CORONA J

PERFORMANCE EVALUATION REPORT

MISSION 1046-1 and 1046-2

FTV 1638, J-48

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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 1638.

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

This document is the final payload test and performance evaluation report for Missions 1046-1 and 1046-2 which was launched on 14 March 1968.

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INTRODUCTION

This report presents the final performance evaluation of Missions 1046-1 and 1046-2 of the Corona Program. The purpose of this report is to define the performance characteristics of the J-48 payload system and to identify the source of in-flight anomalies.

The performance evaluation was jointly conducted by representatives of Lockheed Missiles and Space Company (LMSC) and ITEK at the facilities of NPIC and AFSPPF. The off-line evaluation using Corona engineering photography acquired over the United States was performed at the individual contractors plants.

The quantitative data used for this report is obtained from government organizations. The diffuse density data, and MTF/AIM resolution are produced by AFSPPF. The vehicle attitude error values, frame correlation times are made at NPIC who also supply the Processing Summary reports published by [redacted]

Computer programs developed by A/P are utilized to calculate and plot the frequency distribution of the various contributors to image smear, which in turn permits analysis and correlation of the conditions of photography to the information content and quality of the acquired pictures. Computer analysis of the exposure, processing and illumination data provides the necessary data to analyze the exposure criteria selected for the mission.

This report contains certain data summarized from [redacted] Processing Summary, [redacted] and from AFSPPF TERO Report, [redacted]

SECTION 1

SYSTEM PERFORMANCE

A. MISSION OBJECTIVES

The payload section of Mission 1046, placed into orbit by Flight Test Vehicle #1638 and THORAD Booster #518, consisted of two panoramic cameras, two Stellar-Index cameras, 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 J-48 payload system. This Corona "J" system is designed to acquire search and reconnaissance photography of selected areas of the earth from orbital altitudes. A seven day -1 mission and a seven day -2 mission was planned.

B. MISSION DESCRIPTION

The payload was launched from Vandenberg Air Force Base (VAFB) at 2200:14Z (1400:14 PST) on 14 March 1968. 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 1046-1 consisted of a 7 day operation and was completed by air recovery on 21 March 1968. Mission 1046-2 was completed with an air recovery on 29 March 1968 following an 8 day photographic operation.

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

ORBITAL PARAMETERS

Parameter	Predicted	Orbit 56 Actuals
Period (Min.)	90.37	90.343
Perigee (N.M.)	99.9	100.443
Apogee (N.M.)	218.3	218.800
Inclination (Deg.)	83.0	83.004
Perigee Latitude (Deg. N.)	19.3	29.970
Eccentricity	0.01645	0.01644

A single OAS rocket was fired on Rev 13, Rev 81, and Rev 176. These rocket firings produced the following results:

OAS Rocket Performance

Pass	Period Seconds	Velocity Ft/Sec	Impulse Lb/Sec
13	11.3	17.7	2200
81	10.9	17.0	2060
176	11.7	18.3	2050

The remaining rocket was fired after the second recovery.

C. PANORAMIC CAMERAS

Both instruments operated satisfactorily throughout both missions, and produced good image quality except for an apparent out of focus condition along one side of each format, gradually worsening throughout the mission. The anomaly was attributed to an excessive accumulation of emulsion dust resulting from the pronounced scratching characteristics of the camera system with the soft SO-230 emulsion.

SCHEMATIC INBOARD PROFILE - CORONA J SYSTEM

MISSION 1046

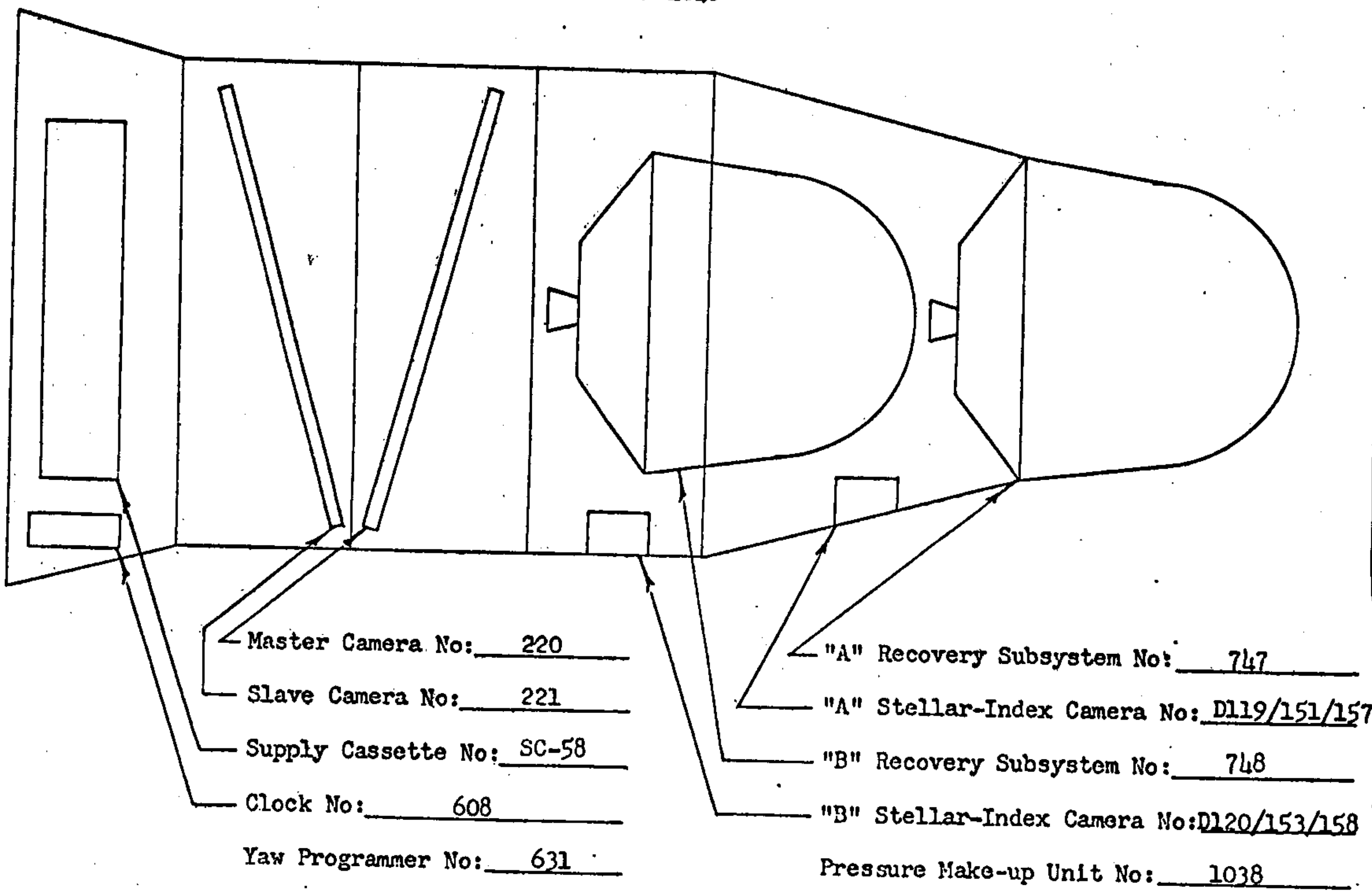


FIGURE 1-1

D. STELLAR-INDEX CAMERAS

Both the "A" and "B" S/I's operated satisfactorily and most Stellar images appear as points rather than the usual odd shaped stars. All Stellar and Index formats were free of static marking.

E. OTHER SUBSYSTEMS

The clock, instrument, pressure make-up, command and thermal control subsystems performed satisfactorily.

F. COMPONENT IDENTIFICATIONS AND SETTINGS

1. MASTER PANORAMIC CAMERA

a. COMPONENT ASSIGNMENT

Component	Serial Number
Main Camera	220
Main Camera Lens	1762435
Supply Horizon Camera	310-G6
Supply Horizon Camera Lens	19096
Take-up Horizon Camera	321-G5
Take-up Horizon Camera Lens	23763
Supply Cassette	SC-58

b. CAMERA DATA AND FLIGHT SETTINGS

Main Camera:

Lens	24" f/3.5
Slit Width	0.140"
Filter Type	Wratten 23A
Film Type	Eastman Type SO-230

Supply (Port) Horizon Camera:

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

Take-up (Starboard) Horizon Camera:

Lens	55mm f/6.3
Aperture Setting	f/11.0
Exposure Time	1/100 second
Filter Type	Wratten 23A

2. SLAVE PANORAMIC CAMERA

a. COMPONENT ASSIGNMENT

Component	Serial Number
Main Camera	221
Main Camera Lens	1792435
Supply Horizon Camera	322-G6
Supply Horizon Camera Lens	23802
Take-Up Horizon Camera	322-G5
Take-up Horizon Camera Lens	23804
Supply Cassette	SC-58

b. CAMERA DATA AND FLIGHT SETTINGS

Main Camera:

Lens	24" f/3.5
Slit Width	0.110"
Filter Type	Wratten 21
Film Type	Eastman Type SO-230

Supply (Starboard) Horizon Camera:

Lens	55mm f/6.3
Aperture Setting	f/11.0
Exposure Time	1/100 second
Filter Type	Wratten 25

Take-up (Port) Horizon Camera:

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

3. MISSION 1044-1 STELLAR-INDEX CAMERA

a. COMPONENT ASSIGNMENT

Component	Serial Number
Camera	D-119
Index Reseau	151
Stellar Reseau	157

b. CAMERA DATA AND FLIGHT SETTINGS

Stellar Camera:

Lens	85mm f/1.8
Exposure Time	2.0 second
Filter Type	None
Film Type	Eastman Type 3401

Index Camera:

Lens	38mm f/4.5
Exposure Time	1/500 second
Filter Type	Wratten 21
Film Type	Eastman Type 3400

4. MISSION 1044-2 STELLAR-INDEX CAMERA

a. COMPONENT ASSIGNMENT

Component	Serial Number
Camera	D-120
Index Reseau	153
Stellar Reseau	158

b. CAMERA DATA AND FLIGHT SETTINGS

Stellar Camera:

Lens	85mm f/1.8
Exposure Time	2.0 second
Filter Type	None
Film Type	Eastman Type 3401

Index Camera:

Lens	38mm f/4.5
Exposure Time	1/500 second
Filter Type	Wratten 21
Film Type	Eastman Type 3400

SECTION 2

PRE-FLIGHT SYSTEMS TESTS

As a standard procedure, the J payload systems are subjected to a series of tests which demonstrates a satisfactory level of confidence that the systems will indeed perform as required in their respective missions. The tests include an operational-type exposure to simulate thermal/altitude ennironment, a light-leak evaluation, and a dynamic measure of the photo graphic performance capabilities. Significant baseline levels and anomalies experienced with this system during the pre-flight test are as follows:

A. ENVIRONMENTAL TEST

The J-48 payload system was submitted to an environmental test in the Sunnyvale HIVOS Chamber from 10 October 1967 to 16 October 1967. Primary objectives were to verify proper system operation under thermal-altitude environment, Corona marking susceptibility in the pressure sensitive ranges, and detect any anomalies that would detract from system effectiveness.

All of the primary objectives were achieved except the Slave camera cycle rate deteriorated (over-speed) until the field flattener mechanism failed and the drive transistor fuses opened. The cycle rates began to deteriorate during Rev 9 of the "B" phase and the maximum error of 25 per cent was experienced on Rev 12. The payload was removed from the chamber for subsequent refurbishment. The cause of this failure was attributed to a breakdown of the tachometer in the Slave camera system.

Both Index cameras operated normally during the test. However, the shutters on both Stellar units malfunctioned sporadically throughout the respective portions of the test. Subsequent analysis attributed the anomaly to inadequate lubrication by shutter manufacturer. The shutters were properly lubricated and returned to the system.

The pressure make-up system performed satisfactorily throughout the test. A total of 1300 Δ PSI was expended during the test with an average gas consumption rate of 8.8 Δ PSI/min for the entire test.

The cycle counter on the Master camera dropped 8 counts during the test.

The command system functioned properly throughout the test with no evidence of any equipment malfunctions.

This test employed SO-230 film exclusively. It was the first time this material has been subjected to a full system environmental test evaluation. No objectionable corona marking was experienced, but the film exhibited an apparent environmental sensitivity that produced a uniform fogging to a density of 0.04 to 0.06 above base plus process fog in all emulsion areas unprotected during "sit" periods. The magnitude of this environmental fogging phenomenon diminished towards the end of the test.

B. RESOLUTION TEST

Initial resolution and theodolite tests were performed on 1 October 1967. Results of the thru-focus resolution tests of pan instruments 220 and 221 show the following characteristics:

Master Pan Instrument No. 220

Maximum high contrast resolution 217 lines/mm at -0.001 focal position.

Maximum low contrast resolution 131 lines/mm at -0.0015 focal position.

Slave Instrument No. 221

Maximum high contrast resolution 220 lines/mm at -0.002 focal position.

Maximum low contrast resolution 128 lines/mm at -0.002 focal position.

Additional Boston investigations indicated that optimum focus position would be attained by adding 0.0015" shim to the scan head of the Slave instrument, and 0.0020" shim to the Master instrument. The modified instruments were retested 30 November 1967, with the following results:

Master Pan Instrument No. 220

Maximum low contrast resolution 127 lines/mm at -0.0035 focal position.

Slave Pan Instrument No. 221

Maximum low contrast resolution 127 lines/mm at -0.0035 focal position.

The final test data for both instruments is shown in Figures 2-1 and 2.2. Both instruments met the system requirements specification.

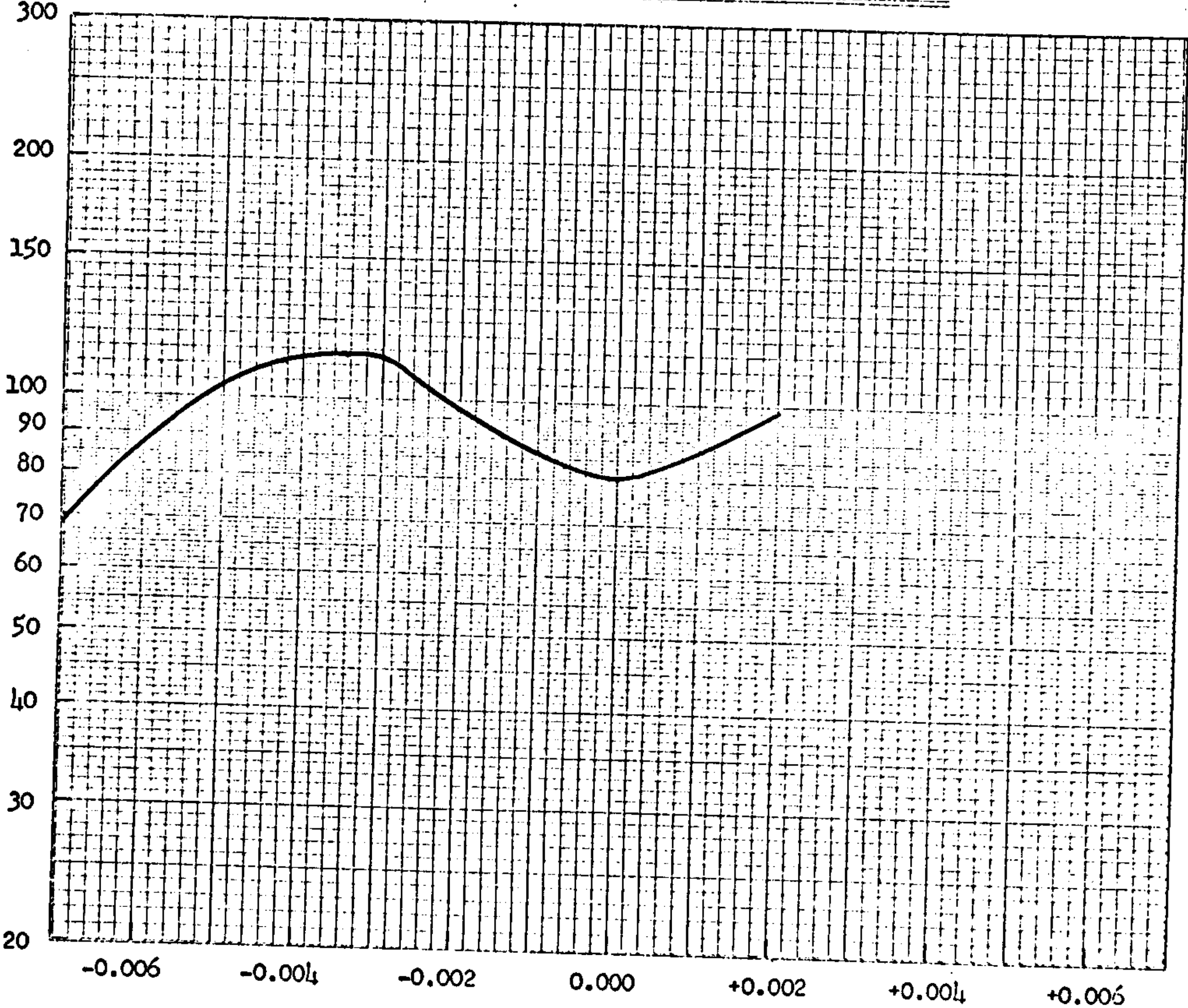
C. LIGHT LEAK TEST

The J-48 system was tested for light leaks on 18 September 1967, revealing minor leaks in the corners of the drum seal in each camera. Because of the inpracticality of repairing these leaks, and the relatively minor level of fogging experienced, corrective action was waived. Additional fogging was just perceptible on both films in the area corresponding to the SRV cover interface, but because of the apparently non-objectionable level no corrective action was taken.

D. FLIGHT LOADING AND CERTIFICATION

Loading of flight film was accomplished on 4 March 1968, and final pre-flight acceptance tests performed 8 March 1968. All functions were nominal, with no indications of light leaks or other sources of performance degradation. Rail scratching was quite heavy, but appeared to be within the range of marking experienced by past systems.

PRE-FLIGHT DYNAMIC RESOLUTION



PHOTOGRAPHIC RESOLUTION (Lines per Millimeter)

THROUGH FOCUS INCREMENTS (Inches)

FIGURE 2-1

Camera No: 220

Payload No: J-48

Resolution (1/mm)

High Contrast: [redacted]

Low Contrast: 127

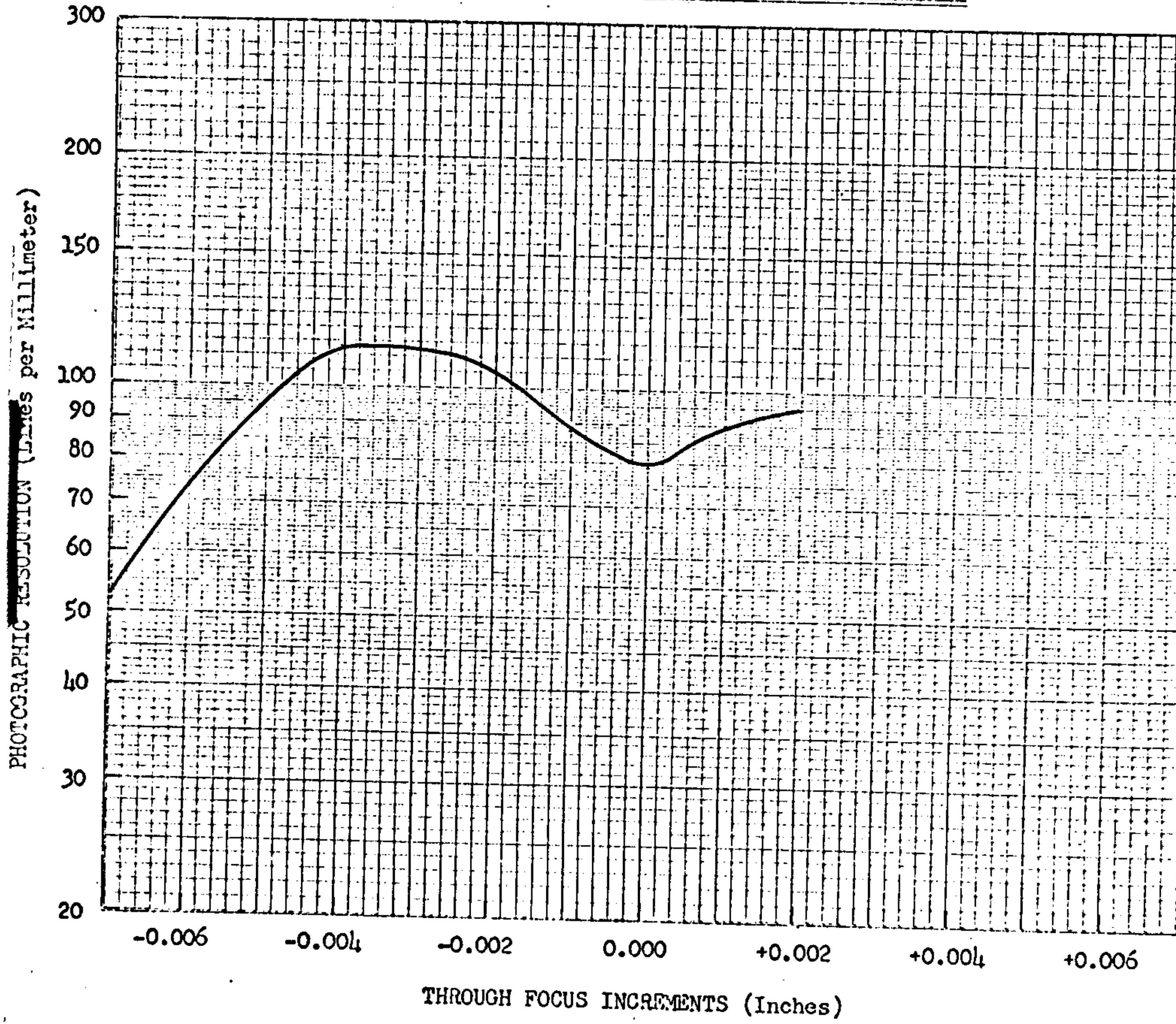
Film Type: 3404

Test Date: 30 November 19[redacted]

~~TOP SECRET~~ C[redacted]

C[redacted]

PRE-FLIGHT DYNAMIC RESOLUTION



Camera No: 221

Payload No: J-48

Resolution (1/mm)

High Contrast: ______

Low Contrast: 127

Film Type: 3404

Test Date: 30 November 1967

FIGURE 2-2

SECTION 3

FLIGHT OPERATIONS

A. SUMMARY

All ascent and injection events were nominal. Event times were close to the predicted and the Agena shut-down by velocity-meter was observed. The resultant orbit parameters were within three (3) sigma dispersions.

Both panoramic cameras operated satisfactorily throughout the flight. However, vehicle perturbations were observed during the engineering passes from day six (6) to the end of the flight.

The instrumentation system, command system, clock system, pressure make-up system, recovery systems, and the yaw function generator performed satisfactorily throughout the flight.

B. PANORAMIC CAMERA PERFORMANCE

Both panoramic cameras indicated normal operation throughout the flight. Camera system dynamic operation, 99/101 clutch, start-up, shut-down, and film transport functions were normal on the observed engineering operations over the [redacted] tracking station.

The final analysis of all available telemetry data revealed a condition that had been experienced on previous J-1 payload systems. This condition occurs as a result of the phase relation of the two panoramic cameras. There exists an $I\omega$ unbalance on each unit as the scan head is accelerated prior to photograph scan and when these $I\omega$ unbalances are phased correctly an oscillatory roll motion is imparted to the Agena vehicle. Normally the cycle rates of the two units of a J-1 system are slightly different so their phase relationship is constantly changing. However, the two units of the J-48 system were cycling at almost identical rates and this permits the phase relationship between units to remain constant. When an adverse phase relationship was obtained at the start of an operation it would remain throughout the operation and a repetitive pattern of roll perturbations resulted. Figure 3-1 describes the relationship of periodic gas valve activity vs phase angle between the panoramic instruments.

The cut and wrap operation and transfer to the -2 recovery system occurred on Rev 103 utilizing KIK-ZORRO 38 Command (early -1 to -2 switch-over).

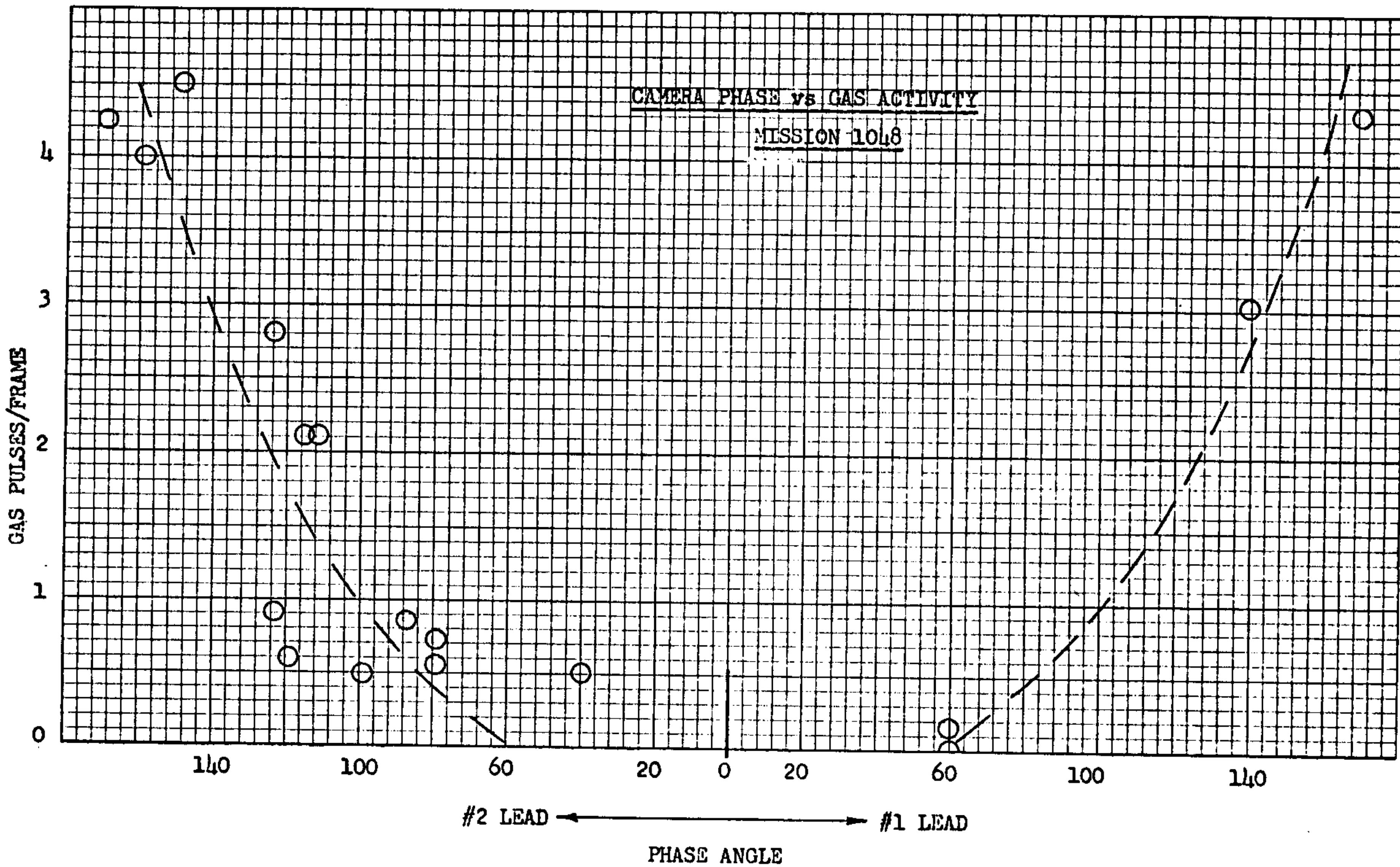

CAMERA PHASE vs GAS ACTIVITY
MISSION 1048
GAS PULSES/FRAME
0
1
2
3
4
140
100
60
20
0
20
60
100
140
#2 LEAD
#1 LEAD
PHASE ANGLE

FIGURE 3-1

The panoramic film was depleted on Rev 231, Frame No. 63 and Frame No. 50 for the Master and Slave cameras respectively.

Panoramic Film Consumption

	Actual Frames	
	Master	Slave
Pre-Launch	89	90
-1 Mission	2983	2983
-2 Mission	3034	3017
Total	6106	6090

FMC Match

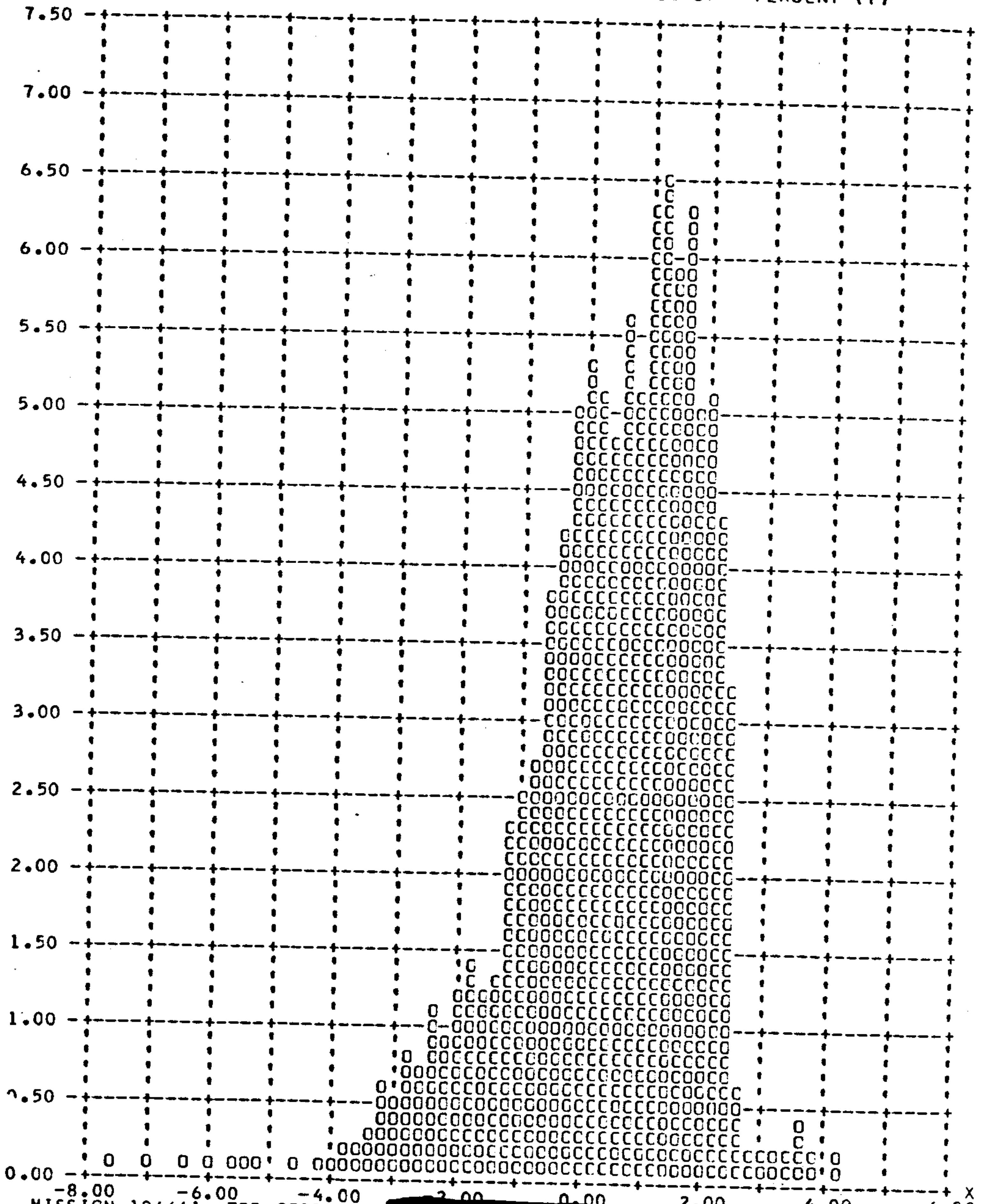
The V/H ramp to orbit match was acceptable throughout the flight. The following settings of RTC 6, 8, and 10 were utilized to obtain the optimum FMC match during the flight.

Rev	RTC 6	RTC 8	RTC 10	Comments
L/O	7	4	6	Settings for nominal orbit.
6	7	3	8	Changed to compensate for orbit dispersions.
14	7	4	7	To compensate for orbit changes following DMU firing.
141	7	4	8	To compensate for normal perigee shift.
188	7	4	9	To compensate for normal perigee shift.

The resulting performance of the overall V/H match is statistically summarized in Figures 3-2 through 3-5.

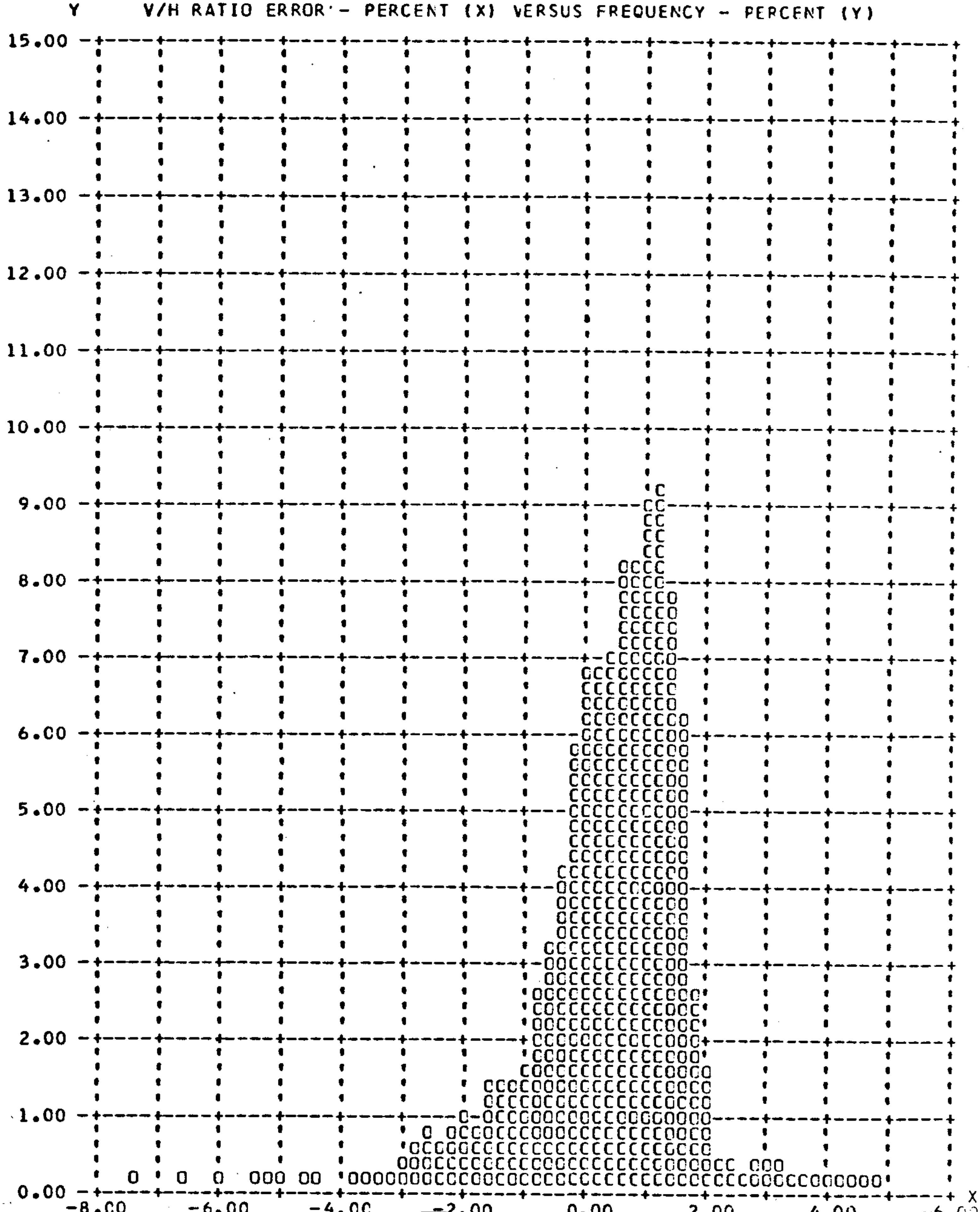
FRAMES 1-6 OF EACH CP OMITTED 90 PERCENT = 2.22

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



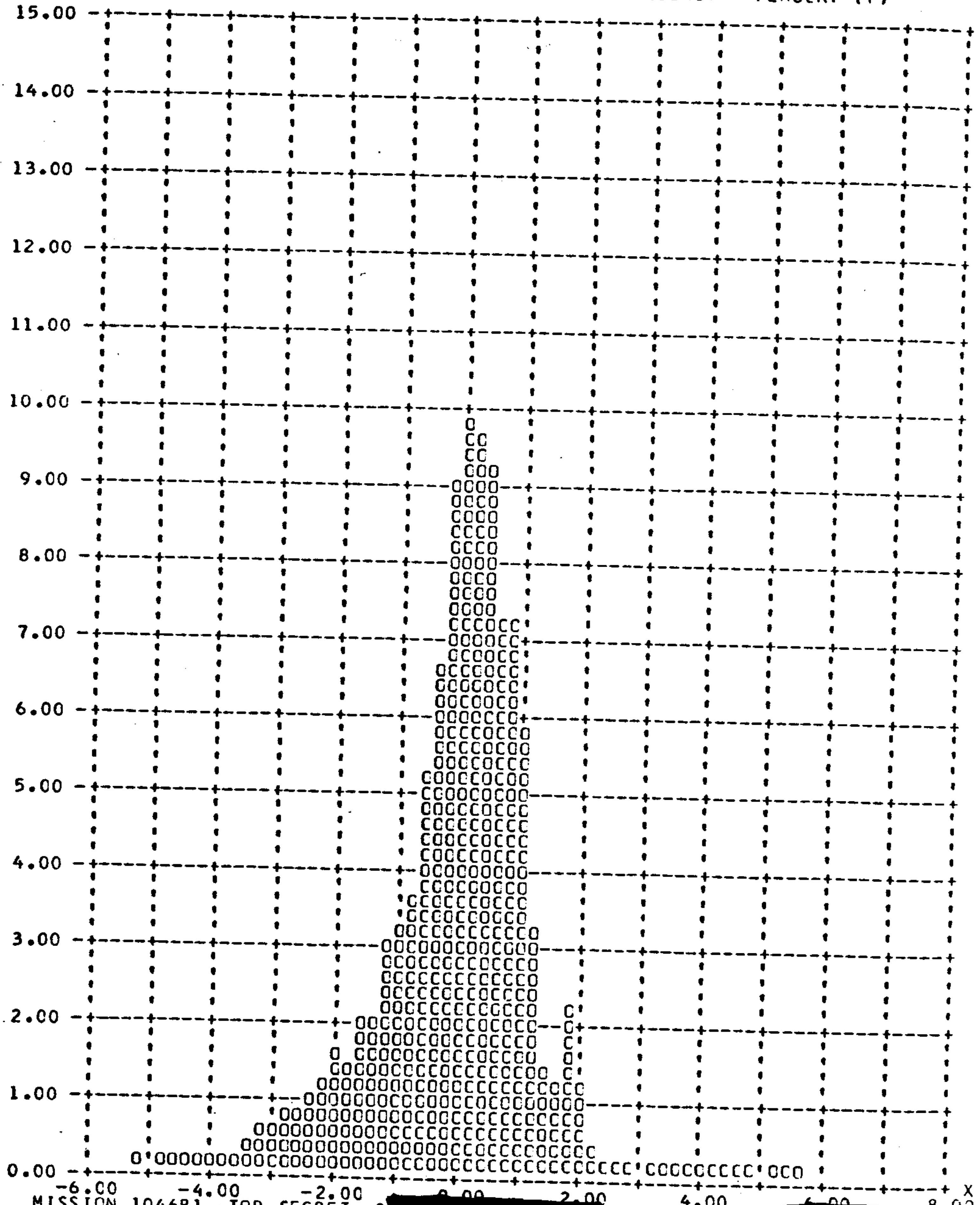
MISSION 1046A2 ~~TOP SECRET~~ C[redacted] CONTROL NO. [redacted]
FRAMES 1-6 OF EACH OP OMITTED 90 PERCENT = 1.72

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



MISSION 1046A2 ~~TOP SECRET~~ C[redacted] - CONTROL NO [redacted]

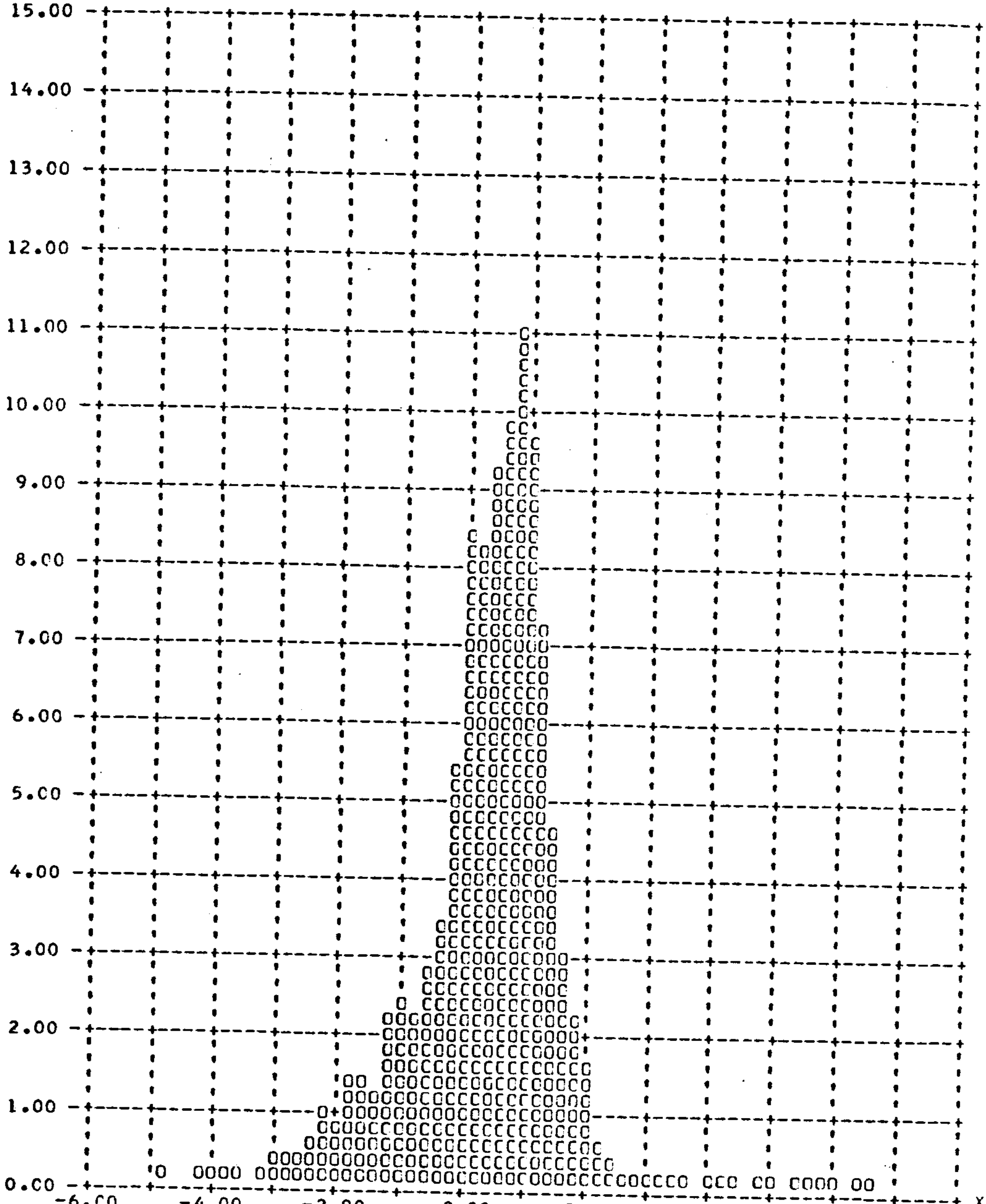
Y V/H RATIO ERROR - PERCENT (X) VERSUS FREQUENCY - PERCENT (Y)



MISSION 1046B2 ~~TOP SECRET~~ C[redacted] - CONTROL NO. [redacted]

FRAMES 1-8 OF EACH OP OMITTED 90 PERCENT = 1.68

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



C. STELLAR/INDEX CAMERA PERFORMANCE

Both the -1 and -2 Stellar/Index cameras operated satisfactorily on all monitored engineering passes. Telemetry data indicated the programmer, metering functions, and shutter monitors performed satisfactorily. Both the Stellar and the Index cameras contained film at the end of the -2 mission.

D. INSTRUMENTATION AND COMMAND SYSTEM PERFORMANCE

The instrumentation system performed normally throughout the total mission.

E. CLOCK SYSTEM PERFORMANCE

The clock system operation was normal for the entire mission. Satisfactory time correlation between the flight clock and the [redacted] Tracking Station was obtained. The ratio of clock time to system time was 1:00000018903.

F. PRESSURE MAKE-UP SYSTEM PERFORMANCE

The pressure make-up system operated normally throughout the flight. Average supply gas pressure drop was approximately 6.85 ΔPSI/Min. of operation. The total operate time was 240.5 minutes with 169 camera operates. A surplus of 440 lbs. of gas supply existed at the end of the mission.

G. THERMAL ENVIRONMENT

The thermal environment achieved with this system was near the pre-flight predictions. A temperature range of 86°F to 73°F was predicted for the beginning of the -1 mission and the actual system temperatures were 85°F and 75°F for the Master and Slave instruments respectively. The predicted temperature range for the beginning of the -2 mission was 77°F to 63°F and the actual system temperatures were 71°F and 68°F for the Master and Slave cameras respectively.

H. YAW PROGRAMMER

The vehicle Yaw Programmer functioned properly throughout the mission. However, a minor profile mismatch was noted in post-flight analysis. Investigations are continuing to determine the factors contributing to the apparent discrepancy. A more complete description of this function and its effect on mission performance is presented in Sections 4, 7, and 8.

I. RECOVERY SYSTEM

An early switchover from the A to the B Recovery systems was performed on Pass 103, with all functions appearing normal. The 1046-1 recovery capsule was successfully recovered by air-catch on Rev 113 at 1648 PST on 21 March 1968. Capsule impact was approximately 20 N.M. north of the predicted impact. All available data has been analyzed and all functions appeared to have occurred normally. All re-entry events appeared normal and close to the predictions except for deceleration and main chute deployment which were slightly out of tolerance.

	Latitude	Longitude
Predicted	27° 8.8' N	167° 9.8' W
Actual	27° 28' N	167° 02' W

The 1046-2 recovery capsule was successfully recovered by air-catch on Rev 240 at 1601 PST on 29 March 1968. All re-entry events appeared normal and close to the predictions. Capsule impact was approximately 20 N.M. north of the predicted point, but was within tolerance.

	Latitude	Longitude
Predicted	24° 0' N	171° 35.8' W
Actual	24° 21' N	171° 38.2' W

J. RADIATION DOSAGE

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

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

	Mission 1046-1		Mission 1046-2	
Emulsion	B + F Density	Radiation	B + F Density	Radiation
Type 3401	0.14	0.3 R	0.18	0.6 R
Royal X Pan	0.21	0.3 R	0.26	0.5 R

These levels are below that which will degrade the photography.

SECTION 4

PHOTOGRAPHIC PERFORMANCE

The photographic quality of Mission 1046-1 was generally good and comparable to the better Corona J-1 systems to date. Portions of the 1046-1 mission were comparable to the best photography ever produced by a J-1 camera. However, for photographic interpretation purposes Mission 1046-1 was rated as fair to good, and 1046-2 was fair to poor. The loss of utility was attributed to an anomaly that produced varying image quality across the in-flight direction of the format and became progressively worse throughout the flight. Weather conditions were generally favorable, with a high percentage of cloud-and haze-free acquisitions.

A. PANORAMIC INSTRUMENTS

The Master camera produced 2988 frames (8135 feet) of photography during Mission 1046-1, and 3029 frames (8015 feet) during Mission 1046-2. The Slave camera produced 2990 frames (8133 feet) during Mission 1046-1, and 3010 frames (7965 feet) during Mission 1046-2. The quality of the photography produced by the two cameras was very similar. The MIP Frames were rated 90 for Mission 1046-1 and 85 for 1046-2.

The array of fixed resolution targets at Ft. Huachuca, Arizona, were recorded during Mission 1046-2. The average system resolution of these targets were judged to be approximately 11 feet for both instruments.

Both instruments experienced varying degrees of out-of-focus imagery, progressively worsening through the mission. The anomaly was very pronounced on the forward-looking camera, appearing as a distinct out-of-focus condition along the binary block side of the format with gradual improvement in image quality and focus across the film width. This discrepancy appears to have been caused by a significant emulsion dust build-up on the scan head rollers which affected the focus. Emulsion dust was observed on the hub roller of the 1046-2 SRV. A measure of the anomaly variations in the Master record was provided by the resolution targets at Ft. Huachuca, Arizona, which appeared near the 200-PPS edge of the format in one frame and near the binary block side in the following frame. The first image could be resolved to the 11-foot group, but the second was limited to 15-feet, at best. The target was recorded only once by the Slave camera, with an indicated performance of 11-feet ground resolution.

This system was the first complete mission to utilize SO-230 film, which is approximately 0.5 stop more sensitive than the 3404 material used on previous systems. Subsequent testing indicated that the SO-230 emulsion has a tendency to scratch more severely than 3404, thus creating excessive dust which can accumulate in the system. Investigations have been implemented to attempt significant reductions in both the scratch producing characteristics of the camera systems, and the susceptibility of the SO-230 emulsion to abrasion. In addition, the SO-230 film appeared to have a tendency to experience greater than normal curl in vacumm environment which could possibly have influenced the camera dynamics and contributed to the observed image quality degradation. This characteristic is also being investigated further.

The SO-230 film also exhibited an increase in apparent base plus fog density in areas where the emulsion was unprotected during long instrument-off periods. The magnitude of the observed fogging was 0.04 to 0.06 ΔD early in the mission, but diminished to completely imperceptible levels towards the end of the flight. These fogging characteristics are identical to the results obtained in the pre-flight systems environmental test (Section 2). The fogging was insufficient to produce detectable degradation of the photography.

All auxiliary data recording functions operated normally throughout the flight, with the exception of unexplained variations in density of the Master camera serial number and adjacent index bit. The intermittent variations were not sufficient to constitute a compromise to the photography or to the time word data reduction.

The minor light leaks observed in pre-flight tests (Section 2) were apparent on the flight material. The fog patterns created by the drum seal leaks appeared to be very similar to that observed in test, and created only minor effects on the information content of the photography. There was very heavy, degrading, fog present on portions of the film in the area of the SRV cover during non-photographic "sit" periods. A similar pattern was barely perceptible in pre-flight test, implying that the source of the light penetration became much more significant in test and launch activities. Appropriate procedures have been implemented to re-check the SRV potential problem areas for indications of developing light leaks.

The out-of focus anomaly described above induced sufficient degradation of image quality to literally mask the detection of image smear characteristics. It is therefore not possible to express any measure of degradation experienced by the system as a result of the net IMC errors, the yaw steering deviations observed or the camera/vehicle pertubations indicated by the attitude gas jet activity (Ref. Section 3).

B. STELLAR/INDEX CAMERAS

The Stellar/Index film recovered consisted of 461 frames of photography from each film path of S/I D119/151/157 (Mission 1046-1), and 479 frames from each path of S/I D120/153/158 (Mission 1046-2). The cameras operated normally throughout the respective mission. There were 15 to 30 or more Stellar images detectable on most frames despite a level of flare which affected approximately 60 per cent of each frame. Most of the Stellar images were good, and were point-type images. Approximately 30 per cent of the frames contained images that were slightly elongated.

The Index cameras produced good quality imagery through each of the respective missions. The reseaus were sharp and well defined in both instruments. No static marking was reported on the Index material. Minor corona static occurred intermittently throughout the 1046-1 Stellar record, but at no time did the marking enter the active format.

C. PERFORMANCE MEASUREMENTS

A summary of MTF/AIM resolution values measured by SPPF is tabulated below. The microdensitometer slit used was 1 micron by 80 microns.

Mission	Camera	Cycles/mm	Avg	Ground Resolution
1046-1	Fwd	87	79	13'
1046-2	Fwd	70		
1046-1	Aft	86	85	12½'
1046-2	Aft	84		

The details of the measurement and computing techniques, targets measured and target locations are fully reported in the evaluation report published by AFSPPF and are not included in this report. These values were determined by using the "Interim MTF/AIM Program" technique.

SECTION 5

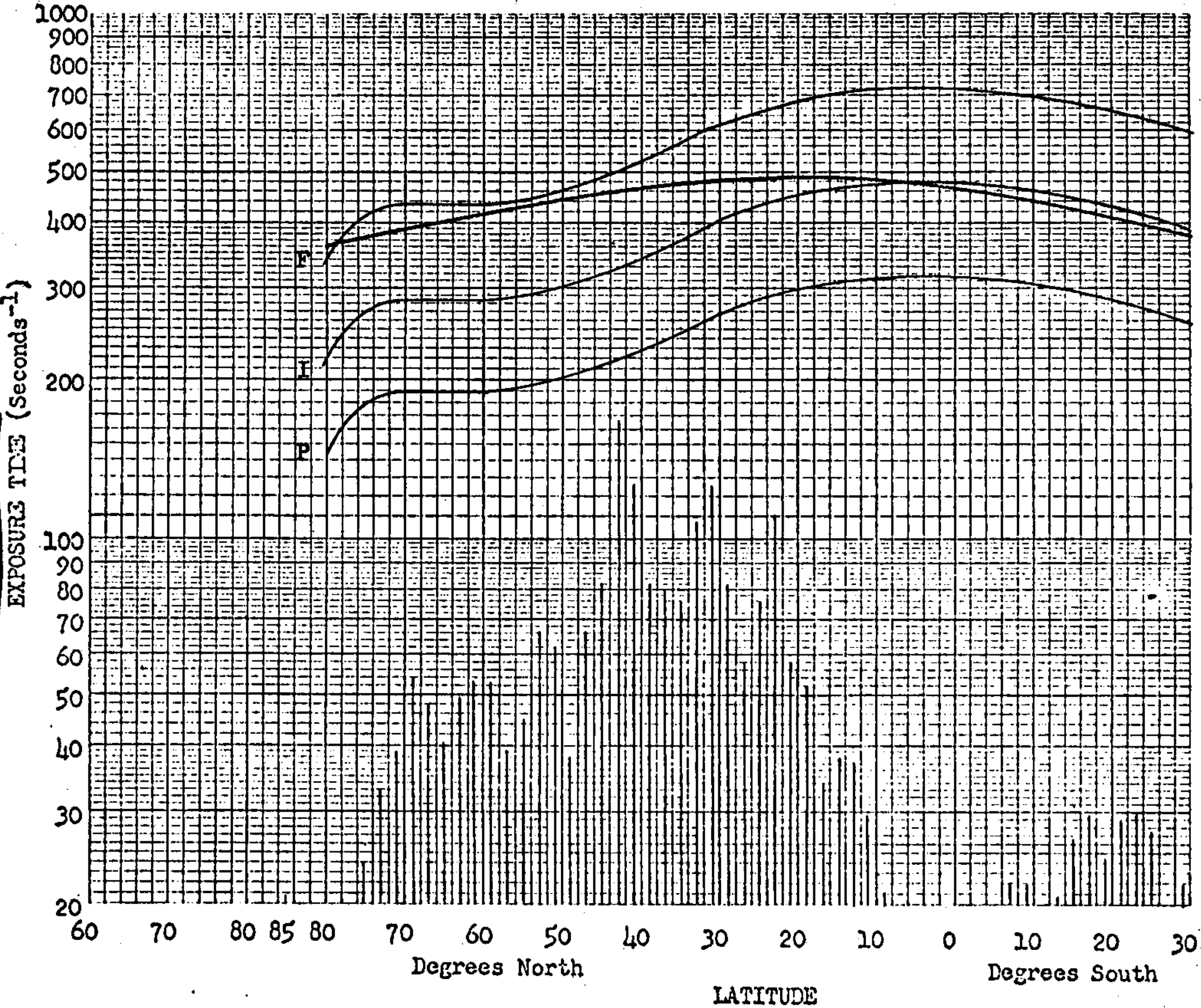
PANORAMIC CAMERA EXPOSURE

The Master camera contained a 0.140 inch slit and a Wratten 23A filter. The Slave camera had a 0.110 inch slit and a Wratten 21 filter. These conditions placed the nominal exposure between the calculated exposure criteria curves for full and intermediate processing. The exposure criteria was adjusted for the higher speed of the SO-230 film, and for the corresponding differences in filter factors. The net result was an increase in the exposure criteria of approximately 2/3-stop. Similarly, the slits used in this mission represented approximately 2/3-stop reduction from the slits that normally would have been used with 3404 film.

The photographic results obtained during the mission indicate that the exposure criteria was not adjusted sufficiently to accommodate an increased sensitivity of the SO-230 emulsion in the high vacuum envirornment. This phenomenon is discussed more extensively in Section 6 of this report.

The nominal exposure times of the Master and Slave cameras are shown as a function of latitude for passes D-40, D-120, and D-200 in Figures 5-1 to 5-6. Superimposed on these plots are relative distributions of camera operations for the portion of the mission represented by each plot.

EXPOSURE POINTS



[redacted]

Mission No: 1046

Payload No: J-48

Camera No: 220

Pass No: 40

Launch Date: 3/14/68

Launch Time: 2200 Z

Slit Width: .140

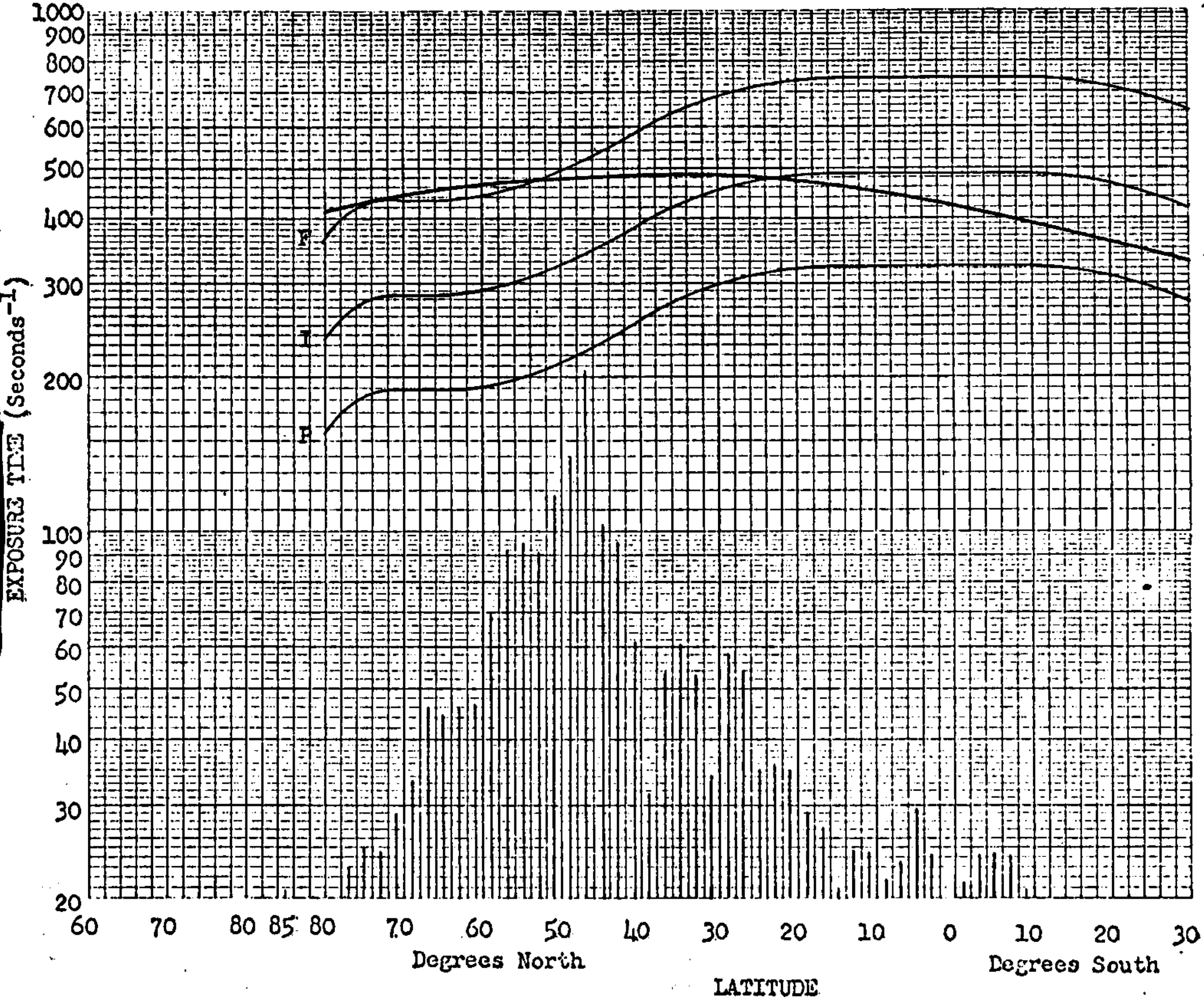
Filter Type: Wratten 23A

Film Type: SO-230

[redacted]

FIGURE 5-1

EXPOSURE POINTS



Mission No: 1046

Payload No: J-48

Camera No: 220

Pass No: 120

Launch Date: 3/14/68

Launch Time: 2200 Z

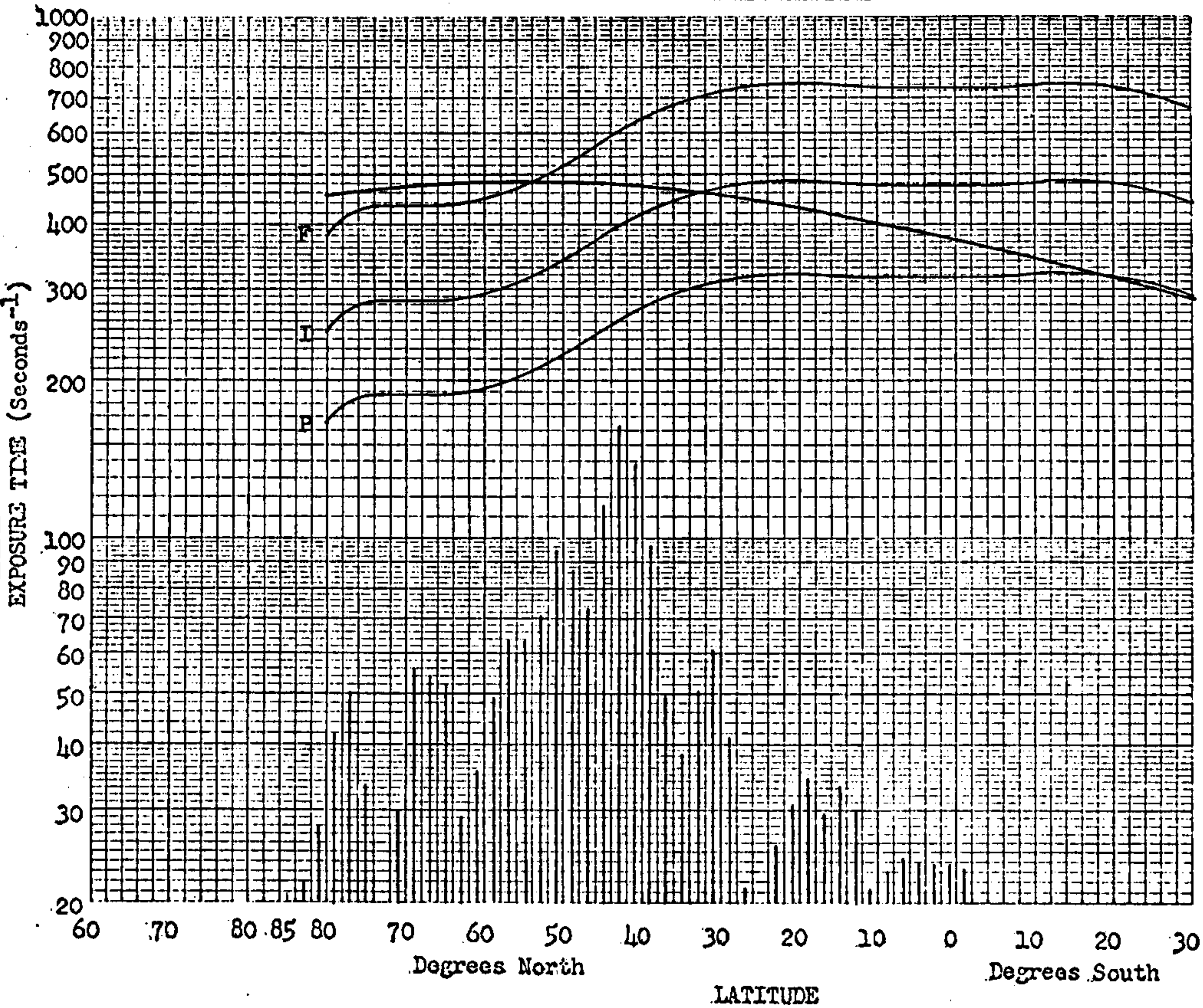
Slit Width: .140

Filter Type: Wratten 23A

Film Type: SO-230

FIGURE 5-2

EXPOSURE POINTS



Mission No: 1046

Payload No: J-48

Camera No: 220

Pass No: 200

Launch Date: 3/14/68

Launch Time: 2200 Z

Slit Width: .140

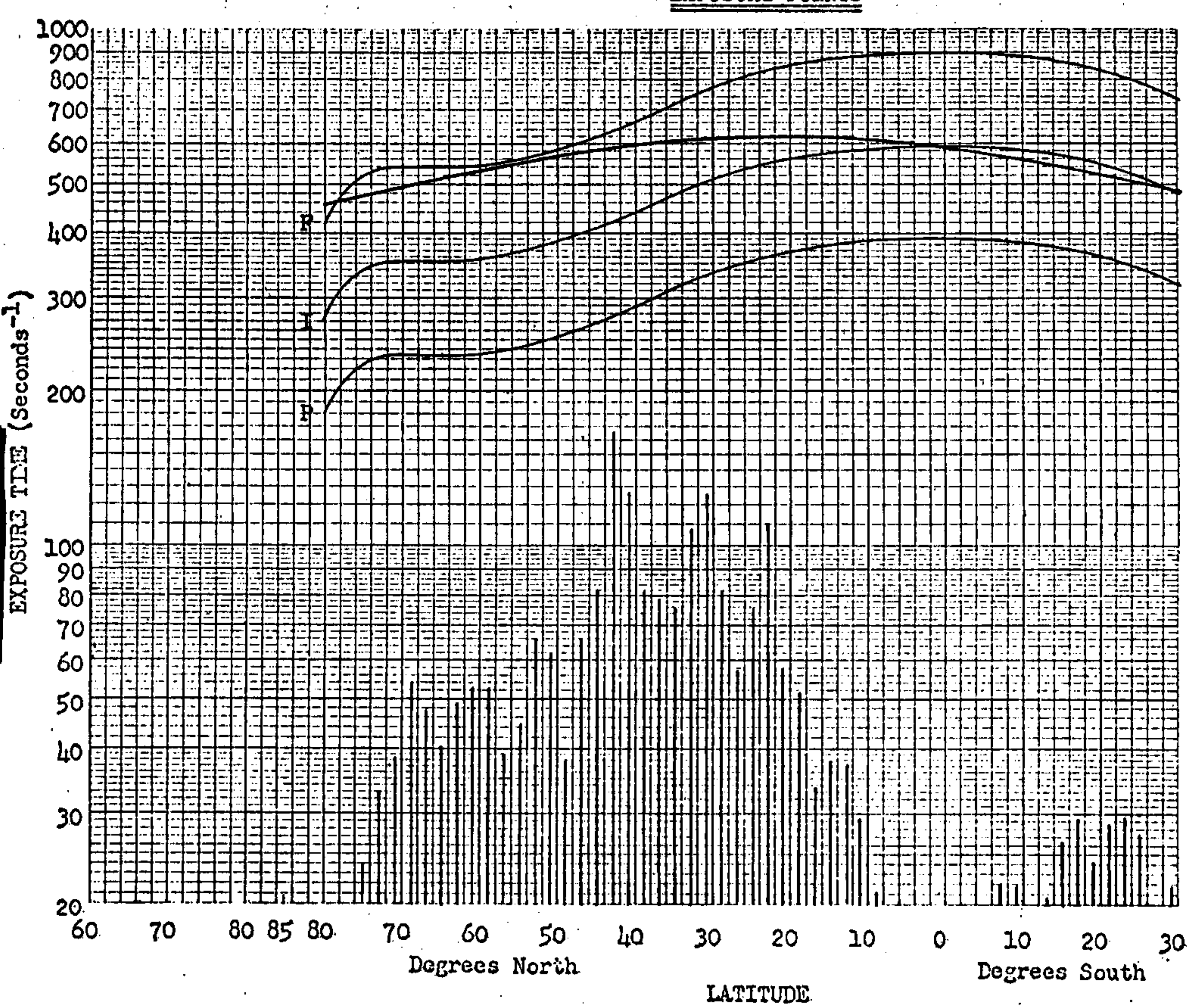
Filter Type: Wratten 23A

Film Type: SO-230

[redacted]

FIGURE 5-3

EXPOSURE POINTS



Mission No: 1046

Payload No: J-48

Camera No: 221

Pass No: 40

Launch Date: 3/14/68

Launch Time: 2200 Z.

Slit Width: .110

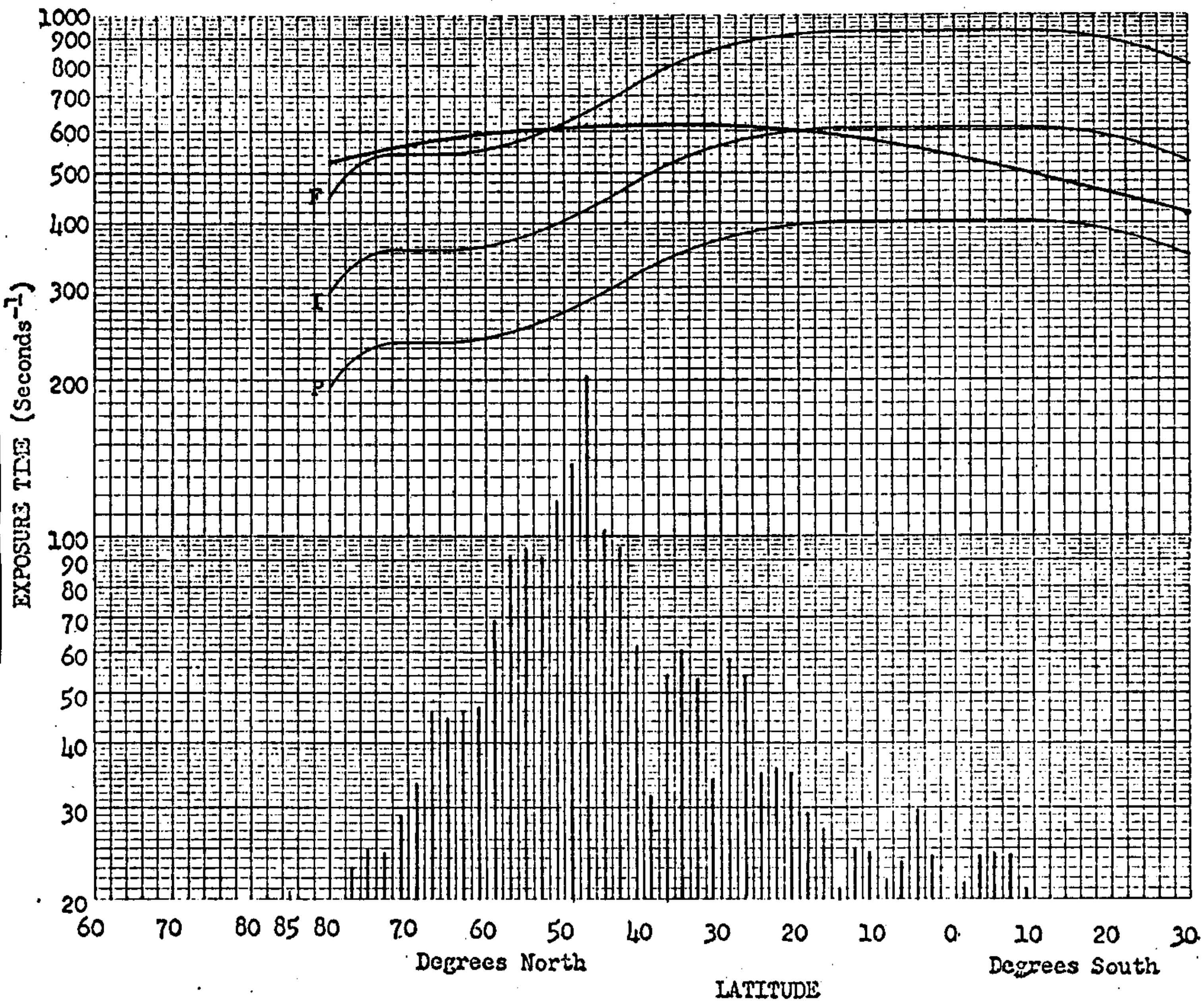
Filter Type: Wratten 21

Film Type: SO-230

[redacted]

FIGURE 5-4

EXPOSURE POINTS



Mission No: 1046

Payload No: J-48

Camera No: 221

Pass No: 120

Launch Date: 3/14/68

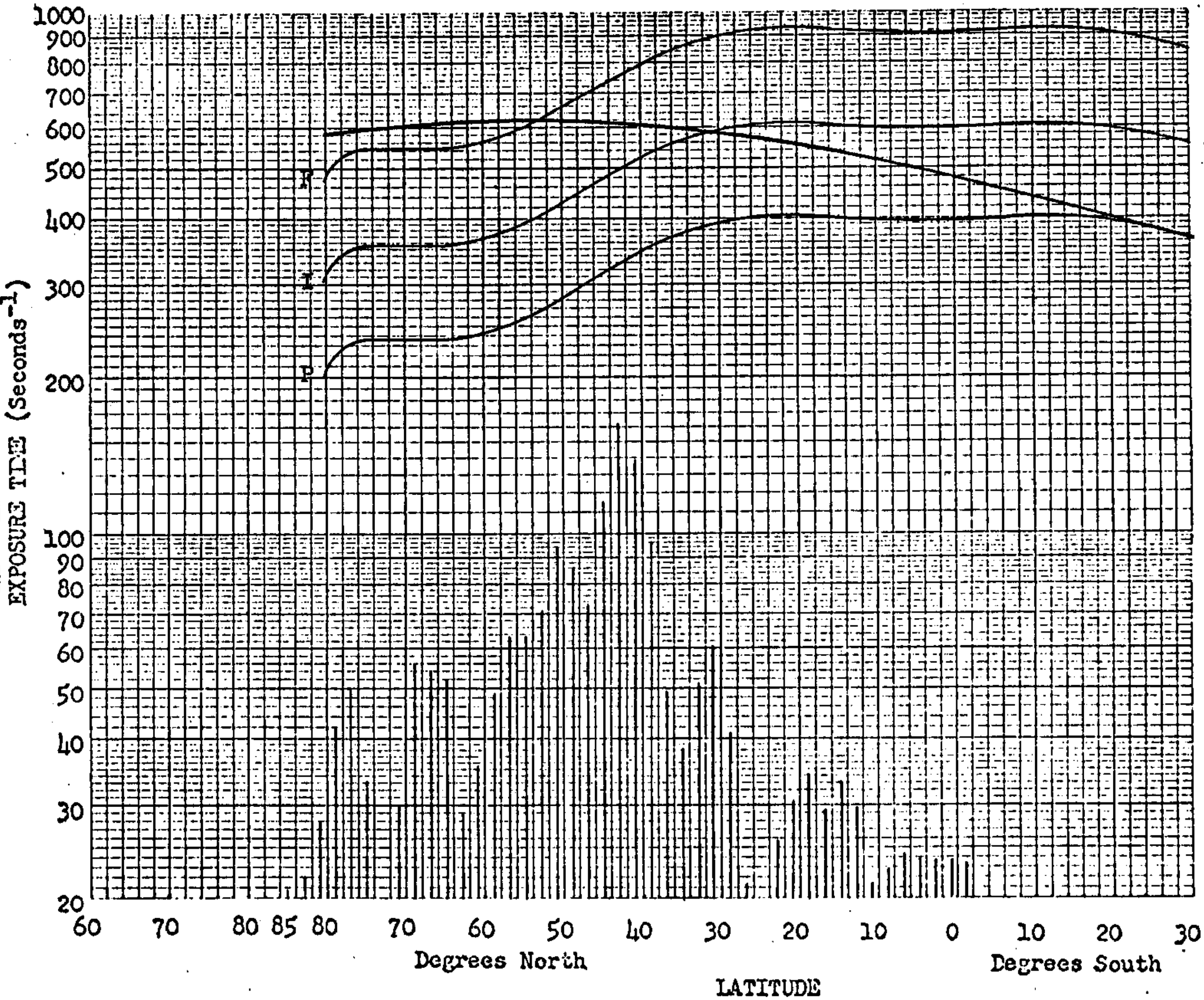
Launch Time: 2200 Z

Slit Width: .110

Filter Type: Wratten 21

Film Type: SO-230

EXPOSURE POINTS



Mission No: 1046

Payload No: J-48

Camera No: 221

Pass No: 200

Launch Date: 3/14/68

Launch Time: 2200 Z

Slit Width: .110

Filter Type: Wratten 21

Film Type: SO-230

FIGURE 5-6

[redacted]

SECTION 6

DIFFUSE DENSITY MEASUREMENTS

The diffuse density measurements made by AFSPPF were computer sorted at A/P to permit analysis of the density ranges resulting from the three levels of conventional processing. The sorting technique utilizes the base plus fog density values for the conventionally processed materials where measurements up to 0.09 density are considered as having received Primary processing, 0.10 to 0.17 as Intermediate, and above 0.17 density as Full. The percentage of this material that was processed at each level, based on the computer sort, is tabulated below with the predicted and reported processing percentages.

Mission	Camera		Primary	Intermediate	Full	Transition
1046-1	Fwd	Predicted	0	40	60	--
		Reported	36	34	12	18
		Computed	0	78	22	--
1046-1	Aft	Predicted	0	38	62	--
		Reported	24	25	24	27
		Computed	0	58	42	--
1046-2	Fwd	Predicted	3	40	57	--
		Reported	45	24	16	15
		Computed	0	67	33	--
1046-2	Aft	Predicted	1	41	58	--
		Reported	32	29	24	15
		Computed	0	51	49	--

The distinct disparity between the reported and computed percentages can be attributed to the differences in base plus fog levels when using SO-230 film rather than 3404. The sorting technique described above is based on the processing characteristics of 3404 film, which is presently the primary material in the CORONA Program. The variations involved are readily apparent by comparing the sensitometric curves in Figures 6-1 with the specified sorting limits. These limits were not modified for Mission 1046 analysis, but will be adjusted appropriately if SO-230, or equivalent, materials are adopted for operational use, and if reasonably repeatable process control standards are developed.

The summary graphic computer plots of the sampled density distributions are not influenced by the sorting limits. These plots indicate an overall higher than normal density distribution, despite the high percentage of intermediate and primary processing reported. (The computer plots are no longer included as a portion of this report, but are available at A/P for reference, as desired).

The significant difference between the predicted and reported processing percentages reflects a sizeable deviation in exposure characteristics from the nominal criteria. As explained in Section 5 of this report, the normally used exposure criteria was modified by approximately 2/3-stop to accommodate the increase in film speed and different filter factors. The flight film processing control samples indicated an emulsion sensitivity virtually identical to that used for this exposure planning. The reported processing levels and the resulting medium densities indicates an additional increase, estimated to be approximately 1/2-stop, to the adjusted exposure criteria.

This apparent increase in exposure has been attributed to an increase in emulsion sensitivity in high vacuum. This phenomenon appears to be reversible, in that film soaked in a vacuum environment and later photographically exposed at ambient conditions exhibits the same sensitivity as untreated film, except for a residual fog level of 0.04 to 0.06 density. The increase in sensitivity in a vacuum was substantiated in investigations by [redacted] as described in the report "Sensitometric Effect of Vacuum and Low Temperature on Three Aerial Films", May 1968. Additional investigations are being undertaken to better understand the phenomenon and how to appropriately compensate the exposure criteria.

A summary of the processing and exposure analysis for the conventionally processed material is shown in Table 6-1. The terrain D-Min criteria, (range) for proper exposure and processing is 0.40 tc 0.90 density units. The area measured for D-Min is selected subjectively and is not necessarily the absolute D-Min in the photography.

The terrain D-Min criteria has been found to be an inadequate indicator of optimum target exposure. Maximum intelligence is derived from specific target densities meeting this criteria; which, in general, results in overall terrain D-Min values repeatedly below the 0.40 density level. It is therefore apparent that the more desirable messions will, most likely, be reported as significantly underexposed by the present terrain D-Min criteria.

The density range chart and the density distribution plots previously included in these reports, are maintained at A/P for reference, as desired.

MISSION 1046-1 INSTR - FWD SO-230 PROCESSING AND EXPOSURE ANALYSIS

PROCESS LEVEL	SAMPLE SIZE	UNDER EXPOSED	UNDER PROCESSED	CORRECT EXP&PROC	OVER PROCESSED	OVER EXPOSED
PRIMARY	0	0 PC	0 PC	0 PC	88 PC	89 PC
INTERMEDIATE	175	0 PC	8 PC	78 PC	13 PC	2 PC
FULL	49	4 PC	0 PC	96 PC	0 PC	0 PC
ALL LEVELS	224	1 PC	6 PC	82 PC	10 PC	1 PC

MISSION 1046-1 INSTR - AFT SO-230 PROCESSING AND EXPOSURE ANALYSIS

PROCESS LEVEL	SAMPLE SIZE	UNDER EXPOSED	UNDER PROCESSED	CORRECT EXP&PROC	OVER PROCESSED	OVER EXPOSED
PRIMARY	0	0 PC	0 PC	0 PC	68 PC	66 PC
INTERMEDIATE	130	1 PC	5 PC	79 PC	13 PC	2 PC
FULL	93	3 PC	0 PC	82 PC	15 PC	0 PC
ALL LEVELS	223	2 PC	3 PC	80 PC	14 PC	1 PC

MISSION 1046-2 INSTR - FWD SO-230 PROCESSING AND EXPOSURE ANALYSIS

PROCESS LEVEL	SAMPLE SIZE	UNDER EXPOSED	UNDER PROCESSED	CORRECT EXP&PROC	OVER PROCESSED	OVER EXPOSED
PRIMARY	0	0 PC	0 PC	0 PC	82 PC	80 PC
INTERMEDIATE	159	0 PC	12 PC	76 PC	12 PC	0 PC
FULL	79	13 PC	0 PC	82 PC	5 PC	0 PC
ALL LEVELS	238	4 PC	8 PC	78 PC	10 PC	0 PC

MISSION 1046-2 INSTR - AFT SO-230 PROCESSING AND EXPOSURE ANALYSIS

PROCESS LEVEL	SAMPLE SIZE	UNDER EXPOSED	UNDER PROCESSED	CORRECT EXP&PROC	OVER PROCESSED	OVER EXPOSED
PRIMARY	0	0 PC	0 PC	0 PC	62 PC	62 PC
INTERMEDIATE	121	0 PC	4 PC	73 PC	23 PC	0 PC
FULL	118	1 PC	0 PC	89 PC	10 PC	0 PC
ALL LEVELS	239	0 PC	2 PC	81 PC	17 PC	0 PC

PROCESS LEVEL	BASE & FOG	UNDER EXPOSED	UNDER PROCESSED	CORRECT EXP&PROC	OVER PROCESSED	OVER EXPOSED
PRIMARY	0.01-0.09	0.01-0.13	0.14-0.39	0.40-0.90	---------	0.91 AND UP
INTERMED	0.10-0.17	0.01-0.20	0.21-0.39	0.40-0.90	0.91-1.34	1.35 AND UP
FULL	0.18 AND UP	0.01-0.39	---------	0.40-0.90	0.91-1.69	1.70 AND UP

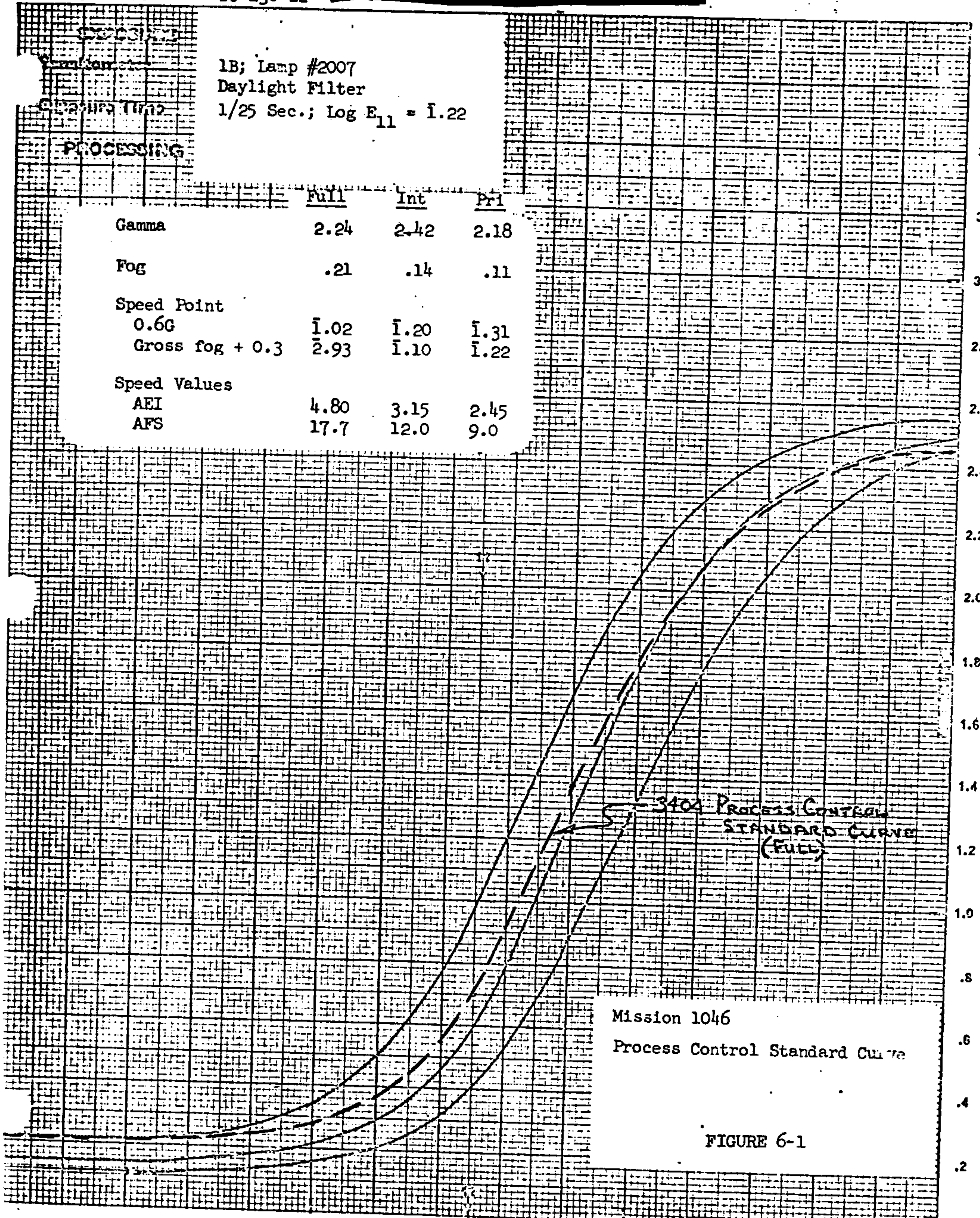
TABLE 6-1

FILM TYPE SO-230-12 [redacted]

1B; Lamp #2007
Daylight Filter
1/25 Sec.; Log E_{11} = $\bar{1}.22$

PROCESSING

	Full	Int	Pri
Gamma	2.24	2.42	2.18
Fog	.21	.14	.11
Speed Point			
0.6G	$\bar{1}.02$	$\bar{1}.20$	$\bar{1}.31$
Gross fog + 0.3	$\bar{2}.93$	$\bar{1}.10$	$\bar{1}.22$
Speed Values			
AEI	4.80	3.15	2.45
AFS	17.7	12.0	9.0



Mission 1046

Process Control Standard Curve

FIGURE 6-1

SECTION 7

VEHICLE ATTITUDE

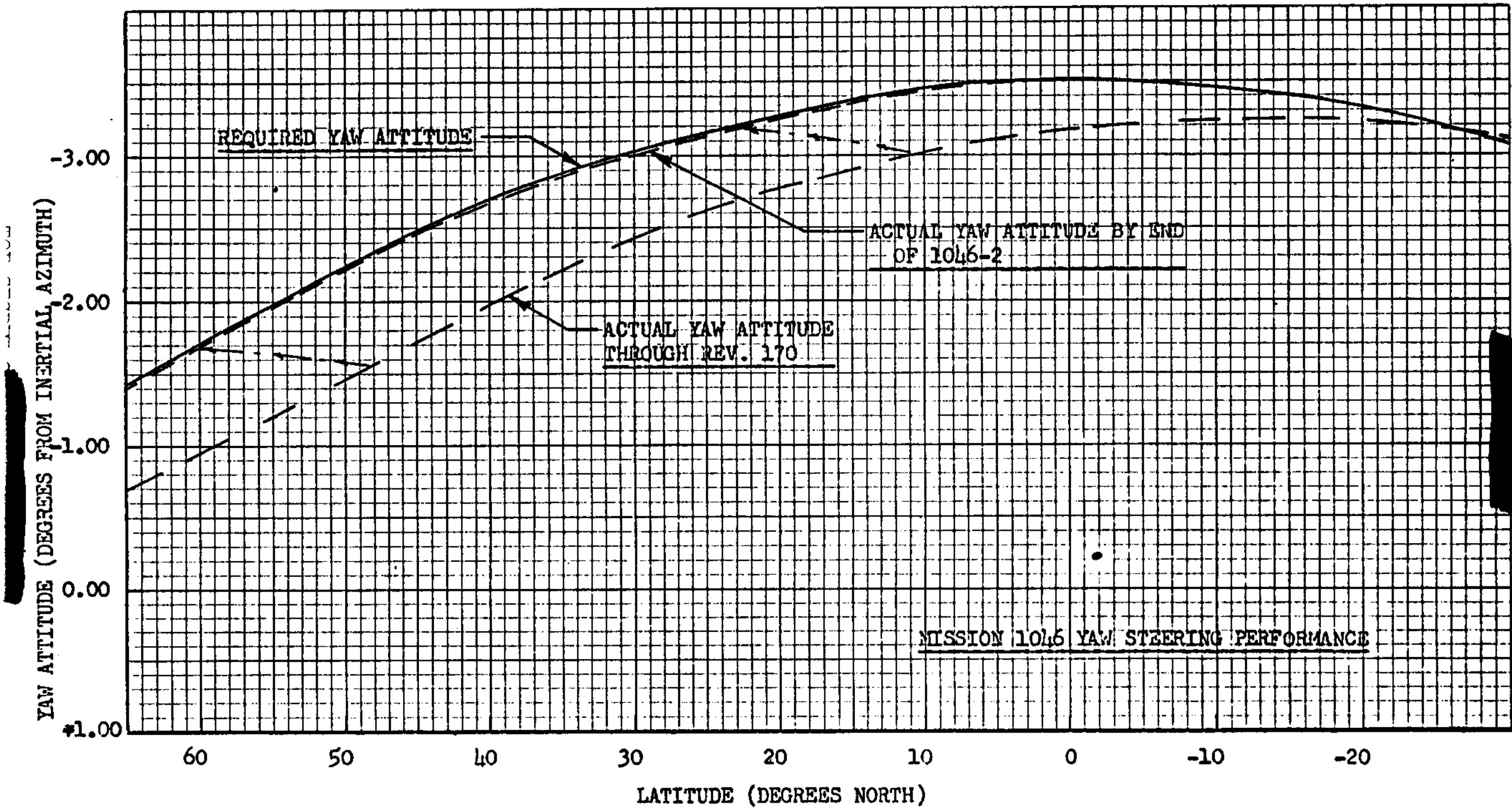
The vehicle attitude errors for both Mission 1046-1 and 1046-2 were derived from the reduction of the Stellar camera photography. This attitude data is supplied at A/P by NPIC.

The attitude errors for each frame and the attitude control rates are calculated at the A/P computer facility. The computer also plots the frequency distribution of the rates and errors. These plots are no longer included as a part of this report, but are maintained at A/P and are available for reference, as desired.

The summary table below lists the maximum attitude errors and rates that were experienced during 90 per cent of the FWD camera photographic operations, excluding the first six frames of each operation, and the total range of the errors and rates.

	Mission 1046-1		Mission 1046-2	
Value	90%	Range	90%	Range
Pitch Error (°)	0.21	-0.35 to +1.05	0.26	-0.52 to +0.42
Roll Error (°)	0.52	+0.14 to +0.88	0.15	-0.22 to +0.48
Yaw Angle Error (°)	0.88	-0.10 to +1.15	0.78	-0.20 to +1.05
Pitch Rate (°/hr.)	44.26	-35 to +100	47.31	-65 to +90
Roll Rate (°/hr.)	18.02	-54 to +54	17.58	-42 to +44
Yaw Rate (°/hr.)	23.98	-58 to +50	19.19	-42 to +54

The yaw angle error represents the difference between the actual vehicle yaw attitude and the ideal yaw angle that would provide correct ground image motion. The vehicle attitude control system demonstrated an apparent inconsistency in responding to the programmed ideal yaw angle. It has not yet been determined whether the apparent error emanated from the yaw function generator or from the attitude control system proper. The biased yaw angle error indicated reflects this condition. Figure 7-1 graphically depicts these relationships. The effects on image quality are small and were not separable from the other degrations present in this system.



[redacted]

[redacted]

FIGURE 7-1

SECTION 8

IMAGE SMEAR ANALYSIS

The frame correlation tape supplied to A/P by NPIC contains the binary time word of each frame of photography. A computer program has been assembled at A/P which calculates the exposure time of each frame and compares the camera cycle rate with the ephemeris to calculate the V/H mismatch (Section 3), which is then combined with the vehicle attitude error and rate values of each frame and the crab error caused by earth rotation at the latitude of each frame. The program outputs the net IMC error and the total along track and cross track limit of ground resolution that can be acquired by a camera regardless of focal length and system capabilities.

The computer rejects the first six frames of all operations as the large V/H error induced by camera start-up is not representative of the overall system operations. The computer plotted frequency distributions of IMC errors and resolution limits are no longer included in this report, but are maintained at A/P for reference, as desired.

The summary table 8-1 presents the maximum IMC errors and resolution limits that existed during 90% of the photographic operations and the total range of values during all operations that were computed.

The relatively low values obtained in Mission 1046 reflect the combined effects of nominal V/H match and a significant reduction in exposure time because of the use of the faster SO-230 film. The consistent difference in resolution limit values between the forward and aft-looking instruments is, in reality, an illustration of the relative influence of the difference in exposure time when coupled with smear contributing V/H and attitude errors. As discussed in Section 6 of this report, it appears that the exposure time could have been reduced even further, which would induce corresponding reductions in image smear. The short exposure times minimuzed the smearing influence of the minor yaw steering mismatch described in Section 7. The degradation of photographic performance induced by the emulsion dust build-up was sufficient to preclude any visual identification of image smear.

MISSION 1046

IMC RATIO AND RESOLUTION LIMITS

VALUE	UNITS	CAMERA	MISSION 1046-1 90%	MISSION 1046-1 RANGE	MISSION 1046-2 90%	MISSION 1046-2 RANGE
IMC Ratio Error	%	FWD	2.33	-7.8 to +4.6	2.23	-5.8 to +5.4
		AFT	1.90	-8.0 to +5.5	1.77	-5.2 to +6.2
Along Track Resolution Limit	Feet	FWD	1.82	0.2 to 6.8	1.72	0.2 to 6.8
		AFT	1.13	0.2 to 5.4	1.09	0.2 to 4.2
Cross Track Resolution Limit	Feet	FWD	1.35	0.2 to 2.0	1.17	0.2 to 1.9
		AFT	0.92	0.2 to 2.3	0.75	0.2 to 1.2

TABLE 8-1

SECTION 9

SYSTEM RELIABILITY

Reliability calculations for the payload are based on a sample beginning with M-7. Hence both the major part of the Mural program and the "J" program are covered in the calculation. For certain auxiliaries, i.e., the Stellar-Index camera and the horizon cameras, the sample size is changed to recognize incorporation of modified equipment or new designs where reliability was one of the principal reasons for the modification. However, for primary mission function, the sample size is consistent with reliability reporting for the vehicle.

The reliability estimates of this section deal exclusively with the payload. Failures to achieve orbit or vehicle induced failures are thereby excluded. Recoveries before a complete mission has been completed are considered as full missions providing that early termination was caused by reasons not connected with payload operation. Film quality is not considered in the reliability estimate calculation. Hence, only electrical and mechanical functioning are considered.

The reliability estimate is also divided into primary and secondary functions. The primary functions are operation of the panoramic cameras, main camera door operation, operation of the payload clock, and recovery operations. The secondary mission functions are horizon camera operation excluding catastrophic open shutter failure mode, auxiliary data recording, and Stellar-Index camera operation. A summary of estimated reliability is shown in Table 10-3.

Panoramic Camera Reliability

Sample Size - 207 opportunities to operate.

Two failures - S/I Programmer on System J-19

Film Transport on System J-42

Assume - 3000 cycles per camera per mission.

Estimated Reliability = 98.7 at 50% confidence level

Main Camera Door Reliability

Sample Size - 65 vehicles x 2 doors = 130 opportunities to operate

Estimated Reliability = 99.5 at 50% confidence level.

Payload Command and Control

Sample Size - 12,432 hours operation in sample

Two failures

Estimated Reliability = 96.4% at 50% confidence level

Payload Clock Reliability

Sample Size - 12,432 hours operation in sample

No failures

Estimated Reliability - 99.1% at 50% confidence level

Estimated Reliability of Payload Functioning on orbit = 96.8% at 50% confidence level

Recovery System Reliability

95 opportunities to recover

1 failure - improper separation due to water seal - cutter failure

Estimated Reliability - 98.2% at 50% confidence level

Stellar-Index Camera Reliability

Sample begins with J5 (Does not include KISIC units in 1100 series systems)

Sample size = 30,180 cycles

Four failures

Estimated Reliability = 93.6% at 50% confidence level.

Horizon Camera Reliability

Sample begins with J5 - 124,000

Estimated Reliability of Single Camera - 99.2% at 50% confidence level

Estimated Reliability of Four Horizon cameras at a Parallel Redundant System = 99.9% at 50% confidence level.

SECTION 10

SUMMARY DATA

The comparison of the operating parameters and the performance achieved by previous missions has been difficult due to the large volume of data that results from each mission. Some of the pertinent characteristics from prior missions have been summarized in Tables 10-1 through 10-3.

The summary data was started with Mission 1004 as the J-05 camera system was the first to incorporate the major modifications of the titanium drum and scan arm, four roller scan head and Corona J capabilities. Only thos missions that culminated in the recovery of some photography have been listed, therefore Missions 1003, 1005 and 1032 are deleted.

MISSION SUMMARY

MISSION NUMBER	PAYLOAD NUMBER	VEHICLE NUMBER	LAUNCH DATE	LAUNCH TIME	ORBIT INCLINATION (°)	PERIGEE ALTITUDE (NM)	PERIGEE LOCATION (°N)	RECOVERY PASS	MASTER CAMERA CAMERA NUMBER	MASTER CAMERA SLIT (°)	MASTER CAMERA FILTER TYPE	SLAVE CAMERA CAMERA NUMBER	SLAVE CAMERA SLIT (°)	SLAVE CAMERA FILTER TYPE	STELLAR-INDEX CAMERA NUMBER
1029	J-27	1623	2/2/66	2132 Z	75.1	99.5	22.5	81 / 160	178	0.275	W-25	179	0.175	W-21	D79/94/91 / D76/70/94
1030	J-29	1622	3/9/66	2202 Z	75.0	97.5	18.7	81 / 159	182	0.275	W-25	183	0.175	W-21	D94/100/107 / D82/195/102
1031	J-30	1627	4/7/66	2202 Z	75.1	104.5	23.3	113 / 177	184	0.225	W-23A	185	0.150	W-21	D83/101/89 / D86/106/86
1032	J-28	1625	5/3/66	1925 Z	—	—	—	— / —	180	0.150	W-21	181	0.150	W-21	D81/97/101 / D80/73/100
1033	J-33	1630	5/24/66	0213 Z	66.1	102.0	60.7	82 / 178	194	0.200	W-21	195	0.200	W-21	D91/105/109 / D84/102/75
1034	J-31	1626	6/21/66	2131 Z	80.1	105.4	18.2	81 / 161	186	0.200	W-23A	187	0.150	W-21	D85/109/76 / D87/107/105
1035	J-36	1628	9/20/66	2114 Z	85.0	99.5	29.1	81 / 160	188	0.225	W-23A	189	0.175	W-21	D95/112/113 / D96/104/116
1036	J-32	1631	8/9/66	2046 Z	100.0	102.4	22.9	115 / 212	190	0.200	W-23A	191	0.150	W-21	D89/110/111 / D88/108/10
1037	J-38	1632	11/8/66	1957 Z	100.0	91.8	14.5	66 / 197	198	0.225	W-23A	199	0.175	W-21	D101/128/128 / D106/136/13
1038	J-34	1629	1/14/67	2128 Z	80.1	96.9	29.2	81 / 193	192	0.225	W-23A	193	0.175	W-21	D93/86/112 / D90/111/10
1039	J-39	1635	2/22/67	2202 Z	80.0	97.0	30.2	81 / 177	206	0.225	W-23A	207	0.175	W-21	D103/131/132 / D100/125/12
1040	J-35	1636	3/30/67	1854 Z	85.1	99.7	28.3	81 / 145	196	0.175	W-21	197	0.225	W-23A	D78/95/96 / D92/79/110
1041	J-40	1634	5/9/67	2152 Z	85.1	100.1	33.0	93 / 215	208	0.225	W-23A	209	0.175	W-21	D105/134/133 / D102/127/12
1042	J-37	1633	6/16/67	2135 Z	80.0	96.5	29.1	97 / 240	204	0.200	W-23A	205	0.150	W-21	D97/120/117 / D98/121/11
1043	J-42	1637	8/7/67	2144 Z	80.0	102.1	16.3	113 / 240	200	0.200	W-23A	201	0.150	W-21	D107/135/135 / D112/143/13
1101	CR-1	1641	9/15/67	1941 Z	80.0	84.8	5.7	97 / 208	302	*	W-21 / W-23A	303	*	W-23A / W-25	DISIC NO. 3
1044	J-41	1639	11/2/67	2131 Z	81.5	98.9	18.4	97 / 144	202	0.225	W-23A	203	0.175	W-21	D99/122/120 / D104/132/131
1102	CR-2	1642	12/9/67	2226 Z	81.6	86.4	19.0	83 / 212	304	*	W-21 / SF05	305	*	W-25 / SF09	DISIC NO. 4
1045	J-45	1640	1/24/68	2226 Z	81.5	96.8	7.8	112 / 223	214	0.225	W-23A	215	0.175	W-21	D109/137/138 / D108/139/14
1046	J-48	1638	3/14/68	2200 Z	83.0	99.9	30.0	113 / 240	220	0.140**	W-23A	221	0.110**	W-21	D119/151/157 / D120/153/158

TABLE 10-1

**SO-230 FILM USED IN MISSION 1046.

* 300 SERIES INSTRUMENTS USE VARIABLE SLIT EXPOSURE CONTROL. REFER TO FINAL REPORT, SECTION 2.

REC/JOM 1/66

TOP SECRET C[redacted]

[redacted]

PERFORMANCE SUMMARY

MISSION NUMBER	CAMERA	SERIAL NUMBER	M.I.P. VALUE	AFSPPF MTF/AIM AVERAGE (INTERIM)	AFSPPF MTF/AIM SLIT (μ)	AFSPPF MTF/AIM AVERAGE (STANDARD)	90% ATTITUDE ERROR (°) PITCH	90% ATTITUDE ERROR (°) ROLL	90% ATTITUDE ERROR (°) YAW	90% ATTITUDE RATES (°/HR.) PITCH	90% ATTITUDE RATES (°/HR.) ROLL	90% ATTITUDE RATES (°/HR.) YAW	90% V/H ERROR (%)	90% RESOLUTION LIMIT (FEET) ALONG TRACK	90% RESOLUTION LIMIT (FEET) CROSS TRACK	I.M.C. ERROR
1045-1	FWD	214 / 215	90	68	80	—	0.23	0.47	0.26	20.3	27.1	25.8	3.5	4.0	1.0	3.4
	AFT			72			0.26	0.45	0.26	21.0	24.9	24.3	3.5	3.4	0.7	3.8
1045-2	FWD		90	68			0.42	0.25	0.63	25.2	37.9	28.8	2.6	3.2	2.1	2.7
	AFT			72			0.45	0.23	0.60	26.5	35.3	29.0	4.0	4.2	1.1	4.4
1046-1	FWD	220 / 221	90	87	80	—	0.21	0.52	0.88	44.3	18.0	24.0	2.2	1.8	1.4	2.3
	AFT			86			0.23	0.54	0.90	44.8	16.4	21.2	1.7	1.1	0.9	1.9
1046-2	FWD		85	70			0.26	0.15	0.78	47.3	17.6	19.2	1.8	1.7	1.2	2.2
	AFT			84			0.29	0.15	0.78	40.4	14.9	18.0	1.7	1.1	0.8	1.8

TABLE 10-2

REC/JOM
8/67

ESTIMATED RELIABILITY SUMMARY

(AT 50% CONFIDENCE LEVEL)

MISSION NUMBER	PRIMARY FUNCTIONS: PANORAMIC CAMERA — SAMPLE	FAILURES	RELIABILITY	PANORAMIC CAMERA DOORS — SAMPLE	FAILURES	RELIABILITY	COMMAND & CONTROL SYSTEM — SAMPLE	FAILURES	RELIABILITY	PAYLOAD CLOCK — SAMPLE	FAILURES	RELIABILITY	ON-ORBIT FUNCTIONS — RELIABILITY	RECOVERY SYSTEM — SAMPLE	FAILURES	RELIABILITY	SECONDARY FUNCTIONS: STELLAR-INDEX CAMERAS — SAMPLE	FAILURES	RELIABILITY	HORIZON CAMERAS — SAMPLE	FAILURES	RELIABILITY
1101	191	2	98.6	122	0	99.4	11,208	2	** 96.1	11,208	0	** 98.9	** 96.5	87	1	98.1	12,965	0	* 77.2	112,000	0	99.1
1044	195	2	98.6	124	0	99.5	11,424	2	96.1	11,424	0	99.0	96.5	89	1	98.2	28,480	4	93.3	115,000	0	99.[redacted]
1102	199	2	98.7	126	0	99.5	11,736	2	96.2	11,736	0	99.0	96.6	91	1	98.3	17,765	1	* 63.5	118,000	0	99.[redacted]
1045	203	2	98.7	128	0	99.5	12,072	2	96.3	12,072	0	99.0	96.8	93	1	98.4	29,330	4	93.5	121,000	0	99.[redacted]
1046	207	2	98.7	130	0	99.5	12,432	2	96.4	12,432	0	99.1	96.8	95	1	98.2	30,180	4	93.6	124,000	0	99.[redacted]

TABLE 10-3

** CALCULATIONS ADJUSTED TO NOMINAL 14-DAY MISSION STANDARD

* DISIC REPLACES S/I CAMERAS ON 1100 SERIES SYSTEMS