TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT
MISSION 1017-1
25 FEBRUARY - 2 MARCH 1965
MISSION 1017-2
2 - 6 MARCH 1965

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AUGUST 1965
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54 PAGES

This document contains information referring to

Project Corona

[redacted]

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MISSION 1017-1
25 FEBRUARY - 2 MARCH 1965
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NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

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SYNOPSIS

Mission 1017 (J-14) was launched 25 February 1965. The initial phase, designated Mission 1017-1, accomplished 39 photographic revolutions, including 3 domestic and 2 engineering passes. The payload was recovered in an air catch on 2 March 1965 and second-phase operations were initiated with no intervening deactivation period. Mission 1017-2 accomplished 33 photographic revolutions, including 3 domestic and 3 engineering passes. Recovery of the second payload in an air catch on 6 March 1965 terminated the mission.

The panoramic cameras were operational throughout the mission, but a capping shutter malfunction degraded the slave (AFT) camera photography in the last 5 passes (133D - 137D). The stellar/index cameras performed satisfactorily throughout Mission 1017-1. A possible solenoid malfunction in the second-phase S/I unit caused a film metering failure. Only 45 stellar formats and 29 index formats were recorded. Of these, approximately 70 percent of the stellar formats and most of the index formats contain multiple exposures.

The photography in Mission 1017 was acquired at solar elevations ranging between 0 and 79 degrees. Geographic latitudes ranged between 9 degrees south and 74 degrees north. Clouds obscured 20 percent of the panoramic photography in Mission 1017-1 and 30 percent in Mission 1017-2.

[redacted]

GENERAL FLIGHT DATA

Mission 1017-1

Launch Date	25 February 1965
Recovery Date	2 March 1965

Mission 1017-2

Starting Date	2 March 1965
Recovery Date	6 March 1965

Orbital Parameters

	Mission 1017-1 (Rev 40)	Mission 1017-2 (Rev 109)
Period	89.99 min	89.86 min
Perigee	92.29 nm	98.45 nm
Apogee	201.90 nm	198.32 nm
Eccentricity	0.0145	0.0139
Inclination Angle	75.07°	75.07°

Photographic Operations

	Mission 1017-1	Mission 1017-2
Operational Passes	34	27
Domestic Passes	3	3
Engineering Passes	2	3
Recovery Revolutions	81	145

[redacted]

PART I. CAMERA OPERATION

1. Master (FWD) Panoramic Camera No 140: The instrument was operational throughout the mission. Camera-induced degradations consist primarily of minor scratches, random minus-density streaks, light leak patterns at or near the at-rest positions, and a number of dendritic static discharges. The latter appear intermittently on both film edges in pass 54D and on the time track edge in passes 84D and 85D. Although some of the discharges intrude on the formats, degradation is minor. The major light-struck areas at or near the camera-rest positions contain the following patterns:

Mission 1017-1: The 6th frame from the end of most passes is degraded by an edge-to-edge rectangle of uniform fog, approximately 6.5 inches wide, located in the take-up section of the frame. The last frame of some passes contains an equipment shadowgraph at the supply end of the format.

Mission 1017-2: The 5th frame from the end of most passes contains a small light trace in the take-up end of the format. A similar pattern is present in the next-to-last frame. The last frame contains an equipment shadowgraph.

The degree of degradation in the frames affected by the uniform fog, light traces, and equipment shadowgraphs is dependent on the extent of time that the camera was at rest and on the solar elevation during the camera-off period. Degradation is not severe in the majority of cases in Mission 1017-1 and is even less in Mission 1017-2.

Faint banding is noted at the start of the scan in the thin-density areas, such as water imagery. Examples are found in passes 93D and 120D. Frames 57-61 of pass 137D (the terminal photographic revolution) are severely degraded by smeared images and intermittent fogging due to impending film exhaustion. In addition, static discharges and abrasions are present on both edges of the film.

[redacted]

2. Slave (AFT) Panoramic Camera No 165: The camera operated without malfunction until pass 133D, frame 24, when the capping shutter failed to close. It stayed open throughout the remainder of the mission. The horizon images and the extreme ends of the panoramic formats suffered the most degradation. The degree of degradation varied with solar elevation. Most of the affected horizon images were later salvaged by special printing of the duplicate positives. Similarly, special printing restored a significant amount of the degraded imagery in the panoramic format end sections. Dendritic static discharges are present intermittently on the fiducial edge of pass 55D and on the frequency marks edge of passes 83D-86D. A number of the discharges intrude on the formats, but image degradation is minor. Banding is detectable in thin-density areas at the scan start. Several passes contain intermittent minus-density streaks. As in the master (FWD) panoramic material, certain fog patterns and light traces appear recurrently at or near camera-off positions. Brief descriptions of these follow:

Mission 1017-1: The first frame of most passes contains a bar-type light trace, approximately 0.75 inches wide, extending from edge to edge within the format near frame-center. The 7th frame from the end is degraded by an edge-to-edge rectangle of uniform fog, approximately 6.5 inches wide, positioned in the take-up section of the frame. The third frame from the end of most passes contains an equipment shadowgraph at the take-up end. A small, irregular fog pattern is present in the next-to-last frame but is not readily detectable in all cases.

Mission 1017-2: The first frame of most passes contains the same bar-type light trace noted in Mission 1017-1. An equipment shadowgraph is present in the third frame from the end and a faint light trace is detectable in the last frame of some passes.

3. Master (FWD) Horizon Cameras: The port (supply) horizon camera was operational throughout the mission. The starboard (take-up) horizon camera shutter malfunctioned (failed to close) in pass 5D, frames 120 and 121, causing the loss of 2 horizon exposures and degrading the panoramic photography in those frames. The overall horizon image quality is good.

[redacted]

4. Slave (AFT) Horizon Cameras: The port (take-up) and starboard (supply) horizon cameras were operational throughout the mission. Image quality is good. However, the Panoramic camera capping shutter malfunction noted in Item 2 degraded all the horizon images from pass 133D, frame 24 to the end of the mission in Pass 137D. Special printing was required to restore the affected images to a useable condition.

5. Stellar Camera No 21 (Mission 1017-1): The instrument was operational throughout the mission. Approximately 30 percent of each format is degraded by flare. All frames contain a minimum of 10 readily identifiable stars which provide better-than-average geometry. However, numerous examples of distorted stellar images are also detectable in most frames. In general, mensuration and reduction of attitude values were enhanced by the above-average contrast and better-than-average geometry, but limited by the prevelance of distorted images. Some difficulty was encountered in resolving the reseau cross in the fiducial marks which were overexposed. The film is free of all but minor degradations.

6. Stellar Camera No 60 (Mission 1017-2): A possible solenoid malfunction is tentatively identified as the cause of a film metering failure, with consequent multiple exposures. The camera generated only 45 stellar formats, of which approximately 70 percent contain evidence of multiple exposures ranging from 2 to 5 exposures per format. The remaining, unaffected frames contain fair-to-good stellar images. The flare is noticeably less intense than in the film exposed during Mission 1017-1, and a considerable number of stellar images are detectable in the flared areas.

7. Index Camera No D21 (Mission 1017-1): The instrument performed without malfunction and produced good-quality terrestrial imagery.

8. Index Camera No D68 (Mission 1017-2): The possible stellar/index solenoid malfunction noted in Item 6 limited the acquired photography to 29 frames, most of which contain multiple exposures that have little or no information content value.

9. Associated Equipment: The old-type binary data block was employed in the master (FWD) panoramic camera and the lamp images are bloomed and distorted. Some read-out problems were encountered in the Slave (AFT) camera material. Specifically, the dimness of Lamp No 17 in passes 20D and 41D and Lamp No 29, in many passes, caused difficulties. In pass 136D, the top row of lamp images tracked

too close to the edge of the film and the time had to be hand-read. The frequency marks are flared, with reflected images, but are recorded outside the formats. The marks appear underexposed in the slave (AFT) camera material of Mission 1017-2 but are readable in all cases.

10. Special Note: Yaw Steering Experiments: Vehicle yaw was programmed in passes 9D-85D. The yaw increments ranged from 0.75 to 1.50 degrees, depending on the system lattitude. This is one of a continuing series of experiments intended to investigate the practical value of controlled yaw as compensation for possible image smear induced by the earth's rotational velocity. Approximately 0.5 degrees of residual (uncompensated) yaw angle remained after implementation of the yaw steering control. Identical terrain photography, acquired with and without yaw steering, was examined for comparison of image quality. The participants in the evaluation were unable to detect a difference between the samples.

PART II. FILM

1. Film Footage/Frame Totals:

	1017-1	1017-2
Master (FWD) Camera	8,252 ft/2,936 frames	7,725 ft/2,914 frames
Slave (AFT) Camera	8,214 ft/2,940 frames	7,672 ft/2,908 frames
Stellar Camera	66 ft/ 420 frames	5 ft/ 45 frames
Index Camera	94 ft/ 420 frames	6 ft/ 29 frames

Total Footage/Frames, Master (FWD) Camera:	15,977 ft/ 5,850 frames
Total Footage/Frames, Slave (AFT) Camera:	15,886 ft/ 5,848 frames
Total Footage/Frames, FWD & AFT Cameras:	31,863 ft/11,698 frames

The last 6 master panoramic frames and the last 7 slave panoramic frames of the terminal pass in Mission 1017-1 (pass 81D) were recovered with the second payload. In every mission employing the 2-phase concept, the last few frames of first-phase photography will be contained at the head of the second-phase payload. Monoscopic coverage, employing either panoramic camera, may be programmed into any part of a mission.

2. Film Processing Data: This section provides evaluations of processing, exposure, density, and physical condition of the original negatives. Processing data is abstracted from records provided by the processing contractor. Evaluation of exposure and determination of the film's physical condition are accomplished by on-site inspection of the negatives as they are made available for breakdown and titling. Densitometric readings and a final, more thorough examination of the original negatives are conducted by photographic analysts at a later date.

Most of the footage in this mission received adequate exposure. However, variations in terrain reflectivity and/or low solar elevations caused some departures from normal exposure results. In order to strike an acceptable minimum/maximum densities mean, infrared densitometry was utilized by the processing contractor to determine the optimum development levels required for the various portions of the panoramic records.

The following development levels were employed in processing the film:

	1017-1		1017-2	
	Master	Slave	Master	Slave
Primary	13%	24%	5%	18%
Intermediate	63%	58%	63%	62%
Full	24%	18%	32%	20%

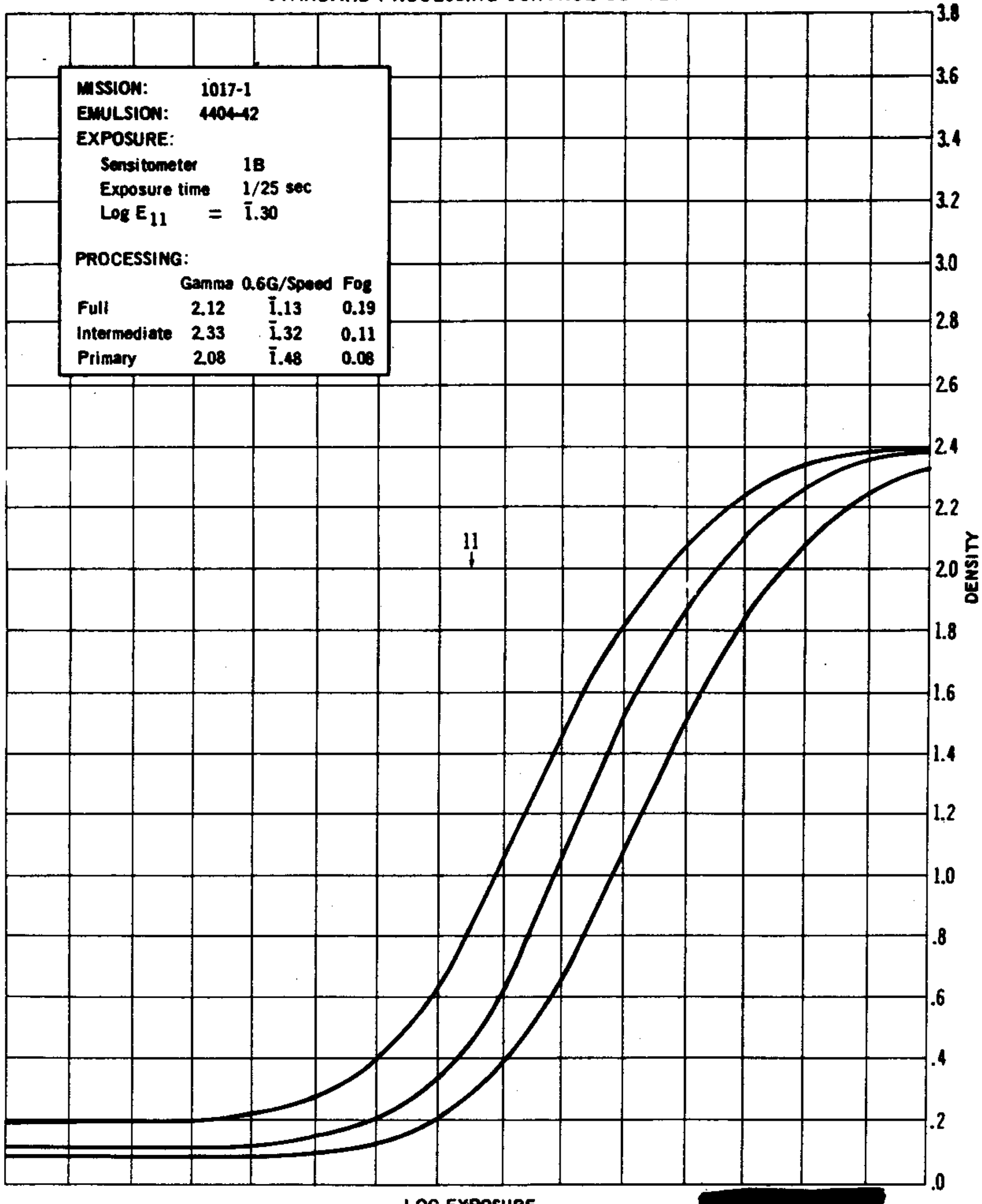
Sixty-two processing level changes were required on the master record and 47 on the slave record on Mission 1017-1. On Mission 1017-2, 51 processing level changes were required on the master record and 46 changes on the slave material. As a whole, density of the mission record is good. Most of the density levels are in the medium category.

3. Physical Film Degradations: No major degradations are present on the panoramic film. Most of the degradations consist of intermittent and minor scratches, digs, pinholes, etc., except for the dendritic static discharges previously mentioned. The only other exceptions worth noting are an uncommonly high number of kinks in the material recovered from Mission 1017-1 and numerous fine, longitudinal emulsion scratches near the take-up end of many frames in the second-phase material. The stellar/index film records are also free of all but minor physical defects.

4. Film Processing Curves: The following pages contain reproductions of the film processing curves for Missions 1017-1 and 1017-2.

[redacted]

STANDARD PROCESSING CONTROL CURVES



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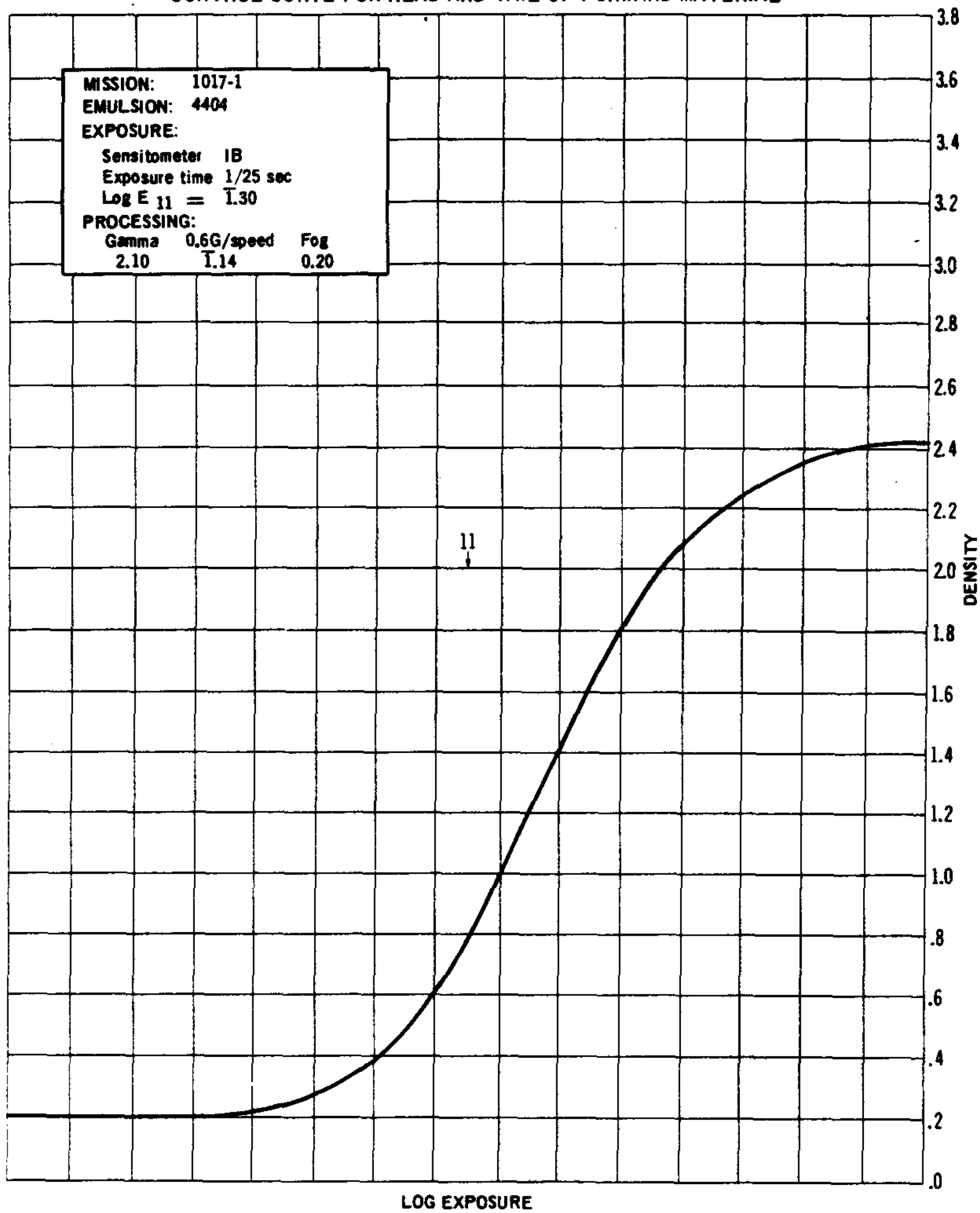
CONTROL CURVE FOR HEAD AND TAIL OF FORWARD MATERIAL



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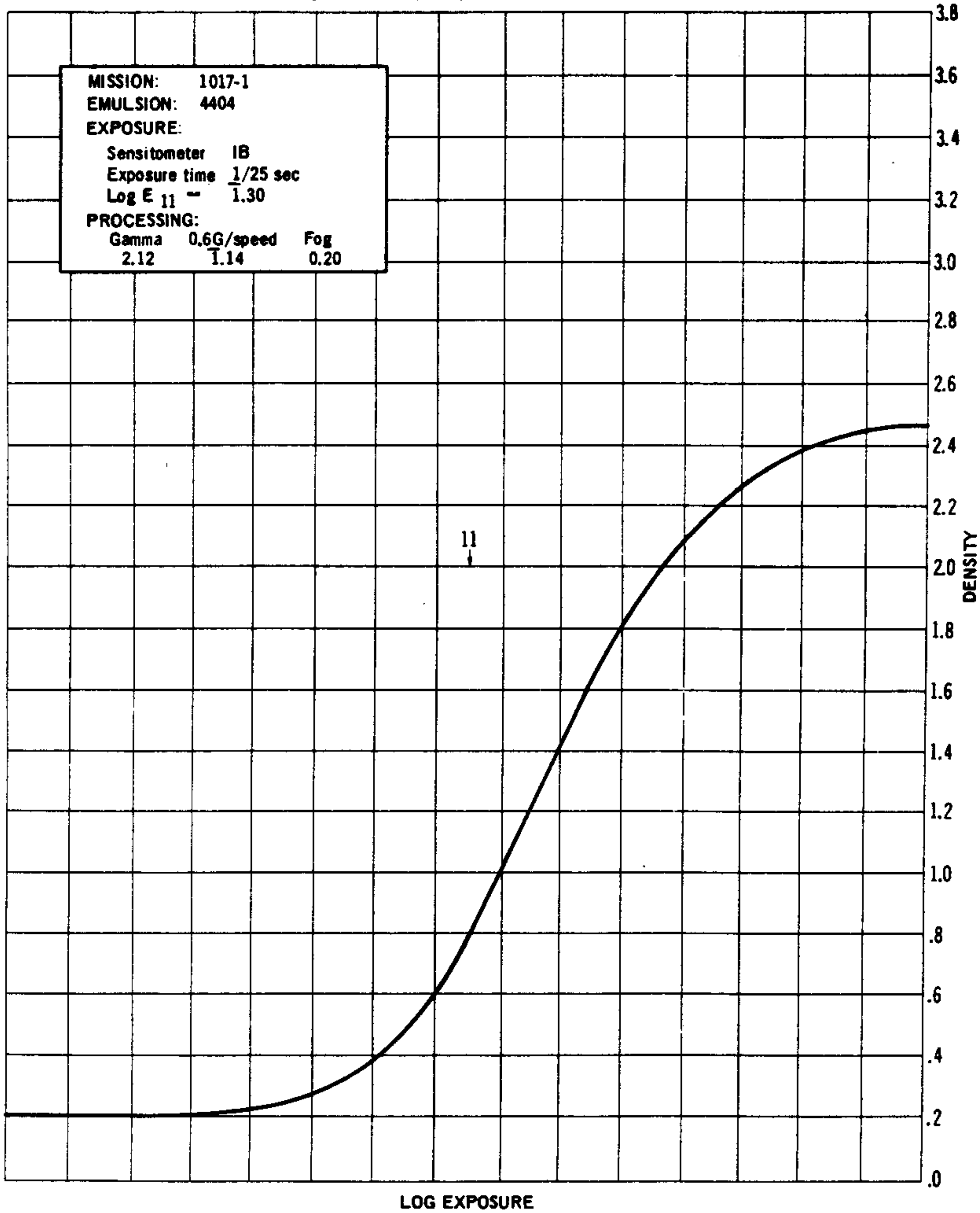
CONTROL CURVE FOR HEAD AND TAIL OF AFT MATERIAL



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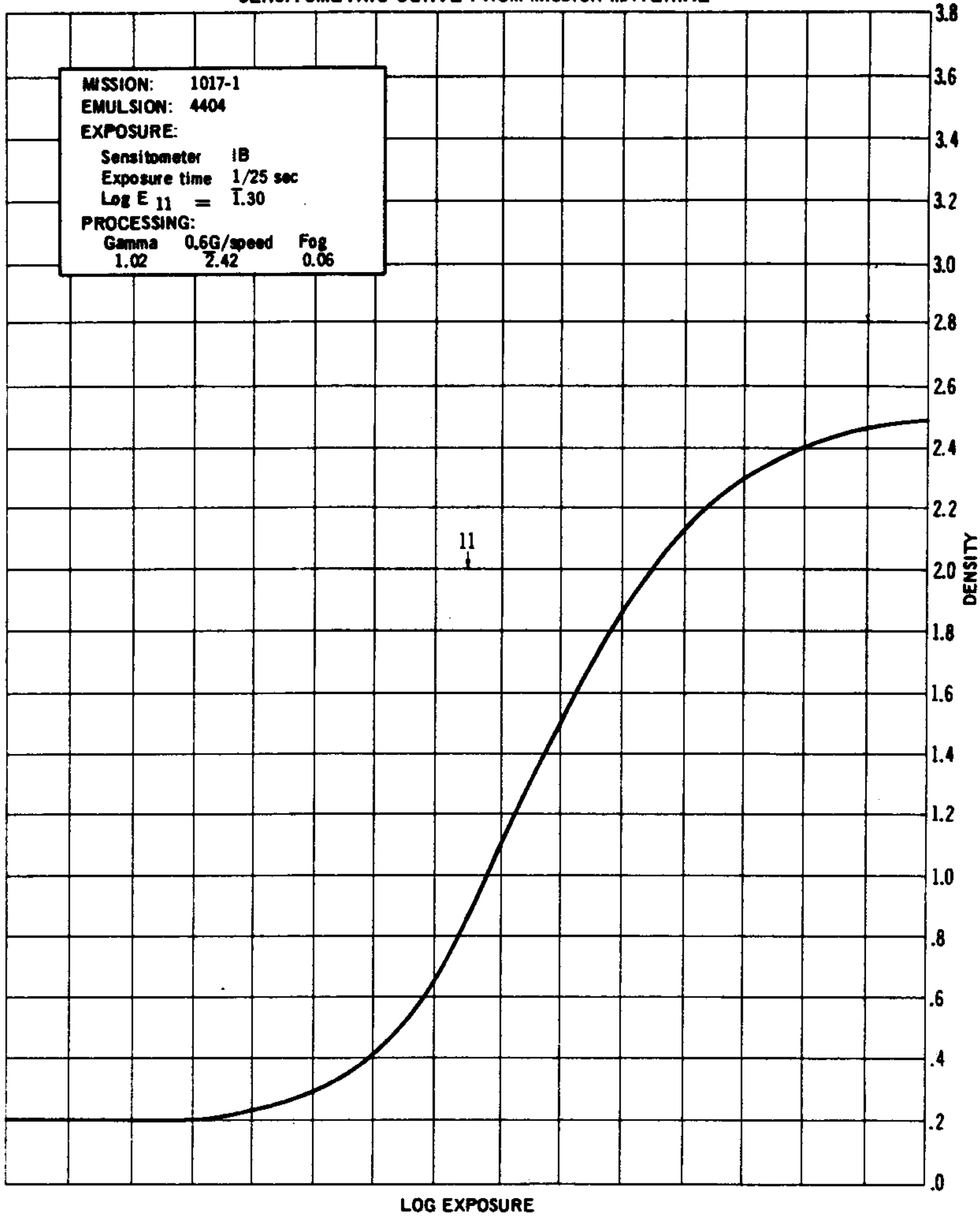
SENSITOMETRIC CURVE FROM MISSION MATERIAL



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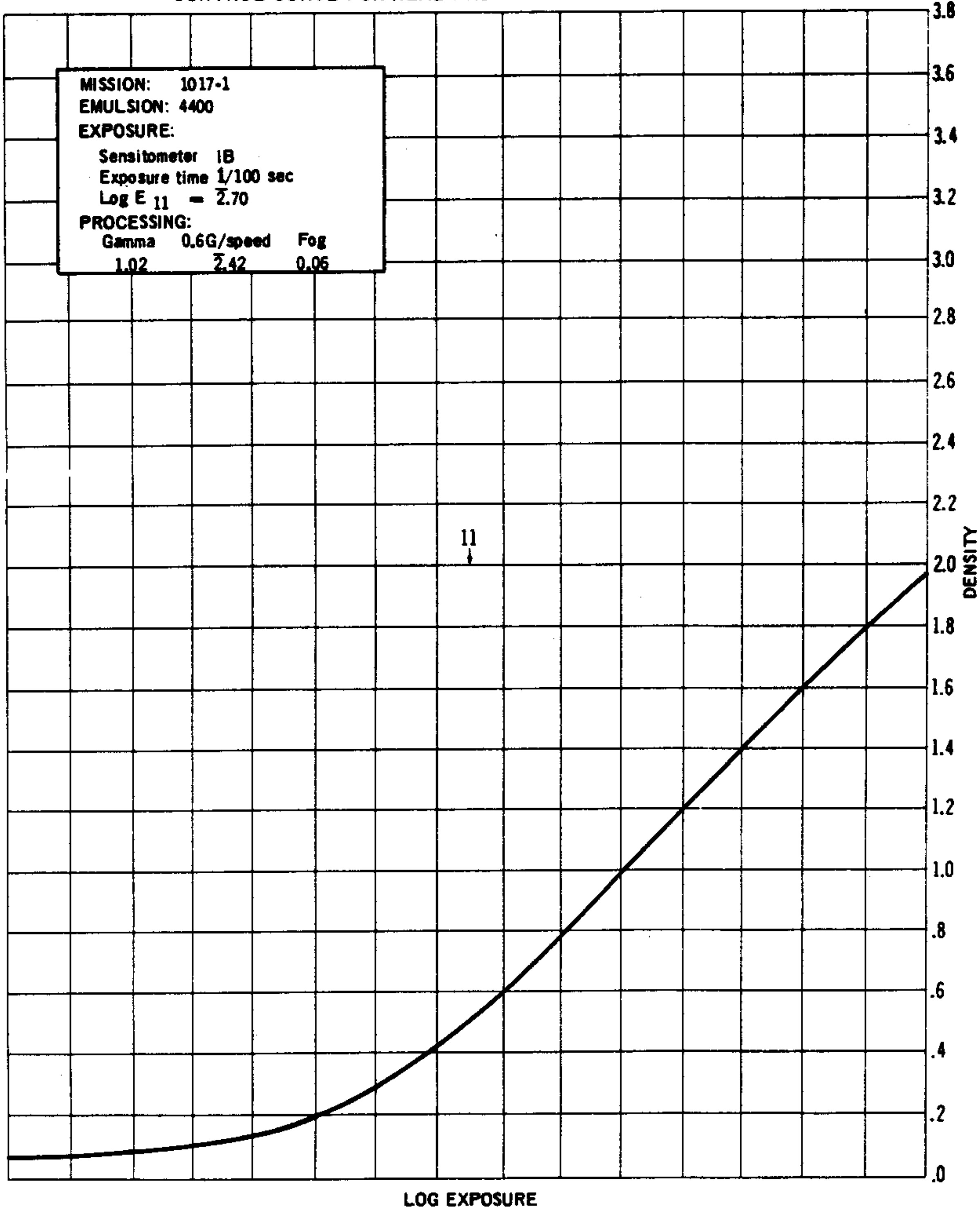

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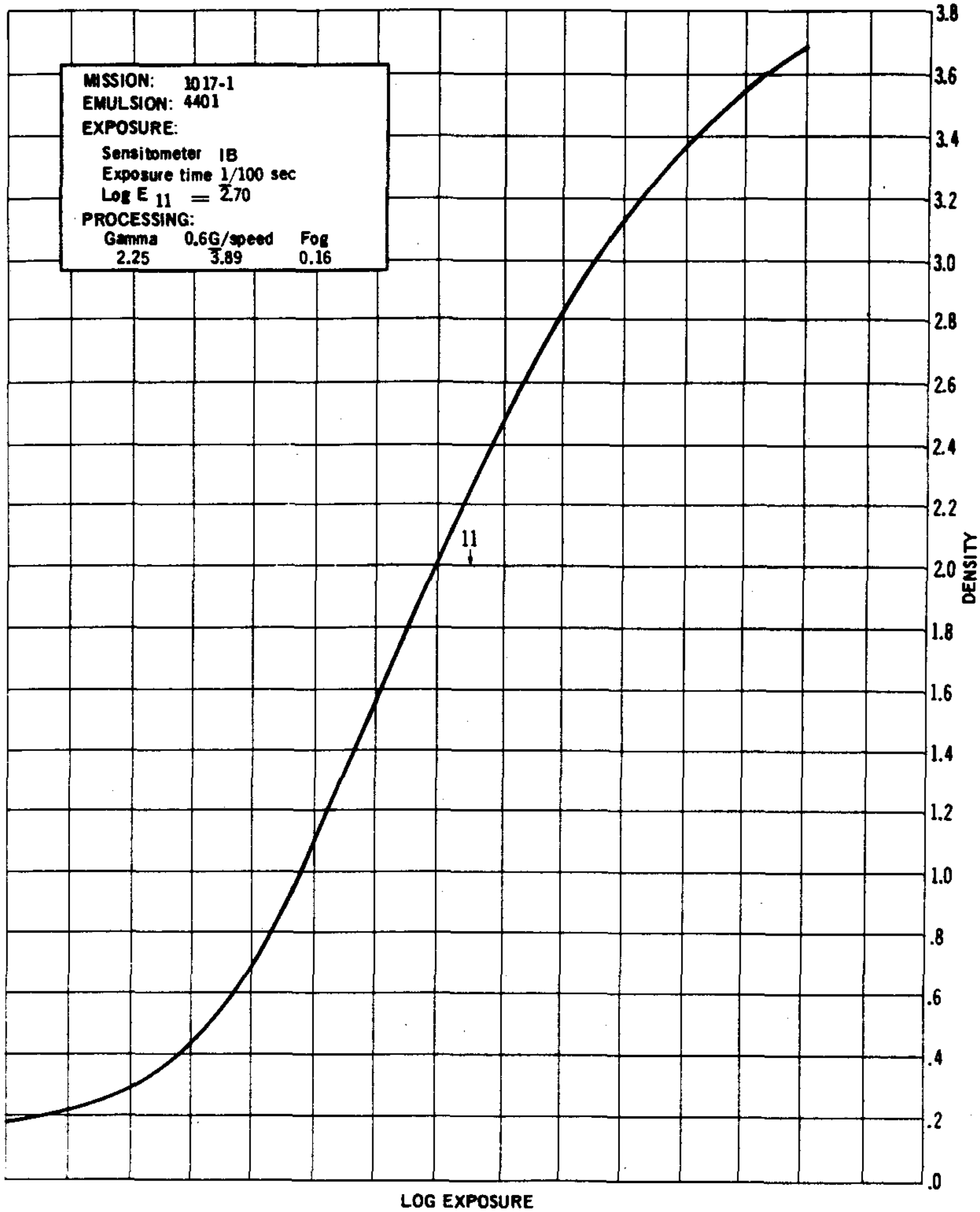

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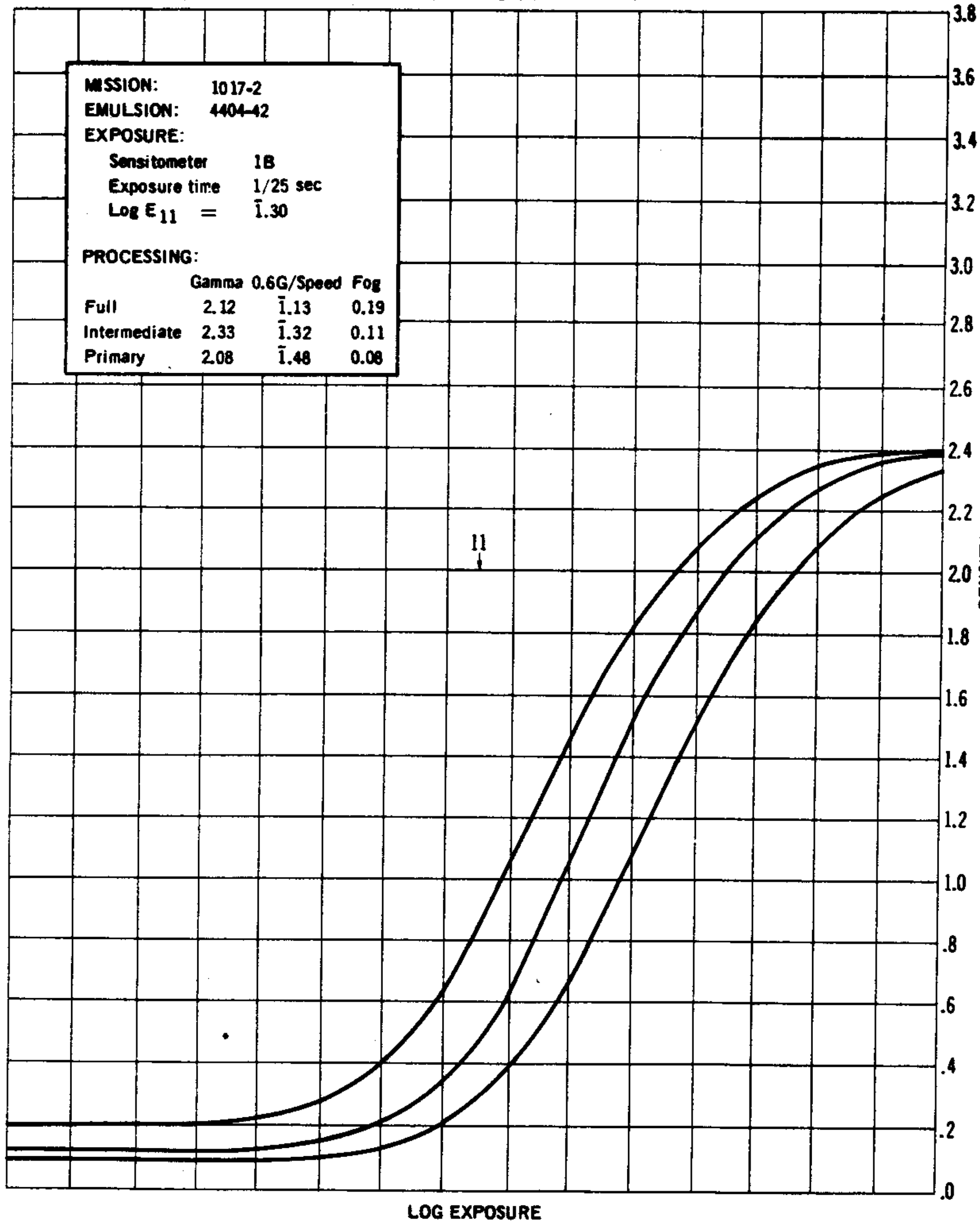

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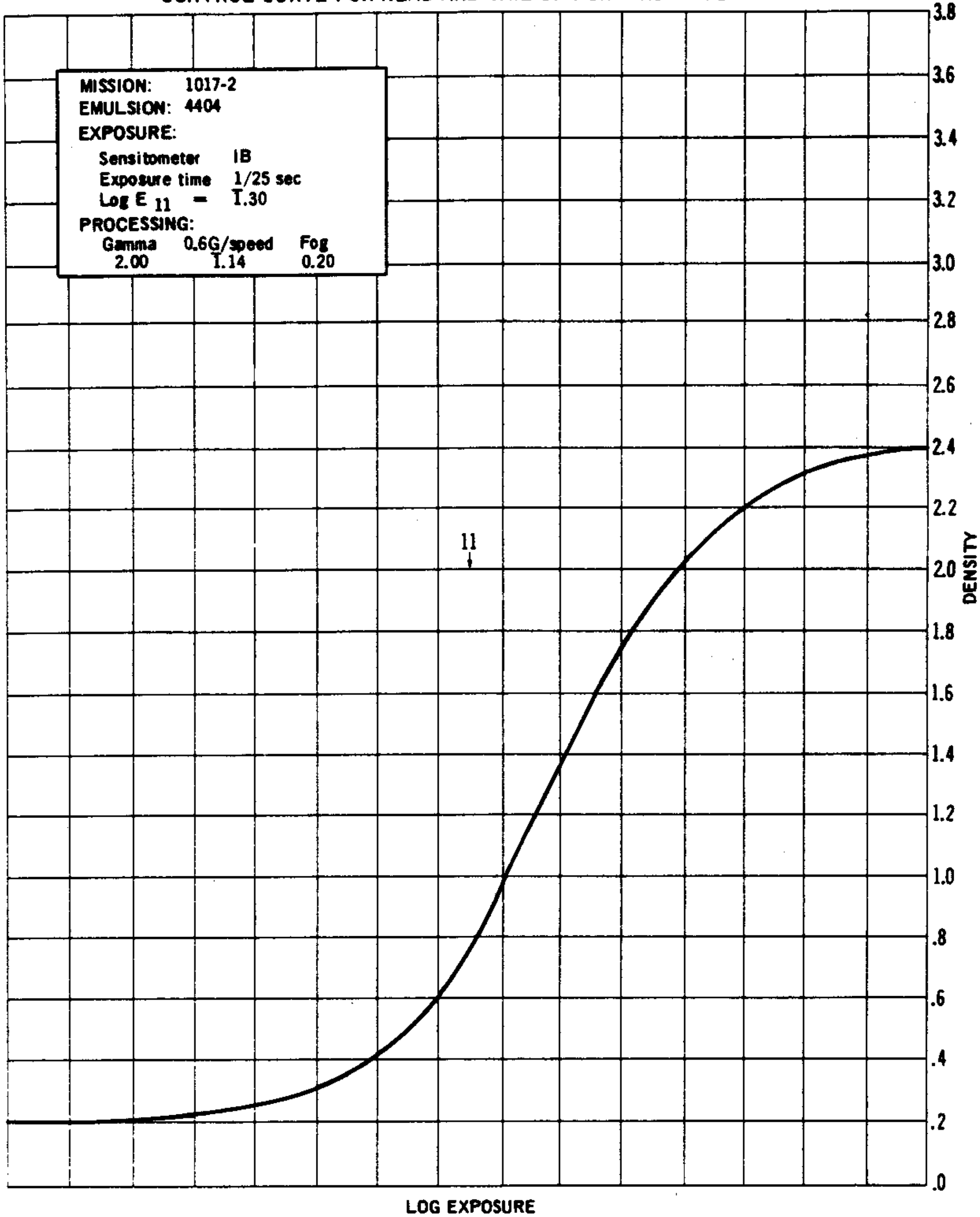

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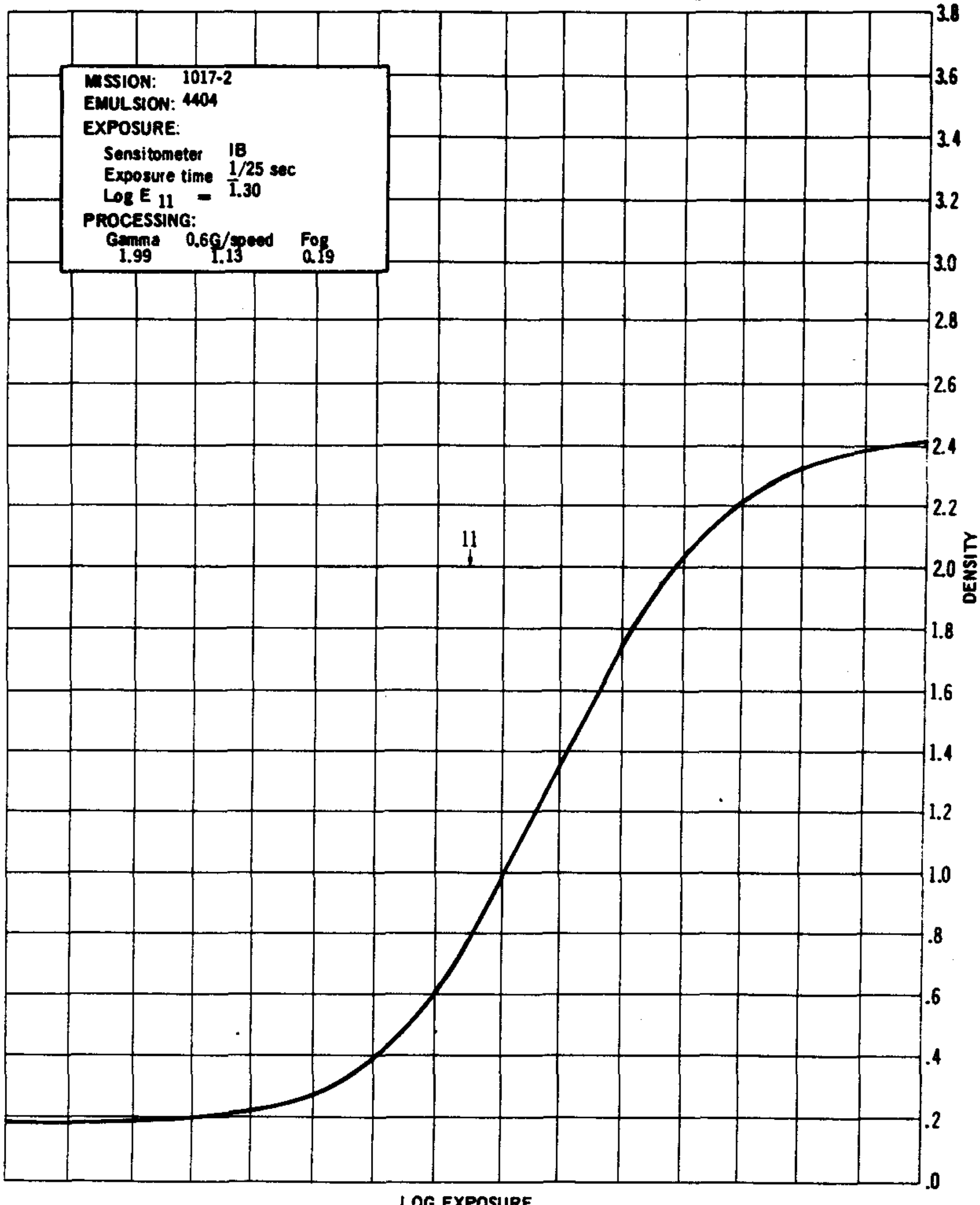

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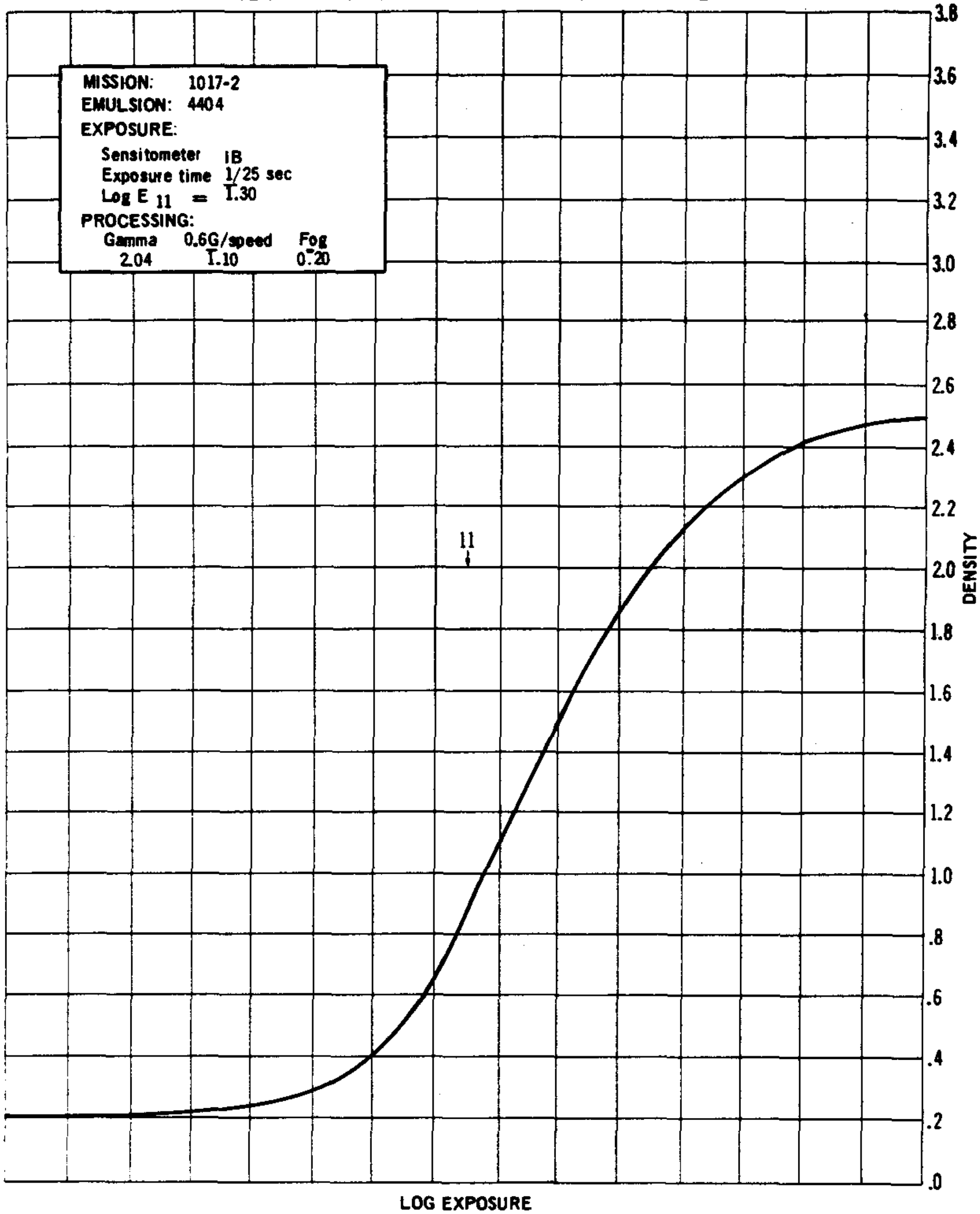

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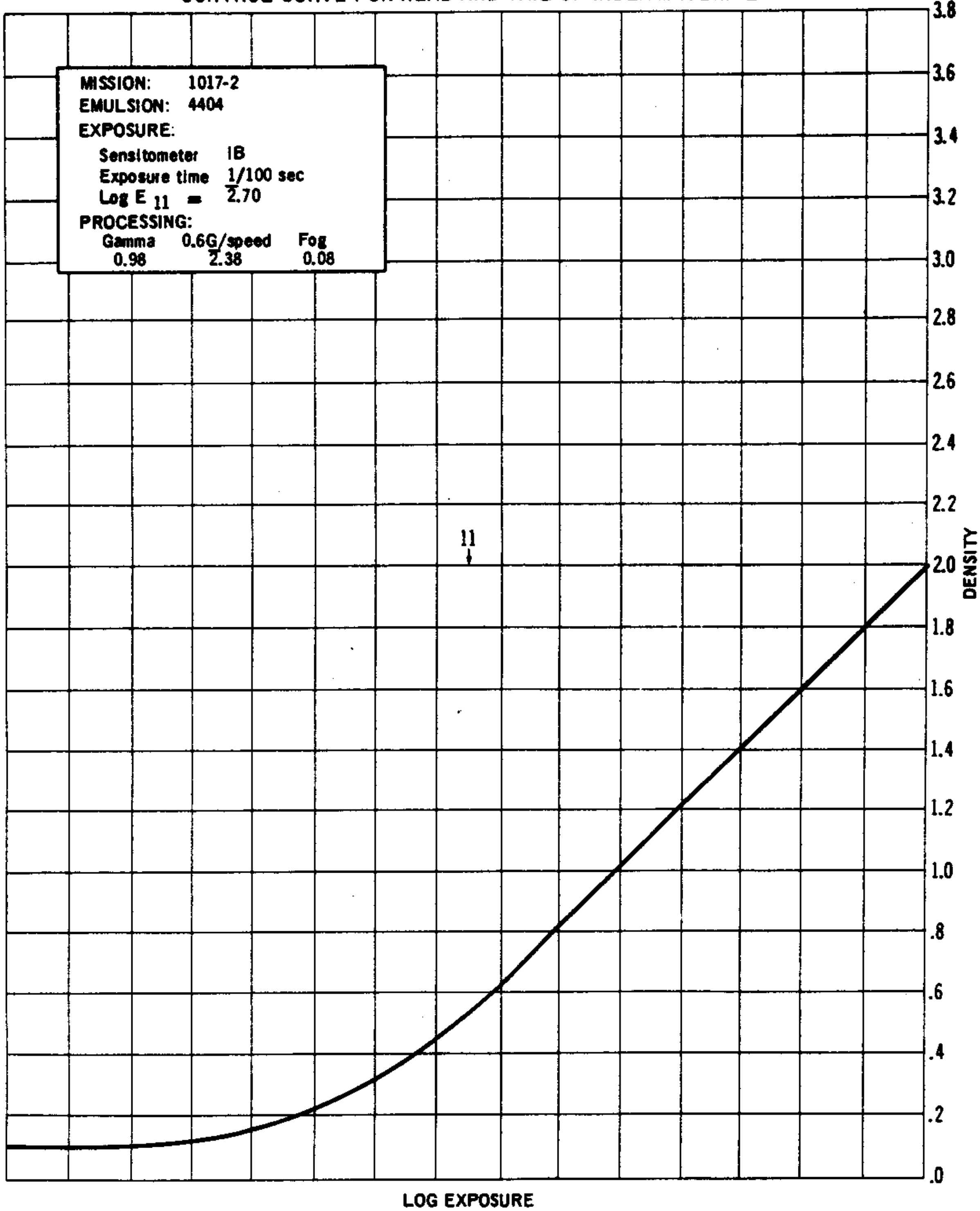

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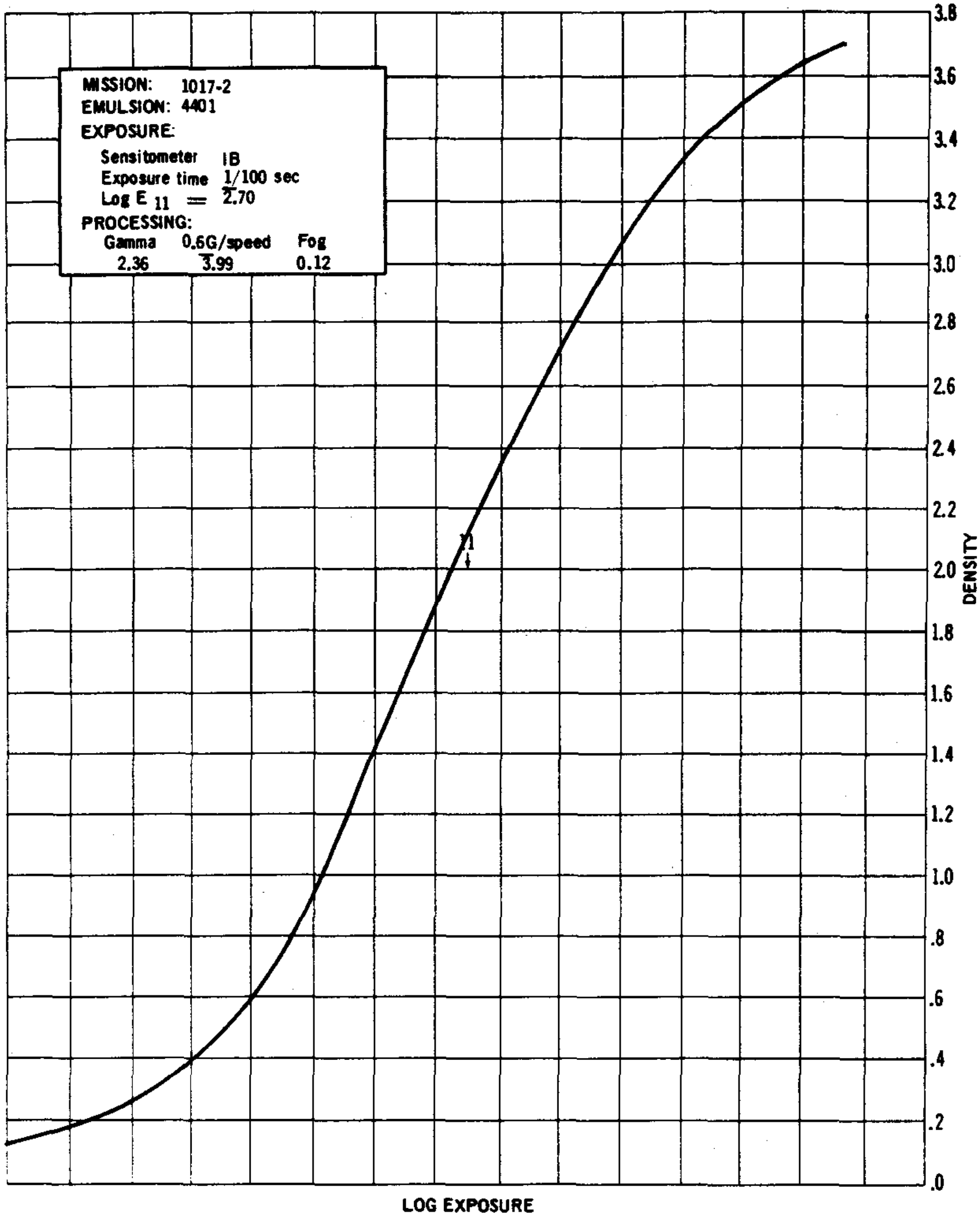

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PART III. IMAGE QUALITY

1. Definition of Photographic Interpretation (PI) Suitability: This is an assessment of the information content of photographic reconnaissance material and its interpretability. A number of interrelated factors are involved, such as the quality of the photography, the extent of target coverage, scale, and weather limitations. However, the criteria for assigning a PI suitability rating may be reduced to (a) the scope of the photographic coverage and (b) the degree to which a photo interpreter may extract useful and reliable information from the material.

PI suitability ratings are categorized as excellent, good, fair, poor, and unusable. These ratings refer to the overall interpretive value of the photography obtained from a particular reconnaissance mission. Individual targets may also be assigned PI suitability ratings if that is necessary or desirable. The standards that determine the various ratings are as follows:

Excellent: The photography is free of degradation by camera malfunctions or processing faults and weather conditions are favorable throughout. The imagery contains sharp, well-defined edges and corners, with no unusual distortions. Contrast is optimal and shadow details, as well as details in the highlight areas, are readily detectable. Observation of small objects and a high order of mensuration are made possible by the consistently superior quality of the photography.

Good: The photography is relatively free of degradations and limiting weather conditions. Edges and corners of objects are well-defined. No unusual distortions are present. Detection and accurate mensuration of small objects are feasible, but to a lesser degree than in material rated as "excellent."

Fair: Degradation is minimal but the acuity of the photography is less than optimum. Edges and corners of objects are not crisply defined and there is loss of detail in shadow and/or highlight areas. Detection and identification of small objects are possible but accuracy of mensuration is reduced by less-than-optimum contrast that prevails.

[redacted]

Poor: Camera-induced degradations and/or weather limitations severely reduce the quality of the photography. Definition of edges and corners is not sharp. Only gross terrain features and culture may be detected or identified and distortion of form may exist. Accurate mensuration of even large objects is doubtful.

Unusable: Degradation of the photography completely precludes detection, identification, and mensuration of cultural details.

2. PI Suitability, Missions 1017-1 and 1017-2: The PI suitability of the photography obtained in Missions 1017-1 and 1017-2 is good. A total of 239 targets was reported in the preliminary PI reports (152 targets in Mission 1017-1 and 87 targets in Mission 1017-2). With regard to photographic quality of the specific targets covered, the notation PQ (Poor Quality) appears only 28 times. The majority of the PQ ratings refer to photography degraded by obliquity and low solar elevations and further degraded by atmospheric haze or blowing snow. The capping shutter malfunction reported in Part I, Item 2 did not seriously reduce PI suitability, since only the extreme ends of the panoramic formats were affected by the resultant fogging in passes 133D - 137D of the slave (AFT) camera. In addition, special printing was employed to salvage a significant amount of the degraded imagery in the panoramic format end sections. Cloud reflectance streaks were observed in a number of instances throughout the mission record but degradation is minimal, particularly in the photography acquired with slave (AFT) panoramic camera.

The comparatively extensive coverage in this mission permitted confirmation of numerous previous suspect activities, new identifications, and revision of information on a number of targets covered in past missions. However, the preliminary PI reports represent the initial scan results only, which are accomplished in a relatively short time without the aid of the precise analytical and mensural instruments normally employed in photographic interpretation. More detailed study of the material usually develops additional information and may uncover matters of interest not noted in the preliminary scan.

3. Definition of Mission Information Potential (MIP): The MIP rating assigned to a mission is an arbitrary figure intended to indicate the quality of the best photography obtained in the mission. It is representative of the camera system's maximum capability for recording information as demonstrated by the instruments employed in each mission.

[redacted]

In consideration of the information the MIP is intended to convey, photography containing adverse factors such as low solar elevation, poor atmospheric conditions, and similar degradations is eliminated in selection of the MIP example. The MIP rating assigned to a mission is indicative solely of the camera system's photographic capability exclusive of degradations which are not camera-derived. The selected photography may constitute a portion of a frame containing a particular target, an entire frame, or several frames. In any case the selections do not indicate the success, quality, or PI suitability of the mission as a whole but only the camera system's maximum effort. The criteria which govern selection of suitable MIP examples are as follows:

a. The photography must be comparatively free of cloud cover and/or atmospheric interference.

b. The selected targets should be at or near frame center in order to minimize the effects of obliquity and similar distortive factors.

c. No photography affected by system malfunctions or inherent degradations can be considered for MIP selection. This eliminates the first few and last few frames of a pass, since these may contain image motion. In addition, the photography must be free of effects induced by vehicle pitch, roll, or yaw deviations from normal.

d. Solar elevation must be near optimum. Overexposed or underexposed photography is not suitable for MIP selections.

e. Preferably, good-contrast targets such as airfields are chosen for comparison with similar targets covered in previous missions.

4. <u>MIP, Missions 1017-1 and 1017-2</u>: Based on the foregoing criteria, frame 9 of pass 30D, FWD, and frame 106 of pass 136D, AFT, are selected as the MIP examples for Missions 1017-1 and 1017-2, respectively. The targets within those frames that exemplify the MIP rating of 85 awarded to both phases of the mission are an airfield (Mission 1017-1) and a built-up culture area (Mission 1017-2). Examination of the overall quality of the photography acquired by both panoramic cameras indicates that the slave (AFT) camera produced slightly better imagery, on the whole.

[redacted]

APPENDIX A. SYSTEM SPECIFICATIONS

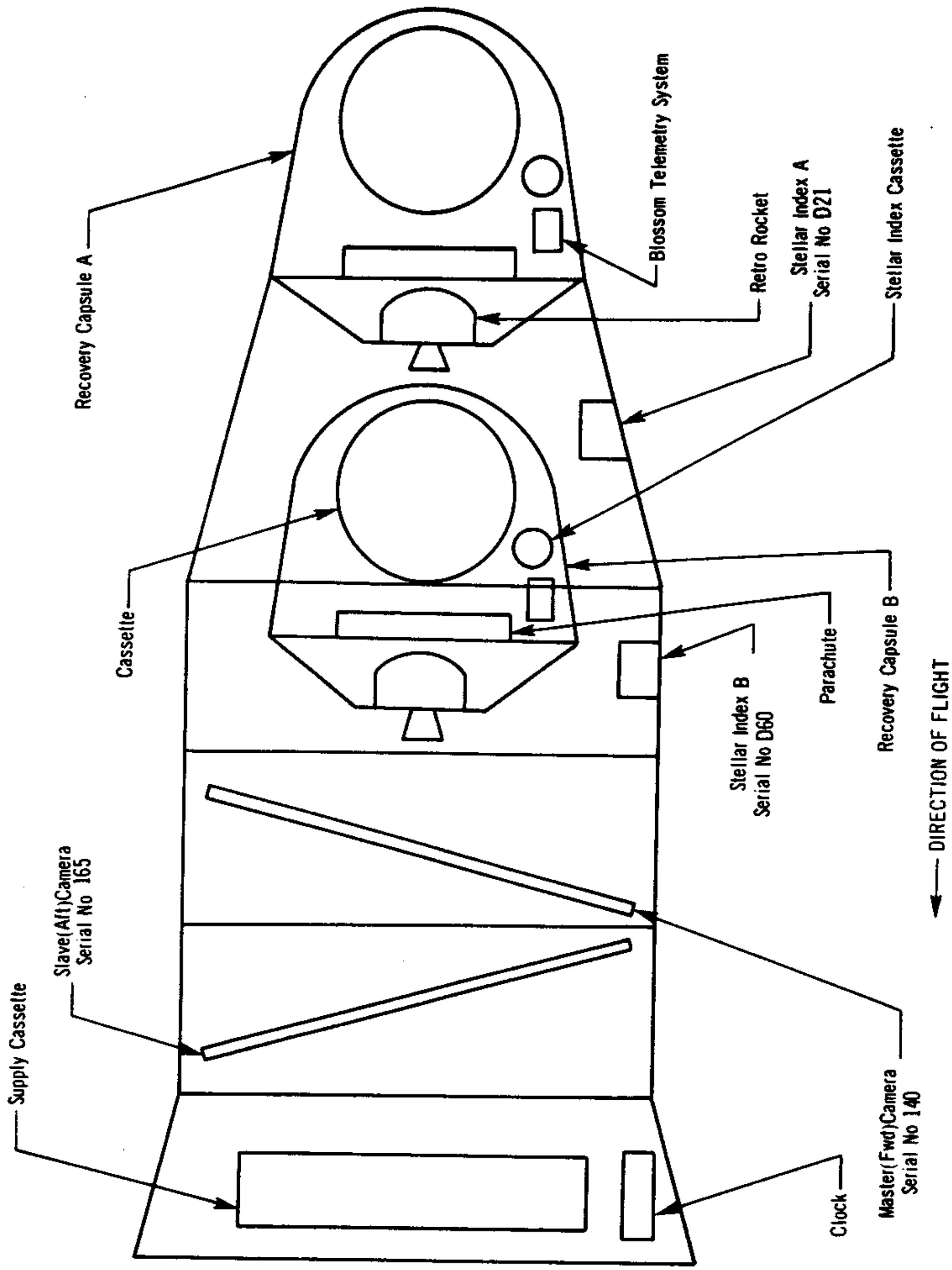
Cameras

	Master (FWD) Panoramic	Master Port Horizon	Master Stbd Horizon	Slave (FWD) Panoramic	Slave Port Horizon	Slave Stbd Horizon	Mission 1017-1		Mission 1017-2	
							Stellar	Index	Stellar	Index
Camera No	140	NA	NA	165	NA	NA	21	21D	60	68D
Lens Serial No	1192435	813524	812314	1432435	814026	813552	10485	811711	10554	817015
Slit Width	0.250"	NA	NA	0.175"	NA	NA	NA	NA	NA	NA
Aperture	f/3.5	f/6.8	f/8.0	f/3.5	f/6.8	f/8.0	f/1.8	f/4.5	f/1.8	f/4.5
Exposure Time	NA	1/100 sec	1/100 sec	NA	1/100 sec	1/100 sec	2.0 sec	1/500 sec	2.0 sec	1/500 sec
Filter	Wratten 25	Wratten 25	Wratten 25	Wratten 21	Wratten 25	Wratten 25	None	None	None	None
Focal Length (mm)	609.628	55.13	55.22	609.580	54.60	54.11	*	*	*	*
Film Length (ft)	16,000	NA	NA	16,000	NA	NA	*	*	*	*
Splices	5	NA	NA	4	NA	NA	None	None	None	None
Emulsion	85-51-12-4	85-51-12-4	85-51-12-4	85-51-12-4	85-51-12-4	85-51-12-4	44-30-9-4	31-4-9-4	44-30-9-4	31-4-9-4
Film Type	4404	4404	4404	4404	4404	4404	4401	4400	4401	4400
Res. Data L/mm (A)	*	12	79	*	88	104	*	*	*	*
Static										
High Contrast	237	*	*	239	*	*	*	*	*	*
Low Contrast	153	*	*	140	*	*	*	*	*	*
Dynamic										
I High Contrast	165	*	*	183	*	*	*	*	*	*
I Low Contrast	129	*	*	130	*	*	*	*	*	*
P High Contrast	171	*	*	182	*	*	*	*	*	*
P Low Contrast	120	*	*	113	*	*	*	*	*	*

NA = Not Applicable
* = Not Available
(A) = AWAR

[redacted]

[redacted]



2. VEHICLE LAYOUT

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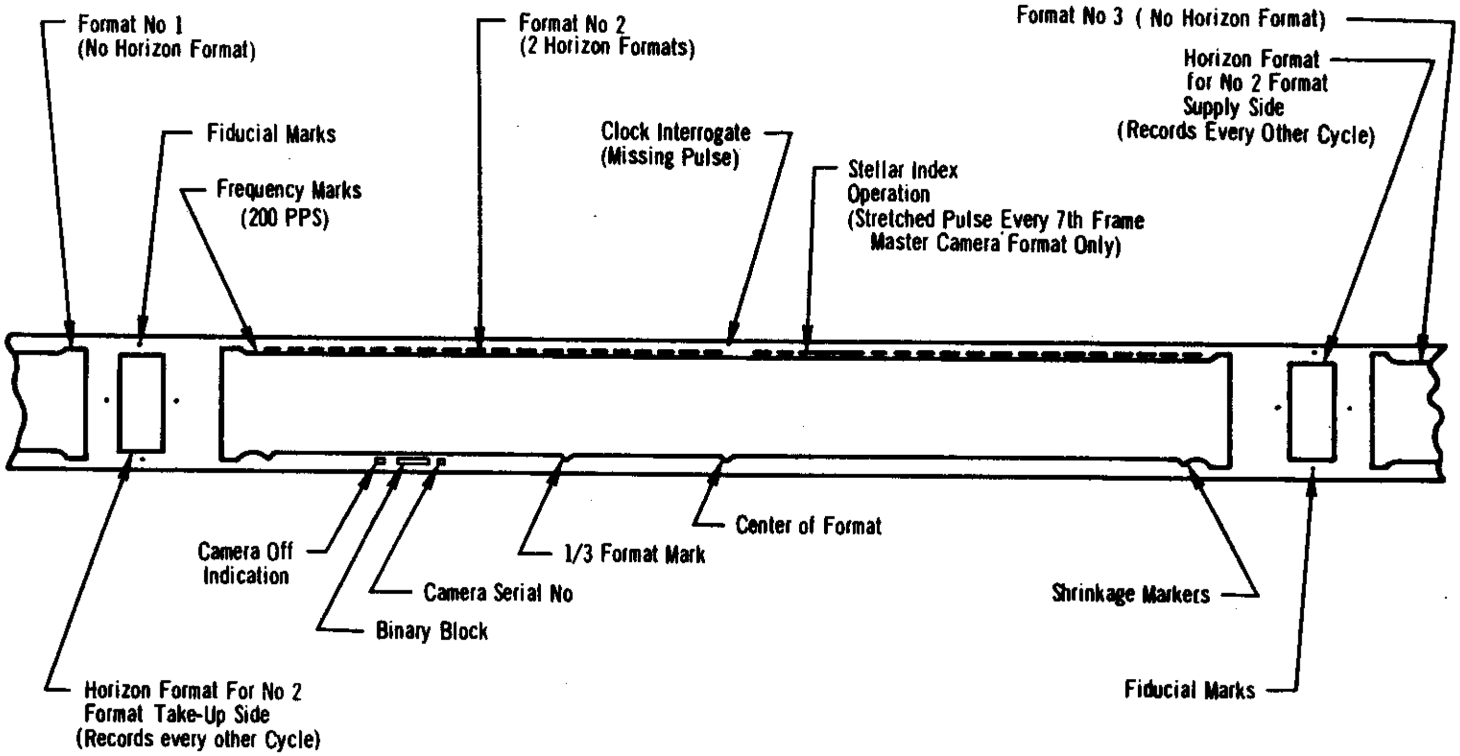
3. FILM SPECIFICATIONS
FORMAT LAYOUT



Master(Fwd)Panoramic Camera No 140
Viewed With Negative Emulsion Down
Direction of Film Transport ←
Direction of Scan →
Direction of Vehicle Motion ↓

Slave(Aft)Panoramic Camera No 165
Viewed With Negative Emulsion Down
Direction of Film Transport ←
Direction of Scan →
Direction of Vehicle Motion ↑

[redacted]

[redacted]

DEFINITION OF PANORAMIC CAMERA FORMAT CALIBRATIONS

Measurements are made with respect to collimator targets fixed with respect to the mechanical interface between the total payload assembly and the orbital vehicle.

Two sets of 3 targets each are aligned to be coplanar within $\pm$ 5 seconds of arc so positioned to form an angle of $-15.00^{\circ} \pm 5$ seconds to the mechanical interface for master camera calibrations and an angle of $+15.00^{\circ} \pm 5$ seconds to the mechanical interface for slave camera calibrations.

A. Target 1 of each set is imaged on the terrain format.

B. The second and third targets of each set are at angles of $75.00^{\circ} \pm 5$ seconds from Target 1 and are imaged on the horizon formats.

The indicated center of format for the panoramic cameras is given by the intersection of a line through the center of mass of the central shrinkage marker drawn normal to the edge of format containing the shrinkage marker and a line parallel to the same edge located at a position half-way between the format edges.

The indicated principal points of the horizon cameras are the points of intersection of lines joining opposite fiducials.

Svo and Yvo are the offsets of Target 1 from the indicated center of format of the panoramic cameras as defined in Paragraph 3.

Xs, Ys and Xt, Yt are the offsets of Targets 2 and 3 from the indicated principal points of the supply and take-up horizon cameras respectively.

The indicated flight direction is the direction of vehicle travel during orbit. The forward edge of format is the edge opposite the shrinkage markers for the master camera and is the edge containing the shrinkage markers for the slave camera.

[redacted]

Dimensions A, B, and C are the spacings of the shrinkage markers and dimensions D and E are the spacing of the Y axis fiducials. Techniques for exact measurement of these dimensions have not been developed. The figures quoted are measurements made on hand-processed film without control of shrinkage.

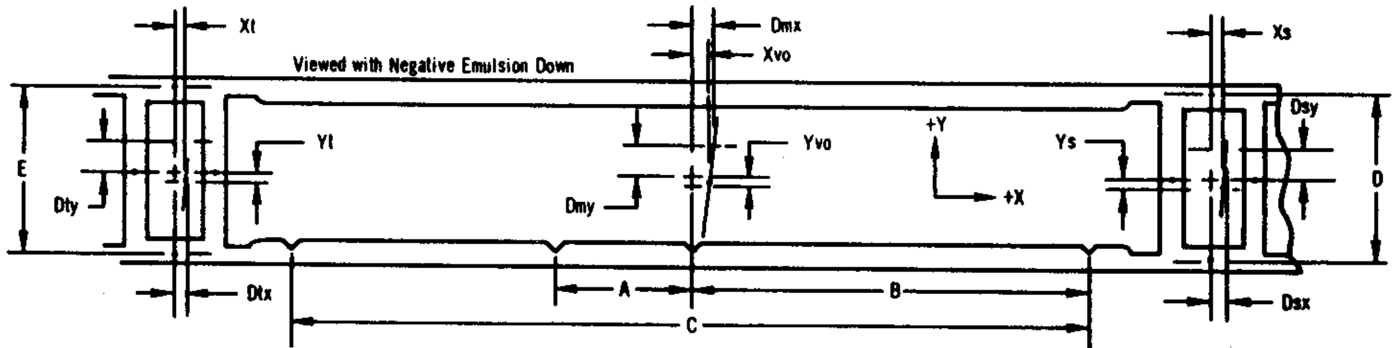
The format dimensions are measured to the best estimate of format edge.

Measurements of the angle between the indicated axis of the panoramic cameras and the line of intersection of the plane defined in Paragraph 2 on the format is obtained from the offset dimensions Dmx and Dmy of Target 1 for each camera.

Measurement of the angle between the indicated axis of the horizon cameras and the line of intersection of the plane defined in Paragraph 2 of the format is made by measuring the scan direction offset of the targets defined in Paragraph 2B at a fixed distance from the target center in the Y direction. Dimensions Dtx, Dty, Dsx, and Dsy are the offsets of these measurements.

[redacted]

5. FILM SPECIFICATIONS
FORMAT DIMENSIONS



Master (Fwd) Camera 140

		Vehicle Motion		Scan Direction	
A	76.1	Xt	-.200	Dtx	-.203
B	354.5	Yt	+.082	Dty	+2.601
C	709.4	Xs	+.144	Dsx	+.141
D	56.475	Ys	-.126	Dsy	+2.442
E	56.460	Xvo	+.740	Dmx	+.733
		Yvo	+1.082	Dmy	+4.082

Format dimensions:

	Panoramic
Height	55.968
Width	755.6

Slave (Aft) Camera 165

		Vehicle Motion		Scan Direction	
A	76.1	Xt	+.126	Dtx	-.124
B	355.2	Yt	-.178	Dty	+1.989
C	710.0	Xs	-.003	Dsx	-.016
D	56.430	Ys	+.014	Dsy	-2.205
E	56.489	Xvo	-.703	Dmx	-.704
		Yvo	+.233	Dmy	+3.233

Format dimensions:

	Panoramic
Height	56.004
Width	755.3

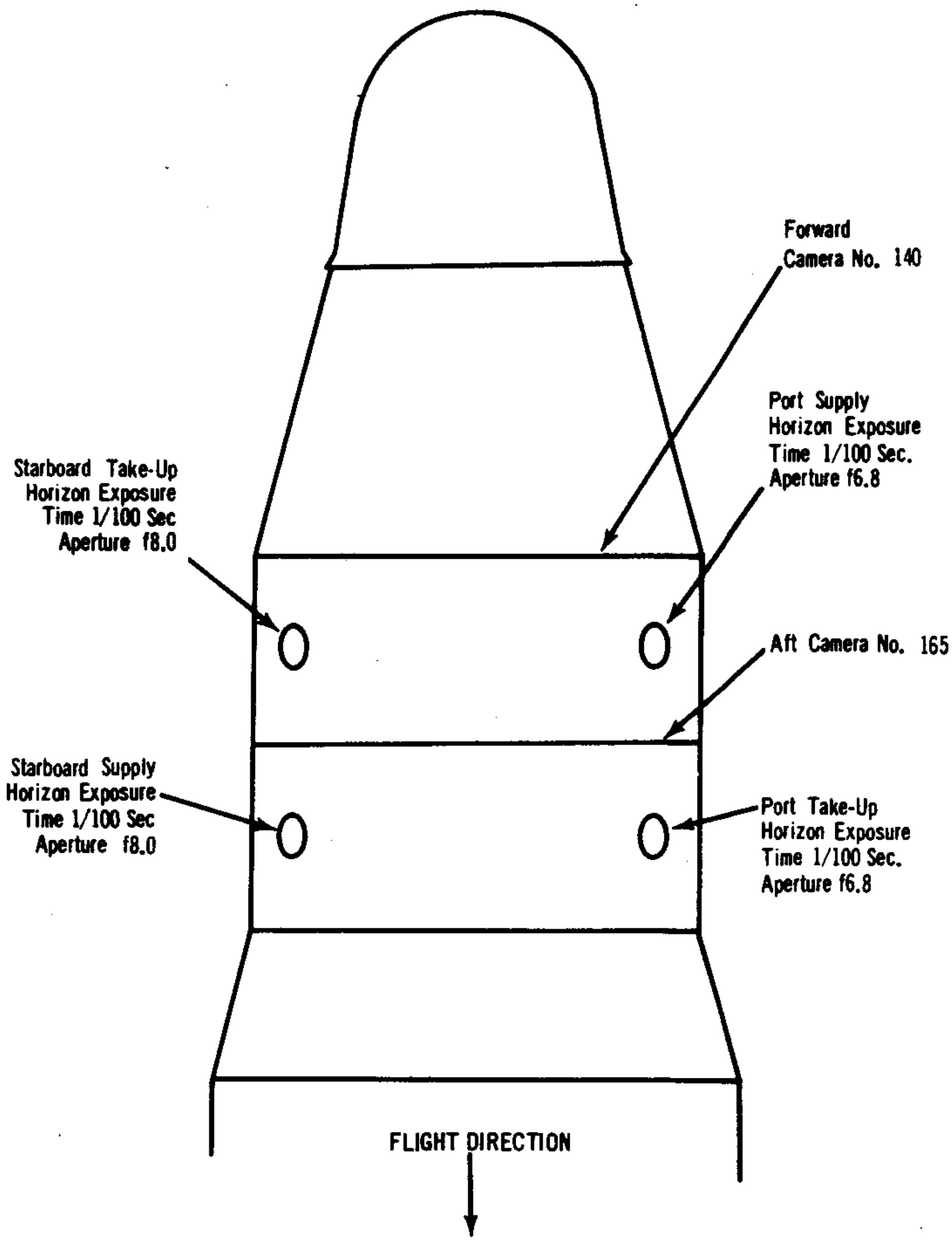
NOTE:
1. All dimensions are in millimeters and are average dimensions of three formats
2. Height of main format is taken at center of format
3. Dt, Dm, Ds, X and Y dimensions are taken 10mm above point defining target center
4. Format Sign Convention

-X+Y	+X+Y
-X-Y	+X-Y

[redacted]

[redacted]

6. HORIZON LENS SETTINGS
(Viewed from top of vehicle in flight)



[redacted]

APPENDIX B. DENSITY READINGS

The following pages contain a compilation of the stellar/index density values obtained with a Macbeth QuantaLog Densitometer, Model EP 1000, fitted with an ET 20 attachment and an 0.5mm aperture.

[redacted]

Mission 1017-1

		STELLAR CAMERA				INDEX CAMERA						
						LIMITING			Gross Fog	TERRAIN		
Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Dmax	Dmin	Delta		Dmax	Dmin	Delta
1D	1	0.64	0.19	0.45	0.18	1.22	0.19	1.03	0.08	NR	NR	NR
2D	2	NR	NR	NR	0.18	0.21	0.10	0.11	0.08	NR	NR	NR
	15	0.62	0.22	0.40	0.70	1.04	0.54	0.50	0.09	0.92	0.54	0.38
4D	16	0.38	0.22	0.16	0.21	0.72	0.24	0.48	0.08	0.72	0.24	0.48
	26	0.76	0.19	0.57	0.17	1.24	0.22	1.02	0.08	1.24	0.22	1.02
5D	27	0.22	0.18	0.04	0.17	0.68	0.21	0.47	0.08	0.62	0.25	0.37
	45	1.55	0.20	1.35	0.15	1.00	0.16	0.84	0.08	0.92	0.40	0.52
6D	46	0.29	0.18	0.11	0.16	0.62	0.27	0.35	0.09	NR	NR	NR
	66	1.42	0.21	1.21	0.18	1.34	0.49	0.85	0.08	NR	NR	NR
7D	67	0.70	0.19	0.51	0.18	0.97	0.18	0.79	0.08	0.97	0.18	0.79
	80	1.36	0.19	1.17	0.16	1.42	0.16	1.26	0.09	1.42	0.16	1.26
8D	81	0.45	0.18	0.27	0.17	0.92	0.36	0.56	0.09	0.92	0.36	0.56
	85	0.59	0.18	0.41	0.17	0.91	0.29	0.62	0.08	0.91	0.29	0.62
9AE	86	NR	NR	NR	0.18	NR	NR	NR	0.08	NR	NR	NR
9D	87	0.75	0.20	0.55	0.18	1.18	0.39	0.79	0.08	1.18	0.39	0.79
	94	0.91	0.20	0.71	0.19	1.20	0.19	1.01	0.09	NR	NR	NR
10D	95	0.98	0.22	0.76	0.19	1.71	0.22	1.49	0.08	0.49	0.22	0.27
	104	0.90	0.20	0.70	0.18	1.42	0.20	1.22	0.08	NR	NR	NR
16D	105	0.94	0.22	0.72	0.18	1.48	0.55	0.93	0.08	NR	NR	NR
	107	1.09	0.21	0.88	0.18	1.34	0.48	0.86	0.08	NR	NR	NR
20D	108	0.38	0.19	0.19	0.17	0.78	0.21	0.57	0.08	0.78	0.21	0.57
	115	0.84	0.18	0.66	0.14	1.08	0.18	0.90	0.08	NR	NR	NR
21D	116	0.21	0.18	0.03	0.14	0.42	0.16	0.26	0.08	NR	NR	NR
	130	0.87	0.18	0.69	0.16	1.09	0.25	0.84	0.08	1.09	0.25	0.84
22D	131	0.34	0.18	0.16	0.16	0.62	0.20	0.42	0.08	0.62	0.20	0.42
	146	1.59	0.19	1.40	0.15	1.34	0.28	1.06	0.08	0.61	0.28	0.33
23D	147	0.74	0.19	0.55	0.16	1.08	0.42	0.66	0.08	NR	NR	NR
	162	1.45	0.21	1.24	0.17	1.34	0.30	1.04	0.08	1.34	0.30	1.04
24D	163	0.39	0.19	0.20	0.17	0.64	0.14	0.50	0.08	0.64	0.14	0.50
	182	1.14	0.19	0.95	0.17	0.74	0.21	0.53	0.08	0.74	0.39	0.35
A25E	183	NR	NR	NR	0.17	NR	NR	NR	0.08	NR	NR	NR
25D	184	0.74	0.20	0.54	0.17	1.12	0.48	0.64	0.08	NR	NR	NR
	199	1.24	0.19	1.05	0.17	1.10	0.19	0.91	0.08	1.10	0.36	0.74
30D	200	1.08	0.23	0.85	0.18	1.29	0.30	0.99	0.08	1.29	0.30	0.99
	202	1.10	0.21	0.89	0.18	0.70	0.21	0.49	0.08	0.70	0.21	0.49
32D	203	1.14	0.24	0.90	0.18	1.19	0.18	1.01	0.08	NR	NR	NR
	205	1.18	0.24	0.94	0.18	1.24	0.22	1.02	0.08	NR	NR	NR
33D	206	0.36	0.19	0.17	0.18	0.72	0.21	0.51	0.08	0.72	0.32	0.40
	208	0.32	0.18	0.14	0.17	0.80	0.27	0.53	0.08	0.74	[illegible]	0.50
35D	209	0.28	0.18	0.10	0.17	0.52	0.19	0.33	0.08	0.52	0.19	0.33
	215	0.48	0.19	0.29	0.16	0.94	0.22	0.72	0.08	0.94	[illegible]	[illegible]

[redacted]

Mission 1017-1

Pass	Frame	Stellar Camera Dmax	Stellar Camera Dmin	Stellar Camera Delta	Stellar Camera Gross Fog	Index Camera Limiting Dmax	Index Camera Limiting Dmin	Index Camera Limiting Delta	Index Camera Gross Fog	Index Camera Terrain Dmax	Index Camera Terrain Dmin	Index Camera Terrain Delta
36D	216	0.23	0.17	0.06	0.15	0.49	0.13	0.36	0.08	0.49	0.13	0.36
	224	0.63	0.18	0.45	0.15	1.06	0.32	0.74	0.08	1.06	0.32	0.74
39D	225	0.63	0.18	0.45	0.15	1.10	0.22	0.88	0.09	0.68	0.31	0.37
	239	1.20	0.27	0.93	0.18	1.30	0.48	0.82	0.08	1.30	0.48	0.82
41D	240	0.82	0.26	0.56	0.18	0.96	0.24	0.72	0.08	0.84	0.40	0.44
	247	2.85	0.22	2.63	0.18	1.29	0.32	0.97	0.08	1.29	0.32	0.97
48D	248	0.89	0.23	0.66	0.20	1.31	0.17	1.14	0.08	NR	NR	NR
	249	0.82	0.22	0.60	0.18	1.02	0.19	0.83	0.08	NR	NR	NR
50D	250	0.36	0.20	0.16	0.17	0.68	0.28	0.40	0.08	0.68	0.28	0.40
	257	0.68	0.21	0.47	0.18	0.80	0.38	0.42	0.08	0.80	0.38	0.42
52D	258	0.35	0.20	0.15	0.17	0.72	0.20	0.52	0.08	0.66	0.30	0.36
	276	1.05	0.19	0.86	0.15	1.02	0.24	0.78	0.08	1.02	0.32	0.70
54D	277	0.34	0.18	0.16	0.16	0.72	0.28	0.44	0.08	0.64	0.30	0.34
	300	1.39	0.23	1.16	0.16	1.43	0.29	1.14	0.08	0.82	0.29	0.53
55D	301	0.29	0.18	0.11	0.17	0.60	0.10	0.50	0.08	NR	NR	NR
	313	0.98	0.21	0.76	0.18	1.31	0.32	0.99	0.08	NR	NR	NR
56D	314	0.58	0.22	0.36	0.18	1.00	0.30	0.70	0.09	1.00	0.30	0.70
	324	1.01	0.25	0.76	0.18	1.13	0.56	0.57	0.09	0.90	0.68	0.22
63D	325	1.39	0.29	1.10	0.19	0.80	0.26	0.54	0.09	0.80	0.26	0.54
	327	1.22	0.21	1.01	0.16	0.72	0.22	0.50	0.09	0.72	0.22	0.50
67D	328	0.34	0.19	0.15	0.16	0.62	0.22	0.40	0.09	0.62	0.22	0.40
	332	0.50	0.18	0.32	0.16	0.83	0.26	0.57	0.09	0.63	0.26	0.37
68D	333	0.78	0.20	0.58	0.16	0.90	0.37	0.53	0.09	0.90	0.37	0.53
	334	0.85	0.21	0.64	0.17	1.10	0.28	0.82	0.09	1.10	0.28	0.82
70D	335	0.92	0.21	0.71	0.16	1.12	0.35	0.77	0.09	1.12	0.35	0.77
	366	0.88	0.19	0.69	0.18	1.08	0.35	0.73	0.09	0.84	0.53	0.31
71D	367	0.27	0.18	0.09	0.16	0.62	0.11	0.51	0.09	0.55	0.22	0.33
	386	0.81	0.20	0.61	0.16	1.22	0.40	0.82	0.09	1.22	0.40	0.82
72D	387	0.58	0.18	0.40	0.15	0.92	0.28	0.64	0.09	0.92	0.28	0.64
	405	1.08	0.22	0.86	0.16	1.32	0.18	1.14	0.09	1.01	0.66	0.35
78D	406	1.00	0.22	0.78	0.16	1.22	0.40	0.82	0.09	0.98	0.40	0.58
	408	1.02	0.21	0.81	0.16	1.28	0.38	0.90	0.09	NR	NR	NR
81D	409	NR	NR	NR	0.16	NR	NR	NR	0.09	NR	NR	NR
	420	0.71	0.19	0.52	0.16	0.93	0.40	0.53	0.09	0.70	0.54	0.16

NR - Denotes No Reading Made

Dmax Range 0.21-2.85
Dmin Range 0.17-0.27
Gross Fog Range 0.14-0.21

Average Dmax 0.81
Average Dmin 0.21
Average Gross Fog 0.17

NR - Denotes No Reading Made

Terrain Dmax Range 0.49-1.42
Terrain Dmin Range 0.13-0.68
Average Terrain Dmax 0.83
Average Terrain Dmin 0.31

Limiting Dmax Range 0.21-1.71
Limiting Dmin Range 0.10-0.56
Average Limiting Dmax 0.99
Average Limiting Dmin 0.27

Gross Fog Range 0.08-0.09
Average Gross Fog 0.08

[redacted]

Mission 1017-2

STELLAR CAMERA

Frame	Dmax	Dmin	Delta	Gross Fog	Frame	Dmax	Dmin	Delta	Gross Fog
1	3.62	1.22	2.40	0.20	23	3.30	0.89	2.41	0.20
2	3.54	1.12	2.42	0.19	24	3.35	1.30	2.05	0.22
3	3.42	0.89	2.53	0.19	25	3.17	0.82	2.35	0.48
4	3.40	0.91	2.49	0.20	26	3.24	0.95	2.29	0.42
5	3.30	0.92	2.38	0.25	27	3.12	0.74	2.38	0.24
6	3.50	1.24	2.26	0.21	28	3.10	0.70	2.40	0.24
7	3.53	1.28	2.25	0.20	29	3.28	0.79	2.49	0.26
8	3.47	1.23	2.24	0.21	30	3.22	0.43	2.79	0.23
9	3.40	0.74	2.66	0.24	31	3.24	0.49	2.75	0.24
10	3.40	0.82	2.58	0.20	32	3.20	0.58	2.62	0.25
11	3.43	0.96	2.47	0.19	33	3.21	0.58	2.63	0.27
12	3.38	0.98	2.40	0.20	34	3.18	0.58	2.60	0.25
13	3.46	1.11	2.35	0.22	35	3.30	1.01	2.29	0.26
14	3.48	1.01	2.47	0.20	36	3.32	0.92	2.40	0.22
15	3.42	0.79	2.63	0.20	37	3.23	0.64	2.59	0.21
16	3.45	1.02	2.43	0.20	38	3.28	0.54	2.74	0.20
17	3.50	0.91	2.59	0.21	39	3.34	0.84	2.50	0.23
18	3.35	0.59	2.76	0.20	40	3.22	1.07	2.15	0.25
19	3.49	1.02	2.47	0.20	41	3.34	0.91	2.43	0.24
20	3.42	1.04	2.38	0.20	42	NR	NR	NR	0.24
21	3.51	1.47	2.04	0.22	43	3.40	1.40	2.00	0.22
22	3.47	1.42	2.05	0.19	44	3.42	1.15	2.27	0.24

Dmax Range 3.10-3.62
Dmin Range 0.43-1.30
Gross Fog Range 0.19-0.48

Average Dmax 3.38
Average Dmin 0.93
Average Gross Fog 0.23

NR - Denotes No Reading Made

Note: The unusually high density values recorded in Item 3 are the result of multiple exposures caused by a possible solenoid malfunction in the Stellar/Index unit (refer to Part I, Item 6).

[redacted]

4. Index Camera No D68 (Mission 1017-2): Due to the possible solenoid malfunction in the Stellar/Index unit, no density readings were made. Of the 29 frames generated in Mission 1017-2, the majority are degraded by multiple exposures.

[redacted]

APPENDIX C. MICRODENSITOMETRY

1. Edge Spread Function: The technique of obtaining the spread function from microdensitometer edge traces is used as an objective measure of the image quality in mission photography. The spread function curve represents a summation of the separate elements of the photographic system. By taking the Fourier Transform of the spread function the modulation transfer function of the system may be obtained.

To satisfy the desire to express image quality in terms of a value, a single number is determined from the spread function curve by measuring its width at 50% amplitude. This width is expressed as a micron distance in image space and may be converted to a distance on the ground. On domestic passes, where 3-bar resolution targets have been available the ground distance determined from edge trace analysis and from the targets has been found to be comparable.

The microdensitometric analysis of edges in the image requires that the object edge fulfill the conditions of a unit step function, i.e., exist for an appreciable distance at a fixed brightness level and change abruptly to a new level which exists for an appreciable distance. This requirement is usually achieved by rooftops of buildings in large-scale photography and aircraft runways or taxiways in small-scale photography.

The mission is examined to determine the MIP frame (Mission Information Potential) which is a subjective selection of the best photography. Straight edges in this imagery meeting the criteria of a step function for a length of at least 120 microns are selected for scanning with the microdensitometer.

The microdensitometer used is a Joyce-Lobel Double Beam Model III CS. It is used with an effective slit of 1 micron by 75 microns. The recording table and specimen table are directly linked with a 1000:1 ratio arm. The speed of the scan is proportional to the rate of pen deflection (as the pen deflection rate increases the speed is decreased giving the pen time to reach its maximum response). The trace thus produced represents a plot of deflection versus distance. The deflection of the pen is essentially linear with density.

Several computer programs that have as output both the spread function and MTF are currently being investigated. The best features of each will be incorporated into a program for the UNIVAC 490. In the interim, the data reduction is done manually.

The microdensitometer plots, which exhibit the steeper density gradients and fall on the straight-line portion of the H & D curve for the material, are traced and smoothed. They are then digitized in a comparator into values of distance (X) and deflection (Y). Since the instrument response is linear with density, it is also linear with exposure on the straight-line portion of the applicable D Log E curve. The values of Y are converted to Log E and the antilog taken to obtain values of relative exposure. The difference between adjacent values of E is divided by the corresponding difference of the measured values of X to produce the slope values (dE/dX) of the original object reflectance distribution. Finally, 50% of the maximum slope is computed, and the distance between the 50% slope values is determined by interpolation. The Line Spread Function (LSF) may also be plotted (slope versus distance) and the 50% amplitude width measured for verification of the calculated value.

The following table shows the 50% amplitude width of the Line Spread Functions determined from the enclosed microdensitometric edge traces made on the original negative. The lines per millimeters is determined by taking the reciprocal of the 50% amplitude width LSF and converting to mm.

[redacted]

SUMMARY TABLE OF EDGE TRACES

Trace Number	Line Spread Function width at 50% amplitude	Reciprocal of LSF width at 50% amplitude
1	14.5 microns	69 L/mm
2	15.3 microns	65 L/mm
3	14.2 microns	71 L/mm
4	11.5 microns	87 L/mm
5	19.6 microns	51 L/mm
6	13.1 microns	76 L/mm