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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT MISSION 1044

SPECIAL STUDY ON DUAL GAMMA/VICOSE VS CONVENTIONAL/SPRAY PROCESSING ANALYSIS

[redacted]

FEBRUARY 1968

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49 PAGES

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PHOTOGRAPHIC EVALUATION REPORT

MISSION 1044

FEBRUARY 1968

NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

[redacted]

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LIST OF ILLUSTRATIONS

GLOSSARY OF TERMS

ABSOLUTE HEIGHT	Vertical distance from the vehicle to the mean ground level of the area being photographed.
ACUITY	Sharpness - Edge definition.
ACUTANCE	Measure of the ability of a lens to reproduce sharp images.
AIR BASE	Ground distance between 2 exposure stations.
ALTITUDE	Vertical distance from the vehicle to the Hough Ellipsoid at the time of exposure.
AZIMUTH OF THE PRINCIPAL RAY	Horizontal clockwise angle, measured from true north to the camera principal ray.
BASE HEIGHT RATIO	Ratio between the air base and the absolute attitude of a stereoscopic pair of photographs.
CAMERA NADIR	Geodetic latitude and longitude of a point vertically beneath the perspective center of the camera lens on the Hough Ellipsoid.
CONE ANGLE	Angle between the principal ray and the vehicle nadir.
COPY GENERATION	Number of reproductive steps by which a negative or positive photographic copy is separated from the original, i.e. the original negative is copy 1, a positive made from the original negative is copy 2, etc.
DATE OF PHOTOGRAPHY	Indicates the day, month, and year (GMT) that the photography was acquired.
EXPOSURE*	Total quantity of light received per unit area on a sensitized plate or film.

EXPOSURE DURATION

Time during which a light-sensitive material is subjected to the influence of light. Expressed in this test in fractions of a second. Formula: Exposure Time (sec) = $\frac{\text{Slit Width (in)}}{\text{Scan Rate (in per sec)}}$

EXPOSURE STATION

Position occupied by the camera lens at the moment of exposure.

FIDUCIAL MARK

A standard geometrical reference point imaged at the margin of a photograph. The intersection of the primary fiducial marks usually defines the principal point.

FOCAL LENGTH: CALIBRATED

Adjusted value of the equivalent focal length. Computed to distribute the effect of lens distortion over the entire field.

FOCAL LENGTH: EQUIVALENT

Distance measured along the lens axis from the rear nodal point to the plane of best average definition over the entire field. Points other than the rear nodal point may be used but must be specified for correct interpretation of data.

FOCAL PLANE

Plane perpendicular to the lens axis, in which images of points in the object field of the lens are focused.

FRAME

One of a series of full-format photographs comprising a roll of film.

GROUND RESOLUTION*

Resolved ground distance as determined from standard bar target resolution targets. A target is considered to be resolved when a grouping of 3 bars can be distinguished as 3 distinct lines. The lines need not have linear form.

HOLEY RAIL DOTS	Images of the rail holes associated with the pan geometry calibration of the camera.
IMC (Image Motion Compensation)	Correction for the forward motion of the vehicle while photographing the terrain.
ISODENSITOMETER	An instrument which is basically a microdensitometer with the capability of repeatedly scanning an image at pre-set intervals. Its output is in the form of a plot representing distance along 2 axes and density differences as code changes within each scan line.
LOCAL SUN TIME	Time of day computed from the position of the sun relative to the imaged terrain.
MICRODENSITOMETER	An instrument which measures the optical density of very small areas in an image. Its output is in the form of a continuous plot of density versus distance across an image. The microdensitometer used in NPIC can accurately measure distances as small as 1 micron and densities up to 5.0+.
NOD INDICATORS	A series of marks imaged in the border area of each frame for the purpose of defining the relative orientation of the optical axis and the ground scene.
NODAL TRACE	A continuous line imaged along the major axis of each frame to define the optical axis of the lens relative to any given instant of exposure.
PANORAMIC CAMERA	Photographs a partial or complete panorama of the terrain in a transverse direction through a scanning motion of the lens system.

PARALLAX	Apparent displacement of the position of an object in relation to a reference point, caused by a change in the point of observation.
PASS	Operational portion of an orbital revolution. A suffix D indicates descending node and a suffix A indicates the ascending node. An additional suffix E indicates that the associated photography was generated for engineering purposes.
PITCH	Rotation of the camera about its transverse axis. Positive pitch indicates nose-up attitude.
PROCESSING LEVEL	Degree of development. Three levels of processing are currently employed: Primary, intermediate, and full.
PRINCIPAL RAY	That ray of light which emanates from a point in object space and passes undeviated through the lens to become imaged at the principal point of the camera system. It is co-incident with the optical axis of the lens.
RESOLUTION	Measure of the smallest array of point objects distinguishable as independent point images, expressed in lines/mm.
ROLL	Rotation of the camera about its longitudinal axis. Positive roll indicates left wing up attitude.
SHADOW FACTOR	A constant for each frame, used to calculate heights from shadow lengths.
SHRINKAGE MARKERS	Calibrated reference points used to calculate deformations of the photographic material.

SOLAR ELEVATION	Vertical angle measured from a plane (tangent to the surface of the earth at the point of intersection of the principal ray) to the sun, the vertex being at the center of the format.
STELLAR CAMERA	Used simultaneously with the index camera to photograph stars in order to determine vehicle attitude.
SYSTEM TIME LABEL	Binary presentation of the accumulative system time.
UNIVERSAL GRID	X, Y coordinate system used to locate images on photographic formats.
VEHICLE AZIMUTH	Clockwise horizontal angle measured from true north to the vehicle ground track.
VIGNETTING	Gradual reduction in density of parts of a photographic image due to the stopping of some of the rays entering the lens.
YAW	Rotation of the camera about its vertical axis. Positive yaw represents nose-left attitude, as viewed from the top of the camera.

*Defined differently than in the "Glossary of NPIC Terminology."

INDEX OF PHOTOGRAPHIC EVALUATION REPORTS AND SPECIAL STUDIES

PER	DOCUMENT NUMBER	SPECIAL STUDY
1033	[redacted]	None
1034		None
1036		None
1037		None
1038		None
1039		None
1040		None
1041		Slant Range Computations Related to Universal Grid Coordinates for the KH-4 Camera System
1042	[redacted]	None
1043		Scan Speed Deviation Analysis of the Forward Camera, Mission 1043
1101	[redacted]	Slant Range Computations Related to Universal Grid Coordinates for the KH-4B Camera System

SYNOPSIS

Mission 1044, a 2 part photographic satellite reconnaissance mission, was launched on 2 November 1967/2131Z. The first payload (Mission 1044-1) was recovered dry on 9 November 1967/2307Z. Photography was obtained during 88 orbital revolutions.

The panoramic cameras operated satisfactorily throughout the mission. Minor bands of smearing are present near the take-up end of many frames from both cameras. A slight veiling condition exists on the starboard horizon of the aft camera. Approximately 5,000 feet of film was removed from each camera and processed in an experimental single viscous, dual gamma developer on the Yardleigh processor. A special study comparing the dual gamma (humpback) process versus the interrupted 3 level process is included as a special study attached to this report.

Both stellar and index cameras operated throughout the mission, and there were no major anomalies.

The image quality of the main cameras is considered to be fair to good. An MIP rating of 85 was assigned to both segments of the mission. Over-all cloud cover is estimated to be 35 percent.

[redacted]

PART I. GENERAL SYSTEM INFORMATION

A. Camera Numbers

Forward-Looking Panoramic Camera	202
Aft-Looking Panoramic Camera	203
Stellar/Index Camera (Mission 1044-1)	D99/122/120
Stellar/Index Camera (Mission 1044-2)	D104/132/131

B. Launch and Recovery Dates

	Mission 1044-1	Mission 1044-2
Launch	2131Z/2 Nov 67	N/A
Recovery	0008Z/9 Nov 67	2309Z/11 Nov 67
Recovery	Rev 97	Rev 144

C. Orbit Elements

	Planned	Actual Rev 45	Actual Rev 110	Actual Photo Range
Period (min)	*	90.468	90.333	N/A
Perigee (nm)	*	98.863	99.531	92.92
Apogee (nm)	*	222.970	219.940	143.07
Eccentricity	*	0.01722	0.01673	N/A
Inclination Angle (deg)	*	81.534	81.539	N/A
Perigee Latitude	*	18.381°N	33.816°N	N/A

N/A - Not Applicable.
*Not Available.

[redacted]

1. Photographic Operations

1. Panoramic Cameras

Type	Mission 1044-1 Revs	Mission 1044-1 Frames	Mission 1044-2 Revs	Mission 1044-2 Frames	Total Revs	Total Frames
Operational						
Fwd	44	2,837	34	2,899	78	5,736
Aft	44	2,820	34	2,919	78	5,739
Operational/Domestic						
Fwd	0	0	1	52	1	52
Aft	0	0	1	51	1	51
Domestic						
Fwd	4	52	3	56	7	108
Aft	4	51	3	56	7	107
Engineering (no imagery)						
Fwd	1	9	1	4	2	13
Aft	1	9	1	4	2	13
Totals						
Fwd	49	2,898	39	3,011	88	5,909
Aft	49	2,880	39	3,030	88	5,910

2. Secondary Cameras

Camera	Frames
Stellar (Mission 1044-1)	449
Index (Mission 1044-1)	449
Stellar (Mission 1044-2)	464
Index (Mission 1044-2)	464

E. Film Usage

	Film Load (Total)	Pre-Flight Footage	Processed Footage
Fwd-Looking (Mission 1044-1)	*16,000	362	8,049
Aft-Looking (Mission 1044-1)	*16,000	362	8,009
Fwd-Looking (Mission 1044-2)	N/A	N/A	7,951
Aft-Looking (Mission 1044-2)	N/A	N/A	7,963
Stellar (Mission 1044-1)	75	3.8	54
Stellar (Mission 1044-2)	75	6.5	53
Index (Mission 1044-1)	135	13.4	105
Index (Mission 1044-2)	135	7.5	111

*Total load for both buckets.
N/A - Not Applicable.

PART II. IMAGE ANALYSIS

A. Fwd-Looking Panoramic Camera

1. Density: The density of the original negative from the fwd-looking camera is generally medium. The Yardleigh (humpback) processed material has a considerably lower percentage of heavy density than the Trenton processed film.

2. Contrast: The contrast of the imagery generated by the fwd-looking camera is generally medium, with approximately 65 percent of the material falling in this category. The remaining 35 percent is about equally divided between high and low contrast.

3. Acuity: The edge sharpness of the forward material is considered to be good. The acuity is equal to the best of the J-3 missions seen in the last 2 years.

4. Imaged Degradation

a. Light Leaks: Two streaks of fog are present on the fifth frame of a few camera operations (Graphic No 1, page 9). A subtle fog pattern is present near the center of format on the next-to-last frame of a few passes. (Graphic No 2, page 9). The degradation caused by the light leaks is very minor.

b. Static: None noted except the minor static associated with manufacturing splices and film supply depletion.

c. Others: Minor bands of smearing are present near the take-up end of many frames. The smearing is only visible under high magnification and seems to be present when banding is apparent. The cause of the smearing has not been established. The binary format edge near the take-up end of the frame has a ragged appearance throughout most of the mission. Wide minus density streaks occur intermittently throughout the mission.

5. Physical Degradation: Minor rail scratches are present throughout. Fine short emulsion cracks are present along both film edges, outside the format at the beginning of the mission. The cracks gradually diminish in number and disappear at approximately pass 37D.

6. Product Quality: Except for the smearing, the product quality of the fwd-looking camera film is good.

B. Aft-Looking Panoramic Camera

1. Density: Same as reported for the forward camera.

2. Contrast: Same as reported for the forward camera.

3. Acuity: The edge sharpness of the aft material is good and is considered to be slightly better than the forward record.

4. Imaged Degradations

a. Light Leaks: The only fog pattern on the aft film occurs near the binary on the third frame from the end on a few passes (Graphic No 3, page 9).

b. Static: Same as reported for the fwd-looking camera.

c. Other: The same type of smearing as reported on the forward material is present on the aft film. The binary format edge at the take-up end of the frame becomes ragged near the end of the first mission. Faint minus density streaks are present intermittently throughout the mission.

5. Physical Degradations: Minor rail scratches are present throughout. The handling marks and manufacturing defects are considered normal for this type of mission.

6. Product Quality: Except for the minor degradation caused by the smearing, the product quality of the aft-looking camera material is good.

C. Stellar Camera (Mission 1044-1)

1. Density: The density in the flared area is heavier than normal. The flare-associated heavy density caused some stellar images to be obliterated on approximately 50 percent of the frames. When the flare density is low enough so that stellar images are visible, the grid image is partially missing along the edge opposite the camera number.

2. Contrast: Adequate for the detection of stellar images where not degraded by the aforementioned heavy density.

3. Image Shape: The stellar images are generally point type.

4. Images Per Frame: There are 15 to 25 stellar images per frame.

5. Flare Level: Flare affects approximately 60 percent of each frame.

6. Imaged Degradations:

a. Light Leaks: None noted.

b. Static: Several fog patterns, caused by dendritic static, are present approximately 3 feet from the end of the mission.

7. Physical Degradations: The last 18 inches are degraded by minor abrasions and scratches in association with the film cut at the end of the mission.

8. Product Quality: There are enough stellar images visible for the attitude reduction, but the heavy density reduced the selection of images.

D. Stellar Camera (Mission 1044-2)

1. Density: Adequate for the detection of stellar images.

2. Contrast: Adequate for the detection of stellar images.

3. Image Shape: The stellar images are generally point type.

4. Images Per Frame: There are 30 or more stellar images per frame.

5. Flare Level: Flare affects approximately 50 percent of each frame.

6. Image Degradations

a. Light Leaks: None noted.

b. Static: Minor corona static markings appear intermittently throughout the mission.

7. Physical Degradations: None noted.

8. Product Quality: The product quality is good.

E. Index Camera (Mission 1044-1)

1. Density: Medium.

2. Contrast: Generally medium to low.

3. Acuity: The edge sharpness is good.

4. Imaged Degradations

a. Light Leaks: None noted.

b. Static: None noted.

5. Physical Degradations: None noted.

6. Product Quality: Good.

F. Index Camera (Mission 1044-2)

1. Density: Generally medium.

2. Contrast: Mostly medium, with about 30 percent low contrast.

3. Acuity: The edge sharpness is good.

4. Imaged Degradations

a. Light Leaks: None noted.

b. Static: Several traces of dendritic static are recorded on the preflight, postflight, and the last 8 frames of the mission.

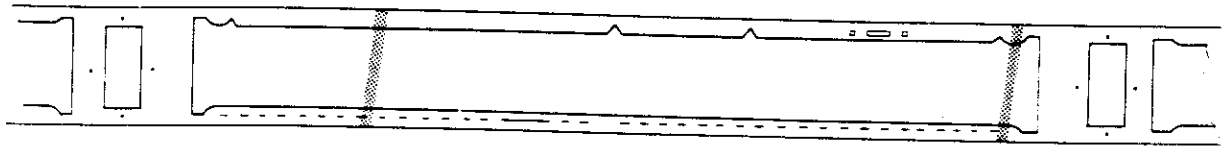
5. Physical Degradations: None noted.

6. Product Quality: Good.

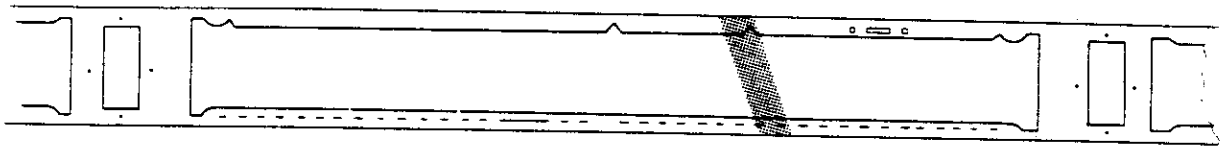
G. Graphic Display (Mission 1044)

The patterns illustrated below are referenced in the text of this report.

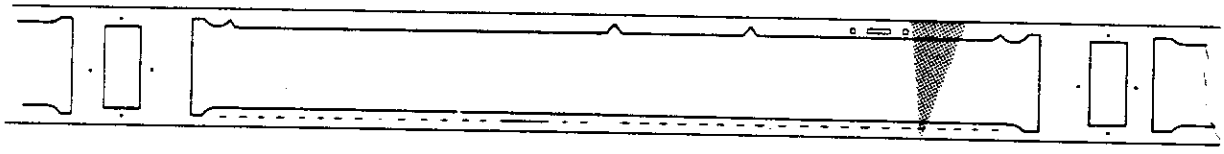
Graphic 1



Graphic 2



Graphic 3



NPIC M-1909

PART III. IMAGED AUXILIARY DATA

A. Fwd-Looking Panoramic Camera

1. Horizon Cameras

a. Starboard-Looking

(1) Imagery: The imagery is good, and the earth's curvature is sharp and well defined.

(2) Fiducials: The fiducial at the time track edge is slightly bloomed, but readable. The other 3 are sharp and well defined.

b. Port-Looking

(1) Imagery: The imagery is good, and the earth's curvature is sharp and well defined.

(2) Fiducials: All 4 fiducials are slightly bloomed but useable.

2. Frequency Marks: Operational throughout the mission.

3. Binary Time Word: All lights of the fwd camera data block produced good quality images throughout most of the mission. Following are the anomalies: The number 28 light functioned intermittently throughout the mission. The number 11 light stayed on for several passes then went off for several passes, and fluctuated in this manner throughout the mission. The binary block is not imaged on pass 85D, frames 134 and 136; pass 117D, frame 20; and pass 125D, frame 9.

4. Binary Index: Good quality and readable.

5. Camera Number: Readable.

6. Pan Geometry Dots: Not applicable.

7. Nodal Traces: Not applicable.

8. Nod Indicators: Not applicable.

B. Aft-Looking Panoramic Camera

1. Horizon Cameras

a. Starboard-Looking

(1) Imagery: A slight veiling condition begins on pass 9D and is present throughout the remainder of the first mission. The veiling begins to clear during the second half of the mission (1044-2) and is completely clear by pass 135D. The earth's curvature is visible through the veiling. However, attitude determination is impaired.

(2) Fiducials: Slightly bloomed but readable.

b. Port-Looking

(1) Imagery: The imagery is good, and the earth's curvature is sharp and well defined.

(2) Fiducials: Slightly bloomed, but useable.

2. Frequency Marks: Operational throughout the mission.

3. Binary Time Word: All the lights of the data block produced good images with the following exceptions: The binary data failed to light on pass 9D, frame 52, and pass 137, frame 35.

4. Binary Index: The binary index image adjacent to the camera number is bloomed, but useable.

5. Camera Number: Bloomed, but legible.

6. Pan Geometry Dots: Not applicable.

7. Nodal Traces: Not applicable.

8. Nod Indicators: Not applicable.

C. Stellar Camera (Mission 1044-1)

1. Grid Image Quality: The grid is sharp and well defined. The grid is not imaged along the edge opposite the camera number on many frames.

2. Correlation Lamp Image Quality: Good.

D. Stellar Camera (Mission 1044-2)

1. Grid Image Quality: Sharp and well defined.

2. Correlation Lamp Image Quality: Good.

E. Index Camera (Mission 1044-1)

1. Grid Image Quality: Sharp and well defined.

2. Correlation Lamp Image Quality: Good.

3. Camera Number Legibility: Readable.

F. Index Camera (Mission 1044-2)

1. Grid Image Quality: Sharp and well defined.

2. Correlation Lamp Image Quality: Good.

3. Camera Number Legibility: Readable.

PART IV. MENSURATION QUALITY

A. Fwd-Looking Panoramic Camera

The mensuration quality of Mission 1044 is considered to be fair to good. There were 16 requests for mensuration during the initial readout of the mission. The requests required 634 pointings taking 48 man hours to complete.

The horizons were considered poor for attitude determination. Therefore, nominal attitude was used in computing distances. Even though a nominal attitude was used, there was a close correlation, with respect to accuracy, to previously measured or known dimensions.

B. Aft-Looking Panoramic Camera

Same as reported for the fwd-looking camera.

PART V. FILM PROCESSING

A. Processing Machines and Process Gamma

Film	Machine	Gamma	Machine	Gamma
	Pass 1D to 63D		Pass 63D to 87D	
Fwd (Mission 1044-1)	Trenton	2.22	Yardleigh (humpback)	1.90
Aft (Mission 1044-1)	Trenton	2.22	Yardleigh (humpback)	2.05
	Pass A88E to 127D		Pass 127D to 140D	
Fwd (Mission 1044-2)	Trenton	2.20	Yardleigh (humpback)	1.88
	Pass A88E to 111D		Pass 111D to 140D	
Aft (Mission 1044-2)	Yardleigh (humpback)	1.94	Trenton	2.25
Stellar (Mission 1044-1)	Trenton	2.27	NA	NA
Stellar (Mission 1044-2)	Trenton	2.28	NA	NA
Index (Mission 1044-1)	Drape	1.09	NA	NA
Index (Mission 1044-2)	Drape	1.13	NA	NA

B. Processing Levels (Trenton Processor)

1. Panoramic Cameras

Film	Primary	Intermediate	Full	Transition	Processing Changes
Fwd (Mission 1044-1)	0%	6%	88%	6%	10
Aft (Mission 1044-1)	2%	12%	71%	15%	26
Fwd (Mission 1044-2)	0%	4%	92%	4%	6
Aft (Mission 1044-2)	5%	17%	63%	15%	26

2. Secondary Cameras

a. Stellar Cameras: The stellar records were processed on the Trenton with no interruption in processing.

b. Index Cameras: The index records were processed on the Drape processor with no interruption in processing.

C. Film Handling Summary

1. Fwd-Looking Camera

a. Capsule De-Filming

(1) Mission 1044-1: No problems encountered.

(2) Mission 1044-2: No problems encountered.

b. Pre-Processing Inspection

(1) Mission 1044-1: No problems encountered. A pre-processing cut was made 5,729 feet from the head of the mission so the last part could be processed on the Yardleigh processing machine using the humpback (dual gamma) process.

(2) Mission 1044-2: No problems encountered. A pre-processing cut was made 5,563 feet from the head of the mission to allow processing the last part with the humpback process.

c. Manufacturing Splices

(1) Mission 1044-1: Pass 52D, frame 23.

(2) Mission 1044-2: Pass 102D, frame 39.

d. Processing Splices

(1) Mission 1044-1: The splice on pass 63D, frame 4, is the result of the pre-processing cut from the humpback process.

(2) Mission 1044-2: The splice between the 2 types of processing of the second mission occurs on frame 15, pass 127D.

e. Manufacturing Defects

(1) Mission 1044-1: Only minor defects noted.

(2) Mission 1044-2: Only minor defects noted.

f. Processing Anomalies

(1) Mission 1044-1: No major problems encountered.

(2) Mission 1044-2: No major problems encountered.

g. Breakdown

(1) Mission 1044-1: No major problems encountered.

(2) Mission 1044-2: No major problems encountered.

2. Aft-Looking Camera

a. Capsule De-Filming

(1) Mission 1044-1: No problems encountered.

(2) Mission 1044-2: No problems encountered.

b. Pre-Processing Inspection

(1) Mission 1044-1: No problems encountered. The cut for the humpback processing was made 5,702 feet from the head of the mission.

(2) Mission 1044-2: No problems encountered. The cut for the humpback processing was made 2,707 feet from the head of the mission.

c. Manufacturing Splices

(1) Mission 1044-1: Pass 53D, frame 37.

(2) Mission 1044-2: Pass 103D, frame 27.

d. Processing Splices

(1) Mission 1044-1: The splice for the cut between the 2 types of processing is on frame 3, pass 63.

(2) Mission 1044-2: The splice for the cut between the 2 types of processing is on frame 3, pass 111D.

e. Manufacturing Defects

(1) Mission 1044-1: Only minor defects noted.

(2) Mission 1044-2: Only minor defects noted.

f. Processing Anomalies:

(1) Mission 1044-1: No major problems encountered.

(2) Mission 1044-2: No major problems encountered.

g. Breakdown

(1) Mission 1044-1: No major problems.

(2) Mission 1044-2: No major problems.

3. Index Camera

a. Capsule De-Filming

(1) Mission 1044-1: No problems encountered.

(2) Mission 1044-2: No problems encountered.

b. Pre-Processing Inspection

(1) Mission 1044-1: No problems.

(2) Mission 1044-2: No problems.

c. Manufacturing Splices

(1) Mission 1044-1: None.

(2) Mission 1044-2: None.

d. Processing Splices

(1) Mission 1044-1: None.

(2) Mission 1044-2: None.

e. Manufacturing Defects

(1) Mission 1044-1: None noted.

(2) Mission 1044-2: None noted.

f. Processing Anomalies: None.

g. Breakdown: No major problems.

4. Stellar Cameras

a. Capsule De-Filming

(1) Mission 1044-1: No problems encountered.

(2) Mission 1044-2: No problems encountered.

b. Pre-Processing Inspection

(1) Mission 1044-1: No problems encountered.

(2) Mission 1044-2: No problems encountered.

c. Manufacturing Splices

(1) Mission 1044-1: None.

(2) Mission 1044-2: None.

d. Processing Splices

(1) Mission 1044-1: None.

(2) Mission 1044-2: None.

e. Manufacturing Defects

(1) Mission 1044-1: None noted.

(2) Mission 1044-2: None noted.

f. Processing Anomalies: None.

g. Breakdown: No major problems.

D. <u>Timetable</u>

Film	Recovered	Received at Processing Site	Spec Ship at NPIC Recd	Priority 1A at NPIC Recd
Fwd (Mission 1044-1)	0008Z/9 Nov 67	1300 EST/9 Nov 67	None	1638 EST/12 Nov 67
Aft (Mission 1044-1)	"	"	"	"
Stellar (Mission 1044-1)	"	"	"	"
Index (Mission 1044-1)	"	"	"	"
Fwd (Mission 1044-2)	2309Z/11 Nov 67	1020 EST/12 Nov 67	"	1933 EST/15 Nov 67
Aft (Mission 1044-2)	"	"	"	"
Stellar (Mission 1044-2)	"	"	"	"
Index (Mission 1044-2)	"	"	"	"

PART VI. PI SUITABILITY

A. Definition of Photographic Interpretation (PI) Suitability

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

PI suitability ratings are categorized as Excellent, Good, Fair, Poor, and 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 good quality of the photography.

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

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

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

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

B. PI Statistics

1. Target Coverage

	Mission 1044-1	Mission 1044-2	Totals
Priority I Targets Programmed -	No specific priority I targets were programmed for this mission, although specific priority areas were selected for the initial readout.		
Priority I Targets Covered -	144	211	355

2. PI Quality Appraisal

Rating	Missiles	Nuclear Energy	Air Facilities	Ports	Elect Commo	Military Activity	Complex
Good	19	2	11	9	1	30	12
Fair	92	3	42	10	1	30	21
Poor	66	0	20	3	0	14	6
Totals	177	5	73	22	2	74	39

3. Summary of PI Quality Ratings (Percentage)

Good	84 or 21.4%
Fair	199 or 50.8%
Poor	109 or 27.8%

4. After the initial readout, an additional 1,545 targets were reported on in supplement reports.

C. PI Comments

1. Atmospheric Attenuation: Following is an analysis of the atmospheric conditions affecting the priority targets as reported by the photo interpreters during the initial scan of the mission.

Weather	Number of Targets
a. Clear	239 or 61%
b. Scattered Clouds	56 or 14%
c. Heavy Clouds	29 or 7.5%
d. Haze	39 or 10%
e. Cloud Shadow	29 or 7.5%

2. Terrain Conditions: The terrain conditions were considered good for the interpretation of mission material. There is a slight increase in the amount of snow covered terrain on this mission compared to the last few missions.

3. Product Interpretability: The interpretability of the mission material is considered to be generally good where not degraded by atmospheric attenuation. There is a predominance of cloud cover over the highest priority targets. As indicated by the above statistics, many of the targets were obscured.

An MIP of 85 was assigned to both parts of the mission.

[redacted] Reconnaissance Report Analysis

RESOLUTION TARGET DATA

	A		B	
Camera Designation	Fwd	Aft	Fwd	Aft
Camera (Looking)	[illegible]	[illegible]	126D	126D
Lens	[illegible]	[illegible]	28	28
Frame	[illegible]	5	[illegible]	
Date of Photography	7 Nov 67	7 Nov 67	10 Nov 67	10 Nov 67
Universal Grid Coordinates	41.0 - 14.7	41.6 - 12.7	46.7 - 9.3	43.8 - 11.8
Geographic Coordinates of Frame Center	34-45N 117-50W	34-41N 117-51W	33-11N 106-22W	33-06N 106-24W
Altitude (ft)	616,574	614,768	605,826	605,288
Camera Tilt (deg)	ND	ND	ND	ND
Roll (deg)	ND	ND	ND	ND
Yaw (deg)	ND	ND	ND	ND
Local Sun Time	1305	1305	1233	1233
Solar Elevation (deg)	36°27'	36°30'	38°31'	38°36'
Solar Azimuth (deg)	198°	198°	189°	189°
Exposure (sec)	1/288	1/369	1/298	1/382
Processing Level	Humpback	Humpback	Full	Full
Vehicle Azimuth (deg)	172°29'	172°38'	172°44'	172°52'
Filter (Wratten)	23A	21	23A	21
Target Type	Fixed	Fixed	Fixed	Fixed
Target Contrast	10:1	10:1	10:1	10:1
Weather Conditions	Clear	Clear	Clear	Clear

ND - Not determined.

GROUND RESOLUTION IN FEET AS DETERMINED FROM THE ORIGINAL NEGATIVE

	A				B				
	Along Track		Across Track			Along Track		Across Track	
	Fwd	Aft	Fwd	Aft		Fwd	Aft	Fwd	Aft
Observer 1	12'6"	9'1"	11'1"	11'6"	Observer 1	*	11'2"	10'	8'
Observer 2	12'6"	[illegible]	11'1"	11'6"	Observer 2	*	11'2"	10'	8'
Observer 3	10'6"	[illegible]	11'1"	12'6"	Observer 3	*	11'2"	10'	8'10"

*Across Track Not Available

PART VII. MISSION DATA

	Fwd Looking Pan	Fwd Take-up Horizon	Fwd Supply Horizon	Aft Looking Pan	Aft Take-up Horizon	Aft Supply Horizon	Mission 1044-1 Stellar	Mission 1044-1 Index	Mission 1044-2 Stellar	Mission 1044-2 Index
Camera Number	202	*	*	203	*	*	D99	D99	D104	D104
Reseau Number	NA	NA	NA	NA	NA	NA	120	122	131	132
Lens Serial Number	2042435	12889	12896	2162435	12883	12903	11392	820200	11318	821942
Slit Width	.225	NA	NA	.175	NA	NA	NA	NA	NA	NA
Aperture	F/3.5	F/8.0	F/6.3	F/3.5	F/6.3	F/8.0	F/1.8	F/4.5	F/1.8	F/4.5
Exposure Time (sec)	1/287 avg	1/100	1/100	1/372 avg	1/100	1/100	1.0	1/500	1.0	1/500
Filter (Wratten)	23A	25	25	21	25	25	None	21	None	21
Focal Length (mm)	609.599	55.00	54.90	609.599	55.00	54.80	85 nom	38.44	85 nom	38.43
Film Length (ft)	16,000	NA	NA	16,000	NA	NA	75	135	75	135
Splices	2	NA	NA	2	NA	NA	None	None	None	None
Emulsion	289-4-9-7	289-4-9-7	289-4-9-7	289-4-9-7	289-4-9-7	289-4-9-7	231-9-9-7	139-1-1-7	231-9-9-7	139-1-1-7
Film Type	3404	3404	3404	3404	3404	3404	3401	3400	3401	3400
Resolution Data (L/mm)										
Static										
High Contrast	235	208	209	253	187	209	*	72 (AWAR)	*	75 (AWAR)
Low Contrast	148	*	*	138	*	*	*	*	*	*
Dynamic										
I High Contrast	197	*	*	194	*	*	*	*	*	*
I Low Contrast	120	*	*	126	*	*	*	*	*	*
P High Contrast	175	*	*	176	*	*	*	*	*	*
P Low Contrast	115	*	*	112	*	*	*	*	*	*

NA - Not Applicable.
* - Not Available.

FIGURE 1. BEST IMAGE QUALITY

Image quality comparable to the best of this mission.

FIGURE 2. CORRESPONDING COVERAGE

Corresponding coverage as imaged by the fwd camera.

NPIC L-4813 NPIC L-4814

[redacted]

	FIGURE 1	FIGURE 2
Camera	203	202
Pass	100D	100D
Frame	61	61
Date of Photography (GMT)	9 Nov 67	9 Nov 67
Universal Grid Coordinates	47.1 - 10.7	43.2 - 12.7
Enlargement Factor	20X	20X
Geographic Coordinates	41-19N 123-34E	42-15N 123-22E
Altitude (ft)	621,034	623,033
Camera Attitude:		
Pitch (deg)	ND	ND
Roll (deg)	ND	ND
Yaw (deg)	ND	ND
Local Sun Time	1246	1246
Solar Elevation (deg)	30°16'	30°15'
Solar Azimuth (deg)	191°	191°
Exposure (sec)	1/296	1/381
Vehicle Azimuth (deg)	171°20'	171°8'
Processing Level	Humpback	Full

[redacted]

[redacted]

[redacted]

FIGURE 3. STELLAR FORMAT AND TYPICAL FLARE PATTERN OF MISSION 1044-1

FIGURE 4. STELLAR FORMAT AND TYPICAL FLARE PATTERN OF MISSION 1044-2

The circles on the photographs indicate the stellar images used for determining the vehicle attitude. The numbers are arbitrarily assigned to the stars for reference to the Albany General (Boss) Catalogue of Stars.

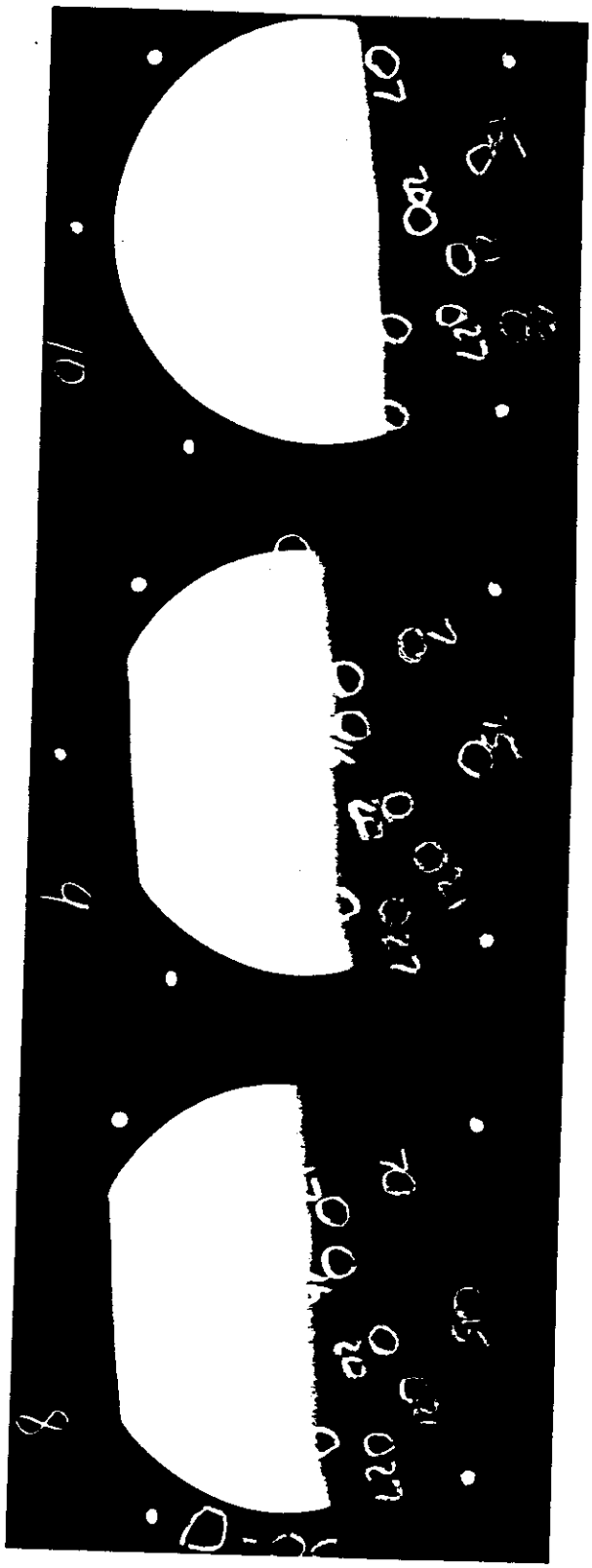
NPIC L-4815 NPIC L-4816

[redacted]

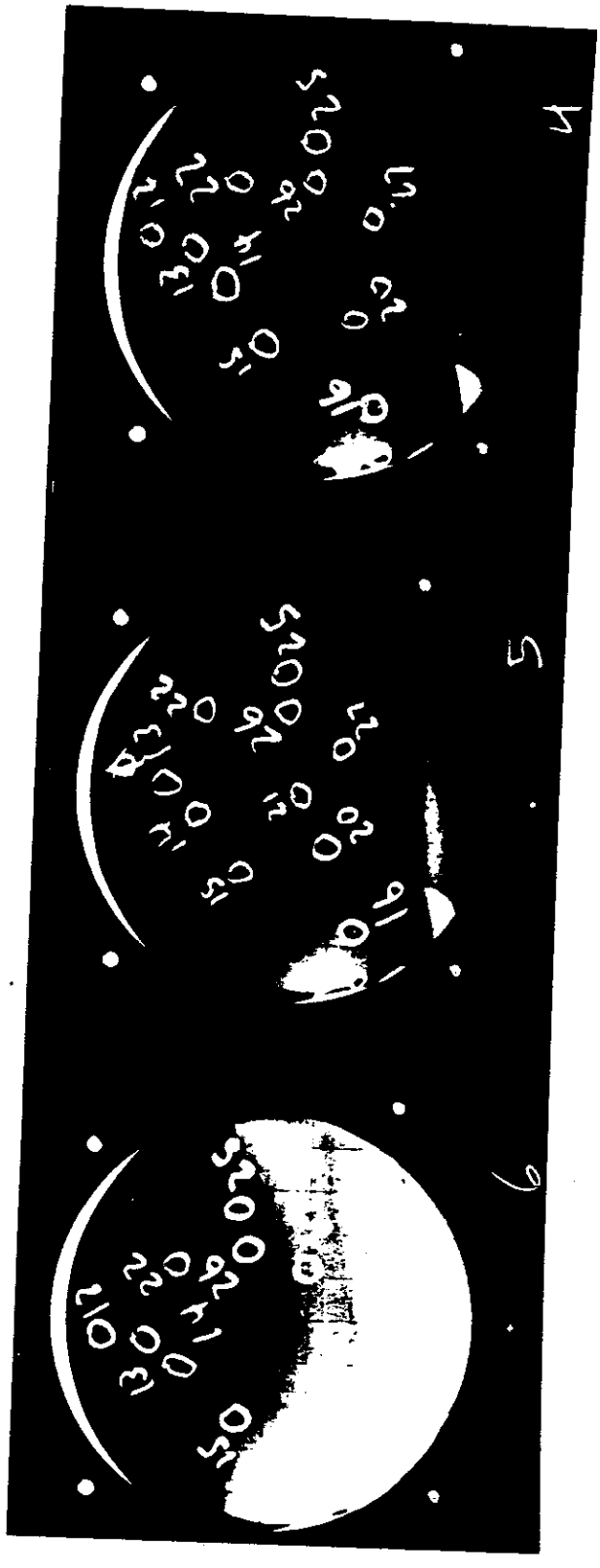
	FIGURE 3	FIGURE 4
Stellar Frames	8, 9, 10	4, 5, 6
Correlates with:		
Main Camera Number	202	202
Pass	5D	88D
Frames	5, 12, 19	26, 33, 38
Date of Photography	3 Nov 67	8 Nov 67
Enlargement Factor	2.5X	2.5X
Exposure Time (sec)	1.0	1.0

[redacted]

[redacted]



[redacted]



Special Study: Dual Gamma/Viscose Vs Conventional/Spray Processing Analysis (Mission 1044)

I. Introduction

An experimental dual gamma chemistry* was used to process 4 lengths of original film from the panoramic cameras of Mission 1044. Each of the 4 experimental lengths measured over 2,300 feet. The remaining panoramic camera film was processed by the conventional interrupted, spray process technique (Trenton processing machine). A profile of the mission and the method of processing is illustrated in Figure 1. The standard characteristic curves of type 3404 film processed in the dual gamma chemistry and the interrupted Trenton process are shown in Figures 2 and 3. These curves were obtained from the processing contractor's evaluation report of Mission 1044 and are presented here for comparison purposes.

*The dual gamma chemistry is a developer applied in viscose form. In effect, the characteristic curve of type 3404 film processed in the dual gamma chemistry contains 2 nearly straight line portions.

II. Background

At the Performance Evaluation Team (PET) meeting for Mission 1044, the characteristics of the dual gamma chemistry were discussed and the film was viewed. The general opinion was that the dual gamma processed film provided better overall information content than the interrupted/Trenton processed film. The PET recommended, subject to a subjective evaluation by the National Photographic Interpretation Center (NPIC), that the processing site have the capability, as soon as practical, to process full camera payloads in the dual gamma chemistry. Thus, the following analysis was conducted at NPIC. Conclusions based on the study are included at the end of this report.

III. Analysis Technique

A. Sixteen targets were selected for the analysis. Stereo photography of these targets was provided by the fwd and aft cameras. In addition, some of the targets were photographed on different days of the mission. The original negatives of these targets contained relatively similar contrast and density characteristics as determined by subjective analysis. The 16 selected targets (32 film positives) were chipped for comparison. The targets chosen represent the various exposure conditions encountered during the mission plus the combinations of processing techniques.

B. The film chips were referenced and a comparison chart was made to determine which film chips were preferred for intelligence content in the highlight areas, in the shadow areas, and for overall preference. The analysis was administered to 7 photo science personnel and 8 photo interpreters. The selections by these 15 analysts were summarized as follows (see Figure 3 for a graphical illustration):

(1) HIGHLIGHT AREA

PROCESS	CAMERA	PREFERENCE (Percentage)
Dual Gamma Vs Trenton	fwd	68.3
	aft	31.7
Dual Gamma Vs Trenton	aft	42.5
	fwd	57.5

(2) SHADOW AREA

PROCESS	CAMERA	PREFERENCE (Percentage)
Dual Gamma Vs Trenton	fwd	63.2
	aft	36.8
Dual Gamma Vs Trenton	aft	58.4
	fwd	41.6

(3) OVERALL

PROCESS	CAMERA	PREFERENCE (Percentage)
Dual Gamma Vs Trenton	fwd	67.5
	aft	32.5
Dual Gamma Vs Trenton	aft	51.8
	fwd	48.2

IV. Conclusions

The differences in intelligence content is subtle in all areas considered. However, 2 developments did emerge from this analysis. They are: (1) The material from the fwd camera is preferred in the majority of instances. (2) The dual gamma product is preferred in the majority of instances when only processing is considered. Contrary to what may have been expected, the most significant degree of preference for the dual gamma product exists in the shadow areas and less noticeable improvement is detected in the highlight areas. In general, the selections, based on overall intelligence content, indicate that the dual gamma product is preferred over the product from the interrupted/Trenton process.