KSC - TR-562
August 4, 1967

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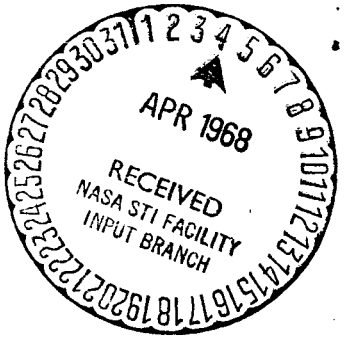
ATLAS/AGENA-24

LUNAR ORBITER-5

FLASH FLIGHT REPORT



Prepared by
AGENA Operations Branch, KSC-ULO

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FLASH FLIGHT REPORT

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SUMMARY

ATLAS/AGENA No. 24 was successfully launched from ETR Complex 13, August 1, 1967, at 2233:00 GMT. The launch plan was 1K with a booster roll azimuth of 105.6 degrees. The launch vehicle consisted of an ATLAS SLV-3 (S/N 5805) first stage and AGENA D (S/N 6634) second stage. The spacecraft was Lunar Orbiter-5. All indications are that a completely successful spacecraft injection was accomplished.

Preliminary analysis of data indicates that vehicle performance through spacecraft separation and AGENA retromaneuver was well within prescribed parameters and the spacecraft is in a lunar trajectory. A successful mid-course maneuver was accomplished August 3, 1967.

SECTION I
LAUNCH INFORMATION

A. MISSION OBJECTIVES

The primary objective of the Lunar Orbiter-E mission is to obtain from Lunar orbit, photography of scientifically interesting areas on the front and far sides of the moon, and supplemental photography of candidate Apollo sites.

Secondary mission objectives are as follows:

1 To provide precision trajectory information for use in improving the definition of the lunar gravitational field.

2 To provide measurements of micrometeoroid flux and radiation dose in the lunar environment primarily for spacecraft performance analysis.

3 To provide a spacecraft which can be tracked in lunar orbit by the Manned Space Flight Net (MSFN) stations for the purpose of exercising and evaluating the tracking network and Apollo Orbit Determination Program.

B. VEHICLE CONFIGURATION

The launch vehicle was a two-stage ATLAS/AGENA. The first stage was an ATLAS SLV-3 (S/N 5805), with the second stage an AGENA-D (S/N 6634).

C. SPACECRAFT CONFIGURATION

The Lunar Orbiter-5 spacecraft (S/N 3) had a nominal weight of 864 pounds and was designed to be mounted within an aerodynamic nose shroud on top of the ATLAS/AGENA launch vehicle. During launch, the solar panels are folded under the spacecraft base and the antennas are held against the side of the structure. In this configuration, the spacecraft is approximately 5 feet in diameter and 5.5 feet long. With the solar panels and antennas deployed, after injection into the translunar trajectory, the maximum span is increased to approximately 18.5 feet along the antenna booms and 12 feet across the solar panels.

SECTION II
FLIGHT PERFORMANCE

A. SPACECRAFT

All spacecraft systems were nominal during liftoff, injection phase, and at Loss of Signal (LOS). Spacecraft telemetry signals were good from liftoff until LOS. All flight events occurred on time and the spacecraft is functioning normally. Midcourse correction is scheduled for August 3, 1967 and retrofire to place the spacecraft into Lunar orbit is scheduled for August 5, 1967.

B. RANGE SAFETY AND TRAJECTORY

All plots were nominal, smooth, and appeared to be on time. Preliminary parking and transfer orbits appeared to be as predicted.

C. ATLAS VEHICLE

1. Airframe. The structural integrity was successfully maintained throughout powered flight. The usual longitudinal oscillations of approximately 5 cps normally observed at liftoff were present and had an amplitude of approximately 1.15g at T+3 seconds. These were damped out by T+23 seconds. The period of maximum aerodynamic buffeting began at approximately T+42 seconds and lasted until approximately T+80 seconds. Maximum axial acceleration occurred at BECO and was approximately 6.0g. At SECO acceleration was 3.2g. Booster separation was satisfactory.

Thrust section temperatures were normal. Thrust section temperature time slice data is presented in table 1.

2. Electrical System. System performance was satisfactory throughout the launch countdown and flight. An anomaly was noted, however, in the inverter operation. Cyclical fluctuations of 0.35 volt peak-to-peak, with a period of about 10 seconds, were observed on each of the inverter output phases from approximately T+54 seconds to approximately T+118 seconds. Cause of this anomaly is not known with certainty. Data from the battery load test is listed in table 2. Electrical system time slice data is presented in table 3.

3. Launch Complex. All supporting systems functioned satisfactorily throughout the countdown and launch. The launcher release system functioned properly and umbilical ejection was normal. Damage in the vicinity of the launcher was normal for a launch.

Table 1. Thrust Section Temperature Time Slice Data

Meas. No.	Description and Location	T-0	BECO	SECO	VECO
P15T	Eng compartment air, sta 1225, QII	82°F	82°F	112°F	106°F
P16T	Eng compartment component	72°F	80°F	104°F	100°F
P671T	Thrust section ambient, sta 1230, QIV	58°F	82°F	160°F	154°F
A743T	Ambient at sust instr panel	46°F	70°F	100°F	116°F
A745T	Ambient at sust fuel pump	88°F	106°F	112°F	112°F

Table 2. Battery Load Test Data

Measurement	Reading
Main ATLAS battery	
Unloaded	34.9 vdc
Loaded and stable	28.2 vdc
ATLAS inverter	
Voltage	115.3 vac
Frequency	399.0 hz
Telemetry battery	
Unloaded	34.9 vdc
Loaded and stable	28.5 vdc

Table 3. Electrical System Time Slice Data

Meas.	Description	T-0	BECO	SECO	VECO
E28V	Vehicle system input	27.8	27.8	27.8	27.95
E95V	28V guidance power in	28.0	28.0	28.0	28.0
E51V	400 cycle phase A	115.6	115.4	114.6	114.6
E52V	400 cycle phase B	116.2	115.8	115.4	115.4
E53V	400 cycle phase C	115.8	115.6	115.4	115.2
Readings for E28V and E95V are in vdc. Others are in vac.					

4. Propulsion. Propulsion system performance was nominal. All pressures appeared smooth during the start sequence, steady state, and shutdown. Vernier No. 2 chamber pressure, measurement P29P, indicated a gradual decay from 257 psia to 248 psia at 34 seconds after BECO then abruptly returned to 257 psia. This anomaly is attributed to carbonization of the sensing line port.

Pneumatic system and vehicle tank pressures were properly maintained throughout the flight. Helium usage was normal, with 650 psia remaining in the booster helium bottles at BECO. The lowest bulkhead differential pressure was 7.5 psid, recorded at T+1.6 seconds, during maximum lox tank pressure oscillations.

Hydraulic system performance was nominal. Oil evacuation was initiated at T-32.8 seconds as noted by the characteristic drop in airborne return pressures. The vernier solo accumulators bottomed out 46.3 seconds after SECO.

The propellant utilization system performed satisfactorily. Error times at stations 1 through 6 are listed in table 4.

Table 4. Propellant Utilization System Error Times

Station	Error Time (secs)	1st Sensor Uncovered
1	0.60	Lox
2	0.20	Lox
3	0.45	Fuel
4	0.45	Fuel
5	2.8	Fuel
6	0.50	Fuel

Preliminary estimates of propellant residuals were 1056 pounds of lox and 767 pounds of fuel. This represents 5.6 seconds additional burn time available with a fuel outage of 347 pounds at theoretical depletion.

5. Flight Control System. The ATLAS flight control system performance was nominal. Flight programmer events were nominal with a roll setting of right 0.423 degree. The roll liftoff transient was small and quickly damped. Max Q occurred between 42 and 80 seconds with no outstanding peaks.

Attitude disturbances at BECO combined with initial pitch up 100 percent and yaw left steering 50 percent excited a 4-second pitch and yaw plane rigid body oscillations that were damped in approximately 55 seconds. The remainder of sustainer flight was smooth with no disturbances. Pitch down and yaw right attitude corrections at SECO produced no oscillations. Pitch and yaw rates at VECO were essentially zero.

6. Radio Guidance System. The Mod III radio guidance system performance was satisfactory. The track subsystem acquired the vehicle in the first cube at T+60.1 seconds, in the conical mode of operation as planned. The automatic switch to monpulse mode occurred at T+65.5 seconds with a good track flag presented to the computer by T+68.8 seconds. Track lock was continuous from acquisition until T+423.1 seconds. Final loss of track lock occurred at T+442.1 seconds with the track antenna at an elevation angle of 1.35 degrees. At this time the received monopulse signal was at the noise level.

The rate subsystem acquired the vehicle at T+57.5 seconds, presenting good flags to the computer by T+58.6 seconds. Rate lock was continuous from acquisition until T+399.1 seconds. Final loss of rate lock occurred at T+419 seconds at which time the received signal was at the noise level.

The A-1 computing subsystem performance was satisfactory. Indications are that the programmed guidance equations were executed without error.

Booster steering was enabled at T+80 seconds as planned, however no booster steering commands were generated or transmitted indicating the vehicle was within the 1.5 sigma trajectory tolerance.

Sustainer steering commands were generated starting at T+137.7 seconds. The initial sustainer pitch command was 100 percent up for 2 seconds followed by 10 percent down command. The initial sustainer yaw command was 75 percent left for 0.5 second followed by 20 percent yaw right command. Pitch and yaw sustainer steering commands were reduced to within $\pm$10 percent by T+147.3 seconds.

Initial vernier steering commands were 10 percent pitch down and 30 percent yaw right (both for 0.5 second) at T+288.6 seconds.

Preliminary quick-look evaluation of the velocity errors at VECO indicate the trajectory was nominal (0.8 sigma depressed).

All discrete commands were properly generated, transmitted, received, and executed. No significant problems occurred during the launch countdown or flight.

7. Telemetry. ATLAS telemetry yielded satisfactory data throughout the flight.

8. ATLAS Command Control. RSC AGC indicated the proper signal level and no commands were sent.

D. AGENA VEHICLE

1. AGENA Guidance and Controls. The AGENA guidance system performed well through LOS as indicated by telemetry received at Building AE. The D-timer events were as planned using the start D-timer time of T+296.3 seconds as a reference. The time of second burn appeared nominal indicating the restart timer functioned normally.

The horizon sensor signals and the system response to them was very smooth and gas valve activity was good.

The transients at first burn ignition were minus 1.6 degrees pitch (damped in 2 seconds), plus 1.4 degrees in yaw (damped in 2 seconds), plus 2.6 degrees in roll (damped in 2 seconds), and then a minus 2.0 degrees roll offset for the duration of the burn.

Data indicates that both AGENA burns were shutdown at the proper velocity by the velocity meter.

2. Electrical System. The AGENA power measurements were normal, and the readings taken from telemetry recordings are presented in table 5.

Table 5. AGENA Power Readings

Measurement	Reading
+28 VDC PS	25 vdc
Current Monitor	13 amps
Pyro bus volts	25.9 vdc
+28 V regulator supply	+28.3 vdc

Table 5. AGENA Power Readings (Cont'd)

Measurement	Reading
-28 V regulator supply	-28.6 vdc
ØAB 400 hz	115 vac
ØBC 400 hz	114 vac

3. Propulsion. AGENA engine performance was excellent. Average first burn total thrust was approximately 16,250 pounds for a duration of 153.1 seconds. Average AGENA propulsion data are presented in table 6.

Table 6. AGENA Propulsion Data

Description	Predicted	Actual
Engine thrust (pounds)	16,270	16,250
Burn duration (seconds) from 90% Pc to cutoff	--	153.1
Chamber pressure (psig)	512.5	512.1
Oxidizer pump inlet pressure (psig) at liftoff	--	35.8
Oxidizer pump inlet temperature (^{o}F) at liftoff	--	53.7
Oxidizer venturi inlet pressure (psia)	--	1083
Fuel pump inlet pressure (psig) at liftoff	--	45.7
Fuel pump inlet temperature (^{o}F) at liftoff	--	53.8
Fuel venturi inlet pressure (psia) at liftoff	--	1103
Turbine speed (rpm)	--	25041

At liftoff propellant tank pressures were satisfactory as indicated on the blockhouse panel meter and were: Fuel 39 psig and oxidizer 31 psig.

Helium sphere load was satisfactory at 3575 psig and 7°F.

Guidance gas load was satisfactory at 3545 psig and 80°F. At LOS at Hangar AE, values were 2400 psig and 16°F.

Hydraulic system performance was normal at an average value of 2910 psig.

Propellant isolation valve operation was as expected. Fuel limit switch was engaged at 9.7 seconds after cutoff command and the oxidizer limit switch was engaged at 10.9 seconds after cutoff commands as indicated on the new PIV monitor telemetry signals. Power was removed to close the PIV circuit at 22.7 seconds after cutoff by the D-timer as planned.

Vehicle propellant loads were as follows:

	Actual	Nominal
Oxidizer (pounds)	9679	9679
Fuel (pounds)	3811	3811

Second burn occurred as planned. Preliminary data indicates normal operation for a duration of 87.2 seconds.

4. Telemetry. All AGENA measurements yielded expected response with one exception. Shroud separation monitor A52 failed prior to BECO.

5. Range Safety. Range Safety carrier was switched off at parking orbit insertion. AGC's were normal and no commands were sent.

6. C-Band Beacon. C-band PRF was steady and indicated normal radar switching until LOS by Antigua telemetry.

E. SEQUENCE OF FLIGHT EVENTS

Significant flight events and times are listed in table 7. Actual times listed are event times received from the Range shortly after launch. Times derived from telemetry will differ slightly in some cases.

Table 7. Significant Flight Events

Event	Expected Time (GMT)	Actual Time (GMT)	Actual Time After Liftoff in Seconds
Liftoff	2233:00.0	2233:00.3	--
BECO	2235:08.9	2235:08.1	128.1
Jettison booster	2235:11.9	2235:12.1	132.1
Start restart timer	2237:31.85	2237:32.7	272.4
SECO	2237:47.9	2237:49.0	288.7
Start D-Timer	2237:51.8	2237:56.7	296.4
VECO	2238:08.1	2238:08.2	307.9
Jettison shroud	2238:10.5	2238:10.6	310.3
ATLAS/AGENA separation	2238:12.5	2238:12.8	312.5
AGENA 1st burn	151.6 seconds duration	153.1 seconds duration	--
AGENA 2nd burn	86.6 seconds duration	Approximately 87.2 seconds	--
Spacecraft separation	2308:32.8	2308:33.5	2133.2
AGENA retromaneuver	2319:32.8	2318:33.0	2732.7

SECTION III
DATA ACQUISITION

A. RANGE TELEMETRY AND RADAR

1. Mainland Telemetry and Radar. Mainland telemetry and radar coverage was as follows:

	Telemetry (mc)	Coverage (in seconds)
Tel-2	249.9 (ATLAS)	-420 to +410
Tel-4	244.3 (AGENA)	-420 to +410
	249.9 (ATLAS)	-420 to +410
	2298.3 (Spacecraft)	-420 to +410
	Radar	
	Mod IV 1.1	0 to +2 on TV
		+2 to +48 on infrared tracker
		+48 to +127 on automatic skin tracker
	Mod IV 1.2	0 to +4 on TV
		+4 to +49 on infrared tracker
		+49 to +127 on automatic skin tracker
	Mod III 1.16	+9 to +72 on automatic skin tracker
		+72 to +478 on automatic beacon
	PAFB 0.18	+13 to +228, +287 to +297, +361 to +468 on automatic beacon
		+228 to +287, +297 to +340 on automatic skin tracker

Radar	Coverage (in seconds)
KSC 19.18	+12 to +82, +197 to +359 on automatic skin tracker
	+82 to +197, +363 to +450, on automatic beacon
Tel Elsse 12-110F Skyscreen flight line radar	+6 to +450
Tel Elsse 14-110P Skyscreen program radar	+6 to +445

The Range Safety carrier was on from 2206:35 to 2234:43 GMT, with no commands being sent.

2. Station 3 Telemetry and Radar. Station 3 coverage was as follows:

Telemetry (mc)	Coverage (in seconds)
244.3 (AGENA)	+75 to +524
249.9 (ATLAS)	+75 to +524
2298.3 (Spacecraft)	+101 to +466
Radar	
3.18	+85 to +484 on automatic beacon

The Range Safety carrier was on from 2234:42 to 2237:24 GMT, with no commands being sent.

3. Station 4 Telemetry and Radar. Station 4 coverage was as follows:

Telemetry (mc)	Coverage (in seconds)
249.9 (ATLAS)	+85 to +525

4. Station 7 Telemetry and Radar. Station 7 was not up for this launch with exception of the Range Safety carrier.

The Range Safety carrier was on from 2237:24 to 2241:17 GMT, with no commands being sent.

5. Station 91 Telemetry and Radar. Station 91 coverage was as follows:

Telemetry (mc)	Coverage (in seconds)
244.3 (AGENA)	+307 to +833
2298.3 (Spacecraft)	+320 to +774
Radar	
91.18	+376 to +780 on automatic beacon

The Range Safety carrier was on from 2241:17 to 2242:12 GMT, with no commands being sent.

6. Range Instrumentation Ship (RIS) Victor. RIS Victor coverage was as follows:

Telemetry (mc)	Coverage (in seconds)
244.3 (AGENA)	+763 to +1225

7. Station 12 Telemetry and Radar. Station 12 coverage was as follows:

Telemetry (mc)	Coverage (in seconds)
244.3 (AGENA)	+1109 to +1660
2298.3 (Spacecraft)	+1168 to +1570
Radar	
12.18	+1187 to +1611 on automatic beacon
12.16	+1187 to +1570 on automatic beacon

8. Range Instrumentation Ship Whiskey. RIS Whiskey coverage was as follows:

Telemetry (mc)	Coverage (in seconds)
244.3 (AGENA)	+1561 to +2081
2298.3 (Spacecraft)	+1549 to +1572

9. Station 13 Telemetry and Radar. Station 13 coverage was as follows:

Telemetry (mc)	Coverage (in seconds)
244.3 (AGENA)	+1840 to +2480
2298.3 (Spacecraft)	+1860 to +2280
Radar	
13.16	+1875 to +2080, +2086 to +2413 on automatic beacon

10. Range Instrumentation Ship Yankee. RIS Yankee coverage was as follows:

Telemetry (mc)	Coverage (in seconds)
244.3 (AGENA)	+2101 to +6830
2298.3 (Spacecraft)	+2252 to +7454

No S-band receiver lock - signal just above noise level.

B. NASA/ULO AND SPECIAL SUPPORT

1. Special ULO Support. The special ULO support for telemetry was of excellent quality and is itemized as follows.

a. Subcable from Antigua (ETR) - voltage controlled oscillators (VCO's) from the AGENA through VCO 16.

b. Real time data from Tananarive (MSFN) - spacecraft data from VCO channel F showing spacecraft separation.

c. Real time data from Carnarvon (MSFN) -velocity meter data showing the retromaneuver.

d. Playback from Pretoria (ETR)-velocity meter and chamber pressure from the AGENA showing AGENA second burn.

In addition Ascension Island and RIS's Whiskey and Yankee were available if necessary. All the data was displayed in Building AE and was of excellent quality.

2. Satellite Tracking Station (STS). The STS provided S-band doppler and redundant telemetry coverage. The 19-foot dish tracked to the horizon with excellent doppler and telemetry. The doppler was displayed in Building AE at the MDC and was of good quality. Antigua supplied S-band doppler from the ULO equipment on site, in realtime, and aside from a pair of mis-locked intervals of short duration, the data were excellent. Ascension doppler was played back after the test and was also of very good quality.

C. OPTICS

This launch was supported by 10 metric cameras, 28 engineering sequential cameras, and 26 documentation cameras. Two engineering sequential cameras and four of the documentation cameras did not operate because of the prevelant weather.

D. WEATHER AND PAD DAMAGE

1. Weather. Upper wind shears were within acceptable limits. At lift-off, the following weather parameters were recorded:

Temperature	75°F
Relative humidity	94 percent
Visibility	10 miles, with light rain
Dew point	73°F
Surface winds	4 knots at 180°
Clouds	Overcast with 10/10 cloud cover
Sea level atmospheric pressure	30.010 inches of mercury

2. Pad Damage. Complex 13 pad damage was light.

SECTION IV
PRELAUNCH OPERATIONS

A. VEHICLE MILESTONES

The significant prelaunch events pertaining to the vehicle are listed in table 8.

Table 8. Significant Vehicle Prelaunch Events

Date	Event
5/27/67	ATLAS and AGENA arrived at ETR
6/6/67	ATLAS 5805 erected on Complex 13
6/23/67	Lunar Orbiter-E spacecraft arrived
6/28/67	ATLAS fuel and lox tanking test
7/7/67	ATLAS B-FACT conducted
7/19/67	ATLAS/AGENA mated at Complex 13
7/20/67	Second B-FACT conducted
7/24/67	J-FACT conducted
7/25/67	AGENA/spacecraft mated
7/28/67	Simulated launch test
8/1/67	Launch

B. PRELAUNCH PROBLEMS (ATLAS)

1. Vernier Yaw Servocylinder Assembly. Both vernier servocylinder feedback transducers were replaced in accordance with NASA direction. The feedback transducers installed on these servocylinders were disapproved for flight by the flight certification board due to incomplete histories.

2. LO2 and Fuel Regulators. The lox and fuel regulators assigned to 5804 (Lunar Orbiter-D) were rejected at ETR for contamination in the inlet ports. The regulators were returned to San Diego, the inlet ports were cleaned, and then installed

on 5805. New regulators were requested to be installed on 5805 after arrival at ETR in accordance with NASA direction since it was felt the cleaning process at San Diego was insufficient for the degree of contamination involved. The new regulators were rejected at ETR due to galling of the inlet port threads. A small particle was visible in the threads of one regulator and was removed. The regulators were accepted and installed on the vehicle.

3. Booster Number 1 Turbopump Accessory Drive Adapter. A blowing leak was observed at the booster number 1 turbopump accessory drive adapter upon initial application of engine control pressure. The leak was eliminated by replacing two O-ring seals.

4. LO_2 Start Tank Low Pressure Relief Valve. The LO_2 start tank low pressure relief valve was replaced after it was found to be leaking excessively. (Leakage rate 260 scim maximum allowable 150 scim.)

5. Boil-Off Valve Closed Timer. The boiloff valve 2 second closed timer, K43, (GSE) was replaced during valve checkout. Time delay was 166 seconds and could not be adjusted to the proper setting. The new timer setting is 1.9 seconds.

6. Fuel Regulator. During pneumatic system high pressure leak checks a blowing leak was found at the fuel regulator inlet fitting. Upon disassembly of the B-nut connection the flare saver was found crushed. No material appeared to be missing and a new flare saver was installed which corrected the leak.

7. Booster Fuel Staging Valve. Measurements made after the dual propellant tanking test indicated that the booster half nozzle was slightly cocked in the sustainer half. The misalignment was approximately 2.5 degrees. GD/C and the manufacturer of the bellows were contacted to determine if this would be detrimental to proper staging and if excessive loading would be imposed on the bellows. Both indicated that the misalignment was acceptable since it was designed for 7 degrees and tested to 4.5 degrees.

8. Launcher Release System Solenoid Valves. The time from release signal to 2480 psig (rise-off point) on initial blowdown was marginal on the B1 cylinder and exceeded .45 second maximum time on B2. The release control solenoid valve was replaced and three successive satisfactory blowdowns were accomplished on July 18, 1967. During a blowdown on July 24, 1967, both cylinders exceeded the maximum time. The release solenoid was again replaced and three subsequent blowdowns were satisfactory. Failure anaiysis on the first solenoid indicated excessive lubricant and misadjustment.

9. Sustainer Aspirator Boost Clips. One clip was found to have a visible crack approximately 1/2-inch long in a weld. The welds on all 23 clips were inspected using dye penetrant and eight were found to be cracked. The cracked areas were re-welded.

10. Booster Turbine Inlet Manifold Assembly. The tie rods for this assembly had been readjusted by Rocketdyne at Neosho, Missouri because of loose jam nuts. The tie rods were inspected for clearance at ETR and found to be out of specification tolerance. They were readjusted to the proper clearances.

11. Transducers.

a. The sustainer yaw position transducer (S256D) did not operate properly during the second B-FACT because of a broken mounting clamp. The transducer assembly was replaced and checked out satisfactorily after the test.

b. The lox tank head pressure (U80P) and the bulkhead delta-P (F116P) transducers were replaced in accordance with GD/C survey 39-67. (Possible contamination because of inadequate cleaning at San Diego.) The replacement transducers were subsequently installed improperly (F116P mounted in the location for U80P). This resulted in U80P becoming contaminated by exposure to the fuel vapors in the fuel tank and made a second replacement of U80P necessary.

12. Solenoids. As a result of survey 31-67, three umbilical solenoids were replaced because of loose shafts.

13. ATLAS Guidance.

a. Receiving inspection at ETR showed that the wave guide to the pulse and rate beacons was misaligned. (This also occurred on 5401, Mariner Venus.) This condition was discovered at San Diego; however, the wave guide sections were not replaced until the vehicle arrived at ETR.

b. Decoder S/N 054 failed in laboratory testing at ETR. The decoder delivered a continuous squelch signal on the third synch pulse, effectively obscuring the address. The malfunction has been verified by G. E. Syracuse, New York, but the cause has not been determined.

c. General Electric experienced an inability to maintain wave guide pressure in the North leg of the rate system. Investigation disclosed that an arc-through had been caused by lightning. The damaged section was replaced.

14. Airborne Electrical. During the J-FACT plus count, several level changes were observed on the 400 cycle three phase voltage. The changes in level were 2 to 3 percent with a duration of approximately 1.2 to 1.4 seconds. This phenomenon has been observed on several previous vehicles and has been determined to be caused by an interaction of the inverter with the gyro "fine" heaters.

15. Autopilot.

a. The pitch gyro spin motor speed became eratic during lab testing at ETR. The gyro can (S/N 701-0066P) was returned to San Diego where a broken leak in the pitch gyro circuit was repaired.

b. Servo amplifier S/N 508-0021P was returned to San Diego because of scratched pins in connector U2J2.

C. PRELAUNCH PROBLEMS (AGENA)

1. Propulsion.

a. The fuel and oxidizer pumps were removed and returned to Bell Aerosystems Corporation for bearing and fuel secondary seal replacement. Later a decision was made to replace the entire engine assembly with an engine incorporating the higher clearance bearings, new fuel secondary seal, and the preferred vendor gears.

b. The oxidizer fast shutdown tank and pyro valve assembly did not fit properly on the engine brackets during engine installation. The bracket nut plates were removed allowing sufficient rotational movement of the valve to align the assembly and complete the installation.

c. The Propellant Isolation Valves (PIV's) were replaced with valves modified to the latest design configuration.

d. The pitch and yaw actuators were replaced at the request of NASA because of marginal hydraulic leaks. The pitch actuator was at the high end of the specification statically at approximately 40 psig. The yaw actuator leaked considerably, but was within specification under dynamic conditions.

e. The new gear case drain and flush procedure was incorporated on this vehicle and 1650 cubic centimeters of MIL-7808D oil was put in the gear case and approximately 1630 cubic centimeters drained out.

2. Range Safety Receivers. Range safety receiver number 2 was replaced at ETR due to low sensitivity.

D. MAJOR TEST SUMMARY (LAUNCH VEHICLE AND SPACECRAFT)

The major launch vehicle and spacecraft tests conducted are summarized in the following paragraphs.

1. Dual Propellant Tanking Test, June 28, 1967. A successful loading of propellants was accomplished. The following anomalies were observed:

1 Following fuel tanking, the proper panel indication of ground fill and drain valve position was not received. The valve was cycled and proper operation was verified from the test stand indicating a problem in the microswitch circuitry. A microswitch adjustment following the test, corrected the problem.

2 During lox tanking the 95 percent light blinked early causing a premature switch to the topping mode of filling. This was verified by the length of time required to complete lox tanking. It was decided that this problem was caused by splashing of the 95 percent probe during tanking. The lox on board was detanked to a level between stations 3 and 4 and tanking was again initiated to verify a normal fill and topping procedure. The system operated normally.

3 During the test the usual lox tank oscillations were evident after switching to internal pressurization. Lox tank pressure exceeded redline values, but the count was continued to T-0. The count was recycled to T-7 minutes, to further observe this condition. (Maximum redline is 32.5 psi and the redline observation was 33.6 psi.) The second time the switch to internal was made, tank pressure again exceeded redline value when a similar pressure of 33.6 psi was observed; however, the test was continued to T-0. After both switches to internal pressurization the tank oscillations were damped out by T-18 seconds and were essentially normal at T-0.

2. B-FACT Number 1, July 7, 1967. A successful B-FACT was conducted. No anomalies were observed.

3. B-FACT Number 2, July 20, 1967. The B-FACT was successfully conducted. The following anomaly was observed:

The sustainer yaw telemetry transducer output remained at approximately 80 percent of full scale during the plus and minus count GCT's. Investigation disclosed that the integral U-clamp, holding the transducer to the engine, was broken. The transducer assembly was replaced and the system was satisfactorily checked out.

4. J-FACT, July 24, 1967. The J-FACT was satisfactorily conducted. The following anomalies occurred during the test:

1 An AGENA RSC battery failed during the plus count. A test of this battery following the J-FACT showed that the battery was faulty.

2 Several voltage level changes were observed on the ATLAS 400-cycle 3-phase output at about T+100. This phenomenon has been observed on several previous ATLASES and is attributed to an interaction between the gyro heater mag-amps and the inverter.

3 An indication of one of the AGENA propellant pump drain guillotine's was not received at the pyro monitor console at T-0. This indication was received on a recorder however. A broken wire at a connector (AGE) was found to be the cause of the failure.

5. Simulated Launch Test, July 28, 1967. The simulated launch test was satisfactorily conducted and all test objectives were met. The following anomalies were observed:

1 The landline transducer for measurement F1304P, staging bottle pressure, was replaced when an intermittent reading was observed.

2 During the test a low hydraulic pressure indication was noted on the remote pressure gauge for the AGENA boom. Investigation disclosed a bad connector and transducer in the system. Both items were replaced and the system was satisfactorily checked out.

In addition, both ATLAS airborne command destruct receivers were changed after the test at the request of ETR.

6. Launch, August 1, 1967. Additional hold time of 2 hours and 24 minutes was required during the countdown due to AGENA velocity meter replacement and severe weather conditions at launch time. During velocity meter replacement, 55 minutes of the 60 minute built-in hold time was used. At approximately T-118 minutes, General Electric was unable to support launch activities when air conditioning was lost due to a blown compressor. At T-94 minutes General Electric had regained air conditioning through use of portable units and was again ready to support launch activities. At T-90 minutes the count was again held for severe weather in the immediate area and this time decreased the available launch window time of 3 hours and 51 minutes to 87 minutes.

E. SPACECRAFT

Significant spacecraft milestones are presented in table 9.

Table 9. Spacecraft Milestones

Date	Event
6/23/67	Spacecraft arrival
7/12/67	Spacecraft completion of checks in Hangar S prior to moving to the ESA
7/13/67	Spacecraft moved to the ESA
7/15/67	Spacecraft fueling
7/20/67	DSIF checks without the shroud
7/21/67	Spacecraft to adaptor mate
7/21-22/67	Thermal barrier installation
7/23/67	Spacecraft encapsulation
7/24/67	Spacecraft checkout with DSIF (shroud on)
7/25/67	Spacecraft to AGENA mate
8/1/67	Launch

F. SPACECRAFT ACTIVITIES PRIOR TO LAUNCH

1. Spacecraft/DSIF 71 Compatability Test, July 20, 1967. During performance of this test all spacecraft systems functioned normally. There were no anomalies.

2. J-FACT, July 24, 1967. The spacecraft did not participate in the J-FACT.

3. Simulated Launch Test, July 28, 1967. At T-430 minutes, spacecraft power turn on was delayed approximately 45 minutes when a problem was encountered at Tel-4 in the retransmission of AGENA channel F telemetry to

DSIF-71. The source of the problem was the switch panel configuration at Tel-4.

The multi-path problem, previously encountered during checkout of the spacecraft while setting up the photo system for optimum video, was once again experienced at T-315 minutes. The traveling wave tube amplifier (TWTA) on high power, utilizing the repeater antenna, did not produce satisfactory results. The command to turn off the TWTA was not received by the spacecraft due to command transmission problems caused by a low uplink signal. However, a successful method for verification of the photo system operation was devised by going to high power on the TWTA with readout from the spacecraft van. The delays caused in finding and correcting the signal transmission problem impacted the simulated RF silence period; but no hold was called and the spacecraft was permitted to operate during the simulated RF silent period.

At T-60 minutes the same problem was experienced with Tel-4 concerning data retransmission. The spacecraft was delayed approximately 7 minutes before beginning internal power checks. From this point the spacecraft encountered no further problems and followed the clock to T-0.

4. Launch, August 1, 1967. The spacecraft count picked up at T-530 minutes and proceeded without incident until setup for photo readout at T-320 minutes when the re-occurring RF multipath problem was again encountered. After many different configurations had been tried, a setup was achieved which allowed optimum video for the photo readout. The spacecraft TWTA was turned off at T-255 minutes just prior to the scheduled RF silent period. The spacecraft made up lost time and caught up with the clock at T-215 minutes. At the time of the hold called for the vehicle, the spacecraft had completed memory loading and was on time with the clock.

During the hold caused by weather the spacecraft was configured in a mode to be least susceptible to transients that might have been caused by lightning.

From T-90 minutes to T-0 the spacecraft count was nominal.