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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT MISSION 1052

WITH SPECIAL STUDY:

SO-293 SECOND GENERATION VS. THIRD GENERATION NEGATIVE

This document contains information referring to Project Corona

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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT

MISSION 1052

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:	Indicates 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: 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 semi major axis of 20925738.18 feet and a semi minor axis of 20855588.20 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 ascending node as the vertex.

[redacted]

INTERPRETABILITY: (PHOTOGRAPHIC) — Suitability of the imagery with respect to answering requirements on a given type of target. Various factors 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 affect interpretability. The 3 levels of interpretability are:

Poor interpretability (P) - Unsuitable for adequately answering 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. A prefix "D" indicates the descending node, a prefix "A" indicates the ascending node, and a prefix "M" indicates a continuous camera operation from the ascending node thru the descending

node. An additional suffix "E" indicates that the associated photography was 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 centers of curvature of the lens surfaces. It is coincident with the optical axis of the lens.

RELATIVE ORIENTATION: The determining (analytically or in a photogrammetric instrument) of 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, in conjunction with the product of the Index camera, is used 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 top of the camera.

*Defined differently than in the Glossary of NPIC Terminology.

INDEX OF PHOTOGRAPHIC EVALUATION REPORTS AND SPECIAL STUDIES

PER	DOCUMENT NUMBER	SPECIAL STUDY
1033	[redacted]	None
1034		None
1035		None
1037		None
1038		None
1039		None
1040		None
1041		Slant Range Computations Related to Universal Grid Coordinates for the J-1 Camera System
1042	[redacted]	None
1043		Scan Speed Deviation Analysis of the Forward Camera, Mission 1043
1044	[redacted]	Dual Gamma/Viscose Vs Conventional/Spray Processing Analysis (Mission 1044)
1045	[redacted]	None
1046		SO-230 Vs 3404 Evaluation
1047		None
1048		None
1049		Image Quality Comparison Mission 1102--Original Negative vs. Duplicate Positive
1050	[redacted]	None
1051		None
1052		SO-239 Second Generation Vs Third Generation Negative
1101	[redacted]	Slant Range Computations Related to Universal Grid Coordinates for the J-3 Camera System
1102	[redacted]	None
1103		None
1104		SO-180 Evaluation Mission 1104
1105		SO-121 Evaluation Mission 1105
1106	[redacted]	None
1107		MIP 1100 Series

SYNOPSIS

Mission 1052, last of the 1000 series missions, was launched on 22 September 1969 at 2111Z. Both buckets were recovered dry after 15 days of photographic operation. The first bucket was recovered on 29 September 1969 at 2358Z; the second on 7 October 1969 at 2257Z.

All camera systems operated satisfactorily throughout the mission with the exception of the fwd-looking record which came out of the rails on the last operation of the second portion of the mission. The fwd-looking camera provided the best imagery (MIP 85); however, the quality is more variable than that obtained from the aft-looking camera.

PART I. GENERAL SYSTEM INFORMATION

A. Camera Numbers

Fwd-Looking	216
Aft-Looking	217
Stellar/Index (1052-1)	D111/137/138
Stellar/Index (1052-2)	D116/140/140

B. Launch and Recovery Dates

	Mission 1052-1	Mission 1052-2
Launch	22 Sep 69/2111Z	*
Recovery	29 Sep 69/2358Z	7 Oct 69/2257Z
Recovery Rev	115	244

C. Orbit Elements

Element	Planned	Actual 1052-1	Actual 1052-2	Photo Range
Period (min)	NA	88.88	88.924	
Perigee (nm)	NA	100.39	99.62	98
Apogee (nm)	NA	144.83	149.6	108
Eccentricity	NA	0.0062	0.00702	
Inclination (deg)	NA	85.04	85.036	
Perigee Latitude	NA	41.77N	47.049N	

* - Not Applicable
NA - Not Available

D. Photographic Operations

1. Panoramic Cameras:

Type	Mission 1052-1 Revs	Mission 1052-1 Frames	Mission 1052-2 Revs	Mission 1052-2 Frames	Total Revs	Total Frames
Operational						
Fwd	35	2,799	44	3,041	79	5,840
Aft	35	2,818	43	3,008	78	5,826
Operational/Domestic						
Fwd	0	0	0	0	0	0
Aft	0	0	0	0	0	0
Domestic						
Fwd	5	156	4	54	9	210
Aft	5	158	4	54	9	212
Engineering (no imagery)						
Fwd	0	0	2	17	2	17
Aft	0	0	2	17	2	17
Totals						
Fwd	40	2,955	50	3,112	90	6,067
Aft	40	2,976	49	3,079	89	6,055

2. Secondary Cameras:

Camera	Frames
Stellar (1052-1)	450
Index (1052-1)	450
Stellar (1052-2)	480
Index (1052-2)	480

E. Film Usage

	Film Load (TOTAL)	Pre-Flight Footage	Processed Footage
Fwd-Looking (1052-1)	16,300*	222'	8,019
Aft-Looking (1052-1)	16,300*	253'	8,144
Fwd-Looking (1052-2)	NA	NA	8,208
Aft-Looking (1052-2)	NA	NA	8,118
Stellar (1052-1)	75'	8'	55
Stellar (1052-2)	75'	**	62
Index (1052-1)	135'	16.5'	119
Index (1052-2)	135'	**	128

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

PART II. IMAGE ANALYSIS

A. Fwd-Looking Panoramic Camera

1. Density: Generally medium with more thin density than heavy density.

2. Contrast: Considered to be medium. As a result of the processing, there is very little high contrast imagery.

3. Acuity: Varies within the format from good to poor. The material displays soft focus areas which appear at random and do not display a repeatable pattern. The forward looking camera does, however, provide the best imagery of the mission.

4. Image Degradations:

a. Light Leaks - Light-leak-induced fog patterns are present on the fifth, sixth from last, third from last and last frame of most passes. These fog patterns are minor and do not cause any serious degrading of the imagery. These fog patterns are illustrated in Graphics 1 and 2. page 10.

b. Static - None noted.

c. Other - Minor transverse banding is present at the take-up end of most frames. Four diagonal indentation marks (minus density) appear twice during the mission (D001 and D219-D229). These groups appear every 37 - 39 inches (Graphic 4, page 10). These marks were observed on the preflight. However, no relationship between the marks and the camera or film can be established.

5. Physical Degradations: The film came out of the rails beginning with frame 1 of pass D236 to the end of the mission. As a result, the imagery is smeared and out of focus, the metering is erratic, the format is not well defined, and the shrinkage marks are not detectable. Two film creases are present on frames 283 - 284, pass D104 and frames 81 - 82 of pass D136. Emulsion build-up on the inboard film rails caused the time word format edge to be ragged. Rail scratches are present throughout the mission.

6. The majority of the above degradations are minor in nature and do not significantly affect the quality of the mission. The major degrading factor is the inconsistent image quality of the fwd-looking camera record.

B. Aft-Looking Panoramic Camera

1. Density: Similar to that of the fwd-looking material.

2. Contrast: Similar to the fwd-looking material.

3. Acuity: The aft camera does not provide the best imagery of this mission. However, the image quality is more consistent and the overall quality is considered to be better than the fwd-camera image quality.

4. Imaged Degradations:

a. Light Leaks - Fog patterns are present on the fifth, fourth from last and last frame of most passes. These fog patterns are minor and difficult to detect at times. Graphic 3 on page 10 illustrates the location and shape of these patterns.

b. Static - Minor edge static (binary edge) was noted intermittently throughout the mission.

c. Other - Two parallel plus density streaks, spaced 1/8 inch apart, are present throughout the second portion of the mission. These marks are located 1.0 inch from the time track edge and run parallel to the major axis of the film. They are believed to be caused by the puck arm assembly. Frames 32 - 35 of pass D25 were fogged during the defilming operation. (See Part V, Section C.) A series of creases (minus density) oriented parallel to the minor axis, are present on passes D25 and D29. These are similar to those on the fwd camera material (Part II, Section A, Paragraph 4c). Frames 32 - 35 of pass D25 were fogged during the defilming operation resulting in severe degradation to these frames.

5. Physical Degradation: Rail scratches are present throughout the mission. A film tear is located in the center of frame 43, pass D56. It extends into the format approximately 1.0 inch at an angle of 65 degrees. This tear was noted during the defilming operation. The exact cause of this tear cannot be determined; however, judging from the imagery and rail hole images in the immediate vicinity the tear appears to have occurred after exposure and possibly could have been the result of transferring the film from a dynamic to static condition during the presplice operation.

6. Product Quality: The above imaged and physical degradations are considered minor, with the exception of the film tear. In general, these anomalies do not affect the product quality.

C. Stellar Camera (Mission 1052-1)

1. Density: An adequate number of stellar images can be detected.

2. Contrast: Suitable for the detection of stellar images both within and outside of the flared area.

3. Imaged Shape: Generally point-type.

4. Images Per Frame: There are approximately 25 stellar images, the majority of which are suitable for attitude reduction.

5. Flare Level: Approximately 50 percent of the format is flared. Stellar images can be detected within the flared area.

6. Imaged Degradations:

a. Light Leaks - None noted.

b. Static - Minor traces of static induced by the pressure plate are present throughout the mission.

c. Other - The reseau lines are slightly washed out in areas not affected by flare.

7. Physical Degradations: Emulsion cracking was noted intermittently throughout the mission.

8. Product Quality: Adequate overall for vehicle attitude determination.

D. Stellar Camera (Mission 1052-2)

1. Density: Normal on those frames not affected by the shutter malfunction. (See paragraph 6c)

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

3. Image Shape: Slightly elongated, but suitable for attitude reduction.

4. Images Per Frame: There are approximately 25 stars imaged, the majority of which are suitable for attitude reduction.

5. Flare level: Approximately ten percent of the format is affected by flare.

6. Imaged Degradations:

a. Light Leaks - A continous longitudinal plus density mark, located between the reseau number and the format, is present from frames 420 through 480.

b. Static - None noted.

c. Other - Approximately 25 frames are overexposed due to a shutter malfunction. The reseau and star images are not detectable.

7. Physical Degradations: Minor emulsion cracking was noted throughout the mission.

8. Product Quality: Good overall and suitable for attitude reduction except for those frames that were overexposed as a result of the shutter malfunction.

E. Index Camera (Mission 1052-1)

1. Density: Generally thin to medium.

2. Contrast: Generally low to medium.

3. Acuity: Good and comparable to recent missions.

4. Imaged Degradations:

a. Light Leaks - None noted.

b. Static - None noted.

5. Physical Degradations: None noted.

6. Product Quality: Good and suitable for determining relative orientation.

F. Index Camera (Mission 1052-2)

1. Density: Generally thin to medium.

2. Contrast: Generally low to medium.

3. Acuity: Good and similar to the imagery acquired on recent missions.

4. Imaged Degradations:

a. Light Leaks - None noted.

b. Static - None noted.

c. Other - Dirt on the reseau was imaged in the bottom righthand corner of the format.

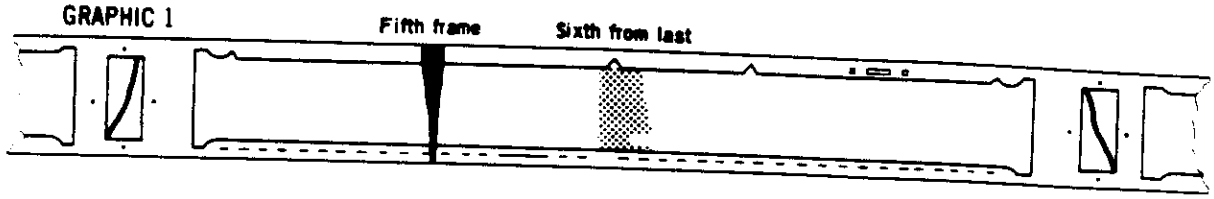
5. Physical Degradations: None noted.

6. Product Quality: Good overall and suitable for relative orientation.

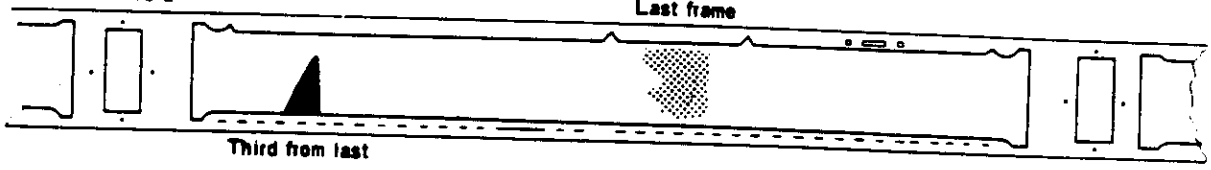
G. Graphic Display

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

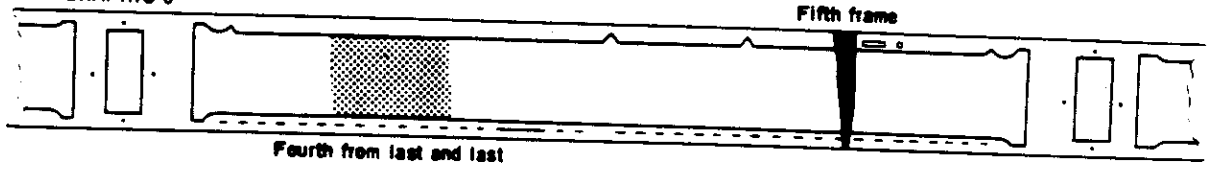
GRAPHIC 1



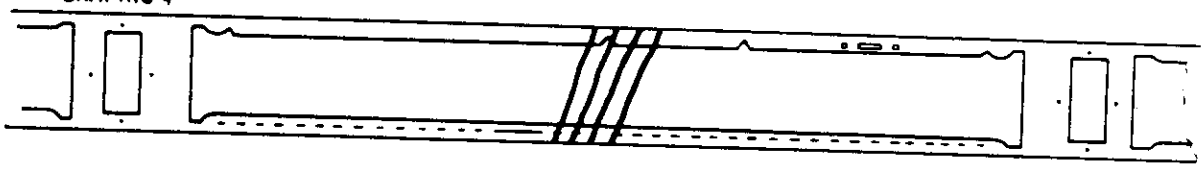
GRAPHIC 2



GRAPHIC 3



GRAPHIC 4



PART III. IMAGED AUXILIARY DATA

A. Fwd-Looking Panoramic Camera

1. Horizon Cameras:

a. Starboard Looking:

(1) Imagery - Good and the earth's curvature is well defined.

(2) Fiducials - Sharp and well defined.

b. Port Looking:

(1) Imagery - The earth's curvature is well defined.

(2) Fiducials - Sharp and well defined.

2. Frequency Marks: Missing (up to 17 inches) on the take-up end of the first frame of some camera operations.

3. Binary Time Word: Imaged properly throughout the mission. During printing, the time word was skewed causing difficulty in reading the time word automatically. Every time word was read manually.

4. Binary Index: Imaged properly.

5. Camera Number: Adequately imaged and readable throughout the mission.

6. Pan Geometry Dots: Approximately 25 percent of the images are obscured. The remaining vary in quality from almost obscured to sharp and well defined.

7. Nodal Traces: Not applicable.

8. Nod Indicators: Not applicable.

B. Aft-Looking Panoramic Camera

1. Horizon Cameras:

a. Starboard-Looking:

(1) Imagery - The horizon arc is well defined.

(2) Fiducials - Sharp and well defined.

b. Port-Looking:

(1) Imagery - The horizon arc is well defined.

(2) Fiducials - Sharp and well defined.

2. Frequency Marks: Missing (up to 12 inches) on the first frame of some camera operations.

3. Binary Time Word: Imaged properly throughout the mission. No problems were encountered during the automatic read-out phase.

4. Binary Index: Imaged properly to insure accurate time word reading on the automatic reader.

5. Camera Number: Readable throughout the mission.

6. Pan Geometry Data: Approximately 25 percent of the images are obscured. The remaining images are poorly defined.

7. Nodal Traces: Not applicable.

8. Nod Indicators: Not applicable.

C. Stellar Camera (Mission 1052-1)

1. Grid Image Quality: Sharp and well-defined.

2. Correlation Lamp Image Quality: Good.

D. Stellar Camera (Mission 1052-2)

1. Grid Image Quality: Sharp and well defined, except on those frames that were overexposed due to the shutter malfunction.

2. Correlation Lamp Image Quality: Good.

E. Index Camera (Mission 1052-1)

1. Grid Image Quality: Sharp and well defined.

2. Correlation Lamp Image Quality: Good.

3. Camera Number Legibility: Readable.

F. Index Camera (Mission 1052-2)

1. Grid Image Quality: Sharp and well defined.

2. Correlation Lamp Image Quality: Good.

3. Camera Number Legibility: Readable.

PART IV. MENSURATION QUALITY

A. Fwd-Looking Panoramic Camera

The mensuration quality for Mission 1052 is good and no problems were encountered. There were 77 requests for mensuration support.

B. Aft-Looking Panoramic Camera

Same as fwd-looking panoramic camera.

PART V. FILM PROCESSING

A. Processing Machines and Process Gamma

Film	Machine	Gamma
Fwd (1052-1)	Yardleigh	1.70
Aft (1052-1)	Yardleigh	1.74
Fwd (1052-2)	Yardleigh	1.76
Aft (1052-2)	Yardleigh	1.77
Stellar (1052-1)	Trenton	2.18
Stellar (1052-2)	Trenton	2.12
Index (1052-1)	Drape	0.93
Index (1052-2)	Drape	0.93

B. Processing Levels

1. Panoramic Cameras: Both records were processed in Dual Gamma Visions Chemistry.

2. Secondary Cameras:

a. Stellar records - Processed at a single level of development.

b. Index records - Processed at a single level of development.

C. Film Handling Summary

1. Fwd-Looking Camera:

a. Capsule Defilming:

(1) Mission 1052-1 - The material was defilmed in a normal manner without incident.

(2) Mission 1052-2 - The material was defilmed in a normal manner without incident.

b. Pre-spooling:

(1) Mission 1052-1 - No problems encountered.

(2) Mission 1052-2 - No problems encountered.

c. Manufacturing Splices:

(1) Mission 1052-1 - Frame 16, pass D29 and frame 104, pass D89.

(2) Mission 1052-2 - Frame 19, pass D166.

d. Processing Splices:

(1) Mission 1052-1 - Frame 25, pass D007.

(2) Mission 1052-2 - None other than normal.

e. Manufacturing Defects:

(1) Mission 1052-1 - None noted.

(2) Mission 1052-2 - None noted.

f. Processing Anomalies:

(1) Mission 1052-1 - A slight processing delay was encountered because of a minus density blotch that appeared on the head scratch check. The problem was corrected and no operational photography was affected.

(2) Mission 1052-2 - None noted.

2. Aft-looking Camera:

a. Capsule Defilming:

(1) Mission 1052-1 - During the presplice operation a film tear was noted halfway into the record (rev 56, frame 43) and repaired with tape. (See PART II, Section B, Paragraph 5). A flash of light, brighter than the normal static discharge, was observed while defilming. The result was the fogging of 5 frames.

(2) Mission 1052-2 - Two convolutions of the aft record were wrapped around the fwd take-up spool. Several tears and scratches resulted and the tears were repaired with tape.

b. Pre-processing Inspection:

(1) Mission 1052-1 - No problems encountered.

(2) Mission 1052-2 - No problems encountered.

c. Manufacturing Splices:

(1) Mission 1052-1 - Frames 55, 56, pass D56.

(2) Mission 1052-2 - Frame 98, pass D106, frame 25, pass D199 and frame 22, pass D200.

d. Processing Splices:

(1) Mission 1052-1 - Frame 43, pass D56.

(2) Mission 1052-2 - None other than normal.

e. Manufacturing Defects:

(1) Mission 1052-1 - None.

(2) Mission 1052-2 - None.

f. Processing Anomalies - None.

g. Breakdown - No problems encountered.

3. Index Camera: No problems encountered during capsule defilming, pre-processing inspection, or breakdown. There were no manufacturing splices, defects, processing anomalies or processing splices other than normal.

4. Stellar Camera: Same as for Index Camera.

D. Timetable

Mission	Film	Recovered	Rec'd at Proc. Site	Spec Ship at NPIC Rec'd	Priority 1 at NPIC Rec'd
1052-1	Fwd	29 Sep 69/2358Z	30 Sep 69/1713Z	None	2 Oct 69/2207L
	Aft	"	"	"	"
	Stellar	"	"	"	"
	Index	"	"	"	"
1052-2	Fwd	7 Oct 69/2257Z	8 Oct 69/1630Z	"	11 Oct 69/1324L
	Aft	"	"	"	"
	Stellar	"	"	"	"
	Index	"	"	"	"

PART VI. PI SUITABILITY

A. PI Statistics

1. Target Coverage:

	Missions 1052-1, 1052-2
Priority 1 Targets Programmed	No specific targets were programmed for this mission.
Priority 1 Targets Covered	281

2. PI Quality Appraisal:

Rating	Missiles	Nuclear Energy	Air Facilities	Ports	Elect Commo	Milit Act	Complex
Good	17	0	1	8	0	3	4
Fair	49	9	39	2	0	12	5
Poor	88	5	29	6	0	5	6

3. Summary of PI Ratings:

Good: 33 or 11.4%
Fair: 116 or 40.3%
Poor: 139 or 48.3%

B. PI Comments

1. Atmospheric Attenuation: The following is an analysis of the atmospheric conditions affecting the priority targets as reported by the photointerpreters during the initial readout of this mission. The total number of targets does not necessarily reflect the number of targets covered because some targets are reported as falling into two or more of the weather categories.

Weather	Number of Targets
a. Clear	146 or 36.5%
b. Scattered clouds	98 or 24.5%
c. Heavy clouds	40 or 10.0%
d. Haze	78 or 19.5%
e. Cloud shadow	38 or 9.5%

2. Terrain Conditions: Considered to be generally fair.

3. PI Suitability: The interpretability of both missions ranges from poor to fair. The interpretability of Mission 1052-1 is considered to be slightly better than 1052-2 due to the higher percentage of cloud-free photography.

PART VII. MISSION DATA

	Forward-Looking			Aft-Looking					
	Pan	Take-up Horizon	Supply Horizon	Pan	Take-up Horizon	Supply Horizon	Mission 1052-1 Stellar	Index	Mission 1052-2 Stellar	Index
Camera Number	216	*	*	217	*	*	D111	D111	D116	D116
Reseau Number	NA	NA	NA	NA	NA	NA	137	138	140	140
Lens Serial Number	158	12838	12877	174	12863	1905	11362	823830	11400	823771
Slit Width	.225	NA	NA	.170	NA	NA	NA	NA	NA	NA
Aperture	F/3.5	F/8.0	F/6.3	F/3.5	F/6.3*	F/8.0	F/1.0	F/4.5	F/1.8	F/4.5
Exposure Time (sec)	1/343 (avg)	1/100	1/100	1/392 (avg)	1/100	1/100	2	1/500	2	1/500
Filter (Wratten)	23A	25	25	21	25	25	None	21	None	21
Focal Length (mm)	609.602	55	55	609.628	55	54.90	85	38.38	85	38.60
Film Length (ft)	16,300	NA	NA	16,300	NA	NA	75	135	75	135
Splices	5	NA	NA	6	NA	NA	None	None	None	None
Emulsion	441-1/2-6-9	441-1/2-6-9	441-1/2-6-9	441-1/2-6-9	441-1/2-6-9	441-1/2-6-9	288-12/2-1-9	189-5-12-0	288-12/2-1-9	189-5-12-0
Film Type	3404	3404	3404	3404	3404	3404	3401	3400	3401	3400
Resolution Data (L/mm)										
Static										
High Contrast	*	209	187	*	187	187	*	73 (Awar)	*	75 (Awar)
Low Contrast	151	*	*	142	*	*	*	*	*	*
Dynamic										
I High Contrast	194	*	*	189	*	*	*	*	*	*
I Low Contrast	128	*	*	131	*	*	*	*	*	*
P High Contrast	*	*	*	*	*	*	*	*	*	*
P Low Contrast	125	*	*	125	*	*	*	*	*	*

* Not available.
NA Not applicable.

[redacted]

RESOLUTION TARGET DATA

Target Designator	A	
Camera (Looking)	Fwd	Aft
Pass	177	177
Frame	8	8
Date of Photography	3 Oct 69	3 Oct 69
Universal Grid Coordinates	21.2 12.8	70.3 10.5
Geographic Coordinates of Format Center	31-38N 109-27W	31-36N 109-30W
Altitude (ft)	596,761	596,598
Camera		
Pitch (deg)	14° 40'	-15° 5'
Roll (deg)	-0° 5'	-0° 14'
Yaw (deg)	ND	ND
Local Sun Time	1157	1157
Solar Elevation (deg)	53° 33'	53° 35'
Solar Azimuth (deg)	10°	10°
Exposure (Sec)	1/299	1/396
Processing Level	Dual Gamma	Dual Gamma
Vehicle Azimuth (deg)	177° 8'	177° 13'
Filter (Wratten)	W-25	W-21
Target Type	Ft. Huachuca	Ft. Huachuca
Target Contrast	11:1	11:1
Weather Conditions	Scattered Clouds	Scattered Clouds

GROUND RESOLUTION IN FEET AS DETERMINED FROM THE ORIGINAL NEGATIVE

A*

	Along Track FWD	AFT	Across Track FWD	AFT
Observer 1	14'1"	14'1"	17'9"	12'7"
	15'10"	12'7"	17'9"	12'7"
Observer 2	14'1"	14'1"	15'10"	12'7"
	15'10"	11'2"	15'10"	10'
Observer 3	14'1"	14'1"	15'10"	12'7"
	15'10"	12'7"	17'9"	12'7"

*DP ON

ND - Not Determined

[redacted]

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SO-239 SECOND GENERATION
VS
THIRD GENERATION NEGATIVE

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I. OBJECTIVES

The objectives of this study are to (1) compare duplicate negatives produced on film type SO-239 (direct reversal type) to standard third generation duplicate negatives produced on 2430 film type and (2) determine which duplicate negative is best suited to the NPIC requirements.

II. INTRODUCTION

A. SO-239 Characteristics

1. Kodak Direct Duplicating Aerial Film Type SO-239 is a blue sensitive, direct reversal film of high acutance, intended for one-step duplication of high-definition aerial reconnaissance negatives.

2. Minute matte particles are incorporated into the emulsion to eliminate newton's rings. These particles act as a physical separator between the original negative and the SO-239 raw stock during the production of a contact-printed duplicate negative. Since the matte particles remain in the emulsion layer after processing, they act as a separator between the SO-239 duplicate negative and subsequent contact reproductions.

B. Use of Third Generation Duplicate Negatives at NPIC

1. The duplicate negatives from satellite missions received at NPIC have been (through early September 1969) third generation copies on 2430 duplicating stock. Duplicate negatives are used at NPIC primarily in the production of paper prints for briefing boards and PI illustration purposes prior to the availability of the original negatives.

2. The duplicate negatives or prints therefrom are seldom used for interpretation purposes. On occasion, however, the need does arise for contact film positives, printed at various density levels (density cuts) to assist the photointerpreter in target readout.

III. INTRODUCTION TO PROCEDURE

A. For comparison purposes, second generation negatives (SO-239) were printed using several passes of Missions 1049, 1104, 1106, and [redacted] in addition to the normal third generation negatives. The materials from Missions 1049 and 1106 were considered to be unsuitable for the evaluation: therefore, only the materials from Missions [redacted] and 1104 were used.

B. Since the duplicate negatives are primarily used in the production of paper prints, the evaluation was primarily directed toward this end.

C. Matte particles incorporated into the SO-239 emulsion become imaged as plus density specks on reproductions made from SO-239 duplicate negatives. The effects of these specks on interpretation suitability is discussed later in this report.

IV. PROCEDURE

A. Three fixed resolution targets imaged on Mission 1104 were read from the original, second generation, and third generation negatives by eight qualified observers. Each target was treated as two separate targets, i.e. along track and across track directions.

B. Several paper prints of various type cultural areas were produced at 40, 60 and 80X magnifications from the original, second generation and third generation negatives of Missions [redacted] and 1104. Several technologists were tasked to subjectively determine which print produced from the duplicate negatives provided the better image quality. The observers were also asked to indicate which print appeared closest in tonal quality to the print from the original negative. In addition, several photointerpreters were presented these enlargements and asked to determine what effect the matte particle images have on the intended purposes of the prints (briefing boards and illustration purposes). The photointerpreters were also asked to indicate a preference between the prints produced from the duplicate negatives.

C. Entire frames from Missions [redacted] and 1104 were contact printed on 2430 duplicating film using SO-239 negatives. Photointerpreters were then presented these contact duplicate positives and asked to determine if the matte particle images would effect interpretation.

D. Photo lab personnel were asked what problems may occur if SO-239 is supplied to NPIC as the standard duplicate negative on each mission.

E. The processing facilities system curves of SO-239 were used to determine if SO-239 is compatable with reproduction of satellite mission material, ie., is dual printing necessary to comply with the NPIC specifications? This was accomplished by considering the normal terrain density extremes of the original negative relative to the SO-239 system curves (see Figures 2a and 3a).

V. RESULTS

A. Readings from three fixed resolution targets indicate a ten percent (average) greater loss in resolution (lines/mm) in third generation negative as compared to the second generation negative (Figure 1A).

B. Prints produced from SO-239 provide better overall image quality and closer similarity to prints produced from the original negative.

C. Images of the matte particles on paper prints at magnifications of 40X and greater degrade the esthetic quality of the print, however the photointerpreter preferred the SO-239 prints due to the better image quality.

D. Matte particle images in a contact print can be detected at 30 to 40X magnification, but do not adversely affect photographic interpretation.

E. Reproductions from the SO-239 duplicate negatives exhibit less apparent grain than prints made from the normal third generation duplicate negative.

F. Photo lab personnel expressed a need for the film type to be indicated on the can label and the material to be wound emulsion outward to conform with equipment design. Each can should contain a label with the following information:

a. Wind this direct reversal film emulsion-out
b. Generation 2
c. Enlarge through base
d. Contact print emulsion to emulsion for film positives
e. Contact print through base for paper prints

G. When considering normal terrain density extremes of the original negative relative to the SO-239 system curve (Figure 3a), the resultant duplicate negative density range is within the NPIC specifications for the photo lab copy duplicate negatives.

VI. CONCLUSIONS

Improved resolution, better image quality, less apparent grain, and compatability with the current duplicating system and specifications indicate that SO-239 film type is better suited to the duplicate negative requirements for the NPIC.

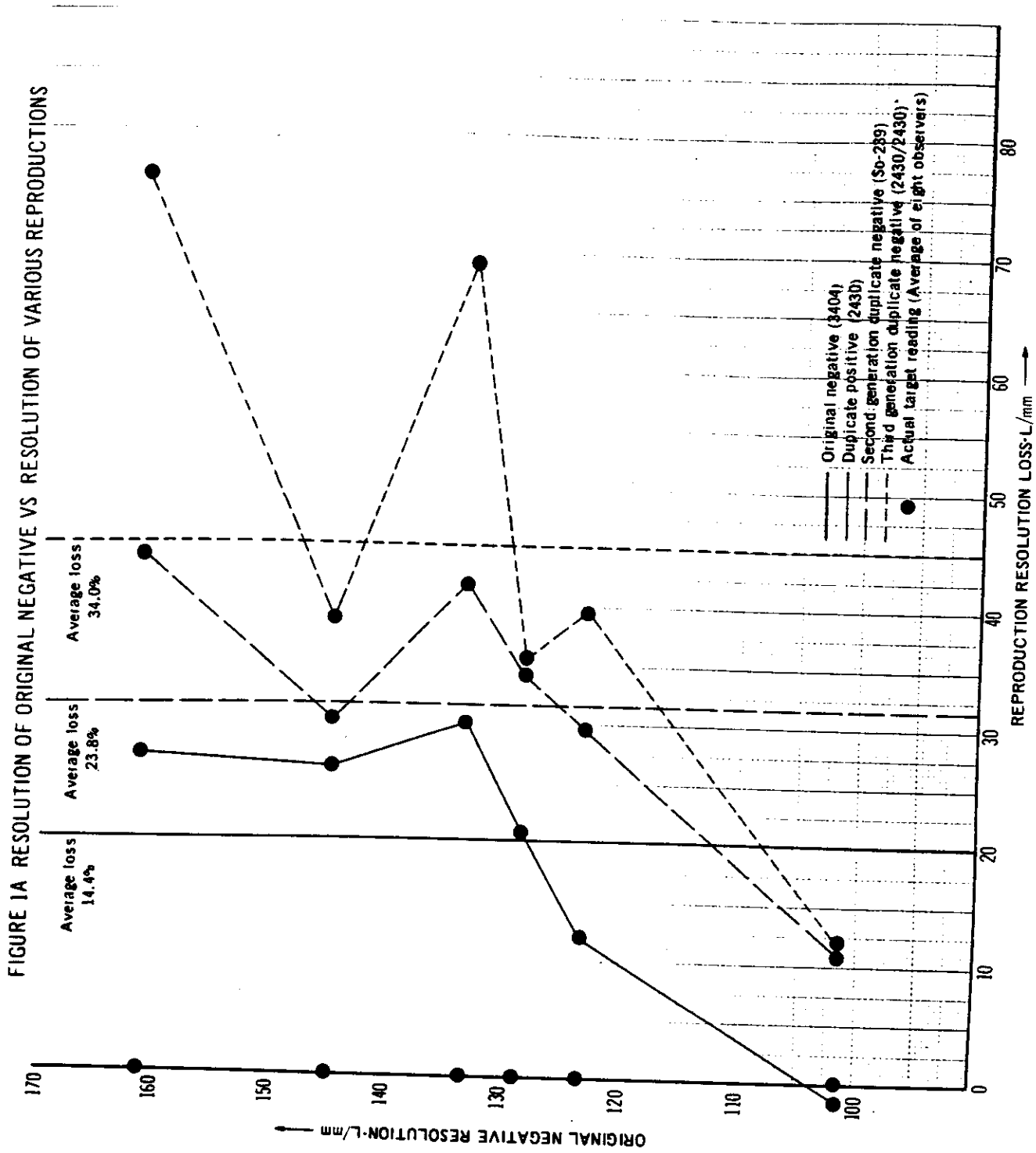
FIGURE 1A RESOLUTION OF ORIGINAL NEGATIVE VS RESOLUTION OF VARIOUS REPRODUCTIONS
Original negative (3404)
Duplicate positive (2430)
Second generation duplicate negative (So-289)
Third generation duplicate negative (2430/2430)
Actual target reading (Average of eight observers)
Average loss 34.0%
Average loss 23.8%
Average loss 14.4%
REPRODUCTION RESOLUTION LOSS-L/mm
ORIGINAL NEGATIVE RESOLUTION-L/mm
0
10
20
30
40
50
60
70
80
100
110
120
130
140
150
160
170

FIGURE 2A CHARACTERISTIC CURVE OF 3404 FILM TYPE PROCESSED WITH DUAL GAMMA CHEMISTRY

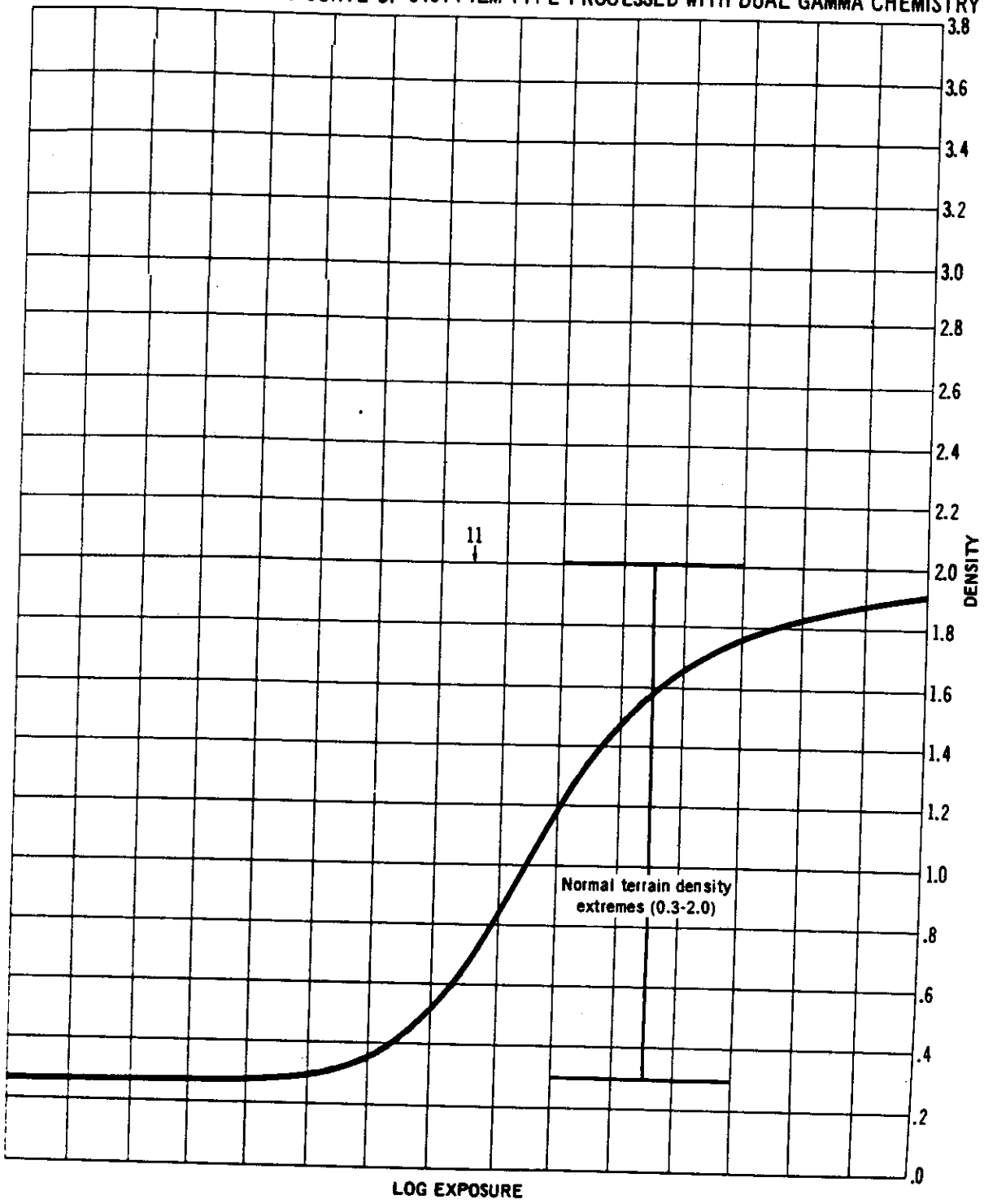

FIGURE 3A SO-239 FILM TYPE SYSTEM CURVE