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TECHNICAL PUBLICATION

NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

PHOTOGRAPHIC EVALUATION REPORT MISSION 1107

SPECIAL STUDIES:

MISSION INFORMATION POTENTIAL 1100 SERIES

EFFECTS OF CONJUGATE IMAGERY LOSS MISSION 1107

[redacted]
MARCH 1970
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PHOTOGRAPHIC EVALUATION REPORT

MISSION 1107

MARCH 1970

NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

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GLOSSARY OF TERMS

ALTITUDE: Vertical distance from the vehicle to the Hough Ellipsoid at the time of exposure.

APOGEE: That point in an elliptical orbit of a satellite at which the distance is greatest between the orbiting body and the surface of the Hough Ellipsoid.

BINARY TIME WORD: Binary presentation of the accumulated system time.

DATE OF PHOTOGRAPHY: The day, month, and year (GMT) that the photography was acquired.

DISIC Dual Improved Stellar Index Camera.

ECCENTRICITY: A measure of the deviation of an ellipse from a true circle, expressed by dividing the distance between the foci of the ellipse by the length of its major axis.

EXPOSURE TIME: Time during which a light-sensitive material is subjected to the influence of light. Expressed in this text in fractions of a second. Formula:

$$\text{Exposure time (sec)} = \frac{\text{slit width (in)}}{\text{scan rate (radians per sec)}}$$

FIDUCIAL MARK: A standard geometrical reference point imaged within the frame of a photograph. The intersection of the primary fiducial marks usually defines the intersection of the principal ray with the focal plane.

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.

FORMAT: The portion of the frame that contains imagery produced by the primary optical system of the camera.

*FRAME: A single exposure which contains the format and peripheral border information relevant to the format.

GENERATION: Number of reproductive steps by which a negative or positive photographic copy is separated from the original scene, ie., the original negative is generation one, a positive made from the original negative is generation two, etc.

*GROUND RESOLUTION: Minimum distance (expressed as bar plus space) between two adjacent linear features, which can be detected by a photographic system, as determined from standard three-bar resolution targets. A target is considered to be resolved when a grouping of three bars can be distinguished as three distinct lines. The image of the lines need not have linear form.

HOUGH ELLIPSOID: A reference ellipsoid around the earth having a semimajor axis of 20,925,738.18 feet and a semiminor axis of 20,855,588.20 feet.

IMAGE MOTION COMPENSATION (IMC): A correction made to compensate for relative image motion at the camera focal plane.

INCLINATION: The angle between the orbital and equatorial planes measured counterclockwise from the equatorial plane to the orbital plane with the acending node as the vertex.

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*Defined differently than in the Glossary of NPIC Terminology.

INTERPRETABILITY: (PHOTOGRAPHIC) Suitability of the imagery with respect to answering requirements on a given type of target. Various factors affect interpretability such as halation, uncompensated image motion, poor contrast, incorrect focus, improper film processing, atmospheric conditions (both natural and manmade), ground resolution, and insufficient natural or artificial lighting of the target. The three levels of interpretability are:

Poor Interpretability (P) - Unsuitable to adequately answer requirements on a given type of target.

Fair Interpretability (F) - Suitable for answering requirements on a given type of target but with only average detail.

Good Interpretability (G) - Suitable for answering requirements on a given type of target in considerable detail.

INDEX CAMERA: A framing camera used to record terrain imagery. The product is used for relative orientation and mapping purposes.

LOCAL SUN TIME: Time of day computed from the position of the sun relative to the imaged terrain.

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.

PAN GEOMETRY DOTS: Images of the rail holes associated with the pan geometry calibration of the camera.

PANORAMIC CAMERA: Photographs a partial or complete panorama of the terrain in a transverse direction through a scanning motion of the lens system.

PASS:	Photographic portion of an orbital revolution. Prefix "D" indicates the descending node; Prefix "A" indicates the ascending node; Prefix "M" indicates a continuous camera operation from the ascending node through the descending node. Suffix "E" indicates photography generated for engineering purposes.
PERIGEE:	That point in an elliptical orbit of a satellite at which its distance is nearest the surface of the Hough Ellipsoid.
PERIOD:	The time required for a satellite to complete one revolution about the earth.
PITCH:	Rotation of the camera about its transverse axis. Positive pitch indicates nose-up attitude.
PRINCIPAL RAY:	That ray of light which emanates from a point in object space and passes undeviated through the center of curvature of a lens surface. It is coincident with the optical axis of the lens.
RELATIVE ORIENTATION:	Determining (analytically or in a photogrammetric instrument) the position and attitude of one of a pair of overlapping photographs with respect to the other photograph.
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.
SOLAR ELEVATION:	The angular distance to the sun measured from a plane tangent to the earth at the intersection of the principal ray of the camera and the earth.

STELLAR CAMERA:	A framing camera which records stellar images. The product is used in conjunction with the Index Camera for attitude determination.
UNIVERSAL GRID:	An X, Y, coordinate system used to define image location on photographic formats.
VEHICLE GROUND TRACK AZIMUTH:	Clockwise horizontal angle measured from the longitudinal meridian's intersection of the earth's surface to the vehicle's 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.

SYNOPSIS

Mission 1107, a two-part satellite reconnaissance mission, was launched at 0131Z, 24 July 1969. The first capsule was recovered from the water on rev 147 at 0425Z, 2 August 1969. The second capsule was recovered via air catch on rev 308 at 0013Z, 12 August 1969.

The forward-looking camera failed on pass 1D and remained inoperative throughout the mission. The aft-looking camera operated properly throughout the mission. The overall quality and interpretation suitability of the mission are rated as fair. The quality is better than an average 1000 series mission, but not as good as the average 1100 series mission. Two factors contributing to the fair interpretability rating are higher than normal acquisition altitudes and lack of stereoscopic coverage.

An MIP of 95 has been assigned to frame 30 of aft pass 122D.

Approximately 70 percent of the mission is cloud free.

The Dual Improved Stellar Index Cameras (DISIC) operated through pass 281 at which time the index camera failed. The stellar cameras failed on pass 282. The index camera used a new f/6.3 lens and provided the best quality imagery to date.

PART I. GENERAL SYSTEM INFORMATION

A. Camera Numbers

Forward-Looking Panoramic Camera	315
Aft-Looking Panoramic Camera	314
DISIC Camera	11

B. Launch and Recovery Dates

	(Mission 1107-1)	(Mission 1107-2)
Launch	24 Jul 69/0131Z	*
Recovery	2 Aug 69/0425Z	12 Aug 69/0013Z
Recovery Rev	147D	308D

C. Orbit Elements

Element	Actual Mission 1107-1 Rev	Actual Mission 1107-2 Rev 149	Photo Range	Pass
Period (min)	88.450	88.447	*	*
Perigee (nm)	99.3	99.6	91.6	298D
Apogee (nm)	128.7	126.1	112.3	9A
Eccentricity	.00352	.00304	*	*
Inclination (deg)	74.98	74.98	*	*
Perigee Latitude	20° 37'N	17° 49'N	*	*

*Not applicable

D. Photographic Operations

1. Panoramic Cameras

Type	Mission 1107-1 Revs	Mission 1107-1 Frames	Mission 1107-2 Revs	Mission 1107-2 Frames	TOTAL Revs	TOTAL Frames
Operational						
Fwd	1	7*	0	0	1	7
Aft	43	2,579	46	2,937	89	5,516
Operational/Domestic						
Fwd	-	-	-	-	-	-
Aft	-	-	-	-	-	-
Domestic						
Fwd	-	-	-	-	-	-
Aft	10	374	7	152	17	526
Engineering (no imagery)						
Fwd	-	-	-	-	-	-
Aft	0	0	1	6	1	6
TOTALS						
Fwd	1	7*	-	-	1	7
Aft	53	2,953	54	3,095	107	6,048

2. Secondary Cameras

Camera	Frames
Stellar (1107-1)	1,913 Starboard; 1,905 Port
Index (1107-1)	1,922
Stellar (1107-2)	1,863 Starboard; 1,864 Port
Index (1107-2)	1,823

*The first five frames were recovered in bucket 1, the last two in bucket 2.

E. Film Usage

Camera	Film Load (TOTAL)	Pre-Flight Footage	Total Processed Footage	Film Type
Fwd-Looking (1107-1)	16,300*	318	325	3404 3401**
Aft-Looking (1107-1)	16,300*	216	8,067	3404
Fwd-Looking (1107-2)	NA	NA	5***	3404
Aft-Looking (1107-2)	NA	NA	8,143	3404
Stellar (1107-1)	2,000*	52	578	3401
Stellar (1107-2)	NA	NA	528	3401
Index (1107-1)	2,200*	67	850	3400
Index (1107-2)	NA	NA	812	3400

*Total load for both buckets.
**Last 100 feet.
NA - Not applicable.
***Part of rev 1D.

PART II. CAMERA OPERATION

A. Fwd-Looking Panoramic Camera

The fwd-looking camera failed during pass 1D. Due to this failure, only four complete frames and 7 inches of another frame were recovered in the first bucket and two partial frames (frame 7 and 8 of pass 1D totaling 50 inches) were recovered in the second bucket. Part of frame 5, all of frame 6, and part of frame 7 were not recovered because this material was located in the area of the film path between the two buckets. Under normal conditions this film is wound back into the second bucket; but in this case the take-up spool of the second bucket could not rotate, so the film between the two buckets was not recovered. Extensive analysis of the material that was recovered did not reveal any clue to the cause of failure. Analysis of telemetry indicated the status of several functions but did not reveal the cause of the anomaly. Two possible causes of the failure have been hypothesized by the Performance Evaluation Team: 1) film restriction or film velocity reduction at the shuttle input; 2) film restriction at the supply cassette.

B. Aft-Looking Panoramic Camera

This camera was operational throughout the mission.

C. Horizon Cameras

1. Fwd-Looking Port and Starboard Cameras: Operated properly on the seven frames recovered.

2. Aft-Looking Port and Starboard Cameras: Cameras were non-operational until frame 15 of pass 8D due to an absence of shutter commands. Thereafter they were operational throughout the mission.

D. DISIC

The DISIC unit experienced a system stall during passes 281 and 282. The most probable cause of the stall was the introduction of a drag on both the stellar and index films. Both the stellar and index films exhibit static markings, unique to the second part of the mission, which began immediately after cut and splice. The static markings indicate an abnormal condition in the 1107-2 film path which is considered pertinent to the eventual stall near the end of the mission. It was noted that the 1107-2 end of the index film cut was anomalous. About one inch of serrated teeth was missing at one end of the cut. Adjacent to this, about 1 1/2 inches exhibited missing or damaged teeth. The opposite end of the cut had ripped and crushed film for a distance of about 1/2 inch. This condition could have occurred in flight or when opening the SRV after recovery. The probable sequence of events leading to the anomaly is as follows:

1. An abnormality in the 1107-2 film path produced severe marking.

2. A drag connected with item 1 was applied to both films.

3. The excessive hold-back load on the index film eventually exceeded the pulling force supplied by the index take-up and resulted in a stall; the stellar take-up continued to operate.

4. Finally, enough film slack was produced by the still operating camera body to result in the metering/pinch roller picking up a loose fold and wrapping enough slack film to produce an index metering roller stall. This condition was then reflected through the drive train to result in a complete DISIC stall.

With equal drag per unit width of film, the index take-up would stall before the stellar take-up. The decreasing tension supplied by the take-ups with increasing film load would make this failure more likely toward the end of a mission.

A subsequent investigation of the DISIC film paths did not provide any evidence or indications that the film path components contributed to the DISIC system stall.

1. Stellar Camera: The stellar camera was operational through starboard frame 24 and port frame 29 of pass 282, at which time the stellar camera failed. Due to the orbit, a high level of solar illumination was present at the starboard lens, so the starboard camera capping shutter was closed for approximately 90 percent of the mission.

2. Index Camera: The index camera failed after frame 1 of pass 281.

PART III. IMAGE ANALYSIS

A. Fwd-Looking Panoramic Camera

1. Density: Undetermined because of the limited amount of material recovered.

2. Contrast: Undetermined because of the limited amount of material recovered.

3. Image Quality: Undetermined because of the limited amount of material recovered. Ninety percent of the material recovered was cloud covered.

4. Image Degradations: Undetermined because of the limited amount of material recovered.

5. Physical Degradations: There were several emulsion lifts and pinholes throughout the recovered material.

B. Aft-Looking Panoramic Camera

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

2. Contrast: The contrast of the original negative is generally medium.

3. Image Quality: The overall image quality of the mission is rated as fair. A subtle out-of-focus appearance is apparent at magnifications of 50x and above. The image quality is poorer than an average 1100 series mission but better than an average 1000 series mission. During the first half of the mission, the imagery at the take-up end of the frame is of slightly better quality than that at the supply end, and the imagery along the data block edge is of slightly better quality than that along the frequency mark edge. On the second half of the mission the imagery along the data block edge is of slightly better quality than that at the frequency mark edge; however, no difference in image quality was noted between the take-up and supply end of the format. An MIP of 95 has been assigned to frame 30A of pass 122D on the first half of the mission; an MIP of 95 has been assigned to frame 20A of pass 170D on the second half of the mission.

4. Imaged Degradations:

a. Light Leaks: A double spur-like fog pattern is present along the titled edge of the fourth frame of most passes (see graphic 1, page 10). This fog pattern was caused by a light leak at a corner of the forward camera drum and was present on the first half of the mission only. A fog pattern, evidenced by a relatively sharp increase in density near the center of the format and gradually diminishing toward the end of the format, it present on the sixth frame from the end of most passes (see graphic 2, page 10). This fog pattern was probably due to a light leak at the latch of the 1107-1 recovery bucket interface. Again, this fog pattern was only noted on the first half of the mission.

b. Static: A few instances of dendritic static were noted at the time track edge of the material during the second half of the mission. Degradation to the imagery is insignificant.

c. Other: A subtle longitudinal plus-density mark is present along the time track edge. This mark is only occasionally detectable.

5. Physical Degradations: None noted.

C. Stellar Camera

1. Density: The density of the port frames is suitable for the detection of stellar images. The density of the starboard frames at the beginning of the mission is excessive; however, the density decreases to a level suitable for the detection of stellar images as the mission progresses.

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

3. Image Shape: The stellar images on all frames after the second frame of each operation are generally point type. The stellar images in the first two frames are elongated due to excessive vehicle roll during the dependent operations. The excessive roll was caused by the start-up of the aft camera.

4. Images Per Frame: Approximately 15 to 25 stellar images are detectable on most port frames. On the few starboard frames acquired, approximately seven stellar images are detectable.

5. Image Degradations:

a. Light Leaks: Fogging associated with an apparent light leak around the capping shutter is present on most starboard frames. This light leak is illustrated in Figure 3.

b. Static: Minor to severe intermittent dendritic and corona static marking occurred throughout the mission. These markings vary in density and frequency. More occurred during the second half of the mission than the first.

c. Other: Plus density pressure plate marks are present on most frames.

5. Physical Degradations: None noted.

D. <u>Index Camera</u>

1. Density: The density is generally medium to heavy.

2. Contrast: The contrast is generally medium.

3. Image Quality: The image quality of the index record is good and the best obtained from this system. This camera used the first f/6.3 lens which has replaced the f/4.5 lens.

4. Imaged Degradations:

a. Light Leaks: None noted.

b. Static: Minor to severe dendritic and corona static markings are present intermittently throughout the mission. They vary in density and frequency. Degradation to the second half of the mission is more severe than to the first half. These markings often enter the format 2 to 3 inches.

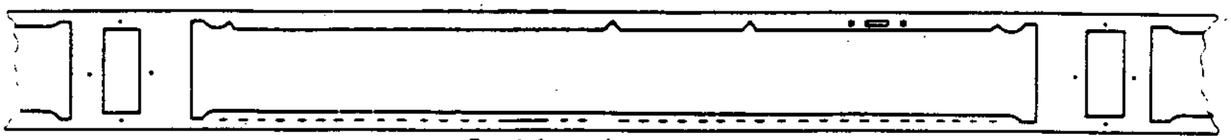
c. Other: Several minus density spots are present on all index frames. They are caused by foreign matter adhering to the reseau plate.

5. Physical Degradation: None noted.

E. Graphic Display

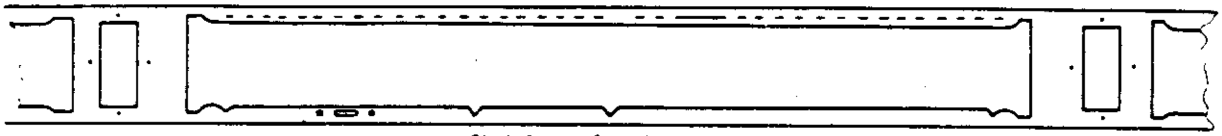
The patterns illustrated below are referenced in the text of this report.

Graphic 1



Fourth frame of most passes

Graphic 2



Sixth frame of most passes

PART IV. IMAGED AUXILIARY DATA

A. Fwd-Looking Panoramic Camera

1. Horizon Cameras

a. Starboard-Looking

(1) Imagery: Clear and distinct.

(2) Fiducials: Sharp and well defined.

b. Port-Looking

(1) Imagery: Clear and distinct.

(2) Fiducials: Sharp and well defined.

2. Frequency Marks: Imaged properly.

3. Binary Time Word: Imaged properly on the material recovered.

4. Camera Number: Readable.

5. Pan Geometry Dots: Sharp and well defined.

6. Nodal Traces: Sharp and well defined throughout the mission.

B. Aft-Looking Panoramic Camera

1. Horizon Cameras

a. Starboard-Looking

(1) Imagery: Clear and distinct.

(2) Fiducials: Sharp and well defined.

b. Port Looking

(1) Imagery: Clear and distinct.

(2) Fiducials: Sharp and well defined.

2. Frequency Marks: Imaged properly.

3. Binary Time Word: Imaged properly throughout the mission.

4. Camera Number: Readable.

5. Pan Geometry Dots: Sharp and well defined on the time word edge. Slightly elongated on the frequency mark edge.

6. Nodal Traces: Sharp and well defined throughout the mission.

C. Stellar Cameras

1. Grid Image Quality: Sharp and well defined.

2. Binary Time Word: Imaged properly throughout the mission.

3. Lens Serial Number Legibility: Readable.

D. Index Camera

1. Grid Image Quality: Sharp and well defined.

2. Binary Time Word: Imaged properly throughout the mission.

3. Camera Number Legibility: Readable.

PART V. MENSURATION QUALITY

Ninety-one individual requests for mensuration support were answered without problem during the initial readout of this mission. The image quality is considered good from a mensuration standpoint; the mensuration quality is comparable to recent missions of this system.

PART VI. FILM PROCESSING

A. Processing Machines and Process Gamma

Camera	Machine	Average Gamma	Film Type
Fwd (1107-1)	Yardleigh	1.95	3404
Aft (1107-1)	Yardleigh	1.94	3404
Fwd (1107-2)	Yardleigh	1.90	3404
Aft (1107-2)	Yardleigh	1.88	3404
Stellar (1107-1)	Trenton	2.10	3401
Stellar (1107-2)	Trenton	2.15	3401
Index (1107-1)	Drape	1.74	3400
Index (1107-2)	Drape	1.82	3400

B. Processing Technique

1. Panoramic Cameras: Both camera records were processed with the dual gamma single level viscous process.

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. Primary Cameras

a. Capsule De-Filming

(1) Mission 1107-1: Recovered from the water; however, no moisture was detected inside the capsule. No problems were encountered during the de-filming operation of 1107-1.

(2) Mission 1107-2: De-filmed on the West Coast and received at the processing site in suitcases.

b. Pre-Processing Inspection: No problems encountered.

c. Manufacturing Splices: Manufacturing splices are located in the following positions:

Pass	Frame
20D	62 Aft
89D	33 Aft
153D	38 Aft
215D	3 Aft

A material change detector (MCD) was located 25 feet from the end of the mission material. Portions of frames 73 and 74 of Pass 298D were not imaged due to the MCD.

d. Processing Anomalies: None noted.

e. Breakdown: No problems encountered.

2. Secondary Cameras

a. Capsule De-Filming: No problems encountered.

b. Pre-Processing Inspection: No problems encountered.

c. Manufacturing Splices: None.

d. Processing Anomalies: None noted.

e. S/I Correlation: No problems encountered.

D. Timetable

Film	Recovered	Received at Processing Site	Spec Ship at NPIC	Priority 1A At NPIC
Fwd (1107-1)	2 Aug 69/0425Z	2 Aug 69/2240Z	None	4 Aug 69/0959Z
Aft (1107-1)	"	"	"	"
Stellar (1107-1)	"	"	"	"
Index (1107-1)	"	"	"	"
Fwd (1107-2)	12 Aug 69/0013Z	12 Aug 69/2120Z	None	14 Aug 69/1238Z
Aft (1107-2)	"	"	"	"
Stellar (1107-2)	"	"	"	"
Index (1107-2)	"	"	"	"

PART VII. PI SUITABILITY

A. PI Statistics

1. Target Coverage

	1107-1	1107-2	Total
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	128	127	245

2. Photographic Interpretability Ratings

Rating	Missiles	Nuclear Energy	Air Facilities	Ports	Military Activity	Other
Good	6	0	2	7	6	0
Fair	89	5	52	4	33	7
Poor	48	3	20	1	11	1
Totals*	143	8	74	12	50	8

3. Summary of Photographic Interpretability Ratings

Good: 21 or 7 percent
Fair: 190 or 64 percent
Poor: 84 or 29 percent

B. PI Comments

1. Atmospheric Attenuation: The photo interpreter's report of weather conditions for Priority 1 targets covered on this mission is as follows:

a.	Clear:	164	or	56 percent
b.	Scattered Clouds:	81	or	27 percent
c.	Heavy Clouds:	28	or	9 percent
d.	Haze:	17	or	6 percent
e.	Cloud Shadow:	5	or	2 percent

* A discrepancy can exist between the total number of targets covered and the total PI reports because some targets are covered more than once.

2. Product Interpretability: The photo interpretability of Mission 1107 is fair. The effectiveness of the mission was reduced by the higher than normal acquisition altitudes and the lack of stereo. A discussion concerning the loss of conjugate imagery is presented as a special study in this report.

PART VIII. RESOLUTION TARGET DATA

A new mobile resolution target, designated the Vernier T-bar, was deployed for this mission. It has a ground resolution range of seven to ten feet in half-foot intervals. This ground resolution range supplements the second (ground resolution of 12 ft) and third (ground resolution of 8 ft) bar groups of the 51-51 T-bar resolution target. This target will be deployed for all future missions.

Vernier T-Bar Resolution Target

Contrast: 5:1

Dimensions:

Group No.	Width (ft)	Length (ft)
1	5.00	25.00
2	4.75	23.75
3	4.50	22.50
4	4.25	21.25
5	4.00	20.00
6	3.75	18.75
7	3.50	17.50

PART VIII RESOLUTION TARGET DATA

	A	B	C
Target Designator			
Camera (Looking)	Aft	Aft	Aft
Pass	A9E	A74E	A74E
Frame	24	14	14
Date of Photography	24 Jul 69	28 Jul 69	28 Jul 69
Universal Grid Coordinates	35.7 - 3.8	36.0-4.2	36.0-4.2
Geographic Coordinates of Format Center	33-38N 114-11w	43-46N 120-48W	43-46N 120-48W
Altitude (ft)	677,241	660,184	660,184
Camera			
Pitch (deg)	-15° 31'	-15° 20'	-15° 20'
Roll (deg)	0° 10'	0° 14'	0° 14'
Yaw (deg)	3° 10'	2° 39'	2° 39'
Local Sun Time	0648	0615	0615
Solar Elevation (deg)	17° 56'	13° 0'	13° 0'
Exposure (sec)	1/245	1/288	1/288
Process	Dual Gamma	Dual Gamma	Dual Gamma
Vehicle Ground Track Azimuth (deg)	15° 22'	18° 44'	18° 44'
Filter (Wratten)	W/21	W/21	W/21
Target Type	51-51 T-Bar	51-51 T-Bar	Vernier T-bar
Target Contrast	5:1	5:1	5:1
Weather Conditions	Scattered Clouds	Clear	Clear

GROUND RESOLUTION IN FEET AS DETERMINED FROM THE ORIGINAL NEGATIVE AND SECOND GENERATION DUPLICATE POSITIVE

Observer		A Along Track	A Across Track	B Along Track	B Across Track	C Along Track	C Across Track
1	ON	16	16	12	12	8	8
	DP	16	NR	12	12	NR	NR
2	ON	16	16	12	12	8.5	8.5
	DP	NR	NR	16	16	NR	NR
3	ON	16	16	12	16	9.5	9
	DP	16	NR	12	16	NR	9.5

PART VIII RESOLUTION TARGET DATA

Target Designator	D	E	F	G
Camera (Looking)	Aft	Aft	Aft	Aft
Pass	129D	129D	242D	242D
Frame	6	6	11	11
Date of Photography	31 Jul 69	31 Jul 69	7 Aug 69	7 Aug 69
Universal Grid Coordinates	31.9-3.8	31.9-3.8	30.6-0.8	30.6-0.8
Geographic Coordinates of Format Center	43-54N 123-17W	43-54N 123-17W	43-10N 124-29W	43-10N 124-29W
Altitude (ft)	585,384	585,384	580,598	580,598
Camera				
Pitch (deg)	-15° 30'	-15° 30'	-15° 20'	-15° 20'
Roll (deg)	-0° 31'	-0° 31'	0° 3'	0° 3'
Yaw (deg)	-2° 25'	-2° 25'	-2° 26'	-2° 26'
Local Sun Time	1530	1530	1400	1400
Solar Elevation (deg)	40° 57'	40° 57'	54° 5'	54° 5'
Exposure (sec)	1/351	1/351	1/588	1/588
Process	Dual Gamma	Dual Gamma	Dual Gamma	Dual Gamma
Vehicle Ground Track Azimuth (deg)	161° 33'	161° 33'	161° 50'	161° 50'
Filter (Wratten)	W/21	W/21	W/21	W/21
Target Type	51-51 T-Bar	Vernier T-Bar	51-51 T-Bar	Vernier T-Bar
Target Contrast	5:1	5:1	5:1	5:1
Weather Conditions	Clear	Clear	Clear	Clear

GROUND RESOLUTION IN FEET AS DETERMINED FROM THE ORIGINAL NEGATIVE AND SECOND GENERATION DUPLICATE POSITIVE

Observer		D Along Track	D Across Track	E Along Track	E Across Track	F Along Track	F Across Track	G Along Track	G Across Track
1	ON	12	12	8.5	NR	8	12	9	9
	DP	12	16	10	NR	12	12	NR	NR
2	ON	12	16	9.5	NR	12	12	8	8.5
	DP	16	16	10	NR	12	12	10	9.5
3	ON	12	12	10	NR	12	12	9	9
	DP	12	16	NR	NR	12	12	8	9

PART VIII RESOLUTION TARGET DATA

Target Designator	H	I
Camera (Looking)	Aft	Aft
Pass	274D	274D
Frame	16	16
Date of Photography	9 Aug 69	9 Aug 69
Universal Grid Coordinates	32.3 - 0.9	32.3 - 0.9
Geographic Coordinates of Format Center	42-55N 118-20W	42-55N 118-20W
Altitude (ft)	565,907	565,907
Camera		
Pitch (deg)	-15° 24'	-15° 24'
Roll (deg)	0° 15'	0° 15'
Yaw (deg)	-2° 25'	-2° 25'
Local Sun Time	1335	1335
Solar Elevation (deg)	56° 58'	56° 58'
Exposure (sec)	1/591	1/591
Process	Dual Gamma	Dual Gamma
Vehicle Ground Track Azimuth (deg)	161° 56'	161° 56'
Filter (Wratten)	W/21	W/21
Target Type	51-51 T-Bar	Vernier T-Bar
Target Contrast	5:1	5:1
Weather Conditions	Clear	Clear

GROUND RESOLUTION IN FEET AS DETERMINED FROM THE ORIGINAL NEGATIVE AND SECOND GENERATION DUPLICATE POSITIVE

Observer		H Along Track	H Across Track	I Along Track	I Across Track
1	ON	8	12	7.5	8.5
	DP	12	12	9.5	10
2	ON	8	12	8	8.5
	DP	12	12	9.5	9.5
3	ON	8	12	8	8.5
	DP	12	12	8	9

NR - Not resolved

[redacted]

[redacted]

~~TOP SECRET RUFF~~

~~NO FOREIGN DISSEM~~

[redacted]

PART IX. MISSION DATA

	FWD PAN	FWD TAKE-UP HORIZON	FWD SUPPLY HORIZON	AFT PAN	AFT TAKE-UP HORIZON	AFT SUPPLY HORIZON	STELLAR PORT	STELLAR STARBOARD	INDEX
Camera Number	315	*	*	314	*	*	*	*	*
Reseau Number	*	*	*	*	*	*	7P	14	113
Lens Serial Number	I 208	315G3	315G4	I 191	314G1	314G2	7P	14	113
Slit Position/ Slit Widths (in)	1/0.168	*	*	1/0.122	*	*	*	*	*
	2/0.215	*	*	2/0.160	*	*	*	*	*
	3/0.268	*	*	3/0.204	*	*	*	*	*
	4/0.335	*	*	4/0.255	*	*	*	*	*
	FS/0.298	*	*	FS/0.219	*	*	*	*	*
Aperture		F/8	F/6.3		F/6.3	F/8	F/2.8	F/2.8	F/6.3
Exposure Time (sec)	Variable	1/100	1/100	Variable	1/100	1/100	1.5	1.5	1/250 or 1/500
Filter (Wratten) Primary	W/23A	W/25	W/25	W/21	W/25	W/25	None	None	W/12
Alternate	21	*	*	SFO-5	*	*	*	*	*
Focal Length (mm)	24.002	54.83	55.00	24.003	55.00	55.00	76.2	76.2	76.2
Film Length (ft)	16,200-100	*	*	16,300	*	*	2,000		2,200
Splices	7 mylar	*	*	6 Permacel	*	*	None		None
Emulsion	3404-441-5-7-9 3401-309-2	*	*	3404-442-10-7-9	*	*	14 VC-1212-4-9		3400-202-4-4-9
Film Type	3404-3401	*	*	3404	*	*	3401		3400
Resolution Data (L/mm)		▲ 166R ▲ 187T	▲ 187R ▲ 166T		▲ 187R ▲ 187T	▲ 187R ▲ 187T	NA	NA	+ 144R + 114T
Static							NA	NA	
High Contrast	★ 299	NA	NA	★ 278	NA	NA	NA	NA	NA
Low Contrast	★ 281	NA	NA	★ 151	NA	NA	NA	NA	NA
Dynamic									
I High Contrast	▲ 283	NA	NA	★ 226	NA	NA	NA	NA	NA
I Low Contrast	▲ 198	NA	NA	★ 136	NA	NA	NA	NA	NA
P High Contrast	▲ 303	NA	NA	★ 268	NA	NA	NA	NA	NA
P Low Contrast	▲ 207	NA	NA	★ 141	NA	NA	NA	NA	NA

NA - Not available.
* - Not applicable.
R - Radial resolution on axis.
T - Tangential resolution on axis.
★ - Resolution tested using a W/21 filter.
▲ - Resolution tested using a W/25 filter.
\+ - Resolution tested using a W/12 filter, 3400 type film, and a high contrast target.

PART X. MISSION INFORMATION POTENTIAL (MIP)
HISTORY, 1100 SERIES

MISSION	MIP#	PASS	FRAME	UNIVERSAL GRID COORD	
1101	85	159D	2Fwd	39.0	1.5
1102*	90	16D	22 Fwd	26.8	1.3
1103	90	79D	15 Fwd	41.8	3.8
1104*	115	16D	6 Fwd	33.1	4.1
1105*	95	16D	20 Aft	47.3	1.2
1106*	110	32D	8 Fwd	17.9	1.8
1107	[illegible]	122D	30 Aft	43.7	2.4

* MIP STANDARD

* MIP Standard

FIGURE 1. MIP SELECTION, MISSION 1107-1

(AFT CAMERA)

This is an example of the best image quality obtained on this mission.

	Figure
Camera	314
Pass	122D
Frame	30 Aft
Date of Photography (GMT)	31 Jul 69
Universal Grid Coordinates	43.7-2.4
Enlargement Factor	40X
Geographic Coordinates	56-57N 24-28E
Altitude (ft)	600,901
Camera Attitude:	
Pitch (deg)	-15° 49'
Roll (deg)	0° 2'
Yaw (deg)	-1° 31'
Local Sun Time	1451
Solar Elevation (deg)	40° 3'
Exposure (sec)	1/338
Filter	W/21
Vehicle Ground Track Azimuth (deg)	153° 50'
Process	Dual Gamma

[redacted]

FIGURE 2. INDEX CAMERA QUALITY

This is an example of the image quality of the index camera.

FIGURE 2

Mission	1107-1
Pass	122
Frame	6
Date	31 Jul 69
Enlargement Factor	1.5X
Exposure (sec)	1/500

Handle Via
Talent-KEYHOLE
Control System Only

[redacted]

FIGURE 3. STELLAR LIGHT LEAK

Stellar format illustrating the light leak around the capping shutter of the starboard camera imaged during the first part of the mission.

FIGURE 3

Mission	1107-1
Pass	26
Frame	33P, 39S, 34P
Date of Photography	25 Jul 69
Enlargement Factor	2X
Exposure (sec)	1.5

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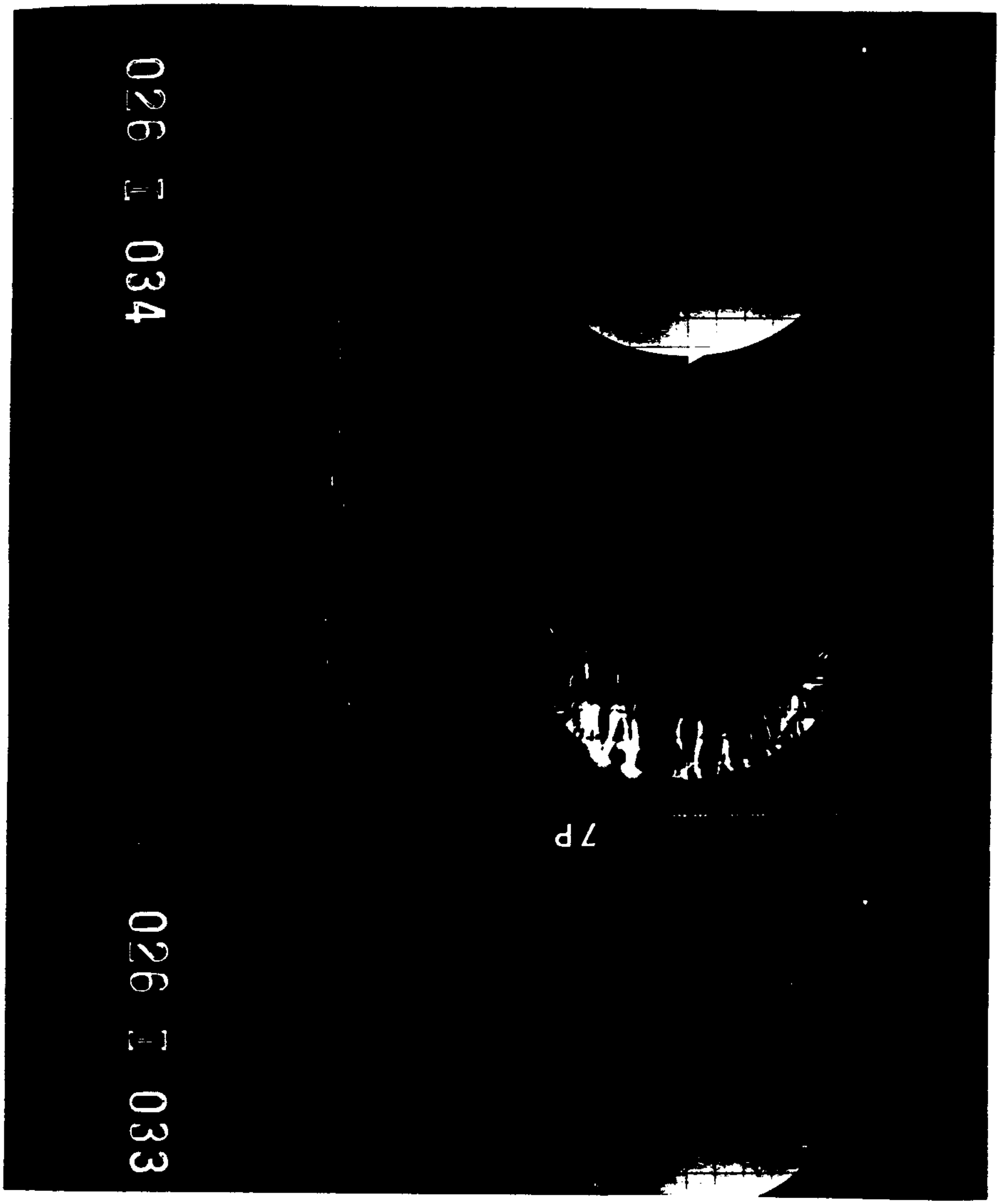
[redacted]



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FIGURES 4 AND 5. STELLAR STATIC PATTERNS

Stellar format illustrating static patterns that were imaged during the second half of the mission.

	FIGURE 4	FIGURE 5
Mission	1107-2	1107-2
Pass	205	268
Frame	31S, 26P, 33S	41S, 36P, 42S
Date	5 Aug 69	9 Aug 69
Englargement Factor	2X	2X
Exposure (sec)	1.5	1.5

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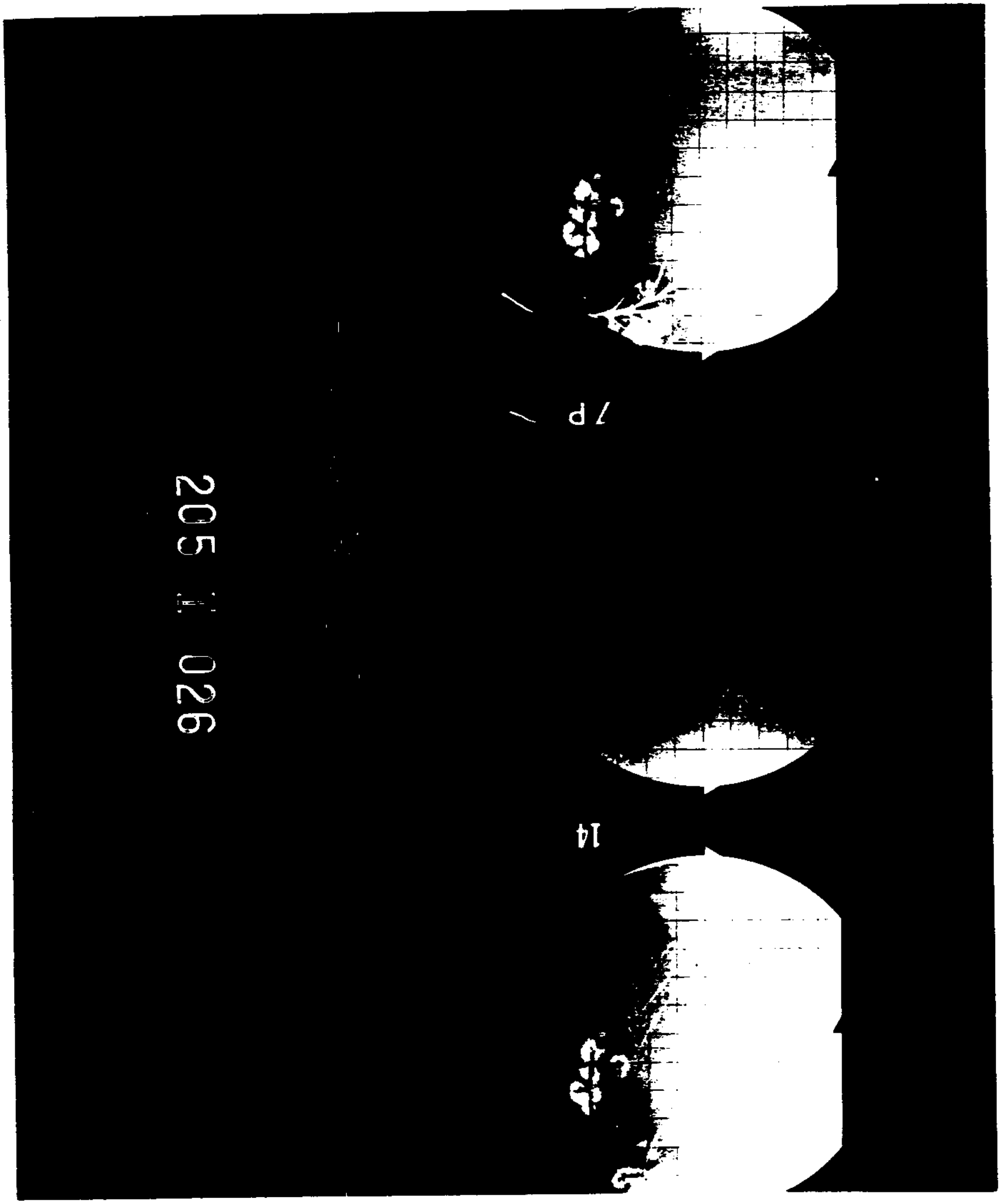
[redacted]



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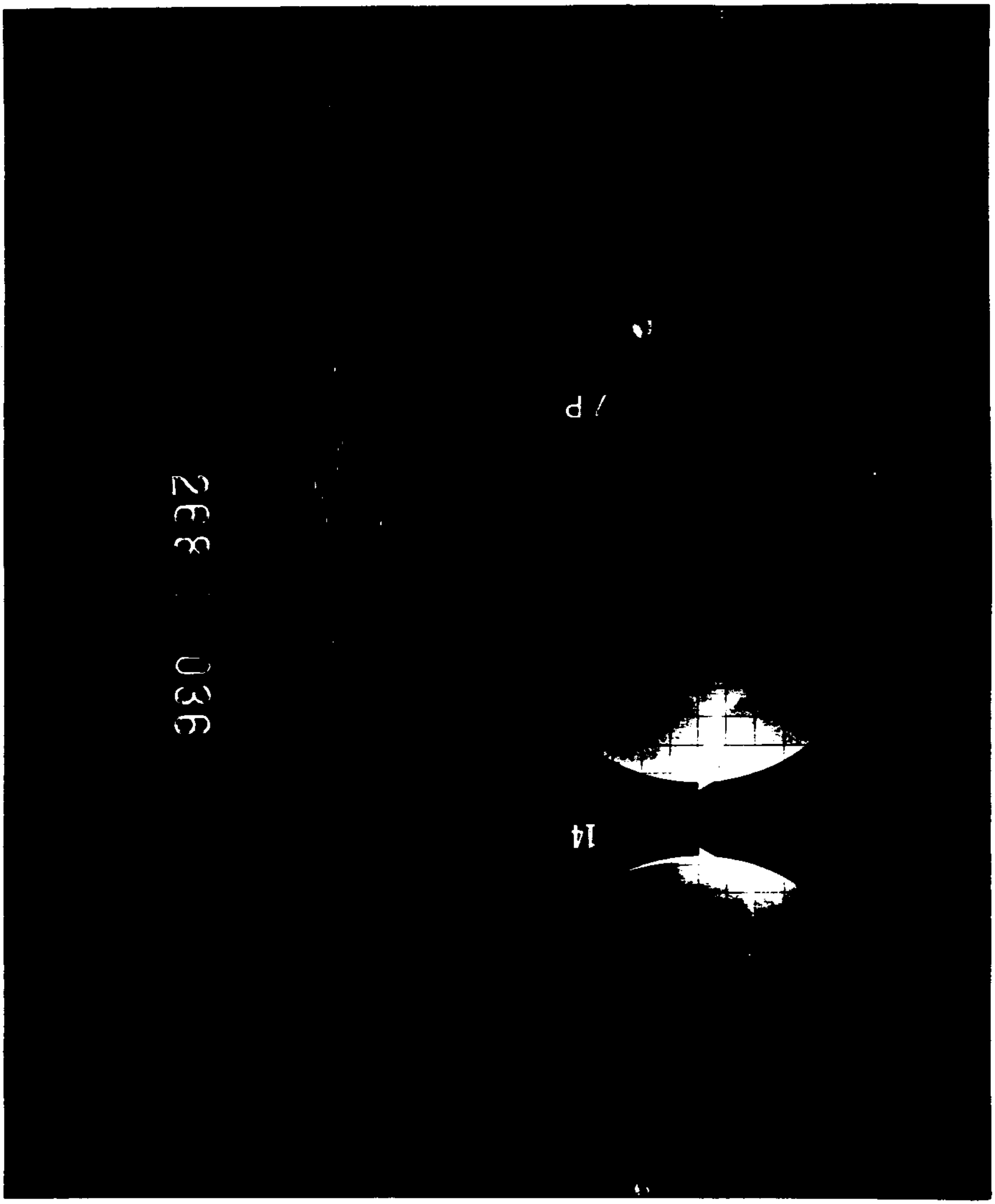
[redacted]



MISSION INFORMATION POTENTIAL
1100 SERIES

TABLE OF CONTENTS

I. DEFINITION OF MISSION INFORMATION POTENTIAL

The Mission Information Potential (MIP) rating indicates the quality of the best photography obtained by a mission. It is representative of the camera system's maximum capability for recording information as demonstrated by the actual imagery obtained from the mission. The MIP rating assigned to a mission is indicative solely of the camera system's photographic capability exclusive of degradations which are not caused by the camera system. The selected photography constitutes only a portion of a frame and does not, in any case, indicate the success, quality, or PI suitability of the mission as a whole--only the camera system's maximum effort.

The following criteria are employed in the selection of a suitable MIP example:

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

(b) The selected areas should be at or near center of format in order to minimize the effects of obliquity and similar distortive factors.

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

(d) Overexposed or underexposed photography is not suitable for MIP selections.

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

(f) Above all, the photography must be representative of the best obtained on the mission and the aforementioned criteria may be compromised when necessary to fulfill this requirement.

II. THE MIP SYSTEM

The MIP rating system was originated on the 9000 series missions and continued through the 1000 series. In actual practice the NPIC breakdown team selects the best or a representative sample of the best photography of each mission. This sample is intended as an indicator of the camera system potential for that particular mission and is not meant to be representative of overall mission success or quality. It is meant only to show the best quality obtained on a particular mission for quality control purposes and to provide a base for comparison of other photography obtained on that mission.

On the 1000 series missions it was customary to relate the quality of a present mission to a recent prior mission, so the assignment of a quality rating was based on an ever-changing standard. This led to a drift in the quality for a particular MIP rating and resulted in a broad/overlapping value of quality for the 80 and 85 MIP ratings. This study was undertaken to eliminate this problem and establish standard procedures for assigning MIP ratings to the 1100 series missions.

III. TEST STANDARDIZATION

A. EQUIPMENT

Previous attempts to rate the MIP chips of the 1000 series missions were reviewed and sample testing of the 1100 series chips was conducted. The following equipment, modifications, and specifications were established for continued use:

1 An American Optical Comparison Microscope will be employed as the viewing instrument.

2 Magnification levels utilized will be either 40X or 100X at the option of the observer. (Most observers prefer to use the 100X magnification for quality determination.)

3 The point source illumination of the A.O. Comparison Microscope will be subdued by means of a diffusion sheet placed between the stages and the MIP chips. The diffusion material is required to alter the illumination of the A.O. Microscope to more closely resemble the illumination of the light tables utilized by the photographic interpreters.

4 The MIP chips will be prepared in accordance with the following specifications:

(a) A second generation contact duplicate positive of the MIP area will be mounted between two sheets of 3 1/4 - x 4-inch cover glass.

(b) The mounted chip will be masked so that only the MIP area can be observed.

(c) The MIP area will be defined by a 1/4-inch-diameter circle cut out of the chip mask. Should additional image area be required in order to contain the specific image items employed in the analysis, a second 1/4-inch circular area will be permitted. But the total image area will not exceed the area contained by two 1/4-inch circular openings in the chip mask. (A 1/4-inch-diameter circle on the contact duplicate is equal in area to approximately one square mile on the ground.)

(d) The chip will be masked so that when viewed from the masked side the emulsion of the film record will be toward the viewer.

(e) The masked chip will be viewed with the mask side (film emulsion) toward the observer.

(f) The side of the mounted chip opposite the mask side will contain the following data:

(1) Mission number

(2) Pass

(3) Frame, camera (fwd or aft)

(4) MIP value assigned

(5) STD if the chip is an MIP value standard

(g) No marking of any description will be made on the masked side of the chip.

(h) Two identical sets of MIP chips will be assembled and maintained. One set will be kept at NPIC, the other at the processing site.

(i) During the testing program, the MIP chips were identified by a randomly assigned alphabetic designation. Once assigned, a correlation between the code letter and the mission number was not permitted until after all testing and analysis had been accomplished. Any bias which may have been introduced by prior knowledge of the chip and mission number relationship was thus eliminated.

E. PROCEDURES

In establishing the test plan and procedures to be utilized in this study, previous test parameters were analyzed for effectiveness, interpretability, and meaning. The ground rules were then discussed with an experimental psychologist and altered to fit a sound testing program.

The initial plan of utilizing samples from both cameras and both portions of all 1100 missions and some 1000 series missions would have been impossible to accomplish in the available time period (prior to Mission 1107). Due to the time factor, reducing the number of comparisons was also necessary. As a result, the test program utilized only the MIP selections from the first mission portions, and unnecessary comparisons (comparing MIPs previously rated as 90 with those rated as 115, etc) were eliminated. Even with this reduced number of samples/comparisons, completion of the test program prior to the flight of Mission 1107 was considered almost impossible. The MIP areas from Missions 1101-1, 1102-1, 1103-1, 1104-1, 1105-1, 1106-1, 1014-1 and 1043-1 were selected for use in this study. Missions 1014-1 and 1043-1 were included to represent the MIP values of 80 and 85, respectively. The total number of combinations to be compared was reduced to sixteen.

The following procedures are considered basic to the test program.

1. The test utilized specific image items on which each observer was required to give a quality decision. This is significant because each evaluator has preferred items on which he bases his determination of image quality. Pre-testing disclosed that an observer's quality decision was, to a certain extent, influenced by the particular item or items upon which he based his judgment. Because of this factor, it was decided that quality decisions should be made by utilizing specific image items. The items chosen were selected as being representative of a cross-section of the image quality determinators present in an average intelligence scene. The following items were chosen for the reasons stated:

(a) Aircraft: A long-time favorite of many image evaluators, aircraft are large enough to permit gross quality decisions and yet they display features which can be employed for fine differentiations in quality.

(b) Small Buildings: These are included as an indication of the imagery to display the form and squareness of corners presented by rectangular, three-dimensional objects on the ground.

(c) Automobiles: Another favorite of the image evaluators, these offer a fairly standard shape and display certain known features in relative positions.

(d) Building Edges: The edges of large buildings were included as a means of introducing a subjective measure of edge sharpness. The quality choice for this item is based solely on the quality or edge sharpness of the edges undergoing comparison.

(e) Runway Markings: Painted numerals indicating runway azimuth are analyzed for their legibility and ease of recognition. The contrast of all numerals with their respective backgrounds must be similar or the comparison is disqualified. Use of the runway markings as an image quality indicator is somewhat comparable to the utilization of high contrast resolution targets. Although specific resolution parameters are unknown, the contrast, features, and interpretability are representative of a comparison of imaged resolution targets.

(f) Overall Quality: This allows the observer to use any criteria, excluding the above items, on which he wishes to base a quality decision. This item was included in order to offer an observer option in the test program.

Of these six items, automobiles and runway markings are scale sensitive, while the others are not necessarily so. The following is an example of the score sheet employed.

Planes		
Small Buildings		
Cars		
Building Edges		
Runway Markings		
Overall Q		

2. Forced choice decisions were required. The evaluator was required to choose the better chip of each pair. No ties were permitted.

3. The presence of a chip on the left or right stage was varied to prevent a possible left-sided or right-sided observer preference.

4. The six imagery items were presented at random, and at no time was the same item employed for successive judgments.

5. Each observer replicated one set of judgments to provide some information with respect to repeatability. The Mission 1104 and 1106 chip pair was chosen for replication due to its high quality and similarity.

6. An example of the sequence utilized for the evaluation follows:

(a) Compare chips A and B using automobiles as the quality criterion. Chip A is on left stage.

(b) Compare chips A and Y using runway markings as the quality criterion. Chip A is on the right stage.

(c) Compare chips A and J using small buildings as the quality criterion. Chip A is on the left stage.

(d) Compare chips A and L using aircraft as the quality criterion. Chip A is on the right stage.

(e) The paired comparisons were:

(1) A & B	(2) A & Y
(3) A & J	(4) A & L
(5) B & D	(6) B & F
(7) B & Y	(8) B & J
(9) B & L	(10) D & Y
(11) D & J	(12) F & Y
(13) F & L	(14) L & Y
(15) D & J	(16) R & L

7. Each pair of chips was compared once for each of the six image items.

8. Certain chips contained no runway markings or automobiles suitable for comparison purposes. These items were thus eliminated from the test program for the paired comparisons containing these chips. Ten comparisons were thus eliminated.

9. Each of the six evaluators made 86 comparisons, totaling 516 comparisons. To prevent observer fatigue, test sessions were limited to three hours or less.

10. The decision sheets of the test procedure are presented in Appendix A.

IV. ANALYSIS OF TEST RESULTS

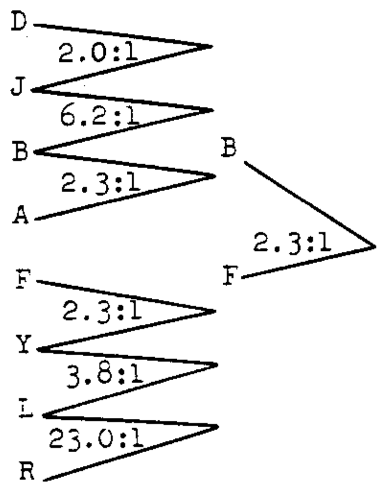
A. The decisions of each evaluator per comparison were totaled and the results are presented below.

CHIP PAIRS

OBSERVERS	A:B	A:Y	A:J	A:L	B:D	B:F	B:Y	B:J	B:L	D:Y	D:J	F:Y	F:L	L:Y	D:J	R:L
1	1:5	4:2	0:6	4:0	0:6	3:3	5:1	0:6	4:0	6:0	4:2	4:2	1:3	3:1	2:4	0:4
2	2:4	4:2	1:5	4:0	0:6	4:2	4:2	1:5	4:0	6:0	1:5	4:2	4:0	0:4	3:3	0:4
3	3:3	6:0	1:5	4:0	0:6	5:1	6:0	1:5	4:0	6:0	4:2	4:2	4:0	1:3	3:3	0:4
4	3:3	5:1	1:5	4:0	0:6	4:2	4:2	1:5	4:0	6:0	4:2	3:3	4:0	0:4	6:0	0:4
5	[illegible]	5:1	[illegible]	4:0	0:6	5:1	6:0	1:5	4:0	6:0	6:0	4:2	4:0	0:4	6:0	0:4
6	[illegible]	4:2	[illegible]	4:0	0:6	4:2	5:1	1:5	4:0	6:0	5:1	6:0	3:1	1:3	4:2	1:3
TOTAL	11:25	28:8	6:30	24:0	0:36	25:11	30:6	5:31	24:0	36:0	24:12	25:11	20:4	5:19	24:12	1:23

B. Utilizing the ratios of the test decision totals, the following ranking was established.

BEST



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The 1000 series MIP 85 value was used as a base for the 1100 series mission ratings. The Y chip (Mission 1043-1), which had previously been rated as an MIP 85, was selected as this base. Employing this value and utilizing the spread of the test score ratios, MIP ratings were accordingly assigned as shown below.

Chip	MIP Value	Mission
D*	115	1104-1
J*	110	1106-1
B*	95	1105-1
A	90	1103-1
F*	90	1102-1
Y*	85	1043-1
L	85	1101-1
R*	80	1014-1

It must be noted that chip R (Mission 1014-1) had been previously rated as an MIP 80. Although the test ratio indicates a lower value would be more accurate, the 80 rating was maintained to avoid rerating the 1000 series missions. It is hoped that this compromise will not be challenged by 1100 series performance.

C. To maintain the rating system thus established, all future mission MIPs will be rated by comparison with the standard MIP chips. The rating scale will be expanded as required and additional standard chips established. The five-increment spacing between standard values (85 to 90; 90 to 95; etc) will be maintained.

D. A mission whose MIP quality falls between two standard values (with five-increment spacing) will be assigned the nearest value.

* MIP Standard

V. SUMMATION

The MIP values of all future 1100 series missions will be determined by the method used during this test procedure. Mission 1107 was the first to be initially rated by this method, and the decision totals of the four breakdown team members are given below. The MIP chip of Mission 1107-7-1 provided only four items suitable for comparison, so preference of 16 per comparison is a perfect score. Mission 1107-2 provided five items suitable for comparison, and thus a preference of 20 represents a perfect score.

1107

MIP Value	Times MIP Chip Preferred	Times 1107-1 Chip Preferred
115	16	0
110	14	2
95	11	5
90	4	12
85	1	15
80	0	16

The closest match was between the 1107-1 chip and the MIP 95 standard, so an MIP of 95 was assigned to Mission 1107-1.

1107-2

MIP Value	Times MIP Chip Preferred	Times 1107-2 Chip Preferred
115	20	0
110	20	0
95	11	9
90	6	14
85	2	18
80	0	20

The closest match was between the 1107-2 chip and the MIP 95 standard, so an MIP of 95 was assigned to Mission 1107-2. The 1107-1 and 1107-2 comparison ratings are given in Appendix B.

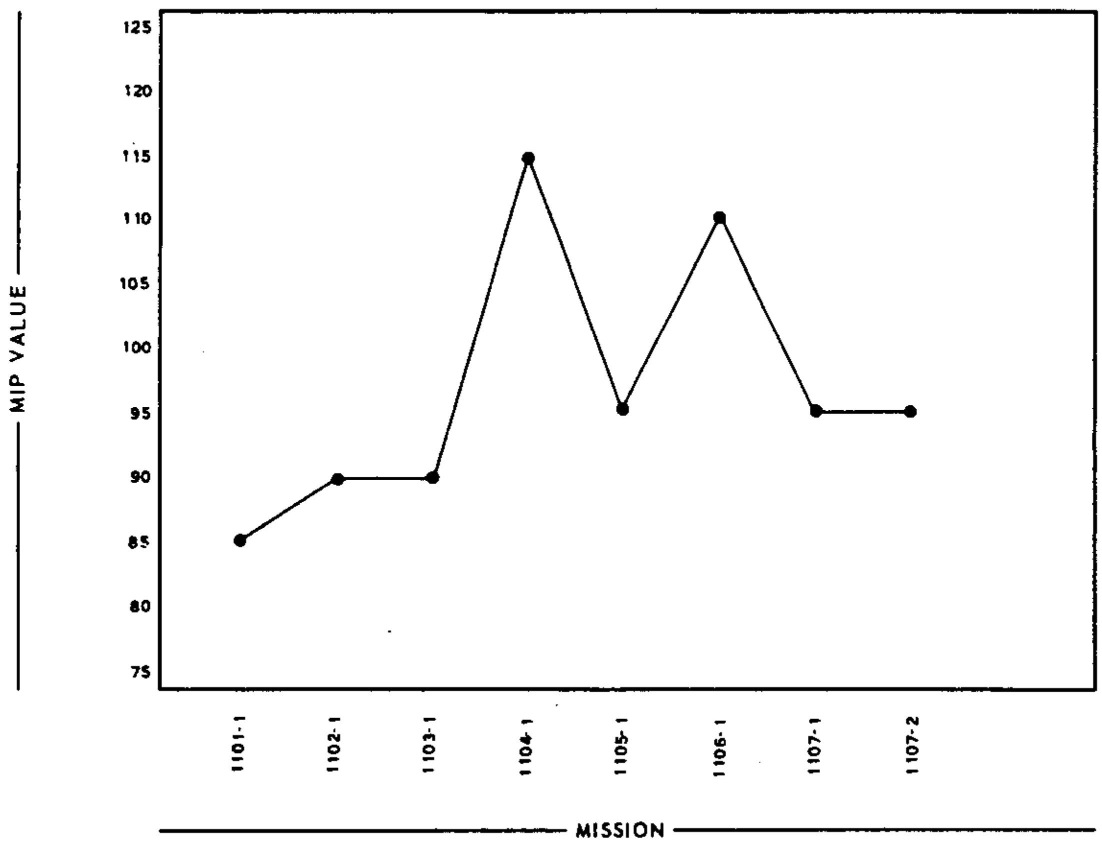
The distribution of the comparison preferences of Missions 1107-1 and 1107-2 substantiates the ranking order of the MIP standards as established. The dispersion also strengthens the rating scale and placement of the five-increment spacing between MIP standard values. We have thus established a set of standard image quality chips, assigned a relative value to each, and devised a methodology by which the MIP quality of future 1100 series missions can be accurately assessed. This accomplishment represents a milestone in the field of image assessment and places a much greater importance and improved reliability on the MIP rating system as it pertains to the 1100 series missions.

This chart summarizes the conclusions of this study.

Revised Value	Mission Number	Previous MIP Value
MIP 115	1104-1*	115
MIP 110	1106-1*	105
MIP 105	None as yet	
MIP 100	None as yet	
MIP 95	1105-1*	100
MIP 90	1102-1*	100
MIP 85	1043-1*	85
MIP 80	1014-1*	80
MIP 85	1101-1	95
MIP 90	1103-1	95
MIP 75	1107-1	--
MIP 95	1107-2	--

* MIP standard

The following graph depicts the MIP history of the 1100 series missions.



APPENDIX A. TEST DECISION SCORE SHEETS
Evaluator 1

	A	B
Planes	X	
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings		X
Overall Q		X

	A	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	A	Y
Planes	X	
Small Buildings		X
Cars	X	
Building Edges		X
Runway Markings	X	
Overall Q	X	

	B	D
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings		X
Overall Q		X

	A	J
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings		X
Overall Q		X

	B	F
Planes		X
Small Buildings	X	
Cars		X
Building Edges		X
Runway Markings	X	
Overall Q	X	

Evaluator 1

	B	Y
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings		X
Overall Q	X	

	D	Y
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

	B	J
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings		X
Overall Q		X

	D	J
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges		X
Runway Markings	X	
Overall Q		X

	B	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	F	Y
Planes		X
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings		X
Overall Q	X	

Evaluator 1

	F	L
Planes		X
Small Buildings	X	
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

	R	L
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

	L	Y
Planes		X
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

Planes		
Small Buildings		
Cars		
Building Edges		
Runway Markings		
Overall Q		

	D	J
Planes		X
Small Buildings	X	
Cars		X
Building Edges		X
Runway Markings	X	
Overall Q		X

Planes		
Small Buildings		
Cars		
Building Edges		
Runway Markings		
Overall Q		

Evaluator 2

	A	B
Planes	X	
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings		X
Overall Q	X	

	A	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	A	Y
Planes	X	
Small Buildings		X
Cars	X	
Building Edges		X
Runway Markings	X	
Overall Q	X	

	B	D
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings		X
Overall Q		X

	A	J
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	X	
Overall Q		X

	B	F
Planes	X	
Small Buildings		X
Cars		X
Building Edges	X	
Runway Markings	X	
Overall Q	X	

Evaluator 2

	B	Y
Planes		X
Small Buildings	X	
Cars	X	
Building Edges		X
Runway Markings	X	
Overall Q	X	

	D	Y
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

	B	J
Planes		X
Small Buildings		X
Cars		X
Building Edges	X	
Runway Markings		X
Overall Q		X

	D	J
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	X	
Overall Q		X

	B	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	F	Y
Planes		X
Small Buildings	X	
Cars	X	
Building Edges		X
Runway Markings	X	
Overall Q	X	

Evaluator 2

	F	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	R	L
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

	L	Y
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

Planes		
Small Buildings		
Cars		
Building Edges		
Runway Markings		
Overall Q		

	D	J
Planes		X
Small Buildings	X	
Cars		X
Building Edges	X	
Runway Markings	X	
Overall Q		X

Planes		
Small Buildings		
Cars		
Building Edges		
Runway Markings		
Overall Q		

Evaluator 3

	A	B
Planes		X
Small Buildings	X	
Cars		X
Building Edges	X	
Runway Markings		X
Overall Q	X	

	A	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	A	Y
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

	B	D
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings		X
Overall Q		X

	A	J
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	X	
Overall Q		X

	B	F
Planes	X	
Small Buildings	X	
Cars		X
Building Edges	X	
Runway Markings	X	
Overall Q	X	

Evaluator 3

	B	Y
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

	D	Y
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

	B	J
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	X	
Overall Q		X

	D	J
Planes	X	
Small Buildings		X
Cars		X
Building Edges	X	
Runway Markings	X	
Overall Q	X	

	B	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	F	Y
Planes		X
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings		X
Overall Q	X	

Evaluator 3

	F	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	R	L
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

	L	Y
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q	X	

Planes		
Small Buildings		
Cars		
Building Edges		
Runway Markings		
Overall Q		

	D	J
Planes		X
Small Buildings	X	
Cars		X
Building Edges	X	
Runway Markings	X	
Overall Q		X

Planes		
Small Buildings		
Cars		
Building Edges		
Runway Markings		
Overall Q		

Evaluator 4

	A	B
Planes	X	
Small Buildings		X
Cars	X	
Building Edges		X
Runway Markings		X
Overall Q	X	

	A	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	A	Y
Planes		X
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

	B	D
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings		X
Overall Q		X

	A	J
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	X	
Overall Q		X

	B	F
Planes		X
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q		X

Evaluator 4

	B	Y
Planes		X
Small Buildings	X	
Cars	X	
Building Edges		X
Runway Markings	X	
Overall Q	X	

	D	Y
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

	B	J
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	X	
Overall Q		X

	D	J
Planes		X
Small Buildings	X	
Cars		X
Building Edges	X	
Runway Markings	X	
Overall Q	X	

	B	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	F	Y
Planes		X
Small Buildings	X	
Cars		X
Building Edges		X
Runway Markings	X	
Overall Q	X	

Evaluator 4

	F	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	R	L
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

	L	Y
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

Planes		
Small Buildings		
Cars		
Building Edges		
Runway Markings		
Overall Q		

	D	J
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

Planes		
Small Buildings		
Cars		
Building Edges		
Runway Markings		
Overall Q		

Evaluator 5

	A	B
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	X	
Overall Q		X

	A	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	A	Y
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges		X
Runway Markings	X	
Overall Q	X	

	B	D
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings		X
Overall Q		X

	A	J
Planes		X
Small Buildings		X
Cars		X
Building Edges	X	
Runway Markings	X	
Overall Q		X

	B	F
Planes	X	
Small Buildings		X
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

Evaluator 5

	B	Y
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

	D	Y
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

	B	J
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	X	
Overall Q		X

	D	J
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

	B	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	F	Y
Planes		X
Small Buildings	X	
Cars		X
Building Edges	X	
Runway Markings	X	
Overall Q	X	

Evaluator 5

	F	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	R	L
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

	L	Y
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

Planes		
Small Buildings		
Cars		
Building Edges		
Runway Markings		
Overall Q		

	D	J
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

Planes		
Small Buildings		
Cars		
Building Edges		
Runway Markings		
Overall Q		

Evaluator 6

	A	B
Planes	X	
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings		X
Overall Q		X

	A	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	A	Y
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges		X
Runway Markings	X	
Overall Q		X

	B	D
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings		X
Overall Q		X

	A	J
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	X	
Overall Q		X

	B	F
Planes	X	
Small Buildings		X
Cars	X	
Building Edges	X	
Runway Markings		X
Overall Q	X	

Evaluator 6

	B	Y
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q		X

	D	Y
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

	B	J
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	X	
Overall Q		X

	D	J
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q		X

	B	L
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	F	Y
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

Evaluator 6

	F	L
Planes	X	
Small Buildings		X
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	R	L
Planes		X
Small Buildings		X
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q		X

	L	Y
Planes	X	
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

Planes		
Small Buildings		
Cars		
Building Edges		
Runway Markings		
Overall Q		

	D	J
Planes		X
Small Buildings		X
Cars	X	
Building Edges	X	
Runway Markings	X	
Overall Q	X	

Planes		
Small Buildings		
Cars		
Building Edges		
Runway Markings		
Overall Q		

APPENDIX B. MISSION 1107 DECISION SCORE SHEETS

1. MISSION 1107-1

Evaluator 1

	1107-1	80
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-1	85
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-1	90
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-1	95
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-1	110
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-1	115
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

Evaluator 2

	1107-1	80
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-1	85
Planes	X	
Small Buildings		X
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-1	90
Planes	X	
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q	X	

	1107-1	95
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q	X	

	1107-1	110
Planes	X	
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-1	115
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

Evaluator 3

	1107-1	80
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-1	95
Planes	X	
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-1	85
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-1	110
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-1	90
Planes		X
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-1	115
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

Evaluator 4

	1107-1	80
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-1	95
Planes	X	
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-1	85
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-1	110
Planes		X
Small Buildings		X
Cars	-	-
Building Edges	X	
Runway Markings	-	-
Overall Q		X

	1107-1	90
Planes	X	
Small Buildings	X	
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q	X	

	1107-1	115
Planes		X
Small Buildings		X
Cars	-	-
Building Edges		X
Runway Markings	-	-
Overall Q		X

2. MISSION 1107-2
Evaluator 1

	1107-2	80
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-2	95
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges		X
Runway Markings	-	-
Overall Q	X	

	1107-2	85
Planes		X
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-2	110
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-2	90
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-2	115
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	-	-
Overall Q		X

Evaluator 2

	1107-2	80
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-2	85
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-2	90
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-2	95
Planes	X	
Small Buildings		X
Cars	X	
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-2	110
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-2	115
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	-	-
Overall Q		X

Evaluator 3

	1107-2	80
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-2	95
Planes		X
Small Buildings	X	
Cars		X
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-2	85
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-2	110
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-2	90
Planes	X	
Small Buildings		X
Cars	X	
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-2	115
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	-	-
Overall Q		X

Evaluator 4

	1107-2	80
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges	X	
Runway Markings	-	-
Overall Q	X	

	1107-2	95
Planes	X	
Small Buildings		X
Cars	X	
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-2	85
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges		X
Runway Markings	-	-
Overall Q	X	

	1107-2	110
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	-	-
Overall Q		X

	1107-2	90
Planes	X	
Small Buildings	X	
Cars	X	
Building Edges		X
Runway Markings	-	-
Overall Q	X	

	1107-2	115
Planes		X
Small Buildings		X
Cars		X
Building Edges		X
Runway Markings	-	-
Overall Q		X

EFFECTS OF CONJUGATE IMAGERY LOSS
MISSION 1107

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

I. INTRODUCTION

The interpretation suitability of Mission 1107 was affected by the loss of conjugate imagery due to the failure of the forward-looking camera on pass 1D. The loss of conjugate imagery eliminated the following photo interpretation advantages:

a. A second look at the target from a different solar azimuth-principal ray relationship.

b. A second photograph for determining speed and direction of moving objects.

c. Stereoscopic coverage. Although Mission 1107 was flown at a higher altitude than previous KH-4B mission, the observations and conclusions of this analysis are related as far as is practical to the lack of conjugate imagery.

II. ADVANTAGES OF CONJUGATE IMAGERY

A. A Second Look-Angle

1. The loss of conjugate imagery eliminated the ability of the photo interpreter to view a target at a different look-angle. As illustrated in Figures 1A and 2A, the aircraft are discernible on the photograph from the aft-looking camera; however, they are very difficult to distinguish on the photograph from the forward-looking camera. This phenomenon is a direct result of the relationship between the camera look-angle and solar position.

2. A second photograph taken from a slightly different camera position and look-angle can provide a less obstructed view of the target. Figures 3A and 4A illustrate how cloud/camera position relationship differences between the forward and aft exposures can yield a more complete look at the target.

B. Determination of Speed and Direction

The time lapse between forward and aft exposures enables the interpreter to determine the speed and direction of moving objects. This was particularly significant on the readout of Mission 1107 because of the interest in troop movement to the Sino-Soviet border. Because of the loss of conjugate imagery, speed and direction of moving objects could not be determined on this mission.

1. Approximately 13 trucks/tanks were detected randomly spaced on a Chinese highway near the Sino-Soviet border; a convoy was also present farther down the highway (see Figure 5A). Without a second look-angle photo interpreters could not determine whether the vehicles were stragglers from the convoy or local traffic.

2. A train was located on the Trans-Siberian RR; however, neither the speed nor the direction of travel could be determined (see Figure 6A).

C. Stereoscopic Coverage

1. **Examples of Relief Loss:**

The following examples are indicative of the problems associated with the loss of relief perception due to monoscopic coverage.

a. Plans for a nuclear test at Lop Nor are usually indicated by an increased number of tents in the area. Tent color blends with the terrain, and tents are very difficult to detect without the relief afforded by stereo (see Figure 7A).

b. Many of the small defensive positions and revetments that are present along the Sino-Soviet border are difficult to detect without stereo. This area is routinely searched in stereo.

c. At King Hussein Airfield in Jordan construction is underway on hangarettes or revetments. Exact identification of the type of construction could not be made due to the lack of stereo coverage (see Figure 8A).

d. At the Lomonosov Nuclear Power Plant in the USSR, new construction is now primarily in a vertical direction. Without stereo, it is very difficult to determine construction progress (see Figure 9A).

e. Activity at Kostroma ICBM Complex, USSR, was interpreted as a possible new launch site. Without stereo the PI could not determine whether this activity was only heavy vehicular earth scarring or actual excavation activity (see Figure 10A).

f. At Tartu Nuclear Weapons Storage Facility, USSR, new construction is underway, but without stereo photo interpreters could not determine construction progress (see Figure 11A).

g. It was very difficult to identify and count aircraft at Rostov Airfield, USSR (see Figure 12A).

h. At Nizhneudinsk Army Barracks near the Sino-Soviet border, approximately 900 vehicles were present in the vehicle parking areas at the beginning of the summer (1969). On Mission 1107, 9 August 1969, only 50 vehicles were counted. The PIs felt that a more positive count could have been made with stereo coverage. Without stereo it was difficult to differentiate between vehicles and discolorations on the surface of the parking lot (see Figure 13A).

i. At Sredne-Belaya Army Barracks, USSR, it was difficult to determine whether the helicopters were HIP or HOUND. The PI reported them as HOUND because HIP have not been seen at Sredne-Belaya. Also, an accurate count of the helicopters could not be made (see Figure 14A).

j. Delta-wing and swept-wing aircraft were difficult to differentiate at Hatserim Airfield, Israel (see Figure 15A).

k. At Tyuratam Launch Complex J, USSR, there was interest in pad damage associated with a launch accident, particularly whether or not a crater resulted. Stereo viewing was accomplished by using the coverage of the target from two mono passes (see Figures 16A and 17A).

2. General Comments

a. A few measurements are made from KH-4 stereo, but most technical intelligence mensuration requirements are answered by using [redacted] photography. However, if KH-4 photography is the only coverage available, stereo coverage is very desirable.

b. When a PI uses KH-4 photography to search for targets, he usually uses coverage from only one camera until an area of interest is located. Then stereo viewing is used to analyze the target.

c. The following general comments were made by the PIs concerning the absence of stereo coverage:

(1) Some targets rated as "possible" would have been rated as "probable" with stereo.

(2) Whenever a change occurs to a target, the loss of stereo is very detrimental.

(3) An accurate count of objects is much more difficult without the relief afforded by stereo coverage.

III. SUMMARY AND CONCLUSION

The following points summarize the advantages of conjugate imagery:

1. A second look at a target from a different camera position can provide the interpreter with a less obstructed view of the target.

2. Conjugate imagery enables the interpreter to determine speed and direction of moving objects.

3. Conjugate imagery and subsequent stereo coverage enable the PI to make a more accurate and detailed analysis of the target.

The National Photographic Interpretation Center concludes that it is an absolute necessity to have stereo coverage if we are to answer the COMIREX requirements as they now stand.

FIGURE 1A. AIRCRAFT NOT READILY DISCERNIBLE

FIGURE 2A. AIRCRAFT ARE READILY DISCERNIBLE

	FIGURE 1A	FIGURE 2A
Mission.	1052	1052
Pass	145	145
Frame.	7 Fwd	7 Aft
Date of Photography (GMT).	1 Oct 69	1 Oct 69
Universal Grid Coordinates	50.1-12.8	41.5-10.3
Enlargement Factor	40X	40X
Geographic Coordinates (format center)	43-32N 116-21W	43-31N 116-25W
Altitude (ft).	597,957	597,345
Camera Attitude:		
Pitch (deg)	14° 56'	-14° 53'
Roll (deg).	-0° 11'	-0° 18'
Yaw (deg)	ND	ND
Local Sun Time	1204	1204
Solar Elevation (deg).	42° 21'	42° 23'
Exposure (sec)	1/300	1/397
Filter	w/23A	w/21
Vehicle Azimuth (deg)	175°38'	175°47'
Process.	Dual Gamma	Dual Gamma

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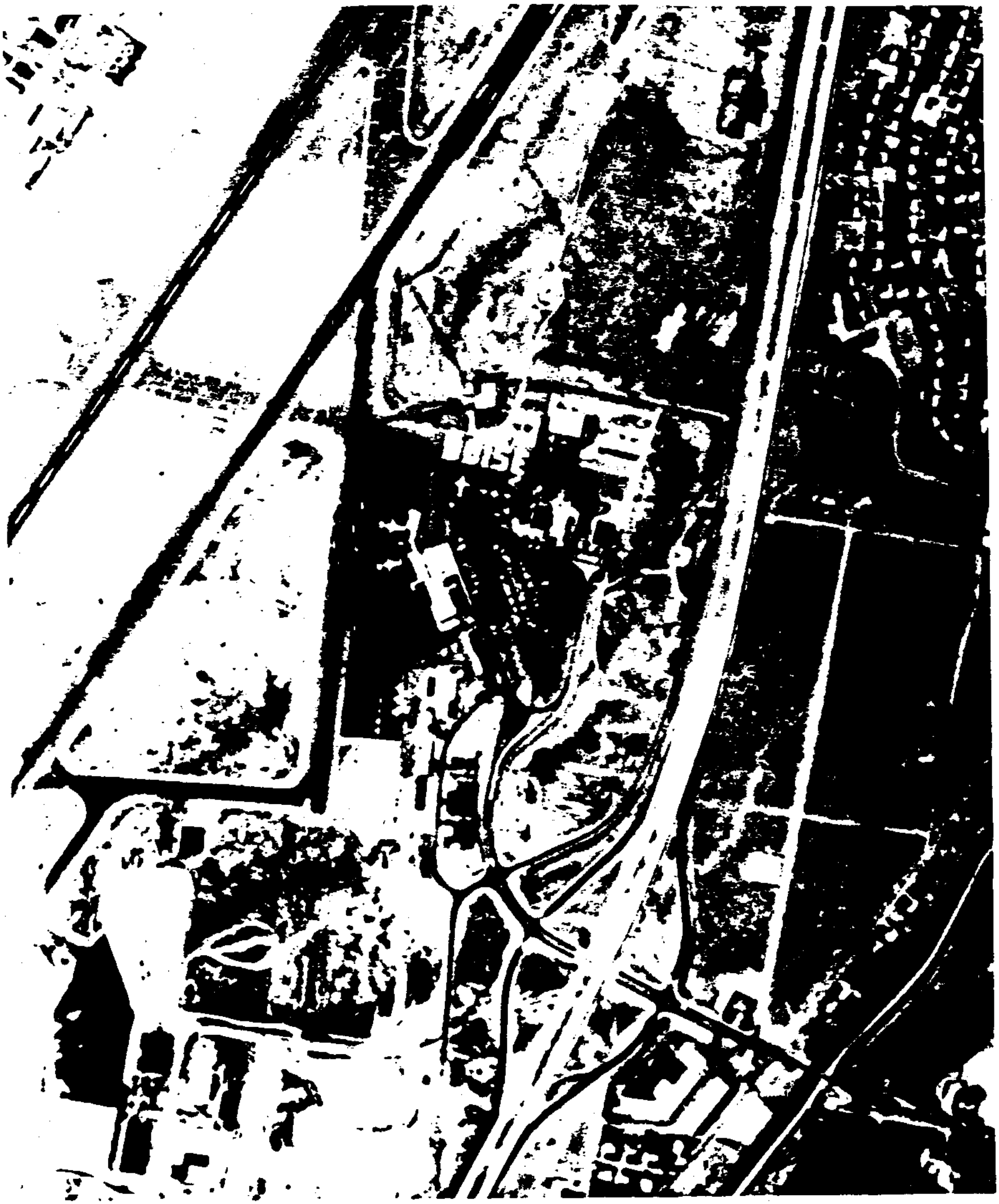

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FIGURE 3A. CLEAR TARGET

FIGURE 4A. CLOUD-COVERED TARGET

	FIGURE 3A	FIGURE 4A
Mission	1052	1052
Pass	47	47
Frame	41 Fwd	41 Aft
Date of Photography (GMT)	25 Sep 69	25 Sep 69
Universal Grid Coordinates	51.3-13.4	33.2-10.4
Enlargement Factor	20X	20X
Geographic Coordinates (format center)	30-39N 88-36W	30-38N 88-42W
Altitude (ft)	582,196	582,116
Camera Attitude:		
Pitch (deg)	14° 28'	-15° 25'
Roll (deg)	0° 14'	0° 12'
Yaw (deg)	-2° 28'	-2° 30'
Local Sun Time	1254	1254
Solar Elevation (deg)	54° 48'	54° 50'
Exposure (sec)	1/304	1/403
Filter	w/23A	w/21
Vehicle Azimuth (deg)	177° 13'	177° 18'
Process	Dual Gamma	Dual Gamma

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FIGURE 5A. ARE VEHICLES PART OF CONVOY OR LOCAL TRAFFIC?

[redacted]

FIGURE 5A

Mission	1107
Pass	265
Frame	35 Aft
Date of Photography (GMT)	9 Aug 69
Universal Grid Coordinates	16.8 - 0.6
Enlargement Factor	40X
Geographic Coordinates (format center)	44-18N 81-54E
Altitude (ft)	571,476
Camera Attitude:	
Pitch (deg)	-15° 6'
Roll (deg)	0° 19'
Yaw (deg)	-2° 1'
Local Sun Time	1335
Solar Elevation (deg)	55° 32'
Exposure (sec)	1/586
Filter	W/21
Vehicle Azimuth (deg)	161° 23'
Process	Dual Gamma

[redacted]

[redacted]

FIGURE 6A. WHAT ARE SPEED AND DIRECTION OF TRAIN?

FIGURE 6A

Mission	1107
Pass	39
Frame	33 Aft
Date of Photography (GMT)	26 Jul 69
Universal Grid Coordinates	44.6 - 3.0
Enlargement Factor	40X
Geographic Coordinates (format center)	55-26N 77-52E
Altitude (ft)	614,880
Camera Attitude:	
Pitch (deg)	-15° 31'
Roll (deg)	0 13'
Yaw (deg)	-1° 33'
Local Sun Time	1611
Solar Elevation (deg)	32° 28'
Exposure (sec)	1/265
Filter	W/21
Vehicle Azimuth (deg)	155° 04'
Process	Dual Gamma

[redacted]

FIGURE 7A. DETECTION OF TENTS IS DIFFICULT

FIGURE 7A

Mission	1107
Pass	297
Frame	82 Aft
Date of Photography (GMT)	11 Aug 69
Universal Grid Coordinates	32.2 - 2.0
Enlargement Factor	40X
Geographic Coordinates (format center)	40-42N 89-01E
Altitude (ft)	559,642
Camera Attitude:	
Pitch (deg)	ND
Roll (deg)	ND
Yaw (deg)	ND
Local Sun Time	1320
Solar Elevation (deg)	59° 56'
Exposure (sec)	1/578
Filter	W/21
Vehicle Azimuth (deg)	162° 44'
Process	Dual Gamma

FIGURE 8A. HANGARETTES OR REVETMENTS?

FIGURE 8A

Mission.	1107
Pass	122
Frame.	79 Aft
Date of Photography (GMT).	31 Jul 69
Universal Grid Coordinates	68.5 - 4.1
Enlargement Factor	40X
Geographic Coordinates (format center)	32-37N 37-14E
Altitude (ft).	580,755
Camera Attitude:	
Pitch (deg)	-15° 16'
Roll (deg).	0° 17'
Yaw (deg)	-2° 31'
Local Sun Time	1557
Solar Elevation (deg).	37° 44'
Exposure (sec)	1/351
Filter	W/21
Vehicle Azimuth (deg).	165° 4'
Process.	Dual Gamma

FIGURE 9A. WHAT IS STATUS OF VERTICAL CONSTRUCTION?

FIGURE 9A

Mission. 1107

Pass 170

Frame. . . . . 18 Aft

Date of Photography (GMT). . . . . 3 Aug 69

Universal Grid Coordinates . . . . 58.6 - 1.7

Enlargement Factor 40X

Geographic Coordinates (format center) 60-08N 30-10E

Altitude (ft). 627,429

Camera Attitude:

Pitch (deg) . . . . -15°21'

Roll (deg). . . . . 0° 16'

Yaw (deg) . . . . -1° [illegible]'

Local Sun Time 1406

Sun Elevation (deg). . . . . 42° 12'

Exposure (sec) 1/413

Filter . . . . W 21

[illegible] . . . . 150° 46'

[illegible] . . . . Dual Gamma

FIGURE 10A. HEAVY VEHICULAR EARTH SCARRING OR ACTUAL EXCAVATION?

FIGURE 10A

Mission	1107
Pass	218
Frame	10 Aft
Date of Photography (GMT)	6 Aug 69
Universal Grid Coordinates	28.4 - 3.6
Enlargement Factor	40X
Geographic Coordinates (format center)	57-45N 41-41E
Altitude (ft)	607,397
Camera Attitude:	
Pitch (deg)	-15° 27'
Roll (deg)	-0° 8'
Yaw (deg)	-1° 41'
Local Sun Time	1338
Solar Elevation (deg)	45° 25'
Exposure (sec)	1/424
Filter	W/21
Vehicle Azimuth (deg)	153° 06'
Processing	Dual Gamma

FIGURE 11A. WHAT IS CONSTRUCTION PROGRESS?

FIGURE 11A

Mission.	1107
Pass	138
Frame.	10 Aft
Date of Photography (GMT).	1 Aug 69
Universal Grid Coordinates	26.9 - 2.8
Enlargement Factor	40X
Geographic Coordinates (format center)	58-14N 26-20E
Altitude (ft).	594,629
Camera Attitude:	
Pitch (deg)	-15° 45'
Roll (deg).	-0° 13'
Yaw (deg)	-1° 34'
Local Sun Time	1440
Solar Elevation (deg)	41° 0'
Exposure (sec)	1/343
Filter	W/21
Vehicle Azimuth (deg).	152° 40'
Process.	Dual Gamma

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FIGURE 12A. AIRCRAFT IDENTIFICATION AND COUNT IS DIFFICULT

FIGURE 12A

Mission	1107
Pass	41
Frame	12 Aft
Date of Photography (GMT)	26 Jul 69
Universal Grid Coordinates	16.5 - 1.0
Enlargement Factor	40X
Geographic Coordinates (format center)	46-59N 38-50E
Altitude (ft)	606,779
Camera Attitude:	
Pitch (deg)	-15° 39'
Roll (deg)	0° 2'
Yaw (deg)	-2° 10'
Local Sun Time	1634
Solar Elevation (deg)	30° 13'
Exposure (sec)	1/268
Filter	W/21
Vehicle Azimuth (deg)	160° 13'
Processing	Dual Gamma

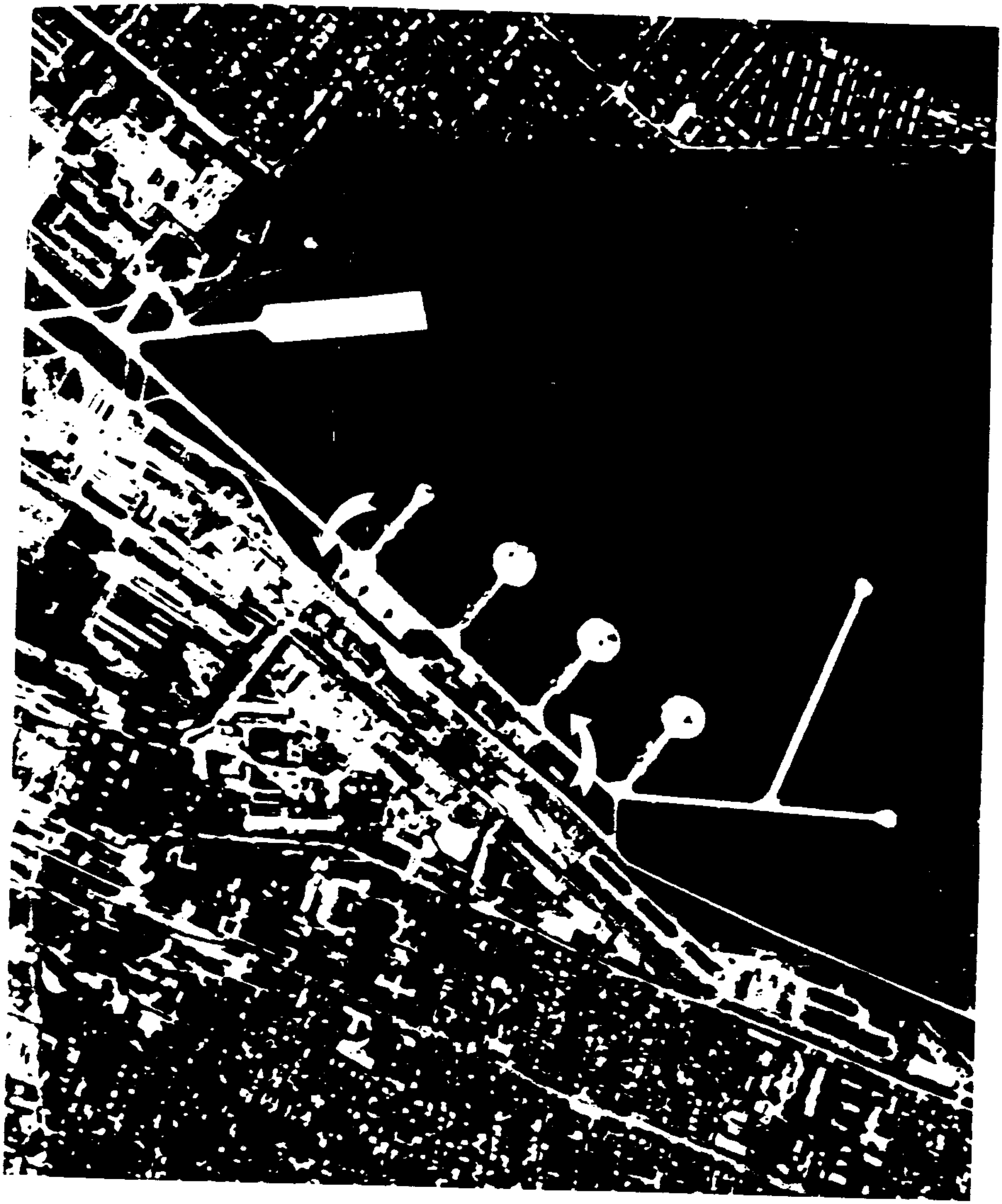

FIGURE 13A. VEHICLES ARE HARD TO DISTINGUISH FROM DISCOLORED PARKING AREA

FIGURE 13A

Mission	1107
Pass	264
Frame	13 Aft
Date of Photography (GMT)	9 Aug 69
Universal Grid Coordinates	14.0 - 1.2
Enlargement Factor	40X
Geographic Coordinates (format center)	54-35N 97-58E
Altitude (ft)	583,482
Camera Attitude:	
Pitch (deg)	-15° 22'
Roll (deg)	0° 9'
Yaw (deg)	-1° 50'
Local Sun Time	1311
Solar Elevation (deg)	49° 01'
Exposure (sec)	1/421
Filter	W/21
Vehicle Azimuth (deg)	155° 41
[illegible]	Dual Gamma

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FIGURE 14A. ARE HELICOPTERS HIPS OR HOUNDS?

FIGURE 14A

Mission	1107
Pass	166
Frame	85 Aft
Date of Photography (GMT)	3 Aug 69
Universal Grid Coordinates	26.4 - 3.0
Enlargement Factor	40X
Geographic Coordinates (format center)	50-34N 127-29E
Altitude (ft)	618,966
Camera Attitude:	
Pitch (deg)	-15° 39'
Roll (deg)	0° 12'
Yaw (deg)	-1° 54'
Local Sun Time	1444
Solar Elevation (deg)	44° 46'
Exposure (sec)	1/421
Filter	W/21
Vehicle Azimuth (deg)	158° 21'
Process	Dual Gamma

[redacted]

FIGURE 15A. SWEPT WING OR DELTA WING AIRCRAFT?

FIGURE 15A

Mission	1107
Pass	106
Frame	9 Aft
Date of Photography (GMT)	30 Jul 69
Universal Grid Coordinates	42.9 - 2.6
Enlargement Factor	40X
Geographic Coordinates (format center)	31-16N 34-46E
Altitude (ft)	584,106
Camera Attitude:	
Pitch (deg)	-15° 43'
Roll (deg)	-0° 09'
Yaw (deg)	-2° 46'
Local Sun Time	1611
Solar Elevation (deg)	34° 42'
Exposure (sec)	1/280
Filter	W/21
Vehicle Azimuth (deg)	165° 23'
Process	Dual Gamma

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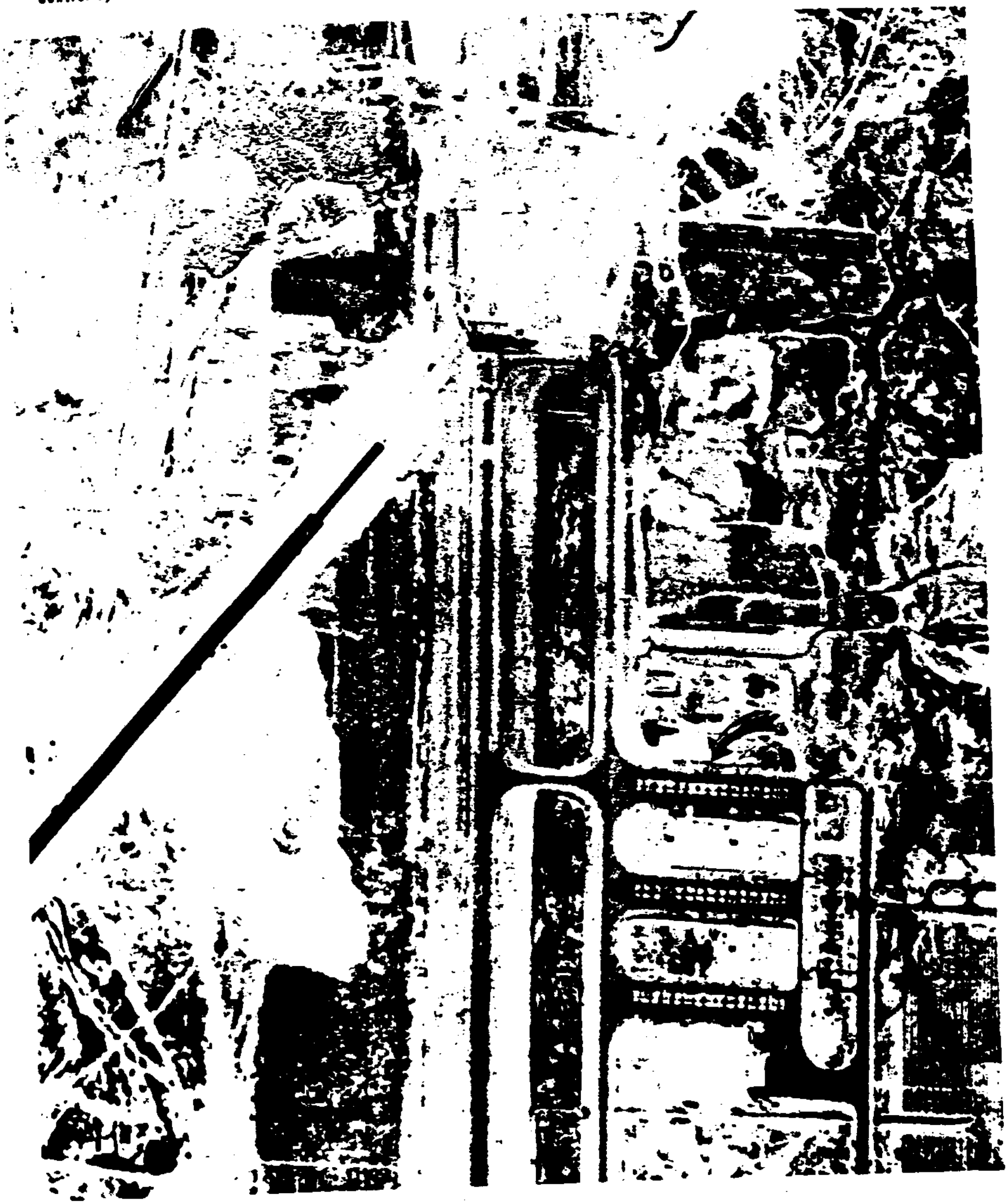

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FIGURES 16A and 17A. STEREO ACCOMPLISHED WITH TWO MONO PASSES

	FIGURE 16A	FIGURE 17A
Mission	1107	1107
Pass	169	298
Frame	55 Aft	14 Aft
Date of Photography (GMT)	3 Aug 69	11 Aug 69
Universal Grid Coordinates	34.9-3.9	61.6-4.0
Enlargement Factor	40X	40X
Geographic Coordinates (format center)	45-57N 63-09E	46-12N 64-10E
Altitude (ft)	612,198	564,215
Camera Attitude:		
Pitch (deg)	-15° 13'	ND
Roll (deg)	0° 9'	ND
Yaw (deg)	-1° 38'	ND
Local Sun Time	1453	1308
Solar Elevation (deg)	45° 45'	56° 18'
Exposure (sec)	1/424	1/601
Filter	W/21	
Vehicle Azimuth (deg)	160° 41'	160° 33'
Process	Dual Gamma	Dual Gamma

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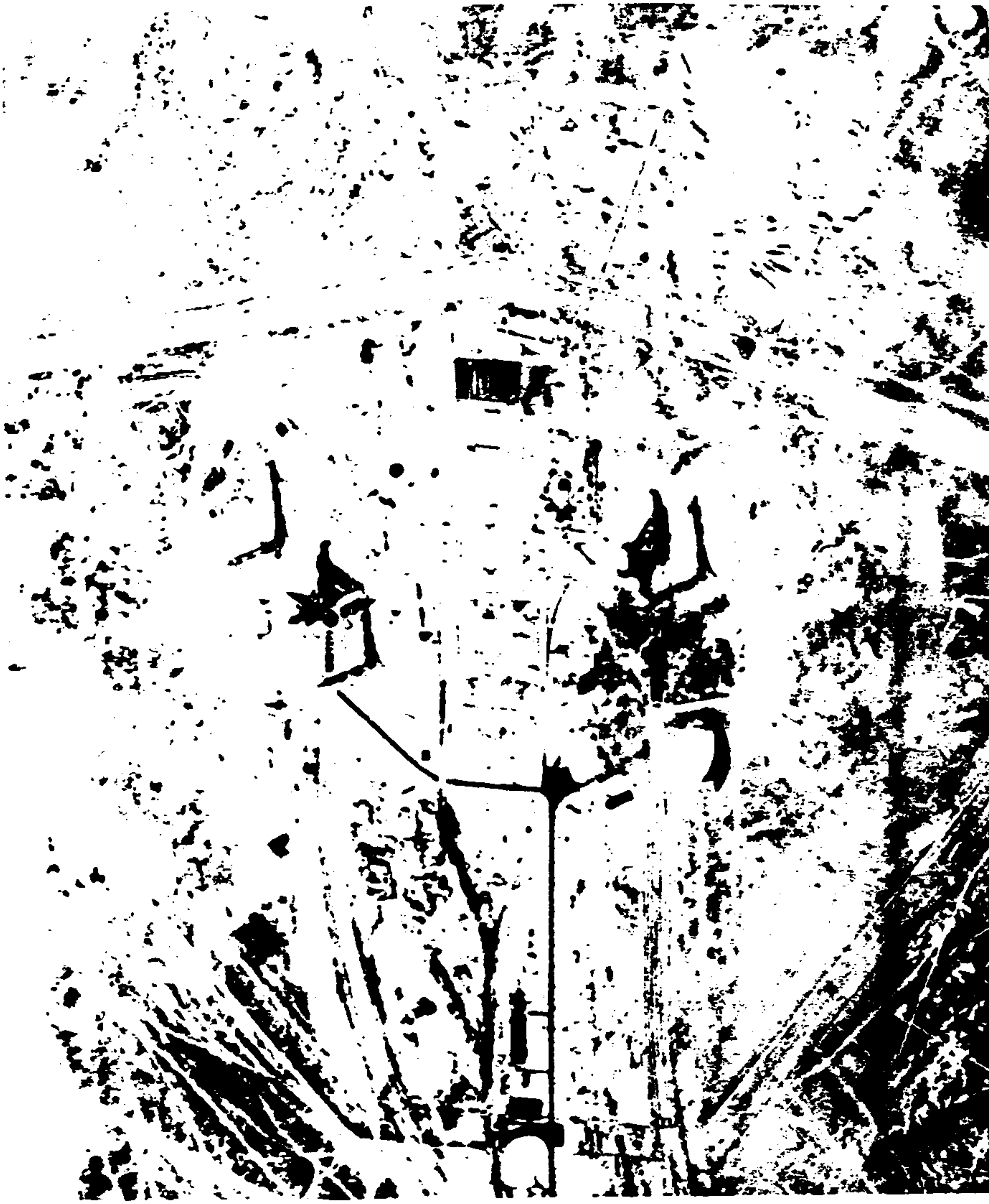

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