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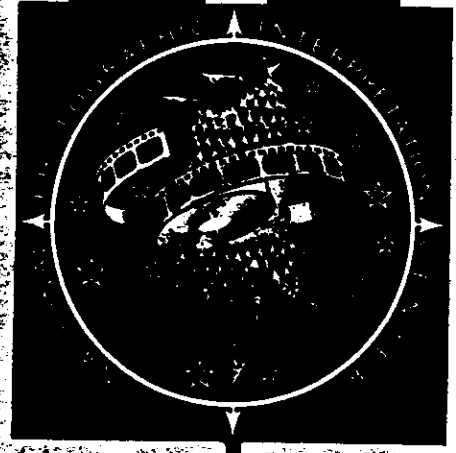
TECHNICAL PUBLICATION



PHOTOGRAPHIC EVALUATION REPORT MISSION 1016-1 15-20 JANUARY 1965 MISSION 1016-2 21-25 JANUARY 1965

[redacted]

SEPTEMBER 1965

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69 PAGES

This document contains information referring to Project Corona

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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT
MISSION 1016-1
15 - 20 JANUARY 1965
MISSION 1016-2
21 - 25 JANUARY 1965

SEPTEMBER 1965

NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

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SYNOPSIS

Mission 1016 (System J-18) was a 2-part satellite reconnaissance mission launched on 15 January 1965 at 2100Z. Photographic coverage was accomplished on 78 passes between 15 and 25 January 1965. All cameras and associated equipment functioned properly. Most stellar frames contain streaked and elongated stellar images. This anomaly caused some difficulty in attitude determination, resulting in some man-hour loss and inaccuracies.

The recovery capsule from Mission 1016-1 was retrieved by air catch during revolution 81. The cameras were reactivated during the same revolution and continued to function properly throughout Mission 1016-2. The second recovery capsule was retrieved by an air catch during revolution 159. The overall density of the stellar photography from Mission 1016-2 appeared heavier than normal and the smeared stellar images were again prevalent. The quality of the film from both index cameras was good. The panoramic cameras also produced good-quality photography and were assigned an MTF rating of 85. Clouds covered approximately 40 percent of the mission.

GENERAL FLIGHT DATA

Date of Launch: 15 January 1965

Actual Orbital Parameters

	Revolution 10	Revolution 110
Period	90.643 min	90.523 min
Perigee	98.721 nm	100.6 nm
Perigee Latitude	26.559°N	43.4°N
Apogee	235.69 nm	233.4 nm
Eccentricity	0.01898	0.01841
Inclination Angle	74.942°N	74.94°N

Recovery:

Mission 1016-1: 20 January 1965/2357Z
Mission 1016-2: 25 January 1965/2131Z

[redacted]

PART 1. CAMERA OPERATIONS

1. Master (FWD) Panoramic Camera No 132:

The master panoramic camera was operational throughout the mission. The film supply was exhausted during pass 156D and the last frame (16) is a partial frame. The film from the master camera is relatively free of camera-induced degradations throughout both parts of the mission. Brief descriptions of minor degradations which occurred during the mission follow:

a. A light struck area is present at the take-up end of the next-to-last frame in most passes. This area is similar to that present in the last several missions of this series.

b. The sixth-from-end frame on passes 25D through 79D contains a bar-shaped area of fog, extending edge to edge near the center of the format. Fog, associated with the film transport, including equipment shadowgraphs is present on the first and last frames of most passes. A faint band of fog extending from the camera number edge of the film is observed on passes 88AE, 115D, 116D, 118D, 120D, 126D, 131D, 132D, 134D, 140D, 142D, 147D, 149D, and 156D.

c. An intermittent minus density streak is present adjacent to the camera number edge of the format on passes 131D, 132D, 134D, 135D, 140D, 148D, 149D, 150D, and 156D.

d. Some highly reflective images are smeared on the material due to reflections within the camera. A good example of this smearing can be found on pass 57D, frame 39.

e. Plus density spots occur each 3.12 inches along the camera number edge of the film on the first 17 frames of pass 83D. These spots begin 0.56 inch from the film edge and disappear at the edge on frame 17.

f. Plus density bands are present at the start of scan on several passes. These are easily observed in thin density areas such as over water.

g. A small scratch appears just inside the format area under the camera number and just outside the format on the edge opposite the camera number. These scratches are roughly parallel to the format edges and occur on each frame of photography from the master camera. Numerous fine, short scratches are present across the format under the camera number and adjacent to the take-up end bonus area. These 2 areas of small scratches combined constitute approximately 2.0 square inches on each frame.

2. Slave (AFT) Panoramic Camera No 133:

The slave panoramic camera was operational throughout the mission. The film supply was exhausted during pass 158D and the last frame (13) is a partial frame. The film from the slave camera is relatively free of camera-induced degradations throughout both parts of this mission. Brief descriptions of minor degradations or malfunctions which occur during the mission follow:

a. A light struck area is present at the take-up end of the third frame from the end and/or the supply end of the fourth frame from the end of most passes. This area is similar to that present in the last several missions of this series. The third frame from the end of most passes contains a bar-shaped area of fog, extending edge to edge of the film in the vicinity of the binary word.

b. Scratches similar to those described on the master camera film were also present on the material from the slave camera.

c. Smearing of highly reflective images, as reported on the master material, is also present on the slave material. A good example of this smearing can be found on pass 6D, frame 152.

d. Minus density streaks which follow the path of the field flattener, are present intermittently on passes 2D, 20D, 32D, 34D, 39D, 40D, and 61D. The majority of these occur near the camera number edge of the formats.

e. Very fine (hair-like) emulsion cracks, possibly due to film mistracking, occur intermittently along the camera number edge of the film on the first 16 photographic passes.

[redacted]

3. Horizon Cameras:

All horizon cameras were operational throughout the mission. The overall photographic quality is good. The starboard looking frames of photographic passes that begin in the northernmost latitudes were underexposed on approximately the first 20 frames. Examples of these underexposures are on passes 39D, 40D, 117D, 118D, and 149D. Density varied according to the solar elevation.

4. Stellar Camera No D55 (Mission 1016-1):

The stellar camera was operational throughout the mission. There are 411 titled frames of photography. A total of 37 star images in the field were used during this mission for attitude determination. Most stellar frames contain streaked and elongated images, which appear dumbell shaped. This degradation caused some difficulty in attitude determination. Stellar reduction did not agree as well as usual with the horizon camera attitude results. The image distortions may be partially attributed to a shutter blade hesitation anomaly. Flare effects approximately 55 percent of each format.

5. Stellar Camera No D59 (Mission 1016-2):

The stellar camera was operational throughout the mission. There are 433 titled frames of photography. As in the first part of Mission 1016 a total of 37 star images in the star field were used for attitude determination. A possible shutter anomaly (blade hesitation) resulted in overexposure of all frames. This added to the difficulty experienced in attitude determination in Mission 1016-1. The correlation fiducial is slightly bloomed at each exposure. Flare patterns appear to be less than usual, possibly due to the density of the photography minimizing the effects of the flare.

6. Index Camera No D55 (Mission 1016-1):

The index camera was operational throughout the mission. The photographic quality is good. There are 411 titled frames of photography.

7. Index Camera No D59 (Mission 1016-2):

The index camera was operational throughout the mission. The photographic quality is good. There are 433 titled frames of photography.

8. Associated Equipment:

This equipment records the technical information required for correlation and mensuration of film from the primary cameras.

Anomalies which occurred on this mission include:

The camera-off indicator was imaged twice on the last frame of each slave camera operation. At times one of these indicators is imaged in the binary word. The slave panoramic camera number and binary index lamp did not appear on the last frame of camera operations except passes 30D, 71D, and 100D. The binary lamps appeared faint throughout the mission. This presented machine difficulties resulting in delays of the binary word readout. Horizon camera fiducial lamps appeared faint or were non-existent on most of the last frames of camera operations that had corresponding horizon camera formats.

[redacted]

PART II. FILM

1. Film Footage

The film footage/frames processed from each of the cameras employed in Mission 1016 are as follows:

	1016-1	1016-2
Master (FWD) Camera	7,950 ft/2,879 frames	7,977 ft/3,020 frames
Slave (AFT) Camera	7,887 ft/2,865 frames	8,005 ft/3,022 frames
Stellar Camera	63 ft/ 411 frames	43 ft/ 433 frames
Index Camera	91 ft/ 411 frames	97 ft/ 433 frames

2. Film Processing

This section provides an evaluation of exposure, processing, and densities of the original negatives from the 10 cameras used in Mission 1016.

a. The exposure was good throughout the mission.

b. Infrared detection densitometry was employed to determine the optimum levels of development for the various portions of the mission. The number of development level changes during the mission were as follows:

	1016-1	1016-2
Master Camera Material	39	36
Slave Camera Material	29	38

The following percentages were processed at the 3 possible levels:

	1016-1		1016-2	
Level of Development	Master	Slave	Master	Slave
Primary	1%	0%	0%	1%
Intermediate	41%	26%	31%	27%
Full	58%	74%	69%	72%

c. The average density of this mission is good and comparable to recent missions in this series. The overall density of the stellar material on Mission 1016-2 appears to be slightly heavier than normal.

3. Film Processing Curves

The following processing curves are a product of the processing contractor.

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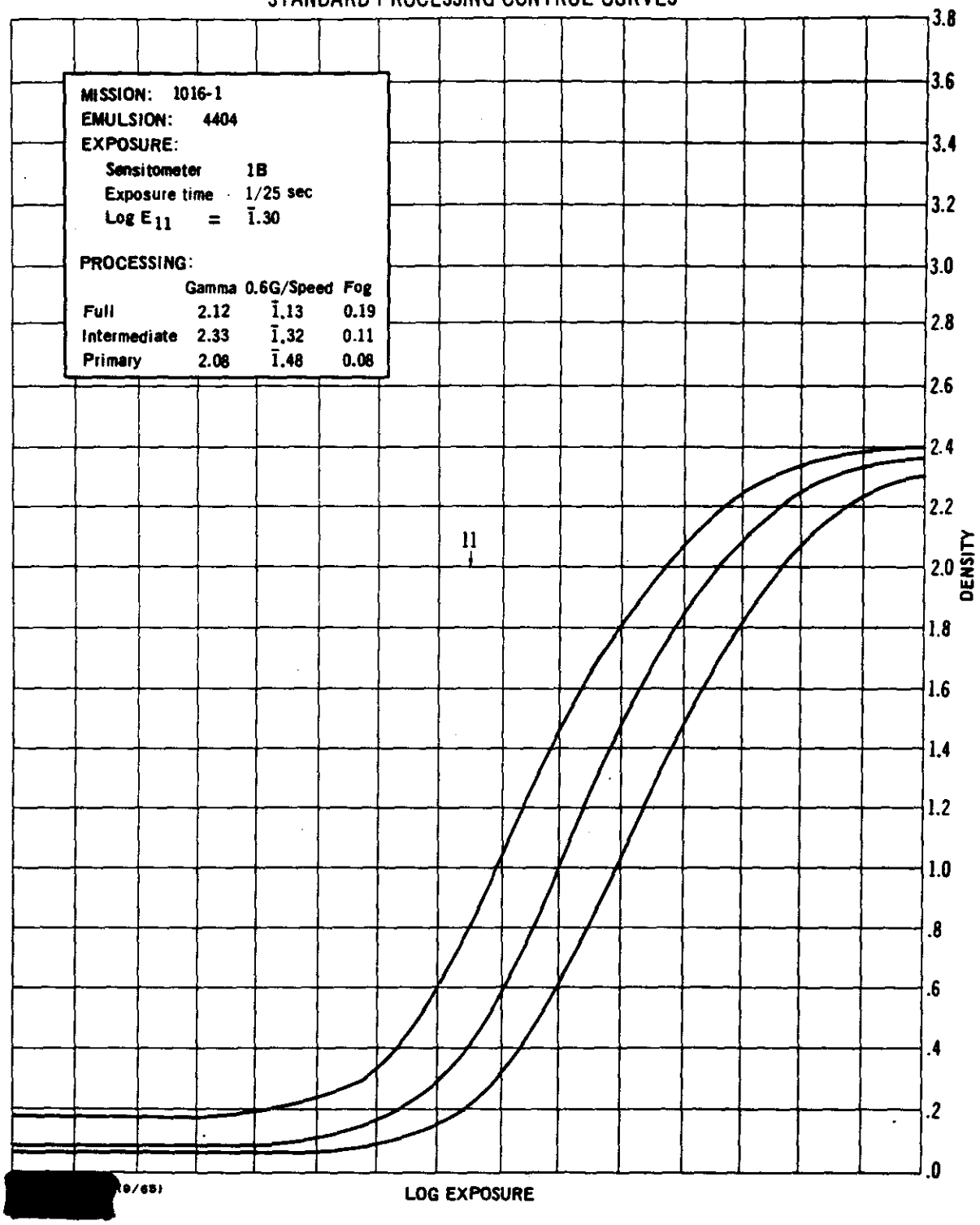
STANDARD PROCESSING CONTROL CURVES



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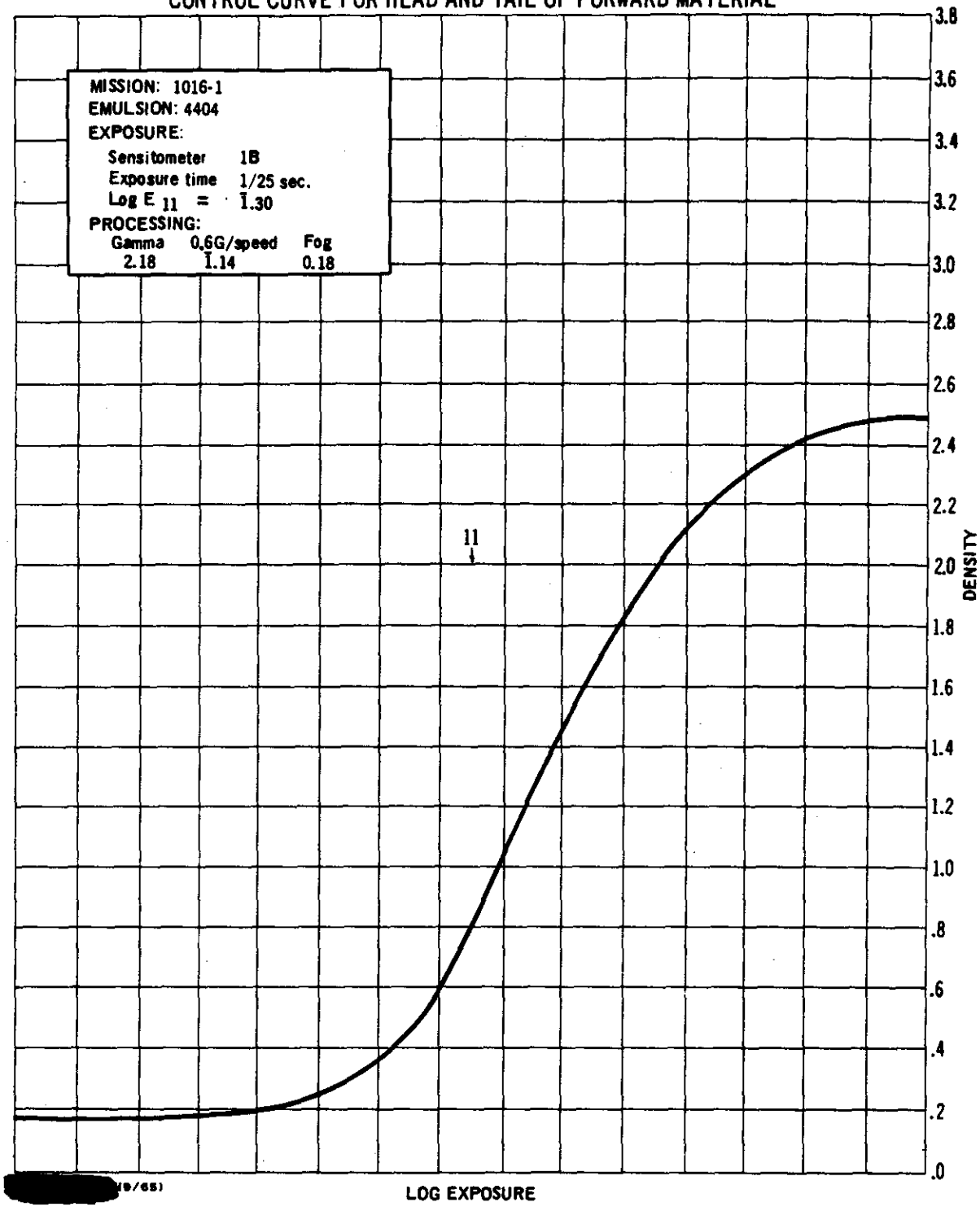

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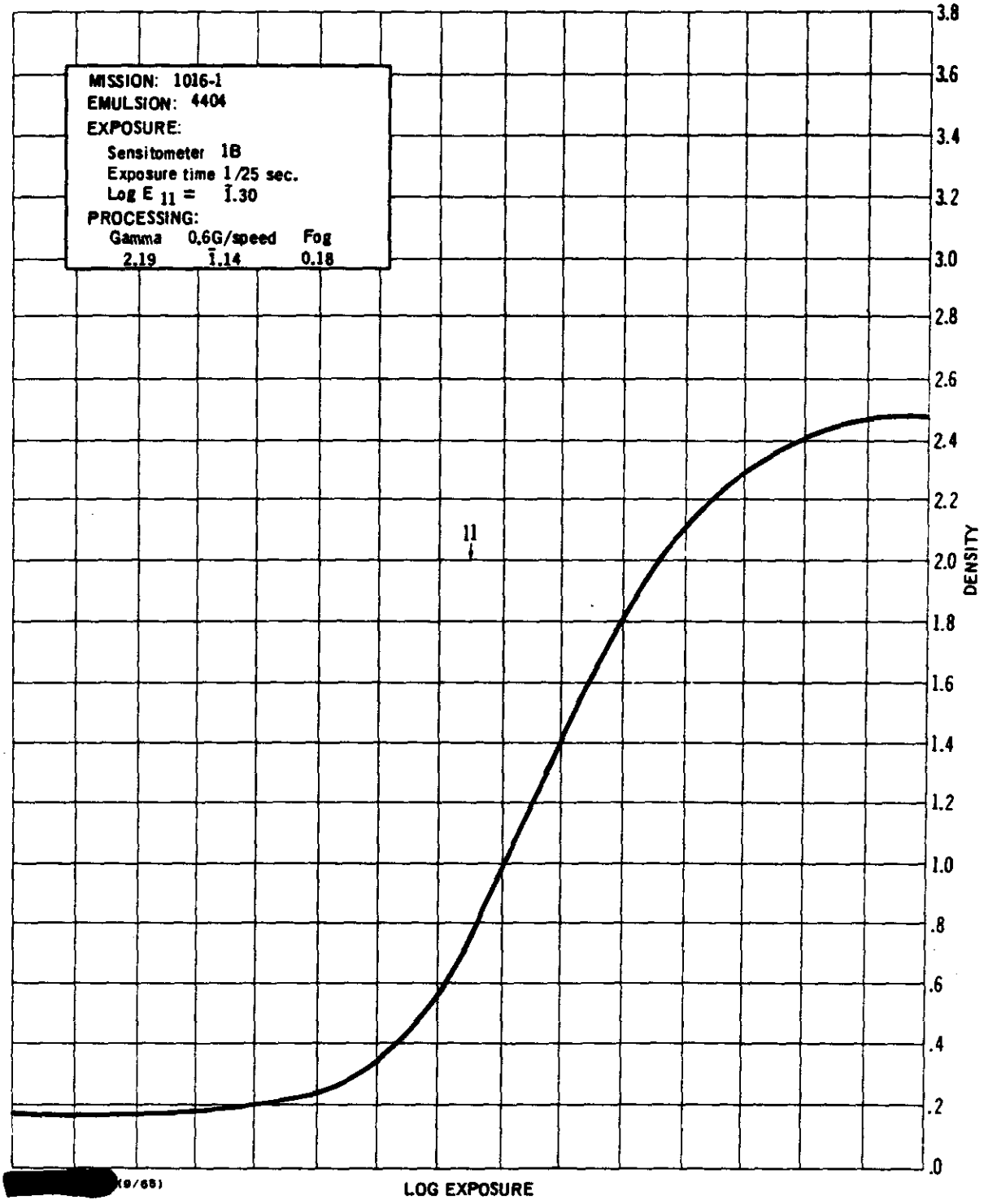

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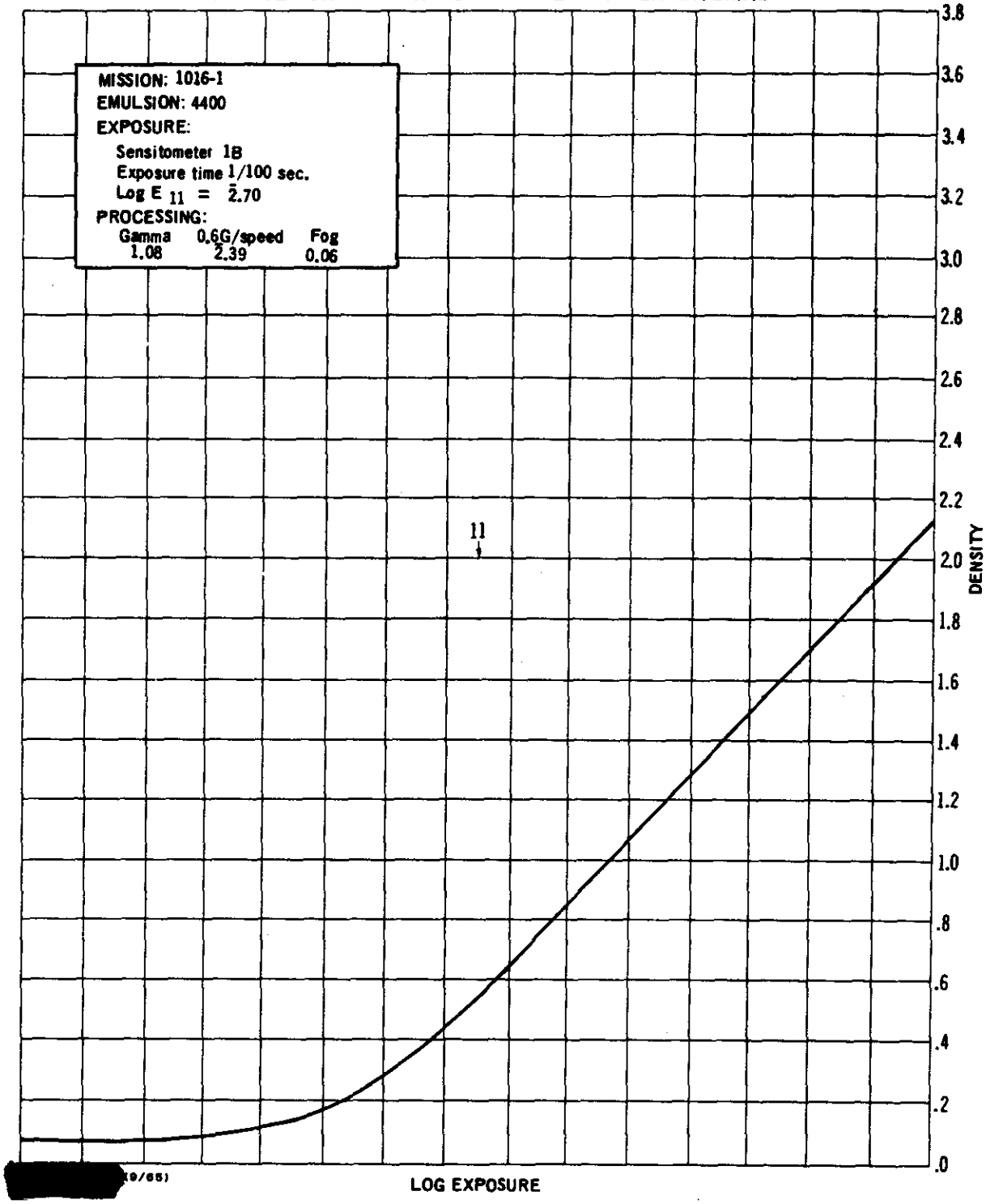

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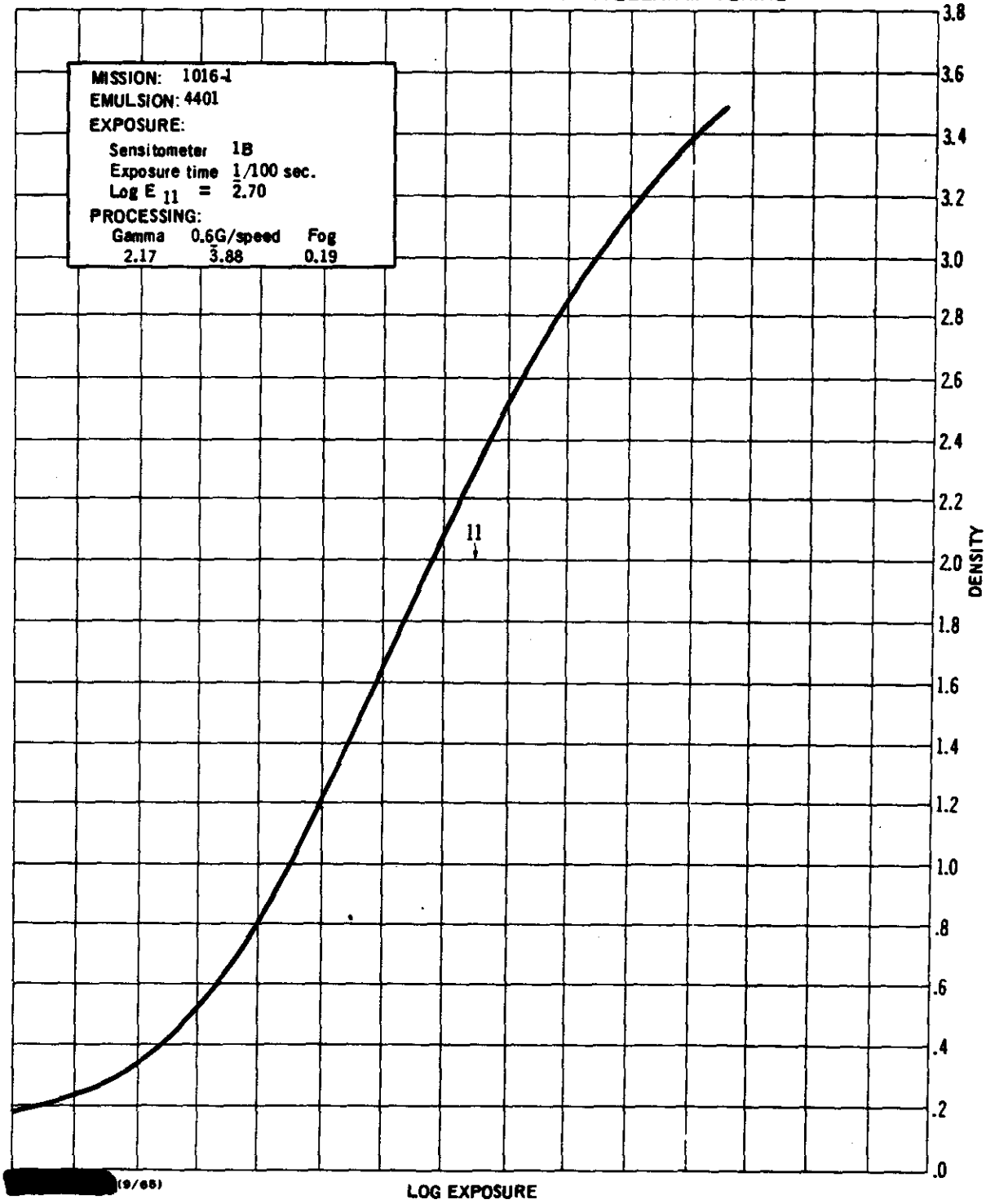

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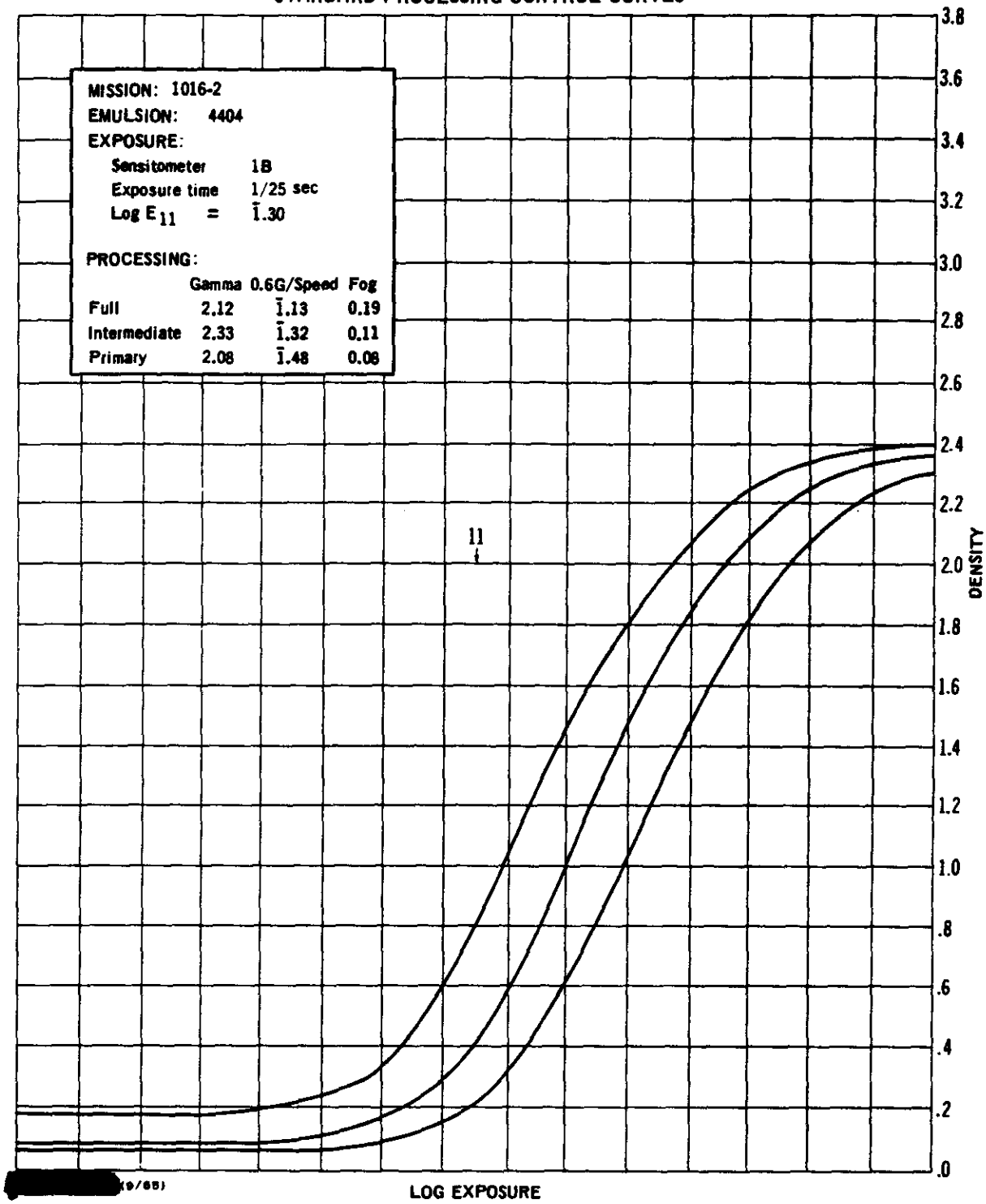

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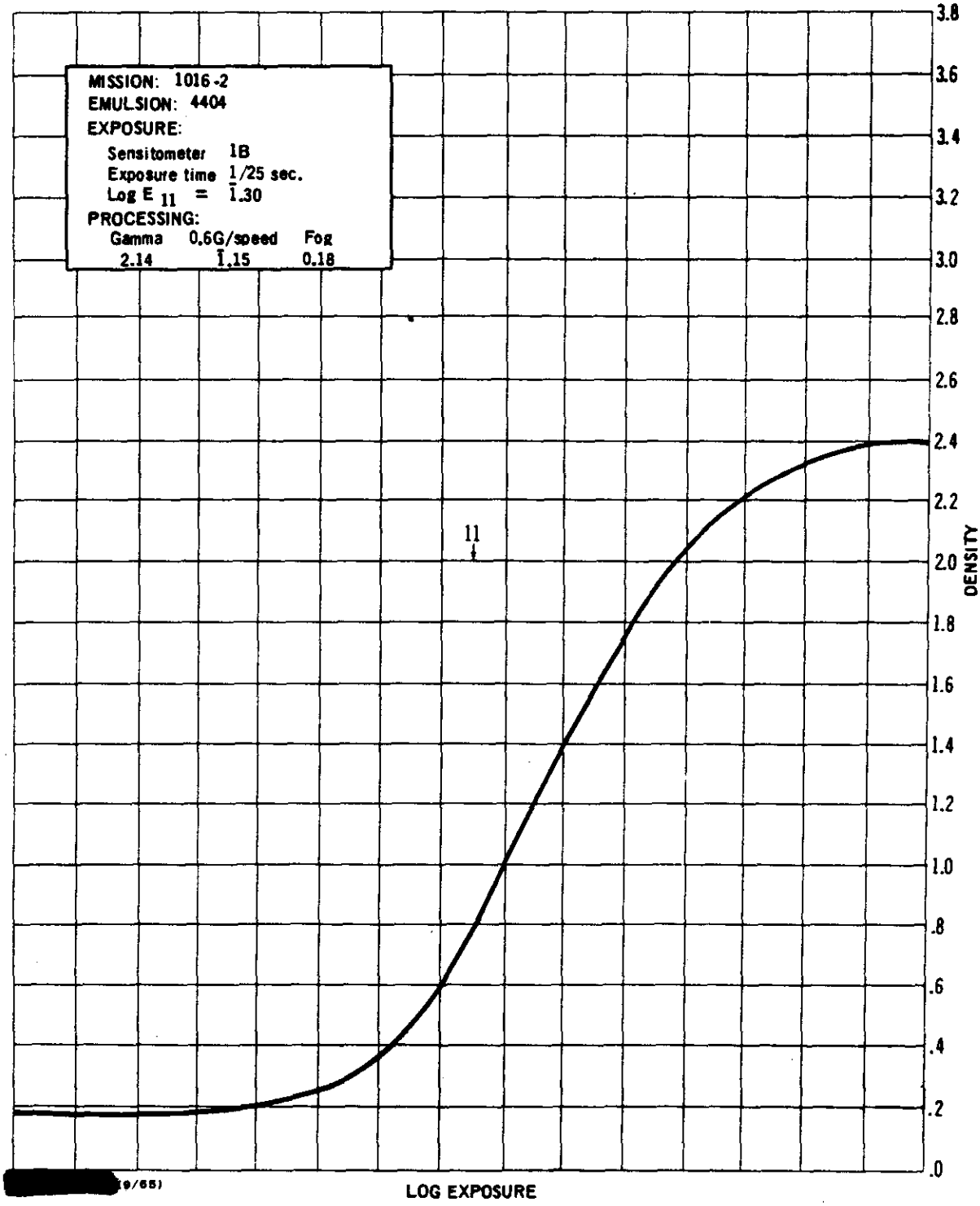

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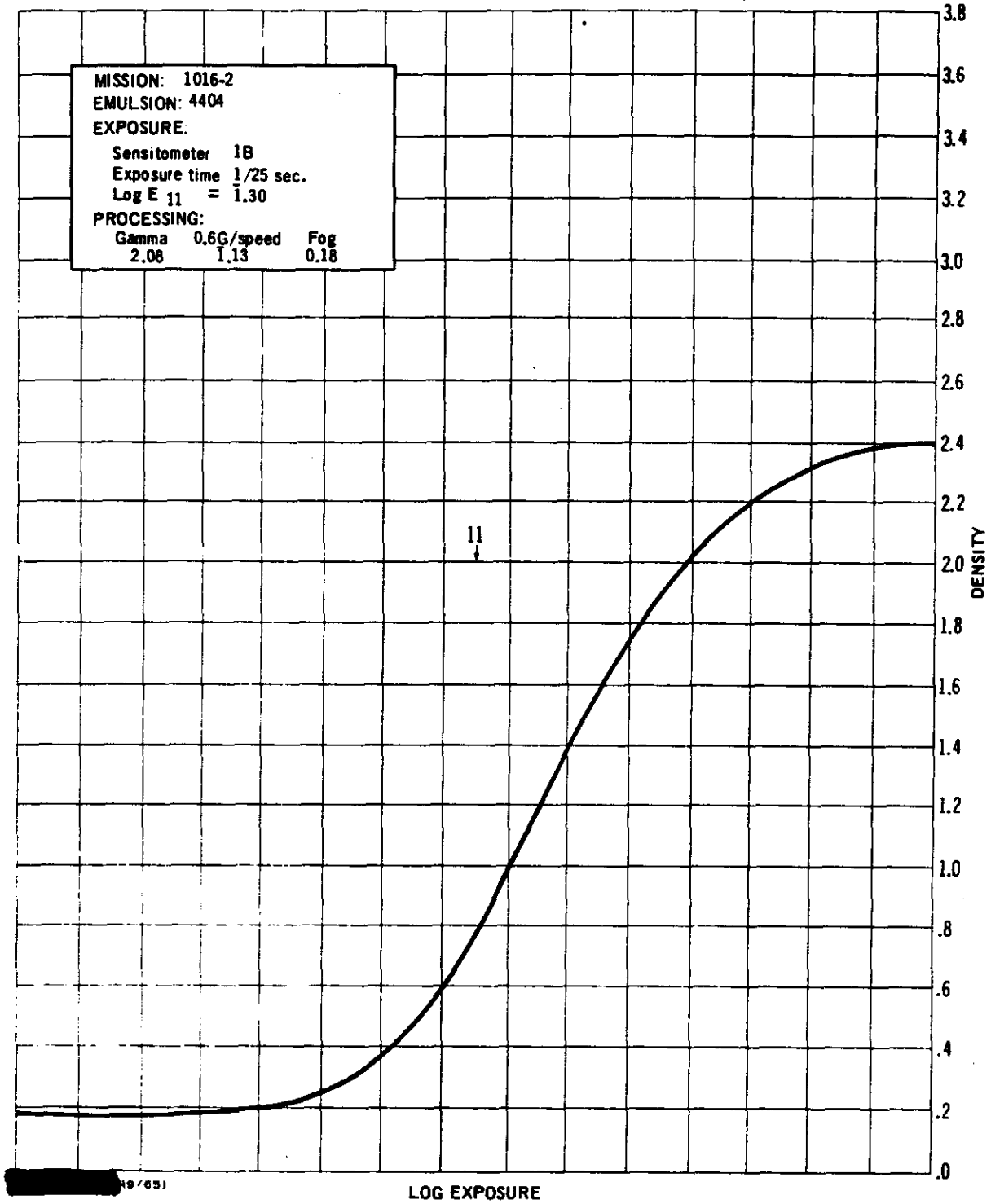

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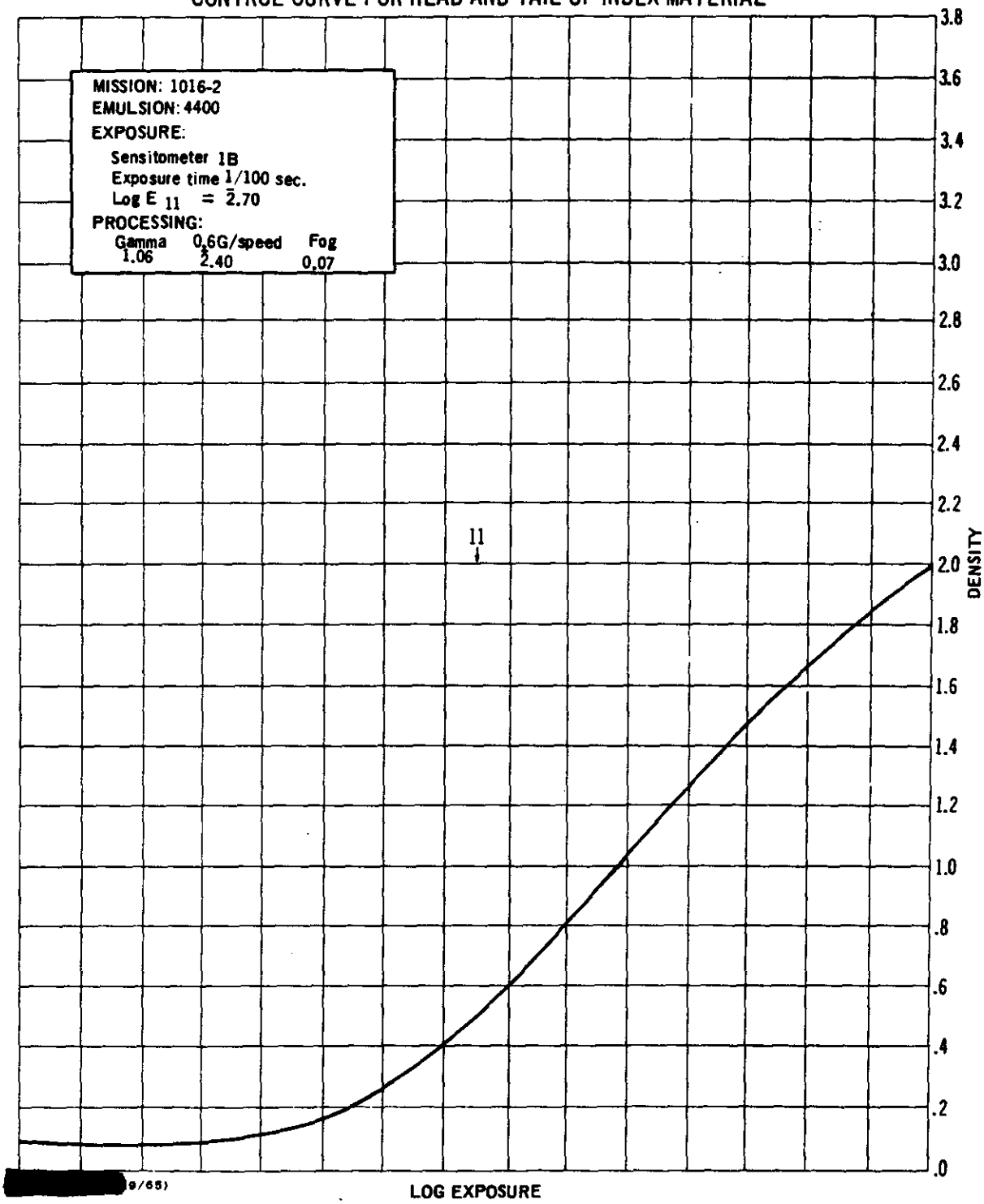

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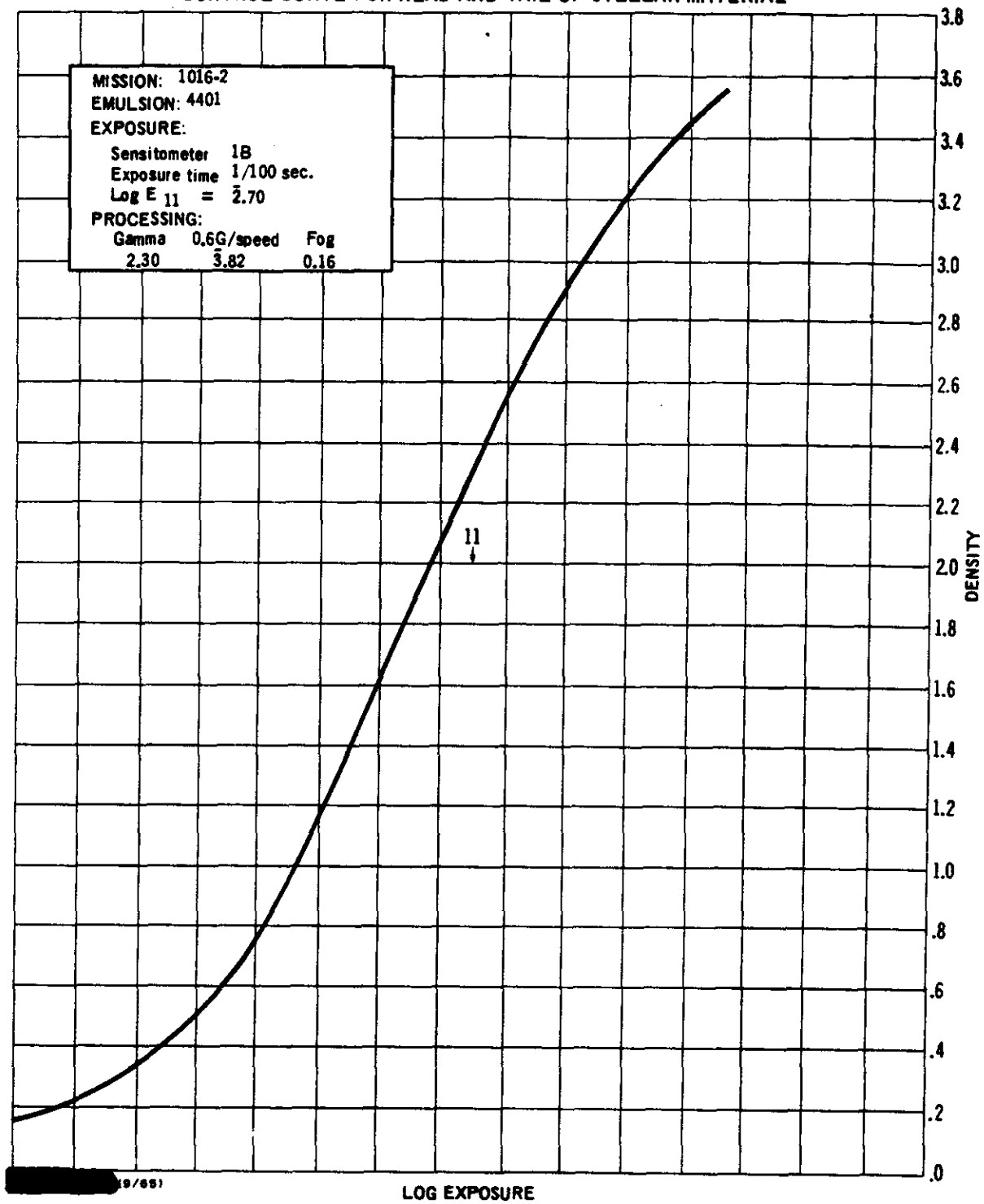

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4. Physical Film Degradations

This section provides an evaluation of the non-camera induced physical film degradations of the original negative from Mission 1016.

a. Master Camera - Minus density comets are present on passes 6D, frames 44 and 46; 25D, frame 23; and 134D, frame 32. Static electrical discharges caused minor dendritic-type fogging along the frequency mark edge of the film on pass 134D, frames 12 through 16. Emulsion scratches are present on the first 5 frames of pass 133D; throughout pass 147D; pass 148D, frame 75; and 151D, frame 10. The first 16 frames of pass 102D are creased and also contain a diminishing base abrasion through frame 30. Title information placed on the original negatives is partially removed and transferred on passes 10D, frames 1 through 15; 15D, frames 22 through 60; 132D, frames 59 and 60; and 135D, frame 64. The minor degradations that occur infrequently throughout the mission include: emulsion lifts, chemical stains, pinholes, finger prints, crimps, and skiving. The last 3 frames of pass 156D (end of the mission) were severely abraded due to exhaustion of film supply. Manufacturer's splices are made in passes 24D, frame 79; 69D, frame 40; 101D, frame 101; 118D, frame 49; and 147D, frame 102. Fog caused by minor static discharges and associated with these manufacturer's splices is found on the adjoining frames.

b. Slave Camera - Minus density comets are present on passes 5D, frame 50; 20D, frames 28 and 33; 69D, frame 27; 70D, frame 65; 100D, frames 98 and 100. A minus density dot, just inside the camera number edge format, occurs each 1.5 inches on the last two frames of pass 131D and continues through frame 79 of pass 135D. Static electrical discharges caused intermittent dendritic-type fogging along the camera number edge of the film on passes 1D and 116D; along the frequency mark edge of the film on pass 101D and along both film's edges on passes 36D, 37D, 55D, 56D, 84D, and 102D. Emulsion scratches occur on passes 20D, frame 33, 100D, frame 168; 101D, frame 132; 132D, frame 78, and intermittently throughout passes 14D and 83D. Title information placed on the original negatives is partially removed

and transferred on passes 69D, frames 19 through 22; 93D, frame 21; 102D, frame 105; 135D, frame 65; 150D, frames 26 and 27; 151D, frame 21. Base scratches are present on passes 18D, frames 3, 4, and 5; 36D, frames 37 through 97; 79D, frame 1; numerous throughout passes 19D and 72D; and intermittent throughout pass 94D. The camera number edge border area of pass 15D, frames 12 through 16, is wrinkled and contains minor emulsion scratches. Pass 86D, frames 1 through 3, are creased and also contain a diminishing base abrasion through frame 32. Pass 93D, frames 47 through 57, were damaged in processing. Damage consisted of emulsion cracks, crimps, edge wrinkle, and lifted emulsion. Frame 48 is the only frame seriously degraded by this processing problem. Frames 11 and 12 of the cut and wrap sequence pass (79D) were damaged as a result of the film wrapping on itself at the inner-core of bucket 2 take-up spool. The minor degradations that occur infrequently throughout the mission include: pinholes, dirt and foreign matter, emulsion digs and scrapes, glove prints, emulsion defects, and blisters. Manufacturer's splices occur in passes 6D, frame 135; 21D, between frames 26 and 27; 55D, frame 40; 100D, frame 66; 135D, frame 60, and 150D, frame 120. Fog caused by minor spot static discharges and associated with these manufacturer's splices is found on the adjoining frames.

c. Stellar Camera No D55 - Several small chemical stains are present throughout the mission. A plus density area is present along the non-camera number edge of the film on frames 294 through 301. The last 24 frames are abraded, possibly due to the film whip after the separation cut was made ending the first half of the mission. The last 25 percent of the mission material contains fine emulsion cracks perpendicular to the film's edges and extending from edge to edge. Slight edge fog, along both film edges, occurs intermittently throughout. A plus density streak is present on the last 44 frames. It is roughly parallel to the film edge and located between the format edge and the fiducial containing the camera number.

d. Stellar Camera No D59 - The plus density streak, similar to the one described on the last 44 frames of Mission 1016-1, is present on the last 33 frames of this part of the mission. Slight edge fog, along both edges of the film, occurs intermittently throughout.

[redacted]

e. Index Camera No D55 - A minus density dot is present 1.41 inches from the camera number edge of the film and 0.22 inch from the take-up end of each frame throughout the mission.

f. Index Camera No D59 - No physical degradations occurred on the material from this camera.

PART III. IMAGE QUALITY

1. Definition of Photographic Interpretation (PI) Suitability

The PI suitability 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 fundamental 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 photographic 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. The standards that determine assignment of the various ratings are:

Excellent: The photography is free of degradations by camera malfunctions or processing faults and the weather conditions are favorable throughout. The imagery contains, sharp, well defined edges and corners with no unusual distortions. Contrast is optimum 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 good quality of the photography.

Good: The photography is relatively free of degradation or limiting atmospheric conditions. Edges and corners 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 present and the acuity of the photography is less than optimum. Edges and corners are not crisply defined and there is loss of detail in shadow or highlight areas. Detection and identification of small objects are possible but accuracy of mensuration is limited by the fall-off in image quality and less-than-optimum contrast prevails.

[redacted]

Poor: Camera-induced degradations or weather limitations severely reduce the effectiveness of the photography. Definition of edges and corners are not well defined. 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 photography completely precludes detection, identification and mensuration of cultural details.

2. PI Suitability, Mission 1016

The PI suitability is good on Mission 1016, comparable to Mission 1015. Photographic interpreters reported on 188 priority targets and 1 bonus target in the preliminary readout. Twenty-nine of these targets were reported as poor quality. The poor quality rating is primarily due to obliquity, snow, clouds, haze, industrial smog, or a combination of several of these degrading factors. The primary degradations on oblique photography are image distortion and the necessity to penetrate more atmosphere due to increasing slant range. With the excessive number of prime targets per pass it is unavoidable that a few of these targets will fall on the photographic obliques. Snow causes lower contrast, increases glare, and decreases edge definition. An example of degradations caused by obliquity and snow is found on pass 54D, frame 42 (FWD). It should be noted that although snow usually hampers identification, it can also occasionally be used as an aid in photo interpretation. From a photo interpreter's standpoint the prime asset to snow covered terrain is in the use of target shadows for improving readout, especially on such targets as radar and communications sites. Snow can also improve the contrast of certain objects. An example of this is found on pass 37D, frame 36 (AFT). The degradation caused by clouds, haze, and industrial smog can be best defined as a lowering of contrast and a reduction of edge sharpness. A good example of these degradations is also found on pass 37D, frame 36 (AFT). This particular frame demonstrates the feasibility of image degradations and image enhancement occurring within one frame.

Highlights of the mission include:

a. A total of 3,452 targets were reported on the detailed analysis of this mission.

b. There are 70 newly identified targets, including:

1. Several missile launch sites.
2. Three possible launch sites.
3. A missile support facility.
4. A missile-associated storage area.
5. Many airfields.
6. Numerous electronics facilities.
7. Several military installations.
8. Two industrial installations.
9. Several storage installations.
10. A thermal powerplant.
11. Nine unidentified installations.

3. Definition of Mission Information Potential (MIP)

The MIP is an arbitrary number not limited by terminal values which is subjectively assigned to the panoramic photography of a mission and which compares it to the other missions. It is meant to be a measure of the camera's maximum capability for recording information, discounting adverse atmospheric conditions, minimum solar elevations, camera malfunctions, or other factors which reduce the quality of the photography.

The MIP is based on the best photography found in a mission, even though the photography may be limited to a few frames. Since these frames are considered to be the best in the mission, they do not indicate the overall success, average quality or general interpretability of the photography.

Criteria for selection of the MIP frame:

a. Eliminate all portions of the mission affected by system malfunctions.

[redacted]

b. Select frames which are free of clouds or atmospheric attenuation.

c. Eliminate the first 10 frames and last frame of a pass because these may be affected by incorrect scan speed.

d. Select frames that are in a continuous strip of approximately 10 cloud-free frames, since cloud shadows from weather fronts are cast for great distances.

e. Determine from the horizon cameras that the panoramic photography is not affected by apparent vehicle perturbations.

f. Select targets that are near the center of the format and on frames as close as possible to perigee for scale purposes and to eliminate obliquity.

g. Select frames having near optimum solar elevation.

h. Select a high contrast target (preferably an airfield) and compare the target to a previous mission which has been given an MIP rating.

4. MIP Rating for Mission 1016

Pass 61D, frame 13 AFT, and pass 126D, frame 5 FWD, are selected as the MIP frames for Missions 1016-1 and 1016-2, respectively. Both missions are assigned MIP ratings of 85 (comparable to Mission 1015).

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APPENDIX A. SYSTEM SPECIFICATIONS

1. Cameras:

Panoramic Camera	Master (FWD)	Slave (AFT)
Camera Number	132	133
Lens Serial Number	1082435	1102435
Slit Width	0.250"	0.175"
Aperture	f/3.5	f/3.5
Filter	Wratten 25	Wratten 21
Operational F/L	609.625 mm	609.60 mm
Film Type	7J-40	7J-40
Film Length	16,000'	16,000'
Splices	5	6
Emulsion	79-8-11-4	79-8-11-4
Resolution:		
Static Bench Test:		
High Contrast	237 L/mm	274 L/mm
Low Contrast	156 L/mm	162 L/mm
Dynamic Test:		
I High Contrast	174 L/mm	194 L/mm
I Low Contrast	128 L/mm	130 L/mm
P High Contrast	189 L/mm	198 L/mm
P Low Contrast	119 L/mm	126 L/mm

Stellar/Index Cameras	STELLAR		INDEX	
	1016-1	1016-2	1016-1	1016-2
Camera Number	D55	D59	D55	D59
Lens Serial Number	11220/55	11237/59	813067/55	813056/50
Reseau Serial Number	50	59	55	50
Filter	None	None	Wratten 21	Wratten 21
Aperture	f/1.8	f/1.8	f/4.5	f/4.5
Exposure Time	2.0 sec	2.0 sec	1/500 sec	1/500 sec
Operational F/L	83.984 mm	83.921 mm	38.406 mm	38.19 mm
Film Type	3J-34	3J-34	7J-33	7J-33
Film Length	NA	NA	NA	NA
Splices	None	None	None	None
Emulsion	44-30-9-4	44-30-9-4	33-1-9-4	33-1-9-4

Note: NA denotes Not Available.

Design focal length of the Stellar Camera is 85 mm and of the Index Camera 38 mm.

Horizon Cameras	MASTER		SLAVE	
	Stbd (Take-up)	Port (Supply)	Stbd (Supply)	Port (Take-up)
Camera Number	132	132	133	133
Lens Serial Number	813551	814012	814020	814030
Exposure Time	1/100 sec	1/100 sec	1/100 sec	1/100 sec
Aperture	f/8.0	f/6.8	f/8.0	f/6.8
Filter	Wratten 25	Wratten 25	Wratten 25	Wratten 25
Operational F/L	54.90 mm	55.05 mm	54.69 mm	55.26 mm
Average L/mm	140 L/mm	139 L/mm	140 L/mm	145 L/mm
Radial Distortion:				
10° Off Axis	0.001 mm	0.000 mm	0.001 mm	0.003 mm
20° Off Axis	0.001 mm	0.001 mm	0.001 mm	0.004 mm
Tangential Distortion	0.003 mm	0.003 mm	0.003 mm	0.004 mm

Master Horizon Cameras

Resolution L/mm	Stbd (Take-Up)						Port (Supply)					
Angle Off Axis	0	10	15	20	25	30	0	10	15	20	25	30
Radial Resolution	170	130	92	79	86	53	160	89	65	63	85	80
Tangential Resolution	170	98	79	62	55	47	160	93	76	75	59	42

Slave Horizon Cameras

Resolution L/mm	Stbd (Take-Up)						Port (Supply)					
Angle Off Axis	0	10	15	20	25	27.5	0	10	15	20	25	27.5
Radial Resolution	160	118	92	75	68	71	170	90	65	60	71	56
Tangential Resolution	160	116	116	66	62	42	170	116	89	63	52	42

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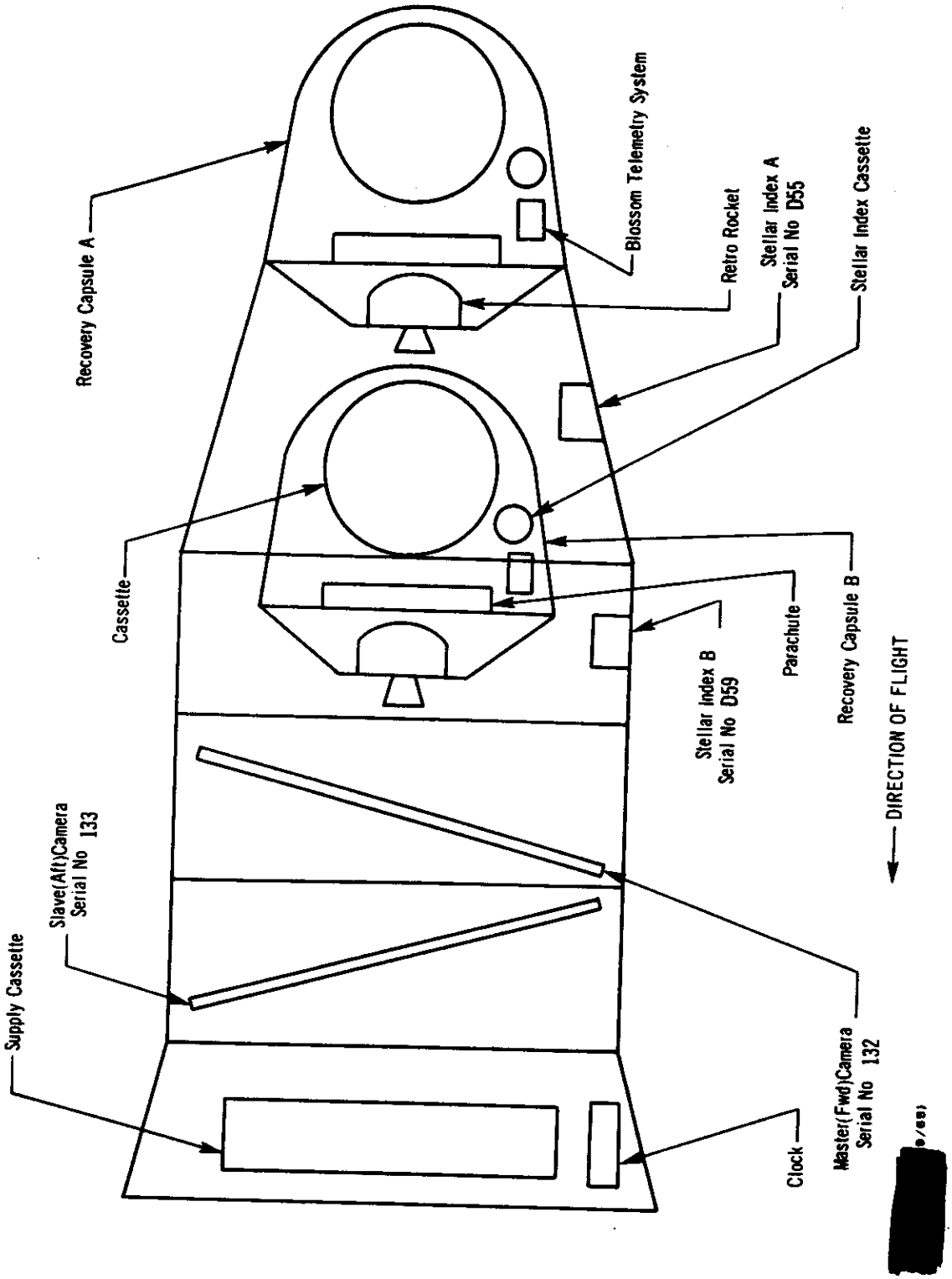
2. VEHICLE CONFIGURATION AND EQUIPMENT LAYOUT



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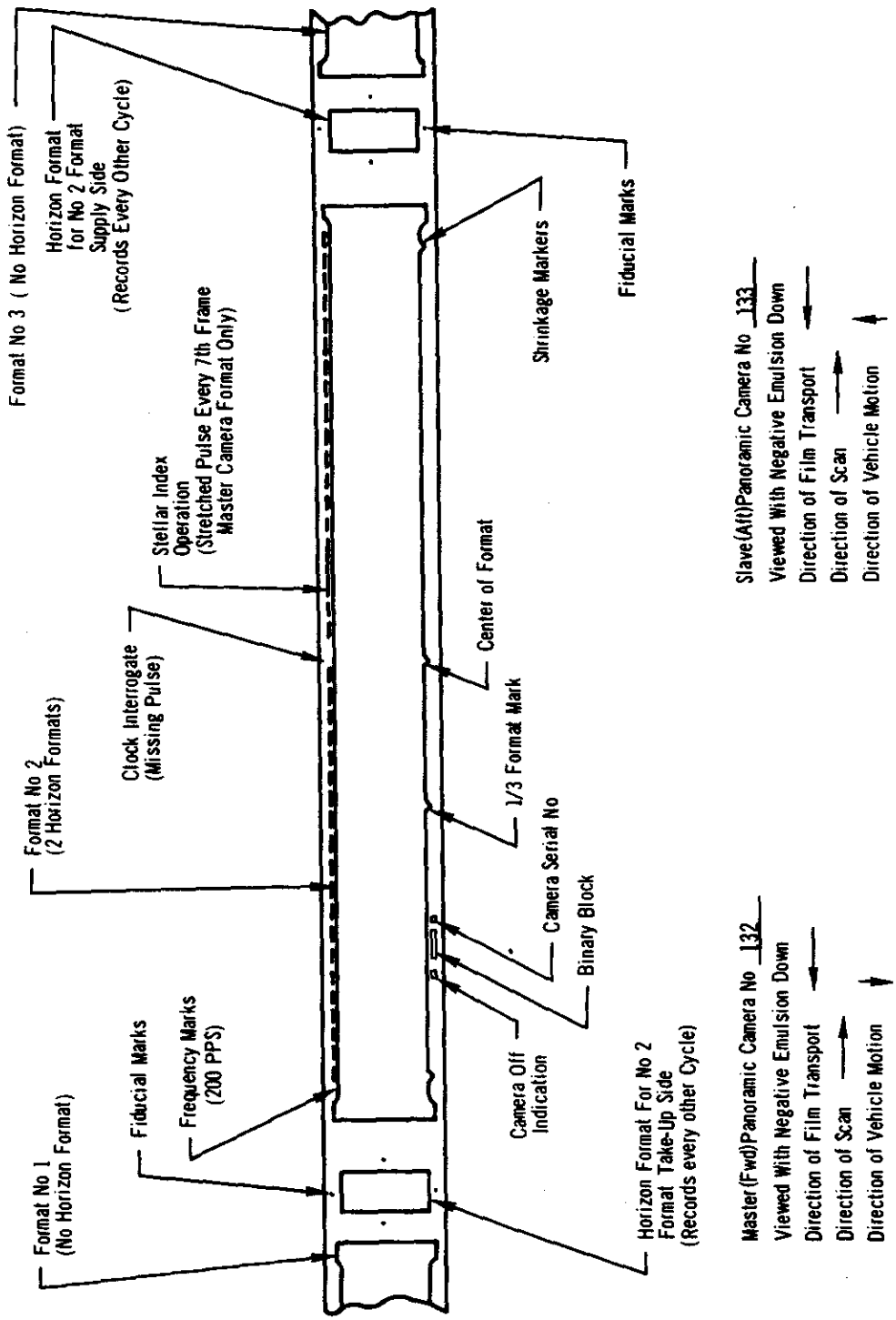
3. PANORAMIC FORMAT CONFIGURATION



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4. 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 ±5 seconds of arc so positioned to form an angle of -15.00 degrees ±5 seconds to the mechanical interface for master camera calibrations and an angle of +15.00 degrees ±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 degrees ±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.

Xvo 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 slave camera.

Dimensions A, B, and C are the spacings of the shrinkage markers, and dimensions D and E are the spacings 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.

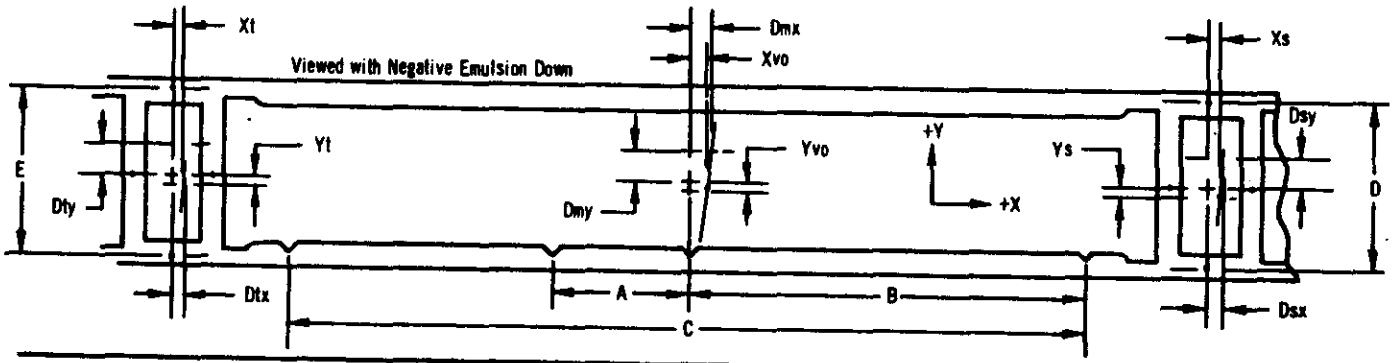
The format dimensions are measured to the best estimate of format edge.

[redacted]

Measurement 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 on 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.

5. PANORAMIC FORMAT DIMENSIONS



Master (Fwd) Camera		Vehicle Motion		Scan Direction	
A	76.1	Xt	+0.490	Dtx	+0.478
B	355.3	Yt	+0.093	Dty	+2.599
C	710.5	Xs	+0.390	Dsx	+0.390
D	56.511	Ys	+0.028	Dsy	+3.069
E	56.498	Xvo	+1.121	Dmx	+1.109
		Yvo	+1.358	Dmy	+4.358

Format dimensions:

	Panoramic
Height	55.375
Width	755.4

Stave (Aft) Camera		Vehicle Motion		Scan Direction	
A	76.1	Xt	+0.005	Dtx	+0.013
B	355.3	Yt	+0.058	Dty	+2.435
C	710.6	Xs	-0.056	Dsx	-0.071
D	56.512	Ys	+0.125	Dsy	-1.287
E	56.421	Xvo	-0.992	Dmx	-1.002
		Yvo	+0.727	Dmy	+3.727

Format dimensions:

	Panoramic
Height	56.249
Width	754.1

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 10 mm above point defining target center
4. Format Sign Convention

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

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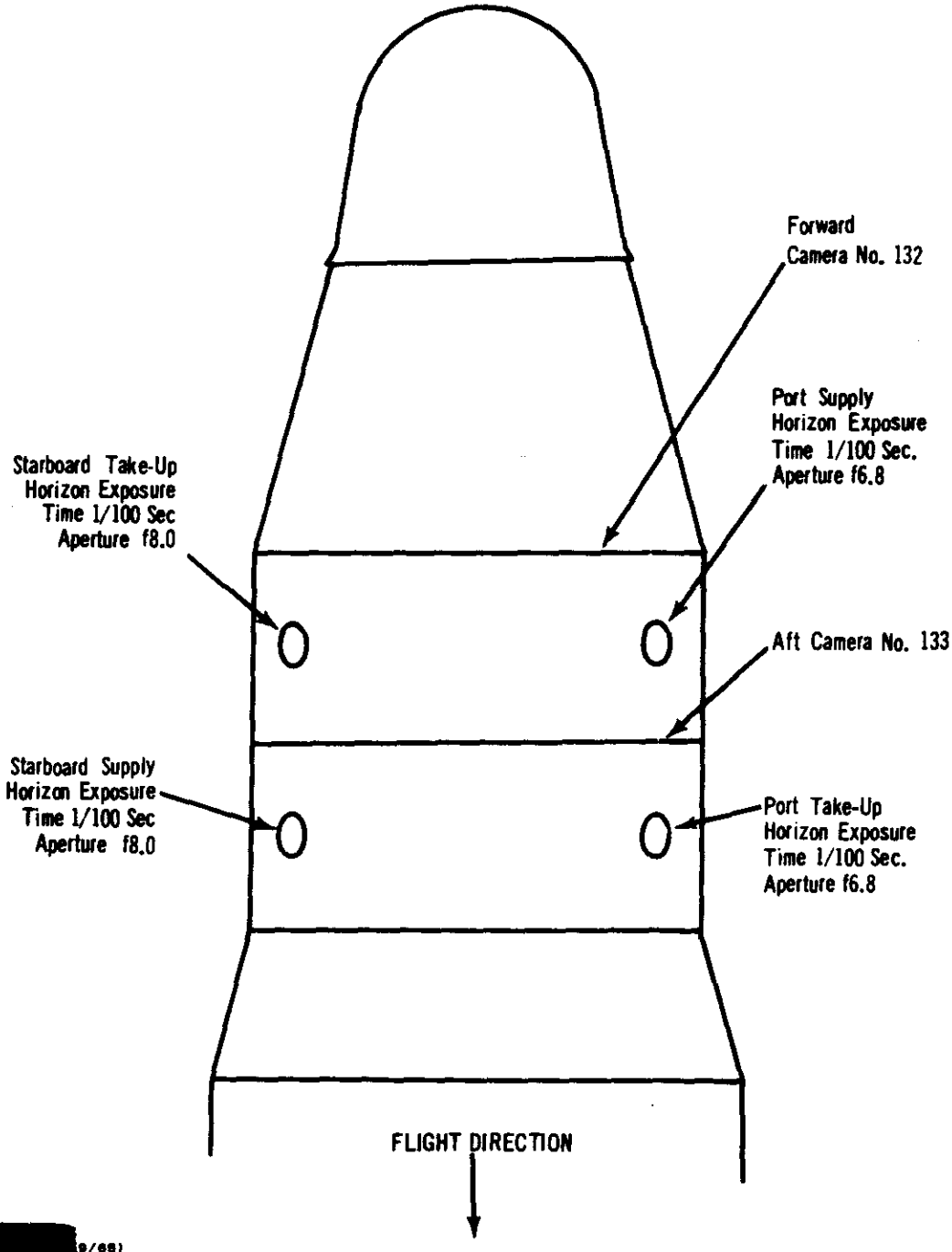
6. HORIZON CAMERA SETTINGS
(Viewed from top of vehicle in flight)



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APPENDIX B. DENSITY READINGS

Density readings were taken using a Macbeth QuantaLog Densitometer, Model EP 1000, with an ET 20 attachment and a 0.5mm aperture. The values are correlated below.

1. Stellar Camera No D55 - Mission 1016-1

Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Pass	Frame	Dmax	Dmin	Delta	Gross Fog
1D	1	1.48	0.37	1.11	0.30	34D	183	1.42	0.22	1.20	0.20
	2	2.00	0.44	1.56	0.30		185	1.61	0.23	1.38	0.19
2D	3	0.89	0.30	0.59	0.29	36D	186	1.83	0.24	1.59	0.20
	5	1.11	0.31	0.80	0.23		199	2.09	0.30	1.79	0.19
3D	6	1.50	0.30	1.20	0.23	37D	200	1.71	0.23	1.48	0.19
	11	1.70	0.30	1.40	0.20		225	2.09	0.31	1.78	0.18
5D	12	1.68	0.29	1.39	0.20	38D	226	1.95	0.28	1.67	0.18
	23	1.88	0.30	1.58	0.20		246	1.70	0.29	1.41	0.20
6D	24	1.70	0.28	1.42	0.21	39D	247	1.27	0.22	1.05	0.18
	48	2.46	0.52	1.94	0.20		265	2.28	0.36	1.92	0.18
8D	49	1.30	0.23	1.07	0.20	40D	266	1.61	0.22	1.39	0.18
	63	2.16	0.41	1.75	0.20		283	2.05	0.39	1.66	0.21
9AE	64	NR	NR	NR	0.20	41D	284	1.89	0.35	1.54	0.22
	65	NR	NR	NR	0.20		290	1.89	0.37	1.52	0.20
10D	66	1.68	0.32	1.36	0.21	52D	291	1.92	0.35	1.57	0.19
	77	2.37	0.42	1.95	0.21		305	2.34	0.39	1.95	0.18
14D	78	1.93	0.40	1.53	0.21	54D	306	1.78	0.30	1.48	0.18
	81	1.64	0.37	1.27	0.20		314	2.29	0.39	1.90	0.18
15D	82	2.15	0.35	1.80	0.19	55D	315	1.59	0.22	1.37	0.18
	91	1.68	0.30	1.38	0.19		324	2.31	0.40	1.91	0.18
16D	92	1.91	0.40	1.51	0.20	56D	325	2.16	0.37	1.79	0.18
	94	1.88	0.36	1.52	0.20		332	2.11	0.41	1.70	0.20
18D	95	1.38	0.22	1.16	0.20	57D	333	1.75	0.29	1.46	0.20
	97	1.43	0.25	1.18	0.19		340	1.89	0.31	1.58	0.20
19D	98	1.76	0.28	1.48	0.19	61D	341	2.15	0.39	1.76	0.22
	101	1.72	0.29	1.43	0.20		344	2.40	0.50	1.90	0.24
20D	102	1.50	0.28	1.22	0.21	62D	345	2.36	0.52	1.84	0.24
	114	1.80	0.30	1.50	0.20		351	1.58	0.28	1.30	0.20
21D	115	1.86	0.30	1.56	0.20	63D	352	2.31	0.42	1.89	0.19
	131	2.18	0.36	1.82	0.19		353	2.25	0.43	1.82	0.19
22D	132	1.73	0.28	1.45	0.19	69D	354	1.82	0.25	1.57	0.19
	147	1.67	0.28	1.39	0.20		375	1.52	0.24	1.28	0.19
24D	148	1.90	0.31	1.59	0.20	70D	376	1.67	0.24	1.43	0.20
	162	2.22	0.41	1.81	0.20		387	2.28	0.39	1.89	0.20
25D	163	2.11	0.33	1.78	0.20	71D	388	1.58	0.22	1.36	0.20
	172	1.94	0.32	1.62	0.20		394	2.02	0.30	1.72	0.20
26D	173	2.08	0.40	1.68	0.21	72D	395	1.81	0.33	1.48	0.20
	175	2.12	0.42	1.70	0.21		405	2.12	0.40	1.72	0.20
30D	176	2.10	0.58	1.52	0.21	77D	406	2.01	0.40	1.61	0.21
	180	2.50	0.50	2.00	0.20		408	1.78	0.41	1.37	0.21
32D	181	2.01	0.41	1.60	0.20	79D	409	2.15	0.47	0.68	0.22
	182	2.03	0.40	1.63	0.20		411	2.04	0.46	1.58	0.21

Dmax Range 2.46-0.89 Average Dmax 1.88 Gross Fog Range 0.30-0.18
Dmin Range 0.58-0.22 Average Dmin 0.34 Average Gross Fog 0.20 NR - Denotes No Reading Made

2. Index Camera No D55 - Mission 1016-1

		LIMITING			Gross Fog	TERRAIN		
Pass	Frame	Dmax	Dmin	Delta		Dmax	Dmin	Delta
1D	1	1.22	0.46	0.76	0.08	NR	NR	NR
	2	1.32	0.42	0.90	0.10	NR	NR	NR
2D	3	0.42	0.15	0.27	0.10	0.42	0.15	0.27
	5	0.72	0.20	0.52	0.10	0.72	0.32	0.40
3D	6	1.02	0.18	0.84	0.10	1.02	0.44	0.58
	11	1.08	0.18	0.90	0.10	0.94	0.24	0.70
5D	12	1.02	0.28	0.74	0.10	1.02	0.28	0.74
	23	1.20	0.32	0.88	0.10	1.20	0.52	0.68
6D	24	0.92	0.32	0.60	0.10	NR	NR	NR
	48	1.98	0.35	1.63	0.10	NR	NR	NR
8D	49	0.64	0.20	0.44	0.10	0.50	0.22	0.28
	63	1.24	0.38	0.86	0.09	1.10	0.38	0.72
9AE	64	NR	NR	NR	0.09	NR	NR	NR
	65	NR	NR	NR	0.09	NR	NR	NR
10D	66	1.38	0.36	1.02	0.08	NR	NR	NR
	77	1.55	0.38	1.17	0.08	NR	NR	NR
14D	78	1.30	0.22	1.08	0.09	1.30	0.46	0.84
	81	1.18	0.32	0.86	0.09	0.60	0.35	0.25
15D	82	1.50	0.34	1.16	0.09	1.10	0.52	0.58
	91	1.24	0.32	0.92	0.09	1.24	0.32	0.92
16D	92	1.14	0.28	0.84	0.09	NR	NR	NR
	94	0.98	0.28	0.70	0.09	NR	NR	NR
18D	95	0.52	0.30	0.22	0.09	0.52	0.30	0.22
	97	0.70	0.16	0.54	0.09	0.58	0.28	0.30
19D	98	0.98	0.22	0.76	0.10	0.88	0.30	0.58
	101	1.28	0.20	1.08	0.10	1.28	0.44	0.84
20D	102	0.60	0.18	0.42	0.10	NR	NR	NR
	114	1.15	0.38	0.77	0.09	1.10	0.38	0.72
21D	115	1.14	0.32	0.82	0.09	NR	NR	NR
	131	1.22	0.46	0.76	0.10	0.50	0.44	0.06

NR - Denotes No Reading Made

TOP SECRET
CORONA
NO FOREIGN DISSEM

Index Camera No D55 (Cont'd)

		LIMITING			Gross Fog	TERRAIN		
Pass	Frame	Dmax	Dmin	Delta		Dmax	Dmin	Delta
22D	132	1.02	0.34	0.68	0.10	0.94	0.38	0.56
	147	1.52	0.36	1.16	0.10	0.86	0.36	0.50
24D	148	0.94	0.30	0.64	0.10	0.94	0.30	0.64
	162	1.50	0.32	1.18	0.10	1.32	0.32	1.00
25D	163	1.12	0.42	0.70	0.09	NR	NR	NR
	172	1.10	0.30	0.80	0.09	0.60	0.45	0.15
26D	173	1.38	0.52	0.86	0.08	NR	NR	NR
	175	1.50	0.39	1.11	0.09	NR	NR	NR
30D	176	1.53	0.29	1.24	0.08	NR	NR	NR
	180	1.68	0.44	1.24	0.08	NR	NR	NR
32D	181	1.15	0.19	0.96	0.09	NR	NR	NR
	182	1.10	0.20	0.90	0.09	NR	NR	NR
34D	183	0.64	0.18	0.46	0.09	0.64	0.18	0.46
	185	0.72	0.14	0.58	0.09	0.72	0.26	0.46
36D	186	0.92	0.30	0.62	0.08	0.70	0.30	0.40
	199	1.08	0.18	0.90	0.08	1.08	0.34	0.74
37D	200	1.16	0.42	0.74	0.09	NR	NR	NR
	225	1.14	0.26	0.88	0.10	0.98	0.32	0.66
38D	226	1.32	0.54	0.78	0.09	NR	NR	NR
	246	1.50	0.30	1.20	0.09	1.32	0.30	1.02
39D	247	0.52	0.16	0.36	0.10	NR	NR	NR
	265	1.20	0.34	0.86	0.10	NR	NR	NR
40D	266	0.78	0.18	0.60	0.10	NR	NR	NR
	283	1.60	0.18	1.42	0.10	1.60	0.40	1.20
41D	284	1.63	0.28	1.34	0.09	0.76	0.42	0.34
	290	1.80	0.17	1.63	0.09	0.78	0.34	0.44
52D	291	0.94	0.42	0.52	0.08	0.94	0.42	0.52
	305	1.21	0.32	0.89	0.08	0.92	0.40	0.52
54D	306	0.70	0.20	0.50	0.08	0.70	0.20	0.50
	314	1.37	0.46	0.91	0.08	0.86	0.52	0.34

NR - Denotes No Reading Made

TOP SECRET
CORONA
NO FOREIGN DISSEM

Index Camera No D55 (Cont'd)

Pass	Frame	LIMITING Dmax	LIMITING Dmin	LIMITING Delta	Gross Fog	TERRAIN Dmax	TERRAIN Dmin	TERRAIN Delta
55D	315	0.48	0.30	0.18	0.08	NR	NR	NR
	324	1.25	0.85	0.40	0.09	NR	NR	NR
56D	325	1.14	0.30	0.84	0.09	0.62	0.30	0.32
	332	0.92	0.22	0.70	0.09	NR	NR	NR
57D	333	1.20	0.24	0.96	0.09	0.78	0.42	0.36
	340	1.08	0.35	0.73	0.09	NR	NR	NR
61D	341	1.40	0.33	1.07	0.09	1.40	0.52	0.88
	344	1.50	0.20	1.30	0.09	1.50	0.46	1.04
62D	345	1.28	0.38	0.90	0.09	NR	NR	NR
	351	1.12	0.28	0.84	0.09	0.78	0.38	0.40
63D	352	1.48	0.58	0.90	0.10	NR	NR	NR
	353	1.54	0.29	1.25	0.09	NR	NR	NR
69D	354	0.68	0.26	0.42	0.09	0.68	0.26	0.42
	375	1.40	0.22	1.18	0.09	0.58	0.28	0.30
70D	376	0.88	0.14	0.74	0.09	0.52	0.20	0.30
	387	1.42	0.55	0.87	0.09	1.12	0.90	0.20
71D	388	0.44	0.22	0.22	0.09	0.44	0.22	0.22
	394	1.00	0.50	0.50	0.09	1.00	0.50	0.50
72D	395	0.98	0.32	0.66	0.09	NR	NR	NR
	405	1.42	0.82	0.60	0.09	NR	NR	NR
77D	406	1.48	0.28	1.20	0.09	NR	NR	NR
	408	1.58	0.12	1.46	0.09	NR	NR	NR
79D	409	1.08	0.18	0.90	0.09	NR	NR	NR
	411	1.00	0.30	0.70	0.09	NR	NR	NR

	Limiting	Terrain
Dmax Range	1.98 - 0.48	1.60 - 0.42
Dmin Range	0.85 - 0.12	0.90 - 0.15
Dmax Average	1.15	0.90
Dmin Average	0.31	0.36

Gross Fog Range 0.10 - 0.08
Average Gross Fog 0.09

NR - Denotes No Reading Made

3. Stellar Camera No D59 - Mission 1016-2

Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Pass	Frame	Dmax	Dmin	Delta	Gross Fog
83D	1	3.38	0.88	2.50	0.24	118D	228	3.47	0.52	2.95	0.22
	15	3.52	1.26	2.26	0.25		245	3.59	1.99	1.60	0.28
84D	16	3.57	1.30	2.27	0.29	120D	246	3.41	1.32	2.09	0.27
	30	3.34	1.84	1.50	0.22		252	3.45	1.47	1.98	0.21
85D	31	3.44	0.48	2.96	0.24	126D	253	3.50	1.65	1.85	0.22
	49	3.47	1.32	2.15	0.22		254	3.40	1.42	1.98	0.21
86D	50	3.32	0.42	2.90	0.23	131D	255	3.48	1.08	2.40	0.21
	68	3.59	1.62	1.97	0.23		259	3.50	1.34	2.16	0.23
88AE	69	NR	NR	NR	0.24	132D	260	3.48	0.98	2.50	0.22
	70	NR	NR	NR	0.23		282	3.35	1.42	1.93	0.21
88D	71	3.48	1.10	1.38	0.24	133D	283	3.49	1.53	1.96	0.22
	74	3.44	1.42	2.02	0.24		291	3.50	1.75	1.75	0.23
89D	75	3.54	1.78	1.76	0.24	134D	292	3.49	0.65	2.84	0.25
	78	3.60	2.39	1.21	0.24		305	3.51	1.64	1.87	0.22
93D	79	3.42	1.39	2.03	0.21	135D	306	3.50	1.00	2.50	0.22
	88	3.46	1.73	1.73	0.21		317	3.52	1.30	2.22	0.22
94D	89	3.55	1.64	1.91	0.23	140D	318	3.32	1.12	2.20	0.22
	92	3.54	1.62	1.92	0.21		321	3.35	1.01	2.34	0.21
99D	93	3.46	1.20	2.26	0.24	142D	322	3.42	1.27	2.15	0.21
	103	3.47	1.20	2.27	0.21		324	3.48	1.20	2.28	0.21
100D	104	3.32	0.48	2.84	0.23	147D	325	3.46	1.09	2.37	0.21
	132	3.37	1.10	2.27	0.21		349	3.52	1.93	1.59	0.20
101D	133	3.42	0.72	2.72	0.22	148D	350	3.42	0.79	2.63	0.22
	151	3.46	1.49	1.97	0.20		377	3.46	1.49	1.97	0.22
102D	152	3.43	0.87	2.56	0.21	149D	378	3.41	0.32	2.09	0.22
	168	3.53	1.72	1.81	0.22		400	3.49	1.85	1.64	0.22
104D	169	3.54	1.11	2.43	0.22	150D	401	3.48	0.94	2.54	0.24
	180	3.58	1.21	2.37	0.23		421	3.27	1.73	1.54	0.21
110DE	181	3.53	1.29	2.24	0.23	151D	422	3.40	1.68	1.72	0.22
	182	3.50	1.32	2.18	0.24		426	3.41	1.49	1.92	0.22
165D	183	3.51	1.21	2.30	0.24	156D	427	3.32	1.22	2.10	0.22
	194	3.49	1.82	1.67	0.24		430	3.32	1.40	2.92	0.22
116D	195	3.52	0.96	2.56	0.24	158D	431	3.46	1.52	1.94	0.22
	210	3.58	1.46	2.12	0.24		433	3.43	1.49	1.94	0.22
117D	211	3.45	0.40	3.05	0.23						
	227	3.55	1.60	1.95	0.22						

Dmax Range 3.60 - 3.27 Average Dmax 3.45 Gross Fog Range 0.29 - 0.20
Dmin Range 2.39 - 0.42 Average Dmin 1.29 Average Gross Fog 0.23 NR - Denotes No Reading Made

4. Index Camera No D59 - Mission 1016-2

		LIMITING				TERRAIN		
Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Dmax	Dmin	Delta
83D	1	0.62	0.30	0.32	0.10	0.62	0.30	0.32
	15	1.12	0.28	0.84	0.10	1.12	0.46	0.66
84D	16	1.40	0.30	1.10	0.10	1.02	0.48	0.54
	30	1.62	0.40	1.22	0.10	NR	NR	NR
85D	31	0.50	0.26	0.24	0.09	0.50	0.26	0.24
	49	1.32	0.30	1.02	0.09	1.32	0.30	1.02
86D	50	0.24	0.18	0.06	0.08	0.24	0.18	0.06
	68	1.30	0.64	0.66	0.08	1.30	0.82	0.48
88AE	69	NR	NR	NR	0.08	NR	NR	NR
	70	NR	NR	NR	0.08	NR	NR	NR
88D	71	1.10	0.32	0.78	0.08	1.10	0.50	0.60
	74	1.30	0.54	0.76	0.08	1.30	0.64	0.66
89D	75	1.76	0.52	1.24	0.10	NR	NR	NR
	78	1.90	0.60	1.30	0.10	NR	NR	NR
93D	79	1.12	0.34	0.78	0.10	1.10	0.34	0.76
	88	2.00	0.32	1.68	0.10	NR	NR	NR
94D	89	1.66	0.42	1.24	0.10	NR	NR	NR
	92	1.64	0.32	1.32	0.10	0.87	0.60	0.27
99D	93	0.88	0.30	0.58	0.10	0.88	0.30	0.58
	103	1.04	0.24	0.80	0.10	1.04	0.38	0.64
100D	104	0.32	0.16	0.16	0.10	NR	NR	NR
	132	1.02	0.20	0.82	0.10	1.02	0.20	0.82
101D	133	0.62	0.22	0.40	0.10	0.62	0.22	0.40
	151	1.32	0.38	0.94	0.10	1.10	0.38	0.72
102D	152	0.68	0.20	0.48	0.10	0.68	0.32	0.36
	168	1.12	0.36	0.76	0.10	1.00	0.82	0.18
104D	169	0.92	0.18	0.74	0.10	0.92	0.44	0.48
	180	1.80	0.18	1.62	0.10	0.55	0.32	0.23
110DE	181	1.03	0.32	0.71	0.09	0.82	0.42	0.40
	182	0.93	0.21	0.72	0.10	0.93	0.21	0.72
165D	183	1.00	0.22	0.78	0.10	0.76	0.30	0.46
	194	1.48	0.28	1.20	0.10	NR	NR	NR
116D	195	0.55	0.19	0.36	0.10	0.55	0.19	0.36
	210	1.44	0.57	0.87	0.10	1.12	0.52	0.60
117D	211	0.20	0.10	0.10	0.10	NR	NR	NR
	227	1.26	0.80	0.46	0.10	1.26	0.80	0.46
118D	228	0.22	0.12	0.10	0.10	0.22	0.12	0.10

NR - Denotes No Reading Made

[redacted]

Index Camera No D59 (Cont'd)

		LIMITING			Gross Fog	TERRAIN		
Pass	Frame	Dmax	Dmin	Delta		Dmax	Dmin	Delta
	245	1.23	0.62	0.61	0.10	NR	NR	NR
120D	246	2.08	0.28	1.80	0.09	0.72	0.50	0.22
	252	1.78	0.46	1.32	0.09	0.56	0.44	0.12
126D	253	1.32	0.28	1.04	0.09	1.12	0.42	0.70
	254	1.33	0.19	1.14	0.09	1.21	0.32	0.89
131D	255	1.00	0.28	0.72	0.09	1.00	0.41	0.59
	259	1.08	0.28	0.80	0.09	1.08	0.28	0.80
132D	260	0.62	0.24	0.38	0.10	0.62	0.24	0.38
	282	1.78	0.19	1.59	0.10	1.17	0.48	0.69
133D	283	1.18	0.22	0.96	0.10	NR	NR	NR
	291	1.29	0.29	1.00	0.10	1.29	0.40	0.89
134D	292	0.42	0.29	0.13	0.10	NR	NR	NR
	305	1.07	0.67	0.40	0.09	1.07	0.67	0.40
135D	306	0.70	0.18	0.52	0.09	0.60	0.30	0.30
	317	1.04	0.19	0.85	0.09	0.30	0.19	0.11
140D	318	1.58	0.15	1.43	0.09	0.78	0.20	0.58
	321	1.32	0.14	1.18	0.09	0.62	0.26	0.36
142D	322	1.42	0.21	1.21	0.09	NR	NR	NR
	324	1.34	0.27	1.07	0.10	NR	NR	NR
147D	325	1.00	0.32	0.68	0.10	1.00	0.32	0.68
	349	1.72	0.70	1.02	0.09	NR	NR	NR
148D	350	0.62	0.30	0.32	0.09	0.62	0.30	0.32
	377	1.21	0.38	0.83	0.09	0.66	0.38	0.28
149D	378	NR	NR	NR	0.09	NR	NR	NR
	400	1.30	0.42	0.88	0.09	1.30	0.42	0.88
150D	401	0.58	0.22	0.36	0.09	NR	NR	NR
	421	1.17	0.29	0.88	0.09	NR	NR	NR
151D	422	1.49	0.22	1.27	0.09	NR	NR	NR
	426	1.09	0.24	0.85	0.09	1.09	0.40	0.69
156D	427	1.28	0.38	0.90	0.10	0.60	0.40	0.20
	430	1.49	0.30	1.19	0.10	0.68	0.52	0.16
158D	431	1.35	0.28	1.07	0.09	NR	NR	NR
	433	1.30	0.17	1.13	0.09	NR	NR	NR

	Limiting	Terrain
Dmax Range	2.08 - 0.20	1.32 - 0.22
Dmin Range	0.80 - 0.10	0.82 - 0.12
Dmax Average	1.16	0.88
Dmin Average	0.31	0.39
Gross Fog	0.10 - 0.08	
Average Gross Fog	0.09	

NR - Denotes No Reading Made

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 percent 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 (Mission Information Potential) frame, 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.

[redacted]

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.

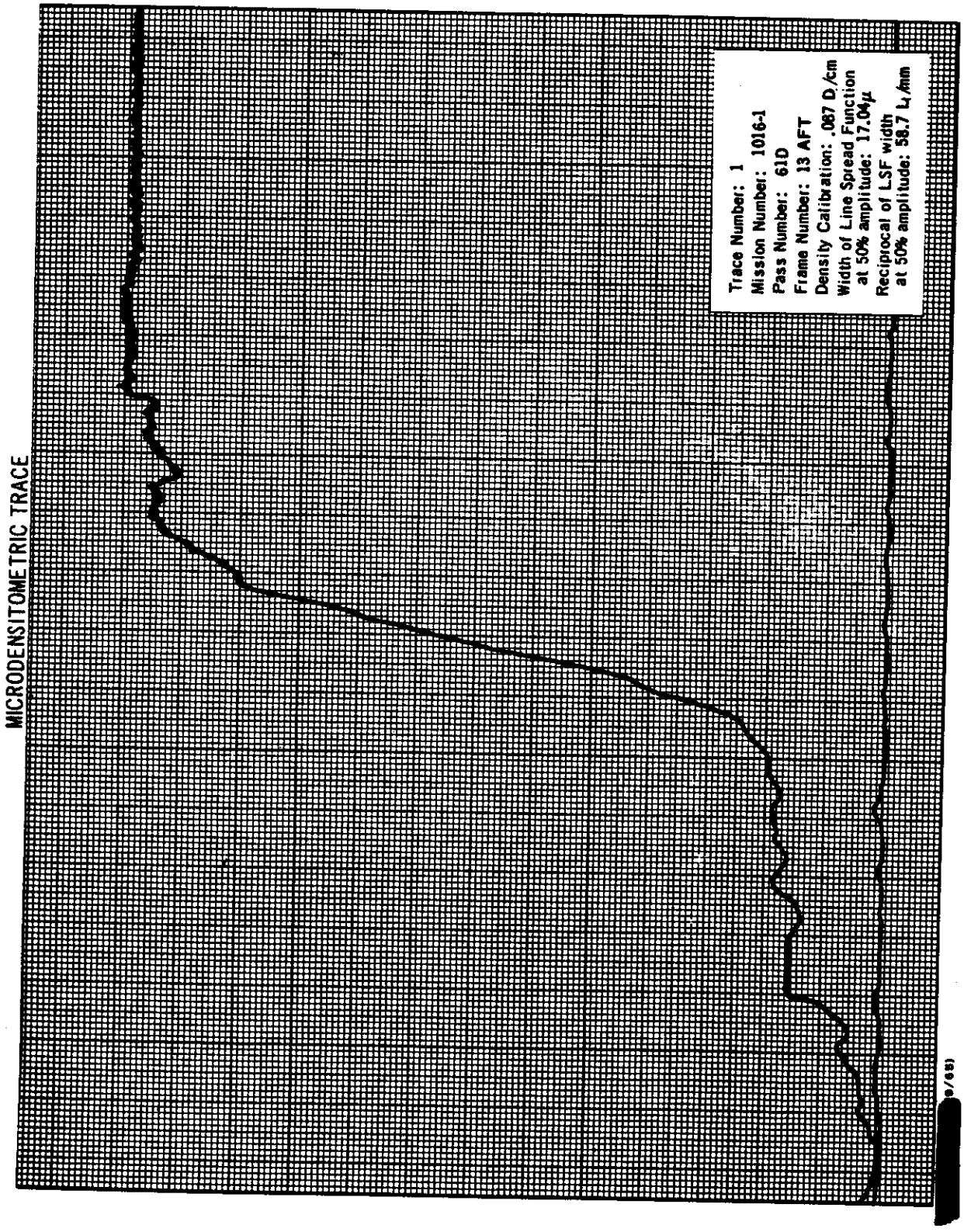
Several computer programs that have as output both the spread function and MTF are currently being investigated. The best features of each will be incorporated into a program for the UNIVAC 490. In the interim the data reduction is done manually.

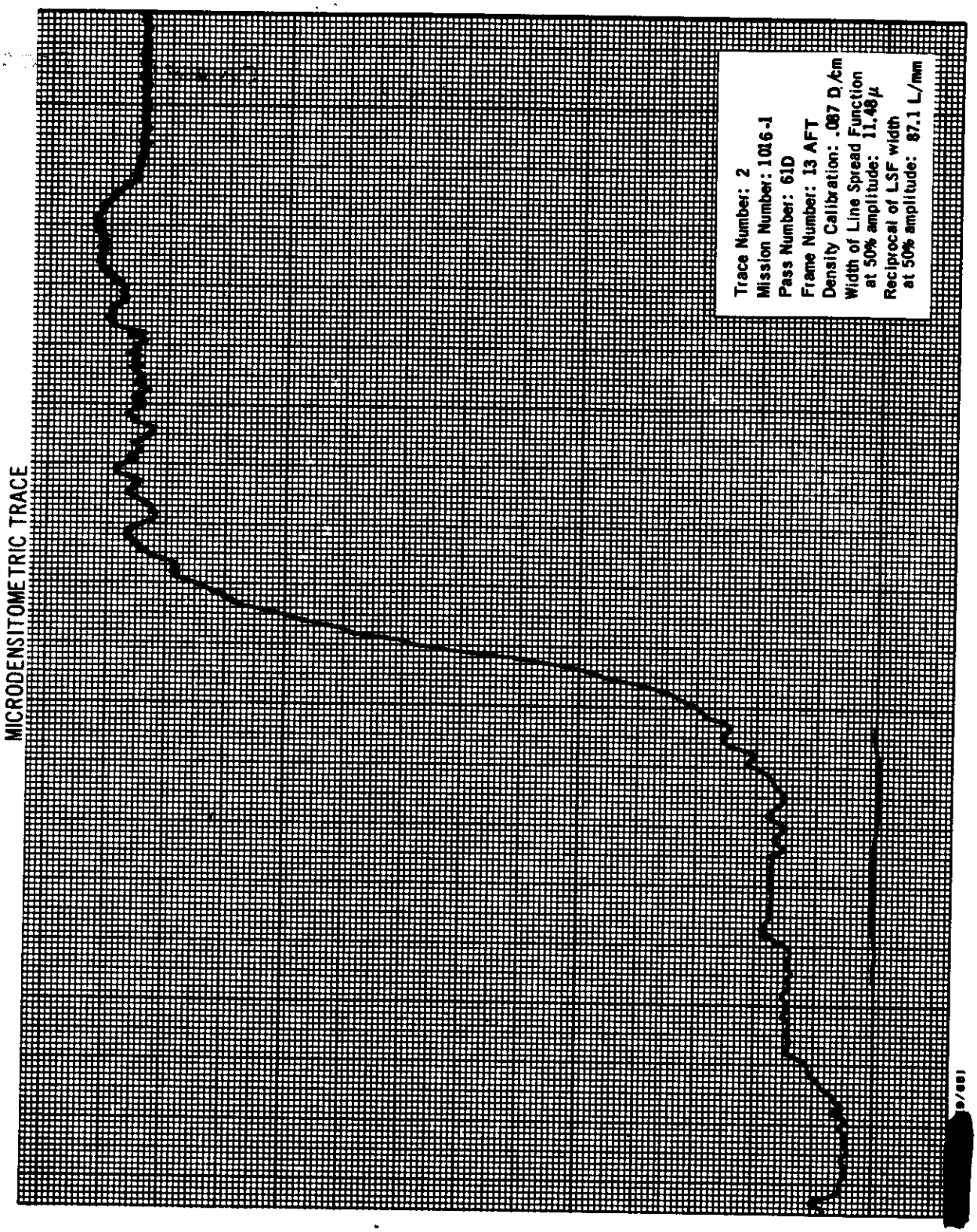
The microdensitometer plots, which exhibit the steeper density gradients and fall on the straight-line portion of the H & D curve for the material, are traced and smoothed. They are then digitized in a comparator into values of distance (X) and deflection (Y). Since the instrument response is linear 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 percent of the maximum slope is computed, and the distance between the 50 percent slope values is determined by interpolation. The Line Spread Function (LSF) may also be plotted (slope versus distance) and the 50 percent amplitude width measured for verification of the calculated value.

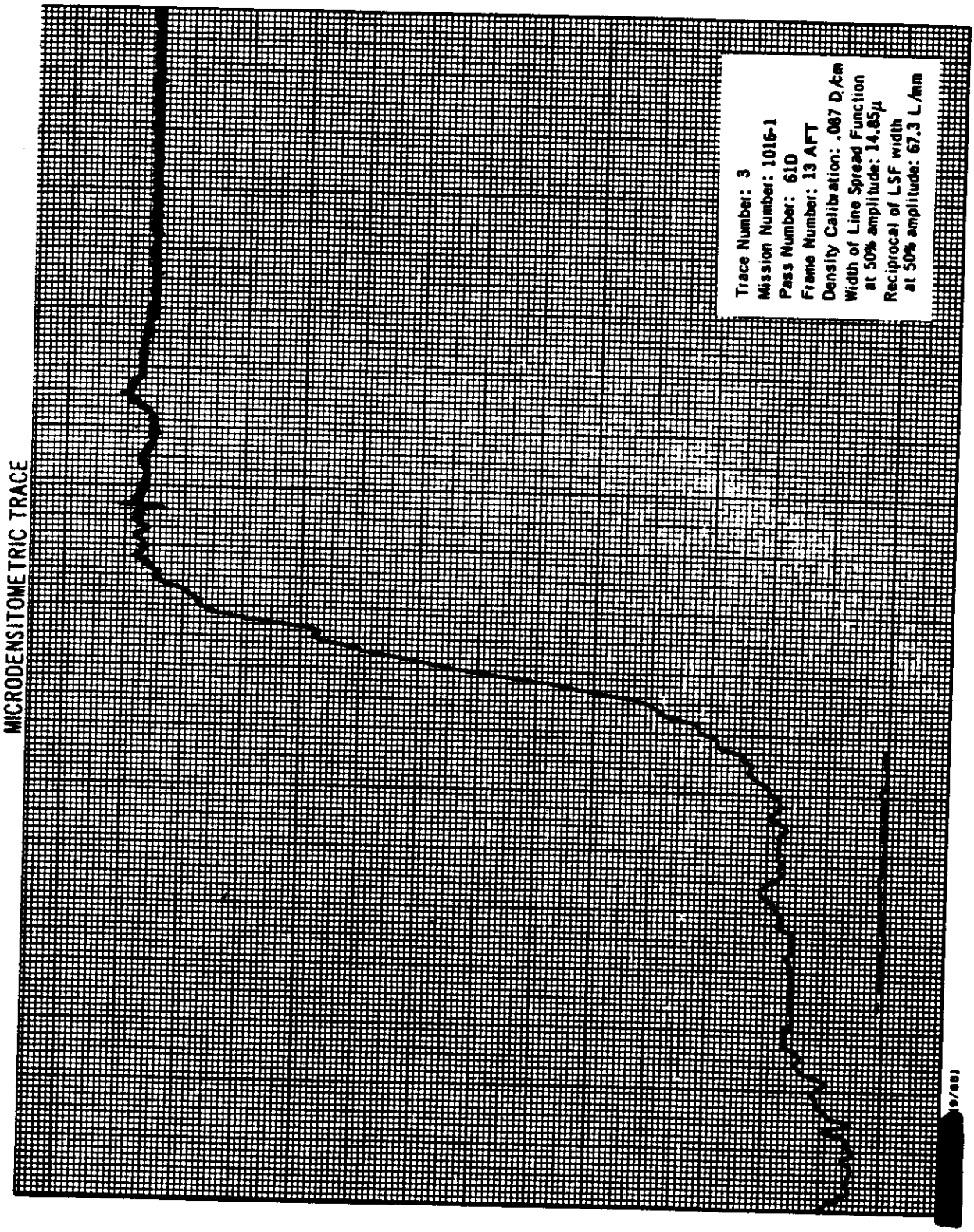
The following table shows the 50 percent amplitude width of the LSF determined from the enclosed microdensitometric edge traces made on the original negative. The lines per millimeter is determined by taking the reciprocal of the 50 percent amplitude width LSF and converting to millimeters.

SUMMARY TABLE OF EDGE TRACES

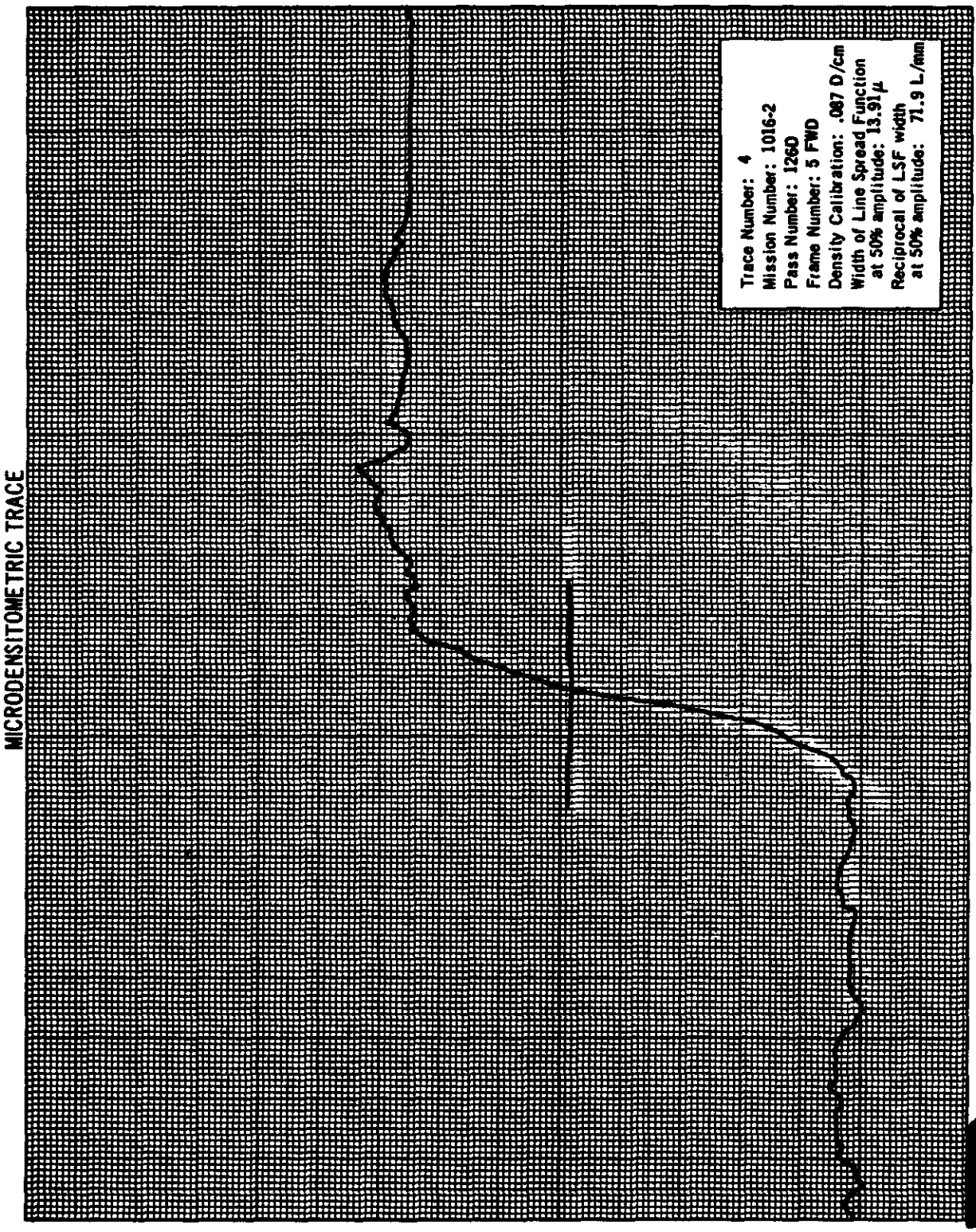
Trace Number	Line Spread Function Width at 50% Amplitude	Reciprocal of LSF Width at 50% Amplitude
1016-1		
1	17.04 microns	58.7 L/mm
2	11.48 microns	87.1 L/mm
3	14.85 microns	67.3 L/mm
1016-2		
4	13.91 microns	71.9 L/mm
5	13.59 microns	73.6 L/mm

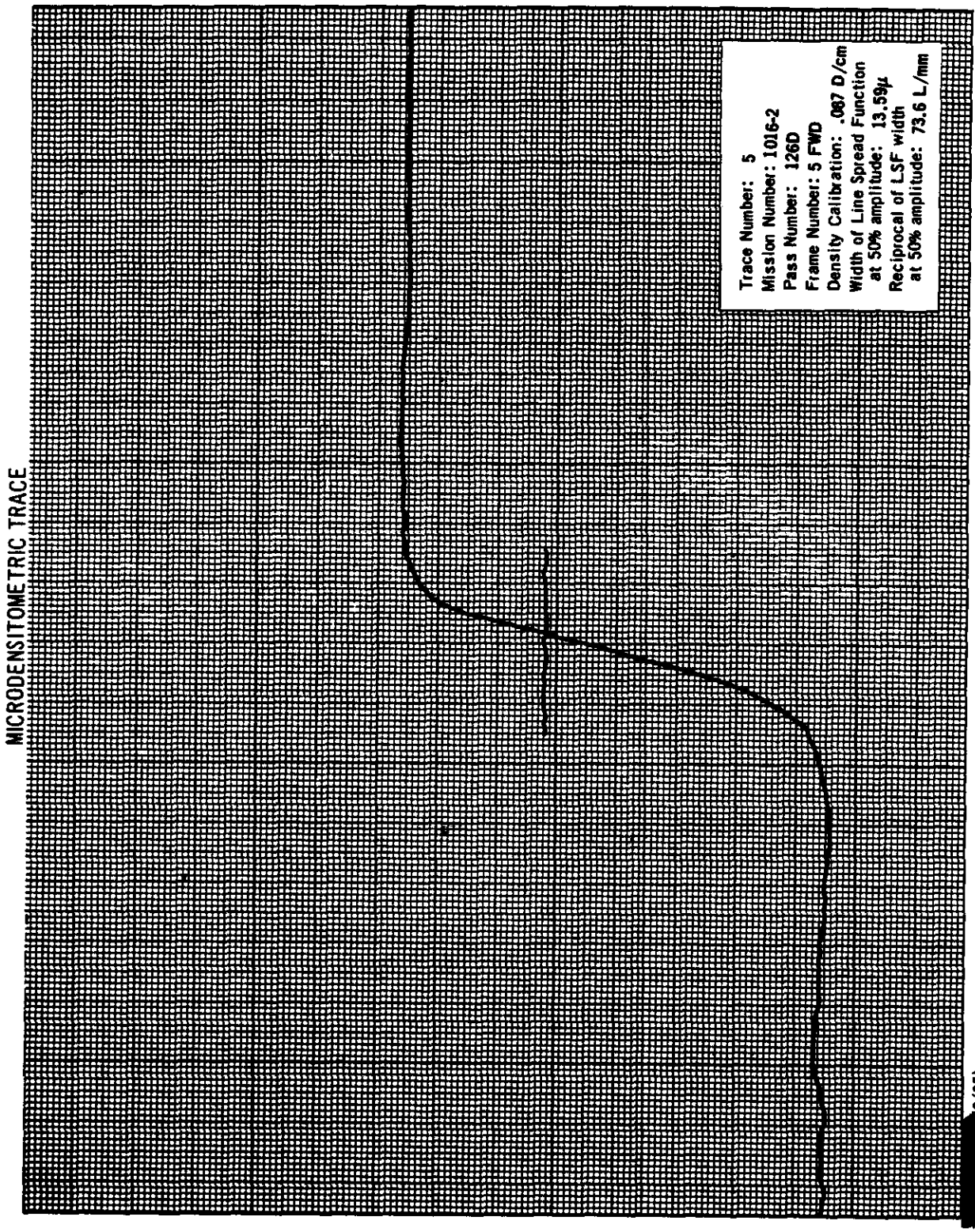

MICRODENSITOMETRIC TRACE
Trace Number: 1
Mission Number: 1016-1
Pass Number: 61D
Frame Number: 13 AFT
Density Calibration: .087 D./cm
Width of Line Spread Function at 50% amplitude: 17.04μ
Reciprocal of LSF width at 50% amplitude: 58.7 L/mm


MICRODENSITOMETRIC TRACE
Trace Number: 2
Mission Number: 1016-1
Pass Number: 61D
Frame Number: 13 AFT
Density Calibration: .087 D/cm
Width of Line Spread Function at 50% amplitude: 11.48 μ
Reciprocal of LSF width at 50% amplitude: 87.1 L/mm


MICRODENSITOMETRIC TRACE
Trace Number: 3
Mission Number: 1016-1
Pass Number: 61D
Frame Number: 13 AFT
Density Calibration: .087 D./cm
Width of Line Spread Function
at 50% amplitude: 14.85μ
Reciprocal of LSF width
at 50% amplitude: 67.3 L./mm

[redacted]


MICRODENSITOMETRIC TRACE
Trace Number: 4
Mission Number: 1016-2
Pass Number: 126D
Frame Number: 5 FWD
Density Calibration: .087 D/cm
Width of Line Spread Function
at 50% amplitude: 13.91 μ
Reciprocal of LSF width
at 50% amplitude: 71.9 L/mm


MICRODENSITOMETRIC TRACE
Trace Number: 5
Mission Number: 1016-2
Pass Number: 126D
Frame Number: 5 FWD
Density Calibration: .087 D/cm
Width of Line Spread Function
at 50% amplitude: 13.59μ
Reciprocal of LSF width
at 50% amplitude: 73.6 L/mm

[redacted]

3. INTRODUCTION TO ISODENSITRACING

The Joyce-Lobel Double Beam Microdensitometer has been adapted to include the recently developed isophotometer equipment made by Tech/Ops. When used with the attachment it is properly called an Isodensitracer (IDT).

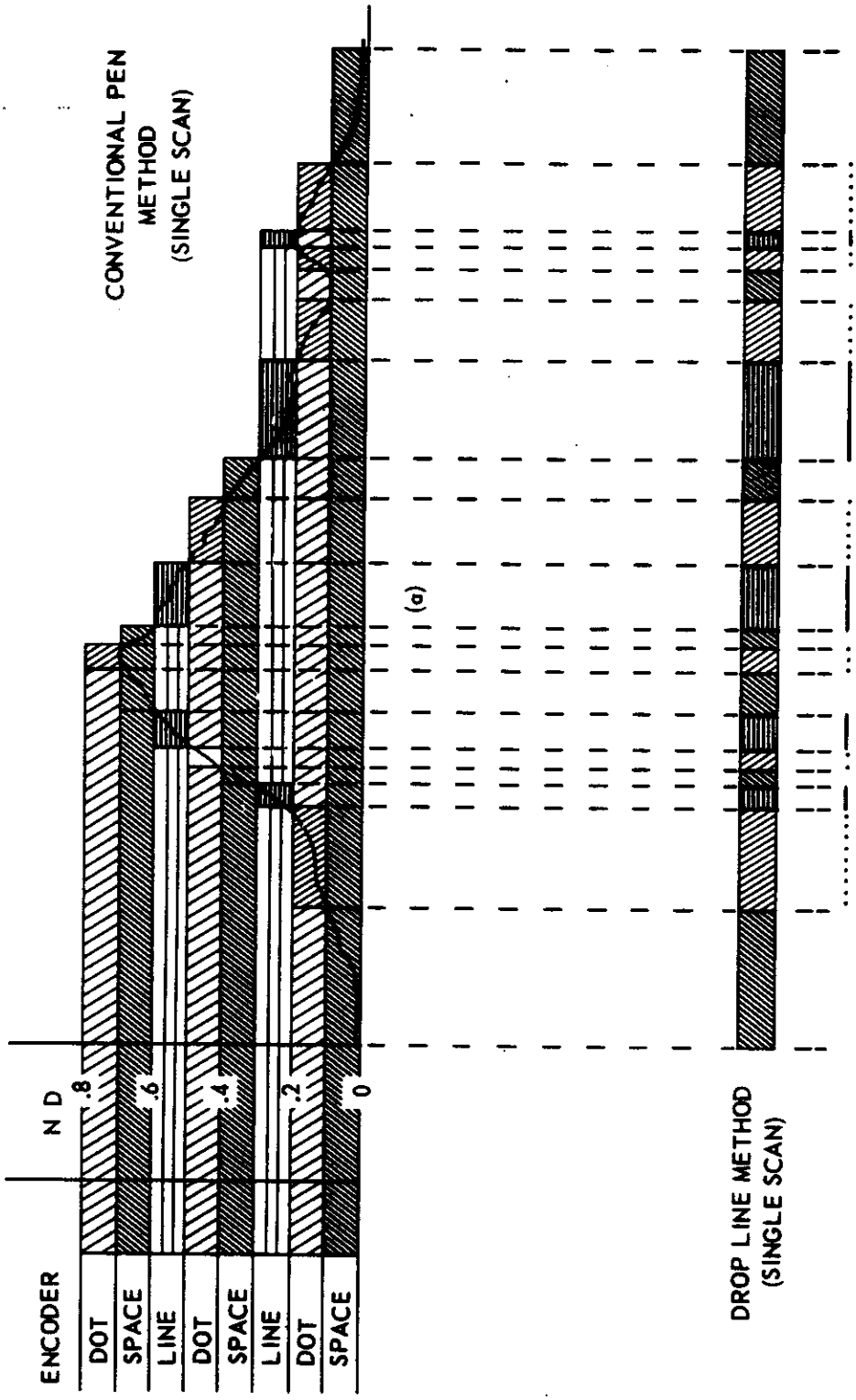
The optical system of the IDT automatically makes a series of closely spaced parallel scans. For each scan of the specimen a corresponding coded parallel line is recorded, forming a contour map of the scanned area.

The code in the recorded lines indicates the amount of density change in pre-set increments and also shows whether the density is increasing or decreasing. When density is increasing, the 3-symbol code line is printed in the sequence: blank-dot-line-blank-dot-line. Whenever the density is decreasing the symbol sequence changes to: line-dot-blank-line-dot-blank. Each symbol in the sequence represents a density increment and is continuously plotted until the density in the specimen changes by that increment; then the next symbol in the specimen is plotted.

When the IDT has completed a scan, recording the density profile along that single scan line in code, the pen lifts from the recording paper and both the specimen table and the recording table return to the starting X position. At the same time the specimen table and the recording pen step in the Y direction, then the next scan is begun. This sequence is repeated automatically until the instrument has mapped the density of the specimen area. Contours are thus formed by adjacent, like symbols.

Precise specimen-to-record magnifications can be set at from 1:1 to 1:1000 in the X direction as in the basic Joyce-Lobel instrument and at from 1:1 to 1:3100 in the Y direction. The X and Y ratios can be set separately.

The following illustration shows how a conventional microdensitometric trace is portrayed as a 3-symbol code line by the IDT. Each successive scan is a code line and is printed parallel to (b).



DESCRIPTION OF ISODENSITOMETRIC CODE.

[redacted]

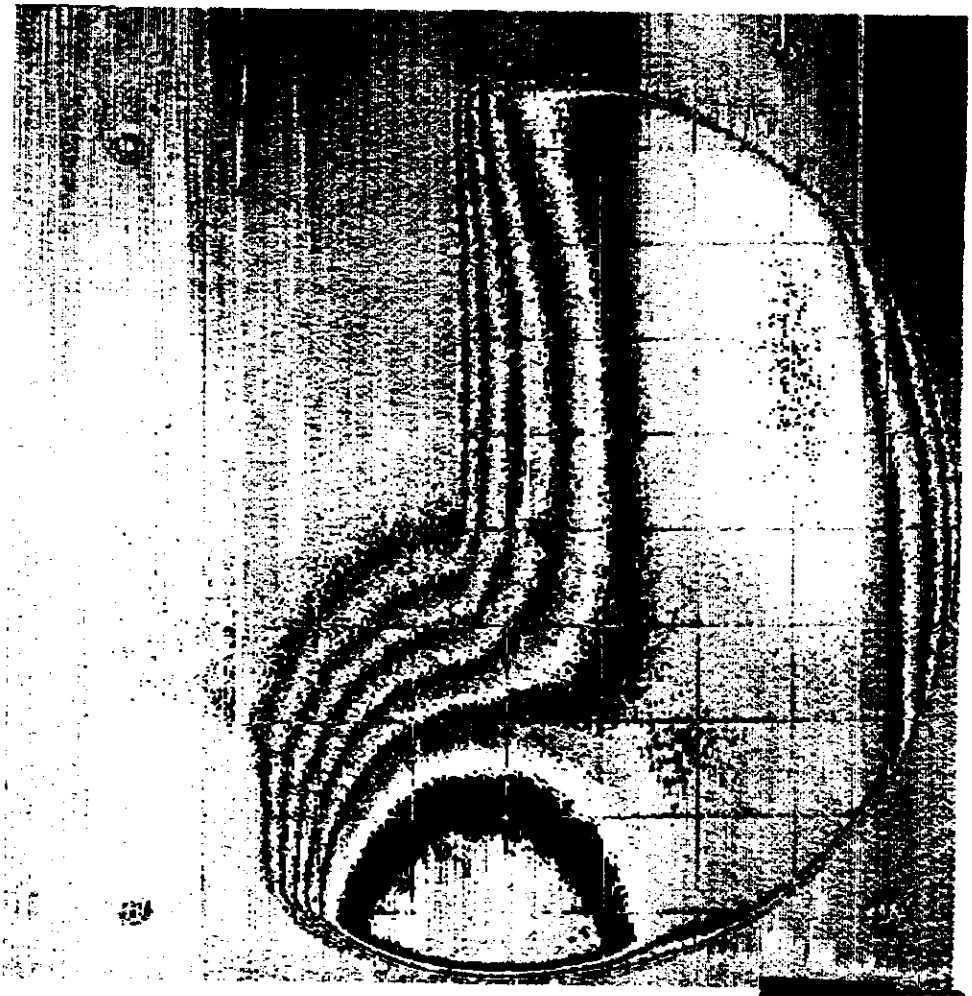
4. Isodensitraces of Stellar Format

The traces included in this report illustrate one of many applications of the IDT that are being explored. In the traces the flare pattern and the density gradient in the flare affected areas of the stellar format are easily seen. Two traces were necessary to represent the full range of density in the format. The first trace contains the low density areas of the frame, with the high densities going off scale -- as in the uniform "line" coded area. The second trace shows the details in the high density areas, with the low densities going off scale.

Both traces were made with a specimen-to-record magnification of 5X in the X and Y directions. The increment between symbols in the code lines was set at 0.12 density, and the total range of density in each trace does not exceed 3.00 density. The effective limiting aperture (spot size) of the ITD was set at 75 microns.

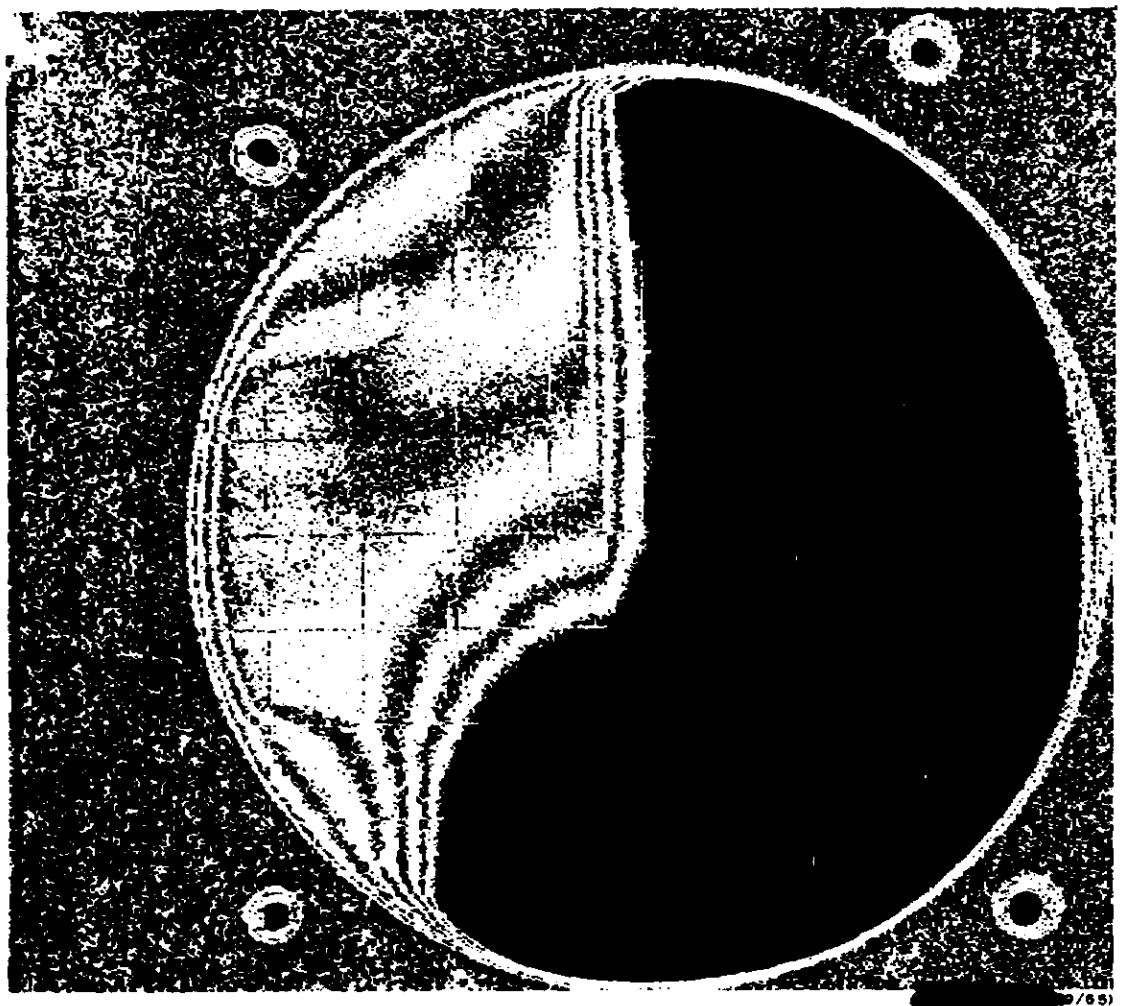
Notice of Missing Page(s)

Pages 56 and 57 of the original document were blank and not numbered.



TRACE 1. ISODENSITRACE OF STELLAR FRAME 342, LOW DENSITIES.

[redacted]



TRACE 2. ISODENSITRACE OF STELLAR FRAME 342, HIGH DENSITIES.

APPENDIX D. CLOUD COVER ANALYSIS

1. INTRODUCTION

This study represents a statistical analysis of the cloud cover on the photography of Mission 1016. The basis of this study is the cloud cover data for each quarter segment of every individual frame of photography. The data are obtained by analysts specifically trained in estimating cloud cover by designated categories.

Five cloud categories have been formulated for use in this photography (Reference, Table 1). These categories allow for the wide latitude of cloud cover conditions commonly found on a frame of this photography. Note in Table 1 that a mean cloud percentage value has been calculated for each category for use in determining a combined cloud cover percentage for all operational passes of the mission.

The occurrence of each cloud category within an operational pass is expressed as a percentage of 100 and appears in Table 2. Each percentage is a ratio of the number of occurrences of a given cloud cover category to the total number of cloud observations in a photo pass. For example: if the number of category 1 occurrences in a given pass is 200 out of a total of 1000 (250 frames x 4 quarters), all categories combined, than 20 percent of the pass would be classed as category 1.

Also, a cloud cover percentage per pass is included in the last column of Table 2 under "Cloud Cover % Per Pass". This value is determined by the summation of the products of category percentage in each pass and the mean cloud percentage for that category as established in Table 1. For example: if it is determined that the following percentages exist in a given pass:

20% Category 1
15% Category 2
30% Category 3
25% Category 4
10% Category 5

[redacted]

Then, by using the mean cloud percentage established in Table 1, the following computations are made:

$$
\begin{aligned}
0.20 \times 5.0 &= 1.00\% \\
0.15 \times 17.5 &= 2.63\% \\
0.30 \times 38.0 &= 11.40\% \\
0.25 \times 75.0 &= 18.75\% \\
0.10 \times 100.0 &= 10.00\% \\
&\overline{43.78\%}
\end{aligned}
$$

Hence, 43.8 percent of this pass is cloud covered.

TABLE 1

CLOUD COVER CATEGORIES

CATEGORY NUMBER	PERCENT OF CLOUD COVER	DESCRIPTION	MEAN CLOUD PERCENTAGE
1	Less than 10%	Clear	5%
2	10% - 25%	Small Scattered Clouds	17.5%
3	26% - 50%	Large Scattered Clouds	38%
4	51% - 99%	Broken or Connected Clouds	75%
5	100%	Complete Overcast	100%

2. CLOUD COVER DATA MISSIONS 1016-1 & 1016-2

PERCENTAGE OF CLOUD COVER CATEGORIES BY PASSES

Mission 1016-1

Pass Number	1	2	3	4	5	Cloud Cover % Per Pass
2D	71.0	9.0	12.0	8.0	0.0	15.7
3D	49.5	8.2	16.3	26.0	0.0	29.6
5D	78.1	18.5	3.4	0.0	0.0	8.4
6D	21.5	7.7	13.6	48.7	8.5	52.6
8D	15.8	8.5	10.8	29.3	35.6	63.9
10D	1.9	6.3	36.6	51.9	3.3	57.3
14D	20.3	9.4	22.3	48.0	0.0	47.1
18D	82.4	2.8	1.8	13.0	0.0	15.0
19D	39.0	16.2	22.8	22.0	0.0	30.0
20D	47.5	19.3	5.7	15.4	12.1	31.6
21D	33.1	11.5	21.4	27.8	6.2	38.8
22D	26.0	14.9	21.8	29.4	7.9	42.2
24D	27.3	5.1	8.7	17.2	41.7	60.2
25D	25.7	5.9	14.8	31.6	22.0	53.7
26D	0.0	0.0	25.0	74.2	0.8	66.0
30D	0.0	0.0	7.4	91.2	1.4	72.6
34D	77.7	2.7	7.1	12.5	0.0	16.4
36D	62.4	7.0	16.8	12.6	1.2	21.4
37D	41.4	18.3	17.3	22.7	0.3	29.1
38D	26.6	15.6	19.5	28.6	9.7	42.6
39D	24.8	5.7	20.0	41.3	8.2	49.0
40D	32.5	2.1	7.2	53.8	4.4	49.4
41D	3.3	8.0	52.8	35.9	0.0	48.5
52D	47.1	9.5	20.0	22.5	0.9	29.4
54D	27.0	12.8	28.4	15.2	16.6	42.3
55D	46.2	7.1	10.0	13.1	23.7	40.9
56D	10.9	7.0	12.1	59.4	10.6	61.5
57D	0.4	15.6	75.4	8.6	0.0	37.9
69D	57.0	8.6	15.1	15.5	3.8	25.6
70D	25.3	12.5	22.5	38.0	1.7	42.3
71D	39.5	5.5	22.0	32.0	1.0	36.3
72D	0.0	0.0	0.0	46.8	53.2	88.3
77D	0.0	0.9	6.9	88.8	3.4	72.8
	32.1*	9.6*	17.6*	31.1*	9.6*	42.9**

*Average Percentage by Category for Mission.

**Overall Mission Cloud Cover Percentage.

[redacted]

Mission 1016-2

Pass Number	1	2	3	4	5	Cloud Cover % Per Pass
83D	58.0	11.3	17.2	13.5	0.0	21.6
84D	32.5	5.9	16.4	32.8	12.4	45.9
85D	65.7	17.5	13.6	3.2	0.0	13.9
86D	57.6	13.5	14.0	10.3	4.6	22.9
88D	86.5	5.4	5.4	2.7	0.0	9.4
89D	0.0	0.0	7.8	46.1	46.1	83.6
93D	21.6	6.9	33.7	37.5	0.3	43.5
99D	31.8	7.0	21.6	31.7	7.9	42.7
100D	45.7	8.1	13.3	22.8	10.1	35.9
101D	44.6	13.6	16.9	21.6	3.3	30.5
102D	36.1	21.6	15.1	14.3	12.9	35.0
104D	20.7	11.2	19.1	44.4	4.6	48.1
115D	51.5	9.5	18.5	19.7	0.8	26.8
116D	78.8	4.2	7.9	7.1	2.0	15.0
117D	28.8	17.7	23.5	24.2	5.8	37.4
118D	40.1	14.5	15.1	29.1	1.2	33.3
120D	0.0	2.2	70.6	27.2	0.0	47.6
131D	88.4	8.5	2.4	0.6	0.0	7.3
132D	20.9	7.9	44.3	24.6	2.3	40.0
133D	18.8	17.0	14.1	30.5	19.6	51.7
134D	30.1	6.3	11.6	25.5	26.5	52.7
135D	11.5	6.6	9.9	26.9	45.1	70.7
140D	9.2	26.3	61.9	2.6	0.0	30.5
147D	24.1	7.8	19.2	38.9	10.0	49.1
148D	47.6	14.0	31.3	7.1	0.0	22.0
149D	32.6	11.1	19.4	30.6	6.3	40.2
150D	17.5	12.2	16.2	44.3	9.8	52.2
151D	79.4	1.9	15.6	3.1	0.0	12.6
156D	18.2	27.3	41.6	12.9	0.0	31.2
	38.3*	11.0*	20.5*	22.9*	7.3*	36.1**

*Average percentage by category for mission.
**Overall mission cloud cover percentage.