Date: 22 September 1970

Copy No. [redacted]

CORONA J

PERFORMANCE EVALUATION REPORT

MISSION 1108-1 AND 1108-2

FTV 1655, CR-9

Approved: [redacted] Manager
Advanced Projects

Approved: [redacted] Manager
Program [redacted]

FOREWORD

This report details the performance of the payload system during the operational phase of the Program [redacted] Flight Test Vehicle 1655.

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

This document constitutes the final payload test and performance evaluation report for Mission 1108 which was launched on 4 December 1969.

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ILLUSTRATIONS
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INTRODUCTION

This report presents the final performance evaluation of Corona Mission 1108. The purpose of this report is to define the performance characteristics of the CR-9 payload system and to evaluate the technical aspects of the Mission, including analysis of in-flight anomalies.

The payload system was assembled, tested, and certified for flight at the Advanced Projects (A/P) facility of Lockheed Missiles and Space Company (LMSC). A/P also provided services including pre-flight mission parameter planning, preparation of the flight program, in-flight operations support and data analysis, and mission reporting to the community. The initial evaluation of the recovered film was made by NPIC personnel at the processing facility. The Performance Evaluation Team (PET) meeting at NPIC included representatives of LMSC, ITEK Corporation, Eastman Kodak Company, and cognizant government organizations. Off-line evaluation was performed at facilities of individual contractors, using engineering photography acquired over the United States.

The quantitative data summarized in this report is originated by governmental and contractor organizations. Diffuse Terrain Density measurements are produced by the [redacted] The processing Summary report and Target Density measurements are provided by the Air Force Special Projects Production Facility.

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

SECTION 1

MISSION SUMMARY

A. MISSION DESCRIPTION

Corona Satellite Mission 1108 was planned to acquire cartographic and reconnaissance photography of selected terrain areas. Two mission segments were planned to total approximately eighteen days of orbital operation. Each mission segment would return approximately 6000 panoramic frames and each frame would nominally cover 1160 square miles.

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

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

The flight system was launched into the planned orbit from Vandenberg AFG at 21:38 GMT on 4 December 1969.

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

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

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

TABLE 1-1

B. FLIGHT CONFIGURATION

Aft Looking Camera Serial No. 317	
Mission No.	1108
Vehicle No.	1655
System No.	CR-9
Forward Looking Camera Serial No.	317
DISIC Camera Serial No.	12
Lens Data	
Forward Looking Camera (Main Lens)	
Lens Serial No.	I-200
Measured Slit Width (Inches)	
Position 1	0.141
Position 2	0.214
Position 3	0.274
Position 4	0.334
Failsafe	0.237
Optics Filter Type	
Primary	W-25
Alternate	W-25
E.O. Focal Length (Inches) (Vacuum)	24.006
Resolution	
Static (Lines/Millimeter)	
Filter	W-25
High Contrast	292
Low Contrast	186

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

Resolution (Lines/MM)	
Static	
Filter	W-21
High Contrast	248
Low Contrast	148
Dynamic (Lines/MM)	
ITEK Post-Vibration	
Filter	W-21
High Contrast	224
Low Contrast	139
A/P Test	
Filter	W-21
High Contrast	239
Low Contrast	132
Distortion/Pincushion (Microns)	
Angle Off Axis (Deg.)	
3	1
2	0
1	0
0	0
359	0
358	1
357	4

Horizon Optics

Forward Looking Camera

Take-up (Starboard)

Lens Serial No.	23780
Exposure Time (Sec.)	1/100
Aperture	F/8.0
Filter Type	W-25
Oper. Focal Length (MM)	54.82
Radial Distortion (MM)	
10 Deg. Off Axis	0.01
20 Deg. Off Axis	0.05
Tangential Distortion	0.03

Resolution (Lines/MM)

Angle Off Axis (Deg.)	0	5	10	15	20	25	30
(Radial)	209	186	195	181	166	125	26
(Tangential)	187	175	153	131	112	87	55

Supply (Port)

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

Resolution (Lines/MM)

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

Aft Looking Camera

Take-up (Port)

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

Resolution (Lines/MM)

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

Supply (Starboard)

Lens Serial No.	23776
Exposure Time (Sec.)	1/100
Aperture	F/8.0
Filter Type	W-25
Oper. Focal Length (MM)	55.0
Radial Distortion (MM)	
10 Deg. Off Axis	0.01
20 Deg. Off Axis	0.05
Tangential Distortion	0.02

Resolution (Lines/MM)

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

DISIC Camera

Port Stellar Camera

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

Starboard Stellar Camera

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

Terrain Camera

Lens Serial No.	109		
Reseau Serial No.	109		
Filter Type	W-12		
Aperture	F/6.3		
Exposure Time (Sec.)	1/500		
Nominal Focal Length (In.)	3		
Resolution (Hi Contrast L/MM)			
Angle Off Axis (Deg.)	0	7.5	15
Radial	122	112	106
Tangential	108	106	82
Film Type	3400		
Filter	W-12		

Film Types

Forward Looking Camera

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

Aft Looking Camera

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

DISIC Camera

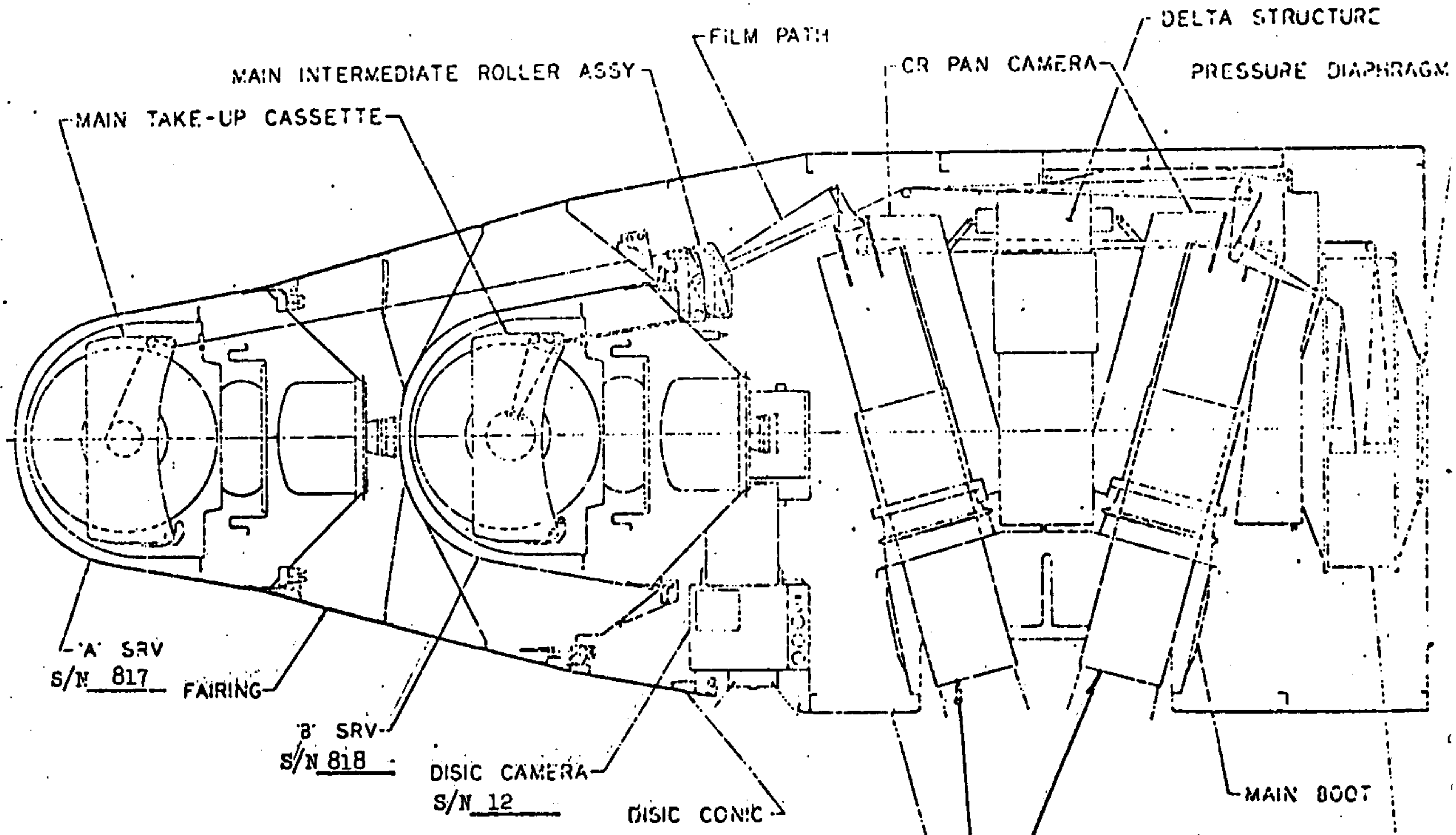
Stellar Camera

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

Terrain Camera

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

PAYLOAD PROFILE AND SERIAL NUMBERS



SYSTEM NO. CR-9

TEST ____________

PMU S/N 1011

SLOPE PROGRAMMER S/N 210

CLOCK S/N 633

HANDLE VIA [redacted]

SECTION 2

PRE-FLIGHT SYSTEMS TEST

A. SUMMARY

As a standard procedure, the J payload systems are subjected to a series of tests with flight type film which demonstrate that the system will perform as required during flight. The principal tests include the following:

1. Exposure of the J payload to a thermal/altitude environment test that approximates flight conditions.
2. A system light leak test that ascertains the light tight integrity of the J system.
3. A dynamic resolution test and Film Lift test (AGT Test) that determine the high and low contrast resolution characteristics of each panoramic camera.
4. A flight readiness test that assures that the payload is acceptable prior to loading with flight film.
5. A flight certification that establishes the flight worthiness of the complete payload including the flight film.

The CR-9 system successfully passed all phases of the testing operations providing acceptable performance and a high degree of operational confidence.

B. ENVIRONMENTAL TEST

The CR-9 payload system was tested in the Sunnyvale HIVOS chamber between 14 July 1969 and 21 July 1969. The primary purpose of the environmental test was to determine the corona marking characteristics of the panoramic cameras and operational performance of the system at altitude.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The telemetry system operation was normal throughout the test.

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

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

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

CR-9 HIVCS

TABLE 2-1, SPECIAL PMU TEST

PMU GAS VALVE ON TIME VS INTERNAL SYSTEM PRESSURE

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

C. LIGHT LEAK TEST

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

D. RESOLUTION TEST/AGT

Resolution Test.

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

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

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

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

TABLE 2-2

CR-9 SYSTEM

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

COLLIMATOR SET FOR VACUUM FOCUS SHIFT OF 0.014 INCHES

INSTRUMENT 316

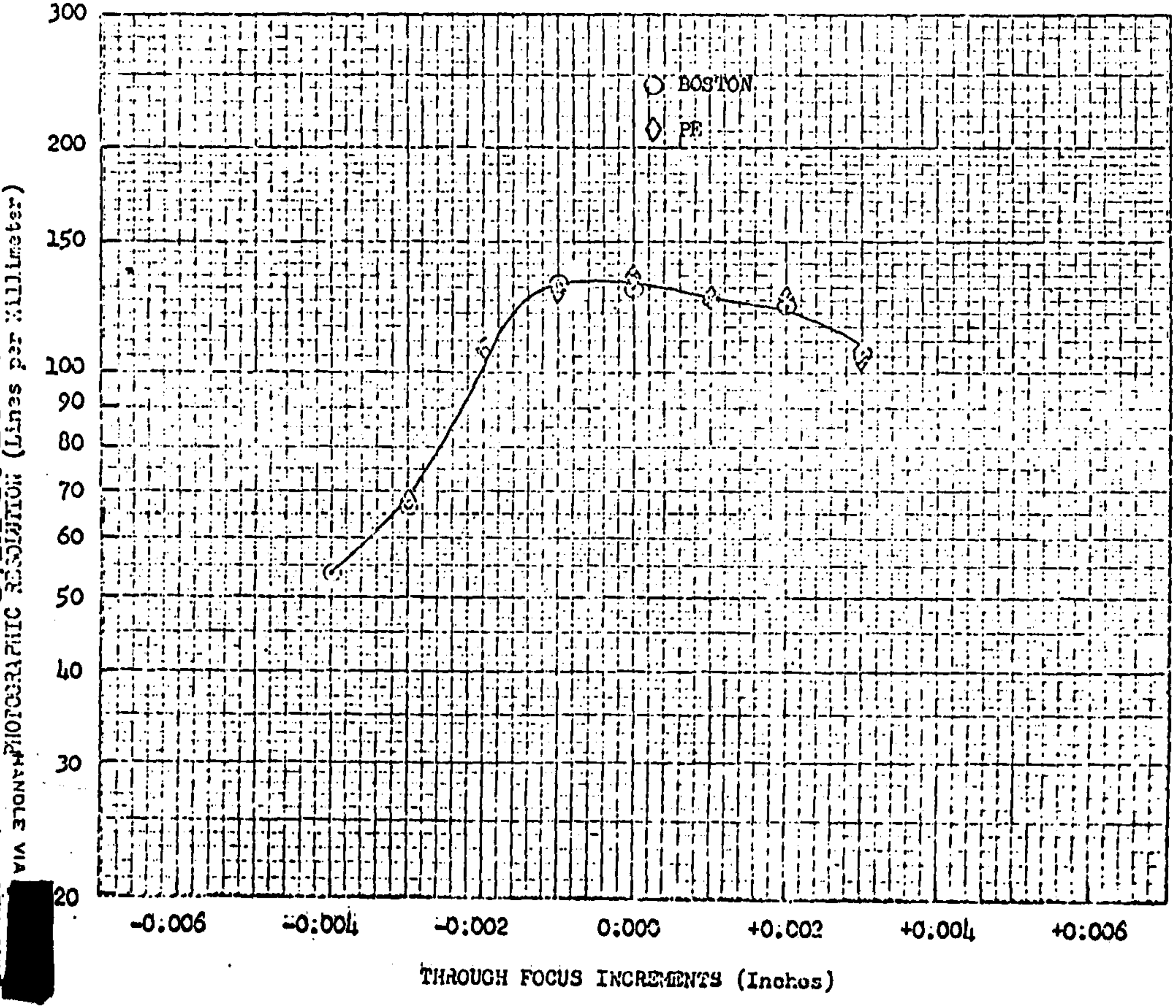
FILM TYPE: COLLIMATOR FOCUS (INCHES)	SO-380 (UTB) BOSTON EAST COAST	3404 A/P TEST 14 AUG. 1969	3404 A/P TEST 6 SEPT. 1969
-0.004	---	54	None
-0.003	88	67	"
-0.002	127	108	"
-0.001	132	132	"
0.000	139	131	"
+0.001	134	127	"
+0.002	124	124	"
+0.003	98	107	"
+0.004	80	---	"

INSTRUMENT 317

FILM TYPE: COLLIMATOR FOCUS (INCHES)	SO-380 (UTB) BOSTON EAST COAST	3404 A/P TEST 14 AUG. 1969	3404 A/P TEST 6 SEPT. 1969
-0.004	---	---	61
-0.003	87	72	95
-0.002	131	94	150
-0.001	188	160	175
0.000	178	189	154
+0.001	138	152	101
+0.002	95	121	73
	66	---	---
	57	---	---

FIGURE 2-1

PRE-FLIGHT DYNAMIC RESOLUTION



Camera 316

Payload No: CR-9

Resolution (1/mm)

High Contrast: N/A

Low Contrast: 2/1

Film Type: 3404

Test Date: 14 Aug. 1969

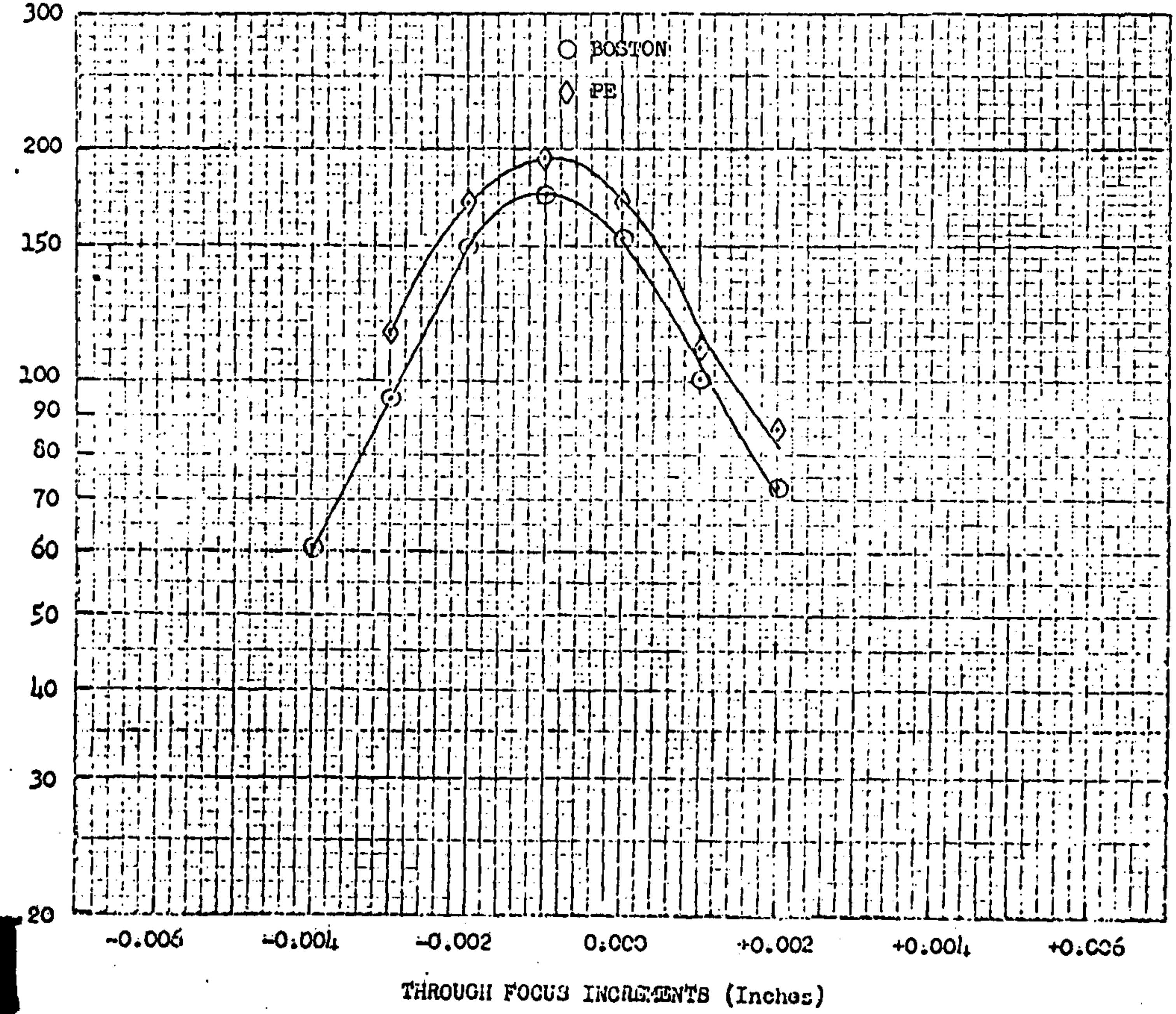
Filter: Wratten 21

Slit: 0.134"

HANDLE VIA [redacted] CONTROL SYSTEM ONLY

FIGURE 2-2

PRE-FLIGHT DYNAMIC RESOLUTION



Camera ____________

Payload No: CR-9

Resolution (1/mm)

High Contrast: N/A

Low Contrast: 2/1

Film Type: 3404

Test Date: 6 Sept. 1969

Filter: Wratten 25

Slit: 0.132"

HANDLE VIA [redacted] CONTROL SYSTEM ONLY

AGT - ASCHENBRENNER GRID TEST

The CR-9 system was subjected to the AG Test on 9 August 1969. The test consisted of 24 cycles of usable material from each camera. Film type 3404 was used throughout the test. The cycle rate was set at 3 seconds per cycle.

A representative format from each camera was evaluated for film lift relative to the scan head rollers. Eighty-one points throughout the usable portion of each format were sampled for film lift. The resulting film lift measurements in inches (mils) above the scan rollers are shown in the attached table and graphical plots, Figures 2-3 and 2-4 and Table 2-3.

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

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

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

Inst. 317 Format 11 Cycle Rate 3 Sec/Cycle

Sample Distance From End of Format (Inches)

Supply End — Take-up End (Start of Scan)

		1"	1½"	4"	9"	CF	9"	4"	1½"	1"
Inboard Side (Time Word)	9	.3	.4	.5	.7	.5	.5	.4	.5	1.0
	8	1.2	.8	.9	.9	.9	.8	.8	.5	1.2
	7	.7	.6	.6	.8	.6	.8	.4	.3	.9
AGT Line Pair	6	.7	.9	.9	.9	.9	1.0	.7	.5	.9
	5	1.2	.8	.8	.9	.9	1.0	.7	.3	.9
	4	1.4	1.4	1.3	1.1	1.1	1.1	.9	.6	1.1
	3	1.6	1.6	1.4	1.2	1.3	1.2	1.1	.9	1.4
Outboard Side	2	1.6	1.4	1.5	1.1	1.3	1.4	1.0	.7	1.4
	1	1.5	1.6	1.6	1.6	1.3	1.1	.8	.8	1.4

100% of the lift values meet the Boston acceptance criteria

1. Acceptable Values: 0.2 to 1.6 inclusive

Inst. 316 Format 13 Cycle Rate 3 Sec/Cycle

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

86% of the lift values meet the Boston acceptance criteria

2. Acceptable Values: 0.7 to 2.1 inclusive

TOP SECRET/C

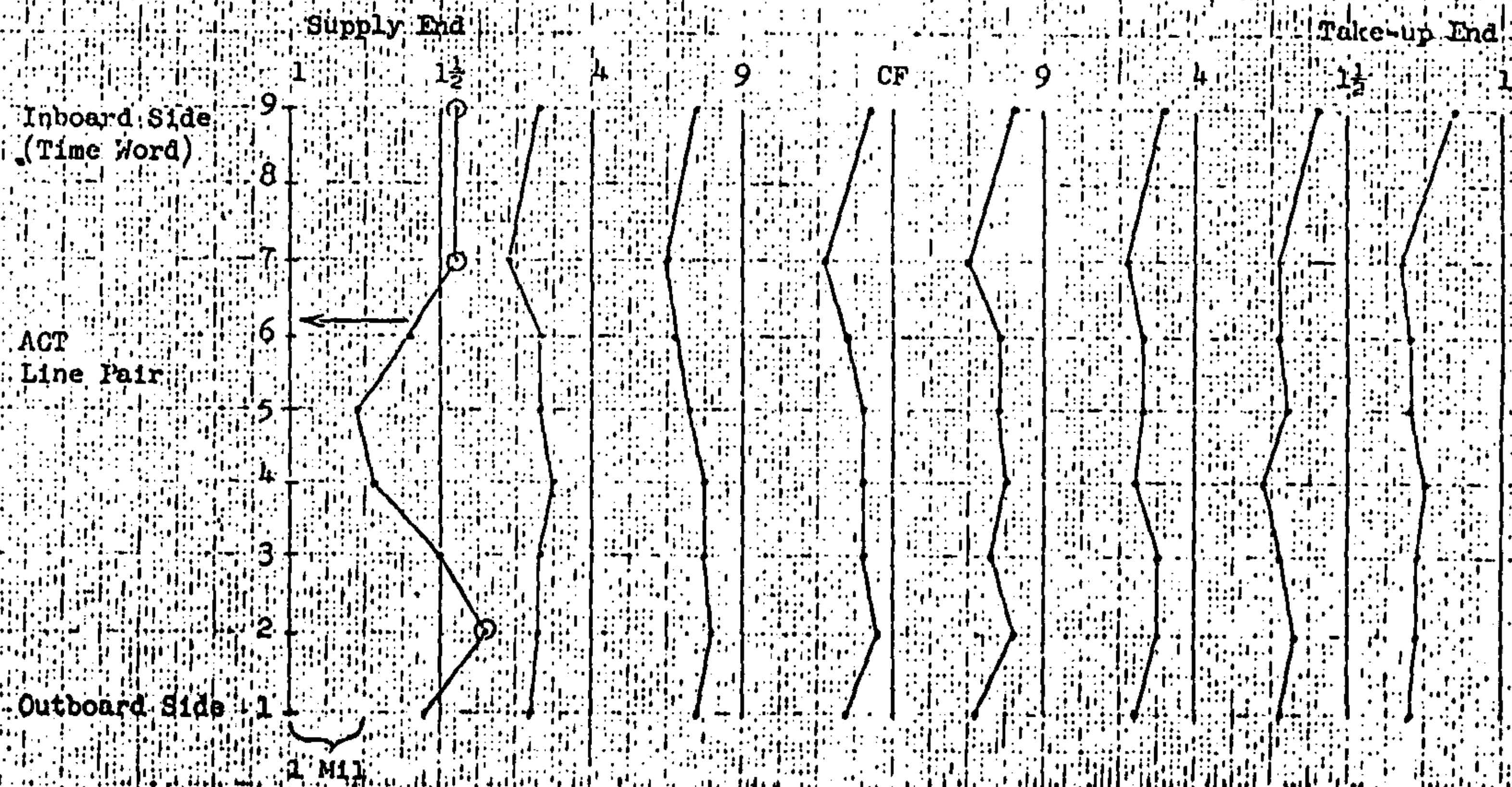
FIGURE 2-3

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

GRAPH 1

FILM LIFT (MILS)*

SAMPLE DISTANCE FROM ENDS OF FORMAT (INCHES)



* Above scan head rollers

Note: Circled points exceed acceptance level .7 to 4.1 mils

Format 13
Cycle rate 3 sec/cycle

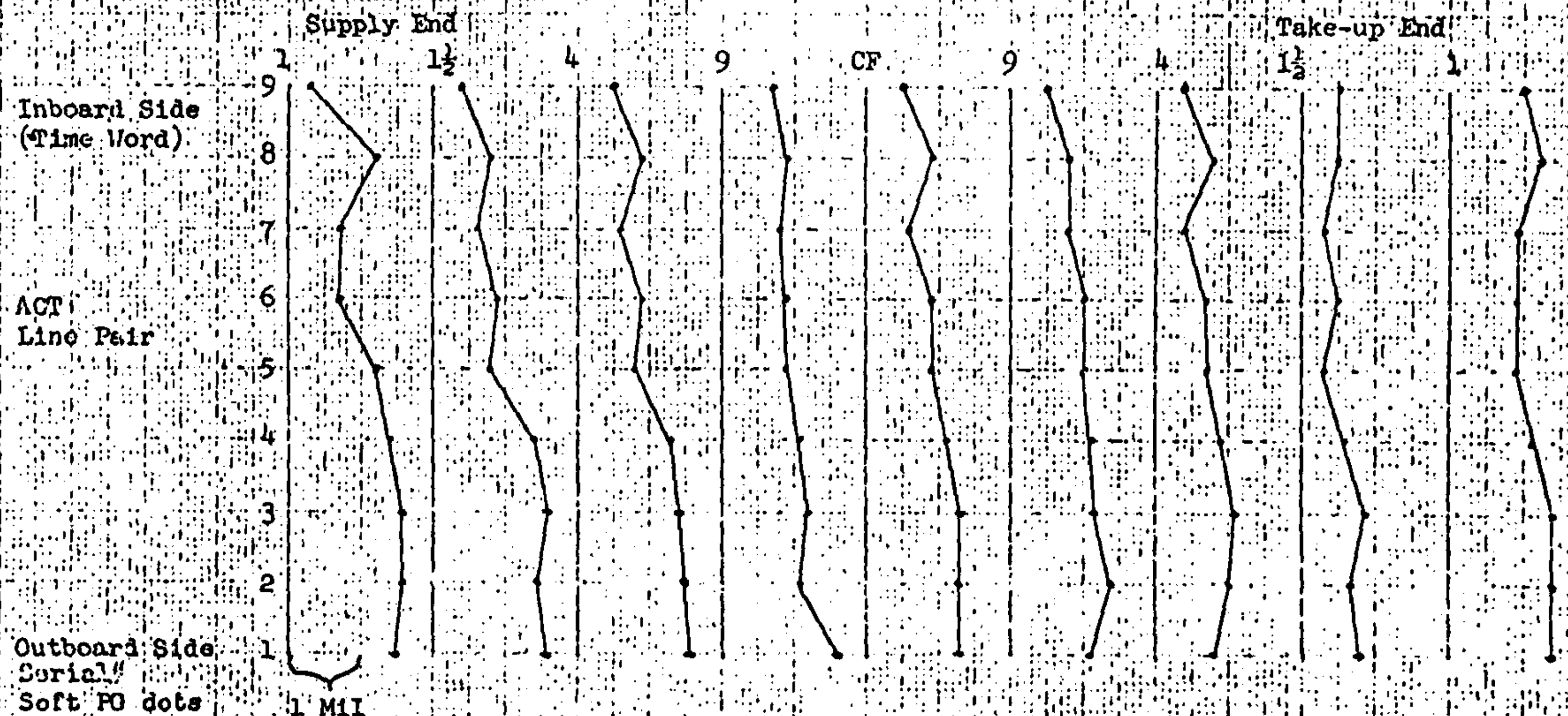
FIGURE 2-4

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

GRAPH 2

LIFT (MILS)*

SAMPLE DISTANCE FROM ENDS OF FORMAT (INCHES)



* Above scan head rollers

Note: Circled points exceed acceptance criteria 2 To /.6 ...

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

E. FLIGHT READINESS TEST

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

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

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

Measurements of processed slit images revealed the following slit values:

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

F. FLIGHT CERTIFICATION

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

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

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

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

The CR-9 system was checked for light leaks following the last camera operation of the confidence run. The space structure proved to be light tight as indicated by the photomultipliers employed in the light leak test.

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

SECTION 3

FLIGHT OPERATIONS

A. SUMMARY

Mission 1108 was launched normally into the planned orbit without incident. All ascent and injection events occurred as programmed. The orbit achieved was within the 3 sigma predicted dispersions. The total mission lasted for 17 days with a 7-day first segment and a 10-day second segment.

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

B. LAUNCH

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

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

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

C. ORBIT

Mission 1108 was launched into the planned orbit. All orbit parameters attained were well within the specified tolerances.

Orbit conditions computed from Rev 2 data are shown in Table 3-1.

TABLE 3-1

Mission 1108 Orbit Parameters (Rev. 2)

Orbital Parameters

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

DMU Operation

Six DMU rockets were utilized for period control throughout the flight to maintain the ground track position. Ground track error varied between 5 and 43 nautical miles east of the nominal track at the equator. A compromise was necessary on Rev 127 and Rev 214 as to the desired perigee altitude and/or location in order to hold the ground track error within acceptable limits. This was necessary because a DMU firing was not available at the particular rev and latitude needed to provide the desired effect on perigee and still minimize the ground track error. This compromise did not degrade mission performance.

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

TABLE 3-2

Rocket No.	Rev. No.	System Time Sec.	Period Change Sec.	Velocity Change Ft/Sec	Period at Firing Min.	Impulse Lb/Sec
1	17	81658	14.05	22.50	88.44	3095
2	49	81518	13.66	21.85	88.41	2939
3	85	12702	9.10	14.70	88.46	2002
4	127	62098	15.29	24.32	88.42	2978
5	166	11061	10.74	17.30	88.48	2106
6*	214	06867	15.83	25.28	88.42	3060

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

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

CR-9/1108
ORBIT HISTORY

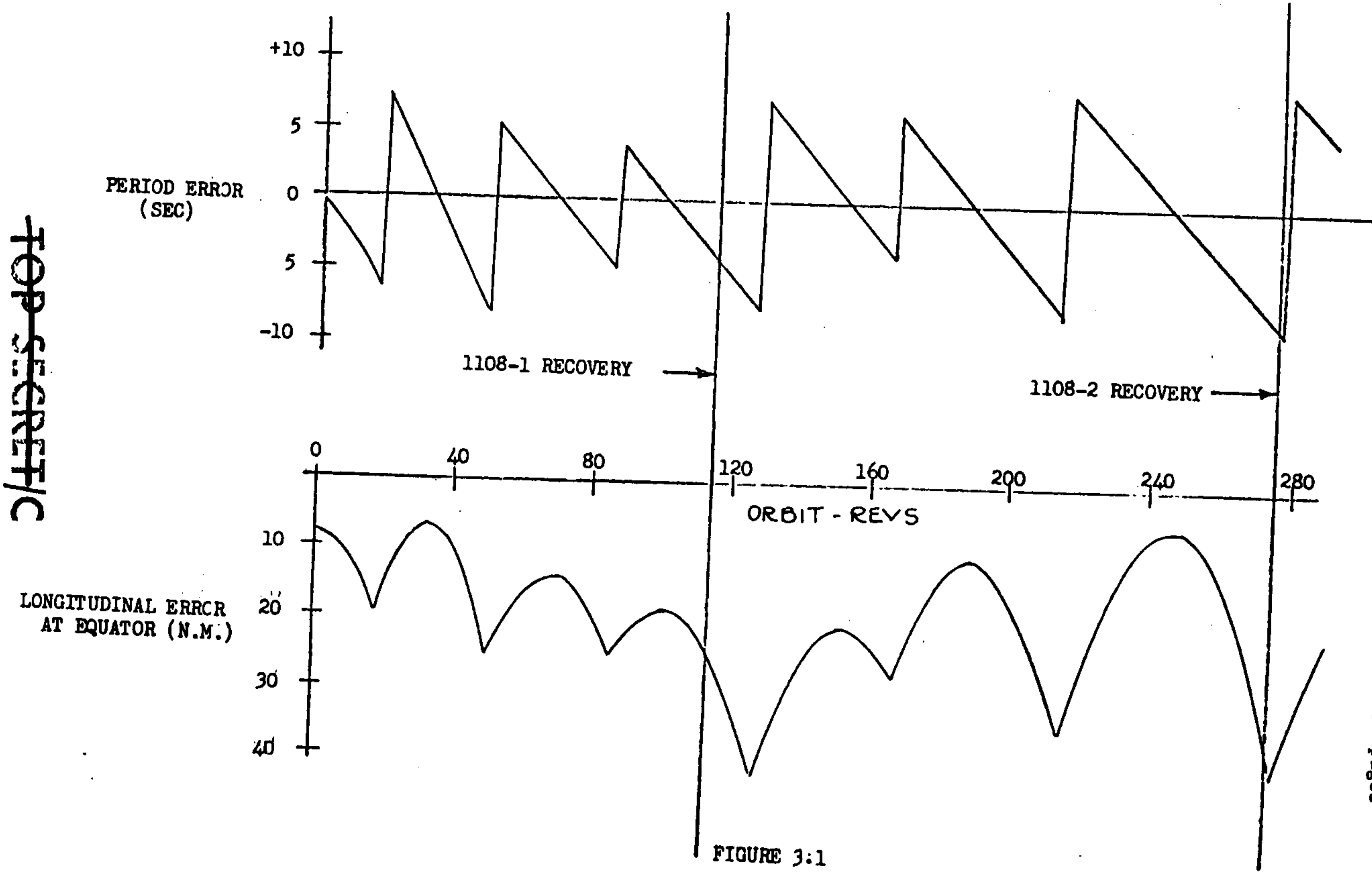


FIGURE 3:1

TOP SECRET/C

CR-9/1108

ORBIT HISTORY

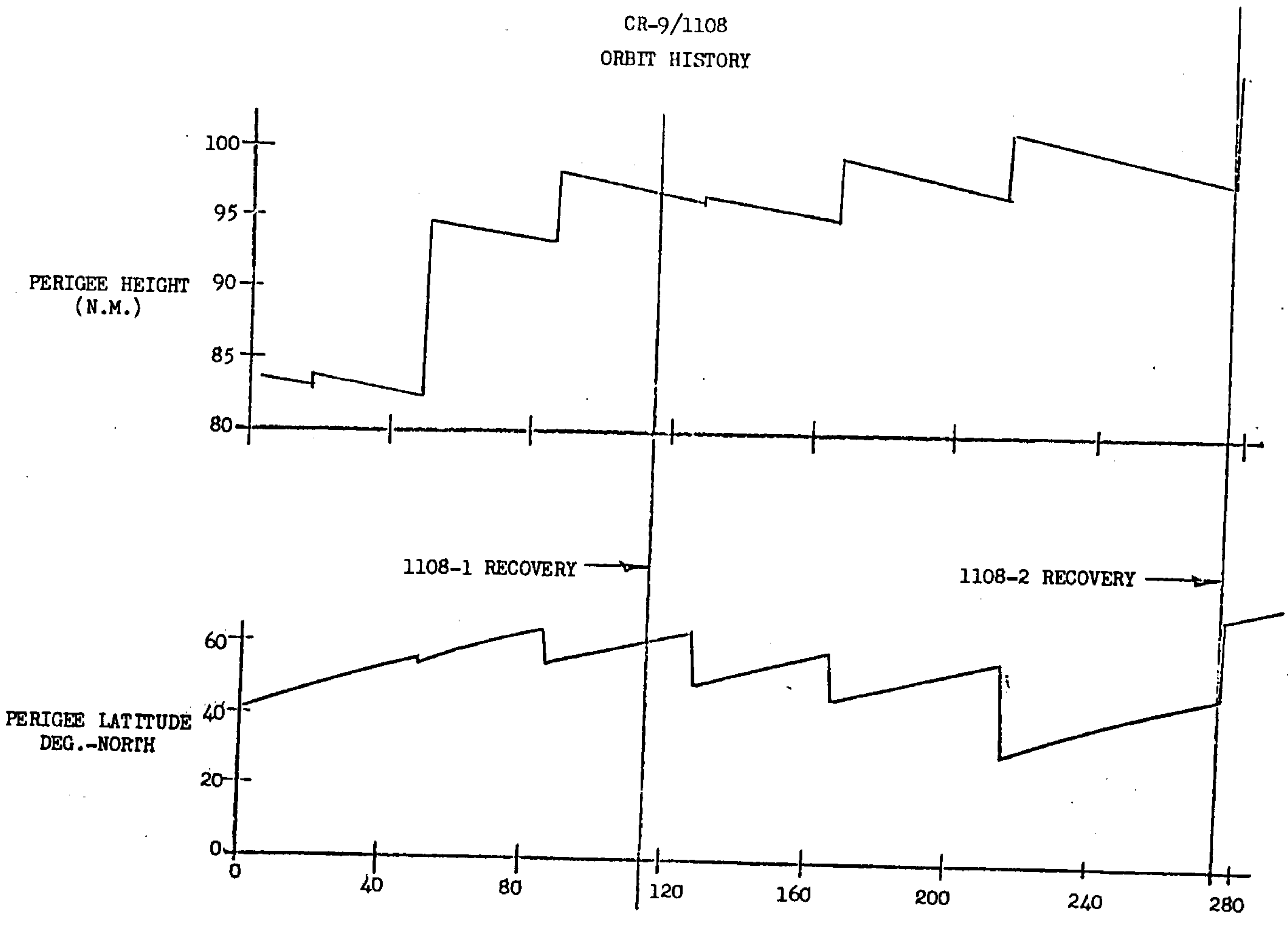


FIGURE 3.2

OPERATION DISTRIBUTION

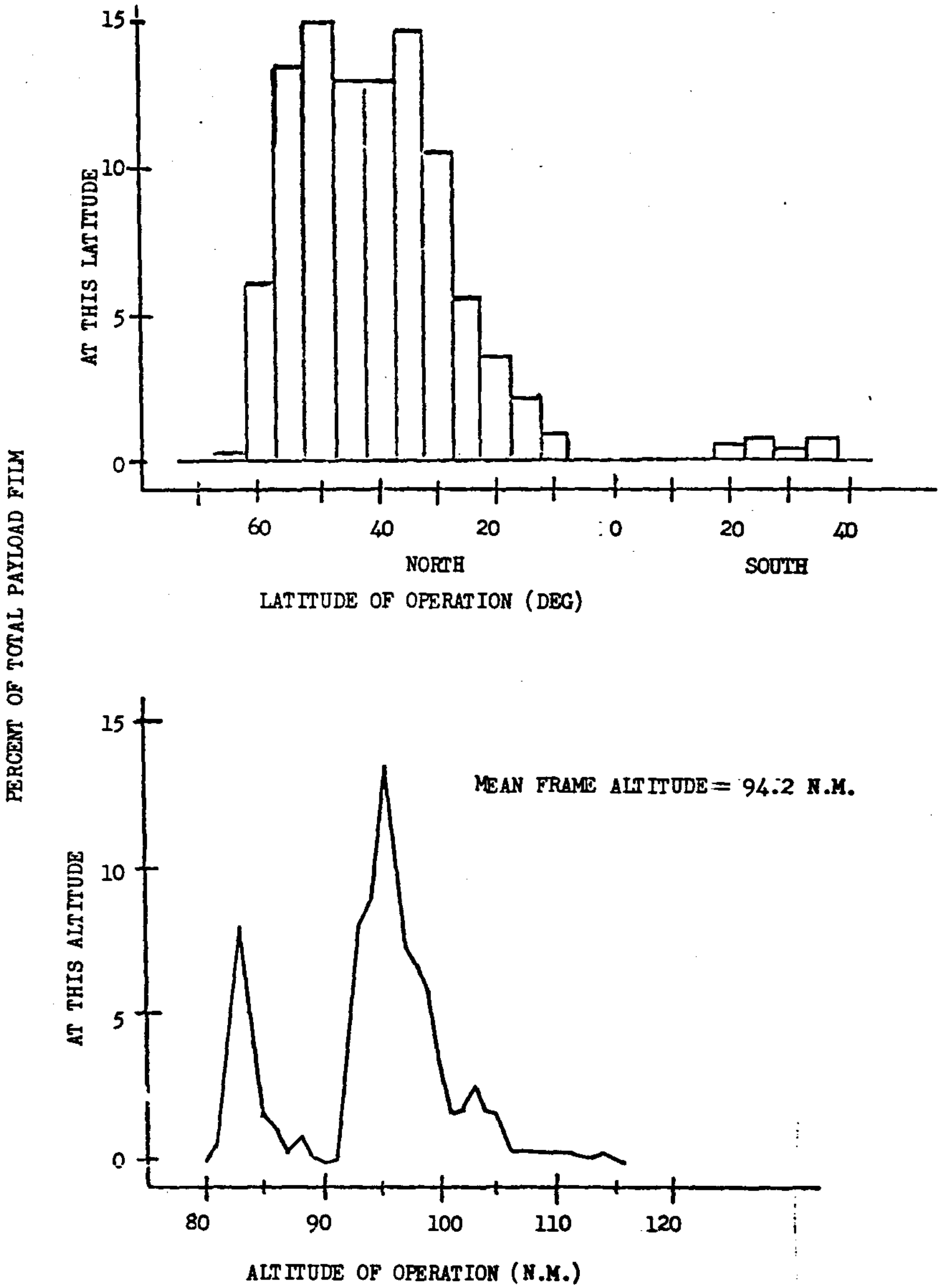


FIGURE 3.3

D. PANORAMIC CAMERAS

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

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

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

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

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

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

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

TABLE 3-3

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

E. DISIC CAMERA #12

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

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

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

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

TABLE 3-4

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

F. INSTRUMENTATION & COMMAND

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

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

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

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

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

G. EXPOSURE CONTROL SYSTEM

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

The failsafe telemetry monitor indicated both panoramic cameras were in the failsafe slit position and the programmer was commanding slit No. 3. At system time 22070, the programmer commanded slit No. 2. The programmer should have commanded slit No. 1 at acquisition and advanced to slit No. 2 at system time 21991. The failsafe circuit performed normally but the programmer failed to operate properly for the remainder of the mission.

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

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

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

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

All other portions of the exposure control system performed normally.

H. CLOCK SYSTEM

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

First Order Fit

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

A_0 = -.11693975959D 06

A_1 = .1000000861750D 01

Sigma = .00111438

No. of points = 322

Second Order Fit

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

A_0 = -.11693976362D 06

A_1 = .1000000875492D 01

A_2 = -.934576992470407D-14

Sigma = .00079239

I. PRESSURE MAKE-UP SYSTEM

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

J. THERMAL ENVIRONMENT

The temperature data obtained during this flight indicated the temperature environment was near the pre-flight prediction as shown in Figure 3-4. The average temperatures during the -1 mission were 65° F and 67° F for panoramic cameras #316 and #317. The average temperatures during the -2 mission were 64°F and 65°F for panoramic cameras #316 and #317.

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

CR-09 FLIGHT TEMPS. VS PREDICTED

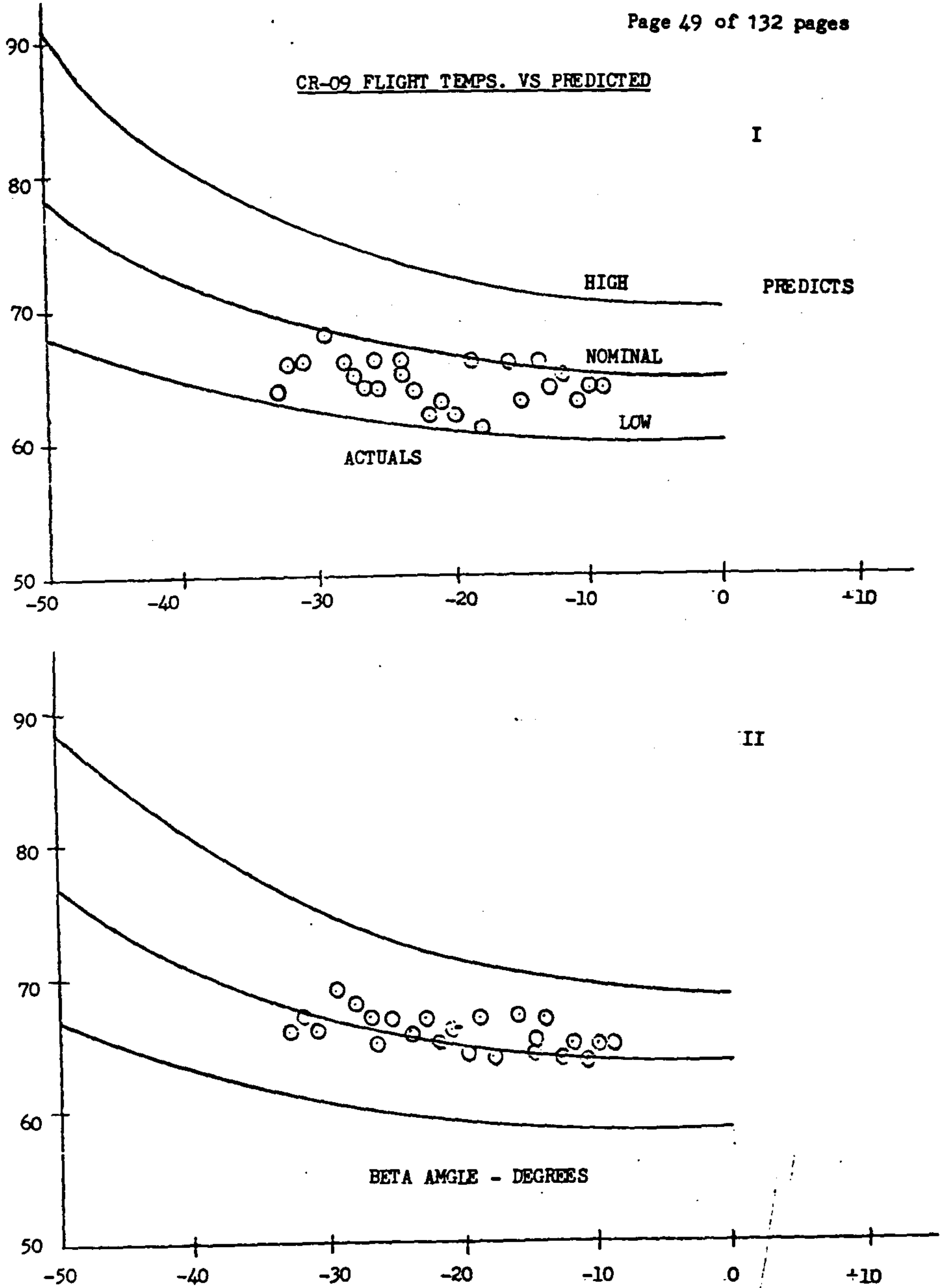


FIGURE 3.4

~~TOP SECRET/C~~ [redacted]

TEMPERATURE SUMMARY (°F) CR-09 TABLE 3-5

Rev. No.		9	16	25	32	41	48	56	65	73	81K	90P	97C	106C	113C	122	129
Beta Angle		-34	-33	-32	-31	-29.5	-28	-27.5	-26.5	-25.5	-24	-23	-22	-21	-20	-19	-18
Pan No. 1 Lens Cell	2	72	70	69	70	69	70	69	67	67	67	67	66	66	66	68	68
Lens Cone	4	75	73	72	73	71	72	71	69	69	69	68	68	68	67	69	69
Rear Rail	6	69	59	62	57	66	58	61	57	61	60	61	58	61	56	66	58
Drive Mtr	10	71	68	66	66	68	66	66	65	65	66	65	64	63	63	65	65
Front Rail	12	67	59	61	57	65	59	60	57	60	59	59	57	60	56	64	58
Average		71	64	66	66	68	66	65	64	64	65	64	62	63	62	66	61
Pan 1 Output AO	8	50	46	48	44	50	46	48	45	48	48	49	47	50	47	53	50
Delta Top Left	14	68	48	55	46	64	47	55	46	55	51	55	46	61	46	65	47
Drum Support	16	68	63	63	61	66	62	63	61	62	62	62	60	61	59	63	61
Pan No. 2 Lens Cell	18	70	69	68	69	69	70	69	68	68	68	68	67	67	67	67	67
Lens Cone	20	68	68	67	68	67	69	68	67	67	67	67	67	67	67	67	67
Rear Rail	22	71	62	65	61	70	62	66	62	66	64	66	62	67	61	69	62
Drive Mtr	26	72	70	68	67	70	68	68	67	67	68	67	66	65	65	66	66
Front Rail	28	70	62	65	60	70	62	66	61	65	64	66	61	67	60	69	61
Average		70	66	67	66	69	68	67	65	67	66	67	65	66	64	67	64
Pan 2 Output AO	24	83	71	75	69	79	69	73	68	72	69	71	66	71	64	72	63
Supply Cassette	30	64	60	62	61	66	62	64	62	64	65	65	63	65	62	66	63
Aux. Electronic Box	32	83	72	76	70	80	71	74	68	72	70	72	66	72	66	74	65
Slope Programmer	34	106	103	101	101	103	100	99	99	98	98	97	96	95	94	95	94
PMU	36	87	80	80	76	85	78	78	76	78	78	78	74	76	74	80	76
Switch Programmer	43	98	84	86	81	92	81	86	81	84	86	84	78	81	78	81	75
Aft Power Box	49	58	55	55	52	61	52	58	55	58	58	58	55	58	55	61	58
SRV "A" T/U	40	60	52	49	44	48	44	46	41	43	44	43	41	44	41	--	--
Retro	42	64	56	55	53	57	53	52	48	50	50	49	47	49	47	--	--
SRV "D" T/U	44	71	67	66	65	66	66	65	64	63	63	62	62	60	62	66	66
Retro	46	71	68	67	66	68	66	65	64	64	65	63	62	62	62	67	66

TEMPERATURE SUMMARY (°F) CR-09 TABLE 3.6

Rev. No.		9	16	25	32	41	48	56	65	73	81K	90P	97C	106C	113C	122	129
Beta Angle		-34	-33	-32	-31	-29.5	-28	-27.5	-26.5	-25.5	-24	-23	-22	-21	-20	-19	-19
Blast Shield	48	64	55	55	49	58	49	49	49	49	52	49	49	52	49	40	124
	50	68	59	56	53	62	53	53	50	50	53	50	47	50	47	27	163
DISIC Platen	53	68	68	68	60	67	60	68	58	63	63	62	57	57	56	68	59
Lens Cell	55	65	66	65	58	65	58	67	56	61	63	60	54	55	54	67	57
Fairing	5	11	126	-7	120	5	96	-9	105	-9	26	-12	73	-1	90	5	93
	7	71	110	48	104	63	92	42	86	42	57	39	71	48	74	57	80
	9	42	84	24	75	36	75	21	63	18	60	18	63	30	60	33	63
	11	52	81	34	75	46	72	31	66	28	61	28	64	37	61	31	78
	13	39	32	29	29	39	32	26	26	29	29	29	26	32	26	39	29
	15	-2	39	-14	39	-5	27	-17	36	-14	-11	-17	21	-8	42	-2	51
DISICONIC	17	2	64	-10	64	-1	44	-13	58	-13	-4	-13	35	-7	52	-1	58
	19	86	104	62	95	74	92	57	86	57	68	54	74	60	74	71	80
	21	54	72	39	66	48	66	36	57	33	54	33	54	39	54	48	57
	23	33	36	27	33	33	30	24	30	24	27	24	30	30	30	36	33
	25	42	39	36	36	45	39	36	33	36	39	36	36	39	36	48	39
	31	-1	26	-10	23	-4	14	-10	26	-10	-10	-13	14	-4	29	2	39
Forward Barrel	33	46	88	22	79	37	64	19	70	16	25	16	46	31	52	37	52
	35	47	53	29	44	41	14	26	38	23	38	23	38	29	35	35	35
	37	37	37	22	31	34	31	22	31	19	22	22	31	28	31	34	34
	39	-15	6	-24	3	-18	-9	-27	6	-27	-30	-27	-12	-18	6	-12	12
Aft Barrel	41	50	83	23	74	41	59	20	65	20	23	17	41	32	47	38	44
	45	47	62	29	56	41	53	26	50	26	50	26	50	32	47	35	44
	47	29	35	17	32	29	32	20	32	20	23	20	32	26	32	29	35
	51	-17	-14	-26	-17	17	-20	-26	-8	-26	-26	-26	-17	-17	-2	-11	4

TEMPERATURE SUMMARY (°F) CR-09

TABLE 3-7

ev. No.		145	154	161	170	178	187*	189	190	194C							
ete Angle		-15	-14	-13	-12	-11	-10	-9.8	-9	-9							
an No. 1 Lens Cell	2	68	68	68	68	67	67	68	68	67							
Lens Cone	4	69	69	68	69	68	67	68	68	67							
Rear Rail	6	58	66	59	64	59	61	61	61	58							
Drive Mtr	10	64	65	65	64	65	64	63	64	64							
Front Rail	12	58	64	59	62	59	61	60	60	58							
verage		63	66	64	65	63	64	64	64	63							
an 1 Output AO	8	50	55	51	55	52	55	54	55	52							
elta Top Left	14	46	65	47	62	47	54	53	52	46							
rum Support	16	60	64	61	62	61	62	61	61	60							
Pan No. 2 Lens Cell	18	67	67	67	67	67	67	67	67	66							
Lens Cone	20	67	67	67	67	67	67	67	67	67							
Rear Rail	22	62	69	62	67	62	64	64	63	61							
Drive Mtr	26	66	66	66	65	66	65	65	65	65							
Front Rail	28	60	68	61	66	61	64	63	63	60							
verage		64	67	64	65	64	65	65	65	64							
Pan 2 Output AO	24	63	69	62	66	62	63	63	63	59							
Supply Cassette	30	63	66	64	65	64	65	64	64	63							
Aux. Electronic Box	32	66	72	65	69	63	66	65	65	61							
Slope Programmer	34	93	93	92	90	91	90	90	91	90							
PMU	36	74	80	76	76	76	76	76	76	79							
Switch Programmer	43	75	78	75	72	78	72	72	75	69							
Aft Power Box	49	55	61	58	61	61	61	61	61	58							
SRV "A" 4/U	40	--	--	--	--	--	--	--	--	--							
Retro	42	--	--	--	--	--	--	--	--	--							
SRV "B" T/U	44	66	68	67	69	68	67	67	67	67							
Retro	46	66	67	67	67	67	67	67	67	66							

TEMPERATURE SUMMARY (°F) CR-09

TABLE 3-8

Rev. No.		145	154	161	170	178	187*	189	190	194C
Beta Angle		-15	-14	-13	-12	-11	-10	9.8	-9	-9
Blast Shield	48	136	34	142	31	145	34	34	34	136
	50	157	21	160	15	151	18	15	18	160
DISIC Platen	53	59	67	60	69	61	60	64	63	59
Lens Cell	55	57	65	58	67	58	57	62	61	57
Fairing	5	73	-1	67	-7	52	-18	-18	-18	70
	7	71	48	68	42	60	30	30	27	60
	9	57	27	57	21	51	9	12	9	54
	11	72	22	72	16	66	7	7	4	78
	13	26	39	32	36	32	29	26	26	42
	15	39	-5	39	-8	66	-17	-17	-20	57
DISICONIC	17	41	-4	38	-7	29	-16	-16	-16	46
	19	74	62	71	57	65	48	48	45	62
	21	51	42	51	36	48	30	30	30	48
	23	30	33	33	30	33	24	24	24	36
	25	39	48	42	48	42	45	45	42	45
	31	26	-1	29	-4	26	-10	-10	-10	45
Forward Barrel	33	37	28	31	23	22	7	4	1	28
	35	32	32	32	26	29	13	16	13	29
	37	31	34	34	28	28	19	22	19	37
	39	-3	-15	-3	-18	-9	-24	-27	-27	9
Aft Barrel	41	29	29	26	23	17	5	2	2	20
	45	41	32	41	26	35	17	20	20	38
	47	29	29	32	26	29	20	20	14	35
	51	-8	-11	-8	-17	-11	-26	-26	-26	7

* Pogo

K. RECOVERY SYSTEM PERFORMANCE

-1 Mission

The -1 recovery capsule was successfully recovered by air catch on Rev. 115. All re-entry events were within tolerance. The impact was near the predicted. The sequence of events is included in Table 3-9.

	Actual	Predicted
Impact Location	25°25.0'N/161°15.0'W	24°57.7'N/161°08.2'W

-2 Mission

The -2 recovery capsule was successfully recovered by air catch on Rev. 276. All re-entry events were within tolerance. The impact was approximately 10 n.m. north of the predicted. The sequence of events is included in Table 3-9.

TABLE 3-9

RE-ENTRY SEQUENCE OF EVENTS

Event	Sys. Time #1	Delta Time #1	Nominal Time	Delta Time #2	Sys. Time #2
Arm	83865.96	76.79	77.00 ± 1.0	76.85	75237.60
Transfer	83940.75	2.00	2.00 ± .25	2.01	75372.44
Elect. Dis.	83941.75	1.00	.90 +.43 -.40	1.00	75373.44
Separation	83942.75	---	----	----	75374.45
Spin	83945.15	3.40	3.40 ± .30	3.41	75376.85
Retro	83952.75	7.60	7.55 ± .45	7.58	75384.43
Despin	83963.33	10.58	10.75 ± .54	10.75	75395.18
T/C Separation	83964.84	1.51	1.50 ± .15	1.48	75396.66
V/M Close	84059.68	193.72	180.0 ± .42	205.10	75502.70
V/M Open	---	---	290.0 ± .67	----	----
"G" Switch Op.	84478.65	525.90	Predicted 536.1 & 541.5	533.23	75917.66
Parachute Cover Off	84504.96	26.31	26.0 ± 1.5	26.11	75943.77
Deceleration Chute Deployed	84505.48	.52	.58 ± .10	.56	75944.33
Main Chute Bag Separate	84516.45	10.97	10.25 ± 1.5	10.43	75954.76
Main Chute Deployed	84516.95	.50	.52 ± .13	.54	75955.30
Main Chute Disreef	84521.70	4.75	4.50 ± .80	4.45	75959.75

L. SRV TAPE RECORDER

The tape recorders in both the -1 and -2 missions performed satisfactorily. A total of 207 minutes of data was recorded and processed from the two recorders.

This was the first system to utilize the added camera dynamic monitors in place of the gas valve monitors. Due to a design error, these monitors were only present when a continuous T/M enable was present.

M. HARDWARE DEFINITIONS

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

Agena

FTV 1655 was an Agena vehicle (SS01B) and a Thorad booster (SLV-2H) S/N 69-039. The vehicle flew nose first in orbit and included the following:

1. J_3 payload with digital storage register.
2. [redacted]
3. Nine Thiokol MDU rockets (2 - 2000 lbs., and 7 - 3000 lb.).
4. Ten panel, single wing, solar array system with two 1H batteries (first utilization on this program).
   A backup system of three 1H batteries with a real time "one time" command for switching the three 1H batteries onto the unregulated bus.
5. 3/4 Speed Type VIII programmer (325 subcycles).
6. A third primary control gas sphere with -5 control gas mixture was installed.

7. First vehicle to use SGLE equipment with all frequencies except capsule links. (Silo command system, alpha up-link and Delta 1 down-link telemetry links. The Uncle (UHF) command system remained unchanged.

<u>Payload</u>

The CR-9 payload configuration included the following:

1. Panoramic Camera
    a) Constant rotating type with first 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 aft looking panoramic camera 316 was equipped with an automatic filter change capability through the material change detector (MCD). The forward looking panoramic camera 317 MCD was disabled 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.

   d) The stellar film take-up in the -2 recovery bucket was prewrapped with 70 feet of leader.

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

This was the first system to have the added camera dynamic monitors in place of the gas valve monitors.

10. Payload Weight

EWO - 1781 lbs.

11. Instrumentation

a) Added a T/M monitor on supply spool motor and supply spool bobber of each camera.

b) Dynamic T/M enable (UHF 127/Silo 327) same as CR-7.

12. Thermal Configuration

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

b) The standard paint configuration was utilized on this system which consisted of 180 degrees black surface (90 degrees both top and bottom) and 180 degrees aluminized surface (90 degrees on each side).

13. Command System

This was the first system to utilize the Silo 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	400
T-4 slit width #2 duration	400
T-6 20 sec. increment inital setting	400
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 - 3798 seconds.

2) Delay step increment - 50 seconds.

Oblateness function

1) Oblateness function period - 5252.

2) Gain factor - 0.1160.

N. 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.

TABLE 3.10

	Mission 1108-1		Mission 1108-2	
Emulsion	B + F Density	Radiation	B + F Density	Radiation
Type 3401	0.11	0.1R	0.13	0.2R
Royal X Pan	0.22	0.2R	0.25	0.3R

These levels are below that which will degrade the photography.

SECTION 4

PHOTOGRAPHIC PERFORMANCE

A. SUMMARY

The photographic performance of the panoramic cameras for Mission 1108 ranged from fair to good. The reduction in scale because of a higher than normal mission altitude (after pass D40) reduced the effectiveness of the mission.

An MIP of 105 for Mission 1108-1 was achieved at an altitude of 82 N.M. and an MIP of 100 for 1108-2 at an altitude of 100 N.M. These MIP's are the highest achieved by a Corona system for a launch near the winter solstice.

No CORN targets were acquired for evaluation on this mission

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 3404 16,300 Ft.	Type 3404 15,200 Ft. Type SO-242 (Color) 800 Ft.

DISIC

Index	Stellar
Type 3400 2,200 Ft.	Type 3401 2,000 Ft.

B. PANORAMIC CAMERAS

1. Image Quality

Forward Looking Camera #317: Film Type 3404

The quality of the imagery provided by the Fwd-Looking camera is variable. Instances of image smear (scan direction) and severe out-of-focus imagery are apparent intermittently throughout the mission. The image smear appears to be associated with exposure duration (Slit width). The out-of-focus imagery is apparent on frames three and four of each pass. The area is approximately one inch wide, located approximately twelve inches from the take-up end of the frame, and extends across the width of the exposed film web. In general, the imagery provided by this camera has a "soft" appearance at magnifications of 50 X and above; however, the best imagery of Mission 1111-1 was selected from the Fwd-Looking camera record. This imagery is located on Pass D30 Frame 20 and is assigned an MIP rating of 105. The overall performance of the Fwd-Looking camera (Image quality) is rated as fair.

Smeared images on the Forward camera were detectable where the wider exposure slits were required. This smearing is most noticeable on the take-up side of the format. The largest uncompensated motion exists on the take-up side of the forward camera where illumination level permitted using narrow slits, the smearing affect was not readily observable in the imagery.

Forward camera was not performing to peak potential throughout most of the mission.

The best imagery of Mission 1108-2 was selected from the Forward camera. This imagery is located on Pass D242 Frame 20 and is assigned an MIP rating of 100.

Aft Looking Camera #316: Film Type 3404

Although the best imagery of the mission was selected from the Forward Looking camera, the image quality of the Aft-Looking camera record is less variable. In general, the imagery can be viewed at 50 X magnification without the noticeable loss of quality as is apparent on the Fwd-Looking record. The overall performance (Image quality) of the Aft-Looking camera is rated good when considering laboratory performance, altitude and time of year.

Aft Looking Camera #316: Colored Film Type SO-242

Mission 1108-2 returned 213 frames of aerial color film, SO-242, at the end of the Aft camera supply. Early evaluations of the color material from this mission were conducted from the color dupes and the resulting comments were generally negative. The photointerpreters reported the PI suitability of the color record as poor for first phase evaluations because of the small scale and lower resolution levels. The PET felt that the best image quality and color balance of the original SO-242 are good, but noted that there is a significant resolution loss from the original to the duplicates. Much of the SO-242 photography appeared to be degraded by haze, particularly at the low solar altitudes (less than 15 degrees). The best color image quality was taken at the higher solar altitudes (40 degrees). This color photography is better than any other color photography obtained to date from the Corona system, even though this flight was flown at 15 percent higher altitude. Particularly notable was the finer dye structure of the SO-242 material when compared with SO-121. Electrostatic fogging does not appear to be a problem with SO-242 in the Corona system.

2. Data Recording

The Fwd and Aft cameras produced acceptable auxiliary data imagery throughout Missions 1108-1 and -2. Imagery of the PG rail holes, 200 pulse per second time track, slur pulse, camera serial number, time word, start of pass mark were present and acceptable.

3. Anomalies

Approximately 35 percent of the data bits on the Aft-Looking camera #316 were bloomed with each data block exposure throughout the mission. This condition was noted during readiness testing at A/P from micro-sensitometer traces. The bits varied in size from approximately B – 10.3 mills and were within specification. This is greater than previous missions but probably could have been used successfully if required.

On Instr. #316 a heavy diagonal crease with associated emulsion lifts and plus density markings extends approximately 15 inches within the format on frame 47 of Pass D199. Imagery in this area indicates this anomaly occurred during defilming and pre-splice operations at [redacted]

On Inst. #317 (Forward-Looking camera) a fog pattern is present on the fourth frame from the end of all camera operations. The density of this pattern is commensurate with camera sit periods. After a 3 rev soak, fog density in the ON measured 1.1 above the base level. A light leak appeared to have originated in the drum and was imaged at the instrument exit roller.

A minus density line with parallel plus density bands appeared intermittently throughout both Forward and Aft records of both -1, and -2 missions. These bands were generally at a slight bias referenced to the film width. These bands sometimes had a brownish appearance and appears to be associated with film manufacture.

Numerous comet-shaped minus density spots are present intermittently throughout the Forward record of the -1 mission. Because head/tail orientation of the comets reverse between manufacturing splices, it was concluded this occurred in film manufacture.

Instances of severe out-of-focus imagery were apparent on frames 3 and 4 of most passes of Inst. #317. This area was approximately 10 inches from the take-up end of the frame. The amount of image degradation is directly associated with length of sit time between passes. On passes with sit times of one rev, the out-of-focus imagery is less severe and is difficult to detect. At least two revs between operates were necessary for consistent detection. These marks were directly associated with the small diameter roller in the extended film width assembly and the small diameter (bobbler) roller in the constant tension assembly. Extended inoperative periods tend to impress these rollers into the film causing the material to be deformed. This deformation is retained during the photographic scan and resulted in out-of-focus imagery at these points.

C. HORIZON CAMERAS

The horizon cameras of the Fwd and Aft panoramic instruments operated properly throughout the entire mission with one minor exception. An extra port horizon image was present with frame 35 of Pass D95. This image is overlapped to a small extent with the starboard image of frame 34, Pass D95. No fiducials were associated with this extra image.

D. DISIC #12 STELLAR/INDEX (TERRAIN) CAMERA

1. Performance

The Index photography was good and compares favorably with previous missions.

The density of the Index record varied from light to heavy with most of the mission medium to heavy. The Index shutter speed was fixed at the maximum speed (1/500) for the DISIC system. Therefore the format density cannot be decreased by increasing shutter speed. It is noted that many of the heavy density frames were exposed over ice and snow.

Point-type star images were recorded in both Stellar cameras but fewer stars were recorded on this mission than on previous missions. Automatic Stellar solar sensors were not activated during this mission.

The last 150 feet of Mission 1108-2 material was not exposed due to a DISIC system failure at Pass 204.

2. Anomalies

The DISIC camera failed to operate after frame 73 of Pass 204. Longer than normal cycle times were noted on Pass 1, and became progressively longer until failure was experienced. The cycle rate from SLP data taken from the last 5 frames was 9.451 sec/cycle as compared to 9.391 sec/cycle from preflight SLP data. A sudden reduction in motor voltage was indicated by the TLM monitor going from 3.5 to 2.0 volts at failure. The cause of this anomaly was the failure of a component in the DISIC DC/AC inverter.

Minor dendritic, wavering plus density static traces and grid plate static discharge in the Port format were present throughout the Stellar film. These marks are characteristic of the system in some pressure areas. Some correlation between marking and PMU Off was noted.

A plus density flare-type mark was present in some of the starboard formats from both mission segments and affected approximately 8 percent of the active format area. Minor sunlight reflections during some operations was considered the cause. Star imagery was present in the flare marked area.

Spot type plus density type discharges were present on the Index film on several operations of Passes 106 through 118. These discharges are of the same character and type that appeared on Mission 1107-2 film. Severity was minor.

Minor dendritic and wavering plus density discharges were present on the Index film and are considered minor and characteristic of the DISIC system.

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 3404

The Wratten 25 (W-25) and Wratten 21 (W-21) filters were selected for the Fwd and Aft looking cameras respectively. 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*	AFT
S_4	0.334	0.289
S_3	0.274	0.185
S_2	0.214	0.140
S_1	0.141	0.084

Typical slit usage for Mission 1108-1 is shown in Figures 5-1 and 5-2 for orbit 57 Fwd and Aft cameras respectively. Similarly, Mission 1108-2 is represented by Figures 5-3 and 5-4 of orbit 205 Fwd and Aft cameras respectively. The solid curve in Figures 5-1 through 5-4 represent the ideal exposure based on exposure criteria dated June 1969. The actual exposure time produced through the programmed used of slits S_4 through S_1 is a step function as shown by the dashed curves shown on Figures 5-1 through 5-4. Figures 5-1 through 5-4 include the relative distribution of camera operations for Mission 1108.

*Fwd = Forward Looking camera #317
Aft = Aft Looking camera #316

EXPOSURE POINTS

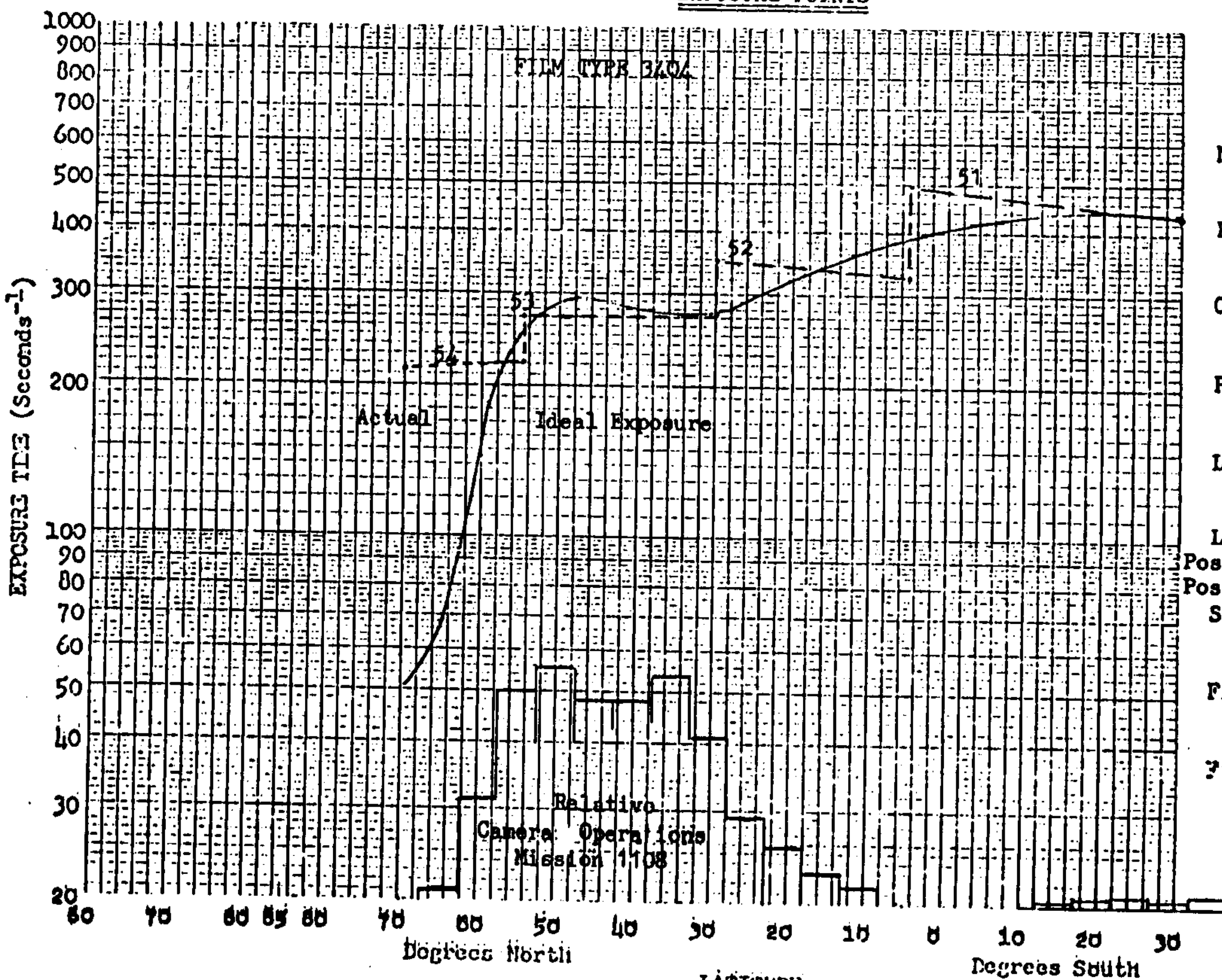


FIGURE 5-1: TYPICAL IDEAL VS ACTUAL EXPOSURE TIME VS LATITUDE

Mission No: 1108-1

Payload No: CR-9

Camera No: 317 Fwd

Pass No: 57D

Launch Date: 4 December

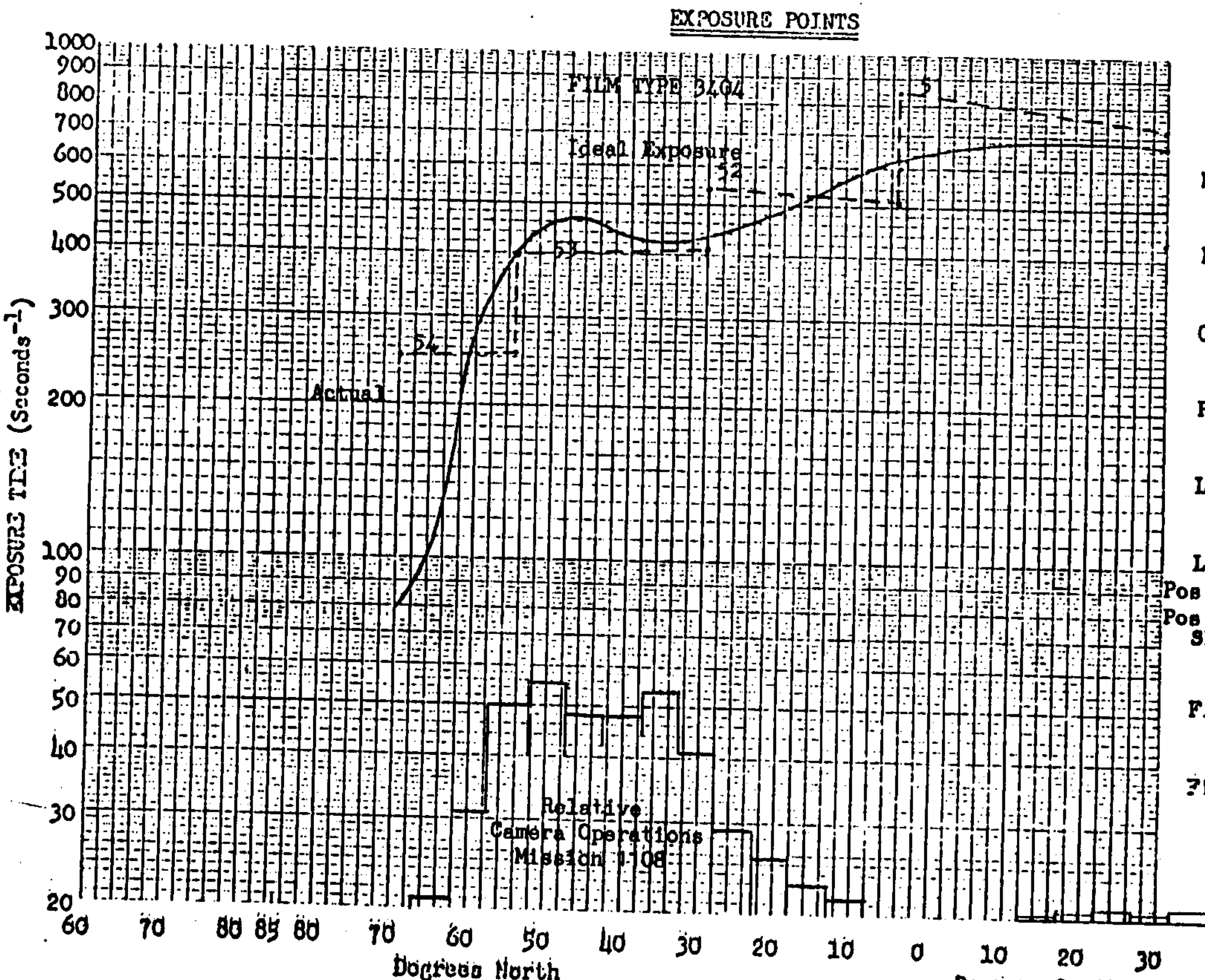
Launch Time: 2138 GMT
1338 PST

Pos 1=0.141 In, Pos 2 = 0.2
Pos 3=0.274 In, Pos 4 = 0.3
Slit Width: F/S = 0.237

Filter Type: W-25 Gel.

Film Type: 3404

TOP SECRET/C



Mission No: 1108-1

Payload No: CR-9

Camera No: 316 Aft

Pass No: 57D

Launch Date: 4 December 1

Launch Time: 2138 GMT 1338 PST

Pos 1 = 0.084 In., Pos 2=0.

Pos 3 = 0.185 In., Pos 4=0.

Slit Width: F/S = 0.154

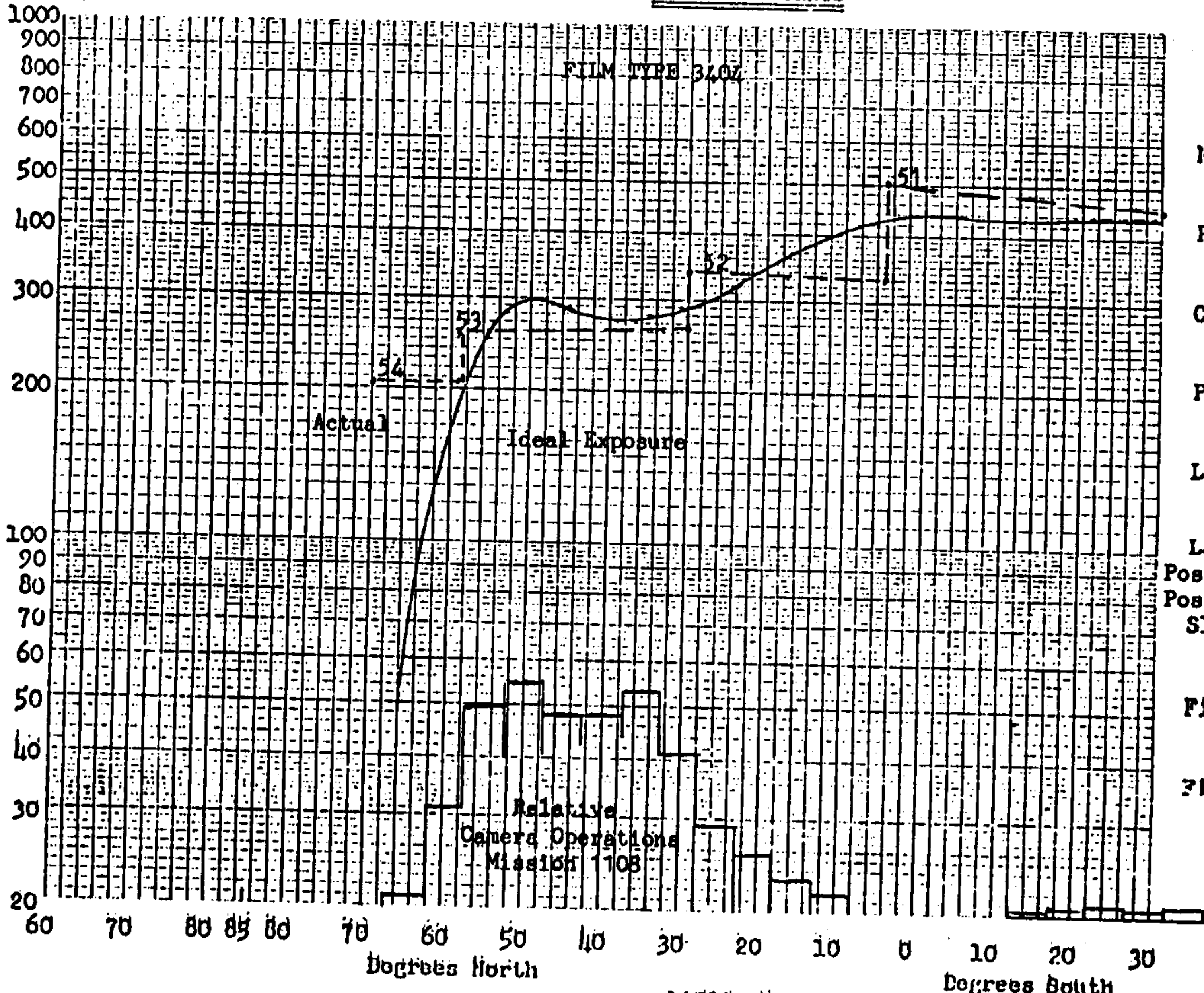
Filter Type: W-21 Gel.

Film Type: 3404

FIGURE 5-21 TYPICAL IDEAL AND ACTUAL EXPOSURE TIME VS LATITUDE
PASS 57D AFT CAMERA

~~TOP SECRET~~/C

EXPOSURE POINTS



Mission No: 1108-2

Payload No: CR-9

Camera No: 317 Fwd

Pass No: 203

Launch Date: 4 December 19

Launch Time: 2138 GMT 1338 PST

Pos 1 = 0.141 In., Pos 2 = 0

Pos 3 = 0.274 In., Pos 4 = 0

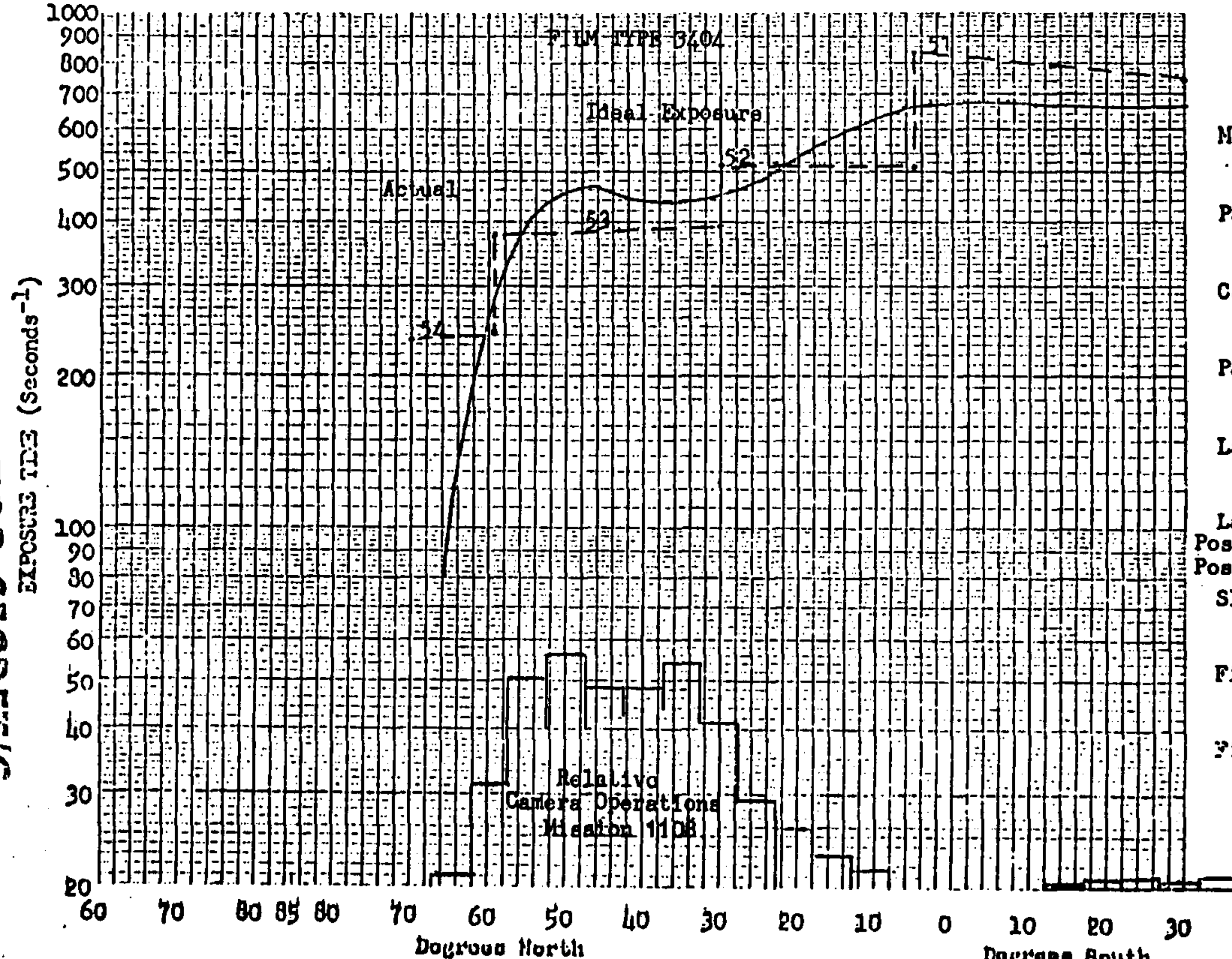
Slit Width: F/S = 0.237

Filter Type: W-25 Gel.

Film Type: 3404

FIGURE 5-3: TYPICAL IDEAL VS ACTUAL EXPOSURE TIME VS LATITUDE PASS 203D FWD CAMERA

EXPOSURE POINTS



Mission No: 1108-2

Payload No: CR-9

Camera No: 316 Aft

Pass No: 203

Launch Date: 4 December 19

Launch Time: 2138 GMT 1338 PST
Pos 1 = 0.084 In., Pos 2 = 0
Pos 3 = 0.185 In., Pos 4 = 0
Slit Width: F/S = 0.154

Filter Type: W-21 Gel.

Film Type: 3404/SO-242 (800 Ft)

FIGURE 5-4: TYPICAL IDEAL VS ACTUAL EXPOSURE TIME VS LATITUDE

TOP SECRET/C

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 1108, reveal that all exposures taken between approximately 58° north and 5° 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 58° and 5° north latitude were exposed properly as will be shown in the following report.

Targets north of 58° north latitude tended to be underexposed as predicted. Targets near the equator and further south were somewhat overexposed based on the pre-flight exposure criteria.

A useful technique, employed on post 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 films response to light as shown in Figure 5-5. Figure 5-5 is a typical negative exposure vs density response curve for film type 3404. 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 5-26 show the frame D-min/D-max values for all the domestic revs for the Forward (Fwd) and Aft-Looking cameras. Included from Mission 1108-1 are frame D-min/D-max values from domestic revs No. 1, 14, 30, 48, 79, and 95. Frame D-min/D-max values from Mission 1108-2 include domestic revs No. 113, 115, 145, 176, 208, and 242.

The frame D-min/D-max values plotted in Figures 5-5 thru 5-26 are represented on the D LOG E curve as a dot for frame D-min and an X for frame D-max. Density values were supplied by [redacted] Density measurements were accomplished manually using a ½ millimeter aperture (500 micrometers).

Examination of D LOG E curves, Figures 5-5 thru 5-26, reveal that the film in the Aft-Looking camera (#316) received slightly more exposure on the average compared to the Fwd camera (#317). Further, the Aft film appears correctly exposed while the Fwd film has a slight underexposed bias on the average as shown by examination of the frame D-min values for all the domestic revs plotted in Figure 5-27. The slight underexposed bias exhibited on the average by the Fwd 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 as shown in Table 5-2.

Figure 5-29 illustrates the positions of the 1108 mission D-mins and D-maxs for frames and targets on the CR-9 Resolution vs Density (Rel Log E) curve. It illustrates an acceptable fit.

Figures 5-30 thru 5-37 further present the 1108 Density distribution situation for the Fwd/Aft cameras for the -1 and -2 missions.

TABLE 5-1

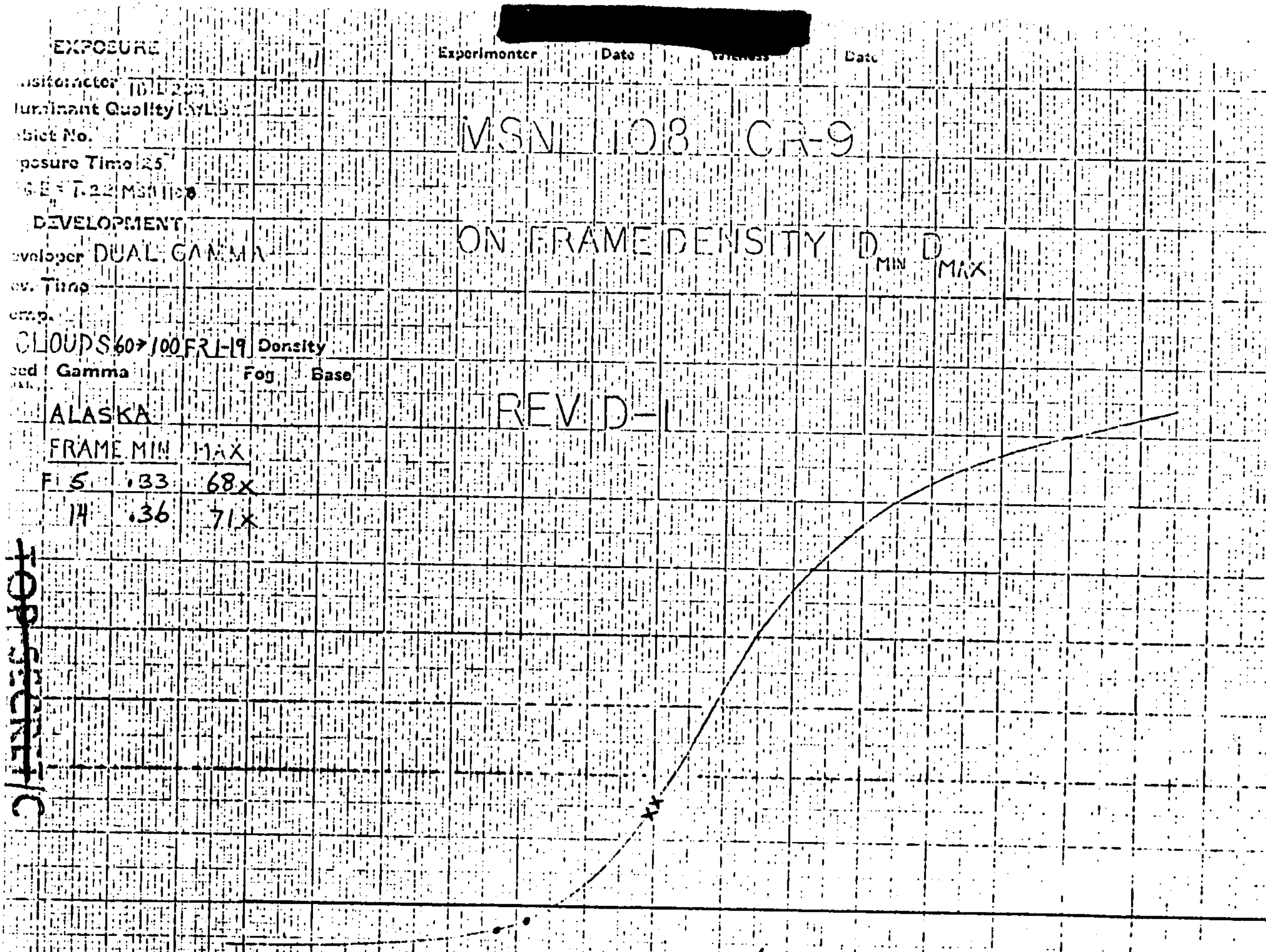
EXPOSURE CLASSIFICATION BY REVS, FWD CAMERA

Slightly Underexposed	Correct Exposure	Overexposed
6,8,30,37	7,11,14,21	
48, 71,87	22,23,24	
113,119,120	25,39,40,53	
184,200,215,217	54,55,56,57	
232,233	68,69,70,73	
242,249	74,76,79,85	
265,	88,89,90,91	
	105,106,115,118	
	134,135,136,137	
	145,150,151,152	
	160,166,167,169,170	
	176,173,183,187	
	199,201,203,208	
	216,218,219	
	231,234,235	
	248,250,252	
	263,264,266	
	267,268	

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.

Exposure classification of Mission 1108 according to the micro D-min values for actual targets obtained from Project Sunny reveals that the entire mission was correctly exposed. The difference in exposure classification obtained by macro frame D-min values vs target micro D-min values is readily seen in Figure 5-28.

Figure 5-28 shows that micro D-min values taken from man made targets (Project Sunny) average more density than macro D-min values taken from the frame which are frequently terrain values.



FRAME D-MIN/D-MAX FROM ON REV D-1

FIGURE 5-5

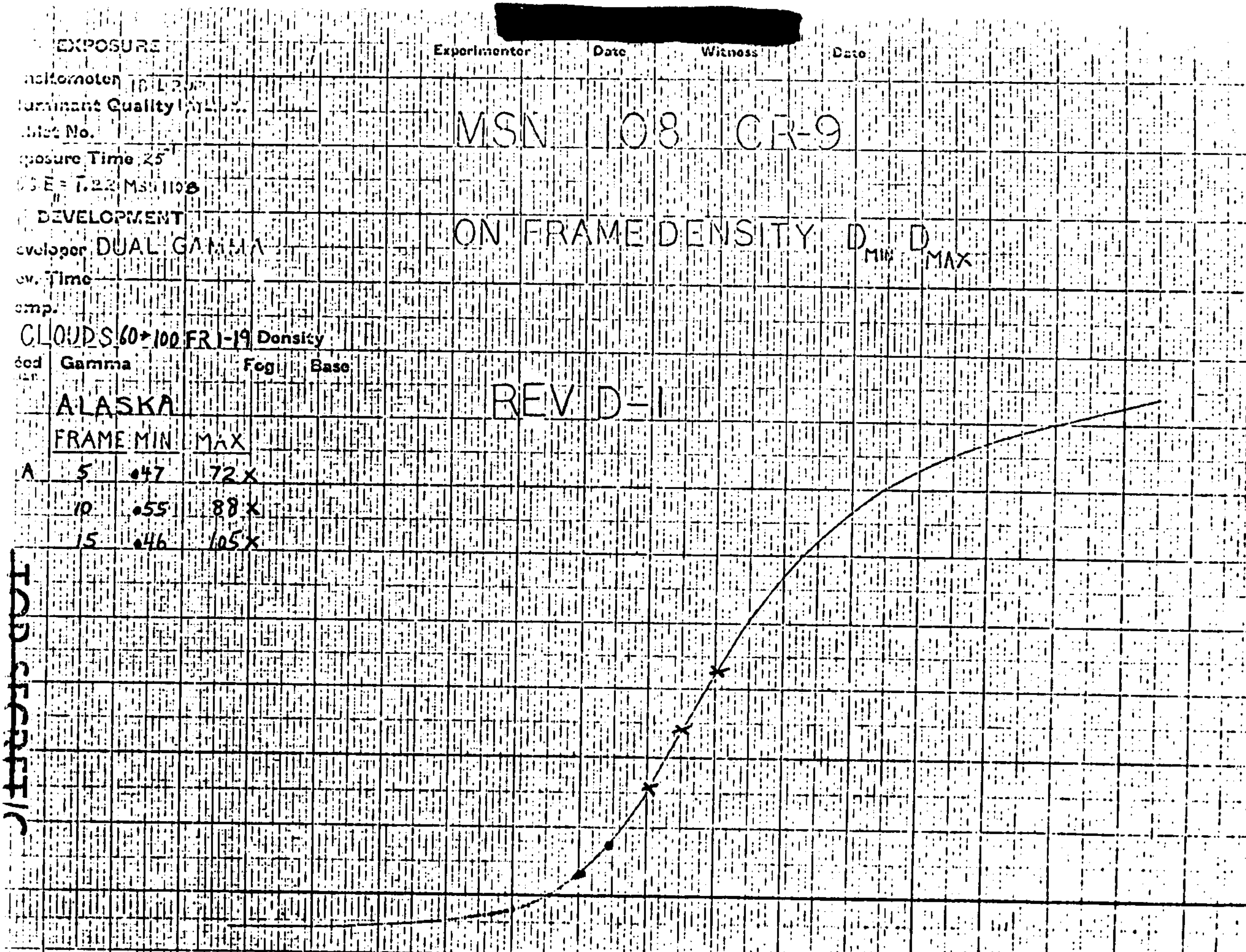

[redacted]
EXPOSURE
Experimentor
Date
Witness
Date
Sensitometer
Illuminant Quality
Filter No.
Exposure Time .25
MSN 108 CR-9
DEVELOPMENT
Developer DUAL GAMMA
Dev. Time
Temp.
ON FRAME DENSITY D_{MIN} D_{MAX}
CLOUDS 60→100 FR 1-19 Density
Gamma
Fog
Base
ALASKA
REV D-1
FRAME MIN MAX
A 5 .47 72 X
10 .55 88 X
15 .46 105 X

FIGURE 5-6

[redacted]

EXPOSURE Experimenter Date Witness Date

nsitometer IB L 207
uminant Quality
bject No.
posure Time 25
G E = 7.22 MSI 108

DEVELOPMENT
veloper DUAL GAMMA
v. Time
mp.
CLOUDS FR Density
od Gamma Fog Base

MSN 108 CR-9

ON FRAME DENSITY D_{MIN} D_{MAX}

REV D-14 OP 1&2

FRAME MIN MAX
• X

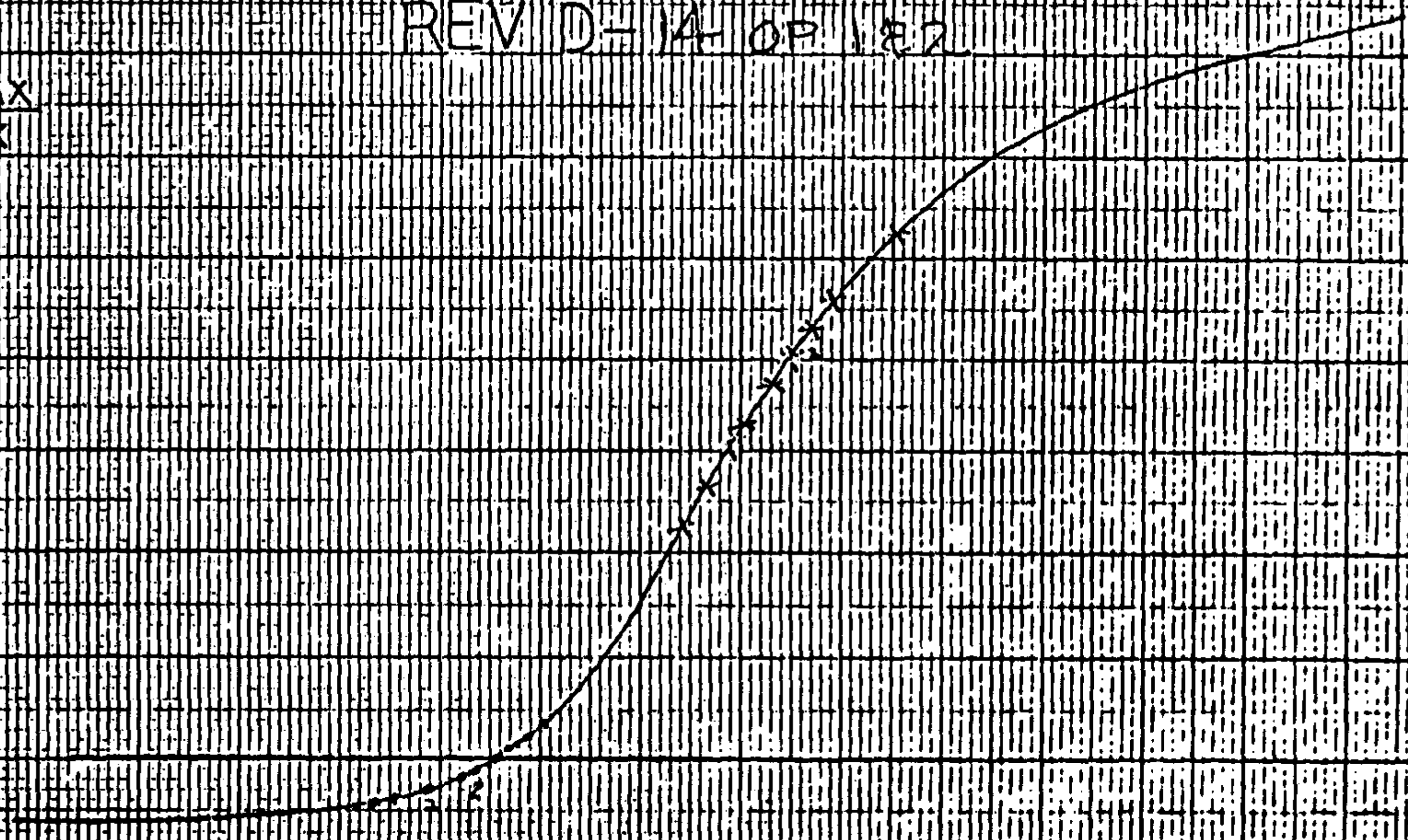


FIGURE 5-7

[redacted]

EXPOSURE | Experimenter | Date | Witness | Date

...sitometer 1B L 2017
...minant Quality DAYLIGHT
...ject No.
...posure Time 25
...E = 1.22 MSN 108

MSN 108 CR-9

DEVELOPMENT
...veloper DUAL GAMMA
... Time
...mp.

ON FRAME DENSITY D_{MIN} D_{MAX}

CLOUDS 10-90 FR. Density
...d Gamma Fog Base

NY & SA

REV D-14 OF 122

FRAME	MIN	MAX
	•	X

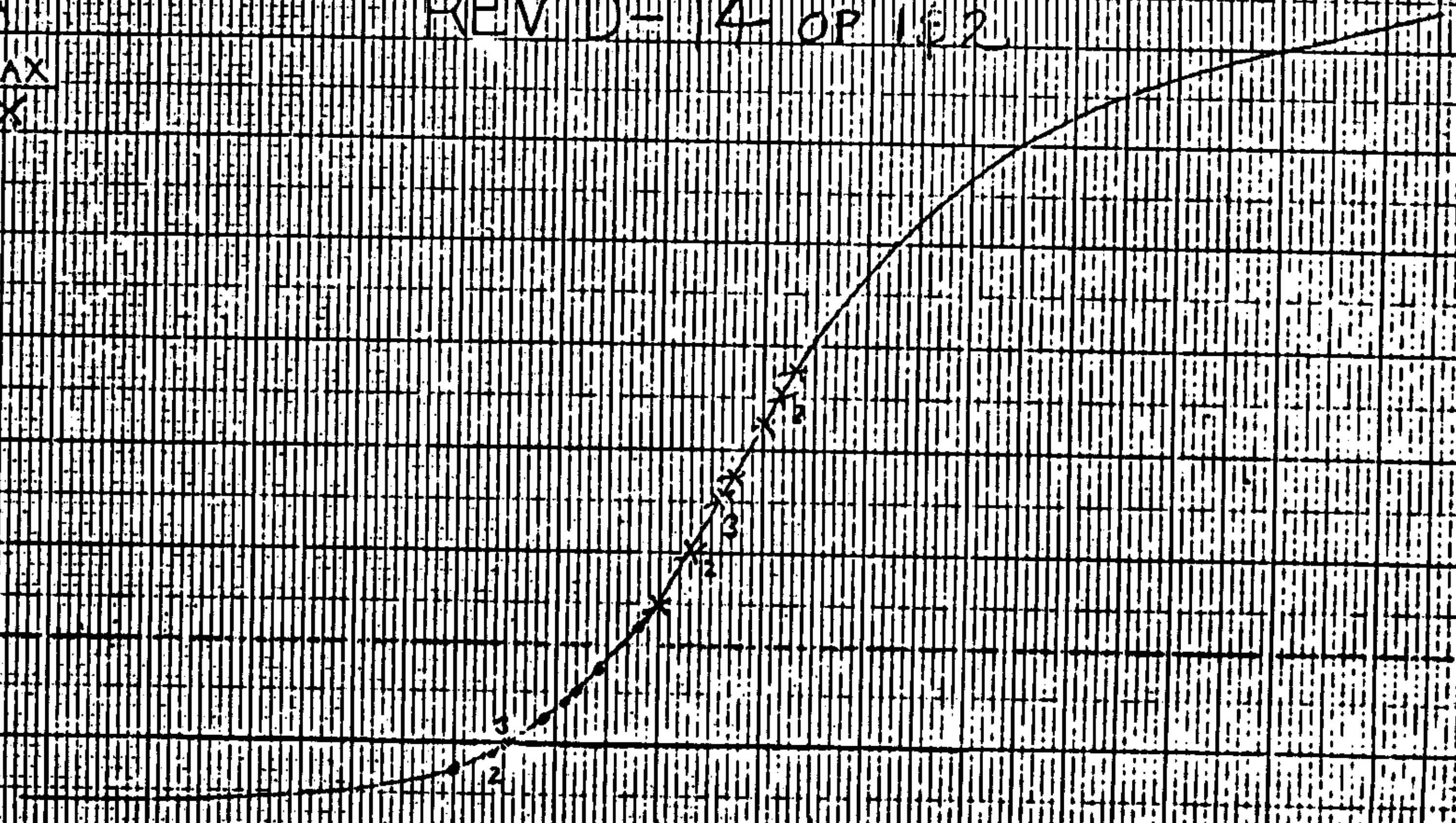


FIGURE 5-9

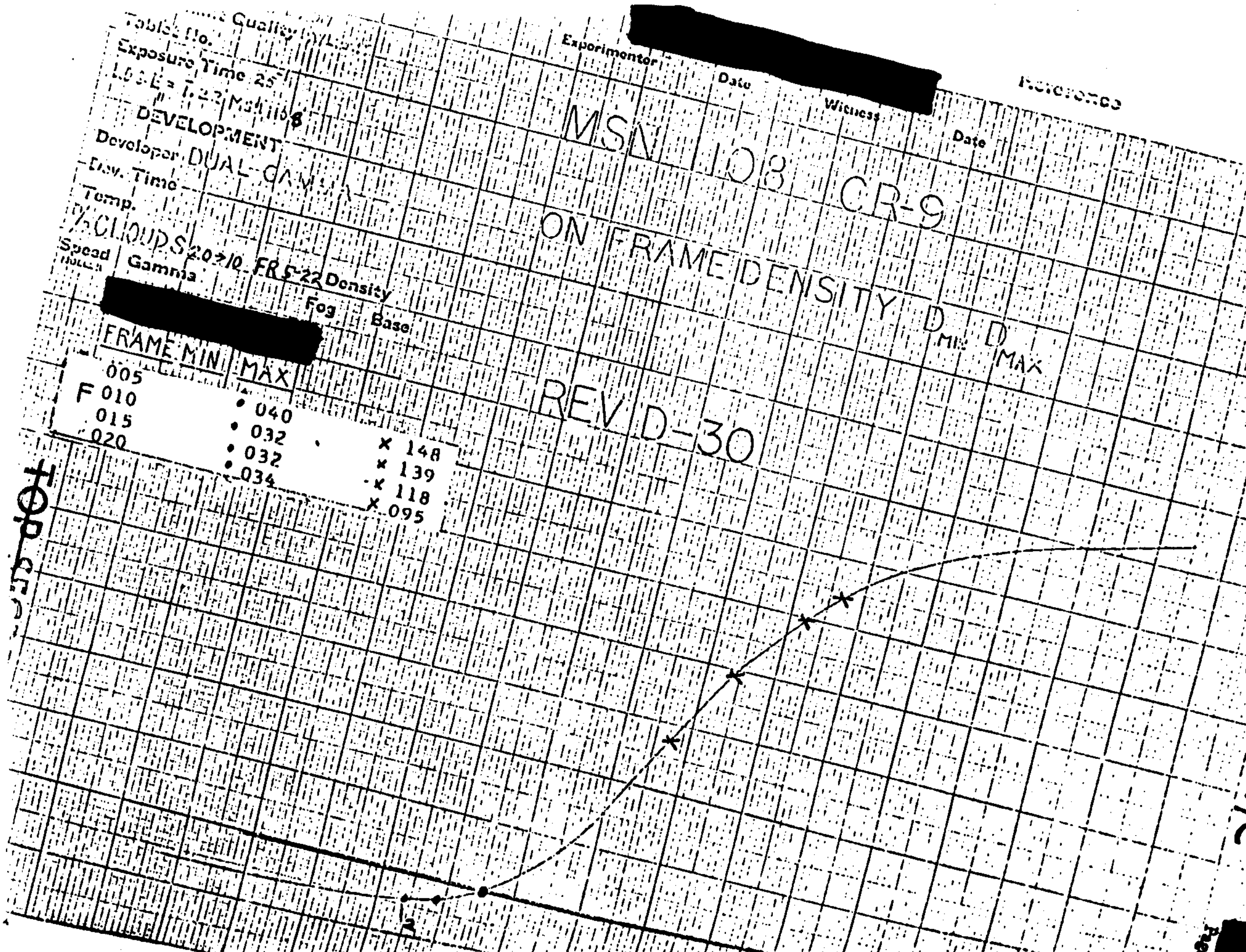

Quality
Tables No.
Exposure Time 25
DEVELOPMENT
Developer DUAL GAMMA
Dev. Time
Temp.
% CLOUDS 2.0>1.0 FR 5-22
Speed
Gamma
Density
Fog
Base
Experimenter [redacted]
Date
Witness
Date
Reference
MSN 108 CR-9
ON FRAME DENSITY D MIN D MAX
REV D-30
FRAME MIN MAX
005
F 010 • 040 × 148
015 • 032 × 139
020 • 032 × 118
• 034 × 095

FIGURE 5-9

[redacted]

EXPOSURE | Experimenter | Date | Witness | Date

Sensitometer IB I 207
Illuminant Quality
Tablet No.
Exposure Time
S.E. = T.22 MSN 1108
DEVELOPMENT
Developer DUAL GAMMA
Dev. Time
Temp.
CLOUDS 20→10 FR 5-22 Density
Gamma | Fog | Base

[redacted]

MSN 1108 CR-9

ON FRAME DENSITY D_{MIN} D_{MAX}

REV D-30

	FRAME	MIN	MAX
A	005	• 055	× 090
	010	• 041	× 120
	015	• 040	× 130
	020	• 040	× 115

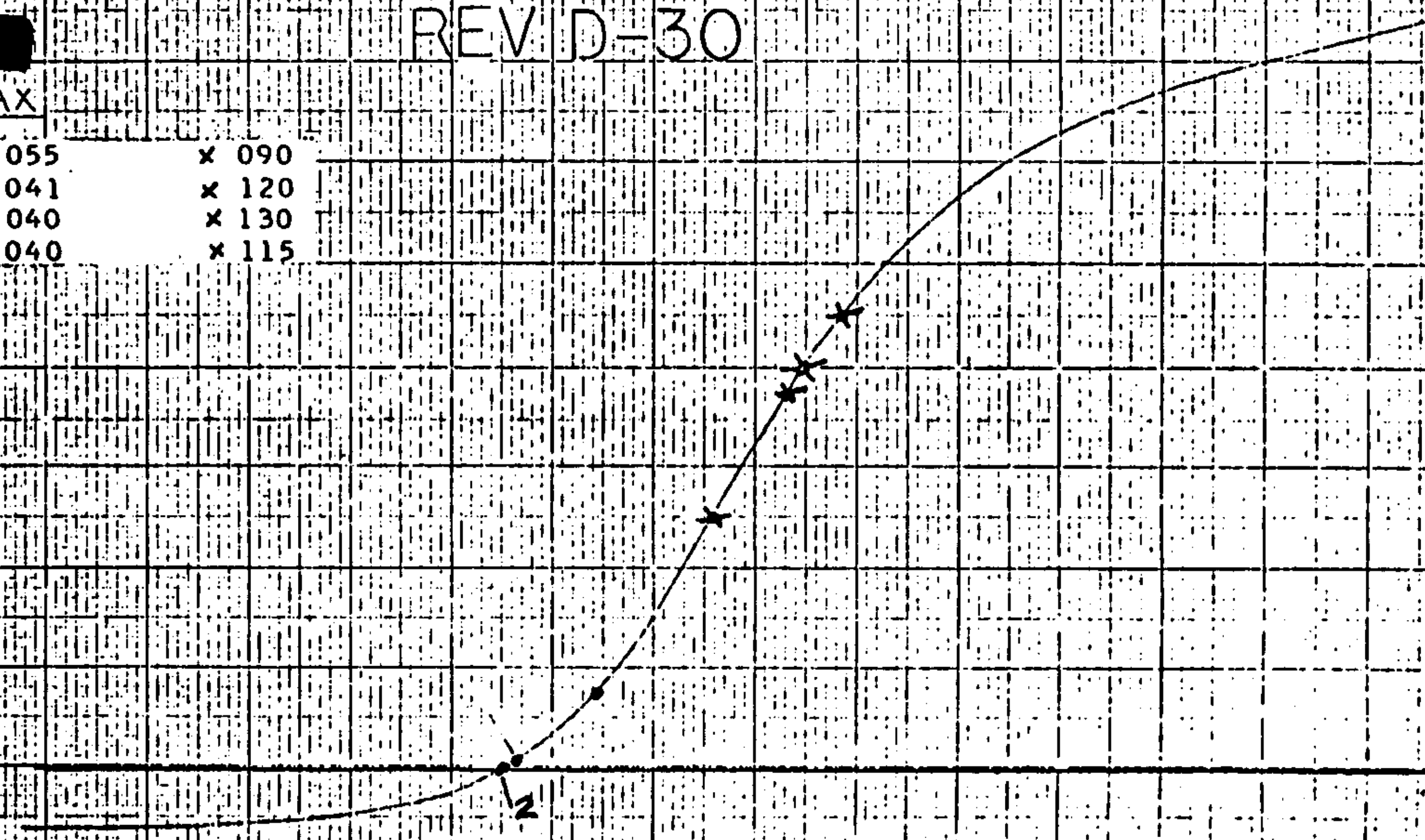


FIGURE 5-10

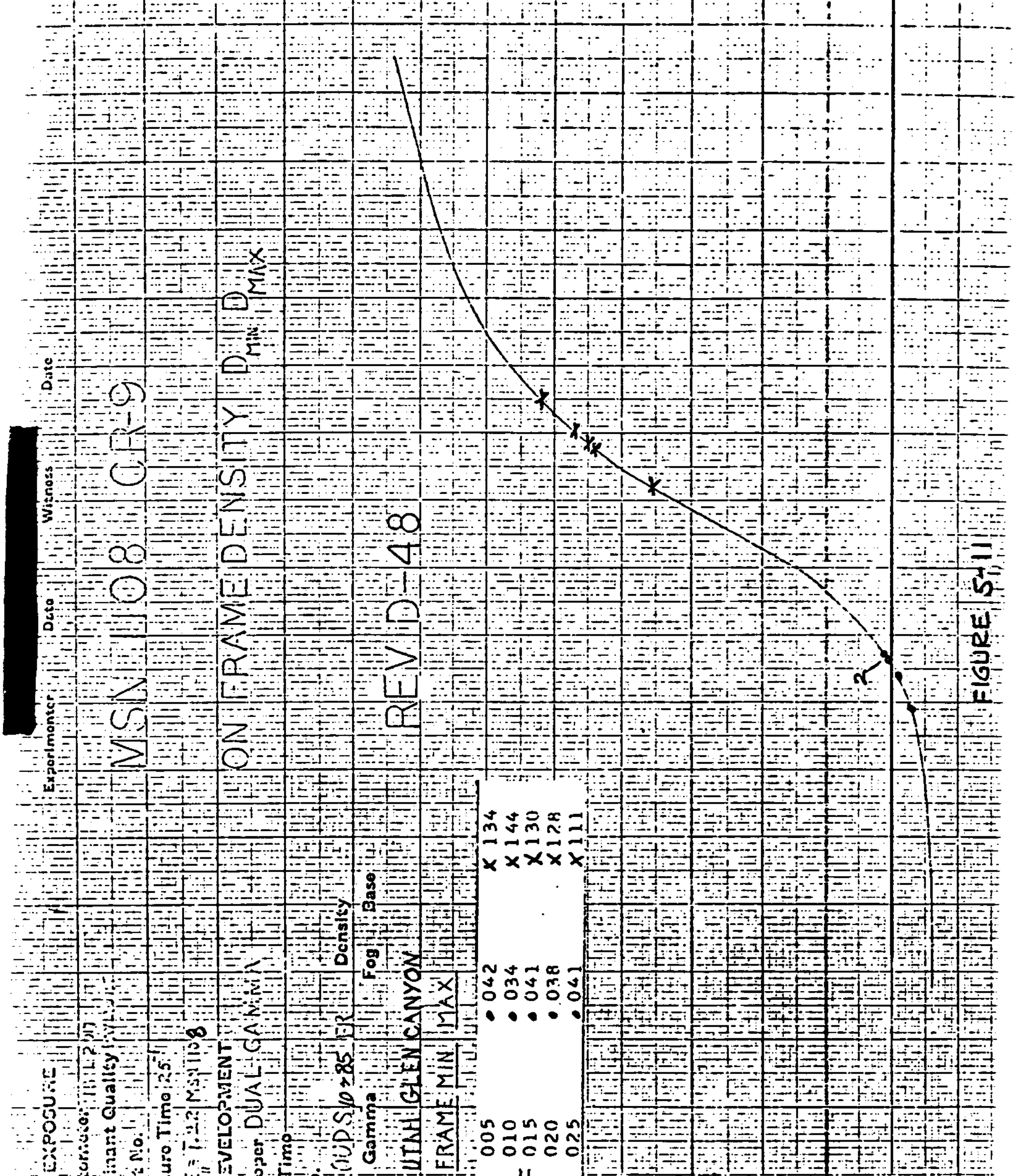

EXPOSURE
Experimenter
[redacted]
Witness
Date
DEVELOPMENT
DUAL GAMMA
Density
Fog
Base
MSN 1108 CR-9
ON FRAME DENSITY D MIN. D MAX
REV D-48
UTAH GLEN CANYON
FRAME MIN MAX
005 .042 X 134
010 .034 X 144
015 .041 X 130
020 .038 X 128
025 .041 X 111

FIGURE 5-11

[redacted]

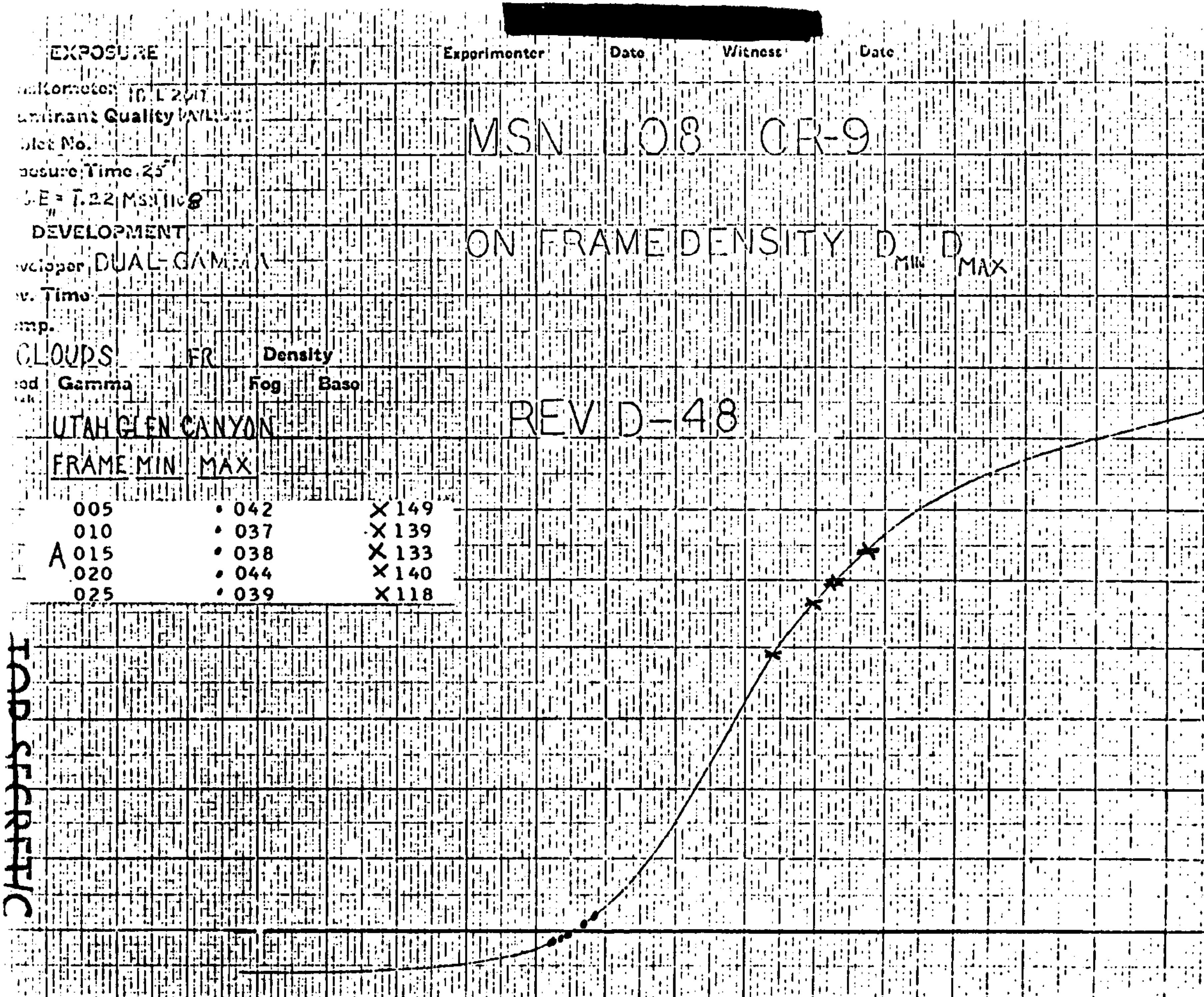


FIGURE 5-12

[redacted]

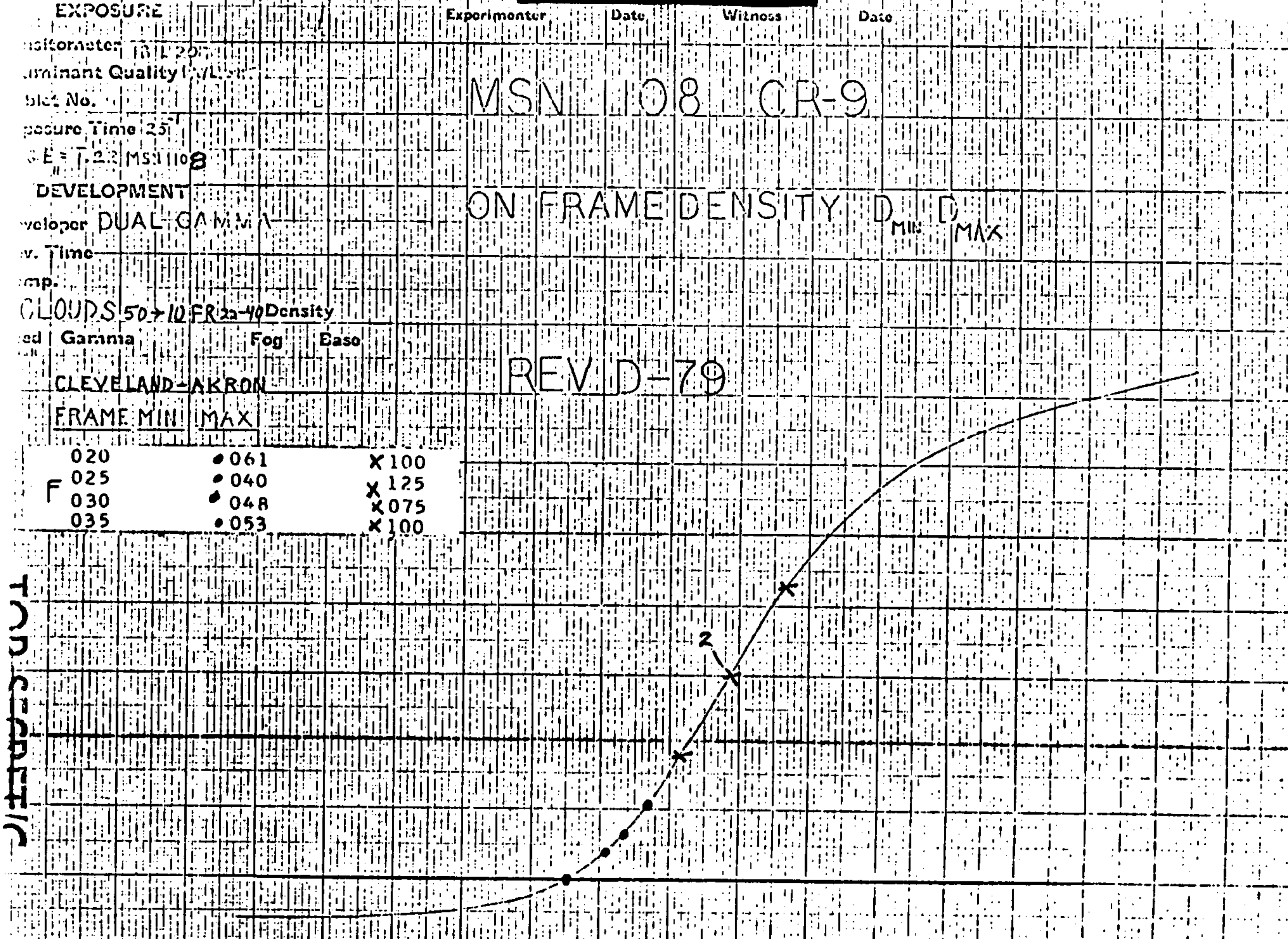


FIGURE 5-13

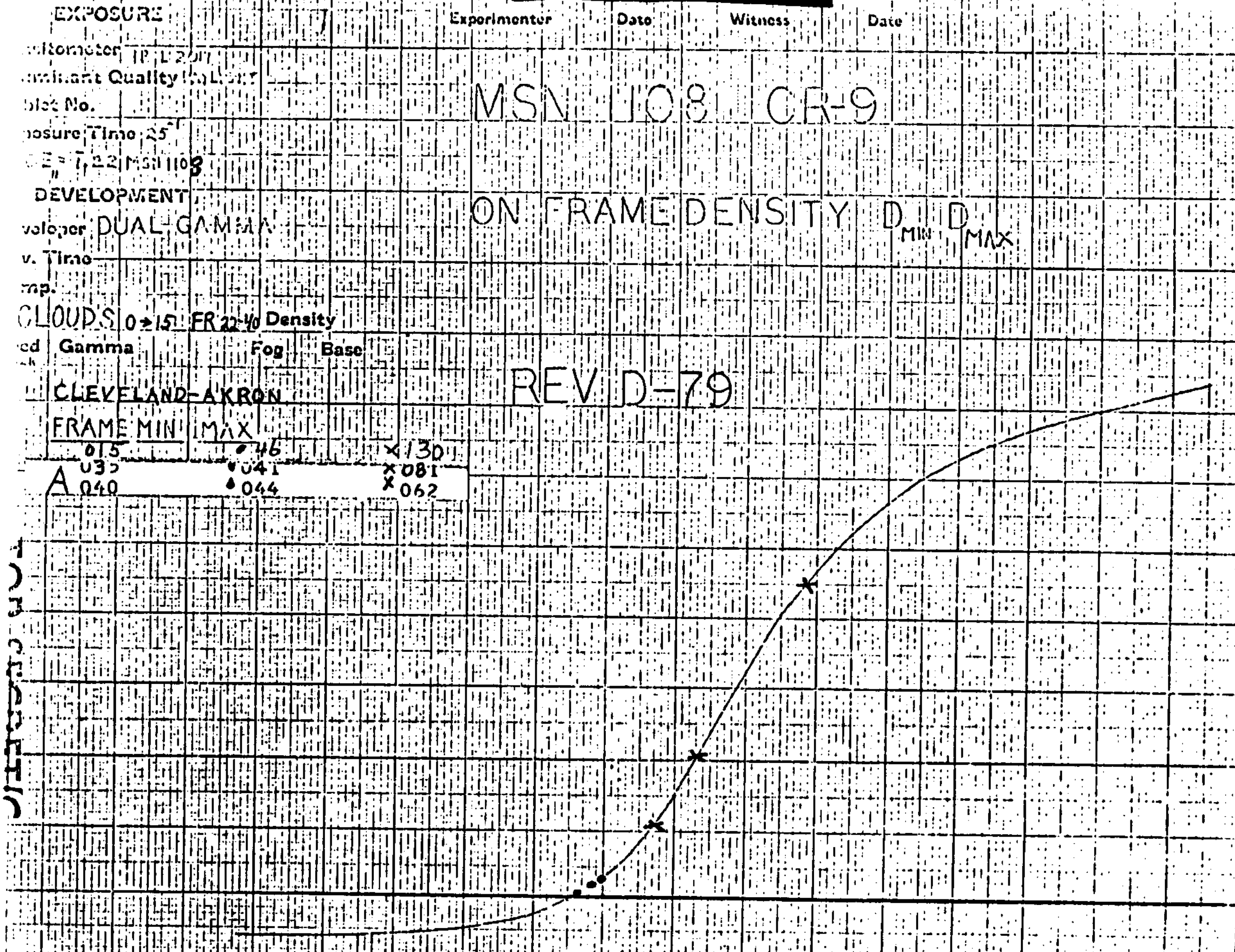

EXPOSURE
Experimenter
Date
Witness
Date
Sensitometer IB L 2b
Illuminant Quality
Sample No.
Exposure Time 25
MSN 1108
DEVELOPMENT
Developer DUAL GAMMA
Dev. Time
Temp.
CLOUDS 0→15 FR 22-40 Density
Gamma
Fog
Base
MSN 1108 CR-9
ON FRAME DENSITY D MIN D MAX
REV D-79
CLEVELAND-AKRON
FRAME MIN MAX
015 .46 130
032 .041 081
A 040 .044 062

FIGURE 5-14

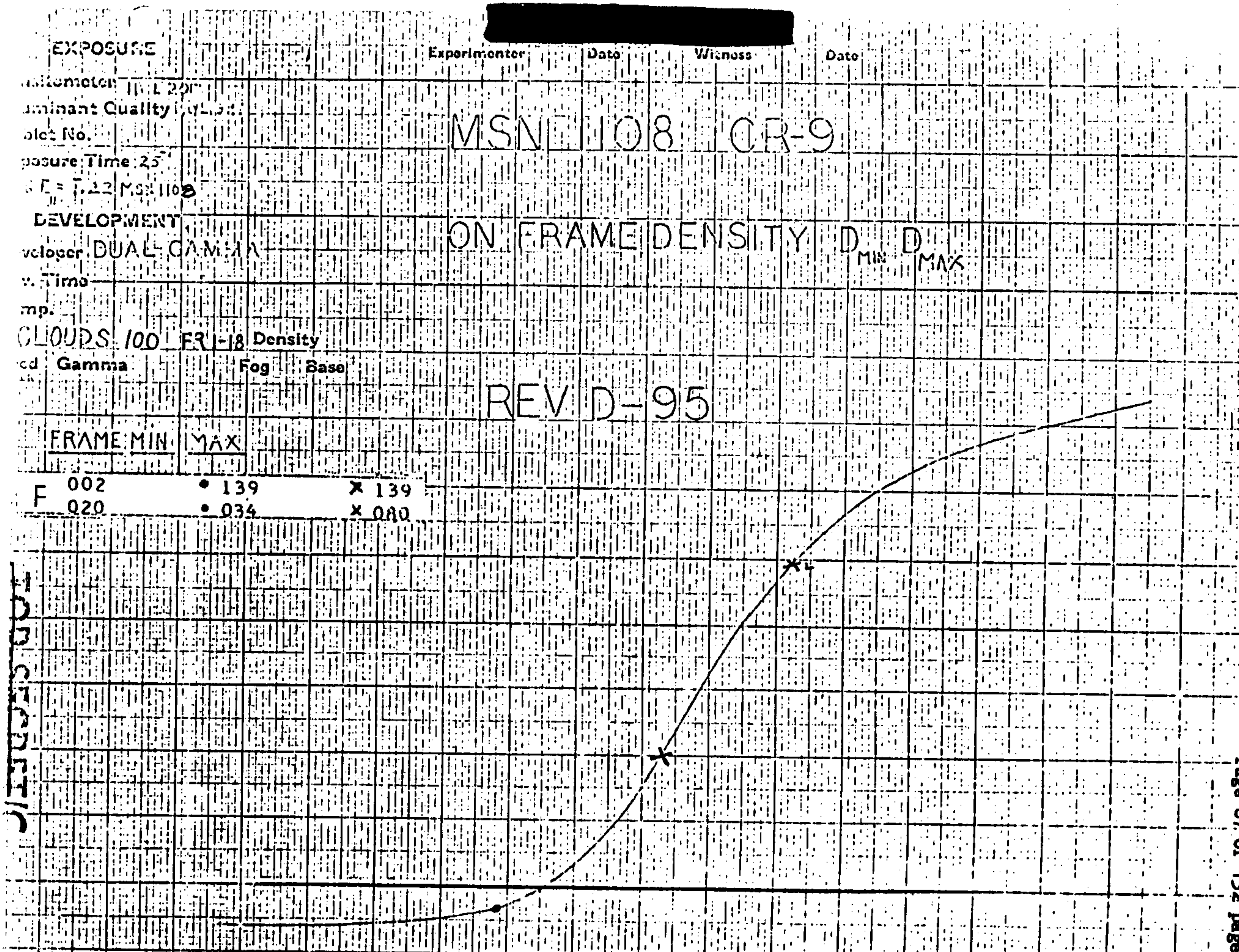

[redacted]
EXPOSURE
Experimenter
Date
Witness
Date
Sensitometer
Illuminant Quality
Step Tablet No.
Exposure Time
DEVELOPMENT
Developer DUAL GAMMA
Temp.
CLOUDS 100
Density
Gamma
Fog
Base
MSN 108 CR-9
ON FRAME DENSITY D_{MIN} D_{MAX}
REV D-95
FRAME MIN MAX
F 002 • 139 × 139
020 • 034 × 080

FIGURE 5-15

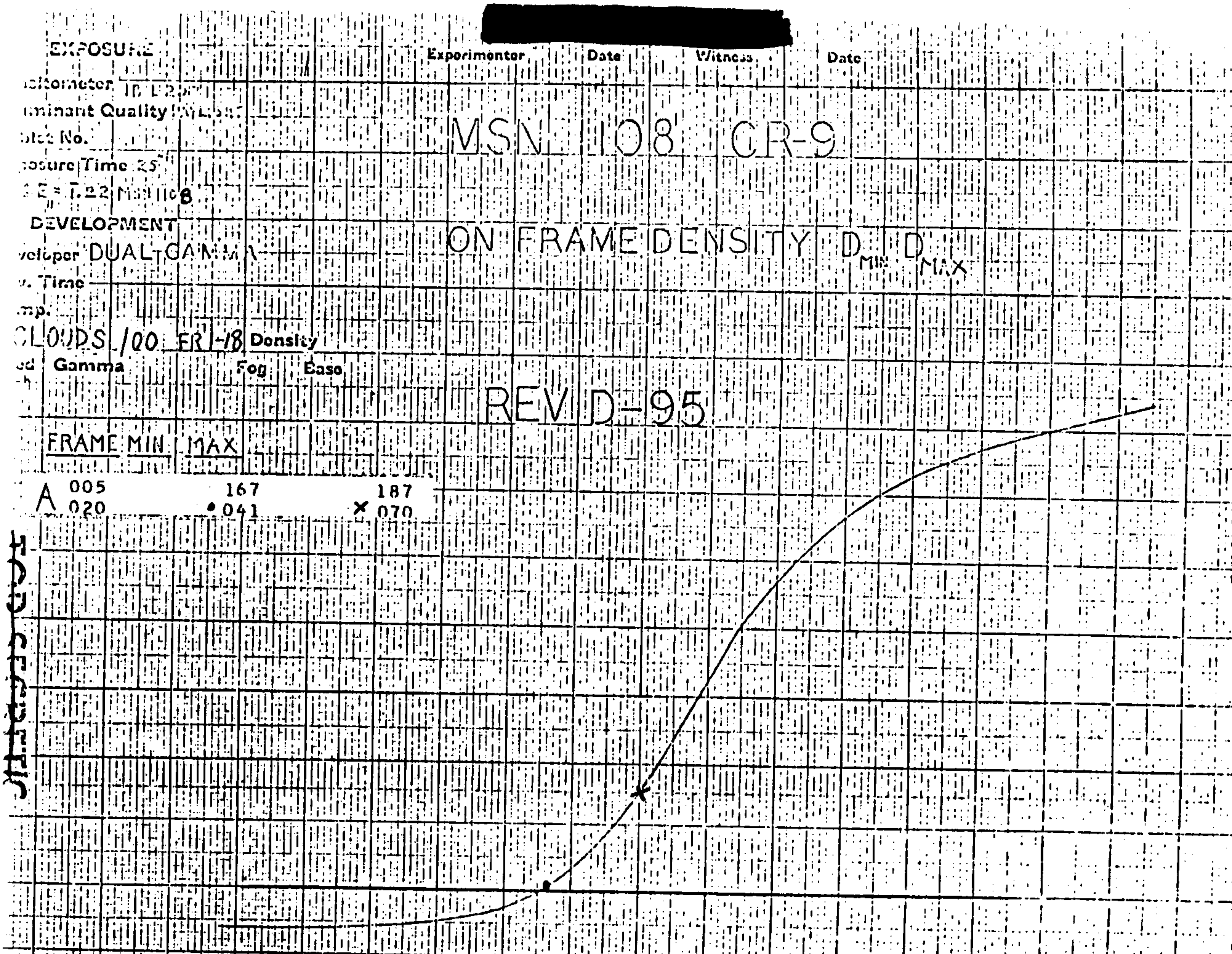

EXPOSURE
Experimenter
Date
Witness
Date
Illuminant Quality
Exposure Time
DEVELOPMENT
Developer DUAL GAMMA
Time
CLOUDS /100 ERI-18 Density
Gamma
Fog
Base
MSN 108 CR-9
ON FRAME DENSITY D_{MIN} D_{MAX}
REV D-95
FRAME MIN MAX
A 005 167 187
020 • 041 × 070

FIGURE 5-16

[redacted]

EXPOSURE | Experimentor | Date | Witness | Date

Sensitometer IB I 2011
Illuminant Quality Daylight
Slide No.
Exposure Time 25"
DE = T.22 MSN 108

DEVELOPMENT
Developer DUAL GAMMA
Dev. Time
Temp.
CLOUDS 50→0 FR 1-26 Density
Gamma Fog Base

MSN 108 CR-9

ON FRAME DENSITY D_{MIN} D_{MAX}

REV D-113

CALIFORNIA

FRAME	MIN	MAX
005	• 033	× 128
010	• 053	× 107
F 015	• 034	× 121
020	• 031	× 140
025	• 032	× 135

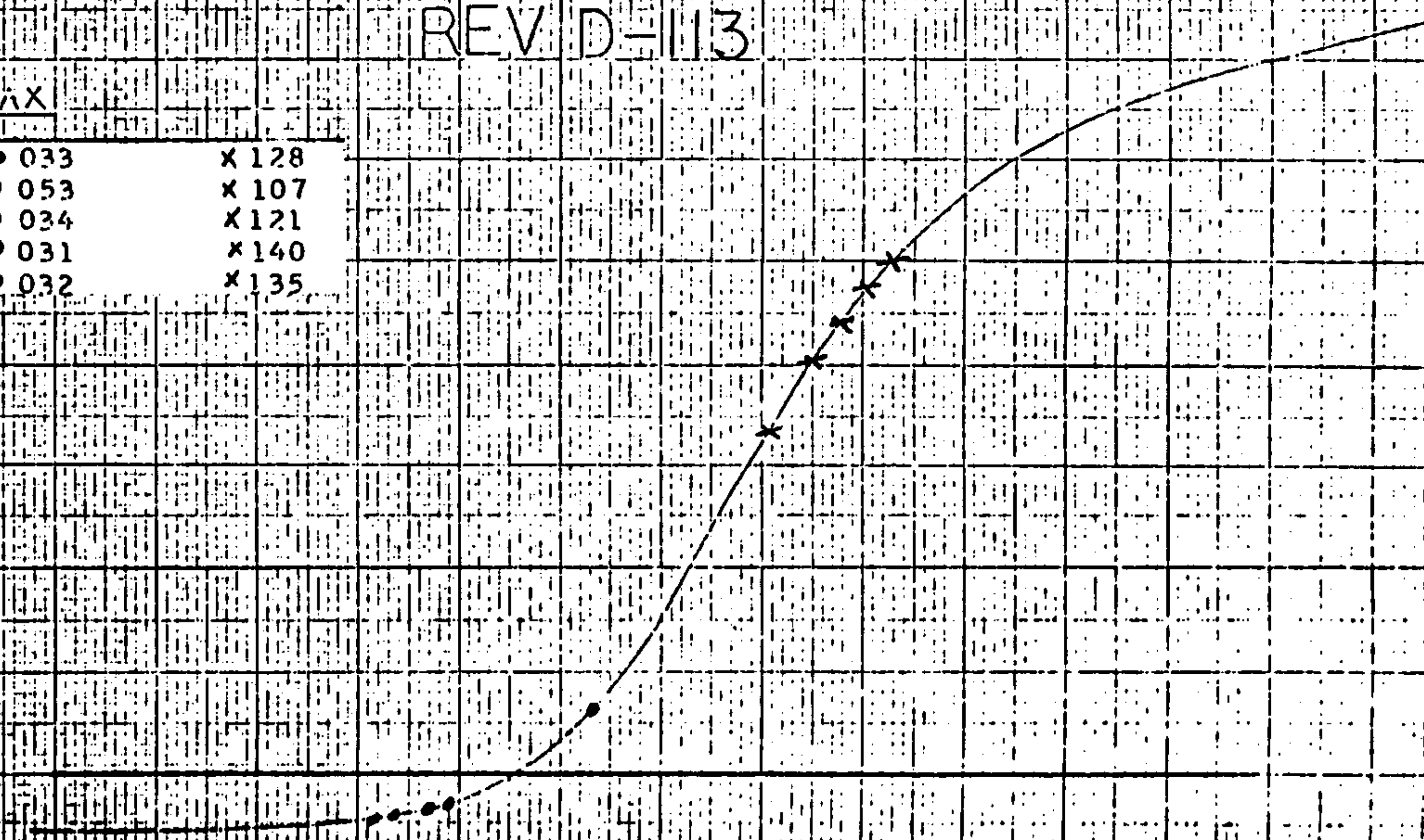


FIGURE 5-17

[redacted]

EXPOSURE — Experimenter — Date — Witness — Date

...sitometer [illegible]
...minant Quality [illegible]
...ist No.
...posure Time 25
...E = 7.22 No. 1108

DEVELOPMENT
...veloper DUAL GAMMA
...v. Time
...mp.

CLOUDS 75→0 ER-32 Density
...ed Gamma — Fog — Base

MSN 108 CR-9

ON FRAME DENSITY D_{MIN} D_{MAX}

REV D-113

CALIFORNIA

	FRAME	MIN	MAX
A	005	• 034	× 145
	010	• 037	× 139
	015	• 041	× 113
	020	• 037	× 133
	025	• 038	× 128
	030	• 040	× 113

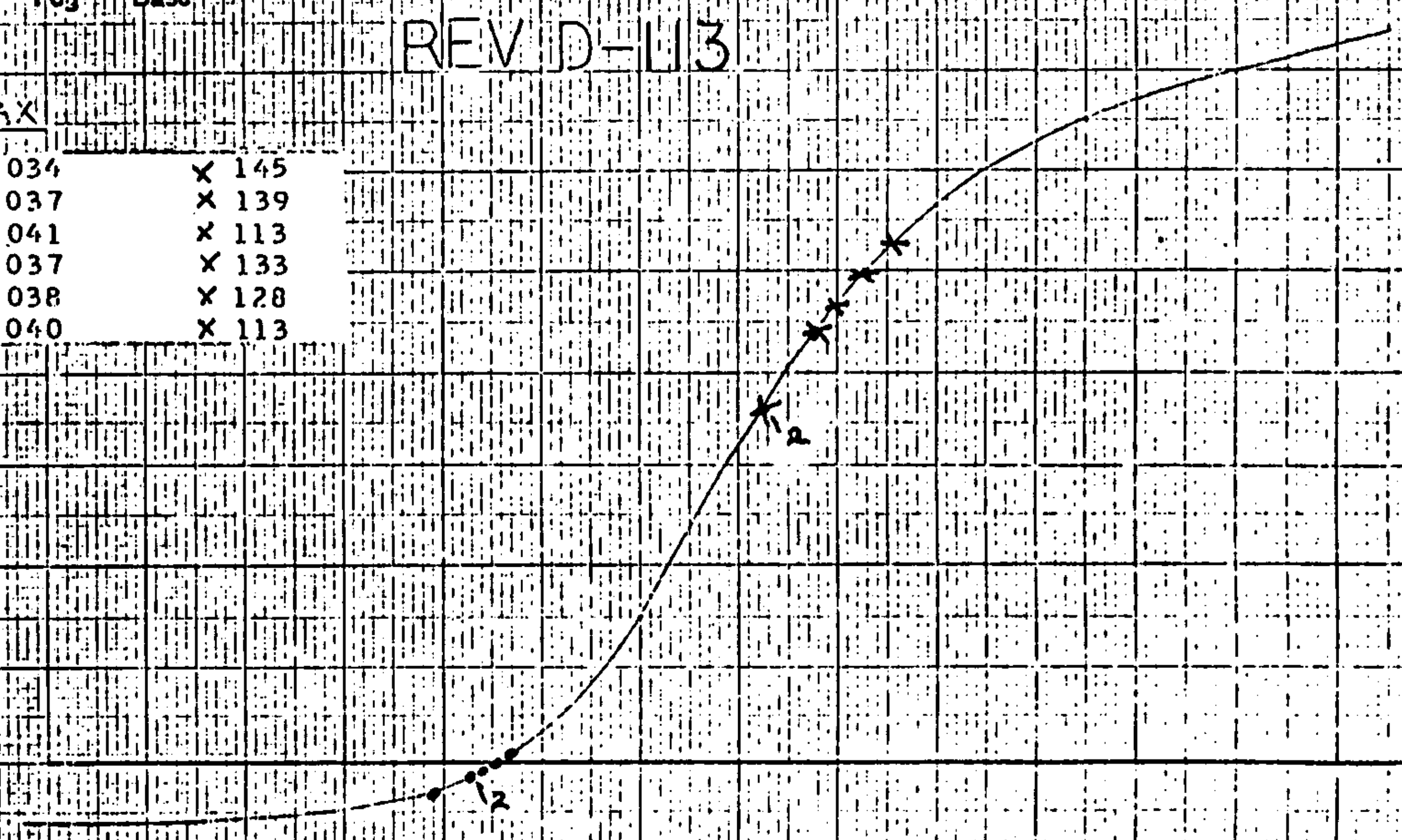


FIGURE 5-18

[redacted]

EXPOSURE | Experimenter | Date | Witness | Date

...sitometer IB L 2...
...minant Quality ...
...ject No.
...posure Time 25
... E = 7.22 MSN 108
DEVELOPMENT
...veloper DUAL GAMMA
...v. Time
...mp.
CLOUDS O FR-22 Density
...ed Gamma Fog Base

MSN 108 CR-9

ON FRAME DENSITY D_{MIN} D_{MAX}

REV D-145

UTAH-GLEN CANYON

FRAME	MIN	MAX
F 005	• 047	× 139
F 010	• 041	× 128
F 015	• 049	× 146
F 020	• 051	× 104

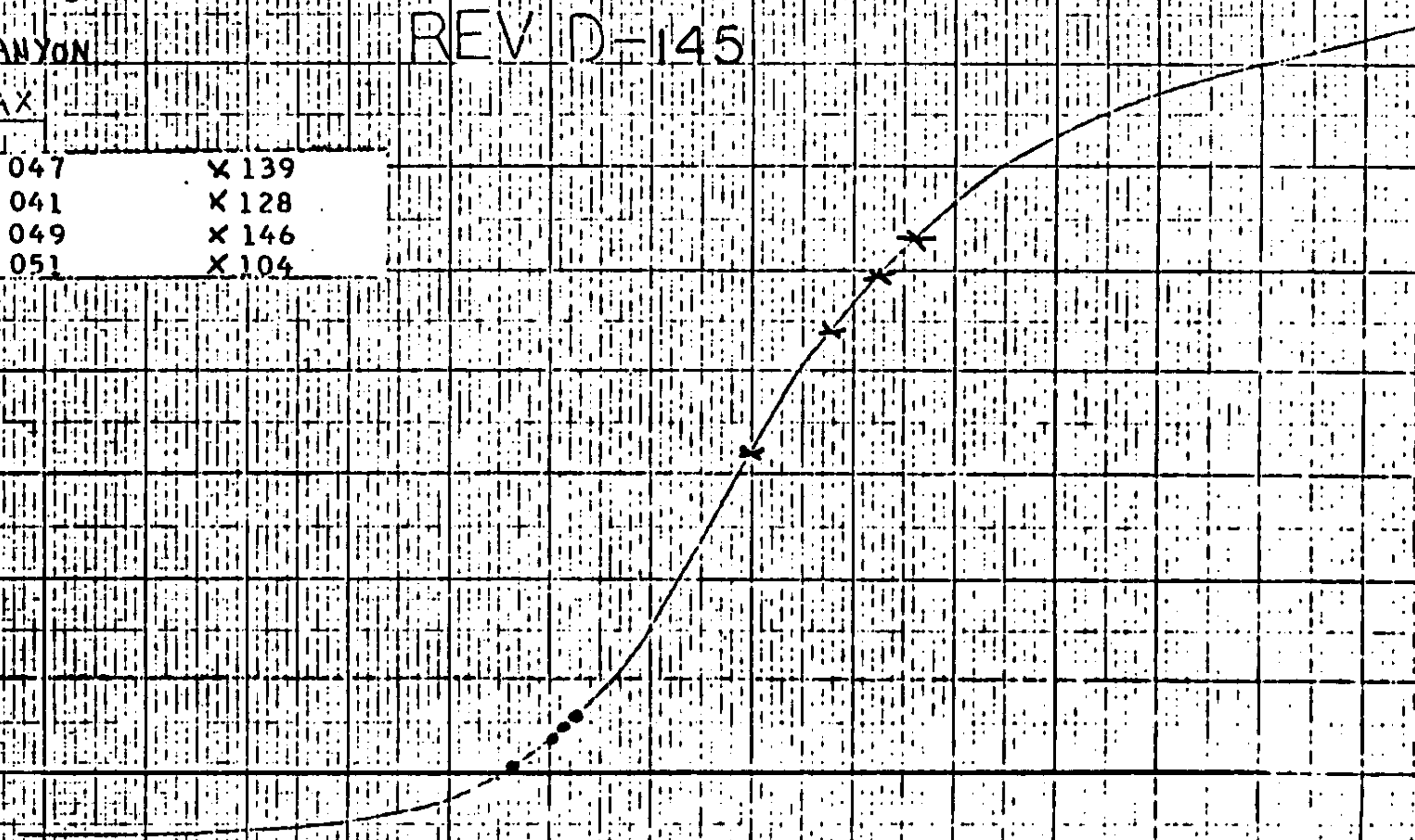


FIGURE 5-19

TOP SECRET/C

[redacted]

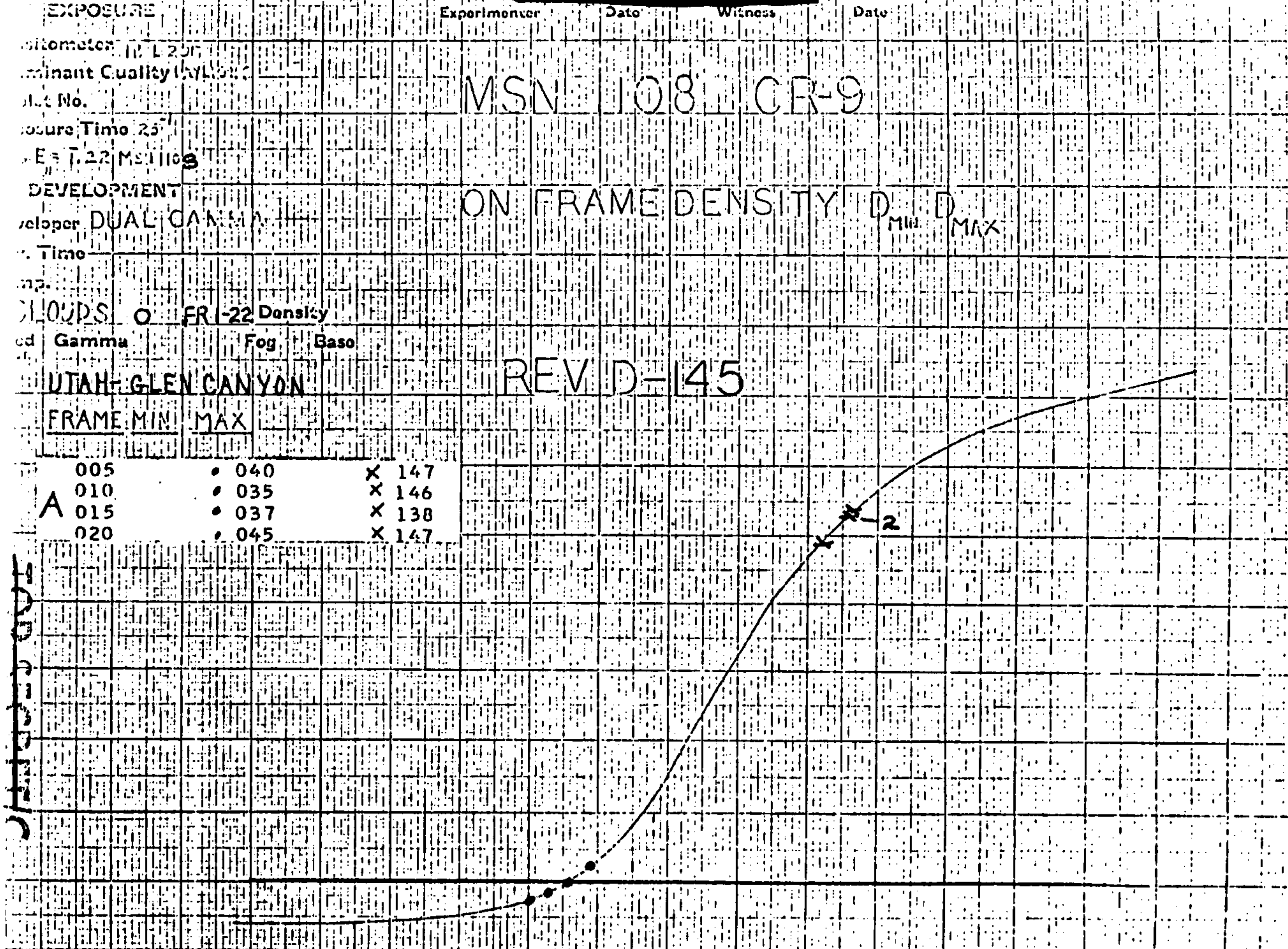


FIGURE 5-20

TOP SECRET/C

EXPOSURE

Experimenter [redacted] Date Witness Date

Sensitometer IIIL 2017

Illuminant Quality

Tablet No.

Exposure Time 25

LOG E = T.22 M...

DEVELOPMENT

Developer DUAL GAMMA

Dev. Time

Temp.

% CLOUDS 90 ± 5 FR 1-23 Density

Speed Gamma Fog Base

MSN 1108 CR-9

ON FRAME DENSITY D_{MIN} D_{MAX}

REV D-176

CHARLOTTE N.C.

FRAME	MIN	MAX
F 005	• 054	× 088
010	• 034	× 068
015	• 032	× 057
020	• 033	× 061
028	• 034	× 094

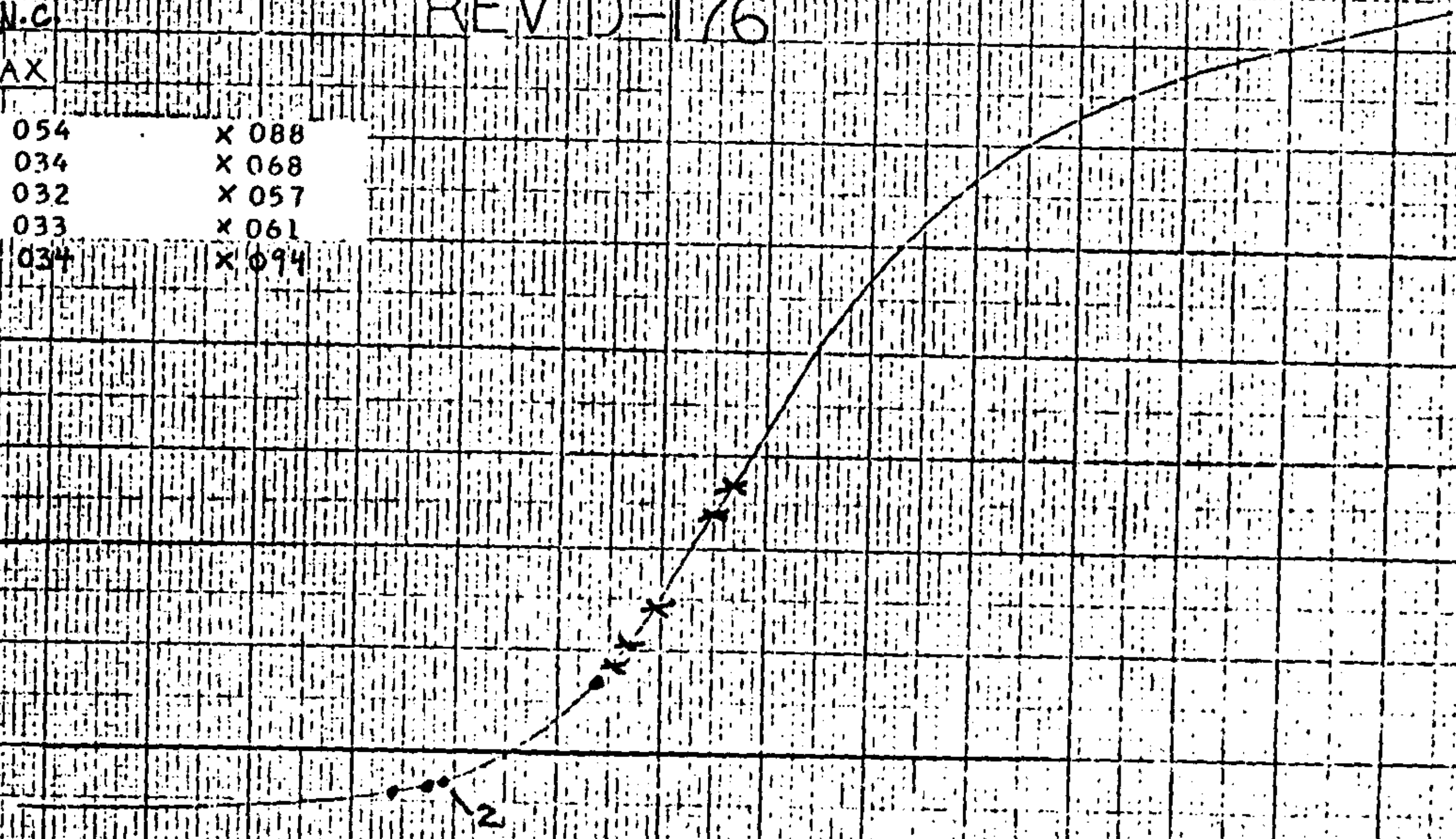


FIGURE 5-21

[redacted]

EXPOSURE | Experimenter | Date | Witness | Date

...itometer [illegible]
...minant Quality [illegible]
...te No.
...osure Time 25
E = 1.22 MSN 108
DEVELOPMENT
...veloper DUAL GAMMA
...v. Time
...mp.
CLOUDS 85-4 FR 1-23 Density
...ed Gamma Fog Base

MSN 108 CR-9

ON FRAME DENSITY D_{MIN} D_{MAX}

REV D-176

CHARLOTTE N.C.

FRAME	MIN	MAX
005	• 037	x 088
A 010	• 049	x 082
015	• 042	x 065
020	• 035	x 069
031	• 037	x 080

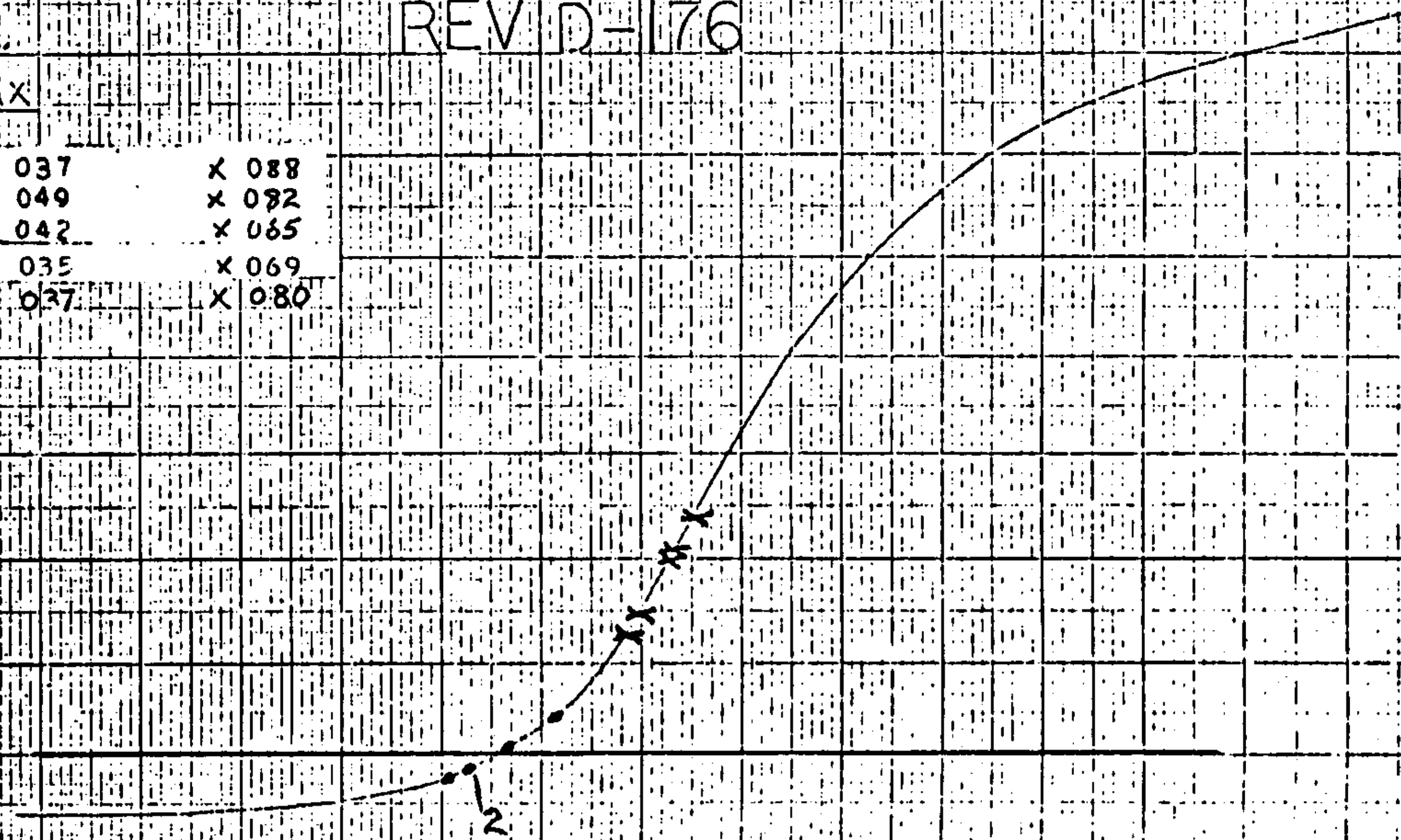


FIGURE 5-22

[redacted]

EXPOSURE | Experimenter | Date | Witness | Date

..itometer: I.B.L 2.47
..minant Quality I.Y.L...
..let No.
..osure Time .25⁻¹
E = T.22 MSN 1108
DEVELOPMENT
..eloper DUAL-GAMMA
.. Time
..mp.
CLOUDS 85+100 FR 15-25 Density
..ed Gamma Fog Base

MSN 108 CR-9

ON FRAME DENSITY D_{MIN} D_{MAX}

REV D-208

FRAME	MIN	MAX
5	• .35	× 1.35
10	• .39	× 1.37
15	• .43	× 1.49
20	• .43	× 1.43

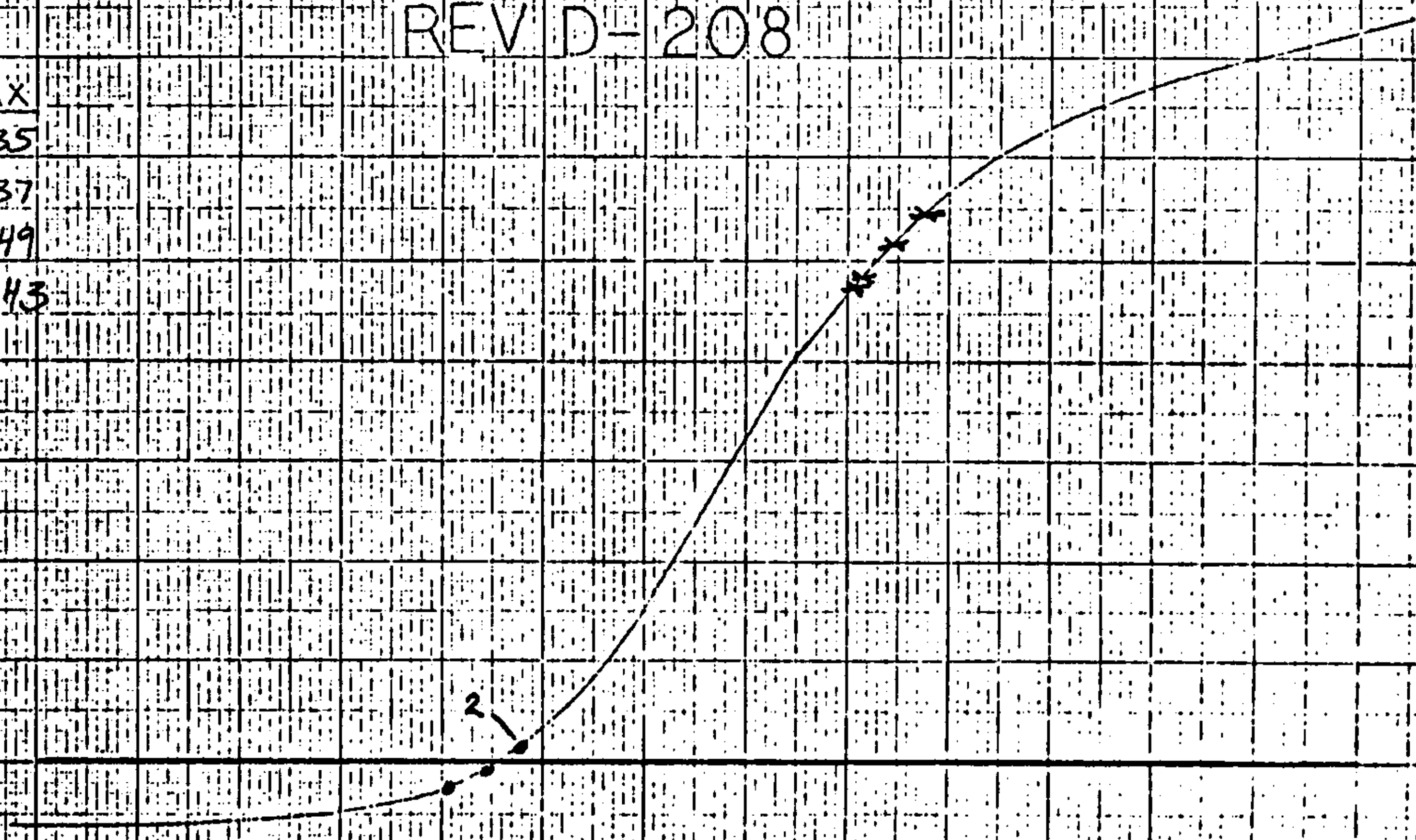


FIGURE 5-23

EXPOSURE

Sensitometer [illegible]

Illuminant Quality [illegible]

Tablet No.

Exposure Time [illegible]

LOG E = 7.22 [illegible]

Experimenter [redacted] Date Witness Date

MSN 1108 CR-9

ON FRAME DENSITY D_{MIN} D_{MAX}

DEVELOPMENT

Developer DUAL GAMMA

Dev. Time

Temp.

% CLOUDS 65 FR

Speed | Gamma | Density: Fog | Base

REV D-208

	FRAME	MIN	MAX
A	005	• 044	× 132
	010	• 036	× 127
	015	• 041	× 116
	020	• 041	× 142

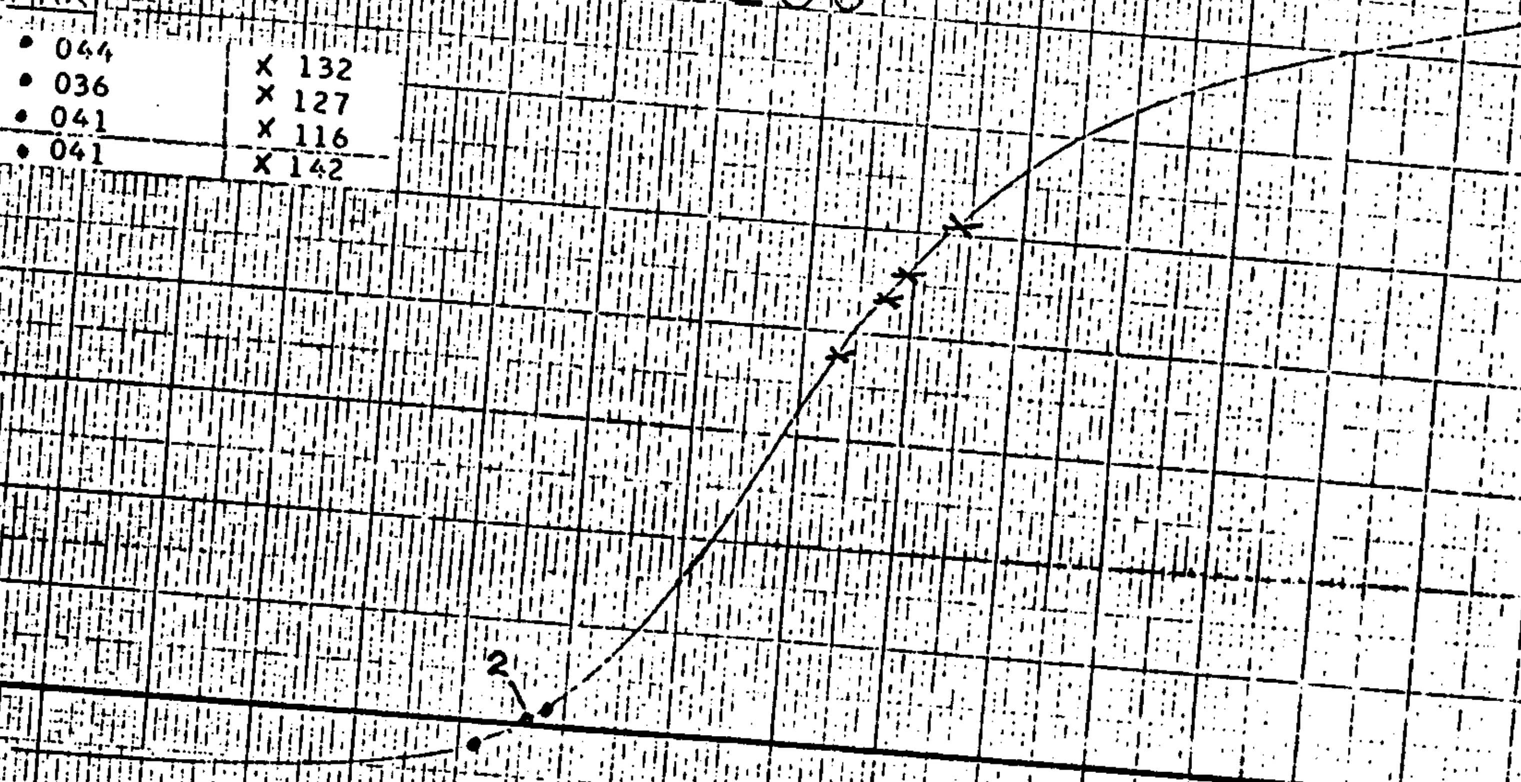


FIGURE 5-24

[redacted]

EXPOSURE | Experimenter | Date | Witness | Date

...itometer 16 L 2??
...minant Quality ...
...let No.
...osure Time 25
E_{II} = 7.22 MS 1108
DEVELOPMENT
...eloper DUAL GAMMA
... Time
...mp.
CLOUDS 40→100 FRI-27 Density
...d Gamma Fog Baso

MSN 1108 CR-9

ON FRAME DENSITY D_{MIN} D_{MAX}

REV D-242

	FRAME	MIN	MAX
F	005	• 035	X 132
	010	• 035	X 106
	015	• 036	X 116
	020	• 034	X 122
	025	• 035	X 121

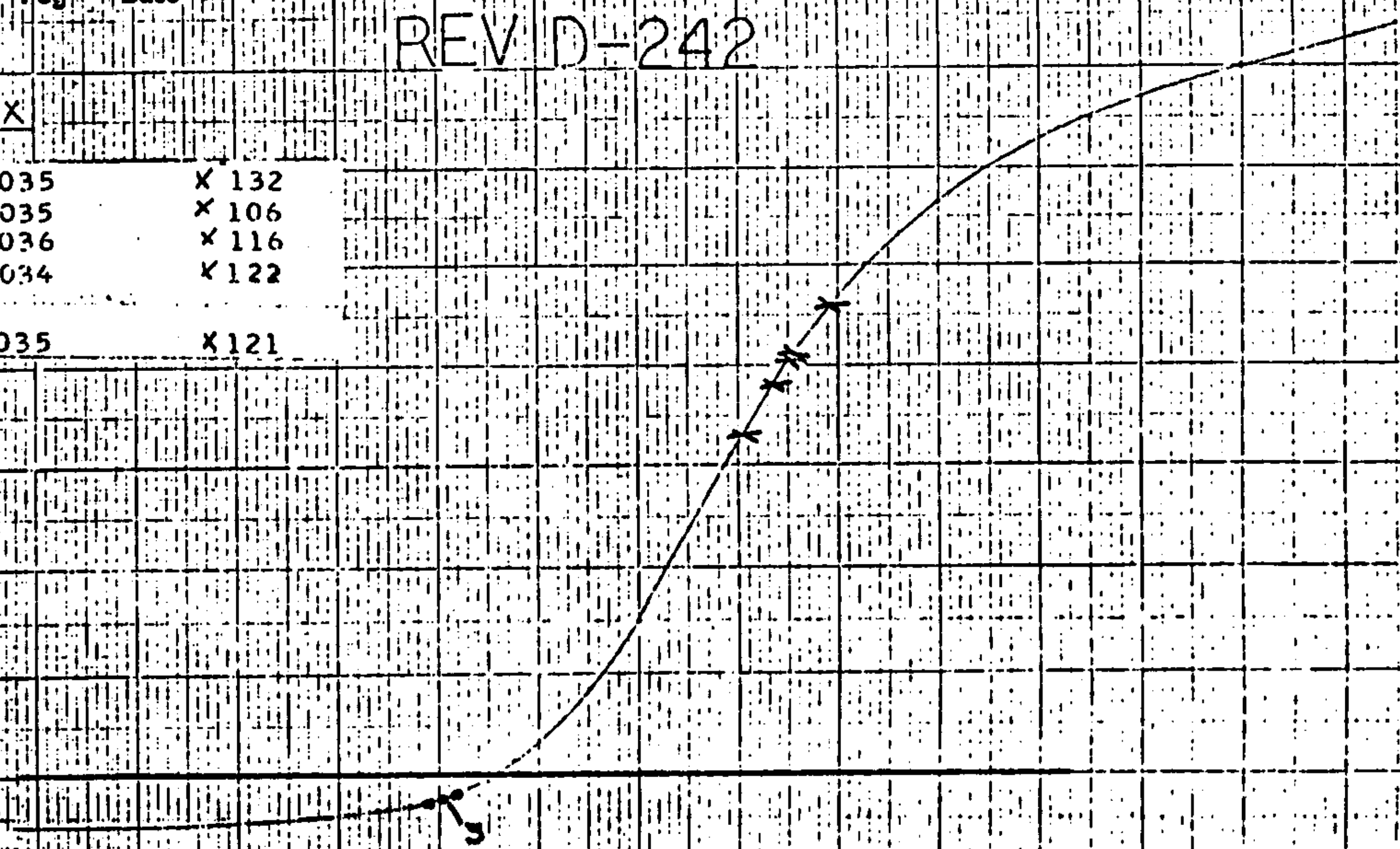


FIGURE 5-25

SECRET/C

Sensitometer: [illegible] Experimenter [redacted] Date Witness Date Reference Date

Illuminant Quality [illegible]

Tablet No.

Exposure Time [illegible]

LOG E = [illegible] MSN 1108

DEVELOPMENT

Developer DUAL GAMMA

Dev. Time

Temp.

% CLOUDS 30→5 FR -26

Speed | Gamma | Density Fog | Base

MSN 1108 CR-9

ON FRAME DENSITY D_{MIN} D_{MAX}

REV D-242

FRAME	MIN	MAX
A 005	• 033	× 129
010	• 033	× 117
015	• 038	× 116
020	• 034	× 118
025	• 052	× 117

FIGURE 5-2[illegible]

TOP SECRET/C

KP 49617A

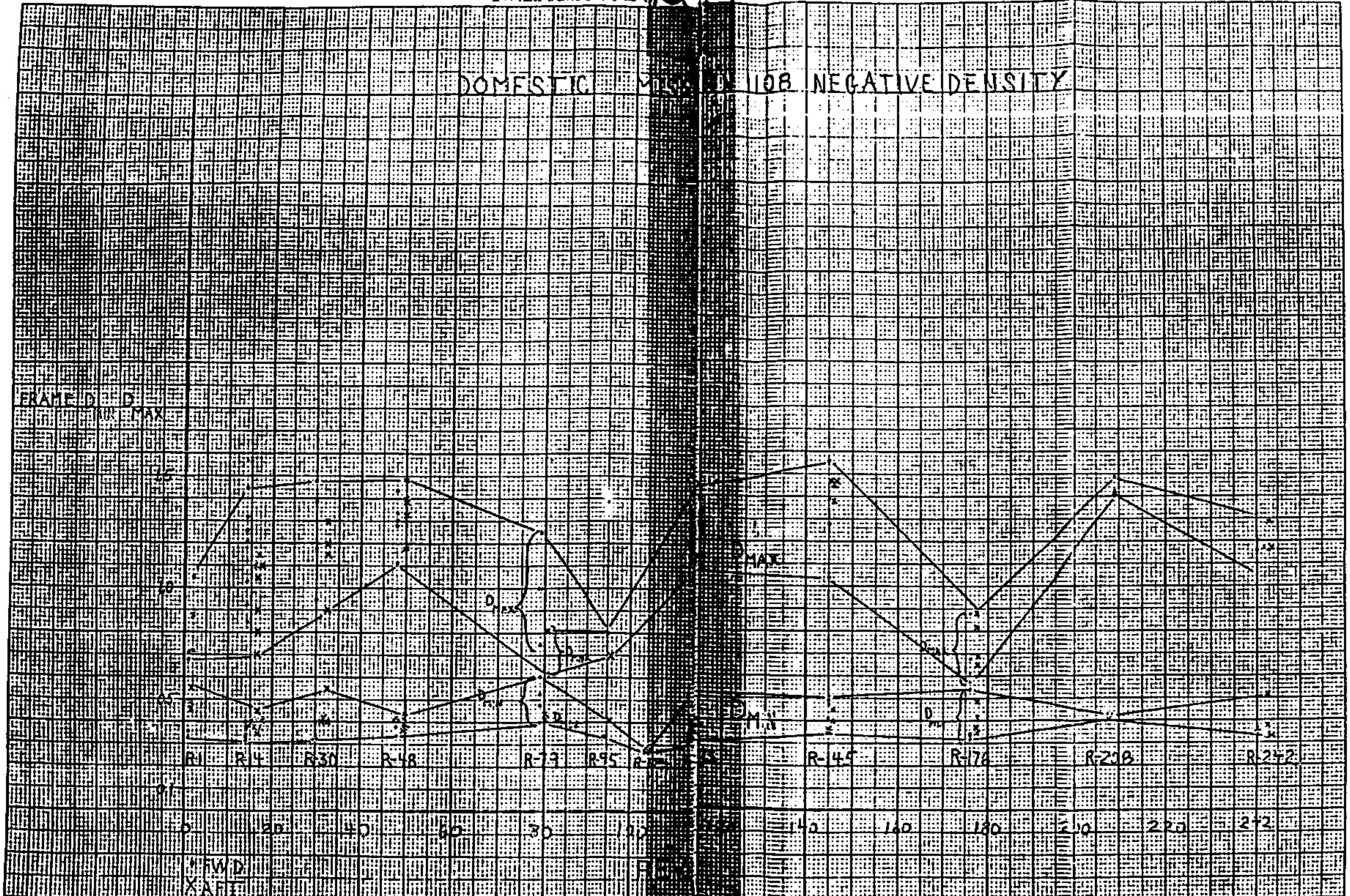

DOMESTIC 108 NEGATIVE DENSITY
FRAME D MIN D MAX
1.5
1.0
.5
D MAX
D MIN
R1
R14
R30
R48
R-79
R95
R-145
R-176
R-208
R-242
0
20
40
60
80
140
160
180
220
242
FWD
AFT

FIGURE 5-27

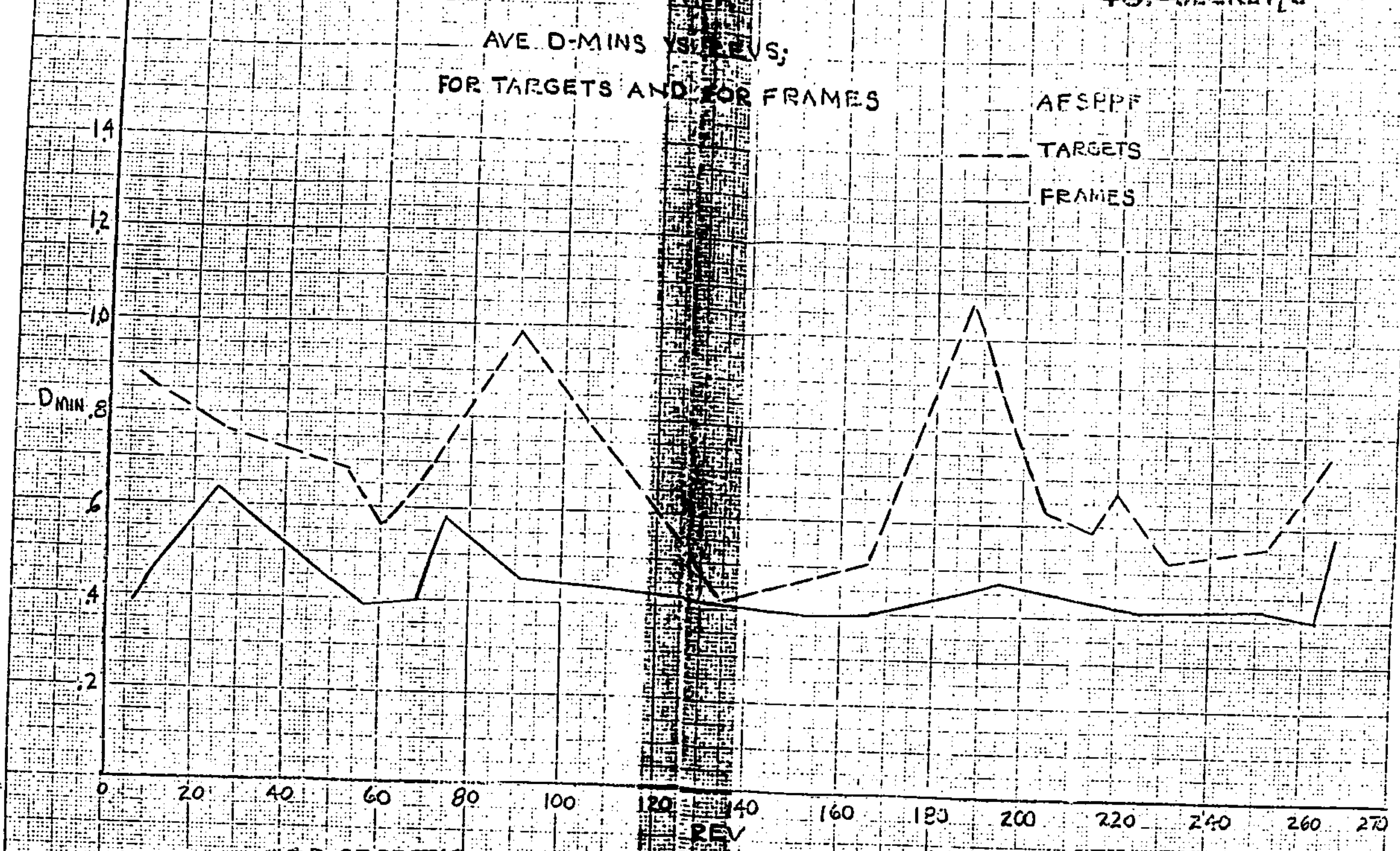
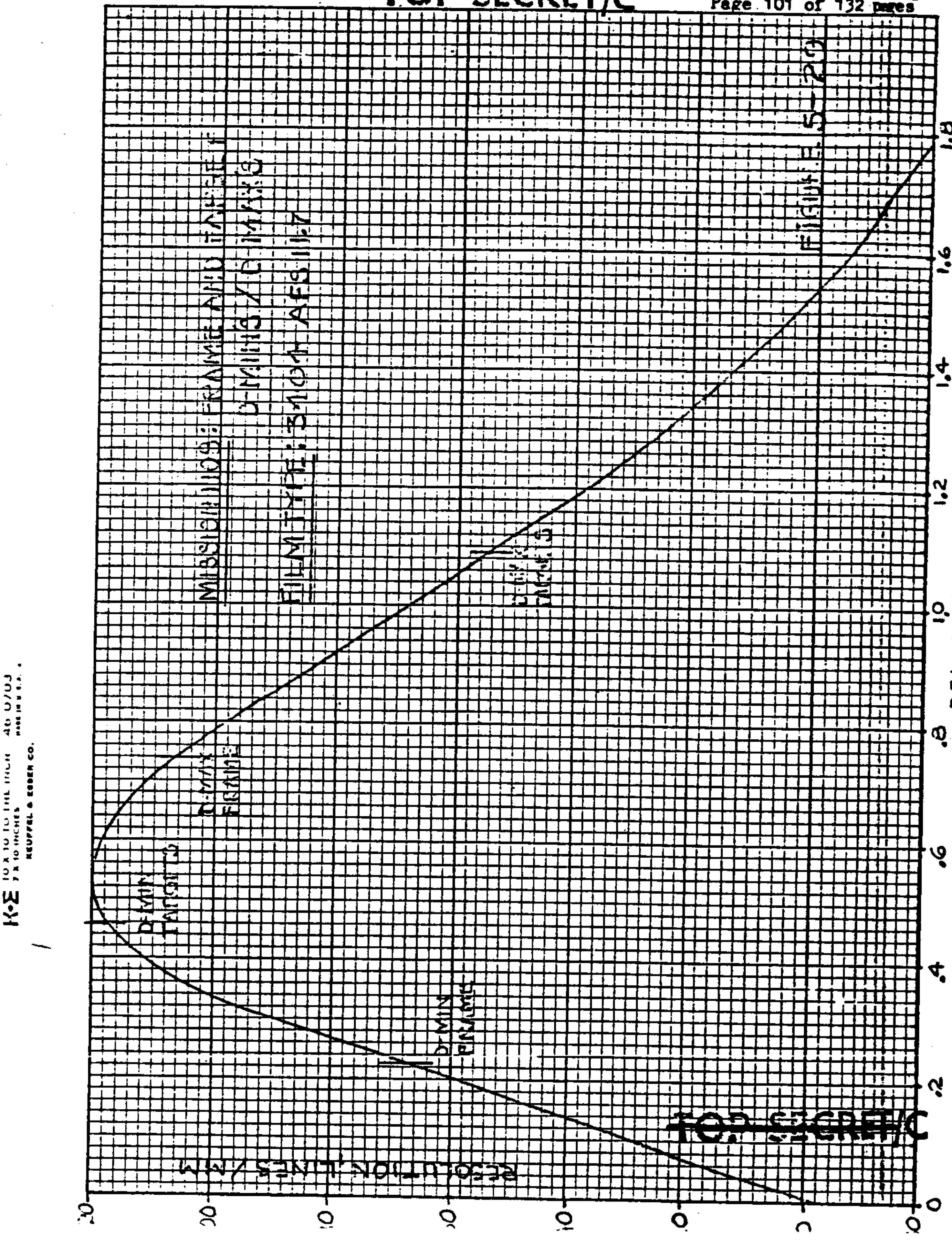

AVE. D-MINS VS. REVS;
FOR TARGETS AND FOR FRAMES
AFSPPF
TARGETS
FRAMES
DMIN
1.4
1.2
1.0
.8
.6
.4
.2
0
20
40
60
80
100
120
140
160
180
200
220
240
260
270
REV

FIGURE 5-28


REL. LOG E
RESOLUTION LINES / MM
D-MIN TARGET
D-MAX FRAME
D-MIN FRAME
D-MAX TARGET
FILM TYPE: 3404 AES II-7
K+E 10 X 10 TO THE INCH 46 0703 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

MISSION * 1108-1 * INSTR * FWD * PLOT OF D MIN * TERRAIN * PROCESSING * DUAL GAMMA

ARITH MEAN * 0.46 * MEDIAN * 0.39 * STD DEV * 0.18 * RANGE * 0.29 TO 1.19 WITH 457 SAMPLES

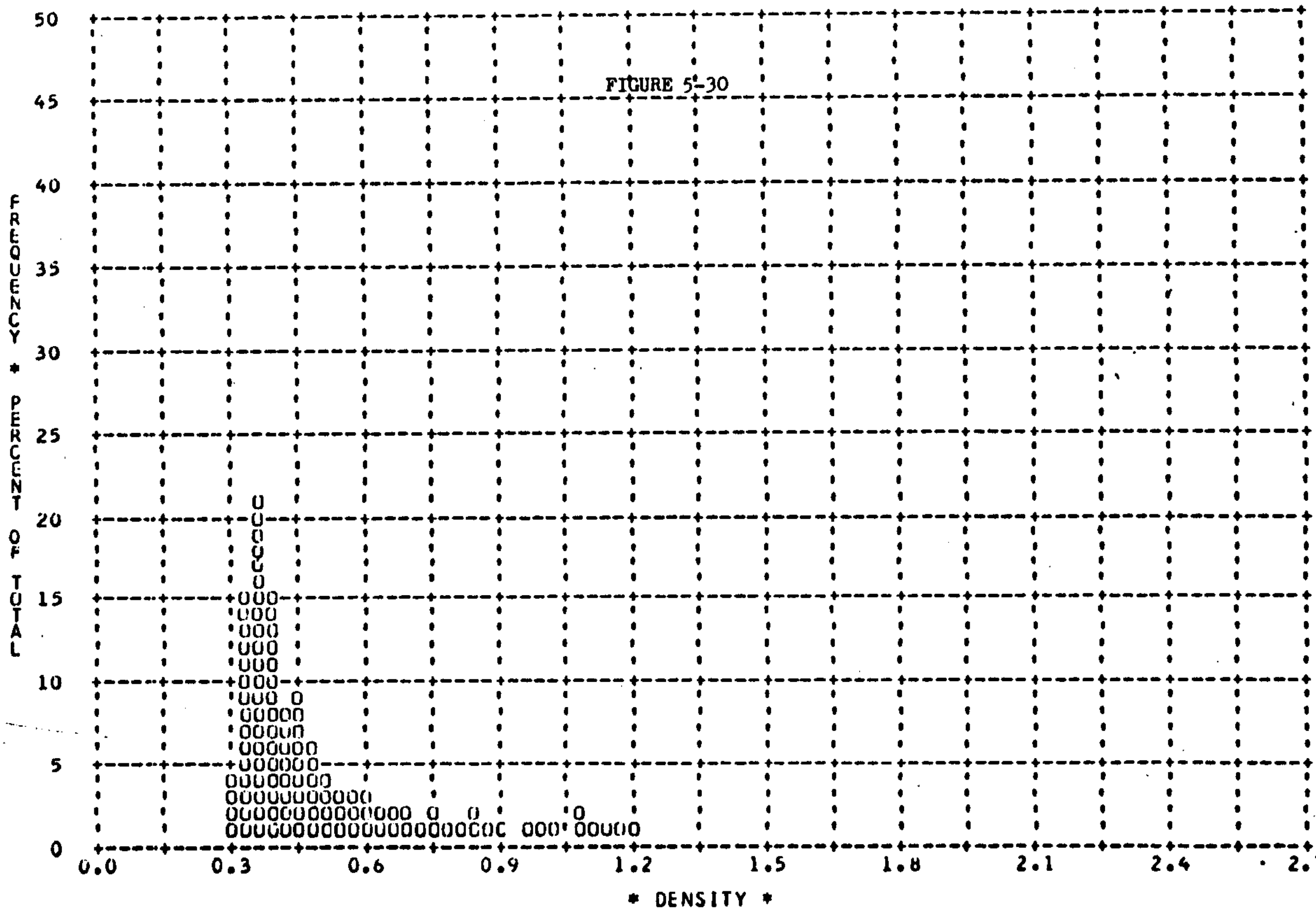


FIGURE 5-30

MISSION * 1108-1 * INSTR * FWD * PLOT OF D MAX * TERRAIN * PROCESSING * DUAL GAMMA

ARITH MEAN * 1.17 * MEDIAN * 1.19 * STD DEV * 0.23 * RANGE * 0.56 TO 1.64 WITH 457 SAMPLES

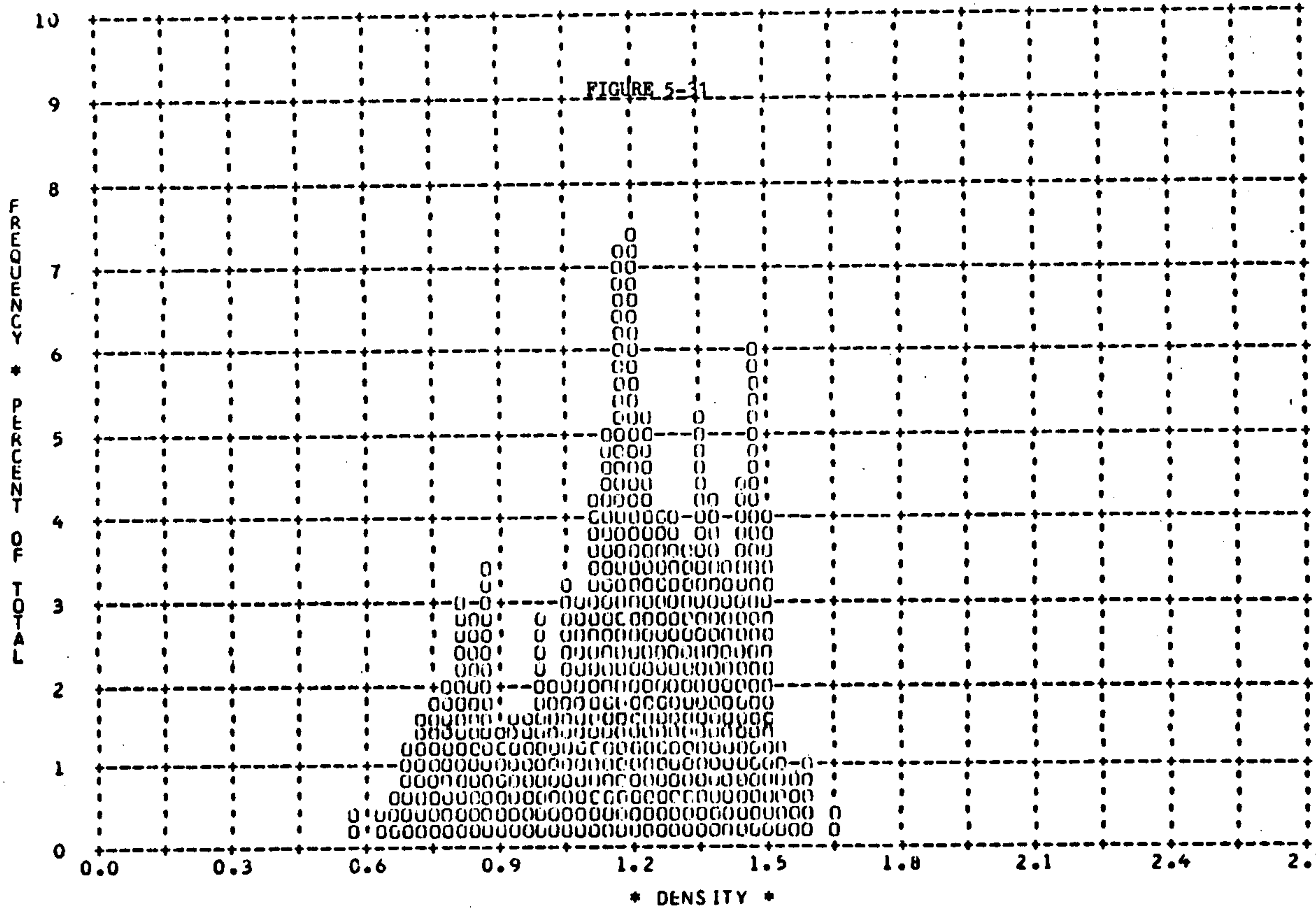


FIGURE 5-31

MISSION * 1108-1 * INSTR * AFT * PLOT OF D MIN * TERRAIN * PROCESSING * DUAL GAMMA

ARITH MEAN * 0.49 * MEDIAN * 0.43 * STD DEV * 0.17 * RANGE * 0.32 TO 1.11 WITH 462 SAMPLES

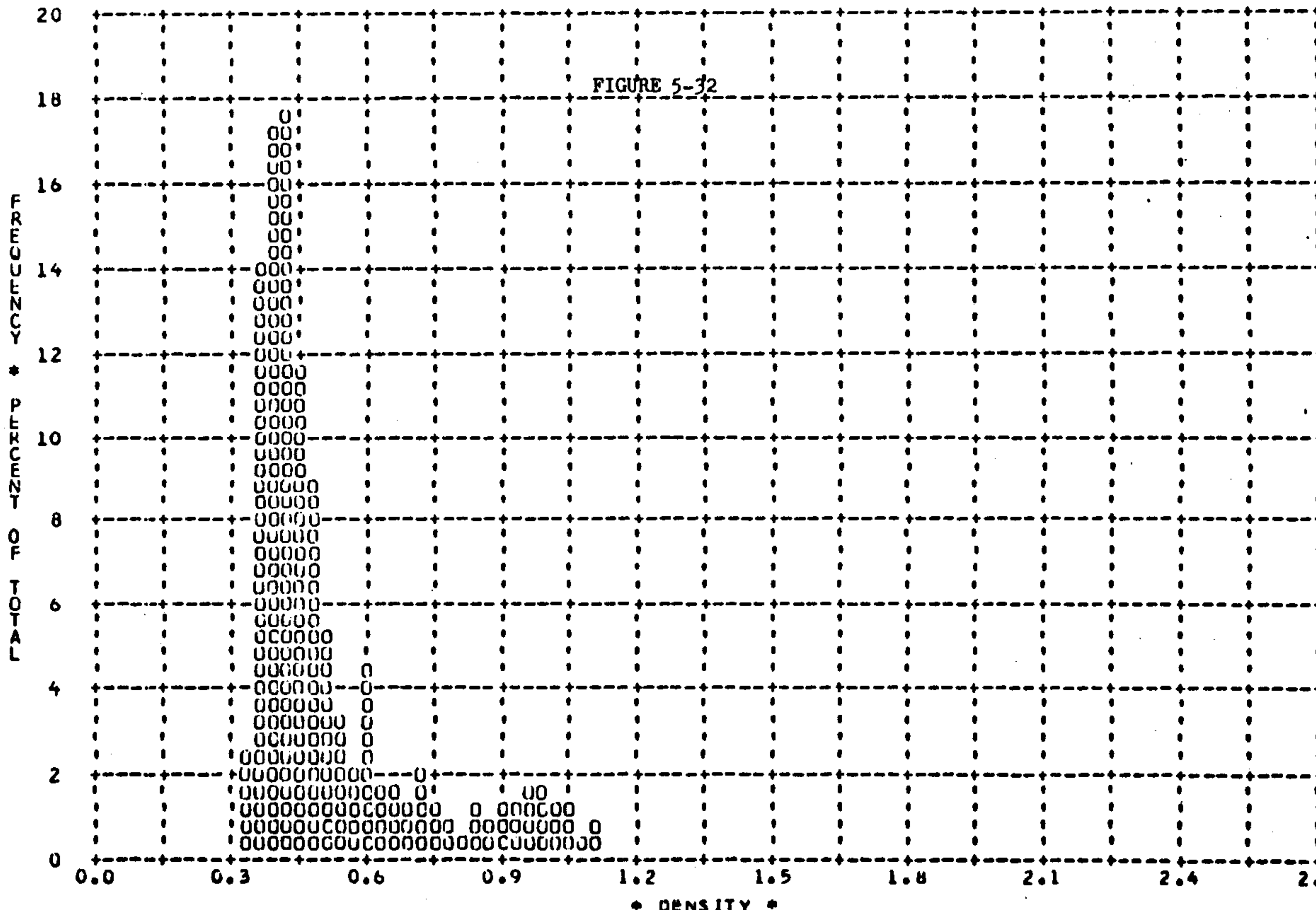


FIGURE 5-32

~~TOP SECRET~~/C--HANDLE VIA [redacted] CONTROL SYSTEM ONLY

MISSION * 1108-1 * INSTR * AFT * PLOT OF D MAX * TERRAIN * PROCESSING * DUAL GAMMA

ARITH MEAN * 1.16 * MEDIAN * 1.17 * STD DEV * 0.20 * RANGE * 0.68 TO 1.56 WITH 462 SAMPLES

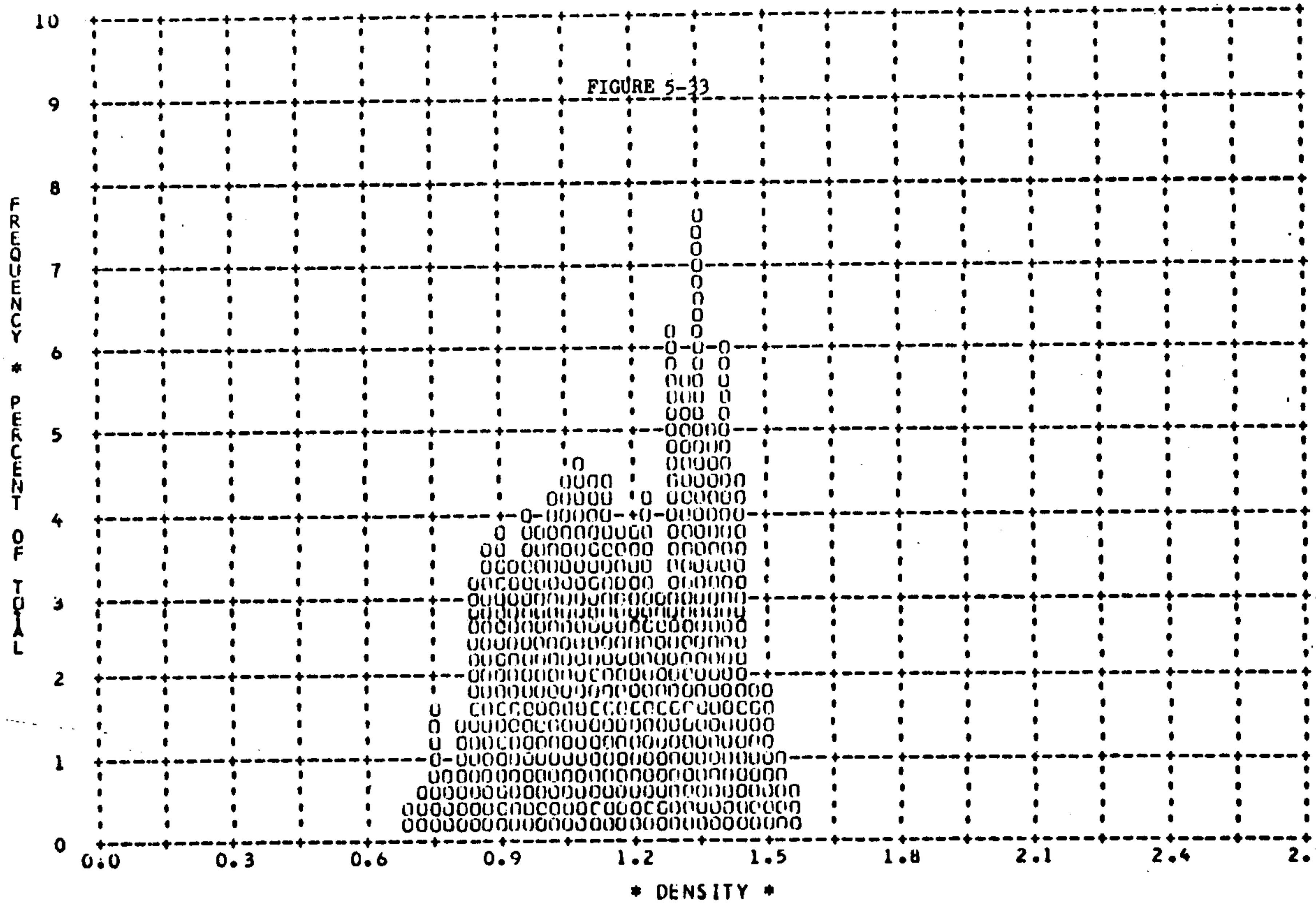


FIGURE 5-33

~~TOP SECRET~~/C--HANDLE VIA [redacted] CONTROL SYSTEM ONLY

~~TOP SECRET~~/C--HANDLE VIA [redacted] CONTROL SYSTEM ONLY

MISSION * 1108-2 * INSTR * FWD * PLOT OF D MIN * TERRAIN * PROCESSING * DUAL GAMMA

ARITH MEAN * 0.42 * MEDIAN * 0.38 * STD DEV * 0.12 * RANGE * 0.29 TO 0.90 WITH 264 SAMPLES

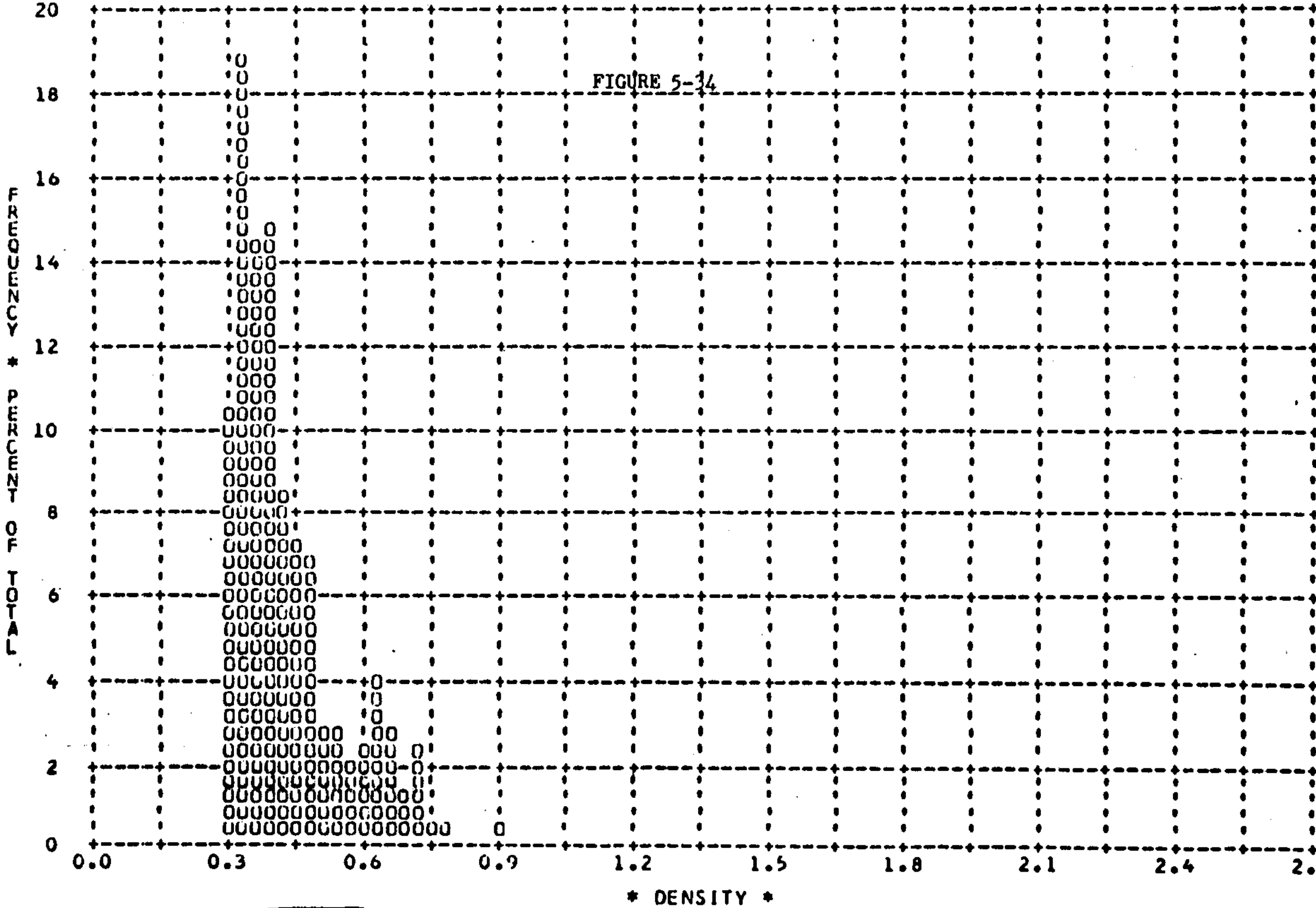


FIGURE 5-34

~~TOP SECRET~~/C--HANDLE VIA [redacted] CONTROL SYSTEM ONLY

~~TOP SECRET~~/C--HANDLE VIA [redacted] CONTROL SYSTEM ONLY

MISSION * 1108-2 * INSTR * FWD * PLOT OF D MAX * TERRAIN * PROCESSING * DUAL GAMMA

ARITH MEAN * 1.36 * MEDIAN * 1.40 * STD DEV * 0.21 * RANGE * 0.79 TO 1.73 WITH 264 SAMPLES

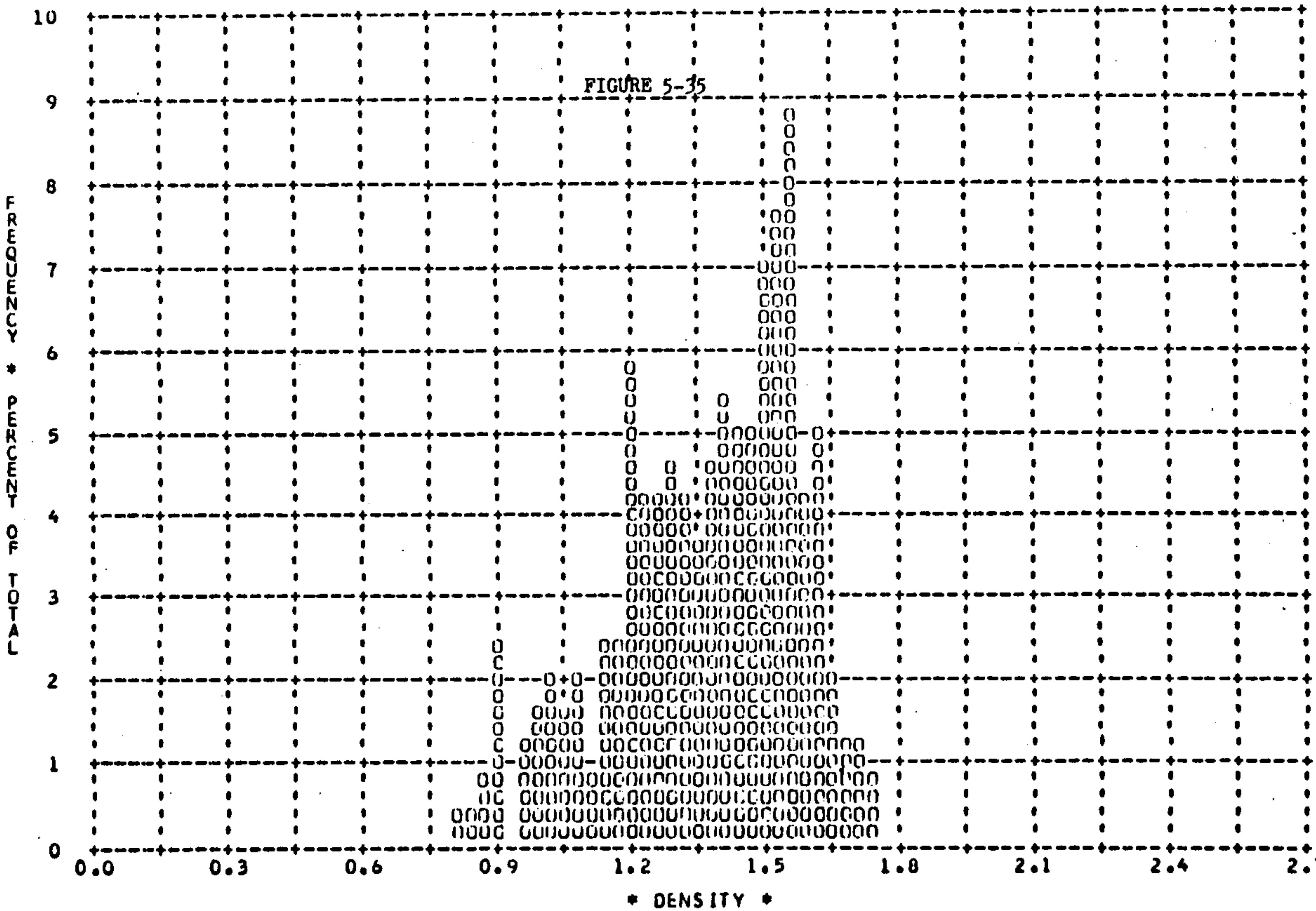


FIGURE 5-35

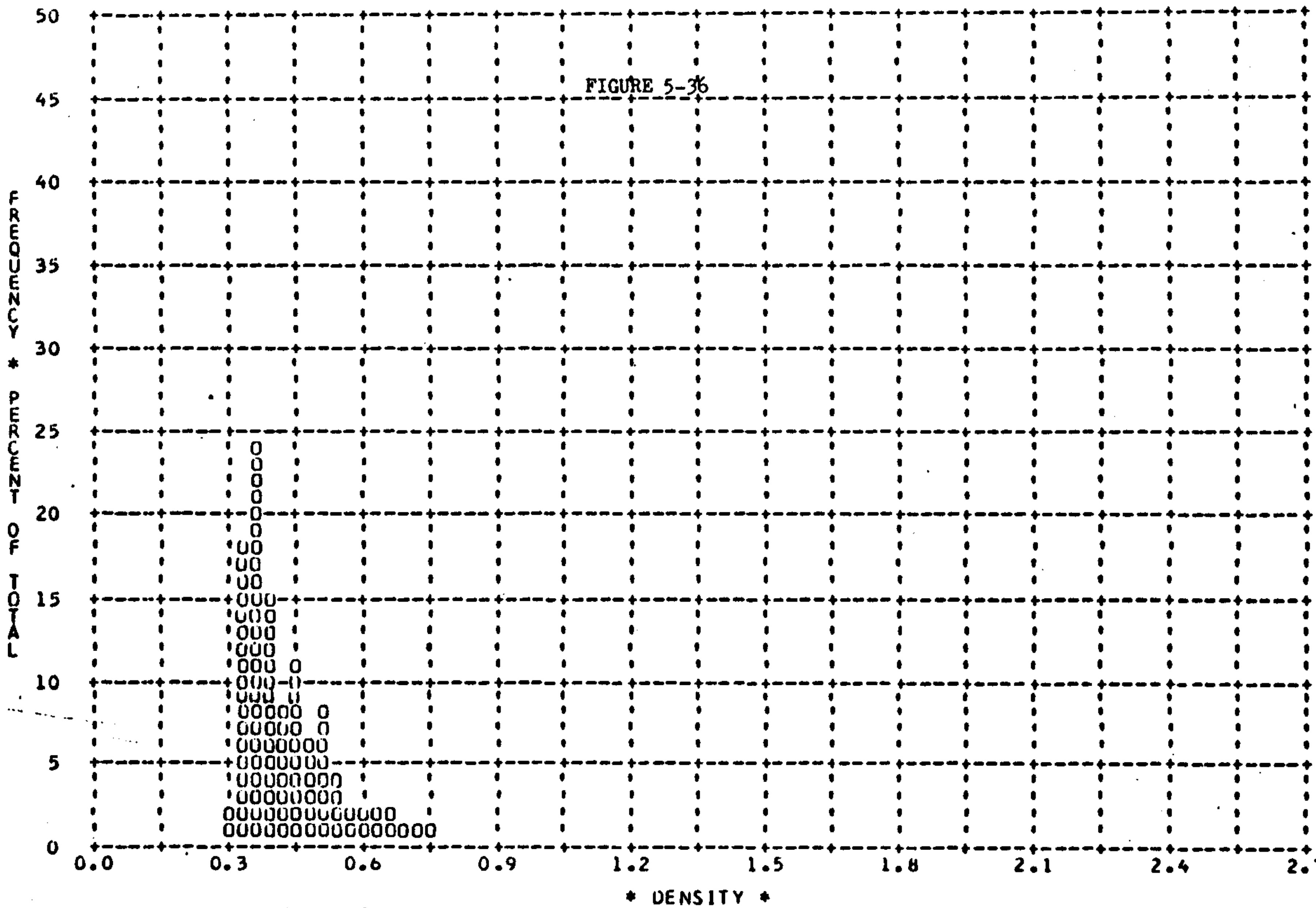
~~TOP SECRET~~/C--HANDLE VIA [redacted] CONTROL SYSTEM ONLY

TOP SECRET/C--HANDLE VIA [redacted] CONTROL SYSTEM ONLY

MISSION * 1108-2 * INSTR * AFT * PLOT OF D MIN * TERRAIN * PROCESSING * DUAL GAMMA

ARITH MEAN * 0.41 * MEDIAN * 0.38 * STD DEV * 0.09 * RANGE * 0.30 TO 0.74 WITH 227 SAMPLES

FIGURE 5-36



MISSION * 1108-2 * INSTR * AFT * PLOT OF D MAX * TERRAIN * PROCESSING * DUAL GAMMA

ARITH MEAN * 1.32 * MEDIAN * 1.32 * STD DEV * 0.17 * RANGE * 0.77 TO 1.65 WITH 227 SAMPLES

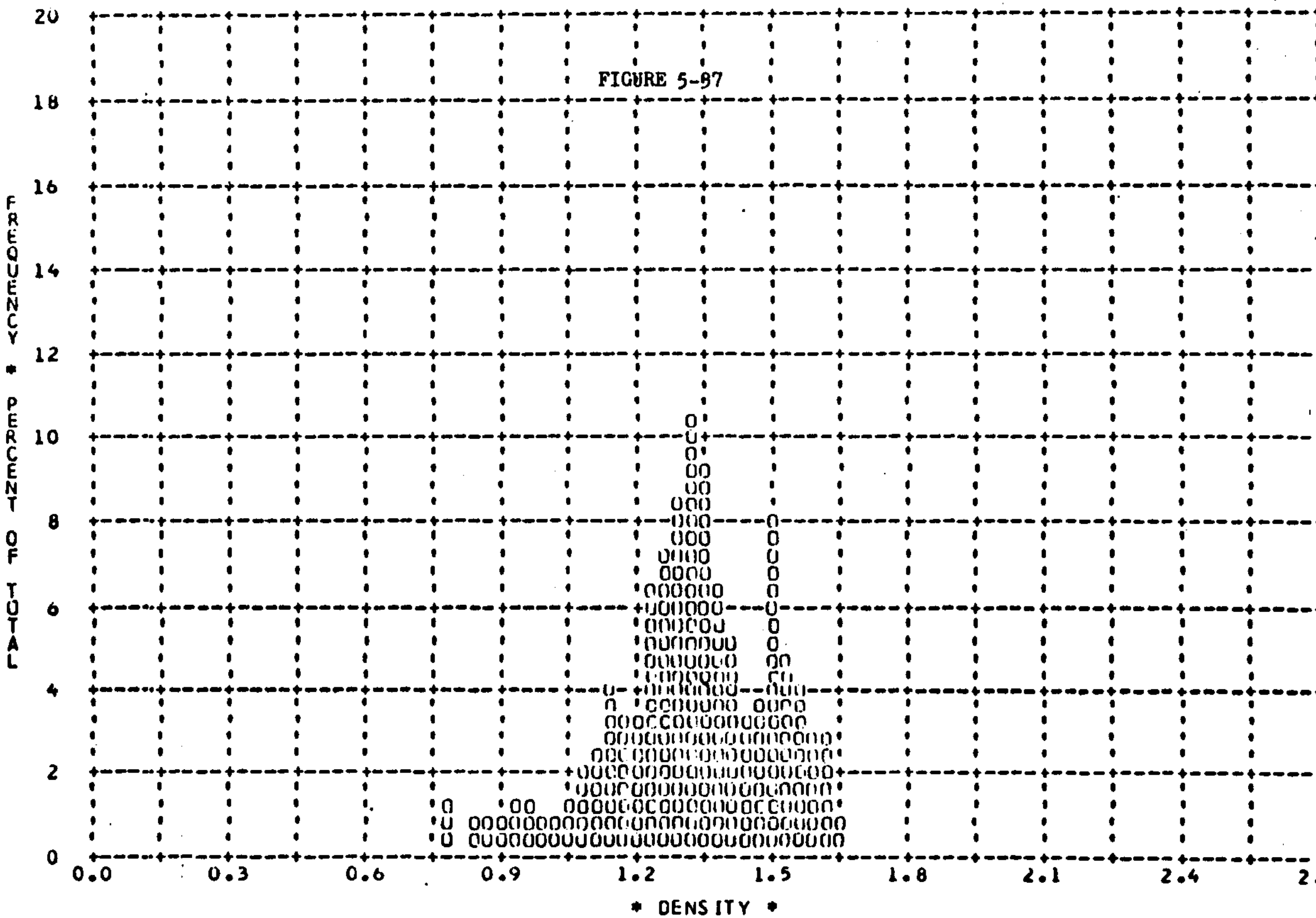


FIGURE 5-97

SPECIAL REPORT SO-242 COLOR FILM

Introduction

The last 811 feet (312 frames) of the Aft-Looking camera film record of Mission 1108-2 was Ektachrome color film.

For the first time in the history of the Corona Program, photographic exposure criteria considered the snow and no snow conditions prevailing on the ground during camera operation.

Real Time snow and no snow weather data, available prior to camera operation, permitted the selection of the optimum exposure time through use of snow and no snow exposure criteria. The graphical exposure criteria actually used relates snow and no snow optimum exposure for SO-242 color film with the solar elevations vs latitude throughout each orbit ground track and the exposure slit choices available.

The no snow exposure criteria vs solar elevation for SO-242 color film is shown in Table 5-2.

TABLE 5-2

NO SNOW EXPOSURE TIME VS SOLAR ELEVATION FOR SO-242 COLOR FILM

Solar Elevation (Degrees)	Exposure Time (Reciprocal Seconds)
10	195
20	400
30	638
45	824
70	995

Exposure criteria used for the snow condition assumed a reduction of the exposure time shown in Table 5-2 by approximately 0.9 stops.

All SO-242 color film exposures were made through a Wratten 2B filter. SO-242 colored film was exposed on revs. No. 242, 248, 249, 250, 252, 263, 264, 265, 266, 267, 268, and 273.

Imagery produced during rev. 242 was the best of all the colored imagery produced during the mission. The information content of rev. 242, SO-242 film was higher than that observed in any other colored film used in the history of the Corona programs. Other colored films used during previous Corona missions include SO-121 and SO-180.

Imagery from rev. 242, Mission 1108, revealed vehicular traffice in Utah and Arizona, crop rows, planes of various sizes, railroad cars of various colors. The color saturation of the processed material was excellent. The exposure used was judged to be correct.

Table 5-3 shows several parameters associated with the good imagery produced in SO-242 colored film during exposure on rev. 242.

TABLE 5-3

SEVERAL NOMINAL PARAMETERS ASSOCIATED WITH EXPOSURE OF SO-242 COLOR FILM DURING REV. 242

Solar Elev. (Degrees)	Geography	North Latitude (Degrees)	Frame Count	Snow
33 to 34	Utah, Arizona	32	10	None

Distance from camera to center of format on the ground: 104 nautical miles.

Distance from camera to vehicular traffic, railroad cars. observed in frames 27 through 35: 120 nautical miles.

Weather	Exposure Time (Reciprocal Seconds)		
	Actual	Per Criteria	Overexposed Based On Criteria
Zero % cloud cover, clear	450	700	Plus 0.7 stops

Note: Imagery appears to be exposed correctly. The color saturation is good.

SECTION 6

VEHICLE ATTITUDE AND IMAGE SMEAR

A. VEHICLE ATTITUDE

The vehicle attitude errors for both Mission 1108-1 and 1108-2 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: ATTITUDE ERRORS

	Mission 1108-1		Mission 1108-2	
Value	90%	Range	90%	Range
Pitch Error (°)	0.86	0.25 to 1.02	0.87	0.25 to 1.04
Roll Error (°)	0.22	0.0 to 0.35	0.20	0.00 to 0.34
Yaw Error (°)	2.57	2.00 to 4.80	2.53	2.0 to 4.40
Pitch Rate (°/hr)	40.07	-90 to +100	38.77	-70 to +80
Roll Rate (°/hr)	19.95	-44 to +44	20.81	-36 to +40
Yaw Rate (°/hr)	34.09	-60 to +100	27.10	-50 to +65

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 distributiolns of IMC errors and resolution limits are shown in Figures 6-5 thru 6-16.

The summary table 6-1 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 1108

IMC RATIO AND RESOLUTION LIMITS

VALUE	UNITS	CAMERA	MISSION 1108-1 90%	MISSION 1108-1 Range	MISSION 1108-2 90%	MISSION 1108-2 Range
IMC Ratio Error	%	Fwd-Looking	1.48	-2.0 to +3.4	1.96	-1.9 to +3.6
		Aft-Looking	1.61	-2.6 to +2.0	1.94	-2.2 to +3.0
Along Track Resolution Limit	Feet	Fwd-Looking	2.33	0.00 to 4.00	2.19	0.0 to 4.8
		Aft-Looking	1.23	0.00 to 3.80	0.80	0.0 to 1.64
Cross Track Resolution Limit	Feet	Fwd-Looking	6.57	3.60 to 11.50	6.59	3.60 to 11.40
		Aft-Looking	6.37	2.60 to 9.80	6.00	3.40 to 10.00
V/H Ratio Error	%	Fwd-Looking	0.97	-1.8 to +2.4	1.92	-1.4 to +3.0
		Aft-Looking	0.97	-1.5 to +2.4	1.97	-1.0 to 3.0

TABLE 6-2

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 0.97

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

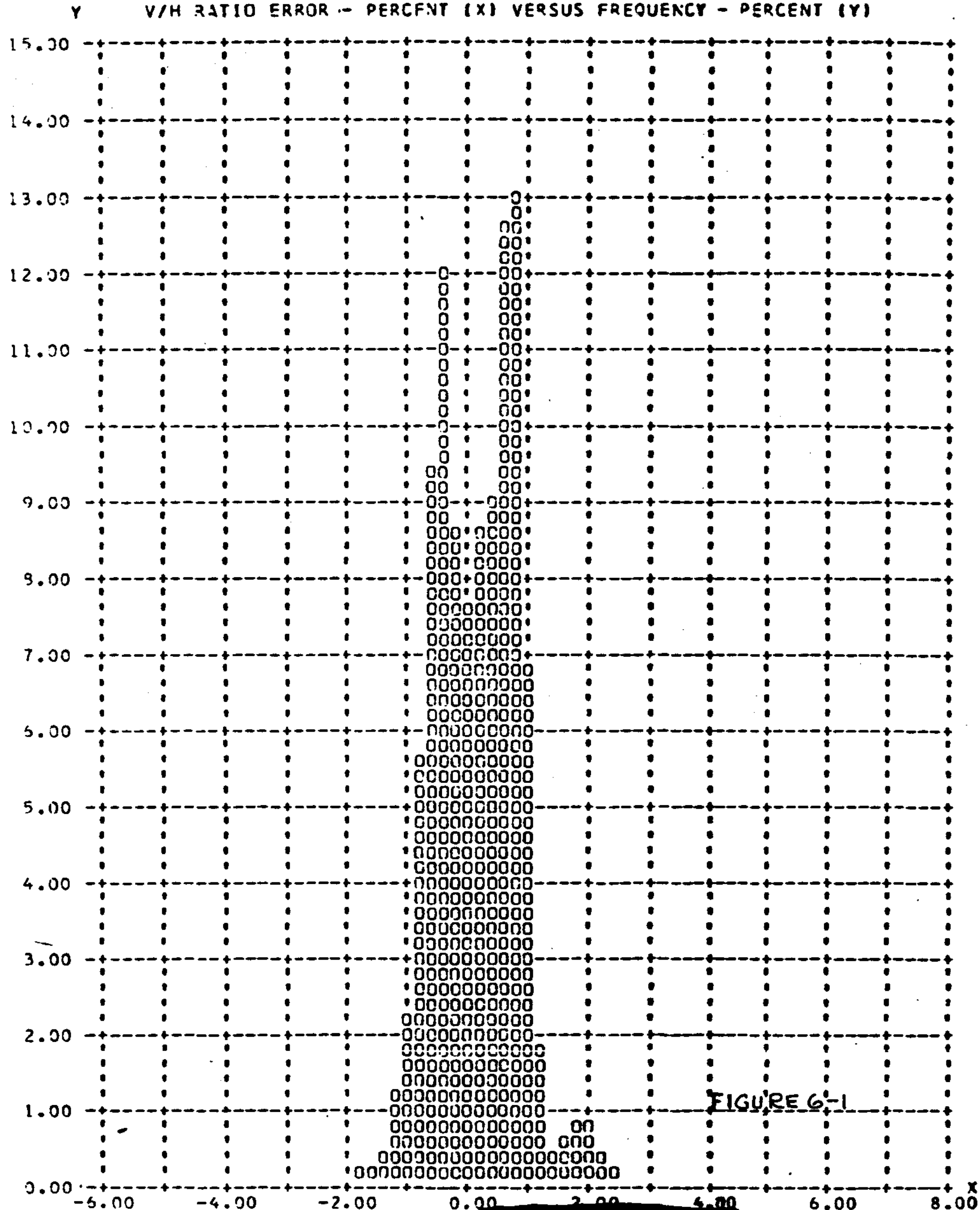


FIGURE 6-1

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 0.97

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

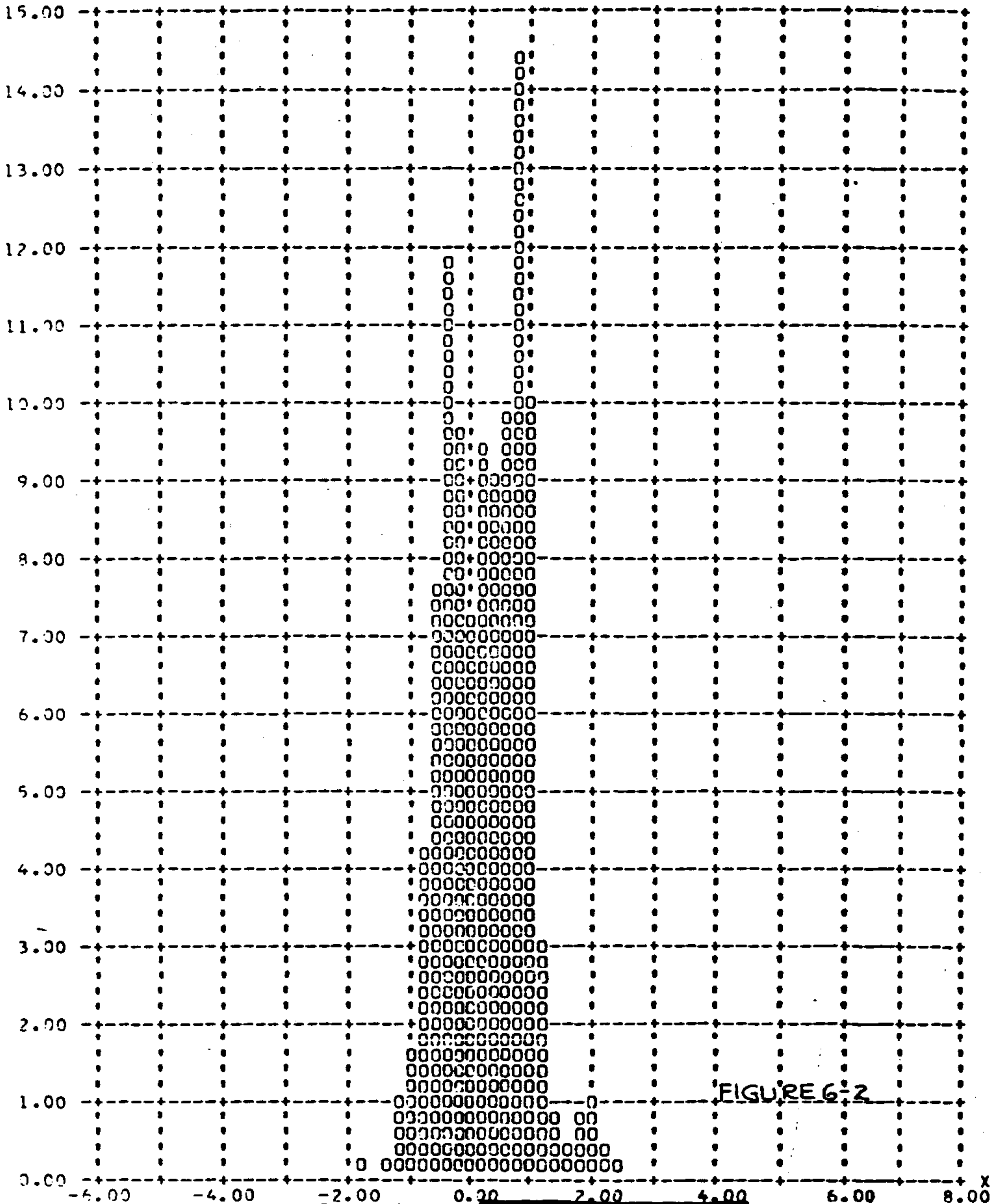
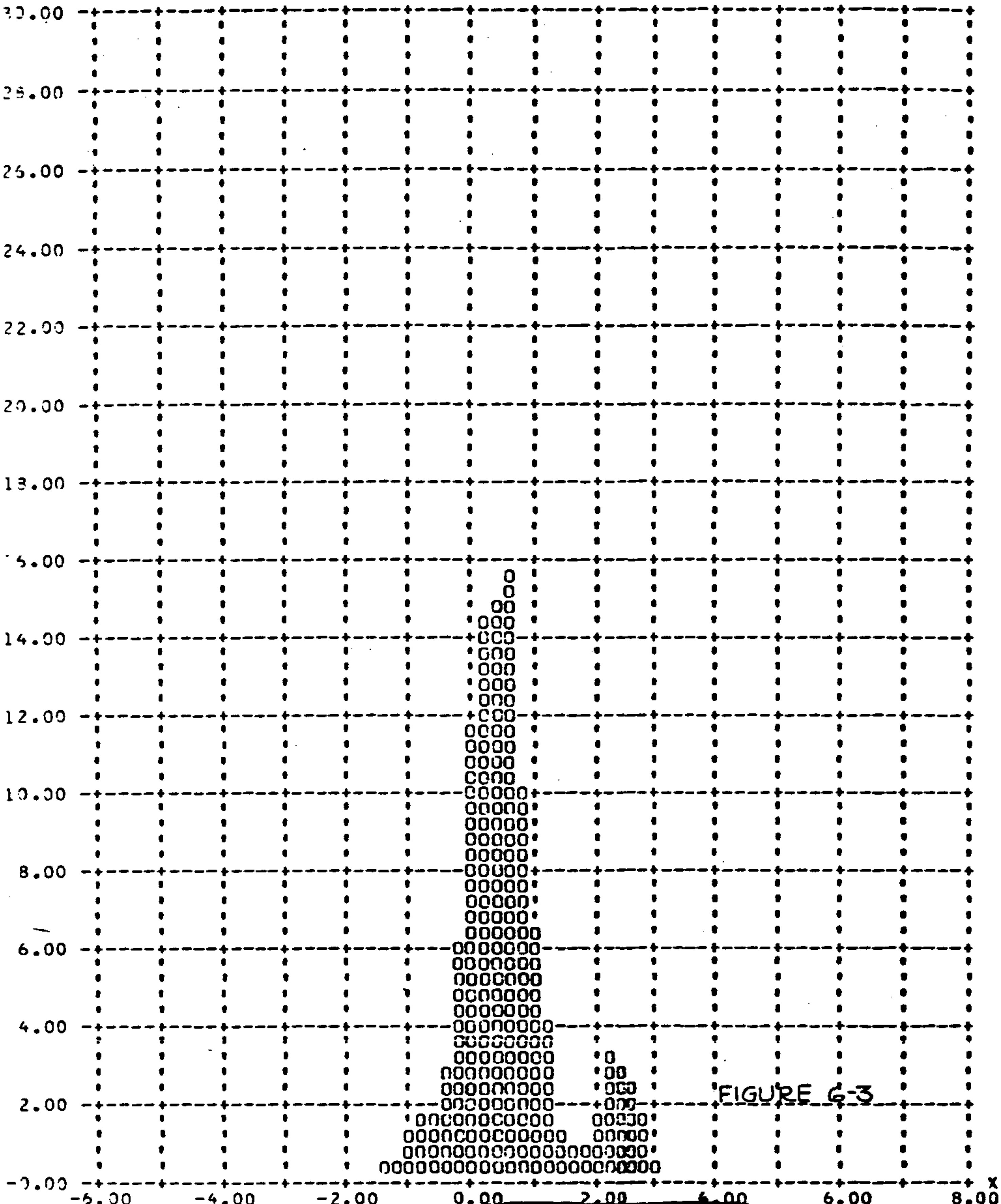


FIGURE 6-2

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 1.92

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



FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 1.97

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

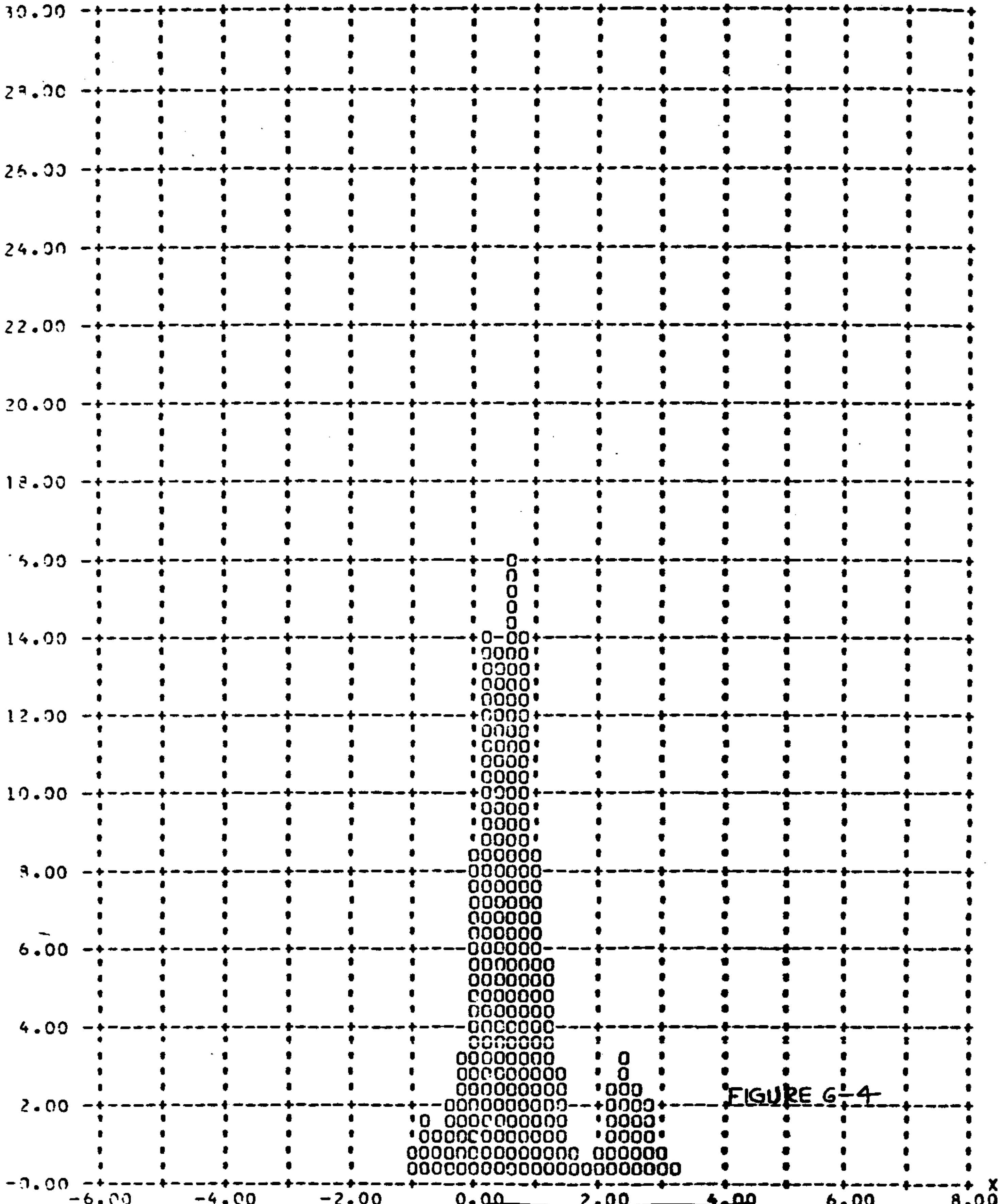


FIGURE 6-4

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 1.48

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

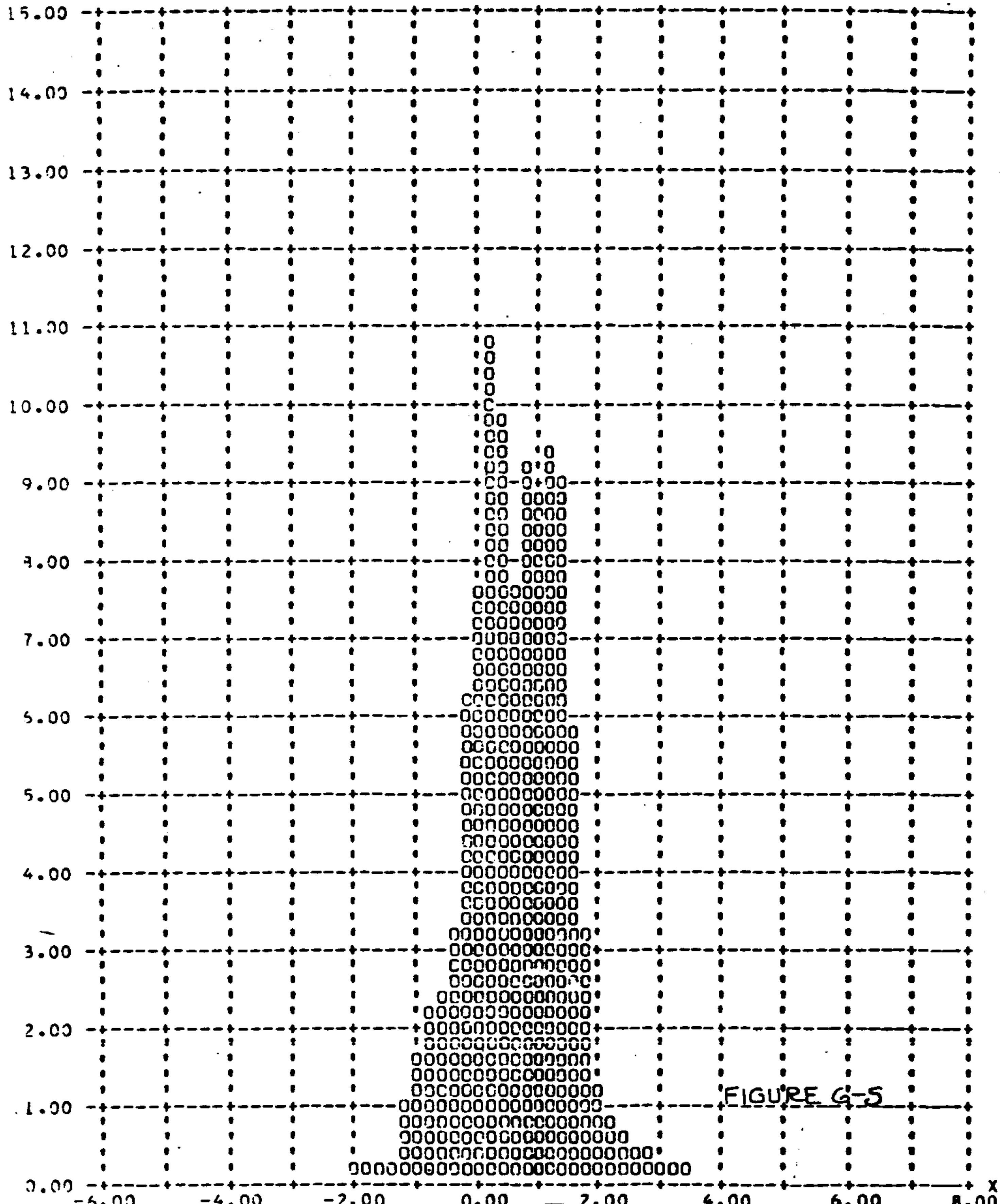


FIGURE G-5

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 6.57

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

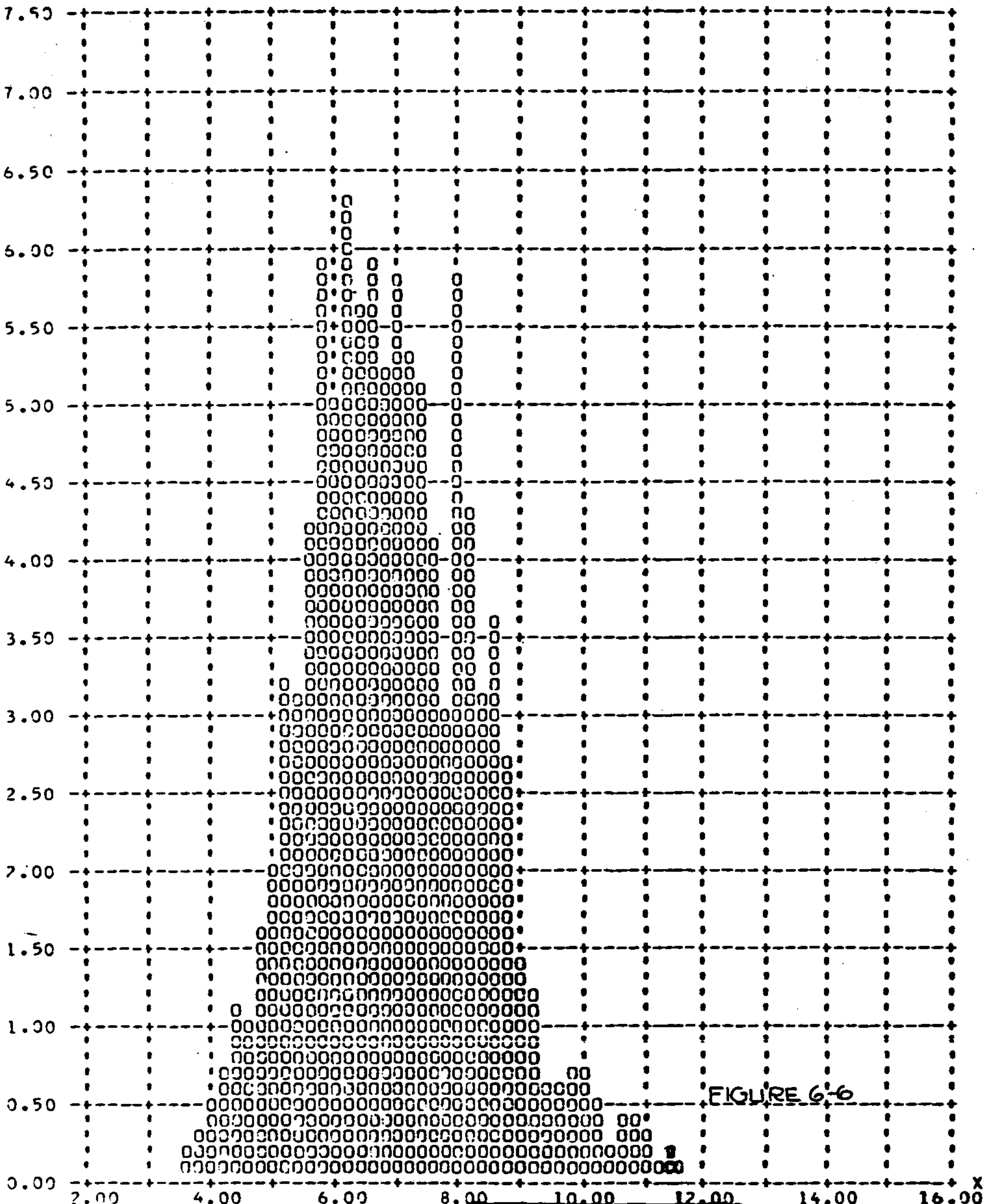


FIGURE 6-6

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 2.32

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

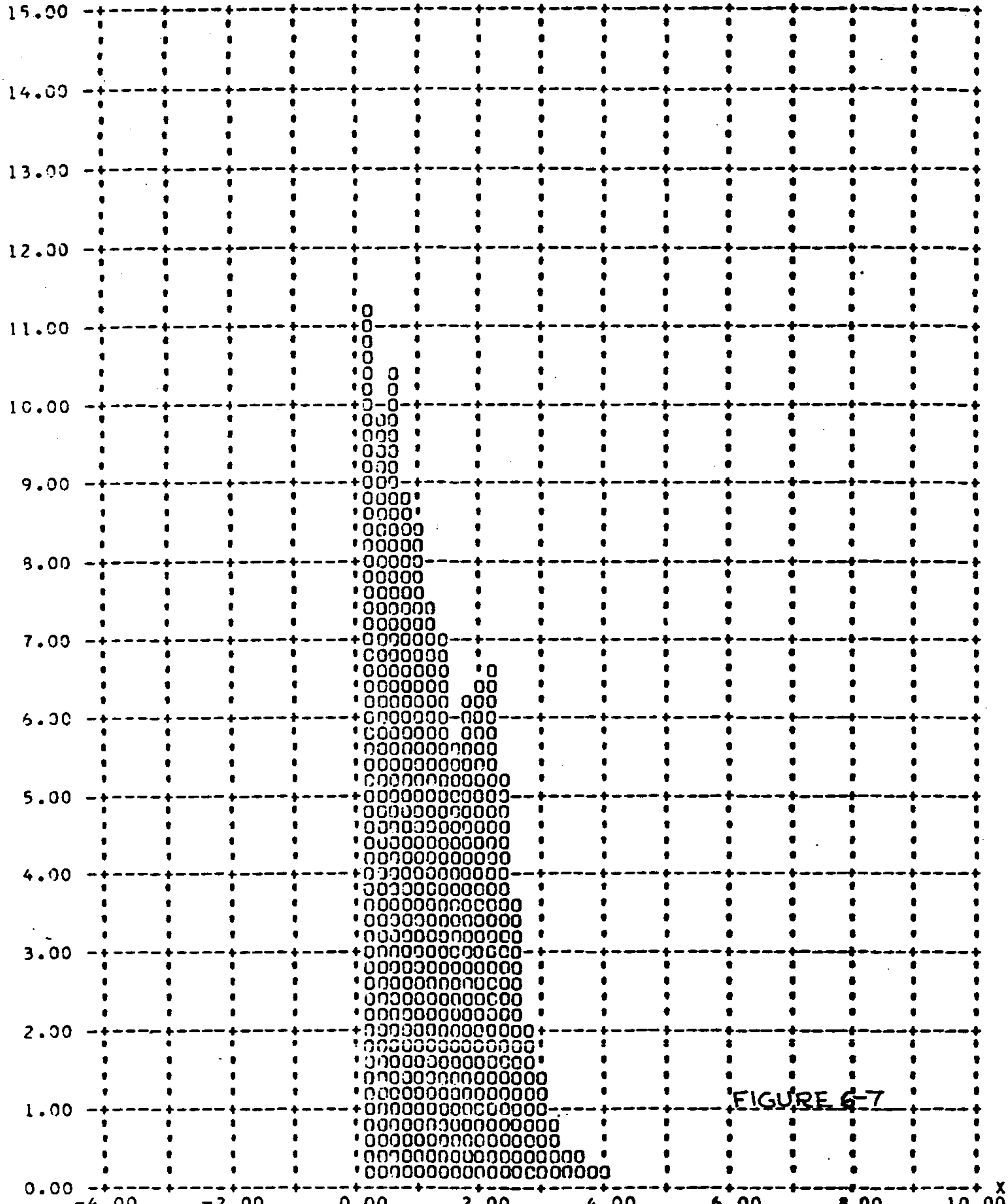


FIGURE 6-7

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 1.61

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

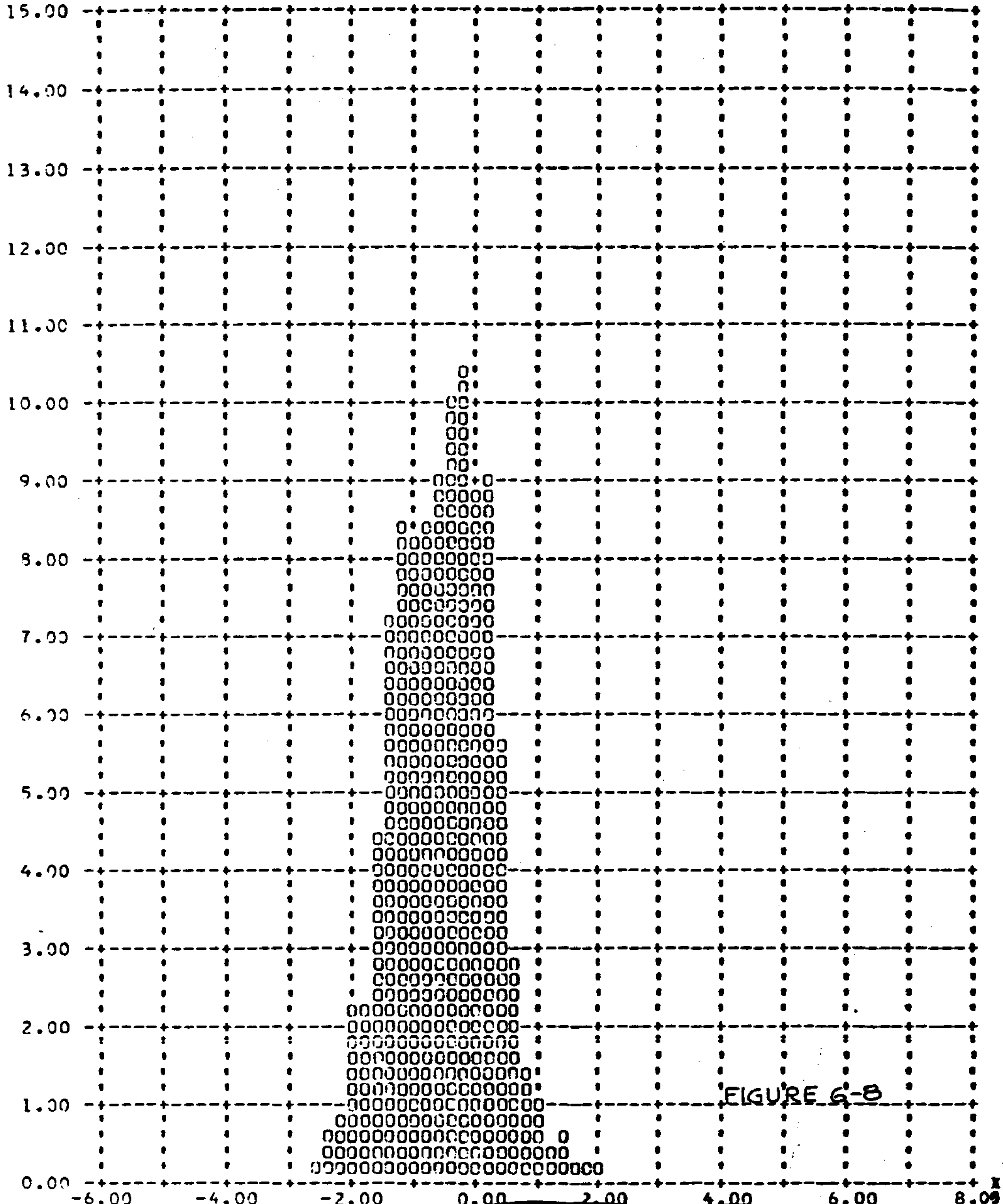


FIGURE 6-8

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 6.37

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

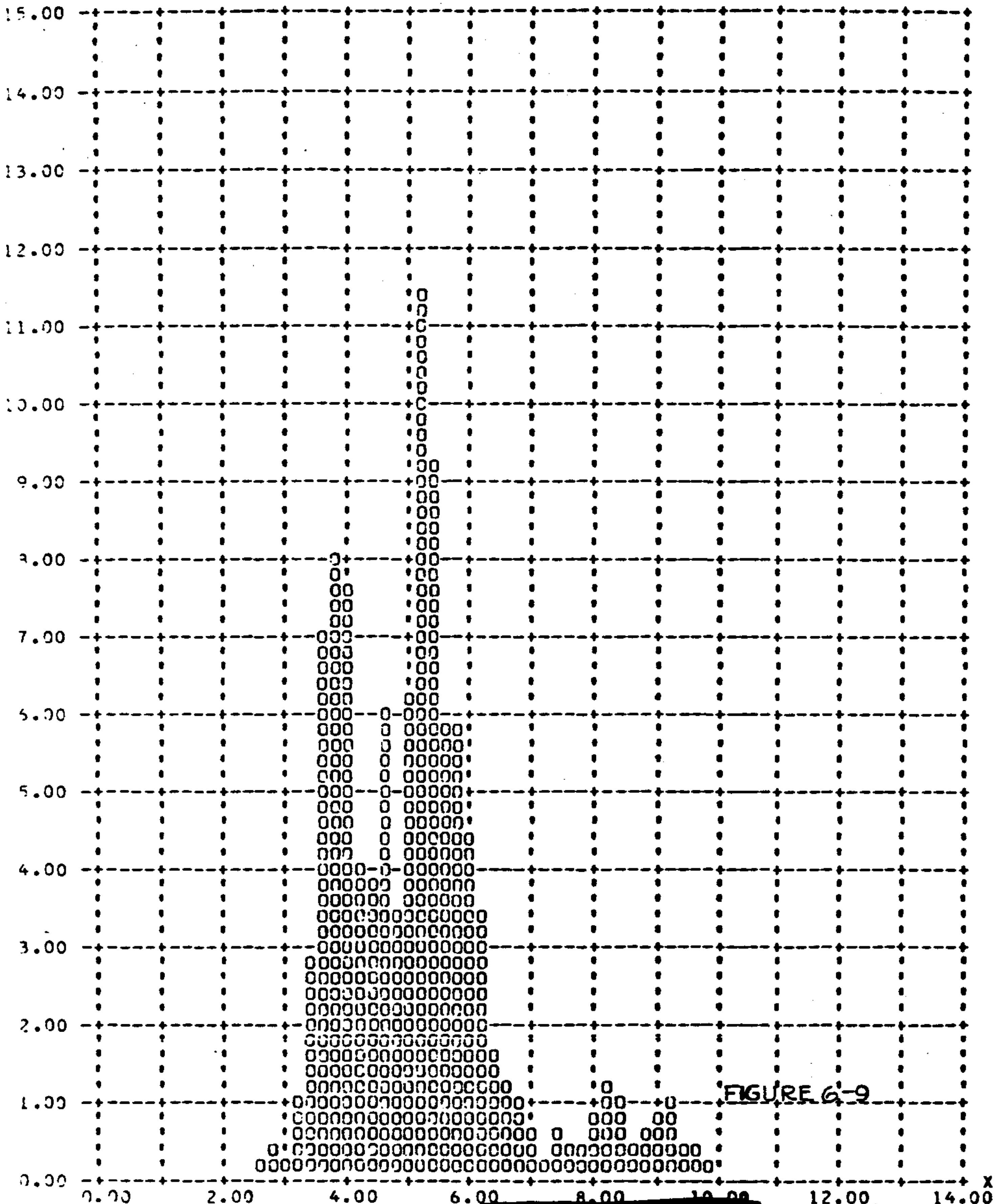


FIGURE 6-9

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 1.23

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

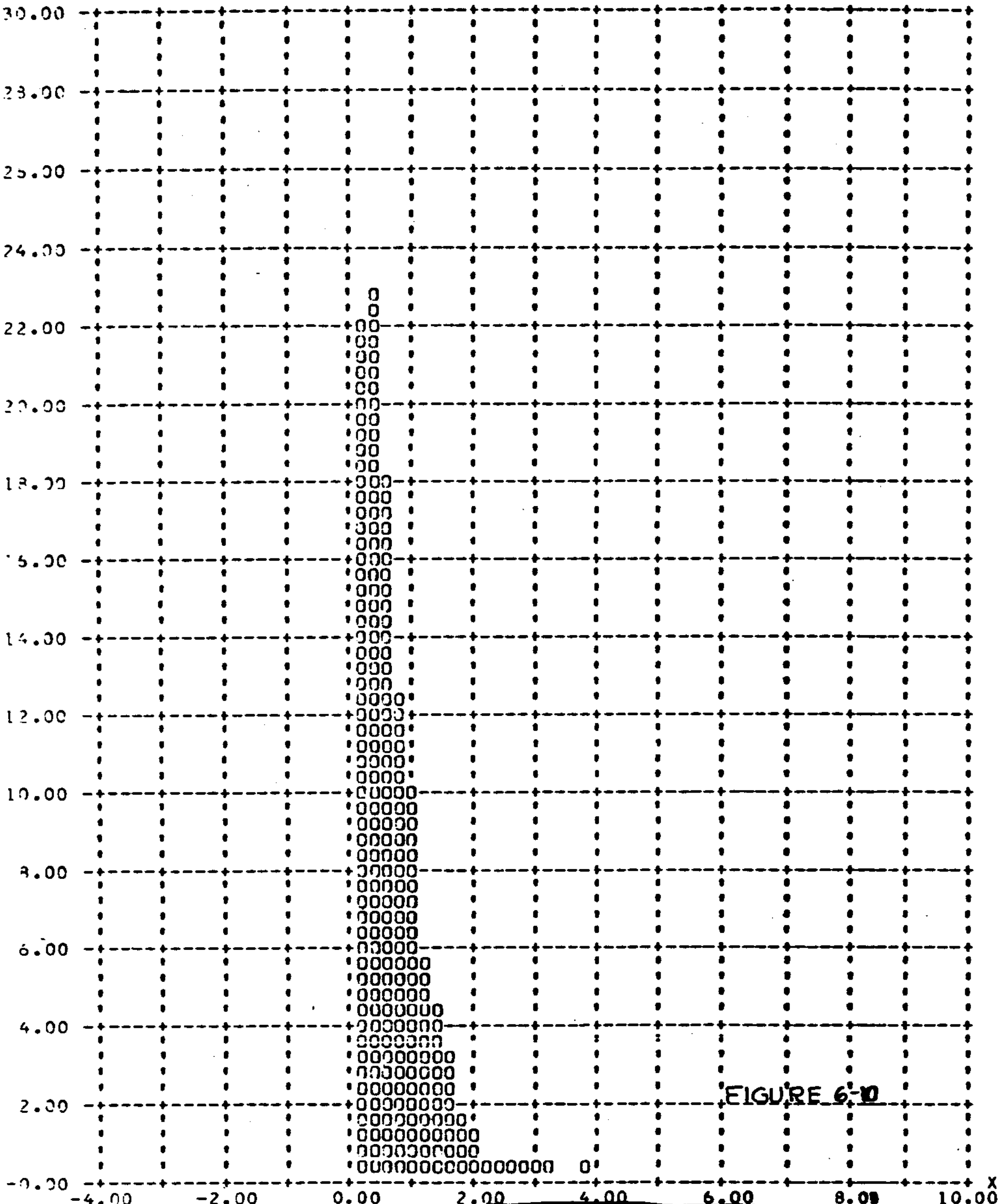
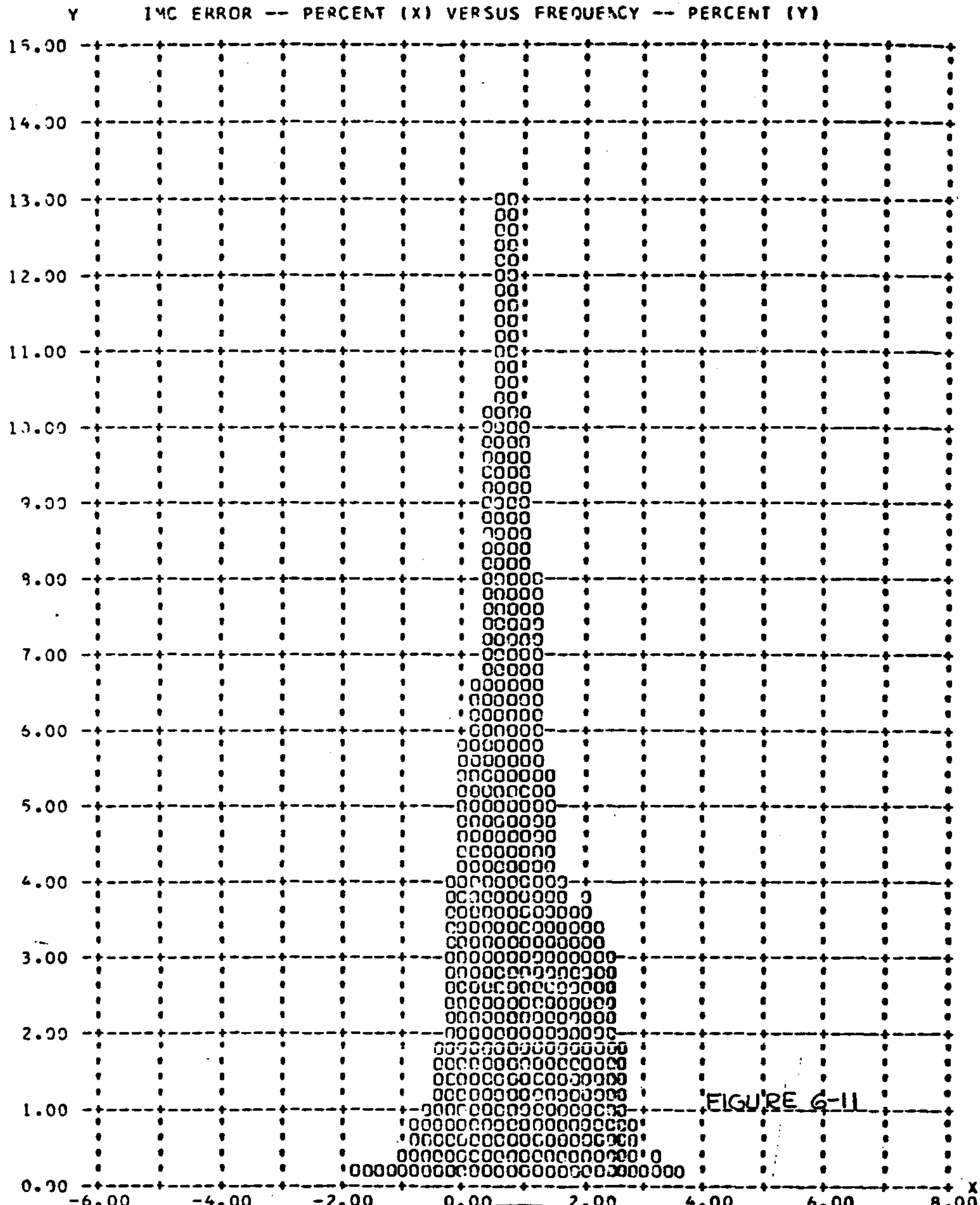


FIGURE 6-10

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 1.96



FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 6.59

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

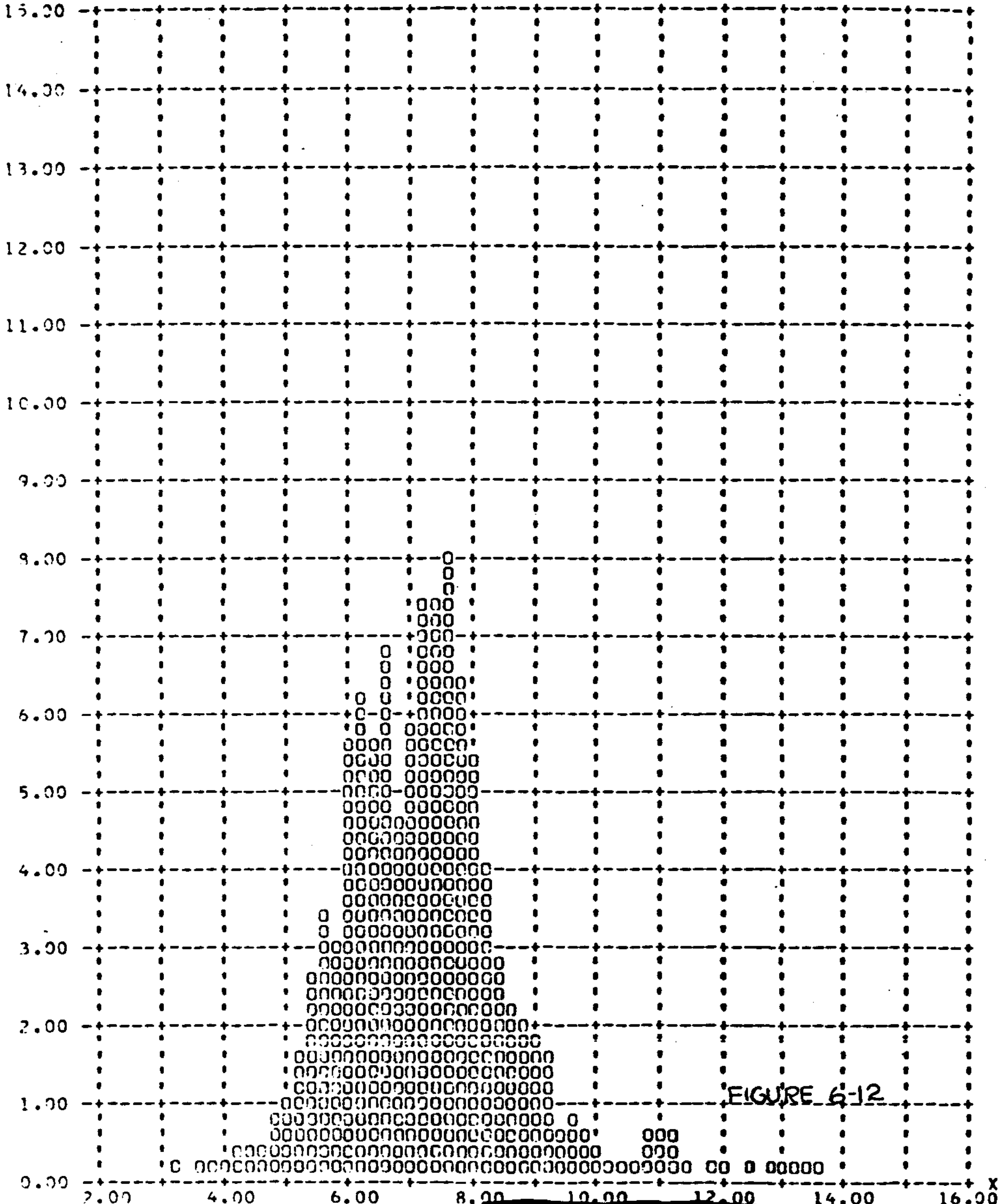


FIGURE 6-12

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 2.19

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

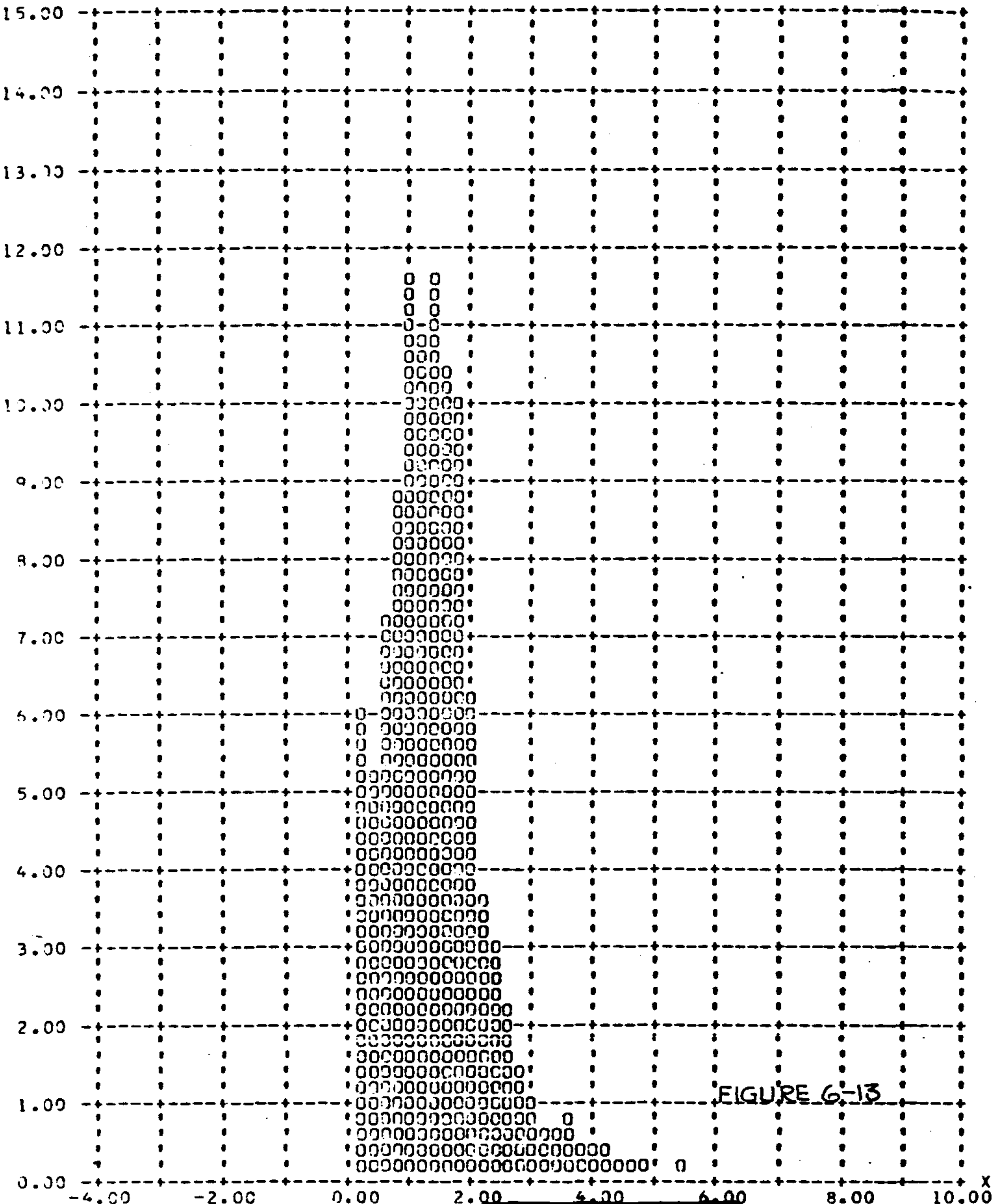


FIGURE 6-13

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 1.94

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

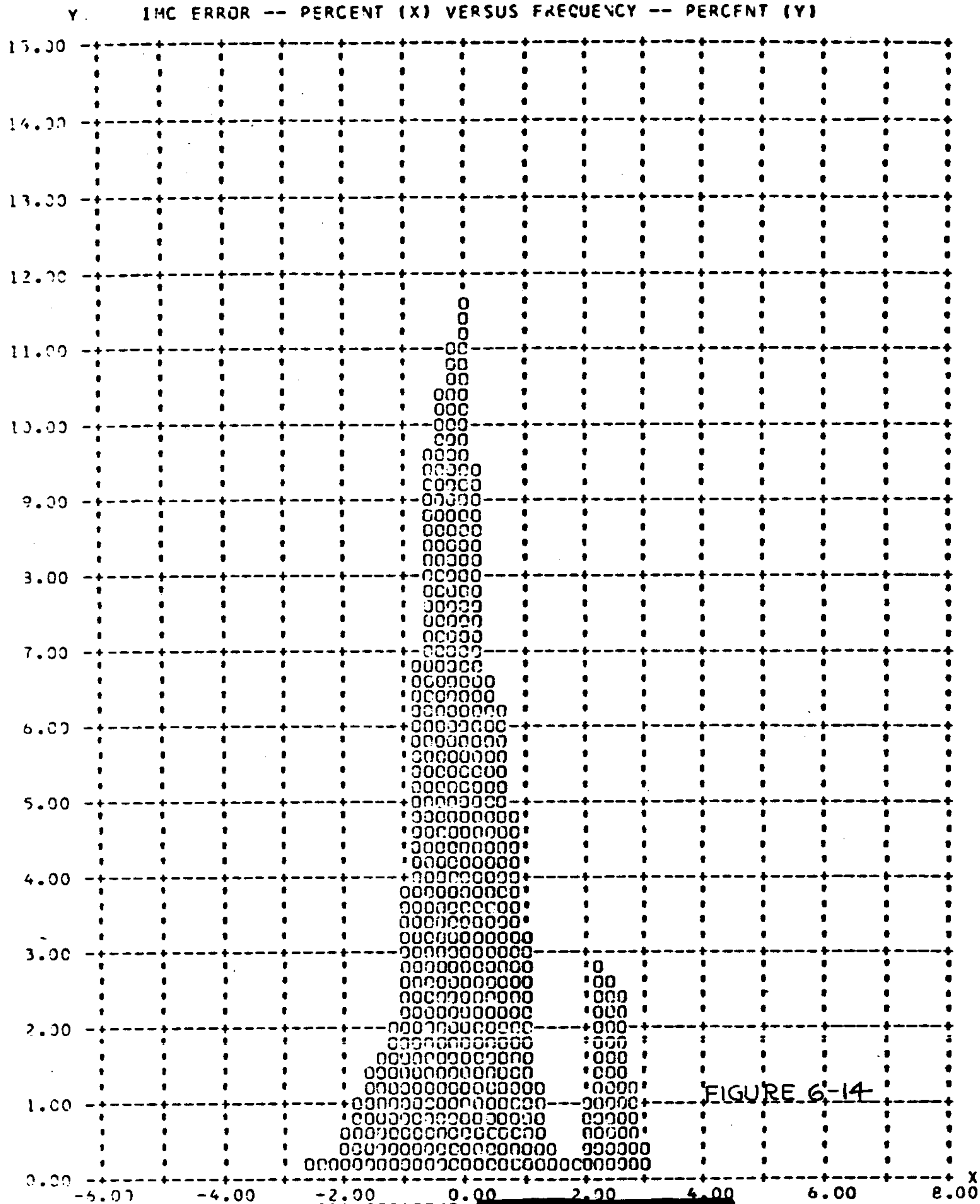


FIGURE 6-14

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 6.00

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

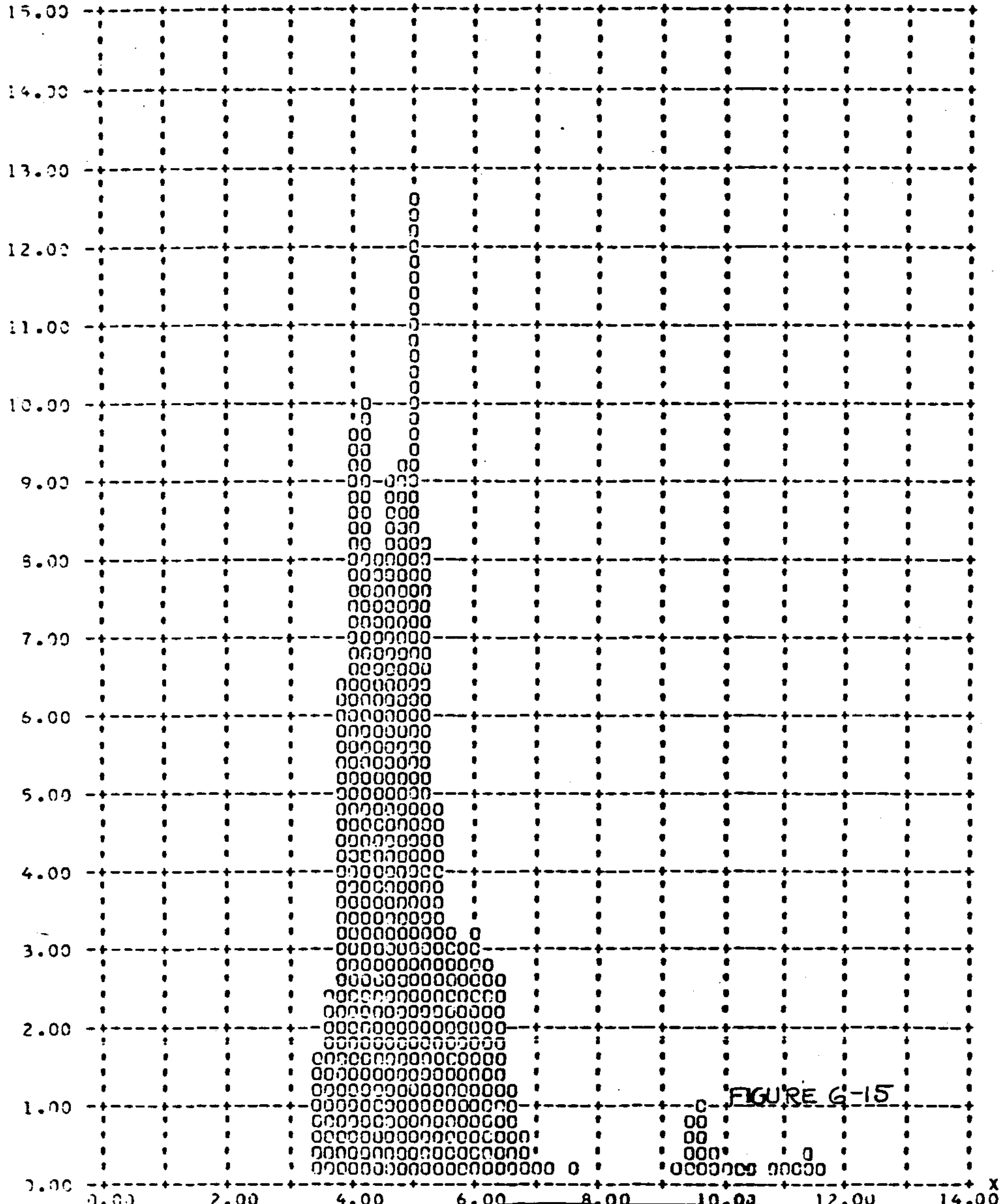


FIGURE 6-15

FRAMES 1-3 OF EACH OP OMITTED 90 PERCENT = 0.80

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

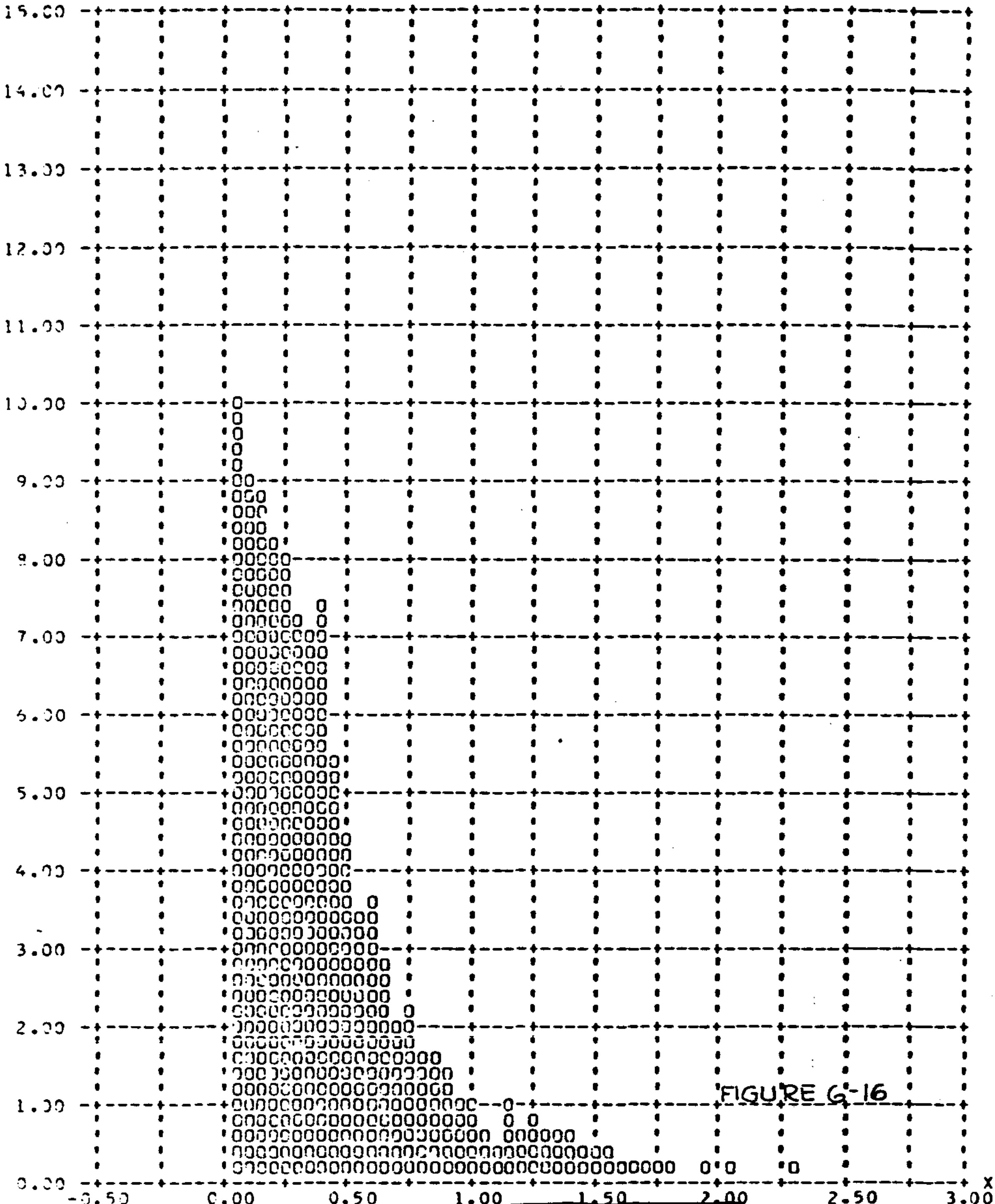


FIGURE G-16

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 contro, 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 1108. A 50 percent confidence level is used.

Primary Function (M-7 and Up)	Opportunities To Operate	Failures	Estimated Reliability
Panoramic Cameras	252	3	98.6%
Panoramic Camera Doors	148	0	99.5%
Command and Control	16416 (Hrs)	2	97.3%
Clock	16416 (Hrs)	0	99.3%
Total Combined Functions above:	-	-	94.7%
Recovery System	119	1	98.59%

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