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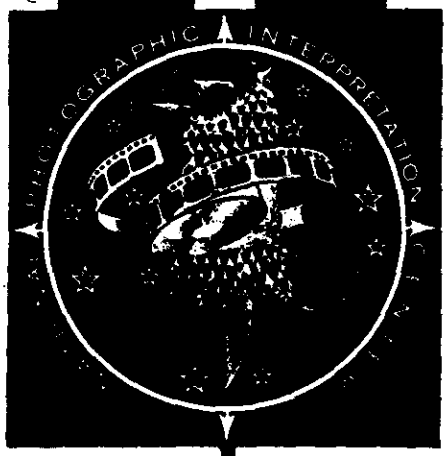
~~NO FOREIGN DISSEM~~

TECHNICAL PUBLICATION



PHOTOGRAPHIC EVALUATION REPORT

MISSION 1013-1

2 - 6 NOVEMBER 1964

MISSION 1013-2

6 - 7 NOVEMBER 1964

[redacted] AUGUST 1965

COPY [redacted]

131 PAGES

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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT
MISSION 1013-1
2 - 6 NOVEMBER 1964
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6 - 7 NOVEMBER 1964

AUGUST 1965

NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

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SYNOPSIS

Mission 1013 (System No J-15), the thirteenth in the "J" series of reconnaissance systems, was launched into orbit on 2 November 1964. The mission accomplished only 25 operational photographic passes and 1 photographic engineering pass.

A malfunction precluded panoramic camera operation after pass 52D, Mission 1013-1. No panoramic photography was achieved on Mission 1013-2. The photography from both the master and slave units was seriously degraded by areas of out-of-focus imagery prior to pass 52D. The photographic quality and interpretation suitability of the panoramic material, when not degraded by the out-of-focus condition, are good and similar to those results achieved on Mission 1012. The horizon images are good and are useable for the determination of vehicle attitude in most passes. Vehicle attitude appears to have been normal throughout the mission.

The Stellar/Index (S/I) unit functioned satisfactorily through both phases of the mission.

Clouds and/or haze obscure or degrade approximately 47 percent of the panoramic photography.

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GENERAL FLIGHT DATA

Mission 1013-1	Launch Date	2 November 1964
	Recovery Date	6 November 1964
Mission 1013-2	Activation Date	7 November 1964
	Recovery Date	8 November 1964

Orbital Parameters

	Mission 1013-1 Actual (Rev 25)
Period	90.814 min
Perigee	93.81 nm
Apogee	244.67 nm
Eccentricity	.02019
Perigee Latitude	29.30°N
Inclination Angle	79.9°

Photographic Operations

	Mission 1013-1	Mission 1013-2
Operational Passes	22	0
Terrestic Passes	3	0
Engineering Passes	1	0
Recovery Revolution	25	31

PART I. CAMERA OPERATION

1. Master (FWD) Panoramic Camera No 158:

The camera was operational through a portion of pass 52D, Mission 1013-1, but was not operational at any time on Mission 1013-2. The malfunction which caused the early termination of panoramic camera operation is presented in Part I, Section 10, Malfunction of Panoramic Cameras. Areas of out-of-focus imagery which severely degrade the photography begin in pass 47DE. The out-of-focus condition is present at the supply end for the first time in frame 13 and at the take-up first on frame 29. These areas vary in shape, size, and degree of softness and recur sporadically throughout the remainder of the mission. Frame 10 of pass 51D is the first of many frames to be entirely out-of-focus. Additional information concerning these areas also is contained in Part I, Section 10, Malfunction of Panoramic Cameras. Other degradations attributed to camera operation include:

(a) Fogged areas of plus density and equipment shadowgraphs caused by non-image forming light are present on the first 3 and last 2 frames of most camera operations. Their pattern is repetitive and the degree of severity is commensurate with the duration of the camera-off period and the sun angle during this time. A crescent-shaped area of plus density is located on the fifth-from-last frame of some passes.

(b) Streaks of minus density are present intermittently throughout the mission. Most of these appear to be oriented parallel to the film edges; however, some are biased in relation to the edges of the film.

(c) A series of emulsion digs and scratches approximately 1.1 inch inside the format under the camera number and a second series at the frequency-mark edge of the format are present on each frame of the mission.

2. Slave (AFT) Panoramic Camera No 159:

This camera operated only through a portion of pass 52D, Mission 1013-1, and did not operate at any time on Mission 1013-2. The malfunction of this unit is discussed in Part I, Section 10, Malfunction of Panoramic Cameras. Areas of out-of-focus imagery at the supply end of each frame severely degrade the photography. These areas begin in [illegible] and recur at random thereafter. The first out-of-focus area at

the take-up end appears in pass 23D, frame 62. Areas of soft focus covering from one-half to two-thirds of the format at the frequency-mark edge of some frames begin in pass 23D, frame 93, and appear intermittently thereafter. The shape, size, and degree of severity of these areas vary throughout the mission. Other degradations include:

(a) The third frame, fourth frame, and second-from-last frame of most camera operations are degraded by biased streaks of plus density presumably caused by non-image forming light entering the unit during the camera off period. Images of equipment are also found on the third-from-last and last frame of some passes. Their pattern is repetitive and their density is commensurate with the duration of the camera-off period and the sun angle during this time.

(b) Numerous streaks of minus density are present throughout the mission. Most appear biased in relation to the edges of the film; however, some are oriented parallel to the film edges. Pass 23D is severely affected by these streaks, which range in length from 3.0 inches to 30 inches. They are randomly located throughout the format area.

(c) A series of emulsion gouges and scratches are present in the vicinity of the data block approximately 0.1 inch inside the format along both the camera-number and frequency-mark edge of each frame.

3. Master (FWD) Horizon Cameras:

Both the port (supply) and starboard (take-up) horizon cameras were operational throughout the mission. The exposure is commensurate with the solar elevation. In most frames the horizons are definable and useable for the determination of vehicle attitude.

4. Slave (AFT) Horizon Cameras

Both the port (take-up) and the starboard (supply) horizon cameras maintained properly throughout the mission. The images are sharp and the horizon areas are useable for determination of vehicle attitude. The exposure is commensurate with the solar elevation.

5. Stellar Camera No 55 (Mission 1013-1):

This stellar camera operated properly throughout the first phase of the mission. Stellar images are present on all frames, even though there is insufficient flare light to image the reseau on the first 43 frames. The flare level is medium to low throughout the mission. Slight edge fog along the edge opposite the correlation mark edge is intermittently present from head to tail. Slight edge fog is present intermittently along the edge containing the correlation mark from frame 370 through 416. Edge static traces are located intermittently along the correlation mark edge from frame 411 through 418 and along the opposite edge from frame 370 through 416. Fine emulsion cracks perpendicular to the major axis are present from frame 360 through 418. Frames 279 through 291 were torn and severely mutilated during the printing process. The following 37 frames were also severely abraded, necessitating use of the duplicate positive for stellar reduction on frames 280 through 311. At least 35 percent of the frames have weak, elongated, or streaked stellar images. Double images are present in frames 73, 74, 84, 263, 295, 296, 308, 309, 310, and 311. Because of a lack of adequate stellar imagery a "2-star" solution was employed on [illegible] frames.

6. Stellar Camera No 54 (Mission 1013-2):

This stellar camera was operational throughout the second phase of the mission. The stellar imagery appears good and the flare level is low. No stellar reduction was accomplished on this material because no panoramic photography was obtained on Mission 1013-2. Edge fog and edge static traces were noted intermittently along both edges of the material throughout the mission. Plus density spots, resembling pressure marks, and associated static traces are present about 0.25 inch from the edge opposite the correlation mark from frame 45 through the end of the mission. They are spaced at about 1.55-inch intervals.

7. Index Camera No 4 (Mission 1013-1):

This camera was operational throughout the first phase of the mission recording a total of 418 frames. The first 37 frames contain imagery because of an extremely low solar elevation during acquisition. The imagery on the remaining frames is of good quality. The reseau is [illegible] on all frames containing imagery. The imagery is mostly [illegible] low contrast as the exposure was adequate. A threadlike [illegible] is present in the lower left corner of all frames, indicating an [illegible] is present on the reseau.

8. Index Camera No 48 (Mission 1013-2):

This camera was employed in the second phase of the mission and operated satisfactorily. The photography consists of 102 frames and is considered to be of good quality. Frames 1 and 2 were fogged, presumably during preflight testing. The reseau is well defined and the imagery is sharp on all frames.

9. Associated Equipment:

This equipment records technical information required for the correlation and mensuration of photography from the primary cameras. At the start of most camera operations the 200 cycles per second frequency marks on the master material are of adequate density. They gradually diminish in intensity and are extremely light or not recorded by the end of most camera operations. The frequency marks are light to non-existent on most of the slave material. They are imaged inside the format area and are visible only when the photographic imagery is of a sufficient density to permit their detection.

Two camera-off markers are present at the end of most master camera operations. Some slave frames contain double, rather than single, camera-off markers.

10. Malfunction of Panoramic Cameras:

The cameras were activated erroneously early on pass 14. This pass had been programmed for a later operation of 14 frames, but because of its unexplained early activation it consisted of 416 frames of master and 417 frames of slave panoramic photography. No reason has been found for the premature camera start or the camera off/on sequence between frames 344/345 of the master and frames 345/346 of the slave camera in pass 14. A second anomaly caused the malfunction of both panoramic cameras and abruptly ended the mission long before its scheduled termination. The factors considered pertinent to this malfunction are presented:

(-) The last frame contained in the A bucket (1013-1) was:

1. Master Panoramic Camera - 2.9 inches of frame 105, pass 127.

2. Slave Panoramic Camera - 15.5 inches of frame 104, pass 127.

(b) The total panoramic footage in the B bucket consisted of only a portion of the residual material from Mission 1013-1, which was:

1. Master Panoramic Camera - 24.7 inches of frame 107 plus 10.2 inches of frame 108, pass 52D.

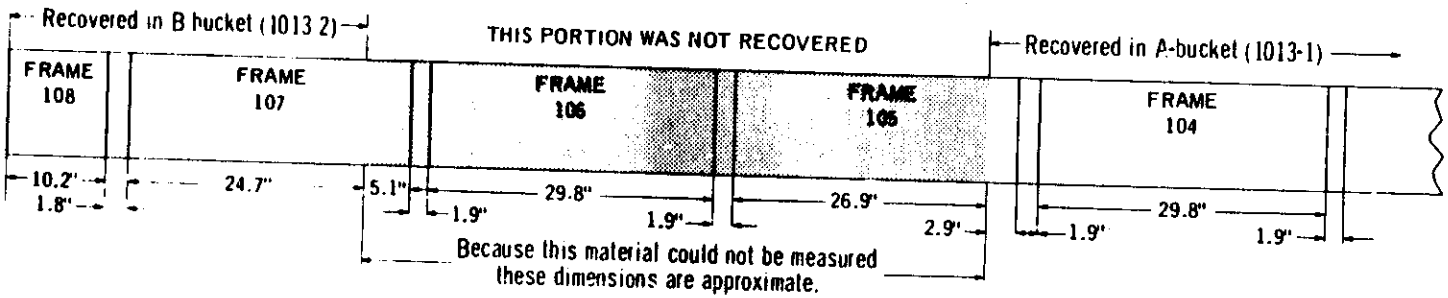
2. Slave Panoramic Camera - 18.0 inches of frame 110 plus 22.5 inches of frame 111, pass 52D.

(c) Those frames not recovered are:

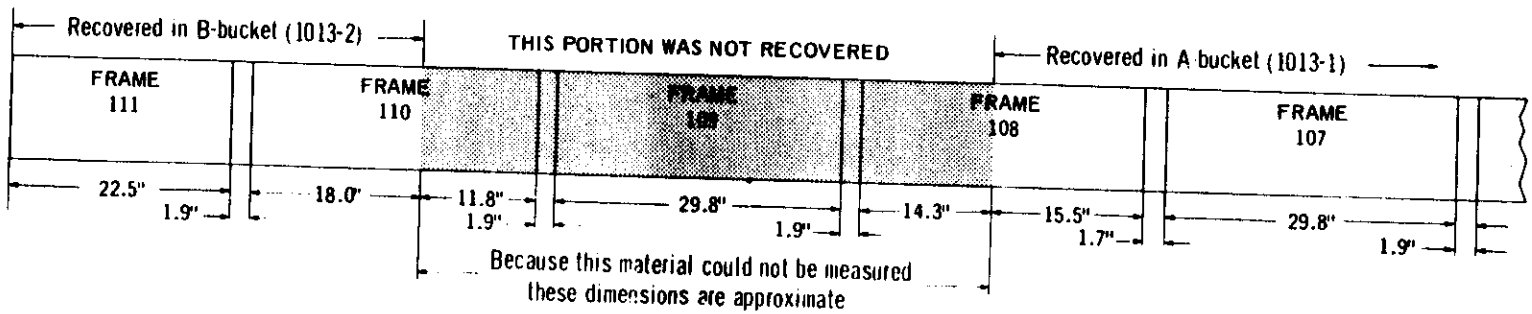
1. Master Panoramic Camera - 26.9 inches of frame 105, all of frame 106, and 5.1 inches of frame 107, pass 52D.

2. Slave Panoramic Camera - 14.3 inches of frame 108, all of frame 109, and 11.8 inches of frame 110, pass 52D.

PASS 52-D



MASTER PANORAMIC FRAMES



SLAVE PANORAMIC FRAMES

NPIC K-3511 (9/65)

(d) Out-of-focus areas which may be associated with the malfunction were first noted in:

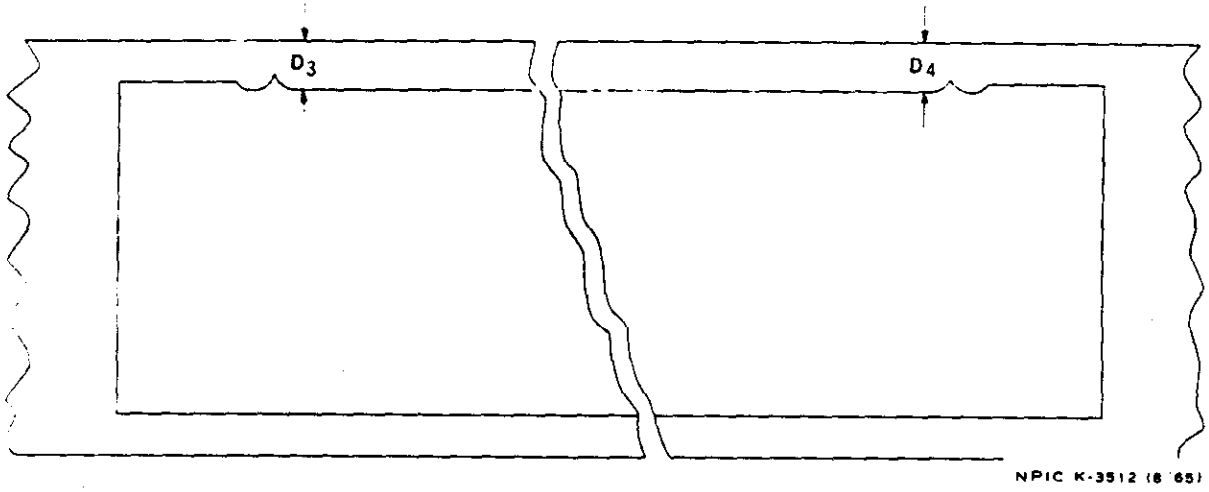
1. Master Panoramic Camera - Soft area, frame 13 of pass 47DE and located at the frequency-mark edge on the supply end of the frame. Another is present at the take-up end of the format in frame 29 of the same pass. The entire format is out-of-focus for the first time in frame 10 of pass 51D.

2. Slave Panoramic Camera - Soft area, frame 4 of pass 4D and located at the supply end of the frame. The soft area is present at the take-up end in frames 62, 64, 66, 68, 72, 76, and 78 of pass 23D. Both the take-up and supply ends become soft on frames 79 and 80 of the same pass.

(e) Pitch measurements were made to determine if the format was biased in relation to the edge of the film:

1. Master Panoramic Material - D_3 Range 0.215 inch to 0.265 inch. D_4 Range 0.220 inch to 0.265 inch.

2. Slave Panoramic Material - D_3 Range 0.220 inch to 0.265 inch. D_4 Range 0.225 inch to 0.265 inch. The tolerances of both units appear normal. No correlation between the presence of the out-of-focus condition and the D_3 and D_4 measurements was established.



(f) Measurements of the distance from the shrinkage marker at the supply end of a frame to the shrinkage marker at the take-up end of the next frame were made to determine if the film metering was normal. The metering was found to be erratic in both cameras. The distance between end shrinkage markers on successive frames ranged from:

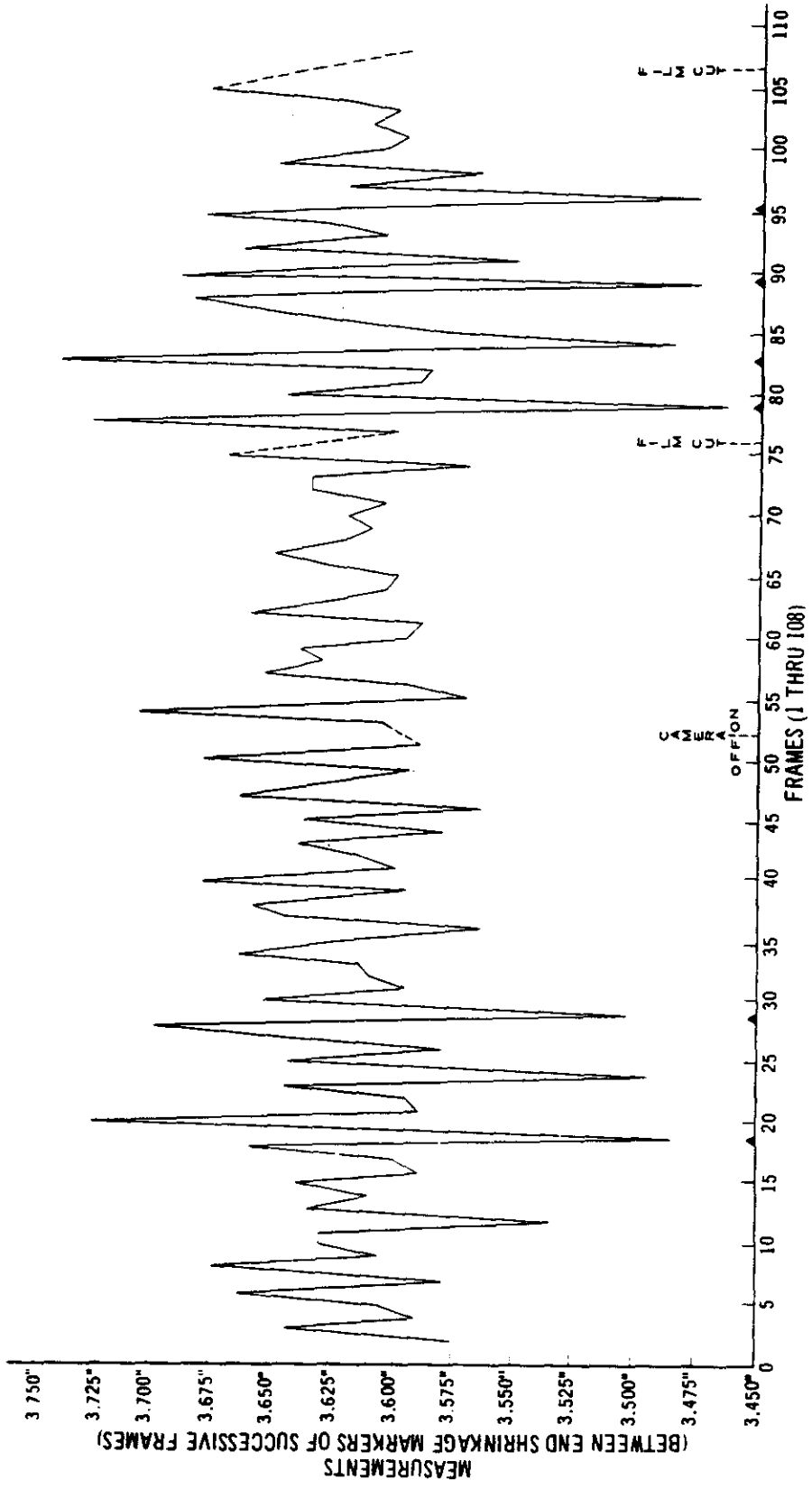
1. Master Panoramic Material: 3.590" to 3.855"

2. Slave Panoramic Material: 3.515" to 3.845"

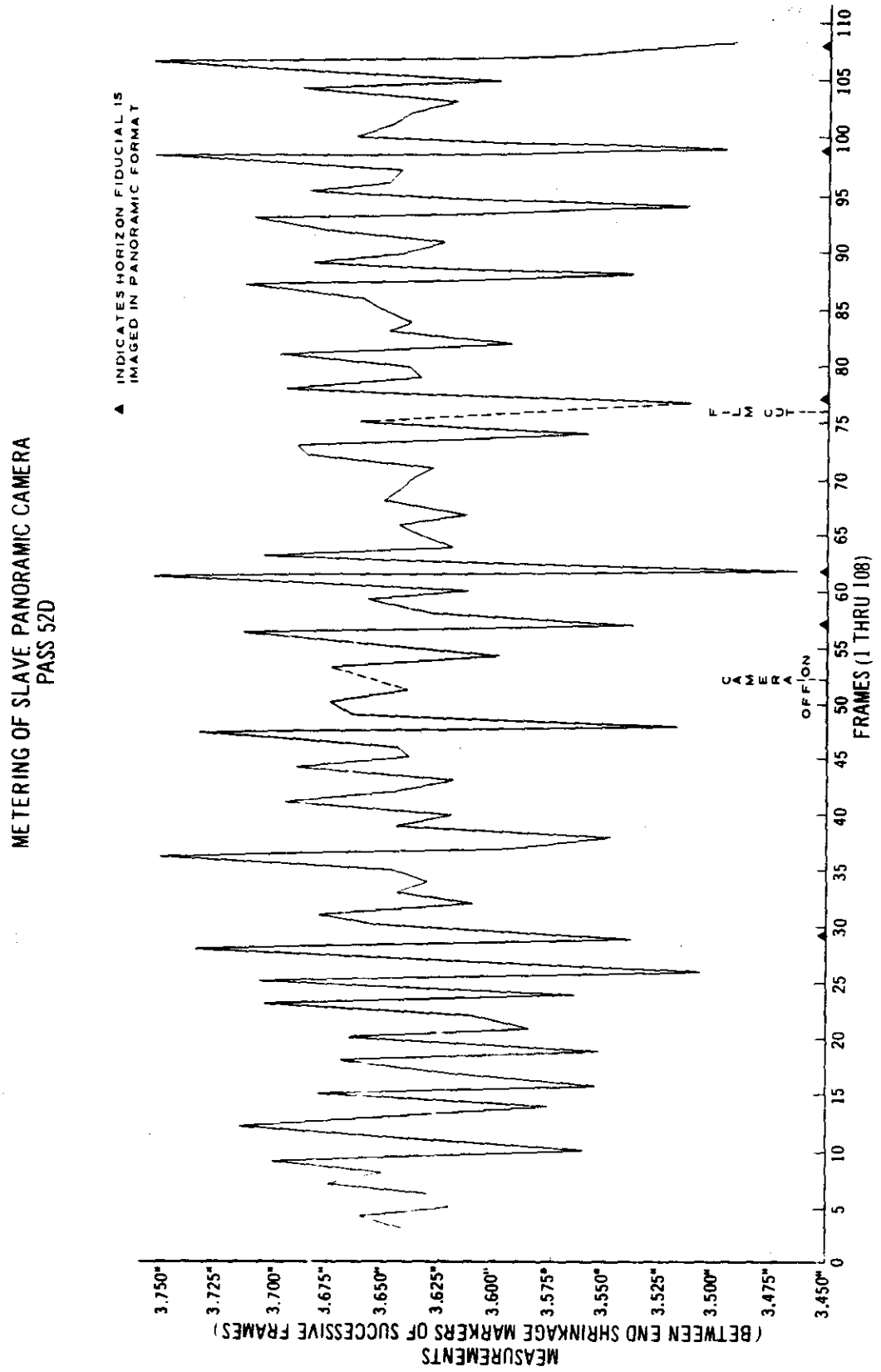
This abnormal metering caused 6 horizon fiducials to be within the panoramic format on the master material and 6 on the slave material.

METERING OF MASTER PANORAMIC CAMERA
PASS 52D

▲ INDICATES HORIZON FIDUCIAL IS IMAGED IN PANORAMIC FORMAT



NPIC K 3513 (8/65)


METERING OF SLAVE PANORAMIC CAMERA
PASS 52D
▲ INDICATES HORIZON FIDUCIAL IS IMAGED IN PANORAMIC FORMAT
CAMERA OFF ON
FILM CUT
FRAMES (1 THRU 108)
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110
3.450" 3.475" 3.500" 3.525" 3.550" 3.575" 3.600" 3.625" 3.650" 3.675" 3.700" 3.725" 3.750"
MEASUREMENTS
(BETWEEN END SHRINKAGE MARKERS OF SUCCESSIVE FRAMES)
NPIC K 3514 (8/65)

(g) The distance between the take-up shrinkage marker and the supply shrinkage marker of the same frame was measured to determine if the length of film format varied:

	Nominal	Excessive
1. Master Panoramic Camera:	28.033"	28.090"
2. Slave Panoramic Camera:	28.020"	28.090"

The excessive format length indicates that more than the required length of film was present in the platten area at the time of the exposure. Such a situation could cause a loss of tension on the film and permit it to buckle in a manner which could allow it to be out of the plane of focus during the exposure. This may account for the out-of-focus imagery present on those frames.

(h) The stellar and index cameras were operational throughout the second portion of the mission (1013-2). This is proof that, although no panoramic film was transported after pass 52D, the master camera continued to scan, since it is the actual scanning operation which activates the S/I unit.

(i) Most of the frames subsequent to a manufacturer's splice on frame 90 of pass 24D of the slave material are entirely or partially out-of-focus. Adhesive transfers located 75 and 120 inches prior to the splice indicate an excessive amount of adhesive was present at the splice. Since areas of out-of-focus imagery are present on the slave photography as early as pass 4D, it is concluded that although binding could have occurred because successive wraps of the film may have been stuck together, this was not the cause of the malfunction but rather only aggravated the out-of-focus condition on the slave material.

(j) The last frames recovered were:

1. Master Panoramic Camera: pass 52D frame 108

2. Slave Panoramic Camera: pass 52D frame 111

The difference in film path between the master and slave panoramic cameras to the recovery vehicle take-up spool accounts for the few frames discrepancy between the cameras. It is evident that both units malfunctioned almost simultaneously.

Conclusions:

Each panoramic camera is a separate unit capable of independent operation. The on-orbit power supply, and the communications and control system inputs, however, are common to both cameras. It is believed that either or both of these may have been the cause of the failure. The erratic metering also indicates possible trouble in the on-orbit power supply. Had there been a power drop sufficient to allow a loss in film tension the probable resultant mistracking would have been capable of jamming the film transport systems of each camera.

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 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.

[redacted]

FIGURE 2. REOCCURRING LIGHT LEAKS PRESENT ON THE MASTER PANORAMIC MATERIAL.

FIGURE 3. REOCCURRING LIGHT LEAKS PRESENT ON THE MASTER PANORAMIC MATERIAL.

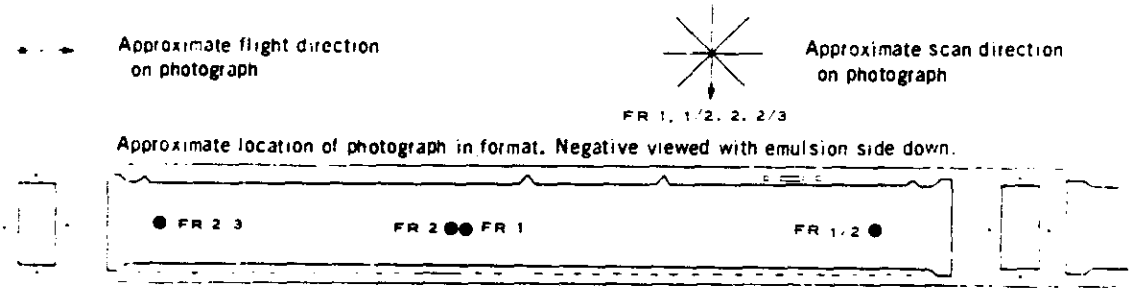
NPIC K-3462 (8/65) NPIC K-3463 (8/65)

Examples of the light leaks present at the beginning of most camera operations are illustrated here. The degree of degradation is dependent upon the length of time the camera is at rest and the amount of illumination it received during this period.

[redacted]

[redacted]

	Left Page - Left Photo	Left Page - Right Photo	Right Page - Left Photo	Right Page - Right Photo
Camera	Fwd	Fwd	Fwd	Fwd
Pass	30D	35D	30D	30D
Frame	1	1/2	2	2 3
Date of Photography	4 Nov 64	5 Nov 64	4 Nov 64	4 Nov 64
Universal Grid Coordinates	43 - 12	80 - 12	41 - 12	8 - 12
Enlargement Factor	Contact	Contact	Contact	Contact
Geographic Coordinates	NA	NA	NA	NA
Altitude (feet)	NA	NA	NA	NA
Camera Attitude:				
Pitch	NA	NA	NA	NA
Roll	NA	NA	NA	NA
Yaw	NA	NA	NA	NA
Vehicle Azimuth	NA	NA	NA	NA
Local Sun Time	NA	NA	NA	NA
Solar Elevation	NA	NA	NA	NA
Solar Azimuth	NA	NA	NA	NA
Exposure	NA	NA	NA	NA

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S FWD 1013-1 4 NOV 64 TOP SECRET RUFF

[redacted]

FIGURE 4. REOCCURRING LIGHT LEAKS PRESENT ON MASTER AND SLAVE PANORAMIC MATERIAL.

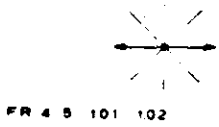
FIGURE 5. REOCCURRING LIGHT LEAKS PRESENT ON MASTER AND SLAVE PANORAMIC MATERIAL.

NPIC K-3464 (8/65) NPIC K-3465 (8/65)

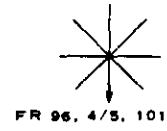
Reoccurring light leaks are present on the master and slave material at the beginning and end of most camera operations.

[redacted]

	Left Page - Left Photo	Left Page - Right Photo	Right Page - Left Photo	Right Page - Right Photo
Camera	Fwd	Aft	Aft	Aft
Pass	24D	51D	24D	24D
Frame	96	4/5	101	102
Date of Photography	4 Nov 64	6 Nov 64	4 Nov 64	4 Nov 64
Universal Grid Coordinates	19 - 12	5 - 12	66 - 12	71 - 12
Enlargement Factor	Contact	Contact	Contact	Contact
Geographic Coordinates	NA	NA	NA	NA
Altitude (feet)	NA	NA	NA	NA
Camera Attitude:				
Pitch	NA	NA	NA	NA
Roll	NA	NA	NA	NA
Yaw	NA	NA	NA	NA
Vehicle Azimuth	NA	NA	NA	NA
Local Sun Time	NA	NA	NA	NA
Solar Elevation	NA	NA	NA	NA
Solar Azimuth	NA	NA	NA	NA
Exposure	NA	NA	NA	NA

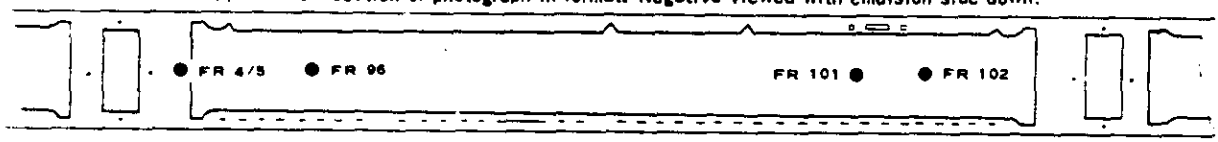


Approximate flight direction on photograph



Approximate scan direction on photograph

Approximate location of photograph in format. Negative viewed with emulsion side down.



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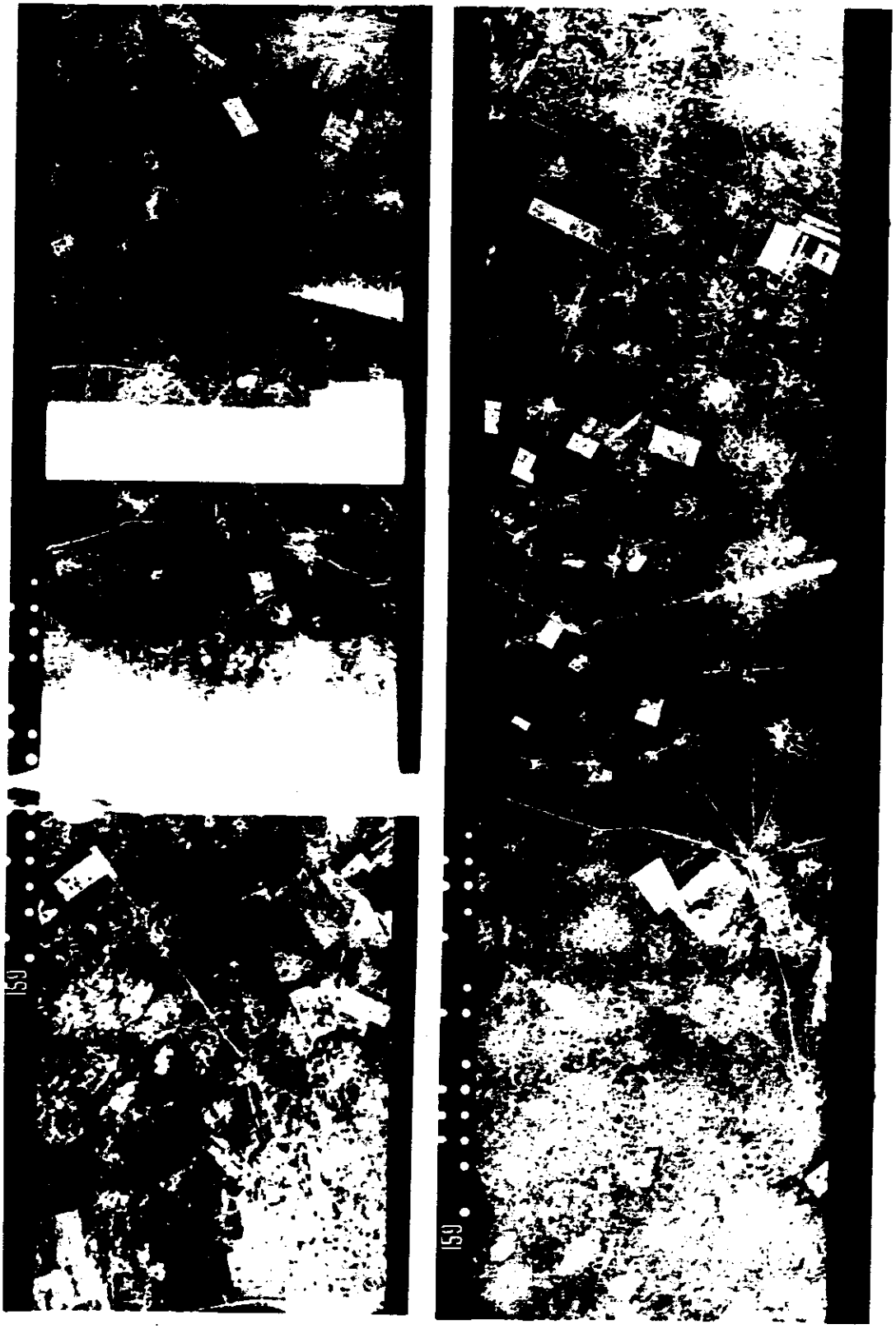

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FIGURE 6. DEGRADATION CAUSED BY OUT-OF-FOCUS CONDITION.

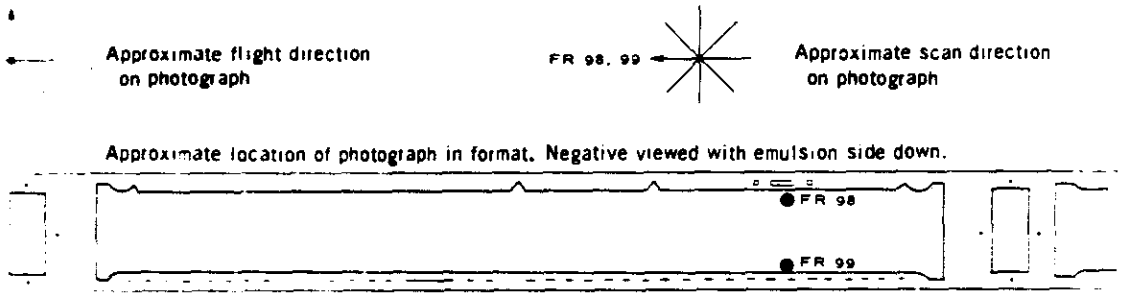
FIGURE 7. DEGRADATION CAUSED BY OUT-OF-FOCUS CONDITION.

NPIC K-3466 (8/65) NPIC K-3467 (8/65)

The same airfield imaged on successive frames is illustrated. The good quality of the imagery on the left photograph contrasts sharply with degraded imagery on the right photograph. The uselessness of the degraded imagery for photo interpretation is evident.

[redacted]

	Left Photo	Right Photo
Camera	Aft	Aft
Pass	36D	36D
Frame	98	99
Date of Photography	5 Nov 64	5 Nov 64
Universal Grid Coordinates	69 - 14	68 - 9
Enlargement Factor	20X	20X
Geographic Coordinates	44°54'N 133°48'E	44°45'N 133°51'E
Altitude (feet)	627,272	626,872
Camera Attitude:		
Pitch	-14°27'	-14°27'
Roll	-0°2'	-0°4'
Yaw	1°31'	1°33'
Vehicle Azimuth	168°23'	168°26'
Local Sun Time	1312	1312
Solar Elevation	27°9'	27°16'
Solar Azimuth	160°	160°
Exposure	1/338	1/338



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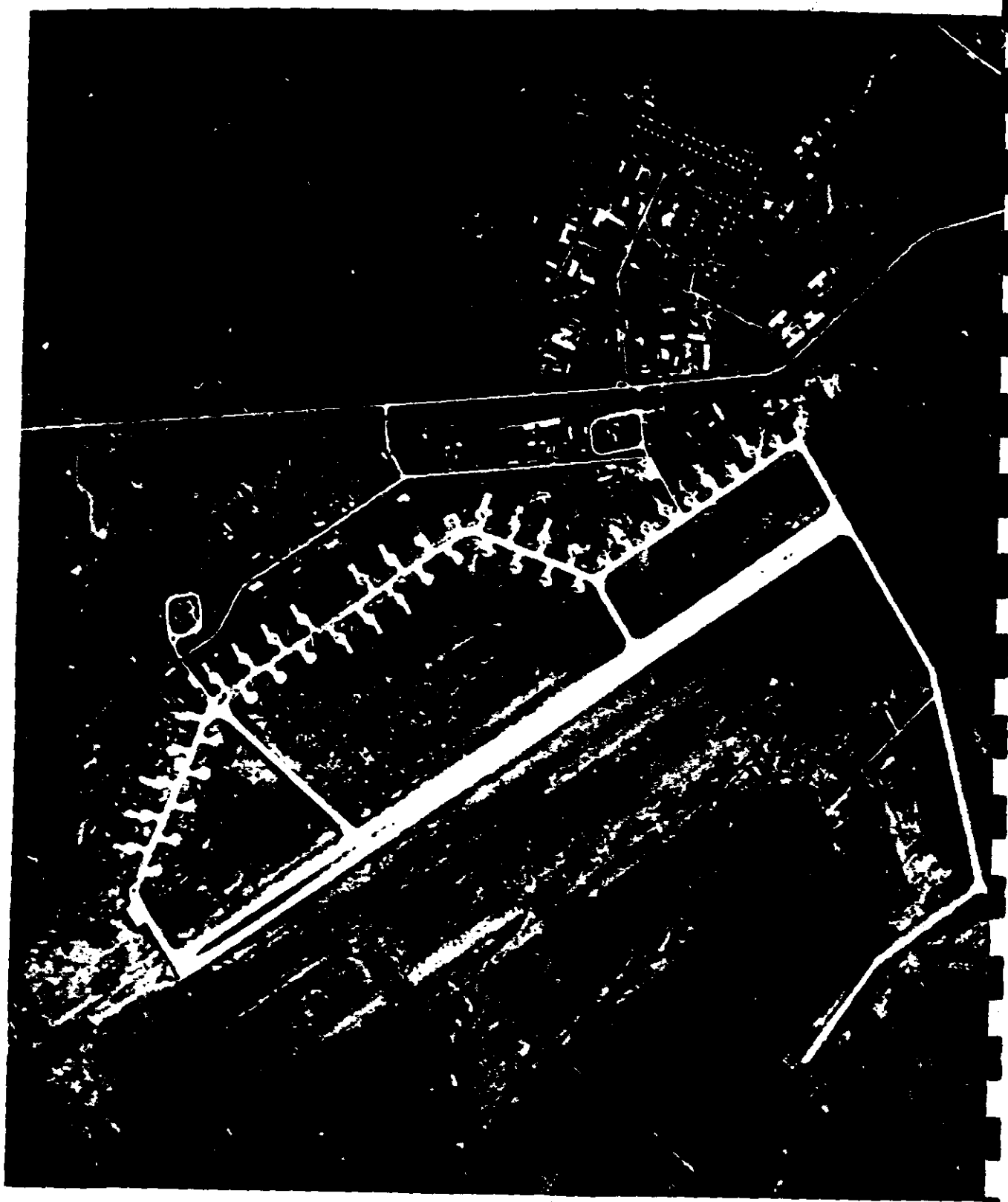

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FIGURE 8. HORIZON FIDUCIAL IMAGED INSIDE PANORAMIC CAMERA FORMAT.

NPIC K-3468 (8/69)

Erratic metering caused several horizon fiducials to be imaged inside the panoramic camera format. The pattern of out-of-focus imagery on the panoramic frames is detectable even on the contact print.

[redacted]

Camera	Fwd
Pass	52D
Frame	88
Date of Photography	6 Nov 64
Universal Grid Coordinates	28 - 12
Enlargement Factor	Contact
Geographic Coordinates	55°32'N 124°12'E
Altitude (feet)	655,296
Camera Attitude:	
Pitch	15°28'
Roll	0°10'
Yaw	0°39'
Vehicle Azimuth	163°49'
Local Sun Time	1243
Solar Elevation	17°46'
Solar Azimuth	164°
Exposure	1/318

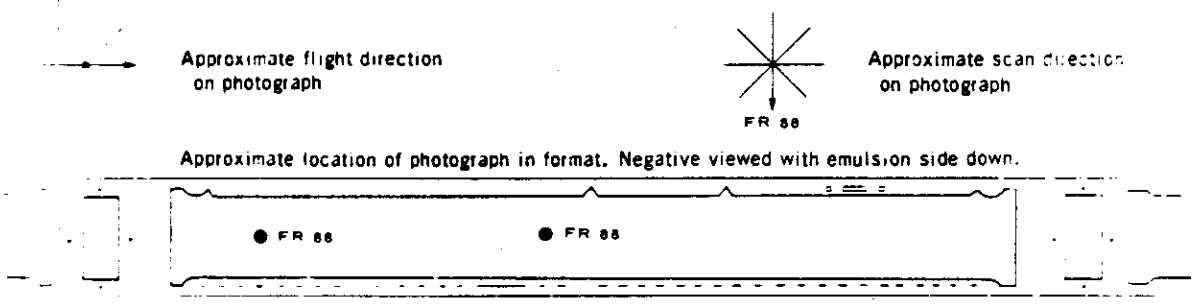

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FIGURE 9. MASTER CAMERA HORIZON IMAGERY.

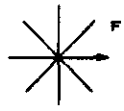
FIGURE 10. MASTER CAMERA HORIZON IMAGERY.

NPIC K-3469 (8/68) NPIC K-3470 (8/68)

All horizon cameras functioned properly throughout the mission. No out-of-focus imagery was noted in the horizon formats and the horizon arcs are well defined. The quality of the master horizon imagery is shown here.

	Left Photo	Right Photo
Camera	Fwd	Fwd
Pass	39D	39D
Frame	123	123
Date of Photography	5 Nov 64	5 Nov 64
Universal Grid Coordinates	5 - 12	87 - 12
Enlargement Factor	4X	4X
Geographic Coordinates	40°55'N 66°23'E	40°55'N 66°23'E
Altitude (feet)	618,519	618,519
Camera Attitude:		
Pitch	15°45'	15°45'
Roll	0°21'	0°21'
Yaw	0°37'	0°37'
Vehicle Azimuth	169°12'	169°12'
Local Sun Time	1314	1314
Solar Elevation	30°36'	30°36'
Solar Azimuth	159°	159°
Exposure	1/100 sec	1/100 sec

Approximate flight direction on photograph



Approximate scan direction on photograph

Approximate location of photograph in format. Negative viewed with emulsion side down.

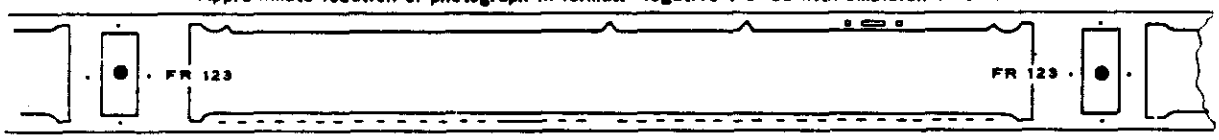


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FIGURE 11. SLAVE CAMERA HORIZON IMAGERY.

FIGURE 12. SLAVE CAMERA HORIZON IMAGERY.

NPIC K-3471 (8/65) NPIC K-3472 (8/65)

The good quality of the horizon photography is evident. The horizon arcs are well defined throughout the mission.

[redacted]

	Left Photo	Right Photo
Camera	Aft	Aft
Pass	24D	24D
Frame	97	97
Date of Photography	4 Nov 64	4 Nov 64
Universal Grid Coordinates	5 - 12	87 - 12
Enlargement Factor	4X	4X
Geographic Coordinates	48°14'N 47°01'E	48°14'N 47°01'E
Altitude (feet)	644,373	644,373
Camera Attitude:		
Pitch	-14°20'	-14°20'
Roll	0°4'	0°4'
Yaw	0°55'	0°55'
Vehicle Azimuth	167°20'	167°20'
Local Sun Time	1314	1314
Solar Elevation	24°5'	24°5'
Solar Azimuth	160°	160°
Exposure	1/100 sec	1/100 sec

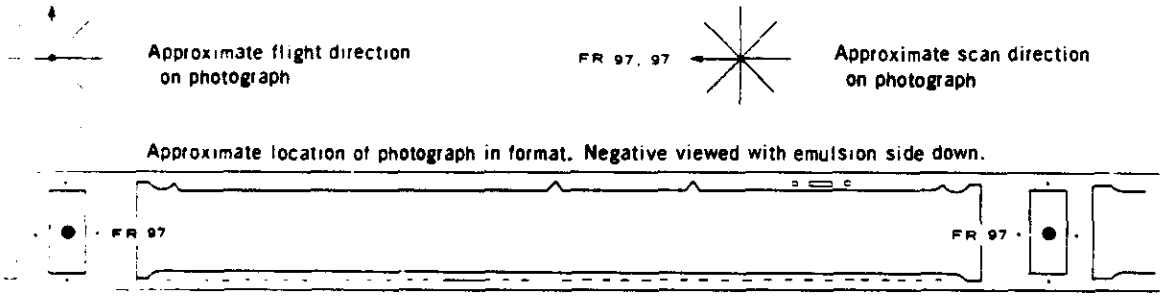

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FIGURE 13. EXAMPLE OF STELLAR IMAGERY.

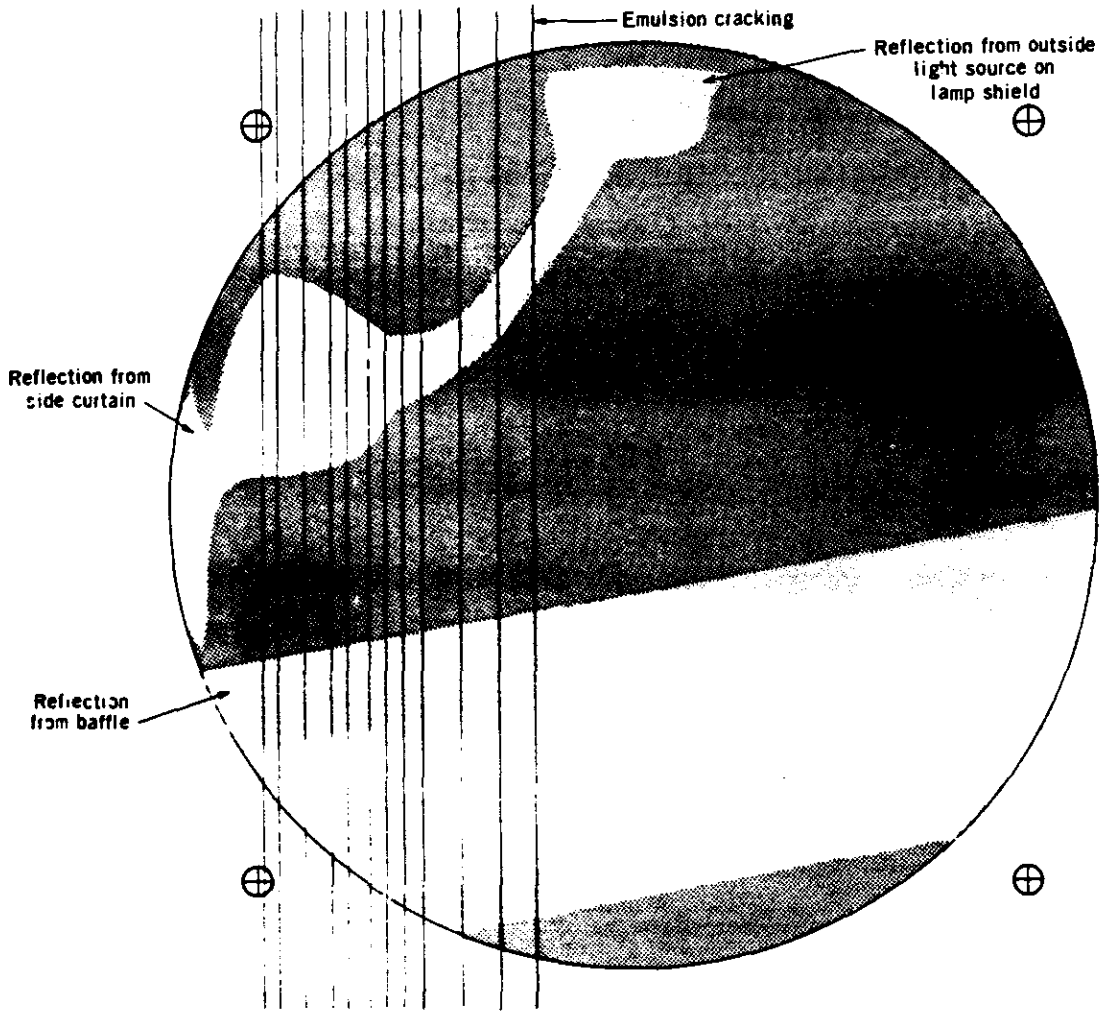
NPIC K-3473 (8/65)

The quality of the stellar photography is apparent. Fine transverse lines of plus density on the original negative which were caused by cracking of the emulsion degrade the imagery.

[redacted]

[redacted]

Stellar Frame Number	412 (Mission 1013-1)
Correlates with FWD Camera:	
Pass	None
Frame	None
Date of Photography	7 November 1964
Enlargement Factor	5X
Vehicle:	
Pitch	NA
Roll	NA
Yaw	NA
Exposure Time	2 sec



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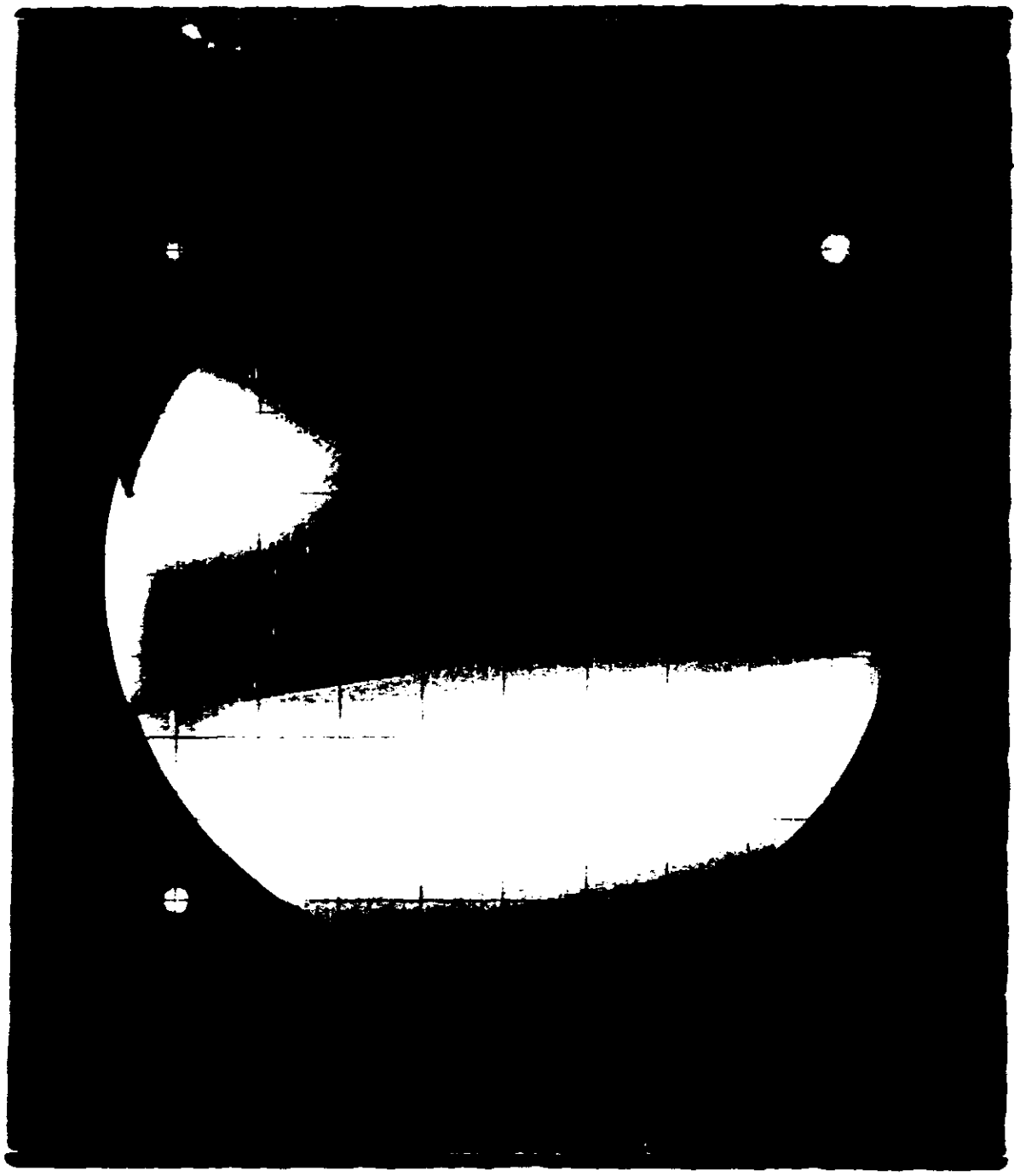

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FIGURE 14. INDEX PHOTOGRAPHY, MISSIONS 1013-1 AND 1013-2.

FIGURE 15. INDEX PHOTOGRAPHY, MISSIONS 1013-1 AND 1013-2.

NPIC K-3474 (8/65) NPIC K-3475 (8/65)

Both index units functioned properly and the quality of the photography on Missions 1013-1 and 1013-2 is excellent.

[redacted]

	Left Photo	Right Photo
Index Frame Number	361 (Mission 1013-1)	50 (Mission 1013-2)
Correlates with FWD Camera:		
Pass	54D	None
Frame	None	None
Date of Photography	6 November 1964	7 November 1964
Enlargement Factor	2.5X	2.5X
Vehicle:		
Pitch	NA	NA
Roll	NA	NA
Yaw	NA	NA
Exposure	1/500 sec	1/500 sec

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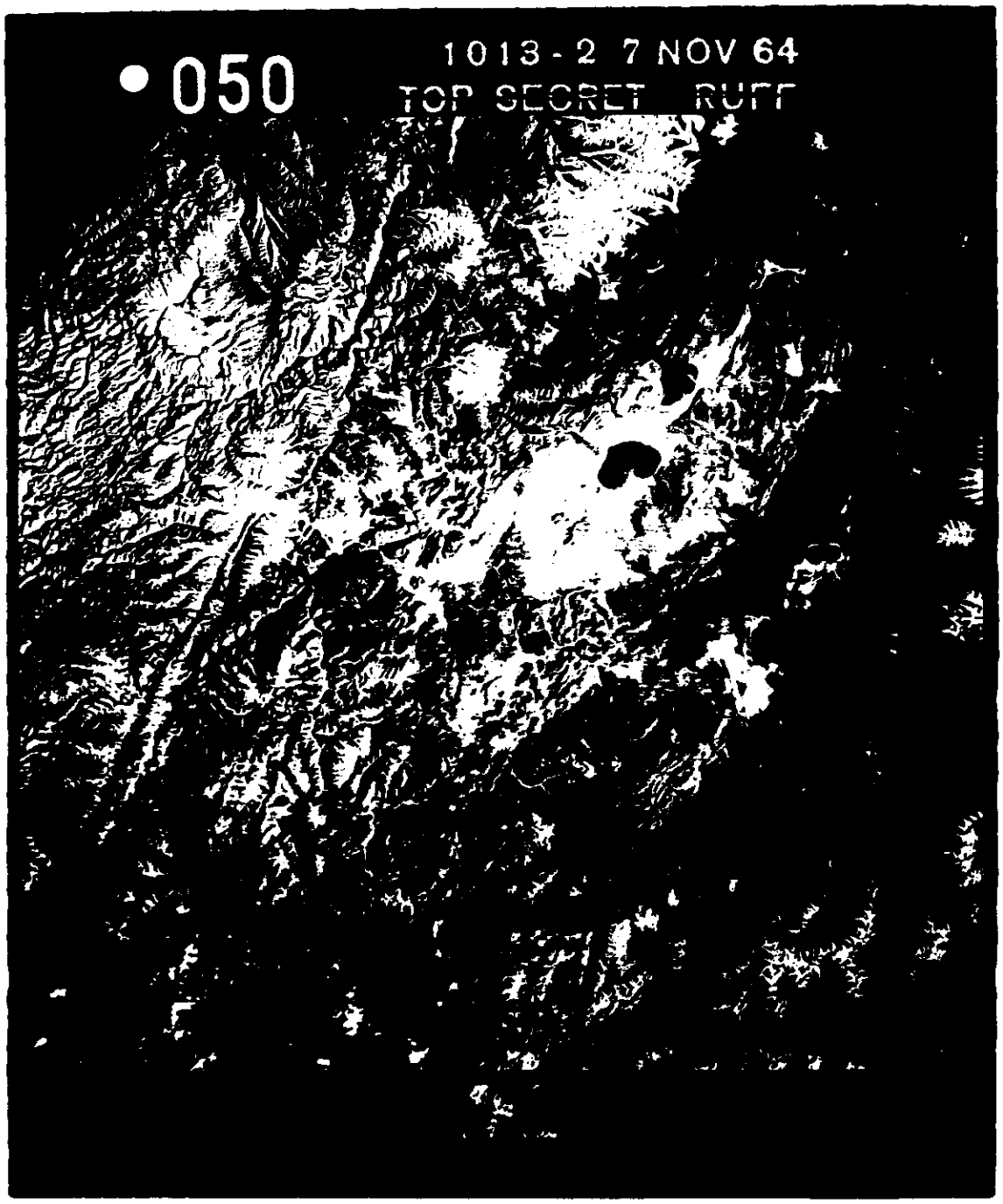

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PART II. FILM

1. Film Footage: The total processed film footage and frames from each of the cameras employed in Mission 1013-1 and 1013-2 are as follows:

Mission 1013-1

CAMERA	FOOTAGE	FRAMES
Master Panoramic	6,122	2,200
Slave Panoramic	6,091	2,229
Stellar	44	418
Index	73	418

Mission 1013-2

CAMERA	FOOTAGE	FRAMES
Master Panoramic	0	0
Slave Panoramic	0	0
Stellar	26	102
Index	45	102

Note: All footage figures are processed machine footages.

2. Film Processing: This section provides an evaluation of exposure, processing, density, contrast, and physical condition of the original negatives from Mission 1013-1 and 1013-2.

(a) The exposure was good throughout the mission. Solar elevations ranged from 2 degrees to 56 degrees (this excludes the engineering passes and pass 1M).

(b) Infrared detection densitometry was employed to determine the optimum levels of development for the film throughout the processing procedure. Thirty-five changes in the development level were made on the master material and 14 on the slave material. The percentages of film processed at the various levels are:

Mission 1013-1

Level of Development	Master	Slave
Primary	0%	2%
Intermediate	42%	7%
Full	58%	91%

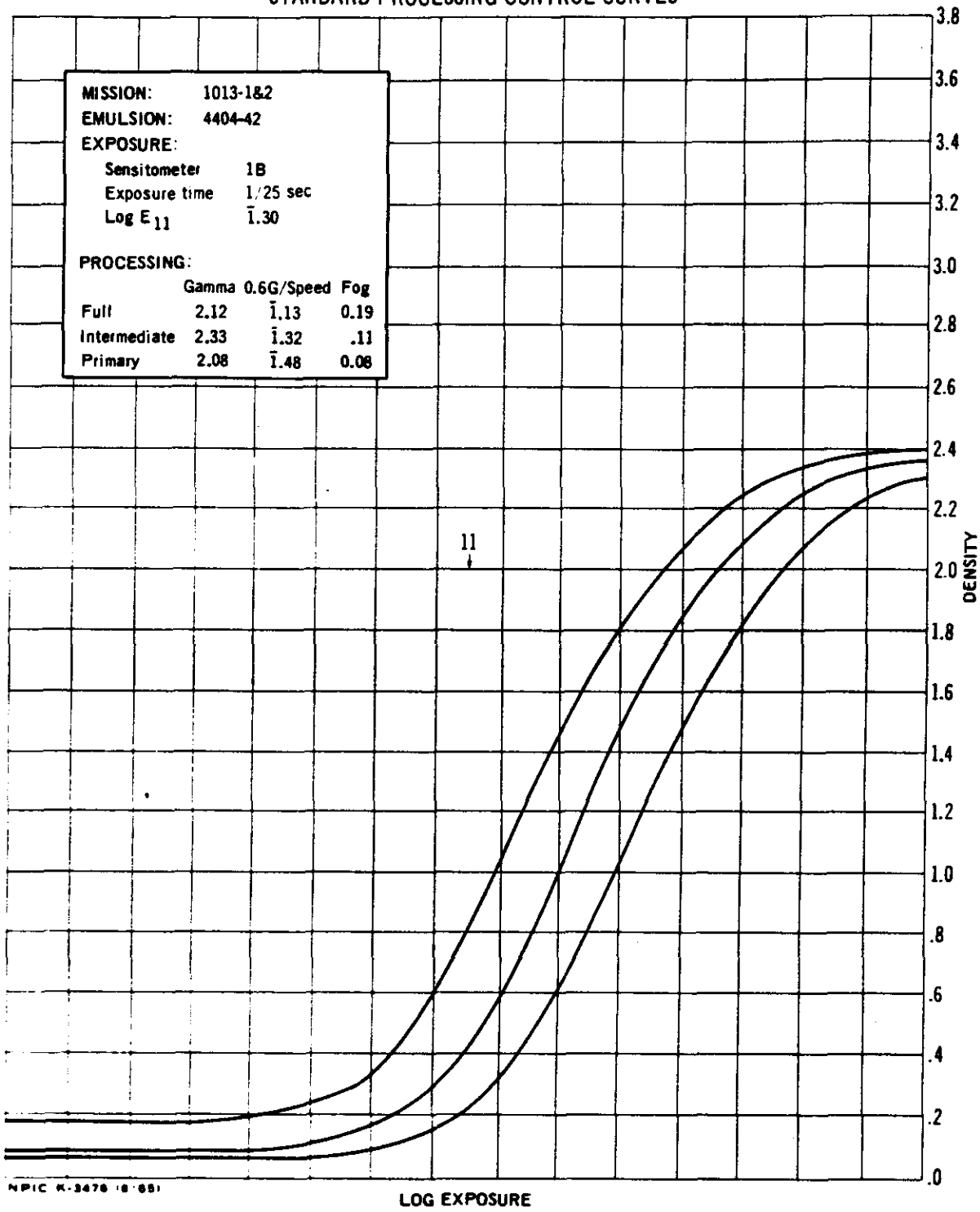
Ten parts of the master film and 5 parts of the slave film required printing at 2 levels to provide duplicate positives of optimum quality.

(c) As is normal, the density and contrast vary depending upon solar elevation and terrain reflectivity. The density, however, is considered good and is comparable to negatives obtained from previous missions.

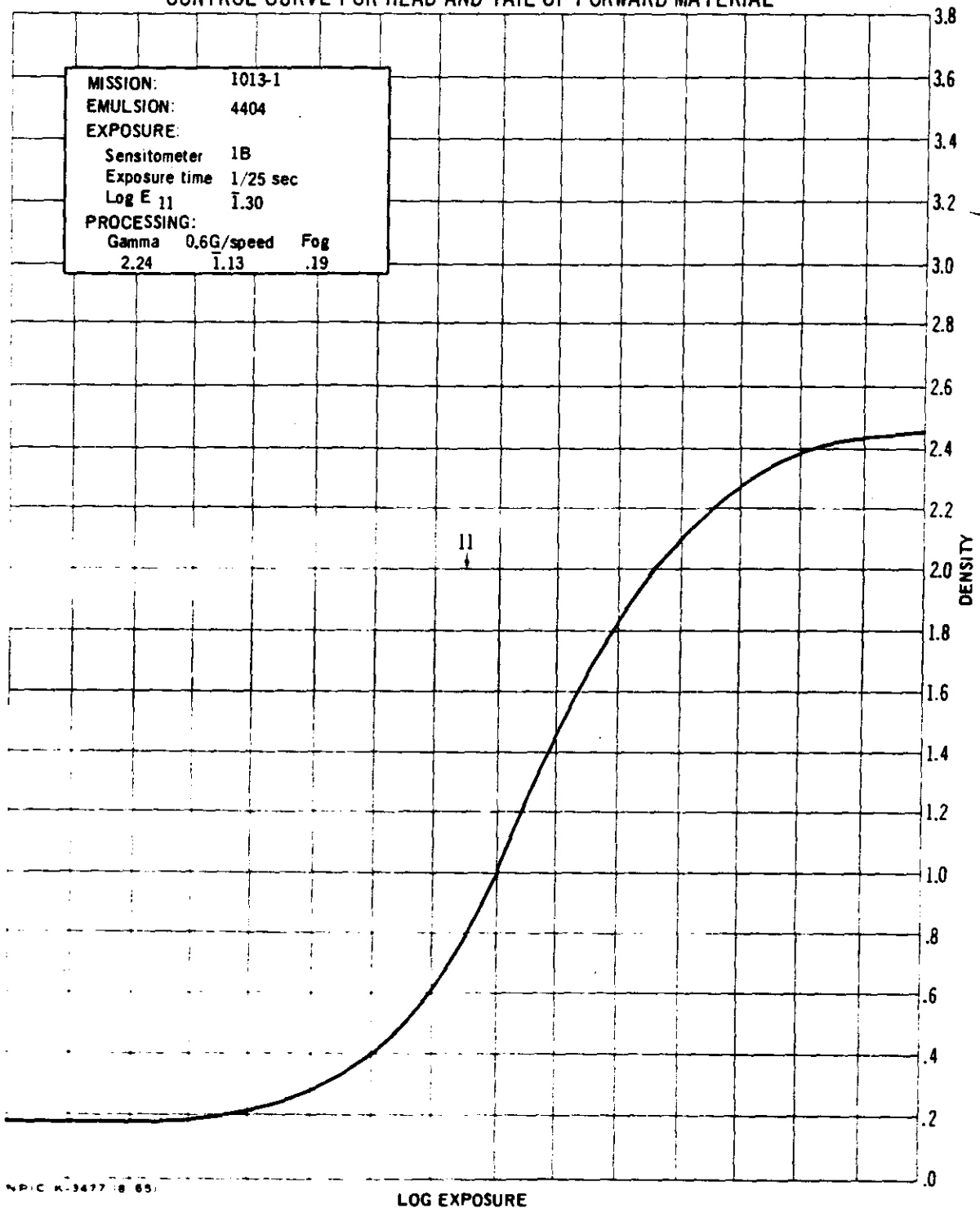
. Physical Film Degradations: The usual minor abrasions, pinholes, and comets were present intermittently throughout the mission. Adhesive transfers generated by a manufacturer's splice on frame [illegible] of pass 2-D of the slave material are located in frames 86, 88, and 89 within the pass. The stellar film from Mission 1013-1 was torn and frames 279 through 291 were severely mutilated during the printing process.

. Film Processing Curves: The following processing curves are [illegible] product of the processing contractor.

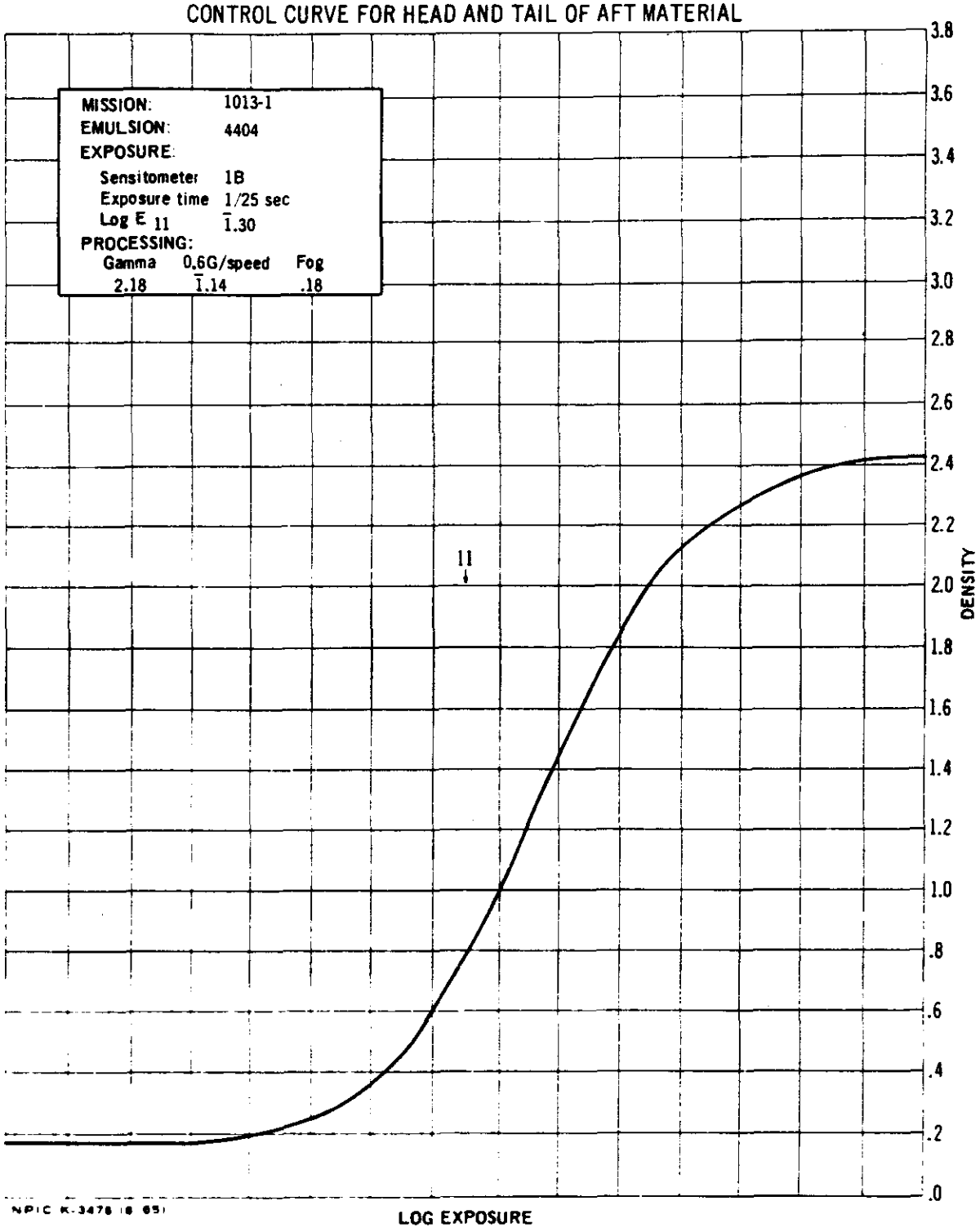
STANDARD PROCESSING CONTROL CURVES



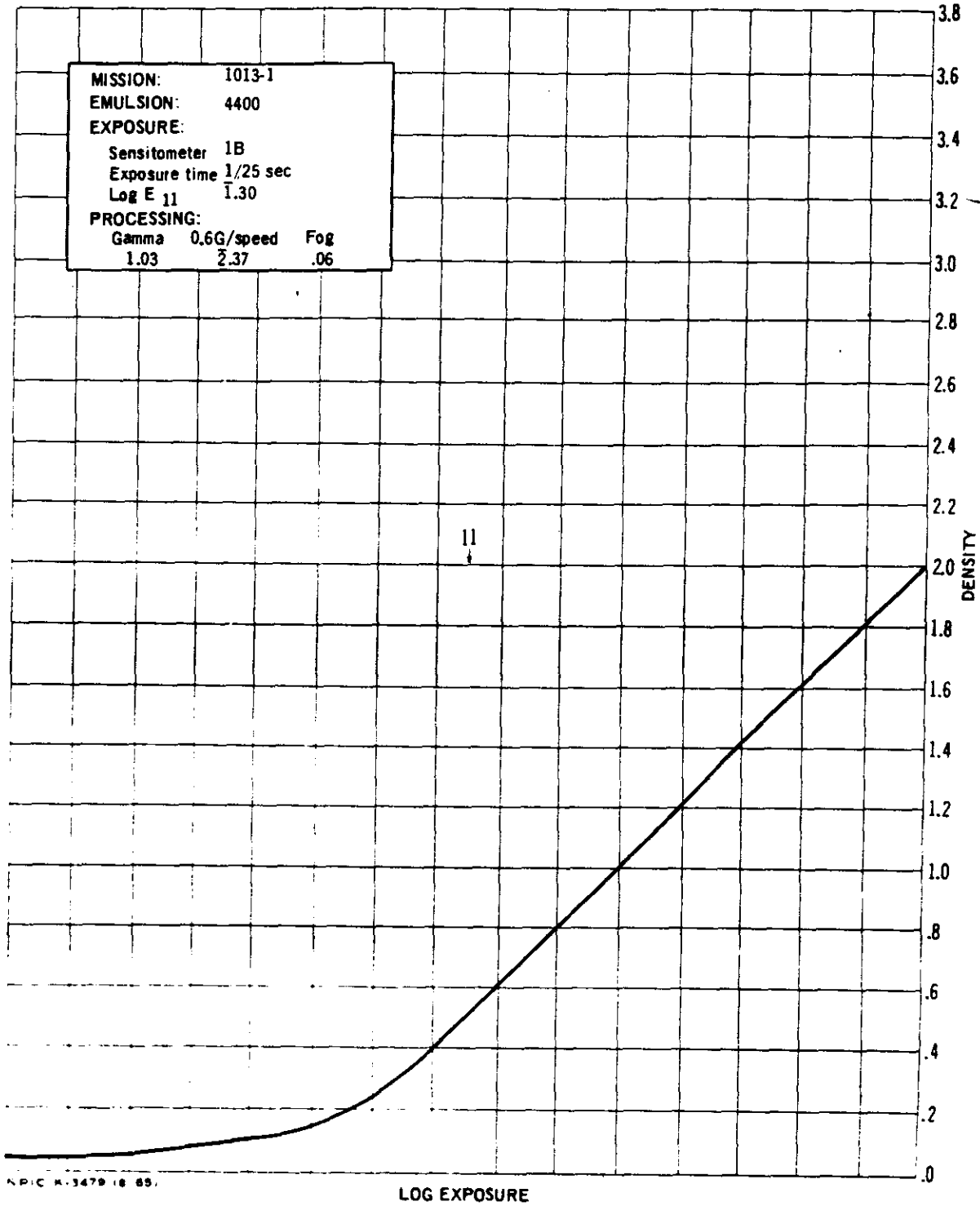
CONTROL CURVE FOR HEAD AND TAIL OF FORWARD MATERIAL



CONTROL CURVE FOR HEAD AND TAIL OF AFT MATERIAL

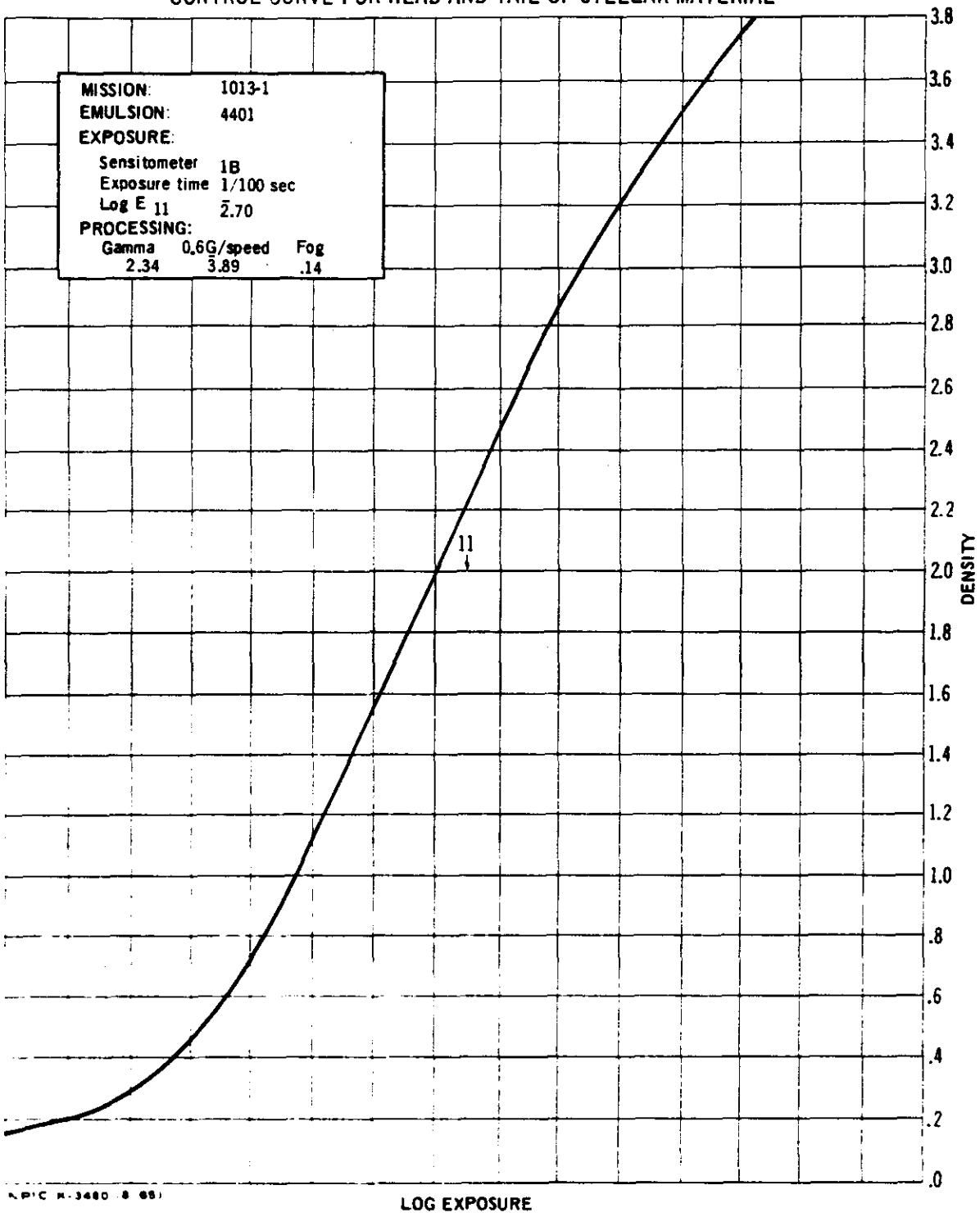


CONTROL CURVE FOR HEAD AND TAIL OF INDEX MATERIAL



[redacted]

CONTROL CURVE FOR HEAD AND TAIL OF STELLAR MATERIAL



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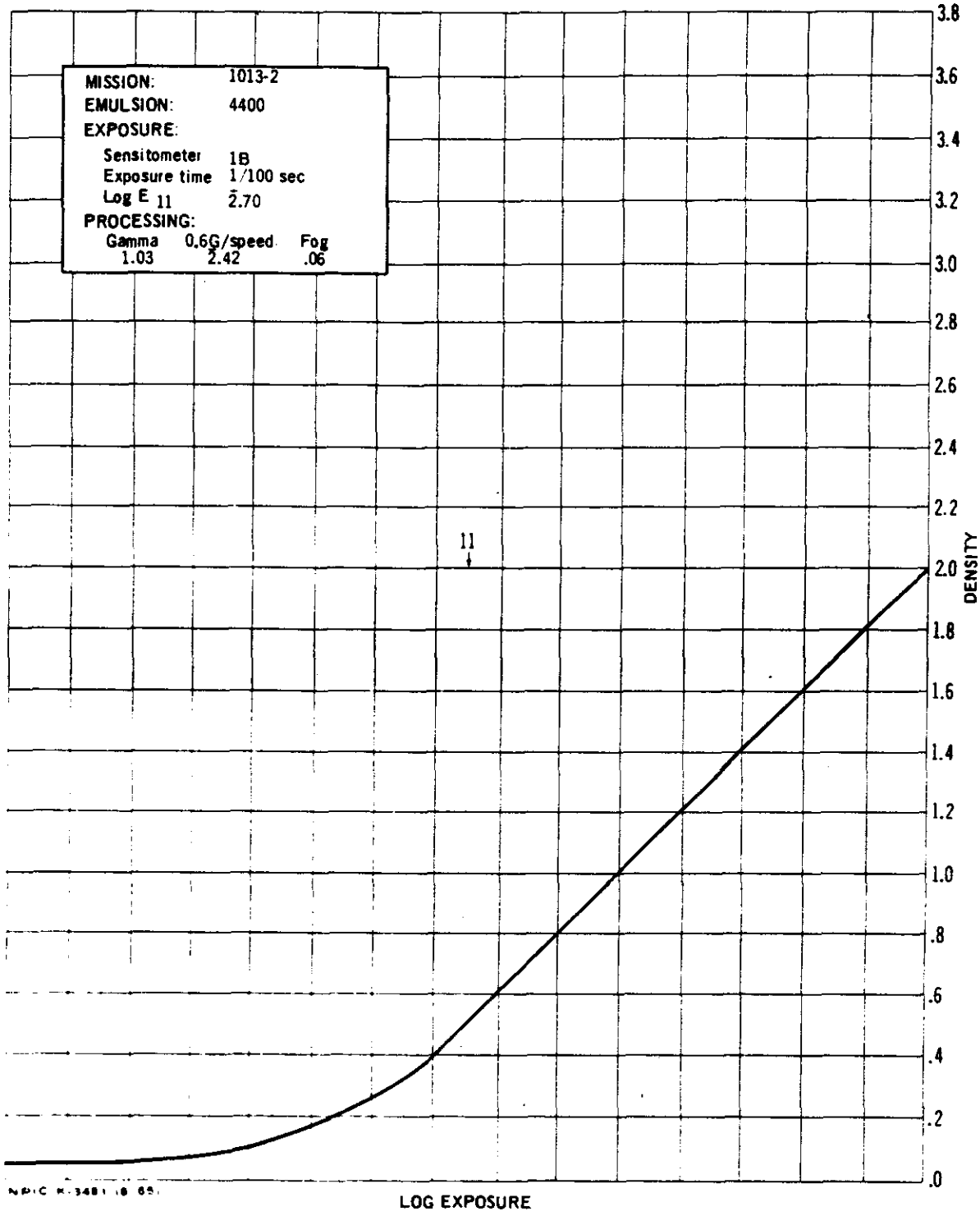
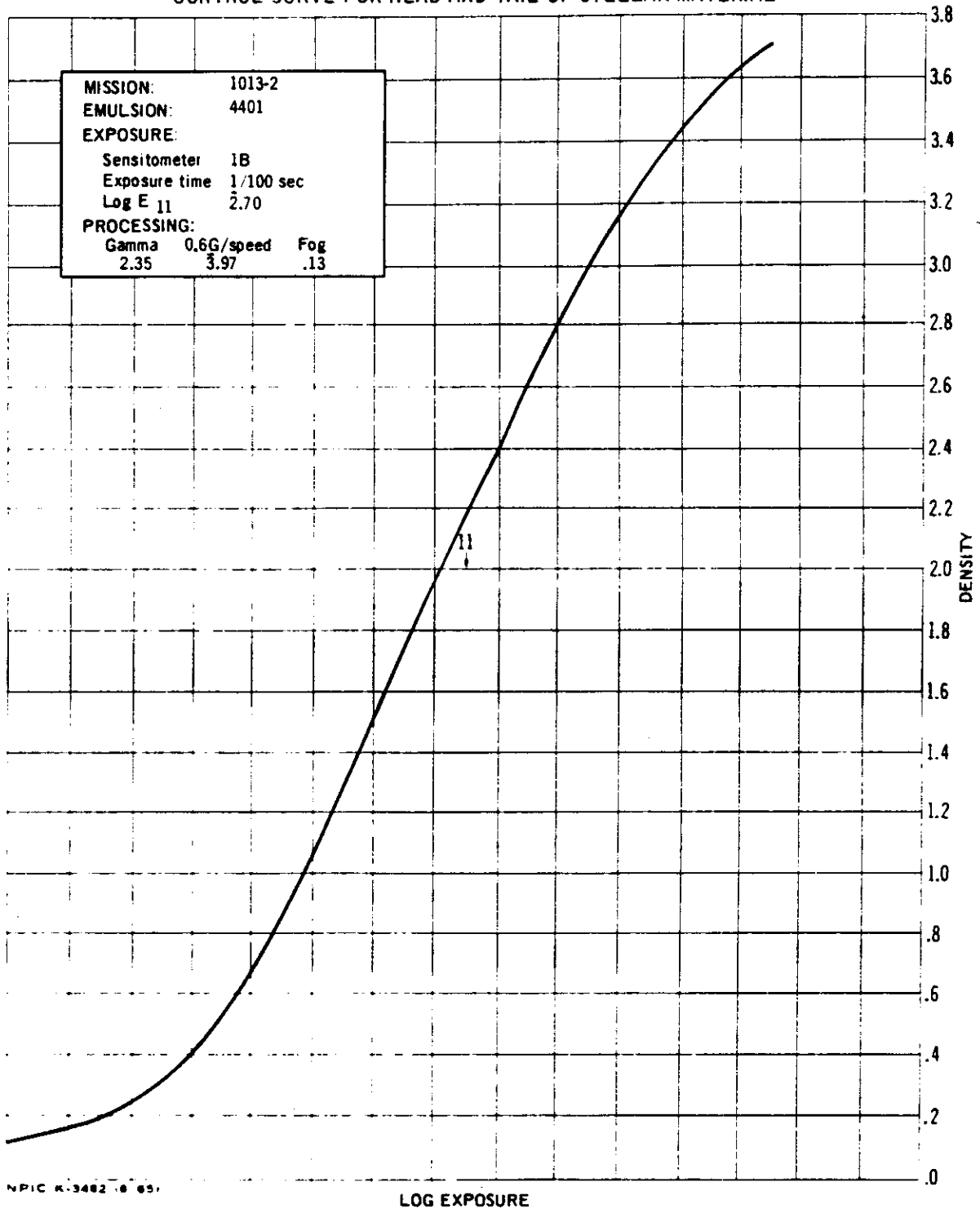
CONTROL CURVE FOR HEAD AND TAIL OF INDEX MATERIAL



CONTROL CURVE FOR HEAD AND TAIL OF STELLAR MATERIAL



NPIC K-3482 (8 65)

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FIGURE 16. EXAMPLE OF THE AFFECT OF ADHESIVE TRANSFER AT MANUFACTURER'S SPLICE.

FIGURE 17. EXAMPLE OF THE AFFECT OF ADHESIVE TRANSFER AT MANUFACTURER'S SPLICE.

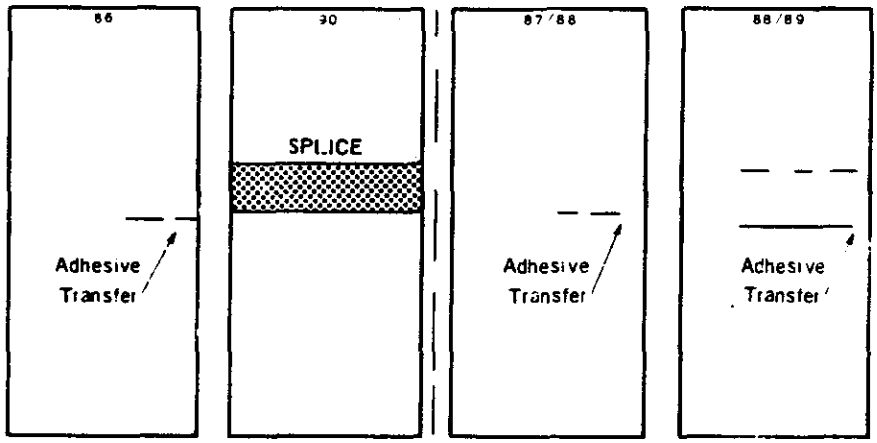
NPIC K-3483 (8/65) NPIC K-3484 (8/65)

What appears as a blank space approximately mid frame in the right photograph on the left page is caused by a manufacturer's splice. The transfer of excessive adhesive from the splice is shown on the accompanying photographs. The exact mating of the transferred adhesive with that missing from the splice can be seen.

[redacted]

[redacted]

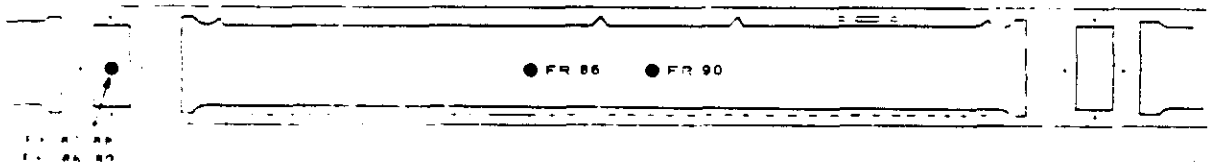
	Left Page - Left Photo	Left Page - Right Photo	Right Page - Left Photo	Right Page Right Photo
Camera	Aft	Aft	Aft	Aft
Pass	24D	24D	24D	24D
Frame	86	90	87/88	88/89
Date of Photography	4 Nov 64	4 Nov 64	4 Nov 64	4 Nov 64
Universal Grid Coordinates	39 - 12	49 - 12	5 - 12	5 - 12
Enlargement Factor	Contact	Contact	Contact	Contact
Geographic Coordinates	NA	NA	NA	NA
Altitude (feet)	NA	NA	NA	NA
Camera Attitude:				
Pitch	NA	NA	NA	NA
Roll	NA	NA	NA	NA
Yaw	NA	NA	NA	NA
Vehicle Azimuth	NA	NA	NA	NA
Local Sun Time	NA	NA	NA	NA
Solar Elevation	NA	NA	NA	NA
Solar Azimuth	NA	NA	NA	NA
Exposure	NA	NA	NA	NA



Approximate flight direction on photograph

Approximate scan direction on photograph

Approximate location of photograph in format. Negative viewed with emulsion side down



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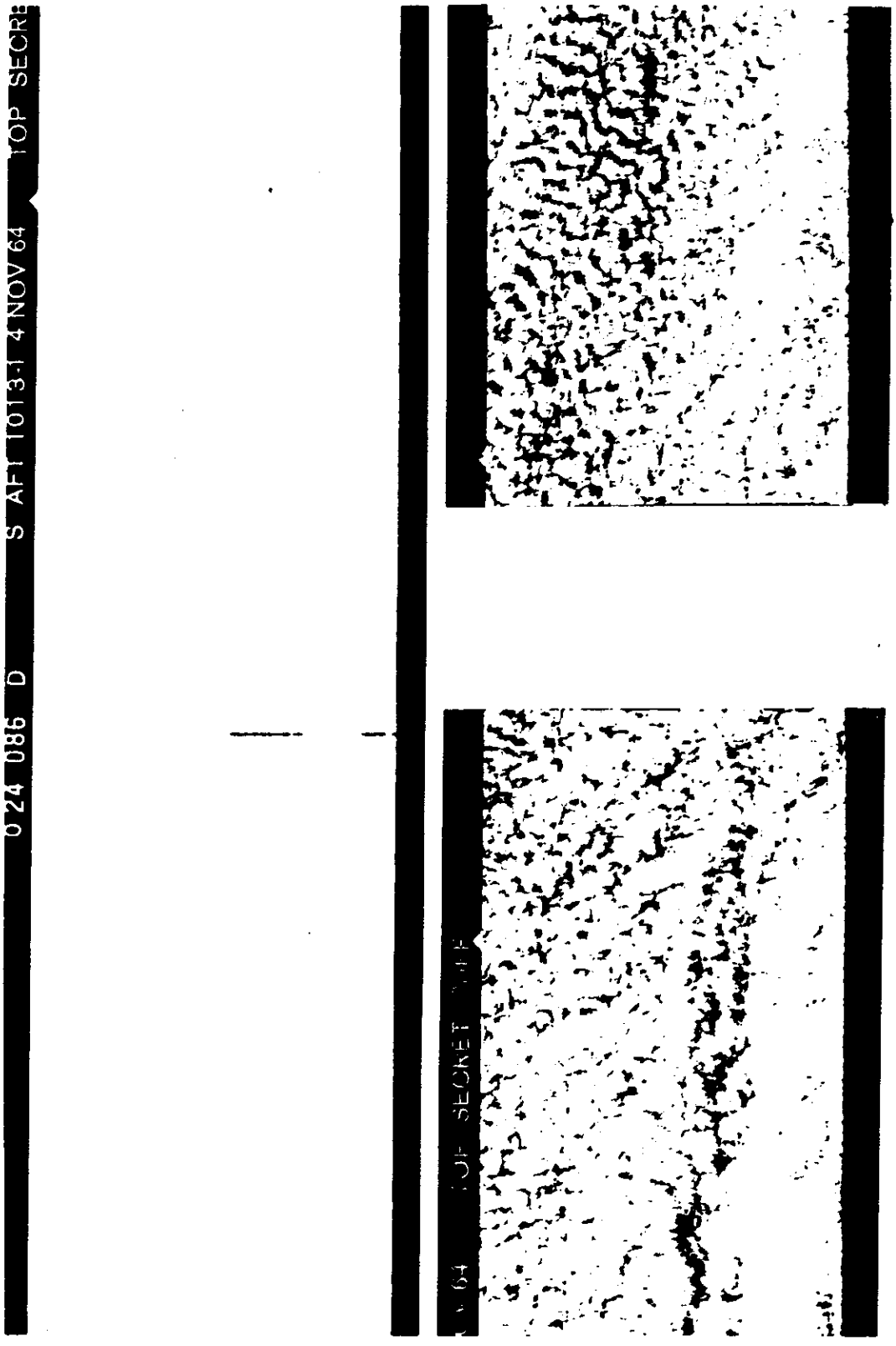

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PART III. IMAGE QUALITY

1. Definition of Photographic Interpretation (PI) Suitability:

This is an assessment of the information content of photographic reconnaissance material and its interpretability. A number of interrelated factors are involved, such as the quality of the photography, the extent of target coverage, scale, weather limitations and similar considerations. 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 mission. The imagery contains sharp, well-defined edges and corners. There is no distortion of object form. Contrast is good and shadow details, as well as details in the highlighted areas, are readily detectable. Observation of small objects and a high order of mensuration are made possible by the consistently high quality of the photography.

Good: The photography is relatively free of camera and process-induced degradations. Weather conditions are good. Image edges and corners are well defined and 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: Degradations are few but the acuity of the photography is less than optimum. Edges and corners of objects are not crisply defined and there is loss of detail in shadow and/or highlight areas. Detection and identification of small images is possible but accuracy of mensuration is hampered by the overall reduction in photographic quality.

Poor: Camera-induced degradation, processing anomalies and/or weather limitations severely reduce the effectiveness of the photography. Definition of edges and corners is poor. Only gross terrain features and culture may be detected or identified and distortion of form may be present. Accurate mensuration of even large objects is doubtful.

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

2. PI Suitability, Mission 1013:

The PI suitability of the photography obtained on Mission 1013 is good where not degraded by the out-of-focus condition. A total of 49 targets were observed and reported in the preliminary readout. Thirteen of these were reported as being of poor quality due to such degrading factors as cloud cover, haze conditions, or high obliquity. At least 7 targets were limited to non-stereo coverage because they fell within an area degraded by the out-of-focus condition.

It should be noted that the preliminary report represents initial scan results only, accomplished in a short time and without the aid of the precise analytical and mensural instruments normally employed in photographic analysis. Continued study of the film may increase the number of targets observed and may alter some of the data obtained in the initial scan of the targets already reported.

3. Definition of Mission Information Potential (MIP):

The MIP rating assigned to a mission is an arbitrary figure intended to indicate the quality of the best photography obtained in a mission. It is representative of the camera system's maximum capability for recording information as demonstrated by the instruments employed in a particular mission. In consideration of the information the MIP rating is intended to convey, photography degraded by adverse factors such as low solar elevations, poor atmospheric conditions, camera and/or process-induced degradations, etc. is eliminated in selection of the MIP example. Note that the MIP rating assigned to a mission is indicative solely of the camera system's photographic capability, and does not represent the overall quality of the mission, per se. The photography selected as the MIP example may constitute a particular target within a portion of a frame, a full frame, or several frames. The criteria which govern selection of MIP examples are as follows:

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

(b) The selected target or targets should be at or near frame-center in order to minimize the effects of obliquity and other distortive factors.

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

(d) Solar elevations must be near optimum. Overexposed or underexposed photography is not suitable for MIP selection.

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

-. MIP, Mission 1013-1:

Based on the foregoing criteria, frame 12 of pass 47DE (AFT) is the MIP selection. An MIP rating of 85 was assigned and the imagery is considered comparable to that obtained on Mission 1012.

The MIP frame contains a large airfield and urban area. The frame is [illegible], cloud cover is minimal, and the photographic quality [illegible] the [illegible] aircraft. The buildings display well defined edges and corners and no unusual distortions are present. Shadow detail, highlight detail, and contrast is optimal and small objects are readily discernible.

The quality of the master panoramic photography is considered comparable to that of the slave.

[redacted]

. MIP AND CORRESPONDING MASTER PANORAMIC FRAME.

. MIP AND CORRESPONDING MASTER PANORAMIC FRAME.

NPIC K-3486 (8/65) NPIC K-3486 (8/65)

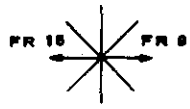
[redacted]rame and corresponding imagery on the master
[redacted]re illustrated. The airfield and residential area
[redacted]ery with well-defined edges and corners. Engine
[redacted]e larger aircraft are readily discernible in
[redacted]er and slave material and the quality is quite

[redacted]

[redacted]

	Left Photo	Right Photo MIP Frame
Camera	Fwd	Aft
Pass	47DE	47DE
Frame	9	15
Date of Photography	5 Nov 64	5 Nov 64
Universal Grid Coordinates	50 - 13	40 - 12
Enlargement Factor	20X	20X
Geographic Coordinates	36°03'N 115°19'W	36°02'N 115°22'W
Altitude (feet)	607,864	606,842
Camera Attitude:		
Pitch	14°27'	-15°23'
Roll	0°9'	0°11'
Yaw	0°47'	0°48'
Vehicle Azimuth	170°18'	170°28'
Local Sun Time	1316	1316
Solar Elevation	34°57'	34°57'
Solar Azimuth	158°	158°
Exposure	1/339 sec	1/340 sec

Approximate flight direction on photograph



Approximate scan direction on photograph

Approximate location of photograph in format. Negative viewed with emulsion side down.

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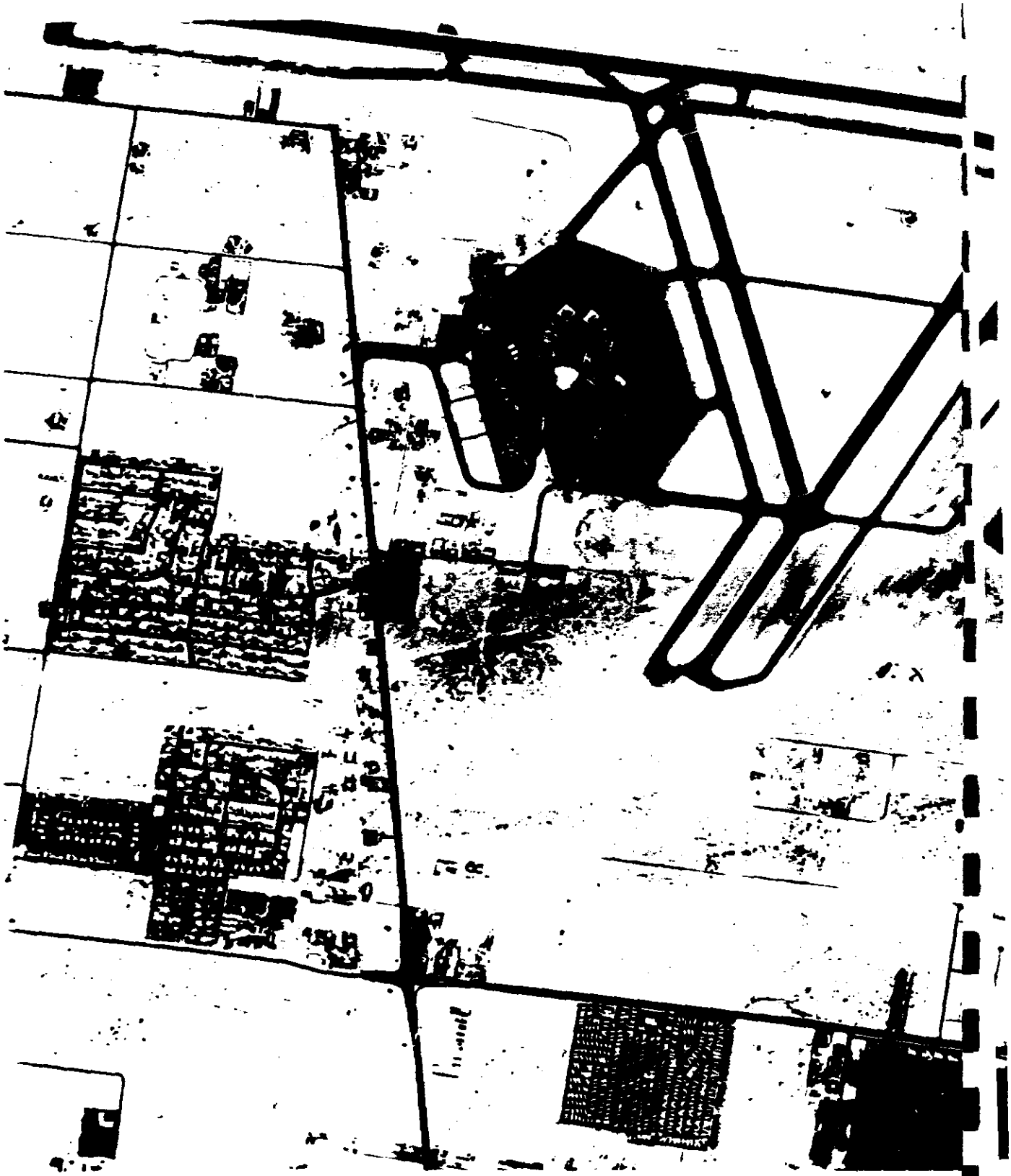

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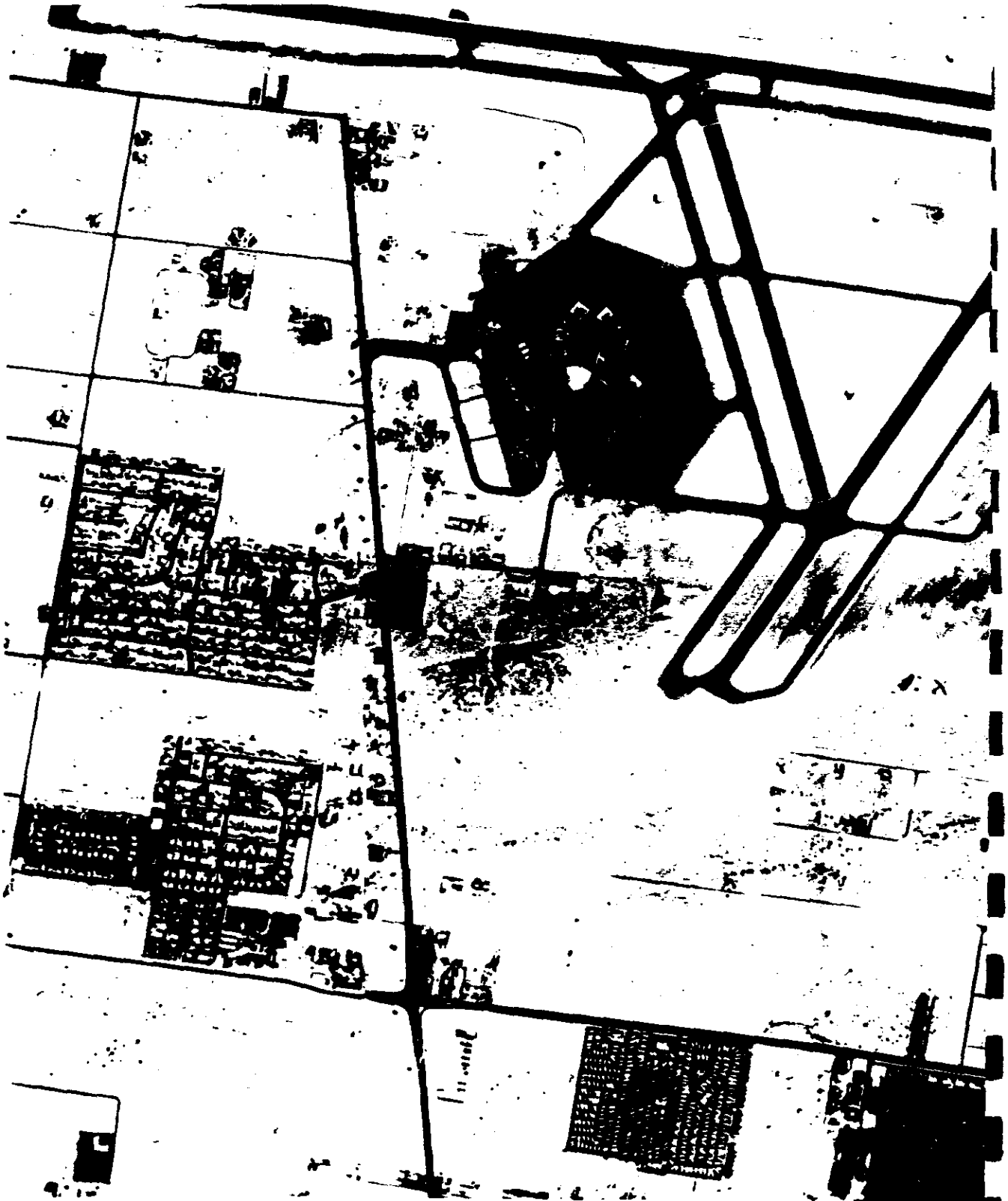

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FIGURE 20. COMPARISON OF QUALITY BETWEEN THE MASTER AND SLAVE CAMERA.

FIGURE 21. COMPARISON OF QUALITY BETWEEN THE MASTER AND SLAVE CAMERA.

NPIC K-3487 (8/65) NPIC K-3488 (8/65)

The comparable good quality of the master and slave panoramic photography is evident in the following illustrations.

[redacted]

	Left Photo	Right Photo
Camera	Fwd	Aft
Pass	39D	39D
Frame	132	140
Date of Photography	5 Nov 64	5 Nov 64
Universal Grid Coordinates	53 - 12	37 - 14
Enlargement Factor	20X	20X
Geographic Coordinates	39°36'N 66°42'E	39°40'N 66°38'E
Altitude (feet)	615,730	614,122
Camera Attitude:		
Pitch	15°34'	-14°25'
Roll	0°21'	0°18'
Yaw	0°36'	0°38'
Vehicle Azimuth	169°31'	169°43'
Local Sun Time	1317	1317
Solar Elevation	31°44'	31°40'
Solar Azimuth	158°	158°
Exposure	1 341	1 341

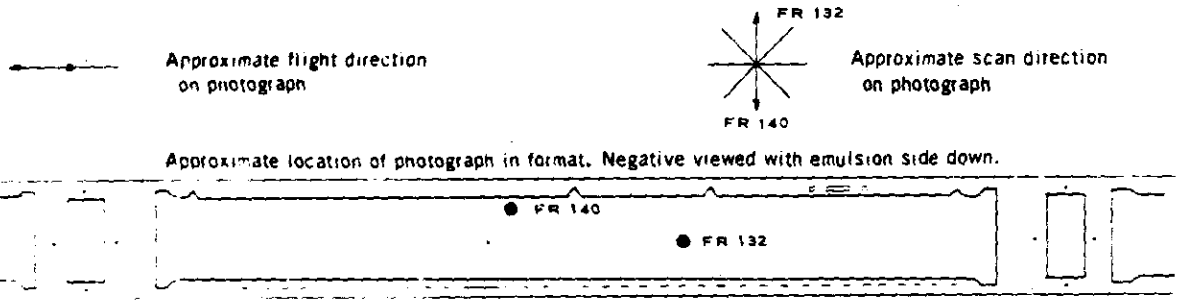

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FIGURE 22, FIGURE 23, FIGURE 24 and FIGURE 25.

DEGRADATION CAUSED BY OUT-OF-FOCUS CONDITION.

NPIC K-3489 (8/65) NPIC K-3490 (8/65) NPIC K-3491 (8/65) NPIC K-3492 (8/65)

The gradual degradation in image quality caused by the out-of-focus condition is readily visible in the accompanying photography. The contact print shows the location of the following enlargements. Good quality photography at the titled edge of the format contrasts sharply with the fuzzy imagery present at the frequency mark edge.

[redacted]

[redacted]

Camera	Aft
Pass	24D
Frame	97
Date of Photography	4 Nov 64
Universal Grid Coordinates	52 - 12
Enlargement Factor	Contact and 20X
Geographic Coordinates	48°14'N 47°01'E
Altitude (feet)	644,373
Camera Attitude:	
Pitch	-14°19'
Roll	0°3'
Yaw	0°54'
Vehicle Azimuth	167°20'
Local Sun Time	1314
Solar Elevation	24°5'
Solar Azimuth	160°
Exposure	1/318

Approximate flight direction on photograph

Approximate scan direction on photograph

Approximate location of photograph in format. Negative viewed with emulsion side down.

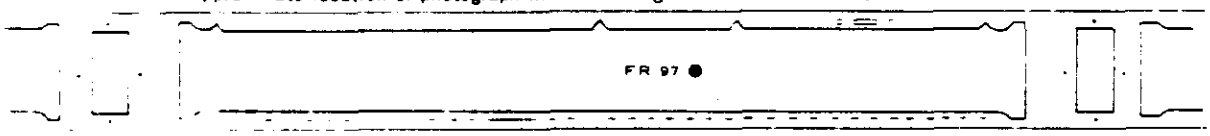

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FIGURE 26. RESOLUTION TARGET, PAHRUMP, NEVADA.

FIGURE 27. RESOLUTION TARGET, PAHRUMP, NEVADA.

NPIC K-3493 (8/65) NPIC K-3494 (8/65)

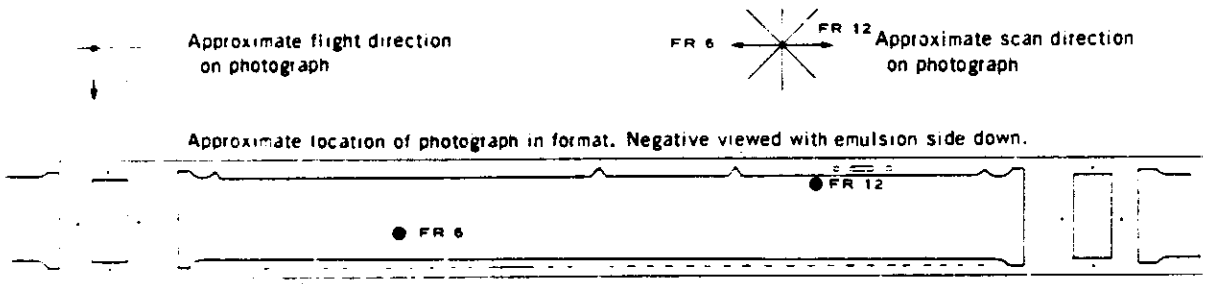
The quality of the resolution target at Pahrump, Nevada is illustrated. The master photography appears slightly better than that of the slave; however, it must be noted that the target is close to the edge of the format on the slave photography and that two-thirds of the frame is degraded by the out-of-focus condition.

[redacted]

	Left Photo	Right Photo
Camera	Fwd	Aft
Pass	47DE	47DE
Frame	6	12
Date of Photography	5 Nov 64	5 Nov 64
Universal Grid Coordinates	28 - 10	63 - 15
Enlargement Factor	40X	40X
Geographic Coordinates	36°30'N 115°25'W	36°29'N 115°28'W
Altitude (feet)	608,439	607,359
Camera Attitude:		
Pitch	14°26'	-15°24'
Roll	0°8'	0°10'
Yaw	0°46'	0°48'
Vehicle Azimuth	170°12'	170°23'
Local Sun Time	1315	1315
Solar Elevation	34°34'	34°35'
Solar Azimuth	157°	157°
Exposure	1/338 sec	1/339 sec

The smallest bar group discernible in both directions on the Forward photography is group number 4 (bar width, 4' 10").

The smallest bar group discernible in both directions on the Aft photography is group number 1 (bar width, 6' 10").



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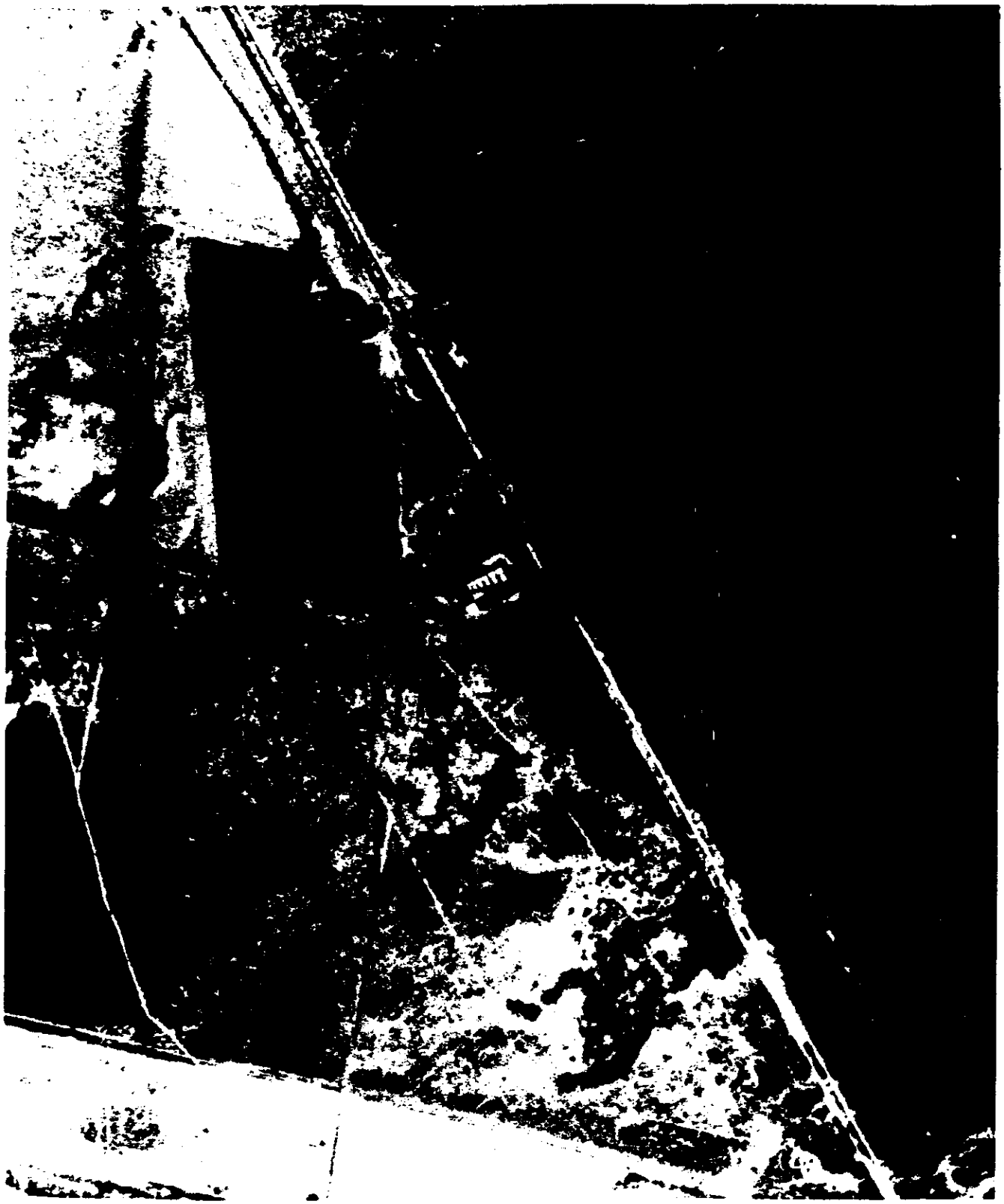

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FIGURE 28. RESOLUTION TARGET, INDIAN SPRINGS, NEVADA.

FIGURE 29. RESOLUTION TARGET, INDIAN SPRINGS, NEVADA.

NPIC K-3495 (8/65) NPIC K-3496 (8/65)

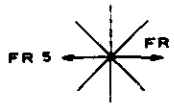
The quality of the resolution target on the forward photography is consistent with the imagery throughout most of the mission. On the aft material the resolution target is within an area degraded by the out-of-focus condition present on portions of the photography. The loss in image quality due to this anomaly is quite apparent.

	Left Photo	Right Photo
Camera	Fwd	Aft
Pass	47DE	47DE
Frame	5	11
Date of Photography	5 Nov 64	5 Nov 64
Universal Grid Coordinates	45 - 15	45 - 10
Enlargement Factor	40X	40X
Geographic Coordinates	36°39'N 115°27'W	36°38'N 115°30'W
Altitude (feet)	608,639	607,538
Camera Attitude:		
Pitch	14°26'	-15°25'
Roll	0°8'	0°10'
Yaw	0°45'	0°48'
Vehicle Azimuth	170°11'	170°21'
Local Sun Time	1315	1315
Solar Elevation	34°27'	34°27'
Solar Azimuth	157°	157°
Exposure	1/338 sec	1/340 sec

The smallest bar groups discernible in both directions on the Forward photography is group number 4 (bar width, 3' 10").

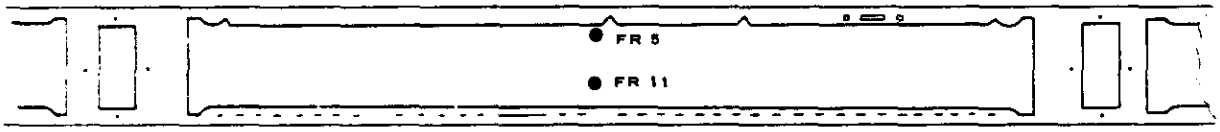
No bar group was distinguishable because the Aft photography was degraded by the out-of-focus condition.

Approximate flight direction on photograph

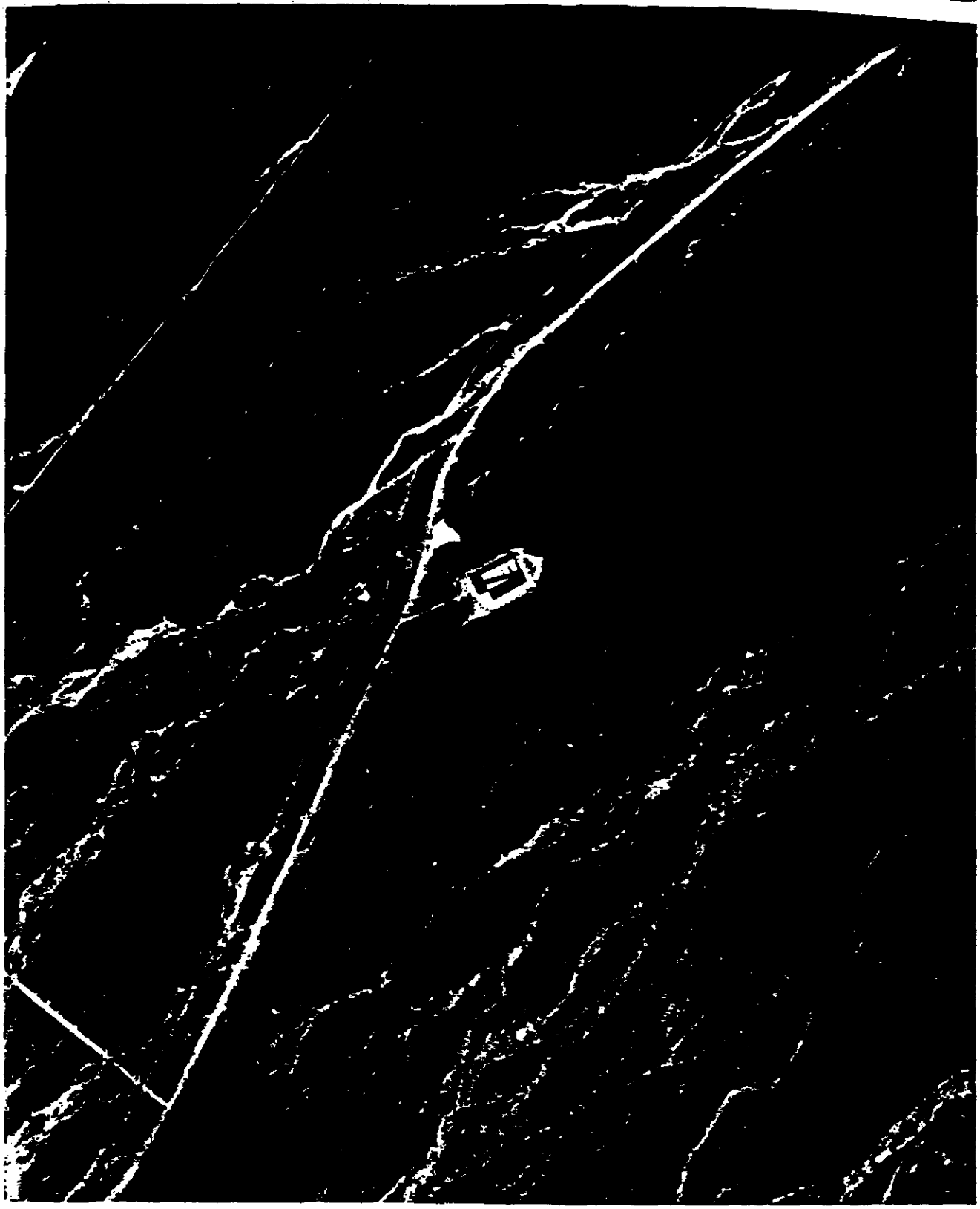


Approximate scan direction on photograph

Approximate location of photograph in format. Negative viewed with emulsion side down.



[redacted]



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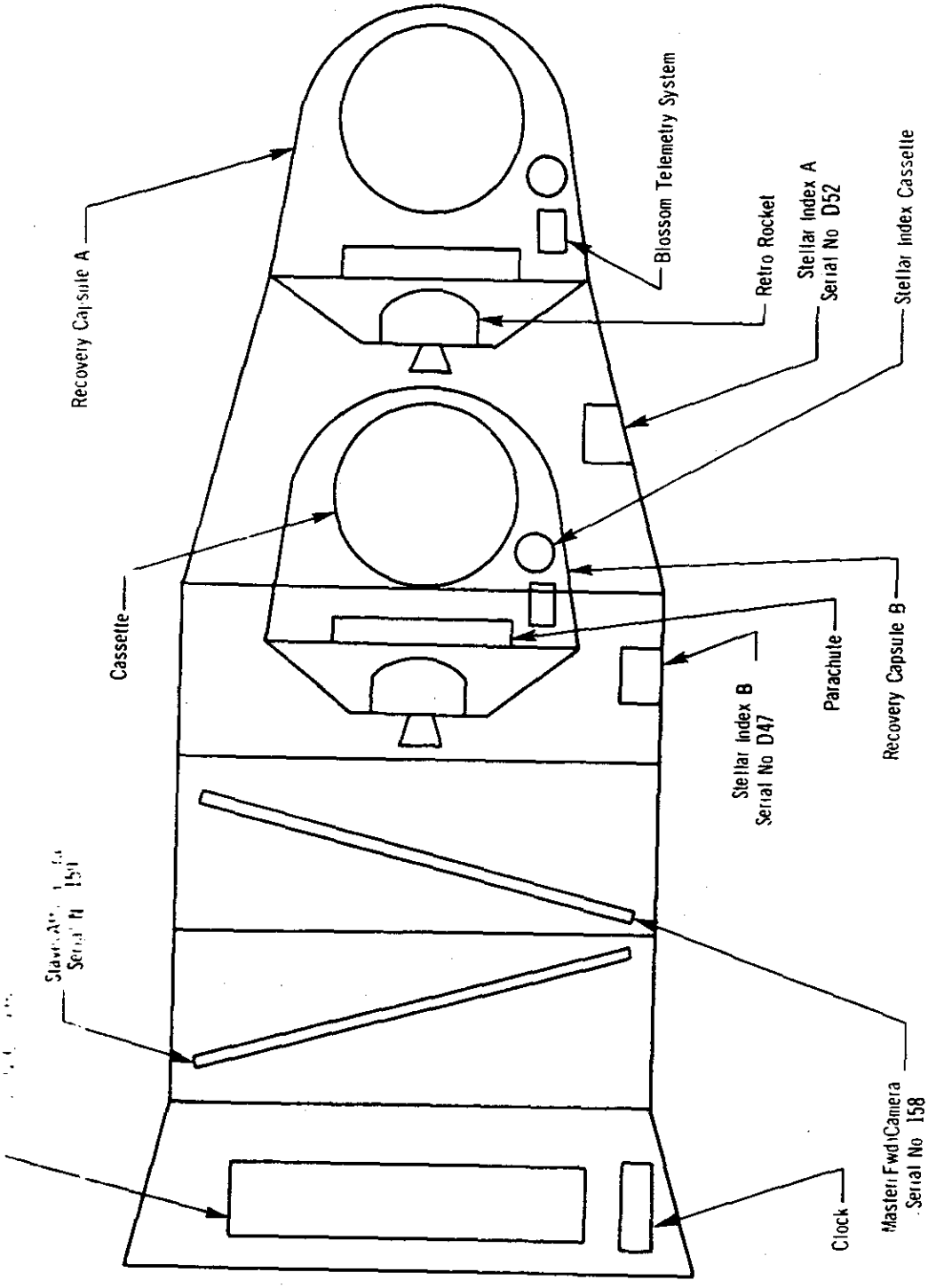
APPENDIX A. SYSTEM SPECIFICATIONS

1. Camera

	Master Panoramic	Port Horizon	Starboard Horizon	Slave Panoramic	Port Horizon	Starboard Horizon	Mission 1013-1		Mission 1013-2	
							Stellar	Index	Stellar	Index
Camera Number	158	*	*	159	*	*	55	49	54	48
Lens Serial No.	1304435	813550	813511	1362435	81227	813553	11065	813057	11094	813055
Slit Width	0.200"	NA	NA	0.200"	NA	NA	NA	NA	NA	NA
Aperture	f/3.5	f/6.8	f/8.0	f/3.5	f/6.8	f/8.0	f/1.8	f/4.5	f/1.8	f/4.5
Exposure Time	NA	1/100 sec	1/100 sec	NA	1/100 sec	1/100 sec	2.0 sec	1/500	2.0 sec	1/500
Filter	Wratten 21	Wratten 25	Wratten 25	Wratten 21	Wratten 25	Wratten 25	None	Wratten 21	None	Wratten 21
Focal L (mm)	609.601	55.12	55.07	609.577	54.48	54.90	NA	38.33	NA	38.177
Film Length	16000'	NA	NA	16000'	NA	NA	*	*	*	*
Splices	4	NA	NA	4	NA	NA	*	*	*	*
Emulsion Data	77-3-9-4	77-3-9-4	77-3-9-4	77-3-9-4	77-3-9-4	77-3-9-4	44-30-7-4	31-4-7-4	44-30-7-4	31-4-7-4
Film Type	4404	4404	4404	4404	4404	4404	4401	4400	4401	4400
Resolution Data (lines per millimeter)										
Static:										
High Contrast	270	91.3(A)	81.8(A)	248	116.1(A)	102.3(A)	*	73.8(AW)	*	85.7(AW)
Low Contrast	171	NA	NA	163	NA	NA	*	*	*	*
Dynamic:										
I High Contrast	171	NA	NA	167	NA	NA	*	*	*	*
I Low Contrast	130	NA	NA	129	NA	NA	*	*	*	*
P High Contrast	189	NA	NA	190	NA	NA	*	*	*	*
P Low Contrast	112	NA	NA	104	NA	NA	*	*	*	*

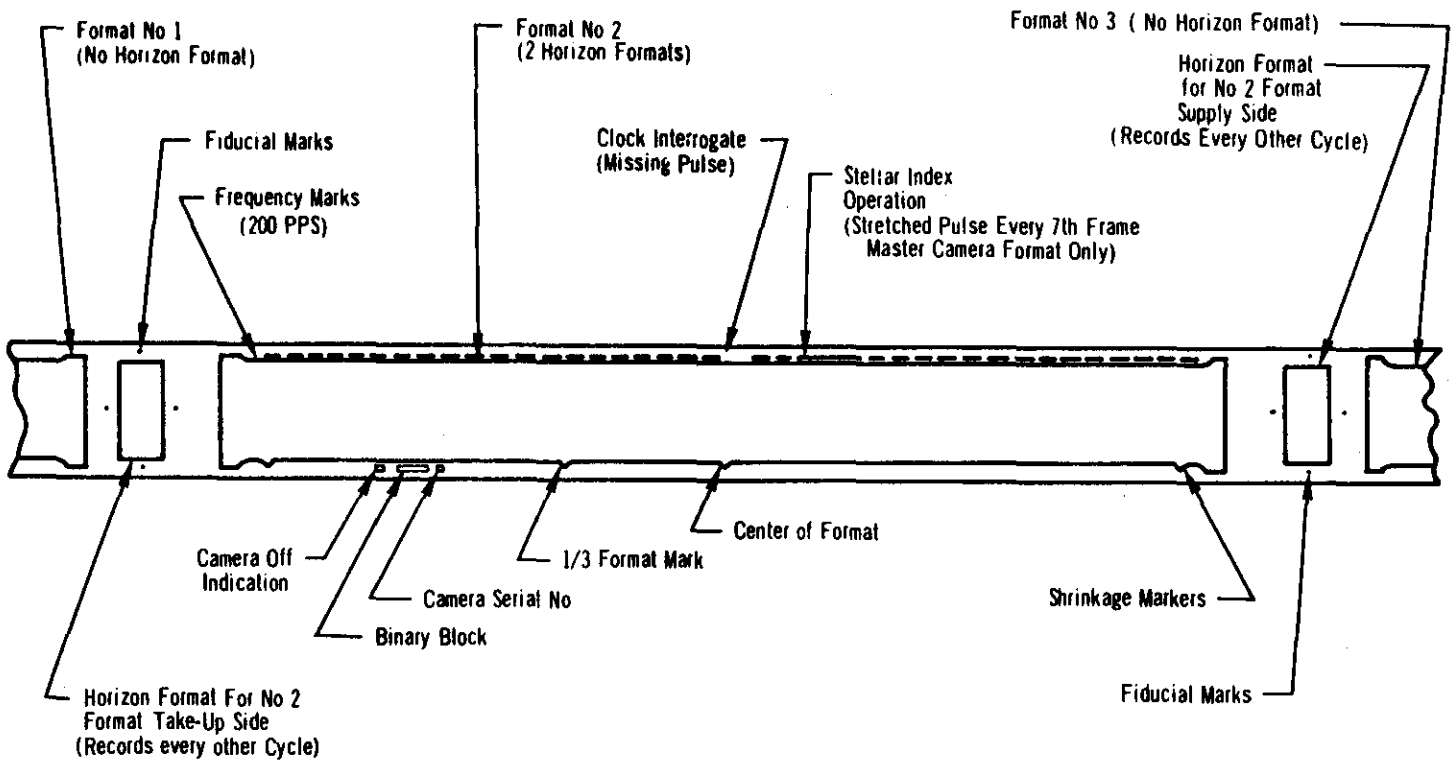
NA - Not Applicable
* - Not Available
(A) - Average
(AW) - Awar

2. VEHICLE LAYOUT



NPIC K 3497 (8 '65)

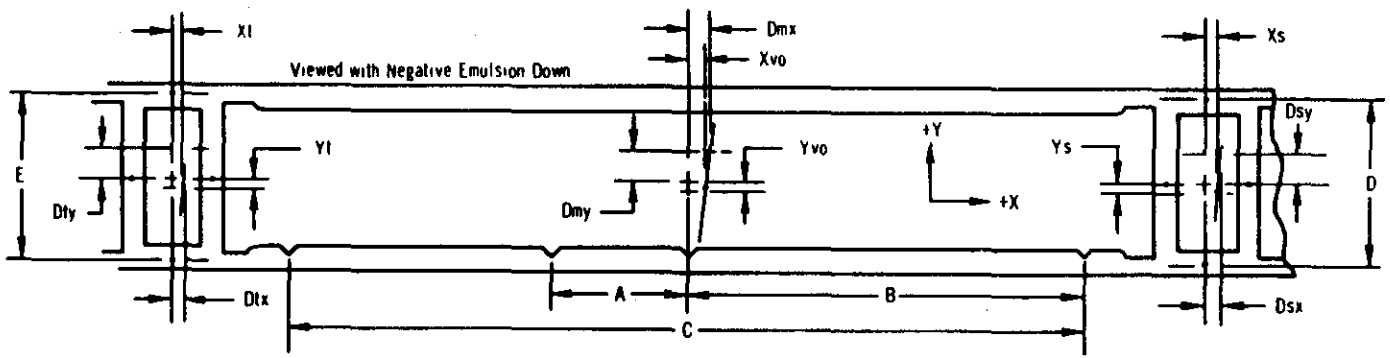
3. FILM SPECIFICATIONS
FORMAT LAYOUT



Master(Fwd)Panoramic Camera No 158
Viewed With Negative Emulsion Down
Direction of Film Transport ←
Direction of Scan →
Direction of Vehicle Motion ↓

Slave(Aft)Panoramic Camera No 159
Viewed With Negative Emulsion Down
Direction of Film Transport ←
Direction of Scan →
Direction of Vehicle Motion ↑

4. FILM SPECIFICATIONS
FORMAT DIMENSIONS



Master (Fwd) Camera		Vehicle Motion		Scan Direction	
A	76.3	Xt	−0.036	Dtx	−0.044
B	355.2	Yt	+0.084	Dty	+2.443
C	710.5	Xs	+0.157	Dsx	+0.161
D	56.476	Ys	+0.002	Dsy	+2.899
E	56.508	Xvo	+0.245	Dmx	+1.238
		Yvo	+1.165	Dmy	+4.165

Format dimensions:

Panoramic	
Height	55875
Width	756.6

Slave (Aft) Camera		Vehicle Motion		Scan Direction	
A	76.0	Xt	+0.925	Dtx	+0.920
B	355.1	Yt	−0.209	Dty	+2.118
C	710.2	Xs	−0.354	Dsx	−0.374
D	56.421	Ys	+0.131	Dsy	−1.988
E	56.503	Xvo	−0.558	Dmx	−0.537
		Yvo	+0.288	Dmy	+3.288

Format dimensions:

Panoramic	
Height	55.654
Width	754.6

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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5. 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" of arc so positioned to form an angle of -15.00° ±5" to the mechanical interface for master camera calibrations and an angle of +15.00° ±5" 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° ±5" 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 offset of Targets 2 and 3 from the indicated principal points of the supply and take-up horizon cameras respectively.

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

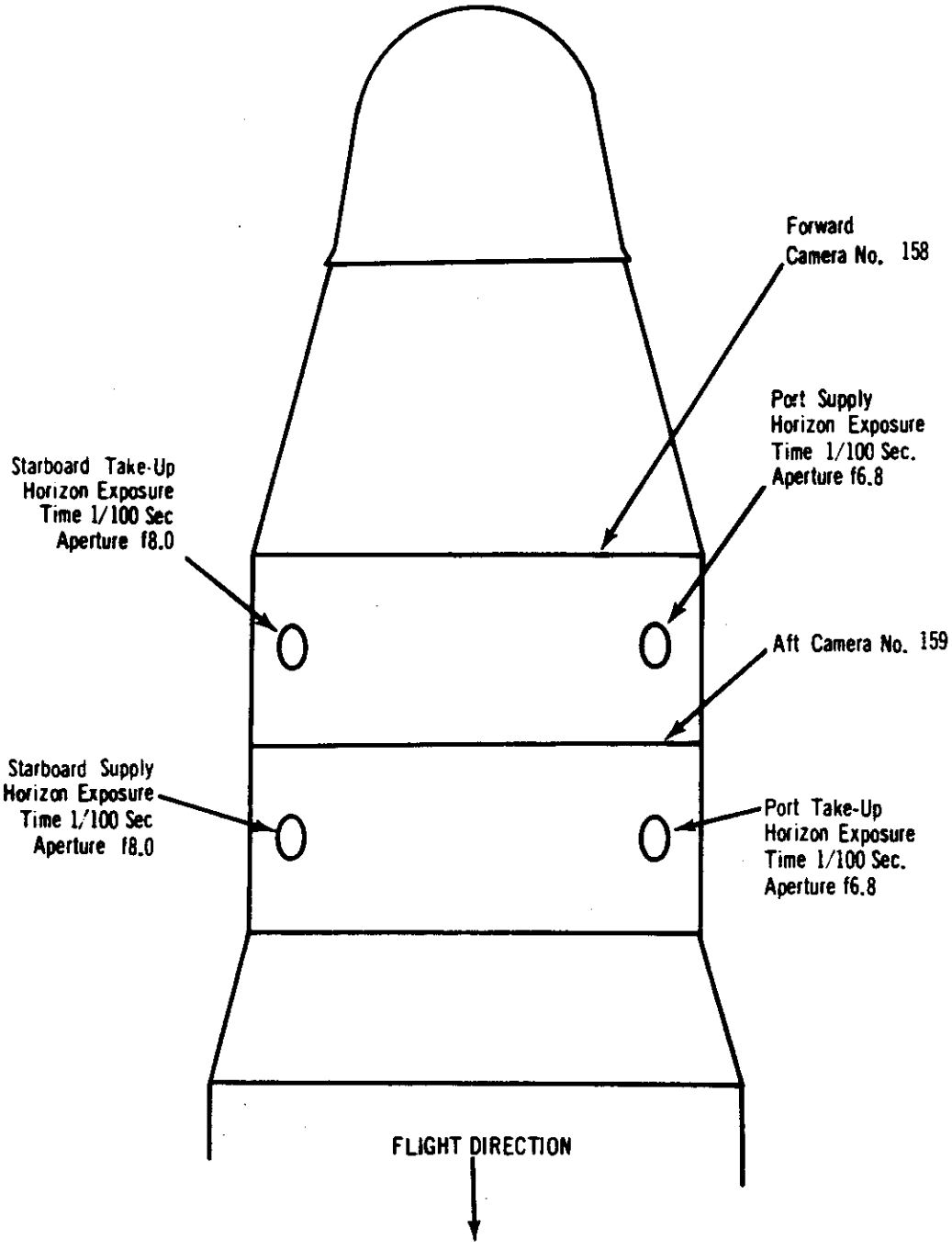
Dimensions A, B and C are the spacings of the shrinkage markers and dimensions D and E are the spacings of the Y Axis fiducials. Techniques for exact measurement of these dimensions have not been developed. The figures quoted are measurements made on hand processed film without control of shrinkage.

The format dimensions are measured to the best estimate of format [illegible].

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.

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



NPIC K-3500 (8/65)

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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 0.5 mm aperture. All values include gross fog.

Mission 1013-1

	STELLAR CAMERA NO 55					INDEX CAMERA NO 49						
						LIMITING				TERRAIN		
Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Dmax	Dmin	Delta	Gross Fog	Dmax	Dmin	Delta
1M	1	NR	NR	NR	0.20	NR	NR	NR	0.07	NR	NR	NR
	59	0.52	0.21	0.31	0.20	1.59	0.17	1.42	0.08	NR	NR	NR
3D	60	0.57	0.22	0.35	0.20	1.08	0.38	0.70	0.08	NR	NR	NR
	64	0.63	0.27	0.36	0.22	1.02	0.20	0.82	0.08	NR	NR	NR
4D	65	0.45	0.23	0.22	0.22	0.94	0.39	0.55	0.08	0.94	0.39	0.55
	75	0.64	0.21	0.43	0.18	1.06	0.20	0.86	0.08	0.87	0.40	0.47
5D	76	0.50	0.21	0.29	0.19	1.13	0.31	0.82	0.08	0.84	0.31	0.53
	88	0.98	0.22	0.76	0.18	1.36	0.76	0.60	0.08	NR	NR	NR
8D	89	0.65	0.20	0.45	0.18	0.92	0.16	0.76	0.08	NR	NR	NR
	106	0.71	0.21	0.50	0.18	1.04	0.19	0.85	0.08	1.04	0.19	0.85
9AE	107	NR	NR	NR	0.17	NR	NR	NR	0.08	NR	NR	NR
	108	NR	NR	NR	0.18	NR	NR	NR	0.08	NR	NR	NR
9D	109	0.79	0.21	0.58	0.18	1.09	0.48	0.61	0.08	1.09	0.48	0.61
	119	0.62	0.24	0.38	0.21	1.18	0.15	1.03	0.08	NR	NR	NR
10D	120	1.38	0.29	1.09	0.23	1.72	0.29	1.43	0.08	0.72	0.29	0.43
	124	1.22	0.30	0.92	0.23	1.78	0.19	1.59	0.08	0.64	0.24	0.40
16D	125	0.73	0.28	0.45	0.24	1.18	0.22	0.96	0.09	NR	NR	NR
	126	0.72	0.28	0.44	0.23	1.19	0.19	1.00	0.08	1.02	0.49	0.53
19D	127	0.61	0.23	0.38	0.19	1.10	0.20	0.90	0.08	1.02	0.20	0.82
	133	0.64	0.25	0.39	0.19	1.22	0.16	1.06	0.08	NR	NR	NR
21D	134	0.71	0.21	0.50	0.19	0.84	0.19	0.65	0.09	0.72	0.19	0.53
	151	0.92	0.24	0.68	0.20	1.53	0.22	1.31	0.08	0.74	0.38	0.36
23D	152	0.88	0.24	0.64	0.21	1.08	0.68	0.40	0.08	NR	NR	NR
	168	0.84	0.22	0.62	0.19	1.35	0.17	1.18	0.08	1.35	0.17	1.18
24D	169	0.28	0.20	0.08	0.18	0.42	0.11	0.31	0.09	NR	NR	NR
	183	0.75	0.24	0.51	0.20	0.82	0.31	0.51	0.09	0.62	0.31	0.31
25D	184	0.72	0.23	0.49	0.21	0.59	0.17	0.42	0.09	0.34	0.17	0.17
	188	0.84	0.28	0.56	0.21	1.08	0.82	0.26	0.08	1.08	0.82	0.26
30D	189	0.96	0.27	0.69	0.22	1.14	0.18	0.96	0.09	NR	NR	NR
	192	1.24	0.29	0.95	0.23	1.43	0.24	1.19	0.09	NR	NR	NR
31D	193	1.12	0.32	0.80	0.22	1.12	0.21	0.91	0.09	1.12	0.21	0.91
	195	1.36	0.27	1.09	0.20	0.75	0.21	0.54	0.09	0.75	0.21	0.54
35D	196	0.57	0.21	0.36	0.21	0.78	0.25	0.53	0.09	0.78	0.25	0.53
	201	0.76	0.22	0.54	0.19	0.84	0.26	0.58	0.08	0.84	0.26	0.58
36D	202	0.59	0.21	0.38	0.19	0.62	0.21	0.41	0.08	0.62	0.21	0.41
	218	1.55	0.29	1.26	0.19	1.13	0.43	0.70	0.08	NR	NR	NR

NR - No Reading Made

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Mission 1013-1

	STELLAR CAMERA NO 55					INDEX CAMERA NO 49						
						LIMITING			Gross Fog	TERRAIN		
Frame	Frame	Dmax	Dmin	Delta	Gross Fog	Dmax	Dmin	Delta		Dmax	Dmin	Delta
37D	241	0.40	0.21	0.19	0.19	0.74	0.15	0.59	0.09	0.74	0.15	0.59
	242	1.08	0.26	0.82	0.19	1.52	0.31	1.21	0.09	NR	NR	NR
38D	243	0.69	0.24	0.45	0.19	0.99	0.52	0.47	0.09	NR	NR	NR
	251	0.91	0.23	0.68	0.19	1.02	0.19	0.83	0.08	1.02	0.35	0.67
39D	252	0.62	0.22	0.40	0.19	0.82	0.18	0.64	0.08	0.62	0.28	0.34
	273	0.87	0.23	0.64	0.20	1.03	0.23	0.80	0.08	1.03	0.23	0.80
50D	274	0.78	0.26	0.52	0.20	1.00	0.15	0.85	0.08	NR	NR	NR
	279	1.01	0.29	0.72	0.22	1.12	0.21	0.91	0.08	NR	NR	NR
51D	280	1.18	0.30	0.88	0.24	1.12	0.20	0.92	0.08	NR	NR	NR
	285	1.12	0.32	0.80	0.23	1.32	0.54	0.78	0.08	NR	NR	NR
47DE	286	0.88	0.34	0.54	0.23	1.01	0.21	0.80	0.08	1.01	0.27	0.74
	289	0.85	0.25	0.60	0.21	1.24	0.15	1.09	0.09	1.24	0.27	0.97
51D	290	0.62	0.23	0.39	0.23	0.85	0.17	0.68	0.09	0.85	0.17	0.68
	296	0.82	0.25	0.57	0.21	0.72	0.15	0.57	0.09	0.72	0.26	0.46
52D	297	0.42	0.21	0.21	0.20	0.30	0.18	0.12	0.09	0.30	0.18	0.12
	317	1.01	0.27	0.74	0.20	1.15	0.14	1.01	0.09	1.15	0.14	1.01
53D	318	0.86	0.23	0.63	0.20	0.94	0.19	0.75	0.08	NR	NR	NR
	349	1.48	0.31	1.17	0.20	1.54	0.34	1.20	0.08	NR	NR	NR
54D	350	0.78	0.22	0.56	0.20	0.72	0.32	0.40	0.08	0.72	0.32	0.40
	370	1.00	0.26	0.74	0.21	0.90	0.41	0.49	0.08	0.90	0.41	0.49
55D	371	0.40	0.21	0.19	0.20	0.42	0.08	0.32	0.08	NR	NR	NR
	392	0.82	0.28	0.54	0.21	0.85	0.13	0.72	0.08	0.28	0.13	0.15
56D	393	0.84	0.26	0.58	0.21	1.48	0.30	1.18	0.08	0.64	0.42	0.22
	401	1.10	0.27	0.83	0.21	1.22	0.39	0.83	0.08	NR	NR	NR
57D	402	0.94	0.25	0.69	0.21	0.91	0.15	0.76	0.09	0.35	0.24	0.11
	407	1.20	0.24	0.96	0.21	1.08	0.22	0.86	0.09	0.44	0.22	0.22
61D	408	1.12	0.27	0.85	0.21	1.48	0.22	1.26	0.09	NR	NR	NR
	414	1.36	0.30	1.06	0.21	1.21	0.28	0.93	0.09	0.48	0.28	0.20
63D	415	0.98	0.27	0.71	0.21	1.05	0.17	0.88	0.09	0.79	0.35	0.44
	418	0.98	0.20	0.78	0.20	1.25	0.25	1.00	0.09	NR	NR	NR
Average		0.85	0.25	0.60	0.20	1.07	0.26	0.80	0.83	0.80	0.29	0.51
Range Low		0.28	0.20	0.08	0.17	0.30	0.08	0.12	0.07	0.30	0.13	0.11
High		1.55	0.34	1.26	0.24	1.78	0.82	1.59	0.09	1.35	0.82	1.18

NR - No Reading Made

Mission 1013-2

	STELLAR CAMERA NO 54					INDEX CAMERA NO 48						
						LIMITING			Gross Fog	TERRAIN		
Pass	Frame	Dmax	Dmin	Delta	Gross Fog	Dmax	Dmin	Delta		Dmax	Dmin	Delta
69D	1	0.78	0.24	0.54	0.25	0.48	0.19	0.29	0.09	0.48	0.19	0.29
	10	1.34	0.42	0.92	0.31	1.00	0.43	0.57	0.09	NR	NR	NR
70D	11	0.68	0.28	0.40	0.22	0.47	0.18	0.29	0.10	0.47	0.18	0.29
	18	0.92	0.29	0.63	0.25	0.68	0.17	0.51	0.10	0.68	0.34	0.34
71D	19	1.40	0.27	1.13	0.21	0.67	0.33	0.34	0.09	0.67	0.33	0.34
	26	1.03	0.27	0.76	0.21	1.60	0.14	1.46	0.09	0.62	0.30	0.32
70D	27	0.28	0.21	0.07	0.21	0.34	0.11	0.23	0.09	NR	NR	NR
	50	1.32	0.25	1.07	0.21	1.01	0.24	0.77	0.09	1.01	0.24	0.77
71D	51	0.28	0.25	0.03	0.21	0.50	0.12	0.38	0.10	NR	NR	NR
	82	1.33	0.23	1.10	0.21	0.84	0.18	0.66	0.10	0.84	0.18	0.66
72AE	83	NR	NR	NR	0.21	NR	NR	NR	0.10	NR	NR	NR
	84	NR	NR	NR	0.21	NR	NR	NR	0.10	NR	NR	NR
72D	85	0.98	0.24	0.74	0.21	0.70	0.20	0.50	0.10	0.40	0.20	0.20
	97	1.48	0.25	1.23	0.21	0.90	0.27	0.63	0.09	NR	NR	NR
77D	98	1.34	0.29	1.05	0.22	1.01	0.14	0.87	0.09	NR	NR	NR
	102	1.27	0.24	1.03	0.20	1.52	0.42	1.10	0.10	NR	NR	NR
Average		1.03	0.27	0.76	0.22	0.84	0.22	0.61	0.10	0.65	0.25	0.40
Range Low		0.28	0.21	0.03	0.20	0.34	0.11	0.23	0.09	0.40	0.18	0.20
High		1.48	0.42	1.23	0.31	1.60	0.43	1.46	0.10	1.01	0.34	0.77

NR - No Reading Made

TOP SECRET RUFF
NO FOREIGN DISSEM
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APPENDIX C. MICRODENSITOMETRY

1. Edge Spread Function:

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

To satisfy the desire to express image quality in terms of a value, a single number is determined from the spread function curve by measuring its width at 50% amplitude. This width is expressed as a micron distance in image space and may be converted to a distance on the ground. On domestic passes, where three 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 step function for a length of at least 120 microns are selected for scanning with the microdensitometer.

The microdensitometer used is a Joyce-Lobel Double Beam Model III CS. It is used with an effective slit of 1 micron by 75 microns. The recording table and specimen table are directly linked with a servo matic 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 produced represents a plot of deflection versus distance. 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.

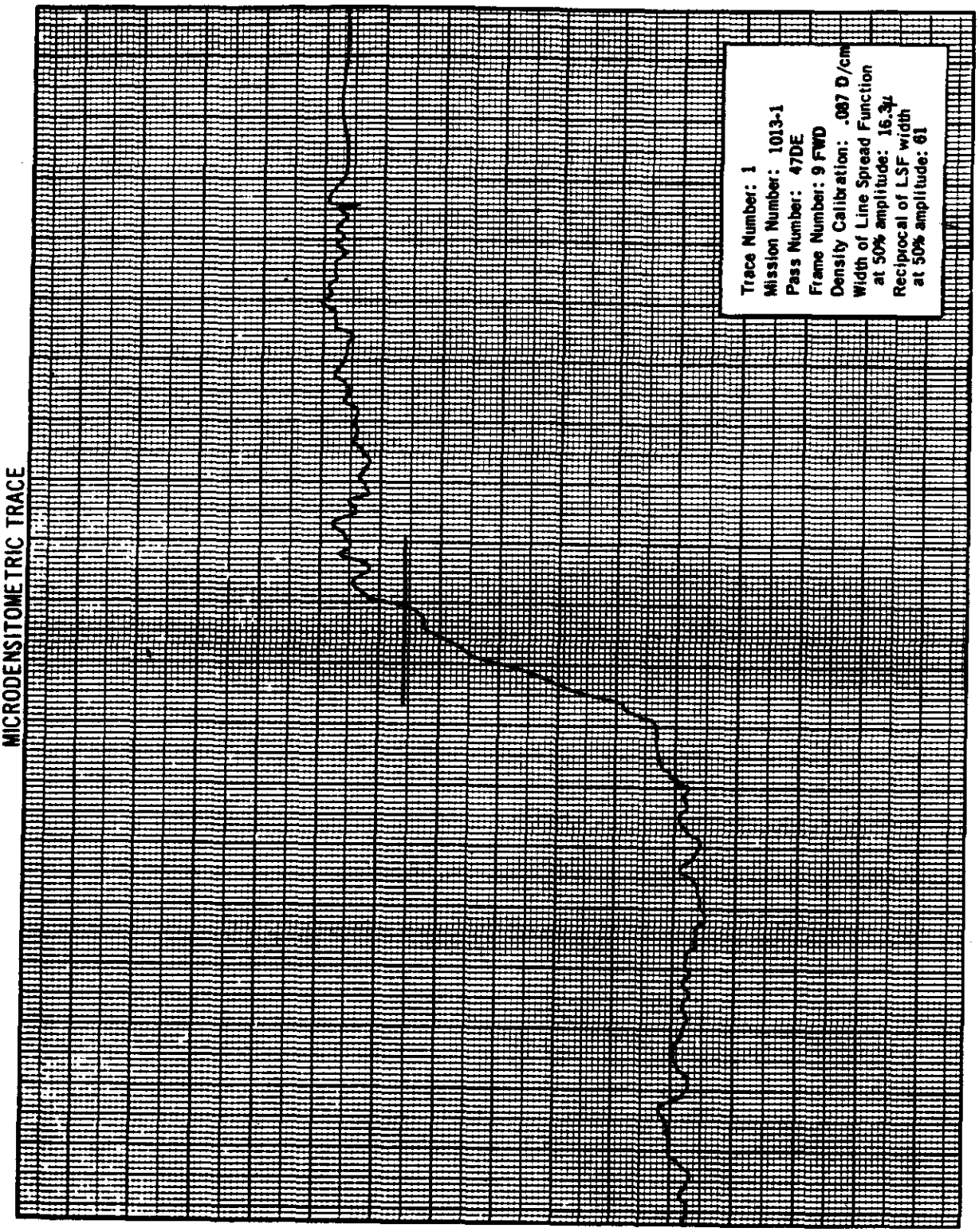
The following table shows the 50 percent amplitude width of the Line Spread Function determined from the enclosed microdensitometric edge traces made on the original negative. The lines per millimeters is determined by taking the reciprocal of the 50 percent amplitude width LSF and converting to millimeters.

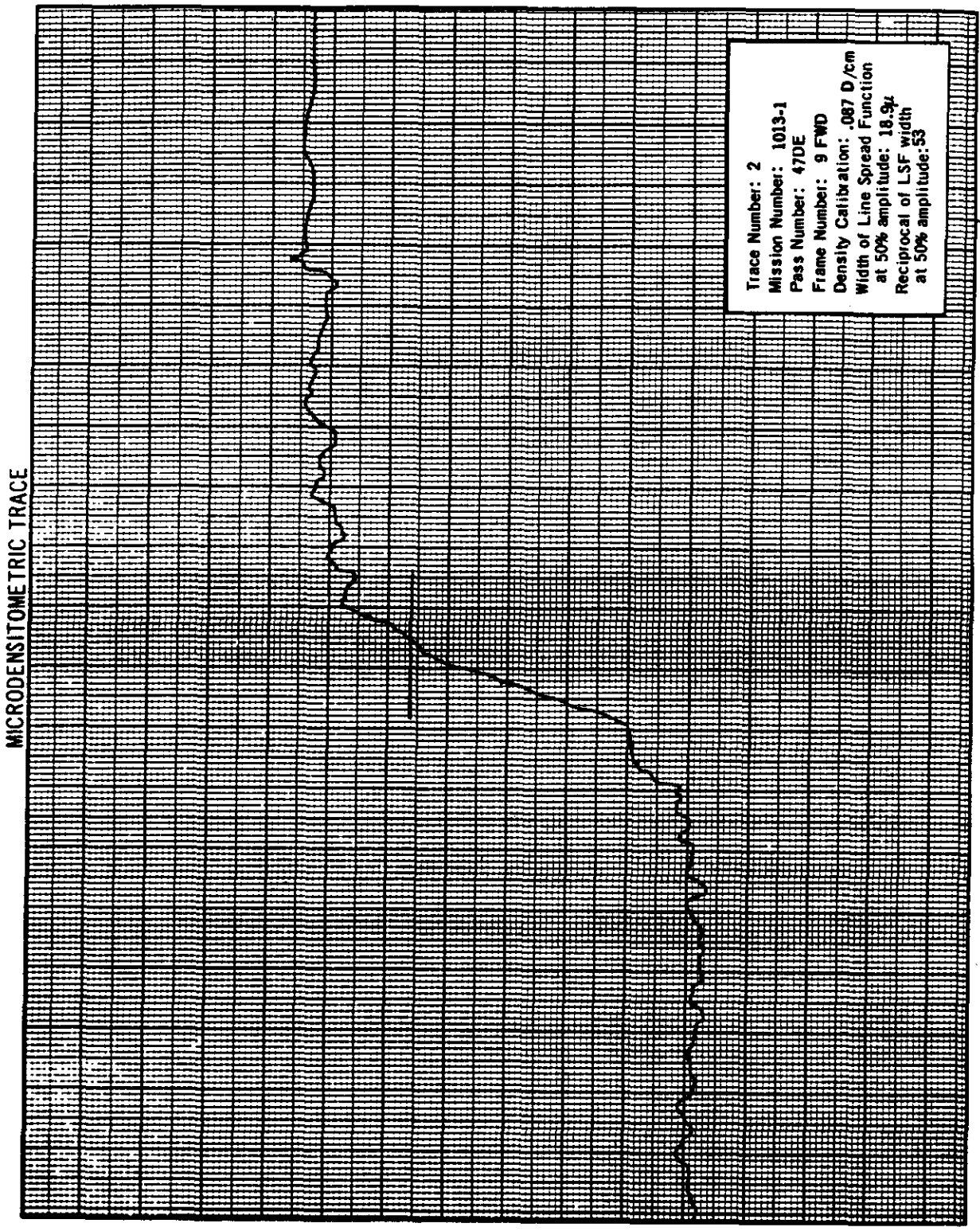
SUMMARY TABLE OF EDGE TRACES

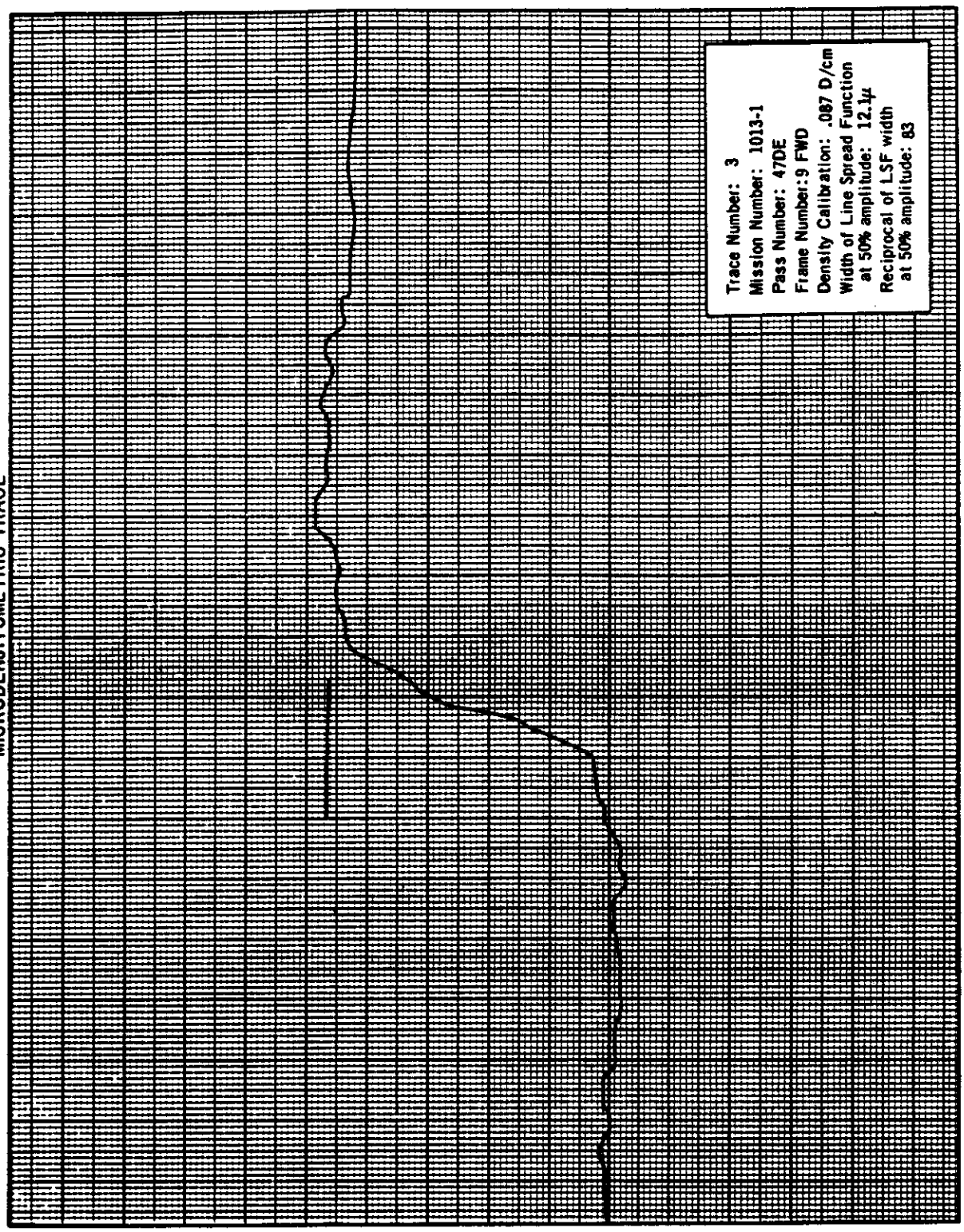
Trace	Line Spread Function Width at 50% Amplitude	Reciprocal of LSF Width at 50% Amplitude
1	16.3 microns	61
2	18.9 microns	53
3	12.1 microns	83
4	11.5 microns	87
5	8.6 microns	116
6	13.9 microns	72
7	11.3 microns	88
8	11.8 microns	85

2. Edge Traces, Mission 1013-1

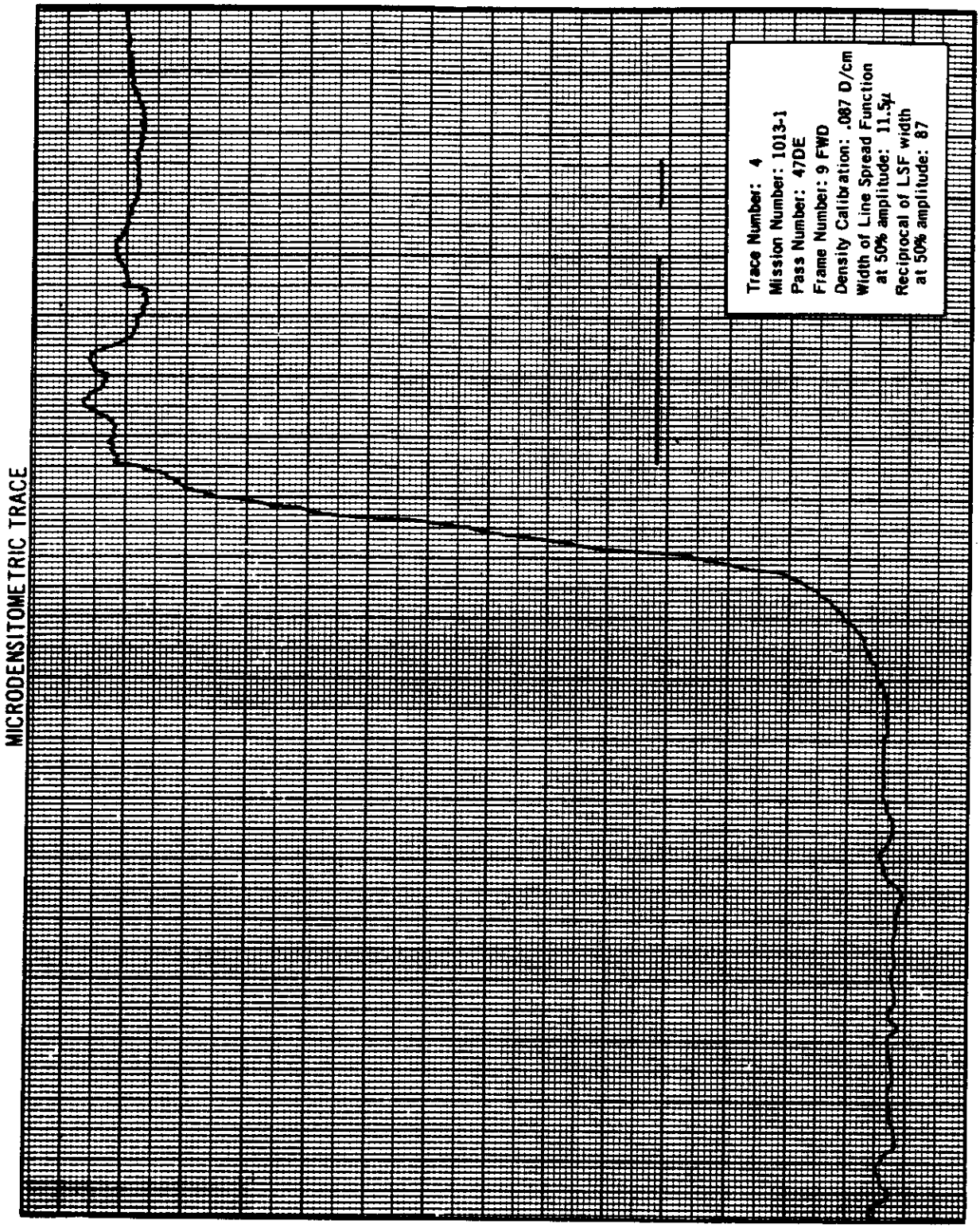
MICRODENSITOMETRIC TRACE

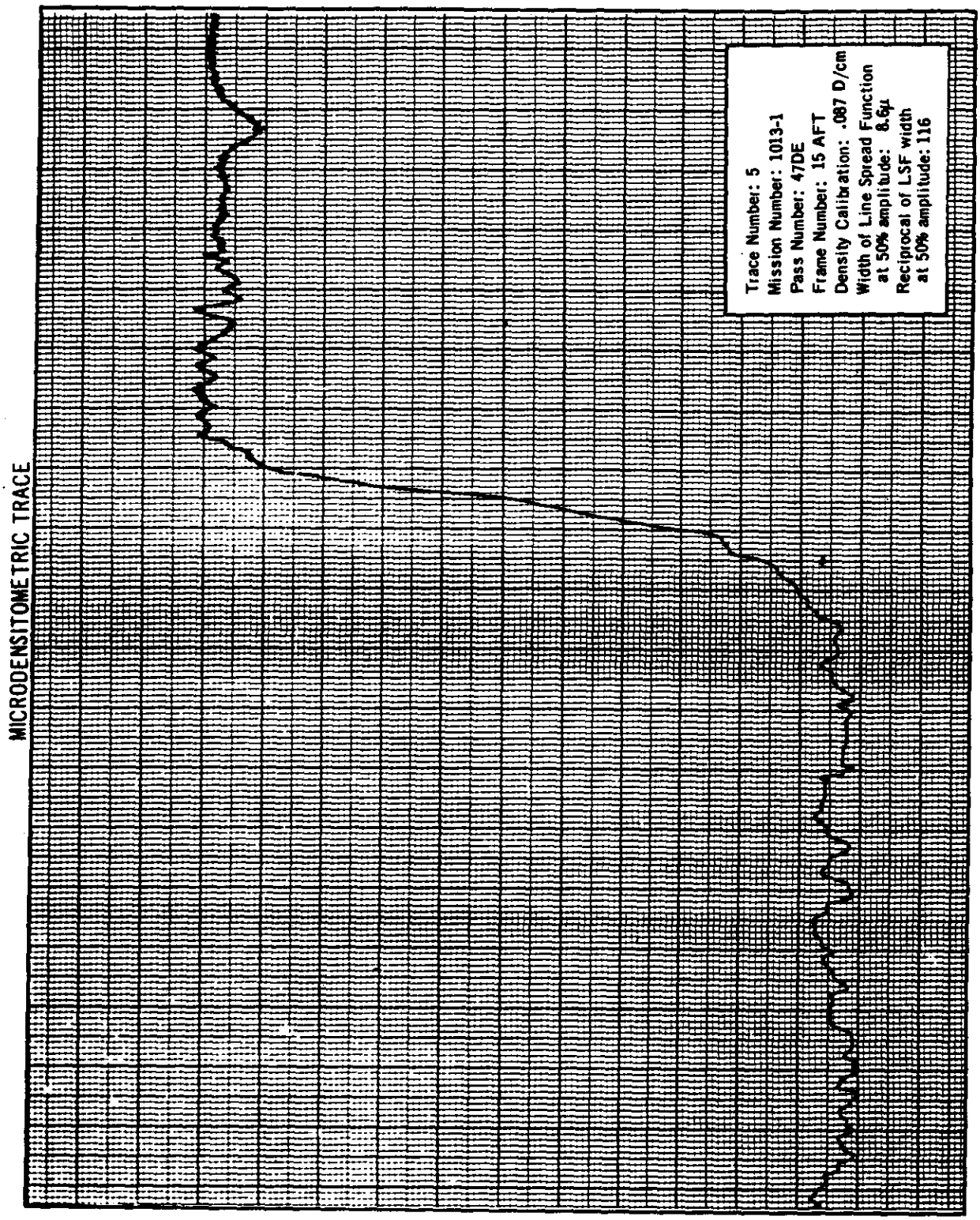


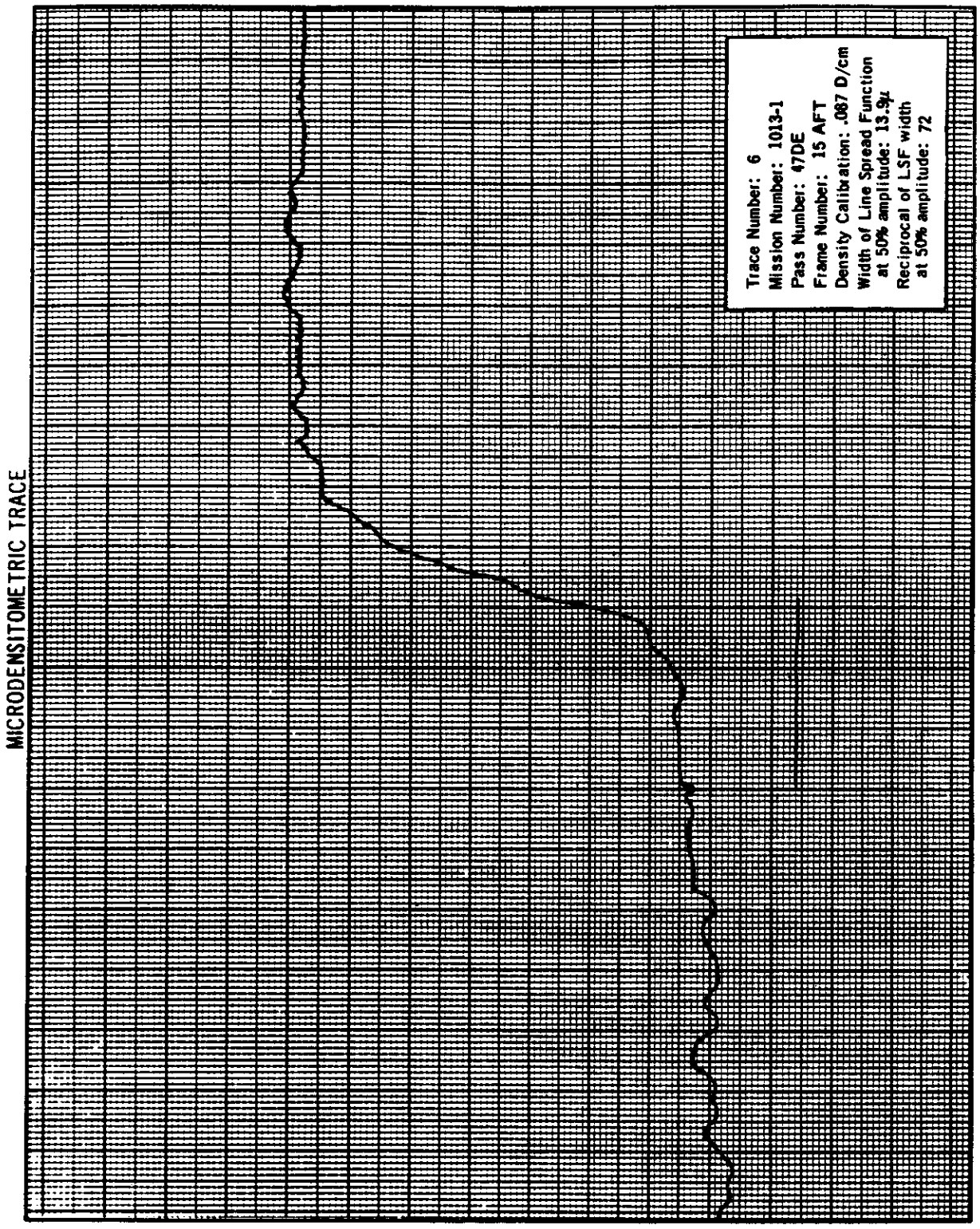

MICRODENSITOMETRIC TRACE
Trace Number: 2
Mission Number: 1013-1
Pass Number: 47DE
Frame Number: 9 FWD
Density Calibration: .087 D/cm
Width of Line Spread Function
at 50% amplitude: 18.9μ
Reciprocal of LSF width
at 50% amplitude: 53

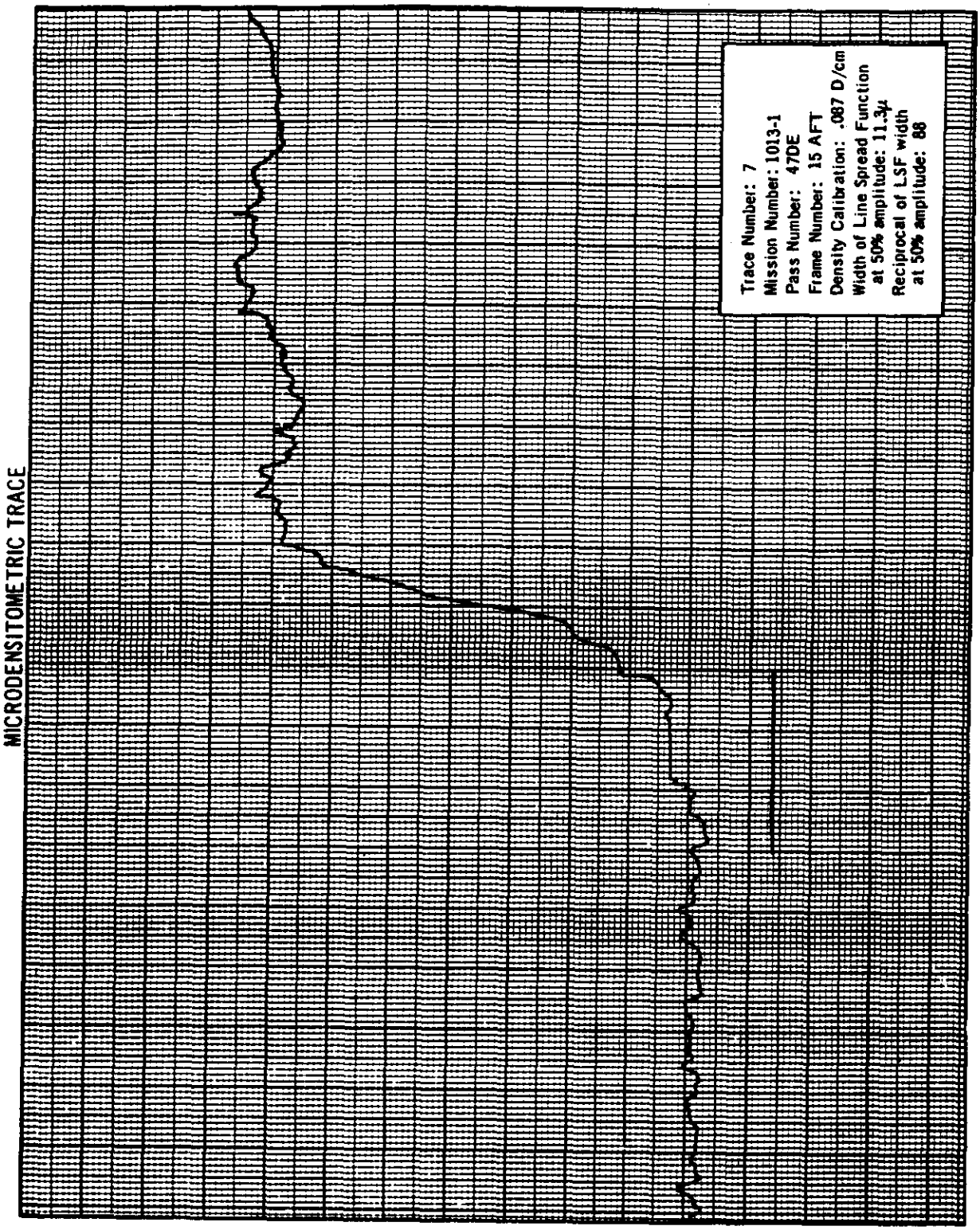

MICRODENSITOMETRIC TRACE
Trace Number: 3
Mission Number: 1013-1
Pass Number: 47DE
Frame Number: 9 FWD
Density Calibration: .087 D/cm
Width of Line Spread Function at 50% amplitude: 12.1μ
Reciprocal of LSF width at 50% amplitude: 83

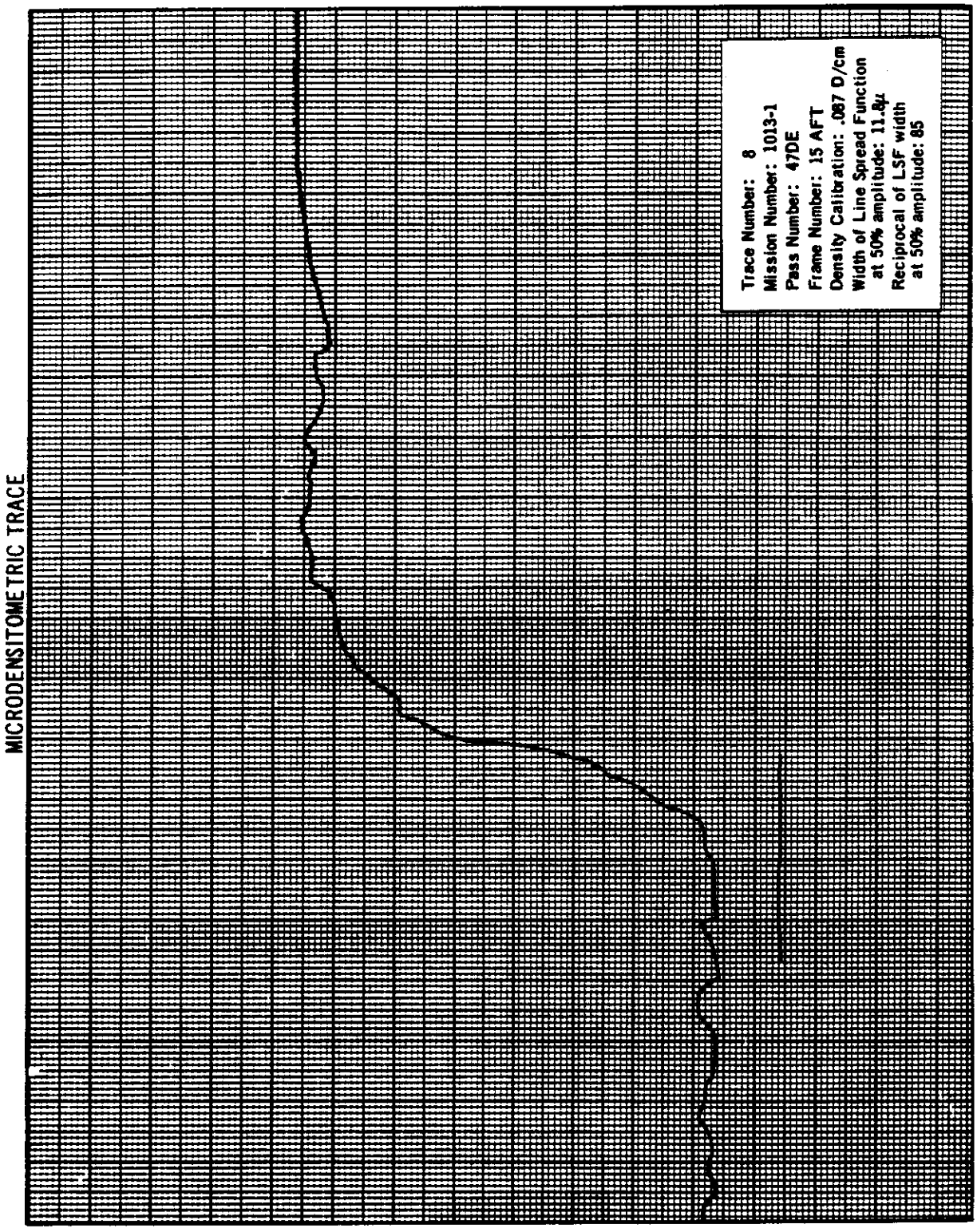
[redacted]


MICRODENSITOMETRIC TRACE
Trace Number: 4
Mission Number: 1013-1
Pass Number: 47DE
Frame Number: 9 FWD
Density Calibration: .087 D/cm
Width of Line Spread Function
at 50% amplitude: 11.5μ
Reciprocal of LSF width
at 50% amplitude: 87


MICRODENSITOMETRIC TRACE
Trace Number: 5
Mission Number: 1013-1
Pass Number: 47DE
Frame Number: 15 AFT
Density Calibration: .087 D/cm
Width of Line Spread Function at 50% amplitude: 8.6μ
Reciprocal of LSF width at 50% amplitude: 116


MICRODENSITOMETRIC TRACE
Trace Number: 6
Mission Number: 1013-1
Pass Number: 47DE
Frame Number: 15 AFT
Density Calibration: .087 D/cm
Width of Line Spread Function at 50% amplitude: 13.9μ
Reciprocal of LSF width at 50% amplitude: 72


MICRODENSITOMETRIC TRACE
Trace Number: 7
Mission Number: 1013-1
Pass Number: 47DE
Frame Number: 15 AFT
Density Calibration: .087 D/cm
Width of Line Spread Function at 50% amplitude: 11.3μ
Reciprocal of LSF width at 50% amplitude: 88

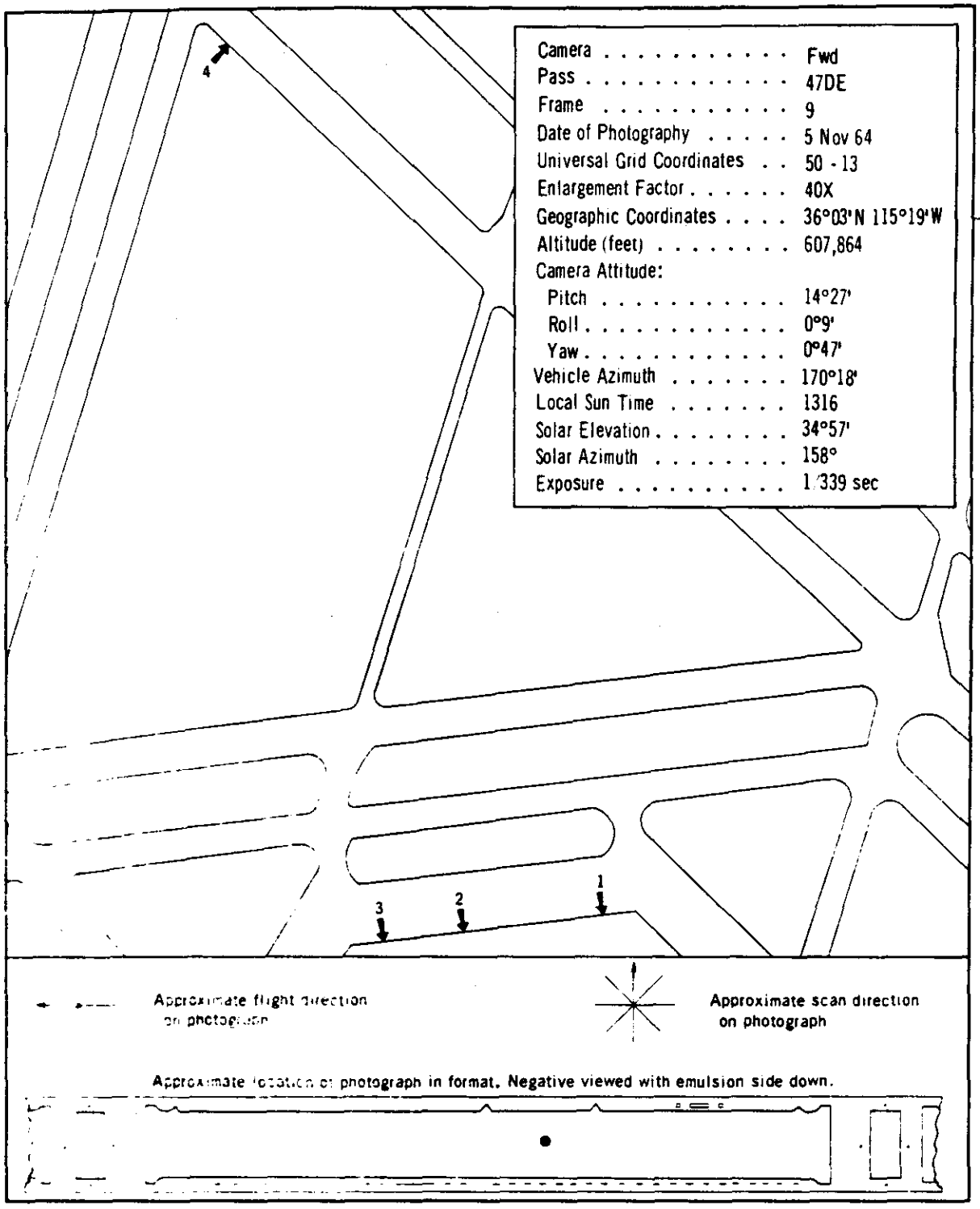

MICRODENSITOMETRIC TRACE
Trace Number: 8
Mission Number: 1013-1
Pass Number: 47DE
Frame Number: 15 AFT
Density Calibration: .087 D/cm
Width of Line Spread Function at 50% amplitude: 11.8μ
Reciprocal of LSF width at 50% amplitude: 85

[redacted]

FIGURE 30. ORIENTATION OF MICRODENSITOMETRIC TRACES ON MISSION 1013-1.

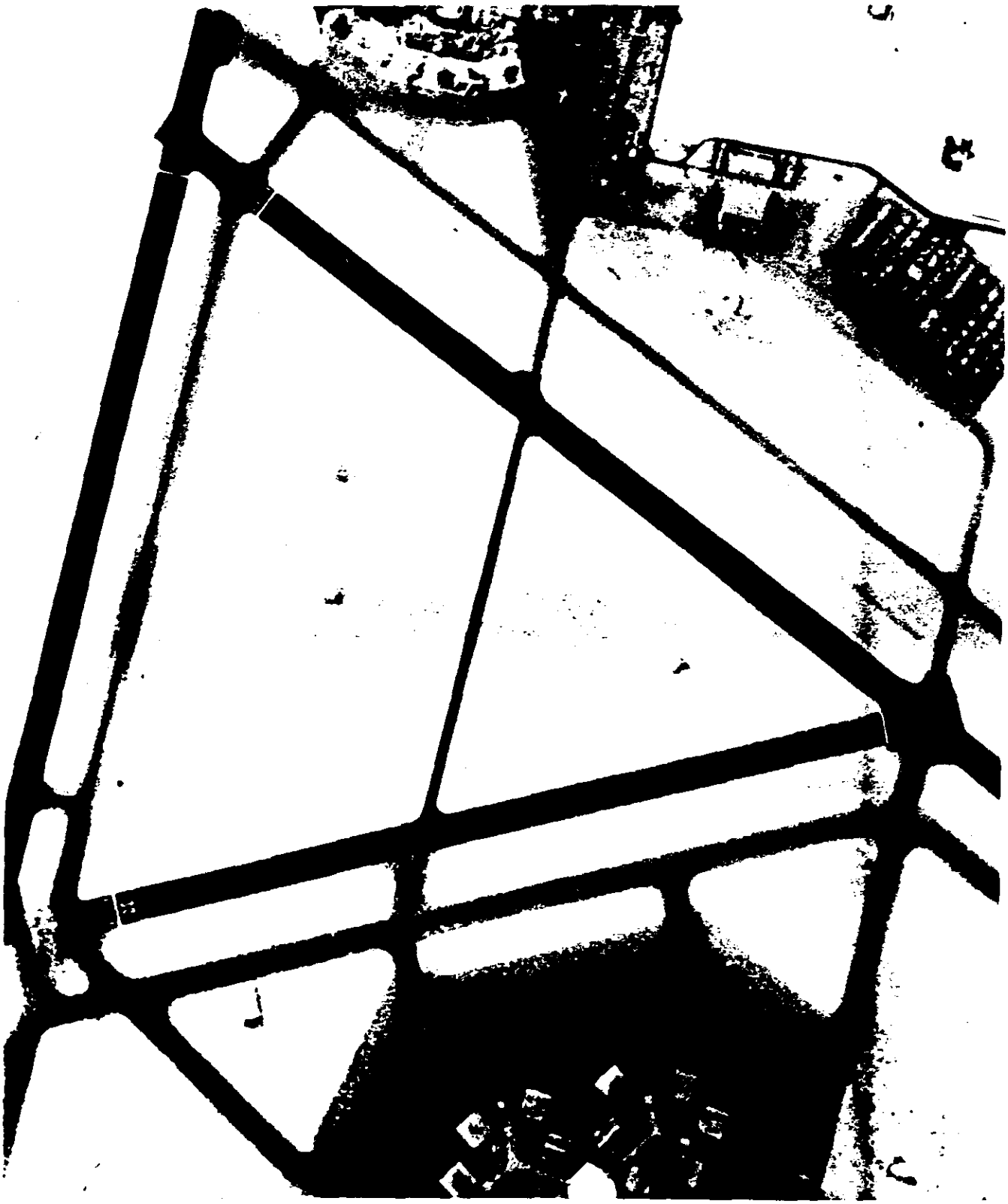
NPIC K-3501 (8/65)

Those edges across which microdensitometric edge traces 1 through 4 were made are illustrated in the accompanying photograph. Arrows indicate the approximate location for each trace.


Camera . . . . . Fwd
Pass 47DE
Frame 9
Date of Photography . . . . . 5 Nov 64
Universal Grid Coordinates . . 50 - 13
Enlargement Factor 40X
Geographic Coordinates . . . . 36°03'N 115°19'W
Altitude (feet) 607,864
Camera Attitude:
Pitch . . . . . 14°27'
Roll . . . . . 0°9'
Yaw . . . . . 0°47'
Vehicle Azimuth . . . . . 170°18'
Local Sun Time 1316
Solar Elevation . . . . . 34°57'
Solar Azimuth . . . . . 158°
Exposure . . . . . 1/339 sec
4
3
2
1
Approximate flight direction on photograph
Approximate scan direction on photograph
Approximate location of photograph in format. Negative viewed with emulsion side down.

Handle Via
~~TALENT-KEYHOLE~~
Control System Only

[redacted]



Handle Via
~~TALENT-KEYHOLE~~
Control System Only

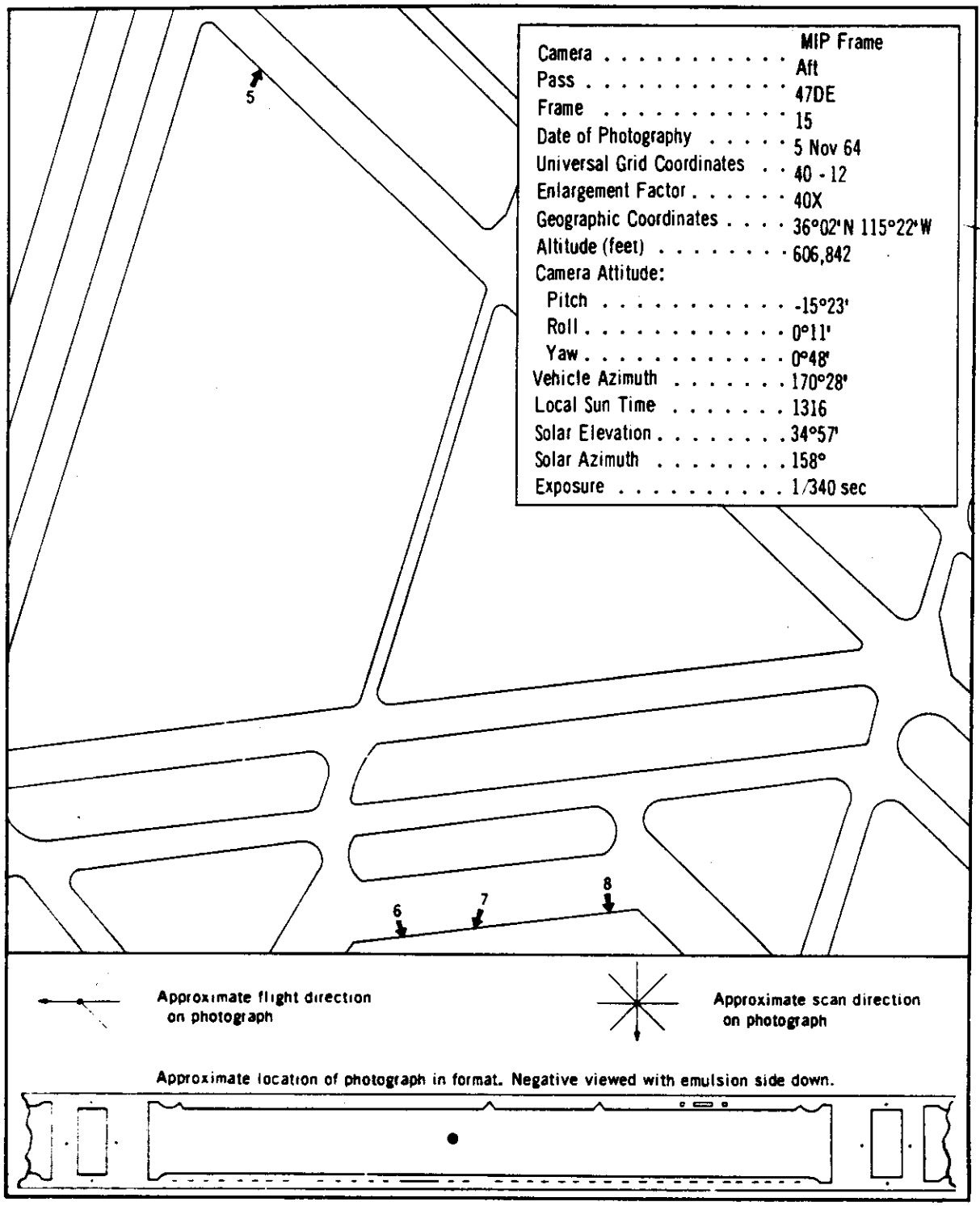
[redacted]

[redacted]

FIGURE 31. ORIENTATION OF MICRODENSITOMETRIC TRACES ON MISSION 1013-1.

NPIC K-3502 (8/65)

Those edges across which microdensitometric edge traces 5 through 8 were made are illustrated in the accompanying photograph. Arrows indicate the approximate location for each trace.


5
6
7
8
Camera . . . . . MIP Frame
Pass . . . . . Aft
Frame 47DE
Date of Photography 15
Universal Grid Coordinates . . 5 Nov 64
Enlargement Factor . . . . . 40 - 12
Geographic Coordinates 40X
Altitude (feet) . . . . . 36°02'N 115°22'W
Camera Attitude: 606,842
Pitch . . . . . -15°23'
Roll . . . . . 0°11'
Yaw . . . . . 0°48'
Vehicle Azimuth . . . . . 170°28'
Local Sun Time 1316
Solar Elevation . . . . . 34°57'
Solar Azimuth . . . . . 158°
Exposure . . . . . 1/340 sec
Approximate flight direction on photograph
Approximate scan direction on photograph
Approximate location of photograph in format. Negative viewed with emulsion side down.

[redacted]

APPENDIX D. CLOUD COVER ANALYSIS

1. Introduction

This study represents a statistical analysis of the cloud cover on the photography of Mission 1013-1. 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:

[redacted]

0.20 x 5.0 = 1.00%
0.15 x 17.5 = 2.63%
0.30 x 38.0 = 11.40%
0.25 x 75.0 = 18.75%
0.10 x 100.0 = 10.00%
~~43.78%~~

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%

[redacted]

2. Cloud Cover Data, Mission 1013-1

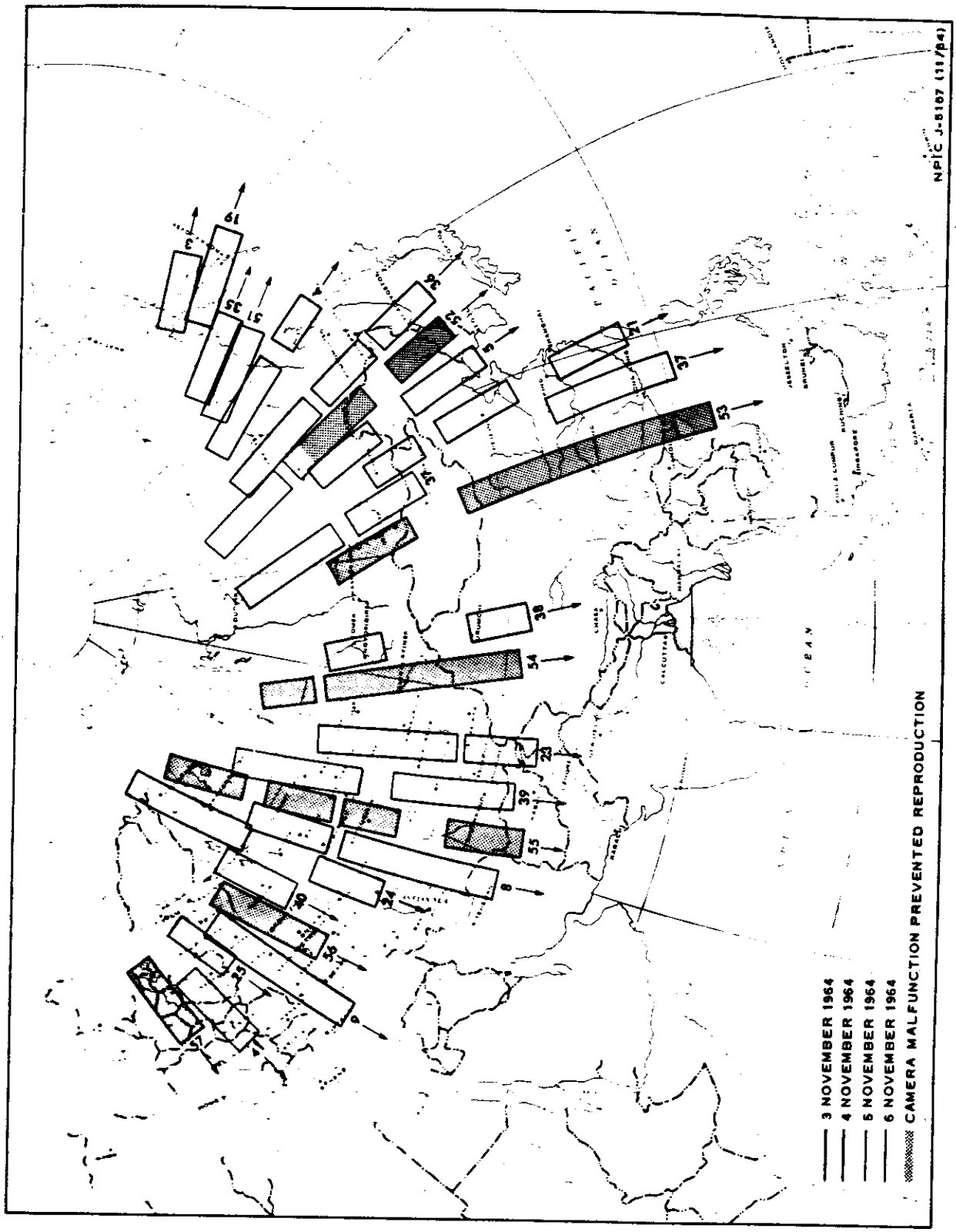
Pass Number	1	2	3	4	5	Cloud Cover % Per Pass
3D	0.0	0.0	5.8	91.7	2.5	73.5
4D	38.5	34.0	17.1	10.4	0.0	22.2
5D	24.3	4.7	4.9	30.4	35.7	62.4
8D	64.1	6.1	5.5	4.5	19.8	29.6
9D	0.5	1.8	6.4	44.9	46.4	82.8
10D	0.7	2.1	28.5	47.9	20.8	68.0
19D	3.9	6.9	27.1	60.8	1.3	58.6
21D	34.8	11.5	17.5	28.3	7.9	39.5
23D	24.6	8.1	11.7	26.6	29.0	56.0
24D	9.0	4.8	18.2	44.7	23.3	65.0
25D	30.6	10.0	8.2	20.6	30.6	52.5
30D	4.7	23.0	46.6	25.0	0.7	41.4
35D	28.1	14.3	10.7	37.2	9.7	45.6
36D	23.9	8.8	10.8	28.8	27.7	56.2
37D	19.8	10.2	13.7	39.0	17.3	54.6
38D	47.6	11.5	6.1	6.4	28.4	39.9
39D	33.5	16.9	9.4	31.8	8.4	40.4
40D	0.0	8.2	32.7	52.0	7.1	60.0
41D	0.0	0.0	0.5	37.3	62.2	90.4
51D	71.4	6.8	9.1	12.7	0.0	17.8
52D	93.2	3.4	3.0	0.4	0.0	6.7
	30.5*	9.5*	12.2*	29.3*	18.5*	48.3**

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

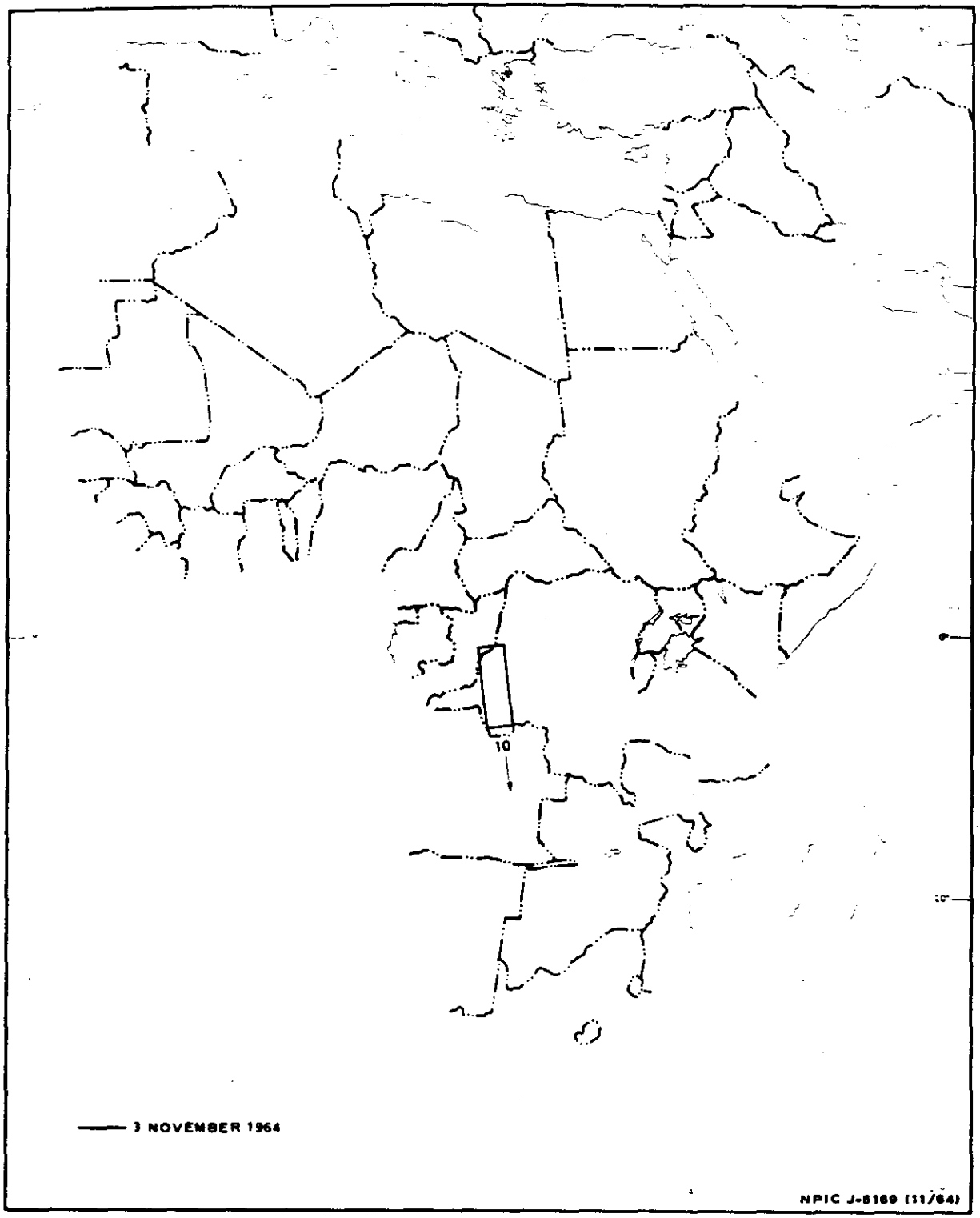
APPENDIX E. MISSION COVERAGE STATISTICS

1. Summary of Plottable Photographic Coverage Mission 1013-1
2-6 November 1964Z

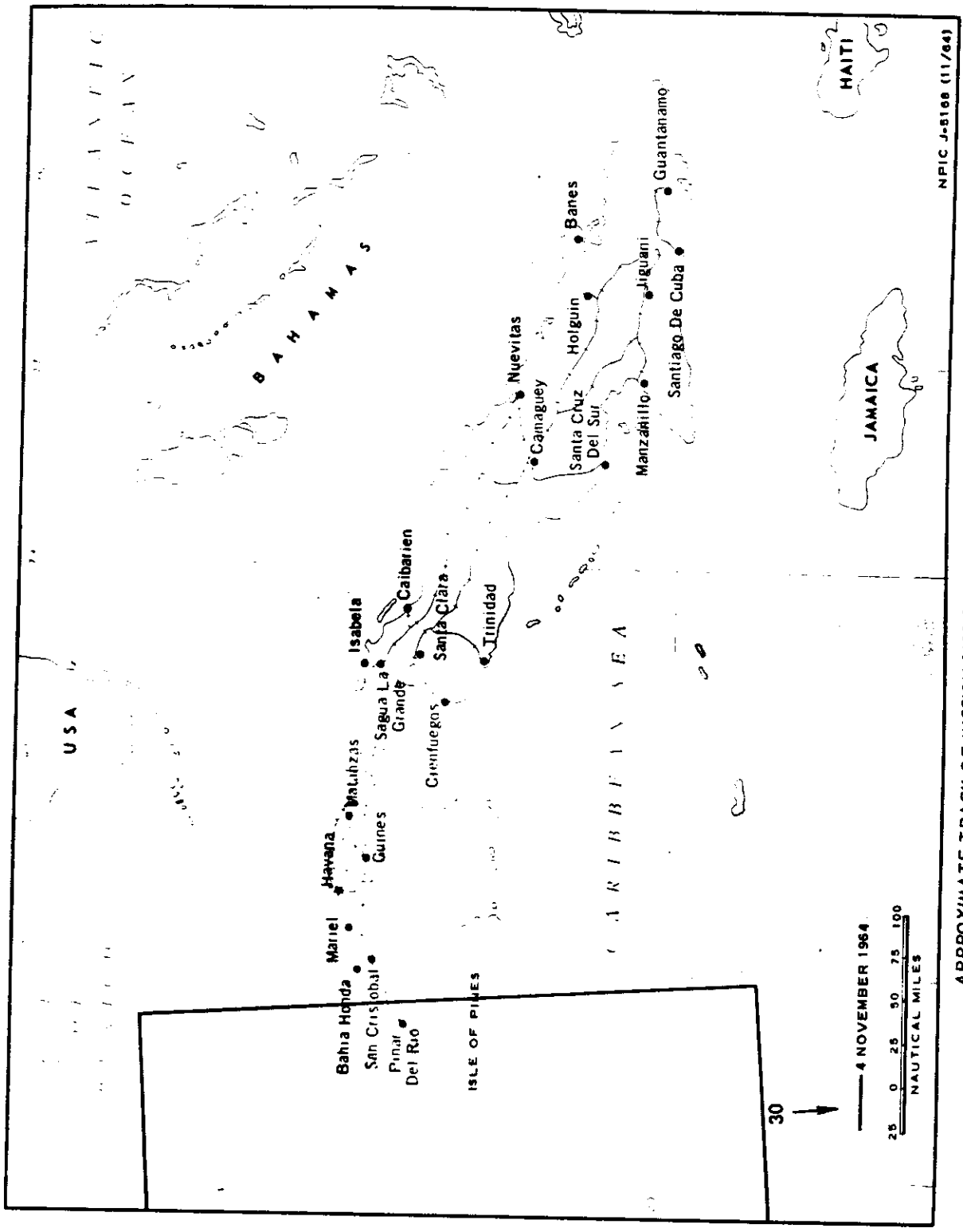
Country	Forward Camera		Aft Camera		Totals	
	Linear nm	Square nm	Linear nm	Square nm	Linear nm	Square nm
Afghanistan	83	11,680	29	4,118	112	15,798
Angola	74	11,100	25	3,750	99	14,850
Austria	34	5,508	12	1,800	46	7,308
China	1,472	196,804	1,224	167,268	2,696	364,072
Congo	124	18,600	124	18,600	248	37,200
Cuba	74	3,080	74	3,080	148	6,160
Czechoslovakia	104	16,848	118	17,700	222	34,548
Finland	10	1,760	12	1,944	22	3,704
Hungary	104	16,848	89	13,350	193	30,198
Iran	164	23,288	71	10,082	235	33,370
Kashmir	30	4,260	12	1,704	42	5,964
Mexico	272	32,200	161	21,140	433	53,340
Mongolia	164	24,600	55	8,250	219	32,850
Norway	82	7,216	86	8,424	168	15,640
Pakistan	30	4,260	12	1,704	42	5,964
Poland	116	18,696	135	20,298	251	38,994
Rumania	12	1,208	10	896	22	2,104
Sweden	12	9,240	18	1,386	30	10,626
Taiwan	82	6,860	351	39,200	433	46,060
Union of Central African Republic	49	7,350	99	14,850	148	22,200
USSR	10,020	1,460,786	10,192	1,501,582	20,212	2,962,368
Yugoslavia	55	8,470	20	3,000	75	11,470
TOTAL	13,167	1,890,662	12,929	1,864,126	26,096	3,754,788
Continental US	1,230	173,164	1,355	190,774	2,585	363,938
GRAND TOTAL	14,397	2,063,826	14,284	2,054,900	28,681	4,118,726



APPROXIMATE TRACK OF MISSION 1013-1, 3-6 NOVEMBER 1964 OVER USSR, FAR AND MIDDLE EAST.



APPROXIMATE TRACK OF MISSION 1013-1, 3-6 NOVEMBER 1964 OVER AFRICA.



APPROXIMATE TRACK OF MISSION 1013-1, 3-6 NOVEMBER 1964 OVER CUBA.