Date: 22 September 1970

Copy No. [redacted]

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CORONA J

PERFORMANCE EVALUATION REPORT

MISSION 1108-1 AND 1108-2

FTV 1655, CR-9

Approved: [redacted]
Manager
Advanced Projects

Approved: [redacted]
Manager
Program [redacted]

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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 1655.

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 1108 which was launched on 4 December 1969.

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ILLUSTRATIONS
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INTRODUCTION

This report presents the final performance evaluation of Corona Mission 1108. The purpose of this report is to define the performance characteristics of the CR-9 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 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 are produced by the [redacted] The processing Summary report and Target Density measurements are provided by the Air Force Special Projects Production Facility.

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 1108 was planned to acquire cartographic and reconnaissance photography of selected terrain areas. Two mission segments were planned to total approximately eighteen days of orbital operation. Each mission segment would return approximately 6000 panoramic frames and each frame would nominally cover 1160 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 AFG at 21:38 GMT on 4 December 1969.

The panoramic cameras operated throughout both mission segments. Both cameras demonstrated acceptable operation during Missions 1108-1 and -2 until film depletion.

Mission 1108-1 was successfully completed, after 7 days of flight, with an air-catch of the recovery capsule. The second mission segment was similarly terminated after 11 days of orbital flight.

Photographic performance of the panoramic cameras varied from fair to good. An MIP of 105 was assigned to Mission 1108-1 and an MIP of 100 was assigned to 1108-2. These were the highest achieved by a Corona system near the winter Solstice. No CORN targets were acquired this mission.

TABLE 1-1

B. FLIGHT CONFIGURATION

Aft Looking Camera Serial No. 317

Mission No.	1108
Vehicle No.	1655
System No.	CR-9
Forward Looking Camera Serial No.	317
DISIC Camera Serial No.	12

Lens Data

Forward Looking Camera (Main Lens)

Lens Serial No.	I-200
Measured Slit Width (Inches)	
Position 1	0.141
Position 2	0.214
Position 3	0.274
Position 4	0.334
Failsafe	0.237
Optics Filter Type	
Primary	W-25
Alternate	W-25
E.O. Focal Length (Inches) (Vacuum)	24.006

Resolution

Static (Lines/Millimeter)

Filter	W-25
High Contrast	292
Low Contrast	186

Dynamic (Lines/Millimeter)	
ITEK Post-Vibration	
Filter	W-25
High Contrast	284
Low Contrast	188
A/P Test	
Filter	W-25
High Contrast	277
Low Contrast	188
Distortion/Pincushion (Microns)	
Angle Off Axis (Deg.)	
3	2
2	1
1	0
0	0
359	0
358	2
357	2
Aft Looking Camera (Main Lens)	
Lens Serial No.	I-195
Optics Slit Width (Inches)	
Position 1	0.084
Position 2	0.140
Position 3	0.185
Position 4	0.289
Failsafe	0.154
Optics Filter Type	
Primary	W-21
Alternate	W-28
E.O. Focal Length (Inches)(Vacuum)	24.0015

Resolution (Lines/MM)

Static

Filter	W-21
High Contrast	248
Low Contrast	148

Dynamic (Lines/MM)

ITEK Post-Vibration

Filter	W-21
High Contrast	224
Low Contrast	139

A/P Test

Filter	W-21
High Contrast	239
Low Contrast	132

Distortion/Pincushion (Microns)

Angle Off Axis (Deg.)	
3	1
2	0
1	0
0	0
359	0
358	1
357	4

Horizon Optics

Forward Looking Camera

Take-up (Starboard)

Lens Serial No.	23780
Exposure Time (Sec.)	1/100
Aperture	F/8.0
Filter Type	W-25
Oper. Focal Length (MM)	54.82
Radial Distortion (MM)	
10 Deg. Off Axis	0.01
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)	209	186	195	181	166	125	26
(Tangential)	187	175	153	131	112	87	55

Supply (Port)

Lens Serial No.	23781
Exposure Time (Sec.)	1/100
Aperture	F/6.3
Filter Type	W-25
Oper. Focal Length (MM)	55.88
Radial Distortion (MM)	
10 Deg. Off Axis	0.01
20 Deg. Off Axis	0.05
Tangential Distortion	0.015

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	207	208	174	162	156	138	43
(Tangential)	209	185	163	147	130	123	56

Aft Looking Camera

Take-up (Port)

Lens Serial No.	23773
Exposure Time (Sec.)	1/100
Aperture	F/6.3
Filter Type	W-25
Oper. Focal Length (MM)	54.93
Radial Distortion (MM)	
10 Deg. Off Axis	0.005
20 Deg. Off Axis	0.04
Tangential Distortion	0.016

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	148	156	184	181	156	150	68
(Tangential)	132	156	171	138	83	68	50

Supply (Starboard)

Lens Serial No.	23776
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	0.05
Tangential Distortion	0.02

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	187	197	184	171	166	142	46
(Tangential)	166	175	161	147	123	96	62

DISIC Camera

Port Stellar Camera

Lens Serial No.	14P
Reseau Serial No.	14P
Aperture	F/2.8
Exposure Time (Sec.)	1.5
Nominal Focal Length (In.)	3
Filter	None

Starboard Stellar Camera

Lens Serial No.	15
Reseau Serial No.	15
Aperture	F/2.8
Exposure Time (Sec.)	1.5
Nominal Focal Length (In.)	3
Filter	None

Terrain Camera

Lens Serial No.	109		
Reseau Serial No.	109		
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	122	112	106
Tangential	108	106	82
Film Type	3400		
Filter	W-12		

Film Types

Forward Looking Camera

Split Load	No
Film Type	3404
Length (Ft.)	16,300
Splices	5
Length Between Splices (Ft.)	3500-1780-4940-1770-2305-2005C
Emulsion Data	443-½-11-9
Payload Weight (Lbs.)	81.5
Spool No.	212
Box Serial No.	10

Aft Looking Camera

Split Load	Yes
Film Type	3404 and SO-242 Color
Length (Ft.)	16,000 (15,200 + 800 Color)
Splices	6
Length Between Splices (Ft.)	2990-4185-4180-1470-2375-MCD -800C
Emulsion Data	444-6-11-9(15,200 FT 3404)., SO-242-2-1, 800 FT
Payload Weight (Lbs.)	80.6
Spool No.	148
Box Serial No.	10

DISIC Camera

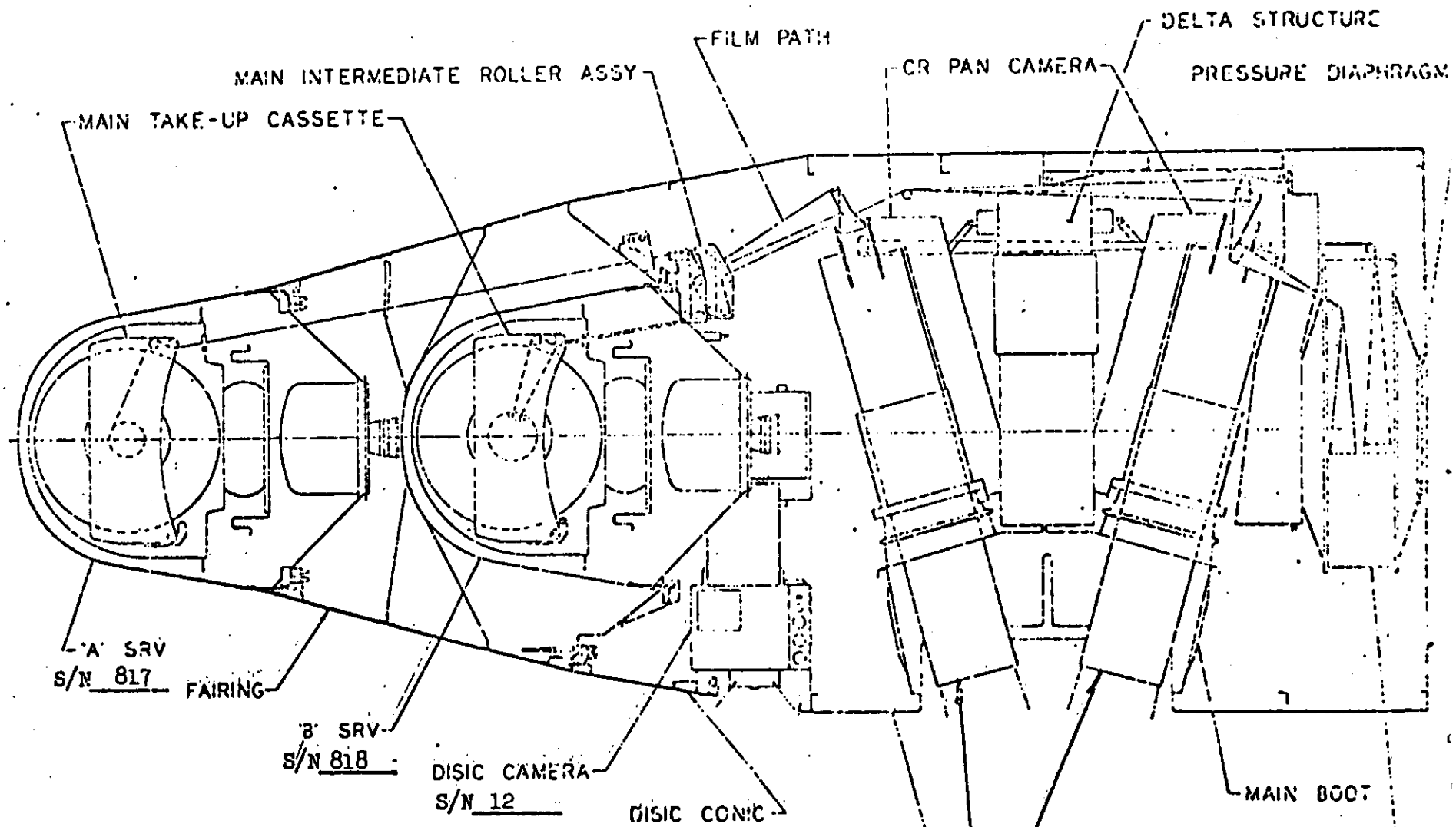
Stellar Camera

Split Load	No
Film Type	3401
Length (Ft.)	2000
Splices	None
Length Between Splices (Ft.)	None
Emulsion Data	319-6-6-9
Payload Weight (Lbs.)	5.3

Terrain Camera

Split Load	No
Film Type	3400
Length (Ft.)	2200
Splices	1
Length Between Splices (Ft.)	1325-875C
Emulsion Data	3400-202-4-4-9
Total Film Weight (Lbs.)	20.0

PAYLOAD PROFILE AND SERIAL NUMBERS



SYSTEM NO. CR-9

TEST _____

PMU S/N 1011

SLOPE PROGRAMMER S/N 210

CLOCK S/N 633

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 test 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 and Film Lift test (AGT Test) that determine 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-9 system successfully passed all phases of the testing operations providing acceptable performance and a high degree of operational confidence.

B. ENVIRONMENTAL TEST

The CR-9 payload system was tested in the Sunnyvale HIVOS chamber between 14 July 1969 and 21 July 1969. 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.

Both main instruments exhibited acceptable corona characteristics during the test. No pan-camera corona occurred.

The terrain portion of DISIC #12 from SRV #1 contained some corona marks. Film type 3400 was used. Approximately 7.5% of the cycles contained minor amounts of corona fog to a maximum density of 0.32 above the base level. Marking was confined to a narrow streak 1/32 inches wide, 1/8 inch into the active area on the time word side. Corona was minimal and met the acceptance criteria.

The terrain portion of DISIC #12 from SRV #2 contained unacceptable corona. Approximately 15.5% of the cycles contained corona fog to a density of 0.3 above the base level. The acceptance criteria permits a maximum of 10% of the frames affected by corona to a maximum of 0.4 density above the base fog level.

The stellar portion of DISIC #12 used film type 3401. Processed stellar film from SRV #1 had 4.5% of the frames affected by minor corona fog to a density of +0.02 above the base level.

Approximately 30% of the stellar cycles from SRV #2 contained corona fog (1204 cycles marked out of approximately 3900). However, 95% of the corona marked cycles had a density less than 0.15 above the base level. Approximately 5% of the marked cycles had a maximum density that ranged between .2 and .4 D. The corona marked cycles combined ("A" and "B") equal 17% of the stellar cycles affected. The percentage exceeds the acceptance criteria of 10%.

A corona waiver for DISIC #12 was recommended and the waiver granted without further altitude testing because the corona density was judged to be low enough that program objectives would not be compromised.

Panoramic cameras #316 and #317 as well as DISIC #12 were subjected to vacuum pressures that ranged from less than 1 to 103 micrometers during testing in the altitude chamber. The gas pressure make-up system (PMU) when turned on produced an equilibrium internal camera pressure of approximately 85 to 100 micrometers regardless of whether the cameras were on or off.

The electro-mechanical characteristics of the panoramic cameras were satisfactory throughout the test. However, unusual characteristics in the forward and reverse drive motor telemetry monitors were observed and later corrected.

The No. 2 instrument (#317) slit width servo system took approximately ten seconds to drive from position 1 to 2 and position 2 to 3. This was corrected. Both of the main instrument output idlers indicate minor film movement backwards at the end of the stow frame. This minor anomaly was accepted.

The DISIC shutter telemetry monitor was inoperative prior to Rev. 8 in the "A" mission and intermittent during the remainder of the test. This anomaly was most probably due to changes in the fogging lamps voltage.

The Command system performed satisfactorily through out the test. The DSR worked normally except for Rev. 8A. The DSR was loaded and a load disable (Uncle 119) was given but the output register failed to advance to the first word of the new load. This intermittent problem of the DSR is a design deficiency which has been experienced on other DSR Command systems and a modification was accomplished to correct this anomaly.

The CR-9 system was instrumented with thermocouples throughout the payload system to provide a detailed analysis of temperatures gradients during the chamber test. The overall thermal test objectives were achieved with this system during the chamber test.

The switch programmer operated normally throughout the test. The slope programmer operated satisfactorily except for Rev 9A when the delay timed out 200 seconds early.

The PMU system operated satisfactorily throughout the test and achieved 100 microns when it was enabled indicating the pulsing network timers were incorrectly set to achieve the desired 65 micron level. A special PMU test was conducted during the "B" phase to determine the required PMU settings for flight. This data is shown in Table 2-1.

An accuracy check of the clock system was performed and the results were satisfactory.

The telemetry system operation was normal throughout the test.

The SRV tape recorder system functioned properly throughout both phases of the test.

Auxiliary data recording imagery observed in the processed panoramic film from both cameras was as follows. The time track was present and acceptable. All PG data along the rails were present and acceptable. The SLP time word bits were unacceptable (too small). The time word exposure was increased with the result that the bit size was acceptable. Bit diameter at the 50% density point ranged between 6 and 10.5 mils. The scan traces were acceptable. The horizon camera fiducials were present and acceptable.

DISIC #12 auxiliary data recording was acceptable including the stellar and terrain serial number, time word, and the reseau grid image.

TABLE 2-1, SPECIAL PMU TEST

PMU GAS VALVE ON TIME VS INTERNAL SYSTEM PRESSURE

TEST NO.	VALVE SETTING (SECONDS) A SURGE TIME ON	B PULSE TIME ON	C PULSE TIME OFF	ALPHATRON PRESSURE (MICRO METERS) START/END SURGE/B, C
1	3.9	.3	1.5	0/104/103
2	2.9	.3	.7	0/80/94
3	.8	.3	1.5	0/28/58
4	1.4	.3	1.5	2/45/67
5	1.0	.3	1.5	18/45/66
6	1.4	.3	1.5	36/70/72
7	1.8	.3	1.5	20/70/74
8	2.1	.3	1.4	32/86/75
9	2.3	.3	1.4	34/94/76
10	2.6	.3	1.5	35/101/74
11	2.6	.3	1.5	1/82/70
12	2.6	.4	1.4	2/82/80
13	2.7	.5	1.4	3/82/88
14	2.7	.6	1.4	5/82/93
15	2.6	.7	1.4	5/82/100
16	3.0	.3	1.4	2/89/71
17	3.1	.3	1.4	1/95/72
18	3.8	.3	1.4	3/103/72
19	2.9	.2	.7	2/84/92
20	2.2	.2	1.6	1/70/62
21	1.6	.1	1.6	1/52/52

C. LIGHT LEAK TEST

The CR-9 system was tested for light leaks on 10 July 1969. Panoramic instruments #316 and #317 were threaded with film type 3401 per the standard operating procedure. The CR-9 system was placed in flight configuration and exposed to external illumination for 90 minutes per side. At the conclusion of the test the payload was retrieved, processed to the full level, and evaluated. No system light leak fog was present on the film from either instrument.

D. RESOLUTION TEST/AGT

Resolution Test.

The CR-9 system resolution testing was conducted at the A/P facility using film type 3404. The Boston East coast data using film type SO-380 (UTB) are included for reference.

Prior to the first A/P test the scan head rollers of Instruments #316 and #317 were shimmed +0.0005 inch. This shimming moved the scan head rollers away from the lens. The intent of the move was to bring the scan head rollers in contact with the 3404 film which has greater dynamic lift than UTB film by approximately +0.0005.

The first A/P test was conducted on 14 August 1969. The results are shown in the following table and Figures 2-1 and 2-2. The peak focus of Instrument #316 moved in the plus collimator focus direction as expected from the addition of the shim. The peak focus of Instrument #317 did not appear to move. The peak focus of Instrument #316 measured 132 to 135 li/mm and occured between the 000 and -.001 position. Instrument #317 peak focus measured 182 to 189 li/mm and appeared to occur between 000 and -.001 but closer to the 000 position Both cameras demonstrated acceptable resolution performance.

However, Instrument #317 was shimmed an additional 0.0005 inch with the intention to cause the peak focus to occur at a more minus collimator position. This change was based on an East coast IMC/thru focus test using film type SO-380 (UTB) that indicated the best focus was biased on the minus position side. A final thru focus resolution test of Instrument #317 only was conducted on 6 September 1969 and showed that the peak focus did move in the minus direction as result of the last scan head shimming. Peak focus is at approximately the -0.0008 to -0.0009 position and is 175 to 195 li/mm low contrast resolution. The previous Instrument #316 resolution test and the subsequent Instrument #317 resolution test results were considered acceptable.

TABLE 2-2

CR-9 SYSTEM

THRU FOCUS LOW CONTRAST (2/1) RESOLUTION (Li/mm)

COLLIMATOR SET FOR VACUUM FOCUS SHIFT OF 0.014 INCHES

INSTRUMENT 316

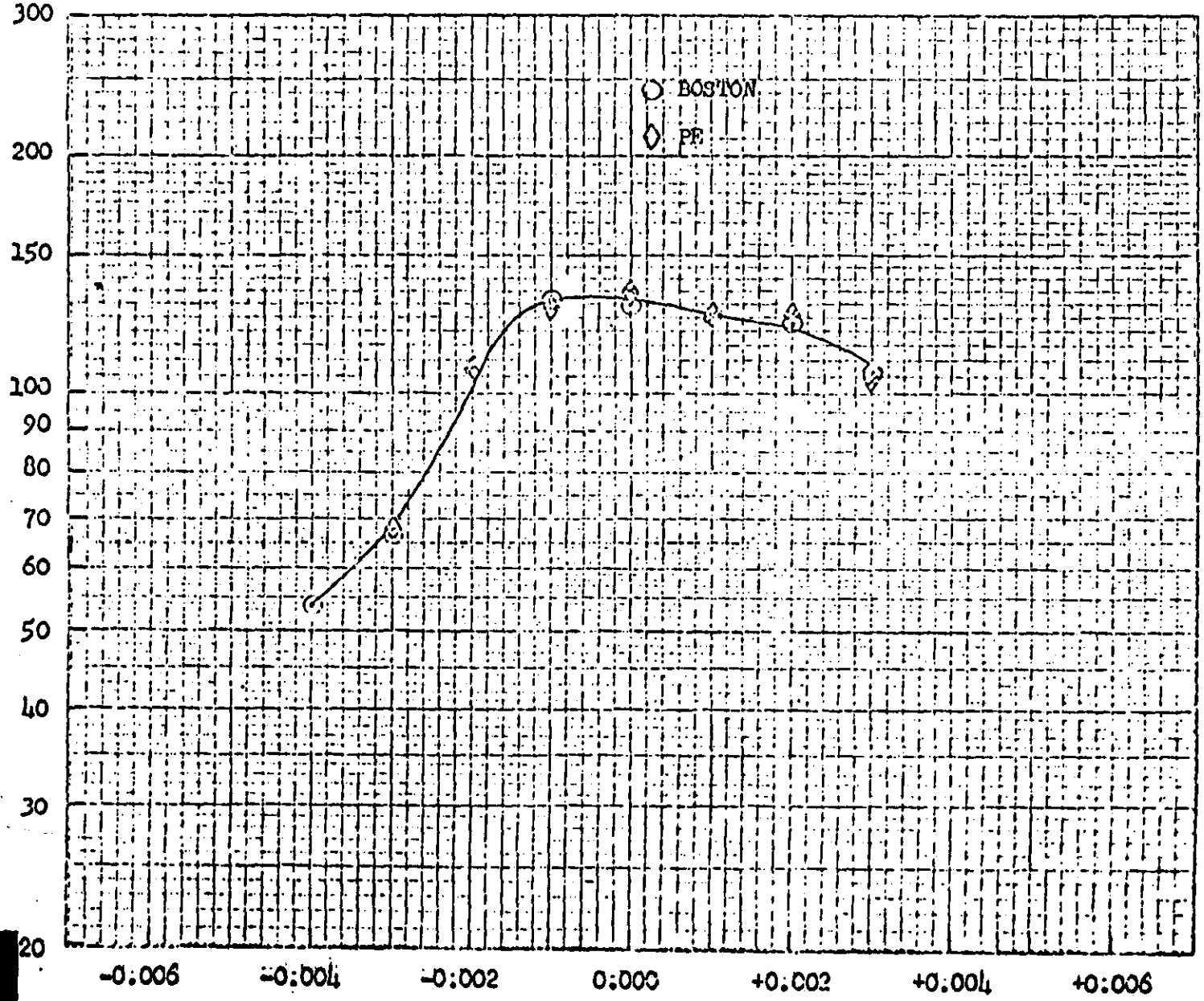
FILM TYPE: COLLIMATOR FOCUS (INCHES)	SO-380 (UTB) BOSTON EAST COAST	3404 A/P TEST 14 AUG. 1969	3404 A/P TEST 6 SEPT. 1969
-0.004	---	54	None
-0.003	88	67	"
-0.002	127	108	"
-0.001	132	132	"
0.000	139	131	"
+0.001	134	127	"
+0.002	124	124	"
+0.003	98	107	"
+0.004	80	---	"

INSTRUMENT 317

-0.004	---	---	61
-0.003	87	72	95
-0.002	131	94	150
-0.001	188	160	175
0.000	178	189	154
+0.001	138	152	101
+0.002	95	121	73
	66	---	---
	57	---	---

FIGURE 2-1

PRE-FLIGHT DYNAMIC RESOLUTION



Camo 316

Payload No: CR-9

Resolution (l/mm)

High Contrast: N/A

Low Contrast: 2/1

Film Type: 3404

Test Date: 14 Aug. 1969

Filter: Wratten 21

Slit: 0.134"

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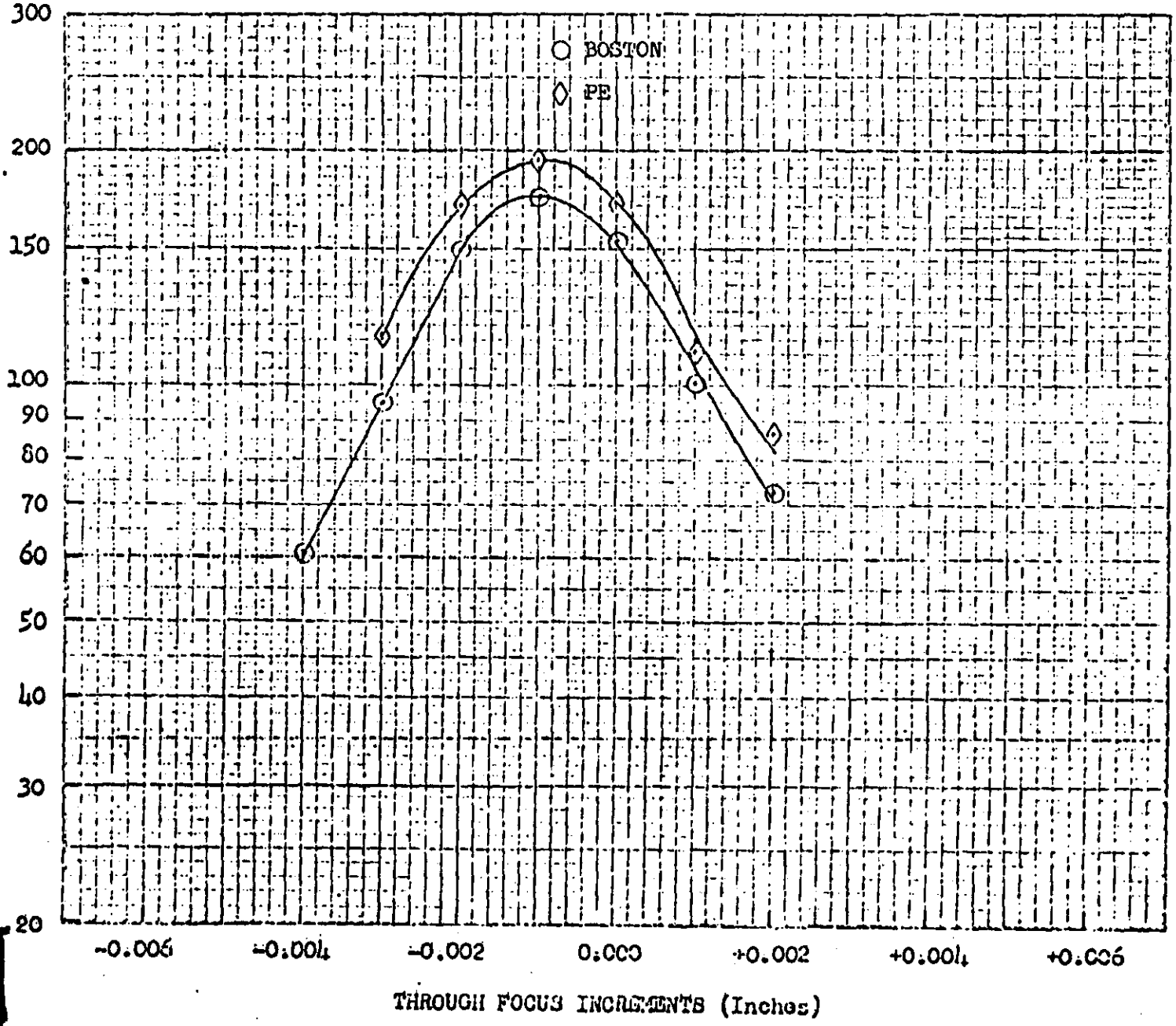
FIGURE 2-2

PRE-FLIGHT DYNAMIC RESOLUTION



Camera _____

Payload No: CR-9

Resolution (l/mm)

High Contrast: N/A

Low Contrast: 2/1

Film Type: 3404

Test Date: 6 Sept. 1969

Filter: Wratten 25

Slit: 0.132"

[redacted] CONTROL SYSTEM ONLY

AGT - ASCHENBRENNER GRID TEST

The CR-9 system was subjected to the AG Test on 9 August 1969. The test consisted of 24 cycles of usable material from each camera. Film type 3404 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. The resulting film lift measurements in inches (mils) above the scan rollers are shown in the attached table and graphical plots, Figures 2-3 and 2-4 and Table 2-3.

The current acceptance criteria was used to determine camera film lift compliance. The criteria used is such that 90% or more of the film lift measurements must be within $\pm$ 0.7 mils of the center of format film lift for the camera to be acceptable.

When the above acceptance criteria is applied to the data shown in Table 2 for camera #316, it is found that only 86% of the film lift measurements are acceptable. Camera #316 therefore does not meet the Boston acceptance criteria. Camera #317 is acceptable with 100% of the film lift values being within tolerance. However, many of the high film lift values of camera #317, although acceptable, are marginal. These high film lift values correlate with very soft rail hole imagery produced on the camera serial number side of the format in part of the HIVOS test and subsequent lamp tests. All film lift values that did not meet the acceptance criteria are underlined in Table 2-3 and are circled in graphical plot, Figure 2-3. The end points sampled are 27.75 inches apart. The usable format is 29.3 inches long.

Note: Table 2 data was used to plot Graphs 1 and 2

Inst. 317 Format 11 Cycle Rate 3 Sec/Cycle

Sample Distance From End of Format (Inches)

		Supply End 1"	1½"	4"	9"	CF	9"	4"	1½"	Take-up End (Start of Scan) 1"
Inboard Side (Time Word)	9	.3	.4	.5	.7	.5	.5	.4	.5	1.0
	8	1.2	.8	.9	.9	.9	.8	.8	.5	1.2
	7	.7	.6	.6	.8	.6	.8	.4	.3	.9
AGT Line Pair	6	.7	.9	.9	.9	.9	1.0	.7	.5	.9
	5	1.2	.8	.8	.9	.9	1.0	.7	.3	.9
	4	1.4	1.4	1.3	1.1	1.1	1.1	.9	.6	1.1
	3	1.6	1.6	1.4	1.2	1.3	1.2	1.1	.9	1.4
Outboard Side	2	1.6	1.4	1.5	1.1	1.3	1.4	1.0	.7	1.4
	1	1.5	1.6	1.6	1.6	1.3	1.1	.8	.8	1.4

100% of the lift values meet the Boston acceptance criteria

1. Acceptable Values: 0.2 to 1.6 inclusive

Inst. 316 Format 13 Cycle Rate 3 Sec/Cycle

		1"	1½"	4"	9"	CF	9"	4"	1½"	1"
Inboard Side (Time Word)	9	2.2	1.3	1.4	1.8	1.6	1.6	1.6	1.4	3.0
	8	---	---	---	---	---	---	---	---	---
	7	2.2	.9	1.0	1.1	1.0	1.1	1.1	.7	3.3
AGT Line Pair	6	1.6	1.3	1.1	1.4	1.4	1.3	1.1	.8	3.2
	5	.9	1.3	1.3	1.6	1.4	1.3	1.2	.8	3.5
	4	1.1	1.5	1.5	1.6	1.5	1.2	.9	1.0	4.2
	3	2.0	1.3	1.5	1.6	1.3	1.5	1.1	.9	4.8
Outboard Side	2	2.6	1.3	1.6	1.8	1.6	1.5	1.3	.9	5.5
	1	1.8	1.2	1.4	1.4	1.1	1.2	1.1	.8	5.9

86% of the lift values meet the Boston acceptance criteria

2. Acceptable Values: 0.7 to 2.1 inclusive

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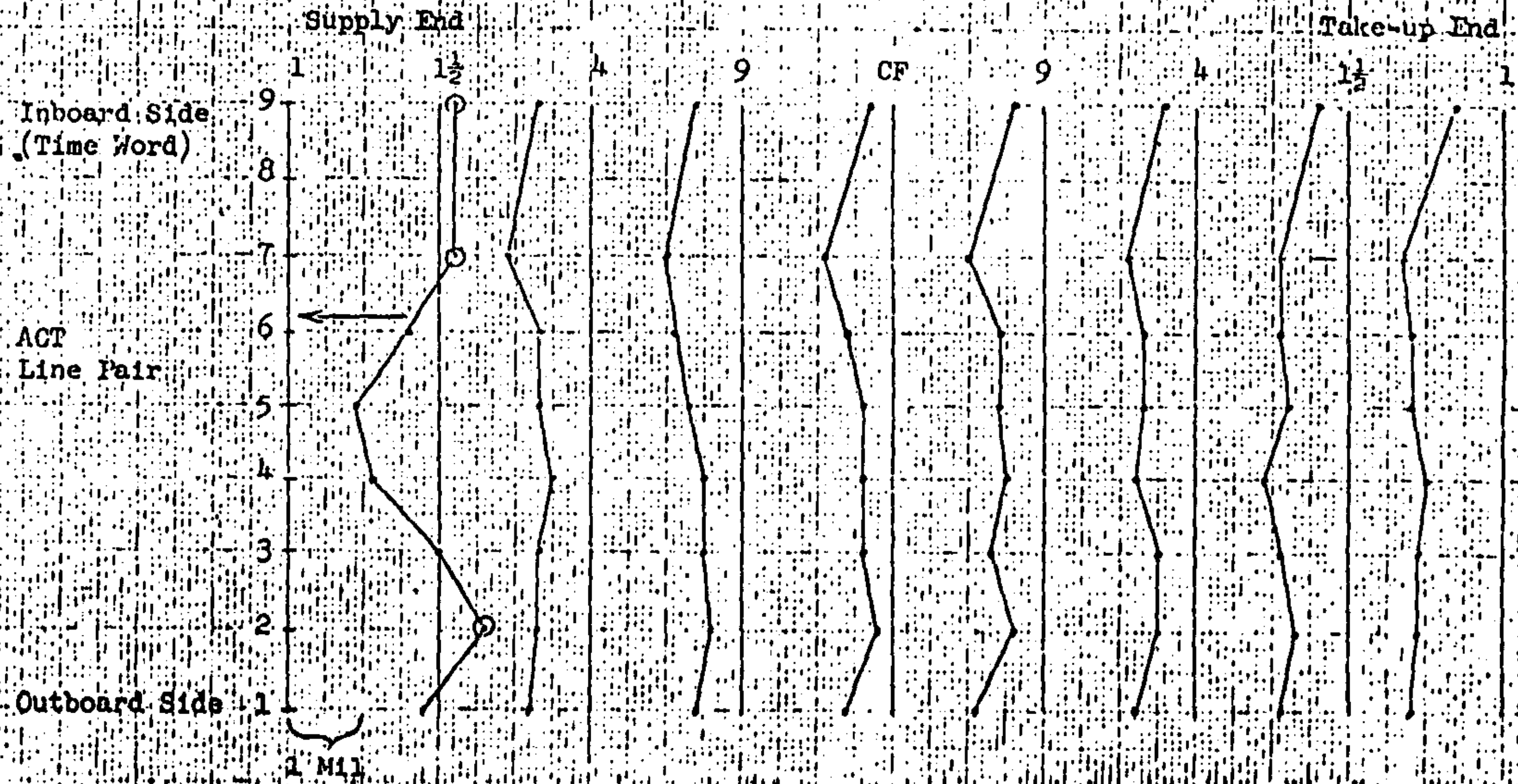
FIGURE 2-3

CR-9 AG TEST - AMBIENT CONDITIONS - INST. 316

GRAPH 1

FILM LIFT (MILS)*

SAMPLE DISTANCE FROM ENDS OF FORMAT (INCHES)



* Above scan head rollers

Note: Circled points exceed acceptance level .7 to 2.1 mils

Format 13
Cycle rate 3 sec/cycle

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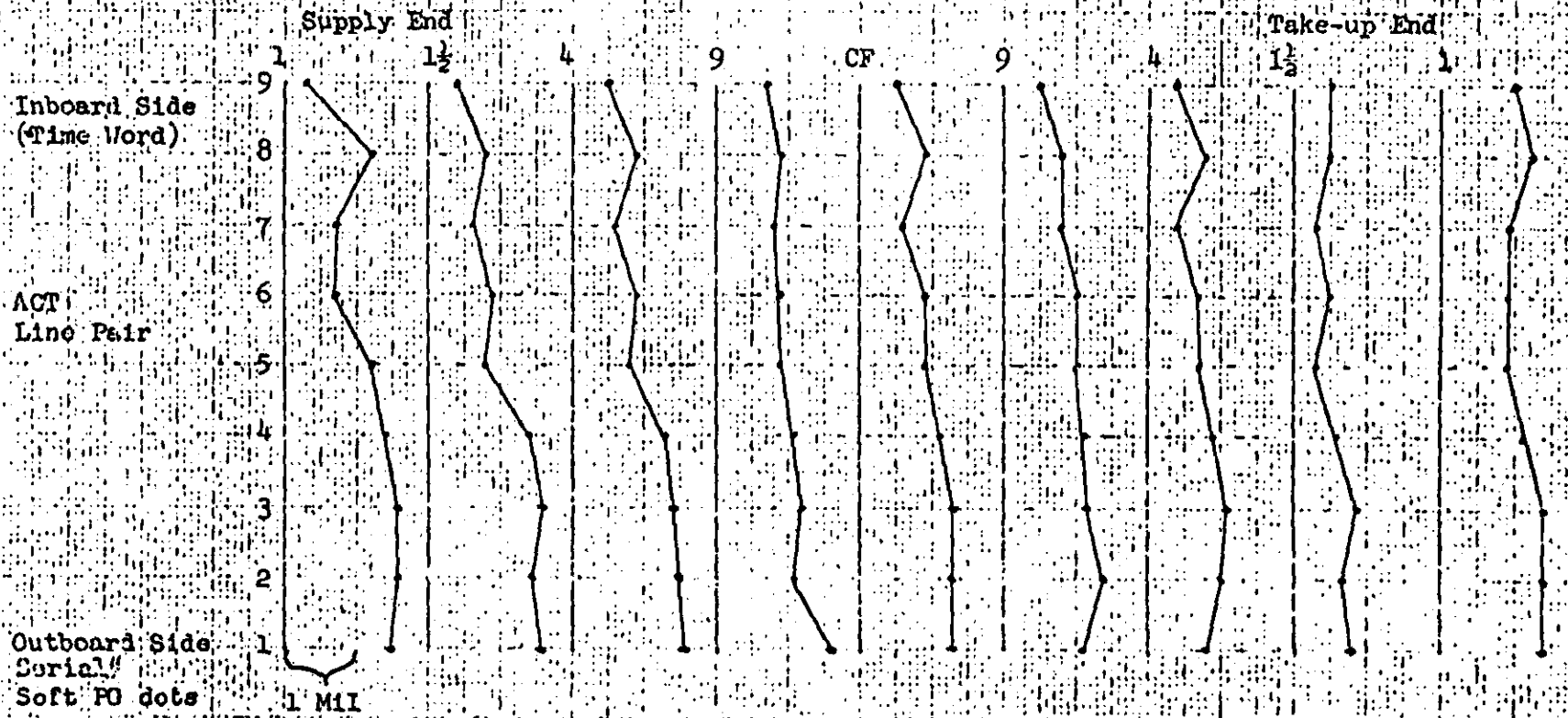
FIGURE 2-4

CR-9 AC TEST - AMBIENT CONDITIONS - INST. 317

GRAPH 2

LIFT (MILS)*

SAMPLE DISTANCE FROM ENDS OF FORMAT (INCHES)



* Above scan head rollers

Note: Circled points exceed acceptance criteria

Format 11
Cycle rate 3 sec/cycle
8-11-69

E. FLIGHT READINESS TEST

The readiness test conducted on 15 November 1969 demonstrated acceptable Instrument #316 and #317 performance as revealed by the processed test film.

It was recommended that CR-9 system be accepted without further readiness testing.

The CR-9 cam/slit sequence and slit width values were verified as part of the readiness test. Evaluation of the processed SO-380 film revealed that the exposure cams do provide acceptable exposure slit widths in the correct sequence.

Measurements of processed slit images revealed the following slit values:

Slit No.	Command Position	SLIT WIDTH (INCHES) Camera 310 AFT	Camera 311 FWD
1	2	0.084	0.141
2	3	0.140	0.214
3	4	0.185	0.274
4	5	0.289	0.334
Fairsafe	11	0.154	0.237

F. FLIGHT CERTIFICATION

The CR-9 flight readiness test was conducted during the 15-18 November 1969 period.

The Primary DISIC Terrain flight film load was rejected because it was loose and egg-shaped. The Primary DISIC Stellar flight film load was rejected because of a defective can. Both were loaded with the Back-up loads. Processed samples of the Terrain and Stellar film showed acceptable performance.

Flight film loading of the CR-9 Panoramic Cameras occurred without incident. Sensitometric examination of samples of the flight film verified satisfactory photographic characteristics.

The confidence run, to certify the CR-9 system for flight, was conducted on 18 November 1969. Operations demonstrated normal and acceptable performance.

The CR-9 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-9 system was accepted for flight on 18 November 1969.

SECTION 3

FLIGHT OPERATIONS

A. SUMMARY

Mission 1108 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 17 days with a 7-day first segment and a 10-day second segment.

The panoramic cameras operated satisfactorily throughout the flight. The panoramic camera film supply for both instruments was depleted prior to the -2 mission recovery. Photographic performance varied from good to poor. The DISIC camera operated properly throughout the -1 mission but failed near the end of the -2 mission. DISIC failure occurred after frame 73 of pass 204.

B. LAUNCH

The flight was launched at 21:38 GMT (13:38 PST) on 4 December 1969 from Satellite Launch complex 3 west at Vandenberg AFB. Launch was within the specified 21:25 to 22:25 launch window. The window was selected to optimize northern latitude coverage throughout the flight. Door ejection, instrumentation switchover and panoramic camera transfer to orbit mode occurred as planned.

Mission 1108 was composed of Thor booster S/N 69-039, Agena vehicle 1655 (first solar array system), and payload system CR-9. The CR-9 payload system contained panoramic cameras S/N 316 and 317 and DISIC camera S/N 12.

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 1108 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 1108 Orbit Parameters (Rev. 2)

Orbital Parameters

Parameter	Predicted	Tolerance	Actual STC	Actual APF
Period (Min.)	88.67	+.25, -.46	88.53	88.53
Perigee (n.m.)	81.2	+6, -6	83.7	84.2
Apogee (n.m.)	150.5	+10, -16	143.2	142.5
Eccentricity	.0099	+.0016,-.0024	.0084	.0084
Inclination (Deg)	81.50	+.22, -.17	81.48	81.49
Argument of Perigee(Deg)	143	+55, -61	137.1	135
Regression Rate(Deg/Rev)	22.31	----	22.27	22.27

DMU Operation

Six DMU rockets were utilized for period control throughout the flight to maintain the ground track position. Ground track error varied between 5 and 43 nautical miles east of the nominal track at the equator. A compromise was necessary on Rev 127 and Rev 214 as to the desired perigee altitude and/or location in order to hold the ground track error within acceptable limits. This was necessary because a DMU firing was

not available at the particular rev and latitude needed to provide the desired effect on perigee and still minimize the ground track error. This compromise did not degrade mission performance.

Table 3-2 is a summary of the DMU firings that occurred during Mission 1108.

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	17	81658	14.05	22.50	88.44	3095
2	49	81518	13.66	21.85	88.41	2939
3	85	12702	9.10	14.70	88.46	2002
4	127	62098	15.29	24.32	88.42	2978
5	166	11061	10.74	17.30	88.48	2106
6*	214	06867	15.83	25.28	88.42	3060

* DMU rockets 7, 8, and 9 were fired after the -2 recovery.

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

CR-9/1108

ORBIT HISTORY

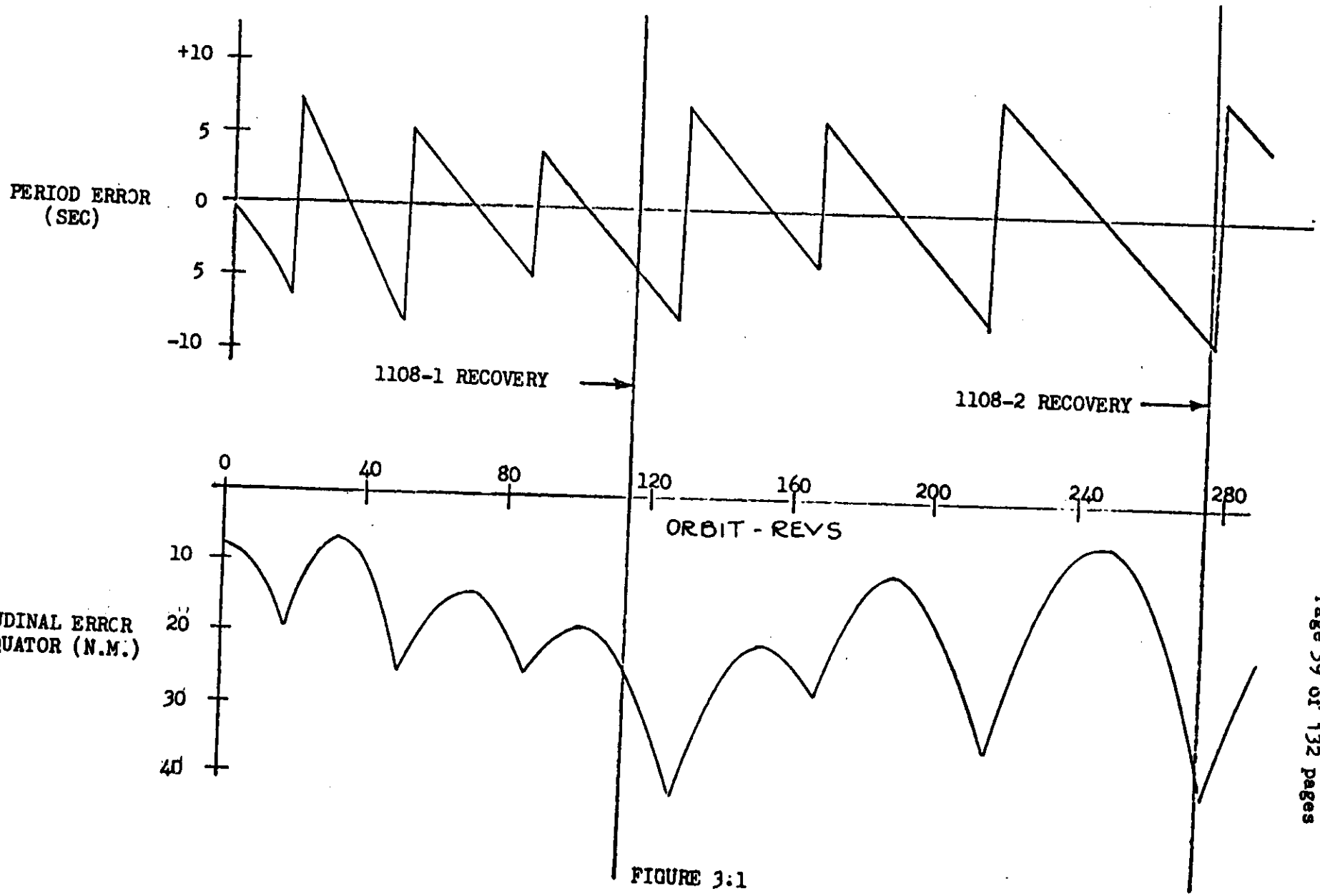


FIGURE 3:1

CR-9/1108

ORBIT HISTORY

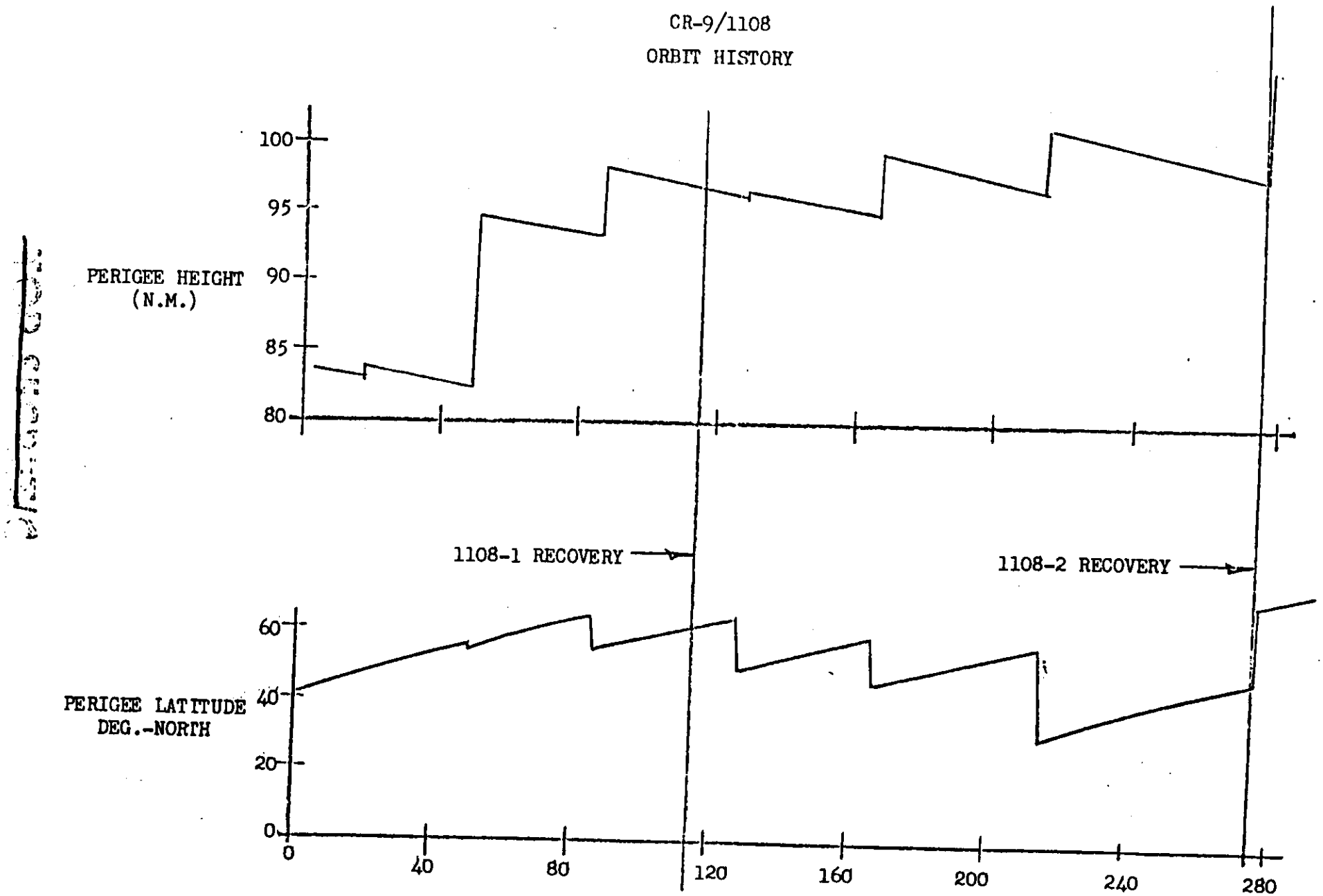
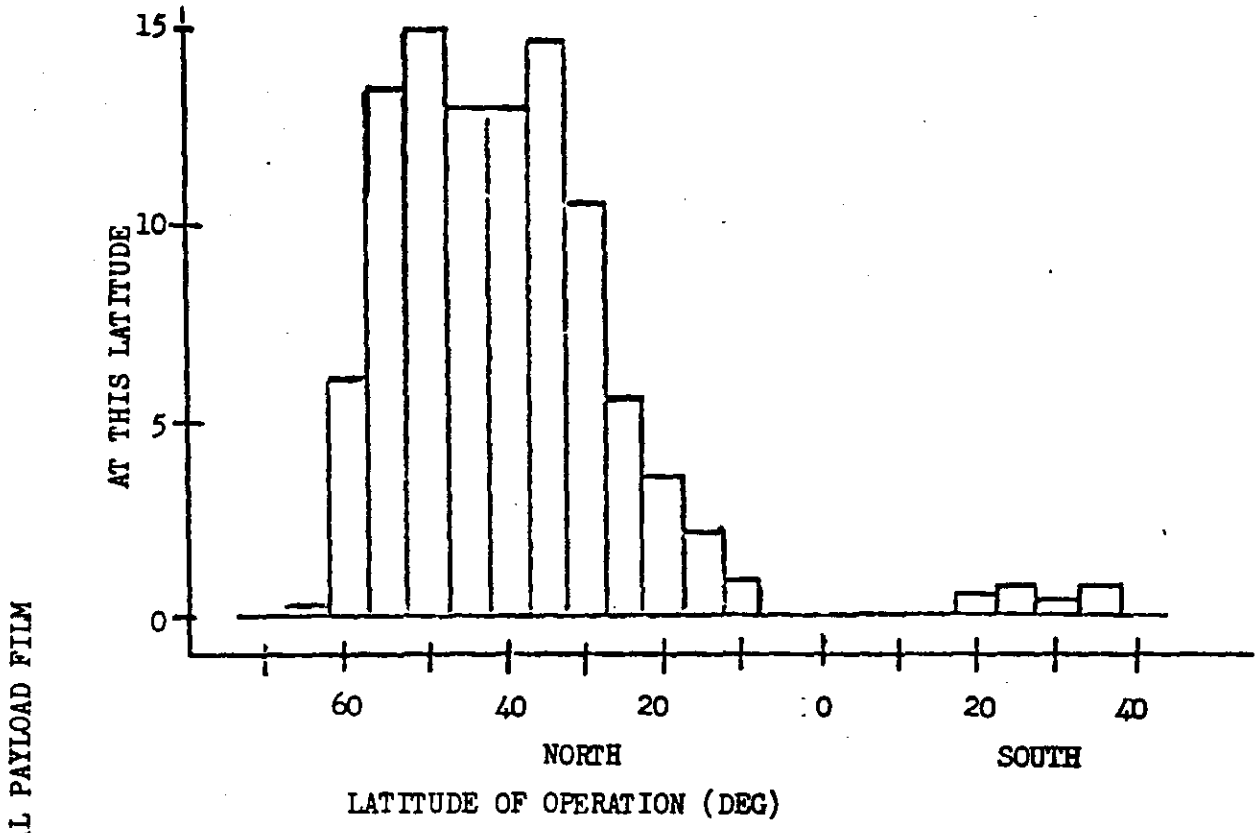


FIGURE 3.2

OPERATION DISTRIBUTION



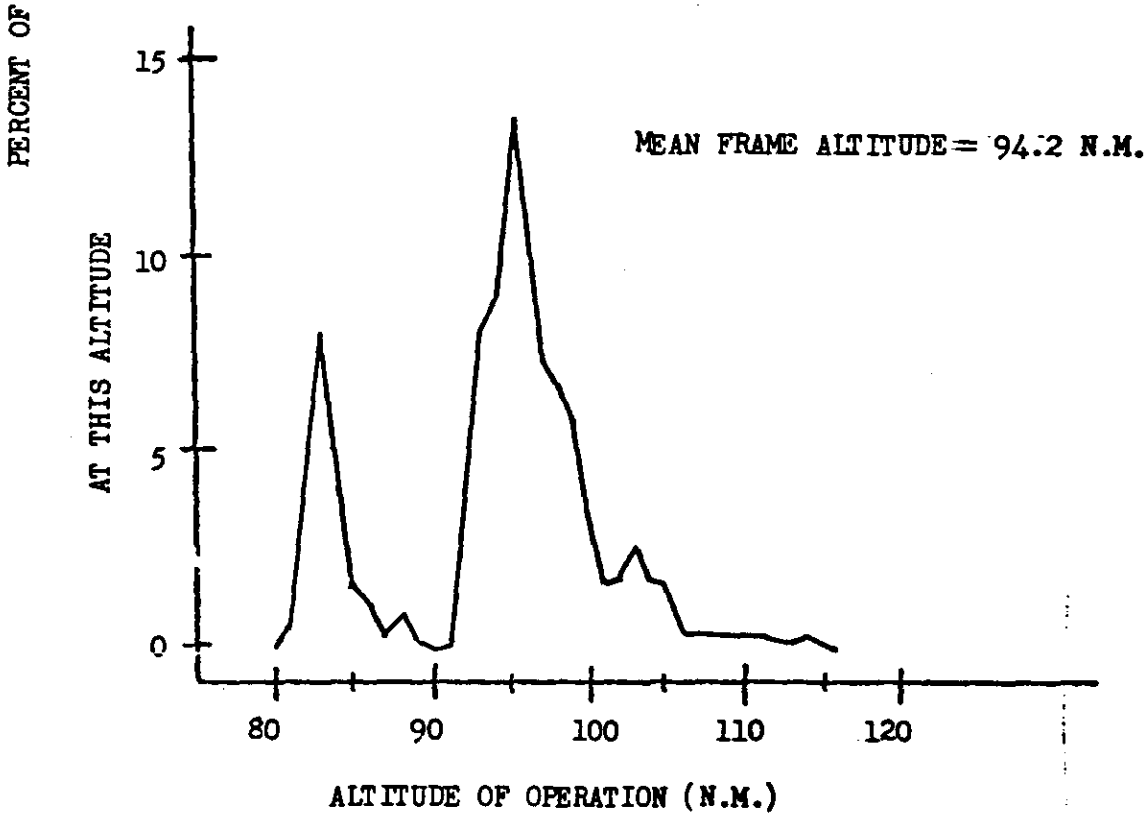


FIGURE 3.3

TOP SECRET

D. PANORAMIC CAMERAS

CR-9 was the first camera system to have the supply cassette servo system installed. A change in the film path from the supply spool to camera system was required to accommodate this modification. This resulted in an increase in the film path of approximately 10.5 inches in length.

A film path modification on the camera transport system was performed also. This resulted in a 7-inch increase in the film length from the output of the shuttle asssembly to the air twist in the barrel.

Both panoramic cameras exhibited normal film transport characteristics and operated satisfactorily throughout the flight. The film type 3404 was used throughout except at the tail end of camera S/N 316.

Panoramic camera S/N 316 contained 800 feet of SO-242 color film on the end of the supply spool. The MCD detector worked properly on Rev 242 during the engineering operation over the [redacted] tracking station. The MCD passed through the system on frame 25-26 of a 37-frame operation.

Panoramic camera 316 passed the film tag end into the recovery system with no film wrap-up.

The film tag end of panoramic camera 317 wrapped up in the film transport mechanism of Rev 269. The frame metering roller telemetry indicated the system did not stow properly.

Film consumption & film type are shown in Table 3-3 for the panoramic camera.

TABLE 3-3

	Frames		Length/Type	
	Pan 316	Pan 317	Pan 316	Pan 317
Pre-Launch Sample	20	20	15,200/3404 800/SO-242	16,300/3404
Pre-Launch Operation	210	208		
-1 Mission	2843	2837		
-2 Mission	2997	3093		
Total	6070	6158		

E. DISIC CAMERA #12

The DISIC camera performed satisfactorily throughout the -1 mission and most of the -2 mission. However, the terrain cycle period varied throughout the flight. The cycle period variations did not exceed the manufacturer's specification limits of 9.375 ± 2%.

The DISIC camera failed on Rev 204 after completing 73 cycles of a planned 137 cycle operate. The most probable cause was an inverter failure. This inverter generates an AC voltage to drive the camera system from the 24 volt unregulated voltage supply. The DISIC camera failed to operate for the remainder of the mission.

Special environmental testing will be conducted by New York to ascertain the cause of this inverter failure to prevent a failure of this nature on future systems.

Film consumption and film type are shown in Table 3-4 for DISIC camera #12.

TABLE 3-4

	Frames		Length in Feet/Film Type	
	Stellar	Terrain	Stellar	Terrain
Pre-Launch Sample	24	24	2000/3401	2200/3400
Pre-Launch Operation	213	160		
-1 Mission	2150	2166		
-2 Mission	2013	2029		
Total	4400	4379		

F. INSTRUMENTATION & COMMAND

The instrumentation system performed satisfactorily throughout the flight. However, the failure of the vehicle link I during Rev. 202 over the [redacted] tracking station prevented full utilization of camera dynamic monitors for the remainder of the flight. The link II telemetry provided sufficient telemetry monitors for command and control of the camera system. The failure was apparently due to a type XIV transmitter failure since the Silo command system remained inoperative.

The continuous T/M channels were normal (Disabled) during the camera operation on Rev. 87. On Rev. 88 [redacted] the continuous channels were Enabled at acquisition. The continuous channels remained Enabled during Rev. 88 [redacted] acquisition, Rev. 89 [redacted] acquisition, and Rev. 90 [redacted] acquisition. During the Rev. 90 [redacted] pass an Uncle 127 was given and the continuous channels were acquired at Rev. 90 [redacted] in the Disabled condition.

The most probable cause of this anomaly is a loose solder ball or dirt on the contacts of one of the relays in the payload system or the relay in the vehicle.

To preclude future anomalies of this type, a special test (PIND) will be conducted on all relays prior to flight on payload systems CR-11 and up.

The command system operation utilizing both the Uncle Command System and the Silo Command System was satisfactory. This was the first system to utilize the Silo Command System and the SGLE equipment in the SCF network. There were minor problems experienced with this new equipment but these problems did not degrade operational command and control of the payload system.

G. EXPOSURE CONTROL SYSTEM

The switch programmer operated normally through Rev. 4 with the panoramic camera slits operating in the automatic mode. At the next acquisition on Rev. 6, the switch programmer was not in the proper position. This failure resulted in utilizing the commandable fixed slit positions for the remainder of the mission. This anomaly did not seriously degrade the operational characteristics of the exposure control system.

The failsafe telemetry monitor indicated both panoramic cameras were in the failsafe slit position and the programmer was commanding slit No. 3. At system time 22070, the programmer commanded slit No. 2. The programmer should have commanded slit No. 1 at acquisition and advanced

to slit No. 2 at system time 21991. The failsafe circuit performed normally but the programmer failed to operate properly for the remainder of the mission.

A circuit analysis was performed on the failsafe system and the exposure programmer. The analysis indicated all failsafe circuitry was isolated from the switch programmer circuitry. However, the proximity of the two failures tends to indicate a common cause of the two failures.

A detailed analysis of all flight data was conducted and the results of this investigation were inconclusive as to the actual cause of the switch programmer failure. The performance of the switch programmer timing functions was random after Rev. 6. The switch programmer command monitor indicated zero volts during numerous acquisitions throughout the flight. This indicated that relays K3, K4, K5, and K6 were all in the unlatched position which is an anomalous condition. The switch programmer slit command monitor was observed in all different positions during all different timing sequences. However, all timers were observed to time out improperly.

A special ground test was conducted with another switch programmer with the "Reset" pulse removed. The results were similar to those experienced during the flight but the T_1 and T_6 timers timed out properly.

A special test was conducted after -2 mission recovery and the results indicated that the panoramic instruments were responding normally to the switch programmer slit commands.

All other portions of the exposure control system performed normally.

H. CLOCK SYSTEM

The clock system operation was normal throughout the flight and resulted in satisfactory clock/system time correlation. The correlation equation and constants are as follows:

First Order Fit

System Time = $A_0 + A_1$ (clock time)

A_0 = -.11693975959D 06

A_1 = .1000000861750D 01

Sigma = .00111438

No. of points = 322

Second Order Fit

System Time = $A_0 + A_1$ (clock time) + A_2 (clock time)^2

A_0 = -.11693976362D 06

A_1 = .1000000875492D 01

A_2 = -.934576992470407D-14

Sigma = .00079239

I. PRESSURE MAKE-UP SYSTEM

The pressure make-up system operated properly throughout the flight. The gas consumption rate was 6.7 lbs/min with 1634 psi remaining at the end of the -2 mission. In-flight pressure sensors were not flown on Mission 1108. For typical internal camera pressures during orbital flight, see the Final Report for Mission 1105, Figure 3-7.

J. THERMAL ENVIRONMENT

The temperature data obtained during this flight indicated the temperature environment was near the pre-flight prediction as shown in Figure 3-4. The average temperatures during the -1 mission were 65° F

and 67° F for panoramic cameras #316 and #317. The average temperatures during the -2 mission were 64°F and 65°F for panoramic cameras #316 and #317.

The temperature data obtained from the [redacted] tracking station acquisitions are included in Tables 3-5, 3-6, 3-7, and 3-8.

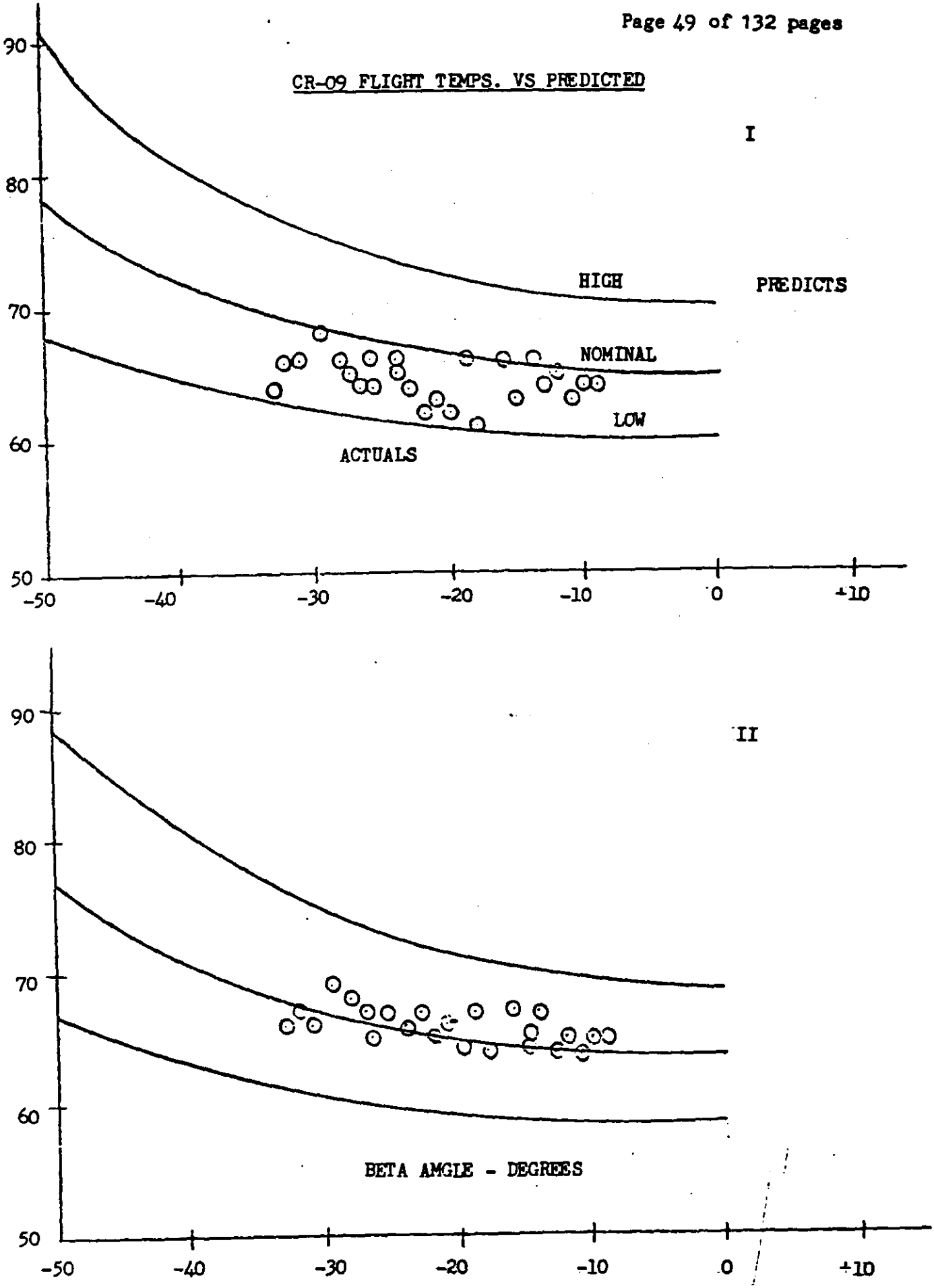

CR-09 FLIGHT TEMPS. VS PREDICTED
I
PREDICTS
HIGH
NOMINAL
LOW
ACTUALS
90
80
70
60
50
-50
-40
-30
-20
-10
0
+10
II
BETA AMGLE - DEGREES

FIGURE 3.4