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CORONA J
PERFORMANCE EVALUATION REPORT
MISSIONS 1006-1 & 1006-2
FTV 1176 - J9

26 October 1964

Approved by [redacted] 11-18-64
Date
Advanced Proj[redacted]

Approved by [redacted] 11/18/6
Mgr. Date
Program[redacted]

[redacted]

[redacted]

[redacted]

FORWORD

This report details the performance of the payload section of the Program [redacted] Vehicle 1176.

Lockheed Missiles and Space Company has responsibility for evaluating payload performance under the System Integration and the "J" System Contracts.

This document is the final payload test and performance evaluation report for Missions 1006-1 and 1006-2 which was launched on 4 June 1964.

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SECRET

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[redacted]

[redacted]

LIST OF ILLUSTRATIONS

[redacted]

[redacted]

LIST OF TABLES

[redacted]

[redacted]

INTRODUCTION

A. PURPOSE

The purpose of this Performance Evaluation Report is 1) to define and establish the performance parameters of Mission 1006-1 and 1006-2, and 2) to identify the problem areas associated with these missions and recommend the appropriate corrective action.

B. INFORMATION SOURCES

The information employed in this report is from government facilities and their sources are:

AFSPPL - Diffuse Densities, RES, and Edge Trace Data

NPIC - Vehicle attitude data, Frame Correlation, [redacted] Edge Trace Reports and Processing Summary

ACIC - Special Yaw Error Reduction

C. PHASES OF EVALUATION

The evaluation was conducted in two phases. Phase one, the in-line [redacted] utilized the original negative and duplicate positive material generated [redacted] those missions and was conducted at customer facilities (AFSPPL, NPIC, [redacted] ACIC). The total mission material was available for the in-line evaluation. Phase two, the off-line evaluation, utilized only that material which was generated from the engineering passes over the continental limits of the United States and was conducted at the Advanced Projects facilities of LMSC.

The effort involved in conducting such an evaluation, and the personnel in such an effort may be more than is readily apparent. The in-line conducted at the customer facilities during other evaluation activities [redacted] accomplished by LMSC Advanced Projects and Itek personnel whose [redacted] experience makes them qualified [redacted]. The [redacted] participants were [redacted]. Itek participants were [redacted]. The off-line evaluation was conducted at the Advanced Projects facilities with equally capable personnel utilizing material obtained from the engineering passes over the Zone of Interior. Advanced Projects' participants, in addition to the above, included [redacted] and [redacted].

[redacted]

[redacted]

SECTION I

SYSTEM PERFORMANCE

A. MISSION OBJECTIVES

Flight Test Vehicle No. 1176 payload consisted of two Panoramic cameras, two Stellar-Index cameras, two Mark 5 recovery capsules, and a space structure to enclose the cameras and provide mounting for the recovery subsystems. The space structure also includes the payload clock, payload telemetry, and electrical cabling and junction boxes. This equipment is designed to obtain search reconnaissance photography of selected areas of the earth.

The planned mission was a two-phase 8 day camera operational mission with no deactivate period.

B. FLIGHT RESULTS

The mission was launched from Vandenberg Air Force Base at 3:59:22 PM PDT on 4 June 1964. The first phase was completed and a successful air catch was made on orbit 65 on 8 June 1964. The second phase of the mission was completed on orbit 128 on 12 June 1964 with a successful air catch recovery of the second capsule.

The comparison between predicted and actual orbit parameters is tabulated below:

	PLANNED	ACTUAL
Inclination	80.00°	79.97°
Period	90.87'	90.59'
Perigee Altitude	99.92 nm	84.00 nm
Initial Perigee Location	40.60°N	63.20°N
Apogee Altitude	250.50 nm	261.00 nm
Eccentricity	0.0209	0.0239

The space structure door covering the slave panoramic camera did not eject on command and remained in place through pass D02. Prior to the photographic operations during pass D03 the door was ejected.

[redacted]

[redacted]

C. PANORAMIC CAMERAS

The Master and Slave panoramic cameras functioned satisfactorily throughout both missions and produced excellent photography despite the V/H errors caused by orbit mismatch. In part this is due to the 10-15% scale improvement resulting from the low perigee. It was possible to observe motor vehicles and identify aircraft types throughout the mission indicating that the cameras produced high resolution photography. No ground resolution targets were photographed. Microdensitometer edge trace measurements by [redacted] reduced to resolution in lines per millimeter indicate that the Fwd camera averaged 84 lines and the Aft camera averaged 87 lines. However, these measurements show a high coefficient of dispersion which indicates caution should be used in interpreting the results. Detailed comments on the edge trace measurements may be found in Section VII of this report.

Intermittent failures in the center-of-format switch closures in both cameras caused the loss of some auxillary data and some Stellar-Index photography.

D. STELLAR INDEX CAMERAS

The Stellar-Index camera operations during Mission 1006-1 were satisfactory for approximately 60% of the mission life. The stellar shutter either failed to close, failed to open or produced multiple exposures during the remainder of the mission. The index camera operated properly throughout Mission 1006-1 however film depletion occured twenty frames early. Both the stellar and terrain photography were rated good during proper camera operation.

The Stellar-Index camera functioned properly through frame 274 of Mission 1006-2. The faulty Master camera center-of-format switch permitted only five additional camera operations to the end of the mission. All of the photography required was rated good.

E. MISSION SUMMARY

A brief summary of Missions 1006-1 and 1006-2 is shown on Tables 1 and 2 on pages 4 and 5. A schematic inboard profile is shown on page 5A.

F. CONCLUSIONS

Missions 1006-1 and 1006-2 achieved the major objective of obtaining search reconnaissance photography.

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Payload No. J-9 Mission No. 1006-1 Booster No. 403 Vehicle No. 1176 SRV No. 638

Launch Date 6-4-64 Launch Time 2259 Z Recovery Date 6-8-64 Recovery Time REV 65 Recovery Mode Air

Orbit Parameters -	Planned	Actual (Rev 1)	Vehicle Attitude -	Error (90%)	Range	Rate (90%)	Range
Inclination	80.00°	79.91°	Pitch	0.41°	0.99 to 0.45°	24.8°/hr	-96.9 to +86.3°/hr
Period	90.87	90.59	Roll	0.42°	0.92 to 0.38°	28.5°/hr	-52.2 to +97.5°/hr
Perigee Altitude	99.92 N.M.	84.0 N.M.	Yaw	1.14°	1.69 to 0.77°	37.8°/hr	-65.4 to +57.1°/hr
Perigee Location	40.60°N	63.20°N	Resolution Limit	Along Track (90%) 13.8'		Range 0' to 24.5'	
Apogee Altitude	250.50 N.M.	261.00 N.M.		Cross Track (90%) 6.7'		Range 0' to 12.6'	
Eccentricity	0.0209	0.0239					

Instrument	MASTER (F/D)	SLAVE (AFT)	STELLAR	INDEX
Serial No.	148	149	D45/47/45	D45/47/45
Pre-Flight Resolution	181 H.C., 110 L.C.	181 H.C., 106 L.C.	-	71 H.C.
Slit of Exposure Time	0.200"	0.200"	2 sec (4/1.8)	1/500 (5/4.5)
Filter/Film	W-21/4404	W-21/4404	None/4401	W-21/4400
Footage Recovered	2883 frames (1943')	2847 frames (1862')	412 frames	392 frames
Photo Quality Edge Trace Spec	ALL-83.7 HIGH 99.9 350H-65, 45H-88, Res-90 Very Good	ALL-86.7, HIGH-90.9 350H-71, 45H-90, Res-84 Very Good	Fair. Shutter failed to open 36 times. Intermittent for pattns (Edge static)	Good. Static last nine frames.
Exposure	Majority Good, Some over	same	Adequate	Good
Density	Low 5%, Med 95%, High 60%	same	"	Low 6%, Med 50, High 46%
Processing Per S.O. Act.	Primary 1 Inter 99 21 Full 48	Primary 8 Inter 99 13 Full 72	Full 100 100	
V/H Error (90%)	-	15.4% (-23.1% to +7.0%)	-	-
Time Track	O.K.	OK	-	-
Data Block	O.K.	OK except when e/c switch failed.	-	-
End of Pass Mark	O.K.	-	-	-
Port H. O. Quality (1/6.8)	Good	Good out when e/c switch failed	-	-
Port H. O. Fiducials	O.K.	O.K.	-	-
Starboard H. O. Quality (1/8)	Soft out of focus. Slight improvement after D-35	Soft. Overexposed	-	-
Starboard H. O. Fiducials	OK	OK	-	-
S/I Fiducials	-	-	One grossly overexposed	OK
S/I Correlation Lamp	-	-	OK	OK
Temperature	Normal - 69°F to 79°F	Normal - 57°F - 74°F	61°F to 70°F	Same
Remarks	Minor edge static. No corona	Slave door on thru D014 D02; off at D03-1. e/c switch failed D01-10 thru D03-17. No static or corona		Out of film to frames early.

[redacted]

[redacted]

Payload No. J-9 | Mission No. 1006-2 | Booster No. 403 | Vehicle No. 1176 | SRV No. 639

Launch Date 6-4-64 | Launch Time 2259 Z | Recovery Date 6-12-64 | Recovery ~~Time~~ Rev 128 | Recovery Mode AIR

Orbit Parameters -	Planned	Actual (Rev 1)
Inclination	80.00°	79.97°
Period	90.81'	90.59'
Perigee Altitude	99.92 N.M.	84.0 N.M.
Perigee Location	40.60°N	63.20°N
Apogee Altitude	250.50 N.M.	261.00 N.M.
Eccentricity	0.0209	0.0239

Vehicle Attitude -	Error (90%)	Range	Rate (90%)	Range
Pitch	0.49°	-0.75° TO +2.00°	31°/HR	-100 TO +100 °/HR
Roll	0.40°	-0.80° TO +0.45	28°/HR	-58 TO +74 °/HR
Yaw	1.08°	-1.70° TO +0.30	30°/HR	-42 TO +78 °/HR

Resolution Limit — Along Track (90%) 10.1' — Range 0' TO 15.0' — Cross Track (90%) 7.0' — Range 2.2' TO 13.0'

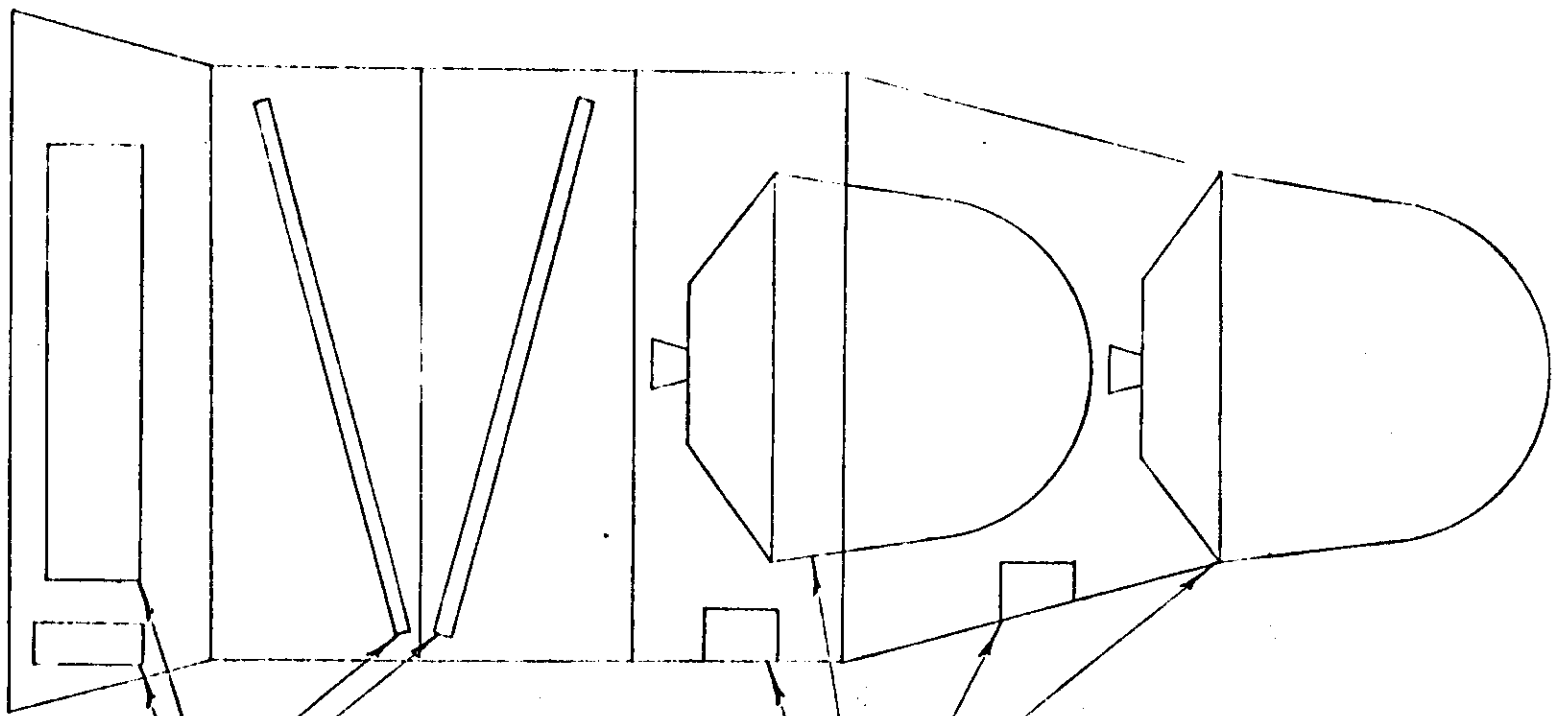
Instrument	MASTER (FWD)	SLAVE (AFT)	STELLAR	INDEX
Serial No.	148	149	D49/53/42	D49/53/42
Pre-Flight Resolution	181 H.C, 110 L.C	181 H.C, 106 L.C	-	72 H.C.
Slit of Exposure Time	0.200"	0.200"	2 SEC (f/1.8)	1/300 (f/4.5)
Filter/Film	W-21/4404	W-21/4404	NONE / 4401	W-21/4400
Footage Recovered	2971 FRAMES (1879')	3021 FRAMES (1005')	274 FRAMES (28')	279 FRAMES (55')
Photo Quality	EDGE TRACE [redacted] ALL - 83.6, HIGH - 90.4 350μ - 64, 43μ - 81 RES - 89	ALL - 87.1, HIGH - 93.9 350μ - 72, 43μ - 90, RES - 89	FAIR. FINE INTERMITTENT FRAMES AFTER D103-1 DUE TO C/P SWITCH.	GOOD. C/P PROBLEM.
Exposure	VERY GOOD	VERY GOOD	ADEQUATE	GOOD
Density	GOOD. BEST OBSERVED TO DATE	SAME	"	LOW 5%, MED 50%, HIGH 45%
Processing (PREDICTED / ACTUAL)	LOW 5%, MED 45%, HIGH 50% PRIMARY 2 / 30 INTER. 46 / 41 FULL 0 / 29	SAME PRIMARY 3 / 35 INTER 48 / 40 FULL 0 / 25	FULL 100 / 100	
F/H Error (90%)	-	11.6% (-16.0% TO +6.0%)	-	-
Time Track	OK	OK	-	-
Data Block	OK TO D103-1 ERRATIC THERE AFTER DUE TO FAULTY C/P SWITCH	OK	-	-
End of Pass Mark	SAME AS DATA BLOCK.	OK	-	-
Port H. O. Quality	GOOD. ERRATIC & SMEARED AFTER D103-1	OK	-	-
Port H. O. Fiducials		OK	-	-
Starboard H. O. Quality	FAIR.	OK	-	-
Starboard H. O. Fiducials		OK	-	-
F/I Fiducials	-	-	OK	OK
F/I Correlation Lamp	-	-	OK	OK
Temperature	51°F TO 69°F	52°F TO 69°F	39°F. TO 55°F.	SAME.
Remarks	C/P SWITCH ERRATIC AFTER D103-1 INTERMITTENT EDGE STATIC. START-UP CORONA. SCRATCHES NEAR D[redacted]	SAME STATIC, CORONA & SCRATCHES AS MASTER.	INTERMITTENT FOR PATCHES.	1° DIAGONAL LIGHT LEAK IN APX 30 FRAMES INTERMITTENT EDGE STATIC. CORONA IN FRAME #186 & LAST TWO FRAMES.

[redacted]

[redacted]

[redacted]

SCHEMATIC LEEWARD PROFILE - CORONA J SYSTEM



Master Camera No: 148

Slave Camera No: 149

Supply Cassette No: SC-11

Clock No: 508

Yaw Programmer No: N/A

"A" Recovery Subsystem No: 638

"A" Stellar-Index Camera No: D45/47/45

"B" Recovery Subsystem No: 639

"B" Stellar-Index Camera No: D49/53/42

Pressure Make-up Unit No: N/A

[redacted]

[redacted]

[redacted]

Failure of the Stellar camera shutter during Mission 1006-1 and failure of the master camera center of format switch caused loss of stellar-index photography during the latter part of Mission 1006-2. This will seriously affect cartographic use of the photography obtained during the mission.

G. RECOMMENDATIONS

Investigation and failure mode analysis resulting from the past flight analysis have resulted in the following actions:

1. Perform complete re-evaluation of the factors that produce uncompensated image motion in the Corona System.
2. Analyze and modify the main door and surrounding structure design to assure normal door injection. LMSC has accomplished this for all future flight units.
3. Modify the center of format switch to reduce future failures. Itek has accomplished this on all future flight units.
4. Study the problems of horizon camera exposure to determine if correct settings are used or whether "fuzzy" horizon images are due to external causes. Joint effort by Itek and LMSC is underway.
5. Review horizon camera boot installation to assure proper tension. LMSC accomplished this review and verified procedures are proper.
6. Improve reliability of stellar camera shutter and eliminate shutter open condition during shutter cock. Itek is phasing in an improved shutter as rapidly as possible.
7. Review Stellar-Index camera supply spool capacity requirements to preclude early depletion.
8. Modify fiducial lamp neutral density filter attachment to assure permanent filter positioning.

[redacted]

[redacted]

SECTION II

SPACE STRUCTURE SUBSYSTEM

A. COMPONENT ASSIGNMENT

Component	Serial Number
Clock	508
Telemeter "A"	T/M 107
Telemeter "B"	T/M 104

B. PREFLIGHT TESTING

The panoramic cameras were installed into their respective barrel sections on 6 March 1964. Command System Test and Pyro tests were completed on 16 March 1964 with no problems. The clock functional testing was accomplished with no recorded anomalies.

The System Light Leak Test was successfully completed on 6 April 1964. Subsequent investigation disclosed a light leak at the Felt Door Assembly. The component was replaced and the light leak removed.

A new Flight Commutator was installed on 26 April 1964 to cure the presence of some bad data points. Point 1152 (Separation Monitor) showed that the wire had pulled from the pins in connectors J100 and J61.

C. ENVIRONMENTAL TESTING

Summary

The J-09 Payload System completed a six-day orbit simulation test at the Sunnyvale HIVOS Chamber. A seven-day test was planned but was shortened as all primary objectives had been met. The chamber program was set for on-orbit temperature and pressure environment.

Pressure data as recorded by an alphatron gage indicated that the instrument pressures were below the suspected corona range. As the instruments were operated, the pressure increased through the corona region. Corona markings were reported to be acceptable on both panoramic instruments and the "A" Stellar/Index. The "B" Stellar/Index was reported as unsatisfactory.

The Electrical and Mechanical operation of the system was generally acceptable, except for the following: (1) The "B" Stellar/Index failed; (2) Cycle rate predictability exceeded limits; (3) Instrument #1 failed to meter

[redacted]

[redacted]

for 1/2 frame on one occasion; and (4) The V/H programmer potentiometer developed an electrical open.

The instrument temperatures varied from 73°F to 82°F for Instrument #1 and 66° to 75°F for Instrument #2 after a nominal 10° self-heating correction.

Two self-heating tests were conducted and showed good repeatability.

A pressure make-up system was tested on selected operations throughout the HIVOS test. Results are reported in T9-4-028, "J-9 Pressure Make-up System Test (4-9-64)".

Instrument Performance

Cycle Counter versus film footage pot deviations ranged from -445 feet on #1 Instrument to + 275 feet on #2 Instrument during the "A" Operation. These deviations are not a good indication of calibration accuracy, since the "A" spools loose wrapped during the test.

Cycle Counter versus film footage pot deviation ranged from -143 feet on the #2 Cassette to +122 feet on the #1 Cassette, during the "B" Mission.

Separation monitor (11-52) read 5V+ throughout the "A" Mission and 0V throughout the "B" Mission. Normal is 0.5 in "A" and 1.2 in "B".

A 3V 60 CPS Voltage appeared on top of the tape recorder channel #1 during the cut and wrap sequence.

Tape recorder Channel #2 was extremely noisy. Data (Status Channel #11) would be unusable.

The "A" S/I Index metering Idler was noisy.

Both film footage pots had as much as .15V level change during a commutator sample.

Serious ground loop problems exist during Instrument Operates. T.M. monitors referenced to 28V regulated return shift as much as 3.0V when both instrument center formats fall together.

Clock Performance

Clock correlation with IRIG "C" showed a maximum of 87 milliseconds slow for the first three days of operation. In the "B" Phase of the HIVOS test, a 3600 second error was detected in the IRIG "C" time generator. Correlation

[redacted]

between the clock and IRIG "C" in the "B" Phase of operation showed the clock to be 96 milliseconds fast after the 3600-seconds error had been corrected.

Temperature Summary

Three self-heating tests were conducted to determine repeatability of self-heating corrections. These were conducted near the beginning, prior to soak, and prior to second recovery during the HIVOS test. The test prior to soak was not a good test as the first part of the test was not recorded. The first and third tests showed good repeatability. The self-heating versus time curve to be used is shown in Figure 1, page 10. Sample instrument temperatures are listed. They are the average temperature and a 10^{o} self-heating correction is applied:

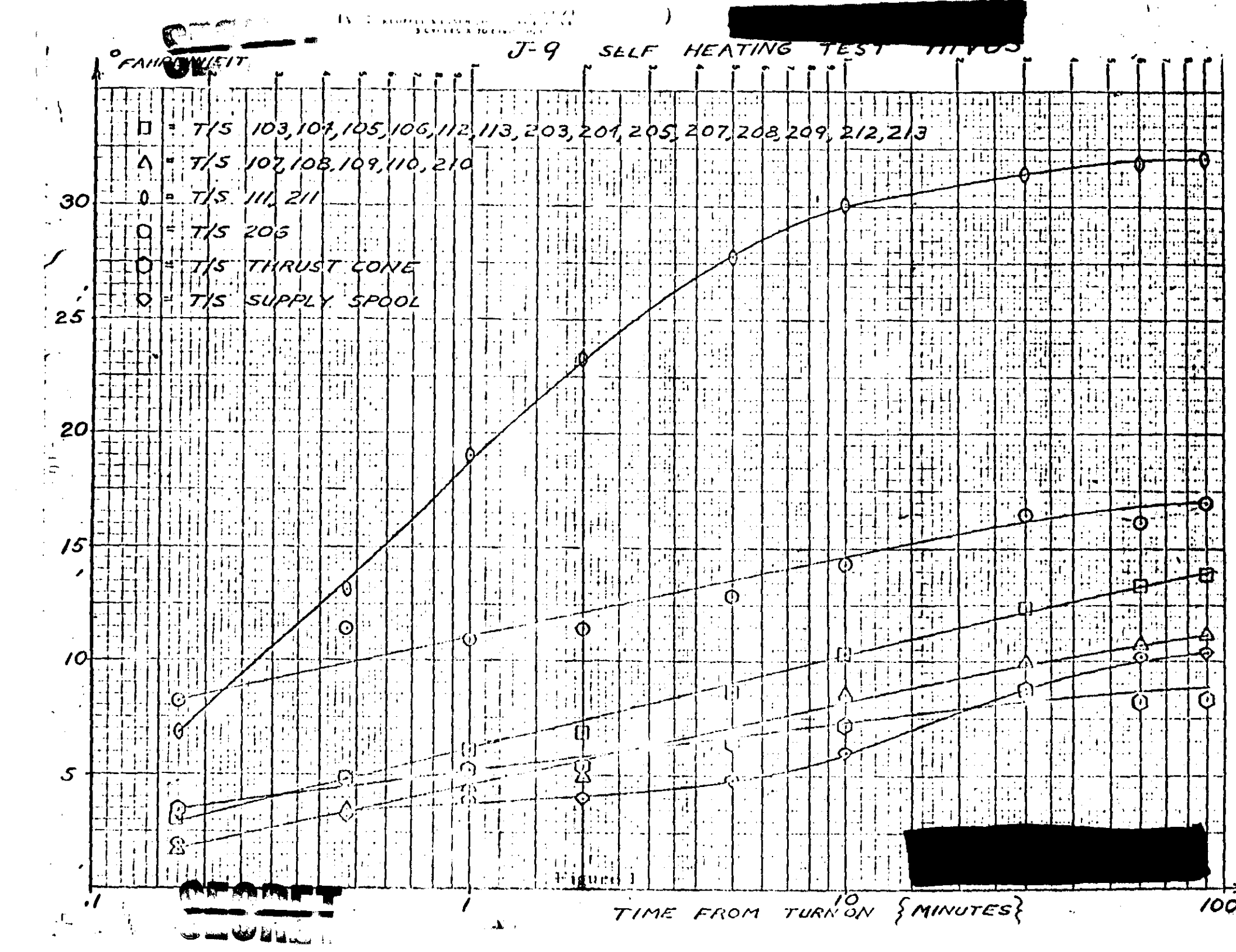
Day	Orbit	Instrument #1	Instrument #2
1	1	70^{o}	70^{o}
2	6	76^{o}	68^{o}
3	11	82^{o}	77^{o}
5	1	70^{o}	62^{o}
5	16	64^{o}	56^{o}
6	11	66^{o}	60^{o}

Pressure Summary

An alphatron gage was used to monitor the internal pressure of the system. A pressure make-up system was used for selected orbits during the "A" Mission. The pressure of the system passed through the suspected corona range during instrument operation without the use of the Pressure-Make-up System. Data taken from Selected Orbits are shown below:

Mission	Orbit	Mode	No. of Cycles	Pressure - Microns of Hg Start	End
A	2	Mono 1	40	15	33
A	2	Mono 2	40	23	40
A	42	Stereo	30	2	10
A	42	Mono 1	16	2	4.5
B	Confidence After Soak	Stereo	17	1.6	4.9
B	1	Stereo	23	1.4	5.0
B	Last	Mono 1	38	0.6	2.7
B	Last	Mono 2	29	0.6	3.4

Note: Pressure make-up system was not used during the operates listed above.


J-9 SELF HEATING TEST
°FAHRENHEIT
□ = T/S 103, 104, 105, 106, 112, 113, 203, 201, 205, 207, 208, 209, 212, 213
△ = T/S 107, 108, 109, 110, 210
0 = T/S 111, 211
○ = T/S 206
⬡ = T/S THRUST CONE
◇ = T/S SUPPLY SPOOL
30
25
20
15
10
5
.1
1
10
100
TIME FROM TURN ON {MINUTES}

[redacted]

D. VAFB TESTING

One main door ejector was replaced as it would not release within the specified pressure range.

E. IN-FLIGHT DATA

Instrumentation and Command Performance

The command system operated properly. No problems were reported. The Instrumentation System functioned normally, except the recovery system separation monitor (11-1-52), and the film footage pot consumption indicators (11-1-25, 31). All temp sensors, status points and continuous channels functioned normally.

The recovery system separation monitor (11-1-52) stepped to 0.9 volts at in-flight reset. The normal level was 0.5 volts. Preflight calibration indicated that 1.0 volts corresponds to "A" SRV demated and "B" SRV mated, and 0.75 volts correspond to "A" SRV mated and "B" SRV demated. Each condition could be caused by either one of two switches being improperly adjusted, allowing a switch to relax during vibration at inflight reset. Changes being considered to prevent recurrence are as follows:

1. Install a new type switch to provide more over-travel capability.
2. Change mounting to produce more over-travel.
3. Epoxy bond switch to mounting bracket after adjustment to prevent slipping.

The film footage pots, both missions, indicated approximately 10% less payload consumption than the cycle counter monitors. The voltage reading was approximately 5% less than was expected. It was determined that the tape recorder input impedance was 250K ohms and the VCO input impedance was 1.0 megohms. This results in a 200K load being connected to the film footage pot wiper during commutator sample time. The pot impedance is 20K maximum and this load reduces the output from a normal 5.0 volts to 4.75 volts. This loading would not appear on channel 8-2-56 and 8-2-47 as the load is only connected while channel 11 commutator is sampling the points. Future system calibration techniques will be revised to allow for VCO and T/R loading.

Panoramic Camera Performance

Both Panoramic cameras operated throughout both missions. Camera operation was monitored on 10 orbits during the flight. Significant items

[redacted]

[redacted]

of operation and malfunctions are as follows:

1. Slave center-format switch failed open on orbit 1[redacted] through mid-orbit 3.
2. Slave door failed to eject at inflight reset but ejected after orbit 2[redacted]
3. Master center-format switch failed closed intermittently after orbit 103.
4. First and second recovery performance was normal.
5. Maximum cycle rate deviations were 2.6 and 3.5 percent for the master and slave respectively.
6. Payload in both instruments was depleted at D-Timer start on orbit 128 over[redacted].

Two anomalies were noted with center-format switches. The first failure was noted on the Aft camera on orbit 1 over[redacted] where the center-format switch failed to close from frame 10 to the end of a 16-frame operation. Comparison of cycle counter readings and post-flight payload analysis showed that the switch is considered as the most probable cause of failure.

The second failure occurred on the Fwd camera center-format switch just after an operation on orbit 103 over[redacted] The center-format switch failed closed intermittently. The switch would close at the appropriate time, but would open randomly. A broken switch is considered to be the most probable cause of failure.

The following steps are being taken to prevent recurrence:

1. Modified techniques to check switch adjustment and operation.
2. Engineering investigation for a new type switch.

The Aft camera door failed to eject at inflight-reset. Telemetry data indicated that the squibs were initiated properly. The payload data report indicated that the slave camera door separated on frame 18 of orbit #3. Thermal deformation is considered as most likely cause of failure. The ejector held pressure and ejected the door when thermal equilibrium in the structure was reached.

The following changes were made to prevent recurrence of this problem:

1. Provide additional relief in areas where binding could occur.
2. Change attachment bolts from aluminum to titanium close tolerance bolts.

[redacted]

[redacted]

[redacted]

3. Increase torque from 40 - 50 inch/pounds to 100 + inch/pounds.
4. Install modified lifter bars.
5. Study paint change to modify thermal response.

Variations of the cycle period repeatability were evident throughout the mission with maximum errors of 2.6 and 3.5 percent for the master and slave instruments respectively. A tabulation of the cycle period data and percent error from the predicted cycle period are included in the listing below.

CYCLE PERIOD DATA

ORBIT	TIME UP RAMP	MASTER Nominal	MASTER Actual	MASTER % Error	SLAVE Nominal	SLAVE Actual	SLAVE %Error
1	2010	2.307	2.290	0.75S	2.322	2.322	0%
9	1010	3.791	3.777	0.37F	3.780	3.843	1.63S
25	1075	3.639	3.640	0	3.629	3.680	1.4 S
40	1136	3.503	3.488	0.43F	3.495	3.536	1.18S
56	1200	3.368	3.360	0.24F	3.361	3.413	1.54S
72	1266	3.220	3.230	0.3 F	3.237	3.290	1.6 S
88	1330	3.117	3.123	0.19S	3.160	3.193	1.04S
103	1390	3.003	3.01	0.2 S	3.004	3.070	2.2 S
110	2975	2.302	2.353	2.11S	2.318	2.400	3.54S
119	1457	2.860	2.923	2.20S	2.862	2.948	3.00S

The cut and wrap sequence occurred over [redacted] All operations, functions and switchover was normal.

The second recovery was initiated over [redacted] Tracking Station and all functions performed normally. At initiation both cameras were observed to be out of film. The 99/101% shuttles were on the take-up side indicating normal film depletion. The film length summary is:

	MASTER	SLAVE
Off Spool Length	210	210
Control Strips (Run through camera and retrieved)	82	64
Recovered in "A" Capsule	7,943	7,862
Recovered in "B" Capsule	7,879	8,005
TOTAL ON SPOOL	16,114 Ft.	16,141 Ft.

Note: Film length should be 16,000 ± 80 Feet

[redacted]

Stellar/Index Camera Performance

Mission 1006-1

The stellar camera functioned normally for 60% of the mission. The stellar shutter failed open, closed and double-pulsed for 40% of the frames taken during the mission.

The index camera functioned properly throughout the mission with no anomalies reported. Film depleted approximately 20 frames prior to the end of the Mission 1006-1.

Mission 1006-2

The stellar and the index cameras operated properly with no shutter, metering or recording abnormalities reported. The master center-format switch failure after orbit 103 caused the S/I to expose 279 frames instead of the nominal 428 frames.

Clock Performance

The clock operation was normal with the time accuracy within the reading accuracy of the analog records used for correlation. A linear clock offset of .209 seconds was indicated between orbits 9 and 126.

Recovery System Performance

Mission 1006-1

A successful air catch of the capsule was made on orbit 65. The impact point was within normal tolerances. All capsule re-entry events, except the thrust-cone physical separation switches, occurred within tolerance. This monitor indicated a 0.75 second delay between the separate signal and the switch actuation. Similar delays have been noted on previous recovery systems with delays ranging up to 1.0 seconds.

The condition of the recovered capsule was satisfactory with damage limited to normal paint blistering. Post-flight inspection and test showed no anomalies.

[redacted]

Below is a tabulation of the sequence to re-entry and recovery event times.

RECOVERY SEQUENCE OF EVENTS (Mission 1006-1)

Event	System Time	Delta Time Actual	Delta Time Nominal
Transfer	3703.84		
Elect. Disconnect	3704.91	1.07	$0.90^{+.430}_{-.400}$
Separation	3705.83	1.99 *	2.0 ± .25
Spin	3708.35	3.44 **	3.4 ± .30
Retro	3715.98	7.63	7.55 ± .45
Despin	3726.58	10.60	10.75 ± .54
T/C Separation	3728.84	2.26	1.5 ± .15
"G" Switch Open	4252.32	-	-
Parachute Cover Off	4285.71	33.39	34.0 ± 1.5
Drogue Parachute Deployed	4286.38	.67	0.75 ± .08
Drogue Parachute Released	4296.72	10.34	10.05 ± 1.5
Main Parachute Deployed	4297.26	.54	1.2 ± .15
Main Parachute Disreefed	4301.35	4.09	4.0 ± 1.7

* From Transfer

** From Electrical Disconnect

Spin Rate - 64.1 RPM

Despin Rate - 11 RPM

Retro Velocity 911 Ft/Sec

Recovery Battery Voltage At Arm 13.7 V

Mission 1006-2

The second recovery unit was successfully recovered by air catch on orbit 128. The impact point was within normal tolerances.

Post-flight inspections and tests showed all events to be normal. Damage to the recovery capsule was limited to normal blistering of paint.

[redacted]

[redacted]

Below is a tabulation of the sequence of monitored re-entry and recovery event times.

RECOVERY SEQUENCE OF EVENTS (Mission 1006-2)

Event	System Time	Delta Time Actual	Delta Time Nominal
Transfer	85696.72		
Elect. Disconnect	85697.76	1.04	$.9 \pm .43 \atop - .40$
Separation*	85698.82	2.10	$2.0 \pm .25$
Spin**	85701.19	3.43	$3.4 \pm .30$
Retro	85708.79	7.60	$7.55 \pm .4$
Despin	85719.49	10.70	$10.75 \pm .81$
T/C Separation	851721.04	1.55	$1.5 \pm .15$
Volt Monitor Closed	85806.96	85.92	100 ± 40
Volt Monitor Open	-	-	-
"G" Switch Open	86299.20		

Spin Rate - 65 RPM

Despin Rate - 12 RPM

Retro Velocity - 884 Ft/Sec.

* From Transfer

** From Electrical Disconnect

De-Activate/Re-Activate Performance

A vehicle de-activate sequence was initiated on orbit 133. All functions performed normally. The vehicle was re-activated again on orbit 149. The proper attitude and stability was regained and maintained.

A Lifeboat Real-Time Recovery Sequence was initiated on orbit 174. All vehicle functions performed as required.

The vehicle power was expended between orbit 191 and orbit 199 where all electrical functions were lost.

The vehicle orbital life ended on 6/17/64 or 6/19/64.

[redacted]

[redacted]

[redacted]

Temperature Summary

Temperature environment of the system is presented in Tables 3 and 4 on pages 18 and 19. Data were obtained from real-time orbits acquired at [redacted] Tracking Station. Self-heating corrections were made based on self-heating data taken during the HIVOS Environmental Chamber Tests. Self-heating correction curves were shown in Figure 1 on page 10.

[redacted]

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SENSOR	L	9	16	25	31	40	47	56	63	72	79	88	95	103	110
Focusing Barrel #1															
1	240+	42	98	45	106	42	106	45	103	11	–	11	37	11	34
2	240+	18	21	25	25	15	54	18	24	1	11	4	14	4	7
3	240+	6	35	10	35	10	35	10	32	21	107	24	115	24	102
4	240+	56	81	56	78	56	75	56	75	44	130	41	133	41	116
5	240+	83	113	88	111	82	105	76	99	49	87	40	87	40	78
6	240+	73	15?	70	154	67	118	67	138						
Barrel No. 2															
1	177	79	107	76	101	70	99	57	93	47	82	44	79	41	76
2	164	56	142	59	145	56	140	43	134	43	126	40	124	37	115
3	208	14	87	20	95	20	95	23	95	17	87	17	95	17	87
4	210	6	13	7	13	7	13	10	13	0	7	3	3	7	7
5	185	21	47	21	44	25	44	25	44	12	31	9	34	15	31
Conic Adapter															
1	178	59	92	59	92	59	86	66	83	43	71	36	71	36	59
Clock															
1	99	71	75	73	73	73	73	73	73	62	62	60	65	60	58
2	103	69	73	71	73	73	72	71	71	58	60	60	60	60	56
Thrust Cone															
1	130+	46	46	44	44	42	44	44	44	48	46	47	46	48	43
2	67	69	63	64	60	64	59	62	55	60	56	56	55	56	54
Stellar Index															
1	88	67	70	64	67	64	64	64	64	55	55	51	55	55	51
2	77	67	64	67	64	64	61	64	61	45	42	42	42	45	39
Recovery Batt. #1															
1	67	68	68	65	66	65	64	64	64	78	75	74	84	74	82
Master Cassette															
2	94	58	54	54	53	53	51	53	52						

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TABLE 3

SENSOR																
Vector	1	9	16	25	31	40	47	56	63	72	79	88	95	103	110	119
3	56	57	55	55	57	55	53	56	62	48	46	47	44	47	43	47
4	65	63	62	61	64	62	57	61	57	55	52	53	50	53	49	53
5	59	68	67	66	66	65	62	64	62	60	56	57	55	57	53	56
6	57	79	75	77	67	75	90	73	69	69	63	65	61	64	61	64
7	62	79	76	75	74	73	72	72	73	69	65	66	64	65	63	65
8	66	72	69	69	67	68	64	66	66	62	58	62	57	60	55	59
9	61	76	71	71	71	71	66	71	68	66	61	63	59	63	58	53
10	60	72	73	69	72	69	68	69	69	62	62	60	62	59	58	59
11	73	72	75	70	76	69	71	70	69	61	62	68	51	58	58	58
12	67	59	57	57	60	56	55	57	54	53	48	50	47	49	45	49
13	61	79	77	76	77	75	71	75	71	69	64	64	60	64	61	62
Slave																
3	54	74	74	71	76	71	72	70	69	64	62	61	59	63	58	59
4	61	73	71	72	73	74	70	71	68	66	62	64	58	67	58	63
5	55	68	65	66	66	68	61	65	62	63	56	58	53	61	52	56
6	53	62	61	62	62	65	59	61	59	59	53	53	51	56	49	53
7	53	63	68	66	69	69	64	65	63	63	57	58	56	58	54	56
8	55	64	63	64	64	66	51	63	58	59	55	57	51	58	51	54
9	56	58	57	58	60	60	54	58	53	55	49	52	48	54	56	56
10	61	70	74	69	73	70	69	68	72	65	61	60	61	63	59	59
11	68	60	58	60	61	64	56	61	57	56	54	54	60	58	52	54
12	58	68	66	66	69	68	64	66	63	63	57	58	55	61	52	56
13	61	73	72	71	74	74	68	70	69	66	63	61	65	65	60	61
Supply Spool																
1	57	55	53	58	58	59	55	58	57	56	51	51	50	50	47	51
2	61	62	61	62	64	64	60	62	62	60	54	57	53	55	51	54

TABLE-4

[redacted]

SECTION III

MASTER (FWD) PANORAMIC CAMERA

A. COMPONENT ASSIGNMENT:

Component	Serial Number
Main Camera	148
Main Camera Lens	1242435
Supply Horizon Camera	161B
Supply Horizon Camera Lens	813549
Take-up Horizon Camera	157A
Take-up Horizon Camera Lens	812206
Supply Cassette	SC-11

B. CAMERA DATA AND FLIGHT SETTINGS:

Main Camera:

Lens	24" f/3.5
Slit Width	0.200"
Filter Type	Wratten 21
Film Type	Eastman Type 4404

Supply (Port) Horizon Camera:

Lens	55mm f/6.8
Aperture Setting	f/6.8
Exposure Time	1/100 seconds
Filter Type	Wratten 25

Take-up (Starboard) Horizon Camera:

Lens	55mm f/6.8
Aperture Setting	f/8.0
Exposure Time	1/100 second
Filter Type	Wratten 25

[redacted]

C. PRE-FLIGHT DATA

Camera number 148 was received at A/P on 27 January 1964 for contractor Receiving Inspection and Acceptance Testing. During these phases the following problems were encountered and action taken:

1. The horizon camera fiducial lamps were inoperative. The burned out lamps were replaced.
2. The intermediate roller assembly would not turn freely. The assembly was replaced as a defective bearing was located.
3. The shuttle assembly did not move freely. This anomaly was waived by Itek.

The camera underwent the normal System Functional Test during which the sticky shuttle assembly caused Fail-Safe #1 to trip. Disassembly of the shuttle determined that some epoxy was in the bearings; the items were cleaned and reinstalled. The cycle rate check recorded rates that were approximately 3% slower than the original settings. The tachometer motor voltages were adjusted to produce the correct rates. The dynamic photographic resolution test results are shown in Figure 2, page 22.

The V/H potentiometer was replaced during Environmental Testing as noise developed at the top of the ramp. The corona discharge marking was confined to the third frame after start and was considered within the acceptable level.

A new design V/H potentiometer was installed during VAFB testing and the V/H transducer with gold plated stepper switch contacts was incorporated.

D. IN-FLIGHT DATA

The detailed summary of the telemetry data obtained during the mission is in Section II. The failure of the center-of-format switch at the start of pass D103 during Mission 1006-2 was observed in-flight.

E. POST-FLIGHT PERFORMANCE EVALUATION

The photographic quality of the FWD camera film was excellent. This is primarily attributed to the processing of the original negative which was much closer to the exposure-processing criteria than achieved on previous missions. The informational content of the photography was exceptionally high because of the low perigee which improved the scale factor by 10% to 15%. The abnormal V/H error that resulted from the orbital anomalies did not significantly affect

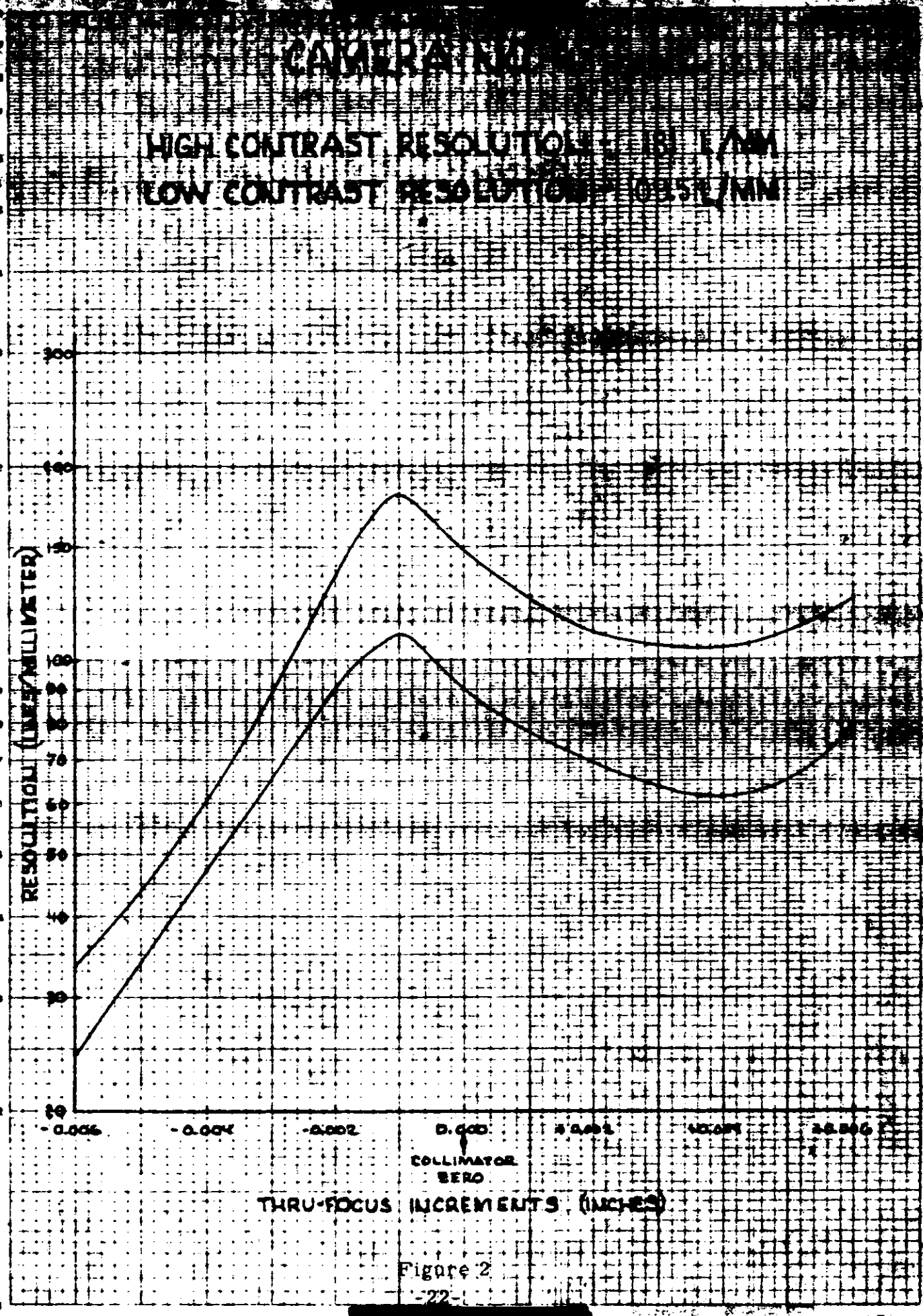
HIGH CONTRAST RESOLUTION: 181 L/MM
LOW CONTRAST RESOLUTION: 0.85 L/MM
RESOLUTION (LINES/MILLIMETER)
300
200
100
90
80
70
60
50
40
30
20
- 0.006
- 0.004
- 0.002
0.000
COLLIMATOR ZERO
THRU-FOCUS INCREMENTS (INCHES)

Figure 2

the resolution of the imagery as the error was below 15.4% during 90% of Mission 1006-1 operations and 11.6% for 90% of Mission 1006-2 operations. The analysis of image smear is contained in Section XV.

The camera center-of-format switch failed intermittently from the start of pass D103 to the end of the mission. This resulted in the loss of the binary data block time word, normal end of pass marks and horizon fiducials. The horizon cameras continued to function however the images were heavily smeared. Testing subsequently conducted by Itek simulated this failure mode when one of the dual center-of-format switches, #S-104, operated normally while the second switch, #S-105, was continually closed.

The dual switches were incorporated to improve reliability; however they actually reduced the reliability. As a result switch #S-105 has been removed from the circuit as recommended by Itek.

During the period of proper center-of-format switch operation the data block, end-of-pass mark and horizon cameras operated properly. The 200 cps time track functioned properly throughout both missions.

The starboard horizon camera photography was very soft through pass D35. The quality was somewhat improved thereafter however it was significantly inferior to the quality of the port camera photography. This was the first case of poor imagery since the incorporation of the 55mm horizon camera lenses. Several theories exist as to the cause of the poor quality however the current studies have been inconclusive to date.

The micro-densitometer traces made of the typical port and starboard horizon line photography are shown in Figure 3, page 24. The poor starboard photography is shown by the low slope of the pass D06 trace and the improvement after D35 corresponds to the increase in slope. The port image trace shows the normal slope that results from usual horizon camera photography.