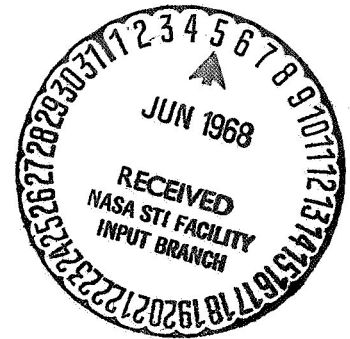


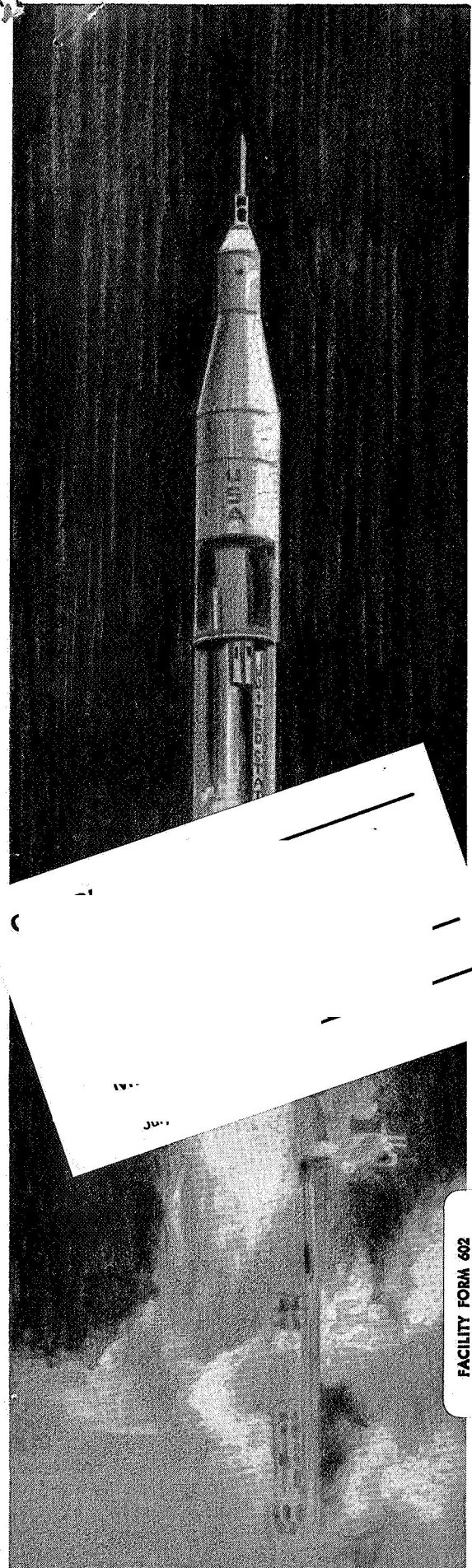
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BB-3.1.5-4-201  
PART IV  
TN-AP-68-311

**contract NAS8-4016 schedule II,  
vehicle systems integration**

**SATURN AS-204/LM-1  
POSTFLIGHT TRAJECTORY**



**N 68-25177**

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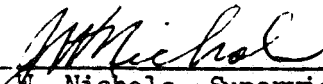
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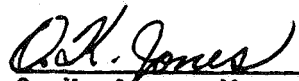
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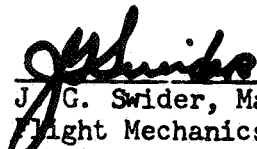
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## FOREWORD

This report presents the postflight trajectory of the Saturn AS-204/LM-1 vehicle from guidance reference release at Cape Kennedy to S-IVB/LM-1 separation which occurred in the vicinity of the Carnarvon tracking station. Included in the report is an analysis of the powered flight trajectory, orbital flight trajectory, the ballistic free flight trajectory of the expended S-IB stage, and orbital effects of S-IVB passivation.

The trajectory determination and documentation were performed by the Aerospace Physics Branch of Chrysler Corporation Space Division in compliance with the work scope of contract NASS-4016, Schedule II, Supplemented Agreement MSFC-1, Amendment 87, BB Item 3.1.5-4-201, Part IV.

Acknowledgements are made to the personnel of Marshall Space Flight Center, R-AERO-FFT, for their assistance and cooperation, and to the Dynamics Programming Unit of CCSD Computer Services for their invaluable assistance.

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## SUMMARY

The Apollo Saturn Vehicle, AS-204/LM-1, was launched from Cape Kennedy, Florida, at 5:48:08 P.M. EST on January 22, 1968. The primary mission of this flight was to place the Lunar Module (LM-1) in an elliptical earth orbit (85 by 120 nm) for unmanned tests of the spacecraft and subsystems operations. This report presents the AS-204/LM-1 postflight trajectory from guidance reference release to S-IVB/LM-1 separation. The trajectory is presented in the earth-fixed plumbline, space-fixed ephemeris, and geographic coordinate systems. Time histories of trajectory parameters are given in tabular form; at 1.0 sec intervals from guidance reference release to S-IB/S-IVB separation, at 5.0 sec intervals from S-IB/S-IVB separation to orbital insertion, and at 10.0 sec intervals from insertion to S-IVB/LM-1 separation. Some discussion is given to the orbital conditions of flight through passivation (in-orbit dump of propellants) of the S-IVB stage. Also included is a tabulation at 10.0 sec intervals of the expended S-IB stage ballistic free flight trajectory to impact.

The trajectory was established from data provided by external electronic tracking systems and telemetered onboard data from the ST-124M guidance platform. The postflight trajectory was very close to the predicted nominal. At S-IVB/LM-1 separation (3235.24 sec) the vehicle had a space-fixed velocity of only 0.9 m/s (2.9 ft/s) greater than nominal. The altitude, at this point, was 1.2 km (0.6 nm) lower than nominal and the flight path angle was 0.005 deg less than nominal.

## 1.0 INTRODUCTION

The Saturn IB AS-204/LM-1 vehicle was launched from KSC at 5:48:08 P.M. EST on January 22, 1968. The launch azimuth from Pad 37B was 90° east of north. After liftoff the vehicle was rolled to a flight azimuth of 72° east of north. The S-IVB stage and spacecraft (Lunar Module) were placed into an elliptical earth orbit for test of the spacecraft subsystems operations. Also a passivation experiment (fuel and LOX dump) was conducted with the S-IVB stage after separation from the spacecraft.

This report presents the postflight mass-point reference trajectory, and associated information, from guidance reference release (-4.956 sec) to S-IVB/LM-1 separation (3235.242 sec). All times are referenced to the established Range Zero of 5:48:08 P.M. EST, unless otherwise specified. Comparison of this trajectory with the nominal is given for some specific parameters as indications of vehicle performance. Reference 1 provides documentation of the nominal trajectory. Also presented in this report are details of available tracking data, the data utilization, an error analysis, the orbital determination, and the S-IB stage ballistic free flight. Accompanying the discussion are figures and tables of the trajectory data in both the metric and English units of measure.

## 2.0 COORDINATE SYSTEMS AND LAUNCH PARAMETERS

The translational motion of the vehicle's center of gravity is tabulated in three coordinate systems: earth-fixed plumbline, space-fixed ephemeris, and geographic. These coordinate systems conform to the "Project Apollo Coordinate System Standards" and are defined in Appendix A and graphically illustrated in Figure 1. The earth-fixed plumbline coordinate system has its origin located at the launch site



on the reference earth model. In the earth-fixed system, the vehicle's center of gravity has an initial displacement of 34.5 m (113.2 ft) above the reference ellipsoid.

The representative model for the earth and its gravitational field is the Fischer Ellipsoid of 1960. All latitude and longitude coordinates are defined with respect to this ellipsoid.

The geographic coordinates and gravity data for launch pad 37B at Cape Kennedy are:

|                         |   |
|-------------------------|---|
| Geodetic Latitude       | 28.531856 deg   |
| Longitude               | 80.564953 deg   |
| Acceleration of Gravity | 9.818 m/sec <sup>2</sup> (32.21 ft/sec <sup>2</sup> ) |

Elevation above the reference ellipsoid are:

|                         |                   |
|-------------------------|-------------------|
| Base of Launch Pedestal | 4.9 m (16.1 ft)   |
| C. G. at First Motion   | 34.5 m (113.2 ft) |

Azimuth alignments are:

|                          |            |
|--------------------------|------------|
| Launch Azimuth           | 90° E of N |
| Flight Azimuth           | 72° E of N |
| ST-124M Platform Azimuth | 72° E of N |

## 3.0 POWERED FLIGHT TRAJECTORY ANALYSIS

### 3.1 Data Sources

Tracking data and telemetered guidance data were available from first motion through insertion (S-IVB CO + 10 sec). The coverage of each tracking system is itemized in Table I and shown in Figure 2. The vehicle ground track relative to the tracking stations is shown in Figure 3. The antenna locations for the various tracking systems and the vehicle's center of gravity versus time are shown in Figure 4. Comparison of each individual tracking system with the reference trajectory is illustrated in Figures 5 through 10 and discussed below. The metric comparisons are shown in Figures 5 through 7 and the measured parameter comparisons are shown in Figures 8 through 10.

#### 3.1.1 ODOP

Data from the ODOP tracking system were available from first motion to 119 sec. ODOP was not used directly in the trajectory but was used indirectly in the Final Launch Phase and MARLOCK computer programs (discussed in section 3.2). Significant weighting influence was given to the XE and YE components of the ODOP data in the MARLOCK trajectory solution. Comparisons between ODOP and the reference trajectory reveal maximum deviations of less than 5 m (16 ft) in the XE and YE components. However, the ZE component began to diverge at 28 sec and continued to a maximum deviation of 35 m (115 ft) at the end of the ODOP track.

#### 3.1.2 GLOTRAC Station I (Mark II Azusa)

Measured parameters and metric data received from GLOTRAC Station I covered a time span of 52.3 to 410.0 sec. The GLOTRAC Station I range

data were used in the MARLOCK solution and deviations of the range from the reference trajectory are negligible. The metric data were not used in establishing the best estimate trajectory. However, comparisons reveal deviations from the reference trajectory of less than 25 m (82 ft), 65 m (213 ft), and 15 m (49 ft) in the XE, YE, and ZE components, respectively.

### 3.1.3 GLOTRAC

Reduced metric GLOTRAC data were received from 23.0 to 552.9 sec. These data were not incorporated in the reference trajectory because of late arrival. The position and velocity data were very smooth and in general the GLOTRAC data appeared to be of excellent quality. Comparisons between GLOTRAC and the reference trajectory reveal maximum deviations of 35 m (115 ft) in the XE, 17 m (56 ft) in the YE and 5 m (16 ft) in the ZE components.

### 3.1.4 Radar

Patrick (0.18) radar produced data from 23.0 to 541.0 sec. The quality of these data was not as high as usually received from station 0.18. The range data were extremely noisy and appeared to have a large bias. The range and elevation data show a discontinuity at approximately 404 sec, apparently caused by a switch from beacon to skin track.

The Grand Bahama (3.18) radar produced a good set of tracking data from 98.0 to 534.0 sec. The range data were in excellent agreement with the reference trajectory and the elevation data contained an apparent bias of less than 0.03 deg. These data were given more weight than usual in the MARLOCK Program.

The Grand Turk (7.18) radar data were available from 201.4 to 604.0 sec. The measured parameter comparisons give an indication of a larger than usual systematic error. The range deviation from the reference trajectory was greater than any of the other radars, with a maximum deviation of approximately 70 m (230 ft) at end of track. However, the data seem to be of good quality. The range data were smoothest of all the radar data and the azimuth data revealed deviations of less than 0.02 deg.

Merritt Island (19.18) radar produced an excellent set of data from 9.0 to 380.0 sec. The maximum deviation in the azimuth angle data was 0.005 deg at the beginning of track and decreased at a linear rate to 0.002 deg at the end of track. The elevation data reveal a maximum deviation of about 0.01 deg after 50 sec of flight. The range shows a maximum deviation of approximately 10 m (33 ft).

There were two independent sets of radar data received from Bermuda; one from the FPQ-6 and one from the FPS-16 instruments. Although data points were received beginning at 11.0 sec (see Table I), useable data did not begin until about 325 sec for the FPQ-6 and about 400 seconds for the FPS-16. Both systems provided useable data through the remaining powered flight. Both systems revealed the same deviation characteristics, from the reference trajectory, as shown in Figures 8 through 10. The peculiarity and consistency of deviations of both trackers lead to the conclusion that station location errors may exist. The FPQ-6 range measurement deviated from the reference trajectory from a + 45 m (148 ft) to a -32 m (-105 ft). The angle deviations were less than 0.02 deg in azimuth and elevation. The FPS-16 range measurement deviated from + 55 m (180 ft) to -12 m (-39 ft).

The azimuth and elevation angle data from the FPS-16 did not appear to be as good as obtained from the FPQ-6 angles. An assumed station location error of 0.00034 deg longitude was applied as a correction to the tracking site longitude. This resulted in a considerable reduction of the range deviations for both the FPQ-6 and FPS-16 instruments, as follows: The FPQ-6 range deviation was reduced to a spread of +16 m (52 ft) to -16 m (-52 ft). The FPS-16 range deviation was reduced to a spread of +28 m (92 ft) to -5 m (-16 ft). Changing the station location also virtually eliminated the humps in the FPQ-6 angle deviations and greatly reduced the humps in the FPS-16 angle deviations.

### 3.2 Trajectory Composition (Powered Flight)

Tracking data from C-band radars, covering the major portion of powered flight, were available for establishing the postflight trajectory. The only data received from high precision tracking systems (in time for utilization) were ODOP and GLOTRAC Station I. Telemetered guidance information and measured meteorological data were also received and utilized in the postflight trajectory determination.

The initial launch phase (from first motion to 28.0 sec) was established by a least squares curve fit to the ODOP data in the Final Launch Phase program (see Reference 2 for discussion of technique). From 28.0 sec to orbit insertion (603.34 sec), the trajectory was established by a composite fit of the available tracking data. This composite fit is often referred to as the best estimate trajectory, the reference postflight trajectory, or the reconstructed trajectory.

The composite fit or best estimate trajectory is established through the utilization of a computer program called MARLOCK. This program uses telemetered guidance velocity data as the generating parameter to compute a trajectory which will best fit the tracking data, yet retain the smoothness of the guidance data. The guidance data can vary only in accordance with an eighteen term error model and the variances assigned to each error coefficient. The error coefficients are determined using the Kalman linear filtering technique and applied to the telemetered guidance data to produce the final smooth and continuous trajectory. Reference 3 gives a theoretical discussion of the MARLOCK program.

### 3.3 Powered Flight Trajectory

A comparison of actual and nominal times at some significant flight events is presented in Table II. Altitude and surface range are graphically illustrated in Figures 11 and 12, respectively, for the entire powered flight. Figure 13 is an illustration of the total inertial acceleration profiles for the S-IB and S-IVB stages. The magnitude of the total earth-fixed velocity vector and the associated elevation angle, positive above the local horizontal, are shown in Figure 14. The magnitude of the space-fixed velocity vector and the angle between this vector and the local horizontal plane are shown in Figure 15. The Mach number and dynamic pressure parameters are shown during the S-IB powered flight in Figure 16.

The meteorological associated trajectory parameters were calculated using measured meteorological data for the day of launch. The measured data were furnished to an altitude of 62 km (33 nm). At this altitude the Patrick AFB, 1963 standard reference atmosphere was merged with the measured data.

Various trajectory parameters, such as altitude, surface range, and velocity, are given at some significant flight event times in Table III. The apex, loss of telemetry, and impact of the discarded S-IB stage are also included in Table III. Several trajectory parameters are compared with nominal at thrust cutoff for the S-IB and S-IVB stages in Table IV. Trajectory parameters, for the purpose of performance evaluation, are compared to nominal in Table V for the S-IB/S-IVB separation event and in Table VI for the S-IVB/LM-1 insertion and separation events. The vehicle flight evaluation report, Reference 4, provides details of vehicle subsystems performance. Tables VII through X present orbital trajectory information which is discussed in Section 4.0 below.

The actual postflight trajectory, from guidance reference release to S-IVB/LM-1 separation is tabulated in both metric and English units of measure in Tables XI through XVI. These tables present the trajectory in the earth-fixed plumbline, space-fixed ephemeris, and geographic coordinate systems. The data are tabulated at 1.0 sec increments from guidance reference release to S-IB/S-IVB separation, continuing at 5.0 sec increments to insertion, and at 10.0 sec increments from insertion to S-IVB/LM-1 separation.

The actual trajectory was very close to the nominal, as reflected in the previously mentioned tables where comparisons are made. The velocity gain due to thrust decay between OECD and S-IB/S-IVB separation amounted to 5.4 m/s (17.7 ft/s) which was 0.9 m/s (3.0 ft/s) less than predicted. The velocity gain after S-IVB CO, due to thrust decay, amounted to 6.8 m/s (22.3 ft/s) which was 0.7 m/s (2.3 ft/s) greater than predicted.

### 3.4 Error Analyses

During the major portion of first stage powered flight, good coverage was provided by ODOP, GLOTRAC Station I, and Merritt Island radar. These three sets of data were the main data used in the MARLOCK program during this portion of the flight. The remaining powered flight trajectory was reconstructed as a composite fit of all available tracking data, consisting mainly of radar data.

The metric data from the ODOP, GLOTRAC Station I systems reveal good agreement with the reference trajectory. The GLOTRAC data for this flight appears to be of excellent quality. The maximum deviation between the GLOTRAC and the reference trajectory was only 35 m (115 ft) in any component. All metric data were smoothed, differentiated and transformed from the point of track (antenna locations) to a common point, the vehicle's center of gravity.

The measured parameter comparisons reveal the maximum range deviation to exist in the Grand Turk (7.18) system, which appears to be the result of a large systematic error. With the exception of Grand Turk the largest range deviation is 55 m (180 ft) in the Bermuda FPS-16 system. However, comparisons after a change in the Bermuda longitude, as previously discussed, reveal a maximum range deviation of 40 m (131 ft) which is in the Patrick (0.18) system. The range and angle deviations of all the radars appear to be biased, or show systematic trends that may be represented by a realistic error model. The comparison curves show only the trend of the data relative to the reference trajectory. The dispersion of these data and their analyses give an indication of the validity of the reference trajectory.



An estimate of the total uncertainty of the powered flight trajectory is presented in Figure 17. At S-IB outboard engine cutoff the position uncertainty is about 30 m (98 ft) and the velocity uncertainty is about 0.3 m/s (1.0 ft/s). At S-IVB CO the uncertainties have increased to about 200 m (656 ft) in the XE and ZE components and 250 m (820 ft) in the YE component. The velocity uncertainties at S-IVB CO have increased to 0.5 m/s (1.6 ft/s) in the DXE and DZE components and 1.5 m/s (4.9 ft/s) in the DYE component.

#### 4.0 ORBITAL TRAJECTORY ANALYSIS

##### 4.1 Orbital Trajectory

The AS-204 S-IVB/LM-1 vehicle was inserted into orbit at 22 hrs 58 min 11.34 sec U.T. (603.34 sec Range Time). Figure 18 is a ground projection plot showing the first two orbital revolutions. The orbital insertion parameters for AS-204 were determined by a least squares differential correction procedure using C-Band radar orbital tracking data over the first two revolutions and by the insertion point established by the best estimate powered flight trajectory.

The primary objective of the AS-204 flight was to provide tests of the Lunar Module (LM) subsystems. Also, a fuel and LOX dump experiment with the S-IVB stage was planned following S-IVB/LM-1 separation. The S-IVB/LM-1 separation occurred over Carnarvon at 3235.242 sec with the S-IVB passivation period (fuel and LOX dump) beginning at 8774.31 sec and ending at 9084.51 sec.

#### 4.2 Orbital Data Sources

Orbital tracking of the AS-204 vehicle was conducted by the NASA Space Tracking and Data Acquisition Network (STADAN). This network provided the C-Band radar data used in determination of the AS-204 orbital trajectory. A summary of the stations furnishing data for use in determining the S-IVB orbital trajectory is presented in Table VII. These data cover portions of the first four revolutions of flight.

Bermuda (FPS-16), Tananarive and Canary Island furnished tracking data in the first revolution prior to S-IVB/LM-1 separation. California was the only tracking site which furnished data during the first revolution following S-IVB/LM-1 separation. Data for the second revolution was furnished by Bermuda (FPS-16), Tananarive, California, Grand Bahama and Hawaii. Tananarive and Ascension tracked the S-IVB vehicle during the third and fourth revolutions and California furnished some data in the third revolution.

#### 4.3 Trajectory Analysis

The Orbital Correction Program (OCP) was used to provide solutions for the insertion conditions and orbital trajectory, utilizing orbital tracking data and representative orbital acceleration models. Solutions were made using various combinations of; Bermuda (FPS-16) data at insertion, Tananarive data in the early part of the first revolution (Rev 1), and Bermuda (FPS-16) and Grand Bahama data in the early part of the second revolution (Rev 2). Solutions were attempted incorporating all orbital tracking data received. However, the four sets of data mentioned above provided the only reasonable solutions. From the most reasonable solution, Table VIII provides a tabulation of the number of observations and the root mean square (RMS) of the residuals associated with each measured parameter.

Telemetered guidance accelerometer data were furnished to represent the actual orbiting vehicle acceleration. These data were utilized in orbital solutions even though there was a gap in the telemetered accelerations from 1400 to 2600 sec, Range Time. Solutions were also made by adjusting the predicted orbital accelerations through perturbations of the drag coefficient to compensate for deviations between the actual and predicted data. The two methods resulted in compatible fits to the tracking data.

Considering the reasonable OCP solutions and the agreement between the orbital and powered flight solutions, the estimated uncertainty of the insertion position and velocity components is no greater than quoted at S-IVB CO in section 3.4, above.

The orbital trajectory from insertion to S-IVB/LM-1 separation was obtained by initializing with the insertion conditions established by the best estimate powered flight trajectory and integrating the equations of motion. The adjusted acceleration data were used due to the large data gap in the telemetered accelerations in this area of flight. This integrated trajectory defined the orbital parameters at insertion and separation. The orbital parameters of the S-IVB stage, subsequent to separation, were computed by initializing at S-IVB/LM-1 separation and integrating the equations of motion using the telemetered guidance accelerations. The orbital parameters at insertion, S-IVB/LM-1 separation, and at the beginning of Rev 2 are presented in Table IX.

#### 4.4 S-IVB Passivation Experiment

The scheduled S-IVB fuel and LOX dump was initiated at 8774.31 sec and terminated at 9084.51 sec. Radar tracking data were not available in the

area of the dump period. Therefore, the orbital parameters at the beginning and end of passivation were calculated from an integrated S-IVB orbital trajectory using the telemetered acceleration data. The telemetered acceleration magnitude profile, during the passivation period, is shown in Figure 19.

In addition to the actual S-IVB orbital trajectory, a theoretical trajectory was initiated at the beginning of passivation and integrated through the dump period assuming nominal drag forces and no dump forces. The orbital parameters at the end of passivation from this theoretical trajectory are compared to the parameters computed from the actual S-IVB orbital trajectory. This comparison, which reveals the effect of the fuel and LOX dump on the S-IVB orbit, is presented in Table X. The effects of the fuel and LOX dump on the S-IVB altitude and space-fixed velocity orbiting profiles are shown in Figures 20 and 21, respectively. The solid line in these figures represent the actual S-IVB orbital trajectory. The dashed line represents the theoretical (no dump) trajectory.

#### 5.0 S-IB AND S-IVB STAGE FREE FLIGHT TRAJECTORIES

Three theoretical free flight trajectories were computed for the discarded S-IB stage using initial conditions at S-IB/S-IVB separation. The trajectories were integrated from separation to impact using actual retro-rocket performance and actual outboard engine decay data. The three trajectories were calculated by assuming nominal drag coefficients for three types of S-IB stage free-flight conditions. These three conditions for the expended S-IB stage are: (1) stabilized at zero deg angle of attack, (2) a tumbling body, and (3) stabilized at 90 deg angle of attack. This provides the following S-IB stage impact locations.

| <u>Drag Condition</u>  | <u>Impact Range</u>   | <u>Impact Time</u> |
|------------------------|-----------------------|--------------------|
| 0 deg Angle of Attack  | 532.99 km (287.79 nm) | 501.6 sec          |
| Tumbling Body          | 523.64 km (282.74 nm) | 562.7 sec          |
| 90 deg Angle of Attack | 517.81 km (279.60 nm) | 604.5 sec          |

Radar tracking data were not available to confirm the results obtained. However, on previous flights the tumbling drag case was proven to be close to the actual tracking data. For this reason, the theoretical free-flight trajectory utilizing the tumbling drag coefficient data is considered the actual trajectory of the expended S-IB stage. This ballistic free flight trajectory is presented in tabular form in Table XVII (metric units) and Table XVIII (English units). The ground track and impact are also shown in Figure 3.

The S-IVB expended stage remained in earth orbit, following S-IVB/LM-1 separation, for approximately 10 revolutions. Due to the lack of tracking data during the final revolutions, the S-IVB free flight re-entry trajectory was not computed. However, it is understood the S-IVB free flight will be documented under a separate cover by R-AERO-FT of the Marshall Space Flight Center.

#### 6.0 GOVERNMENT FURNISHED DATA

The Government furnished data used to establish the postflight trajectory of the AS-204 vehicle is tabulated in Table XIX.

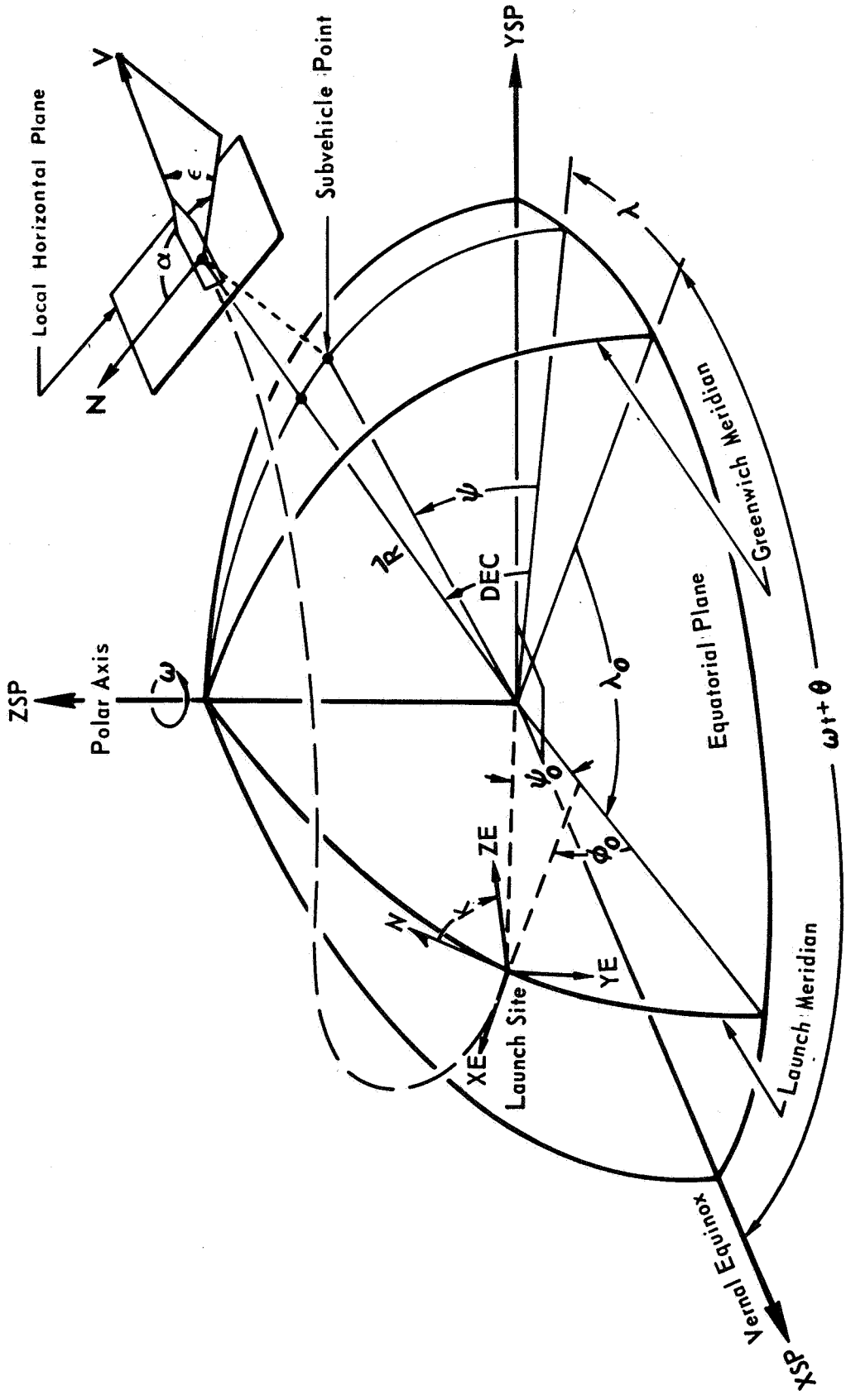


Figure 1. Trajectory Coordinate Systems

DATA UTILIZATION

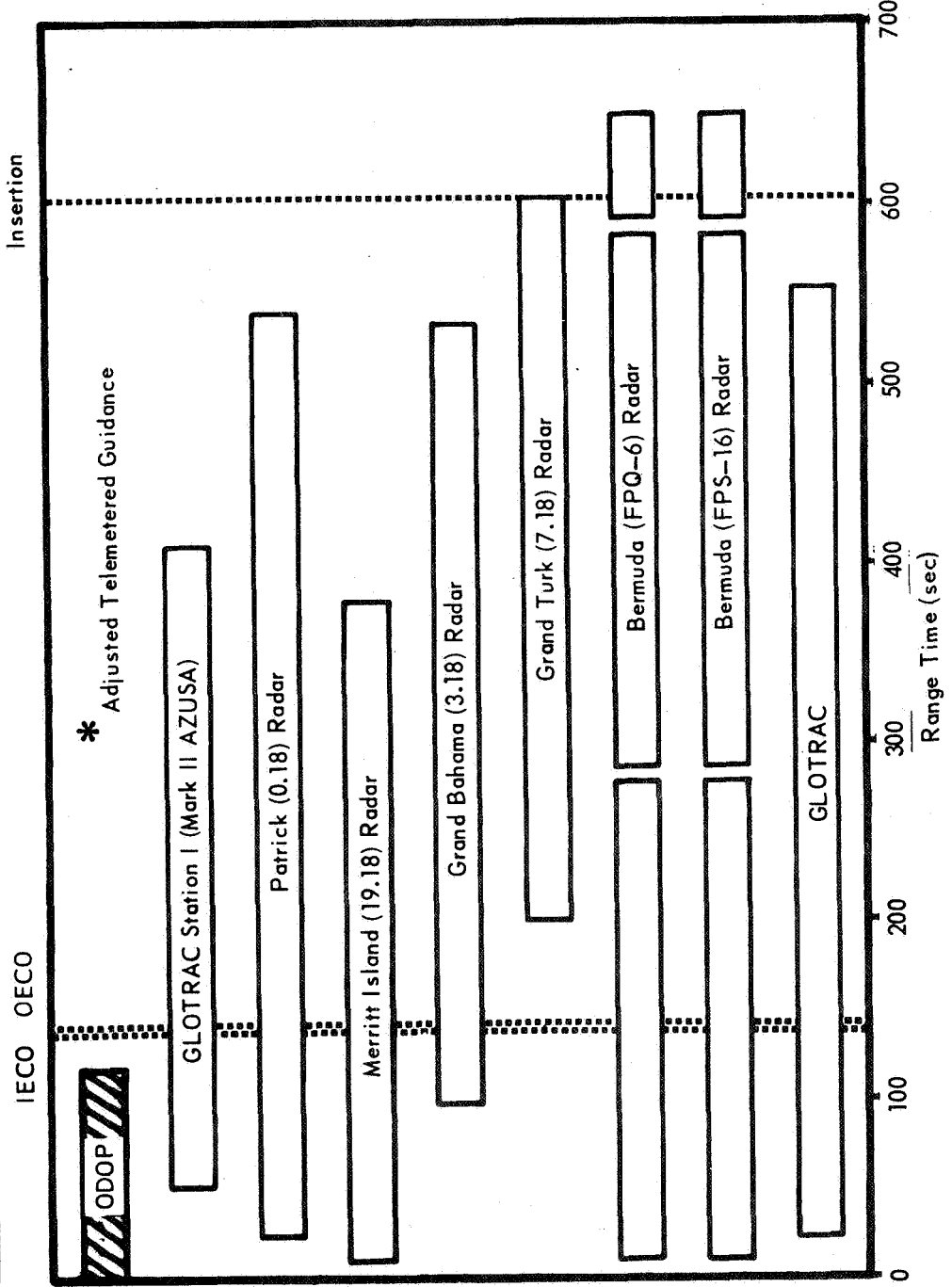


Figure 2. Available Tracking Data (Powered Flight)

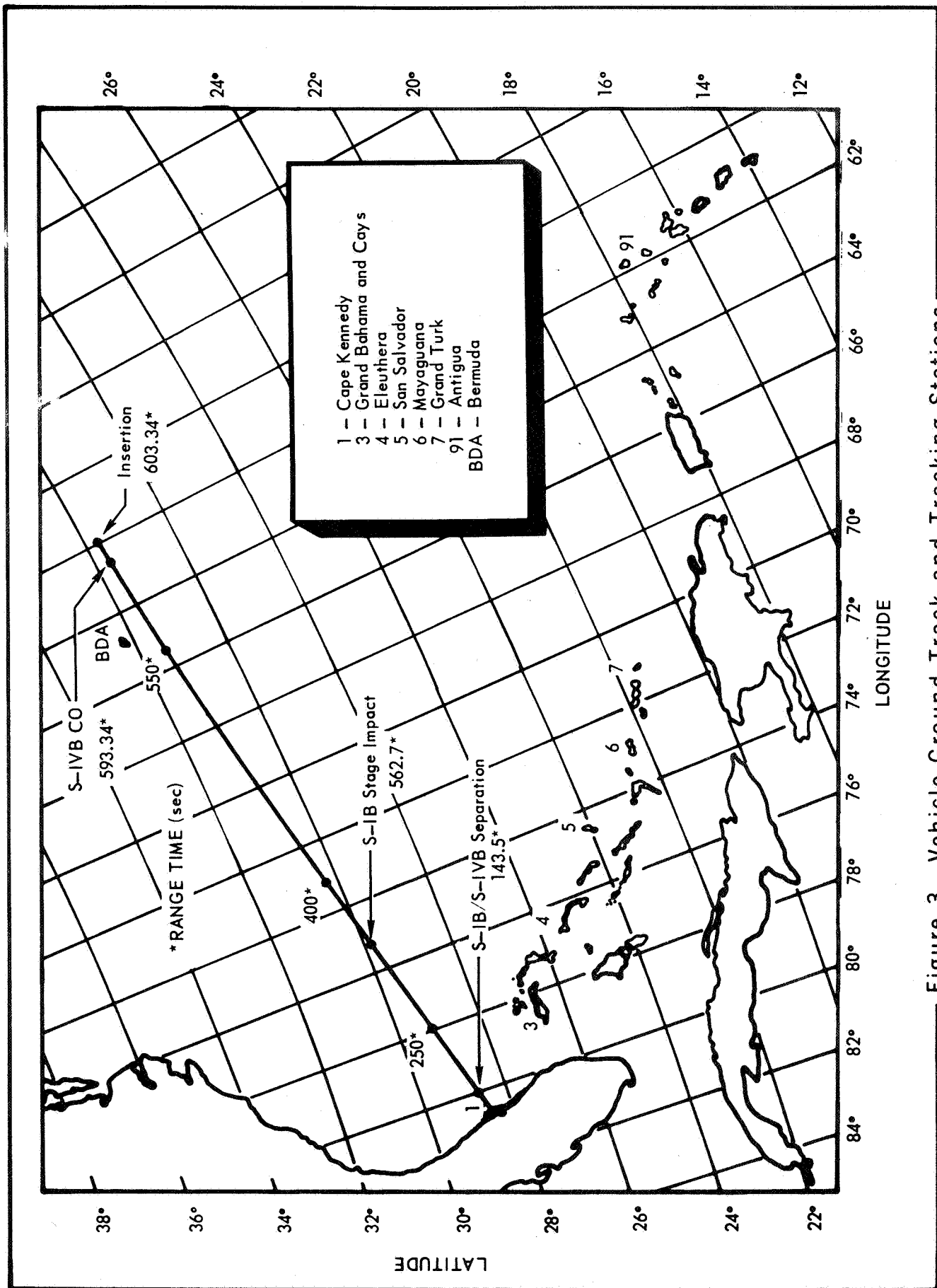


Figure 3. Vehicle Ground Track and Tracking Stations



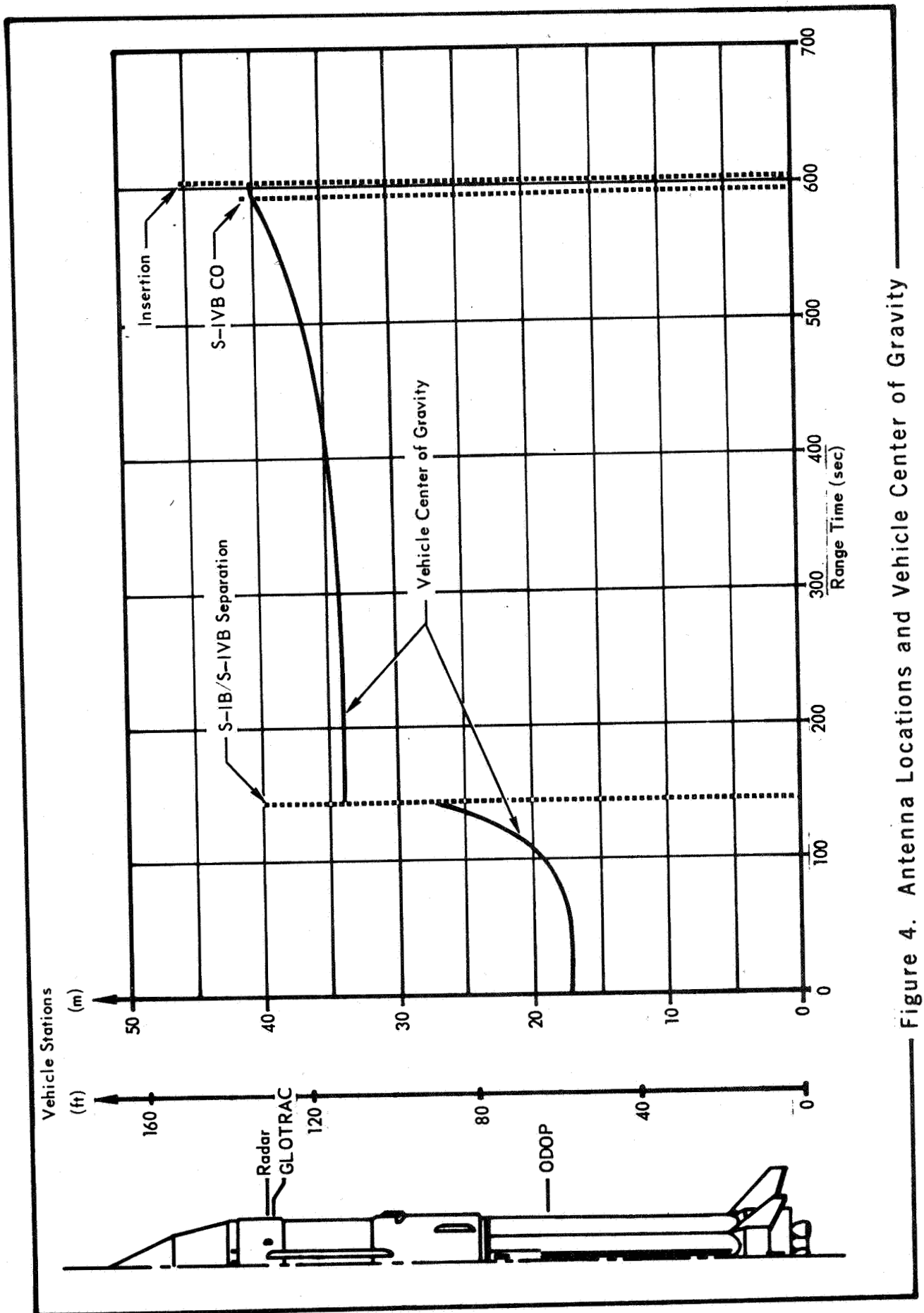


Figure 4. Antenna Locations and Vehicle Center of Gravity

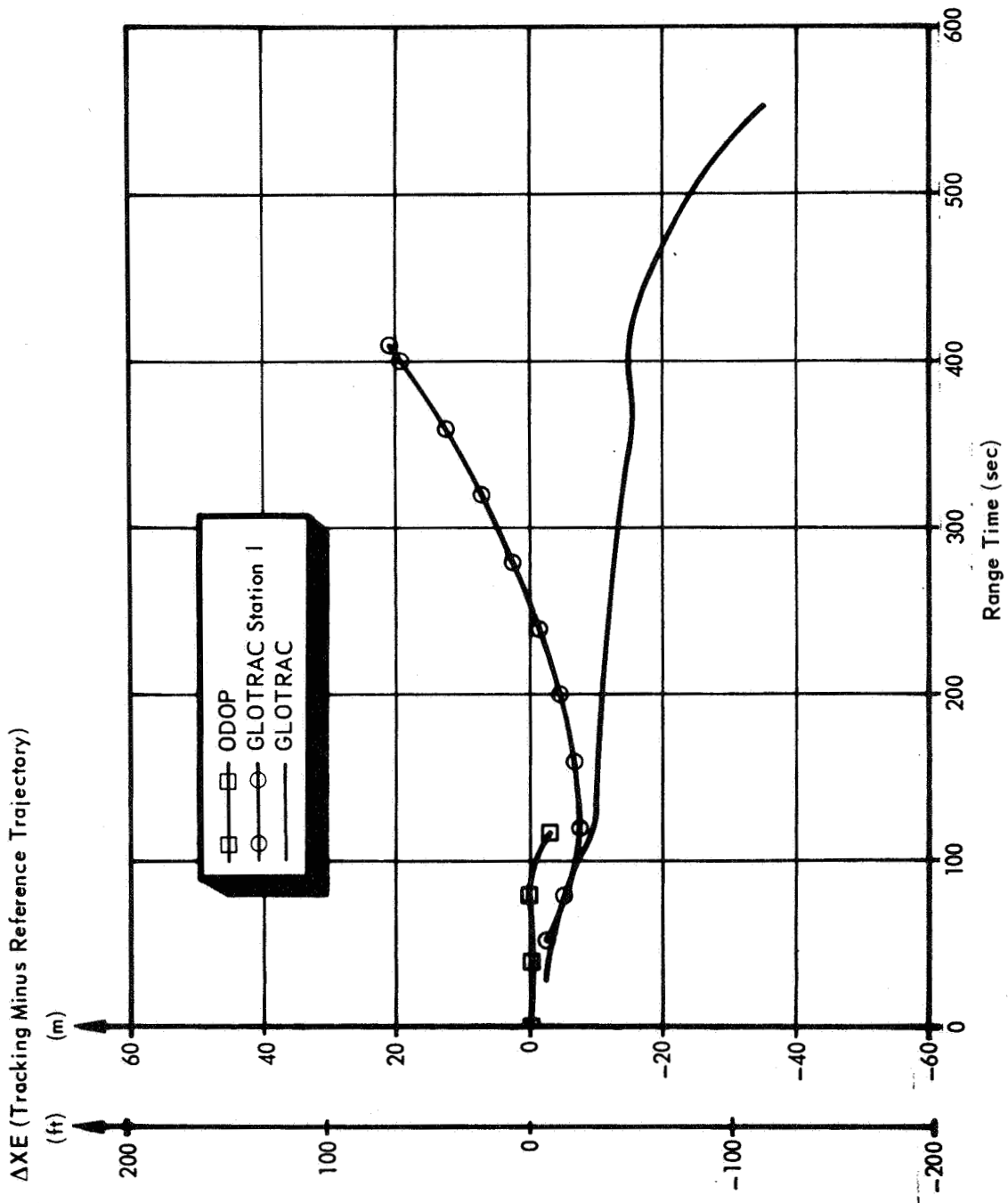


Figure 5. Metric Tracking Comparisons (XE)

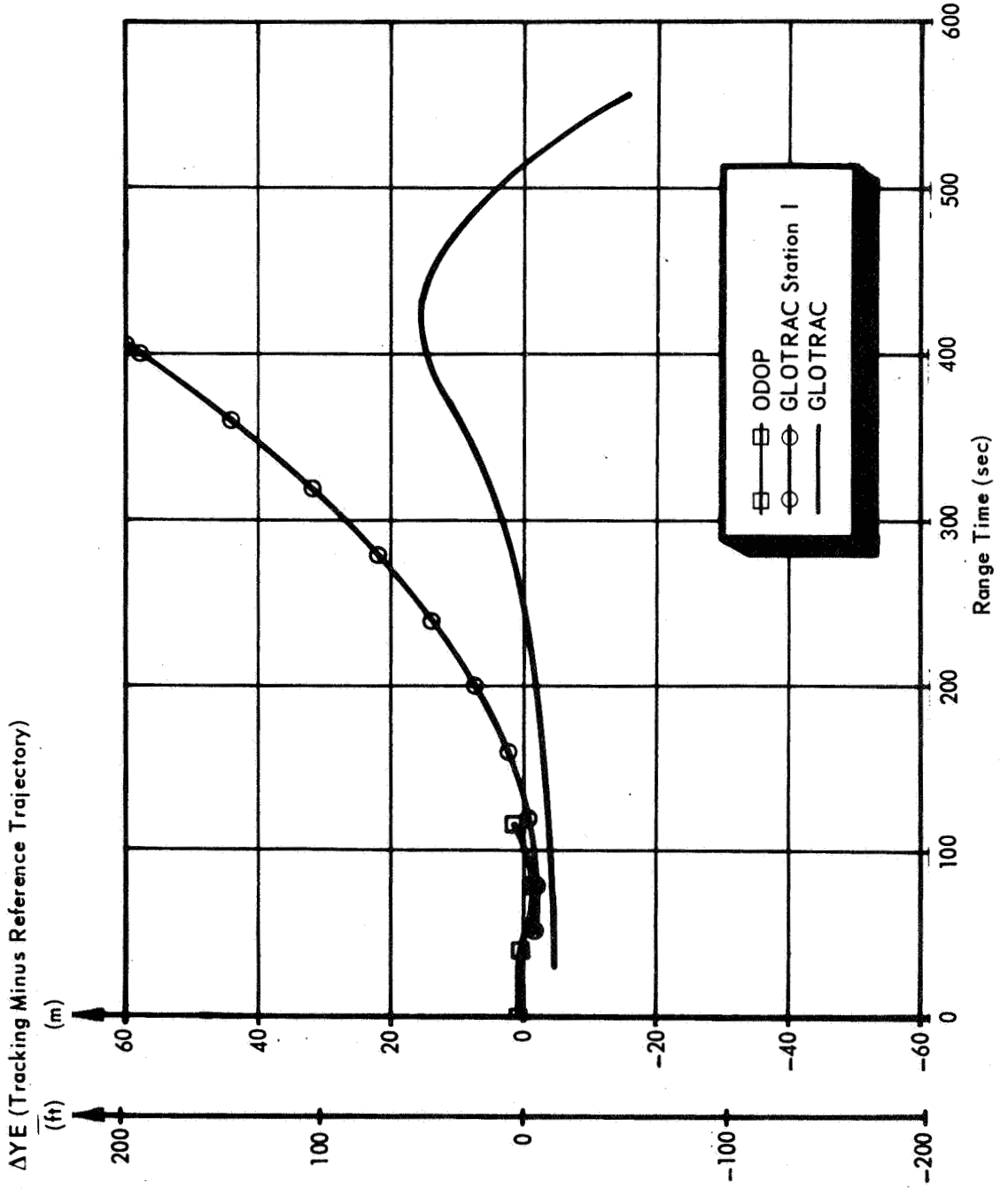


Figure 6. Metric Tracking Comparisons (YE)

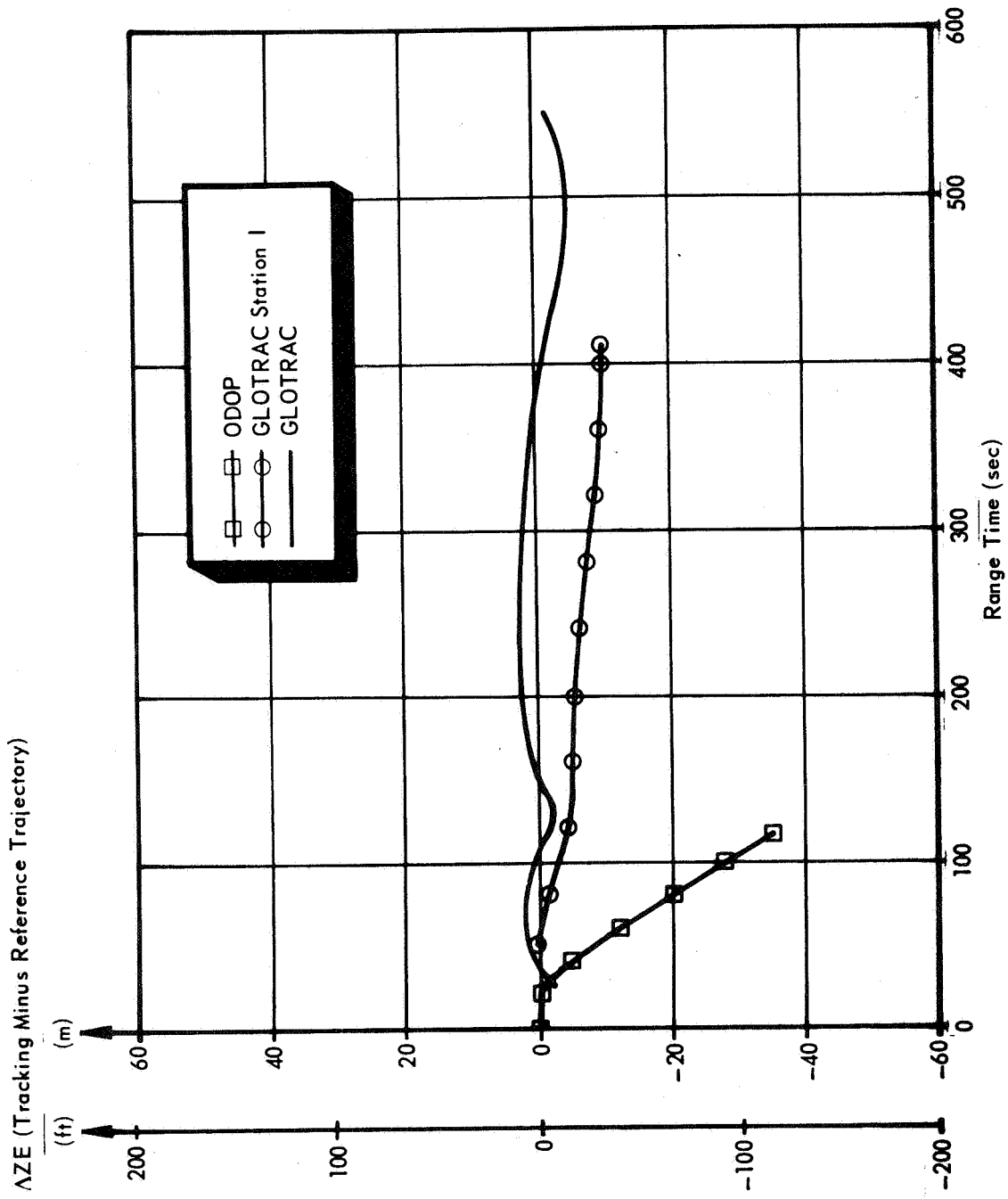


Figure 7. Metric Tracking Comparisons (ZE)

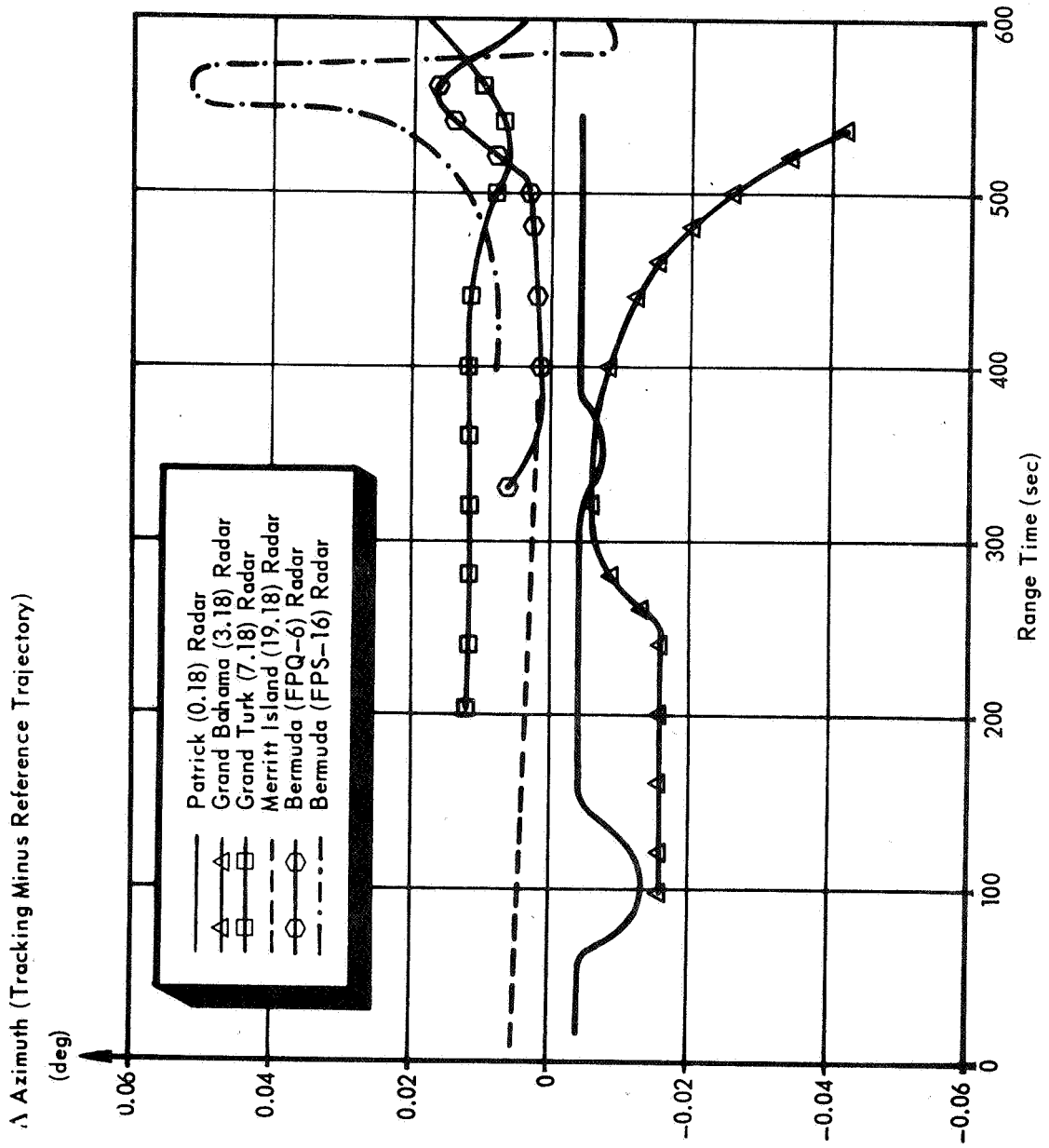


Figure 8. Measured Parameter Tracking Comparison (Azimuth)

$\Delta$ Elevation (Tracking Minus Reference Trajectory)

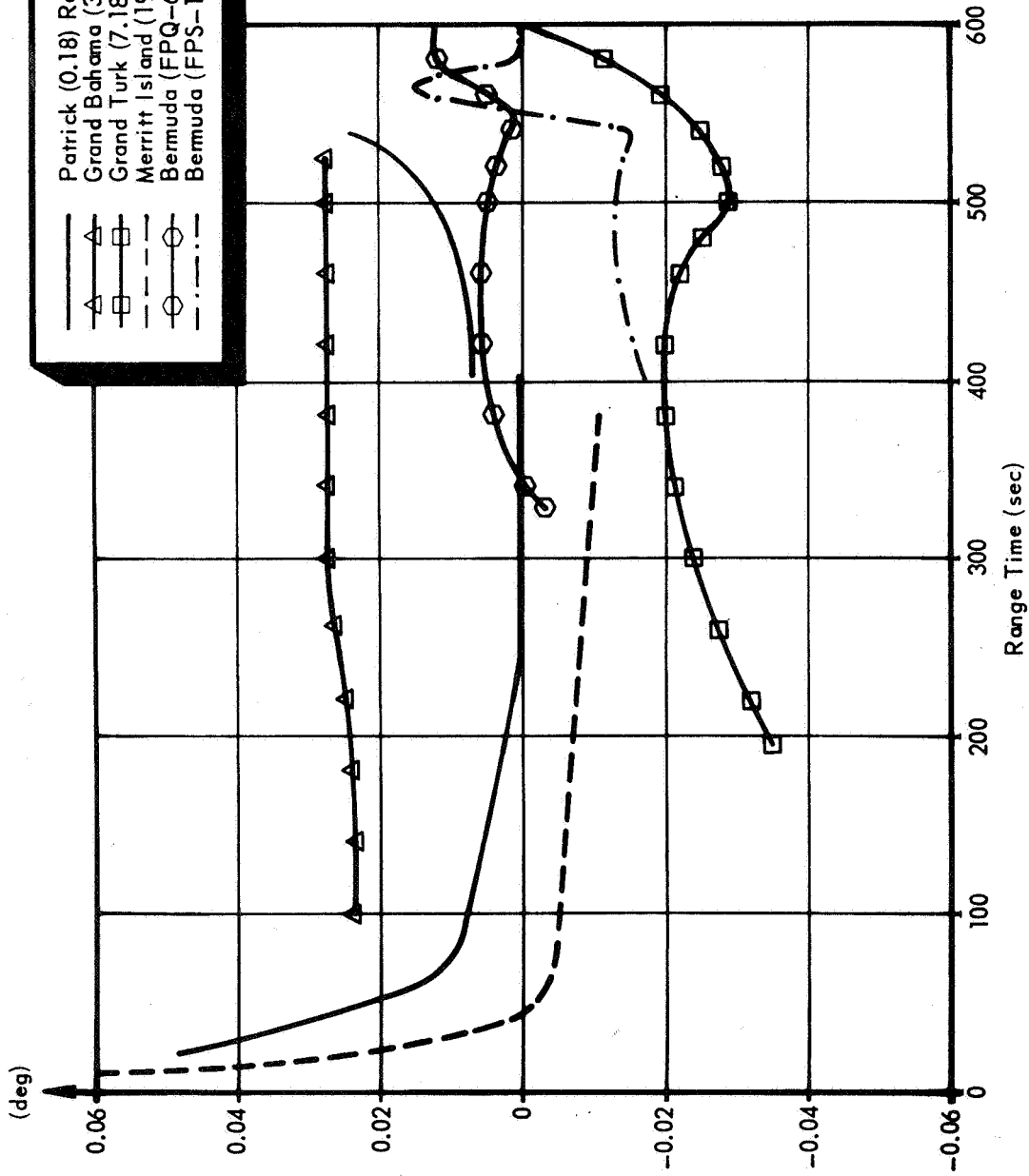


Figure 9. Measured Parameter Tracking Comparison (Elevation)

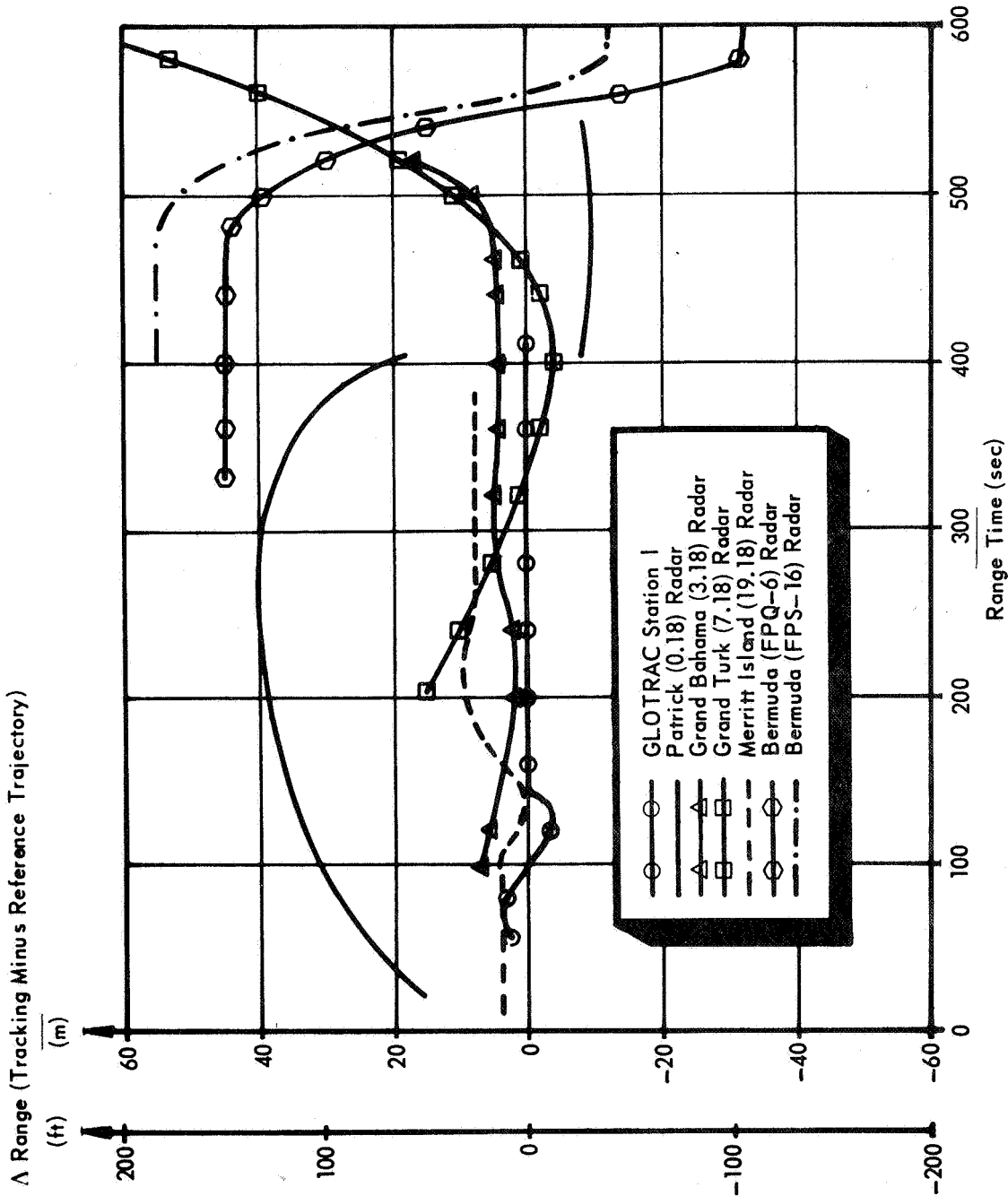


Figure 10. Measured Parameter Tracking Comparison (Range)

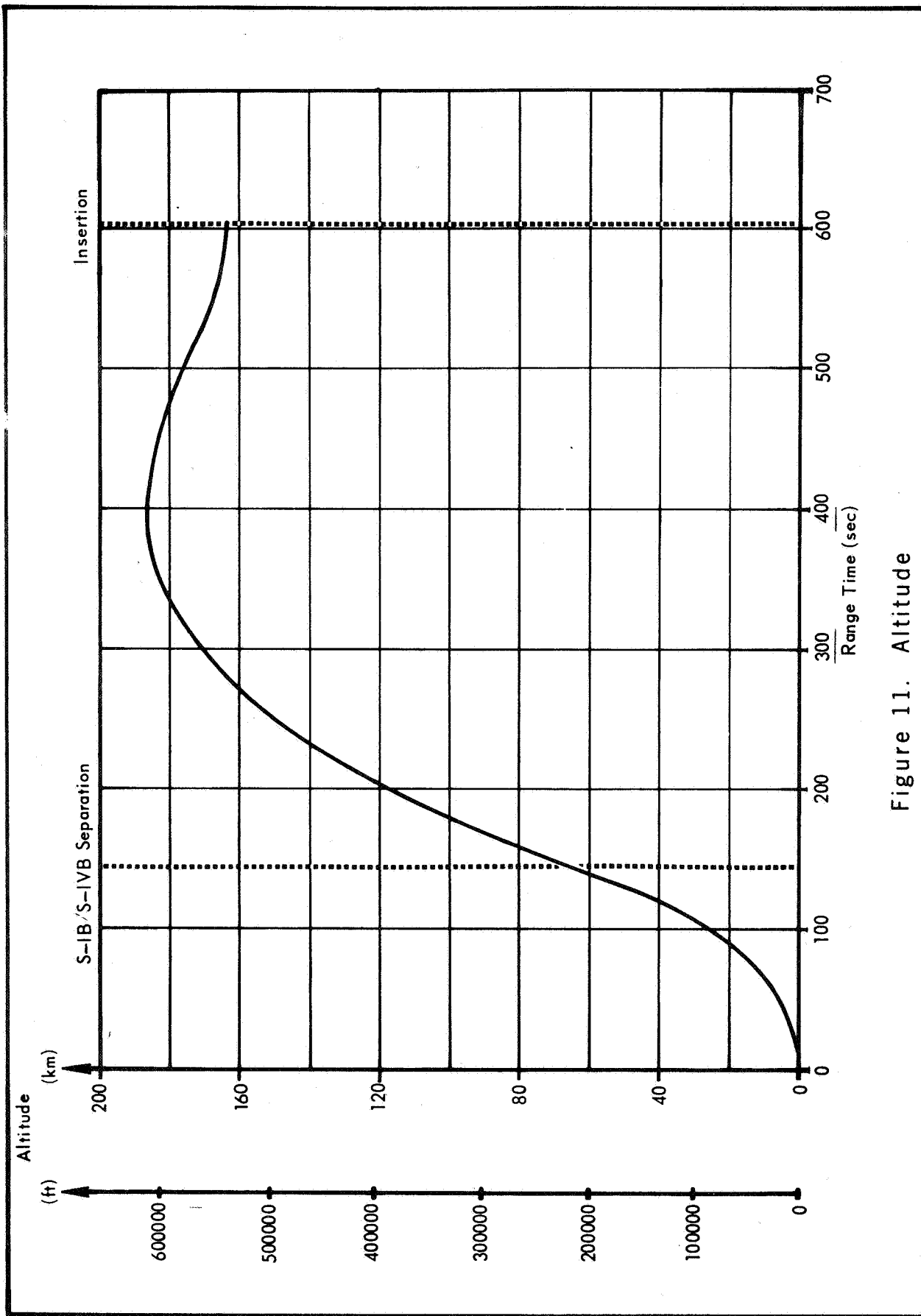


Figure 11. Altitude



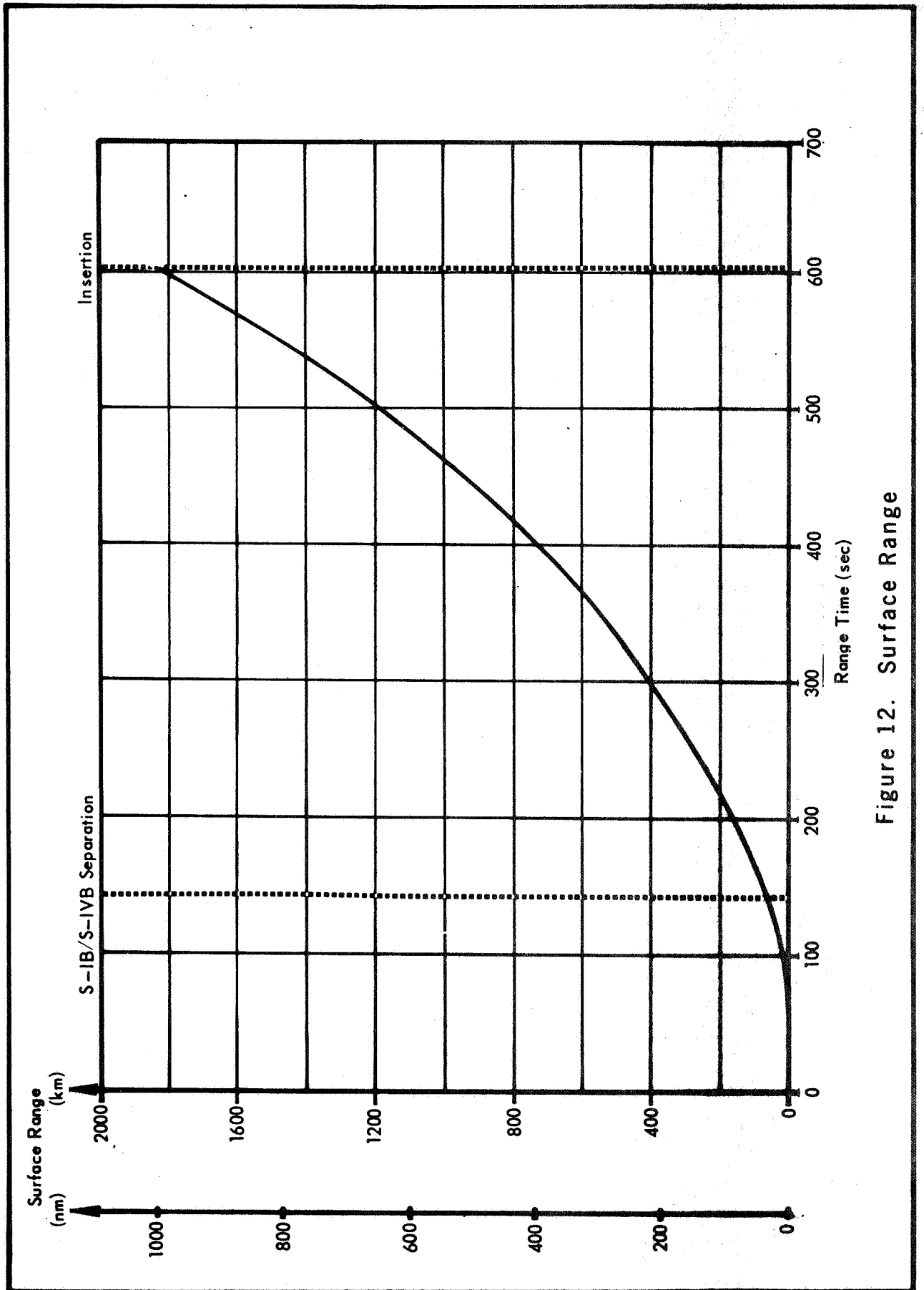


Figure 12. Surface Range

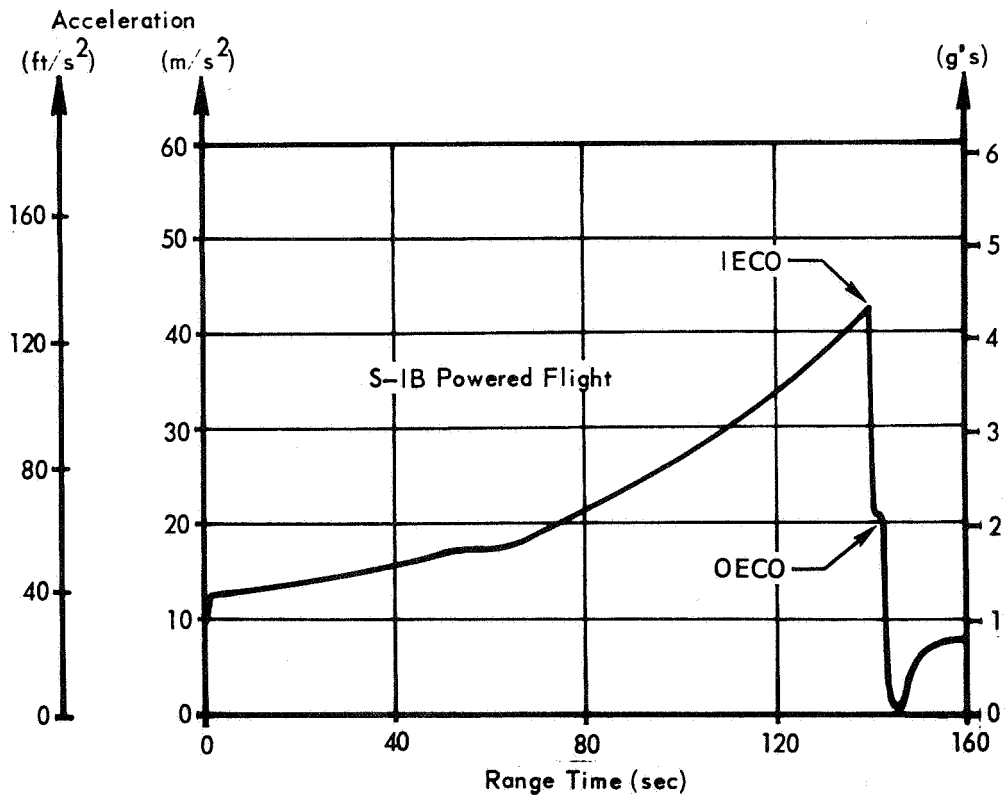
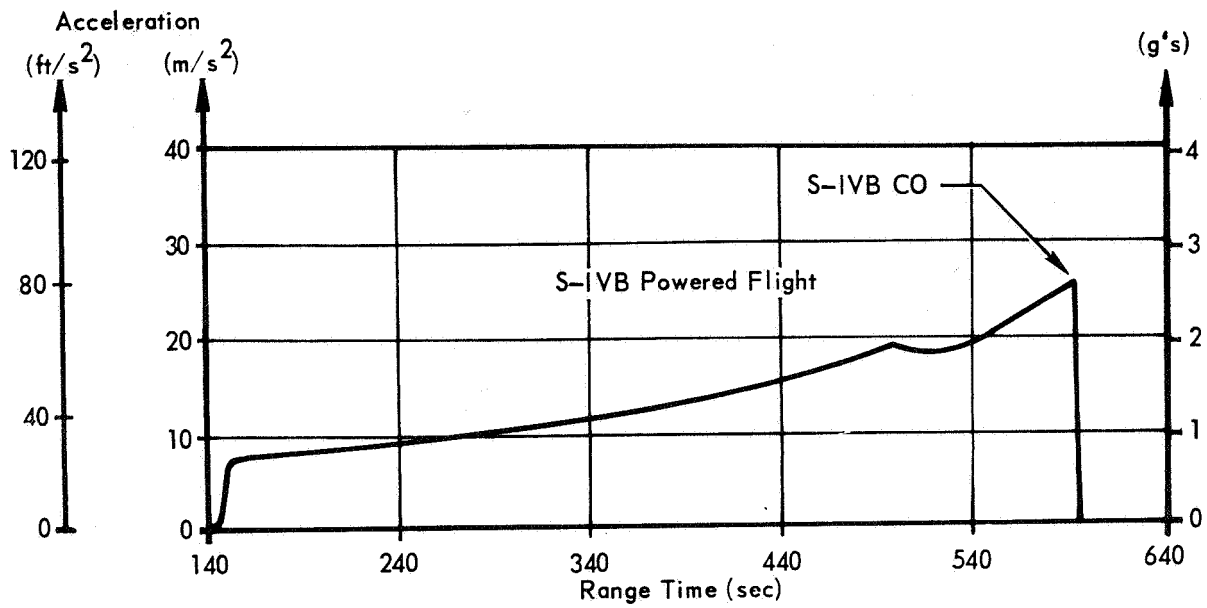


Figure 13. Total Inertial Acceleration

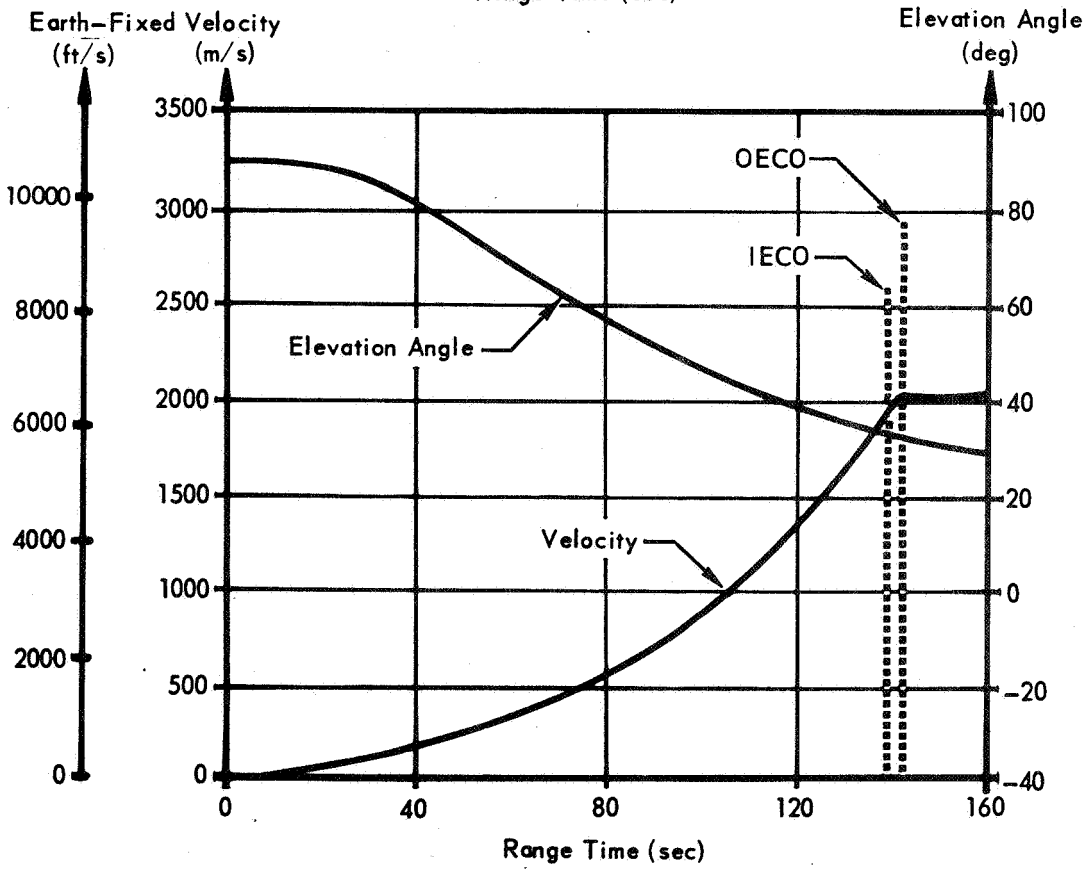
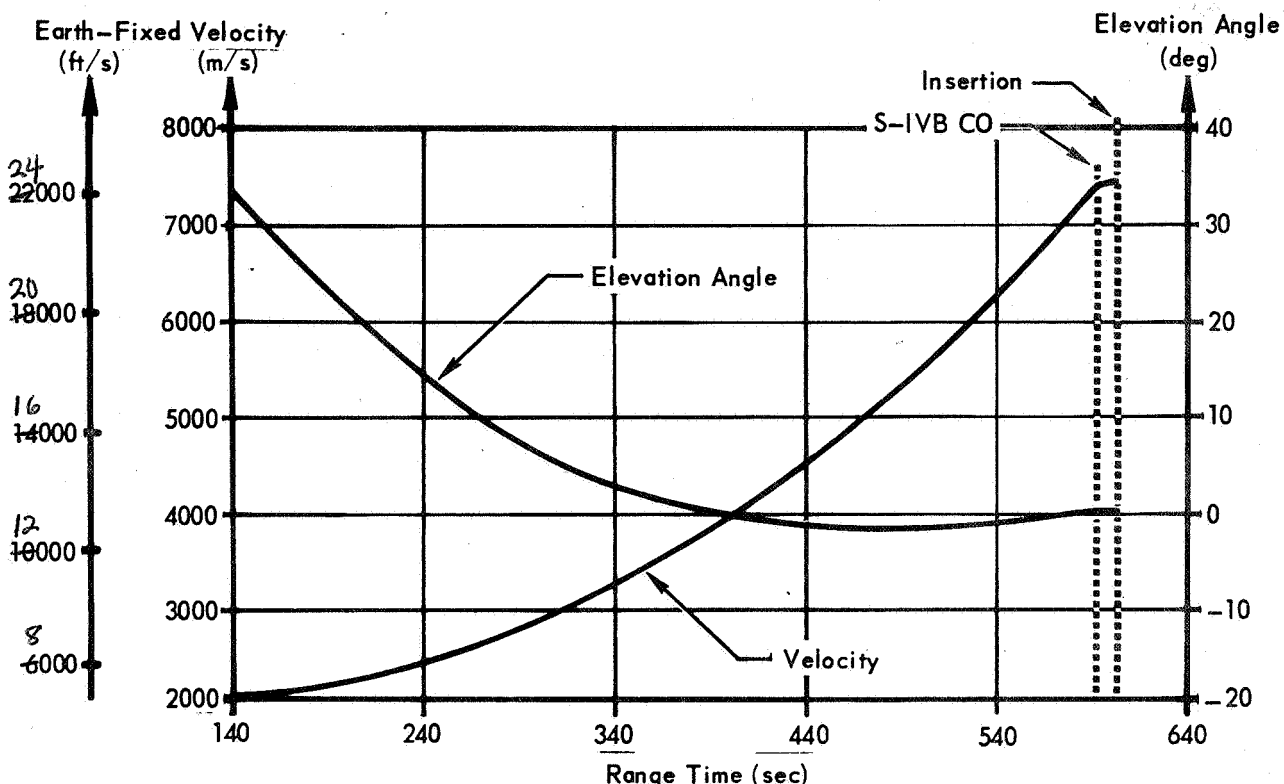


Figure 14. Earth-Fixed Velocity and Elevation Above Local Horizontal

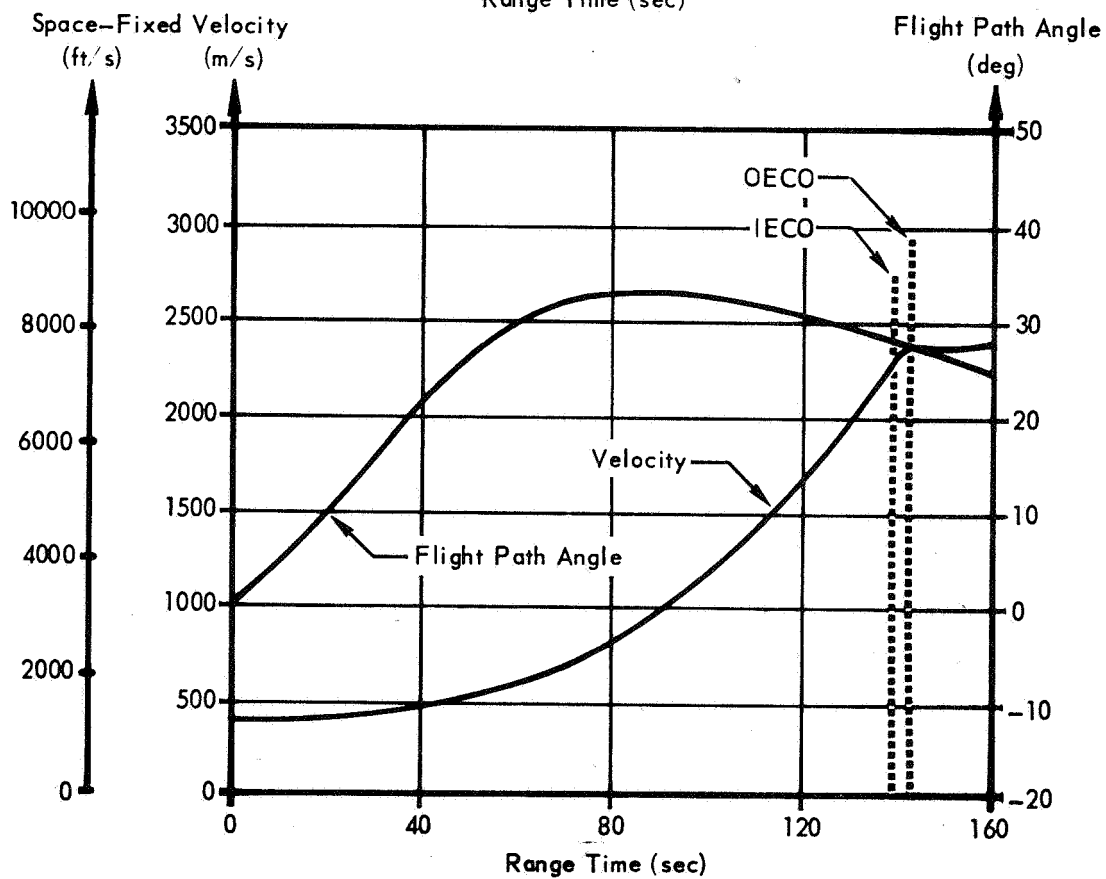
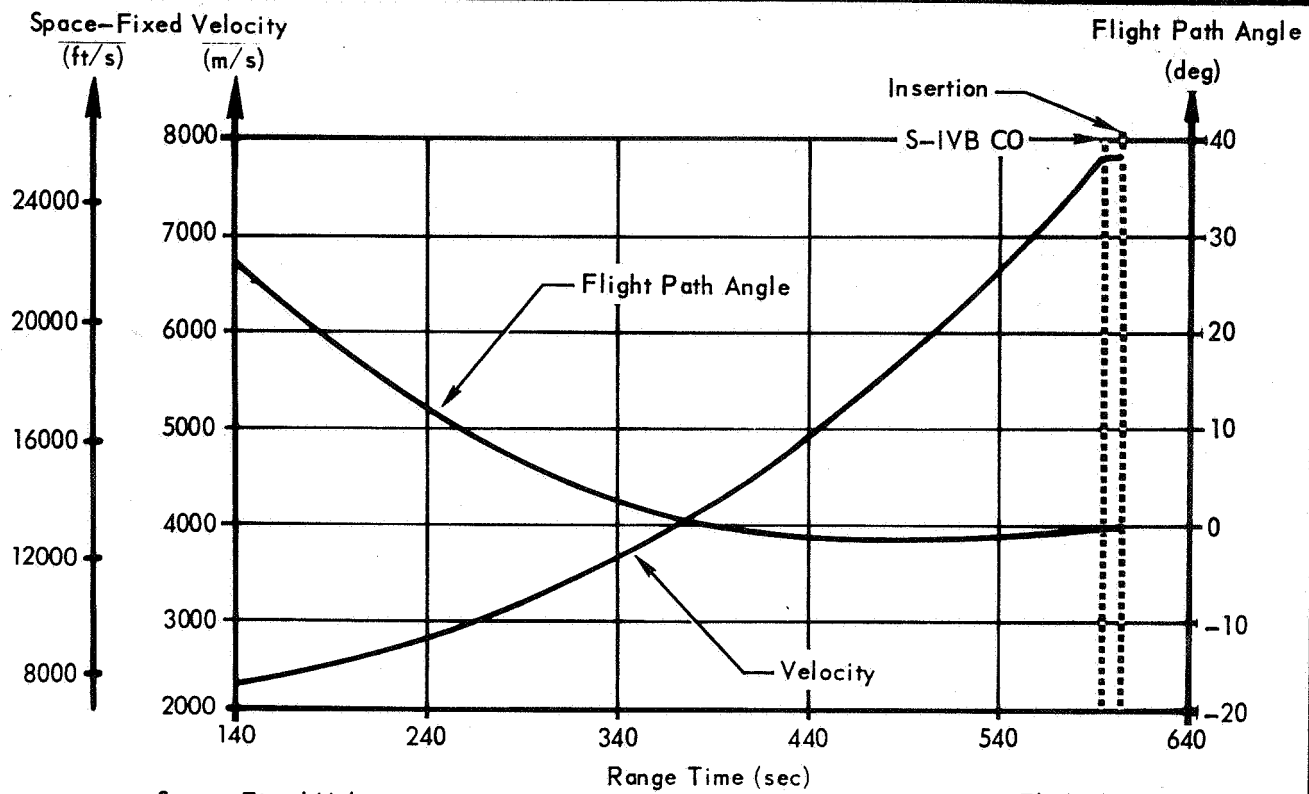


Figure 15. Space-Fixed Velocity and Flight Path Angle

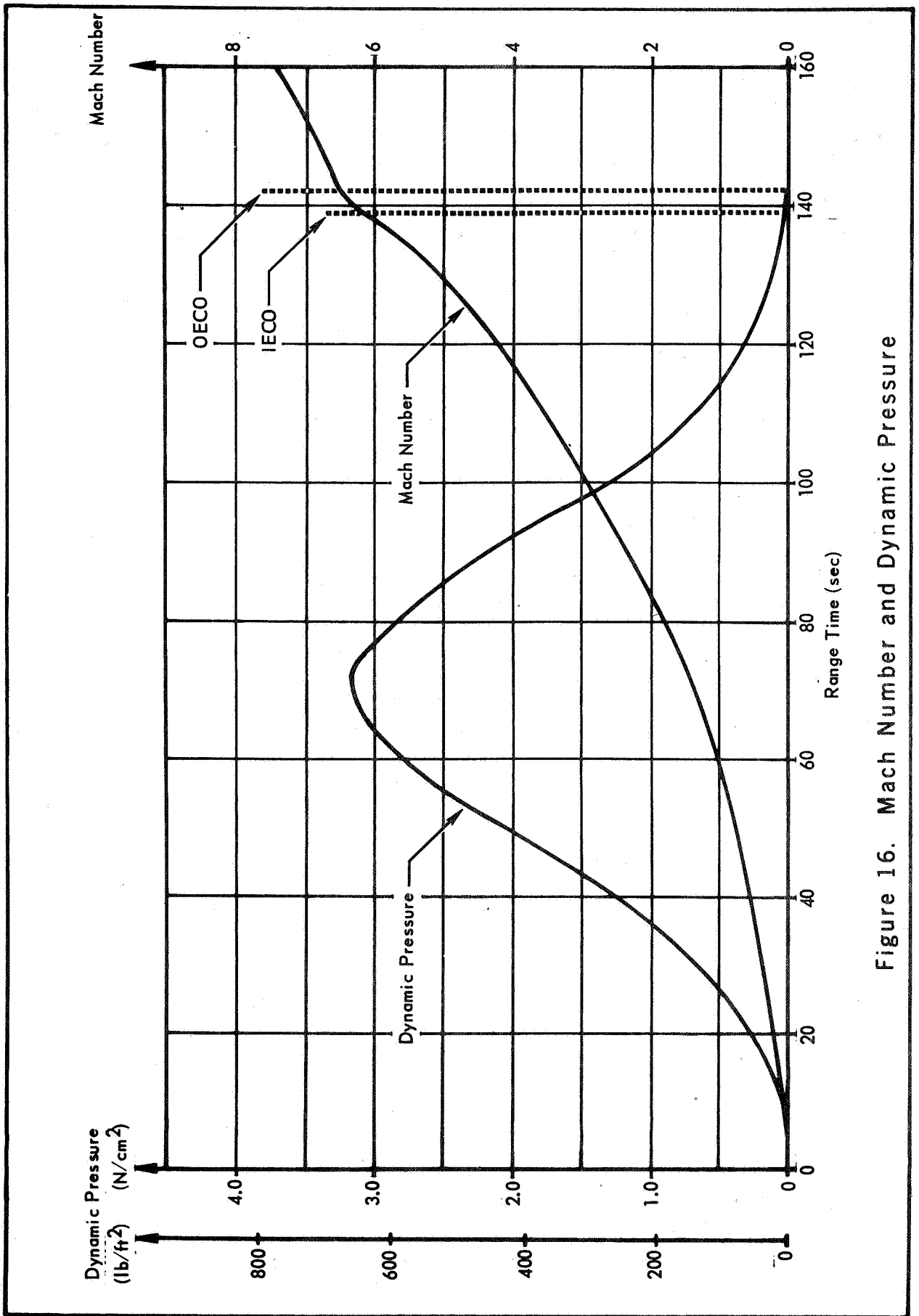


Figure 16. Mach Number and Dynamic Pressure

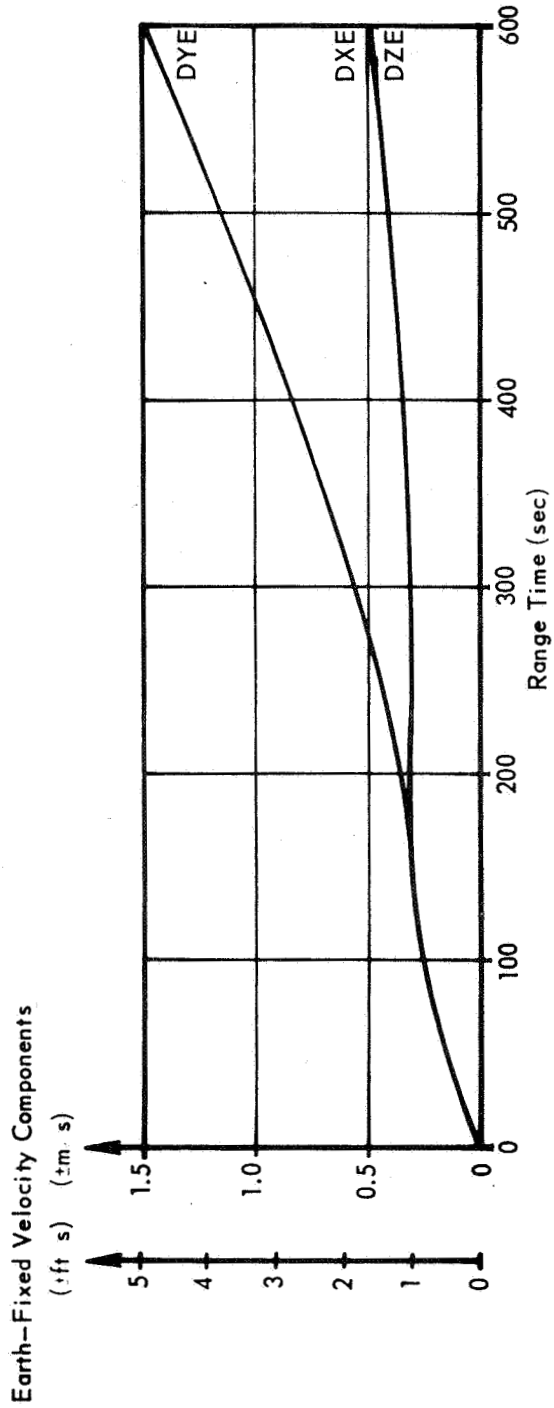
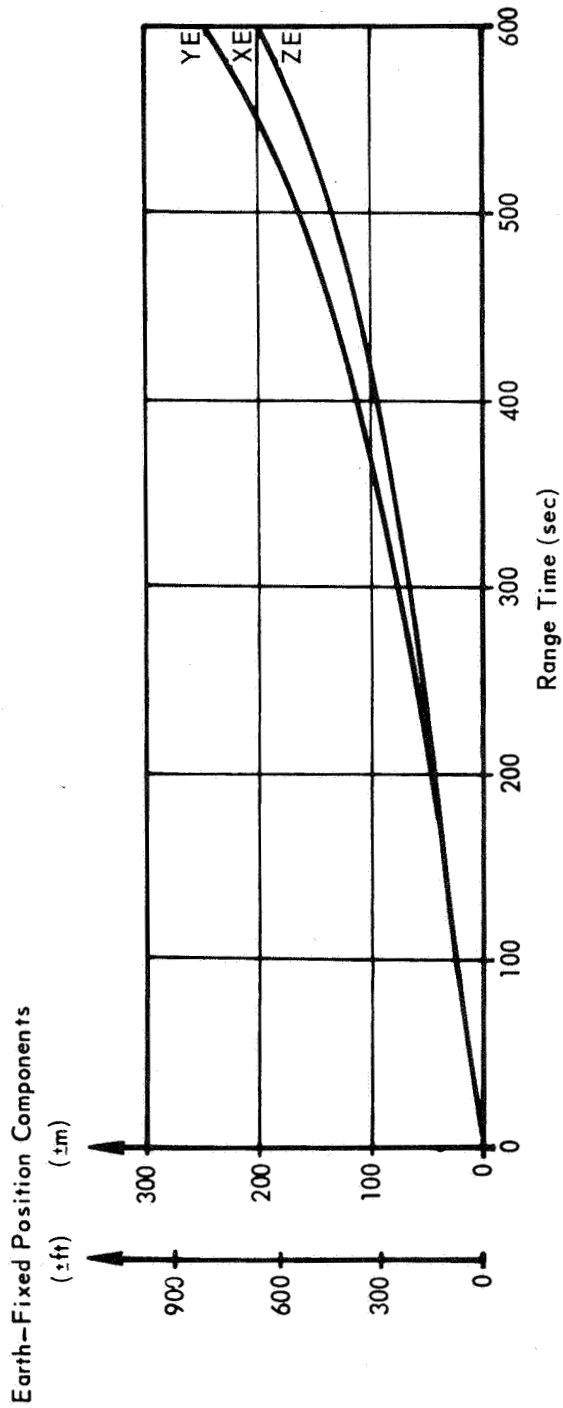


Figure 17. Estimated Uncertainty of Reference Trajectory (Powered Flight)

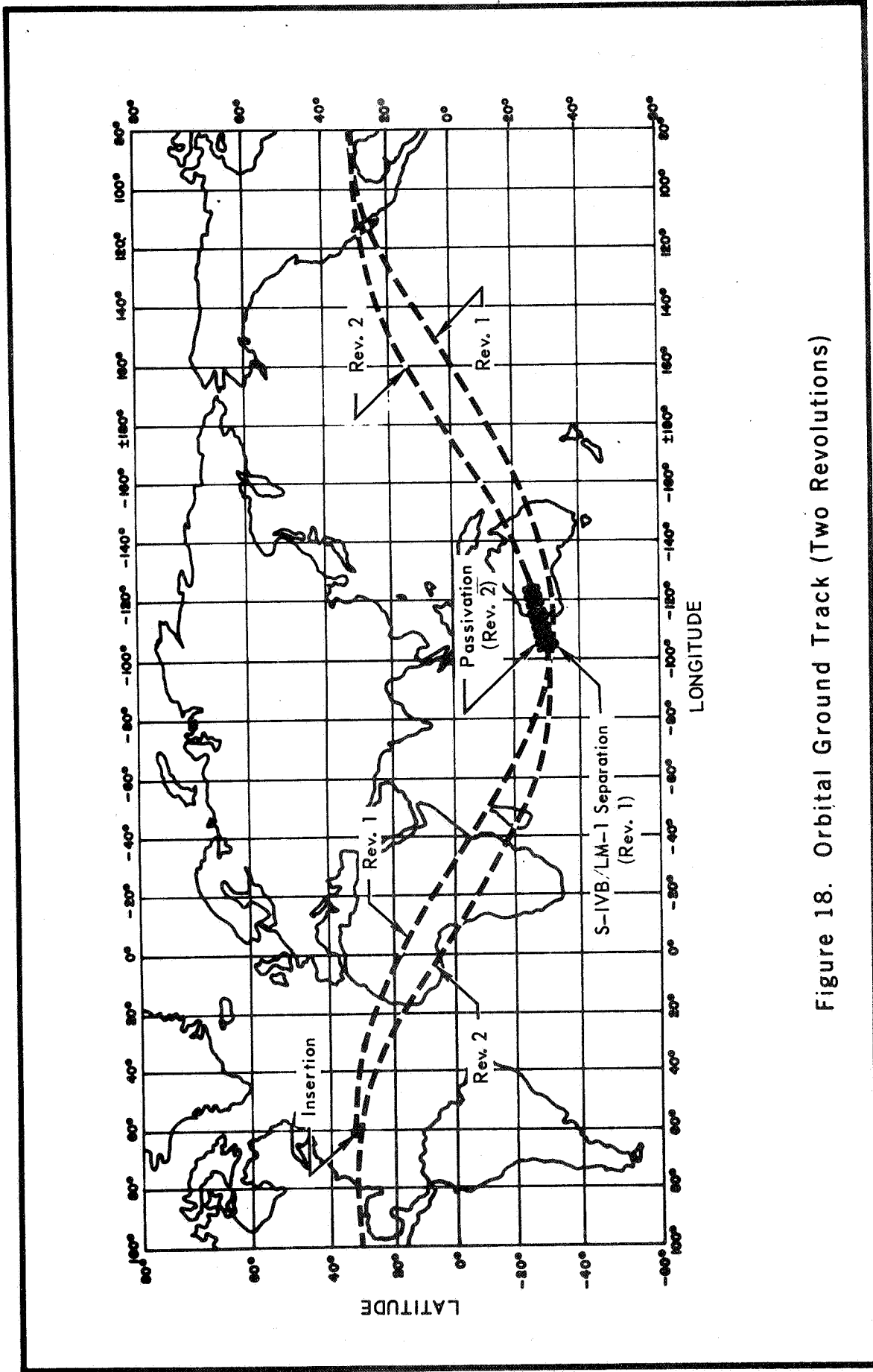


Figure 18. Orbital Ground Track (Two Revolutions)

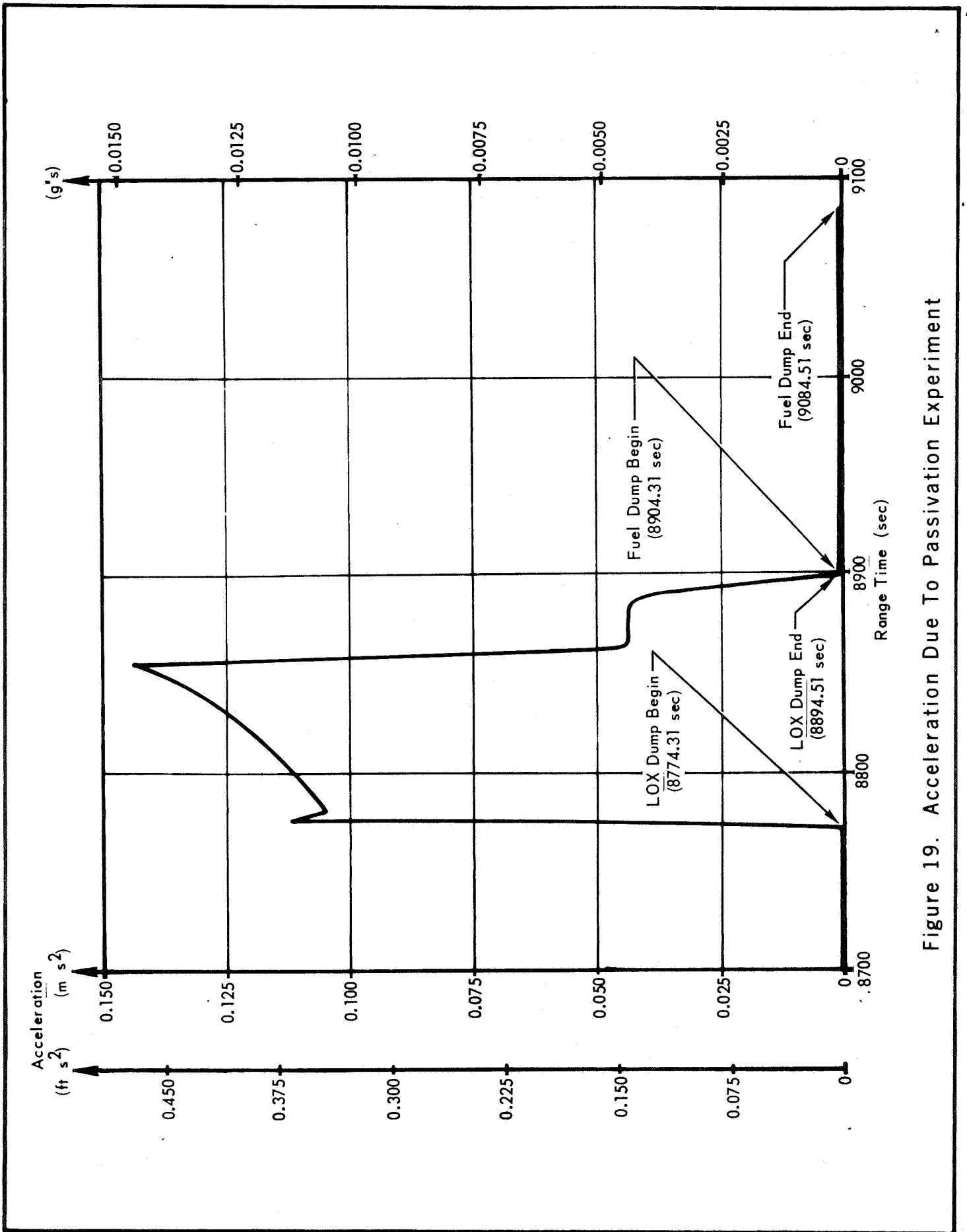


Figure 19. Acceleration Due To Passivation Experiment



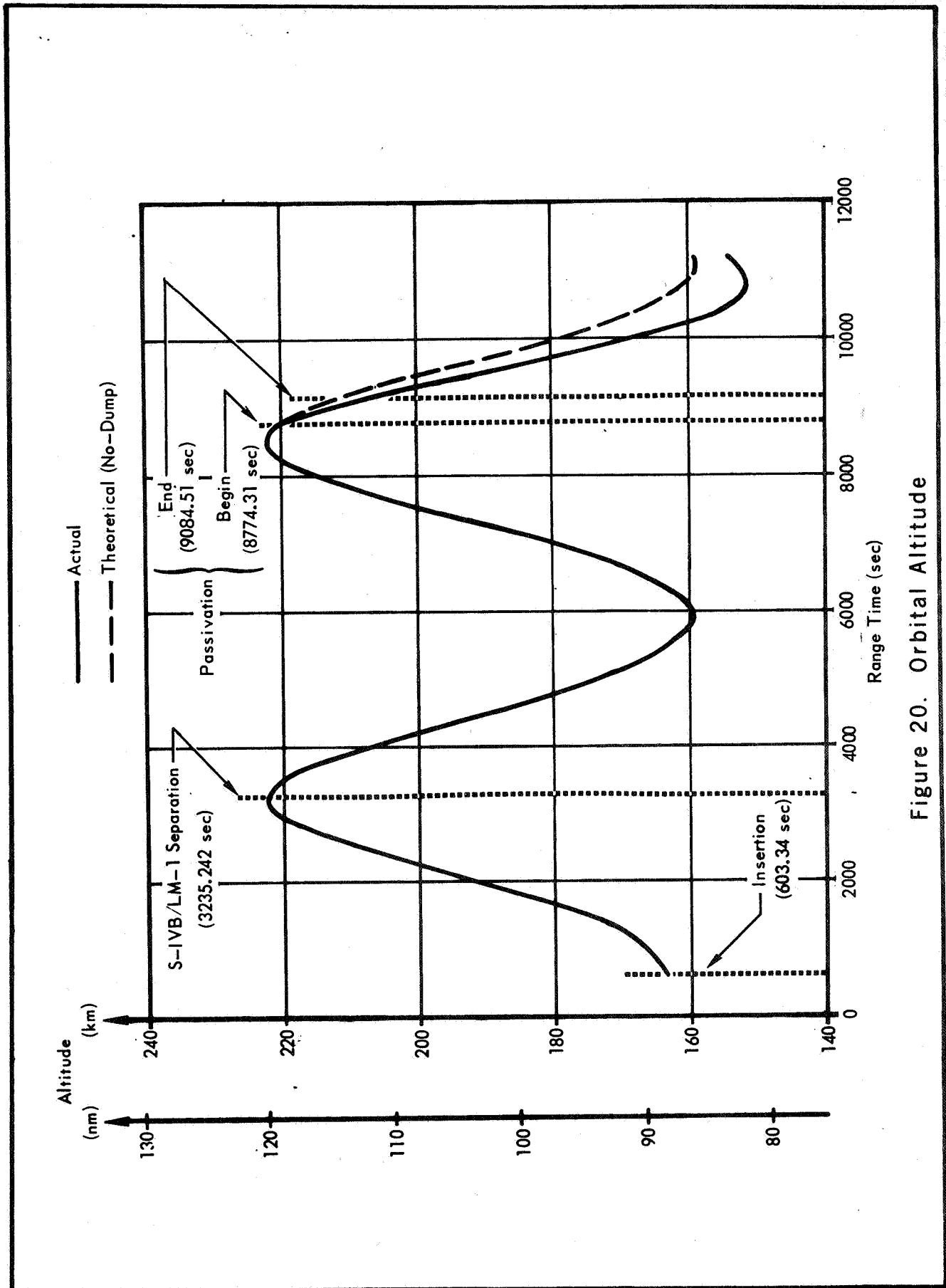


Figure 20. Orbital Altitude

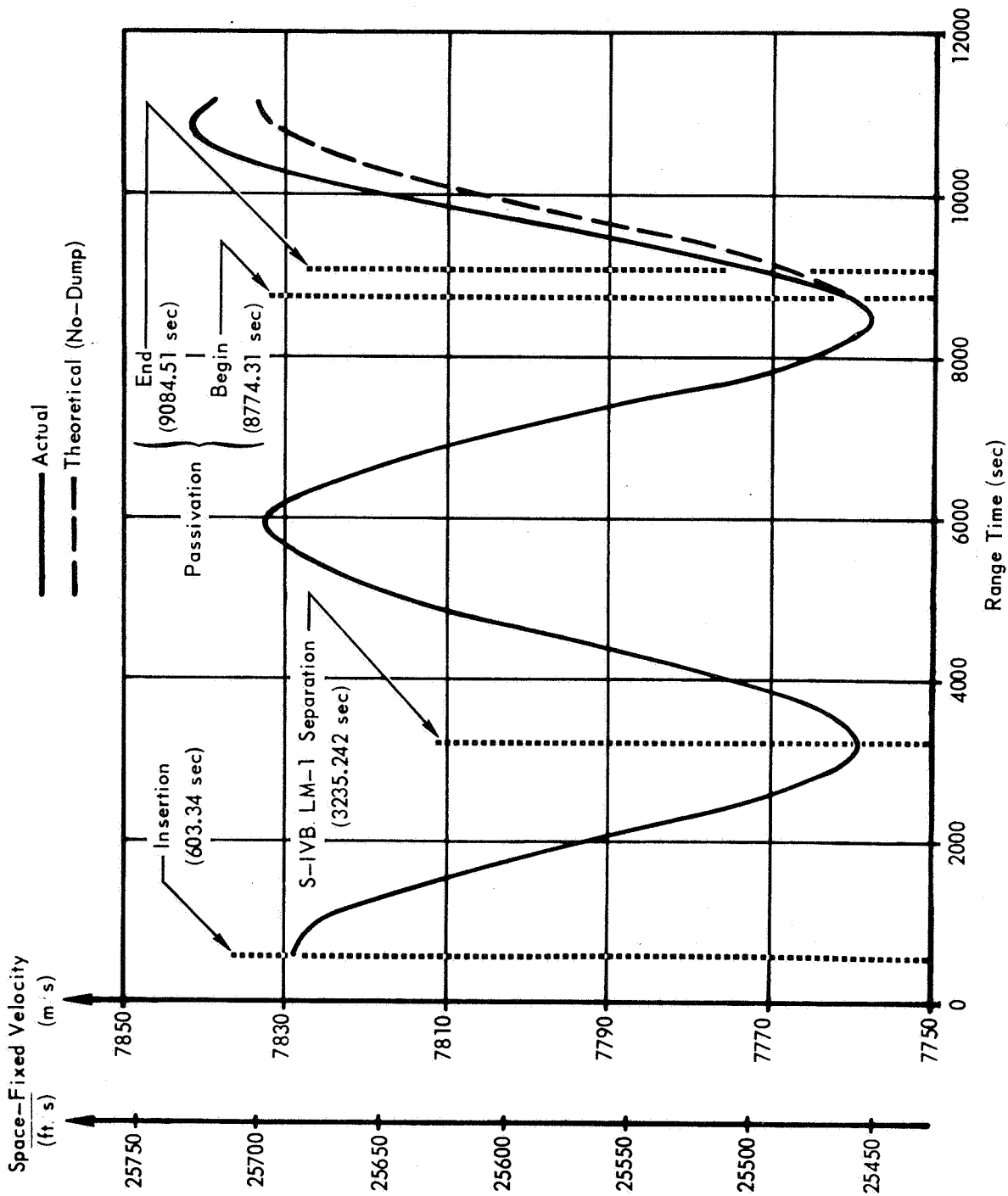


Figure 21. Orbital Space-Fixed Velocity

TABLE I  
TRACKING DATA SOURCES AVAILABLE DURING POWERED FLIGHT

| <u>Data Source</u>                    | <u>Interval(sec)</u>                           |
|---------------------------------------|--|
| ODOP                                  | 0.0 - 119.0                                    |
| GLOTRAC Station I (Mark II AZUSA)     | 52.3 - 410.0                                   |
| Patrick (0.18) Radar (FPQ-6)          | 23.0 - 541.0                                   |
| Merritt Island (19.18) Radar (TPQ-18) | 9.0 - 380.0                                    |
| Grand Bahama (3.18) Radar (TPQ-18)    | 98.0 - 534.0                                   |
| Grand Turk (7.18) Radar (TPQ-18)      | 201.4 - 604.0                                  |
| Bermuda Radar (FPQ-6)                 | 11.0 - 278.0<br>287.0 - 583.0<br>592.0 - 650.0 |
| Bermuda Radar (FPS-16)                | 11.0 - 278.0<br>287.0 - 583.0<br>592.0 - 650.0 |
| GLOTRAC                               | 23.0 - 552.9                                   |

TABLE II  
TIMES OF EVENTS

| <u>Event</u>                     | <u>Time (sec)</u> |                |                |
|----------------------------------|-------------------|----------------|----------------|
|                                  | <u>Actual</u>     | <u>Nominal</u> | <u>Act-Nom</u> |
| Guidance Reference Release       | - 4.956           | ---            | ---            |
| First Motion                     | 0.20              | 0.20           | 0.00           |
| L. O. Signal (Umb. Disc.)        | 0.36              | 0.40           | -0.04          |
| Mach One                         | 59.76             | 60.18          | -0.42          |
| Maximum Dynamic Pressure         | 71.50             | 74.20          | -2.70          |
| IECO                             | 138.97            | 139.34         | -0.37          |
| OECO                             | 142.25            | 142.34         | -0.09          |
| S-IB/S-IVB Separation (Signal)   | 143.50            | 143.64         | -0.14          |
| S-IB/S-IVB Separation (Physical) | 143.57            | 143.72         | -0.15          |
| Guidance Initiation (IGM)        | 159.47            | 159.34         | 0.13           |
| S-IVB CO                         | 593.34            | 598.35         | -5.01          |
| Orbit Insertion                  | 603.34            | 608.35         | -5.01          |
| S-IVB/IM Separation              | 3235.24           | 3235.20        | 0.04           |

Note: Actual times are referenced to Range Zero (5:48:08 P.M. EST). Nominal times are obtained from Reference 1 and adjusted to the actual 0.2 sec first motion time.

TABLE III  
SIGNIFICANT TRAJECTORY PARAMETERS

| <u>Event</u>                                     | <u>Parameters</u>              | <u>Actual Value</u>                                 |
|--|--------------------------------|---|
| First Motion                                     | Range Time                     | 0.20 sec  |
|  | Total Inertial Acceleration    | 12.11 m/s <sup>2</sup> (39.73 ft/s <sup>2</sup> )   |
| Mach 1   | Range Time                     | 59.76 sec   |
|  | Altitude                       | 7.49 km (4.04 nm)                                   |
| Maximum Dynamic Pressure                         | Range Time                     | 71.50 sec   |
|  | Dynamic Pressure               | 3.13 n/cm <sup>2</sup> (653.70 lb/ft <sup>2</sup> ) |
|  | Altitude                       | 11.47 km (6.19 nm)                                  |
| Maximum Total Inertial Acceleration (S-IB Stage) | Range Time                     | 139.07 sec  |
|  | Acceleration                   | 42.71 m/s <sup>2</sup> (140.12 ft/s <sup>2</sup> )  |
| Maximum Earth-Fixed Velocity (S-IB Stage)        | Range Time                     | 142.60 sec  |
|  | Velocity                       | 2025.0 m/s (6643.7 ft/s)                            |
| Apex (S-IB Stage)                                | Range Time                     | 264.93 sec  |
|  | Altitude                       | 129.22 km (69.77 nm)                                |
|  | Surface Range                  | 261.02 km (140.94 nm)                               |
|  | Earth-Fixed Velocity           | 1652.7 m/s (5422.4 ft/s)                            |
| Loss of Telemetry (S-IB Stage)                   | Range Time                     | 397.10 sec  |
|  | Altitude                       | 52.39 km (28.29 nm)                                 |
|  | Surface Range                  | 476.96 km (257.54 nm)                               |
|  | Total Earth-Fixed Acceleration | -7.69 m/s <sup>2</sup> (25.23 ft/s <sup>2</sup> )   |
|  | Elevation Angle From Pad       | 4.09 deg  |

TABLE III (Cont'd)

SIGNIFICANT TRAJECTORY PARAMETERS

| <u>Event</u>                                      | <u>Parameters</u> | <u>Actual Value</u>                               |
|---|-------------------|---|
| Impact (S-IB Stage)                               | Range Time        | 562.70 sec  |
|   | Surface Range     | 523.64 km (282.74 nm)                             |
|   | Cross Range       | 5.27 km (2.85 nm)                                 |
|   | Geodetic Latitude | 29.85 deg   |
|   | Longitude         | 75.39 deg   |
| Maximum Total Inertial Acceleration (S-IVB Stage) | Range Time        | 593.44 sec  |
|   | Acceleration      | 25.38 m/s <sup>2</sup> (83.27 ft/s <sup>2</sup> ) |
| Maximum Earth-Fixed Velocity (S-IVB Stage)        | Range Time        | 595.00 sec  |
|   | Velocity          | 7422.5 m/s (24352.0 ft/s)                         |

TABLE IV

CUTOFF CONDITIONS

| <u>Parameter</u>                         | <u>Units</u>      | <u>IECO</u> | <u>OECO</u> | <u>S-IVB CO</u> |
|--|-------------------|-------------|-------------|-----------------|
| Range Time                               | sec               | 138.97      | 142.25      | 593.34          |
| Altitude                                 | km                | 59.20       | 62.79       | 163.42          |
|  | mm                | 31.96       | 33.90       | 88.24           |
| Range                                    | km                | 54.99       | 60.41       | 1765.21         |
|  | mm                | 29.69       | 32.62       | 953.14          |
| Cross Range, YE                          | km                | 0.24        | 0.25        | 87.57           |
|  | mm                | 0.13        | 0.13        | 47.28           |
| Cross Range Velocity, DYE                | m/s               | 2.4         | 2.6         | 527.6           |
|  | ft/s              | 8.0         | 8.6         | 1731.1          |
| Earth-Fixed Velocity                     | m/s               | 1964.4      | 2022.4      | 7415.0          |
|  | ft/s              | 6445.0      | 6635.3      | 24327.5         |
| Earth-Fixed Velocity Vector<br>Elevation | deg               | 33.58       | 32.84       | -0.01           |
| Earth-Fixed Velocity Vector<br>Azimuth   | deg               | 72.24       | 72.27       | 85.25           |
| Space Fixed Velocity                     | m/s               | 2305.1      | 2365.4      | 7820.8          |
|  | ft/s              | 7562.7      | 7760.4      | 25658.7         |
| Total Inertial Acceleration              | m/s <sup>2</sup>  | 42.59       | 18.71       | 25.38           |
|  | ft/s <sup>2</sup> | 139.73      | 61.38       | 83.26           |

Earth-Fixed Velocity Accuracy

OECO ±0.3 m/s (±1.0 ft/s)  
 S-IVB CO ±0.5 m/s (±1.6 ft/s)

Altitude Accuracy

OECO ± 30 m (±98 ft)  
 S-IVB CO ±200 m (±656 ft)

TABLE V  
S-IB/S-IVB SEPARATION CONDITIONS

| Parameters           | Units | Separation Signal |         |         | Physical Separation (EBW Firing) |         |         |
|----------------------|-------|-------------------|---------|---------|----------------------------------|---------|---------|
|                      |       | Actual            | Nominal | Act-Nom | Actual                           | Nominal | Act-Nom |
| Range Time           | sec   | 143.50            | 143.64  | - 0.14  | 143.57                           | 143.72  | - 0.15  |
| Altitude             | km    | 64.16             | 63.49   | 0.67    | 64.24                            | 63.58   | 0.66    |
|                      | nm    | 34.64             | 34.28   | 0.36    | 34.69                            | 34.33   | 0.36    |
| Range                | km    | 62.52             | 62.63   | - 0.11  | 62.63                            | 62.77   | - 0.14  |
|                      | nm    | 33.76             | 33.82   | - 0.06  | 33.82                            | 33.90   | - 0.08  |
| Space-Fixed Velocity | m/s   | 2365.7            | 2369.8  | - 4.1   | 2365.5                           | 2369.6  | - 4.1   |
|                      | ft/s  | 7761.9            | 7775.3  | - 13.4  | 7761.2                           | 7774.6  | - 13.4  |
| Cross Range          | km    | 0.25              | -0.05   | 0.30    | 0.25                             | -0.05   | 0.30    |
|                      | nm    | 0.13              | -0.03   | 0.16    | 0.13                             | -0.03   | 0.16    |
| Flight Path Angle    | deg   | 27.394            | 27.161  | 0.233   | 27.381                           | 27.146  | 0.235   |
| Heading Angle        | deg   | 75.709            | 75.644  | 0.065   | 75.709                           | 75.644  | 0.065   |



TABLE VI

S-IVB/LM-1 INSERTION AND SEPARATION CONDITIONS

| Parameters           | Units | Orbit Insertion |         |         | S-IVB/LM-1 Separation |         |         |
|----------------------|-------|-----------------|---------|---------|-----------------------|---------|---------|
|                      |       | Actual          | Nominal | Act-Nom | Actual                | Nominal | Act-Nom |
| Range Time           | sec   | 603.34          | 608.35  | - 5.01  | 3235.24               | 3235.20 | 0.04    |
| Altitude             | km    | 163.44          | 163.22  | 0.22    | 222.11                | 223.31  | - 1.20  |
|                      | mm    | 88.24           | 88.12   | 0.12    | 119.93                | 120.58  | - 0.65  |
| Range                | km    | 1837.56         | 1868.55 | -30.99  | 19304.99              | NA      | NA      |
|                      | mm    | 992.20          | 1008.93 | -16.73  | 10423.86              | NA      | NA      |
| Space-Fixed Velocity | m/s   | 7828.5          | 7828.6  | - 0.1   | 7759.1                | 7758.2  | 0.9     |
|                      | ft/s  | 25685.3         | 25685.6 | - 0.3   | 25457.6               | 25454.7 | 2.9     |
| Cross Range          | km    | 92.87           | 96.24   | - 3.37  | 106.04                | NA      | NA      |
|                      | mm    | 50.15           | 51.97   | - 1.82  | 57.25                 | NA      | NA      |
| Flight Path Angle    | deg   | 0.005           | 0.008   | - 0.003 | - 0.013               | - 0.008 | - 0.005 |
| Heading Angle        | deg   | 85.914          | 86.125  | - 0.211 | 94.573                | 94.580  | - 0.007 |

TABLE VII

AVAILABLE ORBITAL TRACKING DATA

| <u>Stations</u>        | <u>Tracking Received</u> |       |       |       |
|------------------------|--------------------------|-------|-------|-------|
|                        | Rev 1                    | Rev 2 | Rev 3 | Rev 4 |
| Bermuda (FPS-16)       | X                        | X     |       |       |
| Tananarive (FPS-16)    | X                        | X     | X     | X     |
| California (FPS-16)    | X                        | X     | X     |       |
| Canary Island (MPS-26) | X                        |       |       |       |
| Grand Bahama (TPQ-18)  |                          | X     |       |       |
| Hawaii (FPS-16)        |                          | X     |       |       |
| Ascension (FPS-16)     |                          |       | X     | X     |

Revolution 1 began at 603.34 sec Range Time

Revolution 2 began at 5901 sec Range Time

Revolution 3 began at 11198 sec Range Time

Revolution 4 began at 16487 sec Range Time

TABLE VIII

## ORBITAL TRACKING UTILIZATION SUMMARY

| Station                     | Time of Track<br>(Range Time in sec) |      | Data<br>Type | Valid<br>Observations | RMS Error<br>of Residuals |
|-----------------------------|--------------------------------------|------|--------------|-----------------------|---------------------------|
| Bermuda (FPS-16)<br>(Rev 1) | Begin                                | 604  | AZ           | 25                    | 0.009 deg                 |
|                             | End                                  | 748  | EL           | 25                    | 0.014 deg                 |
|                             |                                      |      | RA           | 25                    | 11 m (36 ft)              |
| Tananarive<br>(Rev 1)       | Begin                                | 2332 | AZ           | 22                    | 0.011 deg                 |
|                             | End                                  | 2464 | EL           | 21                    | 0.009 deg                 |
|                             |                                      |      | RA           | 22                    | 5 m (16 ft)               |
| Grand Bahama<br>(Rev 2)     | Begin                                | 5824 | AZ           | 42                    | 0.007 deg                 |
|                             | End                                  | 6112 | EL           | 43                    | 0.013 deg                 |
|                             |                                      |      | RA           | 47                    | 6 m (20 ft)               |
| Bermuda (FPS-16)<br>(Rev 2) | Begin                                | 6016 | AZ           | 39                    | 0.011 deg                 |
|                             | End                                  | 6274 | EL           | 41                    | 0.021 deg                 |
|                             |                                      |      | RA           | 44                    | 14 m (46 ft)              |

TABLE IX

## ORBITAL ELEMENTS AT SIGNIFICANT TIMES

| PARAMETERS           | UNITS               | INSERTION         | S-IVB/ $L_{1-2}$ SEPARATION | BEGIN REV. 2      |
|----------------------|---------------------|-------------------|-----------------------------|-------------------|
| Time                 | (Range Time in sec) | 603.34            | 3235.242                    | 5901.0            |
| Space Fixed Velocity | (m/s)<br>(ft/s)     | 7828.4<br>25683.4 | 7759.1<br>25456.4           | 7833.0<br>25698.5 |
| Flight Path Angle    | (deg)               | 0.004             | - 0.013                     | 0.018             |
| Altitude             | (km)<br>(nm)        | 163.44<br>88.25   | 222.11<br>119.93            | 159.07<br>85.89   |
| Apogee               | (km)<br>(nm)        | 221.49<br>119.60  | 216.35<br>116.82            | 223.63<br>120.75  |
| Perigee              | (km)<br>(nm)        | 157.62<br>85.11   | 163.68<br>88.49             | 153.16<br>82.70   |
| Period               | (min)               | 88.28             | 88.29                       | 88.26             |
| Eccentricity         |                     | 0.0049            | 0.0040                      | 0.0054            |
| Inclination          | (deg)               | 31.627            | 31.628                      | 31.627            |

TABLE X

S-IVB PASSIVATION EFFECT ON ORBIT

| PARAMETER            | UNITS | BEGIN DUMP | END DUMP<br>(Actual) | NO DUMP<br>(Theoretical) | EFFECT OF DUMP<br>(Dump Minus No Dump) |
|----------------------|-------|------------|----------------------|--------------------------|--|
| Range Time           | sec   | 8774.31    | 9084.51              | 9084.51                  | ---                                    |
| Apogee               | km    | 216.49     | 223.18               | 217.31                   | 5.87                                   |
|                      | nm    | 116.90     | 120.51               | 117.34                   | 3.17                                   |
| Perigee              | km    | 160.49     | 154.78               | 162.14                   | - 7.36                                 |
|                      | nm    | 86.66      | 83.57                | 87.55                    | - 3.98                                 |
| Space-Fixed Velocity | m/s   | 7760.2     | 7771.6               | 7767.5                   | 4.1                                    |
|                      | ft/s  | 25459.8    | 25497.2              | 25483.7                  | 13.5                                   |
| Flight Path Angle    | deg   | - 0.089    | - 0.263              | - 0.172                  | - 0.091                                |
| Inclination          | deg   | 31.628     | 31.639               | 31.637                   | 0.002                                  |
| Eccentricity         | ---   | 0.0043     | 0.0052               | 0.0042                   | 0.0010                                 |
| Period               | min   | 88.26      | 88.27                | 88.29                    | - 0.02                                 |

TABLE XI  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC                | XE<br>M | YE<br>M | ZE<br>M | DXE<br>M/S | DYE<br>M/S | DZE<br>M/S | DDXE<br>M/S SQ | DDYE<br>M/S SQ | DDZE<br>M/S SQ |
|----------------------------|---------|---------|---------|------------|------------|------------|----------------|----------------|----------------|
| GUIDANCE REFERENCE RELEASE |         |         |         |            |            |            |                |                |                |
| -4.956                     | 35      | 0       | 0       | 0.0        | 0.0        | 0.0        | 0.00           | 0.00           | 0.00           |
| -4.0                       | 35      | 0       | 0       | 0.0        | 0.0        | 0.0        | 0.00           | 0.00           | 0.00           |
| -3.0                       | 35      | 0       | 0       | 0.0        | 0.0        | 0.0        | 0.00           | 0.00           | 0.00           |
| -2.0                       | 35      | 0       | 0       | 0.0        | 0.0        | 0.0        | 0.00           | 0.00           | 0.00           |
| -1.0                       | 35      | 0       | 0       | 0.0        | 0.0        | 0.0        | 0.00           | 0.00           | 0.00           |
| RANGE ZERO AT 17 48 08 EST |         |         |         |            |            |            |                |                |                |
| 0.000                      | 35      | 0       | 0       | 0.0        | 0.0        | 0.0        | 0.00           | 0.00           | 0.00           |
| FIRST MOTION               |         |         |         |            |            |            |                |                |                |
| 0.200                      | 34      | 0       | 0       | -0.0       | -0.0       | 0.0        | 2.32           | 0.02           | 0.02           |
| LIFTOFF                    |         |         |         |            |            |            |                |                |                |
| 0.360                      | 35      | 0       | 0       | 0.4        | 0.0        | 0.0        | 2.36           | 0.02           | 0.01           |
| 1.0                        | 35      | 0       | 0       | 1.9        | 0.0        | 0.0        | 2.51           | 0.01           | 0.01           |
| 2.0                        | 38      | 0       | 0       | 4.5        | 0.0        | 0.0        | 2.69           | -0.00          | 0.00           |
| 3.0                        | 44      | 0       | 0       | 7.3        | 0.0        | 0.0        | 2.83           | -0.01          | 0.00           |
| 4.0                        | 53      | 0       | 0       | 10.2       | 0.0        | 0.0        | 2.93           | -0.00          | -0.00          |
| 5.0                        | 65      | 0       | 0       | 13.2       | -0.0       | 0.0        | 3.01           | -0.01          | -0.01          |
| 6.0                        | 79      | 0       | 0       | 16.2       | -0.0       | -0.0       | 3.08           | -0.02          | -0.01          |
| 7.0                        | 97      | 0       | 0       | 19.3       | -0.0       | -0.0       | 3.14           | -0.02          | -0.00          |
| 8.0                        | 118     | 0       | 0       | 22.5       | -0.1       | -0.0       | 3.20           | -0.02          | -0.00          |
| 9.0                        | 142     | 0       | 0       | 25.7       | -0.1       | -0.0       | 3.27           | -0.02          | -0.00          |
| 10.0                       | 169     | 0       | 0       | 29.0       | -0.1       | -0.0       | 3.34           | -0.02          | 0.01           |
| 11.0                       | 200     | 0       | 0       | 32.4       | -0.1       | 0.0        | 3.42           | -0.02          | 0.02           |
| 12.0                       | 234     | 0       | 0       | 35.9       | -0.1       | 0.0        | 3.50           | -0.02          | 0.03           |
| 13.0                       | 272     | 0       | 0       | 39.4       | -0.1       | 0.1        | 3.58           | -0.01          | 0.05           |
| 14.0                       | 313     | -0      | 0       | 43.0       | -0.2       | 0.1        | 3.67           | -0.01          | 0.07           |
| 15.0                       | 358     | -0      | 1       | 46.7       | -0.2       | 0.2        | 3.76           | -0.01          | 0.10           |
| 16.0                       | 406     | -0      | 1       | 50.5       | -0.2       | 0.3        | 3.85           | -0.01          | 0.13           |
| 17.0                       | 459     | -0      | 1       | 54.4       | -0.2       | 0.5        | 3.93           | -0.00          | 0.17           |
| 18.0                       | 515     | -1      | 2       | 58.4       | -0.2       | 0.7        | 4.02           | 0.00           | 0.22           |
| 19.0                       | 576     | -1      | 3       | 62.5       | -0.2       | 0.9        | 4.10           | 0.01           | 0.27           |
| 20.0                       | 640     | -1      | 4       | 66.6       | -0.2       | 1.2        | 4.18           | 0.02           | 0.32           |

TABLE x1  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>M | YE<br>M | ZE<br>M | DXE<br>M/S | DYE<br>M/S | DZE<br>M/S | DDXE<br>M/S SQ | DDYE<br>M/S SQ | DDZE<br>M/S SQ |
|-------------|---------|---------|---------|------------|------------|------------|----------------|----------------|----------------|
| 21.0        | 709     | -1      | 5       | 70.8       | -0.1       | 1.6        | 4.26           | 0.03           | 0.38           |
| 22.0        | 782     | -1      | 7       | 75.1       | -0.1       | 2.0        | 4.33           | 0.04           | 0.45           |
| 23.0        | 859     | -1      | 9       | 79.5       | -0.0       | 2.4        | 4.41           | 0.05           | 0.51           |
| 24.0        | 941     | -1      | 12      | 84.0       | 0.0        | 3.0        | 4.49           | 0.07           | 0.59           |
| 25.0        | 1027    | -1      | 15      | 88.5       | 0.1        | 3.6        | 4.57           | 0.08           | 0.66           |
| 26.0        | 1118    | -1      | 20      | 93.1       | 0.2        | 4.3        | 4.65           | 0.09           | 0.74           |
| 27.0        | 1213    | -1      | 24      | 97.8       | 0.3        | 5.1        | 4.74           | 0.09           | 0.82           |
| 28.0        | 1313    | -1      | 30      | 102.6      | 0.4        | 6.0        | 4.83           | 0.10           | 0.91           |
| 29.0        | 1418    | -1      | 37      | 107.5      | 0.4        | 6.9        | 4.92           | 0.09           | 1.00           |
| 30.0        | 1528    | -0      | 44      | 112.4      | 0.5        | 8.0        | 5.03           | 0.07           | 1.09           |
| 31.0        | 1643    | -0      | 53      | 117.5      | 0.6        | 9.1        | 5.12           | 0.03           | 1.22           |
| 32.0        | 1763    | 0       | 63      | 122.7      | 0.6        | 10.4       | 5.22           | -0.01          | 1.36           |
| 33.0        | 1889    | 1       | 74      | 127.9      | 0.6        | 11.8       | 5.30           | -0.04          | 1.51           |
| 34.0        | 2019    | 1       | 87      | 133.3      | 0.5        | 13.4       | 5.40           | -0.05          | 1.65           |
| 35.0        | 2155    | 2       | 101     | 138.7      | 0.5        | 15.1       | 5.50           | -0.02          | 1.76           |
| 36.0        | 2297    | 2       | 118     | 144.3      | 0.5        | 16.9       | 5.58           | 0.02           | 1.86           |
| 37.0        | 2444    | 3       | 136     | 149.9      | 0.5        | 18.9       | 5.67           | 0.04           | 1.97           |
| 38.0        | 2596    | 3       | 156     | 155.6      | 0.5        | 20.9       | 5.77           | 0.05           | 2.10           |
| 39.0        | 2755    | 4       | 178     | 161.4      | 0.6        | 23.1       | 5.85           | 0.04           | 2.25           |
| 40.0        | 2919    | 4       | 202     | 167.3      | 0.6        | 25.4       | 5.93           | 0.03           | 2.42           |
| 41.0        | 3090    | 5       | 229     | 173.3      | 0.7        | 27.9       | 6.02           | 0.03           | 2.59           |
| 42.0        | 3266    | 6       | 259     | 179.4      | 0.7        | 30.6       | 6.14           | 0.05           | 2.79           |
| 43.0        | 3448    | 6       | 291     | 185.6      | 0.8        | 33.5       | 6.24           | 0.08           | 3.00           |
| 44.0        | 3637    | 7       | 326     | 191.8      | 0.9        | 36.6       | 6.32           | 0.11           | 3.19           |
| 45.0        | 3832    | 8       | 365     | 198.2      | 1.0        | 39.9       | 6.41           | 0.13           | 3.39           |
| 46.0        | 4034    | 9       | 407     | 204.6      | 1.1        | 43.4       | 6.44           | 0.12           | 3.60           |
| 47.0        | 4242    | 10      | 452     | 211.1      | 1.2        | 47.1       | 6.51           | 0.09           | 3.81           |
| 48.0        | 4456    | 12      | 501     | 217.7      | 1.3        | 51.0       | 6.59           | 0.04           | 4.01           |
| 49.0        | 4677    | 13      | 555     | 224.3      | 1.3        | 55.1       | 6.68           | 0.01           | 4.22           |
| 50.0        | 4904    | 14      | 612     | 231.0      | 1.3        | 59.4       | 6.77           | -0.01          | 4.43           |
| 51.0        | 5139    | 15      | 674     | 237.8      | 1.3        | 63.9       | 6.79           | -0.01          | 4.67           |
| 52.0        | 5380    | 17      | 741     | 244.7      | 1.3        | 68.6       | 6.93           | 0.07           | 4.81           |
| 53.0        | 5628    | 18      | 812     | 251.6      | 1.3        | 73.6       | 6.95           | 0.02           | 5.10           |
| 54.0        | 5883    | 19      | 889     | 258.6      | 1.3        | 78.8       | 7.01           | 0.03           | 5.25           |
| 55.0        | 6146    | 21      | 970     | 265.6      | 1.4        | 84.1       | 6.98           | 0.07           | 5.45           |
| 56.0        | 6415    | 22      | 1058    | 272.7      | 1.5        | 89.7       | 7.10           | 0.14           | 5.75           |
| 57.0        | 6691    | 23      | 1150    | 279.7      | 1.6        | 95.5       | 6.98           | 0.15           | 5.94           |
| 58.0        | 6974    | 25      | 1249    | 286.7      | 1.7        | 101.5      | 6.92           | 0.15           | 6.09           |
| 59.0        | 7265    | 27      | 1354    | 293.5      | 1.7        | 107.7      | 6.83           | 0.09           | 6.38           |
| 59.760      | 7490    | 28      | 1438    | 298.6      | 1.8        | 112.6      | 6.73           | 0.07           | 6.49           |

MACH ONE

TABLE XI  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>M | YE<br>M | ZE<br>M | DXE<br>M/S | DYE<br>M/S | DZE<br>M/S | DDXE<br>M/S SQ | DDYE<br>M/S SQ | DDZE<br>M/S SQ |
|-------------|---------|---------|---------|------------|------------|------------|----------------|----------------|----------------|
| 60.0        | 7562    | 29      | 1465    | 300.2      | 1.8        | 114.1      | 6.71           | 0.06           | 6.54           |
| 61.0        | 7865    | 30      | 1583    | 306.8      | 1.8        | 120.7      | 6.61           | 0.03           | 6.77           |
| 62.0        | 8176    | 32      | 1707    | 313.4      | 1.7        | 127.6      | 6.62           | -0.02          | 6.98           |
| 63.0        | 8493    | 34      | 1839    | 320.2      | 1.8        | 134.5      | 6.73           | 0.21           | 7.08           |
| 64.0        | 8816    | 36      | 1977    | 327.0      | 2.1        | 141.6      | 6.86           | 0.35           | 7.28           |
| 65.0        | 9147    | 38      | 2122    | 334.0      | 2.4        | 149.1      | 6.92           | 0.24           | 7.62           |
| 66.0        | 9485    | 40      | 2275    | 341.0      | 2.6        | 156.8      | 6.98           | 0.31           | 7.89           |
| 67.0        | 9829    | 43      | 2436    | 348.0      | 2.9        | 164.8      | 7.07           | 0.35           | 8.12           |
| 68.0        | 10181   | 46      | 2606    | 355.2      | 3.2        | 173.0      | 7.17           | 0.38           | 8.36           |
| 69.0        | 10540   | 50      | 2783    | 362.5      | 3.6        | 181.5      | 7.24           | 0.45           | 8.72           |
| 70.0        | 10907   | 53      | 2969    | 369.8      | 4.0        | 190.4      | 7.29           | 0.46           | 9.12           |
| 71.0        | 11280   | 58      | 3164    | 377.1      | 4.5        | 199.7      | 7.39           | 0.49           | 9.50           |
| MAX Q       |         |         |         |            |            |            |                |                |                |
| 71.500      | 11470   | 60      | 3265    | 380.8      | 4.7        | 204.5      | 7.46           | 0.47           | 9.68           |
| 72.0        | 11661   | 62      | 3369    | 384.6      | 4.9        | 209.4      | 7.52           | 0.45           | 9.81           |
| 73.0        | 12050   | 67      | 3583    | 392.2      | 5.3        | 219.3      | 7.67           | 0.30           | 10.05          |
| 74.0        | 12446   | 73      | 3808    | 399.9      | 5.5        | 229.4      | 7.82           | 0.08           | 10.21          |
| 75.0        | 12850   | 78      | 4043    | 407.8      | 5.5        | 239.7      | 7.98           | -0.13          | 10.35          |
| 76.0        | 13262   | 84      | 4288    | 415.9      | 5.3        | 250.2      | 8.14           | -0.31          | 10.60          |
| 77.0        | 13682   | 89      | 4544    | 424.1      | 4.8        | 261.0      | 8.24           | -0.47          | 10.91          |
| 78.0        | 14110   | 93      | 4810    | 432.3      | 4.3        | 272.1      | 8.28           | -0.54          | 11.29          |
| 79.0        | 14547   | 98      | 5088    | 440.6      | 3.8        | 283.6      | 8.33           | -0.51          | 11.72          |
| 80.0        | 14992   | 101     | 5378    | 449.0      | 3.4        | 295.5      | 8.46           | -0.36          | 12.11          |
| 81.0        | 15446   | 104     | 5680    | 457.6      | 3.2        | 307.7      | 8.64           | -0.17          | 12.42          |
| 82.0        | 15908   | 108     | 5994    | 466.3      | 3.0        | 320.3      | 8.85           | -0.03          | 12.62          |
| 83.0        | 16379   | 111     | 6321    | 475.2      | 3.0        | 332.9      | 9.03           | 0.03           | 12.76          |
| 84.0        | 16859   | 114     | 6660    | 484.3      | 3.1        | 345.7      | 9.10           | 0.02           | 12.82          |
| 85.0        | 17348   | 117     | 7013    | 493.4      | 3.1        | 358.7      | 9.15           | 0.00           | 13.02          |
| 86.0        | 17846   | 120     | 7378    | 502.6      | 3.1        | 371.9      | 9.23           | -0.00          | 13.38          |
| 87.0        | 18354   | 123     | 7757    | 511.9      | 3.1        | 385.5      | 9.32           | -0.02          | 13.82          |
| 88.0        | 18870   | 126     | 8149    | 521.3      | 3.0        | 399.5      | 9.42           | -0.03          | 14.28          |
| 89.0        | 19397   | 129     | 8556    | 530.7      | 3.0        | 414.0      | 9.49           | -0.05          | 14.67          |
| 90.0        | 19932   | 132     | 8978    | 540.3      | 2.9        | 428.8      | 9.55           | -0.08          | 15.02          |
| 91.0        | 20477   | 135     | 9414    | 549.8      | 2.8        | 444.0      | 9.57           | -0.12          | 15.38          |
| 92.0        | 21032   | 138     | 9866    | 559.4      | 2.7        | 459.6      | 9.58           | -0.16          | 15.79          |
| 93.0        | 21597   | 140     | 10334   | 569.0      | 2.5        | 475.6      | 9.61           | -0.17          | 16.21          |
| 94.0        | 22171   | 143     | 10818   | 578.6      | 2.4        | 492.0      | 9.69           | -0.16          | 16.61          |
| 95.0        | 22754   | 145     | 11318   | 588.4      | 2.2        | 508.9      | 9.78           | -0.13          | 17.02          |
| 96.0        | 23348   | 147     | 11836   | 598.2      | 2.1        | 526.0      | 9.85           | -0.08          | 17.38          |
| 97.0        | 23951   | 149     | 12371   | 608.0      | 2.0        | 543.6      | 9.86           | -0.06          | 17.72          |
| 98.0        | 24564   | 151     | 12923   | 617.9      | 2.0        | 561.5      | 9.89           | -0.04          | 18.06          |



TABLE XI  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XF<br>M | YE<br>M | ZE<br>M | DXE<br>M/S | DYE<br>M/S | DZE<br>M/S | DDXE<br>M/S SQ | DDYE<br>M/S SQ | DDZE<br>M/S SQ |
|-------------|---------|---------|---------|------------|------------|------------|----------------|----------------|----------------|
| 99.0        | 25187   | 153     | 13494   | 627.8      | 2.0        | 579.7      | 9.93           | -0.02          | 18.40          |
| 100.0       | 25820   | 155     | 14083   | 637.8      | 1.9        | 598.3      | 10.00          | -0.02          | 18.77          |
| 101.0       | 26463   | 157     | 14691   | 647.8      | 1.9        | 617.2      | 10.07          | -0.03          | 19.13          |
| 102.0       | 27116   | 159     | 15318   | 657.9      | 1.9        | 636.5      | 10.15          | -0.03          | 19.46          |
| 103.0       | 27779   | 161     | 15964   | 668.1      | 1.9        | 656.2      | 10.22          | -0.02          | 19.79          |
| 104.0       | 28453   | 163     | 16630   | 678.4      | 1.9        | 676.2      | 10.29          | -0.01          | 20.16          |
| 105.0       | 29136   | 165     | 17316   | 688.7      | 1.9        | 696.5      | 10.35          | 0.01           | 20.51          |
| 106.0       | 29830   | 167     | 18023   | 699.0      | 1.9        | 717.2      | 10.43          | 0.04           | 20.85          |
| 107.0       | 30535   | 168     | 18751   | 709.5      | 1.9        | 738.2      | 10.52          | 0.06           | 21.21          |
| 108.0       | 31250   | 170     | 19500   | 720.1      | 2.0        | 759.6      | 10.67          | 0.08           | 21.63          |
| 109.0       | 31975   | 172     | 20271   | 730.9      | 2.1        | 781.4      | 10.78          | 0.07           | 22.01          |
| 110.0       | 32712   | 175     | 21063   | 741.7      | 2.2        | 803.6      | 10.86          | 0.06           | 22.38          |
| 111.0       | 33459   | 177     | 21878   | 752.5      | 2.2        | 826.2      | 10.90          | 0.04           | 22.73          |
| 112.0       | 34217   | 179     | 22716   | 763.5      | 2.3        | 849.1      | 10.93          | 0.04           | 23.08          |
| 113.0       | 34986   | 181     | 23576   | 774.4      | 2.3        | 872.4      | 11.01          | 0.04           | 23.49          |
| 114.0       | 35766   | 184     | 24461   | 785.5      | 2.3        | 896.1      | 11.12          | 0.04           | 23.94          |
| 115.0       | 36558   | 186     | 25369   | 796.7      | 2.4        | 920.2      | 11.21          | 0.04           | 24.36          |
| 116.0       | 37360   | 188     | 26301   | 807.9      | 2.4        | 944.7      | 11.26          | 0.03           | 24.71          |
| 117.0       | 38174   | 191     | 27258   | 819.2      | 2.4        | 969.7      | 11.29          | 0.02           | 25.06          |
| 118.0       | 38999   | 193     | 28241   | 830.5      | 2.4        | 995.0      | 11.38          | 0.00           | 25.52          |
| 119.0       | 39835   | 196     | 29248   | 841.9      | 2.4        | 1020.8     | 11.46          | -0.00          | 26.02          |
| 120.0       | 40683   | 198     | 30282   | 853.4      | 2.4        | 1047.0     | 11.54          | -0.01          | 26.51          |
| 121.0       | 41543   | 201     | 31343   | 865.0      | 2.4        | 1073.7     | 11.58          | -0.01          | 27.00          |
| 122.0       | 42414   | 203     | 32430   | 876.6      | 2.4        | 1101.0     | 11.61          | -0.01          | 27.47          |
| 123.0       | 43297   | 205     | 33545   | 888.2      | 2.4        | 1128.7     | 11.61          | -0.01          | 27.91          |
| 124.0       | 44191   | 208     | 34687   | 899.8      | 2.4        | 1156.8     | 11.61          | -0.01          | 28.33          |
| 125.0       | 45097   | 210     | 35858   | 911.4      | 2.4        | 1185.4     | 11.62          | -0.00          | 28.85          |
| 126.0       | 46014   | 213     | 37058   | 923.0      | 2.4        | 1214.5     | 11.63          | 0.01           | 29.44          |
| 127.0       | 46943   | 215     | 38287   | 934.7      | 2.4        | 1244.3     | 11.67          | 0.00           | 30.04          |
| 128.0       | 47884   | 217     | 39546   | 946.4      | 2.4        | 1274.6     | 11.70          | 0.00           | 30.67          |
| 129.0       | 48836   | 220     | 40836   | 958.1      | 2.4        | 1305.5     | 11.68          | 0.01           | 31.25          |
| 130.0       | 49800   | 222     | 42158   | 969.7      | 2.4        | 1337.1     | 11.60          | 0.00           | 31.80          |
| 131.0       | 50776   | 224     | 43510   | 981.2      | 2.4        | 1369.1     | 11.52          | -0.01          | 32.40          |
| 132.0       | 51763   | 227     | 44895   | 992.7      | 2.4        | 1401.7     | 11.47          | 0.04           | 32.95          |
| 133.0       | 52761   | 229     | 46313   | 1004.1     | 2.4        | 1435.1     | 11.40          | 0.01           | 33.62          |
| 134.0       | 53771   | 231     | 47765   | 1015.4     | 2.4        | 1469.1     | 11.32          | 0.01           | 34.29          |
| 135.0       | 54792   | 233     | 49250   | 1026.8     | 2.4        | 1503.6     | 11.36          | 0.01           | 34.85          |
| 136.0       | 55825   | 236     | 50771   | 1038.3     | 2.4        | 1538.7     | 11.56          | 0.02           | 35.31          |
| 137.0       | 56869   | 238     | 52327   | 1050.1     | 2.4        | 1574.1     | 11.82          | 0.03           | 35.75          |
| 138.0       | 57925   | 240     | 53918   | 1062.3     | 2.4        | 1610.1     | 12.16          | 0.02           | 36.09          |
| 138.970     | 58961   | 243     | 55497   | 1073.8     | 2.4        | 1645.0     | 12.48          | 0.03           | 36.32          |

IECO

TABLE XI  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC                                      | XE<br>M | YE<br>M | ZE<br>M | DXE<br>M/S | DYE<br>M/S | DZE<br>M/S | DDXE<br>M/S SQ | DCYE<br>M/S SQ | DDZE<br>M/S SQ |
|--|---------|---------|---------|------------|------------|------------|----------------|----------------|----------------|
| OEEO   |         |         |         |            |            |            |                |                |                |
| 139.0  | 58993   | 243     | 55546   | 1074.2     | 2.4        | 1645.6     | 12.51          | 0.03           | 36.39          |
| 140.0  | 60071   | 245     | 57206   | 1079.1     | 2.5        | 1669.1     | 2.27           | 0.08           | 20.53          |
| 141.0  | 61151   | 248     | 58885   | 1081.0     | 2.6        | 1687.9     | 1.85           | 0.08           | 18.95          |
| 142.0  | 62233   | 250     | 60581   | 1081.9     | 2.6        | 1704.8     | 1.39           | 0.07           | 16.90          |
| 142.250  | 62504   | 251     | 61008   | 1082.0     | 2.6        | 1708.7     | 0.19           | 0.07           | 15.85          |
| 143.0  | 63315   | 253     | 62293   | 1077.5     | 2.7        | 1713.0     | -5.53          | 0.06           | 6.68           |
| S-IB/S-IVB SEPARATION SIGNAL                     |         |         |         |            |            |            |                |                |                |
| 143.500  | 63853   | 254     | 63150   | 1073.2     | 2.7        | 1713.5     | -8.49          | 0.06           | 1.24           |
| EBW FIRING (SEPARATION SIGNAL PLUS 0.07 SECONDS) |         |         |         |            |            |            |                |                |                |
| 143.570  | 63933   | 254     | 63262   | 1072.6     | 2.7        | 1713.6     | -8.53          | 0.07           | 1.17           |
| 144.0  | 64393   | 255     | 63999   | 1068.6     | 2.7        | 1713.7     | -8.67          | 0.07           | 0.50           |
| 145.0  | 65457   | 258     | 65712   | 1059.4     | 2.7        | 1713.9     | -8.91          | 0.07           | 0.11           |
| 150.0  | 70649   | 272     | 74298   | 1020.8     | 2.8        | 1726.9     | -6.27          | -0.04          | 5.24           |
| 155.0  | 75679   | 284     | 83001   | 992.0      | 2.2        | 1755.5     | -5.57          | -0.14          | 6.08           |
| GUIDANCE INITIATION                              |         |         |         |            |            |            |                |                |                |
| 159.470  | 80057   | 293     | 90907   | 967.4      | 1.7        | 1782.6     | -5.49          | -0.15          | 6.24           |
| 160.0  | 80569   | 294     | 91852   | 964.5      | 1.6        | 1785.8     | -5.48          | -0.13          | 6.23           |
| 165.0  | 85323   | 302     | 100858  | 936.9      | 1.6        | 1816.8     | -5.60          | 0.12           | 6.38           |
| 170.0  | 89936   | 314     | 110023  | 907.7      | 3.3        | 1849.5     | -5.95          | 0.34           | 6.62           |
| 175.0  | 94400   | 335     | 119353  | 878.3      | 5.0        | 1882.6     | -5.79          | 0.38           | 6.67           |
| 180.0  | 98720   | 365     | 128850  | 849.4      | 7.0        | 1916.1     | -5.79          | 0.38           | 6.71           |
| 185.0  | 102895  | 404     | 138515  | 820.7      | 8.9        | 1949.8     | -5.73          | 0.39           | 6.81           |
| 190.0  | 106927  | 454     | 148350  | 792.0      | 10.9       | 1984.1     | -5.73          | 0.42           | 6.89           |
| 195.0  | 110815  | 514     | 158357  | 763.3      | 13.0       | 2018.8     | -5.76          | 0.41           | 7.01           |
| 200.0  | 114560  | 585     | 168539  | 734.4      | 15.4       | 2054.0     | -5.79          | 0.53           | 7.08           |
| 205.0  | 118159  | 669     | 178898  | 705.2      | 18.3       | 2089.8     | -5.87          | 0.65           | 7.23           |
| 210.0  | 121612  | 769     | 189438  | 675.8      | 21.8       | 2126.1     | -5.91          | 0.70           | 7.29           |
| 215.0  | 124917  | 886     | 200160  | 646.2      | 25.3       | 2162.7     | -5.91          | 0.71           | 7.37           |
| 220.0  | 128074  | 1022    | 211066  | 616.6      | 28.8       | 2199.8     | -5.94          | 0.71           | 7.45           |
| 225.0  | 131083  | 1175    | 222158  | 587.0      | 32.5       | 2237.3     | -5.89          | 0.74           | 7.56           |
| 230.0  | 133944  | 1346    | 233440  | 557.6      | 36.2       | 2275.3     | -5.89          | 0.73           | 7.65           |

TABLE XI  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>M | YE<br>M | ZE<br>M | DXE<br>M/S | DYE<br>M/S | DZE<br>M/S | DDXE<br>M/S SQ | DDYE<br>M/S SQ | DDZE<br>M/S SQ |
|-------------|---------|---------|---------|------------|------------|------------|----------------|----------------|----------------|
| 235.0       | 136658  | 1536    | 244912  | 528.1      | 39.9       | 2313.8     | -5.89          | 0.77           | 7.76           |
| 240.0       | 139225  | 1745    | 256578  | 498.5      | 43.7       | 2352.7     | -5.91          | 0.77           | 7.83           |
| 245.0       | 141643  | 1974    | 268440  | 468.9      | 47.6       | 2392.0     | -5.94          | 0.77           | 7.90           |
| 250.0       | 143914  | 2221    | 280499  | 439.2      | 51.4       | 2431.9     | -5.92          | 0.77           | 8.03           |
| 255.0       | 146036  | 2488    | 292759  | 409.6      | 55.4       | 2471.9     | -5.90          | 0.80           | 8.04           |
| 260.0       | 148010  | 2775    | 305220  | 380.2      | 59.4       | 2512.7     | -5.90          | 0.80           | 8.22           |
| 265.0       | 149837  | 3082    | 317886  | 350.7      | 63.4       | 2554.0     | -5.88          | 0.82           | 8.30           |
| 270.0       | 151518  | 3410    | 330761  | 321.3      | 67.6       | 2595.7     | -5.91          | 0.83           | 8.42           |
| 275.0       | 153050  | 3758    | 343845  | 291.7      | 71.8       | 2638.2     | -5.92          | 0.85           | 8.53           |
| 280.0       | 154435  | 4127    | 357143  | 262.1      | 76.0       | 2681.0     | -5.95          | 0.86           | 8.61           |
| 285.0       | 155671  | 4518    | 370656  | 232.3      | 80.4       | 2724.4     | -5.95          | 0.87           | 8.73           |
| 290.0       | 156758  | 4931    | 384387  | 202.6      | 84.3       | 2768.2     | -5.91          | 0.63           | 8.83           |
| 295.0       | 157697  | 5359    | 398339  | 173.2      | 87.1       | 2812.5     | -5.88          | 0.63           | 8.90           |
| 300.0       | 158490  | 5804    | 412513  | 143.7      | 91.1       | 2857.5     | -5.94          | 0.94           | 9.05           |
| 305.0       | 159134  | 6272    | 426914  | 113.9      | 96.1       | 2903.1     | -5.96          | 1.00           | 9.18           |
| 310.0       | 159629  | 6764    | 441545  | 84.2       | 100.8      | 2949.3     | -5.94          | 0.91           | 9.34           |
| 315.0       | 159976  | 7279    | 456409  | 54.4       | 105.4      | 2996.2     | -5.96          | 0.96           | 9.43           |
| 320.0       | 160173  | 7819    | 471509  | 24.5       | 110.4      | 3043.9     | -6.02          | 1.00           | 9.58           |
| 325.0       | 160220  | 8383    | 486848  | -5.7       | 115.4      | 3092.1     | -6.03          | 1.00           | 9.72           |
| 330.0       | 160116  | 8973    | 502431  | -35.9      | 120.4      | 3141.0     | -6.06          | 1.02           | 9.83           |
| 335.0       | 159861  | 9587    | 518259  | -66.2      | 125.6      | 3190.3     | -6.06          | 1.03           | 9.94           |
| 340.0       | 159454  | 10228   | 534335  | -96.5      | 130.8      | 3240.5     | -6.06          | 1.05           | 10.11          |
| 345.0       | 158896  | 10895   | 550665  | -126.8     | 136.1      | 3291.3     | -6.06          | 1.08           | 10.24          |
| 350.0       | 158186  | 11589   | 567250  | -157.2     | 141.4      | 3342.9     | -6.07          | 1.07           | 10.37          |
| 355.0       | 157324  | 12310   | 584094  | -187.6     | 146.8      | 3395.1     | -6.10          | 1.08           | 10.53          |
| 360.0       | 156310  | 13057   | 601202  | -218.2     | 152.3      | 3448.1     | -6.13          | 1.12           | 10.70          |
| 365.0       | 155142  | 13833   | 618577  | -248.8     | 157.9      | 3502.0     | -6.13          | 1.13           | 10.94          |
| 370.0       | 153821  | 14636   | 636224  | -279.6     | 163.6      | 3556.9     | -6.22          | 1.10           | 11.04          |
| 375.0       | 152345  | 15468   | 654147  | -310.7     | 169.3      | 3612.7     | -6.18          | 1.21           | 11.26          |
| 380.0       | 150714  | 16330   | 672352  | -341.9     | 175.2      | 3669.4     | -6.27          | 1.18           | 11.45          |
| 385.0       | 148926  | 17220   | 690843  | -373.4     | 181.2      | 3727.0     | -6.31          | 1.21           | 11.61          |
| 390.0       | 146980  | 18141   | 709623  | -405.1     | 187.2      | 3785.4     | -6.35          | 1.22           | 11.75          |
| 395.0       | 144875  | 19093   | 728698  | -436.9     | 193.3      | 3844.6     | -6.38          | 1.24           | 11.94          |
| 400.0       | 142611  | 20075   | 748071  | -468.8     | 199.6      | 3904.8     | -6.38          | 1.25           | 12.13          |
| 405.0       | 140187  | 21089   | 767748  | -500.9     | 205.9      | 3966.1     | -6.44          | 1.27           | 12.37          |
| 410.0       | 137602  | 22134   | 787733  | -533.1     | 212.3      | 4028.3     | -6.44          | 1.29           | 12.53          |
| 415.0       | 134855  | 23212   | 808032  | -565.5     | 218.8      | 4091.5     | -6.49          | 1.30           | 12.77          |
| 420.0       | 131946  | 24322   | 828650  | -598.1     | 225.4      | 4155.8     | -6.55          | 1.35           | 12.98          |
| 425.0       | 128874  | 25466   | 849592  | -630.9     | 232.2      | 4221.2     | -6.57          | 1.36           | 13.20          |
| 430.0       | 125637  | 26644   | 870864  | -664.0     | 239.0      | 4287.9     | -6.65          | 1.38           | 13.48          |
| 435.0       | 122233  | 27857   | 892473  | -697.4     | 246.0      | 4356.0     | -6.68          | 1.42           | 13.74          |
| 440.0       | 118662  | 29104   | 914426  | -731.0     | 253.1      | 4425.4     | -6.75          | 1.44           | 14.02          |
| 445.0       | 114923  | 30388   | 936730  | -765.0     | 260.3      | 4496.4     | -6.84          | 1.44           | 14.32          |
| 450.0       | 111013  | 31708   | 959391  | -799.2     | 267.5      | 4568.2     | -6.90          | 1.45           | 14.53          |

TABLE XI  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>M | YE<br>M | ZE<br>M | DXE<br>M/S | DYE<br>M/S | DZE<br>M/S | DDXE<br>M/S SQ | DDYE<br>M/S SQ | DDZE<br>M/S SQ |
|-------------|---------|---------|---------|------------|------------|------------|----------------|----------------|----------------|
| 455.0       | 106930  | 33064   | 982415  | -833.8     | 274.9      | 4641.7     | -6.94          | 1.51           | 14.84          |
| 460.0       | 102674  | 34457   | 1005810 | -868.8     | 282.6      | 4716.7     | -7.02          | 1.54           | 15.14          |
| 465.0       | 98242   | 35889   | 1029584 | -904.0     | 290.3      | 4793.1     | -7.10          | 1.57           | 15.43          |
| 470.0       | 93633   | 37361   | 1053743 | -939.7     | 298.3      | 4870.8     | -7.19          | 1.61           | 15.70          |
| 475.0       | 88844   | 38872   | 1078294 | -975.8     | 306.4      | 4950.3     | -7.24          | 1.63           | 16.07          |
| 480.0       | 83874   | 40425   | 1103248 | -1012.2    | 314.5      | 5031.4     | -7.35          | 1.65           | 16.40          |
| 485.0       | 78720   | 42018   | 1128611 | -1050.0    | 323.0      | 5114.3     | -7.82          | 1.73           | 16.79          |
| 490.0       | 73370   | 43655   | 1154395 | -1090.3    | 331.7      | 5199.4     | -8.19          | 1.73           | 17.11          |
| 495.0       | 67816   | 45335   | 1180606 | -1131.7    | 340.4      | 5285.4     | -8.42          | 1.75           | 17.27          |
| 500.0       | 62051   | 47059   | 1207248 | -1174.2    | 349.2      | 5371.0     | -8.60          | 1.77           | 17.11          |
| 505.0       | 56072   | 48827   | 1234317 | -1217.7    | 358.1      | 5456.6     | -8.77          | 1.79           | 16.89          |
| 510.0       | 49873   | 50640   | 1261810 | -1261.9    | 367.3      | 5540.6     | -8.86          | 1.91           | 16.72          |
| 515.0       | 43453   | 52500   | 1289720 | -1306.1    | 376.7      | 5623.2     | -8.81          | 1.82           | 16.53          |
| 520.0       | 36813   | 54406   | 1318044 | -1350.0    | 385.7      | 5706.7     | -8.74          | 1.79           | 16.70          |
| 525.0       | 29955   | 56356   | 1346786 | -1393.3    | 394.3      | 5790.0     | -8.59          | 1.67           | 16.68          |
| 530.0       | 22881   | 58349   | 1375946 | -1435.9    | 402.7      | 5874.1     | -8.42          | 1.69           | 16.95          |
| 535.0       | 15599   | 60383   | 1405529 | -1476.9    | 411.2      | 5959.5     | -7.99          | 1.71           | 17.20          |
| 540.0       | 8117    | 62460   | 1435542 | -1515.3    | 419.7      | 6046.3     | -7.40          | 1.71           | 17.55          |
| 545.0       | 449     | 64580   | 1465995 | -1551.9    | 428.3      | 6135.2     | -7.35          | 1.74           | 17.93          |
| 550.0       | -7405   | 66744   | 1496896 | -1590.8    | 437.1      | 6225.8     | -8.39          | 1.81           | 18.39          |
| 555.0       | -15468  | 68952   | 1528257 | -1635.0    | 446.4      | 6318.9     | -9.15          | 1.89           | 18.82          |
| 560.0       | -23758  | 71208   | 1560088 | -1681.4    | 456.1      | 6414.1     | -9.36          | 1.99           | 19.27          |
| 565.0       | -32283  | 73514   | 1592401 | -1728.3    | 466.1      | 6511.6     | -9.36          | 1.99           | 19.73          |
| 570.0       | -41042  | 75869   | 1625207 | -1776.0    | 476.0      | 6611.4     | -9.81          | 1.99           | 20.17          |
| 575.0       | -50048  | 78274   | 1658519 | -1826.9    | 486.3      | 6713.8     | -10.58         | 2.14           | 20.73          |
| 580.0       | -59316  | 80733   | 1692349 | -1880.3    | 497.4      | 6818.8     | -10.61         | 2.29           | 21.35          |
| 585.0       | -68851  | 83249   | 1726712 | -1933.7    | 508.8      | 6926.9     | -10.91         | 2.23           | 21.94          |
| 590.0       | -78656  | 85820   | 1761621 | -1988.4    | 519.9      | 7038.0     | -10.87         | 2.26           | 22.55          |
| 593.340     | -85356  | 87570   | 1785253 | -2023.6    | 527.7      | 7114.0     | -10.23         | 2.42           | 22.88          |
| 595.0       | -88727  | 88447   | 1797069 | -2037.6    | 528.9      | 7117.4     | -8.05          | 0.46           | -2.09          |
| 600.0       | -99016  | 91098   | 1832629 | -2078.0    | 531.2      | 7106.0     | -8.05          | 0.45           | -2.39          |
| 603.340     | -106001 | 92874   | 1856349 | -2104.8    | 532.7      | 7098.1     | -8.04          | 0.45           | -2.42          |
| 605.0       | -109506 | 93766   | 1868129 | -2118.1    | 533.5      | 7094.0     | -8.03          | 0.45           | -2.44          |
| 610.0       | -120197 | 96439   | 1903568 | -2158.3    | 535.7      | 7081.8     | -8.04          | 0.45           | -2.43          |
| 620.0       | -142181 | 101819  | 1974263 | -2238.5    | 540.2      | 7057.0     | -8.01          | 0.44           | -2.53          |
| 630.0       | -164966 | 107242  | 2044705 | -2318.4    | 544.5      | 7031.2     | -7.98          | 0.44           | -2.62          |

S-IVB GUIDANCE CUTOFF

ORBIT INSERTION

TABLE XI  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>M  | YE<br>M | ZE<br>M | DXE<br>M/S | DYE<br>M/S | DZE<br>M/S | DDXE<br>M/S SQ | DDYE<br>M/S SQ | DDZE<br>M/S SQ |
|-------------|----------|---------|---------|------------|------------|------------|----------------|----------------|----------------|
| 640.0       | -188549  | 112709  | 2114884 | -2398.0    | 548.9      | 7004.4     | -7.93          | 0.43           | -2.75          |
| 650.0       | -212925  | 118219  | 2184789 | -2477.2    | 553.1      | 6976.5     | -7.90          | 0.42           | -2.84          |
| 660.0       | -238091  | 123771  | 2254410 | -2556.0    | 557.3      | 6947.6     | -7.87          | 0.41           | -2.93          |
| 670.0       | -264044  | 129364  | 2323737 | -2634.5    | 561.4      | 6917.8     | -7.83          | 0.41           | -3.02          |
| 680.0       | -290781  | 134998  | 2392763 | -2712.7    | 565.4      | 6887.1     | -7.80          | 0.40           | -3.11          |
| 690.0       | -318297  | 140672  | 2461477 | -2790.5    | 569.3      | 6855.5     | -7.76          | 0.39           | -3.20          |
| 700.0       | -346590  | 146384  | 2529871 | -2868.0    | 573.2      | 6823.1     | -7.73          | 0.38           | -3.29          |
| 710.0       | -375656  | 152135  | 2597936 | -2945.1    | 577.0      | 6789.8     | -7.69          | 0.38           | -3.38          |
| 720.0       | -405491  | 157924  | 2665663 | -3021.8    | 580.7      | 6755.6     | -7.65          | 0.37           | -3.46          |
| 730.0       | -436090  | 163750  | 2733044 | -3098.1    | 584.4      | 6720.5     | -7.61          | 0.36           | -3.55          |
| 740.0       | -467452  | 169612  | 2800071 | -3174.0    | 588.0      | 6684.6     | -7.57          | 0.35           | -3.64          |
| 750.0       | -499570  | 175509  | 2866733 | -3249.5    | 591.5      | 6647.8     | -7.53          | 0.35           | -3.72          |
| 760.0       | -532441  | 181441  | 2933024 | -3324.6    | 594.9      | 6610.2     | -7.49          | 0.34           | -3.81          |
| 770.0       | -566061  | 187407  | 2998934 | -3399.3    | 598.2      | 6571.7     | -7.44          | 0.33           | -3.89          |
| 780.0       | -600425  | 193406  | 3064455 | -3473.5    | 601.5      | 6532.4     | -7.40          | 0.32           | -3.98          |
| 790.0       | -635529  | 199437  | 3129578 | -3547.3    | 604.7      | 6492.2     | -7.35          | 0.31           | -4.06          |
| 800.0       | -671369  | 205499  | 3194296 | -3620.6    | 607.7      | 6451.2     | -7.31          | 0.30           | -4.14          |
| 810.0       | -707939  | 211591  | 3258599 | -3693.4    | 610.7      | 6409.3     | -7.26          | 0.30           | -4.22          |
| 820.0       | -745236  | 217713  | 3322480 | -3765.8    | 613.6      | 6366.7     | -7.21          | 0.29           | -4.31          |
| 830.0       | -783253  | 223864  | 3385930 | -3837.6    | 616.5      | 6323.2     | -7.16          | 0.28           | -4.39          |
| 840.0       | -821987  | 230042  | 3448942 | -3909.0    | 619.2      | 6278.9     | -7.11          | 0.27           | -4.47          |
| 850.0       | -861432  | 236248  | 3511506 | -3979.9    | 621.8      | 6233.9     | -7.06          | 0.26           | -4.55          |
| 860.0       | -901583  | 242479  | 3573616 | -4050.3    | 624.4      | 6188.0     | -7.01          | 0.25           | -4.63          |
| 870.0       | -942435  | 248735  | 3635263 | -4120.1    | 626.8      | 6141.3     | -6.96          | 0.24           | -4.71          |
| 880.0       | -983983  | 255015  | 3696439 | -4189.4    | 629.2      | 6093.8     | -6.90          | 0.23           | -4.79          |
| 890.0       | -1026221 | 261319  | 3757137 | -4258.1    | 631.5      | 6045.6     | -6.85          | 0.22           | -4.86          |
| 900.0       | -1069144 | 267644  | 3817348 | -4326.3    | 633.6      | 5996.6     | -6.79          | 0.21           | -4.94          |
| 910.0       | -1112746 | 273991  | 3877066 | -4394.0    | 635.7      | 5946.8     | -6.74          | 0.20           | -5.02          |
| 920.0       | -1157022 | 280358  | 3936281 | -4461.1    | 637.7      | 5896.2     | -6.68          | 0.19           | -5.09          |
| 930.0       | -1201966 | 286744  | 3994988 | -4527.6    | 639.5      | 5844.9     | -6.62          | 0.18           | -5.17          |
| 940.0       | -1247572 | 293148  | 4053177 | -4593.5    | 641.3      | 5792.9     | -6.56          | 0.17           | -5.24          |
| 950.0       | -1293834 | 299569  | 4110843 | -4658.8    | 643.0      | 5740.1     | -6.50          | 0.16           | -5.32          |
| 960.0       | -1340746 | 306007  | 4167977 | -4723.5    | 644.5      | 5686.6     | -6.44          | 0.15           | -5.39          |
| 970.0       | -1388397 | 312460  | 4224572 | -4787.6    | 646.0      | 5632.3     | -6.38          | 0.14           | -5.46          |
| 980.0       | -1436492 | 318926  | 4280621 | -4851.1    | 647.3      | 5577.4     | -6.32          | 0.13           | -5.53          |
| 990.0       | -1485323 | 325406  | 4336117 | -4914.0    | 648.6      | 5521.7     | -6.25          | 0.12           | -5.60          |
| 1000.0      | -1534775 | 331897  | 4391052 | -4976.2    | 649.7      | 5465.3     | -6.19          | 0.11           | -5.67          |
| 1010.0      | -1584846 | 338400  | 4445420 | -5037.8    | 650.7      | 5408.2     | -6.13          | 0.10           | -5.74          |
| 1020.0      | -1635529 | 344912  | 4499214 | -5098.8    | 651.7      | 5350.5     | -6.06          | 0.09           | -5.81          |
| 1030.0      | -1686819 | 351433  | 4552427 | -5159.0    | 652.5      | 5292.0     | -6.00          | 0.08           | -5.88          |
| 1040.0      | -1738708 | 357961  | 4605052 | -5218.6    | 653.2      | 5232.9     | -5.93          | 0.06           | -5.95          |
| 1050.0      | -1791189 | 364496  | 4657083 | -5277.6    | 653.8      | 5173.1     | -5.86          | 0.05           | -6.01          |
| 1060.0      | -1844257 | 371036  | 4708512 | -5335.8    | 654.2      | 5112.7     | -5.79          | 0.04           | -6.08          |
| 1070.0      | -1897904 | 377581  | 4759334 | -5393.4    | 654.6      | 5051.6     | -5.72          | 0.03           | -6.14          |

TABLE XI  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>M  | YE<br>M | ZE<br>M | DXE<br>M/S | DYE<br>M/S | DZE<br>M/S | DDXE<br>M/S SQ | DDYE<br>M/S SC | DDZE<br>M/S SC |
|-------------|----------|---------|---------|------------|------------|------------|----------------|----------------|----------------|
| 1080.0      | -1952123 | 384128  | 4809541 | -5450.3    | 654.9      | 4989.8     | -5.65          | 0.02           | -6.21          |
| 1090.0      | -2006907 | 390677  | 4859128 | -5506.4    | 655.0      | 4927.5     | -5.58          | 0.01           | -6.27          |
| 1100.0      | -2062249 | 397228  | 4908088 | -5561.9    | 655.0      | 4864.5     | -5.51          | -0.00          | -6.33          |
| 1110.0      | -2118143 | 403777  | 4956416 | -5616.6    | 654.9      | 4800.9     | -5.44          | -0.02          | -6.39          |
| 1120.0      | -2174580 | 410325  | 5004103 | -5670.7    | 654.7      | 4736.6     | -5.37          | -0.03          | -6.45          |
| 1130.0      | -2231553 | 416871  | 5051146 | -5723.9    | 654.4      | 4671.8     | -5.29          | -0.04          | -6.51          |
| 1140.0      | -2289056 | 423412  | 5097538 | -5776.5    | 653.9      | 4606.4     | -5.22          | -0.05          | -6.57          |
| 1150.0      | -2347081 | 429949  | 5143272 | -5828.3    | 653.4      | 4540.4     | -5.14          | -0.06          | -6.63          |
| 1160.0      | -2405619 | 436479  | 5188344 | -5879.3    | 652.7      | 4473.8     | -5.07          | -0.07          | -6.69          |
| 1170.0      | -2464665 | 443002  | 5232747 | -5929.6    | 651.9      | 4406.7     | -4.99          | -0.09          | -6.74          |
| 1180.0      | -2524210 | 449516  | 5276477 | -5979.2    | 650.9      | 4339.0     | -4.91          | -0.10          | -6.80          |
| 1190.0      | -2584246 | 456020  | 5319526 | -6027.9    | 649.9      | 4270.8     | -4.84          | -0.11          | -6.85          |
| 1200.0      | -2644765 | 462513  | 5361891 | -6075.9    | 648.7      | 4202.0     | -4.76          | -0.12          | -6.90          |
| 1210.0      | -2705761 | 468993  | 5403565 | -6123.1    | 647.4      | 4132.7     | -4.68          | -0.14          | -6.96          |
| 1220.0      | -2767225 | 475460  | 5444543 | -6169.5    | 646.0      | 4062.9     | -4.60          | -0.15          | -7.01          |
| 1230.0      | -2829149 | 481939  | 5484821 | -6215.1    | 644.4      | 3992.6     | -4.52          | -0.16          | -7.06          |
| 1240.0      | -2891525 | 488349  | 5524393 | -6259.9    | 642.8      | 3921.7     | -4.44          | -0.17          | -7.11          |
| 1250.0      | -2954345 | 494768  | 5563254 | -6304.0    | 641.0      | 3850.4     | -4.36          | -0.19          | -7.16          |
| 1260.0      | -3017601 | 501168  | 5601399 | -6347.2    | 639.1      | 3778.6     | -4.28          | -0.20          | -7.20          |
| 1270.0      | -3081285 | 507549  | 5638824 | -6389.5    | 637.0      | 3706.3     | -4.20          | -0.21          | -7.25          |
| 1280.0      | -3145389 | 513908  | 5675524 | -6431.1    | 634.9      | 3633.6     | -4.11          | -0.22          | -7.30          |
| 1290.0      | -3209905 | 520246  | 5711494 | -6471.8    | 632.6      | 3560.4     | -4.03          | -0.24          | -7.34          |
| 1300.0      | -3274823 | 526560  | 5746730 | -6511.7    | 630.2      | 3486.7     | -3.95          | -0.25          | -7.39          |
| 1310.0      | -3340137 | 532849  | 5781227 | -6550.8    | 627.6      | 3412.6     | -3.86          | -0.26          | -7.43          |
| 1320.0      | -3405837 | 539111  | 5814981 | -6589.0    | 624.9      | 3338.1     | -3.78          | -0.27          | -7.47          |
| 1330.0      | -3471915 | 545347  | 5847988 | -6626.4    | 622.1      | 3263.2     | -3.70          | -0.29          | -7.51          |
| 1340.0      | -3538362 | 551554  | 5880244 | -6662.9    | 619.2      | 3187.9     | -3.61          | -0.30          | -7.55          |
| 1350.0      | -3605171 | 557731  | 5911745 | -6698.6    | 616.2      | 3112.2     | -3.52          | -0.31          | -7.59          |
| 1360.0      | -3672331 | 563877  | 5942487 | -6733.4    | 613.0      | 3036.1     | -3.44          | -0.32          | -7.63          |
| 1370.0      | -3739836 | 569990  | 5972465 | -6767.4    | 609.7      | 2959.6     | -3.35          | -0.34          | -7.67          |
| 1380.0      | -3807676 | 576070  | 6001677 | -6800.5    | 606.2      | 2882.8     | -3.26          | -0.35          | -7.70          |
| 1390.0      | -3875842 | 582115  | 6030119 | -6832.7    | 602.7      | 2805.6     | -3.18          | -0.36          | -7.74          |
| 1400.0      | -3944327 | 588123  | 6057788 | -6864.0    | 599.0      | 2728.0     | -3.09          | -0.38          | -7.77          |
| 1410.0      | -4013120 | 594094  | 6084679 | -6894.5    | 595.2      | 2650.1     | -3.00          | -0.39          | -7.80          |
| 1420.0      | -4082213 | 600027  | 6110789 | -6924.0    | 591.2      | 2571.9     | -2.91          | -0.40          | -7.84          |
| 1430.0      | -4151597 | 605919  | 6136116 | -6952.7    | 587.2      | 2493.4     | -2.82          | -0.41          | -7.87          |
| 1440.0      | -4221264 | 611769  | 6160657 | -6980.5    | 582.9      | 2414.6     | -2.73          | -0.43          | -7.90          |
| 1450.0      | -4291204 | 617577  | 6184407 | -7007.4    | 578.6      | 2335.5     | -2.64          | -0.44          | -7.93          |
| 1460.0      | -4361408 | 623341  | 6207365 | -7033.4    | 574.2      | 2256.1     | -2.56          | -0.45          | -7.95          |
| 1470.0      | -4431869 | 629060  | 6229528 | -7058.5    | 569.6      | 2176.4     | -2.46          | -0.47          | -7.98          |
| 1480.0      | -4502575 | 634732  | 6250893 | -7082.7    | 564.9      | 2096.5     | -2.37          | -0.48          | -8.01          |
| 1490.0      | -4573519 | 640357  | 6271457 | -7106.0    | 560.0      | 2016.3     | -2.28          | -0.49          | -8.03          |
| 1500.0      | -4644692 | 645932  | 6291218 | -7128.4    | 555.0      | 1935.9     | -2.19          | -0.50          | -8.05          |
| 1510.0      | -4716083 | 651457  | 6310173 | -7149.8    | 549.9      | 1855.2     | -2.10          | -0.52          | -8.08          |

TABLE XI  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>M  | YE<br>M | ZE<br>M | DXE<br>M/S | DYE<br>M/S | DZE<br>M/S | DDXE<br>M/S SQ | DDYE<br>M/S SQ | DDZE<br>M/S SQ |
|-------------|----------|---------|---------|------------|------------|------------|----------------|----------------|----------------|
| 1520.0      | -4787685 | 656930  | 6328321 | -7170.4    | 544.7      | 1774.3     | -2.01          | -0.53          | -8.10          |
| 1530.0      | -4859488 | 662351  | 6345659 | -7190.0    | 539.4      | 1693.2     | -1.92          | -0.54          | -8.12          |
| 1540.0      | -4931482 | 667717  | 6362185 | -7208.7    | 533.9      | 1612.0     | -1.83          | -0.55          | -8.14          |
| 1550.0      | -5003660 | 673028  | 6377898 | -7226.5    | 528.3      | 1530.5     | -1.73          | -0.57          | -8.16          |
| 1560.0      | -5076010 | 678283  | 6392794 | -7243.4    | 522.6      | 1448.8     | -1.64          | -0.58          | -8.17          |
| 1570.0      | -5148525 | 683479  | 6406873 | -7259.4    | 516.7      | 1367.0     | -1.55          | -0.59          | -8.19          |
| 1580.0      | -5221195 | 688616  | 6420133 | -7274.4    | 510.7      | 1285.0     | -1.46          | -0.60          | -8.21          |
| 1590.0      | -5294010 | 693693  | 6432573 | -7288.5    | 504.6      | 1202.9     | -1.36          | -0.62          | -8.22          |
| 1600.0      | -5366961 | 698708  | 6444191 | -7301.7    | 498.4      | 1120.6     | -1.27          | -0.63          | -8.23          |
| 1610.0      | -5440040 | 703660  | 6454985 | -7313.9    | 492.0      | 1038.2     | -1.18          | -0.64          | -8.24          |
| 1620.0      | -5513237 | 708548  | 6464955 | -7325.2    | 485.5      | 955.7      | -1.08          | -0.65          | -8.26          |
| 1630.0      | -5586541 | 713370  | 6474100 | -7335.6    | 478.9      | 873.1      | -0.99          | -0.67          | -8.27          |
| 1640.0      | -5659945 | 718126  | 6482418 | -7345.0    | 472.2      | 790.4      | -0.90          | -0.68          | -8.27          |
| 1650.0      | -5733439 | 722814  | 6489908 | -7353.5    | 465.4      | 707.7      | -0.80          | -0.69          | -8.28          |
| 1660.0      | -5807013 | 727433  | 6496571 | -7361.1    | 458.4      | 624.8      | -0.71          | -0.70          | -8.29          |
| 1670.0      | -5880658 | 731981  | 6502404 | -7367.7    | 451.3      | 541.9      | -0.62          | -0.72          | -8.29          |
| 1680.0      | -5954364 | 736458  | 6507408 | -7373.4    | 444.1      | 458.9      | -0.52          | -0.73          | -8.30          |
| 1690.0      | -6028123 | 740863  | 6511583 | -7378.2    | 436.8      | 375.9      | -0.43          | -0.74          | -8.30          |
| 1700.0      | -6101925 | 745193  | 6514927 | -7382.0    | 429.3      | 292.9      | -0.33          | -0.75          | -8.30          |
| 1710.0      | -6175760 | 749448  | 6517441 | -7384.9    | 421.7      | 209.9      | -0.24          | -0.76          | -8.31          |
| 1720.0      | -6249619 | 753627  | 6519124 | -7386.8    | 414.1      | 126.8      | -0.15          | -0.77          | -8.31          |
| 1730.0      | -6323493 | 757729  | 6519977 | -7387.8    | 406.2      | 43.8       | -0.05          | -0.79          | -8.30          |
| 1740.0      | -6397373 | 761752  | 6520000 | -7387.9    | 398.3      | -39.3      | 0.04           | -0.80          | -8.30          |
| 1750.0      | -6471248 | 765695  | 6519192 | -7387.0    | 390.3      | -122.3     | 0.13           | -0.81          | -8.30          |
| 1760.0      | -6545110 | 769557  | 6517554 | -7385.2    | 382.1      | -205.3     | 0.23           | -0.82          | -8.30          |
| 1770.0      | -6618949 | 773338  | 6515087 | -7382.5    | 373.9      | -288.2     | 0.32           | -0.83          | -8.29          |
| 1780.0      | -6692757 | 777035  | 6511791 | -7378.8    | 365.5      | -371.1     | 0.41           | -0.84          | -8.28          |
| 1790.0      | -6766522 | 780647  | 6507666 | -7374.2    | 357.0      | -453.9     | 0.51           | -0.85          | -8.28          |
| 1800.0      | -6840237 | 784174  | 6502714 | -7368.6    | 348.4      | -536.6     | 0.60           | -0.87          | -8.27          |
| 1810.0      | -6913892 | 787615  | 6496935 | -7362.1    | 339.7      | -619.2     | 0.69           | -0.88          | -8.26          |
| 1820.0      | -6987477 | 790968  | 6490330 | -7354.7    | 330.9      | -701.7     | 0.79           | -0.89          | -8.25          |
| 1830.0      | -7060983 | 794232  | 6482900 | -7346.4    | 321.9      | -784.2     | 0.88           | -0.90          | -8.24          |
| 1840.0      | -7134401 | 797407  | 6474647 | -7337.1    | 312.9      | -866.5     | 0.97           | -0.91          | -8.22          |
| 1850.0      | -7207722 | 800490  | 6465571 | -7326.9    | 303.8      | -948.6     | 1.07           | -0.92          | -8.21          |
| 1860.0      | -7280937 | 803481  | 6455674 | -7315.8    | 294.5      | -1030.7    | 1.16           | -0.93          | -8.20          |
| 1870.0      | -7354035 | 806380  | 6444958 | -7303.7    | 285.2      | -1112.6    | 1.25           | -0.94          | -8.18          |
| 1880.0      | -7427008 | 809184  | 6433424 | -7290.8    | 275.7      | -1194.3    | 1.34           | -0.95          | -8.16          |
| 1890.0      | -7499847 | 811894  | 6421073 | -7276.9    | 266.1      | -1275.8    | 1.44           | -0.96          | -8.15          |
| 1900.0      | -7572542 | 814507  | 6407908 | -7262.0    | 256.5      | -1357.2    | 1.53           | -0.97          | -8.13          |
| 1910.0      | -7645084 | 817023  | 6393930 | -7246.3    | 246.7      | -1438.3    | 1.62           | -0.98          | -8.11          |
| 1920.0      | -7717465 | 819441  | 6379142 | -7229.7    | 236.9      | -1519.3    | 1.71           | -0.99          | -8.09          |
| 1930.0      | -7789675 | 821760  | 6363545 | -7212.1    | 226.9      | -1600.0    | 1.80           | -1.00          | -8.06          |
| 1940.0      | -7861704 | 823979  | 6347141 | -7193.6    | 216.8      | -1680.6    | 1.89           | -1.01          | -8.04          |
| 1950.0      | -7933544 | 826096  | 6329934 | -7174.3    | 206.7      | -1760.9    | 1.98           | -1.02          | -8.02          |

TABLE XI  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>M   | YE<br>M | ZE<br>M | DXE<br>M/S | DYE<br>M/S | DZE<br>M/S | DDXE<br>M/S SQ | DDYE<br>M/S SQ | DDZE<br>M/S SQ |
|-------------|-----------|---------|---------|------------|------------|------------|----------------|----------------|----------------|
| 1960.0      | -8005187  | 828112  | 6311925 | -7154.0    | 196.5      | -1840.9    | 2.07           | -1.03          | -7.99          |
| 1970.0      | -8076621  | 830025  | 6293117 | -7132.8    | 186.1      | -1920.7    | 2.16           | -1.04          | -7.97          |
| 1980.0      | -8147840  | 831834  | 6273512 | -7110.7    | 175.7      | -2000.2    | 2.25           | -1.05          | -7.94          |
| 1990.0      | -8218833  | 833539  | 6253114 | -7087.8    | 165.2      | -2079.5    | 2.34           | -1.06          | -7.91          |
| 2000.0      | -8289592  | 835137  | 6231924 | -7063.9    | 154.6      | -2158.4    | 2.43           | -1.07          | -7.88          |
| 2010.0      | -8360109  | 836630  | 6209946 | -7039.2    | 143.9      | -2237.1    | 2.52           | -1.07          | -7.85          |
| 2020.0      | -8430373  | 838014  | 6187184 | -7013.5    | 133.1      | -2315.4    | 2.61           | -1.08          | -7.82          |
| 2030.0      | -8500376  | 839291  | 6163639 | -6987.0    | 122.2      | -2393.5    | 2.70           | -1.09          | -7.79          |
| 2040.0      | -8570110  | 840458  | 6139315 | -6959.6    | 111.3      | -2471.2    | 2.78           | -1.10          | -7.76          |
| 2050.0      | -8639566  | 841516  | 6114216 | -6931.4    | 100.2      | -2548.6    | 2.87           | -1.11          | -7.72          |
| 2060.0      | -8708735  | 842463  | 6088345 | -6902.2    | 89.1       | -2625.6    | 2.96           | -1.12          | -7.69          |
| 2070.0      | -8777608  | 843298  | 6061705 | -6872.2    | 77.9       | -2702.3    | 3.04           | -1.12          | -7.65          |
| 2080.0      | -8846177  | 844021  | 6034300 | -6841.4    | 66.7       | -2778.6    | 3.13           | -1.13          | -7.61          |
| 2090.0      | -8914433  | 844631  | 6006134 | -6809.7    | 55.3       | -2854.6    | 3.21           | -1.14          | -7.58          |
| 2100.0      | -8982367  | 845127  | 5977210 | -6777.1    | 43.9       | -2930.1    | 3.30           | -1.15          | -7.54          |
| 2110.0      | -9049972  | 845509  | 5947532 | -6743.7    | 32.4       | -3005.3    | 3.38           | -1.15          | -7.50          |
| 2120.0      | -9117238  | 845775  | 5917105 | -6709.4    | 20.8       | -3080.1    | 3.47           | -1.16          | -7.46          |
| 2130.0      | -9184158  | 845926  | 5885932 | -6674.3    | 9.2        | -3154.4    | 3.55           | -1.17          | -7.42          |
| 2140.0      | -9250722  | 845959  | 5854017 | -6638.4    | -2.5       | -3228.4    | 3.64           | -1.17          | -7.37          |
| 2150.0      | -9316922  | 845875  | 5821366 | -6601.6    | -14.3      | -3301.9    | 3.72           | -1.18          | -7.33          |
| 2160.0      | -9382751  | 845674  | 5787981 | -6564.0    | -26.1      | -3375.0    | 3.80           | -1.19          | -7.28          |
| 2170.0      | -9448200  | 845353  | 5753868 | -6525.6    | -38.0      | -3447.6    | 3.88           | -1.19          | -7.24          |
| 2180.0      | -9513261  | 844913  | 5719031 | -6486.4    | -50.0      | -3519.7    | 3.96           | -1.20          | -7.19          |
| 2190.0      | -9577925  | 844354  | 5683475 | -6446.4    | -62.0      | -3591.4    | 4.04           | -1.20          | -7.15          |
| 2200.0      | -9642185  | 843674  | 5647204 | -6405.5    | -74.1      | -3662.7    | 4.12           | -1.21          | -7.10          |
| 2210.0      | -9706033  | 842873  | 5610223 | -6363.9    | -86.2      | -3733.4    | 4.20           | -1.22          | -7.05          |
| 2220.0      | -9769460  | 841950  | 5572537 | -6321.4    | -98.4      | -3803.7    | 4.28           | -1.22          | -7.00          |
| 2230.0      | -9832459  | 840905  | 5534152 | -6278.2    | -110.6     | -3873.4    | 4.36           | -1.23          | -6.95          |
| 2240.0      | -9895022  | 839737  | 5495071 | -6234.2    | -122.9     | -3942.6    | 4.44           | -1.23          | -6.90          |
| 2250.0      | -9957141  | 838446  | 5455301 | -6189.5    | -135.3     | -4011.4    | 4.52           | -1.24          | -6.85          |
| 2260.0      | -10018809 | 837032  | 5414846 | -6143.9    | -147.7     | -4079.5    | 4.59           | -1.24          | -6.79          |
| 2270.0      | -10080017 | 835493  | 5373711 | -6097.6    | -160.1     | -4147.2    | 4.67           | -1.25          | -6.74          |
| 2280.0      | -10140758 | 833830  | 5331903 | -6050.5    | -172.6     | -4214.3    | 4.74           | -1.25          | -6.68          |
| 2290.0      | -10201025 | 832041  | 5289427 | -6002.7    | -185.1     | -4280.9    | 4.82           | -1.25          | -6.63          |
| 2300.0      | -10260810 | 830128  | 5246288 | -5954.1    | -197.7     | -4346.9    | 4.89           | -1.26          | -6.57          |
| 2310.0      | -10320106 | 828088  | 5202491 | -5904.8    | -210.3     | -4412.3    | 4.97           | -1.26          | -6.51          |
| 2320.0      | -10378905 | 825922  | 5158043 | -5854.8    | -222.9     | -4477.2    | 5.04           | -1.27          | -6.46          |
| 2330.0      | -10437199 | 823630  | 5112950 | -5804.0    | -235.6     | -4541.4    | 5.11           | -1.27          | -6.40          |
| 2340.0      | -10494983 | 821210  | 5067216 | -5752.6    | -248.3     | -4605.1    | 5.18           | -1.27          | -6.34          |
| 2350.0      | -10552248 | 818664  | 5020849 | -5700.4    | -261.0     | -4668.2    | 5.26           | -1.28          | -6.28          |
| 2360.0      | -10608988 | 815989  | 4973854 | -5647.5    | -273.8     | -4730.7    | 5.33           | -1.28          | -6.22          |
| 2370.0      | -10665195 | 813187  | 4926237 | -5593.9    | -286.6     | -4792.5    | 5.40           | -1.28          | -6.15          |
| 2380.0      | -10720863 | 810257  | 4878005 | -5539.6    | -299.4     | -4853.8    | 5.46           | -1.28          | -6.09          |
| 2390.0      | -10775984 | 807198  | 4829164 | -5484.6    | -312.3     | -4914.4    | 5.53           | -1.29          | -6.03          |



TABLE XI  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>M   | YE<br>M | ZE<br>M | DXE<br>M/S | DYE<br>M/S | DZE<br>M/S | DDXE<br>M/S SQ | DDYE<br>M/S SQ | DDZE<br>M/S SQ |
|-------------|-----------|---------|---------|------------|------------|------------|----------------|----------------|----------------|
| 2400.0      | -10830552 | 804011  | 4779720 | -5428.9    | -325.2     | -4974.4    | 5.60           | -1.29          | -5.96          |
| 2410.0      | -10884560 | 800695  | 4729679 | -5372.6    | -338.0     | -5033.7    | 5.67           | -1.29          | -5.90          |
| 2420.0      | -10938002 | 797250  | 4679048 | -5315.6    | -350.9     | -5092.4    | 5.73           | -1.29          | -5.83          |
| 2430.0      | -10990870 | 793676  | 4627834 | -5257.9    | -363.9     | -5150.4    | 5.80           | -1.29          | -5.77          |
| 2440.0      | -11043159 | 789973  | 4576043 | -5199.6    | -376.8     | -5207.7    | 5.86           | -1.29          | -5.70          |
| 2450.0      | -11094861 | 786140  | 4523682 | -5140.7    | -389.8     | -5264.4    | 5.93           | -1.30          | -5.63          |
| 2460.0      | -11145970 | 782178  | 4470757 | -5081.1    | -402.7     | -5320.4    | 5.99           | -1.30          | -5.57          |
| 2470.0      | -11196481 | 778086  | 4417276 | -5020.9    | -415.7     | -5375.7    | 6.05           | -1.30          | -5.50          |
| 2480.0      | -11246387 | 773864  | 4363246 | -4960.1    | -428.6     | -5430.3    | 6.11           | -1.30          | -5.43          |
| 2490.0      | -11295681 | 769513  | 4308672 | -4898.7    | -441.6     | -5484.2    | 6.17           | -1.30          | -5.36          |
| 2500.0      | -11344358 | 765032  | 4253564 | -4836.6    | -454.6     | -5537.4    | 6.23           | -1.30          | -5.29          |
| 2510.0      | -11392412 | 760421  | 4197926 | -4774.0    | -467.6     | -5589.9    | 6.29           | -1.30          | -5.21          |
| 2520.0      | -11439836 | 755681  | 4141767 | -4710.8    | -480.5     | -5641.7    | 6.35           | -1.30          | -5.14          |
| 2530.0      | -11486625 | 750810  | 4085094 | -4647.0    | -493.5     | -5692.8    | 6.41           | -1.30          | -5.07          |
| 2540.0      | -11532774 | 745811  | 4027914 | -4582.6    | -506.5     | -5743.1    | 6.47           | -1.30          | -5.00          |
| 2550.0      | -11578276 | 740681  | 3970235 | -4517.7    | -519.4     | -5792.7    | 6.52           | -1.29          | -4.92          |
| 2560.0      | -11623125 | 735422  | 3912063 | -4452.2    | -532.4     | -5841.5    | 6.58           | -1.29          | -4.85          |
| 2570.0      | -11667317 | 730034  | 3853407 | -4386.1    | -545.3     | -5889.6    | 6.63           | -1.29          | -4.77          |
| 2580.0      | -11710846 | 724516  | 3794274 | -4319.6    | -558.2     | -5936.9    | 6.68           | -1.29          | -4.70          |
| 2590.0      | -11753707 | 718870  | 3734671 | -4252.5    | -571.1     | -5983.5    | 6.74           | -1.29          | -4.62          |
| 2600.0      | -11795894 | 713094  | 3674606 | -4184.8    | -584.0     | -6029.3    | 6.79           | -1.29          | -4.54          |
| 2610.0      | -11837402 | 707190  | 3614087 | -4116.7    | -596.8     | -6074.4    | 6.84           | -1.28          | -4.47          |
| 2620.0      | -11878226 | 701158  | 3553121 | -4048.0    | -609.7     | -6118.6    | 6.89           | -1.28          | -4.39          |
| 2630.0      | -11918361 | 694997  | 3491717 | -3978.9    | -622.5     | -6162.1    | 6.94           | -1.28          | -4.31          |
| 2640.0      | -11957803 | 688709  | 3429882 | -3909.3    | -635.3     | -6204.8    | 6.99           | -1.28          | -4.23          |
| 2650.0      | -11996545 | 682292  | 3367624 | -3839.2    | -648.0     | -6246.7    | 7.03           | -1.27          | -4.15          |
| 2660.0      | -12034584 | 675749  | 3304950 | -3768.6    | -660.7     | -6287.8    | 7.08           | -1.27          | -4.07          |
| 2670.0      | -12071916 | 669078  | 3241870 | -3697.6    | -673.4     | -6328.1    | 7.13           | -1.27          | -4.00          |
| 2680.0      | -12108534 | 662281  | 3178391 | -3626.1    | -686.0     | -6367.6    | 7.17           | -1.26          | -3.91          |
| 2690.0      | -12144435 | 655357  | 3114520 | -3554.1    | -698.7     | -6406.3    | 7.22           | -1.26          | -3.83          |
| 2700.0      | -12179615 | 648308  | 3050267 | -3481.8    | -711.2     | -6444.2    | 7.26           | -1.25          | -3.75          |
| 2710.0      | -12214069 | 641133  | 2985640 | -3409.0    | -723.7     | -6481.2    | 7.30           | -1.25          | -3.66          |
| 2720.0      | -12247793 | 633833  | 2920646 | -3335.8    | -736.2     | -6517.4    | 7.34           | -1.25          | -3.58          |
| 2730.0      | -12280783 | 626409  | 2855294 | -3262.2    | -748.7     | -6552.8    | 7.38           | -1.24          | -3.50          |
| 2740.0      | -12313035 | 618860  | 2789592 | -3188.1    | -761.0     | -6587.4    | 7.42           | -1.24          | -3.41          |
| 2750.0      | -12344545 | 611188  | 2723549 | -3113.7    | -773.4     | -6621.1    | 7.46           | -1.23          | -3.33          |
| 2760.0      | -12375309 | 603393  | 2657172 | -3039.0    | -785.7     | -6654.0    | 7.50           | -1.23          | -3.25          |
| 2770.0      | -12405323 | 595475  | 2590471 | -2963.8    | -797.9     | -6686.1    | 7.53           | -1.22          | -3.16          |
| 2780.0      | -12434584 | 587436  | 2523454 | -2888.3    | -810.0     | -6717.2    | 7.57           | -1.21          | -3.08          |
| 2790.0      | -12463088 | 579274  | 2456129 | -2812.4    | -822.1     | -6747.6    | 7.60           | -1.21          | -2.99          |
| 2800.0      | -12490831 | 570993  | 2388505 | -2736.2    | -834.2     | -6777.1    | 7.64           | -1.20          | -2.91          |
| 2810.0      | -12517811 | 562591  | 2320590 | -2659.7    | -846.2     | -6805.7    | 7.67           | -1.19          | -2.82          |
| 2820.0      | -12544024 | 554069  | 2252394 | -2582.8    | -858.1     | -6833.5    | 7.70           | -1.19          | -2.73          |
| 2830.0      | -12569467 | 545429  | 2183924 | -2505.7    | -869.9     | -6860.4    | 7.73           | -1.18          | -2.65          |

TABLE XI  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>M   | YE<br>M | ZE<br>M | DXE<br>M/S | DYE<br>M/S | DZE<br>M/S | DDXE<br>M/S SQ | DDYE<br>M/S SQ | DDZE<br>M/S SQ |
|-------------|-----------|---------|---------|------------|------------|------------|----------------|----------------|----------------|
| 2840.0      | -12594136 | 536671  | 2115190 | -2428.2    | -881.7     | -6886.4    | 7.76           | -1.17          | -2.56          |
| 2850.0      | -12618029 | 527795  | 2046199 | -2350.4    | -893.4     | -6911.6    | 7.79           | -1.17          | -2.47          |
| 2860.0      | -12641144 | 518803  | 1976961 | -2272.4    | -905.0     | -6935.8    | 7.82           | -1.16          | -2.38          |
| 2870.0      | -12663476 | 509695  | 1907485 | -2194.0    | -916.6     | -6959.2    | 7.85           | -1.15          | -2.30          |
| 2880.0      | -12685023 | 500471  | 1837779 | -2115.4    | -928.1     | -6981.8    | 7.87           | -1.14          | -2.21          |
| 2890.0      | -12705783 | 491134  | 1767853 | -2036.6    | -939.5     | -7003.4    | 7.90           | -1.14          | -2.12          |
| 2900.0      | -12725754 | 481682  | 1697714 | -1957.5    | -950.8     | -7024.2    | 7.92           | -1.13          | -2.03          |
| 2910.0      | -12744932 | 472118  | 1627372 | -1878.1    | -962.0     | -7044.1    | 7.95           | -1.12          | -1.94          |
| 2920.0      | -12763315 | 462443  | 1556836 | -1798.6    | -973.1     | -7063.0    | 7.97           | -1.11          | -1.85          |
| 2930.0      | -12780902 | 452656  | 1486114 | -1718.8    | -984.2     | -7081.1    | 7.99           | -1.10          | -1.76          |
| 2940.0      | -12797691 | 442759  | 1415216 | -1638.8    | -995.1     | -7098.3    | 8.01           | -1.09          | -1.68          |
| 2950.0      | -12813678 | 432754  | 1344150 | -1558.6    | -1006.0    | -7114.7    | 8.03           | -1.08          | -1.59          |
| 2960.0      | -12828862 | 422640  | 1272926 | -1478.2    | -1016.8    | -7130.1    | 8.05           | -1.07          | -1.50          |
| 2970.0      | -12843242 | 412419  | 1201552 | -1397.7    | -1027.4    | -7144.6    | 8.06           | -1.06          | -1.41          |
| 2980.0      | -12856815 | 402091  | 1130037 | -1317.0    | -1038.0    | -7158.2    | 8.08           | -1.05          | -1.32          |
| 2990.0      | -12869581 | 391659  | 1058391 | -1236.1    | -1048.5    | -7170.9    | 8.10           | -1.04          | -1.23          |
| 3000.0      | -12881537 | 381122  | 986622  | -1155.1    | -1058.8    | -7182.7    | 8.11           | -1.03          | -1.14          |
| 3010.0      | -12892682 | 370483  | 914740  | -1073.9    | -1069.1    | -7193.6    | 8.12           | -1.02          | -1.05          |
| 3020.0      | -12903015 | 359741  | 842753  | -992.6     | -1079.3    | -7203.6    | 8.14           | -1.01          | -0.95          |
| 3030.0      | -12912534 | 348898  | 770671  | -911.2     | -1089.3    | -7212.7    | 8.15           | -1.00          | -0.86          |
| 3040.0      | -12921239 | 337955  | 698502  | -829.7     | -1099.2    | -7220.9    | 8.16           | -0.99          | -0.77          |
| 3050.0      | -12929128 | 326914  | 626256  | -748.1     | -1109.0    | -7228.2    | 8.17           | -0.98          | -0.68          |
| 3060.0      | -12936200 | 315775  | 553942  | -666.4     | -1118.7    | -7234.5    | 8.17           | -0.96          | -0.59          |
| 3070.0      | -12942455 | 304539  | 481568  | -584.6     | -1128.3    | -7240.0    | 8.18           | -0.95          | -0.50          |
| 3080.0      | -12947892 | 293208  | 409145  | -502.8     | -1137.8    | -7244.5    | 8.19           | -0.94          | -0.41          |
| 3090.0      | -12952510 | 281784  | 336681  | -420.8     | -1147.1    | -7248.2    | 8.19           | -0.93          | -0.32          |
| 3100.0      | -12956309 | 270266  | 264184  | -338.9     | -1156.4    | -7250.9    | 8.20           | -0.92          | -0.23          |
| 3110.0      | -12959288 | 258657  | 191665  | -256.9     | -1165.5    | -7252.7    | 8.20           | -0.90          | -0.14          |
| 3120.0      | -12961447 | 246957  | 119133  | -174.9     | -1174.4    | -7253.6    | 8.20           | -0.89          | -0.05          |
| 3130.0      | -12962785 | 235169  | 46596   | -92.8      | -1183.3    | -7253.6    | 8.20           | -0.88          | 0.05           |
| 3140.0      | -12963303 | 223293  | -25936  | -10.8      | -1192.0    | -7252.7    | 8.20           | -0.86          | 0.14           |
| 3150.0      | -12963001 | 211330  | -98455  | 71.3       | -1200.5    | -7250.9    | 8.20           | -0.85          | 0.23           |
| 3160.0      | -12961878 | 199282  | -170951 | 153.3      | -1209.0    | -7248.2    | 8.20           | -0.84          | 0.32           |
| 3170.0      | -12959935 | 187151  | -243415 | 235.3      | -1217.3    | -7244.5    | 8.20           | -0.82          | 0.41           |
| 3180.0      | -12957172 | 174937  | -315838 | 317.3      | -1225.5    | -7240.0    | 8.20           | -0.81          | 0.50           |
| 3190.0      | -12953589 | 162642  | -388211 | 399.2      | -1233.5    | -7234.5    | 8.19           | -0.80          | 0.59           |
| 3200.0      | -12949188 | 150268  | -460526 | 481.1      | -1241.4    | -7228.2    | 8.19           | -0.78          | 0.68           |
| 3210.0      | -12943967 | 137815  | -532771 | 563.0      | -1249.1    | -7220.9    | 8.18           | -0.77          | 0.77           |
| 3220.0      | -12937929 | 125286  | -604940 | 644.7      | -1256.7    | -7212.7    | 8.17           | -0.75          | 0.86           |
| 3230.0      | -12931073 | 112682  | -677022 | 726.4      | -1264.1    | -7203.6    | 8.16           | -0.74          | 0.95           |

S-IVB/LM SEPARATION

3235.242      -12927153      106045      -714771      769.2      -1268.0      -7198.5      8.16      -0.73      1.00

TABLE XII  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC                | XSP<br>KM | YSP<br>KM | ZSP<br>KM | CXSP<br>M/S | DYSP<br>M/S | DZSP<br>M/S | DDXSP<br>M/S SQ | DDYSP<br>M/S SQ | DDZSP<br>M/S SQ |
|----------------------------|-----------|-----------|-----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| GUIDANCE REFERENCE RELEASE |           |           |           |             |             |             |                 |                 |                 |
| -4.956                     | 5169.524  | 2173.506  | 3028.451  | -158.5      | 377.0       | 0.0         | 0.00            | 0.03            | 0.00            |
| -4.0                       | 5169.373  | 2173.866  | 3028.451  | -158.5      | 377.0       | 0.0         | 0.00            | 0.03            | 0.00            |
| -3.0                       | 5169.214  | 2174.243  | 3028.451  | -158.5      | 376.9       | 0.0         | 0.00            | 0.03            | 0.00            |
| -2.0                       | 5169.056  | 2174.620  | 3028.451  | -158.6      | 376.9       | 0.0         | 0.00            | 0.03            | 0.00            |
| -1.0                       | 5168.897  | 2174.996  | 3028.451  | -158.6      | 376.9       | 0.0         | 0.00            | 0.03            | 0.00            |
| RANGE ZERO AT 17 48 08 EST |           |           |           |             |             |             |                 |                 |                 |
| 0.000                      | 5168.739  | 2175.373  | 3028.451  | -158.6      | 376.9       | 0.0         | 0.00            | 0.03            | 0.00            |
| FIRST MOTION               |           |           |           |             |             |             |                 |                 |                 |
| 0.200                      | 5168.707  | 2175.449  | 3028.451  | -158.6      | 376.9       | 0.0         | 1.88            | 0.84            | 1.09            |
| LIFTOFF                    |           |           |           |             |             |             |                 |                 |                 |
| 0.360                      | 5168.682  | 2175.509  | 3028.451  | -158.3      | 377.0       | 0.2         | 1.91            | 0.85            | 1.12            |
| 1.0                        | 5168.581  | 2175.751  | 3028.451  | -157.1      | 377.6       | 0.9         | 2.04            | 0.90            | 1.19            |
| 2.0                        | 5168.424  | 2176.129  | 3028.453  | -155.0      | 378.5       | 2.2         | 2.18            | 0.95            | 1.29            |
| 3.0                        | 5168.270  | 2176.508  | 3028.456  | -152.8      | 379.4       | 3.5         | 2.29            | 0.99            | 1.36            |
| 4.0                        | 5168.119  | 2176.888  | 3028.460  | -150.5      | 380.3       | 4.9         | 2.37            | 1.02            | 1.41            |
| 5.0                        | 5167.969  | 2177.269  | 3028.465  | -148.1      | 381.3       | 6.3         | 2.43            | 1.05            | 1.45            |
| 6.0                        | 5167.823  | 2177.650  | 3028.472  | -145.7      | 382.4       | 7.8         | 2.49            | 1.07            | 1.48            |
| 7.0                        | 5167.678  | 2178.033  | 3028.481  | -143.2      | 383.4       | 9.3         | 2.54            | 1.09            | 1.51            |
| 8.0                        | 5167.536  | 2178.417  | 3028.491  | -140.7      | 384.5       | 10.8        | 2.59            | 1.12            | 1.54            |
| 9.0                        | 5167.397  | 2178.802  | 3028.502  | -138.1      | 385.5       | 12.3        | 2.64            | 1.14            | 1.58            |
| 10.0                       | 5167.260  | 2179.188  | 3028.516  | -135.4      | 386.7       | 13.9        | 2.70            | 1.17            | 1.61            |
| 11.0                       | 5167.126  | 2179.575  | 3028.530  | -132.7      | 387.8       | 15.6        | 2.75            | 1.21            | 1.65            |
| 12.0                       | 5166.994  | 2179.964  | 3028.547  | -130.0      | 389.0       | 17.2        | 2.81            | 1.25            | 1.69            |
| 13.0                       | 5166.866  | 2180.353  | 3028.565  | -127.2      | 390.2       | 18.9        | 2.87            | 1.29            | 1.74            |
| 14.0                       | 5166.740  | 2180.744  | 3028.585  | -124.3      | 391.5       | 20.7        | 2.93            | 1.34            | 1.78            |
| 15.0                       | 5166.617  | 2181.137  | 3028.606  | -121.4      | 392.8       | 22.5        | 2.99            | 1.40            | 1.83            |
| 16.0                       | 5166.497  | 2181.530  | 3028.630  | -118.4      | 394.2       | 24.4        | 3.04            | 1.46            | 1.88            |
| 17.0                       | 5166.380  | 2181.925  | 3028.655  | -115.3      | 395.7       | 26.3        | 3.10            | 1.52            | 1.93            |
| 18.0                       | 5166.266  | 2182.321  | 3028.682  | -112.3      | 397.2       | 28.2        | 3.14            | 1.59            | 1.98            |
| 19.0                       | 5166.156  | 2182.719  | 3028.712  | -109.1      | 398.7       | 30.2        | 3.19            | 1.66            | 2.02            |
| 20.0                       | 5166.048  | 2183.119  | 3028.743  | -105.9      | 400.4       | 32.3        | 3.23            | 1.74            | 2.07            |

TABLE XII  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>KM | YSP<br>KM | ZSP<br>KM | DXSP<br>M/S | DYSP<br>M/S | DZSP<br>M/S | DDXSP<br>M/S SQ | DDYSP<br>M/S SQ | DDZSP<br>M/S SQ |
|-------------|-----------|-----------|-----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 21.0        | 5165.944  | 2183.520  | 3028.776  | -102.7      | 402.1       | 34.4        | 3.26            | 1.82            | 2.11            |
| 22.0        | 5165.842  | 2183.923  | 3028.812  | -99.5       | 404.0       | 36.5        | 3.29            | 1.91            | 2.16            |
| 23.0        | 5165.745  | 2184.328  | 3028.849  | -96.2       | 405.9       | 38.7        | 3.32            | 1.99            | 2.20            |
| 24.0        | 5165.650  | 2184.735  | 3028.889  | -92.9       | 407.9       | 40.9        | 3.35            | 2.08            | 2.25            |
| 25.0        | 5165.559  | 2185.144  | 3028.931  | -89.6       | 410.0       | 43.2        | 3.38            | 2.18            | 2.30            |
| 26.0        | 5165.471  | 2185.555  | 3028.976  | -86.2       | 412.2       | 45.5        | 3.41            | 2.28            | 2.35            |
| 27.0        | 5165.386  | 2185.968  | 3029.022  | -82.8       | 414.4       | 47.9        | 3.44            | 2.38            | 2.41            |
| 28.0        | 5165.305  | 2186.384  | 3029.072  | -79.4       | 416.8       | 50.3        | 3.48            | 2.49            | 2.48            |
| 29.0        | 5165.227  | 2186.803  | 3029.123  | -75.9       | 419.3       | 52.8        | 3.50            | 2.59            | 2.55            |
| 30.0        | 5165.153  | 2187.223  | 3029.177  | -72.4       | 421.9       | 55.4        | 3.53            | 2.69            | 2.64            |
| 31.0        | 5165.082  | 2187.646  | 3029.234  | -68.9       | 424.6       | 58.1        | 3.53            | 2.81            | 2.75            |
| 32.0        | 5165.015  | 2188.073  | 3029.294  | -65.4       | 427.5       | 60.9        | 3.52            | 2.94            | 2.87            |
| 33.0        | 5164.951  | 2188.501  | 3029.356  | -61.9       | 430.4       | 63.9        | 3.50            | 3.08            | 2.98            |
| 34.0        | 5164.891  | 2188.934  | 3029.422  | -58.5       | 433.5       | 66.9        | 3.51            | 3.22            | 3.06            |
| 35.0        | 5164.834  | 2189.369  | 3029.490  | -55.0       | 436.8       | 70.0        | 3.55            | 3.36            | 3.12            |
| 36.0        | 5164.780  | 2189.808  | 3029.562  | -51.4       | 440.2       | 73.1        | 3.57            | 3.49            | 3.16            |
| 37.0        | 5164.731  | 2190.250  | 3029.636  | -47.9       | 443.7       | 76.3        | 3.59            | 3.62            | 3.21            |
| 38.0        | 5164.685  | 2190.695  | 3029.714  | -44.3       | 447.3       | 79.5        | 3.61            | 3.76            | 3.28            |
| 39.0        | 5164.642  | 2191.145  | 3029.796  | -40.8       | 451.1       | 82.9        | 3.60            | 3.92            | 3.37            |
| 40.0        | 5164.603  | 2191.598  | 3029.880  | -37.2       | 455.1       | 86.3        | 3.57            | 4.07            | 3.46            |
| 41.0        | 5164.567  | 2192.055  | 3029.968  | -33.7       | 459.2       | 89.8        | 3.55            | 4.25            | 3.56            |
| 42.0        | 5164.535  | 2192.517  | 3030.060  | -30.1       | 463.5       | 93.4        | 3.56            | 4.46            | 3.65            |
| 43.0        | 5164.507  | 2192.983  | 3030.155  | -26.6       | 468.1       | 97.1        | 3.54            | 4.68            | 3.72            |
| 44.0        | 5164.482  | 2193.454  | 3030.254  | -23.1       | 472.8       | 100.8       | 3.52            | 4.88            | 3.79            |
| 45.0        | 5164.460  | 2193.929  | 3030.357  | -19.7       | 477.7       | 104.7       | 3.49            | 5.08            | 3.88            |
| 46.0        | 5164.442  | 2194.410  | 3030.464  | -16.3       | 482.9       | 108.6       | 3.40            | 5.26            | 3.95            |
| 47.0        | 5164.428  | 2194.895  | 3030.575  | -12.9       | 488.2       | 112.6       | 3.34            | 5.44            | 4.07            |
| 48.0        | 5164.416  | 2195.386  | 3030.689  | -9.6        | 493.7       | 116.7       | 3.29            | 5.62            | 4.20            |
| 49.0        | 5164.408  | 2195.883  | 3030.808  | -6.4        | 499.3       | 121.0       | 3.24            | 5.80            | 4.33            |
| 50.0        | 5164.403  | 2196.385  | 3030.931  | -3.2        | 505.2       | 125.4       | 3.20            | 6.00            | 4.44            |
| 51.0        | 5164.401  | 2196.894  | 3031.059  | -0.1        | 511.2       | 129.9       | 3.10            | 6.20            | 4.52            |
| 52.0        | 5164.403  | 2197.409  | 3031.191  | 3.1         | 517.4       | 134.4       | 3.16            | 6.40            | 4.56            |
| 53.0        | 5164.407  | 2197.930  | 3031.328  | 6.1         | 523.9       | 139.1       | 3.01            | 6.62            | 4.69            |
| 54.0        | 5164.415  | 2198.457  | 3031.470  | 9.1         | 530.5       | 143.8       | 2.99            | 6.77            | 4.75            |
| 55.0        | 5164.425  | 2198.991  | 3031.616  | 12.0        | 537.3       | 148.5       | 2.87            | 6.94            | 4.76            |
| 56.0        | 5164.439  | 2199.532  | 3031.767  | 14.9        | 544.4       | 153.4       | 2.84            | 7.26            | 4.84            |
| 57.0        | 5164.455  | 2200.080  | 3031.923  | 17.5        | 551.6       | 158.2       | 2.64            | 7.38            | 4.82            |
| 58.0        | 5164.474  | 2200.636  | 3032.084  | 20.1        | 559.0       | 163.1       | 2.52            | 7.48            | 4.83            |
| 59.0        | 5164.495  | 2201.199  | 3032.250  | 22.5        | 566.5       | 168.0       | 2.28            | 7.66            | 4.92            |

MACH ONE

59.760 5164.513 2201.632 3032.379 24.1 572.2 171.7 2.14 7.71 4.91

TABLE XII  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>KM | YSP<br>KM | ZSP<br>KM | DXSP<br>M/S | DYSP<br>M/S | DZSP<br>M/S | DDXSP<br>M/S SQ | DDYSP<br>M/S SQ | DCZSP<br>M/S SQ |
|-------------|-----------|-----------|-----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 60.0        | 5164.518  | 2201.770  | 3032.420  | 24.6        | 574.0       | 172.9       | 2.09            | 7.74            | 4.93            |
| 61.0        | 5164.544  | 2202.348  | 3032.596  | 26.5        | 581.7       | 177.9       | 1.88            | 7.88            | 4.97            |
| 62.0        | 5164.572  | 2202.934  | 3032.776  | 28.3        | 589.6       | 182.9       | 1.76            | 8.03            | 5.07            |
| 63.0        | 5164.601  | 2203.528  | 3032.962  | 30.2        | 597.7       | 187.9       | 1.87            | 8.26            | 4.96            |
| 64.0        | 5164.632  | 2204.129  | 3033.152  | 32.1        | 606.0       | 192.9       | 1.91            | 8.53            | 4.96            |
| 65.0        | 5164.665  | 2204.740  | 3033.348  | 34.0        | 614.6       | 198.0       | 1.75            | 8.78            | 5.17            |
| 66.0        | 5164.700  | 2205.359  | 3033.549  | 35.7        | 623.4       | 203.2       | 1.68            | 9.05            | 5.22            |
| 67.0        | 5164.736  | 2205.988  | 3033.755  | 37.4        | 632.5       | 208.5       | 1.65            | 9.29            | 5.29            |
| 68.0        | 5164.775  | 2206.625  | 3033.966  | 39.0        | 641.9       | 213.9       | 1.61            | 9.54            | 5.38            |
| 69.0        | 5164.815  | 2207.272  | 3034.183  | 40.6        | 651.5       | 219.4       | 1.51            | 9.89            | 5.45            |
| 70.0        | 5164.856  | 2207.929  | 3034.405  | 42.0        | 661.6       | 225.0       | 1.34            | 10.24           | 5.57            |
| 71.0        | 5164.899  | 2208.595  | 3034.633  | 43.3        | 671.9       | 230.6       | 1.24            | 10.60           | 5.70            |
| 71.500      | 5164.920  | 2208.933  | 3034.749  | 43.9        | 677.2       | 233.5       | 1.20            | 10.76           | 5.79            |
| 72.0        | 5164.943  | 2209.273  | 3034.867  | 44.4        | 682.6       | 236.4       | 1.17            | 10.87           | 5.88            |
| 73.0        | 5164.988  | 2209.961  | 3035.106  | 45.6        | 693.5       | 242.4       | 1.12            | 11.05           | 6.14            |
| 74.0        | 5165.034  | 2210.660  | 3035.352  | 46.6        | 704.6       | 248.7       | 1.10            | 11.13           | 6.44            |
| 75.0        | 5165.081  | 2211.371  | 3035.604  | 47.7        | 715.7       | 255.3       | 1.09            | 11.21           | 6.73            |
| 76.0        | 5165.129  | 2212.092  | 3035.863  | 48.7        | 727.0       | 262.2       | 1.04            | 11.39           | 7.03            |
| 77.0        | 5165.178  | 2212.826  | 3036.129  | 49.7        | 738.4       | 269.4       | 0.91            | 11.60           | 7.28            |
| 78.0        | 5165.229  | 2213.570  | 3036.402  | 50.4        | 750.1       | 276.7       | 0.73            | 11.89           | 7.47            |
| 79.0        | 5165.279  | 2214.326  | 3036.683  | 51.0        | 762.2       | 284.2       | 0.56            | 12.27           | 7.58            |
| 80.0        | 5165.331  | 2215.095  | 3036.971  | 51.6        | 774.6       | 291.8       | 0.50            | 12.70           | 7.62            |
| 81.0        | 5165.383  | 2215.876  | 3037.267  | 52.1        | 787.5       | 299.5       | 0.54            | 13.10           | 7.64            |
| 82.0        | 5165.435  | 2216.670  | 3037.570  | 52.6        | 800.7       | 307.2       | 0.64            | 13.41           | 7.67            |
| 83.0        | 5165.488  | 2217.478  | 3037.881  | 53.3        | 814.1       | 314.9       | 0.74            | 13.61           | 7.76            |
| 84.0        | 5165.542  | 2218.299  | 3038.200  | 54.0        | 827.7       | 322.6       | 0.75            | 13.68           | 7.81            |
| 85.0        | 5165.596  | 2219.133  | 3038.527  | 54.7        | 841.5       | 330.5       | 0.68            | 13.85           | 7.90            |
| 86.0        | 5165.651  | 2219.982  | 3038.862  | 55.3        | 855.5       | 338.5       | 0.56            | 14.18           | 8.05            |
| 87.0        | 5165.707  | 2220.845  | 3039.204  | 55.7        | 869.8       | 346.6       | 0.40            | 14.56           | 8.22            |
| 88.0        | 5165.763  | 2221.722  | 3039.555  | 56.0        | 884.5       | 354.9       | 0.24            | 14.96           | 8.40            |
| 89.0        | 5165.819  | 2222.615  | 3039.914  | 56.2        | 899.6       | 363.4       | 0.09            | 15.29           | 8.56            |
| 90.0        | 5165.875  | 2223.522  | 3040.282  | 56.1        | 915.0       | 372.0       | -0.05           | 15.59           | 8.71            |
| 91.0        | 5165.932  | 2224.445  | 3040.659  | 55.9        | 930.7       | 380.8       | -0.24           | 15.87           | 8.85            |
| 92.0        | 5165.987  | 2225.384  | 3041.044  | 55.6        | 946.6       | 389.7       | -0.45           | 16.18           | 8.99            |
| 93.0        | 5166.043  | 2226.339  | 3041.438  | 55.0        | 962.9       | 398.8       | -0.65           | 16.54           | 9.14            |
| 94.0        | 5166.097  | 2227.310  | 3041.842  | 54.3        | 979.7       | 408.0       | -0.79           | 16.90           | 9.27            |
| 95.0        | 5166.151  | 2228.298  | 3042.255  | 53.4        | 996.7       | 417.3       | -0.92           | 17.27           | 9.40            |
| 96.0        | 5166.204  | 2229.304  | 3042.677  | 52.3        | 1014.1      | 426.8       | -1.04           | 17.62           | 9.50            |
| 97.0        | 5166.256  | 2230.327  | 3043.108  | 51.2        | 1031.8      | 436.3       | -1.20           | 17.90           | 9.57            |
| 98.0        | 5166.307  | 2231.367  | 3043.549  | 49.9        | 1049.8      | 445.9       | -1.35           | 18.21           | 9.66            |

MAX Q

TABLE XII  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>KM | YSP<br>KM | ZSP<br>KM | DXSP<br>M/S | DYSP<br>M/S | DZSP<br>M/S | DDXSP<br>M/S SQ | DDYSP<br>M/S SQ | DDZSP<br>M/S SQ |
|-------------|-----------|-----------|-----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 99.0        | 5166.356  | 2232.427  | 3044.000  | 48.4        | 1068.2      | 455.6       | -1.49           | 18.50           | 9.75            |
| 100.0       | 5166.404  | 2233.504  | 3044.461  | 46.9        | 1086.8      | 465.4       | -1.63           | 18.83           | 9.89            |
| 101.0       | 5166.450  | 2234.601  | 3044.931  | 45.1        | 1105.7      | 475.4       | -1.75           | 19.14           | 10.02           |
| 102.0       | 5166.495  | 2235.716  | 3045.412  | 43.3        | 1124.9      | 485.5       | -1.87           | 19.44           | 10.16           |
| 103.0       | 5166.537  | 2236.851  | 3045.903  | 41.3        | 1144.5      | 495.7       | -1.98           | 19.73           | 10.27           |
| 104.0       | 5166.577  | 2238.006  | 3046.404  | 39.2        | 1164.4      | 506.0       | -2.11           | 20.06           | 10.40           |
| 105.0       | 5166.616  | 2239.180  | 3046.915  | 37.0        | 1184.5      | 516.5       | -2.24           | 20.38           | 10.50           |
| 106.0       | 5166.652  | 2240.375  | 3047.437  | 34.7        | 1205.0      | 527.0       | -2.35           | 20.70           | 10.61           |
| 107.0       | 5166.685  | 2241.590  | 3047.969  | 32.3        | 1225.9      | 537.7       | -2.46           | 21.03           | 10.73           |
| 108.0       | 5166.716  | 2242.827  | 3048.512  | 29.8        | 1247.1      | 548.5       | -2.55           | 21.43           | 10.90           |
| 109.0       | 5166.745  | 2244.084  | 3049.066  | 27.1        | 1268.6      | 559.5       | -2.67           | 21.78           | 11.06           |
| 110.0       | 5166.771  | 2245.364  | 3049.632  | 24.3        | 1290.5      | 570.6       | -2.79           | 22.10           | 11.21           |
| 111.0       | 5166.794  | 2246.666  | 3050.208  | 21.4        | 1312.7      | 581.9       | -2.96           | 22.39           | 11.34           |
| 112.0       | 5166.814  | 2247.990  | 3050.796  | 18.4        | 1335.2      | 593.3       | -3.11           | 22.69           | 11.46           |
| 113.0       | 5166.831  | 2249.337  | 3051.395  | 15.2        | 1358.0      | 604.8       | -3.26           | 23.05           | 11.60           |
| 114.0       | 5166.844  | 2250.706  | 3052.006  | 11.8        | 1381.2      | 616.5       | -3.42           | 23.45           | 11.78           |
| 115.0       | 5166.854  | 2252.099  | 3052.628  | 8.3         | 1404.8      | 628.4       | -3.55           | 23.83           | 11.93           |
| 116.0       | 5166.861  | 2253.516  | 3053.262  | 4.6         | 1428.7      | 640.4       | -3.70           | 24.13           | 12.06           |
| 117.0       | 5166.864  | 2254.957  | 3053.909  | 0.8         | 1453.0      | 652.5       | -3.87           | 24.41           | 12.19           |
| 118.0       | 5166.863  | 2256.423  | 3054.568  | -3.2        | 1477.6      | 664.8       | -4.04           | 24.81           | 12.36           |
| 119.0       | 5166.858  | 2257.912  | 3055.239  | -7.4        | 1502.6      | 677.2       | -4.24           | 25.24           | 12.54           |
| 120.0       | 5166.849  | 2259.428  | 3055.922  | -11.7       | 1528.0      | 689.9       | -4.44           | 25.66           | 12.71           |
| 121.0       | 5166.835  | 2260.969  | 3056.619  | -16.3       | 1553.8      | 702.6       | -4.66           | 26.07           | 12.87           |
| 122.0       | 5166.816  | 2262.535  | 3057.328  | -21.1       | 1580.0      | 715.6       | -4.88           | 26.47           | 13.01           |
| 123.0       | 5166.793  | 2264.129  | 3058.050  | -26.1       | 1606.6      | 728.6       | -5.11           | 26.83           | 13.13           |
| 124.0       | 5166.764  | 2265.749  | 3058.786  | -31.4       | 1633.6      | 741.8       | -5.34           | 27.17           | 13.24           |
| 125.0       | 5166.730  | 2267.397  | 3059.534  | -36.9       | 1660.9      | 755.1       | -5.59           | 27.60           | 13.38           |
| 126.0       | 5166.691  | 2269.071  | 3060.296  | -42.7       | 1688.7      | 768.6       | -5.89           | 28.08           | 13.54           |
| 127.0       | 5166.646  | 2270.774  | 3061.072  | -48.7       | 1717.0      | 782.3       | -6.18           | 28.59           | 13.73           |
| 128.0       | 5166.594  | 2272.506  | 3061.861  | -55.1       | 1745.8      | 796.1       | -6.48           | 29.10           | 13.91           |
| 129.0       | 5166.536  | 2274.266  | 3062.664  | -61.7       | 1775.1      | 810.0       | -6.80           | 29.57           | 14.05           |
| 130.0       | 5166.470  | 2276.055  | 3063.481  | -68.8       | 1804.8      | 824.1       | -7.15           | 29.99           | 14.17           |
| 131.0       | 5166.398  | 2277.875  | 3064.312  | -76.2       | 1835.0      | 838.4       | -7.54           | 30.44           | 14.31           |
| 132.0       | 5166.319  | 2279.724  | 3065.158  | -83.9       | 1865.5      | 852.7       | -7.85           | 30.89           | 14.39           |
| 133.0       | 5166.231  | 2281.605  | 3066.018  | -92.0       | 1896.6      | 867.2       | -8.27           | 31.40           | 14.56           |
| 134.0       | 5166.135  | 2283.517  | 3066.892  | -100.6      | 1928.2      | 881.8       | -8.68           | 31.92           | 14.71           |
| 135.0       | 5166.030  | 2285.461  | 3067.782  | -109.4      | 1960.3      | 896.6       | -8.94           | 32.38           | 14.88           |
| 136.0       | 5165.917  | 2287.437  | 3068.686  | -118.3      | 1992.9      | 911.6       | -9.02           | 32.83           | 15.09           |
| 137.0       | 5165.794  | 2289.446  | 3069.605  | -127.3      | 2025.9      | 926.9       | -9.04           | 33.28           | 15.33           |
| 138.0       | 5165.663  | 2291.488  | 3070.539  | -136.1      | 2059.4      | 942.5       | -8.95           | 33.67           | 15.59           |
| 138.970     | 5165.527  | 2293.501  | 3071.461  | -145.0      | 2091.8      | 957.5       | -8.82           | 33.97           | 15.80           |

IECO

TABLE XII  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC                                      | XSP<br>KM | YSP<br>KM | ZSP<br>KM | CXSP<br>M/S | DYSP<br>M/S | DZSP<br>M/S | DDXSP<br>M/S SQ | DDYSP<br>M/S SQ | DDZSP<br>M/S SQ |
|--|-----------|-----------|-----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 139.0  | 5165.522  | 2293.564  | 3071.490  | -145.0      | 2092.4      | 957.8       | -8.83           | 34.04           | 15.83           |
| 140.0  | 5165.372  | 2295.670  | 3072.453  | -153.5      | 2113.3      | 966.5       | -8.94           | 17.58           | 6.59            |
| 141.0  | 5165.215  | 2297.791  | 3073.423  | -161.8      | 2129.4      | 972.5       | -8.47           | 16.14           | 5.96            |
| 142.0  | 5165.049  | 2299.928  | 3074.398  | -170.0      | 2143.4      | 977.4       | -7.79           | 14.31           | 5.19            |
| OEEO   |           |           |           |             |             |             |                 |                 |                 |
| 142.250  | 5165.007  | 2300.464  | 3074.643  | -172.0      | 2146.6      | 978.5       | -8.22           | 13.03           | 4.34            |
| 143.0  | 5164.875  | 2302.077  | 3075.377  | -178.0      | 2148.6      | 977.5       | -8.13           | 3.56            | -0.88           |
| S-1B/S-IVB SEPARATION SIGNAL                     |           |           |           |             |             |             |                 |                 |                 |
| 143.500  | 5164.785  | 2303.151  | 3075.866  | -181.9      | 2147.5      | 975.5       | -7.72           | -1.90           | -3.77           |
| EBW FIRING (SEPARATION SIGNAL PLUS 0.07 SECONDS) |           |           |           |             |             |             |                 |                 |                 |
| 143.570  | 5164.781  | 2303.297  | 3075.934  | -182.5      | 2147.3      | 975.3       | -7.71           | -1.97           | -3.82           |
| 144.0  | 5164.702  | 2304.220  | 3076.353  | -185.9      | 2146.0      | 973.4       | -7.48           | -2.56           | -4.06           |
| 145.0  | 5164.512  | 2306.364  | 3077.325  | -193.6      | 2142.9      | 969.1       | -7.47           | -2.96           | -4.28           |
| 150.0  | 5163.447  | 2317.055  | 3082.123  | -232.9      | 2140.0      | 954.1       | -8.01           | 2.07            | -1.54           |
| 155.0  | 5162.184  | 2327.784  | 3086.878  | -272.3      | 2152.8      | 948.6       | -7.91           | 2.95            | -0.89           |
| GUIDANCE INITIATION                              |           |           |           |             |             |             |                 |                 |                 |
| 159.470  | 5160.888  | 2337.435  | 3091.109  | -307.6      | 2165.8      | 944.6       | -7.94           | 3.10            | -0.80           |
| 160.0  | 5160.724  | 2338.583  | 3091.609  | -311.7      | 2167.4      | 944.1       | -7.92           | 3.10            | -0.82           |
| 165.0  | 5159.067  | 2349.458  | 3096.318  | -351.3      | 2182.8      | 939.4       | -8.02           | 3.28            | -1.04           |
| 170.0  | 5157.208  | 2360.413  | 3100.999  | -392.7      | 2199.6      | 932.9       | -8.37           | 3.45            | -1.33           |
| 175.0  | 5155.140  | 2371.455  | 3105.648  | -434.4      | 2216.9      | 926.5       | -8.25           | 3.56            | -1.27           |
| 180.0  | 5152.864  | 2382.583  | 3110.264  | -475.8      | 2234.6      | 920.1       | -8.28           | 3.58            | -1.26           |
| 185.0  | 5150.381  | 2393.801  | 3114.849  | -517.3      | 2252.5      | 913.9       | -8.28           | 3.67            | -1.21           |
| 190.0  | 5147.691  | 2405.109  | 3119.404  | -559.0      | 2270.8      | 907.8       | -8.32           | 3.74            | -1.22           |
| 195.0  | 5144.791  | 2416.510  | 3123.928  | -600.9      | 2289.5      | 901.8       | -8.41           | 3.82            | -1.19           |
| 200.0  | 5141.681  | 2428.005  | 3128.421  | -643.2      | 2308.7      | 895.6       | -8.44           | 3.92            | -1.28           |
| 205.0  | 5138.358  | 2439.597  | 3132.883  | -685.9      | 2328.4      | 888.9       | -8.56           | 4.05            | -1.39           |
| 210.0  | 5134.821  | 2451.290  | 3137.310  | -729.0      | 2348.5      | 881.8       | -8.61           | 4.10            | -1.43           |
| 215.0  | 5131.068  | 2463.083  | 3141.701  | -772.3      | 2369.0      | 874.7       | -8.65           | 4.16            | -1.42           |
| 220.0  | 5127.098  | 2474.980  | 3146.057  | -815.8      | 2389.7      | 867.6       | -8.72           | 4.21            | -1.41           |
| 225.0  | 5122.910  | 2486.981  | 3150.377  | -859.6      | 2410.9      | 860.6       | -8.74           | 4.32            | -1.38           |
| 230.0  | 5118.502  | 2499.089  | 3154.663  | -903.5      | 2432.3      | 853.8       | -8.78           | 4.38            | -1.35           |

TABLE XII  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>KM | YSP<br>KM | ZSP<br>KM | CXSP<br>M/S | DYSP<br>M/S | DZSP<br>M/S | DDXSP<br>M/S SQ | DDYSP<br>M/S SQ | DDZSP<br>M/S SQ |
|-------------|-----------|-----------|-----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 235.0       | 5113.874  | 2511.305  | 3158.916  | -947.8      | 2454.2      | 847.1       | -8.84           | 4.47            | -1.35           |
| 240.0       | 5109.024  | 2523.632  | 3163.134  | -992.3      | 2476.4      | 840.3       | -8.90           | 4.52            | -1.34           |
| 245.0       | 5103.951  | 2536.070  | 3167.319  | -1037.1     | 2498.9      | 833.6       | -8.96           | 4.56            | -1.33           |
| 250.0       | 5098.652  | 2548.621  | 3171.471  | -1082.2     | 2521.7      | 827.1       | -9.02           | 4.66            | -1.29           |
| 255.0       | 5093.129  | 2561.287  | 3175.590  | -1127.3     | 2544.7      | 820.5       | -9.00           | 4.68            | -1.31           |
| 260.0       | 5087.379  | 2574.070  | 3179.676  | -1172.8     | 2568.3      | 814.1       | -9.10           | 4.82            | -1.26           |
| 265.0       | 5081.400  | 2586.972  | 3183.731  | -1218.5     | 2592.4      | 807.9       | -9.13           | 4.89            | -1.24           |
| 270.0       | 5075.193  | 2599.994  | 3187.755  | -1264.4     | 2616.8      | 801.7       | -9.22           | 4.96            | -1.23           |
| 275.0       | 5068.755  | 2613.140  | 3191.748  | -1310.8     | 2641.6      | 795.6       | -9.28           | 5.05            | -1.22           |
| 280.0       | 5062.084  | 2626.411  | 3195.711  | -1357.6     | 2666.8      | 789.5       | -9.35           | 5.10            | -1.22           |
| 285.0       | 5055.179  | 2639.809  | 3199.643  | -1404.7     | 2692.3      | 783.4       | -9.42           | 5.19            | -1.20           |
| 290.0       | 5048.037  | 2653.334  | 3203.546  | -1452.1     | 2718.0      | 777.9       | -9.51           | 5.17            | -0.95           |
| 295.0       | 5040.657  | 2666.988  | 3207.424  | -1499.9     | 2743.6      | 773.5       | -9.53           | 5.22            | -0.92           |
| 300.0       | 5033.039  | 2680.772  | 3211.279  | -1547.8     | 2770.2      | 768.3       | -9.57           | 5.46            | -1.17           |
| 305.0       | 5025.180  | 2694.691  | 3215.106  | -1595.9     | 2797.6      | 762.3       | -9.65           | 5.57            | -1.19           |
| 310.0       | 5017.079  | 2708.748  | 3218.903  | -1644.5     | 2825.4      | 756.7       | -9.75           | 5.66            | -1.06           |
| 315.0       | 5008.734  | 2722.946  | 3222.673  | -1693.6     | 2853.6      | 751.4       | -9.81           | 5.74            | -1.09           |
| 320.0       | 5000.143  | 2737.285  | 3226.416  | -1743.0     | 2882.4      | 745.8       | -9.92           | 5.84            | -1.11           |
| 325.0       | 4991.303  | 2751.771  | 3230.132  | -1793.0     | 2911.7      | 740.4       | -10.01          | 5.94            | -1.08           |
| 330.0       | 4982.212  | 2766.404  | 3233.820  | -1843.4     | 2941.3      | 735.0       | -10.10          | 6.02            | -1.08           |
| 335.0       | 4972.868  | 2781.185  | 3237.482  | -1894.1     | 2971.3      | 729.6       | -10.16          | 6.10            | -1.06           |
| 340.0       | 4963.269  | 2796.118  | 3241.116  | -1945.3     | 3002.0      | 724.4       | -10.24          | 6.24            | -1.03           |
| 345.0       | 4953.414  | 2811.205  | 3244.726  | -1996.9     | 3033.2      | 719.3       | -10.31          | 6.35            | -1.01           |
| 350.0       | 4943.300  | 2826.451  | 3248.310  | -2048.8     | 3064.9      | 714.3       | -10.40          | 6.43            | -0.98           |
| 355.0       | 4932.926  | 2841.855  | 3251.869  | -2101.2     | 3097.0      | 709.5       | -10.51          | 6.54            | -0.96           |
| 360.0       | 4922.287  | 2857.422  | 3255.404  | -2154.2     | 3129.8      | 704.6       | -10.62          | 6.67            | -0.95           |
| 365.0       | 4911.383  | 2873.153  | 3258.915  | -2207.6     | 3163.3      | 700.0       | -10.76          | 6.86            | -0.91           |
| 370.0       | 4900.210  | 2889.055  | 3262.404  | -2261.7     | 3197.4      | 695.4       | -10.89          | 6.88            | -0.89           |
| 375.0       | 4888.765  | 2905.128  | 3265.870  | -2316.5     | 3232.2      | 690.9       | -10.96          | 7.12            | -0.90           |
| 380.0       | 4877.044  | 2921.378  | 3269.314  | -2372.0     | 3267.6      | 686.5       | -11.15          | 7.21            | -0.87           |
| 385.0       | 4865.044  | 2937.806  | 3272.735  | -2428.1     | 3303.7      | 682.1       | -11.26          | 7.33            | -0.87           |
| 390.0       | 4852.762  | 2954.416  | 3276.135  | -2484.8     | 3340.3      | 677.8       | -11.37          | 7.41            | -0.86           |
| 395.0       | 4840.194  | 2971.210  | 3279.513  | -2542.2     | 3377.5      | 673.5       | -11.50          | 7.56            | -0.84           |
| 400.0       | 4827.339  | 2988.192  | 3282.870  | -2600.0     | 3415.4      | 669.4       | -11.60          | 7.70            | -0.80           |
| 405.0       | 4814.193  | 3005.365  | 3286.207  | -2658.7     | 3454.1      | 665.5       | -11.78          | 7.87            | -0.78           |
| 410.0       | 4800.752  | 3022.734  | 3289.525  | -2717.9     | 3493.5      | 661.6       | -11.90          | 7.98            | -0.77           |
| 415.0       | 4787.012  | 3040.301  | 3292.824  | -2777.9     | 3533.6      | 657.9       | -12.04          | 8.16            | -0.72           |
| 420.0       | 4772.972  | 3058.071  | 3296.104  | -2838.6     | 3574.5      | 654.2       | -12.19          | 8.32            | -0.73           |
| 425.0       | 4758.626  | 3076.048  | 3299.366  | -2900.0     | 3616.3      | 650.6       | -12.34          | 8.48            | -0.70           |
| 430.0       | 4743.970  | 3094.235  | 3302.610  | -2962.4     | 3658.9      | 647.2       | -12.55          | 8.68            | -0.67           |
| 435.0       | 4729.000  | 3112.638  | 3305.838  | -3025.8     | 3702.5      | 644.0       | -12.72          | 8.88            | -0.64           |
| 440.0       | 4713.711  | 3131.261  | 3309.050  | -3089.9     | 3747.1      | 640.8       | -12.92          | 9.08            | -0.62           |
| 445.0       | 4698.099  | 3150.111  | 3312.247  | -3155.4     | 3792.8      | 637.8       | -13.16          | 9.26            | -0.58           |
| 450.0       | 4682.157  | 3169.190  | 3315.428  | -3221.5     | 3839.0      | 634.9       | -13.33          | 9.41            | -0.56           |



TABLE XII  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC           | XSP<br>KM | YSP<br>KM | ZSP<br>KM | DXSP<br>M/S | DYSP<br>M/S | DZSP<br>M/S | DDXSP<br>M/S SQ | DDYSP<br>M/S SQ | DDZSP<br>M/S SQ |
|-----------------------|-----------|-----------|-----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 455.0                 | 4665.881  | 3188.503  | 3318.596  | -3288.8     | 3886.4      | 632.2       | -13.53          | 9.65            | -0.55           |
| 460.0                 | 4649.267  | 3208.057  | 3321.750  | -3357.1     | 3935.0      | 629.5       | -13.75          | 9.86            | -0.53           |
| 465.0                 | 4632.309  | 3227.855  | 3324.891  | -3426.5     | 3984.6      | 626.9       | -13.97          | 10.06           | -0.52           |
| 470.0                 | 4615.000  | 3247.903  | 3328.019  | -3496.9     | 4035.0      | 624.3       | -14.19          | 10.25           | -0.51           |
| 475.0                 | 4597.337  | 3268.207  | 3331.134  | -3568.6     | 4086.7      | 621.9       | -14.43          | 10.52           | -0.46           |
| 480.0                 | 4579.313  | 3288.773  | 3334.238  | -3641.4     | 4139.7      | 619.7       | -14.70          | 10.74           | -0.43           |
| 485.0                 | 4560.920  | 3309.605  | 3337.330  | -3716.3     | 4193.5      | 617.1       | -15.27          | 10.90           | -0.62           |
| 490.0                 | 4542.144  | 3330.709  | 3340.407  | -3794.3     | 4248.2      | 613.7       | -15.75          | 11.00           | -0.71           |
| 495.0                 | 4522.974  | 3352.087  | 3343.467  | -3873.9     | 4303.1      | 610.0       | -16.02          | 11.04           | -0.80           |
| 500.0                 | 4503.404  | 3373.739  | 3346.506  | -3954.0     | 4357.3      | 605.5       | -16.09          | 10.84           | -0.94           |
| 505.0                 | 4483.432  | 3395.660  | 3349.521  | -4035.0     | 4411.1      | 600.6       | -16.12          | 10.59           | -1.09           |
| 510.0                 | 4463.055  | 3417.847  | 3352.510  | -4115.7     | 4463.4      | 594.6       | -16.07          | 10.46           | -1.29           |
| 515.0                 | 4442.277  | 3440.292  | 3355.466  | -4195.6     | 4514.6      | 588.0       | -15.97          | 10.27           | -1.24           |
| 520.0                 | 4421.098  | 3462.994  | 3358.392  | -4275.9     | 4566.3      | 582.2       | -16.02          | 10.39           | -1.13           |
| 525.0                 | 4399.519  | 3485.954  | 3361.289  | -4355.9     | 4617.9      | 576.9       | -15.94          | 10.36           | -0.97           |
| 530.0                 | 4377.540  | 3509.173  | 3364.162  | -4435.8     | 4670.1      | 572.5       | -15.95          | 10.63           | -0.83           |
| 535.0                 | 4355.162  | 3532.658  | 3367.015  | -4515.1     | 4723.9      | 568.9       | -15.75          | 10.98           | -0.58           |
| 540.0                 | 4332.391  | 3556.415  | 3369.854  | -4593.3     | 4779.7      | 567.0       | -15.48          | 11.47           | -0.19           |
| 545.0                 | 4309.230  | 3580.459  | 3372.688  | -4671.1     | 4837.9      | 566.5       | -15.66          | 11.79           | -0.10           |
| 550.0                 | 4285.676  | 3604.794  | 3375.518  | -4751.7     | 4896.5      | 565.1       | -16.72          | 11.78           | -0.53           |
| 555.0                 | 4261.704  | 3629.424  | 3378.335  | -4837.7     | 4955.3      | 561.6       | -17.55          | 11.86           | -0.84           |
| 560.0                 | 4237.294  | 3654.349  | 3381.132  | -4926.6     | 5015.1      | 557.1       | -17.95          | 12.17           | -0.90           |
| 565.0                 | 4212.435  | 3679.578  | 3383.907  | -5017.2     | 5076.6      | 552.9       | -18.23          | 12.51           | -0.78           |
| 570.0                 | 4187.120  | 3705.117  | 3386.661  | -5109.7     | 5139.5      | 548.9       | -18.82          | 12.69           | -0.87           |
| 575.0                 | 4161.332  | 3730.974  | 3389.393  | -5206.1     | 5203.3      | 543.7       | -19.69          | 12.89           | -1.22           |
| 580.0                 | 4135.053  | 3757.152  | 3392.096  | -5305.7     | 5268.6      | 537.5       | -20.03          | 13.42           | -1.18           |
| 585.0                 | 4108.272  | 3783.663  | 3394.769  | -5407.0     | 5336.3      | 531.8       | -20.62          | 13.73           | -1.12           |
| 590.0                 | 4080.979  | 3810.516  | 3397.415  | -5511.2     | 5405.7      | 526.6       | -20.93          | 14.23           | -0.96           |
| S-IVB GUIDANCE CUTOFF |           |           |           |             |             |             |                 |                 |                 |
| 593.340               | 4062.456  | 3828.651  | 3399.169  | -5580.6     | 5454.1      | 523.9       | -20.56          | 14.79           | -0.70           |
| 595.0                 | 4053.179  | 3837.705  | 3400.033  | -5594.5     | 5450.9      | 517.1       | -5.89           | -5.22           | -4.80           |
| 600.0                 | 4025.133  | 3864.892  | 3402.558  | -5623.5     | 5423.7      | 492.8       | -5.73           | -5.47           | -4.87           |
| ORBIT INSERTION       |           |           |           |             |             |             |                 |                 |                 |
| 603.340               | 4006.318  | 3882.976  | 3404.177  | -5642.7     | 5405.3      | 476.6       | -5.70           | -5.49           | -4.87           |
| 605.0                 | 3996.945  | 3891.945  | 3404.955  | -5652.2     | 5396.1      | 468.5       | -5.69           | -5.50           | -4.87           |
| 610.0                 | 3968.613  | 3918.856  | 3407.237  | -5680.7     | 5368.2      | 444.1       | -5.68           | -5.51           | -4.87           |
| 620.0                 | 3911.523  | 3972.259  | 3411.434  | -5737.2     | 5312.3      | 395.3       | -5.60           | -5.59           | -4.88           |
| 630.0                 | 3853.871  | 4025.099  | 3415.143  | -5793.0     | 5255.5      | 346.5       | -5.52           | -5.67           | -4.89           |

TABLE XII  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>KM | YSP<br>KM | ZSP<br>KM | DXSP<br>M/S | DYSP<br>M/S | DZSP<br>M/S | DDXSP<br>M/S SQ | DDYSP<br>M/S SQ | DDZSP<br>M/S SQ |
|-------------|-----------|-----------|-----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 640.0       | 3795.667  | 4077.366  | 3418.364  | -5847.8     | 5197.9      | 297.6       | -5.40           | -5.77           | -4.89           |
| 650.0       | 3736.919  | 4129.054  | 3421.095  | -5901.5     | 5139.4      | 248.7       | -5.32           | -5.84           | -4.90           |
| 660.0       | 3677.639  | 4180.152  | 3423.337  | -5954.4     | 5080.1      | 199.7       | -5.24           | -5.91           | -4.90           |
| 670.0       | 3617.834  | 4230.653  | 3425.089  | -6006.5     | 5020.1      | 150.7       | -5.15           | -5.99           | -4.90           |
| 680.0       | 3557.513  | 4280.551  | 3426.350  | -6057.6     | 4959.4      | 101.6       | -5.07           | -6.06           | -4.90           |
| 690.0       | 3496.684  | 4329.838  | 3427.122  | -6108.0     | 4897.9      | 52.6        | -4.98           | -6.13           | -4.90           |
| 700.0       | 3435.356  | 4378.507  | 3427.400  | -6157.4     | 4835.8      | 3.5         | -4.89           | -6.20           | -4.91           |
| 710.0       | 3373.539  | 4426.552  | 3427.193  | -6206.0     | 4773.0      | -45.5       | -4.80           | -6.26           | -4.90           |
| 720.0       | 3311.240  | 4473.965  | 3426.492  | -6253.7     | 4709.5      | -94.5       | -4.72           | -6.33           | -4.90           |
| 730.0       | 3248.469  | 4520.739  | 3425.302  | -6300.4     | 4645.3      | -143.6      | -4.63           | -6.40           | -4.90           |
| 740.0       | 3185.234  | 4566.870  | 3423.621  | -6346.3     | 4580.5      | -192.6      | -4.54           | -6.46           | -4.90           |
| 750.0       | 3121.545  | 4612.348  | 3421.451  | -6391.3     | 4515.0      | -241.5      | -4.45           | -6.53           | -4.90           |
| 760.0       | 3057.411  | 4657.168  | 3418.790  | -6435.4     | 4448.9      | -290.5      | -4.36           | -6.59           | -4.89           |
| 770.0       | 2992.841  | 4701.324  | 3415.641  | -6478.5     | 4382.2      | -339.4      | -4.26           | -6.65           | -4.89           |
| 780.0       | 2927.844  | 4744.809  | 3412.003  | -6520.7     | 4314.8      | -388.2      | -4.17           | -6.72           | -4.88           |
| 790.0       | 2862.429  | 4787.617  | 3407.877  | -6562.0     | 4246.8      | -437.0      | -4.08           | -6.78           | -4.88           |
| 800.0       | 2796.606  | 4829.742  | 3403.263  | -6602.4     | 4178.2      | -485.7      | -3.99           | -6.84           | -4.87           |
| 810.0       | 2730.385  | 4871.179  | 3398.162  | -6641.8     | 4109.0      | -534.4      | -3.89           | -6.90           | -4.86           |
| 820.0       | 2663.774  | 4911.921  | 3392.575  | -6680.2     | 4039.2      | -583.0      | -3.80           | -6.95           | -4.85           |
| 830.0       | 2596.783  | 4951.962  | 3386.503  | -6717.8     | 3968.9      | -631.5      | -3.70           | -7.01           | -4.84           |
| 840.0       | 2529.422  | 4991.297  | 3379.946  | -6754.3     | 3898.0      | -679.9      | -3.61           | -7.07           | -4.83           |
| 850.0       | 2461.700  | 5029.920  | 3372.906  | -6789.9     | 3826.5      | -728.2      | -3.51           | -7.12           | -4.82           |
| 860.0       | 2393.628  | 5067.826  | 3365.383  | -6824.5     | 3754.5      | -776.3      | -3.42           | -7.17           | -4.81           |
| 870.0       | 2325.213  | 5105.009  | 3357.379  | -6858.1     | 3682.0      | -824.4      | -3.32           | -7.23           | -4.80           |
| 880.0       | 2256.468  | 5141.464  | 3348.895  | -6890.8     | 3609.0      | -872.4      | -3.22           | -7.28           | -4.79           |
| 890.0       | 2187.401  | 5177.187  | 3339.932  | -6922.5     | 3535.4      | -920.2      | -3.12           | -7.33           | -4.78           |
| 900.0       | 2118.022  | 5212.171  | 3330.492  | -6953.1     | 3461.3      | -967.9      | -3.02           | -7.38           | -4.76           |
| 910.0       | 2048.341  | 5246.412  | 3320.575  | -6982.8     | 3386.8      | -1015.5     | -2.93           | -7.43           | -4.75           |
| 920.0       | 1978.369  | 5279.905  | 3310.183  | -7011.5     | 3311.7      | -1062.9     | -2.83           | -7.47           | -4.73           |
| 930.0       | 1908.114  | 5312.645  | 3299.318  | -7039.2     | 3236.2      | -1110.1     | -2.73           | -7.52           | -4.72           |
| 940.0       | 1837.588  | 5344.628  | 3287.981  | -7065.9     | 3160.3      | -1157.2     | -2.63           | -7.57           | -4.70           |
| 950.0       | 1766.799  | 5375.849  | 3276.174  | -7091.6     | 3083.9      | -1204.1     | -2.53           | -7.61           | -4.68           |
| 960.0       | 1695.759  | 5406.304  | 3263.899  | -7116.3     | 3007.0      | -1250.9     | -2.43           | -7.65           | -4.67           |
| 970.0       | 1624.478  | 5435.989  | 3251.157  | -7139.9     | 2929.8      | -1297.5     | -2.32           | -7.69           | -4.65           |
| 980.0       | 1552.964  | 5464.899  | 3237.950  | -7162.5     | 2852.1      | -1343.8     | -2.22           | -7.74           | -4.63           |
| 990.0       | 1481.230  | 5493.030  | 3224.281  | -7184.2     | 2774.0      | -1390.0     | -2.12           | -7.77           | -4.61           |
| 1000.0      | 1409.285  | 5520.378  | 3210.151  | -7204.7     | 2695.6      | -1436.0     | -2.02           | -7.81           | -4.59           |
| 1010.0      | 1337.138  | 5546.940  | 3195.562  | -7224.3     | 2616.7      | -1481.8     | -1.92           | -7.85           | -4.57           |
| 1020.0      | 1264.802  | 5572.711  | 3180.516  | -7242.8     | 2537.5      | -1527.3     | -1.81           | -7.89           | -4.54           |
| 1030.0      | 1192.285  | 5597.689  | 3165.016  | -7260.3     | 2457.9      | -1572.7     | -1.71           | -7.92           | -4.52           |
| 1040.0      | 1119.599  | 5621.869  | 3149.063  | -7276.8     | 2378.0      | -1617.8     | -1.61           | -7.96           | -4.50           |
| 1050.0      | 1046.753  | 5645.249  | 3132.661  | -7292.2     | 2297.8      | -1662.6     | -1.51           | -7.99           | -4.48           |
| 1060.0      | 973.758   | 5667.824  | 3115.811  | -7306.6     | 2217.2      | -1707.3     | -1.40           | -8.02           | -4.45           |
| 1070.0      | 900.624   | 5689.592  | 3098.516  | -7319.9     | 2136.3      | -1751.7     | -1.30           | -8.05           | -4.43           |

TABLE XII  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>KM | YSP<br>KM | ZSP<br>KM | DXSP<br>M/S | DYSP<br>M/S | DZSP<br>M/S | DDXSP<br>M/S SQ | DDYSP<br>M/S SQ | DDZSP<br>M/S SQ |
|-------------|-----------|-----------|-----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 1080.0      | 827.363   | 5710.550  | 3080.779  | -7332.2     | 2055.2      | -1795.8     | -1.20           | -8.08           | -4.40           |
| 1090.0      | 753.983   | 5730.694  | 3062.601  | -7343.5     | 1973.7      | -1839.7     | -1.09           | -8.11           | -4.37           |
| 1100.0      | 680.497   | 5750.023  | 3043.986  | -7353.7     | 1892.0      | -1883.3     | -0.99           | -8.14           | -4.35           |
| 1110.0      | 606.913   | 5768.533  | 3024.936  | -7362.9     | 1810.0      | -1926.6     | -0.88           | -8.16           | -4.32           |
| 1120.0      | 533.243   | 5786.222  | 3005.455  | -7371.0     | 1727.7      | -1969.7     | -0.78           | -8.19           | -4.29           |
| 1130.0      | 459.498   | 5803.087  | 2985.544  | -7378.0     | 1645.2      | -2012.4     | -0.67           | -8.21           | -4.26           |
| 1140.0      | 385.686   | 5819.126  | 2965.207  | -7384.0     | 1562.5      | -2054.9     | -0.57           | -8.23           | -4.23           |
| 1150.0      | 311.820   | 5834.336  | 2944.446  | -7389.0     | 1479.6      | -2097.1     | -0.47           | -8.25           | -4.20           |
| 1160.0      | 237.910   | 5848.717  | 2923.265  | -7392.9     | 1396.5      | -2139.0     | -0.36           | -8.27           | -4.17           |
| 1170.0      | 163.966   | 5862.265  | 2901.667  | -7395.7     | 1313.1      | -2180.6     | -0.26           | -8.29           | -4.14           |
| 1180.0      | 89.998    | 5874.978  | 2879.655  | -7397.5     | 1229.6      | -2221.8     | -0.15           | -8.31           | -4.11           |
| 1190.0      | 16.018    | 5886.856  | 2857.232  | -7398.3     | 1145.9      | -2262.8     | -0.05           | -8.33           | -4.08           |
| 1200.0      | -57.964   | 5897.897  | 2834.401  | -7398.0     | 1062.1      | -2303.4     | 0.06            | -8.34           | -4.04           |
| 1210.0      | -131.938  | 5908.098  | 2811.166  | -7396.6     | 978.1       | -2343.6     | 0.16            | -8.35           | -4.01           |
| 1220.0      | -205.893  | 5917.459  | 2787.529  | -7394.2     | 894.0       | -2383.6     | 0.27            | -8.37           | -3.98           |
| 1230.0      | -279.819  | 5925.979  | 2763.495  | -7390.8     | 809.8       | -2423.2     | 0.37            | -8.38           | -3.94           |
| 1240.0      | -353.705  | 5933.655  | 2739.067  | -7386.3     | 725.5       | -2462.4     | 0.48            | -8.39           | -3.91           |
| 1250.0      | -427.540  | 5940.488  | 2714.242  | -7380.7     | 641.1       | -2501.3     | 0.58            | -8.40           | -3.87           |
| 1260.0      | -501.315  | 5946.476  | 2689.048  | -7374.1     | 556.6       | -2539.8     | 0.68            | -8.41           | -3.83           |
| 1270.0      | -575.018  | 5951.619  | 2663.453  | -7366.4     | 472.0       | -2578.0     | 0.79            | -8.41           | -3.80           |
| 1280.0      | -648.641  | 5955.915  | 2637.483  | -7357.7     | 387.3       | -2615.8     | 0.89            | -8.42           | -3.76           |
| 1290.0      | -722.170  | 5959.366  | 2611.138  | -7348.0     | 302.7       | -2653.2     | 1.00            | -8.42           | -3.72           |
| 1300.0      | -795.597  | 5961.969  | 2584.420  | -7337.2     | 217.9       | -2690.2     | 1.10            | -8.43           | -3.68           |
| 1310.0      | -868.910  | 5963.724  | 2557.334  | -7325.4     | 133.2       | -2726.9     | 1.20            | -8.43           | -3.65           |
| 1320.0      | -942.100  | 5964.633  | 2529.884  | -7312.5     | 48.5        | -2763.1     | 1.31            | -8.43           | -3.61           |
| 1330.0      | -1015.156 | 5964.693  | 2502.073  | -7298.6     | -36.3       | -2799.0     | 1.41            | -8.43           | -3.57           |
| 1340.0      | -1088.068 | 5963.907  | 2473.905  | -7283.6     | -121.0      | -2834.5     | 1.51            | -8.43           | -3.53           |
| 1350.0      | -1160.825 | 5962.273  | 2445.385  | -7267.6     | -205.7      | -2869.5     | 1.61            | -8.42           | -3.48           |
| 1360.0      | -1233.417 | 5959.792  | 2416.516  | -7250.6     | -290.4      | -2904.1     | 1.72            | -8.42           | -3.44           |
| 1370.0      | -1305.834 | 5956.465  | 2387.304  | -7232.6     | -375.0      | -2938.3     | 1.82            | -8.41           | -3.40           |
| 1380.0      | -1378.066 | 5952.292  | 2357.751  | -7213.5     | -459.6      | -2972.1     | 1.92            | -8.41           | -3.36           |
| 1390.0      | -1450.102 | 5947.274  | 2327.862  | -7193.5     | -544.1      | -3005.5     | 2.02            | -8.40           | -3.32           |
| 1400.0      | -1521.931 | 5941.411  | 2297.642  | -7172.4     | -628.4      | -3038.4     | 2.12            | -8.39           | -3.27           |
| 1410.0      | -1593.545 | 5934.705  | 2267.095  | -7150.2     | -712.7      | -3070.9     | 2.22            | -8.38           | -3.23           |
| 1420.0      | -1664.933 | 5927.157  | 2236.225  | -7127.1     | -796.9      | -3103.0     | 2.32            | -8.37           | -3.18           |
| 1430.0      | -1736.085 | 5918.767  | 2205.037  | -7103.0     | -881.0      | -3134.6     | 2.42            | -8.36           | -3.14           |
| 1440.0      | -1806.989 | 5909.537  | 2173.534  | -7077.8     | -964.9      | -3165.8     | 2.52            | -8.34           | -3.09           |
| 1450.0      | -1877.638 | 5899.469  | 2141.723  | -7051.7     | -1048.7     | -3196.5     | 2.62            | -8.33           | -3.05           |
| 1460.0      | -1948.019 | 5888.564  | 2109.607  | -7024.5     | -1132.3     | -3226.7     | 2.72            | -8.31           | -3.00           |
| 1470.0      | -2018.125 | 5876.824  | 2077.190  | -6996.4     | -1215.8     | -3256.5     | 2.82            | -8.29           | -2.96           |
| 1480.0      | -2087.944 | 5864.250  | 2044.478  | -6967.3     | -1299.0     | -3285.8     | 2.92            | -8.27           | -2.91           |
| 1490.0      | -2157.467 | 5850.844  | 2011.475  | -6937.2     | -1382.1     | -3314.7     | 3.02            | -8.26           | -2.86           |
| 1500.0      | -2226.684 | 5836.609  | 1978.186  | -6906.1     | -1465.0     | -3343.0     | 3.11            | -8.23           | -2.81           |
| 1510.0      | -2295.585 | 5821.546  | 1944.616  | -6874.0     | -1547.6     | -3370.9     | 3.21            | -8.21           | -2.77           |

TABLE XII  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>KM | YSP<br>KM | ZSP<br>KM | CXSP<br>M/S | YDYP<br>M/S | DZSP<br>M/S | DDXSP<br>M/S SQ | DCYSP<br>M/S SQ | CCZSP<br>M/S SQ |
|-------------|-----------|-----------|-----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 1520.0      | -2364.161 | 5805.657  | 1910.769  | -6841.0     | -1630.0     | -3398.3     | 3.31            | -8.19           | -2.72           |
| 1530.0      | -2432.402 | 5788.946  | 1876.651  | -6807.0     | -1712.2     | -3425.3     | 3.40            | -8.16           | -2.67           |
| 1540.0      | -2500.297 | 5771.415  | 1842.265  | -6772.0     | -1794.1     | -3451.7     | 3.50            | -8.14           | -2.62           |
| 1550.0      | -2567.839 | 5753.065  | 1807.618  | -6736.1     | -1875.8     | -3477.6     | 3.59            | -8.11           | -2.57           |
| 1560.0      | -2635.017 | 5733.900  | 1772.714  | -6699.2     | -1957.1     | -3503.1     | 3.69            | -8.08           | -2.52           |
| 1570.0      | -2701.821 | 5713.923  | 1737.558  | -6661.4     | -2038.2     | -3528.0     | 3.78            | -8.06           | -2.47           |
| 1580.0      | -2768.242 | 5693.136  | 1702.155  | -6622.7     | -2119.0     | -3552.5     | 3.87            | -8.03           | -2.42           |
| 1590.0      | -2834.271 | 5671.543  | 1666.511  | -6583.0     | -2199.5     | -3576.4     | 3.97            | -7.99           | -2.37           |
| 1600.0      | -2899.899 | 5649.147  | 1630.629  | -6542.4     | -2279.7     | -3599.8     | 4.06            | -7.96           | -2.32           |
| 1610.0      | -2965.116 | 5625.951  | 1594.516  | -6500.9     | -2359.5     | -3622.7     | 4.15            | -7.93           | -2.26           |
| 1620.0      | -3029.913 | 5601.958  | 1558.177  | -6458.4     | -2439.0     | -3645.1     | 4.24            | -7.89           | -2.21           |
| 1630.0      | -3094.282 | 5577.172  | 1521.616  | -6415.1     | -2518.1     | -3667.0     | 4.33            | -7.86           | -2.16           |
| 1640.0      | -3158.212 | 5551.597  | 1484.840  | -6370.8     | -2596.9     | -3688.3     | 4.42            | -7.82           | -2.11           |
| 1650.0      | -3221.695 | 5525.237  | 1447.852  | -6325.7     | -2675.2     | -3709.1     | 4.51            | -7.78           | -2.05           |
| 1660.0      | -3284.722 | 5498.094  | 1410.659  | -6279.6     | -2753.2     | -3729.4     | 4.60            | -7.74           | -2.00           |
| 1670.0      | -3347.285 | 5470.173  | 1373.266  | -6232.7     | -2830.8     | -3749.1     | 4.68            | -7.70           | -1.95           |
| 1680.0      | -3409.374 | 5441.479  | 1335.678  | -6184.9     | -2908.0     | -3768.4     | 4.77            | -7.66           | -1.89           |
| 1690.0      | -3470.981 | 5412.015  | 1297.901  | -6136.3     | -2984.7     | -3787.0     | 4.86            | -7.62           | -1.84           |
| 1700.0      | -3532.097 | 5381.785  | 1259.939  | -6086.7     | -3061.1     | -3805.2     | 4.94            | -7.58           | -1.79           |
| 1710.0      | -3592.713 | 5350.795  | 1221.799  | -6036.4     | -3136.9     | -3822.8     | 5.03            | -7.53           | -1.73           |
| 1720.0      | -3652.821 | 5319.048  | 1183.485  | -5985.1     | -3212.4     | -3839.8     | 5.11            | -7.49           | -1.68           |
| 1730.0      | -3712.413 | 5286.549  | 1145.004  | -5933.1     | -3287.3     | -3856.3     | 5.19            | -7.44           | -1.62           |
| 1740.0      | -3771.480 | 5253.303  | 1106.361  | -5880.2     | -3361.8     | -3872.3     | 5.28            | -7.39           | -1.57           |
| 1750.0      | -3830.014 | 5219.315  | 1067.560  | -5826.5     | -3435.8     | -3887.7     | 5.36            | -7.34           | -1.51           |
| 1760.0      | -3888.007 | 5184.589  | 1028.608  | -5772.0     | -3509.3     | -3902.6     | 5.44            | -7.29           | -1.46           |
| 1770.0      | -3945.450 | 5149.130  | 989.511   | -5716.6     | -3582.3     | -3916.9     | 5.52            | -7.24           | -1.40           |
| 1780.0      | -4002.336 | 5112.945  | 950.273   | -5660.5     | -3654.8     | -3930.6     | 5.60            | -7.19           | -1.35           |
| 1790.0      | -4058.657 | 5076.037  | 910.901   | -5603.5     | -3726.7     | -3943.8     | 5.68            | -7.14           | -1.29           |
| 1800.0      | -4114.405 | 5038.412  | 871.400   | -5545.8     | -3798.1     | -3956.4     | 5.75            | -7.09           | -1.23           |
| 1810.0      | -4169.571 | 5000.076  | 831.775   | -5487.4     | -3869.0     | -3968.5     | 5.83            | -7.03           | -1.18           |
| 1820.0      | -4224.150 | 4961.033  | 792.032   | -5428.1     | -3939.3     | -3979.9     | 5.91            | -6.98           | -1.12           |
| 1830.0      | -4278.131 | 4921.291  | 752.178   | -5368.1     | -4009.1     | -3990.9     | 5.98            | -6.92           | -1.06           |
| 1840.0      | -4331.509 | 4880.854  | 712.217   | -5307.3     | -4078.2     | -4001.2     | 6.05            | -6.86           | -1.01           |
| 1850.0      | -4384.276 | 4839.729  | 672.155   | -5245.8     | -4146.8     | -4011.0     | 6.13            | -6.80           | -0.95           |
| 1860.0      | -4436.424 | 4797.920  | 631.998   | -5183.6     | -4214.8     | -4020.3     | 6.20            | -6.74           | -0.89           |
| 1870.0      | -4487.946 | 4755.435  | 591.752   | -5120.7     | -4282.2     | -4028.9     | 6.27            | -6.68           | -0.84           |
| 1880.0      | -4538.835 | 4712.279  | 551.422   | -5057.0     | -4348.9     | -4037.0     | 6.34            | -6.62           | -0.78           |
| 1890.0      | -4589.083 | 4668.459  | 511.014   | -4992.7     | -4415.1     | -4044.5     | 6.41            | -6.56           | -0.72           |
| 1900.0      | -4638.685 | 4623.980  | 470.533   | -4927.6     | -4480.6     | -4051.5     | 6.48            | -6.50           | -0.67           |
| 1910.0      | -4687.633 | 4578.849  | 429.986   | -4861.9     | -4545.4     | -4057.8     | 6.55            | -6.43           | -0.61           |
| 1920.0      | -4735.920 | 4533.073  | 389.379   | -4795.4     | -4609.7     | -4063.6     | 6.62            | -6.37           | -0.55           |
| 1930.0      | -4783.540 | 4486.659  | 348.716   | -4728.4     | -4673.2     | -4068.8     | 6.68            | -6.30           | -0.49           |
| 1940.0      | -4830.485 | 4439.612  | 308.004   | -4660.6     | -4736.1     | -4073.5     | 6.75            | -6.23           | -0.44           |
| 1950.0      | -4876.750 | 4391.939  | 267.249   | -4592.2     | -4798.3     | -4077.5     | 6.81            | -6.17           | -0.38           |

TABLE XII  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>KM | YSP<br>KM | ZSP<br>KM | DXSP<br>M/S | DYSP<br>M/S | DZSP<br>M/S | DDXSP<br>M/S SQ | DDYSP<br>M/S SQ | DDZSP<br>M/S SQ |
|-------------|-----------|-----------|-----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 1960.0      | -4922.328 | 4343.647  | 226.456   | -4523.2     | -4859.8     | -4081.0     | 6.87            | -6.10           | -0.32           |
| 1970.0      | -4967.212 | 4294.744  | 185.630   | -4453.6     | -4920.7     | -4083.9     | 6.93            | -6.03           | -0.26           |
| 1980.0      | -5011.397 | 4245.236  | 144.779   | -4383.3     | -4980.8     | -4086.3     | 7.00            | -5.96           | -0.20           |
| 1990.0      | -5054.876 | 4195.131  | 103.907   | -4312.4     | -5040.2     | -4088.0     | 7.06            | -5.89           | -0.15           |
| 2000.0      | -5097.644 | 4144.435  | 63.021    | -4241.0     | -5098.9     | -4089.2     | 7.11            | -5.82           | -0.09           |
| 2010.0      | -5139.694 | 4093.155  | 22.126    | -4169.9     | -5156.9     | -4089.8     | 7.17            | -5.74           | -0.03           |
| 2020.0      | -5181.021 | 4041.299  | -18.773   | -4096.3     | -5214.1     | -4089.8     | 7.23            | -5.67           | 0.03            |
| 2030.0      | -5221.618 | 3988.875  | -59.669   | -4023.1     | -5270.6     | -4089.3     | 7.28            | -5.60           | 0.08            |
| 2040.0      | -5261.481 | 3935.890  | -100.556  | -3949.4     | -5326.4     | -4088.1     | 7.34            | -5.52           | 0.14            |
| 2050.0      | -5300.604 | 3882.351  | -141.429  | -3875.1     | -5381.3     | -4086.4     | 7.39            | -5.45           | 0.20            |
| 2060.0      | -5338.981 | 3828.266  | -182.282  | -3800.3     | -5435.6     | -4084.1     | 7.45            | -5.37           | 0.26            |
| 2070.0      | -5376.607 | 3773.642  | -223.110  | -3724.9     | -5489.0     | -4081.3     | 7.50            | -5.29           | 0.31            |
| 2080.0      | -5413.478 | 3718.488  | -263.906  | -3649.1     | -5541.7     | -4077.8     | 7.55            | -5.21           | 0.37            |
| 2090.0      | -5449.587 | 3662.812  | -304.664  | -3572.7     | -5593.5     | -4073.8     | 7.60            | -5.14           | 0.43            |
| 2100.0      | -5484.931 | 3606.619  | -345.380  | -3495.9     | -5644.6     | -4069.2     | 7.65            | -5.06           | 0.49            |
| 2110.0      | -5519.503 | 3549.921  | -386.047  | -3418.5     | -5694.9     | -4064.1     | 7.69            | -4.98           | 0.54            |
| 2120.0      | -5553.300 | 3492.724  | -426.660  | -3340.8     | -5744.4     | -4058.4     | 7.74            | -4.90           | 0.60            |
| 2130.0      | -5586.317 | 3435.036  | -467.212  | -3262.5     | -5793.1     | -4052.1     | 7.78            | -4.82           | 0.66            |
| 2140.0      | -5618.549 | 3376.866  | -507.699  | -3183.8     | -5840.9     | -4045.2     | 7.83            | -4.73           | 0.72            |
| 2150.0      | -5649.991 | 3318.221  | -548.114  | -3104.7     | -5887.9     | -4037.7     | 7.87            | -4.65           | 0.77            |
| 2160.0      | -5680.641 | 3259.110  | -588.452  | -3025.1     | -5934.1     | -4029.7     | 7.91            | -4.57           | 0.83            |
| 2170.0      | -5710.493 | 3199.542  | -628.707  | -2945.2     | -5979.4     | -4021.2     | 7.95            | -4.48           | 0.89            |
| 2180.0      | -5739.543 | 3139.525  | -668.873  | -2864.8     | -6023.9     | -4012.0     | 7.99            | -4.40           | 0.94            |
| 2190.0      | -5767.787 | 3079.067  | -708.946  | -2784.0     | -6067.5     | -4002.3     | 8.03            | -4.31           | 1.00            |
| 2200.0      | -5795.222 | 3018.177  | -748.918  | -2702.9     | -6110.3     | -3992.1     | 8.07            | -4.23           | 1.05            |
| 2210.0      | -5821.844 | 2956.864  | -788.785  | -2621.4     | -6152.2     | -3981.2     | 8.10            | -4.14           | 1.11            |
| 2220.0      | -5847.649 | 2895.136  | -828.541  | -2539.6     | -6193.3     | -3969.9     | 8.14            | -4.06           | 1.17            |
| 2230.0      | -5872.634 | 2833.000  | -868.181  | -2457.4     | -6233.5     | -3957.9     | 8.17            | -3.97           | 1.22            |
| 2240.0      | -5896.796 | 2770.469  | -907.698  | -2374.8     | -6272.7     | -3945.4     | 8.21            | -3.88           | 1.28            |
| 2250.0      | -5920.130 | 2707.549  | -947.088  | -2292.0     | -6311.1     | -3932.4     | 8.24            | -3.79           | 1.33            |
| 2260.0      | -5942.634 | 2644.249  | -986.344  | -2208.8     | -6348.7     | -3918.8     | 8.27            | -3.70           | 1.39            |
| 2270.0      | -5964.305 | 2580.579  | -1025.462 | -2125.4     | -6385.3     | -3904.7     | 8.30            | -3.62           | 1.44            |
| 2280.0      | -5985.141 | 2516.547  | -1064.435 | -2041.6     | -6421.0     | -3890.0     | 8.32            | -3.53           | 1.50            |
| 2290.0      | -6005.137 | 2452.162  | -1103.259 | -1957.6     | -6455.8     | -3874.7     | 8.35            | -3.44           | 1.55            |
| 2300.0      | -6024.292 | 2387.434  | -1141.928 | -1873.3     | -6489.7     | -3858.9     | 8.38            | -3.34           | 1.60            |
| 2310.0      | -6042.603 | 2322.371  | -1180.436 | -1788.8     | -6522.7     | -3842.6     | 8.40            | -3.25           | 1.66            |
| 2320.0      | -6060.068 | 2256.983  | -1218.779 | -1704.1     | -6554.8     | -3825.8     | 8.42            | -3.16           | 1.71            |
| 2330.0      | -6076.684 | 2191.279  | -1256.950 | -1619.1     | -6585.9     | -3808.4     | 8.45            | -3.07           | 1.77            |
| 2340.0      | -6092.449 | 2125.268  | -1294.945 | -1533.9     | -6616.1     | -3790.5     | 8.47            | -2.98           | 1.82            |
| 2350.0      | -6107.361 | 2058.960  | -1332.757 | -1448.5     | -6645.4     | -3772.0     | 8.49            | -2.89           | 1.87            |
| 2360.0      | -6121.418 | 1992.363  | -1370.383 | -1362.9     | -6673.8     | -3753.0     | 8.50            | -2.79           | 1.92            |
| 2370.0      | -6134.618 | 1925.487  | -1407.816 | -1277.1     | -6701.2     | -3733.5     | 8.52            | -2.70           | 1.98            |
| 2380.0      | -6146.959 | 1858.342  | -1445.052 | -1191.2     | -6727.7     | -3713.5     | 8.54            | -2.61           | 2.03            |
| 2390.0      | -6158.441 | 1790.937  | -1482.085 | -1105.1     | -6753.2     | -3693.0     | 8.55            | -2.51           | 2.08            |

TABLE XII  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>KM | YSP<br>KM | ZSP<br>KM | DXSP<br>M/S | DYSP<br>M/S | DZSP<br>M/S | DDXSP<br>M/S SQ | DDYSP<br>M/S SQ | DCZSP<br>M/S SQ |
|-------------|-----------|-----------|-----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 2400.0      | -6169.061 | 1723.281  | -1518.909 | -1018.9     | -6777.8     | -3671.9     | 8.57            | -2.42           | 2.13            |
| 2410.0      | -6178.818 | 1655.385  | -1555.521 | -932.5      | -6801.4     | -3650.3     | 8.58            | -2.32           | 2.18            |
| 2420.0      | -6187.710 | 1587.257  | -1591.914 | -846.0      | -6824.1     | -3628.3     | 8.59            | -2.23           | 2.23            |
| 2430.0      | -6195.737 | 1518.907  | -1628.084 | -759.4      | -6845.8     | -3605.7     | 8.60            | -2.13           | 2.28            |
| 2440.0      | -6202.898 | 1450.344  | -1664.026 | -672.8      | -6866.5     | -3582.6     | 8.61            | -2.04           | 2.33            |
| 2450.0      | -6209.192 | 1381.579  | -1699.734 | -586.0      | -6886.3     | -3559.0     | 8.62            | -1.94           | 2.38            |
| 2460.0      | -6214.618 | 1312.621  | -1735.204 | -499.2      | -6905.2     | -3534.9     | 8.62            | -1.84           | 2.43            |
| 2470.0      | -6219.175 | 1243.479  | -1770.431 | -412.3      | -6923.0     | -3510.3     | 8.63            | -1.75           | 2.48            |
| 2480.0      | -6222.863 | 1174.164  | -1805.410 | -325.3      | -6939.9     | -3485.3     | 8.63            | -1.65           | 2.53            |
| 2490.0      | -6225.682 | 1104.684  | -1840.135 | -238.4      | -6955.8     | -3459.7     | 8.64            | -1.56           | 2.58            |
| 2500.0      | -6227.631 | 1035.050  | -1874.603 | -151.4      | -6970.8     | -3433.7     | 8.64            | -1.46           | 2.63            |
| 2510.0      | -6228.710 | 965.271   | -1908.808 | -64.4       | -6984.7     | -3407.2     | 8.64            | -1.36           | 2.67            |
| 2520.0      | -6228.919 | 895.358   | -1942.745 | 22.6        | -6997.7     | -3380.2     | 8.64            | -1.26           | 2.72            |
| 2530.0      | -6228.257 | 825.320   | -1976.411 | 109.6       | -7009.7     | -3352.8     | 8.64            | -1.17           | 2.77            |
| 2540.0      | -6226.727 | 755.167   | -2009.799 | 196.5       | -7020.8     | -3324.9     | 8.63            | -1.07           | 2.81            |
| 2550.0      | -6224.327 | 684.908   | -2042.907 | 283.5       | -7030.8     | -3296.5     | 8.63            | -0.97           | 2.86            |
| 2560.0      | -6221.058 | 614.554   | -2075.728 | 370.3       | -7039.9     | -3267.7     | 8.62            | -0.87           | 2.91            |
| 2570.0      | -6216.921 | 544.113   | -2108.258 | 457.1       | -7048.0     | -3238.4     | 8.62            | -0.78           | 2.95            |
| 2580.0      | -6211.916 | 473.597   | -2140.493 | 543.8       | -7055.1     | -3208.6     | 8.61            | -0.68           | 3.00            |
| 2590.0      | -6206.044 | 403.015   | -2172.429 | 630.5       | -7061.2     | -3178.4     | 8.60            | -0.58           | 3.04            |
| 2600.0      | -6199.307 | 332.377   | -2204.061 | 717.0       | -7066.3     | -3147.8     | 8.59            | -0.48           | 3.08            |
| 2610.0      | -6191.704 | 261.692   | -2235.384 | 803.4       | -7070.5     | -3116.8     | 8.58            | -0.38           | 3.13            |
| 2620.0      | -6183.238 | 190.971   | -2266.394 | 889.7       | -7073.6     | -3085.3     | 8.57            | -0.29           | 3.17            |
| 2630.0      | -6173.910 | 120.223   | -2297.088 | 975.9       | -7075.8     | -3053.3     | 8.55            | -0.19           | 3.21            |
| 2640.0      | -6163.720 | 49.458    | -2327.460 | 1061.9      | -7077.0     | -3021.0     | 8.54            | -0.09           | 3.26            |
| 2650.0      | -6152.671 | -21.314   | -2357.506 | 1147.8      | -7077.2     | -2988.2     | 8.52            | 0.01            | 3.30            |
| 2660.0      | -6140.765 | -92.082   | -2387.223 | 1233.5      | -7076.4     | -2955.1     | 8.50            | 0.11            | 3.34            |
| 2670.0      | -6128.002 | -162.838  | -2416.606 | 1319.0      | -7074.6     | -2921.5     | 8.49            | 0.20            | 3.38            |
| 2680.0      | -6114.385 | -233.570  | -2445.651 | 1404.3      | -7071.8     | -2887.5     | 8.47            | 0.30            | 3.42            |
| 2690.0      | -6099.916 | -304.271  | -2474.354 | 1489.5      | -7068.1     | -2853.1     | 8.44            | 0.40            | 3.46            |
| 2700.0      | -6084.596 | -374.929  | -2502.712 | 1574.4      | -7063.3     | -2818.3     | 8.42            | 0.50            | 3.50            |
| 2710.0      | -6068.429 | -445.534  | -2530.719 | 1659.0      | -7057.6     | -2783.1     | 8.40            | 0.60            | 3.54            |
| 2720.0      | -6051.417 | -516.078  | -2558.373 | 1743.5      | -7050.9     | -2747.6     | 8.38            | 0.69            | 3.58            |
| 2730.0      | -6033.561 | -586.549  | -2585.669 | 1827.6      | -7043.2     | -2711.6     | 8.35            | 0.79            | 3.61            |
| 2740.0      | -6014.865 | -656.939  | -2612.604 | 1911.5      | -7034.6     | -2675.3     | 8.32            | 0.89            | 3.65            |
| 2750.0      | -5995.331 | -727.237  | -2639.174 | 1995.2      | -7024.9     | -2638.6     | 8.30            | 0.99            | 3.69            |
| 2760.0      | -5974.962 | -797.435  | -2665.376 | 2078.5      | -7014.3     | -2601.6     | 8.27            | 1.08            | 3.72            |
| 2770.0      | -5953.761 | -867.521  | -2691.205 | 2161.6      | -7002.7     | -2564.2     | 8.24            | 1.18            | 3.76            |
| 2780.0      | -5931.731 | -937.486  | -2716.658 | 2244.3      | -6990.2     | -2526.4     | 8.21            | 1.28            | 3.79            |
| 2790.0      | -5908.875 | -1007.321 | -2741.732 | 2326.8      | -6976.6     | -2488.3     | 8.17            | 1.37            | 3.83            |
| 2800.0      | -5885.197 | -1077.015 | -2766.423 | 2408.9      | -6962.1     | -2449.8     | 8.14            | 1.47            | 3.86            |
| 2810.0      | -5860.699 | -1146.560 | -2790.727 | 2490.6      | -6946.6     | -2411.0     | 8.11            | 1.57            | 3.90            |
| 2820.0      | -5835.386 | -1215.945 | -2814.642 | 2572.0      | -6930.2     | -2371.9     | 8.07            | 1.66            | 3.93            |
| 2830.0      | -5809.260 | -1285.160 | -2838.164 | 2653.0      | -6912.8     | -2332.4     | 8.03            | 1.76            | 3.96            |

TABLE XII  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>KM | YSP<br>KM | ZSP<br>KM | DXSP<br>M/S | DYSP<br>M/S | DZSP<br>M/S | DDXSP<br>M/S SQ | DDYSP<br>M/S SQ | DDZSP<br>M/S SQ |
|-------------|-----------|-----------|-----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 2840.0      | -5782.326 | -1354.197 | -2861.290 | 2733.7      | -6894.4     | -2292.7     | 8.00            | 1.85            | 3.99            |
| 2850.0      | -5754.588 | -1423.045 | -2884.016 | 2814.0      | -6875.1     | -2252.6     | 7.96            | 1.95            | 4.03            |
| 2860.0      | -5726.048 | -1491.695 | -2906.340 | 2893.8      | -6854.8     | -2212.2     | 7.92            | 2.04            | 4.06            |
| 2870.0      | -5696.712 | -1560.138 | -2928.259 | 2973.3      | -6833.6     | -2171.5     | 7.88            | 2.14            | 4.09            |
| 2880.0      | -5666.584 | -1628.364 | -2949.768 | 3052.3      | -6811.4     | -2130.4     | 7.83            | 2.23            | 4.12            |
| 2890.0      | -5635.667 | -1696.363 | -2970.866 | 3131.0      | -6788.3     | -2089.1     | 7.79            | 2.32            | 4.15            |
| 2900.0      | -5603.966 | -1764.126 | -2991.550 | 3209.1      | -6764.2     | -2047.5     | 7.75            | 2.42            | 4.17            |
| 2910.0      | -5571.486 | -1831.644 | -3011.816 | 3286.8      | -6739.2     | -2005.7     | 7.70            | 2.51            | 4.20            |
| 2920.0      | -5538.231 | -1898.907 | -3031.662 | 3364.1      | -6713.2     | -1963.5     | 7.66            | 2.60            | 4.23            |
| 2930.0      | -5504.206 | -1965.906 | -3051.086 | 3440.9      | -6686.4     | -1921.1     | 7.61            | 2.70            | 4.26            |
| 2940.0      | -5469.415 | -2032.632 | -3070.083 | 3517.2      | -6658.6     | -1878.4     | 7.56            | 2.79            | 4.28            |
| 2950.0      | -5433.864 | -2099.074 | -3088.653 | 3593.0      | -6629.8     | -1835.4     | 7.51            | 2.88            | 4.31            |
| 2960.0      | -5397.557 | -2165.225 | -3106.791 | 3668.3      | -6600.2     | -1792.2     | 7.46            | 2.97            | 4.33            |
| 2970.0      | -5360.500 | -2231.075 | -3124.497 | 3743.1      | -6569.6     | -1748.8     | 7.41            | 3.06            | 4.36            |
| 2980.0      | -5322.698 | -2296.615 | -3141.766 | 3817.3      | -6538.2     | -1705.1     | 7.36            | 3.15            | 4.38            |
| 2990.0      | -5284.155 | -2361.835 | -3158.598 | 3891.0      | -6505.8     | -1661.2     | 7.30            | 3.24            | 4.40            |
| 3000.0      | -5244.879 | -2426.727 | -3174.989 | 3964.2      | -6472.5     | -1617.0     | 7.25            | 3.33            | 4.43            |
| 3010.0      | -5204.873 | -2491.282 | -3190.937 | 4036.9      | -6438.3     | -1572.6     | 7.19            | 3.42            | 4.45            |
| 3020.0      | -5164.143 | -2555.490 | -3206.441 | 4108.9      | -6403.2     | -1528.0     | 7.14            | 3.51            | 4.47            |
| 3030.0      | -5122.696 | -2619.344 | -3221.497 | 4180.4      | -6367.3     | -1483.2     | 7.08            | 3.60            | 4.49            |
| 3040.0      | -5080.537 | -2682.833 | -3236.105 | 4251.3      | -6330.4     | -1438.2     | 7.02            | 3.69            | 4.51            |
| 3050.0      | -5037.672 | -2745.950 | -3250.261 | 4321.6      | -6292.7     | -1393.0     | 6.96            | 3.77            | 4.53            |
| 3060.0      | -4994.107 | -2808.684 | -3263.965 | 4391.3      | -6254.1     | -1347.6     | 6.90            | 3.86            | 4.55            |
| 3070.0      | -4949.848 | -2871.029 | -3277.213 | 4460.4      | -6214.6     | -1302.0     | 6.84            | 3.95            | 4.57            |
| 3080.0      | -4904.901 | -2932.974 | -3290.004 | 4528.9      | -6174.3     | -1256.3     | 6.78            | 4.03            | 4.59            |
| 3090.0      | -4859.272 | -2994.512 | -3302.337 | 4596.7      | -6133.1     | -1210.3     | 6.72            | 4.12            | 4.60            |
| 3100.0      | -4812.969 | -3055.634 | -3314.210 | 4663.9      | -6091.1     | -1164.2     | 6.65            | 4.20            | 4.62            |
| 3110.0      | -4765.996 | -3116.331 | -3325.621 | 4730.5      | -6048.2     | -1117.9     | 6.59            | 4.28            | 4.63            |
| 3120.0      | -4718.362 | -3176.595 | -3336.568 | 4796.4      | -6004.5     | -1071.5     | 6.52            | 4.37            | 4.65            |
| 3130.0      | -4670.071 | -3236.418 | -3347.051 | 4861.6      | -5959.9     | -1024.9     | 6.45            | 4.45            | 4.66            |
| 3140.0      | -4621.133 | -3295.791 | -3357.066 | 4926.1      | -5914.6     | -978.2      | 6.39            | 4.53            | 4.68            |
| 3150.0      | -4571.552 | -3354.706 | -3366.615 | 4990.0      | -5868.4     | -931.4      | 6.32            | 4.61            | 4.69            |
| 3160.0      | -4521.336 | -3413.156 | -3375.694 | 5053.1      | -5821.3     | -884.4      | 6.25            | 4.69            | 4.70            |
| 3170.0      | -4470.491 | -3471.130 | -3384.302 | 5115.6      | -5773.5     | -837.3      | 6.18            | 4.77            | 4.72            |
| 3180.0      | -4419.026 | -3528.624 | -3392.439 | 5177.3      | -5724.9     | -790.1      | 6.11            | 4.85            | 4.73            |
| 3190.0      | -4366.947 | -3585.626 | -3400.103 | 5238.4      | -5675.5     | -742.7      | 6.04            | 4.93            | 4.74            |
| 3200.0      | -4314.261 | -3642.131 | -3407.294 | 5298.7      | -5625.3     | -695.3      | 5.96            | 5.01            | 4.75            |
| 3210.0      | -4260.976 | -3698.129 | -3414.009 | 5358.2      | -5574.3     | -647.8      | 5.89            | 5.09            | 4.76            |
| 3220.0      | -4207.099 | -3753.614 | -3420.249 | 5417.1      | -5522.5     | -600.2      | 5.82            | 5.17            | 4.77            |
| 3230.0      | -4152.637 | -3808.577 | -3426.013 | 5475.1      | -5470.0     | -552.5      | 5.74            | 5.24            | 4.77            |
| 3235.242    | -4123.857 | -3837.177 | -3428.843 | 5505.3      | -5442.2     | -527.4      | 5.70            | 5.28            | 4.78            |

S-IVB/LM SEPARATION

TABLE XIII  
GEOGRAPHIC COORDINATES

| TIME<br>SEC                | EC DIST<br>KM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>M/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>M/S | RANGE<br>M | ALTITUDE<br>M |
|----------------------------|---------------|-------------|---------------|---------------|-----------------|---------------|-------------|-----------------|---------------|------------|---------------|
| GUIDANCE REFERENCE RELEASE |               |             |               |               |                 |               |             |                 |               |            |               |
| -4.956                     | 6373.353      | -80.5650    | 28.3707       | 0.00          | 90.00           | 0.0           | 90.00       | 0.00            | 408.9         | 0          | 35            |
| -4.0                       | 6373.353      | -80.5650    | 28.3707       | 0.00          | 90.00           | 0.0           | 90.00       | 0.00            | 408.9         | 0          | 35            |
| -5.0                       | 6373.353      | -80.5650    | 28.3707       | 0.00          | 90.00           | 0.0           | 90.00       | 0.00            | 408.9         | 0          | 35            |
| -2.0                       | 6373.353      | -80.5650    | 28.3707       | 0.00          | 90.00           | 0.0           | 90.00       | 0.00            | 408.9         | 0          | 35            |
| -1.0                       | 6373.353      | -80.5650    | 28.3707       | 0.00          | 90.00           | 0.0           | 90.00       | 0.00            | 408.9         | 0          | 35            |
| RANGE ZERO AT 17 48 08 EST |               |             |               |               |                 |               |             |                 |               |            |               |
| 0.000                      | 6373.353      | -80.5650    | 28.3707       | 0.00          | 90.00           | 0.0           | 90.00       | 0.00            | 408.9         | 0          | 35            |
| FIRST MOTION               |               |             |               |               |                 |               |             |                 |               |            |               |
| 0.200                      | 6373.353      | -80.5650    | 28.3707       | 0.00          | 90.00           | 0.0           | 90.00       | 0.00            | 408.9         | 0          | 34            |
| LIFTOFF                    |               |             |               |               |                 |               |             |                 |               |            |               |
| 0.360                      | 6373.353      | -80.5650    | 28.3707       | 109.02        | 89.51           | 0.4           | 90.00       | 0.05            | 408.9         | 0          | 35            |
| 1.0                        | 6373.353      | -80.5650    | 28.3707       | 102.54        | 89.66           | 1.9           | 90.00       | 0.27            | 408.9         | 0          | 35            |
| 2.0                        | 6373.357      | -80.5650    | 28.3707       | 80.81         | 89.81           | 4.5           | 90.00       | 0.64            | 409.0         | 0          | 38            |
| 3.0                        | 6373.362      | -80.5650    | 28.3707       | 40.63         | 89.85           | 7.3           | 90.00       | 1.02            | 409.0         | 0          | 44            |
| 4.0                        | 6373.371      | -80.5650    | 28.3707       | 9.59          | 89.83           | 10.2          | 90.00       | 1.43            | 409.1         | 0          | 53            |
| 5.0                        | 6373.383      | -80.5649    | 28.3707       | 355.52        | 89.79           | 13.2          | 89.99       | 1.84            | 409.1         | 0          | 65            |
| 6.0                        | 6373.397      | -80.5649    | 28.3707       | 348.99        | 89.75           | 16.2          | 89.99       | 2.27            | 409.2         | 0          | 79            |
| 7.0                        | 6373.415      | -80.5649    | 28.3707       | 345.82        | 89.72           | 19.3          | 89.99       | 2.70            | 409.4         | 0          | 97            |
| 8.0                        | 6373.436      | -80.5649    | 28.3707       | 344.63        | 89.70           | 22.5          | 89.98       | 3.15            | 409.5         | 0          | 118           |
| 9.0                        | 6373.460      | -80.5650    | 28.3707       | 345.01        | 89.68           | 25.7          | 89.98       | 3.60            | 409.7         | 0          | 142           |
| 10.0                       | 6373.487      | -80.5650    | 28.3707       | 347.00        | 89.67           | 29.0          | 89.98       | 4.06            | 409.9         | 0          | 169           |
| 11.0                       | 6373.518      | -80.5650    | 28.3707       | 350.75        | 89.65           | 32.4          | 89.97       | 4.53            | 410.2         | 0          | 200           |
| 12.0                       | 6373.552      | -80.5650    | 28.3707       | 356.43        | 89.64           | 35.9          | 89.97       | 5.01            | 410.5         | 0          | 234           |
| 13.0                       | 6373.590      | -80.5650    | 28.3707       | 4.02          | 89.62           | 39.4          | 89.96       | 5.50            | 410.9         | 0          | 272           |
| 14.0                       | 6373.631      | -80.5649    | 28.3707       | 13.10         | 89.59           | 43.0          | 89.96       | 6.00            | 411.3         | 0          | 313           |
| 15.0                       | 6373.676      | -80.5649    | 28.3707       | 22.80         | 89.54           | 46.7          | 89.95       | 6.52            | 411.8         | 1          | 358           |
| 16.0                       | 6373.724      | -80.5649    | 28.3707       | 32.13         | 89.46           | 50.5          | 89.94       | 7.04            | 412.3         | 1          | 406           |
| 17.0                       | 6373.777      | -80.5649    | 28.3707       | 40.39         | 89.36           | 54.4          | 89.93       | 7.57            | 413.0         | 2          | 459           |
| 18.0                       | 6373.833      | -80.5649    | 28.3707       | 47.28         | 89.23           | 58.4          | 89.93       | 8.12            | 413.7         | 2          | 515           |
| 19.0                       | 6373.894      | -80.5649    | 28.3707       | 52.88         | 89.07           | 62.5          | 89.91       | 8.67            | 414.5         | 3          | 576           |
| 20.0                       | 6373.958      | -80.5649    | 28.3707       | 57.37         | 88.88           | 66.6          | 89.90       | 9.23            | 415.4         | 4          | 640           |



TABLE XIII  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>KM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>M/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>M/S | RANGE<br>M | ALTITUDE<br>M |
|-------------|---------------|-------------|---------------|---------------|-----------------|---------------|-------------|-----------------|---------------|------------|---------------|
| 21.0        | 6374.027      | -80.5649    | 28.3707       | 60.97         | 88.67           | 70.8          | 89.89       | 9.79            | 416.5         | 5          | 709           |
| 22.0        | 6374.100      | -80.5649    | 28.3707       | 63.87         | 88.44           | 75.2          | 89.87       | 10.36           | 417.6         | 7          | 782           |
| 23.0        | 6374.177      | -80.5649    | 28.3707       | 66.23         | 88.18           | 79.5          | 89.86       | 10.94           | 418.9         | 9          | 859           |
| 24.0        | 6374.259      | -80.5648    | 28.3707       | 68.15         | 87.90           | 84.0          | 89.84       | 11.52           | 420.3         | 12         | 941           |
| 25.0        | 6374.345      | -80.5648    | 28.3707       | 69.72         | 87.61           | 88.6          | 89.82       | 12.11           | 421.8         | 15         | 1027          |
| 26.0        | 6374.436      | -80.5648    | 28.3707       | 70.98         | 87.29           | 93.2          | 89.80       | 12.70           | 423.5         | 19         | 1118          |
| 27.0        | 6374.531      | -80.5647    | 28.3708       | 71.97         | 86.97           | 97.9          | 89.78       | 13.29           | 425.3         | 24         | 1213          |
| 28.0        | 6374.631      | -80.5647    | 28.3708       | 72.74         | 86.62           | 102.7         | 89.75       | 13.89           | 427.3         | 30         | 1313          |
| 29.0        | 6374.736      | -80.5646    | 28.3708       | 73.30         | 86.26           | 107.7         | 89.72       | 14.49           | 429.4         | 36         | 1418          |
| 30.0        | 6374.846      | -80.5645    | 28.3708       | 73.61         | 85.90           | 112.7         | 89.69       | 15.10           | 431.7         | 44         | 1528          |
| 31.0        | 6374.961      | -80.5644    | 28.3708       | 73.58         | 85.51           | 117.8         | 89.64       | 15.70           | 434.1         | 53         | 1643          |
| 32.0        | 6375.081      | -80.5643    | 28.3708       | 73.37         | 85.10           | 123.1         | 89.59       | 16.31           | 436.7         | 63         | 1763          |
| 33.0        | 6375.207      | -80.5642    | 28.3709       | 73.01         | 84.66           | 128.5         | 89.52       | 16.92           | 439.5         | 74         | 1889          |
| 34.0        | 6375.337      | -80.5641    | 28.3709       | 72.65         | 84.20           | 133.9         | 89.45       | 17.53           | 442.5         | 87         | 2019          |
| 35.0        | 6375.473      | -80.5640    | 28.3709       | 72.40         | 83.73           | 139.6         | 89.38       | 18.13           | 445.8         | 101        | 2155          |
| 36.0        | 6375.615      | -80.5638    | 28.3710       | 72.32         | 83.25           | 145.3         | 89.30       | 18.73           | 449.2         | 118        | 2297          |
| 37.0        | 6375.762      | -80.5636    | 28.3710       | 72.32         | 82.78           | 151.1         | 89.23       | 19.33           | 452.7         | 136        | 2444          |
| 38.0        | 6375.914      | -80.5634    | 28.3711       | 72.35         | 82.30           | 157.0         | 89.15       | 19.93           | 456.5         | 156        | 2596          |
| 39.0        | 6376.073      | -80.5632    | 28.3711       | 72.39         | 81.82           | 163.1         | 89.07       | 20.52           | 460.5         | 178        | 2755          |
| 40.0        | 6376.237      | -80.5630    | 28.3712       | 72.40         | 81.32           | 169.2         | 88.98       | 21.10           | 464.7         | 202        | 2919          |
| 41.0        | 6376.407      | -80.5627    | 28.3713       | 72.41         | 80.81           | 175.5         | 88.89       | 21.68           | 469.1         | 229        | 3090          |
| 42.0        | 6376.584      | -80.5624    | 28.3713       | 72.42         | 80.27           | 182.0         | 88.79       | 22.24           | 473.8         | 258        | 3266          |
| 43.0        | 6376.766      | -80.5621    | 28.3714       | 72.47         | 79.72           | 188.6         | 88.68       | 22.80           | 478.8         | 291        | 3448          |
| 44.0        | 6376.955      | -80.5618    | 28.3715       | 72.56         | 79.16           | 195.3         | 88.58       | 23.35           | 484.0         | 326        | 3637          |
| 45.0        | 6377.150      | -80.5614    | 28.3716       | 72.67         | 78.58           | 202.2         | 88.47       | 23.88           | 489.4         | 365        | 3832          |
| 46.0        | 6377.351      | -80.5610    | 28.3717       | 72.74         | 77.99           | 209.2         | 88.36       | 24.40           | 495.2         | 406        | 4034          |
| 47.0        | 6377.559      | -80.5605    | 28.3718       | 72.79         | 77.38           | 216.3         | 88.24       | 24.91           | 501.2         | 452        | 4242          |
| 48.0        | 6377.774      | -80.5600    | 28.3720       | 72.78         | 76.77           | 223.5         | 88.11       | 25.40           | 507.4         | 501        | 4456          |
| 49.0        | 6377.995      | -80.5595    | 28.3721       | 72.73         | 76.15           | 230.9         | 87.97       | 25.88           | 513.8         | 554        | 4677          |
| 50.0        | 6378.222      | -80.5590    | 28.3723       | 72.67         | 75.53           | 238.5         | 87.82       | 26.34           | 520.5         | 612        | 4904          |
| 51.0        | 6378.456      | -80.5584    | 28.3724       | 72.57         | 74.90           | 246.2         | 87.66       | 26.79           | 527.4         | 674        | 5139          |
| 52.0        | 6378.697      | -80.5577    | 28.3726       | 72.55         | 74.29           | 254.1         | 87.51       | 27.23           | 534.6         | 740        | 5380          |
| 53.0        | 6378.945      | -80.5570    | 28.3728       | 72.51         | 73.65           | 262.2         | 87.35       | 27.65           | 542.1         | 812        | 5628          |
| 54.0        | 6379.201      | -80.5563    | 28.3730       | 72.46         | 73.02           | 270.3         | 87.19       | 28.05           | 549.7         | 888        | 5883          |
| 55.0        | 6379.463      | -80.5555    | 28.3732       | 72.45         | 72.39           | 278.6         | 87.03       | 28.44           | 557.6         | 969        | 6146          |
| 56.0        | 6379.732      | -80.5546    | 28.3734       | 72.48         | 71.75           | 287.0         | 86.87       | 28.80           | 565.8         | 1056       | 6415          |
| 57.0        | 6380.008      | -80.5537    | 28.3737       | 72.51         | 71.10           | 295.5         | 86.71       | 29.14           | 574.1         | 1149       | 6691          |
| 58.0        | 6380.292      | -80.5527    | 28.3739       | 72.51         | 70.47           | 304.1         | 86.55       | 29.47           | 582.6         | 1248       | 6975          |
| 59.0        | 6380.582      | -80.5517    | 28.3742       | 72.51         | 69.81           | 312.6         | 86.38       | 29.75           | 591.3         | 1352       | 7265          |
| 59.760      | 6380.807      | -80.5509    | 28.3744       | 72.49         | 69.31           | 319.1         | 86.25       | 29.95           | 597.9         | 1436       | 7490          |

MACH ONE

TABLE XIII  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>KM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>M/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>M/S | RANGE<br>M | ALTITUDE<br>M |
|-------------|---------------|-------------|---------------|---------------|-----------------|---------------|-------------|-----------------|---------------|------------|---------------|
| 60.0        | 6380.879      | -80.5506    | 28.3745       | 72.49         | 69.15           | 321.2         | 86.20       | 30.01           | 600.0         | 1464       | 7562          |
| 61.0        | 6381.182      | -80.5495    | 28.3748       | 72.45         | 68.49           | 329.7         | 86.02       | 30.25           | 608.9         | 1581       | 7866          |
| 62.0        | 6381.493      | -80.5483    | 28.3751       | 72.39         | 67.82           | 338.4         | 85.84       | 30.47           | 617.9         | 1705       | 8176          |
| 63.0        | 6381.809      | -80.5470    | 28.3755       | 72.43         | 67.18           | 347.3         | 85.68       | 30.69           | 627.2         | 1836       | 8493          |
| 64.0        | 6382.133      | -80.5457    | 28.3758       | 72.52         | 66.55           | 356.4         | 85.53       | 30.90           | 636.8         | 1974       | 8817          |
| 65.0        | 6382.464      | -80.5442    | 28.3762       | 72.57         | 65.91           | 365.7         | 85.37       | 31.09           | 646.6         | 2119       | 9147          |
| 66.0        | 6382.801      | -80.5427    | 28.3766       | 72.63         | 65.27           | 375.3         | 85.21       | 31.27           | 656.7         | 2272       | 9485          |
| 67.0        | 6383.146      | -80.5412    | 28.3771       | 72.70         | 64.64           | 385.1         | 85.06       | 31.44           | 667.1         | 2433       | 9830          |
| 68.0        | 6383.498      | -80.5395    | 28.3775       | 72.76         | 64.01           | 395.1         | 84.90       | 31.60           | 677.7         | 2602       | 10182         |
| 69.0        | 6383.857      | -80.5378    | 28.3780       | 72.85         | 63.38           | 405.4         | 84.75       | 31.75           | 688.7         | 2779       | 10541         |
| 70.0        | 6384.223      | -80.5360    | 28.3784       | 72.92         | 62.73           | 415.9         | 84.60       | 31.88           | 700.0         | 2964       | 10907         |
| 71.0        | 6384.596      | -80.5341    | 28.3790       | 73.01         | 62.07           | 426.8         | 84.45       | 31.99           | 711.7         | 3159       | 11281         |
| MAX Q       |               |             |               |               |                 |               |             |                 |               |            |               |
| 71.500      | 6384.786      | -80.5331    | 28.3792       | 73.05         | 61.74           | 432.3         | 84.37       | 32.04           | 717.7         | 3260       | 11471         |
| 72.0        | 6384.977      | -80.5321    | 28.3795       | 73.08         | 61.41           | 437.9         | 84.29       | 32.09           | 723.8         | 3363       | 11662         |
| 73.0        | 6385.366      | -80.5300    | 28.3800       | 73.12         | 60.76           | 449.4         | 84.13       | 32.19           | 736.1         | 3577       | 12051         |
| 74.0        | 6385.762      | -80.5278    | 28.3806       | 73.12         | 60.14           | 461.1         | 83.95       | 32.28           | 748.6         | 3801       | 12447         |
| 75.0        | 6386.166      | -80.5255    | 28.3812       | 73.07         | 59.53           | 473.1         | 83.76       | 32.38           | 761.4         | 4035       | 12851         |
| 76.0        | 6386.578      | -80.5231    | 28.3818       | 72.97         | 58.95           | 485.4         | 83.55       | 32.48           | 774.3         | 4280       | 13263         |
| 77.0        | 6386.998      | -80.5206    | 28.3825       | 72.83         | 58.38           | 497.9         | 83.33       | 32.58           | 787.6         | 4535       | 13684         |
| 78.0        | 6387.426      | -80.5180    | 28.3832       | 72.69         | 57.81           | 510.8         | 83.11       | 32.66           | 801.1         | 4800       | 14112         |
| 79.0        | 6387.863      | -80.5153    | 28.3839       | 72.56         | 57.23           | 524.0         | 82.88       | 32.72           | 815.0         | 5077       | 14549         |
| 80.0        | 6388.308      | -80.5125    | 28.3847       | 72.46         | 56.65           | 537.5         | 82.66       | 32.78           | 829.4         | 5366       | 14995         |
| 81.0        | 6388.762      | -80.5096    | 28.3855       | 72.39         | 56.08           | 551.5         | 82.46       | 32.83           | 844.1         | 5667       | 15448         |
| 82.0        | 6389.224      | -80.5065    | 28.3864       | 72.35         | 55.52           | 565.7         | 82.27       | 32.87           | 859.2         | 5980       | 15911         |
| 83.0        | 6389.695      | -80.5033    | 28.3872       | 72.33         | 54.99           | 580.3         | 82.09       | 32.92           | 874.5         | 6305       | 16382         |
| 84.0        | 6390.175      | -80.5000    | 28.3881       | 72.32         | 54.49           | 595.0         | 81.92       | 32.97           | 890.0         | 6643       | 16862         |
| 85.0        | 6390.664      | -80.4966    | 28.3891       | 72.31         | 54.00           | 610.0         | 81.75       | 33.02           | 905.7         | 6994       | 17352         |
| 86.0        | 6391.162      | -80.4931    | 28.3901       | 72.30         | 53.52           | 625.3         | 81.59       | 33.06           | 921.7         | 7358       | 17850         |
| 87.0        | 6391.670      | -80.4894    | 28.3911       | 72.29         | 53.04           | 640.8         | 81.42       | 33.09           | 938.0         | 7735       | 18358         |
| 88.0        | 6392.187      | -80.4856    | 28.3921       | 72.27         | 52.56           | 656.8         | 81.26       | 33.11           | 954.7         | 8126       | 18876         |
| 89.0        | 6392.713      | -80.4816    | 28.3932       | 72.26         | 52.07           | 673.1         | 81.09       | 33.12           | 971.8         | 8531       | 19402         |
| 90.0        | 6393.249      | -80.4776    | 28.3944       | 72.24         | 51.59           | 689.8         | 80.92       | 33.12           | 989.3         | 8951       | 19939         |
| 91.0        | 6393.795      | -80.4733    | 28.3956       | 72.22         | 51.11           | 706.7         | 80.76       | 33.11           | 1007.1        | 9385       | 20484         |
| 92.0        | 6394.350      | -80.4689    | 28.3968       | 72.20         | 50.63           | 724.0         | 80.59       | 33.09           | 1025.2        | 9835       | 21040         |
| 93.0        | 6394.914      | -80.4644    | 28.3981       | 72.17         | 50.15           | 741.6         | 80.43       | 33.06           | 1043.7        | 10300      | 21605         |
| 94.0        | 6395.489      | -80.4597    | 28.3994       | 72.15         | 49.67           | 759.6         | 80.26       | 33.02           | 1062.6        | 10781      | 22180         |
| 95.0        | 6396.073      | -80.4549    | 28.4007       | 72.13         | 49.20           | 777.9         | 80.10       | 32.98           | 1081.9        | 11279      | 22764         |
| 96.0        | 6396.667      | -80.4499    | 28.4021       | 72.11         | 48.73           | 796.6         | 79.95       | 32.92           | 1101.5        | 11793      | 23359         |
| 97.0        | 6397.270      | -80.4447    | 28.4036       | 72.10         | 48.26           | 815.6         | 79.80       | 32.87           | 1121.4        | 12325      | 23963         |
| 98.0        | 6397.884      | -80.4393    | 28.4051       | 72.09         | 47.81           | 834.9         | 79.65       | 32.81           | 1141.7        | 12874      | 24577         |

TABLE XIII  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>KM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>M/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>M/S | RANGE<br>M | ALTITUDE<br>M |
|-------------|---------------|-------------|---------------|---------------|-----------------|---------------|-------------|-----------------|---------------|------------|---------------|
| 99.0        | 6398.508      | -80.4338    | 28.4066       | 72.09         | 47.35           | 854.6         | 79.51       | 32.74           | 1162.3        | 13441      | 25201         |
| 100.0       | 6399.142      | -80.4281    | 28.4082       | 72.09         | 46.90           | 874.5         | 79.37       | 32.66           | 1183.2        | 14027      | 25836         |
| 101.0       | 6399.785      | -80.4222    | 28.4099       | 72.09         | 46.47           | 894.8         | 79.23       | 32.59           | 1204.4        | 14631      | 26480         |
| 102.0       | 6400.440      | -80.4162    | 28.4116       | 72.08         | 46.03           | 915.4         | 79.10       | 32.51           | 1226.0        | 15253      | 27134         |
| 103.0       | 6401.104      | -80.4099    | 28.4134       | 72.08         | 45.61           | 936.5         | 78.97       | 32.43           | 1247.9        | 15895      | 27799         |
| 104.0       | 6401.778      | -80.4035    | 28.4152       | 72.08         | 45.19           | 957.8         | 78.84       | 32.34           | 1270.2        | 16557      | 28474         |
| 105.0       | 6402.463      | -80.3969    | 28.4171       | 72.08         | 44.78           | 979.5         | 78.72       | 32.26           | 1292.7        | 17238      | 29160         |
| 106.0       | 6403.158      | -80.3900    | 28.4190       | 72.08         | 44.38           | 1001.5        | 78.60       | 32.17           | 1315.7        | 17940      | 29856         |
| 107.0       | 6403.864      | -80.3830    | 28.4210       | 72.09         | 43.98           | 1023.9        | 78.48       | 32.08           | 1339.0        | 18662      | 30562         |
| 108.0       | 6404.581      | -80.3758    | 28.4230       | 72.10         | 43.60           | 1046.7        | 78.37       | 31.98           | 1362.7        | 19405      | 31279         |
| 109.0       | 6405.308      | -80.3683    | 28.4251       | 72.10         | 43.22           | 1070.0        | 78.26       | 31.89           | 1386.8        | 20170      | 32007         |
| 110.0       | 6406.047      | -80.3607    | 28.4272       | 72.11         | 42.84           | 1093.6        | 78.15       | 31.80           | 1411.2        | 20956      | 32746         |
| 111.0       | 6406.796      | -80.3528    | 28.4295       | 72.11         | 42.48           | 1117.5        | 78.04       | 31.70           | 1436.0        | 21764      | 33496         |
| 112.0       | 6407.556      | -80.3447    | 28.4317       | 72.12         | 42.11           | 1141.8        | 77.94       | 31.60           | 1461.2        | 22595      | 34257         |
| 113.0       | 6408.328      | -80.3364    | 28.4341       | 72.12         | 41.76           | 1166.5        | 77.83       | 31.50           | 1486.7        | 23448      | 35030         |
| 114.0       | 6409.110      | -80.3279    | 28.4365       | 72.13         | 41.41           | 1191.6        | 77.73       | 31.40           | 1512.6        | 24325      | 35813         |
| 115.0       | 6409.904      | -80.3191    | 28.4389       | 72.13         | 41.06           | 1217.2        | 77.63       | 31.30           | 1539.0        | 25225      | 36608         |
| 116.0       | 6410.710      | -80.3101    | 28.4415       | 72.14         | 40.72           | 1243.1        | 77.54       | 31.19           | 1565.7        | 26149      | 37414         |
| 117.0       | 6411.527      | -80.3009    | 28.4441       | 72.14         | 40.39           | 1269.4        | 77.44       | 31.09           | 1592.8        | 27097      | 38232         |
| 118.0       | 6412.355      | -80.2914    | 28.4467       | 72.14         | 40.06           | 1296.0        | 77.35       | 30.98           | 1620.2        | 28069      | 39061         |
| 119.0       | 6413.195      | -80.2817    | 28.4495       | 72.14         | 39.73           | 1323.2        | 77.26       | 30.87           | 1648.2        | 29067      | 39902         |
| 120.0       | 6414.047      | -80.2717    | 28.4523       | 72.15         | 39.41           | 1350.8        | 77.17       | 30.76           | 1676.5        | 30091      | 40755         |
| 121.0       | 6414.911      | -80.2615    | 28.4551       | 72.15         | 39.09           | 1378.8        | 77.08       | 30.65           | 1705.3        | 31140      | 41619         |
| 122.0       | 6415.786      | -80.2510    | 28.4581       | 72.15         | 38.77           | 1407.3        | 76.99       | 30.53           | 1734.6        | 32216      | 42496         |
| 123.0       | 6416.674      | -80.2403    | 28.4611       | 72.16         | 38.45           | 1436.2        | 76.91       | 30.41           | 1764.3        | 33319      | 43384         |
| 124.0       | 6417.573      | -80.2293    | 28.4642       | 72.16         | 38.14           | 1465.5        | 76.83       | 30.29           | 1794.4        | 34449      | 44285         |
| 125.0       | 6418.484      | -80.2180    | 28.4674       | 72.16         | 37.83           | 1495.2        | 76.74       | 30.17           | 1824.9        | 35607      | 45197         |
| 126.0       | 6419.408      | -80.2064    | 28.4706       | 72.17         | 37.52           | 1525.5        | 76.67       | 30.04           | 1855.9        | 36793      | 46121         |
| 127.0       | 6420.343      | -80.1946    | 28.4739       | 72.17         | 37.21           | 1556.2        | 76.59       | 29.91           | 1887.5        | 38007      | 47057         |
| 128.0       | 6421.290      | -80.1825    | 28.4773       | 72.18         | 36.90           | 1587.5        | 76.51       | 29.77           | 1919.5        | 39252      | 48006         |
| 129.0       | 6422.249      | -80.1701    | 28.4808       | 72.18         | 36.59           | 1619.4        | 76.44       | 29.63           | 1952.1        | 40526      | 48966         |
| 130.0       | 6423.220      | -80.1573    | 28.4844       | 72.19         | 36.28           | 1651.7        | 76.37       | 29.49           | 1985.3        | 41831      | 49938         |
| 131.0       | 6424.204      | -80.1443    | 28.4880       | 72.19         | 35.97           | 1684.4        | 76.29       | 29.34           | 2018.8        | 43166      | 50923         |
| 132.0       | 6425.199      | -80.1310    | 28.4918       | 72.20         | 35.66           | 1717.6        | 76.23       | 29.19           | 2052.8        | 44534      | 51919         |
| 133.0       | 6426.207      | -80.1174    | 28.4956       | 72.20         | 35.34           | 1751.5        | 76.16       | 29.04           | 2087.5        | 45933      | 52928         |
| 134.0       | 6427.226      | -80.1034    | 28.4995       | 72.21         | 35.03           | 1785.8        | 76.09       | 28.87           | 2122.7        | 47365      | 53949         |
| 135.0       | 6428.257      | -80.0891    | 28.5035       | 72.21         | 34.72           | 1820.7        | 76.02       | 28.71           | 2158.4        | 48830      | 54981         |
| 136.0       | 6429.300      | -80.0745    | 28.5076       | 72.22         | 34.41           | 1856.2        | 75.96       | 28.56           | 2194.7        | 50330      | 56025         |
| 137.0       | 6430.355      | -80.0596    | 28.5118       | 72.23         | 34.12           | 1892.2        | 75.90       | 28.40           | 2231.5        | 51864      | 57082         |
| 138.0       | 6431.423      | -80.0443    | 28.5161       | 72.23         | 33.85           | 1928.9        | 75.84       | 28.26           | 2268.9        | 53432      | 58151         |
| IECO        |               |             |               |               |                 |               |             |                 |               |            |               |
| 138.970     | 6432.471      | -80.0291    | 28.5203       | 72.24         | 33.58           | 1964.4        | 75.79       | 28.12           | 2305.1        | 54987      | 59201         |

TABLE XIII  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>KM                                    | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>M/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>M/S | RANGE<br>M | ALTITUDE<br>M |  |
|-------------|--|-------------|---------------|---------------|-----------------|---------------|-------------|-----------------|---------------|------------|---------------|--|
| 139.0       | 6432.504   | -80.0286    | 28.5204       | 72.24         | 33.58           | 1965.1        | 75.78       | 28.13           | 2305.8        | 55036      | 59233         |  |
| 140.0       | 6433.595   | -80.0127    | 28.5249       | 72.25         | 33.34           | 1987.5        | 75.75       | 27.97           | 2328.9        | 56672      | 60326         |  |
| 141.0       | 6434.689   | -79.9966    | 28.5294       | 72.26         | 33.11           | 2004.4        | 75.73       | 27.82           | 2346.5        | 58324      | 61421         |  |
| 142.0       | 6435.785   | -79.9803    | 28.5340       | 72.27         | 32.89           | 2019.1        | 75.71       | 27.66           | 2361.9        | 59995      | 62518         |  |
|             | OEEO   |             |               |               |                 |               |             |                 |               |            |               |  |
| 142.250     | 6436.059   | -79.9762    | 28.5351       | 72.27         | 32.84           | 2022.4        | 75.71       | 27.62           | 2365.4        | 60415      | 62793         |  |
| 143.0       | 6436.881   | -79.9639    | 28.5385       | 72.28         | 32.68           | 2023.7        | 75.71       | 27.49           | 2367.2        | 61679      | 63616         |  |
|             | S-IB/S-IVB SEPARATION SIGNAL                     |             |               |               |                 |               |             |                 |               |            |               |  |
| 143.500     | 6437.427   | -79.9556    | 28.5408       | 72.28         | 32.57           | 2021.8        | 75.71       | 27.39           | 2365.7        | 62523      | 64163         |  |
|             | EBW FIRING (SEPARATION SIGNAL PLUS 0.07 SECONDS) |             |               |               |                 |               |             |                 |               |            |               |  |
| 143.570     | 6437.508   | -79.9546    | 28.5411       | 72.28         | 32.56           | 2021.6        | 75.71       | 27.38           | 2365.5        | 62633      | 64244         |  |
| 144.0       | 6437.975   | -79.9475    | 28.5431       | 72.29         | 32.47           | 2019.6        | 75.71       | 27.30           | 2363.8        | 63358      | 64711         |  |
| 145.0       | 6439.055   | -79.9311    | 28.5477       | 72.30         | 32.26           | 2014.9        | 75.72       | 27.11           | 2359.8        | 65043      | 65793         |  |
| 150.0       | 6444.332   | -79.8487    | 28.5706       | 72.34         | 31.20           | 2006.1        | 75.74       | 26.19           | 2354.6        | 73481      | 71077         |  |
| 155.0       | 6449.460   | -79.7653    | 28.5938       | 72.37         | 30.16           | 2016.4        | 75.72       | 25.33           | 2368.2        | 82023      | 76213         |  |
|             | GUIDANCE INITIATION                              |             |               |               |                 |               |             |                 |               |            |               |  |
| 159.470     | 6453.938   | -79.6897    | 28.6148       | 72.39         | 29.25           | 2028.1        | 75.70       | 24.57           | 2382.8        | 89775      | 80697         |  |
| 160.0       | 6454.463   | -79.6806    | 28.6173       | 72.39         | 29.14           | 2029.6        | 75.69       | 24.48           | 2384.6        | 9C701      | 81222         |  |
| 165.0       | 6459.343   | -79.5945    | 28.6411       | 72.44         | 28.13           | 2044.2        | 75.69       | 23.65           | 2402.2        | 99519      | 86110         |  |
| 170.0       | 6464.096   | -79.5069    | 28.6653       | 72.53         | 27.07           | 2060.2        | 75.72       | 22.78           | 2421.3        | 108484     | 90871         |  |
| 175.0       | 6468.718   | -79.4177    | 28.6897       | 72.63         | 26.02           | 2077.5        | 75.76       | 21.92           | 2441.6        | 117600     | 95501         |  |
| 180.0       | 6473.211   | -79.3269    | 28.7144       | 72.73         | 25.00           | 2095.9        | 75.80       | 21.08           | 2463.0        | 126871     | 10001         |  |
| 185.0       | 6477.576   | -79.2346    | 28.7394       | 72.83         | 24.00           | 2115.6        | 75.84       | 20.26           | 2485.3        | 136296     | 104375        |  |
| 190.0       | 6481.817   | -79.1406    | 28.7646       | 72.94         | 23.02           | 2136.4        | 75.88       | 19.46           | 2508.7        | 145879     | 108624        |  |
| 195.0       | 6485.932   | -79.0450    | 28.7902       | 73.04         | 22.06           | 2158.4        | 75.93       | 18.67           | 2533.1        | 155623     | 112747        |  |
| 200.0       | 6489.924   | -78.9478    | 28.8160       | 73.15         | 21.11           | 2181.5        | 75.98       | 17.89           | 2558.5        | 165530     | 116747        |  |
| 205.0       | 6493.791   | -78.8488    | 28.8420       | 73.26         | 20.18           | 2205.7        | 76.05       | 17.12           | 2584.9        | 175602     | 120622        |  |
| 210.0       | 6497.532   | -78.7480    | 28.8683       | 73.41         | 19.25           | 2231.0        | 76.12       | 16.36           | 2612.4        | 185843     | 124371        |  |
| 215.0       | 6501.148   | -78.6455    | 28.8949       | 73.55         | 18.35           | 2257.4        | 76.20       | 15.61           | 2640.8        | 196256     | 127996        |  |
| 220.0       | 6504.639   | -78.5412    | 28.9216       | 73.68         | 17.47           | 2284.8        | 76.27       | 14.88           | 2670.1        | 206842     | 131496        |  |
| 225.0       | 6508.007   | -78.4350    | 28.9486       | 73.82         | 16.61           | 2313.3        | 76.35       | 14.17           | 2700.4        | 217604     | 134872        |  |
| 230.0       | 6511.252   | -78.3270    | 28.9759       | 73.95         | 15.78           | 2342.9        | 76.43       | 13.48           | 2731.6        | 228546     | 138126        |  |

TABLE XIII  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>KM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>M/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>M/S | RANGE<br>M | ALTITUDE<br>M |
|-------------|---------------|-------------|---------------|---------------|-----------------|---------------|-------------|-----------------|---------------|------------|---------------|
| 235.0       | 6514.377      | -78.2170    | 29.0033       | 74.09         | 14.96           | 2373.6        | 76.51       | 12.81           | 2763.9        | 239668     | 141259        |
| 240.0       | 6517.381      | -78.1052    | 29.0310       | 74.22         | 14.17           | 2405.4        | 76.59       | 12.15           | 2797.1        | 250975     | 144272        |
| 245.0       | 6520.266      | -77.9914    | 29.0589       | 74.35         | 13.40           | 2438.0        | 76.67       | 11.51           | 2831.0        | 262469     | 147166        |
| 250.0       | 6523.033      | -77.8756    | 29.0871       | 74.48         | 12.65           | 2471.8        | 76.75       | 10.89           | 2866.0        | 274152     | 149942        |
| 255.0       | 6525.682      | -77.7578    | 29.1155       | 74.62         | 11.93           | 2506.2        | 76.83       | 10.29           | 2901.7        | 286026     | 152600        |
| 260.0       | 6528.215      | -77.6380    | 29.1441       | 74.75         | 11.24           | 2542.0        | 76.91       | 9.70            | 2938.5        | 298095     | 155143        |
| 265.0       | 6530.635      | -77.5161    | 29.1729       | 74.88         | 10.56           | 2578.8        | 76.99       | 9.14            | 2976.3        | 310362     | 157572        |
| 270.0       | 6532.942      | -77.3920    | 29.2020       | 75.01         | 9.91            | 2616.4        | 77.08       | 8.59            | 3014.8        | 322829     | 159888        |
| 275.0       | 6535.139      | -77.2659    | 29.2313       | 75.14         | 9.28            | 2655.2        | 77.16       | 8.06            | 3054.4        | 335501     | 162094        |
| 280.0       | 6537.224      | -77.1376    | 29.2608       | 75.27         | 8.67            | 2694.8        | 77.24       | 7.54            | 3094.8        | 348379     | 164189        |
| 285.0       | 6539.200      | -77.0070    | 29.2905       | 75.40         | 8.08            | 2735.5        | 77.33       | 7.04            | 3136.2        | 361468     | 166174        |
| 290.0       | 6541.068      | -76.8742    | 29.3205       | 75.52         | 7.51            | 2776.9        | 77.41       | 6.56            | 3178.3        | 374769     | 168052        |
| 295.0       | 6542.830      | -76.7392    | 29.3508       | 75.62         | 6.97            | 2819.2        | 77.47       | 6.10            | 3221.0        | 388286     | 169823        |
| 300.0       | 6544.489      | -76.6019    | 29.3813       | 75.74         | 6.45            | 2862.5        | 77.55       | 5.65            | 3264.9        | 402022     | 171492        |
| 305.0       | 6546.044      | -76.4622    | 29.4120       | 75.88         | 5.94            | 2906.9        | 77.64       | 5.22            | 3309.8        | 415981     | 173057        |
| 310.0       | 6547.498      | -76.3201    | 29.4429       | 76.01         | 5.46            | 2952.2        | 77.73       | 4.80            | 3355.5        | 430166     | 174521        |
| 315.0       | 6548.853      | -76.1756    | 29.4741       | 76.14         | 4.99            | 2998.6        | 77.82       | 4.40            | 3402.3        | 444581     | 175885        |
| 320.0       | 6550.108      | -76.0286    | 29.5055       | 76.28         | 4.55            | 3046.0        | 77.92       | 4.01            | 3450.1        | 459231     | 177151        |
| 325.0       | 6551.267      | -75.8791    | 29.5370       | 76.41         | 4.11            | 3094.3        | 78.01       | 3.64            | 3498.7        | 474119     | 178320        |
| 330.0       | 6552.329      | -75.7271    | 29.5688       | 76.54         | 3.70            | 3143.5        | 78.11       | 3.28            | 3548.2        | 489249     | 179392        |
| 335.0       | 6553.296      | -75.5724    | 29.6008       | 76.68         | 3.31            | 3193.4        | 78.21       | 2.93            | 3598.4        | 504624     | 180370        |
| 340.0       | 6554.171      | -75.4151    | 29.6330       | 76.82         | 2.93            | 3244.6        | 78.30       | 2.60            | 3649.8        | 520248     | 181255        |
| 345.0       | 6554.955      | -75.2551    | 29.6654       | 76.95         | 2.57            | 3296.6        | 78.40       | 2.29            | 3702.0        | 536125     | 182049        |
| 350.0       | 6555.651      | -75.0923    | 29.6980       | 77.09         | 2.23            | 3349.6        | 78.50       | 1.99            | 3755.2        | 552260     | 182756        |
| 355.0       | 6556.260      | -74.9268    | 29.7307       | 77.22         | 1.91            | 3403.4        | 78.60       | 1.71            | 3809.2        | 568656     | 183375        |
| 360.0       | 6556.785      | -74.7584    | 29.7637       | 77.36         | 1.60            | 3458.4        | 78.71       | 1.43            | 3864.3        | 585318     | 183911        |
| 365.0       | 6557.227      | -74.5872    | 29.7968       | 77.50         | 1.31            | 3514.4        | 78.81       | 1.18            | 3920.4        | 602251     | 184364        |
| 370.0       | 6557.590      | -74.4130    | 29.8301       | 77.64         | 1.04            | 3571.6        | 78.92       | 0.93            | 3977.7        | 619459     | 184737        |
| 375.0       | 6557.873      | -74.2358    | 29.8636       | 77.77         | 0.77            | 3630.0        | 79.02       | 0.70            | 4036.2        | 636949     | 185032        |
| 380.0       | 6558.080      | -74.0556    | 29.8972       | 77.91         | 0.53            | 3689.4        | 79.13       | 0.47            | 4095.7        | 654725     | 185250        |
| 385.0       | 6558.213      | -73.8722    | 29.9310       | 78.05         | 0.29            | 3750.1        | 79.24       | 0.26            | 4156.4        | 672793     | 185393        |
| 390.0       | 6558.272      | -73.6857    | 29.9650       | 78.20         | 0.07            | 3811.6        | 79.35       | 0.06            | 4218.0        | 691158     | 185463        |
| 395.0       | 6558.260      | -73.4960    | 29.9991       | 78.34         | -0.14           | 3874.2        | 79.46       | -0.12           | 4280.6        | 709824     | 185463        |
| 400.0       | 6558.181      | -73.3029    | 30.0334       | 78.48         | -0.33           | 3937.9        | 79.57       | -0.30           | 4344.3        | 728797     | 185394        |
| 405.0       | 6558.036      | -73.1065    | 30.0678       | 78.63         | -0.51           | 4002.9        | 79.69       | -0.46           | 4409.4        | 748082     | 185260        |
| 410.0       | 6557.828      | -72.9067    | 30.1024       | 78.77         | -0.67           | 4069.0        | 79.80       | -0.61           | 4475.4        | 767685     | 185064        |
| 415.0       | 6557.561      | -72.7035    | 30.1371       | 78.92         | -0.82           | 4136.2        | 79.92       | -0.75           | 4542.7        | 787612     | 184808        |
| 420.0       | 6557.237      | -72.4966    | 30.1719       | 79.06         | -0.96           | 4204.7        | 80.04       | -0.87           | 4611.2        | 807870     | 184496        |
| 425.0       | 6556.859      | -72.2862    | 30.2068       | 79.21         | -1.08           | 4274.4        | 80.16       | -0.99           | 4680.9        | 828463     | 184129        |
| 430.0       | 6556.430      | -72.0721    | 30.2418       | 79.36         | -1.20           | 4345.6        | 80.28       | -1.09           | 4752.1        | 849398     | 183711        |
| 435.0       | 6555.953      | -71.8542    | 30.2769       | 79.51         | -1.30           | 4418.4        | 80.40       | -1.19           | 4824.8        | 870684     | 183246        |
| 440.0       | 6555.432      | -71.6325    | 30.3121       | 79.66         | -1.38           | 4492.5        | 80.53       | -1.27           | 4898.9        | 892327     | 182736        |
| 445.0       | 6554.869      | -71.4069    | 30.3473       | 79.82         | -1.46           | 4568.4        | 80.66       | -1.34           | 4974.8        | 914336     | 182184        |
| 450.0       | 6554.268      | -71.1772    | 30.3827       | 79.97         | -1.53           | 4645.3        | 80.79       | -1.41           | 5051.7        | 936717     | 181595        |

TABLE XIII  
GEOGRAPHIC COORDINATES

| TIME<br>SEC           | EC DIST<br>KM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>M/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>M/S | RANGE<br>M | ALTITUDE<br>M |
|-----------------------|---------------|-------------|---------------|---------------|-----------------|---------------|-------------|-----------------|---------------|------------|---------------|
| 455.0                 | 6553.631      | -70.9434    | 30.4180       | 80.13         | -1.58           | 4724.0        | 80.92       | -1.46           | 5130.3        | 959478     | 180970        |
| 460.0                 | 6552.964      | -70.7055    | 30.4535       | 80.28         | -1.63           | 4804.3        | 81.05       | -1.50           | 5210.7        | 982626     | 180314        |
| 465.0                 | 6552.269      | -70.4633    | 30.4889       | 80.44         | -1.66           | 4886.2        | 81.18       | -1.53           | 5292.5        | 1006171    | 179631        |
| 470.0                 | 6551.551      | -70.2167    | 30.5244       | 80.61         | -1.68           | 4969.6        | 81.32       | -1.55           | 5375.8        | 1030119    | 178924        |
| 475.0                 | 6550.812      | -69.9657    | 30.5598       | 80.77         | -1.69           | 5054.8        | 81.46       | -1.57           | 5461.0        | 1054479    | 178197        |
| 480.0                 | 6550.059      | -69.7101    | 30.5953       | 80.94         | -1.69           | 5141.9        | 81.60       | -1.57           | 5548.1        | 1079261    | 177455        |
| 485.0                 | 6549.294      | -69.4498    | 30.6307       | 81.10         | -1.69           | 5231.0        | 81.75       | -1.57           | 5637.2        | 1104474    | 176702        |
| 490.0                 | 6548.513      | -69.1848    | 30.6661       | 81.27         | -1.70           | 5322.8        | 81.90       | -1.58           | 5728.9        | 1130129    | 175932        |
| 495.0                 | 6547.714      | -68.9149    | 30.7014       | 81.44         | -1.71           | 5415.9        | 82.05       | -1.59           | 5822.0        | 1156237    | 175145        |
| 500.0                 | 6546.897      | -68.6400    | 30.7366       | 81.62         | -1.72           | 5508.9        | 82.20       | -1.60           | 5915.0        | 1182802    | 174340        |
| 505.0                 | 6546.065      | -68.3602    | 30.7716       | 81.80         | -1.72           | 5602.3        | 82.35       | -1.60           | 6008.3        | 1209823    | 173519        |
| 510.0                 | 6545.217      | -68.0754    | 30.8065       | 81.98         | -1.72           | 5694.3        | 82.52       | -1.61           | 6100.3        | 1237299    | 172682        |
| 515.0                 | 6544.355      | -67.7857    | 30.8412       | 82.16         | -1.72           | 5785.2        | 82.68       | -1.60           | 6191.1        | 1265223    | 171832        |
| 520.0                 | 6543.488      | -67.4912    | 30.8756       | 82.35         | -1.69           | 5876.9        | 82.85       | -1.58           | 6282.8        | 1293594    | 170976        |
| 525.0                 | 6542.622      | -67.1918    | 30.9097       | 82.53         | -1.65           | 5968.4        | 83.01       | -1.55           | 6374.3        | 1322416    | 170122        |
| 530.0                 | 6541.769      | -66.8874    | 30.9435       | 82.71         | -1.60           | 6060.5        | 83.17       | -1.50           | 6466.3        | 1351688    | 169280        |
| 535.0                 | 6540.940      | -66.5781    | 30.9770       | 82.89         | -1.51           | 6153.5        | 83.34       | -1.42           | 6559.3        | 1381416    | 168462        |
| 540.0                 | 6540.154      | -66.2637    | 31.0102       | 83.08         | -1.39           | 6247.4        | 83.50       | -1.30           | 6653.2        | 1411603    | 167687        |
| 545.0                 | 6539.432      | -65.9443    | 31.0430       | 83.26         | -1.24           | 6342.9        | 83.67       | -1.16           | 6748.7        | 1442257    | 166976        |
| 550.0                 | 6538.783      | -65.6197    | 31.0754       | 83.45         | -1.10           | 6440.6        | 83.84       | -1.03           | 6846.4        | 1473386    | 166337        |
| 555.0                 | 6538.194      | -65.2897    | 31.1073       | 83.65         | -0.98           | 6542.2        | 84.02       | -0.93           | 6948.0        | 1505005    | 165759        |
| 560.0                 | 6537.659      | -64.9542    | 31.1388       | 83.85         | -0.88           | 6646.5        | 84.20       | -0.83           | 7052.2        | 1537129    | 165234        |
| 565.0                 | 6537.180      | -64.6131    | 31.1698       | 84.05         | -0.76           | 6753.2        | 84.39       | -0.71           | 7158.9        | 1569771    | 164766        |
| 570.0                 | 6536.768      | -64.2662    | 31.2002       | 84.25         | -0.63           | 6862.3        | 84.57       | -0.60           | 7268.1        | 1602942    | 164364        |
| 575.0                 | 6536.424      | -63.9134    | 31.2300       | 84.46         | -0.51           | 6974.9        | 84.76       | -0.48           | 7380.7        | 1636655    | 164029        |
| 580.0                 | 6536.144      | -63.5545    | 31.2593       | 84.67         | -0.40           | 7090.8        | 84.96       | -0.38           | 7496.5        | 1670927    | 163759        |
| 585.0                 | 6535.936      | -63.1893    | 31.2878       | 84.89         | -0.26           | 7209.7        | 85.16       | -0.25           | 7615.4        | 1705773    | 163561        |
| 590.0                 | 6535.813      | -62.8178    | 31.3156       | 85.10         | -0.12           | 7331.9        | 85.36       | -0.12           | 7737.7        | 1741207    | 163447        |
| S-IVB GUIDANCE CUTOFF |               |             |               |               |                 |               |             |                 |               |            |               |
| 593.340               | 6535.783      | -62.5659    | 31.3337       | 85.25         | -0.01           | 7415.0        | 85.50       | -0.01           | 7820.8        | 1765212    | 163423        |
| 595.0                 | 6535.783      | -62.4399    | 31.3426       | 85.32         | 0.00            | 7422.2        | 85.57       | 0.00            | 7828.0        | 1777221    | 163426        |
| 600.0                 | 6535.785      | -62.0601    | 31.3685       | 85.54         | 0.00            | 7422.6        | 85.77       | 0.00            | 7828.4        | 1813398    | 163437        |
| ORBIT INSERTION       |               |             |               |               |                 |               |             |                 |               |            |               |
| 603.340               | 6535.787      | -61.8063    | 31.3851       | 85.69         | 0.01            | 7422.7        | 85.91       | 0.00            | 7828.5        | 1837565    | 163444        |
| 605.0                 | 6535.788      | -61.6801    | 31.3931       | 85.76         | 0.01            | 7422.7        | 85.98       | 0.01            | 7828.4        | 1849576    | 163448        |
| 610.0                 | 6535.792      | -61.2998    | 31.4165       | 85.98         | 0.01            | 7422.7        | 86.19       | 0.01            | 7828.5        | 1885754    | 163460        |
| 620.0                 | 6535.804      | -60.5388    | 31.4596       | 86.43         | 0.01            | 7423.2        | 86.61       | 0.01            | 7828.9        | 1958113    | 163486        |
| 630.0                 | 6535.820      | -59.7770    | 31.4976       | 86.87         | 0.01            | 7423.6        | 87.03       | 0.01            | 7829.4        | 2030475    | 163515        |

TABLE XIII  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>KM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>M/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>M/S | RANGE<br>M | ALTITUDE<br>M |
|-------------|---------------|-------------|---------------|---------------|-----------------|---------------|-------------|-----------------|---------------|------------|---------------|
| 640.0       | 6535.841      | -59.0146    | 31.5306       | 87.31         | 0.02            | 7423.9        | 87.45       | 0.02            | 7829.7        | 2102841    | 163547        |
| 650.0       | 6535.866      | -58.2516    | 31.5586       | 87.76         | 0.02            | 7423.8        | 87.88       | 0.02            | 7829.6        | 2175209    | 163581        |
| 660.0       | 6535.896      | -57.4882    | 31.5815       | 88.21         | 0.02            | 7423.8        | 88.30       | 0.02            | 7829.6        | 2247576    | 163618        |
| 670.0       | 6535.930      | -56.7244    | 31.5993       | 88.65         | 0.03            | 7423.7        | 88.72       | 0.03            | 7829.5        | 2319941    | 163659        |
| 680.0       | 6535.969      | -55.9604    | 31.6121       | 89.10         | 0.03            | 7423.7        | 89.15       | 0.03            | 7829.5        | 2392306    | 163702        |
| 690.0       | 6536.013      | -55.1962    | 31.6198       | 89.54         | 0.04            | 7423.6        | 89.57       | 0.03            | 7829.4        | 2464670    | 163748        |
| 700.0       | 6536.061      | -54.4320    | 31.6224       | 89.99         | 0.04            | 7423.5        | 89.99       | 0.04            | 7829.4        | 2537033    | 163797        |
| 710.0       | 6536.113      | -53.6678    | 31.6200       | 90.44         | 0.04            | 7423.4        | 90.42       | 0.04            | 7829.3        | 2609395    | 163849        |
| 720.0       | 6536.170      | -52.9036    | 31.6125       | 90.89         | 0.05            | 7423.4        | 90.84       | 0.04            | 7829.2        | 2681756    | 163903        |
| 730.0       | 6536.232      | -52.1397    | 31.5999       | 91.33         | 0.05            | 7423.3        | 91.26       | 0.05            | 7829.1        | 2754115    | 163961        |
| 740.0       | 6536.298      | -51.3760    | 31.5822       | 91.78         | 0.05            | 7423.2        | 91.69       | 0.05            | 7829.0        | 2826473    | 164021        |
| 750.0       | 6536.369      | -50.6127    | 31.5595       | 92.22         | 0.06            | 7423.1        | 92.11       | 0.05            | 7829.0        | 2898829    | 164084        |
| 760.0       | 6536.444      | -49.8498    | 31.5318       | 92.67         | 0.06            | 7423.0        | 92.53       | 0.06            | 7828.9        | 2971183    | 164150        |
| 770.0       | 6536.524      | -49.0875    | 31.4989       | 93.11         | 0.06            | 7422.9        | 92.95       | 0.06            | 7828.8        | 3043536    | 164219        |
| 780.0       | 6536.608      | -48.3259    | 31.4611       | 93.56         | 0.07            | 7422.8        | 93.37       | 0.06            | 7828.7        | 3115888    | 164290        |
| 790.0       | 6536.696      | -47.5649    | 31.4182       | 94.00         | 0.07            | 7422.7        | 93.79       | 0.07            | 7828.6        | 3188237    | 164364        |
| 800.0       | 6536.789      | -46.8047    | 31.3704       | 94.44         | 0.07            | 7422.6        | 94.21       | 0.07            | 7828.5        | 3260585    | 164442        |
| 810.0       | 6536.887      | -46.0454    | 31.3175       | 94.88         | 0.08            | 7422.5        | 94.63       | 0.07            | 7828.3        | 3332930    | 164521        |
| 820.0       | 6536.989      | -45.2871    | 31.2596       | 95.32         | 0.08            | 7422.4        | 95.04       | 0.08            | 7828.2        | 3405274    | 164604        |
| 830.0       | 6537.095      | -44.5299    | 31.1968       | 95.76         | 0.08            | 7422.3        | 95.46       | 0.08            | 7828.1        | 3477615    | 164690        |
| 840.0       | 6537.205      | -43.7737    | 31.1291       | 96.20         | 0.09            | 7422.2        | 95.87       | 0.08            | 7828.0        | 3549954    | 164778        |
| 850.0       | 6537.320      | -43.0188    | 31.0564       | 96.63         | 0.09            | 7422.1        | 96.29       | 0.09            | 7827.8        | 3622291    | 164869        |
| 860.0       | 6537.440      | -42.2652    | 30.9789       | 97.06         | 0.09            | 7421.9        | 96.70       | 0.09            | 7827.7        | 3694625    | 164962        |
| 870.0       | 6537.563      | -41.5129    | 30.8964       | 97.50         | 0.10            | 7421.8        | 97.11       | 0.09            | 7827.6        | 3766957    | 165059        |
| 880.0       | 6537.691      | -40.7620    | 30.8092       | 97.93         | 0.10            | 7421.7        | 97.51       | 0.10            | 7827.4        | 3839287    | 165158        |
| 890.0       | 6537.823      | -40.0127    | 30.7171       | 98.36         | 0.10            | 7421.6        | 97.92       | 0.10            | 7827.3        | 3911614    | 165260        |
| 900.0       | 6537.960      | -39.2649    | 30.6202       | 98.78         | 0.11            | 7421.4        | 98.32       | 0.10            | 7827.1        | 3983938    | 165364        |
| 910.0       | 6538.100      | -38.5189    | 30.5185       | 99.21         | 0.11            | 7421.3        | 98.72       | 0.10            | 7827.0        | 4056259    | 165471        |
| 920.0       | 6538.245      | -37.7745    | 30.4121       | 99.63         | 0.11            | 7421.1        | 99.12       | 0.11            | 7826.8        | 4128578    | 165581        |
| 930.0       | 6538.394      | -37.0319    | 30.3010       | 100.05        | 0.12            | 7421.0        | 99.52       | 0.11            | 7826.6        | 4200893    | 165694        |
| 940.0       | 6538.547      | -36.2911    | 30.1852       | 100.46        | 0.12            | 7420.8        | 99.92       | 0.11            | 7826.5        | 4273206    | 165809        |
| 950.0       | 6538.704      | -35.5523    | 30.0648       | 100.88        | 0.12            | 7420.7        | 100.31      | 0.12            | 7826.3        | 4345516    | 165927        |
| 960.0       | 6538.865      | -34.8155    | 29.9398       | 101.29        | 0.13            | 7420.5        | 100.70      | 0.12            | 7826.1        | 4417822    | 166048        |
| 970.0       | 6539.031      | -34.0806    | 29.8102       | 101.70        | 0.13            | 7420.4        | 101.09      | 0.12            | 7825.9        | 4490126    | 166172        |
| 980.0       | 6539.200      | -33.3479    | 29.6761       | 102.11        | 0.13            | 7420.2        | 101.47      | 0.13            | 7825.8        | 4562426    | 166298        |
| 990.0       | 6539.373      | -32.6173    | 29.5375       | 102.51        | 0.14            | 7420.0        | 101.86      | 0.13            | 7825.6        | 4634722    | 166427        |
| 1000.0      | 6539.551      | -31.8889    | 29.3944       | 102.91        | 0.14            | 7419.9        | 102.23      | 0.13            | 7825.4        | 4707015    | 166558        |
| 1010.0      | 6539.732      | -31.1627    | 29.2469       | 103.31        | 0.14            | 7419.7        | 102.61      | 0.13            | 7825.2        | 4779305    | 166692        |
| 1020.0      | 6539.917      | -30.4388    | 29.0950       | 103.71        | 0.14            | 7419.5        | 102.99      | 0.14            | 7825.0        | 4851591    | 166829        |
| 1030.0      | 6540.106      | -29.7173    | 28.9388       | 104.10        | 0.15            | 7419.3        | 103.36      | 0.14            | 7824.8        | 4923873    | 166969        |
| 1040.0      | 6540.299      | -28.9981    | 28.7784       | 104.49        | 0.15            | 7419.2        | 103.73      | 0.14            | 7824.6        | 4996152    | 167111        |
| 1050.0      | 6540.496      | -28.2814    | 28.6136       | 104.88        | 0.15            | 7419.0        | 104.09      | 0.15            | 7824.4        | 5068427    | 167256        |
| 1060.0      | 6540.697      | -27.5670    | 28.4447       | 105.26        | 0.16            | 7418.8        | 104.45      | 0.15            | 7824.1        | 5140698    | 167403        |
| 1070.0      | 6540.901      | -26.8552    | 28.2715       | 105.64        | 0.16            | 7418.6        | 104.81      | 0.15            | 7823.9        | 5212964    | 167553        |

TABLE XIII  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>KM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>M/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>M/S | RANGE<br>M | ALTITUDE<br>M |
|-------------|---------------|-------------|---------------|---------------|-----------------|---------------|-------------|-----------------|---------------|------------|---------------|
| 1080.0      | 6541.109      | -26.1459    | 28.0943       | 106.02        | 0.16            | 7418.4        | 105.17      | 0.15            | 7823.7        | 5285227    | 167706        |
| 1090.0      | 6541.320      | -25.4392    | 27.9130       | 106.36        | 0.16            | 7418.2        | 105.52      | 0.16            | 7823.5        | 5357486    | 167861        |
| 1100.0      | 6541.536      | -24.7350    | 27.7276       | 106.76        | 0.17            | 7418.0        | 105.87      | 0.16            | 7823.2        | 5429740    | 168019        |
| 1110.0      | 6541.755      | -24.0335    | 27.5383       | 107.13        | 0.17            | 7417.8        | 106.21      | 0.16            | 7823.0        | 5501990    | 168180        |
| 1120.0      | 6541.977      | -23.3346    | 27.3450       | 107.49        | 0.17            | 7417.6        | 106.56      | 0.16            | 7822.8        | 5574236    | 168343        |
| 1130.0      | 6542.203      | -22.6383    | 27.1479       | 107.85        | 0.18            | 7417.4        | 106.90      | 0.17            | 7822.5        | 5646477    | 168509        |
| 1140.0      | 6542.433      | -21.9448    | 26.9469       | 108.20        | 0.18            | 7417.2        | 107.23      | 0.17            | 7822.3        | 5718714    | 168678        |
| 1150.0      | 6542.666      | -21.2539    | 26.7421       | 108.56        | 0.18            | 7417.0        | 107.56      | 0.17            | 7822.0        | 5790946    | 168849        |
| 1160.0      | 6542.902      | -20.5657    | 26.5336       | 108.90        | 0.18            | 7416.7        | 107.89      | 0.17            | 7821.8        | 5863173    | 169023        |
| 1170.0      | 6543.142      | -19.8803    | 26.3213       | 109.25        | 0.19            | 7416.5        | 108.21      | 0.18            | 7821.5        | 5935396    | 169199        |
| 1180.0      | 6543.385      | -19.1976    | 26.1055       | 109.59        | 0.19            | 7416.3        | 108.54      | 0.18            | 7821.3        | 6007613    | 169378        |
| 1190.0      | 6543.631      | -18.5176    | 25.8860       | 109.92        | 0.19            | 7416.0        | 108.85      | 0.18            | 7821.0        | 6079826    | 169560        |
| 1200.0      | 6543.881      | -17.8404    | 25.6629       | 110.26        | 0.19            | 7415.8        | 109.17      | 0.18            | 7820.7        | 6152034    | 169744        |
| 1210.0      | 6544.134      | -17.1660    | 25.4364       | 110.59        | 0.20            | 7415.6        | 109.48      | 0.19            | 7820.5        | 6224236    | 169931        |
| 1220.0      | 6544.390      | -16.4943    | 25.2064       | 110.91        | 0.20            | 7415.3        | 109.78      | 0.19            | 7820.2        | 6296434    | 170120        |
| 1230.0      | 6544.649      | -15.8254    | 24.9731       | 111.23        | 0.20            | 7415.1        | 110.08      | 0.19            | 7819.9        | 6368626    | 170312        |
| 1240.0      | 6544.911      | -15.1592    | 24.7363       | 111.55        | 0.20            | 7414.9        | 110.38      | 0.19            | 7819.6        | 6440813    | 170507        |
| 1250.0      | 6545.176      | -14.4959    | 24.4963       | 111.86        | 0.21            | 7414.6        | 110.68      | 0.20            | 7819.3        | 6512994    | 170704        |
| 1260.0      | 6545.445      | -13.8353    | 24.2530       | 112.17        | 0.21            | 7414.3        | 110.97      | 0.20            | 7819.1        | 6585170    | 170904        |
| 1270.0      | 6545.716      | -13.1774    | 24.0065       | 112.48        | 0.21            | 7414.1        | 111.25      | 0.20            | 7818.8        | 6657340    | 171106        |
| 1280.0      | 6545.990      | -12.5223    | 23.7569       | 112.78        | 0.21            | 7413.8        | 111.54      | 0.20            | 7818.5        | 6729504    | 171311        |
| 1290.0      | 6546.267      | -11.8700    | 23.5041       | 113.07        | 0.22            | 7413.6        | 111.82      | 0.20            | 7818.2        | 6801663    | 171518        |
| 1300.0      | 6546.547      | -11.2203    | 23.2483       | 113.37        | 0.22            | 7413.3        | 112.09      | 0.21            | 7817.9        | 6873816    | 171728        |
| 1310.0      | 6546.829      | -10.5734    | 22.9896       | 113.65        | 0.22            | 7413.0        | 112.36      | 0.21            | 7817.6        | 6945962    | 171941        |
| 1320.0      | 6547.114      | -9.9293     | 22.7278       | 113.94        | 0.22            | 7412.8        | 112.63      | 0.21            | 7817.3        | 7018103    | 172156        |
| 1330.0      | 6547.402      | -9.2878     | 22.4632       | 114.22        | 0.22            | 7412.5        | 112.89      | 0.21            | 7817.0        | 7090238    | 172374        |
| 1340.0      | 6547.693      | -8.6490     | 22.1957       | 114.50        | 0.23            | 7412.2        | 113.15      | 0.21            | 7816.6        | 7162366    | 172594        |
| 1350.0      | 6547.986      | -8.0128     | 21.9254       | 114.77        | 0.23            | 7411.9        | 113.41      | 0.22            | 7816.3        | 7234489    | 172816        |
| 1360.0      | 6548.282      | -7.3793     | 21.6524       | 115.04        | 0.23            | 7411.7        | 113.66      | 0.22            | 7816.0        | 7306605    | 173042        |
| 1370.0      | 6548.580      | -6.7484     | 21.3766       | 115.30        | 0.23            | 7411.4        | 113.91      | 0.22            | 7815.7        | 7378714    | 173269        |
| 1380.0      | 6548.880      | -6.1202     | 21.0982       | 115.56        | 0.23            | 7411.1        | 114.15      | 0.22            | 7815.4        | 7450817    | 173499        |
| 1390.0      | 6549.183      | -5.4945     | 20.8172       | 115.81        | 0.24            | 7410.8        | 114.39      | 0.22            | 7815.0        | 7522913    | 173732        |
| 1400.0      | 6549.489      | -4.8713     | 20.5337       | 116.07        | 0.24            | 7410.5        | 114.62      | 0.22            | 7814.7        | 7595003    | 173967        |
| 1410.0      | 6549.796      | -4.2507     | 20.2476       | 116.31        | 0.24            | 7410.2        | 114.86      | 0.23            | 7814.4        | 7667085    | 174205        |
| 1420.0      | 6550.106      | -3.6326     | 19.9591       | 116.56        | 0.24            | 7409.9        | 115.08      | 0.23            | 7814.0        | 7739161    | 174445        |
| 1430.0      | 6550.418      | -3.0170     | 19.6681       | 116.79        | 0.24            | 7409.6        | 115.31      | 0.23            | 7813.7        | 7811230    | 174687        |
| 1440.0      | 6550.732      | -2.4039     | 19.3749       | 117.03        | 0.24            | 7409.3        | 115.53      | 0.23            | 7813.4        | 7883292    | 174932        |
| 1450.0      | 6551.049      | -1.7932     | 19.0793       | 117.26        | 0.25            | 7409.0        | 115.74      | 0.23            | 7813.0        | 7955347    | 175179        |
| 1460.0      | 6551.367      | -1.1848     | 18.7814       | 117.48        | 0.25            | 7408.7        | 115.95      | 0.23            | 7812.7        | 8027395    | 175429        |
| 1470.0      | 6551.687      | -0.5789     | 18.4813       | 117.71        | 0.25            | 7408.3        | 116.16      | 0.24            | 7812.3        | 8099435    | 175681        |
| 1480.0      | 6552.009      | 0.0247      | 18.1790       | 117.92        | 0.25            | 7408.0        | 116.36      | 0.24            | 7812.0        | 8171468    | 175936        |
| 1490.0      | 6552.333      | 0.6261      | 17.8747       | 118.14        | 0.25            | 7407.7        | 116.56      | 0.24            | 7811.6        | 8243494    | 176193        |
| 1500.0      | 6552.659      | 1.2251      | 17.5682       | 118.35        | 0.25            | 7407.4        | 116.76      | 0.24            | 7811.3        | 8315512    | 176452        |
| 1510.0      | 6552.987      | 1.8219      | 17.2597       | 118.55        | 0.25            | 7407.0        | 116.95      | 0.24            | 7810.9        | 8387522    | 176714        |



TABLE XIII  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>KM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>M/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>M/S | RANGE<br>M | ALTITUDE<br>M |
|-------------|---------------|-------------|---------------|---------------|-----------------|---------------|-------------|-----------------|---------------|------------|---------------|
| 1520.0      | 6553.316      | 2.4165      | 16.9492       | 118.75        | 0.26            | 7406.7        | 117.14      | 0.24            | 7810.6        | 8459525    | 176978        |
| 1530.0      | 6553.647      | 3.0090      | 16.6368       | 118.95        | 0.26            | 7406.4        | 117.32      | 0.24            | 7810.2        | 8531520    | 177244        |
| 1540.0      | 6553.980      | 3.5993      | 16.3225       | 119.14        | 0.26            | 7406.0        | 117.50      | 0.24            | 7809.8        | 8603507    | 177513        |
| 1550.0      | 6554.314      | 4.1875      | 16.0064       | 119.33        | 0.26            | 7405.7        | 117.68      | 0.25            | 7809.5        | 8675487    | 177783        |
| 1560.0      | 6554.650      | 4.7736      | 15.6884       | 119.51        | 0.26            | 7405.4        | 117.85      | 0.25            | 7809.1        | 8747458    | 178057        |
| 1570.0      | 6554.987      | 5.3577      | 15.3687       | 119.69        | 0.26            | 7405.0        | 118.02      | 0.25            | 7808.7        | 8819421    | 178332        |
| 1580.0      | 6555.326      | 5.9398      | 15.0473       | 119.87        | 0.26            | 7404.7        | 118.18      | 0.25            | 7808.3        | 8891376    | 178610        |
| 1590.0      | 6555.666      | 6.5200      | 14.7241       | 120.04        | 0.26            | 7404.3        | 118.34      | 0.25            | 7808.0        | 8963323    | 178889        |
| 1600.0      | 6556.007      | 7.0983      | 14.3994       | 120.21        | 0.26            | 7404.0        | 118.50      | 0.25            | 7807.6        | 9035261    | 179171        |
| 1610.0      | 6556.350      | 7.6747      | 14.0731       | 120.37        | 0.27            | 7403.6        | 118.65      | 0.25            | 7807.2        | 9107191    | 179456        |
| 1620.0      | 6556.693      | 8.2492      | 13.7453       | 120.53        | 0.27            | 7403.2        | 118.80      | 0.25            | 7806.8        | 9179113    | 179742        |
| 1630.0      | 6557.038      | 8.8220      | 13.4159       | 120.69        | 0.27            | 7402.9        | 118.95      | 0.25            | 7806.4        | 9251026    | 180030        |
| 1640.0      | 6557.384      | 9.3930      | 13.0851       | 120.84        | 0.27            | 7402.5        | 119.09      | 0.25            | 7806.1        | 9322931    | 180321        |
| 1650.0      | 6557.731      | 9.9623      | 12.7529       | 120.99        | 0.27            | 7402.1        | 119.22      | 0.26            | 7805.7        | 9394826    | 180614        |
| 1660.0      | 6558.079      | 10.5299     | 12.4193       | 121.13        | 0.27            | 7401.8        | 119.36      | 0.26            | 7805.3        | 9466713    | 180908        |
| 1670.0      | 6558.428      | 11.0960     | 12.0844       | 121.27        | 0.27            | 7401.4        | 119.49      | 0.26            | 7804.9        | 9538592    | 181205        |
| 1680.0      | 6558.777      | 11.6604     | 11.7482       | 121.40        | 0.27            | 7401.0        | 119.61      | 0.26            | 7804.5        | 9610461    | 181504        |
| 1690.0      | 6559.128      | 12.2232     | 11.4108       | 121.53        | 0.27            | 7400.7        | 119.73      | 0.26            | 7804.1        | 9682321    | 181804        |
| 1700.0      | 6559.479      | 12.7846     | 11.0721       | 121.66        | 0.27            | 7400.3        | 119.85      | 0.26            | 7803.7        | 9754172    | 182107        |
| 1710.0      | 6559.831      | 13.3445     | 10.7323       | 121.78        | 0.27            | 7399.9        | 119.97      | 0.26            | 7803.3        | 9826015    | 182412        |
| 1720.0      | 6560.184      | 13.9030     | 10.3914       | 121.90        | 0.27            | 7399.5        | 120.08      | 0.26            | 7802.9        | 9897848    | 182718        |
| 1730.0      | 6560.537      | 14.4601     | 10.0494       | 122.02        | 0.27            | 7399.1        | 120.18      | 0.26            | 7802.5        | 9969671    | 183027        |
| 1740.0      | 6560.891      | 15.0159     | 9.7064        | 122.13        | 0.27            | 7398.7        | 120.29      | 0.26            | 7802.1        | 10041486   | 183337        |
| 1750.0      | 6561.245      | 15.5704     | 9.3623        | 122.23        | 0.27            | 7398.3        | 120.38      | 0.26            | 7801.7        | 10113291   | 183649        |
| 1760.0      | 6561.600      | 16.1236     | 9.0173        | 122.34        | 0.27            | 7397.9        | 120.48      | 0.26            | 7801.3        | 10185086   | 183963        |
| 1770.0      | 6561.955      | 16.6757     | 8.6714        | 122.44        | 0.28            | 7397.6        | 120.57      | 0.26            | 7800.9        | 10256873   | 184279        |
| 1780.0      | 6562.310      | 17.2266     | 8.3246        | 122.53        | 0.28            | 7397.2        | 120.66      | 0.26            | 7800.5        | 10328649   | 184596        |
| 1790.0      | 6562.666      | 17.7763     | 7.9769        | 122.62        | 0.28            | 7396.8        | 120.74      | 0.26            | 7800.1        | 10400416   | 184915        |
| 1800.0      | 6563.022      | 18.3250     | 7.6285        | 122.71        | 0.28            | 7396.3        | 120.82      | 0.26            | 7799.7        | 10472174   | 185236        |
| 1810.0      | 6563.378      | 18.8727     | 7.2793        | 122.79        | 0.28            | 7395.9        | 120.90      | 0.26            | 7799.3        | 10543921   | 185558        |
| 1820.0      | 6563.734      | 19.4194     | 6.9293        | 122.87        | 0.28            | 7395.5        | 120.97      | 0.26            | 7798.9        | 10615659   | 185882        |
| 1830.0      | 6564.091      | 19.9651     | 6.5787        | 122.94        | 0.28            | 7395.1        | 121.04      | 0.26            | 7798.5        | 10687387   | 186208        |
| 1840.0      | 6564.447      | 20.5100     | 6.2274        | 123.01        | 0.28            | 7394.7        | 121.11      | 0.26            | 7798.1        | 10759105   | 186535        |
| 1850.0      | 6564.803      | 21.0540     | 5.8756        | 123.08        | 0.28            | 7394.3        | 121.17      | 0.26            | 7797.6        | 10830813   | 186864        |
| 1860.0      | 6565.159      | 21.5972     | 5.5231        | 123.14        | 0.28            | 7393.9        | 121.23      | 0.26            | 7797.2        | 10902511   | 187194        |
| 1870.0      | 6565.515      | 22.1396     | 5.1701        | 123.20        | 0.28            | 7393.5        | 121.28      | 0.26            | 7796.8        | 10974199   | 187525        |
| 1880.0      | 6565.871      | 22.6814     | 4.8166        | 123.26        | 0.28            | 7393.1        | 121.33      | 0.26            | 7796.4        | 11045877   | 187858        |
| 1890.0      | 6566.226      | 23.2224     | 4.4627        | 123.31        | 0.28            | 7392.6        | 121.38      | 0.26            | 7796.0        | 11117544   | 188192        |
| 1900.0      | 6566.582      | 23.7628     | 4.1083        | 123.36        | 0.28            | 7392.2        | 121.43      | 0.26            | 7795.6        | 11189202   | 188527        |
| 1910.0      | 6566.936      | 24.3027     | 3.7535        | 123.40        | 0.27            | 7391.8        | 121.47      | 0.26            | 7795.2        | 11260849   | 188864        |
| 1920.0      | 6567.291      | 24.8420     | 3.3984        | 123.44        | 0.27            | 7391.4        | 121.50      | 0.26            | 7794.7        | 11332486   | 189202        |
| 1930.0      | 6567.645      | 25.3808     | 3.0430        | 123.47        | 0.27            | 7390.9        | 121.53      | 0.26            | 7794.3        | 11404113   | 189541        |
| 1940.0      | 6567.998      | 25.9192     | 2.6873        | 123.51        | 0.27            | 7390.5        | 121.56      | 0.26            | 7793.9        | 11475729   | 189881        |
| 1950.0      | 6568.351      | 26.4572     | 2.3314        | 123.53        | 0.27            | 7390.1        | 121.59      | 0.26            | 7793.5        | 11547335   | 190222        |

TABLE XIII  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>KM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>M/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>M/S | RANGE<br>M | ALTITUDE<br>M |
|-------------|---------------|-------------|---------------|---------------|-----------------|---------------|-------------|-----------------|---------------|------------|---------------|
| 1960.0      | 6568.703      | 26.9948     | 1.9753        | 123.56        | 0.27            | 7389.7        | 121.61      | 0.26            | 7793.1        | 11618930   | 190564        |
| 1970.0      | 6569.055      | 27.5321     | 1.6190        | 123.58        | 0.27            | 7389.2        | 121.63      | 0.26            | 7792.7        | 11690515   | 190907        |
| 1980.0      | 6569.406      | 28.0691     | 1.2626        | 123.59        | 0.27            | 7388.8        | 121.64      | 0.26            | 7792.3        | 11762090   | 191252        |
| 1990.0      | 6569.756      | 28.6060     | 0.9061        | 123.60        | 0.27            | 7388.4        | 121.65      | 0.26            | 7791.8        | 11833653   | 191597        |
| 2000.0      | 6570.105      | 29.1426     | 0.5495        | 123.61        | 0.27            | 7387.9        | 121.66      | 0.26            | 7791.4        | 11905207   | 191943        |
| 2010.0      | 6570.454      | 29.6791     | 0.1929        | 123.62        | 0.27            | 7387.5        | 121.67      | 0.26            | 7791.0        | 11976749   | 192289        |
| 2020.0      | 6570.801      | 30.2156     | -0.1637       | 123.62        | 0.27            | 7387.1        | 121.67      | 0.26            | 7790.6        | 12048281   | 192637        |
| 2030.0      | 6571.148      | 30.7520     | -0.5202       | 123.61        | 0.27            | 7386.6        | 121.66      | 0.25            | 7790.2        | 12119803   | 192985        |
| 2040.0      | 6571.493      | 31.2883     | -0.8766       | 123.61        | 0.27            | 7386.2        | 121.66      | 0.25            | 7789.8        | 12191313   | 193334        |
| 2050.0      | 6571.838      | 31.8248     | -1.2329       | 123.59        | 0.27            | 7385.7        | 121.64      | 0.25            | 7789.3        | 12262813   | 193683        |
| 2060.0      | 6572.181      | 32.3613     | -1.5890       | 123.58        | 0.27            | 7385.3        | 121.63      | 0.25            | 7788.9        | 12334302   | 194033        |
| 2070.0      | 6572.523      | 32.8980     | -1.9449       | 123.56        | 0.26            | 7384.9        | 121.61      | 0.25            | 7788.5        | 12405781   | 194383        |
| 2080.0      | 6572.864      | 33.4349     | -2.3006       | 123.54        | 0.26            | 7384.4        | 121.59      | 0.25            | 7788.1        | 12477248   | 194734        |
| 2090.0      | 6573.204      | 33.9720     | -2.6561       | 123.51        | 0.26            | 7384.0        | 121.57      | 0.25            | 7787.7        | 12548705   | 195085        |
| 2100.0      | 6573.542      | 34.5093     | -3.0112       | 123.48        | 0.26            | 7383.5        | 121.54      | 0.25            | 7787.3        | 12620151   | 195437        |
| 2110.0      | 6573.879      | 35.0470     | -3.3659       | 123.45        | 0.26            | 7383.1        | 121.50      | 0.25            | 7786.9        | 12691586   | 195789        |
| 2120.0      | 6574.215      | 35.5850     | -3.7203       | 123.41        | 0.26            | 7382.7        | 121.47      | 0.25            | 7786.5        | 12763010   | 196141        |
| 2130.0      | 6574.549      | 36.1235     | -4.0743       | 123.36        | 0.26            | 7382.2        | 121.43      | 0.25            | 7786.0        | 12834424   | 196493        |
| 2140.0      | 6574.882      | 36.6624     | -4.4278       | 123.32        | 0.26            | 7381.8        | 121.39      | 0.24            | 7785.6        | 12905826   | 196845        |
| 2150.0      | 6575.213      | 37.2018     | -4.7808       | 123.27        | 0.26            | 7381.3        | 121.34      | 0.24            | 7785.2        | 12977218   | 197197        |
| 2160.0      | 6575.542      | 37.7417     | -5.1333       | 123.21        | 0.26            | 7380.9        | 121.29      | 0.24            | 7784.8        | 13048599   | 197550        |
| 2170.0      | 6575.870      | 38.2822     | -5.4852       | 123.16        | 0.25            | 7380.4        | 121.23      | 0.24            | 7784.4        | 13119969   | 197902        |
| 2180.0      | 6576.196      | 38.8234     | -5.8365       | 123.09        | 0.25            | 7379.0        | 121.18      | 0.24            | 7784.0        | 13191328   | 198254        |
| 2190.0      | 6576.521      | 39.3652     | -6.1872       | 123.03        | 0.25            | 7378.6        | 121.12      | 0.24            | 7783.6        | 13262675   | 198606        |
| 2200.0      | 6576.844      | 39.9078     | -6.5372       | 122.96        | 0.25            | 7379.1        | 121.05      | 0.24            | 7783.2        | 13334012   | 198958        |
| 2210.0      | 6577.165      | 40.4511     | -6.8865       | 122.89        | 0.25            | 7378.7        | 120.98      | 0.24            | 7782.8        | 13405339   | 199309        |
| 2220.0      | 6577.484      | 40.9952     | -7.2351       | 122.81        | 0.25            | 7378.2        | 120.91      | 0.23            | 7782.4        | 13476654   | 199660        |
| 2230.0      | 6577.801      | 41.5401     | -7.5829       | 122.73        | 0.25            | 7377.8        | 120.83      | 0.23            | 7782.0        | 13547958   | 200011        |
| 2240.0      | 6578.116      | 42.0860     | -7.9298       | 122.64        | 0.24            | 7377.3        | 120.75      | 0.23            | 7781.6        | 13619251   | 200361        |
| 2250.0      | 6578.429      | 42.6327     | -8.2759       | 122.55        | 0.24            | 7376.9        | 120.67      | 0.23            | 7781.2        | 13690534   | 200710        |
| 2260.0      | 6578.741      | 43.1805     | -8.6211       | 122.46        | 0.24            | 7376.5        | 120.58      | 0.23            | 7780.8        | 13761805   | 201059        |
| 2270.0      | 6579.050      | 43.7293     | -8.9653       | 122.36        | 0.24            | 7376.0        | 120.49      | 0.23            | 7780.4        | 13833065   | 201407        |
| 2280.0      | 6579.357      | 44.2791     | -9.3086       | 122.26        | 0.24            | 7375.6        | 120.40      | 0.23            | 7780.0        | 13904315   | 201755        |
| 2290.0      | 6579.662      | 44.8301     | -9.6508       | 122.16        | 0.24            | 7375.1        | 120.30      | 0.22            | 7779.7        | 13975554   | 202101        |
| 2300.0      | 6579.965      | 45.3822     | -9.9920       | 122.05        | 0.23            | 7374.7        | 120.20      | 0.22            | 7779.3        | 14046781   | 202447        |
| 2310.0      | 6580.265      | 45.9355     | -10.3322      | 121.93        | 0.23            | 7374.3        | 120.09      | 0.22            | 7778.9        | 14117998   | 202792        |
| 2320.0      | 6580.563      | 46.4900     | -10.6711      | 121.82        | 0.23            | 7373.8        | 119.99      | 0.22            | 7778.5        | 14189204   | 203136        |
| 2330.0      | 6580.859      | 47.0458     | -11.0090      | 121.70        | 0.23            | 7373.4        | 119.87      | 0.22            | 7778.1        | 14260398   | 203479        |
| 2340.0      | 6581.153      | 47.6029     | -11.3456      | 121.57        | 0.23            | 7373.0        | 119.76      | 0.22            | 7777.8        | 14331582   | 203820        |
| 2350.0      | 6581.444      | 48.1614     | -11.6810      | 121.44        | 0.23            | 7372.5        | 119.64      | 0.21            | 7777.4        | 14402755   | 204161        |
| 2360.0      | 6581.733      | 48.7212     | -12.0150      | 121.31        | 0.22            | 7372.1        | 119.51      | 0.21            | 7777.0        | 14473917   | 204500        |
| 2370.0      | 6582.020      | 49.2825     | -12.3478      | 121.17        | 0.22            | 7371.7        | 119.38      | 0.21            | 7776.6        | 14545068   | 204838        |
| 2380.0      | 6582.304      | 49.8453     | -12.6792      | 121.03        | 0.22            | 7371.3        | 119.25      | 0.21            | 7776.3        | 14616208   | 205174        |
| 2390.0      | 6582.585      | 50.4096     | -13.0092      | 120.89        | 0.22            | 7370.8        | 119.12      | 0.21            | 7775.9        | 14687337   | 205509        |

TABLE XIII  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>KM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>M/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>M/S | RANGE<br>M | ALTITUDE<br>M |
|-------------|---------------|-------------|---------------|---------------|-----------------|---------------|-------------|-----------------|---------------|------------|---------------|
| 2400.0      | 6582.864      | 50.9755     | -13.3378      | 120.74        | 0.22            | 7370.4        | 118.98      | 0.20            | 7775.5        | 14758456   | 205843        |
| 2410.0      | 6583.140      | 51.5430     | -13.6648      | 120.59        | 0.21            | 7370.0        | 118.84      | 0.20            | 7775.2        | 14829563   | 206175        |
| 2420.0      | 6583.413      | 52.1121     | -13.9904      | 120.43        | 0.21            | 7369.6        | 118.69      | 0.20            | 7774.8        | 14900659   | 206505        |
| 2430.0      | 6583.684      | 52.6829     | -14.3144      | 120.27        | 0.21            | 7369.2        | 118.54      | 0.20            | 7774.5        | 14971744   | 206833        |
| 2440.0      | 6583.952      | 53.2554     | -14.6367      | 120.10        | 0.21            | 7368.8        | 118.39      | 0.20            | 7774.1        | 15042818   | 207160        |
| 2450.0      | 6584.218      | 53.8297     | -14.9575      | 119.93        | 0.21            | 7368.3        | 118.23      | 0.19            | 7773.8        | 15113881   | 207485        |
| 2460.0      | 6584.481      | 54.4057     | -15.2765      | 119.76        | 0.20            | 7367.9        | 118.07      | 0.19            | 7773.4        | 15184933   | 207808        |
| 2470.0      | 6584.741      | 54.9836     | -15.5938      | 119.58        | 0.20            | 7367.5        | 117.90      | 0.19            | 7773.1        | 15255974   | 208129        |
| 2480.0      | 6584.998      | 55.5633     | -15.9094      | 119.40        | 0.20            | 7367.1        | 117.73      | 0.19            | 7772.7        | 15327003   | 208448        |
| 2490.0      | 6585.252      | 56.1450     | -16.2231      | 119.22        | 0.20            | 7366.7        | 117.56      | 0.19            | 7772.4        | 15398022   | 208764        |
| 2500.0      | 6585.503      | 56.7286     | -16.5349      | 119.03        | 0.19            | 7366.3        | 117.38      | 0.18            | 7772.1        | 15469029   | 209079        |
| 2510.0      | 6585.751      | 57.3141     | -16.8449      | 118.84        | 0.19            | 7365.9        | 117.20      | 0.18            | 7771.7        | 15540025   | 209391        |
| 2520.0      | 6585.997      | 57.9017     | -17.1530      | 118.64        | 0.19            | 7365.5        | 117.02      | 0.18            | 7771.4        | 15611010   | 209701        |
| 2530.0      | 6586.239      | 58.4913     | -17.4590      | 118.44        | 0.19            | 7365.2        | 116.83      | 0.18            | 7771.1        | 15681983   | 210009        |
| 2540.0      | 6586.479      | 59.0829     | -17.7630      | 118.23        | 0.19            | 7364.8        | 116.64      | 0.18            | 7770.8        | 15752944   | 210314        |
| 2550.0      | 6586.715      | 59.6767     | -18.0650      | 118.02        | 0.18            | 7364.4        | 116.44      | 0.17            | 7770.4        | 15823895   | 210616        |
| 2560.0      | 6586.948      | 60.2726     | -18.3648      | 117.81        | 0.18            | 7364.0        | 116.24      | 0.17            | 7770.1        | 15894833   | 210916        |
| 2570.0      | 6587.178      | 60.8707     | -18.6625      | 117.59        | 0.18            | 7363.6        | 116.04      | 0.17            | 7769.8        | 15965759   | 211214        |
| 2580.0      | 6587.405      | 61.4710     | -18.9580      | 117.37        | 0.18            | 7363.3        | 115.83      | 0.17            | 7769.5        | 16036674   | 211508        |
| 2590.0      | 6587.629      | 62.0732     | -19.2512      | 117.14        | 0.17            | 7362.9        | 115.62      | 0.16            | 7769.2        | 16107576   | 211800        |
| 2600.0      | 6587.850      | 62.6782     | -19.5421      | 116.91        | 0.17            | 7362.5        | 115.40      | 0.16            | 7768.9        | 16178467   | 212089        |
| 2610.0      | 6588.067      | 63.2853     | -19.8308      | 116.68        | 0.17            | 7362.2        | 115.18      | 0.16            | 7768.6        | 16249345   | 212375        |
| 2620.0      | 6588.281      | 63.8946     | -20.1170      | 116.44        | 0.17            | 7361.8        | 114.96      | 0.16            | 7768.3        | 16320210   | 212658        |
| 2630.0      | 6588.492      | 64.5063     | -20.4008      | 116.20        | 0.16            | 7361.4        | 114.73      | 0.15            | 7768.0        | 16391062   | 212938        |
| 2640.0      | 6588.700      | 65.1204     | -20.6821      | 115.95        | 0.16            | 7361.1        | 114.50      | 0.15            | 7767.7        | 16461901   | 213215        |
| 2650.0      | 6588.904      | 65.7368     | -20.9609      | 115.70        | 0.16            | 7360.7        | 114.27      | 0.15            | 7767.4        | 16532727   | 213489        |
| 2660.0      | 6589.105      | 66.3556     | -21.2372      | 115.45        | 0.16            | 7360.4        | 114.03      | 0.15            | 7767.2        | 16603539   | 213759        |
| 2670.0      | 6589.302      | 66.9769     | -21.5109      | 115.19        | 0.15            | 7360.1        | 113.79      | 0.14            | 7766.9        | 16674337   | 214026        |
| 2680.0      | 6589.497      | 67.6006     | -21.7819      | 114.93        | 0.15            | 7359.7        | 113.54      | 0.14            | 7766.6        | 16745120   | 214290        |
| 2690.0      | 6589.687      | 68.2268     | -22.0502      | 114.66        | 0.15            | 7359.4        | 113.29      | 0.14            | 7766.4        | 16815889   | 214550        |
| 2700.0      | 6589.875      | 68.8555     | -22.3157      | 114.39        | 0.14            | 7359.1        | 113.04      | 0.14            | 7766.1        | 16886642   | 214807        |
| 2710.0      | 6590.059      | 69.4867     | -22.5785      | 114.12        | 0.14            | 7358.7        | 112.78      | 0.13            | 7765.8        | 16957379   | 215061        |
| 2720.0      | 6590.239      | 70.1204     | -22.8384      | 113.84        | 0.14            | 7358.4        | 112.52      | 0.13            | 7765.6        | 17028100   | 215311        |
| 2730.0      | 6590.416      | 70.7566     | -23.0955      | 113.56        | 0.14            | 7358.1        | 112.25      | 0.13            | 7765.3        | 17098803   | 215557        |
| 2740.0      | 6590.590      | 71.3954     | -23.3496      | 113.27        | 0.13            | 7357.8        | 111.98      | 0.13            | 7765.1        | 17169489   | 215799        |
| 2750.0      | 6590.759      | 72.0367     | -23.6008      | 112.98        | 0.13            | 7357.5        | 111.71      | 0.12            | 7764.8        | 17240156   | 216038        |
| 2760.0      | 6590.926      | 72.6807     | -23.8489      | 112.68        | 0.13            | 7357.2        | 111.43      | 0.12            | 7764.6        | 17310804   | 216273        |
| 2770.0      | 6591.088      | 73.3272     | -24.0940      | 112.39        | 0.13            | 7356.9        | 111.15      | 0.12            | 7764.4        | 17381430   | 216503        |
| 2780.0      | 6591.248      | 73.9762     | -24.3359      | 112.08        | 0.12            | 7356.6        | 110.87      | 0.12            | 7764.2        | 17452035   | 216730        |
| 2790.0      | 6591.403      | 74.6279     | -24.5747      | 111.78        | 0.12            | 7356.3        | 110.58      | 0.11            | 7763.9        | 17522616   | 216953        |
| 2800.0      | 6591.555      | 75.2822     | -24.8103      | 111.47        | 0.12            | 7356.1        | 110.29      | 0.11            | 7763.7        | 17593173   | 217172        |
| 2810.0      | 6591.703      | 75.9391     | -25.0426      | 111.15        | 0.11            | 7355.8        | 109.99      | 0.11            | 7763.5        | 17663704   | 217387        |
| 2820.0      | 6591.848      | 76.5986     | -25.2717      | 110.84        | 0.11            | 7355.5        | 109.69      | 0.11            | 7763.3        | 17734206   | 217598        |
| 2830.0      | 6591.989      | 77.2607     | -25.4974      | 110.51        | 0.11            | 7355.2        | 109.39      | 0.10            | 7763.1        | 17804678   | 217804        |

TABLE XIII  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>KM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>M/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>M/S | RANGE<br>M | ALTITUDE<br>M |
|-------------|---------------|-------------|---------------|---------------|-----------------|---------------|-------------|-----------------|---------------|------------|---------------|
| 2840.0      | 6592.126      | 77.9254     | -25.7197      | 110.19        | 0.11            | 7355.0        | 109.09      | 0.10            | 7762.9        | 17875116   | 218006        |
| 2850.0      | 6592.289      | 78.5927     | -25.9385      | 109.86        | 0.10            | 7354.7        | 108.78      | 0.10            | 7762.7        | 17945519   | 218204        |
| 2860.0      | 6592.389      | 79.2625     | -26.1539      | 109.53        | 0.10            | 7354.5        | 108.46      | 0.09            | 7762.5        | 18015884   | 218397        |
| 2870.0      | 6592.515      | 79.9350     | -26.3658      | 109.19        | 0.10            | 7354.2        | 108.15      | 0.09            | 7762.3        | 18086205   | 218586        |
| 2880.0      | 6592.638      | 80.6100     | -26.5740      | 108.85        | 0.09            | 7354.0        | 107.83      | 0.09            | 7762.1        | 18156479   | 218771        |
| 2890.0      | 6592.756      | 81.2876     | -26.7787      | 108.51        | 0.09            | 7353.8        | 107.50      | 0.09            | 7762.0        | 18226702   | 218951        |
| 2900.0      | 6592.871      | 81.9678     | -26.9797      | 108.16        | 0.09            | 7353.6        | 107.17      | 0.08            | 7761.8        | 18296867   | 219126        |
| 2910.0      | 6592.982      | 82.6505     | -27.1770      | 107.81        | 0.08            | 7353.3        | 106.84      | 0.08            | 7761.6        | 18366967   | 219297        |
| 2920.0      | 6593.089      | 83.3357     | -27.3705      | 107.46        | 0.08            | 7353.1        | 106.51      | 0.08            | 7761.5        | 18436994   | 219463        |
| 2930.0      | 6593.193      | 84.0234     | -27.5603      | 107.10        | 0.08            | 7352.9        | 106.17      | 0.07            | 7761.3        | 18506939   | 219625        |
| 2940.0      | 6593.292      | 84.7136     | -27.7462      | 106.74        | 0.08            | 7352.7        | 105.83      | 0.07            | 7761.1        | 18576790   | 219782        |
| 2950.0      | 6593.388      | 85.4062     | -27.9282      | 106.37        | 0.07            | 7352.5        | 105.49      | 0.07            | 7761.0        | 18646534   | 219934        |
| 2960.0      | 6593.480      | 86.1013     | -28.1063      | 106.00        | 0.07            | 7352.3        | 105.14      | 0.07            | 7760.9        | 18716154   | 220081        |
| 2970.0      | 6593.568      | 86.7987     | -28.2805      | 105.63        | 0.07            | 7352.2        | 104.79      | 0.06            | 7760.7        | 18785628   | 220223        |
| 2980.0      | 6593.652      | 87.4986     | -28.4506      | 105.26        | 0.06            | 7352.0        | 104.44      | 0.06            | 7760.6        | 18854933   | 220360        |
| 2990.0      | 6593.732      | 88.2008     | -28.6167      | 104.88        | 0.06            | 7351.8        | 104.08      | 0.06            | 7760.5        | 18924036   | 220493        |
| 3000.0      | 6593.808      | 88.9053     | -28.7787      | 104.50        | 0.06            | 7351.6        | 103.72      | 0.05            | 7760.3        | 18992896   | 220620        |
| 3010.0      | 6593.881      | 89.6120     | -28.9365      | 104.12        | 0.05            | 7351.5        | 103.36      | 0.05            | 7760.2        | 19061462   | 220743        |
| 3020.0      | 6593.950      | 90.3211     | -29.0902      | 103.73        | 0.05            | 7351.3        | 103.00      | 0.05            | 7760.1        | 19129668   | 220860        |
| 3030.0      | 6594.014      | 91.0323     | -29.2397      | 103.34        | 0.05            | 7351.2        | 102.63      | 0.05            | 7760.0        | 19197422   | 220973        |
| 3040.0      | 6594.075      | 91.7456     | -29.3850      | 102.95        | 0.05            | 7351.0        | 102.26      | 0.04            | 7759.9        | 19264606   | 221080        |
| 3050.0      | 6594.132      | 92.4611     | -29.5260      | 102.55        | 0.04            | 7350.9        | 101.88      | 0.04            | 7759.8        | 19331051   | 221182        |
| 3060.0      | 6594.185      | 93.1787     | -29.6626      | 102.16        | 0.04            | 7350.8        | 101.51      | 0.04            | 7759.7        | 19396524   | 221279        |
| 3070.0      | 6594.234      | 93.8983     | -29.7949      | 101.76        | 0.04            | 7350.7        | 101.13      | 0.03            | 7759.7        | 19460683   | 221371        |
| 3080.0      | 6594.279      | 94.6198     | -29.9228      | 101.35        | 0.03            | 7350.6        | 100.75      | 0.03            | 7759.6        | 19523021   | 221457        |
| 3090.0      | 6594.320      | 95.3433     | -30.0463      | 100.95        | 0.03            | 7350.5        | 100.36      | 0.03            | 7759.5        | 19582760   | 221538        |
| 3100.0      | 6594.358      | 96.0686     | -30.1654      | 100.54        | 0.03            | 7350.4        | 99.98       | 0.03            | 7759.4        | 19638681   | 221614        |
| 3110.0      | 6594.391      | 96.7958     | -30.2800      | 100.13        | 0.02            | 7350.3        | 99.59       | 0.02            | 7759.4        | 19688851   | 221685        |
| 3120.0      | 6594.420      | 97.5247     | -30.3900      | 99.72         | 0.02            | 7350.2        | 99.20       | 0.02            | 7759.3        | 19730275   | 221750        |
| 3130.0      | 6594.446      | 98.2553     | -30.4955      | 99.30         | 0.02            | 7350.1        | 98.81       | 0.02            | 7759.3        | 19758778   | 221810        |
| 3140.0      | 6594.467      | 98.9875     | -30.5964      | 98.89         | 0.02            | 7350.0        | 98.41       | 0.01            | 7759.2        | 19769914   | 221865        |
| 3150.0      | 6594.485      | 99.7213     | -30.6928      | 98.47         | 0.01            | 7350.0        | 98.02       | 0.01            | 7759.2        | 19761432   | 221914        |
| 3160.0      | 6594.499      | 100.4566    | -30.7845      | 98.05         | 0.01            | 7349.9        | 97.62       | 0.01            | 7759.1        | 19735062   | 221958        |
| 3170.0      | 6594.508      | 101.1934    | -30.8715      | 97.62         | 0.01            | 7349.8        | 97.22       | 0.01            | 7759.1        | 19695110   | 221996        |
| 3180.0      | 6594.514      | 101.9315    | -30.9539      | 97.20         | 0.00            | 7349.8        | 96.82       | 0.00            | 7759.1        | 19645887   | 222029        |
| 3190.0      | 6594.516      | 102.6710    | -31.0315      | 96.77         | -0.00           | 7349.8        | 96.41       | -0.00           | 7759.1        | 19590560   | 222056        |
| 3200.0      | 6594.514      | 103.4117    | -31.1045      | 96.35         | -0.00           | 7349.7        | 96.01       | -0.00           | 7759.1        | 19531192   | 222078        |
| 3210.0      | 6594.508      | 104.1535    | -31.1727      | 95.92         | -0.01           | 7349.7        | 95.60       | -0.01           | 7759.1        | 19469087   | 222095        |
| 3220.0      | 6594.497      | 104.8965    | -31.2361      | 95.49         | -0.01           | 7349.7        | 95.20       | -0.01           | 7759.1        | 19405073   | 222106        |
| 3230.0      | 6594.484      | 105.6404    | -31.2948      | 95.05         | -0.01           | 7349.7        | 94.79       | -0.01           | 7759.1        | 19339688   | 222111        |
| 3235.242    | 6594.474      | 106.0308    | -31.3236      | 94.83         | -0.01           | 7349.7        | 94.57       | -0.01           | 7759.1        | 19304991   | 222112        |

S-IVB/LM SEPARATION

TABLE XIV  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC                | XE<br>FT | YE<br>FT | ZE<br>FT | DXE<br>FT/S | DYE<br>FT/S | DZE<br>FT/S | DDXE<br>FT/S SQ | DDYE<br>FT/S SQ | DDZE<br>FT/S SQ |
|----------------------------|----------|----------|----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| GUIDANCE REFERENCE RELEASE |          |          |          |             |             |             |                 |                 |                 |
| -4.956                     | 113      | 0        | 0        | 0.0         | 0.0         | 0.0         | 0.00            | 0.00            | 0.00            |
| -4.0                       | 113      | 0        | 0        | 0.0         | 0.0         | 0.0         | 0.00            | 0.00            | 0.00            |
| -3.0                       | 113      | 0        | 0        | 0.0         | 0.0         | 0.0         | 0.00            | 0.00            | 0.00            |
| -2.0                       | 113      | 0        | 0        | 0.0         | 0.0         | 0.0         | 0.00            | 0.00            | 0.00            |
| -1.0                       | 113      | 0        | 0        | 0.0         | 0.0         | 0.0         | 0.00            | 0.00            | 0.00            |
| RANGE ZERO AT 17 48 08 EST |          |          |          |             |             |             |                 |                 |                 |
| 0.000                      | 113      | 0        | 0        | 0.0         | 0.0         | 0.0         | 0.00            | 0.00            | 0.00            |
| FIRST MOTION               |          |          |          |             |             |             |                 |                 |                 |
| 0.200                      | 113      | 0        | 0        | -0.0        | -0.0        | 0.0         | 7.60            | 0.06            | 0.05            |
| LIFTOFF                    |          |          |          |             |             |             |                 |                 |                 |
| 0.360                      | 113      | 0        | 0        | 1.2         | 0.0         | 0.0         | 7.74            | 0.06            | 0.04            |
| 1.0                        | 116      | 0        | 0        | 6.3         | 0.0         | 0.0         | 8.24            | 0.03            | 0.02            |
| 2.0                        | 126      | 0        | 0        | 14.9        | 0.0         | 0.0         | 8.84            | -0.00           | 0.00            |
| 3.0                        | 146      | 0        | 0        | 24.0        | 0.0         | 0.0         | 9.28            | -0.02           | -0.01           |
| 4.0                        | 174      | 0        | 0        | 33.4        | 0.0         | 0.0         | 9.61            | -0.04           | -0.02           |
| 5.0                        | 212      | 0        | 0        | 43.2        | -0.0        | 0.0         | 9.87            | -0.05           | -0.02           |
| 6.0                        | 260      | 0        | 0        | 53.1        | -0.1        | -0.0        | 10.09           | -0.05           | -0.02           |
| 7.0                        | 319      | 0        | 1        | 63.3        | -0.1        | -0.0        | 10.30           | -0.05           | -0.01           |
| 8.0                        | 387      | 0        | 1        | 73.7        | -0.2        | -0.0        | 10.51           | -0.05           | -0.01           |
| 9.0                        | 466      | 0        | 1        | 84.4        | -0.2        | -0.0        | 10.73           | -0.05           | 0.00            |
| 10.0                       | 556      | -0       | 1        | 95.2        | -0.3        | -0.0        | 10.96           | -0.05           | 0.03            |
| 11.0                       | 657      | -0       | 1        | 106.3       | -0.3        | 0.0         | 11.21           | -0.05           | 0.06            |
| 12.0                       | 768      | -0       | 1        | 117.6       | -0.4        | 0.1         | 11.48           | -0.05           | 0.10            |
| 13.0                       | 892      | -1       | 1        | 129.3       | -0.4        | 0.2         | 11.76           | -0.05           | 0.16            |
| 14.0                       | 1027     | -2       | 1        | 141.2       | -0.5        | 0.4         | 12.04           | -0.04           | 0.23            |
| 15.0                       | 1174     | -2       | 2        | 153.3       | -0.5        | 0.7         | 12.33           | -0.03           | 0.32            |
| 16.0                       | 1334     | -3       | 3        | 165.8       | -0.6        | 1.1         | 12.62           | -0.02           | 0.43            |
| 17.0                       | 1506     | -3       | 4        | 178.6       | -0.6        | 1.6         | 12.91           | -0.01           | 0.56            |
| 18.0                       | 1691     | -4       | 6        | 191.6       | -0.6        | 2.2         | 13.19           | 0.01            | 0.71            |
| 19.0                       | 1889     | -5       | 9        | 205.0       | -0.5        | 3.0         | 13.46           | 0.04            | 0.87            |
| 20.0                       | 2101     | -6       | 13       | 218.5       | -0.5        | 3.9         | 13.72           | 0.07            | 1.06            |

TABLE XIV  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>FT | YE<br>FT | ZE<br>FT | DXE<br>FT/S | DYE<br>FT/S | DZE<br>FT/S | DDXE<br>FT/S SQ | DDYE<br>FT/S SQ | DDZE<br>FT/S SQ | DCZE<br>FT/S SQ |
|-------------|----------|----------|----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|-----------------|
| 21.0        | 2326     | -6       | 17       | 232.4       | -0.4        | 5.1         | 13.97           | 0.10            | 0.10            | 1.25            |
| 22.0        | 2565     | -7       | 23       | 246.5       | -0.3        | 6.5         | 14.22           | 0.14            | 0.14            | 1.46            |
| 23.0        | 2819     | -7       | 30       | 260.8       | -0.1        | 8.0         | 14.47           | 0.18            | 0.18            | 1.69            |
| 24.0        | 3087     | -7       | 39       | 275.4       | 0.1         | 9.8         | 14.72           | 0.22            | 0.22            | 1.92            |
| 25.0        | 3370     | -7       | 51       | 290.3       | 0.3         | 11.9        | 14.98           | 0.25            | 0.25            | 2.17            |
| 26.0        | 3668     | -7       | 64       | 305.4       | 0.6         | 14.2        | 15.25           | 0.28            | 0.28            | 2.42            |
| 27.0        | 3981     | -6       | 80       | 320.8       | 0.9         | 16.7        | 15.54           | 0.30            | 0.30            | 2.70            |
| 28.0        | 4309     | -5       | 99       | 336.5       | 1.2         | 19.6        | 15.86           | 0.32            | 0.32            | 2.98            |
| 29.0        | 4653     | -4       | 120      | 352.5       | 1.5         | 22.7        | 16.16           | 0.29            | 0.29            | 3.27            |
| 30.0        | 5014     | -3       | 145      | 368.8       | 1.7         | 26.1        | 16.49           | 0.23            | 0.23            | 3.59            |
| 31.0        | 5391     | -1       | 174      | 385.4       | 1.9         | 29.9        | 16.81           | 0.09            | 0.09            | 4.00            |
| 32.0        | 5785     | 0        | 206      | 402.5       | 1.9         | 34.2        | 17.12           | -0.04           | -0.04           | 4.46            |
| 33.0        | 6196     | 2        | 243      | 419.7       | 1.8         | 38.9        | 17.39           | -0.14           | -0.14           | 4.95            |
| 34.0        | 6624     | 4        | 286      | 437.2       | 1.7         | 44.0        | 17.72           | -0.15           | -0.15           | 5.40            |
| 35.0        | 7071     | 5        | 333      | 455.2       | 1.6         | 49.6        | 18.05           | -0.07           | -0.07           | 5.77            |
| 36.0        | 7535     | 7        | 386      | 473.3       | 1.6         | 55.6        | 18.31           | 0.06            | 0.06            | 6.12            |
| 37.0        | 8017     | 8        | 445      | 491.8       | 1.7         | 61.9        | 18.59           | 0.13            | 0.13            | 6.48            |
| 38.0        | 8518     | 10       | 511      | 510.5       | 1.8         | 68.5        | 18.91           | 0.17            | 0.17            | 6.88            |
| 39.0        | 9038     | 12       | 584      | 529.6       | 1.9         | 75.7        | 19.20           | 0.13            | 0.13            | 7.39            |
| 40.0        | 9578     | 14       | 664      | 548.9       | 2.1         | 83.3        | 19.45           | 0.10            | 0.10            | 7.94            |
| 41.0        | 10136    | 16       | 752      | 568.5       | 2.2         | 91.5        | 19.76           | 0.10            | 0.10            | 8.51            |
| 42.0        | 10715    | 18       | 849      | 588.5       | 2.3         | 100.4       | 20.15           | 0.17            | 0.17            | 9.14            |
| 43.0        | 11314    | 21       | 955      | 608.8       | 2.5         | 109.9       | 20.46           | 0.26            | 0.26            | 9.83            |
| 44.0        | 11933    | 23       | 1071     | 629.4       | 2.9         | 120.0       | 20.75           | 0.37            | 0.37            | 10.47           |
| 45.0        | 12573    | 26       | 1197     | 650.2       | 3.3         | 130.8       | 21.04           | 0.41            | 0.41            | 11.13           |
| 46.0        | 13234    | 30       | 1334     | 671.3       | 3.6         | 142.3       | 21.13           | 0.39            | 0.39            | 11.81           |
| 47.0        | 13916    | 34       | 1484     | 692.6       | 4.0         | 154.4       | 21.34           | 0.29            | 0.29            | 12.50           |
| 48.0        | 14619    | 38       | 1645     | 714.1       | 4.2         | 167.3       | 21.61           | 0.15            | 0.15            | 13.17           |
| 49.0        | 15345    | 42       | 1820     | 735.8       | 4.3         | 180.8       | 21.91           | 0.03            | 0.03            | 13.84           |
| 50.0        | 16090    | 46       | 2009     | 757.9       | 4.3         | 194.9       | 22.21           | -0.03           | -0.03           | 14.53           |
| 51.0        | 16859    | 50       | 2212     | 780.1       | 4.2         | 209.8       | 22.28           | -0.03           | -0.03           | 15.32           |
| 52.0        | 17651    | 54       | 2430     | 802.8       | 4.3         | 225.2       | 22.74           | 0.23            | 0.23            | 15.78           |
| 53.0        | 18465    | 59       | 2665     | 825.5       | 4.3         | 241.5       | 22.80           | 0.07            | 0.07            | 16.73           |
| 54.0        | 19302    | 63       | 2916     | 848.4       | 4.3         | 258.4       | 23.00           | 0.10            | 0.10            | 17.22           |
| 55.0        | 20163    | 67       | 3184     | 871.3       | 4.5         | 275.8       | 22.90           | 0.23            | 0.23            | 17.88           |
| 56.0        | 21046    | 72       | 3469     | 894.6       | 4.9         | 294.2       | 23.29           | 0.46            | 0.46            | 18.86           |
| 57.0        | 21952    | 77       | 3774     | 917.5       | 5.2         | 313.4       | 22.90           | 0.49            | 0.49            | 19.49           |
| 58.0        | 22882    | 82       | 4098     | 940.5       | 5.5         | 332.9       | 22.70           | 0.49            | 0.49            | 19.98           |
| 59.0        | 23834    | 88       | 4442     | 962.9       | 5.7         | 353.4       | 22.41           | 0.30            | 0.30            | 20.93           |
| 59.760      | 24573    | 92       | 4718     | 979.6       | 5.8         | 369.3       | 22.08           | 0.24            | 0.24            | 21.28           |

MACH ONE

TABLE XIV  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>FT | YE<br>FT | ZE<br>FT | DXE<br>FT/S | DYE<br>FT/S | DZE<br>FT/S | DDXE<br>FT/S SQ | DDYE<br>FT/S SQ | DDZE<br>FT/S SQ |
|-------------|----------|----------|----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 60.0        | 24808    | 94       | 4807     | 984.9       | 5.8         | 374.4       | 22.01           | 0.20            | 21.46           |
| 61.0        | 25805    | 99       | 5193     | 1006.7      | 5.7         | 396.1       | 21.69           | 0.10            | 22.21           |
| 62.0        | 26823    | 105      | 5601     | 1028.3      | 5.6         | 418.5       | 21.72           | -0.07           | 22.90           |
| 63.0        | 27863    | 111      | 6032     | 1050.4      | 6.1         | 441.3       | 22.08           | 0.69            | 23.23           |
| 64.0        | 28925    | 117      | 6485     | 1073.0      | 7.0         | 464.7       | 22.51           | 1.15            | 23.88           |
| 65.0        | 30010    | 124      | 6963     | 1095.7      | 7.7         | 489.1       | 22.70           | 0.79            | 25.00           |
| 66.0        | 31117    | 133      | 7465     | 1118.6      | 8.6         | 514.5       | 22.90           | 1.02            | 25.89           |
| 67.0        | 32249    | 142      | 7993     | 1141.8      | 9.5         | 540.6       | 23.20           | 1.15            | 26.64           |
| 68.0        | 33403    | 152      | 8548     | 1165.3      | 10.6        | 567.5       | 23.52           | 1.25            | 27.43           |
| 69.0        | 34581    | 163      | 9130     | 1189.2      | 11.8        | 595.4       | 23.75           | 1.48            | 28.61           |
| 70.0        | 35782    | 175      | 9740     | 1213.2      | 13.1        | 624.8       | 23.92           | 1.51            | 29.92           |
| 71.0        | 37008    | 189      | 10381    | 1237.2      | 14.7        | 655.3       | 24.24           | 1.62            | 31.17           |
| MAX Q       |          |          |          |             |             |             |                 |                 |                 |
| 71.500      | 37630    | 197      | 10713    | 1249.4      | 15.5        | 671.1       | 24.47           | 1.55            | 31.75           |
| 72.0        | 38258    | 205      | 11053    | 1261.7      | 16.2        | 687.0       | 24.67           | 1.46            | 32.19           |
| 73.0        | 39533    | 221      | 11757    | 1286.7      | 17.4        | 719.5       | 25.17           | 0.97            | 32.97           |
| 74.0        | 40833    | 239      | 12494    | 1312.0      | 18.0        | 752.8       | 25.67           | 0.27            | 33.49           |
| 75.0        | 42159    | 257      | 13264    | 1338.0      | 18.0        | 786.5       | 26.20           | -0.44           | 33.95           |
| 76.0        | 43510    | 275      | 14068    | 1364.4      | 17.2        | 820.9       | 26.72           | -1.02           | 34.79           |
| 77.0        | 44889    | 291      | 14907    | 1391.3      | 15.9        | 856.2       | 27.02           | -1.53           | 35.79           |
| 78.0        | 46294    | 307      | 15782    | 1418.3      | 14.3        | 892.7       | 27.18           | -1.77           | 37.04           |
| 79.0        | 47727    | 320      | 16694    | 1445.6      | 12.6        | 930.4       | 27.34           | -1.66           | 38.45           |
| 80.0        | 49187    | 332      | 17644    | 1473.2      | 11.3        | 969.4       | 27.75           | -1.17           | 39.72           |
| 81.0        | 50675    | 343      | 18634    | 1501.3      | 10.4        | 1009.6      | 28.33           | -0.56           | 40.73           |
| 82.0        | 52191    | 353      | 19665    | 1530.0      | 9.9         | 1050.8      | 29.02           | -0.08           | 41.42           |
| 83.0        | 53736    | 363      | 20737    | 1559.2      | 9.9         | 1092.3      | 29.63           | 0.08            | 41.85           |
| 84.0        | 55311    | 373      | 21851    | 1588.9      | 10.0        | 1134.1      | 29.85           | 0.06            | 42.06           |
| 85.0        | 56915    | 383      | 23007    | 1618.9      | 10.1        | 1176.7      | 30.01           | 0.01            | 42.71           |
| 86.0        | 58550    | 393      | 24206    | 1649.1      | 10.1        | 1220.1      | 30.30           | -0.01           | 43.91           |
| 87.0        | 60215    | 403      | 25449    | 1679.5      | 10.0        | 1264.7      | 30.56           | -0.06           | 45.35           |
| 88.0        | 61910    | 413      | 26737    | 1710.2      | 10.0        | 1310.7      | 30.89           | -0.09           | 46.84           |
| 89.0        | 63637    | 423      | 28071    | 1741.3      | 9.9         | 1358.1      | 31.13           | -0.16           | 48.13           |
| 90.0        | 65394    | 433      | 29454    | 1772.5      | 9.7         | 1406.9      | 31.35           | -0.25           | 49.29           |
| 91.0        | 67183    | 442      | 30887    | 1803.8      | 9.3         | 1456.8      | 31.39           | -0.40           | 50.47           |
| 92.0        | 69003    | 451      | 32369    | 1835.2      | 8.9         | 1507.9      | 31.42           | -0.52           | 51.79           |
| 93.0        | 70855    | 460      | 33904    | 1866.7      | 8.4         | 1560.3      | 31.54           | -0.56           | 53.19           |
| 94.0        | 72738    | 468      | 35491    | 1898.5      | 7.8         | 1614.3      | 31.78           | -0.53           | 54.50           |
| 95.0        | 74653    | 476      | 37133    | 1930.4      | 7.3         | 1669.5      | 32.08           | -0.42           | 55.84           |
| 96.0        | 76600    | 483      | 38831    | 1962.5      | 6.9         | 1725.9      | 32.32           | -0.28           | 57.03           |
| 97.0        | 78579    | 489      | 40586    | 1994.8      | 6.7         | 1783.4      | 32.37           | -0.20           | 58.13           |
| 98.0        | 80591    | 496      | 42399    | 2027.3      | 6.6         | 1842.1      | 32.44           | -0.12           | 59.26           |

TABLE XIV  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>FT | YE<br>FT | ZE<br>FT | DXE<br>FT/S | DYE<br>FT/S | DZE<br>FT/S | DDXE<br>FT/S SQ | DDYE<br>FT/S SQ | DDZE<br>FT/S SQ |
|-------------|----------|----------|----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 99.0        | 82635    | 503      | 44271    | 2059.8      | 6.5         | 1902.0      | 32.56           | -0.07           | 60.38           |
| 100.0       | 84711    | 509      | 46203    | 2092.5      | 6.4         | 1963.0      | 32.79           | -0.07           | 61.58           |
| 101.0       | 86821    | 515      | 48198    | 2125.3      | 6.3         | 2025.1      | 33.05           | -0.08           | 62.75           |
| 102.0       | 88963    | 522      | 50254    | 2158.5      | 6.2         | 2088.4      | 33.29           | -0.10           | 63.86           |
| 103.0       | 91139    | 528      | 52375    | 2191.9      | 6.1         | 2152.8      | 33.52           | -0.06           | 64.92           |
| 104.0       | 93348    | 534      | 54561    | 2225.6      | 6.1         | 2218.4      | 33.76           | -0.03           | 66.14           |
| 105.0       | 95591    | 540      | 56813    | 2259.4      | 6.1         | 2285.0      | 33.97           | 0.04            | 67.29           |
| 106.0       | 97868    | 546      | 59132    | 2293.5      | 6.2         | 2352.9      | 34.21           | 0.14            | 68.42           |
| 107.0       | 100179   | 553      | 61519    | 2327.9      | 6.4         | 2421.9      | 34.51           | 0.21            | 69.59           |
| 108.0       | 102525   | 559      | 63976    | 2362.7      | 6.6         | 2492.3      | 35.01           | 0.27            | 70.95           |
| 109.0       | 104906   | 566      | 66504    | 2397.8      | 6.9         | 2563.8      | 35.36           | 0.25            | 72.22           |
| 110.0       | 107322   | 573      | 69105    | 2433.2      | 7.1         | 2636.5      | 35.63           | 0.20            | 73.41           |
| 111.0       | 109774   | 580      | 71778    | 2468.9      | 7.2         | 2710.6      | 35.75           | 0.14            | 74.58           |
| 112.0       | 112261   | 587      | 74526    | 2504.8      | 7.4         | 2785.7      | 35.87           | 0.13            | 75.73           |
| 113.0       | 114784   | 595      | 77350    | 2540.8      | 7.5         | 2862.2      | 36.12           | 0.13            | 77.07           |
| 114.0       | 117344   | 602      | 80251    | 2577.1      | 7.7         | 2939.9      | 36.48           | 0.12            | 78.55           |
| 115.0       | 119940   | 610      | 83231    | 2613.7      | 7.8         | 3019.1      | 36.79           | 0.14            | 79.91           |
| 116.0       | 122572   | 618      | 86290    | 2650.5      | 7.9         | 3099.6      | 36.96           | 0.10            | 81.07           |
| 117.0       | 125242   | 626      | 89431    | 2687.6      | 8.0         | 3181.3      | 37.05           | 0.05            | 82.23           |
| 118.0       | 127949   | 634      | 92653    | 2724.8      | 8.0         | 3264.4      | 37.33           | 0.01            | 83.72           |
| 119.0       | 130694   | 642      | 95960    | 2762.3      | 8.0         | 3348.9      | 37.60           | -0.01           | 85.38           |
| 120.0       | 133476   | 650      | 99351    | 2800.0      | 8.0         | 3435.0      | 37.85           | -0.03           | 86.96           |
| 121.0       | 136295   | 658      | 102830   | 2837.9      | 8.0         | 3522.7      | 38.00           | -0.04           | 88.57           |
| 122.0       | 139153   | 666      | 106397   | 2875.9      | 7.9         | 3612.1      | 38.08           | -0.02           | 90.14           |
| 123.0       | 142049   | 674      | 110054   | 2914.0      | 7.9         | 3702.9      | 38.10           | -0.02           | 91.55           |
| 124.0       | 144983   | 682      | 113803   | 2952.1      | 7.9         | 3795.2      | 38.08           | -0.03           | 92.96           |
| 125.0       | 147955   | 690      | 117645   | 2990.2      | 7.9         | 3889.0      | 38.13           | -0.00           | 94.65           |
| 126.0       | 150965   | 697      | 121581   | 3028.3      | 7.9         | 3984.6      | 38.17           | 0.02            | 96.58           |
| 127.0       | 154013   | 705      | 125614   | 3066.6      | 7.9         | 4082.3      | 38.29           | 0.01            | 98.57           |
| 128.0       | 157100   | 713      | 129746   | 3105.0      | 7.9         | 4181.8      | 38.38           | 0.01            | 100.61          |
| 129.0       | 160225   | 721      | 133978   | 3143.3      | 7.9         | 4283.3      | 38.31           | 0.03            | 102.52          |
| 130.0       | 163386   | 728      | 138313   | 3181.4      | 7.9         | 4386.7      | 38.06           | 0.00            | 104.33          |
| 131.0       | 166586   | 736      | 142750   | 3219.2      | 7.9         | 4492.0      | 37.80           | -0.04           | 106.30          |
| 132.0       | 169825   | 743      | 147294   | 3256.8      | 8.0         | 4598.9      | 37.63           | 0.13            | 108.10          |
| 133.0       | 173101   | 751      | 151946   | 3294.2      | 7.9         | 4708.3      | 37.40           | 0.03            | 110.30          |
| 134.0       | 176414   | 758      | 156708   | 3331.3      | 7.9         | 4819.8      | 37.14           | 0.03            | 112.50          |
| 135.0       | 179764   | 766      | 161583   | 3368.6      | 7.9         | 4933.1      | 37.27           | 0.03            | 114.34          |
| 136.0       | 183152   | 774      | 166572   | 3406.5      | 7.9         | 5048.1      | 37.93           | 0.07            | 115.85          |
| 137.0       | 186577   | 781      | 171676   | 3445.2      | 7.9         | 5164.5      | 38.78           | 0.10            | 117.29          |
| 138.0       | 190042   | 789      | 176897   | 3485.2      | 8.0         | 5282.4      | 39.90           | 0.07            | 118.41          |
| 138.970     | 193442   | 796      | 182075   | 3523.0      | 8.0         | 5396.9      | 40.94           | 0.10            | 119.16          |

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TABLE XIV  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC                                      | XE<br>FT | YE<br>FT | ZE<br>FT | DXE<br>FT/S | DYE<br>FT/S | DZE<br>FT/S | DDXF<br>FT/S SQ | DCYE<br>FT/S SQ | DCZE<br>FT/S SQ |
|--|----------|----------|----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| OEEO   |          |          |          |             |             |             |                 |                 |                 |
| 139.0  | 193548   | 796      | 182237   | 3524.2      | 8.0         | 5398.8      | 41.04           | 0.10            | 119.39          |
| 140.0  | 197084   | 804      | 187685   | 3540.2      | 8.2         | 5476.0      | 7.45            | 0.26            | 67.36           |
| 141.0  | 200628   | 812      | 193191   | 3546.6      | 8.4         | 5537.9      | 6.07            | 0.26            | 62.17           |
| 142.0  | 204177   | 821      | 198758   | 3549.5      | 8.6         | 5593.3      | 4.56            | 0.23            | 55.45           |
| 142.250  | 205065   | 823      | 200157   | 3549.8      | 8.6         | 5605.9      | 0.62            | 0.23            | 52.00           |
| 143.0  | 207726   | 829      | 204373   | 3535.2      | 8.8         | 5620.1      | -18.14          | 0.20            | 21.92           |
| S-1B/S-IVB SEPARATION SIGNAL                     |          |          |          |             |             |             |                 |                 |                 |
| 143.500  | 209492   | 833      | 207186   | 3520.9      | 8.9         | 5621.7      | -27.85          | 0.20            | 4.07            |
| EBW FIRING (SEPARATION SIGNAL PLUS 0.07 SECONDS) |          |          |          |             |             |             |                 |                 |                 |
| 143.570  | 209754   | 834      | 207552   | 3519.0      | 8.8         | 5621.9      | -27.99          | 0.23            | 3.84            |
| 144.0  | 211264   | 837      | 209970   | 3505.9      | 8.7         | 5622.3      | -28.44          | 0.23            | 1.64            |
| 145.0  | 214755   | 846      | 215592   | 3475.8      | 8.9         | 5622.9      | -29.23          | 0.23            | 0.36            |
| 150.0  | 231787   | 891      | 243759   | 3349.0      | 9.0         | 5665.8      | -20.57          | -0.13           | 17.19           |
| 155.0  | 248290   | 933      | 272312   | 3254.7      | 7.3         | 5759.4      | -18.27          | -0.46           | 19.95           |
| GUIDANCE INITIATION                              |          |          |          |             |             |             |                 |                 |                 |
| 159.470  | 262655   | 962      | 298252   | 3173.7      | 5.6         | 5848.3      | -18.02          | -0.49           | 20.48           |
| 160.0  | 264335   | 965      | 301353   | 3164.3      | 5.4         | 5859.0      | -17.98          | -0.43           | 20.44           |
| 165.0  | 279932   | 990      | 330899   | 3074.0      | 5.4         | 5960.8      | -18.37          | 0.39            | 20.93           |
| 170.0  | 295064   | 1031     | 360969   | 2977.9      | 10.7        | 6067.8      | -19.52          | 1.12            | 21.72           |
| 175.0  | 309712   | 1098     | 391580   | 2881.7      | 16.5        | 6176.7      | -18.99          | 1.25            | 21.87           |
| 180.0  | 323884   | 1197     | 422737   | 2786.9      | 22.9        | 6286.4      | -18.98          | 1.25            | 22.02           |
| 185.0  | 337582   | 1327     | 454445   | 2692.7      | 29.2        | 6397.1      | -18.78          | 1.26            | 22.33           |
| 190.0  | 350810   | 1489     | 486711   | 2598.5      | 35.9        | 6509.6      | -18.81          | 1.38            | 22.59           |
| 195.0  | 363568   | 1686     | 519543   | 2504.3      | 42.7        | 6623.5      | -18.89          | 1.34            | 22.98           |
| 200.0  | 375853   | 1918     | 552949   | 2409.6      | 50.4        | 6739.0      | -18.99          | 1.74            | 23.23           |
| 205.0  | 387662   | 2193     | 586936   | 2313.7      | 60.2        | 6856.3      | -19.27          | 2.14            | 23.72           |
| 210.0  | 398989   | 2522     | 621515   | 2217.0      | 71.4        | 6975.3      | -19.41          | 2.30            | 23.91           |
| 215.0  | 409832   | 2908     | 656691   | 2120.0      | 82.9        | 7095.6      | -19.40          | 2.34            | 24.18           |
| 220.0  | 420189   | 3351     | 692473   | 2022.9      | 94.6        | 7217.2      | -19.48          | 2.34            | 24.43           |
| 225.0  | 430061   | 3854     | 728866   | 1925.9      | 106.6       | 7340.4      | -19.34          | 2.41            | 24.80           |
| 230.0  | 439449   | 4417     | 765878   | 1829.3      | 118.6       | 7464.7      | -19.31          | 2.40            | 25.09           |

TABLE XIV  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>FT | YE<br>FT | ZE<br>FT | DXE<br>FT/S | DYE<br>FT/S | DZE<br>FT/S | DDXE<br>FT/S SQ | DDYE<br>FT/S SQ | DDZE<br>FT/S SQ |
|-------------|----------|----------|----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 235.0       | 448353   | 5041     | 803518   | 1732.5      | 130.9       | 7591.2      | -19.34          | 2.52            | 25.44           |
| 240.0       | 456774   | 5726     | 841792   | 1635.6      | 143.4       | 7718.9      | -19.39          | 2.54            | 25.68           |
| 245.0       | 464709   | 6475     | 880709   | 1538.4      | 156.0       | 7847.8      | -19.48          | 2.52            | 25.93           |
| 250.0       | 472157   | 7287     | 920274   | 1441.1      | 168.7       | 7978.6      | -19.43          | 2.54            | 26.36           |
| 255.0       | 479120   | 8163     | 960495   | 1344.0      | 181.7       | 8109.9      | -19.36          | 2.63            | 26.37           |
| 260.0       | 485598   | 9104     | 1001378  | 1247.2      | 194.9       | 8243.7      | -19.34          | 2.64            | 26.97           |
| 265.0       | 491593   | 10111    | 1042935  | 1150.7      | 208.2       | 8379.4      | -19.28          | 2.69            | 27.24           |
| 270.0       | 497105   | 11186    | 1085173  | 1054.1      | 221.8       | 8516.2      | -19.40          | 2.72            | 27.61           |
| 275.0       | 502133   | 12329    | 1128101  | 957.1       | 235.5       | 8655.4      | -19.41          | 2.78            | 28.00           |
| 280.0       | 506676   | 13542    | 1171728  | 859.8       | 249.4       | 8795.9      | -19.51          | 2.81            | 28.24           |
| 285.0       | 510731   | 14824    | 1216063  | 762.1       | 263.7       | 8938.3      | -19.52          | 2.85            | 28.64           |
| 290.0       | 514298   | 16177    | 1261113  | 664.8       | 276.5       | 9082.1      | -19.39          | 2.07            | 28.98           |
| 295.0       | 517380   | 17582    | 1306886  | 568.1       | 285.7       | 9227.3      | -19.29          | 2.07            | 29.21           |
| 300.0       | 519979   | 19041    | 1353391  | 471.4       | 298.9       | 9374.9      | -19.47          | 3.09            | 29.68           |
| 305.0       | 522092   | 20576    | 1400638  | 373.8       | 315.2       | 9524.5      | -19.54          | 3.27            | 30.13           |
| 310.0       | 523717   | 22192    | 1448638  | 276.1       | 330.7       | 9676.2      | -19.48          | 2.99            | 30.66           |
| 315.0       | 524854   | 23883    | 1497404  | 178.5       | 345.8       | 9830.2      | -19.57          | 3.16            | 30.95           |
| 320.0       | 525502   | 25652    | 1546944  | 80.4        | 362.1       | 9986.4      | -19.74          | 3.28            | 31.44           |
| 325.0       | 525656   | 27504    | 1597271  | -18.5       | 378.6       | 10144.8     | -19.78          | 3.28            | 31.88           |
| 330.0       | 525316   | 29438    | 1648395  | -117.8      | 395.0       | 10305.0     | -19.90          | 3.36            | 32.26           |
| 335.0       | 524479   | 31455    | 1700324  | -217.1      | 411.9       | 10466.7     | -19.88          | 3.38            | 32.62           |
| 340.0       | 523145   | 33557    | 1753068  | -316.6      | 429.0       | 10631.7     | -19.88          | 3.46            | 33.17           |
| 345.0       | 521313   | 35746    | 1806643  | -416.1      | 446.5       | 10798.4     | -19.88          | 3.53            | 33.60           |
| 350.0       | 518983   | 38022    | 1861056  | -515.8      | 464.0       | 10967.5     | -19.93          | 3.52            | 34.01           |
| 355.0       | 516155   | 40386    | 1916320  | -615.6      | 481.5       | 11138.6     | -20.00          | 3.55            | 34.53           |
| 360.0       | 512827   | 42838    | 1972447  | -716.0      | 499.7       | 11312.7     | -20.10          | 3.66            | 35.10           |
| 365.0       | 508996   | 45383    | 2029451  | -816.4      | 518.1       | 11489.6     | -20.12          | 3.72            | 35.90           |
| 370.0       | 504662   | 48019    | 2087349  | -917.4      | 536.6       | 11669.6     | -20.39          | 3.59            | 36.22           |
| 375.0       | 499820   | 50749    | 2146153  | -1019.2     | 555.5       | 11852.6     | -20.27          | 3.96            | 36.95           |
| 380.0       | 494469   | 53575    | 2205879  | -1121.7     | 574.8       | 12038.6     | -20.57          | 3.86            | 37.58           |
| 385.0       | 488602   | 56497    | 2266544  | -1225.0     | 594.4       | 12227.8     | -20.71          | 3.97            | 38.10           |
| 390.0       | 482218   | 59519    | 2328161  | -1328.9     | 614.2       | 12419.2     | -20.84          | 3.99            | 38.53           |
| 395.0       | 475312   | 62640    | 2390741  | -1433.4     | 634.3       | 12613.6     | -20.94          | 4.08            | 39.19           |
| 400.0       | 467884   | 65863    | 2454301  | -1538.0     | 654.8       | 12811.0     | -20.93          | 4.11            | 39.79           |
| 405.0       | 459931   | 69188    | 2518857  | -1643.4     | 675.5       | 13012.2     | -21.12          | 4.18            | 40.59           |
| 410.0       | 451450   | 72618    | 2584426  | -1749.1     | 696.5       | 13216.2     | -21.25          | 4.24            | 41.10           |
| 415.0       | 442439   | 76154    | 2651024  | -1855.4     | 717.7       | 13423.6     | -21.30          | 4.28            | 41.89           |
| 420.0       | 432895   | 79797    | 2718668  | -1962.4     | 739.6       | 13634.6     | -21.48          | 4.44            | 42.57           |
| 425.0       | 422815   | 83550    | 2787375  | -2070.0     | 761.8       | 13849.2     | -21.57          | 4.47            | 43.30           |
| 430.0       | 412194   | 87415    | 2857166  | -2178.6     | 784.2       | 14068.0     | -21.82          | 4.54            | 44.23           |
| 435.0       | 401027   | 91393    | 2928062  | -2288.0     | 807.1       | 14291.5     | -21.92          | 4.64            | 45.09           |
| 440.0       | 389312   | 95487    | 3000086  | -2398.1     | 830.5       | 14519.0     | -22.14          | 4.74            | 46.01           |
| 445.0       | 377044   | 99699    | 3073261  | -2509.7     | 854.1       | 14751.9     | -22.43          | 4.72            | 46.97           |
| 450.0       | 364214   | 104028   | 3147608  | -2622.1     | 877.7       | 14987.6     | -22.63          | 4.76            | 47.68           |

TABLE XIV  
EARTH-FIXED PLUMRLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC           | XE<br>FT | YE<br>FT | ZE<br>FT | DXE<br>FT/S | DYE<br>FT/S | DZE<br>FT/S | DDXE<br>FT/S SQ | DDYE<br>FT/S SQ | DDZE<br>FT/S SQ |
|-----------------------|----------|----------|----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 455.0                 | 350820   | 108477   | 3223146  | -2735.7     | 901.9       | 15228.6     | -22.78          | 4.95            | 48.70           |
| 460.0                 | 336856   | 113049   | 3299902  | -2850.3     | 927.0       | 15474.7     | -23.03          | 5.06            | 49.67           |
| 465.0                 | 322316   | 117748   | 3377899  | -2965.9     | 952.5       | 15725.3     | -23.29          | 5.16            | 50.62           |
| 470.0                 | 307194   | 122575   | 3457161  | -3083.2     | 978.5       | 15980.3     | -23.59          | 5.27            | 51.51           |
| 475.0                 | 291483   | 127534   | 3537711  | -3201.4     | 1005.1      | 16241.0     | -23.77          | 5.36            | 52.71           |
| 480.0                 | 275178   | 132627   | 3619579  | -3320.8     | 1032.0      | 16507.4     | -24.10          | 5.40            | 53.82           |
| 485.0                 | 258268   | 137855   | 3702793  | -3444.7     | 1059.7      | 16779.4     | -25.64          | 5.67            | 55.10           |
| 490.0                 | 240716   | 143225   | 3787385  | -3576.9     | 1088.2      | 17058.3     | -26.88          | 5.68            | 56.14           |
| 495.0                 | 222493   | 148736   | 3873380  | -3713.0     | 1116.6      | 17340.6     | -27.62          | 5.74            | 56.65           |
| 500.0                 | 203580   | 154392   | 3960786  | -3852.5     | 1145.6      | 17621.3     | -28.22          | 5.82            | 56.15           |
| 505.0                 | 183963   | 160193   | 4049596  | -3994.9     | 1174.8      | 17902.4     | -28.77          | 5.86            | 55.43           |
| 510.0                 | 163626   | 166141   | 4139797  | -4140.0     | 1205.0      | 18177.8     | -29.08          | 6.27            | 54.85           |
| 515.0                 | 142563   | 172244   | 4231365  | -4285.1     | 1235.8      | 18448.8     | -28.91          | 5.98            | 54.24           |
| 520.0                 | 120778   | 178497   | 4324292  | -4429.1     | 1265.4      | 18722.8     | -28.66          | 5.86            | 54.78           |
| 525.0                 | 98276    | 184896   | 4418590  | -4571.1     | 1293.7      | 18996.2     | -28.19          | 5.47            | 54.71           |
| 530.0                 | 75070    | 191433   | 4514258  | -4710.8     | 1321.1      | 19272.1     | -27.62          | 5.54            | 55.60           |
| 535.0                 | 51177    | 198108   | 4611316  | -4845.3     | 1349.0      | 19552.0     | -26.21          | 5.61            | 56.42           |
| 540.0                 | 26630    | 204922   | 4709785  | -4971.5     | 1376.9      | 19836.9     | -24.26          | 5.60            | 57.58           |
| 545.0                 | 1472     | 211877   | 4809695  | -5091.6     | 1405.1      | 20128.6     | -24.13          | 5.71            | 58.82           |
| 550.0                 | -24296   | 218975   | 4911077  | -5219.3     | 1434.1      | 20425.7     | -27.53          | 5.95            | 60.32           |
| 555.0                 | -50750   | 226221   | 5013966  | -5364.1     | 1464.4      | 20731.2     | -30.01          | 6.19            | 61.74           |
| 560.0                 | -77950   | 233622   | 5118399  | -5516.4     | 1496.4      | 21043.5     | -30.71          | 6.51            | 63.23           |
| 565.0                 | -105916  | 241186   | 5224412  | -5670.2     | 1529.2      | 21363.6     | -30.78          | 6.52            | 64.75           |
| 570.0                 | -134656  | 248913   | 5332045  | -5826.7     | 1561.7      | 21691.0     | -32.18          | 6.53            | 66.19           |
| 575.0                 | -164202  | 256805   | 5441335  | -5993.9     | 1595.5      | 22027.0     | -34.70          | 7.04            | 68.00           |
| 580.0                 | -194609  | 264873   | 5552326  | -6168.9     | 1632.0      | 22371.5     | -34.81          | 7.50            | 70.05           |
| 585.0                 | -225891  | 273126   | 5665064  | -6344.0     | 1669.2      | 22726.0     | -35.79          | 7.32            | 71.98           |
| 590.0                 | -258058  | 281563   | 5779595  | -6523.6     | 1705.7      | 23090.6     | -35.66          | 7.41            | 73.98           |
| S-IVB GUIDANCE CUTOFF |          |          |          |             |             |             |                 |                 |                 |
| 593.340               | -280040  | 287303   | 5857129  | -6639.2     | 1731.1      | 23340.0     | -33.56          | 7.94            | 75.07           |
| 595.0                 | -291101  | 290181   | 5895897  | -6685.0     | 1735.4      | 23351.1     | -26.41          | 1.51            | -6.86           |
| 600.0                 | -324858  | 298877   | 6012561  | -6817.4     | 1742.9      | 23313.6     | -26.41          | 1.48            | -7.84           |
| ORBIT INSERTION       |          |          |          |             |             |             |                 |                 |                 |
| 603.340               | -347776  | 304706   | 6090385  | -6905.5     | 1747.8      | 23287.6     | -26.38          | 1.48            | -7.94           |
| 605.0                 | -359275  | 307633   | 6129032  | -6949.2     | 1750.2      | 23274.3     | -26.36          | 1.47            | -7.99           |
| 610.0                 | -394350  | 316402   | 6245304  | -7081.0     | 1757.5      | 23234.2     | -26.36          | 1.47            | -7.99           |
| 620.0                 | -466477  | 334051   | 6477241  | -7344.2     | 1772.2      | 23152.8     | -26.27          | 1.45            | -8.30           |
| 630.0                 | -541230  | 351845   | 6708349  | -7606.4     | 1786.6      | 23068.2     | -26.17          | 1.43            | -8.61           |

TABLE XIV  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>FT | YE<br>FT | ZE<br>FT | DXE<br>FT/S | DYE<br>FT/S | DZE<br>FT/S | DDXE<br>FT/S SQ | DDYE<br>FT/S SQ | DDZE<br>FT/S SQ |
|-------------|----------|----------|----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 640.0       | -618600  | 369781   | 6938596  | -7867.5     | 1800.7      | 22980.5     | -26.02          | 1.40            | -9.04           |
| 650.0       | -698575  | 387859   | 7167944  | -8127.2     | 1814.6      | 22888.6     | -25.92          | 1.38            | -9.33           |
| 660.0       | -781141  | 406073   | 7396359  | -8385.9     | 1828.3      | 22793.8     | -25.81          | 1.35            | -9.63           |
| 670.0       | -866289  | 424423   | 7623811  | -8643.5     | 1841.7      | 22696.1     | -25.70          | 1.33            | -9.92           |
| 680.0       | -954007  | 442907   | 7850271  | -8900.0     | 1854.9      | 22595.5     | -25.59          | 1.31            | -10.21          |
| 690.0       | -1044284 | 461521   | 8075711  | -9155.3     | 1867.9      | 22491.9     | -25.47          | 1.29            | -10.50          |
| 700.0       | -1137109 | 480263   | 8300100  | -9409.4     | 1880.6      | 22385.5     | -25.35          | 1.26            | -10.79          |
| 710.0       | -1232469 | 499132   | 8523411  | -9662.4     | 1893.1      | 22276.2     | -25.23          | 1.24            | -11.08          |
| 720.0       | -1330352 | 518124   | 8745614  | -9914.0     | 1905.3      | 22164.0     | -25.10          | 1.21            | -11.36          |
| 730.0       | -1430745 | 537238   | 8966681  | -10164.4    | 1917.3      | 22049.0     | -24.97          | 1.19            | -11.65          |
| 740.0       | -1533636 | 556470   | 9186584  | -10413.5    | 1929.1      | 21931.1     | -24.84          | 1.16            | -11.93          |
| 750.0       | -1639011 | 575818   | 9405294  | -10661.2    | 1940.5      | 21810.4     | -24.70          | 1.13            | -12.21          |
| 760.0       | -1746856 | 595280   | 9622783  | -10907.6    | 1951.8      | 21686.9     | -24.56          | 1.11            | -12.49          |
| 770.0       | -1857157 | 614853   | 9839023  | -11152.5    | 1962.7      | 21560.6     | -24.42          | 1.08            | -12.77          |
| 780.0       | -1969901 | 634533   | 10053986 | -11396.0    | 1973.4      | 21431.6     | -24.28          | 1.05            | -13.04          |
| 790.0       | -2085072 | 654320   | 10267646 | -11638.0    | 1983.8      | 21299.8     | -24.13          | 1.03            | -13.32          |
| 800.0       | -2202656 | 674208   | 10479974 | -11878.5    | 1993.9      | 21165.3     | -23.97          | 1.00            | -13.59          |
| 810.0       | -2322638 | 694197   | 10690942 | -12117.5    | 2003.7      | 21028.0     | -23.82          | 0.97            | -13.86          |
| 820.0       | -2445001 | 714282   | 10900525 | -12354.9    | 2013.3      | 20888.1     | -23.66          | 0.94            | -14.13          |
| 830.0       | -2569730 | 734461   | 11108695 | -12590.7    | 2022.5      | 20745.5     | -23.50          | 0.91            | -14.40          |
| 840.0       | -2696810 | 754732   | 11315426 | -12824.9    | 2031.5      | 20600.2     | -23.34          | 0.88            | -14.66          |
| 850.0       | -2826222 | 775090   | 11520690 | -13057.4    | 2040.2      | 20452.3     | -23.17          | 0.85            | -14.92          |
| 860.0       | -2957952 | 795534   | 11724462 | -13288.2    | 2048.5      | 20301.7     | -23.00          | 0.82            | -15.18          |
| 870.0       | -3091981 | 816060   | 11926716 | -13517.3    | 2056.6      | 20148.6     | -22.82          | 0.79            | -15.44          |
| 880.0       | -3228293 | 836664   | 12127426 | -13744.7    | 2064.3      | 19992.9     | -22.65          | 0.76            | -15.70          |
| 890.0       | -3366869 | 857345   | 12326565 | -13970.3    | 2071.7      | 19834.6     | -22.47          | 0.73            | -15.96          |
| 900.0       | -3507693 | 878098   | 12524109 | -14194.1    | 2078.8      | 19673.8     | -22.29          | 0.69            | -16.21          |
| 910.0       | -3650744 | 898920   | 12720032 | -14416.0    | 2085.6      | 19510.4     | -22.10          | 0.66            | -16.46          |
| 920.0       | -3796006 | 919809   | 12914309 | -14636.1    | 2092.1      | 19344.6     | -21.91          | 0.63            | -16.71          |
| 930.0       | -3943460 | 940760   | 13106915 | -14854.3    | 2098.2      | 19176.3     | -21.72          | 0.60            | -16.95          |
| 940.0       | -4093085 | 961772   | 13297826 | -15070.5    | 2104.0      | 19005.5     | -21.53          | 0.56            | -17.20          |
| 950.0       | -4244864 | 982839   | 13487017 | -15284.8    | 2109.5      | 18832.3     | -21.33          | 0.53            | -17.44          |
| 960.0       | -4398775 | 1003960  | 13674465 | -15497.2    | 2114.6      | 18656.7     | -21.13          | 0.50            | -17.68          |
| 970.0       | -4554800 | 1025130  | 14044032 | -15707.5    | 2119.4      | 18478.8     | -20.93          | 0.46            | -17.92          |
| 980.0       | -4712919 | 1046346  | 14226105 | -15915.8    | 2123.8      | 18298.4     | -20.73          | 0.43            | -18.15          |
| 990.0       | -4873110 | 1067605  | 14406339 | -16122.1    | 2127.9      | 18115.8     | -20.52          | 0.39            | -18.38          |
| 1000.0      | -5035353 | 1088902  | 14584713 | -16326.2    | 2131.6      | 17930.8     | -20.31          | 0.36            | -18.61          |
| 1010.0      | -5199627 | 1110236  | 14761202 | -16528.3    | 2135.0      | 17743.5     | -20.10          | 0.32            | -18.84          |
| 1020.0      | -5365912 | 1131601  | 14935785 | -16728.2    | 2138.0      | 17554.0     | -19.88          | 0.28            | -19.06          |
| 1030.0      | -5534184 | 1152995  | 15108440 | -16926.0    | 2140.7      | 17362.2     | -19.67          | 0.25            | -19.29          |
| 1040.0      | -5704424 | 1174413  | 15279144 | -17121.5    | 2143.0      | 17168.3     | -19.45          | 0.21            | -19.51          |
| 1050.0      | -5876608 | 1195853  | 15447875 | -17314.9    | 2144.9      | 16972.1     | -19.23          | 0.17            | -19.72          |
| 1060.0      | -6050714 | 1217311  | 15614613 | -17506.0    | 2146.5      | 16773.8     | -19.00          | 0.14            | -19.94          |
| 1070.0      | -6226721 | 1238782  | 15614613 | -17694.9    | 2147.7      | 16573.4     | -18.77          | 0.10            | -20.15          |

TABLE XIV  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>FT  | YE<br>FT | ZE<br>FT | DXE<br>FT/S | DYE<br>FT/S | DZE<br>FT/S | DOXE<br>FT/S SQ | DOYE<br>FT/S SQ | DOZE<br>FT/S SQ |
|-------------|-----------|----------|----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 1080.0      | -6404605  | 1260263  | 15779336 | -17881.5    | 2148.5      | 16370.8     | -18.54          | 0.06            | -20.36          |
| 1090.0      | -6584343  | 1281750  | 15942022 | -18065.8    | 2148.9      | 16166.2     | -18.31          | 0.03            | -20.57          |
| 1100.0      | -6765912  | 1303240  | 16102653 | -18247.7    | 2149.0      | 15959.5     | -18.08          | -0.01           | -20.77          |
| 1110.0      | -6949289  | 1324729  | 16261206 | -18427.3    | 2148.7      | 15750.8     | -17.84          | -0.05           | -20.97          |
| 1120.0      | -7134451  | 1346212  | 16417663 | -18604.5    | 2148.0      | 15540.1     | -17.60          | -0.09           | -21.17          |
| 1130.0      | -7321372  | 1367687  | 16572003 | -18779.3    | 2146.9      | 15327.5     | -17.36          | -0.13           | -21.36          |
| 1140.0      | -7510029  | 1389149  | 16724206 | -18951.7    | 2145.4      | 15112.9     | -17.12          | -0.17           | -21.56          |
| 1150.0      | -7700399  | 1410594  | 16874254 | -19121.7    | 2143.5      | 14896.4     | -16.87          | -0.21           | -21.75          |
| 1160.0      | -7892455  | 1432018  | 17022127 | -19289.2    | 2141.3      | 14678.0     | -16.62          | -0.25           | -21.93          |
| 1170.0      | -8086174  | 1453418  | 17167807 | -19454.2    | 2138.6      | 14457.7     | -16.38          | -0.29           | -22.12          |
| 1180.0      | -8281530  | 1474789  | 17311275 | -19616.7    | 2135.6      | 14235.6     | -16.12          | -0.32           | -22.30          |
| 1190.0      | -8478499  | 1496128  | 17452514 | -19776.6    | 2132.1      | 14011.8     | -15.87          | -0.36           | -22.48          |
| 1200.0      | -8677054  | 1517430  | 17591505 | -19934.1    | 2128.3      | 13786.1     | -15.61          | -0.40           | -22.65          |
| 1210.0      | -8877171  | 1538692  | 17728231 | -20088.9    | 2124.0      | 13558.8     | -15.36          | -0.45           | -22.82          |
| 1220.0      | -9078824  | 1559910  | 17862675 | -20241.2    | 2119.4      | 13329.7     | -15.10          | -0.49           | -22.99          |
| 1230.0      | -9281986  | 1581078  | 17994819 | -20390.8    | 2114.3      | 13099.0     | -14.84          | -0.53           | -23.16          |
| 1240.0      | -9486632  | 1602195  | 18124648 | -20537.9    | 2108.8      | 12866.6     | -14.57          | -0.57           | -23.32          |
| 1250.0      | -9692735  | 1623254  | 18252145 | -20682.3    | 2103.0      | 12632.5     | -14.31          | -0.61           | -23.48          |
| 1260.0      | -9900268  | 1644253  | 18377294 | -20824.0    | 2096.7      | 12397.0     | -14.04          | -0.65           | -23.64          |
| 1270.0      | -10109206 | 1665187  | 18500079 | -20963.1    | 2090.0      | 12159.8     | -13.77          | -0.69           | -23.79          |
| 1280.0      | -10319521 | 1686051  | 18620485 | -21099.4    | 2082.9      | 11921.1     | -13.50          | -0.73           | -23.94          |
| 1290.0      | -10531185 | 1706843  | 18738497 | -21233.1    | 2075.4      | 11681.0     | -13.23          | -0.77           | -24.09          |
| 1300.0      | -10744173 | 1727558  | 18854100 | -21364.0    | 2067.5      | 11439.4     | -12.95          | -0.81           | -24.23          |
| 1310.0      | -10958456 | 1748191  | 18967280 | -21492.2    | 2059.1      | 11196.3     | -12.68          | -0.86           | -24.37          |
| 1320.0      | -11174007 | 1768738  | 19078022 | -21617.6    | 2050.3      | 10951.9     | -12.40          | -0.90           | -24.51          |
| 1330.0      | -11390798 | 1789196  | 19186314 | -21740.2    | 2041.2      | 10706.1     | -12.12          | -0.94           | -24.65          |
| 1340.0      | -11608802 | 1809560  | 19292140 | -21860.0    | 2031.6      | 10459.0     | -11.84          | -0.98           | -24.78          |
| 1350.0      | -11827990 | 1829826  | 19395489 | -21977.1    | 2021.6      | 10210.6     | -11.56          | -1.02           | -24.91          |
| 1360.0      | -12048334 | 1849990  | 19496348 | -22091.3    | 2011.1      | 9960.9      | -11.28          | -1.06           | -25.03          |
| 1370.0      | -12269806 | 1870047  | 19594703 | -22202.7    | 2000.3      | 9710.0      | -11.00          | -1.11           | -25.15          |
| 1380.0      | -12492378 | 1889994  | 19690543 | -22311.2    | 1989.0      | 9457.9      | -10.71          | -1.15           | -25.27          |
| 1390.0      | -12716021 | 1909826  | 19783857 | -22416.9    | 1977.3      | 9204.6      | -10.42          | -1.19           | -25.38          |
| 1400.0      | -12940706 | 1929539  | 19874632 | -22519.7    | 1965.2      | 8950.2      | -10.14          | -1.23           | -25.50          |
| 1410.0      | -13166405 | 1949129  | 19962857 | -22619.6    | 1952.7      | 8694.7      | -9.85           | -1.27           | -25.60          |
| 1420.0      | -13393089 | 1968591  | 20048522 | -22716.6    | 1939.7      | 8438.1      | -9.56           | -1.32           | -25.71          |
| 1430.0      | -13620728 | 1987922  | 20131616 | -22810.7    | 1926.4      | 8180.5      | -9.26           | -1.36           | -25.81          |
| 1440.0      | -13849293 | 2007117  | 20212129 | -22901.9    | 1912.6      | 7921.9      | -8.97           | -1.40           | -25.91          |
| 1450.0      | -14078755 | 2026172  | 20290051 | -22990.1    | 1898.4      | 7662.3      | -8.68           | -1.44           | -26.00          |
| 1460.0      | -14309085 | 2045083  | 20365372 | -23075.4    | 1883.7      | 7401.9      | -8.38           | -1.48           | -26.09          |
| 1470.0      | -14540254 | 2063845  | 20438085 | -23157.8    | 1868.7      | 7140.5      | -8.09           | -1.53           | -26.18          |
| 1480.0      | -14772231 | 2082455  | 20508179 | -23237.2    | 1853.2      | 6878.2      | -7.79           | -1.57           | -26.27          |
| 1490.0      | -15004987 | 2100908  | 20575646 | -23313.6    | 1837.3      | 6615.1      | -7.49           | -1.61           | -26.35          |
| 1500.0      | -15238492 | 2119199  | 20640479 | -23387.0    | 1821.0      | 6351.3      | -7.19           | -1.65           | -26.43          |
| 1510.0      | -15472717 | 2137326  | 20702669 | -23457.4    | 1804.3      | 6086.6      | -6.89           | -1.69           | -26.50          |

TABLE XIV  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>FT  | YE<br>FT | ZE<br>FT | DXE<br>FT/S | DYE<br>FT/S | DZE<br>FT/S | DDXE<br>FT/S SQ | DDYE<br>FT/S SQ | DDZE<br>FT/S SQ |
|-------------|-----------|----------|----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 1520.0      | -15707631 | 2155284  | 20762209 | -23524.9    | 1787.1      | 5821.3      | -6.59           | -1.74           | -26.57          |
| 1530.0      | -15943204 | 2173068  | 20819092 | -23589.3    | 1769.6      | 5555.2      | -6.29           | -1.78           | -26.64          |
| 1540.0      | -16179407 | 2190674  | 20873312 | -23650.7    | 1751.6      | 5288.6      | -5.99           | -1.82           | -26.70          |
| 1550.0      | -16416209 | 2208098  | 20924861 | -23709.1    | 1733.2      | 5021.2      | -5.69           | -1.86           | -26.76          |
| 1560.0      | -16653380 | 2225337  | 20973735 | -23764.5    | 1714.4      | 4753.3      | -5.39           | -1.90           | -26.82          |
| 1570.0      | -16891489 | 2242385  | 21019926 | -23816.8    | 1695.2      | 4484.9      | -5.08           | -1.94           | -26.87          |
| 1580.0      | -17129906 | 2259239  | 21063431 | -23866.1    | 1675.6      | 4215.9      | -4.78           | -1.98           | -26.92          |
| 1590.0      | -17368801 | 2275895  | 21104243 | -23912.4    | 1655.5      | 3946.5      | -4.47           | -2.02           | -26.97          |
| 1600.0      | -17608144 | 2292348  | 21142359 | -23955.6    | 1635.1      | 3676.6      | -4.17           | -2.06           | -27.01          |
| 1610.0      | -17847904 | 2308595  | 21177774 | -23995.8    | 1614.2      | 3406.3      | -3.86           | -2.11           | -27.05          |
| 1620.0      | -18088049 | 2324631  | 21210484 | -24032.9    | 1593.0      | 3135.6      | -3.56           | -2.15           | -27.08          |
| 1630.0      | -18328551 | 2340453  | 21240485 | -24066.9    | 1571.3      | 2864.6      | -3.25           | -2.19           | -27.12          |
| 1640.0      | -18569377 | 2356056  | 21267775 | -24097.9    | 1549.2      | 2593.3      | -2.94           | -2.23           | -27.15          |
| 1650.0      | -18810498 | 2371437  | 21292350 | -24125.8    | 1526.8      | 2321.7      | -2.64           | -2.27           | -27.17          |
| 1660.0      | -19051882 | 2386590  | 21314208 | -24150.6    | 1503.9      | 2049.9      | -2.33           | -2.31           | -27.19          |
| 1670.0      | -19293499 | 2401513  | 21333348 | -24172.3    | 1480.6      | 1777.9      | -2.02           | -2.35           | -27.21          |
| 1680.0      | -19535319 | 2416202  | 21349766 | -24191.0    | 1457.0      | 1505.7      | -1.71           | -2.39           | -27.23          |
| 1690.0      | -19777310 | 2430652  | 21363461 | -24206.6    | 1432.9      | 1233.4      | -1.41           | -2.42           | -27.24          |
| 1700.0      | -20019441 | 2444859  | 21374433 | -24219.2    | 1408.5      | 961.0       | -1.10           | -2.46           | -27.24          |
| 1710.0      | -20261683 | 2458820  | 21382681 | -24228.6    | 1383.7      | 688.5       | -0.79           | -2.50           | -27.25          |
| 1720.0      | -20504003 | 2472531  | 21388204 | -24235.0    | 1358.4      | 416.0       | -0.48           | -2.54           | -27.25          |
| 1730.0      | -20746372 | 2485988  | 21391002 | -24238.3    | 1332.8      | 143.6       | -0.18           | -2.58           | -27.25          |
| 1740.0      | -20988759 | 2499186  | 21391075 | -24238.5    | 1306.8      | -128.8      | 0.13            | -2.62           | -27.24          |
| 1750.0      | -21231132 | 2512123  | 21388425 | -24235.7    | 1280.5      | -401.2      | 0.44            | -2.66           | -27.23          |
| 1760.0      | -21473462 | 2524795  | 21383052 | -24229.7    | 1253.7      | -673.4      | 0.75            | -2.69           | -27.22          |
| 1770.0      | -21715716 | 2537197  | 21374957 | -24220.7    | 1226.6      | -945.5      | 1.05            | -2.73           | -27.20          |
| 1780.0      | -21957866 | 2549326  | 21364143 | -24208.6    | 1199.1      | -1217.4     | 1.36            | -2.77           | -27.18          |
| 1790.0      | -22199879 | 2561179  | 21350611 | -24193.5    | 1171.3      | -1489.0     | 1.67            | -2.80           | -27.15          |
| 1800.0      | -22441726 | 2572751  | 21334363 | -24175.3    | 1143.1      | -1760.4     | 1.97            | -2.84           | -27.13          |
| 1810.0      | -22683375 | 2584039  | 21315403 | -24154.0    | 1114.5      | -2031.5     | 2.28            | -2.88           | -27.10          |
| 1820.0      | -22924796 | 2595039  | 21293733 | -24129.7    | 1085.5      | -2302.3     | 2.59            | -2.91           | -27.06          |
| 1830.0      | -23165958 | 2605749  | 21269358 | -24102.3    | 1056.3      | -2572.7     | 2.89            | -2.95           | -27.02          |
| 1840.0      | -23406832 | 2616163  | 21242280 | -24071.9    | 1026.6      | -2842.8     | 3.20            | -2.98           | -26.98          |
| 1850.0      | -23647386 | 2626280  | 21212504 | -24038.4    | 996.6       | -3112.4     | 3.50            | -3.02           | -26.94          |
| 1860.0      | -23887590 | 2636094  | 21180034 | -24001.9    | 966.3       | -3381.5     | 3.80            | -3.05           | -26.89          |
| 1870.0      | -24127414 | 2645603  | 21144875 | -23962.4    | 935.6       | -3650.1     | 4.11            | -3.09           | -26.84          |
| 1880.0      | -24366827 | 2654804  | 21107033 | -23919.8    | 904.5       | -3918.2     | 4.41            | -3.12           | -26.78          |
| 1890.0      | -24605799 | 2663693  | 21066513 | -23874.2    | 873.2       | -4185.8     | 4.71            | -3.15           | -26.72          |
| 1900.0      | -24844301 | 2672267  | 21023320 | -23825.6    | 841.5       | -4452.7     | 5.01            | -3.19           | -26.66          |
| 1910.0      | -25082301 | 2680522  | 20977461 | -23774.0    | 809.4       | -4719.0     | 5.31            | -3.22           | -26.60          |
| 1920.0      | -25319770 | 2688455  | 20928943 | -23719.4    | 777.1       | -4984.6     | 5.61            | -3.25           | -26.53          |
| 1930.0      | -25556679 | 2696062  | 20877772 | -23661.8    | 744.4       | -5249.5     | 5.91            | -3.28           | -26.46          |
| 1940.0      | -25792996 | 2703342  | 20823955 | -23601.2    | 711.4       | -5513.7     | 6.21            | -3.31           | -26.38          |
| 1950.0      | -26028692 | 2710290  | 20767501 | -23537.6    | 678.1       | -5777.1     | 6.50            | -3.35           | -26.30          |

TABLE XIV  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>FT  | YE<br>FT | ZE<br>FT | DXE<br>FT/S | DYE<br>FT/S | DZE<br>FT/S | DDXE<br>FT/S SQ | DDYE<br>FT/S SQ | DDZE<br>FT/S SQ |
|-------------|-----------|----------|----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 1960.0      | -26263738 | 2716904  | 20708416 | -23471.1    | 644.5       | -6039.7     | 6.80            | -3.38           | -26.22          |
| 1970.0      | -26498105 | 2723180  | 20646710 | -23401.6    | 610.6       | -6301.5     | 7.09            | -3.41           | -26.13          |
| 1980.0      | -26731761 | 2729115  | 20582390 | -23329.2    | 576.4       | -6562.4     | 7.39            | -3.44           | -26.04          |
| 1990.0      | -26964679 | 2734707  | 20515466 | -23253.9    | 541.9       | -6822.3     | 7.68            | -3.47           | -25.95          |
| 2000.0      | -27196829 | 2739952  | 20445946 | -23175.6    | 507.1       | -7081.4     | 7.97            | -3.49           | -25.86          |
| 2010.0      | -27428181 | 2744848  | 20373841 | -23094.4    | 472.0       | -7339.5     | 8.26            | -3.52           | -25.76          |
| 2020.0      | -27658707 | 2749391  | 20299160 | -23010.3    | 436.6       | -7596.6     | 8.55            | -3.55           | -25.66          |
| 2030.0      | -27888377 | 2753579  | 20221913 | -22923.3    | 401.0       | -7852.6     | 8.84            | -3.58           | -25.55          |
| 2040.0      | -28117163 | 2757410  | 20142111 | -22833.5    | 365.1       | -8107.6     | 9.13            | -3.61           | -25.44          |
| 2050.0      | -28345036 | 2760879  | 20059764 | -22740.7    | 328.9       | -8361.5     | 9.42            | -3.63           | -25.33          |
| 2060.0      | -28571969 | 2763986  | 19974885 | -22645.1    | 292.4       | -8614.2     | 9.70            | -3.66           | -25.22          |
| 2070.0      | -28797930 | 2766727  | 19887483 | -22546.7    | 255.7       | -8865.8     | 9.98            | -3.68           | -25.10          |
| 2080.0      | -29022893 | 2769099  | 19797572 | -22445.5    | 218.7       | -9116.2     | 10.27           | -3.71           | -24.98          |
| 2090.0      | -29246830 | 2771100  | 19705163 | -22341.4    | 181.5       | -9365.4     | 10.55           | -3.73           | -24.85          |
| 2100.0      | -29469713 | 2772728  | 19610268 | -22234.6    | 144.0       | -9613.3     | 10.82           | -3.76           | -24.73          |
| 2110.0      | -29691513 | 2773980  | 19512901 | -22124.9    | 106.3       | -9859.9     | 11.10           | -3.78           | -24.60          |
| 2120.0      | -29912202 | 2774853  | 19413074 | -22012.5    | 68.4        | -10105.2    | 11.38           | -3.81           | -24.46          |
| 2130.0      | -30131754 | 2775346  | 19310801 | -21897.4    | 30.2        | -10349.2    | 11.65           | -3.83           | -24.33          |
| 2140.0      | -30350140 | 2775457  | 19206095 | -21779.5    | -8.2        | -10591.8    | 11.93           | -3.85           | -24.19          |
| 2150.0      | -30567334 | 2775182  | 19098970 | -21658.8    | -46.8       | -10833.0    | 12.20           | -3.87           | -24.05          |
| 2160.0      | -30783308 | 2774520  | 18989440 | -21535.5    | -85.6       | -11072.7    | 12.47           | -3.89           | -23.90          |
| 2170.0      | -30998035 | 2773469  | 18877521 | -21409.5    | -124.7      | -11311.0    | 12.74           | -3.91           | -23.75          |
| 2180.0      | -31211489 | 2772026  | 18763226 | -21280.8    | -163.9      | -11547.7    | 13.00           | -3.93           | -23.60          |
| 2190.0      | -31423642 | 2770190  | 18646572 | -21149.5    | -203.3      | -11782.9    | 13.27           | -3.95           | -23.45          |
| 2200.0      | -31634469 | 2767959  | 18527572 | -21015.5    | -243.0      | -12016.6    | 13.53           | -3.97           | -23.29          |
| 2210.0      | -31843943 | 2765330  | 18406244 | -20878.9    | -282.8      | -12248.7    | 13.79           | -3.99           | -23.13          |
| 2220.0      | -32052038 | 2762203  | 18282604 | -20739.7    | -322.8      | -12479.2    | 14.05           | -4.01           | -22.97          |
| 2230.0      | -32258728 | 2758874  | 18156666 | -20597.9    | -362.9      | -12708.0    | 14.31           | -4.03           | -22.80          |
| 2240.0      | -32463987 | 2755043  | 18028449 | -20453.5    | -403.3      | -12935.2    | 14.56           | -4.04           | -22.63          |
| 2250.0      | -32667790 | 2750808  | 17897969 | -20306.6    | -443.8      | -13160.6    | 14.82           | -4.06           | -22.46          |
| 2260.0      | -32870111 | 2746167  | 17765242 | -20157.2    | -484.4      | -13384.3    | 15.07           | -4.07           | -22.29          |
| 2270.0      | -33070925 | 2741119  | 17630287 | -20005.3    | -525.2      | -13606.3    | 15.32           | -4.09           | -22.11          |
| 2280.0      | -33270208 | 2735662  | 17493122 | -19850.8    | -566.2      | -13826.5    | 15.57           | -4.10           | -21.93          |
| 2290.0      | -33467934 | 2729795  | 17353763 | -19693.4    | -607.3      | -14044.9    | 15.81           | -4.12           | -21.75          |
| 2300.0      | -33664079 | 2723516  | 17212230 | -19534.6    | -648.5      | -14261.4    | 16.06           | -4.13           | -21.56          |
| 2310.0      | -33858618 | 2716824  | 17068541 | -19372.9    | -689.9      | -14476.1    | 16.30           | -4.14           | -21.37          |
| 2320.0      | -34051527 | 2709718  | 16922714 | -19208.7    | -731.3      | -14688.9    | 16.54           | -4.15           | -21.18          |
| 2330.0      | -34242784 | 2702197  | 16774769 | -19042.1    | -772.9      | -14899.8    | 16.77           | -4.16           | -20.99          |
| 2340.0      | -34432362 | 2694259  | 16624726 | -18873.2    | -814.6      | -15108.7    | 17.01           | -4.18           | -20.79          |
| 2350.0      | -34620241 | 2685904  | 16472602 | -18702.0    | -856.4      | -15315.7    | 17.24           | -4.19           | -20.60          |
| 2360.0      | -34806394 | 2677130  | 16318419 | -18528.4    | -898.3      | -15520.6    | 17.47           | -4.19           | -20.40          |
| 2370.0      | -34990801 | 2667937  | 16162196 | -18352.6    | -940.3      | -15723.6    | 17.70           | -4.20           | -20.19          |
| 2380.0      | -35173438 | 2658323  | 16003955 | -18174.4    | -982.4      | -15924.5    | 17.93           | -4.21           | -19.99          |
| 2390.0      | -35354282 | 2648289  | 15843714 | -17994.0    | -1024.5     | -16123.3    | 18.15           | -4.22           | -19.78          |

TABLE XIV  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>FT  | YE<br>FT | ZE<br>FT | DXE<br>FT/S | DYE<br>FT/S | DZE<br>FT/S | DDXE<br>FT/S SQ | DDYE<br>FT/S SQ | DDZE<br>FT/S SQ |
|-------------|-----------|----------|----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 2400.0      | -35533311 | 2637832  | 15681495 | -17811.4    | -1066.8     | -16320.1    | 18.37           | -4.23           | -19.57          |
| 2410.0      | -35710503 | 2626953  | 15517319 | -17626.6    | -1109.1     | -16514.7    | 18.59           | -4.23           | -19.36          |
| 2420.0      | -35885836 | 2615651  | 15351208 | -17439.6    | -1151.4     | -16707.2    | 18.81           | -4.24           | -19.14          |
| 2430.0      | -36059288 | 2603925  | 15183183 | -17250.5    | -1193.8     | -16897.5    | 19.02           | -4.24           | -18.92          |
| 2440.0      | -36230839 | 2591775  | 15013265 | -17059.2    | -1236.2     | -17085.7    | 19.23           | -4.25           | -18.70          |
| 2450.0      | -36400465 | 2579200  | 14841476 | -16865.8    | -1278.7     | -17271.6    | 19.44           | -4.25           | -18.48          |
| 2460.0      | -36568148 | 2566201  | 14667839 | -16670.4    | -1321.2     | -17455.3    | 19.65           | -4.25           | -18.26          |
| 2470.0      | -36733866 | 2552776  | 14492377 | -16472.8    | -1363.8     | -17636.8    | 19.85           | -4.25           | -18.03          |
| 2480.0      | -36897598 | 2538925  | 14315111 | -16273.3    | -1406.3     | -17816.0    | 20.06           | -4.26           | -17.80          |
| 2490.0      | -37059325 | 2524650  | 14136065 | -16071.7    | -1448.9     | -17992.9    | 20.25           | -4.26           | -17.57          |
| 2500.0      | -37219026 | 2509948  | 13955261 | -15868.2    | -1491.4     | -18167.4    | 20.45           | -4.26           | -17.34          |
| 2510.0      | -37376683 | 2494821  | 13772724 | -15662.7    | -1534.0     | -18339.7    | 20.65           | -4.26           | -17.11          |
| 2520.0      | -37532274 | 2479268  | 13588476 | -15455.3    | -1576.6     | -18509.6    | 20.84           | -4.26           | -16.87          |
| 2530.0      | -37685782 | 2463289  | 13402541 | -15246.0    | -1619.1     | -18677.0    | 21.03           | -4.25           | -16.63          |
| 2540.0      | -37837188 | 2446885  | 13214943 | -15034.8    | -1661.6     | -18842.1    | 21.21           | -4.25           | -16.39          |
| 2550.0      | -37986472 | 2430056  | 13025706 | -14821.7    | -1704.1     | -19004.8    | 21.40           | -4.25           | -16.15          |
| 2560.0      | -38133617 | 2412803  | 12834854 | -14606.9    | -1746.6     | -19165.1    | 21.58           | -4.24           | -15.90          |
| 2570.0      | -38278604 | 2395124  | 12642413 | -14390.2    | -1789.0     | -19322.8    | 21.75           | -4.24           | -15.65          |
| 2580.0      | -38421415 | 2377022  | 12448406 | -14171.8    | -1831.4     | -19478.2    | 21.93           | -4.23           | -15.41          |
| 2590.0      | -38562034 | 2358497  | 12252858 | -13951.6    | -1873.7     | -19631.0    | 22.10           | -4.23           | -15.16          |
| 2600.0      | -38700442 | 2339549  | 12055795 | -13729.8    | -1915.9     | -19781.3    | 22.27           | -4.22           | -14.90          |
| 2610.0      | -38836624 | 2320178  | 11857241 | -13506.2    | -1958.1     | -19929.0    | 22.44           | -4.21           | -14.65          |
| 2620.0      | -38970561 | 2300387  | 11657223 | -13281.0    | -2000.2     | -20074.2    | 22.60           | -4.21           | -14.39          |
| 2630.0      | -39102238 | 2280174  | 11455765 | -13054.2    | -2042.2     | -20216.9    | 22.76           | -4.20           | -14.14          |
| 2640.0      | -39231639 | 2259542  | 11252893 | -12825.7    | -2084.2     | -20357.0    | 22.92           | -4.19           | -13.88          |
| 2650.0      | -39358748 | 2238492  | 11048634 | -12595.7    | -2126.0     | -20494.4    | 23.08           | -4.18           | -13.62          |
| 2660.0      | -39483548 | 2217023  | 10843013 | -12364.2    | -2167.7     | -20629.3    | 23.23           | -4.17           | -13.35          |
| 2670.0      | -39606026 | 2195138  | 10636057 | -12131.1    | -2209.3     | -20761.5    | 23.38           | -4.16           | -13.09          |
| 2680.0      | -39726165 | 2172837  | 10427791 | -11896.6    | -2250.8     | -20891.1    | 23.53           | -4.14           | -12.83          |
| 2690.0      | -39843952 | 2150122  | 10218243 | -11660.6    | -2292.2     | -21018.0    | 23.67           | -4.13           | -12.56          |
| 2700.0      | -39959371 | 2126994  | 10007439 | -11423.1    | -2333.4     | -21142.3    | 23.81           | -4.12           | -12.29          |
| 2710.0      | -40072410 | 2103455  | 9795406  | -11184.3    | -2374.5     | -21263.8    | 23.95           | -4.10           | -12.02          |
| 2720.0      | -40183053 | 2079505  | 9582172  | -10944.1    | -2415.4     | -21382.7    | 24.09           | -4.09           | -11.75          |
| 2730.0      | -40291288 | 2055147  | 9367762  | -10702.6    | -2456.2     | -21498.8    | 24.22           | -4.07           | -11.48          |
| 2740.0      | -40397101 | 2030381  | 9152205  | -10459.8    | -2496.9     | -21612.2    | 24.35           | -4.05           | -11.20          |
| 2750.0      | -40500479 | 2005210  | 8935527  | -10215.7    | -2537.3     | -21722.9    | 24.47           | -4.04           | -10.93          |
| 2760.0      | -40601410 | 1979635  | 8717757  | -9970.3     | -2577.6     | -21830.7    | 24.60           | -4.02           | -10.65          |
| 2770.0      | -40699882 | 1953659  | 8498921  | -9723.8     | -2617.7     | -21935.9    | 24.72           | -4.00           | -10.37          |
| 2780.0      | -40795882 | 1927282  | 8279048  | -9476.0     | -2657.6     | -22038.2    | 24.83           | -3.98           | -10.09          |
| 2790.0      | -40889399 | 1900507  | 8058166  | -9227.1     | -2697.3     | -22137.8    | 24.95           | -3.96           | -9.81           |
| 2800.0      | -40980421 | 1873336  | 7836303  | -8977.1     | -2736.9     | -22234.5    | 25.06           | -3.94           | -9.53           |
| 2810.0      | -41068938 | 1845770  | 7613486  | -8726.0     | -2776.2     | -22328.4    | 25.16           | -3.92           | -9.25           |
| 2820.0      | -41154939 | 1817813  | 7389744  | -8473.9     | -2815.3     | -22419.5    | 25.27           | -3.90           | -8.97           |
| 2830.0      | -41238412 | 1789466  | 7165105  | -8220.7     | -2854.1     | -22507.7    | 25.37           | -3.88           | -8.68           |



TABLE XIV  
EARTH-FIXED PLUMBLINE POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XE<br>FT   | YE<br>FT | ZE<br>FT | DXE<br>FT/S | DYE<br>FT/S | DZE<br>FT/S | DDXE<br>FT/S SQ | DDYE<br>FT/S SQ | DDZE<br>FT/S SQ |
|-------------|------------|----------|----------|-------------|-------------|-------------|-----------------|-----------------|-----------------|
| 2840.0      | -413193348 | 1760732  | 6939599  | -7966.5     | -2892.8     | -22593.2    | 25.47           | -3.85           | -8.40           |
| 2850.0      | -41397738  | 1731612  | 6713252  | -7711.3     | -2931.2     | -22675.7    | 25.56           | -3.83           | -8.11           |
| 2860.0      | -41473572  | 1702109  | 6486094  | -7455.2     | -2969.3     | -22755.4    | 25.65           | -3.80           | -7.82           |
| 2870.0      | -41546839  | 1672227  | 6258154  | -7198.2     | -3007.2     | -22832.2    | 25.74           | -3.78           | -7.54           |
| 2880.0      | -41617533  | 1641966  | 6029460  | -6940.4     | -3044.8     | -22906.1    | 25.83           | -3.75           | -7.25           |
| 2890.0      | -41685644  | 1611331  | 5800042  | -6681.7     | -3082.2     | -22977.1    | 25.91           | -3.72           | -6.96           |
| 2900.0      | -41751164  | 1580323  | 5569928  | -6422.1     | -3119.3     | -23045.2    | 25.99           | -3.70           | -6.67           |
| 2910.0      | -41814084  | 1548945  | 5339147  | -6161.8     | -3156.1     | -23110.4    | 26.07           | -3.67           | -6.38           |
| 2920.0      | -41874398  | 1517201  | 5107729  | -5900.8     | -3192.7     | -23172.7    | 26.14           | -3.64           | -6.08           |
| 2930.0      | -41932098  | 1485092  | 4875702  | -5639.1     | -3228.9     | -23232.1    | 26.21           | -3.61           | -5.79           |
| 2940.0      | -41987177  | 1452623  | 4643097  | -5376.6     | -3264.9     | -23288.5    | 26.28           | -3.58           | -5.50           |
| 2950.0      | -42039629  | 1419796  | 4409941  | -5113.6     | -3300.5     | -23342.0    | 26.34           | -3.55           | -5.20           |
| 2960.0      | -42089446  | 1386614  | 4176266  | -4849.9     | -3335.8     | -23392.6    | 26.40           | -3.52           | -4.91           |
| 2970.0      | -42136624  | 1353080  | 3942099  | -4585.6     | -3370.9     | -23440.2    | 26.46           | -3.48           | -4.61           |
| 2980.0      | -42181157  | 1319198  | 3707471  | -4320.8     | -3405.5     | -23484.9    | 26.51           | -3.45           | -4.32           |
| 2990.0      | -42223038  | 1284970  | 3472411  | -4055.4     | -3439.9     | -23526.6    | 26.56           | -3.42           | -4.02           |
| 3000.0      | -42262264  | 1250401  | 3236950  | -3789.6     | -3473.9     | -23565.3    | 26.61           | -3.38           | -3.73           |
| 3010.0      | -42298829  | 1215494  | 3001115  | -3523.3     | -3507.5     | -23601.1    | 26.65           | -3.35           | -3.43           |
| 3020.0      | -42332729  | 1180252  | 2764938  | -3256.6     | -3540.9     | -23633.9    | 26.69           | -3.31           | -3.13           |
| 3030.0      | -42363961  | 1144678  | 2528447  | -2989.6     | -3573.8     | -23663.7    | 26.73           | -3.28           | -2.83           |
| 3040.0      | -42392519  | 1108777  | 2291673  | -2722.1     | -3606.4     | -23690.6    | 26.76           | -3.24           | -2.54           |
| 3050.0      | -42418402  | 1072551  | 2054646  | -2454.4     | -3638.6     | -23714.4    | 26.79           | -3.20           | -2.24           |
| 3060.0      | -42441606  | 1036006  | 1817394  | -2186.3     | -3670.4     | -23735.3    | 26.82           | -3.16           | -1.94           |
| 3070.0      | -42462127  | 999144   | 1579949  | -1918.0     | -3701.9     | -23753.3    | 26.84           | -3.12           | -1.64           |
| 3080.0      | -42479965  | 961970   | 1342339  | -1649.5     | -3732.9     | -23768.2    | 26.86           | -3.09           | -1.34           |
| 3090.0      | -42495116  | 924487   | 1104595  | -1380.7     | -3763.6     | -23780.1    | 26.88           | -3.05           | -1.04           |
| 3100.0      | -42507579  | 886700   | 866747   | -1111.8     | -3793.8     | -23789.1    | 26.90           | -3.00           | -0.75           |
| 3110.0      | -42517352  | 848612   | 628824   | -842.8      | -3823.7     | -23795.0    | 26.91           | -2.96           | -0.45           |
| 3120.0      | -42524435  | 810228   | 390856   | -573.7      | -3853.1     | -23798.0    | 26.91           | -2.92           | -0.15           |
| 3130.0      | -42528827  | 771552   | 152873   | -304.6      | -3882.1     | -23798.0    | 26.92           | -2.88           | 0.15            |
| 3140.0      | -42530527  | 732588   | -85094   | -35.4       | -3910.7     | -23795.0    | 26.92           | -2.84           | 0.45            |
| 3150.0      | -42529535  | 693340   | -323016  | 233.8       | -3938.8     | -23789.0    | 26.92           | -2.79           | 0.75            |
| 3160.0      | -42525851  | 653813   | -560864  | 502.9       | -3966.5     | -23780.1    | 26.91           | -2.75           | 1.05            |
| 3170.0      | -42519476  | 614012   | -798608  | 772.0       | -3993.7     | -23768.1    | 26.90           | -2.70           | 1.34            |
| 3180.0      | -42510411  | 573940   | -1036217 | 1041.0      | -4020.5     | -23753.2    | 26.89           | -2.66           | 1.64            |
| 3190.0      | -42498657  | 533603   | -1273662 | 1309.8      | -4046.9     | -23735.3    | 26.88           | -2.61           | 1.94            |
| 3200.0      | -42484215  | 493005   | -1510913 | 1578.5      | -4072.7     | -23714.4    | 26.86           | -2.56           | 2.24            |
| 3210.0      | -42467088  | 452150   | -1747940 | 1846.9      | -4098.1     | -23690.6    | 26.83           | -2.52           | 2.53            |
| 3220.0      | -42447277  | 411044   | -1984714 | 2115.2      | -4123.0     | -23663.7    | 26.81           | -2.47           | 2.83            |
| 3230.0      | -42424785  | 369691   | -2221205 | 2383.1      | -4147.5     | -23633.9    | 26.78           | -2.42           | 3.13            |
| 3235.242    | -42411923  | 347917   | -2345050 | 2523.5      | -4160.1     | -23617.1    | 26.77           | -2.39           | 3.28            |

S-IVB/LM SEPARATION

TABLE XV  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC                | XSP<br>NM | YSP<br>NM | ZSP<br>NM | CXSP<br>FT/S | DYSP<br>FT/S | DZSP<br>FT/S | DDXSP<br>FT/S SQ | DCYSP<br>FT/S SQ | DCZSP<br>FT/S SQ |
|----------------------------|-----------|-----------|-----------|--------------|--------------|--------------|------------------|------------------|------------------|
| GUIDANCE REFERENCE RELEASE |           |           |           |              |              |              |                  |                  |                  |
| -4.956                     | 2791.320  | 1173.599  | 1635.233  | -520.0       | 1236.8       | 0.0          | 0.01             | 0.10             | 0.00             |
| -4.0                       | 2791.238  | 1173.794  | 1635.233  | -520.1       | 1236.7       | 0.0          | 0.01             | 0.10             | 0.00             |
| -3.0                       | 2791.152  | 1173.997  | 1635.233  | -520.2       | 1236.7       | 0.0          | 0.01             | 0.10             | 0.00             |
| -2.0                       | 2791.067  | 1174.201  | 1635.233  | -520.3       | 1236.7       | 0.0          | 0.01             | 0.10             | 0.00             |
| -1.0                       | 2790.981  | 1174.404  | 1635.233  | -520.4       | 1236.6       | 0.0          | 0.01             | 0.10             | 0.00             |
| RANGE ZERO AT 17 48 08 EST |           |           |           |              |              |              |                  |                  |                  |
| 0.000                      | 2790.896  | 1174.608  | 1635.233  | -520.4       | 1236.6       | 0.0          | 0.01             | 0.10             | 0.00             |
| FIRST MOTION               |           |           |           |              |              |              |                  |                  |                  |
| 0.200                      | 2790.878  | 1174.648  | 1635.233  | -520.5       | 1236.6       | 0.0          | 6.16             | 2.76             | 3.59             |
| LIFTOFF                    |           |           |           |              |              |              |                  |                  |                  |
| 0.360                      | 2790.865  | 1174.681  | 1635.233  | -519.5       | 1237.0       | 0.6          | 6.27             | 2.80             | 3.66             |
| 1.0                        | 2790.810  | 1174.811  | 1635.233  | -515.4       | 1238.7       | 3.0          | 6.68             | 2.94             | 3.92             |
| 2.0                        | 2790.726  | 1175.016  | 1635.234  | -508.6       | 1241.6       | 7.1          | 7.16             | 3.11             | 4.23             |
| 3.0                        | 2790.643  | 1175.220  | 1635.235  | -501.3       | 1244.7       | 11.4         | 7.51             | 3.24             | 4.45             |
| 4.0                        | 2790.561  | 1175.425  | 1635.237  | -493.8       | 1247.8       | 16.0         | 7.78             | 3.35             | 4.62             |
| 5.0                        | 2790.480  | 1175.631  | 1635.240  | -486.0       | 1251.1       | 20.7         | 7.99             | 3.43             | 4.75             |
| 6.0                        | 2790.401  | 1175.837  | 1635.244  | -478.0       | 1254.4       | 25.5         | 8.17             | 3.51             | 4.86             |
| 7.0                        | 2790.323  | 1176.044  | 1635.249  | -469.8       | 1257.8       | 30.4         | 8.33             | 3.58             | 4.96             |
| 8.0                        | 2790.246  | 1176.251  | 1635.254  | -461.5       | 1261.3       | 35.4         | 8.50             | 3.66             | 5.06             |
| 9.0                        | 2790.171  | 1176.459  | 1635.261  | -453.0       | 1264.9       | 40.5         | 8.67             | 3.75             | 5.17             |
| 10.0                       | 2790.097  | 1176.667  | 1635.268  | -444.4       | 1268.6       | 45.7         | 8.85             | 3.85             | 5.29             |
| 11.0                       | 2790.025  | 1176.877  | 1635.276  | -435.5       | 1272.3       | 51.1         | 9.04             | 3.96             | 5.41             |
| 12.0                       | 2789.954  | 1177.086  | 1635.284  | -426.5       | 1276.2       | 56.5         | 9.23             | 4.09             | 5.55             |
| 13.0                       | 2789.884  | 1177.297  | 1635.294  | -417.2       | 1280.2       | 62.2         | 9.43             | 4.24             | 5.70             |
| 14.0                       | 2789.816  | 1177.508  | 1635.305  | -407.8       | 1284.4       | 67.9         | 9.62             | 4.40             | 5.85             |
| 15.0                       | 2789.750  | 1177.720  | 1635.317  | -398.2       | 1288.8       | 73.9         | 9.81             | 4.58             | 6.01             |
| 16.0                       | 2789.685  | 1177.932  | 1635.329  | -388.4       | 1293.3       | 80.0         | 9.99             | 4.78             | 6.17             |
| 17.0                       | 2789.622  | 1178.145  | 1635.343  | -378.4       | 1298.1       | 86.2         | 10.16            | 4.99             | 6.32             |
| 18.0                       | 2789.561  | 1178.359  | 1635.358  | -368.3       | 1303.0       | 92.6         | 10.31            | 5.21             | 6.48             |
| 19.0                       | 2789.501  | 1178.574  | 1635.374  | -358.0       | 1308.2       | 99.2         | 10.45            | 5.46             | 6.63             |
| 20.0                       | 2789.443  | 1178.790  | 1635.390  | -347.6       | 1313.7       | 105.9        | 10.58            | 5.71             | 6.78             |

TABLE XV  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>NM | YSP<br>NM | ZSP<br>NM | CXSP<br>FT/S | DYSP<br>FT/S | DZSP<br>FT/S | DDXSP<br>FT/S SQ | DDYSP<br>FT/S SQ | DDZSP<br>FT/S SQ |
|-------------|-----------|-----------|-----------|--------------|--------------|--------------|------------------|------------------|------------------|
| 21.0        | 2789.387  | 1179.007  | 1635.408  | -337.0       | 1319.4       | 112.7        | 10.70            | 5.98             | 6.93             |
| 22.0        | 2789.332  | 1179.224  | 1635.428  | -326.4       | 1325.4       | 119.7        | 10.80            | 6.25             | 7.08             |
| 23.0        | 2789.279  | 1179.443  | 1635.448  | -315.6       | 1331.6       | 126.9        | 10.90            | 6.54             | 7.22             |
| 24.0        | 2789.228  | 1179.662  | 1635.469  | -304.8       | 1338.2       | 134.2        | 11.00            | 6.84             | 7.37             |
| 25.0        | 2789.179  | 1179.883  | 1635.492  | -293.8       | 1345.0       | 141.6        | 11.09            | 7.15             | 7.54             |
| 26.0        | 2789.131  | 1180.105  | 1635.516  | -282.8       | 1352.2       | 149.3        | 11.19            | 7.47             | 7.71             |
| 27.0        | 2789.085  | 1180.328  | 1635.541  | -271.6       | 1359.7       | 157.1        | 11.29            | 7.80             | 7.91             |
| 28.0        | 2789.042  | 1180.553  | 1635.568  | -260.4       | 1367.6       | 165.1        | 11.40            | 8.16             | 8.12             |
| 29.0        | 2789.000  | 1180.779  | 1635.596  | -249.0       | 1375.8       | 173.3        | 11.49            | 8.49             | 8.36             |
| 30.0        | 2788.960  | 1181.006  | 1635.625  | -237.6       | 1384.3       | 181.8        | 11.57            | 8.83             | 8.66             |
| 31.0        | 2788.921  | 1181.235  | 1635.656  | -226.2       | 1393.1       | 190.7        | 11.58            | 9.21             | 9.04             |
| 32.0        | 2788.885  | 1181.465  | 1635.688  | -214.7       | 1402.4       | 199.9        | 11.56            | 9.64             | 9.42             |
| 33.0        | 2788.851  | 1181.696  | 1635.721  | -203.2       | 1412.2       | 209.5        | 11.49            | 10.09            | 9.77             |
| 34.0        | 2788.818  | 1181.930  | 1635.757  | -191.8       | 1422.4       | 219.4        | 11.53            | 10.57            | 10.06            |
| 35.0        | 2788.787  | 1182.165  | 1635.794  | -180.3       | 1433.0       | 229.6        | 11.63            | 11.03            | 10.25            |
| 36.0        | 2788.758  | 1182.402  | 1635.832  | -168.8       | 1444.1       | 239.8        | 11.70            | 11.46            | 10.36            |
| 37.0        | 2788.732  | 1182.640  | 1635.873  | -157.1       | 1455.7       | 250.3        | 11.77            | 11.89            | 10.53            |
| 38.0        | 2788.707  | 1182.881  | 1635.915  | -145.4       | 1467.6       | 261.0        | 11.83            | 12.35            | 10.76            |
| 39.0        | 2788.684  | 1183.124  | 1635.959  | -133.7       | 1480.1       | 271.9        | 11.79            | 12.85            | 11.07            |
| 40.0        | 2788.663  | 1183.368  | 1636.004  | -122.1       | 1493.1       | 283.1        | 11.70            | 13.37            | 11.36            |
| 41.0        | 2788.643  | 1183.615  | 1636.052  | -110.5       | 1506.6       | 294.6        | 11.66            | 13.95            | 11.67            |
| 42.0        | 2788.626  | 1183.865  | 1636.102  | -98.9        | 1520.8       | 306.4        | 11.67            | 14.63            | 11.96            |
| 43.0        | 2788.611  | 1184.116  | 1636.153  | -87.4        | 1535.6       | 318.5        | 11.60            | 15.34            | 12.22            |
| 44.0        | 2788.597  | 1184.370  | 1636.206  | -75.9        | 1551.1       | 330.8        | 11.53            | 16.02            | 12.44            |
| 45.0        | 2788.586  | 1184.627  | 1636.262  | -64.5        | 1567.3       | 343.4        | 11.44            | 16.68            | 12.73            |
| 46.0        | 2788.576  | 1184.887  | 1636.320  | -53.3        | 1584.2       | 356.2        | 11.16            | 17.26            | 12.97            |
| 47.0        | 2788.568  | 1185.149  | 1636.379  | -42.3        | 1601.6       | 369.4        | 10.95            | 17.86            | 13.34            |
| 48.0        | 2788.562  | 1185.414  | 1636.441  | -31.6        | 1619.6       | 383.0        | 10.78            | 18.43            | 13.77            |
| 49.0        | 2788.557  | 1185.682  | 1636.506  | -21.0        | 1638.2       | 397.0        | 10.64            | 19.03            | 14.20            |
| 50.0        | 2788.555  | 1185.953  | 1636.572  | -10.5        | 1657.4       | 411.3        | 10.51            | 19.67            | 14.58            |
| 51.0        | 2788.554  | 1186.228  | 1636.641  | -0.2         | 1677.2       | 426.1        | 10.16            | 20.34            | 14.83            |
| 52.0        | 2788.554  | 1186.506  | 1636.712  | 10.1         | 1697.7       | 441.0        | 10.37            | 21.00            | 14.95            |
| 53.0        | 2788.557  | 1186.787  | 1636.786  | 20.0         | 1718.9       | 456.2        | 9.89             | 21.73            | 15.38            |
| 54.0        | 2788.561  | 1187.072  | 1636.863  | 29.9         | 1740.6       | 471.8        | 9.80             | 22.21            | 15.58            |
| 55.0        | 2788.567  | 1187.360  | 1636.942  | 39.4         | 1762.8       | 487.3        | 9.42             | 22.78            | 15.60            |
| 56.0        | 2788.574  | 1187.652  | 1637.023  | 48.8         | 1786.1       | 503.1        | 9.30             | 23.83            | 15.86            |
| 57.0        | 2788.583  | 1187.948  | 1637.108  | 57.5         | 1809.9       | 519.0        | 8.67             | 24.22            | 15.82            |
| 58.0        | 2788.593  | 1188.248  | 1637.194  | 66.1         | 1833.8       | 535.0        | 8.26             | 24.55            | 15.86            |
| 59.0        | 2788.604  | 1188.552  | 1637.284  | 73.7         | 1858.5       | 551.1        | 7.47             | 25.14            | 16.14            |

MACH ONE

59.760 2788.614 1188.786 1637.354 79.0 1877.3 563.3 7.01 25.29 16.12

TABLE XV  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>NM | YSP<br>NM | ZSP<br>NM | DXSP<br>FT/S | DYSP<br>FT/S | DZSP<br>FT/S | DDXSP<br>FT/S SQ | DDYSP<br>FT/S SQ | DCZSP<br>FT/S SQ |
|-------------|-----------|-----------|-----------|--------------|--------------|--------------|------------------|------------------|------------------|
| 60.0        | 2788.617  | 1188.861  | 1637.376  | 80.6         | 1883.3       | 567.3        | 6.85             | 25.39            | 16.18            |
| 61.0        | 2788.631  | 1189.173  | 1637.471  | 87.0         | 1908.6       | 583.6        | 6.17             | 25.85            | 16.31            |
| 62.0        | 2788.646  | 1189.489  | 1637.568  | 92.9         | 1934.3       | 600.1        | 5.79             | 26.35            | 16.65            |
| 63.0        | 2788.661  | 1189.810  | 1637.668  | 99.0         | 1960.9       | 616.5        | 6.13             | 27.09            | 16.28            |
| 64.0        | 2788.676  | 1190.135  | 1637.771  | 105.5        | 1988.2       | 632.8        | 6.27             | 27.99            | 16.28            |
| 65.0        | 2788.696  | 1190.464  | 1637.877  | 111.4        | 2016.3       | 649.7        | 5.75             | 28.80            | 16.97            |
| 66.0        | 2788.715  | 1190.799  | 1637.985  | 117.1        | 2045.4       | 666.8        | 5.52             | 29.70            | 17.12            |
| 67.0        | 2788.735  | 1191.138  | 1638.097  | 122.6        | 2075.3       | 684.2        | 5.41             | 30.48            | 17.35            |
| 68.0        | 2788.755  | 1191.482  | 1638.211  | 128.0        | 2105.8       | 701.8        | 5.30             | 31.28            | 17.64            |
| 69.0        | 2788.777  | 1191.831  | 1638.328  | 133.2        | 2137.6       | 719.8        | 4.94             | 32.44            | 17.88            |
| 70.0        | 2788.799  | 1192.186  | 1638.448  | 137.8        | 2170.5       | 738.1        | 4.41             | 33.58            | 18.29            |
| 71.0        | 2788.822  | 1192.546  | 1638.571  | 141.9        | 2204.5       | 756.6        | 4.06             | 34.77            | 18.68            |
| MAX Q       |           |           |           |              |              |              |                  |                  |                  |
| 71.500      | 2788.834  | 1192.728  | 1638.634  | 143.9        | 2221.9       | 766.1        | 3.92             | 35.29            | 19.01            |
| 72.0        | 2788.846  | 1192.912  | 1638.697  | 145.8        | 2239.5       | 775.6        | 3.83             | 35.68            | 19.30            |
| 73.0        | 2788.870  | 1193.284  | 1638.826  | 149.5        | 2275.3       | 795.4        | 3.69             | 36.25            | 20.16            |
| 74.0        | 2788.895  | 1193.661  | 1638.959  | 153.0        | 2311.6       | 816.0        | 3.61             | 36.53            | 21.12            |
| 75.0        | 2788.921  | 1194.045  | 1639.095  | 156.5        | 2348.2       | 837.6        | 3.58             | 36.76            | 22.09            |
| 76.0        | 2788.947  | 1194.434  | 1639.235  | 159.9        | 2385.1       | 860.2        | 3.40             | 37.36            | 23.06            |
| 77.0        | 2788.973  | 1194.830  | 1639.379  | 162.9        | 2422.6       | 883.7        | 2.97             | 38.05            | 23.90            |
| 78.0        | 2789.000  | 1195.232  | 1639.526  | 165.4        | 2461.1       | 907.9        | 2.38             | 39.01            | 24.51            |
| 79.0        | 2789.028  | 1195.640  | 1639.678  | 167.5        | 2500.6       | 932.5        | 1.82             | 40.26            | 24.88            |
| 80.0        | 2789.056  | 1196.056  | 1639.833  | 169.2        | 2541.4       | 957.4        | 1.64             | 41.68            | 25.01            |
| 81.0        | 2789.084  | 1196.477  | 1639.993  | 170.9        | 2583.6       | 982.5        | 1.76             | 42.98            | 25.06            |
| 82.0        | 2789.112  | 1196.906  | 1640.157  | 172.6        | 2627.0       | 1007.7       | 2.10             | 44.00            | 25.18            |
| 83.0        | 2789.140  | 1197.342  | 1640.325  | 174.7        | 2671.0       | 1033.0       | 2.42             | 44.64            | 25.45            |
| 84.0        | 2789.169  | 1197.786  | 1640.497  | 177.1        | 2715.5       | 1058.4       | 2.47             | 44.88            | 25.62            |
| 85.0        | 2789.199  | 1198.236  | 1640.673  | 179.4        | 2760.7       | 1084.3       | 2.25             | 45.44            | 25.92            |
| 86.0        | 2789.229  | 1198.695  | 1640.854  | 181.3        | 2806.7       | 1110.5       | 1.85             | 46.51            | 26.40            |
| 87.0        | 2789.259  | 1199.161  | 1641.039  | 182.7        | 2853.6       | 1137.2       | 1.30             | 47.76            | 26.96            |
| 88.0        | 2789.289  | 1199.634  | 1641.228  | 183.8        | 2901.9       | 1164.4       | 0.79             | 49.07            | 27.55            |
| 89.0        | 2789.319  | 1200.116  | 1641.422  | 184.3        | 2951.3       | 1192.2       | 0.28             | 50.18            | 28.07            |
| 90.0        | 2789.349  | 1200.606  | 1641.621  | 184.2        | 3001.9       | 1220.5       | -0.17            | 51.16            | 28.56            |
| 91.0        | 2789.380  | 1201.104  | 1641.824  | 183.6        | 3053.4       | 1249.3       | -0.79            | 52.07            | 29.03            |
| 92.0        | 2789.410  | 1201.611  | 1642.032  | 182.3        | 3105.8       | 1278.6       | -1.48            | 53.10            | 29.50            |
| 93.0        | 2789.440  | 1202.127  | 1642.245  | 180.5        | 3159.3       | 1308.3       | -2.12            | 54.26            | 29.98            |
| 94.0        | 2789.469  | 1202.651  | 1642.463  | 178.0        | 3214.1       | 1338.5       | -2.61            | 55.43            | 30.42            |
| 95.0        | 2789.499  | 1203.185  | 1642.686  | 175.1        | 3270.0       | 1369.2       | -3.03            | 56.67            | 30.83            |
| 96.0        | 2789.527  | 1203.728  | 1642.914  | 171.7        | 3327.0       | 1400.1       | -3.41            | 57.79            | 31.15            |
| 97.0        | 2789.555  | 1204.280  | 1643.147  | 168.0        | 3385.1       | 1431.4       | -3.93            | 58.74            | 31.41            |
| 98.0        | 2789.583  | 1204.842  | 1643.385  | 163.7        | 3444.3       | 1462.9       | -4.43            | 59.73            | 31.68            |

TABLE XV  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>NM | YSP<br>NM | ZSP<br>NM | CXSP<br>FT/S | DYSP<br>FT/S | DZSP<br>FT/S | DDXSP<br>FT/S SC | DDYSP<br>FT/S SC | DDZSP<br>FT/S SC |
|-------------|-----------|-----------|-----------|--------------|--------------|--------------|------------------|------------------|------------------|
| 99.0        | 2789.609  | 1205.414  | 1643.629  | 158.9        | 3504.4       | 1494.8       | -4.90            | 60.71            | 32.00            |
| 100.0       | 2789.635  | 1205.996  | 1643.877  | 153.7        | 3565.5       | 1527.0       | -5.34            | 61.77            | 32.44            |
| 101.0       | 2789.660  | 1206.588  | 1644.131  | 148.1        | 3627.6       | 1559.7       | -5.75            | 62.79            | 32.89            |
| 102.0       | 2789.684  | 1207.190  | 1644.391  | 142.0        | 3690.7       | 1592.8       | -6.14            | 63.78            | 33.32            |
| 103.0       | 2789.707  | 1207.803  | 1644.656  | 135.6        | 3754.9       | 1626.3       | -6.50            | 64.73            | 33.68            |
| 104.0       | 2789.729  | 1208.426  | 1644.926  | 128.7        | 3820.1       | 1660.2       | -6.94            | 65.83            | 34.11            |
| 105.0       | 2789.749  | 1209.060  | 1645.202  | 121.5        | 3886.2       | 1694.4       | -7.35            | 66.87            | 34.46            |
| 106.0       | 2789.769  | 1209.706  | 1645.484  | 113.9        | 3953.4       | 1729.1       | -7.72            | 67.92            | 34.80            |
| 107.0       | 2789.787  | 1210.362  | 1645.772  | 105.9        | 4021.8       | 1764.1       | -8.07            | 69.01            | 35.20            |
| 108.0       | 2789.804  | 1211.030  | 1646.065  | 97.6         | 4091.4       | 1799.6       | -8.36            | 70.31            | 35.76            |
| 109.0       | 2789.819  | 1211.709  | 1646.364  | 88.9         | 4162.1       | 1835.6       | -8.75            | 71.47            | 36.29            |
| 110.0       | 2789.833  | 1212.400  | 1646.669  | 79.9         | 4233.9       | 1872.1       | -9.17            | 72.50            | 36.78            |
| 111.0       | 2789.845  | 1213.103  | 1646.981  | 70.3         | 4306.7       | 1909.1       | -9.70            | 73.47            | 37.20            |
| 112.0       | 2789.856  | 1213.817  | 1647.298  | 60.3         | 4380.5       | 1946.5       | -10.22           | 74.44            | 37.58            |
| 113.0       | 2789.865  | 1214.545  | 1647.621  | 49.7         | 4455.5       | 1984.4       | -10.71           | 75.62            | 38.07            |
| 114.0       | 2789.873  | 1215.284  | 1647.951  | 38.7         | 4531.6       | 2022.7       | -11.21           | 76.94            | 38.65            |
| 115.0       | 2789.878  | 1216.036  | 1648.287  | 27.2         | 4609.0       | 2061.6       | -11.66           | 78.17            | 39.15            |
| 116.0       | 2789.882  | 1216.801  | 1648.630  | 15.1         | 4687.4       | 2100.9       | -12.15           | 79.15            | 39.58            |
| 117.0       | 2789.883  | 1217.580  | 1648.979  | 2.6          | 4767.0       | 2140.7       | -12.70           | 80.10            | 39.98            |
| 118.0       | 2789.883  | 1218.371  | 1649.335  | -10.5        | 4847.7       | 2181.0       | -13.26           | 81.39            | 40.55            |
| 119.0       | 2789.880  | 1219.175  | 1649.697  | -24.2        | 4929.7       | 2221.9       | -13.92           | 82.82            | 41.15            |
| 120.0       | 2789.875  | 1219.993  | 1650.066  | -38.5        | 5013.0       | 2263.3       | -14.55           | 84.19            | 41.71            |
| 121.0       | 2789.868  | 1220.826  | 1650.442  | -53.5        | 5097.6       | 2305.2       | -15.28           | 85.54            | 42.23            |
| 122.0       | 2789.858  | 1221.671  | 1650.825  | -69.2        | 5183.8       | 2347.7       | -16.03           | 86.86            | 42.68            |
| 123.0       | 2789.845  | 1222.532  | 1651.215  | -85.7        | 5271.0       | 2390.6       | -16.76           | 88.01            | 43.07            |
| 124.0       | 2789.830  | 1223.407  | 1651.612  | -102.9       | 5359.5       | 2433.8       | -17.52           | 89.14            | 43.45            |
| 125.0       | 2789.811  | 1224.296  | 1652.016  | -121.0       | 5449.1       | 2477.5       | -18.35           | 90.54            | 43.91            |
| 126.0       | 2789.790  | 1225.200  | 1652.428  | -140.0       | 5540.4       | 2521.7       | -19.32           | 92.13            | 44.43            |
| 127.0       | 2789.766  | 1226.120  | 1652.846  | -159.8       | 5633.3       | 2566.5       | -20.27           | 93.79            | 45.04            |
| 128.0       | 2789.738  | 1227.055  | 1653.273  | -180.7       | 5727.7       | 2611.8       | -21.26           | 95.49            | 45.64            |
| 129.0       | 2789.706  | 1228.005  | 1653.706  | -202.5       | 5823.7       | 2657.6       | -22.31           | 97.01            | 46.11            |
| 130.0       | 2789.671  | 1228.972  | 1654.147  | -225.6       | 5921.3       | 2703.9       | -23.47           | 98.39            | 46.50            |
| 131.0       | 2789.632  | 1229.954  | 1654.596  | -249.8       | 6020.2       | 2750.5       | -24.73           | 99.87            | 46.94            |
| 132.0       | 2789.589  | 1230.953  | 1655.053  | -275.1       | 6120.4       | 2797.5       | -25.76           | 101.36           | 47.21            |
| 133.0       | 2789.542  | 1231.968  | 1655.517  | -301.9       | 6222.5       | 2845.1       | -27.12           | 103.02           | 47.78            |
| 134.0       | 2789.490  | 1233.001  | 1655.989  | -330.0       | 6326.3       | 2893.1       | -28.48           | 104.71           | 48.25            |
| 135.0       | 2789.433  | 1234.050  | 1656.470  | -358.9       | 6431.6       | 2941.7       | -29.34           | 106.25           | 48.82            |
| 136.0       | 2789.372  | 1235.117  | 1656.958  | -388.2       | 6538.4       | 2991.0       | -29.60           | 107.71           | 49.51            |
| 137.0       | 2789.306  | 1236.202  | 1657.454  | -417.6       | 6646.6       | 3041.1       | -29.67           | 109.19           | 50.28            |
| 138.0       | 2789.235  | 1237.305  | 1657.959  | -446.7       | 6756.6       | 3092.1       | -29.38           | 110.47           | 51.15            |

IECO

138.970 2789.161 1238.392 1658.456 -475.8 6863.0 3141.3 -28.93 111.46 51.83

TABLE XV  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC                                      | XSP<br>NM | YSP<br>NM | ZSP<br>NM | DXSP<br>FT/S | DYSP<br>FT/S | DZSP<br>FT/S | DDXSP<br>FT/S SQ | DDYSP<br>FT/S SQ | DDZSP<br>FT/S SQ |
|--|-----------|-----------|-----------|--------------|--------------|--------------|------------------|------------------|------------------|
| 139.0  | 2789.159  | 1238.425  | 1658.472  | -475.8       | 6865.0       | 3142.4       | -28.97           | 111.68           | 51.93            |
| 140.0  | 2789.078  | 1239.563  | 1658.992  | -503.5       | 6933.5       | 3170.8       | -29.32           | 57.66            | 21.62            |
| 141.0  | 2788.993  | 1240.708  | 1659.516  | -530.9       | 6986.1       | 3190.5       | -27.78           | 52.96            | 19.56            |
| 142.0  | 2788.903  | 1241.862  | 1660.042  | -557.9       | 7032.3       | 3206.7       | -25.56           | 46.93            | 17.04            |
| OECCO  |           |           |           |              |              |              |                  |                  |                  |
| 142.250  | 2788.881  | 1242.151  | 1660.174  | -564.4       | 7042.7       | 3210.3       | -26.97           | 42.75            | 14.22            |
| 143.0  | 2788.810  | 1243.022  | 1660.571  | -584.1       | 7049.3       | 3207.0       | -26.66           | 11.69            | -2.88            |
| S-IB/S-IVB SEPARATION SIGNAL                     |           |           |           |              |              |              |                  |                  |                  |
| 143.500  | 2788.761  | 1243.602  | 1660.835  | -596.9       | 7045.5       | 3200.6       | -25.33           | -6.23            | -12.36           |
| EBW FIRING (SEPARATION SIGNAL PLUS 0.07 SECONDS) |           |           |           |              |              |              |                  |                  |                  |
| 143.570  | 2788.759  | 1243.681  | 1660.872  | -598.7       | 7045.0       | 3199.7       | -25.30           | -6.45            | -12.52           |
| 144.0  | 2788.716  | 1244.179  | 1661.098  | -609.8       | 7040.7       | 3193.7       | -24.55           | -8.40            | -13.33           |
| 145.0  | 2788.613  | 1245.337  | 1661.622  | -635.3       | 7030.6       | 3179.3       | -24.52           | -9.73            | -14.06           |
| 150.0  | 2788.038  | 1251.109  | 1664.214  | -764.1       | 7021.1       | 3130.3       | -26.29           | 6.80             | -5.05            |
| 155.0  | 2787.356  | 1256.903  | 1666.781  | -893.5       | 7063.0       | 3112.1       | -25.96           | 9.67             | -2.93            |
| GUIDANCE INITIATION                              |           |           |           |              |              |              |                  |                  |                  |
| 159.470  | 2786.656  | 1262.114  | 1669.065  | -1009.2      | 7105.8       | 3099.0       | -26.04           | 10.16            | -2.64            |
| 160.0  | 2786.568  | 1262.734  | 1669.335  | -1022.8      | 7110.9       | 3097.5       | -25.98           | 10.16            | -2.68            |
| 165.0  | 2785.673  | 1268.606  | 1671.878  | -1152.7      | 7161.5       | 3082.1       | -26.32           | 10.78            | -3.42            |
| 170.0  | 2784.669  | 1274.521  | 1674.406  | -1288.4      | 7216.6       | 3060.8       | -27.45           | 11.32            | -4.36            |
| 175.0  | 2783.553  | 1280.483  | 1676.916  | -1425.1      | 7273.3       | 3039.5       | -27.07           | 11.67            | -4.18            |
| 180.0  | 2782.324  | 1286.492  | 1679.408  | -1561.1      | 7331.2       | 3018.7       | -27.16           | 11.76            | -4.13            |
| 185.0  | 2780.984  | 1292.549  | 1681.884  | -1697.1      | 7390.1       | 2998.5       | -27.16           | 12.06            | -3.97            |
| 190.0  | 2779.531  | 1298.655  | 1684.343  | -1833.9      | 7450.3       | 2978.5       | -27.30           | 12.29            | -4.00            |
| 195.0  | 2777.965  | 1304.811  | 1686.786  | -1971.6      | 7511.6       | 2958.7       | -27.59           | 12.53            | -3.90            |
| 200.0  | 2776.286  | 1311.018  | 1689.212  | -2110.3      | 7574.4       | 2938.4       | -27.70           | 12.85            | -4.22            |
| 205.0  | 2774.492  | 1317.277  | 1691.621  | -2250.4      | 7638.9       | 2916.3       | -28.08           | 13.30            | -4.56            |
| 210.0  | 2772.582  | 1323.591  | 1694.012  | -2391.6      | 7705.1       | 2893.0       | -28.25           | 13.45            | -4.70            |
| 215.0  | 2770.555  | 1329.958  | 1696.383  | -2533.7      | 7772.3       | 2869.7       | -28.39           | 13.66            | -4.66            |
| 220.0  | 2768.411  | 1336.382  | 1698.735  | -2676.7      | 7840.4       | 2846.5       | -28.60           | 13.81            | -4.63            |
| 225.0  | 2766.150  | 1342.862  | 1701.068  | -2820.3      | 7909.6       | 2823.6       | -28.67           | 14.16            | -4.52            |
| 230.0  | 2763.770  | 1349.400  | 1703.382  | -2964.3      | 7980.0       | 2801.2       | -28.82           | 14.37            | -4.41            |

TABLE XV  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>NM | YSP<br>NM | ZSP<br>NM | DXSP<br>FT/S | DYSP<br>FT/S | DZSP<br>FT/S | DDXSP<br>FT/S SQ | DDYSP<br>FT/S SQ | DDZSP<br>FT/S SQ |
|-------------|-----------|-----------|-----------|--------------|--------------|--------------|------------------|------------------|------------------|
| 235.0       | 2761.271  | 1355.996  | 1705.678  | -3109.6      | 8051.9       | 2779.1       | -29.00           | 14.68            | -4.44            |
| 240.0       | 2758.652  | 1362.652  | 1707.956  | -3255.5      | 8124.8       | 2757.0       | -29.19           | 14.82            | -4.41            |
| 245.0       | 2755.913  | 1369.368  | 1710.215  | -3402.4      | 8198.4       | 2735.0       | -29.40           | 14.95            | -4.38            |
| 250.0       | 2753.052  | 1376.145  | 1712.457  | -3550.4      | 8273.3       | 2713.4       | -29.60           | 15.30            | -4.25            |
| 255.0       | 2750.070  | 1382.984  | 1714.681  | -3698.6      | 8348.8       | 2691.9       | -29.54           | 15.34            | -4.29            |
| 260.0       | 2746.965  | 1389.886  | 1716.888  | -3847.8      | 8426.3       | 2671.0       | -29.85           | 15.81            | -4.12            |
| 265.0       | 2743.737  | 1396.853  | 1719.077  | -3997.8      | 8505.3       | 2650.6       | -29.94           | 16.04            | -4.06            |
| 270.0       | 2740.385  | 1403.885  | 1721.250  | -4148.4      | 8585.2       | 2630.2       | -30.24           | 16.28            | -4.04            |
| 275.0       | 2736.909  | 1410.983  | 1723.406  | -4300.7      | 8666.8       | 2610.2       | -30.46           | 16.58            | -3.99            |
| 280.0       | 2733.307  | 1418.148  | 1725.546  | -4454.0      | 8749.2       | 2590.2       | -30.67           | 16.73            | -4.00            |
| 285.0       | 2729.578  | 1425.383  | 1727.669  | -4608.5      | 8833.1       | 2570.3       | -30.90           | 17.04            | -3.93            |
| 290.0       | 2725.722  | 1432.686  | 1729.776  | -4764.0      | 8917.4       | 2552.2       | -31.22           | 16.95            | -3.13            |
| 295.0       | 2721.737  | 1440.059  | 1731.871  | -4920.8      | 9001.2       | 2537.8       | -31.27           | 17.14            | -3.01            |
| 300.0       | 2717.624  | 1447.501  | 1733.952  | -5077.9      | 9088.5       | 2520.6       | -31.39           | 17.90            | -3.83            |
| 305.0       | 2713.380  | 1455.017  | 1736.018  | -5235.9      | 9178.5       | 2500.9       | -31.65           | 18.29            | -3.89            |
| 310.0       | 2709.006  | 1462.607  | 1738.069  | -5395.4      | 9269.6       | 2482.5       | -31.98           | 18.53            | -3.48            |
| 315.0       | 2704.500  | 1470.273  | 1740.104  | -5556.3      | 9362.2       | 2465.1       | -32.18           | 18.83            | -3.59            |
| 320.0       | 2699.861  | 1478.016  | 1742.125  | -5718.6      | 9456.8       | 2447.0       | -32.56           | 19.18            | -3.64            |
| 325.0       | 2695.088  | 1485.837  | 1744.132  | -5882.6      | 9552.8       | 2429.0       | -32.84           | 19.49            | -3.53            |
| 330.0       | 2690.179  | 1493.738  | 1746.123  | -6048.0      | 9650.0       | 2411.4       | -33.13           | 19.75            | -3.55            |
| 335.0       | 2685.134  | 1501.720  | 1748.100  | -6214.2      | 9748.3       | 2393.7       | -33.32           | 20.02            | -3.47            |
| 340.0       | 2679.951  | 1509.783  | 1750.063  | -6382.3      | 9849.2       | 2376.7       | -33.61           | 20.47            | -3.38            |
| 345.0       | 2674.630  | 1517.929  | 1752.012  | -6551.4      | 9951.4       | 2359.8       | -33.84           | 20.82            | -3.32            |
| 350.0       | 2669.169  | 1526.161  | 1753.947  | -6721.9      | 10055.3      | 2343.5       | -34.12           | 21.08            | -3.22            |
| 355.0       | 2663.567  | 1534.479  | 1755.869  | -6893.7      | 10160.7      | 2327.6       | -34.47           | 21.46            | -3.14            |
| 360.0       | 2657.823  | 1542.884  | 1757.778  | -7067.5      | 10268.3      | 2311.8       | -34.84           | 21.89            | -3.13            |
| 365.0       | 2651.935  | 1551.379  | 1759.674  | -7242.8      | 10378.2      | 2296.4       | -35.29           | 22.52            | -2.97            |
| 370.0       | 2645.902  | 1559.965  | 1761.557  | -7420.3      | 10490.2      | 2281.6       | -35.74           | 22.58            | -2.91            |
| 375.0       | 2639.722  | 1568.644  | 1763.429  | -7600.2      | 10604.2      | 2266.9       | -35.94           | 23.35            | -2.96            |
| 380.0       | 2633.393  | 1577.418  | 1765.288  | -7782.1      | 10720.5      | 2252.3       | -36.57           | 23.66            | -2.85            |
| 385.0       | 2626.914  | 1586.288  | 1767.136  | -7966.3      | 10838.9      | 2237.9       | -36.95           | 24.04            | -2.87            |
| 390.0       | 2620.282  | 1595.257  | 1768.971  | -8152.4      | 10958.9      | 2223.7       | -37.31           | 24.31            | -2.83            |
| 395.0       | 2613.496  | 1604.325  | 1770.795  | -8340.4      | 11081.0      | 2209.8       | -37.73           | 24.81            | -2.77            |
| 400.0       | 2606.555  | 1613.494  | 1772.608  | -8530.3      | 11205.4      | 2196.2       | -38.07           | 25.26            | -2.63            |
| 405.0       | 2599.456  | 1622.767  | 1774.410  | -8722.8      | 11332.5      | 2183.3       | -38.64           | 25.83            | -2.56            |
| 410.0       | 2592.199  | 1632.146  | 1776.201  | -8917.2      | 11461.6      | 2170.6       | -39.04           | 26.18            | -2.53            |
| 415.0       | 2584.780  | 1641.631  | 1777.983  | -9113.8      | 11593.2      | 2158.4       | -39.51           | 26.77            | -2.37            |
| 420.0       | 2577.199  | 1651.226  | 1779.754  | -9312.9      | 11727.4      | 2146.3       | -40.00           | 27.29            | -2.41            |
| 425.0       | 2569.452  | 1660.933  | 1781.515  | -9514.5      | 11864.4      | 2134.6       | -40.48           | 27.82            | -2.28            |
| 430.0       | 2561.539  | 1670.753  | 1783.267  | -9719.2      | 12004.1      | 2123.5       | -41.19           | 28.46            | -2.21            |
| 435.0       | 2553.456  | 1680.690  | 1785.010  | -9927.1      | 12147.4      | 2112.7       | -41.72           | 29.12            | -2.11            |
| 440.0       | 2545.201  | 1690.746  | 1786.744  | -10137.6     | 12293.7      | 2102.3       | -42.40           | 29.78            | -2.04            |
| 445.0       | 2536.770  | 1700.924  | 1788.470  | -10352.3     | 12443.6      | 2092.6       | -43.18           | 30.38            | -1.90            |
| 450.0       | 2528.163  | 1711.226  | 1790.188  | -10569.3     | 12595.2      | 2083.1       | -43.74           | 30.86            | -1.84            |

TABLE XV  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC           | XSP<br>NM | YSP<br>NM | ZSP<br>NM | DXSP<br>FT/S | DYSP<br>FT/S | DZSP<br>FT/S | DDXSP<br>FT/S SQ | DDYSP<br>FT/S SQ | DDZSP<br>FT/S SQ |
|-----------------------|-----------|-----------|-----------|--------------|--------------|--------------|------------------|------------------|------------------|
| 455.0                 | 2519.374  | 1721.654  | 1791.899  | -10790.1     | 12750.8      | 2074.1       | -44.38           | 31.65            | -1.79            |
| 460.0                 | 2510.403  | 1732.212  | 1793.602  | -11014.3     | 12910.1      | 2065.1       | -45.10           | 32.35            | -1.75            |
| 465.0                 | 2501.247  | 1742.902  | 1795.297  | -11241.8     | 13072.7      | 2056.7       | -45.83           | 33.01            | -1.69            |
| 470.0                 | 2491.901  | 1753.728  | 1796.986  | -11472.9     | 13238.2      | 2048.2       | -46.54           | 33.62            | -1.69            |
| 475.0                 | 2482.364  | 1764.691  | 1798.668  | -11707.9     | 13407.9      | 2040.3       | -47.34           | 34.51            | -1.52            |
| 480.0                 | 2472.631  | 1775.795  | 1800.344  | -11947.0     | 13581.6      | 2033.1       | -48.23           | 35.24            | -1.42            |
| 485.0                 | 2462.700  | 1787.044  | 1802.014  | -12192.7     | 13758.3      | 2024.6       | -50.10           | 35.77            | -2.03            |
| 490.0                 | 2452.562  | 1798.439  | 1803.676  | -12448.6     | 13937.6      | 2013.4       | -51.68           | 36.10            | -2.34            |
| 495.0                 | 2442.211  | 1809.982  | 1805.328  | -12709.6     | 14117.9      | 2001.2       | -52.56           | 36.20            | -2.61            |
| 500.0                 | 2431.644  | 1821.673  | 1806.969  | -12972.6     | 14295.5      | 1986.6       | -52.80           | 35.56            | -3.10            |
| 505.0                 | 2420.860  | 1833.510  | 1808.597  | -13238.2     | 14472.2      | 1970.5       | -52.87           | 34.74            | -3.59            |
| 510.0                 | 2409.857  | 1845.490  | 1810.210  | -13502.8     | 14643.7      | 1950.8       | -52.74           | 34.30            | -4.24            |
| 515.0                 | 2398.638  | 1857.609  | 1811.807  | -13765.1     | 14811.5      | 1929.3       | -52.39           | 33.69            | -4.08            |
| 520.0                 | 2387.202  | 1869.867  | 1813.386  | -14028.7     | 14981.4      | 1910.2       | -52.56           | 34.10            | -3.71            |
| 525.0                 | 2375.550  | 1882.265  | 1814.951  | -14290.9     | 15150.5      | 1892.8       | -52.30           | 33.98            | -3.18            |
| 530.0                 | 2363.682  | 1894.802  | 1816.502  | -14553.1     | 15321.9      | 1878.2       | -52.34           | 34.88            | -2.72            |
| 535.0                 | 2351.599  | 1907.483  | 1818.043  | -14813.3     | 15498.3      | 1866.6       | -51.68           | 36.03            | -1.89            |
| 540.0                 | 2339.304  | 1920.311  | 1819.576  | -15069.7     | 15681.5      | 1860.4       | -50.80           | 37.63            | -0.63            |
| 545.0                 | 2326.798  | 1933.293  | 1821.106  | -15325.1     | 15872.3      | 1858.7       | -51.37           | 38.67            | -0.32            |
| 550.0                 | 2314.080  | 1946.433  | 1822.634  | -15589.5     | 16064.7      | 1854.0       | -54.86           | 38.65            | -1.74            |
| 555.0                 | 2301.136  | 1959.732  | 1824.155  | -15871.8     | 16257.7      | 1842.5       | -57.57           | 38.92            | -2.74            |
| 560.0                 | 2287.956  | 1973.190  | 1825.665  | -16163.5     | 16453.9      | 1827.8       | -58.88           | 39.94            | -2.94            |
| 565.0                 | 2274.533  | 1986.813  | 1827.163  | -16460.6     | 16655.7      | 1813.9       | -59.80           | 41.06            | -2.57            |
| 570.0                 | 2260.864  | 2000.603  | 1828.651  | -16764.1     | 16861.9      | 1800.9       | -61.73           | 41.62            | -2.85            |
| 575.0                 | 2246.939  | 2014.565  | 1830.126  | -17080.5     | 17071.3      | 1783.9       | -64.62           | 42.30            | -3.99            |
| 580.0                 | 2232.750  | 2028.700  | 1831.585  | -17407.3     | 17285.4      | 1763.4       | -65.73           | 44.04            | -3.87            |
| 585.0                 | 2218.290  | 2043.015  | 1833.029  | -17739.6     | 17507.6      | 1744.9       | -67.66           | 45.05            | -3.67            |
| 590.0                 | 2203.552  | 2057.514  | 1834.457  | -18081.2     | 17735.3      | 1727.6       | -68.66           | 46.67            | -3.14            |
| S-IVB GUIDANCE CUTOFF |           |           |           |              |              |              |                  |                  |                  |
| 593.340               | 2193.551  | 2067.306  | 1835.404  | -18309.1     | 17894.0      | 1718.9       | -67.46           | 48.52            | -2.29            |
| 595.0                 | 2188.541  | 2072.195  | 1835.871  | -18354.5     | 17883.4      | 1696.4       | -19.34           | -17.12           | -15.74           |
| 600.0                 | 2173.398  | 2086.875  | 1837.234  | -18450.0     | 17794.2      | 1616.8       | -18.80           | -17.93           | -15.98           |
| ORBIT INSERTION       |           |           |           |              |              |              |                  |                  |                  |
| 603.340               | 2163.239  | 2096.639  | 1838.108  | -18512.9     | 17733.9      | 1563.5       | -18.71           | -18.01           | -15.99           |
| 605.0                 | 2158.178  | 2101.482  | 1838.529  | -18543.9     | 17703.6      | 1537.0       | -18.66           | -18.06           | -15.99           |
| 610.0                 | 2142.880  | 2116.013  | 1839.761  | -18637.4     | 17612.4      | 1457.1       | -18.65           | -18.07           | -15.99           |
| 620.0                 | 2112.053  | 2144.848  | 1842.027  | -18822.9     | 17428.7      | 1297.0       | -18.38           | -18.33           | -16.01           |
| 630.0                 | 2080.924  | 2173.379  | 1844.030  | -19005.8     | 17242.5      | 1136.8       | -18.10           | -18.59           | -16.03           |



TABLE XV  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>NM | YSP<br>NM | ZSP<br>NM | DXSP<br>FT/S | DYSP<br>FT/S | DZSP<br>FT/S | DDXSP<br>FT/S SC | DDYSP<br>FT/S SC | DCZSP<br>FT/S SC |
|-------------|-----------|-----------|-----------|--------------|--------------|--------------|------------------|------------------|------------------|
| 640.0       | 2049.496  | 2201.602  | 1845.769  | -19185.7     | 17053.6      | 976.4        | -17.73           | -18.92           | -16.05           |
| 650.0       | 2017.775  | 2229.511  | 1847.244  | -19362.0     | 16861.5      | 815.8        | -17.45           | -19.17           | -16.06           |
| 660.0       | 1985.766  | 2257.101  | 1848.454  | -19535.5     | 16667.0      | 655.1        | -17.18           | -19.40           | -16.08           |
| 670.0       | 1953.474  | 2284.370  | 1849.400  | -19706.2     | 16470.1      | 494.3        | -16.90           | -19.64           | -16.08           |
| 680.0       | 1920.903  | 2311.313  | 1850.081  | -19874.2     | 16270.9      | 333.5        | -16.62           | -19.87           | -16.09           |
| 690.0       | 1888.058  | 2337.926  | 1850.498  | -20039.3     | 16069.3      | 172.6        | -16.34           | -20.10           | -16.09           |
| 700.0       | 1854.944  | 2364.205  | 1850.649  | -20201.5     | 15865.5      | 11.6         | -16.05           | -20.33           | -16.09           |
| 710.0       | 1821.565  | 2390.147  | 1850.536  | -20360.8     | 15659.4      | -149.3       | -15.76           | -20.55           | -16.09           |
| 720.0       | 1787.927  | 2415.748  | 1850.158  | -20517.2     | 15451.1      | -310.2       | -15.47           | -20.77           | -16.09           |
| 730.0       | 1754.033  | 2441.004  | 1849.515  | -20670.7     | 15240.6      | -471.0       | -15.18           | -20.99           | -16.08           |
| 740.0       | 1719.889  | 2465.912  | 1848.608  | -20821.3     | 15027.9      | -631.8       | -14.89           | -21.21           | -16.07           |
| 750.0       | 1685.499  | 2490.469  | 1847.436  | -20968.8     | 14813.1      | -792.5       | -14.59           | -21.42           | -16.06           |
| 760.0       | 1650.870  | 2514.669  | 1845.999  | -21113.4     | 14596.1      | -953.0       | -14.29           | -21.63           | -16.05           |
| 770.0       | 1616.005  | 2538.512  | 1844.299  | -21255.0     | 14377.1      | -1113.5      | -13.99           | -21.83           | -16.03           |
| 780.0       | 1580.909  | 2561.992  | 1842.334  | -21393.5     | 14156.1      | -1273.7      | -13.69           | -22.03           | -16.02           |
| 790.0       | 1545.588  | 2585.106  | 1840.106  | -21529.0     | 13933.0      | -1433.8      | -13.39           | -22.23           | -16.00           |
| 800.0       | 1510.047  | 2607.852  | 1837.615  | -21661.3     | 13708.0      | -1593.6      | -13.08           | -22.43           | -15.97           |
| 810.0       | 1474.290  | 2630.226  | 1834.861  | -21790.6     | 13481.0      | -1753.3      | -12.77           | -22.62           | -15.95           |
| 820.0       | 1438.323  | 2652.225  | 1831.844  | -21916.8     | 13252.1      | -1912.6      | -12.46           | -22.81           | -15.92           |
| 830.0       | 1402.151  | 2673.845  | 1828.565  | -22039.9     | 13021.3      | -2071.7      | -12.15           | -23.00           | -15.89           |
| 840.0       | 1365.779  | 2695.085  | 1825.025  | -22159.8     | 12788.7      | -2230.5      | -11.84           | -23.18           | -15.86           |
| 850.0       | 1329.212  | 2715.940  | 1821.224  | -22276.5     | 12554.3      | -2389.0      | -11.52           | -23.36           | -15.83           |
| 860.0       | 1292.456  | 2736.407  | 1817.162  | -22390.1     | 12318.1      | -2547.1      | -11.20           | -23.54           | -15.79           |
| 870.0       | 1255.515  | 2756.484  | 1812.840  | -22500.4     | 12080.1      | -2704.8      | -10.89           | -23.71           | -15.75           |
| 880.0       | 1218.395  | 2776.169  | 1808.259  | -22607.6     | 11840.4      | -2862.1      | -10.57           | -23.88           | -15.71           |
| 890.0       | 1181.102  | 2795.457  | 1803.419  | -22711.5     | 11599.1      | -3019.1      | -10.24           | -24.04           | -15.67           |
| 900.0       | 1143.640  | 2814.347  | 1798.322  | -22812.2     | 11356.1      | -3175.5      | -9.92            | -24.21           | -15.63           |
| 910.0       | 1106.016  | 2832.836  | 1792.967  | -22909.6     | 11111.5      | -3331.6      | -9.60            | -24.37           | -15.58           |
| 920.0       | 1068.234  | 2850.920  | 1787.356  | -23003.7     | 10865.3      | -3487.1      | -9.27            | -24.52           | -15.53           |
| 930.0       | 1030.299  | 2868.599  | 1781.489  | -23094.6     | 10617.6      | -3642.1      | -8.95            | -24.67           | -15.48           |
| 940.0       | 992.218   | 2885.868  | 1775.368  | -23182.1     | 10368.4      | -3796.6      | -8.62            | -24.82           | -15.42           |
| 950.0       | 953.995   | 2902.726  | 1768.992  | -23266.4     | 10117.7      | -3950.6      | -8.29            | -24.97           | -15.37           |
| 960.0       | 915.637   | 2919.171  | 1762.364  | -23347.3     | 9865.6       | -4104.0      | -7.96            | -25.11           | -15.31           |
| 970.0       | 877.148   | 2935.199  | 1755.484  | -23424.9     | 9612.2       | -4256.7      | -7.63            | -25.24           | -15.25           |
| 980.0       | 838.534   | 2950.809  | 1748.353  | -23499.2     | 9357.3       | -4408.9      | -7.29            | -25.38           | -15.18           |
| 990.0       | 799.800   | 2965.999  | 1740.972  | -23570.1     | 9101.2       | -4560.4      | -6.96            | -25.51           | -15.12           |
| 1000.0      | 760.953   | 2980.766  | 1733.343  | -23637.6     | 8843.7       | -4711.3      | -6.63            | -25.63           | -15.05           |
| 1010.0      | 721.997   | 2995.108  | 1725.465  | -23701.8     | 8585.1       | -4861.4      | -6.29            | -25.76           | -14.98           |
| 1020.0      | 682.938   | 3009.023  | 1717.341  | -23762.6     | 8325.2       | -5010.9      | -5.95            | -25.88           | -14.91           |
| 1030.0      | 643.782   | 3022.510  | 1708.972  | -23820.0     | 8064.1       | -5159.7      | -5.62            | -25.99           | -14.84           |
| 1040.0      | 604.535   | 3035.567  | 1700.358  | -23874.0     | 7801.9       | -5307.7      | -5.28            | -26.10           | -14.76           |
| 1050.0      | 565.201   | 3048.190  | 1691.502  | -23924.6     | 7538.7       | -5454.9      | -4.94            | -26.21           | -14.68           |
| 1060.0      | 525.787   | 3060.380  | 1682.403  | -23971.8     | 7274.3       | -5601.3      | -4.60            | -26.31           | -14.60           |
| 1070.0      | 486.298   | 3072.134  | 1673.065  | -24015.5     | 7009.0       | -5747.0      | -4.26            | -26.41           | -14.52           |

TABLE XV  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>NM | YSP<br>NM | ZSP<br>NM | DXSP<br>FT/S | DYSP<br>FT/S | DZSP<br>FT/S | DDXSP<br>FT/S SQ | DDYSP<br>FT/S SQ | DDZSP<br>FT/S SQ |
|-------------|-----------|-----------|-----------|--------------|--------------|--------------|------------------|------------------|------------------|
| 1080.0      | 446.740   | 3083.450  | 1663.487  | -24055.9     | 6742.7       | -5891.7      | -3.92            | -26.51           | -14.44           |
| 1090.0      | 407.118   | 3094.327  | 1653.672  | -24092.8     | 6475.4       | -6035.7      | -3.58            | -26.60           | -14.35           |
| 1100.0      | 367.439   | 3104.764  | 1643.621  | -24126.3     | 6207.3       | -6178.8      | -3.24            | -26.69           | -14.26           |
| 1110.0      | 327.707   | 3114.759  | 1633.335  | -24156.3     | 5938.2       | -6320.9      | -2.90            | -26.78           | -14.17           |
| 1120.0      | 287.928   | 3124.310  | 1622.816  | -24182.9     | 5668.4       | -6462.2      | -2.56            | -26.86           | -14.08           |
| 1130.0      | 248.109   | 3133.416  | 1612.065  | -24206.1     | 5397.8       | -6602.5      | -2.21            | -26.93           | -13.99           |
| 1140.0      | 208.254   | 3142.076  | 1601.083  | -24225.8     | 5126.4       | -6741.9      | -1.87            | -27.01           | -13.89           |
| 1150.0      | 168.369   | 3150.290  | 1589.874  | -24242.1     | 4854.3       | -6880.3      | -1.53            | -27.08           | -13.79           |
| 1160.0      | 128.461   | 3158.054  | 1578.437  | -24254.9     | 4581.5       | -7017.7      | -1.18            | -27.14           | -13.69           |
| 1170.0      | 88.534    | 3165.370  | 1566.775  | -24264.3     | 4308.1       | -7154.1      | -0.84            | -27.20           | -13.59           |
| 1180.0      | 48.595    | 3172.235  | 1554.889  | -24270.2     | 4034.2       | -7289.4      | -0.50            | -27.26           | -13.48           |
| 1190.0      | 8.649     | 3178.648  | 1542.782  | -24272.6     | 3759.7       | -7423.7      | -0.15            | -27.31           | -13.38           |
| 1200.0      | -31.298   | 3184.610  | 1530.454  | -24271.6     | 3484.6       | -7557.0      | 0.19             | -27.36           | -13.27           |
| 1210.0      | -71.241   | 3190.118  | 1517.908  | -24267.2     | 3209.1       | -7689.1      | 0.53             | -27.41           | -13.16           |
| 1220.0      | -111.173  | 3195.172  | 1505.146  | -24259.3     | 2933.2       | -7820.1      | 0.87             | -27.45           | -13.05           |
| 1230.0      | -151.090  | 3199.773  | 1492.168  | -24247.9     | 2656.9       | -7950.0      | 1.22             | -27.49           | -12.93           |
| 1240.0      | -190.985  | 3203.918  | 1478.978  | -24233.1     | 2380.2       | -8078.8      | 1.56             | -27.52           | -12.82           |
| 1250.0      | -230.853  | 3207.607  | 1465.577  | -24214.9     | 2103.2       | -8206.4      | 1.90             | -27.55           | -12.70           |
| 1260.0      | -270.688  | 3210.840  | 1451.967  | -24193.2     | 1826.0       | -8332.8      | 2.24             | -27.58           | -12.58           |
| 1270.0      | -310.485  | 3213.617  | 1438.149  | -24168.1     | 1548.5       | -8458.0      | 2.59             | -27.60           | -12.46           |
| 1280.0      | -350.238  | 3215.937  | 1424.127  | -24139.5     | 1270.8       | -8582.0      | 2.93             | -27.62           | -12.34           |
| 1290.0      | -389.941  | 3217.800  | 1409.902  | -24107.5     | 993.0        | -8704.8      | 3.27             | -27.63           | -12.21           |
| 1300.0      | -429.588  | 3219.206  | 1395.475  | -24072.1     | 715.0        | -8826.3      | 3.61             | -27.64           | -12.09           |
| 1310.0      | -469.174  | 3220.154  | 1380.850  | -24033.3     | 437.0        | -8946.5      | 3.95             | -27.65           | -11.96           |
| 1320.0      | -508.693  | 3220.644  | 1366.028  | -23991.1     | 159.0        | -9065.4      | 4.28             | -27.65           | -11.83           |
| 1330.0      | -548.140  | 3220.677  | 1351.011  | -23945.4     | -119.1       | -9183.1      | 4.62             | -27.65           | -11.70           |
| 1340.0      | -587.510  | 3220.252  | 1335.802  | -23896.4     | -397.1       | -9299.4      | 4.96             | -27.64           | -11.56           |
| 1350.0      | -626.795  | 3219.370  | 1320.402  | -23844.0     | -675.0       | -9414.4      | 5.30             | -27.63           | -11.43           |
| 1360.0      | -665.992  | 3218.030  | 1304.815  | -23788.2     | -952.8       | -9528.0      | 5.63             | -27.62           | -11.29           |
| 1370.0      | -705.094  | 3216.234  | 1289.041  | -23729.0     | -1230.4      | -9640.2      | 5.97             | -27.60           | -11.16           |
| 1380.0      | -744.096  | 3213.981  | 1273.084  | -23666.5     | -1507.8      | -9751.1      | 6.30             | -27.58           | -11.02           |
| 1390.0      | -782.992  | 3211.271  | 1256.945  | -23600.6     | -1785.0      | -9860.6      | 6.63             | -27.55           | -10.88           |
| 1400.0      | -821.777  | 3208.105  | 1240.628  | -23531.3     | -2061.8      | -9968.6      | 6.97             | -27.52           | -10.73           |
| 1410.0      | -860.446  | 3204.484  | 1224.133  | -23458.8     | -2338.4      | -10075.3     | 7.30             | -27.49           | -10.59           |
| 1420.0      | -898.992  | 3200.409  | 1207.465  | -23382.9     | -2614.6      | -10180.4     | 7.63             | -27.45           | -10.44           |
| 1430.0      | -937.411  | 3195.879  | 1190.625  | -23303.7     | -2890.4      | -10284.1     | 7.95             | -27.41           | -10.30           |
| 1440.0      | -975.696  | 3190.895  | 1173.615  | -23221.2     | -3165.7      | -10386.4     | 8.28             | -27.37           | -10.15           |
| 1450.0      | -1013.843 | 3185.459  | 1156.438  | -23135.4     | -3440.6      | -10487.1     | 8.61             | -27.32           | -10.00           |
| 1460.0      | -1051.846 | 3179.570  | 1139.096  | -23046.4     | -3714.9      | -10586.4     | 8.93             | -27.27           | -9.85            |
| 1470.0      | -1089.700 | 3173.231  | 1121.593  | -22954.1     | -3988.7      | -10684.1     | 9.26             | -27.21           | -9.70            |
| 1480.0      | -1127.400 | 3166.442  | 1103.930  | -22858.5     | -4261.9      | -10780.3     | 9.58             | -27.15           | -9.54            |
| 1490.0      | -1164.939 | 3159.203  | 1086.110  | -22759.7     | -4534.4      | -10874.9     | 9.90             | -27.08           | -9.39            |
| 1500.0      | -1202.313 | 3151.517  | 1068.135  | -22657.7     | -4806.3      | -10968.0     | 10.22            | -27.02           | -9.23            |
| 1510.0      | -1239.517 | 3143.383  | 1050.009  | -22552.5     | -5077.4      | -11059.5     | 10.54            | -26.94           | -9.07            |

TABLE XV  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>NM | YSP<br>NM | ZSP<br>NM | DXSP<br>FT/S | DYSP<br>FT/S | DZSP<br>FT/S | DDXSP<br>FT/S SQ | DDYSP<br>FT/S SQ | DDZSP<br>FT/S SQ |
|-------------|-----------|-----------|-----------|--------------|--------------|--------------|------------------|------------------|------------------|
| 1520.0      | -1276.545 | 3134.804  | 1031.733  | -22444.2     | -5347.8      | -11149.4     | 10.85            | -26.87           | -8.91            |
| 1530.0      | -1313.392 | 3125.781  | 1013.310  | -22332.6     | -5617.4      | -11237.8     | 11.17            | -26.79           | -8.75            |
| 1540.0      | -1350.053 | 3116.315  | 994.744   | -22217.9     | -5886.2      | -11324.5     | 11.48            | -26.70           | -8.59            |
| 1550.0      | -1386.522 | 3106.406  | 976.036   | -22100.1     | -6154.1      | -11409.6     | 11.79            | -26.62           | -8.43            |
| 1560.0      | -1422.795 | 3096.058  | 957.189   | -21979.1     | -6421.1      | -11493.1     | 12.10            | -26.52           | -8.26            |
| 1570.0      | -1458.867 | 3085.271  | 938.206   | -21855.1     | -6687.1      | -11574.9     | 12.40            | -26.43           | -8.10            |
| 1580.0      | -1494.731 | 3074.048  | 919.090   | -21728.0     | -6952.2      | -11655.0     | 12.71            | -26.33           | -7.93            |
| 1590.0      | -1530.384 | 3062.388  | 899.844   | -21597.8     | -7216.3      | -11733.6     | 13.01            | -26.23           | -7.77            |
| 1600.0      | -1565.820 | 3050.295  | 880.469   | -21464.6     | -7479.2      | -11810.4     | 13.32            | -26.12           | -7.60            |
| 1610.0      | -1601.035 | 3037.770  | 860.970   | -21328.3     | -7741.1      | -11885.5     | 13.61            | -26.01           | -7.43            |
| 1620.0      | -1636.022 | 3024.815  | 841.348   | -21189.1     | -8001.9      | -11959.0     | 13.91            | -25.90           | -7.26            |
| 1630.0      | -1670.778 | 3011.432  | 821.607   | -21046.8     | -8261.5      | -12030.7     | 14.21            | -25.78           | -7.09            |
| 1640.0      | -1705.298 | 2997.623  | 801.749   | -20901.7     | -8519.9      | -12100.7     | 14.50            | -25.66           | -6.92            |
| 1650.0      | -1739.576 | 2983.389  | 781.778   | -20753.5     | -8777.0      | -12169.0     | 14.79            | -25.53           | -6.74            |
| 1660.0      | -1773.608 | 2968.733  | 761.695   | -20602.5     | -9032.9      | -12235.5     | 15.08            | -25.41           | -6.57            |
| 1670.0      | -1807.389 | 2953.657  | 741.504   | -20448.6     | -9287.4      | -12300.3     | 15.37            | -25.28           | -6.39            |
| 1680.0      | -1840.915 | 2938.164  | 721.209   | -20291.8     | -9540.7      | -12363.4     | 15.65            | -25.14           | -6.22            |
| 1690.0      | -1874.180 | 2922.254  | 700.810   | -20132.1     | -9792.5      | -12424.7     | 15.94            | -25.00           | -6.04            |
| 1700.0      | -1907.180 | 2905.932  | 680.313   | -19969.6     | -10042.9     | -12484.2     | 16.21            | -24.86           | -5.86            |
| 1710.0      | -1939.910 | 2889.198  | 659.719   | -19804.4     | -10291.8     | -12541.9     | 16.49            | -24.71           | -5.68            |
| 1720.0      | -1972.366 | 2872.056  | 639.031   | -19636.3     | -10539.3     | -12597.9     | 16.77            | -24.56           | -5.51            |
| 1730.0      | -2004.543 | 2854.508  | 618.253   | -19465.5     | -10785.2     | -12652.0     | 17.04            | -24.41           | -5.33            |
| 1740.0      | -2036.436 | 2836.557  | 597.387   | -19292.0     | -11029.6     | -12704.4     | 17.31            | -24.25           | -5.14            |
| 1750.0      | -2068.042 | 2818.204  | 576.436   | -19115.7     | -11272.3     | -12754.9     | 17.58            | -24.10           | -4.96            |
| 1760.0      | -2099.356 | 2799.454  | 555.404   | -18936.8     | -11513.5     | -12803.7     | 17.84            | -23.93           | -4.78            |
| 1770.0      | -2130.373 | 2780.308  | 534.293   | -18755.3     | -11752.9     | -12850.6     | 18.11            | -23.77           | -4.60            |
| 1780.0      | -2161.089 | 2760.769  | 513.107   | -18571.1     | -11990.7     | -12895.6     | 18.36            | -23.60           | -4.42            |
| 1790.0      | -2191.500 | 2740.841  | 491.847   | -18384.4     | -12226.8     | -12938.9     | 18.62            | -23.42           | -4.23            |
| 1800.0      | -2221.601 | 2720.525  | 470.518   | -18195.0     | -12461.1     | -12980.3     | 18.88            | -23.25           | -4.05            |
| 1810.0      | -2251.388 | 2699.825  | 449.123   | -18003.1     | -12693.6     | -13019.9     | 19.13            | -23.07           | -3.86            |
| 1820.0      | -2280.858 | 2678.744  | 427.663   | -17808.7     | -12924.3     | -13057.6     | 19.38            | -22.89           | -3.68            |
| 1830.0      | -2310.006 | 2657.285  | 406.144   | -17611.9     | -13153.1     | -13093.4     | 19.62            | -22.70           | -3.49            |
| 1840.0      | -2338.828 | 2635.450  | 384.566   | -17412.5     | -13380.0     | -13127.4     | 19.87            | -22.51           | -3.31            |
| 1850.0      | -2367.319 | 2613.244  | 362.935   | -17210.8     | -13605.0     | -13159.6     | 20.11            | -22.32           | -3.12            |
| 1860.0      | -2395.477 | 2590.670  | 341.252   | -17006.6     | -13828.0     | -13189.8     | 20.34            | -22.12           | -2.93            |
| 1870.0      | -2423.297 | 2567.730  | 319.520   | -16800.1     | -14049.1     | -13218.2     | 20.58            | -21.92           | -2.75            |
| 1880.0      | -2450.775 | 2544.427  | 297.744   | -16591.3     | -14268.1     | -13244.8     | 20.81            | -21.72           | -2.56            |
| 1890.0      | -2477.907 | 2520.766  | 275.925   | -16380.1     | -14485.1     | -13269.4     | 21.04            | -21.52           | -2.37            |
| 1900.0      | -2504.690 | 2496.749  | 254.068   | -16166.7     | -14700.0     | -13292.2     | 21.26            | -21.31           | -2.18            |
| 1910.0      | -2531.119 | 2472.381  | 232.174   | -15951.0     | -14912.9     | -13313.1     | 21.48            | -21.10           | -1.99            |
| 1920.0      | -2557.192 | 2447.664  | 210.248   | -15733.1     | -15123.5     | -13332.1     | 21.70            | -20.89           | -1.81            |
| 1930.0      | -2582.905 | 2422.602  | 188.292   | -15513.0     | -15332.1     | -13349.2     | 21.92            | -20.67           | -1.62            |
| 1940.0      | -2608.253 | 2397.198  | 166.309   | -15290.7     | -15538.4     | -13364.4     | 22.13            | -20.45           | -1.43            |
| 1950.0      | -2633.234 | 2371.457  | 144.303   | -15066.4     | -15742.5     | -13377.7     | 22.34            | -20.23           | -1.24            |

TABLE XV  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>NM | YSP<br>NM | ZSP<br>NM | DXSP<br>FT/S | DYSP<br>FT/S | DZSP<br>FT/S | DDXSP<br>FT/S SQ | DDYSP<br>FT/S SQ | DDZSP<br>FT/S SQ |
|-------------|-----------|-----------|-----------|--------------|--------------|--------------|------------------|------------------|------------------|
| 1960.0      | -2657.844 | 2345.382  | 122.276   | -14840.0     | -15944.3     | -13389.2     | 22.55            | -20.01           | -1.05            |
| 1970.0      | -2682.080 | 2318.976  | 100.232   | -14611.5     | -16143.9     | -13398.7     | 22.75            | -19.78           | -0.86            |
| 1980.0      | -2705.938 | 2292.244  | 78.174    | -14380.9     | -16341.2     | -13406.3     | 22.95            | -19.55           | -0.67            |
| 1990.0      | -2729.415 | 2265.189  | 56.105    | -14148.4     | -16536.1     | -13412.1     | 23.15            | -19.32           | -0.48            |
| 2000.0      | -2752.508 | 2237.816  | 34.029    | -13914.0     | -16728.7     | -13416.0     | 23.34            | -19.08           | -0.29            |
| 2010.0      | -2775.213 | 2210.127  | 11.947    | -13677.6     | -16918.9     | -13417.9     | 23.53            | -18.84           | -0.10            |
| 2020.0      | -2797.527 | 2182.127  | -10.137   | -13439.3     | -17106.7     | -13418.0     | 23.72            | -18.60           | 0.09             |
| 2030.0      | -2819.448 | 2153.820  | -32.219   | -13199.2     | -17292.0     | -13416.2     | 23.90            | -18.36           | 0.28             |
| 2040.0      | -2840.973 | 2125.210  | -54.296   | -12957.3     | -17474.9     | -13412.5     | 24.08            | -18.11           | 0.47             |
| 2050.0      | -2862.097 | 2096.302  | -76.366   | -12713.5     | -17655.3     | -13406.9     | 24.26            | -17.87           | 0.66             |
| 2060.0      | -2882.819 | 2067.098  | -98.425   | -12468.1     | -17833.2     | -13399.4     | 24.43            | -17.62           | 0.84             |
| 2070.0      | -2903.136 | 2037.604  | -120.470  | -12220.9     | -18008.5     | -13390.0     | 24.60            | -17.36           | 1.03             |
| 2080.0      | -2923.044 | 2007.823  | -142.498  | -11972.0     | -18181.3     | -13378.7     | 24.76            | -17.11           | 1.22             |
| 2090.0      | -2942.542 | 1977.760  | -164.506  | -11721.5     | -18351.5     | -13365.6     | 24.92            | -16.85           | 1.41             |
| 2100.0      | -2961.626 | 1947.419  | -186.490  | -11469.4     | -18519.1     | -13350.5     | 25.08            | -16.59           | 1.60             |
| 2110.0      | -2980.293 | 1916.804  | -208.449  | -11215.7     | -18684.1     | -13333.6     | 25.24            | -16.33           | 1.79             |
| 2120.0      | -2998.542 | 1885.920  | -230.378  | -10960.5     | -18846.4     | -13314.8     | 25.39            | -16.06           | 1.97             |
| 2130.0      | -3016.370 | 1854.771  | -252.274  | -10703.8     | -19006.1     | -13294.1     | 25.54            | -15.80           | 2.16             |
| 2140.0      | -3033.774 | 1823.362  | -274.136  | -10445.6     | -19163.0     | -13271.6     | 25.68            | -15.53           | 2.35             |
| 2150.0      | -3050.751 | 1791.696  | -295.958  | -10186.0     | -19317.3     | -13247.2     | 25.82            | -15.26           | 2.53             |
| 2160.0      | -3067.301 | 1759.779  | -317.739  | -9925.0      | -19468.8     | -13220.9     | 25.96            | -14.99           | 2.72             |
| 2170.0      | -3083.419 | 1727.615  | -339.475  | -9662.6      | -19617.5     | -13192.8     | 26.09            | -14.71           | 2.90             |
| 2180.0      | -3099.105 | 1695.208  | -361.163  | -9398.9      | -19763.5     | -13162.8     | 26.22            | -14.43           | 3.09             |
| 2190.0      | -3114.356 | 1662.563  | -382.800  | -9134.0      | -19906.6     | -13131.0     | 26.35            | -14.16           | 3.27             |
| 2200.0      | -3129.170 | 1629.685  | -404.383  | -8867.8      | -20047.0     | -13097.3     | 26.47            | -13.87           | 3.46             |
| 2210.0      | -3143.544 | 1596.579  | -425.910  | -8600.4      | -20184.5     | -13061.8     | 26.59            | -13.59           | 3.64             |
| 2220.0      | -3157.478 | 1563.248  | -447.376  | -8331.9      | -20319.2     | -13024.5     | 26.70            | -13.31           | 3.83             |
| 2230.0      | -3170.969 | 1529.698  | -468.780  | -8062.2      | -20451.0     | -12985.3     | 26.81            | -13.02           | 4.01             |
| 2240.0      | -3184.015 | 1495.934  | -490.118  | -7791.4      | -20579.9     | -12944.3     | 26.92            | -12.73           | 4.19             |
| 2250.0      | -3196.615 | 1461.959  | -511.386  | -7519.6      | -20705.9     | -12901.6     | 27.02            | -12.45           | 4.37             |
| 2260.0      | -3208.766 | 1427.780  | -532.583  | -7246.8      | -20828.9     | -12856.9     | 27.12            | -12.15           | 4.55             |
| 2270.0      | -3220.467 | 1393.401  | -553.705  | -6973.0      | -20949.1     | -12810.5     | 27.22            | -11.86           | 4.73             |
| 2280.0      | -3231.717 | 1358.826  | -574.749  | -6698.3      | -21066.2     | -12762.3     | 27.31            | -11.57           | 4.91             |
| 2290.0      | -3242.515 | 1324.062  | -595.712  | -6422.6      | -21180.5     | -12712.4     | 27.40            | -11.27           | 5.09             |
| 2300.0      | -3252.858 | 1289.111  | -616.592  | -6146.2      | -21291.7     | -12660.6     | 27.48            | -10.97           | 5.27             |
| 2310.0      | -3262.745 | 1253.980  | -637.385  | -5868.8      | -21399.9     | -12607.0     | 27.56            | -10.68           | 5.44             |
| 2320.0      | -3272.175 | 1218.673  | -658.088  | -5590.8      | -21505.1     | -12551.8     | 27.64            | -10.38           | 5.62             |
| 2330.0      | -3281.147 | 1183.196  | -678.699  | -5311.9      | -21607.3     | -12494.7     | 27.71            | -10.07           | 5.79             |
| 2340.0      | -3289.659 | 1147.553  | -699.214  | -5032.4      | -21706.5     | -12435.9     | 27.78            | -9.77            | 5.97             |
| 2350.0      | -3297.711 | 1111.749  | -719.631  | -4752.2      | -21802.5     | -12375.4     | 27.84            | -9.47            | 6.14             |
| 2360.0      | -3305.301 | 1075.790  | -739.948  | -4471.4      | -21895.6     | -12313.1     | 27.90            | -9.16            | 6.31             |
| 2370.0      | -3312.429 | 1039.680  | -760.160  | -4190.0      | -21985.5     | -12249.1     | 27.96            | -8.86            | 6.48             |
| 2380.0      | -3319.093 | 1003.424  | -780.266  | -3908.1      | -22072.4     | -12183.4     | 28.01            | -8.55            | 6.65             |
| 2390.0      | -3325.292 | 967.029   | -800.262  | -3625.6      | -22156.1     | -12116.0     | 28.06            | -8.24            | 6.82             |

TABLE XV  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>NM | YSP<br>NM | ZSP<br>NM | DXSP<br>FT/S | DYSP<br>FT/S | DZSP<br>FT/S | DDXSP<br>FT/S SQ | DDYSP<br>FT/S SQ | DDZSP<br>FT/S SQ |
|-------------|-----------|-----------|-----------|--------------|--------------|--------------|------------------|------------------|------------------|
| 2400.0      | -3331.026 | 930.497   | -820.145  | -3342.7      | -22236.8     | -12046.9     | 28.11            | -7.93            | 6.99             |
| 2410.0      | -3336.295 | 893.836   | -839.914  | -3059.4      | -22314.3     | -11976.2     | 28.15            | -7.62            | 7.16             |
| 2420.0      | -3341.096 | 857.050   | -859.565  | -2775.6      | -22388.7     | -11903.7     | 28.18            | -7.31            | 7.33             |
| 2430.0      | -3345.431 | 820.144   | -879.095  | -2491.6      | -22459.9     | -11829.6     | 28.22            | -7.00            | 7.49             |
| 2440.0      | -3349.297 | 783.123   | -898.502  | -2207.2      | -22528.0     | -11753.9     | 28.25            | -6.68            | 7.66             |
| 2450.0      | -3352.696 | 745.993   | -917.783  | -1922.5      | -22593.0     | -11676.5     | 28.27            | -6.37            | 7.82             |
| 2460.0      | -3355.625 | 708.759   | -936.935  | -1637.7      | -22654.7     | -11597.5     | 28.29            | -6.05            | 7.98             |
| 2470.0      | -3358.086 | 671.425   | -955.956  | -1352.6      | -22713.3     | -11516.9     | 28.31            | -5.74            | 8.14             |
| 2480.0      | -3360.077 | 633.998   | -974.843  | -1067.4      | -22768.7     | -11434.7     | 28.33            | -5.42            | 8.30             |
| 2490.0      | -3361.599 | 596.482   | -993.594  | -782.1       | -22821.0     | -11350.8     | 28.33            | -5.10            | 8.46             |
| 2500.0      | -3362.652 | 558.882   | -1012.205 | -496.7       | -22870.0     | -11265.5     | 28.34            | -4.78            | 8.62             |
| 2510.0      | -3363.234 | 521.205   | -1030.674 | -211.2       | -22915.8     | -11178.5     | 28.34            | -4.47            | 8.77             |
| 2520.0      | -3363.347 | 483.455   | -1048.999 | 74.2         | -22958.4     | -11090.0     | 28.34            | -4.15            | 8.93             |
| 2530.0      | -3362.990 | 445.637   | -1067.177 | 359.5        | -22997.9     | -10999.9     | 28.33            | -3.83            | 9.08             |
| 2540.0      | -3362.164 | 407.757   | -1085.205 | 644.8        | -23034.1     | -10908.3     | 28.32            | -3.51            | 9.23             |
| 2550.0      | -3360.868 | 369.821   | -1103.081 | 930.0        | -23067.0     | -10815.2     | 28.31            | -3.19            | 9.39             |
| 2560.0      | -3359.103 | 331.832   | -1120.803 | 1214.9       | -23096.8     | -10720.6     | 28.29            | -2.87            | 9.53             |
| 2570.0      | -3356.869 | 293.798   | -1138.368 | 1499.7       | -23123.3     | -10624.5     | 28.27            | -2.55            | 9.68             |
| 2580.0      | -3354.166 | 255.722   | -1155.774 | 1784.2       | -23146.6     | -10527.0     | 28.24            | -2.23            | 9.83             |
| 2590.0      | -3350.996 | 217.611   | -1173.018 | 2068.5       | -23166.6     | -10428.0     | 28.22            | -1.90            | 9.98             |
| 2600.0      | -3347.358 | 179.469   | -1190.098 | 2352.4       | -23183.5     | -10327.5     | 28.18            | -1.58            | 10.12            |
| 2610.0      | -3343.253 | 141.302   | -1207.011 | 2636.0       | -23197.1     | -10225.6     | 28.14            | -1.26            | 10.26            |
| 2620.0      | -3338.682 | 103.116   | -1223.755 | 2919.1       | -23207.4     | -10122.3     | 28.10            | -0.94            | 10.40            |
| 2630.0      | -3333.645 | 64.915    | -1240.328 | 3201.8       | -23214.5     | -10017.5     | 28.06            | -0.62            | 10.54            |
| 2640.0      | -3328.143 | 26.705    | -1256.728 | 3484.1       | -23218.4     | -9911.4      | 28.01            | -0.29            | 10.68            |
| 2650.0      | -3322.177 | -11.508   | -1272.952 | 3765.8       | -23219.0     | -9803.9      | 27.96            | 0.03             | 10.82            |
| 2660.0      | -3315.748 | -49.720   | -1288.997 | 4046.9       | -23216.4     | -9695.1      | 27.90            | 0.35             | 10.95            |
| 2670.0      | -3308.856 | -87.925   | -1304.863 | 4327.5       | -23210.6     | -9584.9      | 27.84            | 0.67             | 11.09            |
| 2680.0      | -3301.504 | -126.118  | -1320.546 | 4607.4       | -23201.5     | -9473.4      | 27.77            | 0.99             | 11.22            |
| 2690.0      | -3293.691 | -164.293  | -1336.045 | 4886.7       | -23189.2     | -9360.5      | 27.71            | 1.31             | 11.35            |
| 2700.0      | -3285.419 | -202.445  | -1351.356 | 5165.2       | -23173.7     | -9246.4      | 27.63            | 1.63             | 11.48            |
| 2710.0      | -3276.690 | -240.569  | -1366.479 | 5443.0       | -23154.9     | -9131.0      | 27.56            | 1.95             | 11.60            |
| 2720.0      | -3267.504 | -278.660  | -1381.411 | 5720.0       | -23133.0     | -9014.3      | 27.48            | 2.28             | 11.73            |
| 2730.0      | -3257.862 | -316.711  | -1396.150 | 5996.2       | -23107.8     | -8896.4      | 27.40            | 2.60             | 11.85            |
| 2740.0      | -3247.767 | -354.719  | -1410.694 | 6271.5       | -23079.3     | -8777.3      | 27.31            | 2.91             | 11.98            |
| 2750.0      | -3237.220 | -392.677  | -1425.040 | 6545.9       | -23047.7     | -8656.9      | 27.22            | 3.23             | 12.10            |
| 2760.0      | -3226.221 | -430.580  | -1439.188 | 6819.4       | -23012.9     | -8535.4      | 27.12            | 3.55             | 12.22            |
| 2770.0      | -3214.774 | -468.424  | -1453.134 | 7091.9       | -22974.8     | -8412.6      | 27.03            | 3.87             | 12.33            |
| 2780.0      | -3202.879 | -506.202  | -1466.878 | 7363.3       | -22933.6     | -8288.7      | 26.92            | 4.19             | 12.45            |
| 2790.0      | -3190.537 | -543.910  | -1480.417 | 7633.8       | -22889.2     | -8163.7      | 26.82            | 4.50             | 12.56            |
| 2800.0      | -3177.752 | -581.542  | -1493.749 | 7903.1       | -22841.6     | -8037.5      | 26.71            | 4.82             | 12.67            |
| 2810.0      | -3164.524 | -619.093  | -1506.872 | 8171.3       | -22790.8     | -7910.2      | 26.60            | 5.14             | 12.78            |
| 2820.0      | -3150.856 | -656.558  | -1519.785 | 8438.4       | -22736.8     | -7781.8      | 26.48            | 5.45             | 12.89            |
| 2830.0      | -3136.750 | -693.931  | -1532.486 | 8704.2       | -22679.7     | -7652.4      | 26.36            | 5.76             | 13.00            |

TABLE XV  
SPACE-FIXED EPHEMERIS POSITIONS, VELOCITIES AND ACCELERATIONS

| TIME<br>SEC | XSP<br>NM | YSP<br>NM | ZSP<br>NM | DXSP<br>FT/S | DYSP<br>FT/S | DZSP<br>FT/S | DDXSP<br>FT/S SQ | DDYSP<br>FT/S SQ | DDZSP<br>FT/S SQ |
|-------------|-----------|-----------|-----------|--------------|--------------|--------------|------------------|------------------|------------------|
| 2840.0      | -3122.206 | -731.208  | -1544.973 | 8968.8       | -22619.5     | -7521.9      | 26.24            | 6.08             | 13.10            |
| 2850.0      | -3107.229 | -768.383  | -1557.244 | 9232.2       | -22556.1     | -7390.3      | 26.11            | 6.39             | 13.21            |
| 2860.0      | -3091.819 | -805.451  | -1569.298 | 9494.2       | -22489.5     | -7257.8      | 25.98            | 6.70             | 13.31            |
| 2870.0      | -3075.979 | -842.407  | -1581.133 | 9754.9       | -22419.9     | -7124.2      | 25.84            | 7.01             | 13.41            |
| 2880.0      | -3059.710 | -879.246  | -1592.748 | 10014.2      | -22347.1     | -6989.6      | 25.70            | 7.32             | 13.50            |
| 2890.0      | -3043.017 | -915.963  | -1604.140 | 10272.1      | -22271.2     | -6854.1      | 25.56            | 7.63             | 13.60            |
| 2900.0      | -3025.900 | -952.552  | -1615.308 | 10528.6      | -22192.3     | -6717.6      | 25.42            | 7.93             | 13.69            |
| 2910.0      | -3008.362 | -989.009  | -1626.251 | 10783.6      | -22110.2     | -6580.3      | 25.27            | 8.24             | 13.78            |
| 2920.0      | -2990.405 | -1025.328 | -1636.967 | 11037.1      | -22025.1     | -6442.0      | 25.12            | 8.55             | 13.87            |
| 2930.0      | -2972.033 | -1061.504 | -1647.454 | 11289.0      | -21936.9     | -6302.8      | 24.96            | 8.85             | 13.96            |
| 2940.0      | -2953.248 | -1097.533 | -1657.712 | 11539.3      | -21845.7     | -6162.7      | 24.80            | 9.15             | 14.05            |
| 2950.0      | -2934.052 | -1133.409 | -1667.739 | 11788.0      | -21751.5     | -6021.8      | 24.64            | 9.45             | 14.13            |
| 2960.0      | -2914.448 | -1169.128 | -1677.533 | 12035.0      | -21654.2     | -5880.1      | 24.48            | 9.75             | 14.21            |
| 2970.0      | -2894.439 | -1204.684 | -1687.093 | 12280.4      | -21553.9     | -5737.5      | 24.31            | 10.05            | 14.30            |
| 2980.0      | -2874.027 | -1240.073 | -1696.418 | 12524.0      | -21450.7     | -5594.2      | 24.14            | 10.35            | 14.37            |
| 2990.0      | -2853.216 | -1275.289 | -1705.506 | 12765.9      | -21344.4     | -5450.0      | 23.96            | 10.64            | 14.45            |
| 3000.0      | -2832.008 | -1310.328 | -1714.357 | 13006.0      | -21235.2     | -5305.2      | 23.78            | 10.94            | 14.52            |
| 3010.0      | -2810.406 | -1345.185 | -1722.968 | 13244.3      | -21123.1     | -5159.6      | 23.60            | 11.23            | 14.60            |
| 3020.0      | -2788.414 | -1379.854 | -1731.340 | 13480.7      | -21008.0     | -5013.3      | 23.41            | 11.52            | 14.67            |
| 3030.0      | -2766.035 | -1414.332 | -1739.469 | 13715.2      | -20890.0     | -4866.3      | 23.23            | 11.81            | 14.73            |
| 3040.0      | -2743.271 | -1448.614 | -1747.357 | 13947.8      | -20769.1     | -4718.6      | 23.04            | 12.10            | 14.80            |
| 3050.0      | -2720.125 | -1482.694 | -1755.001 | 14178.5      | -20645.3     | -4570.3      | 22.84            | 12.38            | 14.86            |
| 3060.0      | -2696.602 | -1516.568 | -1762.400 | 14407.2      | -20518.7     | -4421.3      | 22.64            | 12.66            | 14.93            |
| 3070.0      | -2672.704 | -1550.232 | -1769.553 | 14633.9      | -20389.2     | -4271.7      | 22.44            | 12.95            | 14.99            |
| 3080.0      | -2648.435 | -1583.679 | -1776.460 | 14858.5      | -20256.9     | -4121.6      | 22.24            | 13.23            | 15.04            |
| 3090.0      | -2623.797 | -1616.907 | -1783.120 | 15081.1      | -20121.8     | -3970.8      | 22.03            | 13.51            | 15.10            |
| 3100.0      | -2573.432 | -1682.684 | -1795.692 | 15301.6      | -19983.9     | -3819.6      | 21.82            | 13.78            | 15.15            |
| 3120.0      | -2547.711 | -1715.224 | -1801.603 | 15519.9      | -19843.2     | -3667.8      | 21.61            | 14.06            | 15.21            |
| 3130.0      | -2521.637 | -1747.526 | -1807.263 | 15736.1      | -19699.8     | -3515.4      | 21.39            | 14.33            | 15.26            |
| 3140.0      | -2495.212 | -1779.585 | -1812.671 | 15950.0      | -19553.6     | -3362.7      | 21.17            | 14.60            | 15.30            |
| 3150.0      | -2468.440 | -1811.397 | -1817.826 | 16161.8      | -19404.7     | -3209.4      | 20.95            | 14.87            | 15.35            |
| 3160.0      | -2441.326 | -1842.957 | -1822.729 | 16371.3      | -19253.1     | -3055.7      | 20.73            | 15.14            | 15.39            |
| 3170.0      | -2413.872 | -1874.261 | -1827.377 | 16578.5      | -19098.9     | -2901.6      | 20.50            | 15.40            | 15.43            |
| 3180.0      | -2386.083 | -1905.304 | -1831.771 | 16783.4      | -18942.0     | -2747.0      | 20.27            | 15.67            | 15.47            |
| 3190.0      | -2357.963 | -1936.083 | -1835.909 | 16986.0      | -18782.5     | -2592.1      | 20.04            | 15.93            | 15.51            |
| 3200.0      | -2329.514 | -1966.593 | -1839.791 | 17186.3      | -18620.3     | -2436.8      | 19.80            | 16.18            | 15.54            |
| 3210.0      | -2300.743 | -1996.830 | -1843.418 | 17384.1      | -18455.6     | -2281.2      | 19.57            | 16.44            | 15.58            |
| 3220.0      | -2271.651 | -2026.789 | -1846.787 | 17579.5      | -18288.3     | -2125.3      | 19.32            | 16.70            | 15.61            |
| 3230.0      | -2242.245 | -2056.467 | -1849.899 | 17772.5      | -18118.5     | -1969.1      | 19.08            | 16.95            | 15.64            |
|             |           |           |           | 17963.0      | -17946.2     | -1812.6      | 18.83            | 17.20            | 15.66            |
| 3235.242    | -2226.705 | -2071.910 | -1851.427 | 18061.9      | -17854.8     | -1730.4      | 18.70            | 17.33            | 15.68            |

S-IVB/LM SEPARATION

TABLE XVI  
GEOGRAPHIC COORDINATES

| TIME<br>SEC                | EC DIST<br>NM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>FT/S | HEAD<br>DEG | FLI-PATH<br>DEG | SF VEL<br>FT/S | RANGE<br>NM | ALTITUDE<br>FT |
|----------------------------|---------------|-------------|---------------|---------------|-----------------|----------------|-------------|-----------------|----------------|-------------|----------------|
| GUIDANCE REFERENCE RELEASE |               |             |               |               |                 |                |             |                 |                |             |                |
| -4.956                     | 3441.335      | -80.5650    | 28.3707       | 0.00          | 90.00           | 0.0            | 90.00       | 0.00            | 1341.6         | 0.000       | 111            |
| -4.0                       | 3441.335      | -80.5650    | 28.3707       | 0.00          | 90.00           | 0.0            | 90.00       | 0.00            | 1341.6         | 0.000       | 112            |
| -3.0                       | 3441.335      | -80.5650    | 28.3707       | 0.00          | 90.00           | 0.0            | 90.00       | 0.00            | 1341.6         | 0.000       | 112            |
| -2.0                       | 3441.335      | -80.5650    | 28.3707       | 0.00          | 90.00           | 0.0            | 90.00       | 0.00            | 1341.6         | 0.000       | 112            |
| -1.0                       | 3441.335      | -80.5650    | 28.3707       | 0.00          | 90.00           | 0.0            | 90.00       | 0.00            | 1341.6         | 0.000       | 112            |
| RANGE ZERO AT 17 48 08 EST |               |             |               |               |                 |                |             |                 |                |             |                |
| 0.000                      | 3441.335      | -80.5650    | 28.3707       | 0.00          | 90.00           | 0.0            | 90.00       | 0.00            | 1341.6         | 0.000       | 111            |
| FIRST MOTION               |               |             |               |               |                 |                |             |                 |                |             |                |
| 0.200                      | 3441.335      | -80.5650    | 28.3707       | 0.00          | 90.00           | 0.0            | 90.00       | 0.00            | 1341.6         | 0.000       | 112            |
| LIFTOFF                    |               |             |               |               |                 |                |             |                 |                |             |                |
| 0.360                      | 3441.335      | -80.5650    | 28.3707       | 109.02        | 89.51           | 1.2            | 90.00       | 0.05            | 1341.7         | 0.000       | 114            |
| 1.0                        | 3441.336      | -80.5650    | 28.3707       | 102.54        | 89.66           | 6.3            | 90.00       | 0.27            | 1341.7         | -0.000      | 116            |
| 2.0                        | 3441.337      | -80.5650    | 28.3707       | 80.81         | 89.81           | 14.9           | 90.00       | 0.64            | 1341.8         | -0.000      | 126            |
| 3.0                        | 3441.340      | -80.5650    | 28.3707       | 40.63         | 89.85           | 24.0           | 90.00       | 1.02            | 1341.9         | -0.000      | 146            |
| 4.0                        | 3441.345      | -80.5650    | 28.3707       | 9.59          | 89.83           | 33.4           | 90.00       | 1.43            | 1342.1         | 0.000       | 174            |
| 5.0                        | 3441.351      | -80.5649    | 28.3707       | 355.52        | 89.79           | 43.2           | 89.99       | 1.84            | 1342.3         | 0.000       | 212            |
| 6.0                        | 3441.359      | -80.5649    | 28.3707       | 348.99        | 89.75           | 53.1           | 89.99       | 2.27            | 1342.7         | 0.000       | 261            |
| 7.0                        | 3441.369      | -80.5649    | 28.3707       | 345.82        | 89.72           | 63.3           | 89.99       | 2.70            | 1343.1         | 0.000       | 315            |
| 8.0                        | 3441.380      | -80.5649    | 28.3707       | 344.63        | 89.70           | 73.7           | 89.98       | 3.15            | 1343.6         | 0.000       | 387            |
| 9.0                        | 3441.393      | -80.5650    | 28.3707       | 345.01        | 89.68           | 84.4           | 89.98       | 3.60            | 1344.2         | -0.000      | 466            |
| 10.0                       | 3441.408      | -80.5650    | 28.3707       | 347.00        | 89.67           | 95.2           | 89.98       | 4.06            | 1344.9         | 0.000       | 556            |
| 11.0                       | 3441.425      | -80.5650    | 28.3707       | 350.75        | 89.65           | 106.3          | 89.97       | 4.53            | 1345.8         | 0.000       | 657            |
| 12.0                       | 3441.443      | -80.5650    | 28.3707       | 356.43        | 89.64           | 117.6          | 89.97       | 5.01            | 1346.8         | 0.000       | 765            |
| 13.0                       | 3441.463      | -80.5650    | 28.3707       | 4.02          | 89.62           | 129.3          | 89.96       | 5.50            | 1348.0         | 0.000       | 892            |
| 14.0                       | 3441.485      | -80.5649    | 28.3707       | 13.10         | 89.59           | 141.2          | 89.96       | 6.00            | 1349.3         | 0.000       | 1027           |
| 15.0                       | 3441.510      | -80.5649    | 28.3707       | 22.80         | 89.54           | 153.3          | 89.95       | 6.52            | 1350.9         | 0.000       | 1174           |
| 16.0                       | 3441.536      | -80.5649    | 28.3707       | 32.13         | 89.46           | 165.8          | 89.94       | 7.04            | 1352.8         | 0.001       | 1333           |
| 17.0                       | 3441.564      | -80.5649    | 28.3707       | 40.39         | 89.36           | 178.6          | 89.93       | 7.57            | 1354.9         | 0.001       | 1506           |
| 18.0                       | 3441.595      | -80.5649    | 28.3707       | 47.28         | 89.23           | 191.7          | 89.93       | 8.12            | 1357.2         | 0.001       | 1691           |
| 19.0                       | 3441.627      | -80.5649    | 28.3707       | 52.88         | 89.07           | 205.0          | 89.91       | 8.67            | 1360.0         | 0.002       | 1889           |
| 20.0                       | 3441.662      | -80.5649    | 28.3707       | 57.37         | 88.88           | 218.6          | 89.90       | 9.23            | 1363.0         | 0.002       | 2101           |

TABLE XVI  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>NM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>FT/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>FT/S | RANGE<br>NM | ALTITUDE<br>FT |
|-------------|---------------|-------------|---------------|---------------|-----------------|----------------|-------------|-----------------|----------------|-------------|----------------|
| 21.0        | 3441.699      | -80.5649    | 28.3707       | 60.97         | 88.67           | 232.4          | 89.89       | 9.79            | 1366.4         | 0.003       | 2326           |
| 22.0        | 3441.739      | -80.5649    | 28.3707       | 63.87         | 88.44           | 246.6          | 89.87       | 10.36           | 1370.2         | 0.004       | 2565           |
| 23.0        | 3441.780      | -80.5649    | 28.3707       | 66.23         | 88.18           | 261.0          | 89.86       | 10.94           | 1374.4         | 0.005       | 2819           |
| 24.0        | 3441.824      | -80.5648    | 28.3707       | 68.15         | 87.90           | 275.6          | 89.84       | 11.52           | 1379.0         | 0.007       | 3087           |
| 25.0        | 3441.871      | -80.5648    | 28.3707       | 69.72         | 87.61           | 290.5          | 89.82       | 12.11           | 1384.0         | 0.008       | 3370           |
| 26.0        | 3441.920      | -80.5648    | 28.3707       | 70.98         | 87.29           | 305.7          | 89.80       | 12.70           | 1389.5         | 0.010       | 3668           |
| 27.0        | 3441.972      | -80.5647    | 28.3708       | 71.97         | 86.97           | 321.2          | 89.78       | 13.29           | 1395.4         | 0.013       | 3981           |
| 28.0        | 3442.026      | -80.5647    | 28.3708       | 72.74         | 86.62           | 337.1          | 89.75       | 13.89           | 1401.9         | 0.016       | 4309           |
| 29.0        | 3442.082      | -80.5646    | 28.3708       | 73.30         | 86.26           | 353.3          | 89.72       | 14.49           | 1408.8         | 0.020       | 4654           |
| 30.0        | 3442.142      | -80.5645    | 28.3708       | 73.61         | 85.90           | 369.8          | 89.69       | 15.10           | 1416.2         | 0.024       | 5014           |
| 31.0        | 3442.204      | -80.5644    | 28.3708       | 73.58         | 85.51           | 386.6          | 89.64       | 15.70           | 1424.2         | 0.028       | 5392           |
| 32.0        | 3442.269      | -80.5643    | 28.3708       | 73.37         | 85.10           | 403.9          | 89.59       | 16.31           | 1432.8         | 0.034       | 5786           |
| 33.0        | 3442.336      | -80.5642    | 28.3709       | 73.01         | 84.66           | 421.5          | 89.52       | 16.92           | 1442.0         | 0.040       | 6196           |
| 34.0        | 3442.407      | -80.5641    | 28.3709       | 72.65         | 84.20           | 439.5          | 89.45       | 17.53           | 1451.9         | 0.047       | 6625           |
| 35.0        | 3442.480      | -80.5640    | 28.3709       | 72.40         | 83.73           | 457.9          | 89.38       | 18.13           | 1462.5         | 0.055       | 7071           |
| 36.0        | 3442.556      | -80.5638    | 28.3710       | 72.32         | 83.25           | 476.6          | 89.30       | 18.73           | 1473.6         | 0.063       | 7535           |
| 37.0        | 3442.636      | -80.5636    | 28.3710       | 72.32         | 82.78           | 495.7          | 89.23       | 19.33           | 1485.4         | 0.073       | 8018           |
| 38.0        | 3442.718      | -80.5634    | 28.3711       | 72.35         | 82.30           | 515.1          | 89.15       | 19.93           | 1497.7         | 0.084       | 8519           |
| 39.0        | 3442.804      | -80.5632    | 28.3711       | 72.39         | 81.82           | 535.0          | 89.07       | 20.52           | 1510.8         | 0.096       | 9039           |
| 40.0        | 3442.893      | -80.5630    | 28.3712       | 72.40         | 81.32           | 555.2          | 88.98       | 21.10           | 1524.6         | 0.109       | 9578           |
| 41.0        | 3442.985      | -80.5627    | 28.3713       | 72.41         | 80.81           | 575.8          | 88.89       | 21.68           | 1539.1         | 0.124       | 10137          |
| 42.0        | 3443.080      | -80.5624    | 28.3713       | 72.42         | 80.27           | 597.0          | 88.79       | 22.24           | 1554.5         | 0.140       | 10715          |
| 43.0        | 3443.178      | -80.5621    | 28.3714       | 72.47         | 79.72           | 618.6          | 88.68       | 22.80           | 1570.7         | 0.157       | 11314          |
| 44.0        | 3443.280      | -80.5618    | 28.3715       | 72.56         | 79.16           | 640.7          | 88.58       | 23.35           | 1587.8         | 0.176       | 11933          |
| 45.0        | 3443.386      | -80.5614    | 28.3716       | 72.67         | 78.58           | 663.3          | 88.47       | 23.88           | 1605.8         | 0.197       | 12573          |
| 46.0        | 3443.494      | -80.5610    | 28.3717       | 72.74         | 77.99           | 686.2          | 88.36       | 24.40           | 1624.6         | 0.219       | 13234          |
| 47.0        | 3443.607      | -80.5605    | 28.3718       | 72.79         | 77.38           | 709.6          | 88.24       | 24.91           | 1644.2         | 0.244       | 13916          |
| 48.0        | 3443.722      | -80.5600    | 28.3720       | 72.78         | 76.77           | 733.4          | 88.11       | 25.40           | 1664.6         | 0.271       | 14620          |
| 49.0        | 3443.842      | -80.5595    | 28.3721       | 72.73         | 76.15           | 757.7          | 87.97       | 25.88           | 1685.7         | 0.299       | 15345          |
| 50.0        | 3443.964      | -80.5590    | 28.3723       | 72.67         | 75.53           | 782.6          | 87.82       | 26.34           | 1707.7         | 0.330       | 16090          |
| 51.0        | 3444.091      | -80.5584    | 28.3724       | 72.57         | 74.90           | 807.9          | 87.66       | 26.79           | 1730.5         | 0.364       | 16859          |
| 52.0        | 3444.221      | -80.5577    | 28.3726       | 72.55         | 74.29           | 833.8          | 87.51       | 27.23           | 1754.0         | 0.400       | 17651          |
| 53.0        | 3444.355      | -80.5570    | 28.3728       | 72.51         | 73.65           | 860.1          | 87.35       | 27.65           | 1778.5         | 0.438       | 18465          |
| 54.0        | 3444.493      | -80.5563    | 28.3730       | 72.46         | 73.02           | 886.9          | 87.19       | 28.05           | 1803.6         | 0.479       | 19303          |
| 55.0        | 3444.634      | -80.5555    | 28.3732       | 72.45         | 72.39           | 913.9          | 87.03       | 28.44           | 1829.3         | 0.523       | 20163          |
| 56.0        | 3444.780      | -80.5546    | 28.3734       | 72.48         | 71.75           | 941.7          | 86.87       | 28.80           | 1856.2         | 0.570       | 21046          |
| 57.0        | 3444.929      | -80.5537    | 28.3737       | 72.51         | 71.10           | 969.6          | 86.71       | 29.14           | 1883.7         | 0.621       | 21953          |
| 58.0        | 3445.082      | -80.5527    | 28.3739       | 72.51         | 70.47           | 997.6          | 86.55       | 29.47           | 1911.4         | 0.674       | 22882          |
| 59.0        | 3445.238      | -80.5517    | 28.3742       | 72.51         | 69.81           | 1025.7         | 86.38       | 29.75           | 1939.9         | 0.730       | 23834          |
| MACH ONE    |               |             |               |               |                 |                |             |                 |                |             |                |
| 59.760      | 3445.360      | -80.5509    | 28.3744       | 72.49         | 69.31           | 1046.9         | 86.25       | 29.95           | 1961.6         | 0.776       | 24574          |



TABLE XVI  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>NM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>FT/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>FT/S | RANGE<br>NM | ALTITUDE<br>FT |
|-------------|---------------|-------------|---------------|---------------|-----------------|----------------|-------------|-----------------|----------------|-------------|----------------|
| 60.0        | 3445.399      | -80.5506    | 28.3745       | 72.49         | 69.15           | 1053.7         | 86.20       | 30.01           | 1968.5         | 0.790       | 24809          |
| 61.0        | 3445.563      | -80.5495    | 28.3748       | 72.45         | 68.49           | 1081.8         | 86.02       | 30.25           | 1997.7         | 0.854       | 25806          |
| 62.0        | 3445.730      | -80.5483    | 28.3751       | 72.39         | 67.82           | 1110.2         | 85.84       | 30.47           | 2027.4         | 0.921       | 26824          |
| 63.0        | 3445.901      | -80.5470    | 28.3755       | 72.43         | 67.18           | 1139.4         | 85.68       | 30.69           | 2057.9         | 0.991       | 27864          |
| 64.0        | 3446.076      | -80.5457    | 28.3758       | 72.52         | 66.55           | 1169.3         | 85.53       | 30.90           | 2089.1         | 1.066       | 28926          |
| 65.0        | 3446.255      | -80.5442    | 28.3762       | 72.57         | 65.91           | 1199.9         | 85.37       | 31.09           | 2121.3         | 1.144       | 30011          |
| 66.0        | 3446.437      | -80.5427    | 28.3766       | 72.63         | 65.27           | 1231.3         | 85.21       | 31.27           | 2154.6         | 1.227       | 31119          |
| 67.0        | 3446.623      | -80.5412    | 28.3771       | 72.70         | 64.64           | 1263.4         | 85.06       | 31.44           | 2188.6         | 1.314       | 32250          |
| 68.0        | 3446.813      | -80.5395    | 28.3775       | 72.76         | 64.01           | 1296.2         | 84.90       | 31.60           | 2223.4         | 1.405       | 33405          |
| 69.0        | 3447.007      | -80.5378    | 28.3780       | 72.85         | 63.38           | 1330.0         | 84.75       | 31.75           | 2259.4         | 1.500       | 34583          |
| 70.0        | 3447.205      | -80.5360    | 28.3784       | 72.92         | 62.73           | 1364.7         | 84.60       | 31.88           | 2296.7         | 1.601       | 35785          |
| 71.0        | 3447.406      | -80.5341    | 28.3790       | 73.01         | 62.07           | 1400.1         | 84.45       | 31.99           | 2335.0         | 1.706       | 37011          |
| MAX Q       |               |             |               |               |                 |                |             |                 |                |             |                |
| 71.500      | 3447.509      | -80.5331    | 28.3792       | 73.05         | 61.74           | 1418.3         | 84.37       | 32.04           | 2354.7         | 1.760       | 37633          |
| 72.0        | 3447.612      | -80.5321    | 28.3795       | 73.08         | 61.41           | 1436.7         | 84.29       | 32.09           | 2374.5         | 1.816       | 38262          |
| 73.0        | 3447.822      | -80.5300    | 28.3800       | 73.12         | 60.76           | 1474.3         | 84.13       | 32.19           | 2415.0         | 1.932       | 39537          |
| 74.0        | 3448.036      | -80.5278    | 28.3806       | 73.12         | 60.14           | 1512.7         | 83.95       | 32.28           | 2456.1         | 2.052       | 40837          |
| 75.0        | 3448.255      | -80.5255    | 28.3812       | 73.07         | 59.53           | 1552.1         | 83.76       | 32.38           | 2498.0         | 2.179       | 42163          |
| 76.0        | 3448.476      | -80.5231    | 28.3818       | 72.97         | 58.95           | 1592.4         | 83.55       | 32.48           | 2540.5         | 2.311       | 43515          |
| 77.0        | 3448.703      | -80.5206    | 28.3825       | 72.83         | 58.38           | 1633.7         | 83.33       | 32.58           | 2583.9         | 2.449       | 44894          |
| 78.0        | 3448.934      | -80.5180    | 28.3832       | 72.69         | 57.81           | 1675.9         | 83.11       | 32.66           | 2628.4         | 2.592       | 46300          |
| 79.0        | 3449.170      | -80.5153    | 28.3839       | 72.56         | 57.23           | 1719.1         | 82.88       | 32.72           | 2674.0         | 2.742       | 47734          |
| 80.0        | 3449.410      | -80.5125    | 28.3847       | 72.46         | 56.65           | 1763.6         | 82.66       | 32.78           | 2721.1         | 2.898       | 49195          |
| 81.0        | 3449.655      | -80.5096    | 28.3855       | 72.39         | 56.08           | 1809.3         | 82.46       | 32.83           | 2769.4         | 3.060       | 50683          |
| 82.0        | 3449.905      | -80.5065    | 28.3864       | 72.35         | 55.52           | 1856.1         | 82.27       | 32.87           | 2818.9         | 3.229       | 52200          |
| 83.0        | 3450.159      | -80.5033    | 28.3872       | 72.33         | 54.99           | 1903.7         | 82.09       | 32.92           | 2869.1         | 3.405       | 53747          |
| 84.0        | 3450.418      | -80.5000    | 28.3881       | 72.32         | 54.49           | 1952.1         | 81.92       | 32.97           | 2919.9         | 3.587       | 55323          |
| 85.0        | 3450.682      | -80.4966    | 28.3891       | 72.31         | 54.00           | 2001.4         | 81.75       | 33.02           | 2971.4         | 3.777       | 56928          |
| 86.0        | 3450.952      | -80.4931    | 28.3901       | 72.30         | 53.52           | 2051.4         | 81.59       | 33.06           | 3023.8         | 3.973       | 58564          |
| 87.0        | 3451.226      | -80.4894    | 28.3911       | 72.29         | 53.04           | 2102.4         | 81.42       | 33.09           | 3077.3         | 4.177       | 60231          |
| 88.0        | 3451.505      | -80.4856    | 28.3921       | 72.27         | 52.56           | 2154.7         | 81.26       | 33.11           | 3132.1         | 4.388       | 61928          |
| 89.0        | 3451.789      | -80.4816    | 28.3932       | 72.26         | 52.07           | 2208.3         | 81.09       | 33.12           | 3188.3         | 4.606       | 63656          |
| 90.0        | 3452.078      | -80.4776    | 28.3944       | 72.24         | 51.59           | 2263.0         | 80.92       | 33.12           | 3245.7         | 4.833       | 65415          |
| 91.0        | 3452.373      | -80.4733    | 28.3956       | 72.22         | 51.11           | 2318.7         | 80.76       | 33.11           | 3304.2         | 5.067       | 67206          |
| 92.0        | 3452.673      | -80.4689    | 28.3968       | 72.20         | 50.63           | 2375.3         | 80.59       | 33.09           | 3363.6         | 5.310       | 69029          |
| 93.0        | 3452.978      | -80.4644    | 28.3981       | 72.17         | 50.15           | 2433.0         | 80.43       | 33.06           | 3424.2         | 5.561       | 70883          |
| 94.0        | 3453.288      | -80.4597    | 28.3994       | 72.15         | 49.67           | 2492.0         | 80.26       | 33.02           | 3486.2         | 5.821       | 72768          |
| 95.0        | 3453.603      | -80.4549    | 28.4007       | 72.13         | 49.20           | 2552.2         | 80.10       | 32.98           | 3549.4         | 6.090       | 74686          |
| 96.0        | 3453.924      | -80.4499    | 28.4021       | 72.11         | 48.73           | 2613.4         | 79.95       | 32.92           | 3613.7         | 6.368       | 76636          |
| 97.0        | 3454.250      | -80.4447    | 28.4036       | 72.10         | 48.26           | 2675.8         | 79.80       | 32.87           | 3679.1         | 6.655       | 78619          |
| 98.0        | 3454.581      | -80.4393    | 28.4051       | 72.09         | 47.81           | 2739.2         | 79.65       | 32.81           | 3745.7         | 6.952       | 80634          |

TABLE XVI  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>NM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>FT/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>FT/S | RANGE<br>NM | ALTITUDE<br>FT |
|-------------|---------------|-------------|---------------|---------------|-----------------|----------------|-------------|-----------------|----------------|-------------|----------------|
| 99.0        | 3454.918      | -80.4338    | 28.4066       | 72.09         | 47.35           | 2803.7         | 79.51       | 32.74           | 3813.2         | 7.258       | 82682          |
| 100.0       | 3455.260      | -80.4281    | 28.4082       | 72.09         | 46.90           | 2869.1         | 79.37       | 32.66           | 3881.8         | 7.574       | 84762          |
| 101.0       | 3455.608      | -80.4222    | 28.4099       | 72.09         | 46.47           | 2935.6         | 79.23       | 32.59           | 3951.4         | 7.900       | 86876          |
| 102.0       | 3455.961      | -80.4162    | 28.4116       | 72.08         | 46.03           | 3002.4         | 79.10       | 32.51           | 4022.3         | 8.236       | 89024          |
| 103.0       | 3456.319      | -80.4099    | 28.4134       | 72.08         | 45.61           | 3072.4         | 78.97       | 32.43           | 4094.2         | 8.583       | 91204          |
| 104.0       | 3456.684      | -80.4035    | 28.4152       | 72.08         | 45.19           | 3142.4         | 78.84       | 32.34           | 4167.2         | 8.940       | 93419          |
| 105.0       | 3457.054      | -80.3969    | 28.4171       | 72.08         | 44.78           | 3213.4         | 78.72       | 32.26           | 4241.3         | 9.308       | 95668          |
| 106.0       | 3457.429      | -80.3900    | 28.4190       | 72.08         | 44.38           | 3285.7         | 78.60       | 32.17           | 4316.5         | 9.687       | 97952          |
| 107.0       | 3457.810      | -80.3830    | 28.4210       | 72.09         | 43.98           | 3359.3         | 78.48       | 32.08           | 4393.0         | 10.077      | 100270         |
| 108.0       | 3458.197      | -80.3758    | 28.4230       | 72.10         | 43.60           | 3434.2         | 78.37       | 31.98           | 4470.8         | 10.478      | 102623         |
| 109.0       | 3458.590      | -80.3683    | 28.4251       | 72.10         | 43.22           | 3510.4         | 78.26       | 31.89           | 4549.8         | 10.891      | 105011         |
| 110.0       | 3458.988      | -80.3607    | 28.4272       | 72.11         | 42.84           | 3587.8         | 78.15       | 31.80           | 4630.0         | 11.315      | 107436         |
| 111.0       | 3459.393      | -80.3528    | 28.4295       | 72.11         | 42.48           | 3666.5         | 78.04       | 31.70           | 4711.4         | 11.752      | 109896         |
| 112.0       | 3459.804      | -80.3447    | 28.4317       | 72.12         | 42.11           | 3746.2         | 77.94       | 31.60           | 4793.9         | 12.200      | 112393         |
| 113.0       | 3460.220      | -80.3364    | 28.4341       | 72.12         | 41.76           | 3827.2         | 77.83       | 31.50           | 4877.7         | 12.661      | 114927         |
| 114.0       | 3460.643      | -80.3279    | 28.4365       | 72.13         | 41.41           | 3909.6         | 77.73       | 31.40           | 4962.7         | 13.134      | 117497         |
| 115.0       | 3461.072      | -80.3191    | 28.4389       | 72.13         | 41.06           | 3993.3         | 77.63       | 31.30           | 5049.1         | 13.620      | 120105         |
| 116.0       | 3461.506      | -80.3101    | 28.4415       | 72.14         | 40.72           | 4078.3         | 77.54       | 31.19           | 5136.8         | 14.119      | 122750         |
| 117.0       | 3461.948      | -80.3014    | 28.4441       | 72.14         | 40.39           | 4164.6         | 77.44       | 31.09           | 5225.6         | 14.631      | 125433         |
| 118.0       | 3462.395      | -80.2929    | 28.4467       | 72.14         | 40.06           | 4252.1         | 77.35       | 30.98           | 5315.8         | 15.156      | 128154         |
| 119.0       | 3462.848      | -80.2847    | 28.4495       | 72.14         | 39.73           | 4341.2         | 77.26       | 30.87           | 5407.3         | 15.695      | 130913         |
| 120.0       | 3463.308      | -80.2767    | 28.4523       | 72.15         | 39.41           | 4431.6         | 77.17       | 30.76           | 5500.4         | 16.248      | 133710         |
| 121.0       | 3463.775      | -80.2685    | 28.4551       | 72.15         | 39.09           | 4523.6         | 77.08       | 30.65           | 5594.9         | 16.814      | 136547         |
| 122.0       | 3464.247      | -80.2610    | 28.4581       | 72.15         | 38.77           | 4617.2         | 76.99       | 30.53           | 5691.0         | 17.395      | 139422         |
| 123.0       | 3464.727      | -80.2540    | 28.4611       | 72.16         | 38.45           | 4712.0         | 76.91       | 30.41           | 5788.4         | 17.991      | 142337         |
| 124.0       | 3465.212      | -80.2473    | 28.4642       | 72.16         | 38.14           | 4808.1         | 76.83       | 30.29           | 5887.1         | 18.601      | 145291         |
| 125.0       | 3465.704      | -80.2410    | 28.4674       | 72.16         | 37.83           | 4905.6         | 76.74       | 30.17           | 5987.1         | 19.226      | 148284         |
| 126.0       | 3466.203      | -80.2354    | 28.4706       | 72.17         | 37.52           | 5004.8         | 76.67       | 30.04           | 6088.8         | 19.866      | 151316         |
| 127.0       | 3466.708      | -80.1946    | 28.4739       | 72.17         | 37.21           | 5105.8         | 76.59       | 29.91           | 6192.4         | 20.522      | 154388         |
| 128.0       | 3467.219      | -80.1825    | 28.4773       | 72.18         | 36.90           | 5208.5         | 76.51       | 29.77           | 6297.7         | 21.194      | 157500         |
| 129.0       | 3467.737      | -80.1701    | 28.4808       | 72.18         | 36.59           | 5312.8         | 76.44       | 29.63           | 6404.7         | 21.882      | 160651         |
| 130.0       | 3468.262      | -80.1573    | 28.4844       | 72.19         | 36.28           | 5418.9         | 76.37       | 29.49           | 6513.4         | 22.587      | 163840         |
| 131.0       | 3468.793      | -80.1443    | 28.4880       | 72.19         | 35.97           | 5526.4         | 76.29       | 29.34           | 6623.5         | 23.308      | 167070         |
| 132.0       | 3469.330      | -80.1310    | 28.4918       | 72.20         | 35.66           | 5635.3         | 76.23       | 29.19           | 6735.0         | 24.046      | 170340         |
| 133.0       | 3469.874      | -80.1174    | 28.4956       | 72.20         | 35.34           | 5746.3         | 76.16       | 29.04           | 6848.8         | 24.802      | 173649         |
| 134.0       | 3470.424      | -80.1034    | 28.4995       | 72.21         | 35.03           | 5859.0         | 76.09       | 28.87           | 6964.2         | 25.575      | 176997         |
| 135.0       | 3470.981      | -80.0891    | 28.5035       | 72.21         | 34.72           | 5973.6         | 76.02       | 28.71           | 7081.5         | 26.366      | 180383         |
| 136.0       | 3471.544      | -80.0745    | 28.5076       | 72.22         | 34.41           | 6090.0         | 75.96       | 28.56           | 7200.5         | 27.176      | 183809         |
| 137.0       | 3472.114      | -80.0596    | 28.5118       | 72.23         | 34.12           | 6208.1         | 75.90       | 28.40           | 7321.2         | 28.004      | 187276         |
| 138.0       | 3472.691      | -80.0443    | 28.5161       | 72.23         | 33.85           | 6328.6         | 75.84       | 28.26           | 7444.0         | 28.851      | 190784         |
|             |               |             |               |               |                 |                |             |                 |                |             |                |
| 138.970     | 3473.257      | -80.0291    | 28.5203       | 72.24         | 33.58           | 6445.0         | 75.79       | 28.12           | 7562.7         | 29.691      | 194228         |

IECO

TABLE XVI  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>NM                                    | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>FT/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>FT/S | RANGE<br>NM | ALTITUDE<br>FT |
|-------------|--|-------------|---------------|---------------|-----------------|----------------|-------------|-----------------|----------------|-------------|----------------|
| 139.0       | 3473.274   | -80.0286    | 28.5204       | 72.24         | 33.58           | 6447.3         | 75.78       | 28.13           | 7565.0         | 29.717      | 194335         |
| 140.0       | 3473.863   | -80.0127    | 28.5249       | 72.25         | 33.34           | 6520.7         | 75.75       | 27.97           | 7640.7         | 30.600      | 197919         |
| 141.0       | 3474.454   | -79.9966    | 28.5294       | 72.26         | 33.11           | 6576.2         | 75.73       | 27.82           | 7698.5         | 31.493      | 201512         |
| 142.0       | 3475.046   | -79.9803    | 28.5340       | 72.27         | 32.89           | 6624.5         | 75.71       | 27.66           | 7749.0         | 32.395      | 205113         |
|             | OECO   |             |               |               |                 |                |             |                 |                |             |                |
| 142.250     | 3475.194   | -79.9762    | 28.5351       | 72.27         | 32.84           | 6635.3         | 75.71       | 27.62           | 7760.4         | 32.621      | 206014         |
| 143.0       | 3475.638   | -79.9639    | 28.5385       | 72.28         | 32.68           | 6639.6         | 75.71       | 27.49           | 7766.5         | 33.304      | 208715         |
|             | S-IB/S-IVB SEPARATION SIGNAL                     |             |               |               |                 |                |             |                 |                |             |                |
| 143.500     | 3475.933   | -79.9556    | 28.5408       | 72.28         | 32.57           | 6633.3         | 75.71       | 27.39           | 7761.4         | 33.760      | 210508         |
|             | EBW FIRING (SEPARATION SIGNAL PLUS 0.07 SECONDS) |             |               |               |                 |                |             |                 |                |             |                |
| 143.570     | 3475.976   | -79.9546    | 28.5411       | 72.28         | 32.56           | 6632.5         | 75.71       | 27.38           | 7760.7         | 33.819      | 210774         |
| 144.0       | 3476.228   | -79.9475    | 28.5431       | 72.29         | 32.47           | 6625.9         | 75.71       | 27.30           | 7755.2         | 34.210      | 212308         |
| 145.0       | 3476.811   | -79.9311    | 28.5477       | 72.30         | 32.26           | 6610.4         | 75.72       | 27.11           | 7742.2         | 35.120      | 215855         |
| 150.0       | 3479.661   | -79.8487    | 28.5706       | 72.34         | 31.20           | 6581.6         | 75.74       | 26.19           | 7725.2         | 39.677      | 233192         |
| 155.0       | 3482.430   | -79.7653    | 28.5938       | 72.37         | 30.16           | 6615.4         | 75.72       | 25.33           | 7769.8         | 44.289      | 250041         |
|             | GUIDANCE INITIATION                              |             |               |               |                 |                |             |                 |                |             |                |
| 159.470     | 3484.848   | -79.6897    | 28.6148       | 72.39         | 29.25           | 6654.0         | 75.70       | 24.57           | 7817.6         | 48.475      | 264755         |
| 160.0       | 3485.131   | -79.6806    | 28.6173       | 72.39         | 29.14           | 6658.8         | 75.69       | 24.48           | 7823.4         | 48.975      | 266478         |
| 165.0       | 3487.766   | -79.5945    | 28.6411       | 72.44         | 28.13           | 6706.7         | 75.69       | 23.65           | 7881.3         | 53.736      | 282514         |
| 170.0       | 3490.333   | -79.5069    | 28.6653       | 72.53         | 27.07           | 6759.1         | 75.72       | 22.78           | 7944.1         | 58.577      | 298134         |
| 175.0       | 3492.828   | -79.4177    | 28.6897       | 72.63         | 26.02           | 6815.8         | 75.76       | 21.92           | 8010.7         | 63.499      | 313322         |
| 180.0       | 3495.254   | -79.3269    | 28.7144       | 72.73         | 25.00           | 6876.5         | 75.80       | 21.08           | 8080.6         | 68.505      | 328088         |
| 185.0       | 3497.611   | -79.2346    | 28.7394       | 72.83         | 24.00           | 6940.8         | 75.84       | 20.26           | 8153.8         | 73.594      | 342438         |
| 190.0       | 3499.901   | -79.1406    | 28.7646       | 72.94         | 23.02           | 7009.1         | 75.88       | 19.46           | 8230.5         | 78.769      | 356377         |
| 195.0       | 3502.123   | -79.0450    | 28.7902       | 73.04         | 22.06           | 7081.2         | 75.93       | 18.67           | 8310.6         | 84.030      | 369906         |
| 200.0       | 3504.279   | -78.9478    | 28.8160       | 73.15         | 21.11           | 7157.0         | 75.98       | 17.89           | 8394.0         | 89.379      | 383027         |
| 205.0       | 3506.366   | -78.8488    | 28.8420       | 73.28         | 20.18           | 7236.4         | 76.05       | 17.12           | 8480.7         | 94.817      | 395741         |
| 210.0       | 3508.387   | -78.7480    | 28.8683       | 73.41         | 19.25           | 7319.5         | 76.12       | 16.36           | 8570.8         | 100.347     | 408043         |
| 215.0       | 3510.339   | -78.6455    | 28.8949       | 73.55         | 18.35           | 7406.0         | 76.20       | 15.61           | 8663.9         | 105.970     | 419935         |
| 220.0       | 3512.224   | -78.5412    | 28.9216       | 73.68         | 17.47           | 7496.0         | 76.27       | 14.88           | 8760.1         | 111.686     | 431417         |
| 225.0       | 3514.043   | -78.4350    | 28.9486       | 73.82         | 16.61           | 7589.5         | 76.35       | 14.17           | 8859.4         | 117.497     | 442494         |
| 230.0       | 3515.795   | -78.3270    | 28.9759       | 73.95         | 15.78           | 7686.5         | 76.43       | 13.48           | 8961.8         | 123.405     | 453170         |

TABLE XVI  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>NM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>FT/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>FT/S | RANGE<br>NM | ALTITUDE<br>FT |
|-------------|---------------|-------------|---------------|---------------|-----------------|----------------|-------------|-----------------|----------------|-------------|----------------|
| 235.0       | 3517.482      | -78.2170    | 29.0033       | 74.09         | 14.96           | 7787.5         | 76.51       | 12.81           | 9067.8         | 129.410     | 463449         |
| 240.0       | 3519.104      | -78.1052    | 29.0310       | 74.22         | 14.17           | 7891.6         | 76.59       | 12.15           | 9176.7         | 135.516     | 473334         |
| 245.0       | 3520.662      | -77.9914    | 29.0589       | 74.35         | 13.40           | 7998.7         | 76.67       | 11.51           | 9288.2         | 141.722     | 482829         |
| 250.0       | 3522.156      | -77.8756    | 29.0871       | 74.48         | 12.65           | 8109.4         | 76.75       | 10.89           | 9403.0         | 148.030     | 491935         |
| 255.0       | 3523.586      | -77.7578    | 29.1155       | 74.62         | 11.93           | 8222.5         | 76.83       | 10.29           | 9519.9         | 154.442     | 500656         |
| 260.0       | 3524.954      | -77.6380    | 29.1441       | 74.75         | 11.24           | 8339.8         | 76.91       | 9.70            | 9640.7         | 160.958     | 508998         |
| 265.0       | 3526.261      | -77.5161    | 29.1729       | 74.88         | 10.56           | 8460.6         | 76.99       | 9.14            | 9764.7         | 167.582     | 516967         |
| 270.0       | 3527.507      | -77.3920    | 29.2020       | 75.01         | 9.91            | 8584.0         | 77.08       | 8.59            | 9891.1         | 174.314     | 524568         |
| 275.0       | 3528.693      | -77.2659    | 29.2313       | 75.14         | 9.28            | 8711.3         | 77.16       | 8.06            | 10021.1        | 181.156     | 531804         |
| 280.0       | 3529.819      | -77.1376    | 29.2608       | 75.27         | 8.67            | 8841.3         | 77.24       | 7.54            | 10153.6        | 188.110     | 538677         |
| 285.0       | 3530.886      | -77.0070    | 29.2905       | 75.40         | 8.08            | 8974.6         | 77.33       | 7.04            | 10289.2        | 195.177     | 545191         |
| 290.0       | 3531.894      | -76.8742    | 29.3205       | 75.52         | 7.51            | 9110.6         | 77.41       | 6.56            | 10427.4        | 202.359     | 551351         |
| 295.0       | 3532.846      | -76.7392    | 29.3508       | 75.62         | 6.97            | 9249.2         | 77.47       | 6.10            | 10567.7        | 209.658     | 557164         |
| 300.0       | 3533.741      | -76.6019    | 29.3813       | 75.74         | 6.45            | 9391.5         | 77.55       | 5.65            | 10711.6        | 217.075     | 562637         |
| 305.0       | 3534.581      | -76.4622    | 29.4120       | 75.88         | 5.94            | 9537.0         | 77.64       | 5.22            | 10858.8        | 224.612     | 567774         |
| 310.0       | 3535.366      | -76.3201    | 29.4429       | 76.01         | 5.46            | 9685.7         | 77.73       | 4.80            | 11009.0        | 232.271     | 572576         |
| 315.0       | 3536.098      | -76.1756    | 29.4741       | 76.14         | 4.99            | 9837.9         | 77.82       | 4.40            | 11162.5        | 240.055     | 577052         |
| 320.0       | 3536.776      | -76.0286    | 29.5055       | 76.28         | 4.55            | 9993.3         | 77.92       | 4.01            | 11319.1        | 247.965     | 581205         |
| 325.0       | 3537.401      | -75.8791    | 29.5370       | 76.41         | 4.11            | 10151.9        | 78.01       | 3.64            | 11478.8        | 256.004     | 585039         |
| 330.0       | 3537.975      | -75.7271    | 29.5688       | 76.54         | 3.70            | 10313.3        | 78.11       | 3.28            | 11641.1        | 264.173     | 588557         |
| 335.0       | 3538.497      | -75.5724    | 29.6008       | 76.68         | 3.31            | 10477.1        | 78.21       | 2.93            | 11805.8        | 272.475     | 591764         |
| 340.0       | 3538.969      | -75.4151    | 29.6330       | 76.82         | 2.93            | 10645.0        | 78.30       | 2.60            | 11974.5        | 280.911     | 594668         |
| 345.0       | 3539.393      | -75.2551    | 29.6654       | 76.95         | 2.57            | 10815.6        | 78.40       | 2.29            | 12145.8        | 289.484     | 597275         |
| 350.0       | 3539.768      | -75.0923    | 29.6980       | 77.09         | 2.23            | 10989.4        | 78.50       | 1.99            | 12320.1        | 298.197     | 599592         |
| 355.0       | 3540.097      | -74.9268    | 29.7307       | 77.22         | 1.91            | 11166.0        | 78.60       | 1.71            | 12497.3        | 307.050     | 601625         |
| 360.0       | 3540.381      | -74.7584    | 29.7637       | 77.36         | 1.60            | 11346.3        | 78.71       | 1.43            | 12678.0        | 316.047     | 603382         |
| 365.0       | 3540.619      | -74.5872    | 29.7968       | 77.50         | 1.31            | 11530.2        | 78.81       | 1.18            | 12862.3        | 325.189     | 604869         |
| 370.0       | 3540.815      | -74.4130    | 29.8301       | 77.64         | 1.04            | 11717.9        | 78.92       | 0.93            | 13050.3        | 334.481     | 606093         |
| 375.0       | 3540.968      | -74.2358    | 29.8636       | 77.77         | 0.77            | 11909.3        | 79.02       | 0.70            | 13242.0        | 343.925     | 607059         |
| 380.0       | 3541.080      | -74.0556    | 29.8972       | 77.91         | 0.53            | 12104.4        | 79.13       | 0.47            | 13437.4        | 353.523     | 607774         |
| 385.0       | 3541.152      | -73.8722    | 29.9310       | 78.05         | 0.29            | 12303.3        | 79.24       | 0.26            | 13636.5        | 363.279     | 608244         |
| 390.0       | 3541.184      | -73.6857    | 29.9650       | 78.20         | 0.07            | 12505.2        | 79.35       | 0.06            | 13838.5        | 373.195     | 608474         |
| 395.0       | 3541.177      | -73.4960    | 29.9991       | 78.34         | -0.14           | 12710.6        | 79.46       | -0.12           | 14044.0        | 383.274     | 608473         |
| 400.0       | 3541.134      | -73.3029    | 30.0334       | 78.48         | -0.33           | 12919.6        | 79.57       | -0.30           | 14253.0        | 393.519     | 608248         |
| 405.0       | 3541.056      | -73.1065    | 30.0678       | 78.63         | -0.51           | 13132.9        | 79.69       | -0.46           | 14466.5        | 403.932     | 607809         |
| 410.0       | 3540.944      | -72.9067    | 30.1024       | 78.77         | -0.67           | 13349.6        | 79.80       | -0.61           | 14683.2        | 414.517     | 607166         |
| 415.0       | 3540.800      | -72.7035    | 30.1371       | 78.92         | -0.82           | 13570.2        | 79.92       | -0.75           | 14903.7        | 425.277     | 606326         |
| 420.0       | 3540.625      | -72.4966    | 30.1719       | 79.06         | -0.96           | 13794.9        | 80.04       | -0.87           | 15128.5        | 436.215     | 605300         |
| 425.0       | 3540.421      | -72.2862    | 30.2068       | 79.21         | -1.08           | 14023.8        | 80.16       | -0.99           | 15357.3        | 447.334     | 604097         |
| 430.0       | 3540.189      | -72.0721    | 30.2418       | 79.36         | -1.20           | 14257.2        | 80.28       | -1.09           | 15590.7        | 458.638     | 602727         |
| 435.0       | 3539.932      | -71.8542    | 30.2769       | 79.51         | -1.30           | 14496.0        | 80.40       | -1.19           | 15829.4        | 470.132     | 601200         |
| 440.0       | 3539.650      | -71.6325    | 30.3121       | 79.66         | -1.38           | 14739.1        | 80.53       | -1.27           | 16072.5        | 481.818     | 599526         |
| 445.0       | 3539.346      | -71.4069    | 30.3473       | 79.82         | -1.46           | 14988.2        | 80.66       | -1.34           | 16321.5        | 493.702     | 597718         |
| 450.0       | 3539.021      | -71.1772    | 30.3827       | 79.97         | -1.53           | 15240.6        | 80.79       | -1.41           | 16573.8        | 505.787     | 595783         |

TABLE XVI  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>NM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>FT/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>FT/S | RANGE<br>NM | ALTITUDE<br>FT |
|-------------|---------------|-------------|---------------|---------------|-----------------|----------------|-------------|-----------------|----------------|-------------|----------------|
| 455.0       | 3538.678      | -70.9434    | 30.4180       | 80.13         | -1.58           | 15498.7        | 80.92       | -1.46           | 16831.8        | 518.076     | 593733         |
| 460.0       | 3538.317      | -70.7055    | 30.4535       | 80.28         | -1.63           | 15762.3        | 81.05       | -1.50           | 17095.3        | 530.576     | 591581         |
| 465.0       | 3537.942      | -70.4633    | 30.4889       | 80.44         | -1.66           | 16030.9        | 81.18       | -1.53           | 17363.8        | 543.289     | 589339         |
| 470.0       | 3537.554      | -70.2167    | 30.5244       | 80.61         | -1.68           | 16304.4        | 81.32       | -1.55           | 17637.2        | 556.220     | 587021         |
| 475.0       | 3537.156      | -69.9657    | 30.5598       | 80.77         | -1.69           | 16584.0        | 81.46       | -1.57           | 17916.8        | 569.373     | 584636         |
| 480.0       | 3536.749      | -69.7101    | 30.5953       | 80.94         | -1.69           | 16869.7        | 81.60       | -1.57           | 18202.3        | 582.754     | 582203         |
| 485.0       | 3536.336      | -69.4498    | 30.6307       | 81.10         | -1.69           | 17162.1        | 81.75       | -1.57           | 18494.6        | 596.368     | 579730         |
| 490.0       | 3535.914      | -69.1848    | 30.6661       | 81.27         | -1.70           | 17463.2        | 81.90       | -1.58           | 18795.7        | 610.221     | 577206         |
| 495.0       | 3535.483      | -68.9149    | 30.7014       | 81.44         | -1.71           | 17768.8        | 82.05       | -1.59           | 19101.2        | 624.318     | 574622         |
| 500.0       | 3535.042      | -68.6400    | 30.7366       | 81.62         | -1.72           | 18073.8        | 82.20       | -1.60           | 19406.1        | 638.662     | 571982         |
| 505.0       | 3534.592      | -68.3602    | 30.7716       | 81.80         | -1.72           | 18380.3        | 82.35       | -1.60           | 19712.4        | 653.252     | 569288         |
| 510.0       | 3534.134      | -68.0754    | 30.8065       | 81.98         | -1.72           | 18682.2        | 82.52       | -1.61           | 20014.3        | 668.088     | 566543         |
| 515.0       | 3533.669      | -67.7857    | 30.8412       | 82.16         | -1.72           | 18980.2        | 82.68       | -1.60           | 20312.1        | 683.166     | 563755         |
| 520.0       | 3533.201      | -67.4912    | 30.8756       | 82.35         | -1.69           | 19281.1        | 82.85       | -1.58           | 20613.0        | 698.485     | 560946         |
| 525.0       | 3532.733      | -67.1918    | 30.9097       | 82.53         | -1.65           | 19581.2        | 83.01       | -1.55           | 20913.0        | 714.047     | 558143         |
| 530.0       | 3532.273      | -66.8874    | 30.9435       | 82.71         | -1.60           | 19883.4        | 83.17       | -1.50           | 21215.1        | 729.853     | 555380         |
| 535.0       | 3531.825      | -66.5781    | 30.9770       | 82.89         | -1.51           | 20188.6        | 83.34       | -1.42           | 21520.1        | 745.905     | 552697         |
| 540.0       | 3531.401      | -66.2637    | 31.0102       | 83.08         | -1.39           | 20496.7        | 83.50       | -1.30           | 21828.1        | 762.205     | 550155         |
| 545.0       | 3531.011      | -65.9443    | 31.0430       | 83.26         | -1.24           | 20810.0        | 83.67       | -1.16           | 22141.4        | 778.757     | 547822         |
| 550.0       | 3530.660      | -65.6197    | 31.0754       | 83.45         | -1.10           | 21130.7        | 83.84       | -1.03           | 22462.1        | 795.565     | 545726         |
| 555.0       | 3530.343      | -65.2897    | 31.1073       | 83.65         | -0.98           | 21463.9        | 84.02       | -0.93           | 22795.2        | 812.638     | 543830         |
| 560.0       | 3530.053      | -64.9542    | 31.1388       | 83.85         | -0.88           | 21806.0        | 84.20       | -0.83           | 23137.2        | 829.983     | 542107         |
| 565.0       | 3529.795      | -64.6131    | 31.1698       | 84.05         | -0.76           | 22156.1        | 84.39       | -0.71           | 23487.3        | 847.609     | 540571         |
| 570.0       | 3529.572      | -64.2662    | 31.2002       | 84.25         | -0.63           | 22514.2        | 84.57       | -0.60           | 23845.4        | 865.519     | 539252         |
| 575.0       | 3529.387      | -63.9134    | 31.2300       | 84.46         | -0.51           | 22883.6        | 84.76       | -0.48           | 24214.8        | 883.723     | 538154         |
| 580.0       | 3529.235      | -63.5545    | 31.2593       | 84.67         | -0.40           | 23263.8        | 84.96       | -0.38           | 24594.9        | 902.229     | 537267         |
| 585.0       | 3529.123      | -63.1893    | 31.2878       | 84.89         | -0.26           | 23653.9        | 85.16       | -0.25           | 24985.0        | 921.044     | 536619         |
| 590.0       | 3529.057      | -62.8178    | 31.3156       | 85.10         | -0.12           | 24054.9        | 85.36       | -0.12           | 25386.1        | 940.177     | 536243         |
| 593.340     | 3529.041      | -62.5659    | 31.3337       | 85.25         | -0.01           | 24327.5        | 85.50       | -0.01           | 25658.7        | 953.138     | 536166         |
| 595.0       | 3529.041      | -62.4399    | 31.3426       | 85.32         | 0.00            | 24351.1        | 85.57       | 0.00            | 25682.3        | 959.622     | 536175         |
| 600.0       | 3529.042      | -62.0601    | 31.3685       | 85.54         | 0.00            | 24352.4        | 85.77       | 0.00            | 25683.6        | 979.156     | 536210         |
| 603.340     | 3529.043      | -61.8063    | 31.3851       | 85.69         | 0.01            | 24352.7        | 85.91       | 0.00            | 25683.9        | 992.205     | 536233         |
| 605.0       | 3529.043      | -61.6801    | 31.3931       | 85.76         | 0.01            | 24352.6        | 85.98       | 0.01            | 25683.8        | 998.691     | 536247         |
| 610.0       | 3529.046      | -61.2998    | 31.4165       | 85.98         | 0.01            | 24352.8        | 86.19       | 0.01            | 25684.0        | 1018.226    | 536286         |
| 620.0       | 3529.052      | -60.5388    | 31.4596       | 86.43         | 0.01            | 24354.2        | 86.61       | 0.01            | 25685.5        | 1057.296    | 536372         |
| 630.0       | 3529.061      | -59.7770    | 31.4976       | 86.87         | 0.01            | 24355.5        | 87.03       | 0.01            | 25686.9        | 1096.369    | 536466         |

S-IVB GUIDANCE CUTOFF

|         |          |          |         |       |       |         |       |       |         |         |        |
|---------|----------|----------|---------|-------|-------|---------|-------|-------|---------|---------|--------|
| 593.340 | 3529.041 | -62.5659 | 31.3337 | 85.25 | -0.01 | 24327.5 | 85.50 | -0.01 | 25658.7 | 953.138 | 536166 |
| 595.0   | 3529.041 | -62.4399 | 31.3426 | 85.32 | 0.00  | 24351.1 | 85.57 | 0.00  | 25682.3 | 959.622 | 536175 |
| 600.0   | 3529.042 | -62.0601 | 31.3685 | 85.54 | 0.00  | 24352.4 | 85.77 | 0.00  | 25683.6 | 979.156 | 536210 |

ORBIT INSERTION

|         |          |          |         |       |      |         |       |      |         |          |        |
|---------|----------|----------|---------|-------|------|---------|-------|------|---------|----------|--------|
| 603.340 | 3529.043 | -61.8063 | 31.3851 | 85.69 | 0.01 | 24352.7 | 85.91 | 0.00 | 25683.9 | 992.205  | 536233 |
| 605.0   | 3529.043 | -61.6801 | 31.3931 | 85.76 | 0.01 | 24352.6 | 85.98 | 0.01 | 25683.8 | 998.691  | 536247 |
| 610.0   | 3529.046 | -61.2998 | 31.4165 | 85.98 | 0.01 | 24352.8 | 86.19 | 0.01 | 25684.0 | 1018.226 | 536286 |
| 620.0   | 3529.052 | -60.5388 | 31.4596 | 86.43 | 0.01 | 24354.2 | 86.61 | 0.01 | 25685.5 | 1057.296 | 536372 |
| 630.0   | 3529.061 | -59.7770 | 31.4976 | 86.87 | 0.01 | 24355.5 | 87.03 | 0.01 | 25686.9 | 1096.369 | 536466 |

TABLE XVI  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>NM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>FT/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>FT/S | RANGE<br>NM | ALTITUDE<br>FT |
|-------------|---------------|-------------|---------------|---------------|-----------------|----------------|-------------|-----------------|----------------|-------------|----------------|
| 640.0       | 3529.072      | -59.0146    | 31.5306       | 87.31         | 0.02            | 24356.6        | 87.45       | 0.02            | 25687.9        | 1135.444    | 536570         |
| 650.0       | 3529.085      | -58.2516    | 31.5586       | 87.76         | 0.02            | 24356.4        | 87.88       | 0.02            | 25687.8        | 1174.519    | 536683         |
| 660.0       | 3529.101      | -57.4882    | 31.5815       | 88.21         | 0.02            | 24356.2        | 88.30       | 0.02            | 25687.6        | 1213.594    | 536806         |
| 670.0       | 3529.120      | -56.7244    | 31.5993       | 88.65         | 0.03            | 24356.0        | 88.72       | 0.03            | 25687.4        | 1252.668    | 536938         |
| 680.0       | 3529.141      | -55.9604    | 31.6121       | 89.10         | 0.03            | 24355.8        | 89.15       | 0.03            | 25687.3        | 1291.742    | 537080         |
| 690.0       | 3529.164      | -55.1962    | 31.6198       | 89.54         | 0.04            | 24355.6        | 89.57       | 0.03            | 25687.1        | 1330.816    | 537231         |
| 700.0       | 3529.190      | -54.4320    | 31.6224       | 89.99         | 0.04            | 24355.4        | 89.99       | 0.04            | 25686.8        | 1369.888    | 537391         |
| 710.0       | 3529.219      | -53.6678    | 31.6200       | 90.44         | 0.04            | 24355.1        | 90.42       | 0.04            | 25686.6        | 1408.961    | 537561         |
| 720.0       | 3529.250      | -52.9036    | 31.6125       | 90.89         | 0.05            | 24354.9        | 90.84       | 0.04            | 25686.4        | 1448.032    | 537740         |
| 730.0       | 3529.283      | -52.1397    | 31.5999       | 91.33         | 0.05            | 24354.6        | 91.26       | 0.05            | 25686.1        | 1487.103    | 537929         |
| 740.0       | 3529.319      | -51.3760    | 31.5822       | 91.78         | 0.05            | 24354.4        | 91.69       | 0.05            | 25685.8        | 1526.173    | 538127         |
| 750.0       | 3529.357      | -50.6127    | 31.5595       | 92.22         | 0.06            | 24354.1        | 92.11       | 0.05            | 25685.6        | 1565.242    | 538334         |
| 760.0       | 3529.397      | -49.8498    | 31.5318       | 92.67         | 0.06            | 24353.8        | 92.53       | 0.06            | 25685.3        | 1604.311    | 538550         |
| 770.0       | 3529.440      | -49.0875    | 31.4989       | 93.11         | 0.06            | 24353.5        | 92.95       | 0.06            | 25684.9        | 1643.378    | 538775         |
| 780.0       | 3529.486      | -48.3259    | 31.4611       | 93.56         | 0.07            | 24353.2        | 93.37       | 0.06            | 25684.6        | 1682.445    | 539010         |
| 790.0       | 3529.534      | -47.5649    | 31.4182       | 94.00         | 0.07            | 24352.8        | 93.79       | 0.07            | 25684.3        | 1721.510    | 539254         |
| 800.0       | 3529.584      | -46.8047    | 31.3704       | 94.44         | 0.07            | 24352.5        | 94.21       | 0.07            | 25683.9        | 1760.575    | 539507         |
| 810.0       | 3529.637      | -46.0454    | 31.3175       | 94.88         | 0.08            | 24352.1        | 94.63       | 0.07            | 25683.5        | 1799.638    | 539769         |
| 820.0       | 3529.691      | -45.2871    | 31.2596       | 95.32         | 0.08            | 24351.8        | 95.04       | 0.08            | 25683.1        | 1838.701    | 540040         |
| 830.0       | 3529.749      | -44.5299    | 31.1968       | 95.76         | 0.08            | 24351.4        | 95.46       | 0.08            | 25682.7        | 1877.762    | 540320         |
| 840.0       | 3529.809      | -43.7737    | 31.1291       | 96.20         | 0.09            | 24351.0        | 95.87       | 0.08            | 25682.3        | 1916.822    | 540609         |
| 850.0       | 3529.871      | -43.0188    | 31.0564       | 96.63         | 0.09            | 24350.6        | 96.29       | 0.09            | 25681.9        | 1955.881    | 540908         |
| 860.0       | 3529.935      | -42.2652    | 30.9789       | 97.06         | 0.09            | 24350.2        | 96.70       | 0.09            | 25681.5        | 1994.938    | 541215         |
| 870.0       | 3530.002      | -41.5129    | 30.8964       | 97.50         | 0.10            | 24349.8        | 97.11       | 0.09            | 25681.0        | 2033.994    | 541531         |
| 880.0       | 3530.071      | -40.7620    | 30.8092       | 97.93         | 0.10            | 24349.4        | 97.51       | 0.10            | 25680.5        | 2073.049    | 541856         |
| 890.0       | 3530.142      | -40.0127    | 30.7171       | 98.36         | 0.10            | 24348.9        | 97.92       | 0.10            | 25680.0        | 2112.102    | 542190         |
| 900.0       | 3530.216      | -39.2649    | 30.6202       | 98.78         | 0.11            | 24348.5        | 98.32       | 0.10            | 25679.5        | 2151.154    | 542533         |
| 910.0       | 3530.292      | -38.5189    | 30.5185       | 99.21         | 0.11            | 24348.0        | 98.72       | 0.10            | 25679.0        | 2190.205    | 542885         |
| 920.0       | 3530.370      | -37.7745    | 30.4121       | 99.63         | 0.11            | 24347.6        | 99.12       | 0.11            | 25678.5        | 2229.254    | 543246         |
| 930.0       | 3530.450      | -37.0319    | 30.3010       | 100.05        | 0.12            | 24347.1        | 99.52       | 0.11            | 25678.0        | 2268.301    | 543615         |
| 940.0       | 3530.533      | -36.2911    | 30.1852       | 100.46        | 0.12            | 24346.6        | 99.92       | 0.11            | 25677.4        | 2307.347    | 543994         |
| 950.0       | 3530.618      | -35.5523    | 30.0648       | 100.88        | 0.12            | 24346.1        | 100.31      | 0.12            | 25676.8        | 2346.391    | 544381         |
| 960.0       | 3530.705      | -34.8155    | 29.9398       | 101.29        | 0.13            | 24345.6        | 100.70      | 0.12            | 25676.3        | 2385.433    | 544778         |
| 970.0       | 3530.794      | -34.0806    | 29.8102       | 101.70        | 0.13            | 24345.1        | 101.09      | 0.12            | 25675.7        | 2424.474    | 545183         |
| 980.0       | 3530.886      | -33.3479    | 29.6761       | 102.11        | 0.13            | 24344.5        | 101.47      | 0.13            | 25675.1        | 2463.513    | 545597         |
| 990.0       | 3530.979      | -32.6173    | 29.5375       | 102.51        | 0.14            | 24344.0        | 101.86      | 0.13            | 25674.5        | 2502.550    | 546019         |
| 1000.0      | 3531.075      | -31.8889    | 29.3944       | 102.91        | 0.14            | 24343.4        | 102.23      | 0.13            | 25673.8        | 2541.585    | 546450         |
| 1010.0      | 3531.173      | -31.1627    | 29.2469       | 103.31        | 0.14            | 24342.9        | 102.61      | 0.13            | 25673.2        | 2580.618    | 546891         |
| 1020.0      | 3531.273      | -30.4388    | 29.0950       | 103.71        | 0.14            | 24342.3        | 102.99      | 0.13            | 25672.5        | 2619.649    | 547339         |
| 1030.0      | 3531.375      | -29.7173    | 28.9388       | 104.10        | 0.15            | 24341.7        | 103.36      | 0.14            | 25671.8        | 2658.679    | 547798         |
| 1040.0      | 3531.479      | -28.9981    | 28.7784       | 104.49        | 0.15            | 24341.1        | 103.73      | 0.14            | 25671.2        | 2697.706    | 548264         |
| 1050.0      | 3531.585      | -28.2814    | 28.6136       | 104.88        | 0.15            | 24340.5        | 104.09      | 0.15            | 25670.5        | 2736.731    | 548739         |
| 1060.0      | 3531.694      | -27.5670    | 28.4447       | 105.26        | 0.16            | 24339.9        | 104.45      | 0.15            | 25669.8        | 2775.755    | 549223         |
| 1070.0      | 3531.804      | -26.8552    | 28.2715       | 105.64        | 0.16            | 24339.2        | 104.81      | 0.15            | 25669.0        | 2814.776    | 549715         |

TABLE XVI  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>NM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>FT/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>FT/S | RANGE<br>NM | ALTITUDE<br>FT |
|-------------|---------------|-------------|---------------|---------------|-----------------|----------------|-------------|-----------------|----------------|-------------|----------------|
| 1080.0      | 3531.916      | -26.1459    | 28.0943       | 106.02        | 0.16            | 24338.6        | 105.17      | 0.15            | 25668.3        | 2853.794    | 550216         |
| 1090.0      | 3532.031      | -25.4392    | 27.9130       | 106.39        | 0.16            | 24338.0        | 105.52      | 0.16            | 25667.6        | 2892.811    | 550726         |
| 1100.0      | 3532.147      | -24.7350    | 27.7276       | 106.76        | 0.17            | 24337.3        | 105.87      | 0.16            | 25666.8        | 2931.825    | 551244         |
| 1110.0      | 3532.265      | -24.0335    | 27.5383       | 107.13        | 0.17            | 24336.6        | 106.21      | 0.16            | 25666.0        | 2970.837    | 551771         |
| 1120.0      | 3532.385      | -23.3346    | 27.3450       | 107.49        | 0.17            | 24335.9        | 106.56      | 0.16            | 25665.2        | 3009.847    | 552308         |
| 1130.0      | 3532.507      | -22.6383    | 27.1479       | 107.85        | 0.18            | 24335.2        | 106.90      | 0.17            | 25664.5        | 3048.854    | 552852         |
| 1140.0      | 3532.631      | -21.9448    | 26.9469       | 108.20        | 0.18            | 24334.5        | 107.23      | 0.17            | 25663.6        | 3087.858    | 553405         |
| 1150.0      | 3532.757      | -21.2539    | 26.7421       | 108.56        | 0.18            | 24333.8        | 107.56      | 0.17            | 25662.8        | 3126.861    | 553966         |
| 1160.0      | 3532.884      | -20.5657    | 26.5336       | 108.90        | 0.18            | 24333.1        | 107.89      | 0.17            | 25662.0        | 3165.860    | 554537         |
| 1170.0      | 3533.014      | -19.8803    | 26.3213       | 109.25        | 0.19            | 24332.4        | 108.21      | 0.18            | 25661.2        | 3204.857    | 555116         |
| 1180.0      | 3533.145      | -19.1976    | 26.1055       | 109.59        | 0.19            | 24331.6        | 108.54      | 0.18            | 25660.3        | 3243.852    | 555703         |
| 1190.0      | 3533.278      | -18.5176    | 25.8860       | 109.92        | 0.19            | 24330.9        | 108.85      | 0.18            | 25659.4        | 3282.843    | 556299         |
| 1200.0      | 3533.413      | -17.8404    | 25.6629       | 110.26        | 0.19            | 24330.1        | 109.17      | 0.18            | 25658.6        | 3321.833    | 556903         |
| 1210.0      | 3533.550      | -17.1660    | 25.4364       | 110.59        | 0.20            | 24329.3        | 109.48      | 0.19            | 25657.7        | 3360.819    | 557516         |
| 1220.0      | 3533.688      | -16.4943    | 25.2064       | 110.91        | 0.20            | 24328.5        | 109.78      | 0.19            | 25656.8        | 3399.802    | 558137         |
| 1230.0      | 3533.828      | -15.8254    | 24.9731       | 111.23        | 0.20            | 24327.7        | 110.08      | 0.19            | 25655.9        | 3438.783    | 558767         |
| 1240.0      | 3533.969      | -15.1592    | 24.7363       | 111.55        | 0.20            | 24326.9        | 110.38      | 0.19            | 25655.0        | 3477.761    | 559405         |
| 1250.0      | 3534.113      | -14.4959    | 24.4963       | 111.86        | 0.21            | 24326.1        | 110.68      | 0.20            | 25654.0        | 3516.735    | 560053         |
| 1260.0      | 3534.257      | -13.8353    | 24.2530       | 112.17        | 0.21            | 24325.3        | 110.97      | 0.20            | 25653.1        | 3555.707    | 560708         |
| 1270.0      | 3534.404      | -13.1774    | 24.0065       | 112.48        | 0.21            | 24324.5        | 111.25      | 0.20            | 25652.1        | 3594.676    | 561372         |
| 1280.0      | 3534.552      | -12.5223    | 23.7569       | 112.78        | 0.21            | 24323.7        | 111.54      | 0.20            | 25651.2        | 3633.641    | 562044         |
| 1290.0      | 3534.701      | -11.8700    | 23.5041       | 113.07        | 0.22            | 24322.9        | 111.82      | 0.20            | 25650.2        | 3672.604    | 562725         |
| 1300.0      | 3534.852      | -11.2203    | 23.2483       | 113.37        | 0.22            | 24322.1        | 112.09      | 0.21            | 25649.2        | 3711.563    | 563414         |
| 1310.0      | 3535.005      | -10.5734    | 22.9896       | 113.65        | 0.22            | 24321.0        | 112.36      | 0.21            | 25648.2        | 3750.520    | 564111         |
| 1320.0      | 3535.159      | -9.9293     | 22.7278       | 113.94        | 0.22            | 24320.1        | 112.63      | 0.21            | 25647.2        | 3789.473    | 564816         |
| 1330.0      | 3535.314      | -9.2878     | 22.4632       | 114.22        | 0.22            | 24319.2        | 112.89      | 0.21            | 25646.2        | 3828.422    | 565530         |
| 1340.0      | 3535.471      | -8.6490     | 22.1957       | 114.50        | 0.23            | 24318.3        | 113.15      | 0.21            | 25645.2        | 3867.368    | 566253         |
| 1350.0      | 3535.630      | -8.0128     | 21.9254       | 114.77        | 0.23            | 24317.4        | 113.41      | 0.22            | 25644.1        | 3906.311    | 566983         |
| 1360.0      | 3535.789      | -7.3793     | 21.6524       | 115.04        | 0.23            | 24316.4        | 113.66      | 0.22            | 25643.1        | 3945.251    | 567722         |
| 1370.0      | 3535.950      | -6.7484     | 21.3766       | 115.30        | 0.23            | 24315.5        | 113.91      | 0.22            | 25642.0        | 3984.187    | 568468         |
| 1380.0      | 3536.113      | -6.1202     | 21.0982       | 115.56        | 0.23            | 24314.6        | 114.15      | 0.22            | 25641.0        | 4023.119    | 569224         |
| 1390.0      | 3536.276      | -5.4945     | 20.8172       | 115.81        | 0.24            | 24313.6        | 114.39      | 0.22            | 25639.9        | 4062.048    | 569987         |
| 1400.0      | 3536.441      | -4.8713     | 20.5337       | 116.07        | 0.24            | 24312.6        | 114.62      | 0.22            | 25638.8        | 4100.973    | 570759         |
| 1410.0      | 3536.607      | -4.2507     | 20.2476       | 116.31        | 0.24            | 24311.6        | 114.86      | 0.23            | 25637.7        | 4139.895    | 571538         |
| 1420.0      | 3536.774      | -3.6326     | 19.9591       | 116.56        | 0.24            | 24310.7        | 115.08      | 0.23            | 25636.6        | 4178.813    | 572325         |
| 1430.0      | 3536.943      | -3.0170     | 19.6681       | 116.79        | 0.24            | 24309.7        | 115.31      | 0.23            | 25635.5        | 4217.727    | 573121         |
| 1440.0      | 3537.112      | -2.4039     | 19.3749       | 117.03        | 0.24            | 24308.6        | 115.53      | 0.23            | 25634.4        | 4256.637    | 573924         |
| 1450.0      | 3537.283      | -1.7932     | 19.0793       | 117.26        | 0.25            | 24307.6        | 115.74      | 0.23            | 25633.3        | 4295.544    | 574736         |
| 1460.0      | 3537.455      | -1.1848     | 18.7814       | 117.48        | 0.25            | 24306.6        | 115.95      | 0.23            | 25632.1        | 4334.446    | 575556         |
| 1470.0      | 3537.628      | -0.5789     | 18.4813       | 117.71        | 0.25            | 24305.6        | 116.16      | 0.24            | 25631.0        | 4373.345    | 576383         |
| 1480.0      | 3537.802      | 0.0247      | 18.1790       | 117.92        | 0.25            | 24304.5        | 116.36      | 0.24            | 25629.9        | 4412.240    | 577218         |
| 1490.0      | 3537.977      | 0.6261      | 17.8747       | 118.14        | 0.25            | 24303.5        | 116.56      | 0.24            | 25628.7        | 4451.131    | 578061         |
| 1500.0      | 3538.153      | 1.2251      | 17.5682       | 118.35        | 0.25            | 24302.4        | 116.76      | 0.24            | 25627.5        | 4490.017    | 578911         |
| 1510.0      | 3538.330      | 1.8219      | 17.2597       | 118.55        | 0.25            | 24301.3        | 116.95      | 0.24            | 25626.4        | 4528.900    | 579770         |

TABLE XVI  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>NM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>FT/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>FT/S | RANGE<br>NM | ALTITUDE<br>FT |
|-------------|---------------|-------------|---------------|---------------|-----------------|----------------|-------------|-----------------|----------------|-------------|----------------|
| 1520.0      | 3538.508      | 2.4165      | 16.9492       | 118.75        | 0.26            | 24300.2        | 117.14      | 0.24            | 25625.2        | 4567.778    | 580636         |
| 1530.0      | 3538.686      | 3.0090      | 16.6368       | 118.95        | 0.26            | 24299.1        | 117.32      | 0.24            | 25624.0        | 4606.652    | 581509         |
| 1540.0      | 3538.866      | 3.5993      | 16.3225       | 119.14        | 0.26            | 24298.0        | 117.50      | 0.24            | 25622.8        | 4645.522    | 582390         |
| 1550.0      | 3539.047      | 4.1875      | 16.0064       | 119.33        | 0.26            | 24296.9        | 117.68      | 0.25            | 25621.6        | 4684.388    | 583279         |
| 1560.0      | 3539.228      | 4.7736      | 15.6884       | 119.51        | 0.26            | 24295.8        | 117.85      | 0.25            | 25620.4        | 4723.249    | 584175         |
| 1570.0      | 3539.410      | 5.3577      | 15.3687       | 119.69        | 0.26            | 24294.6        | 118.02      | 0.25            | 25619.1        | 4762.106    | 585078         |
| 1580.0      | 3539.593      | 5.9398      | 15.0473       | 119.87        | 0.26            | 24293.5        | 118.18      | 0.25            | 25617.9        | 4800.959    | 585989         |
| 1590.0      | 3539.776      | 6.5200      | 14.7241       | 120.04        | 0.26            | 24292.4        | 118.34      | 0.25            | 25616.7        | 4839.807    | 586907         |
| 1600.0      | 3539.961      | 7.0983      | 14.3994       | 120.21        | 0.26            | 24291.2        | 118.50      | 0.25            | 25615.5        | 4878.651    | 587832         |
| 1610.0      | 3540.146      | 7.6747      | 14.0731       | 120.37        | 0.27            | 24290.0        | 118.65      | 0.25            | 25614.2        | 4917.490    | 588765         |
| 1620.0      | 3540.331      | 8.2492      | 13.7453       | 120.53        | 0.27            | 24288.8        | 118.80      | 0.25            | 25613.0        | 4956.324    | 589704         |
| 1630.0      | 3540.517      | 8.8220      | 13.4159       | 120.69        | 0.27            | 24287.7        | 118.95      | 0.25            | 25611.7        | 4995.154    | 590651         |
| 1640.0      | 3540.704      | 9.3930      | 13.0851       | 120.84        | 0.27            | 24286.5        | 119.09      | 0.25            | 25610.4        | 5033.980    | 591604         |
| 1650.0      | 3540.891      | 9.9623      | 12.7529       | 120.99        | 0.27            | 24285.3        | 119.22      | 0.26            | 25609.2        | 5072.800    | 592564         |
| 1660.0      | 3541.079      | 10.5299     | 12.4193       | 121.13        | 0.27            | 24284.0        | 119.36      | 0.26            | 25607.9        | 5111.616    | 593531         |
| 1670.0      | 3541.268      | 11.0960     | 12.0844       | 121.27        | 0.27            | 24282.8        | 119.49      | 0.26            | 25606.6        | 5150.427    | 594504         |
| 1680.0      | 3541.456      | 11.6604     | 11.7482       | 121.40        | 0.27            | 24281.6        | 119.61      | 0.26            | 25605.3        | 5189.234    | 595485         |
| 1690.0      | 3541.646      | 12.2232     | 11.4108       | 121.53        | 0.27            | 24280.4        | 119.73      | 0.26            | 25604.0        | 5228.035    | 596471         |
| 1700.0      | 3541.835      | 12.7846     | 11.0721       | 121.66        | 0.27            | 24279.1        | 119.85      | 0.26            | 25602.7        | 5266.832    | 597465         |
| 1710.0      | 3542.026      | 13.3445     | 10.7323       | 121.78        | 0.27            | 24277.9        | 119.97      | 0.26            | 25601.4        | 5305.623    | 598464         |
| 1720.0      | 3542.216      | 13.9030     | 10.3914       | 121.90        | 0.27            | 24276.6        | 120.08      | 0.26            | 25600.1        | 5344.410    | 599470         |
| 1730.0      | 3542.407      | 14.4601     | 10.0494       | 122.02        | 0.27            | 24275.3        | 120.18      | 0.26            | 25598.8        | 5383.192    | 600482         |
| 1740.0      | 3542.598      | 15.0159     | 9.7064        | 122.13        | 0.27            | 24274.1        | 120.29      | 0.26            | 25597.5        | 5421.969    | 601500         |
| 1750.0      | 3542.789      | 15.5704     | 9.3623        | 122.23        | 0.27            | 24272.8        | 120.38      | 0.26            | 25596.2        | 5460.740    | 602524         |
| 1760.0      | 3542.981      | 16.1236     | 9.0173        | 122.34        | 0.27            | 24271.5        | 120.48      | 0.26            | 25594.9        | 5499.507    | 603554         |
| 1770.0      | 3543.172      | 16.6757     | 8.6714        | 122.44        | 0.28            | 24270.2        | 120.57      | 0.26            | 25593.5        | 5538.268    | 604590         |
| 1780.0      | 3543.364      | 17.2266     | 8.3246        | 122.53        | 0.28            | 24268.9        | 120.66      | 0.26            | 25592.2        | 5577.024    | 605631         |
| 1790.0      | 3543.556      | 17.7763     | 7.9769        | 122.62        | 0.28            | 24267.6        | 120.74      | 0.26            | 25590.9        | 5615.775    | 606678         |
| 1800.0      | 3543.748      | 18.3250     | 7.6285        | 122.71        | 0.28            | 24266.2        | 120.82      | 0.26            | 25589.5        | 5654.521    | 607730         |
| 1810.0      | 3543.941      | 18.8727     | 7.2793        | 122.79        | 0.28            | 24264.9        | 120.90      | 0.26            | 25588.2        | 5693.262    | 608788         |
| 1820.0      | 3544.133      | 19.4194     | 6.9293        | 122.87        | 0.28            | 24263.6        | 120.97      | 0.26            | 25586.9        | 5731.997    | 609851         |
| 1830.0      | 3544.325      | 19.9651     | 6.5787        | 122.94        | 0.28            | 24262.2        | 121.04      | 0.26            | 25585.5        | 5770.727    | 610919         |
| 1840.0      | 3544.518      | 20.5100     | 6.2274        | 123.01        | 0.28            | 24260.9        | 121.11      | 0.26            | 25584.2        | 5809.452    | 611992         |
| 1850.0      | 3544.710      | 21.0540     | 5.8756        | 123.08        | 0.28            | 24259.5        | 121.17      | 0.26            | 25582.8        | 5848.171    | 613070         |
| 1860.0      | 3544.902      | 21.5972     | 5.5231        | 123.14        | 0.28            | 24258.2        | 121.23      | 0.26            | 25581.5        | 5886.885    | 614152         |
| 1870.0      | 3545.095      | 22.1396     | 5.1701        | 123.20        | 0.28            | 24256.8        | 121.28      | 0.26            | 25580.1        | 5925.593    | 615239         |
| 1880.0      | 3545.287      | 22.6814     | 4.8166        | 123.26        | 0.28            | 24255.4        | 121.33      | 0.26            | 25578.8        | 5964.296    | 616331         |
| 1890.0      | 3545.479      | 23.2224     | 4.4627        | 123.31        | 0.28            | 24254.1        | 121.38      | 0.26            | 25577.4        | 6002.994    | 617427         |
| 1900.0      | 3545.670      | 23.7628     | 4.1083        | 123.36        | 0.28            | 24252.7        | 121.43      | 0.26            | 25576.0        | 6041.686    | 618528         |
| 1910.0      | 3545.862      | 24.3027     | 3.7535        | 123.40        | 0.27            | 24251.3        | 121.47      | 0.26            | 25574.7        | 6080.372    | 619632         |
| 1920.0      | 3546.053      | 24.8420     | 3.3984        | 123.44        | 0.27            | 24249.9        | 121.50      | 0.26            | 25573.3        | 6119.053    | 620740         |
| 1930.0      | 3546.245      | 25.3808     | 3.0430        | 123.47        | 0.27            | 24248.5        | 121.53      | 0.26            | 25572.0        | 6157.728    | 621853         |
| 1940.0      | 3546.435      | 25.9192     | 2.6873        | 123.51        | 0.27            | 24247.1        | 121.56      | 0.26            | 25570.6        | 6196.398    | 622969         |
| 1950.0      | 3546.626      | 26.4572     | 2.3314        | 123.53        | 0.27            | 24245.7        | 121.59      | 0.26            | 25569.2        | 6235.062    | 624088         |



TABLE XVI  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>NM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>FT/S | HEAD<br>DEG | FLT-PATH<br>DEG | SF VEL<br>FT/S | RANGE<br>NM | ALTITUDE<br>FT |
|-------------|---------------|-------------|---------------|---------------|-----------------|----------------|-------------|-----------------|----------------|-------------|----------------|
| 1960.0      | 3546.816      | 26.9948     | 1.9753        | 123.56        | 0.27            | 24244.3        | 121.61      | 0.26            | 25567.9        | 6273.720    | 625211         |
| 1970.0      | 3547.006      | 27.5321     | 1.6190        | 123.58        | 0.27            | 24242.9        | 121.63      | 0.26            | 25566.5        | 6312.373    | 626337         |
| 1980.0      | 3547.195      | 28.0691     | 1.2626        | 123.59        | 0.27            | 24241.5        | 121.64      | 0.26            | 25565.1        | 6351.020    | 627466         |
| 1990.0      | 3547.384      | 28.6060     | 0.9061        | 123.60        | 0.27            | 24240.0        | 121.65      | 0.26            | 25563.8        | 6389.662    | 628598         |
| 2000.0      | 3547.573      | 29.1426     | 0.5495        | 123.61        | 0.27            | 24238.6        | 121.66      | 0.26            | 25562.4        | 6428.297    | 629733         |
| 2010.0      | 3547.761      | 29.6791     | 0.1929        | 123.62        | 0.27            | 24237.2        | 121.67      | 0.26            | 25561.0        | 6466.927    | 630870         |
| 2020.0      | 3547.949      | 30.2156     | -0.1637       | 123.62        | 0.27            | 24235.8        | 121.67      | 0.26            | 25559.7        | 6505.551    | 632010         |
| 2030.0      | 3548.136      | 30.7520     | -0.5202       | 123.61        | 0.27            | 24234.3        | 121.66      | 0.25            | 25558.3        | 6544.170    | 633152         |
| 2040.0      | 3548.323      | 31.2883     | -0.8766       | 123.61        | 0.27            | 24232.9        | 121.66      | 0.25            | 25556.9        | 6582.783    | 634297         |
| 2050.0      | 3548.509      | 31.8248     | -1.2329       | 123.59        | 0.27            | 24231.4        | 121.64      | 0.25            | 25555.6        | 6621.389    | 635443         |
| 2060.0      | 3548.694      | 32.3613     | -1.5890       | 123.58        | 0.27            | 24230.0        | 121.63      | 0.25            | 25554.2        | 6659.990    | 636591         |
| 2070.0      | 3548.879      | 32.8980     | -1.9449       | 123.56        | 0.26            | 24228.6        | 121.61      | 0.25            | 25552.9        | 6698.586    | 637740         |
| 2080.0      | 3549.063      | 33.4349     | -2.3006       | 123.54        | 0.26            | 24227.1        | 121.59      | 0.25            | 25551.5        | 6737.175    | 638891         |
| 2090.0      | 3549.246      | 33.9720     | -2.6561       | 123.51        | 0.26            | 24225.7        | 121.57      | 0.25            | 25550.2        | 6775.759    | 640043         |
| 2100.0      | 3549.429      | 34.5093     | -3.0112       | 123.48        | 0.26            | 24224.2        | 121.54      | 0.25            | 25548.8        | 6814.336    | 641196         |
| 2110.0      | 3549.611      | 35.0470     | -3.3659       | 123.45        | 0.26            | 24222.8        | 121.50      | 0.25            | 25547.5        | 6852.908    | 642351         |
| 2120.0      | 3549.792      | 35.5850     | -3.7203       | 123.41        | 0.26            | 24221.3        | 121.47      | 0.25            | 25546.1        | 6891.474    | 643506         |
| 2130.0      | 3549.972      | 36.1235     | -4.0743       | 123.36        | 0.26            | 24219.9        | 121.43      | 0.25            | 25544.8        | 6930.034    | 644661         |
| 2140.0      | 3550.152      | 36.6624     | -4.4278       | 123.32        | 0.26            | 24218.4        | 121.39      | 0.24            | 25543.4        | 6968.589    | 645817         |
| 2150.0      | 3550.331      | 37.2018     | -4.7808       | 123.27        | 0.26            | 24216.9        | 121.34      | 0.24            | 25542.1        | 7007.137    | 646973         |
| 2160.0      | 3550.509      | 37.7417     | -5.1333       | 123.21        | 0.26            | 24215.5        | 121.29      | 0.24            | 25540.8        | 7045.680    | 648129         |
| 2170.0      | 3550.686      | 38.2822     | -5.4852       | 123.16        | 0.25            | 24214.0        | 121.23      | 0.24            | 25539.4        | 7084.216    | 649285         |
| 2180.0      | 3550.862      | 38.8234     | -5.8365       | 123.09        | 0.25            | 24212.6        | 121.18      | 0.24            | 25538.1        | 7122.747    | 650440         |
| 2190.0      | 3551.037      | 39.3652     | -6.1872       | 123.03        | 0.25            | 24211.1        | 121.12      | 0.24            | 25536.8        | 7161.272    | 651595         |
| 2200.0      | 3551.212      | 39.9078     | -6.5372       | 122.96        | 0.25            | 24209.7        | 121.05      | 0.24            | 25535.5        | 7199.791    | 652748         |
| 2210.0      | 3551.385      | 40.4511     | -6.8865       | 122.89        | 0.25            | 24208.2        | 120.98      | 0.24            | 25534.2        | 7238.304    | 653901         |
| 2220.0      | 3551.557      | 40.9952     | -7.2351       | 122.81        | 0.25            | 24206.8        | 120.91      | 0.23            | 25532.8        | 7276.811    | 655053         |
| 2230.0      | 3551.728      | 41.5401     | -7.5829       | 122.73        | 0.25            | 24205.3        | 120.83      | 0.23            | 25531.5        | 7315.312    | 656203         |
| 2240.0      | 3551.899      | 42.0860     | -7.9298       | 122.64        | 0.24            | 24203.9        | 120.75      | 0.23            | 25530.2        | 7353.807    | 657352         |
| 2250.0      | 3552.068      | 42.6327     | -8.2759       | 122.55        | 0.24            | 24202.4        | 120.67      | 0.23            | 25528.9        | 7392.297    | 658498         |
| 2260.0      | 3552.236      | 43.1805     | -8.6211       | 122.46        | 0.24            | 24201.0        | 120.58      | 0.23            | 25527.7        | 7430.780    | 659642         |
| 2270.0      | 3552.403      | 43.7293     | -8.9653       | 122.36        | 0.24            | 24199.5        | 120.49      | 0.23            | 25526.4        | 7469.258    | 660785         |
| 2280.0      | 3552.569      | 44.2791     | -9.3086       | 122.26        | 0.24            | 24198.1        | 120.40      | 0.23            | 25525.1        | 7507.729    | 661925         |
| 2290.0      | 3552.733      | 44.8301     | -9.6508       | 122.16        | 0.24            | 24196.7        | 120.30      | 0.22            | 25523.8        | 7546.195    | 663062         |
| 2300.0      | 3552.897      | 45.3822     | -9.9920       | 122.05        | 0.23            | 24195.2        | 120.20      | 0.22            | 25522.6        | 7584.655    | 664197         |
| 2310.0      | 3553.059      | 45.9355     | -10.3322      | 121.93        | 0.23            | 24193.8        | 120.09      | 0.22            | 25521.3        | 7623.109    | 665329         |
| 2320.0      | 3553.220      | 46.4900     | -10.6711      | 121.82        | 0.23            | 24192.4        | 119.99      | 0.22            | 25520.1        | 7661.557    | 666456         |
| 2330.0      | 3553.380      | 47.0458     | -11.0090      | 121.70        | 0.23            | 24191.0        | 119.87      | 0.22            | 25518.8        | 7699.999    | 667581         |
| 2340.0      | 3553.538      | 47.6029     | -11.3456      | 121.57        | 0.23            | 24189.6        | 119.76      | 0.22            | 25517.6        | 7738.435    | 668702         |
| 2350.0      | 3553.696      | 48.1614     | -11.6810      | 121.44        | 0.23            | 24188.2        | 119.64      | 0.21            | 25516.3        | 7776.866    | 669819         |
| 2360.0      | 3553.852      | 48.7212     | -12.0150      | 121.31        | 0.22            | 24186.7        | 119.51      | 0.21            | 25515.1        | 7815.290    | 670932         |
| 2370.0      | 3554.006      | 49.2825     | -12.3478      | 121.17        | 0.22            | 24185.3        | 119.38      | 0.21            | 25513.9        | 7853.709    | 672040         |
| 2380.0      | 3554.160      | 49.8453     | -12.6792      | 121.03        | 0.22            | 24184.0        | 119.25      | 0.21            | 25512.7        | 7892.121    | 673144         |
| 2390.0      | 3554.311      | 50.4096     | -13.0092      | 120.89        | 0.22            | 24182.6        | 119.12      | 0.21            | 25511.5        | 7930.528    | 674243         |

TABLE XVI  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>NM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>FT/S | HEAD<br>DEG | FLI-PATH<br>DEG | SF VEL<br>FT/S | RANGE<br>NM | ALTITUDE<br>FT |
|-------------|---------------|-------------|---------------|---------------|-----------------|----------------|-------------|-----------------|----------------|-------------|----------------|
| 2400.0      | 3554.462      | 50.9755     | -13.3378      | 120.74        | 0.22            | 24181.2        | 118.98      | 0.20            | 25510.3        | 7968.928    | 675337         |
| 2410.0      | 3554.611      | 51.5430     | -13.6648      | 120.59        | 0.21            | 24179.8        | 118.84      | 0.20            | 25509.1        | 8007.323    | 676426         |
| 2420.0      | 3554.759      | 52.1121     | -13.9904      | 120.43        | 0.21            | 24178.4        | 118.69      | 0.20            | 25508.0        | 8045.712    | 677509         |
| 2430.0      | 3554.905      | 52.6829     | -14.3144      | 120.27        | 0.21            | 24177.1        | 118.54      | 0.20            | 25506.8        | 8084.095    | 678587         |
| 2440.0      | 3555.050      | 53.2554     | -14.6367      | 120.10        | 0.21            | 24175.7        | 118.39      | 0.20            | 25505.6        | 8122.472    | 679659         |
| 2450.0      | 3555.193      | 53.8297     | -14.9575      | 119.93        | 0.21            | 24174.4        | 118.23      | 0.19            | 25504.5        | 8160.843    | 680725         |
| 2460.0      | 3555.335      | 54.4057     | -15.2765      | 119.76        | 0.20            | 24173.0        | 118.07      | 0.19            | 25503.4        | 8199.208    | 681784         |
| 2470.0      | 3555.475      | 54.9836     | -15.5938      | 119.58        | 0.20            | 24171.7        | 117.90      | 0.19            | 25502.2        | 8237.567    | 682837         |
| 2480.0      | 3555.614      | 55.5633     | -15.9094      | 119.40        | 0.20            | 24170.4        | 117.73      | 0.19            | 25501.1        | 8275.920    | 683884         |
| 2490.0      | 3555.751      | 56.1450     | -16.2231      | 119.22        | 0.20            | 24169.1        | 117.56      | 0.19            | 25500.0        | 8314.267    | 684923         |
| 2500.0      | 3555.887      | 56.7286     | -16.5349      | 119.03        | 0.19            | 24167.8        | 117.38      | 0.18            | 25498.9        | 8352.607    | 685954         |
| 2510.0      | 3556.021      | 57.3141     | -16.8449      | 118.84        | 0.19            | 24166.5        | 117.20      | 0.18            | 25497.8        | 8390.942    | 686979         |
| 2520.0      | 3556.154      | 57.9017     | -17.1530      | 118.64        | 0.19            | 24165.2        | 117.02      | 0.18            | 25496.7        | 8429.271    | 687996         |
| 2530.0      | 3556.285      | 58.4913     | -17.4590      | 118.44        | 0.19            | 24163.9        | 116.83      | 0.18            | 25495.7        | 8467.593    | 689005         |
| 2540.0      | 3556.414      | 59.0829     | -17.7630      | 118.23        | 0.19            | 24162.6        | 116.64      | 0.18            | 25494.6        | 8505.909    | 690006         |
| 2550.0      | 3556.541      | 59.6767     | -18.0650      | 118.02        | 0.18            | 24161.4        | 116.44      | 0.17            | 25493.6        | 8544.219    | 690998         |
| 2560.0      | 3556.667      | 60.2726     | -18.3648      | 117.81        | 0.18            | 24160.1        | 116.24      | 0.17            | 25492.5        | 8582.523    | 691983         |
| 2570.0      | 3556.792      | 60.8707     | -18.6625      | 117.59        | 0.18            | 24158.9        | 116.04      | 0.17            | 25491.5        | 8620.820    | 692958         |
| 2580.0      | 3556.914      | 61.4710     | -18.9580      | 117.37        | 0.18            | 24157.7        | 115.83      | 0.17            | 25490.5        | 8659.111    | 693925         |
| 2590.0      | 3557.035      | 62.0735     | -19.2512      | 117.14        | 0.17            | 24156.4        | 115.62      | 0.16            | 25489.5        | 8697.395    | 694882         |
| 2600.0      | 3557.154      | 62.6782     | -19.5421      | 116.91        | 0.17            | 24155.2        | 115.40      | 0.16            | 25488.5        | 8735.673    | 695830         |
| 2610.0      | 3557.272      | 63.2853     | -19.8308      | 116.68        | 0.17            | 24154.1        | 115.18      | 0.16            | 25487.5        | 8773.944    | 696768         |
| 2620.0      | 3557.387      | 63.8946     | -20.1170      | 116.44        | 0.17            | 24152.9        | 114.96      | 0.16            | 25486.6        | 8812.208    | 697697         |
| 2630.0      | 3557.501      | 64.5063     | -20.4008      | 116.20        | 0.16            | 24151.7        | 114.73      | 0.15            | 25485.6        | 8850.465    | 698616         |
| 2640.0      | 3557.613      | 65.1204     | -20.6821      | 115.95        | 0.16            | 24150.6        | 114.50      | 0.15            | 25484.7        | 8888.715    | 699524         |
| 2650.0      | 3557.724      | 65.7368     | -20.9609      | 115.70        | 0.16            | 24149.4        | 114.27      | 0.15            | 25483.8        | 8926.958    | 700422         |
| 2660.0      | 3557.832      | 66.3556     | -21.2372      | 115.45        | 0.16            | 24148.3        | 114.03      | 0.15            | 25482.8        | 8965.194    | 701309         |
| 2670.0      | 3557.939      | 66.9769     | -21.5109      | 115.19        | 0.15            | 24147.2        | 113.79      | 0.14            | 25481.9        | 9003.421    | 702186         |
| 2680.0      | 3558.044      | 67.6006     | -21.7819      | 114.93        | 0.15            | 24146.1        | 113.54      | 0.14            | 25481.1        | 9041.641    | 703052         |
| 2690.0      | 3558.147      | 68.2268     | -22.0502      | 114.66        | 0.15            | 24145.0        | 113.29      | 0.14            | 25480.2        | 9079.853    | 703906         |
| 2700.0      | 3558.248      | 68.8555     | -22.3157      | 114.39        | 0.14            | 24143.9        | 113.04      | 0.14            | 25479.3        | 9118.057    | 704749         |
| 2710.0      | 3558.347      | 69.4867     | -22.5785      | 114.12        | 0.14            | 24142.9        | 112.78      | 0.13            | 25478.5        | 9156.252    | 705580         |
| 2720.0      | 3558.445      | 70.1204     | -22.8384      | 113.84        | 0.14            | 24141.8        | 112.52      | 0.13            | 25477.6        | 9194.438    | 706400         |
| 2730.0      | 3558.540      | 70.7566     | -23.0955      | 113.56        | 0.14            | 24140.8        | 112.25      | 0.13            | 25476.8        | 9232.615    | 707207         |
| 2740.0      | 3558.634      | 71.3954     | -23.3496      | 113.27        | 0.13            | 24139.8        | 111.98      | 0.13            | 25476.0        | 9270.782    | 708003         |
| 2750.0      | 3558.725      | 72.0367     | -23.6008      | 112.98        | 0.13            | 24138.8        | 111.71      | 0.12            | 25475.2        | 9308.939    | 708785         |
| 2760.0      | 3558.815      | 72.6807     | -23.8489      | 112.68        | 0.13            | 24137.8        | 111.43      | 0.12            | 25474.5        | 9347.086    | 709556         |
| 2770.0      | 3558.903      | 73.3272     | -24.0940      | 112.39        | 0.13            | 24136.8        | 111.15      | 0.12            | 25473.7        | 9385.221    | 710313         |
| 2780.0      | 3558.989      | 73.9762     | -24.3359      | 112.08        | 0.12            | 24135.9        | 110.87      | 0.12            | 25472.9        | 9423.345    | 711058         |
| 2790.0      | 3559.073      | 74.6279     | -24.5747      | 111.78        | 0.12            | 24135.0        | 110.58      | 0.11            | 25472.2        | 9461.456    | 711789         |
| 2800.0      | 3559.155      | 75.2822     | -24.8103      | 111.47        | 0.12            | 24134.0        | 110.29      | 0.11            | 25471.5        | 9499.553    | 712508         |
| 2810.0      | 3559.235      | 75.9391     | -25.0426      | 111.15        | 0.11            | 24133.1        | 109.99      | 0.11            | 25470.8        | 9537.637    | 713212         |
| 2820.0      | 3559.313      | 76.5986     | -25.2717      | 110.84        | 0.11            | 24132.3        | 109.69      | 0.11            | 25470.1        | 9575.705    | 713903         |
| 2830.0      | 3559.389      | 77.2607     | -25.4974      | 110.51        | 0.11            | 24131.4        | 109.39      | 0.10            | 25469.4        | 9613.757    | 714580         |

TABLE XVI  
GEOGRAPHIC COORDINATES

| TIME<br>SEC | EC DIST<br>NM | LONG<br>DEG | GC LAT<br>DEG | VEL-AZ<br>DEG | VEL-ELEV<br>DEG | EF VEL<br>FT/S | HEAD<br>DEG | FLI-PATH<br>DEG | SF VEL<br>FT/S | RANGE<br>NM | ALTITUDE<br>FT |
|-------------|---------------|-------------|---------------|---------------|-----------------|----------------|-------------|-----------------|----------------|-------------|----------------|
| 2840.0      | 3559.463      | 77.9254     | -25.7197      | 110.19        | 0.11            | 24130.5        | 109.09      | 0.10            | 25468.8        | 9651.791    | 715243         |
| 2850.0      | 3559.535      | 78.5927     | -25.9385      | 109.86        | 0.10            | 24129.7        | 108.78      | 0.10            | 25468.1        | 9689.805    | 715892         |
| 2860.0      | 3559.606      | 79.2625     | -26.1539      | 109.53        | 0.10            | 24128.9        | 108.46      | 0.09            | 25467.5        | 9727.799    | 716527         |
| 2870.0      | 3559.674      | 79.9350     | -26.3658      | 109.19        | 0.10            | 24128.1        | 108.15      | 0.09            | 25466.9        | 9765.769    | 717147         |
| 2880.0      | 3559.740      | 80.6100     | -26.5740      | 108.85        | 0.09            | 24127.3        | 107.83      | 0.09            | 25466.3        | 9803.714    | 717752         |
| 2890.0      | 3559.804      | 81.2876     | -26.7787      | 108.51        | 0.09            | 24126.6        | 107.50      | 0.09            | 25465.7        | 9841.632    | 718343         |
| 2900.0      | 3559.866      | 81.9678     | -26.9797      | 108.16        | 0.09            | 24125.8        | 107.17      | 0.08            | 25465.2        | 9879.517    | 718918         |
| 2910.0      | 3559.926      | 82.6505     | -27.1770      | 107.81        | 0.08            | 24125.1        | 106.84      | 0.08            | 25464.6        | 9917.368    | 719479         |
| 2920.0      | 3559.983      | 83.3357     | -27.3705      | 107.46        | 0.08            | 24124.4        | 106.51      | 0.08            | 25464.1        | 9955.180    | 720025         |
| 2930.0      | 3560.039      | 84.0234     | -27.5603      | 107.10        | 0.08            | 24123.8        | 106.17      | 0.07            | 25463.6        | 9992.947    | 720555         |
| 2940.0      | 3560.093      | 84.7136     | -27.7462      | 106.74        | 0.08            | 24123.1        | 105.83      | 0.07            | 25463.1        | 10030.664   | 721069         |
| 2950.0      | 3560.145      | 85.4062     | -27.9282      | 106.37        | 0.07            | 24122.5        | 105.49      | 0.07            | 25462.6        | 10068.323   | 721567         |
| 2960.0      | 3560.194      | 86.1013     | -28.1063      | 106.00        | 0.07            | 24121.8        | 105.14      | 0.07            | 25462.1        | 10105.915   | 722050         |
| 2970.0      | 3560.242      | 86.7987     | -28.2805      | 105.63        | 0.07            | 24121.2        | 104.79      | 0.06            | 25461.7        | 10143.428   | 722517         |
| 2980.0      | 3560.287      | 87.4986     | -28.4506      | 105.26        | 0.06            | 24120.7        | 104.44      | 0.06            | 25461.3        | 10180.849   | 722968         |
| 2990.0      | 3560.331      | 88.2008     | -28.6167      | 104.88        | 0.06            | 24120.1        | 104.08      | 0.06            | 25460.9        | 10218.162   | 723402         |
| 3000.0      | 3560.372      | 88.9053     | -28.7787      | 104.50        | 0.06            | 24119.6        | 103.72      | 0.05            | 25460.5        | 10255.343   | 723820         |
| 3010.0      | 3560.411      | 89.6120     | -28.9365      | 104.12        | 0.05            | 24119.0        | 103.36      | 0.05            | 25460.1        | 10292.366   | 724222         |
| 3020.0      | 3560.448      | 90.3211     | -29.0902      | 103.73        | 0.05            | 24118.5        | 103.00      | 0.05            | 25459.7        | 10329.194   | 724607         |
| 3030.0      | 3560.483      | 91.0323     | -29.2397      | 103.34        | 0.05            | 24118.1        | 102.63      | 0.05            | 25459.4        | 10365.779   | 724976         |
| 3040.0      | 3560.516      | 91.7456     | -29.3850      | 102.95        | 0.05            | 24117.6        | 102.26      | 0.04            | 25459.1        | 10402.055   | 725327         |
| 3050.0      | 3560.547      | 92.4611     | -29.5260      | 102.55        | 0.04            | 24117.2        | 101.88      | 0.04            | 25458.7        | 10437.933   | 725681         |
| 3060.0      | 3560.575      | 93.1787     | -29.6626      | 102.16        | 0.04            | 24116.8        | 101.51      | 0.04            | 25458.5        | 10473.285   | 725981         |
| 3070.0      | 3560.602      | 93.8983     | -29.7949      | 101.76        | 0.04            | 24116.4        | 101.13      | 0.03            | 25458.2        | 10507.928   | 726282         |
| 3080.0      | 3560.626      | 94.6198     | -29.9228      | 101.35        | 0.03            | 24116.0        | 100.75      | 0.03            | 25457.9        | 10541.588   | 726565         |
| 3090.0      | 3560.648      | 95.3433     | -30.0463      | 100.95        | 0.03            | 24115.7        | 100.36      | 0.03            | 25457.7        | 10573.845   | 726832         |
| 3100.0      | 3560.668      | 96.0686     | -30.1654      | 100.54        | 0.03            | 24115.3        | 99.98       | 0.03            | 25457.5        | 10604.040   | 727081         |
| 3110.0      | 3560.686      | 96.7958     | -30.2800      | 100.13        | 0.02            | 24115.0        | 99.59       | 0.02            | 25457.3        | 10631.129   | 727313         |
| 3120.0      | 3560.702      | 97.5247     | -30.3900      | 99.72         | 0.02            | 24114.8        | 99.20       | 0.02            | 25457.1        | 10653.496   | 727527         |
| 3130.0      | 3560.716      | 98.2553     | -30.4955      | 99.30         | 0.02            | 24114.5        | 98.81       | 0.02            | 25456.9        | 10668.886   | 727723         |
| 3140.0      | 3560.728      | 98.9875     | -30.5964      | 98.89         | 0.02            | 24114.3        | 98.41       | 0.01            | 25456.8        | 10674.900   | 727903         |
| 3150.0      | 3560.737      | 99.7213     | -30.6928      | 98.47         | 0.01            | 24114.0        | 98.02       | 0.01            | 25456.6        | 10670.319   | 728064         |
| 3160.0      | 3560.745      | 100.4566    | -30.7845      | 98.05         | 0.01            | 24113.9        | 97.62       | 0.01            | 25456.5        | 10656.081   | 728208         |
| 3170.0      | 3560.750      | 101.1934    | -30.8715      | 97.62         | 0.01            | 24113.7        | 97.22       | 0.01            | 25456.4        | 10634.508   | 728333         |
| 3180.0      | 3560.753      | 101.9315    | -30.9539      | 97.20         | 0.00            | 24113.5        | 96.82       | 0.00            | 25456.3        | 10607.930   | 728441         |
| 3190.0      | 3560.754      | 102.6710    | -31.0315      | 96.77         | -0.00           | 24113.4        | 96.41       | -0.00           | 25456.3        | 10578.056   | 728531         |
| 3200.0      | 3560.753      | 103.4117    | -31.1045      | 96.35         | -0.00           | 24113.3        | 96.01       | -0.00           | 25456.2        | 10546.000   | 728604         |
| 3210.0      | 3560.749      | 104.1535    | -31.1727      | 95.92         | -0.01           | 24113.2        | 95.60       | -0.01           | 25456.2        | 10512.466   | 728657         |
| 3220.0      | 3560.744      | 104.8965    | -31.2361      | 95.49         | -0.01           | 24113.2        | 95.20       | -0.01           | 25456.2        | 10477.901   | 728693         |
| 3230.0      | 3560.736      | 105.6404    | -31.2948      | 95.05         | -0.01           | 24113.1        | 94.79       | -0.01           | 25456.2        | 10442.596   | 728711         |
| 3235.242    | 3560.731      | 106.0308    | -31.3236      | 94.83         | -0.01           | 24113.1        | 94.57       | -0.01           | 25456.2        | 10423.861   | 728713         |

S-IVB/LM SEPARATION

TABLE XVII  
S-1B STAGE FREE FLIGHT TRAJECTORY  
EARTH-FIXED PLUMBLINE VELOCITIES

| EARTH-FIXED PLUMBLINE POSITIONS |        |      |        | EARTH-FIXED PLUMBLINE VELOCITIES |      |        |        | ALTITUDE | RANGE   | LCNG    | LAT |
|---------------------------------|--------|------|--------|----------------------------------|------|--------|--------|----------|---------|---------|-----|
| TIME                            | XE     | YE   | ZE     | DXE                              | DYE  | DZE    | M      | M        | M       | DEG     | DEG |
| SEC                             | M      | M    | M      | M/S                              | M/S  | M/S    |        |          |         |         |     |
| 150.0                           | 70552  | 274  | 74141  | 997.9                            | 3.1  | 1688.8 | 70978  | 73435    | 79.8502 | 28.7339 |     |
| 160.0                           | 80055  | 310  | 91005  | 903.2                            | 3.9  | 1684.5 | 80697  | 89998    | 79.6887 | 28.7790 |     |
| 170.0                           | 88620  | 353  | 107835 | 809.8                            | 4.8  | 1681.6 | 89519  | 106492   | 79.5276 | 28.8237 |     |
| 180.0                           | 96252  | 405  | 124638 | 716.7                            | 5.6  | 1678.9 | 97452  | 122931   | 79.3669 | 28.8679 |     |
| 190.0                           | 102954 | 466  | 141413 | 623.9                            | 6.6  | 1676.1 | 104497 | 139322   | 79.2065 | 28.9117 |     |
| 200.0                           | 108730 | 537  | 158159 | 531.2                            | 7.5  | 1673.2 | 110658 | 155671   | 79.0464 | 28.9551 |     |
| 210.0                           | 113580 | 616  | 174876 | 438.8                            | 8.5  | 1670.2 | 115935 | 171983   | 78.8864 | 28.9981 |     |
| 220.0                           | 117506 | 706  | 191562 | 346.5                            | 9.5  | 1667.0 | 120330 | 188264   | 78.7266 | 29.0407 |     |
| 230.0                           | 120510 | 806  | 208215 | 254.3                            | 10.5 | 1663.7 | 123845 | 204520   | 78.5669 | 29.0830 |     |
| 240.0                           | 122593 | 917  | 224836 | 162.2                            | 11.6 | 1660.3 | 126479 | 220756   | 78.4072 | 29.1249 |     |
| 250.0                           | 123755 | 1038 | 241422 | 70.2                             | 12.7 | 1656.8 | 128235 | 236978   | 78.2475 | 29.1665 |     |
| 260.0                           | 123997 | 1171 | 257971 | -21.8                            | 13.8 | 1653.2 | 129112 | 253190   | 78.0876 | 29.2078 |     |
| 270.0                           | 123320 | 1315 | 274484 | -113.7                           | 15.0 | 1649.4 | 129110 | 269400   | 77.9277 | 29.2487 |     |
| 280.0                           | 121723 | 1471 | 290959 | -205.7                           | 16.2 | 1645.5 | 128230 | 285611   | 77.7676 | 29.2893 |     |
| 290.0                           | 119206 | 1640 | 307393 | -297.7                           | 17.5 | 1641.4 | 126472 | 301830   | 77.6072 | 29.3296 |     |
| 300.0                           | 115768 | 1821 | 323787 | -389.8                           | 18.7 | 1637.3 | 123834 | 318062   | 77.4465 | 29.3697 |     |
| 310.0                           | 111410 | 2014 | 340138 | -481.9                           | 20.0 | 1633.0 | 120316 | 334312   | 77.2855 | 29.4094 |     |
| 320.0                           | 106130 | 2221 | 356446 | -574.1                           | 21.4 | 1628.5 | 115918 | 350585   | 77.1241 | 29.4489 |     |
| 330.0                           | 99927  | 2442 | 372709 | -666.5                           | 22.7 | 1624.0 | 110637 | 366889   | 76.9622 | 29.4881 |     |
| 340.0                           | 92799  | 2676 | 388925 | -759.1                           | 24.1 | 1619.3 | 104474 | 383227   | 76.7998 | 29.5271 |     |
| 350.0                           | 84745  | 2924 | 405093 | -851.8                           | 25.5 | 1614.4 | 97425  | 399605   | 76.6368 | 29.5658 |     |
| 360.0                           | 75763  | 3186 | 421212 | -944.7                           | 27.0 | 1609.3 | 89490  | 416029   | 76.4732 | 29.6043 |     |
| 370.0                           | 65852  | 3463 | 437278 | -1037.6                          | 28.4 | 1603.8 | 80668  | 432504   | 76.3089 | 29.6426 |     |
| 380.0                           | 55013  | 3755 | 453283 | -1129.8                          | 29.9 | 1596.7 | 70959  | 449027   | 76.1440 | 29.6806 |     |
| 390.0                           | 43268  | 4061 | 469193 | -1217.9                          | 31.3 | 1583.6 | 60382  | 465571   | 75.9787 | 29.7183 |     |
| 400.0                           | 30714  | 4379 | 484883 | -1287.6                          | 32.2 | 1547.8 | 49025  | 482012   | 75.8142 | 29.7554 |     |
| 410.0                           | 17775  | 4699 | 499857 | -1273.3                          | 31.0 | 1417.3 | 37272  | 497830   | 75.6559 | 29.7907 |     |
| 420.0                           | 6275   | 4975 | 512158 | -957.9                           | 22.5 | 975.9  | 26780  | 510937   | 75.5245 | 29.8197 |     |
| 430.0                           | -767   | 5134 | 518932 | -479.4                           | 10.2 | 419.0  | 20304  | 518230   | 75.4514 | 29.8358 |     |
| 440.0                           | -4253  | 5202 | 521632 | -258.6                           | 4.3  | 164.7  | 17050  | 521196   | 75.4216 | 29.8422 |     |
| 450.0                           | -6491  | 5233 | 522776 | -202.4                           | 2.2  | 77.7   | 14913  | 522515   | 75.4083 | 29.8451 |     |
| 460.0                           | -8410  | 5250 | 523327 | -183.0                           | 1.3  | 36.6   | 13045  | 523220   | 75.4013 | 29.8466 |     |
| 470.0                           | -10163 | 5259 | 523566 | -167.8                           | 0.7  | 13.5   | 11318  | 523600   | 75.3974 | 29.8473 |     |
| 480.0                           | -11773 | 5264 | 523633 | -154.5                           | 0.3  | 1.2    | 9719   | 523797   | 75.3954 | 29.8477 |     |
| 490.0                           | -13257 | 5267 | 523611 | -142.5                           | 0.2  | -4.9   | 8237   | 523895   | 75.3945 | 29.8479 |     |
| 500.0                           | -14629 | 5267 | 523545 | -131.9                           | 0.1  | -7.7   | 6865   | 523941   | 75.3940 | 29.8479 |     |
| 510.0                           | -15902 | 5268 | 523463 | -123.0                           | 0.0  | -8.6   | 5590   | 523963   | 75.3937 | 29.8480 |     |
| 520.0                           | -17093 | 5268 | 523376 | -115.4                           | -0.0 | -8.8   | 4396   | 523972   | 75.3936 | 29.8479 |     |
| 530.0                           | -18212 | 5267 | 523289 | -108.8                           | -0.0 | -8.6   | 3273   | 523976   | 75.3936 | 29.8479 |     |
| 540.0                           | -19271 | 5267 | 523204 | -103.0                           | -0.0 | -8.2   | 2211   | 523978   | 75.3936 | 29.8479 |     |
| 550.0                           | -20274 | 5267 | 523124 | -97.8                            | -0.0 | -7.9   | 1204   | 523979   | 75.3935 | 29.8479 |     |
| 560.0                           | -21229 | 5267 | 523047 | -93.2                            | -0.0 | -7.5   | 247    | 523980   | 75.3935 | 29.8478 |     |
| IMPACT                          |        |      |        |                                  |      |        |        |          |         |         |     |
| 562.7                           | -21475 | 5266 | 523027 | -92.1                            | -0.0 | -7.5   | 0      | 523980   | 75.3935 | 29.8478 |     |

TABLE XVIII  
S-1B STAGE FREE FLIGHT TRAJECTORY  
EARTH-FIXED PLUMBLINE POSITIONS EARTH-FIXED PLUMBLINE VELOCITIES

| TIME<br>SEC | XE<br>FT | YE<br>FT | ZE<br>FT | DXE<br>FT/S | DYE<br>FT/S | DZE<br>FT/S | ALTITUDE<br>FT | RANGE<br>NM | LCNG<br>DEG | LAT<br>DEG |
|-------------|----------|----------|----------|-------------|-------------|-------------|----------------|-------------|-------------|------------|
| 150.0       | 231468   | 900      | 243245   | 3273.8      | 10.3        | 5540.6      | 232868         | 39.626      | 79.8502     | 28.7339    |
| 160.0       | 262649   | 1016     | 298574   | 2963.4      | 12.9        | 5526.6      | 264754         | 48.563      | 79.6887     | 28.7790    |
| 170.0       | 290747   | 1159     | 353791   | 2656.7      | 15.7        | 5517.0      | 293698         | 57.464      | 79.5276     | 28.8237    |
| 180.0       | 315787   | 1330     | 408917   | 2351.3      | 18.5        | 5508.1      | 319723         | 66.335      | 79.3669     | 28.8679    |
| 190.0       | 337776   | 1530     | 463952   | 2046.8      | 21.5        | 5499.0      | 342838         | 75.179      | 79.2065     | 28.9117    |
| 200.0       | 356725   | 1761     | 518894   | 1742.9      | 24.6        | 5489.4      | 363050         | 84.001      | 79.0464     | 28.9551    |
| 210.0       | 372637   | 2022     | 573739   | 1439.6      | 27.8        | 5479.5      | 380364         | 92.803      | 78.8864     | 28.9981    |
| 220.0       | 385519   | 2317     | 628483   | 1136.8      | 31.1        | 5469.2      | 394784         | 101.589     | 78.7266     | 29.0407    |
| 230.0       | 395375   | 2645     | 683122   | 834.4       | 34.5        | 5458.4      | 406314         | 110.360     | 78.5669     | 29.0830    |
| 240.0       | 402208   | 3007     | 737650   | 532.2       | 38.0        | 5447.3      | 414959         | 119.122     | 78.4072     | 29.1249    |
| 250.0       | 406020   | 3406     | 792066   | 230.3       | 41.7        | 5435.7      | 420718         | 127.875     | 78.2475     | 29.1665    |
| 260.0       | 406815   | 3841     | 846363   | -71.4       | 45.4        | 5423.7      | 423595         | 136.623     | 78.0876     | 29.2078    |
| 270.0       | 404592   | 4315     | 900539   | -373.1      | 49.3        | 5411.3      | 423590         | 145.370     | 77.9277     | 29.2487    |
| 280.0       | 399352   | 4827     | 954588   | -674.9      | 53.2        | 5398.5      | 420703         | 154.118     | 77.7676     | 29.2893    |
| 290.0       | 391095   | 5380     | 1008508  | -976.7      | 57.3        | 5385.3      | 414933         | 162.870     | 77.6072     | 29.3296    |
| 300.0       | 379818   | 5973     | 1062293  | -1278.7     | 61.4        | 5371.6      | 406279         | 171.628     | 77.4465     | 29.3697    |
| 310.0       | 365519   | 6609     | 1115939  | -1581.0     | 65.7        | 5357.5      | 394738         | 180.397     | 77.2855     | 29.4094    |
| 320.0       | 348196   | 7287     | 1169442  | -1883.7     | 70.1        | 5343.0      | 380308         | 189.178     | 77.1241     | 29.4489    |
| 330.0       | 327845   | 8010     | 1222797  | -2186.7     | 74.5        | 5328.0      | 362984         | 197.976     | 76.9622     | 29.4881    |
| 340.0       | 304460   | 8778     | 1276000  | -2490.3     | 79.1        | 5312.5      | 342762         | 206.792     | 76.7998     | 29.5271    |
| 350.0       | 278036   | 9592     | 1329046  | -2794.5     | 83.7        | 5296.5      | 319637         | 215.630     | 76.6368     | 29.5658    |
| 360.0       | 248567   | 10453    | 1381929  | -3099.3     | 88.5        | 5279.9      | 293604         | 224.492     | 76.4732     | 29.6043    |
| 370.0       | 216049   | 11362    | 1434639  | -3404.2     | 93.3        | 5261.8      | 264657         | 233.382     | 76.3089     | 29.6426    |
| 380.0       | 180490   | 12319    | 1487148  | -3706.8     | 98.1        | 5238.6      | 232805         | 242.298     | 76.1440     | 29.6806    |
| 390.0       | 141957   | 13324    | 1539348  | -3995.6     | 102.7       | 5195.6      | 198105         | 251.226     | 75.9787     | 29.7183    |
| 400.0       | 100766   | 14368    | 1590825  | -4224.3     | 105.7       | 5078.1      | 160844         | 260.097     | 75.8142     | 29.7554    |
| 410.0       | 58315    | 15416    | 1639950  | -4177.6     | 101.8       | 4650.1      | 122284         | 268.633     | 75.6559     | 29.7907    |
| 420.0       | 20589    | 16321    | 1680309  | -3142.6     | 73.7        | 3201.7      | 87861          | 275.705     | 75.5245     | 29.8197    |
| 430.0       | -2519    | 16845    | 1702533  | -1572.9     | 33.4        | 1374.8      | 66616          | 279.641     | 75.4514     | 29.8358    |
| 440.0       | -13956   | 17066    | 1711391  | -848.4      | 14.1        | 540.3       | 59938          | 281.241     | 75.4216     | 29.8422    |
| 450.0       | -21297   | 17168    | 1715145  | -664.0      | 7.3         | 255.0       | 48928          | 281.953     | 75.4083     | 29.8451    |
| 460.0       | -27595   | 17224    | 1716953  | -600.5      | 4.1         | 120.0       | 42799          | 282.333     | 75.4013     | 29.8466    |
| 470.0       | -33345   | 17255    | 1717738  | -550.6      | 2.2         | 44.4        | 37132          | 282.538     | 75.3974     | 29.8473    |
| 480.0       | -38627   | 17271    | 1717957  | -506.9      | 1.1         | 3.9         | 31885          | 282.645     | 75.3954     | 29.8477    |
| 490.0       | -43498   | 17279    | 1717882  | -467.6      | 0.5         | -16.2       | 27025          | 282.697     | 75.3945     | 29.8479    |
| 500.0       | -47996   | 17282    | 1717669  | -432.9      | 0.2         | -25.1       | 22524          | 282.722     | 75.3940     | 29.8479    |
| 510.0       | -52173   | 17283    | 1717399  | -403.5      | 0.0         | -28.3       | 18339          | 282.734     | 75.3937     | 29.8480    |
| 520.0       | -56080   | 17282    | 1717112  | -378.5      | -0.1        | -28.8       | 14422          | 282.739     | 75.3936     | 29.8479    |
| 530.0       | -59754   | 17282    | 1716826  | -356.8      | -0.1        | -28.1       | 10737          | 282.741     | 75.3936     | 29.8479    |
| 540.0       | -63226   | 17281    | 1716550  | -337.8      | -0.1        | -27.1       | 7255           | 282.743     | 75.3936     | 29.8479    |
| 550.0       | -66518   | 17280    | 1716285  | -320.9      | -0.1        | -25.9       | 3952           | 282.743     | 75.3935     | 29.8479    |
| 560.0       | -69650   | 17279    | 1716032  | -305.9      | -0.1        | -24.7       | 809            | 282.743     | 75.3935     | 29.8478    |
| 562.7       | IMPACT   | 17278    | 1715967  | -302.3      | -0.1        | -24.5       | 0              | 282.744     | 75.3935     | 29.8478    |

TABLE XIX

## GOVERNMENT FURNISHED DOCUMENTATION

DELIVERABLE ITEM NO. BB 3.1.5-4-201

| GFDA NO.       | DATE MSFC APPROVAL | DESCRIPTION OF GFD REQ'D                             | IDENTIFICATION OF GFD  |
|----------------|--------------------|--|--|
| 04A00006       | 1/11/68            | Final Vehicle Mass Characteristics                   | R-P&VE-VAM-67-108.   |
| 04A00006       | 1/11/68            | SA-204/SA-205 Vehicle Antenna Locations              | BB-3.16.10-1   |
| 04A00006       | 1/11/68            | L/V Operational Trajectory                           | BB-3.1.3-10-M01, Part IV (TN-AP-67-255)  |
| 04A00006       | 1/11/68            | Tracking & Telemetry Station Locations               | OD Item 9.2.1.3-1  |
| 04A00007       | 1/11/68            | Processed Data Requirements                          | AS-204/LM-1 Processed Data Requirements Document (CGSD)  |
| 04A00019       | 1/31/68            | Orbital Radar Tracking Data and Initial State Vector | BDA(FPS-16) Revs. 1 & 2, HAW Revs. 2 & 7, CAL Revs. 1, 2, & 3, CYI Rev. 1, TAN Revs. 2, 3, 4, & 5. Use Predicted Initial State Vector    |
| 04A00028       | 3/ 4/68            | Updated ODOP Tracking Data                           | ODOP Tracking, Reel No. 22052  |
| 04A00029       | 3/ 4/68            | Final T-O Meteorological Data                        | Final T-O Meteorological Data, Reel No. 2559   |
| 04A00030       | 3/ 4/68            | Updated Guidance Velocities and Accelerations        | Guidance Velocities and Accelerations, Reel No. 14443  |
| 04A00030       | 3/ 4/68            | Corrected Measured Parameters (Radars)               | Sta. 0.18, Reel No. 24377, Sta. 3.18, Reel No. 15606, Sta. 19.18, Reel No. 3040, GLOTAC Sta. 1, Reel No. 2112, Sta. 7.18, Reel No. 23702 |
| 04A00030       | 3/ 4/68            | Orbital Tracking Data                                | TAN Rev. 1   |
| 04A00031       | 3/ 4/68            | Final Metric Tracking Data (PVA)                     | GLOTAC (PVA), Reel No. 19689   |
| 04A00031       | 3/ 4/68            | Orbital Venting Accelerations                        | Guidance Polynomials (Orbital Venting Accelerations)   |
| 04A00031       | 3/ 4/68            | Orbital Tracking Data                                | ASC Revs. 3 & 4, CBI Rev. 2, FRE Revs. 5, 6, & 7.  |
| 04A00031 Rev.A | 3/21/68            | Orbital Venting Accelerations                        | Corrected Guidance Polynomials (Orbital Venting Accelerations)   |

#### REFERENCES

1. Aerospace Physics Branch, Chrysler Corporation Space Division, "AS-204/IM-1 Launch Vehicle Operational Flight Trajectory (Revision 1), TN-AP-67-255, dated 25 July 1967.
2. Sheats, John P., "Methods For Establishing A Launch Phase Trajectory", MTP-AERO-63-5, dated January 11, 1963.
3. Cawood, D. W. and Jacobson, O. M., "MARLOCK II Flight Evaluation Program, Volume I: Theoretical Manual", TM 54/30-54, Vol. I of III IMSC/HREC A711226-I, dated May, 1965.
4. Saturn Flight Evaluation Working Group, "Results of the Fourth Saturn IB Launch Vehicle Test Flight AS-204", MPR-SAT-FE-68-2, dated April 1968 (U).

#### DISTRIBUTION

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APPENDIX A

DEFINITIONS OF SYMBOLS

| <u>Symbol</u>       | <u>Definitions</u>   |
|---------------------|--|
| XE, YE, ZE          | Position, velocity and acceleration components in the <u>Earth-Fixed Cartesian Coordinate System</u> .   |
| DXE, DYE, DZE       | The origin of this system is the projection of the center of gravity of the complete vehicle at first motion onto the Fischer Ellipsoid of 1960. The Y-Z plane is tangent to the reference ellipsoid at the origin of the coordinate system. The positive Z-axis is oriented in the flight azimuth direction, 72 deg E of N. The X-axis is normal to the Y-Z plane and is positive above the origin. The Y-axis is normal to the X-Z plane and is in a right hand relation to the X-Z axes with the positive direction 162 deg E of N. The origin of this earth-fixed system rotates with an angular velocity identical to that of the earth. The earth-fixed coordinate system is shown in Figure 1.  |
| DDXE, DDYE, DDZE    |  |
| XSP, YSP, ZSP       | Position, velocity and acceleration components in the <u>Space-Fixed Ephemeris Coordinate System</u> . The origin of this system is located at the geocentric center of the earth. The Z-axis points north along the earth's axis of rotation (through the north pole). The X-Y plane is coincident with the equatorial plane. The X-axis points through the vernal equinox. The reference equinox and equator are the mean equinox and equator of date for the epoch of midnight or zero hours on the day of launch. The Y-axis is normal to the X-Z plane and in a right hand relation to the X-, Z-axes. The direction of the coordinate axes remain fixed in space although the origin continues to move with the center of the earth. The space-fixed ephemeris coordinate system is shown in Figure 1. |
| DXSP, DYSP, DZSP    |  |
| DDXSP, DDYSP, DDZSP |  |
| E. C. DIST          | Position of vehicle in the <u>Geographic Coordinate System</u> . Position in this system is defined by the radius vector from the vehicle to the geocentric center of the earth (E.C.DIST), geocentric latitude (G.C. LAT) and longitude (LONG). Geocentric latitude is the angle between the radius vector of the sub-vehicle point and the equatorial plane, positive north of the equator. Longitude is the angle between the projection of the radius vector into the equatorial plane and the Greenwich meridian, measured positive east of the Greenwich meridian.   |
| LONG                |  |
| G.C. LAT            |  |



## DEFINITIONS OF SYMBOLS (CONT'D)

| <u>Symbols</u> | <u>Definitions</u>  |
|----------------|---|
| E.F. VEL       | Earth-fixed velocity of the vehicle in the <u>Geographic Coordinate System</u> . Velocity in this system is given in terms of azimuth (VEL-AZ), elevation (VEL-ELEV), and magnitude of the velocity vector (E.F.VEL). Azimuth is the angle between the projection of the velocity vector into the local horizontal plane and the north direction in this plane. Elevation is the angle between the velocity vector and the local horizontal plane. The local horizontal plane is defined as the plane perpendicular to the radius vector from the vehicle to the geocentric center of the earth. The geographic coordinate system is shown in Figure 1. |
| VEL-AZ         |   |
| VEL-ELEV       |   |
| S.F. VEL       | Space-fixed velocity of vehicle in the Geographic Coordinate System. Velocity is given in terms of flight-path angle (FLT-PATH), heading angle (HEAD), and magnitude of the velocity vector (S.F.VEL). The flight-path angle is the angle between the space fixed velocity vector and the plane normal to the radius vector from the vehicle to the geocentric center of the earth, measured positive upward from this plane. The heading angle is measured positive clockwise from north to the projection of the space-fixed velocity vector in the plane normal to the radius vector.  |
| FLT-PATH       |   |
| HEAD           |   |
| LAT            | Geodetic latitude of vehicle.   |
| MACH           | Mach number.  |
| DYN PRES       | Dynamic Pressure.   |
| ALTITUDE       | Distance from the reference ellipsoid to the center of gravity of the vehicle measured along the radius vector from the vehicle to the geocentric center of the earth.  |
| RANGE          | Surface range measured along a spherical earth from the launch site to the subvehicle point. The subvehicle point is defined as the intersection of the reference ellipsoid and the reference ellipsoid normal passing through the vehicle.   |
| DEC            | The Declination angle is the angle between the radius vector from the center of the earth to the vehicle and the equatorial plane, positive north of the equator.   |