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AS-202 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY

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ABSTRACT

This report presents the launch vehicle operational flight trajectory for the Saturn IB vehicle AS-202. Included is a discussion of the predicted trajectory, the mission objectives, and constraints, plus the associated dispersion study, and tracking summary.

A successful flight will place an Apollo spacecraft into a lob-type trajectory and will aid in determining the performance of the launch vehicle and spacecraft subsystems in preparation of manned orbital missions.

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AS-202 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY

SUMMARY

Vehicle AS-202, having a suborbital flight with planned recovery of its Command Module (CM), is scheduled for launch in the third quarter of 1966.

The S-IB boost phase uses a pre-set time tilt polynomial to produce a trajectory which closely simulates that defined for the operational manned earth orbital Saturn IB. The booster propels the vehicle to an altitude of 56.5 kilometers and a range of 57 kilometers. After separation, a single J-2 engine provides thrust to reach a velocity of 6800 m/sec at approximately 601.5 seconds after lift-off. The Iterative Guidance Mode (IGM) is employed to guide the S-IVB stage in the pitch and yaw planes, while the Auxiliary Propulsion System (APS) provides roll control. S-IVB cutoff signal occurs at an altitude of 217.3 km and a range of 1595.4 km.

Using the operational trajectory as a base, the three-sigma vehicle dispersion envelopes presented in this report were established by using the root-sum-square (RSS) technique.

SECTION I. INTRODUCTION

The launch vehicle operational flight trajectory for the Apollo/Saturn 202 mission, the third Saturn IB launch, is officially documented in this report. Also presented are the associated dispersion envelopes and the tracking data summary.

AS-202, comprising an S-IB stage, S-IVB stage, instrument unit (IU), and payload, is scheduled for launch from complex 34 at Cape Kennedy in 1966, and will maneuver from a 100-degree east-of-north launch azimuth to a 105-degree flight azimuth. The Command Module (CM) is scheduled for a water landing within acceptable recovery area. There are no planned alternate missions for AS-202.

Acknowledgements are made to G. Wittenstein, J. Weiler, and B. Brothers for their assistance and cooperation; also to Miss Jean Shelton for her contribution of the tracking portion.

SECTION II. MISSION DESCRIPTION

A. MISSION OBJECTIVES

The mission of the Apollo AS-202 is to demonstrate the compatibility between the Saturn IB launch vehicle and spacecraft, and to determine the performance of the launch vehicle and spacecraft subsystems in preparation for manned orbital missions.

The planned mission profile and support plans reflect the requirements of the following primary objectives: (1) To demonstrate structural integrity of the launch vehicle and spacecraft and confirm launch loads; (2) to evaluate separation sequencing system; (3) to verify operation of propulsion, guidance and control, and electrical systems; (4) to flight test the Emergency Detection System (EDS) in closed-loop configuration; (5) to evaluate the thermal performance of the Command Module (CM) heat shield ablator during a high-heat load, long duration entry, and (6) to demonstrate the mission support facilities required for launch mission operations and CM recovery. For more detailed information on the AS-202 mission, see Reference 1.

B. MISSION CONSTRAINTS

Certain mission constraints affecting the launch vehicle trajectory shaping and establishment of the S-IVB terminal conditions have been considered: (1) The first stage trajectory will closely simulate the first stage history of the nominal Apollo-Saturn IB orbital mission. (2) The space vehicle will have a launch azimuth of 100 degrees. (3) Guidance and steering command rates are limited to one degree per second in pitch, yaw, and roll with a lapse of 10 seconds following lift-off before initiation of maneuvers. (4) Tilt arrest will be initiated before inboard engine cutoff and will be maintained until guidance initiation which occurs after Launch Escape System (LES) jettison. (5) The S-IVB stage propellant loading will be greater than 98,430 kgs (217,000 lbm). (6) S-IVB programmed mixture ratio (PMR) shift is to provide a high step (5.5) duration of 295 seconds. (7) A minimum of 10 seconds between S-IVB cutoff signal and S-IVB/CSM separation is required.

SECTION III. VEHICLE CHARACTERISTICS

A. CONFIGURATION

The launch vehicle, consisting of four major vehicle assemblies, the S-IB stage, S-IVB stage, IU, and payload, is shown in figure 1. A weight breakdown is given in appendix A.

The S-IB booster stage of the multistage Saturn IB vehicle develops the thrust necessary for the vehicle to achieve the altitude and velocity required by the upper stages to perform the mission and accomplish objectives. Eight H-1 engines, uprated to 890,000 Newtons (200,000 lbf), supplied by four each LOX and fuel (RP-1) containers clustered around a center LOX container, are mounted in a square pattern. Four fixed inboard mounts cant the engines three degrees while the four outboard engines are canted six degrees radially outward from the vertical axis of the vehicle and gimbal ±8 degrees to provide thrust vector control for trajectory guidance. The total stage thrust is nominally rated at 7,100,000 Newtons (1,600,000 lbf).

The S-IVB stage is powered by a single J-2 engine installed on the centerline of the stage and having rated thrust of 890,000 Newtons (200,000 lbf). Pitch and yaw control during powered flight is maintained by deflection of this engine. Roll control is achieved by the Auxiliary Propulsion System (APS) consisting of two modules, each having three engines of 670 Newtons (150 lbf) thrust.

The Instrument Unit (IU) houses the ST-124-M-III inertial platform, the Launch Vehicle Digital Computer (LVDC), and the electrical equipment required for launch vehicle performance; and is the second flight prototype of the Saturn IB/V Instrument Unit.

Apollo spacecraft 011, as the AS-202 payload, consists of the Launch Escape System (LES), Command Module (CM), Service Module (SM), and a Spacecraft-Lunar Excursion Module (LEM) adapter (SLA). Although the mission is unmanned, the systems are designed to be controlled or monitored by astronauts. The crew compartment is a three-man pressurized cabin containing spacecraft controls and displays, observation windows, access hatches, and environmental controls.

Reference 2 contains more detailed information on the vehicle configuration.

B. MASS

Shown in Appendix A are the mass characteristics used to generate the AS-202 launch vehicle operational flight trajectory. These data were extracted from reference 3.

C. PROPULSION

The propulsion characteristics used to generate the data presented in this report were obtained from references 4 and 5. Plots of thrust, flow rates, and specific impulse for both flight stages will be published at a later date for flight evaluation purposes.

D. GUIDANCE

The inertial Saturn IB guidance system performs navigation evaluations, issues discrete commands, initiates certain guidance and control functions, and issues steering commands to guide the launch vehicle to the pre-specified terminal conditions. These functions are accomplished by means of the AS-202 Flight Program which is stored in the Launch Vehicle Digital Computer (LVDC) (see reference 6). Inputs to the LVDC for navigation and guidance evaluations are the pre-specified constants for the S-IB stage and S-IVB guidance modes (see reference 7), and the inertial accelerations, i.e., velocity increments, sensed by the ST-124-M-III stabilized platform accelerometers during powered flight.

The navigation subroutine which is in the LVDC Flight Program combines gravitational acceleration evaluations with the inertial platform data to compute the position and velocity vectors with respect to an earth-centered, inertial coordinate system. The state variables as determined by the LVDC navigation subroutine are then used by the LVDC guidance subroutine to compute attitude commands.

The LVDC guidance system subroutine calculates the vehicle attitude commands in the Euler Angle System (χ_x, χ_y, χ_z). The commanded attitude angles are compared with the ST-124-M-III gimbal angles (θ_x, θ_y, θ_z) which represent the vehicle's attitude. The attitude error angles are then utilized by the control computer to calculate motor swivel commands.

S-IB stage guidance consists of a three-segment time function polynomial in the pitch plane of the form:

$$\chi_p (T) = \sum_{i=o}^{3} A_i T^i .$$

The above polynomial is evaluated approximately every .9 seconds, which is the major loop computation cycle of the LVDC during S-IB operation until active guidance.

S-IVB stage guidance is the Iterative Guidance Mode (IGM) for two flight stages. For more information on the IGM formulation for AS-202, see Reference 8. The targeting constants and pre-settings for the AS-202 mission are found in Appendix B.

SECTION IV. TRAJECTORY DESCRIPTION

A. POWERED PORTION

Shown in table 1 is the nominal sequence of events for AS-202, and in table 2, a trajectory and orbit fact sheet. Table 3 gives some significant parameters for certain events. The above tables serve as a summary of the following description.

Guidance Reference Release (GRR) signal occurs approximately five seconds before launch commit, at which time the LVDC begins its computations and the platform becomes inertial. Vehicle first motion occurs approximately 0.2 seconds before Instrument Unit (IU) umbilical disconnect. At the moment of IU umbilical disconnect, time base one (T_{B1}) is initiated. The launch vehicle will rise vertically for 10.2 seconds in order to clear the launch facilities, and will then simultaneously begin its pitch program and roll maneuver.

S-IB stage shaping was constrained to be characteristic of the operational Saturn IB orbital mission. In addition to this, the pitch program was shaped to minimize aerodynamic moments during the period of highest pressure. The tilt program was not biased for wind as the expected launch date occurs during a low-wind period. A tilt arrest of 60 degrees is programmed at 136 seconds after lift-off to insure ample damping time for various sequences. The first stage tilt program is shown in figure 2, along with the nominal S-IVB stage commanded attitude history.

AS-202 is the second IB flight utilizing the three-second time differential between inboard engine cutoff (IECO) and outboard engine cutoff (OECO) selected after coordination with interested laboratories (reference 9) as the optimum solution to performance penalties imposed by the six-second carry-over from the Saturn I vehicles. IECO and OECO are predicted to occur at 140.87 and 143.87 seconds after first motion.

Approximately 3.8 seconds are required for J-2 engine thrust buildup. This portion of the trajectory also includes ullage rocket burn for propellant seating after separation.

S-IVB mainstage operation begins when the J-2 thrust level reaches 90 percent of its nominal value. Tilt arrest, which began 136 seconds after lift-off, is continued until 172.75 seconds, allowing sufficient time for the LES tower and ullage rocket casings to be jettisoned. The Saturn guidance system, the Iterative Guidance Mode (IGM), is implemented at this time to guide the vehicle to desired terminal conditions.

This is the second flight utilizing a Programmed Mixture Ratio (PMR) shift to increase performance capability by shifting power levels. The Propellant Utilization (PU) system provides in-flight propellant mass history and signals for the fuel tank pressure step and depletion logic.

At PU activation (6.8 seconds after J-2 ignition), the system senses the LOX overload and commands the engine to burn at the high engine mixture ratio of 5.5:1. Flight of the S-IVB stage will continue at the high mixture ratio until the measured LOX error is removed. The mixture ratio shift for this trajectory is expected to occur at 450 seconds of flight time. The PU system will then command the engine to burn at the reference mixture ratio (RMR) of 4.7, striving for simultaneous depletion of LOX and LH_2 for maximum stage performance.

The IGM will steer the vehicle in its normal mode until approximately 46 seconds before expected S-IVB cutoff. At this time, the $\tilde{\chi}$ mode is entered, and IGM thereafter enforces only the velocity vector end conditions. This serves to desensitize the guidance system to any large oscillations in thrust and flow rates. To avoid any slosh guidance interaction, a digital filter for F/m has been implemented for AS-202, replacing the digital filter for the AS-201 (see reference 10). Until the time of $\tilde{\chi}$ mode, navigation and guidance calculations were being made on the average of every 1.7 seconds. Due to reduction in the number of computations performed by the LVDC, at this time, the computation cycle is reduced to every 1.4 seconds until cutoff.

Guidance Cutoff Signal (GCS) is sent by the LVDC when the inertial velocity reaches 6800 m/sec. Actual cutoff time is solved by a velocity and time function polynomial for the desired cutoff velocity.

The conditions at Guidance Cutoff Signal are time - 601.55 sec; space-fixed velocity - 6799.63 m/sec; space-fixed path angle - 86.004 deg.

Shown in figures 3 through 9 is a graphical display of the AS-202 trajectory.

B. BALLISTIC PORTION

Retro-rockets are ignited at separation of the S-IB/S-IVB to decelerate the S-IB stage. This portion of the trajectory, with subsequent ballistic flight to impact, is presented in tables 15 through 18. Two motion picture cameras, recording S-IB/S-IVB separation, S-IVB ullage burn, and J-2 engine ignition are ejected from the S-IB stage after separation. The S-IB and camera capsule impact footprint is presented in figure 10. The nominal camera capsule trajectory is presented in table 23.

Following S-IVB Guidance Cutoff Signal, there is a 10-second coast, after which the CSM is separated from the S-IVB stage. The S-IVB coast trajectory is presented in tables 19 through 22 with impact footprint in figure 11.

SECTION V. DISPERSION ANALYSIS

A. THREE-SIGMA DISPERSION ANALYSIS

Since a deviation from the mean is statistically probable, it is necessary to determine, within reasonable limits, a vehicle envelope which will describe the flight of AS-202. Off-nominal trajectories were developed by introducing perturbations of a $\pm 3\sigma$ magnitude into the nominal profile. Propulsion and nonpropulsion perturbations were considered for each stage of the launch vehicle. Individual perturbations are considered to be independent and are assumed to exhibit a normal (Gaussian) distribution and have equal probabilities of occurrence.

In determining the dispersed flight corridor, the effects of each of the off-nominal parameters on significant trajectory variables were determined. The root-sum-square (RSS) technique was then used to determine probable plus and minus variations as a function of time for each of the variables considered. This technique accumulates the various perturbation effects by squaring each resulting parameteric dispersion and extracting the square root. Thus,

$$\Delta \text{ parameter} = \left|\text{Perturbed Parameter}\right| - \left|\text{Nominal Parameter}\right|$$

$$+\text{RSS} = \sqrt{(+\Delta P)^2}$$

$$-\text{RSS} = \sqrt{(-\Delta P)^2} \ .$$

The error sources considered are presented in Appendix C. The

detailed results of this analysis are presented in tables 24 through 39. S-IB dispersions, both propulsive and nonpropulsive, are shown in tables 24 through 27 at outboard engine cutoff with the total envelope presented in tables 28 and 29. Tables 30 through 33 give the nominal parameters with dispersion deltas at Guidance Cutoff Signal (GCS) due to S-IB stage errors. S-IVB perturbations are given in tables 34 through 37. A total vehicle envelope at GCS is shown in tables 38 and 39. Dispersions due to platform tolerances are not presented here, but will be presented at a later date. Actual measured platform alignments and gyro drifts were used in generating the nominal trajectory.

The predicted three-sigma envelope shown in tables 38 and 39 is applicable at S-IVB/CSM separation except for velocity due to thrust decay uncertainties. The revised velocity envelope at S-IVB/CSM separation is ±.65 m/sec.

Significant results at Guidance Cutoff Signal are as follows:

Time	=	+19.8 sec, -18.5 sec
Radius Vector Magnitude	=	+263 meters, -103 meters
Space-Fixed Path Angle	=	-.002 deg.

Flight Performance Reserve (FPR) = 1650 lbm.

An FPR of 1650 lbm is necessary to achieve the mission under three-sigma considerations, and is within the performance capability of the AS-202 launch vehicle.

A special note needs to be made on the results of the ±LOX and ±Fuel (LH_2) cases for the S-IVB stage. These cases cause shifts in the time that the PU value will come off the stop. As was mentioned earlier, the primary reason for a Planned Mixture Ratio step is for performance purposes; however, for AS-202, the nominal step time is non-optimum; hence, a gain in residual appears in the results of the -fuel and +LOX cases. The associated loss in nominal useable residual is approximately 68 kg (150 lbm).

For a quick-look analysis, a group of selected partials are given in tables 40 and 41, which are applicable at outboard engine cutoff and GCS, respectively.

B. OTHER DISPERSIONS

Control engine-out capability is almost nonexistent for a minus three-sigma performing vehicle; however, analysis reveals capability

in this case from approximately 130 seconds after first motion. There is less than a 50 percent probability of a successful mission if a control engine fails earlier than 90 seconds of flight time. The above results are based solely on performance capability.

SECTION VI. TRACKING ANALYSIS

This section presents the expected coverage of the AS-202 mission from primary tracking and telemetry sites. Tracking coverage will be provided by C-band radars, ODOP uprange, GLOTRAC, and close-in optical systems.

A map defining the vehicle ground trace and the coverage redundancy above an elevation of five degrees is shown in figure 8. Coverage will be available from at least three stations through S-IVB cutoff.

A detailed assessment of the visibility of the vehicle to each ground station scheduled to receive telemetry and track the onboard electronic systems is given in figures 12 through 17. Elevation angles and slant range histories are shown from lift-off through S-IVB impact. Antigua, the last ground site to receive data from the vehicle before impact, will track the S-IVB to a flight time of approximately 910 seconds.

TABLE 1

SEQUENCE OF EVENTS

NOMINAL TIME FROM FIRST MOTION (MIN:SEC)	NOMINAL TIME FROM FIRST MOTION (SEC)	PROGRAM TIME REFERENCE (SEC)	PREDICTED SEQUENCE
-0:05.0	-5.0		GUIDANCE REFERENCE RELEASE (STABILIZED PLATFORM BECOMES INERTIAL)
-0:03.1	-3.1		S-IB MAINSTAGE IGNITION SEQUENCE BEGINS
0:00.0	0.0		FIRST MOTION
0:00.2	0.2	$(0.0)_1$	LIFT-OFF SIGNAL, START TIME BASE #1
0:10.2	10.2		PITCH AND ROLL MANEUVER INITIATED
0:15.2	15.2		ROLL MANEUVER TO OBTAIN 105° FLIGHT AZIMUTH COMPLETED
1:05.0	65.0		MACH NUMBER = 1.0
1:19.0	79.0		MAXIMUM DYNAMIC PRESSURE
2:15.87	135.87	$(135.67)_1$	ENABLE S-IB PROPELLANT LEVEL SENSORS
2:15.9	135.90		PITCH TILT ARREST
2:17.87	137.87	$(0.0)_2$	S-IB PROPELLANT LEVEL SENSOR ACTIVATION, APPROXIMATE START OF TIME BASE #2
2:20.87	140.87	$(3.0)_2$	INBOARD ENGINE CUTOFF
2:21.75	141.67	$(3.8)_2$	START SEPARATION CAMERAS
2:23.87	143.87	$(0.0)_3$	OUTBOARD ENGINE CUTOFF, APPROXIMATE START OF TIME BASE #3
2:24.47	144.47	$(0.6)_3$	ULLAGE ROCKET IGNITION
2:24.67	144.67	$(0.8)_3$	SEPARATION SIGNAL & COMMAND RETRO-ROCKET IGNITION
2:24.75	144.75		SEPARATION STRUCTURE COMPLETELY SEVERED
2:26.15	146.15		S-IVB ENGINE START COMMAND
2:26.37	146.37		END OF S-IB THRUST DECAY
2:28.42	148.42		ULLAGE ROCKET THRUST TERMINATION

TABLE 1 (CONT)

NOMINAL TIME FROM FIRST MOTION (MIN:SEC)	NOMINAL TIME FROM FIRST MOTION (SEC)	PROGRAM TIME REFERENCE (SEC)	PREDICTED SEQUENCE
2:29.47	149.57	$(11.7)_2$	I.U. WILL ISSUE OUTBOARD CUTOFF AND START TIME BASE #3 IF THESE EVENTS DO NOT OCCUR BY TIME BASE #2 + 11.7 SEC
2:29.95	149.95		S-IVB MAINSTAGE 90 PERCENT THRUST LEVEL
2:32.95	152.95		ACTIVATE PROPELLANT UTILIZATION SYSTEM
2:36.67	156.67		JETTISON ULLAGE ROCKET MOTORS
2:49.75	169.75		CAMERA CAPSULE EJECTED FROM SEPARATED S-IB STAGE
2:50.00	170.00		JETTISON LAUNCH ESCAPE SYSTEM
2:52.75	172.75	$(28.88)_3$	INITIATE ACTIVE GUIDANCE
7:29.95	449.95		PROPELLANT UTILIZATION VALVE LEAVES HARD-OVER POSITION, BEGINNING OF PMR SHIFT
7:50.25	470.25		ITERATIVE GUIDANCE MODE NOMINAL SHIFT TIME
8:17.8	507.78		NOMINAL S-IB BALLISTIC IMPACT
10:01.55	601.55	$(457.68)_3$	S-IVB GUIDANCE CUTOFF SIGNAL
10:01.79	601.79	$(0.0)_4$	DEACTUATION OF S-IVB THRUST OK PRESSURE SWITCHES; START TIME BASE #4
10:03.4	603.41		END OF S-IVB THRUST DECAY
10:10.09	610.09	$(8.3)_4$	START S-IVB/CSM SEPARATION SEQUENCE (SIGNAL SENT TO CSM) START RCS ULLAGE
10:11.55	611.55		INSERTION
10:11.79	611.79	$(10.0)_4$	SIGNAL FROM MCP TO FIRE SEPARATION SQUIBS
25:21.1	1521.07		NOMINAL S-IVB BALLISTIC IMPACT

TABLE 2

AS-202 TRAJECTORY AND ORBIT FACT SHEET

A. LAUNCH

Launch Complex and Pad	34
Latitude	28.521958 (deg)
Longitude (west)	80.561142 (deg)
Launch Azimuth	100 (deg)
Flight Azimuth	105 (deg)

B. TRAJECTORY HISTORY*

First Stage

S-IB Stage Pitch Tilt Initiation	10.2 (sec)
S-IB Stage Roll Tilt Termination	15.2 (sec)
S-IB Stage Roll Angle	5.0 (deg)
S-IB Stage Mach One	65 (sec)
S-IB Stage Maximum Dynamic Pressure	79 (sec)
S-IB Stage Pitch Tilt Arrest	136 (sec)
S-IB Low Level Sensed	137.87 (sec)
S-IB Stage Pitch Angle at Tilt Arrest	60.00 (deg)
S-IB Stage Inboard Engine Cutoff (IECO)	140.87 (sec)
S-IB Stage Outboard Engine Cutoff (OECO)	143.87 (sec)
S-IB Stage Velocity at OECO (Space Fixed) (Earth Fixed)	2209.53 (m/sec) 1855.41 (m/sec)
S-IB Stage Path Angle at OECO (Space Fixed) (Earth Fixed)	64.46 (deg) 59.11 (deg)

TABLE 2 (CONT)

S-IB Stage Altitude at OECO	55.63 (km)
S-IB Stage Range at OECO	55.68 (km)
S-IB/S-IVB Separation	
Ullage Ignition (S-IVB Stage)	144.55 (sec)
S-IB/S-IVB Separation Signal	144.75 (sec)
Retro-Rocket Ignition (S-IB Stage)	144.75 (sec)
Second Stage	
S-IVB Stage (Main) Ignition Command	146.15 (sec)
S-IVB Stage Ullage Rocket Cutoff	148.42 (sec)
S-IVB Stage 90% Thrust Attained	149.95 (sec)
S-IVB Stage Launch Escape System Jettisoned	170.00 (sec)
S-IVB Stage Guidance Initiation	172.75 (sec)
S-IVB Stage Guidance Cutoff Signal (GCS)	601.55 (sec)
S-IVB Stage Velocity at GCS	6799.63 (m/sec)
S-IVB Stage Path Angle at GCS	86.0036 (deg)
S-IVB Stage Altitude at GCS	217.31 (km)
S-IVB Stage Range At GCS	1595.40 (km)
S-IVB Stage Latitude at GCS (Geodetic)	23.6487 (deg)
S-IVB Stage Longitude at GCS	65.5384 (deg)
C. INSERTION CONDITIONS (S-IVB/CSM SEPARATION)	
Time	611.55 (sec)
Space-Fixed Velocity	6798.73 (m/sec)
Path Angle of Velocity Vector (Against Local Vertical)	86.1678 (deg)

TABLE 2 (CONT)

Altitude (Oblate Earth)	221.91 (km)
Ground Range	1657.06 (km)
Geodetic Latitude (north)	23.4258 (deg)
Longitude (west)	64.9850 (deg)
Azimuth of Velocity Vector (Positive East from North)	112.2241 (deg)

D. IMPACT DATA

S-IB Stage

Time	507.78 (sec)
Latitude (Geodetic)	27.4103 (deg)
Longitude	76.3436 (deg)

S-IVB Stage

Time	1521.07 (sec)
Latitude (Geodetic)	4.7609 (deg)
Longitude	31.4236 (deg)

*All values are space fixed where applicable unless otherwise noted. Times are referenced to First Motion.

TABLE 3

SIGNIFICANT PARAMETERS AT SELECTED EVENTS

Parameter \ Event	LIFT-OFF	OUTBOARD ENGINE CUTOFF	GUIDANCE INITIATION	GUIDANCE CUTOFF SIGNAL
TIME (SEC)	0.0	143.87	172.75	601.55
ALTITUDE (M)	32.0	55629.3	80428.3	217311.8
RANGE (M)	0.0	55636.9	102716.5	1595396.6
RADIUS (M)	6373353.5	6428991.6	6453825.7	6592060.6
VELOCITY (M/S) (Space-Fixed)	408.97	2209.52	2269.64	6799.63
PATH ANGLE (DEG) (Space-Fixed)	90.0	64.459	69.842	86.004
MASS (KGS)	595226.	193546.	133780.	36844.8
CHI (PITCH) (DEG)*	0.0	60.0	60.0	80.709
ATTITUDE (DEG)**	.0177	-60.098	-60.211	-81.104
DYNAMIC PRESSURE (N/M^2)	0.0	985.343	33.019	.000

*Measured positive nose downrange from space-fixed vertical at launch.

**Measured negative nose downrange from space-fixed vertical at launch.

TABLE 4

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	ALTITUDE (M)	RADIUS (M)	SPACE-FIXED PATH-ANGLE (DEG)	SPACE FIXED VELOCITY (M/S)	SPACE FIXED AZIMUTH (DEG)
	0.00	00:00.0	32.	6373354.	90.000	408.97	90.00
	5.00	00:05.0	59.	6373381.	88.642	409.15	89.98
	10.00	00:10.0	147.	6373468.	86.777	409.72	89.97
	14.00	00:14.0	266.	6373587.	85.016	410.63	89.95
	19.00	00:19.0	484.	6373805.	83.057	412.70	89.95
	24.00	00:24.0	789.	6374110.	80.493	416.51	89.97
	29.00	00:29.0	1189.	6374510.	77.734	422.68	90.05
	34.00	00:34.0	1695.	6375017.	75.301	432.12	90.19
	39.00	00:39.0	2320.	6375641.	72.330	445.59	90.41
	44.00	00:44.0	3072.	6376394.	69.433	463.90	90.75
	49.00	00:49.0	3963.	6377284.	66.734	487.61	91.23
	54.00	00:54.0	5001.	6378323.	64.710	517.07	91.75
	59.00	00:59.0	6196.	6379518.	62.620	552.41	92.39
	64.00	01:04.0	7554.	6380876.	61.000	593.04	93.19
	69.00	01:09.0	9070.	6382393.	60.107	637.38	93.83
	74.00	01:14.0	10745.	6384068.	59.333	688.26	94.59
	79.00	01:19.0	12590.	6385914.	58.818	746.56	95.38
	84.00	01:24.0	14614.	6387939.	58.567	812.39	96.16
	87.00	01:27.0	15919.	6389245.	58.527	855.65	96.62
	89.00	01:29.0	16828.	6390154.	58.530	886.05	96.92
	94.00	01:34.0	19240.	6392568.	58.640	967.44	97.63
	99.00	01:39.0	21860.	6395190.	58.911	1056.83	98.30
	104.00	01:44.0	24695.	6398026.	59.246	1154.28	98.92
	109.00	01:49.0	27749.	6401083.	59.743	1259.92	99.49
	114.00	01:54.0	31031.	6404367.	60.319	1374.15	100.00
	119.00	01:59.0	34544.	6407884.	60.954	1497.35	100.47
	124.00	02:04.0	38296.	6411639.	61.521	1630.07	100.89
	129.00	02:09.0	42291.	6415638.	62.238	1772.99	101.26
	134.00	02:14.0	46534.	6419886.	62.981	1926.87	101.60
	139.00	02:19.0	51031.	6424388.	63.621	2092.62	101.92
	143.06	02:23.1	54856.	6428218.	64.266	2196.94	102.11
(1)	143.87	02:23.9	55629.3	6428992.	64.459	2209.53	102.14
(2)	144.75	02:24.8	56463.6	6429827.	64.631	2210.25	102.16

(1) Outboard Engine Cutoff
(2) Separation

TABLE 4 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	ALTITUDE (M)	RADIUS (M)	SPACE-FIXED PATH-ANGLE (DEG)	SPACE FIXED VELOCITY (M/S)	SPACE FIXED AZIMUTH (DEG)
	144.75	02:24.8	56464.	6429827.	64.565	2210.25	102.16
	145.00	02:25.0	56701.	6430064.	64.684	2209.28	102.16
	146.00	02:26.0	57640.	6431005.	64.892	2205.41	102.17
	147.00	02:27.0	58570.	6431936.	65.100	2201.58	102.18
	148.00	02:28.0	59492.	6432859.	65.309	2197.83	102.19
	149.00	02:29.0	60405.	6433773.	65.513	2195.53	102.20
(3)	149.95	02:30.0	61269.	6434638.	65.139	2196.15	102.22

(3) J-2 90% thrust

TABLE 4 (CONT'D)

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	ALTITUDE (M)	RADIUS (M)	SPACE-FIXED PATH-ANGLE (DEG)	SPACE FIXED VELOCITY (M/S)	SPACE FIXED AZIMUTH (DEG)
	149.95	02:30.0	61269.	6434638.	65.139	2196.15	102.22
	160.00	02:40.0	70053.	6443434.	67.347	2223.66	102.38
	170.00	02:50.0	78262.	6451656.	69.235	2258.78	102.54
(4)	172.75	02:52.8	80428.	6453826.	69.842	2269.64	102.58
	179.00	02:59.0	85213.	6458619.	70.714	2295.02	102.69
	189.00	03:09.0	92525.	6465944.	72.124	2334.66	102.87
	199.00	03:19.0	99487.	6472919.	73.351	2375.55	103.06
	209.00	03:29.0	106113.	6479560.	74.341	2419.58	103.28
	219.00	03:39.0	112409.	6485871.	75.493	2466.79	103.49
	229.00	03:49.0	118378.	6491856.	76.597	2517.16	103.71
	239.00	03:59.0	124029.	6497523.	77.480	2570.64	103.92
	249.00	04:09.0	129365.	6502876.	78.496	2627.23	104.13
	259.00	04:19.0	134394.	6507922.	79.460	2686.92	104.34
	269.00	04:29.0	139123.	6512669.	80.373	2749.73	104.55
	279.00	04:39.0	143558.	6517123.	81.095	2815.64	104.76
	289.00	04:49.0	147709.	6521293.	81.913	2884.77	104.97
	299.00	04:59.0	151584.	6525188.	82.679	2957.13	105.18
	309.00	05:09.0	155191.	6528816.	83.280	3032.75	105.39
	319.00	05:19.0	158539.	6532187.	83.954	3111.56	105.59
	329.00	05:29.0	161640.	6535310.	84.576	3193.68	105.80
	339.00	05:39.0	164505.	6538199.	85.148	3279.23	106.01
	349.00	05:49.0	167146.	6540864.	85.587	3368.24	106.22
	359.00	05:59.0	169575.	6543318.	86.071	3460.71	106.43
	369.00	06:09.0	171805.	6545575.	86.505	3556.66	106.64
	379.00	06:19.0	173853.	6547651.	86.829	3656.25	106.85
	389.00	06:29.0	175736.	6549562.	87.175	3759.75	107.07
	399.00	06:39.0	177470.	6551326.	87.474	3867.24	107.28
	409.00	06:49.0	179075.	6552961.	87.729	3978.81	107.50
	419.00	06:59.0	180571.	6554489.	87.905	4094.58	107.71
	429.00	07:09.0	181982.	6555933.	88.076	4214.81	107.93
	439.00	07:19.0	183331.	6557316.	88.201	4339.76	108.15
	449.00	07:29.0	184645.	6558666.	88.271	4469.71	108.37
	460.00	07:40.0	186085.	6560147.	88.320	4618.31	108.62
	470.00	07:50.0	187420.	6561520.	88.325	4756.33	108.84
	480.00	08:00.0	188780.	6562920.	88.349	4889.05	109.07
	490.00	08:10.0	190155.	6564337.	88.371	5019.95	109.30
	500.00	08:20.0	191567.	6565792.	88.346	5153.14	109.52
	510.00	08:30.0	193059.	6567328.	88.296	5290.47	109.75
	520.00	08:40.0	194651.	6568966.	88.215	5432.52	109.98
	530.00	08:50.0	196379.	6570742.	88.100	5579.06	110.22

(4) Initiate Active Guidance

TABLE 4 (CONT'D)

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	ALTITUDE (M)	RADIUS (M)	SPACE-FIXED PATH-ANGLE (DEG)	SPACE FIXED VELOCITY (M/S)	SPACE FIXED AZIMUTH (DEG)
	540.00	09:00.0	198279.	6572689.	87.979	5730.84	110.46
	550.00	09:10.0	200392.	6574853.	87.794	5888.45	110.70
	560.00	09:20.0	202780.	6577293.	87.560	6051.73	110.94
	570.00	09:30.0	205516.	6580083.	87.288	6220.93	111.19
	580.00	09:40.0	208675.	6583298.	86.916	6397.38	111.44
	590.00	09:50.0	212341.	6587021.	86.540	6580.87	111.69
	600.00	10:00.0	216595.	6591335.	86.122	6769.96	111.95
(5)	601.55	10:01.6	217312.	6592061.	86.004	6799.63	111.99
	611.55	10:11.6	221906.	6596716.	86.168	6798.73	112.24

(5) S-IVB Guidance cutoff signal (GCS)

TABLE 5

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	ALTITUDE (FT)	RADIUS (FT)	SPACE-FIXED PATH-ANGLE (DEG)	SPACE FIXED VELOCITY (FT/S)	SPACE FIXED AZIMUTH (DEG)
	0.00	00:00.0	105.	20909953.	90.000	1341.76	90.00
	5.00	00:05.0	194.	20910042.	88.642	1342.34	89.98
	10.00	00:10.0	481.	20910329.	86.777	1344.22	89.97
	14.00	00:14.0	871.	20910719.	85.016	1347.20	89.95
	19.00	00:19.0	1588.	20911436.	83.057	1354.01	89.95
	24.00	00:24.0	2587.	20912435.	80.493	1366.51	89.97
	29.00	00:29.0	3900.	20913748.	77.734	1386.75	90.05
	34.00	00:34.0	5562.	20915410.	75.301	1417.73	90.19
	39.00	00:39.0	7611.	20917459.	72.330	1461.91	90.41
	44.00	00:44.0	10079.	20919928.	69.433	1521.99	90.75
	49.00	00:49.0	13001.	20922850.	66.734	1599.79	91.25
	54.00	00:54.0	16408.	20926257.	64.710	1696.41	91.75
	59.00	00:59.0	20329.	20930179.	62.620	1812.38	92.39
	64.00	01:04.0	24783.	20934634.	61.000	1945.67	93.09
	69.00	01:09.0	29757.	20939610.	60.107	2091.13	93.83
	74.00	01:14.0	35253.	20945107.	59.333	2258.07	94.59
	79.00	01:19.0	41304.	20951161.	58.818	2449.34	95.38
	84.00	01:24.0	47946.	20957806.	58.567	2665.32	96.16
	87.00	01:27.0	52227.	20962090.	58.527	2807.24	96.62
	89.00	01:29.0	55209.	20965073.	58.530	2906.98	96.92
	94.00	01:34.0	63124.	20972992.	58.640	3174.01	97.63
	99.00	01:39.0	71720.	20981594.	58.911	3467.28	98.30
	104.00	01:44.0	81019.	20990900.	59.246	3787.00	98.92
	109.00	01:49.0	91041.	21000930.	59.743	4133.60	99.49
	114.00	01:54.0	101807.	21011704.	60.319	4508.35	100.00
	119.00	01:59.0	113335.	21023242.	60.954	4912.56	100.47
	124.00	02:04.0	125643.	21035562.	61.521	5348.01	100.89
	129.00	02:09.0	138749.	21048681.	62.238	5816.90	101.26
	134.00	02:14.0	152671.	21062618.	62.981	6321.74	101.60
	139.00	02:19.0	167425.	21077389.	63.621	6865.56	101.92
	143.06	02:23.1	179975.	21089954.	64.266	7207.81	102.11
(1)	143.87	02:23.9	182511.	21092494.	64.459	7249.11	102.14
(2)	144.75	02:24.8	185248.	21095234.	64.631	7251.48	102.16

(1) Outboard Engine Cutoff
(2) Separation

TABLE 5 (CONT'D)

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	ALTITUDE (FT)	RADIUS (FT)	SPACE-FIXED PATH-ANGLE (DEG)	SPACE FIXED VELOCITY (FT/S)	SPACE FIXED AZIMUTH (DEG)
	144.75	02:24.8	185248.	21095233.	64.565	7251.49	102.16
	145.00	02:25.0	186026.	21096012.	64.684	7248.29	102.16
	146.00	02:26.0	189108.	21099098.	64.892	7235.61	102.17
	147.00	02:27.0	192160.	21102154.	65.100	7223.03	102.18
	148.00	02:28.0	195183.	21105181.	65.309	7210.72	102.19
	149.00	02:29.0	198178.	21108180.	65.513	7203.17	102.20
(3)	149.95	02:30.0	201014.	21111019.	65.139	7205.22	102.22

(3) J-2 90% Thrust

TABLE 5 (CONT'D)

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PARAMETERS

TIME (SEC)	TIME (MIN:SEC)	ALTITUDE (FT)	RADIUS (FT)	SPACE-FIXED PATH-ANGLE (DEG)	SPACE FIXED VELOCITY (FT/S)	SPACE FIXED AZIMUTH (DEG)
149.95	02:30.0	201014.	21111019.	65.139	7205.22	102.22
160.00	02:40.0	229832.	21139877.	67.347	7295.47	102.38
170.00	02:50.0	256764.	21166849.	69.235	7410.69	102.54
(4)172.75	02:52.8	263872.	21173970.	69.842	7446.33	102.58
179.00	02:59.0	279572.	21189695.	70.714	7529.60	102.69
189.00	03:09.0	303560.	21213727.	72.124	7659.64	102.87
199.00	03:19.0	326400.	21236613.	73.351	7793.80	103.06
209.00	03:29.0	348140.	21258400.	74.341	7938.25	103.28
219.00	03:39.0	368795.	21279104.	75.493	8093.16	103.49
229.00	03:49.0	388381.	21298741.	76.597	8258.39	103.71
239.00	03:59.0	406918.	21317332.	77.480	8433.85	103.92
249.00	04:09.0	424426.	21334894.	78.496	8619.53	104.13
259.00	04:19.0	440925.	21351450.	79.460	8815.34	104.34
269.00	04:29.0	456439.	21367024.	80.373	9021.41	104.55
279.00	04:39.0	470991.	21381638.	81.095	9237.67	104.76
289.00	04:49.0	484609.	21395320.	81.913	9464.46	104.97
299.00	04:59.0	497322.	21408099.	82.679	9701.87	105.18
309.00	05:09.0	509156.	21420002.	83.280	9949.96	105.39
319.00	05:19.0	520142.	21431060.	83.954	10208.52	105.59
329.00	05:29.0	530316.	21441308.	84.576	10477.94	105.80
339.00	05:39.0	539715.	21450784.	85.148	10758.62	106.01
349.00	05:49.0	548378.	21459528.	85.587	11050.67	106.22
359.00	05:59.0	556347.	21467580.	86.071	11354.04	106.43
369.00	06:09.0	563665.	21474985.	86.505	11668.82	106.64
379.00	06:19.0	570384.	21481794.	86.829	11995.58	106.85
389.00	06:29.0	576560.	21488063.	87.175	12335.14	107.07
399.00	06:39.0	582251.	21493851.	87.474	12687.80	107.28
409.00	06:49.0	587517.	21499217.	87.729	13053.83	107.50
419.00	06:59.0	592426.	21504231.	87.905	13433.67	107.71
429.00	07:09.0	597052.	21508966.	88.076	13828.12	107.93
439.00	07:19.0	601478.	21513505.	88.201	14238.06	108.15
449.00	07:29.0	605791.	21517934.	88.271	14664.41	108.37
460.00	07:40.0	610516.	21522793.	88.320	15151.93	108.62
470.00	07:50.0	614894.	21527298.	88.325	15604.77	108.84
480.00	08:00.0	619356.	21531892.	88.349	16040.20	109.07
490.00	08:10.0	623867.	21536538.	88.371	16469.67	109.30
500.00	08:20.0	628501.	21541313.	88.346	16906.62	109.52
510.00	08:30.0	633394.	21546351.	88.296	17357.20	109.75
520.00	08:40.0	638619.	21551726.	88.215	17823.23	109.98
530.00	08:50.0	644290.	21557552.	88.100	18303.99	110.22

(4) Initiate active guidance

TABLE 5 (CONT'D)

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	ALTITUDE (FT)	RADIUS (FT)	SPACE-FIXED PATH-ANGLE (DEG)	SPACE FIXED VELØCITY (FT/S)	SPACE FIXED AZIMUTH (DEG)
	540.00	09:00.0	650520.	21563942.	87.979	18801.98	110.46
	550.00	09:10.0	657453.	21571041.	87.794	19319.05	110.70
	560.00	09:20.0	665287.	21579046.	87.560	19854.77	110.94
	570.00	09:30.0	674264.	21588199.	87.288	20409.88	111.19
	580.00	09:40.0	684630.	21598747.	86.916	20988.77	111.44
	590.00	09:50.0	696656.	21610962.	86.540	21590.79	111.69
	600.00	10:00.0	710614.	21625115.	86.122	22211.15	111.95
(5)	601.55	10:01.6	7129659.	21627497.	86.004	22308.50	111.99
	611.55	10:11.6	7280388.	21642770.	86.168	22305.55	112.24

(5) S-IVB GCS

TABLE 6

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	EARTH FIXED PATH ANGLE (DEG)	EARTH FIXED VELOCITY (M/S)	EARTH FIXED AZIMUTH (DEG)	GROUND RANGE (M)
	0.00	00:00.0	0.000	0.00	0.0	0.
	5.00	00:05.0	0.584	11.05	13.01	0.
	10.00	00:10.0	0.589	23.92	9.87	1.
	14.00	00:14.0	0.608	35.54	15.37	1.
	19.00	00:19.0	0.631	51.86	49.22	2.
	24.00	00:24.0	1.292	70.04	82.55	6.
	29.00	00:29.0	2.492	90.24	94.79	19.
	34.00	00:34.0	4.178	112.91	99.45	48.
	39.00	00:39.0	6.290	138.04	101.69	148.
	44.00	00:44.0	8.824	165.82	102.90	202.
	49.00	00:49.0	11.684	196.56	103.59	360.
	54.00	00:54.0	14.762	230.59	104.02	599.
	59.00	00:59.0	17.975	268.17	104.30	944.
	64.00	01:04.0	21.259	308.69	104.49	1422.
	69.00	01:09.0	24.586	350.57	104.63	2056.
	74.00	01:14.0	27.913	397.85	104.74	2876.
	79.00	01:19.0	31.162	451.84	104.83	3916.
	84.00	01:24.0	34.306	512.77	104.91	6080.
	87.00	01:27.0	36.121	552.94	104.95	6129.
	89.00	01:29.0	37.294	581.24	104.98	6804.
	94.00	01:34.0	40.063	657.46	105.03	8730.
	99.00	01:39.0	42.651	741.66	105.07	11030.
	104.00	01:44.0	45.067	833.98	105.11	13747.
	109.00	01:49.0	47.307	934.67	105.14	16922.
	114.00	01:54.0	49.383	1044.14	105.17	20598.
	119.00	01:59.0	51.309	1162.81	105.20	24822.
	124.00	02:04.0	53.109	1291.19	105.22	29640.
	129.00	02:09.0	54.796	1429.93	105.21	35102.
	134.00	02:14.0	56.381	1579.85	105.22	41264.
	139.00	02:19.0	57.877	1741.83	105.23	48182.
	143.06	02:23.1	58.916	1843.38	105.26	54950.
(1)	143.87	02:23.9	59.107	1856.41	105.27	55637.
(2)	144.75	02:24.8	59.312	1855.49	105.28	57026.

(1) Outboard Engine Cutoff
(2) Separation

TABLE 6 (CONT'D)

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	EARTH FIXED PATH ANGLE (DEG)	EARTH FIXED VELOCITY (M/S)	EARTH FIXED AZIMUTH (DEG)	GROUND RANGE (M)
	144.75	02:24.8	59.312	1855.48	105.28	57026.
	145.00	02:25.0	59.371	1854.32	105.29	57423.
	146.00	02:26.0	59.606	1849.68	105.30	59004.
	147.00	02:27.0	59.841	1845.08	105.31	60585.
	148.00	02:28.0	60.078	1840.57	105.33	62166.
	149.00	02:29.0	60.314	1837.52	105.34	63747.
(3)	149.95	02:30.0	60.532	1837.47	105.35	65256.

(3) J-2 90% Thrust

TABLE 6 (CONT'D)

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	EARTH FIXED PATH ANGLE (DEG)	EARTH FIXED VELOCITY (M/S)	EARTH FIXED AZIMUTH (DEG)	GROUND RANGE (M)
	149.95	02:30.0	60.532	1837.47	105.35	65257
	160.00	02:40.0	62.841	1858.21	105.45	81418
	170.00	02:50.0	65.055	1887.32	105.56	98046
(4)	172.75	02:52.8	65.646	1896.66	105.58	102717
	179.00	02:59.0	66.920	1918.86	105.66	113494
	189.00	03:09.0	68.564	1954.59	105.79	131176
	199.00	03:19.0	70.024	1992.23	105.94	149359
	209.00	03:29.0	71.435	2033.37	106.13	168054
	219.00	03:39.0	72.798	2077.96	106.31	187285
	229.00	03:49.0	74.102	2125.98	106.49	207072
	239.00	03:59.0	75.348	2177.38	106.66	227438
	249.00	04:09.0	76.536	2232.13	106.83	248405
	259.00	04:19.0	77.661	2290.19	107.01	269996
	269.00	04:29.0	78.724	2351.59	107.18	292233
	279.00	04:39.0	79.726	2416.28	107.35	315140
	289.00	04:49.0	80.665	2484.35	107.52	338742
	299.00	04:59.0	81.543	2555.81	107.68	363064
	309.00	05:09.0	82.362	2630.66	107.85	388134
	319.00	05:19.0	83.122	2708.83	108.02	413977
	329.00	05:29.0	83.823	2790.41	108.19	440621
	339.00	05:39.0	84.465	2875.51	108.36	468095
	349.00	05:49.0	85.053	2964.16	108.52	496429
	359.00	05:59.0	85.587	3056.33	108.69	525654
	369.00	06:09.0	86.067	3152.04	108.86	555801
	379.00	06:19.0	86.493	3251.45	109.04	586902
	389.00	06:29.0	86.867	3354.81	109.21	618992
	399.00	06:39.0	87.193	3462.19	109.38	652107
	409.00	06:49.0	87.471	3573.67	109.56	686287
	419.00	06:59.0	87.700	3689.39	109.74	721568
	429.00	07:09.0	87.882	3809.58	109.92	757993
	439.00	07:19.0	88.018	3934.50	110.10	795604
	449.00	07:29.0	88.108	4064.43	110.28	834448
	460.00	07:40.0	88.158	4213.02	110.49	878655
	470.00	07:50.0	88.171	4351.03	110.68	920235
	480.00	08:00.0	88.203	4483.74	110.87	963121
	490.00	08:10.0	88.227	4614.61	111.07	1007275
	500.00	08:20.0	88.204	4747.77	111.27	1052699
	510.00	08:30.0	88.146	4885.09	111.47	1099422
	520.00	08:40.0	88.063	5027.11	111.68	1143488
	530.00	08:50.0	87.946	5173.62	111.88	1196937

(4) Initiate active guidance

TABLE 6 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	EARTH FIXED PATH ANGLE (DEG)	EARTH FIXED VELOCITY (M/S)	EARTH FIXED AZIMUTH (DEG)	GROUND RANGE (M)
	540.00	09:00.0	87.798	5325.38	112.10	1247814
	550.00	09:10.0	87.608	5482.95	112.31	1300167
	560.00	09:20.0	87.359	5646.22	112.53	1354048
	570.00	09:30.0	87.055	5815.39	112.75	1409505
	580.00	09:40.0	86.695	5991.82	112.97	1466590
	590.00	09:50.0	86.283	6175.31	113.20	1525363
	600.00	10:00.0	85.824	6364.40	113.43	1585871
(5)	601.55	10:01.6	85.750	6394.07	113.47	1595397
	611.55	10:11.6	85.924	6392.86	113.73	1657060

(5) S-IVB GCS

TABLE 7

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	EARTH FIXED PATH ANGLE (DEG)	EARTH FIXED VELOCITY (FT/S)	EARTH FIXED AZIMUTH (DEG)	GROUND RANGE (FT)
	0.00	00:00.0	0.000	0.00	0.000	0.
	5.00	00:05.0	0.584	36.26	13.01	0.
	10.00	00:10.0	0.589	78.49	9.87	3.
	14.00	00:14.0	0.608	116.60	15.37	3.
	19.00	00:19.0	0.631	170.15	49.22	7.
	24.00	00:24.0	1.292	229.80	82.55	20.
	29.00	00:29.0	2.492	296.07	94.79	62.
	34.00	00:34.0	4.178	370.44	99.45	157.
	39.00	00:39.0	6.290	452.89	101.69	486.
	44.00	00:44.0	8.824	544.04	102.90	663.
	49.00	00:49.0	11.684	644.89	103.59	1181.
	54.00	00:54.0	14.762	756.53	104.02	1965.
	59.00	00:59.0	17.975	879.83	104.30	3097.
	64.00	01:04.0	21.259	1012.77	104.49	4665.
	69.00	01:09.0	24.586	1150.17	104.63	6745.
	74.00	01:14.0	27.913	1305.28	104.74	9435.
	79.00	01:19.0	31.162	1482.41	104.83	12848.
	84.00	01:24.0	34.306	1682.33	104.91	19948.
	87.00	01:27.0	36.121	1814.10	104.95	20108.
	89.00	01:29.0	37.294	1906.97	104.98	22323.
	94.00	01:34.0	40.063	2157.01	105.03	28642.
	99.00	01:39.0	42.651	2433.28	105.07	36188.
	104.00	01:44.0	45.067	2736.17	105.11	45102.
	109.00	01:49.0	47.307	3066.50	105.14	55518.
	114.00	01:54.0	49.383	3425.65	105.17	67579.
	119.00	01:59.0	51.309	3814.99	105.20	81437.
	124.00	02:04.0	53.109	4236.18	105.22	97244.
	129.00	02:09.0	54.796	4691.39	105.21	115164.
	134.00	02:14.0	56.381	5183.23	105.22	135381.
	139.00	02:19.0	57.877	5714.68	105.23	158077.
	143.06	02:23.1	58.916	6047.82	105.26	180282.
(1)	143.87	02:23.9	59.107	6087.30	105.27	182536.
(2)	144.75	02:24.8	59.312	6087.57	105.28	187093.

(1) Outboard Engine Cutoff
(2) Separation

TABLE 7 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	EARTH FIXED PATH ANGLE (DEG)	EARTH FIXED VELOCITY (FT/S)	EARTH FIXED AZIMUTH (DEG)	GROUND RANGE (FT)
	144.75	02:24.8	59.312	6087.55	105.28	187093.
	145.00	02:25.0	59.371	6083.72	105.29	188396.
	146.00	02:26.0	59.606	6068.51	105.30	193583.
	147.00	02:27.0	59.841	6053.41	105.31	198770.
	148.00	02:28.0	60.078	6038.61	105.33	203957.
	149.00	02:29.0	60.314	6028.62	105.34	209144.
(3)	149.95	02:30.0	60.532	6028.46	105.35	214094.

(3) J-2 90% Thrust

TABLE 7 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	EARTH FIXED PATH ANGLE (DEG)	EARTH FIXED VELOCITY (FT/S)	EARTH FIXED AZIMUTH (DEG)	GROUND RANGE (FT)
	149.95	02:30.0	60.532	6028.46	105.35	214094
	160.00	02:40.0	62.841	6096.50	105.45	267116
	170.00	02:50.0	65.055	6192.00	105.56	321669
(4)	172.75	02:52.8	65.646	6222.63	105.58	336992
	179.00	02:59.0	66.920	6295.49	105.66	372350
	189.00	03:09.0	68.564	6412.71	105.79	430362
	199.00	03:19.0	70.024	6536.18	105.94	490015
	209.00	03:29.0	71.435	6671.15	106.13	551352
	219.00	03:39.0	72.798	6817.44	106.31	614444
	229.00	03:49.0	74.102	6975.00	106.49	679363
	239.00	03:59.0	75.348	7143.62	106.66	746180
	249.00	04:09.0	76.536	7323.25	106.83	814968
	259.00	04:19.0	77.661	7513.75	107.01	885802
	269.00	04:29.0	78.724	7715.19	107.18	958757
	279.00	04:39.0	79.726	7927.44	107.35	1033912
	289.00	04:49.0	80.665	8150.77	107.52	1111344
	299.00	04:59.0	81.543	8385.22	107.68	1191141
	309.00	05:09.0	82.362	8630.79	107.85	1273389
	319.00	05:19.0	83.122	8887.22	108.02	1358174
	329.00	05:29.0	83.823	9154.88	108.19	1445588
	339.00	05:39.0	84.465	9434.09	108.36	1535724
	349.00	05:49.0	85.053	9724.94	108.52	1628683
	359.00	05:59.0	85.587	10027.34	108.69	1724564
	369.00	06:09.0	86.067	10341.34	108.86	1823470
	379.00	06:19.0	86.492	10667.49	109.04	1925507
	389.00	06:29.0	86.867	11006.58	109.21	2030788
	399.00	06:39.0	87.193	11358.88	109.38	2139434
	409.00	06:49.0	87.471	11724.65	109.56	2251569
	419.00	06:59.0	87.700	12104.30	109.74	2367321
	429.00	07:09.0	87.882	12498.61	109.92	2486822
	439.00	07:19.0	88.018	12908.47	110.10	2610217
	449.00	07:29.0	88.108	13334.76	110.28	2737656
	460.00	07:40.0	88.158	13822.24	110.49	2882692
	470.00	07:50.0	88.171	14275.05	110.68	3019106
	480.00	08:00.0	88.203	14710.43	110.87	3159807
	490.00	08:10.0	88.227	15139.81	111.07	3304667
	500.00	08:20.0	88.204	15576.68	111.27	3453694
	510.00	08:30.0	88.146	16027.18	111.47	3606982
	520.00	08:40.0	88.063	16493.14	111.68	3751554
	530.00	08:50.0	87.946	16973.82	111.88	3926910

(4) Initiate Active Guidance

TABLE 7 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	EARTH FIXED PATH ANGLE (DEG)	EARTH FIXED VELOCITY (FT/S)	EARTH FIXED AZIMUTH (DEG)	GROUND RANGE (FT)
	540.00	9:00.0	87.798	17471.71	112.10	4093827
	550.00	9:10.0	87.608	17988.69	112.31	4265588
	560.00	9:20.0	87.359	18524.33	112.53	4442362
	570.00	9:30.0	87.055	19079.37	112.75	4624302
	580.00	9:40.0	86.695	19658.22	112.97	4811588
	590.00	9:50.0	86.283	20260.22	113.20	5004410
	600.00	10:00.0	85.824	20880.58	113.43	5202925
(5)	601.55	10:01.6	85.750	20977.92	113.47	5234177
	611.55	10:11.6	85.924	20973.95	113.73	5436549

(5) S-IVB GCS

TABLE 8

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XPP PLUMBLINE (M)	YPP COORDINATE (M)	ZPP SYSTEM (M)	XPP-DØT (M/S)	YPP-DØT (M/S)	ZPP-DØT (M/S)
	0.00	6614.	6373328.	16785.	395.02	-0.13	-105.92
	5.00	8590.	6373354.	16255.	395.01	10.79	-106.07
	10.00	10565.	6373440.	15725.	395.00	23.53	-106.24
	14.00	12145.	6373557.	15300.	395.05	35.04	-106.41
	19.00	14121.	6373773.	14767.	395.41	51.23	-106.54
	24.00	16101.	6374074.	14235.	396.61	69.26	-106.71
	29.00	18089.	6374470.	13701.	399.10	89.25	-106.84
	34.00	20095.	6374972.	13167.	403.53	111.56	-106.99
	39.00	22129.	6375590.	12632.	410.59	136.00	-107.12
	44.00	24207.	6376336.	12096.	421.08	162.47	-107.25
	49.00	26347.	6377220.	11560.	435.66	190.89	-107.37
	54.00	28571.	6378250.	11023.	454.86	221.13	-107.51
	59.00	30904.	6379435.	10486.	479.16	252.94	-107.65
	64.00	33372.	6380781.	9947.	508.66	285.20	-107.81
	69.00	35999.	6382285.	9408.	542.96	315.89	-107.96
	74.00	38812.	6383944.	8869.	583.77	348.17	-108.11
	79.00	41849.	6385771.	8328.	631.82	382.65	-108.28
	84.00	45144.	6387775.	7786.	687.59	418.86	-108.45
	87.00	47262.	6389066.	7461.	724.91	441.43	-108.55
	89.00	48738.	6389964.	7244.	751.40	456.81	-108.63
	94.00	52671.	6392347.	6701.	823.13	496.53	-108.87
	99.00	56984.	6394933.	6156.	903.32	537.57	-109.17
	104.00	61719.	6397726.	5610.	992.19	579.58	-109.52
	109.00	66920.	6400731.	5061.	1089.87	622.50	-109.95
	114.00	72633.	6403954.	4511.	1196.72	666.29	-110.49
	119.00	78904.	6407397.	3957.	1313.16	710.85	-111.13
	124.00	85782.	6411065.	3400.	1439.83	755.95	-112.13
	129.00	93320.	6414959.	2835.	1577.37	801.53	-113.76
	134.00	101575.	6419082.	2263.	1726.60	847.55	-115.46
	139.00	110608.	6423436.	1681.	1888.48	893.84	-117.31
	143.06	118517.	6427125.	1203.	1993.75	915.14	-118.45
(1)	143.87	120143.	6427869.	1106.	2007.53	915.30	-118.54
(2)	144.75	121910.	6428671.	1002.	2011.18	909.02	-118.56

(1) Outboard Engine Cutoff
(2) Separation

TABLE 8 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XPP PLUMBLINE (M)	YPP COORDINATE (M)	ZPP SYSTEM (M)	XPP-DØT (M/S)	YPP-DØT (M/S)	ZPP-DØT (M/S)
	144.75	121910.	6428671.	1002.	2011.18	909.02	-118.56
	145.00	122415.	6428899.	972.	2011.19	906.63	-118.55
	146.00	124426.	6429801.	854.	2011.21	897.12	-118.54
	147.00	126437.	6430693.	736.	2011.23	887.61	-118.53
	148.00	128448.	6431576.	617.	2011.29	878.13	-118.52
	149.00	130460.	6432450.	499.	2012.56	869.42	-118.52
(3)	149.95	132382.	6433276.	386.	2016.16	862.62	-118.56

(3) J-2 90% Thrust

TABLE 8 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XPP PLUMBLINE (M)	YPP COORDINATE (M)	ZPP SYSTEM (M)	XPP-DØT (M/S)	YPP-DØT (M/S)	ZPP-DØT (M/S)
	149.95	132382.	6433276.	386.	2016.16	862.62	-118.56
	160.00	152903.	6441620.	-810.	2071.60	799.27	-119.58
	170.00	173916.	6449311.	-2010.	2131.14	738.75	-120.66
(4)	172.75	179800.	6451320.	-2342.	2148.16	722.52	-120.99
	179.00	193347.	6455724.	-3100.	2186.41	687.02	-121.39
	189.00	215495.	6462351.	-4314.	2241.96	639.88	-121.56
	199.00	238185.	6468533.	-5529.	2296.27	596.39	-121.24
	209.00	261427.	6474281.	-6731.	2352.55	552.79	-119.51
	219.00	285243.	6479591.	-7919.	2410.84	508.88	-118.19
	229.00	309651.	6484461.	-9093.	2471.11	464.85	-116.76
	239.00	334672.	6488890.	-10253.	2533.36	420.65	-115.37
	249.00	360325.	6492875.	-11399.	2597.67	376.14	-113.99
	259.00	386632.	6496415.	-12532.	2664.01	331.50	-112.63
	269.00	413613.	6499507.	-13651.	2732.48	286.62	-111.27
	279.00	441289.	6502149.	-14756.	2803.12	241.44	-109.94
	289.00	469683.	6504338.	-15848.	2876.04	196.09	-108.62
	299.00	498818.	6506072.	-16927.	2951.35	150.42	-107.32
	309.00	528719.	6507348.	-17993.	3029.09	104.38	-106.06
	319.00	559409.	6508161.	-19047.	3109.25	58.01	-104.81
	329.00	590913.	6508510.	-20088.	3191.98	11.37	-103.58
	339.00	623258.	6508391.	-21117.	3277.43	-35.56	-102.39
	349.00	656471.	6507800.	-22135.	3365.70	-82.94	-101.22
	359.00	690581.	6506733.	-23140.	3456.79	-130.75	-100.09
	369.00	725617.	6505187.	-24135.	3550.78	-178.87	-98.99
	379.00	761607.	6503157.	-25119.	3647.86	-227.35	-97.92
	389.00	798586.	6500641.	-26092.	3748.34	-276.16	-96.89
	399.00	836586.	6497635.	-27055.	3852.33	-325.47	-95.91
	409.00	875644.	6494133.	-28009.	3959.93	-375.25	-94.97
	419.00	915798.	6490132.	-28954.	4071.34	-425.41	-94.07
	429.00	957085.	6485626.	-29889.	4186.81	-475.98	-93.24
	439.00	999548.	6480613.	-30817.	4306.65	-527.00	-92.45
	449.00	1043234.	6475088.	-31737.	4431.17	-578.48	-91.72
	460.00	1092754.	6468412.	-32741.	4573.44	-635.73	-91.01
	470.00	1139150.	6461792.	-33648.	4705.31	-688.92	-90.42
	480.00	1186835.	6454623.	-34548.	4831.00	-745.77	-89.79
	490.00	1235761.	6446872.	-35443.	4954.22	-804.80	-89.37
	500.00	1285928.	6438532.	-36335.	5079.54	-863.23	-89.10
	510.00	1337365.	6429608.	-37224.	5208.67	-922.46	-88.87
	520.00	1390115.	6420081.	-38111.	5342.05	-983.32	-88.61
	530.00	1444219.	6409942.	-38995.	5479.59	-1045.06	-88.40

(4) Initiate Active Guidance

TABLE 8 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XPP PLUMBLINE (M)	YPP COORDINATE (M)	ZPP SYSTEM (M)	XPP-DØT (M/S)	YPP-DØT (M/S)	ZPP-DØT (M/S)
	540.00	1499723.	6399179.	-39877.	5622.02	-1107.99	-88.21
	550.00	1556679.	6387784.	-40758.	5770.13	-1171.15	-88.07
	560.00	1615145.	6375763.	-41638.	5924.16	-1232.92	-88.03
	570.00	1675182.	6363132.	-42517.	6084.34	-1293.45	-87.98
	580.00	1736858.	6349902.	-43396.	6252.13	-1352.64	-87.85
	590.00	1800249.	6336086.	-44273.	6427.32	-1410.59	-87.69
	600.00	1865423.	6321697.	-45148.	6608.42	-1467.47	-87.58
(5)	601.55	1875677.	6319418.	-45284.	6636.88	-1476.19	-87.60
	611.55	1941970.	6304227.	-46156.	6616.02	-1563.18	-86.99

(5) S-IVB GCS

TABLE 9

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PLUMBLINE COMPONENTS

TIME (SEC)	XPP PLUMBLINE COORDINATE (FT)	YPP SYSTEM (FT)	ZPP (FT)	XPP-DØT (FT/S)	YPP-DØT (FT/S)	ZPP-DØT (FT/S)
0.00	21701.	20909870.	55067.	1295.98	-0.43	-347.50
5.00	28181.	20909956.	53330.	1295.97	35.40	-348.00
10.00	34661.	20910237.	51590.	1295.94	77.20	-348.57
14.00	39845.	20910622.	50195.	1296.09	114.97	-349.10
19.00	46328.	20911329.	48450.	1297.27	168.08	-349.54
24.00	52823.	20912317.	46702.	1301.21	227.23	-350.09
29.00	59348.	20913616.	44951.	1309.37	292.83	-350.53
34.00	65928.	20915262.	43199.	1323.93	366.01	-351.01
39.00	72602.	20917292.	41444.	1347.07	446.19	-351.44
44.00	79418.	20919739.	39686.	1381.50	533.03	-351.86
49.00	86440.	20922637.	37927.	1429.33	626.27	-352.28
54.00	93738.	20926016.	36166.	1492.33	725.49	-352.72
59.00	101392.	20929905.	34402.	1572.04	829.86	-353.21
64.00	109487.	20934322.	32636.	1668.84	935.69	-353.71
69.00	118105.	20939254.	30867.	1781.37	1036.38	-354.19
74.00	127337.	20944700.	29096.	1915.26	1142.30	-354.71
79.00	137298.	20950694.	27323.	2072.91	1255.42	-355.26
84.00	148110.	20957268.	25546.	2255.86	1374.20	-355.80
87.00	155059.	20961502.	24479.	2378.30	1448.25	-356.14
89.00	159902.	20964450.	23767.	2465.23	1498.72	-356.39
94.00	172805.	20972269.	21984.	2700.56	1629.02	-357.19
99.00	186954.	20980752.	20197.	2963.65	1763.67	-358.16
104.00	202490.	20989915.	18404.	3255.23	1901.50	-359.31
109.00	219555.	20999776.	16606.	3575.68	2042.33	-360.73
114.00	238297.	21010348.	14799.	3926.24	2185.98	-362.50
119.00	258870.	21021644.	12982.	4308.28	2332.18	-364.60
124.00	281436.	21033677.	11154.	4723.85	2480.15	-367.90
129.00	306169.	21046453.	9302.	5175.10	2629.71	-373.23
134.00	333252.	21059981.	7423.	5664.70	2780.66	-378.81
139.00	362886.	21074264.	5515.	6195.80	2932.56	-384.89
143.06	388837.	21086369.	3945.	6541.18	3002.43	-388.61
(1) 143.87	394170.	21088810.	3629.	6586.38	3002.95	-388.91
(2) 144.75	399967.	21091441.	3287.	6598.36	2982.35	-388.98

(1) Outboard Engine Cutoff
(2) Separation

TABLE 9 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XPP PLUMBLINE COORDINATE (FT)	YPP SYSTEM (FT)	ZPP (FT)	XPP-DØT (FT/S)	YPP-DØT (FT/S)	ZPP-DØT (FT/S)
	144.75	399967.	21091441.	3288.	6598.37	2982.35	-388.96
	145.00	401623.	21092189.	3190.	6598.39	2974.51	-388.95
	146.00	408222.	21095148.	2802.	6598.47	2943.29	-388.92
	147.00	414820.	21098076.	2413.	6598.53	2912.09	-388.89
	148.00	421419.	21100973.	2024.	6598.72	2881.01	-388.85
	149.00	428019.	21103840.	1636.	6602.89	2852.42	-388.86
(3)	149.95	434323.	21106551.	1265.	6614.71	2830.13	-388.97

(3) J-2 90% Thrust

TABLE 9 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XPP PLUMBLINE COORDINATE SYSTEM (FT)	YPP (FT)	ZPP (FT)	XPP-DØT (FT/S)	YPP-DØT (FT/S)	ZPP-DØT (FT/S)
	149.95	434323.	21106551.	1265.	6614.71	2830.13	-388.97
	160.00	501650.	21133924.	-2657.	6796.60	2622.26	-392.34
	170.00	570591.	21159157.	-6595.	6991.94	2423.72	-395.85
(4)	172.75	589896.	21165750.	-7685.	7047.78	2370.46	-396.94
	179.00	634341.	21180196.	-10170.	7173.26	2254.01	-398.26
	189.00	707005.	21201938.	-14154.	7355.52	2099.36	-398.82
	199.00	781446.	21222223.	-18139.	7533.70	1956.66	-397.76
	209.00	857701.	21241080.	-22085.	7718.35	1813.61	-392.08
	219.00	935836.	21258500.	-25982.	7909.58	1669.54	-387.76
	229.00	1015915.	21274478.	-29834.	8107.31	1525.09	-383.06
	239.00	1098004.	21289009.	-33639.	8311.55	1380.08	-378.51
	249.00	1182170.	21302084.	-37400.	8522.53	1234.05	-373.99
	259.00	1268478.	21313698.	-41115.	8740.18	1087.60	-369.51
	269.00	1356998.	21323843.	-44785.	8964.84	940.35	-365.07
	279.00	1447800.	21332510.	-48412.	9196.58	792.13	-360.70
	289.00	1540956.	21339692.	-51995.	9435.84	643.36	-356.37
	299.00	1636544.	21345382.	-55535.	9682.91	493.51	-352.11
	309.00	1734642.	21349567.	-59033.	9937.98	342.45	-347.95
	319.00	1835330.	21352236.	-62490.	10200.95	190.33	-343.86
	329.00	1938690.	21353380.	-65906.	10472.36	37.31	-339.83
	339.00	2044808.	21352988.	-69282.	10752.74	-116.66	-335.91
	349.00	2153776.	21351050.	-72620.	11042.33	-272.13	-332.09
	359.00	2265687.	21347550.	-75920.	11341.18	-428.95	-328.37
	369.00	2380632.	21342477.	-79183.	11649.53	-586.85	-324.77
	379.00	2498712.	21335818.	-82411.	11968.06	-745.89	-321.26
	389.00	2620031.	21327564.	-85604.	12297.71	-906.02	-317.87
	399.00	2744705.	21317701.	-88765.	12638.87	-1067.80	-314.65
	409.00	2872849.	21306212.	-91893.	12991.91	-1231.13	-311.58
	419.00	3004585.	21293083.	-94992.	13357.41	-1395.70	-308.64
	429.00	3140042.	21278302.	-98062.	13736.25	-1561.62	-305.89
	439.00	3279358.	21261855.	-101106.	14129.43	-1729.00	-303.31
	449.00	3422683.	21243727.	-104125.	14537.96	-1897.89	-300.93
	460.00	3585150.	21221823.	-107419.	15004.72	-2085.73	-298.58
	470.00	3737370.	21200105.	-110393.	15437.36	-2260.23	-296.66
	480.00	3893817.	21176584.	-113347.	15849.75	-2446.76	-294.59
	490.00	4054335.	21151154.	-116283.	16253.99	-2640.41	-293.20
	500.00	4218923.	21123794.	-119208.	16665.15	-2832.12	-292.32
	510.00	4387680.	21094516.	-122126.	17088.83	-3026.44	-291.56
	520.00	4560745.	21063259.	-125035.	17526.41	-3226.12	-290.73
	530.00	4738253.	21029994.	-127936.	17977.66	-3428.69	-290.01

(4) Initiate Active Guidance

TABLE 9 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN SPACE-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XPP PLUMBLINE COORDINATE (FT)	YPP SYSTEM (FT)	ZPP (FT)	XPP-DØT (FT/S)	YPP-DØT (FT/S)	ZPP-DØT (FT/S)
	540.00	4920351.	20994681.	-130831.	18444.95	-3635.15	-289.40
	550.00	5107214.	20957298.	-133720.	18930.89	-3842.34	-288.95
	560.00	5299033.	20917859.	-136606.	19436.21	-4045.02	-288.81
	570.00	5496004.	20876418.	-139492.	19961.76	-4243.60	-288.66
	580.00	5698352.	20833013.	-142374.	20512.23	-4437.78	-288.22
	590.00	5906329.	20787685.	-145252.	21087.00	-4627.92	-287.69
	600.00	6120156.	20740476.	-148124.	21681.17	-4814.52	-287.34
(5)	601.55	6153796.	20732999.	-148570.	21774.54	-4843.14	-287.40
	611.55	6371293.	20683160	-151430.	21706.10	-5128.54	-285.40

(5) S-IVB GCS

TABLE 10

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XXXE (M)	YYYE (M)	ZZZE (M)	DXXE (M/S)	DYYE (M/S)	DZZE (M/S)
	0.00	-0.	32.	0.	-0.00	-0.00	[illegible]
	5.00	0.	59.	-0.	0.01	11.05	-0.08
	10.00	0.	146.	-1.	0.00	23.92	-0.18
	14.00	0.	264.	-2.	0.04	35.54	-0.28
	19.00	1.	482.	-3.	0.37	51.86	-0.34
	24.00	5.	786.	-5.	1.53	70.02	-0.42
	29.00	18.	1185.	-7.	3.96	90.15	-0.46
	34.00	48.	1691.	-10.	8.30	112.60	-0.50
	39.00	106.	2315.	-12.	15.24	137.20	-0.51
	44.00	206.	3067.	-15.	25.60	163.84	-0.51
	49.00	368.	3956.	-17.	40.00	192.45	-0.48
	54.00	614.	4994.	-20.	59.00	222.91	-0.43
	59.00	967.	6188.	-22.	83.05	254.99	-0.37
	64.00	1453.	7545.	-23.	112.28	287.55	-0.28
	69.00	2097.	9060.	-24.	146.29	318.59	-0.15
	74.00	2927.	10734.	-25.	186.77	351.29	0.01
	79.00	3977.	12577.	-24.	234.45	386.25	0.22
	84.00	5284.	14599.	-23.	289.79	423.03	0.49
	87.00	6208.	15903.	-21.	326.84	446.00	0.68
	89.00	6888.	16810.	-19.	353.15	461.66	0.81
	94.00	8829.	19219.	-14.	424.37	502.15	1.14
	99.00	11146.	21834.	-8.	504.01	544.09	1.50
	104.00	13883.	24662.	1.	592.29	587.13	1.89
	109.00	17083.	27707.	11.	689.32	631.22	2.28
	114.00	20792.	30976.	23.	795.48	676.34	2.67
	119.00	25054.	34472.	38.	911.19	722.40	3.08
	124.00	29920.	38201.	54.	1037.07	769.18	3.23
	129.00	35443.	42165.	69.	1173.78	816.66	2.89
	134.00	41678.	46369.	83.	1322.14	864.79	2.62
	139.00	48685.	50814.	95.	1483.10	913.46	2.34
	143.06	54850.	54528.	105.	1586.66	936.51	2.38
(1)	143.87	56244.	55347.	107.	1601.42	937.02	2.50
(2)	144.75	57654.	56169.	109.	1605.03	930.97	2.62

(1) Outboard Engine Cutoff
(2) Separation

TABLE 10 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XXXE (M)	YYYE (M)	ZZZE (M)	DXXE (M/S)	DYYE (M/S)	DZZE (M/S)
	144.75	57654.	56169.	109.	1605.03	930.97	2.62
	145.00	58057.	56402.	110.	1605.03	928.64	2.66
	146.00	59662.	57326.	112.	1605.03	919.35	2.80
	147.00	61267.	58241.	115.	1605.02	910.06	2.95
	148.00	62872.	59146.	118.	1605.06	900.81	3.09
	149.00	64478.	60043.	121.	1606.30	892.34	3.23
(3)	149.95	66012.	60891.	125.	1609.87	885.79	3.34

(3) J-2 90% Thrust

TABLE 10 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XXXE (M)	YYYE (M)	ZZZE (M)	DXXE (M/S)	DYYE (M/S)	DZZE (M/S)
	149.95	66012.	60891.	125.	1609.87	885.79	3.34
	160.00	82449.	69480.	162.	1664.89	825.27	4.03
	170.00	99393.	77444.	205.	1724.11	767.73	4.72
(4)	172.75	104158.	79534.	219.	1741.05	752.34	4.88
	179.00	115160.	84129.	251.	1779.14	718.80	5.62
	189.00	133233.	91088.	315.	1834.40	674.79	7.29
	199.00	151846.	97635.	398.	1888.46	634.52	9.49
	209.00	171009.	103779.	511.	1944.55	594.26	13.15
	219.00	190743.	109519.	659.	2002.73	553.83	16.45
	229.00	211070.	114856.	841.	2062.96	513.41	19.93
	239.00	232009.	119788.	1058.	2125.26	472.96	23.41
	249.00	253582.	124314.	1309.	2189.69	432.35	26.95
	259.00	275810.	128435.	1597.	2256.23	391.77	30.55
	269.00	298714.	132149.	1920.	2324.98	351.10	34.19
	279.00	322317.	135456.	2281.	2395.98	310.30	37.89
	289.00	346642.	138355.	2678.	2469.34	269.50	41.65
	299.00	371712.	140846.	3114.	2545.17	228.55	45.47
	309.00	397554.	142926.	3588.	2623.52	187.43	49.34
	319.00	424191.	144594.	4101.	2704.35	146.17	53.28
	329.00	451649.	145849.	4654.	2787.85	104.84	57.29
	339.00	479957.	146691.	5247.	2874.16	63.43	61.37
	349.00	509142.	147117.	5881.	2963.36	21.79	65.51
	359.00	539234.	147126.	6558.	3055.47	-20.04	69.73
	369.00	570261.	146716.	7276.	3150.56	-61.96	74.02
	379.00	602255.	145886.	8038.	3248.84	-103.98	78.41
	389.00	635250.	144636.	8845.	3350.60	-146.07	82.88
	399.00	669279.	142964.	9696.	3455.95	-188.38	87.43
	409.00	704381.	140868.	10594.	3565.02	-230.88	92.07
	419.00	740592.	138346.	11538.	3677.97	-273.46	96.82
	429.00	777954.	135399.	12530.	3795.08	-316.13	101.66
	439.00	816508.	132024.	13572.	3916.65	-358.92	106.62
	449.00	856303.	128220.	14663.	4042.98	-401.80	111.69
	460.00	901564.	123540.	15923.	4187.36	-449.18	117.40
	470.00	944110.	118831.	17123.	4321.27	-493.07	122.67
	480.00	987965.	113665.	18377.	4449.19	-540.56	127.98
	490.00	1033084.	108013.	19682.	4574.80	-590.05	133.12
	500.00	1079469.	101868.	21039.	4702.59	-638.66	138.25
	510.00	1127149.	95240.	22448.	4834.31	-687.70	143.52
	520.00	1176169.	88111.	23910.	4970.41	-738.00	148.99
	530.00	1226571.	80478.	25428.	5110.80	-788.79	154.60

(4) Initiate Active Guidance

TABLE 10 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XXXE (M)	YYYE (M)	ZZZE (M)	DXXE (M/S)	DYYE (M/S)	DZZE (M/S)
	540.00	1278401.	72333.	27003.	5256.21	-840.35	160.39
	550.00	1331714.	63672.	28636.	5407.40	-891.67	166.36
	560.00	1386568.	54506.	30331.	5564.56	-941.12	172.50
	570.00	1443025.	44855.	32087.	5727.91	-988.82	178.91
	580.00	1501152.	34737.	33910.	5898.90	-1034.61	185.73
	590.00	1561027.	24169.	35803.	6077.33	-1078.58	192.89
	600.00	1622718.	13171.	37769.	6261.71	-1120.92	200.29
(5)	601.55	1632435.	11430.	38080.	6290.68	-1127.35	201.43
	611.55	1695289.	-236.	40112.	6274.52	-1207.08	204.87

(5) S-IV GCS

TABLE 11

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XXXE (FT)	YYYE (FT)	ZZZE (FT)	DXXE (FT/S)	DYYE (FT/S)	DZZE (FT/S)
	0.00	-0.	106.	0.	-0.00	-0.00	0.00
	5.00	0.	193.	-1.	0.02	36.26	-0.27
	10.00	0.	478.	-3.	0.01	78.49	-0.60
	14.00	0.	866.	-6.	0.13	116.60	-0.93
	19.00	3.	1581.	-11.	1.23	170.14	-1.10
	24.00	17.	2578.	-17.	5.03	229.74	-1.37
	29.00	60.	3889.	-24.	12.98	295.78	-1.53
	34.00	158.	5548.	-32.	27.25	369.44	-1.64
	39.00	347.	7594.	-41.	50.01	450.12	-1.69
	44.00	676.	10061.	-49.	83.98	537.52	-1.66
	49.00	1208.	12981.	-57.	131.25	631.40	-1.57
	54.00	2014.	16385.	-65.	193.57	731.35	-1.42
	59.00	3172.	20303.	-71.	272.48	836.57	-1.21
	64.00	4767.	24754.	-77.	368.39	943.39	-0.92
	69.00	6880.	29725.	-80.	479.95	1045.24	-0.49
	74.00	9603.	35216.	-81.	612.75	1152.52	0.05
	79.00	13048.	41263.	-80.	769.18	1267.24	0.72
	84.00	17337.	47898.	-74.	950.77	1387.90	1.60
	87.00	20369.	52174.	-68.	1072.32	1463.24	2.22
	89.00	22599.	55152.	-63.	1158.63	1514.63	2.66
	94.00	28965.	63055.	-47.	1392.30	1647.48	3.74
	99.00	36568.	71635.	-26.	1653.59	1785.07	4.91
	104.00	45548.	80912.	2.	1943.21	1926.27	6.19
	109.00	56048.	90903.	36.	2261.54	2070.94	7.49
	114.00	68214.	101627.	77.	2609.84	2218.95	8.77
	119.00	82199.	113098.	124.	2989.46	2370.06	10.09
	124.00	98164.	125331.	177.	3402.46	2523.57	10.60
	129.00	116282.	138338.	227.	3851.00	2679.33	9.48
	134.00	136737.	152128.	272.	4337.72	2837.24	8.58
	139.00	159729.	166712.	313.	4865.80	2996.91	7.69
	143.06	179953.	178897.	343.	5205.58	3072.54	7.82
(1)	143.87	184462.	181585.	351.	5254.00	3074.21	8.20
	144.75	189154.	184282.	358.	5265.85	3054.36	8.60

(1) Outboard Engine Cutoff
(2) Separation

TABLE 11 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XXXE (FT)	YYYE (FT)	ZZZE (FT)	DXXE (FT/S)	DYYE (FT/S)	DZZE (FT/S)
	144.75	189154.	184281.	358.	5265.84	3054.36	8.60
	145.00	190476.	185046.	360.	5265.84	3046.71	8.72
	146.00	195742.	188078.	369.	5265.84	3016.23	9.19
	147.00	201008.	191079.	378.	5265.82	2985.77	9.67
	148.00	206274.	194050.	388.	5265.94	2955.43	10.14
	149.00	211541.	196991.	398.	5270.03	2927.62	10.59
(3)	149.95	216574.	199773.	409.	5281.71	2906.14	10.97

(3) J-2 90% Thrust

TABLE 11 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XXXE (FT)	YYYE (FT)	ZZZE (FT)	DXXE (FT/S)	DYYE (FT/S)	DZZE (FT/S)
	149.95	216574.	199773.	409.	5281.71	2906.14	10.97
	160.00	270502.	227952.	530.	5462.25	2707.59	13.21
	170.00	326093.	254082.	674.	5656.52	2518.81	15.47
(4)	172.75	341725.	260939.	717.	5712.11	2468.32	16.01
	179.00	377820.	276014.	823.	5837.07	2358.26	18.42
	189.00	437116.	298846.	1034.	6018.38	2213.89	23.91
	199.00	498181.	320324.	1304.	6195.72	2081.76	31.14
	209.00	561052.	340482.	1677.	6379.75	1949.68	43.15
	219.00	625799.	359316.	2162.	6570.62	1817.02	53.98
	229.00	692487.	376823.	2759.	6768.24	1684.42	65.38
	239.00	761186.	393004.	3470.	6972.63	1551.71	76.82
	249.00	831963.	407855.	4296.	7184.01	1418.48	88.43
	259.00	904889.	421374.	5239.	7402.32	1285.33	100.22
	269.00	980034.	433561.	6301.	7627.89	1151.89	112.19
	279.00	1057471.	444411.	7483.	7860.82	1018.03	124.32
	289.00	1137276.	453922.	8788.	8101.52	884.18	136.66
	299.00	1219528.	462093.	10217.	8350.29	749.85	149.18
	309.00	1304310.	468917.	11772.	8607.33	614.92	161.89
	319.00	1391702.	474390.	13455.	8872.55	479.56	174.80
	329.00	1481790.	478507.	15269.	9146.48	343.96	187.96
	339.00	1574662.	481268.	17215.	9429.65	208.10	201.33
	349.00	1670414.	482667.	19296.	9722.30	71.48	214.93
	359.00	1769140.	482696.	21514.	10024.51	-65.75	228.77
	369.00	1870936.	481351.	23872.	10336.49	-203.29	242.86
	379.00	1975904.	478629.	26373.	10658.93	-341.14	257.24
	389.00	2084152.	474528.	29018.	10992.78	-479.22	271.91
	399.00	2195798.	469043.	31812.	11338.43	-618.05	286.84
	409.00	2310961.	462165.	34756.	11696.25	-757.49	302.08
	419.00	2429765.	453893.	37854.	12066.83	-897.18	317.65
	429.00	2552342.	444221.	41110.	12451.04	-1037.18	333.54
	439.00	2678834.	433148.	44526.	12849.89	-1177.54	349.81
	449.00	2809392.	420670.	48107.	13264.38	-1318.24	366.45
	460.00	2957887.	405315.	52241.	13738.06	-1473.69	385.16
	470.00	3097472.	389865.	56179.	14177.38	-1617.67	402.47
	480.00	3241355.	372918.	60291.	14597.09	-1773.47	419.87
	490.00	3389384.	354373.	64574.	15009.18	-1935.85	436.74
	500.00	3541564.	334214.	69026.	15428.44	-2095.33	453.59
	510.00	3697995.	312466.	73647.	15860.59	-2256.24	470.88
	520.00	3858822.	289078.	78445.	16307.12	-2421.27	488.81
	530.00	4024182.	264036.	83425.	16767.71	-2587.91	507.23

(4) Initiate active guidance

TABLE 11 (CONT)

S-IB/S-IVB NOMINAL TRAJECTORY IN EARTH-FIXED PLUMBLINE COMPONENTS

	TIME (SEC)	XXXE (FT)	YYYE (FT)	ZZZE (FT)	DXXE (FT/S)	DYYE (FT/S)	DZZE (FT/S)
	540.00	4194229.	237313.	88592.	17244.78	-2757.05	526.22
	550.00	4369139.	208898.	93951.	17740.83	-2925.41	545.81
	560.00	4549109.	178826.	99510.	18256.42	-3087.66	565.94
	570.00	4734333.	147163.	105273.	18792.37	-3244.16	586.98
	580.00	4925040.	113965.	111254.	19353.35	-3394.38	609.34
	590.00	5121480.	79296.	117464.	19938.75	-3538.64	632.84
	600.00	5323877.	43212.	123913.	20543.67	-3677.56	657.13
(5)	601.55	5355758.	37500.	124934.	20638.71	-3698.65	660.86
	611.55	5561972.	774.	131601.	20585.70	-3960.24	672.15

(5) S-IVB GCS

TABLE 12

S-IB/S-IVB NOMINAL ATTITUDE HISTORY

	TIME (SEC)	CHI PITCH (DEG)	CHI YAW (DEG)	CHI RØLL (DEG)	PHI PITCH (DEG)	PHI YAW (DEG)	PHI RØLL (DEG)
	0.00	0.000	0.000	5.000	0.018	0.005	-4.990
	5.00	0.000	0.000	5.000	-0.026	-0.066	-4.962
	10.00	0.000	0.000	5.000	-0.028	-0.069	-4.972
	14.00	0.264	0.000	1.200	-0.240	-0.131	-2.755
	19.00	0.866	0.000	0.000	-0.596	0.006	0.637
	24.00	1.853	0.000	0.000	-1.552	-0.088	0.033
	29.00	3.251	0.000	0.000	-2.806	-0.075	-0.054
	34.00	5.091	0.000	0.000	-4.501	-0.071	0.067
	39.00	7.405	0.000	0.000	-6.665	-0.076	0.028
	44.00	10.111	0.000	0.000	-9.294	-0.078	0.026
	49.00	13.064	0.000	0.000	-12.125	-0.082	0.033
	54.00	16.187	0.000	0.000	-15.178	-0.086	0.034
	59.00	19.436	0.000	0.000	-18.372	-0.089	0.037
	64.00	22.765	0.000	0.000	-21.659	-0.092	0.040
	69.00	26.130	0.000	0.000	-25.014	-0.085	0.041
	74.00	29.487	0.000	0.000	-28.372	-0.082	0.042
	79.00	32.782	0.000	0.000	-31.659	-0.075	0.054
	84.00	35.963	0.000	0.000	-34.939	-0.065	0.060
	87.00	37.757	0.000	0.000	-36.799	-0.063	0.067
	89.00	38.908	0.000	0.000	-37.982	-0.063	0.074
	94.00	41.643	0.000	0.000	-40.802	-0.082	0.294
	99.00	44.195	0.000	0.000	-43.536	-0.081	0.212
	104.00	46.590	0.000	0.000	-45.983	-0.094	0.247
	109.00	48.855	0.000	0.000	-48.252	-0.119	0.214
	114.00	51.015	0.000	0.000	-50.416	-0.148	0.181
	119.00	53.098	0.000	0.000	-52.514	-0.165	0.160
	124.00	55.129	0.000	0.000	-54.683	-0.447	0.139
	129.00	57.135	0.000	0.000	-56.678	-0.441	0.133
	134.00	59.142	0.000	0.000	-58.718	-0.459	0.120
	139.00	60.000	0.000	0.000	-60.257	-0.470	0.090
	143.06	60.000	0.000	0.000	-60.117	-0.298	0.007
(1)	143.87	60.000	0.000	0.000	-60.100	-0.263	-0.018
(2)	144.75	60.000	0.000	0.000	-60.078	-0.242	-0.017

(1) Outboard Engine Cutoff
(2) Separation

TABLE 12 (CONT)

S-IB/S-IVB NOMINAL ATTITUDE HISTORY

TIME (SEC)	CHI PITCH (DEG)	CHI YAW (DEG)	CHI RØLL (DEG)	PHI PITCH (DEG)	PHI YAW (DEG)	PHI RØLL (DEG)
144.75	60.000	0.000	0.000	-60.079	-0.242	-0.017
145.00	60.000	0.000	0.000	-60.070	-0.237	-0.015
146.00	60.000	0.000	0.000	-59.998	-0.223	0.011
147.00	60.000	0.000	0.000	-59.837	-0.218	0.073
148.00	60.000	0.000	0.000	-59.550	-0.221	0.183
149.00	60.000	0.000	0.000	-59.158	-0.246	0.182
(3) 149.95	60.000	0.000	0.000	-58.930	-0.320	0.238

(3) J-2 90% Thrust

TABLE 12 (CONT)

S-IB/S-IVB NOMINAL ATTITUDE HISTORY

	TIME (SEC)	CHI PITCH (DEG)	CHI YAW (DEG)	CHI RØLL (DEG)	PHI PITCH (DEG)	PHI YAW (DEG)	PHI RØLL (DEG)
	149.95	60.000	0.000	0.000	-58.930	-0.320	0.238
	160.00	60.000	0.000	0.000	-60.102	-0.532	-0.043
	170.00	60.000	0.000	0.000	-60.183	-0.542	0.246
(4)	172.75	60.000	-0.000	0.000	-60.211	-0.606	0.340
	179.00	53.750	-0.807	0.000	-55.203	0.263	-0.072
	189.00	47.254	-0.905	0.000	-47.117	0.278	0.310
	199.00	48.402	-2.248	0.000	-48.505	1.462	-0.219
	209.00	49.772	-1.928	0.000	-49.862	1.326	-0.060
	219.00	51.025	-2.019	0.000	-51.141	1.369	0.216
	229.00	52.148	-1.962	0.000	-52.266	1.311	-0.256
	239.00	53.415	-1.952	0.000	-53.531	1.292	0.247
	249.00	54.514	-1.930	0.000	-54.655	1.261	-0.072
	259.00	55.617	-1.915	0.000	-55.751	1.239	0.066
	269.00	56.752	-1.891	0.000	-56.891	1.206	0.118
	279.00	57.819	-1.877	0.000	-57.974	1.182	-0.244
	289.00	58.879	-1.858	0.000	-59.026	1.156	0.021
	299.00	60.016	-1.832	0.000	-60.170	1.121	0.149
	309.00	61.043	-1.816	0.000	-61.210	1.096	-0.168
	319.00	62.048	-1.801	0.000	-62.224	1.071	-0.264
	329.00	63.013	-1.782	0.000	-63.190	1.044	0.303
	339.00	64.047	-1.761	0.000	-64.221	1.014	-0.261
	349.00	65.051	-1.744	0.000	-65.240	0.989	0.029
	359.00	65.959	-1.726	0.000	-66.160	0.961	0.302
	369.00	66.861	-1.712	0.000	-67.063	0.937	-0.314
	379.00	67.750	-1.698	0.000	-67.960	0.915	0.009
	389.00	68.675	-1.677	0.000	-68.880	0.885	0.346
	399.00	69.597	-1.660	0.000	-69.854	0.856	-0.210
	409.00	70.408	-1.649	0.000	-70.665	0.837	0.026
	419.00	71.255	-1.631	0.000	-71.518	0.809	0.380
	429.00	72.091	-1.617	0.000	-72.357	0.785	-0.237
	439.00	72.923	-1.603	0.000	-73.195	0.762	0.047
	449.00	73.736	-1.584	0.000	-74.013	0.734	0.206
	460.00	74.582	-1.572	0.000	-74.869	0.711	-0.296
	470.00	75.257	-1.562	0.000	-75.571	0.690	-0.009
	480.00	76.305	-1.559	0.000	-76.590	0.689	-0.043
	490.00	76.588	-1.493	0.000	-76.955	0.608	-0.197
	500.00	76.533	-1.451	0.000	-76.929	0.559	-0.141
	510.00	78.165	-1.502	0.000	-78.489	0.597	-0.237
	520.00	78.694	-1.493	0.000	-78.995	0.580	0.021
	530.00	79.586	-1.501	0.000	-79.889	0.580	0.219

(4) Initiate active guidance

TABLE 12 (CONT)

S-IB/S-IVB NOMINAL ATTITUDE HISTORY

	TIME (SEC)	CHI PITCH (DEG)	CHI YAW (DEG)	CHI RØLL (DEG)	PHI PITCH (DEG)	PHI YAW (DEG)	PHI RØLL (DEG)
	540.00	80.251	-1.504	0.000	-80.586	0.576	-0.230
	550.00	80.464	-1.493	0.000	-80.853	0.559	0.188
	560.00	80.298	-1.483	0.000	-80.642	0.537	0.345
	570.00	80.444	-1.535	0.000	-80.831	0.581	-0.151
	580.00	80.531	-1.566	0.000	-80.911	0.607	0.347
	590.00	80.620	-1.582	0.000	-81.006	0.618	-0.332
	600.00	80.704	-1.510	0.000	-81.089	0.563	0.121
(5)	601.55	80.708	-1.499	0.000	-81.104	0.531	0.189
	611.55	80.700	-3.908	0.000	-81.005	1.807	-0.041

(5) S-IVB GCS

TABLE 13

S-IB/S-IVB AERODYNAMIC PARAMETERS

	TIME (SEC)	MACH (U)	DRAG (N)	ALPP TØT.ANG.ATTK (DEG)	DYNAMIC PRESSURE (N/M2)	RELATIVE VELØCITY (M/S)	TØTAL ACCELERATIØN (M/S2)
	0.00	0.00	26556	0.00	0.00	0.00	11.66
	5.00	0.03	17583	0.37	71.92	11.05	12.19
	10.00	0.07	27812	0.38	334.32	23.92	12.54
	14.00	0.10	42551	0.36	729.91	35.54	12.86
	19.00	0.15	70931	0.41	1523.51	51.86	13.24
	24.00	0.20	111845	0.35	2701.13	70.04	13.61
	29.00	0.26	121544	0.31	4316.15	90.24	14.05
	34.00	0.33	126996	0.27	6431.72	112.91	14.54
	39.00	0.41	159584	0.26	9034.66	138.04	15.01
	44.00	0.49	195652	0.30	12082.28	165.82	15.51
	49.00	0.59	235036	0.24	15497.98	196.56	16.04
	54.00	0.70	275871	0.19	19162.10	230.59	16.61
	59.00	0.83	344233	0.15	22894.43	268.17	17.16
	64.00	0.97	590105	0.12	26306.34	308.69	17.28
	69.00	1.13	723407	0.12	28812.30	350.57	17.71
	74.00	1.32	637462	0.12	30680.71	397.85	18.74
	79.00	1.54	558420	0.07	31555.29	451.84	19.81
	84.00	1.79	466659	0.04	30730.60	512.77	20.98
	87.00	1.94	412036	0.05	29207.41	552.94	21.71
	89.00	2.05	377311	0.19	27884.62	581.24	22.20
	94.00	2.30	294837	0.48	23511.40	657.46	23.48
	99.00	2.56	222680	0.51	19183.59	741.66	24.80
	104.00	2.84	168057	0.53	15220.67	833.98	26.15
	109.00	3.15	121397	0.47	11764.38	934.67	27.58
	114.00	3.46	83111	0.32	8767.09	1044.14	29.10
	119.00	3.78	54721	0.12	6353.70	1162.81	30.74
	124.00	4.12	34843	0.42	4496.63	1291.19	32.50
	129.00	4.47	21702	0.65	3128.11	1429.93	34.41
	134.00	4.85	13151	1.06	2157.43	1579.85	36.51
	139.00	5.35	7590	1.07	1500.99	1741.83	38.82
	143.06	5.74	4482	0.18	1073.28	1842.43	20.09
(1)	143.87	5.80	3619	0.39	985.30	1872.60	16.70
(2)	144.75	5.83		0.63	891.62	1872.71	2.00

(1) Outboard Engine Cutoff
(2) Separation

TABLE 13 (CONT)

S-IB/S-IVB AERODYNAMIC PARAMETERS

	TIME (SEC)	MACH (U)	DRAG (N)	ALPP TØT.ANG.ATTK (DEG)	DYNAMIC PRESSURE (N/M2)	RELATIVE VELØCITY (M/S)	TØTAL ACCELERATIØN (M/S2)
	144.75	5.77	3736	0.32	875.25	1855.48	0.25
	145.00	5.78	3628	0.39	849.56	1854.32	0.25
	146.00	5.79	3226	0.72	754.63	1849.68	0.24
	147.00	5.81	2883	1.13	670.54	1845.08	0.24
	148.00	5.82	2599	1.67	596.01	1840.57	0.53
	149.00	5.85	2363	2.32	530.66	1837.52	3.18
(3)	149.95	5.88	2167	2.78	476.45	1837.47	5.94

(3) J-2 90% Thrust

TABLE 13 (CONT).

S-IB/S-IVB AERODYNAMIC PARAMETERS

	TIME (SEC)	MACH (U)	DRAG (N)	ALPP TØT.ANG.ATTK (DEG)	DYNAMIC PRESSURE (N/M2)	RELATIVE VELØCITY (M/S)	TØTAL ACCELERATIØN (M/S2)
	149.95	5.88	4940	2.78	476.45	1837.47	5.87
	160.00	6.30	1598	4.11	152.52	1858.21	7.07
	170.00	6.76	510	6.42	46.26	1887.32	7.20
(4)	172.75	6.90	373	7.04	33.02	1896.66	7.44
	179.00	7.12	216	13.44	14.73	1918.86	7.53
	189.00	7.11	88	23.36	3.87	1954.59	7.67
	199.00	6.87	29	23.68	1.13	1992.23	7.82
	209.00	6.53	10	23.93	0.39	2033.37	7.97
	219.00	6.14	0.	24.21	0.15	2077.96	8.12
	229.00	5.71	0.	24.60	0.07	2125.98	8.29
	239.00	5.17	0.	24.80	0.04	2177.38	8.45
	249.00	4.76	0.	25.08	0.02	2232.13	8.62
	259.00	4.49	0.	25.33	0.01	2290.19	8.81
	269.00	4.30	0.	25.49	0.01	2351.59	8.99
	279.00	4.18	0.	25.65	0.01	2416.28	9.19
	289.00	4.10	0.	25.78	0.01	2484.35	9.40
	299.00	4.06	0.	25.76	0.01	2555.81	9.62
	309.00	4.07	0.	25.80	0.01	2630.66	9.85
	319.00	4.10	0.	25.81	0.00	2708.83	10.08
	329.00	4.15	0.	25.82	0.00	2790.41	10.34
	339.00	4.22	0.	25.71	0.00	2875.51	10.61
	349.00	4.30	0.	25.57	0.00	2964.16	10.88
	359.00	4.39	0.	25.48	0.00	3056.33	11.16
	369.00	4.50	0.	25.36	0.00	3152.04	11.46
	379.00	4.61	0.	25.21	0.00	3251.45	11.80
	389.00	4.73	0.	24.99	0.00	3354.81	12.15
	399.00	4.86	0.	24.67	0.00	3462.19	12.51
	409.00	4.99	0.	24.48	0.00	3573.67	12.89
	419.00	5.13	0.	24.21	0.00	3689.39	13.30
	429.00	5.28	0.	23.91	0.00	3809.58	13.74
	439.00	5.44	0.	23.59	0.00	3934.50	14.22
	449.00	5.59	0.	23.24	0.00	4064.43	14.69
	460.00	5.78	0.	22.87	0.00	4213.02	15.23
	470.00	5.95	0.	22.59	0.00	4351.03	14.85
	480.00	6.11	0.	22.03	0.00	4483.74	14.38
	490.00	6.26	0.	22.12	0.00	4614.61	14.50
	500.00	6.43	0.	22.56	0.00	4747.77	14.86
	510.00	6.59	0.	21.40	0.01	4885.09	15.32
	520.00	6.77	0.	21.28	0.01	5027.11	15.76
	530.00	6.94	0.	20.75	0.01	5173.62	16.25

(4) Initiate active guidance

TABLE 13 (CONT)

S-IB/S-IVB AERODYNAMIC PARAMETERS

	TIME (SEC)	MACH (U)	DRAG (N)	ALPP TØT.ANG.ATTK (DEG)	DYNAMIC PRESSURE (N/M2)	RELATIVE VELØCITY (M/S)	TØTAL ACCELERATIØN (M/S2)
	540.00	7.12	0.	20.40	0.01	5325.38	16.82
	550.00	7.30	0.	20.45	0.01	5482.95	17.50
	560.00	7.49	0.	20.93	0.01	5646.22	18.18
	570.00	7.68	0.	20.97	0.01	5815.39	18.95
	580.00	7.87	0.	21.08	0.01	5991.82	19.82
	590.00	8.06	0.	21.13	0.00	6175.31	20.60
	600.00	8.24	0.	21.17	0.00	6364.40	21.17
(5)	601.55	8.27	0	21.17	0.00	6394.07	21.27
	611.55	8.21	0	22.05	0.00	6392.86	0.04

(5) S-IVB GCS

TABLE 14

S-IB/S-IVB AERODYNAMIC PARAMETERS

	TIME (SEC)	MACH (U)	DRAG (LBS)	ALPP TØT.ANG.ATTK (DEG)	DYNAMIC PRESSURE (LB/FT^2)	RELATIVE VELØCITY (F/S)	TØTAL ACCELERATIØN (F/S2)
	0.00	0.00	5970.	0.00	0.0	0.00	38.25
	5.00	0.03	3953.	0.37	1.49	36.26	39.99
	10.00	0.07	6252.	0.38	6.93	78.49	41.15
	14.00	0.10	9566.	0.36	15.13	116.60	42.19
	19.00	0.15	15946.	0.47	31.58	170.15	43.45
	24.00	0.20	25144.	0.35	55.99	229.80	44.64
	29.00	0.26	27324.	0.31	89.47	296.07	46.11
	34.00	0.33	28549.	0.27	133.33	370.44	47.70
	39.00	0.41	35876.	0.26	187.29	452.89	49.24
	44.00	0.49	43985.	0.30	250.47	544.04	50.88
	49.00	0.59	52837.	0.24	321.27	644.89	52.63
	54.00	0.70	62018.	0.19	397.23	756.53	54.50
	59.00	0.83	77387.	0.15	474.60	879.83	56.28
	64.00	0.97	132661.	0.12	545.33	1012.77	56.71
	69.00	1.13	162627.	0.12	597.28	1150.17	58.09
	74.00	1.32	143306.	0.12	636.01	1305.28	61.48
	79.00	1.54	125538.	0.07	654.14	1482.41	65.00
	84.00	1.79	104909.	0.04	673.05	1682.33	68.83
	87.00	1.94	92629.	0.05	605.47	1814.10	71.24
	89.00	2.05	84822.	0.19	578.05	1906.97	72.85
	94.00	2.30	66283.	0.48	487.39	2157.01	77.02
	99.00	2.56	50060.	0.51	397.68	2433.28	81.36
	104.00	2.84	37780.	0.53	315.52	2736.17	85.79
	109.00	3.15	27291.	0.47	243.88	3066.50	90.48
	114.00	3.46	18684.	0.32	181.74	3425.65	95.48
	119.00	3.78	12301.	0.12	131.71	3814.99	100.85
	124.00	4.12	7832.	0.42	93.22	4236.18	106.61
	129.00	4.47	4879.	0.65	64.85	4691.39	112.89
	134.00	4.85	2957.	1.06	44.72	5183.23	119.77
	139.00	5.35	1706.	1.07	31.12	5714.68	127.35
	143.06	5.74	1007.	0.18	22.25	6044.72	65.92
(1)	143.87	5.80	906.	0.39	20.43	6143.70	54.79
(2)	144.75	5.83	814.	0.63	18.48	6144.06	6.56

(1) Outboard Engine Cutoff
(2) Separation

TABLE 14 (CONT)

S-IB/S-IVB AERODYNAMIC PARAMETERS

TIME (SEC)	MACH (U)	DRAG (LBS)	ALPP TØT.ANG.ATTK (DEG)	DYNAMIC PRESSURE (LB/FT^2)	RELATIVE VELØCITY (F/S)	TØTAL ACCELERATIØN (F/S2)
144.75	5.77	840.	0.32	18.14	6087.55	0.82
145.00	5.78	816.	0.39	17.61	6083.72	0.81
146.00	5.79	725.	0.72	15.64	6068.51	0.78
147.00	5.81	648.	1.13	13.90	6053.41	0.79
148.00	5.82	584.	1.67	12.36	6038.61	1.73
149.00	5.85	532.	2.32	11.00	6028.62	10.43
(3) 149.95	5.88	486.	2.78	9.88	6028.46	19.49

(3) J-2 90% Thrust

TABLE 14 (CONT)

S-IB/S-IVB AERODYNAMIC PARAMETERS

	TIME (SEC)	MACH (U)	DRAG (LBS)	ALPP TØT.ANG.ATTK (DEG)	DYNAMIC PRESSURE (LB/FT^2)	RELATIVE VELØCITY (F/S)	TØTAL ACCELERATIØN (F/S2)
	149.95	5.88	1110.	2.78	9.88	6028.46	19.27
	160.00	6.30	360.	4.11	3.16	6096.50	23.20
	170.00	6.76	115.	6.42	.96	6192.00	23.61
(4)	172.75	6.90	84.	7.04	.68	6222.63	24.41
	179.00	7.12	47.	13.44	.24	6295.49	24.70
	189.00	7.11	20.	23.36	.08	6412.71	25.16
	199.00	6.87	6.	23.68	.03	6536.18	25.65
	209.00	6.53	2.	23.93	.01	6671.15	26.15
	219.00	6.14	1.	24.21	0.00	6817.44	26.64
	229.00	5.71	0.	24.60	0.00	6975.00	27.19
	239.00	5.17	0.	24.80	0.00	7143.62	27.72
	249.00	4.76	0.	25.08	0.00	7323.25	28.28
	259.00	4.49	0.	25.33	0.00	7513.75	28.89
	269.00	4.30	0.	25.49	0.00	7715.19	29.49
	279.00	4.18	0.	25.65	0.00	7927.44	30.14
	289.00	4.10	0.	25.78	0.00	8150.77	30.86
	299.00	4.06	0.	25.76	0.00	8385.22	31.57
	309.00	4.07	0.	25.80	0.00	8630.79	32.30
	319.00	4.10	0.	25.81	0.00	8887.22	33.07
	329.00	4.15	0.	25.82	0.00	9154.88	33.92
	339.00	4.22	0.	25.71	0.00	9434.09	34.81
	349.00	4.30	0.	25.57	0.00	9724.94	35.70
	359.00	4.39	0.	25.48	0.00	10027.34	36.63
	369.00	4.50	0.	25.36	0.00	10341.34	37.60
	379.00	4.61	0.	25.21	0.00	10667.49	38.70
	389.00	4.73	0.	24.99	0.00	11006.58	39.86
	399.00	4.86	0.	24.67	0.00	11358.88	41.04
	409.00	4.99	0.	24.48	0.00	11724.65	42.29
	419.00	5.13	0.	24.21	0.00	12104.30	43.63
	429.00	5.28	0.	23.91	0.00	12498.61	45.07
	439.00	5.44	0.	23.59	0.00	12908.47	46.64
	449.00	5.59	0.	23.24	0.00	13334.76	48.19
	460.00	5.78	0.	22.87	0.00	13822.24	49.97
	470.00	5.95	0.	22.59	0.00	14275.05	48.72
	480.00	6.11	0.	22.03	0.00	14710.43	47.17
	490.00	6.26	0.	22.12	0.00	15139.81	47.56
	500.00	6.43	0.	22.56	0.00	15576.68	48.76
	510.00	6.59	0.	21.40	0.00	16027.18	50.27
	520.00	6.77	0.	21.28	0.00	16493.14	51.70
	530.00	6.94	0.	20.75	0.00	16973.82	53.31

(4) Initiate Active guidance

TABLE 14 (CONT)

S-IB/S-IVB AERODYNAMIC PARAMETERS

	TIME (SEC)	MACH (U)	DRAG (LB)	ALPP TØT.ANG.ATTK (DEG)	DYNAMIC PRESSURE (LB/FT^2)	RELATIVE VELØCITY (F/S)	TØTAL ACCELERATIØN (F/S2)
	540.00	7.12	0.	20.40	0.00	17471.71	55.19
	550.00	7.30	0.	20.45	0.00	17988.69	57.42
	560.00	7.49	0.	20.93	0.00	18524.33	59.64
	570.00	7.68	0.	20.97	0.00	19079.37	62.18
	580.00	7.87	0.	21.08	0.00	19658.22	65.03
	590.00	8.06	0.	21.13	0.00	20260.22	67.58
	600.00	8.24	0.	21.17	0.00	20880.58	69.44
(5)	601.55	8.27	0.	21.17	0.00	20977.92	69.78
	611.55	8.21	0.	22.05	0.00	20973.95	0.13

(5) S-IVB GCS

TABLE 15

S-IB RETRO AND COAST-TO-IMPACT TRAJECTORY IN SPACE-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	ALTITUDE (M)	RADIUS (M)	VELOCITY (M/SEC)	PATH ANGLE (DEG)
	144.75	02:24.8	56459.	6429825.	2210.33	64.633
	145.00	02:25.0	56700.	6430062.	2206.72	64.698
(1)	145.93	02:25.9	57574.	6430941.	2191.66	64.919
	202.00	03:22.0	94975.	6468405.	2001.63	77.994
	252.00	04:12.0	104576.	6478066.	1955.21	90.871
	302.00	05:02.0	91880.	6465431.	2015.83	103.657
	352.00	05:52.0	56876.	6430490.	2156.59	115.140
	402.00	06:42.0	17944.	6391604.	6962.49	113.360
	452.00	07:32.0	7975.	6381639.	4572.45	111.521
	502.00	08:22.0	715.	6374378.	4323.67	106.881
(2)	507.78	08:27.8	0.	6373663.	4312.14	106.448

(1) S-IB RETRO CUTOFF
(2) S-IB THEORETICAL IMPACT

TABLE 15 (CONT)

S-IB RETRO AND COAST-TO-IMPACT TRAJECTORY IN SPACE-FIXED PARAMETERS

	TIME (SEC)	X (M)	Y (M)	Z (M)	X-DOT (M/SEC)	Y-DOT (M/SEC)	Z-DOT (M/SEC)
	144.75	121883.	6428669.	2163.	2011.26	909.02	-118.55
	145.00	122388.	6428897.	2134.	2008.97	905.31	-118.54
(1)	145.93	124269.	6429740.	2022.	1990.28	890.63	-118.50
	148.00	126441.	6431554.	1147.	1995.19	868.96	-118.39
	252.00	331168.	6469586.	-11072.	1947.44	-129.63	-116.33
	302.00	427875.	6451235.	-16850.	1919.59	-604.62	-114.71
	352.00	522862.	6409159.	-22536.	1867.89	-1071.98	-112.77
	402.00	593007.	6363973.	-28335.	598.57	-333.59	-123.27
	452.00	615291.	6351813.	-34573.	388.03	-206.80	-125.45
	502.00	634343.	6342606.	-40865.	379.23	-164.92	-126.20
(2)	507.78	636535.	6341662.	-41595.	379.32	-161.61	-126.28

(1) S-IB RETRO CUTOFF
(2) S-IB THEORETICAL IMPACT

TABLE 16

S-IB RETRO- AND COAST-TO-IMPACT TRAJECTORY IN SPACE-FIXED PARAMETER

	TIME (SEC)	TIME (MIN:SEC)	ALTITUDE (FT)	RADIUS (FT)	VELOCITY (FT/SEC)	PATH ANGLE (DEG)
	144.75	02:24.8	181952.	21095227.	7251.74	64.633
	145.00	02:25.0	186023.	21096005.	7239.90	64.698
(1)	145.93	02:25.9	188891.	21098888.	7190.49	64.919
	148.00	02:28.0	194977.	21104974.	7150.33	65.379
	252.00	04:12.0	343097.	21253498.	6414.73	90.871
	302.00	05:02.0	301446.	21212045.	6613.62	103.657
	352.00	05:52.0	186601.	21097409.	7075.43	115.140
	402.00	06:42.0	58871.	20969830.	22842.82	113.360
	452.00	07:32.0	26164.	20937136.	15001.48	111.521
	502.00	08:22.0	2345.8	20913314.	14185.27	106.881
(2)	507.78	08:27.8	0.0	20910969.	14147.44	106.448

(1) S-IB RETRO CUTOFF
(2) S-IB THEORETICAL IMPACT

TABLE 16 (CONT)

S-IB RETRO- AND COAST TO IMPACT TRAJECTORY IN SPACE-FIXED PARAMETERS

	TIME (SEC)	X (FT)	Y (FT)	Z (FT)	X-DOT (FT/SEC)	Y-DOT (FT/SEC)	Z-DOT (FT/SEC)
	144.75	399879.	21091434.	7096.	6598.62	2982.35	-388.94
	145.00	401535.	21092182.	7001.	6591.11	2970.18	-388.91
(1)	145.93	407707.	21094948.	6634.	6529.79	2922.01	-388.78
	148.00	414833.	21100900.	3763.	6545.90	2850.92	-388.42
	252.00	1086509.	21225677.	-36325.	6389.24	-425.30	-381.66
	302.00	1403789.	21165470.	-55282.	6297.87	-1983.66	-376.35
	352.00	1715427.	21027425.	-73937.	6128.25	-3516.99	-369.98
	402.00	1945561.	20879177.	-92963.	1963.81	-1094.46	-404.43
	452.00	2018671.	20839282.	-113428.	1273.06	-678.48	-411.58
	502.00	2081178.	20809075.	-134072.	1244.19	-541.08	-414.04
(2)	507.78	2088369.	20805978.	-136467.	1244.49	-530.22	-414.30

(1) S-IB RETRO CUTOFF
(2) S-IB THEORETICAL IMPACT

TABLE 17

S-IB RETRO AND COAST-TO-IMPACT TRAJECTORY IN EARTH-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	RANGE (M)	VELOCITY (M/SEC)	PATH ANGLE (DEG)	GEODETIC LATITUDE (DEG)	LONGITUDE (DEG)
	144.75	02:24.8	56994.	1855.51	59.31	28.3777	79.9809
	145.00	02:25.0	57391.	1851.69	59.37	28.3767	79.9771
(1)	145.93	02:25.9	58869.	1835.83	59.60	28.3732	79.9625
	148.00	02:28.0	62217.	1821.96	60.11	28.3757	79.9479
	252.00	04:12.0	221892.	1551.27	91.10	27.9791	78.3847
	302.00	05:02.0	298327.	1627.02	107.01	27.7786	77.6420
	352.00	05:52.0	375339.	1801.95	120.56	27.5702	76.8972
	402.00	06:42.0	429040.	360.82	139.92	27.4213	76.3801
	452.00	07:32.0	432656.	168.19	175.78	27.4110	76.3454
	502.00	08:22.0	432844.	125.55	179.69	27.4103	76.3436
(2)	507.78	08:27.8	432847.	122.10	179.74	27.4103	76.3436

(1) S-IB RETRO CUTOFF
(2) S-IB THEORETICAL IMPACT

TABLE 17 (CONT)

S-IB RETRO AND COAST-TO-IMPACT TRAJECTORY IN EARTH-FIXED PARAMETERS

	TIME (SEC)	XXXE (M)	YYYE (M)	ZZZE (M)	XXXE-DOT (M/SEC)	YYYE-DOT (M/SEC)	ZZZE-DOT (M/SEC)
	144.75	57658.	56167.	109.	1605.07	930.95	2.62
	145.00	58060.	56400.	110.	1602.78	927.28	2.65
(1)	145.93	59561.	57264.	112.	1592.87	912.71	2.76
	148.00	62840.	59123.	118.	1589.02	891.36	3.04
	252.00	225562.	100652.	1122.	1548.87	-84.84	15.67
	302.00	302579.	84802.	2028.	1531.32	-594.40	20.40
	352.00	378500.	45738.	3144.	1494.10	-1007.04	23.93
	402.00	429917.	3483.	4012.	212.97	-291.24	3.88
	452.00	432852.	-6706.	4068.	.83	-168.19	.02
	502.00	432542.	-13963.	4062.	-8.00	-125.30	-.15
(2)	507.78	432496.	-14677.	4061.	-7.89	-121.84	-.15

(1) S-IB RETRO CUTOFF
(2) S-IB THEROETICAL IMPACT

TABLE 18

S-IB RETRO AND COAST-TO-IMPACT TRAJECTORY IN EARTH-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	RANGE (FT)	VELOCITY (FT/SEC)	PATH ANGLE (DEG)	GEODETIC LATITUDE (DEG)	LONGITUDE (DEG)
	144.75	02:24.8	187005.	6087.63	59.31	28.3777	79.9809
	145.00	02:25.0	188291.	6075.10	59.37	28.3767	79.9771
(1)	145.93	02:25.9	193140.	6023.06	59.60	28.3732	79.9625
	148.00	02:28.0	204124.	5977.56	60.11	28.3757	79.9479
	252.00	04:12.0	727992.	5089.47	91.10	27.9791	78.3847
	302.00	05:02.0	978763.	5337.99	107.01	27.7786	77.6420
	352.00	05:52.0	1231427.	5911.91	120.56	27.5702	76.8972
	402.00	06:42.0	1407612.	1183.79	139.92	27.4213	76.3801
	452.00	07:32.0	1419475.	551.80	175.78	27.4110	76.3454
	502.00	08:22.0	1420092.	411.91	179.69	27.4103	76.3436
(2)	507.78	08:27.8	1420102.	400.59	179.74	27.4103	76.3436

(1) S-IB RETRO CUTOFF
(2) S-IB THEORETICAL IMPACT

TABLE 18 (CONT)

S-IB RETRO AND COAST-TO-IMPACT TRAJECTORY IN EARTH-FIXED PARAMETERS

	TIME (SEC)	XXXE (FT)	YYYE (FT)	ZZZE (FT)	XXXE-DOT (FT/SEC)	YYYE-DOT (FT/SEC)	ZZZE-DOT (FT/SEC)
	144.75	189167.	184275.	358.	5265.98	3054.30	8.60
	145.00	190486.	185039.	361.	5258.46	3042.26	8.70
(1)	145.93	195410	187874.	367.	5225.95	2994.46	9.06
	148.00	206168.	193973	387.	5213.32	2924.41	9.97
	252.00	740033.	330223.	3681.	5081.59	-278.35	51.41
	302.00	992713.	278225.	6654.	5024.02	-1950.13	66.93
	352.00	1241798.	150059.	10315.	4901.90	-3303.94	78.51
	402.00	1410489.	11427.	13163.	698.72	-955.51	12.73
	452.00	1420118.	-22001.	13346.	2.72	-551.80	.07
	502.00	1419101.	-45810.	13327.	-26.25	-411.09	-.49
(2)	507.78	1418950.	-48153.	13324.	-25.89	-399.74	-.49

(1) S-IB RETRO CUTOFF
(2) S-IB THEORETICAL IMPACT

TABLE 19

S-IVB COAST-TO-IMPACT TRAJECTORY IN SPACE-FIXED PARAMETERS

TIME (SEC)	TIME (MIN:SEC)	ALTITUDE (M)	RADIUS (M)	VELOCITY (M/SEC)	PATH ANGLE (DEG)
611.55	10:11.55	221333	6596142	6802.98	86.168
653.0	10:53.0	238048	6613109	6780.30	86.923
703.	11:43.0	253202	6628565	6759.71	87.844
753.	12:33.0	262867	6638531	6746.51	88.774
803.	13:23.0	267037	6642996	6740.71	89.709
818.8	13:38.8	267212	6643263	6740.41	90.004
853.	14:13.0	265710	6641956	6742.28	90.645
903.	15:03.0	258888	6635412	6751.23	91.578
953.	15:53.0	246581	6623368	6767.58	92.505
1003.	16:43.0	228009	6605836	6791.32	93.422
1053.	17:33.0	205567	6582832	6822.49	94.326
1103.	18:23.0	176904	6554379	6861.09	95.213
1153.	19:13.0	142843	6520505	6907.16	96.079
1203.	20:03.0	103423	6481247	6960.43	96.921
1253.	20:53.0	59071	6437026	6630.31	97.769
1303.	21:43.0	29811	6407824	1308.68	101.895
1353.	22:33.0	18473	6396491	573.44	111.443
1403.	23:23.0	10460	6388479	481.80	104.609
1453.	24:13.0	5289	6383308	472.61	100.936
1503.	25:03.0	1270	6379289	469.32	98.892
*1521.1	25:21.1	0	6378019	468.57	98.373

*S-IVB THEORETICAL IMPACT

TABLE 19 (CONT)

S-IVB COAST-TO-IMPACT TRAJECTORY IN SPACE-FIXED PARAMETERS

TIME (SEC)	X (M)	Y (M)	Z (M)	X-DOT (M/SEC)	Y-DOT (M/SEC)	Z-DOT (M/SEC)
611.55	1940020.	6304231.	-45626.	6620.59	-1562.33	-86.86
653.00	2212039.	6231988.	-49163.	6501.58	-1922.18	-83.76
703.00	2533133.	6125217.	-53253.	6338.70	-2346.95	-79.81
753.00	2845563.	5997466.	-57140.	6155.07	-2761.30	-75.63
803.00	3148301.	5849265.	-60813.	5951.07	-3164.93	-71.23
818.79	3241734.	5798299.	-61926.	5882.46	-3290.12	-69.80
853.00	3440335.	5681157.	-64260.	5726.96	-3557.51	-66.62
903.00	3720665.	5493705.	-67471.	5482.91	-3938.66	-61.79
953.00	3988296.	5287489.	-70436.	5219.04	-4307.96	-56.76
1003.00	4242239.	5063115.	-73144.	4935.38	-4664.92	-51.53
1053.00	4481503.	4821213.	-75586.	4631.89	-5008.96	-46.10
1103.00	4705097.	4562445.	-77751.	4308.49	-5339.45	-40.47
1153.00	4912019.	4287506.	-79629.	3965.03	-5655.63	-34.64
1203.00	5101261.	3997137.	-81212.	3601.14	-5956.39	-28.63
1253.00	5270371.	3694818.	-82590.	3036.69	-5893.91	-35.51
1303.00	5354639.	3518544.	-88876.	465.15	-1204.49	-213.25
1353.00	5364599.	3482254.	-100434.	79.95	-515.14	-238.89
1403.00	5369090.	3460185.	-112491.	109.34	-401.89	-242.20
1453.00	5375227.	3440644.	-124610.	133.17	-383.18	-242.49
1503.00	5382233.	3421726.	-136738.	145.84	-374.35	-242.60
1521.10	5384896.	3414983.	-141121	148.87	-372.20	-242.62

TABLE 20

S-IVB COAST-TO-IMPACT TRAJECTORY IN SPACE-FIXED PARAMETERS

	TIME (SEC)	TIME (MIN:SEC)	ALTITUDE (FT)	RADIUS (FT)	VELOCITY (FT/SEC)	PATH ANGLE (DEG)
	611.55	10:11.55	726158	21640887	22319.49	86.168
	653.0	10:53.0	780997	21696553	22245.08	86.923
	703.	11:43.0	830715	21747261	22177.53	87.844
	753.	12:33.0	802425	21779958	22134.22	88.774
	803.	13:23.0	876106	21794607	22115.19	89.709
	818.8	13:38.8	876680	21795483	22114.21	90.004
	853.	14:13.0	871752	21791195	22121.34	90.645
	903.	15:03.0	849370	21769725	22149.71	91.578
	953.	15:53.0	808993	21730211	22203.35	92.505
	1003	16:43.0	748061	21672691	22281.23	93.422
	1053	17:33.0	674432	21597219	22383.50	94.326
	1103	18:23.0	580394	21503869	22510.14	95.213
	1153	19:13.0	468645	21392734	22661.29	96.079
	1203	20:03.0	339314	21263934	22836.06	96.921
	1253	20:53.0	193802	21118852	21752.99	97.769
	1303	21:43.0	97805	21023045	4293.57	101.895
	1353	22:33.0	60607	20985864	1881.36	111.443
	1403	23:23.0	34318	20959577	1580.71	104.609
	1453	24:13.0	17352	20942612	1550.56	100.936
	1503	25:03.0	4167	20929427	1539.76	98.892
*	1521.1	25:21.1	0	20925260	1537.30	98.373

*S-IVB THEORETICAL IMPACT

TABLE 20 (CONT)

S-IVB COAST-TO-IMPACT TRAJECTORY IN SPACE-FIXED PARAMETERS

TIME (SEC)	X (FT)	Y (FT)	Z (FT)	X-DOT (FT/SEC)	Y-DOT (FT/SEC)	Z-DOT (FT/SEC)
611.55	6364896.	20683174.	-149693.	21721.09	-5125.77	-284.96
653.00	7257346.	20446155.	-161296.	21330.66	-6306.38	-274.80
703.00	8310805.	20095856.	-174715.	20796.25	-7699.98	-261.84
753.00	9335837.	19676728.	-187468.	20193.81	-9059.39	-248.13
803.00	10329072.	19190503.	-199516.	19524.51	-10383.63	-233.70
810.00	10620345.	19023291.	-203170.	19299.39	-10794.37	-299.00
853.00	11287189	18638969.	-210826.	18789.22	-11671.62	-218.56
903.00	12206907	18023967.	-221361.	17988.55	-12922.12	-202.74
953.00	13084961	17347405.	-231088.	17122.83	-14133.73	-186.24
1003.00	13918107	16611269.	-239974.	16192.19	-15304.85	-169.07
1053.00	14703094	15817628.	-247984.	15196.51	-16433.61	-151.24
1103.00	15436670	14968650.	-255087.	14135.48	-17517.90	-132.77
1153.00	16115548	14066622.	-261250.	13008.62	-18555.23	-113.65
1203.00	16736421	13113966.	-266442.	11814.77	-19541.96	-93.94
1353.00	17291244	12122105.	-270966.	9962.90	-19336.99	-116.51
1303.00	17567714	11543781.	-291586.	1526.07	- 3951.75	-699.64
1353.00	17600391	11424718.	-329508.	262.31	-1690.09	-783.76
1403.00	17615125	11352313.	-369065.	358.72	-1318.54	-794.61
1453.00	17635260	11288201.	-408826.	436.92	-1257.15	-795.58
1503.00	17658245	11226134.	-448615.	478.48	-1228.19	-795.94
*1521.10	17666982	11204011.	-462996.	488.40	-1221.14	-796.01

*S-IVB THEORETICAL IMPACT

TABLE 21

S-IVB COAST-TO-IMPACT TRAJECTORY IN EARTH-FIXED PARAMETERS

TIME (SEC)	TIME (MIN:SEC)	RANGE (M)	VELOCITY (M/SEC)	PATH ANGLE (DEG)	LATITUDE (DEG)	LONGITUDE (DEG)
611.55	10:11.55	1657306	6397.13	85.925	23.4279	64.9823
653.00	10:53.	1912211	6373.29	86.726	22.4830	62.7157
703.	11:43	2218101	6351.72	87.706	21.3008	60.0402
753.	12:33	2522776	6337.98	88.695	20.0746	57.4219
803.	13.23.0	2826777	6332.08	89.690	18.8065	54.8537
818.8	13:38.8	2922730	6331.84	90.005	18.3976	54.0519
853.	14:13	3130640	6333.99	90.686	17.4982	52.3286
903.	15:03	3434900	6343.73	91.679	16.1511	49.8396
953.	15:53	3740093	6361.28	92.665	14.7662	47.3797
1003.	16:43	4046763	6386.66	93.640	13.3443	44.9417
1053	17:33	4355461	6419.86	94.598	11.8859	42.5187
1103	18:23	4466753	6460.89	95.537	10.3914	40.1032
1153	19:13	4981220	6509.77	96.452	8.8608	37.6878
1203	20:03	5299461	6566.21	97.338	7.2943	35.2648
1253	20:53	5619100	6239.35	98.259	5.7067	32.8488
1303	21:43	5791261	907.46	107.292	4.8470	31.5533
1353	22:33	5807600	209.61	159.030	4.7671	31.4331
1403	23:23.0	5808465	121.54	178.920	4.7611	31.4239
1453	24:13.	5808496	89.66	179.905	4.7609	31.4237
1503	25:03.0	5808501	72.55	179.929	4.7609	31.4236
*1521.1	25:21.1	5808503	68.23	179.932	4.7609	31.4236

*S-IVB THEORETICAL IMPACT

TABLE 21 (CONT)

S-IVB COAST-TO-IMPACT TRAJECTORY IN EARTH-FIXED PARAMETERS

TIME (SEC)	XXXE (M)	YYYE (M)	ZZZE (M)	XXXE-DOT (M/SEC)	YYYE-DOT (M/SEC)	ZZZE-DOT (M/SEC)
611.55	1695314.	-231.	40113.	6279.09	-1206.19	205.03
653.00	1953605.	-57118.	48894.	6181.17	-1537.62	218.46
703.00	2259380.	-143843.	60188.	6046.91	-1930.02	232.96
753.00	2558005.	-249985.	72157.	5895.23	-2314.30	245.49
818.79	2938594.	-418544.	88767.	5669.52	-2807.44	258.83
853.00	3130360.	-518885.	97717.	5540.51	-3058.16	264.28
903.00	3402385.	-680811.	111093.	5337.67	-3417.47	270.36
953.00	3663844.	-860487.	124714.	5117.83	-3768.10	274.09
1003.00	3913884.	-1057472.	138461.	4880.89	-4109.80	275.39
1053.00	4151645.	-1271312.	152211.	4626.67	-4442.23	274.16
1103.00	4376258.	-1501533.	165834.	4355.00	-4764.97	270.32
1153.00	4586837.	-1747639.	179197.	4065.26	-5077.52	263.76
1203.00	4782478.	-2009103.	192163.	3757.18	-5379.04	254.39
1253.00	4960624.	-2282786.	204475.	3224.40	-5336.75	227.67
1303.00	5046013.	-2436399.	210638.	318.62	-849.29	25.86
1353.00	5046899.	-2456029.	210885.	-116.45	-191.90	-4.40
1403.00	5041316.	-2461899.	210641.	-94.58	-76.21	-4.32
1453.00	5037251.	-2465088.	210456.	-70.73	-55.01	-3.22
1503.00	5034080.	-2467553.	210312.	-57.25	-44.49	-2.60
*1521.10	5033078.	-2468332.	210266.	-53.85	-41.84	-2.44

*S-IVB THEORETICAL IMPACT

TABLE 22

S-IVB COAST-TO-IMPACT TRAJECTORY IN EARTH-FIXED PARAMETERS

TIME (SEC)	TIME (MIN:SEC)	GROUND RANGE (FT)	EARTH-FIXED VELOCITY (FT/SEC)	EARTH-FIXED PATH ANGLE (DEG)	GEOD.-LAT POSITIVE-N (DEG)	LONGITUDE POSITIVE-W (DEG)
611.55	10:11.55	5437356	20987.97	85.925	23.4279	64.9823
653.00	10:53.0	6273658	20909.75	86.726	22.4830	62.7157
703.00	11:43.0	7277234	20838.96	87.706	21.3008	60.0402
753.00	12:33.0	8276824	20793.90	88.695	20.0746	57.4219
803.00	13:23.0	9274203	20774.53	89.690	18.8065	54.8537
818.79	13:38.8	9589009	20773.74	90.005	18.3976	54.0519
853.00	14:13.0	10271129	20780.82	90.686	17.4982	52.3286
903.00	15:03.0	11269357	20812.76	91.679	16.1511	49.8396
953.00	15:53.0	12270647	20870.35	92.665	14.7662	47.3797
1003.00	16:43.0	13276782	20953.60	93.640	13.3443	44.9417
1053.00	17:33.0	14289571	21062.53	94.598	11.8859	42.5187
1103.00	18:23.0	14654702	21197.16	95.537	10.3914	40.1032
1153.00	19:13.0	16342586	21357.52	96.452	8.8608	37.6878
1203.00	20:03.0	17386684	21542.70	97.338	7.2943	35.2648
1253.00	20:53.0	18435368	20470.31	98.259	5.7067	32.8488
1303.00	21:43.0	19000201	2977.23	107.292	4.8470	31.5533
1353.00	22:33.0	19053806	736.58	159.030	4.7671	31.4331
1403.00	23:23.0	19056644	398.76	178.920	4.7611	31.4239
1453.00	24:13.0	19056746	294.16	179.905	4.7609	31.4237
1503.00	25:03.0	19056762	238.02	179.929	4.7609	31.4236
*1521.10	25:21.1	19056769	223.87	179.932	4.7609	31.4236

*S-IVB THEORETICAL IMPACT

TABLE 22 (CONT)

S-IVB COAST-TO-IMPACT TRAJECTORY IN EARTH-FIXED PARAMETERS

TIME (SEC)	XXXE (FT)	YYYE (FT)	ZZZE (FT)	XXXE-DOT (FT/SEC)	YYYE-DOT (FT/SEC)	ZZZE-DOT (FT/SEC)
611.55	5562055.	-759.	131603.	20600.53	-3957.32	672.68
653.00	6409465.	-187396.	160414.	20279.43	-5044.67	716.74
703.00	7412664.	-471925.	197466.	19838.93	-6332.07	764.29
753.00	8392406.	-820159.	236736.	19341.31	-7592.85	805.40
803.00	9345856.	-1230762.	277894.	18787.35	-8826.73	839.77
818.79	9641056.	-1373177.	291230.	18600.78	-9210.77	849.17
853.00	10270210.	-1702378.	320595.	18177.53	-10033.34	867.07
903.00	11162681.	-2233632.	364478.	17512.04	-11212.17	887.00
953.00	12020486.	-2823120.	409167.	16790.79	-12362.54	899.24
1003.00	12840827.	-3469397.	454270.	16013.43	-13483.60	903.51
1053.00	13620883.	-4170972.	499380.	15179.35	-14574.23	899.48
1103.00	14357802.	-4926290.	544075.	14287.72	-15633.10	886.87
1153.00	15048678.	-5733724.	587918.	13337.46	-16658.54	865.35
1203.00	15690545.	-6591545.	630456.	12326.71	-17647.76	834.60
1253.00	16275014.	-7489454.	670849.	10578.75	-17509.01	746.94
1303.00	16555161.	-7993434.	691071.	1045.35	-2786.38	84.83
1353.00	16558068.	-8057837.	691880.	-382.04	-629.59	-14.44
1403.00	16539751.	-8077095.	691081.	-310.30	-250.04	-14.19
1453.00	16526415.	-8087560.	690471.	-232.04	-180.48	-10.57
1503.00	16516011.	-8095647.	689999.	-187.82	-145.96	-8.52
*1521.10	16512724.	-8098203.	689849.	-176.66	-137.27	-8.00

*S-IVB THEORETICAL IMPACT

TABLE 23

NOMINAL CAMERA TRAJECTORY

TIME (SEC)	TIME (MIN:SEC)	RRR (M)	ALT (M)	GEODETIC LATITUDE (DEG)	LONGITUDE (DEG)	RANGE (M)
170.0	2:50	6445476	72083	28.293	79.611	96430
200.0	3:20	6462527	89099	28.180	79.159	142616
250.0	4:10	6473031	99544	27.987	78.412	219050
300.0	5:00	6461203	87654	27.786	77.669	295517
350.0	5:50	6427045	53432	27.578	76.924	372513
400.0	6:40	6389647	15990	27.433	76.419	425006
450.0	7:30	6381367	7708	27.426	76.395	427499
500.0	8:20	6375616	1957	27.425	76.394	427579
520.8	8:40.8	6373659	0	27.425	76.394	427580

TABLE 24

DISPERSIONS DUE TO THREE-SIGMA S-IB STAGE

PROPULSION TOLERANCES AT OUTBOARD ENGINE CUTOFF

VARIATIONS	TIME FROM LIFT-OFF (SEC)	PATH ANGLE SPACE FIXED (DEG)	ALTITUDE (M)	RANGE (M)	VELOCITY SPACE FIXED (M/SEC)
NOMINAL	143.870	64.459	55629.3	55636.9	2209.53
PROPELLANT LOADING MASS (+)	0.43	0.153	-32.4	459.6	7.78
PROPELLANT LOADING MASS (-)	-0.43	-0.163	33.6	-454.0	-4.75
THRUST AND FLOW RATE (+)	-2.17	-1.142	1329.4	-1727.6	2.80
THRUST AND FLOW RATE (-)	2.23	1.126	-1511.0	1677.6	-5.30
I_{SP} ($-\dot{W}$)	0.50	0.120	285.4	641.6	8.99
I_{SP} ($+\dot{W}$)	-0.50	-0.122	-285.6	-638.2	-9.03
MIXTURE RATIO (+)	-.320	-0.333	-334.9	-518.0	-11.55
MIXTURE RATIO (-)	.160	0.016	168.0	260.3	5.80
HIGH GROUND WIND	.770	.388	-576.2	553.5	-1.71
LOW GROUND WIND	-.470	-.202	153.0	-445.2	-3.58
HIGH AMBIENT TEMPERATURE	-.690	-.324	358.0	-577.4	-1.63
LOW AMBIENT TEMPERATURE	.900	.409	-457.2	754.1	2.35
POSITIVE RSS	2.602	1.274	1424.6	2064.4	13.72
NEGATIVE RSS	-2.438	-1.266	-1737.2	-2097.1	-16.85

TABLE 25

DISPERSIONS DUE TO THREE-SIGMA S-IB STAGE

PROPULSION TOLERANCES AT OUTBOARD ENGINE CUTOFF

VARIATIONS	X SPACE FIXED (M)	Y SPACE FIXED (M)	Z SPACE FIXED (M)	X-DOT SPACE FIXED (M/SEC)	Y-DOT SPACE FIXED (M/SEC)	Z-DOT SPACE FIXED (M/SEC)	VEHICLE RADIAL DISTANCE (M)
NOMINAL	120143.1	6427868.8	1106.3	2007.53	915.30	-118.54	6428991.6
PROPELLANT LOADING MASS (+)	634.3	-43.8	-50.4	9.64	-2.05	-0.14	-32.0
PROPELLANT LOADING MASS(-)	-628.7	44.9	50.3	-7.08	3.68	0.12	33.3
THRUST AND FLOW RATE (+)	-2583.1	1375.8	248.0	-17.31	41.01	0.39	1328.1
THRUST AND FLOW RATE (-)	2551.9	-1557.9	-255.0	13.91	-41.77	-.41	-1509.8
I_{SP} $(-\dot{W})$	851.9	270.1	-58.4	10.23	-0.47	-0.12	285.9
I_{SP} $(+\dot{W})$	-848.3	-270.4	58.3	-10.28	0.48	0.12	-286.1
MIXTURE RATIO (+)	-656.3	-323.2	38.3	-11.05	-3.72	0.12	-335.3
MIXTURE RATIO (-)	329.5	162.1	-19.2	5.54	1.87	-0.06	168.2
HIGH GROUND WIND	853.9	-591.8	-85.1	4.77	-14.77	-.10	-575.7
LOW GROUND WIND	-6331.5	164.4	52.9	-6.51	4.62	.09	152.6
HIGH AMBIENT TEMPERATURE	-850.2	373.5	76.6	-6.82	10.97	.10	357.6
LOW AMBIENT TEMPERATURE	1110.1	-477.5	-100.0	8.78	-13.77	-.13	-456.6
POSITIVE RSS	3116.1	1469.9	278.5	22.84	42.90	.46	1423.6
NEGATIVE RSS	-7002.1	-1784.6	-333.1	-25.81	-46.59	-.48	-1736.3

TABLE 26

DISPERSIONS DUE TO THREE-SIGMA S-IB STAGE

NON-PROPULSION TOLERANCES AT OUTBOARD ENGINE CUTOFF

VARIATIONS	TIME FROM LIFT-OFF (SEC)	PATH ANGLE SPACE FIXED (DEG)	ALTITUDE (M)	RANGE (M)	VELOCITY SPACE FIXED (M/SEC)
NOMINAL	143.870	64.459	55629.3	55636.9	2209.53
NON-PROPELLANT MASS	0.00	0.014	-55.8	-28.0	-1.24
THRUST MISALIGNMENT (NORMAL)	0.00	0.029	-5.3	14.9	1.56
THRUST MISALIGNMENT (IN PLANE)	0.00	0.779	-581.0	1033.7	9.84
AXIAL DRAG COEFFICIENT (+)	0.00	0.120	-518.9	-245.1	-7.32
AXIAL DRAG COEFFICIENT (-)	0.00	-0.104	452.3	208.5	5.73
HEADWIND	0.00	-0.124	27.3	-900.8	-7.59
TAILWIND	0.00	0.004	136.8	952.8	7.30
LEFT CROSS WIND	0.00	-0.016	-28.8	-209.7	-2.18
RIGHT CROSS WIND	0.00	0.014	23.3	291.8	2.49
POSITIVE RSS	0.00	0.789	751.9	1451.2	13.90
NEGATIVE RSS	0.00	-0.796	-781.5	-1408.9	-14.73

TABLE 27

DISPERSIONS DUE TO THREE-SIGMA S-IB STAGE

NON-PROPULSION TOLERANCES AT OUTBOARD ENGINE CUTOFF

VARIATIONS	X SPACE FIXED (M)	Y SPACE FIXED (M)	Z SPACE FIXED (M)	X-DOT SPACE FIXED (M/SEC)	Y-DOT SPACE FIXED (M/SEC)	Z-DOT SPACE FIXED (M/SEC)	VEHICLE RADIAL DISTANCE (M)
NOMINAL	120143.1	6427868.8	1106.3	2007.53	915.30	-118.54	6428991.6
NON-PROPELLANT MASS	-29.3	-55.3	0.1	-0.90	-1.00	0.01	-55.8
THRUST MISALIGNMENT (NORMAL)	-6.9	-8.4	-1259.7	-0.36	-0.28	-32.52	-8.7
THRUST MISALIGNMENT (IN PLANE)	1032.2	-599.5	-0.3	21.87	-22.91	0.02	-580.2
AXIAL DRAG COEFFICIENT (+)	-256.9	-514.3	1.6	-4.65	-7.22	0.02	-519.0
AXIAL DRAG COEFFICIENT (-)	218.8	448.5	-1.4	3.46	5.99	-0.01	452.5
HEADWIND	-910.8	42.9	-260.9	-9.22	1.18	-3.02	26.0
TAILWIND	965.0	120.2	228.4	6.85	2.77	1.18	138.2
LEFT CROSS WIND	-212.7	-23.1	772.6	-1.87	-0.34	6.85	-26.8
RIGHT CROSS WIND	280.5	15.8	-975.9	2.13	0.50	-6.42	20.9
POSITIVE RSS	1457.5	761.7	1495.3	23.29	23.90	33.25	751.5
NEGATIVE RSS	-1416.8	-792.2	-1614.7	-24.27	-24.05	-33.28	-781.0

TABLE 28

THREE-SIGMA VEHICLE ENVELOPE

AT OUTBOARD CUTOFF

VARIATIONS	TIME FROM LIFT-OFF (SEC)	PATH ANGLE SPACE FIXED (DEG)	ALTITUDE (M)	RANGE (M)	VELOCITY SPACE FIXED (M/SEC)
THREE-SIGMA DISPERSION DUE TO S-IB NON-PROPULSION TOLERANCES	0.000	0.789	751.9	1451.2	13.90
MINUS THREE-SIGMA DISPERSION DUE TO S-IB NON-PROPULSION TOLERANCES	0.000	-0.796	-781.5	-1408.9	-14.73
THREE-SIGMA DISPERSION DUE TO S-IB PROPULSION TOLERANCES	2.602	1.274	1424.6	2064.4	13.72
MINUS THREE-SIGMA DISPERSION DUE TO S-IB PROPULSION TOLERANCES	-2.438	-1.266	-1737.2	-2097.1	-16.85
POSITIVE RSS	2.602	1.499	1610.9	2523.4	19.53
NEGATIVE RSS	-2.438	-1.495	-1904.9	-2526.4	-22.38

TABLE 29

THREE-SIGMA VEHICLE ENVELOPE

AT OUTBOARD CUTOFF

VARIATIONS	X SPACE FIXED (M)	Y SPACE FIXED (M)	Z SPACE FIXED (M)	X-DOT SPACE FIXED (M/SEC)	Y-DOT SPACE FIXED (M/SEC)	Z-DOT SPACE FIXED (M/SEC)	VEHICLE RADIAL DISTANCE (M)
THREE-SIGMA DISPERSION DUE TO S-IB NON-PROPULSION TOLERANCES	1457.5	761.7	1495.3	23.29	23.90	33.25	751.5
MINUS THREE-SIGMA DISPERSION DUE TO S-IB NON-PROPULSION TOLERANCES	-1416.8	-792.2	-1614.7	-24.27	-24.05	-33.28	-781.0
THREE-SIGMA DISPERSION DUE TO S-IB PROPULSION TOLERANCES	3116.1	1469.9	278.5	22.84	42.90	.46	1423.6
MINUS THREE-SIGMA DISPERSION DUE TO S-IB PROPULSION TOLERANCES	-7002.1	-1784.6	-333.1	-25.81	-46.59	-.48	-1736.3
POSITIVE RSS	3440.1	1655.5	1521.0	33.62	49.11	33.25	1609.8
NEGATIVE RSS	-7144.0	-1952.5	-1648.7	-35.43	-52.52	-33.28	-1903.9

TABLE 30

DISPERSIONS DUE TO THREE-SIGMA S-IB STAGE

PROPULSION TOLERANCES AT GUIDANCE CUTOFF SIGNAL

VARIATIONS	TIME FROM LIFT-OFF (SEC)	PATH ANGLE SPACE FIXED (DEG)	ALTITUDE (M)	RANGE (M)	VELOCITY SPACE FIXED (M/SEC)	RESERVE PROPELLANT MASS (KG)	GEODETIC LATITUDE + NORTH (DEG)	LONGITUDE + WEST OF GREENWICH (DEG)
NOMINAL	601.548	86.004	217311.8	1595396.6	6799.63	1049.73	23.648700	65.517500
PROPELLANT LOADING MASS (+)	-0.051	0.000	-3.3	1722.2	0.00	91.86	-0.005755	-0.015686
PROPELLANT LOADING MASS (-)	-0.250	0.000	0.4	-315.0	0.00	-34.30	0.001393	0.002716
THRUST AND FLOW RATE (+)	-3.031	0.000	11.6	-2185.6	0.00	164.46	0.011397	0.018024
THRUST AND FLOW RATE (-)	3.574	0.000	-12.2	1534.0	0.00	-257.49	-.00992	-.011720
I_{SP} $(-\dot{W})$	-0.075	0.000	-2.4	2030.7	0.00	109.79	-0.006766	-0.018505
I_{SP} $(+\dot{W})$	0.072	0.000	1.5	-2044.9	0.00	-109.47	0.006812	0.018635
MIXTURE RATIO (+)	0.503	0.000	-0.2	-2236.9	0.00	-157.62	0.006894	0.020645
MIXTURE RATIO (-)	-0.252	0.000	-1.1	1112.4	0.00	78.77	0.003428	-0.010262
HIGH GROUND WIND	1.331	-.001	65.6	833.8	.00	-106.06	-.004590	-.006770
LOW GROUND WIND	-.391	-.001	89.0	-1228.1	.00	-14.85	-.136420	.010920
HIGH AMBIENT TEMPERATURE	-.889	-.001	93.7	-1250.1	.00	37.54	-.135690	.010820
LOW AMBIENT TEMPERATURE	1.152	-.001	61.3	1613.1	.00	47.68	-.148020	-.013960
POSITIVE RSS	4.024	.000	157.7	3738.7	.00	239.60	.015410	.036638
NEGATIVE RSS	-3.194	-.002	-12.9	-4139.3	.00	-340.25	-.243170	-.032744

TABLE 31

DISPERSIONS DUE TO THREE-SIGMA S-IB STAGE

PROPULSION TOLERANCES AT GUIDANCE CUTOFF SIGNAL

VARIATIONS	X SPACE FIXED (M)	Y SPACE FIXED (M)	Z SPACE FIXED (M)	X-DOT SPACE FIXED (M/SEC)	Y-DOT SPACE FIXED (M/SEC)	Z-DOT SPACE FIXED (M/SEC)	VEHICLE RADIAL DISTANCE (M)
NOMINAL	1875677.4	6319418.3	-45283.7	6636.88	-1476.19	-87.60	6592060.6
PROPELLANT LOADING MASS (+)	1687.3	-502.1	-21.7	-0.40	-1.79	0.01	-1.6
PROPELLANT LOADING MASS (-)	-409.8	121.4	5.8	0.09	0.42	0.00	0.0
THRUST AND FLOW RATE (+)	-3344.4	999.3	44.1	0.79	3.55	-0.02	8.6
THRUST AND FLOW RATE (-)	2909.0	-872.8	-38.7	-.69	-3.08	+.02	-9.4
I_{SP} $(-\dot{W})$	1984.1	-589.1	-25.5	-0.46	-2.09	0.01	-0.6
I_{SP} $(+\dot{W})$	-1999.5	592.1	26.1	0.47	2.12	-0.01	-0.3
MIXTURE RATIO (+)	-2022.8	597.1	25.8	0.47	2.13	-0.01	-2.0
MIXTURE RATIO (-)	1004.8	-298.1	-12.6	-0.23	-1.05	0.00	-0.1
HIGH GROUND WIND	1363.4	-335.3	-17.3	-.33	-1.25	+.01	66.8
LOW GROUND WIND	-1345.1	490.7	17.5	.30	1.56	-.01	87.7
HIGH AMBIENT TEMPERATURE	-1559.0	558.7	20.5	.34	1.80	-.01	92.2
LOW AMBIENT TEMPERATURE	2065.4	-548.2	-26.7	-.50	-1.98	.02	62.7
POSITIVE RSS	4730.8	1507.8	63.7	1.13	5.24	.03	157.0
NEGATIVE RSS	-4866.5	-1364.8	-61.6	-.95	-4.86	-.03	-9.8

TABLE 32

DISPERSIONS DUE TO THREE-SIGMA S-IB STAGE

NON-PROPULSIVE TOLERANCES AT GUIDANCE CUTOFF SIGNAL

VARIATIONS	TIME FROM LIFT-OFF (SEC)	PATH ANGLE SPACE FIXED (DEG)	ALTITUDE (M)	RANGE (M)	VELOCITY SPACE FIXED (M/SEC)	RESERVE PROPELLANT MASS (KG)	GEODETIC LATITUDE + NORTH (DEG)	LONGITUDE + WEST OF GREENWICH (DEG)
NOMINAL	601.548	86.004	217311.8	1595396.6	6799.63	1049.73	23.648700	65.517500
NON-PROPELLANT MASS	0.098	0.0	-1.2	-199.2	0.0	-19.05	0.000542	0.001869
THRUST MISALIGNMENT (NORMAL)	0.107	0.0	-1.3	-32.7	0.0	-20.42	0.0000057	0.000324
THRUST MISALIGNMENT (IN PLANE)	-0.175	0.0	-16.3	3188.3	0.0	33.42	-0.010548	-0.029087
AXIAL DRAG COEFFICIENT (+)	1.022	0.0	1.0	32.9	0.0	-109.77	-0.001467	0.000324
AXIAL DRAG COEFFICIENT (-)	-0.110	0.0	1.8	2274.2	0.0	-107.05	-0.007541	-0.020741
HEADWIND	0.473	0.0	2.9	-2121.1	0.0	-90.42	0.006552	0.019569
TAILWIND	-0.527	0.0	-3.2	2006.3	0.0	100.61	-0.006082	-0.018562
LEFT CROSS WIND	0.118	0.0	-0.5	-489.8	0.0	-22.56	0.001478	0.004536
RIGHT CROSS WIND	-0.137	0.0	-1.7	596.2	0.0	26.24	-0.001817	-0.005512
POSITIVE RSS	1.155	0.0	16.7	4445.2	0.0	152.84	0.012517	0.035402
NEGATIVE RSS	-0.600	0.0	-16.7	-3865.9	0.0	-146.68	-0.014522	-0.040679

TABLE 33

DISPERSIONS DUE TO THREE-SIGMA S-IB STAGE

NON-PROPULSION TOLERANCES AT GUIDANCE CUTOFF SIGNAL

VARIATIONS	X SPACE FIXED (M)	Y SPACE FIXED (M)	Z SPACE FIXED (M)	X-DOT SPACE FIXED (M/SEC)	Y-DOT SPACE FIXED (M/SEC)	Z-DOT SPACE FIXED (M/SEC)	VEHICLE RADIAL DISTANCE (M)
NOMINAL	1875677.4	6319418.3	-45283.7	6636.88	-1476.19	-87.60	6592060.6
NON-PROPELLANT MASS	-159.9	46.0	2.2	0.04	0.17	0.00	-1.3
THRUST MISALIGNMENT (NORMAL)	8.9	-4.0	-11.0	0.00	-0.02	-0.01	-1.3
THRUST MISALIGNMENT (IN PLANE)	3089.3	-930.4	-39.7	-0.73	-3.29	0.02	-13.3
AXIAL DRAG COEFFICIENT (+)	430.7	-126.2	-5.6	-0.10	-0.45	0.00	1.4
AXIAL DRAG COEFFICIENT (-)	2213.0	-652.4	-28.6	-0.52	-2.34	0.01	3.9
HEADWIND	-1918.8	569.6	23.3	0.45	2.02	-0.01	1.1
TAILWIND	1783.9	-530.6	-23.2	-0.42	-1.89	0.01	-1.5
LEFT CROSS WIND	-439.9	129.5	8.2	0.10	0.46	0.00	-0.9
RIGHT CROSS WIND	537.4	-160.5	-9.0	-0.13	-0.57	0.00	-1.1
POSITIVE RSS	4257.2	1099.5	48.1	0.86	3.89	0.03	14.1
NEGATIVE RSS	-3666.7	-1271.4	-56.3	-1.00	-4.52	-0.03	-13.6

TABLE 34

DISPERSIONS DUE TO THREE-SIGMA S-IVB STAGE

PROPULSION TOLERANCES AT GUIDANCE CUTOFF SIGNAL

VARIATIONS	TIME FROM LIFT-OFF (SEC)	PATH ANGLE SPACE FIXED (DEG)	ALTITUDE (M)	RANGE (M)	VELOCITY SPACE FIXED (M/SEC)	RESERVE PROPELLANT MASS (KG)	GEODETIC LATITUDE + NORTH (DEG)	LONGITUDE + WEST OF GREENWICH (DEG)
NOMINAL	601.548	86.004	217311.8	1595396.6	6799.63	1049.73	23.648700	65.517500
PROPELLANT LOADING MASS (+)	4.677	0.000	-15.7	10286.1	0.00	9.11	-0.040999	-0.090626
PROPELLANT LOADING MASS (-)	-4.588	0.000	22.1	-11070.5	0.00	-25.99	0.043448	0.097881
THRUST AND FLOW RATE (+)	-15.578	0.000	46.8	-51241.8	0.00	420.86	0.192917	0.457119
THRUST AND FLOW RATE (-)	16.391	0.000	-60.6	51434.7	0.00	-527.82	-0.196423	-0.456810
I_{SP} $(-\dot{W})$	1.442	0.00	4.7	6944.4	0.00	336.69	-0.025387	-0.062241
I_{SP} $(+\dot{W})$	-1.475	0.000	2.4	-7578.7	0.00	-334.14	0.027549	0.068012
MIXTURE RATIO (+FUEL)	7.716	0.000	-99.6	29668.7	0.00	-108.00	-0.110869	-0.264690
MIXTURE RATIO (-FUEL)	-7.476	0.000	167.1	-31786.2	0.00	70.01	0.117043	0.284645
MIXTURE RATIO (+LOX)	-2.868	0.000	182.4	-21956.0	0.00	67.24	0.077873	0.197948
MIXTURE RATIO (-LOX)	3.185	-0.002	-93.0	20223.0	0.00	-112.86	-0.072745	-0.181747
POSITIVE RSS	19.034	0.000	252.8	63943.4	0.00	547.71	.24418	.58598
NEGATIVE RSS	-18.166	-.002	-149.9	-65560.2	0.00	-644.45	-.24185	-.56908

TABLE 35

DISPERSIONS DUE TO THREE-SIGMA S-IVB STAGE

PROPULSION TOLERANCES AT GUIDANCE CUTOFF SIGNAL

VARIATIONS	X SPACE FIXED (M)	Y SPACE FIXED (M)	Z SPACE FIXED (M)	X-DOT SPACE FIXED (M/SEC)	Y-DOT SPACE FIXED (M/SEC)	Z-DOT SPACE FIXED (M/SEC)	VEHICLE RADIAL DISTANCE (M)
NOMINAL	1875677.4	6319418.3	-45283.7	6636.88	-1476.19	-87.60	6592060.6
PROPELLANT LOADING MASS (+)	12014.4	-3578.4	-156.2	-2.83	-12.72	0.08	-4.5
PROPELLANT LOADING MASS (-)	-12763.3	3779.9	166.2	2.98	13.49	-0.08	10.3
THRUST AND FLOW RATE (+)	-56947.8	16595.5	743.7	13.05	60.16	-0.36	-5.9
THRUST AND FLOW RATE (-)	57296.7	-17274.3	-744.5	-13.72	-60.60	0.38	-7.2
I_{SP} $(-\dot{W})$	7448.7	-2200.4	-97.7	-1.75	-7.87	0.05	11.7
I_{SP} $(+\dot{W})$	-8091.7	2387.6	105.2	1.89	8.55	-0.05	-5.1
MIXTURE RATIO (+FUEL)	32369.9	-9786.9	-419.9	-7.73	-34.29	0.21	-69.5
MIXTURE RATIO (-FUEL)	-34410.7	10269.6	454.8	8.00	36.41	-0.22	135.1
MIXTURE RATIO (+LOX)	-22849.1	6916.3	302.4	5.35	24.22	-0.15	161.1
MIXTURE RATIO (-LOX)	21255.8	-6434.9	-275.8	-5.00	-22.29	0.14	-73.2
POSITIVE RSS	70585.8	21182.1	943.4	16.59	76.07	.47	210.8
NEGATIVE RSS	-71955.6	-21289.4	-916.8	-16.85	-74.62	-.46	-101.6

TABLE 36

DISPERSIONS DUE TO THREE-SIGMA S-IVB STAGE

NON-PROPULSION TOLERANCES AT GUIDANCE CUTOFF SIGNAL

VARIATIONS	TIME FROM LIFT-OFF (SEC)	PATH ANGLE SPACE FIXED (DEG)	ALTITUDE (M)	RANGE (M)	VELOCITY SPACE FIXED (M/SEC)	RESERVE PROPELLANT MASS (KG)	GEODETIC LATITUDE + NORTH (DEG)	LONGITUDE + WEST OF GREENWICH (DEG)
NOMINAL	601.548	86.004	217311.8	1595396.6	6799.63	1049.73	23.648700	65.517500
NON-PROPELLANT MASS (+)	0.452	0.0	1.0	1161.1	0.0	-86.21	-0.004520	-0.010281
NON-PROPELLANT MASS (-)	-0.294	0.0	-1.0	-756.7	0.0	56.23	0.002942	0.006702
XCG OFFSET (+)	0.000	0.0	-7.5	243.8	0.0	0.00	-0.000825	-0.002216
XCG OFFSET (-)	0.006	0.0	7.1	-247.8	0.0	-1.14	0.008290	0.002254
ZCG OFFSET (+)	-0.006	0.0	-0.2	-0.5	0.0	1.07	-0.000051	0.000031
ZCG OFFSET (-)	0.011	0.0	-0.1	-3.8	0.0	-2.20	0.000056	0.000015
THRUST MISALIGNMENT (PITCH)	0.015	0.0	5.4	-542.2	0.0	-2.85	0.001812	0.004936
THRUST MISALIGNMENT (YAW)	0.034	0.0	-0.3	-19.1	0.0	-6.45	0.000054	0.000179
POSITIVE RSS	0.454	0.0	8.9	1304.6	0.0	56.68	0.003555	0.008626
NEGATIVE RSS	-0.297	0.0	-9.3	-963.5	0.0	-86.53	-0.004940	-0.011619

TABLE 37

DISPERSIONS DUE TO THREE-SIGMA S-IVB STAGE

NON-PROPULSION TOLERANCES AT GUIDANCE CUTOFF SIGNAL

VARIATIONS	X SPACE FIXED (M)	Y SPACE FIXED (M)	Z SPACE FIXED (M)	X-DOT SPACE FIXED (M/SEC)	Y-DOT SPACE FIXED (M/SEC)	Z-DOT SPACE FIXED (M/SEC)	VEHICLE RADIAL DISTANCE (M)
NOMINAL	1875677.4	6319418.3	-45283.7	6636.88	-1476.19	-87.60	6592060.6
NON-PROPELLANT MASS (+)	1327.8	-391.4	-17.8	-0.31	-1.41	0.01	2.3
NON-PROPELLANT MASS (-)	-865.3	254.5	11.7	0.20	0.90	0.00	-1.8
XCG OFFSET (+)	239.7	-78.6	-2.9	-0.06	-0.27	0.00	-7.3
XCG OFFSET (-)	-241.4	78.8	3.1	0.06	0.27	0.00	6.9
ZCG OFFSET (+)	-2.8	0.8	7.5	0.00	0.00	0.01	-0.1
ZCG OFFSET (-)	0.7	-0.3	-7.3	0.00	0.00	-0.01	-0.1
THRUST MISALIGNMENT (PITCH)	-530.4	162.4	6.8	0.13	0.56	0.00	4.9
THRUST MISALIGNMENT (YAW)	-5.9	1.4	-4.2	0.00	0.01	0.00	-0.3
POSITIVE RSS	1449.8	312.0	16.4	0.24	1.10	0.02	8.8
NEGATIVE RSS	-1043.2	-431.0	-21.0	-0.34	-1.54	-0.01	-9.0

TABLE 38

THREE-SIGMA VEHICLE ENVELOPE

AT GUIDANCE CUTOFF SIGNAL

VARIATIONS	TIME FROM LIFT-OFF (SEC)	ALTITUDE (M)	VEHICLE RADIAL DISTANCE (M)	PATH ANGLE SPACE FIXED (DEG)	VELOCITY SPACE FIXED (M/SEC)	RESERVE PROPELLANT MASS (KG)
THREE-SIGMA DISPERSION DUE TO S-IB STAGE	4.187	158.6	157.6	0.000	0.000	+284.20
MINUS THREE-SIGMA DISPERSION DUE TO S-IB STAGE	-3.250	-21.1	-16.8	-.002	-0.000	-370.52
THREE-SIGMA DISPERSION DUE TO S-IVB STAGE	19.345	253.0	211.0	0.000	.000	550.65
MINUS THREE-SIGMA DISPERSIONS DUE TO S-IVB STAGE	-18.168	-150.2	-101.6	-0.002	.000	-650.23
POSITIVE RSS	19.792	298.6	263.4	0.000	0.000	620.01
NEGATIVE RSS	-18.456	-151.7	-103.0	-.002	0.000	-748.39

TABLE 39

THREE-SIGMA VEHICLE ENVELOPE

AT GUIDANCE CUTOFF SIGNAL

VARIATIONS	X SPACE FIXED (M)	Y SPACE FIXED (M)	Z SPACE FIXED (M)	X-DOT SPACE FIXED (M/SEC)	Y-DOT SPACE FIXED (M/SEC)	Z-DOT SPACE FIXED (M/SEC)
THREE-SIGMA DISPERSION DUE TO S-IB STAGE	6364.3	1866.1	798.2	1.42	6.53	.04
MINUS THREE-SIGMA DISPERSION DUE TO S-IB STAGE	-6093.2	-1865.2	-834.5	-1.38	-6.64	-.04
THREE-SIGMA DISPERSION DUE TO S-IVB STAGE	70600.7	21184.4	943.5	16.59	76.08	.47
MINUS THREE-SIGMA DISPERSION DUE TO S-IVB STAGE	-71963.2	-21293.8	-917.0	-16.85	-74.64	-.46
POSITIVE RSS	70887.0	21266.4	1235.8	16.65	76.36	.47
NEGATIVE RSS	-72220.7	-21375.3	-1239.9	-16.90	-74.93	-.46

TABLE 40

PERFORMANCE PARTIALS* APPLICABLE AT OECO

Dependent Parameter / Dispersion	TIME	SPACE FIXED PATH ANGLE	SPACE FIXED VELOCITY	ALTITUDE	RANGE	CROSS RANGE	UNITS
NON-PROPELLENT MASS	0	.046 deg	- .41 m/s	-18.4 m	-9.2 m	0 m	Per 100 lbm
DRAG	0	.012 deg	- .73 m/s	- 51.9 m	- 24.5 m	0 m	Per 1%
PROPELLENT MASS	.016 sec	.006 deg	.29 m/s	- 1.3 m	17.3 m	- 1.9 m	Per 100 lbm
F & $\dot{W}$	-1.49 sec	-.76 deg	3.53 m/s	1007.3 m	-1151.7 m	170.0 m	Per 1%
I_{SP}	.56 sec	.133 deg	10.03 m/s	318.3 m	712.9 m	-64.9 m	Per Second

$$*\text{Partial} = \frac{(\text{Dispersion Parameter} - \text{Nominal Parameter})}{(\text{Dispersion Value} - \text{Nominal Value})}$$

TABLE 41

PERFORMANCE PARTIALS* APPLICABLE AT GCS

Dependent Parameter / Dispersion	TIME (SEC)	SPACE FIXED PATH ANGLE	SPACE FIXED VELOCITY	ALTITUDE (M)	RANGE (M)	CROSS RANGE (M)	DELTA PROPELLENT (LBM)	UNITS
NON-PROPELLENT MASS (S-IB)	.032	0	0	- .4	- 66	.7	- 13.8	Per 100 lbm
DRAG	.102	0	0	0	227	2.8	- 24.2	Per 1%
PROPELLENT MASS (S-IB)	-.009	0	0	0	65	-.8	2.9	Per 100 lbm
F & $\dot{W}$ (S-IB)	- 2.387	0	0	8.0	- 1457	29.3	378.4	Per 1%
I_{SP} (S-IB)	- .083	0	0	- 2.7	2272	28.9	268.2	Per 1 sec
NON-PROPELLENT MASS (S-IVB)	.237	0	0	.5	611.1	- 9.4	- 99.8	Per 100 lbm
PROPELLENT MASS (S-IVB)	.205	0	0	- 1.0	483.8	- 7.3	2.5	Per 100 lbm
F & $\dot{W}$ (S-IVB)	- 5.333	0	0	20.3	-17143	248.0	387.9	Per 1%
I_{SP} (S-IVB)	.473	0	0	1.5	2429	- 33.7	236.1	Per 1 sec
LOX LOAD (S-IVB)	- .156	0	0	7.3	- 1093	15.7	- 12.9	Per 100 lbm
FUEL LOAD (S-IVB)	2.049	0	0	- 35.5	8685	- 124.3	65.1	Per 100 lbm

$$*\text{Partial} = \frac{\{\text{Dispersion Parameter} - \text{Nominal Parameter}\}}{\{\text{Dispersion Value} - \text{Nominal Value}\}}$$

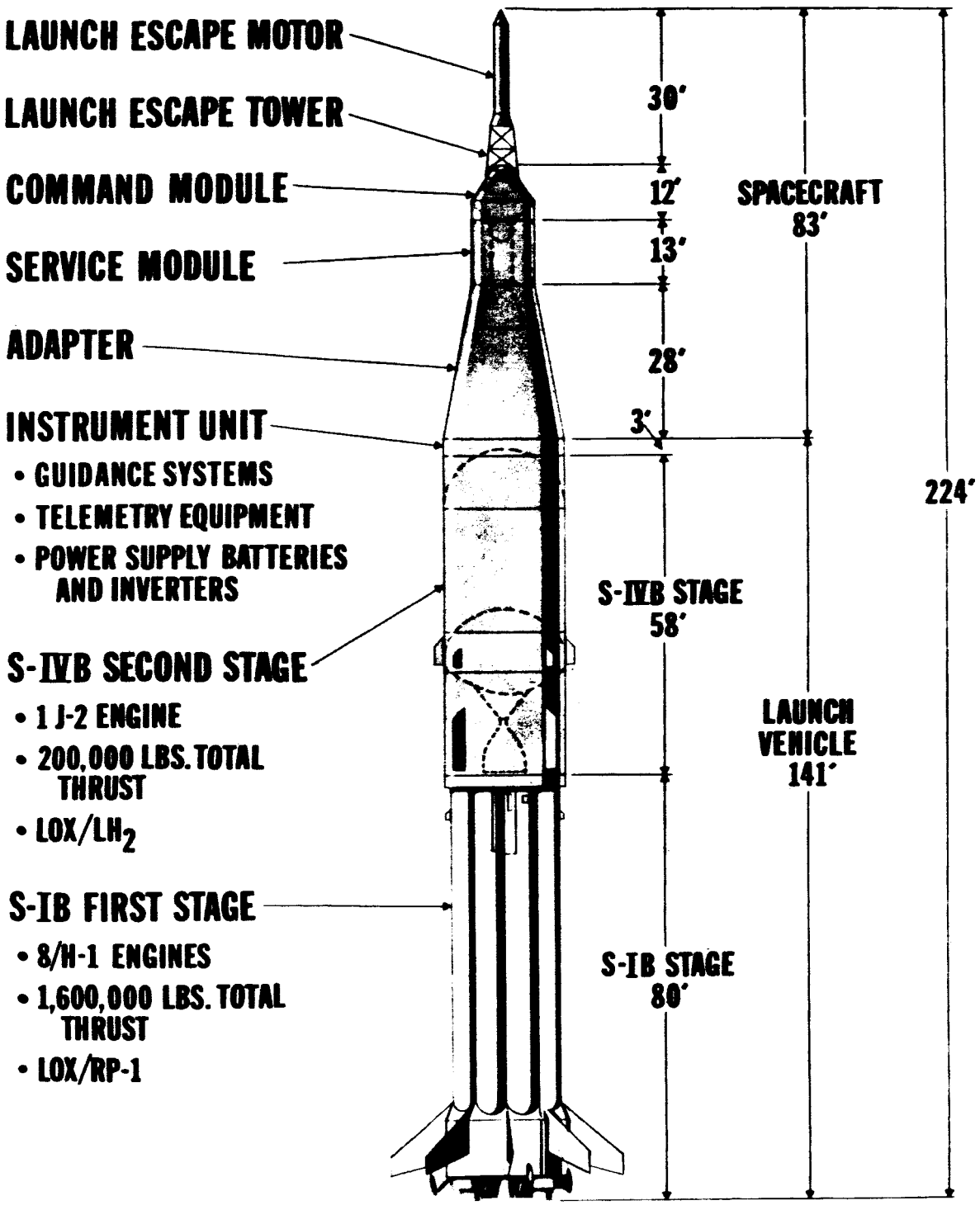

FIG. 1. APOLLO / SATURN IB SPACE VEHICLE

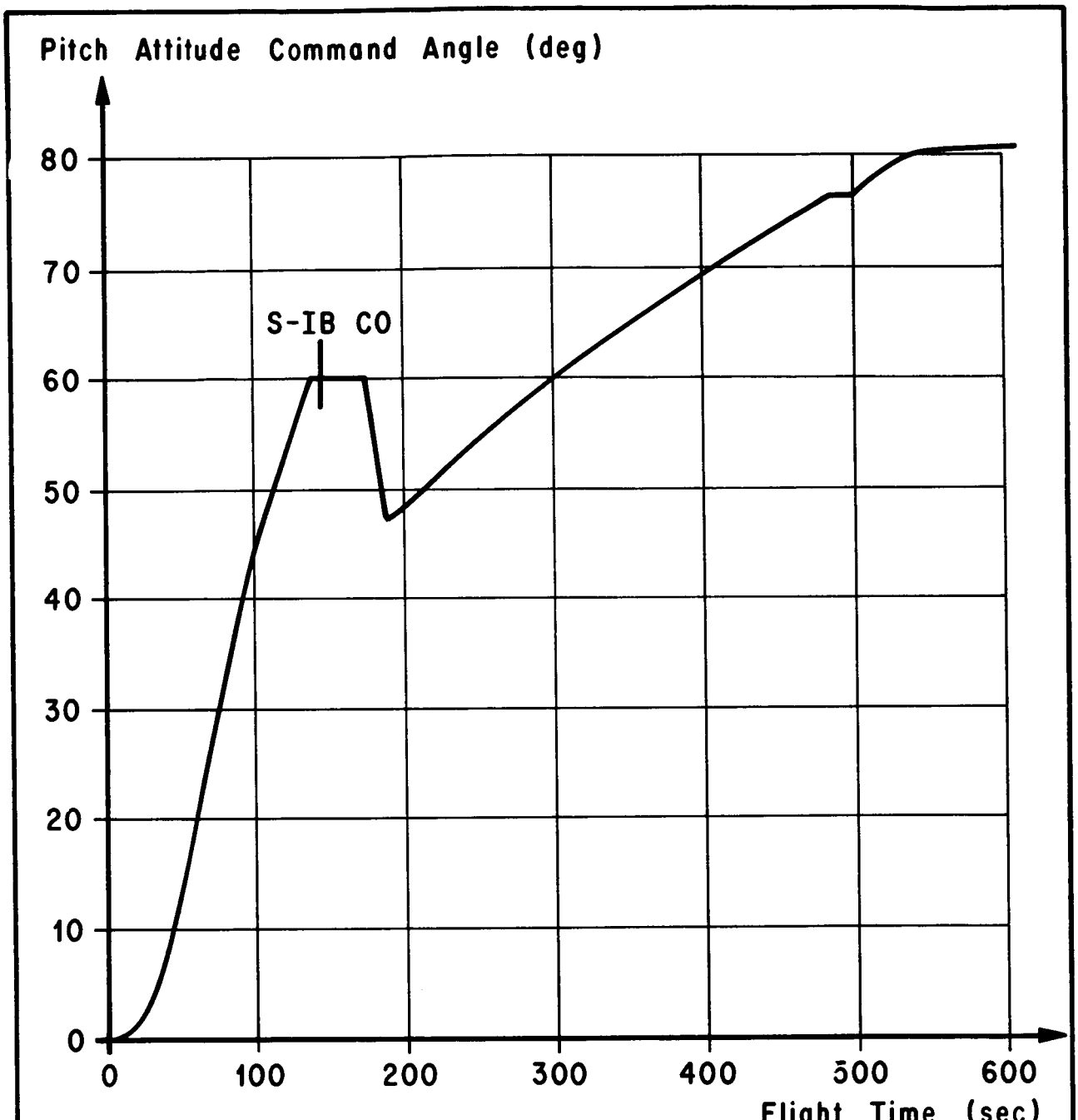

FIG. 2. AS-202
NOMINAL PITCH ATTITUDE COMMAND
VERSUS FLIGHT TIME

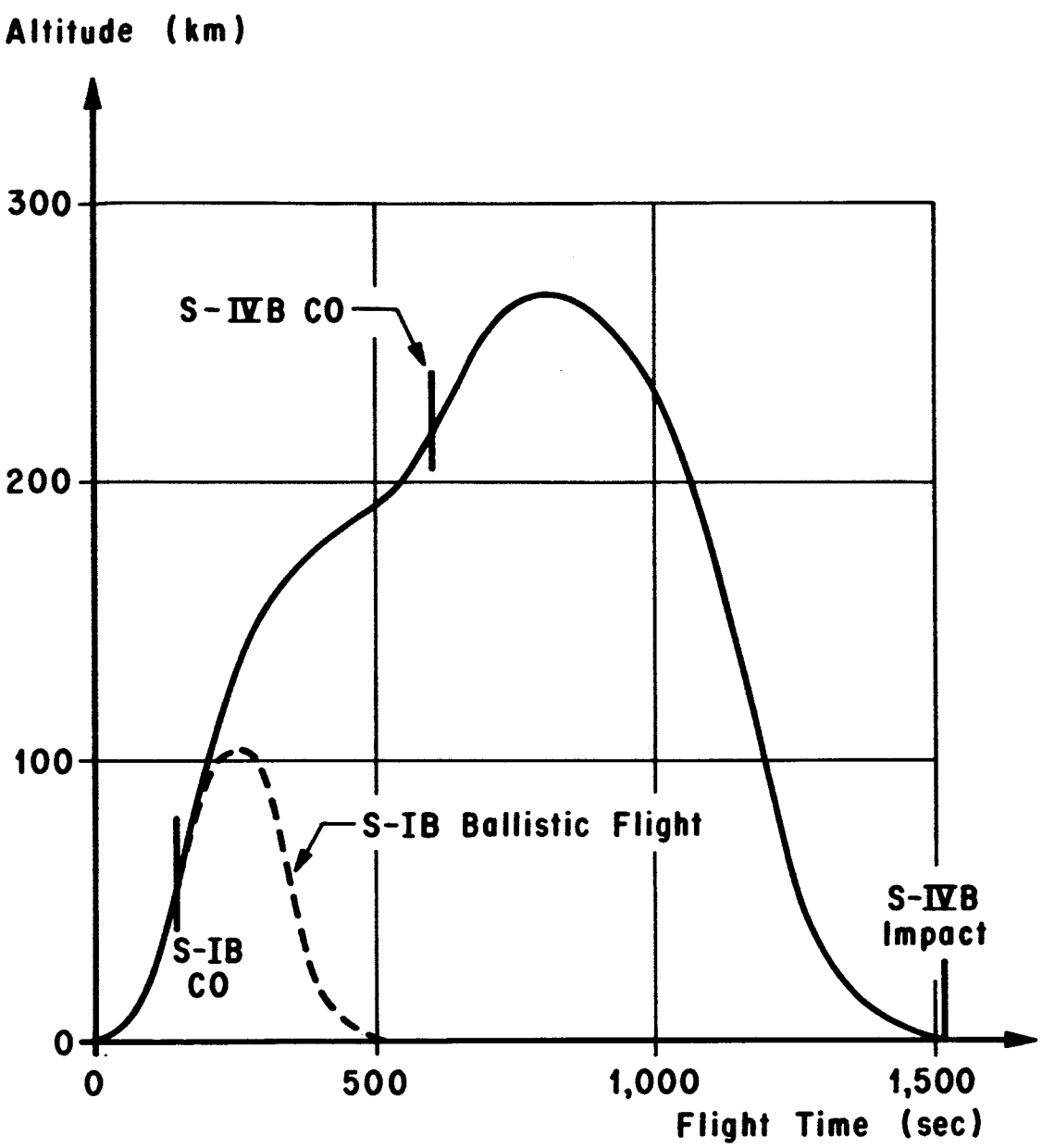

FIG. 3. AS-202 LAUNCH VEHICLE ALTITUDE VERSUS FLIGHT TIME

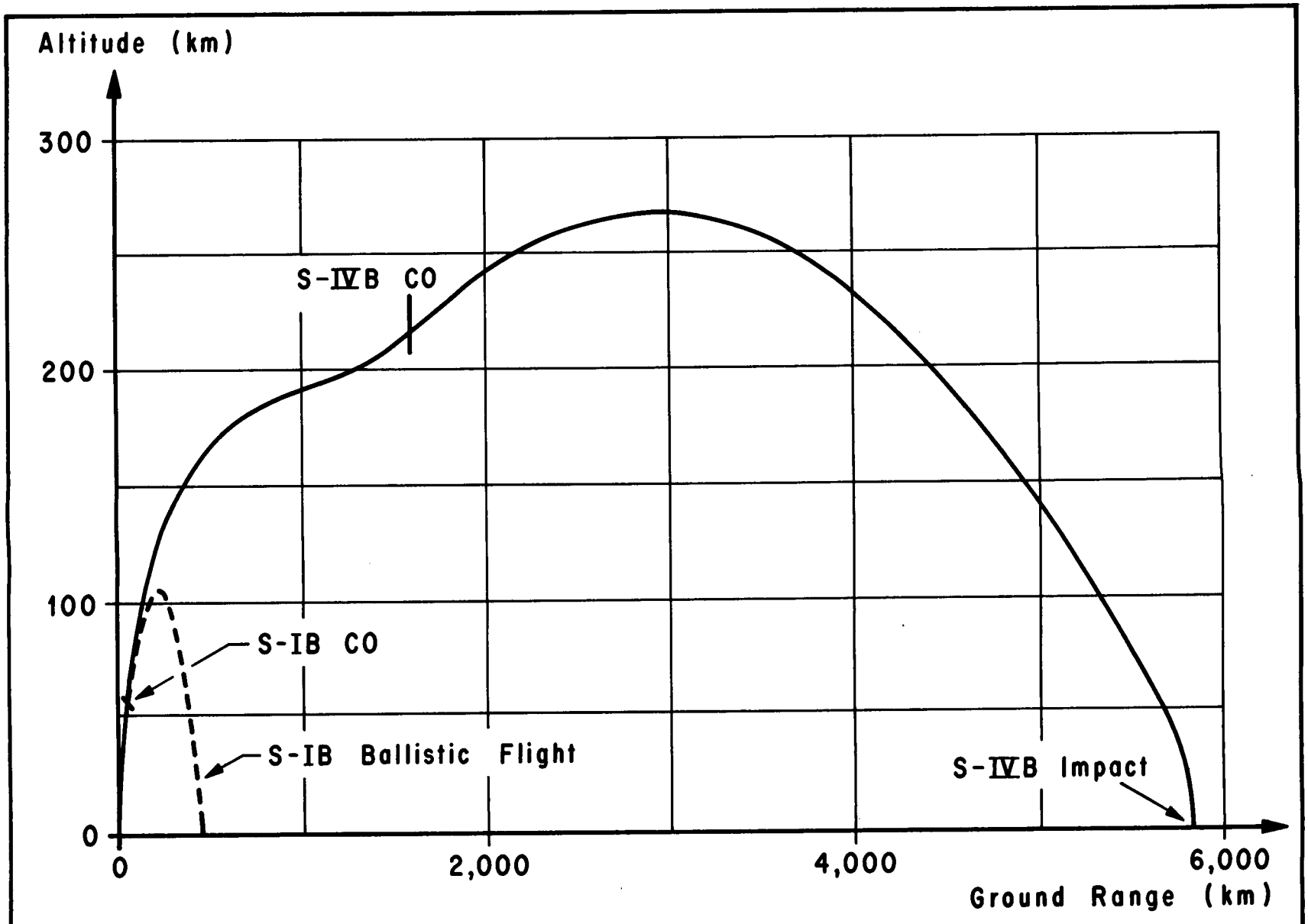

FIG. 4. AS-202 LAUNCH VEHICLE ALTITUDE VERSUS GROUND RANGE

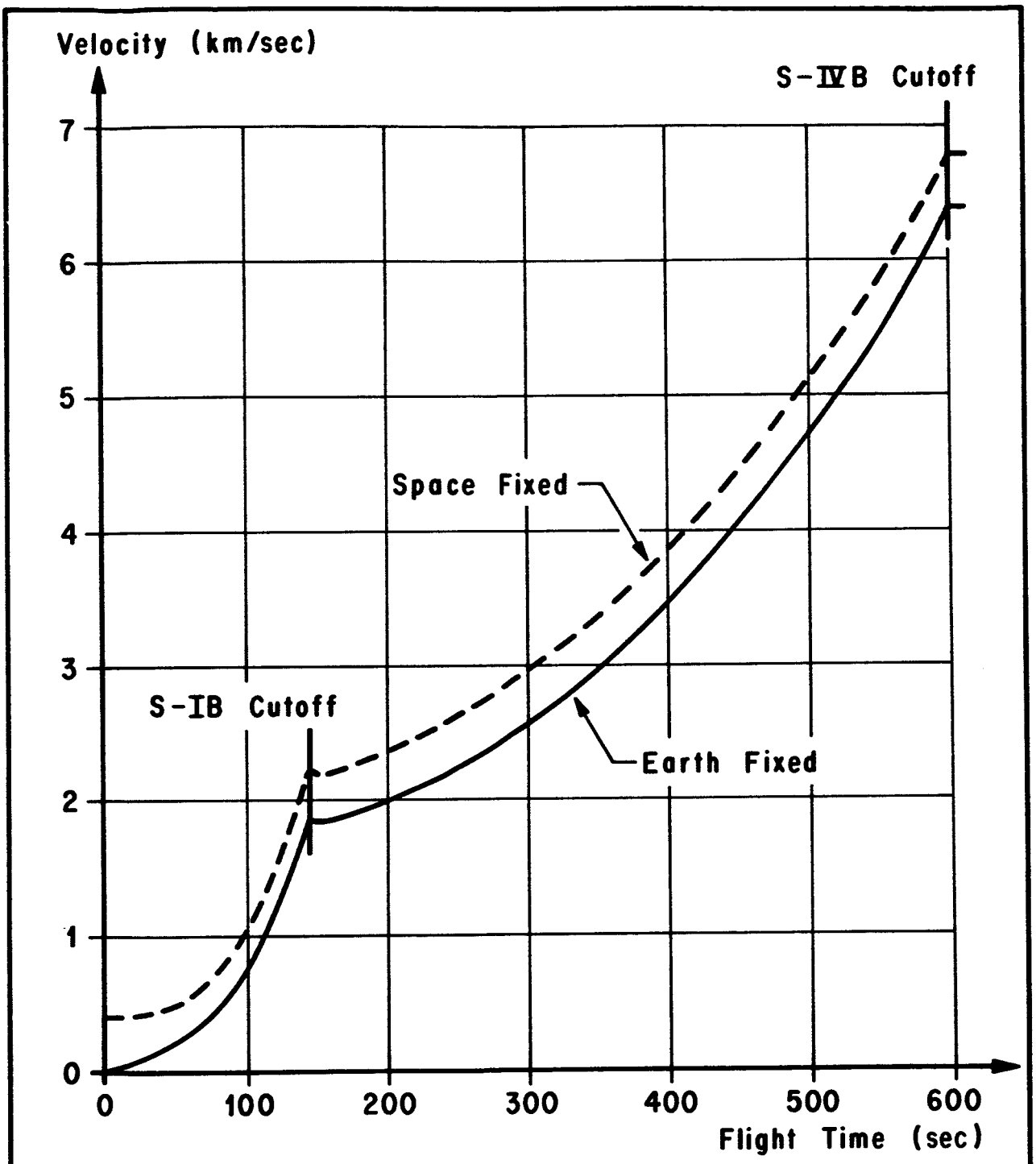

FIG. 5. AS-202 SPACE FIXED AND EARTH FIXED VELOCITY VERSUS FLIGHT TIME

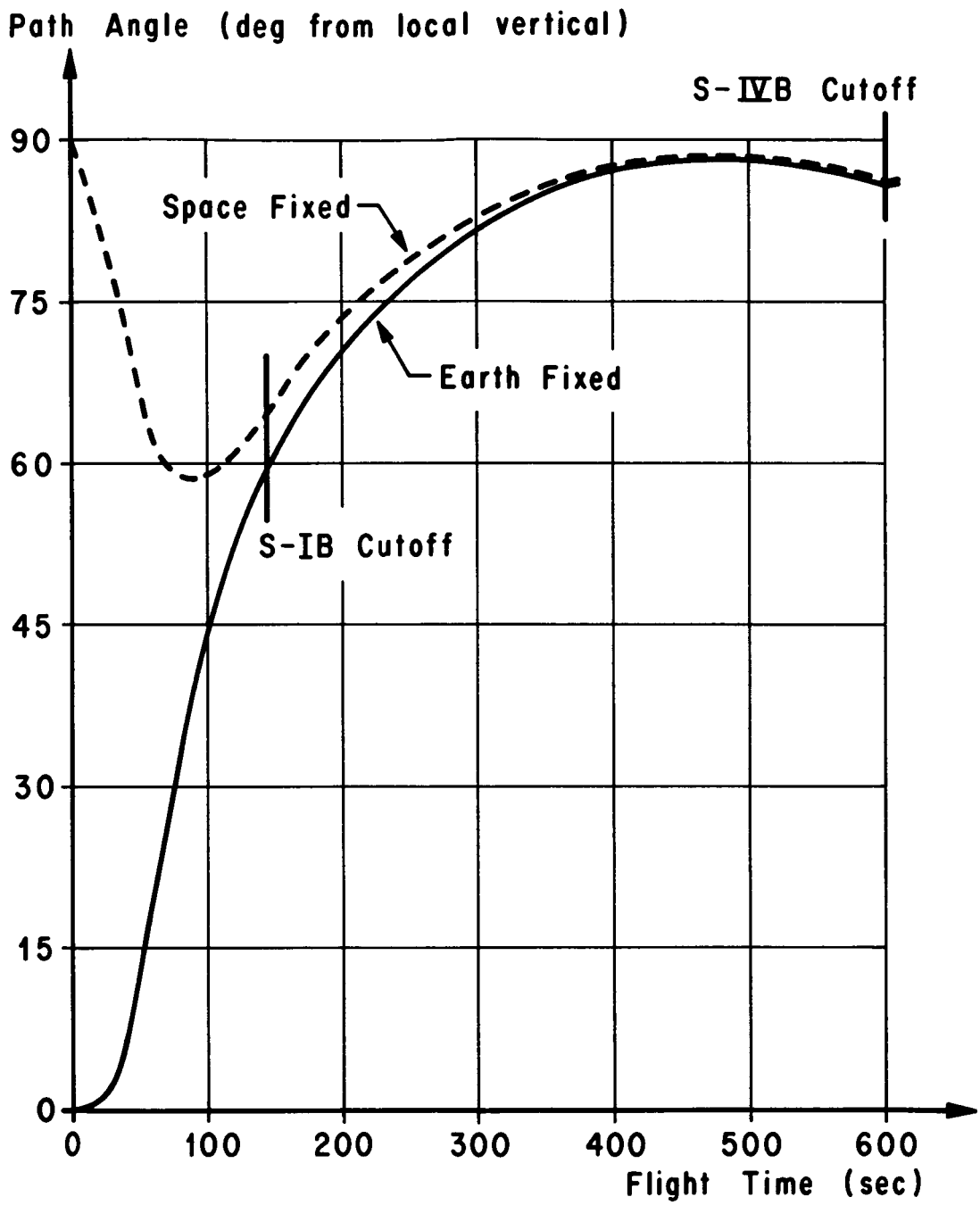

FIG. 6. AS-202 SPACE FIXED AND EARTH FIXED PATH ANGLE VERSUS FLIGHT TIME

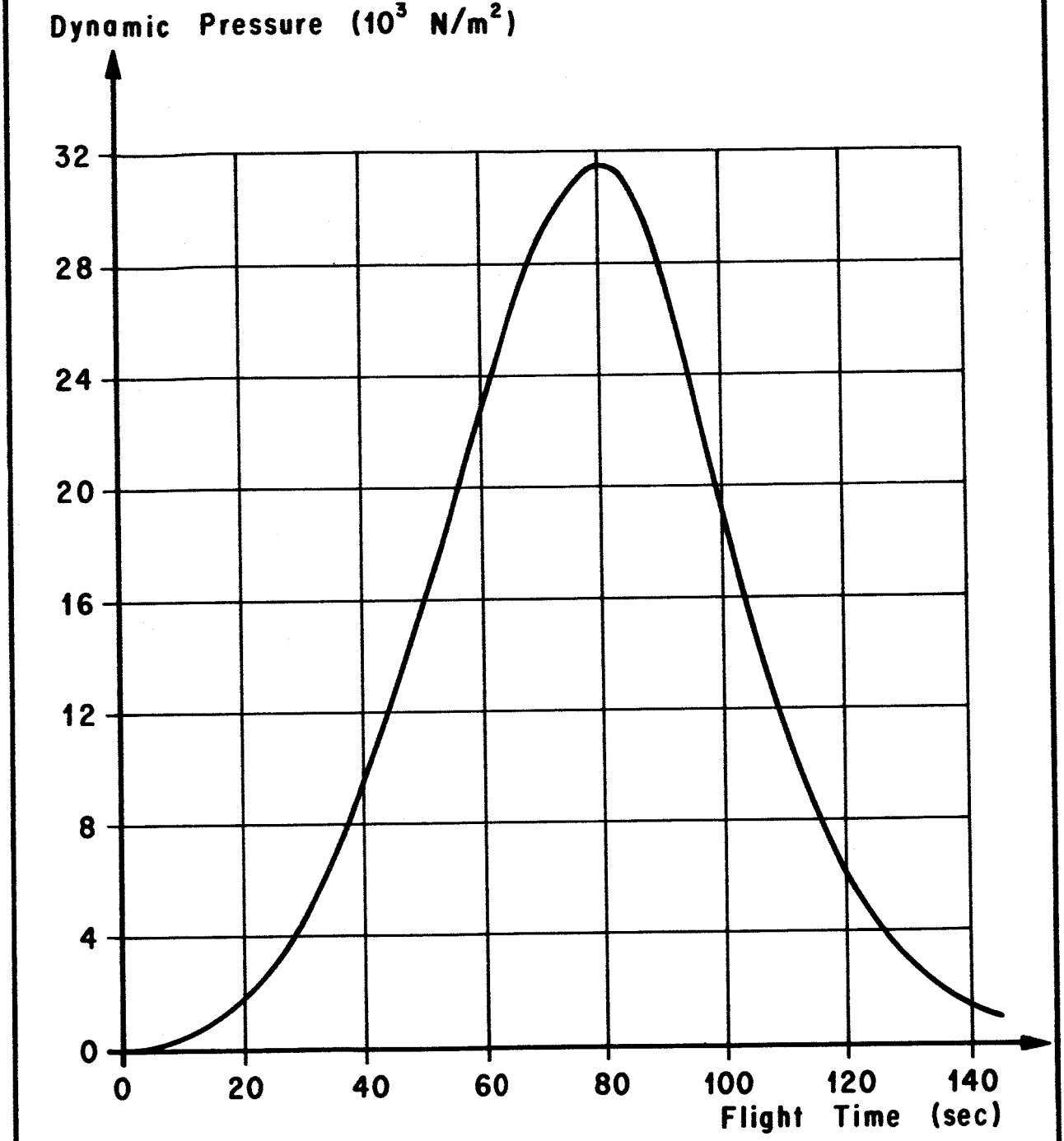

FIG. 7. AS-202 DYNAMIC PRESSURE VERSUS FLIGHT TIME

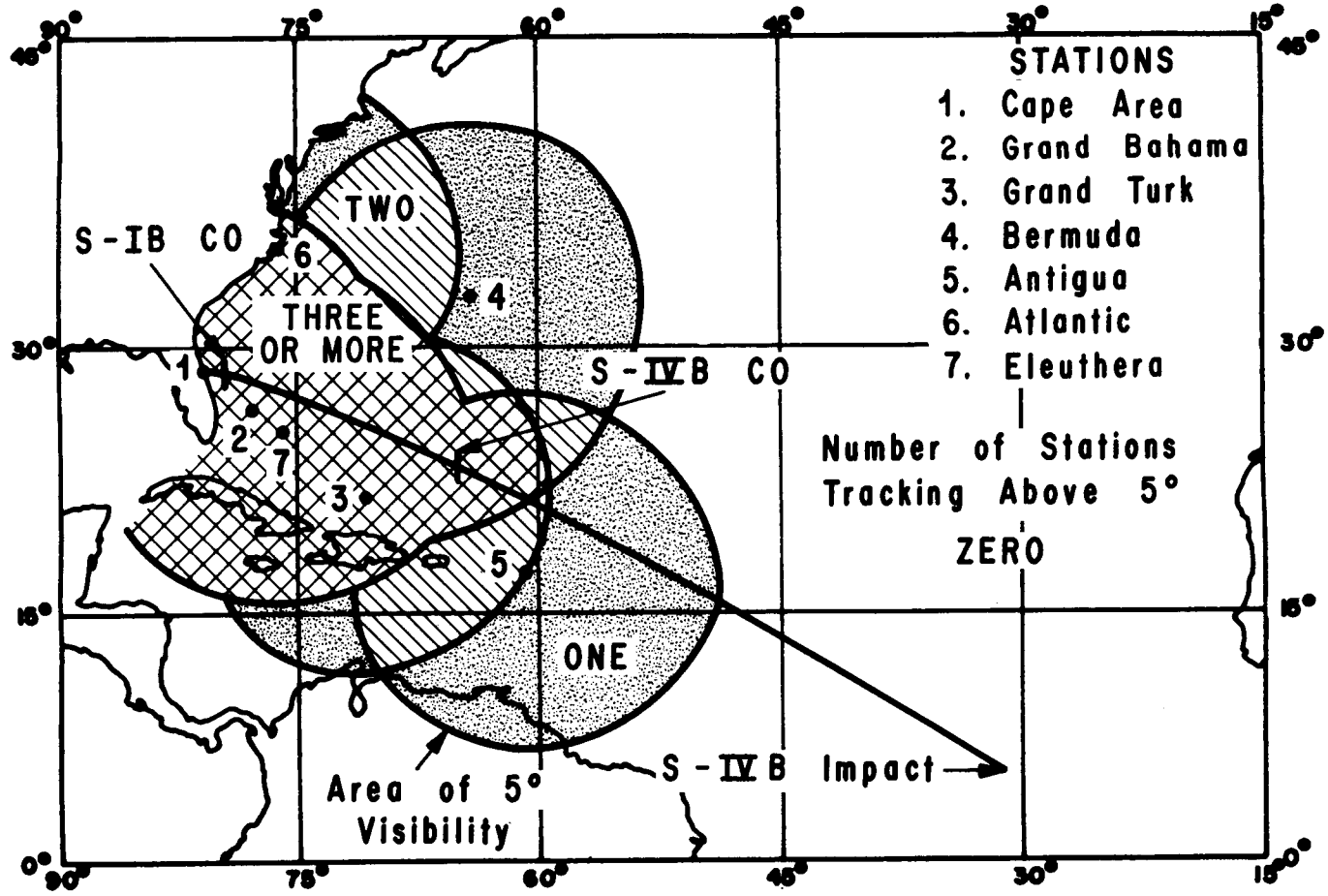

FIG. 8. AS - 202 LAUNCH VEHICLE GROUND TRACE

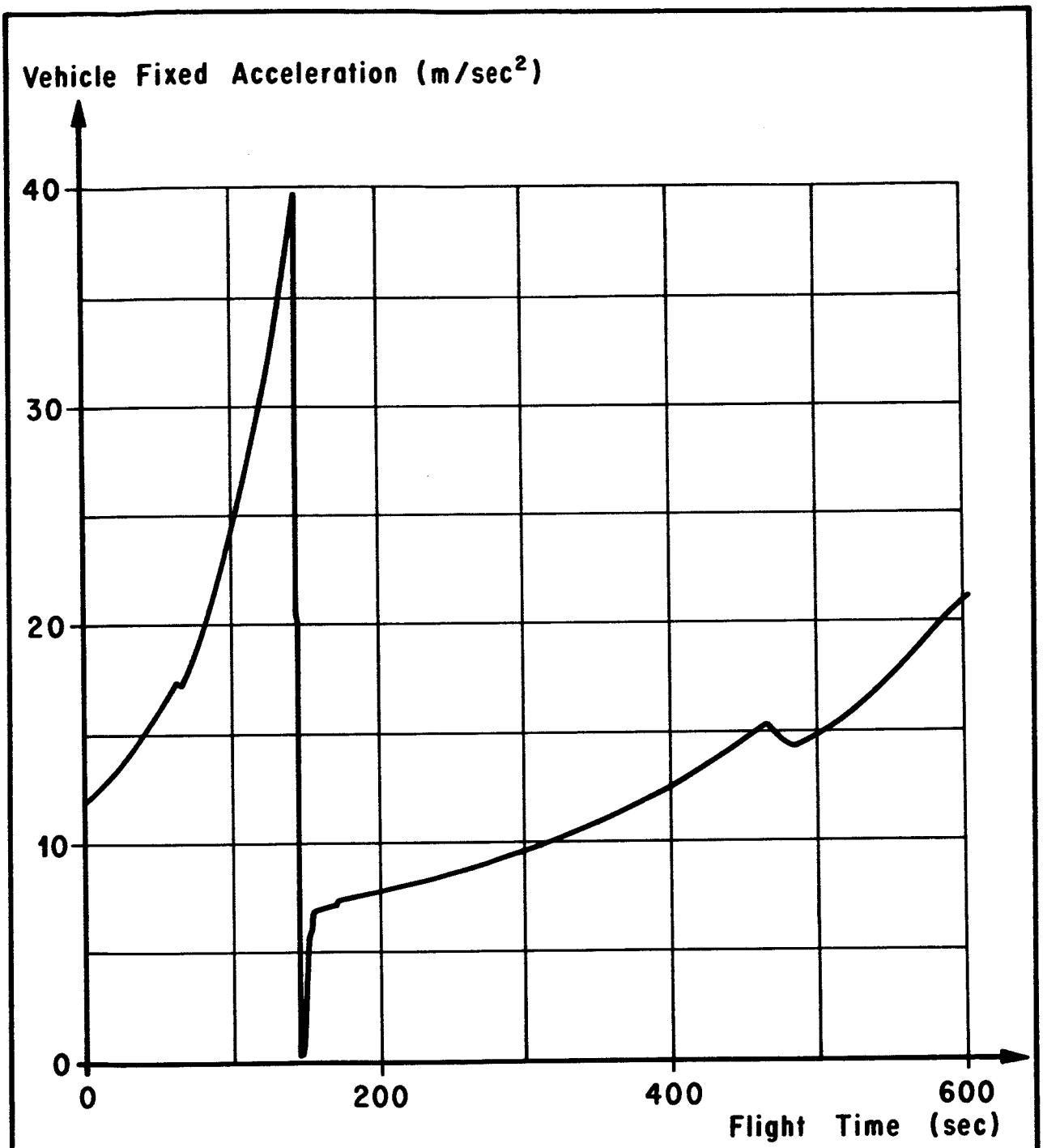

FIG. 9. AS-202 VEHICLE FIXED ACCELERATION VERSUS FLIGHT TIME

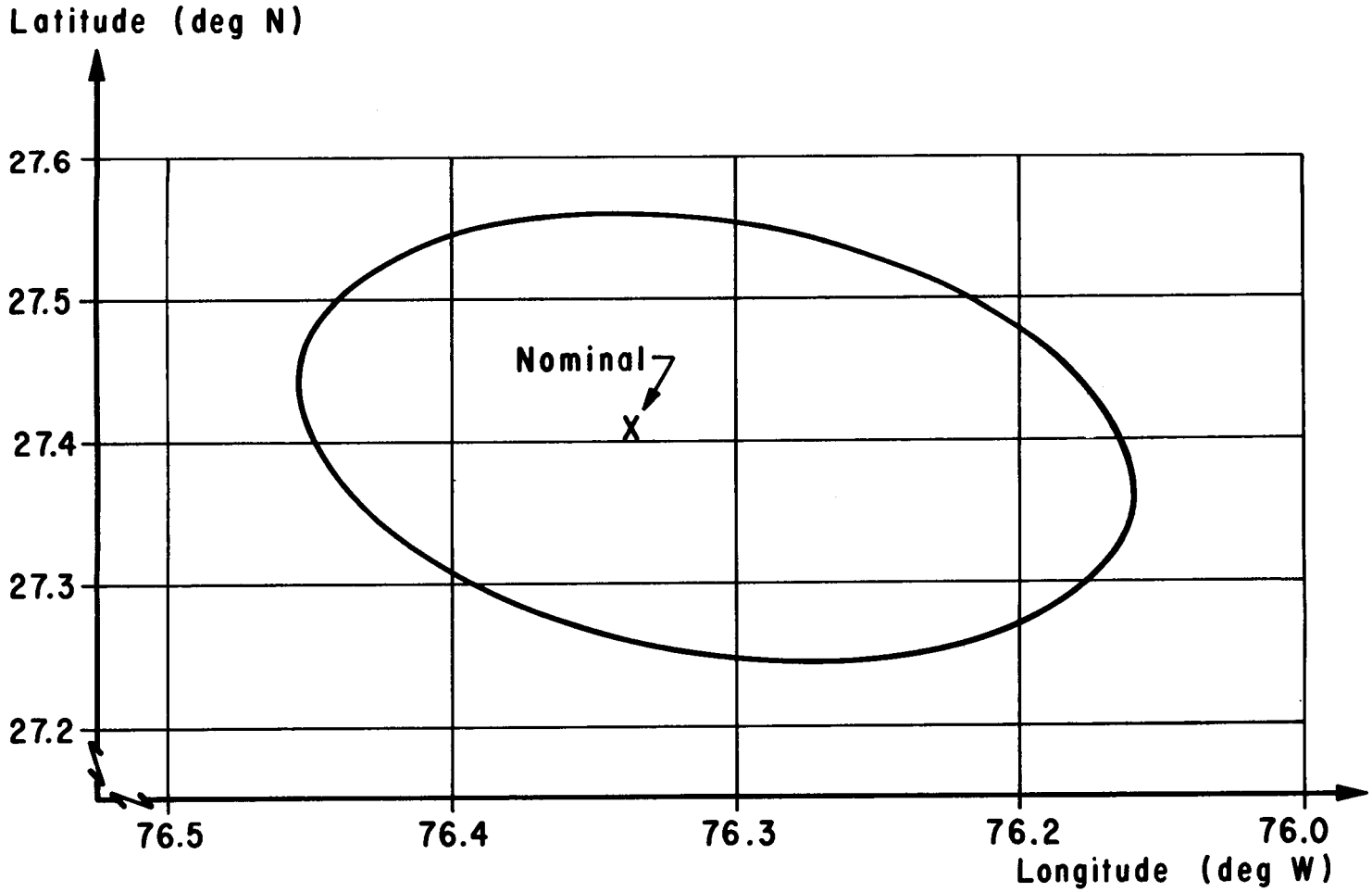

FIG. 10. AS-202
S-IB STAGE AND CAMERA CAPSULE IMPACT ENVELOPE

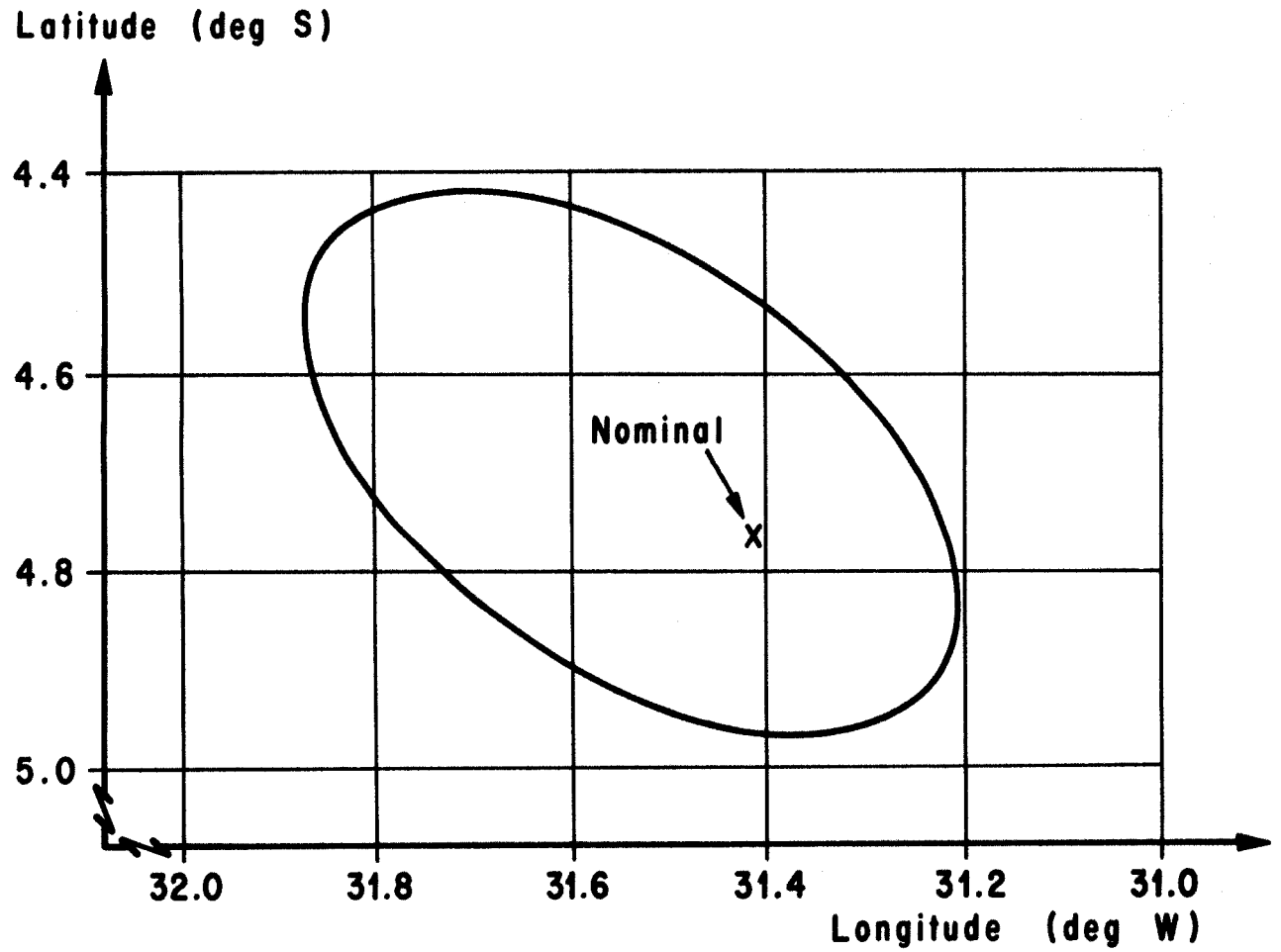

FIG. 11. AS-202 S-IVB STAGE IMPACT ENVELOPE

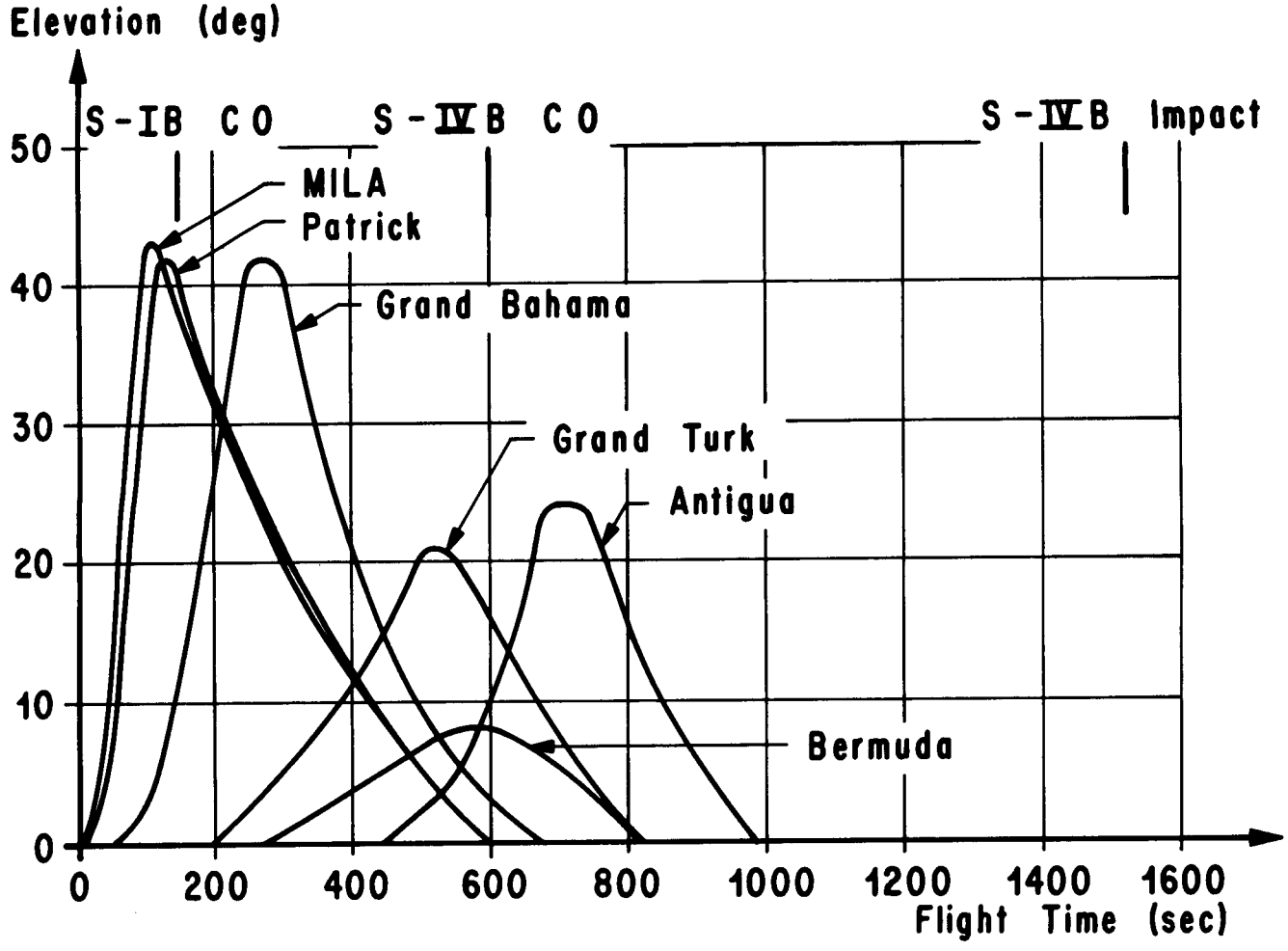

FIG. 12. AS - 202 C - BAND RADAR ELEVATION HISTORIES

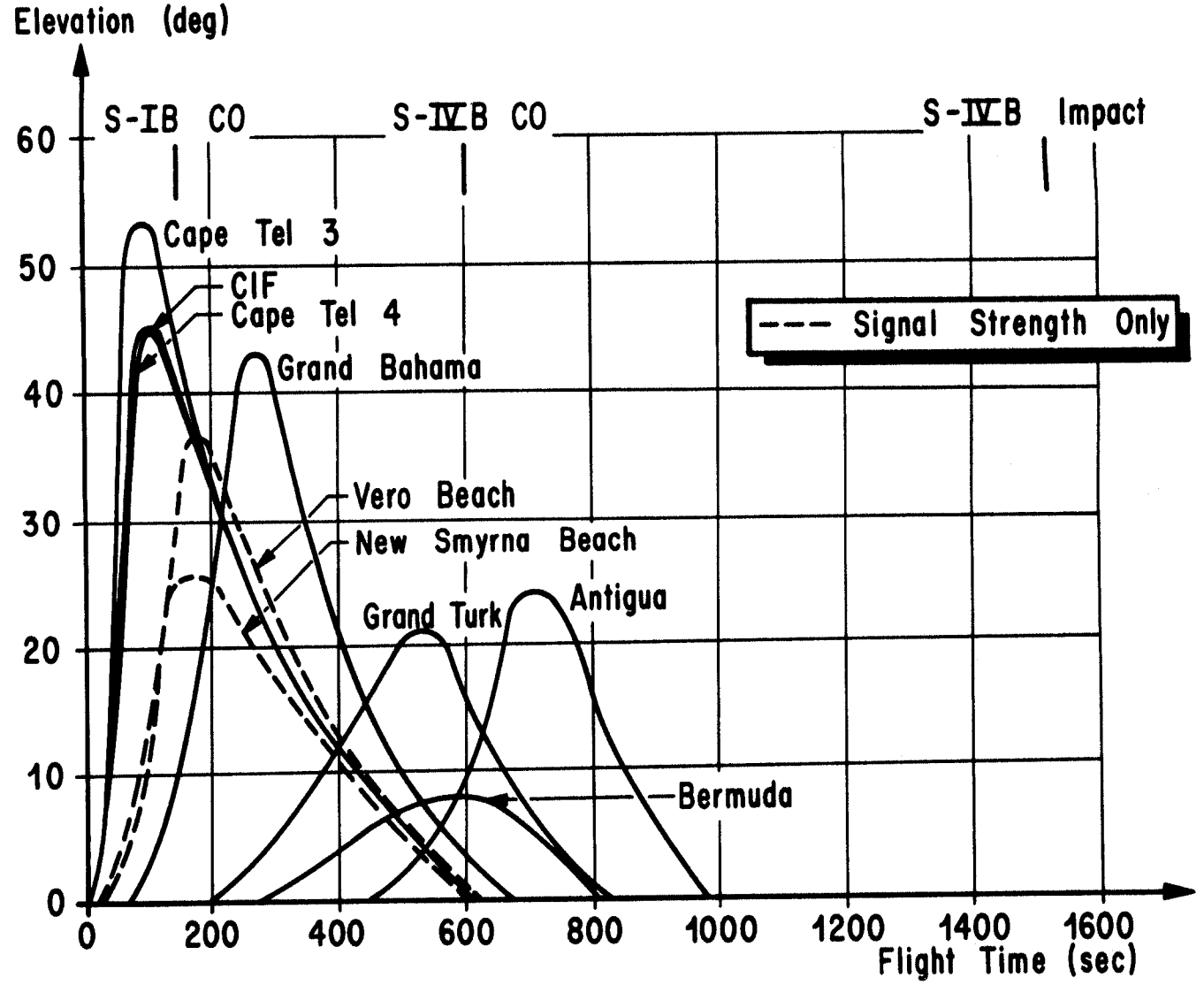

FIG. 13. AS-202 TELEMETRY ELEVATION HISTORIES

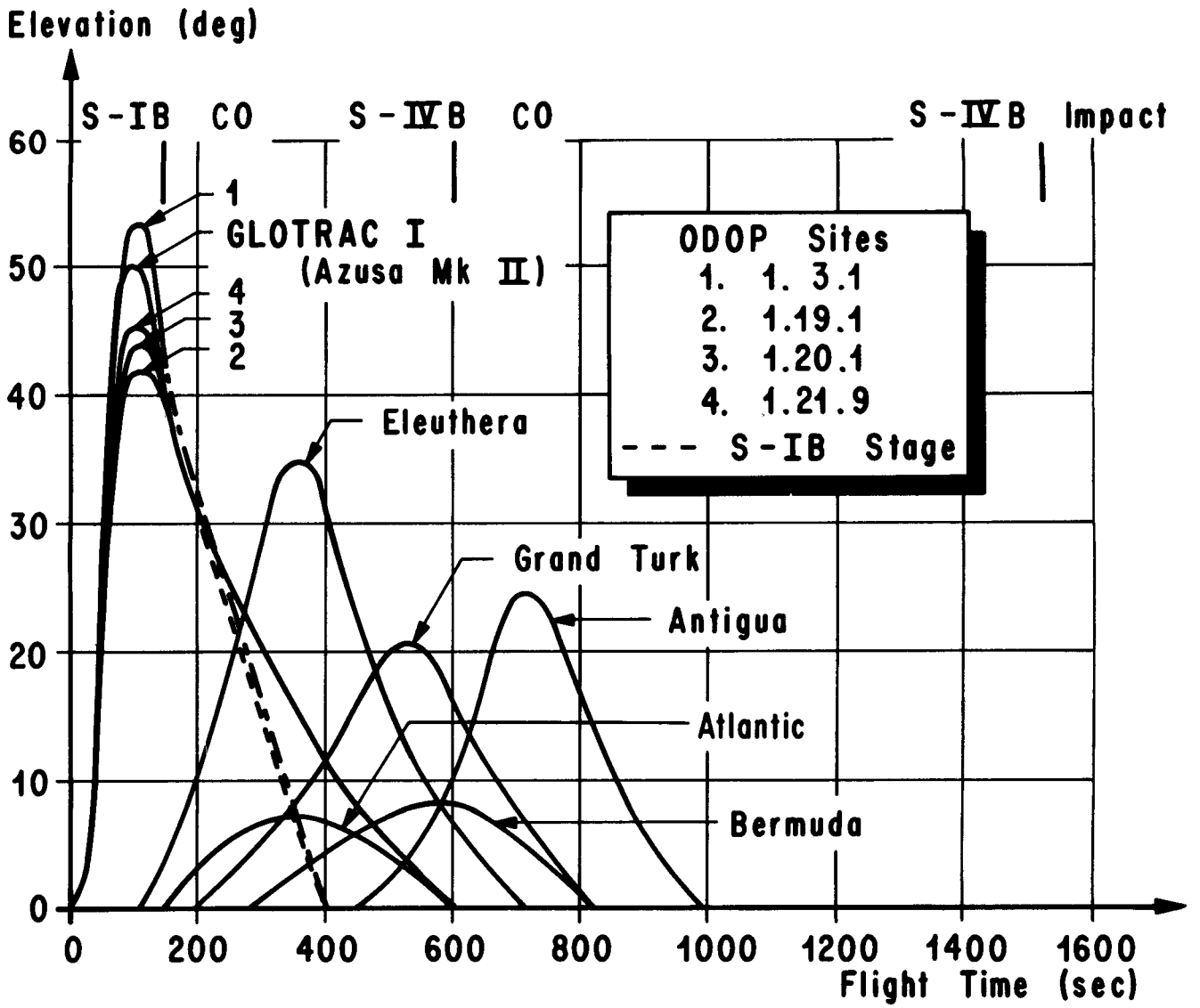

FIG. 14. AS - 202 GLOTRAC AND ODOP ELEVATION HISTORIES

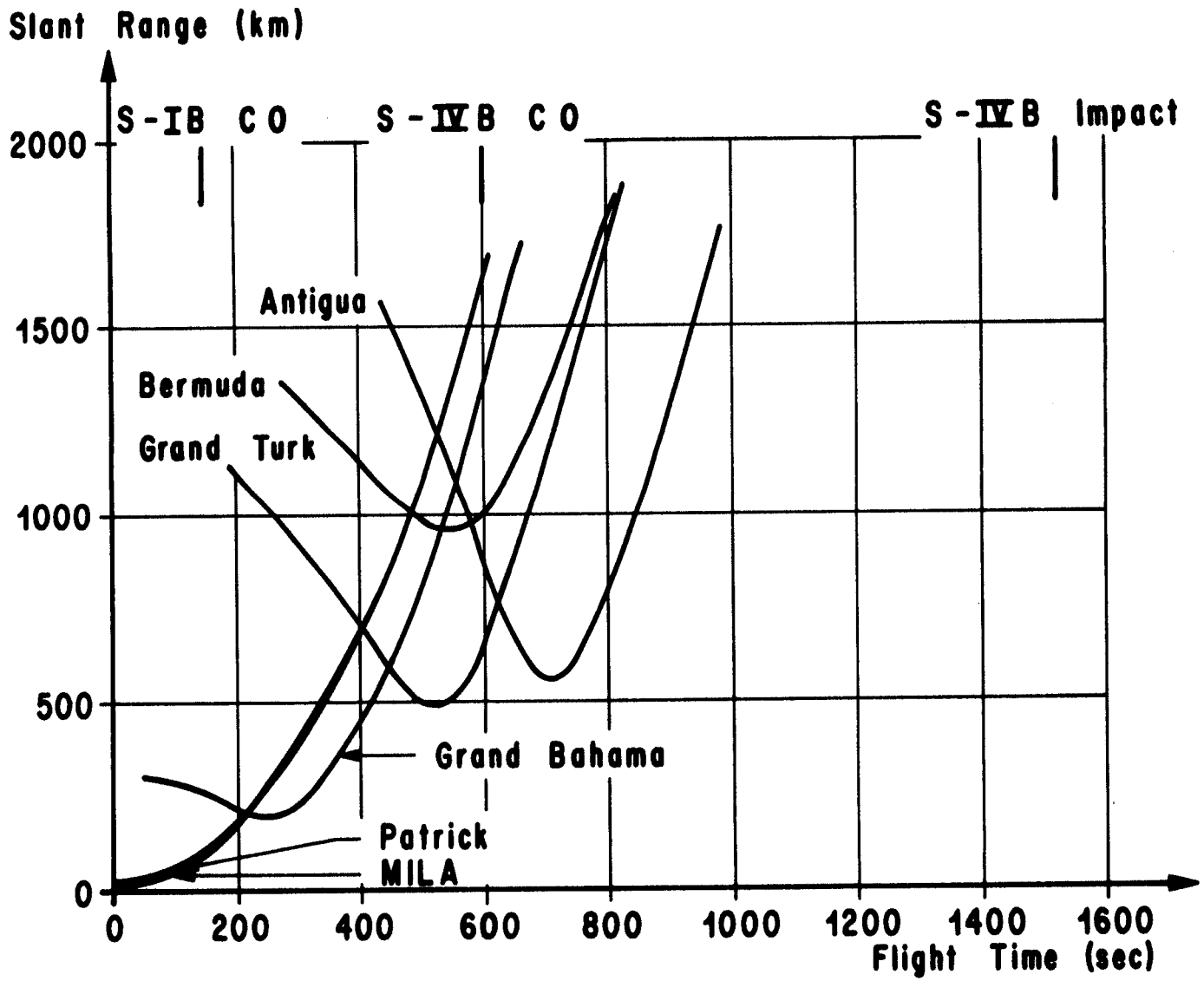

FIG. 15. AS-202 C-BAND RADAR SLANT RANGE HISTORIES

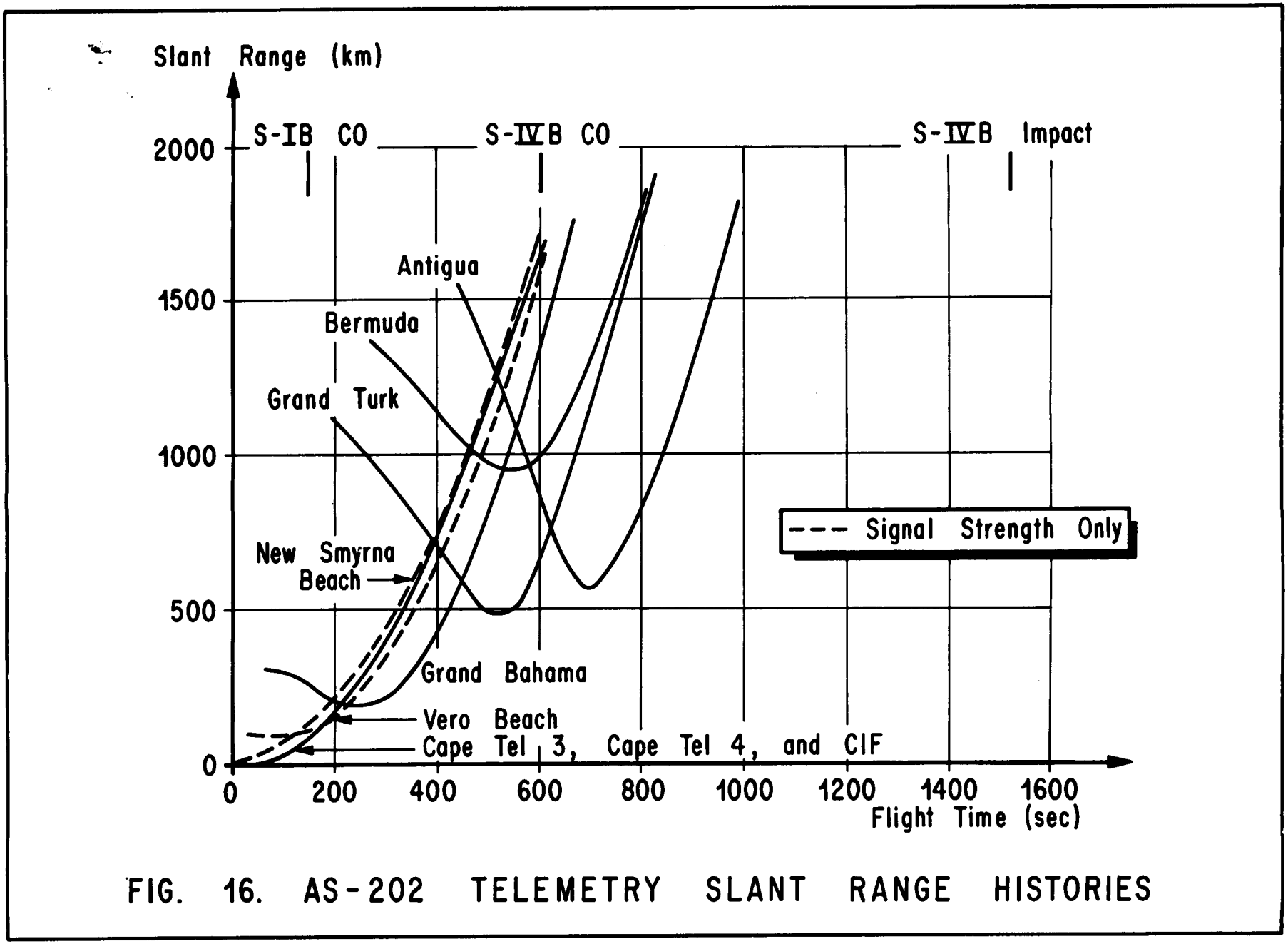

FIG. 16. AS-202 TELEMETRY SLANT RANGE HISTORIES

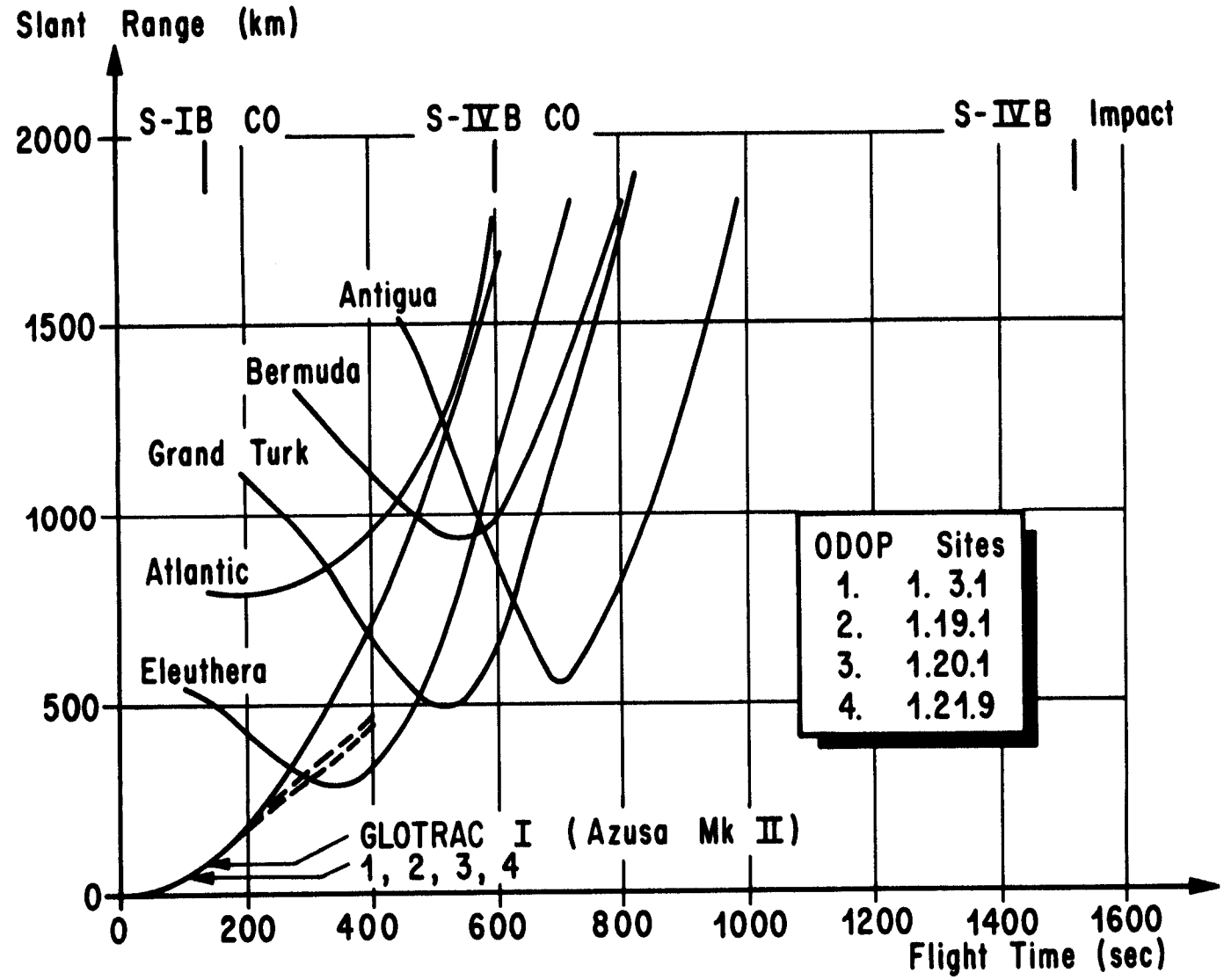

FIG. 17. AS-202 GLOTRAC AND ODOP SLANT RANGE HISTORIES

APPENDIX A

1. LAUNCH VEHICLE MASS BREAKDOWN AND DISBURSEMENT

Item	Mass (lbm)
S-IB Stage, Dry	91550
S-IB/S-IVB Interstage (Incl. retro-rocket prop.)	6408
S-IVB Stage, Dry (at ground ignition)	23264
Instrument Unit at G. I.	4502

AS-201 MASS DISBURSEMENT

Item	Mass (lbm)
S-IB Stage at Ground Ignition (G. I.)	1003833
S-IB/S-IVB Interstage at G. I.	6408
S-IVB Stage at G. I.	254725
Vehicle Instrument Unit (V. I. U.) at G. I.	4502
Spacecraft at G. I.	56906
First Flight Stage at G. I.	1326374
S-IB Thrust Buildup (10887 LOX, 3237 RP-1)	-14124
First Flight Stage at Lift-Off	1312249
S-IB Mainstage (611014 LOX, 270500 RP-1)	-881514
S-IB Frost	-1000
S-IB Gear Box Consumption (RP-1)	-722
S-IB Seal Purge	-7
S-IB Fuel Additive (oronite)	-24
S-IB I. E. T. D. (761 LOX, 1400 RP-1)	-2161
S-IVB Frost	-100
First Flight Stage at O. E. C. O. Signal	426722
S-IB OETD To Sep. (579 LOX, 1061 RP-1)	-1640
First Flight Stage at Separation	425082
S-IB Stage at Separation	-102641
S-IB/S-IVB Interstage	-6408
S-IVB Aft Frame	-25
S-IVB Ullage Rocket Propellant	-77
S-IVB Detonation Package	-4
Second Flight Stage at Ignition	315927
S-IVB Thrust Buildup Prop (318 LOX, 111 LH_2)	-429
S-IVB LH_2 Start Tank	-4
S-IVB Ullage Rocket Propellant	-105

Item	Mass (lbm)
Second Flight Stage at Lift-Off (90% Thrust)	315389
S-IVB Mainstage (189943 LOX, 35462 LH_2)	-225405
S-IVB Ullage Rocket Cases	-220
S-IVB Aux. Prop. - Power Roll Control	-4
Launch Escape System	-8521
Second Flight Stage at Guidance Cutoff Signal	81229
S-IVB Thrust Decay (117 LOX, 27 LH_2)	-142
Second Flight Stage at E. T. D.	81087
Second Flight Stage at Separation	81087
S-IVB Stage at Separation	-28169
V. I. U.	-4502
Adapter (less ring)	-3713
Spacecraft	44672

2. SPACECRAFT MASS BREAKDOWN

Item	Mass (lbm)
Command Module	11800
Service Module Less Propellant	9765
Service Module Propellant	23020
Adapter Ring	87
Total	44672

APPENDIX B

AS-202 OPERATIONAL TRAJECTORY

IGM PRESETTINGS

LVDC SYMBOL	INITIAL VALUE	UNITS	DESCRIPTION
*---	28.88	sec	Time from time base 3 (T3) to initiate IGM guidance
T_{1i}	299.25	sec	Time-to-go for first IGM stage
T_{3i}	129.9	sec	Time-to-go for second IGM stage
τ_3	322.733	sec	Nominal value of $m/\dot{m}$ at initiation of second IGM stage
Vex1	4165.45	m/sec	J-2 exhaust velocity ($go.I_{sp}$) for first IGM stage
Vex3	4209.49	m/sec	J-2 exhaust velocity (go.Isp) for second IGM stage
V_T	6800	m/sec	Terminal velocity for IGM equations. J-2 cutoff velocity mangitude
X_{VT}	0.	m	Desired cutoff position vector components in IGM coordinate system
Y_{VT}	6592538.9	m	
Z_{VT}	0.	m	
$\dot{X}_{VT}$	6783.4753	m/sec	Desired cutoff velocity vector components in IGM coordinate system
$\dot{Y}_{VT}$	473.8503	m/sec	
$\dot{Z}_{VT}$	0.	m/sec	
$\ddot{X}_{VGT}$	0.	m/s^2	Terminal gravitation vector components in IGM coordinate system
$\ddot{Y}_{VGT}$	-9.17139	m/sec^2	
$\ddot{Z}_{VGT}$	0.	m/s^2	
ϵ	46.	sec	Value of T_{3_i} to initiate IGM $\Delta \bar{V}$ guidance
T_{r1}	6667	N/D	Mission dependent constant multiplier for terminal range angle equation

LVDC SYMBOL	INITIAL VALUE	UNITS	DESCRIPTION
T_{r_2}	0.	N/D	Mission dependent constants for N_3 and N_4 equations
T_{r_3}	0.	N/D	
T_{SMC}	190	sec	Time to initiate thrust misalignment correction
T_2	0.	N/D	Multiplier of N_2 and N_4 in χ'_x and χ'_z equations
ΔT_{NOM}	R-ASTR		
AP1	.409699		Transformation matrix from navigation coordinate system to the (X_4, Y_4, Z_4) coordinate system
AP2	-.91221574		
AP3	-.0028925398		
AP4	.91211505		
AP5	.40969873		
AP6	-.013894577		
AP7	.013859920		
AP8	.0030542649		
AP9	.99989925		
*---	236.1	sec	Time from time base 3 (T3) to sample F/M for IGM staging
FLAG	2	N/D	Number of successive F/M decreases required for IGM staging criteria
ACC	.0001	m/s^2	Tolerance for F/M comparison
T_{1_o}	299.25	sec	Constants for updating second stage time-to-go for perturbed EMR shift time
A_o	512.90	sec	
A_1	-1.28	N/D	

LVDC SYMBOL	INITIAL VALUE	UNITS	DESCRIPTION
PCO	30	sec	Back-up time for IGM staging
τ_{10}	558.64	sec	Constants for artificial
$*C_o$	30	sec	T_3 mode
M_{o2}	133922	kg	Mass at active guidance initiation
$\dot{M}_2$	238.71	kg/sec	Average flow rate of first IGM stage
$\dot{M}_3$	195.449	kg/sec	Average flow rate of second IGM stage

*LVDC symbol not defined

APPENDIX C

THREE-SIGMA LAUNCH VEHICLE PERTURBATIONS

I. S-IB STAGE PERFORMANCE

A. Propulsion Group

Propellent Loading Mass	±.3%
Thrust and Flowrate	±1.5%
I_{SP} (flowrate)	± .9 sec
Mixture Ratio Fuel Bias	+2000 lbm fuel -1000 lbm fuel
High Surface Wind	(Ref.
Low Surface Wind	(Ref.
High Ambient Surface Temperature	(Ref.
Low Ambient Surface Temperature	(Ref.

B. Non-Propulsive Group

Non-Propellent Mass	± 304 lbm
Thrust Misalignment (pitch)	± .62 deg
Thrust Misalignment (yaw)	± .62 deg
Axial Drag Coefficient	± 10%
Headwind	(Ref.
Tailwind	(Ref.
Left Crosswind	(Ref.
Right Crosswind	(Ref.

II. S-IVB STAGE PERFORMANCE

A. Propulsion Group

Propellent Loading Mass	± 1%
Thrust and Flowrate	± 3%
I_{SP}	± 3.12 sec
Mixture Ratio (+ Fuel)	(Ref.
Mixture Ratio (- Fuel)	(Ref.
Mixture Ratio (+ LOX)	(Ref.
Mixture Ratio (-LOX)	(Ref.

B. Non-Propulsion Group

Non-Propellent Mass	189 lbm, -122 lbm
Lateral cg offsets (in plane)	± .05 meters
Lateral cg offsets (normal)	± .05 meters
Thrust Misalignment (pitch)	± .62 deg
Thrust Misalignment (yaw)	± .62 deg

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9. Memorandum, R-P&VE-PPF-65-M-142 (628), S-IB Stage Sequence Change, November 17, 1965 (U).

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AS-202 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY

By

Pamelia B. Pack

The information in this report has been reviewed for security classification. Review of any information concerning Department of Defense or Atomic Energy Commission programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

This document has also been reviewed and approved for technical accuracy.

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R-AERO-DIR, Mr. Jean
R-AERO-A, Mr. Dahm
R-AERO-AT, Mr. Wilson
R-AERO-ATA, Mr. Elkin
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R-AERO-AU, Mr. Young
R-AERO-A, Mr. Holderer
R-AERO-G, Mr. Baker
R-AERO-D, Mrs. Chandler
R-AERO-DD, Mr. Ryan
R-AERO-DAG, Mr. Telfer
R-AERO-DAP, Mr. Cremin
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R-AERO-F, Mr. Stone
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R-AERO-FO, Mr. Hill (5)
R-AERO-P, Mr. Teague (10)
R-AERO-P, Mr. McNair
R-AERO-P, Mr. Ledford (15)
R-AERO-T, Mr. Reed
R-AERO-T, Mr. Cummings
R-AERO-Y, Mr. Vaughan
R-AERO-P, Mr. Tinius
R-TEST-DIR, Mr. Heimburg
R-ME-DIR, Mr. Kuers
R-SAI, Earl Butler
R-P&VE-DIR, Mr. Lucas
R-P&VE-DIR, Mr. Hellebrand
R-P&VE-XJ, Mr. Griner
R-P&VE-P, Mr. Paul
R-P&VE-VOI, Mr. Byers
R-P&VE-AVA, Mr. Denton
R-P&VE-VS, Mr. Schulze
R-P&VE-S, Mr. Kroll
R-P&VE-SL, Mr. Showers
R-P&VE-S, Mr. Hunt
R-P&VE-PTD, Mr. Hastings
R-P&VE-DIR, Mr. Palaoro (2)
R-P&VE-VAW, Mr. Marmann
R-P&VE-VAW, Mr. Scott
R-P&VE-PPE, Mr. McKay
R-P&VE-PPE, Mr. Igou
R-QUAL-DIR, Mr. Grau
R-COMP-DIR, Dr. Hoelzer
R-COMP-RRT, Mr. Crafts
PA-Mr. Jones
I-MO-O, Mr. Ladner
R-ASTR-DIR, Dr. Haeussermann
R-ASTR-I, Mr. Hoberg
R-ASTR-F, Mr. Blackstone
R-ASTR-F, Mr. Hosenthien
R-ASTR-F, Mr. Scofield
R-ASTR-FO, Mr. Mink
R-ASTR-NGI, Mr. Blanton
R-ASTR-NGI, Mr. Nicaise (2)
R-ASTR-NGI, Mr. Schaefer
R-ASTR-NG, Mr. Seltzer
R-ASTR-NG, Mr. Winkler
R-ASTR-NG, Mr. Chubb
R-ASTR-G, Mr. Mandel
R-ASTR-G, Mr. Thomason
R-ASTR-N, Mr. Moore
R-ASTR-R, Mr. Taylor
R-ASTR-S, Mr. Mack
R-ASTR-M, Mr. Boehm
I-I/IB-TF, Maj. Kminek (2)
R-ASTR-E, Mr. Fichtner
R-ASTR-IRD, Mr. Ely
R-ASTR-EA, Mr. Greer
R-ASTR-IR, Mr. Barr
R-ASTR-IR, Mr. Eden
NAA, Mr. Tooker (2)