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NASA Project Mercury Working Paper No. 192

POSTLAUNCH REPORT

FOR

MERCURY-REDSTONE NO. 3

(MR-3)

CLASSIFIED DOCUMENT

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE TASK GROUP

Langley Field, Va.

June 16, 1961

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POSTLAUNCH REPORT FOR MERCURY-REDSTONE NO. 3

(MR-3)

NASA Project Mercury Working Paper No. 192

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N O T I C E

LIFF-OFF TIME FOR THE MR-3 FLIGHT WAS 1434:13.48. RANGE ZERO TIME WAS ESTABLISHED AS 1434:13 ZULU (0934:13 EST). ALL TIMES REFERRED TO IN THE BODY OF THIS REPORT ARE PRESENTED AS ELAPSED TIME IN MINUTES AND SECONDS FROM RANGE ZERO, EXCEPT WHERE SPECIFICALLY NOTED. FOR EXAMPLE, AN ELAPSED TIME OF 2 MINUTES AND 31 SECONDS WILL BE PRESENTED AS 02:31.

1.0 INTRODUCTION

The first Mercury manned space flight was successfully accomplished on May 5, 1961. Alan B. Shepard was the pilot.

This flight was the third Mercury-Redstone flight in a program which has been established to investigate the capabilities and physiological reactions of man during brief space flight.

Astronaut Shepard satisfactorily performed his assigned tasks during all phases of the flight. Capsule and booster systems performed as planned.

The capsule achieved an altitude of 101 nautical miles, a range of 263 nautical miles, and was in weightless flight for slightly over 5 minutes.

Postflight examination of Shepard and inspection of the capsule showed both to be in excellent condition.

The mission was successful in all respects.

2.0 MISSION DESCRIPTION

MR-3 was launched at 0934 hours EST May 5, 1961, after holds totaling 3 hours and 34 minutes. These holds included a planned hold of 1 hour. Astronaut Shepard was in the capsule for a total of 4 hours and 14 minutes prior to launch.

The powered flight phase of the mission was normal in every respect. Booster cut-off occurred at 02:22 at which time the velocity was 6414 feet per second. Tower jettisoning was also accomplished at 02:22. During the powered phase of the flight, the pilot made several voice communications reporting on capsule and booster conditions. He later stated that vibration was of sufficient magnitude to distort markings on the dials on the instrument panel at transonic velocities. Records indicate the vibration reached about 11g at the capsule adapter.

Capsule separation occurred normally at 02:32, and after 5 seconds of rate damping, capsule turn around was accomplished. A period of weightless flight ensued which amounted to slightly more than 5 minutes. The pilot made numerous observations and performed many tasks during this period. He performed these tasks well and barely noticed that he was in a weightless condition. Medical records indicate no adverse effects from this period of weightless flight.

Reentry was started on schedule, as indicated by the 0.05g relay becoming actuated at 07:38. A deceleration force of 11g was recorded during reentry. The pilot made several communications during this period, indicating that his condition was satisfactory.

Landing occurred on schedule at 15:22. The pilot reported the landing shock to be moderate. Recovery was swift; a helicopter was hooked onto the capsule within two minutes after landing. The pilot made his egress through the side hatch and was hoisted aboard the helicopter. The helicopter then lifted the capsule and deposited both capsule and the pilot on the aircraft carrier Lake Champlain 11 minutes after capsule landing.

Astronaut Shepard made an extremely lucid accounting of the flight on tape while aboard the carrier, the complete transcription of which is included in this report. After a brief physical examination he was flown to Grand Bahama Island for a more extensive physical examination, additional debriefing and rest. The post-flight examinations showed him to be in excellent physical condition.

The capsule was brought back to Cape Canaveral the morning after the flight for a post-flight inspection. The inspection showed it to be in excellent condition.

3.0 VEHICLE DESCRIPTION

3.1 Capsule

Capsule no. 7 was utilized for the MR-3 mission. It was essentially identical to capsule no. 5 which was utilized on the MR-2 mission. These two capsules differ from later manned capsules as to the window arrangement and the method of releasing the side hatch. These differences are outlined in Figure 3.1-1. The instrument panel on capsule no. 7 has a different arrangement than on later capsules. A view of the panel is shown in Figure 3.1-2.

The capsule and capsule systems were as described in NASA Space Task Group Working Paper 148 with minor deviations. A photograph of the capsule is shown in Figure 3.1-3.

The measured physical parameters of the capsule are shown in the table below:

Configuration		Launch	Orbit	Re-entry	Flotation
Weight (pounds)		4040.28	2855.14	2579.00	2316.03
Center of	Z	170.212	121.10	124.61	119.77
Gravity	X	.11	.15	.14	-.10
(Station)	Y	.04	-.01	-.09	.02
Moment of	Roll Iz	318	273	263	248
Inertia	Pitch Ix	7331	590	515	332
(Slug/Ft^2)	Yaw Iy	7346	604	529	347

The axis system used in referencing the instrumentation system and capsule physical characteristics is presented in Figure 3.1-4. Positive directions for attitudes and rates are indicated by arrows. Maximum diameter of the capsule is at Z = 104.50 station.

3.2 Booster

The booster was a modified Redstone, essentially identical to that used for the MR-BD mission, discussed in Marshall Space Flight Center Report MTP-AERO-61-36, and, except for some details, the same as those used for the previous Mercury-Redstone missions. The automatic abort sensing system was flown closed loop. Figure 3.2-1 shows the capsule-booster configuration.

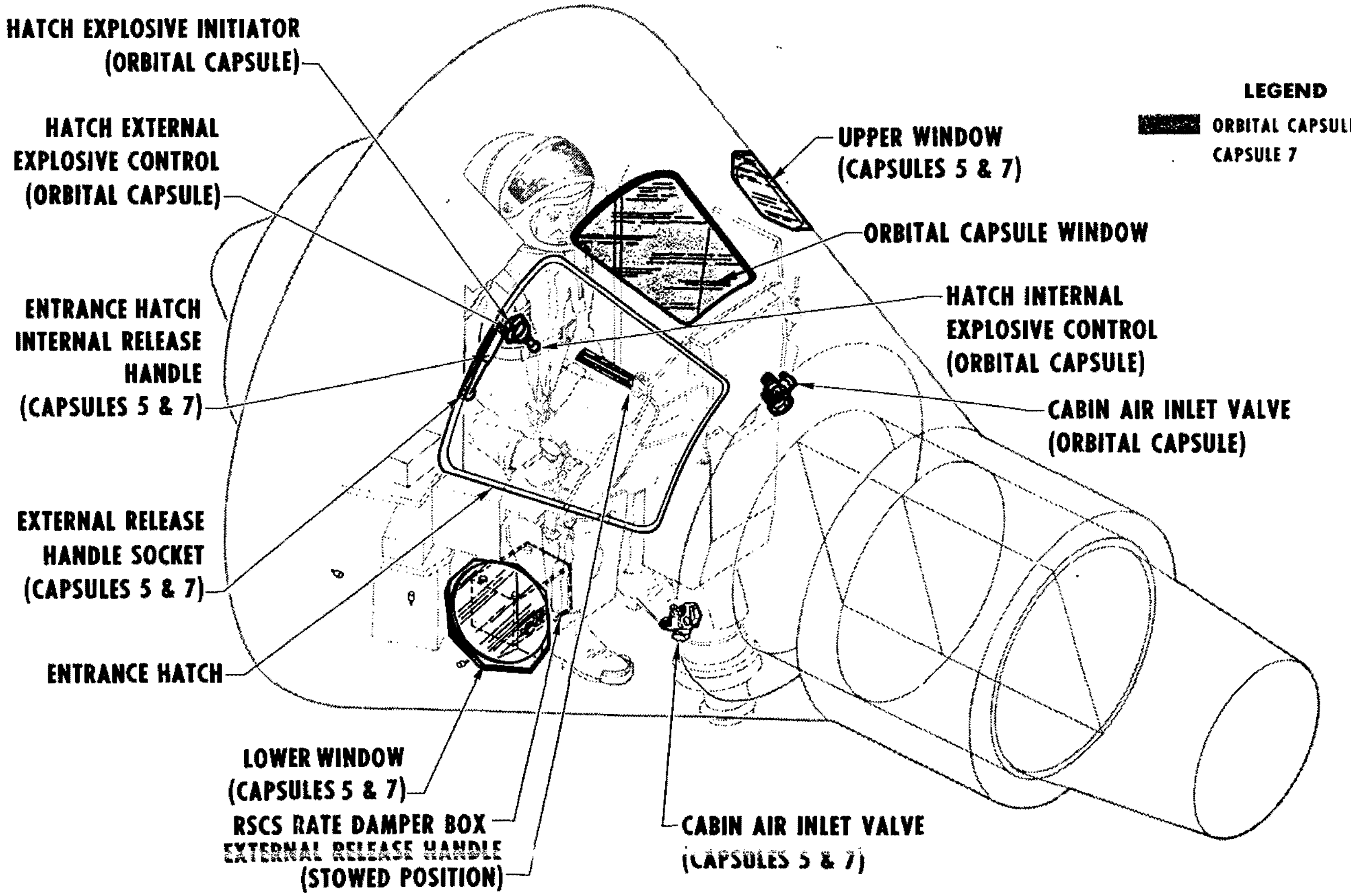
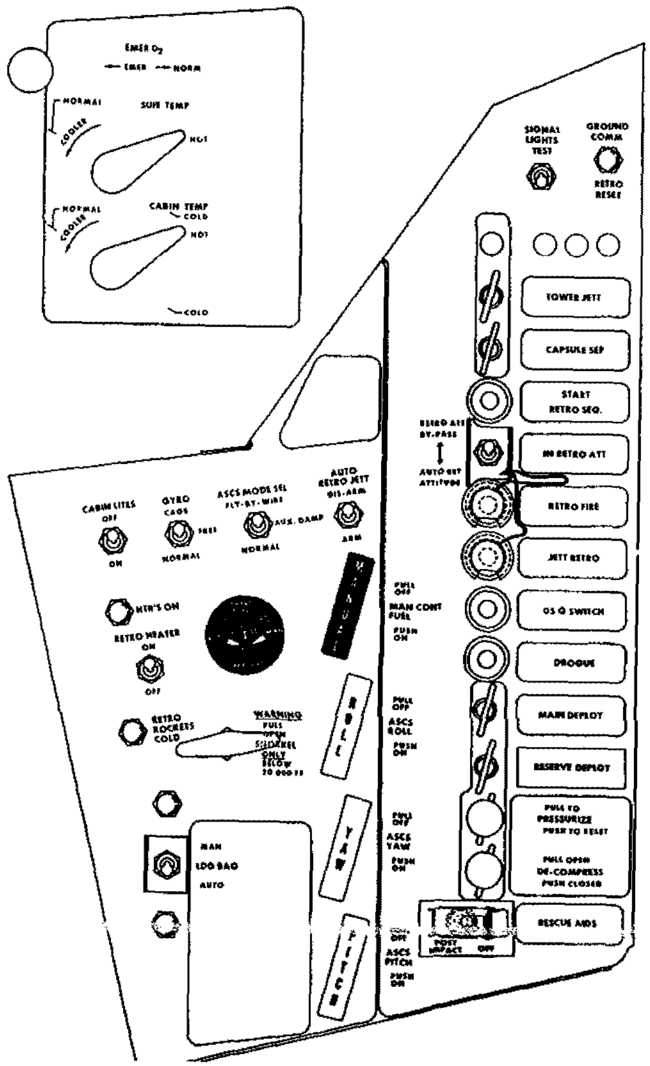


FIGURE 3.1-1 CONFIGURATION DIFFERENCES BETWEEN CAPSULE 7 AND LATER CAPSULES

LEFT AND RIGHT CONSOLES



MAIN INSTRUMENT PANEL

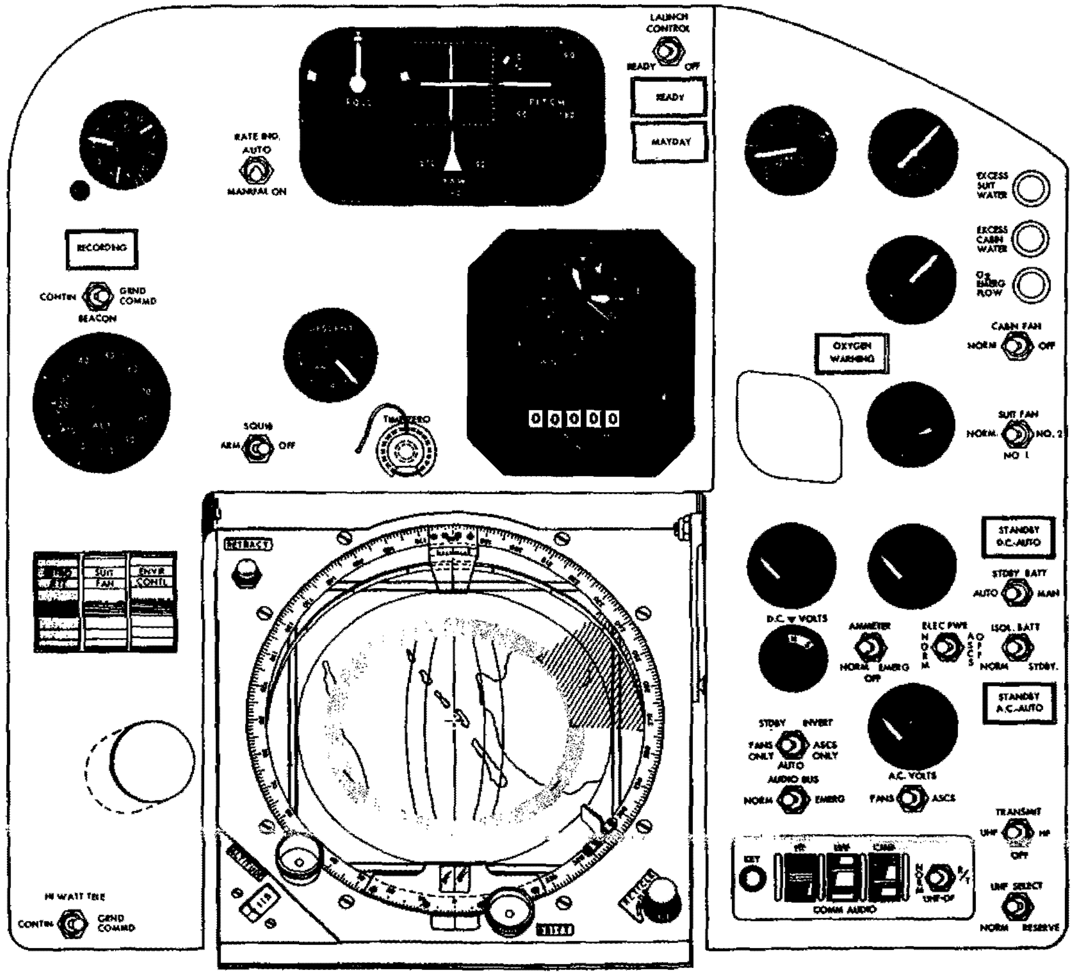


FIGURE 3.1-2 CAPSULE 7 INSTRUMENT PANEL

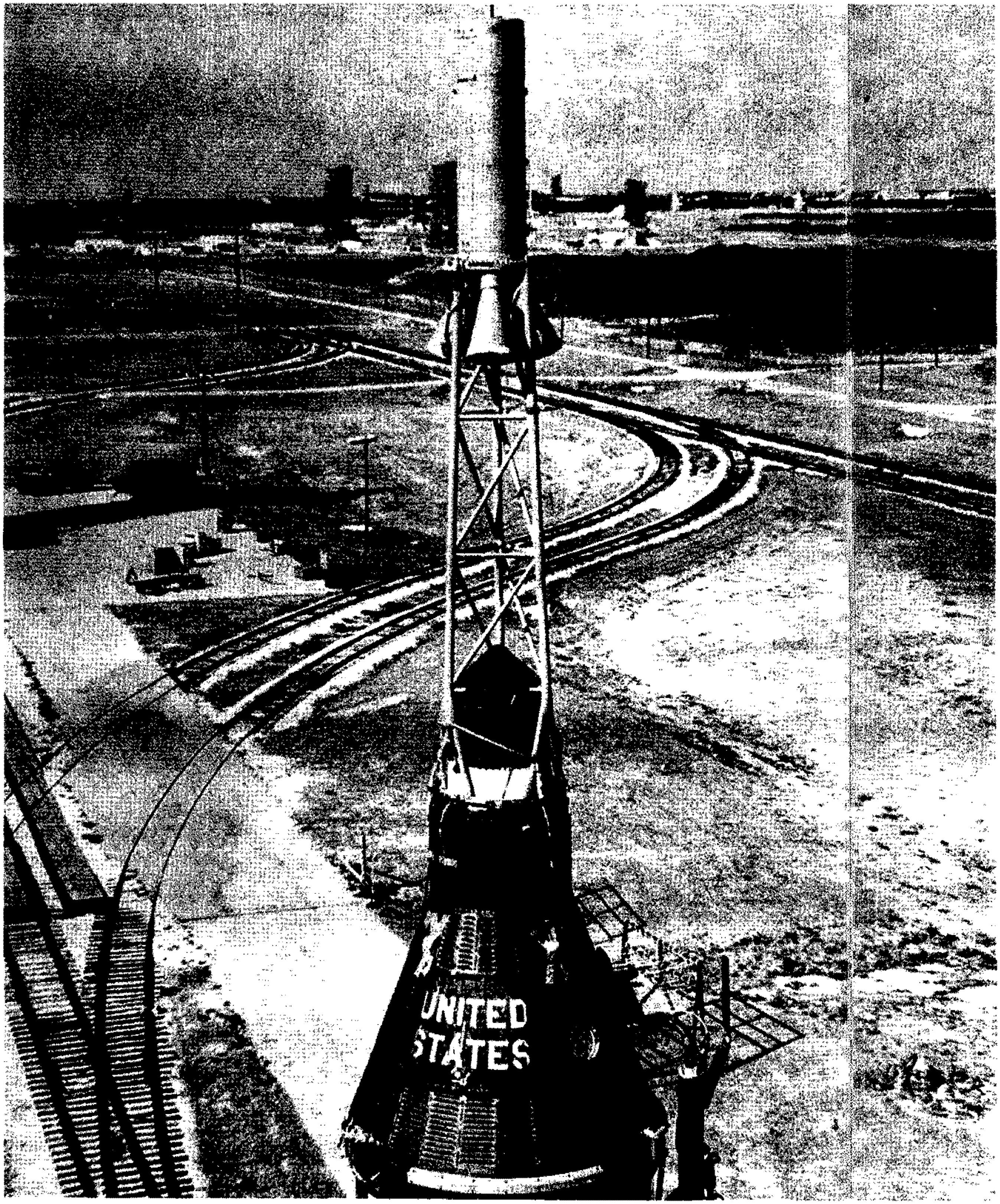


FIGURE 3.1-3 VIEW OF CAPSULE 7 AND ESCAPE SYSTEM MOUNTED ON BOOSTER

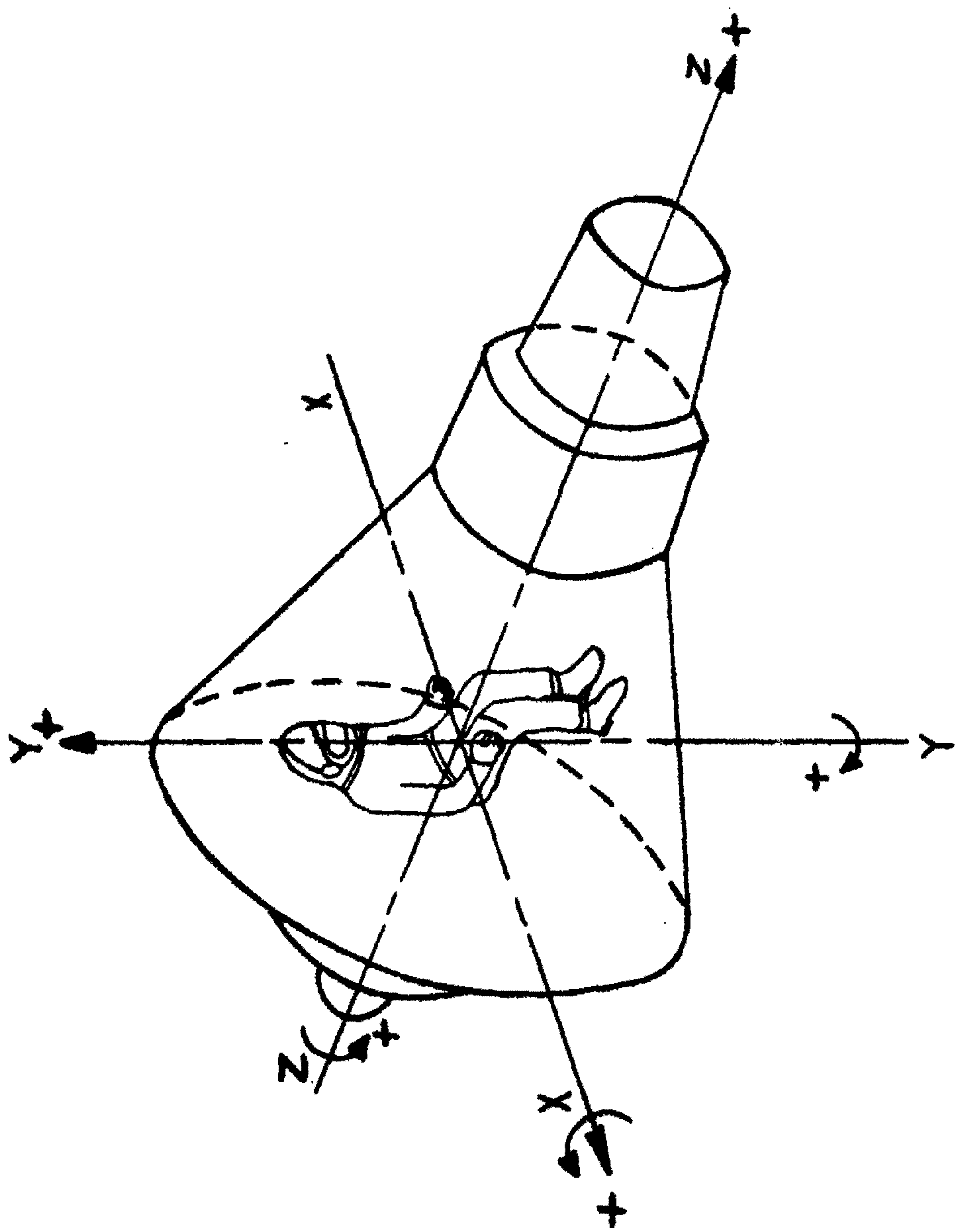


FIGURE 3.1-4 CAPSULE AXIS SYSTEM

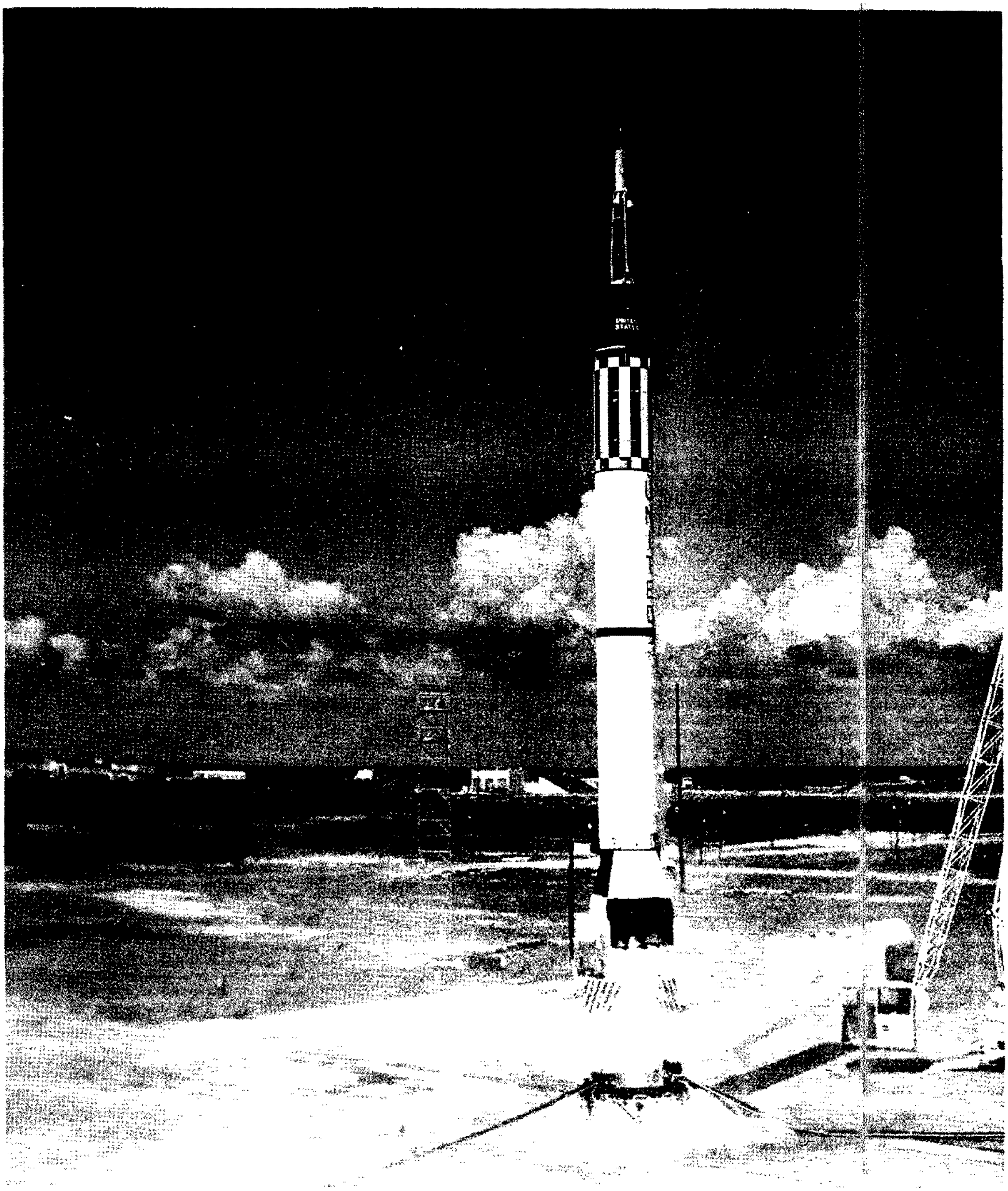


FIGURE 3.2-1 CAPSULE-BOOSTER COMBINATION AT LIFT-OFF

4.0 EVENTS AND TRAJECTORY

The actual trajectory flown was very close to the nominal calculated trajectory. The sequence of events occurred according to plan. (The failure of one telelight to function is discussed in Section 5.5.2.)

4.1 Sequence of Events

The planned and actual times at which the major events occurred are given in the following table:

Event	Planned Time	Actual Time
Booster Cut-Off	02:23.1	02:21.8
Tower Release	02:23.1	02:22.0
Tower Escape Rocket Fire	02:23.1	02:22.2
Capsule Separation	02:33.1	02:32.3
Time of Retro-fire Sequence, T_r	04:41.5	04:44.7
Retro-attitude Comm. Relay	04:41.5	04:44.7
Retro #1 Fire	05:11.5	05:14.1
Retro #2 Fire	05:16.5	05:18.8
Retro #3 Fire	05:21.5	05:23.6
Retro-package Jettison	06:10.5	06:13.6
.05 g Relay	07:43.0	07:48.2
Drogue Chute Deploy	09:36.0	09:38.1
Main Chute Deploy	10:14.3	10:14.8
Antenna Fairing Release	10:14.3	10:14.8
Main Chute Disconnect	14:47.7	15:22.0

NOTE: With the exception of booster cut-off, all events were determined from commutated data. Thus the events could vary from the above times by as much as +0 to -0.8 seconds.

4.2 Trajectory

The trajectory data presented in this report are based on the real-time output of the Range-Safety Impact Predictor Computer (which used MK II AZUSA, Cape and Grand Bahama FPS-16 radars). The range times at which data from the various tracking facilities were used as inputs to the Range-Safety Impact Predictor computer are listed below:

Facility	Elapsed Time Min:Sec
Cape 1.16	00:00-00:32
AZUSA MK II	00:32-02:34
GBI 3.16	02:34-10:00

A comparison of the planned and actual conditions at capsule separation is presented below:

Quantity	Planned	Actual	Difference
Time, min:sec	02:33.1	02:32.3	00:00.8
Altitude, ft.	246898	243640	-3258
Inertial Velocity, Ft/sec	7301.9	7388	86
Inertial Flight-Path Angle, degrees	39.05	39.01	.04
Inertial Heading Angle, degrees	102.0	101.7	-.3
Earth-Fixed Velocity Ft/sec	6331	6414	83
Earth-Fixed Flight-Path Angle, degrees	46.61	46.47	-.14
Earth-Fixed Heading Angle, degrees	105.69	105.23	-.46

The planned and actual capsule separation conditions agree within the nominal accuracies of the Mercury-Redstone booster guidance system.

A comparison of actual and planned trajectory parameters is shown below:

Quantity	Planned	Actual
Range, N.M.	256.3	263.1
Maximum Altitude, N.M.	100.3	101.2
Maximum Exit Dynamic Pressure lb/sq ft	598	586
Maximum Exit Longitudinal Load Factor, g	6.3	6.3
Maximum Re-Entry Dynamic Pressure lb/sq ft	591	605
Maximum Re-Entry Longitudinal Load Factor, g	10.8	11.0
Period of Weightlessness Min:sec	04:53	05:04

The ground track of the flight is shown in Figure 4.2-1 and the altitude range profile is shown in Figure 4.2-2. Time histories of the pertinent quantities are shown in Figures 4.2-3 to 4.2-7. In each figure the measured values derived from AZUSA and FPS-16 radar data are compared with the pre-flight-planned trajectory (no wind). The aerodynamic parameters for the pre-flight trajectories were computed using the annual Patrick AFB atmosphere. Time history of the computed angle of attack during the powered flight is presented in Figure 4.2-8. These data were computed using the telemetered booster gyro incremental pitch position and the earth-fixed flight path angle computed from the AZUSA tracking data. Between the cut-off signal and capsule separation an angle-of-attack increase occurred due to LOX venting near one of the booster fins. The magnitude of this increase in angle-of-attack was approximately as expected.

In Figure 4.2-9, separation distances between the booster and the capsule during retrofiring as calculated for the nominal mission are compared with separation distances calculated using actual flight event times and actual flight retrofire attitudes. The minimum separation distance calculated from flight conditions was greater than the predicted pre-flight nominal value primarily because of the lower retro-attitude during the actual mission.

The various predictions of impact point are compared with actual capsule recovery point in Figure 4.2-10. As can be noted from the figure, the actual recovery point as estimated by the recovery ship differs from the pre-flight nominal by 6.2 miles, and the Mercury Control Center real time prediction by 3 miles.

A preliminary analysis of the AZUSA MK II tracking data and the Cape 1.16 radar data indicated that the posigrade rocket performance was about as expected. The seperation velocity was approximately 30±3 feet per second. Although the radar tracking data during retrofiring was noisy, the inertial velocity decrease along the flight path was measured to be approximately 390±30 feet per second. The computed velocity decrease along the flight path for this capsule, with a nominal total impulse along the body axis and an average retro-attitude angle of 20 degrees above the local horizontal, is approximately 420 feet per second. This computed value is within the reading accuracy of the measured value.

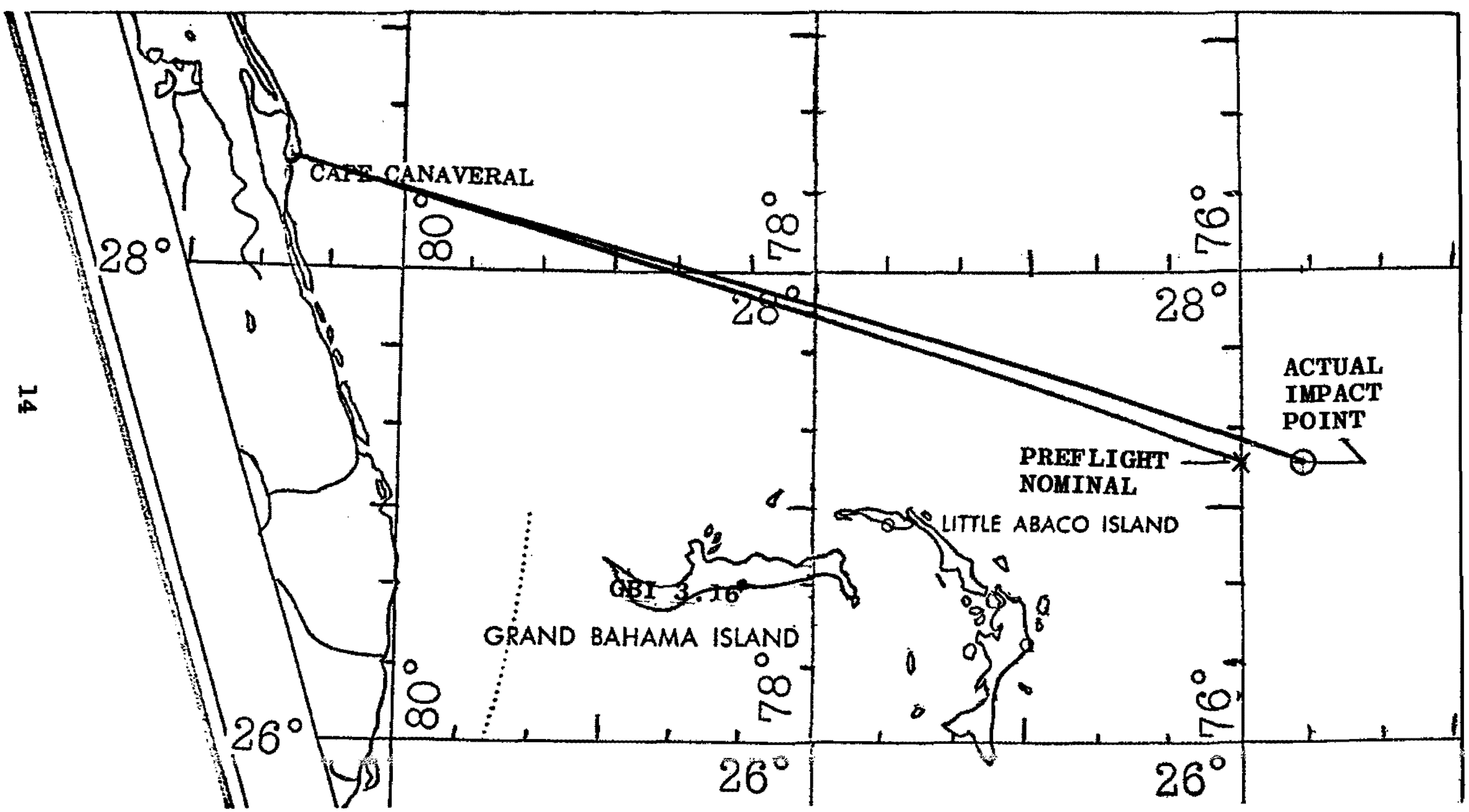


FIGURE 4.2-1 GROUND TRACK

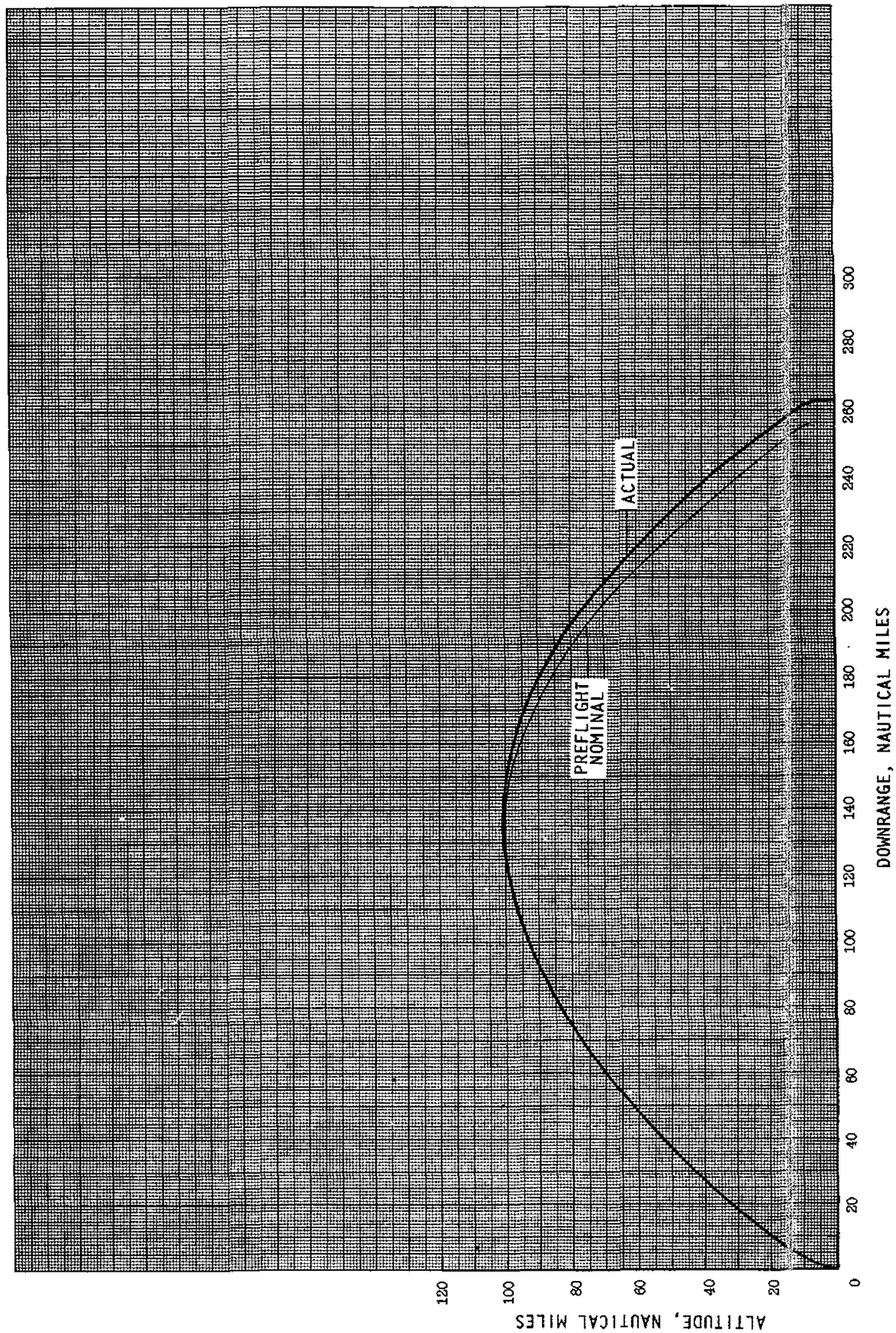


FIGURE 4.2-2.- ALTITUDE VERSUS RANGE.

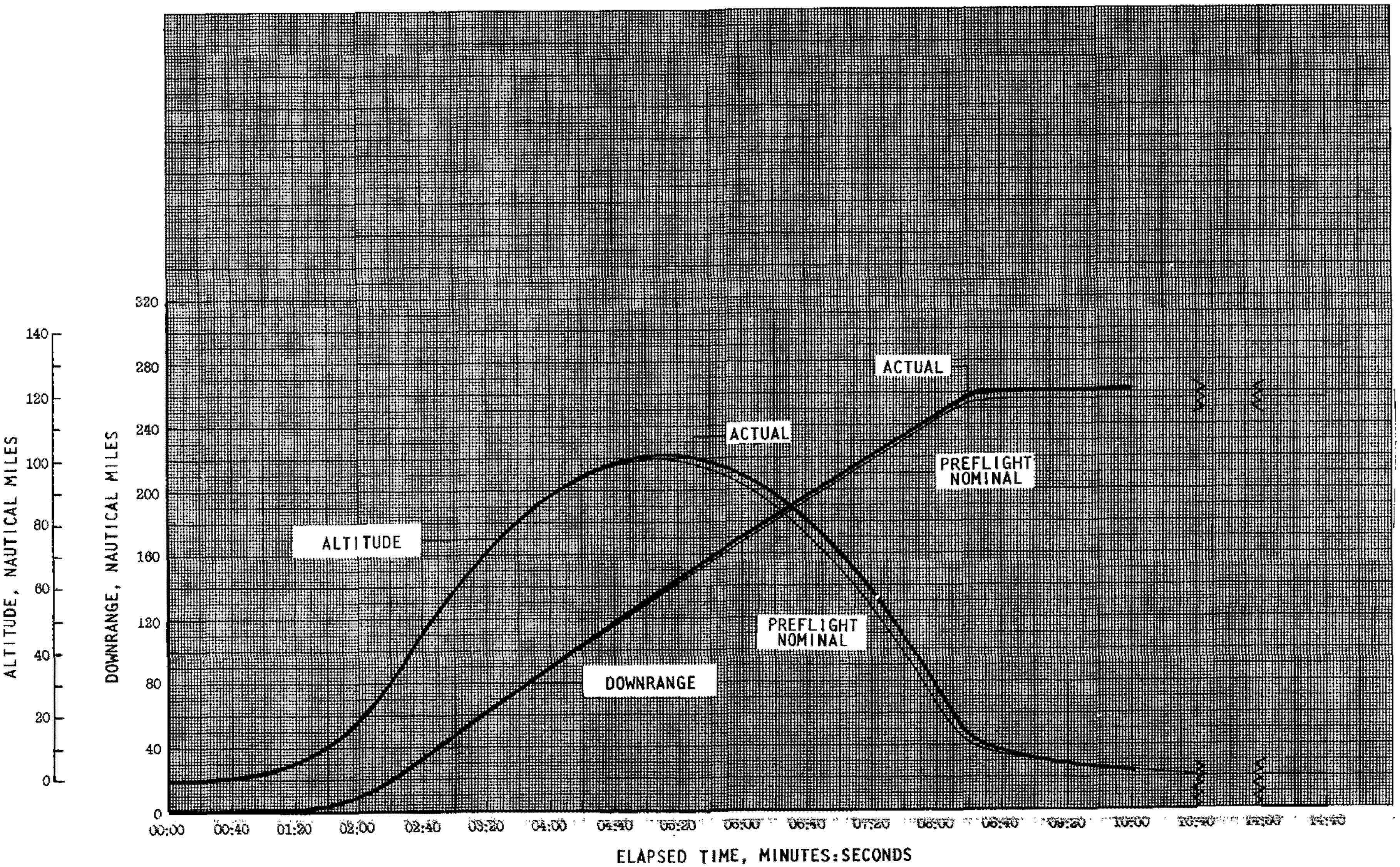


FIGURE 4.2-3.- TIME HISTORY OF ALTITUDE AND RANGE.

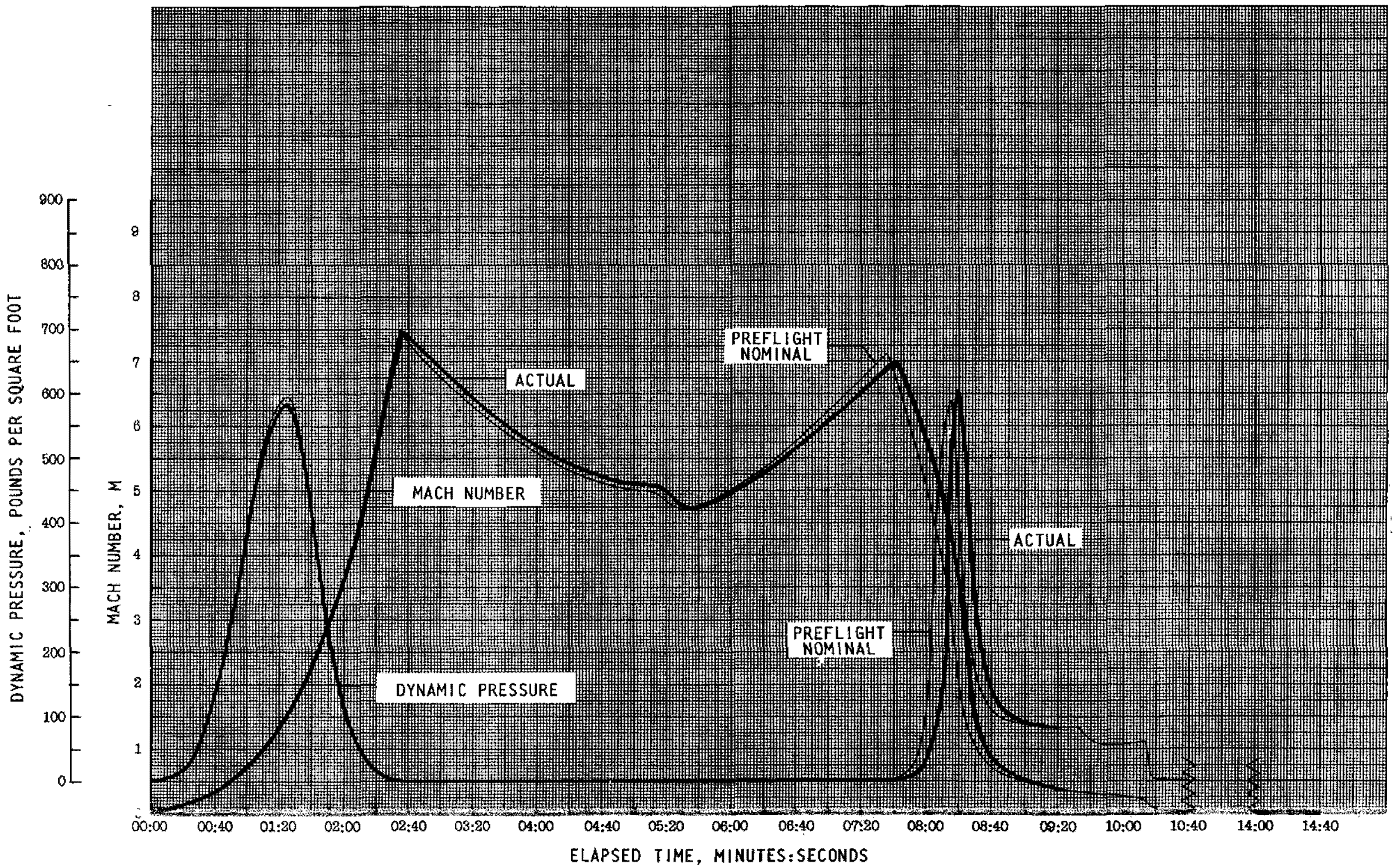


FIGURE 4.2-4.- TIME HISTORY OF MACH NUMBER AND DYNAMIC PRESSURE.

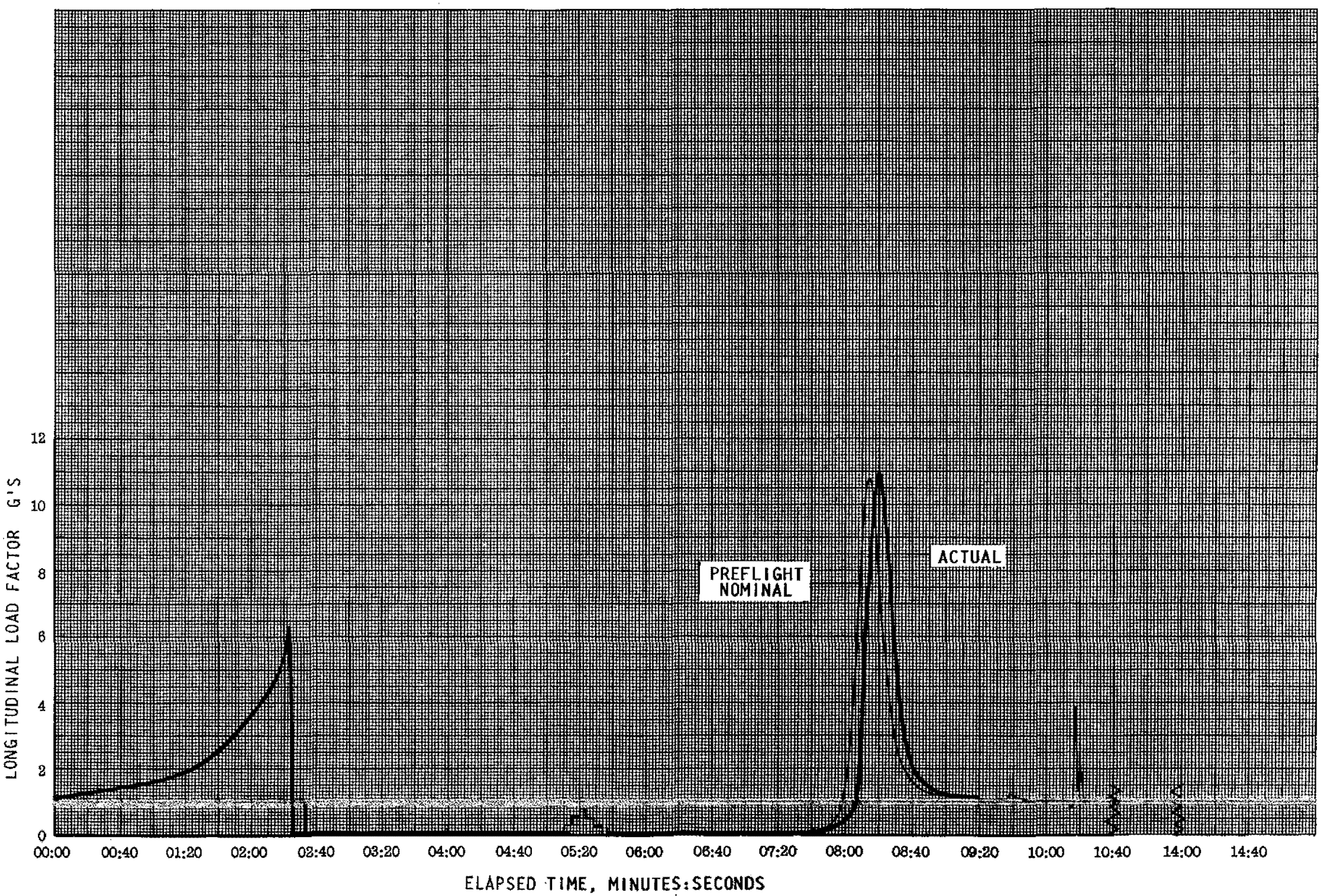


FIGURE 4.2-5.- TIME HISTORY OF LONGITUDINAL LOAD FACTOR.

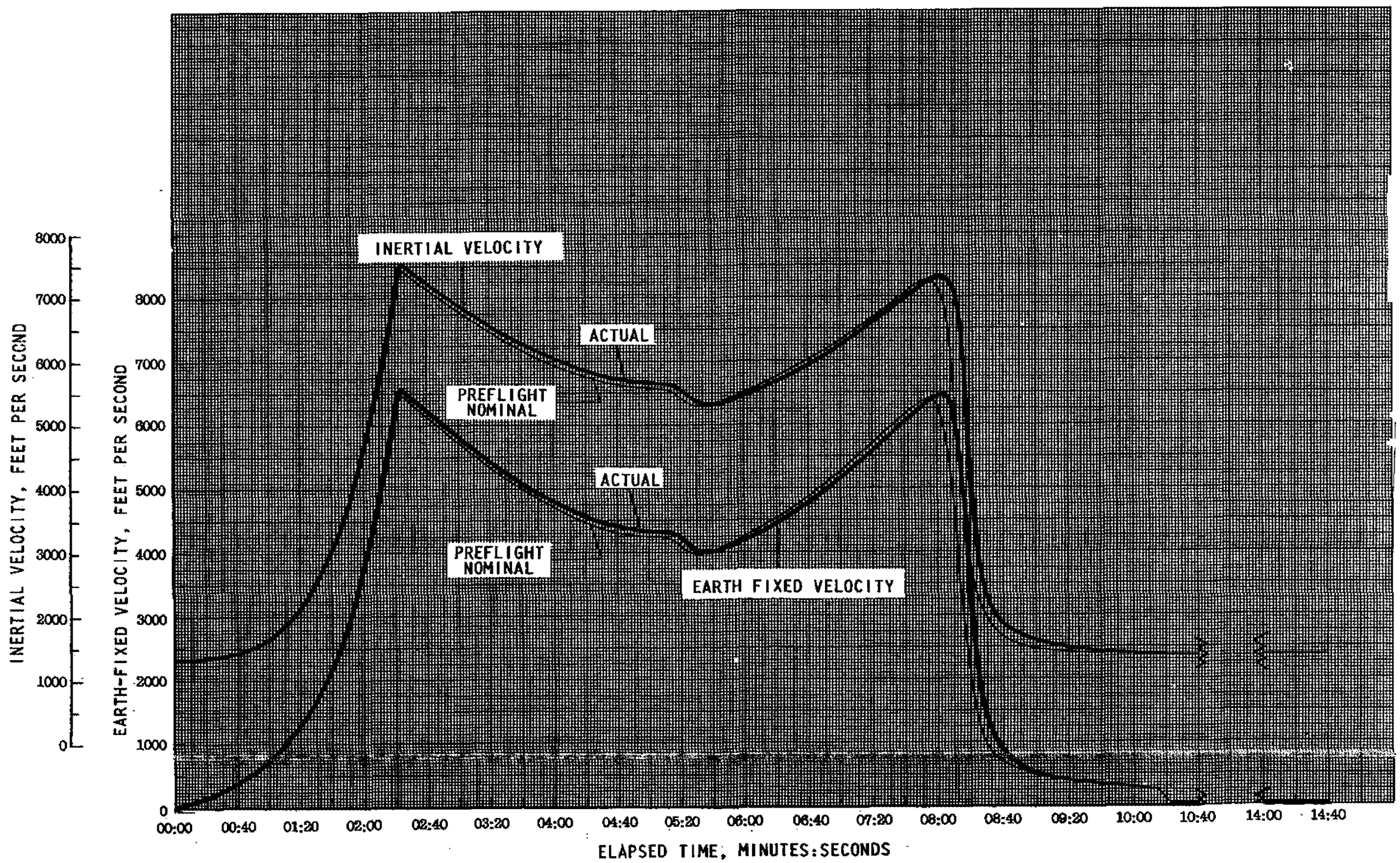


FIGURE 4.2-6.- TIME HISTORY OF INERTIAL AND EARTH-FIXED VELOCITY.

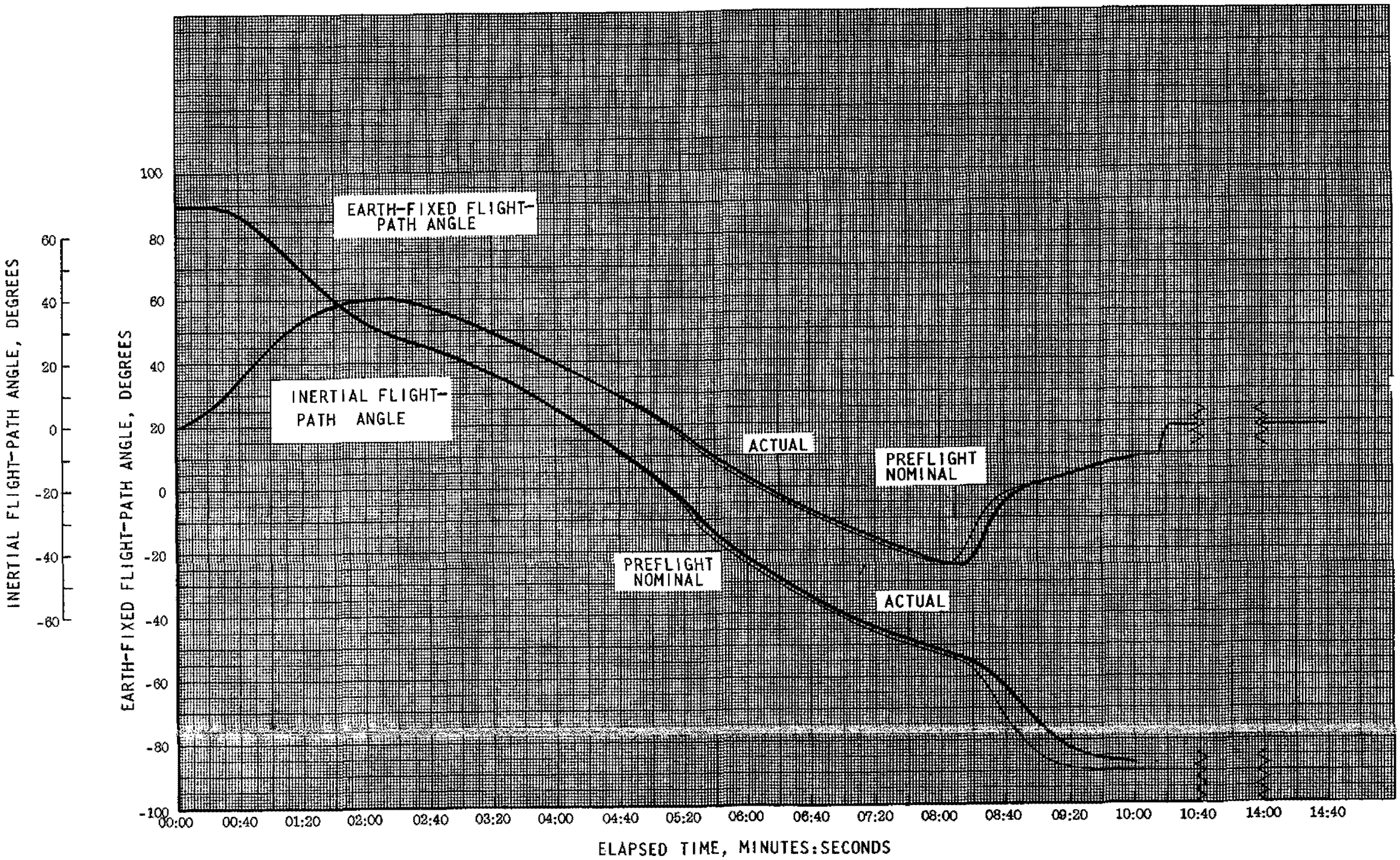


FIGURE 4.2-7.- TIME HISTORY OF INERTIAL AND EARTH-FIXED FLIGHT-PATH ANGLE.

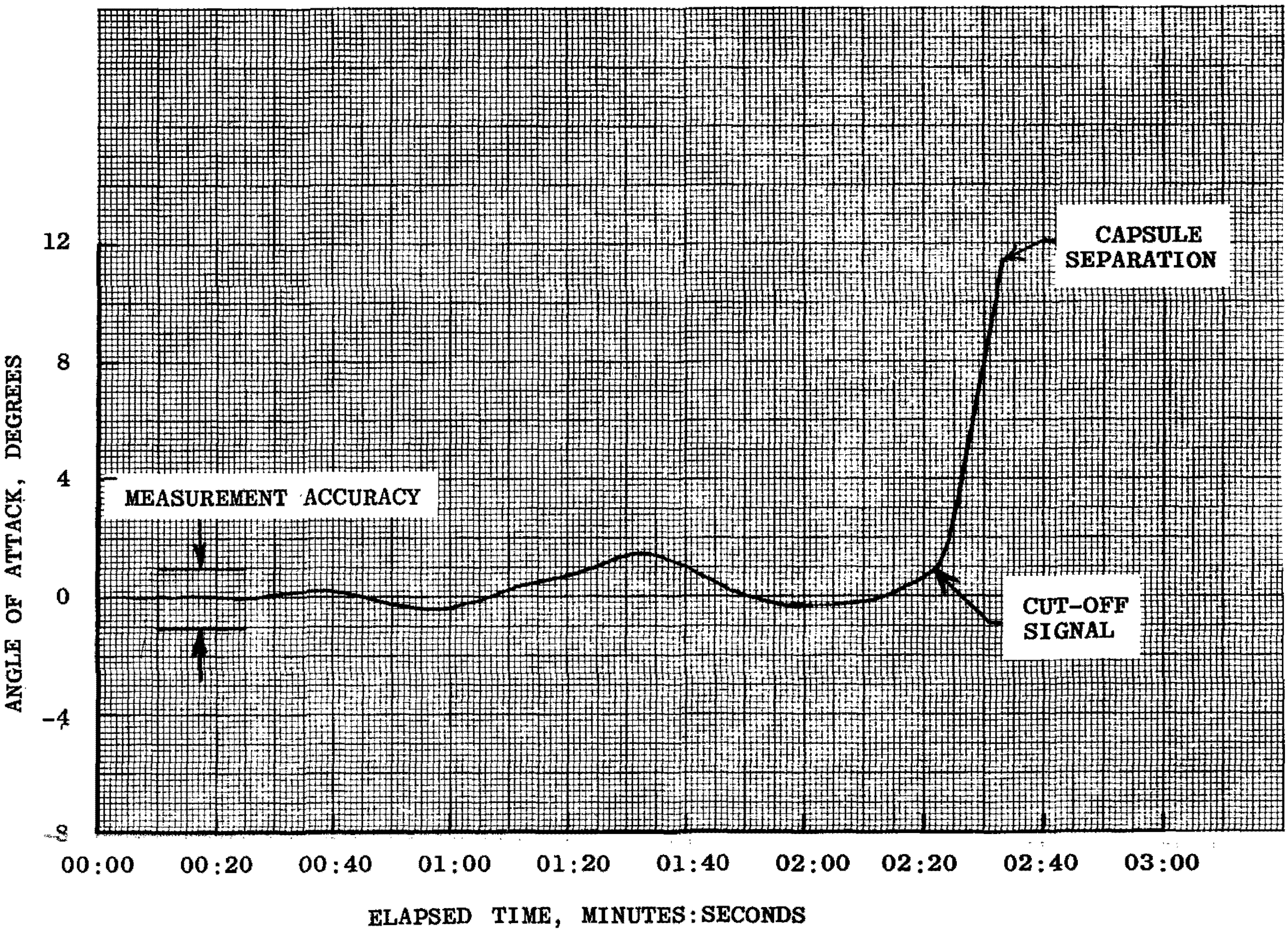


FIGURE 4.2-8.- TIME HISTORY OF COMPUTED ANGLE OF ATTACK DURING POWERED FLIGHT.

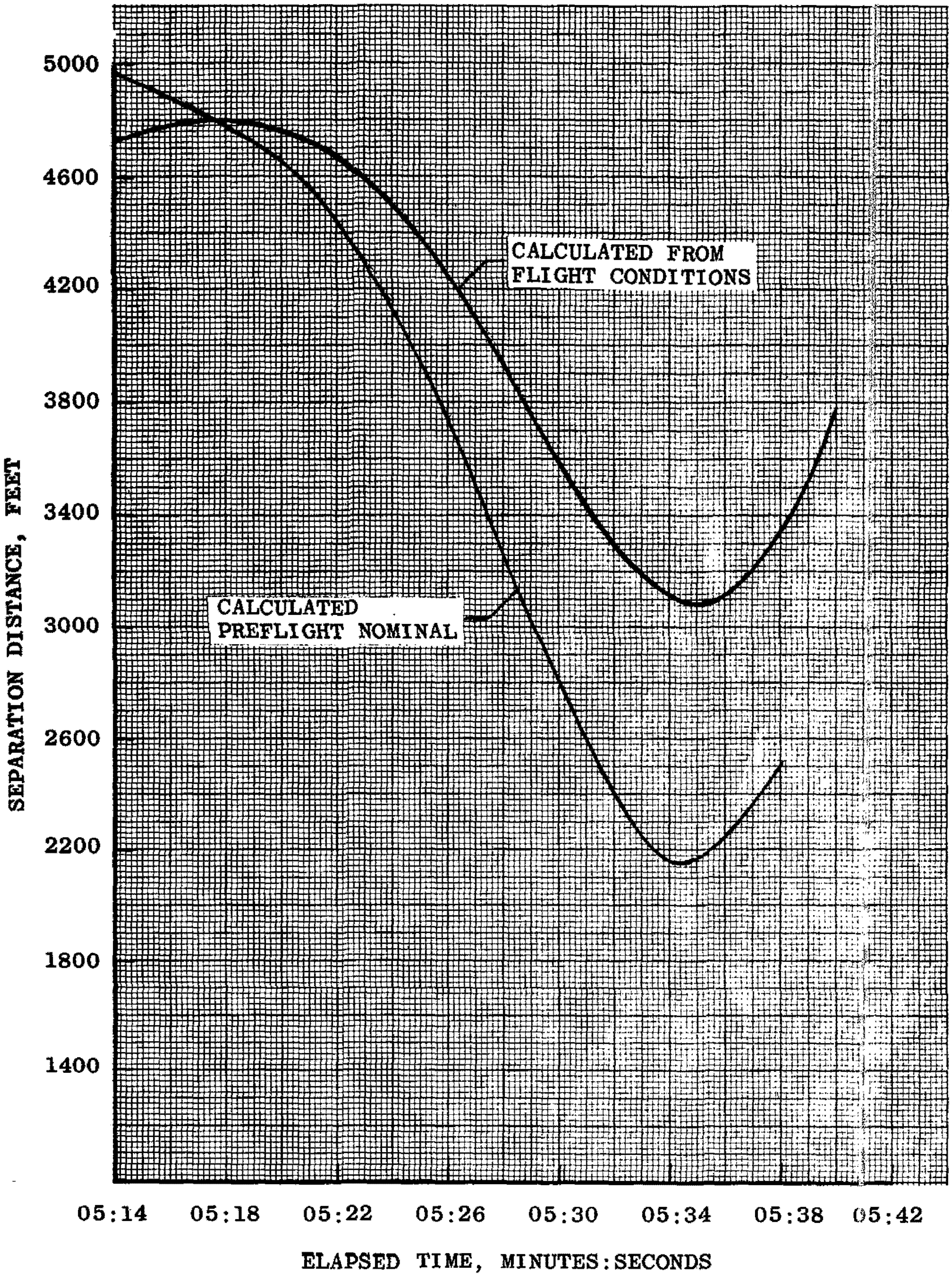


FIGURE 4.2-9.- TIME HISTORY OF SEPARATION DISTANCE BETWEEN CAPSULE AND BOOSTER DURING RETROFIRING.

CONFIDENTIAL

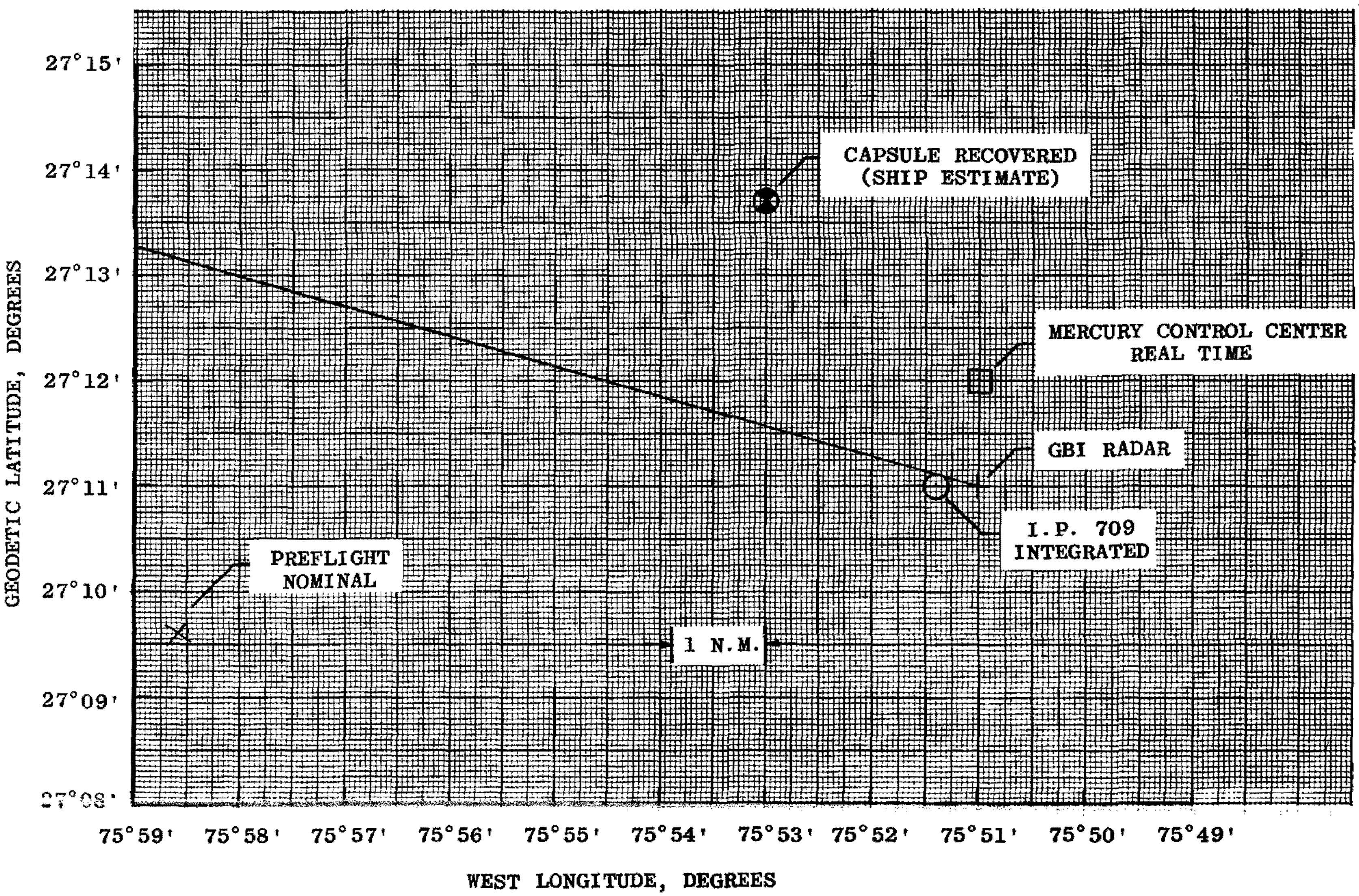


FIGURE 4.2-10.- COMPARISON OF LANDING POINTS COMPUTED BY VARIOUS METHODS WITH ACTUAL LANDING POINT.

CONFIDENTIAL

5.0 CAPSULE PERFORMANCE

Capsule performance was generally good for the mission.

5.1 Capsule Environmental Measurements

5.1.1 Accelerations

The longitudinal acceleration data are presented in Figure 4.2-5. During exit the acceleration increased from about 1.15g at lift-off to a value of 6.3g, which occurred at booster cutoff (02:22). The acceleration then decayed to zero, and remained at zero for slightly over five minutes with the exception of periods of posigrade rocket firing at about 02:31 and retrorocket firing at about 05:14. The first measurable acceleration during reentry occurred at 07:48. The acceleration increased to a peak value of 11g at 08:21. Accuracy of acceleration data measurement would not permit determination of magnitudes for posigrade rocket firing, retrograde rocket firing, and drogue parachute deployment. Main parachute deployment resulted in an acceleration of about 4g. The normal and lateral accelerations were small throughout the flight.

5.1.2 Heating

A resistance element temperature sensor was installed on a shingle near the Z=123 ring. The shingle temperature during flight was about as expected, as shown in Figure 5.1-1.

5.2 Capsule Control System

Attitude control of the capsule throughout the mission was divided between the automatic and the manual systems or combinations of both, as planned.

Estimates of the times during which each type of control was exercised are shown tabulated in Figure 5.2-1. These times were obtained by coordinating the times of events, the pilot's statements, and a comparison of automatic RCS solenoid and control stick operation with indicated capsule rates.

The performance of the control system is shown on Figure 5.2-2, and is discussed in the following paragraphs. The performance of the pilot in exercising manual control is dealt with in Section 7.3.3.

5.2.1 Automatic Stabilization and Control System (ASCS)

The ASCS in capsule 7 used a type A-7 amplifier-calibrator which retained the original 14.5° orbit attitude. The retro-attitude permission function was bypassed to ensure completion of the retro-sequence. The automatic system performed satisfactorily during those phases of the mission where it was operative.

5.2.1.1 Turnaround Maneuver

Between 02:32 and 03:04, 5 seconds of rate damping followed by the turnaround to orbit attitude were accomplished as planned. The slight excursions observed during the turnaround maneuver were well within the expected limits.

5.2.1.2 Attitude Hold

From 03:04 to 03:44, the pilot progressively took over control of the capsule from the automatic system, one axis at a time. The automatic system provided the stabilization required of it during this period.

There are some deductions that can be made about the performance of the RCS during this interval. Between 03:04 and 03:18, when the roll control was in orbit mode, repeated clockwise solenoid operations were unsuccessful in overcoming a counterclockwise disturbing torque. At 03:18, before the error could increase beyond about 9°, a manual stick input in pitch moved the capsule to a pitch attitude of -27° which switched the ASCS to the orientation mode. After about 5 seconds, the capsule was returned to the orbit mode, but repeated clockwise solenoid operation continued until the automatic system was switched off at 03:44. The counterclockwise disturbing torque could have been supplied either by a small opening of the manual-proportional valve or leakage of the solenoid valve. The negative control stick displacement of about 2° during this period tends to confirm the first hypothesis. However, the negative displacement was even greater from 04:00 to 04:45, when the system was in the pure manual mode. During this time, although no apparent manual roll stick displacement was made, the capsule rolled slightly in the clockwise direction. This would seem to conclusively rule out the possibility of the counterclockwise torque being supplied by the manual system. However, the issue is still somewhat clouded by the existence of a large amount of hysteresis in the control system.

Postflight inspection of the high-thrust counterclockwise roll thruster did, however, reveal that a piece of material was lodged in the poppet extension and that the extension had been damaged in the area of seat contact. From this it may be deduced that, although it is highly probable that the roll solenoids were leaking in flight, the probability that the counterclockwise thrust was produced by the manual-proportional thrusters cannot be entirely ruled out.

5.2.1.3 Fly-by-wire

From 03:44 to 06:00 the pilot used purely manual control as discussed in Section 7.3.3. At 05:55, he reported switching to fly-by-wire. At 06:49, he confirmed still being in this mode, and did not report switching to normal ASCS till 07:04.

However, analysis of the records during this period suggests that, although the ASCS mode selector was in the fly-by-wire position, the pilot was actually flying in both manual-proportional and fly-by-wire modes. This would occur if the manual fuel valve was left in the "on" position and the roll, pitch and yaw fuel valves were turned on. The reasons for this will be described for each axis in turn as follows.

YAW -

Between 06:30 and 06:40 and again between 06:50 and 07:00, there were sequences which commenced with the blipping of both the high- and low-righthand thrust solenoids in response to a positive manual control motion. Then followed sharp checking control motions in the opposite direction which succeeded in approximately cancelling out the effect of the first motion on the capsule. However, only the low-thrust yaw solenoids were blipped in the left-hand direction. Since the ratio of thrusts of the high- and low-torque thrusters is 24:1, it is inconceivable that similar responses would be obtained by the high thrusters acting in one way and low thrusters in the other. This circumstance can only be explained by assuming that the capsule motion is not being controlled solely by the solenoid-operated thrusters, but by the manual-proportional thrusters as well. The stick displacement at which the fly-by-wire switches are actuated is highly nonlinier with respect to the manual valve opening, thus making the above noted performance credible.

PITCH -

At about 06:50 there was a large positive control motion of the stick resulting in a capsule pitch rate of about 4 degrees per second. There was no pitch solenoid action at this time. This again can only be explained by the capsule being in the manual-proportional mode, but with the ASCS mode selector in the fly-by-wire position, since otherwise the solenoids would be actuated by the gyros.

ROLL -

Between 06:07 and 06:18 a checked roll command was made. Capsule motions and solenoid actions were all in the expected sequence. However, detailed analysis of the records has shown that the rates involved were substantially less than those produced by the solenoid action noted in other segments of the flight when the ASCS was in the automatic mode.

It was also noted that none of the rates obtained about any axis during the whole period in question exceeded that corresponding to a single high thruster. This behavior could be explained if the automatic fuel was not turned on or only partly turned on. However, it is much more likely that it is due to the manual blips being of much shorter duration than the ASCS blips. It should be noted that the length of the pulses cannot be obtained from the instrumentation records because the solenoid pulses are first fed through a holding circuit and then commutated before being recorded. Thus there is no direct evidence of the duration of the solenoid pulses.

Although the pilot cannot accurately confirm that he shut off the manual fuel when going to fly-by-wire, he is very strongly of the opinion that he did turn on the automatic system fuel at that time, especially because he is very certain that he did not turn it on after obtaining retro-attitude, when he switched to ASCS, at about 07:11. The ASCS functioned after this time. Hence, it is assumed that instead of flying on the fly-by-wire mode alone, the pilot was actually using a combination of the manual-proportional mode and the fly-by-wire mode.

5.2.1.4 Reentry Attitude Hold

After attaining reentry attitude manually, the pilot switched to ASCS at 07:11 and remained in this mode until switching to manual at just after the time that 0.05g was sensed.

The ASCS maintained satisfactory attitudes during this period, but remained in the orientation mode much longer than would have been expected. This was probably because the damping of the initial conditions was not nearly as rapid as it should have been. Also, from about 07:24 to 07:31, the right-hand low-torque yaw solenoid remained on, but resulted in negligible motion of the capsule. After this, this solenoid appeared to act normally. This operation can be explained by a malfunction of the solenoid valves.

The ASCS supplied a roll rate of about 10°/sec at 0.05g. After this time, the attitude gyros ceased to give meaningful data.

5.2.1.5 Reentry

After trying to provide damping manually during reentry, the pilot stated that he switched to ASCS. This was probably about 08:40 when a marked reduction in the amplitude of the oscillations took place. The amplitude remained low until drogue deployment after which time the control system was not effective. The amplitudes then increased due to the action of the drogue chute and capsule combination.

5.2.2 Reaction Control System

In general, the performance of the system was satisfactory. Some difficulty was experienced with leakage through the high-thrust roll solenoid valves during the prelaunch static firing. This was stopped by cycling the system unpressurized.

As stated previously, the postlaunch inspection revealed metal imbedded in the poppet of counterclockwise high-thrust roll solenoid. The rigging of the manual valves was such that there was considerable misalignment between the neutral valve positions and the neutral stick positions. Also, there was no centering of the stick. These effects were noted in the flight results.

The approximate quantities of fuel on board at launch were 33 and 23½ pounds in the automatic and manual subsystems respectively. The quantities remaining during the various phases of the mission were as follows:

Event	Elapsed Time Min:Sec	Fuel Quantities (lbs) Auto	Man
Launch	0	33	23½
Following turn around	03:11	29	23½
Following man. exer.	03:58	29	22
At retro att. comm.	04:45	29	21
At retro #1 ignition	05:14	29	20½
Following retro-fire	05:45	29	18½
At switch to ASCS	07:11	29	18½
At 0.05g	07:48	26	18½
At drogue deploy	09:38	20	18
At main deploy	10:15	10½	18
Following jettison	11:15	0	0

5.3 Capsule Environmental System

5.3.1 Pilot Equipment

The pilot made the flight wearing a full pressure suit designed to maintain a 5.5 psi oxygen atmosphere in the absence of cabin pressure. The suit serves a dual purpose as a ventilation or cooling garment and was utilized only in that capacity on this flight. A parachute harness was worn over the suit which replaced some suit-restraining straps and gave a capability of attaching a chest-pack parachute for emergency descent.

The pilot was supported by a custom-fitted contour counch mounted to give maximum support during launch and reentry g loadings. He was restrained in the couch by shoulder, chest, lap, knee straps and toe caps.

A "window pole" was supplied to reach the window filters and to make certain controls accessible which cannot be reached directly with the suit pressurized

5.3.2 Environmental-Control System

The environmental-control system operated properly with no malfunctions indicated. The suit and cabin pressures as shown in Figure 5.3-1 follow static pressure during the appropriate phases of launch and re-entry, within the accuracy of the measurement system. Both pressures held constant at 5.7 psia during the period when static ambient pressure was below this valve. The entire mission was accomplished on the normal oxygen bottle. No measurable quantity of coolant was used due to the shortness of flight.

Figure 5.3-2 shows the variation of suit inlet and cabin temperatures during the flight. Preflight calibration checks indicated that the cabin air temperature when read out on telemetry records was approximately 4 degrees high.

5.4 Capsule Communications

Communications were generally good throughout the mission. Voice communication with the pilot was satisfactory from lift-off to landing, except for a brief period when exercise of HF was attempted. Details of communication equipment operation are presented in the Appendix (Section 10.5).

5.5 Capsule Electrical and Sequential System

5.5.1 Electrical System

The electrical system performed satisfactorily. Figure 5.5-1 presents a time history of voltages and current. Main-bus steady-state voltage was 24 volts at lift-off and remained at 24 volts during the flight. Capsule current at lift-off was 26 amperes. At retro-rocket firing, peak current pulses in excess of 35 amperes were recorded with attendant main-bus voltage drop to 22 volts. Fan-bus voltage remained steady throughout the flight at 115 volts.

About $1\frac{1}{2}$ hours prior to launch the temperature reading of the 150 VA fan-bus inverter increased to 190° F. It was decided at this time to switch the fan-bus power source to the standby inverter for flight. However, telemetry records and review of the instrument panel camera film established that the fan-bus was again drawing its power from the 150 VA main inverter at lift-off.

Blockhouse notations and telemetry records indicated that the switch back to the 150 VA main inverter occurred approximately thirteen minutes prior to lift-off. Review of the instrument panel camera film indicates that at about this time the pilot's glove is in very close proximity to the inverter toggle switch as he rotates the voltmeter selector knob.

It is believed that the pilot inadvertently brushed the inverter selector switch back to the main inverter position during a voltmeter check at approximately -13 minutes.

5.5.2 Sequential System

The schedule of sequential events is presented in Section 4.1. Available records indicate that the sequential system performed within specifications for the entire flight with the exception of the pilot's retro-jettison telelight. The pilot stated that the light did not illuminate green after retro-jettison, although retro-pack separation was confirmed by observation and by telemetry. After the pilot depressed the emergency retro-jettison switch, the green light came on. No explanation of this malfunction is available at this time.

5.6 Capsule Mechanical Systems

5.6.1 Parachutes

The drogue parachute deployed normally at about 21,000 feet and was observed by the pilot. The 63-foot ring-sail main chute deployed at about 10,600 and functioned normally.

5.6.2 Landing Bag

The landing bag performed satisfactorily and, although there was no instrumentation provided to record landing accelerations, the pilot reported that the landing impact was moderate. He compared the acceleration to that of an aircraft catapult launch. Although one heat sink stud apparently pierced the fiber-glass protective shield (see Section 10.1.1), no damage was done to the lower pressure bulkhead. The capsule heeled over to approximately 60° from the vertical immediately after the landing, and slowly righted in a normal manner. Reports on the time for righting are conflicting; best estimates put the time at a minute or less.

The damage to the bag which is recorded in Section 10.1.1 was very minor. It is believed that the tears in the bag occurred during the recovery operation or subsequent handling of the capsule.

5.6.3 Rockets and Pyrotechnics

Except for one abnormality discovered during the post-flight inspection, all rockets and pyrotechnics are believed to have fired normally and in the proper sequence. During post-flight inspection it was found that the tower-jettison emergency control initiator was fired. The initiator was disassembled and found to have been fired in the normal manner by pull-ring actuation. During the debriefing the pilot stated he did not fire the initiator. Consequently, it is not known when the unit was fired. It is known, however, that it was not used to separate the tower.

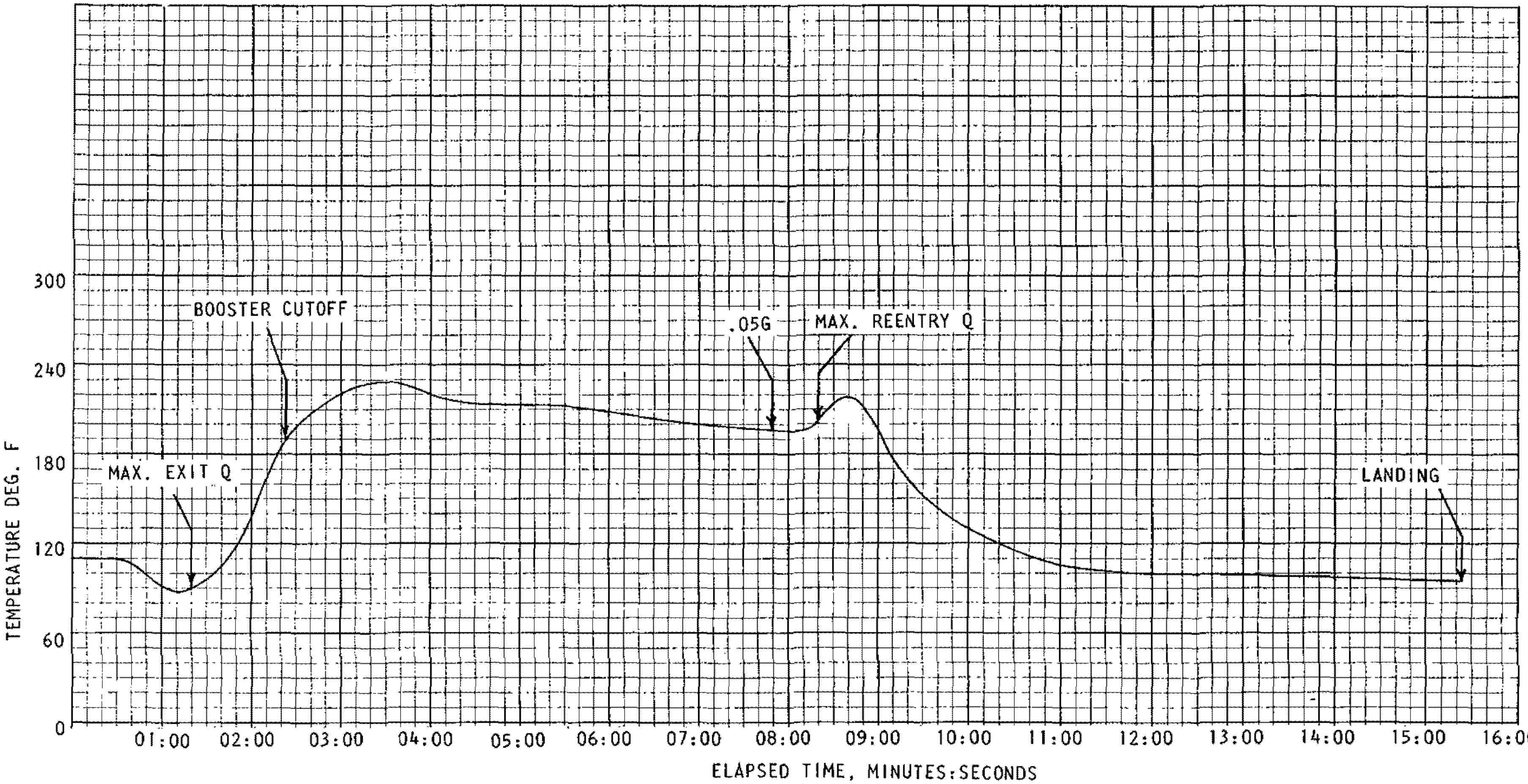


FIGURE 5 1-1 VARIATION OF SHINGLE TEMPERATURE WITH TIME

CONFIDENTIAL

TIME	MISSION PHASE	MODE OF CONTROL		
		PITCH	YAW	ROLL
02:32 - 02:37	Sep. Damping	ASCS Rate Damper	ASCS Rate Damper	ASCS Rate Damper
02:37 - 03:04	Turnaround	ASCS Orientation Mode	ASCS Orientation Mode	ASCS Orientation Mode
03:04 - 03:11	Orbit Attitude Hold and Pitch and Roll Yaw Maneuvers	ASCS Orbit Mode	ASCS Orbit Mode	ASCS Orbit Mode
03:11 - 03:18		Manual	Orbit Mode	Orbit Mode
03:18 - 03:26		Manual	Orientation Mode	Orientation Mode
03:26 - 03:30		Manual	Manual	Orientation Mode
03:30 - 03:44		Manual	Manual	Orbit Mode
03:44 - 05:14		Manual	Manual	Manual
05:14 - 05:37	Retrofire	Manual	Manual	Manual
05:37 - 06:00	Maneuvers and Obtain Reentry Attitude	Manual	Manual	Manual
06:00 - 07:11		Man. and F. B. W.	Man. and F. B. W.	Man. and F. B. W.
07:11 - 08:06	Reentry Attitude	ASCS Orientation Mode	ASCS Orientation Mode	ASCS Orientation Mode
08:06 - 08:40	Reentry Damping	Manual	Manual	Manual
08:40 - 09:38	Reentry Damping	ASCS	ASCS	ASCS

FIGURE 5.2-1 SUMMARY OF CONTROL SYSTEM PERFORMANCE

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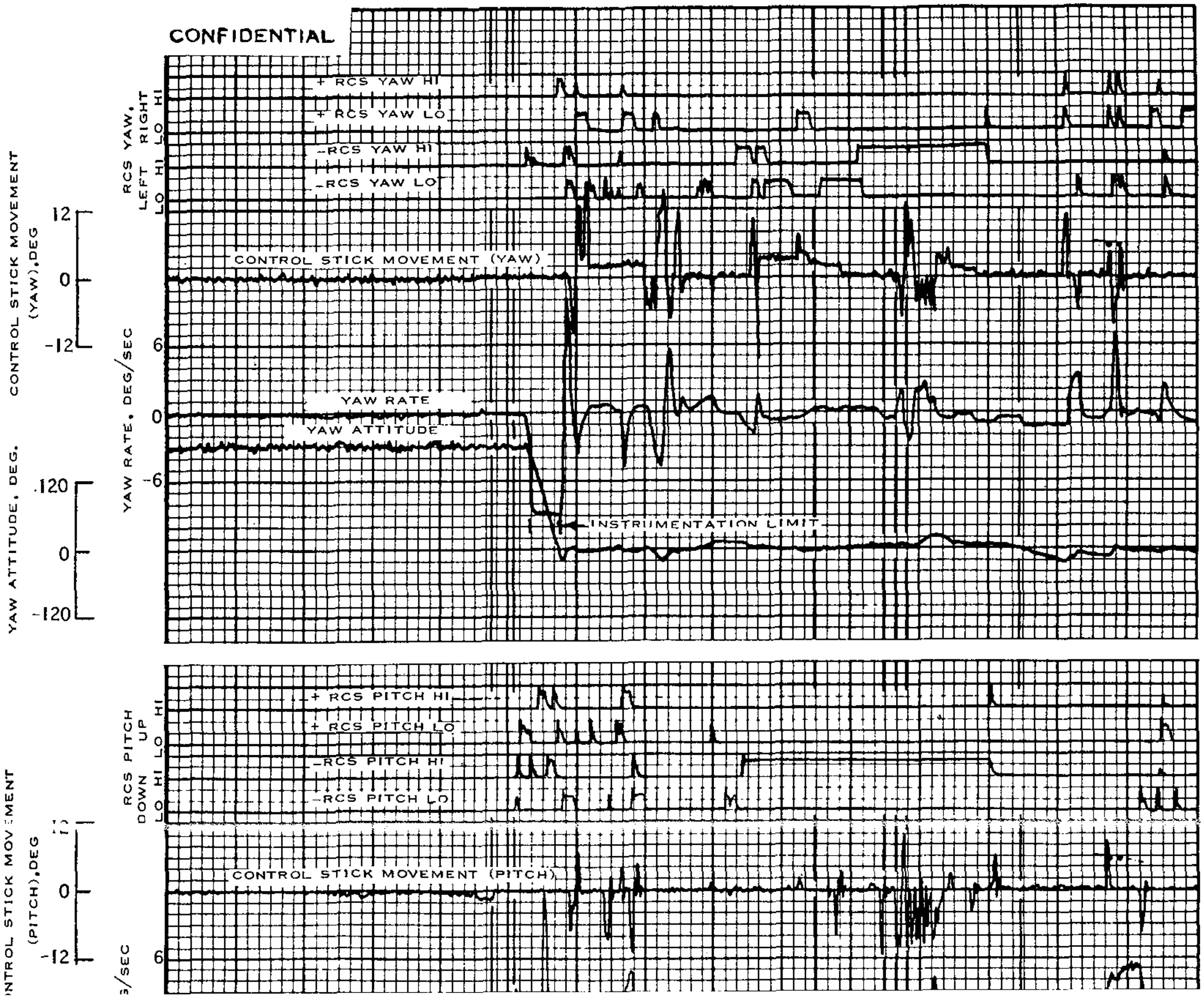

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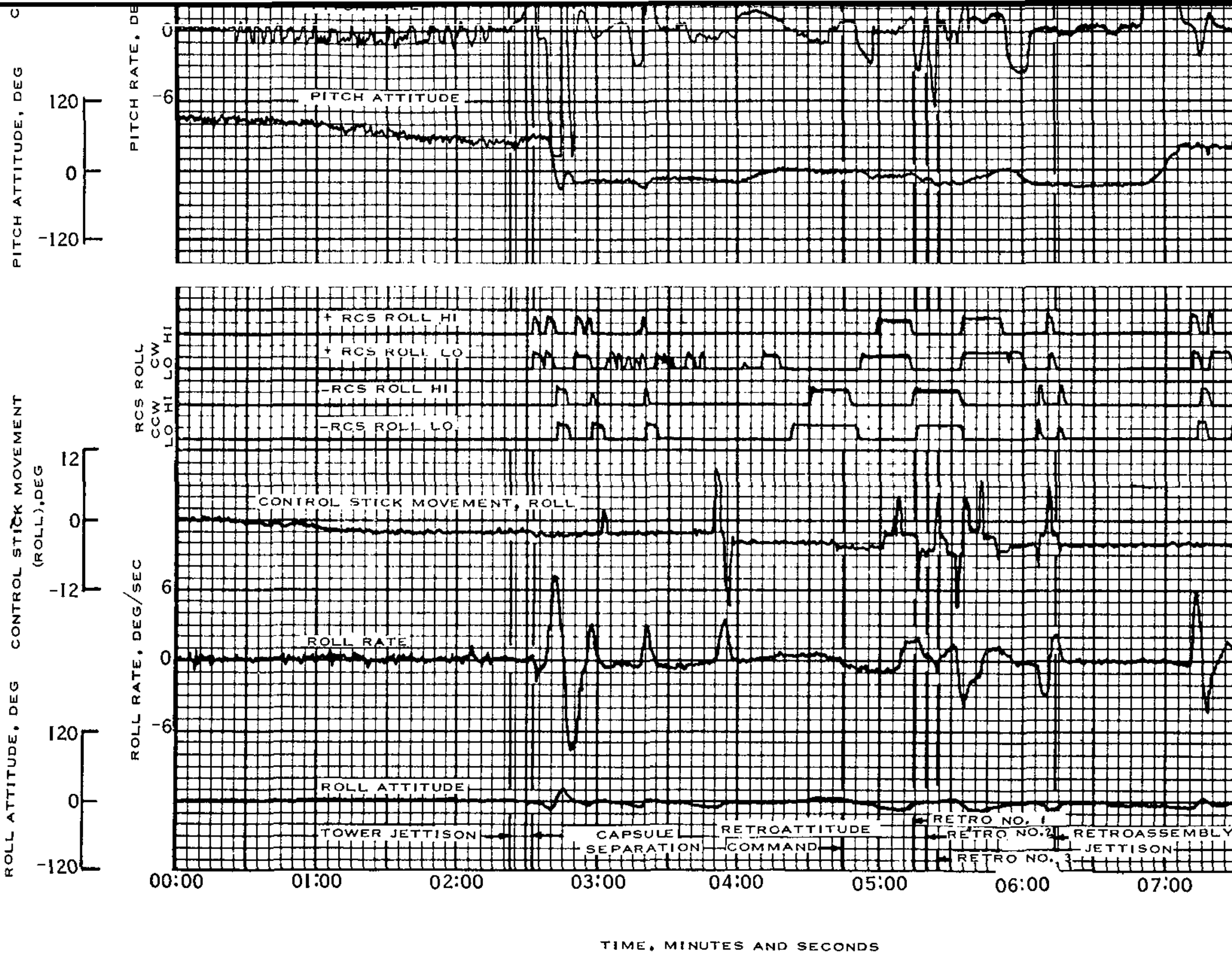
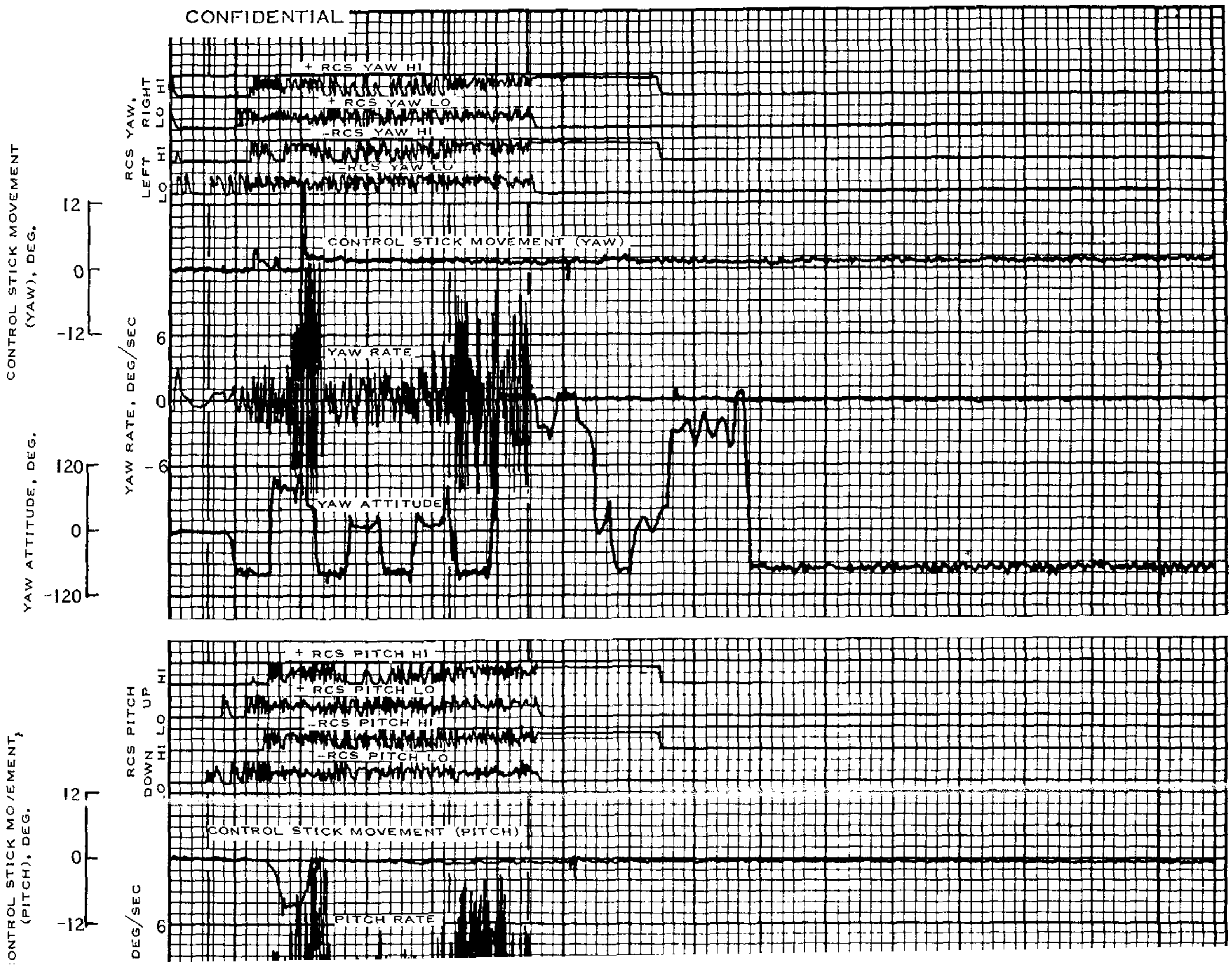


FIGURE 5.2-2 CONTROL SYSTEM PERFORMANCE



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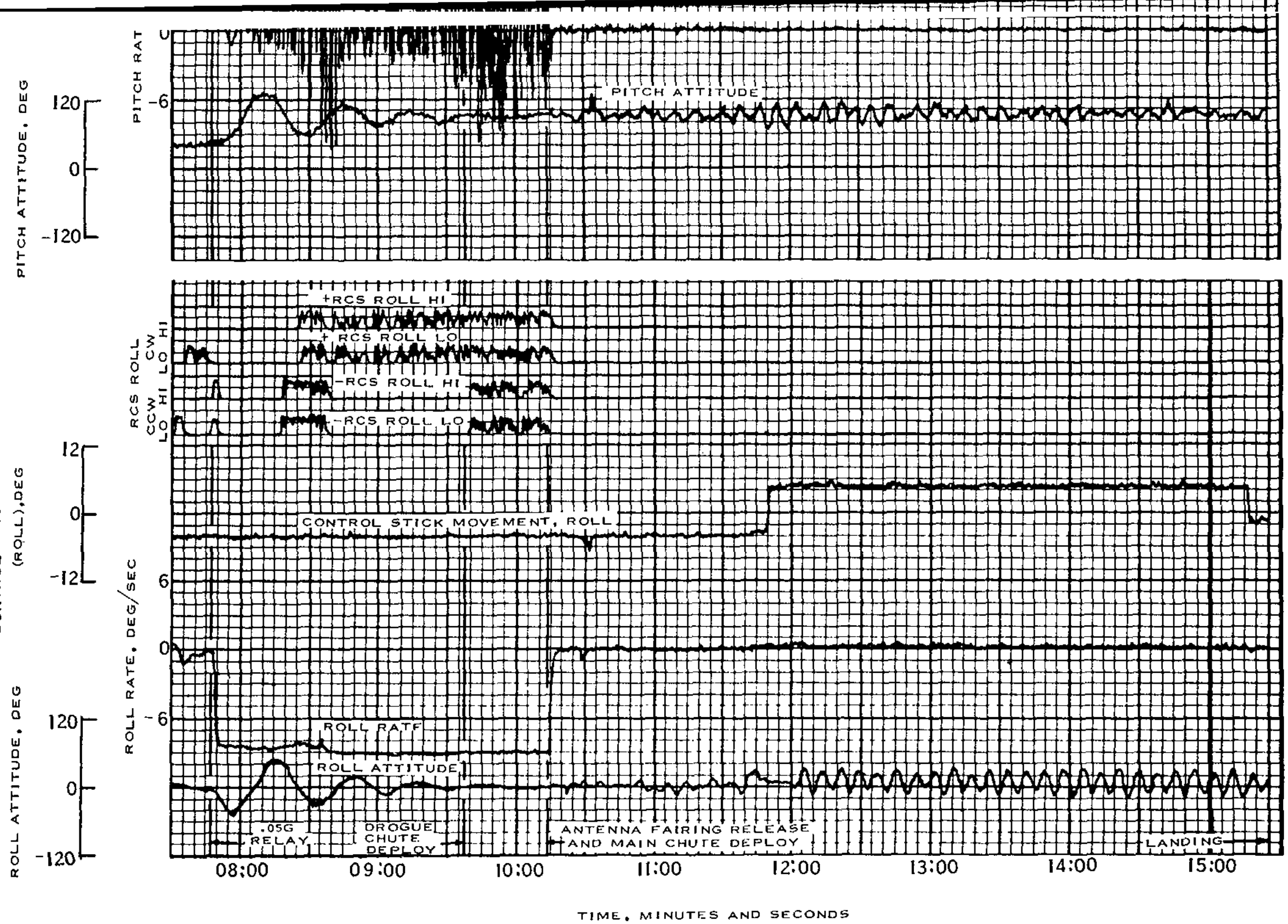

FIGURE 5.2-2 (CONCLUDED) CONTROL SYSTEM PERFORMANCE

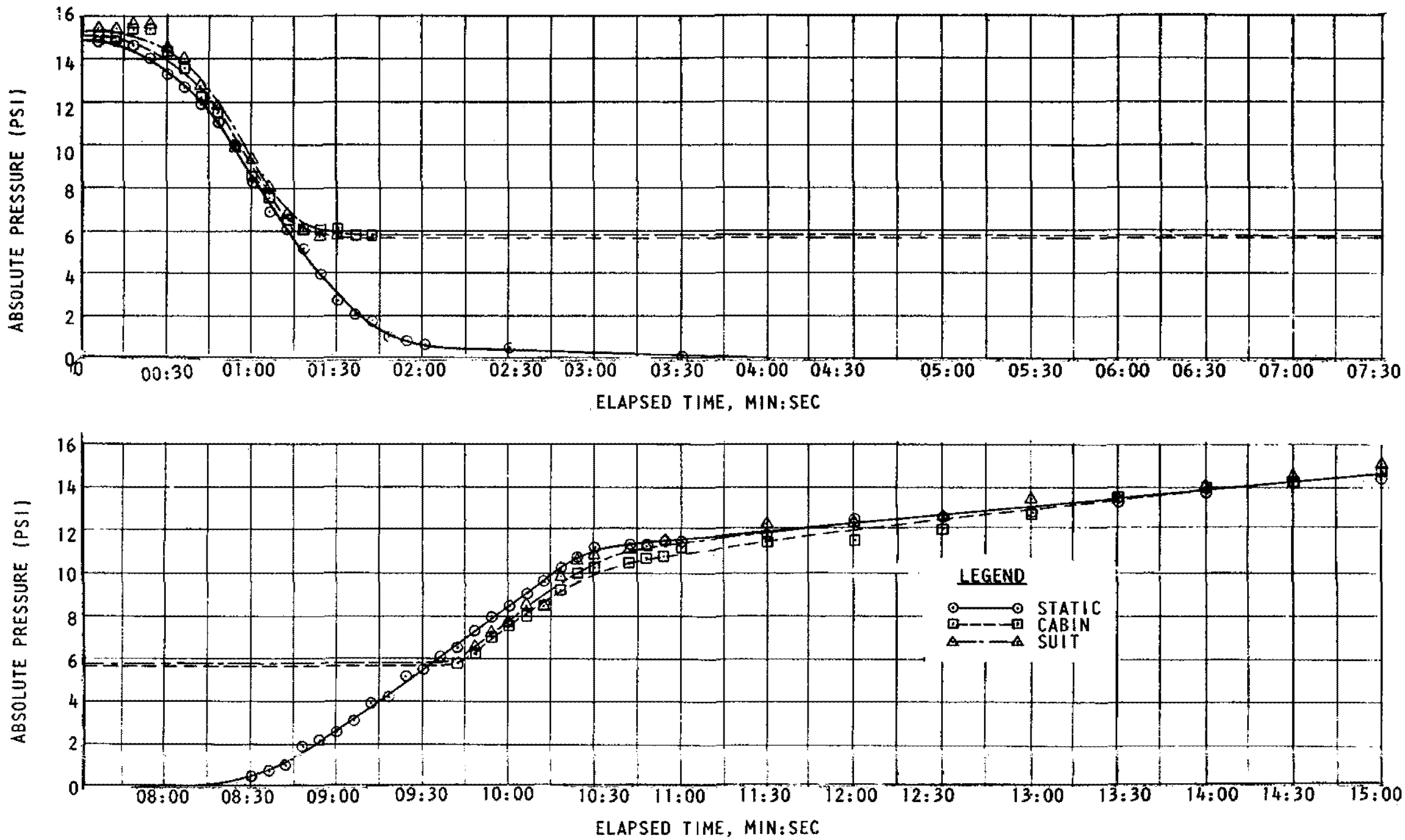

FIGURE 5.3-1 VARIATION OF STATIC, CABIN, AND SUIT PRESSURES WITH ELAPSED TIME

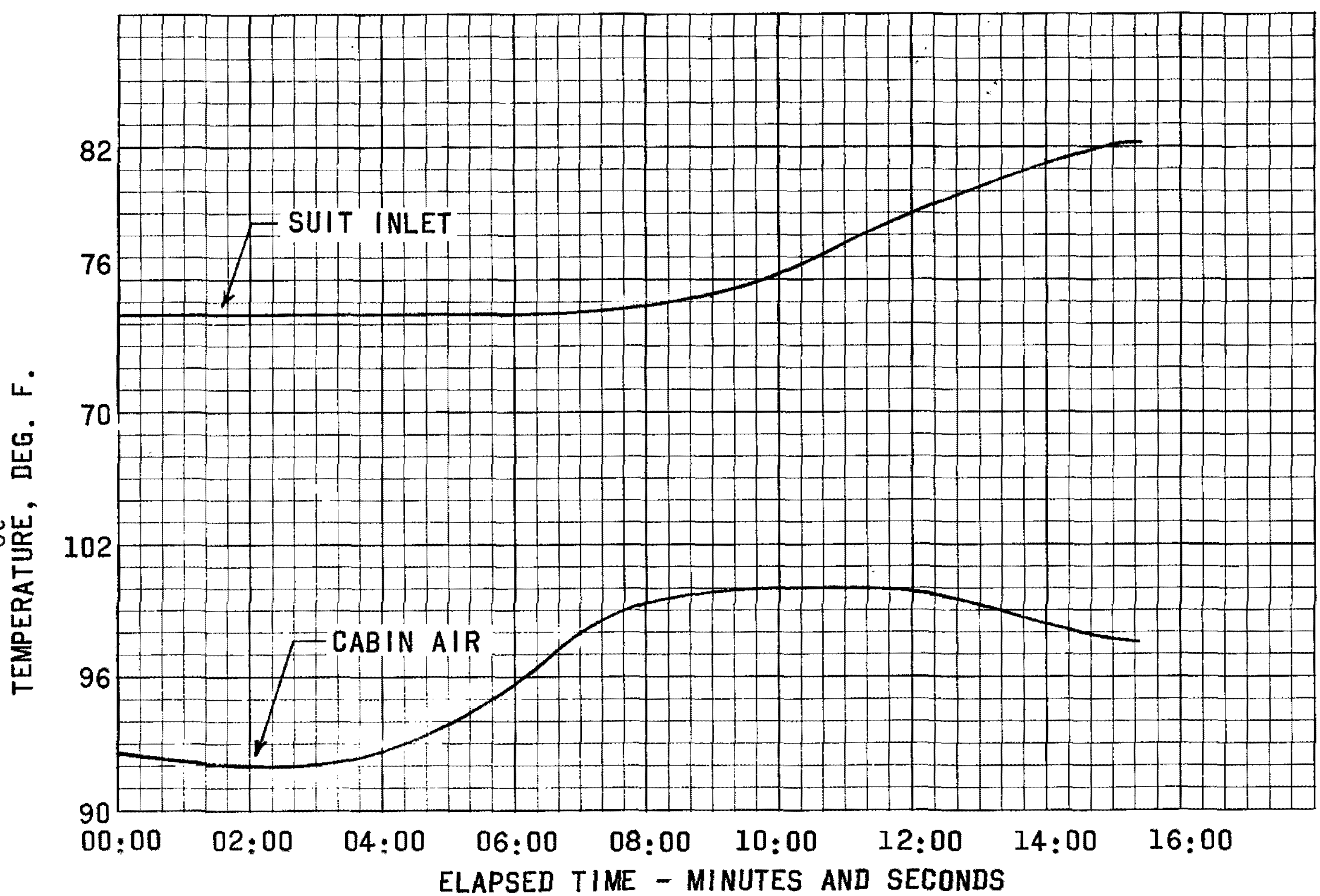

FIGURE 5.3-2.- VARIATION OF CABIN AND SUIT TEMPERATURE WITH TIME.

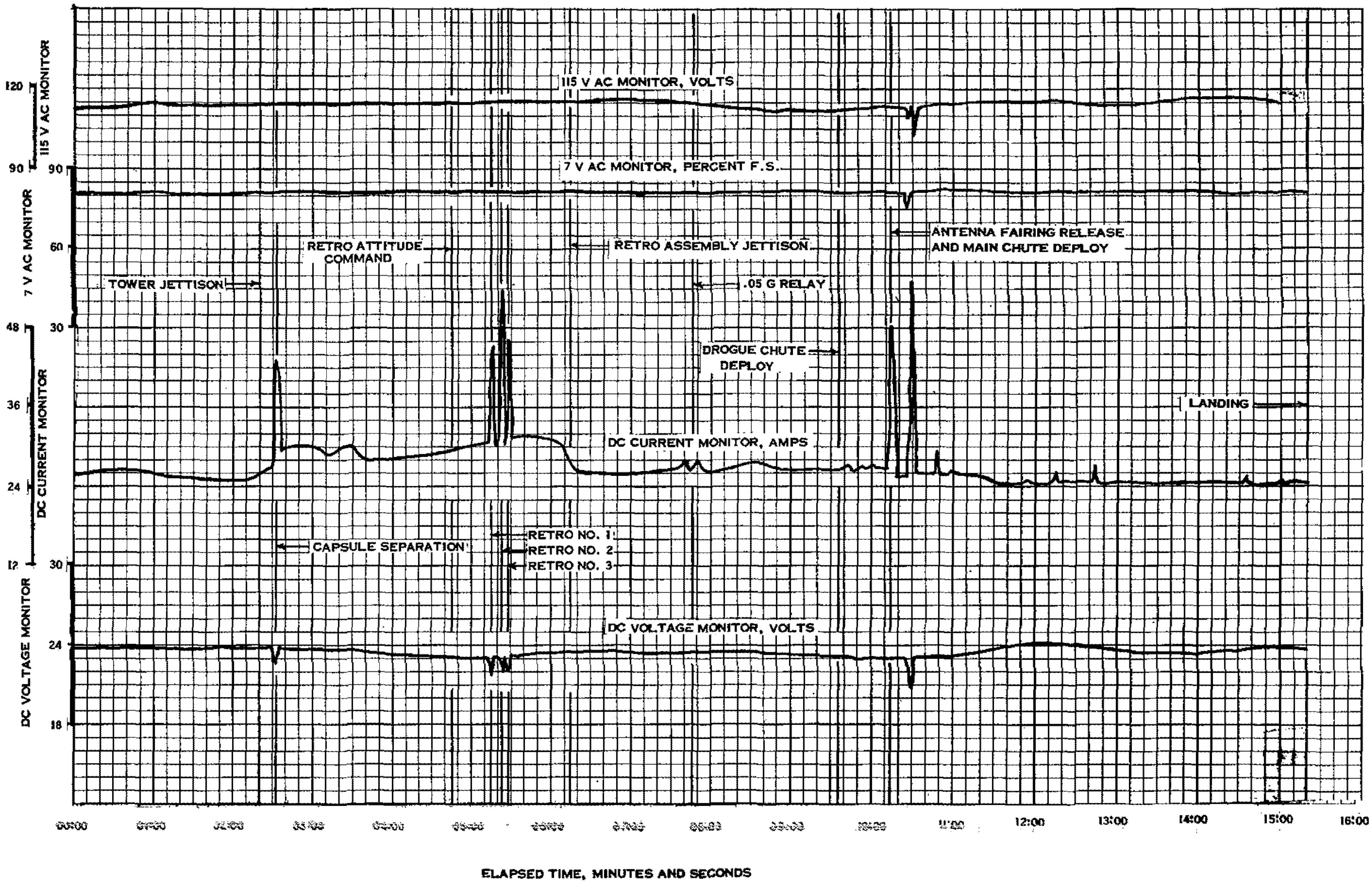

FIGURE 5.5—1 TIME HISTORIES OF DC CURRENT, DC VOLTAGE, AND AC VOLTAGE

6.0 BOOSTER PERFORMANCE

The Mercury-Redstone booster number 7 utilized for the MR-3 mission functioned normally throughout the powered flight phase of the mission.

Cut-off was initiated by the booster velocity sensor at 02:21.8. The vehicle and capsule attained an earth fixed velocity of 6,414 feet per second as compared to a planned velocity of 6,331 feet per second. This is within the allowable tolerance of the integrating accelerometer velocity cut-off sensor.

A 30g accelerometer was located inside of the adapter section adjacent to the capsule adapter clamp ring. This instrument was used to measure radial vibration in this area and was monitored through the booster telemetry system. The maximum amplitude of the composite wave form as read from the telemetry trace was approximately 11g and occurred between 01:10 and 01:25. A spectral analysis of this vibration as furnished by the Marshall Space Flight Center is shown in Figure 6.0-1. Not shown on this figure is a vibration of low magnitude (about 0.14g) occurring at 33 cps, which is near the second longitudinal mode of the booster.

Fifteen minutes prior to lift-off a hold was called to replace a 115 volt, 400 cycle inverter. The hold lasted 52 minutes, after which the count was recycled to -35 minutes and resumed. A second hold was called at -2 minutes which was caused by an increase in the pressure reading on the propulsion regulator (H_2O_2 tank pressure regulating valve). This excess pressure was corrected by cycling the vent valves several times. The pressure reading then returned to normal and functioned normally throughout the flight. The hold lasted for 1 minute after which the count was resumed and continued until launch.

The booster engine and associated systems, guidance and control systems and booster telemetry all functioned properly during flight.

The abort limits and the actual deviations from nominal attitudes and rates during powered flight are presented below.

Abort Parameter	Abort Limit	Flight Figures
Control Voltage (Nominal 60 volts)	Drop to 50 volts	57 volts
Attitude Error Sensor		
Pitch	± 5°	0°
Yaw	± 5°	0°
Roll	± 10°	± 1.7°
Rate Sensor		
Pitch	± 5°/sec	± 1.5°/sec
Yaw	± 5°/sec	± 1.6°/sec
Roll*	± 12°/sec	± 4.7°/sec
Combustion Chamber Pressure Switch (Nominal 317.5 psig)	Drop to 210 psig	312.5 psig

*This switch was not armed on the MR-3 flight.

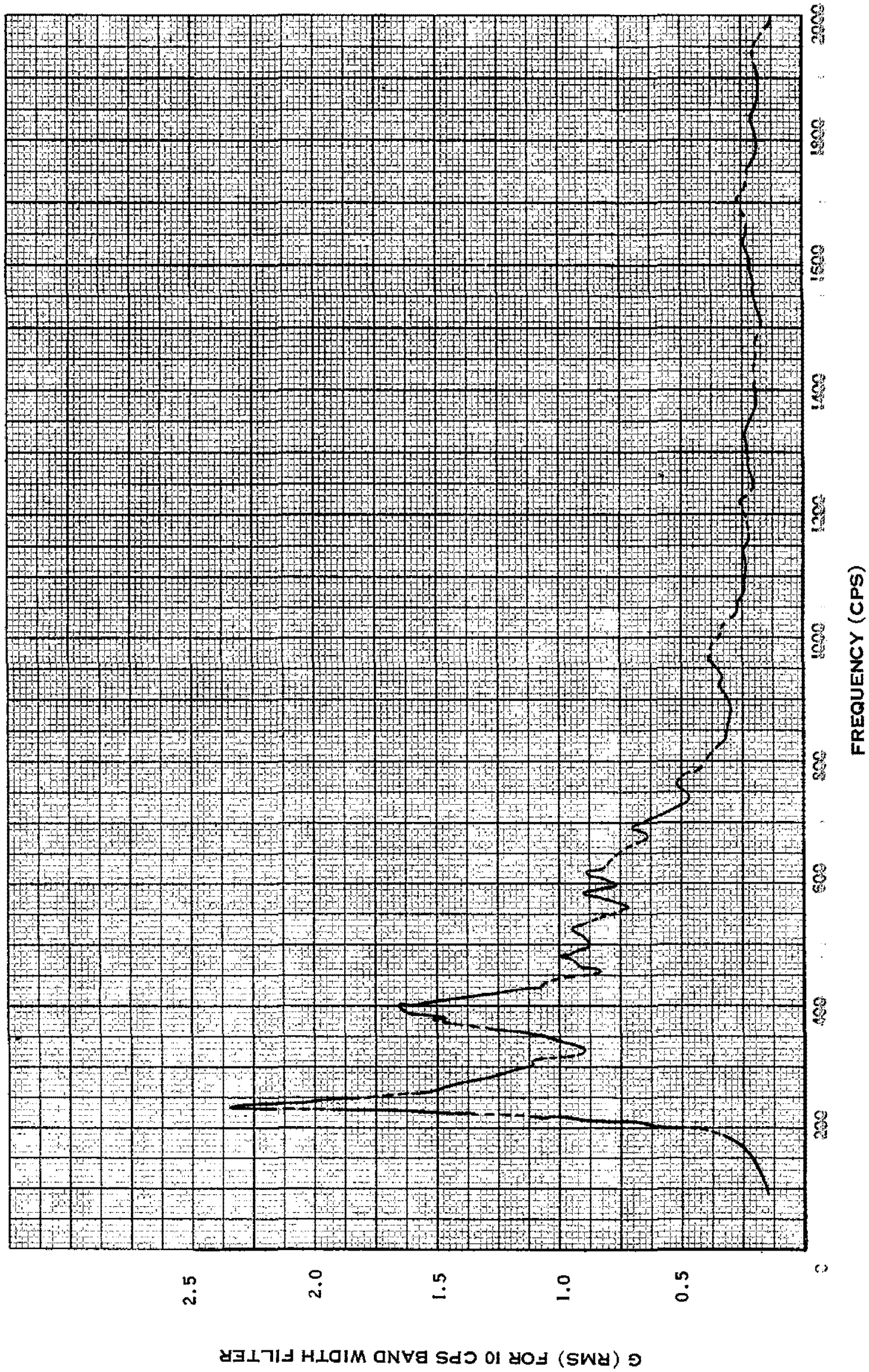

FIGURE 6.0-1.-SPECTRAL ANALYSIS OF VIBRATION AT ADAPTER AT 01:10.

7.0 PILOT ACTIVITIES

A major objective of this first manned ballistic flight was to evaluate the pilot's reactions to space flight. This section presents the pilot's personal report of the flight together with preliminary evaluations of his flight performance and physiological responses.

Figure 7.0-1 shows the appearance of Astronaut Shepard during his preparation on the day of the flight. The following table outlines his schedule on the morning of the flight:

0110 EST -	Awakened
	Shower
	High Protein Breakfast
	Physical Exam (brief)
	Don Sensors
	(a) Pair of sternal ECG leads
	(b) Pair of axillary ECG leads
	(c) Respiration thermistor
	(d) Deep body temperature
	Don Suit, Pressure Checks
0355 EST -	Enter Transfer Van
0435 EST -	Arrive at Pad (Briefing)
0515 EST -	Ascend Gantry
0520 EST -	Insertion Begun
0625 EST -	Denitrogenated For One Hour
0637 EST -	Gantry Removed
(0700 EST -	Scheduled Launch)
0934 EST -	Lift-off

7.1 Pilot Report

The following is a transcription of a tape recording made by Astronaut Shepard aboard the aircraft carrier approximately one to two hours after flight. This tape recording constitutes an essential part of the planned debriefing of Shepard and covers the time period from his entrance into the capsule to his arrival aboard the aircraft carrier. The period of the flight between retro-jettison and main chute deployment was not described aboard the carrier. A description of this part of the flight between retro-jettison and main parachute was lost and was recorded on the day after the flight and is included herein.

"This is the first flight debriefing, and before I go into the formal debriefing kit, I would like to say, as a general comment, that I quite frankly did a whole lot better than I thought I was going to be able to do. I was able to maintain control of the capsule fairly well throughout all of the manual maneuvers I made. I was able to follow the sequences fairly well throughout the entire flight, and, as a general comment, I felt that even though I did not accomplish every single detail that we had planned for the flight, I still did much better than I had originally thought I would.

"With that general comment as a start, I'll go into the first question of the debriefing kit which says 'What would you like to say first?' and I've just said it. Question No. 2 'Starting from your insertion into the capsule and ending with your arrival aboard the recovery ship, tell us about the entire mission.'

"Starting with foot over the sill back at Pad 5, I make these remarks. The preparations of the capsule and its interior were indeed excellent. Switch positions were completely in keeping with the gantry check lists. The gantry crew had prepared the suit circuit purge properly. Everything was ready to go when I arrived, so as will be noted elsewhere, there was no time lost in the insertion. Insertion was started as before. My new boots were so slippery on the bottom that my right foot slipped off the right elbow of the couch support and on down into the torso section causing some superficial damage to the sponge rubber insert -- nothing of any great consequence, however. From this point on, insertion proceeded as we had practiced. I was able to get my right leg up over the couch calf support and part way across prior to actually getting the upper torso in. The left leg went in with very little difficulty. With the new plastic guard I hit no switches that I noticed. I think I had a little trouble getting my left arm in, and I'm not quite sure why. I think it's mainly because I tried to wait too long before putting my left arm in. Outside of that, getting into the capsule and the couch went just about on schedule, and we picked up the count for the hooking up of the face plate seal, for the hooking up of the biomed. connector, communications, and placing of the lip mike. Everything went normally.

"The suit purge went longer than usual because of the requirement of telemetry to adjust the potentiometers on the ECG cards; so, as a result, I got a fairly good long suit purge and a comfortable one. The temperature was certainly comfortable during suit purge. Joe[1] seemed to

[1] Joe Schmitt, NASA Suit Technician.

have no trouble with the straps as he was strapping me in. Everything seemed to go as scheduled. I think we would have saved a little time at this point, since we were already in a very long suit purge, if Joe had tightened the straps up immediately rather than going out and coming back in again. However, at this point, he may have been getting a little bit tired, so it was probably just as well that the sequence went as we planned it according to the SEDR. As a result of this very long purge, I was surprised that the suit circuit oxygen partial pressure was only 95 percent.

"The oxygen partial pressure in the suit circuit apparently is not necessarily a function of the length of the purge. If it is, then 95 percent seems to be a fairly good endpoint for the system that we are using. After suit purge, the suit-pressure check showed no gross leaks; the suit circuit was determined to be intact, and we proceeded with the final inspection of the capsule interior and the removal of the safety pins. I must admit that it was indeed a moving moment to have the individuals with whom I've been working so closely shake my hand and wish me bon voyage at this time.

"The point at which the hatch itself was actually put on seemed to cause no concern, but it seemed to me that my metabolic rate increased slightly here. Of course, I didn't know the quantitative analysis, but it appeared as though my heartbeat quickened just a little bit as the hatch went on. I noticed that this heartbeat or pulse rate came back to normal again shortly thereafter with the execution of normal sequences. The installation of the hatch, the cabin purge, all proceeded very well, I thought. As a matter of fact, there were very few points in the capsule count that caused me any concern.

"As will be noted by members of the medical team, it became apparent that we were going to hold first for lack of camera coverage as a result of clouds. At this point I decided that I better relieve my bladder.[2] I did, and felt much more comfortable. It caused some consternation. My suit inlet temperature changed, and it may possibly have affected the left lower chest sensor. We can check back to see if the moment at which the bladder was relieved actually coincided with a loss or deterioration of good ECG signal from that pair. My general comfort after this point seemed to be good. Freon flow was increased from 30 to 45, and although I suspect body temperature may have increased slightly, I at no time really felt uncomfortable. I, of course, shifted around continuously to

[2] Shepard had been in the suit over 4 hours at this time.

try to get proper circulation, particularly in the lower limbs, and found that normal upper torso and arm movements in following sequence items were such that proper circulation was provided. The couch fit was fine. The helmet fit and sponge support was fine for the static condition. I'll describe deviations later.

"The parachute is definitely in the way of a yaw movement. When you make an attempt to yaw left, the wrist seal bearing on the right wrist bumps into the parachute, not to the point where it makes yaw impossible, but it certainly does interfere with it. It also, of course, interferes with the voice-operated relay sensitivity control and voice-operated relay shut-off switch which I did reach later in the flight using the 'window pole.' So then we had several holds during the count, but my general comfort was maintained, and I found as we did finally proceed down to the last part of the count that my pulse rate appreciably increased.

"I felt no apprehension at any time, but I did find that if I thought that some people were a little slow in reporting that their panel was in GO condition, I started to get a little bit flustered. I think that I was anxious to go at this point after having been in the capsule for some time.[3] The transition from freon flow to suit and capsule water flow was made smoothly even though we were very late in the count at that time.

"The transfer from MOPIS circuitry to RF was made smoothly. I was able to transmit and get an RF check with the Control Center and with the chase planes as well as with the blockhouse in plenty of time prior to one minute, when, of course, attention did naturally shift to the umbilical and the periscope.

"Backtracking here slightly, I see that I have slipped by gantry removal at -55 minutes which, as far as I was concerned, posed no problem to me. I was well tied in by that time, and at -45 the panel check posed no problem. I had no difficulty at any time with the CTC[4] on any of the check-off items -- I think primarily due to his foresightedness in reading off check-off lists when he had the opportunity, rather than following the launch count document to the second. Escape tower arming at -22 was no problem -- all you had to do was throw a switch, and, as we all know,

[3] About 4 hours by now.
[4] Capsule Test Conductor.

the escape tower did not fire. The T-15 panel check was satisfactory, the -5 status check was satisfactory, and I would say that the countdown right up to the point of umbilical pull indeed was satisfactory. This ties me back in where I was before, to the periscope.

"I noticed the umbilical go out and I saw the head of the boom start to drop away as the periscope retracted electrically. This fact was reported, as well as main bus voltage and current, over RF prior to lift-off. I had the feeling somehow that maybe I would've liked a little more over RF with respect to the booster countdown steps. I remember hearing firing command, but it may very well be that although Deke[5] was giving me other sequences over RF prior to main stage and lift-off, I did not hear them. I may have been just a little bit too excited. I do remember being fairly calm at T-0 and getting my hand up to start the watch when I received the lift-off from the Control Center on RF. The time-zero relays closed properly, the onboard clock started properly, and I must say the lift-off was a whole lot smoother than I expected. I really expected to have to use full volume control on UHF and HF to be able to receive. I did not have to -- I think I was legible to Tel. 3[6] because all of my transmissions over UHF were immediately acknowledged without any repeats being requested.

"Again, insofar as the mission itself is concerned, lift-off was very smooth. I noticed no vibrations of any consequence at all during the period of about the first 30-45 seconds (I would say as a guess). I got an extra transmission in primarily to insure myself of a good voice link and also to let the people on the ground know that I was still in good shape. The 30-second scheduled transmission went according to schedule, right on time. I did start that a little bit early, I remember, as I wanted to again let the people know that I was in good shape. It seemed to me that somewhere about 45 seconds to a minute after lift-off, I started noticing an increase in vibrations at the couch. It was a gradual increase; there was not any concern. As a matter of fact I'd really been looking for an increase in sound levels and roughness just after one minute because of going transonic and because of the max q point, so I wasn't too upset by this. I think maybe if we look back at film (the pilot coverage film) we'll be able to see my helmet bouncing around, vibrating.

[5] Capsule Communicator in Mercury Control Center.
[6] Mercury Control Center.

Actually there was vibration there to a degree where it distorted some of the reading of the instruments. I made the voice report at one minute on schedule and from there on up to max q noticed the increase in sound level and increase in vibration.

"The cabin pressure, as we know, sealed properly at 5.5. It seemed to slow down a little bit at 6. As a matter of fact, I almost reported it as being sealed at 6, but it gradually came down to 5.5. A quick glance at the suit circuit absolute-pressure gage confirmed this. After this, things really started to smooth out. The booster noises seemed to fade away, and booster vibrations got a lot smoother. As a matter of fact, I mentioned that over RF, so we'll have that on record. There was a very definite transition in vibration, not a sharp one, but a gradual one, nonetheless noticeable. The report at 1 plus 30 was made on schedule. We, of course, included the main and isolated battery voltages at that time. I found that my scan pattern was not as good as it might have been, and I don't remember looking at the electrical panel as much as I probably should have, paying more attention, of course, to the oxygen panel and the fuel panel.

"At 2 minutes, normal periodic transmission was made, and, of course, I gave all systems 'GO' happily at that point. I remember feeling particularly happy at that point because the flight was proceeding very smoothly and the capsule was working very nicely as far as I could tell. I also called out an additional acceleration of, I think, 5-1/2g here.

"Cut-off as far as I could tell on the capsule clock came exactly on schedule, right around 142 seconds (2 plus 22). Tower jettisoned. Immediately I noticed the noise in tower jettisoning. I didn't notice any smoke coming by the porthole as I expected I might in my peripheral vision. I think maybe I was riveted on the 'tower jettison' green light which looked so good in the capsule. I threw the 'retro-jettison' switch to disarm at this point as I noted over RF, and 'capsule separation' came on green right on schedule at 2 plus 32. Aux damping at this point, I thought, was satisfactory. I don't remember reporting it specifically because I reported the periscope coming out, and I think at this point I was going to report it, but the turn-around maneuver actually started on ASCS. I remember reporting the turn-around maneuver, and at that point, at about 3 minutes, I went through hand control motions, as was noted, and I started switching to the manual control system. I switched of course to pitch first, pitched to retro-attitude, and back to orbit attitude. The ASCS controlled in yaw and roll as I was doing this. I then switched next to manual yaw, and ASCS roll still continued to function. I switched then finally to manual roll. I was in the full manual system and found that controlling the capsule was just about the same as it had been on the Procedures Trainer gyro simulation.

"I did not pick up any noticeable noise of the jets. I think if I'd had time I might have been able to decrease the volume control of the radio circuits and picked it up, but at this point I didn't have time to investigate it. I remember thinking that I did not hear the noise of the manual jets firing at this time.

"I controlled fairly close to orbit attitude on manual and then switched to the scope, and the picture in the scope certainly was remarkable. Unfortunately, I had a filter in the scope to cut the sunlight down on the pad, and I did not feel that I had the time to reach it and change it on the pad. It was difficult for me to reach the filter-intensity knob with the suit on without bumping the abort handle with the wrist seal bearing and suit gage, so as a result I remember saying, 'Well, I'll leave the periscope filter in this position and try to remember to change it later on even though it may get me in trouble.' Of course, actually, it did, because I had in the medium-gray filter which very effectively obliterated most of the colors. Clarifying that last remark, there is no question about being able to distinguish between cloud masses and land masses. This is very easy to do even with a gray filter, and I was able to distinguish the low pressure area as described[7] in the southeastern part of the United States. As I think I mentioned over RF, Cape Hatteras was obliterated by cloud cover. The cloud cover of 3 to 4 tenths, low scattered on the east coast of Florida, was most apparent. The west coast of Florida and the Gulf were clear. I could see Lake Okeechobee. As I described, I could see the shoals in the vicinity of Bimini. I could see Andros Island. The Bahama Islands, GBI itself, and Abaco were confusing because there was cloud cover there, just enough to confuse my view. I think if I had a little bit more time with the periscope here, though, I would have been able to definitely distinguish these islands, but the cloud cover was confusing to me at that point. I noticed also that I apparently had in a slow pitch rate because I noticed that I wasn't controlling the manual pitch too

[7] In preflight weather briefing.

much at this point. I think I was paying too much attention looking out at the awe-inspiring sight in the periscope.

"The countdown to retro-sequence helped me. It helped me come back to the next sequence which was to occur. The next sequence of course was retro. The onboard timer started retro essentially on schedule; the retro-sequence and retro-attitude lights came green, as expected. I went manually to retro-attitude, and I wasn't quite as happy with the pitch control here as I was with yaw and roll. Somehow I got a little bit behind with my pitch control, and I got down fairly close to 20 to 25 degrees rather than staying up around the 34 degrees. Of course, as we all know, the index of this particular capsule is at 45 degrees, but I don't think this added to the confusion; however, I think the confusion was my own here. Okay, with respect to retro-firing -- there is no question about it, when those retros go, your transition from zero g of weightlessness to essentially 0.5g is noticeable. You notice the noise of the retros and you notice the torque of the retros. I think I did a fairly good job of controlling the retros outside of the pitch deviation which I mentioned, and I thought that I was able certainly to control them within reasonable tolerance.

"At the end of retros, the plan was to go to fly-by-wire, which I did. I switched to fly-by-wire, pulled manual, and then, at this point, the plan was to go to yaw and then roll, but I noticed I was a little lower in pitch than I wanted to be at the end of retro-fire itself, so I started back on the pitch. At this point, it was either a yaw or a roll maneuver that I made, I'm not sure which one. I think it's probably yaw because that is the one I was supposed to make first. About the time the retros were to have jettisoned, I heard the noise and saw a little bit of the debris (one of the retro-pack retaining straps). I checked and there was no light at that time. Deke[8] called up and said he confirmed retro-jettison, and about this time I hit the manual override and the light came on. This, as I recall, is the only item sequence-wise in the capsule that did not perform properly. Then, using fly-by-wire, I did not do the specific roll 20 degrees and back as we had planned, because it took a little extra time to verify that retro-pack jettison had occurred.

"I went on down to re-entry attitude on fly-by-wire, and I think I made the general comment that as far as I

[8] Astronaut Donald K. (Deke) Slayton, Capsule Communicator in the Mercury Control Center.

am concerned the trainers -- the procedures trainer as well as the ALFA trainer -- are all pretty close to the actual case. I say this now, because on those I have a tendency to be able to control these trainers on the manual system better than I can with the fly-by-wire system. And I think it's just a matter of not using fly-by-wire very much. By that I mean that normally we're controlling retros manually and normally controlling re-entry manually, and when you switch to fly-by-wire as we had been doing here, the first tendency is to over-control in rate. The microswitch distances for the high and low thrust jets are very small, and we've had trouble on this. With these microswitches, particularly capsule seven, you get high torque right away, whether you want it or not, and so I noticed the same thing on the capsule. The first thing I did was over-control and got a higher rate than I thought I should have gotten.

"On fly-by-wire I went to re-entry attitude, switched to ASCS which stabilized at about 40 degrees. At this point, the periscope came in on schedule, and I remember reporting 'periscope in.' Then I got involved with looking out the windows for the stars and anything else that I could see. At this time in the flight, of course, this window looks generally at the horizon, at the moon and the stars.[9] There was nothing there at all -- I couldn't see anything in the way of stars or planets out in that area, although I did move my head around. I got a little confused because I thought I ought to get my head up to see the horizon out the left window. I never did get a horizon, and I think it was because of the attitude. We had figured out it was 15 degrees above the horizon as I recall, and I thought I ought to be able to see the horizon but I never did see it. That, plus the fact that I was looking for the stars that I couldn't see out of that window, actually got me behind in the flight. This was the only point in the flight at which I felt that I really wasn't on top of things. What happened here was that .05 g came quickly, as I reported, and I started switching to manual control, and I thought I had time to get on to manual control, but I didn't. The g-build-up started sooner than I figured it would. I don't know whether it was just that I was late because of being late on the time, or whether we don't have the same time difference between .05 g and g-build-up on our trainer that we actually had in flight -- we can check this later. What I'm talking about is the time period between .05 g and the g-build-up in re-entry.

[9] The stars he was to look for.

As I can remember on the trainer, I would have time to go ahead and get on manual control and get set up before the g's built up, but I was surprised when the g's started building up as soon as they did. I wasn't ready for it, but I thought we were in good shape because we were still on the ASCS when the .05g relay latched in. As a result, the roll started on schedule . . . ." END OF RECORD.

(There is a portion of Astronaut Shepard's report missing from the tape recording at this part of the flight. During a later debriefing at GBI the next day, Shepard described this portion of the flight essentially as follows:)

The acceleration pulse during reentry was about as expected and as was experienced on the centrifuge during training, except that in flight the environment was smoother. During the early part of g-build-up, Shepard switched to manual-proportional control on all axes. He allowed the roll put in by the ASCS to continue. He controlled the oscillations somewhat in pitch and yaw during g-build-up only. The oscillations during and after the g-pulse were mild and not uncomfortable. He arrived at 40,000 feet sooner than he expected to due to a 30-second error in the procedures trainer, and at that time switched to ASCS in all axes in order to give full attention to observing drogue chute deployment. The drogue came out at the intended altitude and was clearly visible through the periscope. The capsule motions when on the drogue chute were not uncomfortable. The snorkel opened at 15,000 feet which Shepard thought was late (although within value specifications). The main chute came out at the intended altitude.

Astronaut Shepard's recording made on the carrier continues:

"As to the chute, I was delighted to see it. I had pushed all hand controllers in so that I noticed that all the peroxide had dumped on schedule. At this point I shifted to the R/T position of the UHF-DF switch. The UHF-select was still normal, and I think at this point I reached over and flipped off the VOX relay switch. I realized after I had done it that it was a superfluous maneuver because the transmitters were keyed anyway. I was a little confused here, I guess. I felt that the carrier[10] was coming in and out for some reason, so I went over there and threw that VOX power switch off. In

[10] The hum of the carrier frequency.

any event, after going to the R/T position, shortly thereafter, I established contact with the Indian Ocean Ship[11] and gave them the report of the parachute being good, the rate-of-descent indicator being at about 35 ft/sec and everything looked real good. The peroxide was dumped, the landing bag was green, and, of course the 'Rescue Aids' switch was off at that point. They relayed back shortly after that, as I recall.

"CARDFILE 23, the relay airplane, came in first of all with a direct shot and then with a relay, so that I was able to get the word to the Cape prior to other sources that I was indeed in good shape up to this point. The opening shock of the parachute was not uncomfortable. My colleagues will recognize it was a reassuring kick in the butt. I think I made the hand controller movements after the main chute. I can't vouch for it. The exact times of this sequence I do not recall at this point but we can cross-check again. Altitude-wise, the drogue and main came out right on the money, as far as indicated altitude was concerned.

"I put the transmission through that I was okay prior to impact. I was able to look out and see the water, with the capsule swinging back and forth. It was not uncomfortable at all. As a matter of fact, I felt no uncomfortable physiological sensations, really, at any point during the flight. Excited, yes, but nothing uncomfortable at all. Prior to impact, I had removed my knee straps; I had released my face plate seal bottle and had removed the exhaust hose from the helmet. Back to the impact now -- the impact itself was as expected. It was a jolt but not uncomfortable. The capsule went over on my right hand side, down pretty close to the water, and, of course stayed at about 60° off the vertical. I reached down and flipped the 'Rescue Aids' switch at this time to jettison the reserve chute and to eject the HF antenna although I <u>did</u> leave my transmit switch in the UHF position. At this point I could look out the left window and tell the dye marker package was working properly. The right window was still under water. I began looking around for any indication of water inside but did not find any. I had broken my helmet at the neck ring seal at this point, and I did no transmitting here. I left the switch on R/T because I didn't want any discharge from the UHF antenna.

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[11] This ship was being exercised for the MR-3 mission and had been positioned in the landing area.

"The capsule righted itself slowly to a near vertical position, though I thought to myself 'It is taking an awfully long time to get up there,' but it did get up there. About the time it did get up there, I started to relax a little bit and started to read off my instruments. I had made a report to CARDFILE 23 after impact over UHF that I was indeed all right, and it was relayed back to the Cape. Then, getting back to the point where the capsule was close to the vertical, I was going to get a readoff of the instruments at this time, prior to shutting down the power. I got the main bus voltage and current, and I got a call from the helicopter and thought that communicating with him was much more important. So I did. I am not sure that he heard me at first, but I was able to get through to him that I would be coming out as soon as he lifted the door clear of the water. In the meantime, I experienced very little difficulty in getting the cable from the door around the manual controller handle and tightened up. I called the helo and told him I was ready to come out, and he verified that he was pulling me up. I told him I was powering down and disconnecting communications. The door was ready to go off. I disconnected the biomedical lead, I undid my lap belt, disconnected the communications lead, and opened the door. I very easily worked my way up into a sitting position on the door sill. Just prior to doing this, I took my helmet off and I put it over the hand controller.

"The helo was right there. I waited before grabbing the 'horsecollar' for a few minutes because I hadn't seen it hit the water. They dropped it down in the water and pulled it back up again. I grabbed it and got into it with very little difficulty, and shortly thereafter, was lifted directly from a sitting position out of the capsule up toward the chopper. The only thing that gave me any problem at all, and it was only a minor one, was that I banged into the HF antenna. Of course, it is so flexible that it didn't give me any trouble. I got into the chopper with no difficulty at all, and I must admit was delighted to get there. Of course, the pickup of the capsule went very nicely. The sea conditions were such that they were able to get it up right away, and the next thing I knew we were making a pass at the flat top. My sensations at this time were very easy to describe and very easy to notice. It was a thrill, a humble feeling, and an exalted feeling, that everything had gone so well during the flight.

"I have not used the script[12] here, so I will go over it now to be sure that I have covered most of these items. Item 3 -- the most outstanding impression of the flight in special sensory areas. I think it is really very difficult to describe any one thing as being more outstanding than any other. It was all fascinating, interesting, challenging, and everything all wrapped up into one. But I don't really remember noticing the weightless condition until I noticed a washer flying by. 'Well,' I thought, 'you are supposed to be making some comment on being weightless.' So I did think about it a little bit. Of course, as we had known before in the backseat of the F-100's it is a real comfortable feeling. There is no tendency to be thrown around at all and no uncomfortable sensations being strapped in as we are. I guess the most outstanding impression that I had was the fact that I was able to do as well as I did. A very good flight.

"Major surprises? No major surprises. Some minor ones which I have described. I expected to be able to see the stars and planets, which I could not do. I think I could have found them with a little more time to look. The fact that I did not hear the jets firing -- although I do remember now hearing the control jets working just after re-entry, after I went back to ASCS. I remember hearing some of the high-thrust jets going at this time. In reference to the sky and stars, I have described the stars which I did not see and which I tried to see. I described the landing in the water; I described check points; I remember mentioning over RF that I was able to see Okeechobee, also Andros and the Bimini Atoll which was (the latter) most apparent because of the differences in color between the shoals and the deep water.

"I did not describe the perimeter[13] too well because of cloud cover around the perimeter. The predicted perimeter cloud cover was most accurate. The clouds were such that the ones that had any vertical formation were pretty far away, and I didn't really notice much difference in cloud heights. I think had I been much closer to them, I would have been able to notice this a little more. They were pretty far from the center of the scope so some distortion occurs. We talked about the horizon. Essentially, there was only the one haze layer between the cloud cover and the deep blue.

[12] The debriefing form.
[13] The perimeter of the field of view through the periscope.

"Weightlessness gave me no problem at all. The last question: 'Describe any sound, smell, or sensory impressions associated with the flight experienced.' Sounds? Of course -- the booster sounds, the pyros firing, the escape tower jettisoning and the retros firing. Of course all these sounds were new. Although none of them were really loud enough to be upsetting, they were definitely noticeable. The only unusual smell in the capsule was a gun powder smell after -- it seems to me after main chute deploy. I think this was after the main antenna can went off. I don't remember smelling it before, but I did get it after main chute, and, of course, I didn't get it until after I opened my face plate. It didn't appear to be disturbing to me, so I didn't close the face plate. No other sensory impressions that I noticed that I can recall at this time that we did not have in training. The g-load, the onset and decline of g were familiar during re-entry and powered flight. They were not upsetting. They were not unusual.

"I am sorry that I did forget to work the hand controller under g-load during powered flight as we had discussed, but I thought that I was operating fairly well during powered flight. I think the fact that I forgot this is not too significant. Well, I think that's just about the size of it for now. We will continue this on a more quantitative basis later on. This is Shepard, off."

7.2 Medical and Physiological Studies

An evaluation of the astronaut's physiological reactions to the multiple stresses of space flight and a determination of whether such flights are harmful were important objectives of this mission. Special interest concerned the effects on the pilot of 5 minutes of weightlessness and his responses to acceleration-weightlessness transition periods.

This preliminary evaluation of the status of the pilot made use of the following sources of information:

a. Biosensor data.

b. Voice communications.

c. Onboard motion pictures of the pilot and instrument panel.

d. Pilot debriefing records.

e. Telemetered and recorded environmental data.

f. Medical data.

All of the above sources are described elsewhere in this report except for items a. and f. which will be treated in some detail in this section.

7.2.1 Physiological Studies

The pilot was instrumented with sensors to obtain an electrocardiogram, respiration rate, and body temperature traces. Only the general nature of these sensors will be described, since the methods of amplification, transmission and recording are reported elsewhere.

The pilot's electrocardiogram (ECG) was obtained from two pairs of electrodes attached to his chest (Figure 7.2-1). The electrodes consisted of a flat rubber cup containing a wire mesh screen connected to shielded wires leading to the ECG amplifiers. The cup was filled with a conductive paste and covered with an adhesive patch which bound cup to skin. Continuity was checked at each step of the pilot's preparation. The output of the peak ECG pulse was approximately 1.5 millivolts for each pair.

Respiration rate was measured using a thermistor mounted on one of the helmet lip microphones. The thermistor was equipped with a shield to protect it from stray air currents and at the same time to detect either nasal or mouth breathing. A rough index of respiration volume could also be obtained, but is not reliable because of head movement within the helmet.

Deep body temperature was obtained using a thermistor in a rectal probe.

Performance of the physiological sensors was checked during dressing and in the transfer van. ECG, respiration and body temperature were monitored continuously from time of insertion into the capsule at 0520 EST until shortly after capsule impact at 0949 EST. The quality of ECG from lead 2 remained good throughout. The axillary lead (1) deteriorated at 0736 EST. Lead 1 continued to provide data intermittently from that point on but intermittently caused interference with the voltage-controlled oscillator of the respiration trace.

Respiration trace quality was variable, and the shallow trace excursions made interpretation difficult during certain phases of the flight. Body temperature was obtained throughout the mission and no report of sensor discomfort was made. Figure 7.2-2 shows a sample record of the telemetered biological data obtained during the flight. The record shows the ECG spikes inverted due to recording reversal.

Figure 7.2-3 shows a plot of pulse rate, respiration rate and major countdown events against time. For this figure, and the next, pulse rate was obtained by counting Q-R-S complexes (main spikes) of the ECG over 15-second periods. Respiration rate was obtained over 30-second periods.

In general, pulse rate varied throughout the prelaunch countdown. During some of the more significant events, the pulse rate showed brief rises as illustrated in Figure 7.2-3.

Figure 7.2-4 shows a summary of the in-flight pulse rate (taken every 15 sec.), respiration rate (taken every 30 sec.) and body temperature (every minute) plotted along with some of the principal flight events. Also shown on this chart for comparison are envelopes of pulse rates measured for this astronaut during certain key events of previous centrifuge programs simulating the Mercury-Redstone flight.

It is apparent that pulse-rate responses during the flight were in excess of those previously obtained on the centrifuge. Maximum pulse rate occurred at the end of the booster acceleration and capsule separation, reaching a rate of 138 beats per minute. Pulse rate during the flight reached a low of 108 (comparable to lift-off level) just prior to the onset of re-entry acceleration. It is noted that a rise in pulse rate occurred at time of retrofire which is consistent with findings in the centrifuge program.

The pilot did not show an anticipatory increase in pulse and respiratory rate preceding the onset of re-entry accelerations. This increase rate has been observed during centrifuge programs. This could have been related to his attention to other mission duties. A peak pulse rate of 132 beats/min. occurred immediately following reentry g. This is within anticipated levels.

The ECG displayed no abnormal rhythm or wave form disturbance during the countdown or the flight. Minimal sinus arrythmia (variation in rhythm of heartbeat) was occasionally noted, but this is a recognized normal physiological finding.

Body temperature remained nearly constant at a normal level during the countdown and flight. Environmental factors (suit temperature, cabin temperature, suit pressure, acceleration levels, and oxygen consumption) stayed within expected levels.

Analysis of other data sources gives additional information relating to pilot physiology. Mental processes (speech, memory, perception, and mobility) appeared intact throughout the mission as evidenced by the appropriate pilot actions and his close adherence to the planned program. The pilot's voice was clear, precise, little altered by the flight environment, and conveyed some information as to his feelings.

Vision appeared to be intact throughout. No grey-out or black-out was observed or reported. Onboard films show the pilot scanning the instrument panel in an appropriate way. Detailed external observations were made and capsule instruments were read correctly.

Good auditory acuity was present, even through the boost phase, as evidenced by the pilot's comments, his prompt and appropriate replies, and his detection of flight events by hearing.

No disorientation or semicircular-canal disturbance was recognized. Pilot-observer camera film shows no nystagmus (jerky, uncontrolled eye movements) and the pilot reported no dizziness or blurred vision.

7.2.2 Medical Studies

Detailed medical examinations were performed prior to the flight and at the debriefing site. A brief physical examination was made promptly after the pilot's return to the recovery ship. The purpose of these studies was to detect inapparent as well as obvious injuries as well as to obtain "before and after" physiological information. Several physicians independently examined the pilot without being informed of the findings of the others.

The following examinations were performed before and after the flight:

a. Detailed general physical examination.

b. Specialist examinations.

(1) Ophthalmology.

(2) Neurology.

(3) Psychiatry.

c. Electroencephalogram.

d. Electrocardiogram (12 lead).

e. Chest X-ray (posterior-anterior and lateral views).

f. Biomedical studies on venous blood and urine (includes electrolyte, steroid, and enzyme determinations).

Results or changes noted in the examinations follow. The pilot appeared to be well, in excellent spirits and in good physical condition during all post-flight examinations. Figure 7.2-5 shows the general appearance of the pilot on the recovery vessel.

Body weight had decreased by 4 lbs. 10 oz. Some of this was due to evaporation from the skin and from the respiratory tract, plus an unknown quantity of urine which was excreted but not collected.

The weight loss was greater than expected when compared to the weight loss encountered in Mercury-Redstone simulation runs in the centrifuge. However, this is consistent when the extra time spent in the capsule and the higher level pilot activity is taken into consideration.

Blood pressure was 118/58 mm Hg before the flight, 130/90 on the recovery ship, and 102/70 at the debriefing examination.

Compared with preflight studies, the exercise-tolerance test showed a delay in pulse-return to resting levels.

Skin: There was a slight redness over the scapulae (shoulders) noted in the post-flight examination. This was probably due to pressure-point effects from the couch and has been frequently encountered during centrifuge programs.

Lungs: Diminished breath sounds were noted at both bases posteriorly and subcrepitant rales (fine wheezing) cleared by coughing were heard in these same areas. Both changes were more pronounced on the right side. This finding is not believed to be of great significance in view of the prevalence of such rales following centrifuge experiences. Chest X-ray films taken at the debriefing site on the day of the flight and on the next day showed no significant change from preflight films.

Biochemical studies are not available at the time of reporting.

7.3 Pilot Performance

A set of in-flight activities were assigned to the pilot for the purpose both of investigating man's capability in space environment and providing a demonstration of several of the vehicle manual systems. These activities included four areas:

a. Capsule sequence monitoring, which involved the monitoring and override as required of 27 critical capsule functions.

b. Communications, which involved sending approximately 118 items of information to the ground by voice during the flight.

c. Attitude control, which involved maintaining the vehicle attitude within prescribed limits while performing 12 flight maneuvers during the flight.

d. External observations, which involved observing the earth through the periscope, and the stars and horizon through the window.

Astronaut Shepard had been through 120 simulated Mercury-Redstone flights on the Mercury Procedures Trainer prior to the MR-3 flight. During this training the activity program mentioned above was developed and practiced. He had received 10 simulated flights on the AMAL Centrifuge during October 1960 and 2 refresher runs in April of 1961.

Figure 7.3-1 summarizes the records obtained of the pilot's activities during the flight. From top to bottom are presented respiration rate, pulse rate, pitch, yaw and roll attitude and stick position, control mode in use, acceleration, voice reports, major capsule events and time.

7.3.1 Vehicle Sequence Monitoring

All the 27 major capsule events appear to have been monitored by the pilot. Twenty-one items were confirmed via the voice link. The pilot manually activated the retro-jettison switch when the green light failed to come on. He also switched on the rescue aids after impact as provided for in the standard operating procedure. The pilot's scan pattern, as shown from the onboard pilot-observer camera film, was good throughout the flight. He appeared to be alert at all times.

7.3.2 Voice Communications

During the flight the astronaut made 78 communications to the ground. The communications transcript is given in Figure 7.3-2 and is keyed by number to Figure 7.3-1. The voice procedures, timing, phraseology, and information content were quite similar to those used in the procedures trainer.

7.3.3 Attitude Control

The attitude control activities of the pilot are summarized in Figure 7.3-1. In this figure can be seen most of the 12 major maneuvers which were planned. The first attitude maneuver, marked (A) on the figure, was performed on manual-proportional control pitch only, with yaw and roll being controlled by the ASCS. This maneuver was performed essentially as on the Mercury Procedures Trainer, though with a somewhat lower rate and attitude change.

Next, a left-yaw maneuver, (B) on the figure, was performed on manual-proportional control with the ASCS controlling the roll only. This maneuver was also performed essentially as on the trainer. The third maneuver was a roll maneuver (C) accomplished under manual control in all three axes. Since the roll was already diverging, the maneuver consisted of bringing roll back to zero.

Following this roll maneuver, the pilot shifted to periscope reference. Manual control in yaw and roll on periscope reference was reasonable. During this period on the periscope in which the pilot was describing his view of the earth, control in pitch was not as well maintained. Following this he had planned to make a maneuver in yaw using the periscope view as a reference. Because of the shortage of time, he made only a few small yaw adjustments (D) at this point to observe the shift in yaw reference.

Following retro-sequence command[1], the pilot pitched toward retro-attitude on manual-proportional control but stopped at orbit attitude. After firing of the first retro-rocket he continued to pitch to retro-attitude but failed to achieve the desired -34° value. The departure of the retro-attitude from the desired can be explained on the basis of a misunderstanding of the retro-attitude setting on the pitch indicator. The pilot did not realize that the pitch attitude had been changed from the original -43° setting to the correct -34° attitude setting. For this reason, he was attempting to maintain a -34° attitude during retro-fire by keeping the pitch indicator needle slightly displaced above the marking at the nine o'clock position to the approximate location of what he thought to be the -34° point. He did not know that he was actually striving to maintain an attitude of 9 degrees less than the -34° attitude, or -25°.

During the retro-fire period (F), the pilot's attitude control performance was good and similar to that displayed on the simulator. He reported that maintaining attitude during retro-fire involved approximately the same level of difficulty in flight as in the Mercury Procedures Trainer.

Following the retro-fire period, the pilot reported switching to fly-by-wire mode. It is believed he

[1] Because the attitude permission circuitry has been bypassed, the retro-attitude telelight showed green. However, in this flight, this did not mean that retro-attitude had been attained as in the Procedures Trainer. The pilot reported the green telelight on the voice link.

was in a combination of fly-by-wire mode and manual-proportional mode as explained in Section 5.2.1. Because of the similarity of operation of the capsule in these two modes, the pilot was not aware that he was not in pure fly-by-wire mode.

Since the capsule was deviating from retro-attitude, he made an unscheduled maneuver to correct for pitch. Next a left-roll maneuver (G) was performed as scheduled. The rate with which this maneuver was performed was high. A yaw maneuver was also scheduled. This maneuver was delayed and left incomplete (H) due to the distraction presumably produced by the malfunction of the retro-jettison sequence light. The next attitude maneuver (I) was to pitch from retro-attitude to reentry attitude. This maneuver was accomplished smoothly though at a higher rate than in the simulator. The pilot leveled off at +40° pitch with greater accuracy than generally shown in the simulator. At this point he returned to ASCS mode. It was intended in the flight plan for the pilot to take over manual-proportional control prior to .05g and insert the roll rate (J) which is used during the reentry period to cut down landing point dispersion. However, he took considerable time to attempt to look for stars through the window and the reentry maneuver was started by the autopilot before he took over manual control. According to the pilot's debriefing and the telemetry records, he did put in some stick inputs in an attempt at rate damping during the reentry g build-up. The records indicated that these stick inputs had little, if any, effect on the oscillation rate of the capsule.

During reentry it was apparant that the pitch hand control, which was not mass-balanced in this capsule, moved in the positive direction, presumably due to g loading.

Thus, all of the 12 major maneuvers planned for the flight were attempted in some form with the exception of the insertion of the reentry roll rate. The control system satisfactorily responded to pilot inputs.

7.3.4 External Observations

The pilot observed the earth through the periscope from 03:59 to approximately 04:44. During this time he was able to verify that the view through the scope was approximately as described in his preflight briefing. He was not able to define the extent of the periscope coverage with precision because clouds covered the eastern and Gulf coasts above Florida. Despite the use of the gray filter, he was able to easily distinguish between land, water, and cloud formations. Preselected large targets such as Tampa Bay, Okeechobee, and Andros Island were visible. He was able to confirm the accuracy of the cloud cover map prepared for his preflight weather briefing. The pilot attempted to view stars out the window between 07:14 and 07:48. He was unable to see any stars. However: (1) His eyes were not dark-adapted since the cabin lights were on full white light, and there was some glare from the sun along the edge of the window, and (2) at the time of these observations the best targets (the moon and Jupiter) which would have been in a good position earlier in the morning, were not visible through the window. The pilot devoted, as would be expected, more time to external observations during the flight than on trainer runs. This reduced the time available for other activities and accounts for the short-cutting of some of the attitude maneuvers.

7.4 Interpretations and Conclusions

The five minutes of weightlessness posed no apparent problem for the pilot on this flight. He experienced no unexpected physiological sensations at any time during the flight. His physiological reactions and performance throughout the flight were within the limits anticipated from training experience. The training program appeared, both from the pilot's report and from his performance during the flight, to have been satisfactory for this ballistic mission. The pilot successfully performed a large number of tasks and observations during the flight.

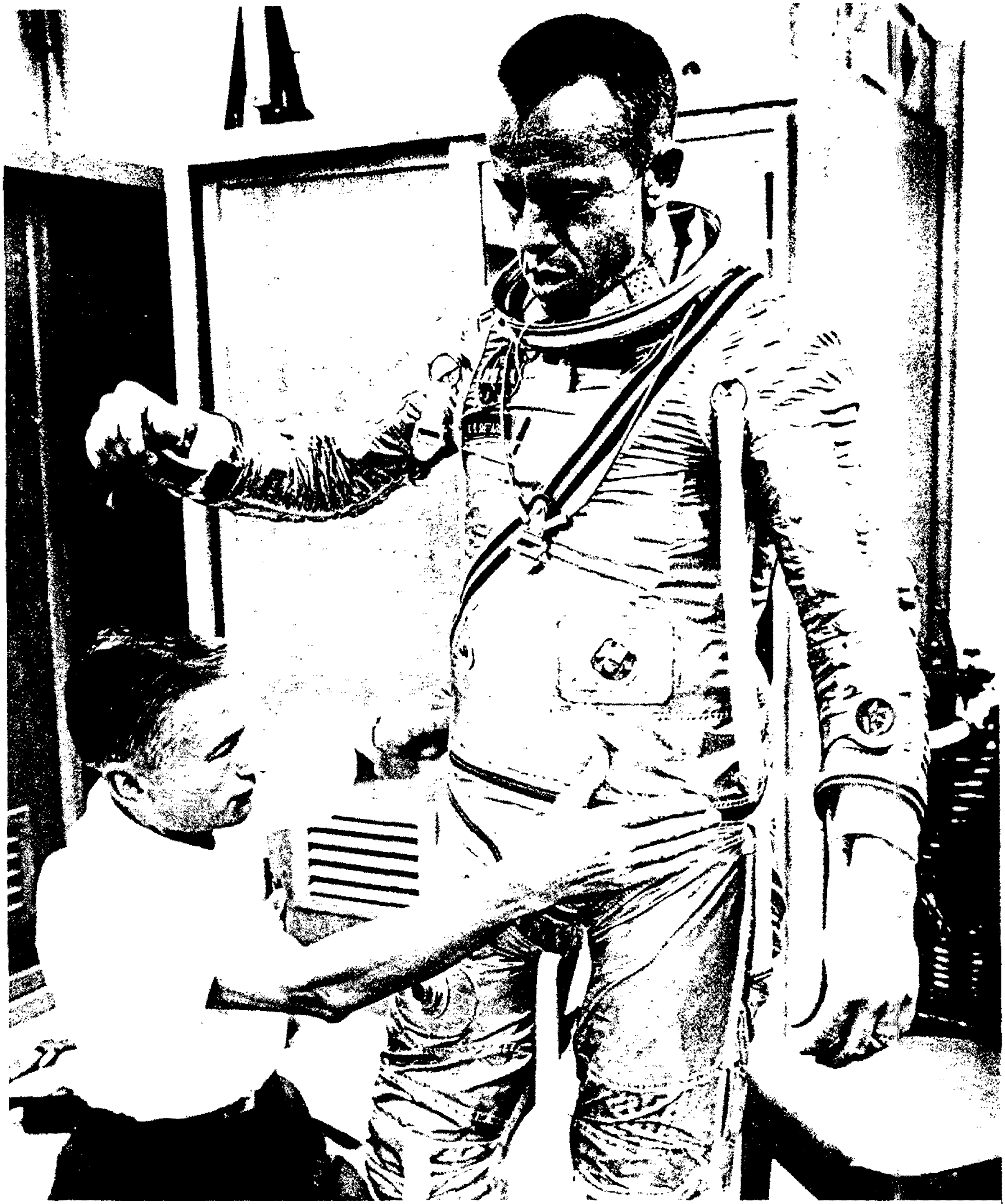
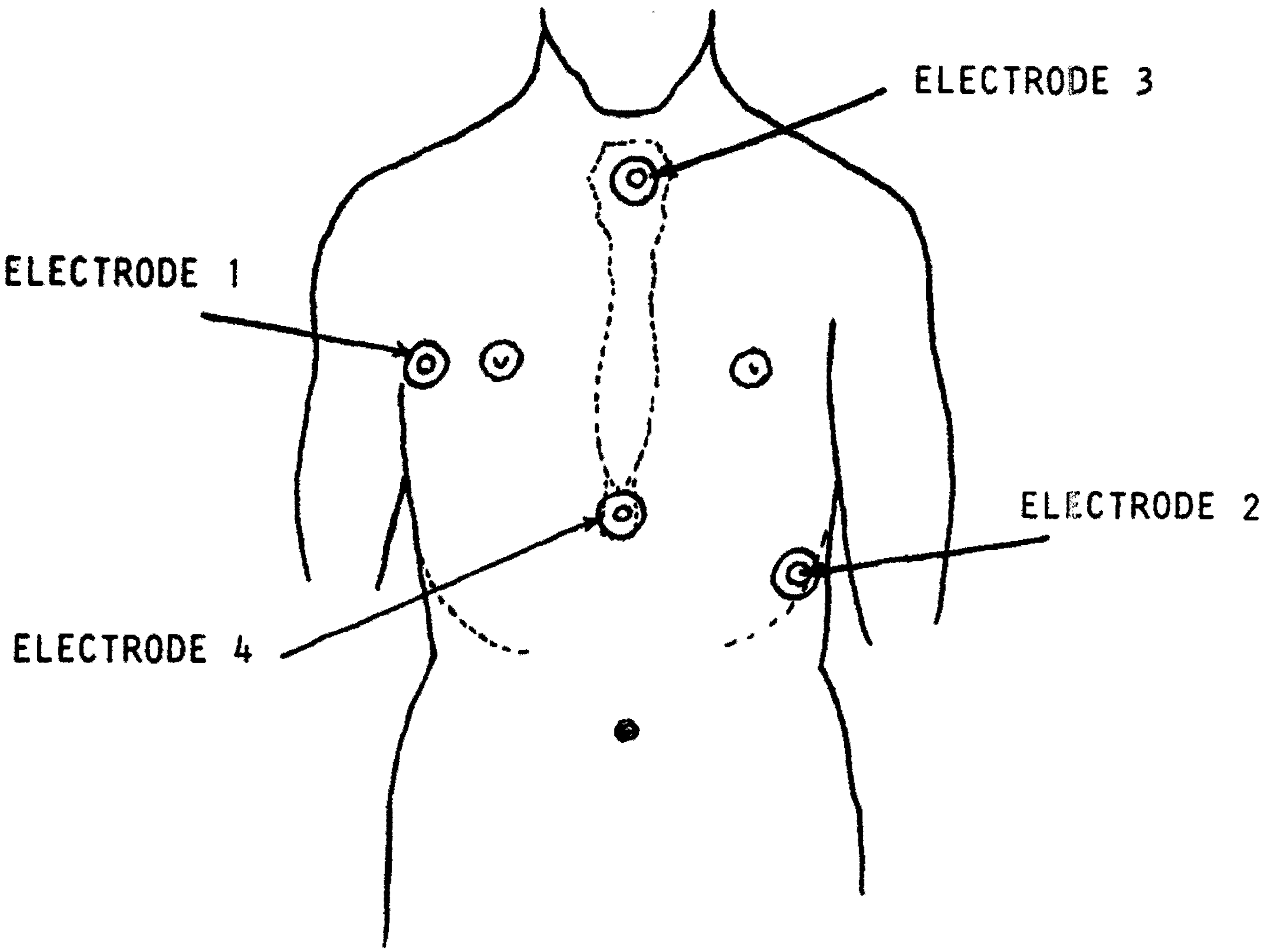


FIGURE 7.0-1 - PILOT PREPARATION DURING THE MORNING OF THE FLIGHT

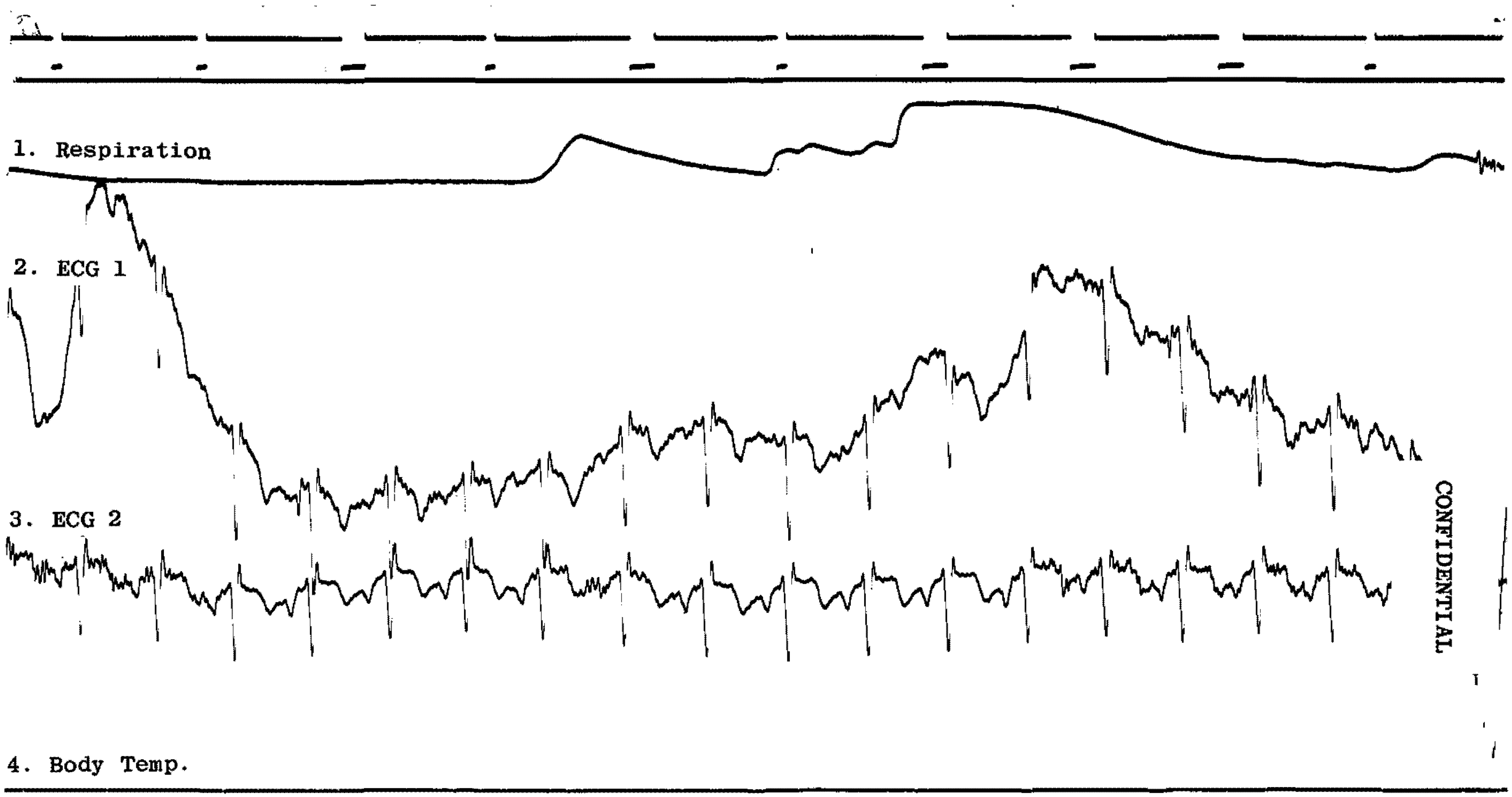


MONITORING DATA

LEAD 1 = ELECTRODES 1 & 2 = AXILLARY LEAD

LEAD 2 = ELECTRODES 3 & 4 = STERNAL LEAD

FIGURE 7.2-1 - FRONT VIEW SHOWING PLACEMENT OF ECG ELECTRODES



Notes:

1. The respiration trace shows small amplitude displacements in the center typical of change with speech.

2. ECG 1 shows typical base line shifts encountered on this flight. (ECG traces appear inverted due to recording reversal.)

3. ECG 2 (sternal) shows occasional ripples of muscle (movement) interference.

FIGURE 7.2-2 - SAMPLE OF TELEMETERED BIOLOGICAL RECORD OBTAINED DURING THE FLIGHT.

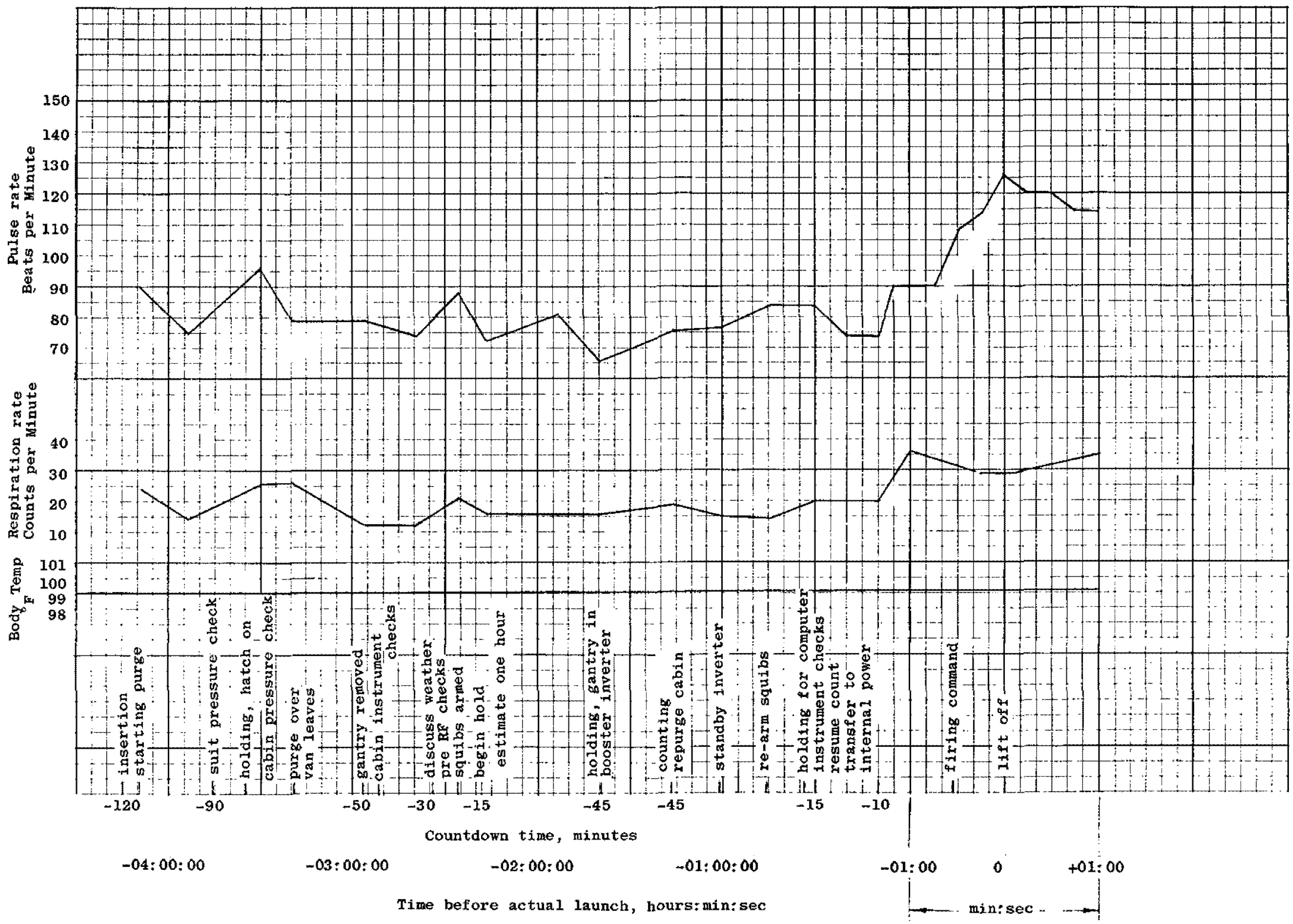


FIGURE 7.2-3 - TIME HISTORY OF PILOT PHYSIOLOGICAL DATA DURING COUNTDOWN, SHOWN CORRELATED WITH MAJOR EVENTS.

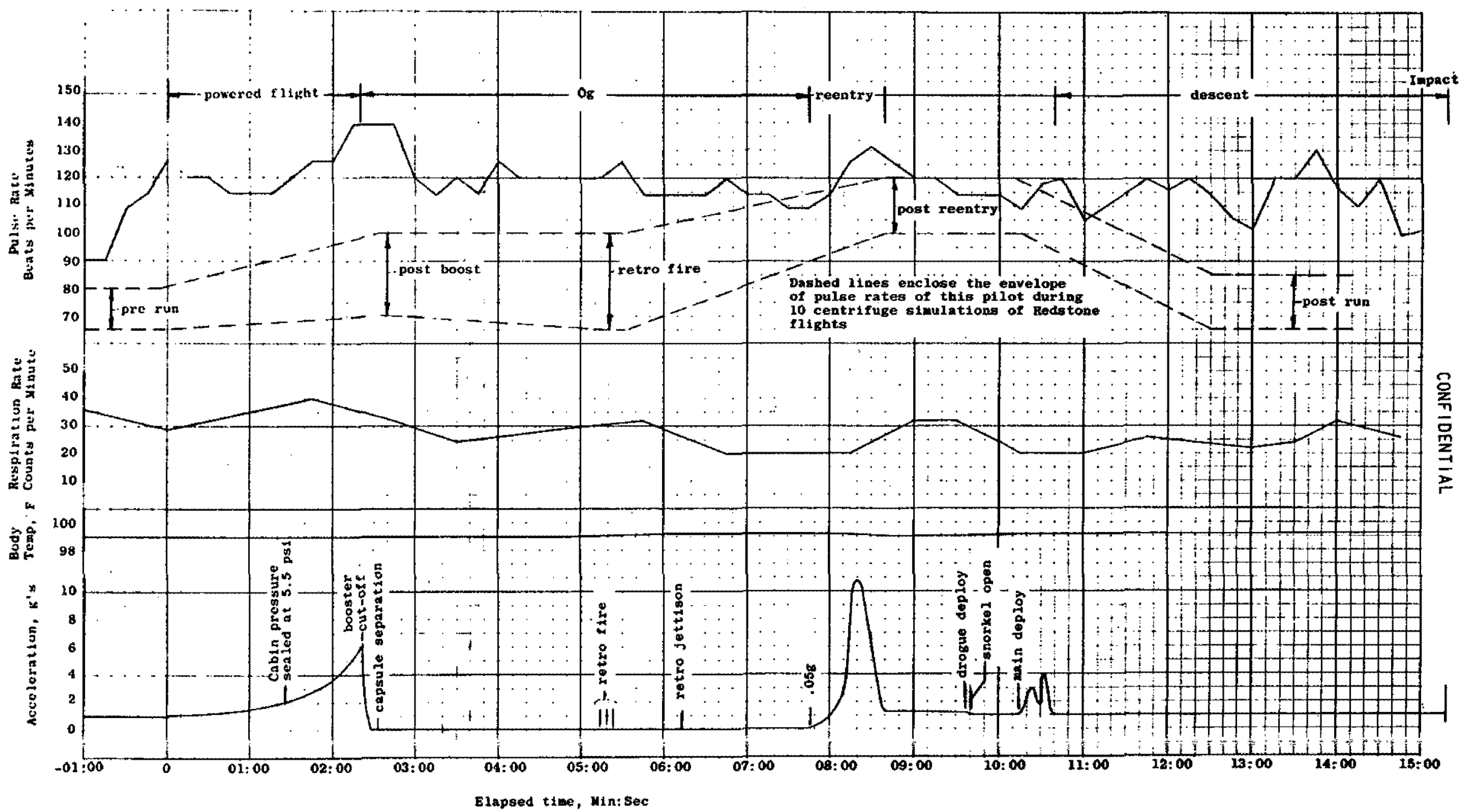


FIGURE 7.2-4 - TIME HISTORY OF PILOT PHYSIOLOGICAL DATA DURING FLIGHT, SHOWN CORRELATED WITH MAJOR EVENTS AND PREVIOUS CENTRIFUGE DATA.

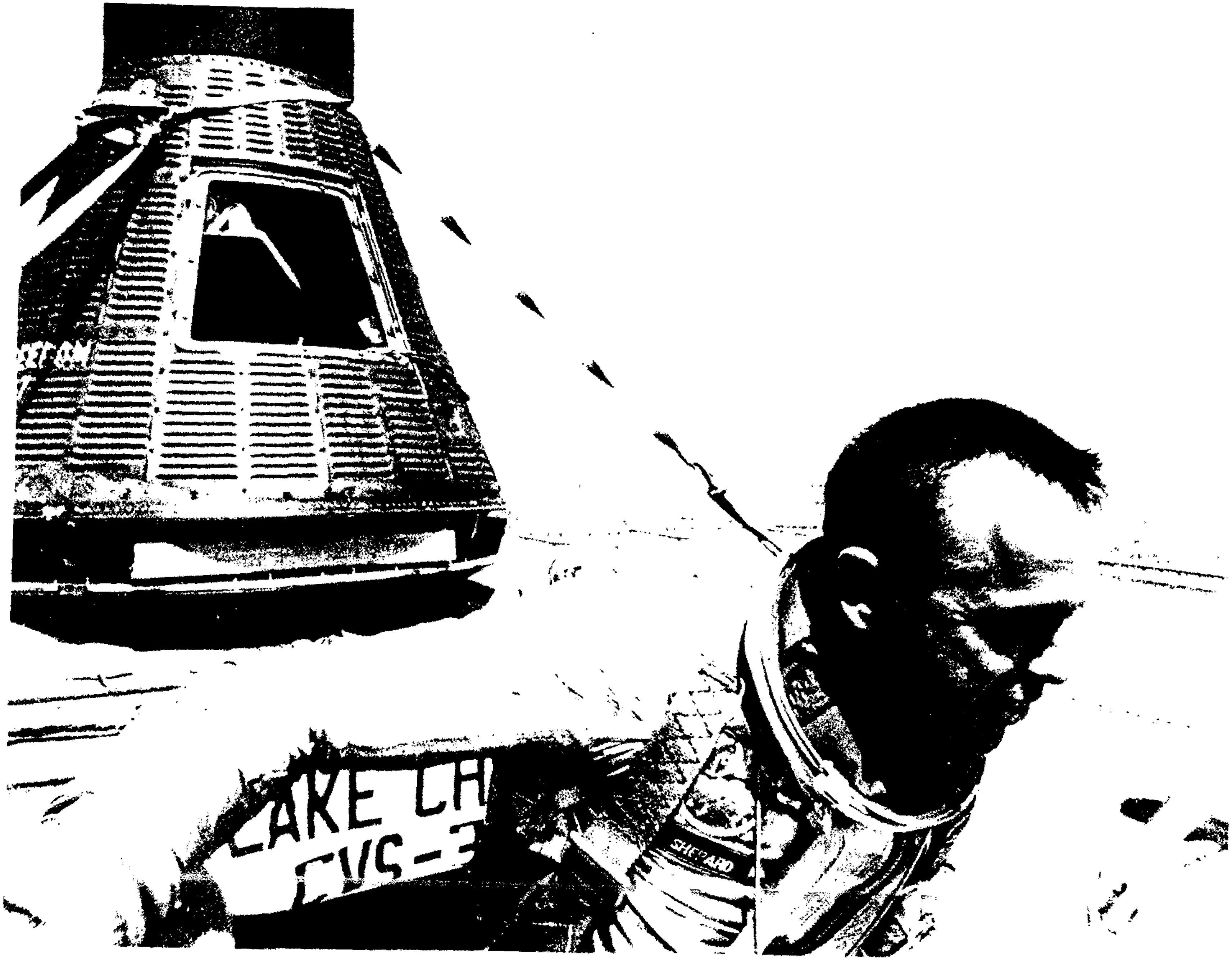


FIGURE 7.2-5 - PHOTOGRAPH OF PILOT ON THE RECOVERY VESSEL.

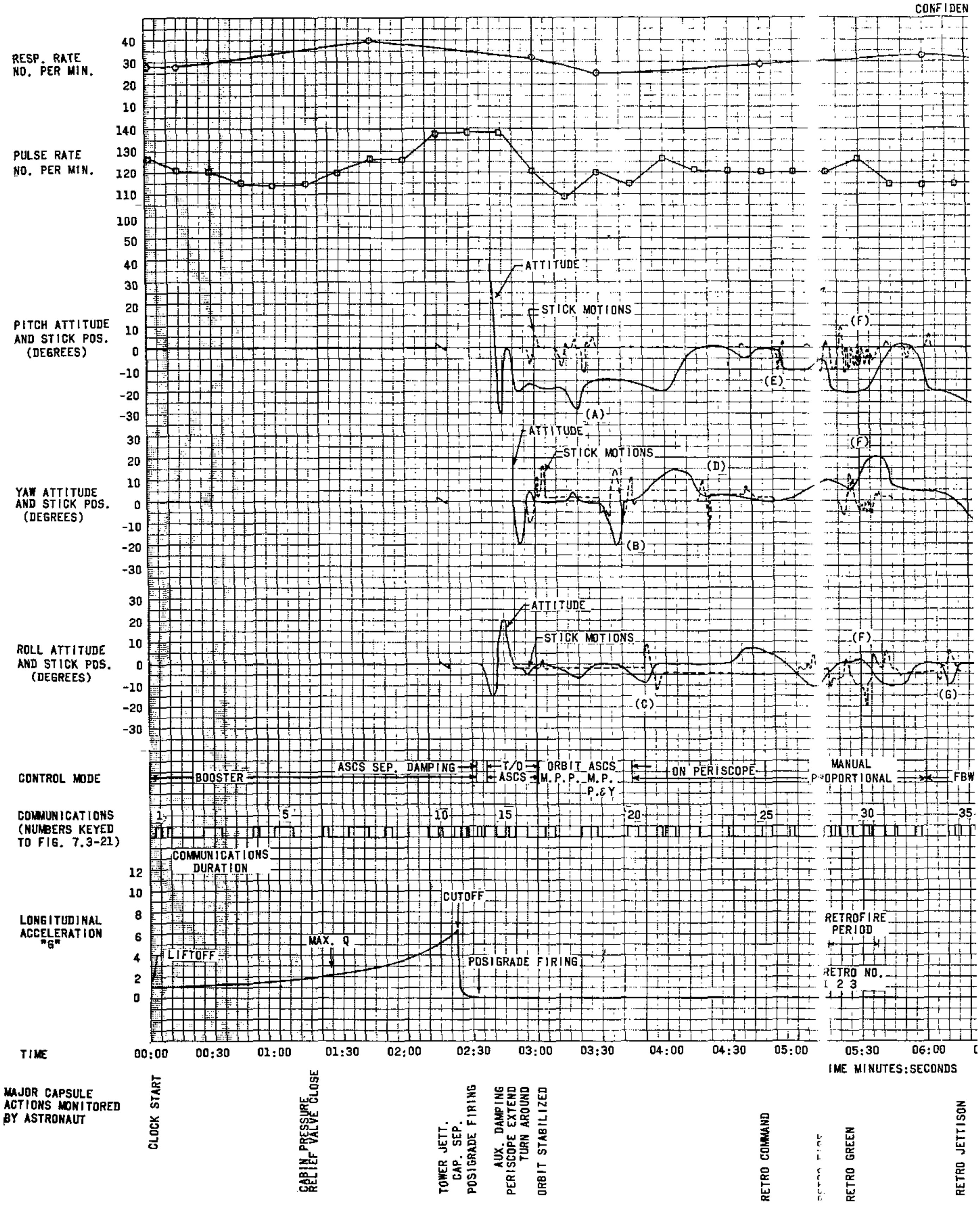


FIGURE 7.3-1.- CORRELATION OF PILOT CONTROL ACTIONS, COMMUNICATION, PHYSIOLOGICAL FUNCTIONS AND MISSION EVENTS.

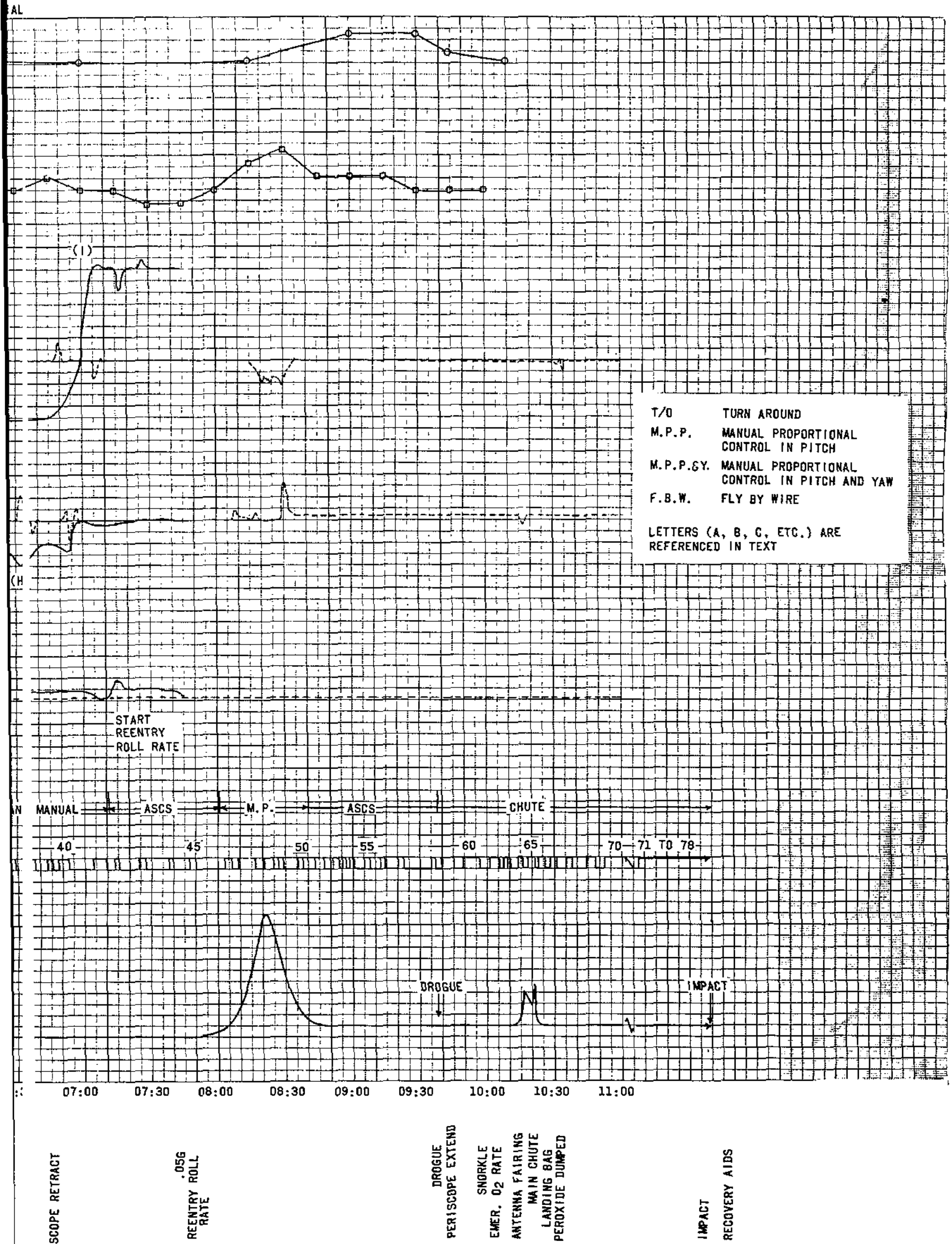

T/O TURN AROUND
M.P.P. MANUAL PROPORTIONAL CONTROL IN PITCH
M.P.P.&Y. MANUAL PROPORTIONAL CONTROL IN PITCH AND YAW
F.B.W. FLY BY WIRE
LETTERS (A, B, C, ETC.) ARE REFERENCED IN TEXT
START REENTRY ROLL RATE
MANUAL
ASCS
M.P.
ASCS
CHUTE
40
45
50
55
60
65
70
71 TO 78
DROGUE
IMPACT
07:00
07:30
08:00
08:30
09:00
09:30
10:00
10:30
11:00
SCOPE RETRACT
.05G
REENTRY ROLL RATE
DROGUE
PERISCOPE EXTEND
SNORKLE
EMER. O2 RATE
ANTENNA FAIRING
MAIN CHUTE
LANDING BAG
PEROXIDE DUMPED
IMPACT
RECOVERY AIDS

FIGURE 7.3-2 PILOT VOICE COMMUNICATIONS DURING MR-3 FLIGHT

NUMBER	TIME MIN:SEC	DURATION SECONDS	VOICE
1	00:02.3	3	Ahh, Roger; lift-off and the clock is started
2	00:08.3	2	Yes sir, reading you loud and clear
3	00:25.5	8.5	This is Freedom Seven. The fuel is go, 1.2 g, cabin at 14 psi, oxygen is go
4	00:48.5	2.5	Freedom Seven is still go
5	00:58.5	8.5	This is Seven. Fuel is go, 1.8 g, 8 psi cabin, and the oxygen is go
6	01:21.5	2.6	Cabin pressure is holding at 5.5. Cabin holding at 5.5
7	01:33	10	Fuel is go, 2.5 g, cabin 5.5, oxygen is go, the main bus 24, and the isolated battery is 29
8	01:50.5	3	Okay, it's a lot smoother now. A lot smoother
9	02:01	9	Seven here. Fuel is go, 4 g, 5.5 cabin, oxygen go, all systems go
10	02:15	1.5	5 g
11	02:22	2.5	Cut-off. Tower jettison green
12	02:27.5	1.5	Disarm
13	02:32.5	2	Capsule separation is green
14	02:35.5	6	Periscope is coming out and the turn-around has started
15	02:50	3	ASCS is okay
16	02:53.5	2.5	Control movements

FIGURE 7.3-2 (Cont'd)

NUMBER	TIME MIN:SEC	DURATION SECONDS	VOICE
17	03:04	4.5	Okay, switching to manual pitch
18	03:21	2.5	Pitch is okay
19	03:24	4.5	Switching to manual yaw
20	03:42	5	Yaw is okay. Switching to manual roll
21	03:55.5	2.5	Roll is okay
22	03:59.5	4.5	On the periscope. What a beautiful view
23	04:05.5	9.5	Cloud cover over Florida. 3 to 4 tenths near the eastern coast. Obscured up to Hatteras
24	04:20.5	8.5	I can see Okeechobee. Identify Andros Island Identify the Reefs
25	04:44.5	4	Start retro-sequence. Retro-attitude on green
26	04:56.5	2.5	Control is smooth
27	05:13	3	Retro one, very smooth
28	05:16.5	1.5	Retro two
29	05:23.5	2.5	Retro three
30	05:31	2.5	All three retros are fired
31	05:35	6	Okay. Three retros have fired. Retro-jettison is back to arm.
32	05:45.5	1.5	Negative
33	05:55	3	Switching to fly-by-wire
34	06:11	2.5	Roll is okay

FIGURE 7.3-2 (Cont'd)

NUMBER	TIME MIN:SEC	DURATION SECONDS	VOICE
35	06:16.5	4.5	Roger; do not have a light
36	06:25	6	I do not have a light. I see the straps falling away. I heard a noise. I will use override
37	06:30.5	3	Override used, the light is green
38	06:36.5	2	Ahh, Roger
39	06:44.5	2	Periscope is retracting
40	06:49	4.5	I'm on FBW. Going to re-entry attitude
41	07:04.5	6	Okay, Buster. Re-entry attitude, switching to ASCS normal
42	07:14	2	ASCS is okay
43	07:25	3	Switching HF for radio check
44	07:39		Ahh, Roger, reading you loud and clear HF, Deke. How me?[1]
45	07:48		Ahh, Reading you loud and clear HF, How me?[1]
46	08:04	3	Okay. This is Freedom Seven
47	08:10	7.5	"G" build-up 3, 6, 9
48	08:21	4	Okay - Okay
49	08:27.5	2	Okay
50	08:36.5	2	Okay
51	08:44	4	This is Seven - Okay

[1] HF was not received.

FIGURE 7.3-2 (Cont'd)

NUMBER	TIME MIN:SEC	DURATION SECONDS	VOICE
52	08:51	3	45,000 feet now
53	08:56	1.5	40,000 feet
54	08:58	4	I'm back on ASCS
55	09:05	2	35,000 feet
56	09:14	2	30,000 feet
57	09:20	6	Ahh, Roger, Deke, reading you loud and clear. How me?
58	09:35	1	Ahh, Roger
59	09:39	6	The drogue is green at 21,000. The periscope is out. The drogue is out.
60	09:48	8	Okay at drogue deploy. I've got 70 percent auto - 90 percent manual. Oxygen is still okay
61	10:02	4	And the snorkels (out) at about 15,000 feet
62	10:06	2	Emergency flow rate is on
63	10:08	2	Standing by for main
64	10:15	2	Main on green
65	10:18	2	Main chute is reefed
66	10:22	4	Main chute is green. Main chute is coming unreefed and it looks good
67	10:28	4	Main chute is good. Rate of descent is reading about 35 ft/sec.
68	10:40	2	Hello Cap Com. Freedom Seven How do you read?

FIGURE 7.3-2 (Cont'd)

NUMBER	TIME MIN:SEC	DURATION SECONDS	VOICE
69	10:55	3	Hello CARDFILE 23, this is Freedom Seven. Do you read?
70	11:03	14	Affirmative Indian Cap Com. let me give you a report. I'm at 7,000 feet, the main chute is good, the landing bag is on green, my peroxide has dumped, my condition is good
71	11:29	2	That is affirmative -- please relay
72	12:36	3	Hello CARDFILE 23, CARDFILE 23, Freedom Seven. Over.
73	12:49	13	Ahh, this is Seven. Relay back to Cap Com please. My altitude now 4,000 feet, condition as before, the main chute is good, the landing bag has deployed, the peroxide has dumped
74	14:03	3	Ahh, CARDFILE 23, Freedom Seven
75	14:09	5	I'm about 1,500 feet now. The main chute still looks good. The rate of descent is indicating 30 ft/sec.
76	14:52	1	Ahh, Roger
77	14:59	3	This is Seven. Go ahead
78	15:05	4	Negative. Just relaying my condition is still good. I'm getting ready for impact
	15:22		(Landing)

8.0 FLIGHT CONTROL AND NETWORK OPERATIONS

The performance of the flight control team and network necessary to support the flight control of the MR-3 mission was good and in most cases adequate to allow an evaluation of the flight in real time. The flight was normal in all respects as far as flight control was concerned. No ground commands or emergency procedures were required.

8.1 Trajectory Displays and Computer Operation

The trajectory of MR-3, displayed in real time, showed very good agreement with nominal values. A deviation of approximately -1° in flight path angle was noted between 01:10 and 01:50. The MR-BD flight showed the same characteristic, indicating an increase in the pitch program during this period.

During the countdown all trajectory checks indicated the Goddard computers and associated equipment to be satisfactory. However, at -15:00 a hold was called because the program in the IP-709 computer was found to be in error. It was discovered at this time that because of the higher sampling rate of the Mark II AZUSA that the output of the IP-709 and the Mercury Buffer transmitting data to the Goddard computers were not compatible. A program change was introduced in the IP-709 computer by the AMR IP-709 operators. Because past experience has shown that program changes often result in erroneous trajectory displays, it was necessary to rerun a computer check through the entire computer and data transmission system. This caused a further hold in the countdown.

The predicted impact point was obtained in real time from the Goddard computer and was within about one minute of latitude and two minutes of longitude of the point at which the recovery forces retrieved the capsule.

The retro-fire controller's displays functioned properly after lift-off, and signals from the interim clock were satisfactorily received.

8.2 Telemetered Data and Real Time Displays

The telemetered data presented to the flight controllers was of excellent quality and allowed complete evaluation of the quantities required for this mission.

The mission events sequence panel and telemetered events to the Goddard computer were operated manually, using the events monitor panel in the support area. The one to two second delay using this procedure is acceptable for the Mercury-Redstone mission.

8.3 Communications

8.3.1 Ground Communications

Both teletype and voice communications with the Indian Ocean Ship, which was located about 7 miles north of the planned landing area for this flight, were unreliable during the prelaunch period. However, during launch they were satisfactory.

The Mercury Control Center-NASA net to the Capsule Test Conductor was at times very weak, possibly due to tying the MOPIS system and the blockhouse sound-powered system together. All other ground communications were satisfactory.

8.3.2 Capsule Communications

Capsule voice communications were generally satisfactory with some exceptions. No HF was received from the capsule by Mercury Control Center. The low power UHF transmitter was not exercised. The aircraft relay system gave intermittent and unsatisfactory communications.

8.4 Use of Other Mercury Network Facilities

The Indian Ocean Ship actively participated in this mission. Three flight controllers were onboard to provide real time telemetry readout and back-up voice transmission to the pilot during the re-entry and landing phases.

The Atlantic Ocean Ship passively monitored this flight and was located 2 to 3 miles off shore from Cape Canaveral. The Bermuda Station also passively monitored the flight.

Acquisition times for the various ground systems are given in the Appendix (Section 10.5.1).

9.0 RECOVERY

9.1 Recovery Plans

Recovery forces were positioned for the MR-3 flight as shown in Figure 9.1-1. Aircraft provided the primary capability for detail location through the use of electronic direction-finding equipment. Helicopters operating from the aircraft carrier Lake Champlain, and a destroyer provided the downrange capability for retrieval. Launch-site recovery forces were on-station to support possible landings in the launch-site area.

All recovery units were on their assigned stations at the time of launch.

9.2 Recovery Operation

The recovery operation was excellent; the pilot was recovered by helicopter and deposited onboard the aircraft carrier Lake Champlain 11 minutes after capsule landing.

Sighting of the capsule descending on the main chute was made by airborne helicopters and the Lake Champlain at +12 minutes. Capsule landing was made at +15 minutes, and a helicopter hooked onto the capsule at +17 minutes. The helicopter partially lifted the capsule, and pilot egress was made through the side hatch. After donning the personnel "horsecollar" which had been lowered, the pilot was lifted into the helicopter by the personnel hoist as shown in Figure 9.2-1. One minute after pilot egress, the capsule was lifted from the water (Figure 9.2-2), and both the capsule and pilot were ferried to the Lake Champlain.

Adequate countdown information was received by the recovery forces. They were informed of satisfactory booster flight approximately 3 minutes after lift-off. The calculated landing position was sent to them approximately 5 miles northeast of the primary position (see Figure 9.2-1). The Lake Champlain was thereby able to head to the landing point and sighted the descending capsule 4 miles off the port bow at +12 minutes.

9.3 Observations

The explosively-actuated telescoping HF recovery antenna erected after helicopter hook-onto the capsule but prior to pilot egress. The activation time was normal; the helicopter moved into recovery position earlier than planned. The helicopter pilot observed only a 10-foot length of the antenna rather than the normal 16 feet. Later inspection showed the last 6 feet had probably been blown off at erection. There was no evidence of this section striking the helicopter. The remaining 10-foot section was not cut off by the helicopter crew and caused no difficulty in recovery.

Observation of the capsule before it was placed on the ship showed that the heat sink, landing bag fabric, steel straps supporting the heat sink, and the capsule interior appeared to be in excellent condition. The recovery light was flashing and the dye marker canister still attached. The entrance hatch was missing. No water was found within the capsule. Both windows were covered with moisture. The periscope was extended. (For details of a later post-flight inspection, see Section 10.1, in the Appendix.)

9.4 Post-Recovery Handling

After carrying out post-recovery procedures, the capsule was delivered to the Cape Canaveral skid strip by helicopter the following morning. Further transport to Hangar "S" was made by a LARC vehicle.

9.5 Performance of Recovery Aids

The recovery aids performed as intended. Approximately 2 minutes after capsule landing, voice communications between the pilot and helicopter were established. There was no time for HF fix, and none was attempted. The explosion of the SOFAR bomb which was ejected at main chute deployment gave a fix which was within 6 nautical miles of the actual point of impact. This is considered satisfactory.

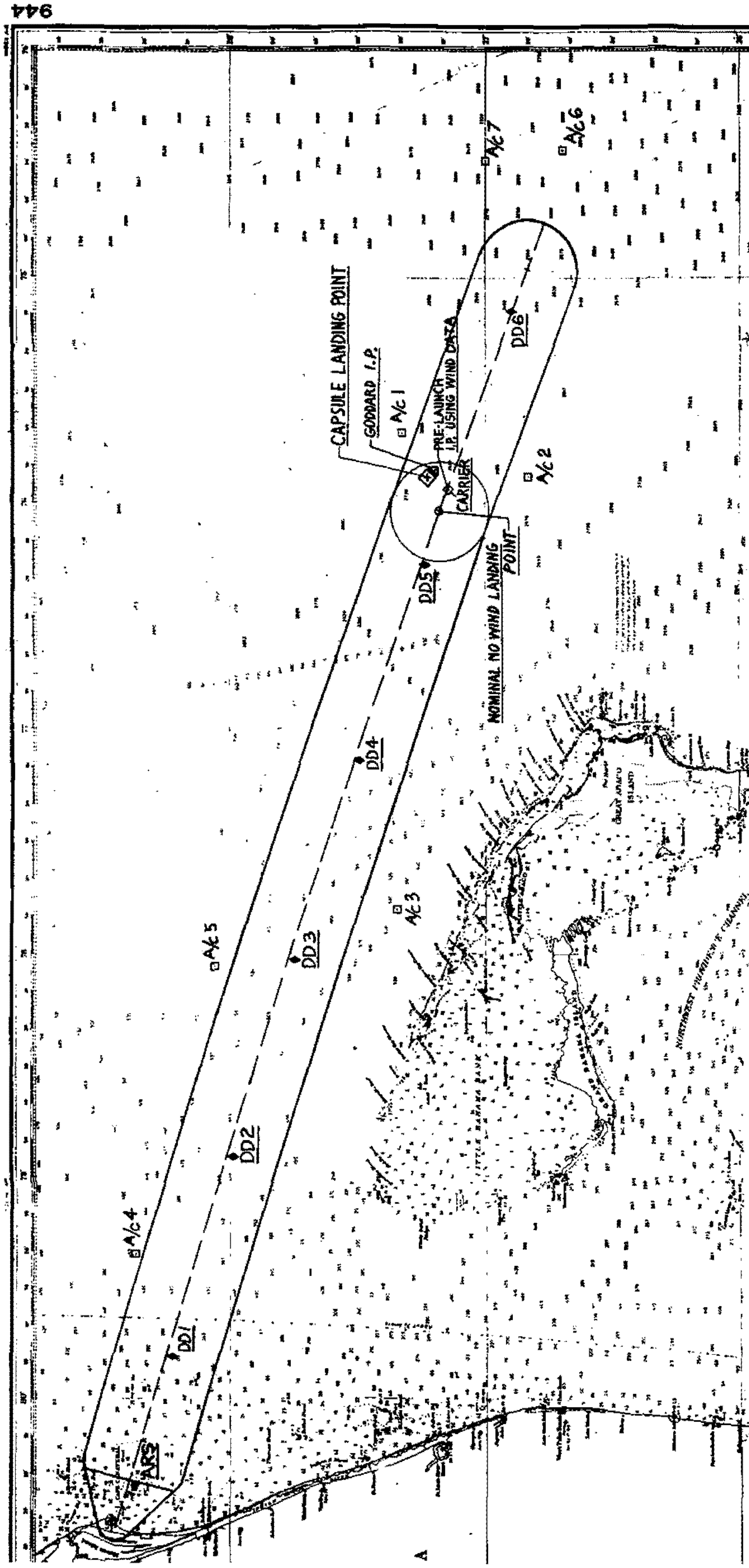


FIGURE 9.1-1 CHART OF RECOVERY OPERATIONS

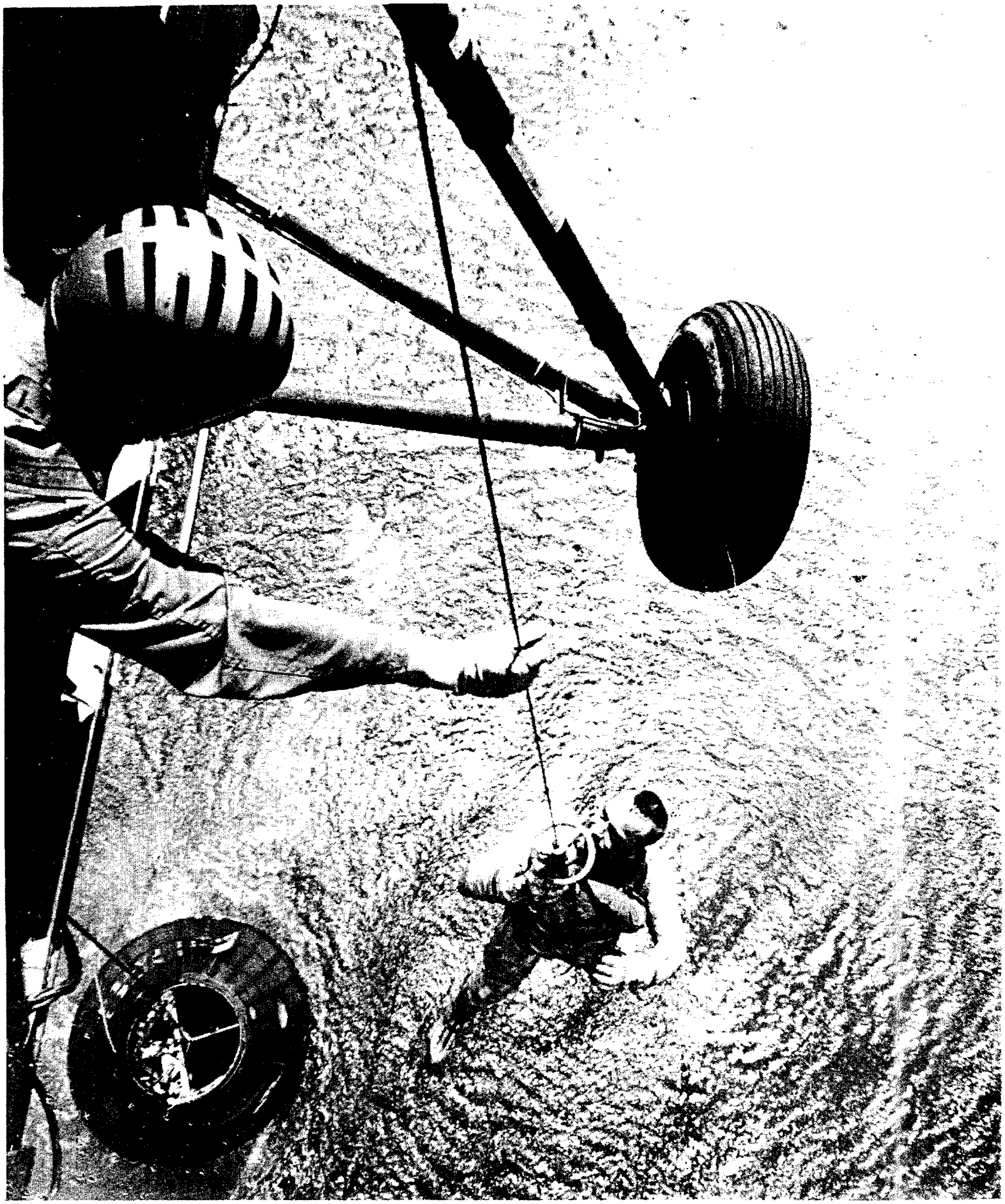


FIGURE 9.2-1 ASTRONAUT SHEPARD BEING HOISTED ABOARD THE HELICOPTER

FIGURE 9.2-2 CAPSULE 7 BEING LIFTED BY HELICOPTER

10.0 APPENDIX

10.1 Capsule Post-Flight Inspection

10.1.1 Structure

Post-flight inspection of the capsule showed it to be in excellent condition with the following exceptions:

a. The entrance hatch was missing. Although the cable was properly attached to the capsule by the pilot, the crimped metal clip on the lower end of the cable had been closed over the plastic sheath rather than over the cable, and had allowed the cable to pull out.

b. The upper 6-foot portion of the telescopic whip antenna was missing and had apparently been ejected when the antenna was extended (see Section 9.0). The remaining portion of the antenna had been severed from the capsule by the recovery ship crew.

c. The fiberglass shield beneath the large pressure bulkhead had one hole punched in it at stringer no. 18, apparently by one of the heat sink studs. One heat-sink release mechanism stud on the outer perimeter of the heat sink was bent, also at stringer no. 18.

d. The landing bag was torn in several areas. This is believed to have been done in handling, rather than at landing. One heat-sink retaining cable was crushed locally, but not cut. One of the stainless steel straps was extended by ½ inch.

e. One external shingle slipped approximately 1/16 inch and rode hard on the side of the capsule-adapter clamp ring limit switch plunger between stringers no. 1 and 23.

f. The lens on the flashing beacon was cracked. It is believed that this probably occurred during post-launch handling operations.

g. The phenolic capsule-adapter joint ring at Z=104.5 was chipped locally near stringer no. 21. This appears to have been damaged by the hatch as it was released and dropped from its installed position during post-impact egress.

h. The pilot-couch honeycomb was not compressed.

i. The pull-ring on the tower-jettison emergency control initiator was noticed to be in the "pulled-out" position. Upon examination this initiator was found to have been fired by the action of pulling the ring.

j. There was considerable corrosion where dissimilar metals were in direct contact -- e.g., lead ballast on beryllium heat sink and aluminum washers on titanium bolts on large pressure bulkhead.

10.1.2 Capsule Switch and Control Positions

Figure 10.1-1 shows the switch and control positions which were recorded on the recovery ship at +7 hours, except as noted.

10.2 Launch Operations

The MR-3 launching was originally scheduled for seven o'clock on the morning of May 2, 1961. However, because of capsule telemetry problems and unsatisfactory weather conditions, the effort was called off after several holds at T-140. The launching was rescheduled for the morning of May 5, 1961, at seven o'clock. The vehicle was successfully launched in the second attempt at 0934 hours EST.

The launch procedure was arranged with a split countdown. The countdown started at -640 minutes on the morning preceding the launch. A planned hold of approximately 15 hours was called at -390 minutes. The 15-hour hold was used to accomplish pyrotechnic and hydrogen-peroxide servicing. In order to reduce the time slippage past the scheduled launch time of seven o'clock, a second planned hold of one hour was allowed for at -140 minutes which is shortly before pilot insertion. Therefore the countdown was resumed at -390 minutes on the night of May 4, 1961, at thirty minutes after eleven o'clock.

Several holds occurred during the second part of the count. The first of these, one of ten minutes duration, was at -265 minutes. This hold in the countdown was necessary to complete work preparatory to making RF checks with the gantry removed. At -140 minutes a scheduled hold of fifty minutes realigned the countdown with the scheduled launch time. These fifty minutes were profitably used to complete mechanical work which would have necessitated a hold even if one had not been planned. A third hold, one of about twenty minutes duration, came at about -120 minutes to complete preparations for pilot insertion. The delay was caused in part by the excessive number of people on the third level of the service structure. The next hold was at -80 minutes which lasted seven minutes. This hold allowed capsule processing to be realigned with the countdown time. Pad Safety found it necessary to hold for one minute to clear excessive personnel from the pad area at -30 minutes. At -15 minutes a hold was initiated because clouds precluded acquiring the required photographic coverage. During this hold for weather conditions the booster developed a power supply problem and an inverter had to be replaced. The total hold time for these two conditions was eighty-six minutes. The countdown was recycled to -35 minutes at the end of the hold. It became necessary to hold again at -15 minutes for an IP-709 program check which required seventeen minutes. The last interruption in the countdown occurred at -2 minutes caused by an increase in pressure reading on the propulsion regulator (H_2O_2 tank pressure regulating valve). The pressure was alleviated by cycling the vent valve from the blockhouse. The hold lasted one minute.

The total hold time after the planned one-hour hold caused the launch to occur two hours and thirty-four minutes after the scheduled time.

10.3 Weather Conditions

The weather conditions in the launch area at time of lift-off were as follows:

Cloud cover	1/10 cumulus
Visibility	10 miles
Surface winds	12 knots
Waves	1 foot

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

Landing area weather conditions were as follows:

Cloud cover	Clear
Visibility	Unlimited
Surface winds	12 knots
Waves	2 feet

10.4 Capsule History

Figure 10.4-1 presents a bar chart showing the significant preflight preparation periods following manufacture of Capsule 7. As the chart shows, the capsule was delivered to Hangar "S" at Cape Canaveral on December 9, 1960.

Upon delivery, the instrumentation system and selected items of the communication system were removed from the capsule to be bench tested. During this bench-test period, the capsule underwent rework which included cleaning up of discrepancy items deferred from St. Louis and making changes to the capsule that were required to be made prior to beginning systems tests.

Systems tests were begun as soon as all instrumentation and communications components were reinstalled in the capsule. These tests required a total of 46 days. During this period the electrical, sequential, instrumentation, communication, environmental, reaction control, and stabilization and control systems were individually tested. Included in the test of the environmental system were two runs in an altitude chamber with an astronaut installed in the capsule.

At the completion of systems tests, another work period was scheduled in which the landing bag system was installed on the capsule.

At the completion of this work period, a simulated flight test was performed, followed by installation of pyrotechnics and parachutes. The capsule was then weighed, balanced, and delivered to the launching pad to be mated with the booster. Nineteen days were spent on the launching pad, prior to launch, testing the booster and capsule systems, both separately, and as a unit. Also, practice insertions of an astronaut into the capsule were performed during this period.

Simulated flight 1 with the booster was accomplished at the completion of systems tests on the launching pad. A change was then required in the booster circuitry which necessitated another simulated flight test (simulated flight 2). The capsule-booster combination was then ready for flight. The flight was postponed several days due to weather; however, this allowed time for replacing instrumentation components which were malfunctioning. A final simulated flight was then run (simulated flight 3). The capsule was launched two days after this final test.

During capsule systems tests and work period, both in Hangar "S" and on the launching pad, modifications were made to the capsule as a result of either a capsule malfunction or an additional requirement placed on the capsule. The most significant modifications made to capsule 7 while at Cape Canaveral were as follows:

a. Manual sensitivity control and a power cut-off switch were added to the VOX relay.

b. A check valve was installed between the vacuum relief valve and the snorkel inflow valve.

c. The cabin pressure relief valve was replaced with one which would not open until it experienced an equivalent head of 15 inches of water.

d. Screens were added at the heat barriers upstream of the thrust chambers (downstream of the solenoid valves).

e. The high-thrust pitch and yaw thrusters were welded at the juncture between the thrust chambers and the heat barriers.

f. The cables to the horizon scanners in the antenna canister were wrapped with reflective tape to minimize RF interference from capsule communications components.

g. The retro-interlock circuit was by-passed by installing a jumper plug in the amplifier-calibrator.

h. Permission relays were installed to both the capsule-adapter ring limit switches and the capsule-tower ring limit switches.

i. Capacitors were installed in the circuits to the orbit attitude, retro-jettison, and impact inertia arm time delay relays.

j. Capsule wiring was changed to extend the periscope at 21,000 feet.

k. The potting on the capsule adapter umbilical connectors was extended 0.75 inch from both connector ends and the connector was wrapped with asbestos and heat reflective tape. Also, the fairings over these connectors were cut away and a cover was added which provided more clearance between the fairings and the connectors.

l. The lower pressure bulkhead was protected from puncture damage that might result from heat sink recontact. Aluminum honeycomb was added, bolts reversed, and brackets with sharp protrusions were potted solidly with RTV-90 and plates between the brackets and the bulkhead.

m. Pitch indicator markings were changed from -43° to -34° for retro-attitude indication.

10.5 Communication Details

10.5.1 Telemetry

Signal strength on both the high and low telemetry links were adequate for collection of data from time of lift-off to impact. No one receiving station maintained telemetry contact throughout the flight, but the combined reception of all stations gave complete coverage. The following table shows the various stations recording telemetry data with periods of reception of sufficient strength for data purposes.

STATION	SIGNAL TIMES			
	High Link		Low Link	
	Acquisition	Loss	Acquisition	Loss
Mercury Control Center	Transmitter Activation	08:42	Transmitter Activation	08:55
Tel II	Transmitter Activation	09:06	Transmitter Activation	09:05
GBI	*		00:57	10:54
Bermuda	03:37	07:21	03:42	06:47
Indian Ocean Ship	01:24	15:22 (Landing)	01:24	15:22 (Landing)
Atlantic Ocean Ship	Transmitter Activation	09:01	Transmitter Activation	09:01
Aircraft 800	08:48	15:22 (Landing)	08:48	15:22 (Landing)

*Data not available at the time this report was prepared.

10.5.2 Voice Communications

UHF voice communications were good throughout the mission. Considerable spurious keying of the transmitter occurred, apparently because of improper sensitivity adjustment of the voice-operated relay.

At 07:10 the pilot switched to HF for a check. Mercury Control Center reported no HF reception. Hangar "S" communications station received the capsule transmission, but the signal was of very poor quality and barely audible. It is not known whether the capsule received HF at any time since UHF and HF were being transmitted simultaneously.

At 07:48 UHF contact was again established and reception was intelligible to the time of pilot recovery. The GBI hardline to MCC was used from 09:21 since line-of-sight condition precluded direct communication with MCC.

The aircraft carrier received UHF voice from the time the capsule had descended to 40,000 feet to pilot recovery. The Indian Ocean Ship received UHF voice from the capsule from 7,000 feet altitude until recovery. UHF voice was utilized throughout the recovery period.

During the period between bicone antenna separation and landing the onboard tape recording contains a noise which, upon investigation, was found to be caused by the SARAH beacon. This corresponds to the period of SARAH operation.

10.5.3 Radar

Both C- and S-band radar systems functioned normally. Good track was obtained throughout the flight. Radar acquisition at GBI was reported to have been excellent, but at the time of this report records were available for only Patrick FPS-16, Cape FPS-16 and Cape Mod II. Patrick FPS-16 tracked reliably until 09:12, Cape FPS-16 until 08:31, and Cape Mod II until 08:32.

10.5.4 Recovery Communications

Since the capsule was visible to recovery forces before impact, little exercise of radio recovery equipment was made. Recovery forces reported the operation of the SARAH beacon to be normal. The HF antenna was actuated by the explosive charge. The upper 6 feet of the antenna were apparently lost at this time.

10.6 Instrumentation Details

The instrumentation system in capsule 7 was basically the specification Mercury system, the major exception being the use of an "interim" clock rather than the MAC satellite clock.

The system functioned properly throughout the flight with the exception of the interim clock, which stopped for approximately 15 seconds during re-entry (08:15 to 08:30) and the 1.7 KC ECG channel of both telemetry links. The interim clock is known to become inoperative under high g conditions and malfunction during re-entry was anticipated. The loss of the ECG channel is thought to have been caused by a loose probe. This loss occurred approximately 2 hours before lift-off. The associated voltage-controlled-oscillator (V.C.O.) output became so erratic after probe loss that signal "splash over" was introduced on the 1.3 KC and 2.3 KC V.C.O. channels. However, interference was not excessive and data on these channels was generally suitable for reduction.

Panel instruments and the tape recorder operated normally throughout the flight. The frame rate of the pilot-observer camera was 6 frames per second and the instrument-panel camera rate was 3 frames per second. The earth and sky camera and instrument panel camera operated normally during flight, but a review of the film from the pilot-observer camera shows a time discrepancy which was apparently due to a camera stoppage or a slow down at some time between .05 g and drogue deploy. Telemetry channel and commutator segment assignments are presented in Figure 10.6-1.

10.7 AMR Support, Data Coverage, and Film Review

10.7.1 AMR Support and Data Coverage

All Atlantic Missile Range (AMR) instrumentation committed to support the mission was manned and operational at launch. This instrumentation gave required coverage of the flight and resulted in good operational support and data coverage. Information regarding range-instrumentation status and data coverage is presented.

OPTICS:

Type	Station	No. of Items Committed	No. of Items Obtained
Metric	1	24	24
Engineering Sequential	1 & 3	43	42
Documentary	1 & 3	51	51
A.F. Office of Information Services	1	7	7

RADAR: Twelve radars located at stations 1, 3 and 5 (Cape, GBI and San Salvador) were used in support of this operation. Five of these were C-band radars, six were S-band, and one was X-band. In addition, the C-band radar at Bermuda supported the mission. These radars provided considerable overlap and continuous track to 10:15 at which time the S-band radars at GBI lost track at elevation angles near zero.

TELEMETRY: Excellent telemetry data were obtained from both capsule links from lift-off to landing. A combination of the Cape TLM-18 antenna and the GBI antennas feeding the downrange subcable provided real-time telemetry to the Cape Telemetry Facility (Tel 2) to 10:54. Switchover from the Tel 2 TLM-18 antennas to the GBI subcable signal was accomplished at 06:40 at which time the Cape TLM-18 signal strength was 250 μv and the GBI signal was 400 μv. Two telemetry aircraft in the landing area recorded telemetry to landing and provided adequate overlap of the GBI signal.

AZUSA: The AZUSA Operator's report indicated that AZUSA coverage was obtained to approximately 06:40.

10.7.2 Film Review

The engineering sequential film coverage for the launch was good, and quick-look review of available film items showed no malfunctions. Capsule umbilical ejection, periscope retraction, and door closure were clearly shown and appeared to be normal. Tracking cameras provided good coverage up to booster burnout.

The film from three onboard cameras were good. The pilot-observer camera (16mm) and earth-sky camera (70mm) contained color film. The instrument panel film (16mm) contained black-and-white film. The lack of a time reference on the pilot-observer and instrument panel film makes time correlation difficult. This was especially true in the case of the pilot-observer camera film because of camera slowdown as described in section 10.6.

10.8 Flight Safety Reviews

A Capsule Review meeting was held on April 28, 1961. At this meeting NASA and McDonnell system engineers reported on capsule status. The capsule was pronounced ready for flight with two possible exceptions which were as follows: (1) Lack of proper clearance between booster-to-capsule interface umbilicals and the capsule-adapter clamp ring fairings. The fix for this condition is described in paragraph k of Section 10.4. (2) It was disclosed that during electrical mate on the pad a one-ampere fuse in a test-interrupt box in the catastrophic fail circuitry between the booster and capsule was blown. During subsequent tests this failure, which occurred during a heavy rain, could not be duplicated. The Capsule Review Board decided that bench tests should be performed to determine whether or not an electrical short in this circuitry was fail safe. The results of these tests were to be reported at the Mission Review meeting for final disposition of the problem.

The Mission Review meeting was held on April 29, 1961. Booster, capsule, range and recovery status were presented. There were two problems requiring resolution. (1) Blown fuse in catastrophic failure circuit during electrical mate. The tests of the catastrophic fail circuitry, requested by the Capsule Review Board, showed that an electrical short would probably cause an inadvertent abort. It therefore was decided to protect this circuit with a 30-ohm current limiting resistor. (2) Trajectory. It was disclosed that the three-sigma trajectory to be flown by the booster was sufficiently close to destruct boundaries to be of major concern. Range Safety agreed to increase the destruct boundaries for the flight.

Following the delay of the first attempted launch, a second Mission Review meeting was held on May 4, 1961. No discrepancies were reported and MR-3 was again declared ready for flight.

FIGURE 10.1-1 - CAPSULE SWITCH AND CONTROL POSITIONS AT RECOVERY

RIGHT CONSOLE

EMER O_2 HANDLE	EMER
SUIT TEMP CONTROL	
CABIN TEMP CONTROL	

MAIN INSTRUMENT PANEL

LAUNCH CONTROL SWITCH	READY
READY LIGHT	OFF
MAYDAY LIGHT	OFF
CABIN PRESSURE GAGE	
CABIN AIR GAGE	
CABIN REL. HUMIDITY GAGE	
COOLANT QUANTITY GAGE	
O_2 EMERG FLOW LIGHT	ON[1]
OXYGEN WARNING LIGHT	ON[1]
CABIN FAN SWITCH	NORM
OXYGEN GAGE	
SUIT FAN SWITCH	#2[2]
D-C AMPS GAGE	12 AMPS[1]
STANDBY D-C AUTO LIGHT	OFF
STDBY BATT SWITCH	AUTO
AMMETER SWITCH	OFF
ISOL BATT SWITCH	NORM
ELEC PWR SWITCH	NORM
STANDBY A-C AUTO LIGHT	OFF
FANS/ASCS SWITCH	FANS
TRANSMIT SWITCH	OFF
UHF DF SWITCH	NORM
UHF SELECT SWITCH	NORM
AUDIO BUS SWITCH	NORM
STDBY INVERT SWITCH	FANS[2,3]
A-C VOLTS (FANS)	114[1]
A-C VOLTS (ASCS)	111[1]
D-C VOLTS SWITCH	M
D-C BUS VOLTAGE	
MAIN BUS	25[1]
SECONDARY BUS	25[1]
#1 BUS	26[1]
#2 BUS	26[1]
#3	26[1]
#4	26[1]
STANDBY BUS	29[1]
ISOLATED BUS	28[1]
SATELLITE CLOCK	
TIME ZERO GUARD	INSTALLED
SQUIB ARM SWITCH	ARM
HI-WATT TELE SWITCH	GRND
SWITCH FUSES - RETRO JETT	#1(UP)
SUIT FAN	#2(DOWN)[2]
ENVR CONTL	#2(DOWN)[2]
ALTIMETER	
BEACON SWITCH	CONTIN
RECORDING LIGHT	OFF
ACCELEROMETER	
RATE IND SWITCH	MANUAL ON

LEFT CONSOLE

TOWER JETT LIGHT	OFF
TOWER JETT PULL RING	OUT[4]
CAPSULE SEP LIGHT	OFF
CAPSULE SEP LIGHT	OFF
CAPSULE SEP PULL RING	IN
START RETRO SEQ LIGHT	OFF
IN RETRO ATT LIGHT	OFF
RETRO ATT SWITCH	AUTO RET
RETRO FIRE LIGHT	OFF
RETRO FIRE SWITCH GUARD	REMOVED
JETT RETRO LIGHT	ON[1]
JETT RETRO SWITCH GUARD	INSTALLED
.05G SWITCH LIGHT	OFF
DROGUE LIGHT	OFF
MAIN DEPLOY LIGHT	OFF
MAIN DEPLOY PULL RING	IN
RESERVE DEPLOY PULL RING	IN
RESERVE DEPLOY LIGHT	OFF
PRESSURIZE PULL RING	IN
De-COMPRESS PULL RING	IN
RESCUE AIDS LIGHT	ON[1]
RESCUE AIDS SWITCH	POST IMPACT
PITCH CONTROL HANDLE	IN
YAW CONTROL HANDLE	IN
ROLL CONTROL HANDLE	IN
LDBG SWITCH	AUTO
LDBG BAG LIGHTS	
SNORKEL HANDLE	IN
FUEL CONTROL - AUTO	
FUEL CONTROL - MAN	
RETRO HEATER SWITCH	OFF
RETRO ROCKET LIGHTS	
MANUAL CONTROL HANDLE	IN
CABIN LIGHTS SWITCH	ON
GYRO SWITCH	NORMAL
ASCS MODE SEL SWITCH	NORM
AUTO RETRO-JETT SWITCH	ARM
SQUIB SWITCH (MAIN PANEL)	OFF

FUSE PANEL

EMER .05G	#1(UP)
ASCS .05G	#1(UP)
RETRO MAN CONTRL	#1(UP)
NO. 3 RETRO RCKT	#1(UP)
NO. 2 RETRO RCKT	#1(UP)
NO. 1 RETRO RCKT	#1(UP)
EMERG RETRO SEQ	#1(UP)
PERISCOPE	#1(UP)
RESERVE DEPLOY SYS A	#1(UP)
EMERG CAP SEP CONTRL	#1(UP)
EMERG MAIN SYS A	#1(UP)
EMERG RETRO JETT	#1(UP)
EMERG DROGUE DEPLOY	#1(UP)
EMERG POSIGRADE	#1(UP)
EMER ESCAPE RCKT	#1(UP)
EMERG TOWER JETT	#1(UP)
EMER TOWER SEP	#1(UP)
TOWER SEP CONTRL	#2(DOWN)[5]
ANT SWITCH	#1(UP)
PROGRAMMR	#1(UP)
LOW TEL TRANS	#1(UP)
COM RCVR A	#1(UP)
SPARE	#1(UP)

[1] These readings were taken at 16:45 hours on May 5, 1961, on the recovery ship when the squib arm switch and ammeter switch were turned on.

[2] Although these switches were found to be in the incorrect position during inspection, a review of the onboard instrument panel camera film shows that they were in the correct position during flight. Consequently, it is assumed that they were brushed during egress of the pilot or at post flight inspection.

[3] See paragraph 5.5.1.

[4] See paragraph 5.6.3.

[5] This switch does not show in the onboard instrument panel camera film. However, the pilot stated that all fuse switches were in the #1 position prior to lift-off and that he did not change the position of this switch during the flight. Therefore, it is assumed that this switch was brushed to the #2 position during egress of the pilot or at post-flight inspection.

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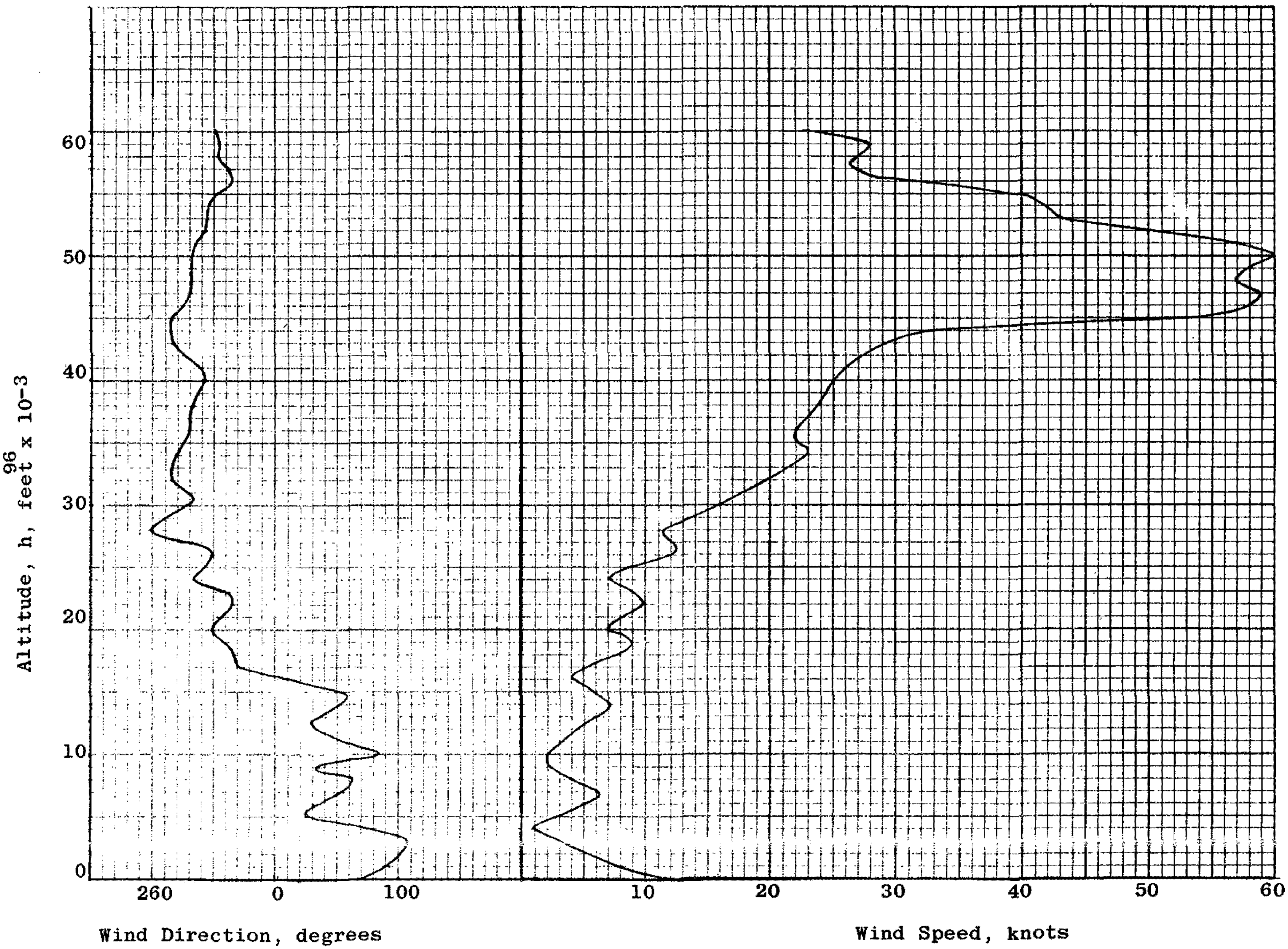

FIGURE 10.3-1 CAPE WIND PROFILE APPROXIMATELY 5 MINUTES AFTER LAUNCH .

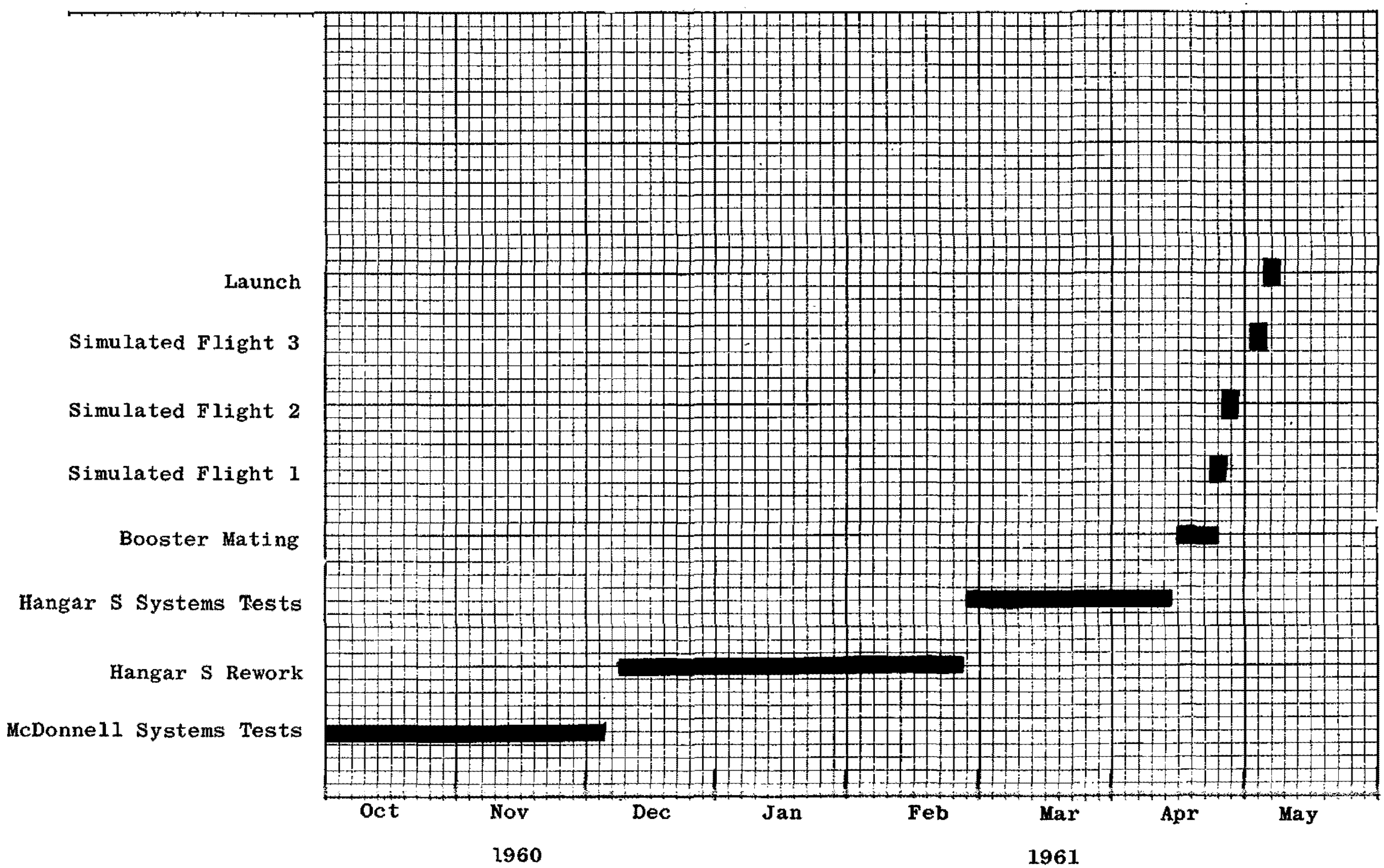

FIGURE 10.4-1: CHECKOUT HISTORY OF CAPSULE NO. 7.

FIGURE 10.6-1 TELEMETRY CHANNEL AND

COMMUTATION SEGMENT ASSIGNMENTS

IRIG Channel	Commutator Segment	Measurement	Instrument Range
5	Cont.	Respiration Rate & Depth	
6	Cont.	ECG-1	
7	Cont.	ECG-2	
12	1	3 Volt Reference	
	2	Ground Reference	
	3	7 VAC Monitor	
	4	Body Temperature	95° to 108°F
	5,27,49,71,85 Hi	Pitch Rate	±10 Deg/sec
	5,27,49,71,85 Lo	Yaw Rate	±10 Deg/sec
	6	3 Volt Reference	
	7	3 Volt Reference	
	8	Suit Pressure	0-15 psia
	9	Roll Rate	±6 Deg/sec
	10	Cabin Air Temp.	0-200°F
	11	Suit Inlet Air Temp.	35° to 100°F
	12	O_2 Emergency Supply Press	0-3000 psia
	13,43,73	Y Axis Acceleration	±4 g
	14,44,74	X Axis Acceleration	±4 g
	15,45,75	Z Axis Acceleration	±30 g
	16,86	Pitch Attitude	-130° to 190°
	17,88	Roll Attitude	-130° to 190°
	18	Yaw Attitude	-70° to 250°
	19 Hi	Not used	
	19 Lo	Not used	
	20 Hi	Outer Skin Temp-Aft	-65° to 1000°F
	20 Lo	Outer Skin Temp-Fwd	-65° to 1000°F
	21 Hi	Inverter Temp-Main 250 VA	0-300°F
	21 Lo	Inverter Temp-Main 150 VA	0-300°F
	22	Static Pressure	0-15 psia
	23	Control Stick Movement-Roll	±13°
	24	Control Stick Movement-Pitch	±13°
	25	Control Stick Movement-Yaw	±10°
	26	Interim Clock	0-10 sec
	28	Interim Clock	0-100 sec
	29	Interim Clock	0-1000 sec
	30	Interim Clock	0-10,000 sec
	31	Interim Clock	0-10 sec
	32	Interim Clock	0-100 sec
	33	Interim Clock	0-10 sec
	34	Interim Clock	0-100 sec
	35	Interim Clock	0-1000 sec
	36	Time of Retrograde (T_r)	ON-OFF
	37	Interim Clock	0-1000 sec
	38	Interim Clock	0-10,000 sec
	39	RCS Pressure - Auto	0-3500 psi
	40	RCS Pressure - Manual	0-3500 psi

FIGURE 10.6-1 (CONCLUDED)

IRG Channel	Commutator Segment	Measurement	Instrument Range
12	41	AC Voltage Monitor	0-120 VAC
	42	DC Current Monitor	0-50 Amps
	46	Tower Release	ON-OFF
	47	Capsule Separation	ON-OFF
	48	Retro Attitude Comm.	ON-OFF
	50	Retro #1 Fire	ON-OFF
	51	Retro #2 Fire	ON-OFF
	52	Retro #3 Fire	ON-OFF
	53	Retro Assembly Jettison	ON-OFF
	54	Drogue Chute Deploy	ON-OFF
	55	Antenna Fairing Release	ON-OFF
	56	Main Chute Deploy	ON-OFF
	57	Main Chute Jettison	ON-OFF
	58	Reserve Chute Deploy	ON-OFF
	59	Pilot Abort	ON-OFF
	60	Mayday	ON-OFF
	61	Tower Escape Rocket	ON-OFF
	62	Standby Invert On	ON-OFF
	63	Standby Battery On	ON-OFF
	64	Calibrate Signal ON	R Cal 80% Z Cal 50%
	65	High Jet Solenoid + Pitch	ON-OFF
	66	High Jet Solenoid - Pitch	ON-OFF
	67	Low Jet Solenoid + Pitch	ON-OFF
	68	Low Jet Solenoid - Pitch	ON-OFF
	69	High Jet Solenoid + Roll	ON-OFF
	70	High Jet Solenoid - Roll	ON-OFF
	72	Periscope Retract	ON-OFF
	76	Low Jet Solenoid + Roll	ON-OFF
	77	Low Jet Solenoid - Roll	ON-OFF
	78	High Jet Solenoid - Yaw	ON-OFF
	79	High Jet Solenoid + Yaw	ON-OFF
	80	Low Jet Solenoid - Yaw	ON-OFF
	81	Low Jet Solenoid + Yaw	ON-OFF
	82	Cabin Pressure	0-15 psia
	83	DC Voltage Monitor	0-30 VDC
	84	Coolant Bottle Pressure	0-500 psia
	87	.05 g Relay	ON-OFF

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