NASA TECHNICAL MEMORANDUM

NASA TM X-53263

MAY 17, 1965

SA-9, 8, and 10 DISPERSION ANALYSIS

by GERALD WITTENSTEIN AND JERRY D. WEILER
Aero-Astrodynamics Laboratory

NASA

George C. Marshall Space Flight Center, Huntsville, Alabama

TECHNICAL MEMORANDUM X-53263

SA-9, 8 AND 10 DISPERSION ANALYSIS

By

Gerald Wittenstein and Jerry D. Weiler

George C. Marshall Space Flight Center

ABSTRACT

24567

This report replaces the Part II portion of the SA-9 Final Trajectory. The data used to generate the analysis presented here is based on final SA-9 Data. The only differences in the flights of SA-9, 8 and 10 will be a shift in the nominal similar to the shift described in this report.

A detailed discussion of dispersions, their philosophy, and application with respect to a nominal trajectory is presented. A brief description of the SA-9 nominal trajectory is contained as a reference in this report.

It is felt by the authors that the group of trajectories presented in the dispersion analysis is representative and yields a satisfactory envelope for the remaining Block II flight profiles (SA-8 and SA-10). Considering the vehicle $\pm 2\sigma$ perturbations, all mission objectives and requirements will be met with a high level of confidence.

Author

NASA-GEORGE C. MARSHALL SPACE FLIGHT CENTER

TECHNICAL MEMORANDUM X-53263

May 17, 1965

SA-9, 8, and 10 DISPERSION ANALYSIS

By

Gerald Wittenstein and Jerry D. Weiler

TRAJECTORY SECTION
FLIGHT MECHANICS BRANCH
FLIGHT EVALUATION AND OPERATIONS STUDIES DIVISION
AERO-ASTRODYNAMICS LABORATORY

TABLE OF CONTENTS

LIST OF TABLES

TECHNICAL MEMORANDUM X-53263

SA 9, 8, AND 10 DISPERSION ANALYSIS

SUMMARY

SA-9 was the first Saturn flight to have a primary payload mission. Therefore, insuring a successful flight required that both payload and vehicle primary objectives be met with a high level of confidence. To accomplish this, the nominal trajectory was shaped so that there was approximately an equal confidence in "not" exceeding 113.4 kg (250 lbm) of liquid hydrogen (LH_2) and of achieving a guidance cutoff (95 per cent). It should be pointed out that in the event of a $+2\sigma$ vehicle dispersion the 113.4 kg (250 lbm) limit of LH_2 will be exceeded. Conversely, if a -2σ vehicle dispersion occurs, then a depletion cutoff will result rather than a guidance cutoff. In both cases the confidence of this occurring is quite small.

Considering only first stage performance perturbations and a nominal S-IV stage, then the following $\pm 2\sigma$ Root Sum Square (RSS) variations about the nominal at S-I stage cutoff are

Time	= $\pm$	2.141 sec
Altitude	= $\pm$	1,986.2 m
Range	= $\pm$	3,652.7 m
Velocity	= $\pm$	44.62 m/sec
Path Angle	= $\pm$	.937 deg

This yields at guidance cutoff signal (GCS) of the S-IV stage a $\pm 2\sigma$ Root Sum Square (RSS) envelope about the nominal of

Time	= $\pm$	2.860 sec
Altitude	= $\pm$	14.0 m
Range	= $\pm$	13,833.4 m
Velocity	= $\pm$	0.0 m/sec
Path Angle	= $\pm$	0.004 deg
Residual	= $\pm$	263.14 kg

Assuming a nominal performing first stage and only S-IV stage perturbations, the following $\pm 2\sigma$ Root Sum Square (RSS) deviations occur about the nominal at guidance cutoff signal (GCS)

Time	= ±	9.656 sec
Altitude	= ±	30.9 m
Range	= ±	35,685.2 m
Velocity	= ±	0.0 m/sec
Path Angle	= ±	0.002 deg
Residuals	= ±	184.2 kg

The nominal orbital configuration will guarantee greater than a one-year lifetime and a maximum altitude of approximately 750 km. In the event of a -2σ vehicle dispersion, the apogee altitude will be reduced to approximately 700 km, which does not significantly change the lifetime.

SECTION I. INTRODUCTION

The primary objectives of the SA-9, 8 and 10 vehicles are to place the Pegasus satellite into an orbit which has a guaranteed lifetime of one year under 2σ Root Sum Square (RSS) considerations and the continued development of the Saturn I, Block II vehicles. The Pegasus satellite's primary objectives are to measure the magnitude and direction of medium size meteoroids, store this information and transmit it back to earth upon telemetered commands.

SA-9, 8 and 10 are Saturn I, Block II vehicles, which consist of S-I Stage, S-IV Stage, instrument unit, and Apollo boilerplate (BP 16). The boilerplate consists of a service module, a command module, a launch escape system, and a Pegasus satellite.

Nominally for the SA-9, the S-I stage will propel the vehicle to an altitude of approximately 89 km, with a range of approximately 79 km. The S-IV stage, using the iterative guidance mode (IGM), will arrive at the following conditions at guidance cutoff signal (GCS): (guidance cutoff signal is initiated when the velocity reaches 7,678.95 m/sec) a time of 629.93 sec, an altitude of 500.06 km, a path angle of 90.018°, and a range of 1,861.2 km. See Reference 1 for a more complete description of the nominal trajectory.

SA-9, launched from Cape Kennedy, Pad 37B, on February 16, 1965, flew a successful mission, placing the Pegasus satellite into the predicted orbit and preliminary results show that all the mission objectives were accomplished.

In obtaining the flight profile necessary to achieve the mission requirements, the following assumption was made: A successful flight will occur if the vehicle can achieve the mission requirements

satisfactorily under a $\pm 2\sigma$ Root Sum Square (RSS) dispersion. It is upon this assumption that the nominal trajectory is based. By coordination with responsible people of the Center, the dispersion analysis presented in the description is considered representative of a $\pm 2\,\sigma$ Root Sum Square (RSS) normal type distribution.

In light of the LH_2 problem (see Reference 2), it became necessary to reduce the nominal Flight Performance Reserve such that there would be approximately a 95 per cent confidence in achieving a guidance cut-off and of "not" exceeding 113.4 kg (250 lbm) of LH_2. This leads to a dispersion analysis which must consider primarily both a guidance cut-off and the safety of the Pegasus satellite.

Lieftime and orbital information was obtained from the Operations Studies Branch, R-AERO-FO.

The authors wish to thank Pamelia B. Pack for her assistance in obtaining the data presented in this report.

SECTION II. DESCRIPTION

A. Theory

Since a deviation from the mean is statistically probable, it is necessary to determine within reasonable limits a vehicle envelope which will describe the flights of SA-9, 8 and 10. This envelope will determine the necessary performance characteristics of the vehicle which are needed to accomplish the mission. It is assumed that a successful mission will occur if the requirements can be met 95 per cent of the time. Therefore, individual perturbations (I_{sp}, F, winds, etc.) of a $\pm 2\,\sigma$ magnitude must be considered for the dispersion analysis. For the purpose of this report, all individual perturbations are assumed to describe a normal (Gaussian) distribution. Statistically, all disturbances can occur with an equal probability and, therefore, it is necessary to determine a total vehicle $\pm\ 2\sigma$ deviation.

The individual perturbations are considered to be independent; however, the propulsion group used in the S-I stage is complete only if the group and magnitude of the dispersion obtained from P&VE Laboratory are contained in the dispersion analysis. The propulsion group of the S-I stage consists of the following perturbations: propellant loading, I_{sp} (flowrate), thrust and flowrate (I_{sp}= constant), mixture ratio, ground winds, and ambient temperature. All other perturbations are considered completely uncorrelated.

After establishing the median trajectory (by use of the Monte Carlo Method described below), it was found that this corresponded to the nominal trajectory as presented in Part I. Using this (nominal)

as a base, a $\pm 2\sigma$ vehicle dispersion was determined by applying the Root Sum Square Method. The Root Sum Square method uses the fact that for a number of perturbations, which have a 2σ magnitude and are independent of each other, a total vehicle 2σ perturbation can be found by squaring the individual perturbations and taking the square root of the sum (see Reference 3). A similar method which was used for determining the vehicle 2σ perturbation is the Monte Carlo technique. In general, this technique generates a large number of cases and statistically analyzes them. For more information about this method, see Reference 4. The results of both methods were essentially identical. The only difference in the two is in the prediction of the envelope for a large number of parameters. For SA-9, 8 and 10 the only envelope established by the Monte Carlo technique was the delta 2σ residual dispersions.

B. Mission Objectives and Requirements

Generation of the final flight profile must satisfy, if at all possible, all the mission requirements and objectives. Those which most affect the flight profile are as follows

1. Having a minimum of LH_2 residual at cutoff. The desired amount is less than 113.4 kg (250 lbm).
2. Achieving a guidance cutoff (GCS).
3. Guaranteeing a one-year lifetime.
4. Not exceeding an apogee altitude of 750 km.

SA-9, 8 and 10 are unique in (up to this time in the Saturn program) that the flight profile is bounded by both high and low performance. Requirements one and two contradict each other in that number one calls for a large Flight Performance Reserve and number two calls for zero residuals. In the nominal case, Flight Performance Reserve is treated as residuals. It was for this reason that the approach was to compromise requirements one and two such that an equal confidence results for both requirements.

Since the dispersion envelope is treated statistically and must be representative, it is essentially independent of influencing most of the requirements. To satisfy the requirements for SA-9, the envelope had to be shifted so that requirements one and two could both be met with a high level of confidence. The method used to accomplish this was to adjust the nominal Flight Performance Reserve, which is necessary to satisfy the four requirements. For SA-9, the S-I Stage loading was changed to accomplish this. For SA-8 and 10 the iterative guidance mode terminal conditions will be altered to assure the correct Flight Performance Reserve on board.

Shown below is a graphical representation of the results of this shift. The shaded area in Figure 1 indicates the regions where a

guidance cutoff does not occur and where 113.4 kg (250 lbm) of LH_2 is exceeded.

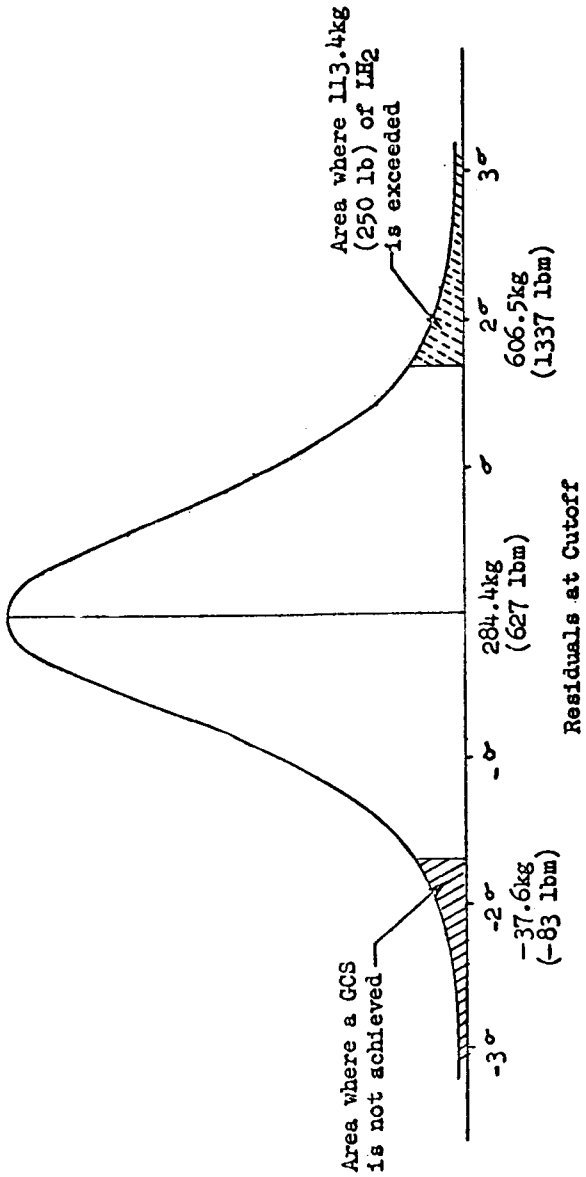


Figure 1

C. Presentation of the Dispersions and Root Sum Square Method

The dispersions considered to be representative for SA-9, 8 and 10 are as follows:

1. S-I Stage

(a)	Non-Propellant Mass	(-237. lbm)
(b)	Propellant Loading Mass	(1,712. lbm)
(c)	Thrust and Flow Rate (I_{sp} = Constant)	(-.75 per cent)
(d)	Flow Rate	(1 per cent)
(e)	Thrust Misalignment (Normal)	(.37 deg)
*(f)	Thrust Misalignment (Inplane +)	(.37 deg)
*(g)	Thrust Misalignment (Inplane -)	(.37 deg)
(h)	Mixture Ratio Shift	(.47 per cent)
(i)	Longitudinal Drag Coefficient	(10 per cent)
*(j)	2 σ Headwind	(See Reference 5)
*(k)	2 σ Tailwind	(See Reference 5)
*(l)	2 σ Left Crosswind	(See Reference 5)
*(m)	2 σ Right Crosswind	(See Reference 5)
*(n)	+2 σ Ground Wind	(See Reference 6)
*(o)	-2 σ Ground Wind	(See Reference 6)
(p)	+2 σ Ambient Temperature	(See Reference 6)
*(q)	-2 σ Ambient Temperature	(See Reference 6)

2. S-IV Stage

(a)	Non-Propellant Mass	(+ 78lbm)
(b)	Propellant Loading Mass	(335 lbm)
(c)	Thrust and Flow Rate (I_{sp} = Constant)	(-.5 per cent)
(d)	Flow Rate	(-.5 per cent)
(e)	Thrust Misalignment (Normal)	(.41 deg)
(f)	Mixture Ratio	(8.5 per cent)

3. Guidance System Hardware Errors

(a)	Accelerometer Errors	(See Reference 8)
(b)	Gyro Drift Errors	(See Reference 8)
(c)	Azimuth Alignment Errors	(See Reference 8)
(d)	Resolver Chain Errors	(See Reference 8)
(e)	Platform Leveling Errors	($\pm$.005 arc sec.)

The envelope about the nominal state parameters (X, Y, etc.) takes into account guidance scheme and guidance hardware errors in both the S-I stage and S-IV stage. As seen in the results, the deviations are not symmetric. However, this result has been taken into account in the generation of the final flight profile. The starred (*) cases above are the nonsymmetric cases considered in this analysis.

Shown below is the analytical method used in obtaining the root sum squared deviations for stage and vehicle perturbations.

P_i = Dispersion Parameter - Nominal Parameter
Where i = 1, 2, 3 1 = S-I Stage
2 = S-IV Stage
3 = Total Vehicle

P_g = Guidance System Hardware Errors

The S-I Stage RSS is obtained as follows:

$$\text{Positive RSS}_I = \sqrt{\Sigma(+P_1)^2}$$

$$\text{Negative RSS}_I = \sqrt{\Sigma(-P_1)^2}$$

$$\text{RSS}_I = \frac{\text{Positive RSS}_I + \text{Negative RSS}_I}{2}$$

The S-IV Stage RSS is obtained as follows:

$$\text{Positive RSS}_{IV} = \sqrt{\Sigma(+P_2)^2}$$

$$\text{Negative RSS}_{IV} = \sqrt{\Sigma(-P_2)^2}$$

$$\text{RSS}_{IV} = (\text{Positive RSS}_{IV} + \text{Negative RSS}) \div 2$$

The vehicle RSS is obtained as follows:

$$\text{Positive RSS}_V = \sqrt{\Sigma(+P_1)^2 + \Sigma(+P_2)^2 + \Sigma(+P_g)^2}$$

$$\text{Negative RSS}_V = \sqrt{\Sigma(-P_1)^2 + \Sigma(-P_2)^2 + \Sigma(-P_g)^2}$$

$$\text{RSS}_V = (\text{Positive RSS}_V + \text{Negative RSS}_V) \div 2$$

D. Discussion of Engine-Out Capability

Engine-out cases are not considered in the $\pm 2\sigma$ RSS since the probability of one not occurring is supposedly greater than 3σ (i.e., 99%). For SA-9 it is impossible to have an outboard engine-out in the first stage and make the nominal orbit, although it is possible to have an engine-out at approximately 130 seconds and make an orbit with a guaranteed lifetime of one year. For an inboard engine, it is possible to have an engine-out at approximately 80 seconds and still make the predicted orbit. An engine-out in the S-IV stage must come after 300 seconds of flight time in order to make the predicted orbit. If, however, an engine-out occurs after 583.2 sec. of flight time, all engines will cut off. This is due to the arming of the LOX cutoff capability, which is established by range safety requirements. If this takes place before 624. sec. of flight time, no orbit can be made.

SECTION III. RESULTS

A. SA-9 Nominal Trajectory

The nominal SA-9 trajectory, including retro and coast portions, is presented in Tables 2A through 6B. The tables labeled with an A represent space-fixed values and those labeled with a B represent earth-fixed values.

B. Dispersion Analysis

Shown in tables 7A through 15 are the results of the dispersion analysis. Tables 7A through 13D contain the nominal values with corresponding deltas which apply at outboard engine cutoff, S-IV guidance initiation, S-IV guidance cutoff, and S-IV insertion. These results are due to guidance scheme and performance perturbations. Table 14 contains the nominal values with the corresponding deltas due to guidance system hardware errors at S-IV guidance cutoff. Table 15 contains the RSS envelope for the vehicle.

C. Vehicle RSS (S-IV Residual was the only parameter considered.)

The vehicle root sum squared deviations are as follows:

$+RSS_V$ = 313 kg (690 lbm)

$-RSS_V$ = 331 kg (730 lbm)

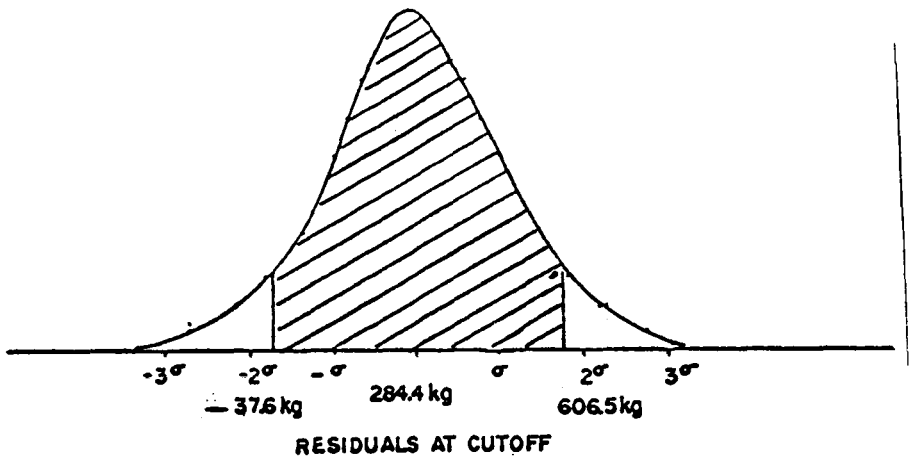
RSS_V = 322 kg (710 lbm)

D. Partials

Shown in Tables 17 and 18 is a group of partials applicable for SA-9. A note of caution of the validity of these partials should be made in the event of a combination of perturbations. These partials should be applicable for SA-8 and SA-10.

E. Confidence

The results of the dispersion analysis yields an envelope which gives a 90 per cent confidence in having a successful flight. However, if high performance occurs, at least one objective will be met (guidance cutoff). In the event of low performance, one objective will also be met (not exceed 113.4 kg (250 lbm) of LH_2). The 90 per cent confidence results from the conflict between requirements one and two as listed in the description. Shown below is the region where a successful flight will occur (shaded area).



RESIDUALS AT CUTOFF

F. Orbital Results

Introduction of the 2σ perturbations listed in the description causes only a small deviation in the predicted orbit of 750 km - 500 km apogee and perigee altitudes. This is credited to the use of the iterative guidance mode employed in the S-IV stage of SA-9.

Shown in table 16 are the perigee and apogee variations due to S-I, S-IV stage performance deviations and the guidance system hardware errors. Also included are the $\pm$ 2σ root sum square values.

G. Final Result

According to preliminary results from the flight evaluation, the SA-9 flight fell within the predicted envelope. The dispersion analysis considered here should well define the flight profile of SA-8 and 10.

TABLE I

SA-9 SEQUENCE OF EVENTS

Time (From Lift-Off)	Event
0.00	Lift-Off
8.00	Initiate Roll and Pitch Tilt
23.00	Terminate Roll
136.05	Signal from Sequencer to Enable Level Sensors
138.00	Tilt Arrest
140.05	S-I Stage Level Sensor Signal
141.65	Inboard Cutoff (S-I Stage)
147.65	Outboard Cutoff (S-I Stage)
148.35	Ullage Rocket Ignition (S-IV Stage)
148.45	Separation, Immediately Followed by Retro Rocket Ignition (S-I Stage)
150.15	S-IV Mainstage Ignition
152.15	Ullage Rocket Thrust Termination
160.45	Jettison Ullage Rocket Casing and LES
166.00	Initiate Active Guidance
584.25	Signal from Sequencer to Arm LOX Cutoff Capability
630.49	S-IV Stage Guidance Cutoff Signal
640.49	End of Powered Flight
810.49	Close Blowdown Non-Propellant Vents
811.49	Start S-IV Pegasus/Apollo Separation
871.49	Begin Pegasus Wing Deployment
931.49	Terminate Wing Deployment

TABLE 2A

S-I STAGE NOMINAL TRAJECTORY

	TIME (SEC)	GROUND DISTANCE (KM)	ALTITUDE (KM)	SPACE FIXED VELOCITY (M/SEC)	SPACE FIXED PATH ANGLE (DEG)	ACCELERATION V DOT EARTH-FIXED (M/SEC SQ)	MASS (KG)	DYNAMIC PRESSURE (N/M SQ)	THRUST (N)	MACH	DRAG (N)
	0.0	-0.00	0.03	408.9	90.00	0.35	505602	0	6572064	0.00	44130
	5.0	-0.00	0.07	409.3	87.49	3.91	492212	190	6753506	0.05	22220
	10.0	-0.00	0.21	410.8	84.61	4.32	478821	863	6791182	0.11	46250
	15.0	0.00	0.46	414.2	81.50	4.75	465342	2128	6829135	0.18	73563
	20.0	0.01	0.83	421.4	78.21	5.22	451863	4072	6873897	0.25	105802
	25.0	0.04	1.33	433.2	74.86	5.74	438347	6732	6922208	0.33	143917
	30.0	0.11	1.97	450.5	71.57	6.31	424831	10078	6980261	0.42	191764
	35.0	0.23	2.76	473.3	68.46	6.92	411304	14008	7043472	0.52	253962
	40.0	0.43	3.71	501.4	65.59	7.55	397777	18325	7110570	0.63	332302
	45.0	0.72	4.83	534.1	62.99	8.10	384259	22706	7179106	0.75	455554
	50.0	1.12	6.13	571.0	60.72	8.53	370742	26701	7249178	0.89	644144
	55.0	1.63	7.62	610.6	58.90	8.42	357214	29627	7316097	1.03	1033881
	60.0	2.28	9.29	653.4	57.46	9.29	343687	31310	7379136	1.19	1082928
	65.0	3.08	11.14	702.7	56.21	10.55	330116	32042	7439179	1.38	1028993
	70.0	4.07	13.20	759.8	55.12	12.12	316544	31498	7495462	1.61	902787
	75.0	5.27	15.49	825.7	54.16	13.90	302973	29363	7546175	1.88	743176
	80.0	6.72	18.04	901.4	53.35	15.86	289401	25058	7586017	2.15	571143
	85.0	8.46	20.88	988.1	52.78	17.93	275908	20039	7614116	2.42	409607
	90.0	10.55	24.03	1086.3	52.50	20.01	262414	15292	7630979	2.71	283534
	95.0	13.05	27.50	1196.0	52.49	22.15	248937	11235	7638788	3.02	188232
	100.0	16.01	31.31	1317.3	52.72	24.38	235460	7880	7640589	3.35	118386
	105.0	19.49	35.48	1450.1	53.09	26.74	222007	5300	7638739	3.69	72293
	110.0	23.55	40.02	1595.0	53.51	29.28	208554	3442	7633791	4.04	43314
	115.0	28.26	44.96	1752.6	53.95	32.03	195127	2180	7622999	4.42	25593
	120.0	33.65	50.34	1924.2	54.33	35.10	181700	1373	7610799	4.90	15019
	125.0	39.80	56.19	2111.5	54.65	38.57	168324	850	7598087	5.59	5931
	130.0	46.76	62.56	2316.8	54.90	42.54	154949	480	7582555	6.45	1758
	135.0	54.62	69.52	2543.1	55.12	47.11	141645	236	7560087	7.51	317
	140.0	63.46	77.11	2794.3	55.38	52.54	128342	95	7530398	8.79	41
(1)	140.6	64.63	78.10	2827.4	55.41	53.27	126687	84	7523500	8.97	55
	142.0	67.29	80.33	2871.1	55.52	25.54	123970	61	3920265	9.27	52
(2)	146.6	76.48	87.94	2986.2	55.90	24.93	117821	17	3642249	9.88	22
	147.1	77.38	88.68	2992.4	55.94	-3.34	117102	15	308221	9.90	19
(3)	147.4	78.12	89.28	2991.3	55.99	-3.66	117034	13	270328	9.90	17

(1) IECO
(2) OECO
(3) Separation

TABLE 2B

S-I STAGE NOMINAL TRAJECTORY

	EARTH FIXED PARAMETERS										
	TIME (SEC)	XXXE (KM)	YYYE (KM)	ZZZE (KM)	DXXE (M/SEC)	DYYE (M/SEC)	DZZE (M/SEC)	VELOCITY (M/SEC)	PATH ANGLE (DEG)	LONGITUDE (POSITIVE WEST) (DEG)	GEOD. LAT. (POSITIVE NORTH) (DEG)	GEOC. LAT. (POSITIVE NORTH) (DEG)
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.73	80.5650	28.5319	28.3707
	5.0	-0.0	0.1	-0.0	-0.0	18.0	-0.1	18.0	0.46	80.5649	28.5319	28.3707
	10.0	-0.0	0.2	-0.0	-0.0	38.6	-0.2	38.6	0.45	80.5649	28.5319	28.3707
	15.0	0.0	0.5	-0.0	0.7	61.2	-0.3	61.2	0.73	80.5649	28.5319	28.3707
	20.0	0.0	0.8	-0.0	3.5	86.1	-0.3	86.2	2.32	80.5648	28.5319	28.3707
	25.0	0.0	1.3	-0.0	9.3	113.2	-0.4	113.5	4.69	80.5645	28.5318	28.3707
	30.0	0.1	2.0	-0.0	18.8	142.4	-0.5	143.6	7.49	80.5638	28.5317	28.3705
	35.0	0.2	2.8	-0.0	31.9	173.8	-0.7	176.7	10.38	80.5626	28.5315	28.3703
	40.0	0.4	3.7	-0.0	48.7	207.2	-1.0	212.8	13.18	80.5606	28.5311	28.3699
	45.0	0.7	4.8	-0.0	68.4	242.6	-1.4	252.0	15.70	80.5577	28.5305	28.3693
	50.0	1.1	6.1	-0.0	91.0	279.2	-1.8	293.7	18.00	80.5538	28.5296	28.3685
	55.0	1.6	7.6	-0.0	116.2	315.3	-2.0	336.0	20.18	80.5487	28.5286	28.3674
	60.0	2.3	9.3	-0.0	144.7	351.4	-2.3	380.0	22.33	80.5422	28.5272	28.3660
	65.0	3.1	11.1	-0.1	178.4	390.6	-2.6	429.4	24.48	80.5343	28.5255	28.3643
	70.0	4.1	13.2	-0.1	218.2	434.3	-2.9	486.0	26.61	80.5245	28.5233	28.3622
	75.0	5.3	15.5	-0.1	265.0	483.1	-2.9	551.0	28.66	80.5126	28.5207	28.3596
	80.0	6.7	18.0	-0.1	319.6	537.5	-2.6	625.3	30.64	80.4983	28.5175	28.3564
	85.0	8.5	20.9	-0.1	384.0	596.9	-2.0	709.8	32.64	80.4810	28.5136	28.3525
	90.0	10.6	24.0	-0.1	459.9	660.3	-1.3	804.6	34.72	80.4604	28.5088	28.3477
	95.0	13.1	27.5	-0.1	547.8	726.7	-0.6	910.0	36.85	80.4357	28.5031	28.3420
	100.0	16.1	31.3	-0.1	648.1	795.8	0.1	1026.3	38.98	80.4065	28.4962	28.3352
	105.0	19.6	35.4	-0.1	760.5	868.0	0.8	1154.1	41.01	80.3721	28.4881	28.3271
	110.0	23.7	40.0	-0.1	884.5	944.5	1.6	1294.0	42.87	80.3320	28.4786	28.3177
	115.0	28.5	44.9	-0.1	1020.3	1026.2	2.3	1447.1	44.54	80.2857	28.4676	28.3067
	120.0	34.0	50.2	-0.1	1168.2	1114.9	3.1	1614.8	45.99	80.2325	28.4549	28.2940
	125.0	40.2	56.1	-0.1	1328.9	1212.4	4.0	1798.8	47.23	80.1719	28.4404	28.2795
	130.0	47.3	62.4	-0.1	1504.3	1320.1	5.0	2001.4	48.27	80.1033	28.4238	28.2630
	135.0	55.3	69.3	-0.0	1697.6	1438.5	6.3	2225.2	49.19	80.0260	28.4051	28.2444
	140.0	64.3	76.8	0.0	1914.3	1567.1	7.7	2473.9	50.08	79.9390	28.3840	28.2233
(1)	140.6	65.5	77.8	0.0	1942.7	1584.0	7.9	2506.7	50.18	79.9275	28.3812	28.2205
	142.0	68.2	80.0	0.0	1982.5	1603.1	8.2	2549.6	50.39	79.9014	28.3748	28.2142
(2)	146.6	77.6	87.5	0.1	2091.2	1647.8	9.5	2662.4	51.03	79.8110	28.3527	28.1921
(3)	147.1	78.5	88.2	0.1	2097.7	1649.0	9.7	2668.3	51.09	79.8022	28.3505	28.1900
	147.4	79.3	88.8	0.1	2098.3	1646.2	9.7	2667.0	51.14	79.7949	28.3487	28.1882

(1) IECO
(2) OECO
(3) Separation

TABLE 3A

S-IV ULLAGE PORTION TRAJECTORY

TIME (SEC)	GROUND DISTANCE (KM)	ALTITUDE (KM)	SPACE FIXED VELOCITY (M/SEC)	SPACE FIXED PATH ANGLE (DEG)	ACCELERATION V DOT EARTH-FIXED (M/SEC SQ)	MASS (KG)	DYNAMIC PRESSURE (N/M SQ)	THRUST (N)	MACH	DRAG (N)
147.4	78.12	89.28	2991.3	55.99	-4.97	62191	13	62517	9.90	116
148.0	79.31	90.25	2988.8	56.06	-4.95	62164	11	62517	9.87	96
149.1	81.60	92.11	2984.0	56.20	-4.93	62114	8	62517	9.70	67

TABLE 3B

S-IV ULLAGE PORTION TRAJECTORY

EARTH FIXED PARAMETERS											
TIME (SEC)	XXXE (KM)	YYYE (KM)	ZZZE (KM)	DXXE (M/SEC)	DYYE (M/SEC)	DZZE (M/SEC)	VELOCITY (M/SEC)	PATH ANGLE (DEG)	LONGITUDE (POSITIVE WEST) (DEG)	GEOD. LAT. (POSITIVE NORTH) (DEG)	GEOC. LAT. (POSITIVE NORTH) (DEG)
147.4	79.3	88.8	0.1	2098.3	1646.2	9.7	2667.0	51.14	79.7949	28.3487	28.1882
148.0	80.5	89.8	0.1	2098.6	1641.2	9.9	2664.1	51.22	79.7832	28.3459	28.1854
149.1	82.8	91.6	0.1	2099.1	1631.5	10.1	2658.6	51.37	79.7607	28.3403	28.1798

TABLE 4A

S-IV STAGE NOMINAL TRAJECTORY

	TIME (SEC)	GROUND DISTANCE (KM)	ALTITUDE (KM)	SPACE FIXED VELOCITY (M/SEC)	SPACE FIXED PATH ANGLE (DEG)	ACCELERATION V DOT EARTH-FIXED (M/SEC SQ)	MASS (KG)	DYNAMIC PRESSURE (N/M SQ)	THRUST (N)	MACH	DRAG (N)
	149.1	81.60	92.11	2984.0	56.20	-4.92	62114	8	63342	9.70	67
	150.0	83.40	93.57	2980.4	56.32	-4.54	62066	6	85632	9.57	50
	159.4	102.82	108.91	2989.4	57.42	0.95	61225	0	408862	8.30	4
	160.0	104.03	109.84	2990.3	57.49	1.12	59748	0	408777	8.23	3
(1)	165.0	114.49	117.82	2999.1	58.05	1.26	59262	0	408045	7.22	1
	170.0	125.05	125.70	3008.1	58.60	1.30	58776	0	407307	6.12	0
	180.0	146.43	141.18	3026.2	59.55	1.52	57807	0	405791	4.78	0
	190.0	168.18	156.33	3047.7	60.53	1.85	56841	0	404391	4.15	0
	200.0	190.31	171.13	3072.2	61.53	2.15	55878	0	403497	3.89	0
	210.0	212.86	185.59	3099.5	62.51	2.44	54916	0	402675	3.77	0
	220.0	235.84	199.70	3129.6	63.49	2.73	53957	0	402034	3.69	0
	230.0	259.26	213.49	3162.6	64.46	3.03	52998	0	401419	3.64	0
	240.0	283.15	226.94	3198.4	65.42	3.34	52040	0	401095	3.60	0
	250.0	307.53	240.06	3237.1	66.36	3.64	51083	0	400327	3.58	0
	260.0	332.40	252.85	3278.7	67.29	3.94	50129	0	399377	3.57	0
	270.0	357.81	265.33	3323.2	68.21	4.24	49178	0	398438	3.57	0
	280.0	383.75	277.49	3370.5	69.11	4.55	48229	0	397337	3.57	0
	290.0	410.26	289.32	3420.7	70.00	4.86	47284	0	396360	3.58	0
	300.0	437.35	300.84	3473.9	70.87	5.18	46340	0	395963	3.60	0
	310.0	465.04	312.05	3530.1	71.72	5.50	45398	0	395536	3.62	0
	320.0	493.36	322.94	3589.6	72.55	5.84	44457	0	395366	3.65	0
	330.0	522.33	333.53	3652.2	73.37	6.19	43516	0	395372	3.69	0
	340.0	551.97	343.80	3718.2	74.17	6.53	42574	0	395297	3.73	0
	350.0	582.32	353.77	3787.6	74.94	6.89	41633	0	395144	3.77	0
	360.0	613.39	363.42	3860.3	75.70	7.24	40692	0	394923	3.82	0
	370.0	645.21	372.78	3936.5	76.45	7.60	39752	0	394558	3.87	0
	380.0	677.81	381.82	4016.2	77.17	7.97	38814	0	394185	3.93	0
	390.0	711.22	390.55	4099.5	77.88	8.35	37876	0	394058	3.99	0
	400.0	745.46	398.98	4186.5	78.56	8.74	36938	0	394062	4.06	0
	410.0	780.57	407.09	4277.4	79.23	9.15	36001	0	394205	4.13	0
	420.0	816.58	414.90	4372.3	79.88	9.56	35062	0	394366	4.21	0
	430.0	853.52	422.39	4471.4	80.51	9.99	34123	0	394563	4.30	0
	440.0	891.42	429.57	4574.6	81.13	10.43	33183	0	394403	4.39	0
	450.0	930.33	436.43	4682.2	81.73	10.87	32245	0	394198	4.48	0
	460.0	970.28	442.97	4794.3	82.31	11.34	31307	0	394021	4.58	0
	470.0	1011.31	449.19	4910.9	82.87	11.82	30369	0	393962	4.68	0
	480.0	1053.46	455.07	5032.5	83.42	12.33	29431	0	393966	4.79	0
	490.0	1096.77	460.63	5159.2	83.96	12.86	28493	0	394105	4.91	0
	500.0	1141.29	465.85	5291.2	84.47	13.42	27555	0	394272	5.03	0
	510.0	1187.07	470.73	5429.0	84.98	14.01	26617	0	394504	5.16	0

TABLE 4A (Cont)

S-IV STAGE NOMINAL TRAJECTORY

	TIME (SEC)	GROUND DISTANCE (KM)	ALTITUDE (KM)	SPACE FIXED VELOCITY (M/SEC)	SPACE FIXED PATH ANGLE (DEG)	ACCELERATION V DOT EARTH-FIXED (M/SEC SQ)	MASS (KG)	DYNAMIC PRESSURE (N/M SQ)	THRUST (N)	MACH	DRAG (N)
	520.0	1234.16	475.27	5572.7	85.47	14.63	25677	0	394514	5.29	0
	530.0	1282.61	479.45	5722.6	85.94	15.27	24738	0	394442	5.43	0
	540.0	1332.48	483.27	5879.1	86.40	15.95	23799	0	394346	5.58	0
	550.0	1383.83	486.73	6042.6	86.85	16.68	22861	0	394237	5.74	0
	560.0	1436.74	489.82	6213.7	87.28	17.47	21922	0	394428	5.90	0
	570.0	1491.26	492.52	6392.9	87.70	18.33	20982	0	394631	6.08	0
	580.0	1547.49	494.84	6580.9	88.11	19.25	20043	0	394861	6.26	0
	590.0	1605.49	496.75	6778.4	88.51	20.24	19101	0	394900	6.45	0
	600.0	1665.37	498.24	6986.2	88.90	21.31	18160	0	394881	6.66	0
	610.0	1727.23	499.31	7205.1	89.28	22.47	17220	0	394568	6.88	0
	620.0	1791.17	499.92	7436.2	89.66	23.76	16280	0	394179	7.11	0
(2)	629.9	1856.85	500.07	7678.9	90.02	25.16	15349	0	393580	7.36	0
	630.1	1857.69	500.07	7680.6	90.02	1.21	15333	0	18777	7.36	0
(3)	639.9	1924.14	499.98	7682.1	90.01	0.01	15319	0	0	7.36	0

(1) Initiate Active Guidance
(2) GCS
(3) Insertion

TABLE 4B

S-IV STAGE NOMINAL TRAJECTORY

	TIME (SEC)	EARTH FIXED PARAMETERS XXXE (KM)	YYYE (KM)	ZZZE (KM)	DXXE (M/SEC)	DYYE (M/SEC)	DZZE (M/SEC)	VELOCITY (M/SEC)	PATH ANGLE (DEG)	LONGITUDE (POSITIVE WEST) (DEG)	GEOD. LAT. (POSITIVE NORTH) (DEG)	GEOC. LAT. (POSITIVE NORTH) (DEG)
	149.1	82.8	91.6	0.1	2099.1	1631.5	10.1	2658.6	51.37	79.7607	28.3403	28.1798
	150.0	84.7	93.0	0.1	2099.7	1674.1	10.3	2654.5	51.49	79.7430	28.3360	28.1755
	159.4	104.7	108.1	0.2	2141.9	1573.8	12.0	2658.0	52.73	79.5522	28.2888	28.1285
	160.0	105.9	109.0	0.2	2144.8	1570.9	12.2	2658.6	52.80	79.5404	28.2858	28.1255
(1)	165.0	116.7	116.8	0.3	2169.8	1546.5	13.1	2664.6	53.45	79.4378	28.2602	28.1000
	170.0	127.6	124.4	0.3	2194.3	1522.8	16.9	2671.0	54.07	79.3343	28.2342	28.0742
	180.0	149.8	139.5	0.6	2239.3	1480.9	26.2	2684.8	55.16	79.1250	28.1807	28.0209
	190.0	172.4	154.1	0.9	2287.2	1437.7	33.5	2701.7	56.29	78.9126	28.1253	27.9657
	200.0	195.5	168.2	1.2	2337.5	1393.7	39.2	2721.7	57.44	78.6968	28.0681	27.9087
	210.0	219.1	181.9	1.6	2389.5	1349.6	43.8	2744.6	58.59	78.4773	28.0091	27.8499
	220.0	243.3	195.2	2.1	2443.2	1305.4	47.4	2770.5	59.72	78.2540	27.9483	27.7893
	230.0	268.0	208.0	2.6	2498.7	1261.0	50.4	2799.3	60.85	78.0267	27.8858	27.7270
	240.0	293.3	220.4	3.1	2556.0	1216.2	53.0	2831.1	61.97	77.7952	27.8214	27.6629
	250.0	319.1	232.4	3.6	2615.2	1171.2	55.3	2866.0	63.07	77.5593	27.7553	27.5970
	260.0	345.6	243.8	4.2	2676.2	1125.6	57.4	2903.9	64.16	77.3189	27.6873	27.5293
	270.0	372.7	254.9	4.8	2739.1	1079.5	59.6	2944.8	65.23	77.0737	27.6173	27.4596
	280.0	400.4	265.4	5.4	2803.9	1032.8	61.7	2988.7	66.29	76.8237	27.5454	27.3879
	290.0	428.8	275.5	6.0	2870.7	985.3	64.0	3035.7	67.33	76.5686	27.4713	27.3141
	300.0	457.8	285.1	6.7	2939.5	937.0	66.5	3085.9	68.35	76.3082	27.3951	27.2382
	310.0	487.6	294.3	7.4	3010.3	887.9	69.1	3139.3	69.34	76.0425	27.3165	27.1599
	320.0	518.0	302.9	8.1	3083.4	837.9	71.9	3196.1	70.32	75.7712	27.2356	27.0793
	330.0	549.2	311.0	8.8	3158.8	786.9	74.8	3256.2	71.27	75.4941	27.1521	26.9962
	340.0	581.2	318.6	9.6	3236.5	734.8	78.0	3319.8	72.20	75.2110	27.0661	26.9104
	350.0	614.0	325.7	10.4	3316.6	681.5	81.3	3386.9	73.11	74.9217	26.9772	26.8220
	360.0	647.5	332.3	11.2	3399.2	626.8	84.8	3457.5	74.00	74.6261	26.8856	26.7307
	370.0	682.0	338.2	12.1	3484.2	570.6	88.4	3531.8	74.86	74.3238	26.7909	26.6364
	380.0	717.2	343.7	13.0	3571.8	512.7	92.1	3609.6	75.70	74.0147	26.6932	26.5390
	390.0	753.4	348.5	13.9	3662.0	453.1	96.0	3691.2	76.51	73.6986	26.5922	26.4384
	400.0	790.5	352.7	14.9	3754.9	391.6	100.0	3776.6	77.30	73.3751	26.4878	26.3345
	410.0	828.5	356.3	15.9	3850.7	328.1	104.2	3866.0	78.07	73.0442	26.3798	26.2270
	420.0	867.5	359.3	17.0	3949.4	262.5	108.4	3959.6	78.81	72.7055	26.2682	26.1158
	430.0	907.5	361.6	18.1	4051.1	194.4	112.8	4057.4	79.52	72.3587	26.1527	26.0008
	440.0	948.5	363.1	19.2	4156.0	123.9	117.3	4159.5	80.23	72.0036	26.0332	25.8818
	450.0	990.6	364.0	20.4	4263.9	50.5	121.9	4266.0	80.91	71.6400	25.9095	25.7586
	460.0	1033.8	364.1	21.7	4375.1	-25.8	126.6	4377.0	81.57	71.2674	25.7815	25.6311
	470.0	1078.2	363.5	22.9	4489.6	-105.4	131.5	4492.8	82.21	70.8857	25.6488	25.4990
	480.0	1123.6	362.0	24.3	4607.6	-188.3	136.4	4613.5	82.82	70.4945	25.5114	25.3621
	490.0	1170.3	359.7	25.7	4729.3	-274.9	141.5	4739.4	83.42	70.0935	25.3690	25.2203
	500.0	1218.2	356.5	27.1	4854.9	-365.3	146.7	4870.8	84.00	69.6823	25.2213	25.0733
	510.0	1267.4	352.4	28.6	4984.5	-460.1	152.0	5008.0	84.55	69.2606	25.0682	24.9208

TABLE 4B (Cont)

S-IV STAGE NOMINAL TRAJECTORY

	EARTH FIXED PARAMETERS										
	TIME (SEC)	XXXE (KM)	YYYE (KM)	ZZZE (KM)	DXXE (M/SEC)	DYYE (M/SEC)	DZZE (M/SEC)	VELOCITY (M/SEC)	PATH ANGLE (DEG)	LONGITUDE (POSITIVE WEST) (DEG)	GEOD. LAT. (POSITIVE NORTH) (DEG)	GEOC. LAT. (POSITIVE NORTH) (DEG)
	520.0	1317.9	347.3	30.2	5118.2	-559.5	157.5	5151.1	85.09	68.8280	24.9093	24.7627
	530.0	1369.8	341.2	31.8	5256.3	-663.6	163.0	5300.6	85.62	68.3841	24.7444	24.5985
	540.0	1423.1	334.0	33.4	5399.0	-773.0	166.7	5456.7	86.12	67.9284	24.5732	24.4280
	550.0	1477.8	325.7	35.1	5546.4	-888.2	174.6	5619.8	86.61	67.4605	24.3954	24.2510
	560.0	1534.0	316.2	36.9	5698.9	-1009.7	180.6	5790.5	87.08	66.9799	24.2106	24.0670
	570.0	1591.8	305.5	38.7	5857.0	-1137.9	186.7	5969.5	87.54	66.4861	24.0185	23.8758
	580.0	1651.2	293.4	40.6	6021.0	-1273.5	192.9	6157.3	87.98	65.9785	23.8187	23.6768
	590.0	1712.2	280.0	42.6	6191.4	-1417.3	199.4	6354.6	88.41	65.4564	23.6107	23.4698
	600.0	1775.0	265.1	44.6	6368.4	-1570.2	206.9	6562.3	88.83	64.9192	23.3940	23.2541
	610.0	1839.6	248.6	46.7	6552.5	-1733.2	212.6	6781.1	89.24	64.3662	23.1683	23.0294
	620.0	1906.1	230.4	48.9	6744.2	-1907.3	219.5	7012.2	89.64	63.7966	22.9328	22.7950
(2)	629.9	1974.1	210.5	51.1	6943.2	-2091.8	226.5	7255.0	90.02	63.2135	22.6888	22.5521
	630.1	1974.9	210.3	51.1	6944.4	-2093.4	226.6	7256.6	90.02	63.2061	22.6856	22.5490
(3)	639.9	2043.4	189.2	53.4	6923.9	-2165.1	230.0	7258.1	90.01	62.6183	22.4363	22.3009

(1) Initiate Active Guidance
(2) GCS
(3) Insertion

TABLE 5A

S-I RETRO PORTION TRAJECTORY

	TIME (SEC)	GRØUND DISTANCE (KM)	ALTITUDE (KM)	SPACE FIXED VELØCITY (M/SEC)	SPACE FIXED PATH ANGLE (DEG)	ACCELERATIØN V DØT EARTH-FIXED (M/SEC SQ)	MASS (KG)	DYNAMIC PRESSURE (N/M SQ)	THRUST (N)	MACH	DRAG (N)
(1)	147.4	78.12	89.28	2991.3	55.99	-11.03	54935	13	275724	9.90	2120
	148.0	79.31	90.25	2984.7	56.07	-13.06	54709	11	387046	9.85	1758
	148.4	80.16	90.95	2979.2	56.13	-14.57	54544	10	468726	9.77	1524
	149.4	82.20	92.60	2963.8	56.28	-16.78	54201	7	587092	9.59	1092
(2)	149.9	83.12	93.34	2958.1	56.34	-5.94	54124	6	6	9.51	945

(1) Retro Ignition
(2) Retro E.T.D.

TABLE 5B

S-I RETRO PORTION TRAJECTORY

	EARTH FIXED PARAMETERS										
	TIME (SEC)	XXXE (KM)	YYYE (KM)	ZZZE (KM)	DXXE (M/SEC)	DYYE (M/SEC)	DZZE (M/SEC)	VELOCITY (M/SEC)	PATH ANGLE (DEG)	LONGITUDE (POSITIVE WEST) (DEG)	GEOD. LAT. (POSITIVE NORTH) (DEG)	GEOC. LAT. (POSITIVE NORTH) (DEG)
(1)	147.4	79.3	88.8	0.1	2098.3	1646.2	9.7	2667.0	51.14	79.7949	28.3487	28.1882
	148.0	80.5	89.8	0.1	2095.4	1638.6	9.8	2660.0	51.22	79.7832	28.3459	28.1854
	148.4	81.4	90.4	0.1	2092.6	1632.7	9.9	2654.2	51.28	79.7748	28.3438	28.1833
	149.4	83.5	92.1	0.1	2084.3	1617.1	10.1	2638.1	51.41	79.7547	28.3389	28.1784
(2)	149.9	84.4	92.8	0.1	2081.6	1610.9	10.1	2632.2	51.48	79.7458	28.3366	28.1762

(1) Retro Ignition
(2) Retro E.T.D.

TABLE 6A

S-I COAST TO IMPACT TRAJECTORY

TIME (SEC)	GROUND DISTANCE (KM)	ALTITUDE (KM)	SPACE FIXED VELOCITY (M/SEC)	SPACE FIXED PATH ANGLE (DEG)	ACCELERATION V DOT EARTH-FIXED (M/SEC SQ)	MASS (KG)	DYNAMIC PRESSURE (N/M SQ)	THRUST (N)	MACH	DRAG (N)
149.9	83.12	93.34	2958.1	56.34	-5.94	54124	6	0	9.51	945
152.0	87.44	96.81	2946.9	56.63	-5.88	54124	3	0	9.22	493
158.0	99.58	106.37	2915.8	57.43	-5.75	54124	1	0	8.28	92
164.0	111.67	115.63	2885.5	58.25	-5.62	54124	0	0	7.15	27
170.0	123.73	124.57	2856.0	59.09	-5.48	54124	0	0	5.91	6
176.0	135.75	133.21	2827.3	59.94	-5.35	54124	0	0	4.96	3
182.0	147.73	141.55	2799.5	60.81	-5.21	54124	0	0	4.35	1
188.0	159.68	149.58	2772.4	61.70	-5.06	54124	0	0	3.92	1
194.0	171.59	157.30	2746.2	62.60	-4.92	54124	0	0	3.65	1
200.0	183.47	164.72	2720.8	63.52	-4.77	54124	0	0	3.46	0
206.0	195.32	171.84	2696.3	64.46	-4.61	54124	0	0	3.33	0
212.0	207.13	178.65	2672.7	65.41	-4.46	54124	0	0	3.23	0
218.0	218.92	185.17	2649.9	66.38	-4.30	54124	0	0	3.14	0
224.0	230.68	191.38	2628.1	67.36	-4.13	54124	0	0	3.05	0
230.0	242.42	197.29	2607.2	68.36	-3.96	54124	0	0	2.99	0
236.0	254.13	202.90	2587.3	69.37	-3.79	54124	0	0	2.93	0
242.0	265.82	208.21	2568.3	70.40	-3.61	54124	0	0	2.87	0
248.0	277.49	213.22	2550.3	71.44	-3.43	54124	0	0	2.82	0
254.0	289.13	217.93	2533.2	72.49	-3.24	54124	0	0	2.77	0
260.0	300.76	222.34	2517.2	73.56	-3.05	54124	0	0	2.73	0
266.0	312.37	226.46	2502.1	74.64	-2.86	54124	0	0	2.69	0
272.0	323.96	230.27	2488.1	75.74	-2.66	54124	0	0	2.65	0
278.0	335.54	233.79	2475.1	76.84	-2.46	54124	0	0	2.62	0
284.0	347.10	237.02	2463.2	77.96	-2.26	54124	0	0	2.59	0
290.0	358.65	239.94	2452.3	79.08	-2.05	54124	0	0	2.56	0
296.0	370.19	242.57	2442.5	80.22	-1.84	54124	0	0	2.54	0
302.0	381.72	244.90	2433.8	81.36	-1.63	54124	0	0	2.52	0
308.0	393.24	246.94	2426.1	82.51	-1.41	54124	0	0	2.50	0
314.0	404.75	248.68	2419.6	83.67	-1.20	54124	0	0	2.49	0
320.0	416.25	250.12	2414.1	84.83	-0.98	54124	0	0	2.48	0
326.0	427.76	251.27	2409.8	86.00	-0.75	54124	0	0	2.47	0
332.0	439.25	252.12	2406.5	87.17	-0.53	54124	0	0	2.46	0
338.0	450.75	252.68	2404.4	88.34	-0.31	54124	0	0	2.45	0
344.0	462.24	252.94	2403.4	89.51	-0.08	54124	0	0	2.45	0
346.5	467.01	252.96	2403.3	90.00	0.01	54124	0	0	2.45	0
350.0	473.73	252.90	2403.5	90.69	0.14	54124	0	0	2.45	0
356.0	485.22	252.57	2404.8	91.86	0.36	54124	0	0	2.45	0
362.0	496.72	251.95	2407.1	93.03	0.59	54124	0	0	2.46	0
368.0	508.22	251.02	2410.6	94.20	0.81	54124	0	0	2.47	0
374.0	519.72	249.81	2415.1	95.37	1.03	54124	0	0	2.48	0

TABLE 6A (Cont)

S-I COAST TO IMPACT TRAJECTORY

TIME (SEC)	GROUND DISTANCE (KM)	ALTITUDE (KM)	SPACE FIXED VELOCITY (M/SEC)	SPACE FIXED PATH ANGLE (DEG)	ACCELERATION V DOT EARTH-FIXED (M/SEC SQ)	MASS (KG)	DYNAMIC PRESSURE (N/M SQ)	THRUST (N)	MACH	DRAG (N)
380.0	531.23	248.29	2420.8	96.53	1.25	54124	0	0	2.49	0
386.0	542.75	246.48	2427.6	97.68	1.47	54124	0	0	2.51	0
392.0	554.27	244.38	2435.4	98.83	1.68	54124	0	0	2.53	0
398.0	565.81	241.98	2444.4	99.97	1.89	54124	0	0	2.55	0
404.0	577.35	239.28	2454.4	101.11	2.10	54124	0	0	2.57	0
410.0	588.91	236.28	2465.5	102.23	2.31	54124	0	0	2.60	0
416.0	600.48	232.99	2477.6	103.34	2.51	54124	0	0	2.63	0
422.0	612.07	229.40	2490.8	104.45	2.71	54124	0	0	2.66	0
428.0	623.67	225.51	2505.1	105.54	2.91	54124	0	0	2.70	0
434.0	635.29	221.33	2520.3	106.62	3.10	54124	0	0	2.74	0
440.0	646.93	216.84	2536.6	107.68	3.29	54124	0	0	2.78	0
446.0	658.58	212.06	2553.8	108.73	3.47	54124	0	0	2.83	0
452.0	670.26	206.98	2572.0	109.77	3.65	54124	0	0	2.89	0
458.0	681.97	201.60	2591.2	110.80	3.83	54124	0	0	2.94	0
464.0	693.69	195.92	2611.4	111.81	4.00	54124	0	0	3.00	0
470.0	705.44	189.93	2632.4	112.80	4.17	54124	0	0	3.07	0
476.0	717.22	183.65	2654.4	113.78	4.33	54124	0	0	3.16	0
482.0	729.03	177.07	2677.4	114.75	4.49	54124	0	0	3.25	0
488.0	740.86	170.18	2701.2	115.69	4.65	54124	0	0	3.36	0
494.0	752.73	162.99	2725.8	116.63	4.80	54124	0	0	3.50	0
500.0	764.63	155.50	2751.4	117.54	4.95	54124	0	0	3.71	1
506.0	776.56	147.70	2777.8	118.44	5.10	54124	0	0	4.01	1
512.0	788.52	139.60	2805.0	119.32	5.24	54124	0	0	4.47	2
518.0	800.53	131.20	2833.1	120.19	5.38	54124	0	0	5.14	3
524.0	812.57	122.48	2861.9	121.04	5.51	54124	0	0	6.22	8
530.0	824.65	113.46	2891.6	121.88	5.65	54124	0	0	7.43	30
536.0	836.77	104.14	2922.0	122.70	5.77	54124	1	0	8.50	133
538.6	842.04	100.00	2935.4	123.05	5.83	54124	2	0	8.96	279
542.0	848.94	94.50	2953.2	123.50	5.89	54124	5	0	9.41	757
548.0	861.15	84.55	2984.9	124.28	5.93	54124	22	0	9.89	5040
554.0	873.40	74.30	3016.1	125.05	5.64	54124	174	0	9.41	27340
560.0	885.68	63.75	3042.5	125.80	4.05	54124	767	0	8.86	119900
566.0	897.94	52.95	3049.1	126.50	-1.85	54124	2900	0	8.39	445390
572.0	910.00	42.06	2982.1	127.07	-24.78	54124	11051	0	8.27	1692829
578.0	921.16	31.72	2636.8	127.13	-99.81	54124	38169	0	7.59	5760339
584.0	929.62	23.64	1836.1	125.45	-146.50	54124	58809	0	5.15	8296130
590.0	934.42	18.83	1116.4	121.10	-90.32	54124	36442	0	2.77	5269157
596.0	936.76	16.23	749.2	115.38	-41.79	54124	15771	0	1.47	2666642
602.0	937.93	14.69	590.3	110.80	-15.63	54124	7275	0	0.88	1285037
608.0	938.59	13.54	535.5	109.84	-3.93	54124	5557	0	0.70	686092

TABLE 6A (Cont)

S-I COAST TO IMPACT TRAJECTORY

	TIME (SEC)	GROUND DISTANCE (KM)	ALTITUDE (KM)	SPACE FIXED VELOCITY (M/SEC)	SPACE FIXED PATH ANGLE (DEG)	ACCELERATION V DOT EARTH-FIXED (M/SEC SQ)	MASS (KG)	DYNAMIC PRESSURE (N/M SQ)	THRUST (N)	MACH	DRAG (N)
	614.0	939.03	12.48	508.0	110.02	-2.28	54124	5330	0	0.63	620574
	620.0	939.34	11.45	488.8	110.07	-1.69	54124	5334	0	0.58	603116
	626.0	939.55	10.46	474.3	109.85	-1.47	54124	5358	0	0.54	598628
	632.0	939.69	9.52	463.4	109.42	-1.31	54124	5376	0	0.50	594361
	638.0	939.78	8.61	455.3	108.87	-1.18	54124	5382	0	0.47	589431
	644.0	939.85	7.75	449.3	108.27	-1.06	54124	5381	0	0.44	584326
	650.0	939.88	6.92	444.9	107.65	-0.97	54124	5376	0	0.42	579478
	656.0	939.91	6.13	441.5	107.04	-0.88	54124	5371	0	0.40	575188
	662.0	939.93	5.37	438.9	106.45	-0.83	54124	5361	0	0.38	572340
	668.0	939.94	4.64	436.9	105.88	-0.77	54124	5346	0	0.36	569129
	674.0	939.94	3.93	435.3	105.33	-0.71	54124	5330	0	0.35	566004
	680.0	939.95	3.26	433.9	104.82	-0.65	54124	5315	0	0.33	563082
	686.0	939.95	2.60	432.8	104.35	-0.60	54124	5300	0	0.32	560360
	692.0	939.95	1.97	431.8	103.90	-0.56	54124	5286	0	0.31	557790
	698.0	939.95	1.36	430.9	103.49	-0.51	54124	5272	0	0.29	555337
	704.0	939.96	0.76	430.2	103.11	-0.47	54124	5259	0	0.28	552969
	710.0	939.96	0.18	429.5	102.77	-0.43	54124	5245	0	0.27	550652
(1)	712.0	939.96	0.00	429.3	102.66	-0.41	54124	5240	0	0.27	549907

(1) Theoretical Ballistic Impact

TABLE 6B

S-I COAST TO IMPACT TRAJECTORY

TIME (SEC)	EARTH FIXED PARAMETERS XXXE (KM)	YYYE (KM)	ZZZE (KM)	DXXE (M/SEC)	DYYE (M/SEC)	DZZE (M/SEC)	VELOCITY (M/SEC)	PATH ANGLE (DEG)	LONGITUDE (POSITIVE WEST) (DEG)	GEOD. LAT. (POSITIVE NORTH) (DEG)	GEOC. LAT. (POSITIVE NORTH) (DEG)
149.9	84.4	92.8	0.1	2081.6	1610.9	10.1	2632.2	51.48	79.7458	28.3366	28.1762
152.0	88.8	96.2	0.1	2080.9	1591.2	10.6	2619.6	51.77	79.7033	28.3262	28.1658
158.0	101.3	105.6	0.2	2078.9	1535.8	11.7	2584.7	52.61	79.5841	28.2967	28.1364
164.0	113.8	114.6	0.3	2076.8	1480.6	12.9	2550.6	53.47	79.4654	28.2671	28.1069
170.0	126.2	123.3	0.3	2074.7	1425.6	14.1	2517.3	54.35	79.3472	28.2374	28.0774
176.0	138.7	131.7	0.4	2072.5	1370.7	15.2	2484.8	55.26	79.2294	28.2077	28.0477
182.0	151.1	139.8	0.5	2070.3	1316.0	16.3	2453.2	56.19	79.1121	28.1779	28.0180
188.0	163.5	147.5	0.6	2067.9	1261.4	17.5	2422.3	57.14	78.9953	28.1480	27.9883
194.0	175.9	154.9	0.7	2065.6	1206.9	18.6	2392.4	58.12	78.8788	28.1181	27.9584
200.0	188.3	162.0	0.8	2063.1	1152.6	19.7	2363.3	59.12	78.7628	28.0881	27.9285
206.0	200.7	168.8	1.0	2060.6	1098.4	20.7	2335.2	60.14	78.6471	28.0579	27.8985
212.0	213.0	175.2	1.1	2058.1	1044.3	21.8	2308.0	61.19	78.5319	28.0278	27.8684
218.0	225.4	181.3	1.2	2055.5	990.3	22.9	2281.7	62.26	78.4169	27.9975	27.8383
224.0	237.7	187.1	1.4	2052.8	936.5	23.9	2256.4	63.36	78.3024	27.9671	27.8080
230.0	250.0	192.5	1.5	2050.0	882.7	24.9	2232.2	64.48	78.1882	27.9367	27.7777
236.0	262.3	197.7	1.7	2047.2	829.1	26.0	2208.9	65.63	78.0743	27.9061	27.7473
242.0	274.6	202.5	1.8	2044.4	775.5	27.0	2186.7	66.79	77.9607	27.8755	27.7167
248.0	286.8	207.0	2.0	2041.5	722.0	28.0	2165.6	67.99	77.8474	27.8447	27.6861
254.0	299.1	211.1	2.2	2038.5	668.7	28.9	2145.6	69.20	77.7344	27.8139	27.6554
260.0	311.3	215.0	2.3	2035.5	615.4	29.9	2126.7	70.43	77.6216	27.7830	27.6246
266.0	323.5	218.5	2.5	2032.4	562.1	30.9	2108.9	71.69	77.5091	27.7520	27.5937
272.0	335.7	221.7	2.7	2029.3	509.0	31.8	2092.4	72.97	77.3969	27.7208	27.5627
278.0	347.8	224.6	2.9	2026.1	455.9	32.7	2077.0	74.26	77.2849	27.6896	27.5316
284.0	360.0	227.2	3.1	2022.8	402.8	33.6	2062.8	75.57	77.1731	27.6583	27.5004
290.0	372.1	229.5	3.3	2019.5	349.8	34.5	2049.9	76.91	77.0615	27.6268	27.4690
296.0	384.2	231.4	3.5	2016.2	296.9	35.4	2038.2	78.25	76.9501	27.5953	27.4376
302.0	396.3	233.0	3.7	2012.7	244.0	36.3	2027.8	79.61	76.8388	27.5636	27.4061
308.0	408.4	234.3	4.0	2009.3	191.1	37.1	2018.7	80.99	76.7278	27.5318	27.3744
314.0	420.4	235.3	4.2	2005.7	138.3	38.0	2010.8	82.37	76.6169	27.4999	27.3426
320.0	432.4	236.0	4.4	2002.1	85.5	38.8	2004.3	83.77	76.5061	27.4679	27.3107
326.0	444.5	236.4	4.6	1998.5	32.7	39.6	1999.1	85.17	76.3955	27.4357	27.2787
332.0	456.4	236.4	4.9	1994.8	-20.0	40.4	1995.3	86.58	76.2850	27.4035	27.2465
338.0	468.4	236.1	5.1	1991.0	-72.7	41.2	1992.7	88.00	76.1746	27.3711	27.2143
344.0	480.3	235.5	5.4	1987.2	-125.5	42.0	1991.6	89.41	76.0643	27.3385	27.1819
346.5	485.3	235.2	5.5	1985.6	-147.3	42.3	1991.5	90.00	76.0185	27.3250	27.1684
350.0	492.2	234.6	5.6	1983.3	-178.2	42.7	1991.7	90.83	75.9541	27.3059	27.1493
356.0	504.1	233.4	5.9	1979.3	-230.9	43.5	1993.2	92.24	75.8440	27.2731	27.1167
362.0	516.0	231.8	6.2	1975.3	-283.6	44.2	1996.1	93.66	75.7339	27.2401	27.0839
368.0	527.8	230.0	6.4	1971.3	-336.3	44.9	2000.3	95.07	75.6238	27.2071	27.0509
374.0	539.6	227.8	6.7	1967.1	-389.1	45.6	2005.8	96.47	75.5138	27.1738	27.0178

TABLE 6B (Cont)

S-I COAST TO IMPACT TRAJECTORY

TIME (SEC)	XXXE (KM)	YYYE (KM)	ZZZE (KM)	EARTH FIXED PARAMETERS DXXE (M/SEC)	DYYE (M/SEC)	DZZE (M/SEC)	VELOCITY (M/SEC)	PATH ANGLE (DEG)	LONGITUDE (POSITIVE WEST) (DEG)	GEOD. LAT. (POSITIVE NORTH) (DEG)	GEOC. LAT. (POSITIVE NORTH) (DEG)
380.0	551.4	225.3	7.0	1963.0	-441.8	46.3	2012.6	97.86	75.4039	27.1405	26.9846
386.0	563.2	222.5	7.2	1958.7	-494.6	47.0	2023.7	99.24	75.2939	27.1070	26.9512
392.0	574.9	219.4	7.5	1954.4	-547.4	47.6	2030.2	100.61	75.1840	27.0733	26.9177
398.0	586.6	215.9	7.8	1950.0	-600.2	48.3	2040.9	101.97	75.0740	27.0395	26.8840
404.0	598.3	212.2	8.1	1945.6	-653.1	48.9	2052.9	103.32	74.9640	27.0055	26.8501
410.0	610.0	208.1	8.4	1941.1	-706.0	49.5	2066.1	104.64	74.8540	26.9713	26.8161
416.0	621.6	203.7	8.7	1936.6	-759.0	50.1	2080.6	105.95	74.7439	26.9370	26.7819
422.0	633.2	199.0	9.0	1931.9	-812.0	50.7	2096.3	107.24	74.6337	26.9025	26.7476
428.0	644.8	194.0	9.3	1927.2	-865.1	51.3	2113.1	108.51	74.5235	26.8679	26.7131
434.0	656.4	188.6	9.6	1922.5	-918.2	51.8	2131.1	109.77	74.4133	26.8331	26.6784
440.0	667.9	182.9	9.9	1917.7	-971.4	52.3	2150.3	110.99	74.3029	26.7981	26.6435
446.0	679.4	177.0	10.3	1912.8	-1024.7	52.9	2170.6	112.20	74.1924	26.7629	26.6085
452.0	690.8	170.6	10.6	1907.8	-1078.0	53.4	2191.9	113.39	74.0818	26.7275	26.5732
458.0	702.3	164.0	10.9	1902.8	-1131.4	53.8	2214.4	114.55	73.9710	26.6919	26.5378
464.0	713.7	157.1	11.2	1897.7	-1184.9	54.3	2237.9	115.69	73.8601	26.6562	26.5022
470.0	725.0	149.8	11.5	1892.5	-1238.5	54.8	2262.4	116.80	73.7491	26.6202	26.4664
476.0	736.4	142.2	11.9	1887.2	-1292.2	55.2	2287.9	117.90	73.6379	26.5841	26.4304
482.0	747.7	134.3	12.2	1881.9	-1346.0	55.6	2314.4	118.96	73.5265	26.5477	26.3942
488.0	759.0	126.1	12.5	1876.5	-1399.9	56.0	2341.8	120.01	73.4149	26.5112	26.3578
494.0	770.2	117.5	12.9	1871.0	-1453.9	56.4	2370.2	121.02	73.3031	26.4744	26.3212
500.0	781.4	108.6	13.2	1865.5	-1508.1	56.8	2399.5	122.02	73.1911	26.4374	26.2843
506.0	792.6	99.4	13.6	1859.9	-1562.3	57.1	2429.6	122.99	73.0789	26.4002	26.2472
512.0	803.7	89.9	13.9	1854.1	-1616.7	57.5	2460.7	123.94	72.9664	26.3627	26.2100
518.0	814.8	80.0	14.2	1848.3	-1671.2	57.8	2492.5	124.86	72.8536	26.3251	26.1724
524.0	825.9	69.8	14.6	1842.5	-1725.8	58.1	2525.2	125.76	72.7406	26.2872	26.1347
530.0	836.9	59.3	14.9	1836.5	-1780.6	58.4	2558.7	126.64	72.6273	26.2490	26.0967
536.0	847.9	48.4	15.3	1830.4	-1835.6	58.7	2592.9	127.50	72.5136	26.2106	26.0584
538.6	852.7	43.6	15.4	1827.8	-1859.4	58.8	2608.0	127.86	72.4643	26.1939	26.0418
542.0	858.9	37.3	15.6	1824.3	-1890.7	58.9	2627.9	128.33	72.3997	26.1720	26.0200
548.0	869.8	25.7	16.0	1817.9	-1945.7	59.1	2663.5	129.14	72.2855	26.1331	25.9812
554.0	880.7	13.9	16.4	1810.5	-2000.1	59.3	2698.5	129.93	72.1709	26.0939	25.9422
560.0	891.6	1.8	16.7	1799.4	-2050.4	59.3	2728.7	130.71	72.0561	26.0546	25.9030
566.0	902.3	-10.7	17.1	1774.8	-2085.2	58.9	2738.9	131.46	71.9416	26.0152	25.8638
572.0	912.8	-23.2	17.4	1702.6	-2062.8	56.9	2675.3	132.22	71.8291	25.9763	25.8251
578.0	922.4	-35.0	17.7	1455.0	-1821.6	48.9	2331.9	133.04	71.7251	25.9402	25.7892
584.0	929.6	-44.2	18.0	928.0	-1213.7	31.4	1528.1	134.18	71.6462	25.9128	25.7619
590.0	933.7	-49.7	18.1	461.2	-651.5	15.7	798.4	136.24	71.6015	25.8973	25.7464
596.0	935.6	-52.6	18.2	217.8	-357.1	7.5	418.4	140.13	71.5797	25.8896	25.7388
602.0	936.5	-54.3	18.2	106.7	-227.9	3.8	251.7	146.41	71.5689	25.8859	25.7350
608.0	937.0	-55.5	18.2	61.3	-192.9	2.3	202.4	153.88	71.5627	25.8837	25.7329

TABLE 6B (Cont)

S-I COAST TO IMPACT TRAJECTORY

	EARTH FIXED PARAMETERS								LONGITUDE (POSITIVE WEST) (DEG)	GEOD. LAT. (POSITIVE NORTH) (DEG)	GEOC. LAT. (POSITIVE NORTH) (DEG)
	TIME (SEC)	XXXE (KM)	YYYE (KM)	ZZZE (KM)	DXXE (M/SEC)	DYYE (M/SEC)	DZZE (M/SEC)	VELOCITY (M/SEC)	PATH ANGLE (DEG)			
	614.0	937.3	-56.6	18.2	35.1	-131.1	1.4	184.5	160.52	71.5586	25.8822	25.7314
	620.0	937.5	-57.7	18.3	17.0	-172.1	0.8	173.0	165.85	71.5557	25.8812	25.7304
	626.0	937.5	-58.7	18.3	4.5	-163.5	0.4	163.6	169.93	71.5538	25.8805	25.7297
	632.0	937.5	-59.7	18.3	-4.0	-155.2	0.1	155.2	172.97	71.5524	25.8801	25.7293
	638.0	937.5	-60.6	18.3	-9.4	-147.5	-0.1	147.8	175.17	71.5516	25.8797	25.7289
	644.0	937.4	-61.4	18.3	-12.8	-140.5	-0.3	141.1	176.72	71.5510	25.8795	25.7287
	650.0	937.3	-62.3	18.3	-14.8	-134.2	-0.3	135.0	177.80	71.5507	25.8794	25.7286
	656.0	937.2	-63.0	18.3	-15.8	-128.5	-0.4	129.5	178.53	71.5504	25.8793	25.7285
	662.0	937.1	-63.8	18.3	-16.3	-123.3	-0.4	124.3	179.02	71.5503	25.8792	25.7284
	668.0	937.0	-64.5	18.3	-16.3	-118.4	-0.4	119.5	179.33	71.5502	25.8792	25.7284
	674.0	936.9	-65.2	18.2	-16.1	-114.0	-0.4	115.1	179.53	71.5502	25.8792	25.7284
	680.0	936.9	-65.9	18.2	-15.8	-109.9	-0.4	111.0	179.66	71.5501	25.8791	25.7283
	686.0	936.8	-66.5	18.2	-15.4	-106.1	-0.4	107.2	179.73	71.5501	25.8791	25.7283
	692.0	936.7	-67.2	18.2	-15.0	-102.7	-0.4	103.8	179.78	71.5501	25.8791	25.7283
	698.0	936.6	-67.8	18.2	-14.6	-99.5	-0.4	100.6	179.80	71.5501	25.8791	25.7283
	704.0	936.5	-68.4	18.2	-14.2	-96.6	-0.3	97.6	179.81	71.5500	25.8791	25.7283
	710.0	936.4	-68.9	18.2	-13.8	-93.9	-0.3	94.9	179.82	71.5500	25.8790	25.7283
(1)	712.0	936.4	-69.1	18.2	-13.7	-93.1	-0.3	94.1	179.82	71.5500	25.8790	25.7282

(1) Theoretical Ballistic Impact

TABLE 7A

S-I STAGE STATE PARAMETERS AT ØUTBØARD CUT-ØFF

RESULTING FRØM TWØ-SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	TIME FRØM LIFTØFF (SEC)	ALTITUDE (M)	RANGE (M)	INTEGRATED PLATFØRM ACCELERATIØNS X1-DØT (M/SEC)	ETA-DØT (M/SEC)	ZETA-DØT (M/SEC)	PATH ANGLE SPACE FIXED (DEG)	VELØCITY SPACE FIXED (M/SEC)
NØMINAL	146.620	87944.3	76482.4	2121.20	3048.73	-11.10	55.898	2986.21
NØN-PRØPELLANT MASS	.000	-65.3	-39.8	-1.31	-1.41	.00	.010	-1.86
PRØPELLANT LØADING MASS	-.294	-54.1	-356.4	-5.14	-1.45	.04	-.071	-3.51
THRUST AND FLØW RATE	1.170	-325.8	1106.1	8.69	-6.44	-.13	.362	-2.45
FLØW RATE	-1.302	-1217.1	-1989.5	-31.63	-19.13	.17	-.197	-29.93
THRUST MISALIGNMENT	.000	-6.4	-8.1	-.28	-.25	-39.64	.023	1.37
IN-PLANE THRUST MISALIGN	.000	-813.9	1346.7	28.53	-26.86	-.02	.712	9.61
THRUST MISALIGNMENT	.000	791.3	-1363.2	-29.03	26.34	.02	-.714	-9.83
MIXTURE RATIØ	-.330	-611.0	-747.5	-17.70	-14.25	.07	.004	-20.82
AXIAL DRAG CØEFFICIENT	.000	-941.4	-435.8	-6.63	-11.51	-.03	.123	-11.82
HEADWIND	.000	123.8	-1303.6	-12.64	1.11	-3.31	-.135	-9.80
TAILWIND	.000	-142.9	1827.2	16.94	-1.04	4.34	.171	13.40
LEFT CRØSS WIND	.000	140.6	-1655.0	-16.23	.94	2.62	-.169	-13.10
RIGHT CRØSS WIND	.000	96.3	-771.9	-8.56	.71	-24.19	-.081	-5.76
HIGH GRØUND WIND	-.262	-496.0	-574.9	-12.40	-10.15	.04	.002	-14.52
LØW GRØUND WIND	.078	365.2	295.2	7.72	7.50	-.01	-.033	10.14
HIGH AMBIENT TEMPERATURE	-.565	216.3	-518.1	-4.82	3.25	.08	-.184	.79
LØW AMBIENT TEMPERATURE	1.537	-640.0	1355.4	11.15	-9.73	-.22	.495	-4.11
PØSITIVE RSS	2.372	1924.8	3624.3	52.40	38.86	39.97	.986	43.22
NEGATIVE RSS	1.910	2047.6	3681.1	54.57	40.83	46.56	.888	46.02
RSS	2.141	1986.2	3652.7	53.48	39.84	43.26	.937	44.62

TABLE 7B

S-I STAGE STATE PARAMETERS AT ØUTBØARD CUT-ØFF

RESULTING FRØM TWØ-SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	X SPACE FIXED (M)	Y SPACE FIXED (M)	Z SPACE FIXED (M)	X-DØT SPACE FIXED (M/SEC)	Y-DØT SPACE FIXED (M/SEC)	Z-DØT SPACE FIXED (M/SEC)	VEHICLE RADIAL DISTANCE (M)
NØMINAL	140902.8	6459781.9	1104.5	2505.85	1620.02	-117.18	6461318
NØN-PRØPELLANT MASS	-41.8	-64.4	-.1	-1.31	-1.42	.00	-65
PRØPELLANT LØADING MASS	-480.0	-43.8	33.8	-5.09	1.42	.03	-54
THRUST AND FLØW RATE	1581.6	-360.1	-133.5	8.50	-17.88	-.12	-325
FLØW RATE	-2563.5	-1162.8	145.5	-31.38	-6.60	.16	-1219
THRUST MISALIGNMENT	-24.1	-10.0	-1634.8	-.27	-.26	-39.55	-11
IN-PLANE THRUST MISALIGN	1346.8	-842.9	.2	28.44	-26.92	-.02	-813
THRUST MISALIGNMENT	-1364.4	820.5	-.3	-28.95	26.40	.02	790
MIXTURE RATIØ	-903.1	-591.8	37.4	-17.63	-11.10	.07	-612
AXIAL DRAG CØEFFICIENT	-462.4	-931.8	-2.3	-6.60	-11.63	-.03	-942
HEADWIND	-1319.2	151.0	-357.3	-12.54	1.13	-3.28	122
TAILWIND	1846.9	-181.4	495.5	16.79	-1.07	4.30	-140
LEFT CRØSS WIND	-1675.8	177.3	420.1	-16.10	.96	2.58	141
RIGHT CRØSS WIND	-825.9	106.8	-2728.1	-8.50	.73	-23.97	88
HIGH GRØUND WIND	-698.4	-481.1	29.6	-12.35	-7.66	.03	-496
LØW GRØUND WIND	338.5	358.0	-8.6	7.70	6.79	-.01	365
HIGH AMBIENT TEMPERATURE	-746.2	232.4	65.3	-4.73	8.79	.08	216
LØW AMBIENT TEMPERATURE	1973.9	-683.0	-177.4	10.91	-24.80	-.20	-639
PØSITIVE RSS	4423.9	1904.6	1772.3	52.04	38.06	39.87	1925
NEGATIVE RSS	4297.9	2036.6	3211.8	54.23	45.00	46.37	2048
RSS	4360.9	1970.6	2492.1	53.14	41.53	43.12	1987

TABLE 7C

S-I STAGE STATE PARAMETERS AT ØUTBØARD CUT-ØFF

RESULTING FRØM TWØ-SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	X EARTH FIXED (M)	Y EARTH FIXED (M)	Z EARTH FIXED (M)	X-DØT EARTH FIXED (M/SEC)	Y-DØT EARTH FIXED (M/SEC)	Z-DØT EARTH FIXED (M/SEC)	PATH ANGLE EARTH FIXED (DEG)	VELØCITY EARTH FIXED (M/SEC)
NØMINAL	77599.7	87478.9	62.4	2091.19	1647.75	9.54	51.034	2662.38
NØN-PRØPELLANT MASS	-41.2	-64.9	-.5	-1.29	-1.43	-.01	.007	-1.90
PRØPELLANT LØADING MASS	-362.0	-49.6	-1.1	-5.07	1.30	-.04	-.086	-3.19
THRUST AND FLØW RATE	1117.0	-339.5	2.6	8.57	-17.55	.05	.400	-4.00
FLØW RATE	-2032.2	-1192.6	-13.7	-31.12	-7.21	-.26	-.275	-28.92
THRUST MISALIGNMENT	-15.6	-6.2	-1634.9	-.01	-.13	-39.56	.006	-.03
IN-PLANE THRUST MISALIGN	1354.4	-830.6	5.1	28.74	-26.57	.10	.814	6.53
THRUST MISALIGNMENT	-1371.8	808.0	-5.3	-29.24	26.05	-.10	-.816	-6.69
MIXTURE RATIØ	-765.7	-601.7	-5.0	-17.46	-11.36	-.12	-.033	-20.74
AXIAL DRAG CØEFFICIENT	-453.8	-936.0	-6.9	-6.44	-11.71	-.13	.117	-12.28
HEADWIND	-1318.6	139.9	-363.8	-12.53	.94	-3.39	-.170	-9.28
TAILWIND	1846.0	-165.8	504.5	16.77	-.82	4.45	.218	12.75
LEFT CRØSS WIND	-1679.5	160.9	411.9	-16.15	.70	2.44	-.211	-12.25
RIGHT CRØSS WIND	-812.8	105.9	-2732.0	-8.30	.70	-24.04	-.113	-6.13
HIGH GRØUND WIND	-589.2	-488.8	-4.0	-12.22	-7.85	-.11	-.024	-14.46
LØW GRØUND WIND	304.0	361.4	2.6	7.61	6.89	.07	-.018	10.23
HIGH AMBIENT TEMPERATURE	-522.4	222.7	-.1	-4.77	8.63	-.00	-.204	1.58
LØW AMBIENT TEMPERATURE	1365.6	-656.8	.3	11.03	-24.37	.01	.546	-6.22
PØSITIVE RSS	3674.5	1916.3	1759.9	51.98	37.84	39.88	1.126	41.95
NEGATIVE RSS	3745.0	2042.1	3204.6	54.12	44.64	46.41	1.026	44.87
RSS	3709.8	1979.2	2482.3	53.05	41.24	43.15	1.076	43.41

TABLE 8A

S-IV STAGE STATE PARAMETERS AT GUIDANCE INITIATION

RESULTING FROM S-I STAGE TWO-SIGMA MAGNITUDE PERFORMANCE VARIATIONS

VARIATIONS	TIME FROM LIFTOFF (SEC)	ALTITUDE (M)	RANGE (M)	INTEGRATED PLATFORM ACCELERATIONS X1-DOT (M/SEC)	ETA-DOT (M/SEC)	ZETA-DOT (M/SEC)	PATH ANGLE SPACE FIXED (DEG)	VELOCITY SPACE FIXED (M/SEC)
NOMINAL	165.000	117819.3	414489.7	2206.68	3116.12	-11.89	58.054	2999.08
NON-PROPELLANT MASS	.000	-84.8	-62.6	-1.37	-.94	-.29	.003	-1.64
PROPELLANT LOADING MASS	.000	443.6	164.3	-4.23	.42	.00	-.050	-3.41
THRUST AND FLOW RATE	1.000	-900.6	907.1	7.96	-6.97	-.13	.340	-1.68
FLOW RATE	-1.000	-888.9	-1907.5	-30.48	-17.41	.51	-.141	-30.06
THRUST MISALIGNMENT	.000	2.9	-6.2	-.34	.45	-40.12	.009	1.69
IN-PLANE THRUST MISALIGN	.000	-1282.8	1864.5	28.02	-26.79	-.29	.691	10.82
THRUST MISALIGNMENT	.000	1253.6	-1913.1	-30.02	26.52	-.46	-.710	-12.19
MIXTURE RATIO	.000	-309.6	-361.4	-16.18	-12.73	.12	.059	-20.37
AXIAL DRAG COEFFICIENT	.000	-1161.6	-539.0	-6.60	-11.50	-.09	.135	-11.52
HEADWIND	.000	133.9	-1517.3	-12.22	1.39	-3.00	-.124	-9.60
TAILWIND	.000	-125.8	2123.4	17.04	-.12	4.74	.142	14.31
LEFT CROSS WIND	.000	138.9	-1941.9	-16.44	1.01	2.93	-.157	-13.61
RIGHT CROSS WIND	.000	117.3	-927.9	-8.70	1.67	-23.97	-.092	-5.62
HIGH GROUND WIND	.000	-240.7	-250.6	-12.03	-9.42	.17	.043	-15.13
LOW GROUND WIND	.000	379.1	260.9	7.24	7.55	-.12	-.058	10.06
HIGH AMBIENT TEMPERATURE	.000	1286.3	590.0	-1.45	6.71	-.51	-.133	2.22
LOW AMBIENT TEMPERATURE	2.000	-330.5	2558.3	14.59	-6.39	-.51	.532	-.60
POSITIVE RSS	2.449	2582.8	4456.4	51.56	38.19	40.51	.970	43.58
NEGATIVE RSS	1.414	2253.6	3945.9	53.48	38.66	46.84	.856	46.46
RSS	1.932	2418.2	4201.2	52.52	38.42	43.68	.913	45.02

TABLE 8B

S-IV STAGE STATE PARAMETERS AT GUIDANCE INITIATIØN

RESULTING FRØM S-I STAGE TWØ-SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	X SPACE FIXED (M)	Y SPACE FIXED (M)	Z SPACE FIXED (M)	X-DØT SPACE FIXED (M/SEC)	Y-DØT SPACE FIXED (M/SEC)	Z-DØT SPACE FIXED (M/SEC)	VEHICLE RADIAL DISTANCE (M)
NØMINAL	187633.5	6488509.8	-1053.1	2586.96	1512.70	-117.74	6491222
NØN-PRØPELLANT MASS	-66.2	-82.9	-4.8	-1.37	-.95	-.29	-85
PRØPELLANT LØADING MASS	180.2	438.6	.7	-4.24	.50	.00	444
THRUST AND FLØW RATE	1298.5	-938.4	-116.8	7.78	-16.84	-.11	-900
FLØW RATE	-2369.2	-821.9	120.0	-30.24	-7.82	.50	-890
THRUST MISALIGNMENT	-29.6	-3.1	-2367.9	-.33	.44	-39.98	-3
IN-PLANE THRUST MISALIGN	1860.4	-1336.5	-4.4	27.89	-26.90	-.29	-1281
THRUST MISALIGNMENT	-1911.5	1308.3	-7.8	-29.89	26.63	-.46	1252
MIXTURE RATIØ	-377.0	-299.0	2.0	-16.17	-12.74	.12	-310
AXIAL DRAG CØEFFICIENT	-582.6	-1145.5	-3.9	-6.56	-11.67	-.09	-1162
HEADWIND	-1541.5	176.5	-412.3	-12.08	1.42	-2.96	132
TAILWIND	2156.6	-186.1	581.0	16.84	-.16	4.68	-123
LEFT CRØSS WIND	-1974.0	196.1	472.4	-16.26	1.05	2.87	139
RIGHT CRØSS WIND	-983.5	136.0	-3163.4	-8.62	1.69	-23.67	108
HIGH GRØUND WIND	-262.2	-233.3	2.7	-12.03	-9.43	.17	-241
LØW GRØUND WIND	276.7	371.3	-1.7	7.23	7.59	-.12	379
HIGH AMBIENT TEMPERATURE	638.3	1268.6	-7.0	-1.49	6.92	-.51	1287
LØW AMBIENT TEMPERATURE	3397.7	-428.9	-238.3	14.16	-25.88	-.48	-329
PØSITIVE RSS	5287.6	2589.2	2489.1	51.12	38.28	40.36	2582
NEGATIVE RSS	4333.7	2283.9	3983.6	53.14	46.12	46.56	2253
RSS	4810.6	2436.5	3236.3	52.13	42.20	43.46	2418

TABLE 8C

S-IV STAGE STATE PARAMETERS AT GUIDANCE INITIATION

RESULTING FROM S-I STAGE TWO-SIGMA MAGNITUDE PERFORMANCE VARIATIONS

VARIATIONS	X EARTH FIXED (M)	Y EARTH FIXED (M)	Z EARTH FIXED (M)	X-DOT EARTH FIXED (M/SEC)	Y-DOT EARTH FIXED (M/SEC)	Z-DOT EARTH FIXED (M/SEC)	PATH ANGLE EARTH FIXED (DEG)	VELOCITY EARTH FIXED (M/SEC)
NOMINAL	116685.7	116771.6	271.1	2169.77	1546.55	13.10	53.449	2664.56
NON-PROPELLANT MASS	-65.4	-83.6	-5.5	-1.35	-.96	-.31	.001	-1.66
PROPELLANT LOADING MASS	175.7	440.5	2.9	-4.27	.47	-.01	-.063	-3.22
THRUST AND FLOW RATE	906.5	-917.3	.1	7.92	-16.54	.02	.380	-3.04
FLOW RATE	-1959.0	-853.6	-7.8	-30.02	-8.41	.10	-.210	-29.33
THRUST MISALIGNMENT	-15.9	3.2	-2368.0	-.02	.59	-39.98	-.007	.34
IN-PLANE THRUST MISALIGN	1874.0	-1317.3	2.7	28.25	-26.50	-.15	.794	8.00
THRUST MISALIGNMENT	-1924.7	1288.6	-15.3	-30.24	26.20	-.61	-.819	-9.25
MIXTURE RATIO	-373.9	-302.8	-1.0	-16.02	-12.93	-.03	.031	-20.55
AXIAL DRAG COEFFICIENT	-570.7	-1151.4	-10.4	-6.37	-11.78	-.20	.132	-12.00
HEADWIND	-1540.9	161.8	-420.8	-12.07	1.21	-3.08	-.158	-9.16
TAILWIND	2155.0	-165.5	592.9	16.80	.13	4.85	.186	13.84
LEFT CROSS WIND	-1978.6	174.5	461.5	-16.31	.74	2.71	-.199	-12.84
RIGHT CROSS WIND	-966.6	134.7	-3168.6	-8.40	1.66	-23.75	-.124	-5.95
HIGH GROUND WIND	-259.8	-236.0	.5	-11.92	-9.57	.06	.022	-15.26
LOW GROUND WIND	272.9	374.2	.9	7.13	7.68	-.04	-.048	10.26
HIGH AMBIENT TEMPERATURE	625.3	1275.2	.2	-1.64	6.95	-.46	-.147	2.68
LOW AMBIENT TEMPERATURE	2598.8	-378.3	4.2	14.27	-25.25	-.15	.596	-2.79
POSITIVE RSS	4531.6	2586.4	2484.4	51.14	38.08	40.36	1.110	42.63
NEGATIVE RSS	4019.5	2269.3	3978.1	53.12	45.64	46.61	.992	45.38
RSS	4275.5	2427.9	3231.2	52.13	41.86	43.49	1.051	44.00

TABLE 9A

S-IV STAGE STATE PARAMETERS AT GUIDANCE INITIATION

RESULTING FROM S-IV STAGE TWO-SIGMA MAGNITUDE PERFORMANCE VARIATIONS

VARIATIONS	TIME FROM LIFTOFF (SEC)	ALTITUDE (M)	RANGE (M)	INTEGRATED PLATFORM ACCELERATIONS X1-DOT (M/SEC)	ETA-DOT (M/SEC)	ZETA-DOT (M/SEC)	PATH ANGLE SPACE FIXED (DEG)	VELOCITY SPACE FIXED (M/SEC)
NOMINAL	165.000	117819.3	114489.7	2206.68	3116.12	-11.89	58.054	2999.08
NON-PROPELLANT MASS	.000	39.2	31.7	1.14	.98	.01	-.006	1.48
PROPELLANT LOADING MASS	.000	135.1	89.3	2.13	2.46	.07	-.021	3.07
THRUST AND FLOW RATE	.000	-2.6	-3.0	-.46	-.37	.01	.002	-.59
FLOW RATE	.000	-.4	-.4	-.09	-.07	.00	.000	-.11
THRUST MISALIGNMENT	.000	-.1	-.1	-.01	-.01	-1.17	.001	.03
MIXTURE RATIO	.000	6.6	7.8	1.15	.92	-.01	-.004	1.46
POSITIVE RSS	.000	140.8	95.1	2.71	2.83	1.17	.023	3.76
NEGATIVE RSS	.000	140.8	95.1	2.71	2.83	1.17	.023	3.76
RSS	.000	140.8	95.1	2.71	2.83	1.17	.023	3.76

TABLE 9B

S-IV STAGE STATE PARAMETERS AT GUIDANCE INITIATION

RESULTING FROM S-IV STAGE TWO-SIGMA MAGNITUDE PERFORMANCE VARIATIONS

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	187633.5	6488509.8	-1053.1	2586.96	1512.70	-117.74	6491222
NON-PROPELLANT MASS	33.4	38.3	.3	1.13	.99	.01	39
PROPELLANT LOADING MASS	94.9	132.4	1.4	2.12	2.48	.07	135
THRUST AND FLOW RATE	-3.1	-2.5	.1	-.46	-.37	.01	-3
FLOW RATE	-.5	-.4	.0	-.09	-.07	.00	-
THRUST MISALIGNMENT	-.1	-.1	-8.4	-.01	-.01	-1.17	-
MIXTURE RATIO	8.1	6.4	-.1	1.15	.92	-.01	7
POSITIVE RSS	101.0	138.0	8.5	2.71	2.84	1.17	141
NEGATIVE RSS	101.0	138.0	8.5	2.71	2.84	1.17	141
RSS	101.0	138.0	8.5	2.71	2.84	1.17	141

TABLE 9C

S-IV STAGE STATE PARAMETERS AT GUIDANCE INITIATION

RESULTING FROM S-IV STAGE TWO-SIGMA MAGNITUDE PERFORMANCE VARIATIONS

VARIATIONS	X EARTH FIXED (M)	Y EARTH FIXED (M)	Z EARTH FIXED (M)	X-DOT EARTH FIXED (M/SEC)	Y-DOT EARTH FIXED (M/SEC)	Z-DOT EARTH FIXED (M/SEC)	PATH ANGLE EARTH FIXED (DEG)	VELOCITY EARTH FIXED (M/SEC)
NOMINAL	116685.7	116771.6	271.1	2169.77	1546.55	13.10	53.449	2664.56
NON-PROPELLANT MASS	33.0	38.6	.6	1.12	1.00	.02	-.004	1.49
PROPELLANT LOADING MASS	93.5	133.4	2.3	2.09	2.50	.09	-.019	3.15
THRUST AND FLOW RATE	-3.1	-2.5	.0	-.46	-.38	.00	.001	-.59
FLOW RATE	-.5	-.4	.0	-.09	-.07	.00	.000	-.11
THRUST MISALIGNMENT	-.0	-.0	-8.4	-.01	-.01	-1.17	.000	-.02
MIXTURE RATIO	8.0	6.5	-.0	1.14	.93	-.00	-.002	1.47
POSITIVE RSS	99.5	139.1	8.7	2.67	2.88	1.17	.019	3.83
NEGATIVE RSS	99.5	139.1	8.7	2.67	2.88	1.17	.019	3.83
RSS	99.5	139.1	8.7	2.67	2.88	1.17	.019	3.83

TABLE 10A

S-IV STAGE STATE PARAMETERS AT GUIDANCE CUT-ØFF SIGNAL

RESULTING FRØM S-I STAGE TWØ-SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	TIME FRØM LIFTØFF (SEC)	ALTITUDE (M)	RANGE (M)	INTEGRATED PLATFØRM ACCELERATIØNS X1-DØT (M/SEC)	ETA-DØT (M/SEC)	ZETA-DØT (M/SEC)	PATH ANGLE SPACE FIXED (DEG)	VELØCITY SPACE FIXED (M/SEC)
NØMINAL	629.931	500066.9	1856845.4	7489.93	3127.37	-.13	90.019	7678.95
NØN-PRØPELLANT MASS	.106	.9	-312.0	.12	1.42	.00	-.000	.00
PRØPELLANT LØADING MASS	-.116	1.1	-1404.2	-.07	.30	.00	.000	.00
THRUST AND FLØW RATE	1.543	.3	2520.1	1.40	12.56	.00	-.002	.00
FLØW RATE	.493	9.7	-8127.2	.95	14.30	.00	-.002	.00
THRUST MISALIGNMENT	.521	1.1	-1249.0	.68	6.30	-.00	-.002	.00
IN-PLANE THRUST MISALIGN	-.008	-5.4	6461.5	1.07	-5.36	.00	.000	.00
THRUST MISALIGNMENT	.158	6.6	-6900.9	-.90	7.22	.00	-.001	.00
MIXTURE RATIØ	.969	4.9	-4282.9	1.10	14.10	.00	-.000	.00
AXIAL DRAG CØEFFICIENT	.884	2.1	-1775.3	.94	10.99	.00	.000	.00
HEADWIND	.468	4.7	-3637.6	-.01	8.29	-.00	-.002	.00
TAILWIND	-.713	-3.6	5007.7	.08	-11.70	.00	-.001	.00
LEFT CRØSS WIND	.646	4.4	-4746.3	-.09	10.78	.00	.001	.00
RIGHT CRØSS WIND	.730	.5	-3398.7	.42	10.11	-.00	.001	.00
HIGH GRØUND WIND	.708	2.9	-3198.1	.78	10.32	.00	.001	.00
LØW GRØUND WIND	-.586	-1.0	1788.3	-.59	-7.54	-.00	-.001	.00
HIGH AMBIENT TEMPERATURE	-.787	1.4	-1227.6	-.65	-6.31	-.00	-.001	.00
LØW AMBIENT TEMPERATURE	2.055	-1.6	3375.7	1.76	16.60	.00	-.000	.00
PØSITIVE RSS	3.249	14.9	13377.1	3.23	38.01	.00	.004	.00
NEGATIVE RSS	2.471	13.1	14289.7	2.65	31.40	.00	.004	.00
RSS	2.860	14.0	13833.4	2.94	34.71	.00	.004	.00

TABLE 10B

S-IV STAGE STATE PARAMETERS AT GUIDANCE CUT-ØFF SIGNAL

RESULTING FRØM S-I STAGE TWØ-SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	X SPACE FIXED (M)	Y SPACE FIXED (M)	Z SPACE FIXED (M)	X-DØT SPACE FIXED (M/SEC)	Y-DØT SPACE FIXED (M/SEC)	Z-DØT SPACE FIXED (M/SEC)	VEHICLE RADIAL DISTANCE (M)
NØMINAL	2234043.7	6501811.6	-46160.7	7260.71	-2498.15	-87.32	6875073
NØN-PRØPELLANT MASS	-275.7	95.4	-8.4	.13	.37	.01	1
PRØPELLANT LØADING MASS	-1478.5	508.5	9.4	.55	1.60	-.01	-
THRUST AND FLØW RATE	3188.0	-1096.1	-128.8	-1.14	-3.32	.12	3
FLØW RATE	-8091.3	2781.6	-43.4	3.19	9.28	.04	2
THRUST MISALIGNMENT	-1065.9	368.4	163.8	.49	1.42	.48	
IN-PLANE THRUST MISALIGN	6585.0	-2269.9	4.8	-2.54	-7.37	.01	1
THRUST MISALIGNMENT	-6975.2	2396.9	-16.4	2.71	7.88	-.00	
MIXTURE RATIØ	-3979.8	1369.0	-82.6	1.53	4.46	.07	1
AXIAL DRAG CØEFFICIENT	-1456.4	501.2	-73.7	.55	1.58	.07	1
HEADWIND	-3522.0	1212.8	-2.0	1.43	4.14	.11	1
TAILWIND	4821.0	-1660.8	6.3	-1.81	-5.26	-.16	1
LEFT CRØSS WIND	-4581.7	1574.5	-104.8	1.72	5.00	-.05	-
RIGHT CRØSS WIND	-3175.8	1091.9	236.8	1.20	3.48	.65	-2
HIGH GRØUND WIND	-2978.2	1024.0	-66.5	1.12	3.25	.05	-
LØW GRØUND WIND	1589.2	-546.4	49.8	-.56	-1.62	-.04	1
HIGH AMBIENT TEMPERATURE	-1566.9	539.6	66.8	.64	1.85	-.06	
LØW AMBIENT TEMPERATURE	4264.9	-1468.9	-170.4	-1.63	-4.73	.16	2
PØSITIVE RSS	13576.1	4867.7	347.5	5.49	15.95	.85	5
NEGATIVE RSS	14158.1	4672.7	318.8	5.24	15.21	.54	4
RSS	13867.1	4770.2	333.2	5.36	15.58	.69	4

TABLE 10C

S-IV STAGE STATE PARAMETERS AT GUIDANCE CUT-ØFF SIGNAL

RESULTING FRØM S-I STAGE TWØ-SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	X EARTH FIXED (M)	Y EARTH FIXED (M)	Z EARTH FIXED (M)	X-DØT EARTH FIXED (M/SEC)	Y-DØT EARTH FIXED (M/SEC)	Z-DØT EARTH FIXED (M/SEC)	PATH ANGLE EARTH FIXED (DEG)	VELØCITY EARTH FIXED (M/SEC)
NØMINAL	1974066.3	210526.4	51097.2	6943.17	-2091.75	226.51	90.020	7254.96
NØN-PRØPELLANT MASS	-322.3	97.5	5.3	.12	.40	.03	-.000	.00
PRØPELLANT LØADING MASS	-1449.5	436.4	-39.0	.45	1.48	-.05	.000	-.00
THRUST AND FLØW RATE	2598.5	-782.1	205.9	-.76	-2.50	.48	-.002	.01
FLØW RATE	-8393.0	2524.8	-107.1	2.74	9.10	.06	-.002	.00
THRUST MISALIGNMENT	-1296.2	388.2	236.6	.47	1.59	.58	-.002	.01
IN-PLANE THRUST MISALIGN	6670.3	-2012.9	126.6	-2.13	-7.06	.08	.000	.00
THRUST MISALIGNMENT	-7126.1	2143.0	-118.9	2.29	7.61	-.04	-.001	-.00
MIXTURE RATIØ	-4424.5	1331.5	15.4	1.40	4.68	.23	-.000	.00
AXIAL DRAG CØEFFICIENT	-1835.1	552.3	56.5	.56	1.89	.24	.000	.00
HEADWIND	-3757.6	1131.6	15.5	1.25	4.17	.17	-.002	.00
TAILWIND	5173.0	-1558.9	-30.6	-1.60	-5.32	-.26	-.001	-.00
LEFT CRØSS WIND	-4901.2	1474.6	-75.4	1.52	5.06	.03	.001	.00
RIGHT CRØSS WIND	-3519.5	1053.5	307.2	1.08	3.62	.77	.001	.01
HIGH GRØUND WIND	-3303.9	993.9	9.8	1.02	3.40	.17	.001	.00
LØW GRØUND WIND	1847.9	-555.9	-24.9	-.54	-1.79	-.15	-.001	-.00
HIGH AMBIENT TEMPERATURE	-1265.3	381.9	-102.8	.44	1.44	-.24	-.001	-.00
LØW AMBIENT TEMPERATURE	3480.0	-1049.7	275.9	-1.11	-3.65	.63	-.000	.01
PØSITIVE RSS	13813.1	4439.1	549.2	4.72	15.72	1.32	.004	.02
NEGATIVE RSS	14759.8	4160.3	383.1	4.41	14.63	.91	.004	.01
RSS	14286.4	4299.7	466.2	4.57	15.18	1.11	.004	.02

TABLE 10D

S-IV STAGE STATE PARAMETERS AT GUIDANCE CUT-ØFF SIGNAL

RESULTING FRØM S-I STAGE TWØ-SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	RESIDUAL PRØPELLANT MASS (KG)	LØNGITUDE + WEST ØF GREENWICH (DEG)	GEØDETIC LATITUDE + NØRTH (DEG)	VELØCITY ØVER CIRCULAR (M/SEC)
NØMINAL	284.34	63.21351	22.688750	64.62
NØN-PRØPELLANT MASS	-9.95	.00282	.001044	.00
PRØPELLANT LØADING MASS	-16.73	.01247	.005178	-.00
THRUST AND FLØW RATE	-35.05	-.02188	-.010338	.00
FLØW RATE	-168.84	.07264	.029054	.00
THRUST MISALIGNMENT	-49.00	.01209	.002531	.00
IN-PLANE THRUST MISALIGN	.73	-.05758	-.023443	.00
THRUST MISALIGNMENT	-14.82	.06157	.024886	.00
MIXTURE RATIØ	-122.16	.03854	.014765	.00
AXIAL DRAG CØEFFICIENT	-83.15	.01616	.005737	.00
HEADWIND	-44.02	.03274	.012523	.00
TAILWIND	66.93	-.04509	-.017181	.00
LEFT CRØSS WIND	-60.79	.04237	.017070	.00
RIGHT CRØSS WIND	-68.65	.03166	.009461	-.00
HIGH GRØUND WIND	-91.21	.02877	.011039	.00
LØW GRØUND WIND	62.33	-.01616	-.006028	.00
HIGH AMBIENT TEMPERATURE	20.90	.01065	.005053	.00
LØW AMBIENT TEMPERATURE	-48.73	-.02931	-.013849	.00
PØSITIVE RSS	251.31	.12811	.050405	.00
NEGATIVE RSS	274.98	.11950	.048053	.00
RSS	263.14	.12380	.049229	.00

TABLE 11A

S-IV STAGE STATE PARAMETERS AT GUIDANCE CUT-ØFF SIGNAL

RESULTING FRØM S-IV STAGE TWØ SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	TIME FRØM LIFTØFF (SEC)	ALTITUDE (M)	RANGE (M)	INTEGRATED PLATFØRM ACCELERATIØNS X1-DØT (M/SEC)	ETA-DØT (M/SEC)	ZETA-DØT (M/SEC)	PATH ANGLE SPACE FIXED (DEG)	VELØCITY SPACE FIXED (M/SEC)
NØMINAL	629.931	500066.9	1856845.4	7489.93	3127.37	-.13	90.019	7678.95
NØN-PRØPELLANT MASS	-.375	-.2	-772.1	-.35	-2.33	-.00	.001	.00
PRØPELLANT LØADING MASS	-1.396	2.3	-3781.1	-1.14	-7.10	-.00	.001	.00
THRUST AND FLØW RATE	2.482	-6.0	8624.0	1.92	9.81	.00	-.002	.00
FLØW RATE	1.279	-4.5	5759.4	.78	3.36	.00	-.001	.00
THRUST MISALIGNMENT	.001	1.4	-2.4	.00	.01	.00	-.000	-.00
MIXTURE RATIØ	-9.133	29.8	-33926.4	-6.41	-32.56	-.00	-.000	.00
PØSITIVE RSS	9.659	30.9	35685.2	6.84	34.98	.00	.002	.00
NEGATIVE RSS	9.659	30.9	35685.2	6.84	34.98	.00	.002	.00
RSS	9.659	30.9	35685.2	6.84	34.98	.00	.002	.00

TABLE 11B

S-IV STAGE STATE PARAMETERS AT GUIDANCE CUT-ØFF SIGNAL

RESULTING FRØM S-IV STAGE TWØ SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	X SPACE FIXED (M)	Y SPACE FIXED (M)	Z SPACE FIXED (M)	X-DØT SPACE FIXED (M/SEC)	Y-DØT SPACE FIXED (M/SEC)	Z-DØT SPACE FIXED (M/SEC)	VEHICLE RADIAL DISTANCE (M)
NØMINAL	2234043.7	6501811.6	-46160.7	7260.71	-2498.15	-87.32	6875073
NØN-PRØPELLANT MASS	-937.9	321.9	32.5	.31	.91	-.03	-1
PRØPELLANT LØADING MASS	-4415.4	1517.4	121.1	1.64	4.78	-.10	-2
THRUST AND FLØW RATE	9785.7	-3375.8	-215.8	-3.70	-10.73	.17	3
FLØW RATE	6384.4	-2200.9	-111.4	-2.43	-7.04	.08	1
THRUST MISALIGNMENT	-1.3	.6	-141.7	.00	.00	.08	1
MIXTURE RATIØ	-38291.3	13056.9	797.8	14.58	42.78	-.60	-4
PØSITIVE RSS	40288.0	13752.4	855.1	15.33	44.93	.64	6
NEGATIVE RSS	40288.0	13752.4	855.1	15.33	44.93	.64	6
RSS	40288.0	13752.4	855.1	15.33	44.93	.64	6

TABLE 11C

S-IV STAGE STATE PARAMETERS AT GUIDANCE CUT-ØFF SIGNAL

RESULTING FRØM S-IV STAGE TWØ SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	X EARTH FIXED (M)	Y EARTH FIXED (M)	Z EARTH FIXED (M)	X-DØT EARTH FIXED (M/SEC)	Y-DØT EARTH FIXED (M/SEC)	Z-DØT EARTH FIXED (M/SEC)	PATH ANGLE EARTH FIXED (DEG)	VELØCITY EARTH FIXED (M/SEC)
NØMINAL	1974066.3	210526.4	51097.2	6943.17	-2091.75	226.51	90.020	7254.96
NØN-PRØPELLANT MASS	-796.5	239.2	-51.9	.21	.70	-.12	.001	-.00
PRØPELLANT LØADING MASS	-3900.9	1173.9	-210.1	1.20	3.97	-.43	.001	-.01
THRUST AND FLØW RATE	8896.3	-2687.1	413.2	-2.79	-9.19	.79	-.002	.01
FLØW RATE	5942.5	-1793.6	236.2	-1.87	-6.18	.42	-.001	.01
THRUST MISALIGNMENT	1.6	2.1	-141.6	.01	.01	.08	-.000	.01
MIXTURE RATIØ	-35033.0	10459.5	-1537.3	11.10	37.02	-2.91	-.000	-.04
PØSITIVE RSS	36845.9	11012.4	1629.2	11.66	38.85	3.08	.003	.05
NEGATIVE RSS	36845.9	11012.4	1629.2	11.66	38.85	3.08	.003	.05
RSS	36845.9	11012.4	1629.2	11.66	38.85	3.08	.003	.05

TABLE 11D

S-IV STAGE STATE PARAMETERS AT GUIDANCE CUT-ØFF SIGNAL

RESULTING FRØM S-IV STAGE TWØ SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	RESIDUAL PRØPELLANT MASS (KG)	LØNGITUDE + WEST ØF GREENWICH (DEG)	GEØDETIC LATITUDE + NØRTH (DEG)	VELØCITY ØVER CIRCULAR (M/SEC)
NØMINAL	284.34	63.21351	22.688750	64.62
NØN-PRØPELLANT MASS	-34.93	.00675	.003081	-.00
PRØPELLANT LØADING MASS	-18.02	.03320	.014747	-.00
THRUST AND FLØW RATE	-6.38	-.07595	-.033137	.00
FLØW RATE	105.93	-.05087	-.021838	.00
THRUST MISALIGNMENT	-.06	-.00050	.001091	.00
MIXTURE RATIØ	-145.67	.29943	.129412	-.00
PØSITIVE RSS	185.08	.31490	.136201	.00
NEGATIVE RSS	185.08	.31490	.136201	.00
RSS	185.08	.31490	.136201	.00

TABLE 12A

S-IV STAGE ØRBITAL INSERTIØN STATE PARAMETERS

RESULTING FRØM S-I STAGE TWØ-SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	TIME FRØM LIFTØFF (SEC)	ALTITUDE (M)	RANGE (M)	INTEGRATED PLATFØRM ACCELERATIØNS X1-DØT (M/SEC)	ETA-DØT (M/SEC)	ZETA-DØT (M/SEC)	PATH ANGLE SPACE FIXED (DEG)	VELØCITY SPACE FIXED (M/SEC)
NØMINAL	639.931	499976.6	1924144.5	7492.64	3125.80	-.13	90.013	7682.08
NØN-PRØPELLANT MASS	.106	1.3	-312.0	.13	1.42	.00	-.000	.00
PRØPELLANT LØADING MASS	-.116	.3	-1404.1	-.07	.30	.00	.000	.00
THRUST AND FLØW RATE	1.543	2.3	2520.0	1.39	12.54	.00	-.002	.00
FLØW RATE	.493	12.0	-8127.2	.99	14.28	.00	-.002	.03
THRUST MISALIGNMENT	.521	3.3	-1249.0	.68	6.29	-.00	-.002	.01
IN-PLANE THRUST MISALIGN	-.008	-6.2	6461.4	1.04	-5.39	.00	.000	-.01
THRUST MISALIGNMENT	.158	7.6	-6900.9	-.88	7.25	.00	-.001	.01
MIXTURE RATIØ	.969	4.7	-4282.8	1.12	14.08	.00	-.000	.02
AXIAL DRAG CØEFFICIENT	.884	1.2	-1775.4	.94	10.97	.00	.000	.02
HEADWIND	.468	6.7	-3637.7	.00	8.29	-.00	-.002	.01
TAILWIND	-.713	-2.6	5007.4	.06	-11.70	.00	-.001	-.01
LEFT CRØSS WIND	.646	3.0	-4746.1	-.08	10.78	.00	.001	.01
RIGHT CRØSS WIND	.730	-.6	-3398.6	.44	10.10	-.00	.001	.02
HIGH GRØUND WIND	.708	1.9	-3198.3	.79	10.30	.00	.001	.02
LØW GRØUND WIND	-.586	.7	1788.0	-.59	-7.53	-.00	-.001	-.01
HIGH AMBIENT TEMPERATURE	-.787	2.6	-1227.6	-.65	-6.29	-.00	-.001	-.00
LØW AMBIENT TEMPERATURE	2.055	-1.7	3375.8	1.76	16.57	.00	-.000	.00
PØSITIVE RSS	3.249	17.5	13376.9	3.25	37.98	.00	.004	.05
NEGATIVE RSS	2.471	15.3	14289.6	2.66	31.37	.00	.004	.05
RSS	2.860	16.4	13833.2	2.96	34.67	.00	.004	.05

TABLE 12B

S-IV STAGE ØRBITAL INSERTIØN STATE PARAMETERS

RESULTING FRØM S-I STAGE TWØ-SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	X SPACE FIXED (M)	Y SPACE FIXED (M)	Z SPACE FIXED (M)	X-DØT SPACE FIXED (M/SEC)	Y-DØT SPACE FIXED (M/SEC)	Z-DØT SPACE FIXED (M/SEC)	VEHICLE RADIAL DISTANCE (M)
NØMINAL	2306537.8	6476417.0	-47030.7	7235.58	-2579.39	-86.67	6875049
NØN-PRØPELLANT MASS	-274.3	99.1	-8.3	.13	.36	.01	1
PRØPELLANT LØADING MASS	-1472.9	524.4	9.3	.57	1.60	-.01	-1
THRUST AND FLØW RATE	3176.1	-1129.6	-127.6	-1.18	-3.32	.12	5
FLØW RATE	-8058.8	2874.1	-43.0	3.32	9.23	.04	4
THRUST MISALIGNMENT	-1060.9	382.5	168.5	.52	1.41	.48	3
IN-PLANE THRUST MISALIGN	6558.8	-2343.8	5.0	-2.64	-7.38	.01	
THRUST MISALIGNMENT	-6947.5	2475.8	-16.4	2.82	7.88	-.00	1
MIXTURE RATIØ	-3964.2	1413.4	-81.9	1.60	4.42	.07	1
AXIAL DRAG CØEFFICIENT	-1451.1	516.8	-73.0	.57	1.55	.07	-
HEADWIND	-3507.7	1254.1	-.9	1.48	4.13	.11	3
TAILWIND	4802.3	-1713.3	4.7	-1.89	-5.23	-.16	2
LEFT CRØSS WIND	-4563.9	1624.3	-105.3	1.79	4.99	-.05	-2
RIGHT CRØSS WIND	-3163.6	1126.5	243.3	1.26	3.46	.65	-3
HIGH GRØUND WIND	-2967.0	1056.4	-59.9	1.17	3.22	.05	-1
LØW GRØUND WIND	1583.3	-562.4	49.4	-.59	-1.60	-.05	2
HIGH AMBIENT TEMPERATURE	-1560.4	558.4	66.2	.66	1.86	-.06	1
LØW AMBIENT TEMPERATURE	4248.3	-1516.4	-168.7	-1.69	-4.75	.17	2
PØSITIVE RSS	13522.5	5026.9	353.2	5.71	15.90	.85	9
NEGATIVE RSS	14102.1	4824.6	319.6	5.45	15.16	.54	8
RSS	13812.3	4925.7	336.4	5.58	15.53	.69	9

TABLE 12C

S-IV STAGE ØRBITAL INSERTIØN STATE PARAMETERS

RESULTING FRØM S-I STAGE TWØ-SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	X EARTH FIXED (M)	Y EARTH FIXED (M)	Z EARTH FIXED (M)	X-DØT EARTH FIXED (M/SEC)	Y-DØT EARTH FIXED (M/SEC)	Z-DØT EARTH FIXED (M/SEC)	PATH ANGLE EARTH FIXED (DEG)	VELØCITY EARTH FIXED (M/SEC)
NØMINAL	2043414.3	189235.6	53380.1	6923.87	-2165.12	230.02	90.014	7258.15
NØN-PRØPELLANT MASS	-321.0	101.6	5.6	.12	.40	.03	-.000	.00
PRØPELLANT LØADING MASS	-1445.0	451.1	-39.5	.47	1.48	-.05	.000	.00
THRUST AND FLØW RATE	2590.4	-807.4	21[illegible].6	-.79	-2.51	.47	-.002	.01
FLØW RATE	-8365.1	2615.6	-106.5	2.86	9.06	.06	-.002	.03
THRUST MISALIGNMENT	-1291.5	403.9	242.4	.49	1.58	.58	-.002	.01
IN-PLANE THRUST MISALIGN	6648.2	-2083.8	127.4	-2.23	-7.07	.07	.000	-.00
THRUST MISALIGNMENT	-7102.7	2219.2	-119.3	2.39	7.62	-.03	-.001	.01
MIXTURE RATIØ	-4410.1	1378.1	17.8	1.47	4.65	.24	-.000	.03
AXIAL DRAG CØEFFICIENT	-1829.7	570.9	58.9	.59	1.86	.24	.001	.02
HEADWIND	-3745.0	1173.3	17.2	1.31	4.16	.18	-.002	.01
TAILWIND	5156.4	-1612.0	-33.2	-1.67	-5.31	-.26	-.001	-.02
LEFT CRØSS WIND	-4885.5	1525.0	-75.1	1.59	5.04	.04	.001	.02
RIGHT CRØSS WIND	-3508.5	1089.6	314.9	1.13	3.61	.77	.001	.02
HIGH GRØUND WIND	-3293.7	1027.8	11.5	1.07	3.38	.17	.001	.02
LØW GRØUND WIND	1842.2	-573.7	-26.3	-.57	-1.77	-.15	-.001	-.01
HIGH AMBIENT TEMPERATURE	-1260.9	396.6	-105.1	.46	1.45	-.23	-.001	-.01
LØW AMBIENT TEMPERATURE	3468.6	-1086.5	282.2	-1.16	-3.67	.63	-.000	.01
PØSITIVE RSS	13767.8	4596.0	561.5	4.94	15.68	1.31	.004	.06
NEGATIVE RSS	14711.6	4306.5	390.5	4.61	14.60	.91	.004	.05
RSS	14239.7	4451.3	476.0	4.77	15.14	1.11	.004	.06

TABLE 12D

S-IV STAGE ØRBITAL INSERTIØN STATE PARAMETERS

RESULTING FRØM S-I STAGE TWØ-SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	RESIDUAL PRØPELLANT MASS (KG)	LØNGITUDE + WEST ØF GREENWICH (DEG)	GEØDETIC LATITUDE + NØRTH (DEG)	VELØCITY ØVER CIRCULAR (M/SEC)
NØMINAL	254.41	62.61827	28.436318	67.74
NØN-PRØPELLANT MASS	-9.95	.00281	.001053	.00
PRØPELLANT LØADING MASS	-16.73	.01242	.005230	.00
THRUST AND FLØW RATE	-35.05	-.02178	-.010456	.00
FLØW RATE	-168.84	.07238	.029325	.03
THRUST MISALIGNMENT	-49.00	.01208	.002533	.01
IN-PLANE THRUST MISALIGN	.73	-.05736	-.023664	-.01
THRUST MISALIGNMENT	-14.82	.06135	.025123	.01
MIXTURE RATIØ	-122.16	.03841	.014893	.02
AXIAL DRAG CØEFFICIENT	-83.15	.01611	.005781	.02
HEADWIND	-44.02	.03263	.012635	.01
TAILWIND	66.93	-.04494	-.017330	-.01
LEFT CRØSS WIND	-60.79	.04222	.017228	.01
RIGHT CRØSS WIND	-68.64	.03159	.009521	.01
HIGH GRØUND WIND	-91.21	.02868	.011136	.02
LØW GRØUND WIND	62.33	-.01610	-.006076	-.01
HIGH AMBIENT TEMPERATURE	20.90	.01060	.005112	-.00
LØW AMBIENT TEMPERATURE	-48.73	-.02917	-.014008	.01
PØSITIVE RSS	251.31	.12767	.050870	.05
NEGATIVE RSS	274.98	.11907	.048507	.05
RSS	263.14	.12337	.049688	.05

TABLE 13A

S-IV STAGE ØRBITAL INSERTIØN STATE PARAMETERS

RESULTING FRØM S-IV STAGE TWØ SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	TIME FRØM LIFTØFF (SEC)	ALTITUDE (M)	RANGE (M)	INTEGRATED PLATFØRM ACCELERATIØNS X1-DØT (M/SEC)	ETA-DØT (M/SEC)	ZETA-DØT (M/SEC)	PATH ANGLE SPACE FIXED (DEG)	VELØCITY SPACE FIXED (M/SEC)
NØMINAL	639.931	499976.6	1924144.5	7492.64	3125.80	-.13	90.013	7682.08
NØN-PRØPELLANT MASS	-.375	-1.9	-772.1	-.35	-2.33	-.00	.001	.00
PRØPELLANT LØADING MASS	-1.396	.4	-3781.4	-1.14	-7.11	-.00	.001	.01
THRUST AND FLØW RATE	2.482	-3.8	8624.2	1.92	9.81	.00	-.002	.00
FLØW RATE	1.279	-3.5	5759.2	.78	3.37	.00	-.001	-.00
THRUST MISALIGNMENT	.001	1.2	-2.3	.00	.01	.00	-.000	-.00
MIXTURE RATIØ	-9.133	29.1	-33927.1	-6.40	-32.60	-.00	.000	.01
PØSITIVE RSS	9.659	29.7	35686.0	6.83	35.01	.00	.003	.02
NEGATIVE RSS	9.659	29.7	35686.0	6.83	35.01	.00	.003	.02
RSS	9.659	29.7	35686.0	6.83	35.01	.00	.003	.02

TABLE 13B

S-IV STAGE ØRBITAL INSERTIØN STATE PARAMETERS

RESULTING FRØM S-IV STAGE TWØ SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	X SPACE FIXED (M)	Y SPACE FIXED (M)	Z SPACE FIXED (M)	X-DØT SPACE FIXED (M/SEC)	Y-DØT SPACE FIXED (M/SEC)	Z-DØT SPACE FIXED (M/SEC)	VEHICLE RADIAL DISTANCE (M)
NØMINAL	2306537.8	6476417.0	-47030.7	7235.58	-2579.39	-86.67	6875049
NØN-PRØPELLANT MASS	-934.7	330.8	32.2	.32	.90	-.03	-3
PRØPELLANT LØADING MASS	-4398.9	1565.2	120.1	1.70	4.76	-.10	-3
THRUST AND FLØW RATE	9748.3	-3482.7	-214.1	-3.81	-10.68	.17	5
FLØW RATE	6359.6	-2270.9	-110.6	-2.50	-7.00	.09	2
THRUST MISALIGNMENT	-1.2	.5	-140.9	.00	.00	.08	1
MIXTURE RATIØ	-38143.3	13483.4	791.7	15.06	42.58	-.61	-5
PØSITIVE RSS	40132.4	14200.3	848.6	15.83	44.72	.65	9
NEGATIVE RSS	40132.4	14200.3	848.6	15.83	44.72	.65	9
RSS	40132.4	14200.3	848.6	15.83	44.72	.65	9

TABLE 13C

S-IV STAGE ØRBITAL INSERTIØN STATE PARAMETERS

RESULTING FRØM S-IV STAGE TWØ SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	X EARTH FIXED (M)	Y EARTH FIXED (M)	Z EARTH FIXED (M)	X-DØT EARTH FIXED (M/SEC)	Y-DØT EARTH FIXED (M/SEC)	Z-DØT EARTH FIXED (M/SEC)	PATH ANGLE EARTH FIXED (DEG)	VELØCITY EARTH FIXED (M/SEC)
NØMINAL	2043414.3	189235.6	53380.1	6923.87	-2165.12	230.02	90.014	7258.15
NØN-PRØPELLANT MASS	-794.3	246.1	-53.1	.22	.70	-.11	.001	.00
PRØPELLANT LØADING MASS	-3889.0	1213.6	-214.4	1.25	3.96	-.43	.001	-.00
THRUST AND FLØW RATE	8868.0	-2778.7	418.0	-2.88	-9.16	.78	-.002	.02
FLØW RATE	5923.2	-1855.2	240.4	-1.94	-6.15	.41	-.001	.00
THRUST MISALIGNMENT	1.6	2.1	-140.8	.01	.01	.08	-.000	.01
MIXTURE RATIØ	-34920.3	10828.6	-1566.2	11.49	36.87	-2.87	.000	-.03
PØSITIVE RSS	36727.5	11399.8	1659.5	12.07	38.69	3.04	.003	.04
NEGATIVE RSS	36727.5	11399.8	1659.5	12.07	38.69	3.04	.003	.04
RSS	36727.5	11399.8	1659.5	12.07	38.69	3.04	.003	.04

TABLE 13D

S-IV STAGE ØRBITAL INSERTIØN STATE PARAMETERS

RESULTING FRØM S-IV STAGE TWØ SIGMA MAGNITUDE PERFØRMANCE VARIATIØNS

VARIATIØNS	RESIDUAL PRØPELLANT MASS (KG)	LØNGITUDE + WEST ØF GREENWICH (DEG)	GEØDETIC LATITUDE + NØRTH (DEG)	VELØCITY ØVER CIRCULAR (M/SEC)
NØMINAL	254.41	62.61827	22.436318	67.74
NØN-PRØPELLANT MASS	-34.93	.00671	.003115	.00
PRØPELLANT LØADING MASS	-18.01	.03306	.014907	.00
THRUST AND FLØW RATE	-6.23	-.07564	-.033484	.01
FLØW RATE	106.08	-.05066	-.022061	-.00
THRUST MISALIGNMENT	-.06	-.00050	.001083	.00
MIXTURE RATIØ	-146.35	.29821	.130772	.01
PØSITIVE RSS	185.08	.31362	.137631	.01
NEGATIVE RSS	185.08	.31362	.137631	.01
RSS	185.08	.31362	.137631	.01

TABLE 14

DISPERSIONS RESULTING FROM GUIDANCE SYSTEM HARDWARE ERRORS

S-IV STATE PARAMETERS AT S-IV GUIDANCE CUT-OFF

VARIATIONS	TIME FROM LIFTOFF (sec)	ALTITUDE (m)	VELOCITY (m/sec)	PATH ANGLE SPACE FIXED (deg)	VEHICLE RADICAL DISTANCE (m)
NOMINAL	629.931	500066.9	7678.95	90.019	6875073
ACCELEROMETER MISALIGNMENT	0	1.2	0	0	1
PLATFORM DRIFT DUE TO X GYRO	0	1.5	0	0	1
PLATFORM DRIFT DUE TO Y GYRO	.003	2.0	.01	0	1
PLATFORM DRIFT DUE TO Z GYRO	.019	192.7	.26	.014	180
SCALE FACTOR	.008	66.4	.21	.002	63
BIAS	.007	70.8	.18	.002	68
PLATFORM MISALIGNMENT	.017	131.3	.42	.004	233
POSITIVE RSS	.028	252.5	.57	.015	308
NEGATIVE RSS	.028	252.5	.57	.015	308
RSS	.028	252.5	.57	.015	308

TABLE 15

S-IV RSS ENVELOPE

STATE PARAMETERS AT S-IV GUIDANCE SIGNAL CUT-OFF

RSS DISPERSIONS	TIME FROM LIFTOFF (sec)	ALTITUDE (m)	VELOCITY (m/sec)	PATH ANGLE SPACE FIXED (deg)	VEHICLE RADICAL DISTANCE (m)
+RSS DUE TO S-I PERFORMANCE PERTURBATIONS	3.249	14.9	.00	.004	5
+RSS DUE TO S-IV PERFORMANCE PERTURBATIONS	9.659	30.9	.00	.002	6
+RSS DUE TO GUIDANCE SYSTEM HARDWARE ERRORS	.028	252.5	.57	.015	308
-RSS DUE TO S-I PERFORMANCE	2.471	13.1	.00	.004	4
-RSS DUE TO GUIDANCE SYSTEM HARDWARE ERRORS	9.659	30.9	.00	.002	6
-RSS DUE TO GUIDANCE SYSTEM HARDWARE ERRORS	.028	252.5	.57	.015	308
+RSS DISPERSION FOR VEHICLE	10.191	254.8	.57	.016	308
-RSS DISPERSION FOR VEHICLE	9.970	254.7	.57	.016	308
$\overline{RSS}_v$	10.081	254.8	.57	.016	308

TABLE 16 ORBITAL DISPERSIONS

Perigee & Apogee Variations
Due to S-I Stage Deviations

Deviation	Perigee (m)	Apogee (m)
Nominal	496900	747100
Non-Propellant Mass	1	8
Propellent Loading Mass	1	14
Thrust & Flow Rate (I_{sp} = Constant)	2	21
Flow Rate	11	141
Thrust Misalignment (Normal)	2	38
Thrust Misalignment (In Plane +)	-6	-29
Thrust Misalignment (In Plane -)	7	41
Mixture Ratio Shift	5	94
Longitudinal Drag Coefficient	2	58
2σ Headwind	6	44
2σ Tailwind	-3	-53
2σ Left Crosswind	4	54
2σ Right Crosswind	0	49
+2σ Ground Wind	3	68
-2σ Ground Wind	0	42
+2σ Ambient Temperature	2	6
-2σ Ambient Temperature	-1	20

Perigee & Apogee Variations
Due to S-IV Stage Deviations and Guidance Systems Hardware Errors

Deviation	Perigee (m)	Apogee(m)
Nominal	496900	747100
Propellant Loading Mass	-1	-1
Non-Propellant Mass	2	12
Thrust & Flow Rate (I_{sp}= Constant)	-5	20
Flow Rate	-4	-6
Thrust Misalignment (Normal)	+2	2
Mixture Ratio	3	68
Guidance System Hardware Errors	$\pm$378	$\pm$3273

Perigee & Apogee RSS Deviations

Type	Perigee (m)	Apogee (m)
$+RSS_I$	17	220
$-RSS_I$	7	74
$+RSS_{IV}$	30	147
$-RSS_{IV}$	6	72
$+RSS_G$	378	3273
$-RSS_G$	378	3273
$+RSS_V$	380	3284
$-RSS_V$	378	3275
$\overline{RSS_V}$	379	3280

TABLE 17

PERFORMANCE PARTIALS APPLICABLE AT S-I STAGE OUTBOARD CUTOFF

INDEPENDENT VARIABLE \ DEPENDENT VARIABLE	Units	Time	Path Angle (E.F.)	Velocity (E.F.)	Altitude	Range	X (E.F.)	Y (E.F.)	Z (E.F.)	$\dot{X}$ (E.F.)	$\dot{Y}$ (E.F.)	$\dot{Z}$ (E.F.)
	Units→	sec	deg	m/sec	m	m	m	m	m	m/sec	m/sec	m/sec
NON-PROPELLANT MASS	100 lbm wt	0.00	.003	-.8	-28.	-17.	-17.4	-27.4	0.	-.54	-.60	0.0
PROPELLANT LOADING MASS	100 lbm wt	.017	.004	-.2	3.	-21.	21.2	2.9	0.	.30	-.08	0.0
THRUST AT ISP = CONSTANT	+1%	-1.560	-.533	5.3	435.	-1,473.	-1,487.0	452.5	-3.5	-11.41	23.40	-.07
ISP ($\dot{w}$)	-1%	-1.302	-.275	-29.9	-1,217.	-1,990.	-2,032.2	-1,192.6	-13.7	-31.12	-7.21	-.26
NORMAL THRUST MISALIGNMENT	1 deg	0.00	.016	-.1	-17.	-22.	-42.2	-16.8	-4,418.6	-.03	-.35	-106.92
INPLANE THRUST MISALIGNMENT	1 deg	0.00	2.200	17.6	-2,200.	3,640.	3,660.5	-2,244.9	13.8	77.68	-71.81	.27
MIXTURE RATIO	+1%	.702	.070	44.1	1,300.	1,590.	1,629.2	1,280.2	10.6	37.15	24.17	.26
DRAG COEFFICIENT	+1%	0.00	.012	-1.2	-94.	-44.	-45.4	-93.6	-.7	-.64	-1.17	-.01

TABLE 18

PERFORMANCE PARTIALS APPLICABLE AT S-IV STAGE GCS

	INDEPENDENT VARIABLE / DEPENDENT VARIABLE	Units	Time	Path Angle (S.F.)	Altitude	Range	Propellant Reserve (Weight)	Velocity Exceeding Circular	Integrated Platform Accelerations ξ	$\dot{\eta}$	ζ	Cross-range (E.F.)	Crossrange Velocity (E.F.)
		Units →	sec	deg	m	m	lbm		m/sec	m/sec	m/sec	m	m/sec
S-I STAGE VARIATIONS	NON-PROPELLANT MASS	100 lbm wt	.045	0.0	0.	-131.	-9.	0.	.05	.60	0.0	2.	.01
	PROPELLANT LOADING MASS	100 lbm wt	.007	0.0	0.	82.	2.	0.	.00	-.02	0.0	2.	.00
	THRUST AT ISP = CONSTANT	+1%	-2.057	.003	0.	-3,360.	102.	0.	-1.87	-16.75	0.0	-274.	-.64
	ISP ($\dot{w}$)	-1%	.493	-.002	10.	-8,127.	-372.	0.	.95	14.30	0.0	-107.	.06
	NORMAL THRUST MISALIGNMENT	1 deg	1.408	-.005	3.	-3,376.	-292.	0.	1.84	17.03	0.0	639.	1.57
	INPLANE THRUST MISALIGNMENT	1 deg	-.022	0.0	-15.	17,463.	4.	0.	2.89	-14.49	0.0	342.	.22
	MIXTURE RATIO	+1%	-2.062	0.0	-10.	9,113.	573.	0.	-2.34	-30.00	0.0	-33.	-.49
	DRAG COEFFICIENT	+1%	.088	0.0	0.	-178.	-18.	0.	.09	1.10	0.0	6.	.02
S-IV STAGE VARIATIONS	NON-PROPELLANT MASS	100 lbm wt	-.478	.001	0.	-985.	99.	0.	-.45	-2.97	0.0	-66.	-.15
	PROPELLANT LOADING MASS	100 lbm wt	.417	0.0	-1.	1,129.	12.	0.	.34	2.12	0.0	63.	.13
	THRUST AT ISP = CONSTANT	+1%	-4.964	.004	12.	-17,248.	28.	0.	-3.84	-19.62	0.0	-820.	-.16
	ISP ($\dot{w}$)	+1%	2.558	-.002	-9.	11,519.	467.	0.	1.56	6.72	0.0	472.	.84
	NORMAL THRUST MISALIGNMENT	1 deg	.002	0.0	3.	-6.	0	0.	0.0	.02	0.0	-345.	.20
	MIXTURE RATIO	+1%	-1.075	0.0	4.	-3,991.	-38.	0.	-.75	-3.83	0.0	-181.	-.34

REFERENCES

1. NASA TMX-53203, "SA-9 Final Predicted Trajectory, Part I. Nominal Trajectory," January 29, 1965

2. R-P&VE-PT-65-M-27-P, "Maximum Allowable Residual for S-IV (SA-9, 8, 10) Based on Current Venting System," January 27, 1965

3. Beers, Yardley, "Introduction to the Theory of Error," Addison-Wesley, Inc., Reading, Massachusetts, 1962

4. AERO-IN-11-64, "Monte Carlo Performance Analysis Computer Program," April 15, 1964

5. Memorandum from Chief, Aerophysics and Astrophysics Branch, M-AERO-G, "Range Safety Wind Profiles for Selected Flight Azimuths," March 29, 1963

6. R-P&VE-PPE-64-M-296, "Final S-IV-9 Propulsion Prediction," December 28, 1964

7. R-P&VE-PPE-64-M-287, "Final S-I-9 Performance Prediction," December 17, 1964

8. R-ASTR-G-120-65, "Test Data From Serial Number 7, ST124 Platform for SA-9," January 15, 1965.

APPROVAL

SA-9, 8 AND 10 DISPERSION ANALYSIS

By

Gerald Wittenstein and Jerry D. Weiler

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 report has also been reviewed and approved for technical accuracy.

O M Hardage, Jr.

O. M. HARDAGE, JR.
Chief, Trajectory Section
Flight Mechanics Branch

Lloyd O. Stone

LLOYD O. STONE
Chief, Flight Mechanics Branch

F Speer

FRIDTJOF A. SPEER
Chief, Flight Evaluation and
Operations Studies Division

E. D. GEISSLER
Director, Aero-Astrodynamics
Laboratory

DISTRIBUTION

I-I/IB-DIR, Col. James
I-I/IB-T, Mr. Bender
R-AERO-DIR, Dr. Geissler
R-AERO-DIR, Mr. Jean
R-AERO-AT, Mr. Wilson
R-AERO-AD, Mr. Nunley
R-AERO-DD, Mr. Winch
R-AERO-DD, Mr. Ryan
R-AERO-F, Dr. Speer
R-AERO-FF, Mr. Lindberg (6)
R-AERO-FF, Mr. Hagood
R-AERO-FP, Mr. Clarke
R-AERO-FO, Mr. Kurtz
R-AERO-FO, Mr. Naumcheff
R-AERO-FO, Mrs. McNair
R-AERO-FF, Mr. Sheats
R-AERO-FF, Mr. Horst
R-AERO-FM, Mr. Stone
R-AERO-FM, Mr. Hardage (10)
R-AERO-FM, Mr. Wittenstein (5)
R-AERO-FM, Mr. Weiler
R-AERO-FM, Mr. Sullivan
R-AERO-FM, Mr. Leonard
R-AERO-P, Mr. McNair (6)
R-AERO-P, Mr. Teague (10)
R-AERO-Y, Mr. Vaughan
R-AERO-Y, Mr. Smith
R-ASTR-F, Mr. Blackston
R-ASTR-NGI, Mr. Blunton
R-ASTR-NGI, Mr. Nicaise (2)
R-ASTR-NGO, Mr. Winkler
R-ASTR-TJ, Mr. Noel
R-P&VE-PP, Mr. Heusinger
R-P&VE-PPE, Mr. McKay
R-P&VE-VAW, Mr. Scott
MS-IP
MS-IPL (8)

MSC

MSC-PT6, Mr. McKann
MSC-PS3, Mr. Perrine
MSC-FM, Mr. Mayer
MSC-FM, Mr. Incerto
HME-P
CC-P
MS-H

EXTERNAL

Scientific and Technical Information
Facility (25)
P. O. Box 5700
Bethesda, Maryland
ATTN: NASA Representative
(S-AK RKT)