4.1 GUIDANCE MODES: Guidance of the SA-205 Launch Vehicle into orbit is divided into two distinct guidance modes: (1) Pre-IGM; and (2) IGM.

The Pre-IGM Guidance Mode provides pitch, yaw and roll vehicle attitude commands as a function of time from liftoff to the time of IGM initiation. The S-IB stage pitch program polynomials derived for the AS-205 mission are delineated in Appendix B, Table 1B. Also included in Table 1B is a time history of the yaw and roll attitude commands.

The IGM Guidance Mode is a two-stage three-dimensional formulation of the Iterative Guidance Mode equations and logic. The IGM Guidance Mode provides active guidance of the S-IVB stage in pitch and yaw from the time of IGM initiation, TB3 + 44 seconds, to orbit insertion. The commanded roll attitude is zero. The IGM equations and logic programmed for the LVDC Flight Program are defined in Reference 3. The IGM presettings derived for the AS-205 Revised L/V Reference Trajectory are given in Appendix B, Table 3B.

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 References 11 - 13.

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 References 11 - 13.

4.3 S-IB STAGE PITCH PROGRAM: A trajectory simulation technique which commands a prespecified vehicle pitch angle of attack (α_p) history throughout the S-IB stage of flight was utilized to shape the S-IB stage tilt program. It is noted that all trajectory simulations incorporated the vehicle data referenced herein and the guidance and control modes discussed above. A family of launch vehicle trajectories was generated in the absence

of any wind profile for a series of α_p histories. From this family, the trajectory which collectively best satisfied each of the following criteria was chosen:

- 1) Acceptable S-IB/S-IVB Stage Separation Conditions;
- 2) Near zero pitch angle of attack throughout the high dynamic pressure region of flight;
- 3) Commanded vehicle attitude rates less than one degree per second;
- 4) Aerodynamic Heating:
Aerodynamic heating indicator (AHI) at S-IB staging comparable to the Reference Trajectory value.

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

- 5) Maximum L/V Weight in Orbit Capability.

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

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

$$X_Z = f(T)$$

where

$$T = t - T_1 + \text{NGMDT}$$

with

$$t = \text{time from GRR}$$

$$T_1 = \text{time base \# 1. (0.2 second after first motion; } T_1 = 5.2 \text{ sec.)}$$

$$\text{NGMDT} = 1. \text{ sec. (Approximation of LVDC major loop cycle time.)}$$

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

4.4 IGM PRESETTINGS: A set of IGM presettings for the AS-205 Revised L/V Reference Trajectory was derived and is presented in Table 3B. The terminology used to define the IGM parameters is consistent with Reference 3. It is noted that the IGM presettings are strongly dependent on the proposed flight sequence of events, the S-IVB stage propulsion characteristics defined for the SA-205 Launch Vehicle and the targeting conditions assumed herein.

A review of the presettings will be made concurrently with generation of the AS-205 Launch Vehicle Operational Trajectory.

An investigation of the L/V orbital plane targeting conditions is summarized in Figure 16. The orbital plane targeting conditions determined for the AS-207 Reference Trajectory (Reference 1)

Argument of Descending Node (θ_N): 102.329 (deg)

Inclination (i): 28.896 (deg)

were used as the base point for the data increments. It is noted that the Reference Trajectory values yield a near optimum L/V weight in orbit capability for the SA-205 vehicle considered herein. Therefore, from a performance standpoint the above IGM parameters are applicable for the AS-205 Revised L/V Reference Trajectory. Figure 16 also depicts the vehicle yaw attitude angle history for the family of S-IVB stage trajectories considered. It is concluded that the Reference Trajectory targeting parameters provide a more desirable vehicle yaw attitude angle flight history.

SECTION 5

LAUNCH VEHICLE TRAJECTORY

The nominal programmed sequence of events for the AS-205 Revised Launch Vehicle Reference Trajectory is summarized in Table 1. This sequence of events is consistent with the flight sequence provided in References 4 and 5 and the propulsion and mass data referenced herein. In addition, Table 1 provides a summary of significant trajectory events.

Table 2 provides a summary of trajectory parameters at pertinent events from liftoff to orbit insertion. 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 launch vehicle trajectory are presented in Tables 5 - 6. The corresponding tabular listings in English units are given in Appendix C. Graphical displays of the ascent trajectory profile are shown in Figures 1 through 4.

A comparison of the AS-205 Revised Reference Trajectory with the previously published AS-207 Reference Trajectory and the original AS-205 mission trajectory is presented in Table 7.

5.1 S-IB STAGE FLIGHT PHASE: Tabulated listings of trajectory parameters for the S-IB phase of flight are presented in Table 5. This phase of the launch vehicle trajectory 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 (Tb1) is assumed to be 0.2 seconds after first motion. The S-IB stage flight phase ends at S-IB/S-IVB physical separation which is assumed to be 1.379 seconds after outboard engine cutoff signal (OECS).

A time history of the S-IB stage pitch attitude steering command is depicted in Figure 5. Figures 6 and 7 present summaries of the resulting vehicle pitch attitude rate and attitude error command. A summary of the pitch plane angle of attack throughout the S-IB stage of flight is presented in Figure 8. Figure 9 presents a summary of the dynamic pressure history. The S-IB stage longitudinal acceleration history is depicted in Figure 10.

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. (Reference 5.)

5.2 S-IVB STAGE FLIGHT PHASE: Tabulated listings of the launch vehicle trajectory from S-IB/S-IVB separation to the time of orbit insertion are presented in Table 6. Orbit insertion was defined to be at guidance cutoff signal (GCS) plus 10.2 seconds. GCS occurs when the inertial velocity magnitude equals a prespecified value of 7780.98 m/sec. This phase of the L/V trajectory includes the ullage rocket burns, J-2 engine thrust buildup

and decay, the EMR shift, and jettisoning of the ullage rocket cases and the Launch Escape System.

The pitch and yaw attitude angle steering commands during the S-IVB stage of powered flight are depicted in Figure 11. The S-IVB stage acceleration history is depicted in Figure 12. Trajectory parameters pertinent to an analysis of the trajectory from S-IB/S-IVB separation to the time of LES jettison are depicted in Figures 13 - 15.

5.3 LAUNCH VEHICLE PERFORMANCE CHARACTERISTICS: The predicted nominal S-IB and S-IVB stage performance characteristics for the SA-205 vehicle are presented in Table 8. These data are time averages of the detailed vehicle performance data referenced herein.

SECTION 6

REFERENCES

1. CCSD, TN-AP-66-84, "Launch Vehicle Reference Trajectory, AS-207 Mission", 7 September 1966.
2. MSFC, R-ASTR-NG-121-65, "LVDC Mission Defining Document for The AS-205 Mission", dated 24 November 1966.
3. MSFC No. III-4-423-5, "LVDC Equation Defining Document for The AS-205 Flight Program", dated 12 February 1966.
4. MSFC Drawing No. 10M30155, "Saturn IB/SA-205 Flight Sequence", dated 27 July 1966.
5. MSFC, R-AERO-FM-85-66, "Final Data Package For AS-205", dated 13 September 1966.
6. CCSD, TB-AP-66-50, "Axial Force Characteristics of the Saturn IB/Apollo, AS-204 Vehicle", dated 16 August 1966 (MSFC, R-AERO-AD-66-37); NASA TMX-53348, "Static Aerodynamic Characteristics of Apollo-Saturn IB Vehicle", dated 13 October 1966.
7. CCSD, WG-66-11-2-102 REV. C, "Final Predicted Mass Characteristics, Saturn IB Vehicle AS-205, dated 2 December 1966.
8. "S-IB Stage Final Propulsion Prediction", CCSD Reel # 6310; "Douglas S-IVB Stage Final Propulsion Prediction", CCSD Reel # 6515.
9. MSFC, R-P&VE-PPE-66-M-90, "Saturn IB J-2 Engine Characteristics", dated 11 May 1966.
10. MSFC, R-P&VE-PPF-66-M-82, "Data for Use in S-IB-203 and Sub Vehicle Specifications and Future Separation Studies", dated 21 June 1966.
11. MSFC, R-ASTR-F-66-47, "Control Gains and Shaping Networks for Saturn AS-205, S-IB and S-IVB Stages", dated 10 March 1966.
12. MSFC, R-ASTR-NG-88-66, "Control System Information for AS-205", dated 21 June 1966.
13. MSFC, R-ASTR-F-66-127, "Control System Switch Point For AS-204 and AS-205", dated 8 July 1966.
14. MSFC, R-ASTR-F-66-139, "M/F Filter For AS-204", dated 25 July 1966.

TABLE 1

AS-205 REVISED L/V REFERENCE TRAJECTORY
PROGRAMMED SEQUENCE OF EVENTS

<u>NOMINAL FLIGHT TIME</u> <u>(HR:MIN:SEC)</u>	<u>TIME (SEC)</u>	<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.
0:2:17.8	137.68	(137.5) ₁	Enable S-IB Propellant Level Sensors.
0:2:19.8	139.68	(0.0) ₂	Level Sensor Activation. Initiate Time Base 2.
0:2:22.9	142.88	(3.2) ₂	Inboard Engine Cutoff (IECO).
0:2:25.9	145.88	(0.0) ₃	Outboard Engine Cutoff (OECO). Initiate Time Base 3.
0:2:27.2	147.18	(1.3) ₃	Separation Signal.
0:2:28.6	148.58	(2.7) ₃	J-2 Engine Start Command.
0:2:34.6	154.58	(8.7) ₃	Activate PU System.
0:2:39.2	159.18	(13.3) ₃	Jettison Ullage Rocket Motors.
0:3:06.9	186.88	-----	Jettison LES.
0:3:10.0	189.88	(44.0) ₃	Initiate Active Guidance.
0:9:52.9	592.91	-----	Guidance Cutoff Signal (GCS).
0:9:53.1	593.11	(0.0) ₄	Initiate Time Base 4.
0:10:03.1	603.11	-----	Orbit Insertion.

TABLE 2

AS-205 REVISED L/V REFERENCE TRAJECTORY
TRAJECTORY SUMMARY

Event	Flight Time (sec)	Altitude (km)	Space Fixed Velocity (m/s)	Flight Path Angle (deg)	Space Fixed Velocity Azimuth	Geodetic Latitude (deg)	Longitude (deg)
First Motion	0.00	0.03	408.97	90.00	90.00	28.52	80.56
Max. Dyn. Pressure	78.00	12.56	749.10	58.56	87.30	28.53	80.52
Tilt Arrest	137.00	51.09	2063.02	62.76	84.60	28.57	80.09
IECO	142.88	56.82	2271.79	63.67	84.49	28.58	80.00
OECO	145.88	59.86	2326.60	64.14	84.48	28.59	79.95
S-IB/S-IVB Physical Sep.	147.26	61.26	2324.84	64.40	84.50	28.59	79.93
J-2 Eng. Start Command	148.58	62.58	2319.70	64.66	84.51	28.59	79.91
Jettison LES	186.88	96.51	2445.09	71.10	84.75	28.66	79.22
Initiate IGM (Approx.)	190.00	98.96	2460.14	71.57	84.77	28.67	79.16
EMR Shift	471.00	198.63	5287.69	89.60	89.96	29.06	70.38
Guidance Cutoff Signal	592.91	197.51	7780.98	90.01	93.68	28.84	63.09
Orbit Insertion	603.11	197.50	7788.65	90.00	94.06	28.80	62.35

TABLE 3

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IB STAGE END CONDITIONS OF FLIGHT

Flight Time (t):	OECO + 1.379 seconds	147.262	(sec)
Radius (R):		6434558.	(m)
Altitude:		61258.	(m)
Space Fixed Velocity (V):		2324.84	(m/s)
Space Fixed Path Angle (θ):		64.401	(deg)
Space Fixed Flight Azimuth (AZI):		84.497	(deg)
Earth Fixed Flight Azimuth (AZE):		83.152	(deg)
Geodetic Latitude (ϕ):		28.592	(deg)
Longitude (λ):	(Pos West)	79.930	(deg West)
Range:		62.26	(km)

POSITION AND VELOCITY COMPONENTS (PLUMBLINE)

X	=	122984.	(m)
Y	=	6433333.	(m)
Z	=	25211.	(m)
\dot{X}	=	2115.07	(m/s)
\dot{Y}	=	964.10	(m/s)
\dot{Z}	=	43.11	(m/s)

VEHICLE ATTITUDE AND ATTITUDE RATE

Pitch Attitude Angle (ϕ_p):	-60.844	(deg)
Yaw Attitude Angle (ϕ_y):	- 0.079	(deg)
Roll Attitude Angle (ϕ_r):	- 0.005	(deg)
Pitch Rate ($\dot{\phi}_p$):	- 0.010	(deg/s)
Yaw Rate ($\dot{\phi}_y$):	+ 0.006	(deg/s)
Roll Rate ($\dot{\phi}_r$):	- 0.002	(deg/s)

TABLE 4

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE END CONDITIONS OF FLIGHT

Flight Time (t): GCS	592.906	(sec)
Radius (R):	6570734.	(m)
Altitude:	197513.	(m)
Space Fixed Velocity (V):	7780.98	(m/s)
Space Fixed Flight Path Angle (θ):	90.006	(deg)
Space Fixed Flight Azimuth (AZI):	93.682	(deg)
Earth Fixed Flight Azimuth (AZE):	93.892	(deg)
Geodesic Latitude (ϕ):	28.843	(deg)
Longitude (λ): (Pos West)	63.094	(deg West)
Inclination (i):	28.896	(deg)
Descending Node (θ_N):	102.328	(deg)

POSITION AND VELOCITY COMPONENTS (PLUMBLINE)

X	=	1975791.	(m)
Y	=	6266317.	(m)
Z	=	63836.	(m)
\dot{X}	=	7418.68	(m/s)
\dot{Y}	=	-2341.51	(m/s)
\dot{Z}	=	155.30	(m/s)

VEHICLE ATTITUDE ANGLES

Pitch Attitude Angle (ϕ_p)	=	-103.795	(deg)
Yaw Attitude Angle (ϕ_y)	=	1.404	(deg)
Roll Attitude Angle (ϕ_r)	=	- 0.506	(deg)

OSCULATING CONIC PARAMETERS

*Perigee Altitude	=	166.70	(km)
*Apogee Altitude	=	192.58	(km)
Eccentricity	=	0.0020	
Semi-Major Axis	=	6557.81	(km)
Period	=	88.08	(min)

* Referenced to Equatorial Radius (6378.166)

TABLE 4 (Cont'd)

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE END CONDITIONS OF FLIGHT

Flight Time (t): GCS + 10.2 seconds:	603.106	(sec)
Radius (R):	6570733.	(m)
Altitude:	197497.	(m)
Space Fixed Velocity (V):	7788.65	(m/s)
Space Fixed Flight Path Angle (θ):	90.002	(deg)
Space Fixed Flight Azimuth (AZI):	94.061	(deg)
Earth Fixed Flight Azimuth (AZE):	94.292	(deg)
Geodetic Latitude (ϕ):	28.796	(deg)
Longitude (λ): (Pos West)	62.349	(deg West)
Inclination (i):	28.896	(deg)
Descending Node (θ_N):	102.326	(deg)

POSITION AND VELOCITY COMPONENTS (PLUMBLINE)

X	=	2051387.	(m)
Y	=	6241960.	(m)
Z	=	65417.	(m)
\dot{X}	=	7397.27	(m/s)
\dot{Y}	=	- 2433.00	(m/s)
\dot{Z}	=	154.64	(m/s)

VEHICLE ATTITUDE ANGLES

Pitch Attitude Angle (ϕ_p)	=	-103.798 (deg)
Yaw Attitude Angle (ϕ_y)	=	1.398 (deg)
Roll Attitude Angle (ϕ_r)	=	- 0.902 (deg)

OSCULATING CONIC PARAMETERS

*Perigee Altitude	=	192.30 (km)
*Apogee Altitude	=	192.80 (km)
Eccentricity	=	0.00004
Semi-Major Axis	=	6570.71 (km)
Period	=	88.34 (min)

* Referenced to Equatorial Radius (6378.166)

TABLE 5
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	RANGE (KM)	ALTITUDE (KM)	VELOCITY (M/SEC)	SPACE FIXED PATH ANGLE (DEG)	LONGITUDINAL ACCELERATION (M/SEC ²)	MASS (KG)	THRUST (TOTAL) (N)	DYNAMIC PRESSURE (KG/M ²)	MACH NO.	PITCH ANGLE OF ATTACK (DEG)
1) -5.00	-0.00	0.03	408.97	90.000	0.000	592787.	0.	0.	0.00	0.000
2) 0.00	0.00	0.03	408.97	90.000	11.761	586593.	6844075.	0.	0.00	0.000
5.00	0.00	0.06	409.10	86.396	12.275	572964.	6984908.	8.	0.03	-0.115
10.00	-0.00	0.15	409.61	86.552	12.607	559279.	7014658.	36.	0.07	-0.195
15.00	-0.00	0.31	410.83	84.454	13.016	545529.	7080198.	93.	0.11	-0.383
20.00	0.00	0.55	413.54	82.095	13.433	531691.	7139964.	186.	0.17	-0.334
25.00	0.01	0.88	418.26	79.510	13.863	517811.	7190373.	323.	0.22	-0.290
30.00	0.03	1.31	425.87	76.759	14.311	503900.	7245173.	510.	0.29	-0.259
35.00	0.07	1.86	437.12	73.914	14.780	489965.	7302886.	749.	0.36	-0.080
40.00	0.14	2.53	452.75	71.070	15.285	476014.	7367967.	1039.	0.44	-0.054
45.00	0.27	3.33	473.45	68.336	15.814	462050.	7433553.	1375.	0.53	-0.058
50.00	0.46	4.28	499.83	65.823	16.369	448075.	7501543.	1747.	0.63	-0.049
55.00	0.75	5.38	532.01	63.613	16.920	434098.	7570985.	2137.	0.75	-0.003
60.00	1.15	6.65	569.80	61.791	17.269	420121.	7638138.	2517.	0.88	0.010
65.00	1.69	8.08	611.85	60.473	17.334	406138.	7697140.	2829.	1.03	0.012
70.00	2.39	9.66	658.82	59.548	18.233	392098.	7761233.	3064.	1.20	0.017
75.00	3.29	11.42	713.01	58.858	19.292	378046.	7823372.	3223.	1.40	0.011
78.00	3.94	12.56	749.10	58.557	19.961	369614.	7857596.	3254.	1.54	0.001
80.00	4.42	13.36	774.70	58.402	20.429	363995.	7877041.	3237.	1.64	-0.007
85.00	5.81	15.48	844.13	58.164	21.623	349948.	7919400.	3043.	1.89	-0.029
90.00	7.51	17.81	921.38	58.122	22.863	335949.	7949991.	2643.	2.14	-0.047
95.00	9.55	20.35	1006.48	58.246	24.151	322011.	7970347.	2149.	2.38	-0.029
100.00	11.98	23.11	1099.40	58.487	25.468	308082.	7979560.	1708.	2.64	0.044
105.00	14.83	26.10	1200.28	58.835	26.837	294167.	7980994.	1325.	2.92	-0.013
110.00	18.15	29.33	1309.35	59.267	28.291	280272.	7978159.	998.	3.23	-0.095
115.00	21.98	32.80	1427.02	59.773	29.840	266399.	7968397.	726.	3.54	-0.328
120.00	26.37	36.52	1553.84	60.344	31.506	252555.	7951139.	514.	3.86	-0.670
125.00	31.36	40.49	1690.42	60.977	33.321	238749.	7931270.	356.	4.20	-1.243
130.00	37.01	44.73	1837.55	61.673	35.312	224983.	7907662.	243.	4.55	-1.871
135.00	43.38	49.22	1996.15	62.436	37.499	211266.	7875840.	166.	4.98	-2.767
137.00	46.14	51.09	2063.02	62.763	38.438	205799.	7861222.	144.	5.20	-3.169
140.00	50.53	53.97	2167.23	63.259	39.925	197616.	7837132.	115.	5.57	-2.678
142.88	55.03	56.82	2271.79	63.666	41.411	189777.	7803867.	91.	5.96	-1.630
145.00	58.49	58.97	2312.13	64.000	20.894	185981.	3830916.	73.	6.16	-1.087
145.88	59.96	59.86	2326.60	64.139	17.341	164807.	3197911.	66.	6.23	-0.860
147.18	62.13	61.18	2325.16	64.385	0.107	183928.	13670.	50.	6.27	-0.548
147.26	62.26	61.26	2324.84	64.471	0.096	183924.	11776.	50.	6.28	-0.530

1) GR; 2) First Motion; 3) IECO; 4) OECO; 5) Ser. Signal; 6) Physical Jef.

TABLE 5 (Cont'd)
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-1B STAGE FLIGHT DATA

FLIGHT TIME (SEC)	SPACE FIXED POSITION AND VELOCITY VECTORS			SPACE FIXED MAGNITUDE					
	X (M)	Y (M)	Z (M)	UX (M/S)	DY (M/S)	DZ (M/S)	RADIUS (M)	VELOCITY (M/S)	PATH ANGLE (DEG)
1) -5.00	-2240.	6373328.	17784.	405.76	0.00	51.12	6373353.	408.97	90.000
2) 0.00	-212.	6373328.	18040.	405.77	-0.13	51.05	6373353.	408.97	90.000
5.00	1817.	6373355.	18295.	405.77	11.19	50.94	6373381.	409.10	88.396
10.00	3846.	6373442.	18549.	405.72	24.25	50.83	6373471.	409.61	86.552
15.00	5875.	6373600.	18803.	405.79	39.18	50.81	6373631.	410.83	84.454
20.00	7905.	6373838.	19057.	406.55	56.22	50.70	6373871.	413.54	82.095
25.00	9942.	6374166.	19310.	408.28	75.36	50.63	6374203.	418.26	79.510
30.00	11991.	6374595.	19563.	411.68	96.61	50.50	6374636.	425.87	76.759
35.00	14062.	6375136.	19815.	417.28	120.04	50.36	6375182.	437.12	73.914
40.00	16168.	6375799.	20067.	425.73	145.64	50.24	6375851.	452.75	71.070
45.00	18325.	6376596.	20318.	437.71	173.37	50.14	6376654.	473.45	68.336
50.00	20553.	6377536.	20568.	453.96	203.08	50.02	6377602.	499.83	65.823
55.00	22873.	6378629.	20818.	474.89	234.58	49.89	6378704.	532.01	63.613
60.00	25310.	6379884.	21067.	500.81	267.19	49.76	6379969.	569.80	61.791
65.00	27889.	6381300.	21315.	531.47	299.05	49.61	6381396.	611.85	60.473
70.00	30634.	6382874.	21563.	567.48	331.01	49.46	6382984.	658.82	59.548
75.00	33575.	6384614.	21810.	610.30	365.37	49.30	6384740.	713.01	58.858
78.00	35449.	6385743.	21958.	639.47	387.06	49.20	6385879.	749.10	58.557
80.00	36749.	6386532.	22056.	660.44	401.95	49.13	6386675.	774.70	58.402
85.00	40192.	6388637.	22301.	718.35	440.59	48.96	6388802.	844.13	58.164
90.00	43946.	6390941.	22545.	784.32	481.04	48.78	6391131.	921.38	58.122
95.00	48049.	6393450.	22789.	858.51	523.08	48.58	6393671.	1006.48	58.246
100.00	52544.	6396174.	23031.	940.81	566.77	48.35	6396431.	1099.40	58.487
105.00	57472.	6399120.	23272.	1031.57	511.74	48.09	6399420.	1200.28	58.835
110.00	62874.	6402294.	23512.	1131.06	657.88	47.75	6402645.	1309.35	59.267
115.00	68798.	6405700.	23750.	1239.83	704.96	47.34	6406114.	1427.02	59.773
120.00	75289.	6409344.	23985.	1358.52	752.76	46.89	6409831.	1553.84	60.344
125.00	82401.	6413229.	24218.	1487.93	800.89	46.27	6413804.	1690.42	60.977
130.00	90188.	6417353.	24448.	1629.05	848.95	45.55	6418033.	1837.55	61.673
135.00	98713.	6421717.	24674.	1783.08	896.23	44.77	6422523.	1996.15	62.436
137.00	102344.	6423528.	24763.	1848.63	914.69	44.43	6424391.	2063.02	62.763
140.00	108042.	6426313.	24895.	1951.15	942.33	43.92	6427269.	2167.23	63.259
3) 142.88	113814.	6429071.	25021.	2053.16	971.42	43.42	6430127.	2271.79	63.666
145.00	118210.	6431134.	25113.	2096.02	975.06	43.20	6432269.	2312.13	64.000
145.88	120068.	6431995.	25151.	2111.81	975.43	43.15	6433164.	2326.60	64.139
147.18	122817.	6433257.	25207.	2115.08	964.85	43.11	6434478.	2325.16	64.385
147.26	122984.	6433333.	25211.	2115.07	964.10	43.11	6434558.	2324.84	64.401

1) GRR; 2) First Motion; 3) IEEO; 4) OEEO; 5) Sep. Signal; 6) Physical Sep.

TABLE 5 (Cont'd)
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-1B STAGE FLIGHT DATA

FLIGHT TIME (SEC)	EARTH FIXED POSITION			EARTH FIXED VELOCITY			POSITION (M)	EARTH FIXED VELOCITY			PATH ANGLE (DEG)
	X (M)	Y (M)	Z (M)	UX (M/S)	UY (M/S)	UZ (M/S)		VELOCITY (M/S)	VELOCITY (M/S)	VELOCITY (M/S)	
1) -5.00	0.	32.	-0.	-0.00	-0.00	0.00	32.	0.00	0.00	0.00	N/A
2) 0.00	-0.	32.	-0.	-0.00	-0.00	-0.00	32.	0.00	0.00	0.00	N/A
5.00	0.	60.	-0.	-0.02	11.45	-0.04	60.	11.45	11.45	0.368	0.368
10.00	-0.	149.	-0.	-0.10	24.64	-0.08	149.	24.64	24.64	0.395	0.395
15.00	-1.	309.	-1.	-0.07	39.71	-0.03	309.	39.71	39.71	0.221	0.221
20.00	0.	550.	-1.	0.62	56.87	-0.08	550.	56.88	56.88	0.685	0.685
25.00	7.	882.	-1.	2.27	76.15	-0.08	882.	76.18	76.18	1.742	1.742
30.00	26.	1315.	-2.	5.55	97.54	-0.15	1315.	97.70	97.70	3.288	3.288
35.00	66.	1861.	-3.	11.03	121.12	-0.22	1862.	121.62	121.62	5.227	5.227
40.00	141.	2530.	-4.	19.31	146.88	-0.27	2534.	148.15	148.15	7.512	7.512
45.00	265.	3333.	-6.	31.09	174.79	-0.31	3344.	177.54	177.54	10.108	10.108
50.00	459.	4281.	-7.	47.12	204.72	-0.34	4306.	210.07	210.07	12.981	12.981
55.00	744.	5383.	-9.	67.78	236.46	-0.36	5435.	245.99	245.99	16.011	16.011
60.00	1145.	6648.	-11.	93.40	269.36	-0.38	6746.	285.09	285.09	19.136	19.136
65.00	1686.	8076.	-13.	123.74	301.55	-0.39	8250.	325.95	325.95	22.317	22.317
70.00	2391.	9663.	-15.	159.39	333.90	-0.37	9955.	369.99	369.99	25.518	25.518
75.00	3291.	11419.	-16.	201.80	368.70	-0.33	11884.	420.32	420.32	28.685	28.685
78.00	3939.	12558.	-17.	230.72	390.71	-0.30	13161.	453.74	453.74	30.547	30.547
80.00	4421.	13354.	-18.	251.50	405.83	-0.26	14067.	477.44	477.44	31.768	31.768
85.00	5819.	15481.	-19.	308.92	445.10	-0.15	16538.	541.80	541.80	34.731	34.731
90.00	7524.	17808.	-19.	374.35	486.29	0.00	19333.	613.69	613.69	37.542	37.542
95.00	9576.	20346.	-19.	447.94	529.17	0.20	22487.	693.31	693.31	40.182	40.182
100.00	12016.	23103.	-17.	529.59	573.85	0.42	26041.	780.87	780.87	42.616	42.616
105.00	14886.	26087.	-15.	619.65	619.93	0.69	30035.	876.52	876.52	44.874	44.874
110.00	18227.	29305.	-10.	718.40	667.33	0.94	34511.	980.53	980.53	46.967	46.967
115.00	22085.	32762.	-5.	826.37	715.84	1.22	39511.	1093.31	1093.31	48.922	48.922
120.00	26508.	36465.	2.	944.20	765.27	1.55	45081.	1215.38	1215.38	50.758	50.758
125.00	31545.	40416.	10.	1072.71	815.22	1.81	51269.	1347.33	1347.33	52.505	52.505
130.00	37254.	44617.	20.	1212.87	865.32	2.09	58125.	1489.91	1489.91	54.182	54.182
135.00	43695.	49068.	31.	1365.91	914.90	2.44	65704.	1644.01	1644.01	55.816	55.816
137.00	46492.	50917.	36.	1431.06	934.35	2.60	68950.	1709.08	1709.08	56.464	56.464
140.00	50937.	53764.	44.	1532.95	963.56	2.87	74062.	1810.64	1810.64	57.414	57.414
142.88	55502.	56585.	53.	1634.33	994.27	3.17	79261.	1913.01	1913.01	58.211	58.211
145.00	59011.	58658.	60.	1676.88	998.81	3.41	83233.	1951.81	1951.81	58.715	58.715
145.88	60498.	59580.	63.	1692.55	999.54	3.54	84911.	1965.66	1965.66	58.917	58.917
147.18	62703.	60874.	68.	1695.76	989.31	3.68	87391.	1963.25	1963.25	59.202	59.202
147.26	62836.	60952.	68.	1695.75	988.58	3.69	87542.	1962.87	1962.87	59.219	59.219

1) GR; 2) First Motion; 3) IEEO; 4) OEEO; 5) Sep. Signal; 6) Physical Sep.

TABLE 5 (Cont'd)
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-1B STAGE FLIGHT DATA

FLIGHT TIME (SEC)	RANGE (KM)	ALTITUDE (KM)	LONGITUDE (POS. WEST) (DEG)	GEODEIC LATITUDE (DEG)	GEOCENTRIC LATITUDE (DEG)
1) -5.00	-0.00	0.03	80.561	28.522	28.361
2) 0.00	0.00	0.03	80.561	28.522	28.361
5.00	0.00	0.06	80.561	28.522	28.361
10.00	-0.00	0.15	80.561	28.522	28.361
15.00	-0.00	0.31	80.561	28.522	28.361
20.00	0.00	0.55	80.561	28.522	28.361
25.00	0.01	0.88	80.561	28.522	28.361
30.00	0.03	1.31	80.561	28.522	28.361
35.00	0.07	1.86	80.560	28.522	28.361
40.00	0.14	2.53	80.560	28.522	28.361
45.00	0.27	3.33	80.558	28.522	28.361
50.00	0.46	4.28	80.556	28.523	28.362
55.00	0.75	5.38	80.554	28.523	28.362
60.00	1.15	6.65	80.550	28.524	28.362
65.00	1.69	8.08	80.544	28.524	28.363
70.00	2.39	9.66	80.537	28.525	28.364
75.00	3.29	11.42	80.528	28.526	28.365
78.00	3.94	12.56	80.521	28.527	28.366
80.00	4.42	13.36	80.516	28.527	28.366
85.00	5.81	15.48	80.502	28.529	28.368
90.00	7.51	17.81	80.485	28.531	28.370
95.00	9.55	20.35	80.464	28.533	28.372
100.00	11.98	23.11	80.440	28.536	28.375
105.00	14.83	26.10	80.411	28.539	28.378
110.00	18.15	29.33	80.377	28.543	28.382
115.00	21.98	32.80	80.338	28.547	28.386
120.00	26.37	36.52	80.294	28.552	28.391
125.00	31.36	40.49	80.243	28.558	28.397
130.00	37.01	44.73	80.186	28.564	28.403
135.00	43.38	49.22	80.121	28.571	28.410
137.00	46.14	51.09	80.093	28.574	28.413
140.00	50.53	53.97	80.049	28.579	28.418
142.88	55.03	56.82	80.003	28.584	28.422
145.00	58.49	58.97	79.968	28.588	28.426
145.88	59.96	59.86	79.953	28.589	28.428
147.18	62.13	61.18	79.931	28.591	28.430
147.26	62.26	61.26	79.930	28.592	28.430

3) 142.88
4) 145.88
5) 147.18
6) 147.26

1) GR; 2) First Motion; 3) IE; 4) OE; 5) Sep. Signal; 6) Physical Sep.

TABLE 5 (Cont'd)
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-1B STAGE FLIGHT DATA

FLIGHT TIME (SEC)	VEHICLE ATTITUDE ANGLE		VEHICLE ATTITUDE RATE		ATTITUDE ERROR		COMMAND ROLL (DEG)
	PITCH (DEG)	YAW (DEG)	PITCH (DEG/S)	YAW (DEG/S)	PITCH (DEG)	YAW (DEG)	
1) 5.00	0.000	0.000	-0.004	0.000	0.000	0.000	-0.000
2) 0.00	-0.018	0.002	-0.004	0.000	-0.018	0.002	-0.010
5.00	0.016	-0.021	-0.007	0.008	0.016	-0.021	0.009
10.00	0.009	-0.027	0.000	0.001	0.009	-0.027	-0.004
15.00	-0.332	0.079	-0.133	-0.044	0.166	0.079	1.311
20.00	-1.045	-0.024	-0.144	0.026	0.196	-0.024	0.745
25.00	-2.105	-0.006	-0.265	-0.014	0.298	-0.006	0.816
30.00	-3.645	-0.096	-0.360	-0.028	0.325	-0.096	-0.622
35.00	-5.426	0.001	-0.427	-0.014	0.504	0.001	0.131
40.00	-7.706	-0.033	-0.482	0.006	0.561	-0.033	-0.003
45.00	-10.327	-0.034	-0.501	-0.002	0.641	-0.034	-0.007
50.00	-13.212	-0.038	-0.583	-0.001	0.664	-0.038	0.001
55.00	-16.217	-0.044	-0.616	-0.001	0.689	-0.044	0.001
60.00	-19.351	-0.051	-0.635	-0.001	0.690	-0.051	0.001
65.00	-22.553	-0.056	-0.643	0.001	0.682	-0.056	0.001
70.00	-25.774	-0.057	-0.644	-0.000	0.673	-0.057	0.002
75.00	-28.974	-0.057	-0.634	-0.001	0.658	-0.057	0.002
78.00	-30.863	-0.057	-0.624	0.001	0.649	-0.057	0.001
80.00	-32.104	-0.055	-0.616	0.001	0.644	-0.055	0.001
85.00	-35.119	-0.053	-0.589	0.001	0.630	-0.053	-0.000
90.00	-37.982	-0.049	-0.556	0.001	0.611	-0.049	-0.001
95.00	-40.640	-0.045	-0.492	0.001	0.560	-0.045	-0.001
100.00	-43.042	-0.054	-0.489	0.002	0.584	-0.054	0.003
105.00	-45.400	-0.052	-0.456	-0.001	0.539	-0.052	0.000
110.00	-47.624	-0.086	-0.452	-0.000	0.502	-0.086	-0.001
115.00	-49.864	-0.093	-0.446	-0.002	0.542	-0.093	-0.004
120.00	-52.100	-0.097	-0.450	-0.000	0.544	-0.097	-0.006
125.00	-54.483	-0.178	-0.462	0.006	0.460	-0.178	-0.013
130.00	-56.857	-0.170	-0.498	-0.003	0.488	-0.170	-0.014
135.00	-59.462	-0.177	-0.540	-0.002	0.431	-0.177	-0.019
137.00	-60.545	-0.179	-0.530	-0.000	0.417	-0.179	-0.021
140.00	-61.054	-0.180	0.161	-0.001	-0.219	-0.180	-0.027
3) 142.88	-60.854	-0.178	0.002	0.000	-0.019	-0.178	-0.007
4) 145.00	-60.853	-0.105	0.006	0.033	-0.019	-0.105	-0.006
4) 145.88	-60.845	-0.087	0.011	0.009	-0.010	-0.087	-0.004
5) 147.18	-60.843	-0.075	-0.009	0.006	-0.008	-0.075	-0.004
6) 147.26	-60.844	-0.079	-0.010	0.006	-0.009	-0.079	-0.005

1) GR; 2) First Motion; 3) IECO; 4) OECO; 5) Sep. Signal; 6) Physical Sep.

TABLE 6
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE FLIGHT DATA

	FLIGHT TIME (SEC)	RANGE (KM)	ALTITUDE (KM)	SPACE VELOCITY (M/SEC)	FIXED PATH ANGLE (DEG)	LONGITUDINAL ACCELERATION (M/SEC ²)	MASS (KG)	THRUST (TOTAL) (N)	DYNAMIC PRESSURE (KG/M ²)	PITCH ATTITUDE COMMAND (DEG)
1)	147.26	62.26	61.26	2324.84	64.401	0.266	137883.	38915.	56.	60.835
2)	148.58	64.47	62.58	2319.70	64.659	0.256	137853.	37166.	47.	60.835
3)	151.50	69.34	65.44	2311.87	65.225	5.479	137659.	755416.	32.	60.835
3)	151.98	70.14	65.91	2312.86	65.314	6.319	137600.	870634.	30.	60.835
4)	155.00	75.22	68.80	2320.02	65.860	6.459	136955.	885366.	20.	60.835
4)	159.18	82.32	72.72	2332.73	66.596	7.434	135898.	1010719.	12.	60.835
4)	160.00	83.72	73.48	2335.64	66.737	7.443	135700.	1010473.	11.	60.835
5)	180.00	119.18	90.94	2414.61	70.041	7.715	130828.	1009306.	1.	60.835
5)	186.88	131.92	96.51	2445.09	71.195	8.053	125318.	1009198.	0.	60.835
5)	190.00	137.79	98.96	2460.14	71.569	8.104	124558.	1009387.	0.	60.585
200.00	157.02	106.53	106.53	2509.18	72.889	8.271	122120.	1010028.	0.	51.185
220.00	197.23	120.66	120.66	2613.04	75.105	8.597	117240.	1007947.	0.	55.986
240.00	239.95	133.45	133.45	2731.41	77.190	8.977	112361.	1008703.	0.	59.133
260.00	285.38	144.92	144.92	2863.69	79.107	9.394	107484.	1009688.	0.	61.856
280.00	333.74	155.13	155.13	3010.31	80.353	9.805	102607.	1006171.	0.	64.213
300.00	385.24	164.10	164.10	3171.50	82.426	10.324	97731.	1008973.	0.	66.957
320.00	440.14	171.89	171.89	3347.67	83.828	10.871	92857.	1009424.	0.	69.628
340.00	498.69	178.53	178.53	3540.35	85.073	11.462	87977.	1008389.	0.	72.044
360.00	561.19	184.09	184.09	3749.37	86.156	12.141	83102.	1008991.	0.	74.554
380.00	627.95	188.62	188.62	3976.68	87.090	12.879	78223.	1007468.	0.	77.122
400.00	699.32	192.21	192.21	4222.89	87.878	13.725	73349.	1006695.	0.	79.584
420.00	775.66	194.92	194.92	4490.68	88.529	14.737	68474.	1009101.	0.	82.169
440.00	857.42	196.86	196.86	4782.71	89.048	15.861	63592.	1008642.	0.	84.673
460.00	945.08	198.15	198.15	5100.56	89.439	17.117	58719.	1005132.	0.	87.182
477.00	1024.62	198.83	198.83	5391.03	89.681	17.545	54630.	958466.	0.	89.191
480.00	1039.15	198.91	198.91	5442.25	89.718	17.439	53949.	940828.	0.	89.647
500.00	1139.84	199.20	199.20	5782.82	89.977	17.589	49647.	873262.	0.	92.717
520.00	1247.29	199.03	199.03	6142.52	90.158	18.884	45517.	859575.	0.	95.105
540.00	1362.00	198.58	198.58	6531.90	90.229	20.433	41455.	847063.	0.	97.521
560.00	1484.61	198.04	198.04	6959.21	90.292	22.633	37429.	847126.	0.	100.260
580.00	1616.01	197.64	197.64	7438.59	90.394	25.522	33383.	852022.	0.	104.780
592.91	1705.98	197.51	197.51	7780.98	90.076	27.635	30768.	850281.	0.	104.015
600.00	1756.68	197.50	197.50	7788.57	90.002	0.028	30680.	850.	0.	104.015
603.11	1778.87	197.50	197.50	7788.65	90.002	0.028	30679.	850.	0.	104.015

1 2 1

1) Physical Sep; 2) J-2 Eng. Start Com; 3) 90% J-2 Thrust; 4) Ullage Jettison; 5) Jettison LES; 6) CCS; 7) Orbit Insert.

TABLE 6 (Cont'd)
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	SPACE FIXED POSITION AND VELOCITY VECTORS			SPACE FIXED VELOCITY VECTORS			SPACE FIXED VELOCITY PATH ANGLE		
	X (M)	Y (M)	Z (M)	UX (M/S)	UY (M/S)	DZ (M/S)	RADIUS (M)	VELOCITY (M/S)	ANGLE (DEG)
1) 147.26	122984.	6433333.	25211.	2115.07	964.10	43.11	6434558.	2324.84	64.401
2) 148.58	125778.	6434598.	25268.	2115.12	951.54	43.07	6435877.	2319.70	64.659
3) 151.50	131949.	6437334.	25393.	2118.13	925.44	42.99	6438736.	2311.87	65.225
4) 151.98	132973.	6437780.	25414.	2120.61	922.21	42.97	6439204.	2312.86	65.225
5) 155.00	139395.	6440533.	25543.	2136.81	902.62	42.77	6442092.	2320.02	65.860
6) 159.18	148385.	6444255.	25721.	2161.21	876.92	42.36	6446014.	2332.73	66.596
7) 160.00	150151.	6444969.	25756.	2166.30	872.10	42.29	6446769.	2335.64	66.737
8) 180.00	194738.	6461238.	26583.	2293.08	755.32	40.45	6464226.	2414.61	70.041
9) 186.88	210677.	6466301.	26860.	2337.59	715.91	39.80	6469788.	2445.09	71.105
10) 190.00	217993.	6468505.	26983.	2358.54	698.59	39.47	6472233.	2460.14	71.569
11) 200.00	241910.	6475227.	27379.	2423.71	648.07	40.30	6479802.	2509.18	72.889
12) 220.00	291645.	6487304.	28227.	2552.50	557.41	44.69	6493917.	2613.04	75.105
13) 240.00	344064.	6497523.	29166.	2691.31	463.74	49.30	6506691.	2731.41	77.190
14) 260.00	399354.	6505842.	30199.	2839.48	367.64	54.05	6518157.	2863.69	79.107
15) 280.00	457711.	6512210.	31329.	2997.71	268.76	58.93	6528350.	3010.31	80.853
16) 300.00	519333.	6516571.	32557.	3166.47	166.68	63.94	6537313.	3171.50	82.426
17) 320.00	584441.	6518854.	33887.	3346.41	60.96	69.08	6545088.	3347.67	83.828
18) 340.00	653277.	6518976.	35322.	3539.22	-49.43	74.39	6551722.	3540.35	85.073
19) 360.00	726094.	6516843.	36864.	3744.89	-164.81	79.85	6557272.	3749.37	86.156
20) 380.00	803172.	6512344.	38517.	3965.45	-286.14	85.48	6561798.	3976.68	87.090
21) 400.00	884814.	6505353.	40284.	4201.54	-414.23	91.30	6565374.	4222.89	87.878
22) 420.00	971354.	6495722.	42170.	4455.76	-550.38	97.33	6568082.	4490.68	88.529
23) 440.00	1063182.	6483276.	44179.	4730.67	-695.95	103.61	6570021.	4782.71	89.048
24) 460.00	1160727.	6467813.	46316.	5027.64	-852.29	110.14	6571304.	5100.56	89.439
25) 477.00	1248477.	6452123.	48238.	5297.10	-995.23	115.86	6571979.	5391.03	89.681
26) 480.00	1264439.	6449098.	48587.	5344.26	-1021.44	116.82	6572064.	5442.25	89.718
27) 500.00	1374420.	6426836.	50986.	5653.95	-1207.77	123.05	6572355.	5782.82	89.977
28) 520.00	1490692.	6400681.	53509.	5976.99	-1410.46	129.35	6572195.	6142.52	90.158
29) 540.00	1613657.	6370308.	56160.	6323.85	-1630.02	135.81	6571748.	6531.96	90.229
30) 560.00	1743847.	6335338.	58944.	6701.37	-1871.35	142.58	6571224.	6959.21	90.202
31) 580.00	1881997.	6295254.	61867.	7121.55	-2143.27	149.90	6570842.	7438.59	90.094
32) 592.91	1975791.	6266317.	63836.	7418.68	-2341.51	155.30	6570734.	7780.98	90.006
33) 600.00	2028402.	6249472.	64936.	7406.10	-2405.72	154.89	6570733.	7788.57	90.002
34) 603.11	2051587.	6241960.	65417.	7397.27	-2433.00	154.64	6570733.	7788.65	90.002

1) Physical Sep; 2) J-2 Eng. Start Com; 3) 90% J-2 Thrust; 4) Ullage Jettison; 5) Jettison LES; 6) CCS; 7) Orbit Insert.

TABLE 6 (Cont'd)
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	EARTH FIXED POSITION			EARTH FIXED VELOCITY			POSITION (M)	EARTH FIXED VELOCITY (M/S)	EARTH FIXED MAGNITUDE	PATH ANGLE (DEG)
	X (M)	Y (M)	Z (M)	DX (M/S)	DY (M/S)	DZ (M/S)				
1) 147.26	62836.	60952.	68.	1695.75	988.58	3.69	87542.	1962.87	59.219	
2) 148.58	65077.	62250.	73.	1695.75	976.34	3.83	90055.	1956.74	59.509	
3) 151.50	70024.	65059.	85.	1698.66	950.97	4.14	95583.	1946.74	60.155	
3) 151.98	70845.	65517.	87.	1701.11	947.89	4.19	96497.	1947.38	60.262	
4) 155.00	76002.	68349.	100.	1717.14	929.20	4.46	102215.	1952.44	60.924	
4) 159.18	83235.	72185.	119.	1741.32	904.79	4.73	110176.	1962.36	61.824	
160.00	84658.	72921.	123.	1746.36	900.22	4.78	111734.	1964.74	61.997	
180.00	120837.	89817.	235.	1872.25	789.98	6.42	150562.	2032.10	66.071	
186.88	133878.	95127.	281.	1916.56	752.95	7.05	164234.	2059.17	67.386	
190.00	139883.	97448.	303.	1937.42	736.73	7.32	170480.	2072.78	67.961	
200.00	159587.	104570.	388.	2002.29	689.82	10.08	190796.	2117.81	69.598	
220.00	200887.	117556.	671.	2130.59	606.73	18.55	232756.	2215.37	72.351	
240.00	244866.	128842.	1132.	2269.25	521.29	27.65	276697.	2328.52	74.925	
260.00	291717.	138400.	1780.	2417.65	434.12	37.32	322888.	2456.60	77.274	
280.00	341642.	146154.	2628.	2576.47	344.92	47.58	371617.	2599.89	79.393	
300.00	394849.	152182.	3688.	2746.22	253.36	58.48	423176.	2758.50	81.284	
320.00	451565.	156311.	4972.	2927.56	159.05	70.04	477880.	2932.72	82.951	
340.00	512042.	158517.	6495.	3122.24	61.00	82.38	536057.	3123.92	84.414	
360.00	576543.	158726.	8272.	3330.24	-40.88	95.50	598050.	3331.86	85.674	
380.00	645355.	156850.	10321.	3553.66	-147.58	109.51	664223.	3558.41	86.747	
400.00	718795.	152787.	12659.	3793.17	-259.76	124.46	734962.	3804.09	87.644	
420.00	797206.	146416.	15306.	4051.45	-378.59	140.50	810685.	4071.53	88.378	
440.00	880995.	137592.	18287.	4331.12	-505.24	157.74	891862.	4363.34	88.956	
460.00	970602.	126146.	21624.	4633.62	-640.92	176.28	979004.	4681.06	89.388	
477.00	1051699.	114210.	24763.	4908.49	-764.84	193.10	1058172.	4971.47	89.654	
480.00	1066497.	111881.	25347.	4956.68	-787.61	196.07	1072649.	5022.69	89.695	
500.00	1168800.	94529.	29468.	5273.92	-950.47	216.11	1172987.	5363.24	89.976	
520.00	1277556.	73768.	33999.	5605.66	-1128.02	237.28	1280136.	5722.95	90.169	
540.00	1393192.	49312.	38968.	5962.46	-1320.31	259.93	1394609.	6112.43	90.245	
560.00	1516266.	20829.	44408.	6351.42	-1531.87	284.45	1517059.	6539.73	90.215	
580.00	1647546.	-12141.	50363.	6784.92	-1770.89	311.46	1648360.	7019.13	90.100	
6) 592.91	1737060.	-36126.	54505.	7091.95	-1946.01	330.76	1738290.	7361.53	90.006	
600.00	1787367.	-50141.	56865.	7083.52	-2004.03	334.28	1788974.	7369.13	90.002	
7) 603.11	1809353.	-56403.	57905.	7076.50	-2028.75	335.67	1811158.	7369.22	90.002	

1) Physical Sep; 2) J-2 Eng. Start Com; 3) 90% J-2 Thrust; 4) Ullage Jettison; 5) Jettison LES; 6) CCS; 7) Orbit Insert.

TABLE 6 (Cont'd)
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE FLIGHT DATA

	FLIGHT TIME (SEC)	RANGE (KM)	ALTITUDE (KM)	LONGITUDE (POS. WEST) (DEG)	GEODEIC LATITUDE (DEG)	GEOCENTRIC LATITUDE (DEG)
1)	147.26	62.26	61.26	79.930	28.592	28.430
2)	148.58	64.47	62.58	79.907	28.594	28.433
	151.50	69.34	65.44	79.858	28.599	28.438
3)	151.98	70.14	65.91	79.850	28.600	28.439
	155.00	75.22	68.80	79.798	28.605	28.444
4)	159.18	82.32	72.72	79.726	28.613	28.452
	160.00	83.72	73.48	79.712	28.614	28.453
	180.00	119.18	90.94	79.352	28.651	28.490
5)	186.88	131.92	96.51	79.222	28.664	28.502
	190.00	137.79	98.96	79.162	28.670	28.508
	200.00	157.02	106.53	78.967	28.689	28.527
	220.00	197.23	120.66	78.558	28.727	28.565
	240.00	239.95	133.45	78.122	28.764	28.602
	260.00	285.38	144.92	77.659	28.801	28.639
	280.00	333.74	155.13	77.165	28.837	28.674
	300.00	385.24	164.10	76.639	28.872	28.709
	320.00	440.14	171.89	76.077	28.905	28.743
	340.00	498.69	178.53	75.478	28.937	28.774
	360.00	561.19	184.09	74.837	28.966	28.804
	380.00	627.95	188.62	74.153	28.993	28.831
	400.00	699.32	192.21	73.421	29.017	28.854
	420.00	775.66	194.92	72.638	29.037	28.874
	440.00	857.42	196.86	71.798	29.051	28.888
	460.00	945.08	198.15	70.898	29.060	28.897
	477.00	1024.62	198.83	70.081	29.061	28.898
	480.00	1039.15	198.91	69.932	29.061	28.898
	500.00	1139.84	199.20	68.898	29.053	28.890
	520.00	1247.29	199.03	67.795	29.034	28.871
	540.00	1362.00	198.58	66.618	29.003	28.841
	560.00	1484.61	198.04	65.360	28.958	28.795
	580.00	1616.01	197.64	64.015	28.895	28.732
6)	592.91	1705.98	197.51	63.094	28.843	28.681
	600.00	1756.68	197.50	62.576	28.811	28.649
7)	603.11	1778.87	197.50	62.349	28.796	28.634

1) Physical Sep; 2) J-2 Eng. Start Com; 3) 90% J-2 Thrust; 4) Ullage Jettison;
5) Jettison LES; 6) CCS; 7) Orbit Insert.

TABLE 6 (Cont'd)
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	VEHICLE ATTITUDE		ANGLE		VEHICLE ATTITUDE RATE		ATTITUDE ERROR		COMMAND ROLL (DEG)
	PITCH (DEG)	YAW (DEG)	PITCH (DEG)	ROLL (DEG)	PITCH (DEG/S)	YAW (DEG/S)	PITCH (DEG)	YAW (DEG)	
1) 147.26	-60.844	-0.079	-0.005	-0.010	0.006	-0.002	-0.009	-0.079	-0.005
2) 148.58	-60.896	-0.070	-0.012	-0.062	0.007	-0.009	-0.061	-0.070	-0.012
3) 151.50	-61.082	-0.067	-0.047	0.001	-0.033	-0.022	-0.247	-0.067	-0.047
4) 151.98	-61.068	-0.089	-0.059	0.055	-0.057	-0.029	-0.233	-0.089	-0.059
5) 155.00	-60.665	-0.327	-0.138	0.143	-0.065	-0.004	0.170	-0.327	-0.138
6) 159.18	-60.454	-0.385	0.117	-0.033	0.021	0.126	0.380	-0.385	0.117
7) 160.00	-60.487	-0.367	0.228	-0.043	0.022	0.146	0.348	-0.367	0.228
8) 180.00	-60.701	-0.334	0.465	-0.002	-0.001	-0.054	0.133	-0.334	0.465
9) 186.88	-60.713	-0.337	0.143	-0.001	-0.001	-0.041	0.122	-0.337	0.143
10) 190.00	-60.706	-0.382	0.023	0.016	-0.000	-0.040	-0.122	-0.617	0.023
11) 200.00	-52.012	1.398	-0.607	0.838	0.011	-0.008	-0.827	-0.489	-0.607
12) 220.00	-55.834	1.826	-0.015	0.072	-0.004	-0.054	0.152	-0.421	-0.015
13) 240.00	-58.818	1.880	-0.308	-0.103	-0.002	-0.022	0.315	-0.418	-0.308
14) 260.00	-61.556	1.872	-0.631	-0.115	-0.001	-0.020	0.300	-0.426	-0.631
15) 280.00	-63.914	1.849	-0.292	-0.120	-0.002	0.084	0.299	-0.439	-0.292
16) 300.00	-66.617	1.820	0.064	-0.125	-0.002	-0.044	0.340	-0.451	0.064
17) 320.00	-69.226	1.794	-0.801	-0.182	-0.002	-0.033	0.402	-0.469	-0.801
18) 340.00	-71.700	1.768	0.568	-0.100	-0.001	-0.045	0.344	-0.475	0.568
19) 360.00	-74.232	1.738	-0.219	-0.114	-0.001	-0.042	0.322	-0.490	-0.219
20) 380.00	-76.799	1.704	-0.510	-0.136	-0.000	0.069	0.323	-0.508	-0.510
21) 400.00	-79.273	1.678	0.530	-0.122	-0.002	-0.049	0.311	-0.515	0.530
22) 420.00	-81.852	1.641	-0.419	-0.121	-0.003	-0.049	0.317	-0.531	-0.419
23) 440.00	-84.341	1.604	0.094	-0.126	-0.001	0.073	0.332	-0.546	0.094
24) 460.00	-86.842	1.572	0.183	-0.133	-0.002	-0.031	0.340	-0.559	0.183
25) 477.00	-88.867	1.528	-0.397	-0.111	-0.006	-0.035	0.324	-0.570	-0.397
26) 480.00	-89.220	1.514	-0.500	-0.155	-0.003	-0.026	0.427	-0.576	-0.500
27) 500.00	-92.362	1.494	-0.432	-0.133	-0.001	0.079	0.355	-0.590	-0.432
28) 520.00	-94.774	1.454	0.380	-0.110	-0.003	-0.035	0.332	-0.597	0.380
29) 540.00	-97.166	1.410	-0.286	-0.128	-0.003	-0.032	0.355	-0.611	-0.286
30) 560.00	-99.885	1.375	-0.829	-0.138	-0.003	0.075	0.375	-0.625	-0.829
31) 580.00	-103.648	1.325	0.460	-0.573	0.017	0.006	1.133	-0.652	0.460
32) 592.91	-103.795	1.404	-0.506	0.001	-0.001	-0.078	0.221	-0.643	-0.506
33) 600.00	-103.797	1.400	-0.854	-0.000	-0.001	-0.026	0.218	-0.647	-0.854
34) 603.11	-103.798	1.398	-0.902	-0.000	-0.000	-0.013	0.217	-0.648	-0.902

1) Physical Sep; 2) J-2 Eng. Start Com; 3) 90% J-2 Thrust; 4) Ullage Jettison; 5) Jettison LES; 6) CGS; 7) Orbit Insert.

TABLE 7

AS-205 REVISED L/V REFERENCE TRAJECTORY
 REFERENCE TRAJECTORY COMPARISON

<u>Description</u>	<u>Revised Reference Trajectory</u>	<u>AS-207 Reference Trajectory</u>	<u>AS-205 L/V Operational Trajectory</u>
<u>MAX. DYNAMIC PRESSURE</u>			
Time (sec)	78.00	75.00	79.00
Altitude (km)	12.56	12.53	12.74
Space-Fixed Velocity (m/s)	749.1	775.0	773.1
Path Angle (deg)	58.56	59.52	5.53
Angle of Attack (deg)	0.001	0.00	- 0.16
Dynamic Pressure (kg/m ²)	3254.	3520.	3167.
Longitudinal Acceleration (m/s ²)	19.96	20.40	20.05
Heating Indicator (kg-m/m ² -rad)	18.4 x 10 ⁶	20.1 x 10 ⁶	18.6 x 10 ⁶
<u>O.E.C.O</u>			
Time (sec)	145.88	141.15	147.13
Altitude (km)	59.86	57.69	59.29
Space-Fixed Velocity (m/s)	2326.60	2377.8	2375.76
Path Angle (deg)	64.14	65.01	65.80
Angle of Attack (deg)	- 0.86	2.28	- 0.62
Dynamic Pressure (kg/m ²)	66.	91.	72.
Heating Indicator (kg-m/m ² -rad)	58.0 x 10 ⁶	66.1 x 10 ⁶	59.7 x 10 ⁶
Geocentric Latitude	28.43	28.43	28.54
Longitude (deg-W)	79.95	79.93	79.92
<u>ORBIT INSERTION</u>			
Time (sec)	603.11	595.27	595.42
Altitude (km)	197.50	192.52	163.20
Space-Fixed Velocity (m/s)	7788.65	7791.6	7834.98
Path Angle (deg)	90.00	90.00	89.99
Geocentric Latitude	28.63	28.65	31.35
Longitude (deg-W)	62.35	62.50	62.15

TABLE 8

AS-205 REVISED L/V REFERENCE TRAJECTORY
LAUNCH VEHICLE STAGE PERFORMANCE CHARACTERISTICS

S-IB Stage

Flight Time Interval: 0.0 - 142.883 seconds (IECO)

	<u>Long. Thrust Sea Level (lbs)</u>	<u>Turbine Thrust (lbs)</u>	<u>Total</u>
Engine # 1	201567.	611.	202178.
Engine # 2	197710.	627.	198337.
Engine # 3	199627.	588.	200215.
Engine # 4	195377.	589.	195966.
Engine # 5	198071.	577.	198648.
Engine # 6	200039.	614.	200653.
Engine # 7	197097.	604.	197701.
Engine # 8	199803.	610.	<u>200413.</u>
Total Average Sea Level Thrust (F_T):			1,594,111.

$$\dot{W}_P = \left[W_t(t=0) - W_t(t=142.883) - W_{aux} \right] / 142.883$$

$$= 6114.76 \text{ (lb/sec)}$$

$$I_{SP} = F_T / \dot{W}_P$$

$$= 260.70 \text{ (sec)}$$

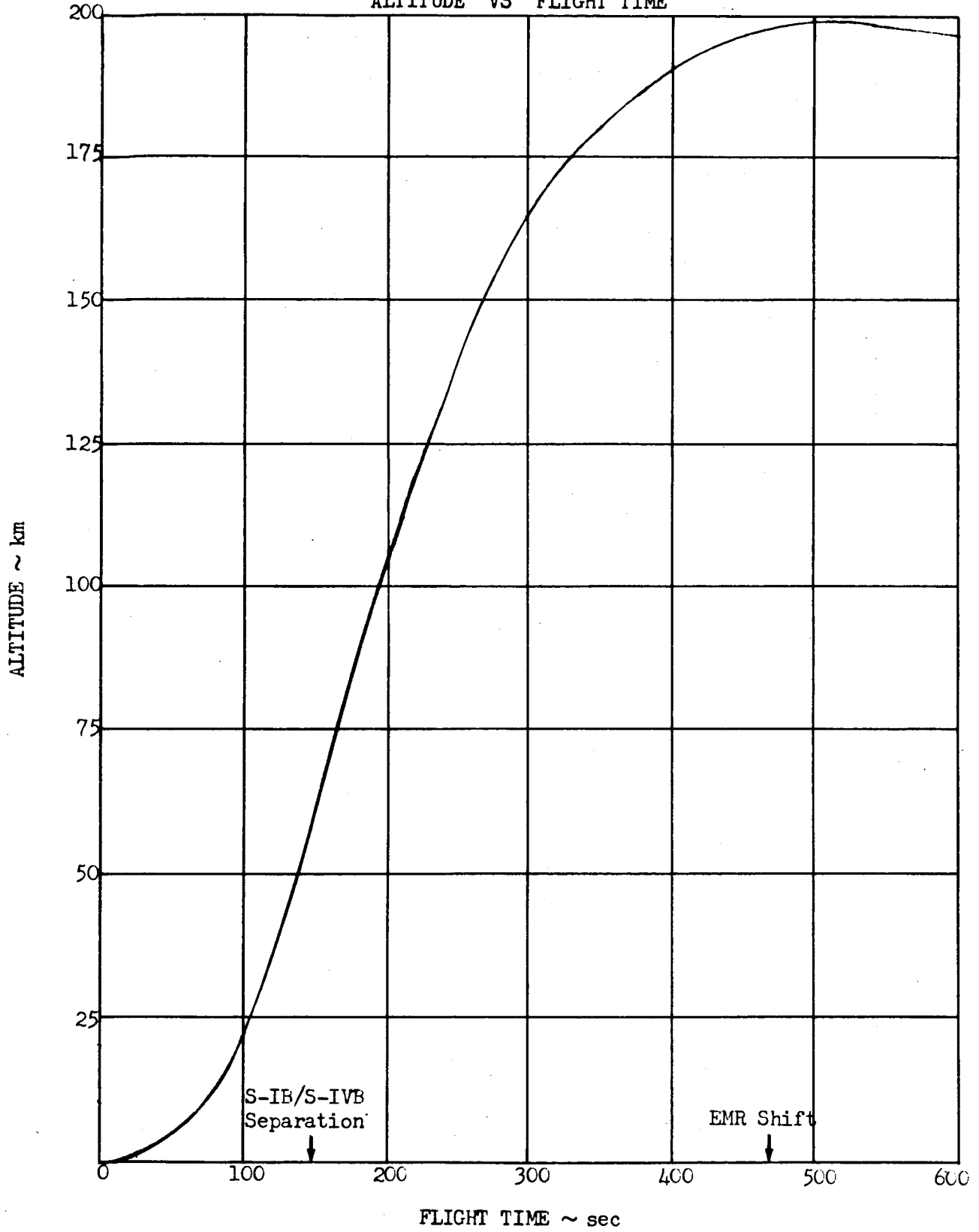
S-IVB Stage

High Thrust Level Flight Time Interval: 155. - 471. seconds
(PU System Activation - EMR Shift)
Low Thrust Level Flight Time Interval: 471. - 593. seconds
(EMR Shift - GCS)

	<u>High Thrust Level</u>	<u>Low Thrust Level</u>
Vacuum Thrust (lbs)	226573.	195285.
Flowrate (lb/sec)	537.03	457.17
Specific Impulse (sec)	421.90	427.16

Figure 1

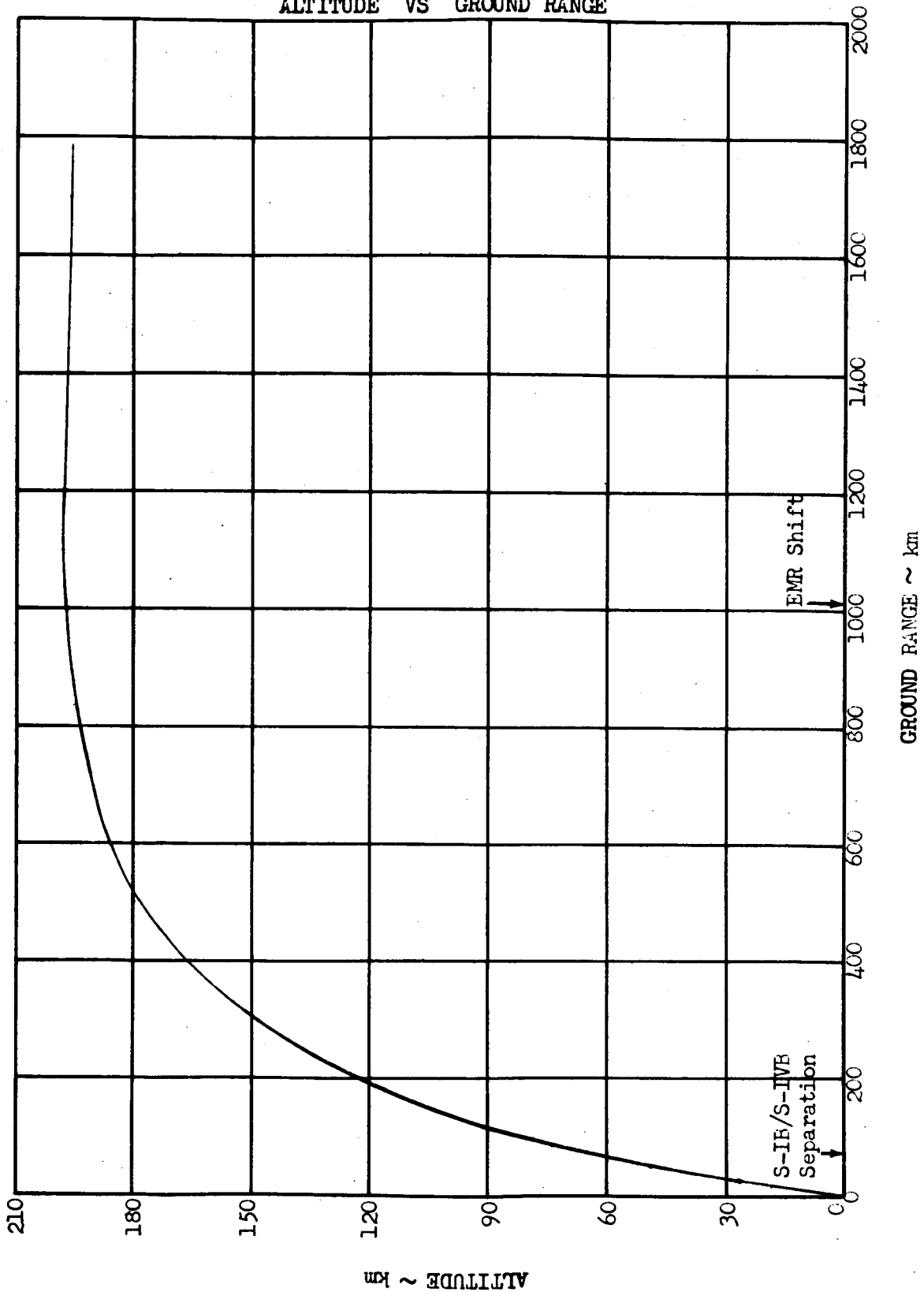
AS-205 REVISED L/V REFERENCE TRAJECTORY
ALTITUDE VS FLIGHT TIME



84-431-62618C
JAN 66

Figure 2

AS-205 REVISED L/V REFERENCE TRAJECTORY
ALTITUDE VS GROUND RANGE



84-031-02810A
JAN 86

Figure 3

AS-205 REVISED L/V REFERENCE TRAJECTORY
VELOCITY VS FLIGHT TIME

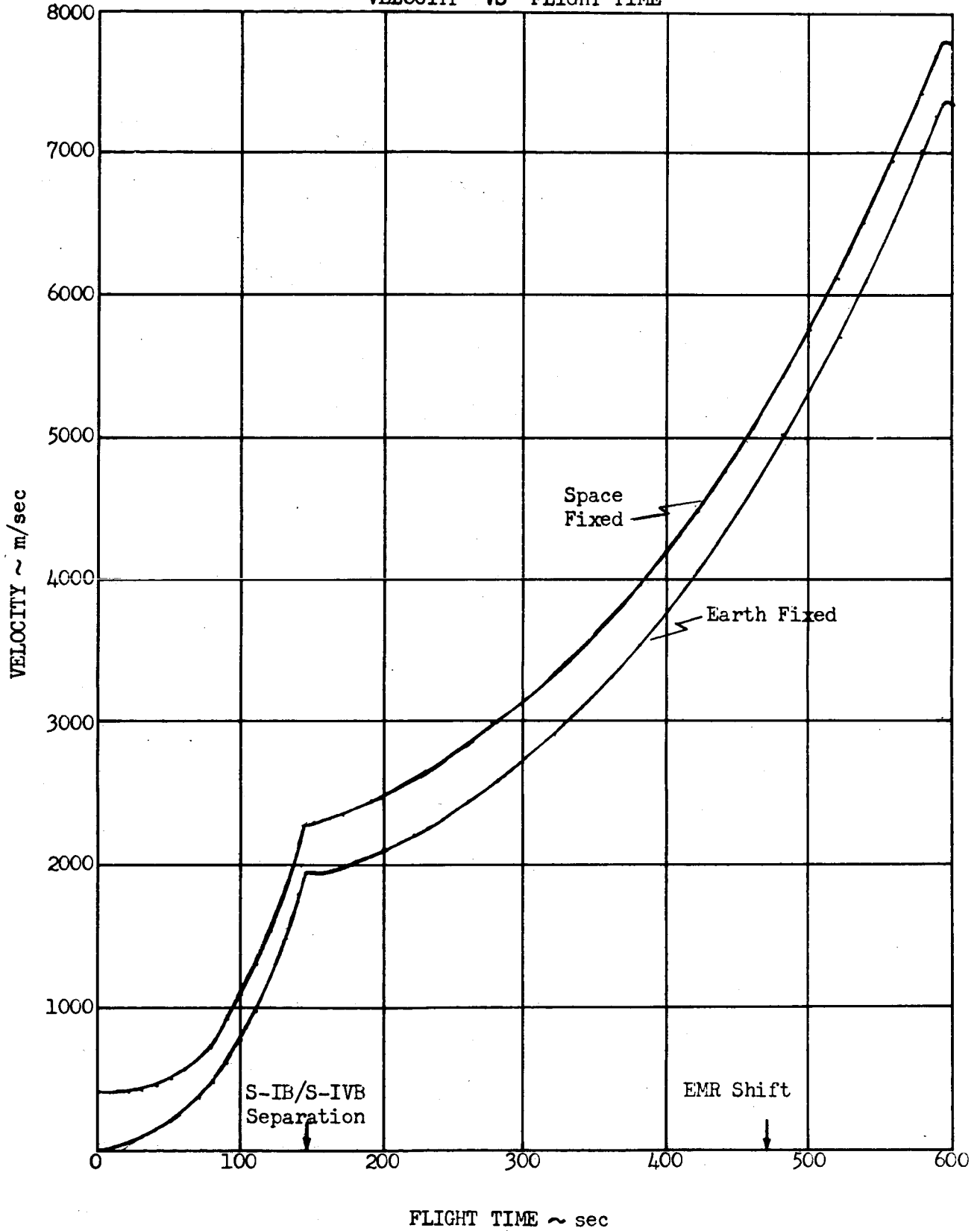


Figure 4

AS-205 REVISED L/V REFERENCE TRAJECTORY
FLIGHT PATH ANGLE VS FLIGHT TIME

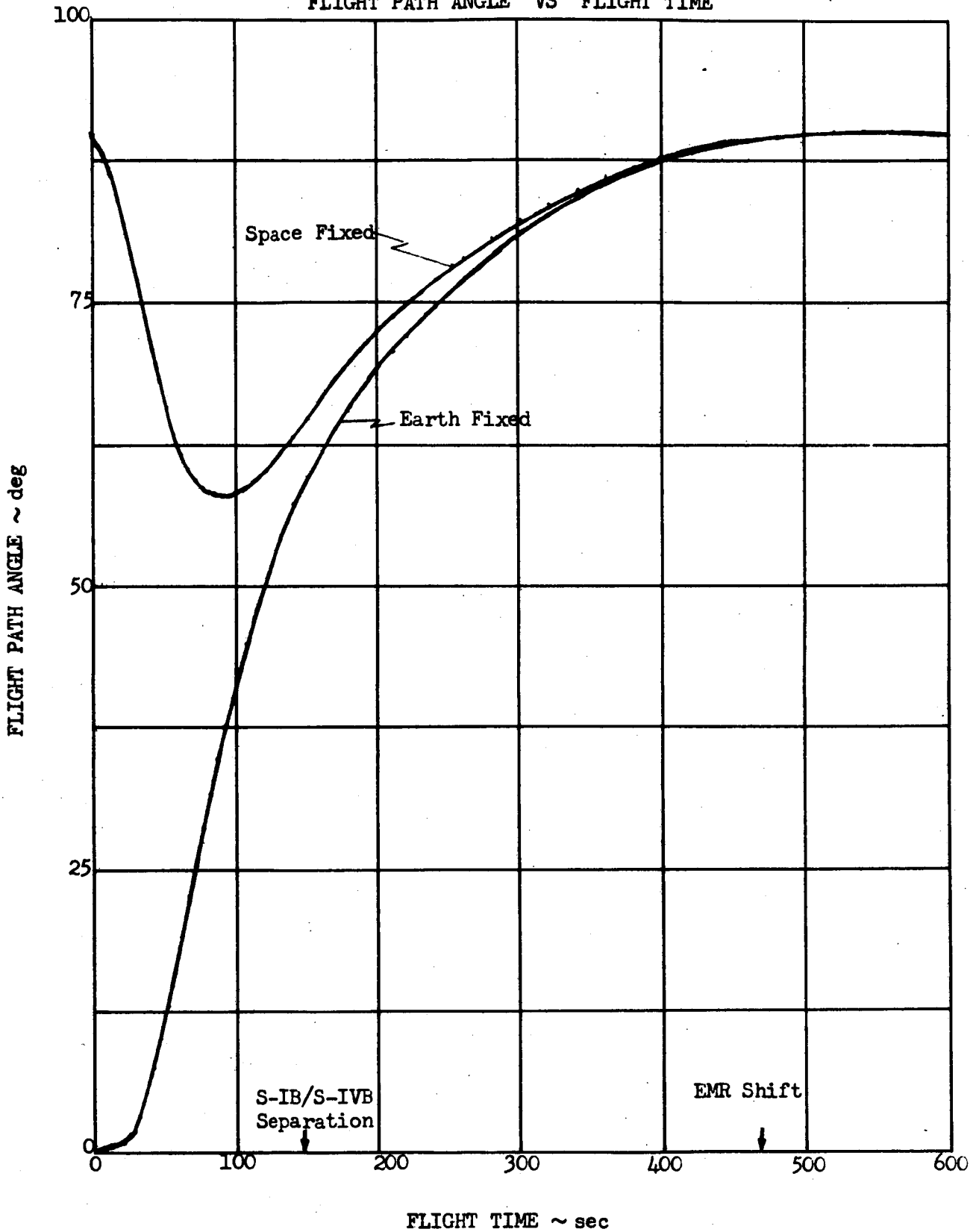
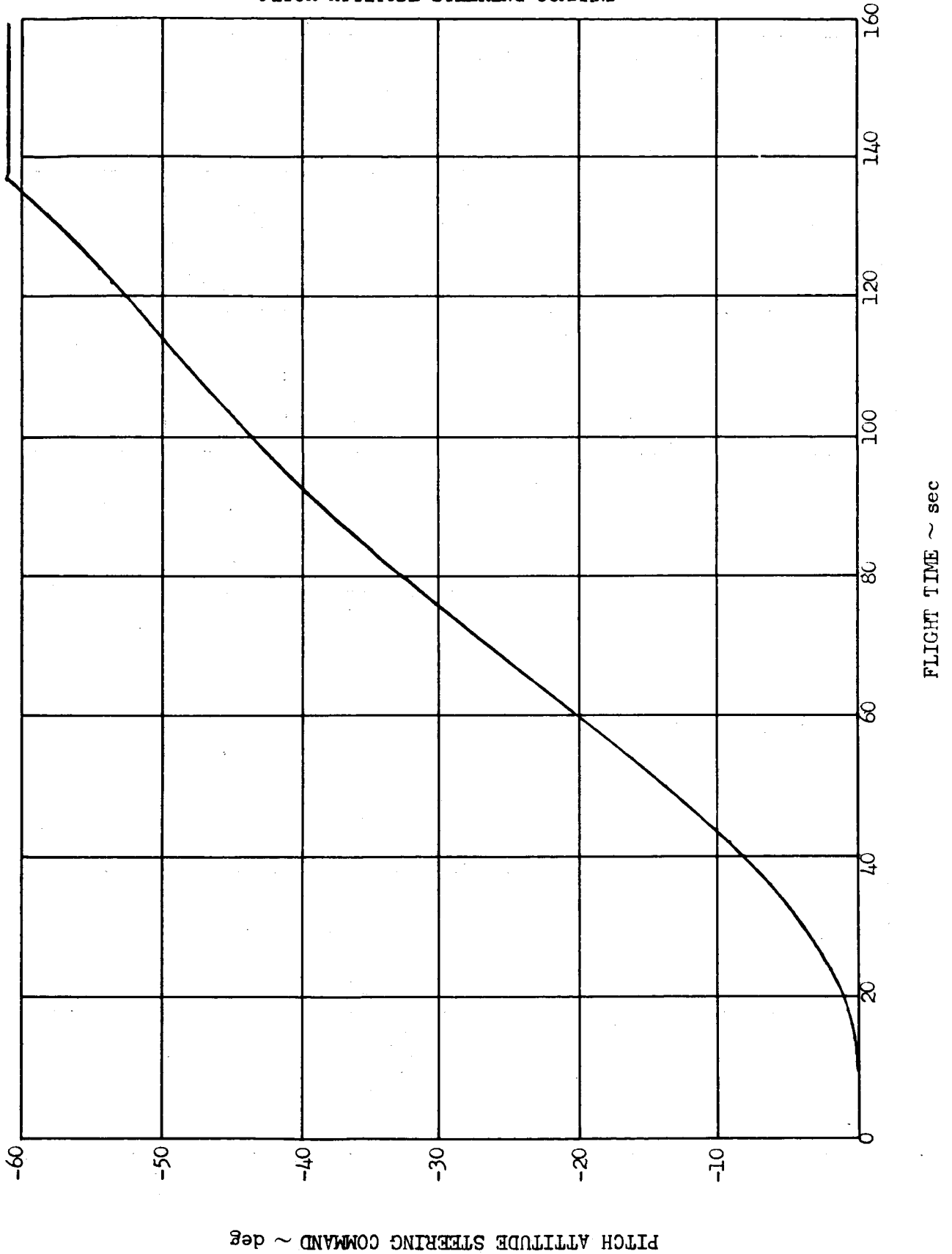


Figure 5

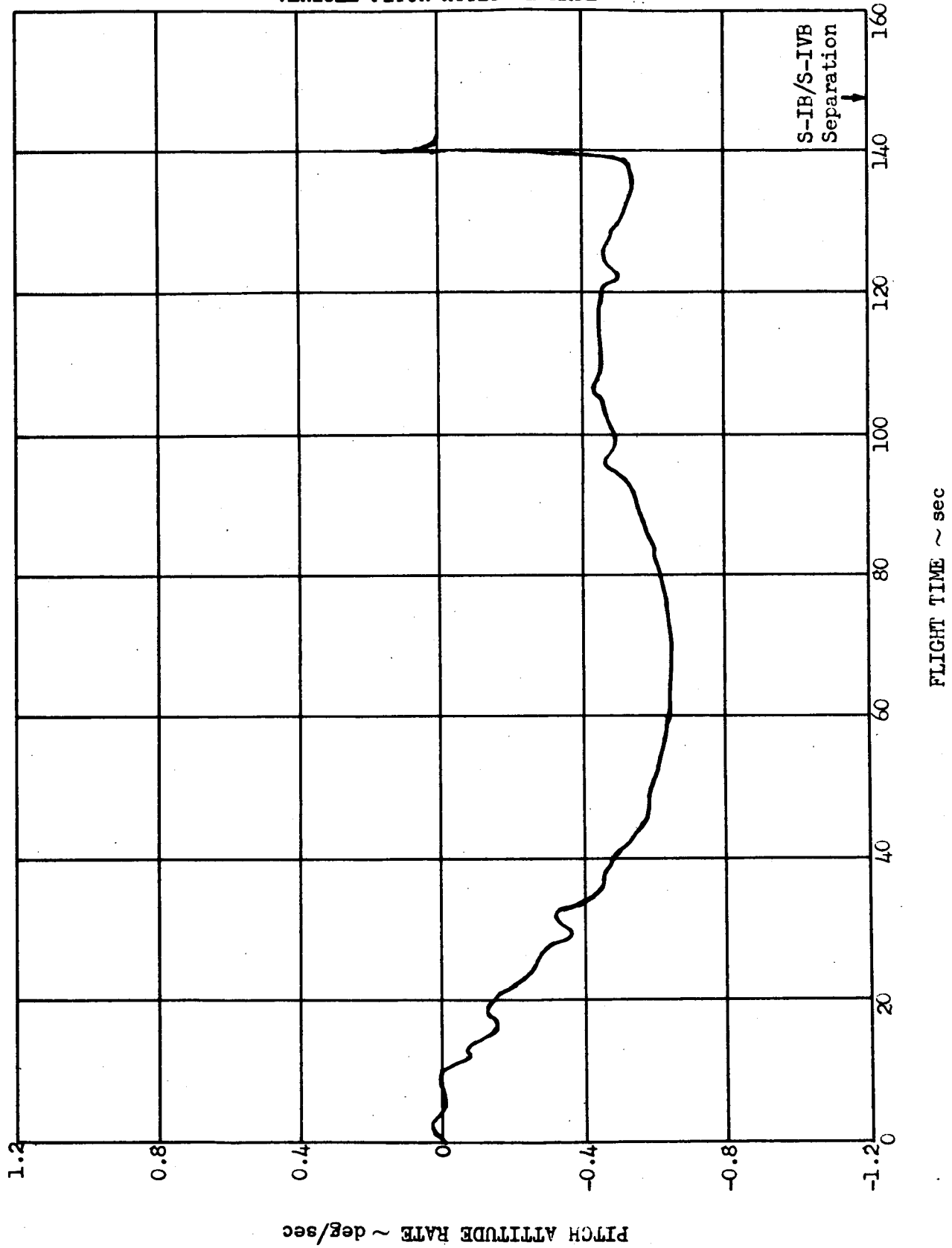
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IB STAGE FLIGHT DATA
PITCH ATTITUDE STEERING COMMAND



84-431-62618C
JAN 66

Figure 6

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IB STAGE FLIGHT DATA
VEHICLE PITCH ATTITUDE RATE



84-431-62618C
JAN 86

Figure 7

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IB STAGE FLIGHT DATA
ATTITUDE ERROR COMMAND

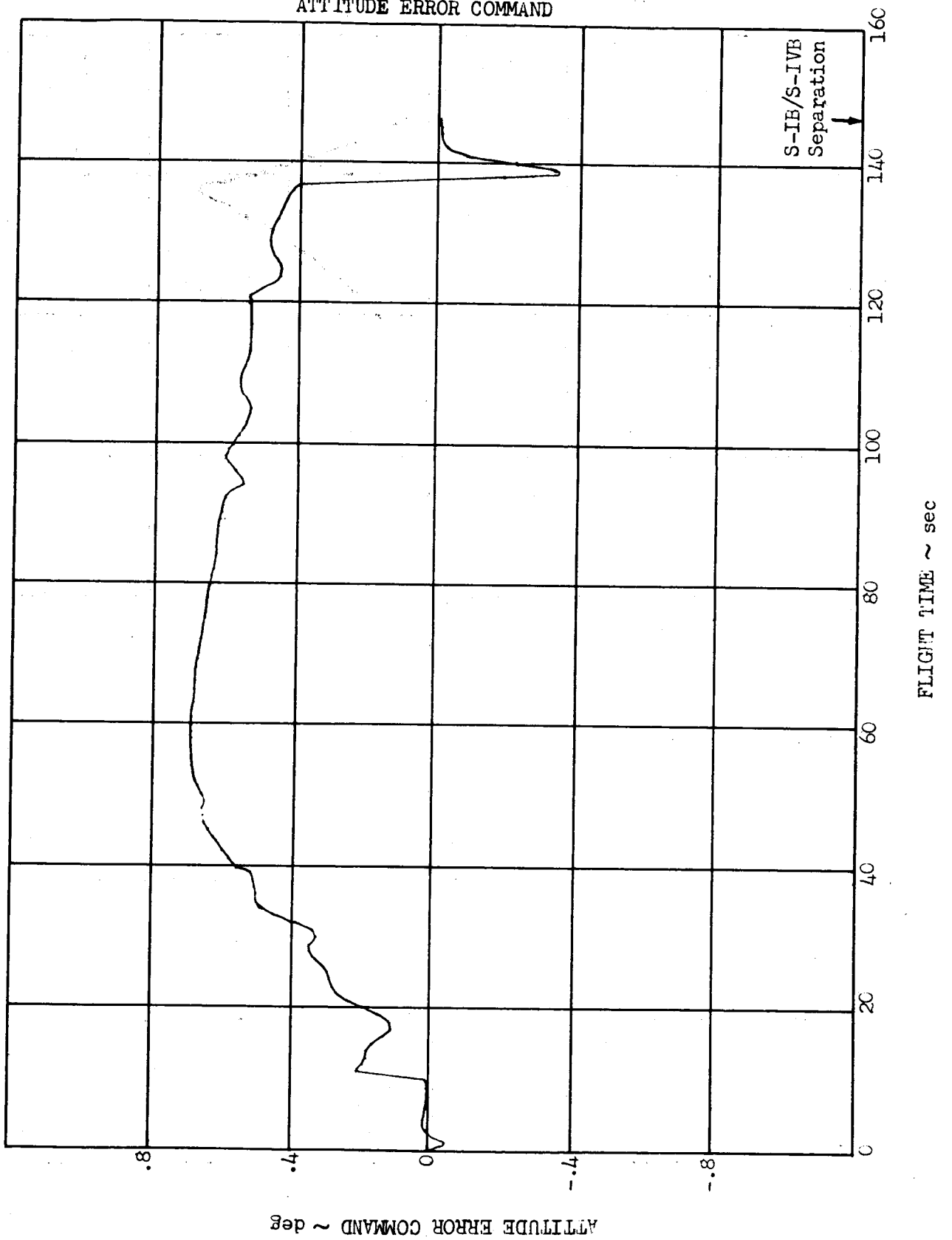


Figure 8

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IB STAGE FLIGHT DATA
ANGLE OF ATTACK HISTORY

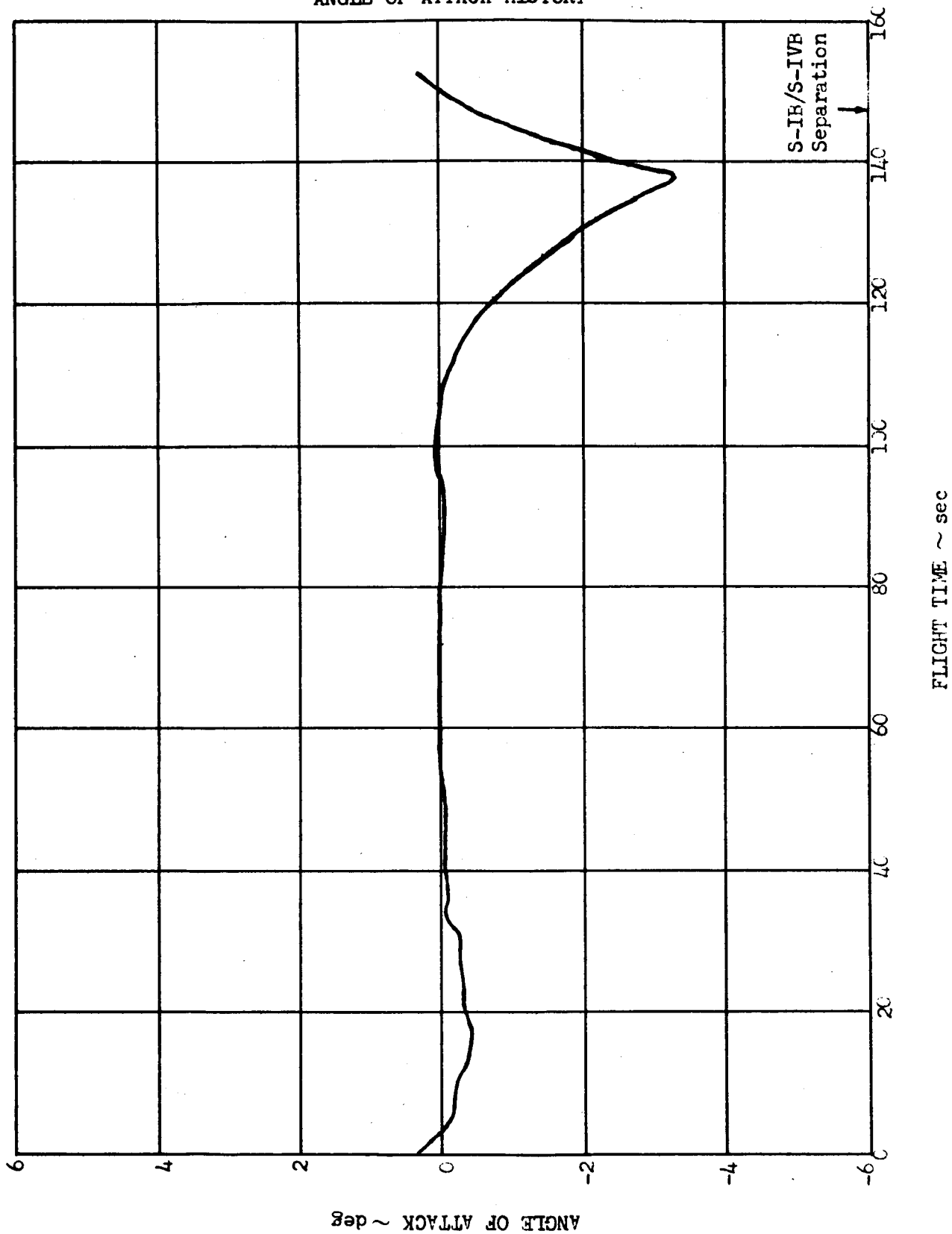
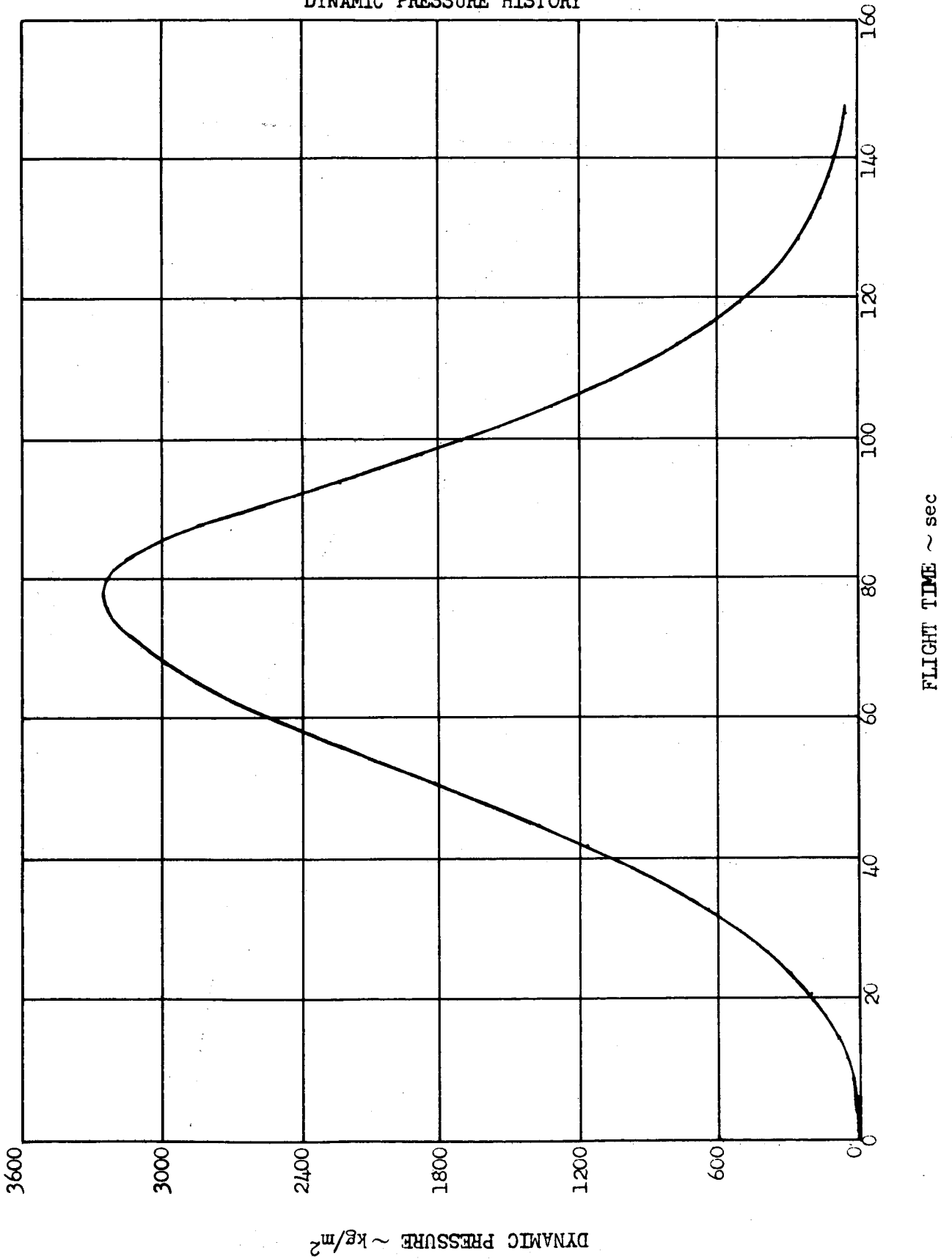


Figure 9

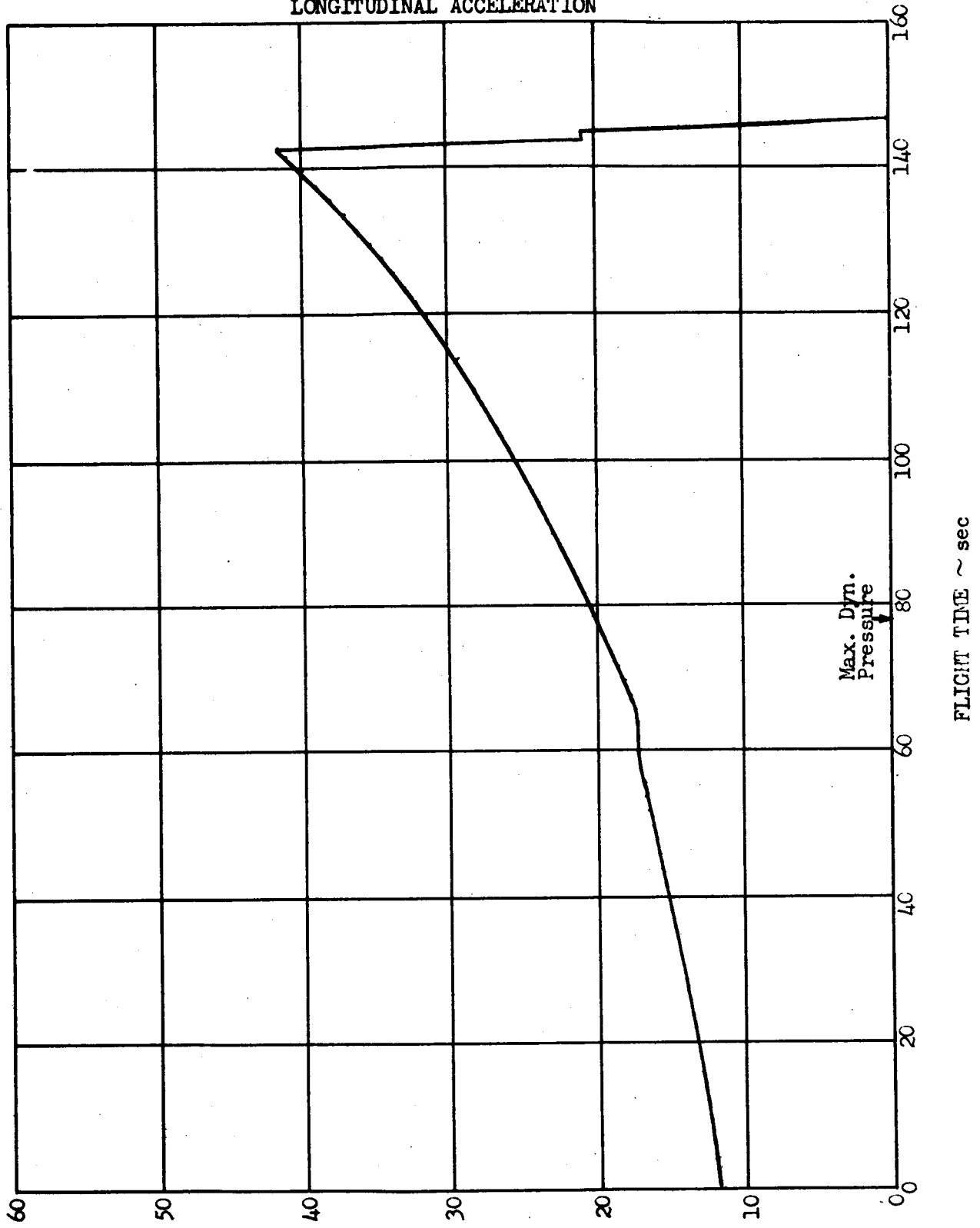
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IB STAGE FLIGHT DATA
DYNAMIC PRESSURE HISTORY



84-431-02618C
JAN 66

Figure 10

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IB STAGE FLIGHT DATA
LONGITUDINAL ACCELERATION



LONGITUDINAL ACCELERATION ~ m/sec^2

FLIGHT TIME ~ sec

Figure 11

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE FLIGHT DATA
PITCH AND YAW ATTITUDE STEERING COMMAND

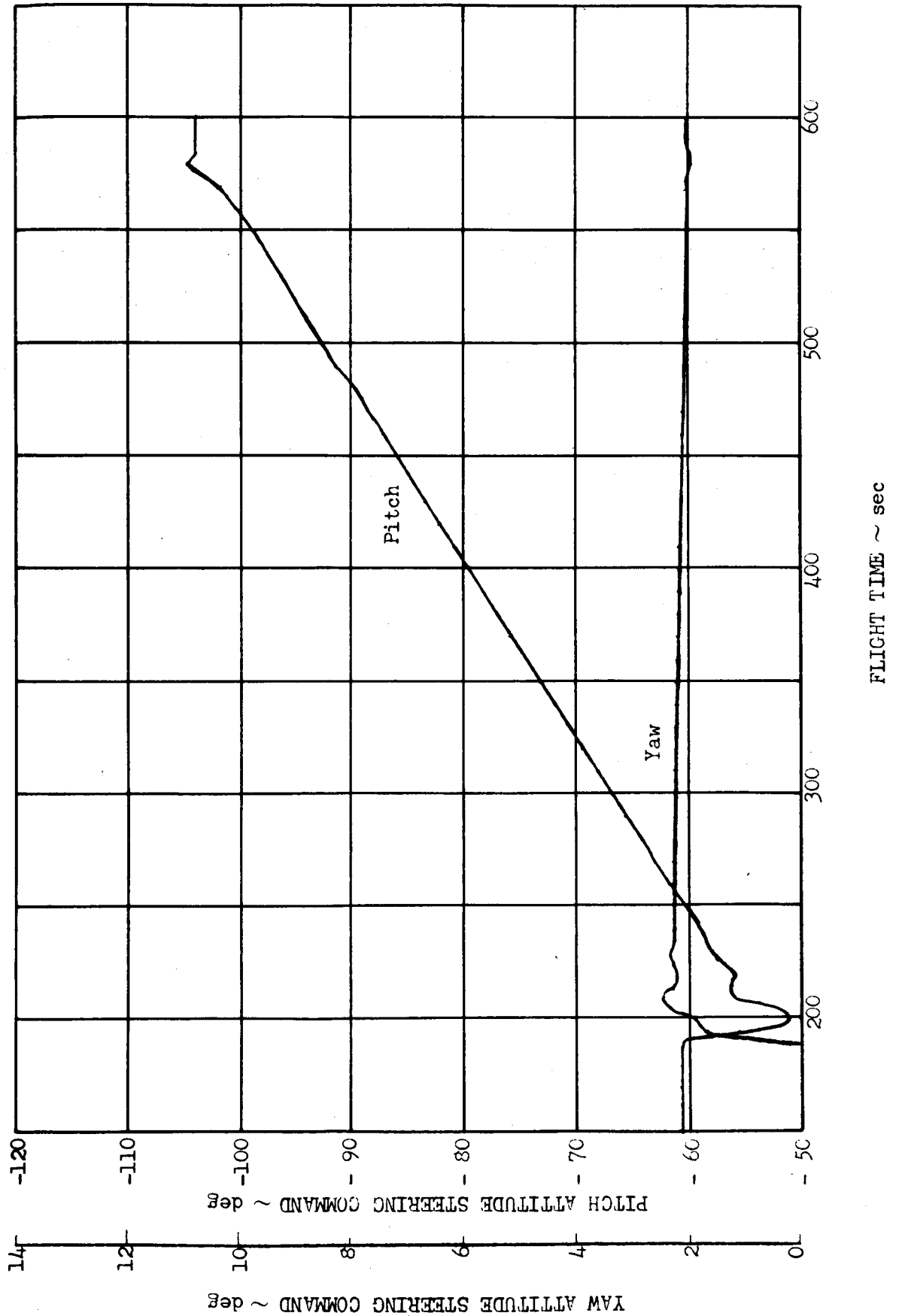


Figure 12

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE FLIGHT DATA
LONGITUDINAL ACCELERATION

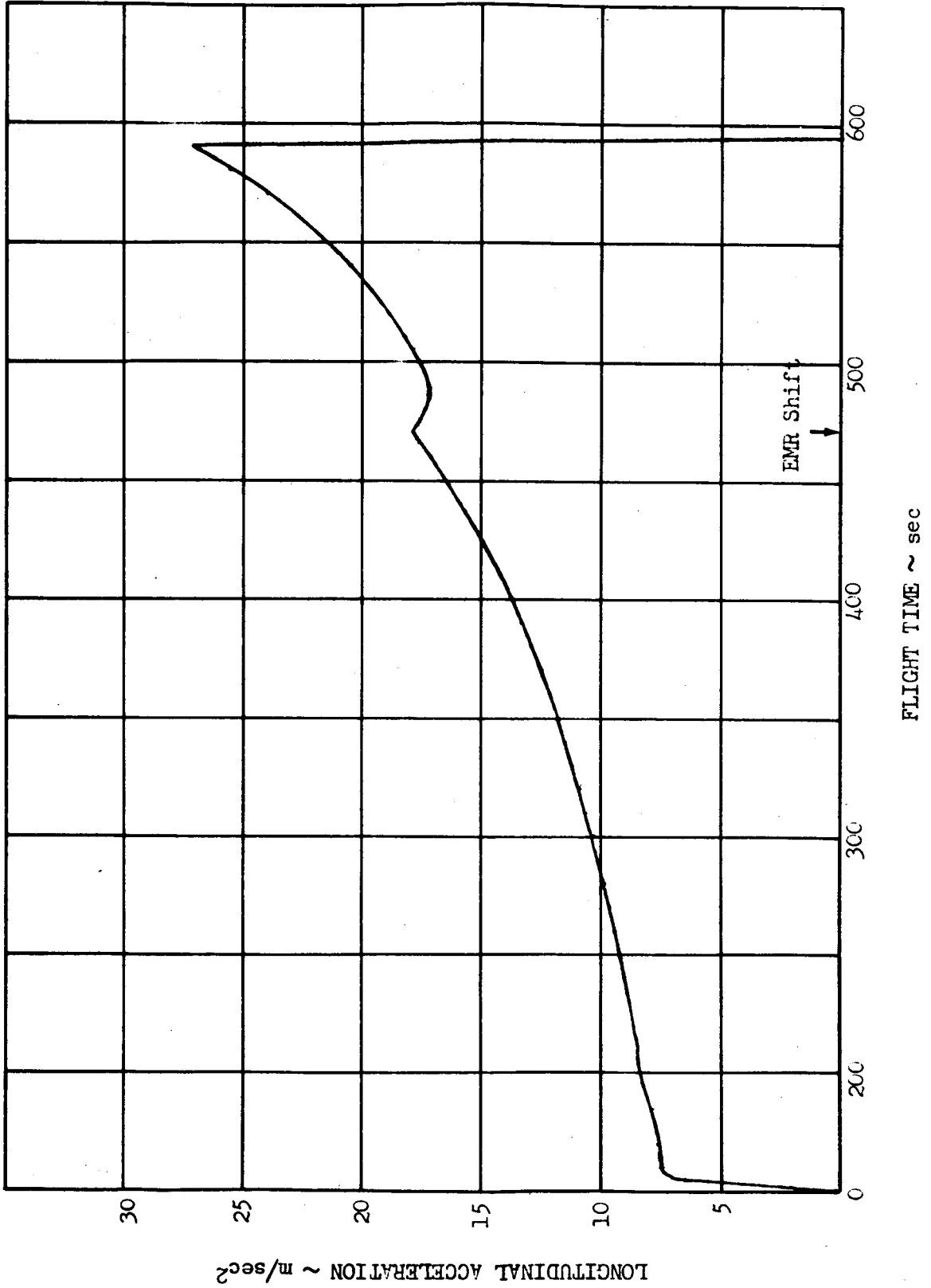


Figure 13

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE FLIGHT DATA
VEHICLE ATTITUDE RATE

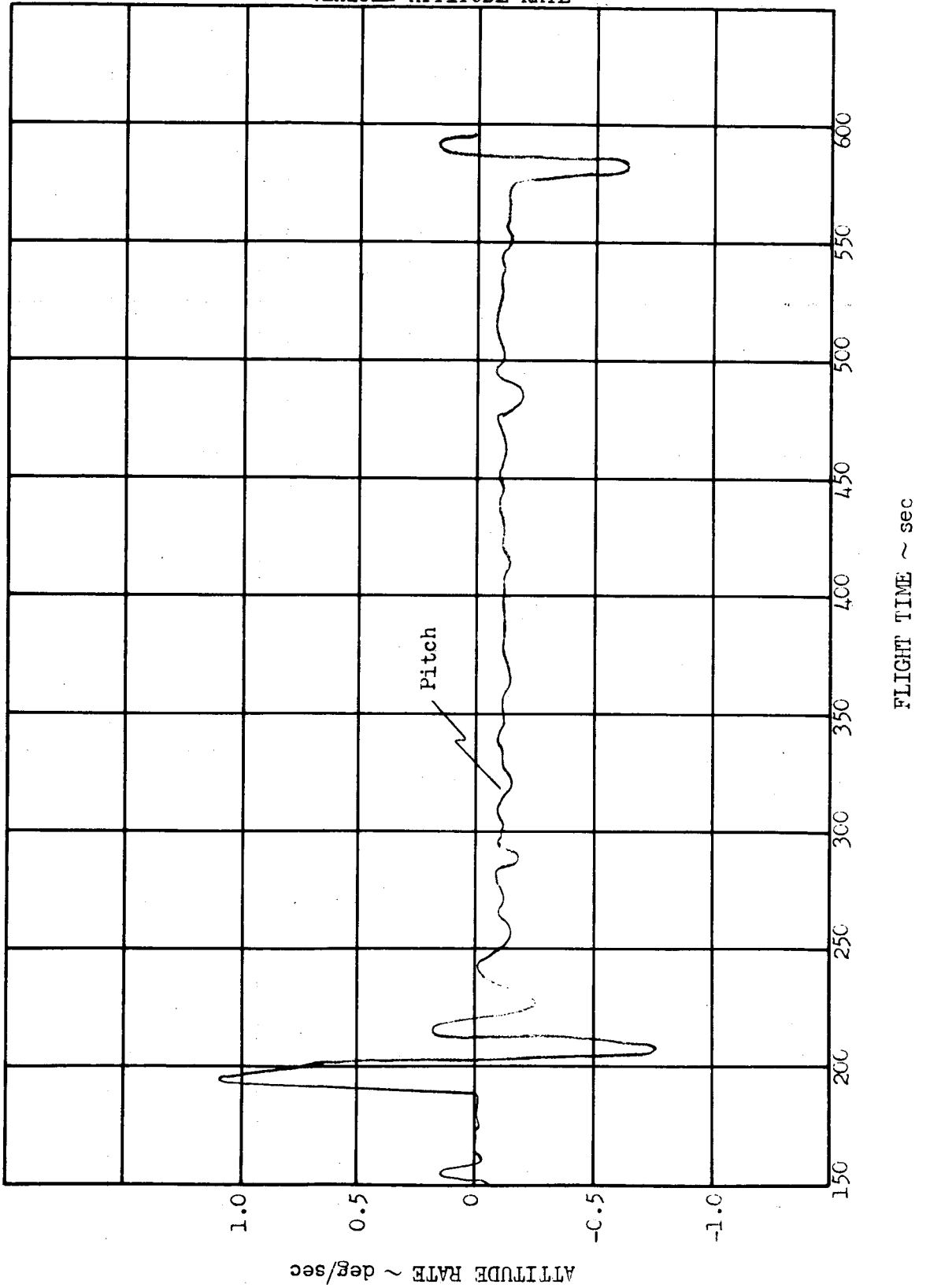
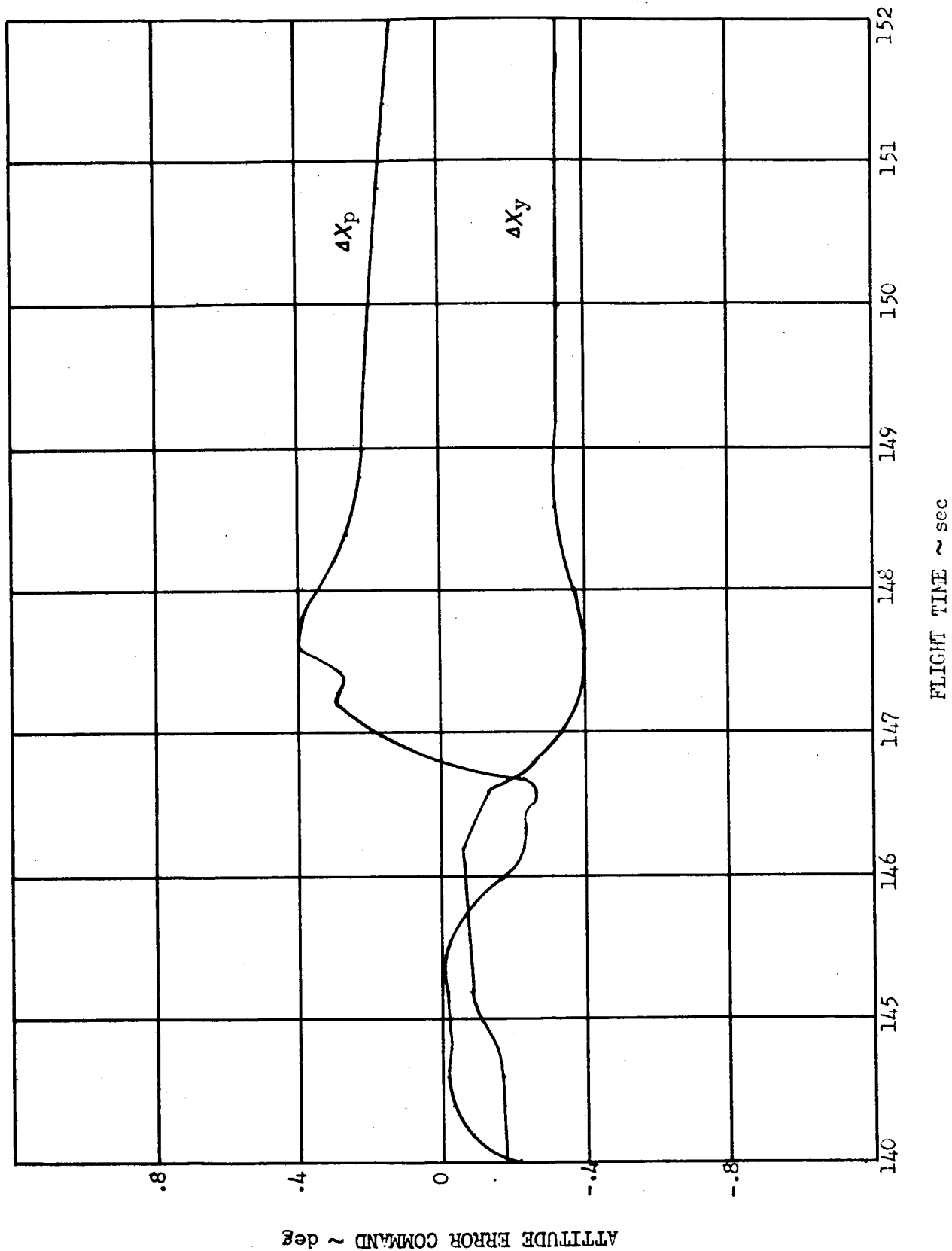


Figure 14

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE FLIGHT DATA
ATTITUDE ERROR COMMAND



84-931-62618C
JAN 86

Figure 15

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE FLIGHT DATA
ANGLE OF ATTACK AND DYNAMIC PRESSURE

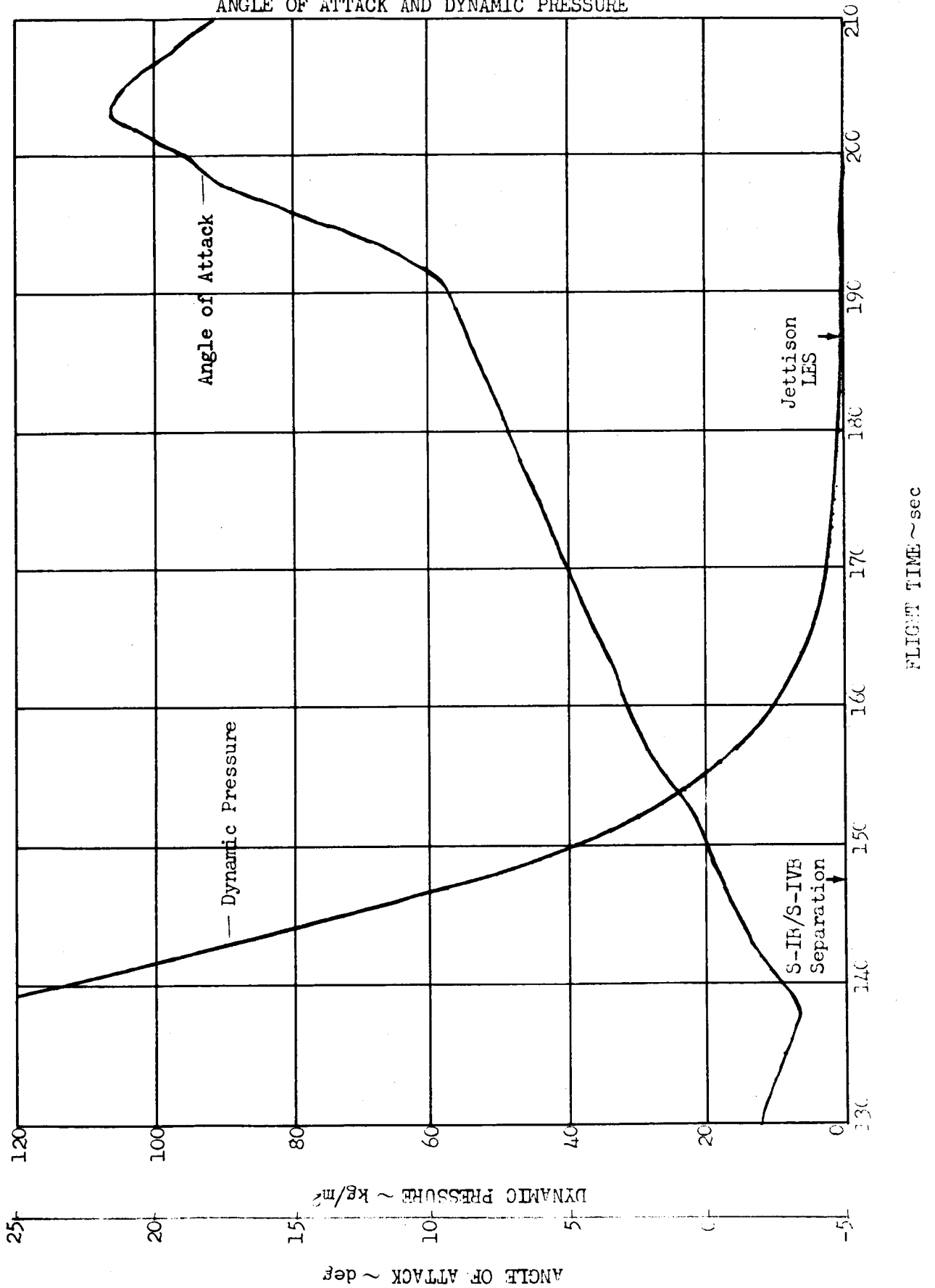
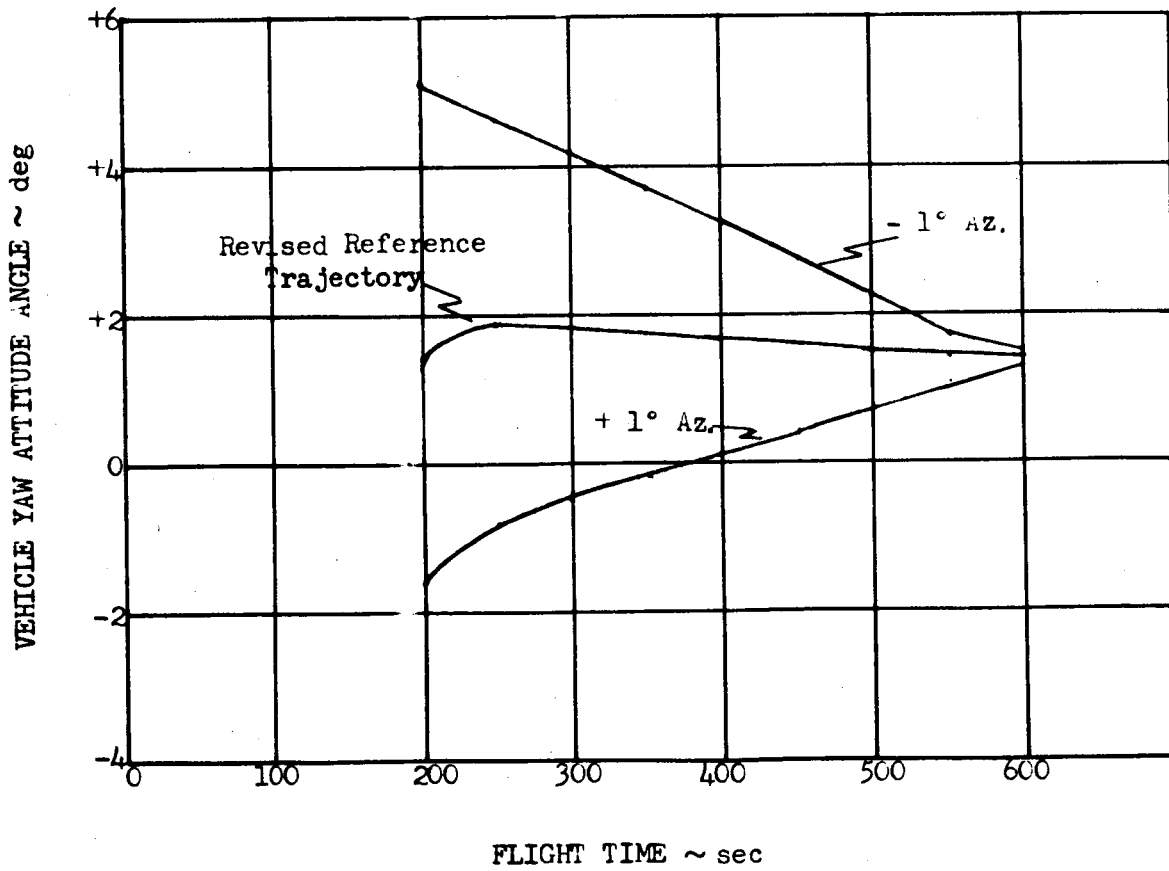
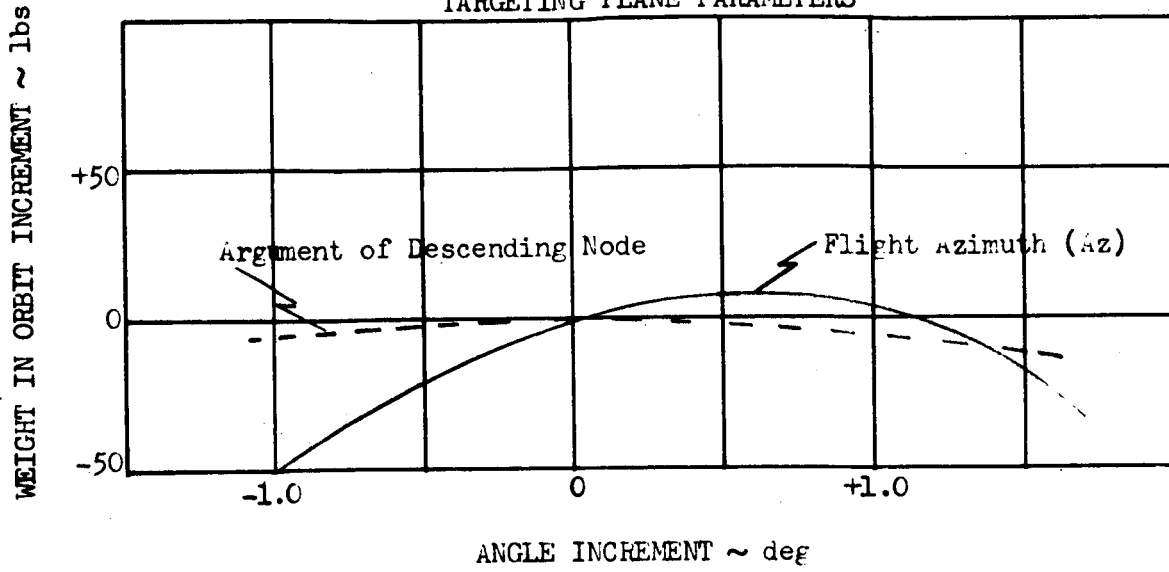


Figure 16

AS-205 REVISED L/V REFERENCE TRAJECTORY
TARGETING PLANE PARAMETERS



84-431-02010A
JAN 66

A P P E N D I X A

"LAUNCH VEHICLE CHARACTERISTICS"

TABLE 1A

AS-205 REVISED L/V REFERENCE TRAJECTORY
VEHICLE WEIGHT BREAKDOWN

Spacecraft*	38,100	
Instrument Unit	4,012	
S-IVB Stage at Injection (Inert)	24,052	
Useable Reserve Propellant (Includes FPR)	<u>1,471</u>	
Injection Weight		67,635
J-2 Thrust Decay Propellant Consumed	<u>196</u>	
S-IVB Cutoff Weight		67,831
APS Propellant Depleted	4	
S-IVB Mainstage Propellant Consumed	226,852	
Launch Escape Subsystem	8,450	
Ullage Cases	<u>220</u>	
S-IVB "90% Thrust" Weight		303,357
S-IVB Thrust Buildup Prpt. Consumed	446	
S-IVB GH ₂ Start Tank	4	
Ullage Propellant Consumed	<u>172</u>	
S-IVB Stage Weight at Separation		303,979
S-IVB Aft Frame Hardware	30	
Ullage Propellant Consumed	9	
S-IVB Separation and Ullage Components	4	
S-IB/S-IVB Interstage with Retro Prop.	6,457	
S-IB Dry Weight	84,356	
S-IB Residuals and Reserves at Separation	10,653	
S-IVB Frost Consumed	100	
S-IB Frost Consumed	1,000	
S-IB Seal Purge Consumed	6	
S-IB Lubricant (Oronite)	27	
S-IB Gearbox Lubricant (Fuel) Consumed	733	
Inboard Engine Thrust Decay Prpt. Consumed	2,129	
Outboard Engine Thrust Decay Prpt. Consumed		
To Separation	1,947	
S-IB Mainstage Propellant Consumed	<u>881,786</u>	
Vehicle Liftoff Weight		1,293,216

* Command Module: 12,250
 SM with SLA Ring: 22,095
 SLA w/o Ring: 3,755
38,100

TABLE 2A
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IB STAGE MASS CHARACTERISTICS

FLIGHT TIME (SEC)	WEIGHT (KG)	CENTER OF GRAVITY		MOMENT OF INERTIA		KULL(Y) (KG-M-S2)
		PITCH(Z) (M)	YAW(X) (M)	PITCH(Z) (KG-M-S2)	YAW(X) (KG-M-S2)	
-5.00						
0.00	586593.	-0.0061	-0.0015	7814048.	7814048.	215921.
5.00	572964.	-0.0063	-0.0015	7801781.	7801781.	210452.
10.00	559279.	-0.0063	-0.0018	7793407.	7793407.	204538.
15.00	545529.	-0.0066	-0.0018	7790280.	7790280.	198510.
20.00	531691.	-0.0066	-0.0018	7784755.	7784755.	192503.
25.00	517811.	-0.0069	-0.0018	7784432.	7784432.	186488.
30.00	503900.	-0.0071	-0.0018	7783809.	7783809.	180468.
35.00	489965.	-0.0073	-0.0018	7782477.	7782477.	174438.
40.00	476014.	-0.0075	-0.0020	7782398.	7782398.	168406.
45.00	462050.	-0.0076	-0.0020	7777958.	7777958.	162373.
50.00	448075.	-0.0080	-0.0020	7773594.	7773594.	156335.
55.00	434098.	-0.0082	-0.0020	7763047.	7763047.	150304.
60.00	420121.	-0.0084	-0.0023	7749632.	7749632.	144277.
65.00	406138.	-0.0088	-0.0023	7727868.	7727868.	138246.
70.00	392098.	-0.0091	-0.0023	7698128.	7698128.	132205.
75.00	378046.	-0.0094	-0.0025	7659423.	7659423.	126175.
78.00	369614.	-0.0097	-0.0025	7629386.	7629386.	122563.
80.00	363595.	-0.0098	-0.0025	7606967.	7606967.	120158.
85.00	349948.	-0.0102	-0.0026	7541834.	7541834.	114142.
90.00	335949.	-0.0107	-0.0028	7460506.	7460506.	108135.
95.00	322011.	-0.0111	-0.0028	7360349.	7360349.	102144.
100.00	308082.	-0.0118	-0.0030	7237019.	7237019.	96156.
105.00	294167.	-0.0122	-0.0030	7087971.	7087971.	90168.
110.00	280272.	-0.0129	-0.0033	6903936.	6903936.	84184.
115.00	266399.	-0.0136	-0.0036	6683363.	6683363.	78207.
120.00	252554.	-0.0142	-0.0036	6420053.	6420053.	72239.
125.00	238749.	-0.0151	-0.0038	6099026.	6099026.	66289.
130.00	224983.	-0.0162	-0.0041	5717265.	5717265.	60359.
135.00	211266.	-0.0173	-0.0043	5263462.	5263462.	54448.
137.00	205799.	-0.0176	-0.0045	5052313.	5052313.	52091.
140.00	197616.	-0.0183	-0.0047	4710978.	4710978.	48556.
142.88	189777.	-0.0191	-0.0048	4349878.	4349878.	45148.
145.00	185981.	-0.0196	-0.0051	4144366.	4144366.	43445.
145.88	184807.	-0.0198	-0.0051	4062630.	4062630.	43144.
147.18	183928.	-0.0198	-0.0051	4001857.	4001857.	42735.
147.26	183924.	-0.0198	-0.0051	4001857.	4001857.	42735.

TABLE 3A
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE MASS CHARACTERISTICS

FLIGHT TIME (SEC)	WEIGHT (KG)	CENTER OF GRAVITY		MUMENT OF INERTIA		ROLL(Y) (KG-M-S2)
		PITCH(Z) (M)	YAW(X) (M)	PITCH(Z) (KG-M-S2)	YAW(X) (KG-M-S2)	
147.26	137883.	-0.0220	-0.0074	8.2160	1125673.	13642.
148.58	137853.	-0.0226	-0.0074	8.2160	1125673.	13642.
151.50	137659.	-0.0220	-0.0074	8.2167	1125364.	13593.
151.98	137600.	-0.0220	-0.0074	8.2170	1125260.	13577.
155.00	136955.	-0.0228	-0.0074	8.2253	1124798.	13576.
159.18	135898.	-0.0229	-0.0074	8.2425	1123726.	13456.
160.00	135700.	-0.0229	-0.0074	8.2453	1123582.	13456.
180.00	130828.	-0.0238	-0.0078	8.3239	1119399.	13453.
186.88	125318.	-0.0249	-0.0076	7.5140	811860.	13361.
190.00	124558.	-0.0250	-0.0078	7.5236	811425.	13361.
200.00	122120.	-0.0256	-0.0079	7.5571	809927.	13359.
220.00	117240.	-0.0260	-0.0083	7.6347	806568.	13357.
240.00	112361.	-0.0276	-0.0086	7.7273	802626.	13354.
260.00	107484.	-0.0286	-0.0090	7.8369	798039.	13351.
280.00	102607.	-0.0300	-0.0096	7.9640	792844.	13349.
300.00	97731.	-0.0314	-0.0101	8.1142	786634.	13346.
320.00	92857.	-0.0331	-0.0106	8.2866	779584.	13343.
340.00	87977.	-0.0347	-0.0112	8.4874	771303.	13340.
360.00	83102.	-0.0366	-0.0118	8.7211	761591.	13338.
380.00	78223.	-0.0387	-0.0126	8.9933	750242.	13334.
400.00	73349.	-0.0414	-0.0134	9.3113	736855.	13332.
420.00	68474.	-0.0441	-0.0144	9.6860	720881.	13329.
440.00	63592.	-0.0474	-0.0150	10.1311	701674.	13325.
460.00	58719.	-0.0513	-0.0169	10.6636	678390.	13322.
477.00	54630.	-0.0551	-0.0183	11.1950	654832.	13319.
480.00	53949.	-0.0557	-0.0184	11.2929	650469.	13318.
500.00	49647.	-0.0605	-0.0201	11.9749	619892.	13315.
520.00	45517.	-0.0657	-0.0219	12.7645	584100.	13311.
540.00	41455.	-0.0719	-0.0242	13.7122	540625.	13307.
560.00	37429.	-0.0796	-0.0269	14.8766	486596.	13303.
580.00	33383.	-0.0891	-0.0301	16.3594	416336.	13298.
592.91	30760.	-0.0960	-0.0327	17.5479	359090.	13294.
600.00	30680.	-0.0968	-0.0328	17.5926	356912.	13294.
603.11	30679.	-0.0968	-0.0328	17.5931	356888.	13294.

TABLE 4A
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-1B STAGE AERODYNAMIC CHARACTERISTICS

FLIGHT TIME (SEC)	MACH NO.	CENTER OF PRESSURE (M)	AXIAL FORCE COEFFICIENT	NORMAL FORCE COEFFICIENT (1/RAD)
-5.00	0.00	17.9500	1.0000	6.2000
0.00	0.00	17.9500	1.0000	6.2000
5.00	0.03	17.9500	1.0000	6.2000
10.00	0.07	17.9500	1.0000	6.2000
15.00	0.11	17.9500	1.0000	6.2000
20.00	0.17	17.9500	0.9095	6.2000
25.00	0.22	17.9500	0.6605	6.2000
30.00	0.29	17.9500	0.5453	6.2000
35.00	0.36	17.9500	0.4795	6.2290
40.00	0.44	17.9500	0.4345	6.2694
45.00	0.53	17.9109	0.4025	6.3301
50.00	0.63	17.7531	0.3850	6.4335
55.00	0.75	17.3897	0.3978	6.6279
60.00	0.88	16.5074	0.5162	7.1747
65.00	1.03	17.1183	0.7630	7.3351
70.00	1.20	18.2259	0.6587	6.8467
75.00	1.40	19.1303	0.5480	6.5425
78.00	1.54	20.2936	0.4952	6.3366
80.00	1.64	21.6013	0.4612	6.1713
85.00	1.89	24.0980	0.4013	5.7600
90.00	2.14	25.3718	0.3656	5.4992
95.00	2.38	26.2897	0.3421	5.3344
100.00	2.64	26.7968	0.3231	5.2084
105.00	2.92	26.8787	0.3088	5.1228
110.00	3.23	26.5367	0.2958	5.0540
115.00	3.54	26.0564	0.2809	4.9835
120.00	3.86	25.6386	0.2487	4.8549
125.00	4.20	26.4203	0.2032	4.7510
130.00	4.55	29.1814	0.1359	4.8316
135.00	4.96	35.2340	0.0263	5.4639
137.00	5.20	35.6555	-0.0316	5.6589
140.00	5.57	35.7525	-0.1288	5.9134
142.88	5.96	35.6496	-0.2397	5.9926
145.00	6.10	35.6212	-0.2938	6.0000
145.88	6.23	35.6121	-0.3151	6.0000
147.18	6.27	35.6070	-0.3269	6.0000
147.26	6.28	35.6068	-0.3275	6.0000

TABLE 5A

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-1B STAGE PROPULSION CHARACTERISTICS

FLIGHT TIME (SEC)	ALTITUDE (KM)	ACCEL (M/S ²)	*** H-1 THRUST MAGNITUDE ***										
			ENGINE 1 (N)	ENGINE 2 (N)	ENGINE 3 (N)	ENGINE 4 (N)	ENGINE 5 (N)	ENGINE 6 (N)	ENGINE 7 (N)	ENGINE 8 (N)			
-5.00	0.03	0.000	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.00	0.03	11.761	870628.	853365.	861998.	843169.	851208.	860066.	847158.	859000.	847158.	859000.	
5.00	0.06	12.275	888123.	870870.	879530.	867628.	868779.	877596.	864570.	876552.	864570.	876552.	
10.00	0.15	12.607	891823.	874545.	883233.	864289.	872491.	881297.	868260.	880250.	868260.	880250.	
15.00	0.31	13.016	899918.	882704.	891339.	872419.	880658.	889475.	876369.	888427.	876369.	888427.	
20.00	0.55	13.433	907322.	890083.	898751.	879774.	888096.	896870.	883764.	895819.	883764.	895819.	
25.00	0.86	13.863	913517.	896278.	904951.	885955.	894315.	903078.	889958.	902026.	889958.	902026.	
30.00	1.31	14.311	920225.	903046.	911664.	892712.	900981.	909796.	896606.	908744.	896606.	908744.	
35.00	1.86	14.780	927278.	910039.	918718.	899694.	907988.	916859.	903599.	915804.	903599.	915804.	
40.00	2.53	15.285	935186.	917889.	926629.	907536.	915972.	924654.	911570.	923597.	911570.	923597.	
45.00	3.33	15.814	943069.	925708.	934512.	915354.	923801.	932541.	919395.	931485.	919395.	931485.	
50.00	4.28	16.369	951278.	934040.	942722.	923082.	931897.	940754.	927488.	939697.	927488.	939697.	
55.00	5.38	16.920	959632.	942399.	951077.	932039.	940384.	949116.	935972.	948057.	935972.	948057.	
60.00	6.65	17.289	967698.	950466.	959143.	940108.	948455.	957308.	944047.	956249.	944047.	956249.	
65.00	8.08	17.334	974846.	957491.	966288.	947138.	955599.	964332.	951203.	963273.	951203.	963273.	
70.00	9.66	18.233	982663.	965192.	974105.	954841.	963181.	972154.	958786.	971095.	958786.	971095.	
75.00	11.42	19.292	990106.	972762.	981550.	962413.	970877.	979479.	966479.	978422.	966479.	978422.	
78.00	12.56	19.961	994146.	977050.	985591.	966700.	974923.	983645.	970524.	982590.	970524.	982590.	
80.00	13.36	20.429	996547.	979330.	987992.	968983.	977205.	986047.	972807.	984994.	972807.	984994.	
85.00	15.48	21.623	1001676.	984340.	993120.	973995.	982458.	991056.	978062.	990002.	978062.	990002.	
90.00	17.81	22.863	1005650.	987705.	997091.	977369.	986066.	994784.	981675.	993733.	981675.	993733.	
95.00	20.35	24.151	1007653.	990447.	999095.	980112.	988562.	997281.	984177.	996231.	984177.	996231.	
100.00	23.11	25.468	1008907.	991463.	1000347.	981136.	989575.	998292.	985199.	997243.	985199.	997243.	
105.00	26.10	26.837	1008969.	991774.	1000409.	981455.	989640.	998355.	985276.	997310.	985276.	997310.	
110.00	29.33	28.251	1008583.	991147.	1000018.	980638.	989489.	997966.	985138.	996921.	985138.	996921.	
115.00	32.80	29.840	1007157.	989971.	998591.	979671.	988304.	996783.	983970.	995740.	983970.	995740.	
120.00	36.52	31.506	1005167.	987745.	996597.	977464.	985826.	994789.	981517.	993749.	981517.	993749.	
125.00	40.45	33.321	1002434.	985505.	993861.	975237.	983328.	992295.	979046.	991257.	979046.	991257.	
130.00	44.73	35.312	999726.	982076.	991145.	971834.	980600.	989331.	976349.	988299.	976349.	988299.	
135.00	49.22	37.499	995627.	978471.	987041.	968251.	976490.	985225.	972278.	984197.	972278.	984197.	
137.00	51.09	38.438	993923.	976768.	985332.	966560.	974537.	983274.	970345.	982248.	970345.	982248.	
140.00	53.97	39.925	990851.	973945.	982258.	963758.	971459.	980195.	967296.	979176.	967296.	979176.	
142.88	56.82	41.411	986527.	969245.	977958.	959118.	967560.	976444.	963413.	975464.	963413.	975464.	
145.00	58.97	40.894	969146.	952198.	960497.	942088.	146.	148.	145.	148.	145.	148.	
145.88	59.86	17.341	658257.	945098.	652485.	935027.	-0.	-0.	-0.	-0.	-0.	-0.	
147.18	61.18	0.107	4411.	1745.	4370.	1726.	-0.	-0.	-0.	-0.	-0.	-0.	
147.26	61.26	0.096	5032.	1619.	3599.	1602.	-0.	-0.	-0.	-0.	-0.	-0.	

TABLE 6A
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-1VB STAGE PROPULSION CHARACTERISTICS

FLIGHT TIME (SEC)	ALTITUDE (KM)	LONGITUDINAL ACCELERATION (M/S ²)	THRUST MAGNITUDE J-2 ENGINE (N)	APS IMPULSE (N-SEC)
147.26	61.26	0.266	0.	0.000
148.58	62.58	0.256	0.	0.000
151.50	65.44	5.479	752069.	0.000
151.98	65.91	6.319	870634.	0.000
155.00	68.80	6.459	885366.	0.000
159.18	72.72	7.434	1010719.	0.000
160.00	73.48	7.443	1010474.	0.000
180.00	90.94	7.715	1009306.	261.627
186.88	96.51	8.053	1009198.	261.627
190.00	98.96	8.104	1009388.	261.627
200.00	106.53	8.271	1010028.	371.830
220.00	120.66	8.597	1007947.	495.506
240.00	133.45	8.977	1008703.	495.506
260.00	144.92	9.394	1009688.	495.506
280.00	155.13	9.806	1006171.	562.656
300.00	164.10	10.324	1008773.	647.035
320.00	171.89	10.871	1009424.	647.035
340.00	178.53	11.462	1008389.	809.735
360.00	184.09	12.141	1008991.	809.735
380.00	188.62	12.879	1007469.	879.111
400.00	192.21	13.725	1006695.	954.334
420.00	194.92	14.737	1009101.	954.334
440.00	196.86	15.861	1008642.	1033.222
460.00	198.15	17.117	1005132.	1102.467
477.00	198.83	17.545	958467.	1102.467
480.00	198.91	17.439	940828.	1102.467
500.00	199.20	17.589	873262.	1173.925
520.00	199.03	18.884	859576.	1245.389
540.00	198.56	20.433	847063.	1245.389
560.00	198.04	22.633	847126.	1312.990
580.00	197.64	25.522	852022.	1399.763
592.91	197.51	27.635	850281.	1399.763
600.00	197.50	0.026	850.	1671.420
603.11	197.50	0.026	850.	1738.616

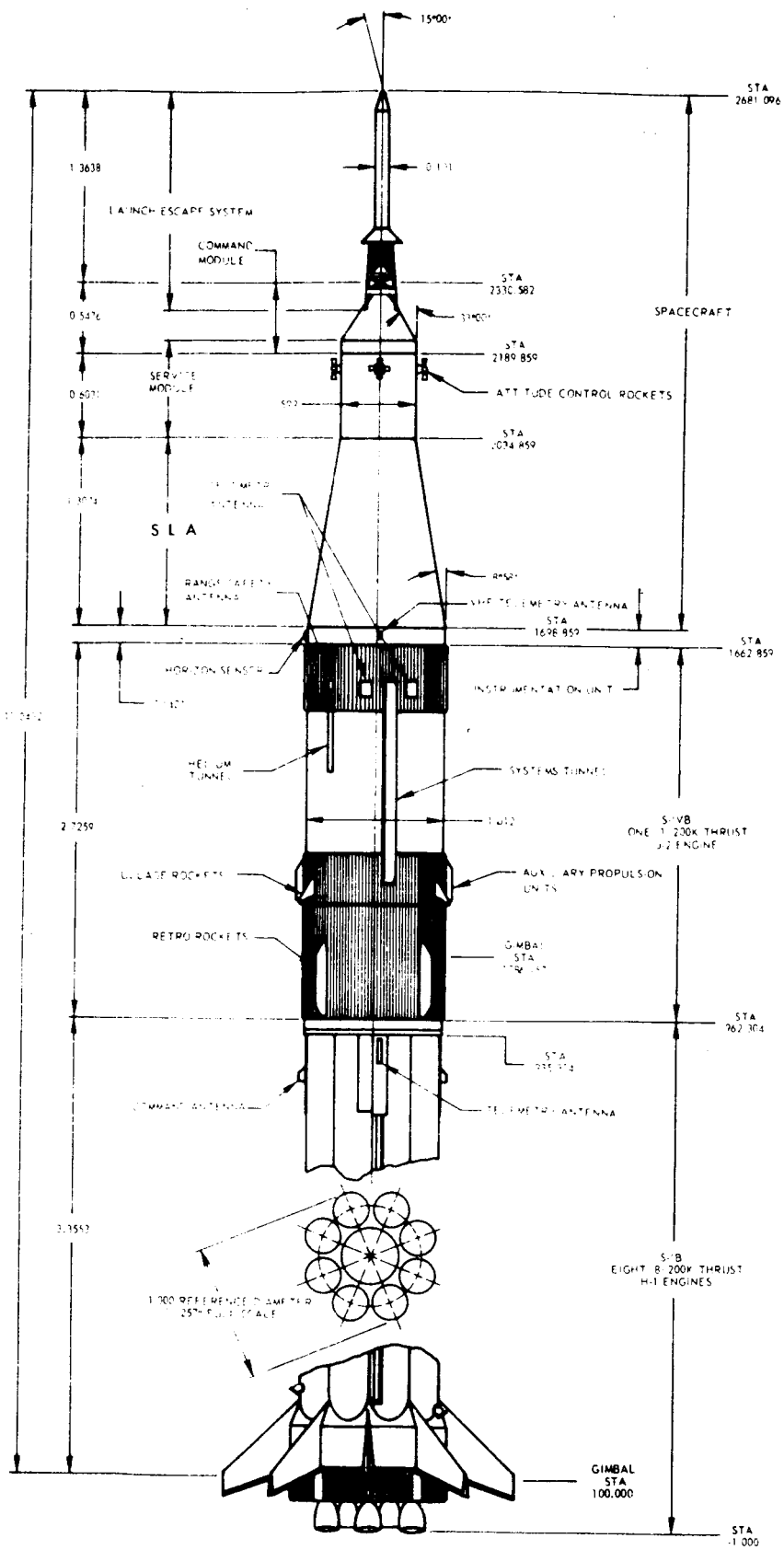


Figure 1a SA-205 VEHICLE PROFILE

Figure 2A

AS-205 REVISED L/V REFERENCE TRAJECTORY
H-1 ENGINE THRUST DECAY

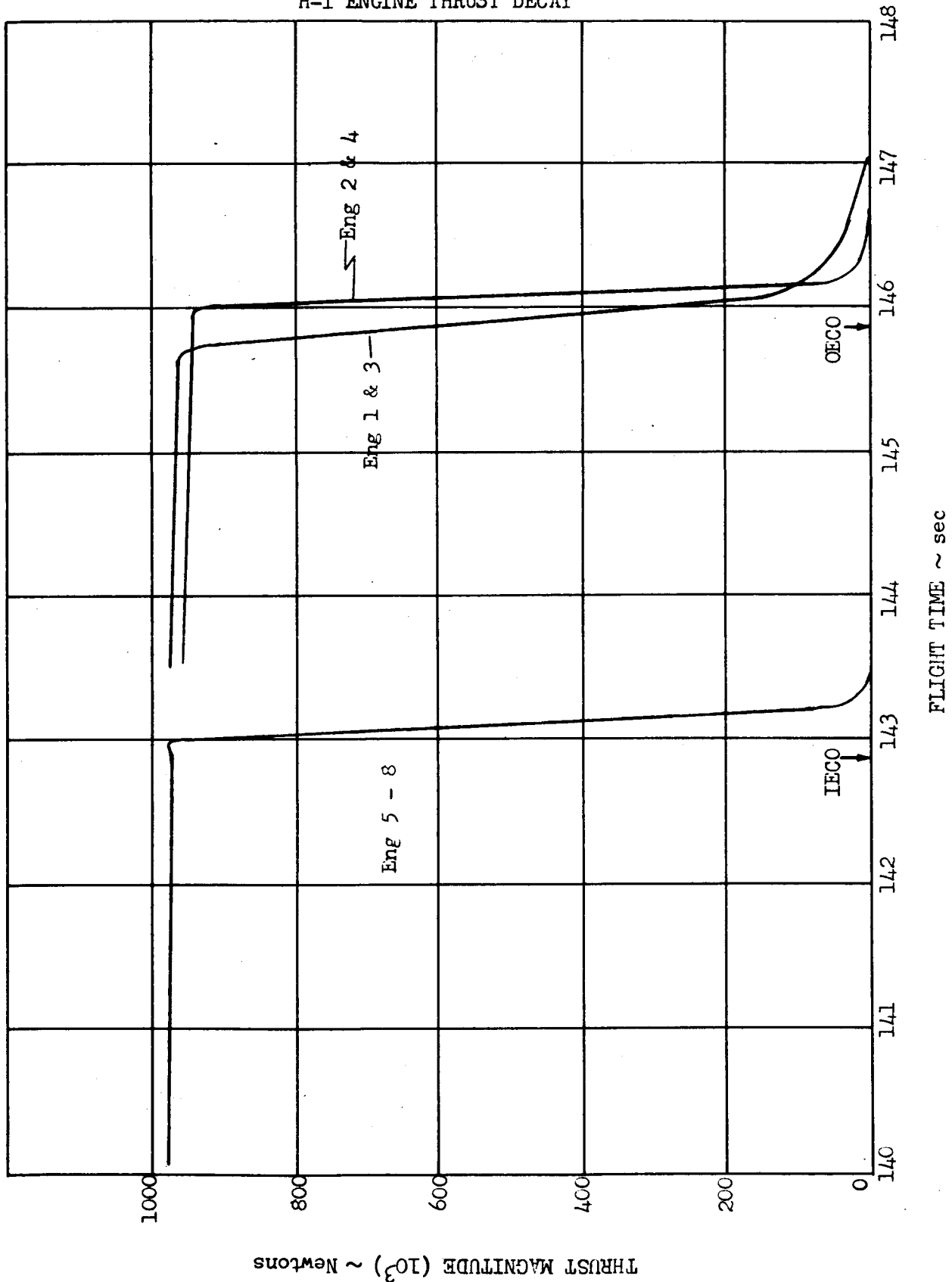


Figure 3A

AS-205 REVISED L/V REFERENCE TRAJECTORY
J-2 ENGINE THRUST BUILDUP

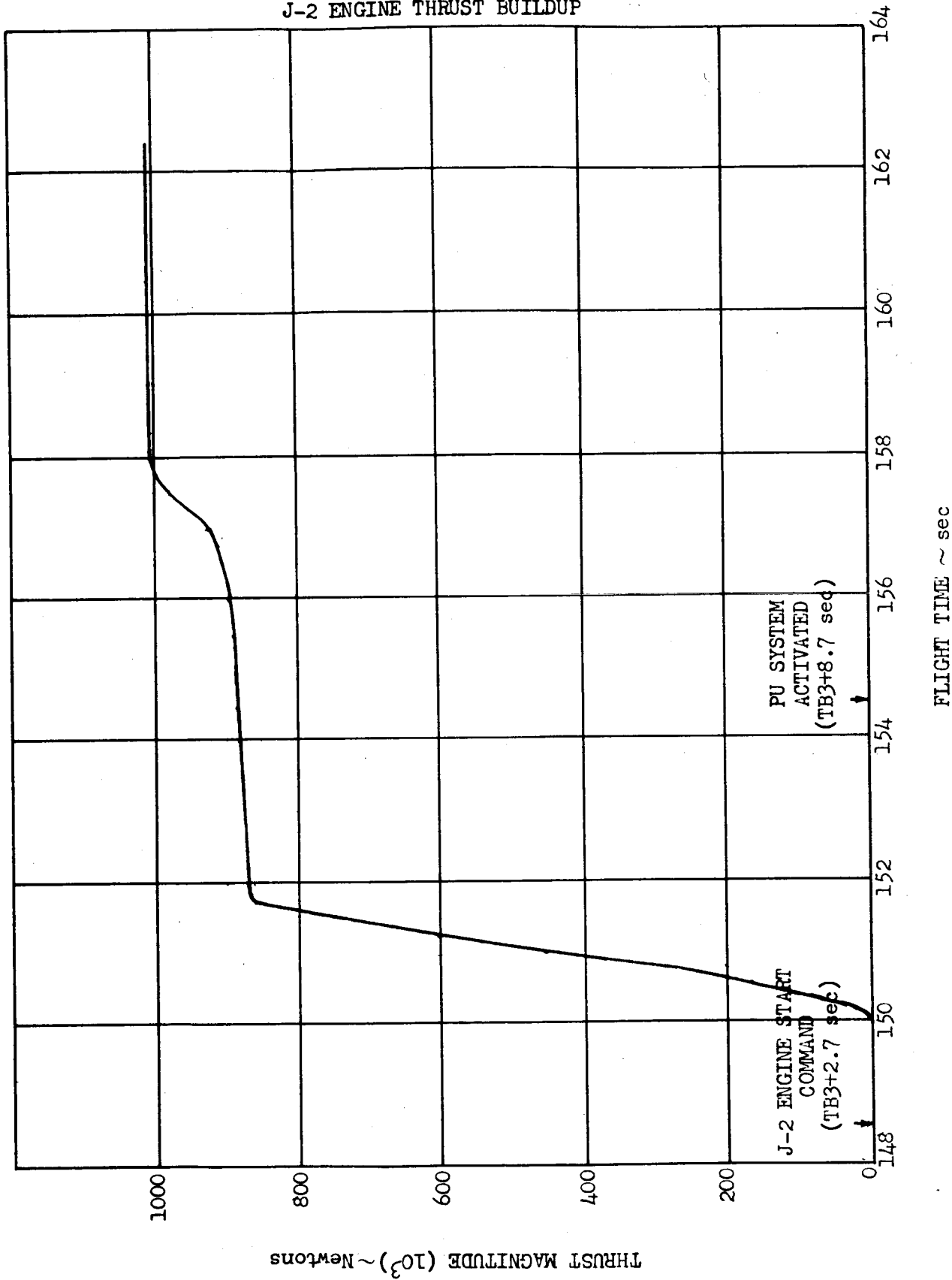
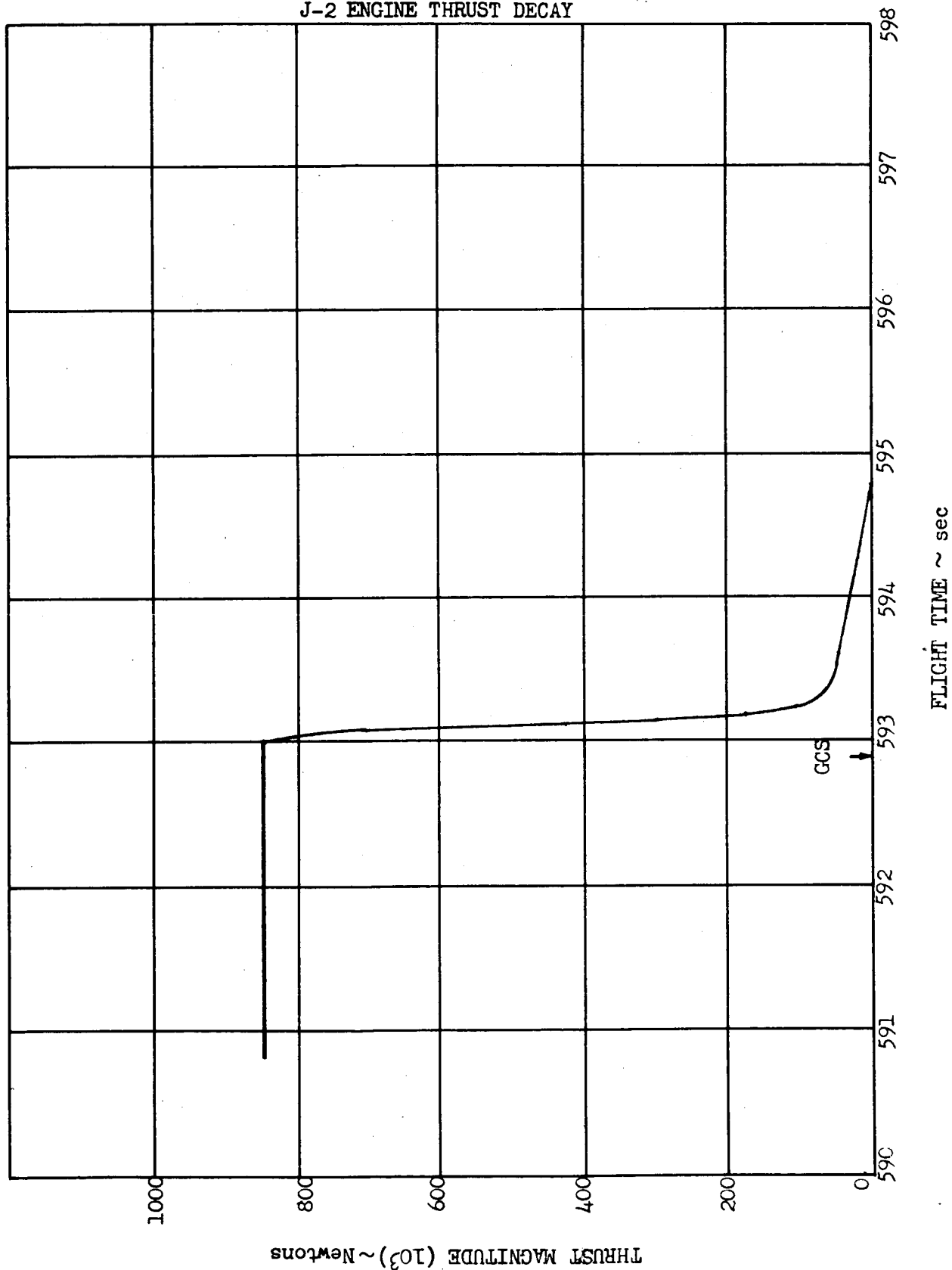


Figure 4A

AS-205 REVISED L/V REFERENCE TRAJECTORY
J-2 ENGINE THRUST DECAY



A P P E N D I X B

"GUIDANCE PRESETTINGS"

TABLE 1B

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IB STAGE STEERING PROGRAMFor the time segment $t - T_1 \leq 10$:

$$\begin{aligned} X_x &= 0. \\ X_y &= -.299848 \text{ rad. } (-17.18 \text{ degrees}) \\ X_z &= 0. \end{aligned}$$

For the time segment $10 < t - T_1 \leq 45$:

$$\begin{aligned} X_z &= A_0 + A_1 T + A_2 T^2 + A_3 T^3 \\ A_0 &= -.155517 \times 10^{-1} \text{ rad.} \\ A_1 &= +.284092 \times 10^{-2} \text{ rad./sec.} \\ A_2 &= -.165429 \times 10^{-3} \text{ rad./sec.}^2 \\ A_3 &= +.321123 \times 10^{-6} \text{ rad./sec.}^3 \\ X_x &= X_y = 0. \end{aligned}$$

For the time segment $45 < t - T_1 \leq 92$:

$$\begin{aligned} X_z &= B_0 + B_1 T + B_2 T^2 + B_3 T^3 \\ B_0 &= +.207839 \times 10^{-1} \text{ rad.} \\ B_1 &= +.229458 \times 10^{-2} \text{ rad./sec.} \\ B_2 &= -.202467 \times 10^{-3} \text{ rad./sec.}^2 \\ B_3 &= +.101124 \times 10^{-5} \text{ rad./sec.}^3 \\ X_x &= X_y = 0. \end{aligned}$$

For the time segment $92 < t - T_1 \leq 137$:

$$\begin{aligned} X_z &= C_0 + C_1 T + C_2 T^2 + C_3 T^3 \\ C_0 &= +.143848 \times 10^{-1} \text{ rad.} \\ C_1 &= -.457693 \times 10^{-1} \text{ rad./sec.} \\ C_2 &= +.337240 \times 10^{-3} \text{ rad./sec.}^2 \\ C_3 &= -.997002 \times 10^{-6} \text{ rad./sec.}^3 \\ X_x &= X_y = 0. \end{aligned}$$

For the time segment $t - T_1 > 137$:

$$\begin{aligned} X_z &= -1.061769 \text{ rad.} \\ X_x &= X_y = 0. \end{aligned}$$

NOTE:

 X_z : Pitch attitude angle measured negative downrange from inertial vertical

$$T = t - T_1 + \text{NGMDT}$$

t: time from GRR

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

NGMDT: Bias to account for system delays

TABLE 2B

AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IB STAGE PITCH ATTITUDE COMMAND

<u>FLIGHT TIME (SEC)</u>	<u>PITCH ATTITUDE COMMAND, X_c (DEG)</u>	<u>FLIGHT TIME (SEC)</u>	<u>PITCH ATTITUDE COMMAND, X_c (DEG)</u>
0	0.0000	82	33.9637
10	0.0000	84	35.1594
12	-0.2599	86	36.3314
14	-0.4015	88	37.4768
16	-0.6125	90	38.5930
18	-0.8931	92	39.6771
20	-1.2412	94	40.6980
22	-1.6565	96	41.6961
24	-2.1379	98	42.6709
26	-2.6847	100	43.6252
28	-3.2959	102	44.5618
30	-3.9707	104	45.4834
32	-4.7081	106	46.3927
34	-5.5073	108	47.2925
36	-6.3675	110	48.1855
38	-7.2876	112	49.0744
40	-8.2669	114	49.9620
42	-9.3044	116	50.8511
44	-10.3993	118	51.7443
46	-11.5507	120	52.6445
48	-12.7023	122	53.5543
50	-13.8758	124	54.4766
52	-15.0728	126	55.4140
54	-16.2906	128	56.3692
56	-17.5264	130	57.3451
58	-18.7774	132	58.3444
60	-20.0409	134	59.3698
62	-21.3140	136	60.4241
64	-22.5939	138	60.8349
66	-23.8780		
68	-25.1633		
70	-26.4472		
72	-27.7268		
74	-28.9994		
76	-30.2622		
78	-31.5123		
80	-32.7471		
		↓	
		IGM Initiation	
			↓
			60.8349

TABLE 3B

AS-205 REVISED L/V REFERENCE TRAJECTORY
IGM PRESETTINGS

<u>LVDC SYMBOL</u>	<u>INITIAL VALUE</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
---	44.	sec	Time from time base 3 to initiate IGM guidance
T_{1i}	286.9	sec	Time to go for first IGM stage
T_{3i}	116.	sec	Time to go for second IGM stage
τ_3	262.52	sec	Average value of m/\dot{m} at initiation of second IGM stage
V_{ex1}	4135.6997	m/sec	Average exhaust velocity ($g_0 \times I_{sp}$) for 1st IGM stage phase of flight
V_{ex3}	4192.6960	m/sec	Average exhaust velocity ($g_0 \times I_{sp}$) for 2nd IGM stage phase of flight
V_T	7780.976	m/sec	Guidance cutoff signal (GCS) criteria. Terminal velocity for IGM equations
X_{VT}	0.	m	Desired terminal position vector components in IGM coordinate system
Y_{VT}	6570774.	m	
Z_{VT}	0.	m	
\dot{X}_{VT}	7780.976	m/sec	Desired cutoff velocity components in IGM coordinate system
\dot{Y}_{VT}	0.	m/sec	
\dot{Z}_{VT}	0.	m/sec	
\ddot{X}_{VGT}	0.	m/sec ²	Terminal gravitation vector components in IGM coordinate system
\ddot{Y}_{VGT}	-9.251	m/sec ²	
\ddot{Z}_{VGT}	0.	m/sec ²	
ϵ	15.	sec	Value of T_{3i} to initiate IGM $\Delta \bar{V}$
---	3.	sec	Value of T_{3i} to freeze IGM (ϵ')

TABLE 3B (Cont'd)

AS-205 REVISED L/V REFERENCE TRAJECTORY
IGM PRESETTINGS

LVDC SYMBOL	INITIAL VALUE	UNITS	DESCRIPTION
T_{r1}	1.8	N/D	Mission dependent constant multiplier for terminal range angle equation
T_{r2}	0.	N/D	Mission dependent constants for N_3 and N_4 equations
T_{r3}	0.	N/D	
---	200.	sec	
\bar{T}_2	0.	sec	Terminal steering time argument
ΔT_{NOM}	R-ASTR	sec	Nominal computation cycle length
TLD	0.	N/D	IGM staging flag (Burn switch)
AP1	-.18749569	E+00	Transformation matrix from navigation coordinate system to the (X_4, Y_4, Z_4) coordinate system $A_z = 82.8200$ $\phi_L = 28.52196$ $\theta_N = 102.32900$ $i = 28.89597$
AP2	-.98223810	E+00	
AP3	-.73231298	E-02	
AP4	+.98202016	E+00	
AP5	-.18761026	E+00	
AP6	+.20946740	E-01	
AP7	-.21948577	E-01	
AP8	-.32640360	E-02	
AP9	+.99975374	E+00	
---	261.	sec	Time from time base 3 to sample F/M for IGM staging (Approximately 70 sec. prior to nominal IGM staging)
FLAG	2.	N/D	Number of F/M decreases required for IGM staging criteria
ACC	0.01	m/sec ²	F/M comparison tolerance for IGM staging
T_{10}	286.9	sec	Constants for updating second stage time-to-go for perturbed EMR shift time
A_0	458.9	sec	
A_1	- 1.194	N/D	

TABLE 3B (Cont'd)

AS-205 REVISED L/V REFERENCE TRAJECTORY
IGM PRESETTINGS

<u>LVDC SYMBOL</u>	<u>INITIAL VALUE</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
PCO	60.	sec	Backup time for IGM staging
τ_{10}	528.	sec	} Constants for artificial τ_3 mode
C_0	35.	sec	
M_{O_2}	124558.41	kg	
\dot{M}_1	243.687	kg/sec	
\dot{M}_3	204.129	kg/sec	

A P P E N D I X C

"LAUNCH VEHICLE TRAJECTORY LISTINGS, ENGLISH UNITS"

TABLE IC
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-1B STAGE FLIGHT DATA

FLIGHT TIME (SEC)	RANGE (NM)	ALTITUDE (FT)	SPACE VELOCITY (FT/SEC)	FIXED PATH ANGLE (DEG)	LONGITUDINAL ACCELERATION (FT/SEC ²)	MASS (LB)	THRUST (TOTAL) (LB)	DYNAMIC PRESSURE (LB/FT ²)	MACH NO.	PITCH ANGLE UP OF ATTACK (DEG)
1) -5.00	-0.000	104.	1341.76	90.000	0.000	1306872.	0.	0.	0.00	0.000
2) 0.00	0.000	104.	1341.76	90.000	38.587	1293216.	1538719.	7.	0.00	0.000
5.00	0.000	195.	1342.20	88.396	40.273	1263169.	1570270.	2.	0.03	-0.115
10.00	-0.000	489.	1343.88	86.552	41.362	1232998.	1576958.	7.	0.07	-0.195
15.00	-0.001	1014.	1347.88	84.454	42.704	1202686.	1591692.	19.	0.11	-0.363
20.00	0.001	1803.	1356.74	82.095	44.072	1172178.	1605128.	38.	0.17	-0.334
25.00	0.004	2891.	1372.23	79.510	45.483	1141577.	1616460.	60.	0.22	-0.290
30.00	0.014	4313.	1397.20	76.759	46.953	1110910.	1628780.	104.	0.29	-0.259
35.00	0.036	6104.	1434.11	73.914	48.492	1080188.	1641754.	153.	0.36	-0.080
40.00	0.077	8299.	1485.39	71.070	50.146	1049431.	1656385.	213.	0.44	-0.054
45.00	0.144	10935.	1553.32	68.336	51.883	1018646.	1671129.	282.	0.53	-0.058
50.00	0.248	14044.	1639.85	65.823	53.705	987837.	1680414.	358.	0.63	-0.049
55.00	0.403	17661.	1745.45	63.613	55.511	957021.	1702025.	438.	0.75	-0.003
60.00	0.619	21809.	1869.43	61.791	56.724	926209.	1717122.	516.	0.88	0.010
65.00	0.911	26495.	2007.37	60.473	56.809	895381.	1730386.	579.	1.03	0.012
70.00	1.291	31704.	2161.50	59.548	59.821	864427.	1744795.	627.	1.20	0.017
75.00	1.776	37466.	2339.27	58.858	63.292	833449.	1758764.	680.	1.40	0.011
78.00	2.125	41203.	2457.69	58.557	65.489	814860.	1766458.	666.	1.54	0.001
80.00	2.385	43817.	2541.65	58.402	67.023	802471.	1770829.	663.	1.64	-0.007
85.00	3.137	50798.	2769.45	58.164	70.942	771502.	1780352.	623.	1.89	-0.029
90.00	4.055	58440.	3022.90	58.122	75.011	740640.	1787229.	541.	2.14	-0.047
95.00	5.158	66776.	3302.11	58.246	79.237	709513.	1791805.	440.	2.38	-0.029
100.00	6.469	75834.	3606.96	58.487	83.557	679205.	1793877.	350.	2.64	0.044
105.00	8.010	85644.	3937.92	58.835	88.048	648527.	1794199.	271.	2.92	-0.013
110.00	9.803	96229.	4295.76	59.267	92.818	617893.	1793561.	204.	3.23	-0.095
115.00	11.870	107612.	4681.83	59.773	97.900	587310.	1791367.	149.	3.54	-0.328
120.00	14.238	119814.	5097.89	60.344	103.367	556787.	1787487.	105.	3.86	-0.670
125.00	16.933	132852.	5545.99	60.977	109.322	526351.	1783020.	73.	4.20	-1.243
130.00	19.984	146736.	6028.70	61.673	115.855	496003.	1777713.	50.	4.55	-1.871
135.00	23.422	161472.	6549.04	62.436	123.029	465762.	1770559.	34.	4.98	-2.767
137.00	24.914	167603.	6768.45	62.703	126.110	453710.	1767273.	29.	5.20	-3.169
140.00	27.283	177052.	7110.33	63.259	130.986	435669.	1761857.	23.	5.57	-2.678
142.88	29.715	186433.	7453.38	63.666	135.664	418387.	1754379.	19.	5.96	-1.630
145.00	31.583	193464.	7585.71	64.000	68.549	410017.	861224.	15.	6.16	-1.087
145.88	32.374	196404.	7633.19	64.139	50.893	407429.	718919.	14.	6.23	-0.860
147.18	33.547	200717.	7628.47	64.385	0.351	405492.	3073.	11.	6.27	-0.548
147.26	33.618	200978.	7627.41	64.401	0.317	405482.	2647.	11.	6.28	-0.530

1) GRN; 2) First Motion; 3) IECC; 4) OECC; 5) Ser. Signal; 6) Physical Ser.

TABLE 1C (Cont'd)
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-1B STAGE FLIGHT DATA

FLIGHT TIME (SEC)	SPACE FIXED POSITION AND VELOCITY VECTORS			SPACE FIXED MAGNITUDE		
	X (FT)	Y (FT)	Z (FT)	RADIUS (FT)	VELOCITY (FT/S)	PATH ANGLE (DEG)
1) -5.00	-7350.	20909869.	58347.	20909952.	1341.76	90.000
2) 0.00	-694.	20909868.	59185.	20909951.	1341.76	90.000
5.00	5963.	20909956.	60021.	20910043.	1342.20	88.396
10.00	12618.	20910244.	60856.	20910336.	1343.88	86.552
15.00	19274.	20910762.	61690.	20910861.	1347.88	84.454
20.00	25936.	20911541.	62522.	20911651.	1356.74	82.095
25.00	32617.	20912617.	63353.	20912739.	1372.23	79.510
30.00	39340.	20914025.	64183.	20914160.	1397.20	76.759
35.00	46136.	20915799.	65010.	20915951.	1434.11	73.914
40.00	53046.	20917975.	65835.	20918146.	1485.39	71.070
45.00	60123.	20920589.	66659.	20920781.	1553.32	68.336
50.00	67430.	20923674.	67480.	20923891.	1639.85	65.823
55.00	75042.	20927262.	68300.	20927507.	1745.45	63.613
60.00	83038.	20931377.	69117.	20931655.	1869.43	61.791
65.00	91499.	20936024.	69932.	20936340.	2007.37	60.473
70.00	100504.	20941188.	70744.	20941549.	2161.50	59.548
75.00	110154.	20946897.	71554.	20947309.	2339.27	58.858
78.00	116302.	20950599.	72034.	20951046.	2457.69	58.557
80.00	120566.	20953188.	72362.	20953659.	2541.65	58.402
85.00	131865.	20960096.	73166.	20960638.	2769.45	58.164
90.00	144179.	20967653.	73968.	20968279.	3022.90	58.122
95.00	157642.	20975886.	74767.	20976612.	3302.11	58.246
100.00	172389.	20984823.	75562.	20985667.	3606.96	58.487
105.00	188555.	20994488.	76353.	20995473.	3957.92	58.835
110.00	206281.	21004900.	77139.	21006054.	4295.70	59.267
115.00	225714.	21016077.	77919.	21017433.	4681.83	59.773
120.00	247012.	21028032.	78692.	21029630.	5097.89	60.344
125.00	270343.	21040776.	79457.	21042662.	5545.99	60.977
130.00	295892.	21054308.	80210.	21056540.	6028.70	61.673
135.00	323860.	21068624.	80951.	21071269.	6549.04	62.436
137.00	335774.	21074566.	81243.	21077397.	6768.45	62.763
140.00	354470.	21083703.	81678.	21086841.	7110.33	63.259
142.88	373405.	21092752.	82091.	21096217.	7453.38	63.666
145.00	387828.	21099520.	82392.	21103244.	7585.71	64.000
145.88	393923.	21102345.	82517.	21106182.	7633.19	64.139
147.18	402943.	21106486.	82701.	21110493.	7628.47	64.385
147.26	403491.	21106736.	82712.	21110754.	7627.41	64.401

1) GRR; 2) First Motion; 3) IECO; 4) OECO; 5) Sep. Signal; 6) Physical Sep.

TABLE 1C (Cont'd)
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-1B STAGE FLIGHT DATA

FLIGHT TIME (SEC)	EARTH FIXED POSITION			EARTH FIXED VELOCITY			EARTH FIXED VELOCITY			EARTH FIXED VELOCITY		PATH ANGLE (DEG)
	X (FT)	Y (FT)	Z (FT)	UX (FT/S)	UY (FT/S)	UZ (FT/S)	POSITION (FT)	VELOCITY (FT/S)	MAGNITUDE	VELOCITY (FT/S)		
1) -5.00	0.	105.	-0.	-0.00	-0.00	0.00	105.	0.00	N/A	0.00	N/A	
2) 0.00	-0.	105.	-0.	-0.00	-0.00	-0.00	105.	0.00	N/A	0.00	N/A	
5.00	0.	196.	-0.	-0.08	37.58	-0.13	196.	37.58	0.368	37.58	0.368	
10.00	-1.	490.	-1.	-0.31	80.84	-0.25	490.	80.84	0.395	80.84	0.395	
15.00	-3.	1015.	-2.	-0.24	130.27	-0.10	1015.	130.27	0.221	130.27	0.221	
20.00	0.	1804.	-3.	2.03	186.60	-0.25	1804.	186.61	0.685	186.61	0.685	
25.00	22.	2892.	-4.	7.45	249.83	-0.27	2892.	249.94	1.742	249.94	1.742	
30.00	84.	4314.	-6.	18.22	320.02	-0.49	4315.	320.54	3.268	320.54	3.268	
35.00	217.	6105.	-10.	36.17	397.38	-0.73	6108.	399.03	5.227	399.03	5.227	
40.00	461.	8300.	-14.	63.34	481.90	-0.90	8313.	486.05	7.512	486.05	7.512	
45.00	869.	10935.	-18.	102.01	573.47	-1.00	10970.	582.47	10.108	582.47	10.108	
50.00	1505.	14046.	-24.	154.60	671.65	-1.11	14126.	689.22	12.981	689.22	12.981	
55.00	2441.	17662.	-29.	222.39	775.79	-1.19	17830.	807.04	16.011	807.04	16.011	
60.00	3756.	21810.	-35.	306.44	883.72	-1.25	22131.	935.34	19.136	935.34	19.136	
65.00	5531.	26495.	-42.	405.97	983.34	-1.28	27066.	1069.40	22.317	1069.40	22.317	
70.00	7844.	31704.	-48.	522.93	1095.46	-1.22	32660.	1213.88	25.518	1213.88	25.518	
75.00	10797.	37403.	-54.	662.09	1209.56	-1.09	38988.	1379.00	28.685	1379.00	28.685	
78.00	12924.	41200.	-57.	756.94	1281.85	-0.97	43179.	1488.66	30.547	1488.66	30.547	
80.00	14505.	43813.	-59.	825.12	1331.45	-0.86	46152.	1566.39	31.768	1566.39	31.768	
85.00	19091.	50790.	-62.	1013.52	1460.31	-0.49	54259.	1777.56	34.731	1777.56	34.731	
90.00	24684.	58427.	-64.	1228.17	1595.43	0.01	63427.	2013.40	37.542	2013.40	37.542	
95.00	31417.	66753.	-62.	1469.61	1736.13	0.66	73777.	2274.62	40.182	2274.62	40.182	
100.00	39424.	75798.	-57.	1737.50	1882.69	1.38	85438.	2561.92	42.616	2561.92	42.616	
105.00	48838.	85588.	-48.	2032.98	2033.90	2.25	98542.	2875.72	44.874	2875.72	44.874	
110.00	59601.	96144.	-34.	2356.96	2189.42	3.10	113225.	3216.95	46.967	3216.95	46.967	
115.00	72458.	107488.	-17.	2711.16	2348.57	3.99	129630.	3566.96	48.922	3566.96	48.922	
120.00	86967.	119635.	0.	3097.76	2510.72	5.07	147905.	3987.46	50.758	3987.46	50.758	
125.00	103494.	132598.	34.	3519.39	2674.60	5.93	168206.	4420.36	52.505	4420.36	52.505	
130.00	122224.	146382.	60.	3979.24	2838.97	6.85	190700.	4888.16	54.182	4888.16	54.182	
135.00	143357.	160585.	102.	4481.34	3001.83	7.99	215563.	5393.72	55.816	5393.72	55.816	
137.00	152532.	167052.	119.	4695.07	3065.46	8.53	226213.	5607.21	56.464	5607.21	56.464	
140.00	167115.	176391.	146.	5029.38	3161.30	9.43	242984.	5940.41	57.414	5940.41	57.414	
142.88	182092.	185648.	174.	5361.99	3262.03	10.38	260043.	6276.29	58.211	6276.29	58.211	
145.00	193605.	192577.	197.	5501.59	3276.94	11.19	273073.	6403.59	58.715	6403.59	58.715	
145.88	198486.	195472.	207.	5552.98	3279.34	11.61	278578.	6449.02	58.917	6449.02	58.917	
147.18	205717.	199717.	223.	5563.51	3245.78	12.08	286716.	6441.10	59.202	6441.10	59.202	
147.26	206156.	199973.	224.	5563.47	3243.36	12.11	287210.	6439.85	59.219	6439.85	59.219	

1) Grid; 2) First Motion; 3) IFCC; 4) OECC; 5) Sep. Signal; 6) Physical Sep.

TABLE 10 (Cont'd)
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-1B STAGE FLIGHT DATA

FLIGHT TIME (SEC)	RANGE (NM)	ALTITUDE (FT)	LONGITUDE (POS./WEST) (DEG)	GEOGETIC LATITUDE (DEG)	GEOCENTRIC LATITUDE (DEG)
1) -5.00	-0.00	104.	80.561	28.522	28.361
2) 0.00	0.00	104.	80.561	28.522	28.361
5.00	0.00	195.	80.561	28.522	28.361
10.00	-0.00	489.	80.561	28.522	28.361
15.00	-0.00	1014.	80.561	28.522	28.361
20.00	0.00	1803.	80.561	28.522	28.361
25.00	0.00	2891.	80.561	28.522	28.361
30.00	0.01	4313.	80.561	28.522	28.361
35.00	0.04	6104.	80.560	28.522	28.361
40.00	0.08	8299.	80.560	28.522	28.361
45.00	0.14	10935.	80.558	28.522	28.361
50.00	0.25	14044.	80.556	28.523	28.362
55.00	0.40	17661.	80.554	28.523	28.362
60.00	0.62	21809.	80.550	28.524	28.362
65.00	0.91	26495.	80.544	28.524	28.363
70.00	1.29	31704.	80.537	28.525	28.364
75.00	1.78	37466.	80.528	28.526	28.365
78.00	2.13	41203.	80.521	28.527	28.366
80.00	2.38	43817.	80.516	28.527	28.366
85.00	3.14	50798.	80.502	28.529	28.368
90.00	4.05	58440.	80.485	28.531	28.370
95.00	5.16	66776.	80.464	28.533	28.372
100.00	6.47	75834.	80.440	28.536	28.375
105.00	8.01	85644.	80.411	28.539	28.378
110.00	9.80	96229.	80.377	28.543	28.382
115.00	11.87	107612.	80.338	28.547	28.386
120.00	14.24	119814.	80.294	28.552	28.391
125.00	16.93	132852.	80.245	28.558	28.397
130.00	19.98	146736.	80.186	28.564	28.403
135.00	23.42	161472.	80.121	28.571	28.410
137.00	24.91	167603.	80.093	28.574	28.413
140.00	27.28	177052.	80.049	28.579	28.418
142.88	29.71	186433.	80.003	28.584	28.422
145.00	31.58	193464.	79.968	28.588	28.426
145.88	32.37	196404.	79.953	28.589	28.428
147.18	33.55	200717.	79.931	28.591	28.430
147.26	33.62	200978.	79.930	28.592	28.430

1) GRK; 2) First Motion; 3) IECC; 4) OECC; 5) Sep. Signal; 6) Physical Sep.

TABLE 2C
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE FLIGHT DATA

	FLIGHT TIME (SEC)	RANGE (NM)	ALTITUDE (FT)	VELOCITY (FT/SEC)	SPACE FIXED PATH ANGLE (DEG)	LONGITUDINAL ACCELERATION (FT/SEC ²)	MASS (LB)	THRUST (TOTAL) (LB)	DYNAMIC PRESSURE (LB/FT ²)	PITCH ATTITUDE COMMAND (DEG)
1)	147.26	33.618	200978.	7627.41	64.401	0.874	303979.	8749.	11.	60.835
2)	148.58	34.809	205308.	7610.57	64.659	0.841	303914.	8355.	10.	60.835
	151.50	37.439	214695.	7584.88	65.225	17.974	303485.	169824.	7.	60.835
3)	151.98	37.875	216229.	7588.13	65.314	20.731	303357.	195726.	6.	60.835
	155.00	40.613	225711.	7611.63	65.860	21.190	301934.	199038.	4.	60.835
4)	159.18	44.451	238587.	7653.32	66.596	24.389	299604.	227219.	2.	60.835
	160.00	45.206	241064.	7662.87	66.737	24.420	299158.	227163.	2.	60.835
	180.00	64.350	298376.	7921.95	70.041	25.310	288427.	226901.	0.	60.835
5)	186.88	71.233	316637.	8021.94	71.105	26.421	276279.	226877.	0.	60.835
	190.00	74.400	324666.	8071.34	71.569	26.587	274604.	226919.	0.	60.585
	200.00	84.782	349517.	8232.22	72.889	27.135	269228.	227063.	0.	51.185
	220.00	106.495	395865.	8572.97	75.105	28.206	258470.	226595.	0.	55.986
	240.00	129.562	437812.	8961.33	77.190	29.453	247713.	226765.	0.	59.133
	260.00	154.092	475468.	9395.32	79.107	30.819	236962.	226987.	0.	61.856
	280.00	180.203	508948.	9876.34	80.853	32.172	226209.	226196.	0.	64.213
	300.00	208.013	538390.	10405.17	82.426	33.871	215460.	226826.	0.	66.957
	320.00	237.654	563931.	10983.18	83.828	35.665	204715.	226927.	0.	69.628
	340.00	269.272	585731.	11615.33	85.073	37.605	193956.	226695.	0.	72.044
	360.00	303.020	603968.	12301.07	86.156	39.834	183209.	226830.	0.	74.554
	380.00	339.068	618846.	13046.84	87.090	42.255	172453.	226488.	0.	77.122
	400.00	377.600	630601.	13854.63	87.878	45.028	161708.	226314.	0.	79.584
	420.00	418.820	639509.	14733.19	88.529	48.349	150959.	226855.	0.	82.169
	440.00	462.967	645883.	15691.30	89.048	52.037	140196.	226752.	0.	84.673
	460.00	510.300	650101.	16734.11	89.439	56.159	129454.	225963.	0.	87.182
	477.00	553.249	652318.	17687.10	89.681	57.561	120438.	215472.	0.	89.191
	480.00	561.098	652597.	17855.16	89.718	57.215	118936.	211507.	0.	89.647
	500.00	615.466	653544.	18972.51	89.977	57.708	109452.	196317.	0.	92.717
	520.00	673.481	652999.	20152.63	90.158	61.956	100348.	193240.	0.	95.105
	540.00	735.419	651499.	21430.30	90.229	67.037	91393.	190427.	0.	97.521
	560.00	801.626	649733.	22832.07	90.202	74.254	82517.	190441.	0.	100.260
	580.00	872.576	648416.	24404.81	90.094	83.733	73597.	191542.	0.	104.780
6)	592.91	921.154	648009.	25528.13	90.006	90.667	67831.	191151.	0.	104.015
	600.00	948.530	647972.	25553.05	90.002	0.091	67637.	191.	0.	104.015
7)	603.11	960.514	647955.	25553.30	90.002	0.091	67635.	191.	0.	104.015

1) Physical Sep; 2) J-2 Eng. Start Com; 3) 90% J-2 Thrust; 4) Ullage Jettison; 5) Jettison LES; 6) CCS; 7) Orbit Insert.

TABLE 20 (Cont'd)
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	SPACE FIXED POSITION AND VELOCITY VECTORS			SPACE FIXED VELOCITY VECTORS			SPACE FIXED MAGNITUDE		
	X (FT)	Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)	RADIUS (FT)	VELOCITY (FT/S)	PATH ANGLE (DEG)
1) 147.26	403491.	21106736.	82712.	6939.21	3163.05	141.42	21110754.	7627.41	64.401
2) 148.58	412658.	21110887.	82899.	6939.37	3121.85	141.32	21115082.	7610.57	64.659
151.50	432905.	21119863.	83311.	6949.24	3036.21	141.06	21124463.	7584.88	65.225
3) 151.98	436263.	21121327.	83379.	6957.40	3025.64	140.99	21125996.	7588.13	65.314
155.00	457334.	21130358.	83803.	7010.53	2961.36	140.33	21135472.	7611.63	65.860
4) 159.18	486828.	21142569.	84388.	7090.60	2877.04	138.99	21148341.	7653.32	66.596
160.00	492621.	21144910.	84501.	7107.29	2861.23	138.73	21150816.	7662.87	66.737
180.00	638905.	21198286.	87216.	7523.22	2478.08	132.71	21208091.	7921.95	70.041
5) 186.88	691197.	21214899.	88122.	7669.27	2348.79	130.57	21226339.	8021.94	71.105
190.00	715201.	21222129.	88527.	7738.01	2291.95	129.50	21234361.	8071.34	71.569
200.00	793669.	21244183.	89827.	7951.80	2126.22	132.20	21259193.	8232.22	72.889
220.00	956839.	21283804.	92607.	8374.36	1828.78	146.61	21305502.	8572.97	75.105
240.00	1128819.	21317331.	95689.	8829.75	1521.45	161.75	21347412.	8961.33	77.190
260.00	1310218.	21344624.	99079.	9315.88	1206.18	177.33	21385029.	9395.32	79.107
280.00	1501676.	21365518.	102785.	9835.00	881.76	193.34	21418472.	9876.34	80.853
300.00	1703847.	21379826.	106815.	10388.67	546.85	209.78	21447878.	10405.17	82.426
320.00	1917458.	21387316.	111179.	10979.02	200.01	226.65	21473385.	10983.18	83.828
340.00	2143296.	21387717.	115885.	11611.63	-152.35	244.08	21495152.	11615.33	85.073
360.00	2382199.	21380718.	120945.	12286.38	-540.73	261.97	21513359.	12301.07	86.156
380.00	2635080.	21365958.	126368.	13010.00	-938.77	280.46	21528208.	13046.84	87.090
400.00	2902934.	21343020.	132167.	13784.57	-1359.02	299.54	21539939.	13854.63	87.878
420.00	3186856.	21311423.	138354.	14618.63	-1805.71	319.34	21548827.	14733.19	88.529
440.00	3488130.	21270589.	144945.	15520.57	-2283.29	339.93	21555185.	15691.30	89.048
460.00	3808158.	21219858.	151957.	16494.88	-2796.23	361.36	21559395.	16734.11	89.439
477.00	4096052.	21168381.	158260.	17378.94	-3265.19	380.11	21561610.	17687.10	89.681
480.00	4148421.	21158457.	159405.	17533.66	-3351.17	383.28	21561890.	17855.16	89.718
500.00	4509252.	21085421.	167275.	18549.71	-3962.49	403.71	21562845.	18972.51	89.977
520.00	4890722.	20995611.	175555.	19609.55	-4627.51	424.38	21562320.	20152.63	90.158
540.00	5294151.	20899960.	184253.	20747.53	-5347.83	445.56	21560851.	21430.30	90.229
560.00	5721283.	20785228.	193384.	21986.13	-6139.59	467.79	21559132.	22832.07	90.202
580.00	6174530.	20653721.	202977.	23364.67	-7031.73	491.79	21557880.	24404.81	90.094
6) 592.91	6482255.	20558782.	209435.	24339.49	-7682.13	509.52	21557527.	25528.13	90.006
600.00	6654861.	20503518.	213040.	24298.23	-7892.79	508.17	21557523.	25553.05	90.002
7) 603.11	6730273.	20478870.	214623.	24269.26	-7982.29	507.36	21557522.	25553.30	90.002

1) Physical Sep; 2) J-2 Eng. Start Com; 3) 90% J-2 Thrust; 4) Ullage Jettison; 5) Jettison LES; 6) CCS; 7) Orbit Insert.

TABLE 2C (Cont'd)
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE FLIGHT DATA

FLIGHT TIME (SEC)	EARTH FIXED POSITION			EARTH FIXED VELOCITY			POSITION (FT)	EARTH FIXED VELOCITY (FT/S)	EARTH POSITION (FT)	EARTH VELOCITY (FT/S)	PATH ANGLE (DEG)
	X (FT)	Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)					
1) 147.26	206156.	199973.	224.	5563.47	3243.36	12.11	287210.	6439.85	287210.	6439.85	59.219
2) 148.58	213506.	204231.	240.	5563.49	3203.21	12.56	295457.	6419.75	295457.	6419.75	59.509
3) 151.50	229739.	213448.	278.	5573.02	3120.00	13.58	313592.	6386.95	313592.	6386.95	60.155
4) 151.98	232432.	214952.	285.	5581.08	3109.89	13.76	316590.	6389.06	316590.	6389.06	60.262
5) 155.00	249350.	224242.	328.	5633.67	3048.56	14.65	335350.	6405.63	335350.	6405.63	60.924
6) 159.18	273082.	236826.	391.	5712.98	2968.46	15.52	361470.	6438.18	361470.	6438.18	61.824
7) 160.00	277750.	239242.	403.	5729.53	2953.48	15.70	366582.	6445.99	366582.	6445.99	61.997
8) 180.00	396448.	294675.	770.	6142.56	2591.81	21.08	493969.	6667.01	493969.	6667.01	66.071
9) 186.88	439233.	312098.	922.	6287.91	2470.32	23.12	538824.	6755.80	538824.	6755.80	67.386
10) 190.00	458933.	319713.	995.	6356.36	2417.10	24.00	559318.	6800.46	559318.	6800.46	67.961
11) 200.00	523580.	343077.	1272.	6569.20	2263.20	33.06	625971.	6948.21	625971.	6948.21	69.598
12) 220.00	659079.	385682.	2201.	6990.12	1990.59	60.87	763636.	7268.28	763636.	7268.28	72.351
13) 240.00	803367.	422711.	3712.	7445.06	1710.25	90.73	907798.	7639.51	907798.	7639.51	74.925
14) 260.00	957077.	454069.	5841.	7931.91	1424.27	122.45	1059344.	8059.70	1059344.	8059.70	77.274
15) 280.00	1120873.	479638.	8623.	8452.99	1131.64	156.11	1219215.	8529.83	1219215.	8529.83	79.393
16) 300.00	1295435.	499284.	12099.	9009.91	831.22	191.86	1388374.	9050.20	1388374.	9050.20	81.284
17) 320.00	1481514.	512831.	16311.	9604.87	521.80	229.80	1567847.	9621.78	1567847.	9621.78	82.951
18) 340.00	1679927.	520069.	21308.	10243.58	200.12	270.27	1758716.	10249.10	1758716.	10249.10	84.414
19) 360.00	1891544.	520754.	27139.	10926.00	-134.12	313.31	1962106.	10931.31	1962106.	10931.31	85.674
20) 380.00	2117307.	514599.	33860.	11658.99	-484.17	359.27	2179208.	11674.57	2179208.	11674.57	86.747
21) 400.00	2358250.	501268.	41531.	12444.80	-852.25	408.34	2411294.	12480.63	2411294.	12480.63	87.644
22) 420.00	2615506.	480367.	50217.	13292.16	-1242.10	460.95	2659726.	13358.03	2659726.	13358.03	88.378
23) 440.00	2890403.	451416.	59995.	14209.70	-1057.61	517.51	2926057.	14315.42	2926057.	14315.42	88.956
24) 460.00	3184391.	413866.	70946.	15202.18	-2102.75	578.36	3211956.	15357.81	3211956.	15357.81	89.388
25) 477.00	3450457.	374704.	81244.	16103.97	-2509.33	633.51	3471694.	16310.61	3471694.	16310.61	89.654
26) 480.00	3499006.	367065.	83159.	16262.06	-2584.04	643.28	3519189.	16478.64	3519189.	16478.64	89.695
27) 500.00	3834646.	310134.	96679.	17302.88	-3118.35	709.02	3848381.	17595.92	3848381.	17595.92	89.976
28) 520.00	4191458.	242021.	111546.	18391.28	-3700.86	778.48	4199921.	18776.09	4199921.	18776.09	90.169
29) 540.00	4570841.	161786.	127849.	19561.89	-4331.73	852.78	4575489.	20053.89	4575489.	20053.89	90.245
30) 560.00	4974626.	68337.	145697.	20837.98	-5025.81	933.22	4977228.	21455.80	4977228.	21455.80	90.215
31) 580.00	5405335.	-39834.	165233.	22260.23	-5810.01	1021.85	5408006.	23028.64	5408006.	23028.64	90.100
32) 592.91	5699015.	-118523.	178822.	23267.57	-6384.53	1085.25	5703051.	24152.01	5703051.	24152.01	90.006
33) 600.00	5864065.	-164506.	186565.	23239.89	-6574.92	1096.71	5869337.	24176.95	5869337.	24176.95	90.002
34) 603.11	5936199.	-185048.	189978.	23216.87	-6655.99	1101.27	5942120.	24177.22	5942120.	24177.22	90.002

1) Physical Sep; 2) J-2 Eng. Start Com; 3) 90% J-2 Thrust; 4) Ullage Jettison; 5) Jettison LES; 6) GCS; 7) Orbit Insert.

TABLE 2C (Cont'd)
AS-205 REVISED L/V REFERENCE TRAJECTORY
S-IVB STAGE FLIGHT DATA

	FLIGHT TIME (SEC)	RANGE (NM)	ALTITUDE (FT)	LONGITUDE (POS.WEST) (DEG)	GEODETIC LATITUDE (DEG)	GEOCENTRIC LATITUDE (DEG)
1)	147.26	33.62	200978.	79.930	28.592	28.430
2)	148.58	34.81	205308.	79.907	28.594	28.433
	151.50	37.44	214695.	79.858	28.599	28.438
3)	151.98	37.88	216229.	79.850	28.600	28.439
	155.00	40.61	225711.	79.798	28.605	28.444
4)	159.18	44.45	238587.	79.726	28.613	28.452
	160.00	45.21	241064.	79.712	28.614	28.453
	180.00	64.35	298376.	79.352	28.651	28.490
5)	186.88	71.23	316637.	79.222	28.664	28.502
	190.00	74.40	324666.	79.162	28.670	28.508
	200.00	84.78	349517.	78.967	28.689	28.527
	220.00	106.49	395865.	78.558	28.727	28.565
	240.00	129.56	437812.	78.122	28.764	28.602
	260.00	154.09	475468.	77.659	28.801	28.639
	280.00	180.20	508948.	77.165	28.837	28.674
	300.00	208.01	538390.	76.639	28.872	28.709
	320.00	237.65	563931.	76.077	28.905	28.743
	340.00	269.27	585731.	75.478	28.937	28.774
	360.00	303.02	603968.	74.837	28.966	28.804
	380.00	339.07	618846.	74.153	28.993	28.831
	400.00	377.60	630601.	73.421	29.017	28.854
	420.00	418.82	639509.	72.638	29.037	28.874
	440.00	462.97	645883.	71.798	29.051	28.888
	460.00	510.30	650101.	70.898	29.060	28.897
	477.00	553.25	652318.	70.081	29.061	28.898
	480.00	561.10	652597.	69.932	29.061	28.898
	500.00	615.47	653544.	68.898	29.053	28.890
	520.00	673.48	652999.	67.795	29.034	28.871
	540.00	735.42	651499.	66.618	29.003	28.841
	560.00	801.63	649733.	65.360	28.958	28.795
	580.00	872.58	648416.	64.015	28.895	28.732
6)	592.91	921.15	648009.	63.094	28.843	28.681
	600.00	948.53	647972.	62.576	28.811	28.649
7)	603.11	960.51	647955.	62.349	28.796	28.634

1) Physical Sep; 2) J-2 Eng. Start Com; 3) 90% J-2 Thrust; 4) Ullage Jettison; 5) Jettison LES;
6) GCS; 7) Orbit Insert.

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