CORONA J

PERFORMANCE EVALUATION REPORT

MISSION 1114-1 and 1114-2

FTV 1660, CR-14

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FOREWORD

This report details the performance of the payload system during the operational phase of the Program [redacted] Flight Test Vehicle 1660.

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 1114 which was launched on 24 March 1971.

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INTRODUCTION

This report presents the final performance evaluation of Corona Mission 1114. The purpose of this report is to define the performance characteristics of the CR-14 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, preparation of the flight program, in-flight operations support and data analysis, and mission reporting to the community. The initial evaluation of the recovered film was made by NPIC, ITEK and LMSC 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 measurements were obtained from [redacted] The processing Summary report was 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 1114 was planned to acquire cartographic and reconnaissance photography of selected terrain areas. Two mission segments were planned to total approximately nineteen days of orbital operation. Each mission segment would return approximately 3100 panoramic frames and each frame would nominally cover 1400 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. In addition, a DISIC Stellar-Terrain camera was incorporated as part of the overall flight system.

The flight system was launched into the planned orbit from Vandenberg AFB at 21:06:00 GMT on 24 March 1971.

The panoramic cameras operated throughout both mission segments. Both cameras demonstrated acceptable operation during Missions 1114-1 and 1114-2. The panoramic film supply was not exhausted due to an Agena H-Timer failure during Rev. 246.

Mission 1114-1 was successfully completed, after 7 days of flight, with an air-catch of the recovery capsule. The second mission segment was similarly terminated after 9 days of orbital flight.

Photographic performance of the panoramic cameras varied from good to fair. An MIP of 120 was assigned to Mission 1114-1 and an MIP of 125 was assigned to 1114-2. Various CORN targets were acquired on this mission and are discussed in Section 4.

B. FLIGHT CONFIGURATION

Mission No.	1114
Vehicle No.	1660
System No.	CR-14
Forward Looking Camera Serial No.	329
Aft Looking Camera Serial No.	328
DISIC Camera Serial No.	1R
Lens Data	
Forward Looking Camera (Main Lens)	
Lens Serial No.	I-216
Measured Slit Width (Inches)	
Position 1	0.142
Position 2	0.184
Position 3	0.220
Position 4	0.323
Failsafe	0.198
Optics Filter Type	
Primary	W-25 Glass .037"
Alternate	W-25 Glass .040"
E.O. Focal Length (Inches) (Vacuum)	24.0031

Resolution		
Static (Lines/Millimeter)		
Filter		W-21
High Contrast		N/A
Low Contrast		168
Dynamic (Lines/Millimeter)		
ITEK Post-Vibration		
Filter		W-25
High Contrast		255
Low Contrast		168
A/P Test		
Filter		W-25
High Contrast		337
Low Contrast		218
Distortion/Pincushion (Microns)		
	Angle Off Axis (Deg.)	
	3	4
	2	3
	1	1
	0	0
	359	0
	358	0
	357	2

Aft Looking Camera (Main Lens)	
Lens Serial No.	I 217
Optics Slit Width (Inches)	
Position 1	0.110
Position 2	0.152
Position 3	0.189
Position 4	0.278
Failsafe	0.163
Optics Filter Type	
Primary	W-23 Glass .037
Alternate	W-23 Glass .040
E.O. Focal Length (Inches)(Vacuum)	23.9995
Resolution (Lines/MM)	
Static	
Filter	W-25
High Contrast	N/A
Low Contrast	204
Dynamic (Lines/MM)	
ITEK Post-Vibration	
Filter	W-21
High Contrast	272
Low Contrast	164
A/P Test	
Filter	W-23
High Contrast	298
Low Contrast	176

Distortion/Pincushion (Microns)

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

Horizon Optics

Forward Looking Camera

Take-up (Starboard)

Lens Serial No.	E40782
Exposure Time (Sec.)	1/100
Aperture	F/8.0
Filter Type	W-25
Oper. Focal Length (MM)	55.0
Radial Distortion (MM)	
10 Deg. Off Axis	0.01
20 Deg. Off Axis	0.037
Tangential Distortion	0.011

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	187	186	154	120	108	127	35
(Tangential)	166	164	144	116	98	91	58

Supply (Port)

Lens Serial No. E40792

Exposure Time (Sec.) 1/100

Aperture F/6.3

Filter Type W-25

Oper. Focal Length DMM) 55.0

Radial Distortion (MM)

10 Deg. Off Axis 0.00

20 Deg. Off Axis 0.03

Tangential Distortion 0.011

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	187	186	163	144	133	114	35
(Tangential)	166	164	144	130	100	82	52

Aft Looking Camera

Take-up (Port)

Lens Serial No. E28518

Exposure Time (Sec.) 1/100

Aperture F/6.3

Filter Type W-25

Oper. Focal Length (MM) 55.0

Radial Distortion (MM)

10 Deg. Off Axis 0.01

20 Deg. Off Axis 0.027

Tangential Distortion 0.005

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	209	186	103	109	133	119	34
(Tangential)	187	185	123	78	103	91	62

Supply (Starboard)

Lens Serial No.	E40781
Exposure Time (Sec.)	1/100
Aperture	F/8.0
Filter Type	W-25
Oper. Focal Length (MM)	55.0
Radial Distortion (MM)	
10 Deg. Off Axis	0.04
20 Deg. Off Axis	0.12
Tangential Distortion	0.01

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	187	208	174	162	115	120	45
(Tangential)	166	164	171	130	105	96	62

DISIC Camera

Port Stellar Camera

Lens Serial No.	16P
Reseau Serial No.	16P
Aperture	F/2.8
Exposure Time (Sec.)	1.5
Nominal Focal Length (In.)	3
Filter	None

Starboard Stellar Camera

Lens Serial No.	10
Reseau Serial No.	10
Aperture	F/2.8
Exposure Time (Sec.)	1.5
Nominal Focal Length (In.)	3
Filter	None

Terrain Camera

Lens Serial No.	103		
Reseau Serial No.	103		
Filter Type	W-12		
Aperture	F/6.3		
Exposure Time (Sec.)	1/500		
Nominal Focal Length (In.)	3		
Resolution (Hi Contrast L/MM)			
Angle Off Axis (Deg.)	0	7.5	15
Radial	91	92	102
Tangential	91	84	75
Film Type	3400		
Filter	W-12		

Film Types

Forward Looking Camera

Split Load	Yes
Film Type	3414/3404/3414
Length (Ft.)	7800/1000/7500
Splices	4
Length Between Splices (Ft.)	3600-4200-1000-3250-4250
Emulsion Data	3414-7-2-3-1
Payload Weight (Lbs.)	81.4
Spool No.	138A B
Box Serial No.	17

Aft Looking Camera

Split Load	Yes
Film Type	3414/3404/3414
Length (Ft.)	7800/1000/7500
Splices	4
Length Between Splices (Ft.)	3590-4210-1000-3905-3595
Emulsion Data	3414-7-2-3-1
Payload Weight (Lbs.)	80.2
Spool No.	224T
Box Serial No.	17

DISIC Camera

Stellar Camera

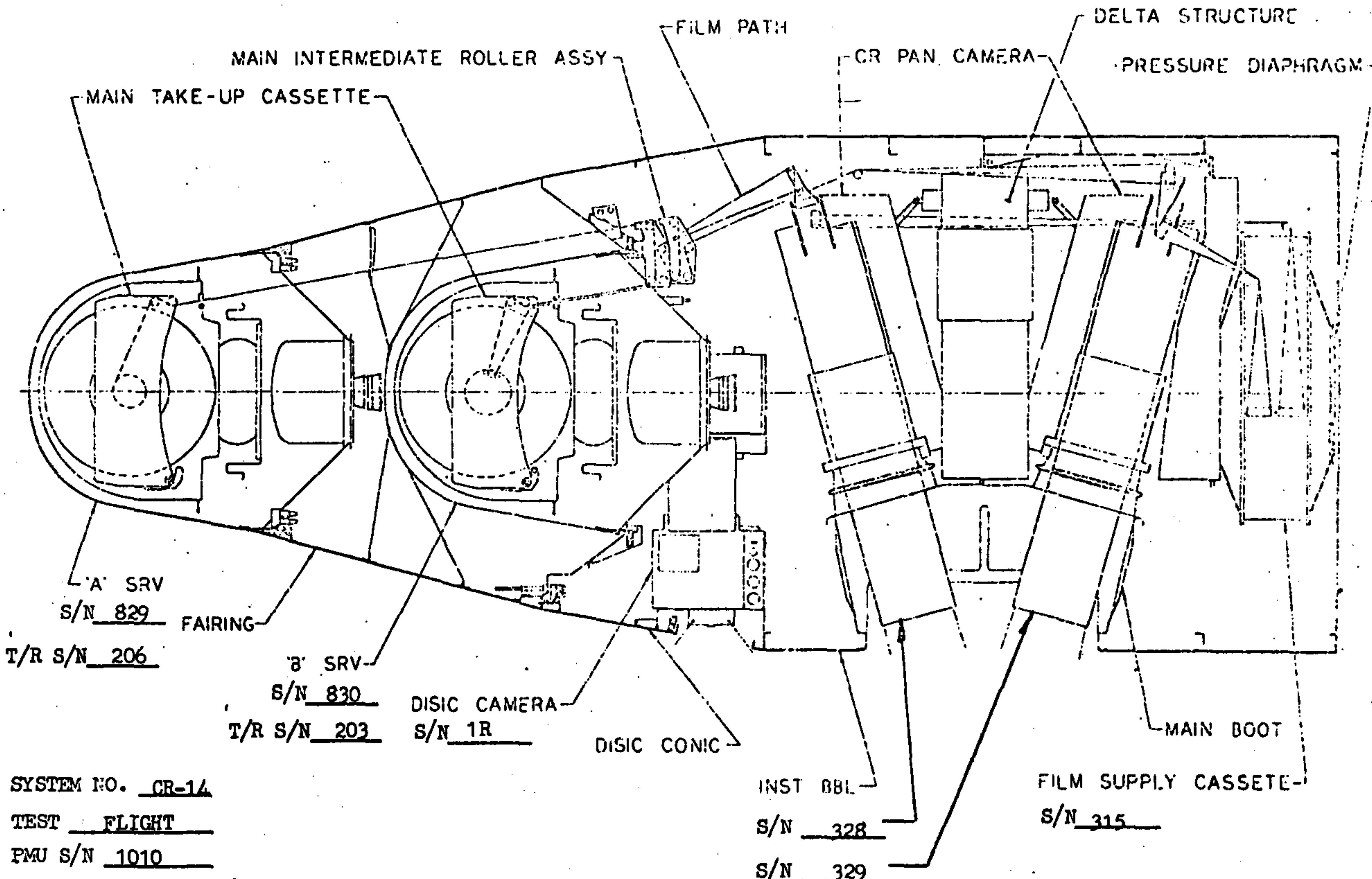
Split Load	No
Film Type	3401
Length (Ft.)	2000
Splices	None
Length Between Splices (Ft.)	None
Emulsion Data	364-1-12-0
Payload Weight (Lbs.)	5.3

Terrain Camera

Split Load	No
Film Type	3400
Length (Ft.)	2200
Splices	None
Length Between Splices (Ft.)	None
Emulsion Data	227-8-9-0
Total Film Weight (Lbs.)	19.5

TOP SECRET/C

PAYLOAD PROFILE AND SERIAL NUMBERS



SYSTEM NO. CR-14

TEST FLIGHT

PMU S/N 1010

SLOPE PROGRAMMER S/N 217

CLOCK S/N 629

SWITCH PROGRAMMER S/N 217

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. Also an AGT - Aschenbrenner grid test for film lift determination.
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-14 system successfully passed all phases of the testing operations providing acceptable performance and a high degree of operational confidence.

B. ENVIRONMENTAL TEST

The CR-14 system was subjected to environmental testing from 2 thru 8 June 1970.

The primary purpose of the environmental test was to determine the corona marking characteristics of the panoramic cameras and operational performance of the system at altitude. The pan cameras were configured for AGT testing.

The system was subjected to internal system pressures at altitude that ranged between 1 and 110 microns by programmed On and Off use of the Gas Pressure Make-Up system.

The panoramic camera payload (film type 3414) was processed to the flight standard level in the toe region of the characteristic curve prior to analysis.

The CR-14 system operations during the altitude test produced the following film consumption:

Test-Film Consumption (Cycle Counter)

Operation	Panoramic Camera No.	
	328 (#1)	329 (#2)
A SRV Frames	3000	2629
B SRV Frames	1761	1758
Total Frames	4761	4387

Evaluation of the processed film indicated there was no corona marking by either panoramic camera.

Aschenbrenner Grid Test indicated acceptable film lift.

Auxiliary data recording was acceptable. Visual analysis of film from panoramic cameras #328 and #329 revealed that imagery of the serial number, time track, H.O. fiducials, start of pass mark, PG traces, and rail holes were acceptable. Microdensitometer measurements revealed that imagery of the time word (SLP bits) from both main cameras was unacceptable. The power to the SLP bits was reduced. A re-test demonstrated that the time word bits were acceptable.

Evaluation of telemetry data indicated satisfactory performance of both panoramic cameras and DISIC IR. (all anomalies were corrected or bought off as acceptable prior to flight.

The DISIC Terrain and Stellar film had a minimal amount of acceptable marking.

All timer start and delay functions were normal.

The exposure control system performed satisfactorily with all start and delay functions occurring normally.

The PMU operation was normal.

The clock accuracy test indicated the clock lost 0.185 seconds during a 5-day period, which was out of tolerance. The clock was subsequently replaced. The new clock functioned normally.

The instrumentation system performance was normal.

The command system was normal.

The SRV tape recorder, the recovery sequences and the cut and wrap sequences were all normal.

The cut and splice sequence was normal. All timer events and transfer functions were within tolerance.

C. LIGHT LEAK TEST

The CR-14 system was tested for light leaks on 27 May 1970. Both instruments were threaded with film type 3401, placed in flight configuration, and exposed to external illumination for 90 minutes per side. At the conclusion of the test the

the film was retrieved, processed to full level, and evaluated. Results were acceptable. There were no light leak fog marks on the processed film.

D. RESOLUTION TEST/AGT

Resolution Testing

The CR-14 system was subjected to through focus dynamic resolution testing using film type 3414.

Figures 2-1 and 2-2 show the graphical thru focus results. The low contrast (2/1) dynamic resolution of the Forward-looking camera (#329) was 218 lines per millimeter; the high contrast resolution was 337 lines per millimeter. The final low contrast (2/1) dynamic resolution of the Aft-looking camera (#328) was 178 lines per millimeter; the high contrast resolution was 298 lines per millimeter.

AGT - Aschenbrenner Grid Test

The CR-14 system was subjected to an AG Test on 26 June 1970. The tests consisted of at least 24 cycles of usable material from each camera. Film type 3414 was used throughout the test. The cycle rate was set at 3 seconds per cycle.

A representative format from each camera was evaluated for film lift relative to the scan head rollers. Eighty-one points throughout the usable portion of each format were sampled for film lift. Figure 2-3 presents an AGT orientation sketch for the lift points selected. The resulting film lift measurements in inches (mils) above the scan rollers demonstrated totally acceptable performance at all points measured.

The current acceptance criteria were used to determine camera film lift compliance. The criteria used are such that 90% or more of the film lift measurements must be within ± 0.7 mils of the center of format film lift for the camera to be acceptable.

With these acceptance criteria applied, both cameras were deemed acceptable.

E. FLIGHT READINESS TEST

The CR-14 Flight Readiness test was conducted on 4 March 1971. All information on the processed DISIC Terrain and Stellar film was present and satisfactory. Both processed and unprocessed film were free of scratches.

Rail scratches on both Panoramic instruments appeared normal and acceptable. Auxiliary data recording on the material from both panoramic cameras was acceptable.

The CR-14 cam/slit sequence and slit width values were verified as part of the first Readiness test. Evaluation of the processed 3414 film revealed that the exposure cams do provide exposure slit widths in the correct sequence.

Measurements of processed slit images revealed the following slit values:

TABLE 2-1: TABLE OF PANORAMIC SLIT WIDTHS (INCHES)

Slit No.	Camera 328 AFT		Camera 329 FWD	
	Requested	Actual	Requested	Actual
1	.115	.110	.144	.142
2	.145	.152	.177	.184
3	.178	.189	.218	.220
4	.283	.278	.308	.323
Failsafe	.155	.163	.190	.198

F. FLIGHT CERTIFICATION

Flight film loading of the CR-14 Panoramic Cameras occurred 11 March 1971. Sensitometric examination of samples of the flight film verified satisfactory photographic characteristics.

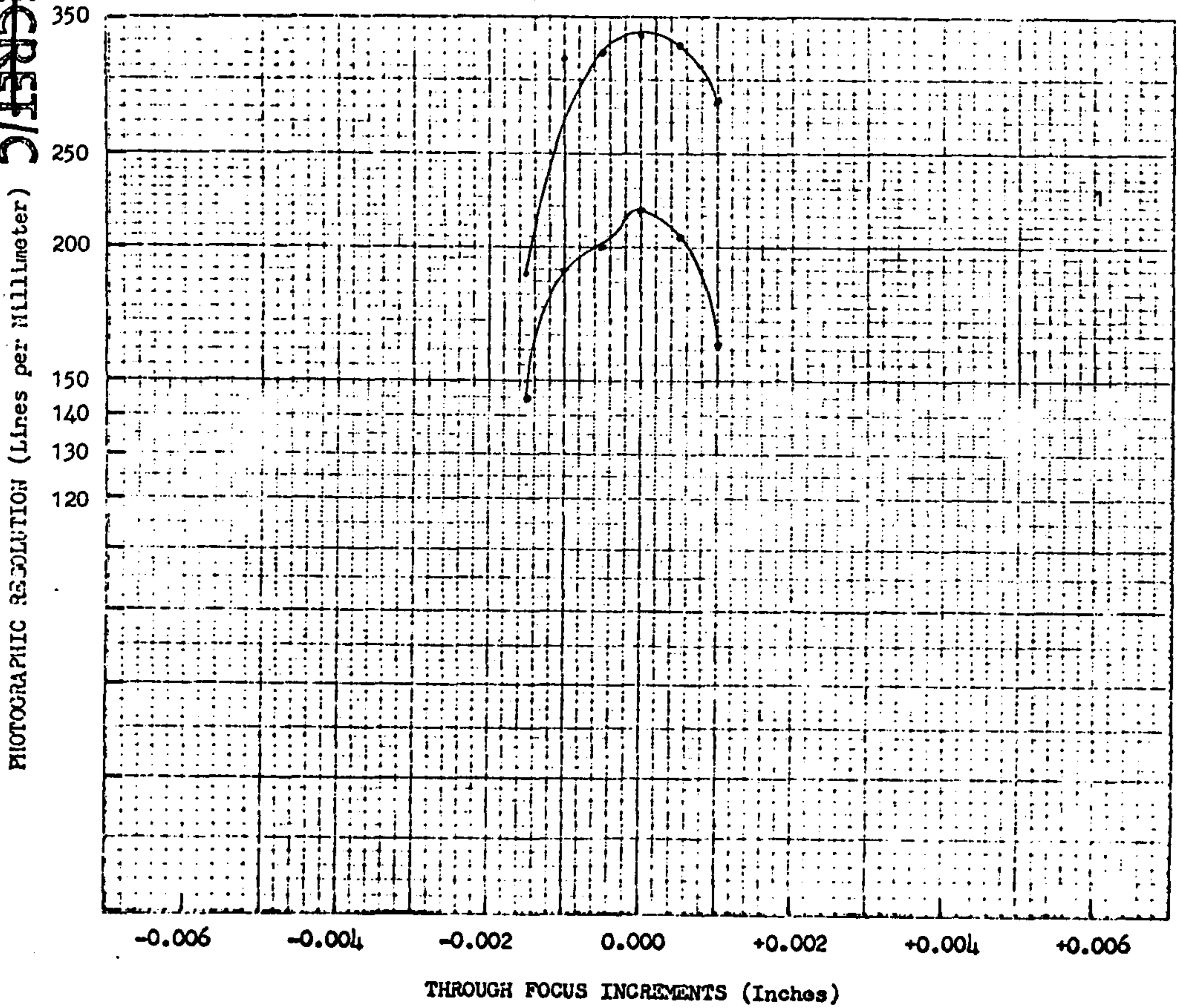
The final confidence run, to certify the CR-14 system for flight, was conducted on 13 March 1971. Rail scratches were continuous but acceptable on the emulsion side of both panoramic payloads. Fine discontinuous scratches were present on the active side of the film installed in both panoramic cameras. Micro scratching was attributed to normal interaction between the film and drum rollers.

The CR-14 system was checked for light leaks following the last camera operation of the confidence run. The space structure proved to be light tight as indicated by the photomultipliers employed in the light leak test.

The CR-14 system was accepted for flight on 14 March 1971.

TOP SECRET/C

PRE-FLIGHT DYNAMIC RESOLUTION



FORWARD LOOKING

Camera No: 329

Payload No: CR-14

Resolution (1/mm) --

High Contrast: 337

Low Contrast: 218

Film Type: 3414

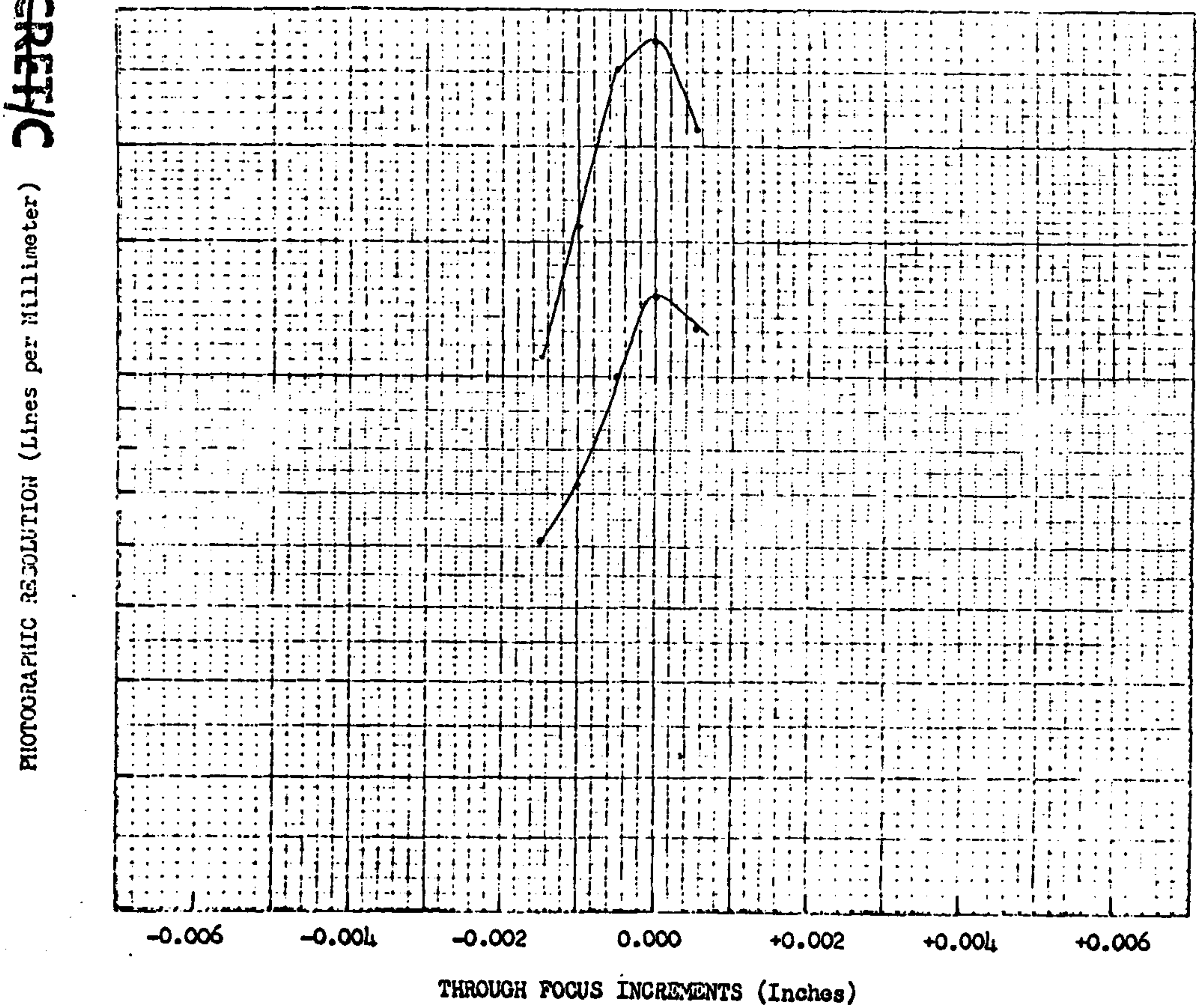
Test Date: 10-5-70

Prepared by [redacted]

Filter: W-25 37 MIL Glass

FIGURE 2-1

PRE-FLIGHT DYNAMIC RESOLUTION



AFT LOOKING

Camera No: 328

Payload No: CR-14

Resolution (1/mm) --
High Contrast: 298

Low Contrast: 178

Film Type: 3414

Test Date: 9-21-70

Prepared By: [redacted]

Filter: W-23A 37 MIL Glass

FIGURE 2-2

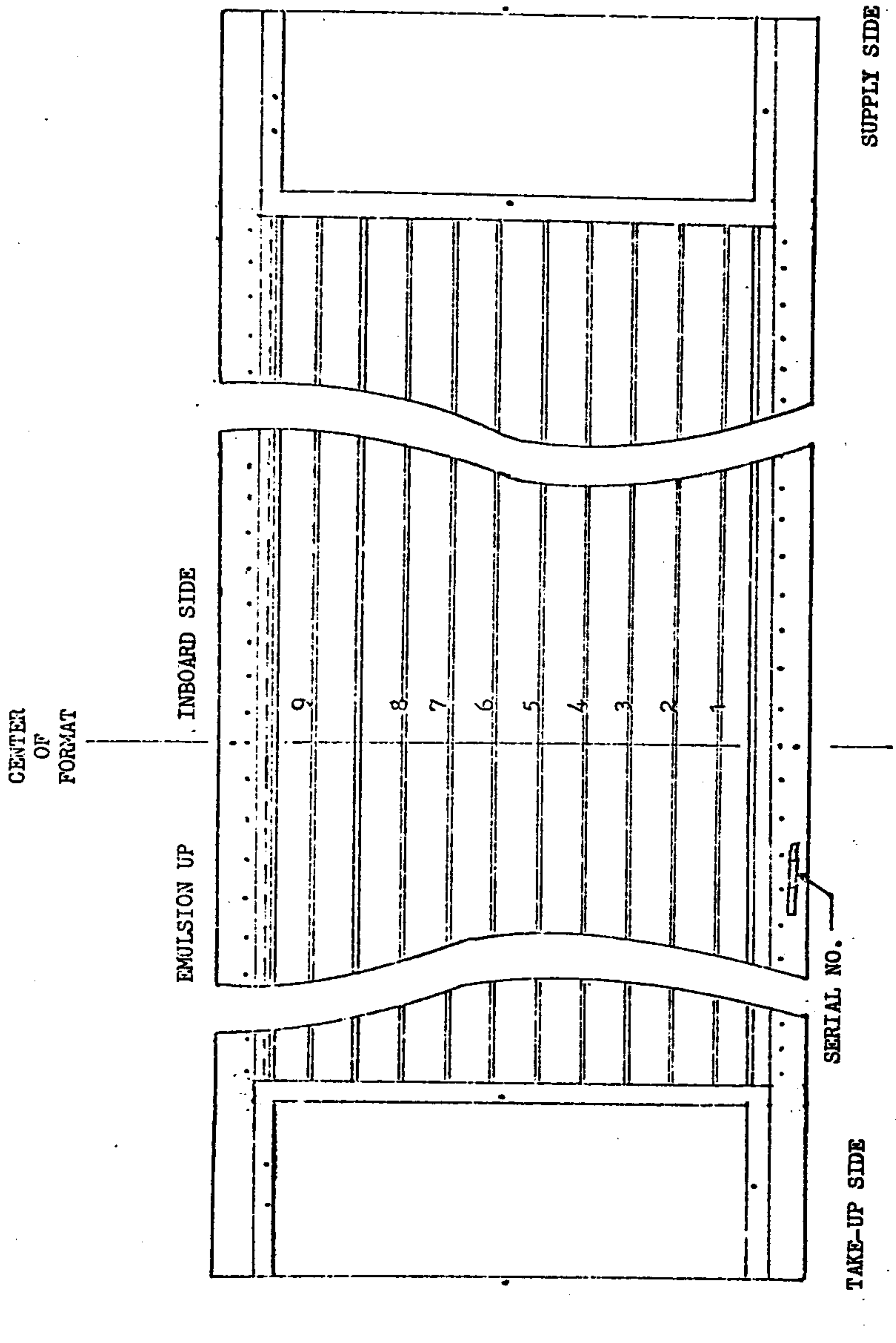


FIGURE 2-3

AGT ORIENTATION SKETCH

SECTION 3

FLIGHT OPERATIONS

A. SUMMARY

Mission 1114 was launched into the planned orbit without incident. All launch, ascent and injection events occurred as programmed. The orbit achieved was within the 3 sigma predicted dispersions. The planned mission length was 19 days with a 8-day first segment and a 11-day second segment. However, due to an excessive vehicle gas consumption and an Agena H-Timer failure, the mission was reduced to a total of 16 days with a 7-day first segment and a 9-day second segment.

The panoramic cameras performed satisfactorily throughout the flight. The panoramic camera film supply was not exhausted prior to the -2 recovery due to the Agena H-Timer failure.

The DISIC camera, clock system, command and instrumentation system, pressure make-up system, recovery systems, and the thermal environment were normal throughout the flight.

B. LAUNCH

The flight was launched at 13:06:00.5 PST 24 March 1971 from Satellite Launch complex 3 west at Vandenberg AFB.

Mission 1114 was composed of Thorad booster (SLV-2H) S/N 538, Agena vehicle 1660, and payload system CR-14. The CR-14 payload system contained panoramic cameras S/N 328 and 329 and DISIC camera S/N 1R.

All ascent events were normal with inflight reset (door ejection), A/P to orbit mode, instrumentation switchover, and panoramic camera transfer to orbit mode occurring as programmed.

C. ORBIT

Mission 1114 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 1114 Orbit Parameters (Rev. 2)

Orbital Parameters

Parameter	Predicted	Tolerance	Actual STC	Actual APF
Period (Min.)	88.67	+0.32, -0.36	88.56	88.55
Perigee (N.M.)	84.5	+8, -8	84.7	87.6
Apogee (N.M.)	145.9	+12, -16	144.8	142.2
Eccentricity	0.0088	+0.0023, -0.0030	0.0077	0.0075
Inclination (Deg)	81.5	+0.21, -0.18	81.50	81.52
Argument of Perigee (Deg)	147	+63, -57	130.6	129.0
Regression Rate (Deg/Rev)	22.31	---	---	---

DMU Operation

Five of the twelve DMU rockets were utilized for period control throughout the flight to maintain the ground track and period control. Ground track error ranged between 174 nautical miles west to 27 nautical miles east of the nominal track at the equator. The firing of DMU rockets supported requirements imposed by the vehicle problem and due to the special access requested by the customer.

Table 3-2 is a summary of the DMU firings that occurred during Mission 1114.

TABLE 3-2

Rocket No.	Rev. No.	System Time Sec.	Period Change Sec.	Velocity Change Ft/Sec	Period at Firing Min.	Impulse Lb/Sec
1	27	47142	13.82	22.28	88.44	3072
2	48	4440	13.48	21.54	88.52	2974
3	134	-------- Stepped	----- over	----------	----------	
4	135	3972	15.35	24.55	88.31	3031
5	158	3957	15.45	24.71	88.43	3042
6	170	3927	15.40	24.60	88.63	3006

Figures 3-1 and 3-2 show Period/Longitude Error and Perigee Latitude/Height respectively throughout the flight.

D. PANORAMIC CAMERAS

Both panoramic cameras exhibited normal transport characteristics and operated satisfactorily throughout the flight.

Each camera contained 16,300 feet of standard base types 3414/3404 film. Due to the vehicle H-Timer failure, the film supply was not depleted prior to the -2 mission recovery.

Film consumption and type are shown in Table 3-3 for the panoramic cameras.

TABLE 3-3

	Frames	
	Pan 328	Pan 329
Sample	20	41
Prelaunch	119	120
-1 Mission	2988	2972
-2 Mission	2815	2800
Left on Orbit	220	229
Total	6162	6162

Film Supply Length and Type

Pan 328	Pan 329
7800 ft/3414	7800 ft/3414
1000 ft/3404	1000 ft/3404
7500 ft/3414	7500 ft/3414
16300 ft total	16300 ft total

E. DISIC CAMERA IR

The DISIC camera system operated satisfactorily during both -1 and -2 missions. The DISIC film supply was not exhausted prior to the -2 recovery due to the failure of the Agena H-Timer.

Film consumption and type are shown in Table 3-4 for DISIC camera IR.

TABLE 3-4

	Frames Terrain
Sample	26
Prelaunch	91
-1 Mission	2457
-2 Mission	2550
Left on Orbit	164
Total	5288

Length/Type

Terrain	Stellar
2200 ft/3400	2000 ft/3401

F. INSTRUMENTATION AND COMMAND

The instrumentation system performed satisfactorily during the -1 and -2 missions. Link Two (2) channel fifteen (15), which consisted of diagnostic data, was noisy after Rev 43. The noise was attributed to a Link Two (2) signal strength problem of the Agena vehicle.

The Real Time Command (RTC) system operation was satisfactory throughout the flight with one exception. On Rev 159 [redacted] the SILO command system malfunctioned during commanding, making it necessary to load the DSR with the UNCLE command system. The first word loaded was a 209 instead of the desired 201. The balance of the load was correct. The DSR was enabled prior to fade and reloaded correctly at 159 [redacted] Post flight investigation revealed that the SILO decoder received an incomplete command message due to a ground station problem that caused a premature termination of the command. As a result, the last SILO command was not executed and the SILO shift register in the Type 22 decoder was not cleared. Therefore, when the DSR was loaded with the UNCLE command system the command words for the first word from both SILO and UNCLE shift registers were added together resulting in the incorrect first word. This situation is normal for the command sequence that occurred on Rev 159 [redacted] Post event testing was conducted in an attempt to simulate a DSR problem. The DSR was loaded forty times from various tracking stations. No DSR loading malfunctions occurred in any of the forty loads.

G. EXPOSURE CONTROL SYSTEM

The slit width control programmer operated satisfactorily throughout the -1 and -2 missions.

H. CLOCK SYSTEM

The clock system performance was satisfactory throughout the flight. The correlation equation and constants are as follows:

<u>First Order Fit</u>

System Time = $A_o + A_1$ (clock time)

A_o = -0.2767048117484806D 05

A_1 = 0.9999997942584964D 00

Sigma = 0.01117422

Number of Points = 257

<u>Second Order Fit</u>

System Time = $A_o + A_1 \text{ (clock time)} + A_2 \text{ (clock time)}^2$

A_o = -0.2767052319235540D 05

A_1 = 0.9999999195136654D 00

A_2 = -0.7442426896944209D -13

Sigma = 0.00247612

Number of Points = 257

I. PRESSURE MAKE-UP SYSTEM

The pressure make-up system operated satisfactorily throughout the flight. The gas pressure drop was 4.9 psi/min of panoramic camera operate and the alternate level gas consumption rate was 1.43 psi/min of DISIC operate time.

J. THERMAL ENVIRONMENT

The temperature data obtained during this flight indicated the temperature environment was within preflight predictions as shown in Figure 3-4. The average temperatures for panoramic cameras S/N 328 and S/N 329 were 61°F and 62°F respectively during the -1 mission, and 60°F and 61°F respectively during the -2 mission.

K. RECOVERY SYSTEM PERFORMANCE

-1 Mission

The -1 recovery capsule was successfully recovered by air catch on Rev 115 on 31 March 1971. All re-entry events were within tolerance. The impact was approximately 10 miles North of predicted.

	Actual	Predicted
Impact Location	24°11"N/162°0'W	24°1'N/162°14'W

-2 Mission

The -2 recovery capsule was successfully recovered by air catch on Rev 260 on 9 April 1971. All re-entry events were within tolerance. The impact was very near predicted.

	Actual	Predicted
Impact Location	17°58'N/153°46'W	18°0'N/153°58'W

L. SRV TAPE RECORDER

The SRV tape recorders for the -1 and -2 missions performed satisfactorily. A total of 210.2 minutes (104.6 minutes for the -1 mission and 105.6 minutes for the -2 mission) was recorded and processed from the two recorders.

M. FMC PERFORMANCE

A satisfactory match to the required FMC was maintained during both the -1 and -2 missions. The mis-match error was less than 1.0% during 82.5% of the first mission and 82.1% of the second mission.

To compensate for the reduction of mission life due to abnormal vehicle control gas usage, the orbit altitude was increased to minimize gas consumption and hence extend mission life. The increase in altitude exceeded the prelaunch setting of the slope programmer operating limits of 80 to 95 nautical miles.

N. HARDWARE DEFINITIONS

The following brief description of principal equipment is shown to clarify more fully the capability of the J-3 system.

Agena

FTV 1660 was an Agena vehicle (SS01B) and a Thorad booster (SLV-2H) S/N 538. The Agena was oriented nose first and included the following:

1. J-3 payload with digital storage register.
2. Twelve Thiokol DMJ rockets (all 3000 lb-sec).
3. -5 heavy control gas mixture (3 spheres).
4. Ten panel solar array system with two 1H batteries (depleting system).
5. 3/4 speed Type VIII programmer (325 subcycles).
6. Aft payload-Doppler Beacon No. 5 and [redacted]
7. High Density Acid (oxidizer) and Hyperzine 300 (fuel), instead of IRFNA.

Payload

The CR-14 payload configuration included the following:

1. Panoramic Camera.
   a) Constant rotating type with servo-controlled supply cassette.
   b) Digital Storage Register (DSR)/Cascade system used for camera enable/disable.
   c) Emergency program backup capability available by RTC.
      UHF 116/Silo 316 Emergency Program Select
      UHF 118/Silo 318 Emergency Intermix Select
      UHF 120/Silo 320 Instrument Mode Select

d) Exposure Control

1) Programmer control by SPC (51, 52, 17) and RTC UHF 105/Silo 305.

2) Automatic slit width control. Override by RTC UHF 101-126/Silo 301-326.

e) Filter selection

1) Control by RTC UHF 103-104/Silo 303-304

2) The automatic filter change capability through the material change detector (MCD), was disconnected prior to launch.

2. DISIC Camera

a) Mode select controlled by RTC UHF 124/Silo 324.

b) Both slave and independent modes of operation had a 1:1 ratio of stellar to terrain frames.

c) Operate off provided by RTC UHF 107/Silo 307.

3. FMC Programmer

a) Initiated by SPC 14 and SPC 27.

b) Control delay increment by RTC UHF 125/Silo 325.

c) Ramp profile provided by
UHF 121/Silo 321 eccentricity start level
UHF 122/Silo 322 eccentricity half-cycle level

4. Pressure Make-up

a) Enable/disable controlled by RTC UHF 110/Silo 310.

b) Two bottle system with dual range capability

c) Low range operation with DISIC independent mode

5. Panoramic "A" to "B" transfer

Available by RTC KIK-Silo 38

6. DISIC "A" to "B" transfer

   Available by RTC KIK-Silo 39

7. Yaw Steering

   Available by RTC UHF 106/Silo 306

8. Agena Tape Recorder

   Time shared with vehicle data

9. SRV Tape Recorder

   Available in -1 and -2 recovery capsules

10. Payload Weight

    EWO - 1810 lbs.

11. Instrumentation

    a) Operational - diagnostic data select. (UHF 127/Silo 327).

12. Thermal Configuration

    The top black was reduced to 56 degrees on the fairing and 76 degrees on the barrel and conic.

13. Command System

    The command system included a DSR for primary operation of the camera system with a two program/4 rev intermix emergency capability.

Exposure Control Settings

	Seconds
T-1 20 sec. increment initial setting	100
T-3 slit width #3 duration	40
T-4 slit width #2 duration	240
T-6 420 sec. increment initial setting	320
T-2 DISIC exposure to 1/500	320
T-5 DISIC exposure to 1/250	320

FMC Control Settings

Eccentricity function

1) Eccentricity function period - 4188 seconds.

2) Delay step increment - 50 seconds.

Oblateness function

1) Oblateness function period - 5248.

2) Gain factor - 0.1136.

CR-14 ORBIT HISTORY

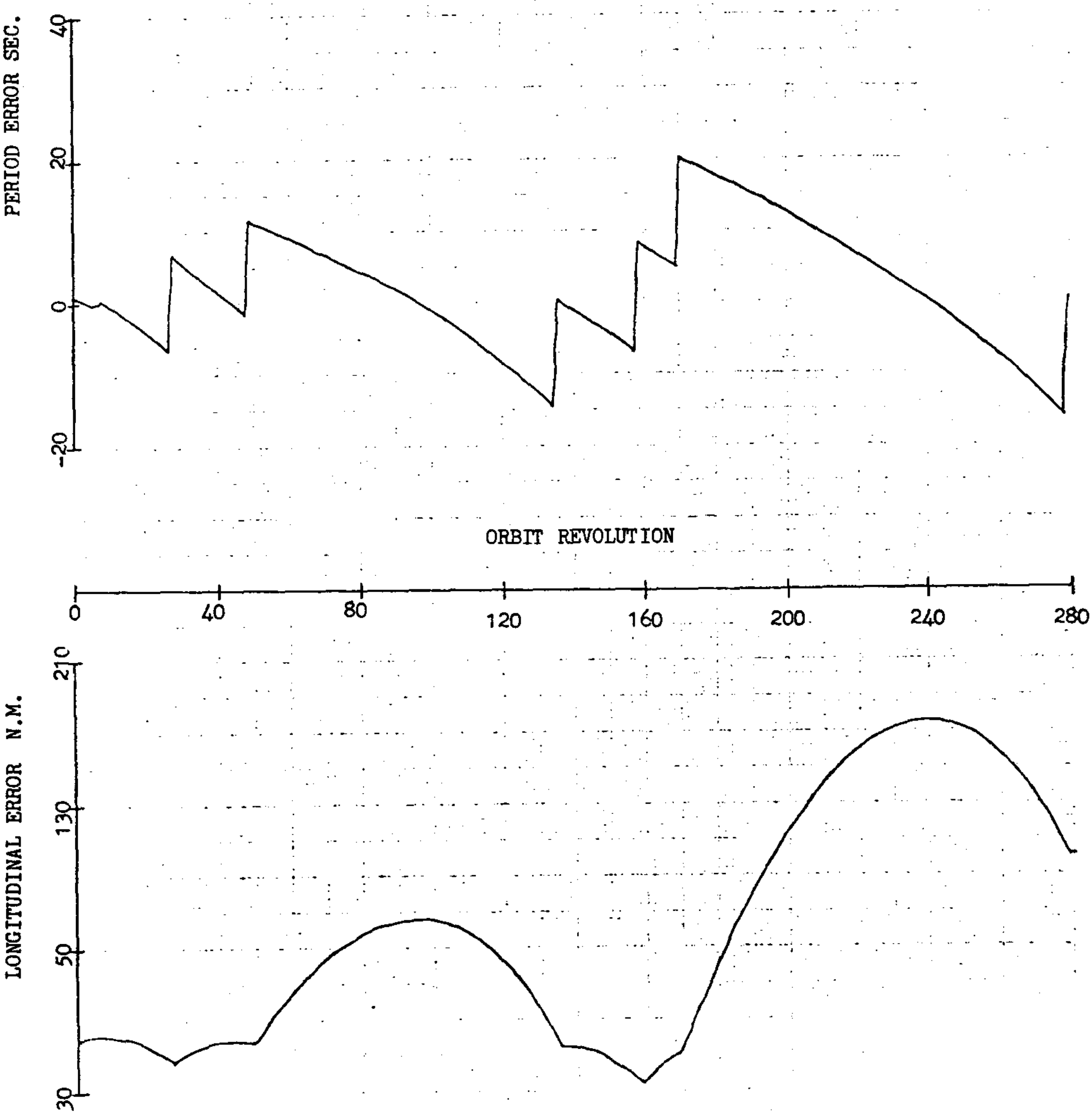


FIGURE 3-1

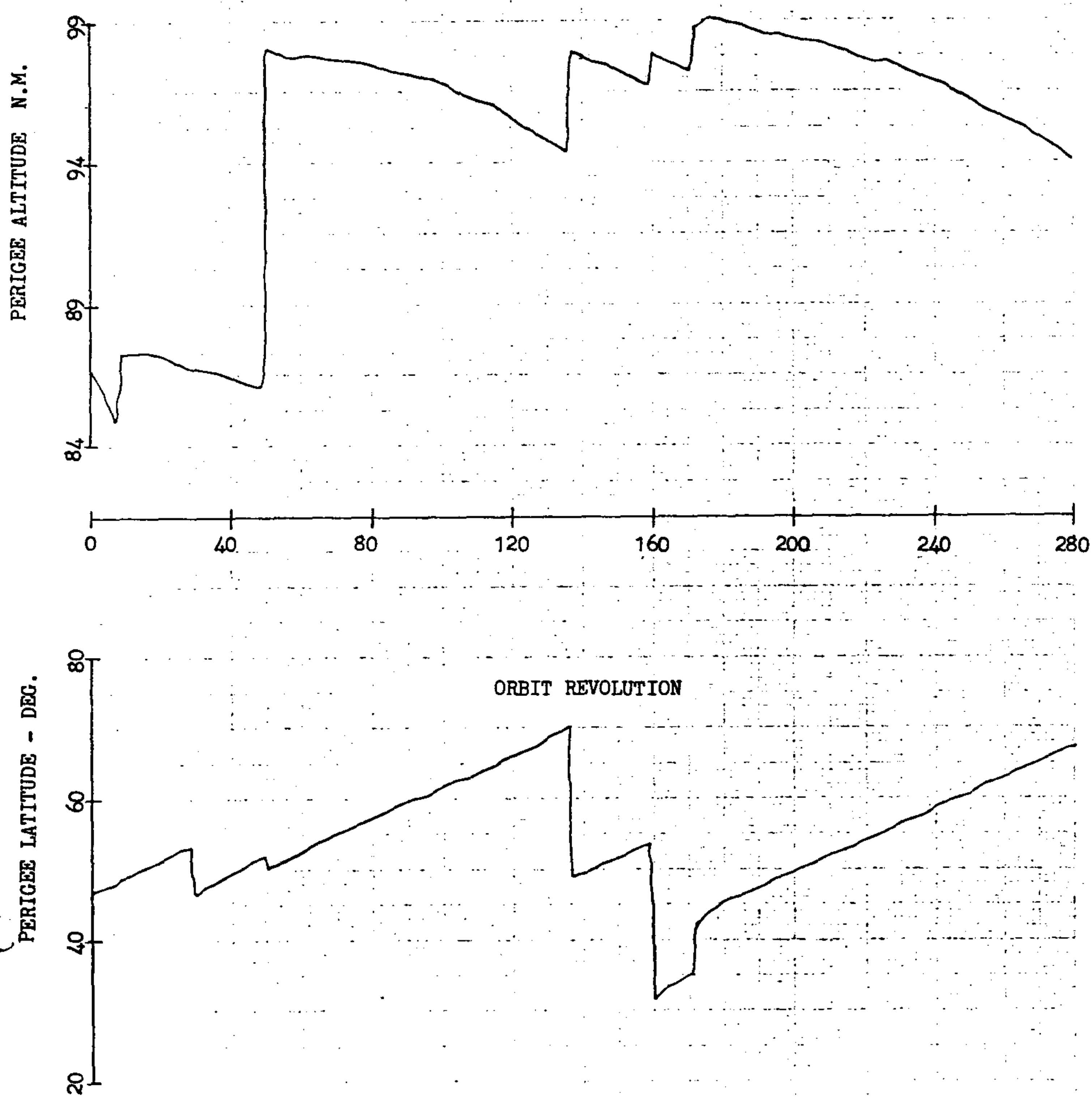

PERIGEE ALTITUDE N.M.
99
94
89
84
0
40
80
120
160
200
240
280
ORBIT REVOLUTION
PERIGEE LATITUDE - DEG.
80
60
40
20

FIGURE 3-2

CR-14/1114

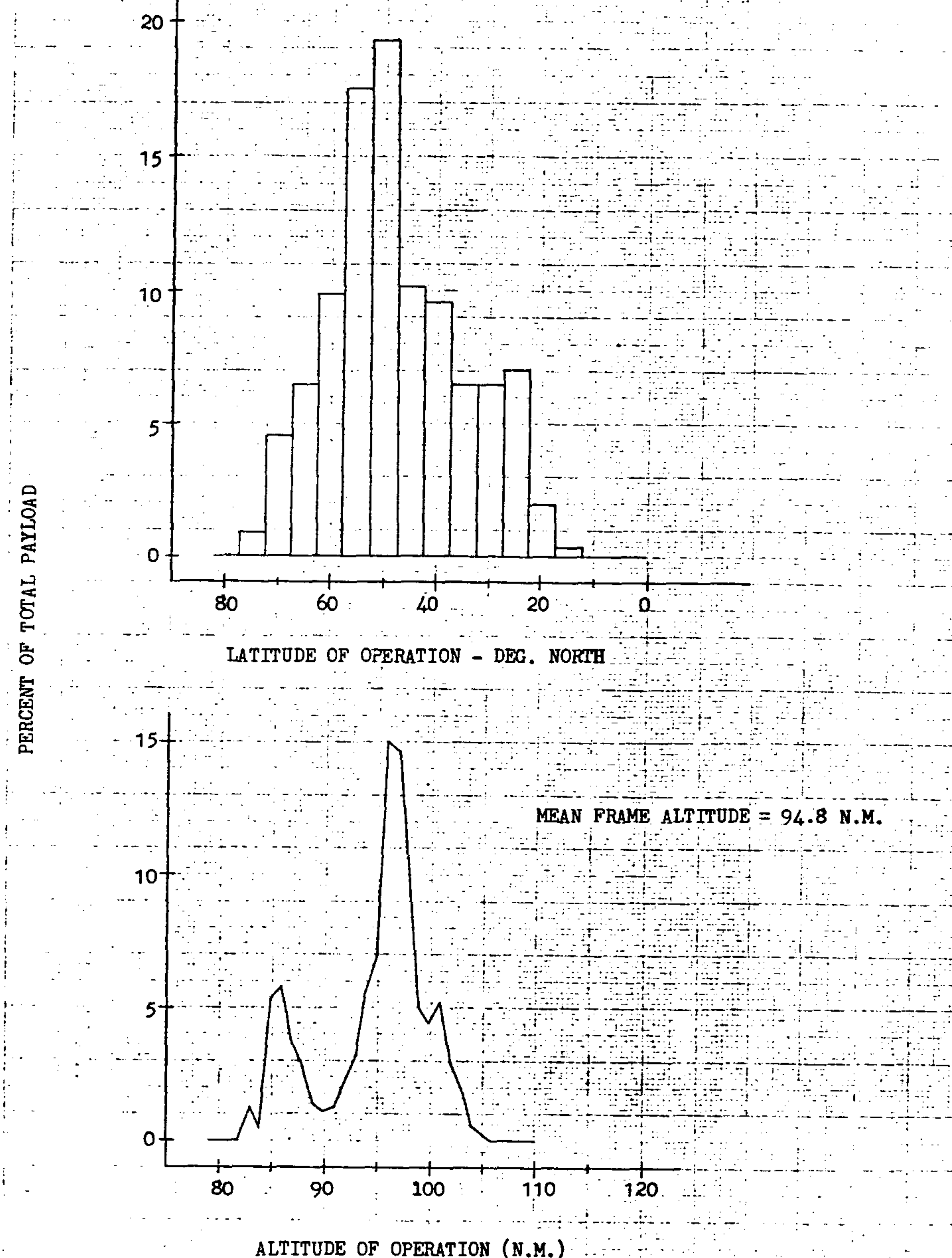
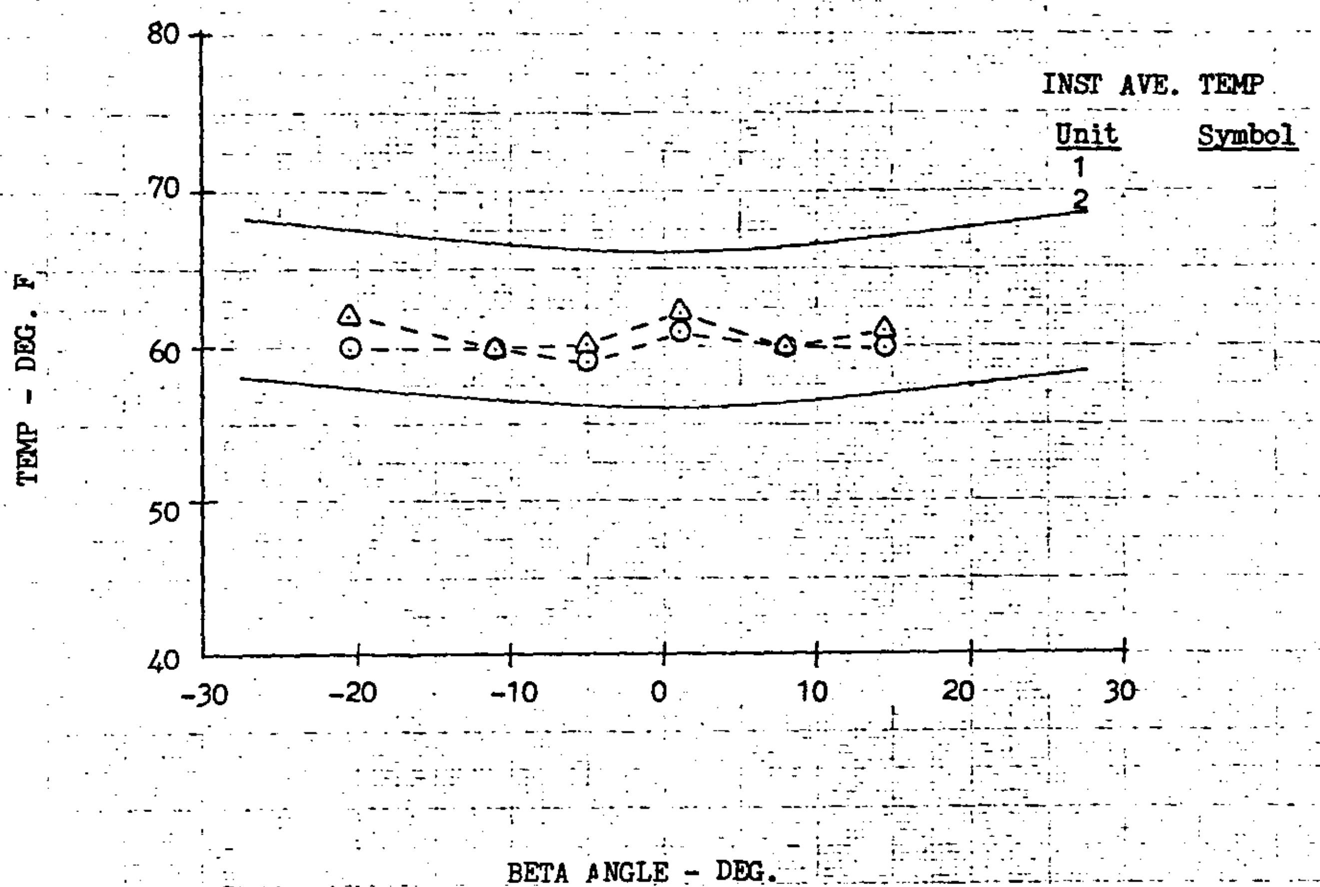


FIGURE 3-3

CR-14 FLIGHT VS PREDICTED TEMPERATURE



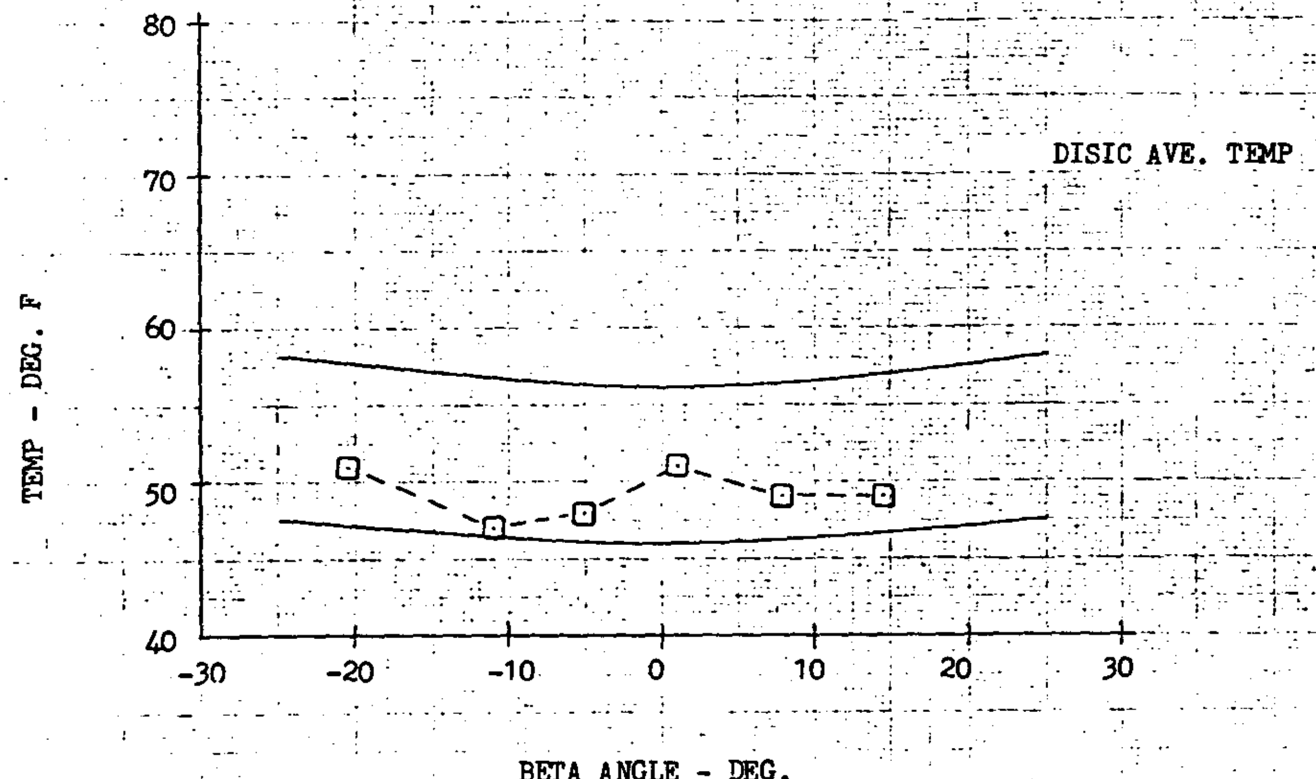


FIGURE 3-4

SECTION 4

PHOTOGRAPHIC PERFORMANCE

A. SUMMARY

The photographic performance of the panoramic cameras for Mission 1114 ranged from good to poor with the largest portion in the good to fair category. The image quality variability was attributed to variations in the acquisition altitude, 85 NM to 105 NM.

An MIP of 120 for Mission 1114-1 was achieved at an altitude of 88 NM, and an MIP of 125 for 1114-2 at an altitude of 105 NM. These MIP's are the highest ever achieved in the history of the Corona Program.

Mission 1114, except for weather and altitude variations produced the most consistently crisp imagery of any Corona system flown. The 3414 film appears to have enhanced mission performance through reduction of exposure time and mean camera smear. Another contributing factor to the excellent flight focus was to pre-focus the cameras for an on-orbit temperature of 60 - 65°F vs 70°F for previous missions. Camera system resolution, based on CORN target analyses, showed Mission 1114 superior to all previous missions. The mean on-orbit resolution of both the Fwd and Aft cameras was estimated to be near the peak level of the CR-14 capability, i.e., 218 L/MM at 2:1 contrast. Optically flat filters were used for the first time throughout this flight.

The photographic performance of the DISIC Index camera was good and was better than all previous missions in that there was no electro-static corona marks on the Stellar or Terrain films.

Aerial film flown was as follows:

Panoramic Cameras

Forward		Aft	
Type 3414	15,300 ft.	Type 3414	15,300 ft.
Type 3404	1,000 ft.	Type 3404	1,000 ft.
Index		**Stellar**	
Type 3400	2,200 ft.	Type 3401	2,000 ft.

B. PANORAMIC CAMERAS

1. Image Quality

Forward-Looking Camera #329: Film Type 3414: Wratten 25 Filter

The overall image quality of the Forward-Looking camera was the best. Unlike Missions 1109 and 1110, 1111, and 1112, most of the imagery retains its sharpness at magnifications up to 70 times with a limited amount to magnifications of 100 X.

A slight variation in quality exists across the format with the better quality along the binary side.

The best imagery for Mission 1114-1 was selected from the Forward-Looking camera and assigned an MIP of 120.

The best imagery for Mission 1114-2 was also selected from the Forward-Looking camera and assigned an MIP of 125.

Aft-Looking Camera #328: Film Type 3414: Wratten 23 Filter

The overall image quality of the Aft-Looking camera was less than the Forward-Looking camera. Unlike most recent missions, it retains its sharpness at magnifications up to 50 times.

2. Data Recording

Both panoramic cameras exhibited acceptable auxiliary data imagery throughout Missions 1114-1 and 1114-2.

3. Panoramic Camera Anomalies

The following anomalies are all of a minor nature and in no way affected the program objective of Mission 1114.

A. A small foreign deposit in frame 4 pass A09E, Aft camera, caused a base scratch through pass D40. The resulting scratch associated with the deposit occurred during processing.

B. The horizon format locations of both Fwd and Aft looking units are slightly erratic with respect to the main camera formats. The two formats never overlay exactly. This anomaly does not affect program imagery. The variation in horizon format location is considered normal for this type of film transport system.

C. A minor base scratch begins in frame 5 of pass A09E of the Fwd looking camera and continues thru the middle of pass D24. Investigation failed to reveal the cause. The minor nature of the scratch justified that no extensive action was considered necessary.

D. Characteristic anomalies having a minor effect on performance are as follows:

1. Roller/equipment shadowgraphs are present on the first and last parts of many passes. These range from 0.5 to 1.5 inches in length across the film web.

2. Some passes contain a small one-eight inch wide density fog pattern across the film web. This occurs on the seventh from last frame on passes so affected (Aft looking camera).

3. Dendritic static is present from pass 151 thru the rest of the mission on Aft looking camera material.
4. Frames 108 and 109 of pass 104 contain very fine scratches and abrasions associated with the cut and wrap sequence.
5. Characteristic out-of-focus areas common to the system were noted on material from the Fwd looking camera.
6. The first pass (Fwd only) contains sequentially overexposed, underexposed, and smeared camera serial number imagery.
7. Rail scratches are heavy on the forward camera preflight material and diminish slightly as the mission progresses.

4. Ground Resolution

Mobile bar targets were displayed and photographed during selected orbits of Mission 1114-1 only. Bar target displays were deployed to ascertain the resolution performance of panoramic cameras #329 (Fwd looking) and #328 (Aft looking). All targets were photographed using film type 3414.

The best 51/51 T bar target resolution was obtained on pass D32 at 88 nautical miles to the target using the Fwd looking camera. The ground resolution was 3.8 feet averaged from 5 readers. The 3.8 feet of ground resolution attained is the best ever achieved in the history of the Corona program. The Aft looking camera was not quite as high in ground resolution as the Fwd unit. The Aft unit produced approximately 25% less resolution relative to the Fwd looking unit.

5. Special Glass Filter Test

Domestic imagery was obtained during Mission 1114-1 using both the 37 Mil and 40 Mil thick glass filters. Imagery produced by both pan cameras was sharpest when acquired with the 37 Mil filter. As a result the 37 Mil filters were used throughout Mission 1114-2.

C HORIZON CAMERAS

The four horizon cameras operated properly throughout the entire mission.

D. DISIC #IR STELLAR/INDEX (Terrain) CAMERA

1. Performance

The Index photography was good. Program objectives were attained with point type star images recorded on both stellar cameras. Approximately 15 to 25 star images were recorded on the port formats; from 10 to 20 star images were recorded on the starboard formats.

2. Anomalies

No abnormal anomalies occurred. Characteristic anomalies are listed as follows:

A. Plus density skew marks are present outside the active stellar format.

B. Occasionally a binary time word was missing due to the timing brush stop point variations.

C. Emulsion build-up occurred on the starboard reseau plate, causing minus density spots.

D. Static marks were present on the trailing edge due to final wrap-up on the film spool.

SECTION 5

PANORAMIC EXPOSURE

A. INTRODUCTION

Exposure of the panoramic camera film is a function of the scan rate, filter and slit width selected, and scene luminance. Since scan rate is adjusted in flight to compensate for forward image motion, exposure reduces to the selection of the filter and slit.

The Wratten filter is selected prior to flight and is therefore fixed for a given film type. However, the slit width is selectable by real-time command in flight within limits established by the pre-flight choice of five slit positions including the failsafe position.

B. FILM TYPE 3414

The Wratten 25 (W-25) and Wratten 23 (W-23) filters were selected for the Fwd and Aft looking cameras respectively. Glass filters were selected for the primary and secondary positions. The somewhat heavier light filtration of the shorter wave lengths below the red region provided by the W-25 filter reduced the amount of non-image forming haze light that appears to be more pronounced in the Fwd looking camera. Since the W-25 filter provides more light filtration than the W-23, the slits selected for the Fwd camera are wider than the corresponding slits selected for the Aft camera.

The exposure slits selected for the Fwd and Aft cameras were was follows:

SLIT WIDTH (INCHES)

Slit I.D.	Fwd #329	Aft #328
S_4	0.323	0.278
S_3	0.220	0.189
S_2	0.184	0.152
S_1	0.142	0.110
F/S	0.198	0.163

Typical slit usage for Mission 1114-1 is shown in Figures 5-1 and 5-2 for orbit 71 Fwd and Aft cameras respectively. Similarly, Mission 1114-2 is represented by Figures 5-3 and 5-4 of orbit 138 Fwd and Aft cameras respectively. The continuous curve in Figures 5-1 through 5-4 represent the ideal exposure based on exposure criteria dated 1970. The actual exposure time produced through the programmed use of slits S_4 through S_1 is a step function as shown on Figures 5-1 through 5-4. Figures 5-1 through 5-4 also include the relative distribution of camera operations for Mission 1114.

Examination of the actual exposure curves versus the ideal exposure, as described in Figures 5-1 through 5-4 reveal that all exposures were within $\pm$ 0.4 F stops of the ideal exposure.

Examination of mission imagery revealed that program objectives were not only met but recorded imagery was the highest in resolution relative to all previous missions flown.

A useful technique, employed on past Corona missions for estimating whether the original negative was exposed properly, will be employed in this report. The method classifies frames of the original negative in terms of "correct", "over", and "under exposed". The basis for these exposure classifications is the assumption that the exposure is reasonably correct when the terrain scene minimum density (D - min) in the processed negative ranges between 0.4 and 0.9. A frame D-min value less than 0.4 suggests a tendency toward underexposure and a value greater than 0.9 indicates a tendency toward overexposure. These D-min cut-off points, though somewhat arbitrary, do consider the film's response to light.