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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT

MISSION 1046

SPECIAL STUDY: COMPARISON OF SO-230 & 3404 FILM TYPES FROM MISSION 1102-2

[redacted]

AUGUST 1968

COPY [redacted]

42 PAGES

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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT

MISSION 1046

AUGUST 1968

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	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 altitude 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.

[redacted]

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) = $\frac{\text{Slit Width (in)}}{\text{Scan Rate (rads per sec)}}$
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.

[redacted]

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 preset 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 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."

[redacted]

INDEX OF PHOTOGRAPHIC EVALUATION REPORTS AND SPECIAL STUDIES

PER	[redacted]	SPECIAL STUDY
1033		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-4A Camera System
1042		None
1043		Scan Speed Deviation Analysis of the Forward Camera, Mission 1043
1101		Slant Range Computations Related to Universal Grid Coordinates for the KH-4B Camera System
1044		Dual Gama/Viscose Vs Conventional/Spray Processing Analysis (Mission 1044)
1102		None
1046		SO230 Vs 3404 Evaluation

SYNOPSIS

Mission 1046, a two-part satellite reconnaissance mission, was launched on 14 March 1968 at 2200Z. Both buckets were recovered dry, the first on 22 March 1968/0048Z and the second on 30 March 1968/0001Z.

Both main cameras operated satisfactorily throughout the mission. However, an abnormal emulsion build-up occurred on the forward camera scan head rollers, causing an out-of-focus area to develop. This area becomes a degrading factor to image quality on the second part of the mission.

The overall image quality is considered to be good on Mission 1046-1 and fair on Mission 1046-2. The aft camera imagery is considered to be of better quality than that obtained by the forward camera. An MIP of 90 was assigned to part one and an 85 to part two.

Film type SO-230 was used in both main cameras throughout the mission. This film type is approximately half again as fast as type 3404. To compensate for this additional emulsion speed, the exposure on both main cameras was decreased by approximately two-thirds of a stop.

All auxiliary cameras functioned properly throughout the mission.

PART I. GENERAL SYSTEM INFORMATION

A. Camera Numbers

Forward-Looking Panoramic Camera 220
Aft-Looking Panoramic Camera 221
Stellar/Index Camera (Mission 1046-1) D119/151/157
Stellar/Index Camera (Mission 1046-2) D120/153/158

B. Launch and Recovery Dates

	(Mission 1046-1)	(Mission 1046-2)
Launch	2200Z/14 Mar 68	*
Recovery	0048Z/22 Mar 68	0001Z/30 Mar 68

C. Orbit Elements

Element	Planned	Actual 1046-1	Actual 1046-2	Photo Range
Period (min)	NA	90.343	90.261	
Perigee (nm)	NA	100.443	102.157	95.99, rev 6
Apogee (nm)	NA	218.800	222.230	195.24, rev 9
Eccentricity	NA	0.01644	0.01669	
Inclination (deg)	NA	83.004	83.004	
Perigee Latitude	NA	29.970N	58.949N	

NA-Not Available.
*Not Applicable.

D. Photographic Operations

1. Panoramic Cameras

Type	Mission Revs	1046-1 Frames	Mission Revs	1046-2 Frames	Total Revs	Total Frames
Operational						
Fwd	48	2,774	56	2,742	104	5,516
Aft	48	2,776	56	2,738	104	5,514
Operational/Domestic						
Fwd	0	0	0	0	0	0
Aft	0	0	0	0	0	0
Domestic						
Fwd	8	204	10	236	18	440
Aft	8	204	10	239	18	443
Engineering (no imagery)						
Fwd	1	10	4	51	5	61
Aft	1	10	3	33	4	43
Totals						
Fwd	57	2,988	70	3,029	127	6,017
Aft	57	2,990	69	3,010	126	6,000

2. Secondary Cameras

Camera	Frames
Stellar (Mission 1046-1)	461
Index (Mission 1046-1)	461
Stellar (Mission 1046-2)	479
Index (Mission 1046-2)	479

[redacted]

E. Film Usage

	Film Load (Total, ft)	Pre-Flight Footage	Processed Footage
Fwd-Looking (Mission 1046-1)	16,300*	235	8,135
Aft-Looking (Mission 1046-1)	16,300*	238	8,133
Fwd-Looking (Mission 1046-2)	NA	NA	8,015
Aft-Looking (Mission 1046-2)	NA	NA	7,965
Stellar (Mission 1046-1)	75	11	55
Stellar (Mission 1046-2)	75	12	53
Index (Mission 1046-1)	130	14	108
Index (Mission 1046-2)	130	12	113

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

PART II. IMAGE ANALYSIS

A. Fwd-Looking Panoramic Camera

1. Density: The density of the forward camera film is considered to be heavier than that on previous missions of this type. A comparison of processing levels with three previous missions shows that Mission 1046 received a substantially higher percentage of primary development. The following table presents the percentage of frames receiving primary development.

TABLE I

Percent of Primary Development Received

	Fwd (Percent)	Aft (Percent)	Date
Mission 1039-1	7	5	22 Feb- 5 Mar 67
Mission 1039-2	18	19	22 Feb- 5 Mar 67
Mission 1044-1	0	2	2 Nov-11 Nov 67
Mission 1044-2	0	5	2 Nov-11 Nov 67
Mission 1045-1	3	3	24 Jan- 7 Feb 68
Mission 1045-2	7	3	24 Jan- 7 Feb 68
Mission 1046-1	36	24	14 Mar-29 Mar 68
Mission 1046-2	45	32	14 Mar-29 Mar 68

The development level is used to produce the optimum density for the mission. The higher percentage of primary development used on this mission suggests that the amount of exposure received was greater than recent missions. There are two major factors that contributed to the relative overexposure. Film type SO-230 was used on both cameras throughout the entire mission. This emulsion is half again as fast as film type 3404 (used on previous missions). In order to compensate for the speed increase, the slit widths were reduced to provide for a 2/3 stop (0.20 Log E) decrease in exposure. The other major factor was the somewhat higher average luminance values encountered during this mission. (Presented in the following table).

TABLE II

	Avg Luminance (foot-Lamberts)			
	Fwd		Aft	
	Min	Max	Min	Max
Average March Launch	850	1750	950	2000
Mission 1046	988	2421	1097	2485

The previous remarks indicate that this mission is relatively overexposed when compared to similar missions of this type. Actually, Mission 1046 could have been exposed to a more correct level. For example, Mission 1046 has little underexposure (8.2 percent) when compared to Mission 1045 (30.1 percent).

2. Contrast: The contrast of the imagery obtained by the fwd-looking camera is generally medium. However, a greater amount of the material has a lower contrast than that of previous missions. This is due in part to the higher density of the material.

3. Acuity: An out-of-focus area on the binary block edge of the film caused varying image acuity across the format. This anomally was the result of an emulsion build-up on the scan head rollers. The emulsion build-up was sufficient enough to lift the inboard side of the film approximately 0.002 inch above the focal plane. The imagery not affected by this anomally is comparable to the better image producing missions of this system.

4. Imaged Degradations:

a. Light Leaks: Light leak induced fog patterns appear more often and are of greater severity than on the more recent missions of this system. The fogging that occurred near the intermediate roller assembly is especially severe when there is a long sit period between camera operations. The fog patterns correlated directly with the duration of camera sit periods. The major fog patterns occurred on the last, first and fifth from last frame, and fifth frame of most passes. The more severe fog patterns cause some degradation to the imagery. The fog patterns are illustrated on Graphics 1 and 2, page 10.

b. Static: None noted.

c. Other: Minor banding is present at the take-up end of some frames. Minor smear is also visible at magnifications above 60X. This appears to be uncompensated smear; however, the smear is less than that occurring on recent missions. Also, at magnifications above 60X an increase in apparent graininess observed.

This is due in part to the relative overexposure observed on this mission. The binary edge of the format, from the take-up end to approximately the center of format, has a ragged appearance. The ragged format did not appear until the end of Mission 1046-1 and continues throughout the remainder of the mission. Up to and including revolution 95, minus density streaks appear intermittently. The streaks are normal to the scan direction and are associated with those areas which were in contact with the rollers during camera inactivity. After revolution 95, the streaks are barely detectable.

5. Physical Degradations: Minor rail scratches are present throughout.

6. Product Quality: The product quality of the fwd-looking panoramic material is considered to be equal to the best of previous missions. However, the quality decreased as the mission progressed due to the aforementioned out-of-focus area. Overall, the image quality of the fwd-looking material is considered to be good when not adversely affected by any of the previously mentioned anomalies.

B. Aft-Looking Panoramic Camera

1. Density: The density of the aft-looking material is considered to be less dense than that of the fwd-looking camera. It is, however, considered to be relatively overexposed when compared to the aft-looking material of recent missions. (Refer to Part II, Sec A, Par. 1).

2. Contrast: Same as reported for the fwd-looking camera.

3. Acuity: The edge sharpness of the imagery from Mission 1046-1 is good and better than that of the fwd-looking camera. However, the second bucket imagery is slightly degraded by the same out-of-focus condition reported for the fwd-looking camera. The acuity is not equal to that of the first part.

4. Image Degradations:

a. Light Leaks: Light leak induced fog patterns occurred with varying severity. The patterns are more frequent and of greater density than those normally encountered from this system. This may be due in part to the faster film type (SO-230) used in this mission. Fog patterns occurred on the first, second, third, and sixth from the last and the last frame of most passes. The major patterns are illustrated on Graphic 3 and 4, page 10. The more severe fog patterns degrade the imagery to the extent where interpretation is difficult. This is especially true on the first bucket (Mission 1046-1).

b. Static: None noted.

c. Other: Same as reported for the fwd-looking camera.

5. Physical Degradations: Minor rail scratches are present throughout the mission. Handling marks and manufacturing defects occur to an average extent.

6. Product Quality: The product quality of the aft-looking record is good. In areas not adversely affected by any of the aforementioned anomalies, the quality is considered to be equal to the best obtained from this system. The quality of the aft-looking material is generally better than that of the fwd-looking material.

C. Stellar Camera (Mission 1046-1)

1. Density: Fifty-five percent of the active format is affected by flare. The density of the flared area is considered normal, and stellar images are detectable in the flared areas.

2. Contrast: The contrast is adequate for the detection of stellar images.

3. Image Shape: The stellar images are generally point type; however, an abnormal number of frames contain slightly elongated images. These elongated images appear to be the result of attitude perturbations.

4. Images per Frame: There are 15 stellar images per frame considered to be usable for attitude reduction.

5. Flare Level: As stated previously, approximately 55 percent of each format is affected by flare.

6. Image Degradations:

a. Light Leaks: None noted.

b. Static: Minor corona static occurs intermittently throughout the mission.

7. Physical Degradations: Pressure marks are present on every other frame. These marks appear outside the format.

8. Product Quality: A sufficient number of stellar images is present to satisfactorily perform attitude reduction.

D. Stellar Camera (Mission 1046-2)

1. Density: Suitable for the detection of stellar images. Although 60 percent of the format is affected by flare, the density of this area is suitable for the identification of stellar images.

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

3. Image Shape: Approximately 50 percent are point type images, while the remainder are slightly elongated. The elongated images are probably the result of attitude perturbations experienced during the mission.

4. Images per Frame: There are approximately 20 images suitable for attitude reductions.

5. Flare Level: As stated in paragraph 1, flare affected 60 percent of the format.

[redacted]

6. Image Degradations:
   a. Light Leaks: None noted.
   b. Static: Minor static is present in various locations intermittently throughout the mission.
7. Physical Degradations: None noted.
8. Product Quality: There are enough stellar images detectable which are suitable for adequate attitude reduction.

E. Index Camera (Mission 1046-1)

1. Density: The average D-max of this mission is 1.1 with a range of 0.6 to 1.4. The average D-min is 0.5 with a range of 0.2 to 1.0. These densities are considered normal for photography acquired during the month of March. The density is considered to be medium.
2. Contrast: The contrast is considered to be medium to low.
3. Acuity: The edge sharpness is good except for the normal fall off in the corners of the format.
4. Image Degradations:
   a. Light Leaks: None noted.
   b. Static: None noted.
5. Physical Degradations: None noted.
6. Product Quality: Good and comparable to that obtained on recent missions of this system.

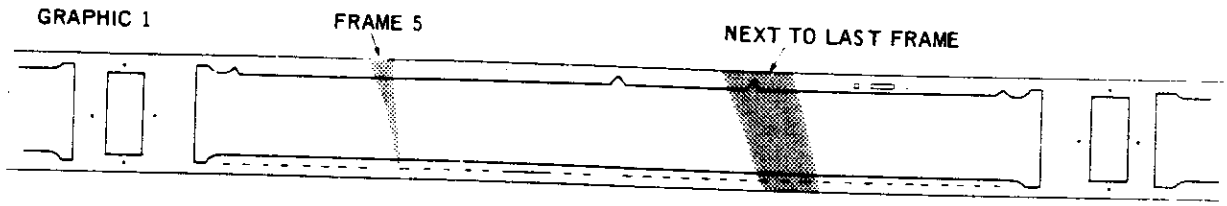
F. Index Camera (Mission 1046-2)

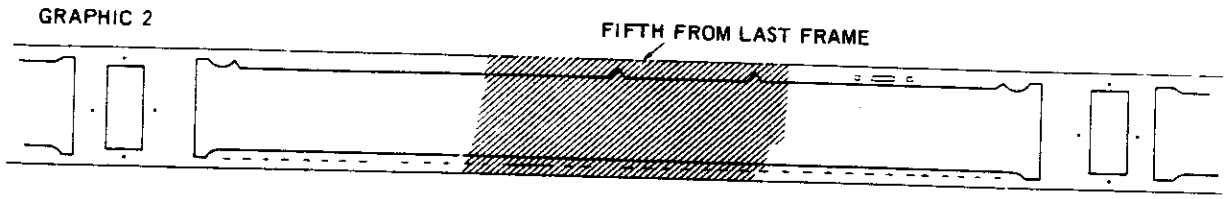
1. Density: The density is considered to be medium. The density values stated for the index camera on Mission 1046-1 (Par E, Sec 1, Pg 9) compare favorably with those for Mission 1046-2.
2. Contrast: The contrast is considered to be medium to low.
3. Acuity: The edge sharpness is good and comparable to that of recent missions.
4. Image Degradations:
   a. Light Leaks: None noted.
   b. Static: None noted.
   c. Other: A minus density mark, which appears to be a foreign particle, is imaged in the format throughout the mission.
5. Physical Degradations: None noted.
6. Product Quality: The product quality is considered to be good.

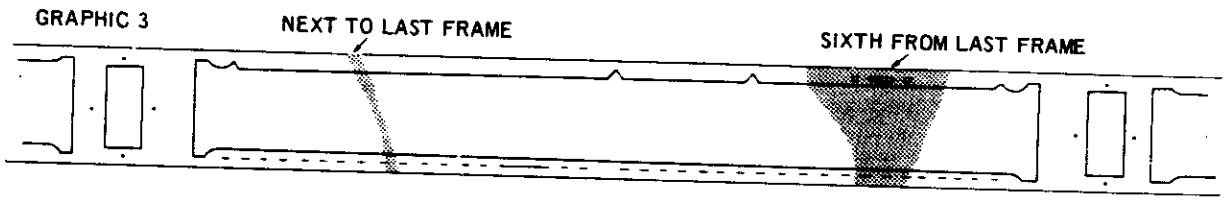
[redacted]

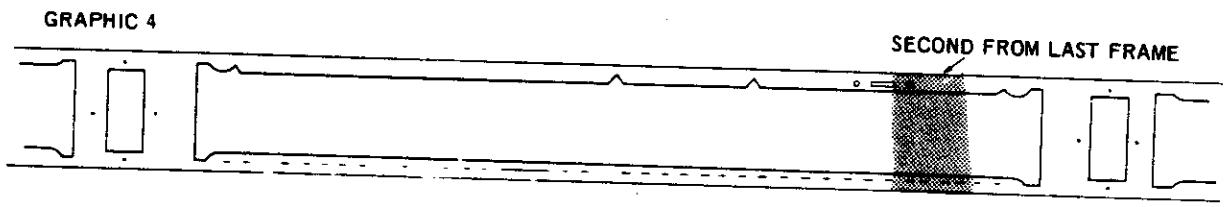
G. Graphic Display (Mission 1046)

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









PART III. IMAGED AUXILIARY DATA

A. Fwd-Looking Panoramic Camera

1. Horizon Cameras
   a. Starboard-looking
      (1) Imagery: A slight veiling condition is apparent beginning on rev 5D, and continuing throughout the first part of the mission. The veiling cleared and is unnoticeable on the second part of the mission. The earth's curvature is visible and properly defined throughout. Attitude determination, where needed, was not hindered due to the veiling.
      (2) Fiducials: The fiducials are sharp and well defined throughout the mission.
   b. Port-looking
      (1) Imagery: The horizon image is sharp and well defined throughout the mission.
      (2) Fiducials: The fiducials are sharp and well defined throughout the mission.

2. Frequency Marks: Up to 10 inches is missing on the take-up end of the first frame of a few operations. An example of this is frame 1, pass 163D.

3. Binary Time Word: All lights were bloomed to varying degrees throughout the mission. The following anomalies were noted during machine readout: Frame 53, Pass 101D had a manufacturer's splice through the binary word. Frame 4, pass 104D has an end-of-pass marker imaged in the middle of the binary word. Frame 7, pass 149D did not have a binary word.

4. Binary Index: The leading index lamp is bloomed throughout the mission. The trailing index lamp is either bloomed or extremely weak up to pass 50D. After pass 50D, the trailing index lamp is bloomed for the remainder of the mission. The blooming decreases in severity during the second part of the mission. The weak index lamp caused difficulty in reading the binary word. The majority of the frames prior to pass 52D were read manually.

5. Camera Number: The camera number is either bloomed or weak prior to pass 52D. After that, the image is bloomed for the remainder of the mission. However, the blooming is less severe during the second part of the mission.

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 at pass 5D and is present throughout the first part of Mission 1046-1. The veiling begins to clear during the second part of Mission 1046-2, and is completely gone by the end of the mission. The horizon image is visible throughout the entire mission. The veiling did not interfere with attitude reduction, where needed.
      (2) Fiducials: Well defined throughout the mission.
   b. Port-looking
      (1) Imagery: The imagery is good, and the earth's curvature is well defined.
      (2) Fiducials: Well defined throughout the mission.

2. Frequency Marks: Up to 10 inches is missing on the take-up end of the first frame of a few operations. An example is frame 1, pass 111D.

3. Binary Time Word: The binary dots are slightly bloomed throughout the mission. The following anomalies were noted during machine readout: The binary word on the duplicate positive is displaced toward the edge of the film on passes 117D, 147D, 148D, and 180D. The displacement of the word caused difficulty in reading the binary word.

4. Binary Index: The leading index image is slightly bloomed. The trailing index image is bloomed to a greater extent. Both indexes were readable.

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 1046-1)

1. Grid Image Quality: On some frames, the grid is not discernible outside the flared area. However, the majority of the frames contain grid images that are sharp and well defined.

2. Correlation Lamp Image Quality: Good.

D. Stellar Camera (Mission 1046-2)

1. Grid Image Quality: The grid image is sharp and well defined.
2. Correlation Lamp Image Quality: Good.

E. Index Camera (Mission 1046-1)

1. Grid Image Quality: Sharp and well defined.
2. Correlation Lamp Image Quality: Good.
3. Camera Number Legibility: Readable.

F. Index Camera (Mission 1046-2)

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

A total of 80 request was received for mensuration on this mission. Of the 80 requests, 55 were for Mission 1046-2. No problems were encountered, and from a mensuration stand point the image quality is considered normal for this system.

B. Aft-Looking Panoramic Camera

Same as reported for the fwd-looking camera.

PART V. FILM PROCESSING

A. Processing Machines and Processing Gamma

Film	Part Machine	Entire Mission Gamma	Part: Machine	NA Gamma
Fwd (Mission 1046-1)	Trenton	2.35	NA	NA
Aft (Mission 1046-1)	Trenton	2.33	NA	NA
Fwd (Mission 1046-2)	Trenton	2.35	NA	NA
Aft (Mission 1046-2)	Trenton	2.30	NA	NA
Stellar (Mission 1046-1)	Trenton	2.24	NA	NA
Stellar (Mission 1046-2)	Trenton	2.13	NA	NA
Index (Mission 1046-1)	Drape	1.06	NA	NA
Index (Mission 1046-2)	Drape	0.90	NA	NA

B. Processing Levels

1. Panoramic Cameras

Film	Primary	Intermediate	Full	Transition	Processing Changes
Fwd (Mission 1046-1)	36%	34%	12%	18%	82
Aft (Mission 1046-1)	24%	25%	24%	27%	74
Fwd (Mission 1046-2)	45%	24%	16%	15%	67
Aft (Mission 1046-2)	32%	29%	24%	15%	68

C. Film Handling Summary

1. Fwd-Looking Camera
   a. Capsule De-Filming:
      (1) Mission 1046-1: No problems encountered. However, the record contained an excessive amount of positive curl.
      (2) Mission 1046-2: No problems encountered. There was, however, an excessive amount of positive curl and an excessive amount of dirt on the core of the take-up spools.
   b. Pre-Processing Inspection:
      (1) Mission 1046-1: No problems encountered.
      (2) Mission 1046-2: No problems encountered.
   c. Manufacturing Splices:
      (1) Mission 1046-1: Frames 46, pass 37D; 19, pass 69D; and 53, pass 101D.
      (2) Mission 1046-2: Frames 9, pass 165D; and 43, pass 214D.
   d. Processing Splices:
      (1) Mission 1046-1: None other than normal.
      (2) Mission 1046-2: None other than normal.
   e. Manufacturing Defects:
      (1) Mission 1046-1: None noted.
      (2) Mission 1046-2: None noted.
   f. Processing Anomalies: None.
   g. Breakdown: No problems encountered.
2. Aft-Looking Camera
   a. Capsule De-Filming:
      (1) Mission 1046-1: No problems encountered. However, the record contained an excessive amount of positive curl.
      (2) Mission 1046-2: No problems encountered. There was, however, an excessive amount of positive curl. An abnormal amount of dirt was present on the core of the take-up spool.
   b. Pre-Processing Inspection:
      (1) Mission 1046-2: No problems encountered.
      (2) Mission 1046-2: Same as that reported for Mission 1046-1.
   c. Manufacturing Splices:
      (1) Mission 1046-1: Frame 18, pass 21D, and frame 31, pass 46D.
      (2) Mission 1046-2: Frame 8/9, pass A104E and frame 6, pass 168D.

[redacted]

d. Processing Splices:
   (1) Mission 1046-1: None other than normal.
   (2) Mission 1046-2: None other than normal.
e. Manufacturing Defects:
   (1) Mission 1046-1: None noted.
   (2) Mission 1046-2: None noted.
f. Processing Anomalies: None.
g. Breakdown: No problems encountered.

3. Index Camera:
   a. Capsule De-Filming:
      (1) Mission 1046-1: No problems encountered.
      (2) Mission 1046-2: No problems encountered.
   b. Pre-Processing Inspection:
      (1) Mission 1046-1: No problems encountered.
      (2) Mission 1046-2: No problems encountered.
   c. Manufacturing Splices:
      (1) Mission 1046-1: None.
      (2) Mission 1046-2: None.
   d. Processing Splices:
      (1) Mission 1046-1: None other than normal.
      (2) Mission 1046-2: None other than normal.
   e. Manufacturing Defects:
      (1) Mission 1046-1: None.
      (2) Mission 1046-2: None.
   f. Processing Anomalies: None.
   g. Breakdown: No problems encountered.

4. Stellar Camera
   a. Capsule De-Filming:
      (1) Mission 1046-1: No problems encountered.
      (2) Mission 1046-2: No problems encountered.
   b. Pre-Processing Inspection:
      (1) Mission 1046-1: No problems encountered.
      (2) Mission 1046-2: No problems encountered.
   c. Manufacturing Splices:
      (1) Mission 1046-1: None.
      (2) Mission 1046-2: None.
   d. Processing Splices:
      (1) Mission 1046-1: None other than normal.
      (2) Mission 1046-2: None other than normal.
   e. Manufacturing Defects:
      (1) Mission 1046-1: None.
      (2) Mission 1046-2: None.
   f. Processing Anomalies: None.
   g. Breakdown: No problems encountered.

[redacted]

D. <u>Timetable</u>

Film	Recovered	Received at Processing Site	Spec Ship at NPIC Recd	Priority 1A at NPIC Recd
Fwd (Mission 1046-1)	22 Mar 68/0048Z	22 Mar 68/1710Z	None	25 Mar 68/0605Z
Aft (Mission 1046-1)	"	"	"	"
Stellar (Mission 1046-1)	"	"	"	"
Index (Mission 1046-1)	"	"	"	"
Fwd (Mission 1046-2)	30 Mar 68/0001Z	30 Mar 68/1735Z	"	3 Apr 68/1330Z
Aft (Mission 1046-2)	"	"	"	"
Stellar (Mission 1046-2)	"	"	"	"
Index (Mission 1046-2)	"	"	"	"

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 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. 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 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 1046-1	Mission 1046-2	Totals
Priority 1 Targets Programmed	No specific targets programmed for this mission.		
Priority 1 Targets Covered	150	104	254

2. PI Quality Appraisal

Rating	Missiles	Nuclear Energy	Air Facilities	Ports	Elect Commo	Military Activity	Complex
Good	8	1	2	1	0	6	3
Fair	48	6	14	8	2	24	10
Poor	54	5	13	8	0	38	25
Totals*	110	12	29	17	2	68	38

3. Summary of PI Quality Ratings (Percentage)

Good 21 or 7.6%
Fair 112 or 40.6%
Poor 143 or 51.8%
276

*A discrepancy exists between the total number of targets covered and the total PI reports because some targets are covered more repeatedly.

C. PI Comments

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

Weather	Number of Targets
a. Clear	129 or 46.7%
b. Scattered Clouds	72 or 26.1%
c. Heavy Clouds	21 or 7.6%
d. Haze	51 or 18.5%
e. Cloud Shadow	3 or 1.1%

2. Terrain Conditions: The terrain conditions were considered fair to good. The terrain in the northern latitudes was snow covered to some extent, thereby limiting interpretation suitability.

3. Product Interpretability: The interpretability is considered fair to good for Mission 1046-1 and poor to fair for Mission 1046-2. The out-of-focus area is a degrading factor in the interpretability of the material obtained from Mission 1046-2.

PART VII. MISSION DATA

	Fwd-Looking Pan	Fwd-Looking Take-up Horizon	Fwd-Looking Supply Horizon	Aft-Looking Pan	Aft-Looking Take-up Horizon	Aft-Looking Supply Horizon	Mission 1046-1 Stellar	Mission 1046-1 Index	Mission 1046-2 Stellar	Mission 1046-2 Index
Camera Number	220	*	*	221	*	*	D119	D119	D120	D120
Reseau Number	NA	NA	NA	NA	NA	NA	157	151	158	153
Lens Serial Number	176	23763	19096	179	23804	23802	11401	825512	11659	825514
Slit Width (in)	.140	NA	NA	.110	NA	NA	NA	NA	NA	NA
Aperture	F/3.5	F/11.0	F/8.0	F/3.5	F/8.0	F/11.0	F/1.8	F/4.5	F/1.8	F/4.5
Exposure Time (sec)	1/462 (Avg)	1/100	1/100	1/588 (Avg)	1/100	1/100	2.0	1/500	2.0	1/500
Filter (Wratten)	23A	25	25	21	25	25	NA	21	NA	21
Focal Length (mm)	610.420	54.50	54.90	610.420	54.95	54.75	85	38.59	85	38.62
Film Length (ft)	16,300	NA	NA	16,300	NA	NA	75	135	75	135
Splices	5	NA	NA	4	NA	NA	None	None	None	None
Emulsion	12-2-2-8	12-2-2-8	12-2-2-8	12-2-2-8	12-2-2-8	12-2-2-8	231-9-9-7	148-3-9-7	231-9-9-7	148-3-9-7
Film Type	SO-230	SO-230	SO-230	SO-230	SO-230	SO-230	3401	3400	3401	3400
Resolution Data (L/mm)										
Static										
High Contrast	205	*	*	203	*	*	*	87 (AWAR)	*	86 (AWAR)
Low Contrast	135	*	*	125	*	*	*	*	*	*
Dynamic										
I High Contrast	*	*	*	*	*	*	*	*	*	*
I Low Contrast	146	*	*	149	*	*	*	*	*	*
P High Contrast	*	*	*	*	*	*	*	*	*	*
P Low Contrast	135	*	*	125	*	*	*	*	*	*

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-Looking camera.

NPIC N-0336

NPIC N-0337

[redacted]

	FIGURE 1	FIGURE 2
Camera	221	220
Pass	9D	9D
Frame	132	132
Date of Photography (GMT)	15 Mar 68	15 Mar 68
Universal Grid Coordinates	52.3-12.3	39.3-12.6
Enlargement Factor	20X	20X
Geographic Coordinates	32-50N	32-50N
	35-19E	36-19E
Altitude (ft)	613,102	615,659
Camera Attitude:		
Pitch (deg)	-14°53'	14°53'
Roll (deg)	00°26'	00°23'
Yaw (deg)	-02°14'	-02°15'
Local Sun Time	1357	1357
Solar Elevation (deg)	45°21'	45°21'
Solar Azimuth (deg)	50°20'	50°20'
Exposure (sec)	1/605	1/474
Vehicle Azimuth (deg)	174°40'	174°33'
Processing Level	Full	Transition

[redacted]

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FIGURE 3. STELLAR FORMAT (Mission 1046-1)

FIGURE 4. STELLAR FORMAT (Mission 1046-2)

The following photographs exhibit the flare pattern prevalent throughout the mission.

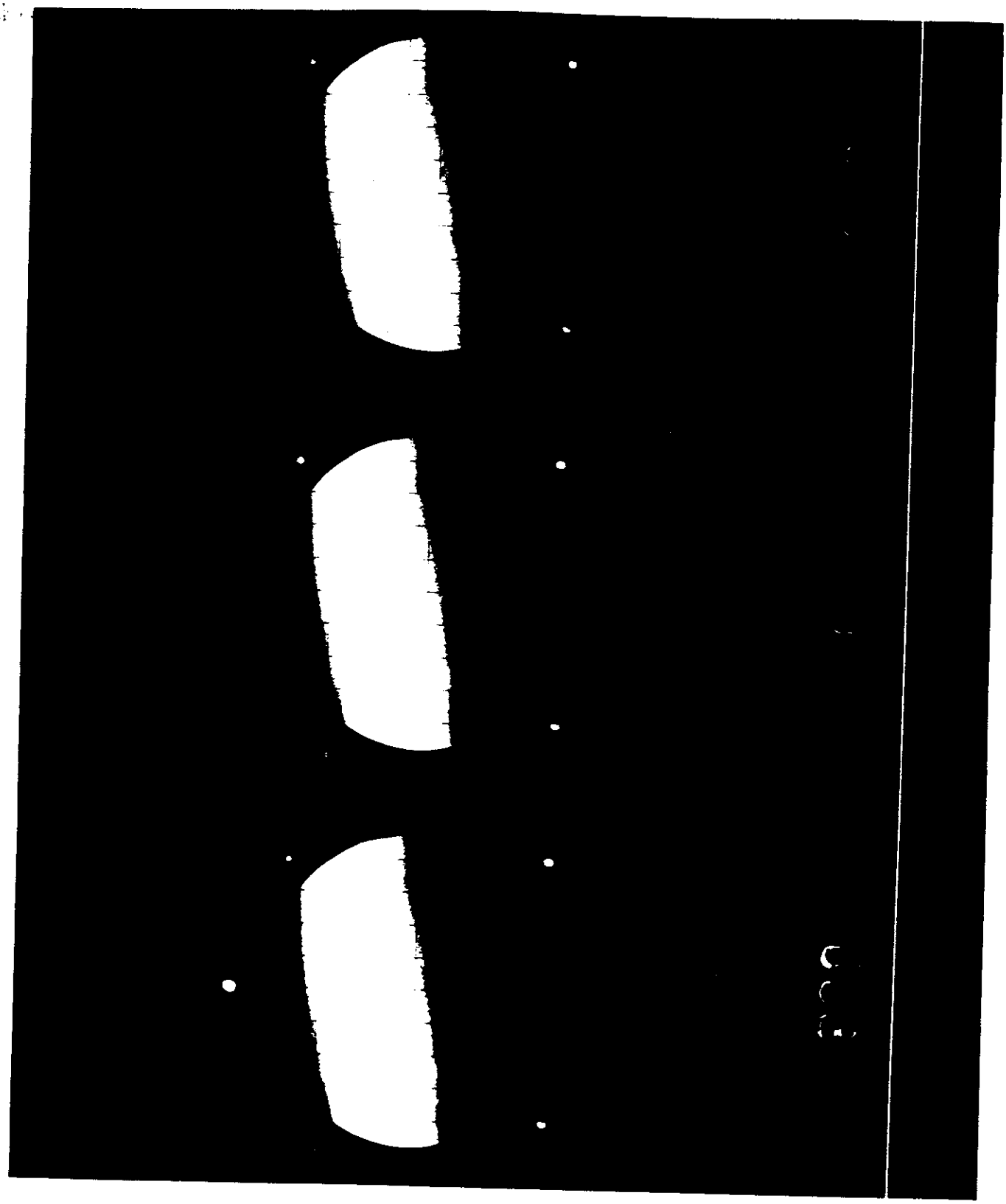
NPIC N-0338

NPIC N-0339

[redacted]

	FIGURE 3	FIGURE 4
Mission Number	1046-1	1046-2
Stellar Frame Numbers	8, 9, 10	8, 9, 10
Correlates with		
Main Camera Number	220	220
Pass	3D	104D
Frames	5, 12, 19	6, 13, 20
Date of Photography	15 Mar 68	21 Mar 68
Enlargement Factor	2.5X	2.5X
Exposure Time	2.0	2.0

[redacted]



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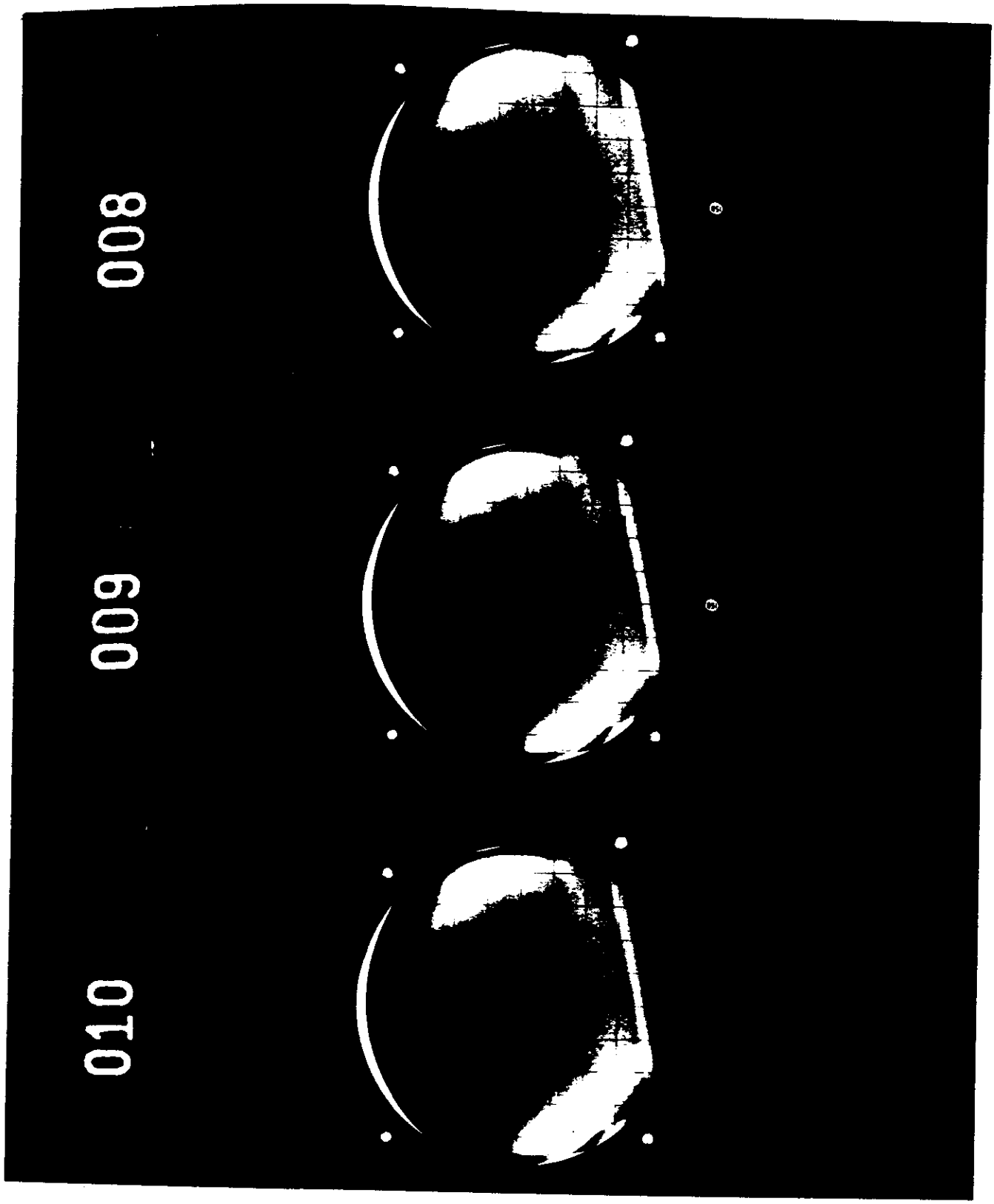

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Special Study:
Comparison of SO-230 & 3404 Film Types
From Mission 1102-2

I. Introduction

The purpose of this special study is to compare the physical and sensitometric characteristics of film types SO-230 and 3404. A subjective comparison of the in-flight performance of the two film types from Mission 1102-2 is also included.

II. Physical and Sensitometric Characteristics

A. Emulsion Speed: SO-230 is approximately half again as fast (2/3 stop) as 3404.

B. Granularity: The granularity as measured by the manufacturer is 22.3 RMS for 3404 and 22.5 RMS for SO-230 at a density of 1.0. The granularity as measured by NPIC is 45.7 RMS for 3404 at a density of 1.9 and 43.2 RMS for SO-230 at a density of 1.7.

C. Resolution:

	1000:1	1.7:1
SO-230	610-615 l/mm	185 l/mm
3404	615 l/mm	200 l/mm

D. Abrasiveness: Abrasion tests on SO-230 are being conducted by the manufacturer. The results of these tests are not available at this time.

E. Film Curl: SO-230 has displayed an abnormal amount of curl. This curl is in excess of recommended limits for this camera system.

F. Processing: The anti-halation dye on this film type is placed between the emulsion and the base. For this reason, the dye is more difficult to remove which could result in higher base plus fog densities.

III. Subjective Evaluation

A. A subjective evaluation of the in-flight performance of film types 3404 and SO-230 was conducted on materials from Mission 1102-2. Approximately 2,000 feet of SO-230 was attached to the tail of the fwd camera film load and 2,500 feet to the tail of the aft camera film load.

B. The areas selected for comparison were from those passes where SO-230 was exposed in the aft camera and 3404 in the fwd camera. Acquisition parameters for these areas were, of course, similar. However, individual camera factors such as exposure, filters, and camera look angle were variable.

C. The DUO-STAR Comparison (split field) microscopes were used to compare conjugate imagery from the two camera records. In addition, photomicrographs were made at various magnifications (20X, 50X, 100X, and 215X).

D. These visual and photographic observations indicate some very subtle differences between the two film types. The SO-230 imagery is of a slightly lower contrast and at higher magnifications (50X and above) appears slightly grainier. However, edge sharpness, shadow and highlight detail, and overall information content are generally identical.

IV. Conclusions

A. Film type SO-230 produces imagery which at higher magnification (50X and above) appears slightly grainier. This apparent graininess, however, does not adversely affect the information content of the material.

B. The curl and abrasive characteristics of SO-230 are currently being analyzed and the results should be available in the near future.

C. The main advantage of SO-230 is its additional emulsion speed (approximately 3.4 AEI) which will allow shorter exposure times, thereby reducing the effects of uncompensated image motion.