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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT MISSION 1104

WITH SPECIAL STUDY SO-180 EVALUATION MISSION 1104

[redacted]

DECEMBER 1968

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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT

MISSION 1104

DECEMBER 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.
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 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 the descending node and a suffix A indicates the as-

	cending 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."

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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 KH4A Camera System
1042		None
1043		Scan Speed Deviation Analysis of the Forward Camera, Mission 1043
1044		Dual Gamma/Viscose Vs Conventional/Spray Processing Analysis (Mission 1044)
1045		None
1046		SO230 Vs 3404 Evaluation
1101		Slant Range Computations Related to Universal Grid Coordinates for the KH4B Camera System
1102		None
1103		None
1104		SO-180 Evaluation Mission 1104

SYNOPSIS

Mission 1104, a two part satellite reconnaissance mission, was launched at 2137Z on 7 August 1968. The first capsule was recovered dry on revolution 115 at 0004Z on 15 August 1968. The second capsule was recovered dry on revolution 244 at 2230Z on 22 August 1968, terminating the mission.

The best image quality of the fwd-looking camera record is considered to be better than any previous photography from this system. The image quality of the fwd-looking camera record is superior to that of the aft-looking camera record. In addition, the aft-camera imagery, exposed through the SF-05 filter, is of poor quality due to the use of a poor quality filter.

Approximately 80 percent of the mission contains cloud-free photography. The Dual Improved Stellar Index Cameras (DISIC) were operational throughout the mission. However, the binary time word image is intermittently degraded throughout the index camera record. The image quality of the index camera record is good and compares favorably with Mission 1103 index imagery.

PART I. GENERAL SYSTEM INFORMATION

A. Camera Numbers

Forward-Looking Panoramic Camera	309
Aft-Looking Panoramic Camera	308
DISIC Camera	7

B. Launch and Recovery Dates

	Mission 1104-1	Mission 1104-2
Launch	7 Aug 68	*
Recovery	15 Aug 68	22 Aug 68
Recovery Rev	115	244

C. Orbit Elements

Element	Planned	Actual 1104-1 (Rev 57)	Actual 1104-2 (Rev 164)	Photo Range
Period (min)	NA	88.564	88.578	*
Perigee (nm)	NA	83.723	81.084	80.047, 138D
Apogee (nm)	NA	141.581	151.007	129.224, 41D
Eccentricity	NA	0.00789	0.00953	*
Inclination (deg)	NA	82.10	82.11	*
Perigee Latitude	NA	14°15'N	32°17'N	*

NA - Not Available.
* - Not Applicable.

D. Photographic Operations

1. Panoramic Cameras

Type	Mission 1104-1 Revs	Mission 1104-1 Frames	Mission 1104-2 Revs	Mission 1104-2 Frames	Total Revs	Total Frames
Operational						
Fwd	39	2,821	34	2,787	73	5,608
Aft	39	2,814	36	2,853	75	5,667
Operational/Domestic						
Fwd	0	0	0	0	0	0
Aft	0	0	0	0	0	0
Domestic						
Fwd	6	123	6	153	12	276
Aft	7	141	7	180	14	321
Engineering (no imagery)						
Fwd	2	35	2	22	4	57
Aft	2	35	2	23	4	58
Totals						
Fwd	47	2,979	42	2,962	89	5,941
Aft	48	2,990	45	3,056	93	6,046

2. Secondary Cameras

Camera	Frames
Stellar (Mission 1104-1)	2,135 starboard, 2,135 port
Index (Mission 1104-1)	2,122
Stellar (Mission 1104-2)	2,566 starboard, 2,559 port
Index (Mission 1104-2)	2,465

E. Film Usage

	Film-Load (Total)	Pre-Flight Footage	Processed Footage
Fwd-Looking (Mission 1104-1)	16,000*	**	8,182 of 3404
Aft-Looking (Mission 1104-1)	16,300*	**	8,208 of 3404
Fwd-Looking (Mission 1104-2)	NA	NA	6,999 of 3404 811 of SO-180
Aft-Looking (Mission 1104-2)	NA	NA	8,062 of 3404
Stellar (Mission 1104-1)	2,000*	**	625 of 3401
Stellar (Mission 1104-2)	NA	NA	691 of 3401
Index (Mission 1104-1)	2,000*	**	947 of 3400
Index (Mission 1104-2)	NA	NA	1,035 of 3400

*Total Load For Both Buckets.
** - Not Available.
NA - Not Applicable.

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PART II. IMAGE ANALYSIS

A. Fwd-Looking Panoramic Camera

1. Density: The density of the original negative on Mission 1104 is generally medium.

2. Contrast: In general, the imagery obtained by the fwd-looking camera is of medium contrast.

3. Acuity: The image quality of the fwd-looking camera record is good and better than that obtained on any previous mission of this system. The improvement in image quality can be partly attributed to the initial use of a third generation Petzval lens in the fwd-looking unit. The best ground resolution read from a mobile CORN target was four feet three point eight inches in the flight direction.

4. Imaged Degradations:

a. Light Leaks:

(1) Fog patterns are present on the seventh-from-last frame of most camera operations of Mission 1104-1 only. The patterns vary in density from thin to very heavy, commensurate with camera sit periods, and in some instances obscure imagery. This fog is attributed to a light leak in the vicinity of the Mission 1104-1 recovery system cover. (Graphic 1, page 9)

(2) On Mission 1104-2, fog is present on the second-from-last frame of some camera operations. Degradation to the imagery is minor. This fog is the result of an apparent light leak in the main barrel structure. (Graphic 2, page 9)

b. Static:

(1) Minor corona-type fog patterns are present near the take-up end of the first frame of most camera operations of Mission 1104-1 and on the first frame of a few camera operations of Mission 1104-2. In a few instances, many frames of an operation are affected.

(2) Another corona-type fog pattern is present on pass 169D, beginning on frame 24 and ending prior to the last two frames. This fog pattern has the appearance of pencil marks that run through the center of the format along the major axis of the material and branch out with extremely long, faint, plus density arms.

(3) Edge static is present along both film edges intermittently throughout the mission.

(4) Degradation to the imagery, resulting from the corona fogging and edge static mentioned above, is minor.

c. Other:

(1) The lens stowed in the center of the format at the end of pass A103E. As a result, only one-half of the last frame of pass A103E was exposed during this camera operation, while the remainder

of the frame was exposed at the start of operation on pass 103D.

(2) The level of performance of the fwd-looking lens (third generation) was sufficiently high to occasionally detect cross-track smear in the imagery. The most obvious example is the CORN display on pass 16D where bar target readings indicate five feet along track and eight feet across track.

5. Physical Degradation: None noted.

6. Product Quality: The overall quality of the fwd-looking camera record is good.

B. Aft-Looking Panoramic Camera

1. Density: Same as reported for the fwd-looking camera.

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

3. Acuity:

a. The best imagery of the aft-looking camera record is good but not equivalent to that of the fwd camera record.

b. Aft camera acquisitions exposed through the SF-05 filter are of poor quality. The imagery is severely degraded and of limited use for interpretation. This poor quality is attributed to imperfections in the filter and is not inherent in normal bicolor acquisitions. These filter imperfections were discovered prior to launch. Therefore, its use was limited to five camera operations.

4. Imaged Degradations:

a. Light Leaks: Fog patterns are present on the sixth-to-last frame of most camera operations of Mission 1104-1 only. The patterns vary in density from light to very heavy, commensurate with camera sit periods, and in some instances obscure imagery. This fog is attributed to a light leak in the vicinity of the Mission 1104-1 recovery system cover. (Graphic 3, page 9)

b. Static: Corona-type fog patterns are present near the take up end of the first frame of a few camera operations. Degradation to the imagery is minor.

c. Other: In many operations, the aft-camera performance was sufficient to identify cross track smear. In such instances, it was observed that the cross track smear recorded in the aft photography was less than that in the forward. This relationship is directly related to the shorter exposure time of the aft camera.

5. Physical Degradation: None noted.

6. Product Quality: The overall quality of the aft-looking camera record is good.

C. Stellar Camera

1. Density: The density of the material from both port and starboard stellar cameras is generally medium. However, the first port and star-

board frame of each camera operation are of heavy density and preclude the detection of stellar images. This anomaly is a system characteristic and will probably appear in future systems.

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

3. Image Shape: The stellar images generally appear as point type images.

4. Image per Frame: A total of 25 to 80 stellar images can be detected in both the port-and starboard-looking stellar camera records. The stellar field at which the cameras were looking contained Taurus and Orion.

5. Flare Level: Approximately ten percent of each port and starboard frame is affected by flare.

6. Imaged Degradations:

a. Light Leaks: Fog, in the form of equipment shadow graphs, is present on the 6th, 7th, and 8th frame before each port camera on. Associated with this fog is a plus density streak approximately 0.25 inch long and 0.1 inch wide near the center of the format of the second frame before most port camera ons. These fog patterns vary in density from thin to very heavy, commensurate with camera sit periods, and in some instances obscure imagery. The most likely cause of this anomaly appears to be a light leak through the "patio pin" hole. This hole is plugged by a screw prior to flight.

b. Static: Dendritic and corona-type fog patterns are present on the stellar camera record. In some instances, these fog patterns enter the format area. However, degradation to the imagery is minor.

c. Other:

(1) Characteristic pressure-induced fog patterns are present in the border area on both film edges throughout the mission.

(2) Both port and starboard camera frames contain repeated patterns of minus density spots which appear to be caused by dirt on the reseau plate. Degradation to the imagery is minor.

7. Physical Degradations: None noted.

8. Product Quality: The overall quality of the stellar record is good and adequate for attitude determination.

E. Index Camera

1. Density: The density of the index camera record is generally heavy.

2. Contrast: The contrast of the index camera record is generally medium.

3. Acuity: The image quality of the index camera record is good and compares favorably with Mission 1103 index imagery.

4. Imaged Degradations:

a. Light Leaks: None noted.

b. Static: Dendritic and corona-type fog patterns are present occasionally throughout the index camera record, primarily toward

the end of Mission 1104-2. In some instances, these static markings are present near center format. Degradation to the imagery is minor.

c. Other: Characteristic pressure-induced fog patterns are present in the border area on both film edges throughout the mission. All index camera frames contain repeated patterns of minus density spots, which appear to be caused by dirt on the reseau. Degradation to the imagery is minor.

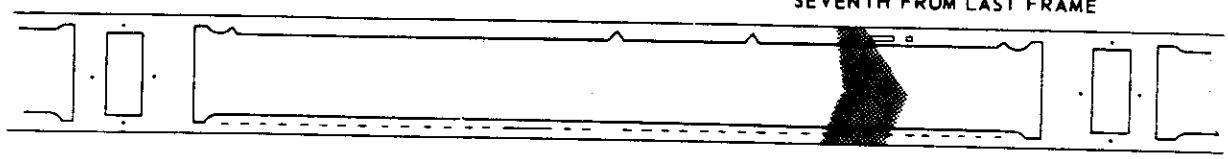
5. Physical Degradations: None noted.

6. Product Quality: The overall quality of the index camera record is good and adequate for attitude determination.

E. Graphic Display

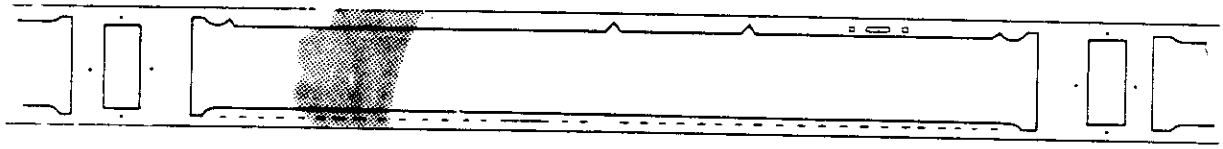
The patterns illustrated below are referenced in the text of this report.

Graphic 1



Graphic 2

Graphic 3



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PART III. IMAGED AUXILIARY DATA

A. Fwd-Looking Panoramic Camera

1. Horizon Cameras
   a. Starboard-looking:
      (1) Imagery: Imaged properly. However, the starboard horizon shutter failed to close during film transport on frame 66, pass 74D and frame 29, pass 155D. The result is heavy fogging of two pan camera frames for each occurrence.
      (2) Fiducials: Sharp and well defined.
   b. Port-looking:
      (1) Imagery: Imaged properly.
      (2) Fiducials: Sharp and well defined.
2. Frequency Marks: Imaged Properly.
3. Binary Time Word: Sharp and well defined.
4. Camera Number: Readable.
5. Pan Geometry Dots: Sharp and well defined.
6. Nodal Traces: Sharp and well defined.
7. Nod Indicators: Sharp and well defined. Mission 1104 is the first mission to have the nod indicators imaged.

B. Aft-Looking Panoramic Camera

1. Horizon Cameras
   a. Starboard-looking:
      (1) Imagery: Imaged properly.
      (2) Fiducials: Sharp and well defined.
2. Frequency Marks: Imaged properly.
3. Binary Time Word: Sharp and well defined.
4. Camera Number: Readable.
5. Pan Geometry Dots: Sharp and well defined.
6. Nodal Traces: Sharp and well defined.
7. Nod Indicators: Sharp and well defined. Mission 1104 is the first mission to have nod indicators imaged.

C. Stellar Camera

1. Grid Image Quality: Sharp and well defined.
2. Binary Time Word: Imaged properly for the system. Automatic reduction of the time word was accomplished without problems.
3. Lens Serial Number Legibility: Good.

D. Index Camera

1. Grid Image Quality: Sharp and well defined.
2. Binary Time Word: The index time word image varies in density

from normal to nonexistent and in most cases is difficult to read visually. This anomaly was caused by an intermittent and improper seating of the data block head during exposure, which probably resulted from a variation in the data block cable position. Data provided on the stellar record were machine readable throughout the mission. Since index data are redundant to stellar data, no stellar/terrain set is missing time data.

4. Camera Number Legibility: Good.

PART IV. MENSURATION QUALITY

A. Fwd-Looking Panoramic Camera: There were 93 requests for mensuration on this mission. No problems were encountered. The image quality is considered to be good for mensuration purposes.

B. Aft-Looking Panoramic Camera: Same as above.

PART V. FILM PROCESSING

A. Processing Machines and Process Gamma

Film	Part: Machine	Entire Mission Gamma	Film Type
Fwd (Mission 1104-1)	Yardleigh	1.70	3404
Aft (Mission 1104-1)	Yardleigh	1.69	3404
Fwd (Mission 1104-2)	Yardleigh	1.76	3404
	Grafton	NA	SO-180
Aft (Mission 1104-2)	Yardleigh	1.83	3404
Stellar (Mission 1104-1)	Trenton	2.10	3401
Stellar (Mission 1104-2)	Trenton	2.10	3401
Index (Mission 1104-1)	Drape	1.52	3400
Index (Mission 1104-2)	Drape	1.66	3400

NA - Not Available.

B. Processing Levels

1. Panoramic Cameras

The black and white portions of both panoramic camera records were processed using the dual gamma process which uses a modified Yardleigh processor to provide single level viscous development.

2. Secondary Cameras:

a. Stellar Cameras: The stellar camera records were processed with a Trenton processor at a single level of development.

b. Index Camera: The index camera records were processed with a Drape processor at a single level of development.

C. Film Handling Summary

1. Fwd-Looking Camera

a. Capsule De-Filming:

(1) Mission 1104-1: Received at the processing site, from the West Coast, in suitcases.

(2) Mission 1104-2: No problems encountered.

b. Pre-Processing Inspection: No problems encountered.

c. Manufacturing Splices:

(1) Mission 1104-1: Frame 99, pass 39D; frame 93, pass 58D, frame 51, pass 74D; frame 29, pass 102D.

(2) Mission 1104-2: Frame 83, pass 106D; frame 222, pass 121D; frame 34, pass 145D; frame 8, pass 169D. The fwd-camera material contained a pre-exposed, pre-processed indicator strip (approximately three feet in length) to indicate the film type

change from 3404 to SO-180. Part of frame 18, all of frame 19, and a small segment of frame 20 of pass 199D were exposed on this non-sensitive strip and lost. A blank piece of film was inserted for frame 19 and titled accordingly.

d. Processing Splices: None other than normal.
e. Manufacturing Defects: None noted.
f. Processing Anomalies: None.
g. Breakdown: No problems encountered.

2. Aft-Looking Camera
   a. Capsule De-Filming:
      (1) Mission 1104-1: Received at the processing site, from the West Coast, in suitcases.
      (2) Mission 1104-2: No problems encountered.
   b. Pre-Processing Inspection: No problems encountered.
   c. Manufacturing Splices:
      (1) Mission 1104-1: Frame 17, pass 52D.
      (2) Mission 1104-2: Frame 24, pass 106D; frame 115, pass 169D.
   d. Processing Splices: None other than normal.
   e. Manufacturing Defects: None noted.
   f. Processing Anomalies: None.
   g. Breakdown: No problems encountered.
3. Index Camera
   a. Capsule De-Filming:
      (1) Mission 1104-1: Received at the processing site, from the West Coast, in suitcases.
      (2) Mission 1104-2: No problems encountered.
   b. Pre-Processing Inspection: No problems encountered.
   c. Manufacturing Splices: None.
   d. Processing Splices: None.
   e. Manufacturing Defects: None noted.
   f. Processing Anomalies: None.
   g. Breakdown: No problems encountered.
4. Stellar Cameras:
   a. Capsule De-Filming:
      (1) Mission 1104-1: Received at the processing site, from the West Coast, in suitcases.
      (2) Mission 1104-2: No problems encountered.
   b. Pre-Processing Inspection: No problems encountered.
   c. Manufacturing Splices: None.
   d. Processing Splices: None other than normal.
   e. Manufacturing Defects: None noted.
   f. Processing Anomalies: None.
   g. Breakdown: No problems encountered.

D. Timetable

Film	Recovered	Received at Processing Site	Priority 1A at NPIC Recd
Fwd (Mission 1104-1)	15 Aug 68/0004Z	NA	18 Aug 68/1356 local time
Aft (Mission 1104-1)	"	"	"
Stellar (Mission 1104-1)	"	"	"
Index (Mission 1104-1)	"	"	"
Fwd (Mission 1104-2)	22 Aug 68/2230Z	"	26 Aug 68/0713 local time
Aft (Mission 1104-2)	"	"	"
Stellar (Mission 1104-2)	"	"	"
Index (Mission 1104-2)	"	"	"

NA - Not Available.
No Special Shipment Received at NPIC.

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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 1104-1	Mission 1104-2	Totals
Priority 1 Targets Programmed	No specific priority 1 targets were programmed on this mission although specific areas were selected for initial readout.		
Priority 1 Targets Covered	88	88	168

2. PI Quality Appraisal

Rating	Missiles	Nuclear Energy	Air Facilities	Ports	Elect Commo	Military Activity	Complex	Bio/Chem Warfare
Good	17	1	7	11	1	0	3	0
Fair	72	8	13	2	0	10	5	1
Poor	38	4	11	6	0	7	7	0
Totals*	127	13	31	19	1	17	15	1

3. Summary of PI Quality Ratings

Good 40 or 17.9%
Fair 111 or 49.5%
Poor 73 or 32.6%

*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. Atmospherics Attenuation: Listed below is the photo interpreter's report of weather conditions for priority 1 targets covered on this mission.

a.	Clear	125 or 55.8 percent
b.	Scattered Clouds	50 or 22.3 percent
c.	Heavy Clouds	23 or 10.3 percent
d.	Haze	25 or 11.2 percent
e.	Cloud Shadow	1 or 0.4 percent

2. Terrain Conditions: The terrain conditions were considered good for interpretation purposes.

3. Product Interpretability: The photo interpretability of Mission 1104 is generally good with the best of the forward camera record being rated very good. The best of the aft camera photography is also good but not equivalent to that of the forward. The aft camera imagery, exposed through the SF-05 filter, is of poor quality. In addition, the overall cloud cover estimate of 20 percent fails to reflect the percentage of cloud cover or degrading atmospherics in the prime target areas. There is generally a high incidence of cloud cover in the areas of intelligence interest.

PART VII. RESOLUTION TARGET DATA

Target Designator	A		B
Camera (Looking)	Fwd	Aft	Aft
Pass	14D	14D	16D
Frame	6	12	6
Date of Photography	8 Aug 68	8 Aug 68	8 Aug 68
Universal Grid Coordinates	36.4-1.3	39.0-4.4	43.1-2.2
Geographic Coordinates of Format Center	41-34N 74-02W	41-34N 74-07W	34-50N 117-38W
Altitude (ft)	567,220	564,897	546,381
Camera			
Pitch (deg)	14°48'	-15°36'	-15°43'
Roll (deg)	-0°10'	-0°12'	-0°13'
Yaw (deg)	-1°59'	-2°4'	-2°21'
Local Sun Time	1320	1320	1324
Solar Elevation (deg)	58°49'	58°51'	62°39'
Solar Azimuth (deg)	140	140	130
Exposure (sec)	1/371	1/492	1/367
Processing Level	Dual Gamma	Dual Gamma	Dual Gamma
Vehicle Azimuth (deg)	171°58'	172°8'	173°18'
Filter (Wratten)	W/25	W/21	SF05
Target Type	51/51 T-Bar	51/51 T-Bar	B2
Target Contrast	5:1	5:1	25:1
Weather Conditions	Clear	Clear	Clear

GROUND RESOLUTION IN FEET AS DETERMINED FROM THE ORIGINAL NEGATIVE

	A				B		
	Along Track		Across Track			Along Track	Across Track
	Fwd	Aft	Fwd	Aft		Aft	Aft
Observer 1	7'1.5"	8'	12'	8'	Observer 1	8'11.6"	10'1"
Observer 2	7'1.5"	7'1.5"	7'1.5"	8'	Observer 2	8'11.6"	8'11.6"
Observer 3	7'1.5"	7'1.5"	7'1.5"	8'	Observer 3	8'11.6"	10'1"

Target Designator	C		D	
Camera (Looking)	Fwd	Aft	Fwd	Aft
Pass	16D	16D	129D	129D
Frame	6	12	10	16
Date of Photography	8 Aug 68	8 Aug 68	15 Aug 68	15 Aug 68
Universal Grid Coordinates	44.5-3.1	30.8-2.6	50.9-3.5	24.5-1.7
Geographic Coordinates of Format Center	34-02N 117-26W	34-02N 117-31W	36-38N 115-49W	36-38N 115-54W
Altitude (ft)	546,390	544,516	495,733	495,988
Camera				
Pitch (deg)	14°41'	-15°45'	15°0'	-15°24'
Roll (deg)	-0°9'	-0°11'	-0°1'	-0°3'
Yaw (deg)	-2°10'	-2°14'	-2°6'	-2°10'
Local Sun Time	1325	1325	1223	1223
Solar Elevation (deg)	62°58'	63°0'	66°44'	66°45'
Solar Azimuth (deg)	130	130	167	167
Exposure (sec)	1/387	1/367	1/422	1/400
Processing Level	Dual Gamma	Dual Gamma	Dual Gamma	Dual Gamma
Vehicle Azimuth (deg)	173°18'	173°25'	172°53'	173°0'
Filter (Wratten)	W/25	SF05	W/25	SF05
Target Type	51/51 T-Bar	51/51 T-Bar	B	B
Target Contrast	5:1	5:1	8.8:1	8.8:1
Weather Conditions	Clear	Clear	Clear	Clear

GROUND RESOLUTION IN FEET AS DETERMINED FROM THE ORIGINAL NEGATIVE

	C				D				
	Along Track		Across Track			Along Track		Across Track	
	Fwd	Aft	Fwd	Aft		Fwd	Aft	Fwd	Aft
Observer 1	6'4.2"	--	10'1"	--	Observer 1	6'1"	--	8'7.3"	--
Observer 2	6'4.2"	--	10'1"	11'3.6"	Observer 2	5'5"	--	8'7.3"	--
Observer 3	6'4.2"	--	10'1"	11'3.6"	Observer 3	6'1"	--	8'7.3"	--

--No Reading Possible.

Target Designator	E		F	
Camera (Looking)	Fwd	Aft	Fwd	Aft
Pass	129D	129D	129D	129D
Frame	12	18	13	19
Date of Photography	15 Aug 68	15 Aug 68	15 Aug 68	15 Aug 68
Universal Grid Coordinates	30.5-0.1	44.9-5.2	30.3-5.2	44.7-0.2
Geographic Coordinates of Format Center	36-24N 115-47W	36-23N 115-51W	36-17N 115-46W	36-16N 115-50W
Altitude (ft)	496,482	495,751	496,358	495,633
Camera				
Pitch (deg)	15°0'	-15°24'	15°0'	-15°24'
Roll (deg)	-0°1'	-0°3'	-0°1'	-0°2'
Yaw (deg)	-2°5'	-2°11'	-2°4'	-2°11'
Local Sun Time	1223	1223	1223	1223
Solar Elevation (deg)	66°57'	66°58'	67°4'	67°5'
Solar Azimuth (deg)	167	167	167	167
Exposure (sec)	1/422	1/400	1/422	1/400
Processing Level	Dual Gamma	Dual Gamma	Dual Gamma	Dual Gamma
Vehicle Azimuth (deg)	172°56'	173°3'	172°57'	173°4'
Filter (Wratten)	W/25	SF05	W/25	SF05
Target Type	C	C	C	C
Target Contrast	9.7:1	9.7:1	9.7:1	9.7:1
Weather Conditions	Clear	Clear	Clear	Clear

GROUND RESOLUTION IN FEET AS DETERMINED FROM THE ORIGINAL NEGATIVE

	E					F			
	Along Track		Across Track			Along Track		Across Track	
	Fwd	Aft	Fwd	Aft		Fwd	Aft	Fwd	Aft
Observer 1	6'10"	--	6'10"	12'2.3"	Observer 1	4'3.8"	12'2.3"	5'5"	10'10.3"
Observer 2	6'1"	--	6'1"	12'2.3"	Observer 2	4'3.8"	12'2.3"	6'10"	10'10.3"
Observer 3	7'8"	--	6'10"	12'2.3"	Observer 3	4'3.8"	12'2.3"	4'10"	10'10.3"

Target Designator	G Fwd	Aft
Camera (Looking)		
Pass	145D	145D
Frame	32	38
Date of Photography	16 Aug 68	16 Aug 68
Universal Grid Coordinates	30.1-1.7	45.1-3.6
Geographic Coordinates of Format Center	33-29N 111-47W	33-28N 111-52W
Altitude (ft)	498,617	498,485
Camera		
Pitch (deg)	14°59'	-15°25'
Roll (deg)	0°5'	0°2'
Yaw (deg)	-2°16'	-2°21'
Local Sun Time	1218	1218
Solar Elevation (deg)	69°48'	69°50'
Solar Azimuth (deg)	166	166
Exposure (sec)	1/421	1/556
Processing Level	Dual Gamma	Dual Gamma
Vehicle Azimuth (deg)	173°23'	173°29'
Filter (Wratten)	W/25	W/21
Target Type	51/51 T-Bar	51/51 T-Bar
Target Contrast	5:1	5:1
Weather Conditions	Clear	Clear

GROUND RESOLUTION IN FEET AS DETERMINED FROM THE ORIGINAL NEGATIVE

	G Along Track		Across Track	
	Fwd	Aft	Fwd	Aft
Observer 1	8'	7'1.5"	12'	12'
Observer 2	8'	7'1.5"	7'1.5"	7'1.5"
Observer 3	8'	7'1.5"	7'1.5"	7'1.5"

Container # 5 Drawer # C Doc # 28

PART IX. ENGINEERING EXPERIMENTS

A. Mission 1104 Experiments: All proposed engineering experiments on Mission 1104 were accomplished as scheduled. However, the bicolor experiment was somewhat limited due to a poor quality SF-05 filter. A description of each experiment is presented below.

1. "Bi-spectral Test": A combination of a Wratten 25 (red filter) and a SF05 (green filter) was used on five passes to obtain conjugate imagery suitable for bicolor presentation.

2. SO-180 Film Type Test: Eight hundred feet of color infrared film (SO-180) was placed at the tail of the fwd-looking camera record.

B. Analysis of Experiments:

1. A detailed analysis on the bi-spectral test performed on Mission 1104 will be included as a special study in a future PER.

2. A detailed report on the Mission 1104, SO-180 Film Type Test is included as a special study in this PER.

C. Scheduled Future Experiments

Mission 1105 Tentative Experiments	SO-121	High Resolution Color Film
Mission 1106 & 1107	Polorizer Through Focus	Winter, Proper Azimuths Stepped Glass Filter

FIGURE 1. BEST IMAGE QUALITY
Image quality comparable to the best of this mission.

FIGURE 2. CORRESPONDING COVERAGE
Corresponding coverage as imaged by the aft-looking camera.

[redacted]

	FIGURE 1	FIGURE 2
Camera	309	308
Pass	16D	16D
Frame	6	12
Date of Photography (GMT)	8 Aug 68	8 Aug 68
Universal Grid Coordinates	33.1-4.1	42.1-1.6
Enlargement Factor	20X	20X
Geographic Coordinates	34-02N 117-26W	34-02N 117-31W
Altitude (ft)	546,390	544,516
Camera Attitude:		
Pitch (deg)	14°41'	-15°45'
Roll (deg)	-0°9'	-0°11'
Yaw (deg)	-2°10'	-2°14'
Local Sun Time	1325	1325
Solar Elevation (deg)	62°58'	63°0'
Solar Azimuth (deg)	130°	130°
Exposure (sec)	1/387	1/367
Vehicle Azimuth (deg)	173°18'	173°25'
Processing Level	Dual Gamma	Dual Gamma

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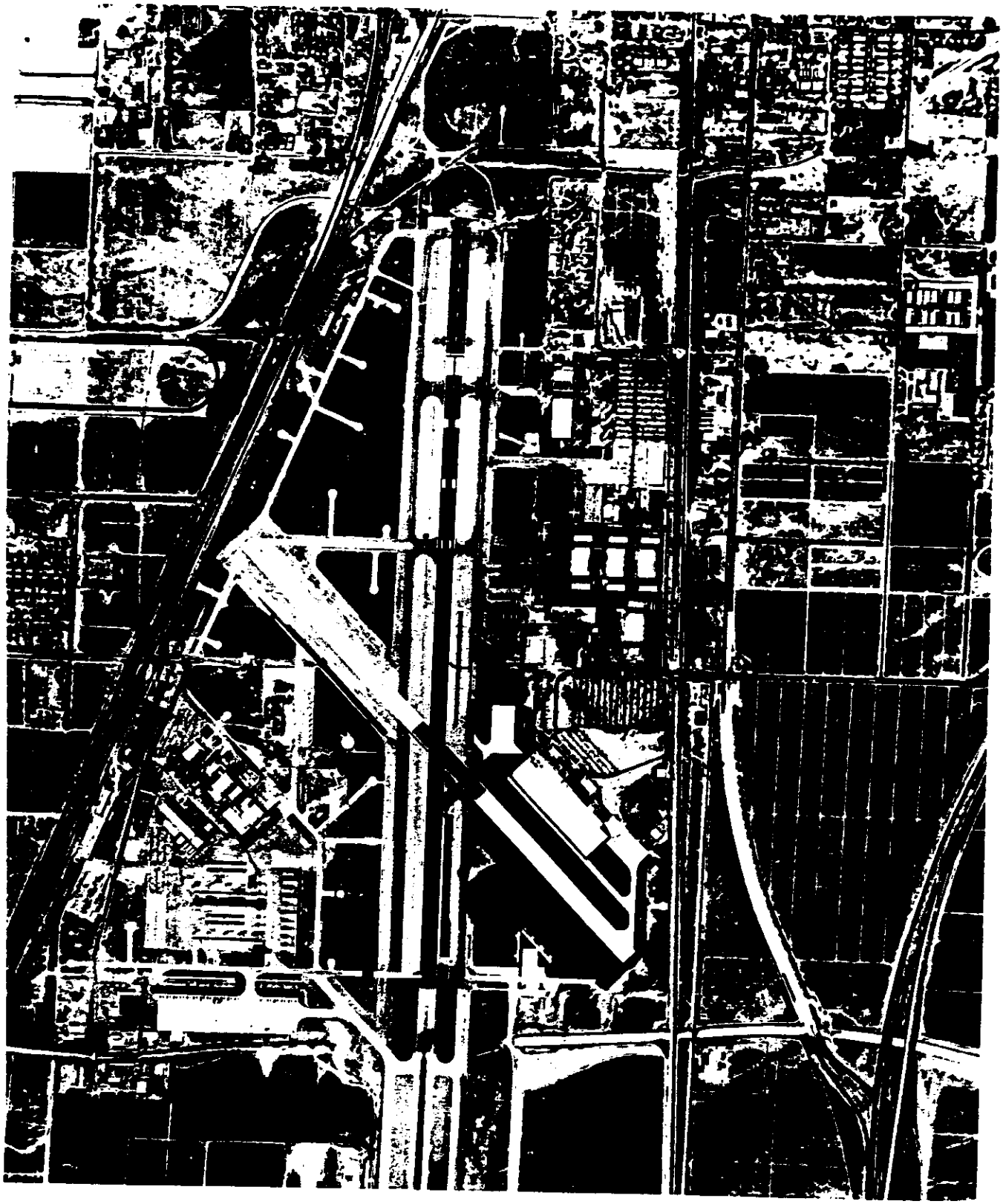

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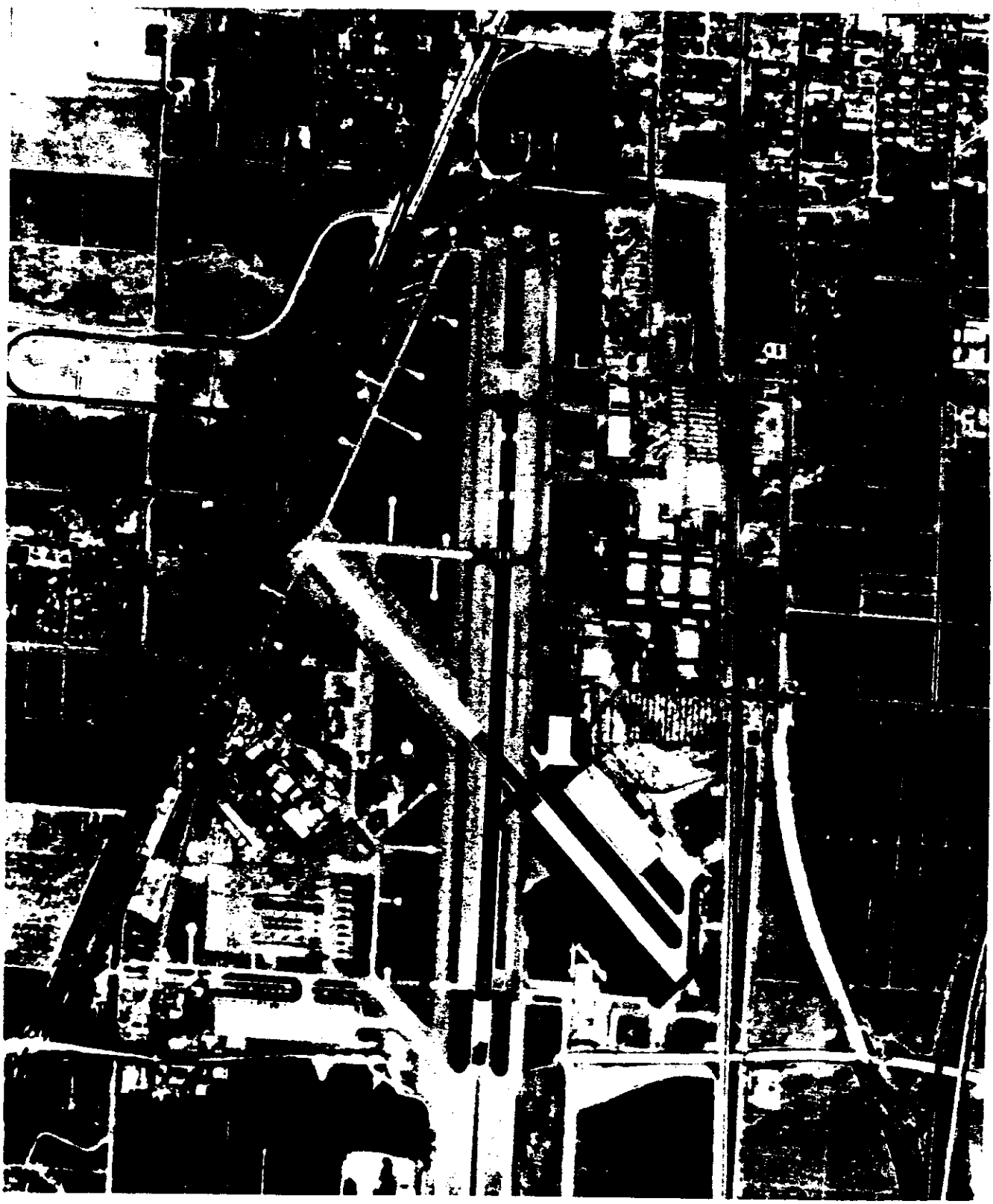

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FIGURE 3. STELLAR FORMAT (MISSION 1104-1)

FIGURE 4. STELLAR FORMAT (MISSION 1104-2)

	FIGURE 3	FIGURE 4
Mission Number	1104-1	1104-2
Pass	70	105
Frames	23P, 29S, 24P	22P, 28S, 23P
Date of Photography	12 Aug 68	12 Aug 68
Enlargement Factor	2.5	2.5
Exposure (sec)	1.5	1.5

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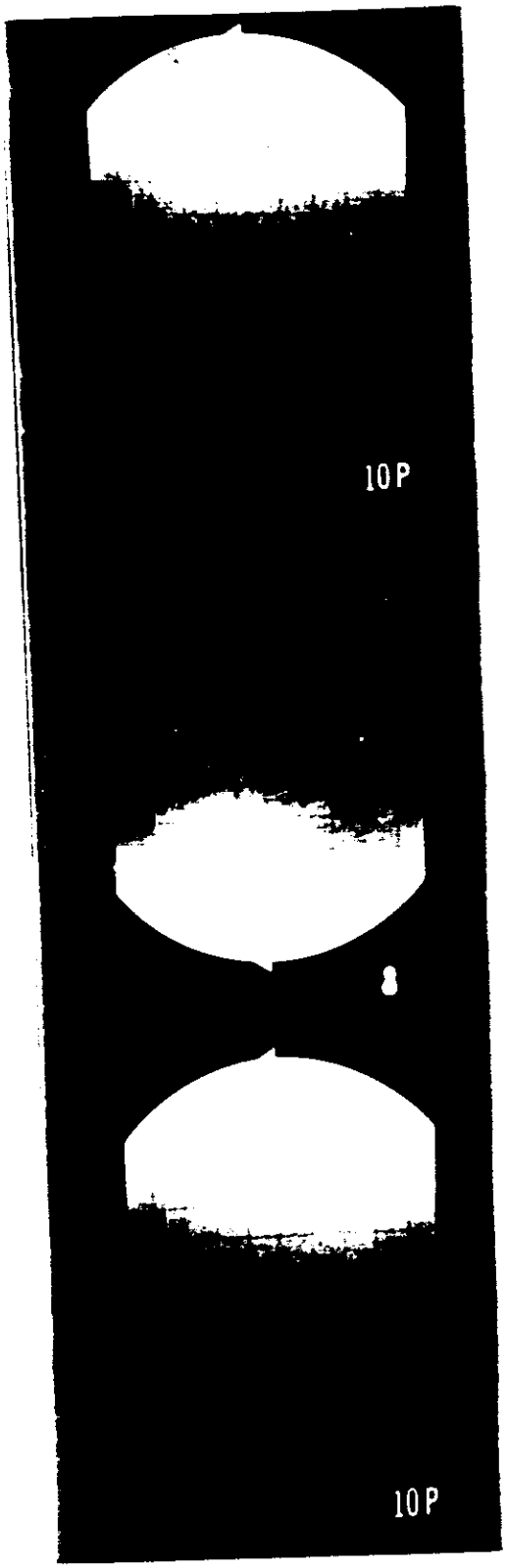

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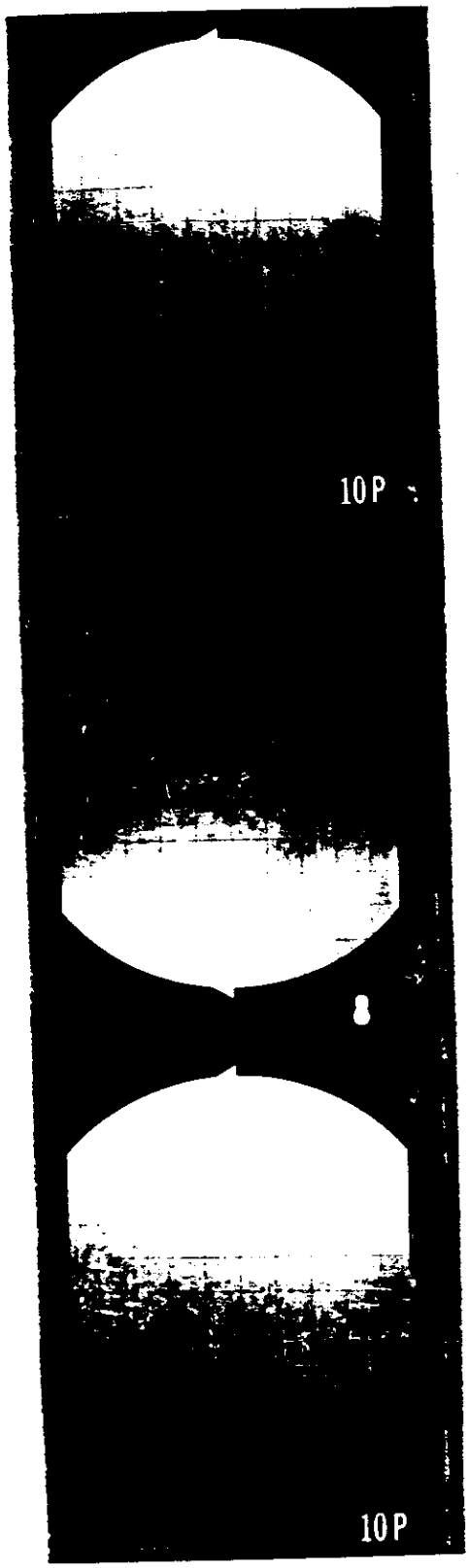

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SPECIAL STUDY

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SO-180 Evaluation

Mission 1104

LIST OF ILLUSTRATIONS

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I INTRODUCTION

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SO-180 EVALUATION

MISSION 1104

I. INTRODUCTION

Extrachrome infrared color film (SO-180) was used in an engineering test at orbital altitudes for the first time during Mission 1104-2. This report presents a comprehensive analysis of the test with regard to the film's characteristics, image quality, and its potential from a technical standpoint.

A. Test Description:

The last 800 feet (301 frames) of the fwd-looking camera film record was SO-180 Ektachrome infrared color film. The SO-180 film was spliced to the end of type 3404 black and white material. It was exposed during acquisitions 20 through 28 of pass 199D, all of passes 200D, 201D, 203D, 210D, 211D, 220D, and frames 1 through 31 of pass 236D. Duplicate area coverage was provided by the aft-looking camera black and white record. Because of the increase in film thickness of SO-180 compared to 3404, (the base thickness of SO-180 is 5.2 mils compared to 2.5 mils for 3404) photographic coverage during passes 215D and 217D was obtained by the aft camera only.

Prior to processing, the time-track edge of the color film was flashed with filtered light to decrease the density along the film edge. This allowed the standard edge titling technique to be used while retaining the auxiliary data. The color film was processed in the Grafton machine without incident. Reproductions of the original were made on SO-271 duplicate color stock and disseminated to customers according to standard requirements.

B. Characteristics of SO-180

SO-180 film is an infrared sensitive, false color, reversal color material. The spectral sensitivity, contrast, and dye composition are designed for detection of reflected infrared radiations, such as from live vegetation. The film will generally differentiate between green painted objects and live green plant life: This it is used for camouflage detection or assessment of crop vigor, and so forth. The following is a cross-sectional design of the film:

Infrared Sensitive Layer - Cyan Positive Image
Green Sensitive Layer - Yellow Positive Image
Red Sensitive Layer - Magenta Positive Image
Base

Note: All photographic emulsions are sensitive to blue radiation which necessitates the use of techniques to control this sensitivity. A yellow filter normally included in reversal color films, to filter out unwanted blue light, is not included in SO-180 film; however, compensation is made by using a yellow filter in the camera lens optical path.

C. System/Film Compatability

The engineering test proved the compatability of SO-180 film with this camera system. However, the increased sensitivity of SO-180 compared to 3404 film causes it to be more susceptible to extraneous light. Because of the prevailing environment at orbital altitudes, corona static will occur during camera operations unless the pressure is maintained at a proper level. To create the needed pressure, a pressure make-up (PMU) unit is used within the orbiting vehicle. During this mission, the regulator on the PMU system malfunctioned. As a result, corona static occurred, causing extensive fogging. The degradation to the color material is severe and is described in detail in PART II of this report.

This test proved not only that SO-180 film is compatable with this camera system but also that the film (in this quantity) can be processed, reproduced, and disseminated on a priority basis. The knowledge made possible from this engineering test can be applied to the state-of-the art in planning for present and future systems.

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II FILM
DEGRADATIONS

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II. FILM DEGRADATIONS

A. Physical Degradations

Longitudinal base and emulsion scratches are present intermittently throughout the SO-180 material. These scratches are slightly more pronounced than those present on the 3404 film; however, little degradation results. Emulsion lifts are prominent along the titled edge of the film and, at times, are present in the format. Splices and associated handling marks are located within frame 66, pass 203D, and frame 4, pass 210D.

B. Imaged Degradations

The faster speed of SO-180 as compared to 3404 makes it more susceptible to fog in association with extraneous light. Therefore, fog patterns associated with camera-off periods are more pronounced on the SO-180 film than on the 3404 film.

The most pronounced degradation to the SO-180 is a red cast of fog of varying saturation, attributed to corona static. This fog is of definite concern in that it adds to the already existing problems in interpreting the imaged information. Warm colors are exaggerated by the fog whereas the saturation of cold colors is reduced. The tonal range and the degree of hue separation is especially limited in the more severely affected areas.

The entire SO-180 record was viewed frame-by-frame to determine the quantity of degradation caused by corona static. All frame formats and their respective percentage of fog degradation are listed in the following table. The percentage figures represent subjective estimates and should be used accordingly. The "E" in the percent column refers to the area outside the format and simply infers that fog is also present in that area.

Pass	Frame	Corona Fog (Percent)
199	20	75E
	21	75E
	22	65E
	23	60E
	24	25E
	25	10
	26	7E
	27	3
	28	3
200	1	0
	2	2
	3	2
	4	10
	5	5
	6	5
	7	E
	8	E
	9	E
	10	E
	11	E
	12	E
	13	E
	14	E
	15	E
	16	E
	17	E
	18	E
	19	E
	20	E
	21	E
	22	E
	23	5
	24	2
	25	1
	26	15
	27	10
	28	10
	29	E
	30	E
	31	E
	32	E
	33	E
	34	E

Pass	Frame	Corona Fog (Percent)
	35	E
	36	E
	37	E
	38	E
	39	E
	40	E
	41	E
201	1	E
	2	5
	3	2
	4	10
	5	15
	6	10
	7	10
	8	5
	9	5
	10-41	0
	42	10
	43	10
	44	10
	45	5
	46	5
	47	30
	48	30
	49	30
	50	25
	51	20
	52	15
	53	10
	54	5
	55	5
	56	5
	57	10
	58	10
	59	5
	60	10
	61	15
	62	15
	63	15
	64	10
	65	15
	66	10
	67	5

Pass	Frame	Corona Fog (Percent)	Pass	Frame	Corona Fog (Percent)
	68	5		40	0
	69	5		41	3
	70	0		42	3
	71	0		43	30
203	1	E		44	30
	2	7		45	25
	3	2		46	15
	4	7		47	15
	5	10		48	12
	6	10E		49-63	10
	7	5E		64	5
	8	5E		65	10
	9	5E		66	5
	10	5E		67	10
	11	5E		68	10
	12	7E		69	15
	13	5E	210	1	5E
	14	2E		2	15E
	15	2E		3	2
	16	2E		4	5E
	17	2E		5	5
	18	5E		6	25E
	19	2E		7	30E
	20	2E		8	35E
	21	5E		9	35E
	22	E		10	55E
	23	E		11	55E
	24	E		12	60E
	25	E		13	60E
	26	E		14	50E
	27	E		15	50E
	28	E		16	50E
	29	E		17	50E
	30	E		18	45E
	31	E		19	45E
	32	E		20	60E
	33	E		21	50E
	34	E		22	60E
	35	10E		23	60E
	36	E		24	60E
	37	15		25	70E
	38	5	211	1	50E
	39	0		2	50E