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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT MISSION 1019-1

29 APRIL - 4 MAY 1965

[redacted]

OCTOBER 1965

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48 PAGES

This document contains information referring to Project Corona

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PHOTOGRAPHIC EVALUATION REPORT
MISSION 1019-1
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NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

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SYNOPSIS

Mission 1019-1 (System No J-04) was launched 29 April 1965. Two periods of photographic operations (Missions 1019-1 and 1019-2) were executed as programmed, but an error in the re-entry sequence prevented recovery of the second film payload.

Mission 1019-1 (29 April-4 May 1965) accomplished 48 photographic revolutions, including 5 domestic and 5 engineering (dark-side) passes. The payload was recovered by air catch on 4 May. All cameras functioned satisfactorily throughout the mission. Telemetry indicated similar camera performances in the second phase, and it appears that only the re-entry sequence error prevented accomplishment of a successful 2-stage effort.

The panoramic records acquired in Mission 1019-1 were assigned a Mission Information Potential (MIP) rating of 85. The photography is comparable to that achieved in Mission 1015, flown 19-30 December 1964. However, the slave (AFT) panoramic record is degraded by the presence of small, out-of-focus areas along the fiducial edge at both ends of the formats. A similar condition was reported in the evaluation of Mission 1015.

Clouds obscured 36 percent of the terrain covered in the mission. Solar elevation data are not available at this time.

GENERAL FLIGHT DATA

Launch Date	29 April 1965
Recovery Date	4 May 1965

Orbital Parameters
(Rev 41)

Period	91.069 Min
Perigee	99.772 nm
Apogee	259.83 nm
Eccentricity	0.02211
Inclination Angle	85.03° N

Photographic Operations

Operational Passes	38
Domestic Passes	5
Engineering Passes	5
Recovery Revolutions	80

PART I. CAMERA OPERATION

1. Master (FWD) Panoramic Camera No 118:

The instrument was operational throughout the mission and camera-induced film degradations consist primarily of various light-struck areas at the beginning and end of each pass record. Their appearances on the film conform to the following repetitive pattern:

(a) 1st frame: an equipment shadowgraph, not readily detectable in all passes.

(b) 5th-from-last frame: an edge-to-edge area of uniform fog, approximately 6 inches wide. This is reported to result from light passing through the vehicle's ablative shield.

(c) Next-to-last frame: a small light trace of irregular configuration, generally found on the fiducial edge at the take-up end of the format. This is the result of light passing through a drum leak and reflecting onto the film from a high-finish thermal surface in the barrel of the camera.

(d) Last frame: An equipment shadowgraph, present in most passes. Degradation of imagery within the affected areas is not severe except in the fifth-from-last frame where the uniform fogging occurs. The degree of degradation depends on solar elevation and azimuth and on the length of the camera-off period following termination of a photographic pass.

Intermittent minus-density streaks are noted in passes 1D and 3D. Their cause is unknown. Most of these streaks run roughly parallel to the major film axis through (or near) the frame centers. Some of the streak paths appear to coincide with field flattener movements, but others do not as readily conform to a possible relationship between the streaks and action of the field flattener.

Continuous rail scratches are present on both film edges. Most frames contain a group of short, fine, longitudinal emulsion scratches under the camera number and similar heavier scratches that extend from the take-up of the frame to the vicinity of the camera number. Although the latter are more prominent than have been observed in previous missions, degradation remains slight. Both types of scratches are tentatively identified as scan head roller scratches, caused during film transport as the scan arm returns to its start position.

2. Slave (AFT) Panoramic Camera No 119:

The unit was operational throughout the mission, and the majority of the camera-induced degradations are on the order of those noted in the fwd panoramic record. The most notable exception is the reappearance of an

out-of-focus condition which has not been observed since Mission 1015. Details of the more common light leaks, scratches, and so forth will be cited after discussion of the focus anomaly.

The degraded areas are on the fiducial edge of the formats, in the vicinity of the shrinkage markers at the take-up and supply ends of the frames. Degradation is more consistent and prominent at take-up. However, degradation at both ends of the formats is sometimes so subtle that detection is difficult, particularly when the imagery in the affected area does not contain sufficient culture for reference and comparison purposes. The size and contour of the out-of-focus areas vary but the estimated total image degradation within the individual frames does not exceed 1 percent. Obviously, however, the presence of a focus problem merits attention without regard to the physical extent of the degradation. Precise determination of the initial appearance of the out-of-focus condition in this mission was hampered by cloud cover and/or lack of culture in the early photographic passes, but there is evidence that the anomaly already existed in pass 5D and was possibly present as early as pass 2D.

Extensive investigation of previous mission records that contained similar degradations, such as Missions 1004, 1007, 1010, 1011, and 1015, indicates a possible relationship between format pitch (the alignment of the individual formats relative to the major axis of the film) and the presence of the out-of-focus condition. Apparently, pitch variations are a significant factor. In addition, it appears that a critical displacement between the pitch of the supply and take-up format ends must occur in order to induce degradation.

No focus anomaly is detectable in the fwd panoramic record acquired in this mission. The format pitch measurements are relatively stable throughout the entire record, and the difference between the pitch measurement at supply and pitch value at take-up of any individual frame seldom exceeds 0.010 inch. (Pitch is measured from the fiducial edge of the format to the edge of the film, at points immediately adjacent to and inboard of the end shrinkage markers.)

The aft pitch measurements exhibit considerable instability, as does the differential between the supply and take-up ends of the formats. Sample pitch values and pertinent comments follow:

[redacted]

Pass	Average Pitch At Take-up (inches)	Average Pitch At Supply (inches)	Average Differential (inches)	Comments
1D	0.245	0.255	0.010	Imagery does not permit positive detection of degradation.
2D	0.235	0.245	0.010	
5D	0.230	0.245	0.015	Small degradation at take-up.
8D	0.230	0.245	0.015	Same as in 5D
9D	0.230	0.245	0.015	Same as in 5D and 8D.
13D	0.232	0.247	0.015	Degradation slightly larger.
19D	0.240	0.250	0.010	Degradation decreased.
21D	0.230	0.245	0.015	Degradation increased.
22D	0.232	0.247	0.015	Same as in 21D.
23D	0.230	0.247	0.017	Degradation slightly more prominent.
24D	0.235	0.252	0.017	Same as in 23D.
25D	0.242	0.253	0.011	No apparent change.
30D	0.242	0.257	0.015	Small degradation detectable both ends.
41D	0.237	0.257	0.020	Degradation more pronounced at supply.
57D	0.240	0.255	0.015	Degradation at take-up much increased, extends approximately 4 inches along format edge and intrudes $\frac{1}{2}$ inch into format at maximum penetration point.
62D	0.245	0.257	0.012	Degradation reverts to previous small extent.
63D	0.242	0.255	0.013	No apparent change at take-up or supply.

Certain conclusions may be drawn from the above tabulations and comments but caution is advised. The pitch measurements were obtained with a 7X monocular fitted with a 0.005 inch reticle. In addition to the obvious limitations of the instrument itself, there is the possibility of human error in taking off the values. Furthermore, it is difficult to detect the presence of degradation and even more difficult to assess its extend where no culture or prominent terrain features are imaged. Bearing these factors in mind, the following conclusions are offered:

(a) There is a critical displacement ratio (pitch at take-up versus pitch at supply) which must be attained in order to induce a detectable out-of-focus condition. Maximum degradation in this mission is observed in pass 57D (which, coincidentally, contains a high culture content) and the pitch readings at take-up averaged 0.240 inch while the supply pitch values averaged 0.255 inch. Although the differential between take-up and supply (0.015 inch) is present in other passes, in no other case is the degradation observed to be as extensive.

(b) The differential between the 2 ends of the format is also a potent factor. Refer to pass 41D, where the difference is 0.020 inch and degradation is not only readily detectable at both ends but now appears to be more prominent at supply.

(c) Finally, it appears that pitch displacement ratio and pitch differential must combine in a critical relationship of values in order to induce maximum degradation. A shift in this relationship will alter the degree and even the location of the out-of-focus condition within a frame.

The aft panoramic record contains a number of light-struck areas similar to those present in the fwd material. However, the repetition pattern differs slightly:

(a) 1st frame: an equipment shadowgraph appears in a few passes.

(b) 6th-from-last frame: an edge-to-edge area of uniform fog, approximately 6 inches wide.

(c) 2nd/3rd-from-last frames: a light trace between the frames which may shift into the supply end of the 3rd-from-last frame or to take-up of the 2nd-from-last frame. An equipment shadowgraph occasionally appears in the 2nd-from-last frame.

(d) Last frame: an equipment shadowgraph is present in a number of passes, and a bar-type light trace is detectable in a few passes.

The same camera-induced scratches noted in the fwd panoramic record are present in the aft material. A continuous plus-density streak runs through the frame-centers of pass 4F. Minus-density streaks are intermittent and few.

[redacted]

Transverse banding is detectable in pass 24D and becomes progressively greater in subsequent passes. As in previous missions, the banding is most prominent at the start of the scan action and is derived from non-linear movement of the scan head with relation to the film. Degradation is not severe.

3. Master (FWD) Horizon Cameras:

The port (supply) and starboard (take-up) horizon cameras were operational throughout the mission. Exposure was adequate except where low solar elevations precluded effective horizon photography. Image quality is good.

4. Slave (AFT) Horizon Cameras:

The port (take-up) and starboard (supply) horizon cameras functioned satisfactorily. Exposure was adequate except where low solar elevations prevailed. Image quality is similar to that obtained with the master horizon cameras.

5. Stellar Camera No 35:

The instrument performed without malfunction and produced good-quality images. All of the stellar frames were used to advantage in the vehicle attitude analysis. It is believed that the attitude values obtained from each frame are correct. As a matter of interest, it is noted that the horizon reduced values do not square with the stellar reductions. With reference to roll, for example, the horizon reductions indicate twice as much roll (in terms of actual minutes of arc) as the stellar reductions reveal.

The geometric distribution of the stellar images (approximately 30 readily identifiable stars) is good. Images are detectable even in the format areas degraded by earth albedo. Albedo degradation, incidentaly, appears to be of less magnitude than in most previous missions.

Approximately 25 frames contain stellar images which are distorted to some degree. The factors which contribute to the distortions (streaking, elongation, and so forth) are not precisely known, but it is currently felt that timing conditions in the panoramic cameras and monoscopic operations in certain circumstances are involved.

6. Index Camera No D35:

The unit was operational throughout the mission and produced good-quality photography, perhaps the best obtained to date.

7. Associated Equipment:

The binary data block failed to record on 6 frames, as follows:

Pass 8D, frame 31 (fwd)
Pass 21D, frame 103 (fwd)
Pass 30D, frame 17 (fwd)
Pass 68D, frame 15 (aft)
Pass 72D, frame 70 (aft)
Pass 74D, frame 12 (aft)

In addition, the uniform fog present in certain frames of the panoramic photography (See Items 1 and 2 of this part) caused the dot reader to make erroneous interpretations of the binary data a number of times during the binary readout.

The frequency marks are flared, but the marks and attendant reflected images are recorded outside of the formats. However, intensity of the marks is not consistent, and they often range from underexposed to adequately exposed within a pass. The end-of-pass markers are heavily overexposed. The horizon format fiducials are slightly flared throughout the fwd panoramic material. One of the horizon fiducials is similarly affected in the aft panoramic record (the fiducial adjacent to the panoramic frames in the starboard horizon formats). The camera number is slightly flared, and the adjacent binary index lamp is considerably bloomed.

[redacted]

PART II. FILM

1. Film Footage/Frame Totals:

The film footage/frame totals for Mission 1019-1 are as follows:

Master (FWD) Panoramic Camera	7,254 ft/2,829 frames
Slave (AFT) Panoramic Camera	7,842 ft/2,779 frames
Stellar Camera	54 ft/ 401 frames
Index Camera	90 ft/ 401 frames
Total Panoramic Footage/Frames	15,096 ft/5,608 frames

(Note: All footage figures are process machine footages.)

2. Film Processing:

This section provides evaluation of processing, density, contrast. and physical condition of the original negatives. Processing data are abstracted from records maintained by the processing contractor. Evaluation of exposure and physical condition of the film are accomplished by on-site inspection of the negative material as it is made available for breakdown and titling. A final, more thorough examination of the original negative is conducted by photographic analysts at a later date.

In general, most of the photography obtained in this mission received adequate exposure. However, low solar elevations and/or variations in terrain reflectivity caused some departures from normal. Densities range from thin (in photography acquired at low solar elevations) to heavy. The majority of the density values (approximately 50 percent) fall in the medium category. Similarly, most of the photography contains medium-contrast imagery.

The following development levels were employed in processing the film:

	Master	Slave
Primary	22%	26%
Intermediate	32%	55%
Full	46%	19%

Sixty-four processing level changes were required for the master (fwd) panoramic record and 41 changes for the slave (aft) material. Three parts required special printing.

3. Physical Film Degradations:

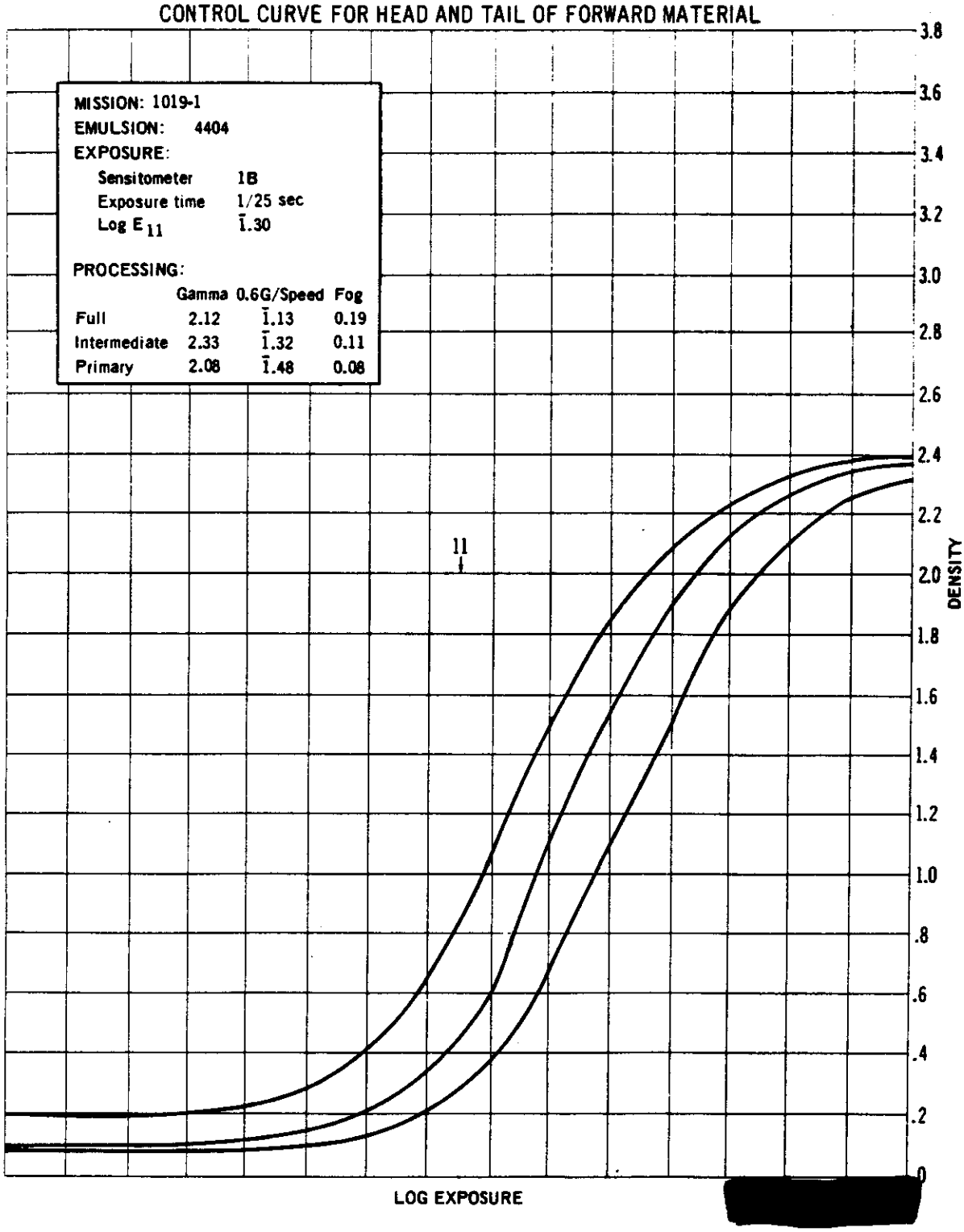
Pass 5D, frame 112 (fwd) contains numerous transverse emulsion scratches. Similar, heavier scratches are present in pass 23D, frame 45 (fwd) near frame-center. In pass 21D (fwd), frames 20-137 are degraded by numerous, small longitudinal emulsion scratches. Continuous heavy, parallel base scratches are present in pass 41D, frames 46-50 (aft).

4. Film Processing Curves:

The following graphs are reproductions of the film processing curves provided by the processing contractor for Mission 1019-1.

[redacted]

CONTROL CURVE FOR HEAD AND TAIL OF FORWARD MATERIAL



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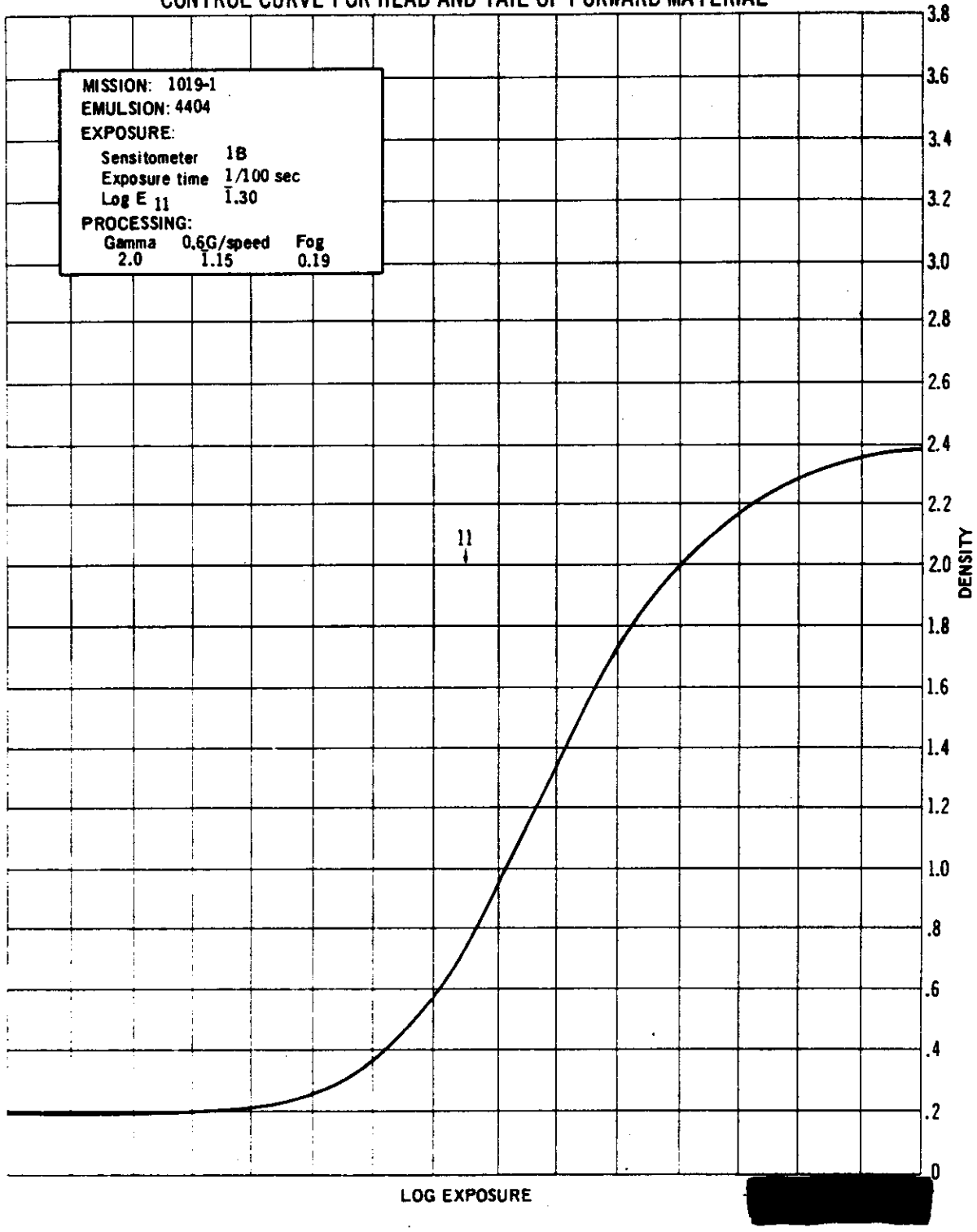
CONTROL CURVE FOR HEAD AND TAIL OF FORWARD MATERIAL



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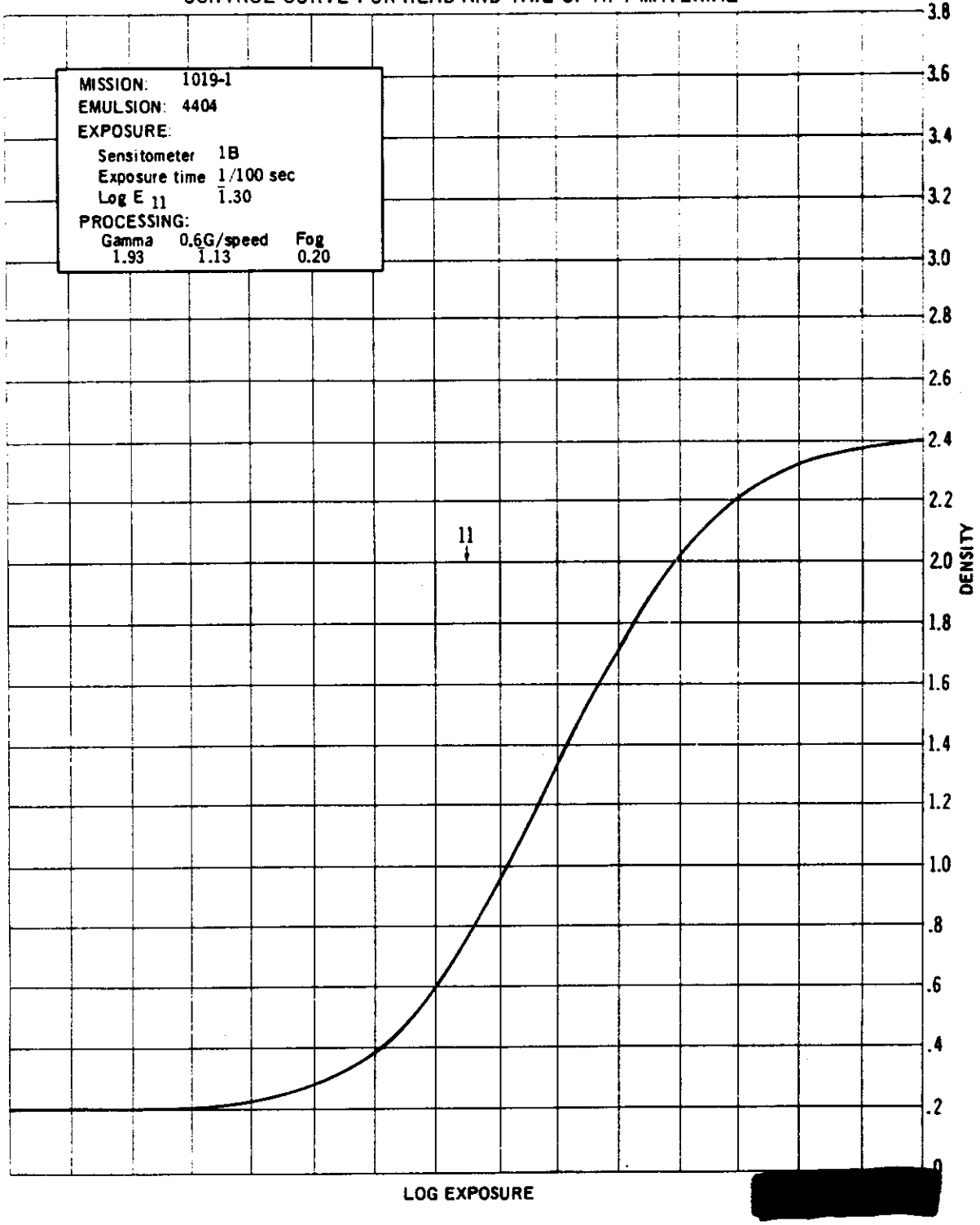
CONTROL CURVE FOR HEAD AND TAIL OF AFT MATERIAL



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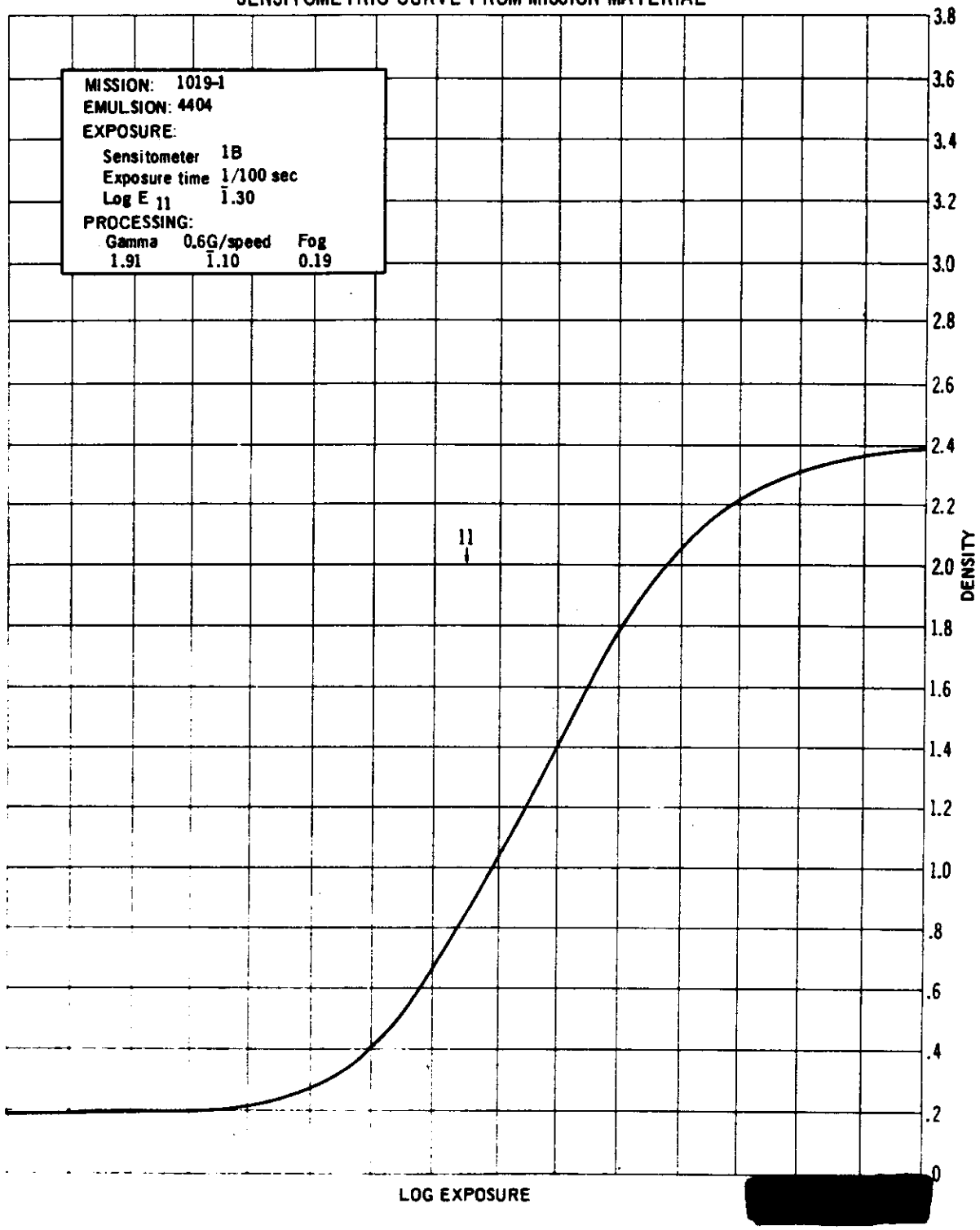
SENSITOMETRIC CURVE FROM MISSION MATERIAL



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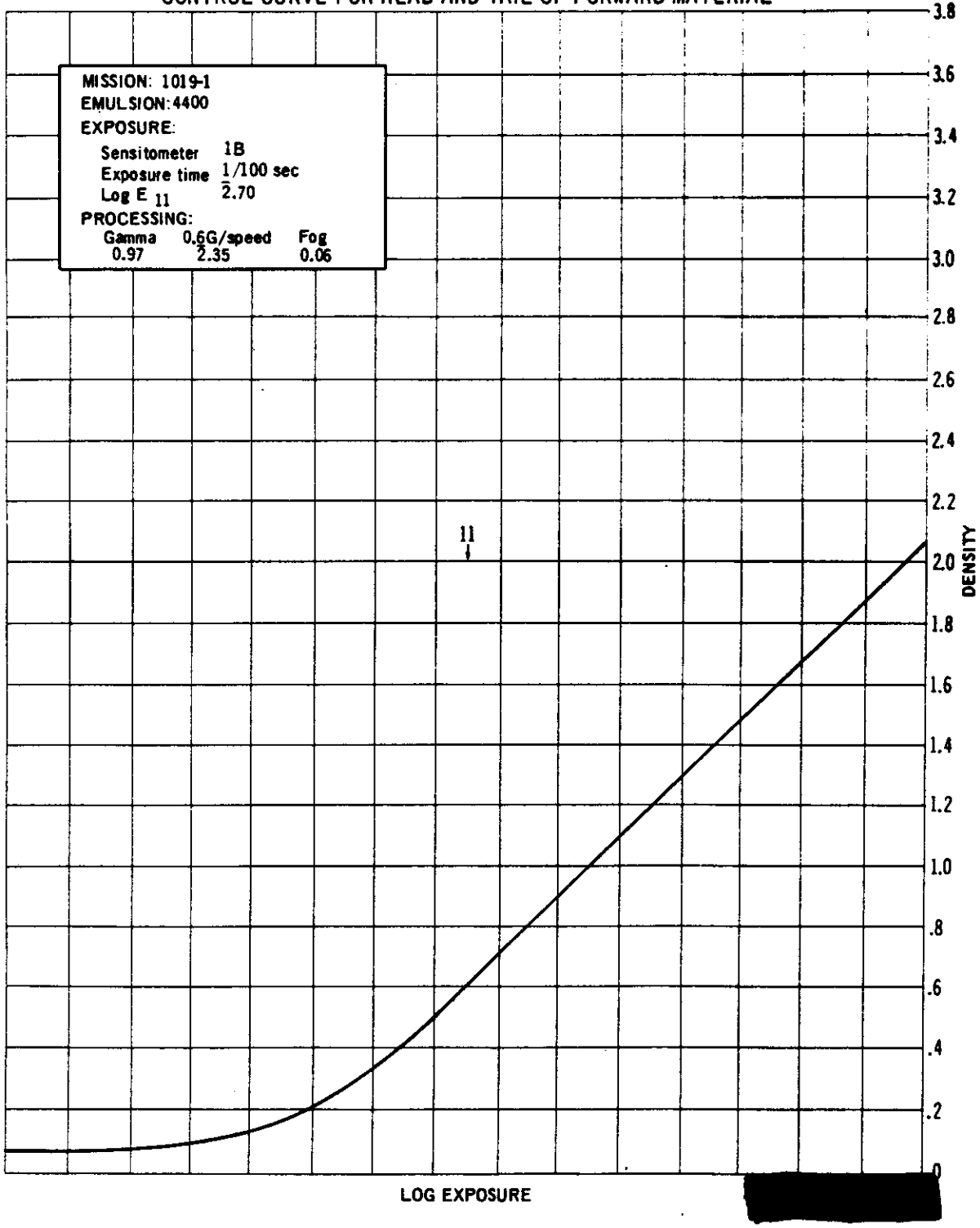
CONTROL CURVE FOR HEAD AND TAIL OF FORWARD MATERIAL



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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 assignment of 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 is 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 optimal. 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 is possible but accuracy of mensuration is reduced by the 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, Mission 1019-1:

The PI suitability of Mission 1019-1 ranges from fair to good. The photographic coverage affords observation of 71 targets. A few of the coverage highlights reported in the preliminary readout are:

(a) Possible new electronics facility under construction at a nuclear weapons proving ground.

(b) Identification of 2 new fixed field missile sites.

(c) New identification of a probable missile training site.

(d) Confirmation of a previously suspect nuclear weapons storage area.

Interpretation of approximately 30 percent of the targets was hampered by unfavorable atmospheric conditions in the target areas. Low contrast and/or obliquity further complicated observation in a number of cases. Cloud reflectance streaking is detectable in portions of the photography, but the attendant degradation is not significant. (This anomaly was discussed in some detail in the report on Mission 1015.)

The initial scan of the mission record was performed in a relatively short time, without the aid of the precise analytical and mensuration instruments normally employed. Continued study of the film may reveal additional targets and may alter some of the information obtained during the initial interpretation phase.

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.

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 because 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, Mission 1019-1:

[redacted]

Based on the foregoing criteria, the airfield near frame-center of frame 14 in pass 57D (fwd) is selected as the MIP example for this mission and is assigned a rating of 85. In general, the photographic quality of the master (fwd) panoramic record is judged to be slightly better than that of the slave material but the difference is neither consistent nor uniform when evaluated on a frame-for-frame basis. The overall quality of the panoramic records is considered comparable to Mission 1015, 19-30 December 1964.

Notice of Missing Page(s)

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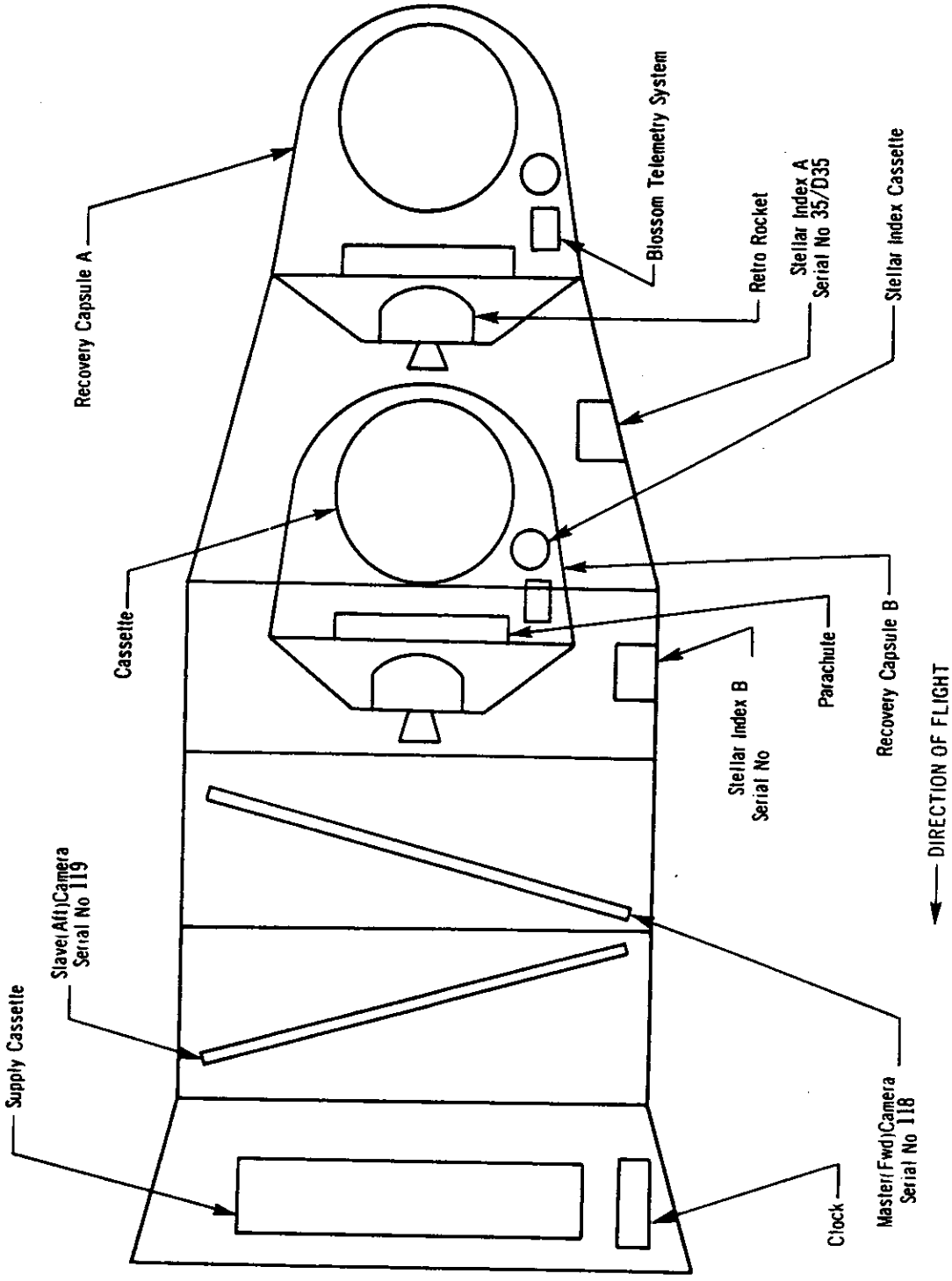
APPENDIX A. SYSTEM SPECIFICATIONS

1. Cameras:

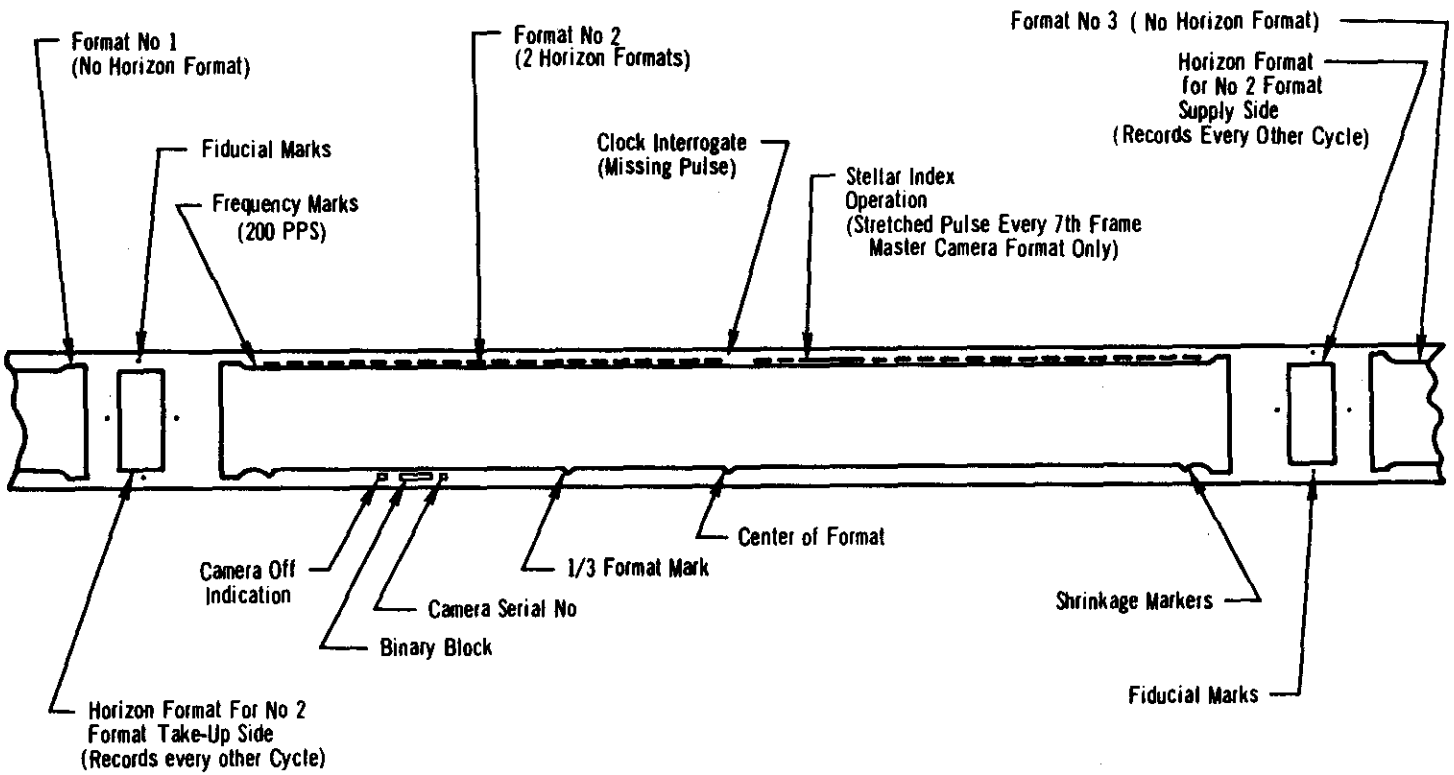
	Master Panoramic	Master Port Horizon	Master Stbd Horizon	Slave Panoramic	Slave Port Horizon	Slave Stbd Horizon	Stellar	Index
Camera No	118	NA	NA	119	NA	NA	35	D35
Lens Serial No	0602435	812313	81203	0572435	813514	813520	10487	813051
Slit Width	0.250"	NA	NA	0.175"	NA	NA	NA	NA
Aperture	f/3.5	f/6.8	f/8.0	f/3.5	f/6.8	f/8.0	f/1.8	f/4.5
Exposure Time	NA	1/100 sec	1/100 sec	NA	1/100 sec	1/100 sec	2.0 sec	1/500 sec
Filter	Wratten 25	Wratten 25	Wratten 25	Wratten 21	Wratten 21	Wratten 21	None	Wratten 21
Focal Length (mm)	609.574	54.579	54.920	609.117	54.94	54.70	NA	NA
Film Length (ft)	16,000	NA	NA	16,000	NA	NA	54	90
Splices	4	NA	NA	5	NA	NA	None	None
Emulsion	81-6-1-5	81-6-1-5	81-6-1-5	81-6-1-5	81-6-1-5	81-6-1-5	54-2-9-4	37-1-12-4
Film Type	4404	4404	4404	4404	4404	4404	4401	4400
Res Data, L/mm (A)	*	121	116	*	*	*	*	74
Static Bench Test:								
High Contrast	265	*	*	258	*	*	*	*
Low Contrast	149	*	*	164	*	*	*	*
Dynamic Test:								
I High Contrast	174	*	*	172	*	*	*	*
I Low Contrast	126	*	*	119	*	*	*	*
P High Contrast	179	*	*	186	*	*	*	*
P Low Contrast	112	*	*	114	*	*	*	*

NA = Not Applicable
* = Not Available
A = AWAR

2. VEHICLE CONFIGURATION AND EQUIPMENT LAYOUT



3. PANORAMIC FORMAT CONFIGURATION



Master (Fwd) Panoramic Camera No 118
Viewed With Negative Emulsion Down
Direction of Film Transport ←
Direction of Scan →
Direction of Vehicle Motion ↓

Stave (Aft) Panoramic Camera No 119
Viewed With Negative Emulsion Down
Direction of Film Transport ←
Direction of Scan →
Direction of Vehicle Motion ↑

[redacted]

[redacted]

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 as 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.

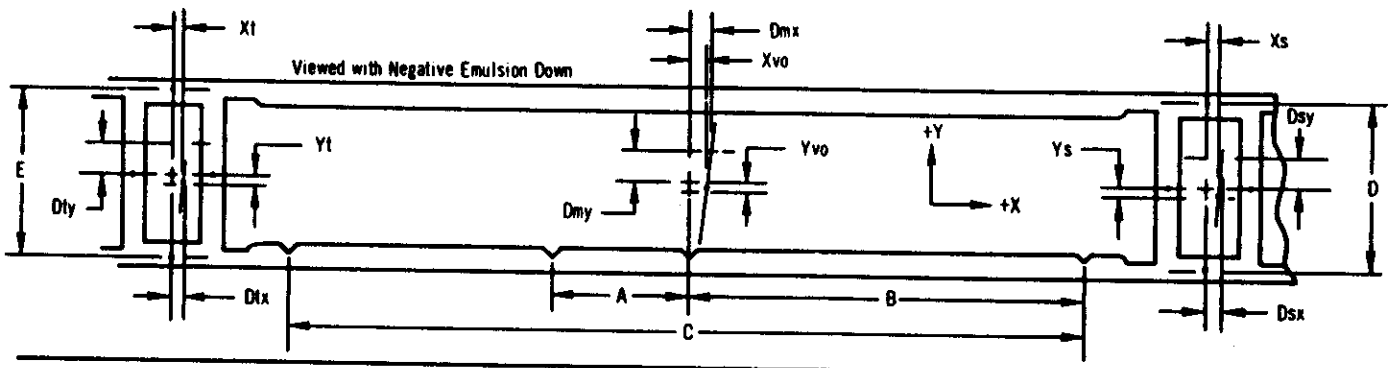
The format dimensions are measured to the best estimate of format edge.

[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 118		Vehicle Motion		Scan Direction	
A	76.1	Xt	−0.299	Dtx	−0.310
B	354.7	Yt	−0.008	Dty	+2.835
C	709.2	Xs	−0.024	Dsx	−0.026
D	56.424	Ys	−0.055	Dsy	+2.637
E	56.422	Xvo	+1.339	Dmx	+1.360
		Yvo	+0.727	Dmy	+3.727

Format dimensions:

Panoramic	
Height	55.738
Width	735.2

Slave (Aft) Camera 119		Vehicle Motion		Scan Direction	
A	75.9	Xt	−0.160	Dtx	−0.162
B	355.0	Yt	−0.031	Dty	+2.462
C	709.8	Xs	−0.276	Dsx	−0.263
D	56.379	Ys	−0.037	Dsy	+2.103
E	56.424	Xvo	−1.089	Dmx	−1.072
		Yvo	+0.730	Dmy	+3.730

Format dimensions:

Panoramic	
Height	55.801
Width	752.1

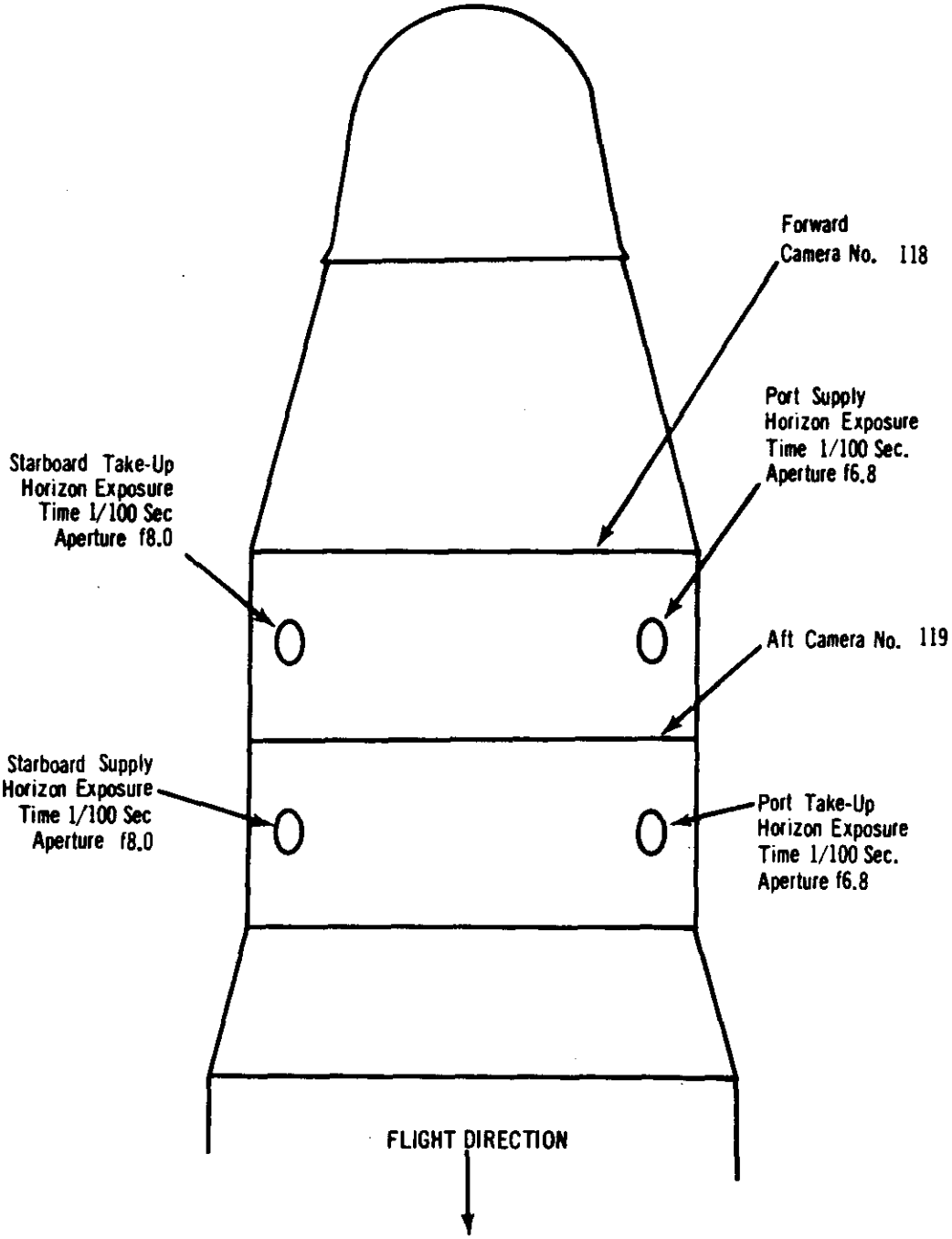
NOTE: 1. All dimensions are in millimeters and are average dimensions of three formats
2. Height of main format is taken at center of format
3. Dt, Dm, Ds, X and Y dimensions are taken 10 mm above point defining target center
4. Format Sign Convention

−X+Y	+X+Y
−X−Y	+X−Y

TOP SECRET
CORONA
NO FOREIGN DISSEM

[redacted]

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



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APPENDIX B. DENSITY READINGS

The following Stellar/Index density readings were made with a Macbeth QuantaLog Densitometer, Model EP 1000, fitted with an ET 20 attachment and an 0.5 millimeter aperture. The readings were obtained at each camera on-off position.

Mission 1019-1

		STELLAR CAMERA				INDEX CAMERA						
						LIMITING			Gross Fog	TERRAIN		
Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Dmax	Dmin	Delta		Dmax	Dmin	Delta
1D	1	2.05	.29	1.76	.24	1.30	.17	1.13	.07	.59	.22	.37
	2	2.11	.29	1.82	.25	1.42	.17	1.25	.07	.52	.36	.16
2D	3	2.15	.31	1.84	.26	1.70	.95	.75	.07	1.70	.95	.75
	6	1.96	.32	1.64	.28	1.70	.52	1.18	.07	1.70	.52	1.18
3D	7	2.25	.36	1.89	.27	1.62	.91	.71	.07	1.62	.91	.71
	12	2.13	.33	1.80	.27	1.75	.95	.80	.07	1.16	1.07	.09
	13	2.11	.33	1.78	.28	1.72	.68	1.04	.07	1.47	.68	.59
	15	2.09	.33	1.76	.30	1.78	.32	1.41	.07	1.28	.32	.96
4D	16	2.01	.34	1.67	.29	1.55	.90	.65	.07	1.55	.90	.65
	22	1.58	.29	1.29	.23	1.60	.27	1.34	.07	1.61	.99	.62
	23	2.49	.32	2.17	.22	1.67	.15	1.52	.07	1.35	.63	.72
	25	2.51	.37	2.14	.22	2.15	.15	2.00	.07	1.67	.41	1.26
5D	26	1.64	.27	1.37	.22	1.45	.75	.70	.07	1.45	.75	.70
	33	2.08	.28	1.80	.22	1.61	.91	.70	.07	NR	NR	NR
	34	2.05	.28	1.77	.23	1.63	.65	.98	.07	1.63	.72	.91
	40	2.12	.30	1.82	.23	1.35	.29	1.06	.07	1.32	.29	1.03
	41	2.01	.27	1.74	.22	1.83	.30	1.53	.07	.89	.55	.34
	43	1.99	.28	1.71	.22	1.52	.39	1.13	.07	.52	.39	.13
	44	2.31	.32	1.99	.22	1.80	.64	1.16	.07	1.80	.64	1.16
	45	2.36	.30	2.06	.22	1.63	.41	1.22	.07	.89	.41	.48
	46	2.03	.29	1.74	.22	1.68	.65	1.03	.07	.83	.65	.18
	48	2.46	.29	2.15	.22	1.67	.29	1.38	.07	.90	.29	.71
6D	49	2.06	.28	1.78	.22	1.53	.85	.68	.07	NR	NR	NR
	62	1.93	.27	1.66	.22	1.73	.32	1.41	.07	.94	.32	.62
	63	2.13	.29	1.84	.22	1.61	.24	1.37	.07	.90	.24	.76
	66	2.22	.28	1.94	.22	1.71	.45	1.26	.07	.85	.45	.40
	67	2.56	.32	2.24	.22	1.34	.56	.78	.07	1.30	.56	.74
	69	2.52	.34	2.18	.22	1.87	.54	1.33	.07	1.53	.54	.99
	70	2.48	.38	2.10	.22	1.77	.64	1.17	.07	.75	.64	.11
	76	2.28	.37	1.91	.22	1.61	.43	1.18	.07	.87	.43	.44
7D	77	2.38	.32	2.06	.22	1.63	.55	1.08	.07	.70	.55	.15
	78	2.41	.32	2.09	.22	1.62	.32	1.30	.07	.65	.32	.33
	79	2.08	.29	1.79	.22	1.63	.32	1.31	.07	1.54	.32	1.22
	81	2.13	.29	1.84	.22	1.48	.62	.86	.07	1.40	.62	.78
	82	2.33	.27	2.06	.22	1.88	.39	1.49	.07	1.88	.59	1.39
	83	2.13	.29	1.84	.22	1.55	.68	.87	.07	1.55	.68	.87
	84	2.11	.28	1.83	.22	1.20	.45	.75	.07	.80	.45	.35
	89	2.26	.29	1.97	.22	1.34	.15	1.19	.07	1.08	.45	.63

NR - Denotes No Reading Made

TOP SECRET
CORONA

Mission 1019-1

	STELLAR CAMERA					INDEX CAMERA						
						LIMITING			Gross Fog	TERRAIN		
Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Dmax	Dmin	Delta		Dmax	Dmin	Delta
8AE	90	.23	.22	.01	.22	.07	.07	0.00	.07	.07	.07	0.00
	91	.22	.22	.00	.22	.07	.07	0.00	.07	.07	.07	0.00
8D	92	2.28	.28	2.00	.22	1.56	.17	1.39	.07	1.56	.17	1.39
	102	2.48	.32	2.16	.23	1.55	.45	1.10	.07	1.55	.45	1.10
9D	103	2.23	.30	1.93	.23	1.59	.35	1.24	.07	.91	.35	.56
	105	2.29	.32	1.97	.23	1.47	.23	1.24	.07	.81	.30	.51
	106	2.38	.33	2.05	.23	1.67	.41	1.26	.07	.53	.41	.12
	110	1.89	.32	1.57	.27	1.85	.38	1.47	.07	1.40	.38	1.02
12D	111	1.79	.32	1.47	.28	1.34	.39	.95	.07	1.34	.39	.95
	112	1.89	.31	1.58	.26	1.52	.41	1.11	.07	1.52	.41	1.11
13D	113	2.00	.29	1.71	.25	1.35	.19	1.16	.07	.89	.19	.70
	117	1.84	.37	1.47	.33	.58	.13	.45	.07	.51	.22	.29
16D	118	2.39	.37	2.02	.33	1.90	.11	1.79	.07	NR	NR	NR
	120	2.27	.38	1.89	.33	1.25	.17	1.08	.07	1.03	.70	.33
19D	121	2.30	.39	1.91	.32	1.65	1.05	.60	.07	NR	NR	NR
	123	2.11	.32	1.79	.27	1.50	.89	.61	.07	1.50	.89	.61
	124	2.26	.30	1.96	.25	1.56	.24	1.32	.07	1.56	.41	1.15
	129	2.11	.29	1.82	.23	1.77	.24	1.53	.07	1.77	.42	1.35
21D	130	1.96	.26	1.70	.22	1.42	.72	.70	.07	1.22	.72	.50
	132	2.01	.27	1.74	.22	1.47	.64	.83	.07	NR	NR	NR
	133	2.23	.28	1.95	.22	.87	.24	.63	.07	.77	.24	.53
	141	2.13	.29	1.84	.22	1.58	.63	.95	.07	.77	.63	.14
	142	2.42	.30	2.12	.22	1.71	.44	1.27	.07	.92	.44	.48
	149	2.79	.42	2.37	.22	1.75	.47	1.28	.07	.69	.47	.22
22D	150	2.39	.32	2.07	.22	1.74	.79	.95	.07	1.74	.79	.95
	153	2.04	.27	1.77	.22	1.77	.51	1.24	.07	.72	.51	.21
	154	2.78	.33	2.45	.22	1.61	.29	1.32	.07	.66	.29	.37
	161	2.43	.29	2.15	.22	1.39	.14	1.25	.07	.71	.33	.38
	162	2.73	.32	2.41	.22	1.71	.25	1.46	.07	.71	.25	.46
	165	2.50	.31	2.19	.22	1.70	.37	1.33	.07	1.70	.44	1.26
23D	166	1.67	.26	1.41	.22	1.26	.53	.73	.07	1.26	.53	.73
	168	1.97	.26	1.71	.22	1.34	.69	.65	.07	1.34	.69	.65
	169	2.41	.29	2.12	.22	1.20	.35	.85	.07	.83	.35	.48
	180	2.71	.35	2.36	.22	1.79	.32	1.47	.07	1.79	.32	1.47
	181	2.13	.30	1.87	.22	1.80	.19	1.61	.07	.68	.43	.25
	186	2.21	.29	1.92	.22	1.95	.21	1.74	.07	.81	.47	.34

NR - Denotes No Reading Made

Mission 1019-1

		STELLAR CAMERA				INDEX CAMERA						
						LIMITING			Gross Fog	TERRAIN		
Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Dmax	Dmin	Delta		Dmax	Dmin	Delta
23D	187	.22	.22	0.00	.22	.07	.07	.00	.07	.07	.07	.00
	188	.22	.22	0.00	.22	.07	.07	.00	.07	.07	.07	.00
	189	2.14	.29	1.85	.23	1.71	.95	.76	.07	NR	NR	NR
	208	2.38	.29	2.09	.22	1.55	.22	1.33	.07	.54	.34	.20
	209	2.11	.28	1.83	.22	1.48	.82	.66	.07	NR	NR	NR
	214	.74	.28	.46	.23	1.52	.13	1.39	.07	1.52	.47	1.05
	215	2.34	.33	2.01	.23	1.55	.12	1.43	.07	.41	.12	.29
	232	2.51	.33	2.18	.24	1.75	.19	1.56	.07	.99	.31	.68
	233	2.10	.29	1.81	.25	1.64	.53	1.11	.07	1.64	.53	1.11
	236	1.91	.32	1.59	.25	1.58	.25	1.33	.07	1.58	.25	1.33
	237	2.19	.32	1.87	.25	1.73	.89	.84	.07	NR	NR	NR
	239	2.27	.32	1.95	.25	1.53	.24	1.29	.07	1.16	.41	.75
	240	2.50	.35	2.15	.26	1.43	.28	1.15	.07	.67	.28	.39
	246	1.97	.34	1.63	.29	.83	.21	.62	.07	.83	.21	.62
	247	1.96	.36	1.66	.26	1.64	.35	1.29	.07	1.02	.35	.67
	251	2.37	.31	2.06	.22	1.76	.34	1.42	.07	.81	.34	.47
	252	2.40	.28	2.12	.22	1.42	.79	.63	.07	1.42	.79	.63
	253	2.11	.28	1.83	.22	1.59	.89	.70	.07	1.59	.89	.70
	254	1.98	.27	1.71	.22	1.03	.21	.82	.07	1.03	.21	.82
	257	2.44	.36	2.14	.22	1.59	.22	1.37	.07	1.59	.22	1.37
	258	2.05	.32	1.73	.23	1.47	.47	1.00	.07	1.47	.47	1.00
	260	2.06	.29	1.77	.23	1.52	.59	.93	.07	1.19	.59	.60
	261	2.18	.29	1.89	.23	1.39	.25	1.14	.07	.79	.25	.54
	264	2.13	.30	1.83	.24	1.35	.32	1.03	.07	1.32	.32	1.00
	265	2.43	.30	2.13	.25	1.48	.26	1.22	.07	.99	.26	.73
	276	2.53	.40	2.13	.30	1.72	.38	1.34	.07	.83	.59	.24
	277	2.24	.39	1.85	.32	1.64	.13	1.51	.07	.56	.13	.43
	280	2.14	.35	1.79	.27	1.54	.17	1.37	.07	.62	.17	.45
	281	2.29	.36	1.99	.25	1.67	.20	1.47	.07	.81	.20	.41
	284	2.23	.29	1.94	.23	1.76	.33	1.43	.07	.58	.33	.25
	285	2.25	.29	1.96	.23	1.17	.27	.90	.07	1.17	.39	.78
	286	2.42	.29	2.13	.22	1.53	.24	1.29	.07	1.47	.24	1.23
	293	2.00	.27	1.73	.22	1.12	.27	.85	.07	1.07	.27	.80
	294	2.18	.28	1.90	.22	1.16	.16	1.00	.07	1.11	.16	.95
	296	2.24	.29	1.95	.22	1.52	.30	1.22	.07	1.34	.30	1.04
	297	2.19	.30	1.89	.22	1.81	.53	1.28	.07	1.12	.53	.59

NR - Denotes No Reading Made

Mission 1019-1

	STELLAR CAMERA					INDEX CAMERA						
						LIMITING			Gross Fog	TERRAIN		
Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Dmax	Dmin	Delta		Dmax	Dmin	Delta
77D	302	2.20	.27	1.93	.22	1.49	.15	1.34	.07	1.49	.57	.92
	303	.24	.22	.02	.22	.07	.07	.00	.07	.07	.07	.00
	304	.24	.22	.02	.22	.07	.07	.00	.07	.07	.07	.00
	305	.24	.22	.02	.22	.07	.07	.00	.07	.07	.07	.00
	306	2.45	.33	2.12	.24	.75	.22	.53	.07	.75	.23	.52
	312	2.40	.33	2.07	.25	1.47	.31	1.16	.07	.65	.31	.34
	313	2.09	.33	1.76	.26	1.42	.24	1.18	.07	1.42	.24	1.18
	315	2.15	.37	1.78	.29	1.48	.83	.65	.07	1.48	.83	.65
	316	2.36	.39	1.97	.30	1.75	.37	1.38	.07	1.03	.37	.66
	317	2.34	.39	1.95	.31	1.84	.39	1.45	.07	.95	.39	.56
	318	2.12	.37	1.75	.32	1.50	.18	1.32	.07	.88	.27	.61
	320	2.05	.32	1.73	.27	1.27	.15	1.12	.07	.80	.43	.37
	321	2.14	.31	1.83	.25	1.58	.92	.66	.07	1.58	.92	.66
	326	1.91	.28	1.63	.22	1.61	.32	1.29	.07	1.61	.32	1.29
	327	1.90	.30	1.60	.22	1.53	.82	.71	.07	1.53	.82	.71
	332	1.84	.28	1.56	.22	1.54	.93	.61	.07	1.54	.93	.61
	333	2.20	.28	1.92	.22	1.67	.32	1.35	.07	.78	.32	.46
	335	2.19	.28	1.81	.22	1.61	.25	1.36	.07	.68	.25	.63
	336	2.13	.29	1.87	.22	.77	.29	.48	.07	.58	.29	.29
	342	2.47	.32	2.15	.22	1.42	.29	1.13	.07	1.42	.29	1.13
	343	.23	.22	.01	.22	.07	.07	.00	.07	.07	.07	.00
	344	2.10	.28	1.82	.22	1.46	.19	1.27	.07	1.46	.52	.94
	351	1.95	.26	1.69	.22	1.43	.10	1.33	.07	1.43	.37	1.06
	352	2.14	.27	1.87	.22	1.06	.15	.91	.07	1.06	.18	.88
	365	2.67	.35	2.32	.23	1.69	.39	1.30	.07	.65	.42	.23
	366	2.29	.29	2.00	.22	1.35	.51	.84	.07	1.14	.51	.63
	374	2.22	.29	1.93	.23	1.15	.31	.84	.07	1.15	.31	.84
	375	1.93	.24	1.69	.23	1.50	.10	1.40	.07	.64	.36	.28
	379	1.78	.25	1.53	.22	1.10	.13	.97	.07	1.10	.27	.83
	380	2.15	.29	1.96	.22	1.42	.59	.83	.07	1.42	.59	.83
	387	2.32	.27	2.05	.22	1.45	.49	.96	.07	1.14	.49	.65
	388	2.23	.26	1.97	.22	1.47	.43	1.04	.07	1.47	1.03	.44
	389	2.55	.32	2.23	.22	1.35	.67	.68	.07	1.35	.85	.50
	390	2.03	.23	1.80	.22	1.09	.11	.98	.07	.69	.11	.58
	392	1.88	.23	1.65	.22	1.67	.15	1.52	.07	.96	.15	.81
78D	393	2.68	.30	2.38	.22	1.92	.20	1.72	.07	.96	.20	.76
	399	2.20	.29	1.91	.22	1.47	.18	1.29	.07	.72	.68	.04
79D	400	2.41	.29	2.12	.22	1.47	.15	1.32	.07	.60	.25	.35
	401	2.43	.32	2.11	.23	1.35	.18	1.17	.07	NR	NR	NR

NR - Denotes No Reading Made

Dmax Range 0.22 - 2.78
Dmin Range 0.22 - 0.39
Gross Fog Range 0.22 - 0.33

Average Dmax 2.14
Average Dmin 0.30
Average Gross Fog 0.24

Dmax Range 0.07 - 2.15
Dmin Range 0.07 - 1.03
Gross Fog Range 0.07

Average Dmax 1.51
Average Dmin 0.42
Average Gross Fog 0.07

[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 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 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 for the traces in this report is located at an Air Force facility. The location of the traces was directed by representatives from NPIC with the Air Force. The instrument is the Mann-Data Micro-Analyzer used with an effective slit of 1 micron by 80 microns. A scan speed of 0.05 millimeter/minute and a chart speed of 4 inches/minute was used for a recording to specimen expansion of 2032:1. One inch on the recording equals 12.5 microns on the specimen. The traces produced represent a

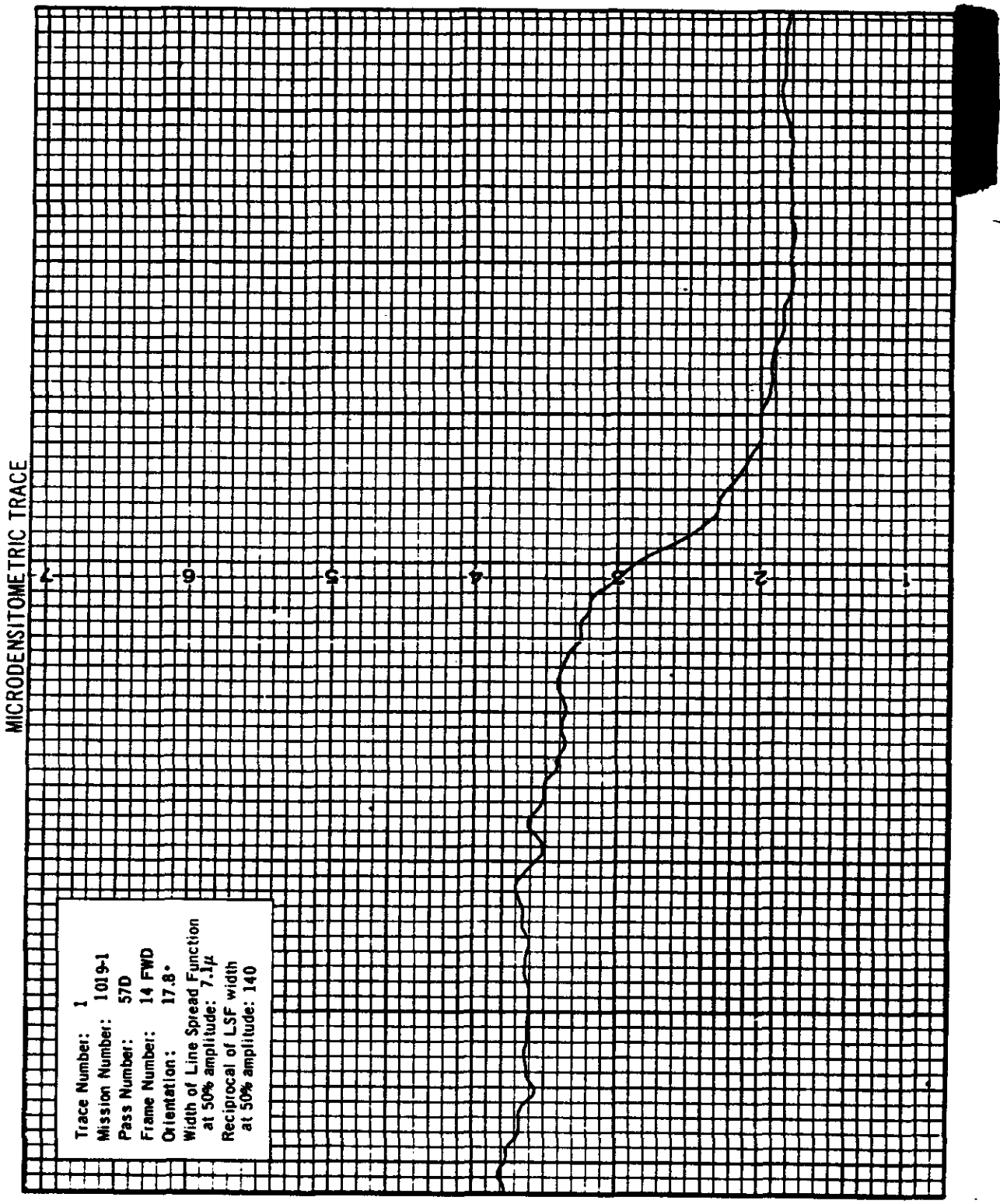
plot of deflection versus distance. The deflection of the pen is essentially linear with density and the horizontal lines on the chart numbered 1 to 7 equal 0 to 3.0 density.

At the same time the traces were made, the electronic output signals from the instrument were digitized as density values and recorded on paper tape for direct analysis by an IBM 1710 computer. Three outputs from the computer are shown in the Summary Table of Edge Traces on page 36 : the width of the Line Spread Function at 50 percent maximum amplitude, the MTF/AIM intersect point, and the Machine RES. The procedure involved in the derivation of these values in the IBM 1710 computer is described in the Air Force Technical Report No 101-31 (Page 79-82). The following table is a summary of the determinations made from edge traces of the original negative. The imagery traced is contained in the frame considered to be typical of the best in this mission.

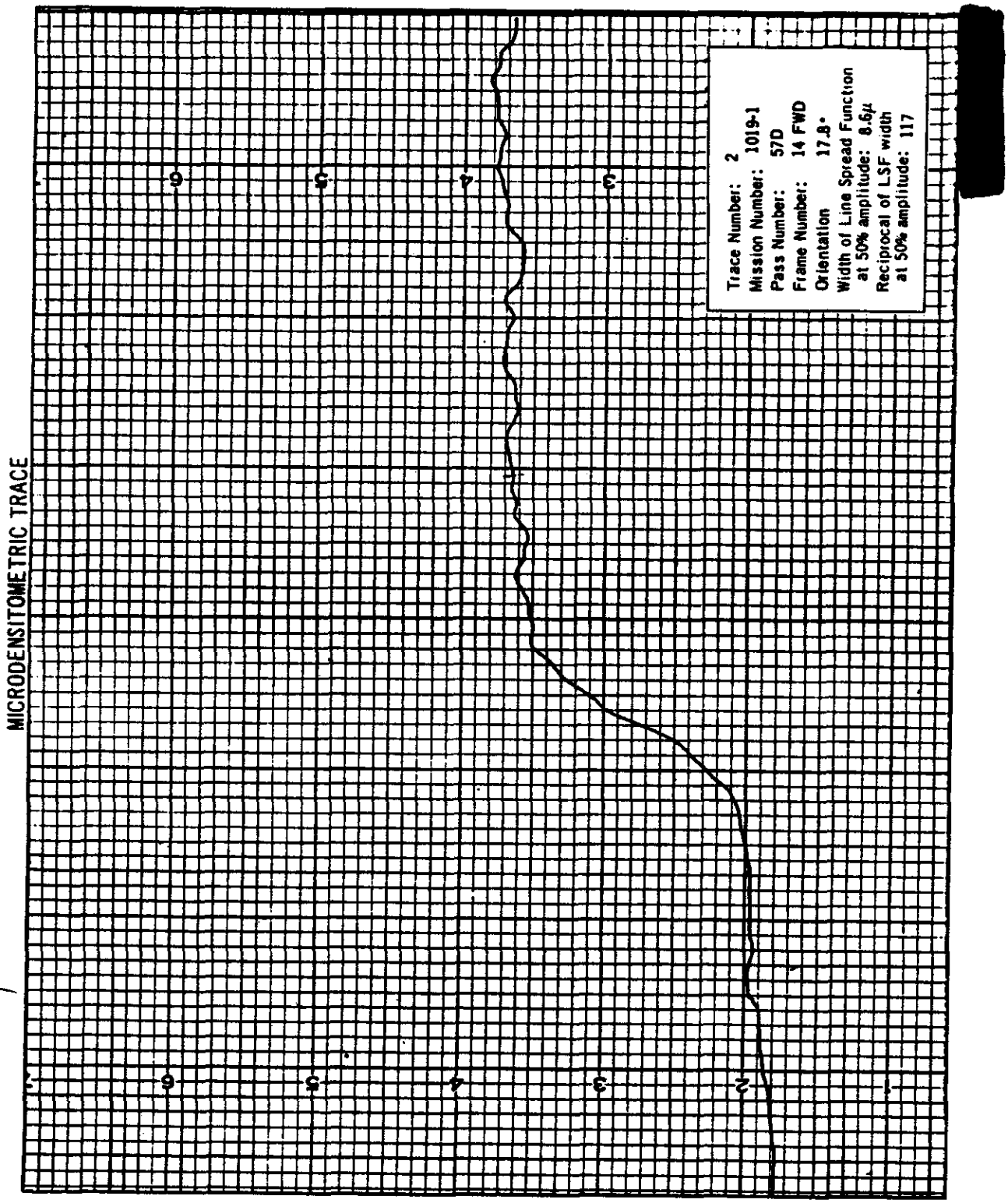
SUMMARY TABLE OF EDGE TRACES
Mission 1019-1

Trace Number	Pass/ Frame	LINE SPREAD FUNCTION			MTF/AIM Interest	Edge Orientation
		50% Width	1000/50% Width	Machine RES		
1	57D/14F	7.1	140	77	80	17.8°
2	57D/14F	8.6	117	86	79	17.8°
3	57D/14F	8.8	113	78	81	17.8°
4	57D/14F	10.8	93	77	65	94.6°
5	57D/14F	8.8	113	62	97	94.6°
6	57D/14F	11.7	85	64	64	94.6°

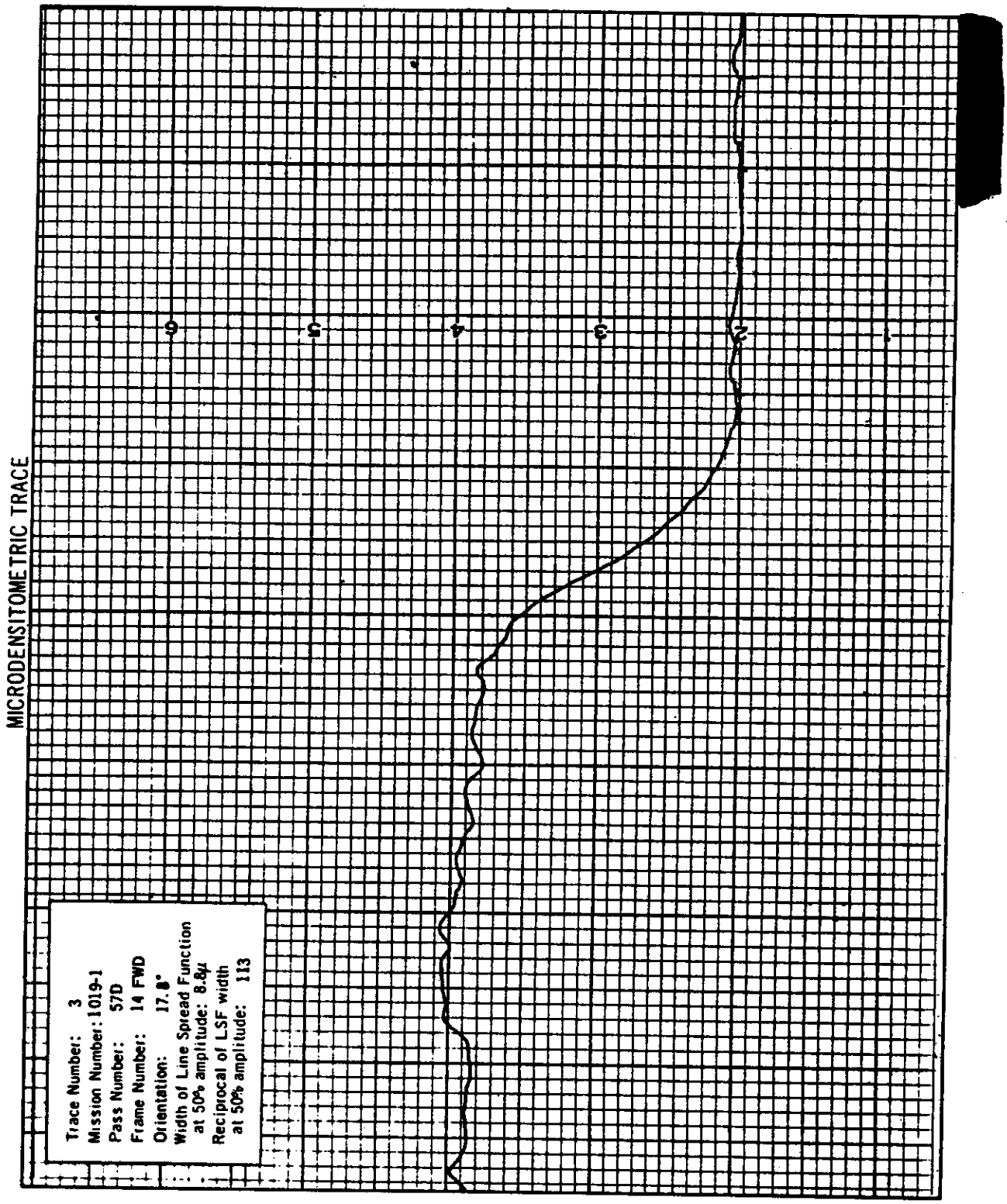
[redacted]

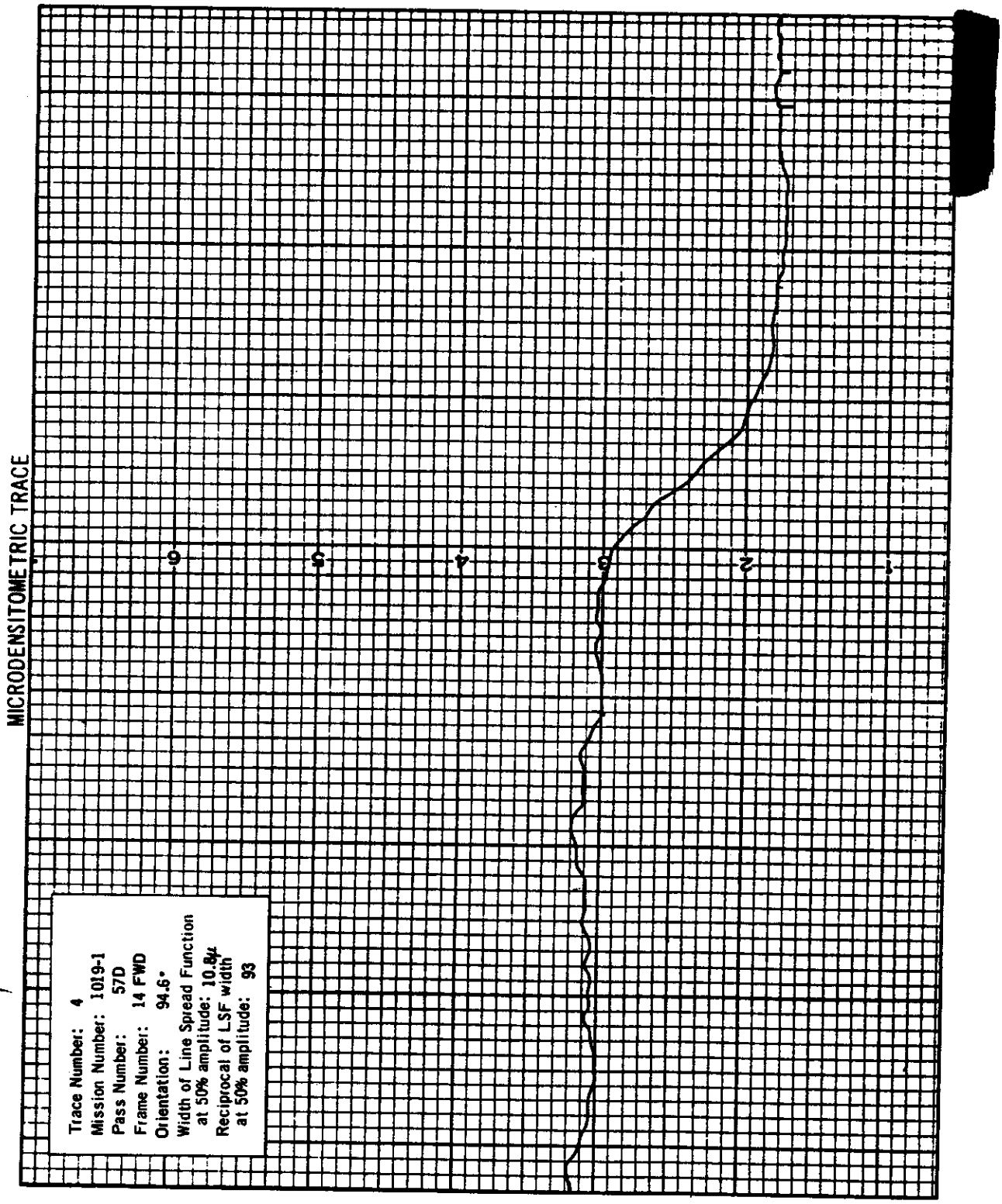

MICRODENSITOMETRIC TRACE
7
6
5
4
3
2
1
Trace Number: 1
Mission Number: 1019-1
Pass Number: 57D
Frame Number: 14 FWD
Orientation: 17.8°
Width of Line Spread Function at 50% amplitude: 7.1μ
Reciprocal of LSF width at 50% amplitude: 140

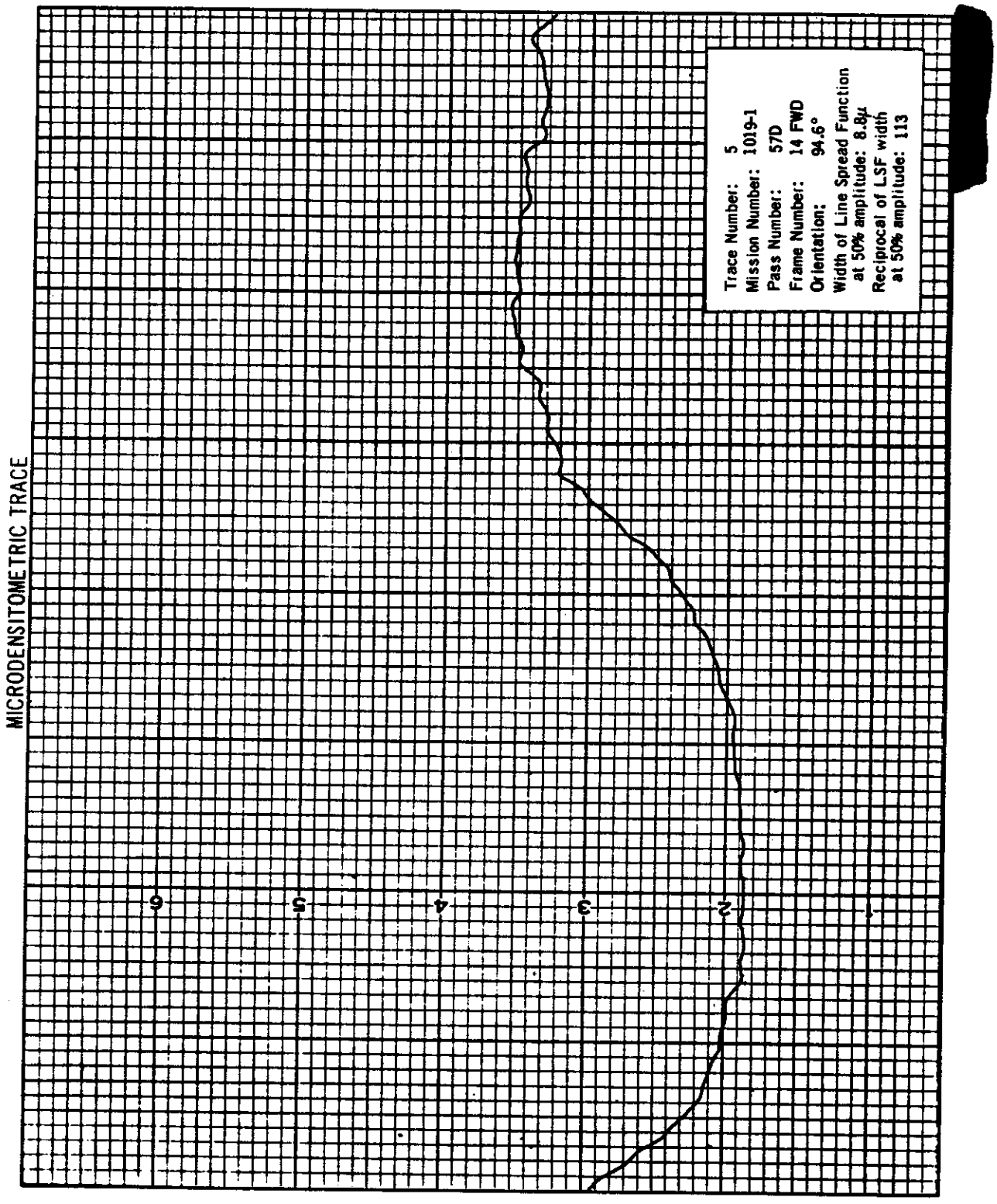
[redacted]



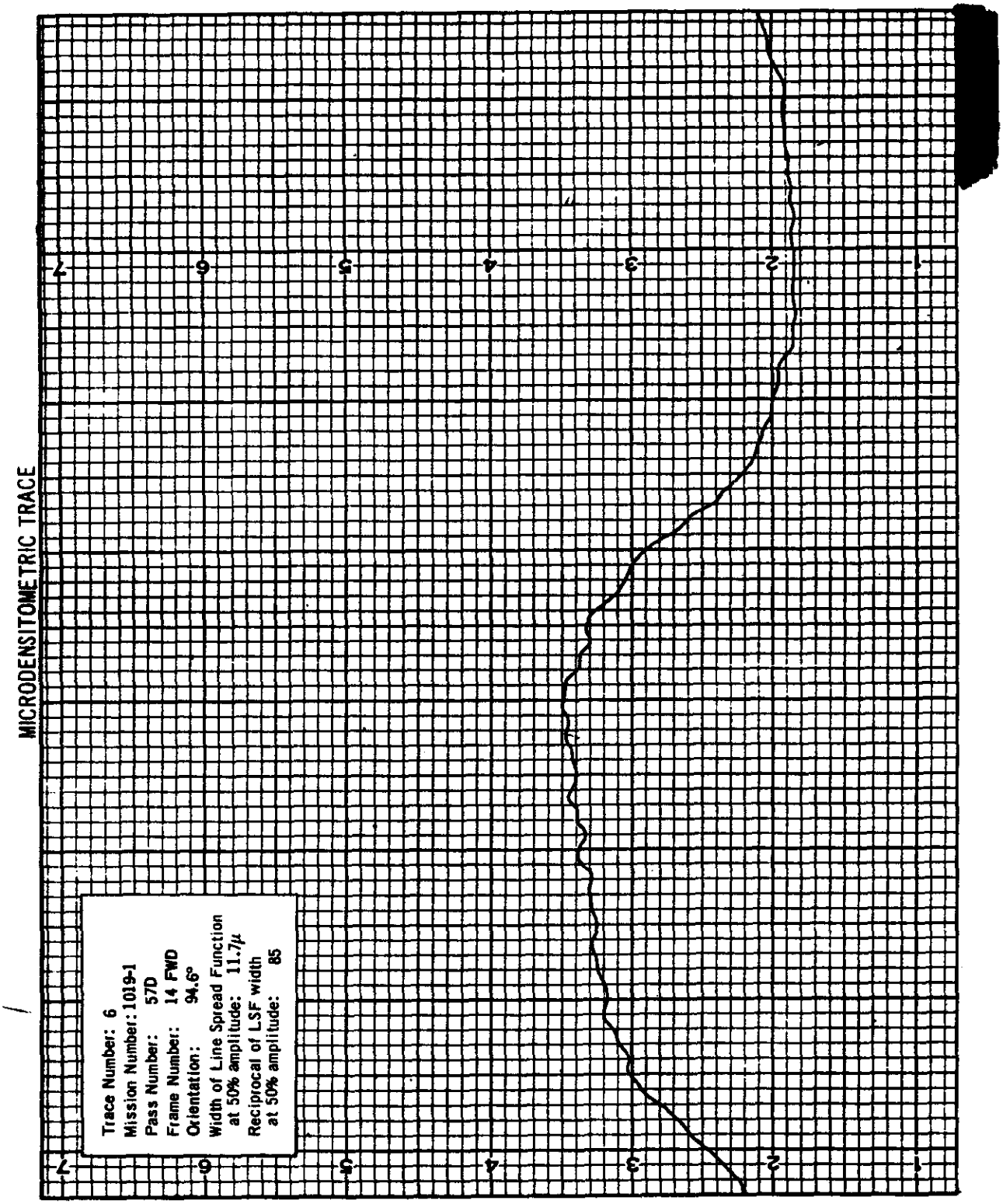
[redacted]


MICRODENSITOMETRIC TRACE
1
2
3
4
5
6
Trace Number: 3
Mission Number: 1019-1
Pass Number: 57D
Frame Number: 14 FWD
Orientation: 17.8°
Width of Line Spread Function at 50% amplitude: 8.8μ
Reciprocal of LSF width at 50% amplitude: 113


MICRODENSITOMETRIC TRACE
6
5
4
3
2
1
Trace Number: 4
Mission Number: 1019-1
Pass Number: 57D
Frame Number: 14 FWD
Orientation: 94.6°
Width of Line Spread Function at 50% amplitude: 10.8μ
Reciprocal of LSF width at 50% amplitude: 93


MICRODENSITOMETRIC TRACE
1
2
3
4
5
6
Trace Number: 5
Mission Number: 1019-1
Pass Number: 57D
Frame Number: 14 FWD
Orientation: 94.6°
Width of Line Spread Function at 50% amplitude: 8.8μ
Reciprocal of LSF width at 50% amplitude: 113

[redacted]


MICRODENSITOMETRIC TRACE
Trace Number: 6
Mission Number: 1019-1
Pass Number: 57D
Frame Number: 14 FWD
Orientation: 94.6°
Width of Line Spread Function at 50% amplitude: 11.7μ
Reciprocal of LSF width at 50% amplitude: 85
1
2
3
4
5
6
7

APPENDIX D. CLOUD COVER ANALYSIS

1. Introduction:

This study represents a statistical analysis of the cloud cover on the photography of Mission 1019-1. The basis of this study is the cloud cover data for each quarter segment of every individual frame of photography. The data is 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, then 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

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.

[redacted]

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%

'. Cloud Cover Data, Mission [illegible]-1

PERCENTAGE OF CLOUD COVER CATEGORIES BY PASSES

Pass Number	1	2	3	4	5	Cloud Cover % Per Pass
1D	83.1	2.4	8.1	6.4	0.0	12.5
2D	33.0	2.6	4.6	48.7	6.1	48.4
3D	72.4	5.9	13.0	5.5	3.3	17.0
4D	43.7	14.1	11.0	17.2	8.8	31.4
5D	27.2	10.2	14.4	37.7	5.3	44.3
6D	41.1	12.1	8.2	20.7	17.7	40.7
7D	9.0	7.3	20.1	57.8	5.8	58.5
8D	5.4	4.6	15.8	55.6	20.6	70.1
9D	41.7	4.2	3.1	11.5	39.5	52.2
10D	78.6	14.3	7.1	0.0	0.0	9.1
11D	67.1	3.9	12.0	17.4	0.0	21.6
12D	31.6	13.4	18.7	22.1	14.2	55.8
13D	28.8	12.2	14.3	29.4	15.3	47.3
14D	59.4	18.7	14.7	12.6	0.4	21.2
15D	54.2	6.6	6.2	17.8	13.2	34.3
16D	1.7	1.1	26.1	71.1	0.0	63.5
17D	100.0	0.0	0.0	0.0	0.0	5.0
18D	0.0	0.0	4.5	58.0	37.5	82.7
19D	36.4	38.5	24.0	3.1	0.0	19.9
20D	48.5	6.5	4.5	30.0	10.5	38.3
21D	0.4	0.6	32.3	64.0	2.7	63.1
22D	25.0	24.5	36.1	14.4	0.0	30.1
23D	80.3	10.6	6.1	3.0	0.0	10.4
24D	59.7	12.5	17.0	10.8	0.0	19.7
25D	96.9	2.6	0.5	0.0	0.0	5.5
26D	39.8	9.3	2.8	48.1	0.0	40.8
27D	43.8	7.3	13.5	28.6	6.8	36.9
28D	46.7	2.2	11.1	39.4	0.6	37.1
29D	63.9	10.2	8.0	17.6	0.3	21.5
30D	100.0	0.0	0.0	0.0	0.0	5.0
31D	49.0	5.6	2.6	38.6	4.2	37.6
32D	52.6	12.5	18.4	16.5	0.0	24.2
33D	87.3	4.6	6.2	1.9	0.0	9.0
34D	42.6	16.5	17.0	23.3	0.6	29.5
35D	26.9	16.7	19.9	33.3	3.2	40.1
	42.7*	9.7*	13.3*	27.6*	6.7*	36.3**

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

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