CORONA J

PERFORMANCE EVALUATION REPORT

MISSION 1111-1 AND 1111-2

FTV 1654, CR-12

Approved [redacted] Manager
Advanced Projects

Approved [redacted] Manager
Program [redacted]

[redacted]

[redacted]

18 November 1970

To: [redacted]

Thru:

From:

Subject: MISSION 1111 FINAL REPORT (CR-12)

Enclosed is the final evaluation report for Mission 1111.

[redacted] Manager
Advanced Projects

IF ENCL... CLASSIFICATION
OF THIS ... Unclassified

[redacted]

FOREWORD

This report details the performance of the payload system during the operational phase of the Program [redacted] Flight Test Vehicle 1654.

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 1111 which was launched on 23 July 1970.

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INTRODUCTION

This report presents the final performance evaluation of Corona Mission 1111. The purpose of this report is to define the performance characteristics of the CR-12 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 Air Force Special Projects Production Facility. The processing Summary report and Ground Density measurements are provided by [redacted]

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

SECTION 1

MISSION SUMMARY

A. MISSION DESCRIPTION

Corona Satellite Mission 1111 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 1360 square miles.

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

The payload was a J-3 configuration, consisting of a space structure containing two panoramic cameras and associated control/support equipment and recovery subsystems for each mission segment. In addition, a DISIC Stellar-Terrain camera was incorporated as part of the overall flight system.

The flight system was launched into the planned orbit from Vandenberg AFB at 01:25 GMT on 23 July 1970.

The panoramic cameras operated throughout both mission segments. Both cameras demonstrated acceptable operation during Missions 1111-1 and -2 until film depletion.

Mission 1111-1 was successfully completed, after 7 days of flight, with an air-catch of the recovery capsule. The second mission segment was similarly terminated after 12 days of orbital flight.

Photographic performance of the panoramic cameras varied from good to fair. An MIP of 105 was assigned to Mission 1111-1 and an MIP of 105 was assigned to 1111-2. Various CORN targets were acquired on this mission and are discussed in Section 4.

B FLIGHT CONFIGURATION

Mission No.	1111
Vehicle No.	1654
System No.	CR-12
Forward Looking Camera Serial No.	325
DISIC Camera Serial No.	2R
Lens Data	
Forward Looking Camera (Main Lens)	
Lens Serial No.	I-213
Measured Slit Width (Inches)	
Position 1	0.131
Position 2	0.176
Position 3	0.234
Position 4	0.287
Failsafe	0.189
Optics Filter Type	
Primary	W-25 Gel 4 Mils
Alternate	W-25 Glass 7 Mils
E.O. Focal Length (Inches) (Vacuum)	.0027

Resolution	
Static (Lines/Millimeter)	
Filter	W-25
High Contrast	N/A
Low Contrast	201
Dynamic (Lines/Millimeter)	
ITEK Post-Vibration	
Filter	W-25
High Contrast	285
Low Contrast	185
A/P Test	
Filter	W-25
High Contrast	266
Low Contrast	192
Distortion/Pincushion (Microns)	
Angle Off Axis (Deg.)	
3	2
2	1
1	0
0	0
359	0
358	2
357	3

Aft Looking Camera (Main Lens)	
Lens Serial No.	I-184
Optics Slit Width (Inches)	
Position 1	0.080
Position 2	0.110
Position 3	0.155
Position 4	0.195
Failsafe	0.135
Optics Filter Type	
Primary	W-21 Gel 4 Mils
Alternate	W-21 Glass 7 Mils
E.O. Focal Length (Inches)(Vacuum)	.0035
Resolution (Lines/MM)	
Static	
Filter	W-21
High Contrast	N/A
Low Contrast	158
Dynamic (Lines/MM)	
ITEK Post-Vibration	
Filter	W-21
High Contrast	253
Low Contrast	139
A/P Test	
Filter	W-21
High Contrast	243
Low Contrast	120

Distortion/Pincushion (Microns)

Angle Off Axis (Deg.)	
3	1
2	0
1	0
0	0
359	0
358	2
357	5

Horizon Optics

Forward Looking Camera

Take-up (Starboard)

Lens Serial No.	40784
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	0.03
Tangential Distortion	0.012

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	187	186	184	113	124	106	25
(Tangential)	166	164	144	98	93	61	35

Supply (Port)

Lens Serial No. 40794

Exposure Time (Sec.) 1/100

Aperture F/6.3

Filter Type W-25

Oper. Focal Length (MM) 55.0

Radial Distortion (MM)

10 Deg. Off Axis 0.00

20 Deg. Off Axis 0.03

Tangential Distortio n 0.012

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	187	186	163	160	156	119	25
(Tangential)	166	164	161	138	116	109	49

Aft Looking Camera

Take-up (Port)

Lens Serial No. 23771

Exposure Time (Sec.) 1/100

Aperture F/6.3

Filter Type W-25

Oper. Focal Length (MM) 55.0

Radial Distortion (MM)

10 Deg. Off Axis 0.005

20 Deg. Off Axis 0.03

Tangential Distortion 0.025

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	187	165	163	143	124	95	25
(Tangential)	187	147	128	123	93	86	55

Supply (Starboard)

Lens Serial No.	40777
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	0.018

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	166	186	184	100	139	119	29
(Tangential)	166	147	144	138	103	96	55

DISIC Camera

Port Stellar Camera

Lens Serial No.	5P
Reseau Serial No.	5P
Aperture	F/2.8
Exposure Time (Sec.)	1.5
Nominal Focal Length (In.)	3
Filter	None

Starboard Stellar Camera

Lens Serial No.	5
Reseau Serial No.	5
Aperture	F/2.8
Exposure Time (Sec.)	1.5
Nominal Focal Length (In.)	3
Filter	None

Terrain Camera

Lens Serial No.	111		
Reseau Serial No.	111		
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	102	100	108
Tangential	102	96	75
Film Type	3400		
Filter	W-12		

Film Types

Forward Looking Camera

Split Load	No
Film Type	3414
Length (Ft.)	16300
Splices	3
Length Between Splices (Ft.)	2795-4455-4580-4470
Emulsion Data	8-62-70
Payload Weight (Lbs.)	80.1
Spool No.	68AT
Box Serial No.	38

Aft Looking Camera

Split Load	No
Film Type	3414
Length (Ft.)	16300
Splices	4
Length Between Splices (Ft.)	2000-3545-4455-4585-1715
Emulsion Data	8-62-7-0
Payload Weight (Lbs.)	80.6
Spool No.	172B
Box Serial No.	38

DISIC Camera

Stellar Camera

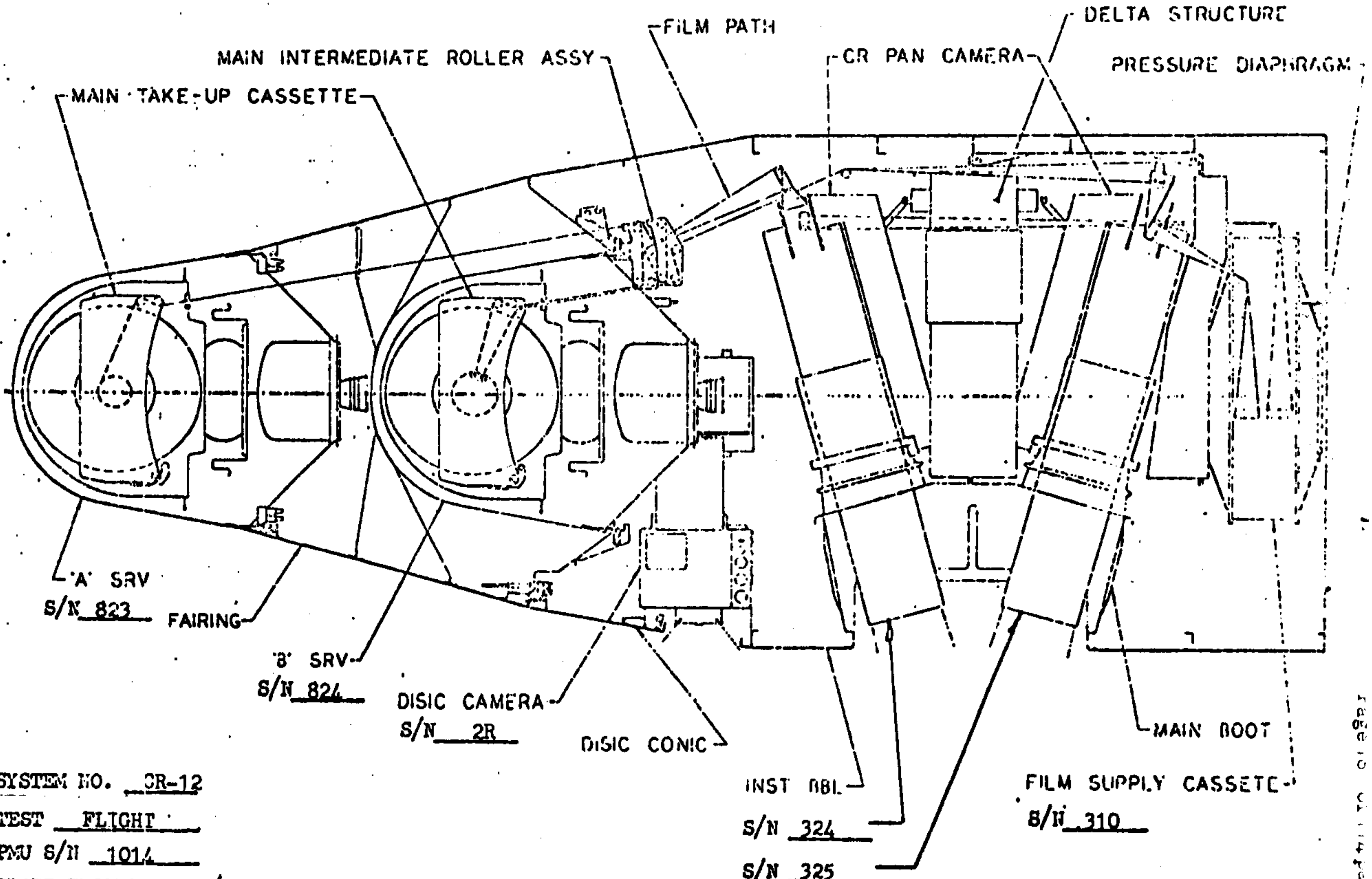
Split Load	No
Film Type	3401
Length (Ft.)	2000
Splices	None
Length Between Splices (Ft.)	None
Emulsion Data	349-8-5-0
Payload Weight (Lbs.)	5.3

Terrain Camera

Split Load	No
Film Type	3400
Length (Ft.)	2200
Splices	None
Length Between Splices (Ft.)	None
Emulsion Data	223-1-5-0
Total Film Weight (Lbs.)	20.2

CR-12

PAYLOAD PROFILE AND SERIAL NUMBERS



SYSTEM NO. CR-12

TEST FLIGHT

PMU S/N 1014

SLOPE PROGRAMMER S/N 200

CLOCK S/N 625

SWITCH PROGRAMMER S/N 211

FIGURE 1-1

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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 <u>thermal/altitude</u> environment that approximates flight conditions.
2. A <u>system light leak test</u> that ascertains the light tight integrity of the J system.
3. A <u>dynamic resolution test</u> that determines the high and low contrast resolution characteristics of each panoramic camera. Also an AGT - Aschenbrenner grid test for film lift determination.
4. A <u>flight readiness test</u> that assures that the payload is acceptable prior to loading with flight film.
5. A <u>flight certification</u> that establishes the flight worthiness of the complete payload including the flight film.

The CR-12 system successfully passed all phases of the testing operations providing acceptable performance and a high degree of operational confidence.

B. ENVIRONMENTAL TEST

The CR-12 system was subjected to environmental testing from 15 thru 22 December 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. The pan cameras were configured for AGT testing.

The system was subjected to internal system pressures at altitude that ranged between 1 and 80 microns by programmed On and Off use of the Gas Pressure Make-Up system. One special pressure sweep that occurred during the "B" SRV portion of the test extended the internal camera pressure range of the panoramic cameras during operation to approximately 104 microns.

The panoramic camera payload (film type SO-380 UTB) was processed to the intermediate level prior to analysis.

The CR-12 system operations during the altitude test produced the following film consumption:

Test-Film Consumption (Cycle Counter)

Operation	Panoramic Camera No.	
	324 (#1)	325 (#2)
A SRV Frames	4121	4120
B SRV Frames	4359	4357
Total Frames	8480	8477

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

Preliminary Dr. A analysis indicated that there was unacceptable film lift on some frames of Instrument #324 film. However the camera was recalibrated, and subsequent AGT testing indicated conditions were acceptable.

Auxiliary data recording was acceptable. Visual analysis of film from panoramic cameras #324 and #325 revealed that imagery of the serial number, time track, H.O. fiducials, start of pass mark, PG traces, and rail holes were acceptable. Microdensitometer measurements revealed that imagery of the time word from both main cameras was acceptable.

Evaluation of telemetry data indicated system performance as follows: (all anomalies were corrected or bought off as acceptable prior to flight.)

Evaluation of the telemetry data indicated that No. 1 camera performance was satisfactory. All start-up, shutdown and transport functions were normal. The No. 2 camera had reduced tension at shutdown, failed to stow on numerous occasions, had uneven film motion after unclamp, experienced a marginal cut and wrap with a loose wrap on the -2 take-up, and had a 12-15 H_z signal on the motor voltages intermittently throughout the test. The start-up and shut-down times were out of spec. The cycle periods for both instruments were unacceptable using the latest slope programmer calibration data. Evaluation of the programmer performance indicated a short circuit in the FMC return during the first 6 revs of the test and a shift in the eccentricity programmer period from the calibrated value of 3591 to 3620 seconds. All cycle period data for the first 6 revs were discarded and the programmer period input was changed to 3620 seconds. This resulted in cycle periods within ± 1% which is acceptable.

The DISIC operation was normal. However the Terrain shutter monitor failed to function and the Stellar film idler was noisy. The A to B transfer (KZ-39) command was normal with all transfer functions occurring as programmed. The DISIC Terrain and Stellar film had a minimal amount of unacceptable corona marking. DISIC corona marking was accepted on a waiver by the user.

All timer start and delay functions were normal.

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

The PMU operation was normal, however the "A" and "C" timers were set incorrectly resulting in an operating pressure of 82 microns. The consumption rate was 8.2 psi/min.

The clock accuracy test indicated the clock lost 0.071 seconds during a 4-day period, which was out of tolerance. The clock was subsequently replaced and functioned normally.

The instrumentation system performance was normal.

The command system was normal except once during the negative checks in rev 8B. The A/P Data Enable command caused the DSR to execute, resulting in an instrument operate. The DSR was reloaded. This condition was traced to a mispatch in the GSE patchboard and was subsequently repatched.

The SRV tape recorder performed satisfactorily with the exception of Digital Data 1 on track 5 of the SRV-A recorder which was unusable because of excessive noise and a higher loss of sync rate than with previous recorders tested.

The cut and wrap sequence resulted in severe damage to the film of both instruments. This was attributed to the system vertical position and UTB film. The sequence of events, timer events, and transfer functions were normal.

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

C. LIGHT LEAK TEST

The CR-12 system was tested for light leaks on 13 July 1970. Both instruments were threaded with film type 3401, placed in flight configuration, and exposed to external illumination for 90 minutes per side. At the conclusion of the test the film was retrieved, processed to full level, and evaluated. Results were acceptable.

D. RESOLUTION TEST/AGT

Resolution Testing

The CR-12 system was subjected to through focus dynamic resolution testing for the originally planned use of UTB film for flight, 3404 film, and for the now assigned 3414 film.

The sequence and results of resolution testing are presented in the following Table 2-1, and further substantiated in the graphical presentations in Figures 2-1 through 2-6.

TABLE 2-1

CR-12 RESOLUTION TESTING

Inst. #	Date	Film Type	Max. Low Contrast Reso. Focal Pos.	L/MM	Results
324	1-31-70	SO-380	-.0015	130	Acceptable
325	1-31-70	SO-380	-.0005	188	Acceptable
324	3-18-70	3404	-.0015	126	Acceptable
325	3-18-70	3404	-.001	187	Acceptable
324	6-16-70	3414	0.000	120	Acceptable
325	6-16-70	3414	0.000	192	Acceptable

AGT - Aschenbrenner Grid Test

The CR-12 system was subjected to AG Tests on 10 and 15 June 1970. The tests consisted of at least 24 cycles of usable material from each camera. Film type 3414 was used throughout the test. The cycle rate was set at 3 seconds per cycle.

A representative format from each camera was evaluated for film lift relative to the scan head rollers. Eighty-one points throughout the usable portion of each format were sampled for film lift. Figure 2-7 presents an AGT orientation sketch for the lift points selected. The resulting film lift measurements in inches (mils) above the scan rollers are shown in the attached table and graphical plots, Figures 2-8 and 2-9.

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

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

E. FLIGHT READINESS TEST

The CR-12 Flight Readiness test was conducted on 10 July 1970. All information on the processed DISIC Terrain and Stellar film was present and satisfactory. Both processed and unprocessed film were free of scratches.

Rail scratches on both Panoramic instruments were heavier than customary. The SLP on Inst. 324 had 4 marginally acceptable bits.

The CR-12 cam/slit sequence and slit width values were verified as part of the first Readiness test. Evaluation of the processed 3414 film revealed that the exposure cams do provide exposure slit widths in the correct sequence.

Measurements of processed slit images revealed the following slit values:

TABLE 2-2 SLIT WIDTH (INCHES)

Slit No.	Camera 324 AFT		Camera 325 FWD	
	Requested	Actual	Requested	Actual
1	.083	.075	.132	.120
2	.114	.079	.176	.166
3	.154	.145	.235	.255
4	.202	.189	.314	.295
Failsafe	.123	.132	.190	.188

It was recommended that the system be prepared for flight.

F. FLIGHT CERTIFICATION

Flight film loading of the CR-12 Panoramic Cameras occurred 17 July 1970. Sensitometric examination of samples of the flight film verified satisfactory photographic characteristics.

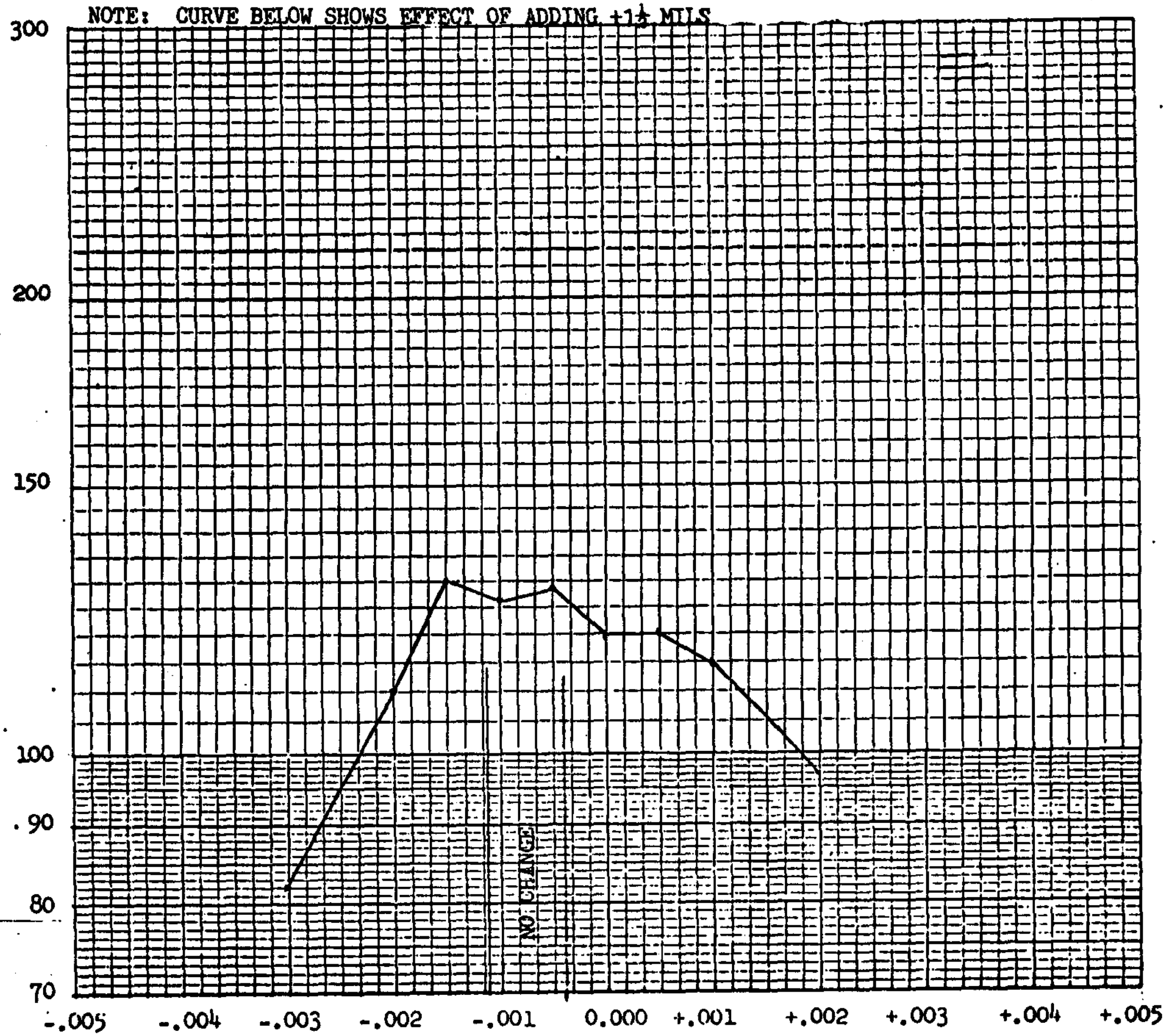
The confidence run, to certify the CR-12 system for flight, was conducted on 20 July 1970. Rail scratches were continuous but very heavy on the emulsion side of both panoramic payloads. More than 14 fine continuous scratches were present on the backing side of the film installed in Instrument #325.

The CR-12 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-12 system was accepted for flight on 21 July 1970.

PRE-FLIGHT DYNAMIC RES- TION

NOTE: CURVE BELOW SHOWS EFFECT OF ADDING +1½ MILS



PHOTOGRAPHIC RESOLUTION (Lines per Millimeter)

THROUGH FOCUS INCREMENTS (Inches)

Camera No. 324

Payload No. CR-12

Filter W-21

Resolution (1/mm)

High Contrast: -

Low Contrast: 2/1

Film Type: SO-380 UTB

Test Date: 1-31-70

Prepared By: [redacted]

Date: 1-31-70

TOP SECRET/C

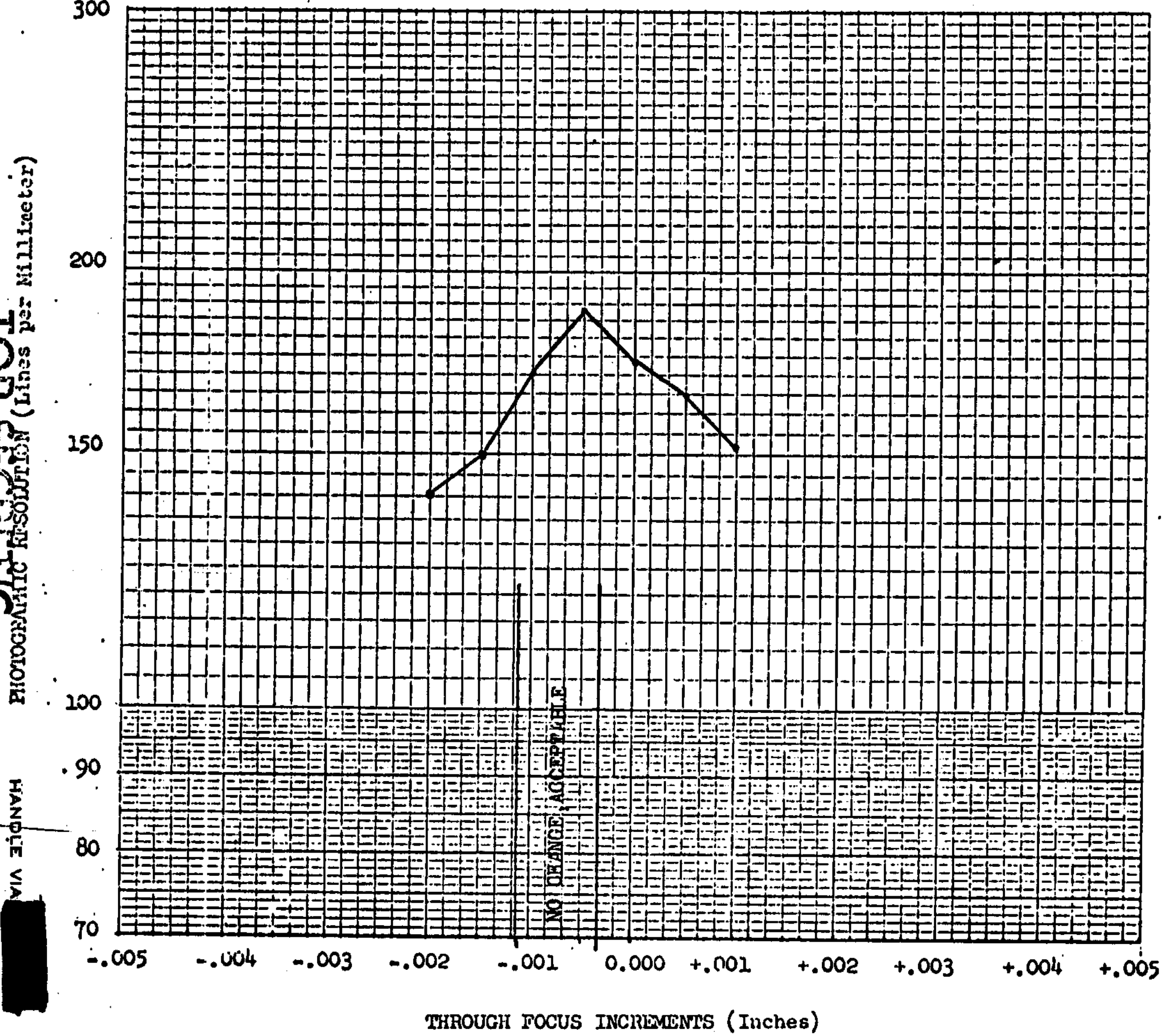


FIGURE 2-2

Camera No. 325
Filter W-23
Payload No. CR-12

Resolution (1/mm)

High Contrast: -

Low Contrast: 2/1

Film Type: SO-380 U

Test Date: 1-30-70

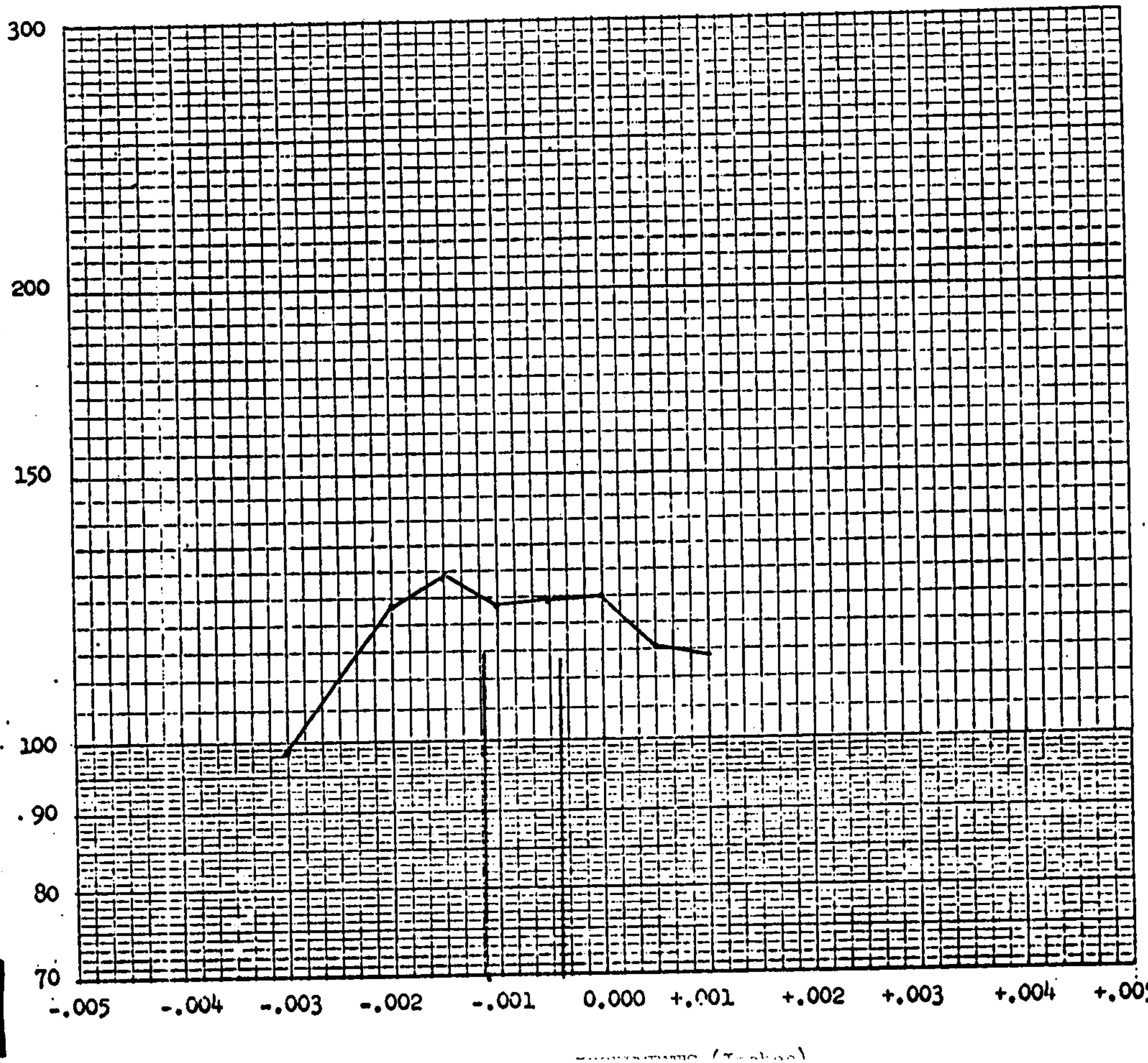
Prepared By: [redacted]

Date: 1-30-70

TOP SECRET/C

HANDLE VIA [redacted] CONTROL SYSTEM ONLY

PRE-FLIGHT DYNAMIC RESO[L]UTION



Camera No. 324

Payload No. CR-12

Resolution (1/mm)

High Contrast: -

Low Contrast: 2/

Film Type: 3404

Test Date: 3-17-70 [redacted]

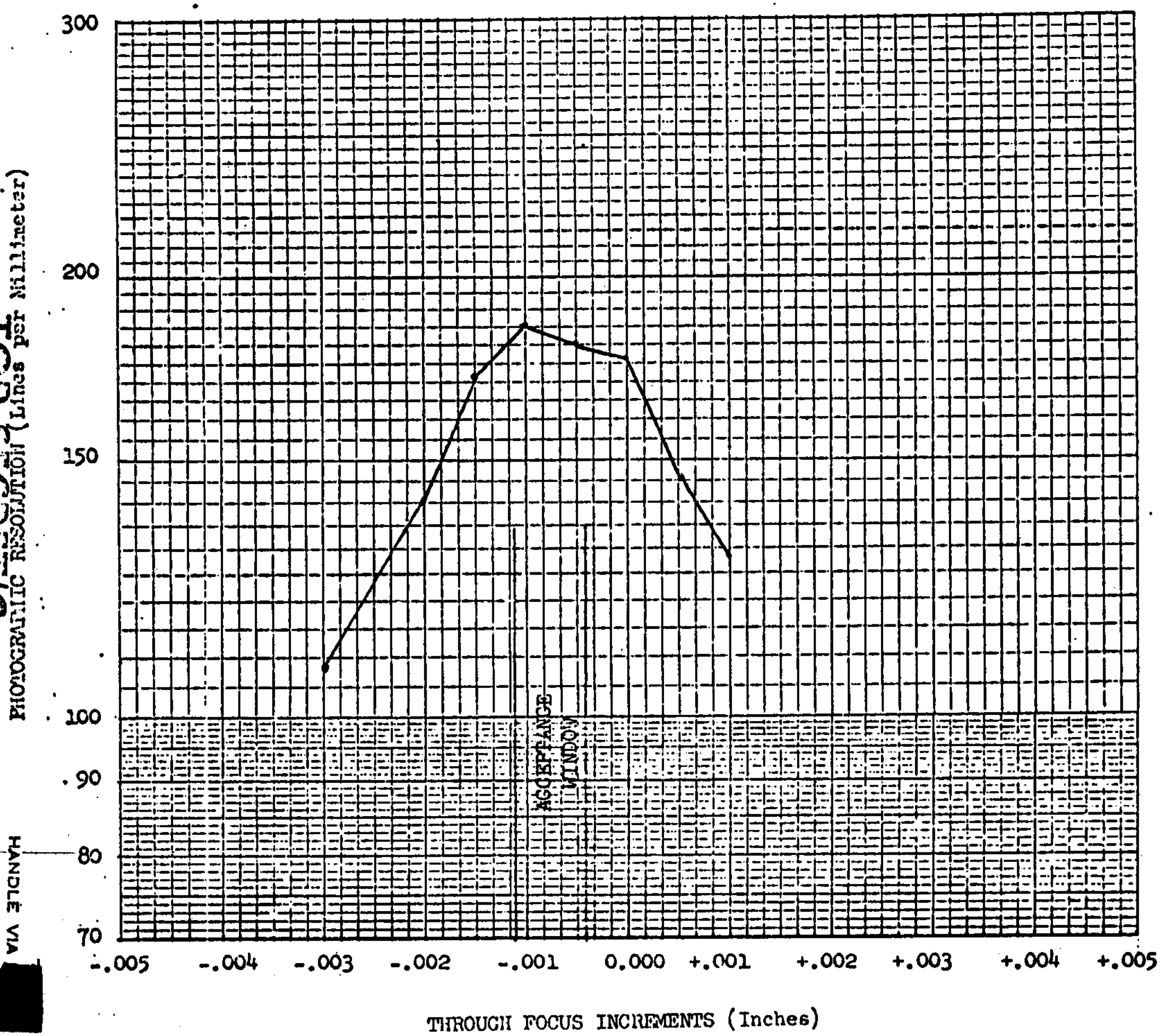
Prepared By: [redacted]

Date: 3-18-70

TOP SECRET/C

HANDLE VIA [redacted] CONTROL SYSTEM ONL

PRE-FLIGHT DYNAMIC RESC TION



Camera No. 325

Payload No. CR-12

Resolution (1/mm)

High Contrast: N

Low Contrast: 2/

Film Type: 3404

Test Date: 3-16-70

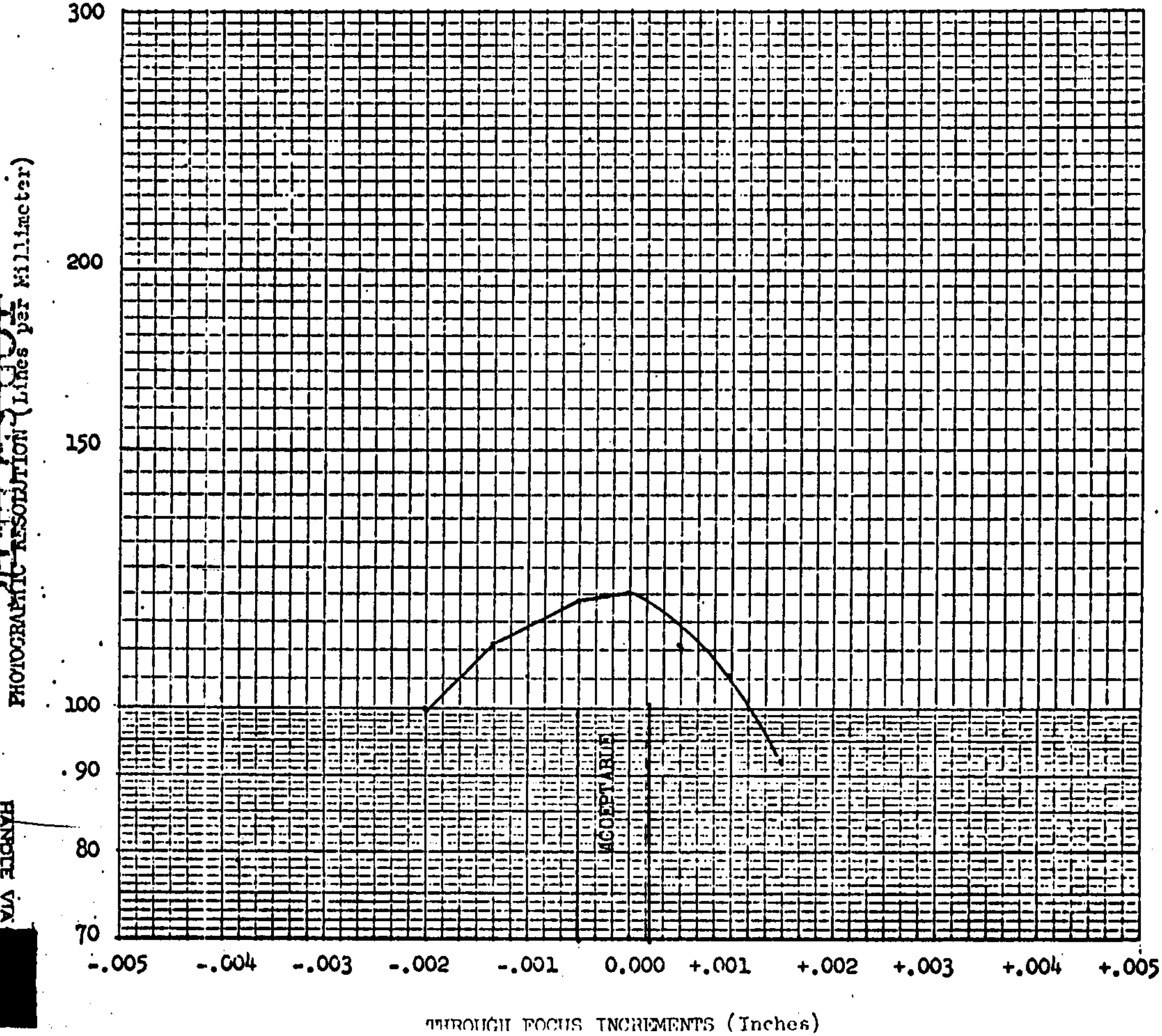
Prepared By [redacted]

Date: 3-16-70

TOP SECRET/C

HANDLE VIA [redacted]
CONTROL SYSTEM C

PRE-FLIGHT DYNAMIC RESC TION



Camera No. 324

Payload No. CR-12

Resolution (1/mm)

High Contrast: -

Low Contrast: 2/1

Film Type: 3414

Test Date: 6-16-70

Prepared By: [redacted]

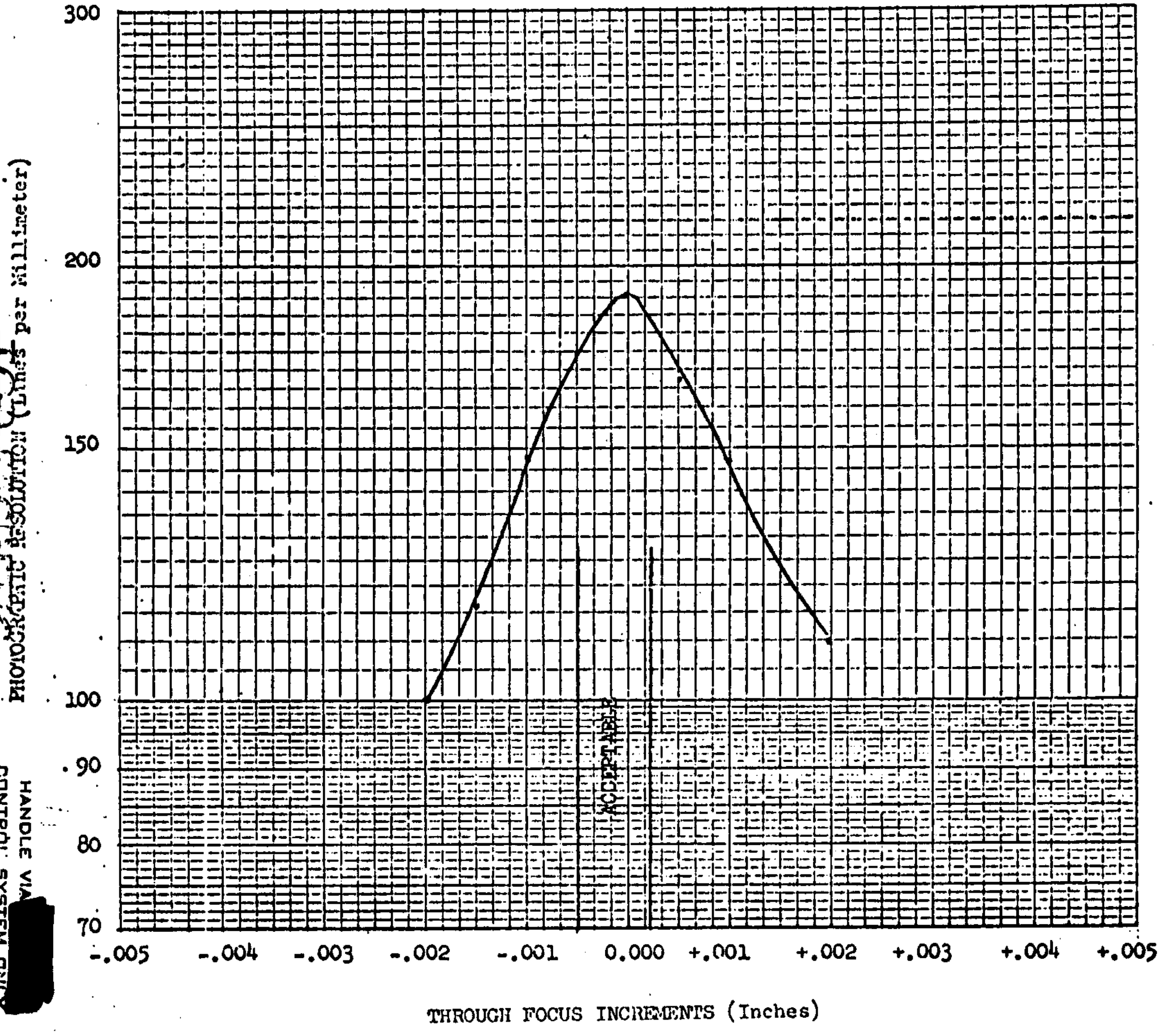
Date: 6-16-70

Process #3677

TOP SECRET/C

HANDLE VIA [redacted] CONTROL SYSTEM ONLY

PRE-FLIGHT DYNAMIC RESO[illegible]TION



Camera No. 325

Payload No. CR-12

Resolution (1/mm)

High Contrast: -

Low Contrast: 2/1

Film Type: 3414

Test Date: 6-16-70

Prepared By: [redacted]

Date: 6-16-70

Process #3677

TOP SECRET

HANDLE VIA [redacted] CONTROL SYSTEM ONLY

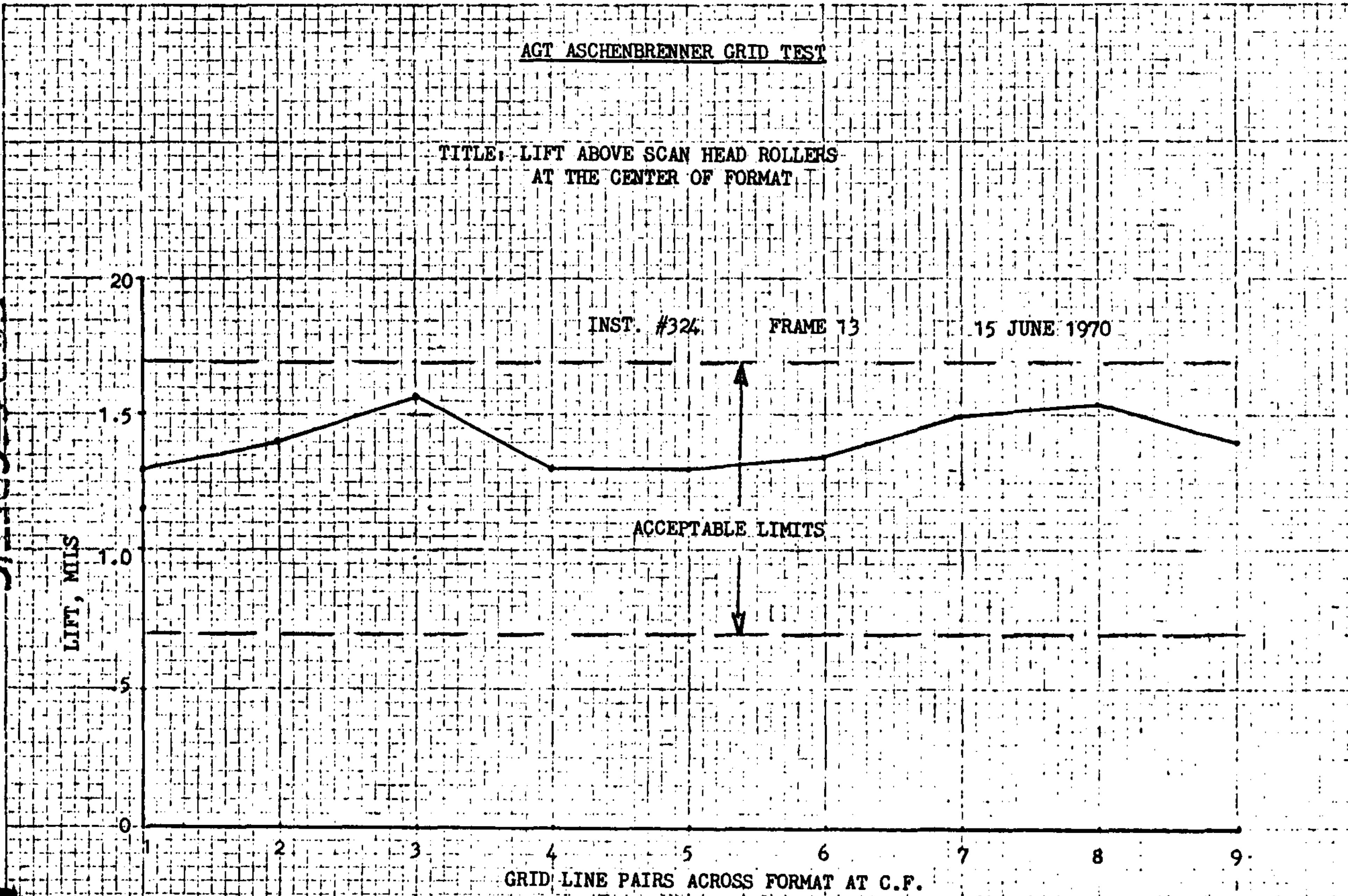

AGT ASCHENBRENNER GRID TEST
TITLE: LIFT ABOVE SCAN HEAD ROLLERS
AT THE CENTER OF FORMAT
INST. #324
FRAME 13
15 JUNE 1970
ACCEPTABLE LIMITS
LIFT, MILS
20
1.5
1.0
.5
0
1
2
3
4
5
6
7
8
9
GRID LINE PAIRS ACROSS FORMAT AT C.F.

FIGURE 2-9

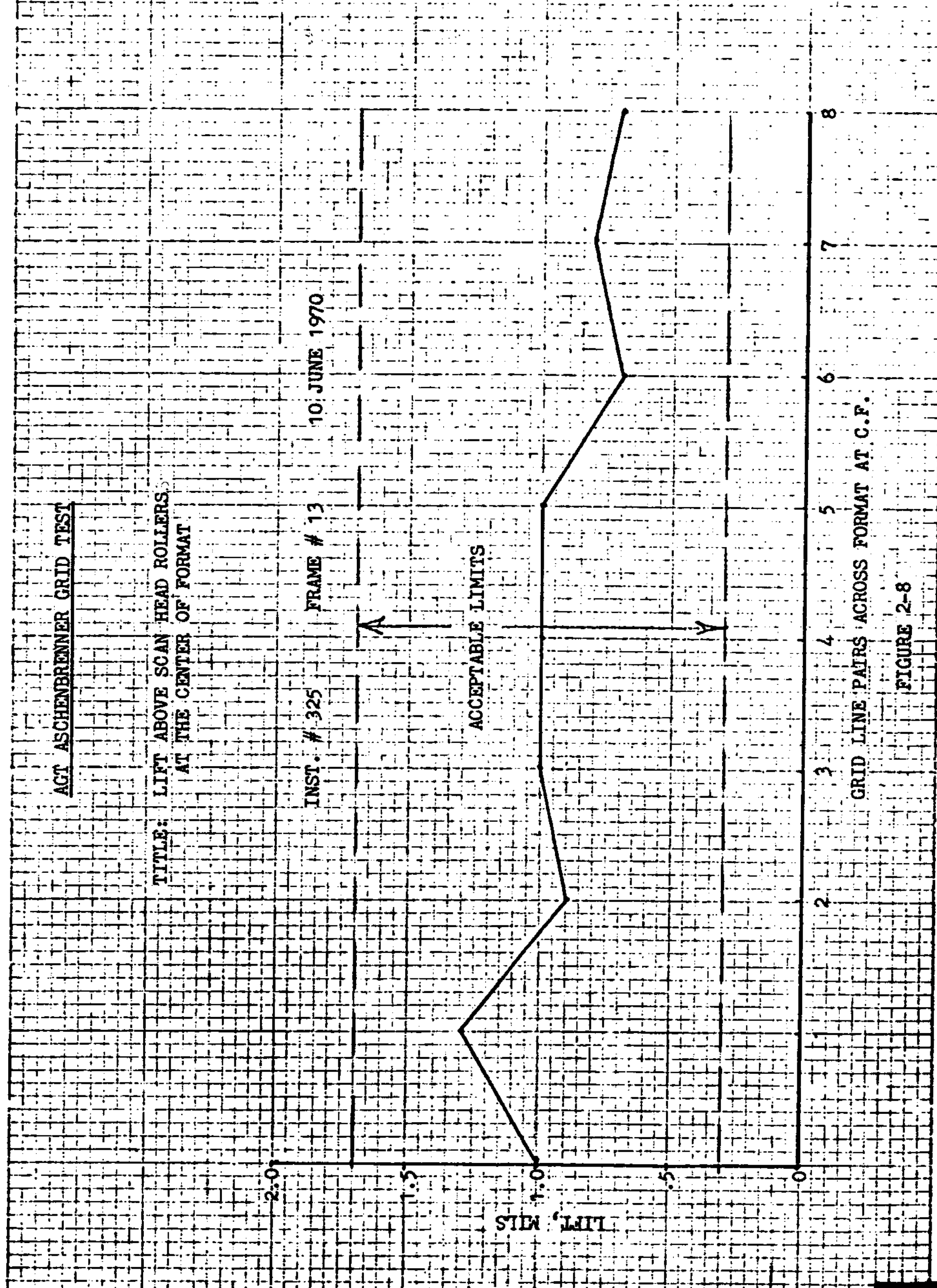
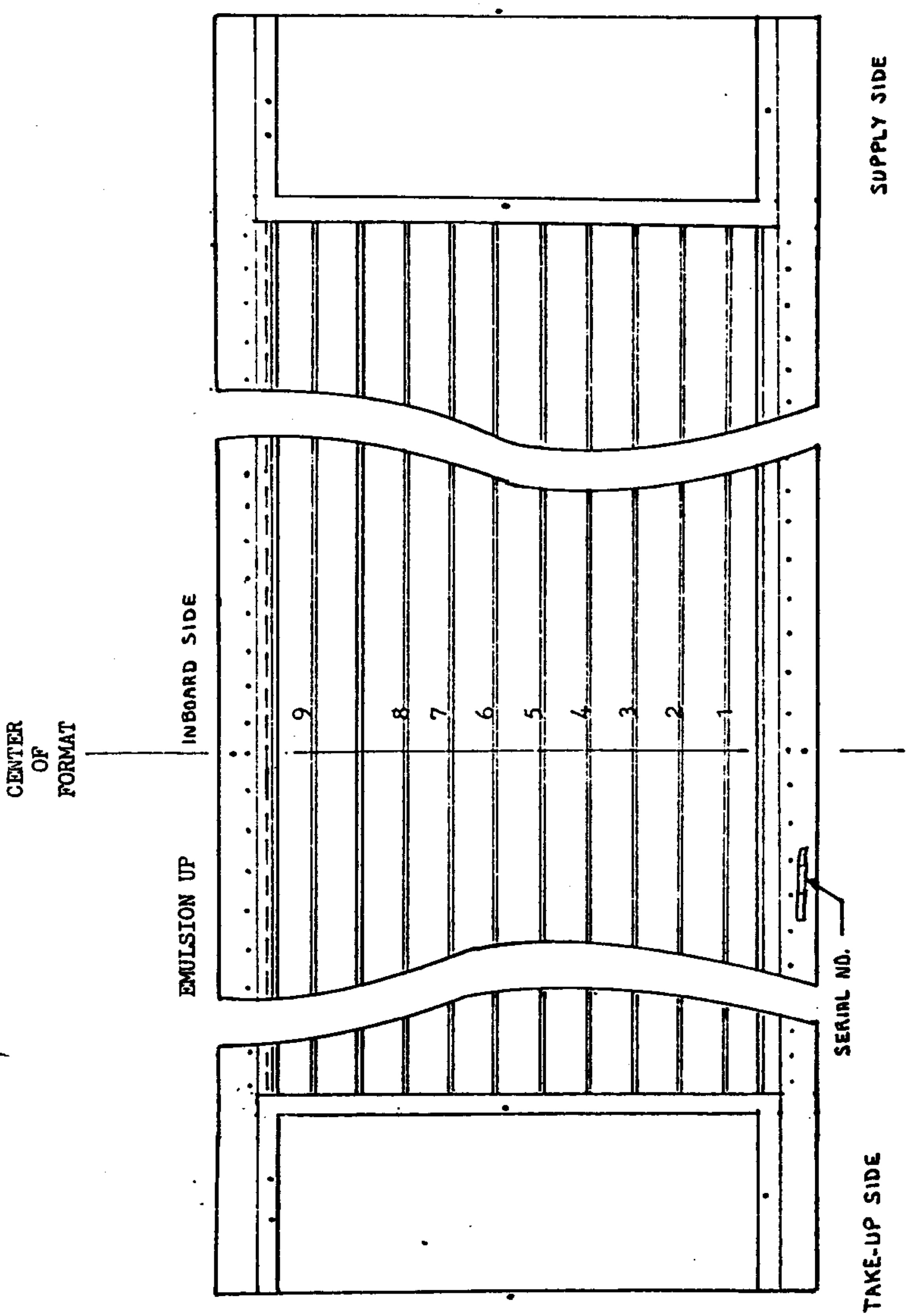

AGT ASCHENBRENNER GRID TEST
TITLE: LIFT ABOVE SCAN HEAD ROLLERS AT THE CENTER OF FORMAT
INST. # 325
FRAME # 13
10 JUNE 1970
ACCEPTABLE LIMITS
LIFT, MILS
2.0
1.5
1.0
.5
0
1
2
3
4
5
6
7
8
GRID LINE PAIRS ACROSS FORMAT AT C.F.

FIGURE 2-8



AGT ORIENTATION SKETCH

FIGURE 2-7

SECTION 3

FLIGHT OPERATIONS

A. SUMMARY

Mission 1111 was launched normally into the planned orbit without incident. All ascent and injection events occurred as programmed. The orbit achieved was within the 3 sigma predicted dispersions. The total mission lasted for 19 days with a 7-day first segment and a 12-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 fair to good. The DISIC camera operated properly throughout the -1 and -2 missions.

B. LAUNCH

The flight was launched at 01:25 GMT on 23 July 1970 from Satellite Launch complex 3 west at Vandenberg AFB.

Mission 1111 was composed of Thorad booster (SLV-2H) S/N 69-046, Agena vehicle 1654, and payload system CR-12. The CR-12 payload system contained panoramic cameras S/N 324 and 325 and DISIC camera S/N 2R.

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 1111 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 1111 Orbit Paremeters (Rev. 2)

Orbital Parameters

Parameter	Predicted	Tolerance	Actual STC	Actual APF
Period (Min.)	89.90	+0.38,-0.37	89.84	89.85
Perigee (N.M.)	88.7	+18,-13	88.8	88.6
Apogee (N.M.)	217.9	+14,-20	215.1	215.9
Eccentricity	0.0180	+0.0030,-0.0044	0.0166	0.0175
Inclination (Deg)	60.00	+0.11,-0.10	59.98	60.02
Argument of Perigee (Deg)	110	+19,-16	106.5	106
Regression Rate (Deg/Rev)	22.81	----	22.79	22.82

DMU Operation

Seven DMU rockets were utilized for period control throughout the flight to maintain the ground track and period control. Ground track error ranged between 7.5 nautical miles west to 45 nautical miles east of the nominal track at the equator. DMU No. 5 was retrofired to achieve a desired ground track 138 nautical miles east of the nominal. The DMU firings were satisfactory for attaining mission objectives.

Table 3-2 is a summary of the DMU firings that occurred during Mission 1111.

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	6	37319	16.40	25.70	88.84	3514
2	79	85901	14.76	23.10	89.89	3166
3	151	42750	16.00	25.10	89.89	3073
4	215	43270	16.10	25.23	89.92	3074
5*	282	59228	-16.40	-25.70	89.92	3120
6*	310	35967	18.44	28.83	89.49	3012
7*	315	64264	18.13	27.99	89.78	2954

*DMU rockets 5, 6, and 7 were fired after the -2 recover.

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

D. PANORAMIC CAMERAS

Both panoramic cameras exhibited normal film transport characteristics and except for one anomaly, operated satisfactorily throughout the flight.

The aft looking panoramic camera S/N 324 failed to stow at the normal position during revs 69 through 88 in the -1 mission and from rev 149 throughout the remainder of the -2 mission. Telemetry from engineering passes verified the camera stowed near the center of format. An analysis of the shut-down circuit indicates a probable malfunction of the stow switch. The mission performance evaluation letter reported a binary bit image anomaly on the second from last frame of each camera S/N 324 operation following rev 214. An analysis of the DDSC indicates that if the C/F switch remains actuated following shut-down, the SLP data head will re-image at the next start-up. The SRV tape recorder data confirmed the double clock interrogate during the periods of stow malfunction.

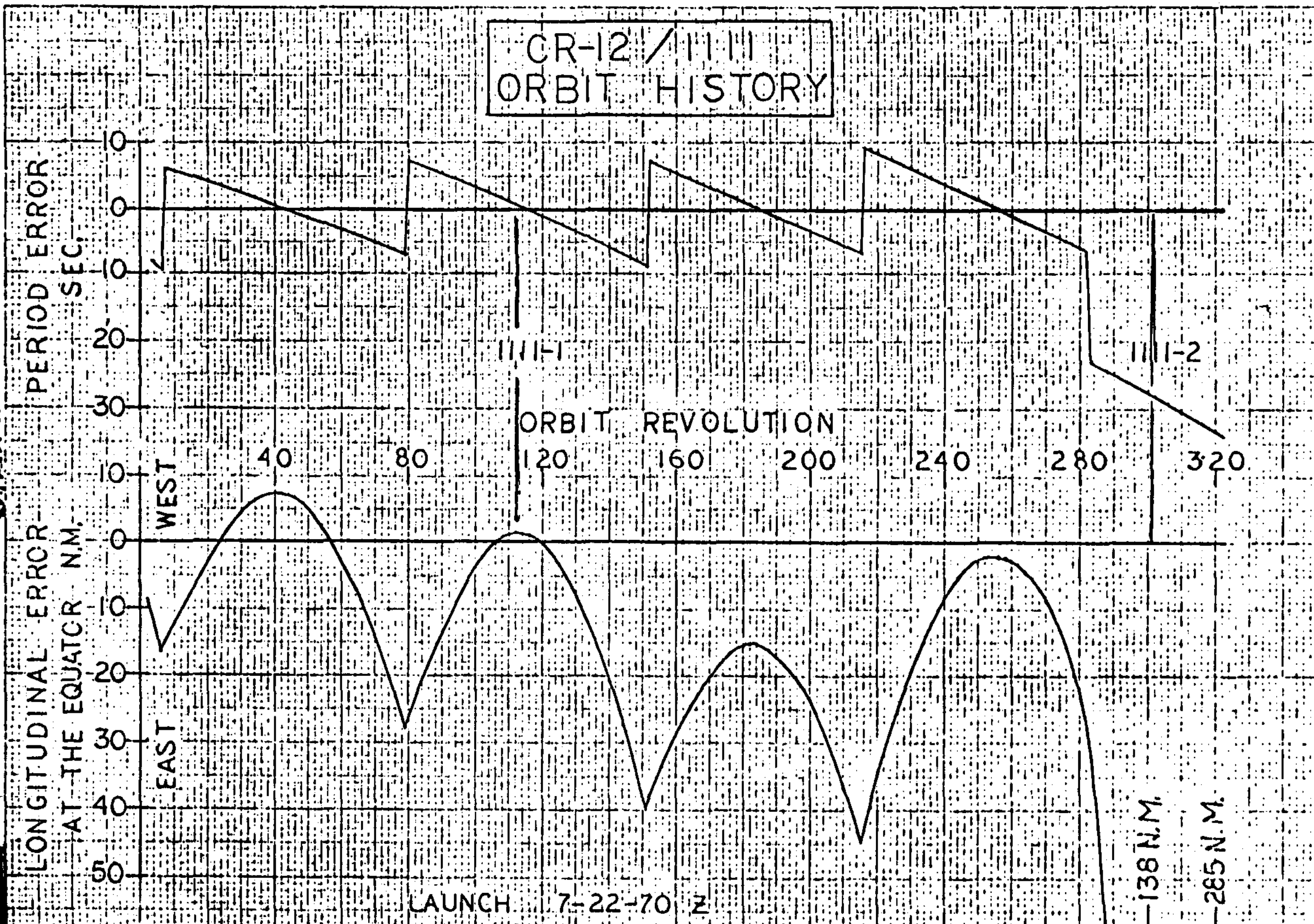


FIGURE 3-1

TOP SECRET/C

HANDLE VIA [redacted]

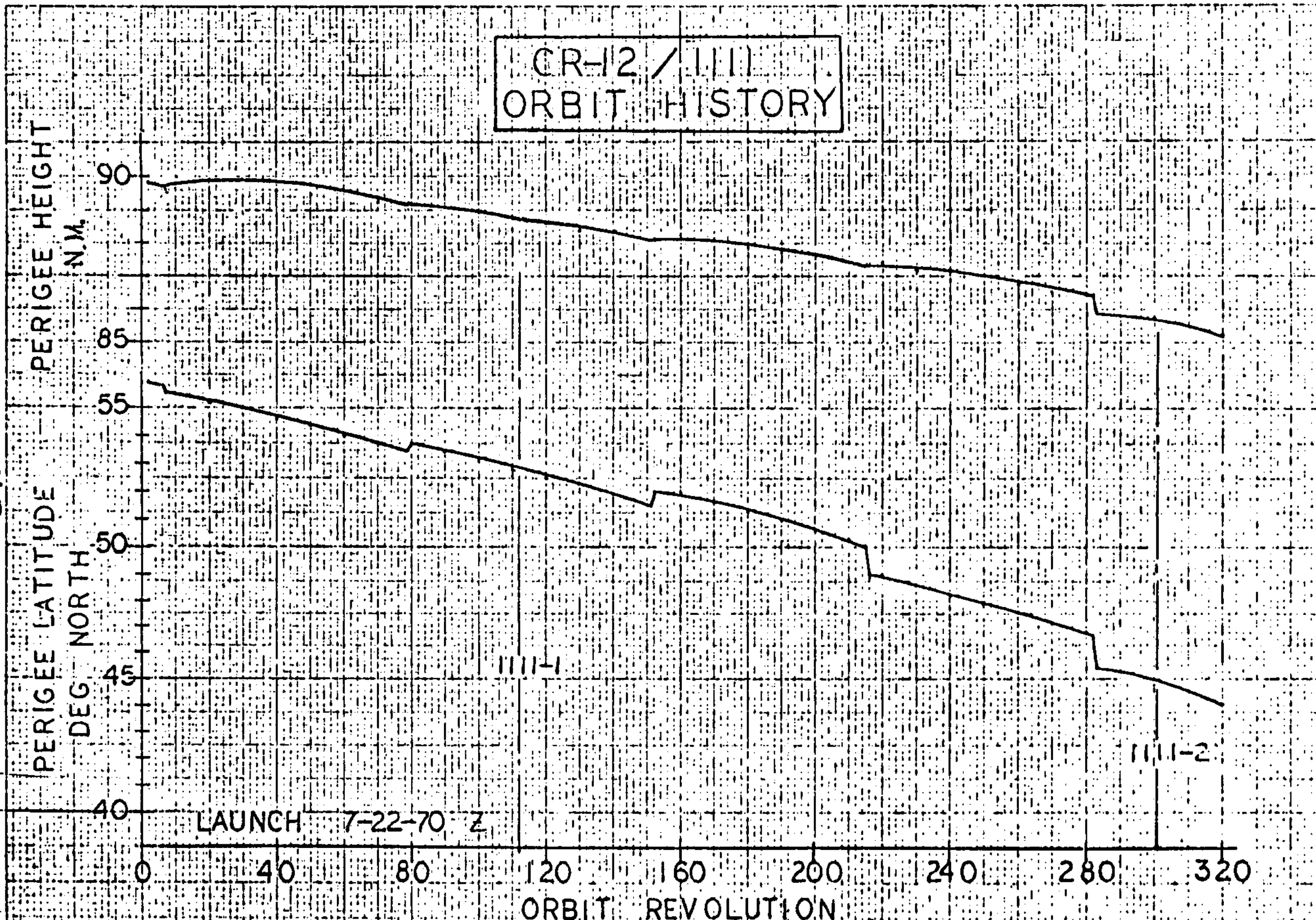


FIGURE 3-2

~~TOP SECRET~~/C

HANDLE VIA [redacted]
CONTROL SYS[redacted]

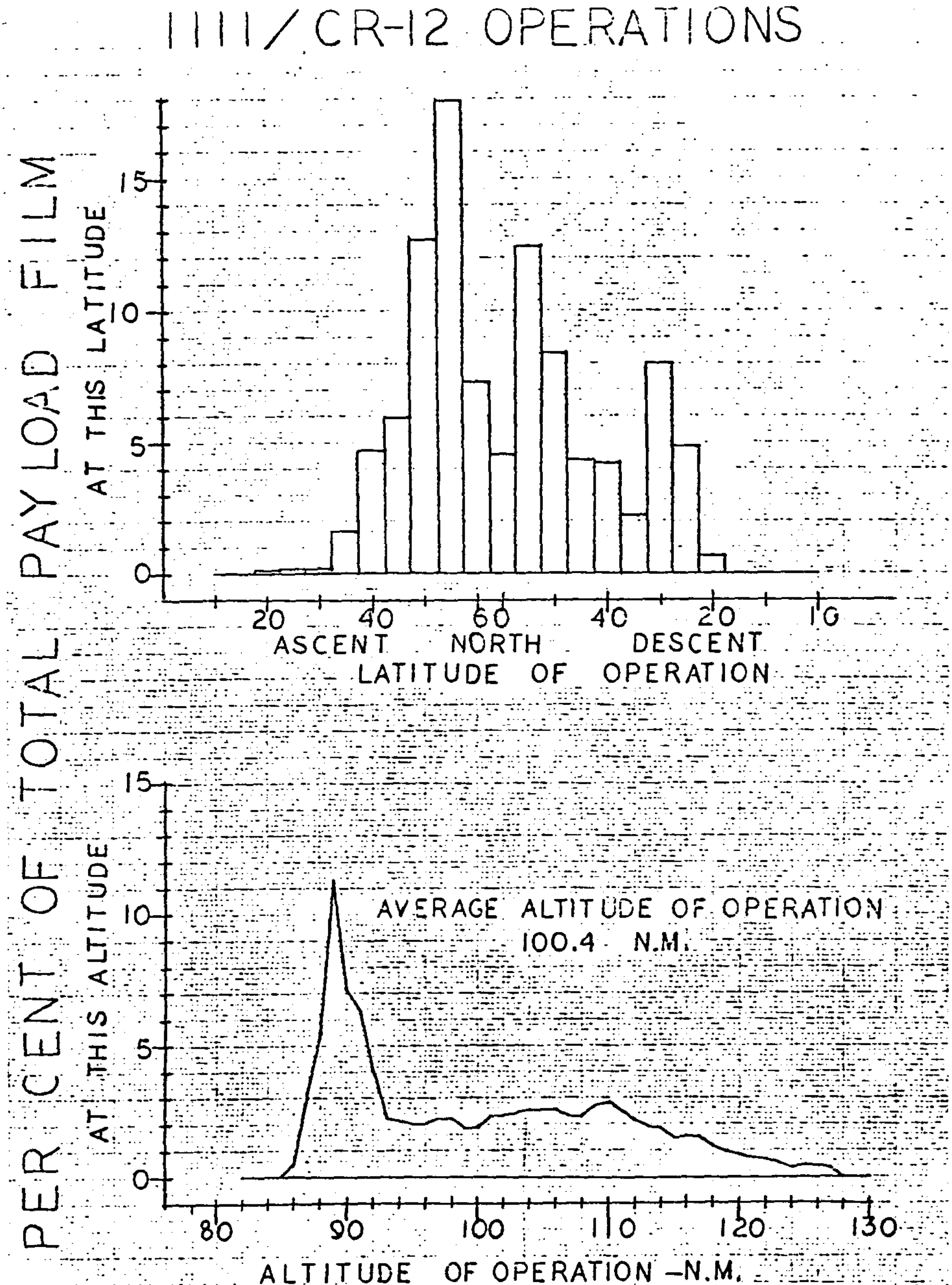

1111/CR-12 OPERATIONS
PER CENT OF TOTAL PAYLOAD FILM
AT THIS LATITUDE
15
10
5
0
20
40
60
40
20
10
ASCENT
NORTH
DESCENT
LATITUDE OF OPERATION
AT THIS ALTITUDE
15
10
5
0
AVERAGE ALTITUDE OF OPERATION
100.4 N.M.
80
90
100
110
120
130
ALTITUDE OF OPERATION –N.M.

FIGURE 3-3

Both cameras contained 16,300 feet of standard base type 3414 film. Panoramic camera S/N 324 film depletion occurred on frame 38 during rev 298. The film tag end of panoramic camera S/N 325 wrapped in the transport mechanism during rev 298. The last frame recovered was frame 16 of rev 298.

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

TABLE 3-3

	Frames		Length/Type	
	Pan 324	Pan 325	Pan 324	Pan 325
Sample	21	20	16300 ft/3414	16300 ft/3414
Prelaunch	132	138		
-1 Mission	2991	2991		
-2 Mission	3019	3013		
Total	6163	6163		

E. DISIC CAMERA

The DISIC camera performed satisfactorily during the -1 and -2 missions. The terrain camera passed the tag end into the recovery system with film depletion occurring on frame 19 during rev 298. The stellar film was not exhausted at -2 mission recovery.

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

TABLE 3-4

	Frames		Length/Type	
	Stellar	Terrain	Stellar	Terrain
Sample	44	26	2000 ft/3401	2200 ft/3400
Prelaunch	120	104		
-1 Mission	2980	2433		
-2 Mission	3350	2714		
Total	6494	5277		

F. INSTRUMENTATION & COMMAND

The instrumentation system performed satisfactorily with one exception. Camera S/N 324 rear rail temperature sensor (channel 11 - 06) failed "out of band high" on rev 111. Channel 11's slow recovery to the out of band condition on point 6 resulted in erroneous reading on points 7, 8, and 9.

The Real Time Command (RTC) system operation utilizing both UNCLE and SILO command systems operated satisfactorily throughout the flight.

G. EXPOSURE CONTROL SYSTEM

The slit width control programmer operated satisfactorily throughout the -1 and -2 missions. All except five of the operations were taken in the automatic mode. SPC 52 was not punched for rev 41 causing the SPC 51 slit width sequence on rev 42 to be wrong. The slit width control was commanded to fixed slit 4 for rev 41.

H. CLOCK SYSTEM

The clock system operation was very non-linear and required a fourth order polynomial to attain an acceptable system time to clock time fit. The correlation equation and constants are as follows:

First Order Fit

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

A_0 = -0.4973188916140692 D06
A_1 = 0.9999996176525097 D00

Sigma = 0.01060234
Number of points = 317

<u>Second Order Fit</u>

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

A_0 = -0.4973188916140692 D06

A_1 = 0.9999997526452726 D00

A_2 = -0.4987307006059397 D-13

Sigma = 0.00240167

Number of points = 317

<u>Fourth Order Fit</u>

System Time = $A_0 + A_1$ (clock time) + A_2 (clock time)^2
+ A_3 (clock time)^3 + A_4 (clock time)^4

A_0 = -0.4973189865475547 D06

A_1 = 0.1000000052707250 D01

A_2 = -0.3699563330216768 D-12

A_3 = 0.1388799373922082 D-18

A_4 = -0.2094108029608987 D-25

Sigma = 0.00035566

Number of points = 317

I. PRESSURE MAKE-UP SYSTEM

The pressure make-up system operated properly throughout the flight. The gas pressure drop was 4.63 psi/min during the -1 mission and 5.48 psi/min during the -2 mission with 1678 psia remaining at the end of the -2 mission.

J. THERMAL ENVIRONMENT

The temperature data obtained during this flight indicated the temperature environment was below pre-flight predictions after rev 152 as shown in Figure 3-4. The average temperatures for panoramic cameras S/N 324 and S/N 325 were 64° and 63° respectively during the -1 mission and 61° and 60° respectively during the -2 mission.

The on orbit temperature summaries are included in Tables 3-5 through 3-12.

K. RECOVERY SYSTEM PERFORMANCE

-1 Mission

The -1 recovery capsule was successfully recovered by air catch on rev 112. All re-entry events were within tolerance. The impact was 8 miles east of prediction.

	Actual	Predicted
Impact Location	20° 51'N/148° 54'W	20° 25.6'N/149° 1.9'W

-2 Mission

The -2 recovery capsule was successfully recovered by air catch on rev 301. All re-entry events were within tolerance. The impact was near predicted.

	Actual	Predicted
Impact Location	23° 08'N/144° 13'W	23° 01'N/144° 08'W

L. SRV TAPE RECORDER

The SRV tape recorders for the -1 and -2 missions performed satisfactorily. A total of 235 minutes of data was recorded and processed from the two recorders.

M. FMC PERFORMANCE

A satisfactory match to the required FMC was maintained during both the -1 and -2 missions. However, the FMC mismatch error experienced as the orbit period changed from nominal was more pronounced during this mission. This was a result of the combined effects of optimizing the FMC parameters for a broad range of anticipated ascending and descending operations and the relatively high eccentric orbit dictated by the 60° inclination.

N. HARDWARE DEFINITIONS

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

Agena

FTV 1654 was an Agena vehicle (SS01B) and a Thorad booster (SLV-2H) S/N 69-046. The vehicle flew nose first in orbit and included the following:

1. J-3 payload with digital storage register.
2. [redacted]
3. Seven Thiokol DMU rockets (all were 3000 lb-sec).
4. Battery configuration of 6 1H batteries - last vehicle to have this configuration.
5. 3/4 Speed Type VIII programmer (325 subcycles).
6. -3 Control gas mixture (2 spheres)
7. SGLE equipment with all frequencies except capsule links. (SILO command system, Alpha up-link and Delta 1 down-link telemetry links) and the Uncle (UHF) command system.

Payload

The CR-12 payload configuration included the following:

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

d) Exposure Control

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

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

e) Filter selection

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

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

2. DISIC Camera

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

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

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

3. FMC Programmer

a) Eccentricity function

1) Initiated by SPC 27 and RTC UHF 125/Silo 325.
2) Ramp profile provided by
UHF 121/Silo 321 eccentricity start level
UHF 122/Silo 322 eccentricity half-cycle level

4. Pressure Make-up

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

b) Two bottle system with dual range capability and the low range disabled.

5. Panoramic "A" to "B" transfer
Available by RTC KIK-Silo 38

6. DISIC "A" to "B" transfer

   Available by RTC KIK-Silo 39

7. Yaw Steering

   Available by RTC UHF 106/Silo 306

8. Agena Tape Recorder

   Time shared with vehicle data

9. SRV Tape Recorder

10. Payload Weight

    EWO - 1783 lbs.

11. Instrumentation

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

12. Thermal Configuration

    a) This payload had no gold surfaces. Aluminized mystic tape was used for the reflective surfaces.

    b) The standard paint configuration of 180 degrees black surface (90 degrees both top and bottom), was modified. The top black surface was reduced to 67 degrees by extending the aluminized surface 15 degrees on the starboard side and 8 degrees on the port side.

13. Command System

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

Exposure Control Settings

	Seconds
T-1 20 sec. increment initial setting	20
T-3 slit width #3 duration	180
T-4 slit width #2 duration	200
T-6 420 sec. increment initial setting	220
T-2 DISIC exposure to 1/500	200
T-5 DISIC exposure to 1/250	*200

*disconnected prior to flight

FMC Control Settings

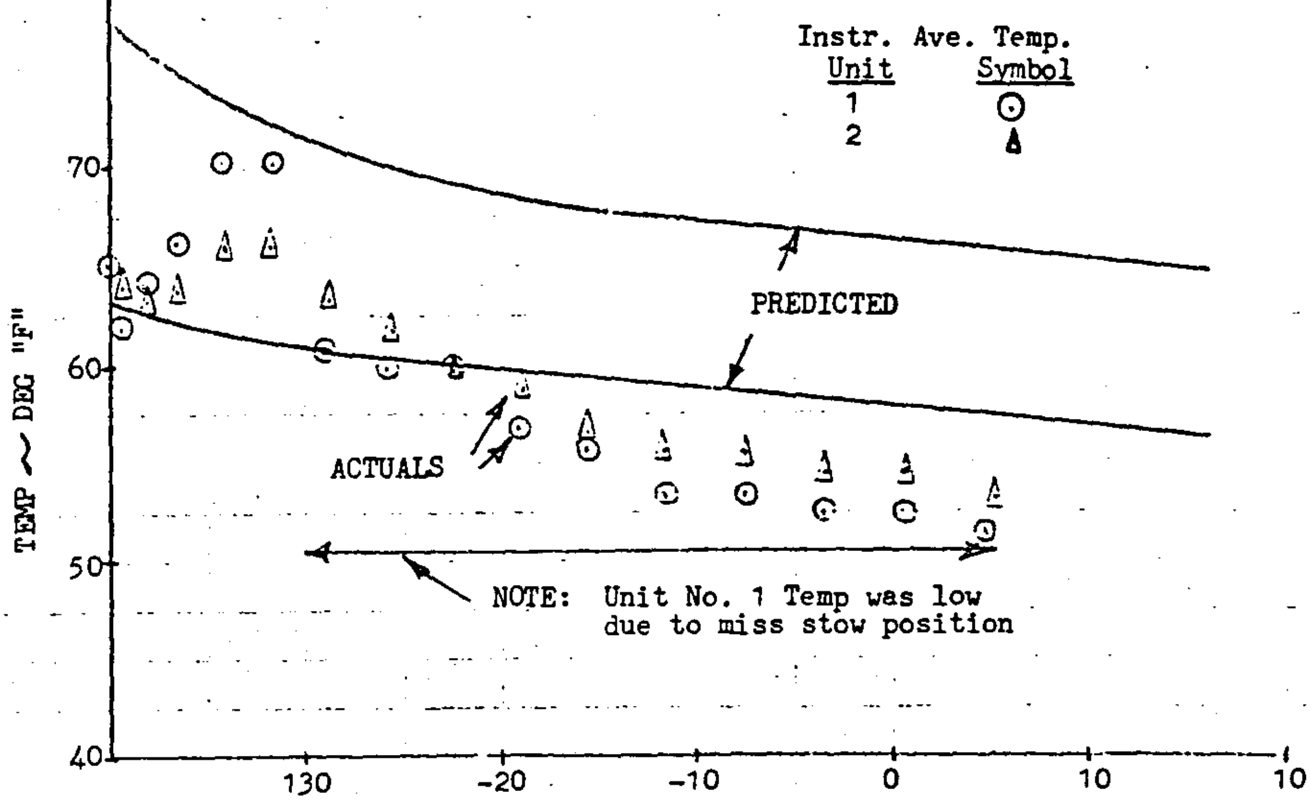
Eccentricity function

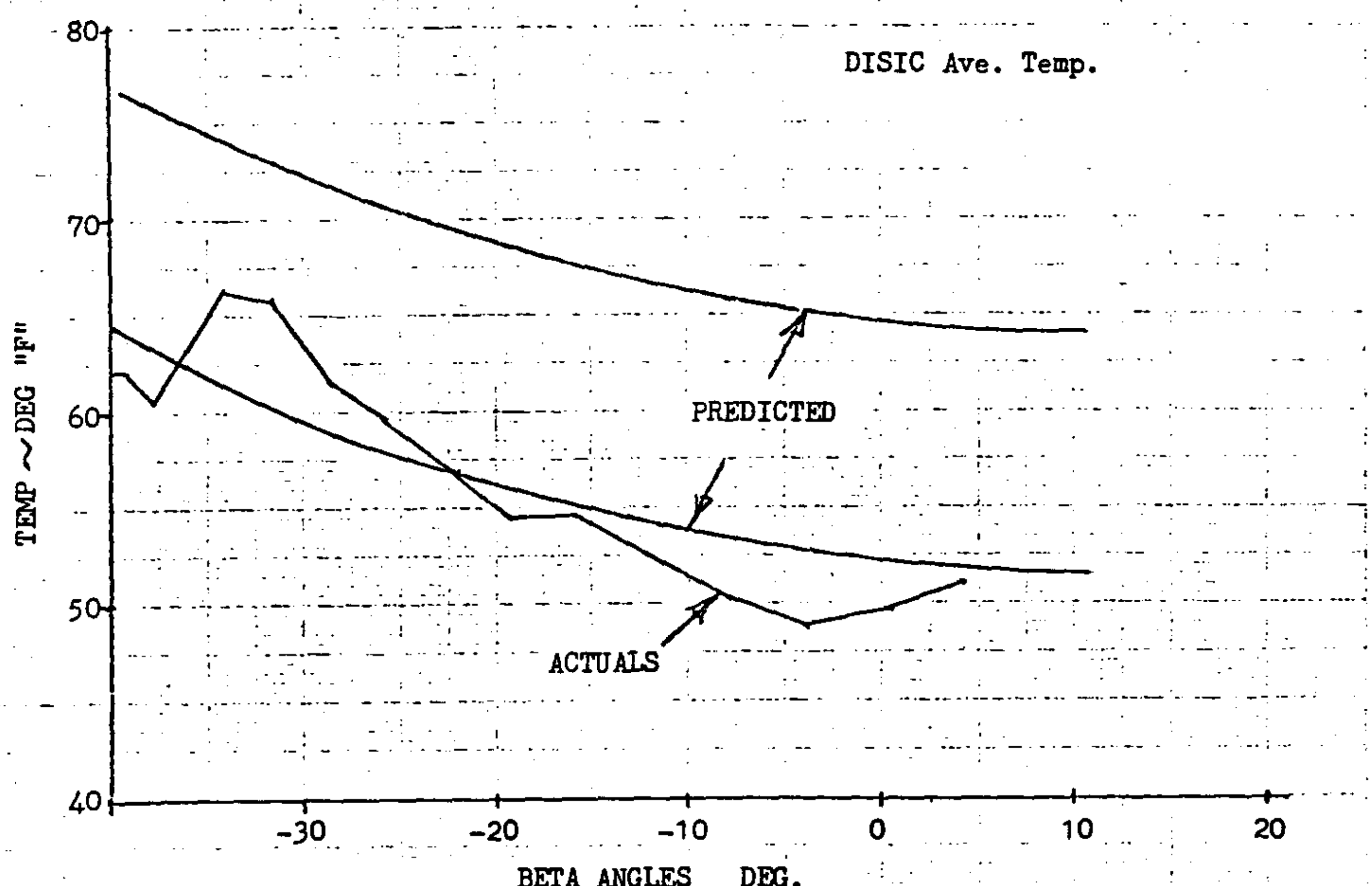
1) Eccentricity function period - 3548 seconds.
2) Delay step increment - 50 seconds.

Oblateness function

1) Oblateness function period - 5244.
2) Gain factor - 0.0349.

CR-12 FLIGHT vs PREDICTED TEMPERATURE





TOP SECRET/C FIGURE 3-4

TEMPERATURE SUMMARY (°F) (CR-6 & Up) Payload CR-12

Rev. No. [redacted]		10	15	26	31	41	47	57	63	73	79	89	94	104	110	120	126
Beta Angle		-39.0	-39.4	-39.9	-40.1	-40.3	-40.3	-40.2	-40.0	-39.6	-39.2	-38.5	-38.1	-37.0	-36.4	-35.1	-34.2
Pan No. 1 Lens Cell	2	66	65	66	65	66	67	67	67	65	63	65	66	67	66	71	71
Lens Cone	4	70	69	70	69	70	71	71	71	68	66	67	69	71	70	75	75
Rear Rail	6	65	68	65	68	68	68	67	69	69	69	67	68	71	75		
Drive Mtr	10	60	60	60	60	63	62	63	63	62	59	59	61	63	63	69	66
Front Rail	12	53	56	54	55	56	56	56	58	56	55	55	55	58	56	67	63
Average		64	64	63	64	65	65	65	65	64	62	62.5	64	66	66	70	70
Pan 1 Output AO	8	39	41	40	41	42	42	42	44	43	41	41	41	44	43		48
Delta Top Left	14	45	68	46	64	48	64	48	66	49	61	47	58	49	60	51	64
Drum Support	16	59	60	59	59	61	60	61	60	61	59	59	60	61	60	69	64
Pan No. 2 Lens Cell	18	68	68	69	69	70	71	71	71	72	71	71	70	71	70	72	72
Lens Cone	20	65	65	66	66	66	68	68	68	69	67	67	67	67	67	69	70
Rear Rail	22	54	58	55	58	57	59	57	61	58	58	57	58	59	59	61	62
Drive Mtr	26	61	61	62	62	65	64	65	65	65	63	63	63	65	65	66	67
Front Rail	28	55	59	56	59	59	59	59	60	59	59	58	59	59	59	61	61
Average		62	62	62	63	64	64	64	65	64.6	64	63	63.4	64	64	66	66
Pan 2 Output AO	24	67	72	68	72	71	73	71	73	71	71	68	69	69	70	71	71
Supply Cassette	30	50	53	54	56	58	58	58	60	61	60	59	59	61	60	62	62
Aux. Electronic Box	32	66	74	67	73	68	73	68	75	69	71	67	69	69	71	72	75
Slope Programmer	34	86	90	89	92	94	94	93	94	93	93	91	93	93	94	93	93
PMU	36	54	56	54	54	56	56	56	56	56	56	54	54	56	56	65	65
Switch Programmer	43	72	81	75	78	78	78	78	81	78	78	75	78	78	78	78	78
Aft Power Box	49	43	49	43	49	49	49	49	52	52	52	49	52	52	52	52	55
SRV "A" T/U	40	48	45	45	43	43	44	43	47	46	46	46	47	44	43	-	32
Retro	42	52	53	49	51	52	52	52	53	52	52	51	52	52	52	-	33
SRV "B" T/U	44	61	61	60	61	63	62	63	62	63	63	62	63	65	67	68	73
Retro	46	59	59	59	59	63	61	63	63	63	61	60	61	63	63	68	69

TABLE 7-5

TEMPERATURE SUMMARY (°F) CR-6 & Up

Payload CR-

Rev. No. [redacted]		10	15	26	31	41	47	57	63	73	79	89	94	104	110	120	126
Beta Angle		-39.0	-39.4	-39.9	-40.1	-40.3	-40.3	-40.2	-40.0	-39.6	-39.1	-38.5	-38.1	-37.0	-36.4	-35.1	-34.2
Blast Shield	48	35	45	35	42	42	42	38	45	38	42	35	42	42	45	106	77
	50	44	54	44	50	50	50	47	54	50	50	44	50	50	54	25	70
DISIC Platen	53	57	58	56	58	59	60	60	61	61	61	59	60	60	63	65	65
Lens Cell	55	57	59	56	59	58	61	59	62	61	62	58	60	58	62	63	66
Fairing	5	90	145	90	150	84	156	54	150	50	159	33	159	33	168	16	185
	7	72	112	72	109	75	112	65	115	65	109	55	103	55	106		
	9	73	76	79	79	79	79	84	81	87	84	84	87	81	87		
	11	67	76	76	79	74	79	76	82	79	85	79	85	76	85	33	96
	13	12	38	12	35	18	35	18	41	18	35	15	32	22	38	15	58
	15	8	63	5	66	5	70	-11	70	-11	73	-18	79	-11	85	-15	97
DISICONIC	17	48	103	45	111	38	119	8	114	5	125	- 8	128	- 5	136	-18	139
	19	91	118	94	118	97	118	91	121	88	115	82	112	82	112	103	156
	21	71	75	78	78	78	78	80	80	83	80	83	83	80	83	83	83
	23	31	58	34	58	28	61	21	65	24	65	17	68	17	71	17	68
	25	23	36	23	36	26	36	26	40	26	36	26	36	30	40	33	50
	31	16	56	12	56	12	59	0	59	0	65	- 3	68	0	74	3	80
Forward Barrel	33	69	158	69	155	66	152	45	155	42	146	32	140	35	143	28	146
	35	61	73	70	73	65	73	65	76	68	76	65	79	65	76	70	73
	37	27	53	27	50	23	50	17	53	20	57	13	60	13	60	13	53
	39	-5	78	-11	81	-14	84	-34	84	-34	90	-37	93	-34	99	-34	104
Aft Barrel	41	74	155	74	152	74	149	54	149	51	143	45	132	45	135	35	138
	45	67	77	77	77	73	77	77	80	80	83	77	85	77	83	77	73
	47	36	61	39	61	33	61	30	64	33	67	26	67	26	70	23	61
	51	-23	43	-26	43	-26	43	-29	46	-26	46	-29	43	-26	52	-23	59
DSR	38	60	71	64	72	66	72	67	74	69	73	68	73	69	73	69	74

TABLE 3-6

TEMPERATURE SUMMARY (°F) (CR-6 & Up)

Payload CR-12

Rev. No. [redacted]		136	142	152	158	167	173	183	189	199	205	215	220	231	236	247	252
Beta Angle		-32.7	-31.8	-30.1	-29.0	-27.3	-26.1	-24.1	-22.8	-20.6	-19.3	-17.0	-15.9	-13.3	-12.1	-9.4	-8.1
Pan No. 1 Lens Cell	2	72	71	67	65	65	63	63	62	62	60	59	59	58	57	58	56
Lens Cone	4	76	74	71	68	67	66	66	65	65	63	63	62	61	60	60	59
Rear Rail	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drive Mtr	10	64	73	55	55	54	53	61	58	58	56	56	55	55	53	54	53
Front Rail	12	64	64	62	58	60	57	59	55	58	53	57	51	56	50	55	50
Average		68	70	63	61	61	60	62	60	60	57	58	56	57	54	56	54
Pan 1 Output AO	8											47	43	47	42	48	44
Delta Top Left	14	51	59	53	57	51	52	52	51	51	50	50	45	50	45	50	44
Drum Support	16	65	63	64	60	61	60	60	58	60	57	58	56	57	54	57	54
Pan No. 2 Lens Cell	18	73	72	72	70	68	67	67	66	66	65	64	63	63	62	62	61
Lens Cone	20	70	70	69	67	66	66	65	65	64	63	63	62	62	61	61	60
Rear Rail	22	61	60	62	58	61	57	60	56	59	55	57	53	57	52	56	52
Drive Mtr	26	67	66	66	64	64	63	62	60	60	58	58	57	57	56	57	56
Front Rail	28	61	59	62	58	60	57	60	55	59	54	58	52	58	51	57	51
Average		66	65.4	66	63.4	64	62	63	60	61.6	59	60	57	59.5	56	58	56
Pan 2 Output AO	24	70	68	69	66	67	64	67	60	63	58	60	56	59	53	56	52
Supply Cassette	30	62	61	62	59	61	58	60	56	58	55	57	53	56	52	56	52
Aux. Electronic Box	32	71	71	71	68	68	66	67	63	65	60	62	57	61	54	58	53
Slope Programmer	34	92	91	90	90	88	88	86	84	83	81	80	78	78	76	76	74
PMU	36	63	63	63	59	61	59	61	56	59	54	56	50	54	47	52	47
Switch Programmer	43	75	78	75	75	75	72	72	69	69	66	66	60	63	57	60	[illegible]
Aft Power Box	49	52	52	52	49	52	52	52	49	52	52	52	46	52	46	52	49
SRV "A" T/U	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retro	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SRV "B" T/U	44	71	72	73	72	71	71	70	69	68	67	66	66	65	63	62	62
Retro	46	70	70	69	67	67	66	65	63	63	61	61	59	59	57	58	57

TABLE 7-7

TEMPERATURE SUMMARY (°F) CR-6 & Up

Payload CR-

Rev. No. [redacted]		136	142	152	158	167	173	183	189	199	205	215	220	231	236	247	252
Beta Angle		-32.7	-31.8	-30.1	-29.0	-27.3	-26.1	-24.1	-22.8	-20.6	-19.3	-17.0	-15.9	-13.3	-12.1	-9.4	-8.1
Blast Shield	48	112	84	35	80	38	87	8	84	8	87	8	87	8	84	8	87
	50	44	75	12	73	18	85	9	85	9	88	9	100	5	97	5	112
DISIC Plater.	53	65	65	64	61	60	59	60	57	57	54	54	54	52	52	52	50
Lens Cell	55	63	65	62	61	58	59	58	56	56	54	52	54	51	52	50	50
Fairing	5	16	179	-12	179	-12	165	-22	162	-22	153	-25	133	-25	139	-25	122
	7											7	97	7	88	7	75
	9											6	73	3	73	6	67
	11	44	74	30	85	37	93	- 3	93	- 3	93	-3	90	-3	90	- 3	85
	13	18	55	18	51	18	45	18	45	18	45	18	35	22	38	22	45
	15	-15	97	-15	100	-15	91	-15	97	-15	97	-15	82	-11	97	-11	94
DISICONIC	17	15	142	-21	145	-21	136	-25	136	-25	136	-25	117	-25	128	-25	117
	19	100	150	76	141	76	132	62	115	55	106	49	91	49	79	46	70
	21	80	89	54	80	51	83	17	75	20	71	17	65	14	61	17	54
	23	21	71	21	65	17	65	11	61	14	58	14	55	11	55	14	51
	25	33	50	33	43	33	43	33	40	33	43	33	36	33	40	36	43
	31	3	83	6	86	6	80	6	86	6	86	6	77	6	86	9	86
Forward Barrel	33	25	132	22	126	18	102	15	93	11	87	8	62	8	59	5	45
	35	68	76	55	70	52	70	27	61	27	58	24	55	24	52	24	46
	37	13	57	13	50	10	50	10	47	13	47	13	43	13	43	13	37
	39	-34	102	-30	107	-30	93	-30	99	-30	99	-30	78	-30	93	-27	87
Aft Barrel	41	35	118	29	115	29	95	26	89	22	83	22	61	19	58	16	48
	45	73	80	57	73	54	77	24	67	24	63	24	60	21	57	21	50
	47	23	67	20	58	17	61	17	55	20	55	17	52	17	52	20	48
	51	-23	52	-20	56	-20	43	-20	49	-16	52	-16	36	-13	49	-13	49
DSR	38	70	73	69	72	68	72	67	71	67	71	66	70	66	69	70	70

TABLE 3-8

TEMPERATURE SUMMARY (°F) (CR-6 & Up)

Payload CR-12

Rev. No. [redacted]		263	268	278	284	294	299
Beta Angle		-5.4	-4.1	-1.5	+.1	+2.7	+4.0
Pan No. 1 Lens Cell	2	56	55	56	55	56	55
Lens Cone	4	59	57	58	57	58	57
Rear Rail	6	-	-	-	-	-	-
Drive Mtr	10	53	52	53	52	52	51
Front Rail	12	55	50	55	50	55	49
Average		56	53	55	53	56	52
Pan 1 Output AO	8	48	45	49	46	51	48
Delta Top Left	14	49	45	50	44	50	42
Drum Support	16	56	53	56	53	55	53
Pan No. 2 Lens Cell	18	61	59	60	59	59	58
Lens Cone	20	60	59	59	59	59	59
Rear Rail	22	55	51	55	51	55	50
Drive Mtr	26	55	54	55	54	54	54
Front Rail	28	56	50	56	50	56	50
Average		57	55	57	55	57	54
Pan 2 Output AO	24	54	49	52	48	51	45
Supply Cassette	30	54	52	54	52	54	52
Aux. Electronic Box	32	56	51	55	50	53	49
Slope Programmer	34	75	74	73	73	71	70
PMU	36	50	47	50	45	47	43
Switch Programmer	43	60	57	57	54	54	51
Aft Power Box	49	52	49	55	52	55	52
SRV "A" T/U	40	-	-	-	-	-	-
Retro	42	-	-	-	-	-	-
SRV "B" T/U	44	61	61	60	60	60	61
Retro	46	57	56	57	56	57	56

TEMPERATURE SUMMARY (°F) CR-6 & Up

Payload CR-

Rcv. No. [redacted]		263	268	278	284	294	299										
Beta Angle		-5.4	-4.1	-1.5	+.1	+2.7	+4.0										
Blast Shield	48	8	90	8	90	8	93										
	50	5	106	5	112	5	130										
DISIC Platen	53	51	49	51	49	50	51										
Lens Cell	55	49	48	49	49	48	50										
Fairing	5	-29	133	-25	119	-29	96										
	7	7	72	7	61	4	38										
	9	6	70	3	73	3	57										
	11	- 3	90	- 3	96	- 3	82										
	13	25	58	28	68	25	68										
	15	-11	111	- 5	111	- 8	97										
DISICONIC	17	-25	134	-21	128	-25	108										
	19	43	64	43	59	36	46										
	21	14	58	14	61	10	48										
	23	14	58	14	65	14	55										
	25	40	50	43	57	43	60										
	31	9	100	12	100	12	91										
Forward Barrel	33	1	45	1	39	- 2	15										
	35	21	46	18	52	18	39										
	37	13	43	17	50	13	40										
	39	-27	104	-24	104	-24	84										
Aft Barrel	41	13	48	16	38	10	22										
	45	21	50	18	57	15	44										
	47	20	52	20	58	20	48										
	51	-13	62	- 6	66	- 6	52										
DSR	38	70	71	65	72	67	72										

TABLE 3-10

TEMPERATURE SUMMARY (°F) CR-6 & Up

Payload CR-1

Rev. No. (Ascent)		APP	APP
Beta Angle		236Sec	434Sec
Blast Shield	48	-	-
	50	-	-
DISIC Platen	53	61	61
Lens Cell	55	65	67
Fairing	5	221	221
	7	311	280
	9	310	260
	11	360	235
	13	310	260
	15	224	209
DISICONIC	17	166	158
	19	252	219
	21	332	228
	23	338	227
	25	272	204
	31	179	155
Forward Barrel	33	170	164
	35	262	167
	37	263	167
	39	160	159
Aft Barrel	41	154	138
	45	216	153
	47	218	159
	51	137	137
DSR	38	59	55

TABLE 3-11

TEMPERATURE SUMMARY (°F) (CR-6 & Up)

Payload CR-12

Rev. No. (Ascent)		LK II on	NEAR FADE
Beta Angle		APP236	APP434
Pan No. 1 Lens Cell	2	61	60
Lens Cone	4	60	59
Rear Rail	6	-	-
Drive Mtr	10	-	-
Front Rail	12	-	-
Average		60.5	59.5
Pan 1 Output AO	8	52	54
Delta Top Left	14	-	-
Drum Support	16	-	-
Pan No. 2 Lens Cell	18	61	61
Lens Cone	20	60	60
Rear Rail	22	60	62
Drive Mtr	26	-	-
Front Rail	28	-	-
Average		60	61
Pan 2 Output AO	24	62	63
Supply Cassette	30	-	-
Aux. Electronic Box	32	-	-
Slope Programmer	34	-	-
FMU	36	-	-
Switch Programmer	43	-	-
Aft Power Box	49	-	-
SRV "A" T/U	40	66	66
Retro	42	58	62
SRV "B" T/U	44	-	-
Retro	46	-	-

SECTION 4

PHOTOGRAPHIC PERFORMANCE

A. SUMMARY

The photographic performance of the panoramic cameras for Mission 1111 ranged from good to poor with the largest portion in the good to fair category. The image quality variability was attributed to variations in the acquisition altitude, 88 NM to 147 NM, and adverse weather conditions where the cloud coverage was approximately 30 percent.

An MIP of 105 for Mission 1111-1 was achieved at an altitude of 129 NM, and an MIP of 105 for 1111-2 at an altitude of 90 NM. These MIP/s are considered extremely good for the acquisition altitudes.

The CRYSPR-C evaluations were performed for the first time on a Corona flight and correlations for CORN targets are discussed subsequently.

Mission 1111, except for weather and altitude variations produced the most consistently crisp imagery of any Corona system flown. The 3414 film appears to to have enhanced mission performance through reduction of exposure time and mean camera smear. Another contributing factor to the excellent flight focus was to pre-focus the cameras for an on-orbit temperature of 60 - 65°F vs 70°F for previous missions. Camera system resolution, based on CORN target analyses, showed Mission 1111 equal to or superior in achieved on-orbit resolution to Missions 1104 and 1106. The mean on-orbit resolution of both the Fwd and Aft cameres was estimated to be near the peak level of the CR-12 capability, i.e., 120 - 160 L/MM at 2:1 contrast.

The photographic performance of the DISIC Index camera is good and compares favorably with previous missions.

Aerial film flown is as follows:

Panoramic Cameras

Forward	Aft
Type 3414 16,300 ft.	Type 3414 16,300 ft.
Index	**Stellar**
Type 3400 2,200 ft.	Type 3401 2,000 ft.

B. PANORAMIC CAMERAS

1. Image Quality

Forward-Looking Camera #325: Film Type 3414; Wratten 25 Filter

The overall image quality of the Forward-Looking camera is good. Unlike Missions 1109 and 1110 most of the imagery retains its sharpness at magnifications up to 50 times.

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

The best imagery for Mission 1111-1 was selected from the Forward-Looking camera and assigned an MIP of 105. This imagery is located on Frame 1 of Pass D10 at an altitude of 129 NM.

The best imagery for Mission 1111-2 was also selected from the Forward-Looking camera and assigned an MIP of 105. This imagery is located on Frame 14 of Pass D189 at an altitude of 90 NM.

Aft-Looking Camera #324: Film Type 3414: Wratten 21 Filter

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

2. Data Recording

The Fwd and Aft looking cameras exhibited acceptable auxiliary data imagery throughout Missions 1111-1 and 1111-2. However, after Pass D214 the binary word was moderately bloomed on the second frame from the end of each aft camera operation. These oversized binary dots were detected in preflight testing and were within acceptable limits.

3. Anomalies

Random intermittent, plus density spots are present on all camera materials beginning with Pass A113 and continuing through the balance of the Mission. Sizes of the spots vary with the largest approximately .005 inch. These spots are similar to those noted on Mission 1110-2 and generally appear in two groupings on the last 8 inches of the supply end of the frame. These spots are heavily clustered together in a pattern on Pass A113 Fwd and Aft and appear as abrasion marks or smudges to the unaided eye. This pattern begins at the supply end and continues approximately 9 inches into each frame of Pass A113. The pattern appears as two parallel, longitudinal markings within the format ultimately converging toward the center of the frame within the last 3 inches. The pattern on the Fwd record continues into Pass D115 with decreasing severity at the end of the pass. An investigation is in process.

The investigation to date has shown that plus density spotting on the panoramic films from both cameras is an electrostatic discharge. The electrostatic spotting appears to take place between some of the rollers on the drum and film during operation in orbit. Internal camera pressure is estimated to be in the range of 1 to 60 micrometers when electrostatic spotting occurs.

On the Fwd record frames 16 through 24 of Pass D242 there are very fine plus density markings. These markings begin as fine, longitudinal rake marks confined to the binary border and sometimes into the format and progress to a more predominant high frequency squiggle mark by frame 21. Degradation to imagery is minor. The system is to be reviewed to find the cause of this anomaly.

A very dense fog pattern is present on the third and fourth frames from the end of all Forward-Looking camera operations. Fog on the third frame from the end is approximately 4 inches in length and covers the width of the format. Fog on the fourth frame from the end protrudes one inch into the format from the binary edge and is approximately 2 inches in length. These fog patterns obscure imagery and are attributable to a light leak in the camera's drum/boot area below the film.

A fog pattern is present near the supply end of the third frame of each Aft camera's operation. This pattern extends approximately ½ inch from the binary edge into the format and causes minor degradation to imagery. This mark appears to be caused by the same light leak described above.

Several minor longitudinal plus density lines are present intermittently through the Fwd record. These lines continue through the horizon format. Markings appear to be a result of abrasions between the film and a transport roller similar to that noted during preflight operations.

A slight variation in image quality exists across the format with the better quality recorded along the camera number edge on the Aft material and the binary edge on the Fwd material. This minor image quality variation is attributed to a minor degree of image plane tilt detected during preflight operations using the Aschenbrenner Grid test technique.

A very dense fog pattern is present near the supply end of the last frame of each Aft-Looking camera's operation on Passes D69 to D86 and D148 to D298 (end of mission). The fog pattern is approximately six inches in length and covers the width of the film web. It was caused by improper lens stow.

On the Aft record after Pass D214 the binary word is moderately bloomed on the second frame from the end of each camera operation. This has been attributed to the lens stow switch malfunction that caused multiple printouts.

A minor longitudinal minus density streak is present along the center of frames 1 to 17 of Pass A113 of the Fwd looking camera. It is approximately ¼ to 1/3 inch wide and correlates with the puck-arm in the take-up.

Minor fog patterns are present intermittently on the first 4 frames of some Fwd looking camera operations and on the first 2 frames of some Aft looking camera operations. These patterns appear as roller shadow graphs and are minor in nature.

Dendritic edge static traces are present on Passes D102, D108, and D112 of the Fwd looking camera and are generally contained within the border. This is a J-3 system characteristic.

Rail scratches along both film edges are heavier than usual.

4. <u>Ground Resolution</u> - Actual (CORN targets) vs Predicted (CRYSPR-C)

Fixed and mobile bar targets were displayed and photographed during selected orbits throughout Mission 1111-1 and -2. Bar target displays were deployed to ascertain the resolution performance of panoramic cameras #325 (Fwd looking) and #324 (Aft looking). All targets were photographed using film type 3414.

The following ground resolution table shows all of the bar target imagery recorded during Mission 1111-1 and -2.

Table 4-1 shows that the best bar target imagery consistently came from the -2 segment of Mission 1111. See revs D-126 and D-189, Table 4-1. Included in Table 4-1 are the predicted CRYSPR resolution values for several selected revs. CRYSPR is the ACRONYM for the new experimental computer run designed to calculate the predicted resolution.

Figure 4-1 shows the graphed relationship of CRYSPR-C resolution vs the actual resolution obtained in flight.

5. <u>Special Test Glass vs Gelatin Filters</u>

A special glass vs gelatin filter test was conducted during Mission 1111-1 revs. D45, 63, 77, and 94. Three observers who subjectively evaluated the imagery agreed that the W-25 and W-21 gelatin filters from the Fwd and Aft cameras produced the sharpest overall terrain imagery. In addition a new objective "Visual Edge Match" technique invented by ITEK Corp. confirmed these findings as a result of a detailed analysis of rev 63 imagery. It is noted that both cameras were focused for the primary filters prior to launch.

TABLE 4-1: BAR TARGET RESOLUTION MISSION 1111: ACTUAL VS CRYSPR-C PREDICTION

Rev., Camera, Frame #	Ground Resolution CRYSPR Feet	Ground Resolution Actual Ft, FMC/Scan	Ground Resolution Actual L/MM	Geographic Location	Scan Angle	Location in Frame Coordinates X	Location in Frame Coordinates Y	Bar Target Type, Contrast	Vertical Alt. (N.M.)	Weather Comments
A10,Fwd,F4	10.0	NR,11.3	129	Edwards	24°	59.5	2.9	B-1,Low 4/1	128.3	Clear
A10,Aft,F10	11.8	9,9	153	Edwards	24°	15.7	3.8	B-1,Low 4/1	128.3	
A10,Fwd,F4	10.0	NR,11.3	129	Edwards	24°	59.5	2.9	B-2, Hi 16/1	128.3	Clear
A10,Aft,F10	11.8	9,9	147	Edwards	24°	15.7	3.8	B-2, Hi 16/1	128.3	
A10,Fwd,F5	8.3	8.5,8.5	159	Lucerne Valley	1°	34.2	2.7	51-51, 5/1	128.0	Clear
A10,Aft,F11	9.6	10,10	146	Calif.	1°	41.2	3.7	51-51, 5/1	128.0	
A10,Fwd,F13		8.5,10				34.8	1.3	51-51, 5/1	127.2	Clear
A10,Aft,F19		12.9.5				40.6	5.3	51-51, 5/1	126.1	
A10,Aft,F20		10,9.5				40.6	0.4	51-51, 5/1	126.0	Clear
A10,Fwd,F15	8.3	8.6,9.6	141	Pahrump	16°	51.5	3.5	C, 9/1	126.3	Clear
A10,Aft,F21	8.6	8.6,9.6	155	Pahrump	16°	23.6	3.4	C, 9/1	126.3	
A10,Fwd,F18	8.0	10.8,10.8	119	Indian Springs	13°	48.4	2.9	C, 9/1	125.7	Clear
A10,Aft,F24	8.1	10.8,10.8	127	Indian Springs	13°	26.8	3.8	C, 9/1	125.7	Clear
D45,Fwd,F5	6.7	7.0,8.0	134		3°	42.3	0.1	51-51, 5/1	90.9	Haze
D45,Aft,F12	6.8	8.0,8.0	142	Webster, N.Y.	3°	33.3	1.0	51-51, 5/1	90.9	Haze
D45,Fwd,F6		7.1,6.3		Dixon, Calif.		42.3	5.0	51-51, 5/1	90.9	Clear
D126,Fwd,F6		5.0,5.0		Dixon, Calif.		41.0	4.7	51-51, 5/1	90.7	Clear
D126,Aft,F12		6.3,6.3				35.0	1.8	51-51, 5/1	90.9	
D126,Fwd,F22		5.6,6.3				44.2	4.9	51-51, 5/1	90.6	Clear
D126,Aft,F28		6.3,7.0				31.7	1.3	51-51, 5/1	90.9	
D189,Fwd,F6		6.3,6.3		Edwards		24.0	3.0	B-1,Low 4/1	89.8	Clear
F189,Aft,F12		6.3,6.3		Edwards		51.2	3.4	B-1,Low 4/1	90.0	

1. NR - Not resolved
2. Filters used for above data: All Gelatin except Rev D-126, F22 and F28 which were Glass
   Fwd Looking Camera: W-25 Filter
   Aft Looking Camera: W-21 Filter

CRYSPR RESOLUTION PREDICTIONS vs ACTUALS

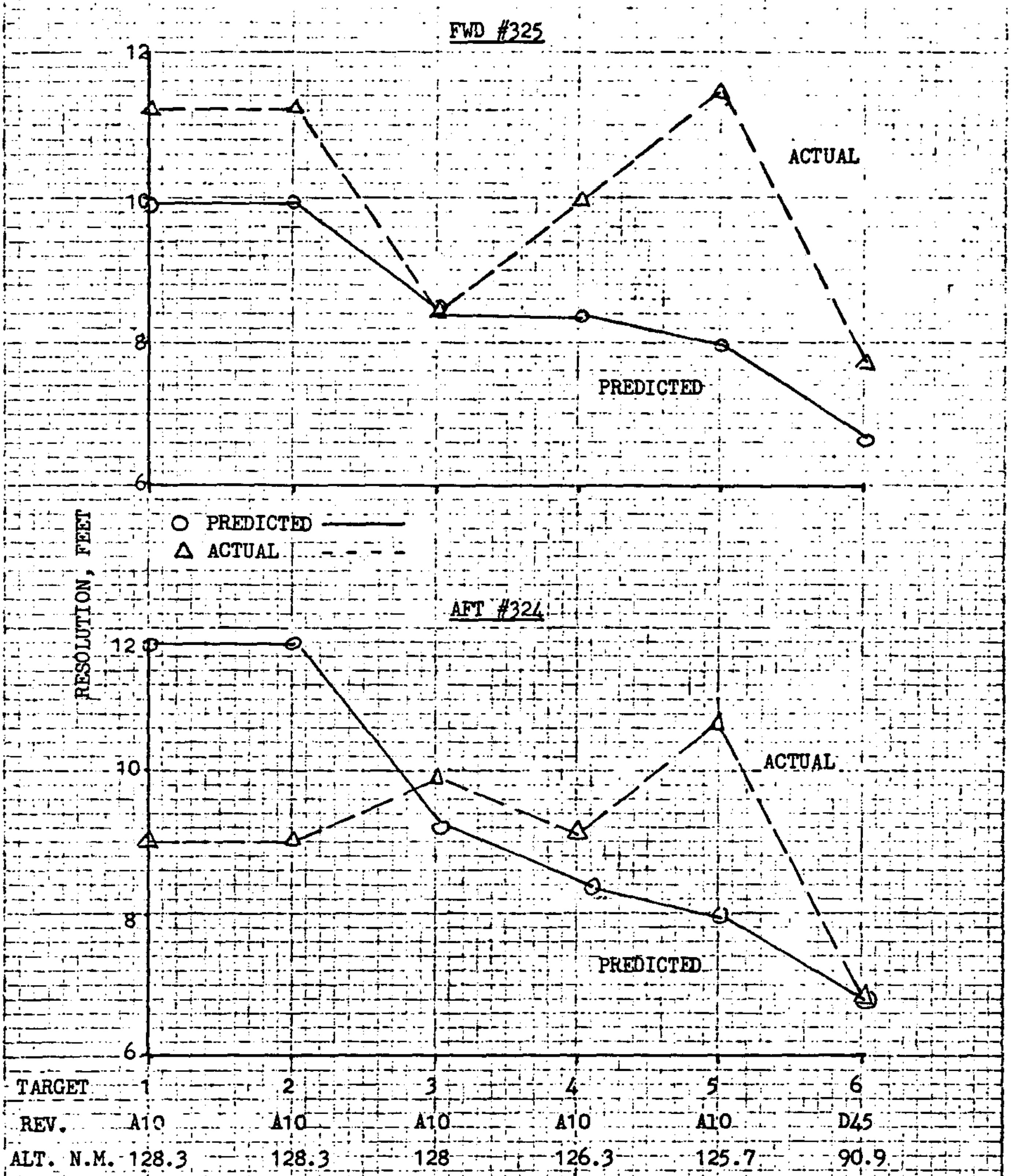


FIGURE 4-1

C. HORIZON CAMERAS

The four horizon cameras operated properly throughout the entire mission.

D. DISIC #2R STELLAR/INDEX (Terrain) CAMERA

1. Performance

The Index photography was good. Program objectives were attained.

Point type star images were recorded on both stellar cameras. Approximately 20 to 30 star images were recorded on the port formats; from 0 to 20 star images were recorded on the starboard formats.

2. Anomalies

Dendritic and Corona static traces are present intermittently throughout the stellar record and terrain record. Degradation was minor and was the lowest static level observed in a DISIC system to date. These marks are characteristic of the system in some sensitive pressure windows.

A series of continuous plus density lines are concentrated in a .8 inch wide band, 1.5 inches from the Index non-binary film edge. Some degradation is present, however practically all imagery is good. This pattern resembles that exhibited on Mission 1110-1 but less severe. Marking first appeared in prefilght testing with flight film.

An image of an eyelash is present on every port frame of Mission 1111-2 after Pass 100, resulting in some local out-of-flat condition in the vicinity of the eyelash.

SECTION 5

PANORAMIC EXPOSURE

A. INTRODUCTION

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

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

B. FILM TYPE 3414

The Wratten 25 (W-25) and Wratten 21 (W-21) filters were selected for the Fwd and Aft looking cameras respectively. Gelatin filters were primary and glass filters were secondary. The somewhat heavier light filtration of the shorter wavelengths below the red region provided by the W-25 filter reduces the amount of non-image forming haze light that appears to be more pronounced in the Fwd camera. Since the W-25 filter provides more light filtration than the W-21, the slits selected for the Fwd camera are wider than the corresponding slits selected for the Aft camera.

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

SLIT WIDTH (INCHES)

Slit I.D.	Fwd #325	Aft #324
S_4	0.287	0.195
S_3	0.234	0.155
S_2	0.176	0.110
S_1	0.131	0.080
F/S	0.189	0.135

Typical slit usage for Mission 1111-1 is shown in Figures 5-1 and 5-2 for orbit 70 Fwd and Aft cameras respectively. Similarly, Mission 1111-2 is represented by Figures 5-3 and 5-4 of orbit 137 Fwd and Aft cameras respectively. The solid curve in Figures 5-1 through 5-4 represent the ideal exposure based on exposure criteria dated November 1969. The actual exposure time produced through the programmed use of slits S_4 through S_1 is a step function as shown on Figures 5-1 through 5-4. Figures 5-1 through 5-4 also include the relative distribution of camera operations for Mission 1111.

Examination of actual mission exposure curves versus the aim point or ideal exposure, as described in typical examples shown in Figures 5-1 through 5-4, for all orbits of Mission 1111, reveal that all exposures taken between approximately 37° North ascending latitude to 20° North latitude descending were within ± 0.4 f stops of the ideal exposure.

Examination of mission imagery revealed that program objectives were not only met but the bulk of the original negatives that were exposed between 37° North ascending to 20° North descending latitude were exposed properly as will be shown in the following report.

A useful technique, employed on past Corona missions for estimating whether the original negative was exposed properly, will be employed in this report. The method classifies frames of the original negative in terms of "correct", "over", and "under exposed". The basis for these exposure classifications is the assumption that the exposure is reasonably correct when the terrain scene minimum density (D - min) in the processed negative ranges between 0.4 and 0.9. A frame D-min value less than 0.4 suggests a tendency toward underexposure and a value greater than 0.9 indicates a tendency toward overexposure. These D-min cut-off points, though somewhat arbitrary, do consider the film's response to light as shown in Figure 5-5. Figure 5-5 is a typical negative exposure vs density response curve for film type 3414. At the 0.4 density level and below it can be seen that the film produces the smallest density response vs light input anywhere on the D LOG E curve. As a result, the tone or contrast of the recorded imagery becomes so low that image elements can neither be transferred to the duplicate positive or seen visually in the original negative. This condition is a result of underexposure.

Figures 5-5 thru 5-14 show the frame D-min/D-max values for all the domestic revs for the Forward (Fwd) and Aft-Looking cameras, revs Nos. 10, 45, 63, 77, and 94, for Mission 1111-1.

The frame D-min/D-max values plotted in Figures 5-5 thru 5-14 are represented on the D LOG E curve as a dot from frame D-min and an X for frame D-max. Density values were supplied by Eastman Kodak Co. Density measurements were accomplished manually using a ½ millimeter aperture (500 micrometers).

Examination of D LOG E curves, Figures 5-5 thru 5-14, revealed that the film in the Fwd-Looking camera (#325) received slightly more exposure on the average compared to the Aft camera (#324). Further, the Fwd film appears correctly exposed while the Aft film has a slight underexposed bias on the average as shown by examination of the frame D-min values for all the domestic revs. The slight underexposed bias exhibited on the average by the Aft camera film is of no consequence.

All denied area revs are classified as slightly underexposed, correctly exposed, or overexposed based on the frame D-min values taken from the Fwd camera by revs.

TABLE 5-1

EXPOSURE CLASSIFICATION BY REVS, FWD CAMERA, D MINS

Slightly Underexposed	Correct Exposure	Overexposed
1A,4,5,6,	3,17,18,19	1D,41,104
7,10,16,20,	25,31,32,34	112,246
33,36,52A,53	35,45,47,52D	
65,68,69,70	54,55,63,64	
83,95,115,116	66,67,71,72	
119,126D,132,148	77,79,81,82	
149,163,165,166	85,86,88,94	
179,180,181,196	97,98,99,102	
197,208,209,225D	103,108,113,117	
239,242,243,250	126A,131,135,144	
298	145,146,147,151	
	160,161,162,167	
	174,178,189,190	
	194,195,210,212	
	214,223,225A,226	
	230,241,259,260	
	273,274,275,293	

The rev is classified as slightly underexposed if the majority of frame D-min values are less than 0.4 density. Correct exposure is indicated when the majority of the frame D-min values are between 0.4 and 0.9 density. Overexposure is indicated when the majority of frame D-min values are over 0.9 density.

Mission No.: 1111-1 Payload No.: CR-12 Pass No.: 70

Camera No.: 325 Fwd Launch Time: 0125 GMT Launch Date: 23 July 19

Film Type.: 3414 Slit Widths: Pos. 1: 0.131 Pos. 2: 0.176

Filter Type.: W-25 Pos. 3: 0.234 Pos. 4: 0.287 F/S: 0.189

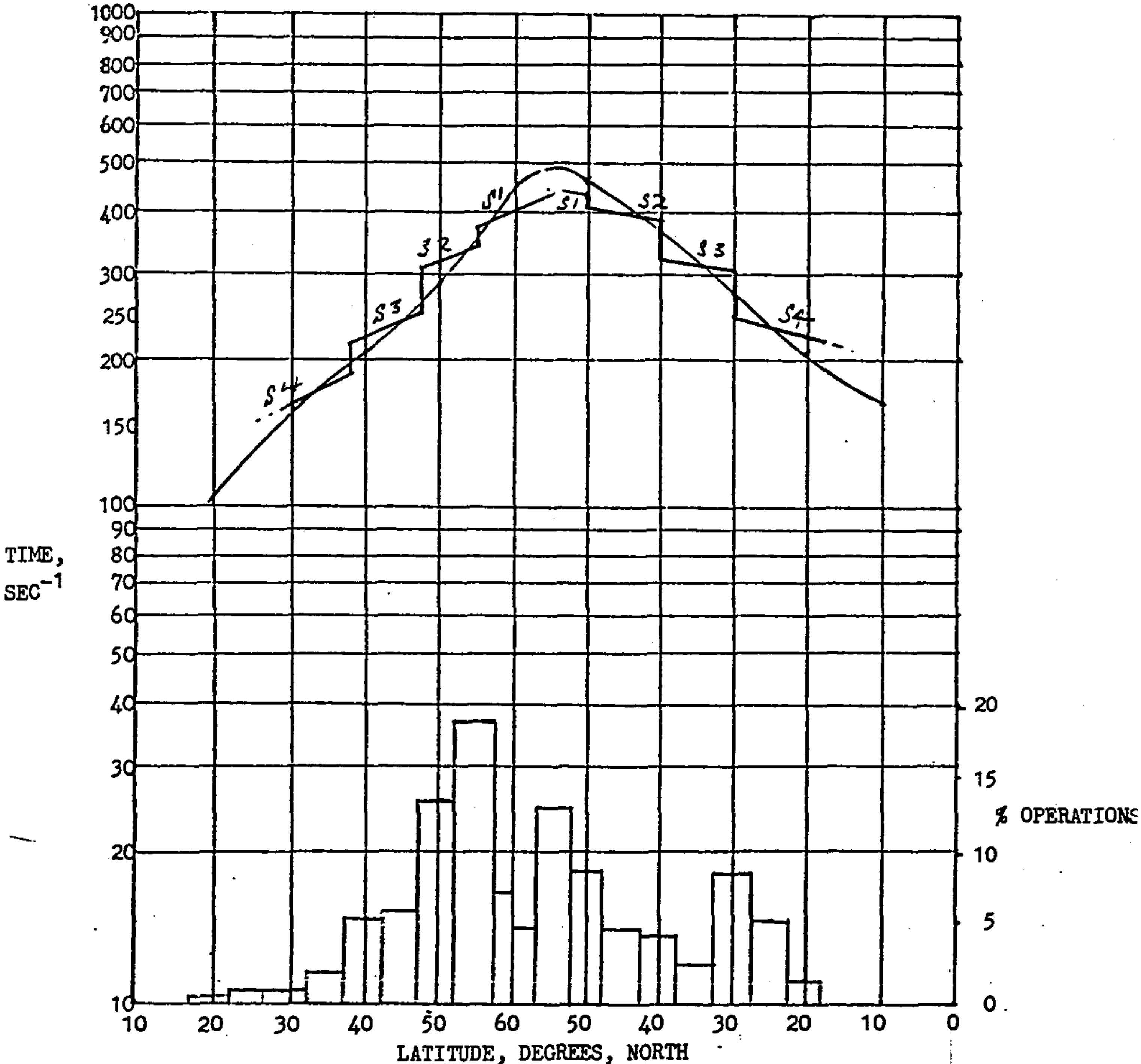


FIGURE 5-1 : COMPARISON OF IDEAL/ACTUAL EXPOSURE TIME vs LATITUDE

~~TOP SECRET~~/C

HANDLE VIA [redacted]
CONTROL SYSTEM ON

Mission No.: 1111-1 Payload No.: CR-12 Pass No.: 70

Camera No.: 324 Aft Launch Time: 0125 GMT Launch Date: 22 July 1970

Film Type.: 3414 Slit Widths: Pos. 1: 0.080 Pos. 2: 0.110

Filter Type.: W-21 Pos. 3: 0.155 Pos. 4: 0.195 F/S: 0.135

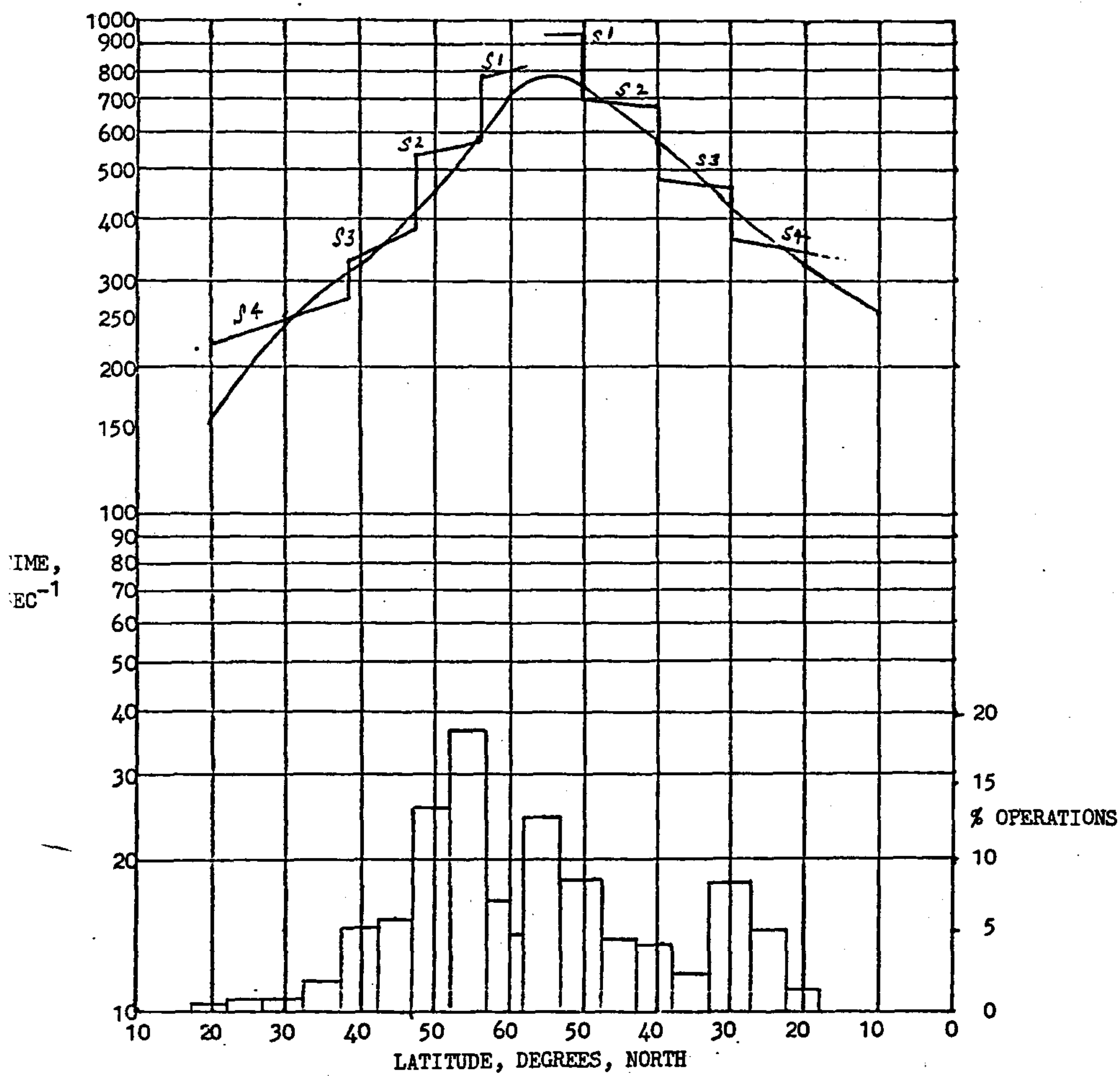


FIGURE 5-2 : COMPARISON OF IDEAL/ACTUAL EXPOSURE TIME vs LATITUDE

TOP SECRET/C

HANDLE VIA [redacted] CONTROL SYSTEM ONLY

Mission No.: 1111-2 Payload No.: CR-12 Pass No.: 137

Camera No.: 325 Fwd Launch Time: 0125 GMT Launch Date: 23 July 1

Film Type.: 3414 Slit Widths: Pos. 1: 0.131 Pos. 2: 0.176

Filter Type.: W-25 Pos. 3: 0.234 Pos. 4: 0.287 F/S: 0.189

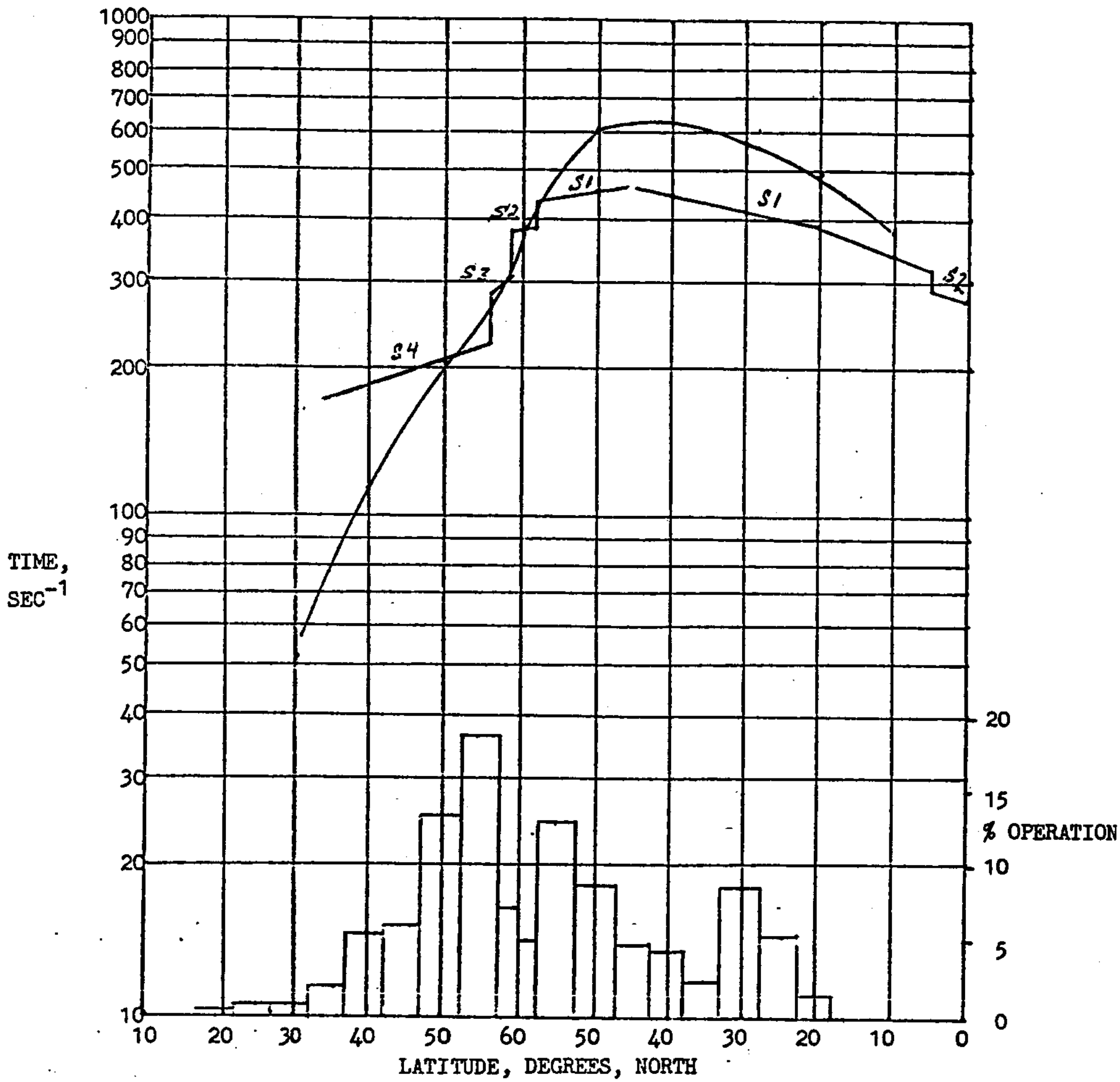


FIGURE 5-3 : COMPARISON OF IDEAL/ACTUAL EXPOSURE TIME vs LATITUDE

~~TOP SECRET~~/C

HANDLE VIA [redacted]
CONTROL SYSTEM

Mission No.: 1111-2 Payload No.: CR-12 Pass No.: 137

Camera No.: 324 Aft Launch Time: 0125 GMT Launch Date: 23 July

Film Type.: 3414 Slit Widths: Pos. 1: 0.080 Pos. 2: 0.110

Filter Type.: W-21 Pos. 3: 0.155 Pos. 4: 0.195 F/S: 0.135

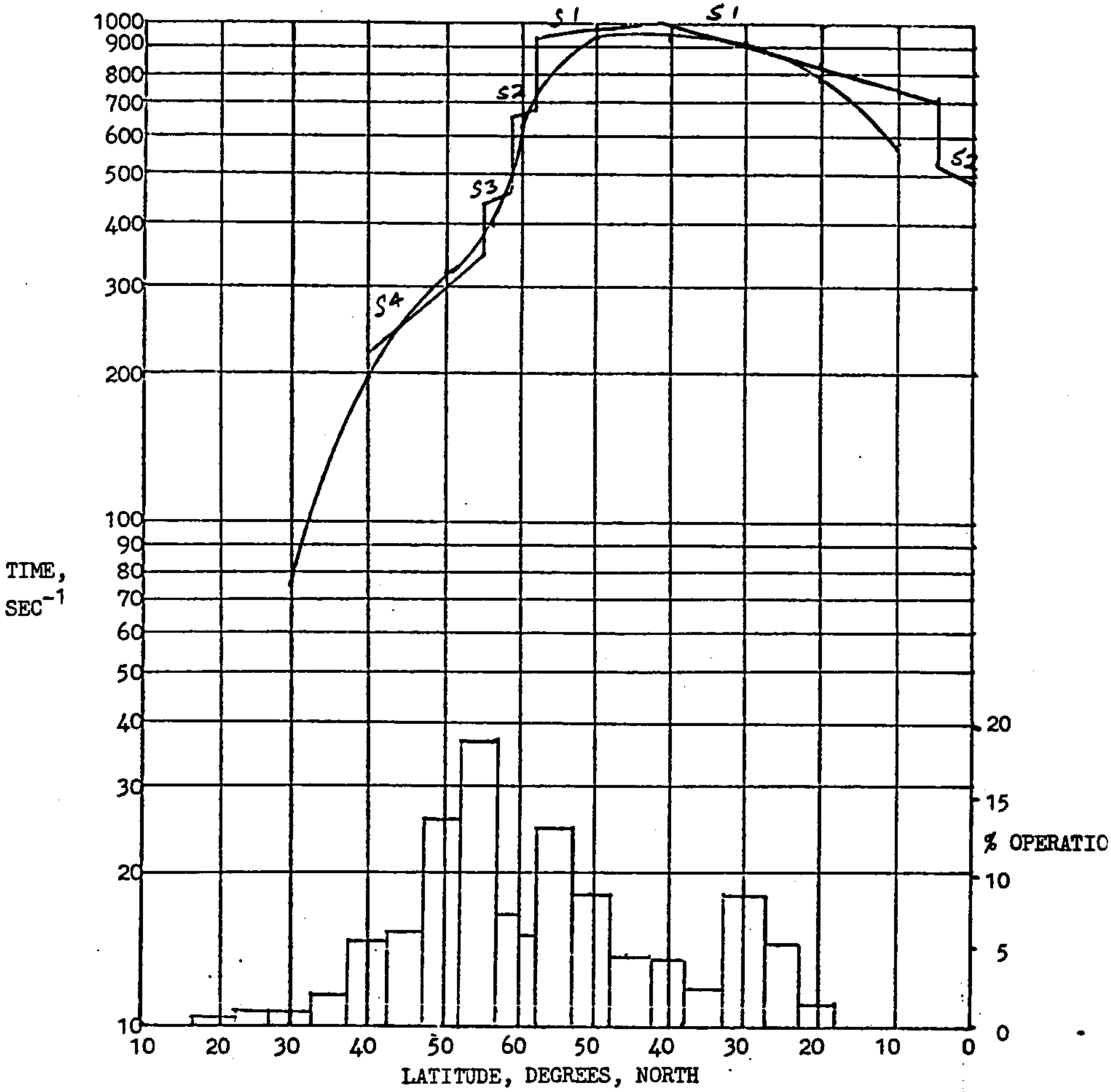


FIGURE 5-4 : COMPARISON OF IDEAL/ACTUAL EXPOSURE TIME vs LATITUDE

~~TOP SECRET~~/C

HANDLE VIA [redacted]
CONTROL SYSTEM

ON FRAME DENSITY Dmin Dmax

Mission 1111-1 CR-12 Rev. A10 Inst. 325 FWD

Frames 1-21

Frame	Dmin	Dmax
6	.40	x1.46
11	.40	x1.49
16	.32	x1.51
21	.35	x1.37

Exposure

Sensitometer 1B; Lamp # 2007
Filter; Daylight
Exposure Time; 1/25 sec.
Log E_{11}; $\bar{1}.22$; Fog .18
Dual Gamma AEI 4.9
Film; 3414 AFS 15.7

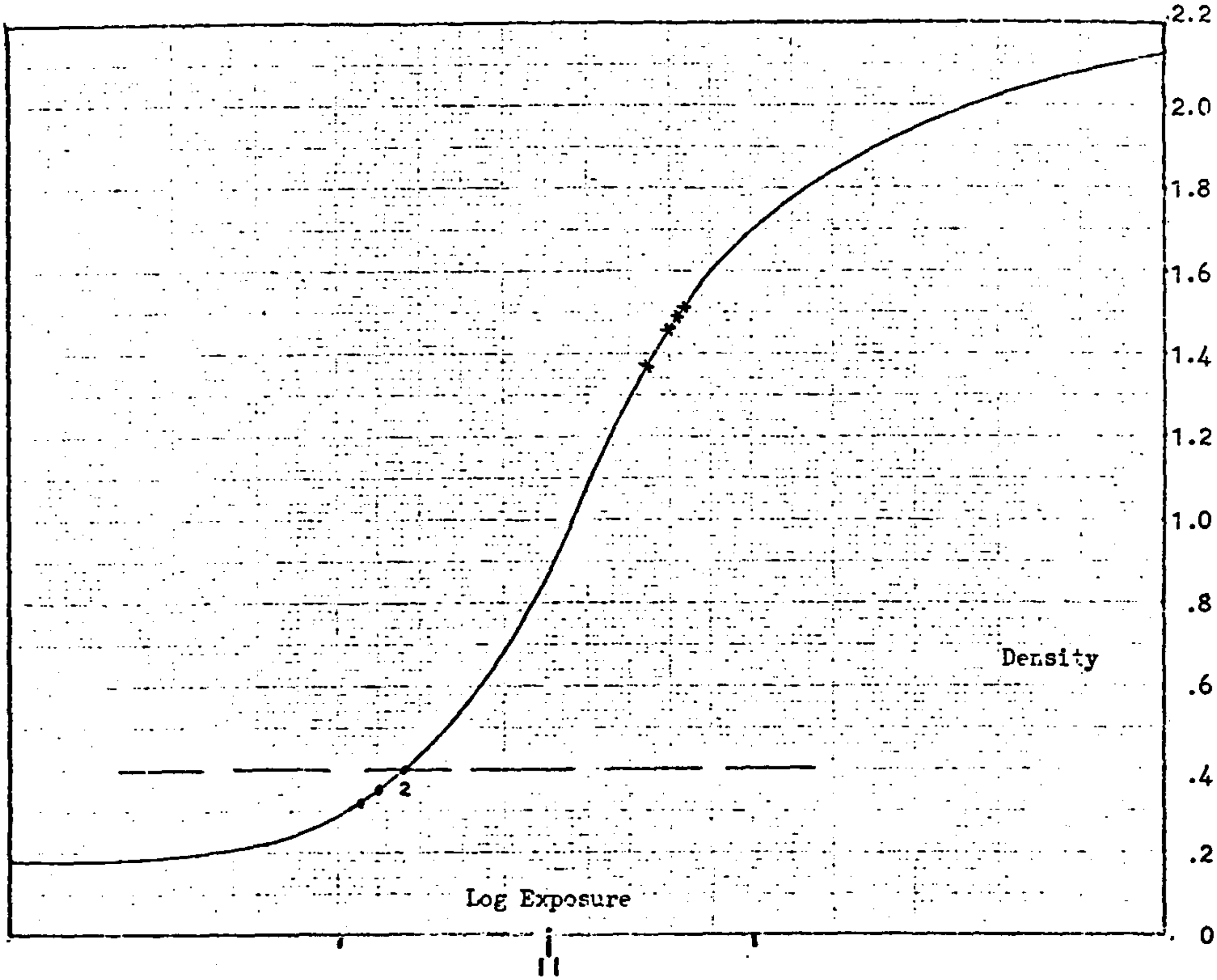


FIGURE 5-5

ON FRAME DENSITY Dmin Dmax

Mission 1111-1 CR-12 Rev. D45 Inst. 325 FWD

Frames 1-30

Frame	Dmin	Dmax
5	.56	x1.18
10	.59	x1.26
15	.43	x1.03
20	.46	x1.06
25	.42	x1.31
30	.59	x1.37

Exposure

Sensitometer 1B; Lamp # 2007
Filter; Daylight
Exposure Time; 1/25 sec.
Log E_{11}; $\bar{1}.22$; Fog .18
Dual Gamma AEI 4.9
Film; 3414 AFS 15.7

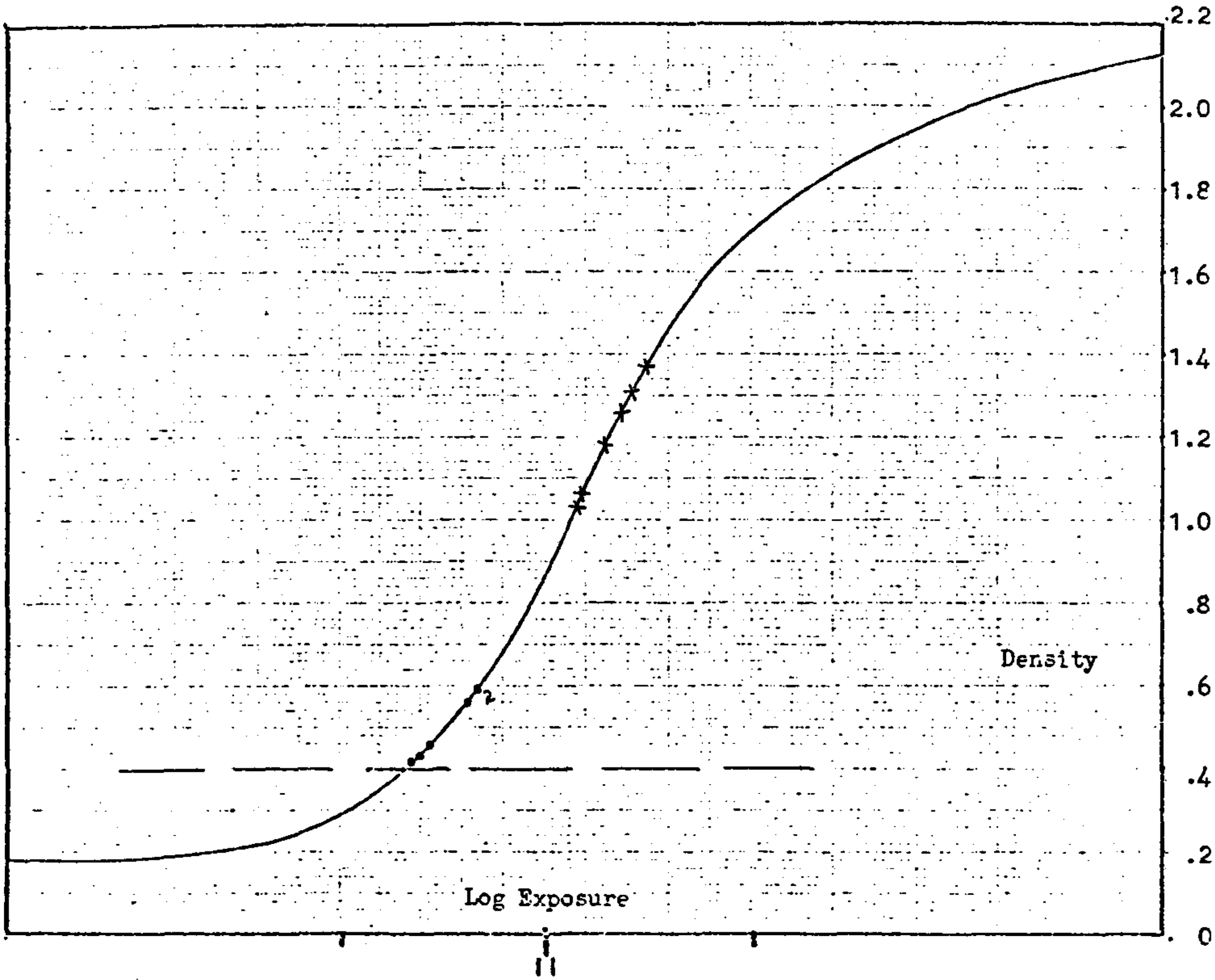


FIGURE 5-6

ON FRAME DENSITY Dmin Dmax

Mission 1111-1 CR-12 Rev. D63 Inst. 325 FWD

Frames 1-20

Frame	Dmin	Dmax
5	.57	x1.40
10	.36	x1.56
15	.76	x1.51
20	.37	x1.42

Exposure

Sensitometer 1B; Lamp # 2007
Filter; Daylight
Exposure Time; 1/25 sec.
Log E_{11}; $\bar{1}.22$; Fog .18
Dual Gamma AEI 4.9
Film; 3414 AFS 15.7

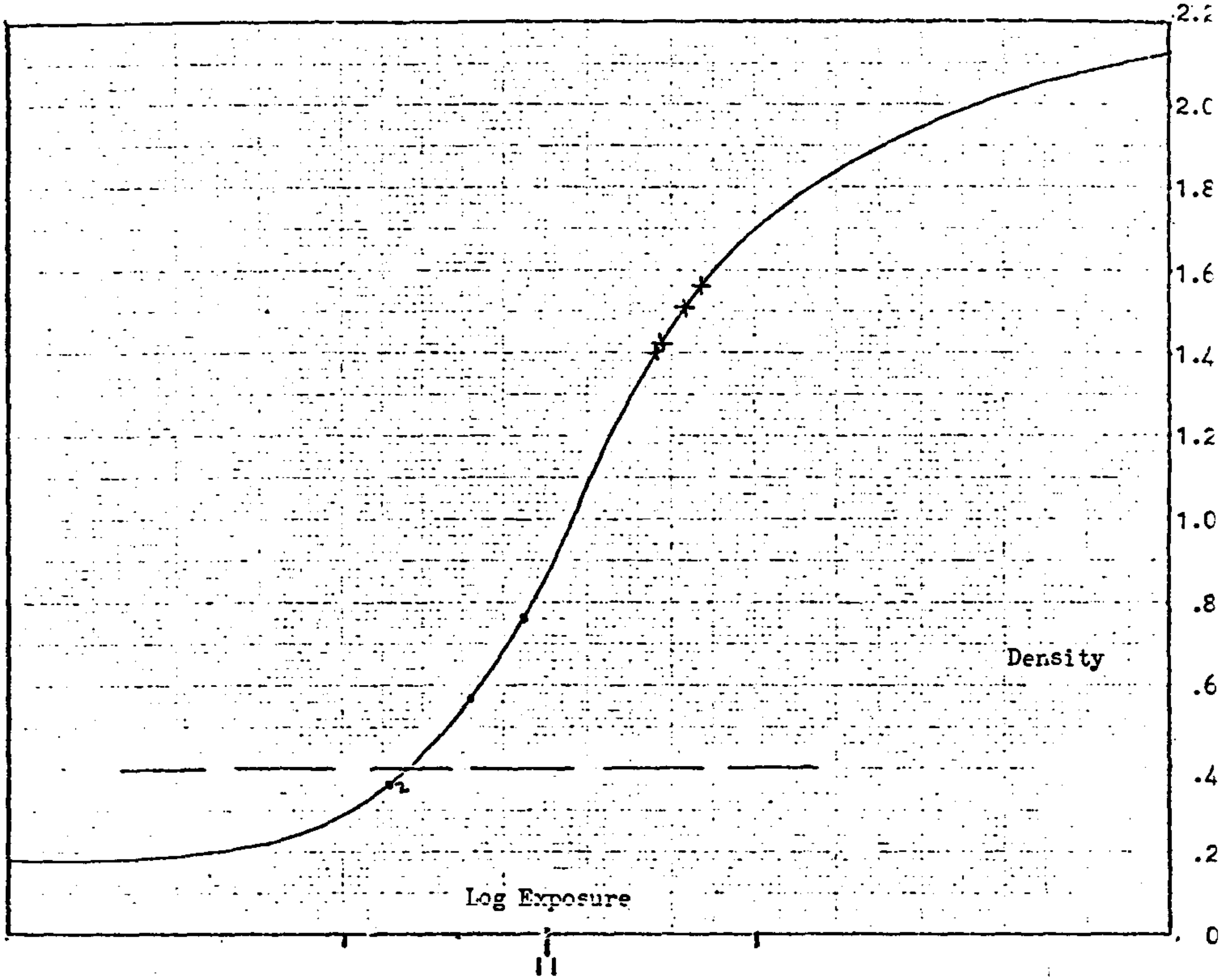


FIGURE 5-7

ON FRAME DENSITY Dmin Dmax

Mission 1111-1 CR-12 Rev. D77 Inst. 325 FWD

Frames 1-20

Frame	Dmin	Dmax
5	.98	x1.08
10	1.00	x1.19
15	.69	x1.02
20	.43	x1.30

Exposure

Sensitometer 1B; Lamp # 2007
Filter; Daylight
Exposure Time; 1/25 sec.
Log E_{11}; $\bar{1}.22$; Fog .18
Dual Gamma AEI 4.9
Film; 3414 AFS 15.7

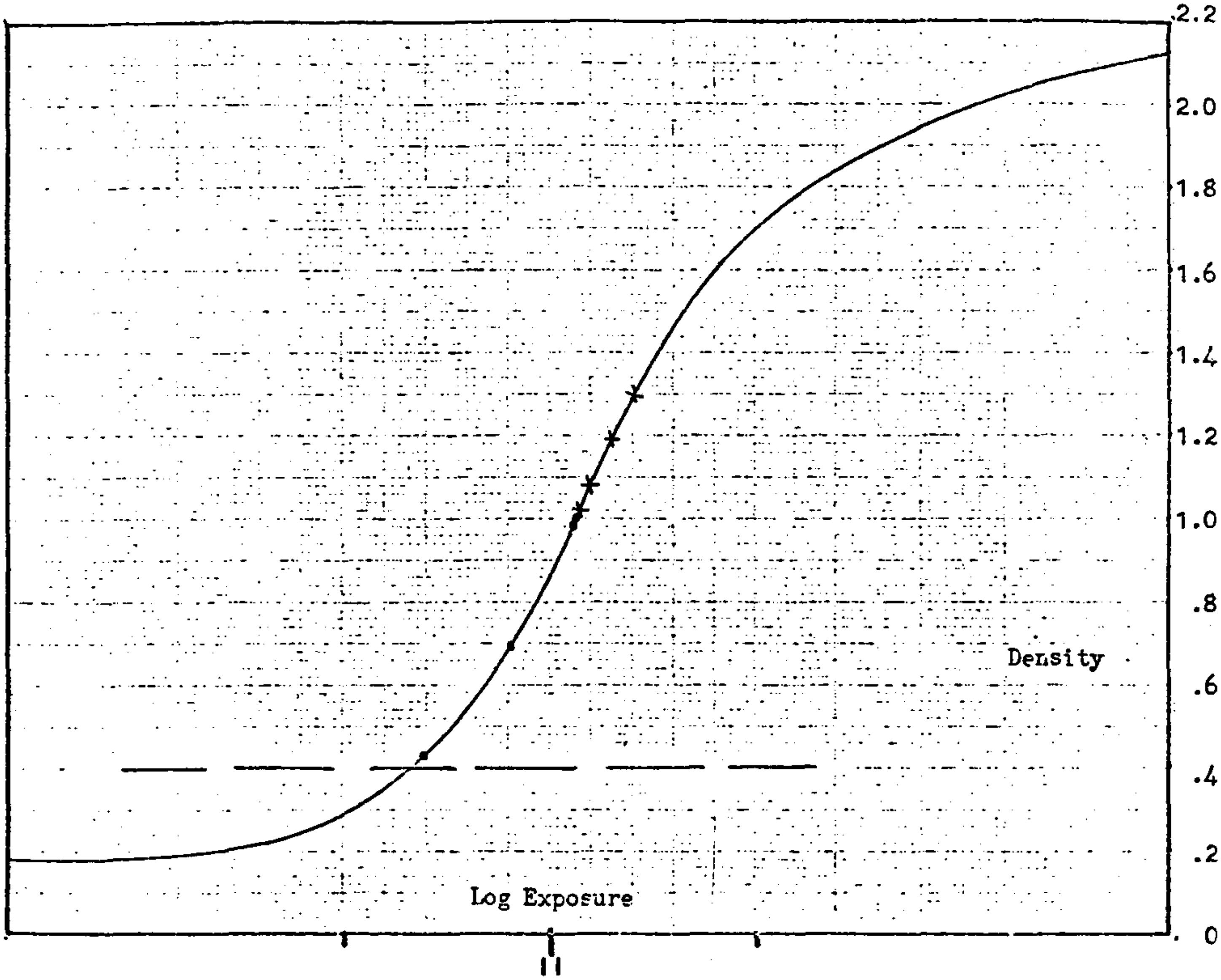


FIGURE 5-8

ON FRAME DENSITY Dmin Dmax

Mission 1111-1 CR-12 Rev. D 94 Inst. 325 FWD

Frames 1-20

Frame	Dmin	Dmax
5	.38	x.85
10	.45	x.98
15	.44	x1.14
20	.27	x1.21

Exposure

Sensitometer 1B; Lamp # 2007
Filter; Daylight
Exposure Time; 1/25 sec.
Log E_{11}; $\bar{1}.22$; Fog .18
Dual Gamma AEI 4.9
Film; 3414 AFS 15.7

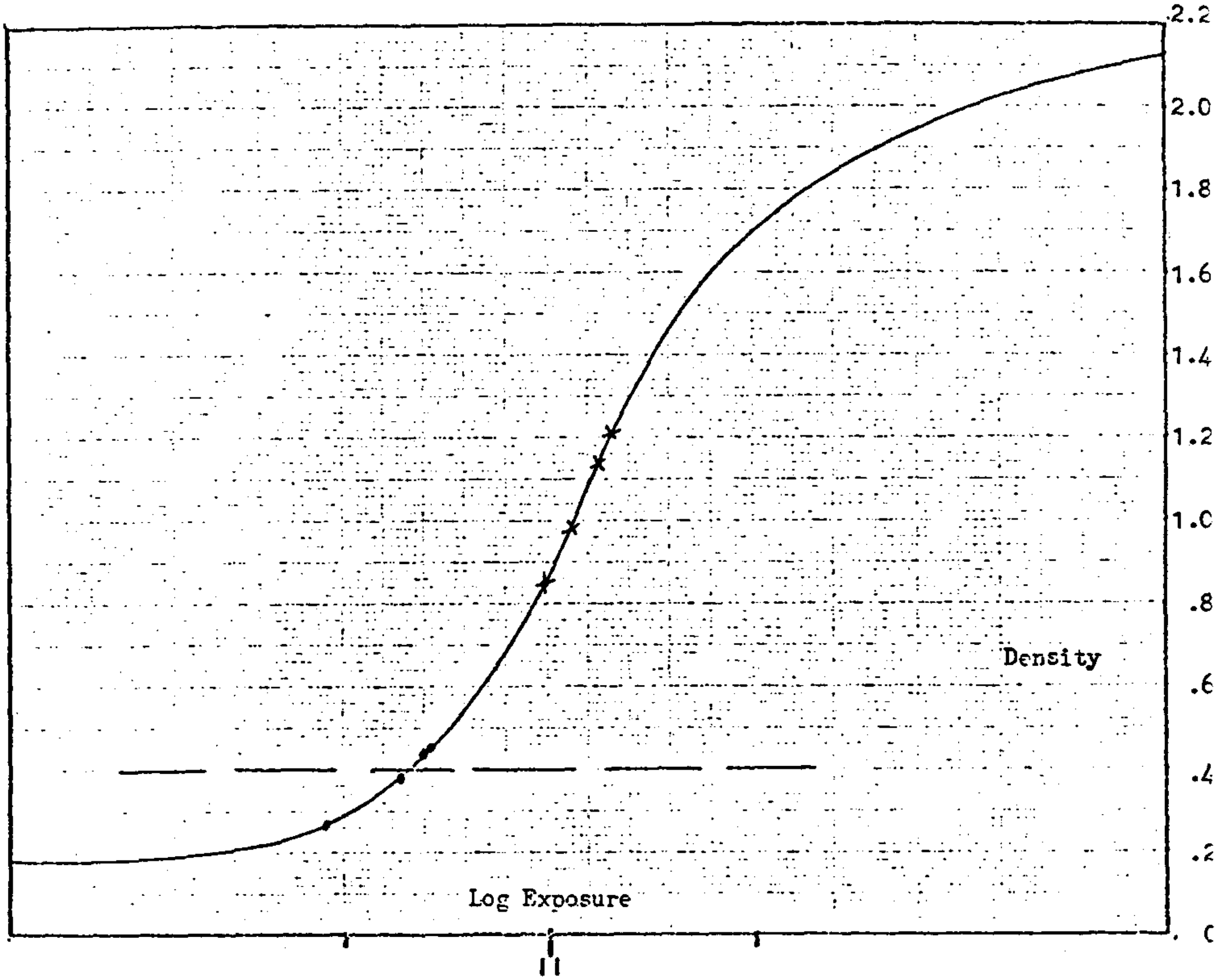


FIGURE 5-9

ON FRAME DENSITY Dmin Dmax

Mission 1111-1 CR-12

Rev. A 10 Inst. 324 AFT

Frames 1-20

Frame	Dmin	Dmax
5	.27	x1.21
10	.27	x1.44
15	.30	x1.44
20	.33	x1.43

Exposure

Sensitometer 1B; Lamp # 2007
Filter; Daylight
Exposure Time; 1/25 sec.
Log E_{11}; $\bar{1}.22$; Fog .18
Dual Gamma AEI 4.9
Film; 3414 AFS 15.7

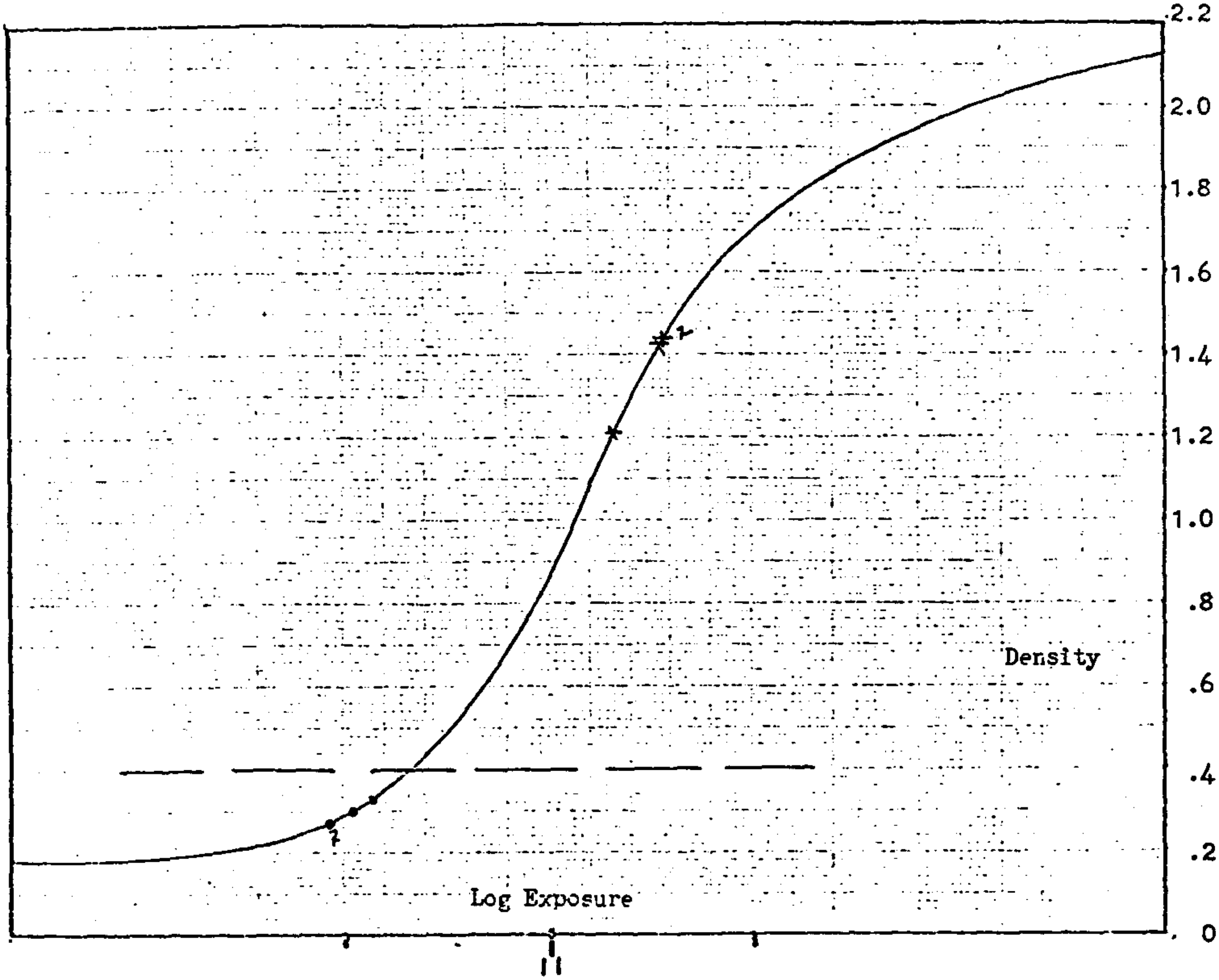


FIGURE 5-10

ON FRAME DENSITY Dmin Dmax

Mission 1111-1 CR-12

Rev. D 45 Inst. 324 AFT

Frames 1-30

Frame	Dmin	Dmax
5	.47	x.92
10	.35	x1.02
15	.53	x.80
20	.57	x.96
25	.45	x.90
30	.51	x.80

Exposure

Sensitometer 1B; Lamp # 2007
Filter; Daylight
Exposure Time; 1/25 sec.
Log E_{11}; $\bar{1}.22$; Fog .18
Dual Gamma AEI 4.9
Film; 3414 AFS 15.7

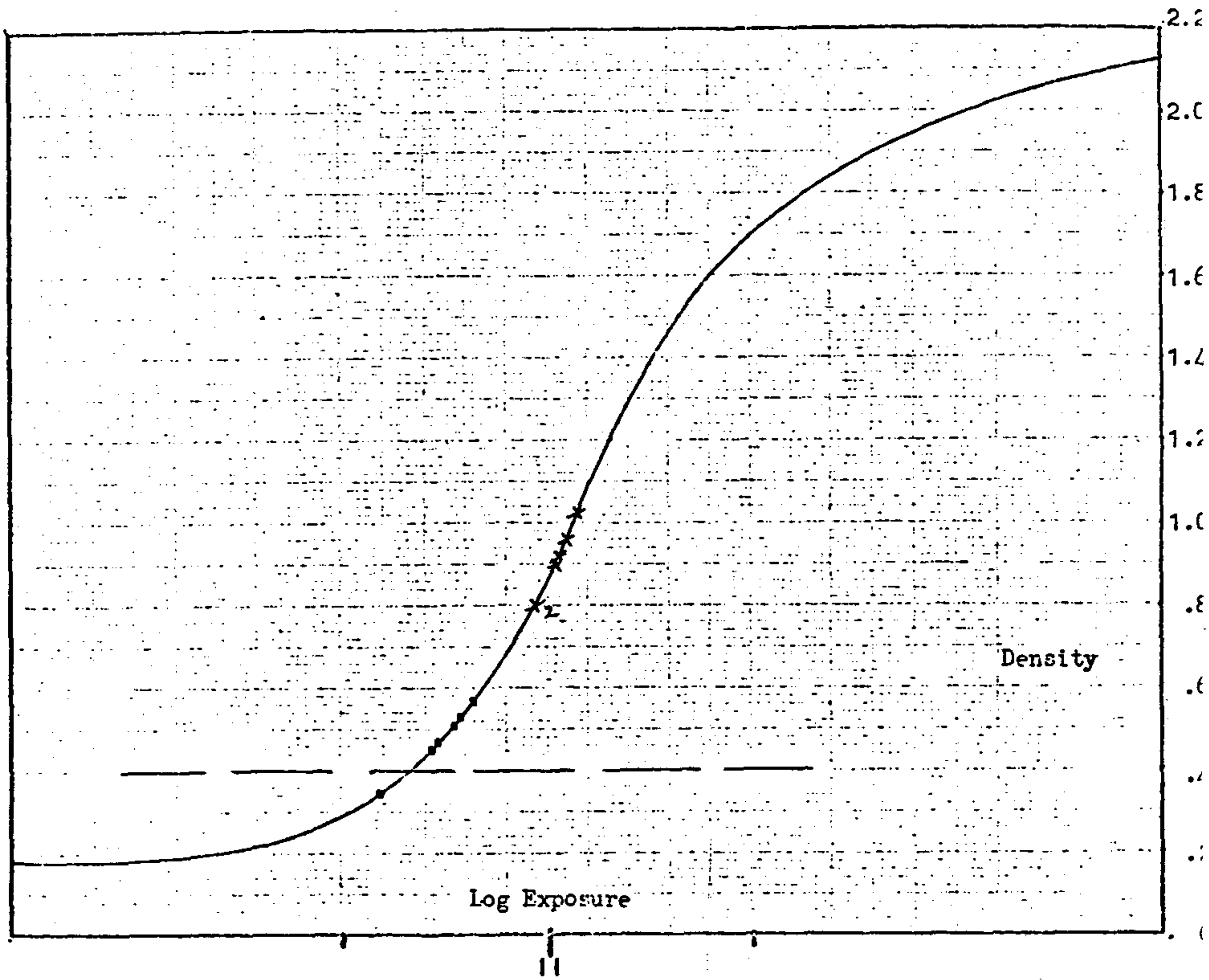


FIGURE 5-11

ON FRAME DENSITY Dmin Dmax

Mission 1111-1 CR-12 Rev. D 63 Inst. 324 AFT

Frames 1-20

Frame	Dmin	Dmax
5	.37	x1.04
10	.39	x1.01
15	.45	x1.15
20	.37	x1.02

Exposure

Sensitometer 1B; Lamp # 2007
Filter; Daylight
Exposure Time; 1/25 sec.
Log E_{11}; $\bar{1}.22$; Fog .18
Dual Gamma AEI 4.9
Film; 3414 AFS 15.7

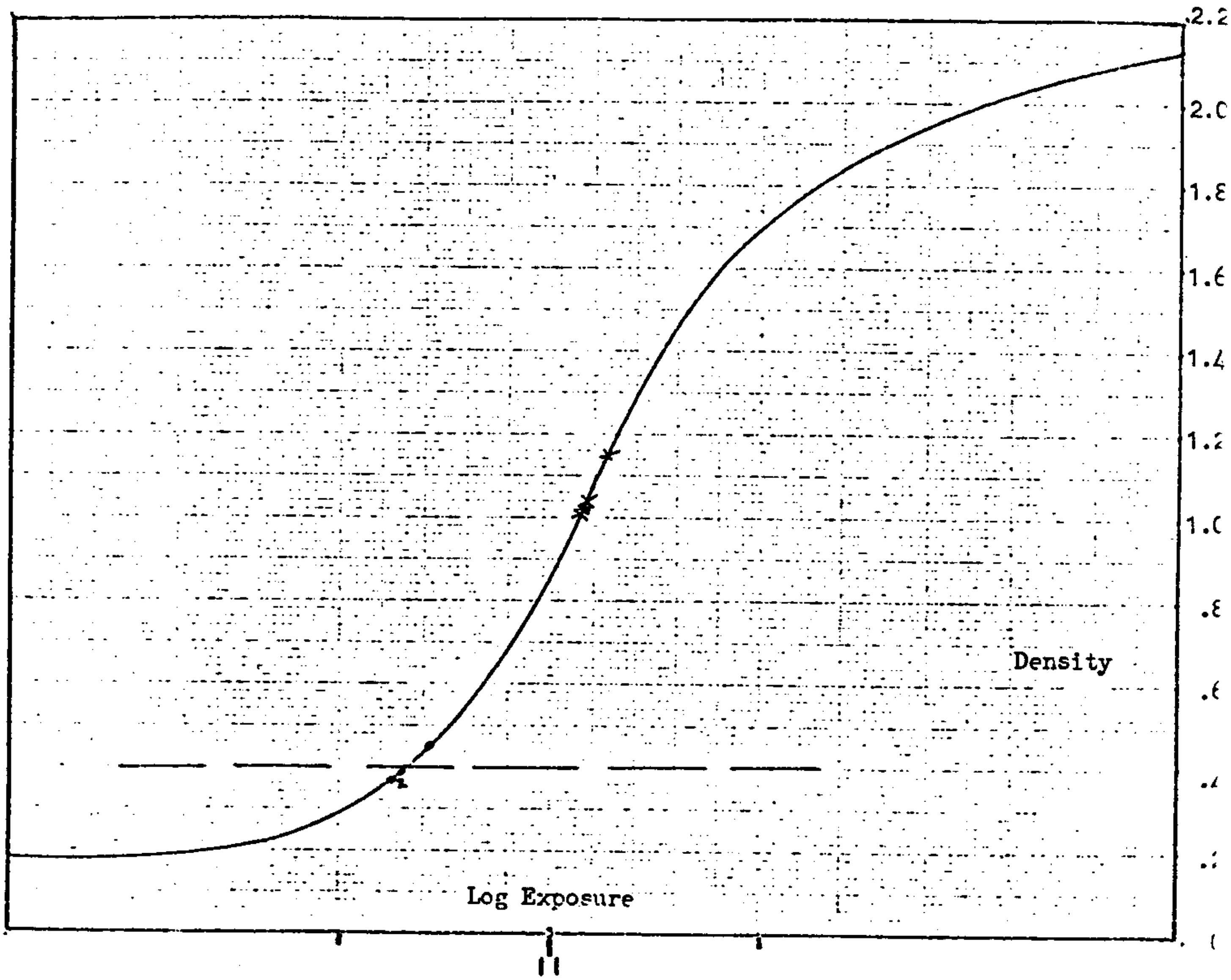


FIGURE 5-12

ON FRAME DENSITY Dmin Dmax

Mission 1111-1 CR-12 Rev. D77 Inst. 324 AFT

Frames 1 - 20

Frame	Dmin	Dmax
5	.58	x1.03
10	.62	x .98
15	.60	x .93
20	.56	x .95

Exposure

Sensitometer 1B; Lamp # 2007
Filter; Daylight
Exposure Time; 1/25 sec.
Log E_{11}; $\bar{1}.22$; Fog .18
Dual Gamma AEI 4.9
Film; 3414 AFS 15.7

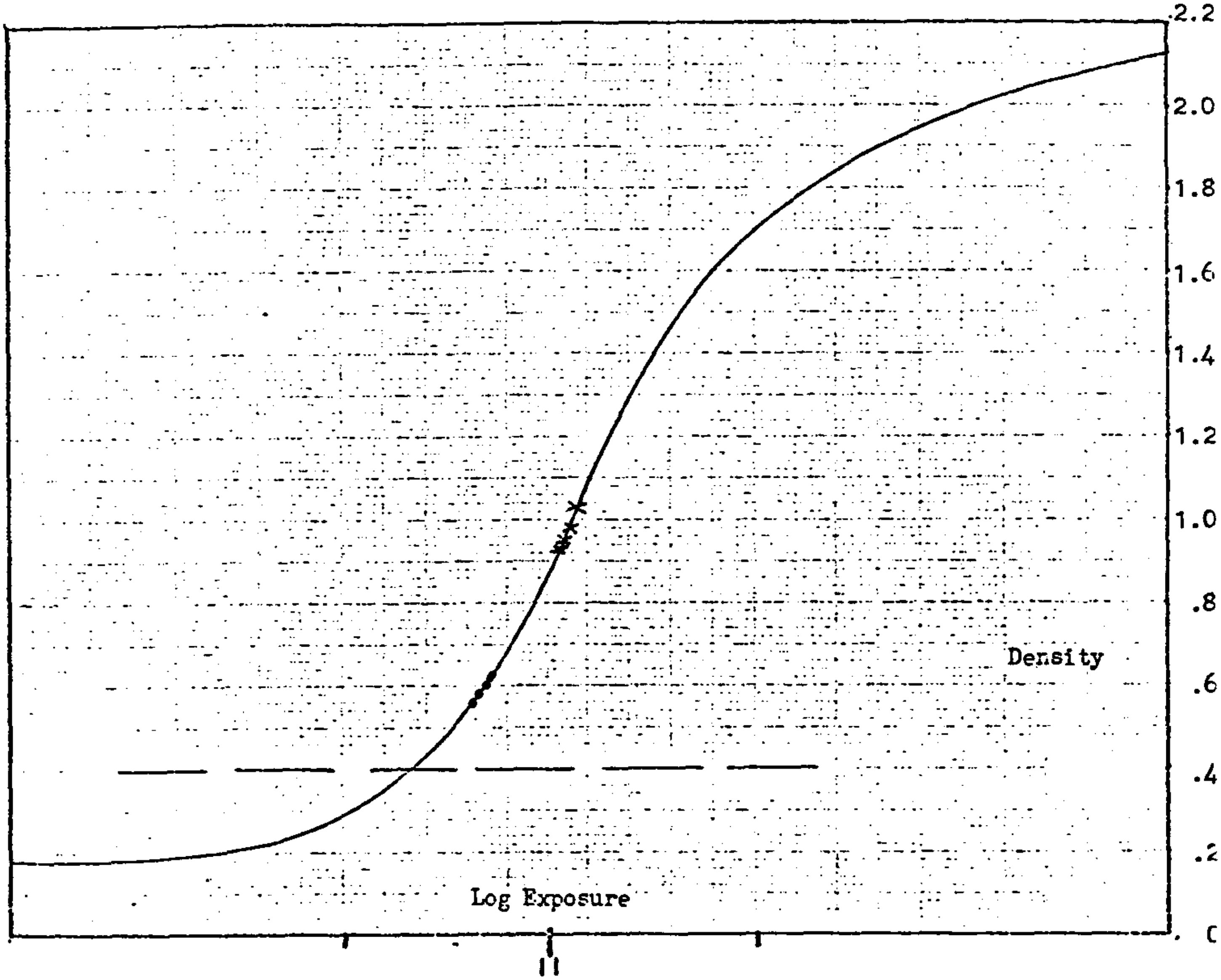


FIGURE 5-13

TOP SECRET/C

HANDLE VIA [redacted]
CONTROL SYSTEM

ON FRAME DENSITY Dmin Dmax

Mission 1111-1 CR-12 Rev. D94 Inst. 324 AFT

Frames 1 - 20

Frame	Dmin	Dmax
5	.30	x .52
10	.26	x .88
15	.47	x .82
20	.36	x .89

Exposure

Sensitometer 1B; Lamp # 2007
Filter; Daylight
Exposure Time; 1/25 sec.
Log E_{11}; $\bar{1}.22$; Fog .18
Dual Gamma AEI 4.9
Film; 3414 AFS 15.7

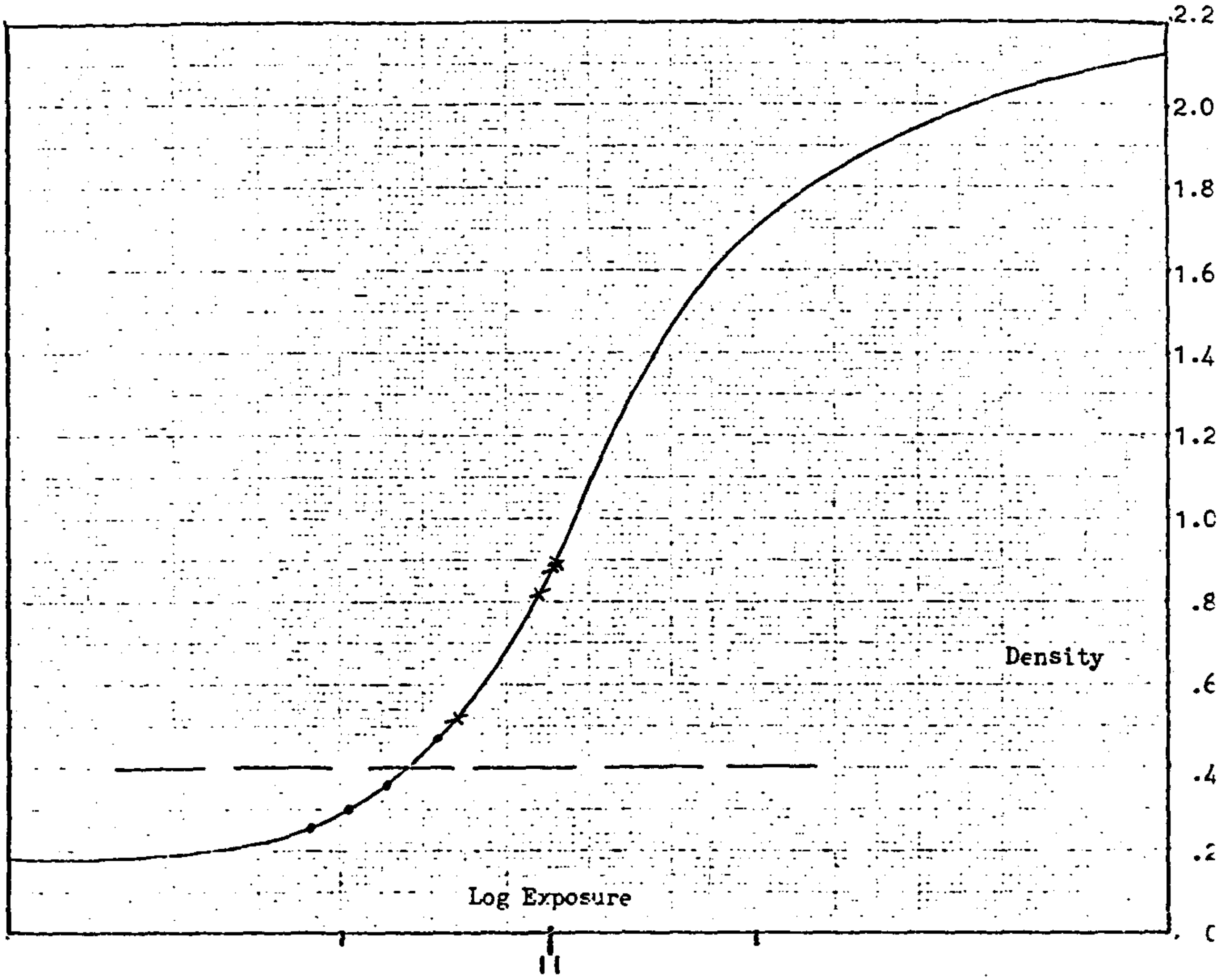


FIGURE 5-14

SECTION 6

VEHICLE ATTITUDE AND IMAGE SMEAR

A. VEHICLE ATTITUDE

The vehicle attitude errors for both Mission 1111-1 and 1111-2 were derived from the reduction of the Stellar camera photography. This attitude data is supplied to 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 percent of the forward camera photographic operations, excluding the first three frames of each operation, and the total range of the errors and rates.

TABLE 6-1

	Mission 1111-1		Mission 1111-2	
Value	90%	Range	90%	Range
Pitch Error (°)	0.47	0.17 to 0.76	0.70	0.18 to 0.90
Roll Error (°)	0.26	0.04 to 0.40	0.23	0.02 to 0.38
Yaw Error (°)	0.40	0.20 to +0.75	0.32	0.50 to +4.5
Pitch Rate (°/hr)	31.03	-75 to +75	41.42	-75 to +90
Roll Rate (°/hr)	21.53	-50 to +50	20.83	-50 to +55
Yaw Rate (°/hr)	32.88	-60 to +80	37.65	-75 to +75

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.

B IMAGE SMEAR

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, Figures 6-1 thru 6-4, 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 three 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 shown in Figures 6-5 thru 6-16.

The summary Table 6-2 presents the maximum IMC errors, resolution limits, and V/h ratio errors that existed during 90% of the photographic operations and the total range of values during all operations that were computed.

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.

MISSION 1111

IMC RATIO AND RESOLUTION LIMITS

VALUE	UNITS	CAMERA	MISSION 1111-1 90%	MISSION 1111-1 Range	MISSION 1111-2 90%	MISSION 1111-2 Range
IMC Ratio Error	%	Fwd-Looking	2.71	-5.0 to +3.0	2.17	-3.2 to +5.0
		Aft-Looking	2.69	-4.0 to +3.5	2.19	-2.2 to +4.5
Cross Track Resolution Limit	Feet	Fwd-Looking	3.8	0.0 to 6.0	2.35	0.00 to 3.6
		Aft-Looking	5.66	0.00 to 10.0	3.70	0.00 to 6.0
Along Track Resolution Limit	Feet	Fwd-Looking	1.71	0.00 to 6.00	1.57	0.0 to 4.5
		Aft-Looking	2.62	0.00 to 7.00	2.25	0.0 to 4.5
V/h Ratio Error	%	Fwd-Looking	2.62	-4.5 to +3.0	2.12	-3.0 to +4.0
		Aft-Looking	2.63	-4.5 to +3.0	1.97	-3.0 to +4.0

TABLE 6-2

[redacted]

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 2.

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

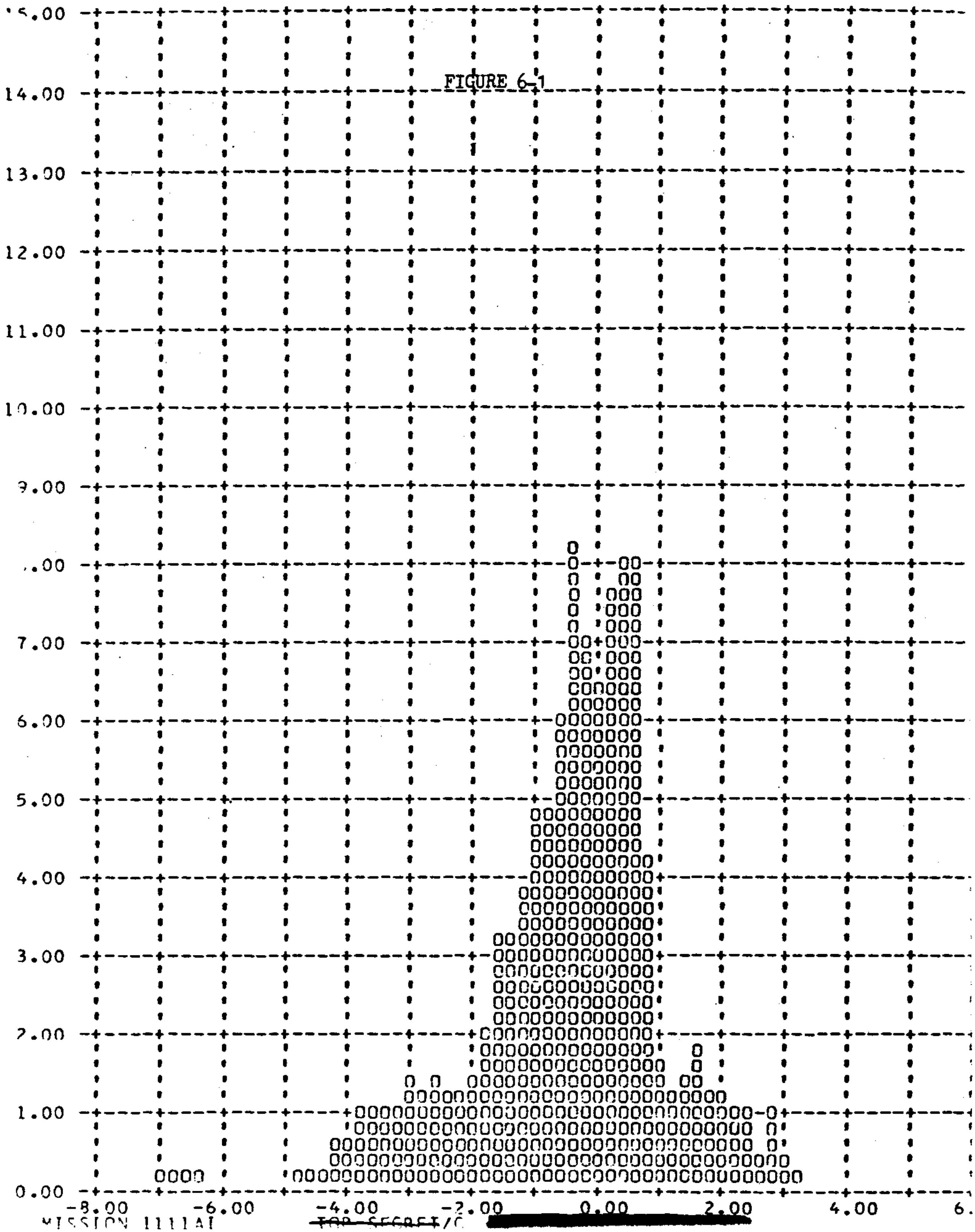


FIGURE 6-1

MISSION 1111AI

~~TOP SECRET/C~~ [redacted]

[redacted] Page of 114 pages

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 2.

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

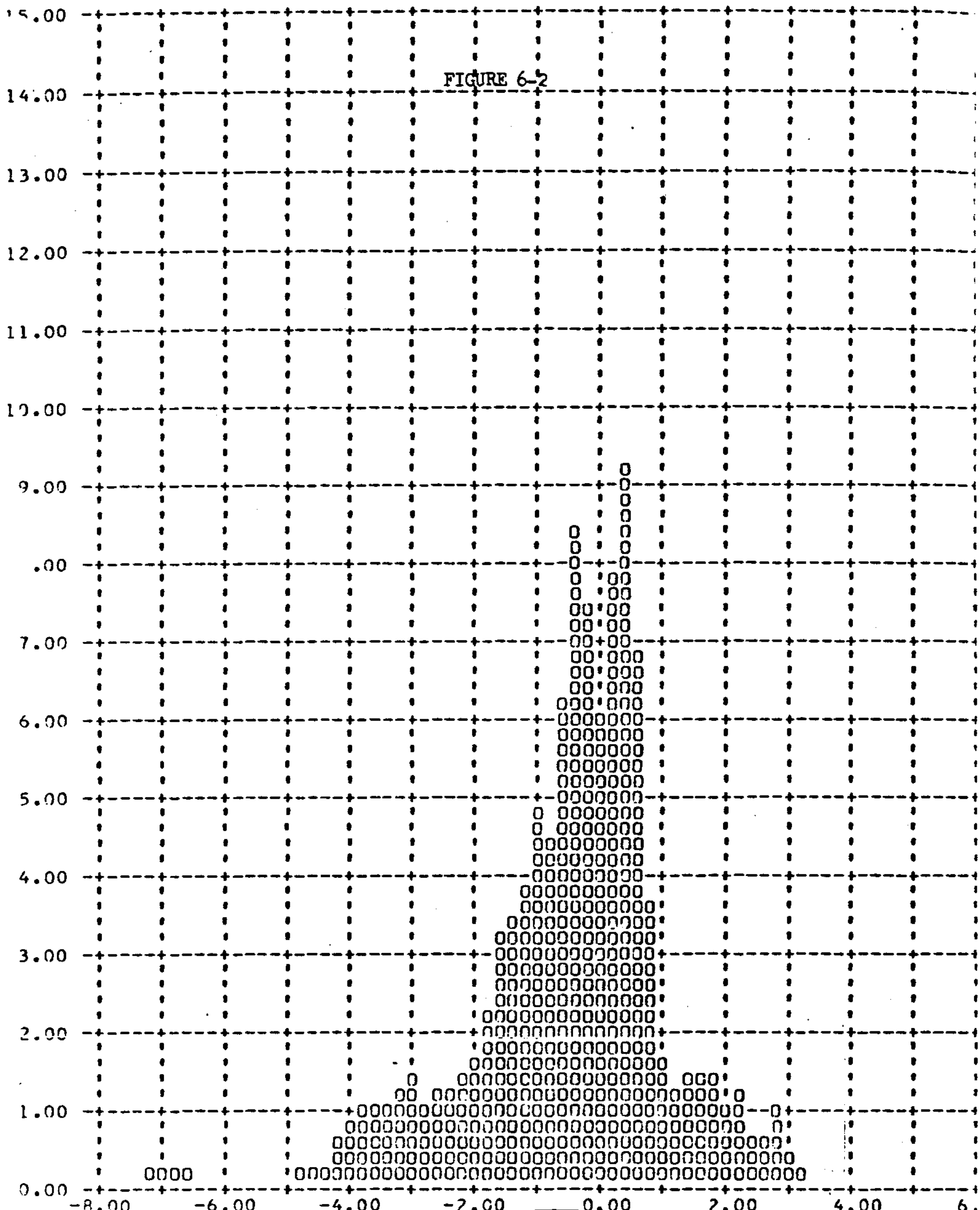


FIGURE 6-2

MISSION 1111A2 ~~TOP SECRET/C~~ [redacted]

FRAMES 1-3 OF EACH OP OMITTED   90 PERCENT = 2.1

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

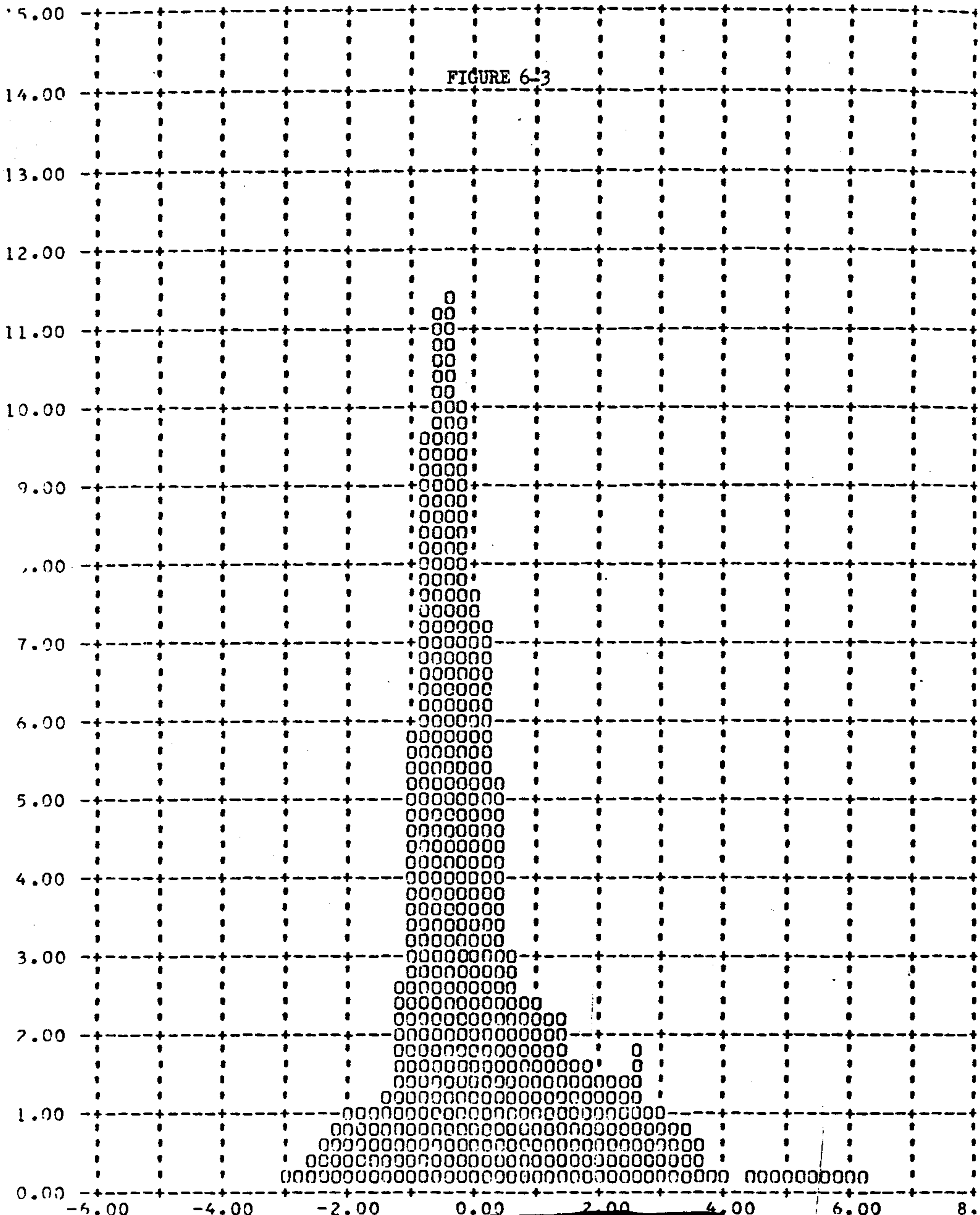


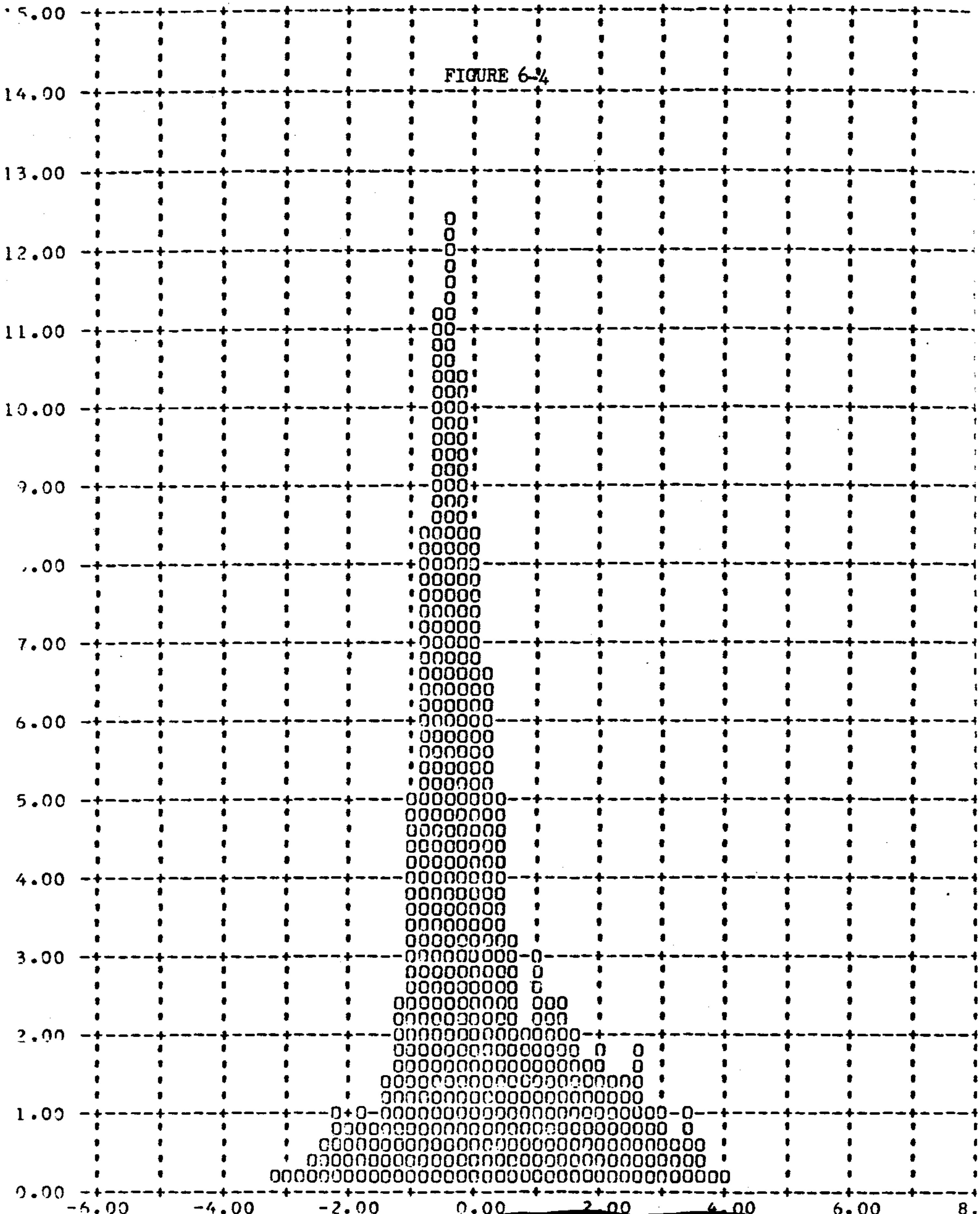
FIGURE 6-3

MISSION 1111B1   TOP SECRET/C [redacted]

[redacted]

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 2.

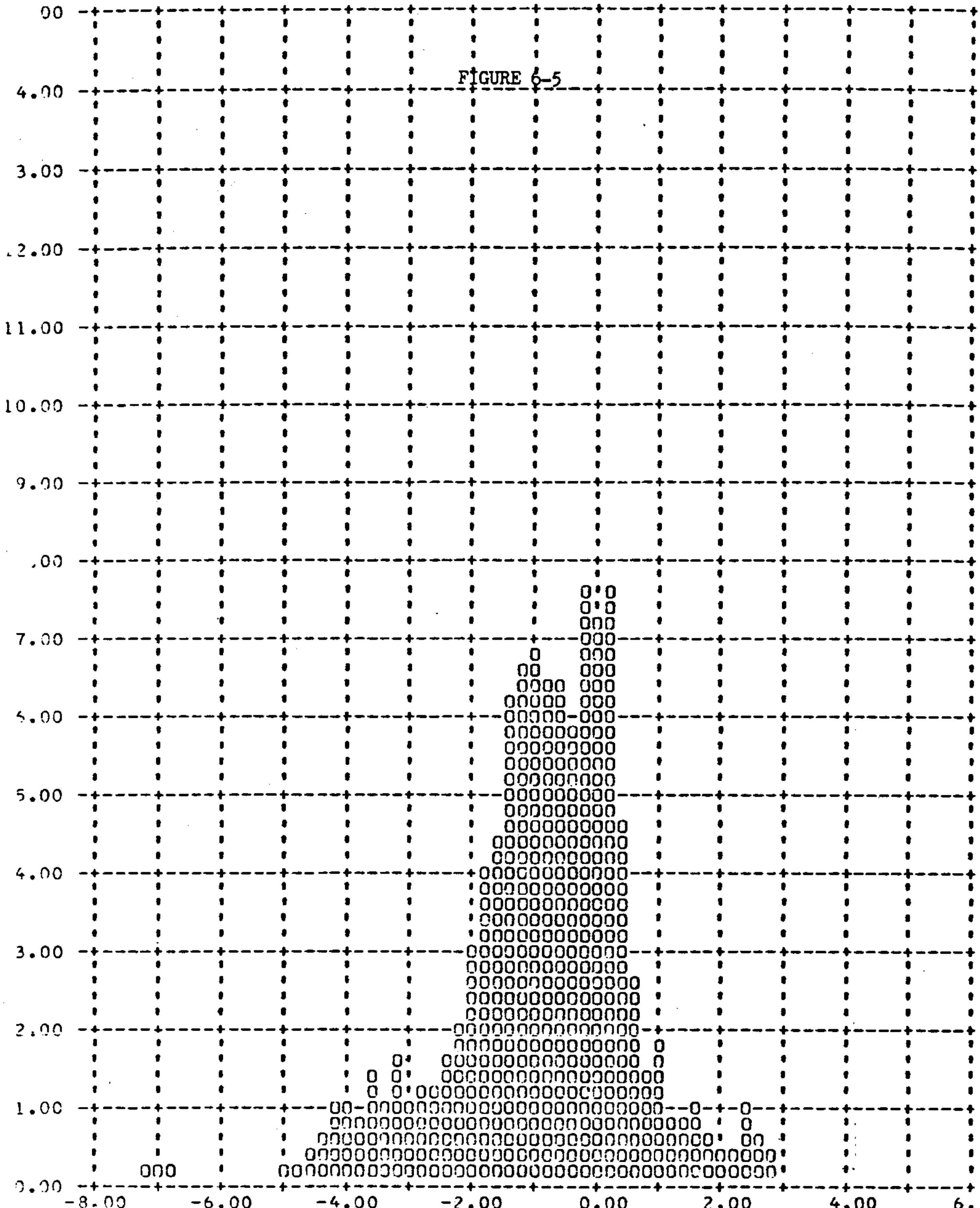
Y V/H RATIO ERROR - PERCENT (X) VERSUS FREQUENCY - PERCENT (Y)



MISSION 1111B2 TOP SECRET/C [redacted]

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 2.7

Y IMC ERROR -- PERCENT (X) VERSUS FREQUENCY -- PERCENT (Y)



FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 3.82

CROSS TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)

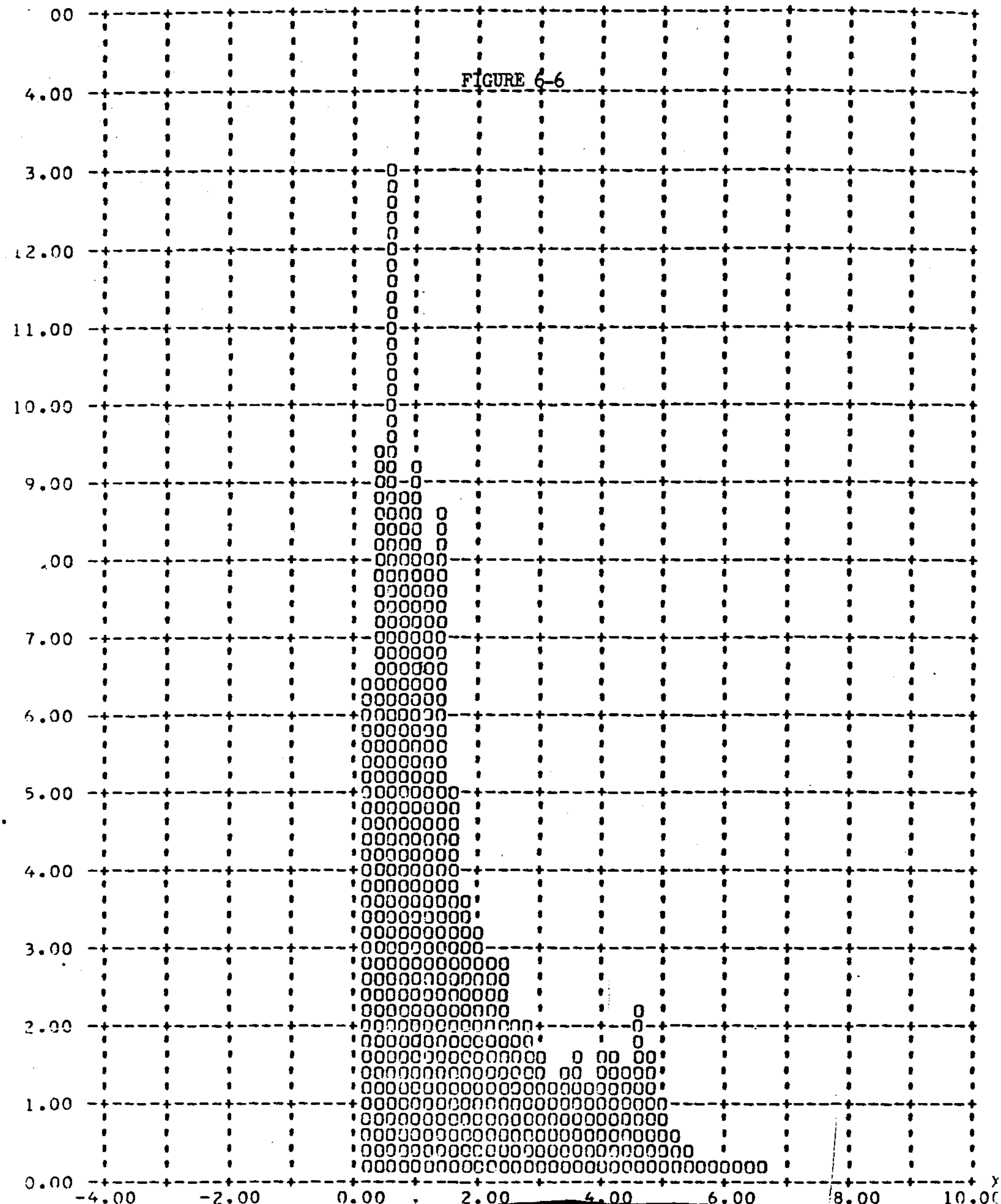
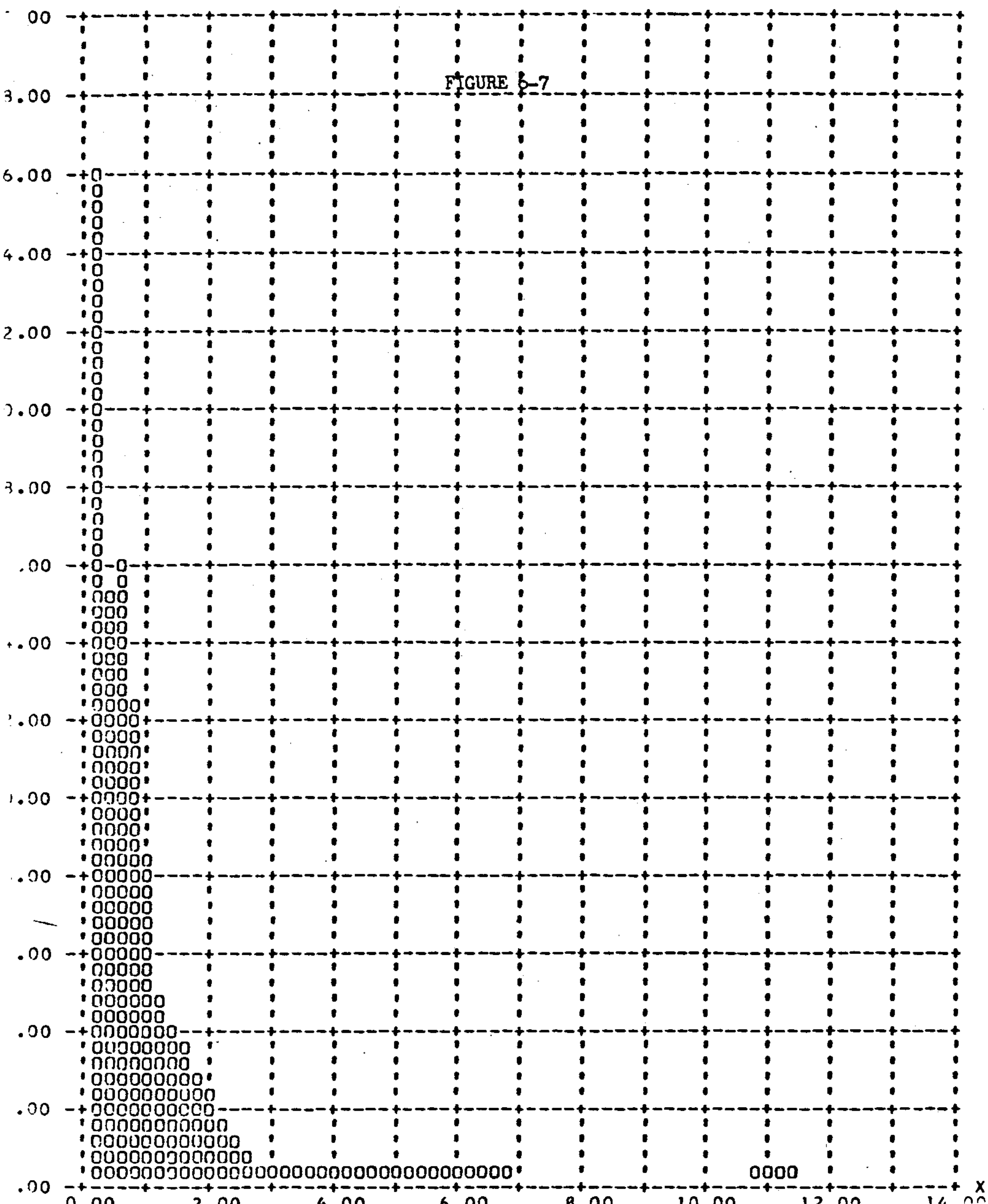


FIGURE 6-6

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 1.71

Y ALONG TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)



FRAMES 1-3 OF EACH OP OMITTED   90 PERCENT = 2.70

IMC ERROR -- PERCENT (X) VERSUS FREQUENCY -- PERCENT (Y)

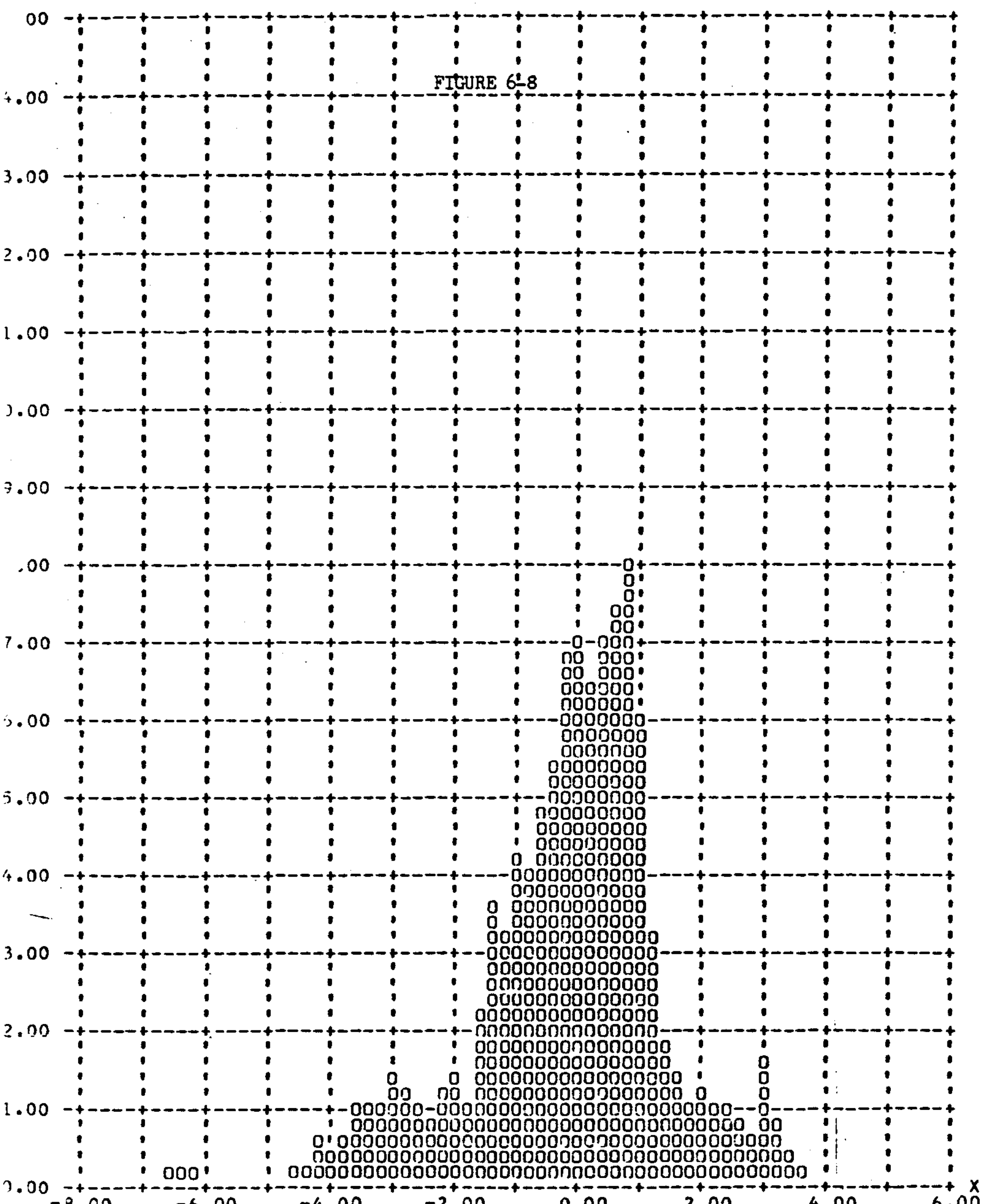


FIGURE 6-8

[redacted]

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 5.55

Y CROSS TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)

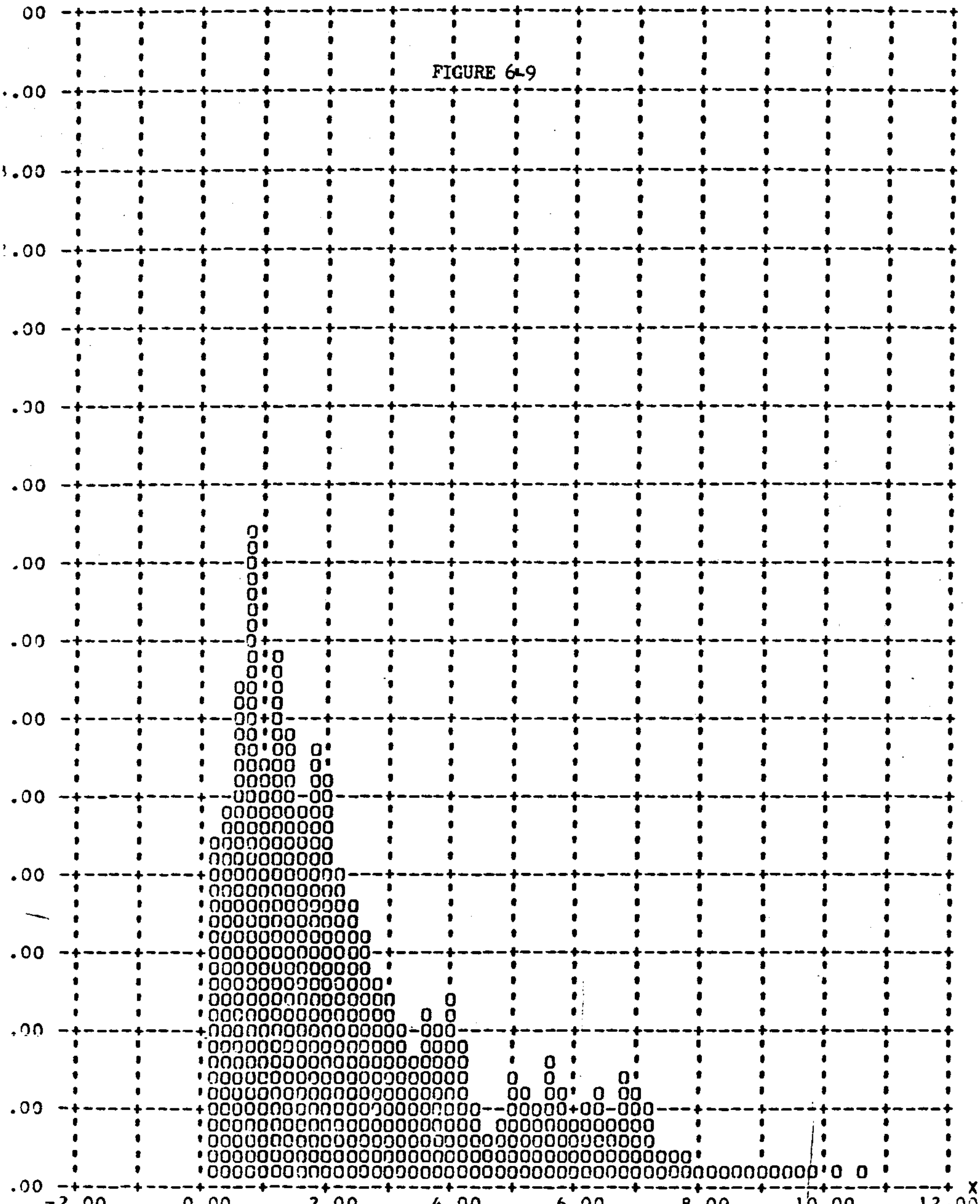
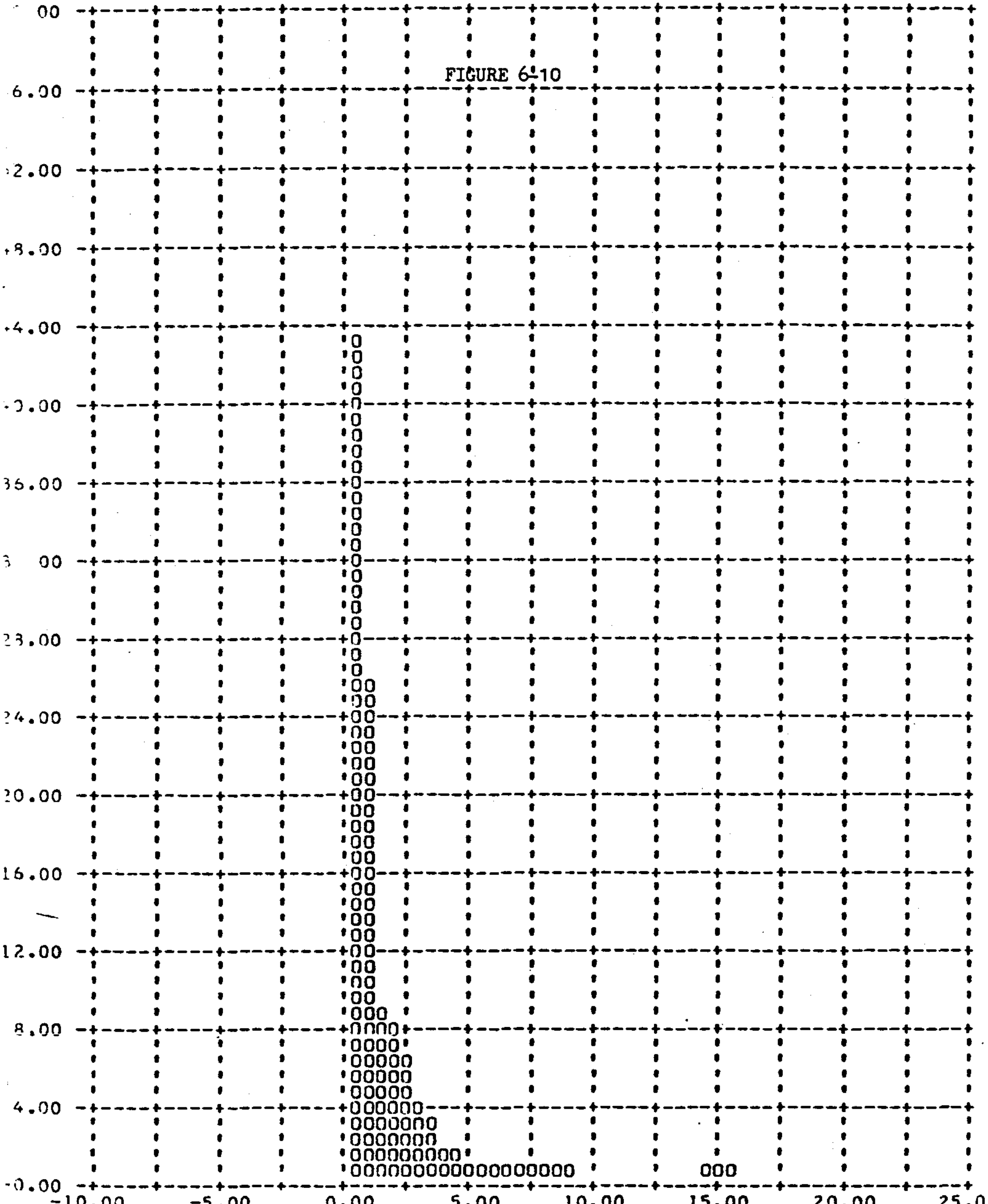


FIGURE 6-9

[redacted]

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 2.62

Y ALONG TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)

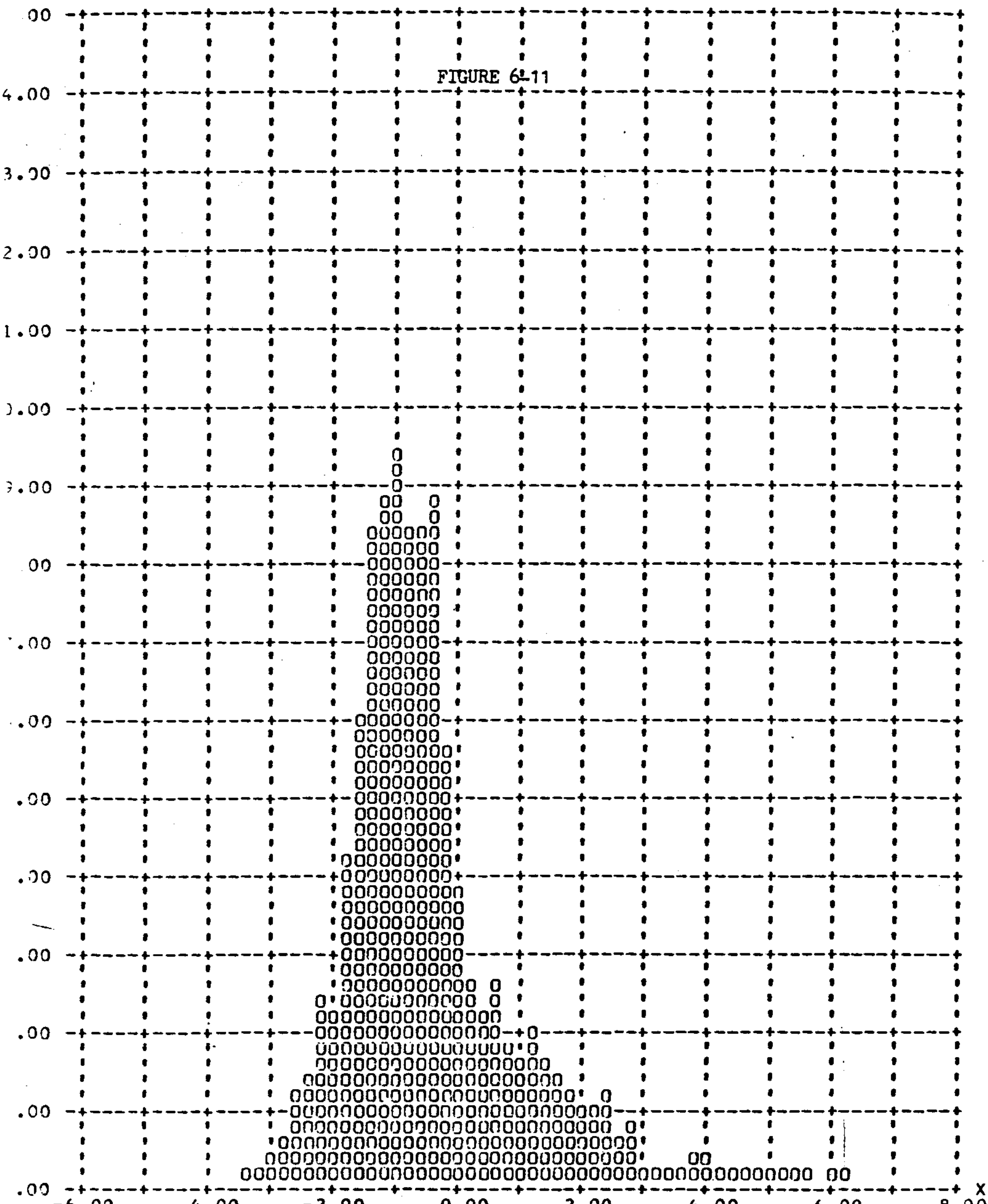


[redacted]

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 2.17

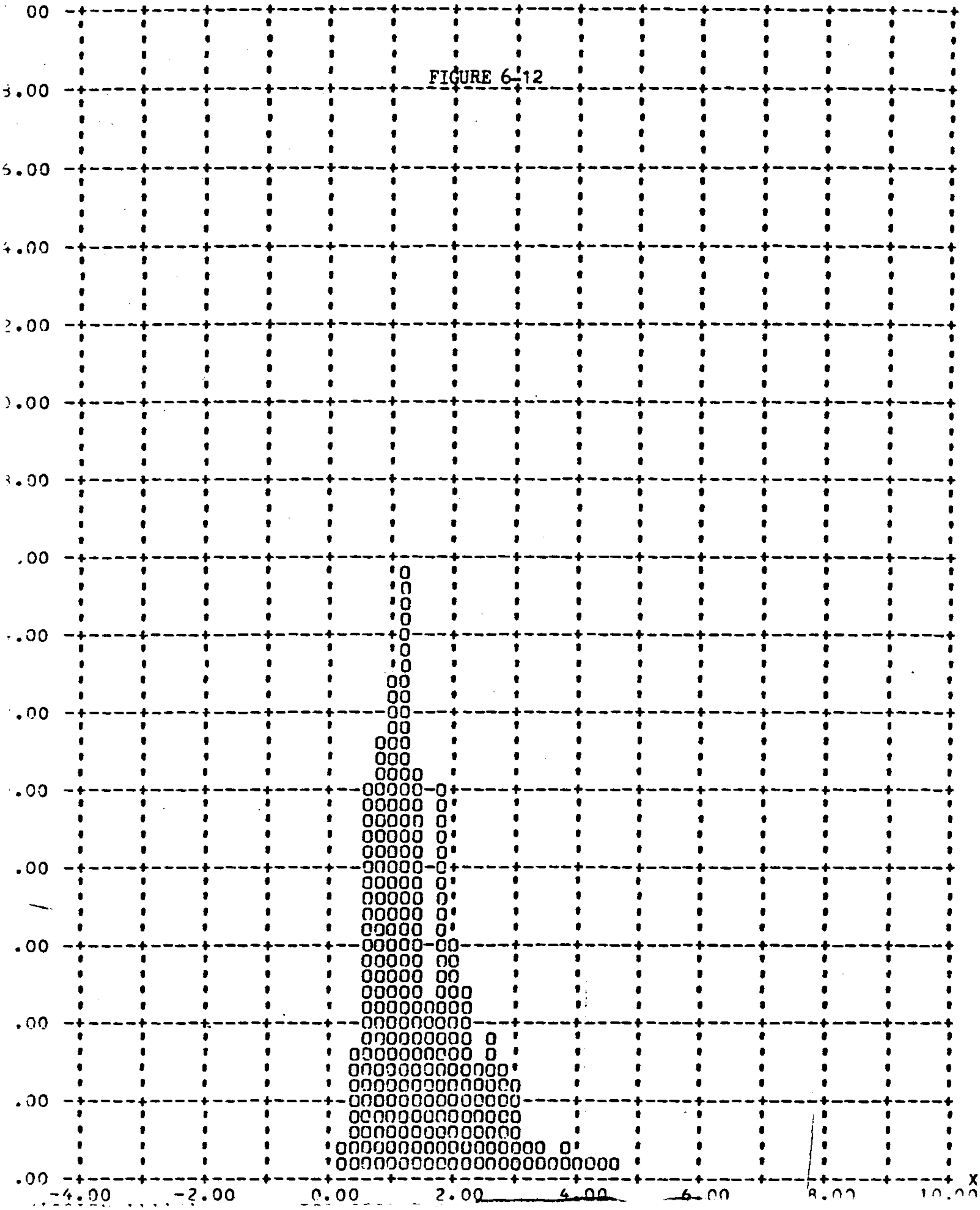
IMC ERROR -- PERCENT (X) VERSUS FREQUENCY -- PERCENT (Y)

FIGURE 6-11



FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 2.43

Y CROSS TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)



FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 1.58

Y ALONG TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)

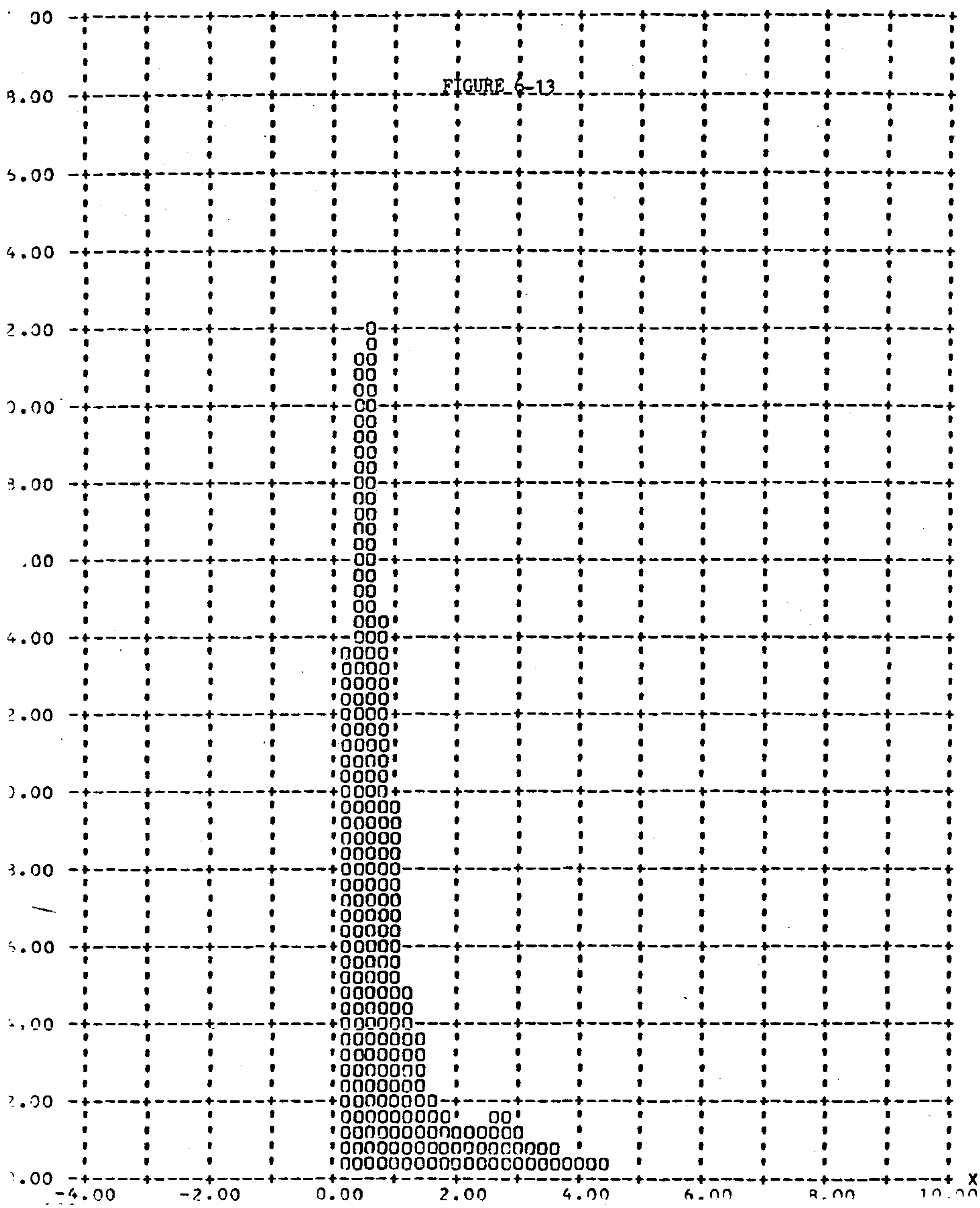


FIGURE 6-13

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 2.21

IMC ERROR -- PERCENT (X) VERSUS FREQUENCY -- PERCENT (Y)

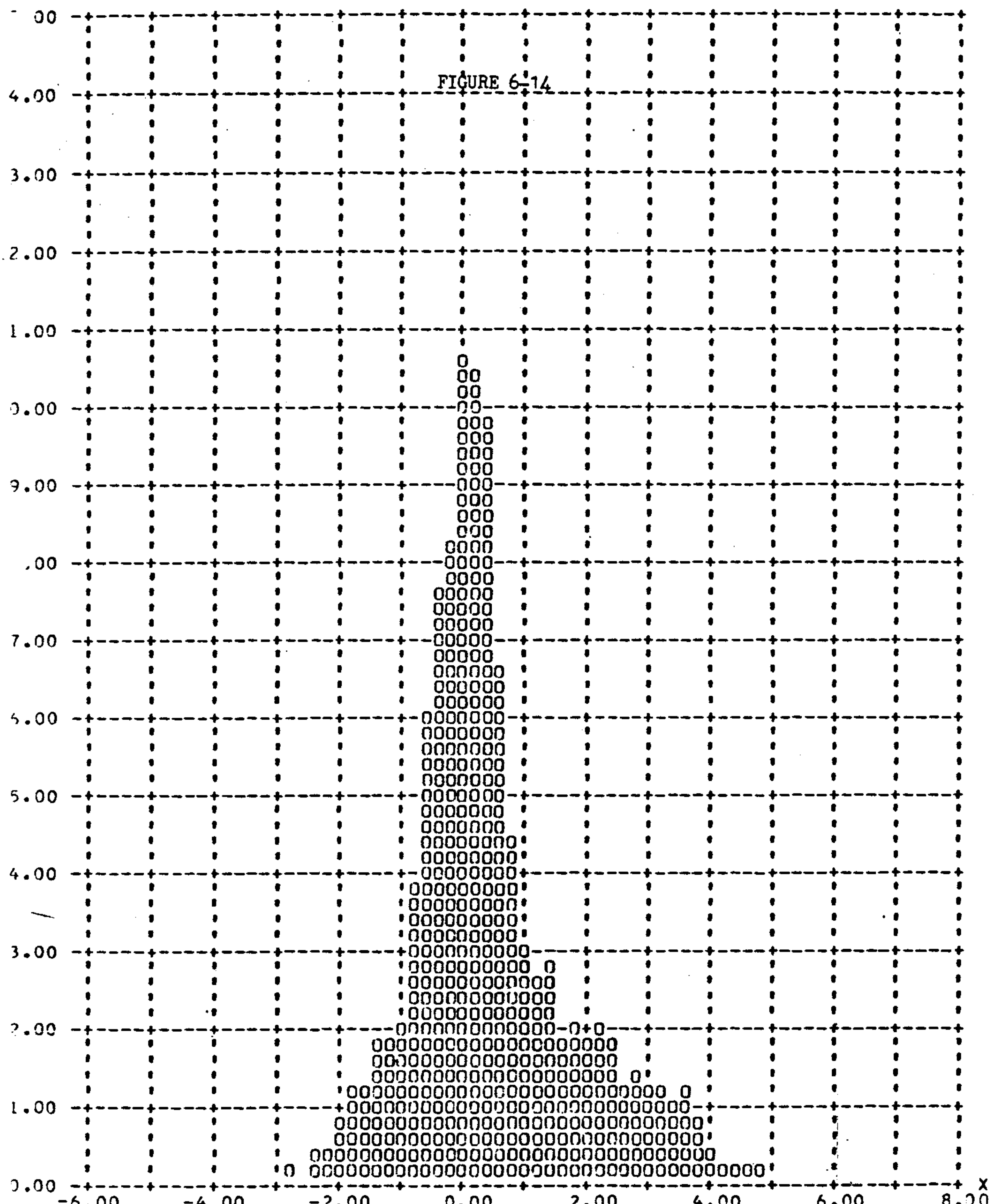
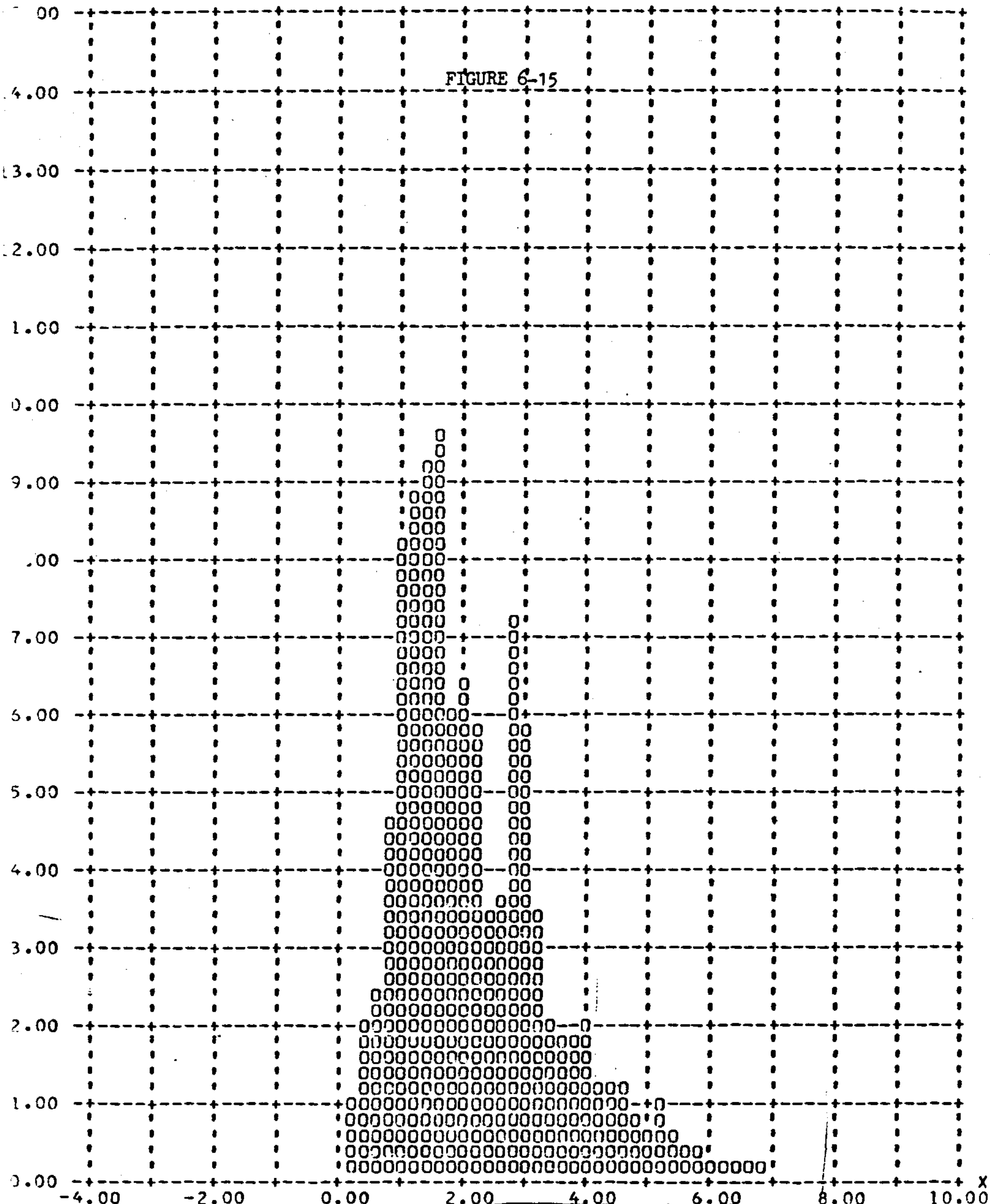


FIGURE 6-14

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 3.65

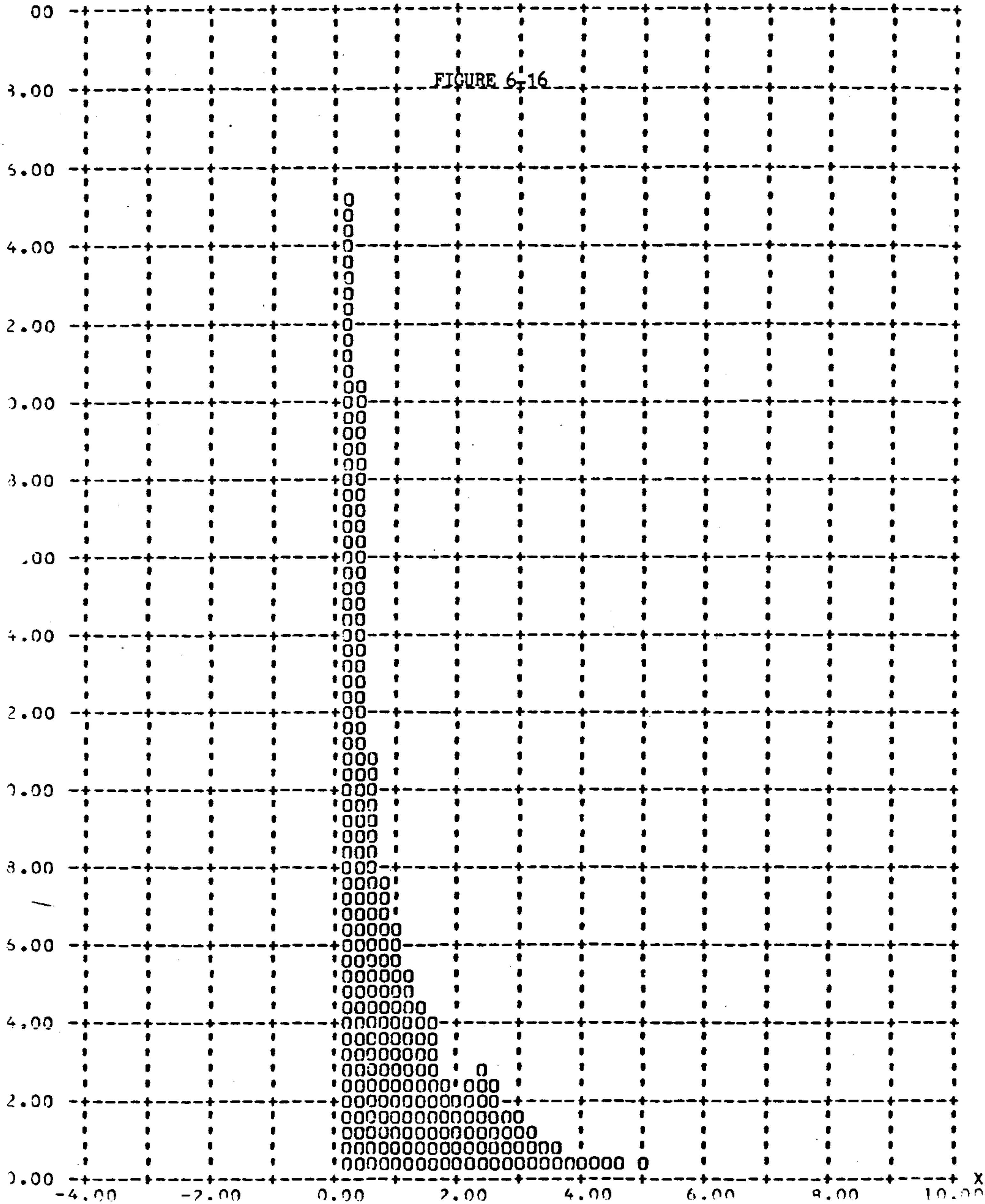
Y CROSS TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)



[redacted]

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 2.24

Y ALONG TRACK RESOLUTION LIMIT - FEET (X) VERSUS FREQUENCY - PERCENT (Y)



SECTION 7

RELIABILITY

Reliability estimates presented in this section begin with samples taken from the Mural Program, M-7 system. As a result most of the Mural Program and all of the "J" program have been included in the reliability analysis. The DISIC camera (1100 series missions) is treated separately from the Stellar-Index camera (1000 series missions).

Reliability estimates are shown for the primary category that includes the panoramic cameras, main panoramic door ejection, payload command and control, payload clock, and overall payload functioning on orbit. The secondary reliability category includes the auxiliary camera functions such as the DISIC and Horizon cameras.

Reliability estimates deal entirely with the payload. Only electrical and mechanical functions are considered. Vehicle failures are not included. Early recovery is treated as a complete mission provided that early termination was not caused by payload malfunction.

The following tabulation summarizes the reliability estimates for Mission 1111 and these are the highest values attained thus far for the Corona system. A 50 percent confidence level is used.

TABLE: 7-1

Primary Function (M-7 and Up)	Opportunities To Operate	Failures	Estimated Reliability
Panoramic Cameras	264	4	98.27%
Panoramic Camera Doors	154	0	99.56%
Command and Control	17784 (Hrs)	2	97.51%
Clock	17784 (Hrs)	0	99.35%
Total Combined Functions above:	-	-	94.8 %

Secondary Function	Sample Size	Failures	Estimated Reliability
DISIC Camera (Sample begins with CR-1)	55,325 Cycles	2	79.4 %
Horizon Camera (Sample begins with J-5)	166,000	0	99.39%

Additionally the CR Payload System Reliability curves are presented in Figures 7-1 through 7-8.

	NAME	DATE	LOCKHEED MISSILES & SPACE COMPANY A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION	Page	TEMP.	PERM.
Prepared	[redacted]	10-6-70	TITLE			
Checked			SUMMARY CR RELIABILITY MAIN INSTRUMENTS (I)	Model CR-12		
Approved	[redacted]	10-7-70		Report No.		

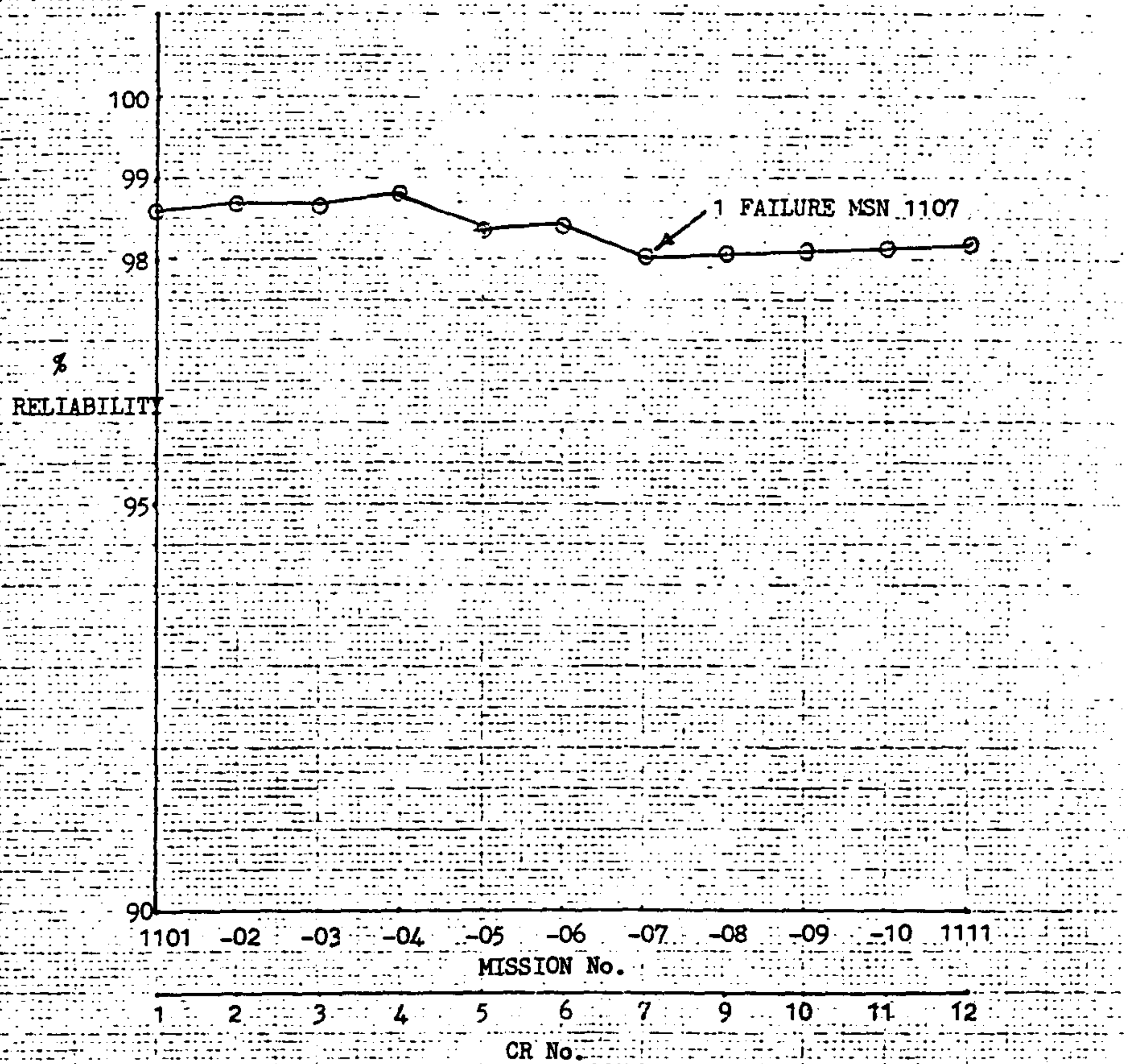


FIGURE 7-1

	NAME	DATE	LOCKHEED MISSILES & SPACE COMPANY A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION	Page	TEMP	PERM
Prepared	[redacted]	10-6-70	TITLE SUMMARY CR RELIABILITY MAIN DOORS (MD)			
Checked				Model CR-12		
Approved	[redacted]	10-7-70		Report No.		

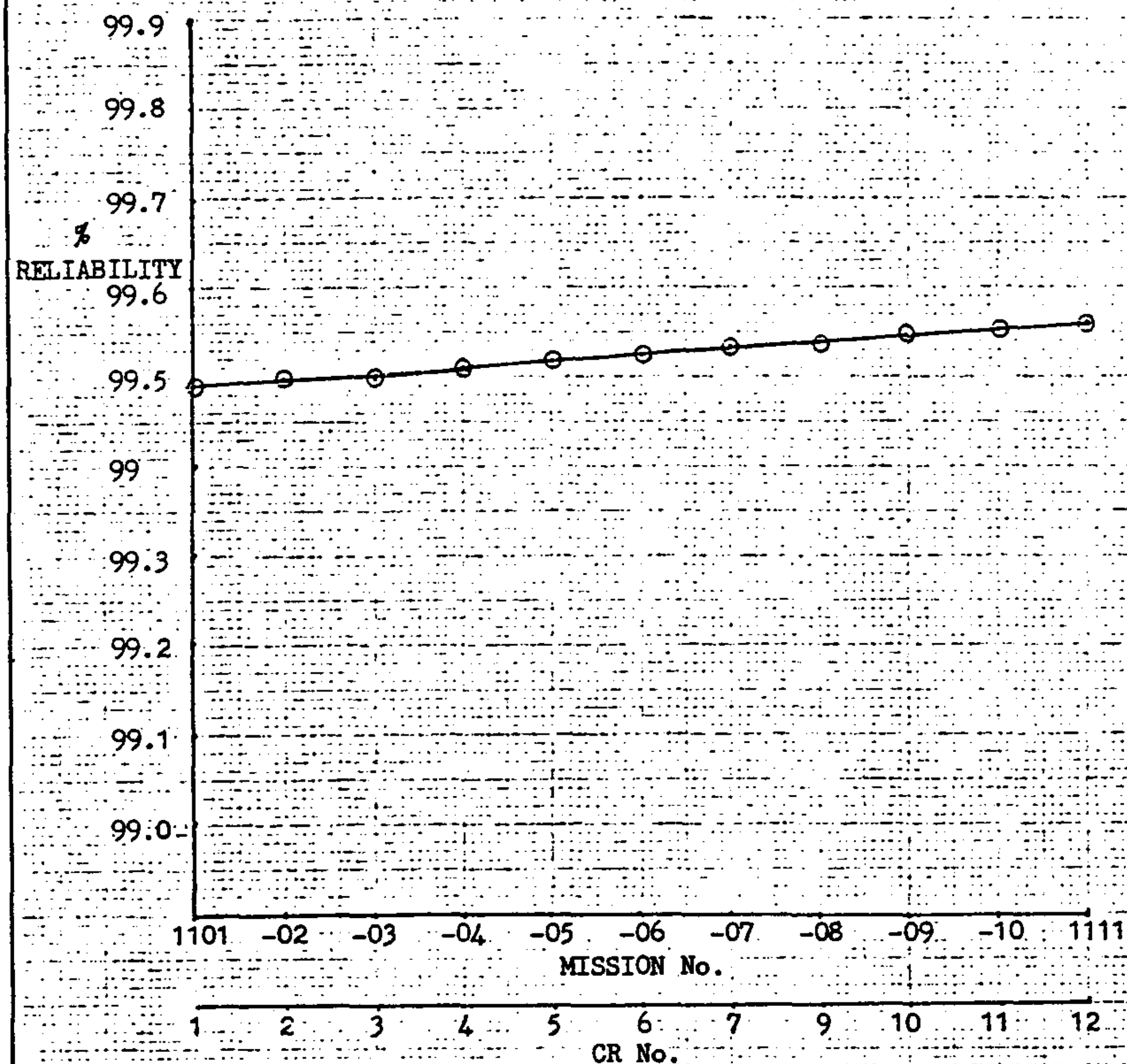
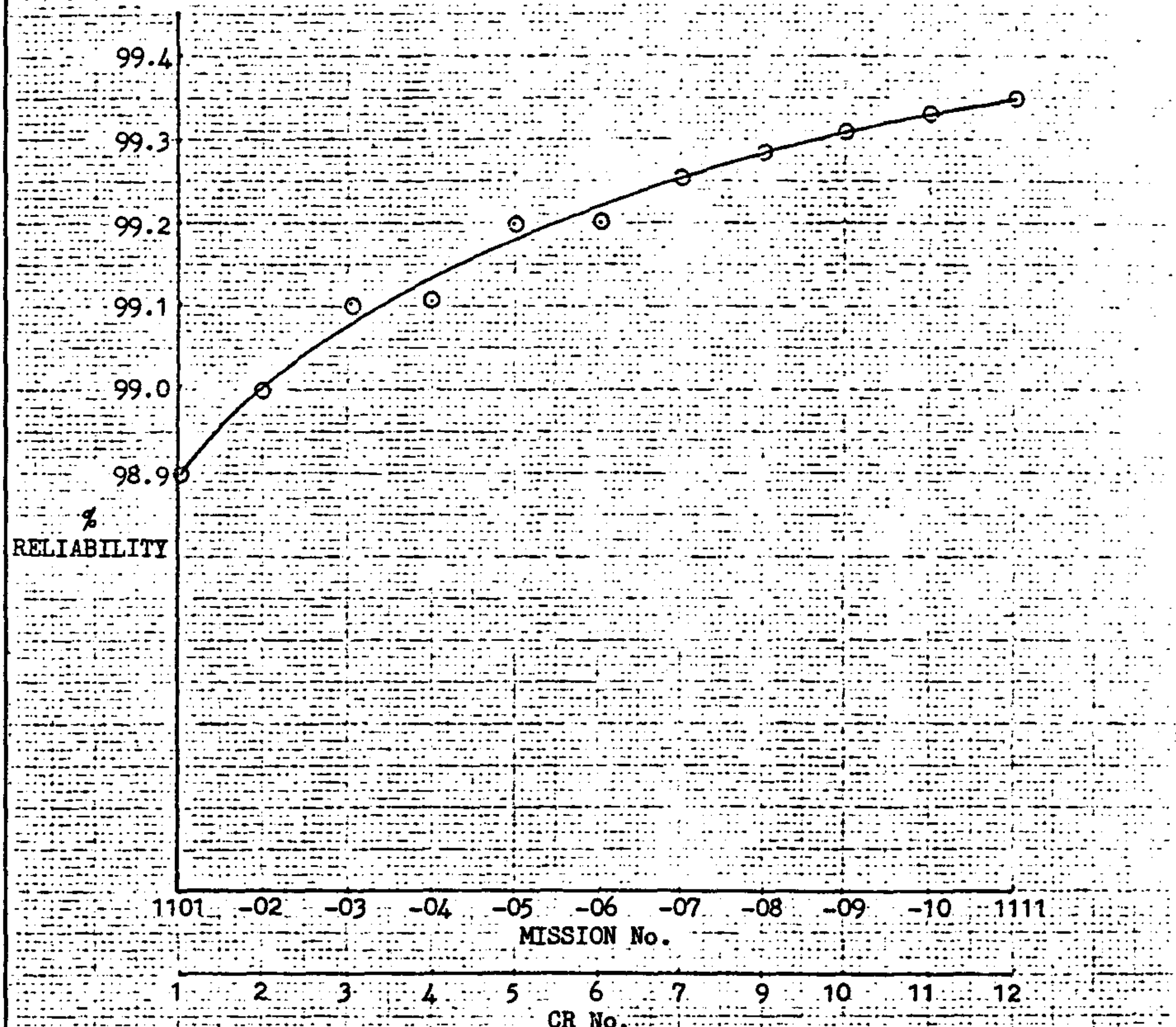


FIGURE 7-2



99.4
99.3
99.2
99.1
99.0
98.9
% RELIABILITY
1101 -02 -03 -04 -05 -06 -07 -08 -09 -10 1111
MISSION No.
1 2 3 4 5 6 7 9 10 11 12
CR No.

FIGURE 7-3

	NAME	DATE	LOCKHEED MISSILES & SPACE COMPANY A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION	Page	TEMP	PERM
Prepared	[redacted]	10-6-70				
Checked			TITLE SUMMARY CR RELIABILITY COMMAND AND CONTROL (CC)	Model CR-12		
Approved	[redacted]	10-7-70		Report No.		

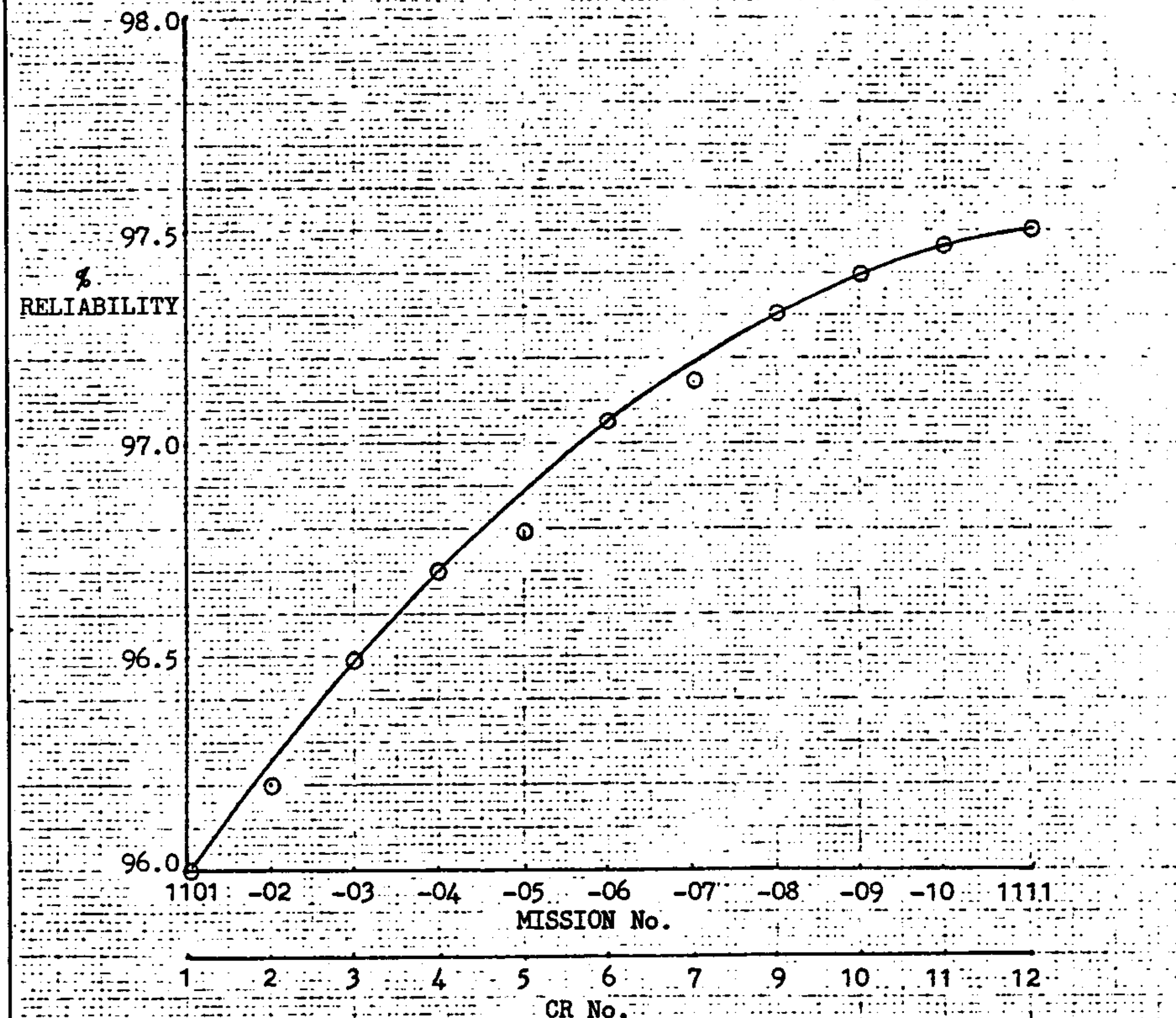


FIGURE 7-4

	NAME	DATE	LOCKHEED MISSILES & SPACE COMPANY A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION	Page	TEMP	PERM
Prepared	[redacted]	10-6-70				
Checked			TITLE CR RELIABILITY(R) SUMMARY ON ORBIT FUNCTIONS*	Model CR-12		
Approved	[redacted]	10-7-70	*R = MD·C·CC·I	Report No.		

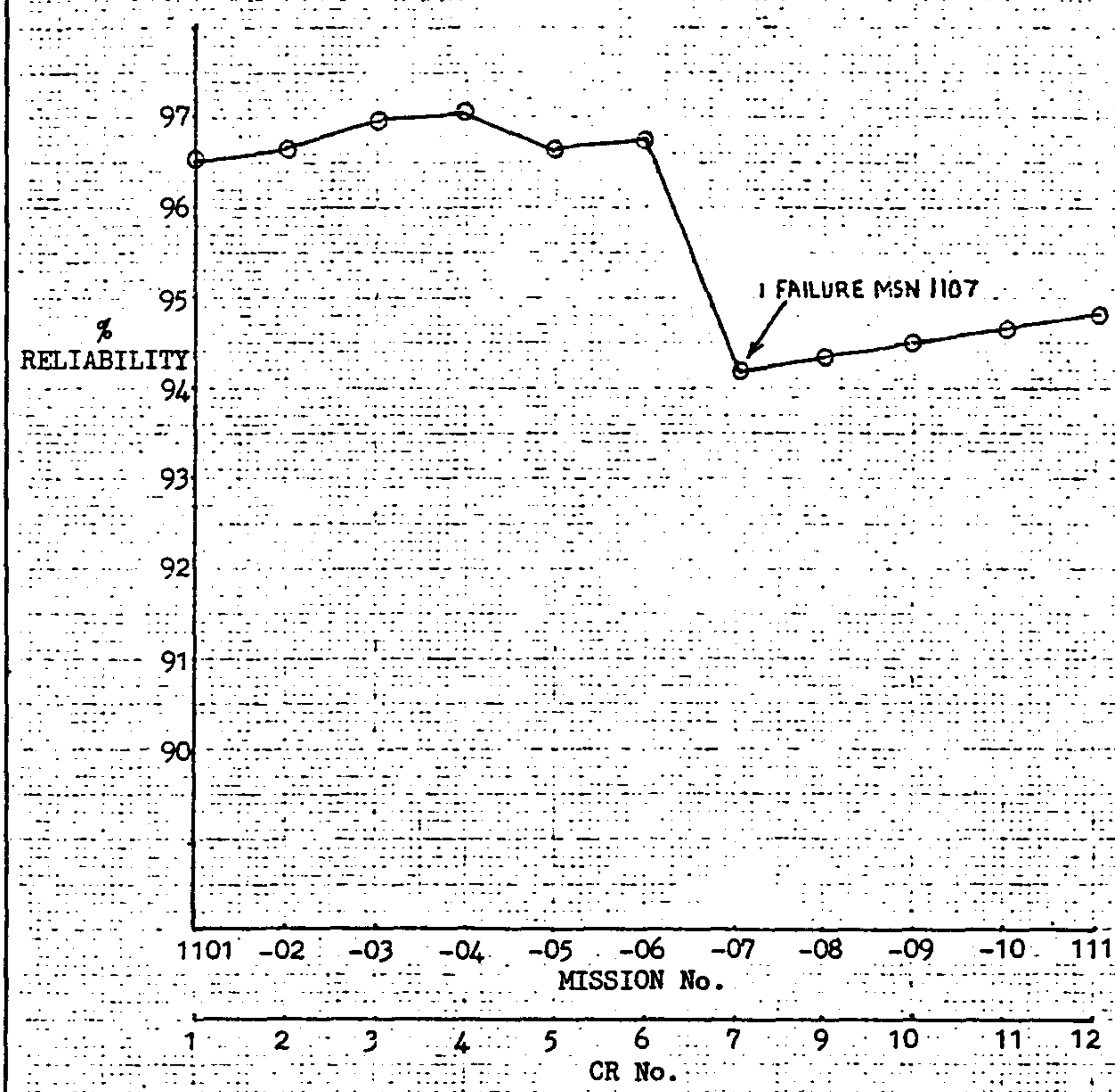


FIGURE 7-5

	NAME	DATE	LOCKHEED MISSILES & SPACE COMPANY A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION	Page	TEMP.	PERM
Prepared	[redacted]	10-6-70	TITLE			
Checked			SUMMARY CR RELIABILITY RECOVERY	Model CR-12		
Approved	[redacted]	10-7-70		Report No.		

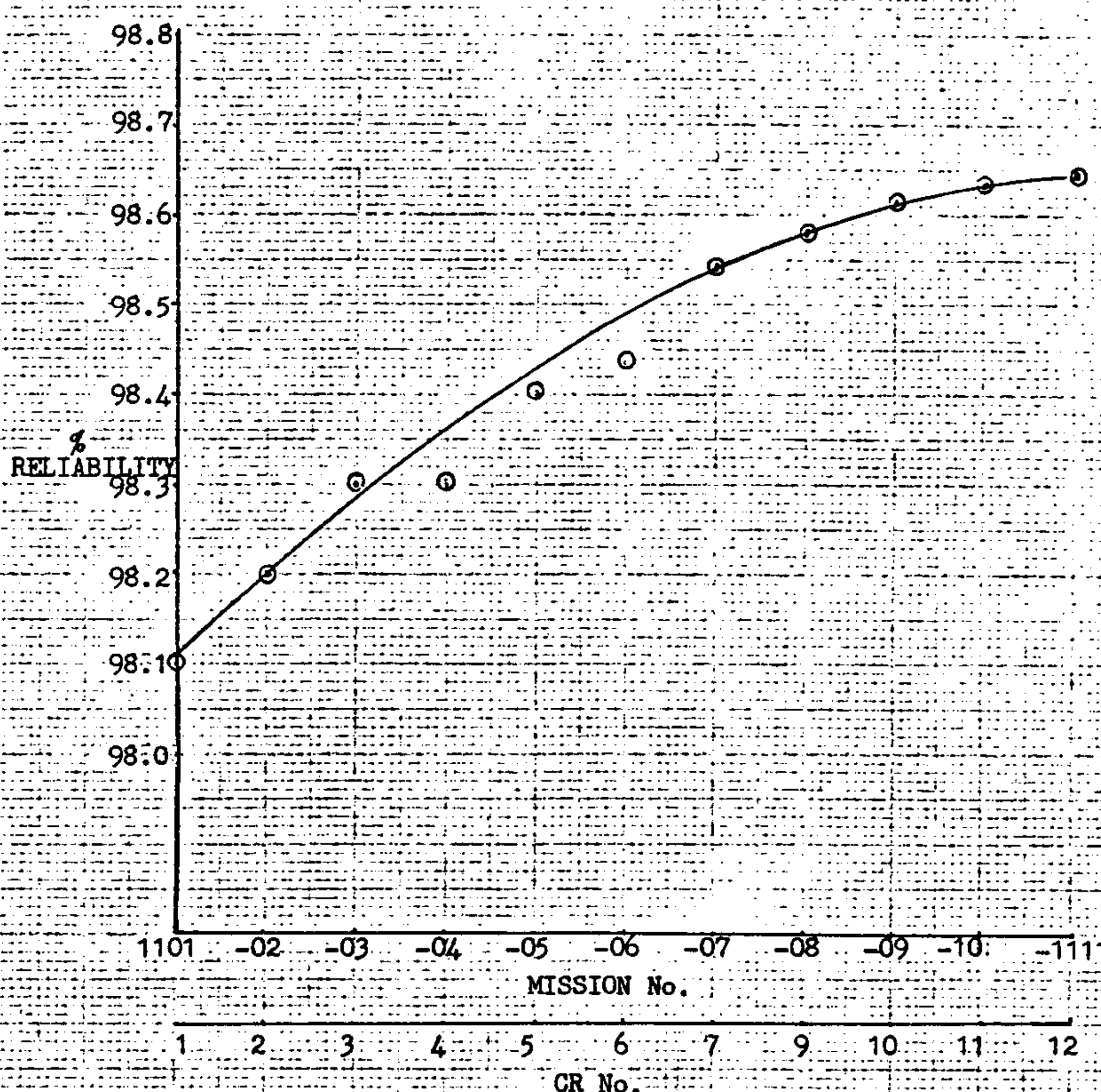


FIGURE 7-6

Name	Date	LOCKHEED MISSILES & SPACE COMPANY	Page
Prepared [redacted]	10-6-70	A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION	
Checked		TITLE: SUMMARY CR RELIABILITY <u>HORIZON CAMERAS</u>	Model CR-12
Approved [redacted]	10-7-70		Report No.

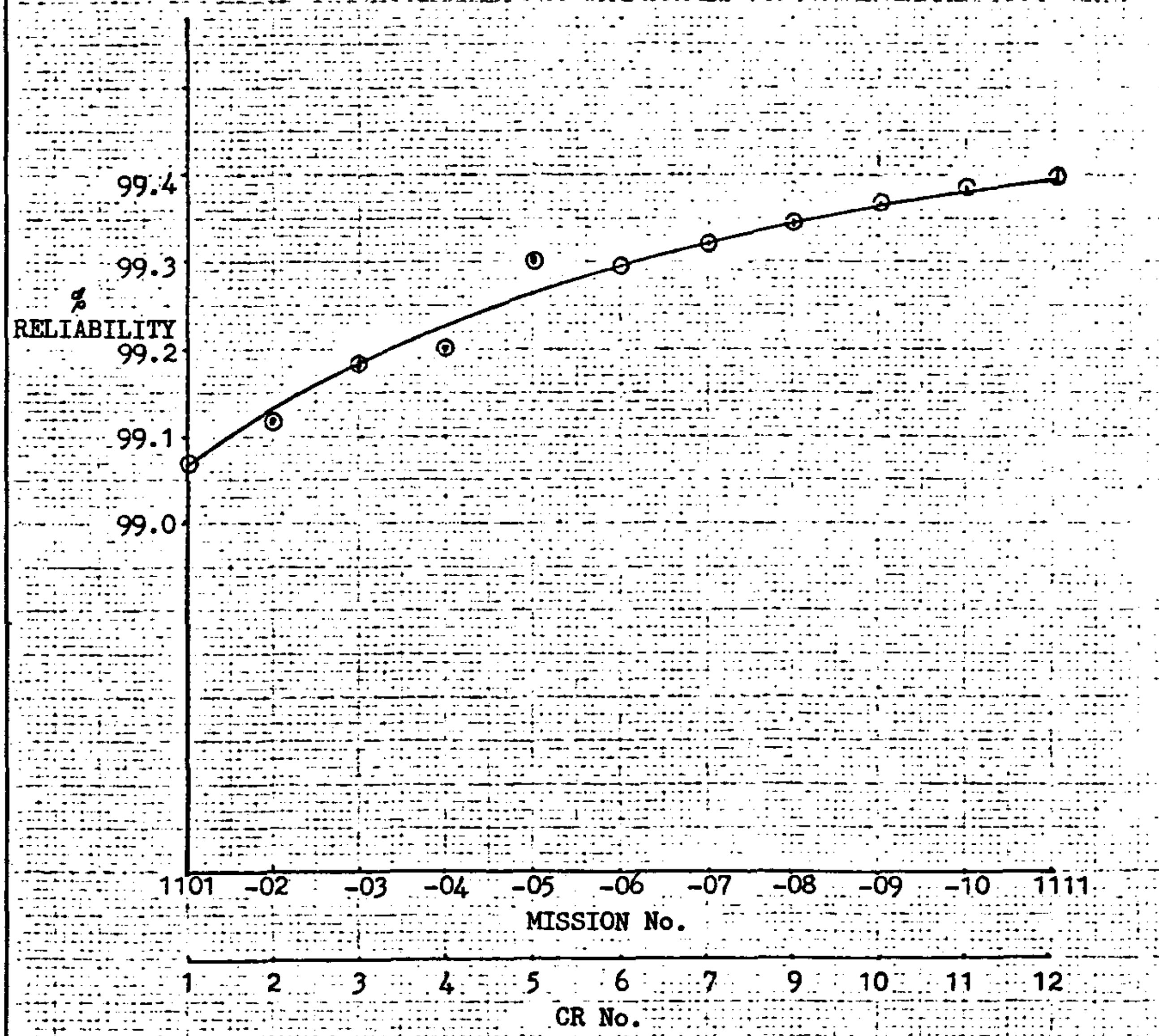


FIGURE 7-7

Prepared	[redacted]	10-6-70	LOCKHEED MISSILES & SPACE COMPANY A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION	Page
Checked			TITLE SUMMARY CR RELIABILITY DISIC	Model CR-12
Approved	[redacted]	10-7-70		Report No.

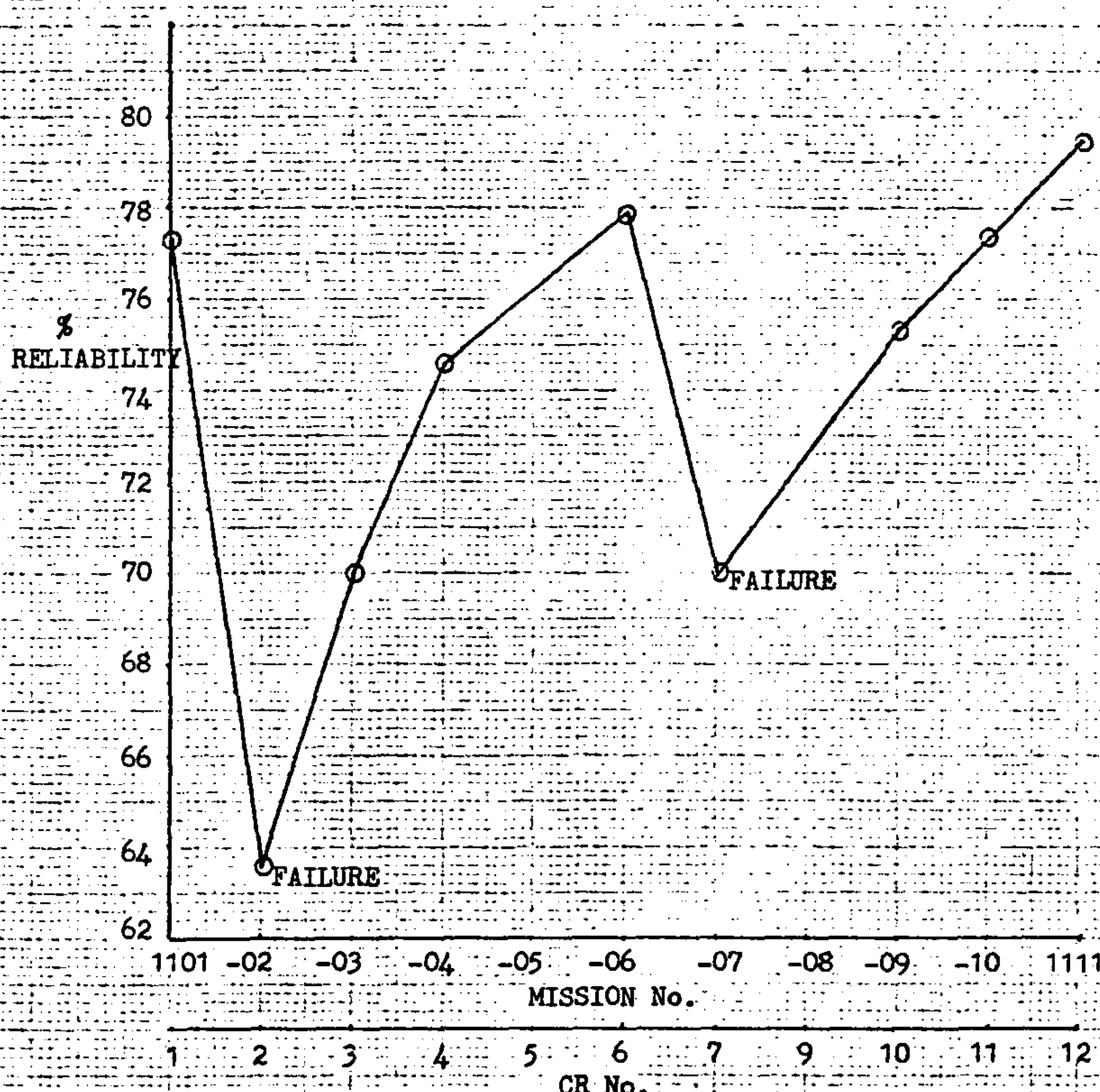


FIGURE 7-8

DISTRIBUTION:

[redacted]