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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT

MISSION 1027-1

9-10 DECEMBER 1965

MISSION 1027-2

11 DECEMBER 1965

[redacted]

MARCH 1966

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53 PAGES

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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT
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MARCH 1966

NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

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SYNOPSIS

Mission 1027 (JX 27) was launched 9 December 1965. The cameras operated satisfactorily throughout the mission. However, telemetry in the early portion of the mission indicated an excessive consumption of vehicle attitude control gas. A decision was then made to employ an emergency mode of camera operation to attain the maximum amount of photography in a limited number of passes. The cameras were operated in the northernmost latitudes during low solar elevations, which resulted in less than optimum exposure for portions of the mission. The control gas supply was exhausted between camera operations of passes 15D and 16D, and subsequent photography was unuseable. The mission was aborted after one day's operation and the payload of Mission 1027-1 was recovered by air catch on 10 December 1965. The cameras were not activated for Mission 1027-2, but its capsule was recovered by air catch on 11 December 1965. Both capsules were recovered using the back-up emergency recovery system referred to as lifeboat. The second capsule contained the last few panoramic frames of Mission 1027-1 and the stellar/index preflight material of Mission 1027-2. The mission consists of 16 photographic passes: 11 operational, 2 domestic, 1 combination (part operational and part domestic), and 2 engineering. The stellar/index cameras operated throughout this abbreviated mission, resulting in 284 titled frames per unit. The index camera photography is rated as good and comparable to most recent index material. The stellar camera photography is rated as good and many star images are detectable in each frame. However, most star images are recorded as odd configurations rather than point-type images. This condition made data reduction difficult, decreased data reliability, and added one day to the completion of the computations. A number of spiral type plus density streaks, multidirectional in pattern and varying in density, are present on approximately 75 frames of the stellar photography. The panoramic photography was acquired at solar elevations ranging from 2 to 63 degrees. Clouds obscured 50 percent of the terrain covered in Mission 1027-1. An MIP rating of 85 was assigned to this mission.

GENERAL FLIGHT DATA

1. Launch and Recovery Dates

Launch Date, Mission 1027	9 December 1965
Recovery Date, Mission 1027-1	10 December 1965
Activation Date, Mission 1027-2	Not Attempted
Recovery Date, Mission 1027-2	11 December 1965

2. Orbital Parameters (Actual)

	Mission 1027-1 (Rev 9)
Period	90.770 min
Perigee	97.400 nm
Apogee	240.900 nm
Eccentricity	0.01990
Inclination Angle	80.050°N
Perigee Latitude	17.260°N

3. Photographic Operations

a. Pass Information

	Mission 1027-1
Operational Passes	11*
Domestic Passes	2
Engineering Passes	2**
Domestic/Operational Passes	1
Total Photographic Passes	16
Recovery Revolution	17

*Includes cut and wrap pass
**Includes one complete pass which was edited out

b. Film Footage/Frame Totals

	Mission 1027-1	
	Fwd (Master) Camera	Aft (Slave) Camera
Footage Available	16,000 (Approx)	16,000 (Approx)
Processed Footage	5,718	5,658
Titled Frames	2,027	1,995

PART I. CAMERA OPERATIONS

1. Fwd-Looking (Master) Panoramic Camera No 164

The forward panoramic camera functioned properly on this mission. There is no major detriment to the material from this camera. Minor degradations include:

a. An area of fog, usually referred to as film transport, is present on the first and last frame of most passes. A light leak in the felt seal at the fwd instrument drum caused an area of fog near the take-up end of the next-to-last frame of most camera operations. (Example: Pass 1D, frame 12). Although the faulty seal permits continuous transmission of light, it is not sufficient to cause any measurable degree of fogging except during camera-off periods, when the light strikes the above described area of the stationary film for an extended time. A band of fog, 2.0 inches wide, extends from edge to edge of the film on frames 8 and 10 of pass 16D. These possibly occurred during the cut and wrap sequence.

b. The emulsion is scratched along both edges between the format and the edge of the film. These are camera-induced "rail" scratches. Additional camera-induced emulsion scratches are located in the format adjacent to the camera number on most frames. Frame 10 of pass 16D is cut through during the cut and wrap sequence of Mission 1027-1. On pass 16D, frame 9 contains several minor emulsion scratches and short irregular plus density streaks associated with the recovery operation.

c. Static caused intermittent dendritic-type fog along the frequency-mark edge of the film on pass 10D, along the camera number edge of the film on pass 13D, and along both edges on pass 11D.

2. Aft-Looking (Slave) Panoramic Camera No 163

The aft panoramic camera functioned properly on this mission. There is no major detriment to the material from this camera. Minor degradations include:

a. An area of fog, usually referred to as film transport, is present on the first and last frame of most passes. A circular pattern of fog, approximately 1.0 inch in diameter, with a curved fog streak extending from it toward the supply end, is present on frame 1 of pass 1D and on frame 2 of most other passes (Example: Pass 8D, frame 2). This fog pattern remains inside the frequency-mark edge of the format, but its location across the frame varies. However, close observation places it at a fixed distance from the film rest position, which varies from pass to pass according to the scan rate at shut down and thus explains its varying location.

Indications are that this fog pattern occurred while the film was stationary between camera operations but before entering the platen area. A light leak in the felt seal at the fwd camera drum caused a splash type fog pattern on the third frame from the end of most passes (Example: Pass 8D, frame 174). This same light leak produces simultaneous fog on the next-to-last frame of the fwd material while the film is stationary and adjacent to each other. The third frame from end of most passes also contains a narrow fog streak perpendicular to the film edges and a fog patch with an equipment (roller) shadowgraph within it. The shadowgraph occurs when a roller shields the film from the light leak (Example: Pass 8D, frame 174). Two narrow diagonal fog streaks are present near the take-up end of the next-to-last frame on most passes (Example: Pass 8D, frame 175).

b. The emulsion is scratched along both edges of the film. These are camera-induced rail scratches. Additional emulsion scratches are located in the format adjacent to the camera number on most frames. Frame 9 of pass 16D was cut through during the cut and wrap sequence of Mission 1027-1. The remaining portion of the pass was returned in the second capsule and a joining splice was made. Associated with the recovery operation are several minor abrasions on pass 16D, frame 8.

c. Static caused intermittent dendritic-type fog along both edges on passes 11D, 13D, and 14D.

3. Fwd (Master) Horizon Cameras

The fwd horizon cameras were operational throughout the mission. The exposure was adequate and the horizon images are good. The first 20 to 30 frames of each pass appear underexposed due to the low solar elevation in the northernmost latitudes.

4. Aft (Slave) Horizon Cameras

The slave horizon cameras were operational throughout the mission. The exposure was adequate and the horizon images are good. The emergency mode of camera operation employed during the mission necessitated camera operation at low solar elevations in the northernmost latitudes and caused the horizon photography to be underexposed at the beginning of these passes.

5. Stellar Camera Unit No D71/87/87 (Mission 1027-1)

The stellar camera functioned properly throughout, recording 284 titled frames. The stellar images appear in odd configurations rather than the normal point images. These configurations, possibly due to vehicle perturbations, cause much difficulty in data reduction. There are at least 3 star images in each frame of stellar photography, but the lack of sharp useable images makes identification and placement in the stellar field extremely difficult.

The flare level on the material is low. Approximately 75 frames contain spiral type plus density streaks. Most of these occur during the first 50 percent of the photography and are similar to those previously described as images of jettisoned fuel. The last 2 stellar frames (correlating with pass 16D) are grossly overexposed.

6. Stellar Camera Unit No D68/74/83 (Mission 1027-2)

The stellar camera was activiated during Mission 1027-2 and only its preflight material was returned in the second capsule.

7. Index Camera Unit No D71/87/87 (Mission 1027-1)

The index camera was operational throughout, recording 284 titled frames. The exposure is good and the imagery is comparable to the index material of recent missions in this series. Edge fog occurs intermittently along the camera-number edge of the film. Minor static along the non-camera-number edge of the film occurs intermittently throughout.

8. Index Camera Unit No D68/74/83 (Mission 1027-2)

The index camera was not activated during Mission 1027-2. Therefore, the preflight is the only index material recovered in the second capsule.

9. Associated Equipment

This equipment records part of the information required for correlation and mensuration of the panoramic cameras. The following anomalies occurred in the operation of the associated equipment.

a. The binary lamps were excellent. No problems were encountered during the automatic machine readout of the binary block. The binary block of fwd frame 217 on pass 13D was obscured by a manufacturer's splace and interpolation was used to obtain its reading.

b. The aft camera port horizon fiducial at the data block edge of the formats varied in intensity and at times was not visible (Example: Pass 7D). This is caused by film or emulsion particles which intermittently obstruct the light. Particles of this nature are a camera characteristic, but are only considered a minor hazard.

c. The fwd camera metered 8 cycles between successive S/I camera operations instead of the correct 7 cycles on pass 5D, frames 22 and 30. Since there was no malfunction of either the S/I camera itself or the related data recording on the panoramic cameras, the anomaly appears to have originated in the stepper switch of the S/I programmer.

d. The last frame of most panoramic camera operations contains an extra end-of-operation marker. At times it is imaged at the take-up end of the first frame of the next camera operation.

FIGURE 1. DESCRIPTION OF PHOTOGRAPHIC DATA

The data pertaining to photographs contained in this publication are defined as follows:

PASS: A pass is the operational portion of an orbital revolution. A suffix D indicates that the photography was acquired during the descending portion; a suffix A indicates that the photography was acquired during the ascending portion; and a suffix M indicates that the photography was acquired during a pass that includes both ascending and descending portions. An additional suffix E indicates that the pass was an engineering operation or that a portion of the pass has been edited.

DATE OF PHOTOGRAPHY: The date of photography indicates the day, month, and year (GMT) that the photography was acquired.

UNIVERSAL GRID COORDINATES: These coordinates are included to locate the illustrated photography within the panoramic format.

ENLARGEMENT FACTOR: The enlargement factor is included to indicate the number of diameters the original material has been enlarged in the photographic illustration.

GEOGRAPHIC COORDINATES: These coordinates are included to indicate the latitude and longitude of the panoramic format.

ALTITUDE: This measurement is the vertical distance from the vehicle to the Hough Ellipsoid at the time of the acquisition of the photography.

PITCH: Rotation of the camera about its transverse axis. Using appropriate aeronautical terminology, positive readings indicate nose-up attitude and negative readings indicate nose-down attitude.

ROLL: Rotation of the camera about its longitudinal axis. Using appropriate aeronautical terminology, positive readings indicate left wing-up attitude and negative readings indicate right wing-up attitude.

YAW: Rotation of the camera about its vertical axis. Positive readings indicate counter-clockwise rotation when viewing the ground nadir from the vehicle mounted camera in-flight.

LOCAL SUN TIME: This time is included to present to the viewer a realistic time of acquisition of the photography illustrated.

SOLAR ELEVATION: The solar elevation is the angular elevation of the sun

above a plane tangent to the surface of the earth at the center of the panoramic format. A negative solar elevation indicates that the sun is below the plane.

SOLAR AZIMUTH: The solar azimuth is the angular measurement of the rays of the sun measured from true north in a clockwise direction.

EXPOSURE: The exposure is the duration of the photographic exposure expressed in a fraction of a second and is computed from the scan rate and slit width.

VEHICLE AZIMUTH: The clockwise measurement from true north to the longitudinal axis of the vehicle heading.

FIGURE 2. STARBOARD (TAKE-UP) HORIZON PHOTOGRAPH

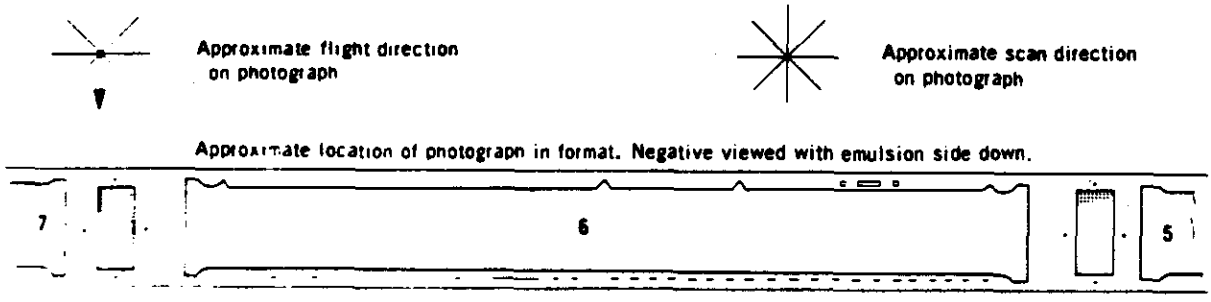
FIGURE 3. PORT (SUPPLY) HORIZON PHOTOGRAPH

The following 2 photographs are examples of the horizon imagery exposed during the failure of the attitude control system.

NPIC K-6264 (2/66) NPIC K-6265 (2/66)

FIGURES 2 & 3

Camera 164
Pass 16D
Frame. . . . . 6 fwd
Date of Photography. . . . . 10 Dec 65
Universal Grid Coordinates . . . . Not Applicable
Enlargement Factor 3X



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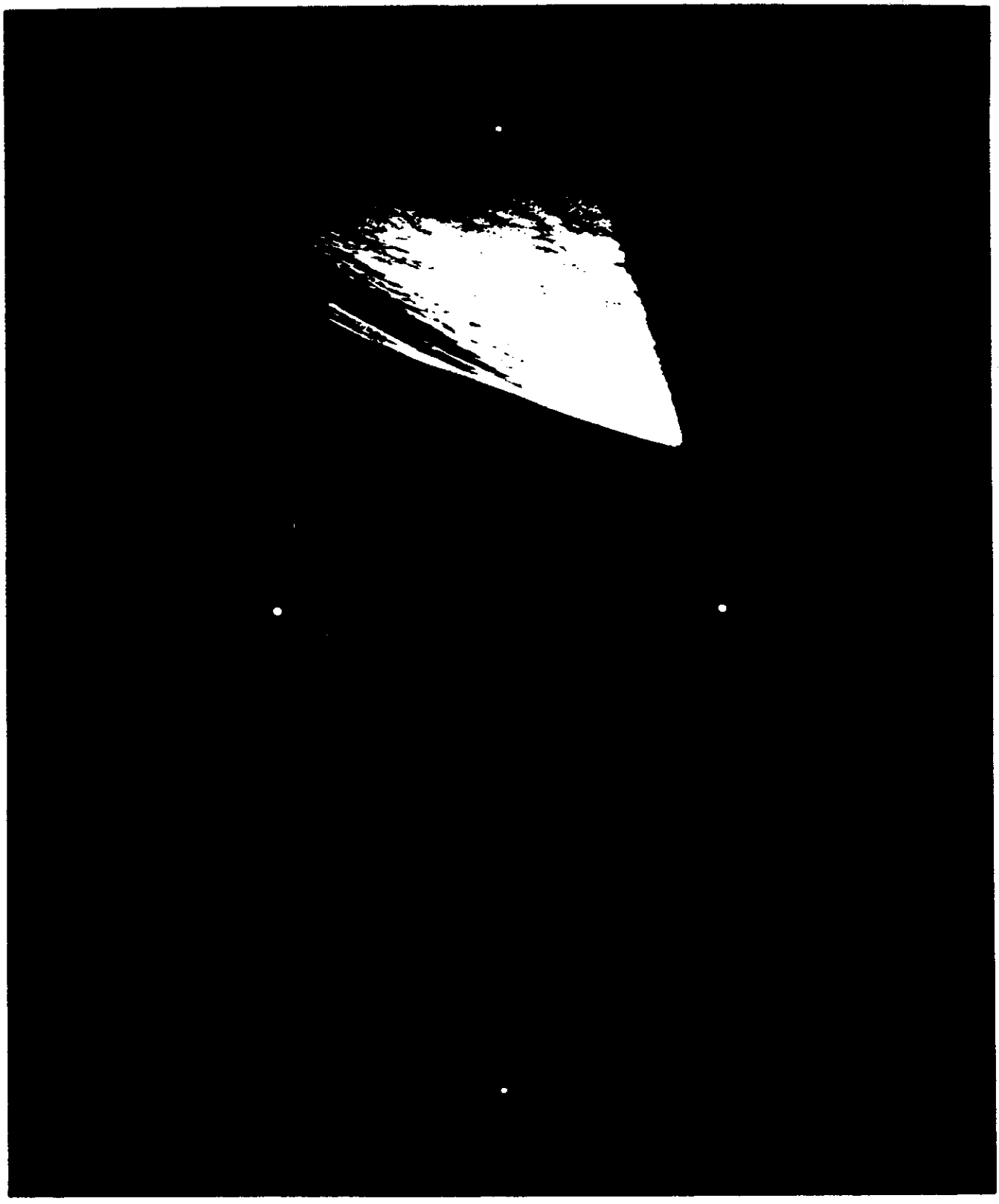

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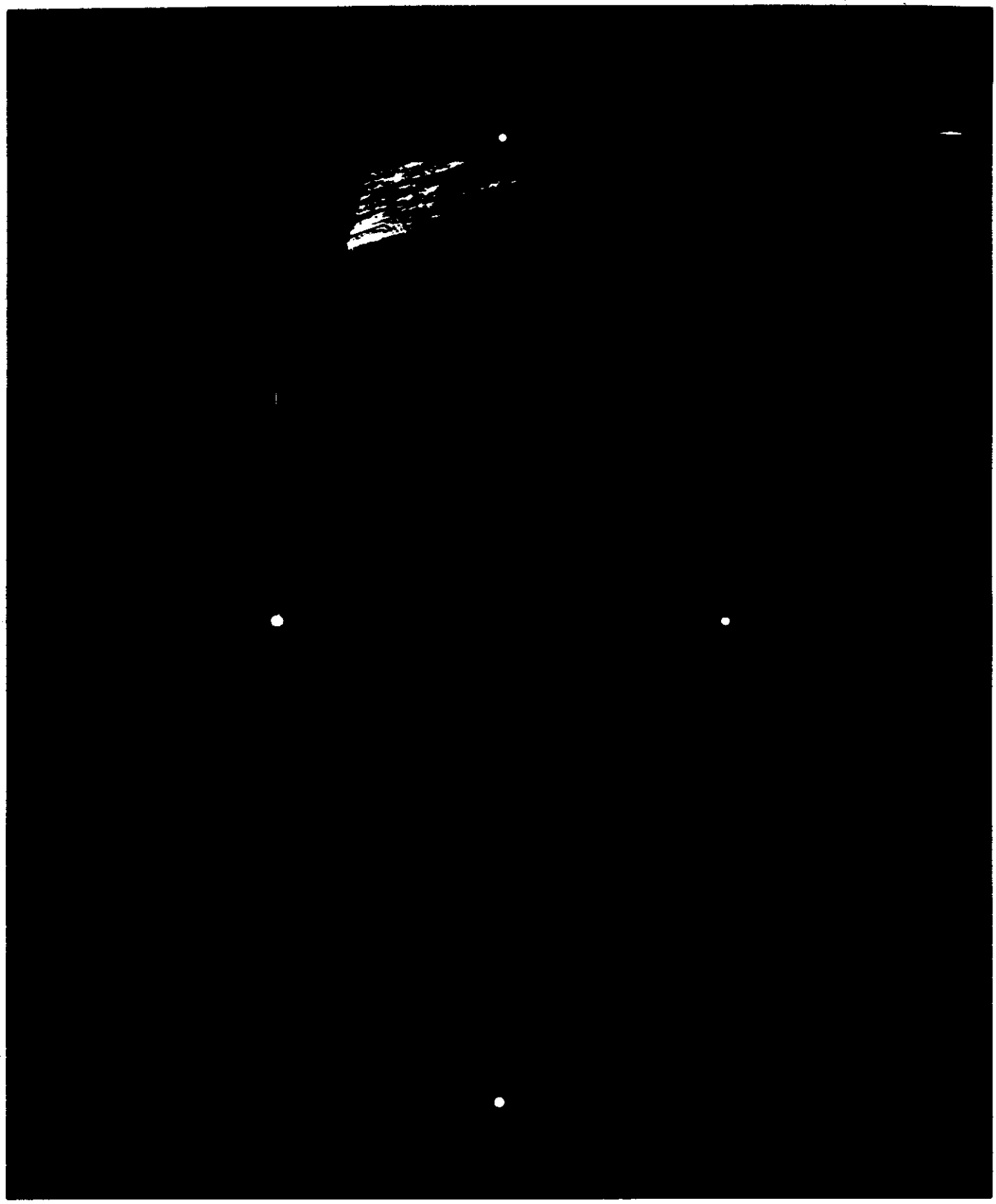


PART II. FILM

1. Film Processing

This section provides evaluation of processing, density, contrast, and special printing of the original negatives.

a. Infrared densitometry was used to determine the optimum levels of development for the panoramic records. The material exposed in Mission 1027-1 required 2 processing level changes for the fwd-looking panoramic camera film and 10 changes for the aft-looking panoramic camera film. The approximate percentage of imagery processed at the different levels is as follows:

	Mission 1027-1	
Development Level	Master	Slave
Primary	0.0	0.0
Intermediate	0.2	20.9
Full	99.8	79.1

Telemetry in the early portion of the mission indicated an excessive consumption of vehicle attitude control gas. Due to this condition, a decision was made to employ an emergency mode of camera operation to attain the maximum amount of photography in a limited number of passes. Therefore, much of the photography was obtained during low solar elevations, which resulted in less than optimum exposure in the northernmost portions of the mission. The low solar elevations also help to explain why the majority of the film was processed at the full level of development. In general, the density of the panoramic and index material is less than normal. The density of the stellar record is adequate to determine the presence of stellar images.

b. Special printing was employed on 4 parts of the master panoramic material and on 3 parts of the slave panoramic material. Special printing is required when the range of the original negative is such that 2 levels of printing duplicate positives is required to obtain greater intelligence value.

2. Film Degradations

The degradations to the original negative of this mission are similar to those noted on prior missions. Rail scratches occur throughout. A fine scratch is present along the format edge beneath the camera number throughout. Minor abrasions occur on pass 16D, frames 9 fwd and 8 aft, probably due to the cut and wrap sequence which cut through frames 10 fwd and 9 aft.

PART III. IMAGE QUALITY

1. Photographic Interpretation (PI) Suitability

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 (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 Unuseable. 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 superior 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 the less-than-optimum contrast prevails.

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.

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

2. PI Suitability, Mission 1027-1

Coverage of intelligence targets in Mission 1027 was limited by the failure of the vehicle attitude control system, which caused a premature termination of the mission. In the preliminary readout, only 46 targets were observed. The interpretability of 20 of these targets was categorized by the PI's as good or fair, and 26 were judged to be poor. The increased ratio of targets rated poor was not caused by the attitude discrepancy, but by weather conditions, obliquity, and low solar elevations.

It should be noted that the preliminary report represents the initial scan results only, accomplished in a short time. The more detailed study of the photography may develop additional information which may make it necessary to alter portions of the preliminary report.

3. 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 malfunction, 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 as 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 possibly 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, Mission 1027-1

Pass 6D, frame 127 fwd has been selected as the MIP frame for Mission 1027-1. It has been assigned an MIP rating of 85. The information potential of the area acquired by the aft camera (frame 131 aft) is almost iden-

tical to this MIP frame.

Due to the failure of the attitude control system, the cameras were not activated on Mission 1027-2. Therefore, no record was obtained and no MIP area was available.

5. Resolution Target Analysis

No 3-bar ground target displays were covered on this mission.

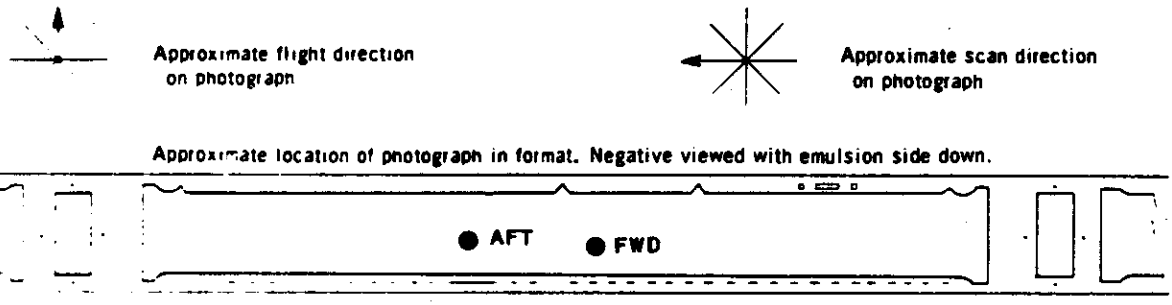
FIGURE 4. MIP SELECTION, MISSION 1027-1

FIGURE 5. AFT PHOTOGRAPH COMPARED WITH THE MIP AREA, MISSION 1027-1

The following photographs show the subtle difference between the MIP frame (fwd photography) and the corresponding aft coverage.

NPIC K-6266 (2/66) NPIC K-6267 (2/66)

	FIGURE 4	FIGURE 5
Camera	164	163
Pass	6D	6D
Frame	127 fwd	131 aft
Date of Photography	10 Dec 65	10 Dec 65
Universal Grid Coordinates	48.6 - 11.5	42.1 - 12.0
Enlargement Factor	20X	20X
Geographic Coordinates	36-35N 101-46E	36-36N 101-42E
Altitude (feet)	640,649	637,443
Camera:		
Pitch	Not Determined	Not Determined
Roll	Not Determined	Not Determined
Yaw	Not Determined	Not Determined
Local Sun Time	1312	1312
Solar Elevation	28°9'	28°8'
Solar Azimuth	201°	201°
Exposure (fractions of second)	1/261	1/349
Processing Level	Full	Full
Vehicle Azimuth	170°17'	170°28



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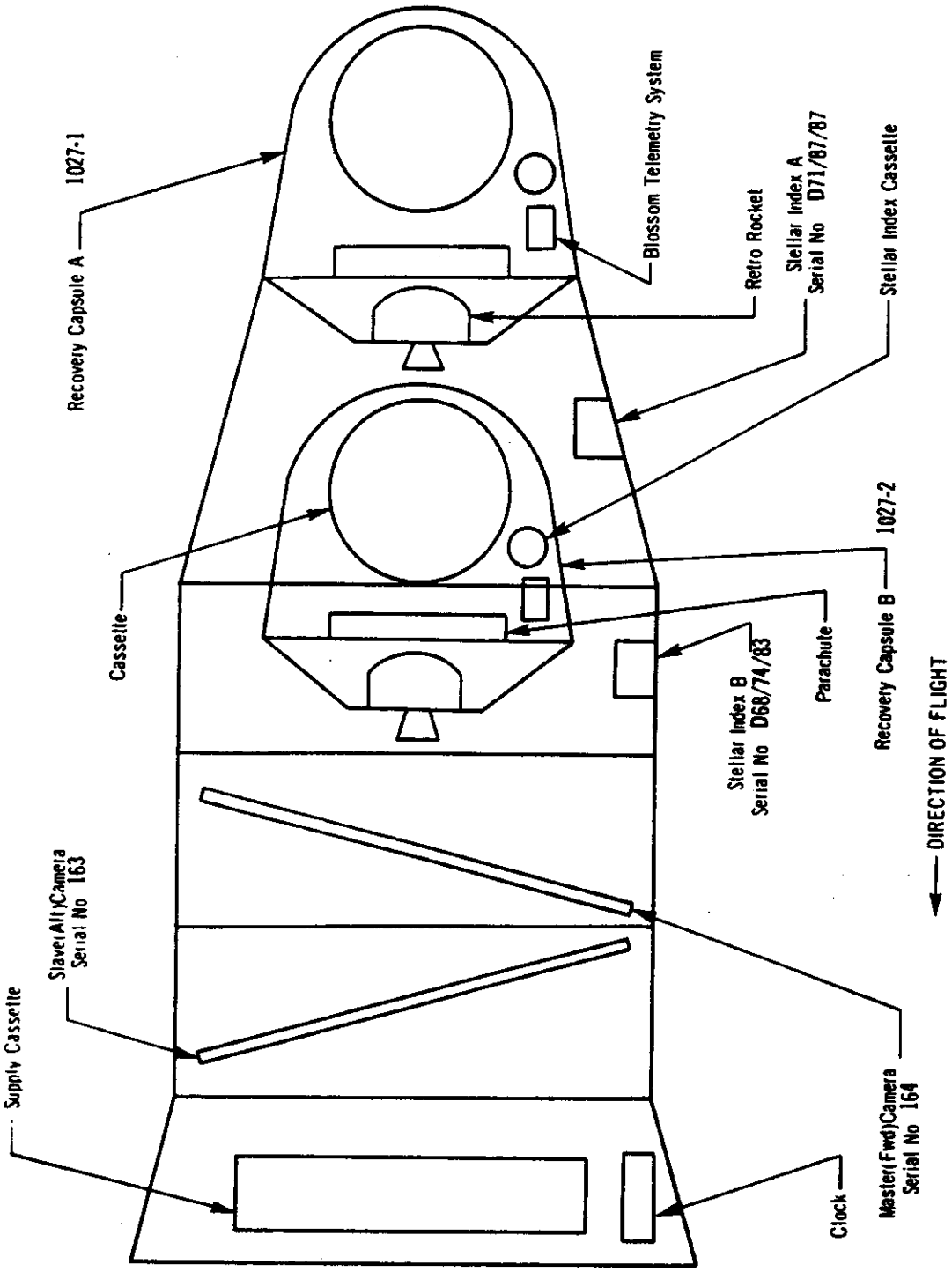
APPENDIX A. SYSTEM SPECIFICATIONS

1. Cameras:

	Master Panoramic	Master Take-Up Horizon	Master Supply Horizon	Slave Panoramic	Slave Take-Up Horizon	Slave Supply Horizon	Mission 1027-1		Mission 1027-2	
							Stellar	Index	Stellar	Index
Camera No	164	NA	NA	163	NA	NA	D71/87/87	D71/87/87	D68/74/83	D68/74/83
Lenses No	NA	NA	NA	NA	NA	NA	87	87	83	74
Lens Serial No	1392435	812271	813510	1392435	812306	814015	10555	817713	10768	817464
Slit Width (in)	.250	NA	NA	.175	NA	NA	NA	NA	NA	NA
Aperture	3.5	8.0	6.8	3.5	6.8	8.0	1.8	4.5	1.8	4.5
Exposure Time (sec)	1/240 Avg.	1/100	1/100	1/340 Avg.	1/100	1/100	2	1/500	2	1/500
Filter (Wratten)	25	25	25	21	25	25	None	21	None	21
Focal Length (mm)	609.600	54.33	55.20	609.600	55.05	54.56	84	38.38	84	38.49
Film Length (ft)	16000	NA	NA	16000	NA	NA	75	135	75	150
Splices	*	NA	NA	5	NA	NA	None	None	None	None
Emulsion	226-55-9-5	226-55-9-5	226-55-9-5	226-55-9-5	226-55-9-5	226-55-9-5	124-35-10-5	106-14-8-5	124-35-10-5	106-14-8-5
Film Type	3404	3404	3404	3404	3404	3404	3401	3400	3401	3400
Resolution Data (L/mm)										
Static										
High Contrast	250	*	*	243	*	*	*	76(A)	*	76(A)
Low Contrast	145	*	*	150	*	*	*	*	*	*
Dynamic										
I High Contrast	192	147	147	183	152	153	*	*	*	*
I Low Contrast	131	*	*	123	*	*	*	*	*	*
P High Contrast	192	*	*	192	*	*	*	*	*	*
P Low Contrast	119	*	*	116	*	*	*	*	*	*

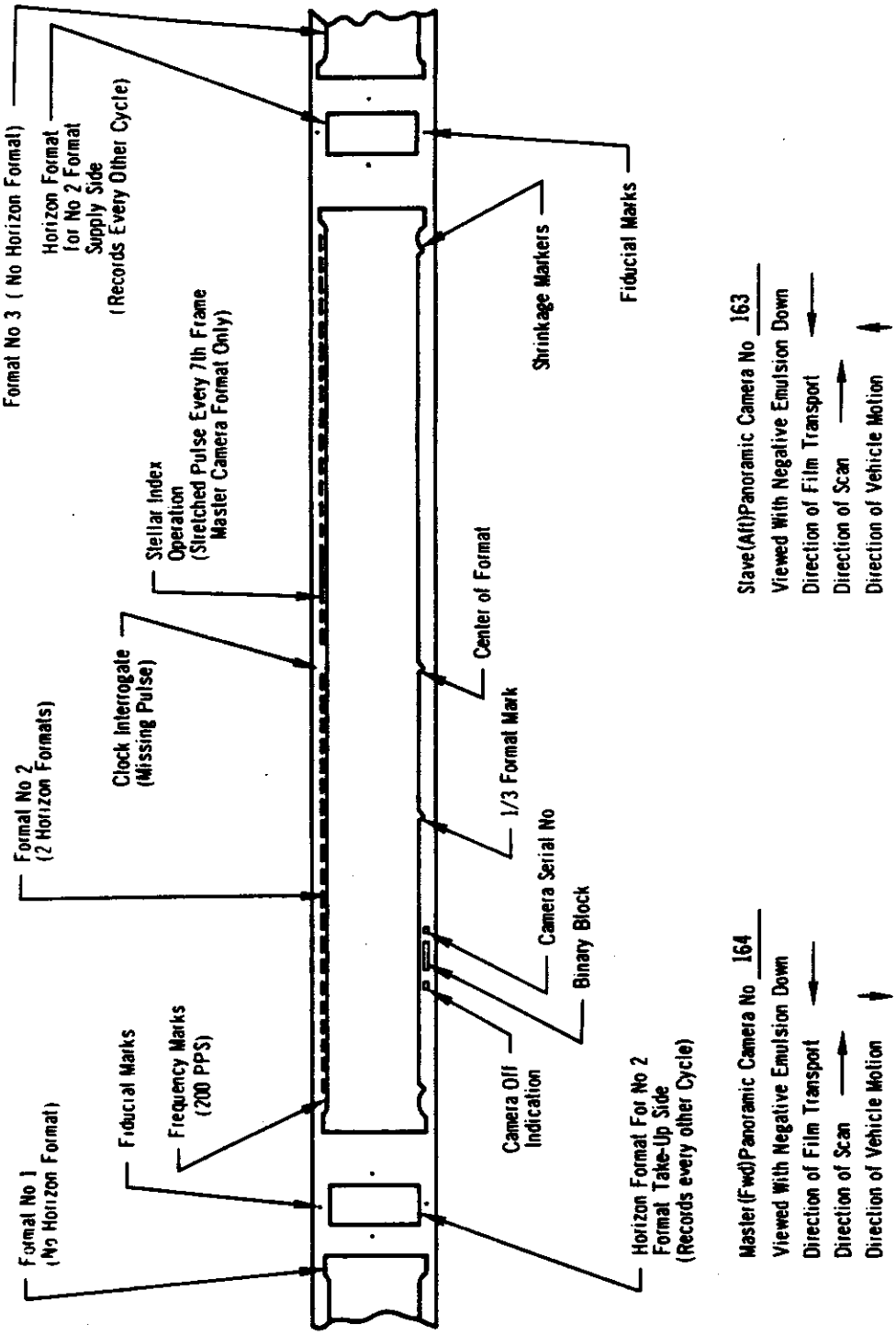
NA - Not Applicable (A) AWAR *Not Available

2. VEHICLE CONFIGURATION AND EQUIPMENT LAYOUT



NPIC K-6260 (2/66)

3. PANORAMIC FORMAT SPECIFICATIONS



NPIC K-6288 (2/68)

APPENDIX B. DENSITY READINGS

1. Stellar Material (Mission 1027-1)

The following 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.

Pass	Frame	Dmax	Dmin	Delta	Gross Fog
1D	1	0.27	0.15	0.12	0.14
5D	2	0.15	0.13	0.02	0.13
	24	0.79	0.14	0.65	0.12
6D	25	0.15	0.13	0.02	0.12
	68	0.69	0.18	0.51	0.13
7D	69	0.15	0.14	0.01	0.13
	100	0.64	0.15	0.49	0.13
8D	101	0.22	0.13	0.09	0.12
	125	0.85	0.15	0.70	0.12
9AE	126	0.12	0.12	0.00	0.12
9D	127	0.31	0.13	0.18	0.12
	167	0.78	0.15	0.63	0.12
10D	168	0.55	0.13	0.42	0.12
	196	1.07	0.15	0.92	0.12
11D	197	0.96	0.14	0.82	0.12
	221	1.04	0.16	0.88	0.12
12D	222	0.24	0.13	0.11	0.12
	223	0.38	0.13	0.25	0.12
13D	224	1.17	0.15	1.02	0.12
	256	0.86	0.14	0.72	0.12
14D	257	0.99	0.15	0.84	0.12
	280	1.20	0.15	1.05	0.12
15D	281	1.18	0.17	1.01	0.12
	282	1.25	0.16	1.09	0.12
*16D	283	3.60	2.50	1.10	0.12
*	284	3.62	1.36	1.26	0.13
Average		0.64	0.15	0.49	0.12
Range		0.12 - 1.25	0.12 - 0.18	0.00 - 1.09	0.12 - 0.14

*These readings are not included in the averages and ranges

2. Index Material (Mission 1027-1)

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

		LIMITING				TERRAIN		
Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Dmax	Dmin	Delta
1D	1	0.70	0.05	0.65	0.04	0.70	0.05	0.65
5D	2	0.40	0.04	0.36	0.04	0.40	0.18	0.22
	24	1.18	0.32	0.86	0.04	0.48	0.32	0.16
6D	25	0.42	0.06	0.36	0.04	0.42	0.08	0.32
	68	1.90	0.32	1.58	0.04	NR	NR	NR
7D	69	0.61	0.06	0.55	0.04	NR	NR	NR
	100	1.12	0.15	0.97	0.04	1.12	0.15	0.97
8D	101	0.48	0.05	0.43	0.04	0.32	0.12	0.20
	125	1.42	0.10	1.32	0.04	1.20	0.70	0.50
9AE	126	0.04	0.04	0.00	0.04	NR	NR	NR
9D	127	0.56	0.10	0.46	0.04	NR	NR	NR
	167	1.68	0.13	1.50	0.04	0.80	0.32	0.48
10D	168	0.82	0.08	0.74	0.04	NR	NR	NR
	196	1.58	0.20	1.38	0.04	0.50	0.20	0.30
11D	197	1.00	0.09	0.91	0.04	1.00	0.34	0.66
	221	1.50	0.22	1.28	0.04	0.58	0.40	0.18
12D	222	0.62	0.04	0.58	0.04	0.62	0.12	0.50
	223	0.58	0.04	0.54	0.04	0.58	0.12	0.46
13D	224	1.89	0.18	1.71	0.04	0.62	0.18	0.44
	256	1.53	0.10	1.43	0.04	0.65	0.35	0.30
14D	257	1.32	0.18	1.14	0.04	NR	NR	NR
	280	1.89	0.08	1.81	0.04	1.18	0.30	0.88
15D	281	1.12	0.12	1.00	0.04	0.48	0.12	0.36
	282	1.28	0.17	1.11	0.04	0.48	0.17	0.31
16D	283	0.04	0.04	0.00	0.04	NR	NR	NR
	284	0.04	0.04	0.00	0.04	NR	NR	NR

Average Terrain Dmax - 0.67
Average Limiting Dmax - 0.99
Average Terrain Dmin - 0.23
Average Limiting Dmin - 0.12
Average Gross Fog - 0.04

Terrain Dmax Range 1.20 - 0.32
Limiting Dmax Range 1.90 - 0.04
Terrain Dmin Range 0.70 - 0.05
Limiting Dmin Range 0.32 - 0.04

NR - Denotes Not Readable

tion in microns, the reciprocal of the 50 percent width in millimeters, and the intersection point of the modulation transfer curve and the aerial image modulation curve. The procedure used in the derivation of these values is described in the SPPF Technical Report No. 101-31 (page 79-82). The edge orientation angle is determined in the microdensitometer and is 0 degree when the edge is parallel to the major axis of the film and 90 degrees when the edge is perpendicular to the major axis of the film.

The edge traces were made on the original negative of this mission. The imagery traced is contained in the frames considered to be typical of the best in the mission.

2. Summary Table of Edge Traces

Trace Number	Pass Frame	Line Spread Function		MTF/AIM Intersect	Edge Orientation
		50% Width In Microns	1000/50% Width		
1	06D/127F	10.8	92	82	142.8°
2	06D/127F	12.9	77	110	132.2°
3	06D/127F	10.7	93	87	141.9°
4	06D/127F	9.8	102	100	167.7°
5	06D/127F	11.3	88	87	167.2°

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.

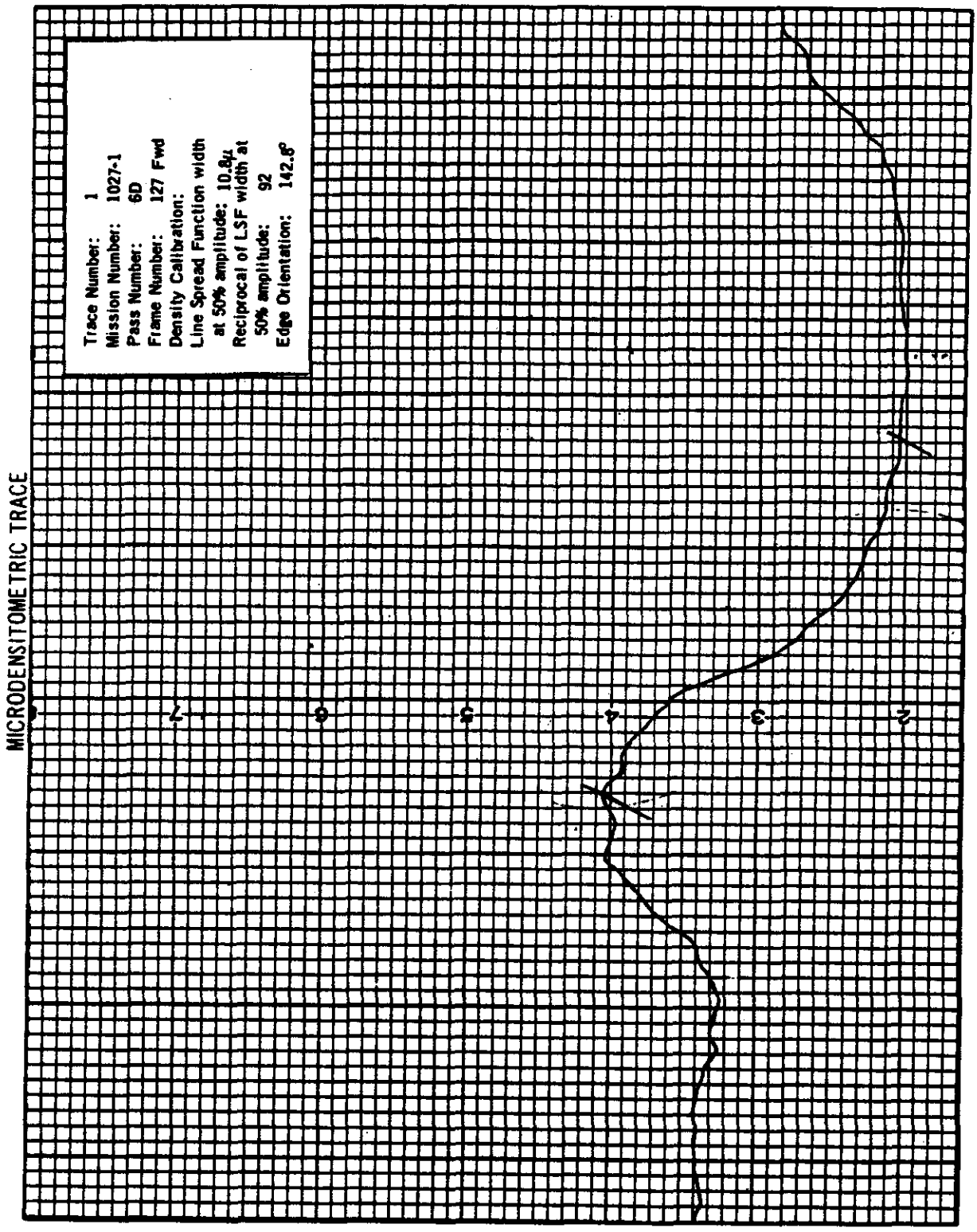
To satisfy the desire to express image quality in terms of a value, a single number is determined from the spread function curve by measuring its width at 50 percent amplitude. This width is expressed as a micron distance in image space and may be converted to a distance on the ground. On domestic passes, 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.

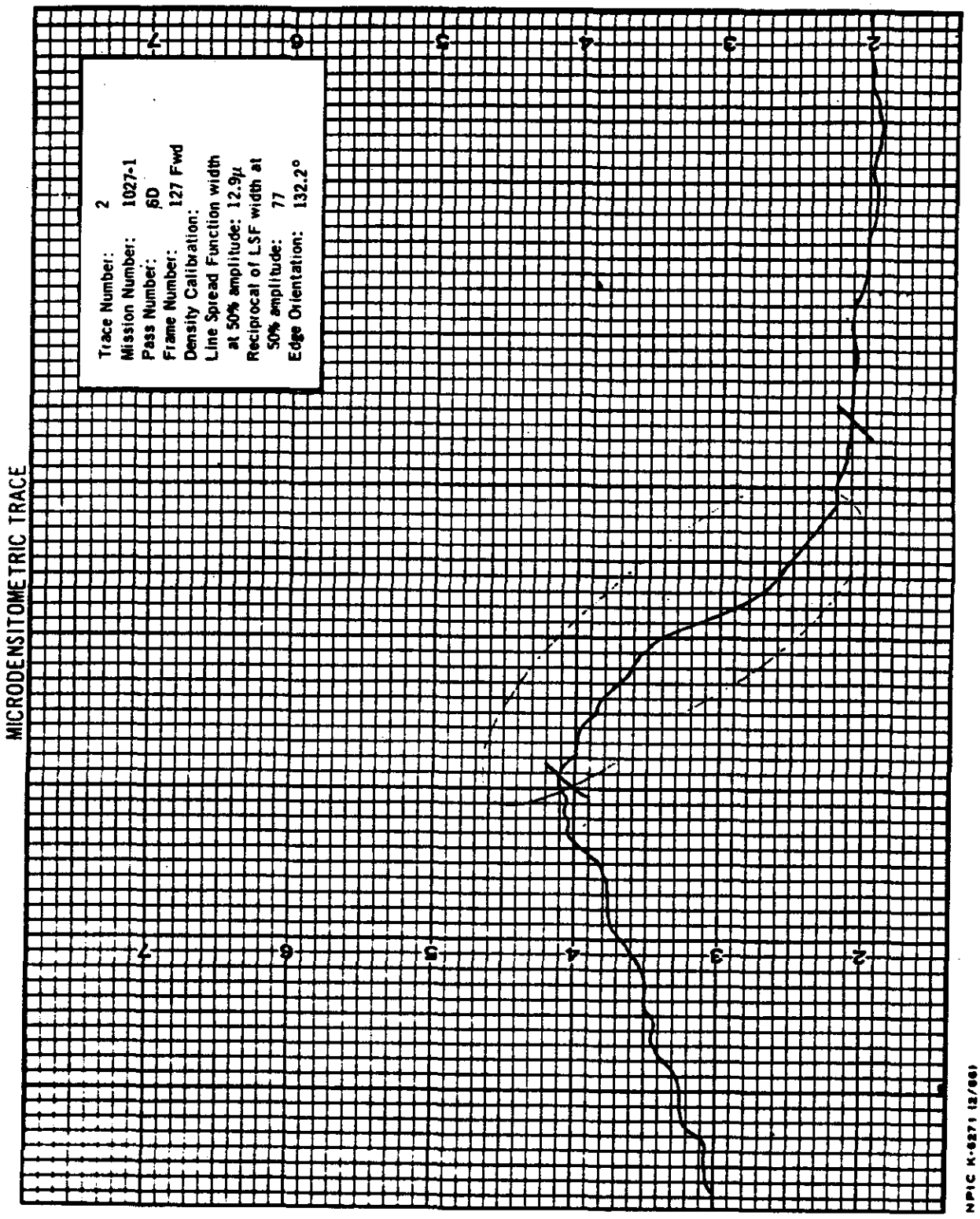
The mission is examined to determine the MIP frame (Mission Information Potential) which is a subjective selection of the best photography. Straight edges in this imagery meeting the criteria of a step function for a length of at least 120 microns are selected for scanning with the microdensitometer.

The microdensitometer used for the traces in this report is located at the SPPF facility. The location of the traces was directed by representatives from NPIC at SPPF. 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 mm/minute and a chart speed of 4.1 inches/minute was used for a recording to specimen expansion of 2083:1. One inch on the recording equals 12.2 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.

In the following table the following computer outputs are listed for each edge traced: The 50 percent amplitude width of the Line Spread Func-

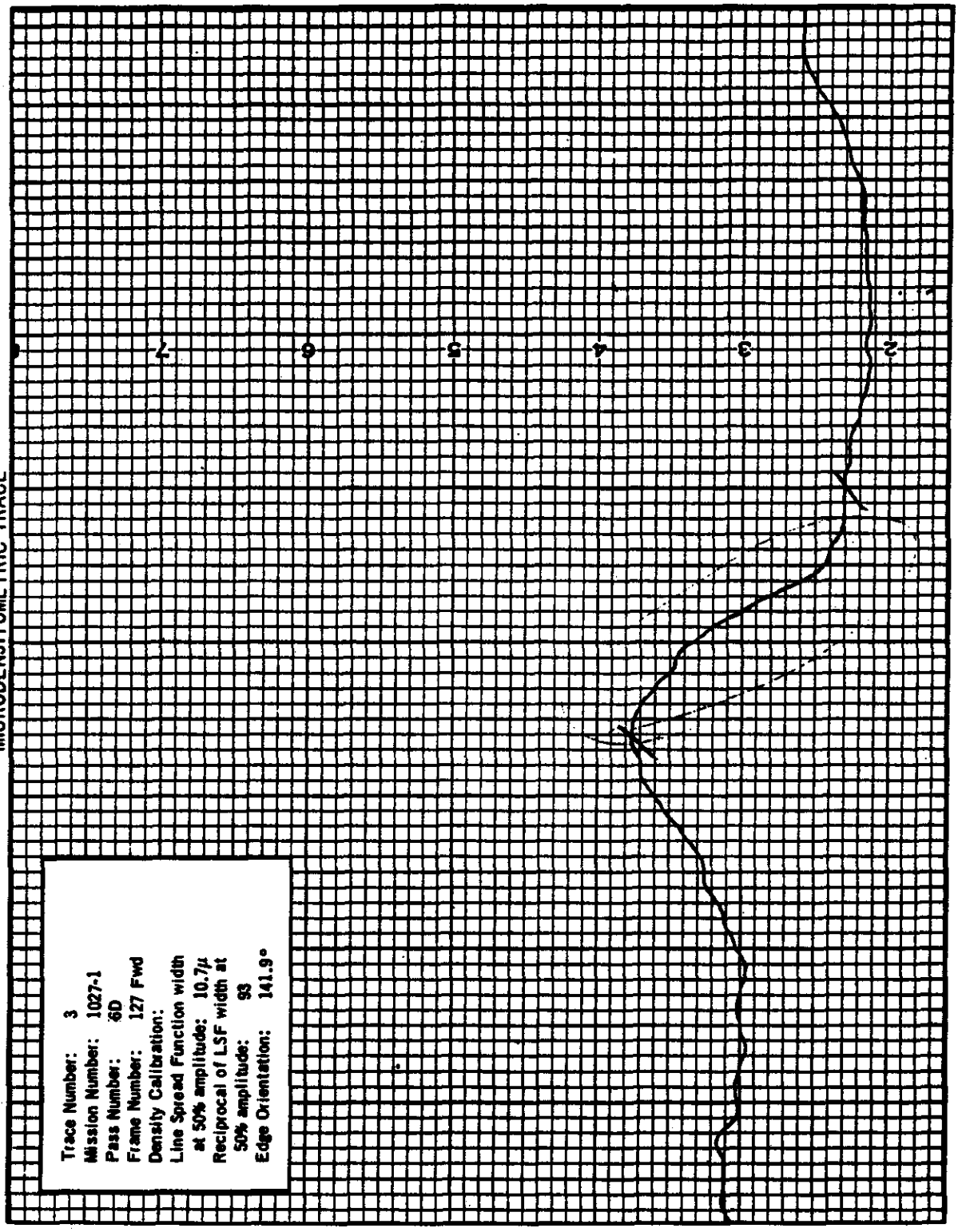


NPIC K-6270 (2/66)


MICRODENSITOMETRIC TRACE
Trace Number: 2
Mission Number: 1027-1
Pass Number: 6D
Frame Number: 127 Fwd
Density Calibration:
Line Spread Function width at 50% amplitude: 12.9μ
Reciprocal of LSF width at 50% amplitude: 77
Edge Orientation: 132.2°
7
6
5
4
3
2
NPIC K-6271 12/66

[redacted]

MICRODENSITOMETRIC TRACE



NPIC K-6372 (2/68)