COPY NO. 43 OF 225 COPIES

[redacted]

POSTLAUNCH MEMORANDUM REPORT

FOR

MERCURY-ATLAS NO. 7 (MA-7)

PART I - MISSION ANALYSIS

CLASSIFICATION CHANGED TO unclassified

BY AUTHORITY OF EO 12356 1 Aug 82

DATE 18 Aug 82

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

Cape Canaveral, Florida

June 15, 1962

[redacted]

CONFIDENTIAL

POSTLAUNCH MEMORANDUM REPORT

FOR

MERCURY-ATLAS NO. 7 (MA-7)

Edited by: E. M. Fields, Senior Editor

J. H. Boynton, Assistant to Senior Editor

R. D. Harrington

R. G. Arbic

E. A. Horton

S. C. White, M.D.

C. A. Berry, M.D.

V. I. Grissom

R. B. Voas, PhD.

W. J. North

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

Cape Canaveral, Florida

June 15, 1962

CONFIDENTIAL

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

NOTICE

NO. 1: LIFT-OFF TIME (2-INCH MOTION) FOR THE MA-7 FLIGHT WAS 07:45:16.57 EST. RANGE ZERO TIME WAS ESTABLISHED AS 07:45:16.00 EST. ALL TIMES REFERRED TO IN THIS REPORT ARE IN ELAPSED TIME IN HRS:MIN:SEC FROM RANGE ZERO UNLESS OTHERWISE NOTED.

NO. 2: THE MA-7 POSTLAUNCH MEMORANDUM REPORT IS IN 2 PARTS, UNDER SEPARATE COVERS, AS FOLLOWS:

PART I - MISSION ANALYSIS.- THIS PART CONTAINS AN OVERALL ANALYSIS OF THE MISSION AND PRESENTS A MINIMUM OF DATA.

PART II - DATA.- THIS PART CONTAINS COMPLETE TIME HISTORIES OF SPACECRAFT DATA, WITHOUT ANALYSIS.

1.0 INTRODUCTION

The second manned orbital flight in Project Mercury was successfully made on May 24, 1962, from the Cape Canaveral Missile Test Center. Astronaut M. Scott Carpenter, shown in figures 1.0-1 and 1.0-2, was the pilot for this Mercury-Atlas (MA-7) mission. This was the fourth orbital flight of a Mercury specification spacecraft and the seventh of a series utilizing the Atlas launch vehicle.

The MA-7 mission was planned for three orbital passes and was a continuation of a program to acquire operational experience and information for manned orbital spaceflight. The objectives of the flight were to evaluate the performance of the manned spacecraft system in a three-pass mission; to evaluate the effects of spaceflight on the astronaut; to obtain the astronaut's opinions on the operational suitability of the spacecraft systems; to evaluate the performance of spacecraft systems replaced or modified as a result of previous missions; and to further exercise and evaluate the performance of the Mercury worldwide network. All objectives were successfully achieved.

A preliminary analysis of the significant data has been made, and the important findings are presented in this report. Brief descriptions of the mission, the spacecraft, and the launch vehicle precede the performance analysis and supporting data. All significant events of the MA-7 mission, beginning with delivery of the spacecraft to the launch site through recovery and postflight examination, are documented.

The graphical information presented herein has been included to support and clarify the text; however, the reader is referred to Part II for a complete presentation without analysis, of all MA-7 time history data.

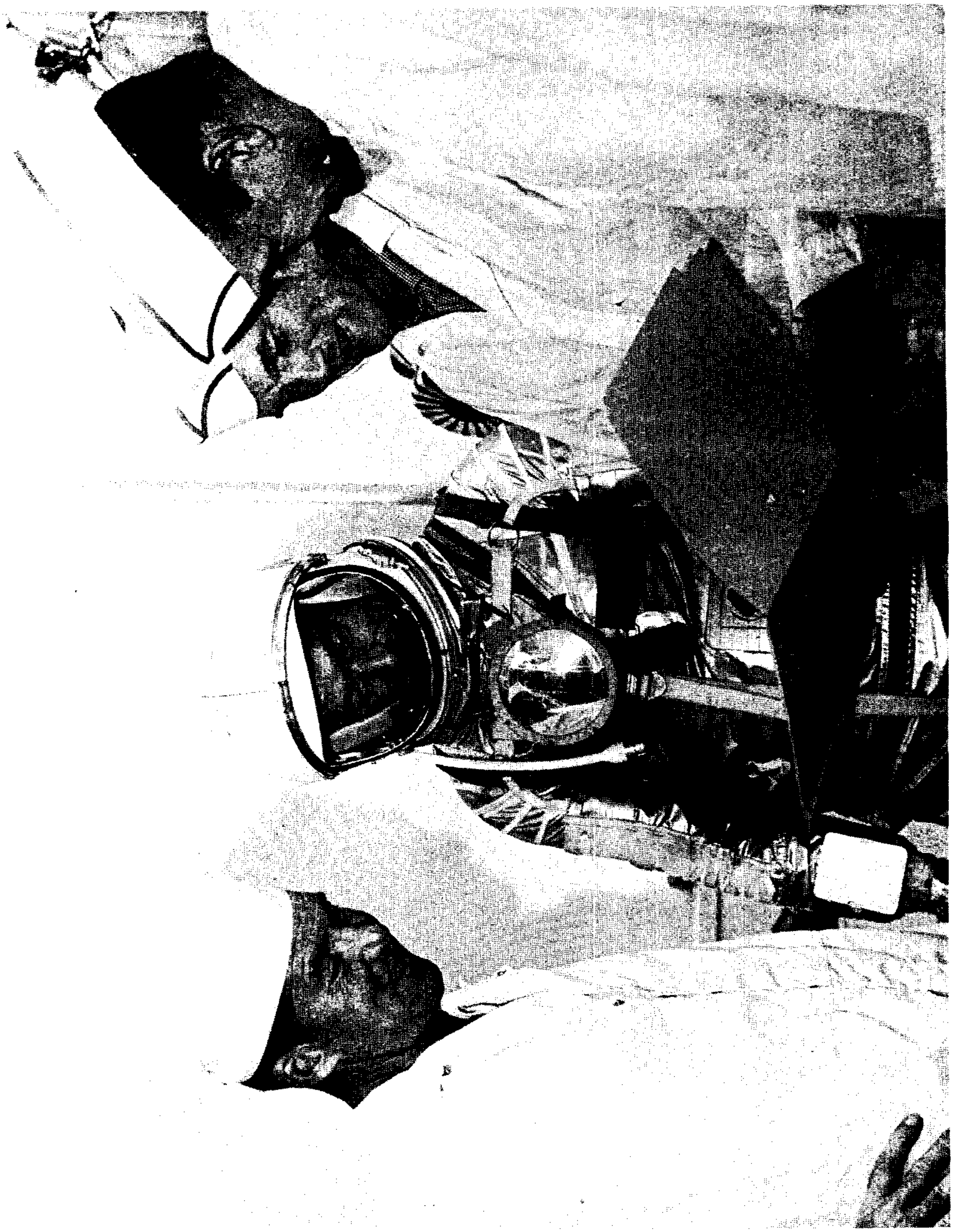


Figure 1.0-1.- Preflight photograph of Astronauts Schirra (MA-7 backup), Carpenter (MA-7 pilot) and Glenn (MA-6 pilot), and Spacecraft Engineer Graham.

Figure 1.0-2.- Astronauts Carpenter and Glenn during an informal postflight discussion.

2.0 MISSION SUMMARY

The MA-7 mission, with Astronaut M. Scott Carpenter as pilot, experienced unscheduled prelaunch holds totaling 45 minutes, and these were directly related to reduced visibility conditions and the measurement of atmospheric refraction in the launch area. A low-level fog and smoke condition precluded required optical coverage at the planned launch time of 7:00 AM, e.s.t. Lift-off occurred approximately at 7:45 AM, e.s.t., on May 24, 1962; 3 hours after the astronaut entered the spacecraft.

Launch vehicle performance was highly satisfactory, and all events occurred as planned through spacecraft separation. General Electric-Burroughs and AZUSA data both indicated a "GO" condition. Orbital insertion conditions were excellent with deviations from nominal values of space-fixed flight-path angle and velocity (post-posigrade) of .0004 degrees and 2.0 ft/sec, respectively. The perigee and apogee of the orbit differed from the nominal values of 86.96 and 144.4 nautical miles by .09 nautical miles and 0.56 nautical miles, respectively.

Spacecraft separation and manual turnaround were accomplished satisfactorily. During the first two and one-half orbital periods, some difficulties were experienced in maintaining suit-circuit temperatures. Control-system fuel usage rates were higher than expected during the early part of this period.

The pilot tracked the launch vehicle tankage, checked out the spacecraft control system, performed planned tasks, and conducted scientific experiments. He also took numerous photographs of the launch vehicle tankage, a tethered balloon, meteorological phenomena, and general terrestrial features.

Upon arriving within communication range of Hawaii on the third pass, the pilot noted that the spacecraft true attitude and indicated attitude in pitch were in disagreement and that the ASCS control mode appeared to have an error in attitude reference. Because of this problem and previous preoccupation with other observations, he got behind in his pre-retro checklist and was occupied with assessing the control problem from that point to retrofire. Retrorocket ignition occurred approximately 3 seconds late, the pitch and yaw attitudes varied during retrofire, and the pilot noted that the sensations during this period did not equal the pronounced effects of accelleration that he had expected. Shortly after retrofire, computed trajectory data indicated that an overshoot of about 250 nautical miles beyond the planned landing area would occur, and subsequent tracking data confirmed the initially-predicted coordinates of the landing point.

The pilot received information after ionization blackout regarding these coordinates and the expected recovery time of about one hour. Retropackage release and periscope retraction operations were reported by the pilot, and these occurred at near nominal times. The pilot also reported depletion of the manual fuel supply prior to ionization blackout. The portion of the reentry through the heat pulse and deceleration buildup were accomplished satisfactorily, but oscillations of the spacecraft increased considerably thereafter. The pilot manually deployed the drogue parachute at an altitude of about 25,000 feet to damp these oscillations.

After landing, the pilot immediately began the normal procedure of egressing from the spacecraft through the recovery compartment, deployed his recovery equipment, and entered his life raft.

Recovery operations were successful, which included deployment of a pararescue team into the water about one hour after landing. This team inflated additional rafts and mounted a flotation collar around the spacecraft to provide additional buoyancy. An HSS-2 helicopter from the aircraft carrier Intrepid recovered the astronaut in good condition about 3 hours after landing, and the spacecraft was retrieved by the destroyer J. R. Pierce about 6 hours after landing.

3.0 LIFT-OFF CONFIGURATION DESCRIPTION

A photograph of the lift-off configuration consisting of spacecraft and launch vehicle is shown in figure 3.0-1.

3.1 Spacecraft Description

Spacecraft number 18 (shown in figure 3.1-1) was employed in the MA-7 orbital mission, and figure 3.1-2 displays the reference axis system employed. This spacecraft was essentially identical to Spacecraft number 13 used on the MA-6 flight. However, some of the more significant features and modifications between the two are listed below:

1. The Sofar bombs and radar chaff were deleted, since they are no longer considered necessary for an effective recovery.

2. The oxygen-quantity telelight was removed because the oxygen partial-pressure transducer, originally located in the cabin, was relocated in the suit. Later the transducer was put back in the cabin, but the oxygen-quantity telelight remained deleted.

3. The earth-path indicator and oxygen partial-pressure indicator were deleted, since they were not necessary to accomplish the mission.

4. The knee and chest straps were removed as a result of re-evaluation of their usefulness.

5. The coolant-quantity and humidity indicators were deleted as unnecessary after an analysis of their performance histories.

6. The instrument-observer camera was removed because the data from this source is no longer considered essential. The pilot-observer camera, using a mirror, performs a part of this function.

7. A 30-inch diameter balloon, deployed in orbit, was installed in order to obtain drag and visibility data.

8. A zero-gravity experiment was carried to obtain data on fluid behavior within a specific envelope configuration while weightless.

9. A temperature survey was incorporated to give a more complete indication of inflight temperatures.

10. A low-level commutator was added to the temperature survey circuit and recorded directly to the onboard tape.

11. The low-frequency-telemetry center frequency was raised 500 kc, from 225.7 mc to 226.2 mc, to eliminate the RF interference which occurrred on the MA-6 flight.

12. The suit-circuit constant-bleed orifice was deleted.

13. The landing bag limit switches were re-wired to prevent erroneous telemetered and indicated deploy signals should one switch malfunction.

14. A maneuver switch was added to remove roll and yaw slaving of spacecraft gyros and pitch orbital precession at atronaut's will.

15. The cabin and suit-circuit steam vents were instrumented, and a dual indicator was installed on the instrument panel to enable the astronaut to evaluate temperatures.

16. The check valve was deleted from the inverter cold-plate water cooling system, since a stuck valve could cause high inverter temperatures.

17. The 1/4-g relay was locked in after SECO because this dropped out with posigrade ignition and interferred with the ASCS damping mode on the MA-6 flight.

18. The parachute landing system was modified, as a result of Project Reef, as follows:

(1) The reefing-cutter pockets were inverted.

(2) The reefing-cutter lanyards were relocated to the canopy.

(3) The reefing line was changed from a 750-pound test to 1,000-pound test line.

(4) The deployment bag was strengthened.

The weight and balance data recorded immediately prior to flight for the MA-7 spacecraft are summarized below.

Spacecraft 18 Weight and Balance Summary

Parameter		Launch	Orbit	Normal Re-entry	Main Chute	Flotation
Weight in Pounds		4244.09	2974.56	2663.36	2557.70	2407.83
Center of Gravity	Z	168.40	121.45	125.10	122.51	119.89
	X	-.07	-.10	-.10	-.09	-.40
Station in Inches	Y	.02	-.01	.00	.03	.05
Moments of Inertia	I_z	354.60	288.90	272.10	268.50	262.80
	I_x	7709.50	646.30	562.20	445.60	376.10
Slugs - Ft^2	I_y	7720.70	658.80	575.30	458.90	389.00

3.2 Launch Vehicle Description

The MA-7 launch vehicle, the Atlas 107-D, was an Atlas Series-D missile modified for the mission as on previous Mercury-Atlas flights.

The Atlas 107-D was modified during factory assembly to include heavier forward tank skins. With the exception that the fuel tank insulation bulkhead was retained, this vehicle configuration did not differ from the launch vehicle (109-D) utilized for the MA-6 mission in any major respect.

The following is a configuration comparison summary of minor changes from Mercury-Atlas 109-D to 107-D.

Class I changes added:

1. Staging time was reduced from 131.3 to 130.1 sec. after lift-off, and backup staging time was altered from 136 to 132.2 sec.

2. Propellant-utilization manometer calibration procedure revised.

3. Boiloff-valve spring rate changed.

4. LOX-tank pressure regulator operating range changed.

5. Servo stabilization provision to eliminate need for special selection of booster engine hydraulic actuators.

6. Propellant utilization telemetry-signal conditioning changed.

7. Booster engine main-oxidizer-valve material changed from aluminum to stainless steel to reduce thermal expansion effects.

8. Improved pneumatic regulators on booster engines.

9. Eliminated interference between high-pressure fuel drain fitting and vehicle structure.

10. The head-suppression and propellant-utilization solenoid valves were modified by reversing the electrical-mechanical position stops in an effort to improve reliability.

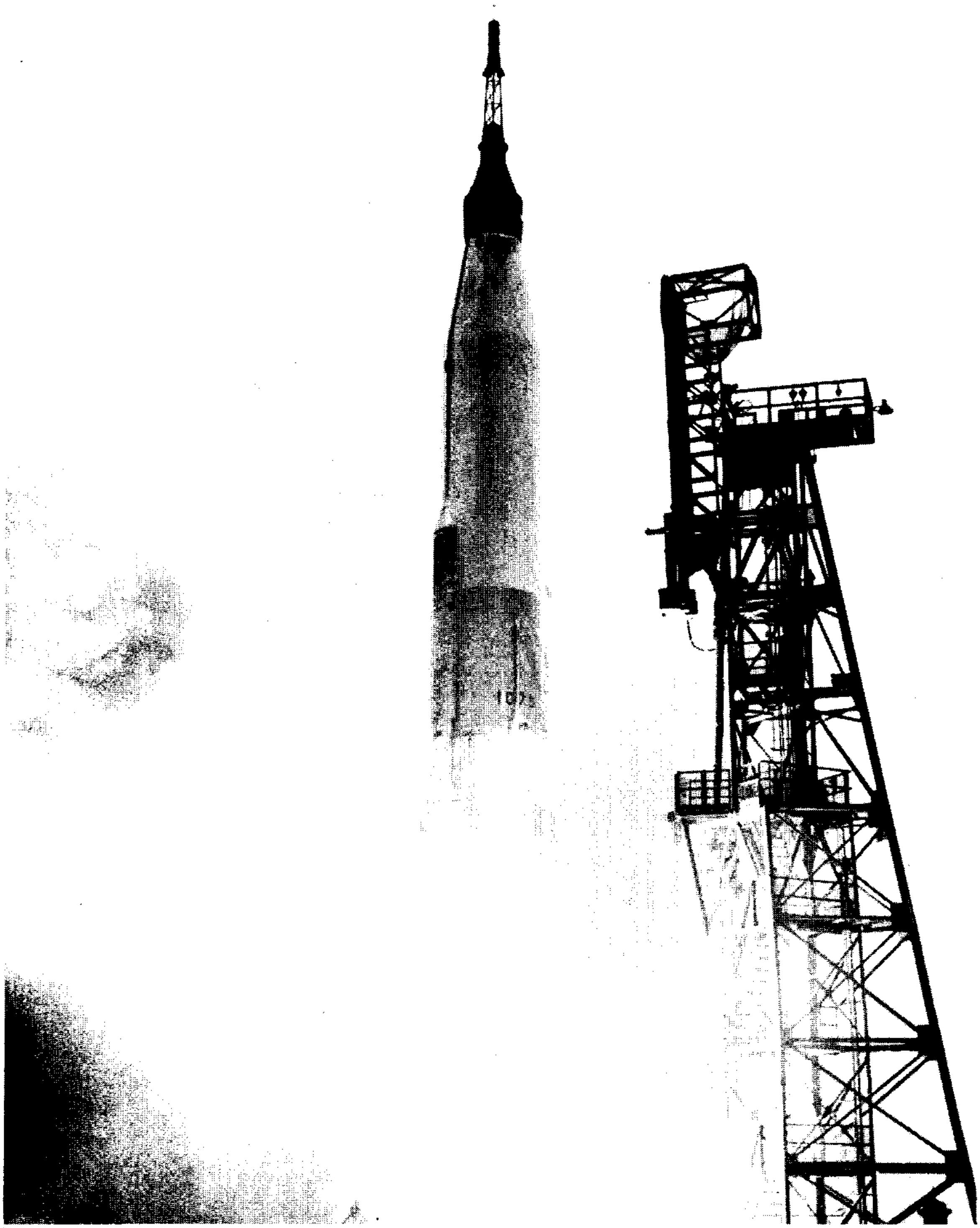


Figure 3.0-1.- MA-7 Launch configuration at lift-off.

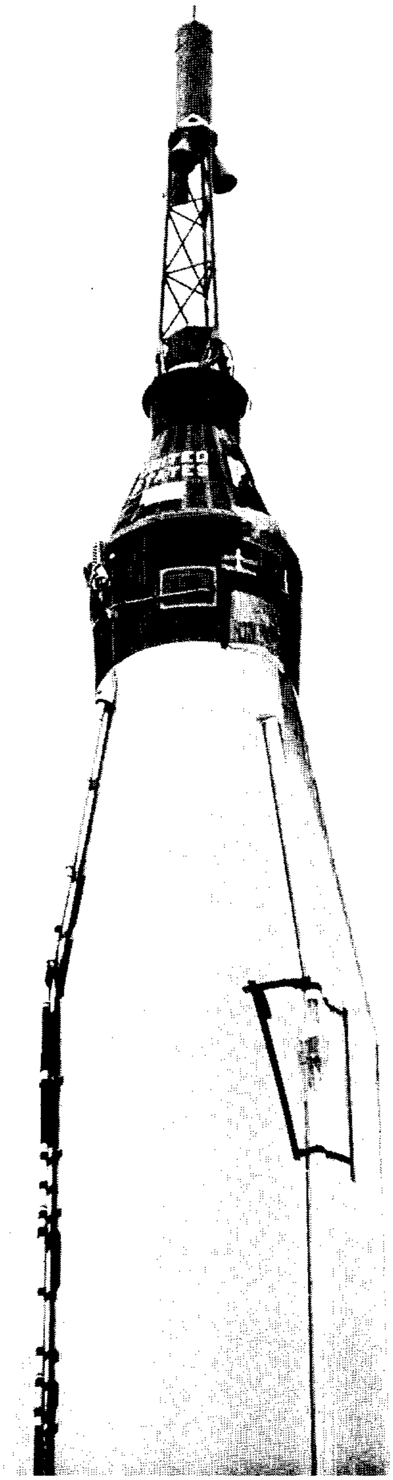
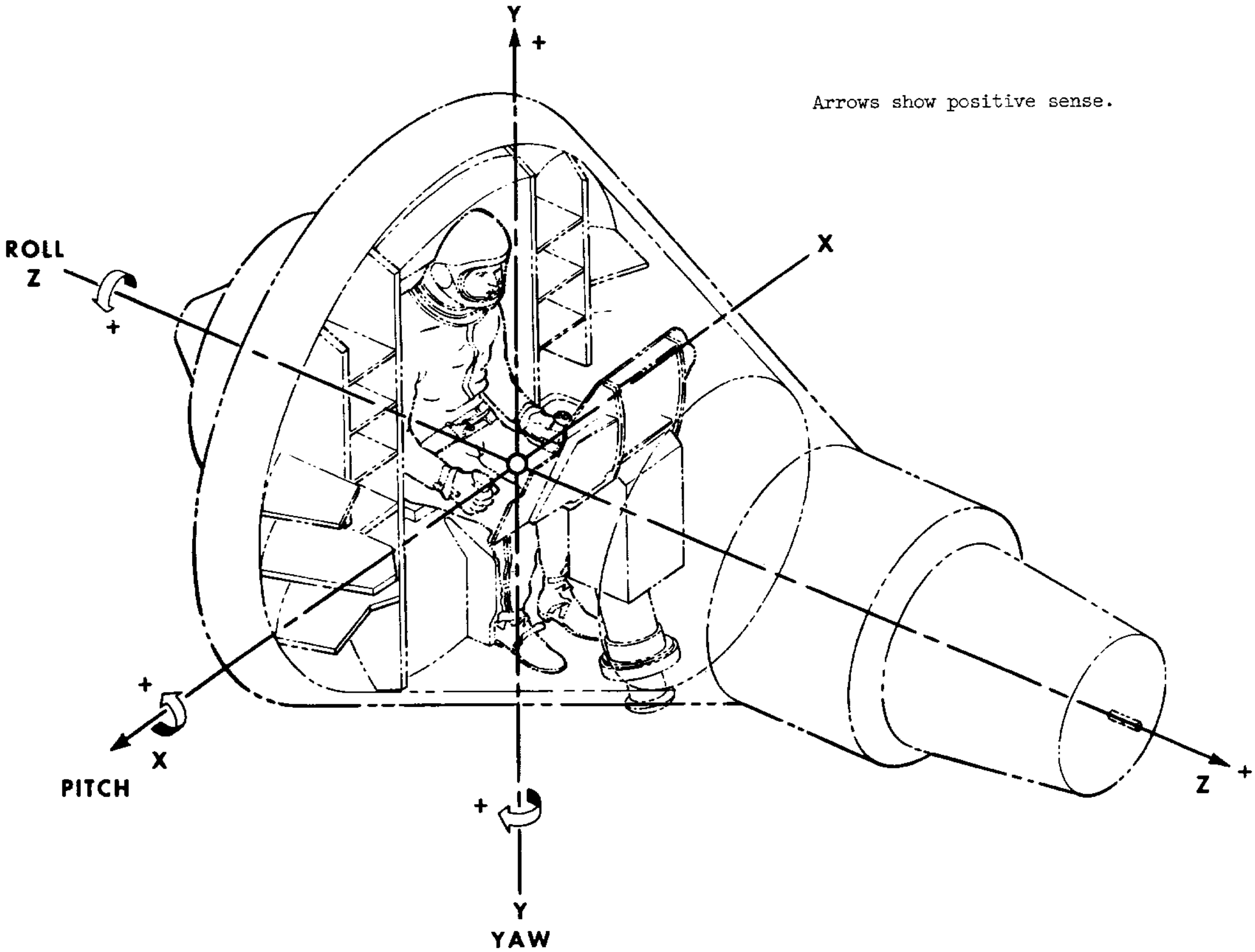


Figure 3.1-1.- MA-7 Spacecraft 18 mounted on the launch vehicle.



Pitch

Pitch is defined as the rotation of the spacecraft about its X-axis. The pitch angle is zero degrees (0°) when the Z-axis lies in a horizontal plane. Using the astronaut's right side as a reference, positive pitch is achieved by counterclockwise rotation from the zero degree (0°) plane. The rate of this rotation is the spacecraft pitch rate and is positive in the direction shown.

Yaw

Yaw is defined as the rotation of the spacecraft about its Y-axis. Clockwise rotation of the spacecraft when viewed from above the astronaut, is called right yaw and is defined as positive.

Yaw angle is considered zero degrees (0°) when the spacecraft is in normal orbital position (blunt end of spacecraft facing line of flight). When the positive Z-axis of the spacecraft is directed along the orbital flight path (recovery end of spacecraft facing line of flight), the yaw angle is 180°.

Roll

Roll is defined as the rotation of the spacecraft about its Z-axis. Clockwise rotation of the spacecraft, as viewed from behind the astronaut, is called right roll and is defined as positive (+). When the X-axis of the spacecraft lies in a horizontal plane, the roll angle is zero degrees (0°).

Accelerometer Polarity with Respect to Gravity

With the spacecraft in the launch position, the Z-axis will be perpendicular to the earth's surface and the Z-axis accelerometer will read +1 "G".

Figure 3.1-2.- MA-7 Axis diagram

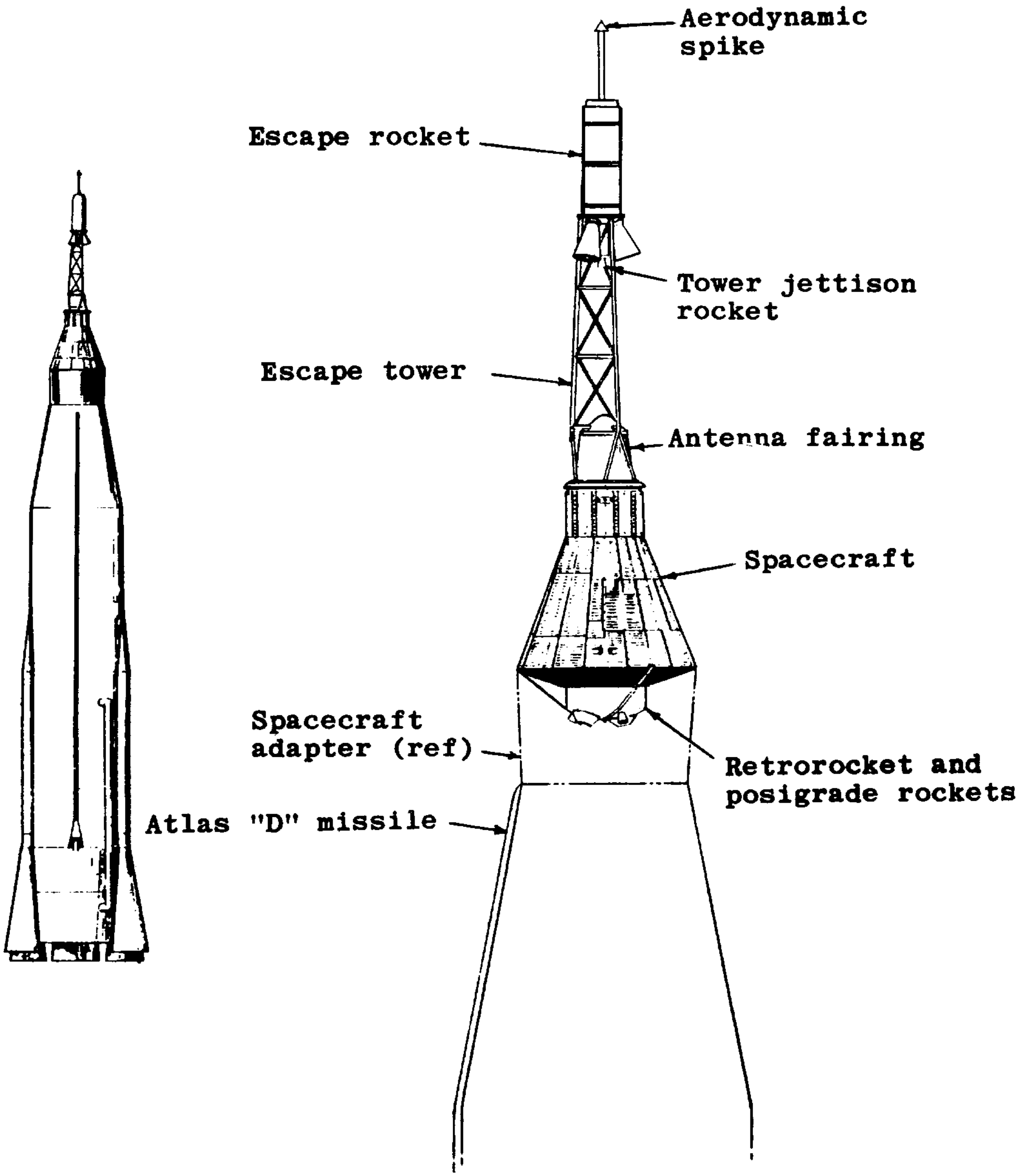


Figure 3.2-1.- Sketch showing general configuration.

4.0 EVENTS, TRAJECTORY, AND GUIDANCE

4.1 Sequence of Events

The times at which the major events of the MA-7 mission occurred are given in table 4.1-1.

4.2 Trajectory

The ground track of the flight is shown in figure 4.2-1, and the altitude-longitude profile is shown in figure 4.2-2.

The launch trajectory data, shown in figure 4.2-3, are based on the real time output of the Range Safety Impact Predictor Computer (which used AZUSA MK II and Cape Canaveral FPS-16 radars) and the General Electric-Burroughs guidance computer. The data from these tracking facilities were used during the time periods listed below.

Facility	Time, Min:Sec
Cape Canaveral FPS-16	0 to 00:39
AZUSA MK II	00:39 to 01:13
GE-Burroughs	01:13 to 05:10

The parameters shown for the "planned" launch trajectory in table 4.1-1 were computed using the 1959, ARDC model atmosphere to maintain consistency with other published preflight trajectory documents. The density of the Cape Canaveral atmosphere is approximately 10 percent higher than that of ARDC model atmosphere in the region of maximum dynamic pressure (about 37,000 feet altitude). As a result, the maximum dynamic pressure expected would be about 10 percent higher than that shown as "planned".

The orbital portion of the trajectory, shown in figure 4.2-4, was derived by first starting with the spacecraft position and velocity vector obtained during the second pass near Bermuda (during the second orbit) as determined by the Goddard computer using Mercury network tracking data. Integrating backward along the flight trajectory to orbital insertion and forward to the start of retrofire at the end of the third pass yielded the calculated orbit. These integrated values were in excellent agreement with the guidance-system measured values at orbital insertion. They were also in accord with the position and velocity vectors determined by the Goddard computer for passes near the Canary Islands (first pass) and Muchea (second and third passes), thus establishing the validity of the integrated orbital portion of the flight trajectory.

The reentry portion of the trajectory, shown in figure 4.2-5, was obtained by starting with the spacecraft position and velocity vector near Cape Canaveral, Florida, as determined by the Goddard computer. Integrating backward along the flight to the end of retrofire and forward to landing yielded the reentry trajectory. This included the assumptions that the drogue parachute deployed at 04:50:54 and the main parachute deployed at 04:51:48.2 as indicated by onboard measurement of the times of these events.

The spacecraft decelerations from the integrated reentry trajectory agree within reading accuracy with the decelerations measured by the onboard accelerometer. In addition, the time of .05 g from the integrated reentry trajectory and from spacecraft onboard measurements agree within one second. This agreement serves to verify the validity of the integrated reentry position of the trajectory.

The fact that the spacecraft landed approximately 250 nautical miles downrange of the nominal impact point and 15 nautical miles north of the nominal ground track can be attributed to improper spacecraft attitude, late retrofire, and a slightly lower (approximately 3%) than nominal retrorocket performance.

Use of measured capsule attitudes, which were given by both scanner and gyro data in integrated trajectory calculations resulted in landing points approximately 400 nautical miles downrange of the actual landing point. Therefore, these attitude data are clearly erroneous. In order to obtain a reasonably accurate estimate of the actual spacecraft attitudes and retrorocket performance which are uniquely related to the measured trajectory and, consequently, the actual landing point, an extensive trajectory analysis was conducted. This study made use of actual radar tracking data immediately prior to and after retrofire, the measured retrofire time, and a calculated spacecraft pre-retrograde weight. Estimated accuracies of space-fixed position and velocity vectors obtained from radar tracking immediately prior to and following retrofire are:

Velocity	± 2 ft/sec
Flight-path angle	± .002°
Altitude	± 400 ft
Heading angle	± .002°

Results of the comparison of the pre- and post-retrofire vectors yielded spacecraft attitudes of 36.5° ± 0.5° in pitch and 27° ± 0.5° in yaw and a retrorocket total impulse which is 3 ±0.5 percent lower than the nominal value of 38,943 lb-sec expected for this particular group of rocket motors. This impulse is within the specification value of 38,880 lb-sec ± 5 percent. These values can be used to generate the measured reentry trajectory and the actual landing point. The roll attitude was neglected, since the roll values of ±20° result in only one-nautical-mile variation in landing point.

The aerodynamic parameters for the planned and integrated reentry trajectories were computed using the MSC model atmosphere (NASA Project Mercury Working Paper No. 205). This is based on Discoverer Satellite program data above 50 nautical mile altitudes, the 1959 ARDC model atmosphere between the 25- and 50-nautical mile altitudes, and the Patrick AFB atmosphere below 25 nautical mile altitudes.

In the trajectory figures the above integrated values are labeled "actual".

A comparison of the planned and actual trajectory parameters is given in table 4.2-1. The difference between these primarily resulted from the actual cutoff velocity and flight-path angle at insertion being slightly higher than planned.

4.3 Guidance

The General Electric-Burroughs, Atlas guidance system performed exceptionally well in this flight. The guidance system locked on the vehicle in both track and rate at 00:73 seconds, approximately as planned, and lost lock at 05:38 (28.1 seconds after SECO).

In figures 4.3-1 to 4.3-3, the velocity and flight-path angle are shown in the region of sustainer cutoff. GE-Burroughs data are shown in figure 4.3-1, and the AZUSA data used in the Range Safety Impact Predictor Computer (IP7090) are shown in figure 4.3-2 to illustrate the noise level during the time of the GO-NO-GO computations. Both the GE-Burroughs and the AZUSA data are considered very good, except for three AZUSA points immediately after SECO. The reason for these three points with such large errors is not known at this time. The points are obviously in error but are included in the figures since these points were generated by the IP 7090 computer and received by the Goddard computers as shown in the figures.

The guidance system gave a cutoff condition which was about 2 ft/sec high in velocity and about .0002° high in flight-path angle. These values are within the expected accuracy range for the system. In figure 4.3-3, these data are shown as flight-path angle versus velocity. This is the type of display used by the Flight Dynamics Officer in the Mercury Control Center for the orbital GO-NO-GO decision. Both GE-Burroughs and AZUSA data indicated a GO decision.

The primary auxiliary sustainer cutoff (ASCO) signal based on General Electric-Burroughs guidance system computations was sent to the launch vehicle simultaneously with SECO. However, the backup ASCO signal was generated at the 7090 computer 0.44 seconds before the guidance SECO discrete was sent. The enable switch in the Mercury Control Center was in the "normal" position, which prevented transmission of this improper ASCO signal. Had this signal been sent, a cutoff velocity of approximately 110 ft/sec, and possible marginal GO-NO-GO insertion conditions, would have resulted. The 7090 computer used AZUSA data to compute the time of ASCO transmission, and the reason for this premature signal is being investigated.

TABLE 4.1-1.- SEQUENCE OF EVENTS

Event	Planned time,[a] hr:min:sec	Actual time, hr:min:sec	Difference, seconds
Booster-engine cutoff (BECO)	00:02:10.1	00:02:08.6	-1.5
Tower release	00:02:32.2	00:02:32.2	0
Escape-rocket ignition	00:02:32.2	00:02:32.2	0
Sustainer-engine cutoff (SECO) discrete		00:05:09.9	
Tail-off complete	00:05:05.3	00:05:10.2	4.9
Spacecraft separation	00:05:06.3	00:05:12.2	5.9
Retrofire sequence initiation	04:32:25.6	04:32:36.5	10.9
Retrorocket No. 1 (left)	04:32:55.6	04:33:10.3	14.7
Retrorocket No. 2 (bottom)	04:33:00.6	04:33:15.3	14.7
Retrorocket No. 3 (right)	04:33:05.6	04:33:20.3	14.7
Retro assembly jettison	04:33:55.6	04:34:10.8	15.2
0.05 g relay	04:43:55.6	04:44:44	48.4 (1.0)[b]
Drogue parachute deployment	04:50:00.6	04:50:54	53.4
Main parachute deployment	04:50:37.6	04:51:48.2	70.6
Landing (accelerometer measurement)	04:55:22.6	04:55:57	34.4 (25.6)[b]
Main parachute jettison	04:55:22.6	04:56:04.8	42.2 (33.4)[b]

[a]Preflight calculated, based on nominal Atlas performance.

[b]The numbers in parentheses show the difference between the actual and the postflight-calculated reentry event times based on actual insertion parameters.

TABLE 4.2-1.- COMPARISON OF PLANNED AND ACTUAL TRAJECTORY PARAMETERS

Condition and quality	Planned	Actual	Difference
Cutoff conditions (including tail-off):			
Range time, seconds	305.3	310.2	4.9
min:sec	05:05.3	05:10.2	
Geodetic latitude, deg north	30.4308	30.5035	.0727
Longitude, deg west	72.5076	72.4111	-.0965
Altitude, feet	528,367	527,859	-508
nautical miles	86.96	86.87	-.09
Range, nautical miles	437.4	443.3	5.9
Space-fixed velocity, feet/second	25,715	25,717	2.0
Space-fixed flight-path angle, deg	-.0006	-.0004	.0002
Space-fixed heading angle, deg east of north	77.4886	77.6008	.1122
Post-posigrade ignition conditions:			
Range time, seconds	307.3	312.2	4.9
min:sec	05:07.3	05:12.2	
Geodetic latitude, deg north	30.4606	30.5374	.0768
Longitude, deg west	72.3605	72.2416	-.1189
Altitude, feet	528,397	527,894	-503
nautical miles	86.96	86.88	-.08
Range, nautical miles	445.2	452.3	7.1
Space-fixed velocity, feet/second	25,736	25,738	2.0
Space-fixed flight-path angle, deg	-.0035	-.0031	.0004
Space-fixed heading angle, deg east of north	77.5672	77.6915	.1243

TABLE 4.2-1.- Concluded

Condition and quality	Planned	Actual	Difference
Orbit parameters:			
Perigee altitude, statute miles	100.1	99.97	-.13
nautical miles	86.96	86.87	-.09
Apogee altitude, statute miles	166.2	166.82	.62
nautical miles	144.4	144.96	.56
Period, min:sec	88:32	88:32	0
Inclination angle, deg	32.52	32.55	.03
Maximum conditions:			
Altitude, statute miles	166.2	166.82	.62
nautical miles	144.4	144.96	.56
Space-fixed velocity, feet/second	25,737.0	25,738.0	1.0
Earth-fixed velocity, feet/second	24,420.0	24,422.1	2.1
Exit acceleration, g	7.7	7.8	.10
Exit dynamic pressure, lbs/ft^2	966* 878**	967	1.0
Entry acceleration	7.6	7.5	-.1
Entry dynamic pressure, psf	450	429	-21.0
Landing point:			
Latitude, deg:min	21°07'N	19°27'N[a]	-1°40'N
Longitude, deg:min	68°00'W	63°59'W[a]	4°01'W

*Based on Cape Canaveral atmosphere.

**Based on 1959 ARDC model atmosphere.

[a]"Actual" landing coordinates shown above were those resulting from the trajectory integration. The retrieval point after landing was reported as 19°30'N and 64°15'W by the recovery ship (see section 9.0).

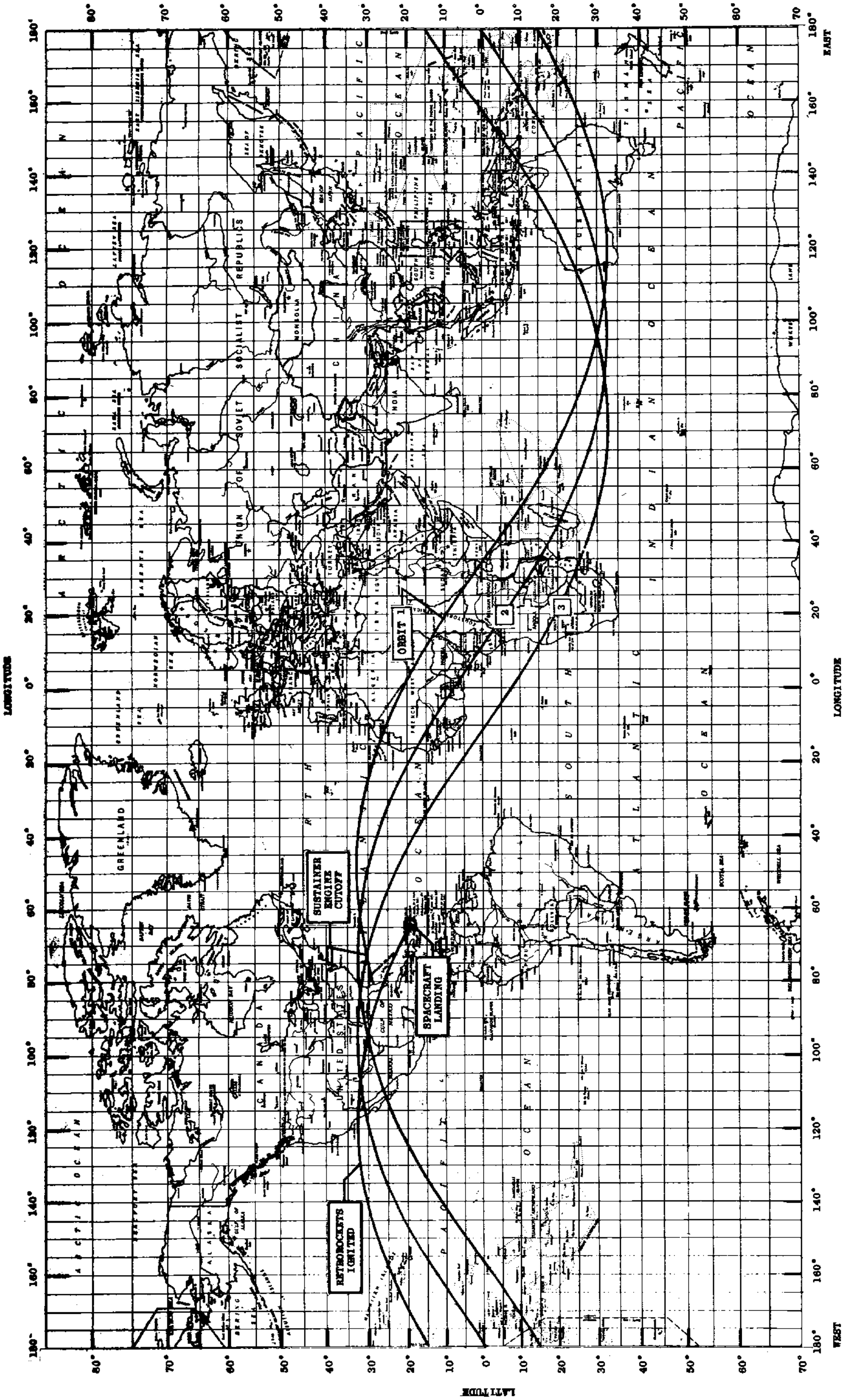


Figure 4.2-1.- Ground track for the MA-7 orbital mission.

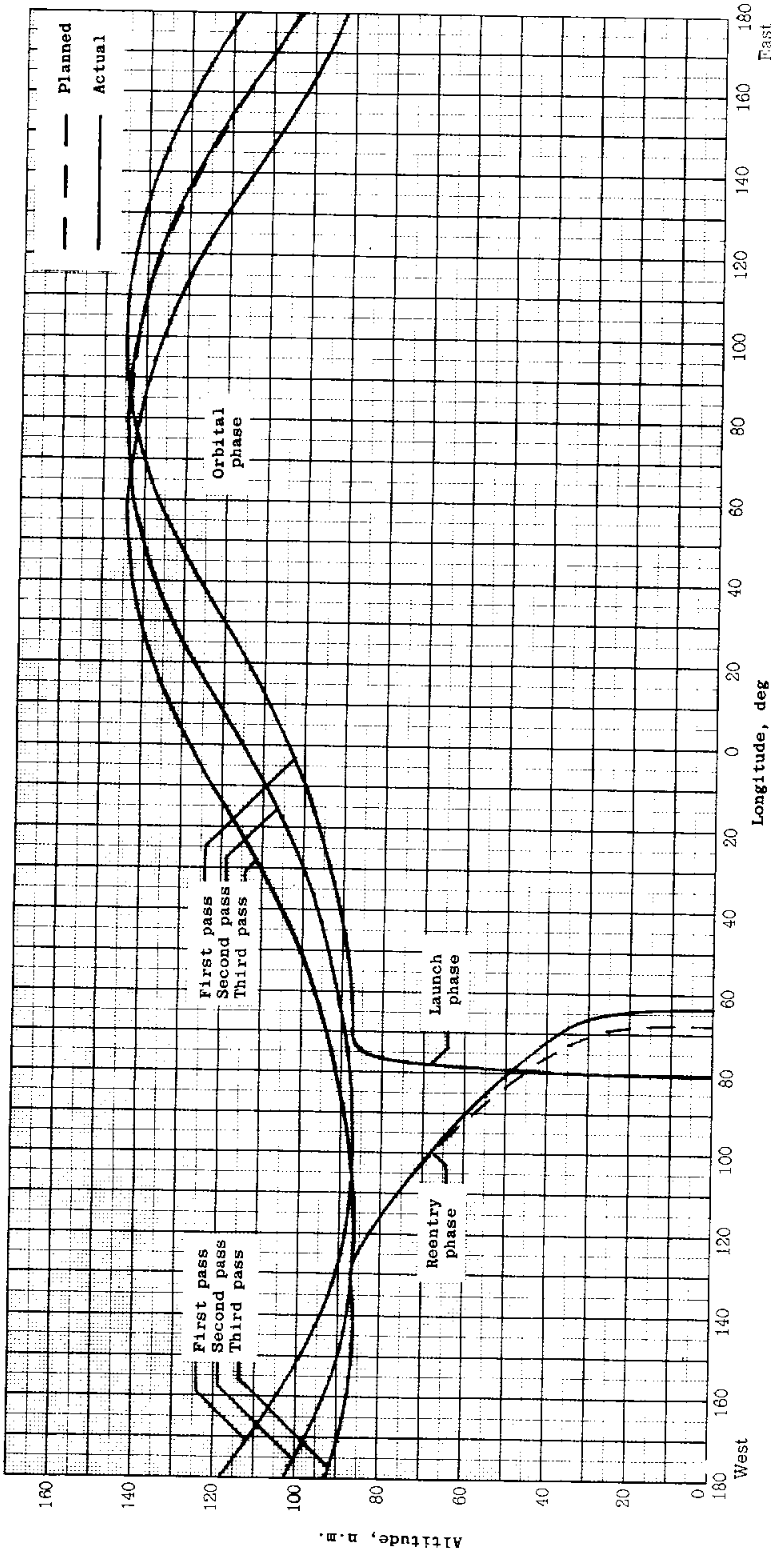
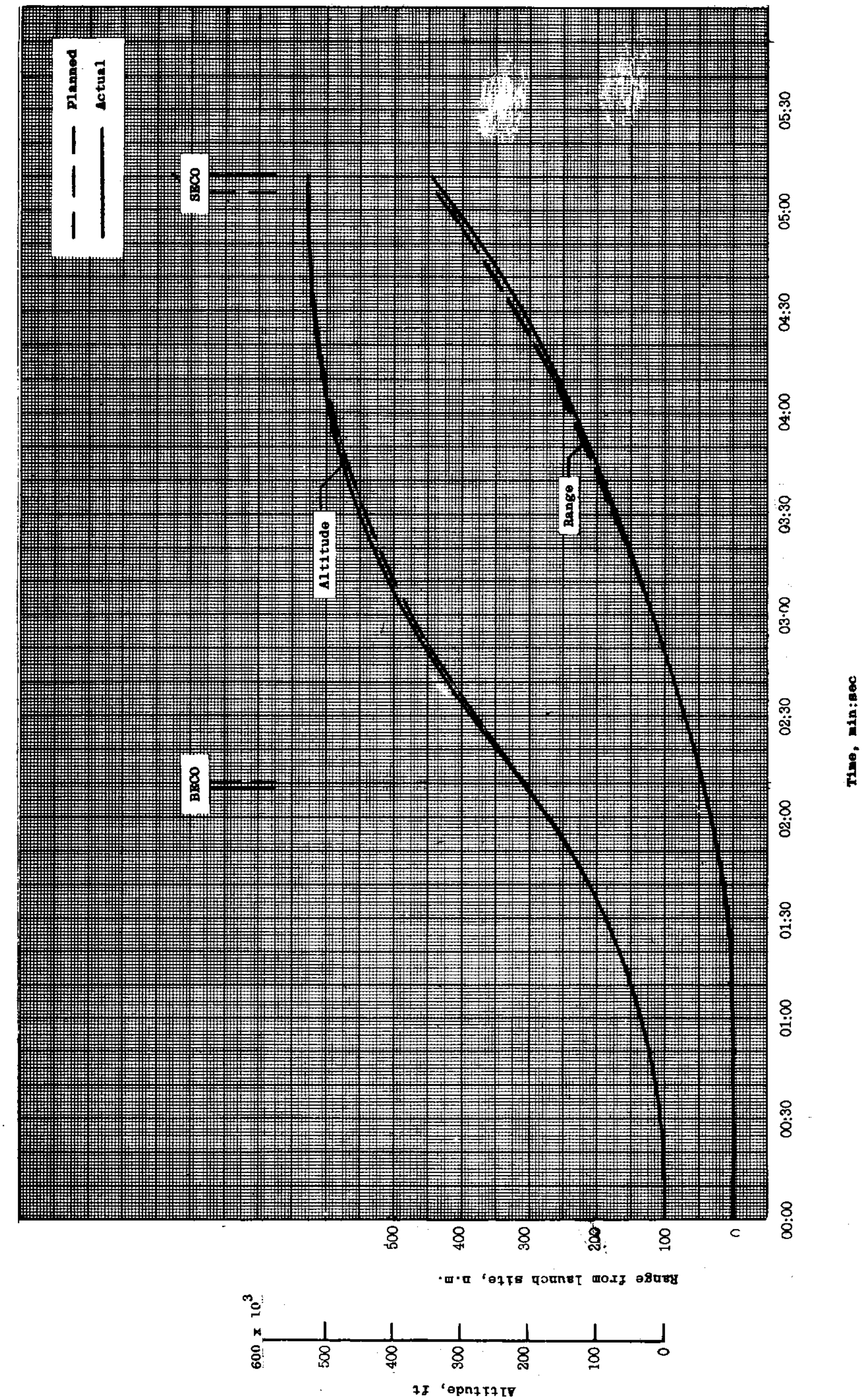


Figure 4.2-2. - Altitude versus longitude profile.

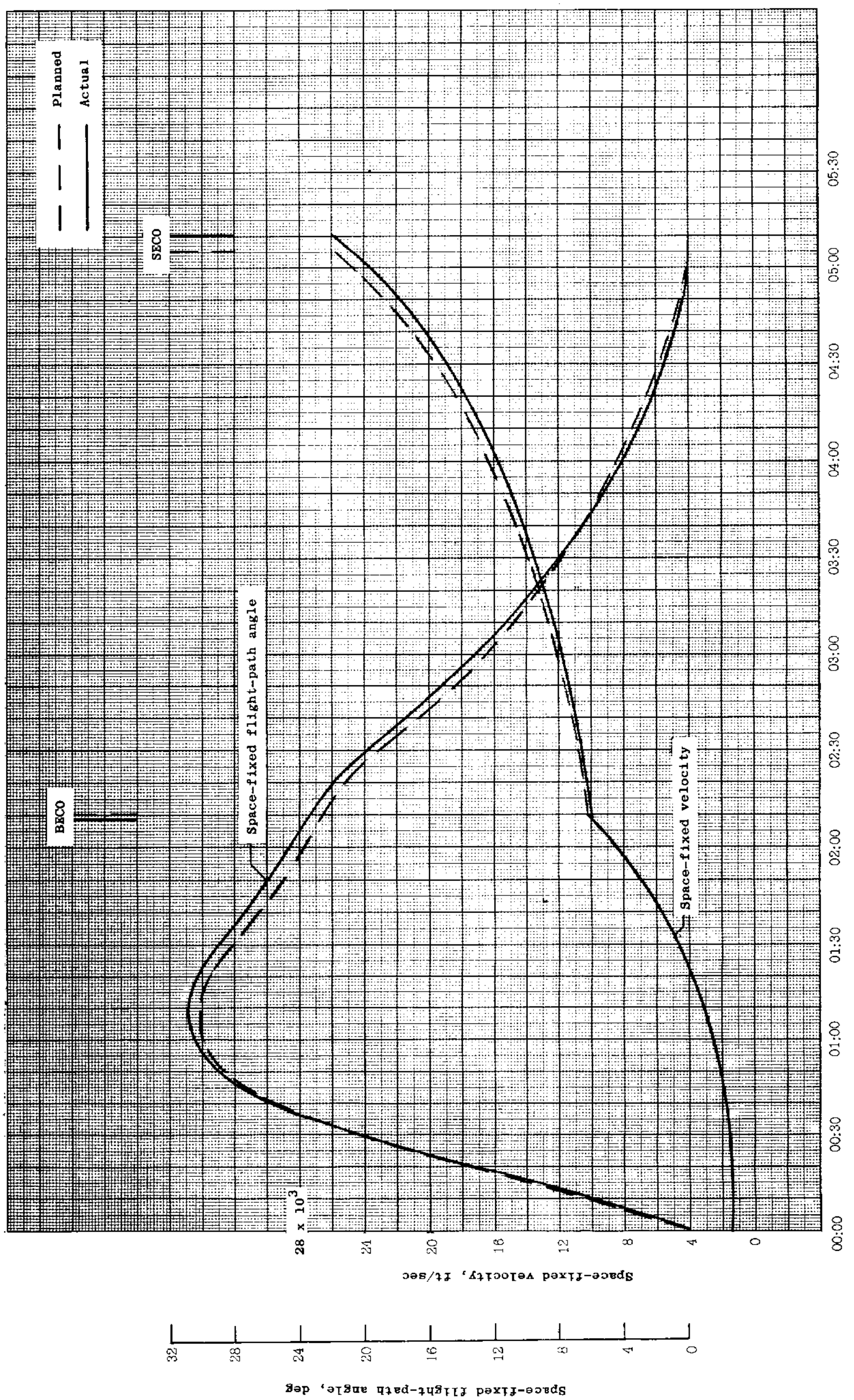
CONFIDENTIAL



(a) Altitude and range.

Figure 4.2-3. - Time histories of trajectory parameters for MA-7 mission launch phase.

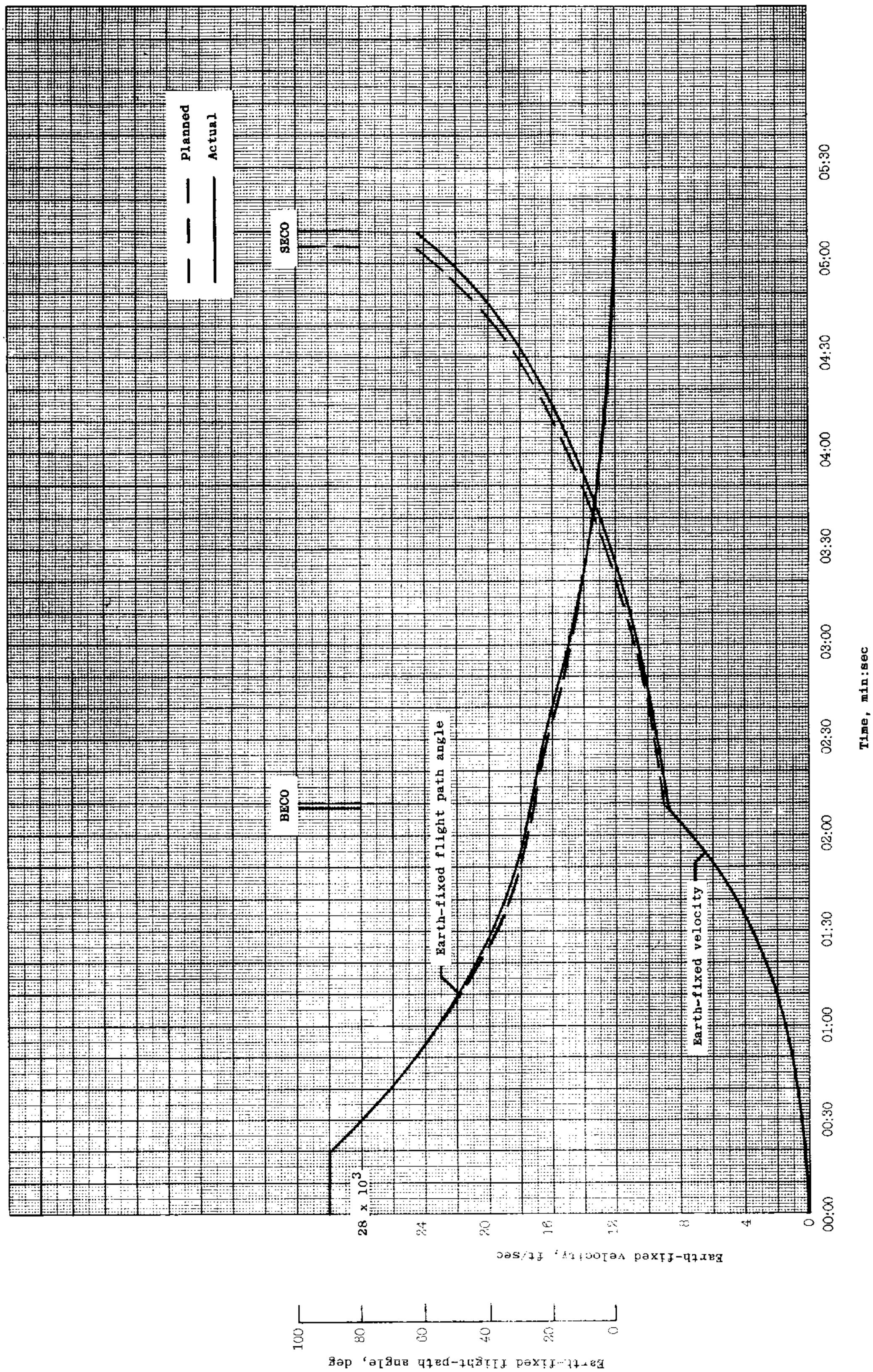
CONFIDENTIAL



Time, min:sec

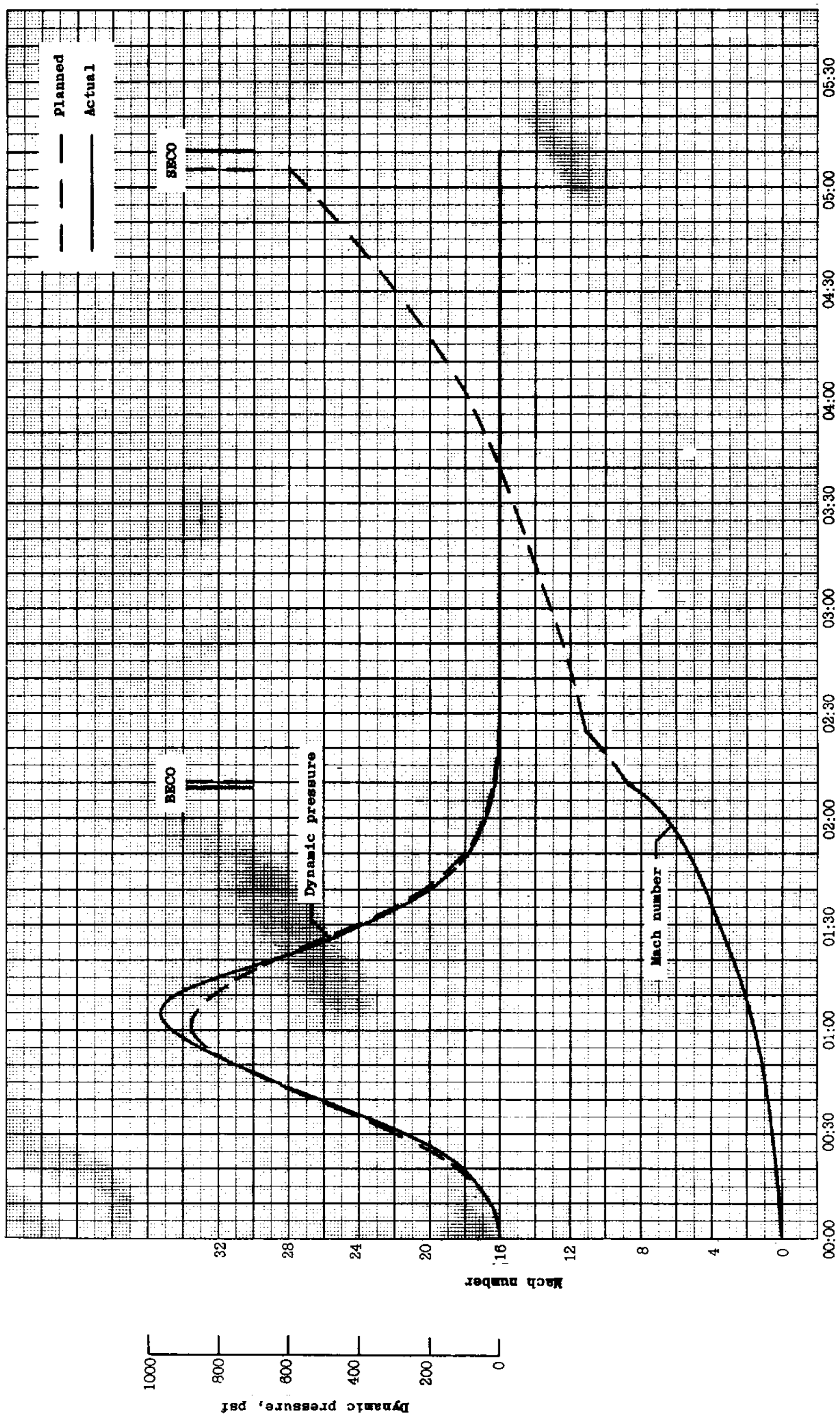
(b) Space-fixed velocity and flight-path angle.

Figure 4.2-3. - Continued.



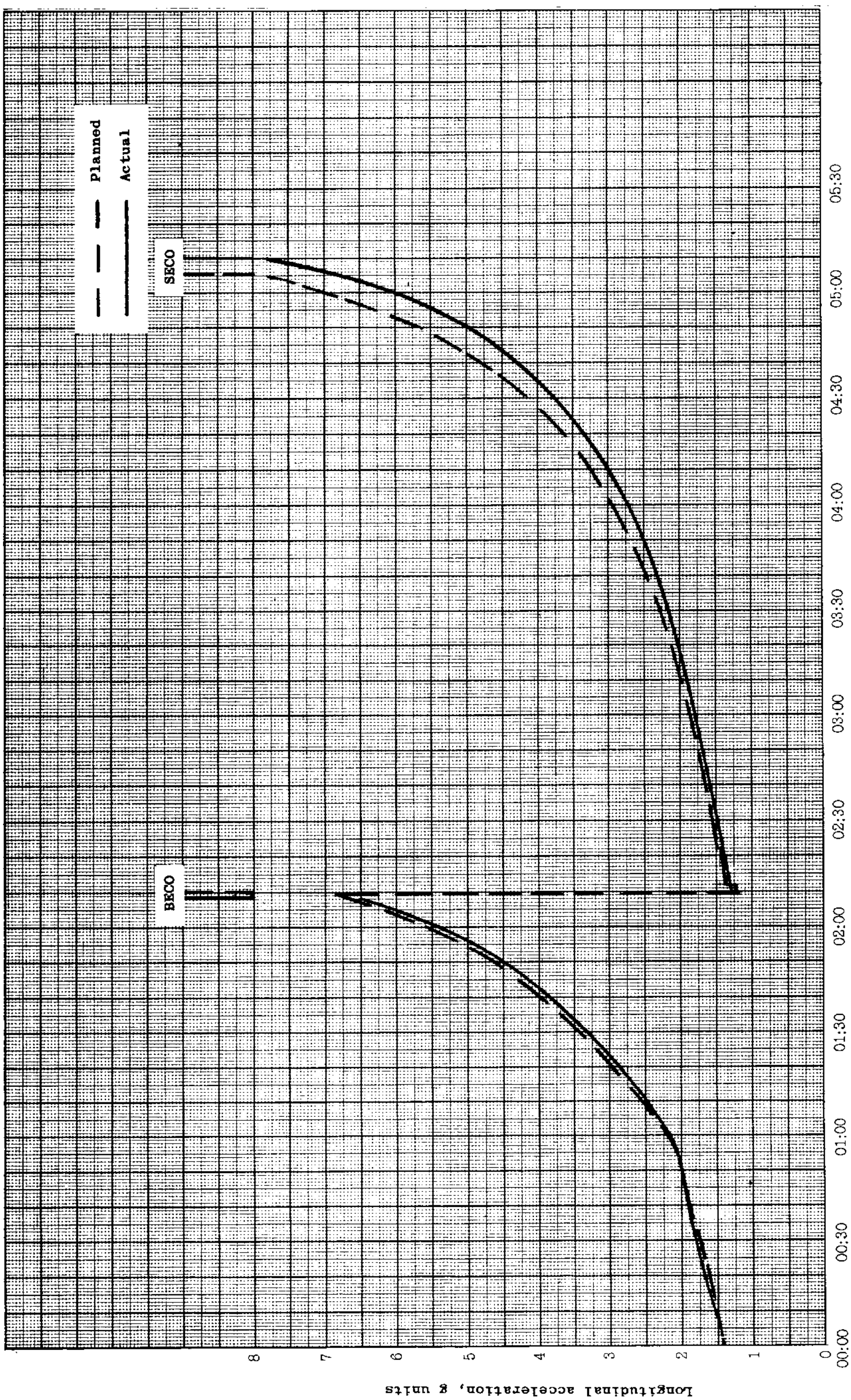
(c) Earth-fixed velocity and flight-path angle.

Figure 4.2-3. - Continued.



(d) Dynamic pressure and Mach number.

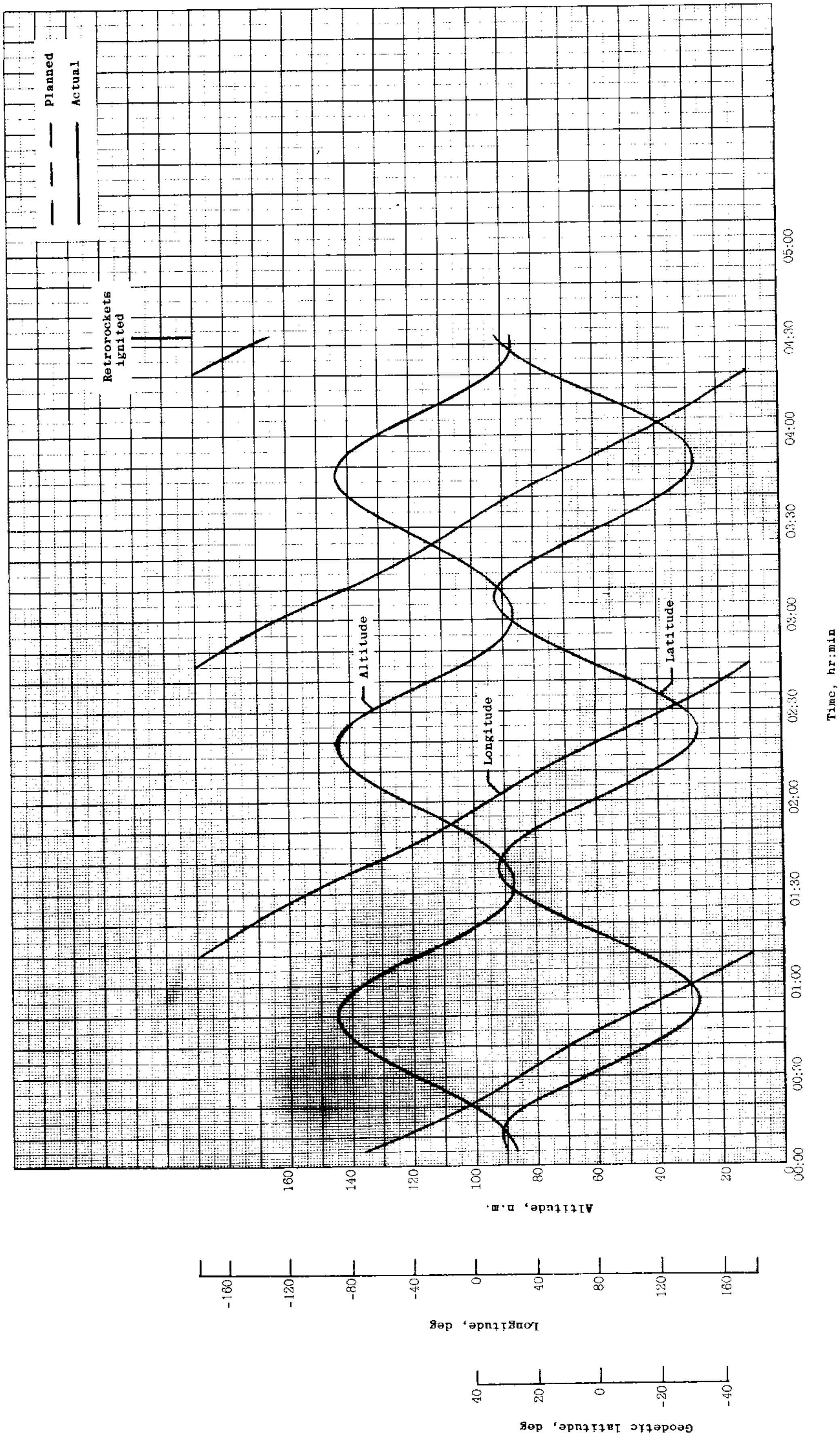
Figure 4.2-3. - Continued.



(e) Longitudinal deceleration along spacecraft Z-axis.

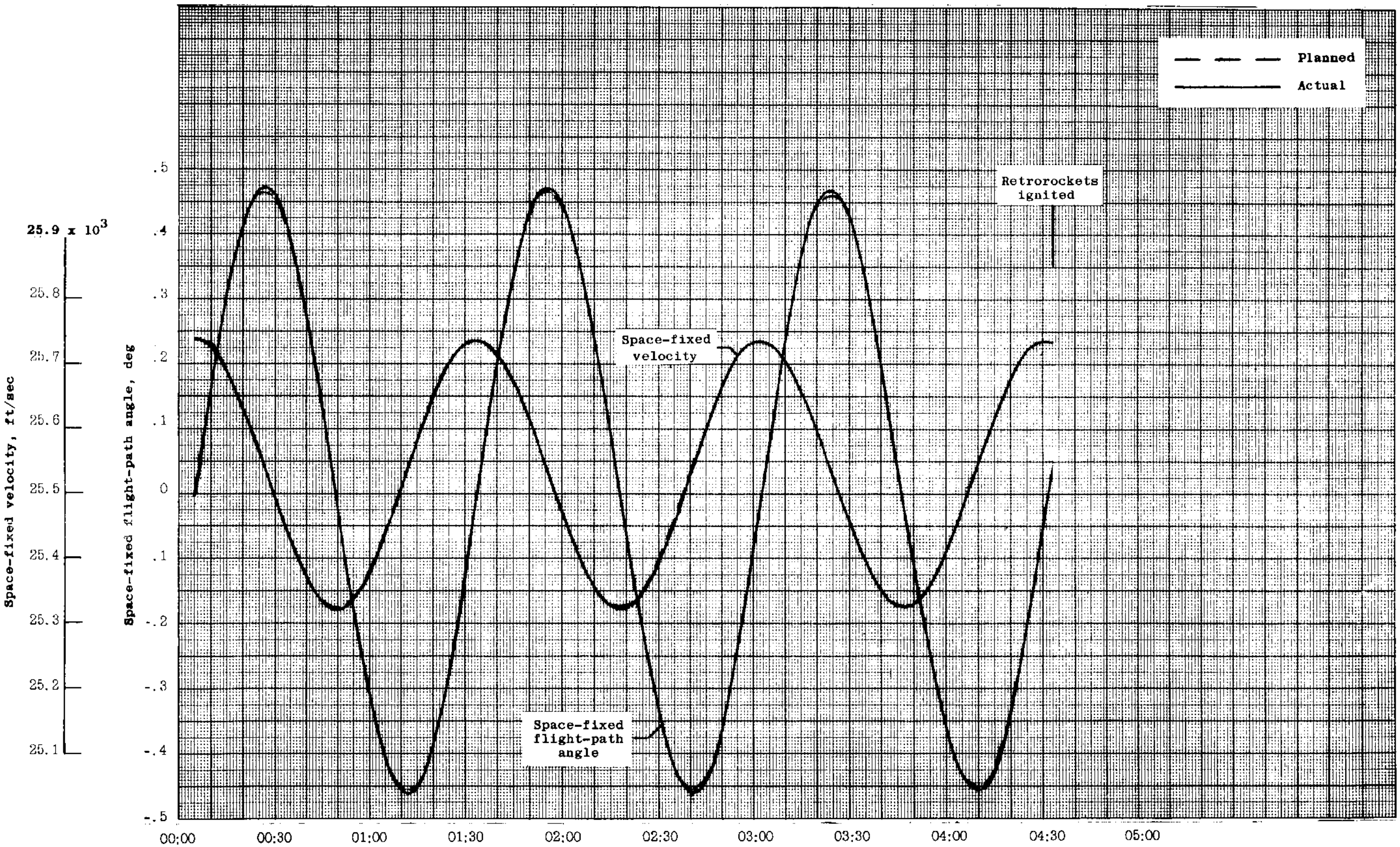
Figure 4.2-3. - Concluded.

CONFIDENTIAL



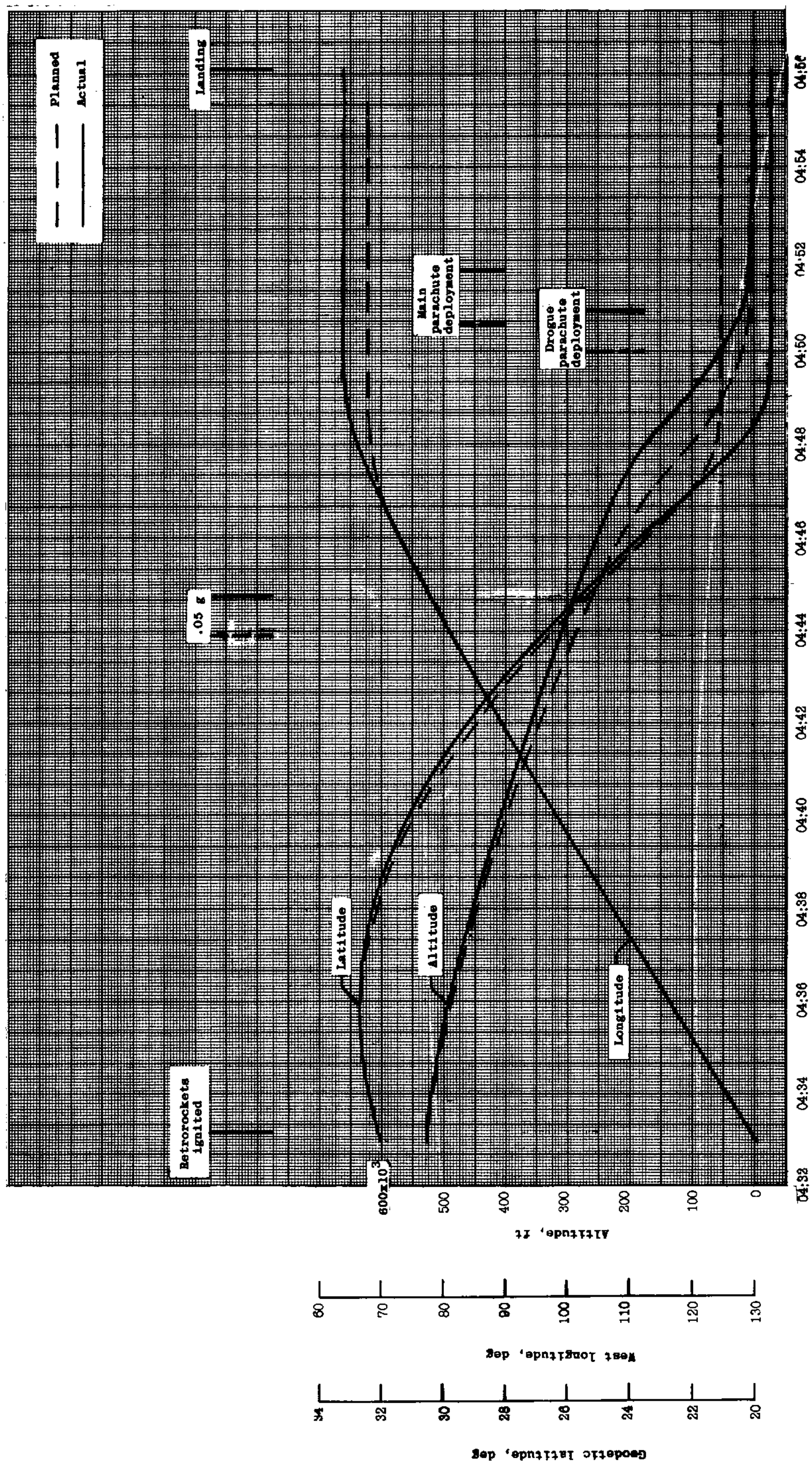
(a) Latitude, longitude, and altitude.

Figure 4.2-4. - Time histories of trajectory parameters for MA-7 mission orbit phase.



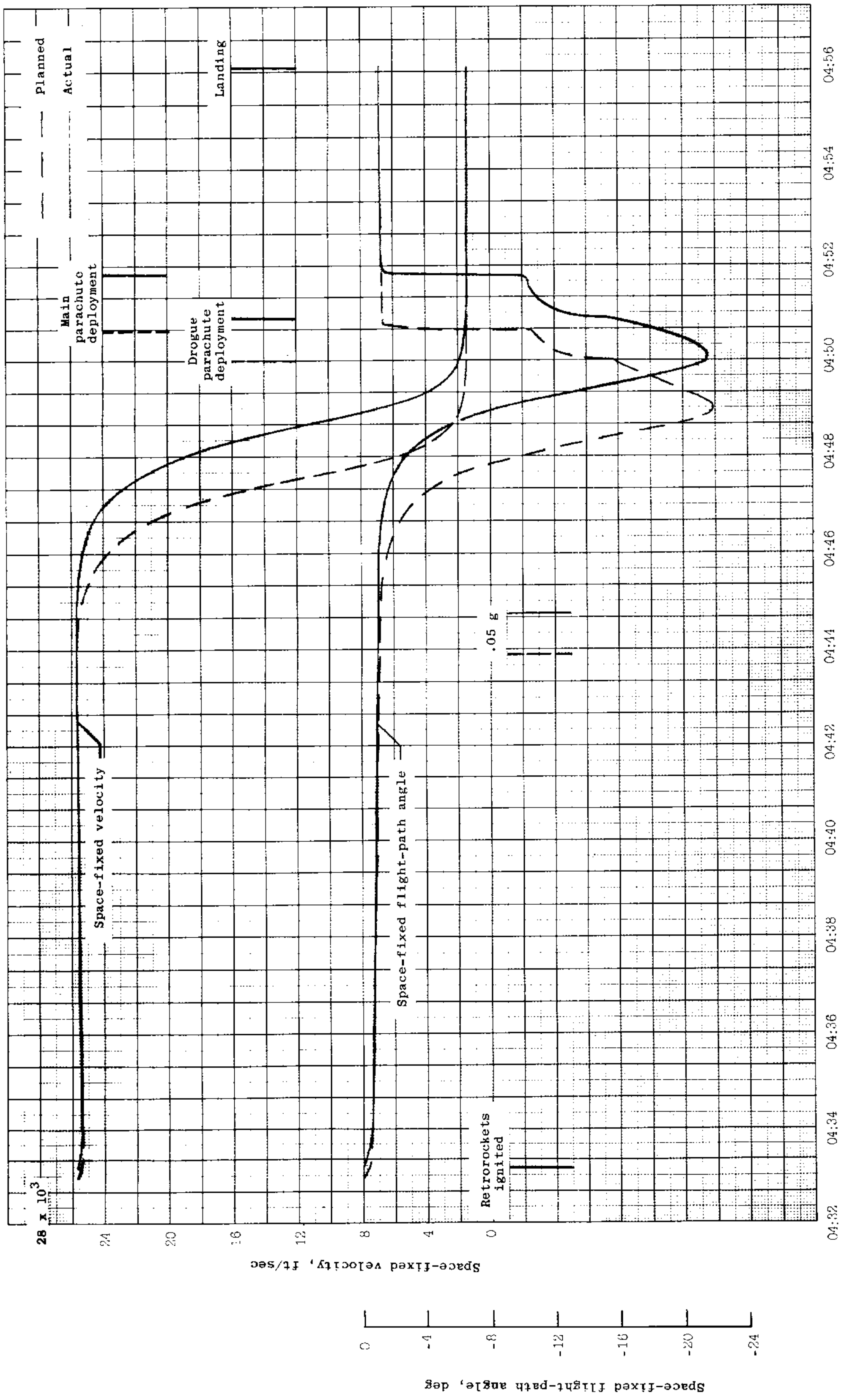
(b) Space-fixed velocity and flight-path angle.

Figure 4.2-4. - Concluded.



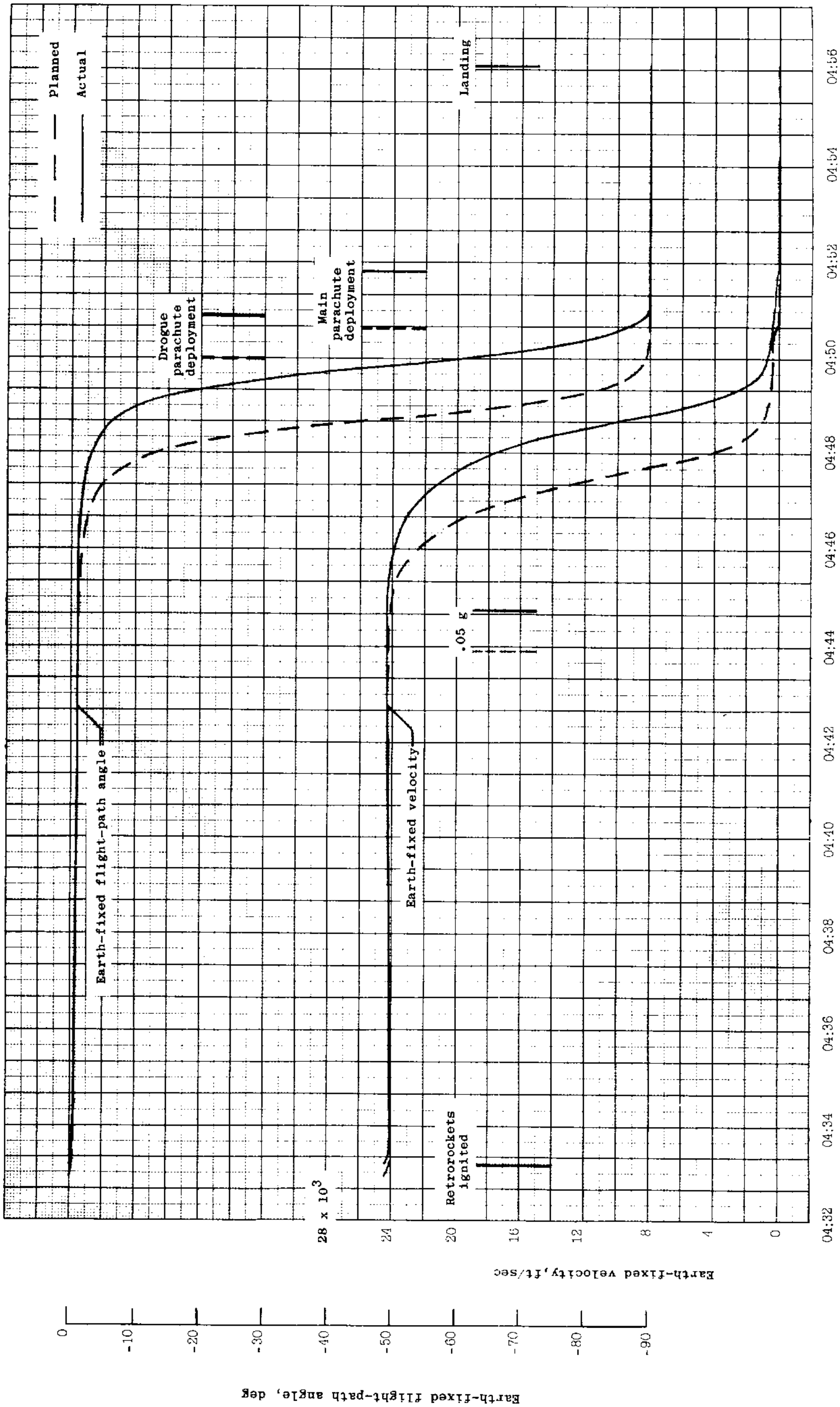
(a) Latitude, longitude, and altitude.

Figure 4.2-5. - Time histories of trajectory parameters for MA-7 mission reentry phase.



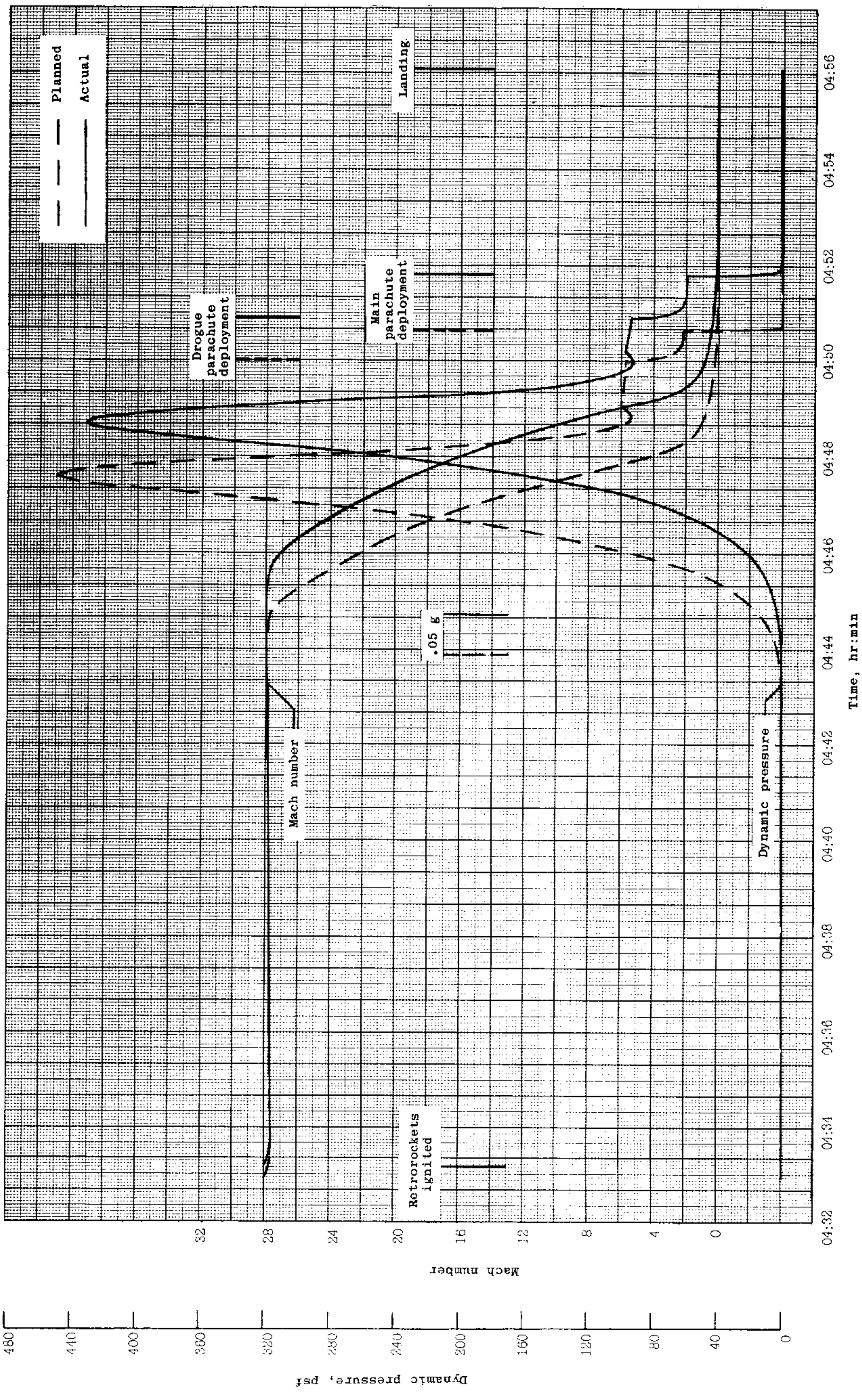
(b) Space-fixed velocity and flight-path angle.

Figure 4.2-5. - Continued.



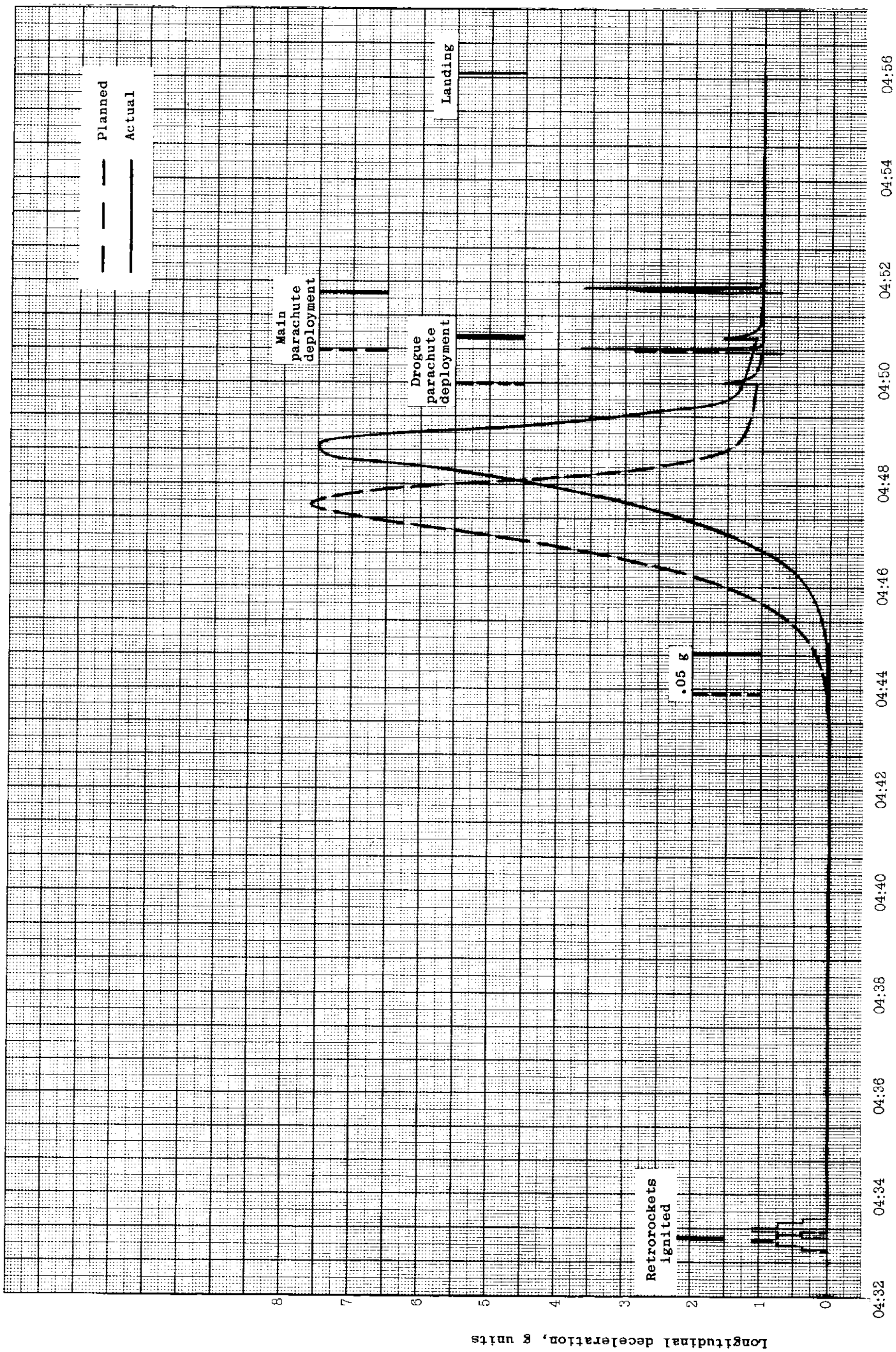
(c) Earth-fixed velocity and flight-path angle.

Figure 4.2-5. - Continued.



(d) Dynamic pressure and Mach number.

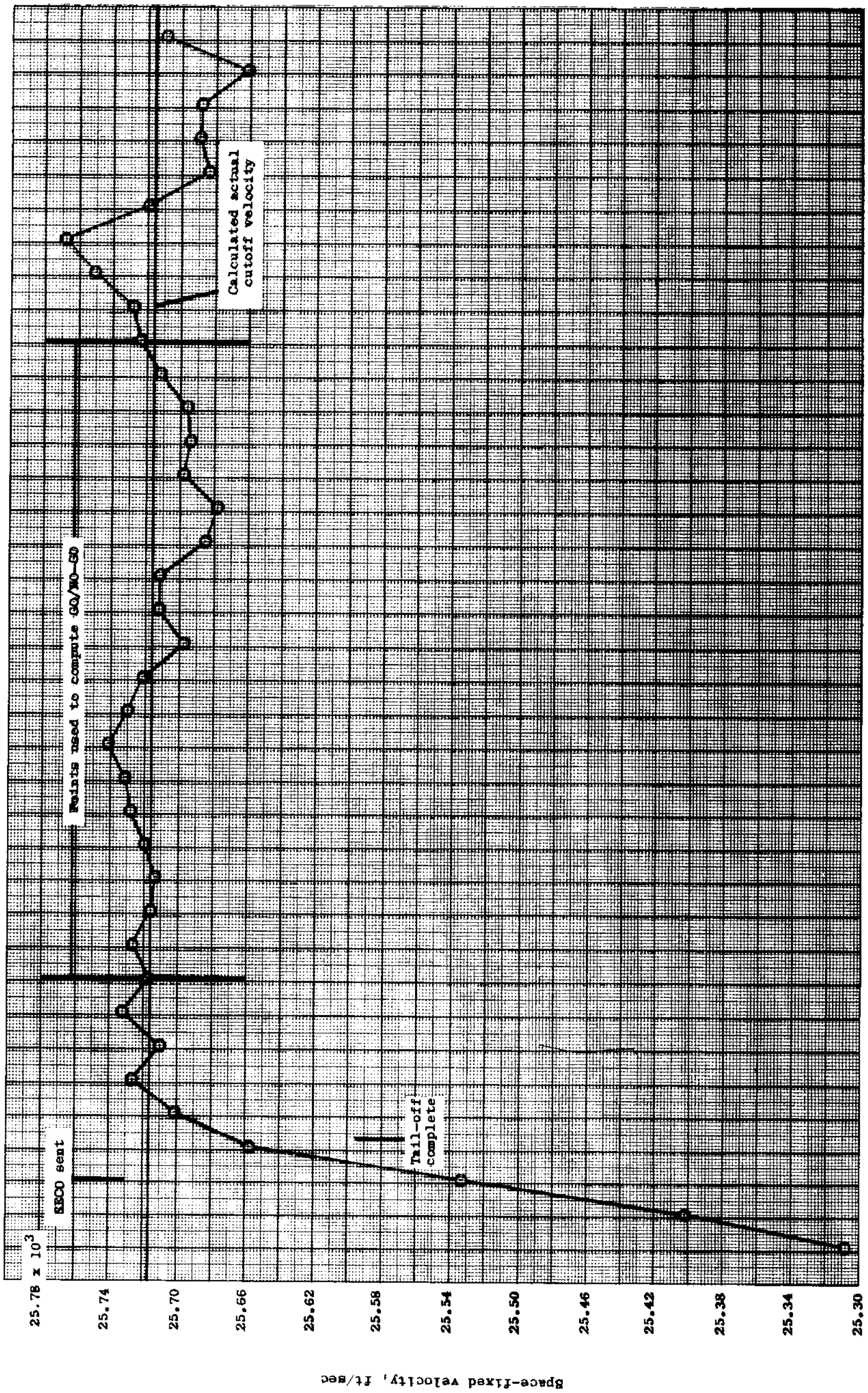
Figure 4.2-5. - Continued.



Time, hr:min

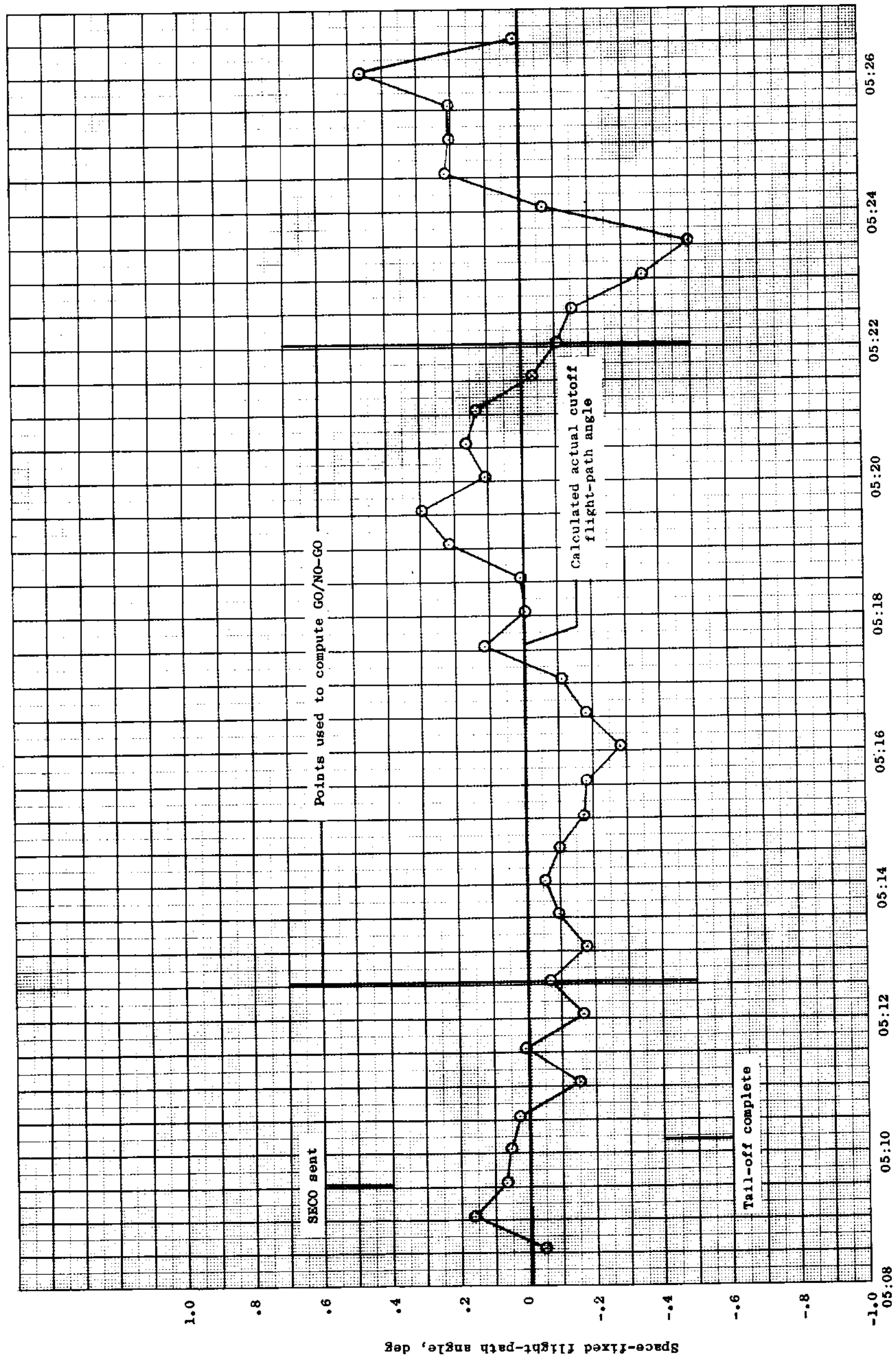
(e) Longitudinal acceleration along spacecraft Z-axis.

Figure 4.2-5. - Concluded.



(a) Space-fixed velocity.

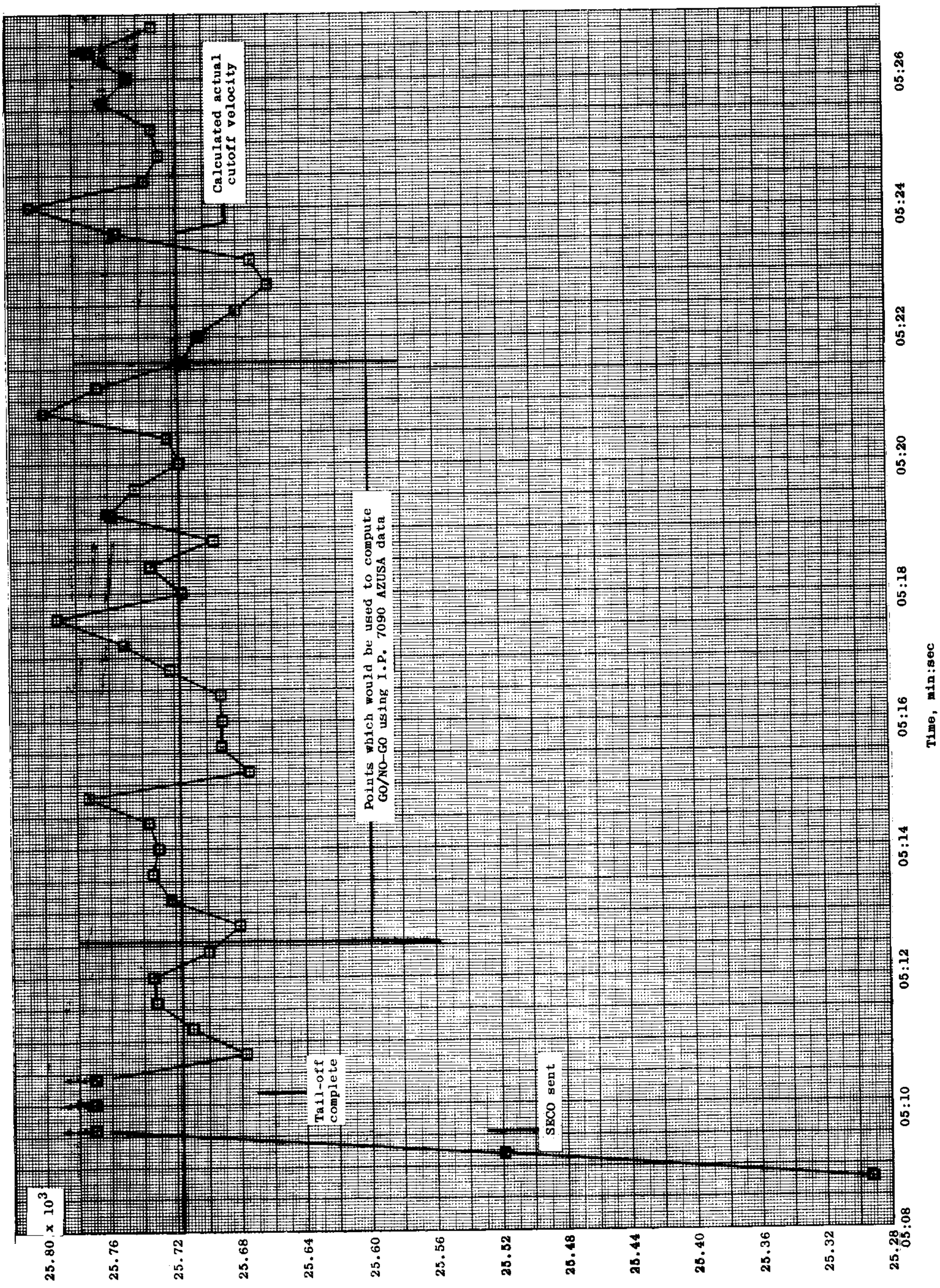
Figure 4.3-1. - Space-fixed velocity and flight-path angle in the region of cutoff using General Electric - Burroughs data.



(b) Space-fixed flight-path angle.

Figure 4.3-1. - Concluded.

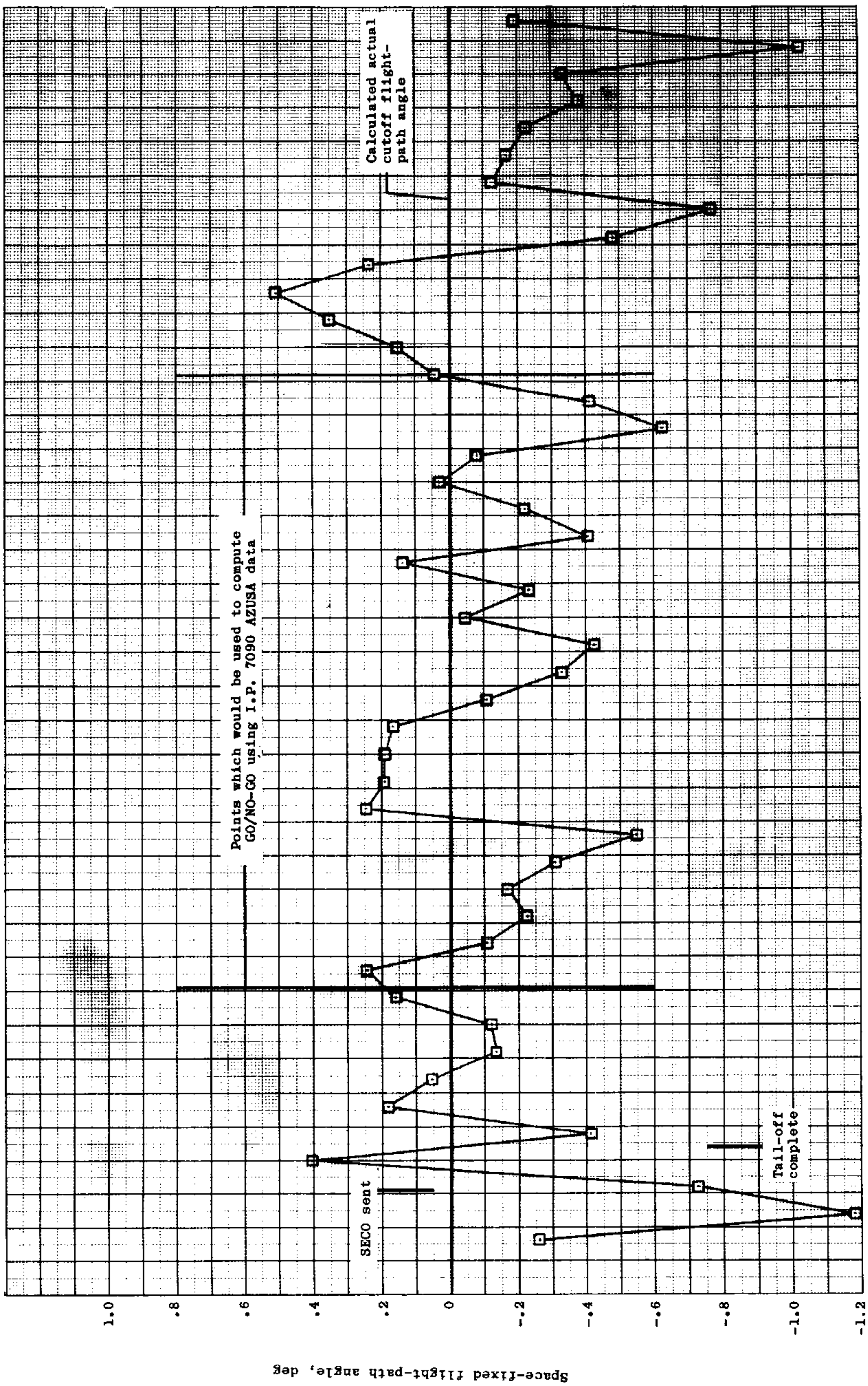
CONFIDENTIAL



(a) Space-fixed velocity.

Figure 4.3-2. - Space-fixed velocity and flight-path angle in the region of cutoff using I.P. 7090 data.

CONFIDENTIAL



(b) Space-fixed flight-path angle.

Figure 4.3-2. - Concluded.

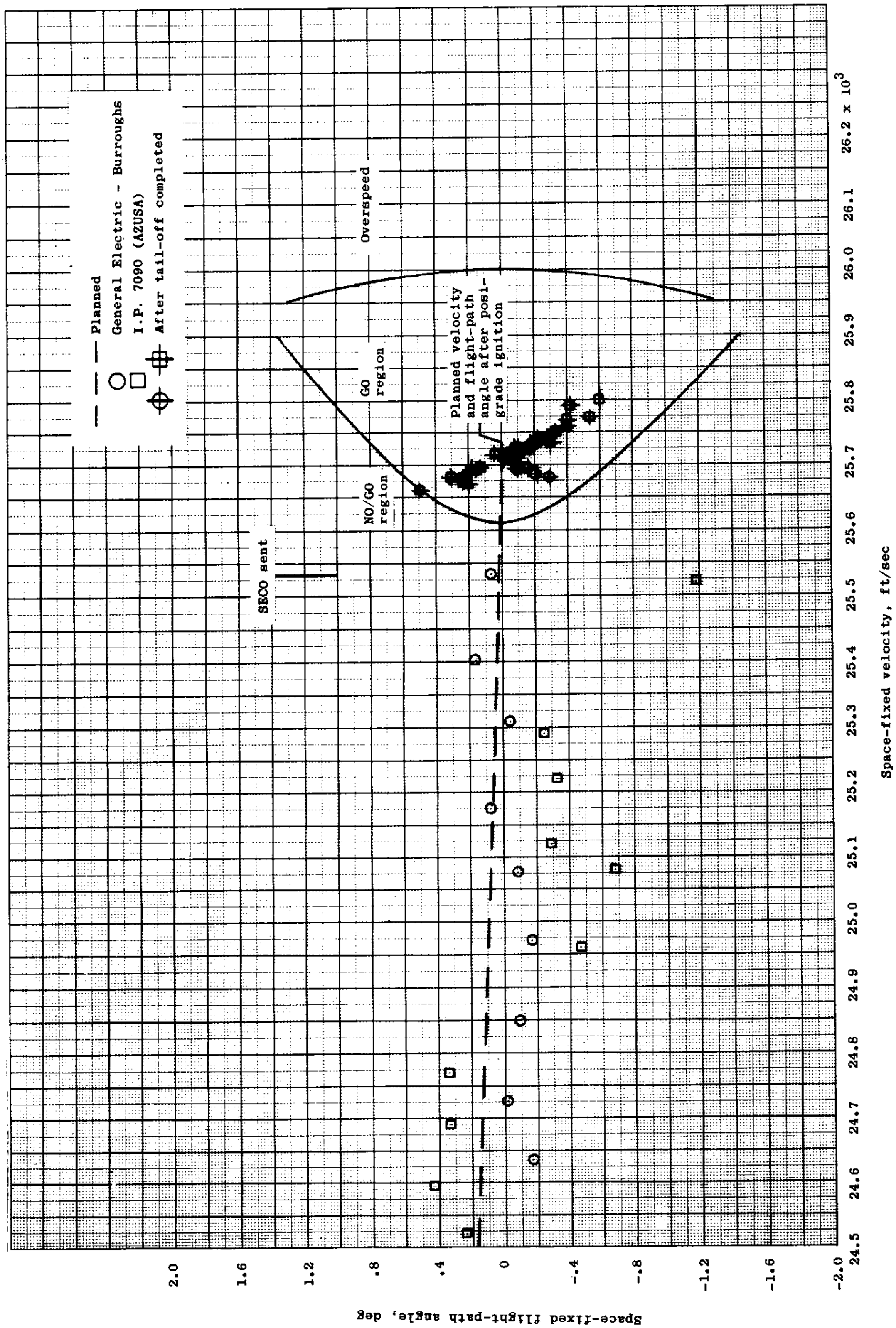


Figure 4.3-3. - Space-fixed flight-path angle versus space-fixed velocity in the region of cutoff.

5.0 SPACECRAFT PERFORMANCE

The spacecraft as an entity performed adequately. Some system anomalies were experienced, and analyses of these are discussed in the following paragraphs. Also discussed, from an overall mission viewpoint, are the spacecraft systems' general performance. Flight data and measurements are generally not shown, other than to clarify an analysis or present measurements of particular interest. Complete time histories of spacecraft data, without analysis, are presented in Part II of this report.

5.1 Spacecraft Control System

With the single exception of the pitch horizon scanner, spacecraft control system components functioned normally through the flight. The horizon scanner problem is discussed in detail in the paragraphs below, and the analysis takes into account the astronaut's comments concerning orbit attitude and attitudes prior to retrograde.

5.1.1 System description.- The spacecraft control system is designed to provide attitude and rate control of the spacecraft and is capable of operation in the following modes:

1. Automatic stabilization and control system (ASCS), with secondary choices of orientation, orbit, and auxiliary damping modes.

2. Fly-by-wire (FBW) system

3. Manual proportional (MP) system

4. Rate stabilization control system (RSCS)

Modes 1 and 2 employ the automatic reaction control system (RCS) thrusters, while modes 3 and 4 use the manual RCS thrusters. Each reaction control system has its own fuel supply and is independent of the other. Combinations of modes 1 and 3, 2 and 3, or 2 and 4 are available to provide "double authority" at the astronaut's discretion. The amplifier-calibrator (Amp Cal) employed standard A-8 logic circuitry and did not have the single-pulse insurance feature in orbit mode that was employed in spacecraft 13 (MA-6). This insurance feature prevented more than one actuation of a given thruster when the Amp Cal effected operation of that thruster. The data from the MA-7 flight do not show any double actuations of thrusters in the orbit mode, and therefore the lack of this insurance feature did not affect the control system performance.

The horizon scanner system employed a standard circuitry which reduced cold-cloud effects.

A MANEUVER switch was placed in series with the 0.05g switch fuse to remove torqueing of the direction-gyro gimbals. This effectively disables the yaw reference slaving system and pitch orbital precession (4°/min) at the astronaut's discretion. This allows the astronaut to perform spacecraft maneuvers without introducing errors in his attitude displays.

5.1.2 Flight Control Analysis.- Systems operation was normal during this flight, with the exception of a pitch horizon scanner malfunction which is evident from the data as having been present before spacecraft separation from the launch vehicle. The pitch horizon scanner output read +17 degrees, 40 seconds after tower separation. At this time, the launch vehicle pitch gyro read approximately -0.5 degrees revealing an 18 degree error in scanner output. By capsule separation the spacecraft pitch gyro had slaved to the pitch scanner output and was in error by about 20 degrees. This is shown in figure 5.1.2-1.

At various times during the orbital phase, the pitch horizon scanner output drifted without apparent spacecraft motion, as was found between 00:07:20 and 00:08:30, where an apparent slaving rate of 20 degrees per minute would be required to duplicate the scanner-gyro reference shift. The nominal gyro slaving rate is 8 degrees per minute. From known astronaut reference positions during the orbital period, the comparable pitch horizon scanner output was observed to be in error by varying amounts between +50 and -20 degrees.

During the retrofire period, a trajectory computation based on radar tracking data (see section 4.2) yielded a mean pitch attitude of -36.5°, whereas the maximum horizon scanner reading was -16° (see figure 7.2.3.6-1). This comparison and that which was made during the launch phase are the only independent sources which verify the scanner bias, and these are in excellent agreement.

Further studies and tests are in progress to localize the nature of the failure. It is believed that the malfunction can be attributed to a random component failure, since the scanner design has previously been qualified.

There were two indications of the gyros not caging to zero during the flight. The astronaut recycled the gyro switch each time and the gyros immediately caged properly.

The ASCS orbit mode performance appeared to be satisfactory, but cannot be evaluated in detail since continuous scanner slaving was employed. The ASCS orbit mode operation can be best analyzed when the gyros have been free for an extended period of time, thereby eliminating the scanner slaving.

The orientation mode displayed a divergent oscillation at 04:26:13 when the astronaut switched to ASCS in order to maintain an accurate retroattitude. This divergent oscillation was caused by the rate-gyro spin motors not having sufficient time to run up, since they were shut down during the previous two hours of manual proportional control system utilization. The nominal rate gyro run up time is 2 minutes.

5.1.3 Control System Utilization.- Spacecraft turnaround was accomplished manually by the astronaut, according to the flight plan, using the FBW control system. ASCS control was initiated at 00:07:10. By 00:56:50, maneuvering had been conducted using all control systems and modes of operation, and the astronaut reported thses operations as satisfactory. However, the brief periods of operation involved may have prevented the pilot from recognizing improper attitude reference.

Manual control (FBW and MP) was used extensively during the flight. Approximately 17 minutes of the flight consisted of double authority control. The control system combinations utilized were FBW with MP and ASCS with MP. It should be noted that the high thrusters were actuated inadvertantly a number of times by the astronaut while using the FBW control system. It is believed that the repeated use of the high thrusters, together with the use of double authority control, resulted in the unfavorable fuel usage rate, which can be seen in figure 7.2.3.7-1.

The FBW control system was used to obtain and hold reentry attitude during retrofire. After retrofire, the MP control system was utilized until manual fuel depletion at 04:34:00. Thereafter, FBW control was used until spacecraft oscillations began to build up during reentry, at which time the auxiliary damping mode of ASCS was utilized until automatic fuel depletion at 04:49:58.

The spacecraft oscillations began to diverge after automatic fuel depletion and continued until manual drogue deploy. A preliminary analysis of the onboard data indicates that the natural frequency and damping ratios of the MA-7 spacecraft during reentry are approximately as predicted, based on an analysis of the MA-6 reentry data.

5.1.4 Reaction control system.- The reaction control system (RCS) was of the standard configuration, with the exception of modified thrust-chamber assemblies. This modification essentially involved replacing the stainless-steel fuel-distribution (Dutch weave) screens with platinum screens and a stainless-steel fuel distribution plate, reducing the volume of the automatic heat barriers and solenoids, and moving the fuel-metering orifice to the solenoid inlet. This change was incorporated into the 1-lb thruster assemblies, but not the 24-lb. Only the platinum screens were added to the 6-lb units.

Objectives of the thruster configuration change for the MA-7 mission were to eliminate the possibility of blocking the fuel metering orifices with particles of Dutch weave screens, as is presumed to have occurred on the MA-6 mission, and also to reduce the total impulse per pulse of low thruster operation in the ASCS orbit mode. Ground tests conducted on this new configuration indicated an approximate reduction of 50 percent of total impulse per thruster pulse.

Heat sinks were attached to the automatic and manual roll-thruster assemblies in a manner similar to that employed on the MA-6 mission, in order to reduce propellant feed-line temperatures.

Performance: The astronaut's report of no malfunctions in the reaction control system is substantiated by the onboard recorded data. The high rates of fuel consumption appear to be consistant with the frequency and duration of thruster activity. There is no evidence, either from flight data or from postflight inspection, of fuel leakage.

Propellant feed-line temperatures were measured during the flight and maximum temperatures recorded are listed below:

Thruster position	Temperature of feed line, $^{\circ}F$	Approximate Time, hr:min
Automatic roll (clockwise)	104	03:48
Automatic roll (counterclockwise)	105	01:55
Manual roll (clockwise)	108	03:28
Manual roll (counterclockwise)	119	03:00
Automatic pitch (up)	128	03:43
Automatic pitch (down)	139	03:27
Automatic yaw (right)	142	03:34
Automatic yaw (left)	136	03:41

An analysis of the data indicates that thruster impulse of the expected magnitude was delivered whenever a thruster solenoid was actuated. Angular velocity changes imparted to the spacecraft by automatic system thruster operations were nominal. Refer to table 5.1.2-1 for a history of automatic and manual fuel usage.

During the spacecraft 18 (MA-7) thrust chamber inspection, all assemblies appeared to be in excellent condition, with evidence of a normal amount of salt water corrosion and heat discoloration. The results of the postflight RCS inspection are presented in table 5.1.2-2. The only noticeable conditions were the heat markings on the pitch and yaw heat barriers, which varied from 0.25 to 0.45 inches long. This was not evident on the 1-pound roll heat barriers; however, there existed a heavier discoloration and slight oxidation of the diffuser plates in the pitch and yaw 1-pound thrust chambers. Diffuser plates in the roll chambers were light blue in color.

The platinum screens in all chambers were found to be in excellent condition with no evidence of deterioration.

All automatic system solenoids were inspected and tested for electrical actuation. The 24-pound pitch-down and yaw-right solenoids failed to operate with 30 VDC applied. This is attributed solely to postflight salt-water corrosion, since no indication exists that these units failed to operate during the flight. All others operated properly under 18 VDC. Detailed inspection of the 1- and 6-pound solenoids revealed no apparent discrepancy, and poppet tips looked good in all respects. No rust was seen within the valves; however, as was evident in a number of cases at the outlet port, it appears as if the voishan washer may be causing the plating to crack at this point.

Inspection of the 24-pound solenoids revealed rust in varying degrees within the bore, mainly at the metal insert and poppet bore lip. The inoperative valves had a heavy salt-like substance within the bore. Inlet screens were generally clean, and the few exceptions that were found revealed minute plastic and crystalline particle deposit.

TABLE 5.1.2-1.- FUEL CONSUMPTION

Time	Mission phase	Automatic system: Fuel used, lb	Automatic system: Fuel remaining lb	Manual system: Fuel used, lb	Manual system: Fuel remaining lb
00:00:00	Launch	0	35.0	0	24.9
00:08:00	Turnaround and damping	1.6	33.4	0	24.9
01:33:32	First pass	15.8	17.6	8.5	16.4
03:07:04	Second pass to retro	5.8	11.8	5.1	11.3
04:33:21	Retro to 0.05 g	5.4	6.4	10.3	1.0
04:44:44	05 g to drogue	5.0	1.4	1.0[a]	0
04:50:54	Drogue to main	1.4[a]	0	--	--

[a]Fuel depletion occurred during this period.

TABLE 5.1.2-2.- SPACECRAFT 18 THRUST CHAMBER INSPECTION

Thruster	Serial number[a]	Inspection results
Yaw right (1-lb)	136	Orifice spacer clean, rust stains evident on the bottom side of orifice and diffuser plate. Platinum screens in good condition.
Yaw left (1-lb)	133	Orifice spacer clean diffuser plate clear. Platinum screens in good condition.
Pitch up (1-lb)	73	Orifice spacer clean, rust stains evident on both sides of diffuser plate and top side of first screen. Platinum screens in good condition.
Pitch down (1-lb)	135	Orifice spacer clean, diffuser plate clear. Screens look excellent.
CCW automatic roll (6-lb)	28	Heavy rust stains on all parts, diffuser plate and orifice clear, platinum screens good.
CCW automatic roll (1-lb)	28	Rust stains evident on orifice spacer and diffuser plate, diffuser plate blue in color. Platinum screens okay.
CW automatic roll (6-lb)	18	Very wet, orifice clean, diffuser plate blue in color, screens very good.
CW automatic roll (1-lb)	18	Orifice spacer clean, no rust, diffuser plate lightly blued on top surface. Screens excellent.
CCW manual (1-6-lb)	21	Orifice and diffuser plate clean, light rust stain on platinum screen. Light corrosion on check valve nose piece.
CW manual (1-6-lb)	28	Corrosion on check valve nose piece, salt like substance found in valve and heat barrier screen. Orifice, diffuser plate and platinum screens in good shape.

[a]The serial number refers to a thrust chamber assembly, which may contain more than one thruster.

5.2 Environmental Control System

The environmental control system (ECS) is designed to provide a comfortable level of temperature and humidity in the pressure suit and to maintain appropriate suit and cabin pressures. The composition of the suit environment is 100% oxygen, and the nominal pressure level is 5.1 psia. Control of this environment is accomplished by removing metabolic heat, carbon dioxide and water. Replenishment of the atmosphere is provided from two tanks, each containing four pounds of gaseous oxygen stored at 7500 psig. In addition to the metabolic requirements of the astronaut, the ECS also removes heat from onboard electrical equipment and supplies gas makeup for cabin overboard leakage.

5.2.1 System description.- The ECS as installed in Spacecraft 18 represents the specification system in all respects. It differs from the ECS of Spacecraft 13 (MA-6) in two respects. First, the constant oxygen bleed employed in MA-6 was deleted; and therefore, oxygen was supplied to the astronaut on demand. Secondly, the oxygen partial pressure was measured in the cabin instead of the suit circuit.

5.2.2 System performance.- Data for the following analysis were obtained from both the commutated data recorded onboard and the onboard voice tape. The latter source was utilized for cabin and suit steam exhaust temperatures, excess coolant water warning light actuations, and heat-exchanger coolant-control valve settings, none of which are recorded.

The only ECS measurement known to be inaccurate was that of the cabin oxygen partial pressure. Difficulty with the oxygen partial pressure sensor had been encountered during spacecraft preparations, and the final calibration was known to be only approximate.

The flight data deviate from design criteria of the system only in the performance of the cabin and suit cooling systems.

Although the cabin air temperature varied between 82°F and 108°F, it remained above 100°F for much of the flight. The variation of cabin temperature with time is plotted in figure 5.2-1. These high temperatures, though tolerable, are undesirable. Tests will be made with a larger fan in the heat exchanger to determine if a significant reduction in cabin temperature can be realized.

The many changes in the cabin comfort control valve setting prevent an accurate analysis of the effects of sunlight and darkness on cabin temperatures.

Suit inlet temperature, suit heat exchanger steam temperature and suit comfort-control-valve settings are presented in figure 5.2-2. The astronaut reported that he found it difficult to determine the proper comfort-control-valve setting which would maintain a comfortable level of suit temperature. Figure 5.2-2 shows appreciable suit-temperature fluctuation resulting from changes in coolant water flow rate (The coolant water flow rate is controlled by the astronaut's manual adjustment of the comfort-control valve).

MA-7 was the first orbital flight from which approximate values for astronaut metabolic oxygen requirements could be calculated. Prelaunch oxygen consumption was determined to be 0.0457 pounds/hour or 261 standard cubic centimeters/minute (measured at 14.7 psia and 70°F). During orbital flight, the astronaut metabolic consumption was calculated to be 0.0722 pounds/hour or 408 standard cubic centimeters/minute. These metabolic consumption rates were calculated from the oxygen pressure decay rates of the primary oxygen tank after accounting for the 60 cc/m constant bleed orifice of the suit demand regulator. The ECS design criteria for the astronaut metabolic rate was 500 scc/minute. This was based upon oxygen usage data obtained during work of similar difficulty under 1 g. The astronaut activity under weightless conditions demonstrated that weightless oxygen consumption rates are of a similar level as those which occurred under 1 g.

5.2.2.1 Launch phase: The ECS operated properly during the launch phase. The cabin and suit pressures maintained the proper differential of 5.5 to 6.0 psi above ambient pressure during ascent, and held at 5.8 and 5.9 psia, respectively.

5.2.2.2 Orbital phase: The cabin and suit pressures decreased slowly during the orbital phase because of a cabin leakage of 1000 cc/minute, as established before flight. The pressure decay ceased at approximately 03:00:00 at which time the cabin pressure control valve began supplying oxygen to compensate for the cabin leakage. The cabin pressure was then maintained at 4.9 psia. The only problems encountered during the orbital phase were the high suit inlet and cabin air temperatures previously described.

The 150- and 250-VA inverter temperatures, shown in figure 5.2-3, increased from 112°F and 128°F, respectively, at launch to 175°F and 186°F, respectively, by 04:00:00. The temperatures appeared to be stable after this time. The rate of temperature increase appeared to decrease after the inverter coolant-control valve was advanced from the number 4 to the number 5 position at 03:00:38. The corresponding change in coolant-water flow is from 0.50 pounds/hour to 0.64 pounds/hour.

The Coolant Quantity Indicating System (CQIS) indicated a coolant-water usage of 10.0 pounds, when corrected for temperature change. Postflight inspection measured a usage of 10.23 pounds. This agreement represents the most accurate CQIS measurements in flight to date. Coolant usage averaged about 2.1 pounds/hour over a period of 4 hours and 50 minutes, compared with a nominal flow rate of 1.6 pounds/hour.

The secondary-oxygen supply pressure increased slightly during the flight. This can be attributed to the increase in supply bottle temperature, as measured during flight. Temperatures were identical for both the primary and secondary supplies, and indicated 72°F at launch and 86°F at landing. The decay of the secondary oxygen supply experienced during MA-6 did not recur during this flight.

5.2.2.3 Reentry phase: The performance of the ECS during reentry was normal. The astronaut opened the inflow and outflow valves manually at 04:51:18 during descent. This placed the system in the postlanding mode. The emergency oxygen rate commenced at this time.

The suit temperature started to increase sharply at a time of approximately 04:25:00 (figure 5.2-2). About one hour earlier (03:27:00), the suit comfort-control-valve setting had been advanced to give a high coolant water flow rate. The ensuing temperature decrease resulted in a comfortable suit temperature level until about 04:15:00, when a fluctuation began and later the subsequent sharp increase in suit temperature began. It is suspected that freezing of the suit heat exchanger occurred because of a high coolant-water flow rate for this period of an hour. This resulted in a decrease of cooling efficiency just prior to and during the reentry phase.

5.2.3 Discussion of problems and concluding remarks.- The oxygen consumption rate obtained from this flight is the first indication of metabolic rate during weightlessness. The inflight value agrees closely with the rate found under 1-g conditions for similar work, and validation of the design criteria for oxygen consumption established for the ECS was accomplished.

The high cabin and suit inlet temperatures were the only problems encountered during the flight. The inability of the cabin cooling system to reduce the cabin air temperature below 95°F is undesirable and may be due to the size of the fan which delivers air to the cabin heat exchanger for cooling. Investigations employing a cabin fan of larger capacity are underway.

Some difficulty in obtaining the proper valve setting for the suit-inlet temperature control was experienced, primarily because of the lag in suit temperature with control manipulations. However, the high temperatures and humidity, as reported by the astronaut, may have partially resulted from obstruction of the heat-exchanger evaporative surfaces by freezing. This partial freezing would slightly increase the evaporation pressure. The design conditions are for evaporation at 0.1 psia pressure and 35° F temperature. An increase of 0.1 psi in this design pressure would raise the corresponding evaporation temperature to 53° F, which in turn significantly reduces the system capability to condense and collect water in the suit circuit. Flight data show that the suit steam-exhaust temperature was approximately 70° F, instead of the expected 50° F, thus indicating that the evaporation temperature was probably near 55° F and that partial freezing may have been experienced. The water-flow and evaporation mechanism of the system is presently under study, and future mission training will more accurately define temperature control procedures for the astronaut.

5.3 Spacecraft Communications

The spacecraft communication system aboard the MA-7 spacecraft was identical to that contained in the MA-6 mission with one minor exception. The VOX power switch was modified to provide a mode whereby the astronaut could record voice on the onboard tape recorder without RF transmission to the ground stations. Switching to the transmitting mode could be accomplished without the normal warmup time because the transmitter was maintained in a standby condition with the VOX power switch in the record position.

5.3.1 Voice communications.- UHF voice communications with the spacecraft were satisfactory. Attempts on the part of the astronaut to utilize HF voice communications were unsuccessful. It is believed that the poor HF reception of the spacecraft transmissions was the result of spacecraft orientation and atmospheric conditions. The HF transmitter will be re-checked during scheduled postflight testing.

5.3.2 Radar beacons.- Performance of the C- and S-band beacons was satisfactory, although it was slightly inferior to that of the MA-6 mission. Several stations reported some countdown on both beacons and amplitude modulation on the C-band beacon. The amplitude modulation may have been caused by the modulation presented by the phase shifter (wobulator) and the drifting mode of the spacecraft, giving a poor antenna orientation. In view of these problems, both beacons were rechecked after the mission and found to be essentially unchanged from their preflight status. Additional bench checks are planned for these beacons.

5.3.3 Location aids.- Recovery forces reported that the auxiliary beacon (Super SARAH) and UHF/DF signals were received. The super SARAH beacon was received at a range of approximately 250 miles. Both the SARAH beacon and UHF/DF were received at ranges of 50 miles from the spacecraft. The HF rescue beacon (SEASAVE) was apparently not received by the recovery stations. The whip antenna used by this SEASAVE beacon was reported by the recovery forces to be fully extended and normal in appearance. The SEASAVE beacon was tested after flight and found to be satisfactory, as shown in the following table. Investigation as to why it was not received is continuing.

Parameter	Preflight Test (SEDR 77[d])	Postflight Test	Design Specification
Transmitter frequency Deviation, CPS	+100	±240	±836
Power Output, watts	1.0	1.0	1.0
BUS Voltage, volts	12.0	12.0	12.0

5.3.4 Command receivers.- The command receivers operated satisfactorily. The discrepancies noted during the MA-6 mission were not evident during this flight. It appears that increasing the low-telemeter frequency by 500 kc eliminated the interference problem, which was previously experienced during the MA-6 reentry blackout period.

[d]SEDR 77 is a simulated mission, during which all applicable systems are exercised.

5.4 Electrical and Sequential System

5.4.1 Electrical system.- The spacecraft electrical system was a specification spacecraft system. Voltage and current profiles were similar to the MA-6 mission and were as expected. Changes in the electrical system from spacecraft 13 are as follows:

1. Inverter AC voltages were monitored on the AC voltmeter rather than by monitor lights.

2. The maximum-altitude-sensor battery was used as an auxilliary battery for the velocity sensor after retrofire command.

3. The 24V isolated bus was monitored on the #2 position of the DC voltmeter select switch (position was blank on spacecraft 13).

4. A switch fuse was added to the phase shifter circuit for ON-OFF control during the special radar test.

Inverter temperatures were about 110°F on the 150-VA inverter and 125°F on the 250-VA inverter at lift-off, and these increased gradually throughout the mission to 175°F and 185°F, respectively. These final temperatures are somewhat lower than those experienced on the MA-6 mission. Inverter cooling is discussed in the Environmental Control System section (5.2) of this report.

It was found during postflight tests that a number of fuses had blown on this mission that had not blown on previous missions. This was undoubtedly caused by sea water that got into the spacecraft after landing, since there were no indications of any fuses, other than squib-firing fuses, blowing prior to landing. The following is a list that apparently blew as a result of sea water producing shorting paths to ground within the spacecraft.

1. Emergency hold control

2. Low-frequency telemetry

3. Instrumentation DC #6

4. Telemetered sequence, 6V isolated

5. Standby inverter

6. Isolated-bus regulator

7. Main inverter fans

8. Automatic H_2O_2 Jettison

9. Phase shifter (switch fuse panel)

10. High-frequency telemetry (switch fuse panel)

Squib-circuit fuses were found blown as in previous flights. In the retrorocket ignition circuits, 5 of 6 had blown, including the #1 retrorocket switch fuse which also had a hole in the ceramic portion along the side. From records of current during retrofire, it was deduced that approximately 7 amps passed through this fuse for 6 or 7 seconds before it blew. It is believed that this was the source of smoke reported by the astronaut during retrofire, since it is quite common for this type of fuse to produce smoke when blown in this manner. It was confirmed by the astronaut during postflight tests, where he observed two similar fuses being blown, that these fuses produce a smoke having the same color and smell as that encountered in flight at the time of retrofire.

Postflight inspection revealed that two of the four diodes in the zehner diode package were badly corroded. The corroded diodes were 14-volt zehners with their positive terminals connected through fuses to the main and isolated buses, respectively, and their negative terminals connected to the positive side of the other two 14-volt zehners, which have their negative terminals connected to capsule ground. The zehner diodes, when powered under a sea water environment, exhibit an electrolytic effect. Electrolysis occurs between the case, which is at a 14-volt positive potential when the diode electrically adjacent to the bus is conducting, and the spacecraft structure, which is at ground or zero potential. This phenominon has been demonstrated in the Hangar S electrical lab.

5.4.2 Sequential system.- The sequential system for spacecraft 18 was similar to that employed for spacecraft 13 (MA-6), but the following modifications were incorporated:

1. The cap-sep bolt-fire relay was electrically latched in at spacecraft separation.

2. The landing-bag deployment monitoring circuit was changed. The limit switches were wired such that the actuation of both was required for telelight operation and telemetry indications.

3. The emergency retrosequence relay contacts were jumpered so that the spacecraft was capable of accepting simultaneous retrofire signals from the clock and ground command.

4. The HF transmitter/receiver was enabled at tower separation rather than spacecraft separation.

5. The O_2-quantity light on the right hand instrument panel was disabled.

6. The scanner slaving signal was changed from programmed to continuous.

7. A barostat was added inside the cabin and wired such that the automatic recovery system was not armed until the cabin pressure was above 9.62 psia on descent (approximately 11,000 feet).

8. The emergency drogue deploy switch was wired such that the periscope would extend and the snorkel door blow-off squibs would ignite when the switch was actuated.

Sequential system performance was as expected throughout the mission with the following exceptions:

1. Retrofire had to be accomplished manually because there was no attitude permission from ASCS. The astronaut reported a 1 to 2 second delay between pushing the retrofire switch and #1 retrorocket ignition. Onboard records indicate that retrofire occurred 3.2 seconds after the clock gave the ignition signal, but there is no indication of any malfunction in the retrorocket system after retro #1 ignition. Postflight tests of the retrosequence circuitry indicate that the system still functions normally. At present there is no explanation for the reported 1 to 2 second delay.

2. The main parachute was deployed manually by the astronaut. This action resulted because of the cabin pressure lagging static pressure as expected. This is discussed with more detail in the Mechanical Systems Section (5.5) of this report. Postflight checks indicated that the automatic system did function during the descent phase, although it was sometime after main parachute deployment, and the exact time cannot be determined. The automatic recovery-sequence system functioned properly during postflight tests.

3. The onboard tape recorder and other telemetry components apparently did not lose input power at landing plus 10 minutes as planned. Upon initial power-up when the spacecraft was returned to Hangar S, it was found that a short existed between the 2 pre-impact buses, which supply power to telemetry, and the spacecraft main DC bus. After the spacecraft was dried in the altitude chamber, it was found that the short no longer existed. It is felt that sea water either got into one of the fuse blocks which contain the three

buses mentioned above or one of the instrumentation packages and shorted the three buses together. This would explain the fact that the pre-impact buses remained powered.

5.5 Mechanical and Rocket Systems

Some anomolies occurred in the mechanical systems, although no serious or dangerous conditions resulted. These anomolies, along with general systems description and performance, are discussed in the following paragraphs.

5.5.1 Recovery sequence.- The recovery sequence system was modified by adding a control baroswitch in the circuit to disarm the recovery system at altitudes above 11,250 feet. The recovery sequence as flown is shown in Figure 5.5.1-1.

5.5.2 Parachutes.- The performance of the drogue and main parachutes upon deployment was satisfactory. Since neither parachute was recovered, a detailed postflight visual inspection could not be made. Observation by the astronaut verified that both parachutes were deployed cleanly and were undamaged during descent. The anomolies encountered with the parachute system can generally be attributed to the changes in the recovery sequence. The drogue parachute was manually deployed at a static pressure of 5.35 psia, which corresponds to a pressure altitude of 25,450 feet. A manual deployment of the drogue at an altitude of about 21,000 feet was planned for this mission. The deployment altitude, however, was left to the astronaut's discretion, and he could have chosen an automatic deployment at approximately 10,000 feet.

The main parachute was to be deployed manually at about 10,000 feet if the astronaut chose, or automatically at a slightly lower altitude if the astronaut chose to wait for automatic deployment. The data show that the control baroswitch, which senses cabin pressure, would have effected main parachute deployment at a pressure altitude of approximately 8250 feet. The astronaut chose the manual procedure and deployed the parachute at a pressure altitude of 8950 feet.

5.5.3 Rockets and pyrotechnics.- A postflight examination of the spacecraft and an analysis of the pertinent data indicate that all rockets and pyrotechnics apparently functioned normally. During retrorocket firing, the astronaut felt that the deceleration was somewhat less than expected. Detailed trajectory analysis, however, indicates that the retrorocket performance was within specification values, as discussed in section 4.0.

It cannot be determined whether certain pyrotechnics actually fired (such as redundant clamp ring bolts and tower-jettison rocket ignition), since the available information shows only that the resulting function was satisfactory.

5.5.4 Explosive-actuated hatch.- The spacecraft explosive-actuated side hatch was unbolted after the spacecraft was placed onboard the recovery ship. The side hatch was not used for astronaut egress, and postflight visual examination shows the hatch to be in excellent condition.

5.5.5 Landing shock attenuation system.-

5.5.5.1 Landing bag: The system was unaltered from the MA-6 configuration, with the exception that the instrumentation limit switches were re-wired for improved reliability. The landing-attenuation system performed normally, as evidenced by the astronaut's statements and from postflight examinations. The rescue personnel, who parachuted into the landing area, examined the landing bag in the water and reported the bag to be in good shape. However, when the spacecraft was hoisted aboard ship, it was found that most or all of the straps were broken and the bag was extensively damaged (see figure 10.1.3-1). This damage may have been caused by wave action while the spacecraft was supported by the flotation collar prior to recovery. All restraining cables and the large pressure bulkhead appeared to be intact; however, a cable-restraining spring had been lost.

5.5.5.2 Ablation shield and main pressure bulkhead: The ablation shield appeared intact, except for a lost center plug, and the usual minor damage occurred to the ablation-shield retaining studs and to the bulkhead protective shield. Although a small air leak was found at a thermocouple lead through the main pressure bulkhead, the bulkhead did not experience any visible damage. Small areas of protective honeycomb were slightly crushed and minor deformation of small tubing was experienced, as in previous missions.

5.5.6 Flotation.- The astronaut reported that the spacecraft did not right itself acceptably after landing. He also stated that it was listing in the pitch-down, yaw-left quadrant at an angle estimated to be about 60° from vertical. Although no photographs are available of the spacecraft before the astronaut egressed, pictures taken after egress show approximately a 45° - 50° list angle. However, it is not known how much water was in the spacecraft cabin when these photographs were taken. The center of gravity (CG) for the MA-7 flotation configuration was at Z = 120.03 inches, which is a corrected calculation to include the loss of the ablation shield center plug and the measured ablation weight loss. The CG was offset from the axis of symmetry by 0.40 inches; these values are in substantial agreement with those for the MA-6 flotation configuration, which were 119.78 and 0.37 inches, respectively. The list angle for previous missions has been reported as approximately 15° - 25° from the vertical. By timing audible events on the onboard tape, it appears that the astronaut initiated his postlanding checklist immediately and had already begun to egress by four minutes after landing. Water stability data, from tests conducted by the Recovery Branch of the Flight Operations Division, indicates that the above CG could have caused the spacecraft to take some 3 or 4 minutes to stabilize in an upright position if the astronaut had remained in the couch. Since the astronaut was apparently moving around in preparation for egressing during this stabilization period, his weight may have nullified any restoring moment that existed. Many unknown factors can influence the spacecraft erection time, including air trapped in the landing bag, insulation-blanket soaking, and the manner in which the reserve parachute is jettisoned. Considering these unaccountable effects and the fact that they cannot be duplicated in a controlled flotation test, the actual list angle is indeterminate. Therefore, the conclusion must be drawn that, after taking into account the astronaut's immediate egress, the higher center of gravity, and a number of possible minor factors; the spacecraft did not have sufficient time to erect itself before the absence of the astronaut changed the equilibrium list angle. This equilibrium angle, based on the unoccupied spacecraft CG, could well have been close to the astronaut's estimate and is in reasonable agreement with the postflight photograph.

5.5.7 Water in spacecraft cabin.- After spacecraft recovery, approximately 65 gallons of salt water were removed from the cabin and an estimated 10 gallons remained in inaccessible places. The astronaut reported that a few drops of water splashed on the tape recorder at the time of landing, which can probably be attributed to water coming in through the cabin pressure-relief valve. Astronaut comments and postflight examinations reveal that this valve was not placed in the locked position. The surge of water which entered the recovery section of the spacecraft upon landing may have had enough velocity head to briefly overcome the valve's negative-pressure-relief setting (approximately 16" of water) and spray through onto the recorder. This valve is located almost directly over the tape recorder installation, as shown in figure 5.5.7-1.

The small amount of water that could have come in through this cabin pressure-relief valve, however, would be negligible compared to the total amount found in the spacecraft cabin. Postflight tests show the cabin leak rate to be about 2670 cc of air per minute, which is an increase of 1670 over the prelaunch value of 1000 cc per minute. A leak was detected in the large pressure bulkhead around a thermocouple connector; however, this leak is not large enough to account for much over 15 percent of the total. The astronaut stated that he heard some water enter through the opening left by the removal of the small pressure bulkhead, but did not believe that this amounted to much more than a few gallons. Although the spacecraft was listing, it was not listing enough for the recovery section to be in the water. It is probable that the water entered through the small pressure bulkhead opening during the egress and the period when the astronaut was using the capsule for support to turn the liferaft over. This water could have entered through the shingles to the recovery section and would not necessarily been noticed by the astronaut whose attention was otherwise occupied.

5.6 Reentry Heating

5.6.1 Heat shield.- The performance of the heat shield (see figure 10.1.2-1) during reentry was satisfactory. The center plug was lost, but a postflight investigation revealed that this occurred after major heating. The area under the plug showed no evidence of charring or excessive heating. Otherwise, the shield suffered only normal cracking and displayed the usual glass droplet streaks. The stagnation point appears to have been approximately in the center of the shield.

Two temperature pickups were recorded. One was located in the center of the shield and the other 27 inches from the center. Temperature-time histories are given in Part II of this report. The maximum temperatures experienced are in agreement with predicted values. Maximum heat-shield temperatures for this and previous flights are presented in figure 5.6.1-1.

The heating appeared to be uniform over the shield, as is shown by 8 core samples taken at various locations in the shield. Visual char depth varied from 0.3 to 0.35 inches. This compares very closely with the MA-5 and MA-6 measurements. No reduction in overall thickness was observed.

The measured weight loss of 13.1 pounds was slightly more than the expected loss of 11 pounds, but is still within the limits of measurement and calculation accuracy. This value is greater than that resulting from previous flights; however, the possibility that previous shields were not completely dry when weighed might have contributed to their lower weight loss. This is especially probable for the MA-4 and MA-5 spacecraft ablation shields. Approximate calculations show that the slightly more shallow reentry for this flight would not have resulted in a significant increase in the ablation loss compared to a nominal reentry.

5.6.2 Afterbody.- The shingles on the conical-cylindrical afterbody show no evidence of adverse heating effects. Temperatures measured on these shingles are also presented in Part II.

5.6.3 White paint patch.- The greatest heating effects experienced by the white patch (shown in figure 10.1-1, upper left of spacecraft) are when it is oriented towards the sun, and since the spacecraft was never positioned in this manner for an extended period, only a trend in the data can be derived. Apparently the spacecraft was rolled several times, which placed the patch toward the sun for brief periods, and during these periods the differential was -40°F between the patch and an oxidized shingle. Just after 0.05 g, the white patch experienced a sudden drop in temperature. No explanation for this is available at the present time. During the primary reentry heating phase, the patch temperature differential increased to +180°F. This is expected and is attributed to the decreasing emissivity of the white paint with increasing temperature.

5.6.4 Green-glow effect.- The astronaut reported a green glow around the recovery section during reentry. No explanation for the cause of this is available. Inspection of the beryllium shingles indicates nothing abnormal in this area; these shingles have about the same appearance as those of previous spacecraft. Beryllium shingles with black paint have been heated in tests to temperatures as high as 2000°F without exhibiting the green glow. However, it is possible that since these tests were conducted using Quartz lamps, this intense lighting condition might have precluded recognition of this phenomena if it were present.

5.7 Scientific Experiments

5.7.1 Tethered inflatable balloon.- This experiment was designed to provide orbital observations of nearby objects of varying surface finishes and to measure the drag of an object of known aerodynamic characteristics in a region of free molecular flow. Balloon drag could then be related to atmospheric density and thus provide a density profile over the altitude range encompassed during the Mercury orbit. It was also intended to obtain qualitative information on the capability of the astronaut to estimate separation distance between the spacecraft and an object of known size and shape in space. The visual portion of the experiment was to evaluate the relative merit of various colors and surface finishes for optimum visibility in a space environment at varying ranges. Additional objectives of this test included observations of the general stability qualities and damping characteristics of the tethered balloon. The appearance, brightness and behavior of small diffuse reflecting discs were to be observed to provide a comparison with other foreign particles in space where appropriate.

Description of test: The test device consisted of a thirty-inch diameter, inflatable balloon fabricated from a two-ply mylar, aluminum foil material, each ply being one-half mil in thickness. The balloon surface was divided into five equal-sized lunes of different colors and surface finish. These finishes were uncolored aluminum foil, yellow fluorescent Day-Glo, orange fluorescent Day-Glo, flat white finish, and a phosphorescent coating (see figure 5.7.1-1). The balloon and inflating bottle were packaged in a cylindrical container located in the antenna cannister under the destabilizer flap.

The balloon and inflation bottle weighed approximately 0.5 pounds and the entire installation including instrumentation weighed approximately five pounds.

The balloon was deployed in orbit at 01:38:00 by firing an actuating squib. A small compressed spring then ejected the balloon and an inflation bottle from the container, along with two balsa block liners and the mylar discs. The balsa blocks were semi-cylinderical in shape and about 6 inches long and 3 inches wide. They were coated Day-Glo orange and black and Day-Glo yellow and black, respectively. These mylar discs were coated with aluminum foil on one side and a diffuse reflecting material on the other. The balloon was tethered to the capsule by a 6-lb test nylon line 100 feet in length which was deployed from a spinning reel. When the ballon had been fully deployed, the line was entirely stripped from the reel but remained attached to a small strain gage mounted in the bottom of the balloon container. Continuous strain gage measurements were to be recorded onboard the spacecraft until the drag test was completed. The balloon was then to be jettisoned and the rate and distance of separation between the spacecraft and balloon were to be estimated by the astronaut.

However, the balloon did not inflate completely and it did not jettison. Therefore, drag measurements and rate and distance of separation of the balloon from the spacecraft were not obtained.

Results: At balloon deployment, the astronaut reported seeing the mylar discs spread out and quickly disappear. His first impression was that the balloon had broken free from the spacecraft; however, the object he was tracking was one of the balsa blocks. He observed this block for about 20 seconds, at which time the balloon came into view, and was only partially inflated.

These observations were verified by pictures taken by the astronaut. During the towed phase, the following results were obtained from astronaut observations, photographs, and the onboard data tape:

1. Pilot comments indicated that deployment occurred with the spacecraft near 0°-0°-0° attitude. These attitudes cannot be confirmed by onboard instrumentation, since the gyros were caged at this time. Attitude rates were noted in all three axes during and after deployment, but the effect of these cannot be conclusively determined.

2. The strain gage instrumentation and the squib-firing system appeared to work well. Strain-gage calibrations also checked well with previous ground checks.

3. The onboard tape indicated that in-and-out oscillations occurred following deployment and spacecraft attitude changes. These oscillations developed because of the inherent elasticity of the balloon and nylon line. However, an annealled aluminum foil shock absorber was included in the ejected system to absorb most of the residual energy of the ejected balloon (see figure 1). Ground simulation tests showed that about 90 percent of the energy imparted to the balloon during deployment was absorbed.

4. Pilot comments and flight photographs showed that the balloon shape tended to be irregular and oblong, and appeared to be about 6 to 8 inches in cross section.

5. Astronaut comments described the balloon motion as being completely random in nature. These random motions may have been caused by large changes in spacecraft attitude which occurred after deployment. However, uneven aerodynamic loads which likely existed on the irregular balloon shape would also be expected to contribute to this random motion. Onboard comments by the astronaut did indicate, however, that during the portion of both the second and third orbital passes when dynamic pressure was increasing, balloon motions tended to become more stable.

6. Approximately 35 minutes after balloon deployment, the astronaut initiated a series of large control maneuvers to check the spacecraft control system. The strain gage measurements indicated that fouling of the tethering line occurred during this period. This conclusion is further substantiated by the fact that subsequent large spacecraft maneuvers were not registered on the strain gage system.

7. At approximately 03:14:00, the astronaut attempted balloon jettison, but the balloon did not release from the spacecraft. However, the onboard strain gage recording indicated a drop in gage output from the level it had held since probable fouling to the output level of the unloaded gage. Although this drop constituted a change of only 2 to 3% in gage output, it does provide a positive indication that the jettison squib fired and that the tethering line was severed.

8. Only the Day-Glo orange and the uncoated aluminum foil were visible to the astronaut, and these were the only colors that appeared in the photographs. Therefore, an effective evaluation of the colors could not be made on this flight.

Summary: Analysis of the experimental results indicates that the balloon deployment, jettison, and the instrumentation systems functioned satisfactorily during flight. Since the balloon failed to inflate properly at deployment, no useful drag and visual observation data were obtained. High rates of change in spacecraft attitude after balloon deployment, as well as the irregular shape of the partially inflated balloon, probably accounted for the random motion of the balloon observed during flight. Effective evaluation of the various colors was not possible since only part of the balloon was exposed.

5.7.2 Zero-gravity liquid behavior.- This experiment is a joint effort of two NASA agencies, the Lewis Research Center and the Manned Spacecraft Center. The design and development of the experiment was based on information obtained in the Lewis drop-tower test program. Lewis Research Center's primary interest in the experiment involves a desire to control liquid ullage in the orbital-rendevous fuel transfer and long term propellant storage operations. Manned Spacecraft Center's interest stems from a desire to utilize this same phenomenon to eliminate the need for propulsion-stage ullage rockets and bladders in attitude control tankage of manned spacecraft.

Objectives: The main purpose of the zero-g experiment is two-fold:

1. To determine the ability of the ullage control surface to maintain a stable liquid-vapor interface during acceleration disturbances experienced by a spacecraft during propulsive and reentry maneuvers.

2. To determine the steady-state interface configuration and to measure the time required for the capillary control surface to position the interface at the start of zero gravity and after being disturbed by the ignition of the retrorockets.

Description of the experiment: The apparatus consisted of a glass sphere (figure 5.7.2-1) approximately 3 7/8 inches in diameter containing a capillary tube, two inches in length and 1 1/4 inches in diameter. Three 5/16"-diameter semicircular holes were cut into the base of the circumference of the capillary. The sphere is encased in an aluminum and a plexiglass half section and suspended by four plexiglass tabs cemented to the glass sphere. The sphere contains 60 milliliters of fluid, which is 20 percent of the actual volume of the sphere. The fluid consists of a mixture of distilled water, green dye, aerosol solution and silicone, with a resultant surface tension of 32 dyne/cm.

Discussion: The pilot-observer camera film used to photograph the experiment was subjected to salt-water contact for approximately 36 hours after landing and prior to its reaching Rochester, N. Y., for developing. The effect of salt water made the film difficult to read for accurate data purposes. However, the film data is sufficient as a rough approximation and confirms the drop-tower test results.

Capsule separation occurred at 00:05:12.8 after lift-off. The liquid in the sphere was first observed to move at 00:05:14 and the capillary appeared to be completely filled at 00:05:26. During the spacecraft turnaround maneuver, the liquid remained in the capillary. It is difficult to read the clock on the film, although the miniscus can be seen in the capillary during the daylight portions of the flight. At no time did it appear that the capillary miniscus was lost because of attitude control operations.

Retrofire was conducted from 4:33:09.6 to 4:33:31.6, with the capillary emptying at 4:33:13 under .35 g acceleration. The liquid began to refill the capillary at 4:33:39 and appeared to have completed this at 4:33:51. The capillary emptied at 4:45:53 during the reentry phase, which was after the 0.5-g point. The accuracy of the onboard accelerometer is not enough to obtain the g-loading that caused the collapse of the miniscus.

Maximum angular acceleration of .011-g on pitch, .0055-g in yaw, and .0033-g in roll during utilization of the reaction control system was experienced during the flight. Although the miniscus appeared to move slightly under these angular accelerations, the level of the miniscus to the standpipe appeared to remain unchanged. The astronaut visually observed the experiment at 3:19:43 hours, and he confirmed that the miniscus completely filled the standpipe and that no oscillations of or bubbles in the liquid were evident.

Results and conclusions: The results of the experiment fully confirm classical capillary-action theory and serve to complement the results of the Lewis Research Center drop-tower tests.

The ability of the capillary to maintain a stable fluid position during angular accelerations imposed by the reaction control system indicates that this method of ullage control is valid within the loading range involved. The results obtained during this experiment will be extrapolated to other liquids, particularly propellants, in accordance with the general laws governing each specific fluid, namely the surface tension, fluid temperature, and the capillary tube diameter. Despite the poor film data quality resulting from salt-water effects, the results of the zero-gravity experiment have enhanced and extended our knowledge of liquid behavior in a weightless environment.

5.7.3. <u>Photographic studies</u>.-

5.7.3.1 Horizon definition: As part of the program to develop navigational procedures for the Apollo spacecraft, Peterson at the Massachusetts Institute of Technology has requested that photographs be taken of the daylight horizon through a dual Blue and Red filter. It is desired to obtain definition of the earth-horizon limb for application to spacecraft navigation system design. Eastman SO 130 film was used for this purpose. This film was intended to provide a measure of the intensity of light scattering as a function of wavelength and altitude. The pilot exposed 26 frames of useable quality, with some losses during film change. One of these photographs is illustrated in figure 5.7.3.1-1. A photometer analysis of the photographs is underway at MIT, and results pertinent to the Apollo mission are expected soon.

5.7.3.2 Meteorological: The Meteorological Satellite Laboratory of the U. S. Weather Bureau requested that the pilot take photographs using Tri-X and infra-red sensitive film through a five filter unit. The purpose of this experiment was to obtain information on the best wavelengths for meteorological satellite photography. The film and filter were taken aboard the spacecraft by the pilot, but time did not permit completion of the experiment.

5.7.3.3 General color photography: Thirty feet of Eastman color negative film was provided for the pilot to take color films of the sunlit earth with the 35mm hand-held camera described in Section 7.2.

Photographs of the booster and balloon were taken to verify the astronaut's observations and provide information for simulation studies. Fourteen pictures were taken of the partially inflated balloon, and fifteen frames of the launch vehicle were exposed.

Photographs of African and North American land masses were desired by Paul D. Lowman of the Theoretical Division of Goddard Space Flight Center. These were requested to build up a catalogue of photographs of various physiographic features of the earth to be used as reference material for studies of other planetary surfaces and for detection of meteorite impact features on the earth. The pilot took 13 frames showing the African land mass, and these were sent to Lowman for analysis.

Photographs of cloud formations are to be used by scientists of the U. S. Weather Bureau Meteorological Satellite Laboratory in studies of weather formations and for comparison with Tiros data. Ninety-six photographs showing cloud formations were obtained. Most of these were clear and revealed interesting cloud patterns. These are being forwarded to the U. S. Weather Bureau for analysis.

Theoretical calculations indicate that the sun should appear flattened just before setting and just after rising. Photographs of the sun at this time were desired by John O'Keefe of the Theoretical

Physics Division of the Goddard Space Flight Center. The pilot made two excellent photographs of the sun at the horizon, and these are being forwarded to Goddard for evaluation.

The color layers at the horizon at sunset may provide information as to the light transfusion characteristics of the upper layer of the atmosphere. John O'Keefe of Goddard has requested these photographs for this purpose, and the pilot obtained 18 photographs of the sunset horizon.

Photographs were desired in order to derive information on the size, brightness, and speed of motion of the particles which Glenn reported. The pilot exposed 19 frames in an attempt to photograph these particles. He appears to have been successful in at least two frames. Several frames appear to have the particles but they are not in focus.

5.7.4 Air-glow layer observations.- During the third orbital pass, the pilot made a series of observations on a luminous band visible around the horizon at night, which was also reported by astronaut, John Glenn. The most decisive observation was made with an air-glow filter supplied by Mr. Lawrence Dunkelman of the Goddard Space Flight Center. The filter transmits a narrow band of wavelengths, approximately 11 Angstrom units wide at the half power point and centered at the wavelength of the strongest radiation of the night airglow (5577 Angstrom).

Calculation based on the pilot's observation that Phecda Ursae Majoris (magnitude 2.5) was lost to sight at the brightest part of the layer indicates that it is about 50 times as bright as a white surface illuminated by moonlight.

From star observations reported on the onboard tape, the densest part of the 5577 layer can be calculated to be at a height of 89 kilometers, which is in good agreement with rocket measurements.

The pilot did not note any structures, either vertical or horizontal, in this layer. He did not attempt to observe it completely around the horizon.

A remarkable feature of this observation is the discrepancy between the pilot's eye estimates of 8^{o}-10^{o} in altitude above the horizon and the results of timed star observations on the other. The latter indicates altitudes of 2^{o}-3^{o}. It appears that there is a strong illusion that exaggerates angles near the horizon, since astronaut Glenn also reported 7^{o}-8^{o} as the height of the luminous band. This phenomenon is perhaps comparable to the well-known illusion which makes the moon seem larger near the horizon.

5.7.5 Ground-flare visibility experiment.- The major objectives of this experiment were to determine the capability of the astronaut to observe a ground light of high intensity while in orbit and to evaluate visibility from the spacecraft at various ranges and slant angles through the atmosphere. This experiment was also intended to provide a quantitative measure of atmospheric attenuation of light.

5.7.5.1 Description of the experiment: The experiment was conducted using two items of equipment. The first of these items was a group of one-million-candlepower flares located near the Woomera tracking station. A total of ten flares were to be used, four during the first orbital pass and three during each succeeding pass. Each flare had a burning time of approximately one and one-half minutes. These flares were scheduled to be ignited in series approximately sixty seconds apart, with the first flare ignition occuring near the point of closest approach of the spacecraft to the station. The second item of equipment to be used inflight consisted of a photometer 4" in diameter, $\frac{1}{4}$" thick and 4.3 oz. in weight. The photometer filter varied from 0.1 neutral density (20.4% light reduction) to 3.8 neutral density (99.98% light reduction).

5.7.5.2 Results: On the first pass over Australia, four flares were ignited simultaneously. However, because of the extensive cloud cover (approximately eight-tenths at 3000 feet), the flares were not visible to the astronaut. Therefore, the experiment was discontinued for the remainder of the mission and no results were obtained.

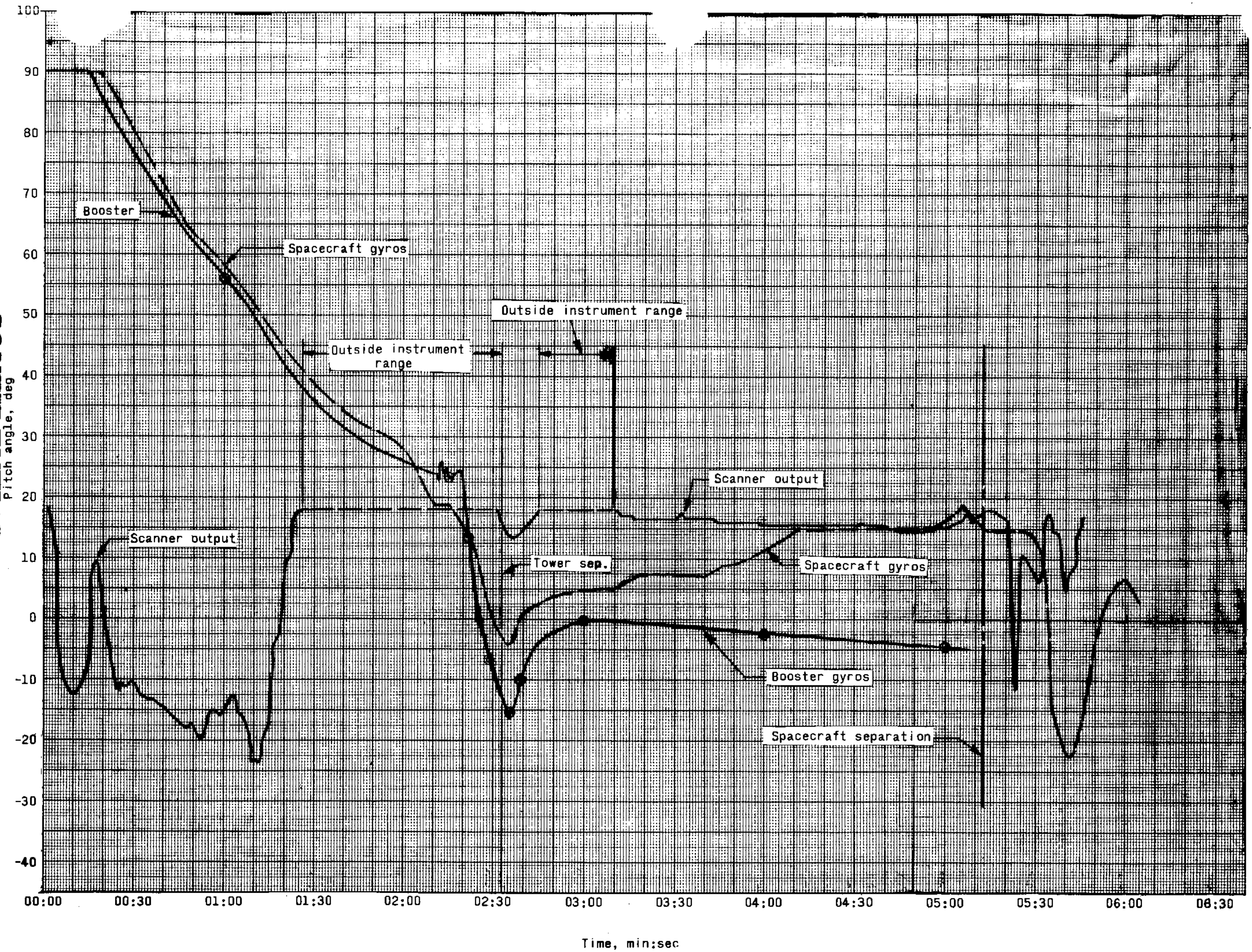


Figure 5.1.2-1.- Spacecraft and launch vehicle indicated attitudes during powered flight

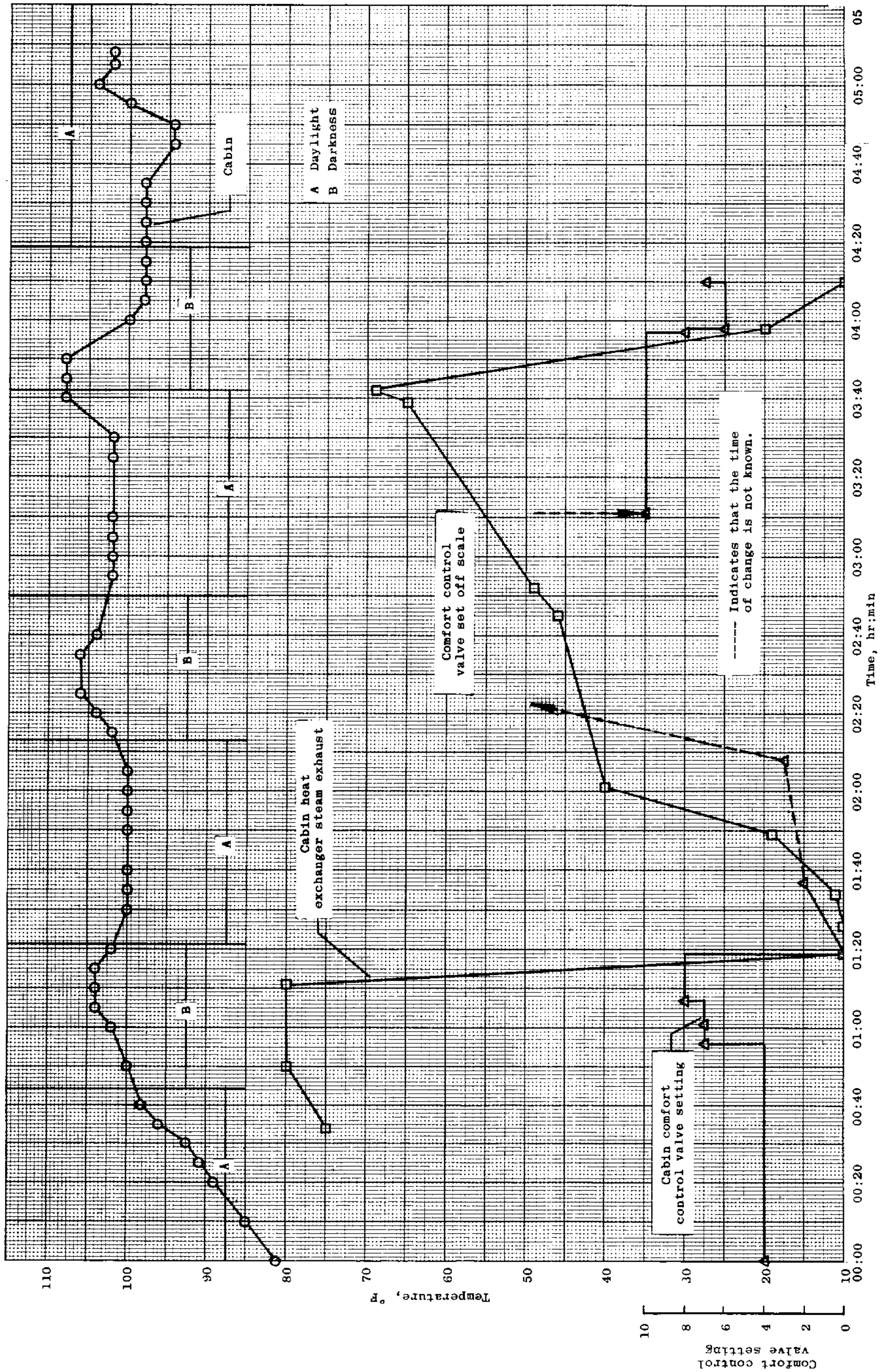


Figure 5.2-1.- Variation of cabin air, cabin heat exchanger steam exhaust temperatures, and associated comfort control valve settings with time.

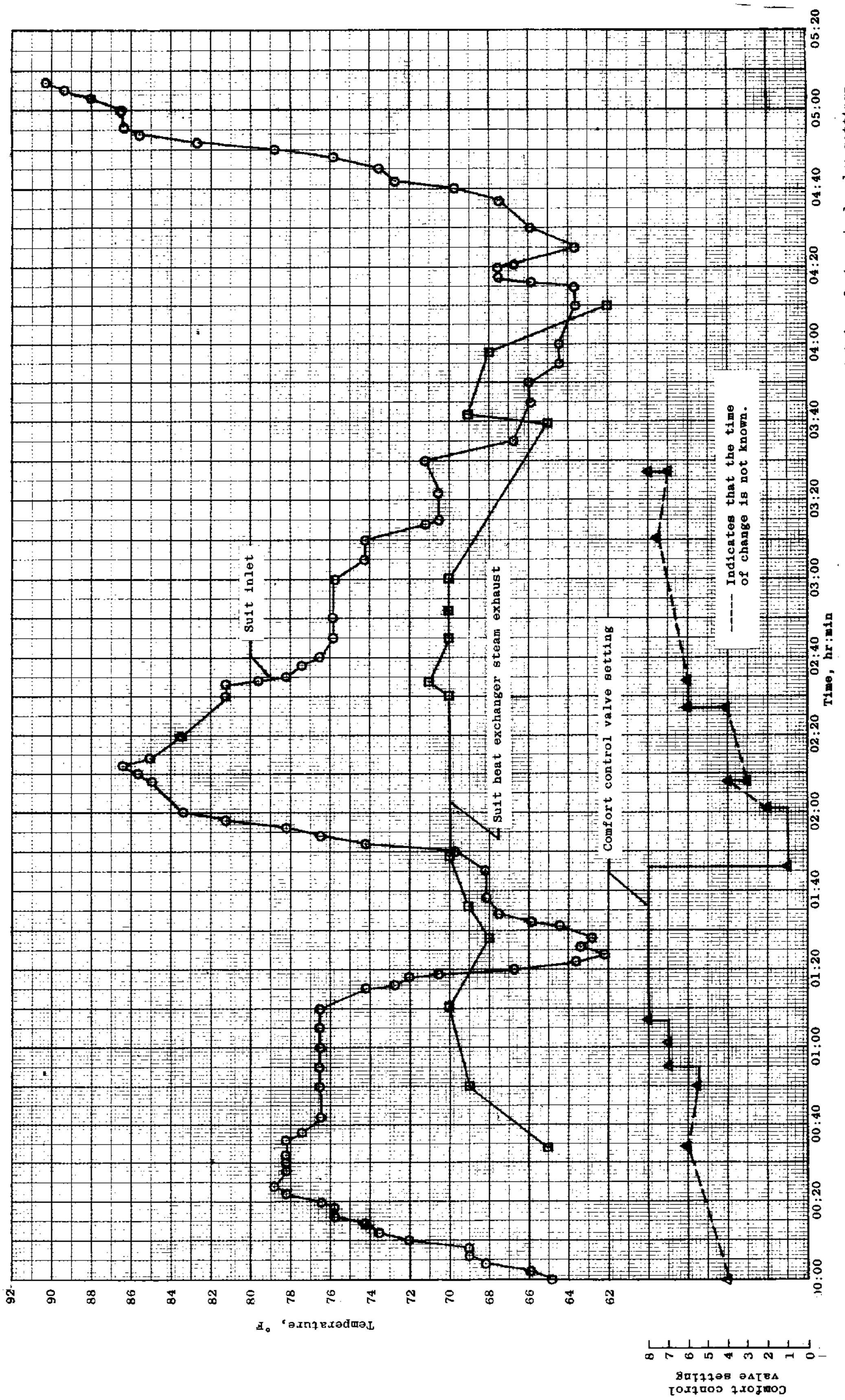


Figure 5.2-2.- Variation of suit inlet, suit heat exchanger steam exhaust temperatures and associated comfort control valve settings with time

CONFIDENTIAL

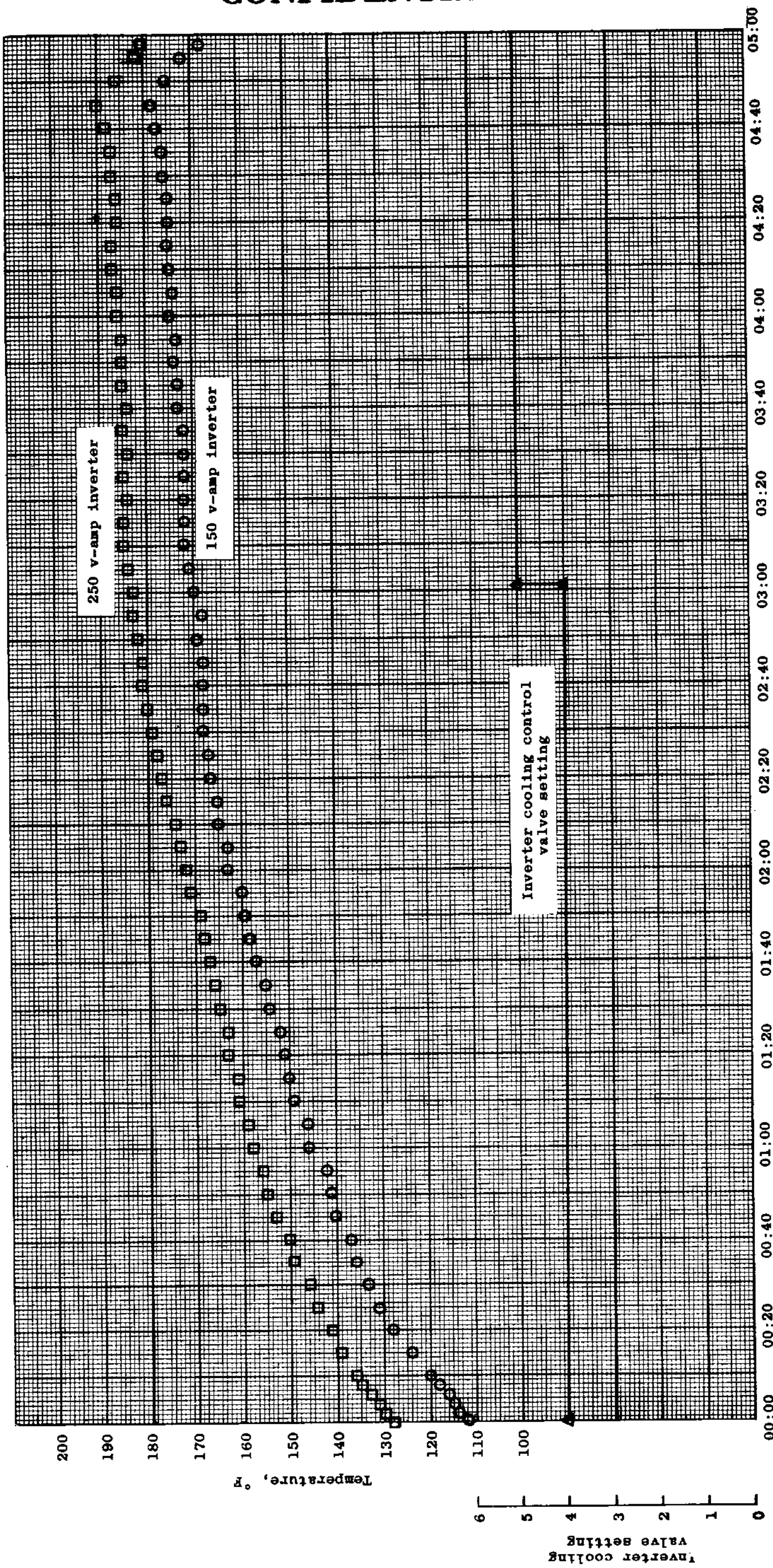
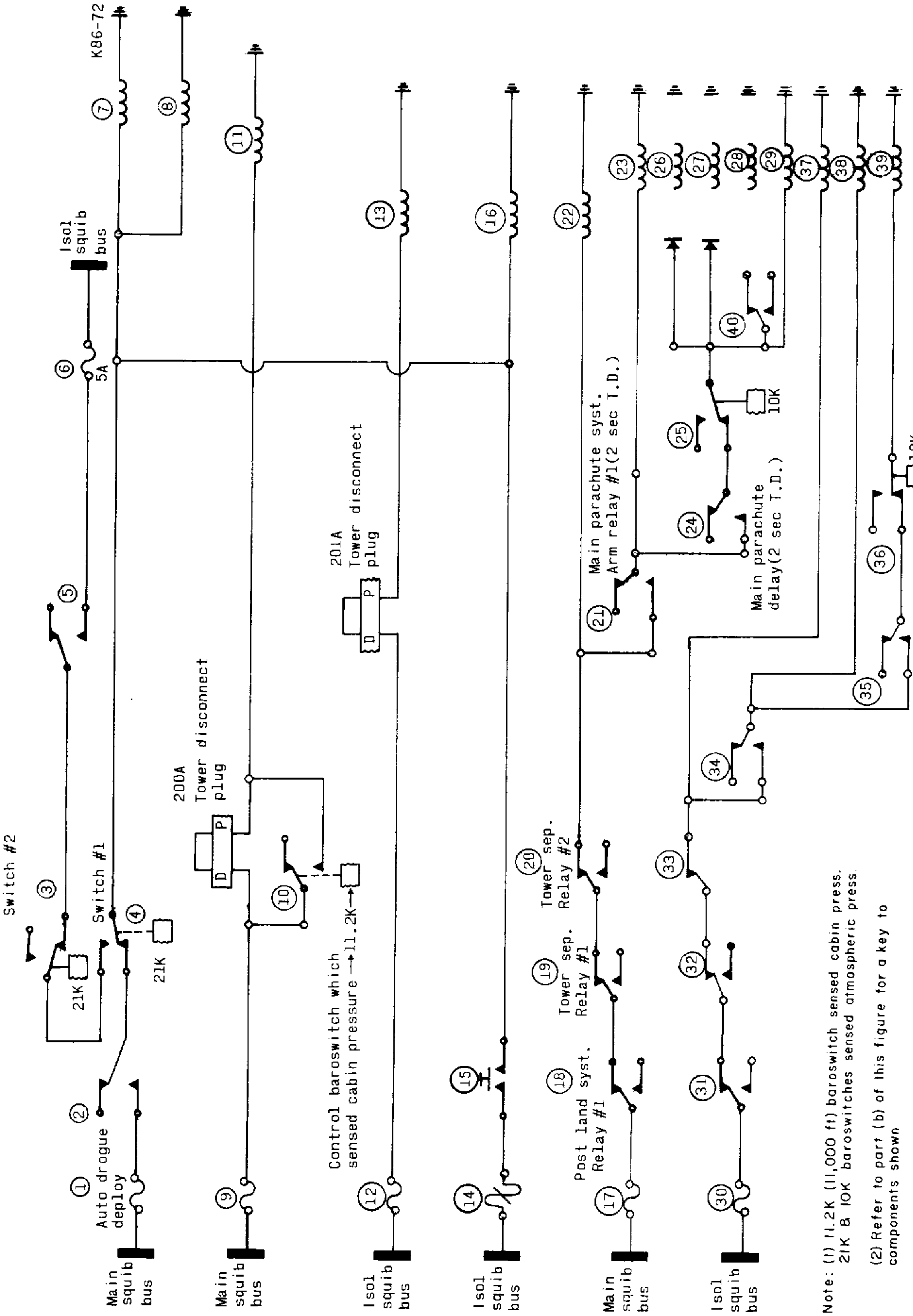


Figure 5.2-3.- Variation of 150 v-amp and 250 v-amp inverter temperatures and associated cooling control valve settings with time.

CONFIDENTIAL



Note: (1) 11.2K (11,000 ft) baroswitch sensed cabin press. 21K & 10K baroswitches sensed atmospheric press.

(2) Refer to part (b) of this figure for a key to components shown

(a) Schematic.

Figure 5.5.1-1.- Logic diagram for parachute deployment system.

1. Automatic drogue deploy fuse (5A)
2. Main parachute system arm #1 (2 sec time delay)
3. 21,000 foot barostat switch #2
4. 21,000 foot barostat switch #1
5. Main parachute system arm #2 (2 sec time delay)
6. Automatic drogue deploy fuse (5A)
7. Drogue deploy relay
8. Inlet-air door release
9. Automatic main system lockout fuse (5A)
10. 11,250 foot barostat switch
11. Tower separation relay #1
12. Automatic main system lockout fuse (5A)
13. Tower separation relay #2
14. Emergency drogue deploy fuse (5A x)
15. Drogue deploy
16. Emergency drogue deploy relay
17. Automatic main deploy fuse (5A)
18. Postlanding system relay #1
19. Tower separation relay #1
20. Tower separation relay #2
21. Main-parachute system arm relay #1 (2 sec time delay)
22. Main-parachute system arm relay #1 (2 sec time delay)
23. Main-parachute delay relay #1 (2 sec time delay)
24. Main-parachute time delay #1 (2 sec time delay)
25. 10,000 ft. barostat switch #1
26. 10,000 Descent
27. 10,000 Descent relay #1
28. Main deploy warning light relay (2 sec time delay)
29. Main deploy #1
30. Automatic main deploy fuse (5A)
31. Post landing system relay #2
32. Tower separation relay #1
33. Tower separation relay #2
34. Main-parachute system arm relay #2 (2 sec time delay)
35. Main-parachute delay #2 (2 sec time delay)
36. 10,000 barostat switch #2
37. Main-parachute system arm relay F# 2 (2 sec time delay)
38. Main-parachute delay relay #2 (2 sec time delay)
39. Main deploy #2
40. Antenna-fairing separation signal

(b) Key to components shown in part (a) of this figure.

Figure 5.5.1-1.- Concluded.

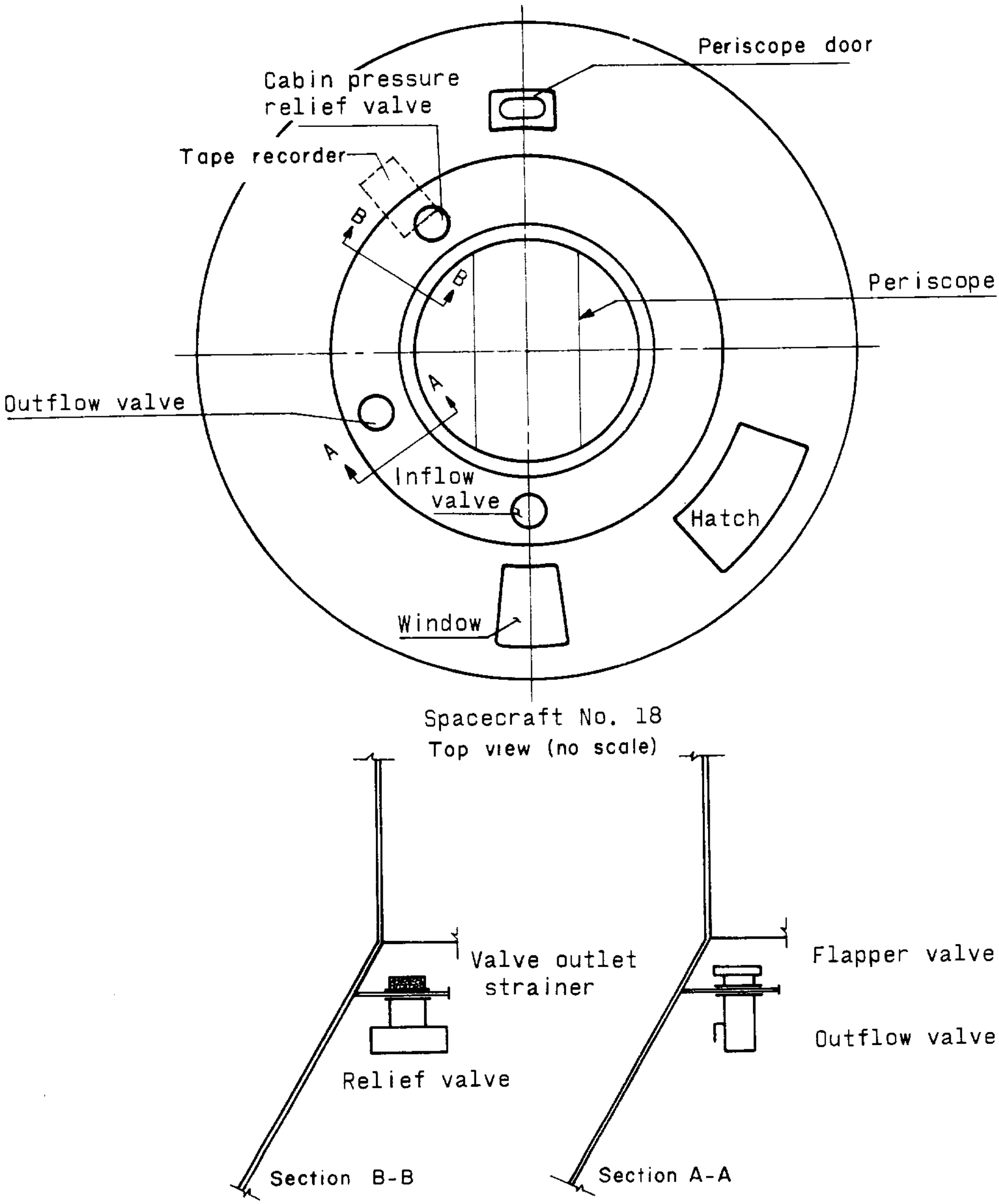


Figure 5.5.7-1.- Sketch showing location of valves in spacecraft small pressure bulkhead.

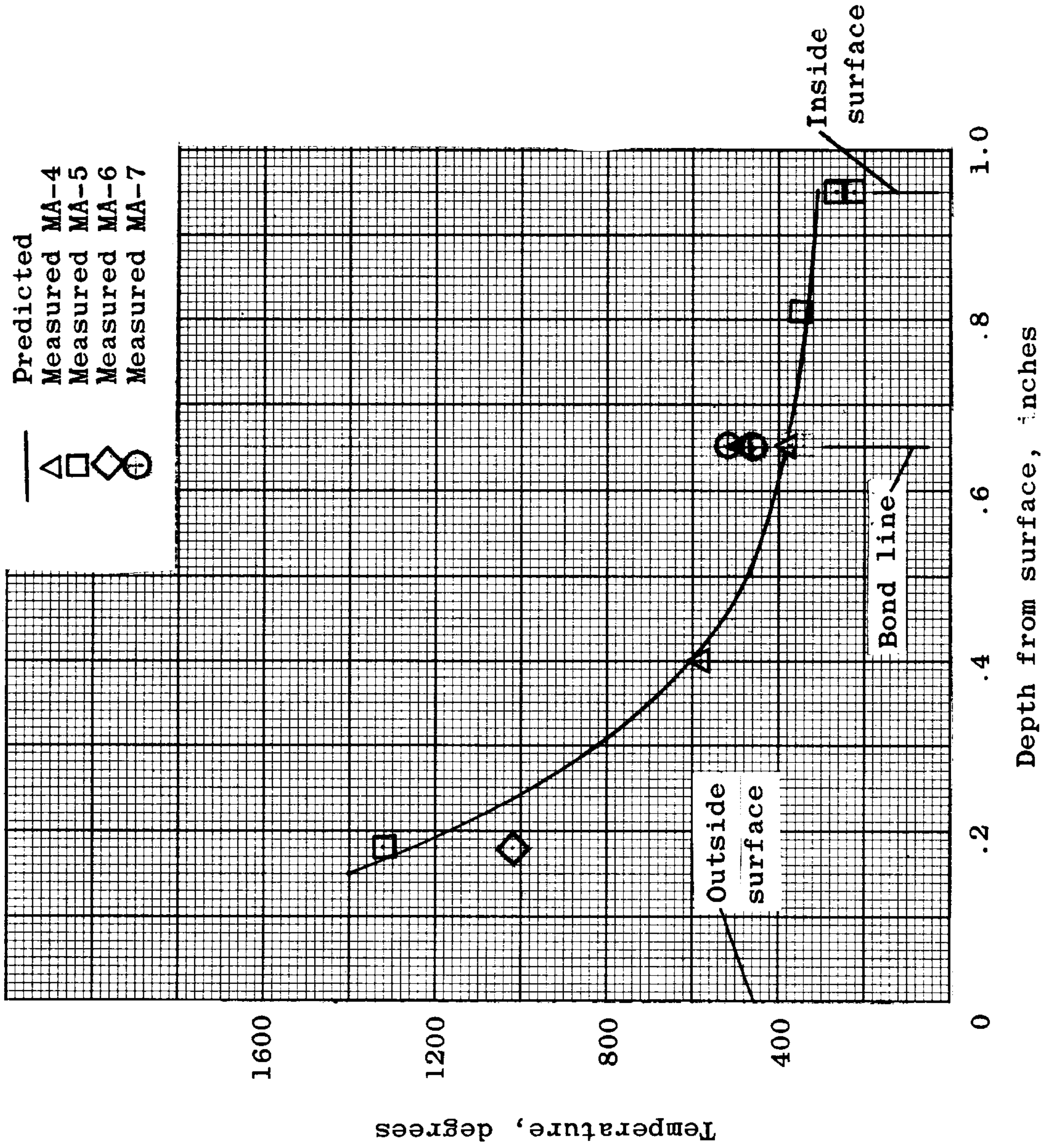


Figure 5.6.1-1.- Maximum ablation shield temperatures experienced on flights.

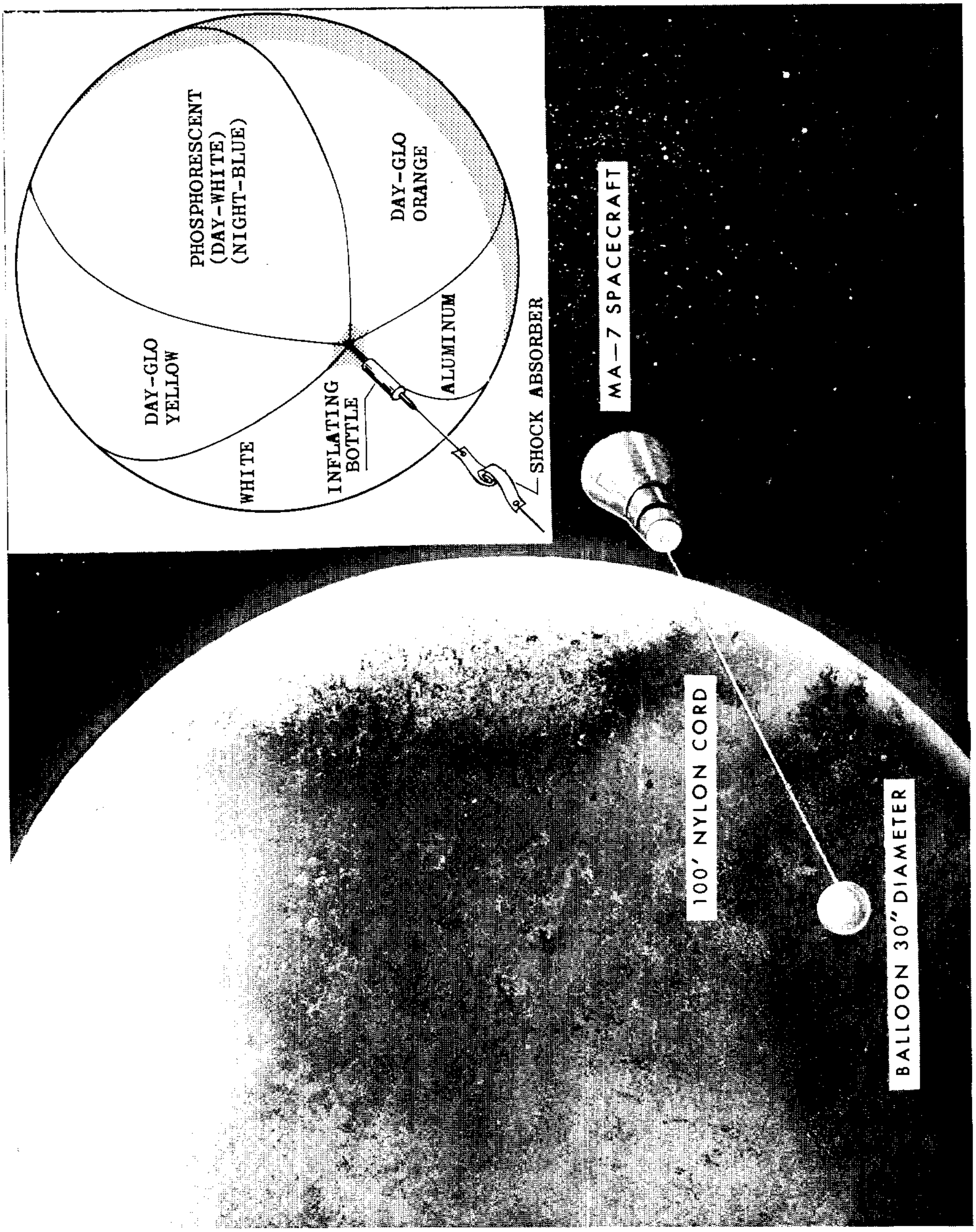
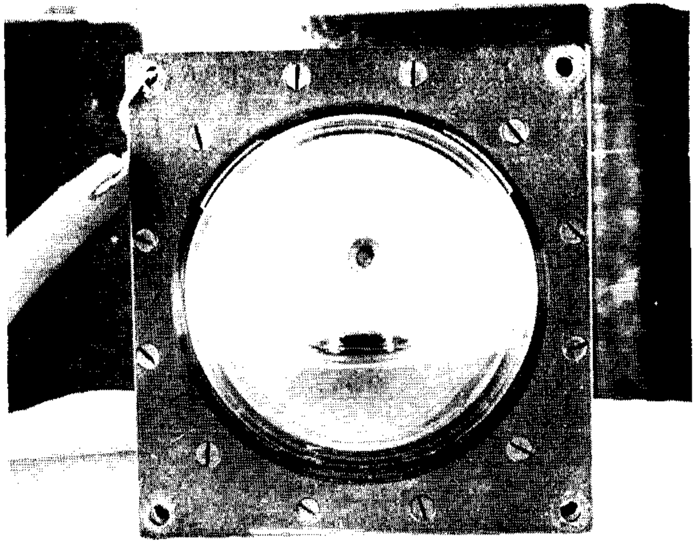
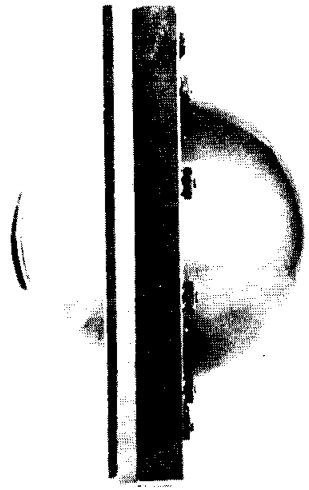


Figure 5.7.1-1.- Balloon experiment planned deployment configuration.

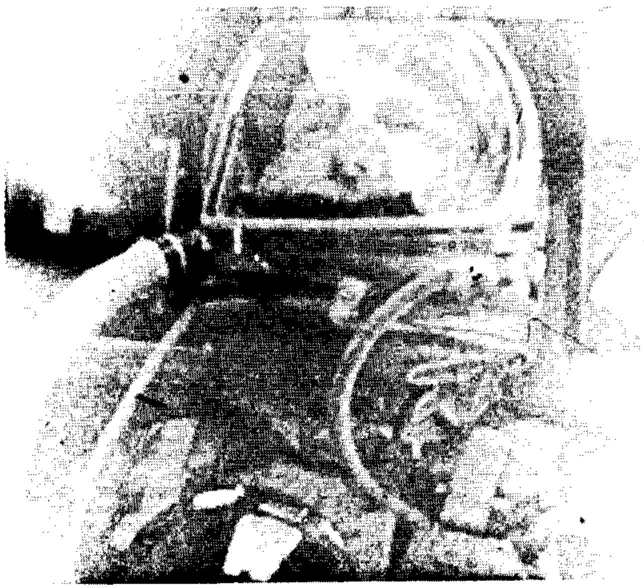


Front view

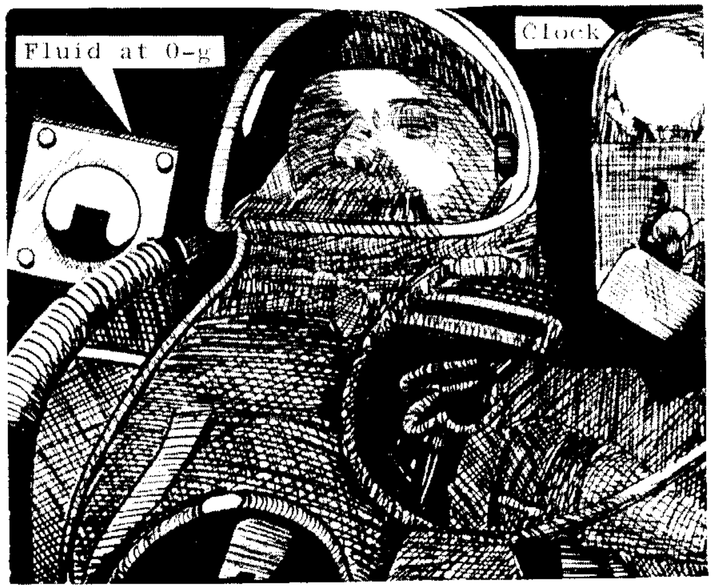


Side view

(a) Flight apparatus



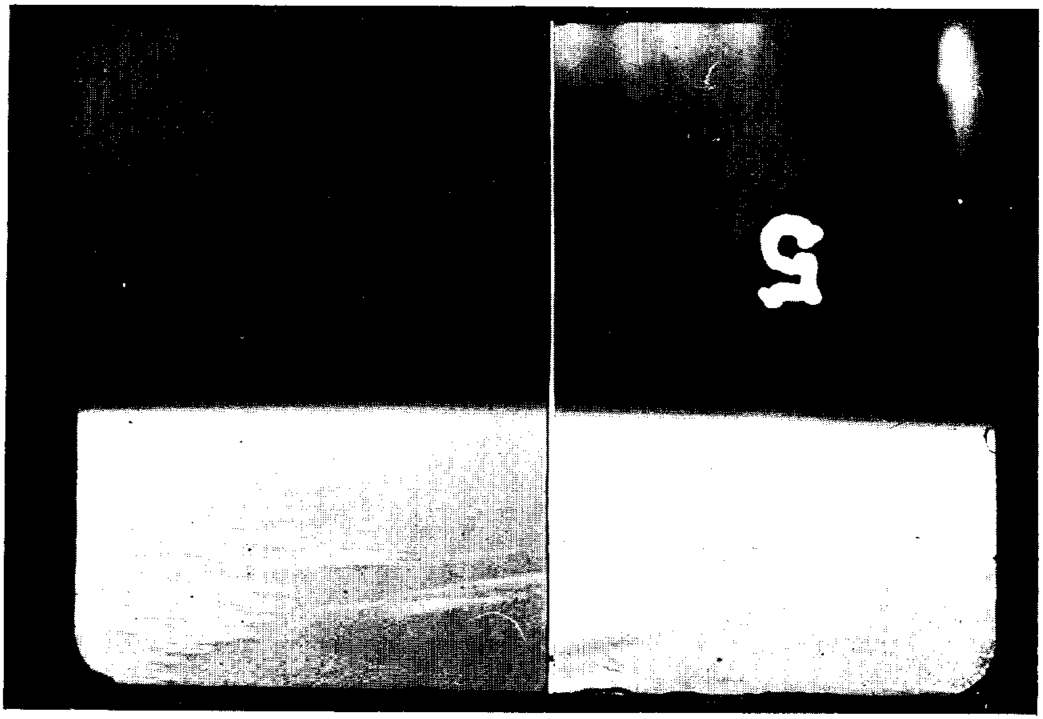
Actual film data



Location sketch

(b) Inflight configuration

Figure 5.7.2-1.- Zero-gravity experiment



Blue, Ratan 47B

Red, Ratan 29

Figure 5.7.3.1-1.- MIT horizon-definition photograph

6.0 LAUNCH VEHICLE PERFORMANCE

All launch vehicle systems performed satisfactorily. The following items are noted for information.

6.1 Hydraulics

The launch vehicle hydraulic system operated satisfactorily throughout the MA-7 powered flight. The sustainer hydraulic system maintained 3080 psi, as indicated by measurement H 310 P (see figure 6.1-1 for location of this transducer). Hydraulic system pressure measurement H 52 P, which began decreasing at 00:03:10 and reached zero at SECO (see figure 6.1-2) is discussed in paragraph 6.2 below.

6.2 Abort Sensing and Implementation System (ASIS)

The ASIS went to a ready condition, that is, all ASIS parameter monitors enabled and both spacecraft fail detect relays energized, at T-3.33 seconds. The additional holddown time for propulsion system verification was 2.95 seconds.

The ASIS performed satisfactorily during the flight. However, the sustainer hydraulic pressure switch No. 2 actuated to the abort position at 00:04:25.1. This switch and the sustainer hydraulic accumulator pressure transducer (H52P) are connected to a common pressure-sensing line. H 52 P showed a gradual decrease in pressure from 2940 psia to zero between 00:03:10 and 00:05:12. Switch No. 2, which was preset to activate at 2015 ±100 psia, activated when H 52 P indicated a pressure of 1050 psia. The sustainer controls, hydraulic pressure transducer indicated that hydraulic pressure remained constant at a normal level throughout the flight, and as result of this, the ASIS sustainer hydraulic pressure switch No. 1 did not activate until normal time after SECO. Both ASIS sustainer hydraulic pressure switches must be actuated to initiate abort command; therefore, this command was not given.

6.3 Airframe

The performance of the airframe was satisfactory, and structural integrity was maintained through powered flight and spacecraft separation. The maximum activity in airframe external dynamic pressure measured at the spacecraft adapter occurred in the vicinity of Mach 1 and at maximum dynamic pressure. This activity decreased with the lessening of ambient pressure.

Noise during tower jettison and posigrade ignition was measured on a microphone located inside the adapter. This was the same behavior as noted in previous Mercury-Atlas flights. Normal clearance and spacecraft separation were indicated by measurement A 828 D "manhole cover", to the retropack extensiometer.

6.4 Guidance

The operation of the Mod III guidance system was entirely satisfactory. The system placed the spacecraft in a satisfactory orbit.

This was the first Mercury flight in which the 6,000-feet rate legs were used for closed loop guidance. Lock was maintained until approximately one second after lift-off. At this time, the system was shifted to the first acquisition cube; full acquisition occurred at approximately 60 seconds. The launch vehicle appeared to pass directly into the cube center. Both track and rate lock were maintained until well after SECO. The final elevation angle at SECO was 7.4 degrees.

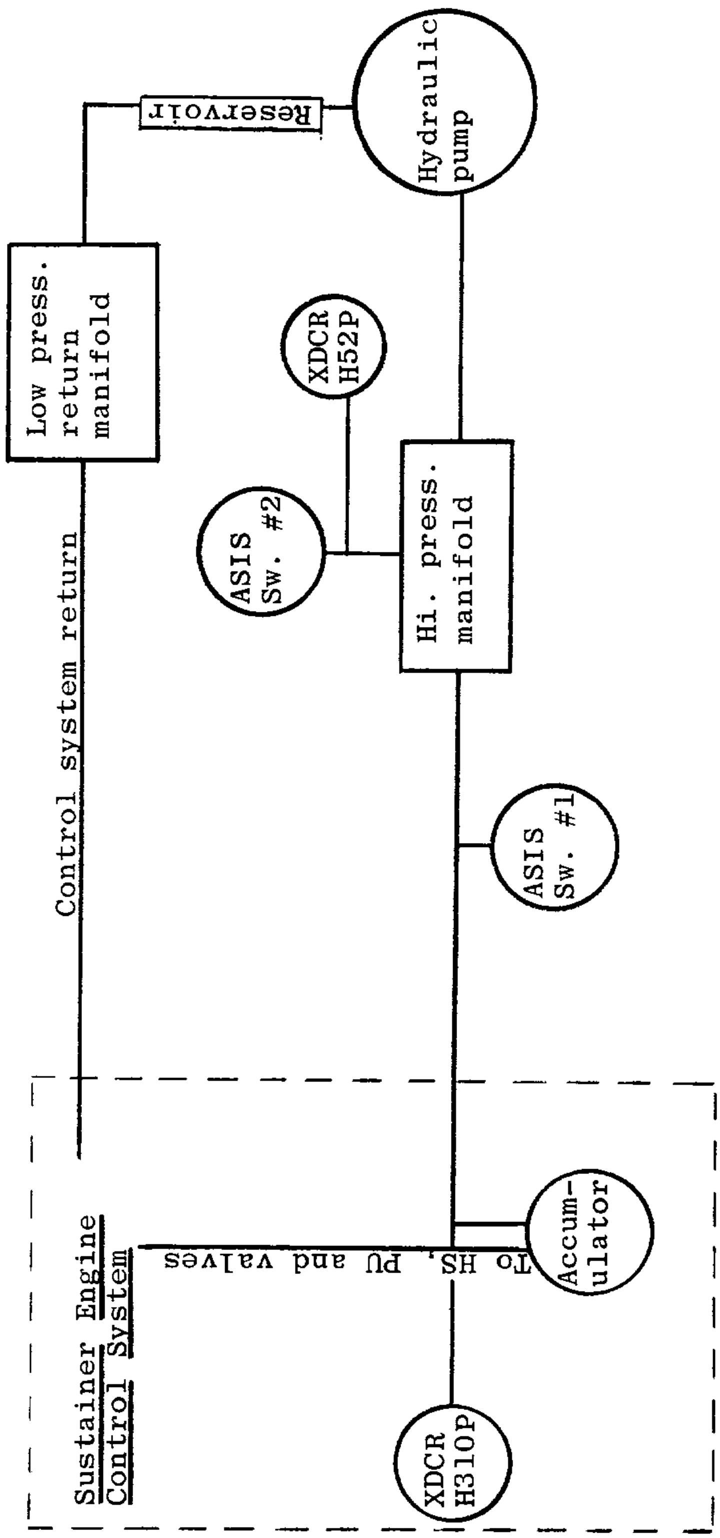


Figure 6.1-1. - Atlas launch-vehicle hydraulic diagram.

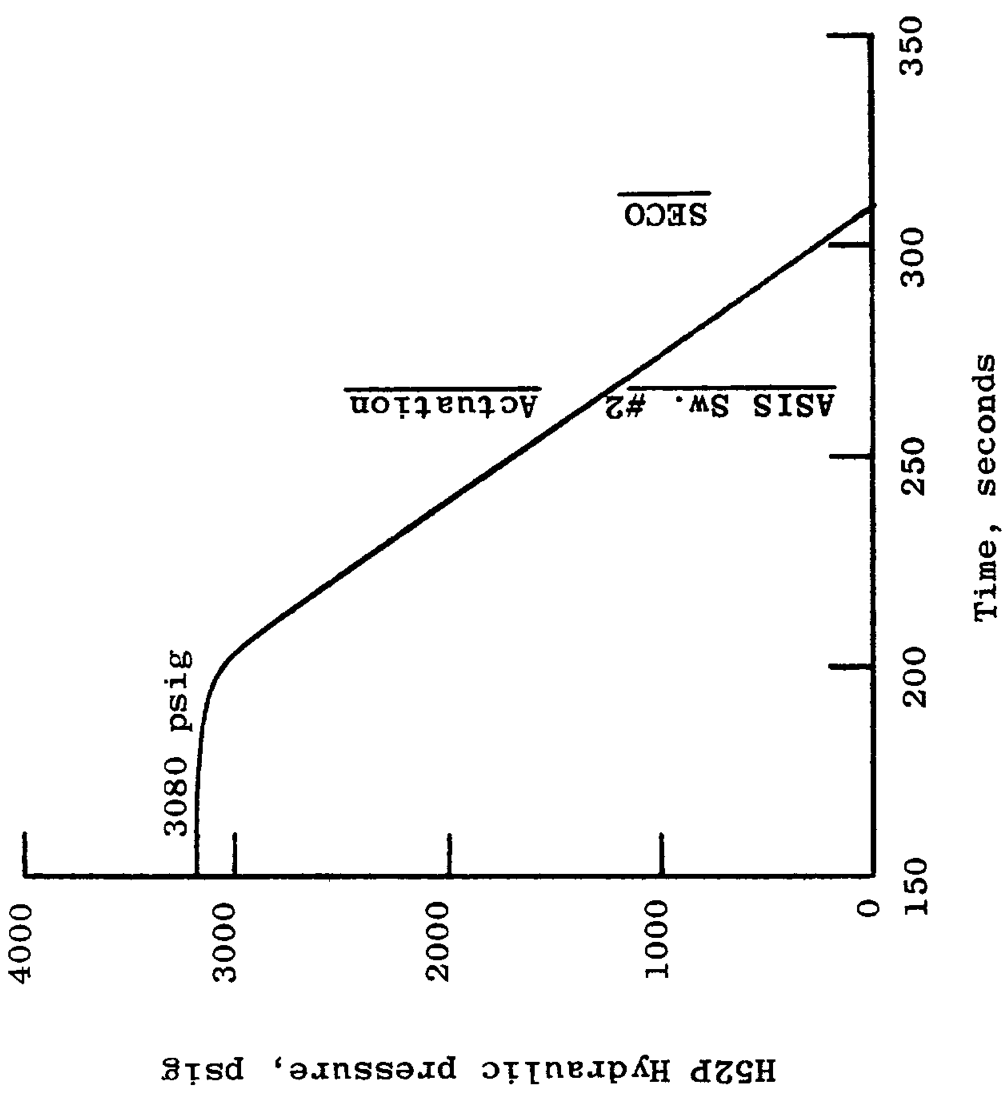


Figure 6.1-2. - Pressure at transducer H52P.

7.0 PILOT ACTIVITIES

7.1 Pilot's Impressions of the Flight

7.1.1 Introduction.- The pilot's narrative account of the flight which follows has been exerpted by the editors from the pilot's debriefing.

7.1.2 Insertion and countdown.- Insertion was accomplished without a hitch, except for a minor problem with the tiedown for the helmet visor seal bottle hose. The countdown went perfectly until the 45 minute weather hold. At T-10 minutes it was picked up again and proceeded perfectly once more until lift-off. During the prelaunch period I had no problems. The couch was comfortable. I had no pressure points. The length of the prelaunch period was not a problem. I believe I could have gone at least twice as long. Throughout the prelaunch period, the launch vehicle was much more dormant than I had expected it to be. I did not hear the clatter that John Glenn had reported. Once I felt the engines gimbaling. I do not recall hearing the boil off valve.

7.1.3 Launch and powered flight.- At firing signal, everything became quiet. I had expected to feel the launch vehicle shake, some machinery start, the vernier engines light off, or to hear the LOX valve make some noise, but I did not. Nothing happened until T-0; then I began to feel the vibration. There was a little bit of shaking. Lift-off was unmistakable.

At around 00:01:30, the sky changed in brightness rather suddenly. It did not become black, but it was no longer a light blue. The noise and vibration increased so little during maximum dynamic pressure that it would not be noticed unless you were looking for it. BECO was very gentle. Three seconds later, staging occurred. There was no mistaking staging. Two very definite noises could be heard; one accompanied the drop in acceleration; the other was associated with staging.

At staging there was a change in the light outside the window and I saw a wisp of smoke. It was gone in a second. Tower jettisoning was unmistakable. I felt a bigger jolt than at staging. Out the window, the tower could be seen way off in the distance, heading straight for the horizon. It was rotating at about 20 RPM, smoke still trailing out of the three nozzles. Just prior to BECO, a cyclic yawing at about 1 c.p.s. was noticeable. It was jerky, not sinusoidal. This picked up again after BECO and increased very gradually until SECO.

At SECO there was a gentle drop off in acceleration. Two separate bangs could be heard; first, the clamp ring explosive bolts and then the louder noise of the posigrade rockets. The Best cue to spacecraft separation was weightlessness. You also notice the silence.

7.1.4 Orbital Flight.-

7.1.4.1 Turnaround: I began the turnaround and wondered why I did not feel anything. At this time, the angular accelerations of the spacecraft can not be felt, and nothing can be seen through the window. The instruments provided the only reference. The turnaround proceeded just as in the trainer except that I was somewhat distracted initially by the new sensation of weightlessness. I followed the needles around and soon there was the horizon. What an arresting sight the first view of the horizon is! At this point, the pilot needs about 30 seconds to drink in this sight and take stock of what has happened.

7.1.4.2 Booster observations: Following the turnaround, I tracked the launch vehicle tankage. It moved down the window as predicted. I believe I described its tumbling rates. These were very slow, it was not rolling. It was pointing away from me with the sustainer engine down. I could see what looked like little ice crystals spewing out the sustainer nozzle. They seemed to be visible for two or three times the length of the booster, in a gradually increasing pattern. The booster was quite bright and easy to see.

7.1.4.3 Weightlessness: Zero g was exactly what I had expected from my brief experience with it in training. I adapted to it quickly. It was very pleasant, a great freedom.

The solid food provided for the flight was found crumbled in its plastic bag. Everytime I opened the bag, some crumbs would come floating out, but once a bite sized piece of food was in the mouth, there was no problem. It was just like eating here on earth.

My only cues to motion were the instruments and the views through the window or the periscope. At times during the flight, the spacecraft angular rates were greater that 6^{o} per second, but aside from vision, I had no sense of movement.

I was never disoriented. I always knew where controls and other objects within the cabin were relative to myself. I could reach anything I needed. I did have one unusual experience. After looking out the window for sometime, I noticed that when I would turn my head to the right to look at the ditty bag, I would get the impression that it was oriented vertically or 90 degrees from where I felt it should be.

There were times when the gyros were caged, and nothing was visible out the window, that I had no idea where the earth was in relation to the spacecraft. But it did not seem important to me. I knew at all times that I had only to wait for a period of time and the earth would appear in the window. The periscope was particularly useful in this respect, because it had such a wide field of view. However, even without it, the window would have been adequate.

7.1.4.4 Control system function: For normal maneuvering in orbit, fly-by-wire, low thrusters only, was the best system. However, I believe for a tracking task, manual proportional control might be desirable. The fly-by-wire high thrusters, and the rate command and auxiliary damping systems were not needed for the tasks that I had to perform in orbit.

In orbit the solenoids of both the high and low thrusters of the fly-by-wire system could be heard. I could hear and feel the rate command system. You do not hear the control linkages but I could hear the manual solenoids and manual thrusters, and I could feel the rate command system kick in. Through the window, the exhaust from the pitch down thrusters could be seen. There was no movement, just a little "V" of white steam in front of the window. It is visible even at night.

7.1.4.5 Unusual flight attitudes: During the flight I had an opportunity to investigate a number of unusual flight attitudes. One of these was forward inverted flight. This was a good way to fly. When I was pitched down close to 90° I think I could pick out the nadir point very easily without reference to the horizon. I could determine whether I was looking straight down or off at an angle. During large portions of the second and third orbit, I allowed the spacecraft to drift. Drifting flight was a thrill. I enjoyed the continuing change of scenery.

Alining the gyros consumed fuel or time, one of the two. The horizon provided a good roll and pitch reference as long as it was visible in the window. But yaw reference was a problem. The best yaw reference was obtained by pitching down 50 to 70 degrees and viewing through the window. Another good yaw reference was available in the periscope at nearly any attitude. The zero pitch mark on the periscope was also a valuable aid in alining the gyros since at zero pitch, the horizon is not in the window.

On the dark side of the earth, the horizon is visible at all times, even before moon rise. Yaw attitude is difficult to determine at night. The best reference is a known star. The periscope is no help in determining yaw on the night side.

7.1.4.6 Communications: In general, communications were excellent. When I was within UHF range, everyone said they could hear me, and I heard very well.

7.1.4.7 Balloon observations: At balloon deployment, I saw one of the balsa blocks and mistook it for the balloon. I saw the confetti as it was jettisoned but it disappeared rapidly. Finally the balloon came into view; it looked to me like it was a wrinkled sphere about 8 to 10 inches thick in the center. It had a little sausage coming out each side. The balloon motion, following deployment, was unpredictable.

7.1.4.8 Terrestrial observations: There was no difference in the apparent color of land, water areas, or clouds from orbital attitude compared to the view from a high flying aircraft. The view looked to me exactly like the pictures from other Mercury flights. The south Atlantic was .9 covered with clouds but all of western Africa was clear. I had a beautiful view of Lake Chad. Parts of Africa were green, and it was easy to tell that the green areas were jungle. There were clouds over the Indian Ocean. The eastern Pacific was roughly .3 to .4 cloud covered. Farther west in the Pacific, it was not so heavily clouded. The western half of Bajah, California was covered with clouds along its entire length but the eastern half was clear. Over the United States on the second orbit, I noticed a good amount of cloudiness, but after retrofire, I could see the area around El Centro quite clearly. I saw a dirt road and had the impression that had there been a truck on it, I could have picked it out. I did not see Florida nor the Cape area.

7.1.4.9 Celestial observations: Because of the light leak around the time correlation clock, I was not fully dark-adapted, nor was the cabin completely dark; therefore, I did not see more stars than I could see from the earth. I am convinced having seen the star Corvus, both during the flight and later in the S2F that a lot more stars can be seen from the ground than I could see through the spacecraft window. I could, nevertheless, readily see and identify the major constellations and use them for heading information. I could not see stars on the daylight side if the earth was in the field of view of the window; however, I do remember seeing stars at the western horizon when the sun was just up in the east but the terminator had not yet reached the western horizon. The sun rises and sun sets were the most beautiful and spectacular events of the flight. I think that, unlike the sun rises and sun sets on earth, those in orbit were all the same. The sharply defined bands of color at the horizon were brilliant.

At a number of points during the flight, I observed the particles reported by John Glenn. They appeared to be like snowflakes. I do not believe that any of them were truly luminous, I think all shown with reflected sunlight. The particles traveled at different speeds but I do not believe I saw any move away from the vehicle as rapidly as the confetti. At dawn on the 3rd orbit, I reached for the densiometer and inadvertently hit the spacecraft hatch, a cloud of particles flew by the window. Since I was yawed to the right, the particles traveled across the front of the window from the right to the left. I continued to knock on the hatch and on other portions of the spacecraft walls and each time a cloud of particles came past the window. The particles varied in size, brightness, and color. Some were gray; some were white. The large ones were 4 to 5 times the size of the small ones. One I saw was a half inch long, and it looked lake a lathe filing. It was shaped like a curly-cue.

7.1.5 Retrosequence.- I think that one reason that I got behind at retrofire was because just at dawn on the third orbit, I discovered the source of the fireflies. I felt that I had time to get that taken care of and prepare for retrofire properly, but time slipped away. It really raced during this period as it did through the whole flight. I needed that time over Hawaii. The Hawaii Cap Com was trying very hard to get me to do the pre-retrograde checklist. After the fireflies, I was busy trying to get alined in orbit attitude. Then I had to evaluate ASCS problem. I got behind. I had to stow things haphazardly; I think everything was stowed, but not in the planned places.

Just prior to retrofire, I had a problem in pitch attitude. I did not have any confidence in the ASCS. By this time, I had gone through the part of the preretro checklist which called for the manual fuel handle to be out as a backup for the ASCS. When I selected the fly-by-wire control system, I did not shut off the manual system. As a result, attitude control during retrofire was accomplished on both the fly-by-wire and the manual control systems.

I feel that attitude control during retrofire was good. My reference was divided between the periscope, the window, and the attitude indicators. At retro attitude as indicated by reference to the window and the periscope, the pitch attitude indicator read -10°. I tried to hold this attitude on the instruments throughout retrofire, but I cross checked attitude in the window and the periscope. I have commented many times that on the trainer you cannot divide your attention between one attitude reference system and another and do a good job in retrofire. But that was the way I controlled attitude during retrofire on this flight.

The initiation of retrofire was just a little bit late, although retrosequence came on time. I received a countdown to retrofire from the California Cap Com. I waited one more second, and then punched the manual retrofire button and one or two seconds after that I felt the first retrorocket fire.

I expected a big boot from the retrorockets. But the deceleration was just a very gentle nudge. The sound of the rockets firing was just audible. Retrofire gave me a sensation, not of being pushed back toward Hawaii as John Glenn reported, but of being slowed down in three increments, so that by the time the retrofire was over, I felt that there had been just enough deceleration to bring the spacecraft to a stop. I felt that if I were to look down, I would see that the motion that I had seen through the window and the periscope before retrofire would have stopped; but of course, it had not.

7.1.6 Reentry.- Retropack jettison occurred on time and the periscope came in on time. At this time, I noticed my appalling fuel state, and realized that I had controlled retrofire on both the manual and fly-by-wire systems. I tried both the manual and the rate-command control modes and got no response. The fuel gage was reading about 6 percent, but the fuel tank was empty. This left me with 15 percent on the automatic system to last out the ten minutes to .05 g and to control the reentry.

If the California Cap Com had not mentioned the retroattitude bypass switch, I think I would have forgotten it, and retrofire would have been delayed considerably longer. He also mentioned an Aux Damp reentry which I think I would have chosen in any case, but it was a good suggestion to have. He was worth his weight in gold for just those two items.

The period prior to the .05 g was a harried one because I did not know whether the fuel was going to hold out. The periscope was retracted. I felt the attitude indicators were useless. The only attitude reference I had was the window. I did not have much fuel to squander at this point holding attitude. I used it sparingly, trying to keep the horizon in the window so that I would have a correct attitude reference. I stayed on fly-by-wire until .05 g. At .05 g I think I still had a reading of about 15 percent on the auto fuel gage.

I began to hear the hissing outside the spacecraft that John Glenn mentioned. The spacecraft was alined within 3 or 4 degrees in pitch and yaw at the start of the reentry period. I feel that it would have reentered properly without any attitude control. The gradual increase of aerodynamic damping during the reentry appeared to be sufficient to aline the capsule properly.

Very shortly after .05 g, I began to pick up oscillations on the pitch and yaw rate needles. These oscillations seemed about the same as those in the trainer during a -0.1* reentry. From this I decided that the spacecraft was in a good reentry attitude and I selected the AUX-damp Control Mode.

I watched both the rate indicator and the window during this period because I was beginning to see the reentry glow. I could see a few flaming pieces falling off the spacecraft. I also saw a long rectangular strap of some kind going off in the distance. The window did not light up to the extent that John Glenn reported. It was just a noticeable increase in illumination. I did not see a fiery glow prior to peak g.

I noticed one thing during the heat pulse that I had not expected. I was looking for the orange glow. It was at this time that I noticed a light green glow that seemed to be coming from the cylindrical section of the spacecraft. It made me feel that the trim angle was not right, and that some of the surface of the recovery compartment might be ablating. I think it must have been the beryllium vaporizing. The fact that the rates were oscillating evenly, strengthened my conviction that the spacecraft was at a good trim angle. The green glow was brighter than the orange glow around the window.

I heard Cape Cap Com up to the blackout. He told me that blackout was expected momentarily. I listened at first for his command transmission, but it did not get through. So I just talked the rest of the way down.

*-0.1 damping coefficient set into the trainer computer.

Acceleration peaked at about 6.7 g. At this time oscillations in rate were nearly inperceptible. AUX-Damp was doing very, very well. The period of peak g was much longer than I had expected. I noticed that I had to breathe a little more forcefully in order to say normal sentences.

7.1.7 Landing.- The accelerometer read $2\frac{1}{2}$ to 3 g when the spacecraft passed through a hundred thousand feet. At around 80 or 70 thousand feet, I may have run out of automatic fuel. I do not remember looking at the fuel gage but the rates began to oscillate pretty badly although the rate needles were still on scale.

My best indication of the amplitude of the oscillation was to watch the sun cross the window, and try to determine the angle through which the spacecraft was oscillating. I could feel the deceleration as we would go to one side in yaw or pitch. I switched the drogue fuse switch on at about 45 thousand feet. At about 40 thousand feet, I began to feel that the spacecraft oscillations were going past 90°. I reported that the oscillations were getting too bad and I deployed the drogue chute manually at around 25,000 feet.

I could see the drogue pulsing and vibrating more than I had expected. It was visible against a cloudy sky. After the drogue chute was deployed, I operated the snorkel manually. The rate handle came up, but I reached over and pushed it up too. I did not notice any increase in cooling at this time.

I switched the main chute fuse switch on at 15,000 feet, and waited for the main chute to deploy. At about 9,500 feet, I manually operated the main chute deploy switch. It came out and streamed. It was reefed for a little while. There is a lot of stress on that chute! You can see how it is being tried. The chute unreefed and it was beautiful! I could see no damage whatsoever. Rate of descent was right on 30 feet per second.

I was convinced that the main chute was good and selected the auto position on landing bag switch and the bag went out immediately. I went through the postreentry and 10K feet checklists and got everything pretty well taken care of.

The impact was much less severe than I had expected. It was more noticeable by the noise than by the g-load. There was also a loud knock at impact. I thought we had a re-contact problem of some kind. I was somewhat dismayed to see water splashed on the face of the tape recorder box immediately after impact. My fears that there might be a leak in the spacecraft appeared to be confirmed by the fact that the spacecraft did not right itself.

7.1.8 Egress.- The spacecraft listed halfway between pitch down and yaw left. I got the proper things disconnected and waited for the spacecraft to right itself. We do not have a window in the egress trainer, but the level of the water on the window seemed to be higher than I had expected. The list did not change.

I knew that I was way off track. I had heard the Cape Cap Com transmitting blind that there would be an hour for recovery. I decided to get out at that time and went about the business of egressing from the spacecraft.

Egress is a tough job. The space is tight and egress is hard. But everything worked properly. The small pressure bulkhead stuck a little bit. Pip pins and initiators came out very well. I easily pushed out the cannister with my bare head. I had the raft and the camera with me. I disconnected the hose after I had the cannister nearly out.

I forgot to seal the suit and I did not deploy the neck dam. I was aware at this time that the neck dam was not up but I had forgotten it earlier right after impact when I should have put it up. I think one of the reasons I did not was that it was so hot. However, it was not nearly as hot as I expected it to be. I think after impact I read 105 on the cabin temperature gage. I was much hotter in orbit than I was after impact. I did notice the humidity. I felt fine.

I climbed out. I had the raft attached to me. I placed the camera up on top of the recovery compartment so that I could get it in the raft with me if the capsule sank. I did not want to take it with me while I inflated the raft.

I slid out of the spacecraft while holding on to the neck. I pulled the raft out after me and inflated it, while still holding on to the spacecraft. The sea state was very good. Later on the swells may have increased to eight or nine feet, but at impact, they were only five or six feet.

7.2 Flight Activities

7.2.1 Preflight training.-

7.2.1.1 Spacecraft checkout activities: The pilot's participation in the spacecraft preflight checkout activities enabled him to become familiar with the MA-7 spacecraft and launch vehicle systems. Table 7.1.1.1-1 summarizes the checkout activities during which he spent 31 hours and 30 minutes in the spacecraft itself and many additional hours before and after each checkout operation in preparation, trouble shooting, observation and discussion. In addition, the pilot spent 79 hours and 30 minutes in the MA-6 spacecraft which also added considerably to his knowledge of Mercury spacecraft and launch vehicle systems.

7.2.1.2 Training activities: Table 7.1.1.2-1 is a brief summary of the training activities on the Langley and Cape Canaveral Procedures trainers and the ALFA trainer from 25 March to 22 May 1962. During this period the pilot spent 70 hours and 40 minutes accomplishing 114 turnarounds, 92 retrofires, and experienced 143 simulated systems failures. The main training emphasis during these simulations was on the practicing of specific attitude maneuvers and rehearsing the inflight activities. The pilot also received training on failure detection and correction which usually resulted in an abort or early reentry. He participated in several of the launch abort and network simulations during which the mission rules were discussed and rehearsed.

7.2.1.3 Training analysis: On the Mercury Procedures Trainers, the pilot achieved a high level of skill in performing maneuvers such as turnaround, retrofire and reentry rate damping. The pilot reported that during the flight these particular maneuvers seemed familiar to him. However, he was less well prepared for these activities which could not be properly simulated and practiced before flight, such as the gyro re-alinement and the more extensive attitude change maneuvers.

In addition, it should be noted that the horizon scanner malfunction encountered during the flight could not be simulated on the Procedures Trainer, nor can practice be given in the analysis of instrument reference problems because of the lack of a system for simulating the view through the spacecraft window. These factors, together with the higher fly-by-wire low thrust levels simulated on the trainer, may have contributed to the pilot's tendency to use the high torque thrusters excessively with the resulting high rate of fuel consumption.

Flight plan activities had to be altered as required when they conflicted at times with operational requirements arising from system malfunctions or mission requirements.

During the flight the pilot had difficulty in obtaining a satisfactory setting on the suit and cabin cooling systems. Much of this difficulty resulted from time lags between regulator settings and system response.

The pilot failed to follow the planned egress procedure with regard to deployment of the neck dam and the sealing of the suit inlet hose valve. The droplets of water which splashed on the tape recorder at landing and the apparent unusual list angle of the spacecraft may have contributed to his desire to perform a rapid egress, with a resulting inattention to deployment of the neck dam.

7.2.1.4 Preflight operations schedule: The specific preflight pilot activities and dates beginning from March 16 to launch date are given in table 7.1.1.4-1. During the preflight preparation period, the pilot maintains a tight schedule of training activities. In addition, a large number of unscheduled demands on the pilot's time resulted in a somewhat crowded schedule.

7.2.2 <u>Flight plan activities</u>.-

7.2.2.1 Design of the flight plan: Pilot activities during orbital flight consisted of observations, experiments, and flight maneuvers. The activities were planned to provide the maximum information in the time available. The observations included pilot recorded comments, photographs, and studies during flight of the earth's surface and atmosphere and celestial phenomena. Experiments in which the pilot actively participated consisted of measurements with a tethered balloon and tests to evaluate the physiological functions of a man in a space environment. Flight maneuvers were devised to obtain information and to develop safe rendezvous, attitude control tasks, and spacecraft orientation problems. The layout of the flight plan presumed an 08:00 e.s.t. launch, which determined the timing of those tasks to be done during daylight and those to be done at night. A nominal trajectory was assumed with regard to station passage and the apogee-perigee points, which affected certain observations and experiments.

7.2.2.2 General results: The mission produced successful measurements of the altitude and thickness of the haze layer and proved its origin to be an expected airglow phenomenon. In addition, the extensive drifting flight in the third orbital pass to conserve fuel, the ingestion of water and bite-size food, and the horizon definition photographs required for the design of the Apollo navigation and guidance system all provided useable results applicable to future spaceflight. Several control tasks have previously been discussed in the pilot report, section 71., or elsewhere in this section; these maneuvers include yaw, drifting flight, inverted flight, gyro uncaging, spacecraft stability, and forward inverted flight. Extensive cloud cover over Australia prevented the observation of flares or the lights from cities and Darwin airport. Partial inflation compromised the success of the tethered balloon experiment, and instrumentation problems in the blood pressure system precluded valid results of calibrated work at zero g.

The scientific experiments called for in the flight plan are discussed in detail in sections 5.7 and 7.3. Spacecraft attitude control activities called for in the flight plan are discussed in the following section (7.2.3)

7.2.3 Spacecraft attitude control and flight procedures.- The major portion of the pilot's performance in controlling his spacecraft attitudes could not be quantitatively analyzed because:

1. The horizon scanners appear to have malfunctioned.

2. There was a considerable period of time in which the spacecraft attitudes were either beyond the horizon scanner saturation limits and/or the gyros were in the caged position.

3. The pilot deviated slightly from procedures rehearsed prior to and during the pilot preflight preparation period.

The pilot's attitude control activities are summarized in table 7.2.3-1. The function and operation of the reaction control system is discussed in section 5.1. The attitude control tasks are discussed below:

7.2.3.1 Turnaround maneuver: The purpose of accomplishing the turnaround maneuver, using the fly-by-wire (FBW) control mode, was to conserve fuel and still complete the turnaround within approximately the nominal time period required by the ASCS system.

The MA-7 FBW turnaround used approximately 1.60 pounds of H_2O_2, whereas the MA-6 ASCS turnaround used over 5 pounds of control fuel. Generally, the turnaround maneuver was accomplished satisfactorily except that the pilot was slow in getting into proper retroattitude (figure 7.2.3.1-1). Since he had an insertion "GO", there was no immediate need to quickly assume the proper retroattitude, and he therefore pitched up to track and photographed the spacecraft sustainer stage.

7.2.3.2 Sustainer tracking: This task was designed to determine the limits of the pilot-spacecraft combination in tracking a moving object at varying separation distances, and to investigate the visual limitation associated with a receding object in space. The pilot, using FBW mode, was to aline the window reticle with the sustainer and pitch down slowly, staying on target, until he was required to return to orbit attitude during contact with CYI. This would normally allow approximately two and a half minutes of tracking. Results of the mission show that the photographing task extended longer than expected. Although he did not perform the tracking maneuver as planned, he commented that precision tracking of objects with small relative motions to the spacecraft could best be done on FBW low or possibly the lowest deflections on manual proportional control.

7.2.3.3 Gyro caging and uncaging procedure: A procedure for alining the gyro indicators to the window reference was formulated and rehearsed during the preflight preparation period. It was intended to use the window and not the periscope under the assumption that the periscope would not be available for future Mercury flights. The pilot's ability to re-aline the gyro indicators to the window reference cannot be determined precisely because of the pitch horizon scanner malfunction. However, the data does indicate that the pilot did generally follow the planned gyro realinement procedure on the first two occasions. Thereafter, he simply went to a true vehicle attitude, using the periscope orbital attitude reference scribe mark, and caged and uncaged at this point. This method of alining the gyros by using the periscope was more economical in both time and fuel expenditure.

7.2.3.4 Yaw maneuvering: The pilot accomplished two 180° yaw turnarounds and several 90° yaw maneuvers during the flight. Since these maneuvers were accomplished only for photography and observation purpose, and not as precision maneuvers, no attempt was made to analyze them quantitatively. The preferred method of yaw attitude control on the daylight side was by reference to ground terrain drift. At night this type of reference is available only when the moon is sufficiently bright to illuminate the clouds. The preferred method of yaw determination on the nightside available at all times is by orientation to known stars that lay close to the orbital plane. Star charts were provided for this purpose. The pilot reported difficulty in finding cues for determining yaw. However, his general comments during debriefing indicated that moonlight or ground lights are necessary for the terrestrial yaw check.

An attempt was made to establish that star patterns can be recognized in both the day and night sectors of an orbit. Through knowledge of constellation patterns, the pilot was able to use the stars for yaw reference. The pilot was able to successfully identify several constellations on the dark side of the earth. Star navigation was not attempted during the day sectors. Constellations Corvus and Cassiopeia were noted during the first pass at about 19 and 35 minutes after sunset respectively. Scorpio was noted during the third pass at about 27 minutes after sunset. The brightest star in each of these constellations is approximately 2.5 magnitude. Ursa Major (Big Dipper) was also identified prior to the haze layer experiment. The pilot reported that the star navigation device was very useful. However, he did have difficulty in reading the charts because of their reflective surface and the cabin lighting arrangement. The pilot stated that he saw fewer stars than he had expected while in orbit because of the light transmission characteristics of the window and internal reflections.

7.2.3.5 Drifting flight, inverted flight: These maneuvers cannot be quantitatively analyzed because the gyros were caged and the horizon scanner outputs were usually questionable. During the flight, the pilot allowed the spacecraft to drift for a total of one hour and seventeen minutes, one hour and six minutes of which was continuous drifting during the third orbital pass to conserve fuel. The pilot reported that drifting flight was not disturbing and that he was not concerned when no external reference was available. He stated that the forward inverted attitude was desirable for orbital flight.

7.2.3.6 Retrofire attitude control: The pilot decided to control attitude during the retrorocket ignition event, using the fly-by-wire control mode, primarily because of an undetermined problem with the automatic stabilization control system. Because of the apparent attitude control problem leading to the deviation in impact point, a review of the pilot's activities prior to and during the retrofire period is presented.

At approximately eleven minutes prior to retrosequence, the pilot discovered a source of the glowing particles reported during the MA-6 mission. Observing and photographing these particles delayed the accomplishment of equipment stowage and completion of the pre-retrofire checklists. At this time, he was reminded to pull his manual fuel handle out, thereby enabling the manual control system as a backup to the automatic control system. At retrofire minus five minutes, he determined that his gyro indications were wrong and quickly rechecked his fly-by-wire and manual proportional control modes. At retrofire minus two minutes, he again checked his automatic control system and decided to use the window and periscope in conjunction with fly-by-wire to control the retrofire. At retrofire minus thirty seconds, he again checked his ASCS orientation mode upon ground request. This drove him down in pitch and he quickly switched back to fly-by-wire and repositioned the spacecraft to retrofire attitude using external reference. Because the manual control system was also enabled, he used double authority during this and the subsequent retrofire maneuver. At retrofire minus twelve seconds, he was told by the ground to go to bypass position and use manual over-ride. The pilot had to manually initiate retrofire which occurred three seconds late.

Apparently, as a result of these control activities just prior to retrofire, the pilot began the period of retrofire with an indicated 25° error in yaw which he gradually reduced during the course of the 22-second period of retrorocket firing (figure 7.2.3.6-1).

7.2.3.7 Fuel Management: The pilot frequently departed from recommended operational procedures concerning control mode switching, which resulted in a greater than normal fuel expenditure rate (figure 7.2.3.7-1). The high rate of fuel usage can be attributed to the following:

1. The pilot inadvertently used the high fly-by-wire thrusters.

2. Double authority control was used on 6 occasions, including the retrofiring sequence, for a total of approximately 17 minutes.

3. The automatic stabilization and control system went into orientation mode 7 times (approximately 1.5 lbs. usage each case). On 3 of these 7 occasions, it is possible that the malfunctioning attitude reference system caused inadvertent use of the orientation mode of control. On 3 occasions, the pilot switched to ASCS "normal" with the gyros caged, and in one case the ground requested that he check his ASCS orientation mode just prior to retrosequence. About 1.5 pounds of fuel was used each time the ASCS went into orientation mode.

7.2.4 Scientific equipment.- The equipment aboard the MA-7 flight and the pilot's comments regarding their operation are as follows:

7.2.4.1 The 35 mm hand held camera: (See figure 7.2.4.1-1) A 35mm Robot Recorder 36 was provided. It was lightened, a pistol grip handle was provided along with other modifications to permit ease of operation, and a clip was provided for attachment to the chart holder during orbit. It was equipped with a standard back assembly and with a 30-foot film capacity magazine. Additional equipment included 2 interchangeable lenses, one a 75mm, f3.5 lens and the other a 45mm, f2.8 lens. Each lens system was provided with an UV-17 filter. This camera functioned well throughout the flight. Although the large capacity back reduced film changing to a minimum, it was still necessary to change films to accomplish specialized photography. The results are contained in the section on Photography Efforts.

7.2.4.2 Film: The 30-foot magazine was preloaded with Eastman Color Negative film (Eastman stock number 5250) and attached to the camera prior to insertion into the spacecraft. This film load represented a 250-exposure capability. The Massachusetts Institute of Technology provided a preloaded film (Eastman stock number SO-1030) to be used for the horizon definition photographs. This film load provided approximately 70 exposures. The Weather Bureau experiment required a 36 exposure film load that was alternately spliced from Tri-X and Infra-red film stocks. Also included was one 36-exposure roll of Ansco Super Hypan film, to provide an alternate to the ECN for photographing the particles. The results obtained by the use of these films will be found in the section on Photographic Efforts.

7.2.4.3 Filter Mosaics: (See figure 7.2.4.3-1) Two filter mosaics were provided. These mosaics were mounted in holders designed to be inserted into the camera at the film plane. One was to be used with the MIT film and the other with the Weather Bureau film. The MIT mosaic consisted of two equal sections of Wratten filter, numbers 29 and 47B. The Weather Bureau mosaic contained 5 equal sections of Wratten filter, numbers .8 neutral density, 25, 47, 58, and 87. Of these, only the MIT mosaic was used, and it performed satisfactorily.

7.2.4.4 Photometer: (See figure 7.2.4.4-1) This device was the same one used during the MA-6 mission. It is used to view sunrise and sunset, to evaluate the pilot's capability to orient to the horizontal, and as a high and low level light meter. This instrument was used by the pilot with satisfactory results.

7.2.4.5 Binoculars: (See figure 7.2.4.5-1) The pilot was provided with a miniature pair of 8 x 20 binoculars. Clips were provided to permit attachment to the chart holder during orbit. The pilot reported utilization during flight was difficult due to the viewing angle with the window.

7.2.4.6 Extinction photometer: (See figure 7.2.4.6-1) This device consisted of a calibrated, circular, varying density filter in a suitable mount. It was used on several occasions during the flight with satisfactory results.

7.2.4.7 Airglow filter: (See figure 7.2.4.7-1) This again is the same device, with a modified mount, as used on the MA-6 flight. It selectively passes light at the 5577Å wave length. This device was used to view the airglow layer on the nightside of the earth.

7.2.4.8 Night adaption eye cover: (See figure 7.2.4.8-1) This device fitted the eye socket in such a manner as to eliminate any direct light from reaching the eye. It was provided with a red lens to allow the pilot the use of his left eye during the adaption period. It functioned properly during the flight although complete dark adaption was prohibited by stray light within the spacecraft.

7.2.4.9 Map booklet, star navigation device and inserts, and flight plan cards: The pilot reported only that the glare from the star navigation device made it difficult to use. The balance of this equipment and its stowage was adequate.

7.2.4.10 Equipment stowage: All equipment had female velcro applied to strategic points, whereas male velcro was applied to the stowage areas. Four equipment areas were provided within the MA-7 spacecraft. During the launch, retrofire, and reentry phases, the equipment was stowed in three locations. First, the equipment container located to the pilot's right, below the hatch, contained the: 35mm hand held camera and associated accessories; photometer, binoculars, and extinction photometer. Second, the "glove compartment", located in the left central section of the center instrument panel console, contained the: exercise device, film, filter mosaics, airglow filter, and the night adaption eye cover. Third, the chart holder, located below the periscope, contained the: map booklet, star navigation device and inserts, and the flight plan cards. During the orbital phase, the equipment was stowed either in these locations or on the velcro applied to the hatch for this purpose. The pilot reported no difficulties with the stowage of any of the equipment.

TABLE 7.2.1.1-1. - TIME PILOT SPENT IN SPACECRAFT 18 DURING HANGAR AND PAD TESTS

Date	Spacecraft Tests	Approximate Duration, hrs+min
12 Apr	SEDR[a] 77 - Systems Test (Hangar S)	6+30
15 Apr	SEDR 77 - Systems Test (Hangar S)	3+30
16 Apr	SEDR 77 - Sequential, Sect. 2	7+00
17 Apr	SEDR 77 - Sequential, Sect. 2	6+00
18 Apr	SEDR 77 - Sequential, Sect. 2	3+00
30 Apr	SEDR 171 - Simulated Flight #1	4+20
4 May	SEDR 171 - Simulated Flight #2 and FACT[b]	0+30
5 May	RCS blip check (special test)	0+40
10 May	SEDR 170 - Launch Simulation and Egress	5+00
12 May	RCS blip check (special test)	1+00
15 May	SEDR 171 - Simulated Flight #3	7+30
	Approximate Total Time	45 hrs

[a]Service Engineering Department Report
[b]Flight Acceptance Composite Test

TABLE 7.2.1.2-1.- PILOT TRAINING SUMMARY ON THE ALFA AND PROCEDURES TRAINERS

Date 1962	Trainer *	Type of Training	Time Hrs. & Min.	No. of Missions	Failure Number and Type						Special** Training Activities
					ECS	RCS	SEQ	Elec	Comm	Misc	
25 Mar	#1	Attitude control	2+15	1			1				1,3
25 Mar	A	Attitude control	1+35								2,4
28 Mar	#2	Attitude control	2+40	2							1,2
29 Mar	#2	Attitude control	1+45	1							1,2
31 Mar	A	Attitude control	1+10								2
31 Mar	#1	Attitude control	2+15	1			1				1,3
2 Apr	#1	Attitude control	1+00	1							1,3
3 Apr	#1	Attitude control	1+30	1							1,3
5 Apr	#1	Attitude control	1+30								1,3
6 Apr	#1	Attitude control	1+00								1,3
9 Apr	#1	Systems failures	2+30	10	4	2	6	2	1	3	3,5,6
10 Apr	#2	Systems failures Attitude control	1+35	7	2		3	4		4	1,5
20 Apr	#2	Systems failures Attitude control	3+15	4	2	1	2	3		1	1,2,5
21 Apr	#2	Systems failures	3+15	8	2	1	6	5	1	5	5,6
26 Apr	A	Attitude control	1+00								2,4
27 Apr	#1	2 Orbit mission	4+00	1			2				2,3,6,7
1 May	#2	Systems failures	2+20	4	1		7	1		3	5,6
2 May	#2	3 Orbit mission	5+35	1							7
4 May	#2	Systems failures	2+00	3			3	2		1	5
5 May	#2	Systems failures Attitude control	3+00	5		1	3	2		4	1,2,3,4,5
7 May	#2	2 Orbit mission	3+35	1	1						7
8 May	#2	Systems failures	1+15	6	3		5	3	1	6	5,6
9 May	#2	MCC/BDA sim.	2+35	3	1	1	1		2		5
10 May	#2	MCC/BDA sim.	1+05	1	2						5
12 May	#2	1 Orbit mission	1+45	1							7
13 May	#2	1 Orbit mission	1+45	1		1					7
14 May	#2	3 Orbit mission	5+40	1							7
18 May	#2	MCC/BDA sim.	2+45	4	1	3		1	1	1	5
21 May	#2	2 Orbit mission	4+15	1	1						7
22 May	#2	Systems failures	0+50	4	4	1	3	3	1	4	5,6
		TOTALS	70+40	73	24	11	43	26	7	32	

* Trainer code: #1 - Langley Procedures Trainer
#2 - Cape Procedures Trainer
A - Alfa Trainer

** Training Activities key :
1 - Turnaround maneuvers
2 - Retrofire attitude control
3 - Reentry rate control
4 - Special attitude maneuvers
5 - Launch aborts
6 - Orbital emergencies
7 - Flight plan work

Totals No. of :
(a) Failures - 143
(b) Turnaround maneuvers - 114
(c) Reentries - 49
(d) Retrofire attitude control - 92

TABLE 7.2.1.4-1.- PILOT PRE-FLIGHT PREPARATION HISTORY

Date	Day	Activity*
16 Mar	Fri	Flight Plan Meeting
19 Mar	Mon	Systems Briefing (ASCS)
20 Mar	Tue	Systems Briefing (RCS & Elect.)
21 Mar	Wed	Booster Review
22 Mar	Thu	Systems Review (ECS & Mech.)
25 Mar	Sun	A.M. - ALFA Trainer P.M. - MPT #1
28 Mar	Wed	MPT #2
31 Mar	Sat	A.M. - MPT #1 P.M. - ALFA Trainer
2 Apr	Mon	MPT #1
3 Apr	Tue	MPT #1
4 Apr	Wed	Trajectory Briefing
5 Apr	Thu	MPT #1
6 Apr	Fri	MPT #1
9 Apr	Mon	MPT #1
10 Apr	Tue	MPT #2
13 Apr	Fri	Scheduling Meeting
15 Apr	Mon	SEDR 77 (Systems Test)
16 Apr	Tue	SEDR 77
17 Apr	Wed	SEDR 77
19 Apr	Thu	Survival Pack Training Zero g Exp. Briefing
20 Apr	Fri	MPT #2
21 Apr	Sat	MPT #2
24 Apr	Tue	Flight Plan Meeting
26 Apr	Thu	ALFA Trainer
27 Apr	Fri	MPT #1
28 Apr	Sat	Morehead Planetarium
30 Apr	Mon	SEDR 171 (Sim. Flt.)
1 May	Tue	MPT #2 MIT Photo Briefing Scheduling
2 May	Wed	MPT #2
3 May	Thu	Egress Training
4 May	Fri	Egress Training MPT #2
5 May	Sat	MPT #2, RCS Static Fire
7 May	Mon	MPT #2
8 May	Tue	SEDR 171 (Sim. Flt. #2 & FACT) MPT #2
9 May	Wed	MCC/BDA Simulation Mission Rules Review Flt. Plan Review
10 May	Thu	MCC/BDA Simulation RCS Blip Check SEDR 170 (Launch & Egress)
11 May	Fri	WX Briefing, Scheduling, Trajectory, & Flt. Plan & Balloon Exp. Briefings
12 May	Sat	MPT #2, RCS Blip Test

TABLE 7.2.1.4-1.- Concluded

Date	Day	Activity*	Date	Day	Activity*
13 May	Sun	MPT #2	18 May	Fri	MCC/BDA Simulation
14 May	Mon	MPT #2, Flt. Plan & M.I.T. Photo Briefings Mission Review	21 May	Mon	MPT #2, Scheduling
			22 May	Tue	MPT #2, Flt. Plan Review
15 May	Tue	SEDR 171 (Sim. Flt. #3)	23 May	Wed	Pilot Briefing, Study
16 May	Wed	Booster & Mission Review	24 May	Thu	Launch
17 May	Thu	Physical Examination			

*Activity code:

MPT #1 (Langley) Mercury Procedures Trainer.

MPT #2 (Cape) Mercury Procedures Trainer.

TABLE 7.2.3-1.- SUMMARY OF MANEUVERING FLIGHT AND INFLIGHT ACTIVITIES

Control mode[a]	Time from launch		Gyro switch position			Maneuvering flight activities
	From	To	Position	From	To	
Aux. Damp.	00:05:12	00:05:22	Normal	Prelaunch	00:12:38	5 sec. rate damping at spacecraft separation.
FBW	00:05:22	00:07:10				Turnaround maneuver
ASCS	00:07:10	00:12:55	Free	00:12:38	00:14:46	Photographing launch vehicle holding attitude for radar track.
FBW	00:12:55	00:16:31	Normal	00:14:46	00:30:53	Used high FBW thrusters.
ASCS	00:16:31	00:17:29				Astronaut reported a window-instrument disagreement.
MP	00:17:29	00:17:48				MP control check.
ASCS	00:17:48	00:17:56				Dropped into orientation mode.
FBW & MP	00:17:56	00:21:28				
ASCS	00:21:28	00:30:52				Dropped into orientation mode. Horizon photography.
FBW	00:30:52	00:39:12	Caged	00:30:53	00:32:10	Used high FBW thrusters.
			Normal	00:32:10	00:33:13	
			Caged	00:33:13	00:33:17	To aline window and gyro indicators.
			Normal	00:33:17	00:33:48	
			Caged	00:33:48	00:33:51	
			Normal	00:33:51	00:36:45	
			Free	00:36:45	00:38:35	Used air glow filter, horizon definition photography.

[a]See · at end of table.

TABLE 7.. ,-1. - Continued

Control mode[a]	Time from launch From	Time from launch To	Gyro switch position Position	Gyro switch position From	Gyro switch position To	Maneuvering, flight activities
ASCS	00:39:12	00:39:13	Caged	00:38:35	00:39:13	Went to ASCS "normal" with gyros caged.
RSCS	00:39:13	00:39:14	Normal	00:39:13	00:56:19	
ASCS	00:39:14	00:45:46				Photographs of sunset, yawed 90° left and right.
FBW	00:45:46	00:48:33				Used high FBW thrusters.
ASCS	00:48:33	00:56:30	Free	00:56:19	01:02:55	Dropped into orientation mode. Occluded Venus, emergency voice check.
RSCS	00:56:30	00:56:53				Re-checked RSCS.
MP	00:56:53	00:58:20				
FBW	00:58:20	01:13:06	Caged	01:02:55	01:43:00	Flare observation (minus 80° pitch, plus 80° yaw). Used high FBW thrusters. Started drifting flight at 01:01:00; Varied spacecraft rates slightly, by rocking arms back and forth. (0.1°/sec). Ate food at 01:08:52. Stopped drifting flight at 01:12:30.
RSCS	01:13:06	01:14:09				
FBW & MP	01:14:09	01:24:50				Yawed 180° to take photographs of sunrise. Observed particles.
FBW	01:24:50	01:37:43				Photographed clouds.
ASCS	01:37:43	01:37:47				Went to ASCS "normal" with gyros caged.
FBW	01:37:47	01:43:01	Normal	01:43:00	02:01:03	Deployed the balloon at 01:38:00.

[a]See key at end of table.

TABLE 7.2.3-1. - Continued

Control mode[a]	Time from launch From	Time from launch To	Gyro switch position Position	Gyro switch position From	Gyro switch position To	Maneuvering, flight activities
ASCS	01:43:01	02:01:07	Caged	02:01:03	02:01:23	Dropped into orientation mode. Observed and took photographs of balloon.
FBW	02:01:07	02:04:20	Free	02:01:23	02:01:43	
			Caged	02:01:43	02:02:29	
ASCS	02:04:20	02:09:00	Normal	02:02:29	02:14:12	Dropped into orientation mode. Observations of sunset.
FBW	02:09:00	02:28:53	Caged	02:14:12	02:14:17	Used high FBW thrusters.
			Normal	02:14:17	02:30:09	Checked stability of spacecraft. Extended maneuver beyond repeater stop limits with gyros "norm" and with balloon attached to spacecraft. Haze layer extincted.
MP	02:28:53	04:26:10	Free	02:30:09	02:38:01	
			Caged	02:38:01	02:55:02	Took Xylose pill. Took photographs of sunrise, observed particles.
			Normal	02:55:02	02:55:24	
			Caged	02:55:24	02:57:38	
			Normal	02:57:38	03:11:39	Drank water, yaw gyro at 250 repeater stop (03:06:00) wobulator check.
			Caged	03:11:39	04:25:53	Started drifting flight at 03:12:00, attempted to jettison balloon. Zero-g and autokinesis experiments, particle observation, horizon photographs, sunset observations, drank water, photometer readings of stars, calibrated exercise. Haze layer observations, occluded stars. Held attitude on moon at 04:12:30. Sunrise and parti-

[a]Se[illegible] at end of table.

TABLE 7.2.3-1. - Continued.

Control mode[a]	Time from launch From	Time from launch To	Gyro switch position Position	Gyro switch position From	Gyro switch position To	Maneuvering, flight activities
						observations and photographs. Stopped drifting flight at 04:18:00. Onboard equipment stowage.
MP	02:28:53	04:26:10	Normal	04:25:53	04:27:53	
ASCS	04:26:10	04:26:26				ASCS gyros run down (RSCS - ASCS switch in Rate Command position) dropped into orientation mode for 16 seconds. Reported ASCS problem.
FBW & MP	04:26:26	04:27:10				Used FBW high thrusters.
Aux Damp	04:27:10	04:27:51				Reported window and gyro indications not in agreement and rate of descent indication at 10-12 ft/sec.
FBW & MP	04:27:51	04:28:37	Caged	04:27:53	04:30:33	Retrograde checklist.
FBW	04:28:37	04:29:41				Used high FBW thrusters.
ASCS	04:29:41	04:29:45				Went to ASCS normal with gyros caged. Stowed equipment.
FBW MP	04:29:45 04:29:57	04:29:57 04:31:23	Normal	04:30:33	04:32:06	Astronaut decided to control retrofire by using FBW control mode. Checked FBW and MP control modes.
ASCS	04:31:23	04:32:02				Rechecked ASCS control mode.
FBW & MP	04:32:02	04:32:43	Free	04:32:06	04:34:09	Retroattitude command - 04:32:06

[a] See key at end of table

TABLE 7.2.3-1.- Concluded.

Control mode[a]	Time from launch From	Time from launch To	Gyro switch position Position	Gyro switch position From	Gyro switch position To	Maneuvering, flight activities
ASCS	04:32:43	04:32:50				Checked orientation mode per ground request. Disliked orientation attitudes. Pitched to a minus 15 gyro attitude and held during the retrofire period. Retroattitude switch in bypass. Yaw and roll gyro indications held at approximately +20° each axis. Retrofire time - 04:33:21.03 (initiated manually by astronaut, retrofire 3 sec late).
FBW & MP	04:32:50	04:33:53	Normal	04:34:09	04:37:56	
			Caged	04:37:56	04:38:00	Used high FBW thrusters. On 250° yaw repeater stop at 04:35:00. Out of manual fuel. Terrain observations. Off yaw repeater stop at 04:40:55. Inserted 4.5°/sec CCW roll at 04:44:55.
			Normal	04:38:00	04:40:14	
			Caged	04:40:14	Landing	
Aux. Damp	04:45:04	04:51:48				Aux. damp put in additional CCW roll to 12°/second. Aux. damp held rates to $\pm \frac{1}{2}$ degree until auto fuel depletion at 04:50:00. Yaw rates pegged at 10°/sec at 04:50:21. Pitch rates pegged at 10°/sec at 04:50:31. Drogue at 04:50:54. Astronaut deployed drogue parachute manually at about 25,000 ft during third small-end-down spacecraft oscillation. Main chute deployed manually 04:51:48. Landing at approximately 04:56:00.

[a] Key:
- ASCS - Automatic stabilization and control system.
- RSCS - Rate stabilization and control system.
- FBW - Fly-by-wire control system.
- MP - Manual proportional control system.
- Aux. Damp. - Auxiliary damping mode of ASCS.

7.3 Aeromedical Studies

The aeromedical studies of the MA-7 mission continued the basic program outlined in previous manned mission reports. The studies are separated into three groups:

1. Clinical examinations: These consist of standard medical procedures, including repeated examinations by physicians; routine and special laboratory tests; X-rays; and special tests, such as retinal photography and tests of the body's balancing mechanism. The pre- and postflight clinical examinations were performed as close together in time as is permitted by recovery operations so as to detect any physical changes resulting from the spaceflight experience.

2. Physiological observations: These consist of data gathered by the sensor systems adapted to both the spacecraft and the pilot. Since the pilot's physiological responses cannot be completely separated from his environment, the discussion in Section 5.2 regarding the environmental control system complements the aeromedical studies.

3. Inflight observations: These are a report of the aeromedical experiments and other pertinent observations that relate to body functions in the space environment.

The preflight aeromedical studies were conducted in order to ascertain the astronaut's state of health and his medical fitness as pertains to the completion of an orbital flight mission. The accumulation of such data before the flight familiarized the aeromedical monitors with the astronaut's normal physiological responses. Following the flight, the biomedical data were analyzed to discover any effects of such a spaceflight.

7.3.1 Clinical examinations.- Clinical observations were accomplished through several medical examinations and before most of the preflight activities listed in table 7.3.1-1. Previous annual physical examinations and the pilot's medical records were reviewed.

7.3.1.1 Clinical history: The aeromedical history of the MA-7 mission began on April 30, 1962, with the astronaut's arrival at Cape Canaveral for preflight preparations. A summary of his activities from this date until his return to Cape Canaveral following the flight is presented in table 7.3.1-1. Throughout this period, his physical and mental health remained excellent. A special diet was used for

19 days before the flight. Re-scheduling of the launch date caused two starts on the low residue diet before the final diet began. The pilot maintained his physical condition through daily workouts on a trampoline and distance running.

On the morning of the flight, the pilot was free of medical complaints, mentally composed and ready for the mission. Breakfast consisted of filet mignon, poached eggs, strained orange juice, toast and coffee. The events of the aeromedical countdown are presented in table 7.3.1.1-1. The preflight fluid intake consisted of 1050 cc of water and sweetened ice tea. He voided three times before launch.

After landing, the astronaut stated, "My status was very good, but I was tired." The fatigue at landing is normal and attributable to the heat load associated with the elevated suit temperature and humidity, the activity required to carry out the flight plan, and the emotional stress associated with a flight. Several postlanding events also contributed to his fatigue. After entering the raft, he recognized that it was upside down. He left the raft, held to the spacecraft, righted the raft and once again climbed aboard. His neck dam was still stowed, and he deployed it with difficulty after his second entry into the raft. An undetermined, but moderate quantity of water had entered his pressure suit.

Astronaut Carpenter drank water and ate food from his survival kit during the three-hour period awaiting helicopter pickup.

Throughout the debriefing period he talked logically about his spaceflight experiences and remained alert.

7.3.1.2 Physical examinations: Abbreviated physical examinations were accomplished prior to most of the planned activities in the prelaunch period. These revealed no variations from previous examinations. Later the aeromedical debriefing team, representing the specialties of internal medicine, neurology, ophthalmology, aviation medicine, psychiatry, radiology and clinical laboratory conducted the comprehensive medical examination. This included the special labyrinthine studies (a modified caloric test and the balance test on successively more narrow rails), electrocardiogram, electroencephalogram and audiogram. The astronaut was in excellent health and showed no significant change from previous examinations.

On the night prior to flight, the pilot obtained approximately three hours of sound sleep. No sedative was required. He was given the preflight examination by the same specialists in aviation medicine, internal medicine and neuropsychiatry. He had an entirely normal mental status. A tabulation of the pre- and postlaunch physical findings is noted in table 7.3.1.2-1.

After a three-hour period in the life raft, the astronaut was examined in the helicopter. The physician reported as follows: "He pulled the tight rubber collar from his neck and cut a hole in his rubber pressure suit sock (left) to drain out sea water. He was anxious to talk and to discuss his experiences, and was cooperative and well controlled. He talked with the helicopter pilot, paced about a bit, and finally relaxed as one normally would after an extended mental and physical exercise." The physical examination aboard the aircraft carrier revealed that he was in good health. Concerning his arrival at Grand Turk Island, the internist member of the debriefing team stated, "He entered the dispensary with the air and the greeting of a man who had been away from his friends for a long time. He was alert, desiring to tell of his adventure and seemed very fit...his appearance and movements suggested strength and excellent neuromuscular coordination." A brief medical examination was undertaken about an hour after the pilot's arrival. The following morning, the comprehensive examination was made by the same group of specialists who had examined him on May 17, 1962. The postflight modified caloric test on May 25 revealed an approximate 1.4°C rise in threshold temperature in the right ear and 1.8°C in the left. The rail tests of dynamic and static equilibrium showed a moderate postflight increase of the pilot's ability to stand with his eyes closed. The significance of these pre- and postflight differences is unknown. The aeromedical debriefing was completed on the second morning following the flight. The results of these examinations are presented in tables 7.3.1.2-1 and 7.3.1.2-2. A mild asymptomatic urethritis was present both pre- and postflight. Treatment was withheld until after the flight. The small postflight rise in hematocrit, coupled with a six-pound weight loss, suggests mild dehydration; however, this did not jeopardize the pilot's health.

Aside from moderate fatigue, based upon the long hours of work and but a few hours sleep, the astronaut remained in excellent health throughout the debriefing period. He returned to Cape Canaveral on May 27, 1962, ready to "do it again."

7.3.2 Physiological data.- Physiological data sources for MA-7 were the same as those reported in previous Mercury manned flights. Data from the Mercury-Atlas three-orbit centrifuge simulation; preflight pad activities, when spacecraft power was available; and the countdown serve for comparison with flight data. The reports from the range medical monitors, the onboard continuous biosensor records, the voice transmissions, and the pilot-observer camera are essential sources. Results of special inflight tests and the debriefing provided additional information.

7.3.2.1 Biosensor system: The biosensor system consists of two sets of electrocardiographic leads, ECG I (axillary) and ECG II (sternal); a rectal temperature thermistor; a respiration rate thermistor; and the blood pressure measuring system (BPMS).

The only biosensor change from MA-6 was the replacement of the manual BPMS with a semi-automatic system. The BPMS is a device for indirect measurement of arterial pressure utilizing the same principle as in clinical sphygmomanometry. In the BPMS, a similar inflatable cuff is employed, with the stethoscope of the clinical method replaced by a microphone positioned under the cuff. The microphone signal exits from the suit through the bioconnector and enters the amplifier in the blood-pressure unit. The BPMS amplifier consists of a shielded preamplifier and two high-gain amplifiers which determine the response characteristics. Each amplifier is designed to have greatly attenuated response outside the 32 to 40 cps pass band by means of resistor-capacitor filtering circuits in each feedback loop. The amplifier output is gated so that unless a signal of sufficient amplitude is present, there is no output signal, and this gating results in a marked reduction in the output noise level for improved readability of the signal. The amplifier is contained in the BPMS controller unit, which also includes the pressure transducer and its batteries, the voltage regulator, and associated mixing and limiting circuits. This system is actuated by manually depressing a switch on the spacecraft instrument panel which initiates the complete 118-second cycle. The cycle includes switching the telemetry channel from ECG II to the BPMS, cuff pressurization and bleed down over a 30-second period, and return of the telemetry to ECG II. The system contains a pressurized oxygen source, with regulator, for cuff inflation and an orifice which relieves the cuff pressure into the suit circuit. The blood-pressure transmitting and recording procedure was the same as that in MA-6. In order to find the arterial pressure, it is necessary to identify the points of inception and cessation of the microphone signal on the cuff pressure signal, which are the systolic and diastolic pressures.

All sensors operated normally during the countdown except the BPMS. At T-34 minutes, three cycles of the BPMS demonstrated intermittency of the microphone, and these values are not included in the data presented. The BPMS cycles near lift-off were normal. Of 24 inflight BPMS cycles obtained from the onboard tape, 6 were easily read, 14 were difficult to read, and 4 were unreadable. One factor in the wide variation of data legibility was the sporadic intermittency of the michrophone throughout the flight. During the open circuit periods, no pulses were transmitted, but the nature of the malfunction is believed not to have affected the data received with regard to the pulse pressure amplitude. Many traces were atypical, as shown in figure 7.3.2.1-2. The pulses indicating systole showed erratic variation in amplitude. This made interpretation of the systolic values difficult; however, the diastolic values were readily obtained. Elevated systolic pressure during the flight may have produced the unusual traces. This cannot be confirmed because these readings are the highest observed with the BPMS in the spacecraft.

The unusual inflight data dictated the need for postflight evaluation of the BPMS. Only the controller unit was available for testing, and this was removed from the spacecraft after the flight. Tests were conducted on subjects in the altitude chamber at sea level and at 27,000 feet (cabin altitude). No adjustments were changed on the flight unit in the initial test series, and an effort was made to duplicate flight conditions. The unit was cycled, and simultaneous blood pressure determinations were made using the usual clinical method for comparison. Readings during fist clenching, arm movements, loose cuff, and rotated cuff were accomplished. The unusual pattern of inflight pulse amplitudes could not be duplicated. The correlation with the clinical readings was generally good, and no malfunctions were detected in the controller unit.

Next, the gain of the pulse amplifier was widely varied. Readings obtained at the various gain settings showed reasonably normal behavior. The BPMS was then moved to the laboratory, and a second test series was begun. The unit operated within the specification limits in spite of its period of immersion in sea water. The postflight calibration of the pressure transducer showed no change. At this point, the system seemed to have performed satisfactorily during the flight, and the inflight data appeared valid. However, these first two series of tests were believed to be inconclusive with regard to the effects of amplifier gain settings and artery-microphone coupling, and to better define the adjustment, calibration, and operation of the BPMS, a third series of tests was initiated. This test series is continuing and will isolate system components and operating procedures to determine their relevance to the level of data obtained. In addition, a more detailed investigation, using spacecraft components, of the correlation between BPMS and clinical readings will be conducted.

During the flight, body movements and profuse perspiration caused a large number of ECG artifacts, but the record was interpretable throughout.

The unstable body temperature readout is believed to be the result of erratic behavior of the amplifier from 59 minutes to 2-1/2 hours after launch, approximately one-third of the flight. This erratic period is shown as a shaded area in figure 7.3.2.3-1. The values at all other times are considered valid.

The respiration rate sensor provided useful preflight information, but inflight coverage was minimal.

The pilot-observer camera film was of poor technical quality resulting from its postlanding immersion in sea water, and it was therefore of limited usefulness. One of the better quality frames is reproduced in figure 5.7.2-1.

7.3.2.2 Preflight physiological data: The preflight activities monitored for MA-7, together with time durations, are listed in the table below:

Pad test monitoring

Event	Duration
1. Simulated launch, MA-6, January 17, 1962	5 hours 12 minutes
2. Simulated flight no. 2, April 30, 1962	4 hours 0 minutes
3. Simulated launch, MA-7, May 10, 1962	3 hours 15 minutes
4. Simulated flight no. 3, May 15, 1962	4 hours 50 minutes
5. Launch countdown, MA-7, May 24, 1962	3 hours 1 minute
Total:	20 hours 18 minutes

Figure 7.3.2.2-1 depicts the respiration rate, heart rate, blood pressure, body temperature and suit-inlet temperature recorded during the MA-7 launch countdown. Values for the same physiological functions obtained from simulated launches are also shown plotted coincident with significant events. Heart and respiration minute rates were obtained by counting for 30 seconds every 3 minutes until 10 minutes before lift-off, at which time counts were made for thirty seconds every minute. All values recorded are within physiologically acceptable ranges.

Examination of the ECG wave form from all preflight data revealed normal sinus arrhythmia (variation in rate), occasional premature atrial contractions (early beats from normal excitation area) and rare premature ventricular contractions (early beats from an excitation area lower in the cardiac musculature). These are normal variations. A sample of the blockhouse record at T-68 (5:52 a.m., e.s.t.) with a normal, adequate blood pressure trace is shown in figure 7.3.2.1-1.

During approximately 50 minutes in the transfer van on launch day, the astronaut's heart rate varied from 56 to 70 beats/minute, with a mean of 65. Respiration rate varied from 8 to 20 cycles/minute, with a mean of 14. The ECG was normal. Additional physiological values were not obtained.

7.3.2.3 Flight physiological data: Figure 7.3.2.3-1 depicts the respiration rate, heart rate, blood pressure, body temperature and suit-inlet temperature during the flight, with values from the Mercury-Atlas, three-orbit centrifuge simulation presented and correlated with flight events.

A summary of heart rate, respiration rate and body temperature is presented in the following table:

Data sources	Heart Rate			Respiration			Body Temperature		
	No. of values	Mean	Range	No. of values	Mean	Range	No. of values	Mean	Range
All preflight data	408	57	42-84	354	15	5-32	128	99.3	98.3-101.5
Countdown	92	62	50-84	75	15	6-26	57	97.8	96.8-98.2
Flight									
launch	7	87	82-96	5	16	10-20	4	98	98
orbital	94	70	60-94	not obtained			60	99.9	98-100.6
entry	115	84	72-104	not obtained			15	100.4	100.2-100.5

The heart rate increased from 84 to the maximum of 96 beats/minute between lift-off and T+30 seconds. This was not associated with maximum acceleration. The orbital phase resulted in a weightless period of 4 hours and 30 minutes. The highest heart rate during the entry phase was 104 beats/minute. This occurred immediately following the highly oscillatory period just after reentry. All heart rates are within accepted ranges.

The inflight blood-pressure data fall into four legibility categories and are summarized in table 7.3.2.3-1. Category I denotes values which are clearly readable. Category II denotes values for which diastole is easily readable, but systole can only be determined with difficulty because of the variation in pulse amplitude. Category III denotes values for which diastole is legible, but determination of systole is questionable. The fourth category is denoted by the times for which no values are recorded and contains the cycles in which the broken microphone wire resulted in few or no pulses being transmitted.

The apparent inflight systolic elevation with a resultant increased pulse pressure is a distinct change from the preflight values, as is evident in the summary of mission blood pressure data, table 7.3.2.3-2. There are three possible explanations for this finding. First, the data may be entirely valid. Second, a mechanical malfunction may have occurred during the flight, which would remove all confidence in the data. And third, the BPMS may have operated properly, but uncertainties in the reduction of inflight data to analytical blood pressure information may be present. These involve a number of system parameters and analytical procedures, notably the effect of amplifier gain on system output, the effect of amplifier saturation, the correlation of sea-level performance with that derived in an orbital environment, the coupling characteristics between the microphone and the cuff, and finally the correct calibration profile between BPMS data and clinically measured blood pressures. These factors are being studied on a continuing basis, and the results of a comprehensive test series will be forthcoming.

If the data are found to be valid, the increased pulse pressure unaccompanied by a change in heart rate indicates one means of increasing cardiac output. An increased cardiac output might occur with overheating, heavy perspiration, exercise, psychological stress (especially with an increased adrenaline output), body positional changes, or in general any orbital flight experiences which deviate from normal activity. The usual response to these stresses is an increase in both pulse pressure and heart rate. However, variations from this means of increasing cardiac output are not uncommon, particularly since they are subject-dependent. The blood pressure data from the MA-6 mission, where the inflight heat stress was not as severe, showed a less marked trend toward increased pulse pressure.

The possibility still exists that a malfunction of the equipment occurred during the flight, although no source of such an occurrence has been detected in postflight testing. Investigations in this regard are continuing. The present explanation for the blood pressure findings is believed to be physiological; however, comprehensive testing to be conducted will either more precisely define the magnitude and confidence level of the inflight data or reveal a major anomaly in the operation of the system which would totally invalidate these data.

Examination of the ECG wave form recorded during the flight showed an entirely normal record except for the variations noted below. There was a single premature atrial contraction (PAC) 13 seconds after sustainer engine cutoff. This was followed by a beat showing suppression of the sinus pacemaker. A second PAC occurred one minute and fifteen seconds before retrofire. At 04:48:19, 21 seconds prior to maximum reentry acceleration, a 43-second period contained a number of cardiac events. This began with a PAC, followed by suppression of the sinus pacemaker and then a normal beat. Twelve seconds later, there was a PAC followed by an aberrant QRS, a compensatory pause, and then a normal beat. Twelve seconds following this there was a third PAC with aberrant conduction followed by a normal cycle. A fourth PAC occurred five seconds later with a less aberrant complex. An atrial fusion beat followed. After 3 normal beats, there were 2 sets of nodal beats. The first set contained 4 nodal beats followed by 3 normal beats. The second contained 5 nodal beats. The remainder of the record was entirely normal. During the period of maximum entry acceleration, the astronaut made a special effort to continue talking. The increased respiratory effort associated with continued speech could have produced these changes. These irregularities did not compromise effective performance. Figure 7.3.2.3-2 illustrates the appearance of physiological data from the onboard tape after one minute of weightlessness. Figure 7.3.2.3-3 shows the physiological data with the premature atrial contraction at 04:32:06 mission elapsed time.

The pilot stated that he was comfortable and could not believe the telemetered body temperature of 102°F. This onboard assessment was helpful in the determination of the significance of these readings. The values in question are shown as a shaded area in figure 7.3.2.3-1, but they are not included in the table above. The 2.6°F. overall increase in body temperature is physiologically tolerable and is believed to have resulted in part from an increased suit-inlet temperature. The trend of gradually increasing body temperature has been observed in previous manned flights.

7.3.3 Mission observations.- The following items rendered the MA-7 mission different from that of MA-6:

1. Bite size food cubes carried in a non-rigid container were included, instead of semi-solid foods in collapsible tubes.

2. The 5.0 gram xylose tablet was taken orally after 2 hours and 36 minutes of exposure to zero g, rather than at the beginning of flight.

3. Water was consumed several times during the flight.

4. Moderate overheating was a factor during the flight, whereas postflight environmental heat stress was present in MA-6.

5. Food and water were consumed during the 3-hour postflight survival experience.

Overall, the astronaut stated that he had anticipated greater physical stress during the flight than was experienced. Weightlessness was a pleasant experience and reminded him of his sensations while skin diving. He oriented rapidly to his new environment. To test vestibular sensitivity, he performed rather violent head maneuvers on several occasions while weightless. These movements caused no disorientation or vertigo. He also moved his head during roll maneuvers and noted no Coriolis effect. Often he had no positional reference, but lack of such reference did not confuse him.

The pilot experienced a momentary illusion involving his position in relation to the special equipment storage kit. At one time when sitting upright in orbit attitude, he was surprised to see that the equipment kit was vertical with respect to the horizon. During mission simulations in the procedures trainer, the equipment kit had always been parallel to the horizon. This illusion was very brief and caused the pilot no subsequent difficulty in the operation of the spacecraft.

Vision and hearing were normal. He readily estimated distances by relative size of objects. Colors and brightness of objects were normal. Tactile approximation, with eyes closed, was unchanged from that experienced in the ground environment. He reported no tendency to over- or undershoot in reaching spacecraft controls.

He felt that bladder sensation was normal while weightless, although he is not certain that he urinated during the flight. He had no urge to defecate. The pilot did not feel tired or sleepy during the flight. He stated that he was frustrated by the stress of time and his inability to control suit temperature. He reported that he was hot from the end of the first orbital pass until the middle of the third pass. Environmental control system readouts confirm this subjective evaluation. He experienced no other heat stress. He used no medications at any time during the mission.

During the flight the pilot consumed solid food, water, and a xylose tablet without difficulty. Once the food was in his mouth, chewing and swallowing were normal. Taste and smell were normal. The solid food was in the form of 3/4-inch cubes with a special coating, packed in a plastic bag, and stored in the equipment kit. Some of the food cubes had crumbled, and the pilot reported that the resulting particles were an aspiration hazard (the crumbling of the food probably occurred prior to or during launch). The elevated cabin temperature caused the chocolate to melt. 1213 cc of water were consumed from the mission water supply, of which approximately 60 percent was consumed inflight, and the remainder was drunk by the astronaut after landing. The xylose experiment was unsuccessful on this flight because of the indefinite time of urination.

Calibrated exercise was performed without difficulty at 03:59:29 ground elapsed time. Because of the overheated condition of the pilot, an earlier scheduled exercise was omitted. A bungee cord with a 16-pound pull through a distance of 6 inches was used. Use of this exerciser caused an increase in heart rate of 12 beats/minute, with a return to previous values within one minute. The blood pressures taken at this time could not be interpreted. This response demonstrated the ability of nominal exercise to elevate the pilot's heart rate. This pulse response to exercise was evidence of a reactive cardiovascular system.

Attempts to produce autokinesis (illusion of vision due to involuntary eye muscle movements) were made on two occasions. Autokinesis was not produced, but the tests were inconclusive.

7.3.4 Conclusions.-

1. The postflight clinical examinations of Astronaut M. Scott Carpenter reveal no significant change from the preflight findings.

2. Aspiration of the crumbled food presents a danger to the astronaut.

3. The inflight pilot responses were within acceptable physiological ranges except for the possible elevation of systolic blood pressure. No compromise of pilot performance was noted. Blood pressure measurements should be obtained on future flights.to allow a more precise determination of the significance of these pressures.

4. The information from the two ECG leads provided invaluable correlation data for blood pressure analysis. The evaluation of any ECG abnormality or artifact requires crosschecking of the two leads.

5. The aberrant ECG tracing during entry was the result of a respiratory maneuver and talking during maximum acceleration.

6. A rapid postlanding pilot-status report is necessary for intelligent use of medical personnel in the recovery forces.

7. Sensory perceptions during the flight, as reported by the astronaut, were normal and equivalent to those under one g.

8. Additional time for remote-site postflight examination and debriefing would be beneficial.

Table 7.3.1-1

MA-7 GENERAL ASTRONAUT ACTIVITIES

Date (1962)	Activity
April 30	Arrived at Cape Canaveral, Simulated Flight, suited
May 2	Procedures Trainer, suited
5	Began Special diet, Aeromedical Feeding Facility
7	Procedures Trainer, suited
9	Procedures Trainer, not suited
10	Simulated Launch (SEDR-170), suited
15	Simulated Flight #3 (SEDR-171), suited
17	Comprehensive Medical Examinations, PAFB Hospital
21	Preflight low residue diet began for third time
23	MA-7 meetings, asleep at 2000 hours
24	Awakened 0115, began Aeromedical Countdown Launch 0745 Recovery Physicians Examination 1530 and 1715 Brief examination, Grand Turk Island 2300
25	Asleep 0230 Awoke 0915 for Aeromedical Debriefing, then Engineering Debriefing
26	Asleep 0045 Awoke 0645 Aeromedical and Engineering Debriefing Skin Diving (3 hours)
27	Asleep 0230 Awoke 0915 Arrived Patrick AFB 1400
28	Departed from Cape Canaveral 1415

Table 7.3.1.1-1

MA-7 Aeromedical Countdown Events

May 24, 1962

Time (e.s.t.)	Activity
0115	Awaken the pilot
0146	Breakfast
0205	Preflight physical examination
0241	Biosensor placement
0304	Don Mercury pressure suit
0325	Pressure suit and biosensor checkout
0340	Hangar S Aeromedical Facility to transfer van
0403	Transfer van to launch pad
0436	Ascend gantry
0443	Astronaut insertion into spacecraft
0745	Lift-off

Table 7.3.1.2-1

PRE- AND POSTFLIGHT MEDICAL FINDINGS

	Patrick AFB, May 17, 1962		May 24, 1962 Preflight, Hgr. S		May 24, 1962 Postflight, USS Intrepid		Grand Turk Island May 25-26, 1962	
Temperature (Oral), °F	97.9		97.4		97.6		97.5	
Pulse rate, beats/min	60		60		76-80		---	
Blood pressure, mm Hg	126/84 RAS[c]		120/78 LAS[d]		116/78 LAS		124/80 LAS	
Respiration, breaths/min	14		12		--		--	
Body weight[a] (nude), lb	151½		154		148		151-3/4	
Extremity measurements[b], Inches	Left	Right	Left	Right	Left	Right	Left	Right
Forearm, maximum	9	8-3/4	10-7/8	11	10-3/4	10-3/4	10-1/4	10-5/8
Forearm, minimum	7	6-7/8	6-3/4	6-5/8	6-5/8	6-1/2	6-3/4	6-3/4
Calf, maximum	12-7/8	13-1/4	13-3/4	13	13	13-1/4	13-3/8	13-3/4
Calf, minimum	8	8-3/8	8	7-7/8	7-3/4	7-3/4	8-1/8	8
Comments:	Complete examination was negative; skin clear except for 2 clusters of inclusion cysts at left axillary ECG site; chest X-ray normal.		Fit for flight; alert with appropriate mental status		Moderate erythema at left chest ECG and BP cuff site; normal mental status; chest X-ray fogged - no interpretation.		Minimal erythema as at postflight sites; exam unchanged from May 17th findings, including ECG, EEC, Audiogram, & Chest X-ray.	

Note: Electrocardiograms on May 17 and May 24, 1962, aboard the recovery vessel were normal and unchanged in all respects.

[a]All body weights on different scales.

[b]Extremity measurements by same individual on May 17, May 24 (preflight), and May 25-26, 1962. On may 17, 1962 measurements made 6 and 10 inches below olecranon on forearms, 6 and 11 inches below patella on legs. All other measurements are maxima and minima.

[c]RAS - Right arm sitting
[d]LAS - Left arm sitting

TABLE 7.3.1.2-2.- MA-7 ASTRONAUT LABORATORY VALUES

Peripheral Blood				
	Preflight		Postflight	
Determination	-7 Days	-2 Days	0015 May 25, 1962	1200 May 26, 1962
Hemoglobin, g, (Cyanmethemoglobin Method)	15.0	13.8	16.0	14.8
Hematocrit, percent	47	42	50	46
White Blood Cells, per mm^3	12,700	11,600	12,500	11,900
Red Blood Cells, Millions per mm^3	5.2	--	5.6	5.2
Differential Blood Count, percent				
Lymphocytes	25	19	27	37
Neutrophiles	71	79	65	58
Monocytes	2	1	3	2
Eosinophiles	2	1	4	2
Basophiles	0	0	1	1

Table 7.3.1.2-2 (continued)

MA-7 Urine Summary *					
Sample Date (all May 1962)	Volume cc	Specific Gravity	pH	Albumin	Microscopic
1215 - 17	250	1.024	5.0	Trace	20-30 WBC/hpf, occasional hyaline casts, occasional RBC/hpf, squamous epithelial cells
1340 - 22	-	1.015	6.0	Negative	Occasional WBC, occasional epithelial cells, rare RBC
Inflight Final urination on water. Exact time unknown, but after egress from spacecraft.	2360	1.003	5.0	Trace	20-25 WBC/hpf, no RBC, no casts
1700 - 24	155	1.013	5.0	30 mg	Some clumps of WBC/lpf 20-25 WBC/hpf, no RBC, no casts
0605** - 25	140	1.016	5.0	Trace	15-20 WBC/hpf, no RBC, no casts
0925 - 25	140	1.016	5.0	Trace	10-15 WBC/hpf, no RBC, no casts
1435 - 25	215	1.024	5.0	Trace	3-5 WBC/hpf, no clumps in lpf, no RBC, no casts
1830 - 25	305	1.021	5.0	Trace	15-20 WBC/lpf, few mucous threads, 1-3 WBC/hpf
0030 - 26	89)	1.005	5.0	Negative	8-12 WBC/hpf, occasional small WBC clusters
0220 - 26	310	1.019	6.0	Trace	Large amount of amorphous urates
0700 - 26	550	1.009	5.0	Negative	10-15 WBC/hpf, small amount of mucous, occasional small cluster of WBC
0945 - 26	310	1.014	5.0	Negative	4-8 WBC/hpf, occasional small WBC cluster, small amount of mucous

* All samples are negative for glucose, ketones, and bile.

** This sample was divided into 3 fractions at collection. Microscopic was immediately done. Only the first fraction showed the presence of appreciable WBC/hpf. Samples 2 and 3 showed 2-3 WBC/hpf. No other formed bodies were noted.

TABLE 7.3.2.3-1.- SUMMARY OF INFLIGHT BLOOD PRESSURE MEASUREMENTS

Legibility Category	Mission elapsed time	Blood Pressure mm/Hg	Pulse Pressure	Legibility Category	Mission Elapsed time	Pressure mm/Hg	Pulse Pressure
I	00:16:07	182/70	112	I	02:25:35	196/54	142
II	00:20:50	164/69	95	II	02:33:27	182/62	120
II	00:24:13	212/69	143	I	02:44:28	196/60	136
III	00:50:10	197/69	128		02:54:38	-	-
III	00:53:21	? /64	-		03:02:47	-	-
III	01:30:40	162/64	98	I	03:15:24	202/54	148
II	01:35:07	182/60	122	II	03:30:56	188/64	124
I	01:43:10	174/60	114	II	03:34:25	214/56	158
I	01:51:03	194/70	124	II	03:49:02	220+/60	160
II	01:56:47	202/54	148		03:58:01	-	-
II	02:04:38	212/62	150		04:00:06	-	-
III	02:10:20	153/56	97	III	04:07:50	? /74	-

NOTE: The reader is referred to paragraph 7.3.2.3 (page 7-33) for a discussion of the validity of these data.

TABLE 7.3.2.3-2.- SUMMARY OF BLOOD PRESSURE DATA

Data source	Number of values	Mean blood pressure mm/Hg	standard DeviationX2 Syst	Diast	Systolic range mm/Hg	Diastolic range mm/Hg	Mean pulse pressure
Preflight physical exams	18	119/73	14	15	98-128	58-84	46
3-orbit Mercury-Atlas centrifuge simulation	30	130/83	22	15	104-155	72-106	47
Launch pad tests	45	127/64	31	18	101-149	44-84	63
MA-7 countdown	13	116/63	18	12	105-139	56-70	53
Totals (preflight)	106	125/71	24	14	98-155	44-106	54
Inflight Category I	6	191/62	19	14	174-202	54-71	129
Category II	9	196/62	36	10	164-220	54-69	134
Postflight physical exams	3	115/76	2	9	114-116	70-80	39

7.4 Conclusions

MA-7 capsule systems operation and pilot performance further indicate that long-duration flight should be feasible in the Mercury spacecraft. Longer duration missions will, however, require that control activity be reduced and extended periods of drifting flight be included in the flight plan.

In spite of difficulties with the automatic stabilization and control system, the pilot was able to manually control attitude satisfactorily during retrofire by cross-referencing the window, the gyros, and the periscope. The down-range and cross-range landing errors appear to have largely resulted from an error in capsule attitude during retrofire. The pilot was using fly-by-wire augmented by the manual proportional control mode at this time.

The attitude control problems experienced prior to retrofire reemphasize the need to evaluate system malfunctions when they become evident during the mission.

All physiological data were normal during the flight except the elevated systolic blood pressure and the associated increased pulse pressure. The explanation of this finding is believed to be physiological, although the exact mechanism is not evident at present; however, system malfunctions, yet undetected, and instrumentation calibration error cannot be completely ruled out at this time. Blood pressure studies in this regard are intensively being pursued. No indication of deteriorated inflight pilot performance was observed, and no physical change can be demonstrated during post-flight examination. The astronaut felt less pressure-suit restriction in the zero-gravity environment.

The high rate of fuel consumption resulted from inadvertent use of the high thrusters in the fly-by-wire mode and discrepancies in the procedures for selecting control modes.

CONFIDENTIAL

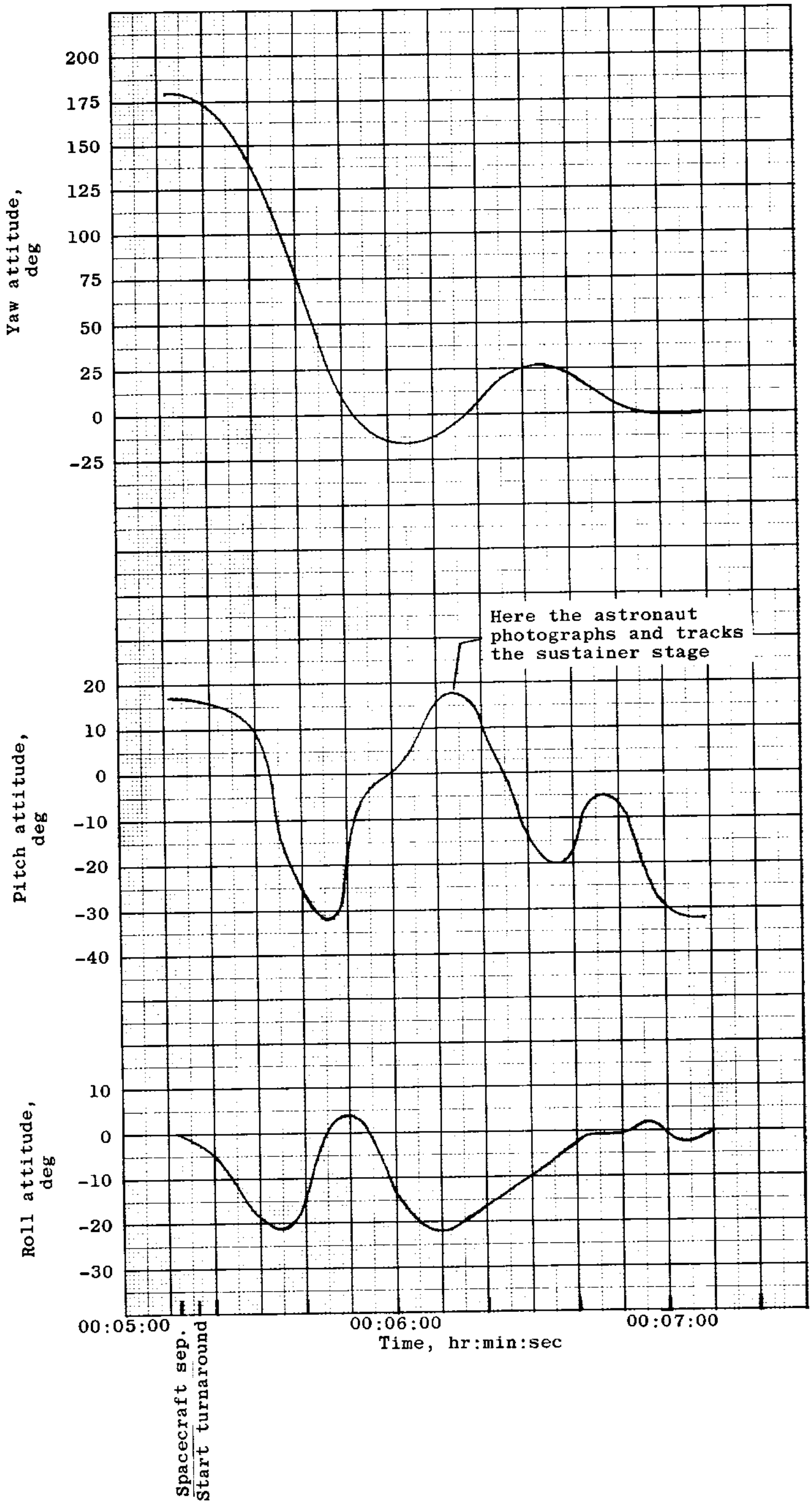


Figure 7.2.3.1-1.- Turnaround maneuver; fly-by-wire control mode, rate and attitude gyro indicator.

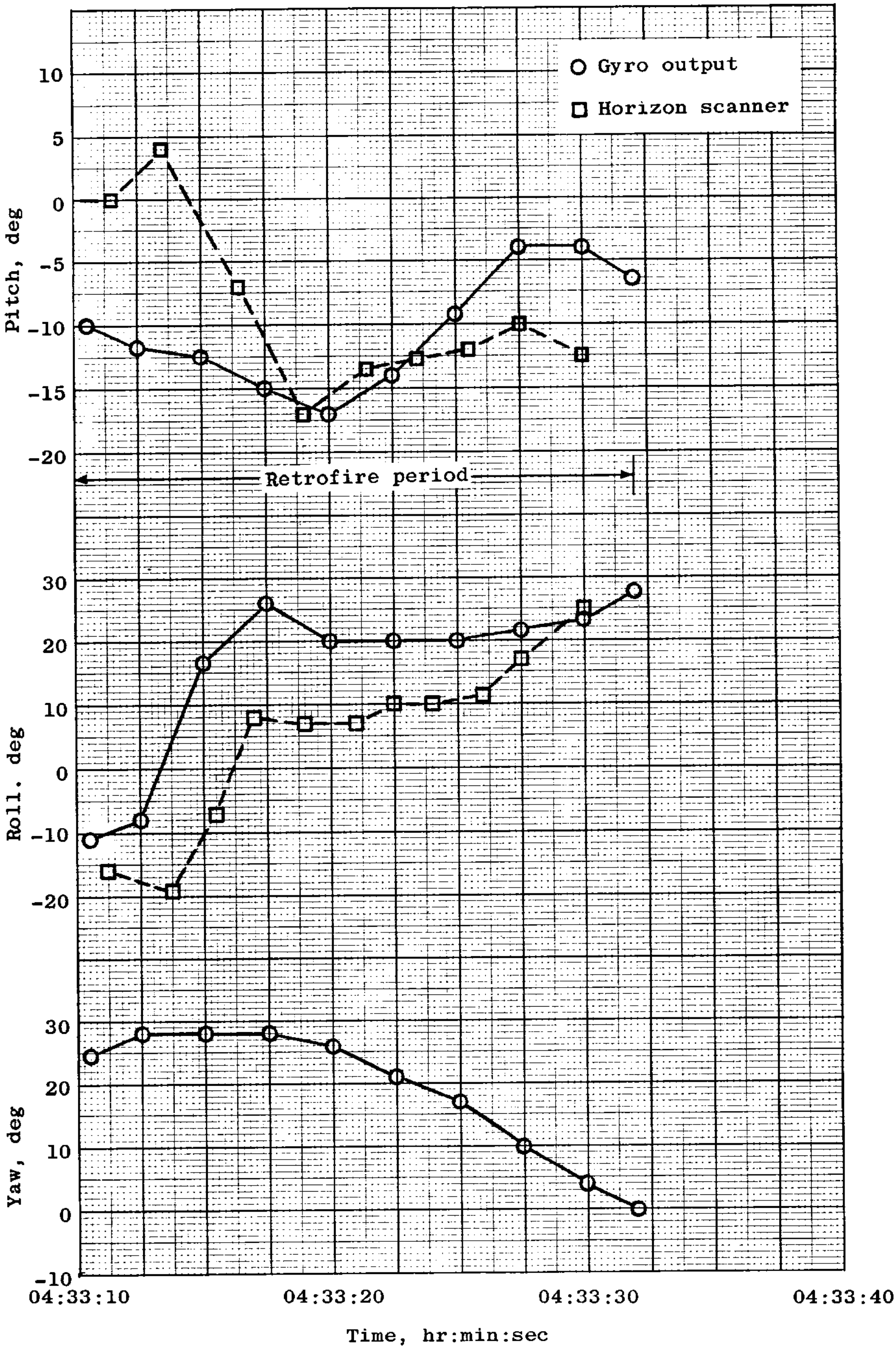


Figure 7.2.3.6-1.- Horizon scanner and gyro output during retrofire period for MA-7.

CONFIDENTIAL

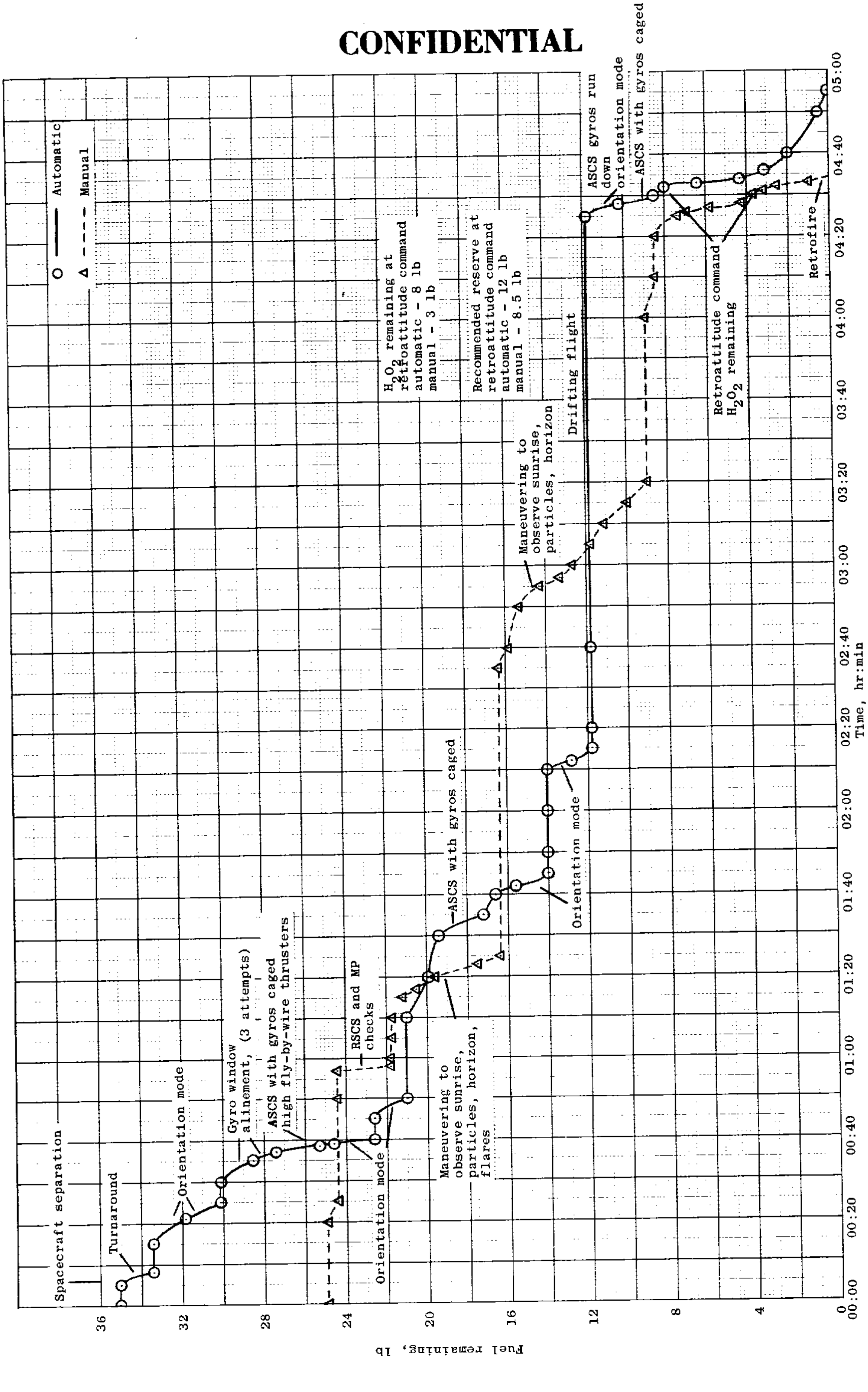


Figure 7.2.3.7-1.- H_2O_2 fuel usage.

CONFIDENTIAL

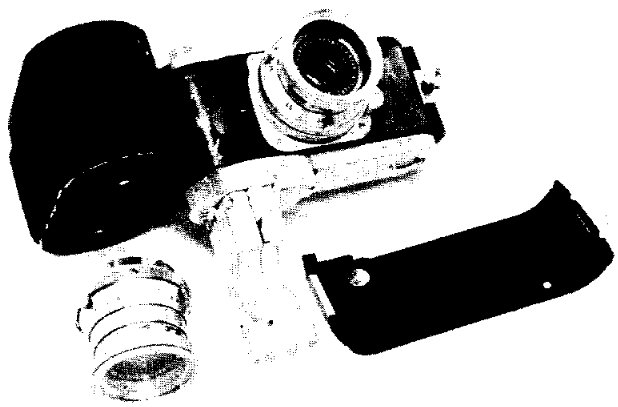


Figure 7.2.4.1-1.- 35mm hand-held camera.

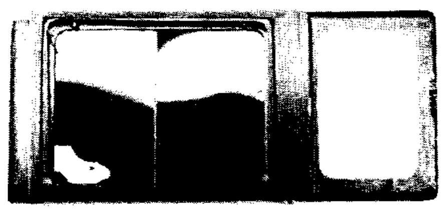


Figure 7.2.4.3-1.- MIT filter mosaic.

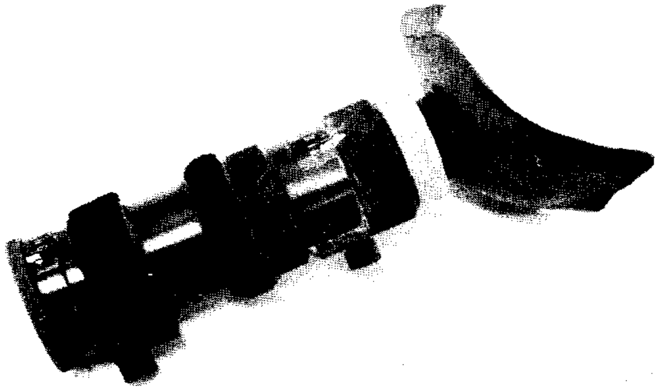


Figure 7.2.4.4-1. Photometer.

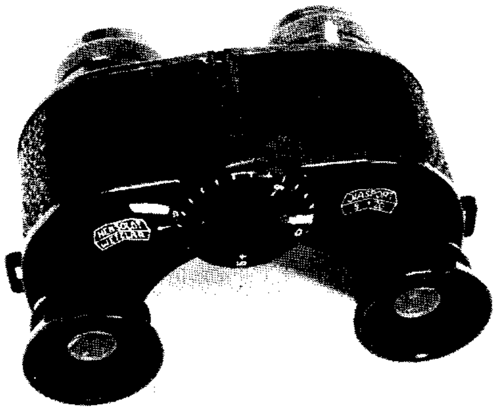


Figure 7.2.4.5-1. Binoculars.

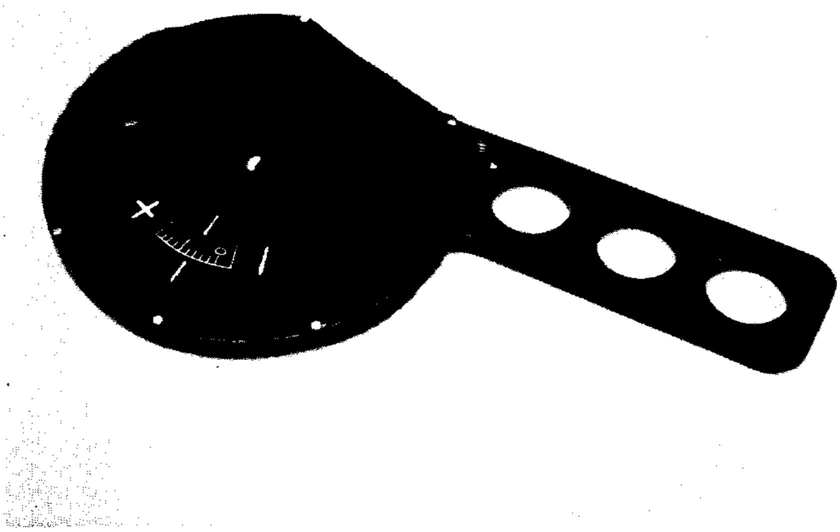


Figure 7.2.4.6-1.- Extinction photometer.

Figure 7.2.4.7-1.- Airglow filter.

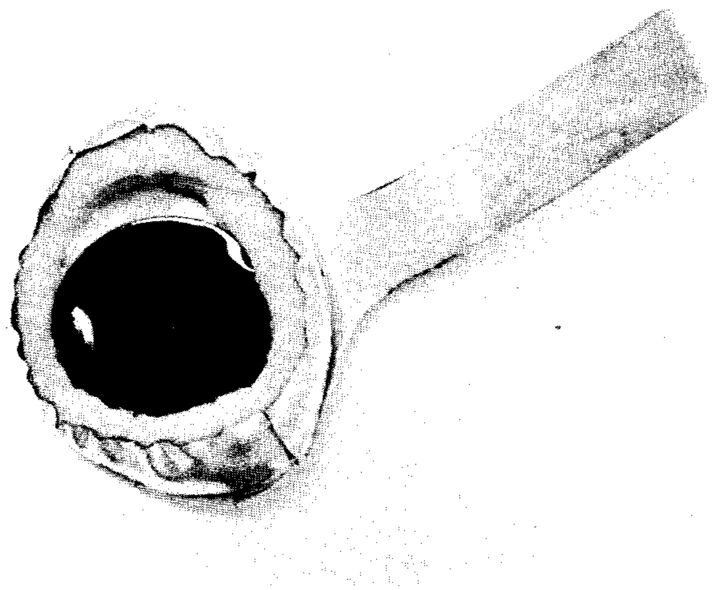


Figure 7.2.4.8-1.- Night adaption eye cover

CONFIDENTIAL

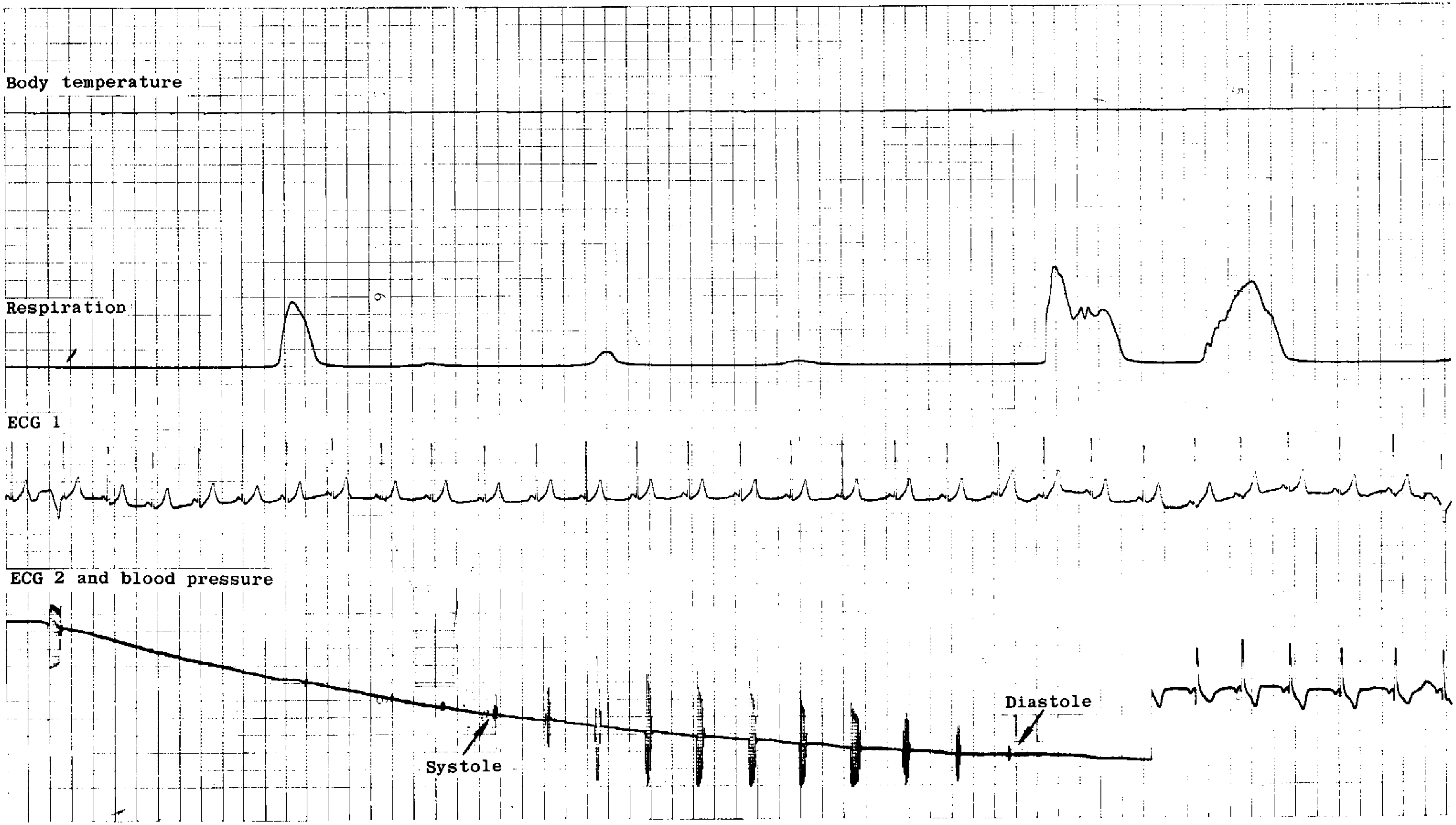


Figure 7.3.2.1-1.- Sample of blockhouse bioinstrumentation record at T-68 minutes, 5:52 a.m., e.s.t., showing an adequate blood pressure trace, value 114/64. Lead 2 is inverted. (Recorder speed 10 mm/sec).

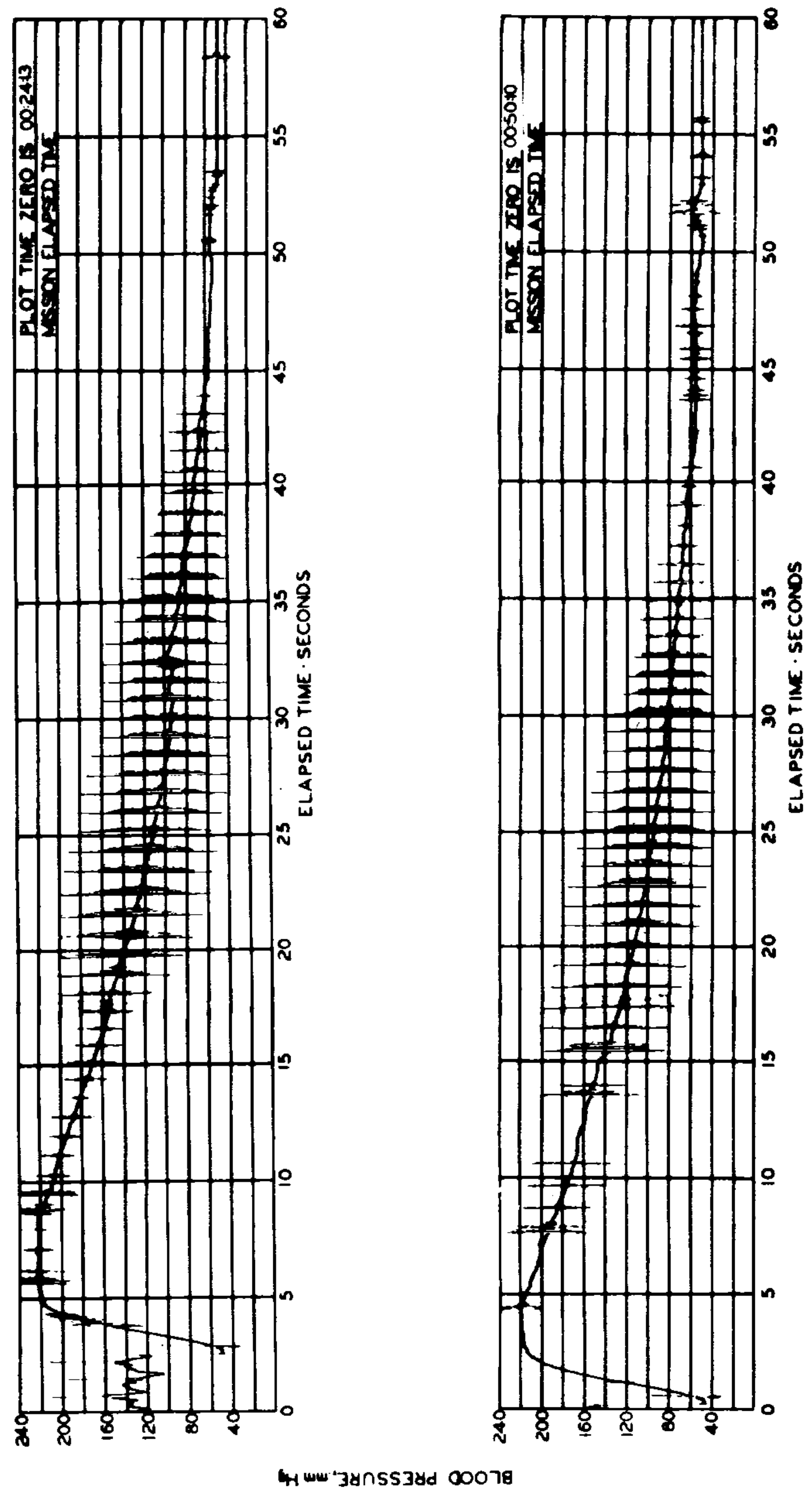
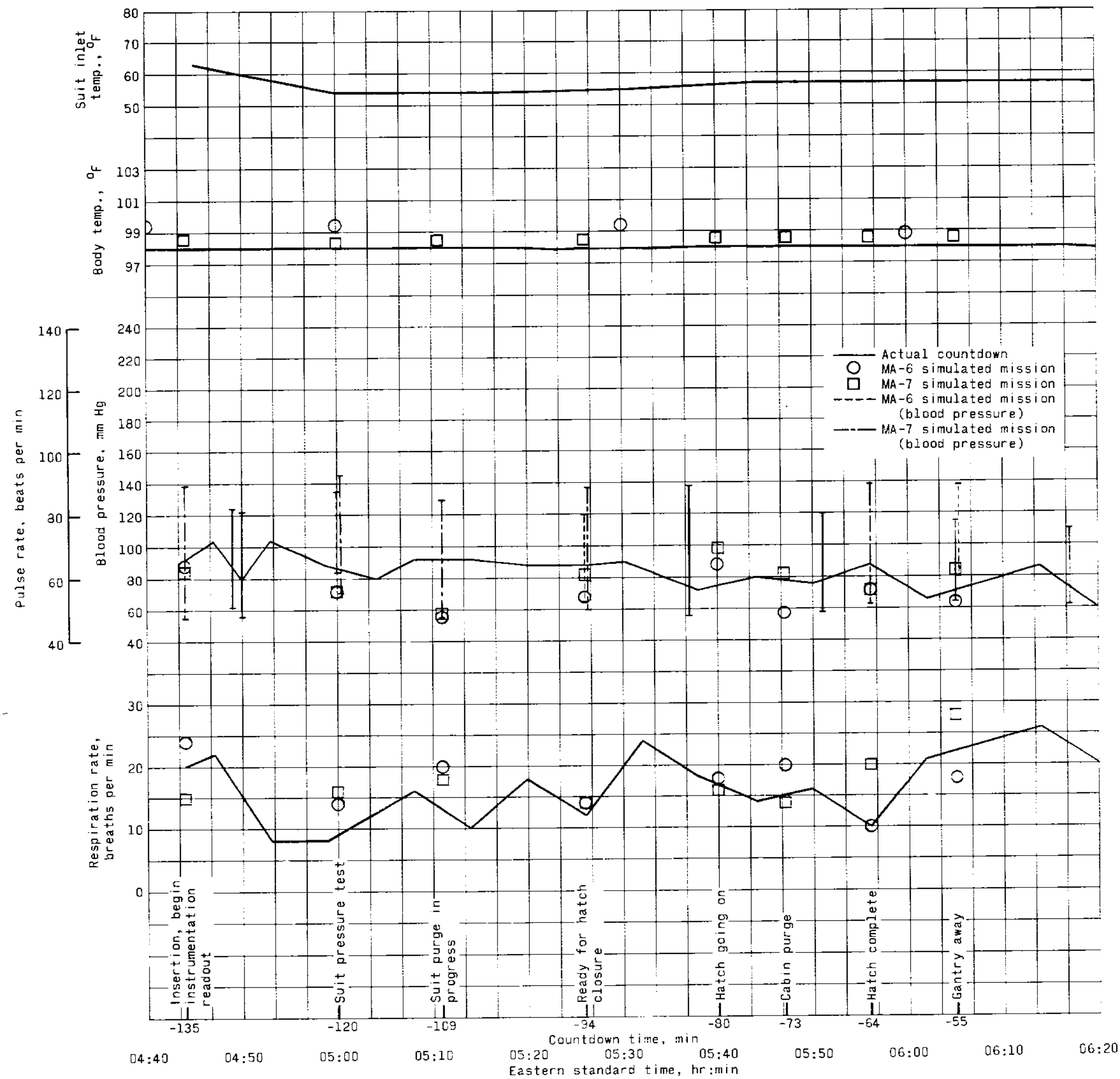
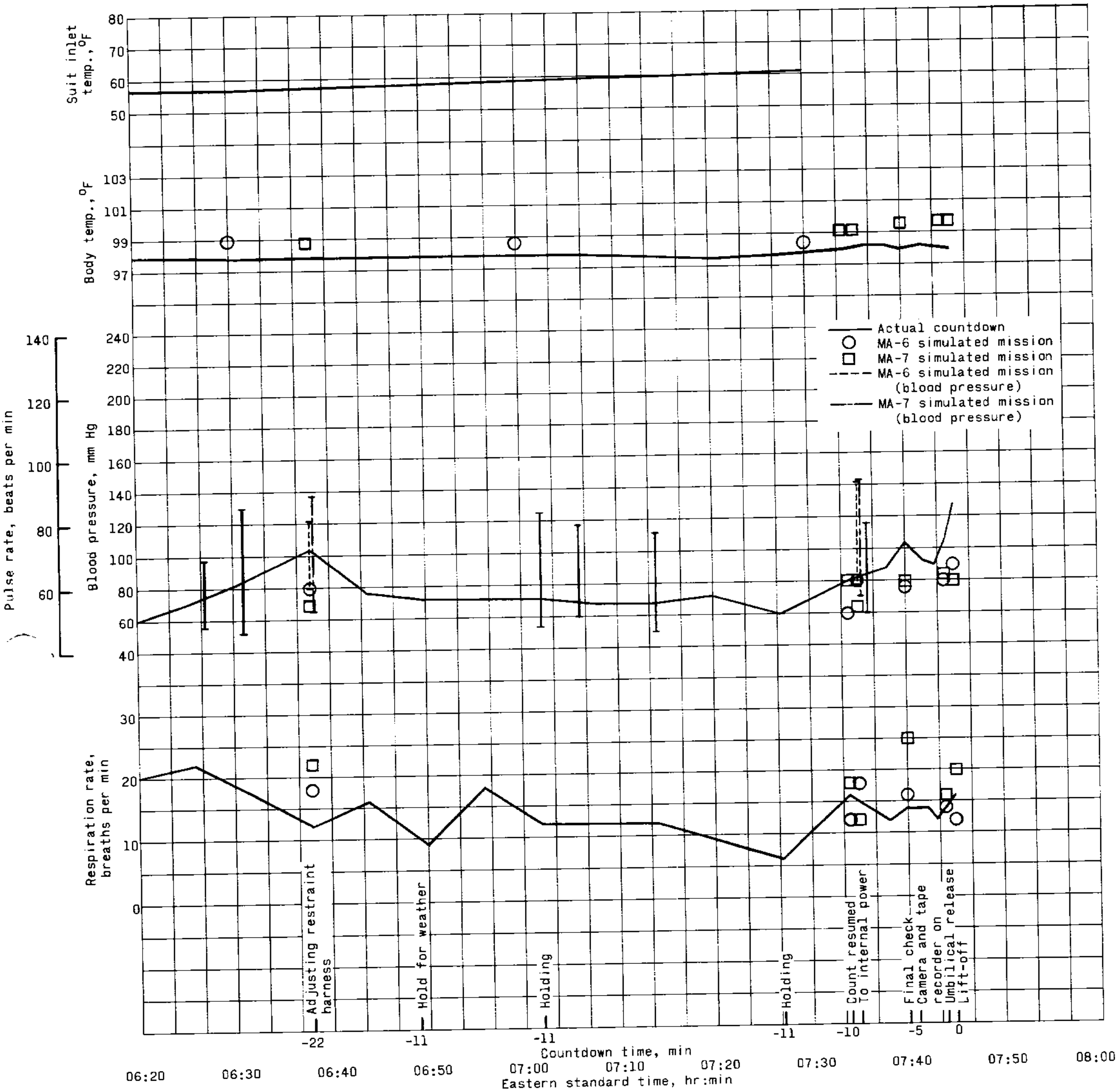


Figure 7.3.2.1-2.- Typical inflight blood pressure data.



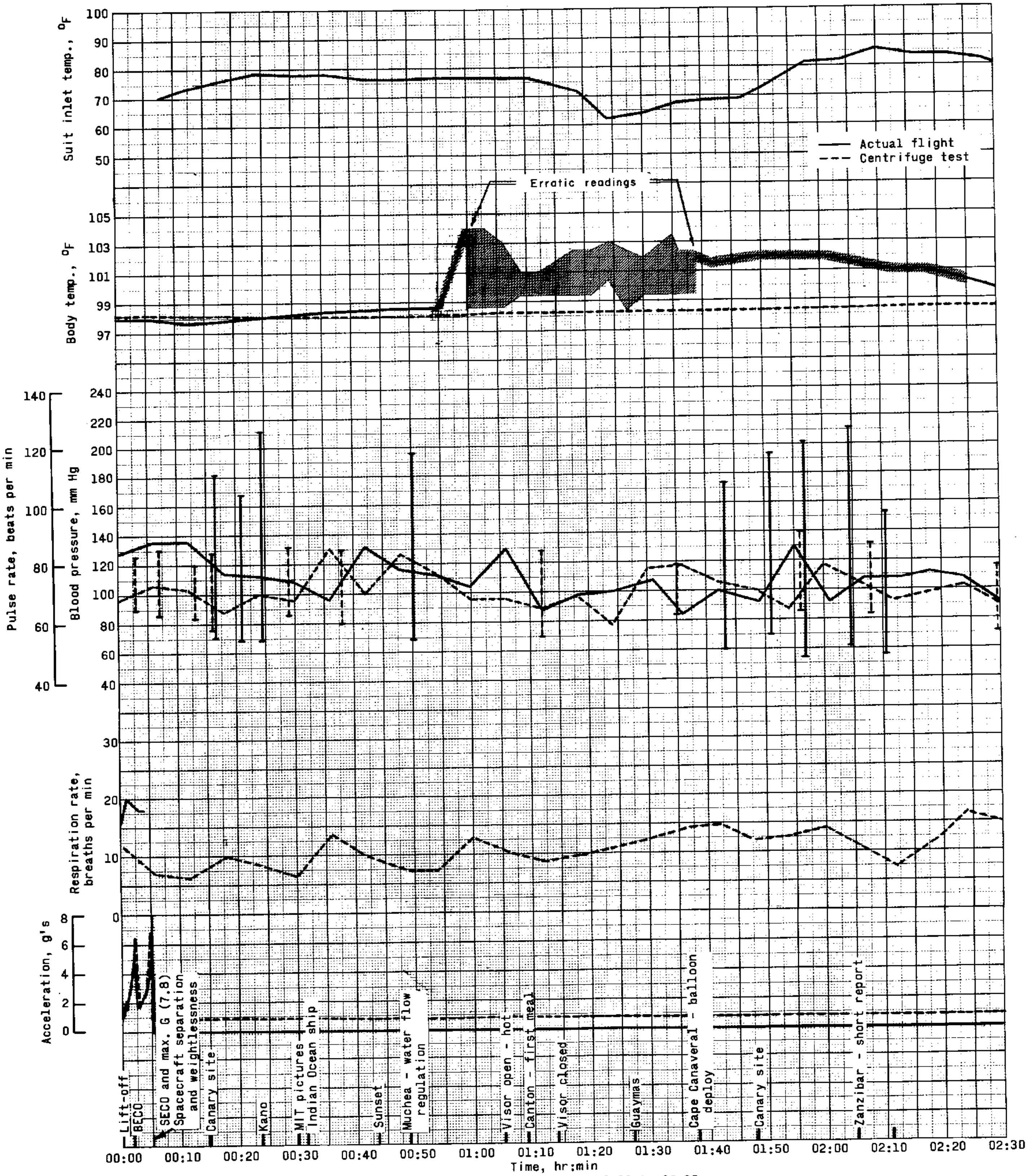
(a) Countdown, 04:40 to 06:20 e.s.t..

Figure 7.3.2.2-1.- Preflight: respiration rate, pulse rate, blood pressure, body temperature and suit inlet temperature for MA-7 countdown with values at selected events from the MA-6 simulated launch of January 17, 1962, and the MA-7 simulated launch of May 10, 1962.



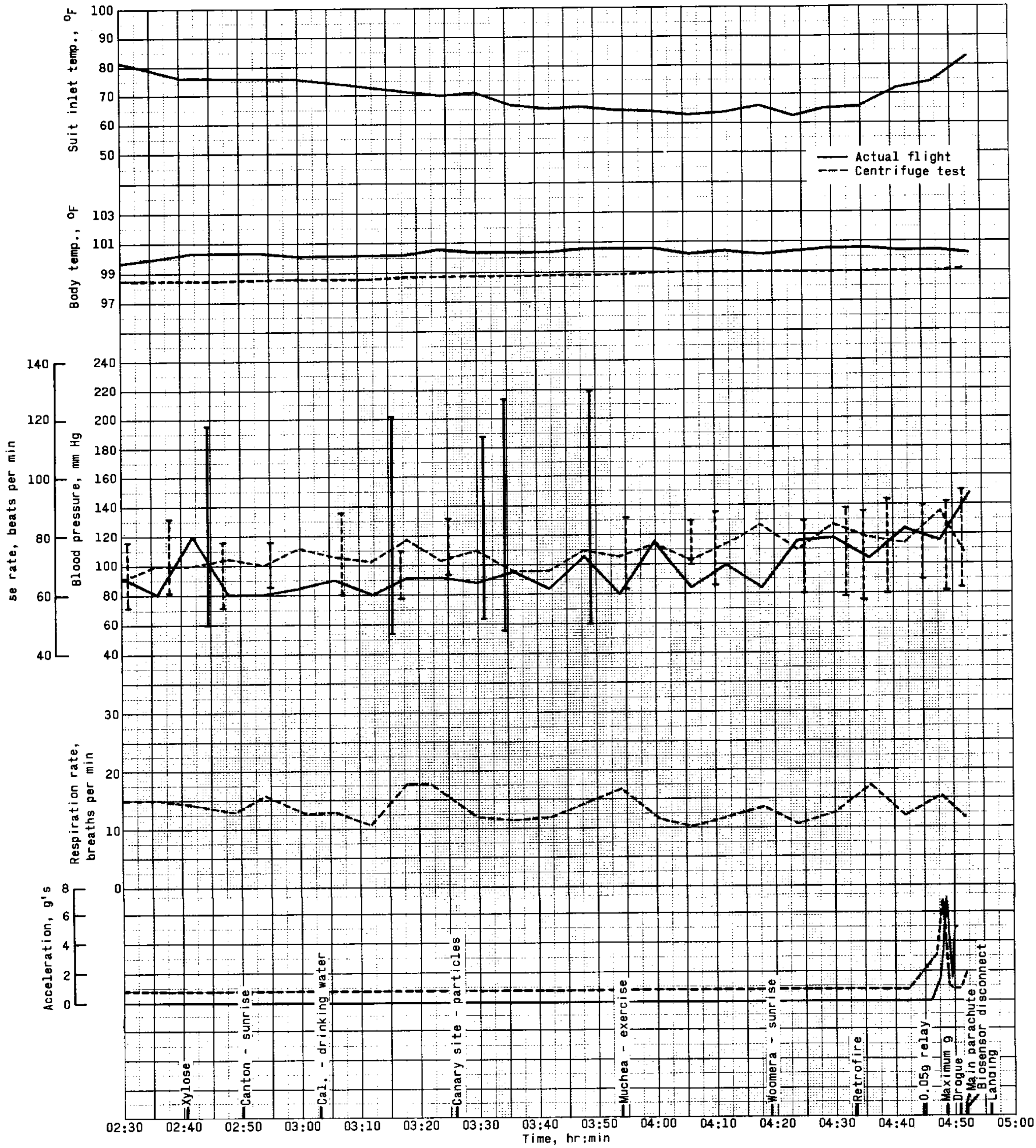
(b) Countdown, 06:20 to 07:45 e.s.t. (lift-off).

Figure 7.3.2.2-1.- Concluded.



(a) Flight elapsed time, 00:00 to 02:30.

Figure 7.3.2.3-1.- Flight: respiration rate, pulse rate, blood pressure, body temperature, and suit inlet temperature during the MA-7 flight, with values from the Mercury-Atlas three-orbit centrifuge dynamic simulation.



(b) Flight elapsed time, 02:30 to biosensor disconnect, 04:52.

Figure 7.3.2.3-1.- Concluded.

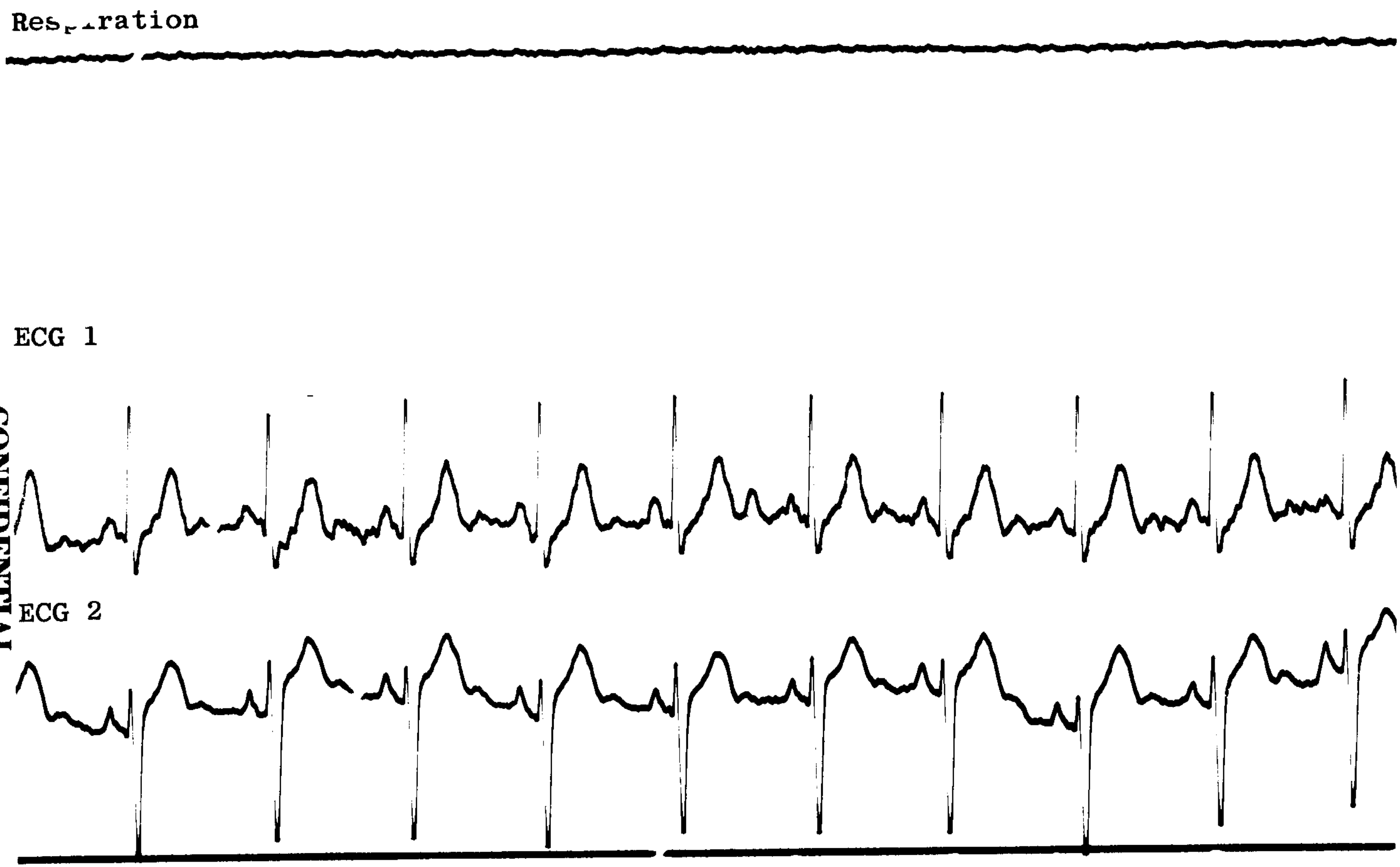


Figure 7.3.2.3-2.- Sample of playback record from the onboard tape showing physiologic data after one minute of weightlessness. (Recorder speed 25 mm/second).

CONFIDENTIAL

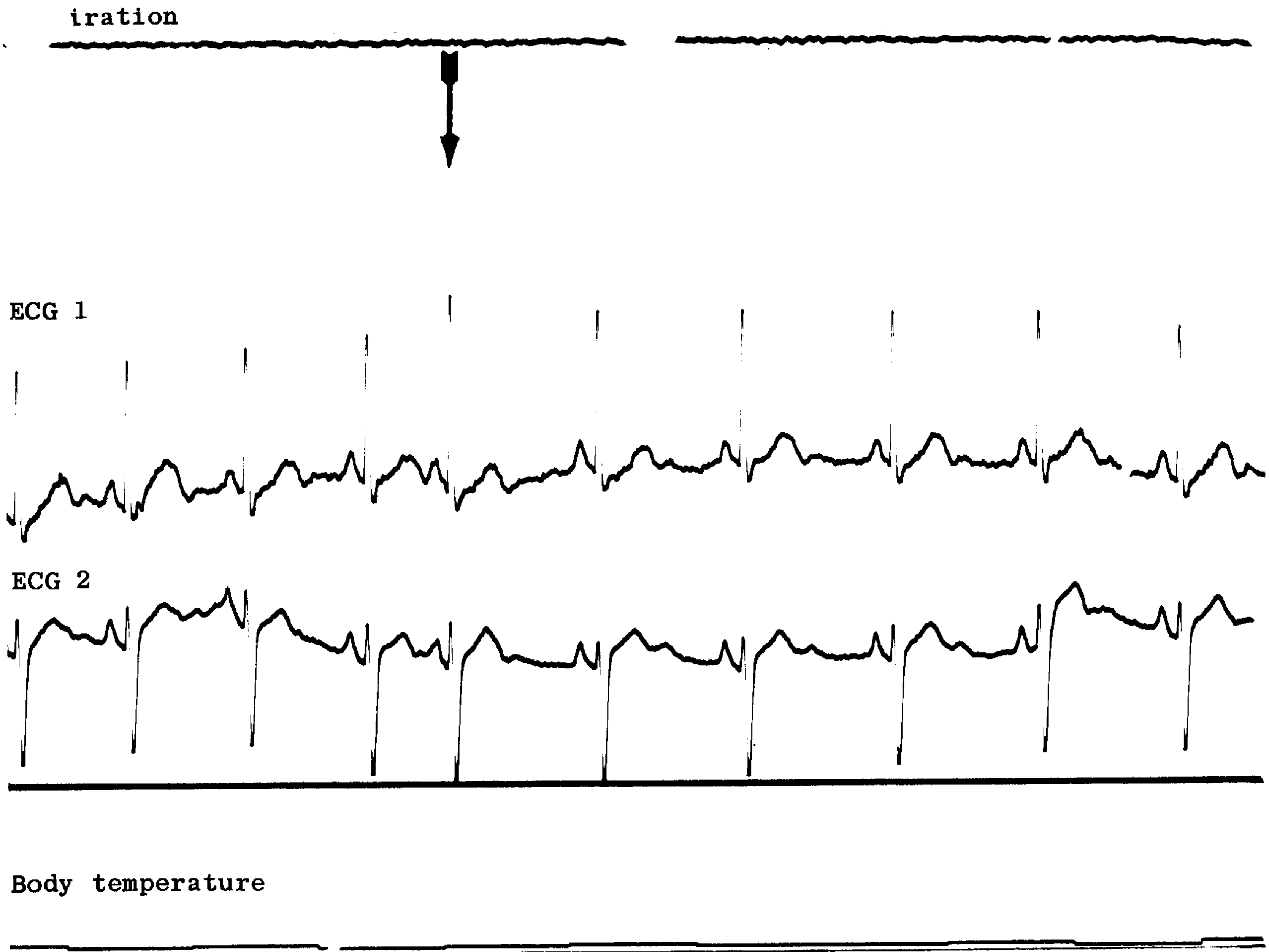


Figure 7.3.2.3-3.- Sample of physiological data from playback of the onboard tape at 04:32:06 mission elapsed time, one minute and 15 seconds before retrofire, illustrating a premature atrial contraction. (Recorder speed 25 mm/second).

CONFIDENTIAL

8.0 FLIGHT CONTROL AND NETWORK PERFORMANCE

8.1 Introduction

The Mercury Network consists of the Mercury Control Center (MCC) at Cape Canaveral (CNV); stations at the Atlantic Missile Range (AMR), Bermuda (BDA), and at thirteen other locations along the orbital ground track; and communications and computing centers at the Goddard Space Flight Center. For this mission, the Indian Ocean Ship was located at 17°45' South, 39°24' East. The Atlantic Ocean Ship was not deployed because of modification commitments to support later missions. The Network affords a data acquisition capability for real-time monitoring and mission control, and for postflight analysis. This section describes the flight monitoring and control and presents information on the performance of the communications, telemetry, tracking, computing, and command systems.

8.2 Flight Control Summary

This summary presents the results of the flight as determined in real time. It is recognized that the results may be somewhat different from those obtained from an analysis of the data and presented in other section of this report.

The preparation of the flight control team and the Mercury Network followed the same procedure as for MA-6 and previous Mercury orbital flights. Simulations carried out prior to the flight are considered as one of the most important steps in the preparation of the flight controllers and the astronaut for the flight. This process is absolutely essential to the safety of the flight.

The countdown for the launch vehicle, spacecraft, and network was as close to perfect as can ever be hoped for. There were some minor problems, but none of these resulted in the necessity for a hold, and the cooperation between the blockhouse and the Mercury Control Center was excellent.

The powered portion of the flight was completely normal, and no problems were experienced in achieving the proper information nor in making the GO-NO-GO decisions at the required times in the flight. The communications to the astronaut throughout the entire mission were satisfactory, but slightly inferior to those of MA-6. The GO-NO-GO decision at sustainer engine cutoff was made rapidly, and there was no doubt that the proper conditions had been achieved. It was immediately apparent in the early reports from the African sites that the suit cooling system was not functioning properly and that the astronaut was uncomfortable. However, the suit temperature began to decrease as a result of increased water flow in the suit circuit, and by the end of the first orbital pass it was down to a satisfactory value. Other than a slight discomfort due to these suit temperatures, the astronaut was obviously in good condition and performing satisfactorily throughout the first pass. A report from Canton (CTN) of a body temperature of 102°, which was also noticed at loss of signal (LOS) from Woomera (WOM) was of some concern until it was decided that the transducer had either failed or had been affected by an in-flight calibration. The only other problem was the large amount of automatic fuel being used by the astronaut during the first pass and he was cautioned against further gross usage over the continental United States. As a result, he used the automatic and fly-by-wire systems sparingly from this point on.

During the second pass, the suit temperature again rose to a rather high value, but again showed a decrease in trend before the end of the second pass. It was obvious throughout the flight that the pilot was having difficulty in achieving the proper water flow setting for the suit cooling system.

The inverter temperatures showed increases similar to previous flights, but these caused no concern because of past experience. It is possible that increases in the water flow to both inverters would have caused a decrease in these temperatures but this was not suggested until late in the flight. The cabin-air temperature followed trends almost identical to the MA-6 flight, although somewhat higher temperatures were reached during the second orbital pass. This, however, did not cause any great concern.

By the end of the second pass, the astronaut had used large amounts of manual fuel and was down to about 42% as he began the third period. The low automatic and manual fuel quantities caused concern on the ground and resulted in a number of repeated requests to the astronaut to conserve his fuel on both systems. As a result, when the astronaut reached HAW at the end of the third orbit, approximately 40% of the fuel was remaining in both systems and this amount of fuel would normally have been ample to perform a retrofire maneuver and reentry on either system.

Throughout the flight the astronaut made a number of voice reports regarding visual observations and discussions on various experiments carried out in the flight. However, these can best be obtained from the transcript of the astronaut's voice reports, and in section 5.7 of the present report.

Upon contact with Hawaii (HAW) at the end of the third pass, the astronaut was instructed to begin his pre-retrosequence checklist and to revert from his present manual-control mode to the ASCS system in preparation for retrofire. This was initiated but when the astronaut went back to ASCS, he reported having trouble with this system and, as a result, was unable to complete the retrosequence checklist properly. It was obvious both from voice reports and telemetry readouts on the ground that the astronaut was concerned over the apparent unsatisfactory operation of the automatic control system and large amounts of manual and automatic fuel were used both over the Hawaii station and prior to acquisition at California.

The astronaut continued to have ASCS problems, in that the pitch horizon scanner yielded improper attitudes, and he performed the retrofire maneuver using manual control. The astronaut was directed to use attitude bypass and manual retrofire initiation by the California CapCom, and it was apparent mainly from the time of retrojettison that the retrofire had taken place several seconds late. Initial reports from the astronaut indicated that the attitudes had been held fairly well during retrofire, but later reports from California did not corroborate this report. Also, the California station reported the measurement of the velocity increment from the integrating accelerometer was approximately 450 feet per second. Because of the first report on capsule attitudes, the initial radar data from California and the resulting impact prediction was suspected to be in error. However, as additional radar data became available from other sites it was obvious that the data was correct and that the landing point would be approximately 250 nautical miles downrange from the planned location. Because of the small amount of automatic fuel remaining following retrofire, and the complete depletion of manual fuel, the astronaut was instructed to use as little fuel as possible in orienting the spacecraft to reentry attitude and to conserve the fuel for use during reentry. He was also instructed to use the auxiliary damping system during the atmospheric reentry portion of the flight.

Upon contact with Cape Canaveral just prior to communications blackout, the astronaut was queried as to the position of the faceplate. He indicated it was still open and was therefore directed to close it. The ionization blackout occurred about 40 seconds late, lending further evidence to the longer reentry range, and the astronaut was told that his landing point would be long and at approximately 19°23 min. North and 63°53 min. West. From this point, no voice communications were received from the astronaut. However, a number of communications were made from MCC both on the command voice system and over the normal UHF and HF voice system. The AMR C-band radars at Cape Canaveral, GBI, and San Salvador tracked the C-band beacon until the spacecraft reached the local horizon, indicating that it had reentered satisfactorily, and these data continued to give the same landing point prediction. All sources of data and methods of calculations, in fact, gave essentially the same impact prediction.

The remainder of the mission involved primarily the recovery operation, which is described in detail in that section of this report.

8.3 Network Performance Summary

Generally, Mercury Network performance was exceellent. The few minor malfunctions did not affect the flight monitoring and control of the mission. Acquisition of data from tracking, telemetry, and air/ground voice systems was satisfactory in both quantity and quality for real-time monitoring and for postflight analysis. The relaying of air/ground voice to the Mercury Control Center from all voice sites contributed substantially in enabling MCC to maintain close real-time monitoring of the mission. (This was not quite as satisfactory as on MA-6, for reasons yet undetermined.)

8.3.1 Trajectory.- The following paragraphs discuss details of tracking, data transmission, computing, and trajectory displays.

8.3.1.1 Tracking: The radar tracking system provided data from both C- and S-band systems satisfactorily for all requirements. The quantity and quality of the data were more than adequate. All sites provided high quality data to the computer on all orbital passes where the capsule was above their horizon. See Figures 8.3.1.1-1 and 8.3.1.1-2. Some sites reported amplitude modulation, lobing, and countdown of both radar beacons, and Bermuda reported local interference on C-band. In spite cf these difficulties, the overall tracking was very good. New radar handover procedures have been developed, and are being used very effectively. Both C-band and S-band spacecraft systems are being checked to determine if their performance could have caused the reported degradation. Evaluation tests of the C-band phase modulator conducted over White Sands and Bermuda are inconclusive, pending detailed analysis of signal strength and spacecraft attitude data. At White Sands, track was lost very shortly after the modulator was turned off, but this was undoubtedly due to extreme range and low elevation angle. During the "blackout" period on reentry, the S-band radars tracked for a maximum of about $1\frac{1}{2}$ minutes. The C-band radars tracked well into the "blackout" condition with the San Salvador FPS-16 losing track just 45 seconds before the end, at which time the elevation angle was about one degree, and the range almost 400 miles.

8.3.1.2 Data Transmission: The transmission of both high-speed and low-speed data was satisfactory throughout the mission.

8.3.1.3 Computing and Trajectory Displays: A modified computer program at the Goddard Space Flight Center was utilized in support of the MA-7 mission. This program was capable of receiving high-speed radar data from BDA, and provided the MCC with an additional source for determining satisfactory orbital insertion (GO-NO-GO). The computing and trajectory display facilities at BDA were retained and operated in parallel with the high speed remoting for this mission since this was the first opportunity to obtain operational experience with the new system. The system performed satisfactorily, and no problems were encountered. With the introduction of high speed data from BDA, the capability of transmitting raw FPS-16 radar data from the AMR radars to the GSFC has been deleted.

Confidence checks during the countdown indicated that the launch monitor system was in a GO condition. The GE personnel reported high refractive indices being measured through a fog bank in the local Cape area by a test aircraft. These indications caused some concern among the guidance personnel who felt this could create noisy data at cut-off similar to that experienced on MA-4. Further evaluation indicated that this noise would probably be of a high frequency nature, and would therefore not cause any significant difficulty. Therefore, the guidance complex considered this a GO condition. This was the first Mercury flight in which the 6000-foot legs of the tracking antenna configuration were actively utilized for guidance. Further study will be required to evaluate in detail the performance of this system.

At liftoff the selected source for display at the MCC was the output of the IP 7090. Cape FPS-16 tracking was utilized until approximately 00:00:35 when the IP 7090 switched to AZUSA. AZUSA was displayed for approximately the next 37 seconds, at which time GE-Burroughs via Goddard was selected and was displayed throughout the powered flight. The GE radar acquired both rate and track at 00:01:02 as planned, and never lost lock throughout the powered flight. The quality of the GE data was excellent up to SECO and during the GO-NO-GO computation. No difficulty was experienced in making the GO-NO-GO decision, and it was not necessary to select either the IP 7090 or BDA data to verify the GE/Burroughs solution. The cutoff conditions are given in Table 8.3.1.3-1.

The programmed phase of the flight showed a minor deviation of plus 1.2° in flight path angle, and plus 1.5 n.m. in altitude at booster engine cutoff. After staging, steering corrected these deviations in both flight path angle and attitude. The yaw velocity error was zero at cutoff.

Low speed tracking data from the remote sites were excellent, such that the orbit was well defined after Canary Island (CYI) tracking was received. Subsequent tracking resulted in no change in the orbit, and only increased confidence in the values obtained. Table 8.3.1.3-2 shows the tracking data obtained.

The retrosequence time set in the spacecraft at launch was 04:32:25. At insertion the computed retrosequence time was 04:32:39. This was reduced to 04:32:28 after correcting the orbit from the Bermuda data. During the rest of the mission the computed time varied only plus or minus one second about 04:32:28. This indicates that the orbit was fixed very early in the flight.

The spacecraft clock was set to 04:32:34, capsule elapsed time, over Muchea (MUC) during the third pass. This setting included a minus one second clock error and a plus six-second correction because of a decrease in spacecraft weight caused by more fuel usage than accounted for in the computer programs. A countdown to retrosequence at a ground elapsed time of 04:32:35 was given from Mercury Control Center.

During the reentry, tracking data established the landing location with a high degree of confidence. Table 8.3.1.3-3 shows the minor variations in landing latitude and longitude as obtained from tracking data across the United States. Cape, GBI, and San Salvador FPS-16's tracked through blackout, reports of which in real time at the MCC were extremely comforting in verifying the integrity of the capsule during reentry.

The performance of the computing system and the tracking facilities was excellent throughout the mission and no malfunctions occurred. It is felt that the performance of the BDA to GSFC high speed data transmission system during this mission was such that the computing facilities and trajectory displays at BDA are no longer necessary in support of the Mercury program.

8.3.2 Telemetry.- The data provided by the telemetry system was generally adequate and of good quality. Coverage was excellent, and data were acquired throughout each pass at every site. Coverage is shown graphically in Figure 8.3.2-1 and in tabular form, with decommutator figures, ranges and elevation angles, in Table 8.3.2-2. Signal strengths were satisfactory, ranging up to 400+ microvolts. The usual ionization "blackout" of telemetry, expected to begin at approximately 04:43:10, did not begin until 04:43:56, because of the landing point overshoot. Grand Turk acquired the signal briefly (6 seconds for the commutated channel, 29 seconds for the continuous channels) at approximately 04:48:44. If Grand Turk acquired at the end of the "blackout" this would indicate an ionization time of

04:48. Loss of signal at Grand Turk was apparently due to range and elevation angle.

No serious problems were experienced in the instrumentation systems, other than apparent difficulties with onboard physiological instrumentation.

Trend charts plotted from the telemetry summary messages showed fairly good consistency except for automatic and manual fuel quantity. Curves for manual fuel quantity and for coolant quantity were compared, since the latter displays only minor deviations. The obvious scatter on fuel quantity is being investigated. This is in part caused by the fact that the full sensor range represents only 54% of the full scale, reducing resolution by almost 2 to 1.

Performance of the acquisition aid system was satisfactory, with the usual multipath errors at elevation angles less than 18 degrees. Operation of the Bermuda remoting system, used for the first time on this mission, was very good.

8.3.3 Air/Ground Voice.- The performance of the primary air/ground voice system (UHF) was generally good throughout the mission, with the exception of the first 1 to 2 minutes of launch, and the period from the onset of "blackout" during reentry to the end of the mission. During the early phase of powered flight the voice transmissions received from the vehicle were very noisy, although readable. The loss of signal after blackout were undoubtedly due to horizon effect. The range to Grand Turk was over 400 miles and to the nearest relay aircraft was approximately 200 miles. In spite of these ranges several Cape Canaveral transmissions were received by the astronaut and one capsule transmission was received by Cape Canaveral, all apparently through the two relay aircraft flying at approximately 25,000 feet.

Signal strengths were adequate to provide very good signal-to-noise ratios for essentially all times the spacecraft was above the local visual horizon at the Network sites. UHF in-range times averaged about six minutes per pass. See figure 8.3.3-1.

Since the UHF system provided adequate communications, the HF system was seldom used. On the first pass, the astronaut heard Canton calling, responded on UHF, then HF, but was not received until within UHF range. No reason can be given at this time for the questionable HF performance. A more efficient antenna, such as a resonant whip or wire, is being considered for the multi-orbit missions, where HF communication will be of paramount importance.

Emergency voice checks, using the command transmitters, resulted in loud and clear reception by the astronaut.

8.3.4 Command System.- The command system for MA-7 operated in a satisfactory manner during the mission. There were more ground system malfunctions than have previously been noted during mission time. These malfunctions are discussed below. A summary of the command handover exercises is shown in Table 8.3.4-1, and a summary of command transmissions is shown in Table 8.3.4-2.

Ground System: A preliminary evaluation of the data shows that all command sites appeared to have command coverage beginning at slant ranges equal to that of the MA-6 mission. The 10 KW command sites using the quadhelix antennas had an average of approximately 35 percent better coverage above the 10 microvolt level than that of the 600 watt command sites.

A total of sixteen functions were transmitted from the command sites. All of the functions were received successfully with the exception of one telemetry "R" calibration from MUC. This function was not received because of the signal strength being below receiver threshold. In addition, the emergency voice via command carrier was used by MUC during the first orbit pass, and by CNV during reentry. MUC's transmission was successful. CNV's transmission was not successful due to ionization blackout and excessive slant range.

The following malfunctions were experienced:

1. The rotary joint on the quadhelix antenna located at Cape Canaveral burned out at T-135 minutes. The AMR unipole antenna along with GBI was used for first pass coverage. The unipole was used with a change in the handover plan for the second and third orbit coverage. The unipole coverage was less than expected with an average of only 26 percent coverage above the 10 microvolt level.

2. The master FRW-2 at Bermuda was inoperative during the mission. An attempt to repair the transmitter prior to the mission was unsuccessful because of numerous teflon ring failures in the power amplifier section of the transmitter. The station did satisfactorily support the mission with the standby FRW-2 and the 10 KW power amplifier.

3. A failover[a] from the master to the standby FRW-2 transmitter occurred at Guaymas during the third orbit pass. This failover was caused by an open fuse in the transmitter power supply. The standby transmitter operated satisfactorily.

4. Although California was not used during the first orbit pass, a failover to the standby transmitter occurred during this time. The cause was an open 310 volt fuse. The fuse was replaced and the mission was completed in a normal manner.

Spacecraft Command System: Command receiver "A" operating from the 18-volt isolated bus had a threshold value of 3.6 microvolts and a saturation value of between 20 to 40 microvolts. Command receiver "B" operating from the 18-volt standby bus has a threshold value of 3.8 microvolts and a saturation value of between 40 to 80 microvolts.

The command system appeared to operate normally. The antenna pattern effects on MA-7 were as noticeable as on previous missions.

8.3.5 Ground Communications.- All the ground communication networks provided good support for the mission. The few isolated instances of outages occurred, but communications were accomplished by alternate circuits. Single-sideband HF communication from the Indian Ocean Ship (IOS) direct to Canaveral or relayed via Ascension or Pretoria, was excellent and aided materially in mission monitoring.

[a] Failover - Failure of primary system, accompanied by automatic switching to standby system.

TABLE 8.3.1.3-1.- ORBITAL INSERTION CONDITIONS AVAILABLE AT MCC

	Nominal	GE	IP	BDA	back from MUC
Velocity with posigrades, fps (avg. of GO-NO-GO)	25,736	25,735	25,750	25,740	25,739
Inertial flight path angle, deg (avg. of GO-NO-GO)	-.0035	-.0314	-.114	+.010	-.00051
Insertion altitude, n.m.	87.0	86.7			86.7
Inclination angle, deg	32.52	32.5			32.5
Orbit capability		7[a]			
Apogee, n.m.	145	143			145

[a] Maximum number displayed in MCC

KEY TO MERCURY NETWORK STATION ABBREVIATIONS

CNV - Cape Canaveral
BDA - Bermuda (island)
ATS - Atlantic Ocean Ship
CYI - Canary Islands
KNO - Kano, Nigeria
ZZB - Zanzibar, East Africa
IOD - Indian Ocean Ship
MUC - Muchea, Australia
WOM - Woomera, Australia
CTN - Canton (island)
HAW - Hawaii
CAL - California (Pt. Auguello)
GYM - Guaymas, Mexico
WHS - White Sands, New Mexico
TEX - Corpus Christi, Texas
EGL - Eglin, Florida
SAL - San Salvador, Bahama Is.
GBI - Grand Bahama Island, Bahama Is.
MCC - Mercury Control Center (CNV)

TABLE 8.3.1.3-2.- RADAR TRACKING

Station	No. of Obs.	No. Valid No	Used D.C.	Accepted	Rejected
BDA-16	58	52	42		
V	74	54	not used		
CYI	68	63	50		
MUC	84	80	50		
WOM	73	32	32		
GYM	70	40	34	late arrival	
WHS	29	17	17		
TEX	71	60	50		
EGL-16	29	29	29	data OK	
V	53	22	15	data OK	
CNV	61	43	34		
BDA-16	57	44	33		
V	13	8	8		
CYI	61	59	37		
MUC	77	62	50		
WOM	data not available at this time		29		
HAW-16	15	15	15		
V	38	32	23		
CAL	25	25	25		
GYM	20	5	0		
WHS	38	20	20		

TABLE 8.3.1.3-2.- (Continued)

Station	No. of Obs.	No. Valid	No. Used D.C.	Accepted	Rejected
TEX	71	55	43	data OK	
EGL-16	37	37	35		
V	30	13	14		
CNV	59	56	49		
BDA-16	48	46	46		
V	18	12	4		
MUC	73	71	50		
HAW F	data not available at this time		29		
V	12	11	18		
CAL F	30	30	30		
V	11	0			
WHS F	data not available at this time		32		
TEX	61	51	41		
EGL-16	data not available at this time		2	late arrival	
V	66	10	6		
CNV[a]	20	17	11		
SAL	14	11		Cape FPS-16 used	

[a] Start of transmission of CNV data was deliberately delayed in the hopes of getting early San Sal data for use at Goddard. San Sal data were not available early enough so transmission of Cape FPS-16 data was commenced.

TABLE 8.3.1.3-3.- REENTRY TRACKING DATA

Station	Latitude, deg. - min.		Longitude, deg. - min.		Approximate Distance from Actual Landing Point, n.m.
Assumed time (assuming correct attitudes)	21	04 N	67	59 W	235, NW
Calif. D.C. 30 points FPS-16 20 points ver	19	14 N	63	34 W	45, SE
WHS D.C. 32 points	19	21 N	63	47 W	30, SE
TEX D.C. 41 points	19	24 N	63	53 W	20, SE
EGL D.C. 02 points FPS-16 06 points ver	(late report)				
CNV D.C.[a] 11 points FPS-16	19	24 N	63	53 W	20, SE

IP-7090 integrated solution on Cape FPS-16 data - 19°27'N, 63°59'W
Actual location reported by recovery ship - 19°30'N, 64°15'W

[a] Start of transmission from CNV was deliberately delayed to obtain San Sal data, so more tracking was actually available from CNV.

TABLE 8.3.2-2.- TELEMETRY PERFORMANCE - ACQUISITION AND LOS TIMES, RANGES, AND ELEVATION ANGLES

Station	Acquisition	Decomm. Lock	Decomm. LOS	LOS	Slant Range		Elev. Angle	
					Acq.	LOS	Acq.	LOS
CNV	0	0	0007:35	0007:46	0	1100		
BDA	0003:01	0003:07	0010:32	0010:34	740	890	-1	-1
CYI	0014:20	0014:44	0021:38	0021:42	800	950	0	-1
KNO	0021:09	0021:26	0028:33	0028:37	880	950	0	-1
ZZB	0029:57	0030:09	0038:00	0038:21	915	1090	-1	-1
IOS	0034:04	0034:38	0038:54	0039:04				
MUC	0049:24	0049:44	0058:12	0058:19	1030	1050	0	0
WOM	0054:06	0054:20	0102:55	0103:	1100	1030	-1	-1
CTN	0109:31	N/A	0116:46	0116:46	930	925	0	0
HAW	Not in Range							
CAL	0127:16	0127:44	0131:36	0131:36	785	1000	0	0
GYM	0126:39	0126:43	0133:31	0133:35	835	835	-1	-1
TEX	0129:18	0129:34	0136:31	0136:53	885	950	-1	-1
EGL	0132:11	N/A	N/A	0137:44	780	560	0	+5
CNV	0133:28	0133:32	0141:12	0141:12	820	1080	-1	-1
BDA	0136:44	0136:59	0144:12	0144:14	840	940	-1	-1
CYI	0147:35	0148:08	0153:57	0154:16	970	960	-1	-1
KNO	0154:50	0155:54	0201:54	0201:54	910	1020	0	-1
ZZB	0204:07	0204:21	0211:05	0211:30	940	1150	0	-1
IOS	0204:48	0205:01	0213:29	0213:39				
MUC	0223:00	0223:24	0231:44	0231:47	1030	1020	-1	-1
WOM	0227:50	0228:06	0235:54	0236:07	1030	1000	0	0
CTN	0243:10	0243:25	0249:44	0249:44	905	865	0	0
HAW	0249:14	0249:48	0255:12	0255:12	920	780	-1	0
CAL	0258:44	0258:52	0305:04	0305:04	800	825	0	0
GYM	0300:13	0300:36	0306:52	0306:57	855	830	-1	-1
TEX	0303:16	0303:24	0310:02	0310:04	850	880	-1	-1
EGL	0305:41	N/A	N/A	0312:46	790	910	0	-1
CNV	0307:04	0307:08	0316:07	0316:13	820		-1	
BDA	0310:10	0310:11	0317:23	0317:26	850	940	-1	-1
CYI	0322:31	0324:54	0325:01	0325:14				
KNO	Not in Range							
ZZB	Not in Range							
IOS	0339:04	0339:13	0346:49	0346:44				
MUC	0356:48	0357:08	0404:25	0404:32	1010	980	0	0
WOM	0403:13	0403:37	0406:27	0406:40	985	930	0	0
CTN	Not in Range							
HAW	0421:58	0422:17	0429:05	0429:11	935	810	-1	0
CAL	0431:10	0431:41	0438:20	0438:20	940	790	-1	0
GYM	0434:02	0434:24	0439:58	0440:03	820	720	-1	+1
TEX	0437:03	0437:07	0442:50	0442:53	790	645	0	+2
EGL	0439:37	N/A	N/A	0443:59	680	415	+2	+10
CNV	0440:58	0441:02	0443:56	0443:56	N/A	N/A		
GT	0448:43	0448:45	0448:51	0449:12	N/A	N/A		

CNV includes GBI and GTK, data remoted via sub-cable.

TABLE 8.3.4-1.- COMMAND HANDOVER SUMMARY

Station	Command Carrier ON	Command Carrier OFF	+10 μv Carrier Coverage Above Line of Sight
CNV	Launch	00:04:05 (00:04:07)	100%
CNV (SAL)	00:04:05 (00:04:07)	00:06:00 (00:06:02)	74%
BDA	00:05:58 (00:05:58)	00:12:00 (00:12:00)	67%
MUC	00:45:00 (00:45:00)	00:59:00 (00:59:00)	40%
GYM	01:20:00 (01:20:00)	01:33:00 (01:33:00)	47%
CNV	01:33:00 (01:33:05)	01:36:30 (01:36:36)	30%
CNV (GBI)	01:36:30 (01:36:36)	01:38:00 (01:38:06)	100%
BDA	01:37:58 (01:37:58)	01:45:00 (01:45:00)	87%
MUC	02:15:00 (02:15:00)	02:32:00 (02:32:00)	49%
HAW	02:45:00 (02:45:00)	02:56:00 (02:56:00)	97%
CAL	02:56:00 (02:56:00)	03:04:00 (03:04:00)	91%
GYM	03:04:00 (03:04:01)	03:06:00 (03:05:59)	33%
CNV	03:06:00 (03:06:00)	03:10:30 (03:10:29)	14%
BDA	03:10:30 (03:10:30)	03:18:00 (03:19:00)	81%

TABLE 8.3.4-1.- (Continued)

Station	Command Carrier ON	Command Carrier OFF	+10μv Carrier Coverage Above Line of Sight
MUC	03:54:00 (03:54:00)	04:05:00 (04:05:00)	31%
HAW	04:15:00 (04:15:00)	04:30:00 (04:30:00)	82%
CAL	04:30:00 (04:30:00)	04:38:00 (04:38:00)	97%
GYM	04:38:00 (04:38:09)	04:40:00 (04:40:01)	55%
CNV	04:40:00 (04:40:00) (04:47:11)[a]	04:43:11 (04:43:10) (04:52:35)	35% 0%

NOTE: The times in parentheses are actual; times not in parentheses are planned.

[a] Turned on in an attempt to communicate with the capsule during reentry.

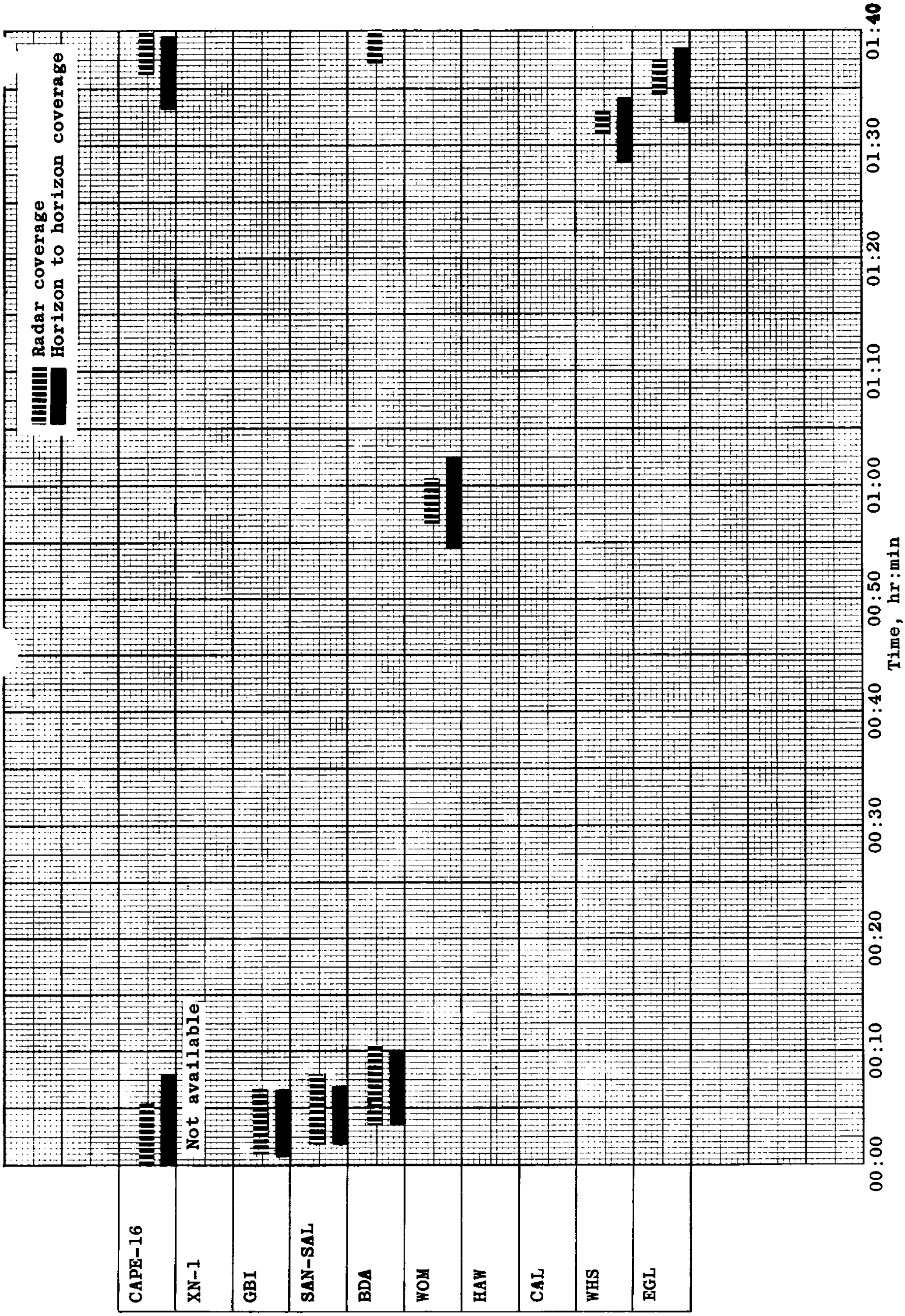
Orbit coverage:

CNV: 10 KW into unipole antenna
GBI: 10 KW into Sterling antenna
BDA: 9.5 KW into quadhelix antenna
HAW, CAL: 10 KW into quadhelix antenna
MUC, GYM: 600 W into quadhelix antenna

TABLE 8.3.4-2.- COMMAND FUNCTION SUMMARY

Station	Function	Time/Duration of Signal Transmission	Slant Range N.M.	Signal Strength at Spacecraft, microvolts
CNV (SAL)	ASCO	00:05:09.9/2 sec.	415	+50
MUC	Z Cal	00:53:49.5/15 sec.	155	30
	R Cal	00:54:08/46.5 sec.	170	20
GYM	Z Cal	01:29:31.8/18 sec.	140	20
	R Cal	01:30:07/32 sec.	135	15
CNV (GBI)	Z Cal	01:37:00.5/4 sec.	375	30
	R Cal	01:37:10.5/6 sec.	370	30
MUC	Z Cal	02:27:04/12 sec.	165	30
	R Cal	02:27:21/16 sec.	145	30
	R Cal	02:27:38/1 sec.	150	30
	R Cal	02:27:40/1 sec.	155	25
	R Cal	02:27:42/1 sec.	160	12
	R Cal	02:27:45/1 sec.	165	5
	R Cal[a]	02:27:47/1 sec.	170	3
CAL	Z Cal	03:01:12.2/14 sec.	310	10
	R Cal	03:01:34/21 sec.	290	+50

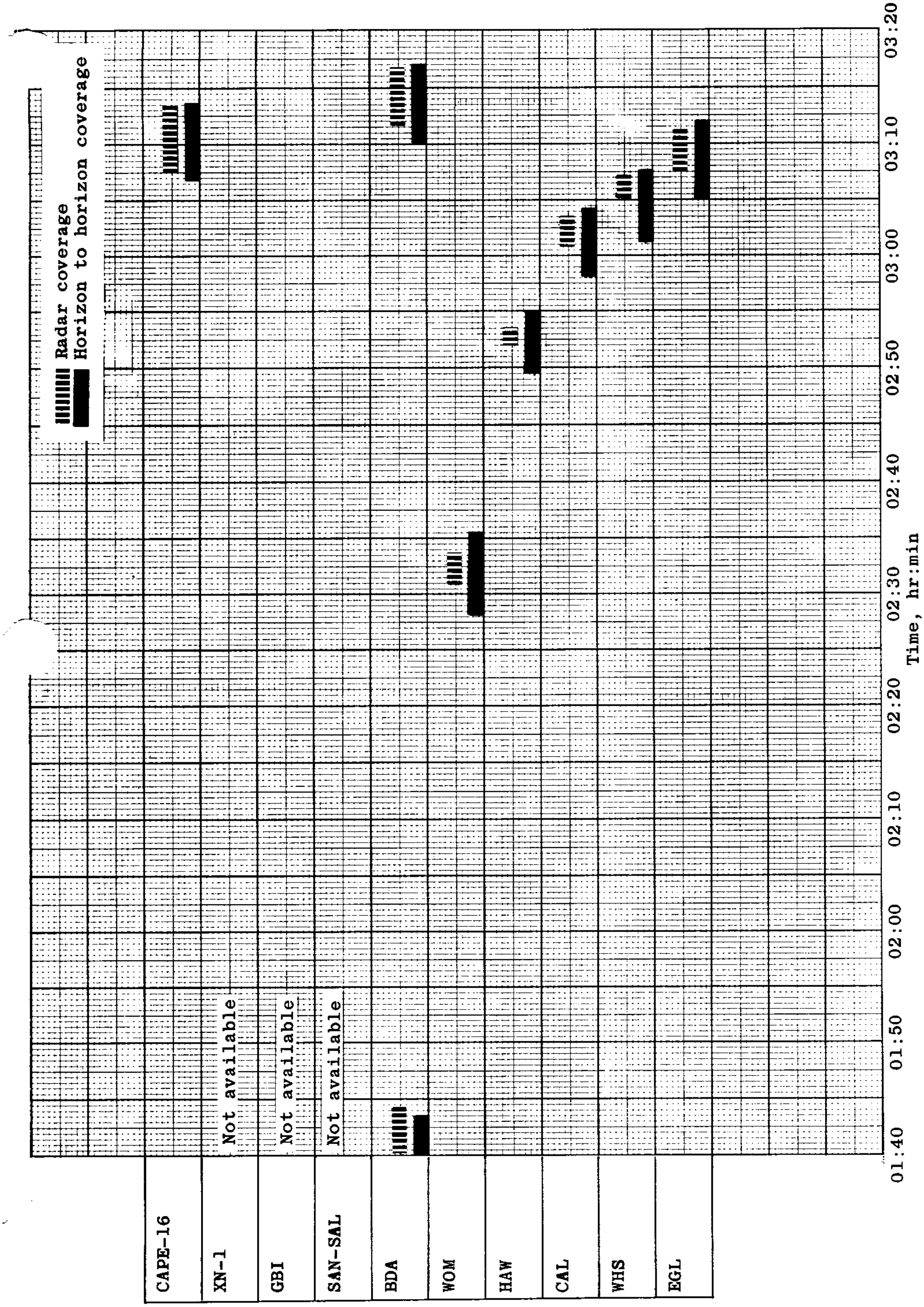
[a] Not received by spacecraft



(a) First orbital pass.

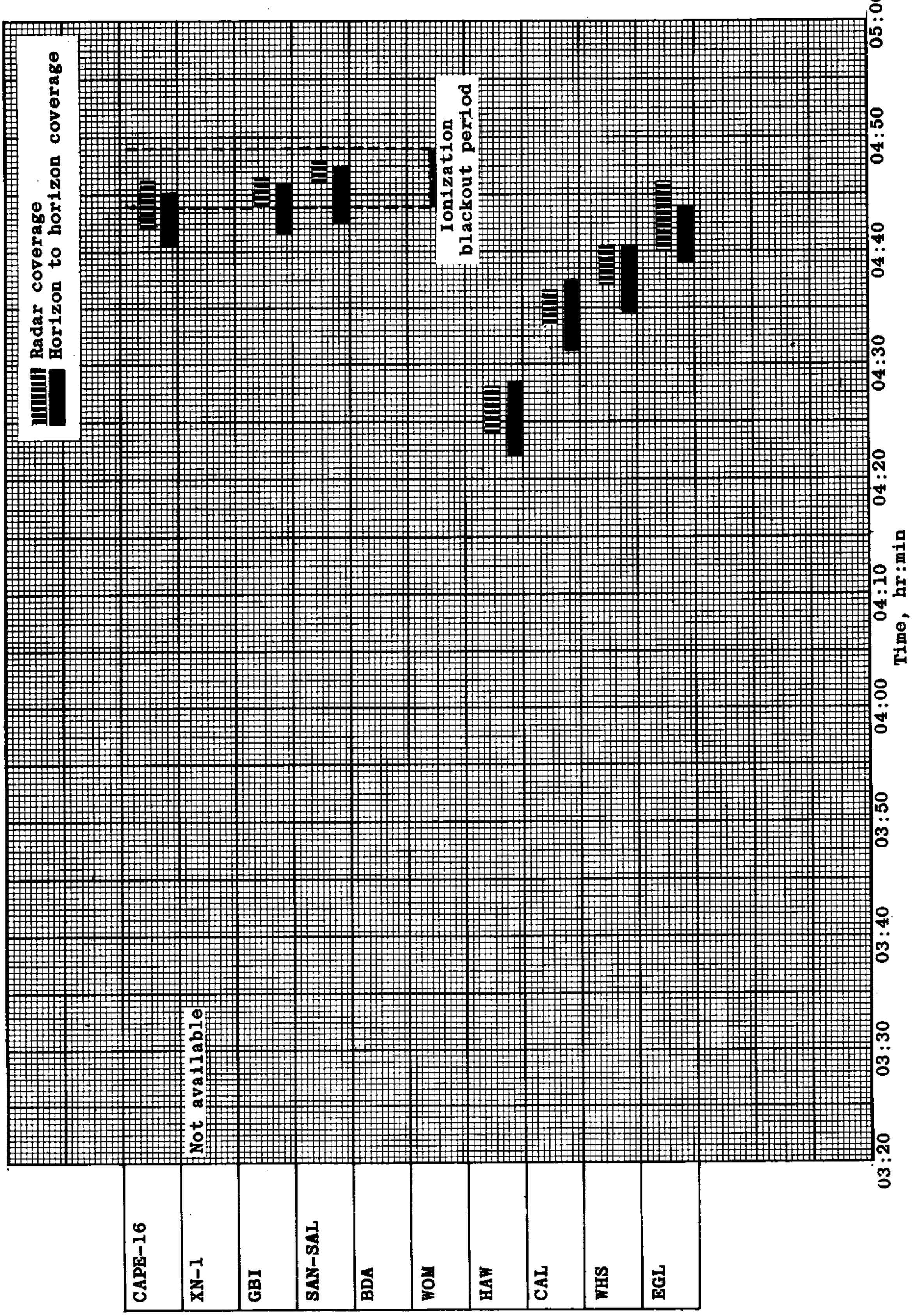
Figure 8.3.1.1-1.- C-band radar coverage

CONFIDENTIAL



(b) Second orbital pass.

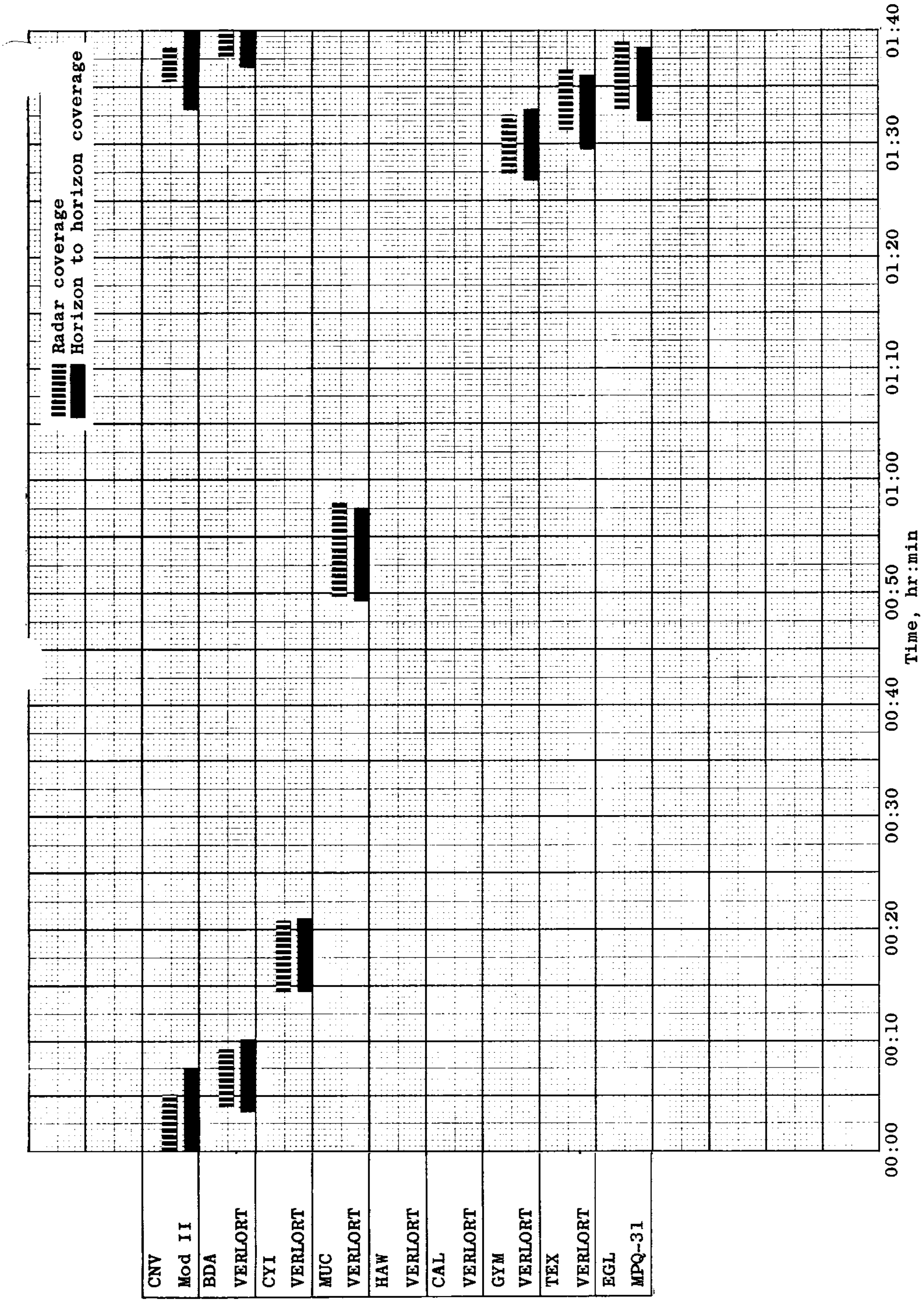
Figure 8.3.1.1-1.- Continued.



(c) Third orbital pass.

Figure 8.3.1.1-1.- Concluded.

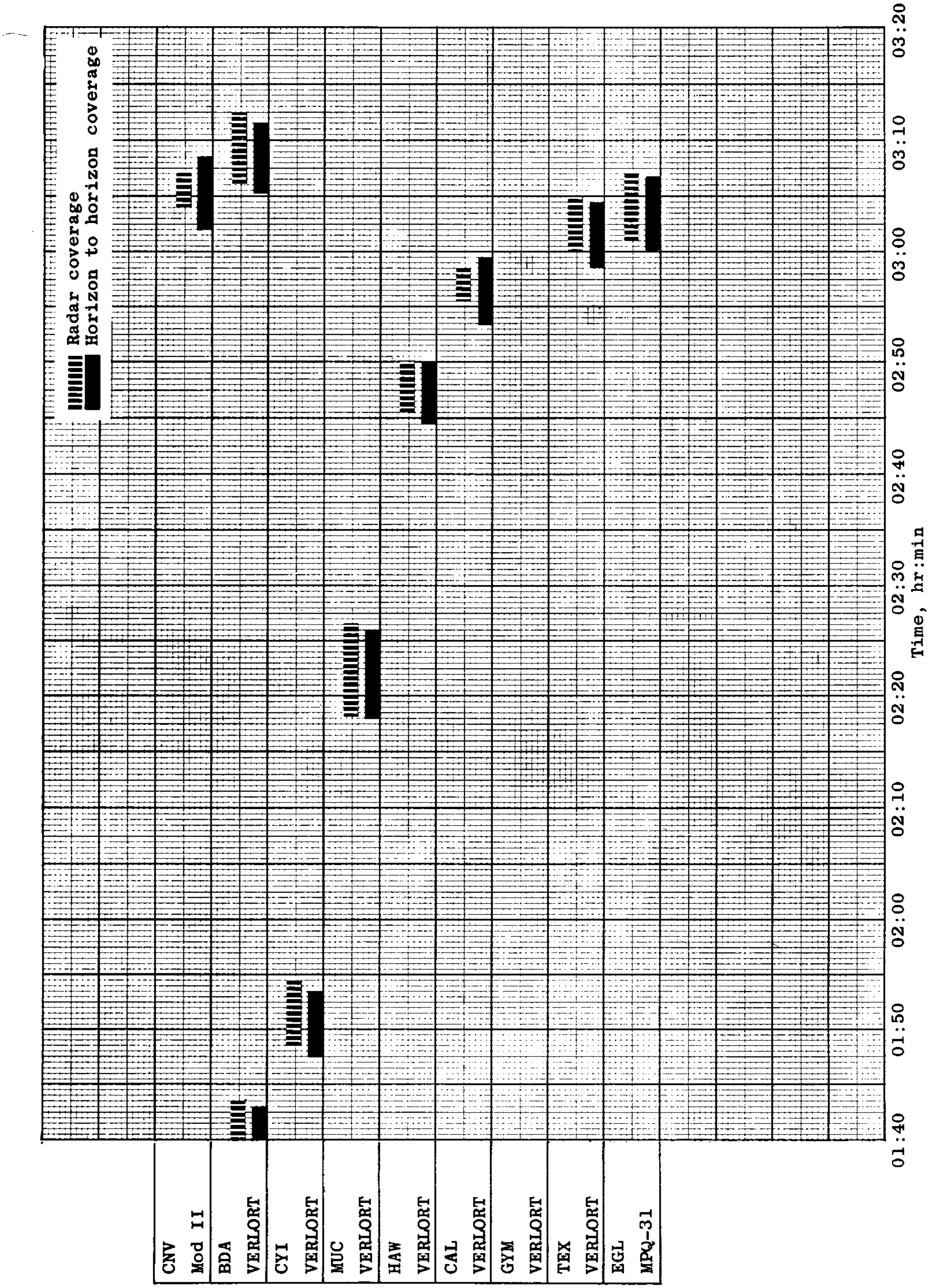
CONFIDENTIAL



(a) First orbital pass.

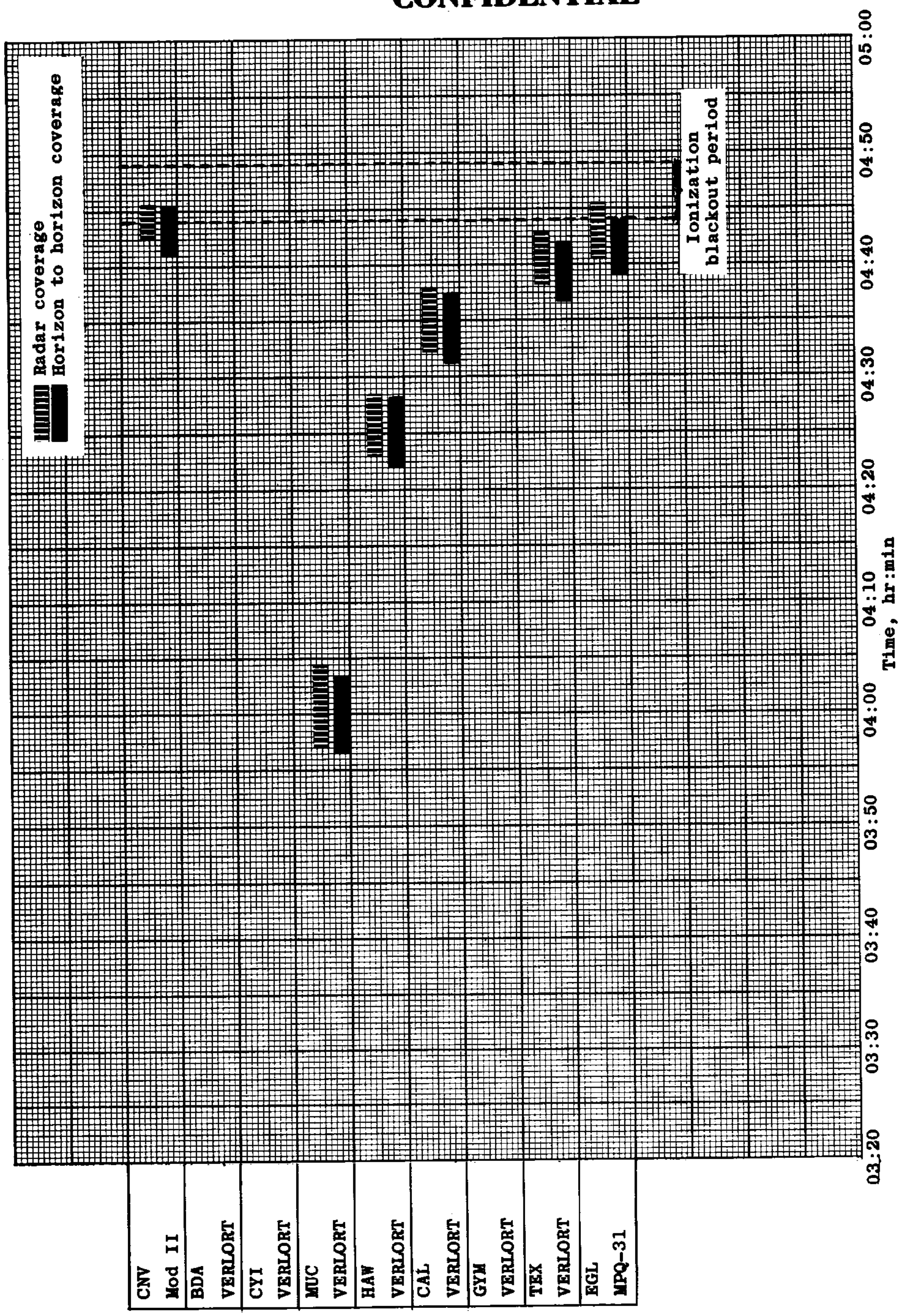
Figure 8.3.1.1-2.- S-band radar coverage.

CONFIDENTIAL



(b) Second orbital pass.

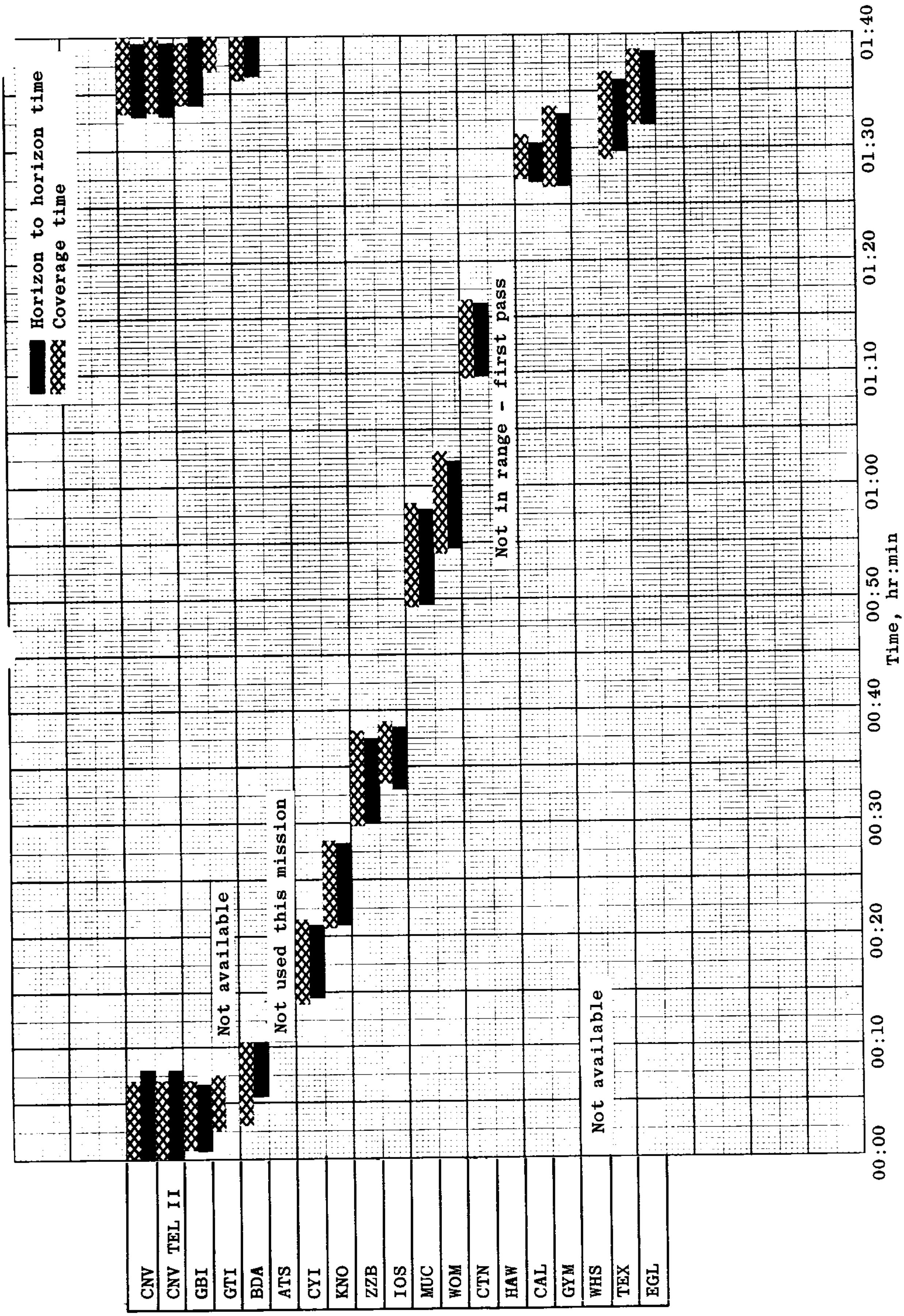
Figure 8.3.1.1-2.- Continued.



(c) Third orbital pass.

Figure 8.3.1.1-2.- Concluded.

CONFIDENTIAL

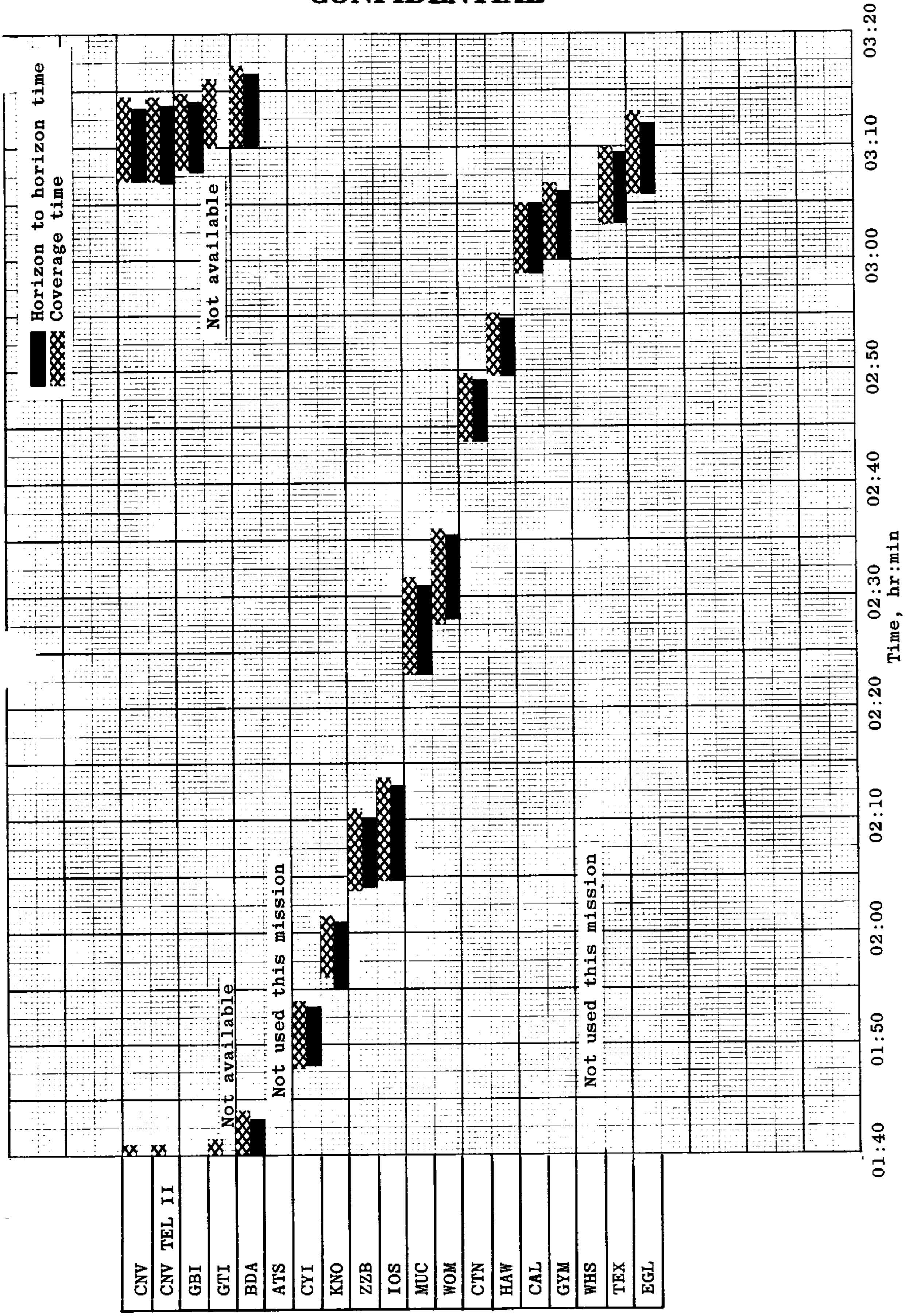


(a) First orbital pass.

Figure 8.3.2-1.- Telemetry reception coverage.

CONFIDENTIAL

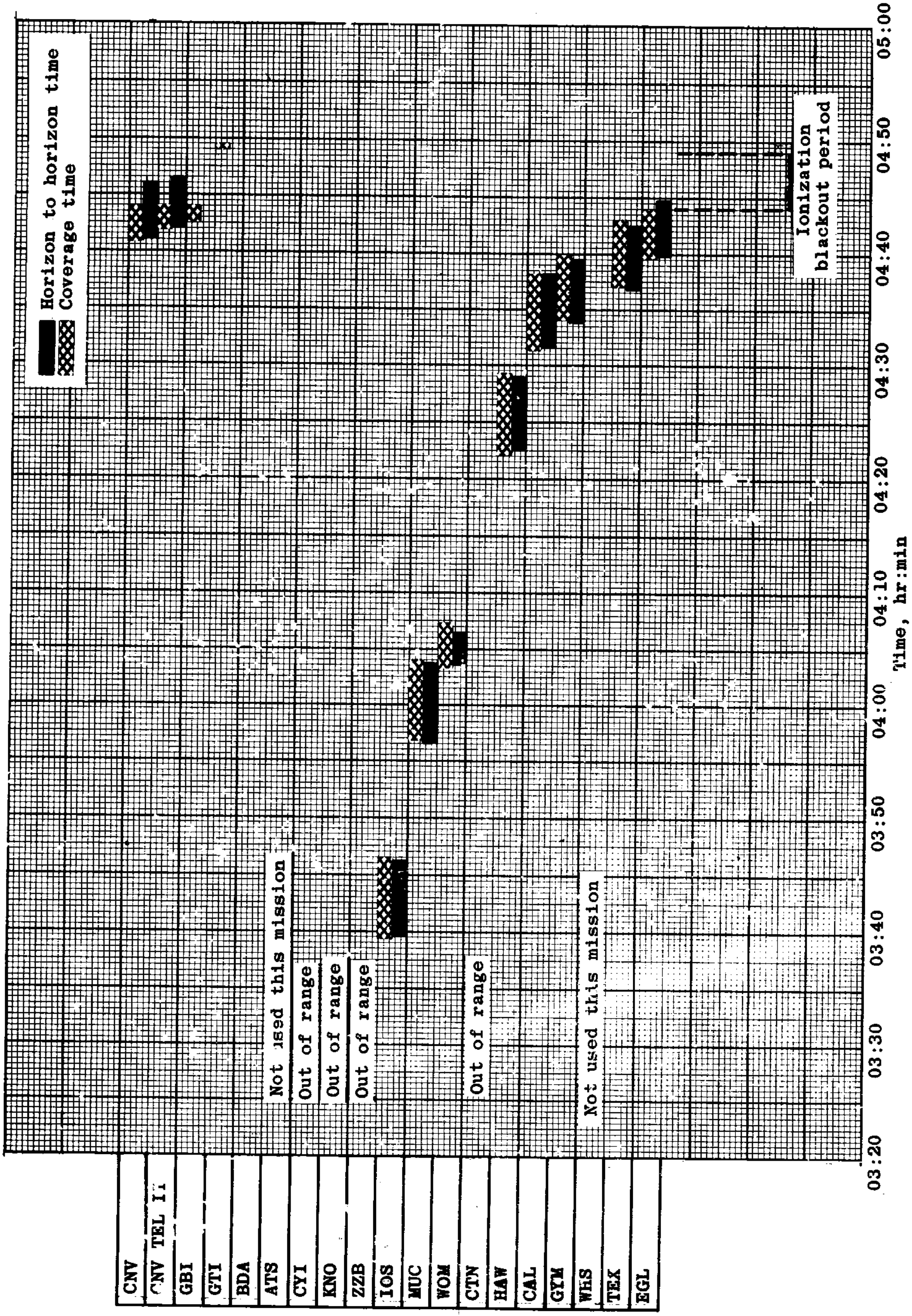
CONFIDENTIAL



(b) Second orbital pass

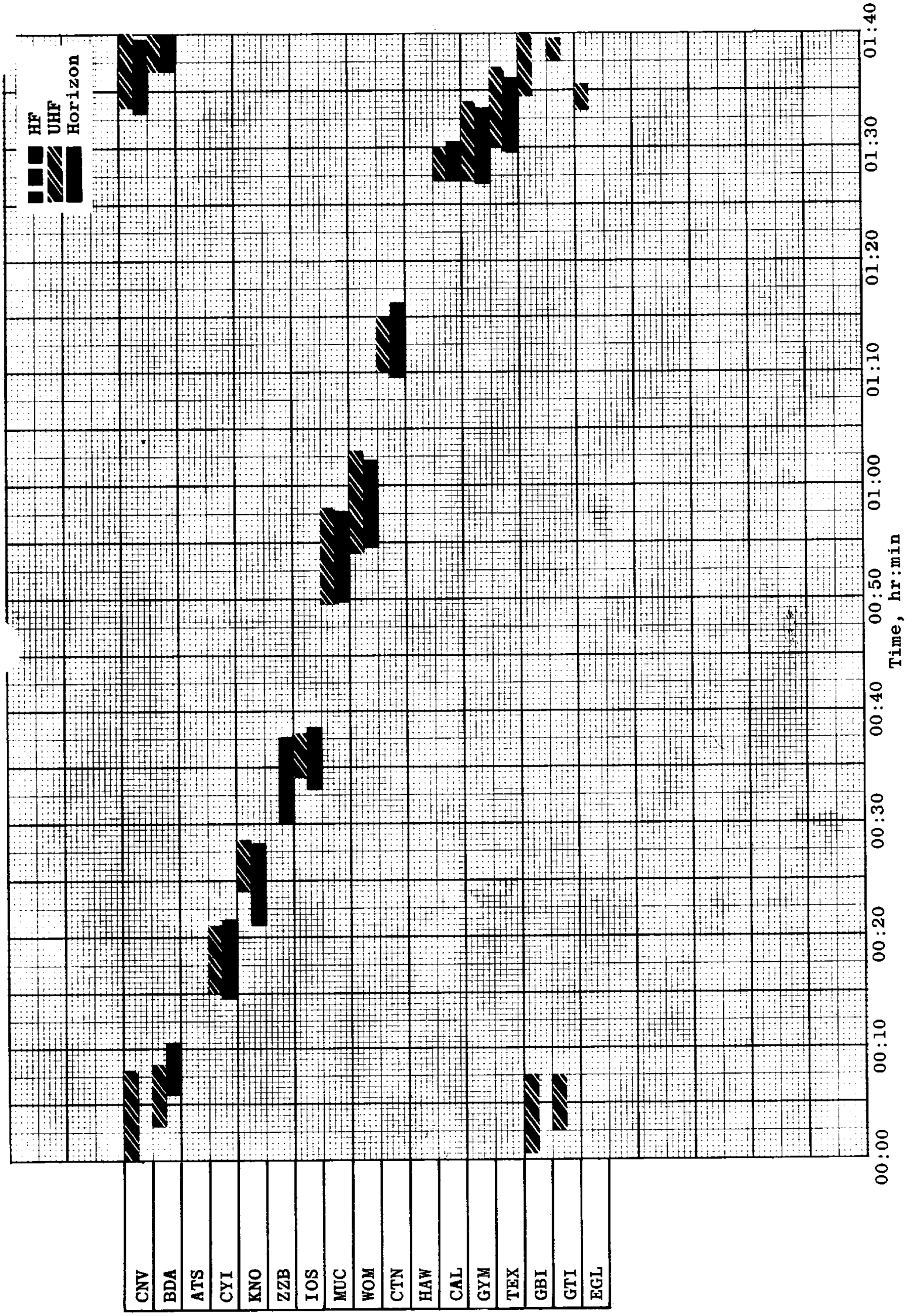
Figure 8.3.2-1.- Continued.

CONFIDENTIAL



(c) Third orbital pass.

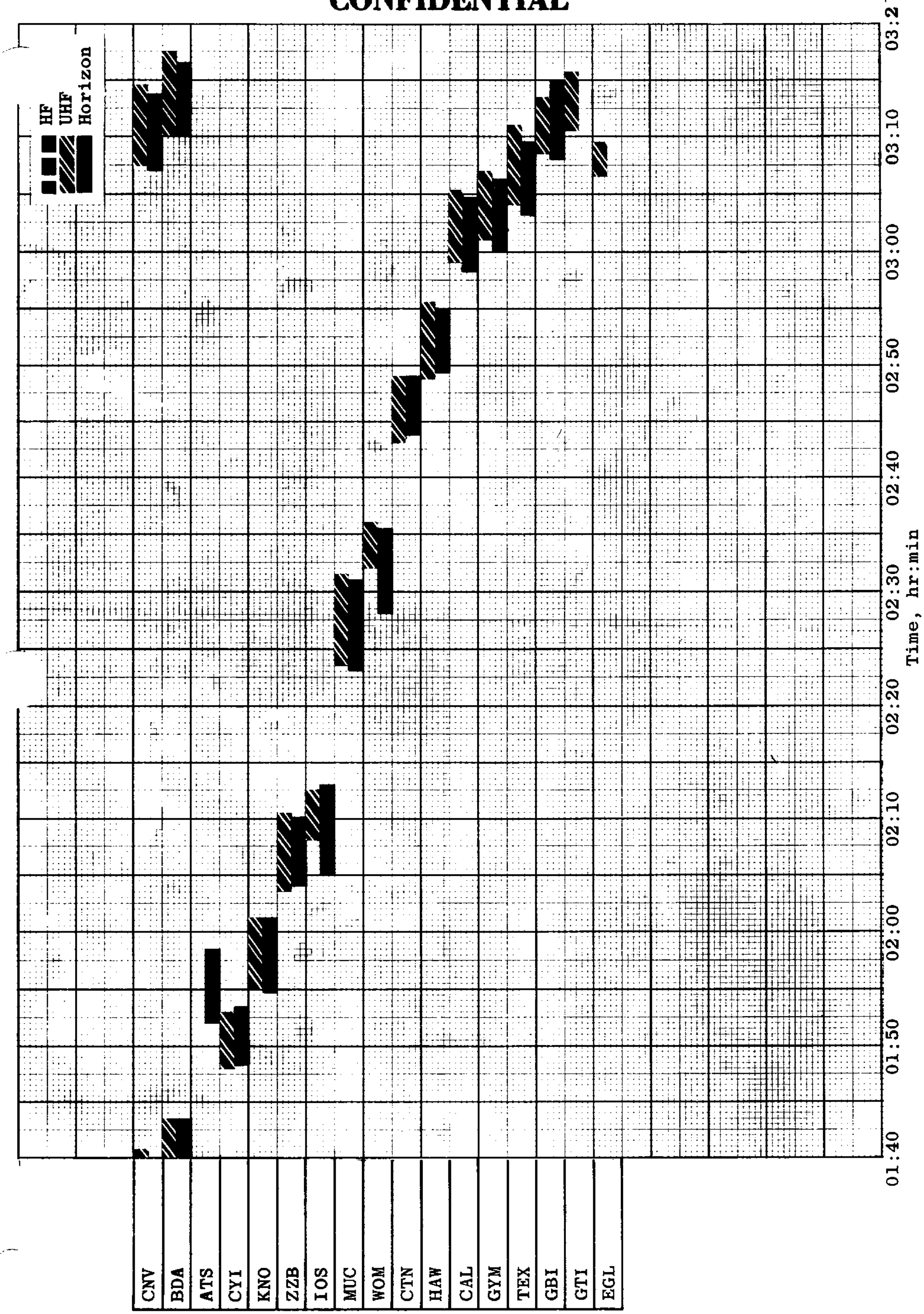
Figure 8.3.2-1. - Concluded.



(a) First orbital pass.

Figure 8.3.3-1.- HF and UHF voice coverage.

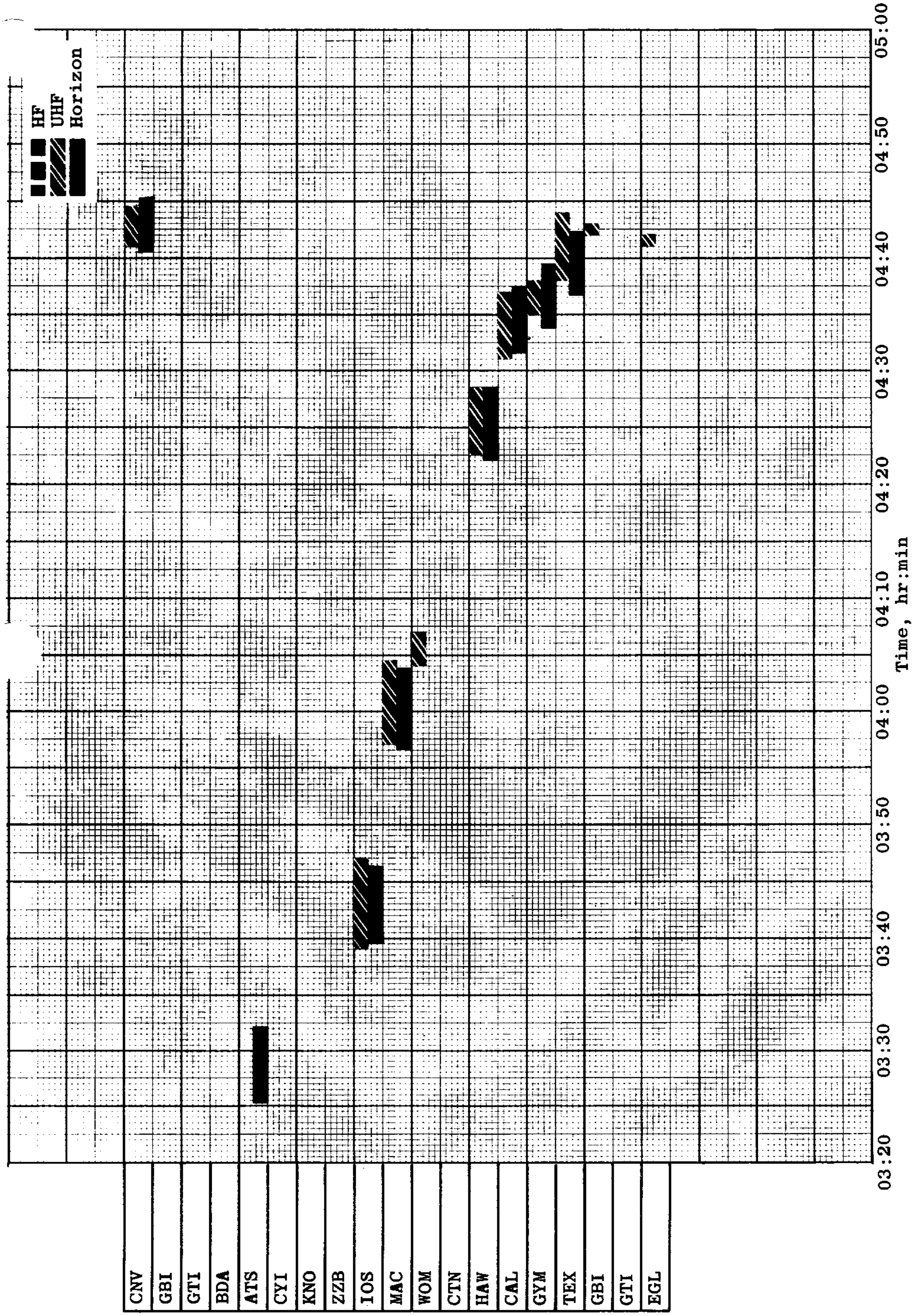
CONFIDENTIAL



(b) Second orbital pass.

Figure 8.3.3-1.- Continued.

CONFIDENTIAL



(c) Third orbital pass.

Figure 8.3.3-1.- Concluded.

9.0 RECOVERY

9.1 Recovery Plans

The Atlantic recovery areas where ships and aircraft were positioned at the time of launch are shown in figure 9.1-1. Recovery capability was provided in areas A through E in the event that it became necessary to abort the mission during powered flight. Recovery forces were distributed so as to provide for recovery within a maximum of 6 hours in areas B, D, E and the first 610 nautical miles of area A, 9 hours in the remainder of area A, and 3 hours in area C. Recovery forces were located to provide recovery within a maximum of 3 hours in area F, G, and H at the end of orbital passes 1, 2, and 3, respectively. A total of 20 ships and 13 aircraft were on station in these Atlantic recovery areas at launch time. In addition, helicopters, amphibious surface vehicles, and small boats were positioned for close recovery support in the vicinity of the launch site.

Figure 9.1-2 shows the contingency-recovery aircraft that were on alert at various staging bases in the event that a landing occurred at any place along the orbital ground track. These aircraft were equipped to locate the spacecraft and to provide emergency on-scene assistance if required.

9.2 Recovery Operations

A chronological summary of significant events pertinent to the recovery operation is presented in the following table. This table was prepared primarily from information available at the Mercury Control Center throughout the operation, with some events confirmed by debriefings of cognizant downrange personnel.

Since the landing was outside the planned landing area (Area H), contingency recovery procedures were followed at MCC. The downrange recovery commander aboard the aircraft carrier Intrepid (CVS) was designated as mission coordinator, and the Coast Guard and other U. S. Naval Commands were querried as to the location of merchant ships or naval vessels (other than those assigned to recovery forces) near the area of the interest. Information from these sources was evaluated and communications were established with the following three ships (positions shown on figure 9.2-1): A Coast Guard cutter at St. Thomas, Virgin Islands, a merchantman located approximately 31 nautical miles north of the calculated landing position, and the Farragut, a destroyer which was located about 75 nautical miles southeast of the calculated landing position. It was determined that the Farragut could arrive in the landing area first, so this ship headed for the landing area at best speed. The other two ships were so notified and they then continued with their normal operations.

Elapsed time from launch, hr:min	Elapsed time from landing, hr:min	Event
		24 May 1962
03:33		An Air Rescue Service SC-54 was launched from Roosevelt Roads, P. R., and assigned a station on the downrange portion of the 3rd-pass recovery area, as shown in figure 9.2-1. This aircraft carried two pararescue personnel, and its deployment was requested as a precautionary measure after the mission was committed to a 3rd orbital pass.
04:37		Recovery forces were informed that the retrorockets had been ignited for a landing in area H.
04:44		Loss of communications to and from spacecraft resulting from ionization blackout.
04:49		End of ionization blackout.
04:50		Recovery forces were informed that the new calculated landing position (CALREP) was 19°24'N, 63°53'W. An Air Rescue Service, SA-16, amphibian aircraft was launched from Roosevelt Roads to proceed to the calculated landing position.
04:54		A P2V search aircraft made UHF/DF contact at 243 mc with the spacecraft and later reported this contact to Mercury Control at 05:02.
04:56[a]	00:00	Spacecraft landing.
04:59	00:03	The new calculated landing position (19°24'N, 63°53'W) was established as the best estimate of the spacecraft landing position. In the meantime, recovery forces from area H were proceeding at best speed toward the landing position.

[a]Actual landing time - 04:55:57 GET.

Elapsed time from launch, hr:min	Elapsed time from landing, hr:min	Event
05:32	00:36	A P2V search aircraft reported visual contact with the spacecraft, and that the astronaut was alongside in a liferaft (see figure 9.2-2).
05:52	00:56	An Air Rescue Service SC-54 in the landing area prepared to deploy pararescue personnel with survival equipment and a spacecraft auxiliary flotation collar.
05:59	01:03	HSS-2 twin-turbine helicopters were launched from the USS Intrepid with an estimated time of arrival (ETA) at the spacecraft of 07:43 (02:47 after spacecraft landing). These helicopters had the capability of personnel retrieval and return to the Intrepid.
06:03	01:07	The first pararescue man jumped from SC-54.
06:08	01:12	The second pararescue man jumped from SC-54.
06:15	01:19	A spacecraft auxiliary flotation collar was deployed from the SC-54. NOTE: The initial task for pararescue personnel was to contact the astronaut and determine his condition. Since the astronaut required no assistance, they then proceeded to attach the collar to the spacecraft to insure a longer flotation lifetime. Radio equipment initially dropped failed to operate properly, and therefore voice communications with the recovery forces were not established at this time. Additional radio equipment was deployed just prior to the time the helicopters arrived on-scene and was not activated.
06:30	01:34	The SA-16 deployed from Roosevelt Roads reported surface conditions in the landing area satisfactory for a safe landing and subsequent take-off.

Elapsed time from launch, hr:min	Elapsed time from landing, hr:min	Event
06:36	01:40	A situation report from the mission coordinator (downrange recovery commander) indicated the following: (a) At 01:33, the astronaut appeared normal, waving to aircraft. (b) Pararescue team had been deployed. (c) Plans were to utilize HSS-2 helicopters for astronaut retrieval rather than the SA-16. These helicopters were deployed with a Mercury program doctor aboard. NOTE: ETA of the Farragut at the spacecraft landing point was 03:19 and ETA of the Pierce (DD-13) was 06:34. The Pierce was equipped to retrieve the spacecraft and the Farragut was prepared to stand by to provide emergency assistance if required.
06:54	01:58	The P2V search aircraft reported the flotation collar attached to the spacecraft and inflated.
07:55	02:59	The astronaut was retrieved by an HSS-2 helicopter (see figure 9.2-3). The doctor reported condition of the astronaut as good. A second HSS-2 retrieved the pararescue team.
08:35	03:39	The Farragut arrived in the landing area and maintained visual contact with the spacecraft.
09:10	04:14	The astronaut was delivered to Mercury medical personnel aboard the Intrepid for medical examination and debriefing.
11:07	06:11	The Pierce recovered the spacecraft and secured it aboard. NOTE: A "shepherds crook" was used to attach a lifting-line to the spacecraft, which was then hoisted aboard. Photographs of the spacecraft prior to and during retrieval are shown in figures 9.2-4 and 9.2-5.

Elapsed time from launch, hr:min	Elapsed time from landing, Hr:min	Event
		25 May, 1962
15:35	10:39	The astronaut arrived at Grand Turk Island for further debriefing.
30:45	25:49	The spacecraft arrived at Cape Canaveral. NOTE: The Pierce delivered the spacecraft to Roosevelt Roads, and it was then airlifted to Cape Canaveral.

9.3 Recovery Aids

All spacecraft recovery aids functioned normally, with the exception that there were no reports of SEASAVE HF/DF beacon reception.

One search aircraft reported contact with the Super SARAH recovery beacon at a range of 250 nautical miles. Another search aircraft reported receiving the SARAH recovery beacon at a range of 50 nautical miles. Aircraft also reported establishing contact with the D/F mode of the UHF transceiver.

The flashing light was reported to be functioning normally and was visible up to 6 miles. The dye marker was sighted by a search aircraft at a range of 15 nautical miles.

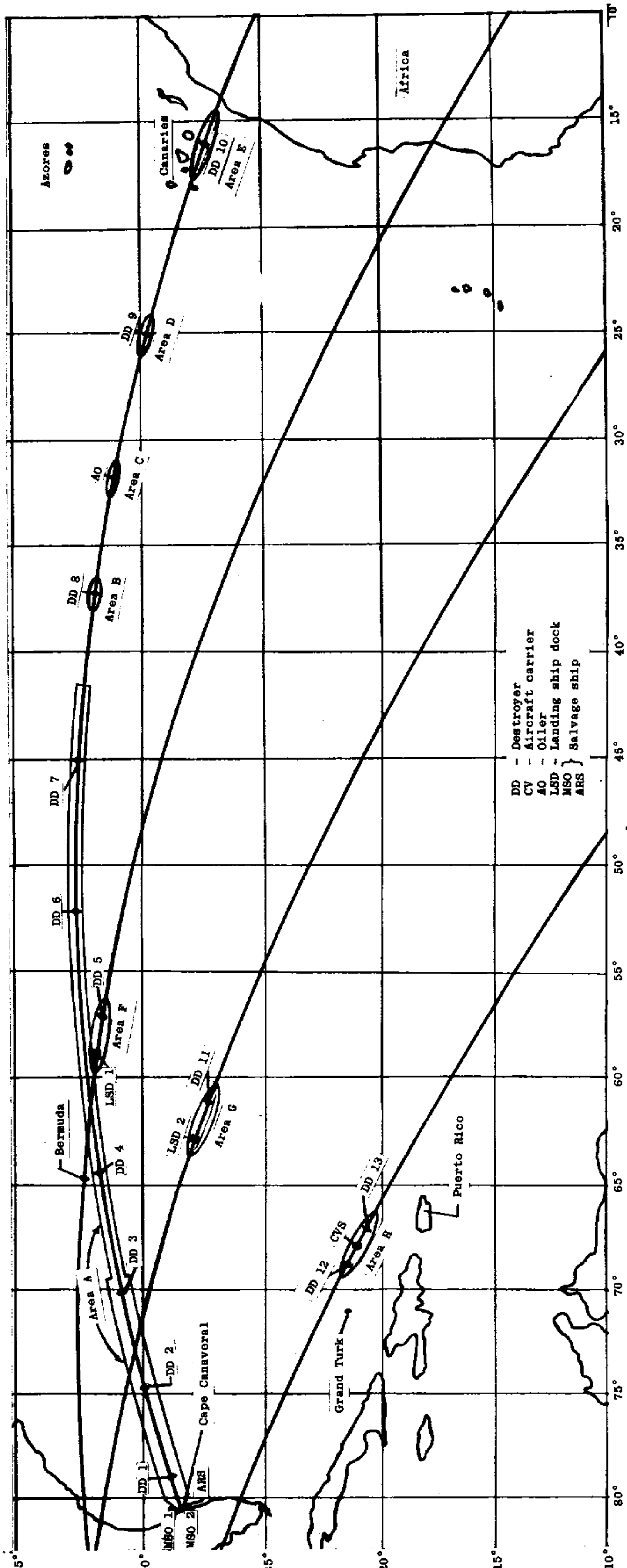


Figure 9.1-1.- Recovery areas and ship locations.

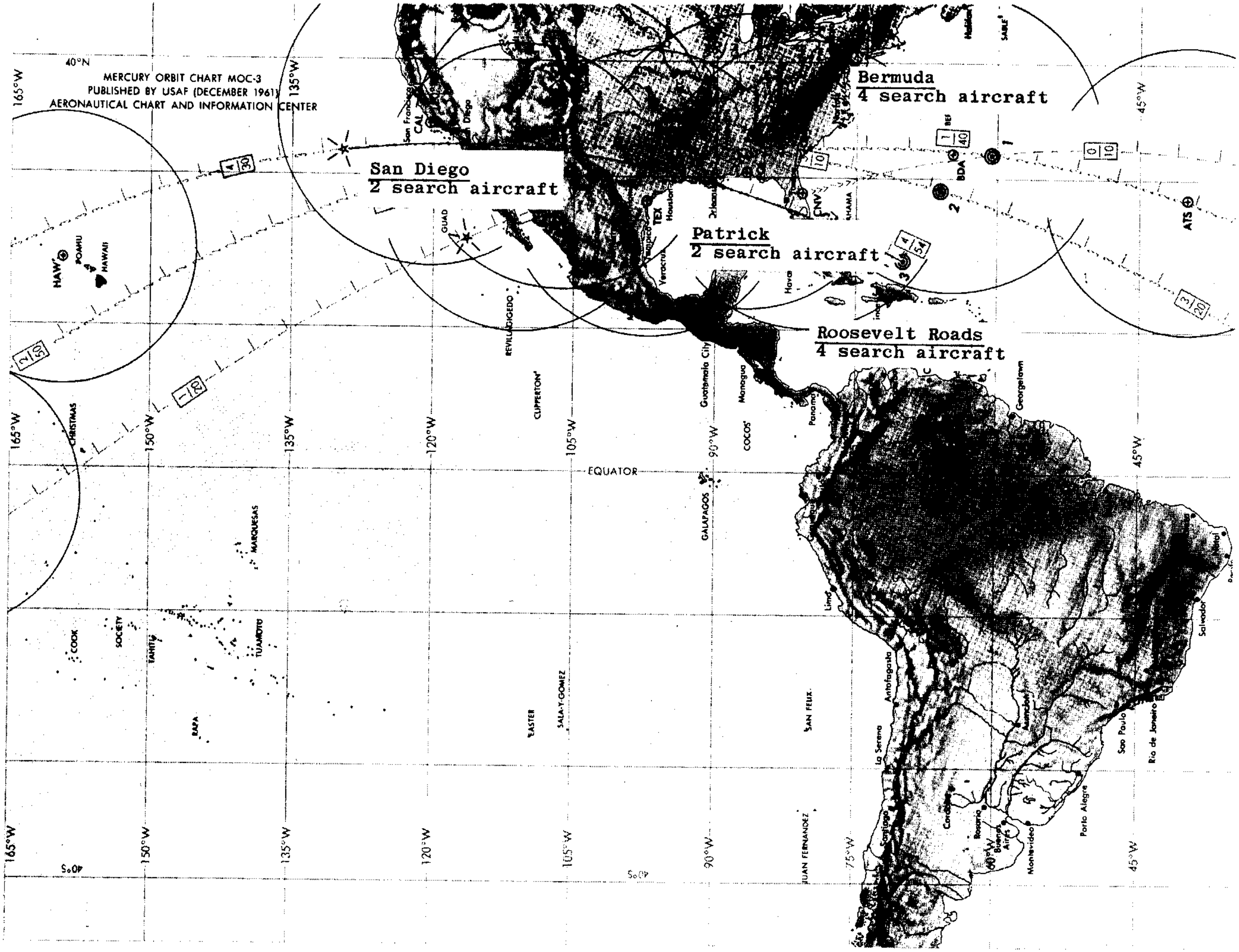


Figure 9.1-2.- Contingency recovery support forces.

CONFIDENTIAL

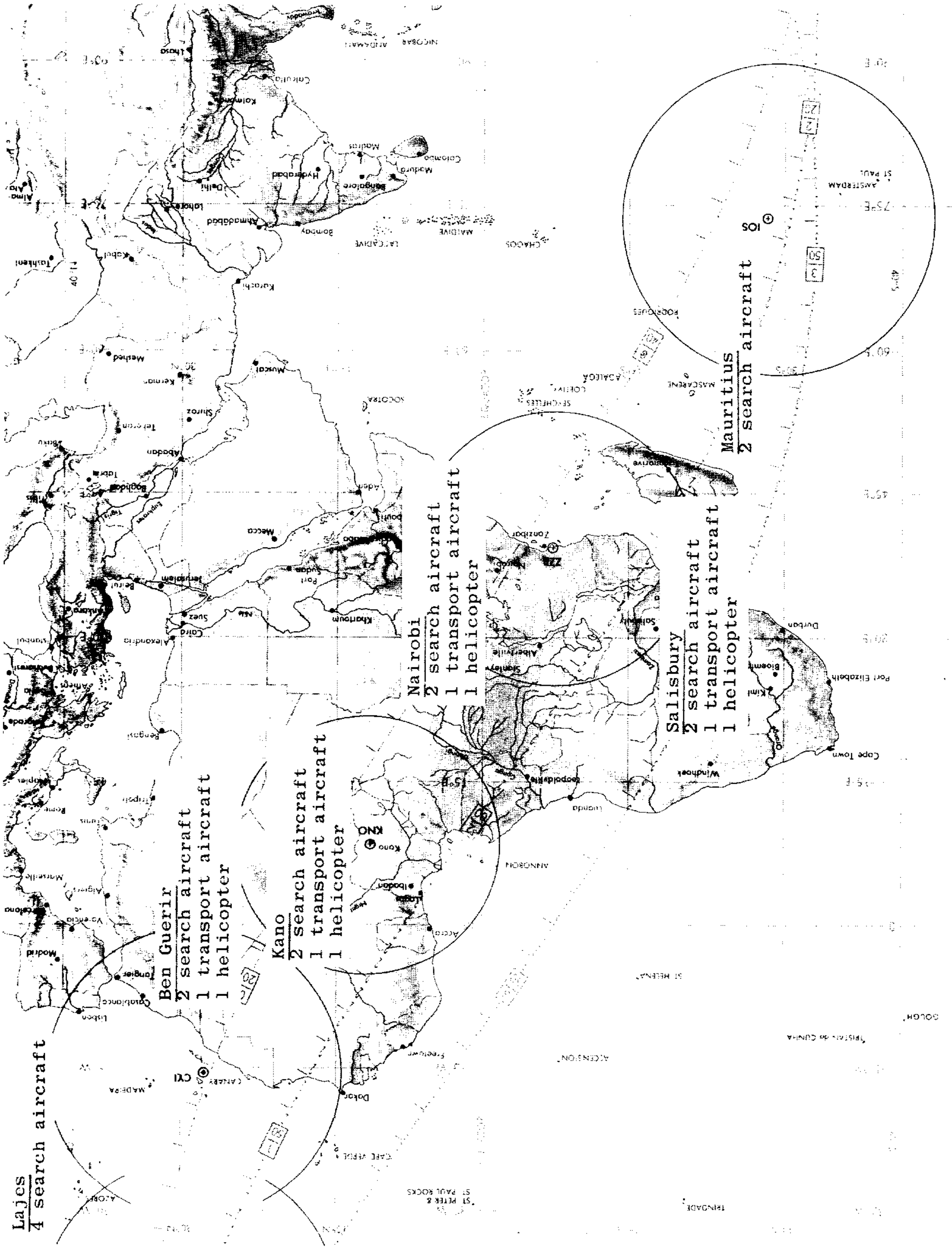


Figure 9.1-2.- Continued.

CONFIDENTIAL

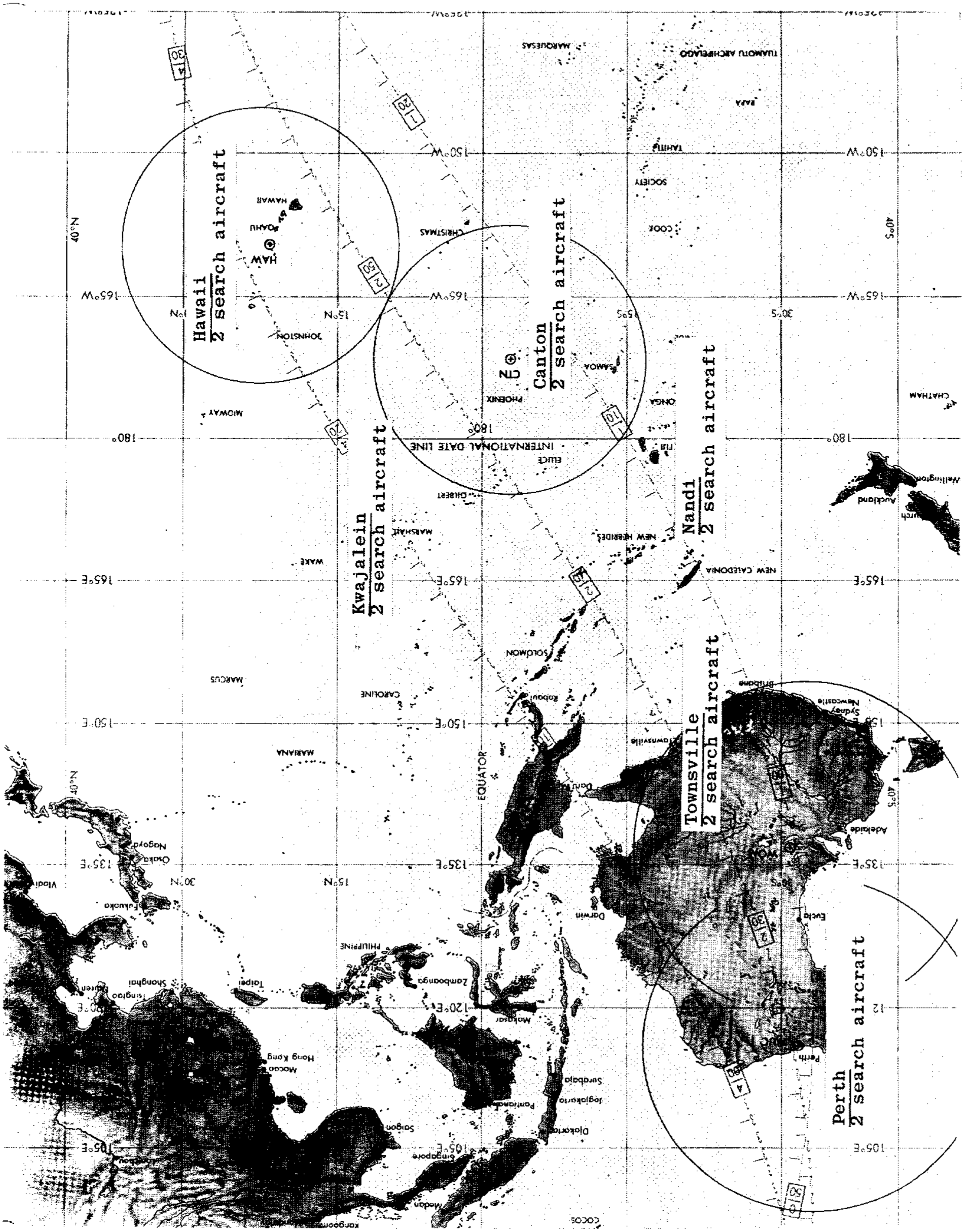


Figure 9.1-2.- Concluded.

CONFIDENTIAL

CONFIDENTIAL

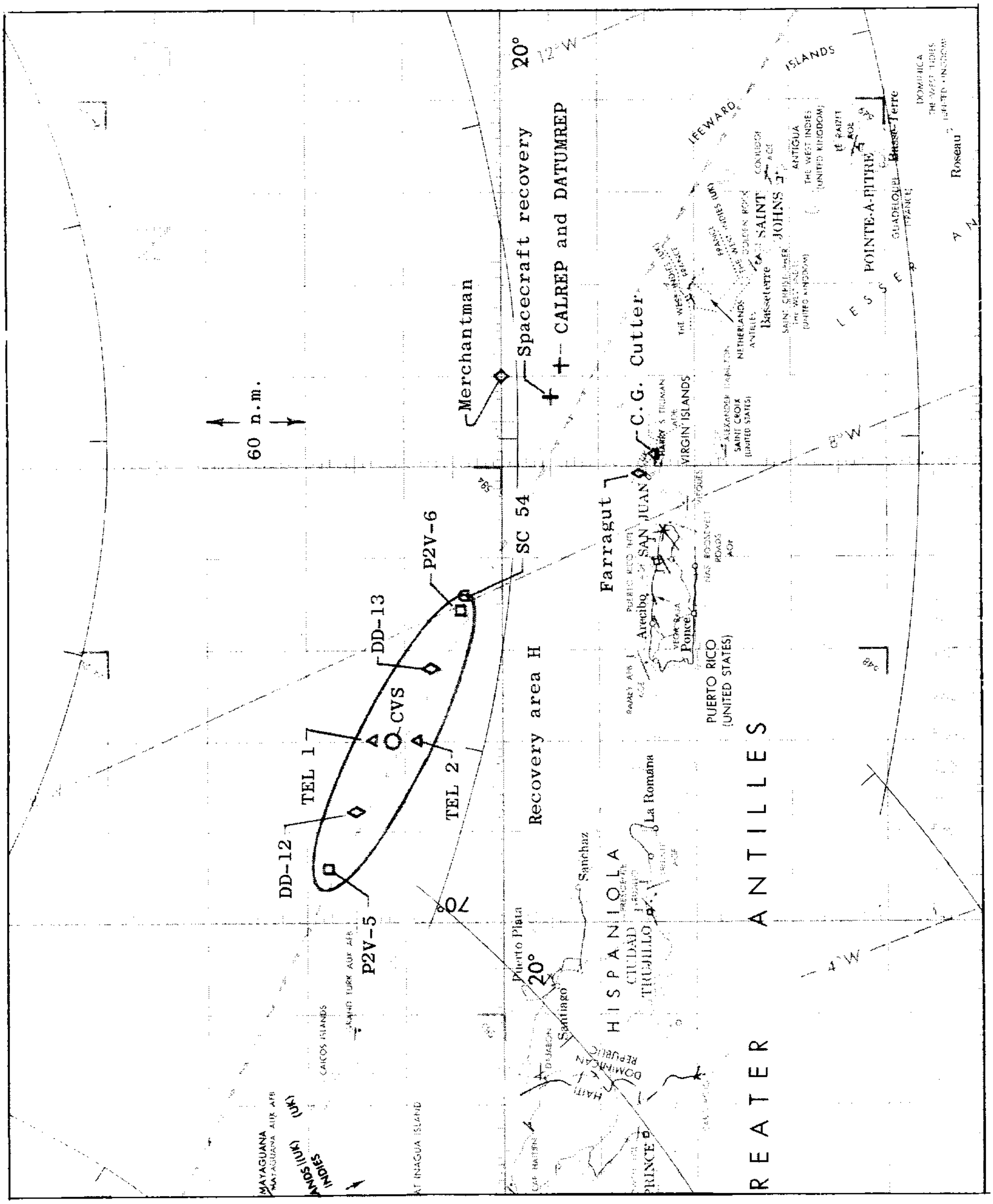


Figure 9.2-1.- Details of landing area H.

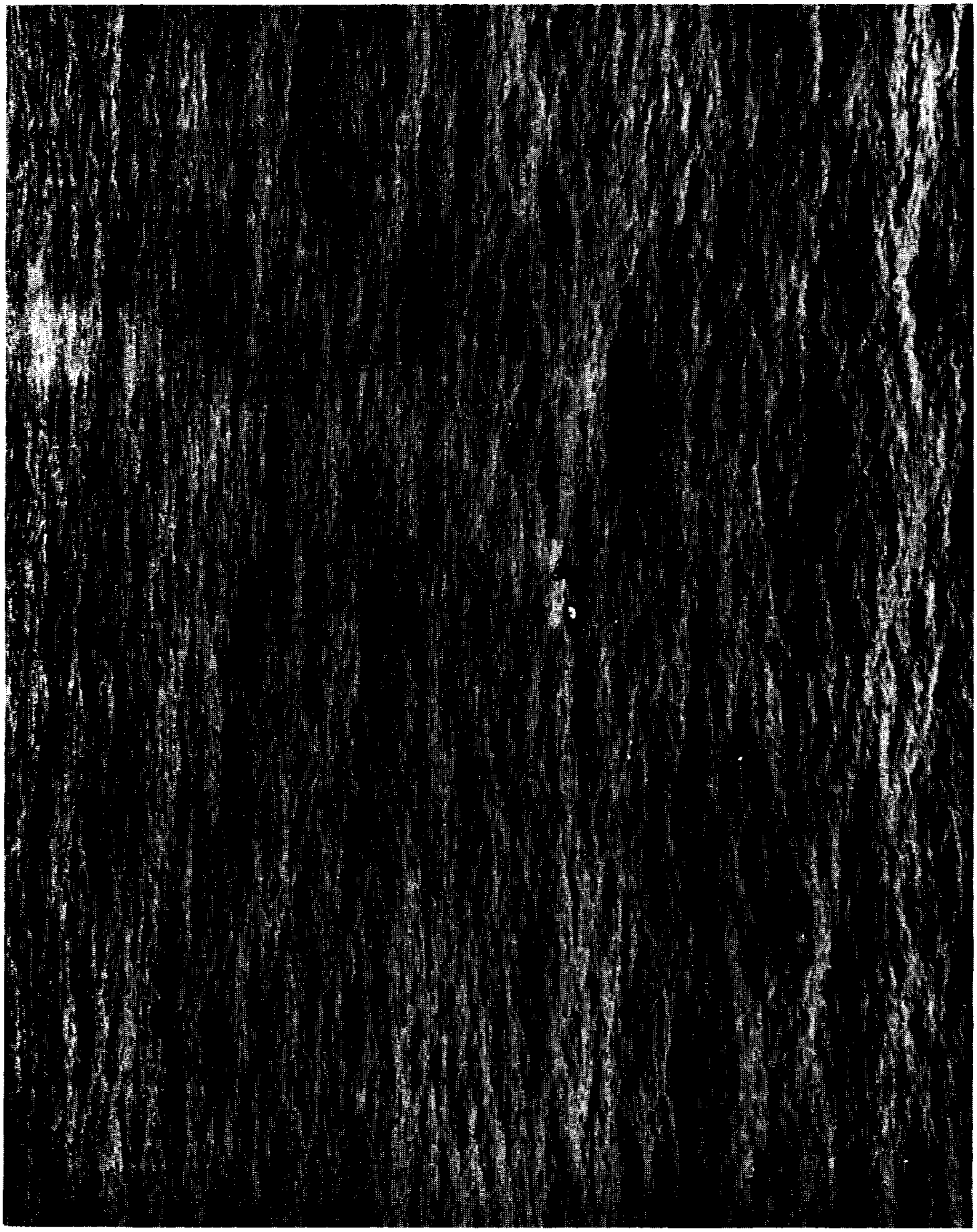


Figure 9.2-2.- Spacecraft prior to installation of auxiliary flotation collar.

Figure 9.2-3.- Astronaut retrieval by HSS-2.

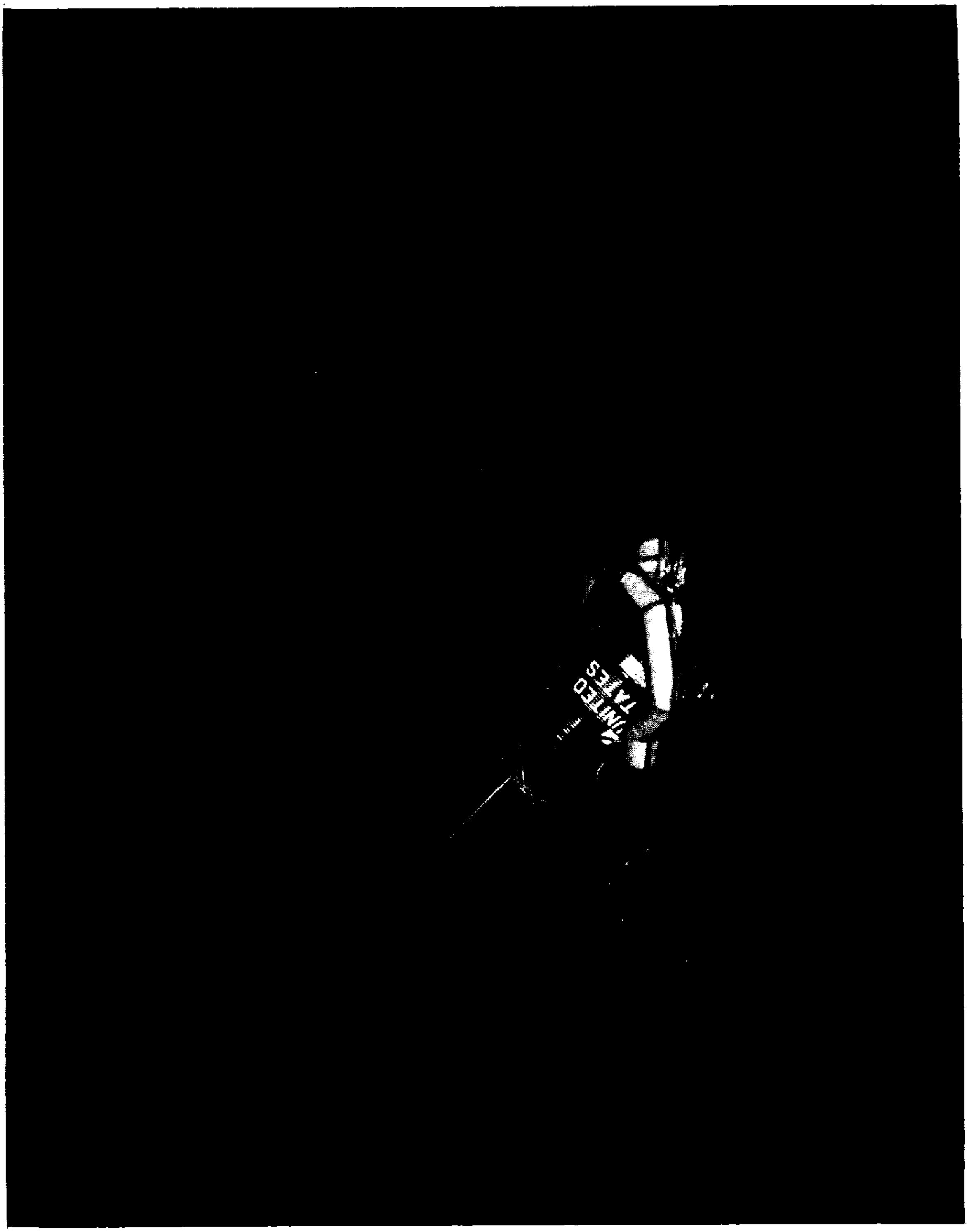


Figure 9.2-4.- Spacecraft prior to pickup.

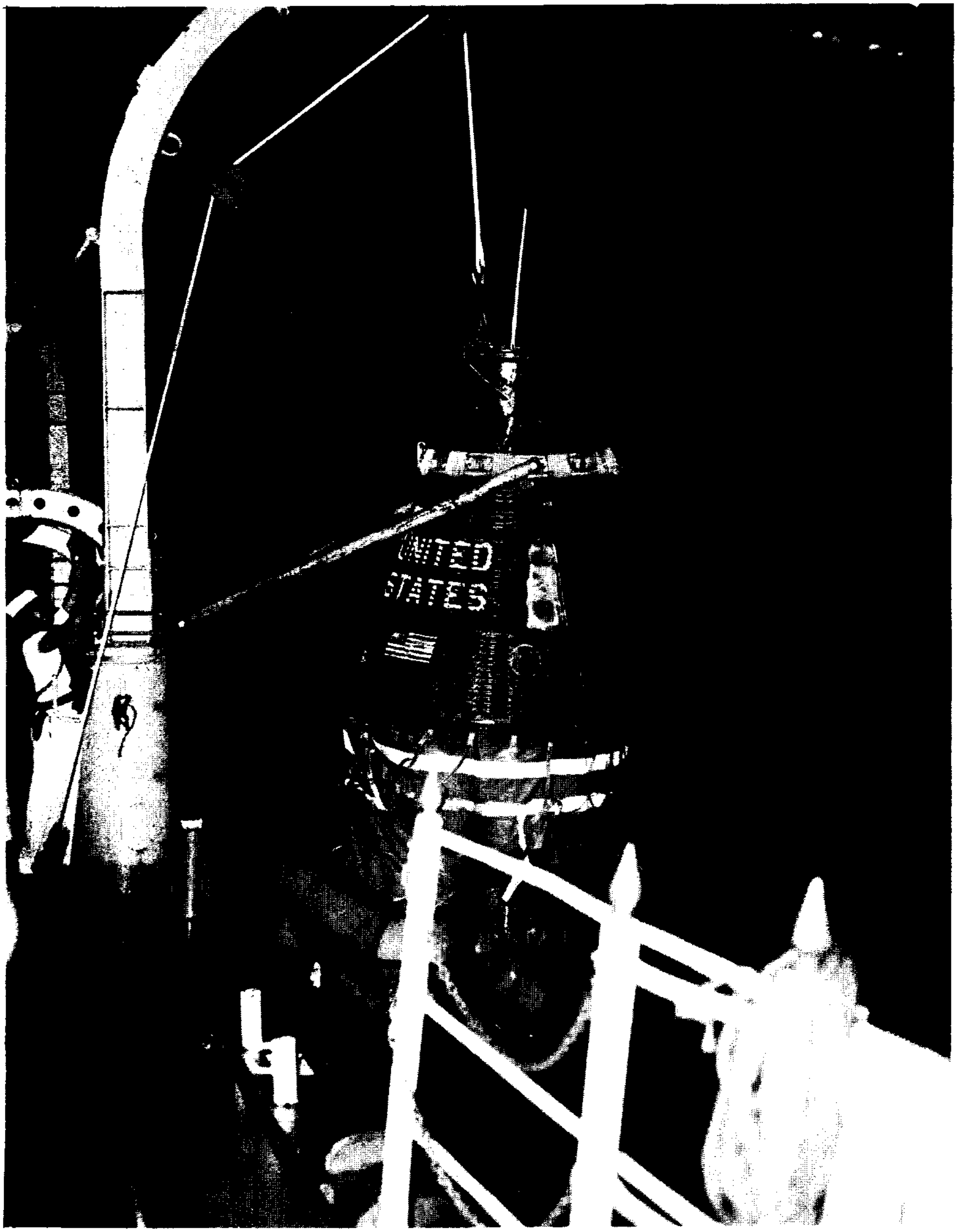


Figure 9.2-5.- Spacecraft being hoisted aboard recovery ship.

10.0 APPENDIX A

10.1 Postflight Inspection

Spacecraft number 18 underwent the normal postflight conditioning procedure. A photographic record was made of this process after the spacecraft was returned to Hangar S, Cape Canaveral. A thorough visual inspection was made of the external and internal areas in the "as-received" condition (see figure 10.1-1). Switch and control positions were noted. The spacecraft was then taken to the pyrotechnic area for external disassembly and inspection, and following this, it was transported to the power area for a postflight systems check.

A de-salting wash-down, tank drainage, and flushing procedure, if applicable, was accomplished, and deterioration safeguards were taken in general. The immediate postflight inspection procedure included external disassembly of the heat shield and conical shingles in order to inspect the pressure bulkhead and internal skin areas. Samples of insulation were removed and stored for later analysis. The following paragraphs discuss individual spacecraft structural systems and the results of a detailed inspection.

10.1.1 Structure.- The spacecraft experienced no inflight damage. The conical-section shingles showed the usual bluish and orange tinge, and the cylindrical-section shingles displayed the usual dark-yellow-gray appearance, both of which were caused by aerodynamic heating. Several shingles were slightly dented and scratched, as in previous missions, presumably during recovery operations.

10.1.2 Ablation shield.- The external surface of the heat shield had the normal, evenly charred, glass-streaked appearance, and some circumferential separation of the edge laminations was evident. The ablation shield center plug was found to be missing, with evidence that the plug remained intact through the reentry heat pulse, as in the MA-5 mission. A number of cracks similar to those experienced in some previous missions were found in the ablation shield exterior; however, these cracks did not compromise mission safety. Considerable recovery-handling dents and cuts were noted. The weight loss of the heat shield during the reentry phase amounted to approximately thirteen pounds. A postflight photograph of the ablation shield is shown in figure 10.1-2.

10.1.3 Landing bag.- The landing bag had been damaged quite extensively, and all landing bag straps had been broken, primarily because of sea action (see figure 10.1.3-1).

10.1.4 Recovery compartment.- The interior of the compartment was undamaged, and the appearance, except for stains from the recovery dye marker, was normal. The butterfly antenna atop the spacecraft was bent somewhat during postflight handling, and the whip antenna had been severed, as in previous missions, as part of the standard recovery procedure.

10.1.5 Main pressure bulkhead.- Small areas of honeycomb were crushed slightly, and some minor deformation of small tubing was noted. This minor damage was evidently due to deflection of the fiberglass protective shield which was struck by the edge of the ablation shield during landing. The fiberglass protective shield was gouged in four places by heat-shield retaining studs during landing re-contact. The main pressure bulkhead was intact, except for a small leak noted below.

10.1.6 Spacecraft interior.- Nearly the entire interior of the spacecraft was wet from sea water which got into the cabin after landing. About four inches of water remained in the astronaut's couch and battery compartments after draining of this sea water aboard ship. Some electrical connectors and internal spacecraft systems were heavily corroded; however, all systems responded well to postflight systems checks. The window was clear, although the usual moisture was present between the two outer panes. A postflight pressure-leak test yielded a leak rate of 2670 cc/min (as compared to about 1000 cc/min preflight) with an audible leak at the thermocouple-lead passage in the large pressure bulkhead. Some of the water found in the spacecraft at recovery undoubtedly came from this source.

10.2 Launch Operations

The spacecraft launch operations were planned about a 610-minute split countdown with a 17 1/3 hour built-in hold at T-390 minutes for spacecraft RCS fuel and pyrotechnic servicing. To provide additional assurance that the projected launch time of 7:00 a.m., e.s.t., 24 May 1962 could be met, a 90-minute built-in hold was scheduled at T-135 minutes.

The second half of the split countdown was started at 11:00 p.m., e.s.t. on 23 May 1962. Launch occurred at 7:45 a.m., e.s.t., on 24 May 1962 after 45 minutes of unplanned holds. The following is a sequence of major events, including holds, which occurred in the countdown:

T-390 min	Start of second half of countdown.
T-135 min	Astronaut insertion.
T-94 min	Spacecraft hatch closure started.
T-74 min	Spacecraft hatch secured, shingle installation started.
T-64 min	Spacecraft shingle installation complete.
T-47 min	Service tower (gantry) first motion.
T-33 min	Service tower stowed.
T-32 min	LOX pumping started.
T-11 min	15-minute hold for weather (launch area smoke and ground fog). Hold extended for additional 15 minutes for weather. Hold extended for additional 10 minutes for evaluation of atmospheric-refraction data. Hold extended for additional 5 minutes to complete refractometer data evaluation.

10.3 Weather Conditions

Weather in the launch area was initially unsatisfactory for required camera coverage because of a ground fog and smoke condition. By 7:30 a.m., e.s.t., conditions had improved considerably and at launch time were as follows:

Sky cover - broken at 700 feet

Wind - 8 knots from 240 degrees (WSW)

Visibility - 1 mile

Temperature - 77°F

Dewpoint - 73°F

Relative humidity - 88 percent

Although the ground visibility at lift-off was limited to one mile, the estimated camera coverage through 250,000 feet was predicted to be good at the time of launch. The coverage actually obtained from various supporting cameras is presented in Section 10.7.

A plot of the launch area wind direction and speed is shown in Figure 10.3-1 for altitudes up to 60,000 feet.

Weather and sea conditions in all Atlantic recovery areas were reported as satisfactory prior to launch. Weather and sea conditions in the planned landing area at the end of the third orbital pass are given below. These were reported by the destroyer, John R. Pierce, at noon, e.s.t., on May 24, 1962

Cloud cover - 4/10 (scattered at 1000 feet)

Wind - 11 knots from 096 degrees (easterly)

Visibility - 10 miles

Air temperature - 84°F

Wet bulb temperature - 79°F (dewpoint)

Water temperature (insertion) - 77°F

Wave height - 3 feet

The destroyer, USS Farragut, standing by the spacecraft at 12:50 p.m., e.s.t., reported the following weather and sea conditions:

Wet bulb temperature - 75°F

Air temperature - 80°F

Wave height - 2 to 3 feet

10.4 Spacecraft History

Spacecraft number 18 arrived at Hangar S, Cape Canaveral, Florida, on November 1, 1961. The preparation period in the hangar consisted of the standard work periods, system checkouts, and configuration changes. Actual work days in the hangar totaled 100 days, of which 40 days were spent on tests. The number of Mission Preparation Sheets (items requiring work) and Discrepancy Reports (unsatisfactory items) were 505 and 560, respectively, and are typical. The spacecraft was transported to the launch site on April 28, 1962. A brief history of the spacecraft is graphically presented in Figure 10.4-1.

Major spacecraft changes and modifications prior to launch are chronologically listed below.

No.	Spacecraft Modification	Completion Date
1.	The heat shield was X-rayed, and the center-plug dowels were determined to be acceptable.	Dec 7, 1961
2.	The auxiliary battery for the maximum-altitude sensor was added.	Dec 9, 1961
3.	Gyros with a silicone-base lubricant were installed.	Dec 14, 1961
4.	The cabin fan inlet duct was equipped with screens to prevent possible cabin fan fouling by foreign material.	Dec 18, 1961
5.	The check valve was removed from the cold-plate water system.	Dec 20, 1961
6.	The oxygen partial-pressure indicator was deleted.	Jan 10, 1962
7.	The suit-compressor check valves were positively oriented and had springs to assist their closing.	Jan 11, 1962
8.	The semi-automatic blood pressure measuring system, which included the fill and dump solenoids, was added.	Jan 24, 1962
9.	The velocity sensor was reset from cap-sep +5 second to cap-sep ±5 minutes.	Jan 25, 1962

No.	Spacecraft Modification	Completion Date
10.	The suit-circuit constant bleed orifice was removed.	Jan 31, 1962
11.	The C-band beacon did not respond during the Service Engineering Department Report (SEDR) 195 interrogation, a communication system radiation test, and was returned to the vendor.	Feb 13, 1962
12.	The cabin relative-humidity indicator was removed.	Feb 14, 1962
13.	The coolant quantity indicator was deleted.	Feb 14, 1962
14.	The Sofar bombs and radar chaff were deleted from the spacecraft.	Feb 14, 1962
15.	The oxygen partial-pressure transducer was removed from the suit circuit and located in the cabin.	Mar 2, 1962
16.	The landing bag limit switches were rewired for improved reliability of the system.	Mar 3, 1962
17.	The 1/4-g relay circuitry was changed to prevent drop-out of this relay during posigrade ignition.	Mar 6, 1962
18.	The oxygen-flow sensor was disabled.	Mar 14, 1962
19.	The low-frequency telemetry center frequency was raised 500 kc.	Mar 30, 1962
20.	A maneuver switch was installed that removed roll and yaw slaving of gyros and pitch orbital precession.	Apr 2, 1962
21.	The hand-controller fly-by-wire switch rod was changed to incorporate a step to prevent travel from going over-center.	Apr 7, 1962
22.	The instrument panel camera was deleted.	Apr 9, 1962
23.	A dual indicator was installed for the suit and cabin steam-vent temperatures.	Apr 12, 1962

No.	Spacecraft Modification	Completion Date
24.	All one-pound thrusters had the Dutch weave screens removed and four platinum screens added plus a distribution plate. The six-pound thrusters had the screens added.	Apr 18, 1962
25.	A 30-inch balloon was installed for obtaining visual acuity effects and aerodynamic drag measurements.	Apr 19, 1962
26.	A separately-commutated temperature survey was installed using thermocouples and resistance elements.	Apr 20, 1962
27.	The oxygen emergency-rate valve and system shut-off valve were hard link connected.	May 3, 1962
28.	Zero-gravity experimental apparatus was installed in the position formerly occupied by the instrument-panel camera.	May 4, 1962
29.	The yaw manual-proportional valve was replaced at the launch site after a simulated launch, since tests had revealed poor centering from left-yaw position.	May 11, 1962
30.	A third barostat was installed in the cabin and wired into the parachute circuitry to prevent automatic-system deployment of the drogue and main parachutes at altitudes above 11,000 feet.	May 19, 1962

The spacecraft spent 26 days aboard Atlas 107-D at the launch site. The following specific activities were accomplished during this time:

No.	Activity	Completion Date
1.	Mechanical mate	Apr 28, 1962
2.	Simulated flight #1 (system)	Apr 30, 1962
3.	Electrical mate and aborts	May 4, 1962
4.	Special hydrogen peroxide tests	May 4, 1962

No.	Activity	Completion Date
5.	Simulated flight #2 (joint FACT)	May 5, 1962
6.	Flight configuration and aborts	May 8, 1962
7.	Launch simulation	May 10, 1962
8.	Simulated flight #3	May 15, 1962
9.	Simulated flight #3	May 18, 1962
10.	Launch	May 24, 1962

10.6 Telemetry, Instrumentation, and Onboard Film

The MA-7 instrumentation system derived information from different locations in the spacecraft and recorded this information on the onboard tape recorder. Much of the information received was transmitted from the spacecraft through two telemetry transmitters. The pilot-observer camera, mounted on the instrument panel, took pictures of the astronaut and a zero-gravity experiment at different frame speeds throughout the mission.

10.6.1 Systems description.- The instrumentation system flown in MA-7 was essentially the same as that of MA-6, although some changes were made to incorporate new experiments and generate additional data. The research experiments added were the zero gravity experiment and the balloon experiment; and a more complete temperature survey was incorporated.

The zero gravity experiment employed the pilot-observer camera, which took pictures of a transparent sphere containing liquid. The balloon experiment used a thirty-inch mylar balloon which was deployed in orbit, and the tension exerted on a strain gage was measured. The output modulated a strain gage oscillator (SGO), which was recorded on the onboard tape recorder. The temperature survey used a solid-state low-level commutator, thermocouples, resistance elements, thermistors and an existing channel of the onboard tape recorder.

Deletions in the spacecraft instrumentation system were the coolant quanitity indicator, O_2 partial-pressure indicator, telemetry high- and low-frequency transmitter temperatures, the backup heat shield temperatures (pickup numbers 3 and 4), and the instrument-panel camera. Cross strapping of the X- and Y-axis accelerations and the command receiver signal strengths were also deleted. In place of the telemetry transmitter temperatures and heat shield temperatures were the "B" nut temperatures on the clockwise and counter-clockwise, automatic and manual, roll thrusters. Backup segments for the command-receiver signal strengths and the four thruster "B" nut temperatures were incorporated with the removal of the cross strapping, which also enabled the separation of the horizon-scanner pitch and roll ignore by placing them on separate segments. Four segments were then left unassigned; one was used as a three-volt reference and the other three were zero references.

Other changes to spacecraft 18 are listed as follows:

1. Suit and cabin steam-vent temperature pickups were installed in the steam-vent overboard ducts and monitored on a dual indicator.

2. A modified integrating accelerometer was installed which reduced the 240 feet per second relay to 210 feet per second.

3. A semi-automatic blood pressure measuring system was installed. A manual start button was installed on the instrument panel.

4. The oxygen partial-pressure transducer was relocated from the suit circuit to the cabin.

5. The suit pressure indicator was calibrated from four to six psia only.

6. The low-frequency-transmitter center frequency was raised 500 Kc to eliminate RF interference experienced during the MA-6 flight.

10.6.2 Prelaunch.- The pilot-observer camera was found to have low clutch tension and was replaced. The oxygen partial-pressure transducer began to rise in output the day before the first scheduled launch. This indicated a drying out of the transducer. A decision was made to remove only the transducer and make calibrations using another set of amplifiers. The calibration curve did not follow the same curve as the previous calibration and a decision was made not to rely on the information received. All telemetry during prelaunch testing was working correctly.

10.6.3 Launch.- During a period of approximately 20 seconds, starting at T+90 secs, extraneous signals appearing at the ECG electrodes drove the subcarrier oscillators (SCO) from bandedge to bandedge. These large fluctuations were caused by the astronaut's high body movements.

At lift-off, the telemetry signals were of good quality, with signal strengths of 8,000 microvolts for the low-link and 10,000 microvolts for the high-link. At tower release, the signal strengths went from 500 microvolts to 700 microvolts on both links. At staging, a loss of signal for one second was evident; this is normal and is caused by flame attenuation. At launch, the transmitter frequencies were -6.0 Kc from the center frequency for the low-link and -5.0 Kc from the center frequency for the high-link. On the first orbital pass, the high-link was +7.0 Kc from the center frequency, and no reading was made on the low-link. Center frequency readings were not made on the telemetry links during the second and third passes. Both telemetry links were modulated for a total of 60 Kc deviation throughout the MA-7 mission.

10.6.4 Orbit.- While in orbit, the astronaut reported the zero-gravity experiment as having, quote: "Fluid gathered around the standpipe. The standpipe appears to be full and the fluid outside the standpipe is about halfway up." Postflight photographs from the pilot-observer camera confirmed this. The mylar balloon was deployed in orbit, but the test was unsuccessful from an overall standpoint. The reader is referred to the scientific experiment section for a more detailed discussion.

The temperature survey worked well throughout the flight; however, the low clockwise automatic thruster (segment 25) gave no temperature reading, indicating a broken thermocouple.

During the orbital phase, the astronaut's temperature rose to 102°F. R-Cal of this pickup reads approximately the same. Records show that one hour after launch, the astronaut's temperature began to rise. The temperature leveled off ten minutes later at 102°F. Thirty minutes later, an R-Cal was given with no change in body-temperature readout. Analysis of the data shows definitely that the body-temperature readout of 102°F was not reliable and it is believed that the instrumentation was reading the R-Cal resistor through a faulty R-Cal relay on the body temperature amplifier.

The blood-pressure measuring system pressurized when the astronaut actuated the start button, but twice during flight it did not show any pulses during bleed-down time. A postflight system check indicated an intermittently operating microdot cable.

The astronaut reported that the rate indicator moved during Z-Cal. This movement is normal, since the Z-Cal changes the load on the transducer.

The oxygen partial-pressure transducer appeared to operate normally during flight; however, post-calibration of the system was not possible because of the condition of the transducer.

10.6.5 Reentry.- The manual fuel indicator read 6% during reentry, but the astronaut reported no more fuel was available. This condition can exist because the transducer reads pressure whether or not fuel is present.

After black-out, telemetry signals were received by Cape Canaveral and aircraft. The low-frequency transmitter signal had dropouts and was weak. Because of the corrosion of the transmitters from the salt water, a postflight check of the transmitters' signal quality would not be informative. The spacecraft's excessive landing range caused the telemetry signal received by the aircraft to be of poor quality.

10.6.6 Summary.- The pilot-observer film quality from MA-7 was poor because of its submersion in both salt and fresh water, making it impossible for an effective developing process. The film was sufficient, however, to confirm theoretical estimates of the liquid behavior in the zero-g experiment. The onboard tape and the astronaut's hand-held camera film provided excellent flight data. The instrumentation and data system provided satisfactory performance for the mission.

10.7 Atlantic Missile Range Support and Data Coverage

General.- The support provided by the Atlantic Missile Range (AMR) was adequate to obtain satisfactory data coverage for the mission. The part of the discussion which follows pertaining to telemetry and radar coverage includes only items not covered in Flight Control and Network Performance (Section 8.0). These items are committed by AMR, but are not available at MCC for real-time flight-control monitoring. Coverage figures are based on AMR's preliminary estimate of data coverage.

10.7.1 Telemetry.- Telemetry aircraft positioned in the third-orbital-pass landing area obtained telemetry signals from the spacecraft following ionization blackout for a six-minute period (04:49:10 to 04:55:11). The received signal was weak, causing numerous dropouts of the decommutator when played back from the tape; however, there were several periods of useable data from the commutated channels. AMR stations 12 (Ascension) and 13 (Pretoria) made telemetry contact with the spacecraft on the third orbit pass from local horizon-to-horizon. Signal-strength records from these two stations are not presently available, but they will be examined for consideration of use of these facilities (especially Pretoria) for future missions.

10.7.2 Radar.- The Patrick AFB FPS-16 (committed for launch only) obtained track of the spacecraft C-band beacon during the launch phase from 00:00:20 to 00:05:25. Mod II radars at Grand Bahama Island (GBI) acquired track of the spacecraft S-band beacon during a portion of the ionization blackout period from 04:44:36 to 04:46:13. The Mod II's at Grand Turk Island (GTI) did not acquire. The FPS-16 at Ascension acquired and tracked for a five-minute period during the third orbital pass. The MPS-25 at Pretoria also observed the spacecraft for approximately one minute during the third pass. The AZUSA MK II ground station at Cape Canaveral obtained track of the launch vehicle transponder from 00:00:39 to 00:06:34.

10.7.3 Optics.- AMR optical coverage, including quantity of instrumentation committed and data obtained during launch and reentry phases, is shown in table 10.7-1. AMR optical tracking from lift-off or first acquisition to limits of visibility is shown in figure 10.7.3-1. The coverage times shown as bars in this figure represent the duration from when either the spacecraft, launch vehicle, or the exhaust flame was first visible until all three were out of sight. As is evident from the figure, optimal camera coverage is in the region near maximum dynamic pressure, and adequate data would have been available had a failure not occurred at this time. Optical data obtained at other times is considered marginal. At lower attitudes, coverage was primarily limited by ground fog and haze and, at higher altitudes, both ground haze and image reduction due to slant range affected optical tracking capability. Since the quality of data required for an engineering evaluation has never been defined, it cannot be stated whether all coverage represented in the figure, and defined above, is completely adequate.

Metric film: Metric films were processed, and the results were tabulated by AMR, but these data were not required for evaluation by MSC, since the powered flight phase was normal.

Engineering sequential film: Engineering sequential coverage at AMR Station 1 during the launch phase was generally satisfactory. This statement is qualified by the fact that a detailed film analysis was not required as a result of normal mission sequence from liftoff. The quality of fixed and tracking camera coverage was very poor because of fog and ground haze conditions. Twelve films were reviewed, including 16mm and 35mm films from three fixed cameras and nine tracking cameras. The quality of fixed camera coverage with respect to exposure and focus was generally good, with the exception of one underexposed film. LOX boiloff, umbilical ejection, periscope retraction and umbilical-door closure, booster ignition, and lift-off appeared to be normal. The quality of tracking camera coverage with respect to exposure, focus, and tracking was generally good, with the exception of one underexposed and one overexposed film. Four tracking cameras indicated normal booster staging and two tracking cameras indicated normal tower separation.

Documentary film: Documentary coverage of the mission provided by available motion picture films was very good in quality but limited in quantity, particularly in the recovery area. Four motion picture films were available for review. Two of these films presented a portion of the prelaunch activities, including astronaut preparation at Hangar S, transfer to the launch site, and portions of the operational activity at the Mercury Control Center and the blockhouse. One of the above films also presented a portion of the recovery operation, including helicopter pickup of the astronaut and transfer to the recovery aircraft carrier. The two remaining motion picture films included views of the astronaut arriving onboard the carrier, suit removal and physical examination, and arrival of the astronaut and debriefing personnel at Grand Turk Island. Documentary coverage of the mission with respect to still photographs available for review exceeded that of motion picture films. These photographs were excellent both in quality and quantity, particularly in the recovery area. Still picture coverage during and after the recovery operation included views of the astronaut and pararescue personnel in the water prior to helicopter pickup, pickup of the astronaut and transfer to the recovery aircraft carrier, spacecraft retrieval from the water by the recovery destroyer, loading of the spacecraft onboard the aircraft for transportation to Cape Canaveral, and close-up views of the spacecraft after recovery. Numerous engineering still photographs were also available showing close-up views of the spacecraft during the usual postflight inspection at Cape Canaveral.

TABLE 10.7-1.- AMR OPTICAL COVERAGE OF LAUNCH AND REENTRY PHASES

Film Type	Station	No. of Items Committed	No. of Items Obtained	Lost Items	Reason for Loss
Metric	1	15	15	0	
Engineering sequential	1	46	45	1	Camera jammed upon starting
Engineering sequential	1	1	0	1[a]	Track not acquired.
Engineering sequential	3	1	0	1[a]	Track not acquired.
Engineering sequential	5	1	0	1[a]	Track not acquired.
Documentary	1	50	50	0	

[a] Planned for reentry coverage.

10.8 Flight Safety Reviews

A series of flight safety review meetings were held prior to the MA-7 flight. The purpose of these meetings is to firmly establish the flight worthiness of the spacecraft and the launch vehicle. In addition, mission review meetings were conducted to ascertain readiness of all supporting elements of the mission. These meetings are discussed briefly in the paragraphs below.

10.8.1 Spacecraft.- The review meeting for spacecraft 18 was held at 4;00 p.m. on May 14, 1962. The history of the spacecraft after arrival at Hangar S and the current status of all the systems were reviewed. The spacecraft was approved as ready for flight, pending satisfactory completion of the final Simulated Flight Test to be conducted on May 15, 1962. The Simulated Flight Test was satisfactory, and the spacecraft was committed as ready for flight.

10.8.2 Launch vehicle.- Three meetings were held to specifically review the status of the Atlas 107-D, the MA-7 launch vehicle, and generally the results of previous Atlas flights. The first was held at 9:00 a.m. on May 16, 1962, at which time the history of the launch vehicle after arrival at Cape Canaveral and current status of the systems were reviewed. The missile was approved as ready for flight, pending a test of the telemetry system, which was scheduled to be and was successfully completed on May 17, 1962.

The second review meeting was held at 1:30 p.m. on May 16, 1962 to brief NASA-MSC management on all anomalies that had occurred in the Atlas R&D and operational flight program since MA-6. The attempted launches and resulting failures of Atlas vehicles 11-F and 1-F were discussed in this meeting.

The third meeting was held on May 18, 1962, at 2:00 p.m. to discuss the latest information on the Atlas vehicles 11-F and 1-F incidents. It was agreed that the information available at the time of the meeting would not affect the MA-7 launch vehicle flight-readiness status, but that intensive investigation would continue and be reported upon at the T-1 day Flight Safety Review Board meeting.

10.8.3 Mission.- Two mission review meetings were held because of a one-week slippage in the launch date. The first was held at 10:00 a.m. on May 16, 1962, and all elements for the flight were found to be in readiness. After the review meeting, a decision was made to install an additional barostat in the spacecraft parachute circuitry and to replace faulty booster flight-control canisters, resulting in a slippage in the launch schedule.

A second mission review meeting was held at 3:00 p.m. on May 22, 1962, during which the spacecraft, launch vehicle, and all support systems were found to be ready for the MA-7 mission.

The T-1 day Flight Safety Review Board met at 9:30 a.m. on May 23, 1962, and this board was advised that the Status Review Board had met at 8:30 a.m. that morning and found the launch vehicle and spacecraft ready for flight. Additional information on the Atlas 11-F and 1-F flight failures indicated that the differences between the E- and F-series and the Mercury D-series start sequences were significant enough to eliminate doubt in the performance of the MA-7 launch vehicle.

10.9 Test Objectives

To evaluate the performance of the MA-7/18 manspacecraft system in a three-pass orbital mission.

To evaluate the effects of orbital space flight on another astronaut and to compare this analysis with previous astronaut/simulator program results.

To obtain the astronaut's opinions on the operational suitability of the spacecraft and supporting systems for manned space flight.

To evaluate the performance of spacecraft systems replaced or modified as a result of the MA-6/13 manned orbital mission.

Figure 10.1-1.- Postflight photograph of spacecraft 18 prior to disassembly in hangar S.

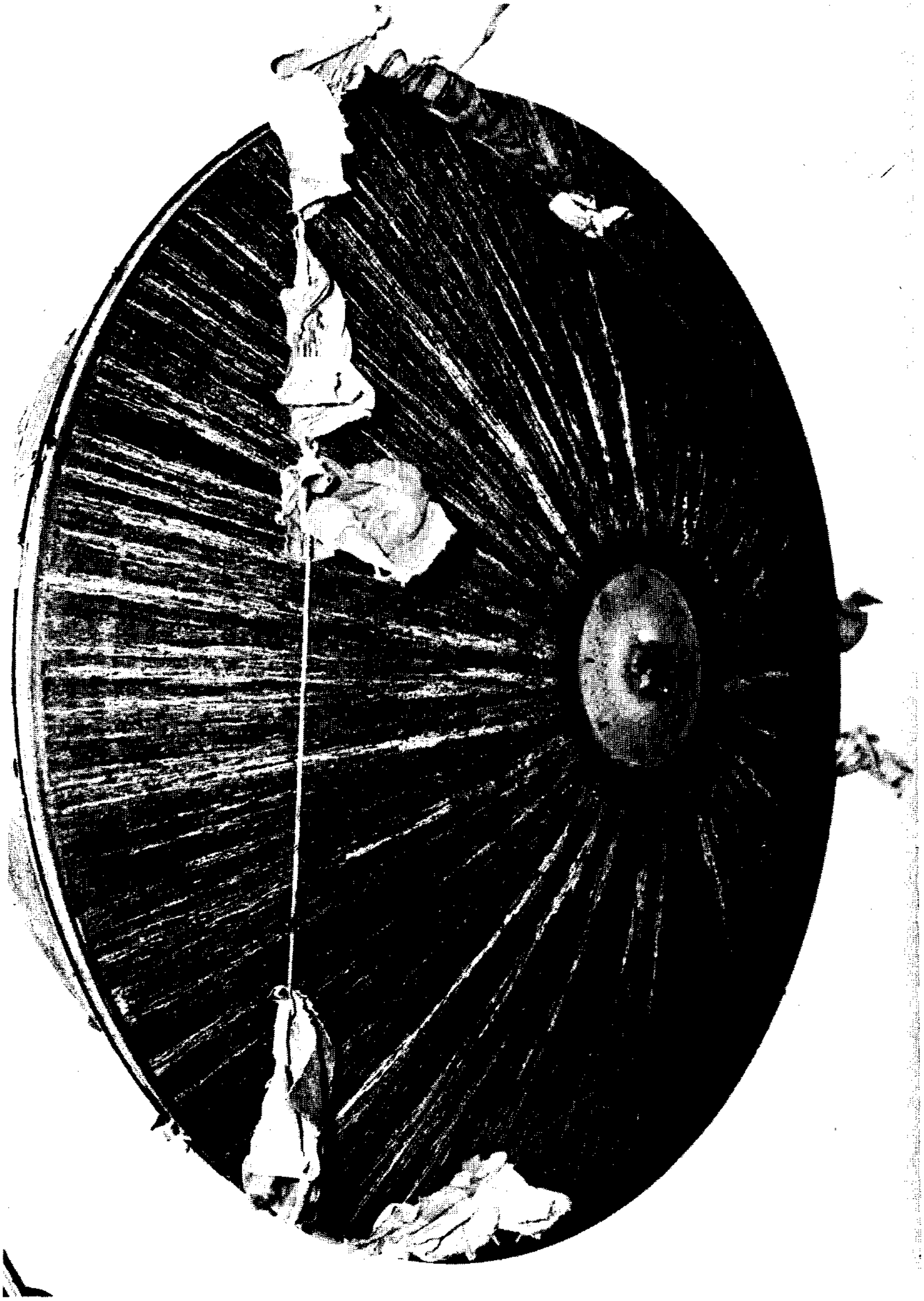


Figure 10.1.2-1.- Postflight photograph of spacecraft 18 ablation shield

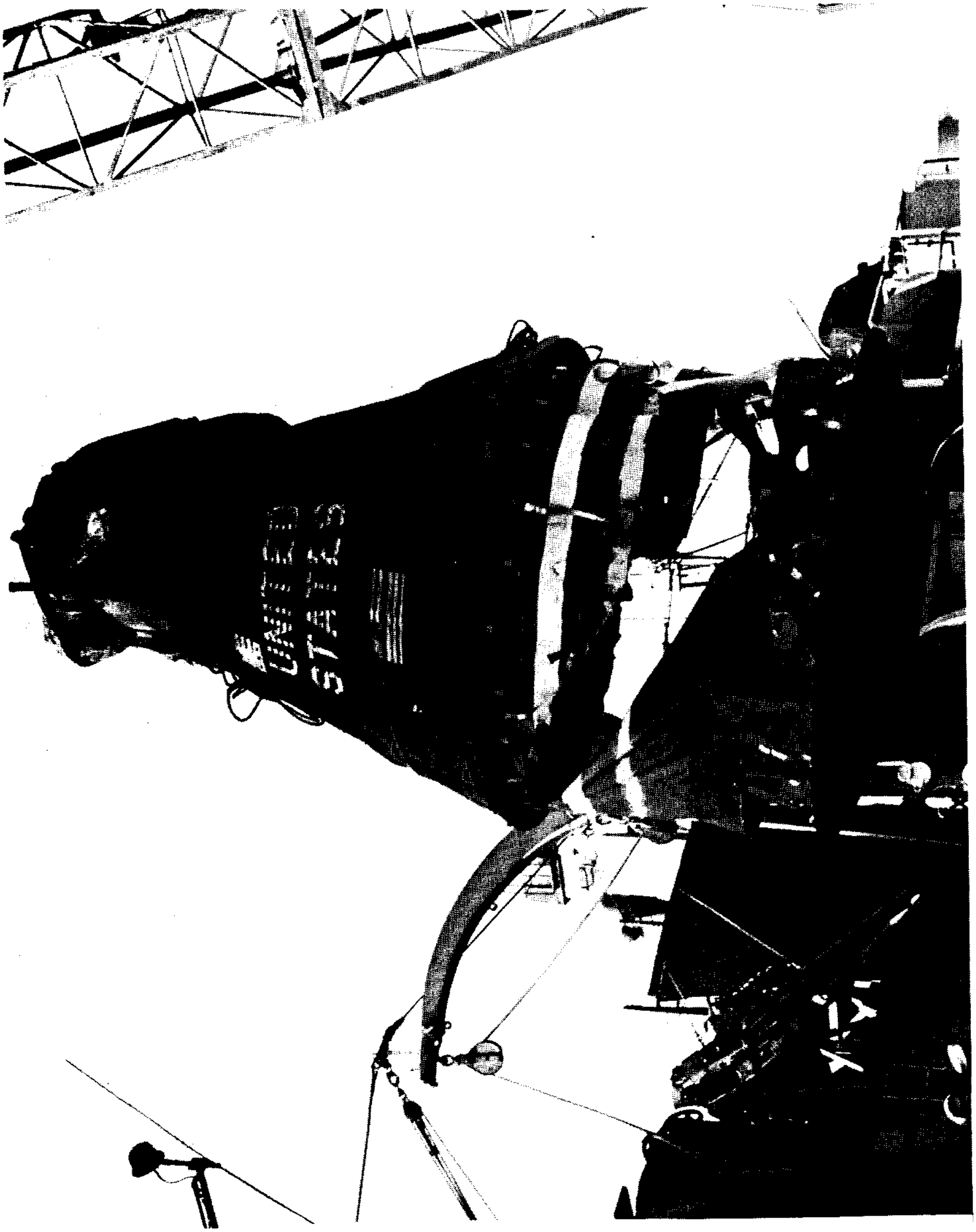


Figure 10.1.3-1.- Spacecraft 18 depicting postflight damage to landing bag and suspension straps.

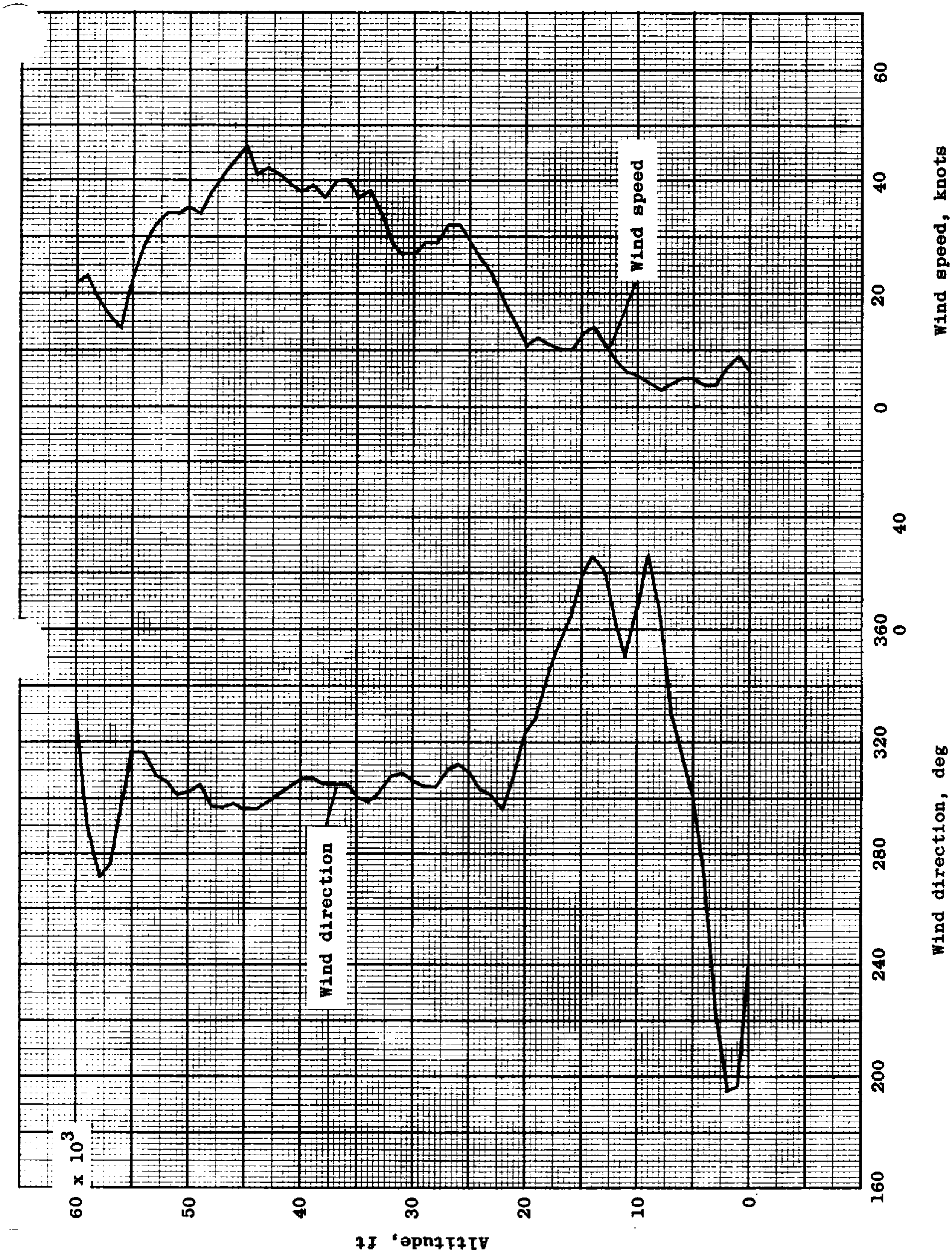


Figure 10.3-1.- Launch site wind direction and speed.

CONFIDENTIAL

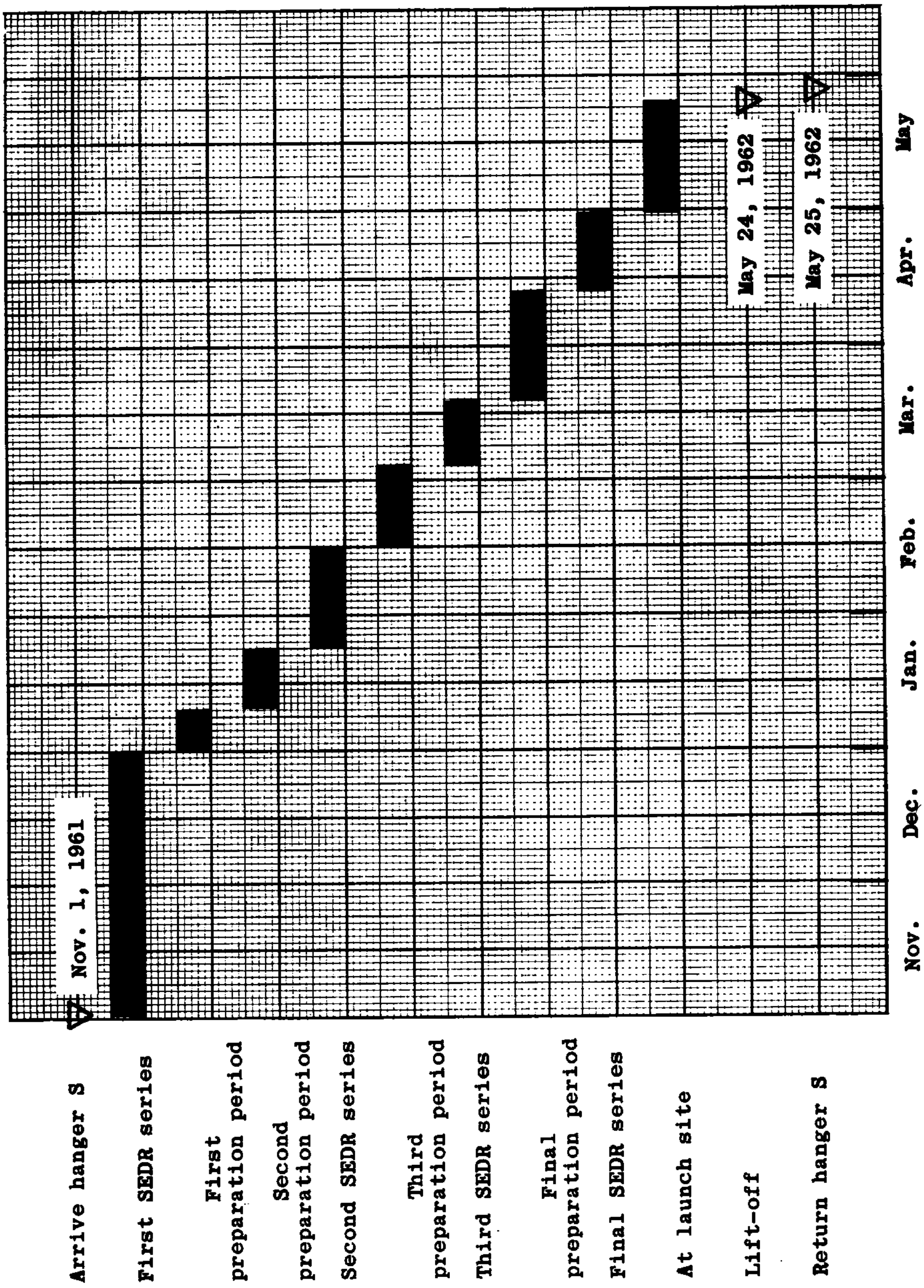


Figure 10.4-1. - Spacecraft 18 prelaunch history.

CONFIDENTIAL

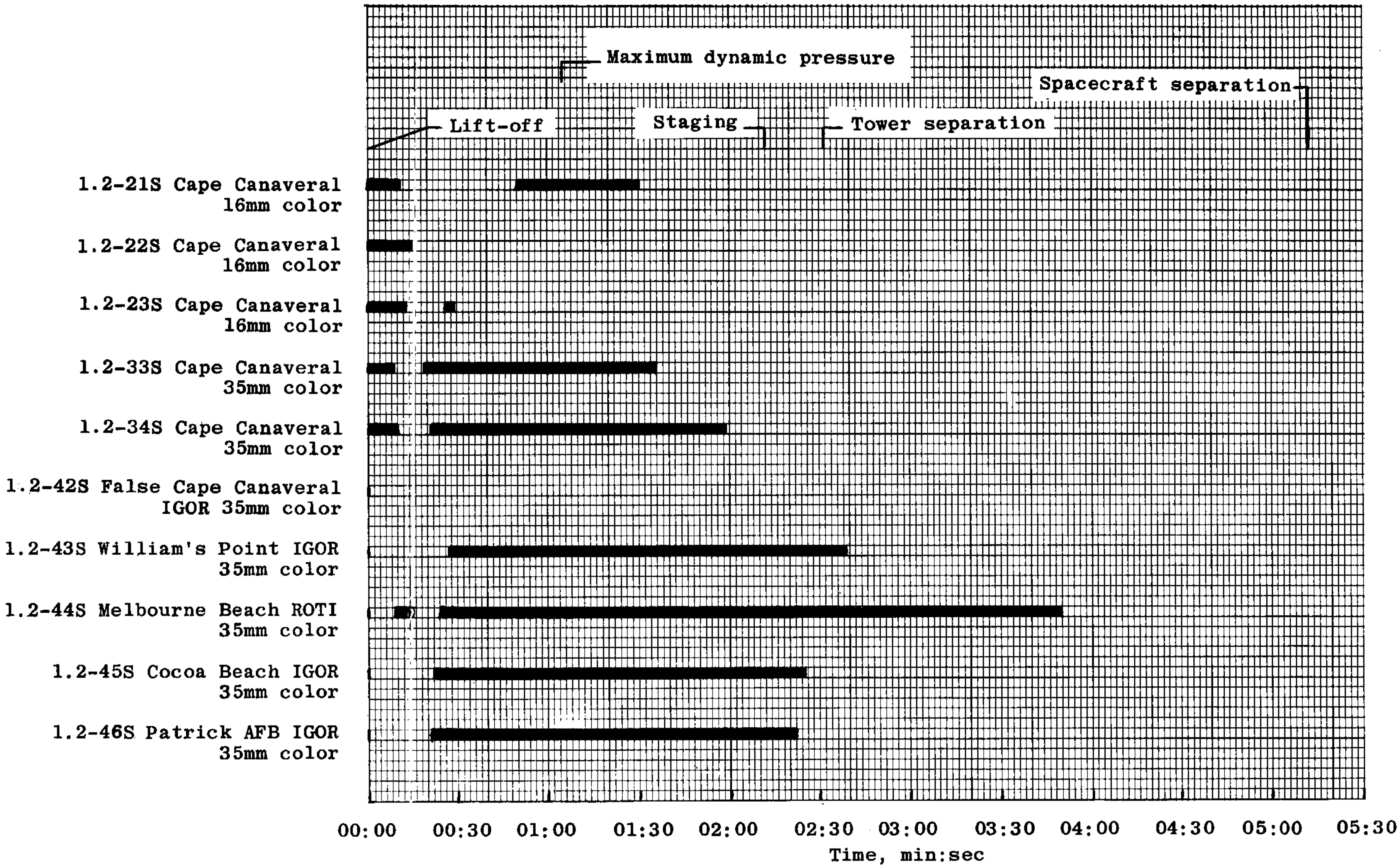


Figure 10.7.3-1.- **AMR** engineering-sequential tracking-camera coverage.

11.0 ACKNOWLEDGEMENT

The Flight Evaluation Team for the MA-7 flight, upon whose analysis this report is based, was composed as follows:

3.0 LIFT-OFF CONFIGURATION DESCRIPTION

3.1 Spacecraft

H. C. Shoaf

3.2 Launch Vehicle Description

D. E. Phillips

4.0 EVENTS, TRAJECTORY, AND GUIDANCE

C. R. Hicks
D. Inserto
J. D. O'Laughlin
K. Osgood
I. E. Hawkins

5.0 SPACECRAFT PERFORMANCE

5.1 Spacecraft Control System

G. T. Sasseen
J. C. Cerven
F. T. Williams
W. Karakulko
P. F. Horsman
V. M. Mitchell

5.2 Environmental Control System

F. Samonski
D. F. Hughes
H. J. McMann

5.3 Spacecraft Communications

W. R. Stelges

5.4 Electrical and Sequential System

T. N. Williams

5.5 Mechanical and Rocket Systems

S. T. Beddingfield
J. Janokaitis, Jr.

5.6 Reentry Heating

O. Kosfeld

5.7 Scientific Experiments

W. O. Armstrong
J. W. Conlon
Dr. J. A. O'Keefe

6.0 LAUNCH VEHICLE PERFORMANCE

D. E. Phillips

7.0 PILOT ACTIVITIES

7.1 Pilot's Impressions of the Flight

H. I. Johnson
Dr. R. E. Dunham

7.2 Flight Activities

H. A. Kuehnel
J. J. Van Bockel
R. Mercer
Dr. J. A. O'Keefe

7.3 Aeromedical Studies

Dr. H. Minners
Dr. E. McCutcheon
Dr. F. Kelly
Dr. D. P. Morris
R. M. Rapp

8.0 FLIGHT CONTROL AND NETWORK PERFORMANCE

C. C. Kraft
H. C. Kyle
T. Roberts
J. D. Hodge
V. M. Dauphin
E. F. Krantz

9.0 RECOVERY

R. F. Thompson
W. Hayes

10.0 APPENDIX
10.1 Postflight Inspection

H. C. Shoaf
W. E. Mosely
K. B. Stoine
A. M. Garza
D. F. Whiting

10.2 Launch Operations

D. E. Phillips

10.3 Weather Conditions

M. McCullough

10.4 Spacecraft History

H. C. Shoaf

10.6 Telemetry, Instrumentation, and Onboard Film

H. Ness

10.7 AMR Optical Coverage

G. W. Knight
F. B. Blanton

10.8 Flight Safety Reviews

N. B. Vaughn

NOTE: Acknowledgement and gratitude is extended to the many typists, artists, and clerical help who assisted so admirably in the publication of this report.

APPENDIX C
12.0 MA-7 AIR-GROUND VOICE COMMUNICATIONS

12.1 Introduction

The table that follows is a verbatim transcript of the MA-7 flight communications taken from the spacecraft onboard tape recording. This is, therefore, a complete transcription of the communications received and transmitted, as well as some inflight comments made while in a record-only mode, by the pilot, Scott Carpenter.

In the table, column one is the ground elapsed time (GET) from lift-off in hours, minutes, and seconds when the communique was initiated. Column two identifies the communicator, as follows:

CC - Capsule (spacecraft) Communicator at the range station

CT - Communications Technician at the range station

F - Flight Director at Bermuda range station

S - Surgeon or Medical Monitor at the range station

Stony - Blockhouse Communicator

All temperatures are given as °F; all pressures are in pounds per square inch, absolute (psia); fuel, oxygen, and coolant quantities are expressed in remaining percent of total nominal capacities; retrosequence times are expressed in GET (hours, minutes, and seconds).

Within the text, a series of three dashes are used to designate times when communiques could not be deciphered. One dash indicates a time pause during a communique. The station in prime contact with the astronaut is designated at the initiation of communications. Also, in the top right hand corner of each page, the station or stations in contact and the orbital pass number are designated.

12.2 Contents of Communication Transcript

12.3 Transcript

CAPE CANAVERAL

	Stony	5,4,3,2,1,0.
00 00 01	P	I feel the lift-off, the clock has started.
00 00 04	CC	(Cape Canaveral) Roger.
00 00 06	P	Loud and clear, Gus.
00 00 07.5	CC	Roger, Aurora 7, stand by for - the time hack.
00 00 11	P	Roger.
00 00 12.5	P	Little bit of shaking, pretty smooth.
00 00 16.5	CC	3,2,1, Mark.
00 00 21	P	Roger, the backup clock has started.
00 00 24.5	CC	Roger, Aurora 7.
00 00 29	P	Clear blue sky. 32 seconds, 9,000, fuel and oxygen steady, cabin pressure 15 1 and dropping. A little rough through max q, and one minute.
00 00 46	CC	Roger, you're looking good from here.
00 00 47	P	Okay, 25 amps and the power is good.
00 00 50.5	CC	Roger, you're looking good.
00 00 59.5	P	Mark, one minute. Cabin pressure is on schedule, fuel and oxygen are steady, 24 amps, all the power is good.
00 01 10.5	CC	Roger, pitch is 56, you look -
00 01 13	P	Roger, my pitch looks good, it's smoothing down a little bit now. I feel the pitch program starting over.
00 01 22.5	CC	Roger.
00 01 26.5	P	The sky is getting quite black at 1 30 - elapsed. Fuel and oxygen is steady, cabin pressure is leveling off at 6 2, 22 amps and the power is still good, one cps sway in yaw.

00 01 44	CC	Roger, understand. Pitch is 37, you look real good.
00 01 59	CC	Standby.
00 02 08.5	P	Roger. There is BECO on time, and -
00 02 14.5	CC	Ah, Roger, understand BECO.
00 02 16	P	Roger, I felt staging. Do you confirm?
00 02 19	CC	Staging?
00 02 20	P	Do you confirm staging?
00 02 22	CC	Aurora 7, we confirm staging.
00 02 24	P	Roger, g peaked at 6.3.
00 02 32	P	The tower is way out. It's gone, the light is green. Going over the BECO check now.
00 02 41.5	CC	Roger, Aurora 7.
00 02 49	P	BECO check is complete.
00 02 54.5	CC	Roger, understand complete. Is that correct?
00 02 57.5	P	That is Roger.
00 03 01.5	P	At three minutes. Fuel and oxygen are still steady, cabin is holding 5 8, power still looks good, my status is good.
00 03 14	CC	Roger, pitch minus, minus 2-1/2, and you're right on, you're good.
00 03 19	P	Roger, reading you loud and clear, Gus.
00 03 29	CC	Aurora 7, --- , you are good.
00 03 33.5	P	Roger, still reading you, broken a little bit. At 30, my status is good, fuel and oxygen are steady. Cabin is holding 5 8, cabin is holding 5 8, power is good, 25 amps.
00 03 47.5	CC	Roger.

00 04 01	P	Four minutes, Aurora 7 is go. Fuel and oxygen steady, cabin holding, 25 amps, power is good.
00 04 12	CC	Roger, Aurora 7. Pitch minus 3-1/2, you're good.
00 04 15.5	P	Roger, reading you on Bermuda antennas now, much louder.
00 04 19	CC	Roger.
00 04 30	P	4 plus 30 my clock, fuel and oxygen steady, 3-1/2 g's. Cabin holding 5 8, 25 amps power is good.
00 04 42	CC	Roger, Aurora 7, you're through .8, V/VR of .8.
00 04 46	P	Roger. .8.
00 05 09	P	Okay, there is BECO, the posigrades fired. I am weightless and starting the fly-by-wire turn-around. Aux Damp is good.
00 05 25.5	CC	Roger. You look good down here.
00 05 27	P	Periscope is out, - and
00 05 32	CC	We have a go, with a 7-orbit capability.
00 05 36	P	Roger. Sweet words.
00 05 38.5	CC	Roger.
00 05 52	P	Okay, turnaround has stopped. I'm pitching down. I have the moon in the center of the window, and the booster off to the right slightly.
00 06 07.5	CC	Roger, understand.
00 06 09.5	P	Fly-by-wire is good in all axes, my pitch attitude is high, coming down now.
00 06 17	CC	Roger, understand.
00 06 38	P	Roger. The control system on fly-by-wire is very good. I have the booster in the center of the window now, tumbling very slowly.

00 06 50.5	CC	Roger, Aurora 7, understand. You sound real good.
00 06 59.5	P	It's very quiet.
00 07 04.5	P	A steady stream of gas, white gas, out of the sustainer engine. Going to ASCS, now.
00 07 15	CC	Roger. Understand.
00 07 17	P	ASCS seems to be holding very well. I have a small island just below me.
00 07 26.5	CC	Aurora 7, standby for retrosequence times.
00 07 29.5	P	Standing by.
00 07 31.5	CC	Area 1 B is 17 17.
00 07 38.5	P	17 17 Roger.
00 07 41.5	CC	Roger, standby for later times. That's all I have right now.
00 07 50	CC	Roger, sequence time for end of orbit.
00 07 53.5	P	Send your message.
00 07 55	CC	Aurora 7, retrosequence time for end of orbit --- 28 26.
00 08 00	P	01 28 26, Roger.
00 08 04	CC	End of mission, 04 32 39.
00 08 09	P	04 32 29, Roger.
00 08 12	CC	Negative 04 3, 04 32 39.
00 08 17.5	P	Roger, understand, 04 32 39.
00 08 21	CC	Roger.
00 08 22.5	P	Roger, I have copied.
00 08 27	P	ASCS looks good, all fly-by-wire thrusters appear to be good in all axes. Going to - beginning to unstow the equipment.

00 08 41	CC	Aurora 7.
00 08 43	P	Roger, and the SECO checklist is complete. She peaked at 6.3.
00 08 51.5	CC	Cap Com. Over.
00 08 53.5	P	Go ahead, Gus. Loud and clear. How me?
00 09 01.5	CC	Aurora 7, Cap Com.
00 09 03	P	Roger, loud and clear. How me?
00 09 07	CC	Aurora 7, Cape Cap Com. Over.
00 09 16	CC	Aurora 7, Cape Cap Com. Over.
00 09 18.5	P	Loud and clear, Gus. How me?
00 09 25	CC	Aurora 7, Cape Cap Com, if you read, retro delay to normal?
00 09 29	P	Retro delay normal, Roger.
00 09 32	CC	--igee 8 6.
00 09 34.5	P	Roger, copied perigee 8 6, did not get apogee.
00 09 54.5	P	Mark, one picture of the booster. Going to transmit and record now. 2, 3, 4, 5, 6, - 10, 11, 12 pictures of the booster, traveling right down the center of the booster, right down the center of the window.
00 10 34	P	Going over the insertion checklist now. D-c volts is main. Retromanual fuse switch is off, retromanual is off, all instruments, are, all bateries okay. The a-c power is good. The, let's see, where's the booster. There's some beautiful cloud patterns down there. The booster is in front of a large cloud pattern. I seem to be, I seem to be much closer to the earth than I expected to be. The booster is approximately two miles away now.
00 11 40	P	I have some pictures of the booster, maybe 17 or 18, all together, then going to the horizon, north sweeping south, there is the moon, just setting. Winding the camera at this time.

00 12 22	P	There is some rather large pieces floating around. The flight plan is now out. Gyros are going to free at 12 33, and I'm going to fly-by-wire to track the booster. I will - this is not a good tracking problem. Our speeds are too close to being the same. I will put it in the center of the right window, plus. I have it right in the center - I feel that - overshot there. Getting ahead of me in pitch.
00 13 29.5	P	The high thrusters work well, close tracking should be done on - on fly-by-wire low only. To follow the booster is a tough job with the highs. Gyros are staying within limits pretty well. Elapsed time is 13 56. I have lost sight of the booster at this time. I'll pick up a retroattitude at this time for Canary radar. Large piece of ---.
00 14 21.5	?	This is Casterfield. Good luck. Over.
00 14 27	P	Aurora 7, copied. Roger, thank you.
00 14 37.5	P	Going back to gyros free, or to gyros normal.

CANARY

00 14 47	CC	Aurora 7. This is Canary Cap Com. How do you read? Over.
00 14 51	P	Hello , Canary Cap Com. Aurora 7, reading you loud and clear. How me?
00 14 56.5	CC	Read you loud and clear also. We have radar track. Please remain in orbit attitude.
00 15 02	P	Roger. Understand. I, my control mode is fly-by-wire, gyros normal, maneuver off. I am picking up retroattitude and automatic control very shortly. Over.
00 15 18.5	CC	Roger. Will you verify that your retrodelay switch is in the normal position.
00 15 24	P	Retrodelay is normal. I say again, retrodelay is normal.

00 15 29.5	CC	Roger. Will you please proceed with the short report. Fuel and oxygen readings.
00 15 38	P	Roger. Fuel 103-100. Oxygen 89-100. All the power is good. Aurora 7 status is go in all respects. Over.
00 15 53.5	CC	Roger. Say again fuel, please. Over.
00 15 56.5	P	Fuel 103-100. Over.
00 16-01.5	CC	Roger. Have copied.
00 16 04.5	CC	Please send blood pressure. Over.
00 16 07	P	Roger. Blood pressure start now.
00 16 19	P	I have, west of your station, many whirls and vortices of cloud patterns. Pictures at this time - 2, 3, 4, 5. Control mode is now automatic. I have the booster directly below me. I think my attitude is not in agreement with the instruments. It's probably because of that gyro free period. Outside of a minor difference in attitude indications, everything is proceeding normally.
00 17 14	CC	Can you confirm orientation, ASCS and fly-by-wire --- operating normal?
00 17 21.5	P	Roger. Wait one.
00 17 53	P	Roger. Canary, TS plus 5 is verified. Manual is satisfactory in all axes. Fly-by-wire and auto is satisfactory, all axes. Aux Damp is okay also. Over.
00 18 08.5	CC	Roger, I have copied. I have new end of orbit, end of mission and 1 Bravo times for you. Are you prepared to copy?
00 18 15	P	Standby one.
00 18 39.5	P	Send your message, Canary.
00 18 41.5	CC	Roger. End of orbit time, 01 28 17. End of mission, 04 32 27. 1 Bravo 16 plus 56. Did you copy? Over.

00 19 05	P	Roger. End of orbit 01 28 17, Hotel 04 32 39, 1 Bravo 16 56. Over.
00 19 22	CC	Correction. Aurora 7, correction 1 Bravo. Make that 16 plus 52. Over.
00 19 30	P	Roger. Understand. 16 52.
00 19 33	CC	Roger. Apogee altitude is 143. Perigee 86. Did you copy? Over.
00 19 43.5	P	Roger. 143 and 86.
00 19 48	CC	Roger. Here are sunrise and sunset times. Sunrise orbit one: 1 plus 21 plus 00. Sunrise, orbit two: 2 plus 50 plus 00. Sunrise, orbit three: 4 plus 19 plus 00.
00 20 16.5	P	Roger, Canary. I'm going to have loss of signal before I get these. I want to get some pictures. Have Muchea or, correction have Kano send these to me, in this order: Sunset, sunrise, sunset, sunrise, break, break. Did you copy?
00 20 36	CC	--- plus 41 plus 20. Did you copy? Over.
00 20 40.5	P	That is negative. I'll have to wait awhile for those.
00 20 50	P	I'll get them from Kano. Thank you.
00 20 52.5	CC	Have a blood pressure reading. Your first attempt was unreadable on the ground. Over.
00 20 58	P	Okay. It's on the air.

KANO

00 23 49	CC	Aurora 7. This is Kano on UHF/HF. Do you read? Over.
00 23 56	P	Roger, Kano Cap Com. Aurora 7, reads you loud and clear. How me?
00 24 02.5	CC	Roger, Aurora 7. Kano Cap Com reads you loud and clear. Welcome back, Scott.

00 24 08	P	Roger.
00 24 09	CC	Blood pressure check, please. Hold your button for 4 seconds and then go through the short report.
00 24 16	P	Roger. Blood pressure start, now. My status is good. The capsule status is good. Fuel is 99-98, oxygen 89-100. Cabin is holding good. All d-c power is good. All a-c power is good. 22 amps. Everything is green and you should be reading blood pressure. Over.
00 24 41.5	CC	Roger. We are reading blood pressure. Do you want to check your UHF low? Over.
00 24 47	P	Roger. Going to UHF low now, standby 15.
00 25 10.5	P	Hello, Kano. Hello, Kano Cap Com. Aurora 7 UHF low. How do you read?
00 25 17	CC	Aurora 7. Kano Cap Com reads you loud and clear. Over.
00 25 20.5	P	Roger. Reading you the same. Going back to UHF high.
00 26 22	CC	Aurora 7, Kano Cap Com. How do you read? Over.
00 26 28	P	Loud and clear, Kano. Send your message.
00 26 32	CC	Roger, Aurora 7. Are you going to be doing your caging, uncaging procedure now? Over.
00 26 37.5	P	Roger. I - am a little behind in the flight plan at this moment. I have been unable at this time to install the MIT film. I finally have it. I'll go through the gyro uncaging procedure very shortly.
00 27 01	CC	Roger.
00 27 34	P	Okay, the MIT film is now in.
00 28 00	P	ASCS is operating okay.
00 28 12.5	CC	What mode are you on now?
00 28 14.5	P	Roger. My mode is auto, gyro normal, maneuver off.

00 28 21.5	CC	Aurora 7, Kano Cap Com. Be sure you're on fly-by-wire before going through the procedures for uncaging.
00 28 27	P	Roger, Roger. Understand.
00 28 54.5	P	I'm going to be unable to complete the MIT pictures on this pass, I believe. Negative, negative, I can fix the problem. Too much film was out of the cannister, that was the problem. Film is now in tight. The small back going on now.
00 29 43.5	P	At 29 43, the first time I was able to get horizon pictures with MIT film. Set at F 8 and 125th. A picture to the south into the sun, directly down my flight path is number two. Number three 15 degrees north at capsule elapse 30 17.
00 30 29.5	P	Stowing the camera at this time. Going to the gyro uncaging procedure at this time. Fly-by-wire, now. Gyros going to cage. Maneuver at this point is on.
00 31 02.5	P	Pitching down, yawing left.

INDIAN OCEAN SHIP

00 31 36	CT	Aurora 7, Aurora 7, Aurora 7. This is I.O.S. Com Tech on HF and UHF. How do you read? Over.
00 31 49	P	Roger, Indian Com Tech. Aurora 7 reading you weak but readable. Go ahead.
00 32 10	CT	Aurora 7, Aurora 7. This is I O.S. Com Tech on HF and UHF. How do you read? Over.
00 32 19	P	Hello, Indian Ship Cap Com. Aurora 7. Loud and clear. How me?
00 33 59	P	Hello, Indian Cap Com, Indian Cap Com, Aurora 7. How do you read?
00 34 17	P	Hello, Indian Cap Com, Indian Cap Com, Aurora 7. How do you read?

00 34 26.5	P	At 34 28, I'm increasing the cabin water valve and the suit valve to 6. Steam vent temperature now reads 65 and 75.
00 34 47	P	Mark, African coastal passage, about 20 seconds ago.
00 35 02.5	P	I'm using the airglow filter at this time. Visor is coming open for a better lock at that. Hello, Indian Cap Com, Aurora 7. Do you read?
00 35 39	P	Maneuver is going off at this time, and I'm going to aline manually, to retroattitude.
00 38 04	P	Station calling Aurora 7. Say again.
00 39 28	P	Okay. That took me some time to aline my attitudes properly. Three more pictures with MIT film, 2, 3, directly into the sun, at an elapsed time of 39 42.
00 40 12.5	P	Okay, going through -
00 42 30.5	P	The big back is going on the camera, at this time. There was a period there when nothing was recorded because I was in VOX power off, instead of record. The big -
00 43 02.5	P	At 43 02, I think my gyros are properly alined.
00 43 15.5	P	What in the world happened to the periscope?
00 43 25	P	Oh, it's dark, that's what happened. It's facing a dark earth. Sunset F16 to F, okay, we'll start with F16. Up north, coming south. Try some at 250.
00 44 12.5	P	It's getting darker. Let me see. Muchea contact, sometime. Oh, look at that sun.
00 44 31	P	F-11.
00 44 45.5	P	F-5 6. That was those last four, were F 3 8. It's quite dark. I didn't begin to get time to dark-adapt.

00 45 15 P Photo lights are off. Cabin lights are going to red at this time. Oh, man, a wide, a beautiful, beautiful red like in John's pictures. Going to fly-by-wire.

00 46 01 P It is a reflection. It is a reflection in the window. That's too bad.

00 46 10 P I see at this point, I'm not sure I am recording on VOX record. I will go to transmit. I have Venus, now approaching the horizon.

00 46 37 P It's about 30 degrees up. It's just coming into view. Bright and unblinking. I cannot - I can see some other stars down below Venus. Going back to ASCS then at this time.

00 47 05 P Bright, bright blue horizon band as the sun gets lower and lower - the horizon band still glows. It looks like five times the width of the - the diameter of the sun. I'm at - now at 47 34 elapsed.

00 47 46.5 P It's now nearly dark, and I can't believe I'm where I am.

00 48 08 P Oh, dear, I've used too much fuel.

00 48 22 P Well, I'm going to have to increase, let's see, going to ASCS at this time.

00 48 38 P My fuel reads 75-100 at this time. The window - is Venus occlude. No, that - that is not correct. Venus did not occlude. I'm getting out the equipment to measure Venus occlusion.

00 49 15 P There is too much red light in the cockpit from the time correlation. Venus at above the - horizon.

MUCHEA

00 49 28.5 CC Aurora 7. This is Muchea Cap Com. How do you read?

00 49 34 P Hello, Muchea Cap Com, Aurora 7. Loud and clear. How me, Deke?

00 49 39 CC Rog. Coming in very good, dad. Sound very good, how's things going?

00 49 45.5	P	Roger. Things are going very well, my status is very good. The capsule status is very good. The control mode is normal. Automatic gyros normal and maneuver off. Fuel is 72-100. Oxygen 88-100. Everything is normal with the exception of - the fact that I am a tad behind in the flight plan. Over.
00 50 11.5	CC	Roger. Understand.
00 50 13	P	Blood pressure is starting now.
00 50 17	CC	Okay. Blood pressure starting. We suggest that you do not exercise during the blood pressure since your temp is up.
00 50 23.5	P	Roger. This is the story on the suit temp. I have increased 2 ten-degree marks since lift-off. And now about - well, 15 degrees above launch mark. My steam vent temperatures read 69 and 80. I'll take one more stab at increasing, or decreasing, temperature by increasing flow rate. If this doesn't work, I'll turn them off and start lower. Over.
00 50 59	CC	Rog. Understand. I'll give you some retrotimes while you're sending blood pressure. End of orbit is 01 28 18. End of mission is 04 32 28.
00 51 15.5	P	Roger. Understand. End of orbit 01 28 18 and 04 32 28 for end of orbit. Over. End of mission.
00 51 26	CC	That's affirmative. We indicate your clock is one second slow and this is compensated for.
00 51 31	P	Roger. Thank you.
00 51 34	CC	GMT time hack at this time - we're coming up on 13 36 57, MARK.
00 51 41	P	Roger. My GMT - my backup GMT are right in sync. with GMT. Over.
00 51 49	CC	That's very good.
00 51 51.5	CC	Okay, if you're ready I'll give you the emergency voice check. We will turn off UHF and HF transmitters for this so that you will not have to change volume.

00 51 59	P	Roger, standing by.
00 52 04.5	CC	Aurora 7. Muchea Cap Com. 1, 2, 3, 4, 5, 5, 4, 3, 2, 1 command voice. How do you read?
00 52 12	P	Roger, Deke. Read you loud and clear, loud and clear emergency voice.
00 52 16.5	CC	Very good, very good. Switching back to UHF.
00 52 20	P	Roger.
00 52 25.5	CC	Aurora 7, Muchea Cap Com on UHF. How do you read?
00 52 28	P	Roger. Muchea Cap Com. Loud and clear. Tell Jerry and Gus and Lewis and - everybody else there, that I worked with "hello." John Whittler, if you see him, tell him to saddle Butch up. Break, break. Is your cloud cover such that I can expect see light - or flares at Woomera? Over.
00 52 52.5	CC	Roger. The cloud coverage here is 3,000 overcast stratus and we think you'll probably see them through the clouds. Woomera is clear.
00 53 03.5	P	Roger.
00 53 18.5	CC	Seven from Muchea. Would you send us one more blood pressure?
00 53 21.5	P	Roger. Starting now.
00 53 28.5	CC	We're going to send you a Z cal at this time.
00 53 31	P	Roger. And - go ahead and send it. I'll - you'll be interested to know that I have no moon, now. The horizon is clearly visible from my present position; that's at 54 44 elapsed. I believe the horizon on the dark side with no moon is very good for pitch and roll. The stars are adequate for yaw in, maybe two minutes of tracking. Over.
00 54 01.5	CC	Roger, understand. Sounds very good. Z cal off, R cal coming on. MARK.
00 54 12	CC	Suggest that you back the fuel control back to your first black mark.

00 54 18	P	Roger. I'll try that. Going all the way off and - back up a little bit lower than where I was.
00 54 28.5	CC	Roger, your suit temperature is down a bit at this point.
00 54 31.5	P	Say again, Deke.
00 54 33	CC	Your suit temperature is down, which is good.
00 54 36.5	P	Well, that's a result of an increase in flow lately. I would think that - I'll try increasing rather than decreasing.
00 54 55.5	P	Hello, Woomera Cap Com, Aurora 7. Do you read?
00 55 00	CC	Roger. This is Woomera, this is Woomera Cap Com. Reading you loud and clear. How me?
	CC	This is Muchea Cap Com. They will not be contacting you for another three minutes.
00 55 08	P	Roger. Go ahead, Deke. Just trying to get the word on the flare.
00 55 12	CC	Roger, understand. I'll give you the settings, correction, the attitudes for the first flare at this time. It would be plus 80 yaw, minus 80 in pitch.
00 55 28.5	P	Roger, understand, Deke. Plus 80 yaw, minus 80 pitch.
00 55 37	CC	Roger, okay. The Cape now advises to keep the suit setting where it was since it's coming down.
00 55 44.5	P	Roger. I - for your information, I have increased it just slightly. My readings now are 7 and 7 on suit and cabin. What are my inverter temperatures and thruster line temperatures, Deke? Are they okay?
00 56 04.5	CC	Rog. We are losing you. We are losing you on air ground. Would you care to contact Woomera at this time?
00 56 11.5	P	Roger.

FOR OFFICIAL USE ONLY

WOOMERA

00 56 14.5	CC	Aurora 7, Aurora 7, this is Woomera. Read you loud and clear. How me?
00 56 18.5	P	Roger, Woomera. Reading you loud and clear, also. I'd like read-out on my inverter temperatures - and mark on your flare. Over.
00 56 29	CC	Roger. We're going to have the flare in approximately two minutes. We'll give you a read-out on your temperatures.
00 56 37	P	Roger. And for your information, Rate Command is also working in all axes. Over.
00 56 47.5	CC	Roger, Rate - Rate Command in all axes.
00 56 52	P	That - that signifies that all control systems are operating satisfactorily. Over.
00 57 00	CC	Roger, understand. All systems okay. We have your temperatures. Your 150 inverter, 152. Your 250 inverter, 167. Do you copy? Over.
00 57 13	P	Roger. Copied, thank you. Standing by.
00 57 16.5	CC	We're going to have the flares, all four of them, go at approximately 58 plus 30. We do have an eight by eight coverage.
00 57 24	P	Roger. I am at - plus 80 yaw, minus 80 pitch, now.
00 57 35	CC	Roger. We'll give you a time hack when we come up to flare test.
00 57 41	P	Roger.
00 57 47	CC	This is Woomera Cap Com, 7. Sir John reports all systems look good down here. And Systems reports everything okay on his panel.
00 57 57	P	Roger. Thank you. It looks good to me, also.
00 58 00	CC	Roger. You are loud and clear. Coming up on the flare test - in approximately 25 seconds.

00 58 05.5	P	Roger.
00 58 09.5	CC	Good air to ground.
00 58 12	P	Roger. Going to fly-by-wire. It doesn't cost so much.
00 58 17.5	CC	Roger. Fly-by-wire, Manual on. Is that affirmative?
00 58 21.5	P	Manual is - no, I'm, my control mode is pure fly-by-wire now.
00 58 26	CC	Roger. Flare test coming up. Stand by. Mark, 58 plus 30, all four flares away.
00 58 52	CC	Aurora 7, Aurora 7, this is Woomera. How do you read? Over.
00 58 55	P	Roger. Reading you loud and clear. Searching for your flares. Stand by.
00 59 02	CC	Roger. We still have approximately 60 seconds left.
00 59 11	CC	You're up to minus 50 on roll.
00 59 15	P	Roger. Backing off, thank you, thank you. Backing off.
00 59 27.5	P	I do not have your flares. I'm sorry, Woomera.
00 59 31	CC	Say again, Seven.
00 59 33.5	P	No joy on your flares. I do not have your flares visible.
00 59 37.5	CC	Have copied. Evidently the cloud coverage is too tight.
00 59 43	P	At this time I have extensive cloud coverage - wait.
00 59 49.5	CC	Did you try Aux Damp when you're in fly-by-wire to see if you are holding attitudes?
00 59 54	P	Negative. I have verified that Aux Damp is operating satisfactorily. Over.

01 00 00	CC	Roger. Understand.
01 00 02	P	I have some lights on the ground underneath me. Standby, I'll try to identify them.
01 00 12	CC	Roger. Wilco.
01 00 42	CC	Aurora 7, Aurora 7, this is Woomera Cap Com. Do you read? Over.
01 00 46	P	Loud and clear, Woomera. Go ahead.
01 00 49	CC	Roger. Could you give us a short report at this time?
01 00 52.5	P	Roger. My control mode is fly-by-wire, gyros are free, and the maneuver switch is off. Fuel reads 75-85, oxygen 88 and 100. Wait till I pick a washer out of the air. And everything is very good. Over.
01 01 23	CC	Roger. You're intermittent. What is your suit temperature? Over.
01 01 29	P	Roger. Suit temperature is now 70. Suit temperature is 70, steam exhaust is 70, the cabin exhaust is 80.
01 01 43	CC	Roger. Do you confirm - do you have your - back down to the black scribe mark?
01 01 51	P	That is negative. I have them both set on seven at this time and - an increase in setting resulted in a decrease - in suit temperature. I think I'd like to try - try them at this setting a little while longer. Over.
01 02 11	CC	Roger, understand. I believe at this time you're supposed to have your midnight snack.
01 02 18	P	Roger. I'll get to that shortly.
01 02 21.5	CC	Roger. You're starting to drift or fade slightly.
01 02 26.5	P	Roger.

01 02 31.5	CC	Are you prepared to go into drifting flight before too long?
01 02 34.5	P	Roger. I can do that at this time. At night yawed -
01 02 40	CC	--- is that affirmative?
01 02 41.5	P	I am going to drifting flight at this time. Over.
01 02 46.5	CC	Roger.
01 02 53.5	P	Gyros are caged. I have about a two-degree per second yaw rate. All gyros are zero. I have Corvus directly above me. I'm yawing over the top. I feel that my attitude is - the line of sight is nearly - nearly vertical.
01 03 55	P	I am in VOX record only now. The time is 104 elapsed. I'm searching the star charts.
01 04 19	P	The finish on the star chart is so shiny that - it's impossible to read because of reflection.
01 04 44.5	P	I've got to turn white lights on, that's all.
01 05 03	P	At 105.
01 05 14.5	P	Attitudes are of no concern to me whatsoever. I know I'm drifting freely. The moon crossed the window not too long ago.
01 05 51.5	P	Let's see, now what can - I am at this moment rocking my arms back and forth and I can make this show up in the roll, yaw and pitch needle. By moving my torso, I can make the pitch rate needle move up to one degree per second. Roll is, needle, rate needle is very sensitive to this. Yaw is also. Let's see, am going to open the visor at this time. Have a few crumbs of food floating around in the capsule.
01 06 58.5	P	At 106 - at 1 minute, 1 hour and 7 minutes elapsed, I'm going above the scale to approximately 8 on cabin and suit.

CANTON

01 07 16	P	Hello, hello, Canton Com Tech, Canton Com Tech, Aurora 7. Weak but readable. Go ahead.
01 07 40.5	CT	Aurora 7, Aurora 7, this is Canton Com Tech, Canton Com Tech. Do you read? Over.
01 07 46.5	P	Hello, Canton Com Tech, Aurora 7. Loud and clear. How me?
01 08 23.5	P	The food - hello, Canton Com Tech, Aurora 7. How do you read?
01 08 33	P	Hello, Canton Com Tech, Aurora 7. How do you read?
01 08 41	P	This food has crumbled badly.
01 08 50.5	P	First meal at 1 08 52.
01 09 21	P	Hello, Canton Com Tech, Canton Com Tech, Aurora 7 on HF. How do you read?
01 09 39.5	CT	Seven, this is Canton Com Tech. Do you read?
01 09 45	P	Canton Com Tech, Aurora 7. Loud and clear. How do you read Aurora 7 on HF? Over.
01 10 07	CT	Aurora 7, Aurora 7, this is Canton Com Tech. Do you read? Over.
01 10 13	P	Roger, Canton Com Tech, loud and clear. How me?
01 10 33.5	CT	Aurora 7, Aurora 7, this is Canton Com Tech. Do you read?
01 10 57	P	Hello, Canton Com Tech, Canton Com Tech, Aurora 7. Loud and clear. How me?
01 11 04	CC	This is Canton. Loud and clear, Aurora 7. Can you begin with the short report?
01 11 10	P	Roger. I've been reading you for some time. I've tried to contact you on HF with no success. My status is good; the capsule status is good; control mode is fly-by-wire; gyros caged; maneuver is off.

The fuel reads 74-85, oxygen is 87-100, the cabin temperature is a bit high at 104, the suit - steam vent temperature is 70 and cabin is 80, but I believe they're coming down. Over.

01 11 49	CC	Roger. Did you wish to check your attitude readings with our telemetry? Over.
01 11 56.5	P	Roger. My - my gyros are caged at this time. Stand by one.
01 12 05	CC	Standing by.
01 12 17	P	I am beginning to pick up what I believe is a - yeah, it's very definitely a cloud pattern equally low.
01 12 31.5	CC	Roger.
01 12 42	P	I am - let's see, Canton, do you have the exact sunrise time for the first orbit? Over.
01 12 55	CC	Say again, Aurora 7.
01 12 57	P	Sunrise time for first orbit. Over.
01 13 03	CC	I have a sunrise time of 1 plus 21 plus 00.
01 13 10	P	1 plus 21 00. Roger. Thank you.
01 13 13.5	CC	Did you - could you comment on whether you are comfortable or not - would you --- a hundred two on body temperature.
01 13 21	P	No, I don't believe that's correct. My visor was open, it is now closed. I can't imagine I'm that hot. I'm quite comfortable, but sweating some.
01 13 38	CC	Roger. Can you confirm then that the face plate is closed, and will be closed for the pass over Guaymas.
01 13 44	P	That is correct, George. I'll leave the face plate closed. I have had one piece of the inflight food. It's crumbling badly and I hate to get it all over, and I have had about four swallows of water at that time.
01 14 04.5	CC	Roger, four swallows of water.

01 14 11	CC	You wish to start your comment now on the haze layer - there was the --- pitch, and at the same time confirm that the flight plan is on schedule.
01 14 16.5	P	Roger. I cannot confirm that the flight plan is completely on schedule. At sunse I was unable to see a separate haze layer - the same - height above the horizon that J hn reported. I'll watch closely at sunrise and see if I can pick it up. Over.
01 14 48	CC	Roger.
01 14 53.5	CC	All readings appear to be normal down here. The capsule looks good from down here.
01 15 01.5	P	Roger, the -
01 15 02.5	CC	--- queries, you can continue on with your observations. Over.
01 15 05.5	P	Roger. Thanks, George, see you next time around.
01 15 10	CC	Okay, Scott. Good luck.

HAWAII

01 15 30.5	CT	Aurora 7, Hawaii Com Tech. How do you read me? Over.
01 15 40	P	I am in VOX record now. I heard Hawaii calling, ha ha, Hawaii calling. I will go to transmit directly, and see if we can pick up Hawaii.
01 15 54	P	Hello, Hawaii Com Tech, Aurora 7 on HF. Loud and clear. How me?
01 16 17.5	P	Hello, Hawaii Com Tech, Hawaii Com Tech, Aurora 7. Loud and clear. How do you read HF? Over.
01 16 32.5	P	Going now to record only while I switch back to UHF.
01 17 30.5	P	Hello, Hawaii, hello, Hawaii Com Tech, Aurora 7. Weak but readable. Go ahead.
01 18 00	CT	Aurora 7, Aurora 7, --- on HF, UHF. How do you read? Over.

01 18 05	P	Roger, Hawaii Com Tech. Aurora 7 reading you loud and clear. How me?
01 18 30	CT	Aurora 7, Hawaii Com Tech. How do you read?
01 18 51.5	P	All right. My - I am at 1 19 02. Have been several times completely disoriented. There, I have Cassiopeia directly in the window and am yawing around for the sunrise - photographs. The sky is quite light in the east.
01 19 51	P	Excess cabin water light came on at that time. I'll have to go back all the way down and off. Suit is - still high. The cabin water gage is reading - plus 9, which is hard to believe.
01 20 15	P	My temperature, my body temperature doesn't feel - feel bad at all. My suit - yes, my suit temperature is down now, also.
01 20 32.5	P	But the steam vent temperature is - still about - 70.
01 22 03	P	I have the fireflies. Hello, Guaymas.
01 22 18	P	I have the particles. I was facing away from the sun at sunrise - and I did not see the particles - just - just yawing about - 180 degrees, I was able to pick up - at this - Stand by, I think I see more.
01 23 00	P	Yes, there was one, random motions - some even appeared to be going ahead. There's one outside. Almost like a light snowflake particle, caught in an eddy. They are not glowing with their own light at this time.
01 23 32	P	It could be frost from a thruster.
01 24 01.5	P	Going to transmit to - record only, at this time.
01 24 11	P	The weightless condition is a blessing, nothing more, nothing less.
01 25 43	P	I am now photographing large cloud banks over the Pacific on a southerly direction.
01 26 08.5	P	I'm drifting slowly to retroattitude at this time.

GUAYMAS

01 27 22	P	Hello, Guaymas Com Tech, Aurora 7. Loud and clear. How me?
01 27 29.5	CC	Roger, Aurora 7, this is Guaymas Cap Com. How me? Over.
01 27 33.5	P	Roger, Guaymas, loud and clear. My control mode is now fly-by-wire, gyros are caged, I'm in - maneuver is off. I'll go to automatic mode directly. My status good; the capsule status is good. The fuel is 69-69, oxygen is 88-100. The cabin steam vent has gone to plus 10, I believe that's a bad gage reading, and suit temperature steam vent is coming down slowly, now reading 68. Over.
01 28 16	CC	Roger. Understand 68. How is your temperature comfort? Over.
01 28 19	P	Roger. My body comfort is good. I am tracking now a very small particle, one isolated particle, about - There is another, very small, could be a light snowflake.
01 28 40	CC	Roger. We're reading - we're having a - a bad body temperature reading on you, 102.4, probably erroneous.
01 28 48.5	P	I can't believe it. My suit temperature shows 60 and I feel quite comfortable. I'm sure I would be sweating more than this if my temperature were 102.
01 28 59.5	CC	Your suit inlet temperature near 61, so it looks pretty good.
01 29 04	P	Roger.
01 29 06.5	CC	Roger. It looks like we have a go for the second orbit as everything appears all right for you.
01 29 13	P	Roger. I was hoping you'd say that, Gordo.
01 29 16	CC	You start to conserve your fuel a bit and maybe, perhaps, use a little more of your manual fuel.

01 29 22	P	Roger. Can do.
01 29 24.5	CC	Roger, are you ready for Z and R cal?
01 29 27	P	Roger, send them.
01 29 28.5	CC	Z cal coming on now.
01 29 31	P	And, MARK, coastal passage.
01 29 35	CC	Say again.
01 29 36	P	Mark, coastal passage coming over the - Baja.
01 29 41	CC	Good.
01 29 43	CC	How does it look?
01 29 46	P	Half covered with clouds, and - and the other half is dry. Will you pass on - this message for me, Gordo, to all the troops at Guaymas?
01 30 05	P	Hola, amigos, felicitaciones a Mexico y especialmente a mi amigos de Guaymas. Desde el espacio exterior, su pais esta cubierto con nubes - and - es - also - se me muy bello. Aqui el tiempo esta muy bueno. Buena suerte desde Aurora Siete. (Translation: Hello, friends, greetings to Mexico and especially to my friends of Guaymas. From outer space, your country is covered with clouds and is very beautiful. Here the weather is very good. Good luck from Aurora 7.)
01 30 33.5	CC	Roger, muchas gracias, amigo.
01 30 35.5	P	Ha ha, okay.
01 30 37.5	CC	Give us a blood pressure.
01 30 39	P	Here you go.
01 30 50	CC	Roger, do you - I'd like to pass your 2 Alpha time on to you, Scotty.
01 30 54.5	P	Roger.

01 30 56	CC	Roger, 2 Alpha time is 01 36 13, with a GMT of 14 21 30, that takes into account your clock error.
01 31 08.5	P	That's 02 36 13?
01 31 12.5	CC	Roger, 01 36 13.
01 31 15.5	P	Roger, 01 36 13 for 2 Alpha.
01 31 19.5	CC	For Golf 03 00 31.
01 31 25	P	Roger, 03 00 31 for Golf.
01 31 28.5	CC	There's a GMT on that of 15 45 48.
01 31 33.5	P	Roger. Standing by for the - my mark on the radar test over White Sands.
	CC	---
01 31 46	P	Roger.
01 31 52.5	CC	Roger, command roll now.
01 31 55	P	Roll now.
01 32 02	P	No, I'll have to get in a better attitude for you first, Gus. It'll mean nothing this way, I mean - Coop.
01 32 10	CC	Roger.
01 32 58.5	CC	You still reading us, Scotty?
01 32 59.5	P	Roger, loud and clear.
01 33 02	CC	Hearing you also. Have you done your roll for the radar yet?
01 33 10.5	P	That's negative. I'm afraid I'm not going to make it, Gordo, unless I get the attitudes - down close.
01 33 21.5	CC	Roger, we're reading your attitudes all right at zero now.
01 33 26.5	P	Roger, the gyros are caged.

CAPE CANAVERAL

01 33 41	CC	Aurora 7, this is Cape Cap Com on emergency voice.
01 33 44	P	Roger, Cape. Loud and clear. How me?
01 33 48	CC	Loud and clear. I'm going back to HF/UHF.
01 33 52.5	P	Roger.
01 33 55	CC	Are you ready for your two Bravo time?
01 33 58	P	Roger, send two Bravo.
01 34 00.5	CC	01 49 30.
01 34 07	P	Roger. 01 49 30.
01 34 12.5	CC	Roger, and two Charlie time is nominal.
01 34 15.5	P	Okay, standby one.
01 34 37.5	P	Okay, Gus, my status is good; my control mode is fly-by-wire; the gyros are still caged; maneuver is off. Fuel is 62 and 68, a little ahead on fuel consumption, fuel quantity light is on, the excess cabin water light is on. I'll try and get auto mode here directly.
01 35 04.5	CC	Roger. Can you give us a blood pressure?
01 35 07	P	Roger. Blood pressure coming now.
01 35 13.5	CC	And after the IOS voice has dropped, will use Zanzibar in that area.
01 35 20	P	Roger, I heard IOS calling but I couldn't raise him.
01 35 24	CC	Roger.
01 35 30	CC	Aurora 7, use a normal balloon release.
01 35 34	P	Roger.
01 35 41	P	And are you going to give me a mark for that?
01 35 47.5	CC	Roger, one at an elapsed time of 1 37.

01 35 51	P	1 37, Roger.
01 36 00	CC	Roger. In two minutes, Echo will be almost directly overhead.
01 36 05	P	Roger.
01 36 08	CC	Could you give us a cabin steam and suit temperature, please?
01 36 11	P	Roger. Suit steam is 69 and cabin is - plus 11. That dropped down very suddenly when the excess cabin water light came on. I think I'm going to - increase - I'll try to increase suit water flow one more time, if that doesn't work I'll drop - down - to closed and start over again.
01 36 46	CC	Aurora 7, cut back your cabin water.
01 36 49	P	Okay. Cabin water going back. I'll start now at two. This is - 20 degrees below launch value.
01 36 58	CC	Roger. I'm going to give you a Z cal.
01 37 00.5	P	Roger.
01 37 07	CC	Okay. I'm going to give you an R cal.
01 37 10	P	Be my guest.
01 37 35	CC	Aurora 7, Cap Com. Do you read?
01 37 37	P	Roger, loud and clear.
01 37 38.5	CC	Roger. Everything looks good down here, except for your fuel usage, you better watch that a little bit.
01 37 44	P	Roger.
01 37 50	CC	Aurora 7, have you deployed the balloon?
01 37 52	P	That is negative. Standby.
01 38 03	P	Balloon deploy, NOW. The balloon is out, and off. I, I see it way out but it - I think now it is way out, and drifting steadily away. I don't see the line, I don't see that any attempt was made to inflate the thing. It's just drifting off.

01 38 38	P	I have only the rectangular shape tumbling at this point about 200 yards back, barely visible, and now wait, here is a line. That was the cover, the balloon is out.
01 39 01	CC	Understand. The balloon is out.
01 39 02.5	P	That is Roger.
01 39 09	P	There is very little acceleration here.
01 39 17	CC	Aurora 7, did the balloon inflate?
01 39 19	P	The balloon is partially inflated. It's not tight. I've lost it at this moment. Wait one, I'll give you a better reading shortly.
01 39 50	P	There is an oscillation beginning.
01 39 54.5	CC	This is an oscillation in the balloon?
01 39 56.5	P	Yes.
01 40 11	P	The line is still not taut. I have some pictures of the line just waving out in back. I would say we have about a one cycle per minute oscillation. It's both in pitch and yaw.
01 40 38.5	CC	How many cycles per minute?
01 40 40	P	One cycle per minute, or maybe one cycle in a minute and a half.
01 41 01	P	The moon is just above the horizon at this time.
01 41 17	P	I have a picture of the balloon.
01 41 25	CC	Aurora 7, Cap Com. Reapeat your last message.
01 41 28.5	P	Roger, I've got a washer to put away.
01 41 33	CC	Roger.

BERMUDA

01 41 40.5	F	Aurora 7, Aurora 7, this is Bermuda Flight. How do you read? Over.

01 41 45	P	Roger. Bermuda Flight, reading you loud and clear.
01 41 49	F	Switch wobulator switch off.
01 41 51.5	P	Roger, phase shifter.
01 41 54	F	MARK!
01 41 56	P	Phase shifter is off.
01 42 18	P	Phase shifter is on, now.
01 42 23.5	CC (Cape)	Aurora 7, Cap Com. What control mode?
01 42 26.5	P	Fly-by-wire.
01 42 28	CC (Cape)	Thank you.
01 43 01	F	Bermuda Flight. How do you read?
01 43 02.5	P	Hello, Bermuda Flight. Reading you loud and clear. How me?
01 43 07	F	Will you run a blood pressure, please? Read you loud and clear.
01 43 10	P	Roger. Blood pressure starting now.
01 43 30	P	I have lost sight of the balloon at this minute.
01 43 34	F	Roger.
01 43 59	P	Also, Bermuda, the balloon not only oscillates in cones in pitch and yaw, it also seems to oscillate in and out toward the capsule, and sometimes the line will be taut, other times it's quite loose.
01 44 20.5	P	It's now about 50 degrees off of the flight path.
01 44 32	P	Pictures of whirls taken, just east of Bermuda, now the balloon line is tight.
01 45 27.5	P	At 01 45 30, I have turned the cabin, or the suit water valve all the way off and back up to one.
01 47 18	P	I'm taping now the fuel quantity warning lights in preparation for the dark side. I think also excess cabin water I'll tape. It's not a satisfactory lighting arrangement to -

CANARY

01 47 48	P	Hello, Canary Cap Com, Aurora 7. Loud and clear. How me?
01 48 10.5	CC	Aurora 7, Aurora 7, this is Canary Cap Com. How do you read? Over.
01 48 16	P	Hello, Canary Cap Com, Aurora 7. Loud and clear. How me?
01 48 21	CC	Roger. You're coming into UHF range. Proceed with the short report. Over.
01 48 27	P	Roger, Canary. My status is good, the capsule status is good, my control mode is automatic, gyros normal, maneuver off. Fuel 51-68, oxygen 85-100, my cabin steam vent temperature now is picking up and reading about 19, suit steam vent temperature still reading 70. I have backed it off to zero and reset it at one. Over.
01 49 09	CC	--- cabin exhaust temperature. Over.
01 49 11.5	P	Cabin exhaust temperature is climbing back up to 19. Over.
01 49 18	CC	Roger, have you been doing any drifting flight? Over.
01 49 23	P	That is Roger. I did quite a bit of drifting flight on the dark side over Woomera and Canton. Over.
01 49 34	CC	Roger, did you observe any haze layers? Over.
01 49 40.5	P	Roger, I did observe haze layers but not the ones that were separated from the horizon that we expected, and that John reported. I'll keep a sharp lookout next time and try to see them after sunset. On the light side there is nothing more than the bright, iridescent blue layer, which separates the actual horizon from the deep black of space. Over.
01 50 15.5	CC	Aurora 7, you are fading rapidly, you are fading. MCC is worried about your auto fuel and manual fuel consumption. They recommend that you try to conserve your fuel.

01 50 28.5	P	Roger, tell them I am concerned also. I will try and conserve fuel.
01 50 41.5	CC	Aurora 7, Aurora 7, I cannot read you. Do you read Canary Cap Com? Over.
01 50 48.5	P	Roger. Canary, copied your message. Over.
01 50 52	CC	Roger. Understand copied message regarding fuel and consumption.
01 50 56.5	P	That is Roger.
01 51 01.5	CC	Surgeon here has requested a blood pressure transmission.
01 51 05.5	P	Blood pressure is coming your way now.
01 51 20	CC	We are receiving same at Canaries and it looks good.
01 51 24	P	Roger.
01 51 41.5	CC	Canary Systems indicates all telemetry readings look good.
01 51 46.5	P	Roger, that's good to hear.
01 51 56.5	CC	Aurora 7, do you have anything to report on your balloon test? Over.
01 52 02.5	P	Roger. The balloon is oscillating through an arc of about 100 degrees. It gets out of view frequently. At this moment, it's nearly vertical. MARK a coastal passage at this time - it seems to - what I'm trying to tell you is that it oscillates 180 degrees, above and below. Over.
01 52 40	P	It also oscillates in and out. Sometimes the line is tight and other times it is not.
01 53 52	P	When I look over to the right side, I have the sensation that -
01 54 05.5	P	Hello.

KANO

01 54 15	CC	This is Kano, how do you read? Over.
01 54 17	P	Hello, Kano. Aurora 7. Loud and clear. How me?
01 54 32.5	CC	Aurora 7, Aurora 7, this is Kano. How do you read? Over.
01 54 37	P	Hello Kano, loud and clear. How me?
01 54 52	CC	Aurora 7, Aurora 7, this is Kano. How do you read? Over.
01 54 59	P	Kano, this is Aurora 7. Reading you loud and clear. How me?
01 55 04	CC	Aurora 7, Kano Cap Com. What is your status? Over.
01 55 08.5	P	Roger. My status is good, fuel reads 51 and - and 69, oxygen is 84 and 100, cabin pressure is holding good. All d-c and a-c power is good. The only thing of - to report regarding the flight plan is that fuel levels are lower than expected. My control mode now is ASCS. I expended my extra fuel in trying to orient after the night side. I think this is due to conflicting requirements of the flight plan. I should have taken time to orient and then work with other items. I think that by remaining in automatic, I can keep - stop this excessive fuel consumption. And the balloon is sometimes visible and sometimes not visible, I haven't any idea where it is now, and there doesn't seem to - and it seems to wander with abandon back and forth, and that's all, Kano.
01 56 44	CC	Roger, Aurora 7. Will you give us a blood pressure check again---. Over.
01 56 49	P	Roger, blood pressure is on the air.
01 57 01	CC	Aurora 7, how are you feeling? Your body temperature is up somewhat. How do you feel? Over.
01 57 07.5	P	Roger. I feel fine. Last time around I - someone told me it was 102. I don't feel, you know, like I'm that hot. Cabin temperature is 101, I'm reading 101, and the suit temperature indicates 74.

01 57 38.5	CC	Are you perspiring any?
01 57 41.5	P	Slightly, on my forehead.
01 57 50	P	Since turning down the suit water valve, the suit steam vent temperature has climbed slightly - am increasing from one to two at this time. This should bring it down. The cabin steam vent temperature has built back up to 40.
01 58 27.5	CC	Roger, Aurora 7, everything looks okay now. We seem to have lost the body temperature readings from previous stations. We are reading 102 right now, but as long as you feel okay right now.
01 58 42	P	Roger, I feel fine.
01 58 46	CC	Can you see anything of the Gulf of Guinea?
01 58 49.5	P	Roger, I just - just passed the coast line and I am over a solid cloud cover at this time.
01 59 05	CC	Roger, Aurora 7. Would you care to send a greeting to the people of Nigeria?
01 59 09	P	Roger, please send my greetings and best wishes of me and my countrymen to all Africans. Over.
01 59 21	CC	Roger, thank you very much. I'm sure it will be appreciated. Over.
01 59 24.5	P	Roger.
01 59 54.5	CC	Aurora 7, Kano. Are we still in contact? Over.
01 59 57.5	P	Say again, Kano.
01 59 59	CC	Roger. Would you repeat in a few words why you thought the fuel usage was great? Over.
02 00 06	P	I expended it on - by manual and fly-by-wire thruster operation on the dark side, and just approaching sunrise. I think that I can cut down the fuel consumption considerably on the second and third orbits. Over.
02 00 32	CC	Roger, understand. Over.

02 00 43.5	CC	Have you started your night adaptation? Over.
02 00 46	P	Roger.
02 01 08	CC	Aurora 7, Kano. Just for your own information, the 250 inverter is on 180 degrees right now. Over.
02 01 18	P	Say again, please.
02 01 21	CC	---. Over.
02 02 43.5	P	At this time, oh-h, this doggone - food bag is a problem.
02 03 00	P	Actually, the food bag is not a problem, the food inside it is. It's crumbled, I dare not open the bag for fear the crumbs will get all through the capsule.
02 03 43	P	Things are very quiet.

ZANZIBAR

02 04 03.5	P	Roger, Zanzibar, loud and clear. How do you read Aurora 7?
02 04 17	CT	Aurora 7, Aurora 7, this is Zanzibar Com Tech, transmitting on HF/UHF. Do you copy? Over.
02 04 26	P	Roger, loud and clear. How me, Zanzibar?
02 04 31	CT	Aurora 7, Aurora 7, this is Zanzibar Cap Com. Read you weak, but readable. Do you have a short report for us?
02 04 38.5	P	Roger, my status is good, the capsule status is good, my control mode is automatic, gyros are normal, maneuver is off. Control fuel is 51 and 69, oxygen is 82 and 100. That's about all except I have, so far, been unable to get my suit steam vent temperature down much below 70. Steam vent, or the water control valve setting at this time is 4 at the prelaunch mark. It may be too high, turning it off at this time and going to three, which is where the cabin is set. Over.
02 05 40	CC	Aurora 7, Zanzibar Cap Com, Roger, Roger. Do you have the latest - contingency area times?

02 05 49	P	Roger, I have them.
02 05 51	CC	Very good. Are you going to start your balloon test?
02 05 55	P	The balloon is out. I don't see any reason for not leaving it on through the dark side, and I just saw a particle going by at about two or three feet per second.
02 06 13	CC	Roger, understand. According to flight plan, you're supposed to go to FBW about now and he says you're on auto mode and I wondered if you plan to go through with this. Over.
02 06 25.5	P	That is negative. I think that the fact that I'm low on fuel dictates that I stay on auto as long as the fuel consumption on automatic is not excessive. Over.
02 06 39.5	CC	Roger, Aurora 7. Congratulations on your trip so far and I'm glad everything has gone ---.
02 06 44.5	P	Thank you very much.
02 06 50.5	P	I now have the wide, blue horizon band. It looks to be, at this time Capsule elapsed 207, to be about the diameter underneath the sun. It seems to be the same thickness underneath the sun as the sun's diameter. North and south it becomes less distinct and lighter. It extends up farther from the horizon.
02 07 29.5	CC	Roger, Aurora 7, that's a hard one to pronounce, anything that we can do for you ---.
02 07 38	P	Negative. I think everything is going quite well.
02 07 41.5	CC	Roger, we'll be waiting. Out.
02 07 43.5	P	Roger. See you next time.

INDIAN OCEAN SHIP

02 07 48	CC	Aurora 7, this is Indian Ocean Ship. Over.
02 07 50.5	P	Roger, Indian Cap Com. Loud and clear. How me?
02 07 54.5	CC	Roger, loud and clear. We have had transmitter trouble on your previous run. We just got a message from the Cape ---, to conserve fuel. I monitored part of your transmission to Zanzibar and understand --- the situation.

02 08 12.5	P	That is Roger.
02 08 14.5	CC	Do you have retrosequence times for 2 Delta, 2 Echo and Golf?
02 08 19	P	That is negative. I have the nominals.
02 08 23.5	CC	Roger. 2 Delta and 2 Echo are still nominal. Area Golf is 03 00 29, 03 00 29.
02 08 35	P	Roger. 03 00 29.
02 08 39	CC	Roger, Aurora 7, I read you loud and clear. Do you have any comments for the --- Ocean?
02 08 46.5	P	That is Roger. I believe we may have some automatic mode difficulty. Let me check fly-by-wire a minute.
02 09 07	P	All thrusters are okay.
02 09 11	CC	Roger.
02 09 17.5	P	However, the gyros do not seem to be indicating properly.
02 09 25.5	CC	Roger.
02 09 27	P	And that is not correct either. The gyros are - are okay, but on ASCS standby, it may be an orientation problem. I'll orient visually and - see if that will help out the ASCS problem.
02 10 11.5	CC	Aurora 7 from Indian Cap Com. Your blood pressure on your --- fairly high and you are supposed to, if possible, give a blood pressure over Indian Ocean Ship.
02 10 23.5	P	Roger. I've put blood pressure up on the air already. Over.
02 10 29.5	CC	Say again, Aurora.
02 10 31	P	Blood pressure is on the air now.
02 10 35	CC	Roger.
02 10 40	S	Blood pressure is coming through fine.
02 10 42.5	CC	Your blood pressure is coming through fine.

02 10 44.5	P	Roger.
02 10 58	CC	Aurora 7, this is Indian Cap Com. We have lost telemetry contact. How do you read me? Over.
02 11 04.5	P	Roger. Still reading you okay.
02 11 07.5	CC	--- Report to Cape you have checked fly-by-wire and all thrusters are okay. Is there anything else?
02 11 13	P	That is negative. Except this problem with steam vent temperature. I'm going - I'll open the visor a minute, that'll cool - it seems cooler with the visor open.
02 11 26	CC	Roger. Did you take xylose?
02 11 28.5	P	That is negative. I will do so now.
02 11 35	CC	Roger.
02 11 45	CC	Aurora 7, confirm you've checked fly-by-wire, and all thrusters okay.
02 11 51.5	P	Roger. Fly-by-wire is checked, all thrusters are okay.
02 11 56	CC	Roger.
02 12 28	CC	Aurora 7, Indian Ocean Cap Com. I do not read your transmission.
02 12 32	P	Roger. Indian Cap Com, Aurora 7.
02 12 35.5	CC	Out.
02 15 11.5	P	Well, I have - I am in record only, and I am getting warm now.
02 15 34	P	Don't know what to do with the cabin.
02 15 45	P	I'll turn it up and see what happens.
02 16 04.5	P	I have gotten badly behind in the flight plan now.
02 17 06	P	Okay, evaluating capsule stability at this time. The capsule is most stable.

02 17 24	P	I seem able to put it at zero rates. Alright, I will do that now. At capsule elapsed 02 17 32 I will zero out all rates.
02 17 45	P	That's as close to zero as I can make it. At 02 17 49 my rates are zero and attitudes are zero plus, or at zero, minus 3, minus 48. Let those rest awhile, and I'll see what we can do about suit temperature.
02 18 14	P	Cabin is rising, suit temperature seems to be rising, too. I'm going to let it go out until 2 25 to see if this is going to bring it down some.
02 18 49	P	I don't need to exercise, I really don't feel I need the exercise. I would get too warm.
02 19 02	P	We'll be getting to Muchea shortly.
02 19 08.5	P	Have a slight pitch up rate at this time, at 02 19 13, I'll zero that out, now. Fly-by-wire - have a slight yaw left rate - I'll zero out now. Attitudes at this time are minus 30.
02 19 57.5	P	Both busses are okay. All - let's see - number two battery is down to 22. One is 24, three is 24, stand-by one and two are 24, isolated is 27, main is 23, main IBU is 27. Two - two is now up. Main battery number two is up.
02 20 34.5	P	I am over the dark side now. The moonrise has not oc-curred and although I still see the lighted area from the setting sun behind us.
02 22 16.5	P	Now, I do have the haze layer at this time. It seems to be brighter than - It's good to open the cabin, open the visor.
02 23 07	P	The reticle now extincts at about 5.6.

MUCHEA

02 23 21	P	Hello, Muchea Cap Com. Aurora 7 loud and clear. How me?
02 23 26	CC	Read you loud and clear also, what's your status?

02 23 28	P	Roger. My status is good, control mode is fly-by-wire, gyros normal, maneuver off. Fuel is 45-6-70, that's 45-70, and oxygen is 84-100. I have only one minor problem, and that is my inability to get the suit steam vent temperature down, Deke.
02 23 56.5	CC	Roger, what's it running now?
02 23 58.5	P	Well, I'm reading 70. I'm really a little at a loss as to how to get it down, my suit - water valve is set now past the marks. This doesn't seem to bring it down, and neither does putting it - negative, that's wrong. The cabin was past the marks. The suit temperature is at prelaunch value of about four. I'm going to go to a setting of plus 6 at this time and see if that will bring it down below 70. Over.
02 24 40.5	CC	Okay, fine. We're indicating 84 suit which is a bit high.
02 24 44.5	P	Roger. My gage shows 7, 76 on the suit.
02 24 50	CC	Rog.
02 24 52	CC	Okay, let me give you a couple of retrotimes here. You have a 2 Dog nominal, Gold is 03 --- 29, Hotel 04 32 26.
02 25 10	P	Roger, understand 26.
02 25 13.5	CC	We're including your clock is still one second slow.
02 25 18.5	P	Roger.
02 25 20	CC	GMT hack of 15 10 42 - MARK. *(02 25 25 CET)
02 25 26	P	Roger, I'm right on and so is the backup.
02 25 29.5	CC	Roger, would you send us a blood pressure, please?
02 25 33.5	P	Starting, Roger, starting now.
02 25 53.5	CC	What mode of communications are you using at this time?

* Editor's note

02 25 58.5	P	I am on UHF high, Deke.
02 26 01	CC	Fine, Roger. Would you try using your mike button once instead of your VOX. See how this comes in.
02 26 05.5	P	Roger. Soon as I get through the blood pressure. I can do it now.
02 26 11.5	P	This is using the push to talk. 1,2,3,4,5,4,3,2,1. How now?
02 26 18	CC	I see no difference. They're identical.
02 26 20	P	Roger, is the modulation pretty good?
02 26 23	CC	Very good.
02 26 24	P	Roger.
02 26 26	P	Capsule stability, Deke, is very, very, good. I've noticed that I can put in a one degree per second rate on the needle just by moving heads and arms, - my head and arms. Over.
02 26 42	CC	Very good, excellent. For your information, there will be no flares at Woomera on this pass since the cloud cover won't allow you to see them anyway.
02 26 50	P	Roger. I was unsuccessful last pass.
02 26 55.5	CC	Okay, I'm going to send you a Z cal at this time.
02 26 59	P	Roger.
02 27 02.5	CC	MARK!
02 27 15.5	CC	Z cal is coming off.
02 27 17.5	P	Roger.
02 27 18.5	CC	On with R cal.
02 27 20	P	Roger.
02 27 33	P	Blood pressure stop.

02 27 34.5	CC	Blood pressure stop. Okay, we're going to oscillate R cal a couple of times here in attempt to reset our temperature problem.
02 27 41.5	P	Roger.
02 27 47	CC	Okay, R cal off. We suggest you go to manual at this point and preserve your auto fuel. Low at this point.
02 27 53.5	P	Roger. Goint to manual now.
02 27 57	CC	Roger.
02 28 00.5	P	At this time I'm reading 45-70 on fuel.
02 28 04.5	CC	Rog. Understand 45-70.
02 28 07	P	Cabin temperature is 107.
02 20 10.5	CC	Cabin 107.
02 23 17.5	CC	I don't believe you've ever received any sunrise, sunset times.
02 28 23	P	Roger, give me the whole lot of them, Deke, or the ones that are coming. Give me rise, set, and rise.
02 28 32	CC	Roger. Will do. Your next sunrise will be 02 50 00.
02 28 40	P	Roger. Copy.
02 28 41.5	CC	Sunset 03 41 20.
02 28 47	P	Roger.
02 28 48.5	CC	Sunrise 04 19 00.
02 28 54.5	P	Roger. Copy.
02 28 59	CC	Well, it sounds like you're doing real well up there, Dad.
02 29 01.5	P	Roger, it's a little warm.
02 29 04	CC	I suspect so.
02 29 09	CC	Been riding your horse the last couple of days.

02 29 12	P	Good.
02 29 23.5	CC	For your information, Cape informs that if we don't stay on manual for quite a spell here we'll probably have to end this orbit.
02 29 31	P	I'll be sure and stay on manual.
02 29 33.5	CC	Roger.
02 29 35.5	CC	You've got a lot of drift left here yet too.
02 29 38.5	P	Say again.
02 29 40	CC	You've got drift capability left yet, too.
02 29 41.5	P	Roger.
02 29 47.5	CC	Did you see any lights over the Australian ---?
02 29 50.5	P	I did - that is Roger, I did see some lights. I couldn't identify them, however.
02 29 57.5	CC	Roger, understand.
02 30 05.5	CC	Would you give us another readout on your suit steam temp? Has this changed any?
02 30 09.5	P	It may have gone down just a tad. It's about zero now, I mean about 70 now. It was a little bit higher. The visor is closed and I'm beginning to feel a little cooler.
02 30 24	CC	Very good.
02 30 27	CC	We indicated 2 degree drop at suit inlet, so it sounds like you're making out a bit.
02 30 30	P	Roger. My control mode now, Deke, is manual, gyros free, and the maneuver is off.
02 30 41.5	CC	Roger. I understand. Manual, gyro free, and maneuver off.
02 30 44.5	P	Roger.

02 31 23.5	CC	Aurora 7, this is Muchea Cap Com. Are you reading?
02 31 26	P	Still reading, Muchea.
02 31 28	CC	Very good.
02 31 30	CC	We are just kind of leaving you alone. How is your balloon doing, incidentally?
02 31 33.5	P	I haven't found it since it got dark. It's - it's - it rambles quite a bit, Deke. It's not inflated fully and it doesn't stretch out on the line tight like I expected. It bounces in and out and oscillates up and down and sideways. Have no good tensiometer readings yet.

WOOMERA

02 32 08	CC	Aurora 7, Aurora 7, this is Woomera Cap Com. How do you read? Over.
02 32 12	P	Hello, Woomera, Aurora 7. Loud and clear. How me?
02 32 17	CC	Roger. You are loud and clear, also.
02 32 20.5	CC	We copied your transmission over Muchea. Understand you still have the balloon on. Is that an affirmative?
02 32 26	P	That is affirmative. I have the balloon on. However, I haven't seen it for some time. It wanders quite a bit and I do not have it in sight at this moment. I believe that - it might be visible against the earth background at this time.
02 32 49	CC	Roger. Do you see the moon at all?
02 32 52	P	I am faced the wrong way and limited in maneuverability I have left because of my fuel state. I can see the terminator between moonlit side, and unmoonlit side. Over.
02 33 08.5	CC	Roger, understand.
02 33 15	CC	You are manual control. Is that right?

02 33 16.5	P	That is correct. My control mode is manual, gyros free, maneuver off. Over.
02 33 22.5	CC	Roger. Could you give us - could you give us cabin temperature?
02 33 31.5	P	Roger. Cabin temperature is 102 at this time.
02 33 37	CC	Roger. What is the suit temperature?
02 33 41	P	Okay, standby.
02 33 49.5	P	Suit temperature is 74, suit steam exhaust is 71.
02 33 58.5	CC	Roger, understand. Are you feeling a little more comfortable at this time?
02 34 02.5	P	I don't know. I'm still warm and still perspiring, but not really uncomfortable. I would like to - I would like to nail this suit temperature problem down. It - for all practical purposes, it's uncontrollable as far as I can see.
02 34 26.5	CC	Roger, understand. You might have to wait a few more minutes before this takes effect. You are on No. 6 Is that right?
02 34 34	P	That is right. Suit temperature is No. 6.
02 34 39	CC	Roger. Systems reports that your suit temperature has dropped two degrees over station, if that's any encouragement to you.
02 34 44.5	P	Roger, thank you, it is.
02 34 46.5	CC	Roger.
02 34 50	CC	Have you taken any food thus far?
02 34 53	P	Yes, I have. However, the food has crumbled badly, and I hate to open the package anymore for fear of getting crumbs all over the capsule. I can verify that eating bite-size food as we packaged for this flight is no problem at all. Even the crumbly foods are eaten with no, with no problem.

02 35 20	CC	Roger. How about water?
02 35 22.5	P	I had taken four swallows at approximately this time last orbit. As soon as I get the suit temperature - pegged a little bit, I'll open the visor and have some more water. Over.
02 35 37	CC	Roger. You are still coming in very loud and clear.
02 35 43	P	Roger.
02 35 45	CC	--- out at this time.
02 37 11	P	For the record now -
02 37 32.5	P	One of the labels for a fuse switch has slipped out, and sideways, and has tied the adjoining fuse switch together with it. This happened to emergency main and reserve deploy fuse switches.
02 38 06.5	P	I caged the gyros. They are too critical. I will try and navigate on the dark side without the gyros.
02 38 30	P	The fuse switch label should be glued in better so that turning off one fuse does not turn off the adjoining one.
02 39 35	P	I guess I'd better try to get that xylose pill out. I hate to do this.
02 40 57.5	P	Oh yes. There is the xylose pill. It didn't melt. All the rest of the stuff in here did melt.
02 41 31	P	Okay, xylose pill being consumed at 02 41 35. The rest of the food is pretty much of a mess. Can't stand this cabin temperature.

CANTON

02 43 39.5	P	Hello, Canton Com Tech. Aurora 7 reads you loud and clear. How me?
02 43 44.5	CC	This is Canton Cap Com. Read you loud and clear. Could you begin your short report, please?
02 43 51	P	Roger, George. My control mode is manual. The gyros are caged, maneuver is off. Fuel is 45 and 64, a little ahead of schedule. Oxygen reads 82-100.

Steam vent temperature in the suit is dropping slightly. It's a little below 70. Cabin is 46. Suit temperature has dropped to about 71 now. All the power is good, and here is a blood pressure. Over.

02 44 30 CC Okay, standing by for blood pressure.

02 44 44 CC We are receiving the blood pressure check. Over.

02 44 47 P Roger.

02 44 50 CC Do you plan on eating as called for by ---. Over.

02 44 57 P I did have the visor open a short time ago for the xylose pill. All of the rest of the food that I have aboard has either crumbled or melted. It's unusable in its present state so I think the xylose pill will constitute my last zero g meal. However, the first one, before the food crumbled, was quite easy. It's no problem to eat this bite-size food - in a weightless state. I also drank some water at that time, which was no problem.

02 45 32.5 CC Roger. I take it, from what you said then, that you have confirmed that your faceplate is closed for the decision on the third orbit.

02 45 42.5 P That is correct, my faceplate is closed. Also, what is the trend of my cabin pressure on the ground? Over.

02 45 51 CC Stand by, please.

02 46 08 CC We are checking on your request there, Scott. Could you hit that button again? We lost your EKG.

02 46 15 P Oh, you want blood pressure or EKG?

02 46 17.5 CC No, we lost the EKG. Possibly you could press on those sensors. Okay, Surgeon informs me that the EKG is now returning. Your other question, cabin pressure is staying at 5 1 approximately.

02 46 36.5 P Roger. No change in reading since launch. Is that correct?

02 46 40	CC	Negative on that. It's gone from 5.8 at launch to approximately 5.1 in very, very gradual descending trend.
02 46 52	P	Roger. My cabin pressure indicator is reading 4.8 at this time.
02 47 02	CC	Roger, I have no comment on this, just that the trend appears to be good here on the ground.
02 47 09.5	P	Roger.
02 47 16.5	CC	Do you have any specific comments on your balloon experiments; for example, the best color contrast with the ---.
02 47 36.5	P	Yes, I would say the day-glow orange is the best.
02 47 41	CC	Roger. For your information, the second sunrise should be expected in approximately three to four minutes.
02 47 47.5	P	Roger, thank you.
02 47 50.5	CC	Everything continues to look very good here on the ground. I've got a reading here on the ground for cabin pressure. This is for your information, is 4.8. Now this does take the trend that has been set up considerably. The suit pressure comes in at 4.9.
02 48 10	P	Roger.
02 48 14	CC	We find now that the - the O_2 partial pressure is fluctuating slightly, and the --- hanging around 4.2.
02 48 26.5	CC	Did you ---?
02 48 29.5	CC	O_2 partial pressure is fluctuating --- 4.2. Over.
02 48 35	P	Roger, copied, George, thank you.
02 48 39	CC	As I said before, everything looks very good here. Surgeon is after me here for you to try another blood pressure. Is this convenient?

02 48 47.5	P	Negative. I won't be able to hold still for it now. I've got the sunrise to worry about.
02 48 52.5	CC	Okay, Roger. We have no further queries. If you have any comments we'll be listening down here.
02 49 00	P	Negative. I have a beautiful sunrise through the window. I'll record it so you can see it.

HAWAII

02 49 07.5	CC	Aurora 7, Aurora 7, Hawaii Com Tech. How do you read me? Over.
02 49 12.5	P	Roger, Hawaii, Aurora 7. Loud and clear. How me?
02 49 17.5	CC	Aurora 7, this is Cap Com. Can you give me a short report, please.
02 49 22	P	Roger. My control mode is manual, gyros caged, maneuver off. Stand by one. My status is good and the capsule status is good. I want to get some pictures of the sunrise. Over.
02 49 37.5	CC	Roger. Give me the short report first.
02 49 40	P	Roger. Fuel is 45-62. Over.
02 49 48	CC	Roger. 45 and 62.
02 49 50.5	P	Roger.
02 50 31	CC	Aurora 7. Did you drink over Canton, did you drink any water over Canton?
02 50 36	P	That is negative. I will do, shortly.
02 50 40.5	CC	Roger, Sir John feels that this is advisable.
02 50 44.5	P	Roger.
02 50 45.5	CC	Do you have an auto fuel warning light?
02 50 48	P	That is right. I have reported it and I believe I reported it a long time ago. It is covered with tape at the moment.

FOR OFFICIAL USE ONLY

02 50 59	CC	Roger.
02 51 24.5	CC	Aurora 7, Aurora 7, Cap Com. Cape Flight advises me that we - that they expected the cabin to do such.
02 51 31.5	P	Roger, thank you.
02 51 34	CC	--- temperature exhaust --- steam exhaust?
02 51 39	P	Roger. Suit exhaust is 70. Cabin exhaust is 49.
02 51 46	CC	Roger.
02 52 20.5	CC	Aurora 7. This is Cap Com. Would like for you to return to gyros normal and see what kind of indication we have, whether or not your window view agrees with your gyros.
02 52 34	P	Roger. Wait one.
02 52 47	P	I have some more of the white particles in view below the capsule. They appear to be traveling exactly my speed. There is one drifting off. It's going faster than I am as a matter of fact.
02 53 11.5	CC	Roger, understand.
02 53 15	P	I haven't seen the great numbers of these particles, but I've seen a few of them. Their motion is random; they look exactly like snowflakes to me.
02 53 29	CC	Roger. Have you tried returning -- .
02 53 33	P	Negative. Le me get within scanner limits first.
02 53 39	CC	Say again.
02 53 40	P	I must adjust my attitude, to within scanner limits first.
02 53 46.5	CC	Roger.
02 54 18.5	P	There were some more of those - little particles. They definitely look like snowflakes this time.

02 54 26	CC	Roger, understand, your particles look like definite snowflakes.
02 54 32	P	However -
02 54 33.5	CC	Can we get a blood pressure from you, Scott?
02 54 34.5	P	Roger. Blood pressure - start - now. I have the balloon - now - pretty steadily below me, not oscillating. And go to gyros normal. Gyros normal now.
02 55 07.5	CC	Roger. TM indicates your - zero pitch.
02 55 15	CC	LOS, Scott, we've had LOS. Can you read me? Over.

CALIFORNIA

02 58 16	CT	Aurora 7, Aurora 7, this is California Com Tech, California Com Tech. Do you hear me? Over.
02 58 22.5	P	Hello, Cal Com Tech, Aurora 7. Loud and clear. How me?
02 58 45	CT	Aurora 7, Aurora 7, this is California Com Tech, California Com Tech. Do you hear? Over.
02 58 51.5	P	Hello, California Com Tech, Aurora 7. Loud and clear. How me?
02 58 56	CT	We're reading you loud and clear, also. Stand by for Cap Com.
02 58 59.5	P	Roger.
02 59 06.5	CC	Aurora 7, California. How do you read?
02 59 09.5	P	Hello, Al, loud and clear. How me?
02 59 12.5	CC	You're loud and clear, Scotty. Short report.
02 59 16.5	P	Roger. Control mode is manual, gyros normal, maneuver off. Fuel is 45-50. Balloon is out. Oxygen 81-100. And my status is good. The capsule status is good, except I'm unable to get a reasonable suit steam exhaust temperature. Still reading 70. Over.

02 59 42	CC	Roger, seems to me as long as suit inlet is going down that you could continue to increase flow until you feel comfortable.
02 59 52.5	P	Roger.
02 59 55	CC	Understand you're GO for orbit three.
02 59 58	P	I am - Roger, I am GO for orbit three.
03 00 00	CC	Seven, this is California.
03 00 12	P	Go, California.
03 00 15	CC	General Kraft is still somewhat concerned about auto fuel. Use as little auto, use no auto fuel unless you have to prior to retrosequence time. And I think maybe you might increase flow to your inverter heat exchanger, to try to bring the temperature down. They are not critical yet, however.
03 00 38	P	Roger, I have gone from 4 to 5 on the inverter at this time. And I think I'll increase just a tad on the suit.
03 00 49.5	CC	Roger. You're sounding good here. Give you a period of quiet while I send Z and R cal.
03 00 55.5	P	Roger.
03 01 06	CC	Seven, this is California sending Z cal on my mark.
03 01 09.5	P	Roger.
03 01 11	CC	One, MARK.
03 01 25	CC	Z cal off.
03 01 26.5	P	Roger.
03 01 29	CC	Stand by for R cal 3,2,1.
03 01 35	P	All right now, I'm beginning to get all of those various particles, they - they're way out. I can see some that are a hundred feet out.
03 01 52.5	CC	Roger. R cal off.

03 01 55.5	P	They all look like snowflakes to me. No don't - they do not glow of their own accord.
03 02 12	CC	Roger, Seven. Do you - have you --- perspire or have you stopped perspiring at the moment?
03 02 20	P	No, I'm still perspiring, Al. I think I'll open up the visor and take a drink of water.
03 02 27	CC	Roger. Sounds like a good idea.
03 02 42	CC	Seven, would you give us a blood pressure, please, in between swallows.
03 03 27	P	Okay, there's your blood pressure. I took about 20 swallows of water. Tasted pretty good.
03 03 38	CC	Roger, Seven. We're sure of that, we're getting Alpha times and - Hotel. You have Hotel, I know. How about 3 Alpha?
03 03 48	P	Roger, and MARK now a tensiometer reading. It's as tight as I've seen the string. Mark another tensiometer reading.
03 03 59	CC	Roger, we have those.
03 04 01	P	Now say again your last question.
03 04 06	CC	Do you have 3 Alpha of 03 11 00?
03 04 12	P	03 11 00.
03 04 16	CC	That is correct.
03 04 22	P	Roger, copied.
03 04 45	CC	Seven, this is California. Do you still read?
03 04 47	P	Roger, loud and clear.
03 04 50	CC	Roger, we have no further inquiries. See you next time.
03 04 53	P	Roger.

FOR OFFICIAL USE ONLY

GUAYMAS

03 05 11	CC	Aurora 7, Guaymas Cap Com.
03 05 13	P	Hello, Guaymas. Go ahead.
03 05 15	CC	Roger, we're reading you loud and clear. We'd like to conduct a wobulator test here. We use White Sands whenever you give us the word.
03 05 23	P	Roger, I have one, it's the yaw gyro on the stop at this time.
03 05 31	CC	Is your wobulator on now?
03 05 33	P	Yes, the wobulator is on.
03 05 35.5	CC	Roger.
03 05 43	CC	What was that on your yaw?
03 05 45.5	P	I have the yaw needle on the 250 stop.
03 05 50.5	CC	Roger.
03 05 52.5	P	I will not cage until after I get rid of the balloon and then I can start a slow yaw to the left to pick it off the stop.
03 06 04	CC	Roger.
03 06 12	CC	Roger, can you turn your wobulator on now and leave it on?
03 06 15.5	P	Roger, it has been on and I haven't touched it.
03 06 19	CC	Roger, understand.
03 06 20.5	P	Do you want it off?
03 06 24	CC	Roger. On and off in approximately 20 second intervals.
03 06 29	P	Okay, wobulator going off - NOW.
03 06 38	CC	Roger, we're relaying this.

03 06 46.5	P	Am I in a position to do a three sixty roll for them at this time?
03 06 51	CC	Your 00 yaw, you do have a yaw input in.
03 06 57	P	Could we do this three sixty roll on this pass at White Sands?
03 07 03	P	Gordo.

CAPE CANAVERAL

03 07 12.5	CC	Aurora 7, Cape Cap Com.
03 07 15	P	Roger, Cape. Loud and clear and break, break. Guaymas, the wobulator is back on now.
03 07 24.5	P	Roger, Cape. go ahead.
03 07 26.5	CC	Roger, Aurora 7, Cape Cap Com back on HF. Give me your report.
03 07 32	P	Roger. Control mode manual, gyros normal, the maneuver switch is off. Fuel is 45-45, oxygen is 70, or, correction, oxygen is 80 and 100. Suit temperature is 68 now and coming down pretty well. Suit steam vent temperature is 69 and beginning to be a little more confortable. Over.
03 08 12	CC	Roger, and how do you feel, now?
03 08 15	P	I feel pretty good. Still warm.
03 08 18	CC	Okay, sounds like you'll be alright.
03 08 23	CC	Did you - your normal balloon release time will be 3 plus 34, Scott?
03 08 28.5	P	3 plus 34, Roger.
03 08 31	CC	Roger, can you describe the balloon and its actions a little to us.
03 08 35	P	Yes, it has a random drift. There is no oscillation that I can predict whatsoever. The - the line leading to the balloon sometimes is tight, sometimes is loose - loose enough, so that there are loops in it. Its - its behaviour is strictly random as far as I can tell. The balloon is not inflated well either. It's an oblong shape out there, rather than a round figure, and I believe when the sun is on it, the day glow orange is the most brilliant, and the silver. That's about all I can tell you, Gus.
03 09 28.5	CC	Roger. Surgeon suggests that you drink as much water as you can. Drink it as often as you can.

03 09 38.5	P	Roger.
03 09 40	CC	Retrosequence times for area 3 B and 3 C are nominal.
03 09 43.5	P	3 B and 3 C nominal. Roger.
03 09 50.5	CC	And we recommend you go to normal on your gyros with the maneuver switch off.
03 09 55	P	Roger, the gyros are normal and the maneuver switch is off.
03 09 59.5	CC	Roger.
03 10 11.5	CC	Would you give us your - your temperature control valve settings, please?
03 10 20	P	Roger, suit is 7.5, cabin is about 10. That's 10 on the cabin and 5 on the inverters. Over.
03 10 35	CC	Roger.
03 10 37.5	CC	Standby for Z cal.
03 10 39.5	P	Roger, standing by.
03 10 46	CC	R cal.
03 10 53.5	P	Mark a tensiometer reading. It's as tight as I've - as it gets.
03 11 29.5	CC	Aurora 7, Cap Com.
03 11 32	P	Go ahead, Cap Com.
03 11 33.5	CC	- drifting flight yet?
03 11 35	P	Say again.
03 11 36.5	CC	Have you done any drifting flight?
03 11 38.5	P	That is Roger, and if I am to save fuel for retro-sequence I think I better start again. Over.
03 11 49	CC	Roger, I agree with you.

03 11 52	P	My control mode is now manual, gyros are caged and I will allow the capsule to drift for a little while.
03 12 04	CC	Roger, and John suggests you try to look back, towards the darkness, at sunrise to see those particles.
03 12 14	P	- Toward the darkness
03 12 16	CC	Roger, at sunrise, try to look toward the darkness.
03 12 18.5	P	Okay, I have done that, and - and - tell him no joy.
03 12 24	CC	Roger.
03 12 36.5	CC	Aurora 7, are you in drifting flight?
03 12 38.5	P	That is Roger.
03 12 40.5	CC	Roger.
03 12 46.5	P	I am looking down almost vertically. It's possible to distinguish, I believe, 4 separate cloud layers.
03 12 57.5	CC	Understand.
03 13 07	P	Balloon - I'll maneuver enough to get the balloon out in trail so I can photograph its departure.
03 13 35.5	CC	Roger.
03 13 55	P	I, incidently, have those little particles visible in the periscope at this time.
03 14 05	CC	Roger, understand the periscope.
03 14 22.5	CC	Aurora 7, Cap Com.
03 14 24	P	Roger, go ahead.
03 14 26.5	CC	We're still fairly happy with your fuel state now. Don't let - we'd like for you not to let either on get down below 40 percent.
03 14 33	P	Roger, I'll try. I have balloon jettison on and off, and I can't get rid of it.

03 14 41	CC	Understand that you can't get rid of the balloon.
03 14 43.5	P	That's right. It will not jettison.
03 14 48.5	CC	Okay.
03 15 19	CC	Aurora 7, Cap Com.
03 15 21.5	P	Go ahead, Cap Com.
03 15 23	CC	Give us your blood pressure and fuel reading.
03 15 26	P	Okay. Fuel is 45-42. Blood pressure on the air.
03 15 32	CC	Rog.
03 15 58	P	I have the particles visible still. They're streaming aft, but in an arc of maybe a 120 or 30 degrees.
03 16 16.5	CC	Aurora 7, Cap Com. Say again.
03 16 19	P	Roger, I have these particles drifting aft again, but they do not parallel the line to the balloon exactly. They drift aft within an arc of maybe 120 to 130 degrees.
03 16 36	CC	Roger.
03 16 41	CC	Aurora 7, Cap Com. Can you give us a comment on the zero g experiment?
03 16 53.5	P	Roger. At this moment, the fluid is all gathered around the standpipe, the standpipe appears to be full and the fluid outside the standpipe is about halfway up. There is a rather large maniscus. I'd say about 60° maniscus.
03 17 27.5	CC	Aurora 7, Cap Com. Repeat as much of your last message as you can.
03 17 32	P	Roger. The standpipe is full of the fluid. The fluid is halfway up the outside of the standpipe - a rather large maniscus, on angle of about 60 degrees. Over.

CANARY

03 20 31	CC	Aurora 7, Aurora 7, this is Canary Cap Com on HF. Do you read? Over.

03 21 00	P	Hello, hello, Canary Cap Com, Aurora 7. Reading you loud and clear, HF. Transmitting HF. How do you read? Over.
03 21 32.5	CC	Aurora 7, this is Canary Cap Com on HF. Do you read? Over.
03 21 40.5	P	Roger, Canary Cap Com. Reading you loud and clear, HF. How me? Over.
03 22 04	P	These pictures of the - small groups of closely-knit clouds are south of Canary, third orbit.
03 22 48.5	P	This must be crossing ITCV. I have never seen weather quite like this.
03 22 34	CC	This is Canary Cap Com on HF. Do you receive? Over.
03 23 36.5	CC	Aurora 7, this is Canary Cap Com. We had no transmissions from you. This is Canary Islands, signing out.
03 24 33	P	I have the Voasmeter out at this time.
03 24 53	P	Hello.
03 25 01	P	Hello, Canary Cap Com, Aurora 7. Reading you loud and clear. How me?
03 25 08	CC	Aurora 7, this is Canary Cap Com. Do you read? Over.
03 25 12.5	P	Go ahead Canary. Reading you loud and clear.
03 25 18.5	P	I am going - I am in the record only position now. I think the best answer to the autokinesis - is that there is none. I noticed none - and I tend to aline the horizontal with my head - it - a horizontal line under zero g is a line paralled to the line drawn between your eyes. I don't get autokinesis. I don't get - now wait a minute maybe I'm beginning to.
03 26 40	P	I should remark that at 3 26 33, I have in the sky, at any time, 10 particles. They no doubt appear to glow to me. They appeared to be little pieces of frost. However, some appear to be way, way far away. There are two - that look like they might be a hundred yards away. I haven't operated the thruster not for some time. Here are two in closer. Now a densiometer

reading on these that are in close. Extinct at 5.5, the elapsed time is 3 27 39. I am unable to see any stars in the black sky at this time. However, these little snowflakes are clearly visible.

03 28 13 P The cabin temperature has droped considerable now, and the setting I have on the suit is 7.

03 28 20.5 P Am going to increase it just a tad more.

03 28 40 P My suit valve, water valve temperature now is - about 8.

03 28 53 P Hello, hello, Kano Cap Com, Aurora 7. Reading you loud and clear. How me?

03 29 24 P I've noticed that every time I turn over to the right everything seems vertical, but I am upside down.

03 29 34 P Now, for the record.

03 29 43.5 P I still feel that, I could easily feel like I am coming in on my back.

03 30 03 P I could very easily come in from another planet, and feel that I am on my - on my back, and that earth is up above me, but that's sorta the way you feel when you come out of a Split S, or out of an Immelmann.

<u>KANO</u>

03 30 48 CC Kano on HF. If you read me, the Sir John requests that you take a blood pressure check now, a blood pressure check for the onboard record. Over.

03 31 00 P Roger. Reading you, Kano, loud and clear. Blood pressure start at this time.

03 31 10 P Visor is coming closed now.

03 31 39 CC Aurora 7, Aurora 7, this is Kano Cap Com. If you read me, would you do a blood pressure check for the onboard records. Over.

03 32 55 P Okay. I'm taking the - I've taken the big back off, going to record only, at this time. Have taken the

big back off of the camera and trying to get some more MIT film at this time. The filter is in. The cassette - is in the camera.

03 33 43	P	The zero g senta, sensations are wonderful. This is the first time I've ever worn this suit and had it confortable.
03 34 07.5	P	I don't know which way I'm pointed, and don't particularly care.
03 34 23	P	Roger. At this time I am hearing Kano calling for a blood pressure check. I will give it to him now. Let's see, I have fuel 45-43, still would like to get just a little rate - just a little one.
03 34 49	P	Let's see, we wanta go back that way.
03 35 35.5	P	I can't see any relationship between thruster action and the fireflies.
03 35 43	P	Mark MIT pictures to 3 35 36, crank two by - at infinity.
03 36 36	P	Coastal passage over Africa.
03 38 33	P	I'm taking many MIT pictures, at capsule elapsed 3 38 38. It will be the only chance we have, I might as well use up all the film.

INDIAN OCEAN SHIP

03 38 54	P	Hello, Indian Com Tech, Aurora 7. Loud and clear. How me?
03 39 13.5	CT	Aurora 7, this is IOS Com Tech, on HF and UHF. How do you read? Over.
03 39 18.5	P	Roger. Loud and clear. How me, Indian Cap Com?
03 39 24	CC	Aurora 7, this is Indian Cap Com. I did not read all of your transmission, but the part I monitored was loud and clear. Go ahead.
03 39 31.5	P	Roger. My status is good, the capsule status is good. I am in drifting flight on manual control. Gyros are caged. The fuel reads 45-42, oxygen 79-100.

		Steam vent temperatures both read 65 now, suit temperature has gone down nicely. It is now 62, and all the power is good. The blood pressure is starting at this time. I've just finished taking some MIT pictures, and that is all I have to report at this time.
03 40 16.5	CC	Roger, Aurora 7. I copy your control mode manual, and gyro caged, fuel 45-42, oxygen 79-100, and I did not hear the last part of your transmission. How do -
03 40 31.5	P	Roger. My status is good, the suit temperature has reduced considerably, steam vent temperatures now read 69 on cabin and suit, suit temperature is 62, and cabin temperature is 101. Over.
03 40 52.5	CC	Roger, suit temperature 62, and cabin temperature 101. Your blood pressure is starting - and understand you are on the manual. Understand also you are drifting for awhile.
03 41 10	P	That is Roger. I am.
03 41 12	CC	Confirm.
03 41 13	P	I am on manual control. I am allowing the capsule to drift. Over.
03 41 18	CC	Roger.
03 41 19	P	Also another departure from the plan is the fact that I have been unable to jettison the balloon. The balloon is still attached - should be no problem.
03 41 33	CC	Roger, understand no problem expected but balloon is still attached. Stand by.
03 24 04	CC	Aurora 7, this is Indian Cap Com. All our retro-sequence times are nominal. Do you want me to call them out to you? Over.
03 24 13	P	Negative. I have them all, thank you.
03 24 19.5	CC	Aurora 7, your last transcription was unreadable. You are fading badly, although intermittently. I will read retrosequence times in the blind. Area 3 Delta, 04 12 32, 04 12 32, Echo 04 22 27, 3 Echo 04 22 27, and the last --- we have is 04 32 26 ---

		now and your capsule clock is still within one second.
03 43 05	P	Roger, Kano. I copied all that.
03 43 08.5	CC	Roger, Aurora. You were loud and clear.
03 43 20	P	The sunsets are most spectacular. The earth is black after the sun has set. The earth is black, the first band close to the earth is red, the next is yellow, the next is blue, the next is green, and the next is sort of a - sort of a purple. It's almost like a very brilliant rainbow. It extends at some -
03 43 54	CC	Indian Cap Com. Check you see about all colors between the horizon and the night sky. You seem to see more layers than Friendship 7.
03 44 05.5	P	Roger. These layers extend from at least 90 degrees either side of the sun at sunset.
03 44 14.5	CC	Aurora 7, I did not hear your whole sentence. Will you repeat, please? Over.
03 44 19	P	Roger. This bright horizon band extends at least 90° north and south of the position of the sunset.
03 44 45	CC	Roger, understand. About the balloon, does Mercury Control Center know you did not -
03 44 52	P	Yes. I tried to release it over their station and was unable to do so. You might remind them that the balloon is still on.
03 45 02	CC	Roger, Aurora 7. Understand.
03 45 25.5	CC	Aurora 7, Indian Cap Com. Your inverter temperatures are 183 for the 150, and 195 for the 250. All your other primaries check out okay on telemetry.
03 45 38	P	Roger, thank you very much.
03 46 15.5	CC	Aurora 7, do you read? Over.
03 46 18.5	P	Go ahead, Indian Cap Com.
03 46 21	CC	Our medical monitor says that we are reading your respiration. I believe this is almost the first

time it's came across.

03 46 28	P	That's very good. I guarantee I'm breathing.
03 46 35	CC	Roger, understand.
03 46 48	P	The eye patch is in place, this time.
03 48 16.5	P	Going to record - record only at this time.
03 48 50	P	At 3 hours and 48 minutes and 51 seconds elapsed, I'm taking a good swig of water. It's pretty cool this time. Stretching my legs a tad. It's quite dark. I'm in drifting flight. Oh, boy! It feels good to get that leg stretched out. That one and the right one too.
03 49 40	P	I drank an awful lot of water and I'm still thirsty. As a matter of fact, I think there - there is a leak in the urinal, I'm sure.
03 50 38	P	Okay, line touch.
03 51 13.5	P	Okay. I'm shaking my head violently from all sides, with eyes closed, up and down, pitch, roll, yaw. Nothing in my stomach, nothing anywhere. There is, now, I will try to poke zero, time zero button. Well, I missed it. I was a little disoriented* as to exactly where things are, not sure exactly what you want to accomplish by this but there is no problem of orienting. Your - your - inner ears and your mental appraisal of horizontal, you just adapt to this environment, like - like you were born in it. It's a great, great freedom.
03 53 25.5	P	Don't let me forget about the shiny finish on the star chart. It makes it very hard to read.
03 53 40.5	P	At 3 53.
03 55 30	P	I'm using the - photometer now - to try and get - a reading. I saw a com - no, it's the balloon that I see, still drifting aimlessly, lighted by moon-

* The result of this test is the same under 1 g and he describes no difficulty in re-establishing relationships.

		light at this time.
03 56 09.5	P	None of the colors are - particularly visible, I think -
03 56 19.5	P	Excess cabin water light is on at this time, 3 56 24, am going to turn it down just a tad - so it will be just about where the suit is. I would say, let's see, from that, that it jumped down to freezing.

MUCHEA

03 57 00	P	Hello, Muchea Cap Com, Aurora 7. Loud and clear. How me?
03 57 06.5	CC	Coming in loud and clear.
03 57 08	P	Roger, Deke, my control mode is manual, gyros are caged, the maneuver switch is off. My fuel reads 45 and 42, the oxygen is reading 76 and 100, steam vent temperatures are 68 on the suit and I just got excess cabin water light, the needle dropped down to 20. Reset cabin water at about 6 and in this capsule it seems optimum settings are right between 6 and 7. Outside of that, all things, all systems are good. And blood pressure is starting now.
03 58 01.5	CC	Roger, okay, starting blood pressure.
03 58 04.5	P	The visor has been open for some time, I've been taking some readings on stars through the haze layer with the photometer, the visor is coming closed now.
03 58 16.5	CC	Roger, understand visor coming closed.
03 58 20	CC	I'll give you retro time for end of mission and would like to have you set the clock to this at this time.
03 58 26.5	P	Roger.
03 58 28.5	CC	32 34
03 58 31	P	Understand, 04 32 34.
03 58 35	CC	Good.

03 58 35.5	P	Okay, it's going into the clock now - whoop.
03 58 46.5	CC	We indicate 35.
03 58 49	P	I do, too, I overshot. Stand by.
03 59 00.5	CC	That's probably close enough for government work.
03 59 07.5	P	For you, to the second.
03 59 15.5	CC	Roger, still you indicate 1 second slow on GET, we indicate you on, on retrotime.
03 59 20.5	P	Roger. I am reading 04 32 34.
03 59 24.5	CC	Would you please exercise prior to your second blood pressure.
03 59 29	P	Roger, I'll give you the calibrated exercise, at this time.
03 59 35.5	CC	Roger.
03 59 38.5	P	Exercise start, now.
04 00 11.5	P	Okay, blood pressure start, not. That was 60 cycles in 30 seconds on the exerciser.
04 00 19.5	CC	60 cycles in 30 seconds.
04 00 25	CC	Did you by any chance try T/M keying over the Cape on your last pass?
04 00 31.5	P	I think I may have to mark time for tensiometer reading on the balloon.
04 00 40.5	CC	Very good.
04 00 43	CC	Understand you still have the balloon with you. It's possible if you go to deploy position and back to release, you can -
04 00 51.5	P	Roger, I've tried that a number of times, Deke. I just can't get rid of it.
04 00 57	CC	Okay, well, she'll probably come into your face on retro-fire, but I'm sure you'll loose it shortly after that.

04 01 02	P	Yeah, I figure. I hope so.
04 01 06	CC	Okay, for your information, cloud --- is five-tenths and it's only one-eighth to the north over Port Moresby, so if you see some lights up in that area, we'd like to know about it.
04 01 18	P	Roger, I'll let you know.
04 01 24	CC	Could you give us a CET hack, please.
04 01 27	P	Roger, CET on my mark will be 4 hours, 1 minute, 35 seconds, stand by. MARK, 4 01 35.
04 01 39	CC	Roger. Still one second off; that's fine.
04 01 45.5	CC	The flight plan calls for you to have a drink of water over here. Do you feel like you need one?
04 01 51	P	Roger, I just, I have had three long drinks of water. The last one was, I think, about 10 minutes ago, Deke.
04 02 00	CC	You're probably loaded for bear, then.
04 02 01.5	P	Roger.
04 02 14	CC	---?
04 02 17	P	Roger, Deke, the haze layer is very bright. I would say 8 to 10 degrees above the real horizon. And I would say that the haze layer is about twice as high above the horizon as the - the bright blue band at sunset is, it's twice as thick. A star, stars are occuluded as we pass through this haze layer. I have a good set of stars to watch going through at this time. I'll try and get some photometer readings.
04 03 12.5	CC	Roger, understand. It's twice as --- sunset.
04 03 14.5	P	It is not twice as thick, it's thinner but it is located at a distance about twice as far away as the top of the - the band at sunset.
04 03 29	CC	Understand.

04 03 33	P	It's very narrow, and as bright as the horizon of the earth itself.
04 03 41	CC	Rog.
04 03 59.5	P	This is a reading on Phecda in - in the Big Dipper, prior to entry in the, the, into the haze layer. It occludes - it is extinct at roughly 2.5. The reticle extincts at 5.5. TM mark for the time in the middle of the haze layer. Spica - stand by.

WOOMERA

04 05 02	CC	Aurora 7, Aurora 7, this is Woomera Cap Com. How do you read? Over.
04 05 05.5	P	Roger. Stand by, Woomera.
04 05 08.5	CC	Roger, standing by.
04 05 15.5	P	In the middle of the haze layer, Phecda will not - I can't even get a reading on it through the photometer. Phicda is now below the horizon, or below and mark about 5 seconds ago, now it emerged from the brightest part of the haze layer. It is now clearly visible. Woomera, my status is very good, fuel is 45 and 42. Standby, I'll give you a full report very shortly.
04 05 55.5	CC	Roger, standing by.
04 06 01.5	P	Visor coming open.
04 06 03.5	CC	Roger, visor open.
04 06 27.5	CC	Aurora 7, this is Woomera. Do you read? Over.
04 06 29.5	P	Roger, Woomera, loud and clear.
04 06 32.5	CC	You say visor is open?
04 06 35.5	P	That's negative. I did not open it, I won't open it until I get through with these readings. Phecda now extincts at 1.7 in the mid, in mid position between the haze layer, and the earth. Okay, Woomera, my - my status is very good. The suit

temperature is coming down substantially. Steam vent temperature is not down much, but the suit environment temperature is 60. I'm quite comfortable. Cabin temperature is 101, cabin is holding an indicated 4 8, oxygen is 75-100, all d-c power continues to be good. 20 Amps, both a-c busses are good, fuel reads 46 and 40. I am in drifting flight. I have had plenty of water to drink. The visor is coming open now. And blood pressure is coming your way at this time.

04 08 00.5	P	Hello, Woomera, Woomera Cap Com, this is Aurora 7. Did you copy my last? Over.
04 09 27.5	P	Cabin temperature, cabin water flow is all the way off and reducing back to about 7.5 now, a little bit less. At this time cabin steam vent, going to record only.
04 09 52.5	P	Cabin steam vent is 10, suit steam vent is 62. I would like to have a little bit more pad on the temperature, but I can't seem to get it. The suit temperature is 60, the cabin temperature continues at 102. I have 22 minutes and 20 seconds left for retrofire. I think that I will try to get some of this equipment stowed at this time.
04 11 07.5	P	There is the moon.
04 11 31.5	P	Looks no different - here than it does on the ground.
04 11 51	P	Visor is open and the visor is coming closed now at this time.
04 12 28	P	I have put the moon - in the center of the window and it just drifts very, very little.
04 12 49.5	P	There seems to be a stagnant place in the, my helmet. The suit is cool, but along my face it's warm.
04 13 51	P	And there is Scorpio.
04 14 46.5	P	Alright, let's see.
04 15 04	P	It's very interesting to remark that my attitude - and the - is roughly pitch up plus 30, roll right

130, and yaw left 20. The balloon at this time is moving right along with me. It's keeping a constant bearing at all times. There is the horizon band again, this time from the moonlit side. Let me see, with the air glow filter, it's very difficult to do this because of the lights from that time correlation clock. Visor coming open now. It's impossible to get dark-adapted in here, with that light the way it is.

04 17 23.5	P	Alright for the record. Interesting, I believe, this haze layer is very bright through the air glow filter. Very bright. The time now is 4 17 44.
04 18 00.5	P	Now, let me see, I'll get an accurate band width.
04 18 21	P	That's very handy, because the band width - there is the sun. ---. The horizon band width is exactly equal to the X. I can't explain it, I'll have to, to -
04 19 22.5	P	Sunrise. Ahhhhh! Beautiful lighted fireflies that time. It was luminous that time. But it's only, okay, they - Alright, I have - If anybody reads I have the fireflies they are very bright. They are capsule emanating. I can rap the hatch and stir off hundreds of them. Rap the side of the capsule. Huge streams come out. They - some appear to glow. Let me yaw around the other way.
04 20 25	P	Some appear to glow but I don't believe they really do, it's just the light of the sun. I'll try to get a picture of it. They're brilliant. I think they would really shine through nine on the photometer. I'll rap, let's see.
04 21 39.5	P	Taking some pictures at f of 2 8 and bulb. The pictures now, here, one of the balloon. The sun is too bright now. That's where they come from. They are little tiny white pieces of frost. I judge from this that the whole side of the capsule must have frost on it.

HAWAII

04 22 07	CT	Aurora 7, this is Hawaii Com Tech, how do you read?

04 22 10	P	Hello, Hawaii, loud and clear. How me?
04 22 19	P	Hawaii Com Tech.
04 22 21	CT	Seven, Hawaii Com Tech, I read you momentarily, on UHF. How do you read? Over.
04 22 26	P	Roger, reading you loud and clear Hawaii. How me?
04 22 31.5	CC	Aurora 7, Hawaii Cap Com. How do you read me?
04 22 35	P	Roger, do you read me or do you not, James?
04 22 39.5	CC	Gee, you are weak, but I read you, you are readable. Are you on UHF-Hi?
04 22 44.5	P	Roger, UHF-Hi.
04 22 47.5	CC	Roger, orientate the spacecraft and go to the ASCS.
04 22 53.5	P	Roger, will do.
04 22 59	P	Roger, copied, going into orbit attitude at this time.
04 23 13	CC	Aurora 7, Aurora 7, do you copy? Over.
04 23 16	P	Roger, copy. Going into orbit attitude at this time.
04 23 24	CC	Roger.
04 24 11	CC	Aurora 7, Hawaii Cap Com, do you read me? Over.
04 24 14	P	Roger, go ahead, Hawaii.
04 24 15	CC	Is your maneuver switch off?
04 24 18	P	The maneuver switch is off.
04 24 20	CC	Roger, are you ready to start your pre-retrosequence checklist.
04 24 23.5	P	Roger, one moment.
04 24 36	P	I'm alining my attitudes. Everything is fine. I have part of the stowage checklist taken care of at this time.

04 24 47	CC	Roger.
04 25 11.5	CC	Aurora 7, do you wish me to read out any of the checklist to you?
04 25 17	P	Roger, let me get the stowage and then you can help me with the pre-retrograde.
04 25 24	CC	Roger, standing by.
04 25 55	CC	Aurora 7, can we get on with the checklist? We have approximately 3 minutes left of contact.
04 26 00	P	Roger, go ahead with the checklist and I'm coming to retroattitude now and my control mode is automatic and my attitudes-standby, wait a minute, I have a problem in.
04 26 33.5	P	I have an ASCS problem here. I think ASCS is not operating properly, let me - . Emergency retrosequence is armed and retro manual is armed. I've got to evaluate this retro - this ASCS problem, Jim, before we go any further.
04 27 04	CC	Roger, standing by. Make sure your emergency drogue deploy and emergency main fuses are off.
04 27 13.5	P	Roger, they are. Okay, I'm going now to fly-by-wire, to Aux Damp, and now - attitudes do not agree. Five minutes to retrograde, light is on. I have a rate of descent, too, of about 10, 12 feet per second.
04 27 46.5	CC	Say again, say again.
04 27 49	P	I have a rate of descent of about 12 feet per second.
04 27 54	CC	What light was on?
04 27 56.5	P	Yes, I am back on fly-by-wire, trying to orient.
04 28 06	CC	Scott, let's try and get some of this retrosequence list checked off before you get to California.
04 28 12.5	P	Okay, go through it, Jim.
04 28 26.5	P	Roger, Jim, go through the checklist for me.

04 28 29.5	CC	Roger, squib switch armed, auto retrojettison switch off, gyros normal, manual handle out, roll, yaw and pitch handles in.
04 28 42.5	P	Roll, yaw, and pitch are in.
04 28 46.5	CC	Retroattitude auto, retract scope auto, maneuver switch off, periscope lever up, UHF HI power, transmit on UHF, beacon continuous, VOX power on transmit and record, all batteries checked. Do you copy?
04 29 10	P	Roger, it's complete.
04 29 15.5	CC	Transmitting in the blind. We have LOS. Ground elapsed time is on my mark, 4 hours, 29 minutes and 30 seconds. Transmitting in the blind to Aurora 7. Make sure all your tone switches are on, your warning lights are bright, the retro manual fuse switch is on, the retrojettison fuse switch is off. Check your face plate and make sure that it is closed.
04 29 59	CC	Aurora 7. Did you copy?
04 30 00.5	P	Roger, copied all; I think we're in good shape. I'm not sure just what the status of the ASCS is at this time.

CALIFORNIA

04 31 36	CT	Aurora 7, Aurora 7, this is California Com Tech, California Com Tech. Do you hear? Over.
04 31 42	P	Hello, California Com Tech. Loud and clear. How me?
04 31 45.5	CT	I'm reading you loud and clear also. Stand by for Cap Com.
04 31 50	CC	Seven, this is Cap Com. Are you in retroattitude?
04 31 53	P	Yes, I don't have agreement with ASCS in the window, Al. I think I'm going to have to go to fly-by-wire and use the window and the scope. ASCS is bad. I'm on fly-by-wire and manual.
04 32 06	CC	Roger, we concur. About 30 seconds to go.

04 32 21	CC	About 10 seconds on my mark.
04 32 23.5	P	Roger.
04 32 28	CC	6, 5, 4, 3, 2, 1.
04 32 36	P	Retrosequence is green.
04 32 40	CC	Roger, check ASCS quickly to see if orientation mode will hold.
04 32 47	CC	If your gyros are off you'll have to use attitude bypass.
04 32 51	P	Gyros are off.
04 32 54.5	CC	But you'll have to use attitude bypass and manual override.
04 32 58.5	P	Roger.
04 33 00	CC	4, 3, 2, 1, 0.
04 33 14.5	P	Okay, fire 1, fire 2, and fire 3. I had to punch off manually. I have a little bit of smoke in the capsule.
04 33 30	CC	Attitudes hold, Scotty.
04 33 31.5	P	Okay, I think they held well, Al, the - I think they were good. I can't tell you what was wrong about them because the gyros were not quite right. But retrojettison - 3 fuse switches are on.
04 33 51.5	CC	Roger, we should have retrojettison in about 10 seconds.
04 33 55	P	Roger.
04 33 56.5	P	That was a nice gentle bump. All three have fired. Retroattitude was red.
04 34 05.5	CC	Roger. Should have retrojettison now.
04 34 10	P	Ah, right then at 34 10, on time.

04 34 15	CC	Roger, how much fuel do you have left both tanks?
04 34 19	P	I have 20 and 5.
04 34 23.5	CC	Roger, I guess we'd better use -
04 34 26	P	I'll use manual.
04 34 27.5	CC	- on reentry unless ASCS holds you in reentry attitude.
04 34 31	P	Yes, it can, I'll have to do it with manual.
04 34 39	CC	Roger, recommend you try Aux Damp first, if it's not working then, go to fly-by-wire.
04 34 45	P	Okay, I'll have to do that.
04 34 53	P	The balloon is gone. I am aparently out of manual fuel, I have to go to fly-by-wire to stop this tumbling.*
04 35 13.5	CC	Roger. Using fly-by-wire to stop tumbling.
04 35 24.5	CC	Aurora 7, understand RSCS did not work.
04 35 27.5	P	I am out of manual fuel, Al.
04 35 31	CC	Roger.
04 35 34.5	P	.05 g should be when?
04 35 37.5	CC	Oh, you have plenty of time. It should be 04 44 elapsed time.
04 35 45	P	Roger.
04 35 46	CC	You have plenty of time. Take your time on fly-by-wire to get into reentry attitude.

* Note: The spacecraft was rotating slowly at this point and was returned to proper attitude by the pilot before it had made ¼ revolution.

04 35 50.5	P	Roger.
04 36 05	CC	I was just looking over your reentry checklist, looks like you're in pretty good shape. You'll have to manually retract the scope.
04 36 14.5	P	No. I didn't. The scope did come in, Al.
04 36 18.5	CC	Roger. I didn't get that. Very good.
04 36 29.5	CC	How are you doing on reentry attitude? Over.
04 36 32.5	P	Stowing a few things first. I don't know yet. Take a while.
04 36 46	P	Okay.
04 36 54	P	Going to be tight on fuel.
04 37 02.5	CC	Roger, you have plenty of time, you have about 7 minutes before .05 g so take ---
04 37 10	P	Roger.
04 37 28	P	Okay. I can make out very, very small - farm land, pasture land below. I see individual fields, rivers, lakes, roads, I think. I'll get back to reentry attitude.
04 37 39.5	CC	Roger, 7, recommend you get close to reentry attitude, using as little fuel as possible and standby on fly-by-wire until rates develop. Over.
04 37 50	P	Roger, will do.
04 38 03	CC	Seven, this is California. We're losing you now. Standby for Cape.
04 38 08.5	P	Roger.

CAPE CANAVERAL

04 40 50.5	CC	Aurora 7, Cape Cap Com. Over.
04 40 52.5	P	Hello Cape Cap Com, Aurora 7. Loud and clear.

04 41 08	CC	Aurora 7, Cape Cap Com. Over
04 41 10	P	Hello, Cape Cap Com, Go ahead.
04 41 12.5	CC	Roger. Do you have your face, face plate closed?
04 41 16	P	Negative, it is now. Thank you.
04 41 18.5	CC	Roger, give me your fuel, please.
04 41 20	P	Fuel is 15 auto, I'm indicating 7 manual but it is empty, and ineffective.
04 41 27	CC	Roger, you have a few minutes to start of blackout.
04 41 33	P	Two minutes, you say?
04 41 49	CC	Aurora 7, Cap Com.
04 41 50	P	Go ahead, Cap Com.
04 41 52.5	CC	Just wanted to hear from you.
04 41 54	P	Roger. It's going to be real tight on fuel, Gus. I've got the horizon in view now, trying to keep rates very low, the, I just lost part of the balloon. The string from the balloon.
04 42 10	CC	- checklist.
04 42 12	P	Yes. We're in good shape for stowage.
04 42 18.5	CC	Aurora 7, have you completed your reentry---
04 42 20.5	P	Roger.
04 42 22	CC	Check.
04 42 28.5	CC	The weather in the recovery area is good, you've got overcast cloud, 3 foot waves, 8 knots of wind, 10 miles visibility and the cloud bases are at 1000 feet.
04 42 39	P	Roger.
04 42 45	CC	Will give you some more as soon as we get an IP.

04 42 47	P	Roger.
04 43 05	CC	Aurora 7, Cap Com, will you check your glove compartment and make sure it's latched and your ---.
04 43 10.5	P	Roger, it's tight.
04 43 12.5	CC	Rog.
04 43 16	CC	Starting into blackout anytime now.
04 43 18	P	Roger.
04 43 21.5	CC	Roger. We show you still have some manual fuel left.
04 43 24.5	P	Yes, but I can't get anything out of it.
04 43 28.5	CC	Roger.
04 43 40	CC	Aurora 7, Cap Com. Do you still read?
04 43 42.5	P	Roger, Loud and clear.
04 43 52	P	I don't have a roll rate in yet, I'll put some in when I begin to get the g build-up.
04 44 07.5	P	I only was reading point 5 g's on the accelerometer. Okay, here comes some rates.
04 44 28.5	P	I've got the orange glow. I assume we're in blackout now, Gus, give me a try. There goes something tearing away.
04 44 52.5	P	Okay. I'm setting in a roll rate at this time.
04 45 06	P	Going to Aux Damp.
04 45 13.5	P	I hope we have enough fuel. I get the orange glow at this time.
04 45 30.5	P	Bright orange glow.
04 45 43.5	P	Picking up just a little acceleration now.

04 46 17.5	P	Not much glow, just a little. Reading .5 g. Aux Damp seems to be doing well. My fuel I hope holds out. There is 1 g. Getting a few streamers of smoke out behind, there's some green flashes out there.
04 47 02.5	P	Reentry is going pretty well, Aux Damp seems to be keeping-oscillations pretty good, we're at 1½ g's now. There was a large flaming piece coming off. Almost looked like it came off the tower.
04 47 36.5	P	Oh, I hope not.
04 47 47	P	Okay. We're reading 3 g's, think we'll have to let the reentry damping check go this time. Reading now 4 g's. The reentry seems to be going okay. The rates there that Aux Damp appears to be handling. I don't think I'm oscillating too much, seem to be rolling right around that glow - the sky behind. Auto fuel still reads 1 4 at 6.5 g's. Rates are holding to within 1½ degrees per second. Indicating about 10 degrees per second roll rate. Still peaked at 6.8 g's. The orange glow has disappeared now. We're off peak g. Still indicating 14% auto fuel, back to 5 g's.
04 49 18.5	P	And I'm standing by for altimeter off the peg. Cape, do you read yet? Altimeter is off the peg. 100 ft., rate of descent is coming down, cabin pressure is - cabin pressure is holding okay. Still losing a few streaming, no that's shock waves. Smoke pouring out behind. Getting ready for the drogue at 45.
04 49 58	P	Oscillations are pretty good, I think ASCS has given up the ghost at this point. Emergency drogus is, fuse switch is coming out not to on.
04 50 20.5	?	---
04 50 29.5	P	Roger, Aurora 7, reading okay. Getting some pretty good oscillations now and we're out of fuel. Looks from the sun like it might be about 45 degrees. Oww, it's coming like - it's really going over.

04 50 51	P	Think I'd better take a try on the drogue. Drogue out manually at 25, it's holding and it was just in time. Main deploy fuse switch is on now, 21 indicated.
04 51 12.5	P	Snorkle orerride now. Emergency flow rate on. Emergency main fuse switch at 15, standing by for the main chute at 10.
04 51 33.5	P	Cabin pressure, cabin altimeter agree on altitude. Should be 13,000 now. Mark 10, I see the main is out, and reefed and it looks good to me. The main chute is out. Landing bag goes to auto now. The drogue has fallen away. I see a perfect chute, visor open. Cabin temperature is only 110 at this point. Helmet hose is off.
04 52 39.5	P	Does anybody read. Does anybody read Aurora 7. Over.
04 52 54.5	P	Hello, any Mercury Recovery Force. Does anyone read Aurora 7? Over.
04 53 04.5	CC	Aurora 7, Aurora 7, Cape Cap Com. Over.
04 53 07.5	P	Roger, say again. You're very weak.
04 53 13	CC	Aurora 7, Aurora 7, Cape Cap Com. Over.
04 53 16	P	Roger, I'm reading you. I'm on the main chute at 5,000, status is good. I am not in contact with any recovery forces. Do you have any information on the recovery time? Over.
04 54 14	P	Hello, any Mercury recovery forces. How do you read Aurora 7? Over.
04 54 27	CC	Aurora 7, Cape Cap Com. Over.
04 54 29	P	Roger. Loud and clear. Aurora 7 reading the Cape, loud and clear. How me, Gus?
04 54 41.5	P	Gus, how do you read?
04 54 56.5	CC	Aurora 7 --- 95, Your landing point is 200 miles long, we will jump the Air Rescue people to you.

04 55 06	P	Roger, understand. I'm reading.
04 55 27	CC	Aurora 7, Aurora 7, Cape Cap Com, be advised your landing point is long, we will jump Air Rescue people to you in about one hour.
04 55 36	P	Roger, understand 1 hour.

DISTRIBUTION

This MA-7 Postlaunch Memorandum Report has the following distribution:

Office of Director, Langley (3)
Office of Director, Houston (3)
Program Analysis and Evaluation, Houston (1)
MSC Files and Library, Langley (5)
Ass't Director for Research and Development, Houston (3)
  Life Systems Division, Houston (6)
  Life Systems Division, Cape (3)
  Systems Evaluation and Development Division, Houston (8)
  Spacecraft Research Division, Houston (8)
Flight Operations Division, Langley (8)
Flight Operations Division, Houston (3)
  Data Coordination Office, Cape (5)
Flight Crew Operations Division, Langley (8)
Flight Crew Operations Division, Houston (3)
  Astronauts' Office, Langley (7)
Apollo Project Office, Houston (10)
Gemini Project Office, Houston (10)
Mercury Project Office, Langley (25)
Mercury Project Office, Cape (2)
  Project Engineering Field Office, Cape (5)
Reliability and Flight Safety Office, Langley (2)
Reliability and Flight Safety Office, Houston (2)
Reliability and Flight Safety Office, Cape (2)
Preflight Operations Division, Cape (15)
Public Affairs Office, Langley (1)
Public Affairs Office, Houston (1)
NASA AMR Project Office, Cape (3)
NASA Representative at MAC (15)
NASA Headquarters (8)
Ames Research Center (6)
Goddard Space Flight Center (6)
NASA Dyna-Soar Office, WPAFB (2)
MSC Cape Files (10)
MSC Houston Files (Remainder for storage) (26)