TR-368
May 31, 1966

JOHN F. KENNEDY SPACE CENTER

SURVEYOR A
(AC - 10)
FLASH FLIGHT REPORT

Prepared by
CENTAUR Operations Branch, KSC/ULO

[redacted]

KSC FORM 16-12 (1/64)

TR-368
May 31, 1966

SURVEYOR A
(AC - 10)
FLASH FLIGHT REPORT

Prepared by
CENTAUR Operations Branch, KSC/ULO

[redacted]

TABLE OF CONTENTS

LIST OF TABLES

SUMMARY

The SURVEYOR A vehicle was launched from Complex 36 pad A on a flight azimuth of 102.28 degrees at 0941 EST, 30 May 1966. Vehicle performance was nominal, with all events occurring at the planned time. The ATLAS sustainer stage was operated until propellent depletion The CENTAUR stage was programmed for a single burn operation to provide the necessary velocity to inject the spacecraft into a lunar transfer orbit Injection was satisfactorily accomplished, the spacecraft was separated from the launch vehicle, and the launch vehicle then performed its retromaneuver to increase the separation distance between the vehicle and spacecraft

SECTION I
LAUNCH INFORMATION

A. MISSION OBJECTIVES

The SURVEYOR-A/AC-10 mission, ETR Test No. 0184, was the first attempt by the United States to place a SURVEYOR Spacecraft into a lunar impact trajectory and softland the spacecraft on the lunar surface. This mission was accomplished with a single continuous-powered ascent from launch to injection of the CENTAUR/SURVEYOR into the lunar impact orbit. Injection occurred after about seven-and-a-half minutes of flight.

The mission also evaluated the capability of the launch vehicle to inject the SURVEYOR spacecraft into a lunar impact trajectory with sufficient accuracy to insure that the spacecraft's programmed midcourse trajectory correction would be well within its capability. The ability of the CENTAUR vehicle to perform a retromaneuver after spacecraft separation was also determined. The engineering payload will evaluate the in-transit performance of the spacecraft, the approach to the moon, and the lunar landing. Operation of the spacecraft on the lunar surface will also be evaluated.

B. LAUNCH VEHICLE CONFIGURATION

1. ATLAS. The ATLAS stage for the AC-10 mission (290D) was similar to that flown on the AC-6 mission. The propulsion plant incorporated two MA-5 165,000 lb thrust booster engines, one 57,000 lb thrust sustainer engine, and two 669 lb thrust vernier engines. The verniers were free to gimbal in the yaw plane for roll control during sustainer flight. The standard Autopilot system controlled the flight trajectory during booster flight, with CENTAUR guidance being enabled 8 seconds after the BECO signal was generated by the CENTAUR guidance system. A single telemetry package monitored inflight performance, with a tee coupler replacing the ring coupler in the telemetry antenna system. Two Avco MK II command receivers supported the Range Safety functions.

2. CENTAUR. The CENTAUR stage (ID) was similar to the AC-6 (2D) vehicle, utilizing two RL 10A-3CM-1 engines. Flight trajectory was controlled by an improved Honeywell, Inc. all-inertial guidance system. Improvements were made in the design of the attitude engine clusters and the insulation panel hinges, based on knowledge gained from the AC-8 flight.

A single telemetry system monitored inflight performance and a C-band beacon was utilized for tracking the stage. The Avco MK II receivers supported the Range Safety functions and a SURVEYOR Destruct System was also incorporated.

C. SPACECRAFT CONFIGURATION

The SURVEYOR-A spacecraft was the first of a series of seven nearly identical SURVEYOR vehicles, configured primarily for support of spacecraft vehicle development and APOLLO support rather than scientific lunar exploration. No operational scientific instrumentation payload items intended for lunar exploration were carried on the spacecraft, with the exception of one post-lunar-landing TV survey camera. Instead, an engineering instrumentation payload consisting of approximately 22 measurements for evaluating spacecraft vehicle performance during lunar transit and soft landing operations, together with associated additional electrical harnessing and signal processing equipment, were substituted. The spacecraft consisted of the spaceframe, the retro rocket, the vernier engines and associated tankage, landing gear, CENTAUR interconnect structure, thermal compartments, crushable blocks, mast, flight control sensor group, descent control radars, flight control sensors, and the payload.

SECTION II
FLIGHT PERFORMANCE

A. SPACECRAFT

The SURVEYOR A spacecraft was injected into the prescribed lunar impact trajectory by the successful CENTAUR single burn. Separation from the CENTAUR occured as programmed, and all spacecraft systems appear to be functioning normally. The mission requirements for the SURVEYOR A preclude a definitive description of overall performance at this time.

B. RANGE SAFETY AND TRAJECTORY

Plots were smooth all the way on present position and IIP. Actual plots appeared near nominal, with BECO and SECO IIP apparently downrange of predicted values, although definite confirmation cannot be made at this time.

The flight azimuth, flight path, and spacecraft injection angle appeared to be nominal. All parameters indicated a smooth flight.

C. GUIDANCE

The launch day calibration data was very consistent with previous calibration data. There were no problems with optic acquisition. LOT time was initiated at 07:30 EST. The quidance Pulse Rebalance unit reached a temperature of 56.8°F at T-0. The maximum temperature was 66.4°F at the time of loss of signal.

Quick-look analysis of guidance telemetered data indicates there were no obvious anomalies and flight performance was nominal to loss of signal. Playbacks and reduction of the digital data are necessary before any definitive evaluation of overall guidance performance can be made.

D. CONTROL SYSTEM

The transients that occurred at liftoff were similar to those experienced on previous flights. The maximum transients at this time were in the pitch plane at a rate of 2.67 deg/sec peak-to-peak and a roll rate of 2.1 deg/sec peak-to-peak.

The programmed command discretes were initiated at the proper times.

Maximum Q region was reached at T+77.2 seconds, and required an engine displacement of plus 2.99 degree and plus 2.86 degree for B1 and B2 pitch respectively.

At T+150 seconds guidance was enabled and steering commands were received on the ATLAS vehicle.

It was observed that during the sustainer phase at T+161 seconds the pitch rate was 0.73 deg/sec peak-to-peak at 1 HZ for a period of 13 seconds, and the roll rate was 0.77 deg/sec peak-to-peak at 1.25 HZ. There were no significant oscillations in the yaw channel.

The oscillations in pitch and yaw during jettisoning of the insulation panels and fairings were comparable to previous flights.

The rates imparted to the CENTAUR at ATLAS/CENTAUR separation were not unusual, with the highest rate in minus roll of 1.84 deg/sec.

Transients at CENTAUR main engine start were 1.87 deg/sec in minus pitch and 4.37 deg/sec in plus roll. Yaw transients were very small.

Small limit cycles were observed in all three planes during the main engine burning time. The pitch rates were 0.34 deg/sec peak-to-peak, the yaw rates were 0.33 deg/sec peak-to-peak, and roll rates were 0.50 deg/sec peak-to-peak at 0.6 HZ.

The presently available data does not indicate any malfunction of the control system.

E. RANGE SAFETY COMMANDS

The Range Safety commands system data indicated nominal operation with sufficient signal levels to respond to a command if required. No commands were received or generated except RF disable. RF disable was received at 1452:42 Z. Range Safety Command transmitter coverage is presented in table 1.

Table 1. Range Safety Command Transmitter Coverage

Event	Time (ZULU)
Mainland RSC Command Carrier On	13:58:30
Mainland RSC Command Carrier Off	14:42:58
STA 3 RSC Command Carrier On	14:42:53
STA 3 RSC Command Carrier Off	14:45:08
STA 7 RSC Command Carrier On	14:45:07
STA 7 RSC Command Carrier Off	14:48:30
STA 9.1 RSC Command Carrier On	14:48:25
STA 9.1 RSC Command Carrier Off	14:53:34
ATLAS RSC #1 AGC - AD7V - 90%-100	
CENTAUR RSC #1 AGC - CD2V - 100%	
CENTAUR RSC #2 AGC - CD7V - 100%	

F. RF SYSTEMS

1. C-Band. The C-Band system performance was nominal (table 2). The frequency was stabilized and the coded beacon afforded excellent tracking data. The system maintained power and was tracked by the various radar sites. Refer to tables 3 and 4 for C-Band and Telemetry Station coverage.

Table 2. C-Band Transponder Range Readouts

Radar	Van	19.18	Van	19.18	Van	19.18
Bcn Int. Freq (MC)	-2.7	+1.5	-4.0	-.5	Nom	-.5
Bcn Int Freq (MC)	+1.5	+1.0	+1.5	+1.0	+1.5	+1.0
Bcn Delay (MS)	1.95	1.91	1.84	1.87	1.84	1.87
Pulse Width (MS)	.6	.6	.6	.6	.6	.6
Range Jitter (MS)	0	0	0	0	0	0
Countdown (%)	0	0	0	0	0	0
Bcn Rcvy Time (MS)	50	---	50	---	50	---
Sensitivity (DBM)	-73	-86.2	-73	-78.2	73	-78.2
Power (DBM)	+61	+57.2	+60	52.5	+60	52.5
Coding (MS)	-.05	Nom	-.05	Nom	-.05	Nom
Time (ZULU)	08:30	08:42	12:00	12:21	14:09	14:09
Condition	GO	GO	GO	GO	GO	GO

Table 3. AC-10 C-Band Radar Coverage

Station	Auto Beacon Coverage (secs)	Auto Skin Coverage (secs)	Remarks
1.16	0-350		No Discrepancies
0.18	241-272,276-292, 297-574	20-241, 272-276, 292-297	No Discrepancies
19.18	10-48,90-105, 118-540	48-90, 105-118	No Discrepancies
3.16	78-220		No Discrepancies
3.18	85-587		No Discrepancies
7.18	198-304,317-326 448-583,670-675		Radar Drop-outs Due To Apparent Low Signal Strength
91.18	355-358,361-372, 377-690		Cause of Radar Drop-outs unknown
12.16	1109-1220,1310-1340, 1500-1580,1630-1775,1850-1905		Drop-outs Due To Range Re-cycle
12.18	1140-1360, 1369-8530		Drop-out Due To Poor Signal
13.16	1523-2178,2267-2524, 2999-3187,3296-3447		Break In Radar Due To Range Re-Cycle

Table 4 . Telemetry Station Coverage

Station	Links (MC)	Coverage (seconds)
Mainland	225.7	Minus 4500-598
	229.9	Minus 4500-552
	2295.0	Minus 4500-153
Station 3	225.7	40-619
	229.9	30-619
	2295.0	125-384
		384-560 intermittent
Station 4	229.9	90-575
Station 7	229.9	167-590
Station 91	225.7	315-781
	2295.0	315-781
Station 12	225.7	1000-5940
	2295.0	1000-2390
		2700-3300 unusable signal
Station 13	225.7	1361-4439
	2295.0	1361-2384
ARIS SIERRA	225.7	587-945
		998-1011
	2295.0	820-945
		998-1011
RIS WHISKEY	225.7	812-1518
	2295.0	785-1520
RIS YANKEE	225.7	780-1475
	229.5	780-1494

G. VEHICLE

1. ATLAS Mechanical. The ATLAS Mechanical Systems operated satisfactorily throughout the flight. Table 5 presents some of the significant mechanical systems data.

The approximate thrust at liftoff, using the chamber pressures presented in table 5, was 384,000 lbs.

The programmed pressure system operated properly at T+20 seconds at which time a 3 psi increase in LO_2 tank ullage pressure was noted.

The thrust section ambient temperature ranged between $68^{o}F$ and $107^{o}F$ at liftoff, increasing to maximums between $80^{o}F$ and $147^{o}F$ during the booster phase.

The ATLAS propellant utilization system operated satisfactory. Data indicates SECO was generated by the LO_2 depletion switches as planned; however, the fuel probes indicated a dry condition almost simultaneously.

The fuel and LO_2 sensing ports uncovered 11.5 sec and 7.5 sec prior to SECO, respectively. The PU valve was positioned against the lower limit from T+122 until SECO except for 5 seconds between T+211 and T+216 when the valve momentarily left the stop in response to a change in the EDO voltage.

There were no usable residual propellants left in the ATLAS.

2. CENTAUR Propulsion and Mechanical. The RL10 engines performed satisfactorily with a steady state total thrust of approximately 29,650 pounds, compared to nominal 30,000 pounds. Duration of burn was 437.9 seconds, compared to planned nominal of 432.7 seconds. The slightly longer burn time may have been due to the apparent lower than nominal thrust. The MECO time used in computing this number was furnished by the Range. Actual flight data may change this value. Oxidizer and fuel boostpump performances were satisfactory in providing main engine inlet pressures of approximately 62 psia for LOX and 34 psia for LH_2. The interim H_2O_2 attitude engine clusters apparently performed satisfactorily in stabilizing the vehicle after MECO and (along with the 50 pound thrust vernier engines) in performing the reorient and H_2O_2 retromaneuver after spacecraft separation.

CENTAUR pneumatic systems data appeared normal for this flight. Engine control regulator pressure was 440 psia.

LOX burp pressurization appeared satisfactory with pressure switch actuation (break) at 38.5 psia, deactivation (make) at 37.9 psia, and a total of 6.25 seconds Burp experienced. LH_2 burp pressure increased tank pressure from 19.4 to 12.03 psia. Hydraulic systems main pump operation was satisfactory during powered flight, and recirculation pumps provided control pressure during the retromaneuver.

The insulation panel and nose fairing jettison sequences occured at the proper time. Data on panel break-wire measurements requires further analysis. Table 6 provides pertinent data on CENTAUR mechanical systems.

Table 5. ATLAS Mechanical Systems Data at Liftoff + 10 Seconds

Measurement	Units	Nominal	Actual
B1 LOX Pump Inlet Press	Psia	57	56
B1 Fuel Pump Inlet Pres	Psia	67	67
B1 Chamber Press	Psia	575	561
B1 Pump Speed	RPM	6100	6360
B2 LOX Pump Inlet Press	Psia	57	56
B2 Fuel Pump Inlet Press	Psia	67	68
B2 Chamber Press	Psia	575	579
B2 Pump Speed	RPM	6000	5600*
Booster GG Chamber Press	Psia	530	528
Booster LOX REF Reg	Psig	623	653
Booster Control Reg Out	Psig	750	744
Booster Hyd Pump Disch.	Psia	3100	3075
Booster Hyd Lo Press	Psia	73	82
Sust LOX Pump Inlet Press	Psia	60	63
Sust LOX Pump Inlet Temp.	^{o}F	-300	-285
Sust Fuel Pump Inlet Press	Psia	70	67
Sust Chamber Press	Psia	700	722
Sust Pump Speed	RPM	10150	10080
Sust Fuel Pump Disch.	Psia	1000	905
V1 Chamber Press	Psia	257	268

Table 5. Mechanical Systems Data at Liftoff + 10 Seconds (Cont'd)

Measurement	Units	Nominal	Actual
V2 Chamber Press	Psia	257	264
Sust GG Disch	Psia	620	611
Sust LOX Ref Reg	Psig	814	809
Sust Control Reg Out	Psig	600	605
Sust/Vern Hyd Press	Psia	3100	3110
Sust Hyd Ret Line Press	Psia	73	73

* Data or scale factor questionable

Table 6. CENTAUR Mechanical Systems

Description	Units	Actual Steady State @MES+200	Nominal Steady State @MES+200
C-1 Engine Chamber Pressure	Psia	293	296
C-2 Engine Chamber Pressure	Psia	284	296
C-1 Engine Pump Speed	Rpm	11425	11400
C-2 Engine Pump Speed	Rpm	11520	11400
C-1 Hydraulic Pump Pressure	Psia	1146	1100
C-2 Hydraulic Pump Pressure	Psia	1118	1100
LOX Boost Pump Tbn Nozzle Box Pr	Psia	97.5	100
LH2 Boost Pump Tbn Nozz Box Pr	Psia	134	135
Engine Ctl Regulator Pressure	Psia	441	450

Table 6 . CENTAUR Mechanical Systems (Cont'd)

Description	Units	Value Steady State @MES+200	Nominal Steady State @MES+200
H_2O_2 Bottle Pressure	Psia	310	305
LOX Tank Ullage Pressure	Psia	28.2	29
LH_2 Tank Ullage Pressure	Psia	18	18
Helium Storage Bottle Pressure	Psia	2470	2600

3. ATLAS Power System. The ATLAS missile power system supported the launch with no anomalies. The internal checks of the RSC, TLM, and main power system during the minus count reflected acceptable load data and current profiles.

The ATLAS vehicle power was transferred to internal at T-2 minutes, yielding acceptable voltage and frequency. At T-0 the main battery voltage was 28.1 vdc supplying the inverter whose output was 14.6 vac at 401.5 cps, as reflected on telemetry. The inverter operated well within the expected voltage and frequency limits throughout powered flight.

4. CENTAUR Power System. The CENTAUR power system consisted of a main vehicle battery, two RSC batteries, and two pyrotechnic batteries. The minus count internal checks afforded excellent load profile data on all batteries with the exception of the pyrotechnic batteries, which are monitored for open circuit voltage only.

The CENTAUR main missile and the telemetry systems were cycled to internal at T-4 minutes, and the telemetry data reflects nominal operation. The CENTAUR current profile (CE1C) was available and afforded excellent data. The start sequence current profile was as expected. The nominal value was 46 amps, with a high of 65 amps during MES. The inverter temperature remained well below the critical value during the count, and at T-0 had decreased to 93.6°F. Telemetry indicates a main missile battery output of 27.4 vdc, and a steady inverter frequency operation at 400 cps.

5. AC-10 Flight Ordnance. The AC-10 flight ordnance were installed beginning with nose fairing encapsulation in the ESA and continuing through F-3 Day and the launch countdown tasks. All ordnance circuits except retro-rockets and gas generator ignitors were resistance checked to insure system integrity. All ordnance functions were performed satisfactorily from ATLAS ignition to spacecraft separation, as reflected on both accelerometer and the telemetered discrete functions.

6. CENTAUR Propellant Utilization. The CENTAUR PU system performed nominally during the countdown and flight. The slew rates at T-105 minutes were 8.8 degrees/sec for both servopositioners. The crossover point during tanking resulted in the following: LH_2= 2591, LOX= 12,800 lbs or 5 (LH_2) - LOX=155 lbs. The CENTAUR PU system responded to the null and unnull commands from the CENTAUR programmer. During the flight the CENTAUR PU controlled the mixture ratio nominally.

H. AC-10 SEQUENCE OF EVENTS

The following table lists the major events and the times at which they occurred for the AC-10 flight.

Table 7 . AC-10 Major Flight Events

Event	Time
CENTAUR Umbilical Eject	T-3.3
AFT Plate Eject	T-3.11
Main Engine Complete	T-0.94
Release	T-0.81
2" Rise (0941:00.99)	T-0
BECO	T+142.2
Booster Jettison	T+145.6
Insulation Panel Jettison	T+176.2
Nose Fairing Jettison	T+203.0
SECO	T+239.3
ATLAS/CENTAUR Separation	T+241.8
CENTAUR MEIG	T+252.0
CENTAUR MECO	T+689.0
Extend Landing Gear	T+715.5

Table 7. AC-10 Major Flight Events (Cont'd)

Event	Time
Extend OMNI Antenna	T+725.7
Switch High Power Transmitter	T+745.4
SURVEYOR Electrical Disconnect	T+752.3
SURVEYOR Separation	T+757.1
Begin Re-Orientation	T+759.5

SECTION III
DATA ACQUISITION

A. TELEMETRY AND INSTRUMENTATION

At the start of the countdown neither Landline nor Telemetry had any discrepancies; all measurements were working. One malfunction occurred during flight; AP671T Thrust Section Ambient Temperature transducer opened at Booster Engine Staging.

Range Operations were very good except that Station 91, Antigua, had a loss of data up the Sub-cable.

B. OPTICS

This launch was supported by 10 metric, 43 engineering sequential, and 27 documentary cameras. All performed satisfactorily with the exception of two engineering sequential and one documentary camera.

SECTION IV
WEATHER AND PAD DAMAGE

A. WEATHER

Weather during the launch operation was good. Upper wind shears were within acceptable limits. At liftoff, the following weather parameters were recorded:

Temperature	82°F
Relative Humidity	67 percent
Visibility	10 miles, unrestricted
Dew Point	70°F
Surface Winds	7 knots at 240 degrees
Clouds	.4 Cumulus, base at 2200 feet; .1 alto stratus at 10,000 feet.
Sea Level Atmospheric Pressure	1015.2 mb

B. PAD DAMAGE

The launcher received only nominal damage.

SECTION V
PRELAUNCH OPERATIONS

A. VEHICLE

1. Milestones. The significant vehicle prelaunch milestones are listed in table 8 .

Table 8 . Significant Vehicle Prelaunch Events

Date	Event
3/15/66	ATLAS arrival at ETR
3/17/66	CENTAUR arrival at ETR
3/21/66	ATLAS Erection
3/31/66	CENTAUR Erection
4/20/66	Tanking Test
4/26/66	Joint FAC Test
5/18/66	FAC Test
5/25/66	Composite Readiness Test
5/28/66	F-2 Day with ATLAS Tanking
5/30/66	Launch at 9:41 EST

2. Major Prelaunch Problems. The ATLAS autopilot system sustained the largest changes during the prelaunch activity. The ATLAS programmer reset anomaly, which manifested itself at AC power transfer and allowed excitation of some low and high power switches, was resolved after extensive troubleshooting and circuit analysis. The modifications to the system consisted of isolating the switch outputs on the AGE side with transistorized relay drivers, and directly connecting the reset signal in the programmer to the "CR buss" which inhibits the time diode matrix and prevents triggering any of the output switches.

The sustainer pitch and yaw actuators were replaced because of questionable output at 10 cps during frequency response.

The displacement gyro package was replaced when the drift rate was exceeded. The replacement package was remarried to the -5 rate group. The servo amplifier experienced questionable environmental conditions during the programmer troubleshooting.

The following replacements, modifications and revalidations were accomplished prior to the FAC test of May 18.

1 The retro motor "armed" indication was not received at the HAC console during the April 26 FACT. Subsequent analysis and checkout could not repeat the anomaly, however, and a prelaunch check on T-4 day revalidated the system.

2 The ATLAS backup RF #1 xmitter and filter were replaced, along with the xmitter in the backup CENTAUR package.

3 The ATLAS sustainer fuel inlet duct was found damaged and was replaced.

4 The inadvertant actuation of the tower fire-x system drenched the ATLAS TLM and necessitated additional checks.

5 The ATLAS pneumatics changeover valve developed a leak and was subsequently replaced.

6 Two nose fairing thermo relays were replaced after inadvertant shorting during testing.

7 Two lines in the ATLAS start system were replaced because of bad flares.

8 A leak developed in computer S/N 19 subsequent to completing a survey. This was corrected and reverified.

9 The ATLAS LO_2 low pressure 11" duct was replaced when it was found crushed after the vehicle was delivered with the prevalves closed.

10 The guidance optical align aperture was enlarged to prevent loss of acquisition.

11 A loose screw was found in the backup guidance platform. This was removed and the system revalidated.

Special precautions were initiated subsequent to the Gemini "target vehicle" anomaly, which consisted of harness wrapping, leak checking, and bolt and "B" nut torquing in the ATLAS thrust section. Special emphasis was placed on a 1000 cps ATLAS engine gimbaling test.

The AC-8 ATLAS PU anomaly generated a survey which required the x-ray of a "trim" capacitor for mounting configuration within the flight package, followed by ac input voltage excursions during lab testing.

3. Major Test Summary.

a. Flight Control and Propellant Tanking Test, April 20, 1966. The test count was begun at the planned time of 0740 EST and conducted per procedure throughout the entire operation. All red lines were go at T-10 seconds and holding for the tanking portion of the operation. At this time, cutoff circuitry was exercised by a pneumatic restep to Step III condition. Following this test, the engine start tanks were pressurized, allowed to stabilize, and vented. The operation was then turned over to autopilot for a safe programmer run, which was successfully completed.

b. FAC Test, April 26, 1966. Prior to the beginning of the test count the Spacecraft was exercised in a readiness test from T-485 minutes to T-125 minutes, and a guidance calibration was performed; Range support was holding at T-55 minutes. The Range Sequencer was started at T-90 minutes, with the test count beginning at 1405 EST.

After performing the hold-fire test at T-10 seconds a simulated problem was reported and the count recycled to T-5 minutes and holding. After the recycle operation ATLAS autopilot reported the lack of a programmer zero indication. Repeated attempts to reset and obtain programmer zero were unsuccessful until the programmer was intentionally moved off zero in the safe mode. After reestablishing the correct configuration and insuring the system could support and complete the test, the count was resumed. Except for the planned hold-fire test at T-10 seconds, the count proceeded from T-5 minutes through a release sequence and a successful plus time armed programmer run.

c. FAC Test, May 18, 1966. The test count began as scheduled at T-55 minutes (1005 EST) and proceeded according to plan until T-10 seconds and holding following the hold fire test. At this time the count was recycled to T-5 minutes and holding, in order to exercise the recycle procedure and the flight azimuth change. The count was resumed at T-5 minutes (1103 EST) and was performed per procedure through release and an automatic programmer start for an armed run.

d. Composite Readiness Test (CRT), May 25, 1966. The test began at T-55 minutes in order to conduct a complete Range Safety Command Test as is accomplished during the FACT. The entire test count was performed per procedure, with a manual start of the ATLAS programmer occurring at 1230.08 EST for T=0. Both the ATLAS and CENTAUR programmers were operated in the armed mode, with all end functions being verified to have occurred as planned. The test was secured at 1310 EST.

e. F-4 Day Operations, 26 May, 1966. The SURVEYOR SC-1 spacecraft was installed and the Readiness Test performed.

f. F-3 Day Operations, 27 May, 1966. The vehicle ordnance was installed, the pyrotechnic circuit checkout was performed, and Launch Readiness Tests were started.

g. F-2 Day Operations, 28 May, 1966, The ATLAS RP-1 tanking was accomplished. The vehicle tank was fueled to 7 gallons above the 100% level, for a total of 11,562 gallons at a density of 49.79 $\#/ft^3$ and a transfer temperature of 76^oF.

During the tanking operation a leak developed at the totalizer, preventing further use of pump FB. The test was completed using pump FA only.

The attitude engines were successfully test fired for a period of 10 seconds each. The resulting test data proved the system acceptable for flight. Systems securing for flight was accomplished by purging the supply system. A final check was made of the boost pump turbine breakaway torque, and the "locked rotor" tools were removed.

A total of 150.5 lbs. of H_2O_2 was tanked into the vehicle. However, venting, firing of the attitude engines, and samples taken for analysis required 18.5 lbs. The H_2O_2 liftoff weight was 132 lbs.

h. F-1 Day Operations, 29 May, 1966. All operations were performed per the countdown procedure. The only problem encountered was that one instrumentation plug had to be changed. All other tasks were begun and completed without difficulty.

i. F-0 Day Operations, 30 May, 1966. The countdown was performed per procedure, with no significant problems. The tower removal task was delayed about 20 minutes because of some difficulty in installing the Quad II MDF detonator fairing and the knee fairings from the conical to cylindrial nosefairing sections The built-in hold at T-90 minutes easily allowed task completion. The built-in hold at T-5 minutes was increased from 20 to 21 minutes to compensate for the latest CENTAUR weight calculations. This changed the planned launch time to 0941 EST.

B. SPACECRAFT

1. Milestones. The significant spacecraft prelaunch milestones are listed in Table 9.

Table 9. Spacecraft Prelaunch Milestone

Date	Event
3/14/66	SC-1 arrival at ETR.
4/15/66	SC-1 encapsulated
4/17/66	SC-1 mated to AC-10
4/26/66	J-FACT and demate
4/27/66	SC-1 de-encapsulation
5/14/66	Propellant Loading at ESF
5/25/66	SC-1 encapsulation
5/26/66	SC-1 mated to AC-10

2. Major Prelaunch Problems.

a. The boost regulator was damaged on April 9, during the caravan exercise from the Explosive Safe Facility (ESF) to Pad 36A, when two pins shorted. A replacement was installed and checked out satisfactorily.

b. A faulty nitrogen tank valve was discovered on April 14, during nose fairing blowdown. The valve was replaced and the nitrogen tank recharged.

c. The retromotor ARM indication was not received at the blockhouse console April 19, during Systems Readiness Test (SRT) countdown dry run, while on stand in the ESF. Subsequent tests and fixes failed to reveal the cause, and the anamoly could not be repeated.

d. A helium tank leak was discovered during spacecraft operations in the Building AO on May 4. This problem was resolved.