[redacted]

CORONA J

PERFORMANCE EVALUATION REPORT

MISSION 1107-1 and 1107-2

FTV 1652, CR-7

Approved [redacted]
Manager
Advanced Projects

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Program [redacted]

FOREWORD

This report details the performance of the payload system during the operational phase of the Program [redacted] Flight Test Vehicle 1652.

Lockheed Missiles and Space Company has the responsibility for evaluating payload performance under the Level of Effort and "J" System contracts.

This document constitutes the final payload test and performance evaluation report for Mission 1107 which was launched on 24 July 1969.

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INTRODUCTION

This report presents the final performance evaluation of Corona Mission 1107. The purpose of the report is to define the performance characteristics of the CR-7 payload system and to evaluate the technical aspects of the Mission, including analysis of in-flight anomalies.

The payload system was assembled, tested, and certified for flight at the Advanced Projects (A/P) facility of Lockheed Missiles and Space Company (LMSC). A/P also provided services including pre-flight mission parameter planning, and mission reporting to the community. The initial evaluation of the recovered film was made by NPIC personnel at the processing facility. The Performance Evaluation Team (PET) meeting at NPIC included representatives of LMSC, ITEK Corporation, Eastman Kodak Company, and cognizant government organizations. Off-line evaluation was performed at facilities of individual contractors, using engineering photography acquired over the United States.

The quantitative data summarized in this report is originated by governmental and contractor organizations. Diffuse terrain density and target density measurements are produced by the Air Force Special Projects Production Facility. The Processing Summary report is provided by [redacted]

These quantitative data are used by A/P computer programs to provide processed information allowing correlation of operational photographic conditions with image quality. Analyses are made of image smear components, limiting ground resolution, and exposure/processing data.

SECTION 1

MISSION SUMMARY

A. MISSION DESCRIPTION

Corona Satellite Mission 1107 was planned to acquire cartographic and reconnaissance photography of selected terrain areas. Two mission segments were planned to total eighteen days of orbital operation. Each mission segment would return approximately 6000 panoramic frames and each frame would nominally cover 1725 square miles.

The flight configuration included a THORAD booster and AGENA satellite vehicle. The on-orbit support provided by the AGENA includes real time command and telemetry links, electrical power, stored payload program timer, and attitude stabilization and control.

The payload was a J-3 configuration, consisting of a space structure containing two panoramic cameras and associated control/support equipment and recovery subsystems for each mission segment.

The flight system was launched into the planned orbit from Vandenberg AFB at 0131 GMT on 24 July 1969 (1831 PDT, 23 July 1969).

Mission 1107-1 was successfully completed by a water recovery after nine days of flight. The second mission segment was completed with an air-catch after an additional ten days of orbital flight.

The aft-looking panoramic camera number 314 operated satisfactorily throughout Missions 1107-1 and 1107-2. At film depletion, the film end was passed into the recovery system with no wrap-up.

The forward-looking panoramic camera number 315 had a film transport failure on the 13th cycle of the first on-orbit operation. It did not operate thereafter.

The DISIC stellar-terrain camera performed normally during the -1 mission and most of the -2 mission. The system failed during an independent operation on the seventeenth day of the flight.

Photographic performance of the aft-looking panoramic camera was judged as fair. The lack of stereo coverage was considered a significant user problem. DISIC photography was considered generally satisfactory.

B. FLIGHT CONFIGURATION

Mission No.	1107
Vehicle No.	1652
System No.	CR-7
Forward Looking Camera Serial No.	315
Aft Looking Camera Serial No.	314
DISIC Camera Serial No.	11

Lens Data

Forward Looking Camera (Main Lens)

Lens Serial No.	I 208
Measured Slit Width (Inches)	
Position 1	0.168
Position 2	0.215
Position 3	0.268
Position 4	0.335
Failsafe	0.298
Optics Filter Type	
Primary	W-23A
Alternate	W-21
E.O. Focal Length (Inches)(Vacuum)	24.002

Resolution	
Static (Lines/Millimeter)	
Filter	W-21
High Contrast	299
Low Contrast	201
Dynamic (Lines/Millimeter)	
ITEK Post-Vibration	
Filter	W-25
High Contrast	283
Low Contrast	198
A/P Test	
Filter	W-25
High Contrast	303
Low Contrast	207
Distortion/Pincushion (MM)	
Angle Off Axis (Deg.)	
3	0.003
2	0.002
1	0.000
0	0.000
359	0.000
358	0.001
357	0.002
Aft Looking Camera (Main Lens)	
Lens Serial No.	I-191
Optics Slit Width (Inches)	
Position 1	0.122
Position 2	0.160
Position 3	0.204
Position 4	0.255
Failsafe	0.219

Optics Filter Type

Primary	W-21
Alternate	SF-05
E.O. Focal Length (Inches)(Vacuum)	24.003

Resolution (Lines/MM)

Static

Filter	W-21
High Contrast	278
Low Contrast	151

Dynamic (Lines/MM)

ITEK Post-Vibration

Filter	W-21
High Contrast	266
Low Contrast	136

A/P Test

Filter	W-21
High Contrast	269
Low Contrast	141

Distortion/Pinchushion (MM)

Angle Off Axis (Deg.)	
3	0.002
2	0.001
1	0.000
0	0.000
359	0.000
358	0.000
357	0.002

Horizon Optics

Forward Looking Camera

Take-up (Starboard)

Lens Serial No.	315G3
Exposure Time (Sec.)	1/100
Aperture	F/8.0
Filter Type	W-25
Oper. Focal Length (MM)	54.83
Radial Distortion (MM)	
10 Deg. Off Axis	0.005
20 Deg. Off Axis	0.04
Tangential Distortion	0.02

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	106	165	163	143	130	134	32
(Tangential)	187	164	161	148	103	86	55

Supply (Port)

Lens Serial No.	315G4
Exposure Time (Sec.)	1/100
Aperture	F6.3
Filter Type	W-25
Oper. Focal Length (MM)	55.00
Radial Distortion (MM)	
10 Deg. Off Axis	0.01
20 Deg. Off Axis	0.04
Tangential Distortion	0.02

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	187	186	163	127	88	150	51
(Tangential)	166	164	161	138	116	96	62

Aft Looking Camera

Take-up (Port)

Lens Serial No.	314G1
Exposure Time (Sec.)	1/100
Aperture	F/6.3
Filter Type	W-25
Oper. Focal Length (MM)	55.00
Radial Distortion (MM)	
10 Deg. Off Axis	0.015
20 Deg. Off Axis	0.05
Tangential Distortion	0.03

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	187	186	184	127	124	150	64
(Tangential)	187	185	161	138	116	96	62

Supply (Starboard)

Lens Serial No.	314G2
Exposure Time (Sec.)	1/100
Aperture	F/8.0
Filter Type	W-25
Oper. Focal Length (MM)	55.00
Radial Distortion (MM)	
10 Deg. Off Axis	0.005
20 Deg. Off Axis	0.05
Tangential Distortion	0.03

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	187	186	206	181	156	134	45
(Tangential)	187	185	181	155	130	109	62

DISIC Camera

Port Stellar Camera

Lens Serial No.	7P
Reseau Serial No.	7P
Aperture	F2.8
Exposure Time (Sec)	1.5
Nominal Focal Lengh (In)	3.0
Filter	None

Starboard Stellar Camera

Lens Serial No.	14
Reseau Serial No.	14
Aperture	F2.8
Exposure Time (Sec)	1.5
Nominal Focal Length (In)	3.0
Filter	None

Terrain Camera

Lens Serial No.		113	
Reseau Serial No.		113	
Filter Type		W-12	
Aperture		F6.3	
Exposure Time (Sec)		1/250 or 1/500	
Nominal Focal Length (In)		3.0	
Resolution (Hl Contrast (L/MM)			
Angle Off Axis (Deg.)	0	7.5	15
(Radial)	144	121	140
(Tangential)	114	114	89
Film Type		3400	
Filter		W-12	

Film Types

Forward Looking Camera

Split Load	Yes
Film Type	3404/3401
Length (Ft.)	16,200 & 100
Splices	7 MYLAR
Length Between Splices (Ft.)	2750-3400-3325-3390-2660 675-MCD-100C
Emulsion Data	3404-441-5-7-9/3401-309-2
Payload Weight (Lbs.)	81.5
Spool No.	112A
Box Serial No.	69

Aft Looking Camera

Split Load	No
Film Type	3404
Length (Ft.)	16,300
Splices	6 Permacel
Length Between Splices (Ft.)	2155-3495-3530-3550-3545-MCD-25C
Emulsion Data	3404-442-10-7-9
Payload Weight (Lbs)	80.7
Spool No.	216B
Box Serial No.	69

DISIC Camera

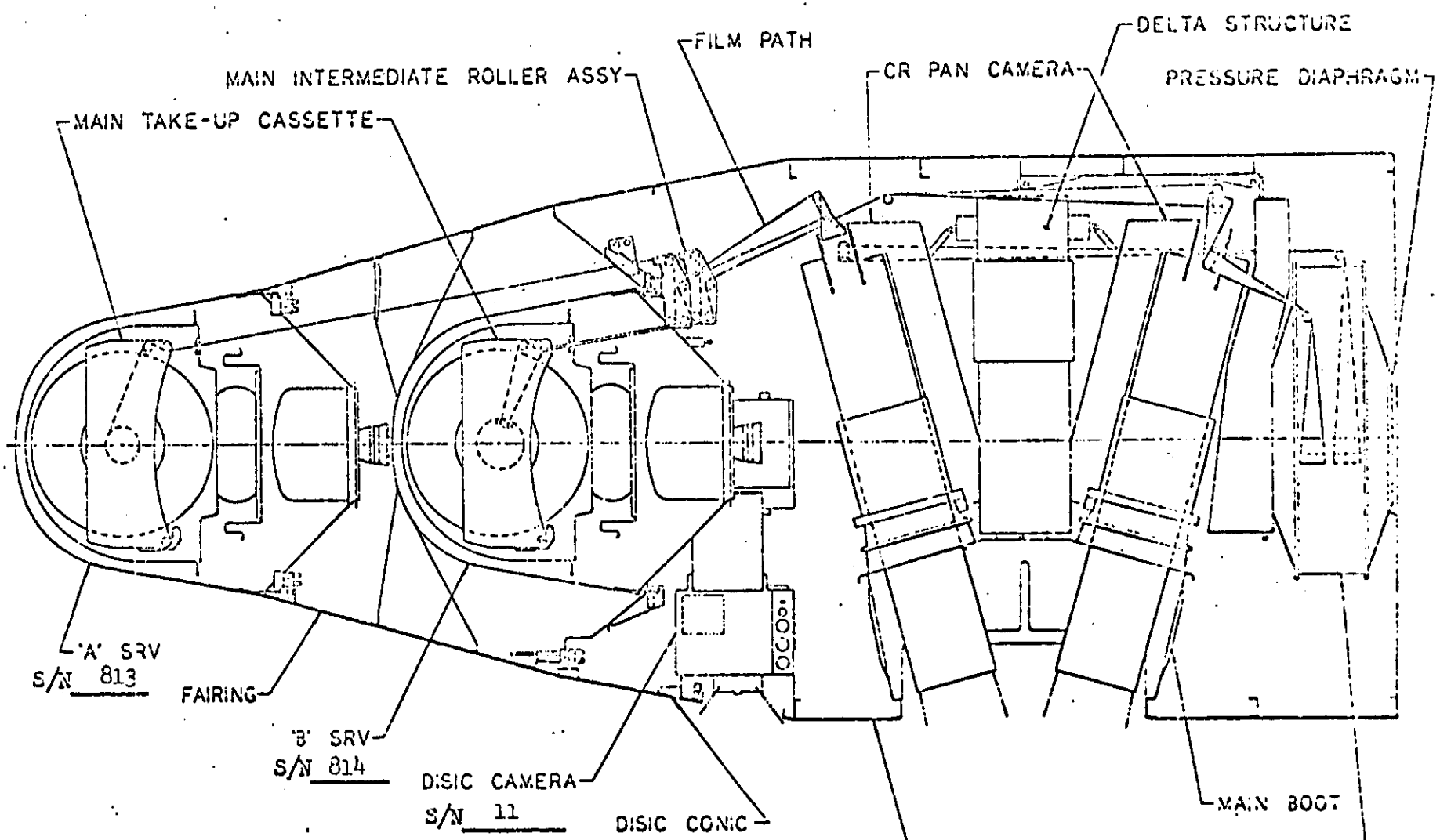
Stellar Camera

Split Load	No
Film Type	3401
Length (Ft.)	2000
Splices	None
Emulsion Data	14 JC-1212-4-9
Payload Weight (Lbs.)	7.2-1.7

Terrain Camera

Split Load	No
Film Type	3400
Length (Ft.)	2200
Splices	None
Emulsion Data	3400-202-4-4-9
Total Film Weight (Lbs.)	22.3-19.9

PAYLOAD PROFILE AND SERIAL NUMBERS



SYSTEM NO. CR-7

TEST 1107

PNU S/N 1009

SLOPE PROGRAMMER S/N 207

CLOCK S/N 630

SWITCH PROGRAMMER S/N 207

FIGURE 1-1

SECTION 2

PRE-FLIGHT SYSTEMS TEST

A. SUMMARY

As a standard procedure, the J payload systems are subjected to a series of tests with flight type film which demonstrate that the system will perform as required during flight. The principal tests include the following:

1. Exposure of the J payload to a thermal/altitude environment that approximates flight conditions.
2. A system light leak test that ascertains the light tight integrity of the J system.
3. A dynamic resolution test that determines the high and low contrast resolution characteristics of each panoramic camera.
4. A flight readiness test that assures that the payload is acceptable prior to loading with flight film.
5. A flight certification that establishes the flight worthiness of the complete payload including the flight film.

The CR-7 system successfully passed all phases of the testing operations providing acceptable performance and a high degree of operation confidence.

B. ENVIRONMENTAL TEST

The CR-7 system was subjected to three environmental tests between February and June 1969.

First Environmental Test. This test was performed at the Sunnyvale HIVOS facility from 26 February 1969 thru 4 March 1969, with the system configured for AGT. Approximately 14,700 feet of SC-230 material was used in each main instrument. Material in the Terrain and Stellar units was 3400 and 3401 respectively. The AGT configuration required disabling the 200 Hz timing lamp circuit.

From evaluation of processed film, it was concluded that corona marking of camera #314 was within acceptable levels, but the corona marking of camera #315 was not acceptable. Corona marking of the DISIC #11, Stellar 3401 film was severe and not acceptable. The marking of the DISIC Terrain 3400 film was within acceptable levels.

Main camera #315 film indicated that no time word, H/O shutter, or fiducial markers were present after an early part of the test. Inspection of the DDSC indicated a Schmidt trigger failure.

The DSR unit functioned satisfactorily except for one anomaly during the register load in Rev. 12B. DSR memory did not clear when the UHF (Load Enable) was sent. Hence, a new load was transmitted and loaded on top of the existing memory load. This anomaly was also experienced in other tests. A new DSR was substituted for subsequent tests.

The Switch Programmer failed to time out correctly during 9 revs. Investigation revealed that the reset/start relay wiper contact was too critical for both wipers to make/break simultaneously. A modification to both the Slope and Switch Programmer boxes was accomplished to rectify the problem.

A pulsing network was added to the PMU system in order to obtain a 60 micron pressure range when PMU is enabled. HIVOS test records indicate that the 60 micron range was not met. This apparently was due to the delta time selected of the pulsing network and only 30 microns were experienced. A change in delta times was made for subsequent tests.

A clock/IRIG time correlation was computed to verify clock accuracy. Accumulative clock error, over a 72-hour period, averaged .010 seconds/day.

The telemetry system operation was normal throughout test except for some spurious noise levels on certain T/M monitors during camera operations. This was investigated and it was found that the return lines of the T/M points were not isolated from unreg return in the recording equipment. This was corrected prior to CR-7 returning to second chamber test.

The SRV tape recorder systems functioned satisfactorily throughout both phases of the HIVOS chamber test. There was however, some difficulty with the ADAPS playback equipment (Ampex recorder) and some data had to be reprocessed to validate system performance.

Second Environmental Test. The CR-7 system was environmentally retested at the Sunnyvale HIVOS facility between 26 March and 1 April 1969. The pan camera film requirement was changed to 3404 film. Approximately 2560 cycles (6800 feet) was run on each pan camera. 3400 film and 3401 film were used in the DISIC Terrain and Stellar units respectively.

Major changes in the system configuration were: Use of test forebodies rather than flight forebodies; installation of new film metering rollers in camera #315; modification of wiring to Switch and Slope Programmers; and adjustment of PMU timer settings.

Camera #314 produced low density corona affecting 70 frames at pressures of 5 to 35 um. of Hg. Camera #315 produced very low density corona affecting 40 frames at pressures of 2.2 to 5.5 um. of Hg. Neither camera produced corona at the normal operating pressures of 50 to 57 um. of Hg.

DISIC #11 Terrain film marking was within acceptable levels. Marking on the Stellar film was much improved from the first HIVOS test. A low density streak, 0.02 to 0.08 density above base fog, affected 20 per cent of the frames. Since this anomaly would not significantly affect program objectives, a waiver was requested and granted.

The delta time settings for the pulsing PMU network did not allow the internal pressure range requirement of 50 microns to be met. A recorded pressure of 35 microns was experienced. The external PMU test box was utilized to control the pressure range. Uncle commands U103 and U104 were commanded to position 8, the alternate filter position. A pressure of 35 microns was also experienced in this configuration. If the PMU system had been working properly approximately 17 microns of pressure should have been experienced. Post chamber test indicated a failure in the internal "B" timing circuit.

The Exposure Control System and FMC System performance was normal.

The following problem occurred in the Command System: Uncle 104 stepped several times during the test, as a result of permacel splices. Uncle 103 however did not step when the permacel splice passed through Instrument 314. This was subsequently found to be due to MCD circuit sensitivity characteristics and not readily changed. The final flight requirements for the system did not include a mixed film load and the MCD circuit was disabled.

The DSR failed during this test. After two hours of operating on 3-29-69 (1500 seconds into Rev 2) the DSR lost frame and word sync, then produced a T/M readout of one's, zero's, and repeat bits that did not correspond to memory. A few minutes later the T/M readout went to a continuous T/M level. During the night the temperature decreased about 10°F, and the DSR functioned normally in the morning. However, after two hours of operation the temperature rose about 10°F, and the DSR malfunctioned in the same manner. The temperature of the components located near the DSR was 110°F at the time of failure. This DSR was subsequently replaced by one that did not have the temperature/pressure sensitivity.

The cycle rates were acceptable throughout the test. The rates were running approximately ½% fast on both instruments. The per cent deviation between the two instruments was approximately ½%, with Instrument 314 running faster.

Third Environmental Test. At the request of the Resident Office, a third HIVOS test was conducted on the CR-7 system during the period 6 to 11 June 1969. A primary purpose of this test was to obtain data on corona marking characteristics of SO-180, a reversal-type, false-color film, with extended infrared

sensitivity. Both main instruments utilized supply rolls consisting of 2,000 feet of 3404 film, followed by 3,000 feet of SO-180. Material used in the DISIC terrain and stellar units was 3400 film and 3401 film. Testing was conducted at pressures ranging from 0.4 to 220 um. of Hg.

On the 3404 film, a small amount of low density corona marking (acceptable) was found from camera #314. This occurred at an internal pressure of 28 um. of Hg. No significant marking was found on the 3404 film from camera #315.

On the SO-180 material, camera #314 generated severe corona marking at all pressures. Camera #315 was relatively clear except for start-up marking and some low density marks associated with the SLP pressure pad. Since it had been decided not to fly SO-180 film in this system, these results were not significant.

The main instruments operated satisfactorily throughout the test except for one malfunction. Cycle rates were computed and the results indicated that at top-of-ramp the rates were running 10.5% slow. Post-chamber testing revealed that the Limiter in Instrument No. 1 was not allowing either panoramic instrument to run at a rate faster than 1.72 sec/cycle. This anomaly was rectified and tested.

T/M data from the DISIC unit indicated satisfactory operation throughout the test except for one anomaly. The T/M monitor did not indicate that the shutter was firing. Post-inspection of the material verified that the shutter operated properly.

The DSR unit was loaded with three simulated flight loads and two malfunctions were noted. The first malfunction was the failure of the output register to shift the executed word out and the new word in. The second malfunction was

the failure of the operate monitor to indicate that an execute had been given. After completing the standard chamber requirements, a special DSR checkout was accomplished at altitude environment. Neither of the failures could be repeated. Another test was conducted after the system was returned to A/P and the DSR was exercised approximately 500 cycles. No anomalies occurred and the DSR is considered flightworthy. The preceding anomalies were the only failures in the command system during chamber testing.

All Timer events from the Switch and Slope programmers occurred as programmed.

A clock accuracy check was computed and results indicated an error of approximately 10 milliseconds/day. This is well within reading error and specification limit.

The pulsing PMU system was tested in the chamber prior to orbital cycling and again during orbital cycling. No anomalies occurred. Gas consumption rate could not be determined due to the abbreviated chamber test.

Film Flatness Tests. Although the first environmental test was configured for AGT, the data were not read at A/P, but were forwarded to Boston. This test, performed on SO-230 (STB) film, was reported to have indicated satisfactory flatness. However, with the change to 3404 film, also STB, but coated differently from SO-230, the test results were not considered directly applicable.

After the second environmental test, there was concern that soft-appearing rail lamp images from camera #315 might be indicative of film movement or a non-flat condition. An AGT on camera #315, using 3404 film, was run on 28 May 1969. The results were evaluated separately by Boston and A/P personnel. The results

of these evaluations were similar with the A/P data indicating more marginal performance along the time word edge of the format than did the Boston data. It was concluded that the extent of flatness variability did not warrant corrective action.

C. LIGHT LEAK TEST

A standard system light leak test was performed on the CR-7 system on 18 November 1968. The panoramic cameras were loaded with 3401 film. The system was placed in flight configuration and was exposed to external illumination calculated to produce a fog density equivalent to that encountered on four orbits of flight using 3404 film. After this exposure, the film was retrieved and processed at the "full" level.

Film from each camera contained one high density fog spot. The source of this fog on each film was traced to one source at the forebody/fairing interface. This was the pin puller teardrop fitting on the -Z axis. This source of light leakage was eliminated by adjustment of a rubber light shield at the teardrop fitting. Subsequent light searches using photometers verified that the leak had been eliminated.

D. RESOLUTION TEST

A thru-focus dynamic resolution test of the CR-7 system was performed on 30 April 1969. This was after the second environmental test but before the third one. The maximum low contrast resolution of camera #314, using a Wratten 21 filter, was 145 lines per millimeter at the -0.001 inch focal position. The maximum low contrast resolution of camera #315, using a Wratten 25 filter, was 220 lines per millimeter at the zero focal position. It is noted that the camera

#314 lens was a second generation type, while the camera #315 lens was a third generation type.

Following the third HIVOS test, on 21 June 1969, a final resolution test was performed to verify the location of peak focus. The following results were obtained.

Pan Camera #314

Maximum high contrast resolution: 269 lines/mm at -0.001" focal position.

Maximum low contrast resolution: 141 lines/mm at -0.001" focal position.

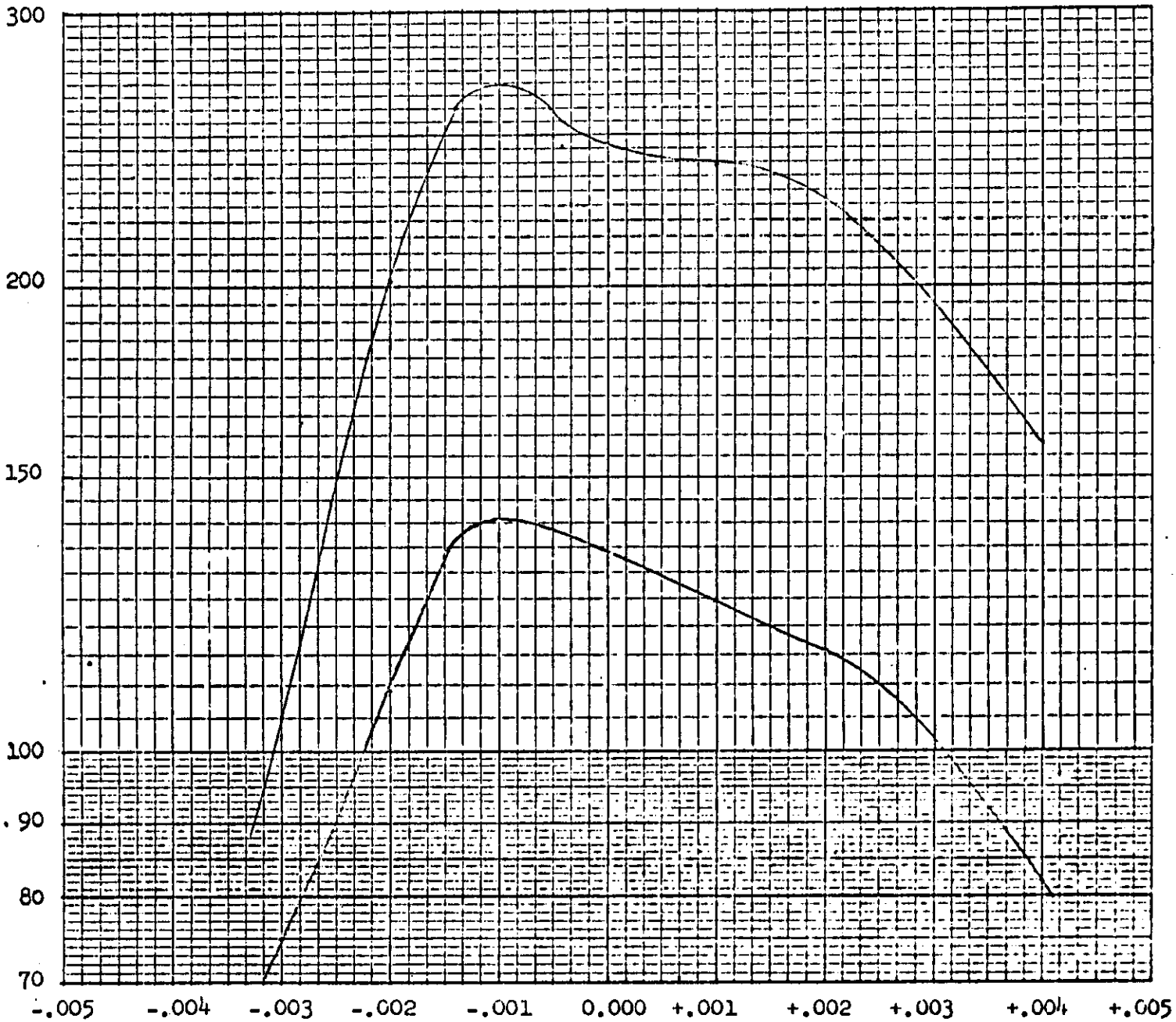
Pan Camera #315

Maximum high contrast resolution: 303 lines/mm at the zero focal position.

Minimum low contrast resolution: 207 lines/mm at the zero focal position.

The results of this final thru-focus resolution test are plotted in Figures 2-1 and 2-2 for panoramic cameras #314 and #315 respectively.

PRE-FLIGHT RESOLUTION, PAN CAMERA #314



Camera No. 314

Payload No. GR-7

Resolution (l/mm)

High Contrast: 269

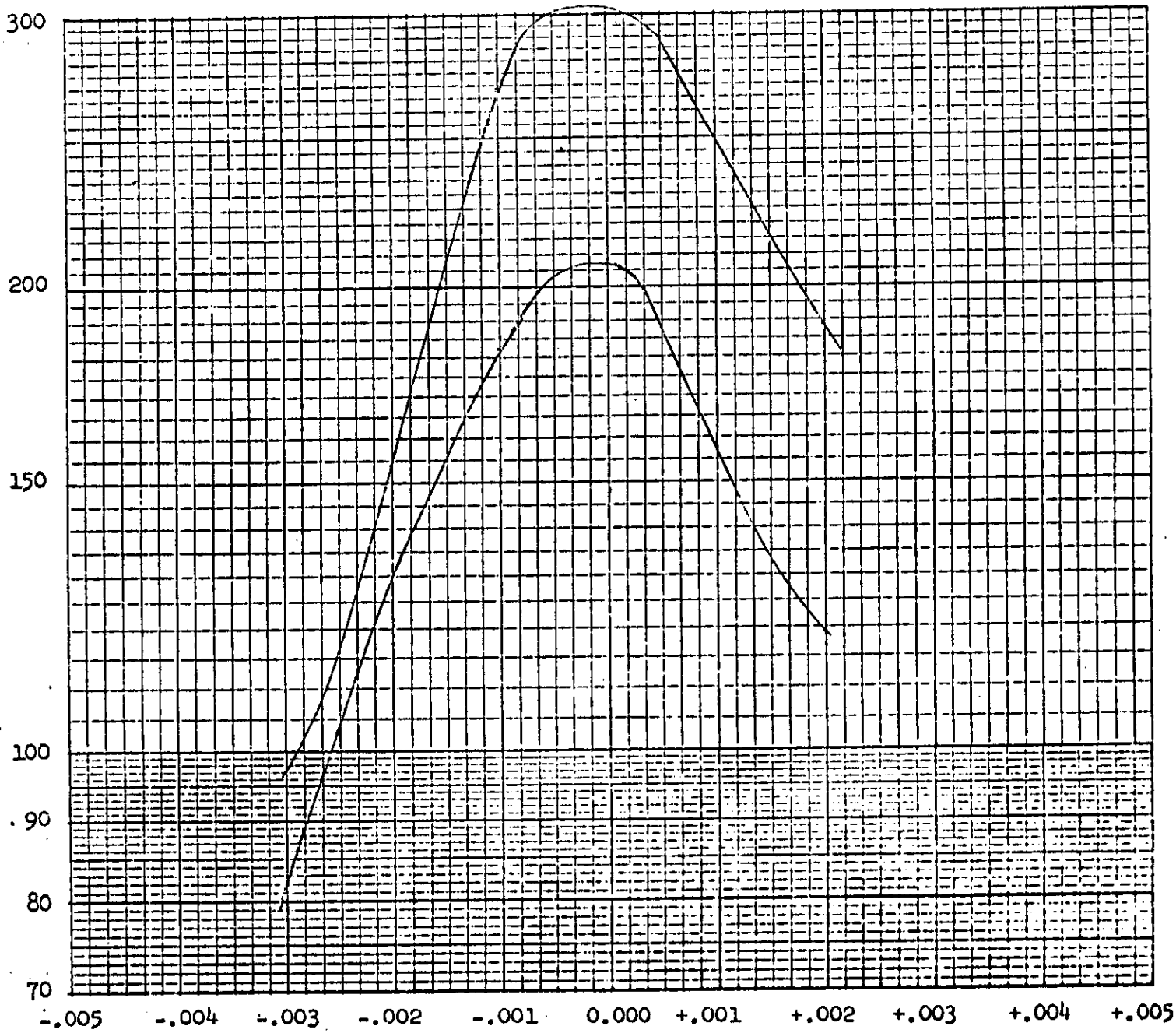
Low Contrast: 141

Film Type: 3404
W-21 filter

Test Date: 6-21-69

FIGURE 2-1

PRE-FLIGHT RESOLUTION, PAN CAMERA #315



Camera No. 315

Payload No. 68-7

Resolution (1/mm)

High Contrast: 303

Low Contrast: 207

Film Type: 3404
W-25 filter

Test Date: 6-21-69

FIGURE 2-2

E. FLIGHT READINESS TEST

DISIC flight readiness was performed on 9 July 1969. All data were present and acceptable. The usual skew bead mark was present along one edge of the Stellar film but did not enter the active format at any point.

Reseau fogging at the center of the Stellar format averaged +.30D gross on the starboard format and +.32D gross on the port. The base was +.12D, leaving a net fog of +.18D for the starboard and +.20D for the port.

Flight readiness was performed on pan cameras #314 and #315 on 11 July 1969. All data were present and acceptable for flight.

Slit image measurements were as follows:

	Aft, #314	Forward, #315
S4	0.255"	0.335"
S3	0.204"	0.268"
S2	0.160"	0.215"
S1	0.122"	0.168"
Failsafe	0.219"	0.298"

F. FLIGHT CERTIFICATION

Flight loading of the DISIC was performed on 12 July 1969. The pan cameras were loaded on 14 July 1969. Both were without incident. Sensitometric measurements made on samples of this flight film for both pan cameras and DISIC verified satisfactory photographic characteristics. Film types evaluated were 3400, 3401 and 3404.

Film tracking was acceptable during dynamic operation. Rail scratching was slight on #315, and moderate on #314.

Final photometer check for light leaks showed a slight leak alongside the drum on Camera #315. The only other leak was at the silver dollar where the strap that grounds the payload frame to the vehicle frame passes through the dollar. This hole is potted at the base at the time of mating to the vehicle.

The photographic performance of the CR-7 was certified for flight.

SECTION 3

FLIGHT OPERATIONS

A. SUMMARY

Mission 1107 was launched normally into the planned orbit without incident. All ascent and injection events occurred as programmed. The orbit achieved was within the 3 sigma predicted dispersions. The total mission lasted for 19 days with an 9-day first segment and a 10-day second segment.

The aft-looking panoramic camera #314 operated satisfactorily throughout the flight. Forward-looking panoramic camera #315 had a film transport failure on the 13th cycle of the first on-orbit operation. Photographic performance, judged only from the aft-looking camera, was fair. Utility of photography was reduced by the lack of stereo coverage. The aft-looking camera performance was about what was expected considering the operational conditions (altitude, illumination) of the mission.

The DISIC camera operated normally throughout the 1107-1 mission and most of the 1107-2 mission. The instrument stalled on rev. 282. Terrain image quality was good -- the best that had been obtained from a DISIC system. The starboard stellar camera was capped for most of the mission because of the high level of solar illumination resulting from the orbit flown. Both stellar and terrain films of 1107-2 were degraded by electrostatic marking which was symptomatic of the instrument failure.

B. LAUNCH

The flight was launched at 1831 hours PDT on 23 July 1969 (0131 hours GMT on 24 July 1969) from Satellite Launch Complex 3 West at Vandenberg Air Force Base. All launch, ascent, and injection events occurred as programmed.

C. ORBIT

Mission 1107 was launched into the planned orbit. All orbit parameters attained were well within the specified tolerances.

Orbit conditions computed from Rev 2 data are shown in Table 3-1.

TABLE 3-1

Mission 1107 Orbit Parameters (Rev. 2)

Orbit Parameter	Predicted	Tolerances	Actual
Period (min)	88.52	(+.32, -.36)	88.49
Perigee Altitude (nm)	99.4	(+11, -12)	102.0
Apogee Altitude (nm)	132.5	(+23, -24)	127.6
Eccentricity	0.0049	(+.0035, -.0034)	0.0034
Inclination (deg)	75.01	(+0.19, -0.17)	74.95
Argument of Perigee (deg)	114	(+105, -101)	136.7
Regression Rate (deg/rev)	22.33		22.32

Seven DMU rockets were used for period control during the 308 revs of the flight to maintain the ground tracks. No firing was required for dispersions as the initial orbit was near nominal.

Ground track errors were approximately 5 nautical miles east to 17 nautical miles west of nominal at the equator. After the final firing on Rev. 279, the ground track error increased to 38 nautical miles west of

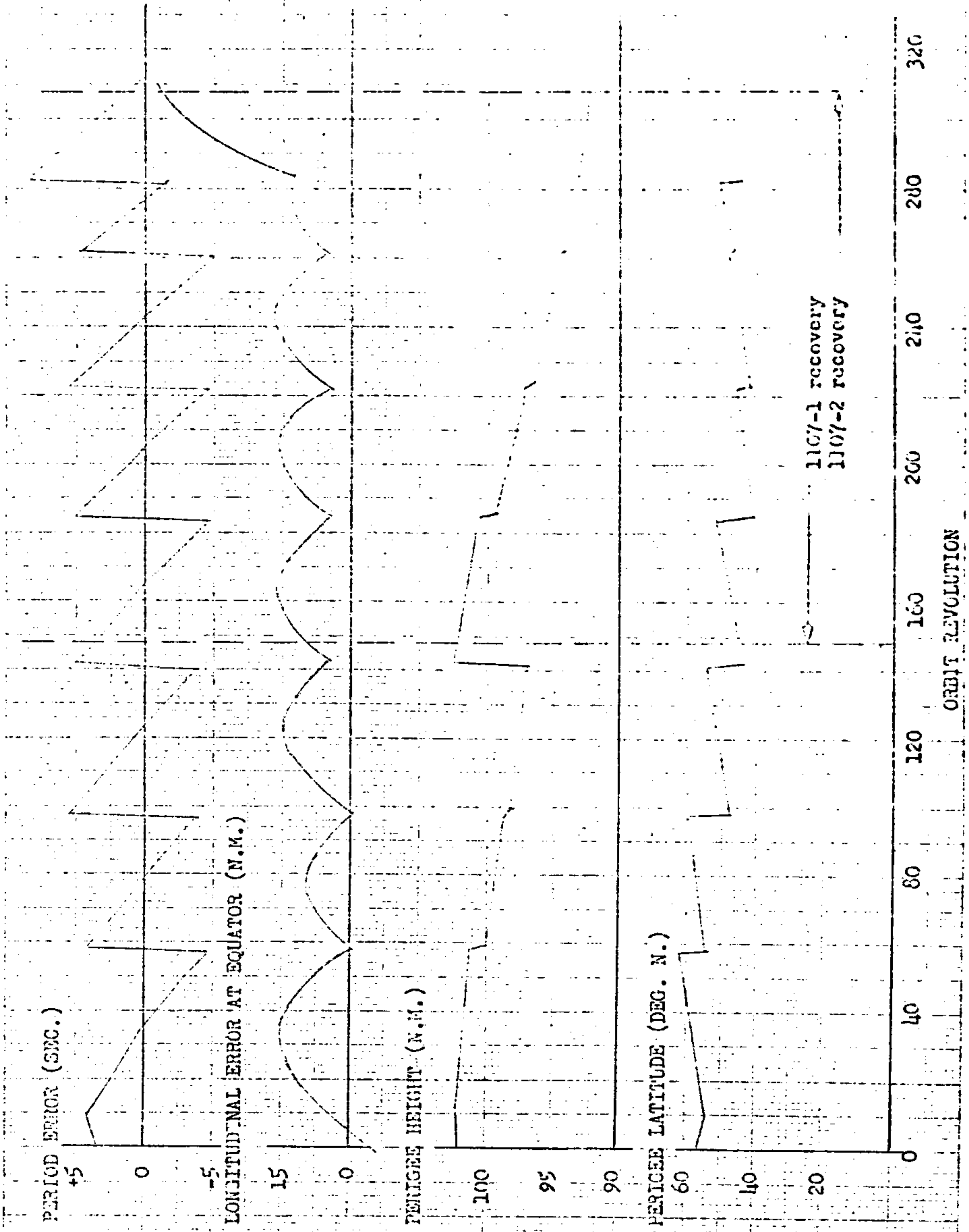


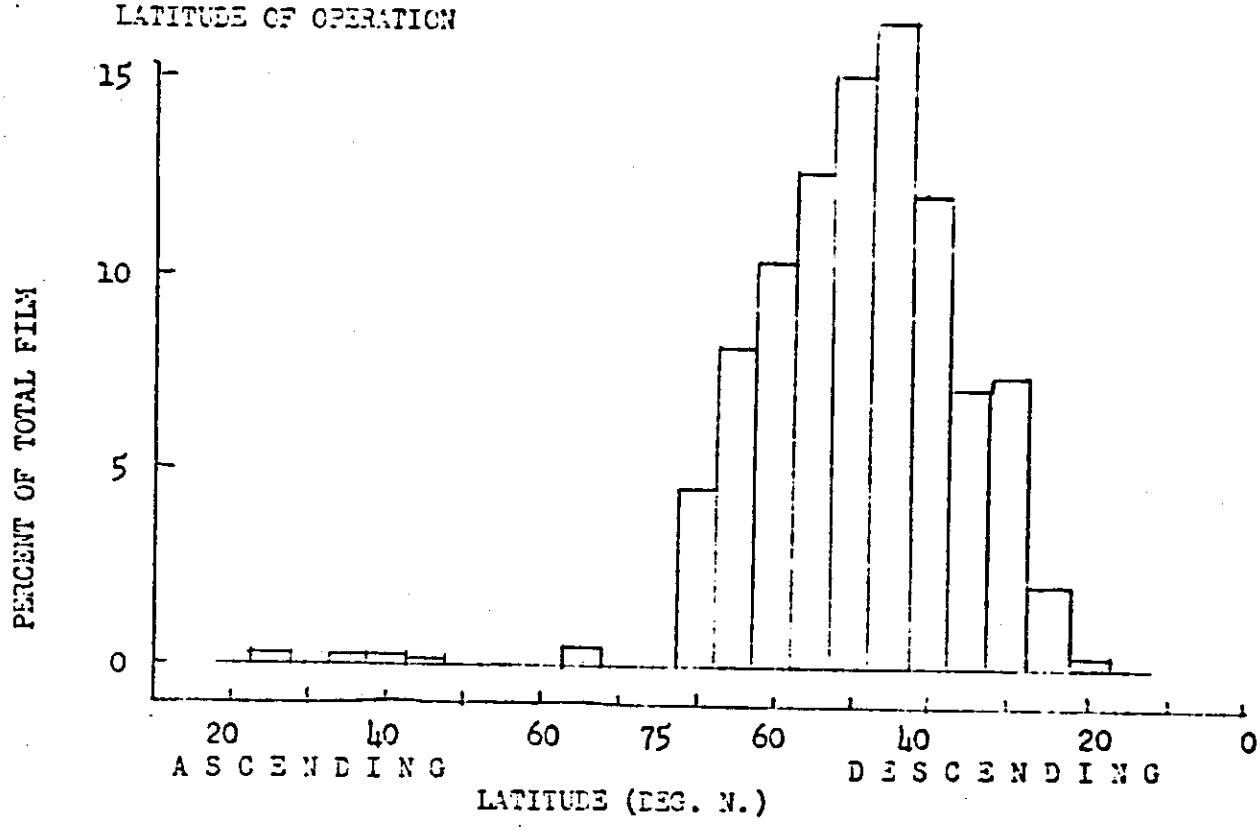
Figure 3-1 CR-7/1107 Orbit History

nominal at Rev. 299 where the last operation was taken. Figure 3-1 shows the orbit history maintained throughout the mission. A summary of the DMU firings is shown in Table 3-2. Figure 3-2 shows the frequency distribution of operations and mean frame altitude of Mission 1107.

TABLE 3-2

Rocket Firings and Orbital Effects

Rocket No.	Pass Fired	System Time	Period Change (Sec)	Velocity Change (Ft/Sec)	Period at Firing (Min.)
1	58	54425	9.27	14.85	88.36
2	97	02615	9.23	14.8	88.37
3	140	59345	9.00	14.5	88.37
4	182	21476	10.03	16.06	88.37
5	220	50110	10.06	16.11	88.37
6	258	78811	10.21	16.32	88.37
7	279	17854	10.16	16.24	88.37



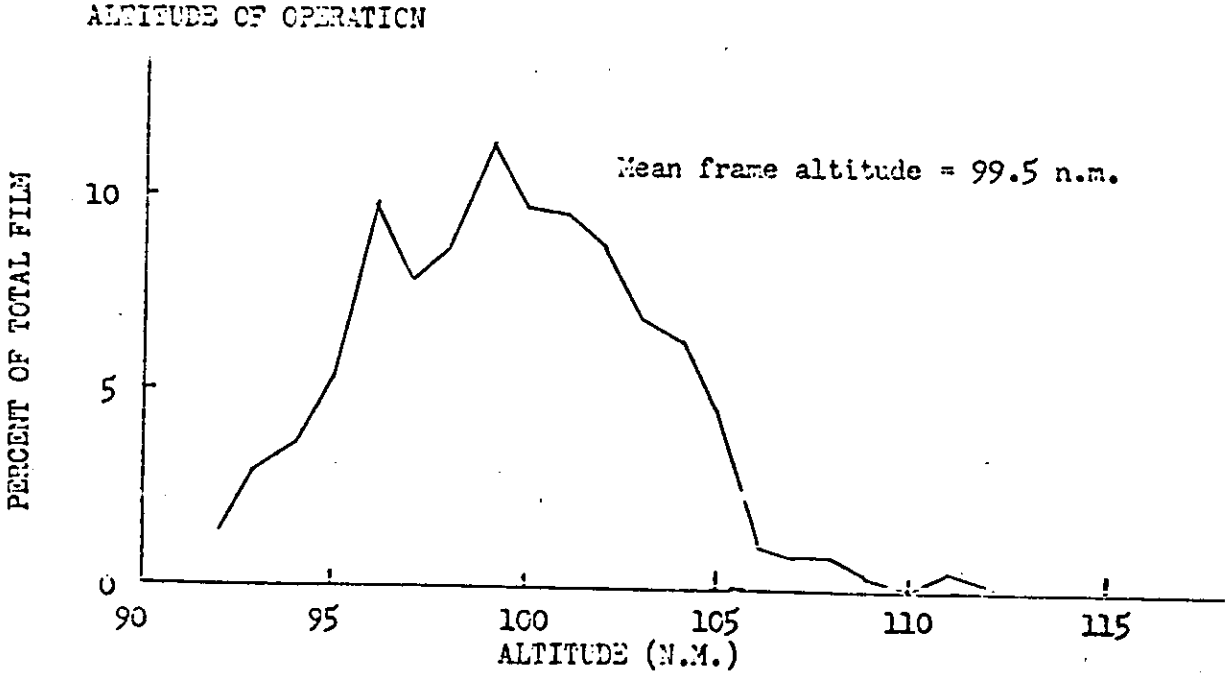


FIGURE 3-2 Location of Pan Camera Operations

D. PANORAMIC CAMERAS

Panoramic camera #314 operated normally throughout the flight. The camera passed the tag end into the recovery system with no wrap-up.

Panoramic camera #315 failed on the first on-orbit operation on Rev. 1 at [redacted] tracking station. The film transport system failed on the 13th frame of a 15-frame operation, however, the lens system continued intermittent rotation through Rev. 4. All of the pre-launch operations were normal and the recovered film provided no indications about the problem.

Just prior to camera shut down, the film transport failed although the camera completed the shut down sequence satisfactorily. The following is a summary of forward-looking camera failure indicators which were abstracted from the telemetry flight data.

1. Erratic rotation of output metering roller.
2. 0.1 Second pause on input idler roller (5 pauses).
3. Take up voltage ramp down starting at idler first pause.
4. Increase in forward drive voltage and decrease in reverse drive voltage.
5. Unregulated current ramp increase from 16 to 30 amps.
6. Tach-feedback indicated slow down starting at 13th center of format (cf).
7. Output metering roller, input idler, output idler, intermediate idler stopped simultaneously at 13th cf.
8. Input metering roller started slow down at approximately the 13th cf and was stopped by 0.7 second later.
9. No film motion followed the 13th exposure.

10. Deramp of lens rotation following 13th exposure appeared normal.
11. Cycle period of 13th frame was 30 milliseconds slow.
12. After failure, there was a slight speed-up of unit when the frame metering roller disengaged.
13. Input/output idler ratios indicated shuttle against 101 percent stop.

Utilizing all the telemetry data, the failure was analyzed in depth by Lockheed and Itek personnel. It was possible, with some degree of confidence, to reconstruct the sequence of failure. However, it was not possible to pinpoint the actual cause or causes. Two possible causes of failure were hypothesized by means of logical analysis:

1. Film restriction or film velocity reduction at the shuttle input.
2. Film restriction at the supply cassette.

Since no cause could be identified, the Performance Evaluation Team (PET) recommended no action and closed the matter as an action item.

A satisfactory ramp-to-orbit match was maintained during both missions of the flight. Except for Revs. 1-8 and 23-25, the V/h mismatch was kept within plus or minus one percent for 95 percent of the frames taken. The ramp-to-orbit match is maintained by selecting the best combinations of start, half-cycle, and delay positions. The exceptions to accurate orbit matching mentioned above were due to use of incorrect orbit data. The V/h match performance is shown in Figures 3-3 and 3-4.

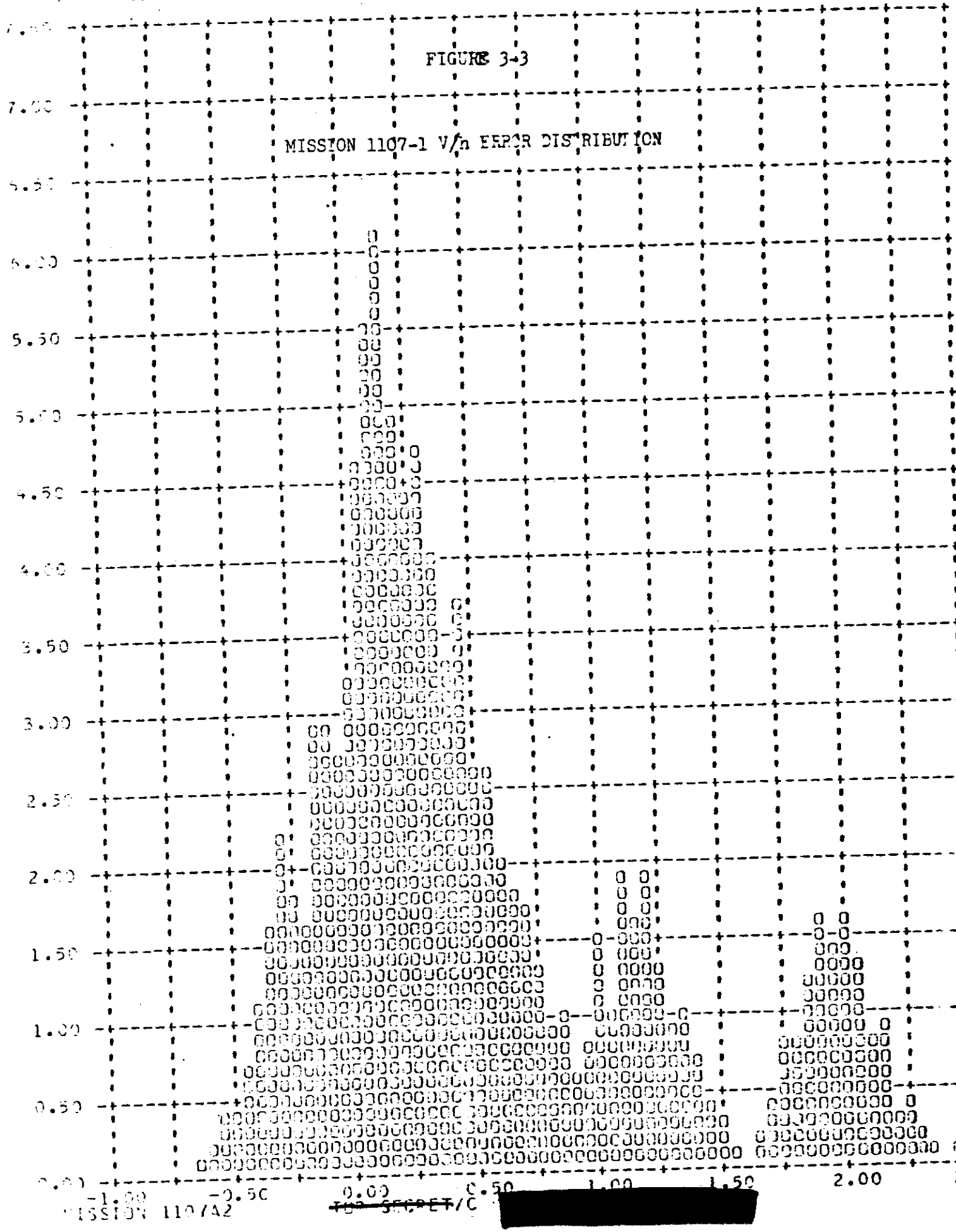
The forward-looking camera metered six and one-half frames into the recovery vehicles before stall. The aft-looking camera produced 2953 frames of photography during Mission 1107-1, and 3095 frames of photography during Mission 1107-2.

FRAMES 1-6 OF EACH OP OMITTED OR PERCENT = 1.77

Y V/H RATIO ERROR - PERCENT (X) VERSUS FREQUENCY - PERCENT (Y)

FIGURE 3-3

MISSION 1107-1 V/h ERROR DISTRIBUTION



FRAMES 1-6 OF EACH OP OMITTED 90 PERCENT = 0.79

Y V/H RATIO ERROR - PERCENT (X) VERSUS FREQUENCY - PERCENT (Y)

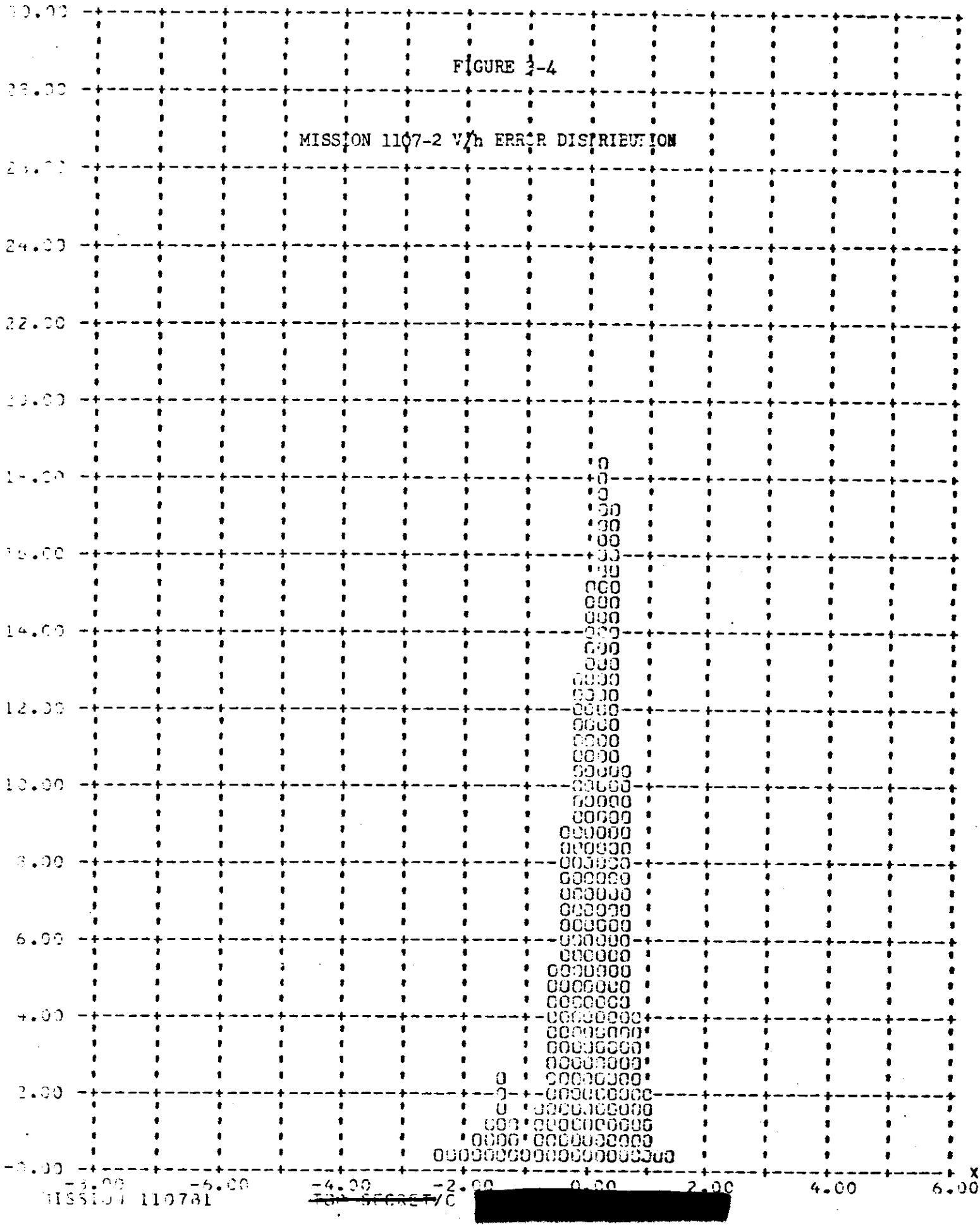


FIGURE 3-4

MISSION 1107-2 V/h ERROR DISTRIBUTION

E. DISIC

The DISIC functioned properly during the -1 mission. On Rev. 282 during the -2 mission, the system failed during a 70 cycle programmed independent operation with 50 cycles completed.

It appeared that for an unknown reason there was a loss of tension in the terrain film take-up which allowed the metering rollers to pick up a loop of film and wrap it around the roller causing a stall. This condition then reflected through the drive train to produce a complete stall. It appeared that several feet of terrain film had been drawn back into the system from the take-up. A wrap-up stall has been the failure mode observed in test when film slack develops downstream from the metering rollers.

An extensive investigation after the flight failed to establish the cause of failure. Test of the recovered take-up assembly indicated normal operation. Examination of DISIC film paths on other systems in test did not suggest a specific cause.

F. INSTRUMENTATION AND COMMAND

The instrumentation system performed normally throughout the flight. The command system performed normally with the exception of the DSR. Two anomalies occurred with the DSR during the mission. The first resulted in a double shift in the output register. This occurred when the Load Disable Command (U-119) was given while a Brush 30 was in the hole of the H-Timer tape on Rev. 82. The first shift in the output register occurred as a normal function of the Load Disable Command. The second shift in the output register occurred as a result of the Logic being enabled while the Brush 30 was in the hole. This is a design deficiency. It will be corrected by soft ware removing Brush 30 punching during tracking station

acquisition times.

The second anomaly occurred 6 times and resulted in the failure to shift the first word into the output register. These were caused by the Load Disable Command being given while three other logic timing sequences were in sync. This failure mode is being corrected by modifying the control logic hardware.

G. EXPOSURE CONTROL SYSTEM

The exposure control system functioned properly throughout the flight. However, fixed slit widths selected by real time commands were found to fit the target requirements better than the automatic control, and was used throughout the flight.

H. CLOCK SYSTEM PERFORMANCE

The clock system operation was normal and resulted in satisfactory clock/system time correlation.

I. PMU SYSTEM OPERATION

The PMU functioned properly throughout the flight, using 9.5 lbs/min. with 1400 psi remaining at the end of the -2 mission.

J. THERMAL ENVIRONMENT

Although average pan camera temperatures were stable throughout the missions, they did not conform to predictions. The forward-looking camera was colder than anticipated since it was not operating throughout the mission. Predicted average temperature ranges and observed average temperatures for both panoramic cameras are shown in Figure 3-5.

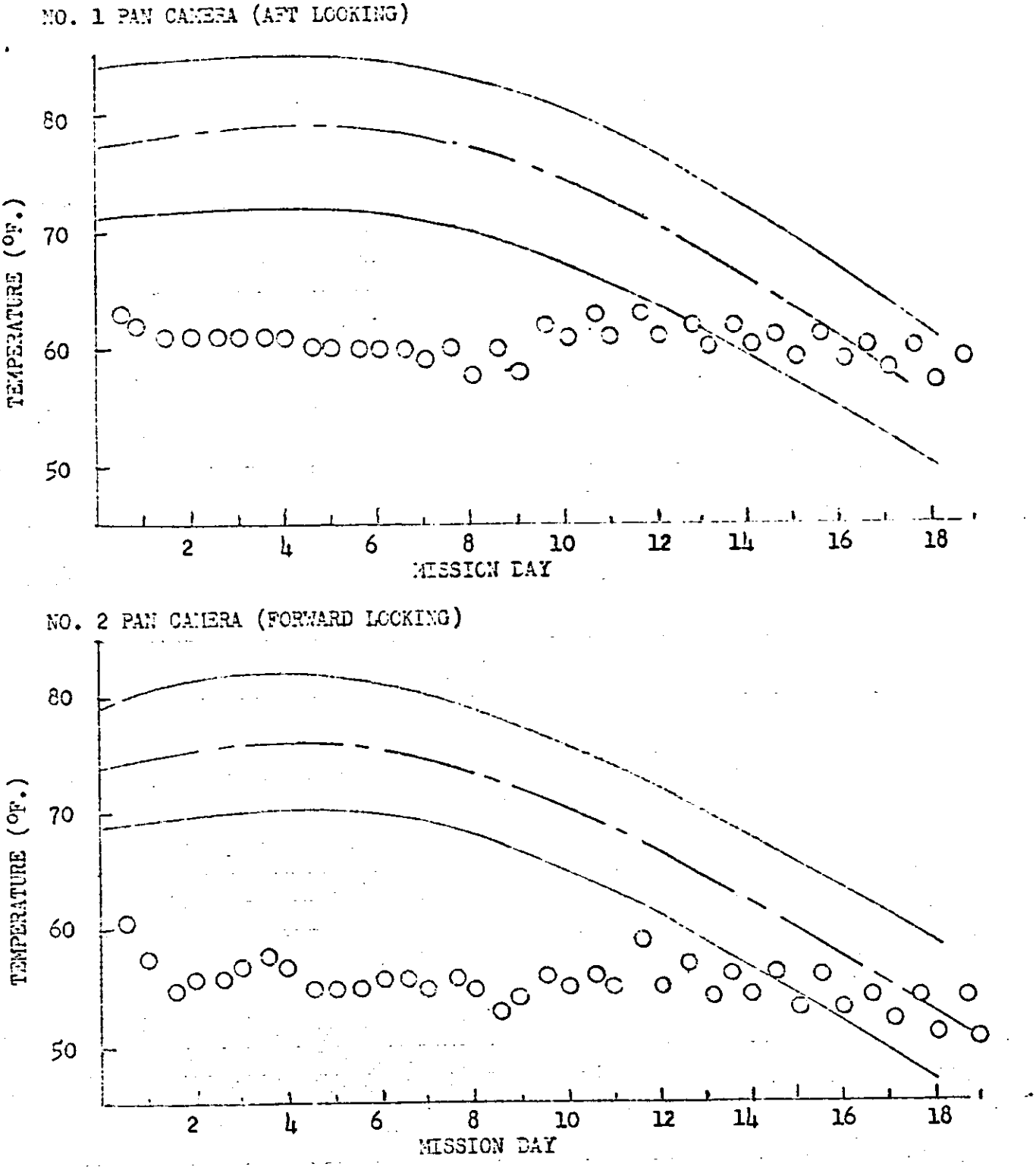


FIGURE 3-5 Panoramic camera temperatures.
The dashed and solid lines indicate predicted temperatures and tolerances respectively. The circles are averages of recorded instrument temperatures.

K. RECOVERY SYSTEM PERFORMANCE

The -1 recovery capsule was successfully recovered by a water recovery on Rev. 147. All re-entry events were within tolerance. The impact was 147 n.m. north of the predicted location. This was caused by a software problem at the Satellite Test Center.

The -2 recovery capsule was successfully recovered by an air catch on Rev. 308. All events were within tolerance. The impact was 28 n.m. north of the prediction.

L. SRV TAPE RECORDER

The tape recorders in both the -1 and -2 missions performed satisfactorily. A total of 236 minutes of data was recorded and processed from the two recorders.

M. POST MISSION TESTING

The post mission testing was conducted to determine the cause of failure on the DISIC and Panoramic Camera #135. Several attempts were made to run the DISIC in Independent and Slave modes with no results. Likewise no results were collected in attempts to run the Panoramic Camera #315.

N. RADIATION DOSAGE

Each recovery system flown on a Corona mission contains a sealed packet of Eastman Type 3401 and Royal X Pan emulsions to determine the total radiation received at the take-up cassette. Both film types have been irradiated by LMSC at various levels and the base plug fog densities recorded after controlled processing.

Following recovery the film dosimeter packets are removed at A/P and processed with a pre-flight sample of the same film type and sensitometric control film. The resulting base plus fog density measurement of the dosimeter strips is used to ascertain the total radiation level. The table below presents the base plus fog readings for the dosimeter strips and the radiation level equivalents.

	Mission 1107-1		Mission 1107-2	
Emulsion	B + F Density	Radiation	B + F Density	Radiation
Type 3401	0.11	0.1R	0.13	0.2R
Royal X Pan	0.25	0.4R	0.26	0.4R

These levels are below that which will degrade the photography.

SECTION 4

PHOTOGRAPHIC PERFORMANCE

A. SUMMARY

The overall photographic quality of Mission 1107 is somewhat less than typical previous J-3 missions. The failure of the forward-looking camera (with a higher resolution, third generation lens) and the resulting lack of stereo photography reduced the effectiveness of the mission.

The DISIC terrain photography was acquired with a reduced aperture lens for the first time. The resulting image quality was better than any previous mission. The DISIC stellar photography was also of acceptable quality. Failure of the DISIC subsystem on rev 282 near the end of the mission was of minor operational significance. However, there were frequent electrostatic discharge effects on both DISIC films through the -2 portion of the mission which did cause significant degradations.

The following footages and exposed frames were recovered from Mission 1107.

Mission	Camera	Film	Footage	Frames
1107-1	Forward	3404	325	5
	Aft	3404	8067	2953
	Stellar	3401	578	1913 Stbd.
				1907 Port
	Terrain	3400	850	1907
1107-2	Forward	3404	4	2
	Aft	3404	8143	3095
	Stellar	3401	528	1863 Stbd.
				1864 Port
	Terrain	3400	812	1823

B. PANORAMIC CAMERAS

1. Image Quality

The 6½ frames of photography recovered from the forward looking camera contained cloud cover with no usable imagery and no basis for evaluating photographic performance.

The overall image quality of the Aft camera was considered to be fair throughout the mission. Some systematic variation in image quality was noted in the formats. During 1107-1, imagery at the take-up end and along the data block edge was slightly better than the remaining areas. During the 1107-2 mission, imagery along the data block edge was slightly better but no difference was detected between supply and take-up ends. In general, the imagery had an out-of-focus appearance at magnifications of 50 X and above.

The MIP (Mission Information Potential) rating assigned to each mission segment was 95. The MIP frame in 1107-1 was number 30 in rev D122; in 1107-2 it was number 20 of rev D170. These MIP ratings are the first established under a revised rating system using standard reference criteria. As a result of this new system, the MIP ratings of all previous 1100 series missions have been changed with the exception of mission 1104.

MIP Ratings of 1100 Series Missions

Mission	Revised MIP	Previous MIP
1101	85	95
1102	90	100
1103	90	95
1104	No Change	115
1105	95	100
1106	110	105
1107	95	---