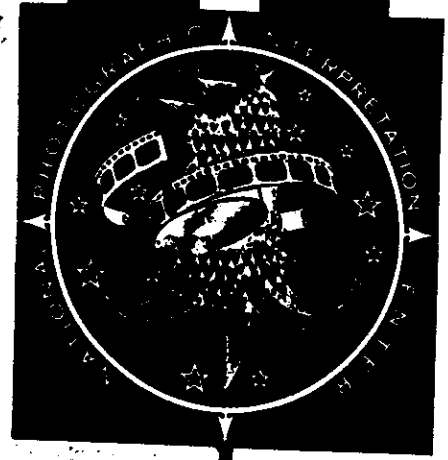
TECHNICAL PUBLICATION




# PHOTOGRAPHIC EVALUATION REPORT

# MISSION 1039

[redacted]

MAY 1967

COPY [redacted]

35 PAGES

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TECHNICAL PUBLICATION

# PHOTOGRAPHIC EVALUATION REPORT

# MISSION 1039

This Photographic Evaluation Report reflects a format revision designed to [illegible], increase information content, and provide reports to the [illegible] on a more timely basis.

While the new PER format does not include a depth analysis of all [illegible] collection, provision has been made to include special studies that dwell upon conditions requiring detailed analysis. These reports will appear, if and when warranted, as attachments to basic PER's. Time permitting, attachments will be issued to the mission PER in which the anomaly occurs; otherwise they will be published with a subsequent PER. Each special study will be identified on the cover of the PER to which it is attached. In addition, an index of the PER's and the associated special studies will appear in each report.

MAY 1967

NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

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## 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 | The distance between 2 exposure stations. (Points in space occupied by the camera lens at the moment of exposure.) |
| 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. |
| 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 text 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 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 the 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 coincident 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. |
| SIDE IMAGE 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 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 |
|---|---|---|
| 1037 | [redacted] | None |
| 1038 | | None |
| 1039 | | None |

## SYNOPSIS

Mission 1039 was launched on 22 February 1967/2202Z. The first capsule was recovered dry on 28 February 1967/0015Z. The air catch of the second recovery capsule, on 5 March 1967/2351Z, ended the 12-day mission which accomplished 110 photographic passes. Although there was a high percentage of cloud cover throughout the mission, the image quality is good and an NIF rating of 85 was assigned. The imagery from the aft-looking camera is of better image quality than that of the forward-looking camera.

The starboard-looking horizon formats of both panoramic cameras are veiled throughout Mission 1039-1 with a gradual clearing near the end. On Mission 1039-2, no veiling is present in either horizon format.

The index camera was operational throughout the mission and there are no major anomalies.

Fifty percent of each stellar format on Mission 1039-1 is effected by flare. Flare covers approximately 20 percent of each format on Mission 1039-2. Stellar images are numerous and of good quality on the photography of both missions.

## PART I. GENERAL SYSTEM INFORMATION

### A. Camera Numbers

| | |
|---|---|
| Forward-Looking Panoramic Camera | 206 |
| Aft-Looking Panoramic Camera | 207 |
| Stellar/Index Camera (Mission 1039-1) | D103/131/132 |
| Stellar/Index Camera (Mission 1039-2) | D100/125/125 |

### B. Launch and Recovery Dates

| | (Mission 1039-1) | (Mission 1039-2) |
|---|---|---|
| Launch | 22 Feb 67/2202Z | - - - - - - - |
| Recovery | 28 Feb 67/0015Z | 5 Mar 67/2351Z |

### C. Orbit Elements

| Element | Planned | (Actual) Rev 42 | (Actual) Rev 122 | Photo Range | |
|---|---|---|---|---|---|
| Period (min.) | N/A | 90.069 | 89.857 | N/A | |
| Perigee (nm) | N/A | 97.027 | 98.285 | 98.202 | Rev 6 |
| Apogee (nm) | N/A | 207.330 | 201.660 | 193.317 | Rev 7 |
| Eccentricity | N/A | .01535 | .01441 | N/A | N/A |
| Inclination (deg) | N/A | 80.021 | 80.020 | N/A | N/A |
| Perigee Latitude | N/A | 30.231 | 47.979 | N/A | N/A |

* Not Available.
N/A - Not Applicable.

### D. Photographic Operations

1. Panoramic Cameras

| Type of Pass | Mission 1039-1 Revs | Mission 1039-1 Frames | Mission 1039-2 Revs | Mission 1039-2 Frames | Total Revs | Total Frames |
|---|---|---|---|---|---|---|
| Operational | | | | | | |
| Fwd | 46 | 2,686 | 42 | 2,791 | 88 | 5,477 |
| Aft | 46 | 2,666 | 42 | 2,813 | 88 | 5,479 |
| Operational/Domestic | | | | | | |
| Fwd | 3 | 121 | -- | -- | 3 | 121 |
| Aft | 3 | 120 | -- | -- | 3 | 120 |

| | Mission 1039-1 Revs | Mission 1039-1 Frames | Mission 1039-2 Revs | Mission 1039-2 Frames | Total Revs | Total Frames |
|---|---|---|---|---|---|---|
| Domestic | | | | | | |
| Fwd | 3 | 77 | 9 | 195 | 12 | 272 |
| Aft | 3 | 77 | 9 | 195 | 12 | 272 |
| Engineering (no imagery) | | | | | | |
| Fwd | 1 | 31 | 3 | 25 | 7 | 56 |
| Aft | 1 | 31 | 3 | 25 | 7 | 56 |
| Totals | | | | | | |
| Fwd | 56 | 2,916 | 54 | 3,011 | 110 | 5,927 |
| Aft | 56 | 2,901 | 54 | 3,033 | 110 | 5,934 |

2. Secondary Cameras

| Camera | Frames |
|---|---|
| Stellar (Mission 1039-1) | 457 |
| Index (Mission 1039-1) | 457 |
| Stellar (Mission 1039-2) | 472 |
| Index (Mission 1039-2) | 472 |

E. Film Usage

| | Film Load (TOTAL) | Pre-Flight Footage | Processed Footage |
|---|---|---|---|
| Fwd-Looking (Mission 1039-1) | 16,000* | 317.4 | 8,027 |
| Aft-Looking (Mission 1039-1) | 16,000* | 29.9 | 7,966 |
| Fwd-Looking (Mission 1039-2) | NA | NA | 7,967 |
| Aft-Looking (Mission 1039-2) | NA | NA | 8,032 |
| Stellar (Mission 1039-1) | 75 | 1.68 | 61 |
| Stellar (Mission 1039-2) | 75 | ** | 57 |
| Index (Mission 1039-1) | 135 | 3.37 | 112 |
| Index (Mission 1039-2) | 135 | ** | 113 |

*Total load for both.
NA - Not Applicable.
**Not Available.

## PART II. IMAGE ANALYSIS

A. Fwd-Looking Panoramic Camera

1. Density: The density of the original negative of Mission 1039-2 is generally medium with approximately 30 percent of the record considered to be heavy. However, the original negative of Mission 1039-1 was judged to be approximately 50 percent heavy. This is attributed to the fact that a considerable amount of snow-covered terrain was photographed on the first half of the mission.

2. Contrast: The contrast is generally medium throughout the mission with the imagery of Mission 1039-1 being of slightly lower contrast. In some snow-covered areas, the lack of contrast caused considerable loss of edge definition. However, the contrast is generally adequate to provide good image detail.

3. Acuity: The edge sharpness of the forward material is superior to that of the two most previous missions. Although a Wratten 23A filter was used and the atmospheric conditions were bad, no loss of acuity is noticeable.

4. Image Degradations

a. Light Leaks: The fog patterns caused by the light leaks are similar to those noted in previous missions. Fog is present on the fifth frame (Graphic No 1, page 9 ) and the second to the last frame (Graphic No 2, page 8 ) of most camera operations. The density varies with the duration of camera inactivity.

b. Static: None noted except that associated with manufacturing splices and film supply depletion.

5. Physical Degradations: Rail scratches are continuous along both film edges throughout the mission. A slight base rub is apparent throughout the forward camera record. It appears as a very subtle minus density line parallel to the major axis of the film approximately 0.75 inch from the camera number edge. The Performance Evaluation Team (PET) agreed that it was caused by the supply cassette constant tension assembly at the final mechanical aperture.

The last 3.[illegible] feet of the master camera material from Mission 1039-2 were removed during presplice because of excessive film damage. The damaged film was hand processed and returned to the mission film flow.

Scratches within the format caused by the scan head rollers are less severe than normal.

6. Product Quality: The overall quality of the forward-looking panoramic photography is good. None of the above-mentioned anomalies caused serious degradation to the image quality. Although visible atmospheric conditions were more severe than on most previous missions, the imagery is comparable to some of the better missions in this system.

B. Aft-Looking Panoramic Camera

1. Density: As reported for the forward camera.

2. Contrast: As reported for the forward camera.

3. Acuity: The edges of cultural imagery are very sharp and are slightly superior to those of the forward camera record.

4. Image Degradations

a. Light Leaks: Fog patterns appear on the third from last frame (graphic No 3, frame [illegible]) and second from last frame (graphic no 4, frame [illegible]) of some camera operations. These patterns are similar to those found in previous missions and their density varies with the duration of camera off periods.

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

5. Physical Degradation: The format edge image on the camera number side becomes ragged approximately mid-way through Mission 1039-1. The condition becomes progressively worse throughout the mission and edge image is very ragged throughout Mission 1039-2. The anomaly is obviously a result of emulsion buildup associated with rail scratches. Although polished rails were used in this mission, the format edges on the aft materials are more ragged than on recent missions.

6. Product Quality: None of the anomalies of Mission 1039 caused any serious degradation of imagery. The imagery is slightly better than that of the forward material and it is better than that of most recent missions.

C. Stellar Camera (Mission 1039-1)

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

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

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

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

5. **Flare Level:** Approximately 50 percent of each frame is affected by flare.

6. **Image Degradations**

a. **Light Leaks:** None noted.

b. **Static:** Small static-induced fog patterns, approximately 1.5 inches apart, are present on the first 29 frames. Other static-induced fog is present intermittently throughout the mission on the edge opposite the correlation lamp.

c. Physical Degradations: None noted.

d. Product Quality: The high flare level caused difficulties in detecting the images. However, after the images were detected, no problems were encountered during the data reduction phase.

e. Stellar Camera (Mission 1039-2)

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: Fifteen to 20 stellar images are detectable on each frame.

5. Flare Level: Approximately 20 percent of each format is affected by flare.

6. Image Degradation

a. Light Leaks: None noted.

b. Static: None noted.

c. Physical Degradations: None noted.

d. Product Quality: Good. The aforementioned anomalies had little or no effect on the image quality.

f. Index Camera (Mission 1039-2)

1. Density: Adequate.

2. Contrast: Medium to low.

3. Acuity: The sharpness of the edges is as good as can be expected from this camera system.

4. Imaged Degradations

a. Light Leaks: None noted.

b. Static: None.

5. Physical Degradations: None.

6. Product Quality: The film and image quality are good.

F. Index Camera (Mission 1039-2)

1. Density: Medium.

2. Contrast: Medium.

3. Acuity: As reported for Mission 1039-1.

4. Image Degradations

a. Light Leaks: None.

b. Static: None.

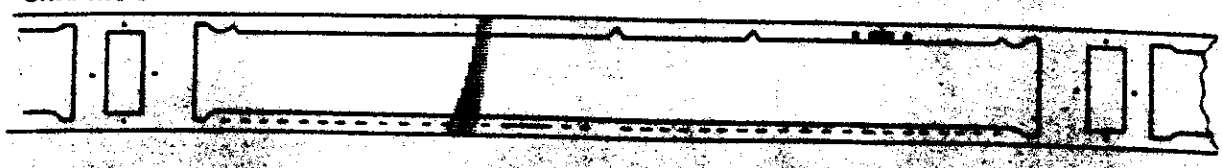
5. Physical Degradations: None.

6. Product Quality: Similar to that of the index camera on Mission 1039-1.

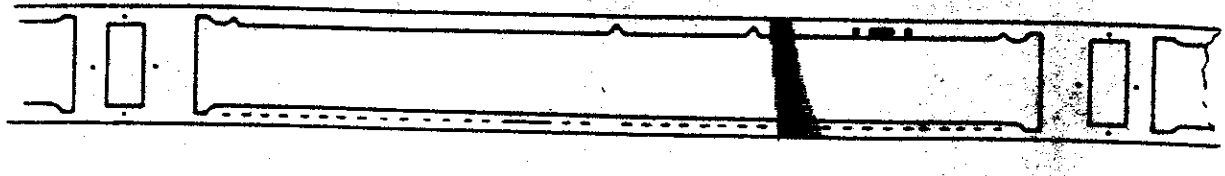
G. Graphic Display

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

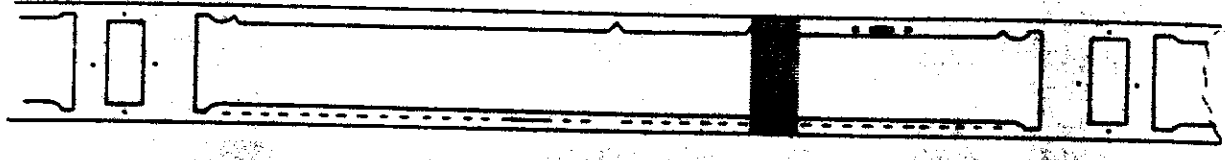
GRAPHIC 1



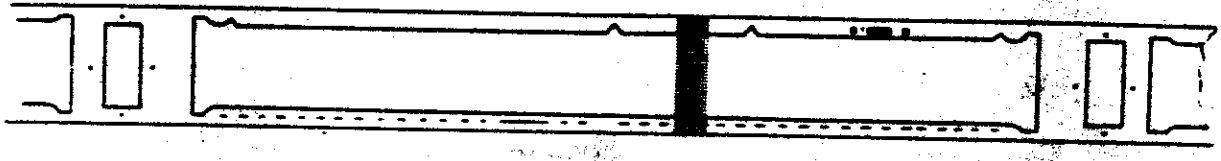
GRAPHIC 2



GRAPHIC 3



GRAPHIC 4



## PART III. IMAGED AUXILIARY DATA

### A. Fwd-Looking Panoramic Camera

1. Horizon Cameras

a. Starboard-looking

(1) Imagery: Veiling of the horizon camera begins on rev 5 and continues throughout the photography recovered in the first capsule. No veiling is noted on Mission 1039-2.

(2) Fiducials: Well defined throughout the missions.

b. Port-looking

(1) Imagery: Good. No veiling noted.

(2) Fiducials: Well defined throughout.

2. Frequency Marks: Well defined throughout the mission.

3. Binary Time Word: The image of lamp No 12 is weak and sometimes not detectable. The lamp image was occasionally bright enough for the binary reader to detect. However, it was generally too weak and the time words had to be read manually.

4. Binary Index: The binary index is bloomed but useable.

5. Camera Number: The first digit is missing throughout the mission. On all 200 series J-1 instruments, the serial number lamp fails to provide enough illumination for the larger 200 series mask. This causes a partial loss of the camera number in the vicinity of digit No 2.

6. Fan-Geometry Dots: N/A.

7. Nodal Traces: N/A.

8. Nodal Indicators: N/A.

### B. Aft-looking Panoramic Camera

1. Horizon Cameras

a. Starboard-looking

(1) Imagery: As reported for the forward camera.

(2) Fiducials: Well defined throughout.

b. Port-looking

(1) Imagery: Good with no veiling noted.

(2) Fiducials: Well defined throughout.

2. Frequency Marks: The 200 PPS timing pulses are missing on the first 2 - 5 inches of the first frame of a few passes on the slave camera. As a result of a study by the camera manufacturer, extensive electrical changes will be incorporated in flight systems J-49 and J-50.

3. Binary Time Word: Same as reported for the forward.

4. Binary Index: The index is bloomed but useable.

5. Camera Number: Same as reported for the forward.

6. Tab-Geometry Dots: N/A.

7. Nodal Traces: N/A.

8. Nod Indicators: N/A.

C. Stellar Camera (Mission 1039-1)

1. Grid Image Quality: Sharp and well defined.

2. Correlation Lamp Image Quality: Sharp and well defined.

D. Stellar Camera (Mission 1039-2)

1. Grid Image Quality: Sharp and well defined.

2. Correlation Lamp Image Quality: Sharp and well defined.

E. Index Camera (Mission 1039-1)

1. Grid Image Quality: Sharp and well defined.

2. Correlation Lamp Image Quality: Sharp and well defined.

3. Camera Number Legibility: Sharp and well defined.

F. Index Camera (Mission 1039-2)

1. Grid Image Quality: Sharp and well defined.

2. Correlation Lamp Image Quality: Sharp and well defined.

3. Camera Number Legibility: Sharp and well defined.

K/A - Not Applicable.

## PART IV. MENSURATION QUALITY

### A. Fwd-Looking Panoramic Camera

The mensuration quality of Mission 1039 is superior to that of the most recent missions in this system. The problems encountered in reading the binary time word caused a delay in production, but no apparent intelligence value was lost because of the delay.

### B. Aft-Looking Panoramic Camera

The mensuration quality of the aft is slightly better than that of the forward. A similar delay in production occurred as was noted in the forward material.