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June 1965

TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT

MISSION 1015-1
19-24 DECEMBER 1964

MISSION 1015-2
25 DECEMBER 1964
28-30 DECEMBER 1964

Declassified and Released by the NRC

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SYNOPSIS

Mission 1015^o (System No J-17) the 15th of the "J" reconnaissance series was launched 19 December 1964. Two operational phases were programmed and designated Missions 1015-1 and 1015-2, respectively.

Mission 1015-1 (19-24 December 1964) accomplished 39 photographic revolutions, including 3 engineering and 4 domestic passes. The first-phase payload was recovered by air catch on 24 December and second-phase photography was initiated on 25 December 1964. Operations were suspended upon completion of pass 89AE and the vehicle was commanded into a controlled deactivated mode. The vehicle was reactivated on 28 December 1964 and photographic operations resumed with pass 142D.

Mission 1015-2 (25 December and 28-30 December 1964) accomplished 30 photographic revolutions, including 5 engineering and 3 domestic passes. Termination of operations and payload recovery were effected on 30 December because the telemetry signalled potential electrical difficulties. However, operation subsequent to recovery of the payload indicated that a mission of normal duration could have been performed.

All cameras functioned satisfactorily and produced good-quality photography. The panoramic record was assigned a Mission Information Potential (MIP) rating of 85 and the photography, in general, is comparable to that achieved in Mission 1012, 17-23 October 1964. However, the slave (AFT) panoramic imagery is degraded by the presence of an out-of-focus area at the supply end of the data block edge of the format. This condition is first observed in pass 4D and is detectable, to some degree, in all following passes. Fortunately, the overall degradation is relatively minor. The affected area is not extensive in size or consistent in severity of degradation and is, at times, difficult to detect. A detailed discussion of this anomaly is contained in Item 2 of Part I Camera Operation.

Clouds obscured 33 percent of the panoramic photography obtained in Mission 1015-1 and increased to 45 percent in Mission 1015-2. Solar elevations ranged from 4 degrees to 69 degrees in Mission 1015-1 and from 2 degrees to 79 degrees in Mission 1015-2. However, most of the photography was acquired with solar elevations between 5 and 35 degrees.

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GENERAL FLIGHT DATA

Mission 1015-1	Launch Date	19 December 1964
	Recovery Date	24 December 1964
Mission 1015-2	Activation Date	25 December 1964
	Deactivation Period	26, 27 December 1964
	Reactivation Date	28 December 1964
	Recovery Date	30 December 1964

Orbital Parameters

	Mission 1015-1 (Rev 10)	Mission 1015-2 (Rev 145)
Period	90.535 Min	90.1996 Min
Perigee	96.56 nm	98.141 nm
Apogee	230.64 nm	220.27 nm
Eccentricity	0.01860	0.016977
Inclination Angle	74.973° N	74.96° N

Photographic Operations

	Mission 1015-1	Mission 1015-2
Operational Passes	32	22
Domestic Passes	4	3
Engineering Passes	3	5
Recovery Revolutions	81D	175D

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PART I. CAMERA OPERATION

1. Master (FWD) Panoramic Camera No 138:

The instrument was operational throughout the mission and camera-induced degradations consist mainly of various light-struck areas at the beginning and end of the photography acquired in each pass. The light leaks produced the following patterns in Mission 1015-1 (noted in order of appearance from head to tail of the individual pass records):

(a) 1st frame: a small flare inside the format, originating on the data block edge and generally found in the take-up half of the frame.

(b) 5th-from-last frame: an edge-to-edge plus-density area 3 to 6 inches wide.

(c) 4th-from-last frame: an irregular light trace resembling a corona static discharge, oriented toward take-up, and more intense on the data block edge of the film.

(d) Next-to-last frame: same as in (c) above, but generally less intense and more prominent on the frequency marks edge.

(e) Last frame: a small flare similar to that noted in the first frame, but less intense.

In Mission 1015-2 the following repetitive patterns are present:

(a) 1st frame: a small flare and/or a bar-type light trace approximately $\frac{1}{4}$ -inch wide, extending from edge to edge within the format.

(b) Next-to-last frame: a small, irregular light trace resembling a corona static discharge.

(c) Last frame: a faint equipment shadowgraph.

Degradation of imagery within the affected areas is minimal in most cases. However, in an isolated case outside the general pattern, heavy fog and dense equipment shadowgraphs severely degrade all of frame 5 and a portion of frame 6 in pass 142D.

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Intermittent, fine base scratches are present throughout the film. Both edges contain continuous rail scratches. There are no outstanding or excessive camera-induced emulsion scratches or abrasions.

2. Slave (AFT) Panoramic Camera No 141:

The camera was operational throughout the mission and the photographic record contains light-struck areas on the order of those noted in Item 1 above. Degradation is slight and will be discussed at a later point. A more notable anomaly is the presence of an out-of-focus area at the supply end of the data block edge of most formats following pass 4D, frame 25. Water, cloud cover, and atmospheric haze in the photography immediately following frame 25 preclude precise determination of the initial appearance of the degradation. Similar out-of-focus areas have been observed in a number of previous mission records, such as Missions 1004, 1007, 1010, 1011, where the degradation appeared almost exclusively in the master (FWD) camera material.

The area affected by the out-of-focus condition in this mission varies slightly in dimensions, contour, and severity of degradation, but its location within the format is reasonably stable. At worst, the degradation extends 4 inches along the edge of the format (taken from the supply end shrinkage marker and measured toward take-up) and intrudes approximately 1 inch into the format in an irregular curve.

The factors involved in this anomaly have not yet been positively established. However, extensive study has resulted in an apparent correlation between film tracking and presence of the out-of-focus condition, which seems to be induced by variations in pitch of the formats (their alignment on the film, relative to the film edges). For example, the format pitch measurements in the master (FWD) camera material are relatively stable and no degradation is detectable:

Pitch range @ take-up: 0.260" - 0.265". Average 0.265".

Pitch range @ supply: 0.215" - 0.230". Average 0.220".

(Note: Pitch values are measured from the format edge to the film edge immediately adjacent to the shrinkage markers at supply and take-up.)

Measurements of format pitch in the slave (AFT) camera material reveal that the take-up values are fairly stable, but the supply values are erratic and the out-of-focus condition appears to be induced by this variation. Sample readings and pertinent comments are tabulated, as follows:

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<u>Pass</u>	<u>Frame</u>	<u>Pitch at Take-up (inches)</u>	<u>Pitch at Supply (inches)</u>	<u>Comments</u>
1D	1	0.250	0.250	Out-of-focus condition not present.
	5	0.250	0.240	
	10	0.255	0.245	
	14	0.255	0.255	
3D	1	0.255	0.240	Large displacement occurs at supply in frame 12, but water/clouds preclude detection of degradation.
	12	0.260	0.265	
	27	0.260	0.255	
4D	1	0.260	0.250	Degradation is readily detectable when supply pitch attains 0.2675 inches but not prior to that. Take-up pitch stabilized at 0.260 inches.
	25	0.255	0.267	
	50	0.260	0.2675	
	75	0.260	0.2675	
5D	1	0.260	0.2675	Haze precludes detection of degradation, frame 1. None present in frames 20 and 45.
	20	0.257	0.245	
	45	0.260	0.265	
6D	1	0.260	0.2675	Supply pitch measurement stabilizes at apparent critical value and degradation exists in all frames.
	50	0.260	0.2675	
	75	0.260	0.2675	

Numerous additional pitch readings were taken as the mission evaluation progressed but no significant departures from the apparent degradation pattern were observed. Summing up, it appears that the following conditions exist when degradation is present:

(a) A critical pitch measurement is attained, either by the supply or take-up end of the format. In this case, it is located at supply and the critical or threshold value is 0.2675 inches.

(b) The pitch differences between take-up and supply vary, but unless a critical displacement has taken place at one end or the other the take-up and supply pitch relationships are of little significance. In this mission the difference in pitch between take-up and supply ranges as high as 0.010 inches with an average difference of 0.0075 inches. Regardless, no degradation is detectable at any time unless the supply pitch reading is at the critical value.

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The reader is cautioned that the foregoing conclusions are derived from study of the film record of Mission 1015 only. Exhaustive study of previous mission records is currently underway and will provide more detailed information and data on the relationship between film tracking and presence of the focus anomaly.

The following light-induced degradations are present in the aft camera material, Mission 1015-1 (noted in most passes):

(a) 7th-from-last frame: a plus density area near supply, which occasionally shifts into the take-up end of the 6th frame from last.

(b) 6th-from-last frame: an intense corona-type light trace, which also affects the 5th-from-last frame in a number of cases.

(c) 3rd-from-last frame: a smaller, less intense corona-type light trace and a faint equipment shadowgraph.

(d) 2nd-from-last frame: a faint equipment shadowgraph at supply, which occasionally shifts into the take-up end of the next-to-last frame.

(e) Next-to-last frame: a small corona-type light trace.

In Mission 1015-2 the following frames of most passes are affected:

(a) 1st frame: a faint equipment shadowgraph at take-up.

(b) Next-to-last frame: a small light trace.

(c) Last frame: faint equipment shadowgraphs in a number of passes.

The aft photography exhibits banding at the start of scan in most frames. This has been observed in previous mission records. In addition, the aft material contains intermittent minus density streaks. However, neither condition appreciably degrades the imagery.

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3. Master (FWD) Horizon Cameras:

The port (supply) and starboard (take-up) horizon cameras were operational throughout the mission. The image corners are vignetted, but the horizon curves are unaffected and remain usable for determination of vehicle attitude. Exposure was adequate except where low solar elevations precluded effective horizon photography.

4. Slave (AFT) Horizon Cameras:

The port (take-up) and starboard (supply) horizon cameras were operational throughout the mission. Quality of the photography is similar to that obtained with the Master (FWD) instruments. The corner vignetting does not deny use of the horizon curves for the purpose of vehicle attitude determination, and exposure was adequate except where low solar elevations prevailed.

5. Stellar Camera No 61 (Mission 1015-1):

The instrument was operational throughout the mission, but approximately 50 percent of each format is degraded by assorted flares and lens element reflections. At least 30 stellar images are recorded, but the majority of frames contain doublets and/or elongated stellar images. Uncertainty of mensuration is approximately 15 minutes of arc. The title edge of the film contains fine, transverse emulsion cracks which extend 0.10 inch into the film (frames 50-384). Fine, edge-to-edge emulsion cracks are present in frames 160-384. Minor abrasions appear intermittently on the title edge but no sequence of occurrence is definable.

6. Stellar Camera No 58 (Mission 1015-2):

The camera performed satisfactorily throughout the mission. A double exposure occurred in the first frame, but is not classified as a malfunction. This anomaly is occasionally induced by the camera programmer at the start of the second phase of a two-section mission, dependent on the position of the camera programmer at launch. Of the 7 possible positions, 3 may cause double exposure of the initial second-phase frame. Quality of the photography is similar to that achieved in Mission 1015-1. The various degradations noted in the first-phase stellar record are also present in this material. In addition, minor dendritic static discharges are present at the end of the film record.

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7. Index Camera No D61 (Mission 1015-1):

The camera was operational throughout the mission and produced good-quality photography.

8. Index Camera No D58 (Mission 1015-2):

The camera operated satisfactorily throughout the mission and quality of the photography is good. As in the stellar material, the first frame contains a double exposure.

9. Associated Equipment:

The binary data block was operational throughout the mission. No lamp failures were noted except in pass 167D, frame 27, where the time word is not recorded. However, the index lamp image adjacent to the camera number in the master (FWD) panoramic camera material is bloomed and the entire data block in the slave (AFT) film contains bloomed lamp images, resulting in non-uniform image sizes and shapes. The frequency marks are flared, but are recorded outside the formats. Single end-of-pass markers are recorded at all camera-off positions. The camera numbers are flared but readable. The horizon camera fiducials are well defined, with little or no flare present.

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FIGURE 1. DESCRIPTION OF PHOTOGRAPHIC DATA.

The data pertaining to photographs contained in this publication are defined as follows:

PASS: A pass is the operational portion of an orbital revolution. A suffix D indicates that the photography was acquired during the descending portion, a suffix A indicates that the photography was acquired during the ascending portion, and a suffix M indicates that the photography was acquired during a pass that includes both ascending and descending portions. An additional suffix E indicates that the pass was an engineering operation or that a portion of the pass has been edited.

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

UNIVERSAL GRID COORDINATES: These coordinates are included to locate the illustrated photography within the panoramic format.

ENLARGEMENT FACTOR: The enlargement factor is included to indicate the number of diameters the original material has been enlarged in the photographic illustration.

GEOGRAPHIC COORDINATES: These coordinates are included to indicate the latitude and longitude of the panoramic format.

ALTITUDE: This measurement is the vertical distance from the vehicle to the Hough Ellipsoid at the time of the acquisition of the photography.

PITCH: Rotation of the camera about its transverse axis. Using appropriate aeronautical terminology, positive readings indicate nose-up attitude and negative readings indicate nose-down attitude.

ROLL: Rotation of the camera about its longitudinal axis. Using appropriate aeronautical terminology, positive readings indicate left wing-up attitude and negative readings indicate right wing-up attitude.

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YAW: - Rotation of the camera about its vertical axis. Positive readings indicate counterclockwise rotation when viewing the ground nadir from the vehicle-mounted camera in-flight.

LOCAL SUN TIME: This time is included to present to the viewer a realistic time of acquisition of the photography illustrated.

SOLAR ELEVATION: The solar elevation is the angular elevation of the sun above a plane tangent to the surface of the earth at the center of the panoramic format. A negative solar elevation indicates that the sun is below the plane.

SOLAR AZIMUTH: The solar azimuth is the angular measurement of the rays of the sun measured from True North in a clockwise direction.

EXPOSURE: The exposure is the duration of the photographic exposure expressed in a fraction of a second and is computed from the scan rate and slit width.

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FIGURE 2. EXAMPLE OF HORIZON CAMERA PHOTOGRAPHY.

NPIC K-1888 (8/88)

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Camera	FWD
Pass	47DE
Frame	9
Date of Photography	22 December 1964
Universal Grid Coordinates	Port Horizon
Enlargement Factor	.....	3X
Geographic Coordinates	.....	36-23N 114-28W
Altitude (feet)	.....	603,816
Camera Altitude		
Pitch	.....	15°14'
Roll	.....	-00°23'
Yaw	.....	00°16'
Local Sun Time	.....	1233 Hours
Solar Elevation	.....	29°44'
Solar Azimuth	.....	171°
Exposure	.....	1/100 Sec



Approximate flight direction
on photograph



Approximate scan direction
on photograph

Approximate location of photograph in format. Negative viewed with emulsion side down.



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FIGURE 3. EXAMPLE OF STELLAR CAMERA PHOTOGRAPHY.

NPIC K-1884 (8/68)

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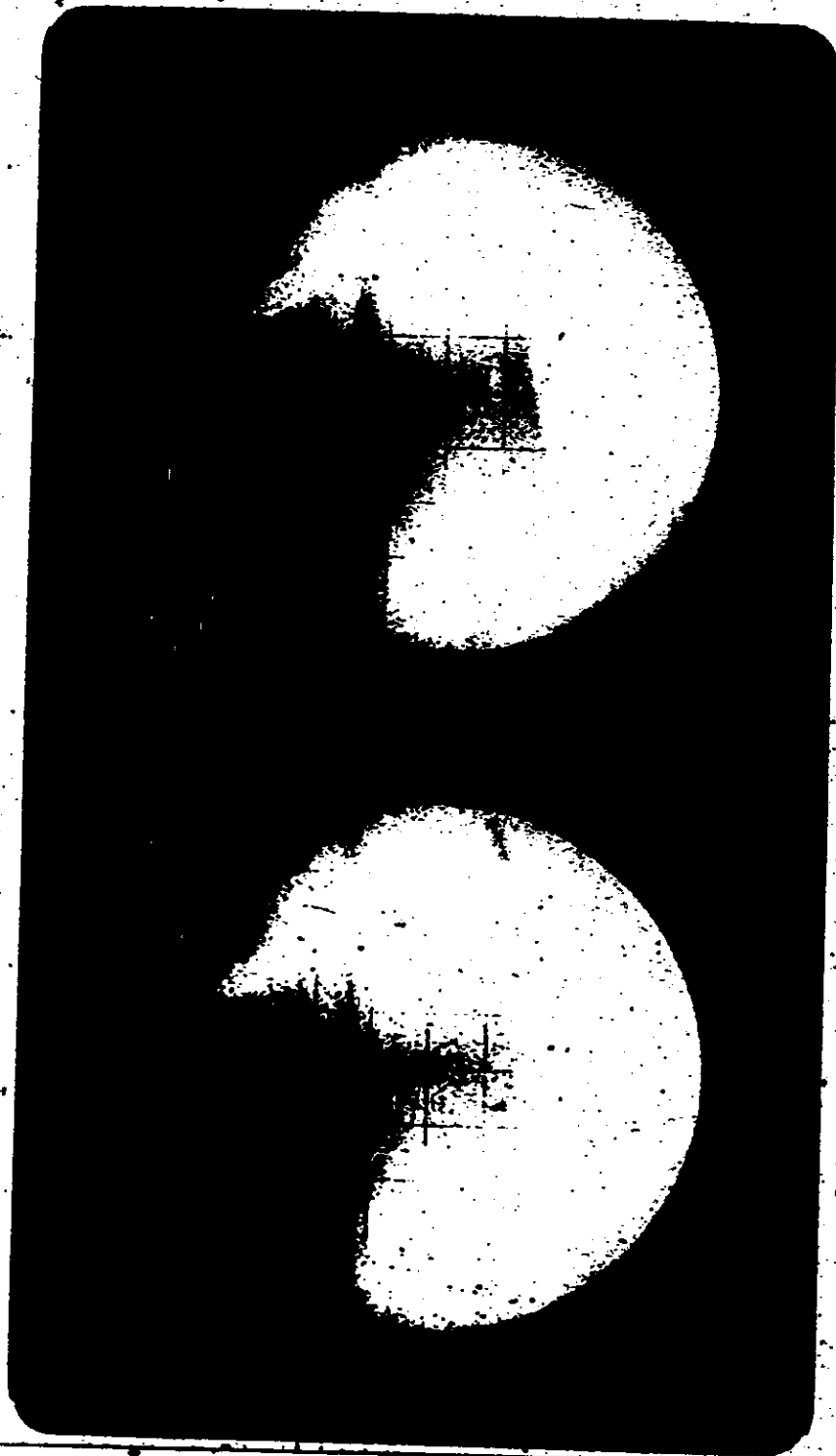


Stellar Frame Number 48 & 49
Correlates with FWD Camera:
Pass 850
Frame 103 & 110
Date of Photography 25 December 1964
Enlargement Factor 3X
Panoramic Camera Attitude During Acquisition
Pitch 15°09' 15°12'
Roll -00°14' -00°17'
Yaw 00°12' 00°17'
Exposure Time 2 Sec

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FIGURE 4. EXAMPLE OF INDEX CAMERA PHOTOGRAPHY.

NPIC X-1888 (8/88)

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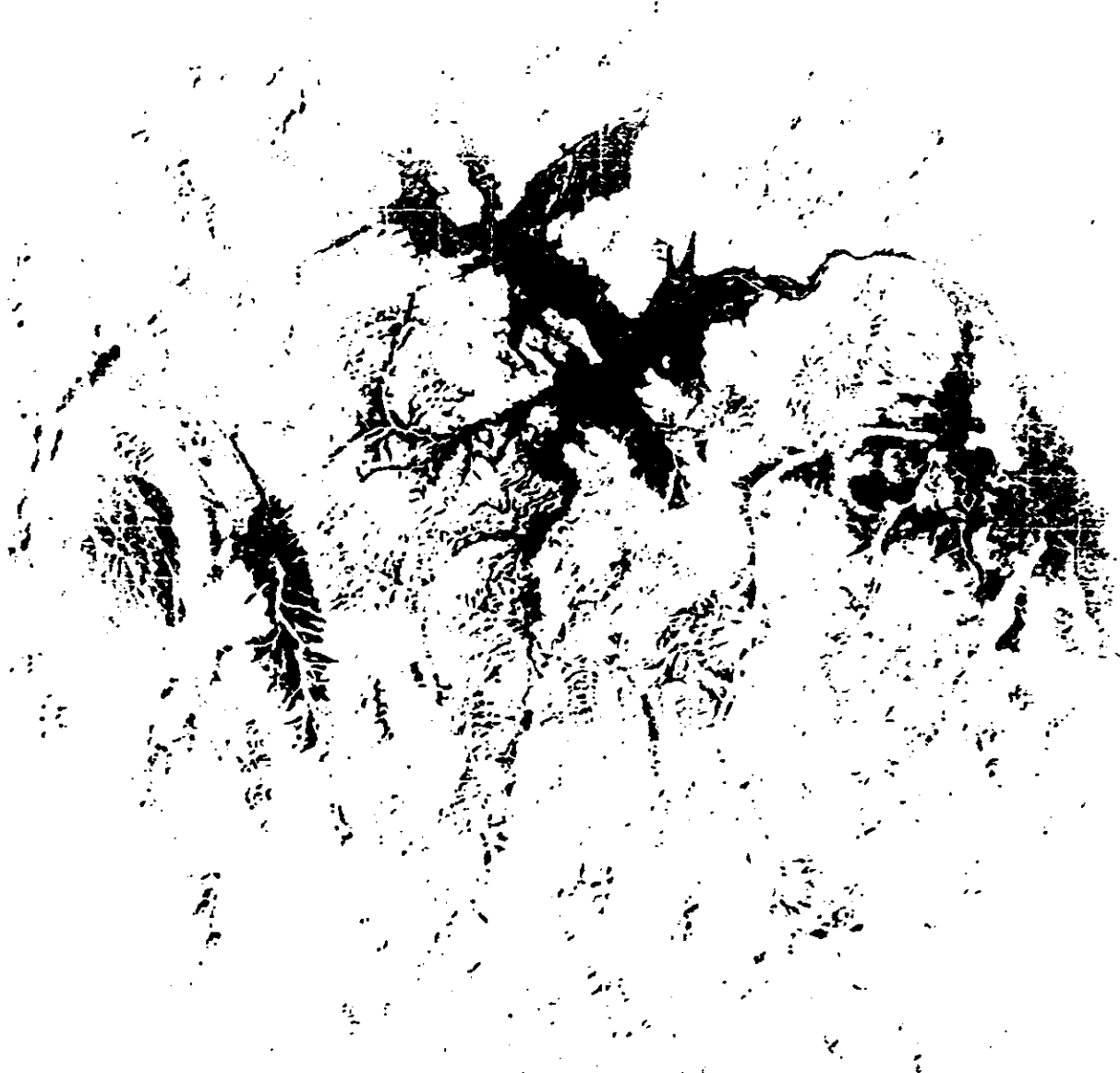
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Index Frame Number 13
Correlates with FWD Camera:
Pass 4D
Frame 43
Date of Photography 20 December 1964
Enlargement Factor 3X
Panoramic Attitude During Acquisition
Pitch 15°09'
Roll -00°26'
Yaw 00°39'
Exposure 1/500 Sec

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FIGURE 5. EXAMPLE OF OUT-OF-FOCUS CONDITION IN AFT PANORAMIC PHOTOGRAPHY.

NPIC K-1886 (8/68)

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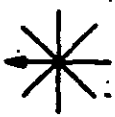
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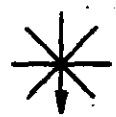
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Camera	AFT
Pass	47DE
Frame	34
Date of Photography	22 December 1964
Universal Grid Coordinates	10-20, Fiducial Edge
Enlargement Factor	.....	2X
Geographic Coordinates	.....	33-16N 113-28W
Altitude (feet)	.....	597,113
Camera Altitude		
Pitch	.....	Not Available
Roll	.....	Not Available
Yaw	.....	Not Available
Local Sun Time	.....	1237 Hours
Solar Elevation	.....	32° 39'
Solar Azimuth	.....	170°
Exposure	.....	1/400 Sec
Location of photo in frame (note inked area)		

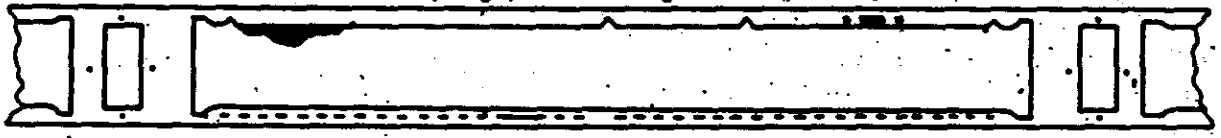


Approximate flight direction
on photograph



Approximate scan direction
on photograph

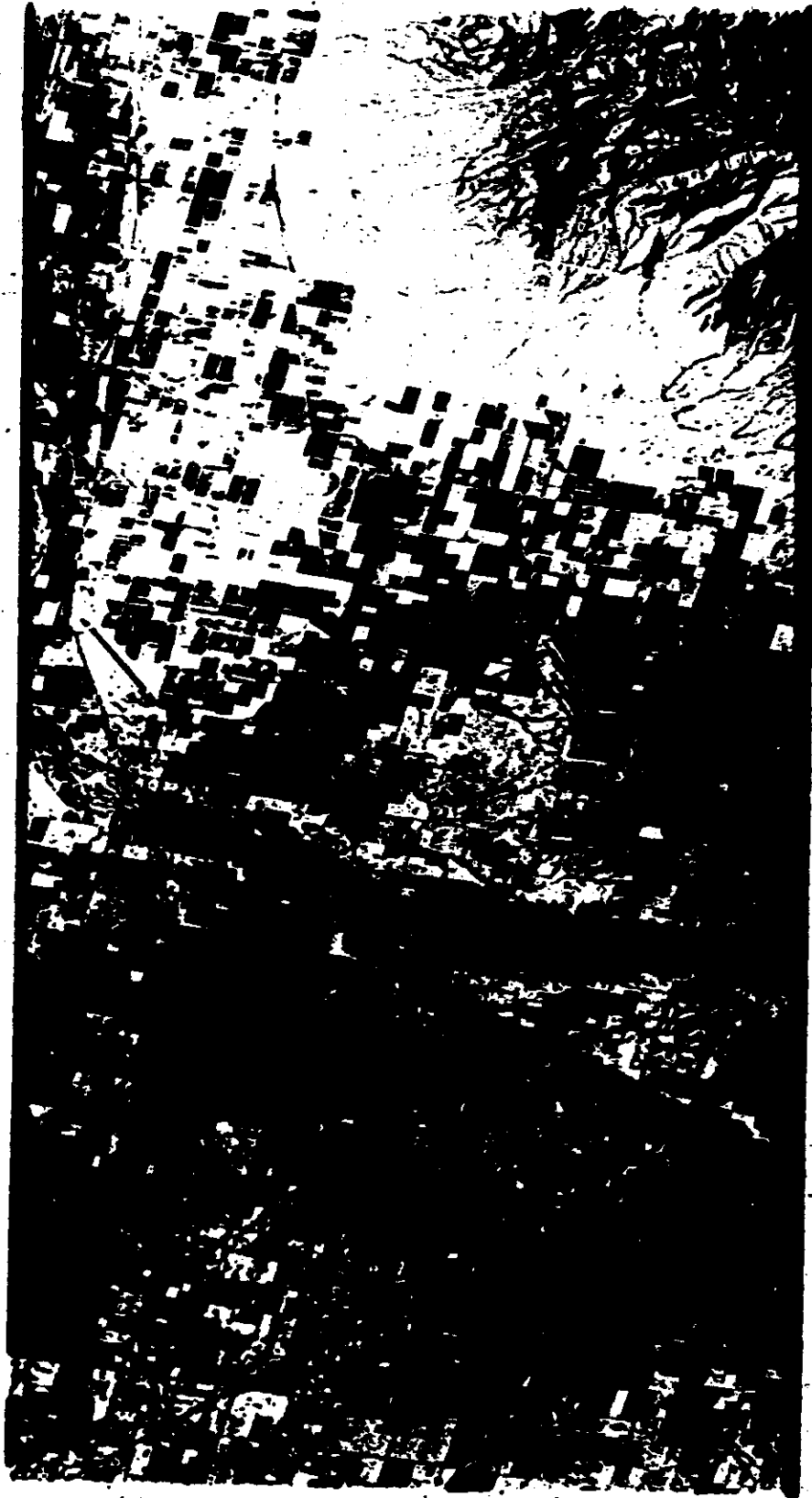
Approximate location of photograph in format. Negative viewed with emulsion side down.



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PART II. FILM

1. Film Footage:

The film footage/frame totals for Mission 1015 are as follows:

	1015-1	1015-2
Master (FWD) Panoramic Camera	7,826 ft/2,690 frames	7,067 ft/2,664 frames
Slave (AFT) Panoramic Camera	7,706 ft/2,648 frames	7,019 ft/2,654 frames
Stellar Camera	61 ft/ 384 frames	53 ft/ 379 frames
Index Camera	104 ft/ 384 frames	78 ft/ 379 frames
<hr/>		
Total Footage/Frames, Master (FWD) Panoramic Camera	14,893 ft/5,354 frames	
Total Footage/Frames, Slave (AFT) Panoramic Camera	14,725 ft/5,302 frames	
Total Footage/Frames, Panoramic Photography	29,618 ft/10,856 frames	

Note: All footage figures are process machine footages.

2. Film Processing:

This section provides evaluation of processing, exposure, density, contrast, and physical condition of the original negatives. Processing data are abstracted from records maintained by the processing contractor. Evaluation of exposure and physical condition of the processed film are accomplished by on-site inspection of the negative material as it is made available for breakdown and titling. A final, more thorough examination of the original negatives is conducted by photographic analysts at a later date.

In general, most of the photography obtained in this mission received adequate exposure. However, low solar elevations and/or variations in terrain reflectivity caused some departures from normal. Densities range from thin (in photography acquired at low solar elevations) to medium. The contrast varies from low to medium, dependent on solar elevation, terrain type, cloud shadow, and similar related factors. Some high contrast photography is present in snow-covered areas (particularly in mountainous terrain) and in shoreline areas. The physical condition of the processed film was good.

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The following development levels were employed in processing the film:

	1015-1		1015-2	
	Master	Slave	Master	Slave
Primary	2%	0%	0%	0%
Intermediate	2%	5%	10%	9%
Full	96%	95%	90%	91%

Four development level changes were made in processing the master record and 11 changes in the slave record, Mission 1015-1. In Mission 1015-2, the master film record required 18 development level changes and the slave record 10. Nine parts were special-printed in Mission 1015-1 and 6 parts required similar treatment in Mission 1015-2.

3. Physical Film Degradations:

There are no outstanding or excessive physical degradations other than an unusual, arrow-shaped scratch in frame 25 of pass 880. The scratch is oriented to the long axis of the film with the "arrowhead" projected towards the take-up end of the format. Slightly curved, the scratch is approximately 0.40 inch long and 0.05 inch wide. Location of the scratch is 0.50 inch inboard of the frequency marks edge and 11.50 inches from take-up. Image destruction is severe; several buildings and a section of road have been obliterated. Investigation indicates that the degradation occurred after the film had been processed, inspected, and titled. More precise determination of the time the damage was caused is not possible.

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FIGURE 6. EXAMPLE OF UNUSUAL SCRATCH DEGRADATION.

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Camera	FWD
Pass	88D
Frame	25
Date of Photography	25 December 1964
Universal Grid Coordinates	54-10 (Scratch Center)
Enlargement Factor	20X
Geographic Coordinates	Not Applicable
Altitude (feet)	Not Applicable
Camera Altitude	
Pitch	Not Applicable
Roll	Not Applicable
Yaw	Not Applicable
Local Sun Time	Not Applicable
Solar Elevation	Not Applicable
Solar Azimuth	Not Applicable
Exposure	Not Applicable

Approximate location of photograph in format. Negative viewed with emulsion side down.



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4. Film Processing Curves:

The following graphs are reproductions of the film processing curves for missions 1015-1 and 1015-2 provided by the processing contractor.

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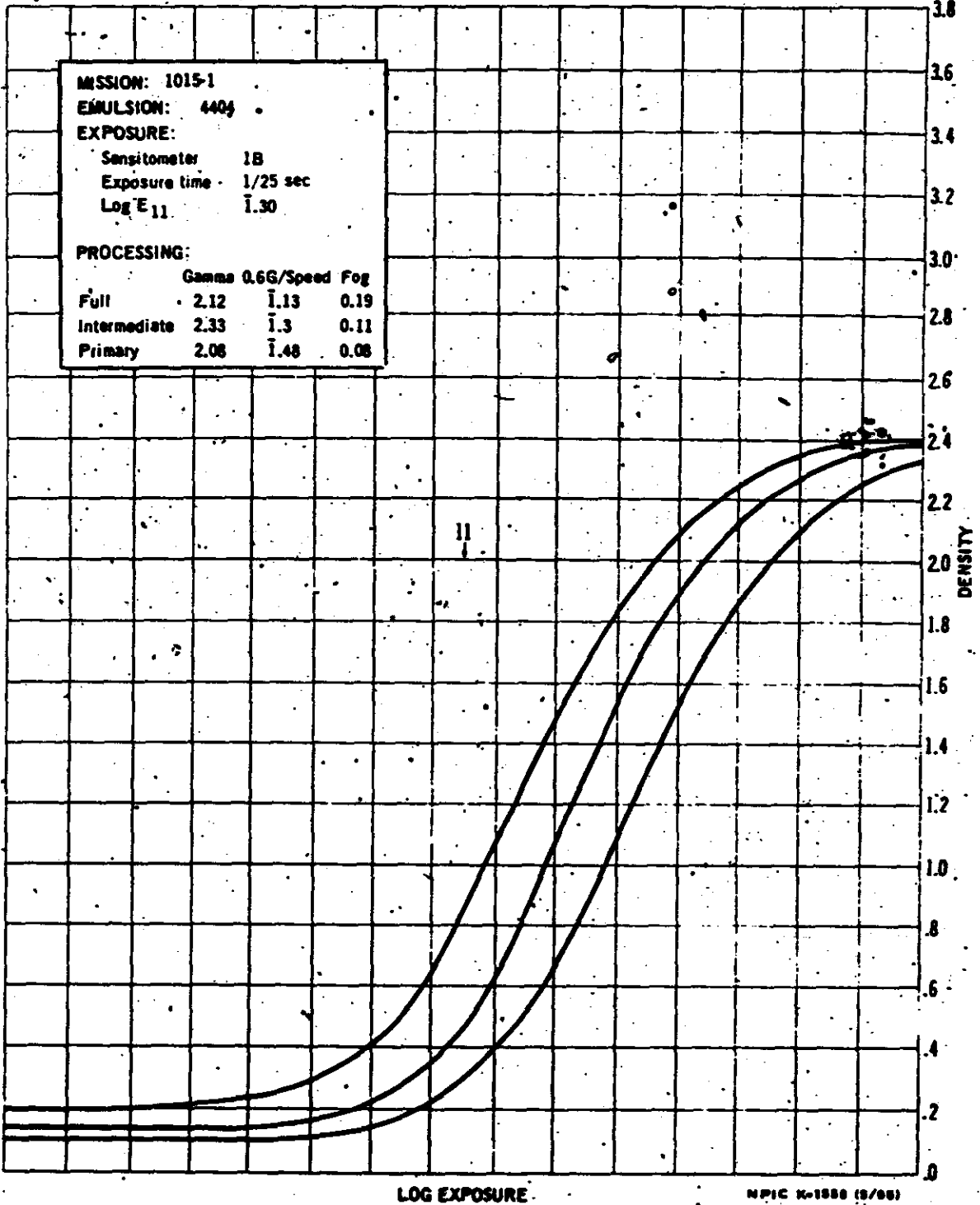
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STANDARD PROCESSING CONTROL CURVES



LOG EXPOSURE

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