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CORONA J

PERFORMANCE EVALUATION REPORT

MISSION 1112-1 and 1112-2

FTV 1658, QR-2R

Approved: [redacted]
Manager
Advanced Projects

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for Manager
Program [redacted]

~~TOP SECRET/C~~

FOREWORD

This report details the performance of the payload system during the operational phase of the Program [redacted] Flight Test Vehicle 1658.

Lockheed Missiles and Space Company has a contractual responsibility for evaluating payload performance. This document constitutes the final payload test and performance evaluation report for Mission 1112, which was launched 18 November 1970.

CONTENTS

FIGURES

FIGURES (Cont'd)

TABLES

INTRODUCTION

This report presents the final performance evaluation of Missions 1112-1 and 1112-2 of the Corona Program. The purpose of this report is to define the performance characteristics of the QR-2R payload system and to identify the sources of in-flight anomalies.

The designation, QR-2R, refers to the Corona J-3 program flight qualification system, QR-2, as refurbished by Itek Corporation. The refurbishment includes replacement of the main lenses with "third generation" lenses, and incorporation of substantially all system modifications effective on the flight date. System configuration data and test history in this report refer only to the refurbished system.

Quantitative data used in this report is obtained from several sources. Some noteworthy changes in these sources are effective with this report. In the past, the Air Force Special Projects Production Facility provided both macro and microdensitometer data with related analyses of exposure performance. They have also provided a variety of resolution performance measures and some mission summary data in mission-oriented technical evaluation reports referred to as TEROs. Because of other commitments, these contributions are being terminated. No TERO was prepared on Mission 1112. No density data (micro or macro) is to be provided after Mission 1112. An examination of diffuse macrodensity data collected by [redacted] for printing control indicates that this existing data will be a useful substitute for the AFSPPF macrodensity data. Machine plotted frequency distributions and summary statistical properties of both data sets are included in this report. Continued use is made of data in the mission processing summary report published by [redacted]

The vehicle attitude error values and frame correlation times are determined by NPIC from DISIC camera data and tape recorder information. Because of failure of both units on the 1112-2 mission, some analyses can be made only on the 1112-1 mission.

SECTION 1

MISSION SUMMARY

A. MISSION OBJECTIVES

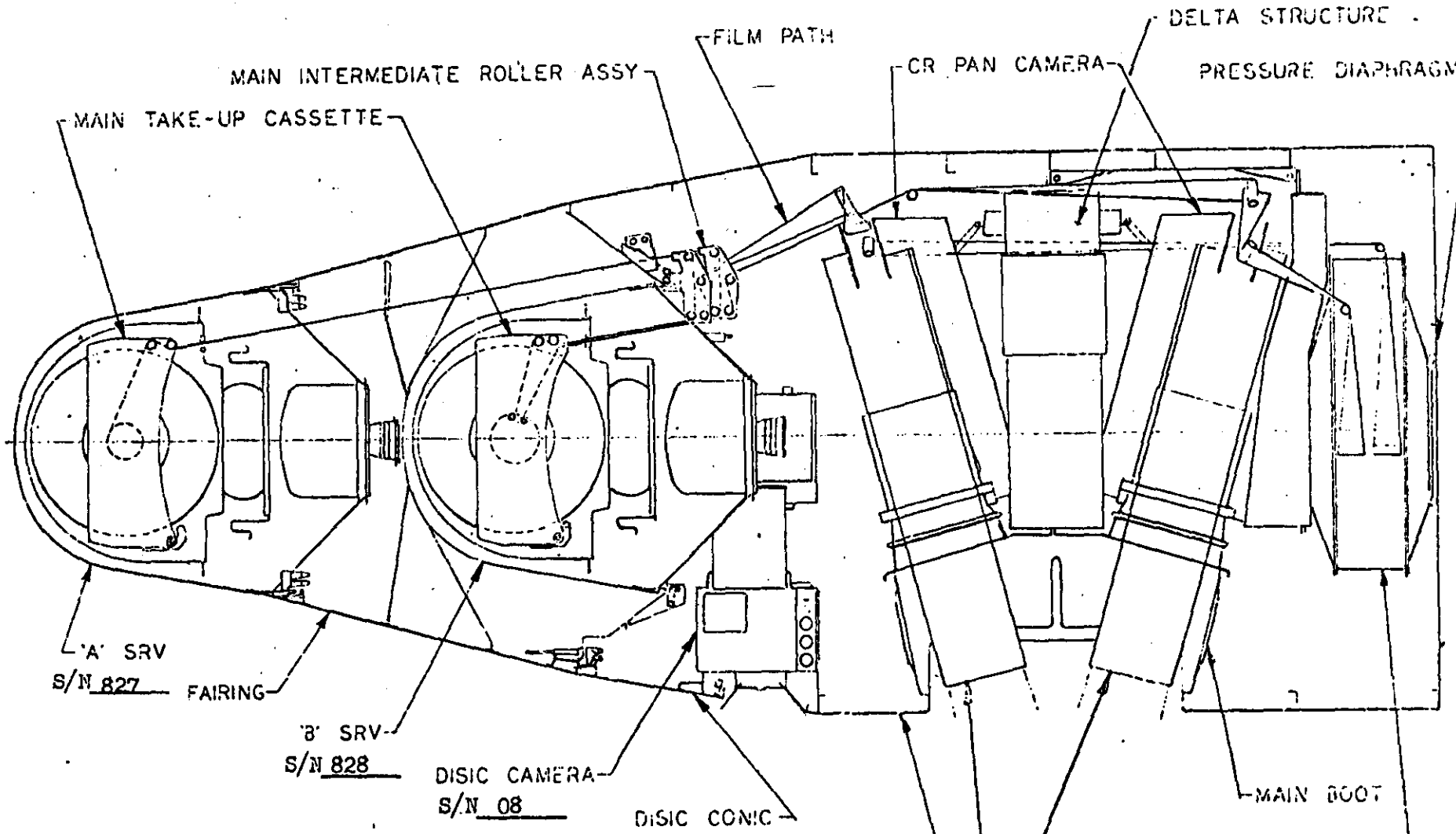
The payload section of Mission 1112, placed into orbit by Flight Test Vehicle 1658 and THORAD Booster (SLV-2H) S/N 552, consisted of two panoramic cameras, one DISIC camera, two Mark 5A recovery capsules and a space structure to enclose the cameras and provide mounting surfaces for all equipment. Figure 1-1 presents an inboard profile of the QR-2R payload system. The Corona "J" system was designed to acquire search and reconnaissance photography of selected areas of the earth from orbital altitudes. A nine day -1 mission and a ten day -2 mission was planned.

B. MISSION DESCRIPTION

The payload was launched from Vandenberg Air Force Base (VAFB) at 2128:00Z (1328:00 PST) on 18 November 1970. Ascent and injection were normal and the achieved orbit was within nominal tolerances. Tracking and command support was effected by the Air Force Satellite Control Facility consisting of tracking and command stations at [redacted] under central control of the Satellite Test Center at Sunnyvale, California. Mission 1112-1 consisted of a 9-day operation and was completed by air recovery on 27 November 1970. Mission 1112-2 was completed with an air recovery on 7 December 1970 following a 10-day photographic operation.

The comparison of the planned and actual orbit parameters is tabulated as follows:

PAYLOAD PROFILE AND SERIAL NUMBERS



SYSTEM NO. OR-2

TEST FLIGHT

PMU S/N 1021

SLOPE PROGRAMMER S/N 213

CLOCK S/N 613

SWITCH PROGRAMMER S/N 200

FIG. 1-1

ORBITAL PARAMETERS

Parameter	Planned	Orbit 2 Actuals
Period (Min.)	88.61	88.56
Perigee (N.M.)	99.7	97.2
Apogee (N.M.)	128.2	122.6
Inclination (Deg.)	83.0	83.0
Perigee Latitude (Deg. N)	238.0	311.3
Eccentricity	0.0043	.0036

Seven drag make-up rockets were fired during the flight to maintain track and period control throughout the mission. The eighth DMU rocket was fired after the -2 mission.

C. PANORAMIC CAMERAS

The aft panoramic camera functioned properly throughout the flight with the exception of an abnormal shut-down on Rev. 3. Telemetry indicated that a premature loss of internal operate command resulted in loss of take-up tension. The resultant misphasing of the 99/101 metering clutch required 20 cycles of camera operation before achieving normal, stabilized operation.

The camera exhausted its 16,300 feet of standard base film, composed of type 3404 and 3414 material. All of the film passed into the recovery system without a wrap-up.

The forward panoramic camera film footage T/M indicated a greater consumption than actual. The erroneous T/M has been attributed to out-of-round take-up in the -1 recovery system. Film scratching, related to the out-of-round anomaly, was present throughout the -1 mission, as well.

On Rev. 6, Frame 135, the forward panoramic camera failed to stow properly with the perturbation probably resulting in a slack loop. Missing center-of-format signals, as indicated by the SRV tape recorder indicate the possibility of defective center of format switches. This anomaly repeated itself on Frame 17 of Rev. 7. Concomitant with the missing center-of-format signal, those functions generated by the switch closure, were absent or degraded.

The forward camera failed during the first frame of the -2 mission. Although the cut and cinch appeared to be normal, from telemetry data, a slowing down of the frame metering function indicated a binding or jamming failure mechanism in the camera drive system.

Only one full frame and two partial frames were recovered from the -2 SRV.

D. DISIC CAMERA

The DISIC camera performed normally during the -1 mission. After a normal A to B transfer sequence, the terrain cycle counter indicated 33 cycles instead of the programmed 71 cycles indicating a stalled condition. Attempts to operate the DISIC in the independent mode failed three times. A loss of terrain take-up is the most probable cause of the DISIC failure.

E. OTHER SUBSYSTEMS

The pressure make-up unit, the clock, exposure control and thermal control subsystems performed satisfactorily as did the Digital Shift register portion of the command system. Satisfactory operation for the SRV tape recorder was achieved only during the -1 mission. The recorder failed early during the -2 mission and subsequent analysis indicated a drive belt failure as the cause.

The slope programmer performance was satisfactory with good ramp matches after the fifth rev. Large perigee dispersions accounted for initial errors.

F. COMPONENT IDENTIFICATIONS AND SETTINGS

1. Forward Looking Panoramic Camera

a. Component Assignment

Component	Serial Number
Main Camera	301
Main Camera Lens	I224
Supply Horizon Camera Lens	E40775
Take-up Horizon Camera Lens	E40786

b. Camera Data and Flight Settings

Main Camera:

Lens	24"f/3.5	
Slit Widths		
S_1	0.154"	
S_2	0.189"	
S_3	0.250"	
S_4	0.320"	
F/S	0.259"	
Filter Types		
Primary	Wratten 23A Glass (0.037")	
Secondary	Wratten 23A Glass (0.040")	
Film Data		
Split Load	Eastman Type 3414	15,300 feet
	Eastman Type 3404	1,000 feet
	Total	16,300 feet

Supply (Port) Horizon Camera:

Lens	55 mm f/6.3
Aperture Setting	f/6.3
Exposure Time	1/100 second
Filter Type	Wratten 25

Take-up (Starboard) Horizon Camera:

Lens	55 mm f/6.3
Aperture Setting	f/8.0
Exposure Time	1.100 second
Filter Type	Wratten 25

2. Aft Looking Panoramic Camera

a. Component Assignment

Component	Serial Number
Main Camera	300
Main Camera Lens	I223
Supply Horizon Camera Lens	E28516
Take-up Horizon Camera Lens	E23756

b. Camera Data and Flight Settings

Main Camera:

Lens	24"f/3.5
Slit Width	
S_1	0.125"
S_2	0.160"
S_3	0.225"
S_4	0.267"
F/S	0.219"

Filter Types

Primary	Wratten 25 Glass (0.037")
Secondary	Wratten 25 Glass (0.040")

Film Data

Split Load	Eastman Type 3414	15,300 feet
	Eastman Type 3404	1,000 feet
	Total	16,300 feet

Supply (Starboard) Horizon Camera:

Lens	55 mm f/6.3
Aperture Setting	f/8.0
Exposure Time	1/100 second
Filter Type	Wratten 25

Take-up (Port) Horizon Camera:

Lens	55 mm f/6.3
Aperture Setting	f/6.3
Exposure Time	1/100 second
Filter Type	Wratten 25

3. DISIC Camera

a. Component Assignment

Component	Serial Number
Camera	008
Index Reseau	108
Stellar Reseaus	
Port	12P
Starboard	11

b. Camera Data and Flight Settings

Stellar Cameras:

Lens	3.0 in. f/2.8
Exposure Time	1.5 seconds
Filter Type	None
Film Type	Eastman Type 3401 (2000 ft.)

Index Camera:

Lens	3 in. f/6.3
Exposure Time	1/500 second
Filter Type	Wratten 12
Film Type	Eastman Type 3400 (2200 ft.)

SECTION 2

PRE-FLIGHT SYSTEMS TEST

The CR payload systems are subjected to a sequential series of tests required to demonstrate a satisfactory confidence level in the flightworthiness of the systems. These tests include static verification, dynamic performance, operation in simulated thermal-altitude environment, light leak evaluation and dynamic photographic performance measurements. Significant baseline levels and anomalies experienced on QR-2 during pre-flight testing are as follows:

A. ENVIRONMENTAL TESTING

The QR-2R payload system was tested in the environmental HIVOS chamber in standard configuration from May 6, 1970 through May 13, 1970. Both cameras used a split load consisting of types 3404 and 3414 film, permitting testing the panoramic cameras with both film types. The DISIC camera used film types 3400 and 3401 for the Terrain and Stellar cameras, respectively.

The processing chemistry was revised to Versamat 641 to more closely match the processing used on flight materials. The QR-2R environmental test was the first Corona System test to utilize this revised chemistry.

1. Pan Instruments

a. Aft Panoramic Camera, S/N 300

Some start-up corona marking in the 1.6 to 8.0 pressure range, but was found to be within acceptable limits.

An intermittent scratch of undetermined origin was found throughout the test.

The transition from 3404 to 3414 type of film was accompanied by some film edge damage although the splice appeared to be normal.

b. Forward Panoramic Camera, S/N 301

Some start-up corona marking was evidenced in the 1.0 to 2.3 μ range. The marking was confined to the 3414 film solely. All of the corona marking was within acceptable levels, except in one instance, which was waived.

2. DISIC Camera

DISIC Camera S/N 8 which was part of the QR-2 flight configuration did not undergo thermal-altitude testing with the QR-2 payload system. DISIC S/N 8 was environmentally tested in the HIVOS chamber as part of the CR-13 test configuration. Two consecutive HIVOS tests were performed because of panoramic instrument corona marking.

a. HIVOS Test #1 (8 April - 15 April 1970)

No anomalous camera operation was noted. Test results showed that the processed Terrain film evidenced some dendritic corona along the film edges, but these were found to be within acceptable levels. The Stellar film showed some corona marking caused by rollers and the reseau grid.

b. HIVOS Test #2 (15 April - 20 April 1970)

Again normal camera operation was experienced. Processing results showed the Terrain film to have a flow type of corona along one or both edges. Since the marking exceeded the 10% limit specification, only a small part of the active format was affected, the condition was waived. The Stellar film was marked by dense

and extensive corona throughout. This marking was caused by the S.L.P. head being improperly shimmed. This condition was corrected prior to the DISIC camera being installed in the QR-2 flight configuration.

3. Subsystem Performance

a. Command System

b. Exposure Control

c. V/h Programmer

d. Clock

All of the above subsystems operated normally throughout the test.

e. Pressure Make-up

Normal operation occurred, however, the alternate PMU level was greater than the desired 16 microns differential pressure at the instrument "ON" command.

f. Status Telemetry

The temperature sensor and status commutator failed during Rev. 9A and remained inoperative until Rev. 10A. The commutator continued to work for the remainder of the test.

g. SRV Tape Recorder

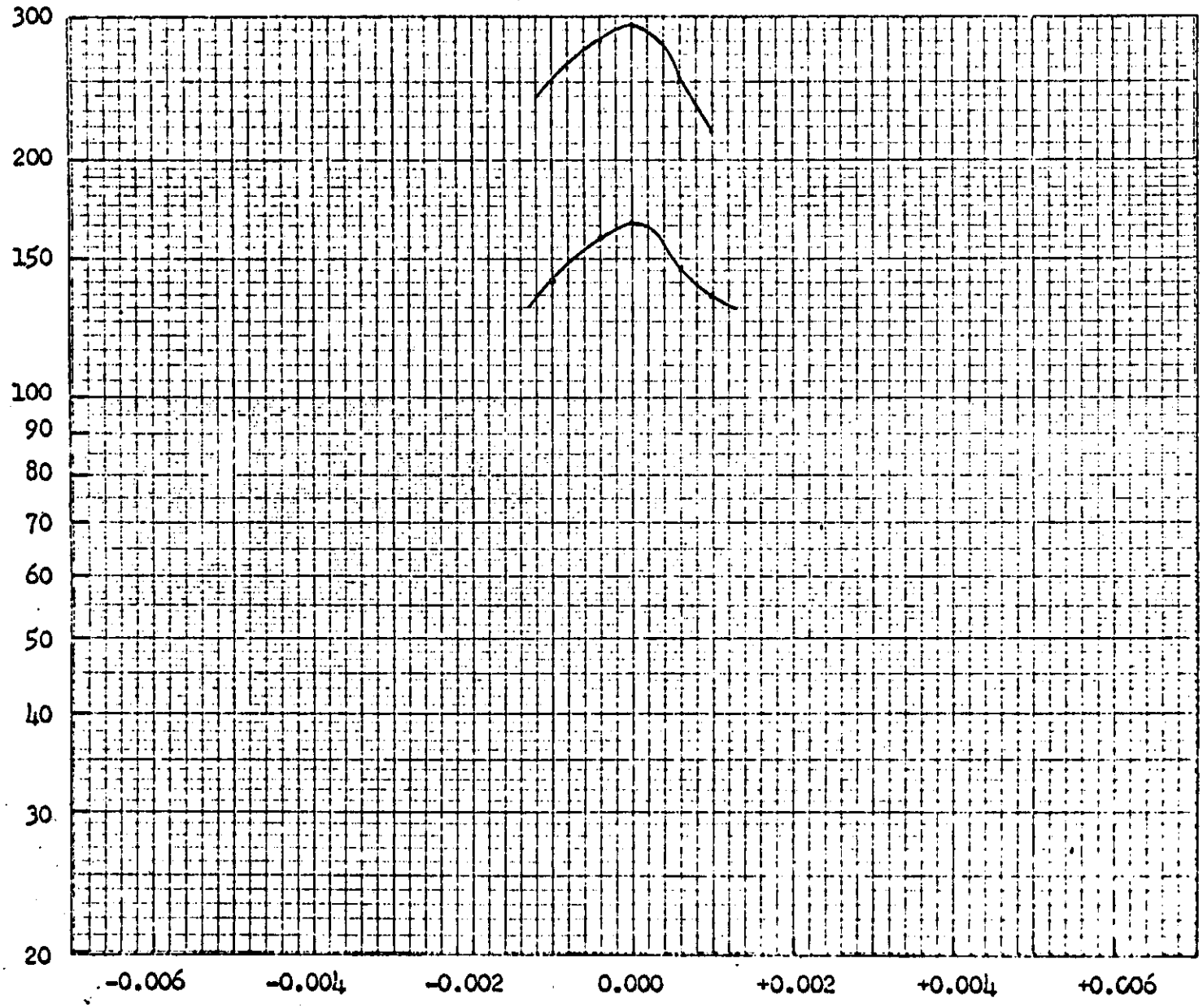
The -1 SRV tape recorder indicated dual C.F. pulses on most operations slower than 2.0/sec/cycle. The -2 tape recorder system failed to record after the end of track 1 resulting in the loss of data after Rev. 1B.

B. RESOLUTION TEST

A series of resolution tests were conducted with the QR-2R system during July 1970, to verify resolution performance with glass filters and check focal shift with different thicknesses of glass. All tests were with 3414 film.

A final test, using primary flight filters was made on 1 October 1970. Aft looking camera #300, using a 0.037 inch thick Wratten 23A glass filter, produced high and low contrast peak resolution values of 294 and 167 lines per millimeter respectively at the -0.0005 inch focal position (based on a 0.0140 inch vacuum focal shift). Forward looking camera #301, using a 0.037 inch thick Wratten 25 glass filter, produced high and low contrast peak resolution values of 303 and 206 lines per millimeter respectively at the focal position. The through-focus resolution values are shown in Figures 2-1 and 2-2.

PRE-FLIGHT DYNAMIC RESOLUTION



Camera No: 300

Payload No: QR-2

Resolution (l/mm)

High Contrast: 223

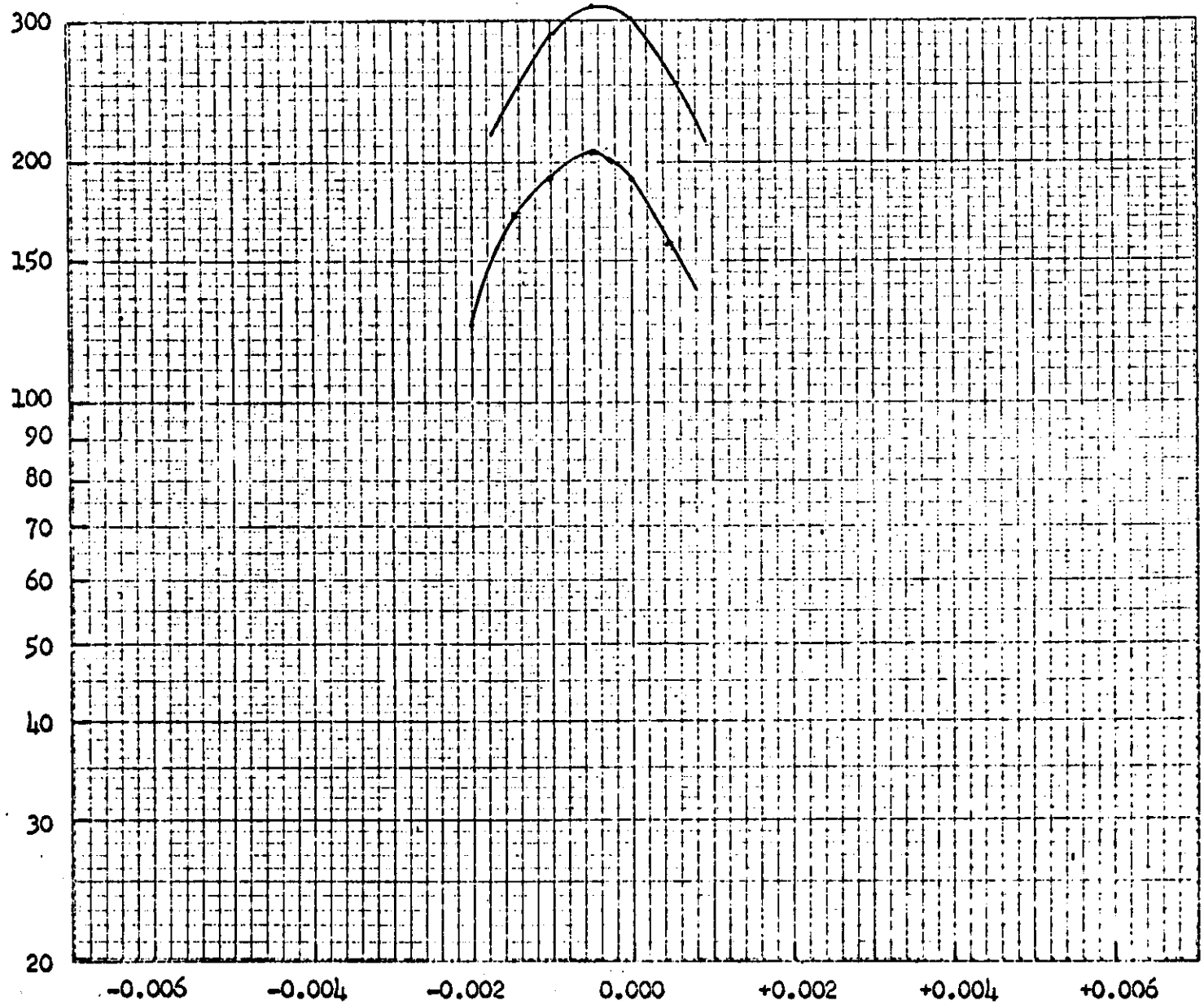
Low Contrast: 167

Film Type: 3414

Test Date: 10-1-70

FIG. 2-1

PRE-FLIGHT DYNAMIC RESOLUTION



Camera No: 301

Payload No: QR-2

Resolution (l/mm)

High Contrast: 315

Low Contrast: 205

Film Type: 3414

Test Date: 10-1-70

FIG. 2-2

C. LIGHT LEAK TEST

A simulated four orbit light soak was performed on 5 May 1970, using type 3401 film. Very minor low density spots were found on the test films from both cameras in the vicinity of the output horizon cameras. These spots appeared to be caused by internal sources that would represent no problem in flight. Two large areas of medium and high density fog were found on the forward looking camera #301, third frame from end of pass. These major leaks were attributed to the aft looking camera #300 drum and/or boot. Corrective action was deferred until the flight readiness sequence of tests.

The flight readiness photometer search on 9 November 1970, revealed major light leaks in the regions previously noted. The leaks at the camera boot/skirt interface were eliminated. However, the photometer record showed that significant leakage occurred at the forward camera drum. No corrective action is available for this condition and some flight marking was expected. Additionally, it was noted that light-tightness at the fairing access could not be verified with the available test cover. However, no problem was apparent with the flight cover used in the 5 May 1970 test.

D. FLIGHT READINESS, LOADING AND CERTIFICATION

A series of DISIC Readiness Tests were conducted from 23 to 30 October 1970, on DISIC #8. Some minor anomalies were observed in stellar and terrain binary bit density, but from consultation with the user organization it was concluded that the condition would not be an operational problem. A stellar metering anomaly was indicated by variable format spacing. The condition was corrected by increasing take-up tension from 0.4 pounds to 0.6 pounds. The final DISIC readiness test was conducted on 30 October. Fogging

density of the stellar formats was satisfactory . A minus density mark was noted in terrain formats due to a defect in the reseau plate. This condition was accepted by the Customer. DISIC #8 was considered acceptable for flight loading. Film loading of DISIC #8 was performed on 2 November 1970. Technical evaluation of film from both camera units demonstrated acceptable characteristics.

A series of four strobe tests were conducted on the panoramic cameras to establish and verify required exposure slitwidths. A Flight Readiness Test on 31 October 1970, demonstrated acceptable data recording, format fogging, and freedom from mechanical marking. The panoramic camera was loaded on 8 November. Technical evaluation of both films demonstrated acceptable characteristics.

The system was certified for flight on 9 November 1970.

SECTION 3

FLIGHT OPERATIONS

A. SUMMARY

Lift off occurred at 1328:00 PST on 18 November 1970, from Vandenberg Air Force Base pad SLC-3 West. All payload launch, ascent, and injection events occurred as programmed. The orbit achieved was within the 3-sigma predicted dispersions.

Aft looking panoramic camera #300 operated satisfactorily throughout the flight except for one abnormal shutdown on rev three. The film supply was exhausted on rev 298.

Forward looking panoramic camera #301 operated normally throughout the -1 mission. However, a telemetry indication of an out of round takeup spool led to a decision to make the A-to-B transfer about one thousand feet earlier in the film supply than would normally be done. The telemetry indication was due to a gouge in the film base that occurred during revs 5 to 35. The forward camera then failed during the A-to-B transfer operation on rev 104.

The DISIC system operated normally during the -1 mission. The A-to-B transfer was made during rev 107. Immediately thereafter, during a dependent/independent operation, the system failed.

The clock system, command system, instrumentation system, exposure control system, FMC system, pressure make-up (PMU) system, and thermal environment were normal throughout the flight. The tape recorder in the -1 SRV functioned normally, however the recorder in the -2 SRV failed after 13 seconds of operation.

A modified PMU was used for the first time to suppress marking on DISIC independent operations.

Recovery of the -1 SRV was deferred to rev 147 because of weather and to allow time to analyze the pan camera and DISIC failure conditions. Both SRV's were successfully recovered by air catch and all recovery events were normal.

B. ORBITAL PARAMETERS

The following tabulation show actual and predicted values (with 3-sigma tolerances) of principal orbit parameters for rev two.

Parameter	Predicted	Actual
Period (min.)	88.61 (+0.33,-0.34)	88.56
Perigee (naut. mi.)	99.7 (+13, -14)	97.2
Apogee (naut. mi.)	128.2 (+17, -18)	122.6
Eccentricity	0.0043(+0.0029,-0.0030)	0.0036
Inclination (deg.)	83.0 (+0.14, -0.12)	83.00
Regression rate (deg./rev.)	22.28	22.23
Argument of Perigee (deg.)	142 (+102, -88)	191
Perigee location (quad/lat.)	238	311.3

C. DMU OPERATION

Ground track and period control were maintained during the flight by firing seven of the eight available DMU rockets.

The following tabulation summarized the DMU rocket firings:

Rocket No.	Rev No.	System Time Seconds	Period Change Seconds	Velocity Change Ft/Sec.	Period at Firing Minutes	Impulse Lb.-Sec.
1	29	58189	15.36	24.55	88.48	3140
2	70	17044	10.58	17.03	88.54	2140
3	120	25218	14.73	23.61	88.46	2963
4	152	22585	11.28	18.08	88.51	2022
5	204	38499	16.87	26.81	88.44	2973
6	254	45992	17.45	27.87	88.43	3069
7	279	06157	17.21	28.15	88.56	3081
8	Fired after -2 recovery					

The ground track errors at the ascending node ranged from 41.6 naut. mi. west of nominal to 38.6 naut. mi. east of nominal. The seventh DMU rocket was fired to move the ground track west of nominal to acquire a priority target on rev 284. Refer to Figures 3-1 and 3-2 for orbit history data. Figure 3-3 shows the latitude and altitude frequencies of pan camera operation.

D. PANORAMIC CAMERA PERFORMANCE

Aft looking panoramic camera #300 experienced an abnormal shutdown on rev 3. Analysis of telemetry and tape recorder data indicated the camera system lost its internal operate command prematurely, precluding normal shutdown. The camera system coasted without takeup tension which permitted film slack. A film loop was drawn into the input metering roller and pressure roller assembly forming a crease. Tension from the constant tension assembly negator spring and application of the supply cassette brake freed the film from the input metering roller. When power was applied with the next operate command the take-up pulled the slack film out of the system. However the 99/101 clutch shuttle was moved to the end of its travel and required about 20 pan camera cycles to achieve stabilized operation.

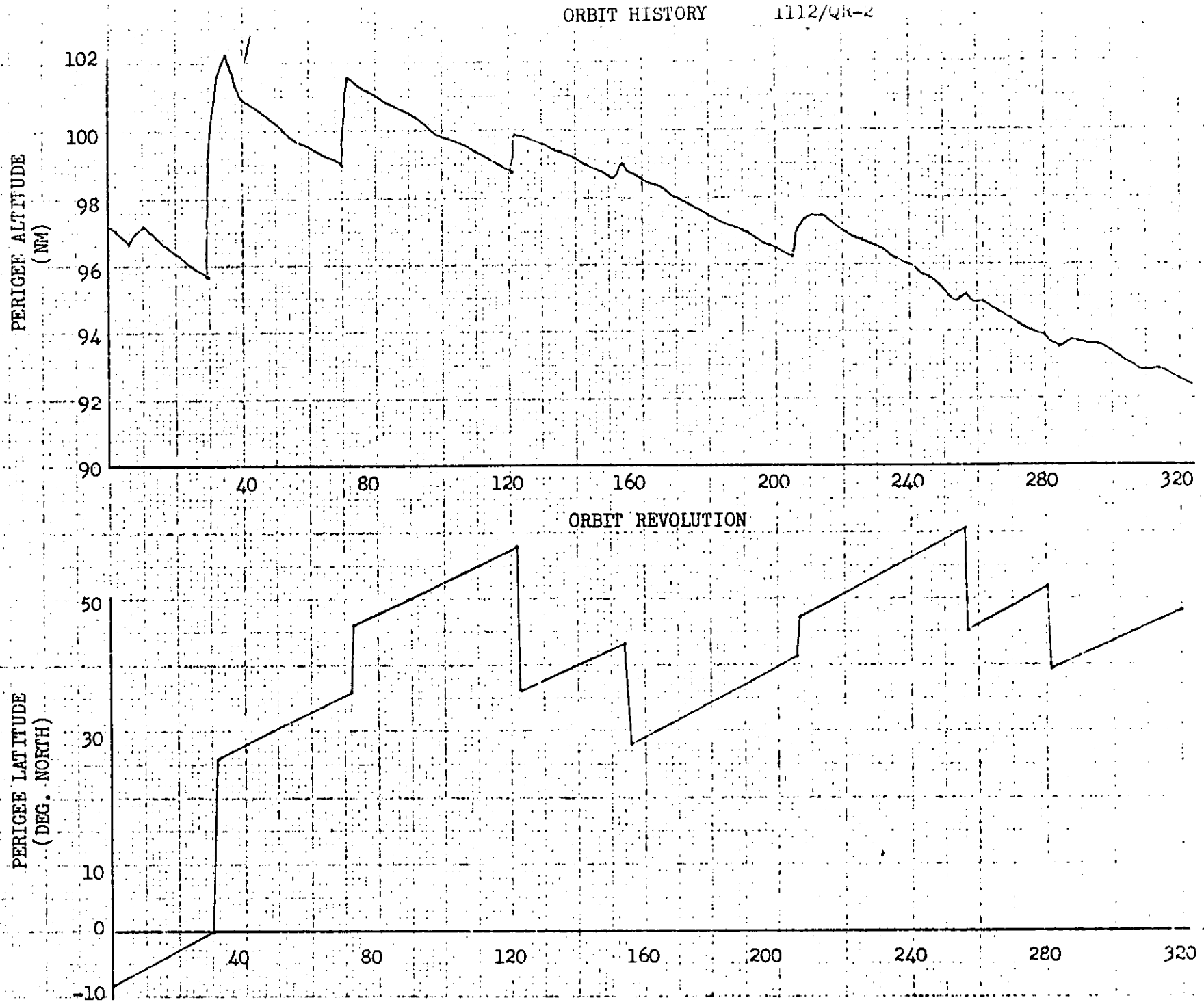

ORBIT HISTORY
PERIGEE ALTITUDE (NM)
102
100
98
96
94
92
90
40
80
120
160
200
240
280
320
ORBIT REVOLUTION
PERIGEE LATITUDE (DEG. NORTH)
50
30
10
0
-10
40
80
120
160
200
240
280
320

Fig. 3-1

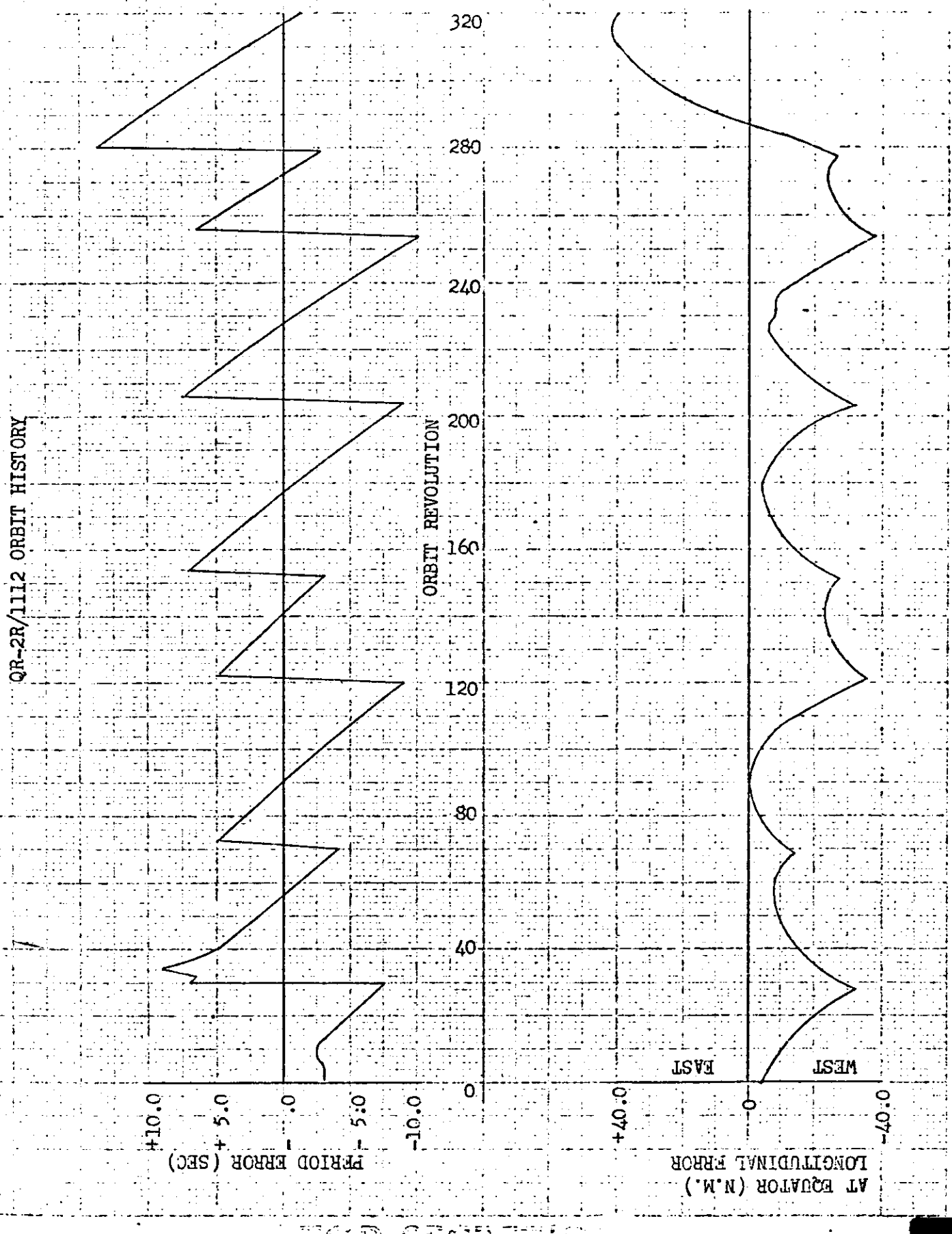
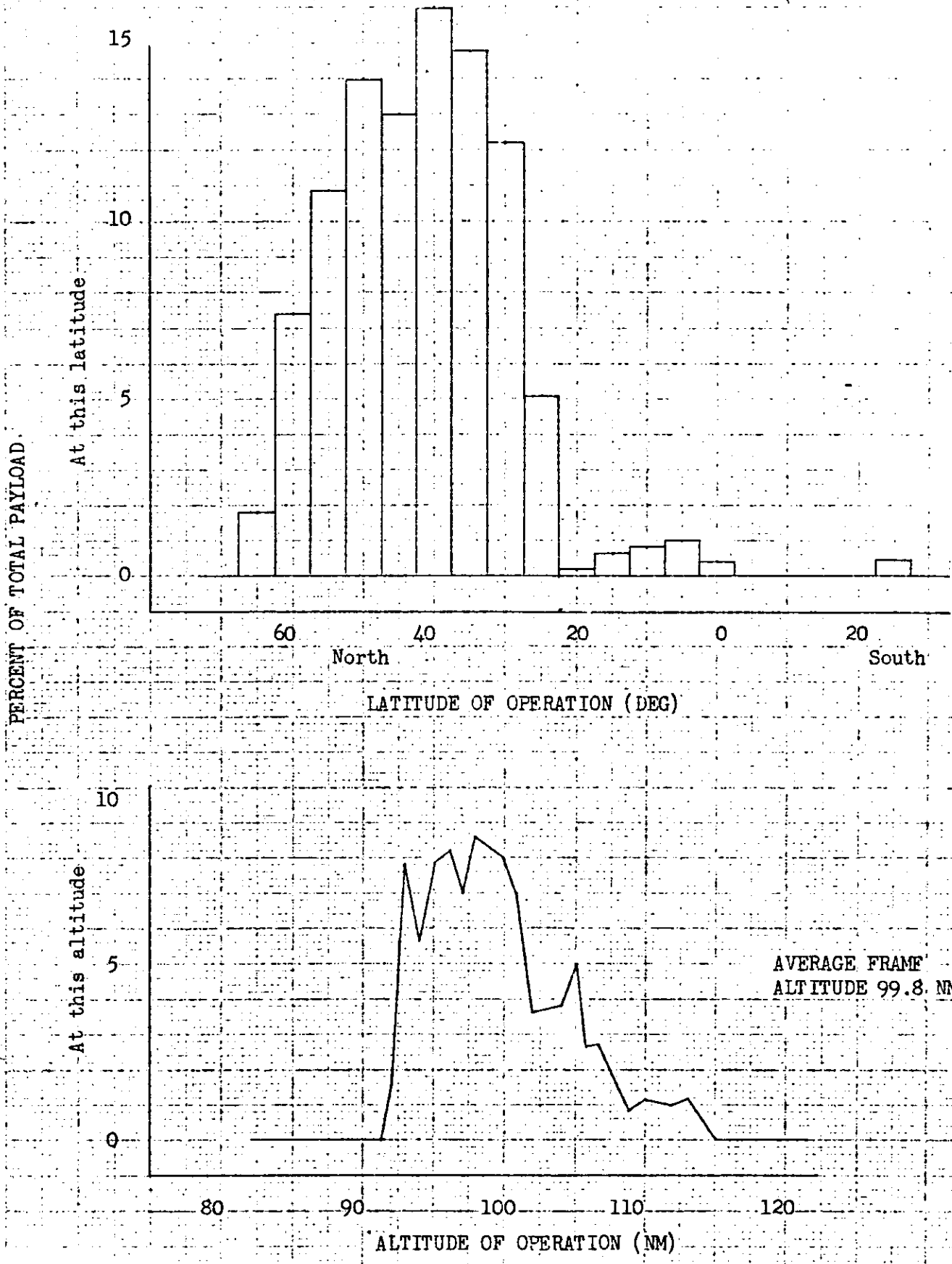

QR-2R/1112 ORBIT HISTORY
ORBIT REVOLUTION
320
280
240
200
160
120
80
40
0
PERIOD ERROR (SEC)
+10.0
+5.0
0
-5.0
-10.0
AT EQUATOR (N.M.)
LONGITUDINAL ERROR
+40.0
0
-40.0
EAST
WEST

FIG. 3-2



FORM LMSC 8306-1

FIG. 3-3

The most probable cause of the premature removal of the operate command was a drop out in the twenty second delay power relay. However, the cause of the 20-second timer anomaly could not be determined. Since the malfunction would generally result in catastrophic failure, a modification was performed on all remaining systems (except CR-13) to hold takeup power on for seven seconds after removal of the internal operate command.

Forward looking panoramic camera #301 film footage pot telemetry monitor indicated one hundred to two hundred cycles higher count than the cycle counters from rev 6 to the end of the -1 mission. Post flight de-spooling indicated the film on the takeup was out-of-round and the telemetry monitor was correctly indicating an abnormal film condition. It was this condition that led to recovery of the -1 mission SRV with about 1000 feet less film than usual.

The film on the takeup spool had a ridge parallel to the major axis of the film. This ridge was found to be caused by a gouge in the base. It was about 0.007 inches wide and 0.8 inches from the time track edge. The gouge was preceeded by a 0.1 inch triangular pressure mark at 6.25 inch intervals, indicating a small particle of unknown origin had lodged in the input metering pressure roller. The particle was detached and carried by the film to a narrow opening between a roller and guide resulting in continuous gouging from frame 62 of rev 5, through a manufacturer's splice, and ending on frame 1 of rev 35. Minor base rubs were apparent at about the same distance from the film edge through the remainder of the -1 mission apparently from a reorientation of the particle. Corresponding rubs were not found in the six feet of film recovered from the forward camera in the -2 mission.

Forward looking camera #301 did not stow properly at the end of an operation on rev 6. Real time telemetry data also indicated a perturbation occurred in the constant tension assembly, probably resulting in a slack loop. Analysis of recovered film and the SRV tape recorder telemetry data showed that the center-of-format signals were missing on frames 133, 134, and 135. Frame 134 should have been the normal stow frame. However, due to the loss of center-of-format signal, the camera operated an extra cycle during the 20 second power-off delay period, resulting in the stow and film slack loop anomaly. Another center-of-format signal was missing on frame 17 of rev 7. The missing center-of-format signals also resulted in lost time words, camera serial numbers, slurred time pulses on four frames and a missing horizon optic exposure on one frame. The most likely cause of the center-of-format anomaly was either an intermittent failure of the center-of-format switch or a marginal adjustment of the switch travel.

Forward looking camera #301 experienced a catastrophic failure while metering during the A to B transfer sequence. The flight cut in the 6 feet of film recovered from the -2 mission was normal. Telemetry data indicated the film cut and take-up cinch were normal and camera functions were normal for more than half of the first cycle. A film metering anomaly occurred when the scan head was within 15 degrees of the platen area as revealed by a slow down in the frame metering function, increase in forward drive motor voltage and an increase in unregulated current. Camera drive functions on the input side of the drive mechanism continued while all output functions ceased, indicating a mechanical failure, jamming or sheared pin in the metering drive mechanism. The camera system remained in the stalled condition throughout the -2 mission and all post event 2 testing. The most probable

cause of the camera failure is a mechanical failure, binding, or jamming of the gear train or star wheel drive mechanism by an object of unknown origin.

E. DISIC PERFORMANCE

The terrain camera was loaded with 2200 feet of type 3400 film and the stellar camera was loaded with 2000 feet of type 3401 film. The DISIC unit performed normally throughout the -1 mission.

The DISIC camera system operated during the panoramic camera A to B transfer sequence through a sneak circuit in the pressure make-up (PMU) control circuitry. This condition resulted in four frames of unprogrammed index and accompanying stellar photography. The sneak circuit was erroneously added when modifying the transfer and command boxes for PMU operation with the DISIC camera independent mode operation.

The DISIC camera system operated properly during the engineering pass on rev 106. The DISIC camera A to B transfer sequence was performed on rev 107 with all transfer functions occurring properly. However, on rev 108, only 33 cycles were registered on the terrain cycle counter instead of the programmed 71 cycles. The DISIC camera was stalled in the metering portion of the cycle. The DISIC camera was turned on in the independent mode three times during the -2 mission, however, the camera system failed to operate. Post flight material analysis indicated no flight terrain material was present and only 28 frames of stellar material. The most probable cause of the DISIC camera failure was the loss of the -2 mission terrain take-up. The flight take-up was tested at Fairchild for thermal altitude testing resulting in a failure after four minutes of operation.

F. INSTRUMENTATION AND COMMAND SYSTEM PERFORMANCE

The instrumentation system performed satisfactorily throughout the flight. The panoramic camera #301 filter change selector appeared as an open T/M point during the engineering operation on rev 307. This condition lasted for approximately 20 seconds and then for the remainder of the pass the selector indicated position 4 instead of position 3. On rev 309, the selector varied between position 3 to position 5 and remained in position 4. Nine RTC commands were issued to correct the selector to position 3. However, the selector stopped in position 10 and remained there thru fade. On rev 311, the selector monitor again appeared as an open T/M point. Two commands were issued and the selector indicated position 2. No other commanding was attempted.

The camera system had failed with the scan head approximately 25 degrees prior to the center-of-format. The physical condition of the scan head, film through the platen area, and the filter selection components are unknown. However, the slit width telemetry monitor also changed slightly on rev 307 indicating that the scan head suffered damage, probably by a film obstruction from the failure of the panoramic camera. It is therefore assumed that the filter change anomaly resulted from the camera failure and was not a separate failure.

The ascent pyro current sensor was inoperative due to an unknown cause. All remaining systems have been verified to be in proper operating condition. Circuit analysis of QR-2R indicates no wiring discrepancies. It is therefore postulated that the most probable cause was a failure of the sensor mechanism.

The real time command (RTC) system operation was satisfactory throughout the flight.

G. FORWARD MOTION COMPENSATION PERFORMANCE

A large perigee dispersion at launch produced a mismatch error between three and six percent during the first five revs. However, a satisfactory ramp to orbit match was maintained throughout the remainder of the flight. The mismatch error was within plus or minus one percent for 88.4 percent of the operations during the -1 mission and within the same limits for 89.6 percent of the operations in the -2 mission.

H. EXPOSURE CONTROL SYSTEM PERFORMANCE

This slit width control programmer was the first to utilize the new Autronic timers. Approximately 90% of all the camera operations were in the automatic mode. The slit width control programmer performed satisfactorily throughout the -1 and -2 missions.

I. CLOCK SYSTEM PERFORMANCE

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

<u>First Order Fit</u>

System Time = $A_0 + A_1$ (Clock Time)

A_0 = -0.1433609439203687 D 06

A_1 = 0.9999998356734852 D 00

Sigma = 0.00458252

Number of Points = 372

Second Order Fit

System Time = A_0 + A_1 (Clock Time) + A_2 (Clock Time)^2

A_0 = -0.1433609597502632 D 06

A_1 = 0.9999998783187686 D 00

A_2 = -0.2180828742766736 D -13

Sigma = 0.00068056

Number of Points = 372

J. PMU SYSTEM OPERATION

The pressure make-up system (PMU) operated properly throughout the flight. The PMU was modified to operate in the low pressure range when the DISIC was operated in the independent mode. There were 116 panoramic camera operates for a total of 213 minutes which resulted in a gas consumption rate of 4.18 lbs/min of operate time. There were 352 DISIC camera operates for a total of 851 minutes for an alternate level gas consumption rate of 1.12 lbs/min of operate time. The large amount of DISIC operate time was due to the command logic (S324-DISIC Independent) and the sneak circuit in the PMU control unit which allowed the PMU to operate with every SPC Brush 48 from rev 241 through rev 307.

K. THERMAL ENVIRONMENT

The temperature data obtained during this flight indicated the temperature environment was within the pre-flight predictions for the duration of the flight. The averages of the panoramic camera temperatures ranged from 58°F to 62°F for S/N 300 and 59°F to 64°F for S/N 301 during the -1 mission and 58°F to 63°F for S/N 300 and 58°F to 62°F for S/N 301 during the -2 mission. Refer to Figure 3-4.

QR-2 FLIGHT VS. PREDICTED TEMPERATURE

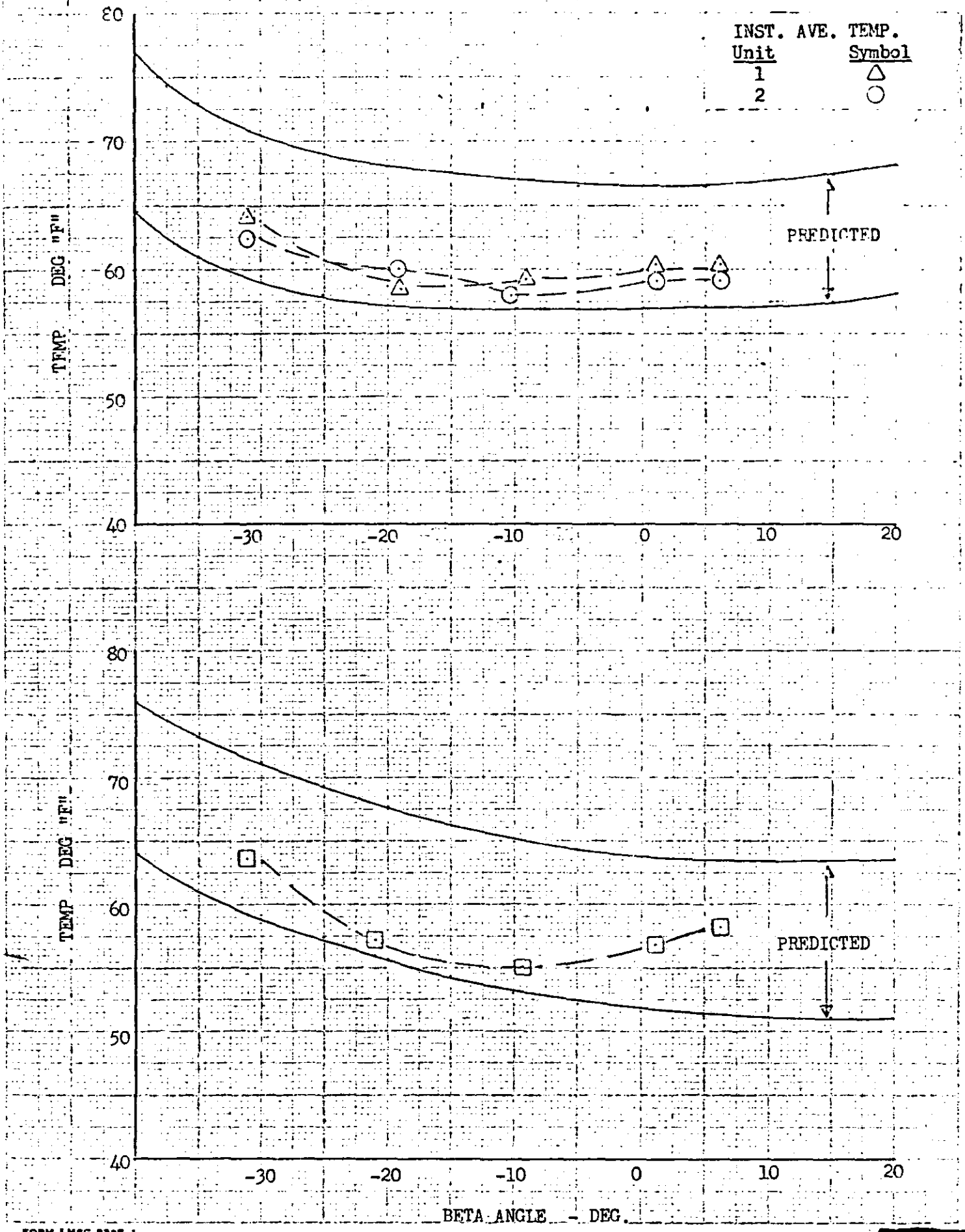


FIG. 3-4

L. RECOVERY SYSTEM PERFORMANCE

The -1 recovery capsule was successfully recovered by air catch on rev 147 at 1509 PST on November 27, 1970. All re-entry events were within tolerance with the impact approximately 17 miles north of the predicted.

	Actual	Predicted
Impact Location	18° 10'N/153° 45W	18° 0.1'N/153° 52.5W

The -2 recovery capsule was successfully recovered by air catch on rev 309 at 1424 PST on December 7, 1970. All re-entry events were within tolerance with the impact occurring approximately 20 miles north of the predicted.

	Actual	Predicted
Impact Location	29° 15'N/164° 59'W	28° 59'N/165° 12'W

M. SRV TAPE RECORDER SYSTEM

The SRV tape recorder for the -1 mission operated normally recording 109 minutes of data. The SRV tape recorder for the -2 mission failed after 13 seconds of the first instrument operation. Post flight ground tests revealed the recorder would not operate in the record mode on the initial test. The reverse mode of operation performed satisfactorily. Several subsequent forward playbacks functioned normally. The recorder then failed at or near the forward playback start position. The recorder was then sent to the vendor and investigation revealed that the iso-drive belt was broken causing loss of tension. The break apparently was caused from a puncture by a sharp object. Manufacturer disassembly revealed loose flakes of glyptol. A glyptol chip apparently lodged between the iso-belt drive and the transport case jamming the transport mechanism. The drive belt was apparently torn through during the operations performed after recovery.

N. POST EVENT 2 TESTING

Both panoramic cameras were enabled on rev 328 in the emergency mode. The film tag end on aft camera # 300 had wrapped up during film exhaustion on rev 298, causing the camera system to remain in a stalled condition. Forward panoramic camera # 301 had failed on rev 104 and had remained in a stalled condition. Telemetry data indicated that the drive motors on both cameras had 18 volts on the plus side of the motor and 3½ volts on the minus side of the motor, 20 amps on the A/P unregulated current monitor. On rev 329, approximately 69 minutes later, the voltage on the minus side of the motor was reduced to almost zero volts, probably due to heating and resistance change.

At fade on rev 330 at the [redacted] Tracking Station, approximately 148 minutes since turn on, the telemetry monitors remained unchanged. Approximately 5 minutes later at the [redacted] Tracking Station acquisition, both instruments indicated 18 volts on both sides of the motor. This condition indicates that there is no current through the motor with increased resistance between the minus side of the motor and ground. This could have been caused by the failure of forward drive transistor. During the first 24 seconds of the acquisition, the voltage on both sides of the motor on camera #301 decreased to zero volts. The most probable cause of this anomaly was a failure and opening of complementary drive transistor. The A/P unregulated current during this time period decreased from 20.0 to 7.5 amps. Telemetry data remained unchanged through the last recorded rev (rev 352).