TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT MISSION 1019-1 29 APRIL - 4 MAY 1965

OCTOBER 1965
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TECHNICAL PUBLICATION

PHOTOGRAPHIC EVALUATION REPORT
MISSION 1019-1
29 APRIL - 4 MAY 1965

OCTOBER 1965

NATIONAL PHOTOGRAPHIC INTERPRETATION CENTER

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SYNOPSIS

Mission 1019-1 (System No [redacted]) was launched 29 April 1965. Two periods of photographic operations (Missions 1019-1 and 1019-2) were executed as programmed, but an error in the re-entry sequence prevented recovery of the second film payload.

Mission 1019-1 (29 April-4 May 1965) accomplished 48 photographic revolutions, including 5 domestic and 5 engineering (dark-side) passes. The payload was recovered by air catch on 4 May. All cameras functioned satisfactorily throughout the mission. Telemetry indicated similar camera performances in the second phase, and it appears that only the re-entry sequence error prevented accomplishment of a successful 2-stage effort.

The panoramic records acquired in Mission 1019-1 were assigned a Mission Information Potential (MIP) rating of 85. The photography is comparable to that achieved in Mission 1015, flown 13-30 December 1964. However, the slave (AFT) panoramic record is degraded by the presence of small, out-of-focus areas along the fiducial edge at both ends of the formats. A similar condition was reported in the evaluation of Mission 1015.

Clouds obscured 36 percent of the terrain covered in the mission. Solar elevation data are not available at this time.

GENERAL FLIGHT DATA

Launch Date	29 April 1965
Recovery Date	4 May 1965

Orbital Parameters (Rev 41)

Period	91.069 Min
Perigee	99.772 nm
Apogee	259.83 nm
Eccentricity	0.02211
Inclination Angle	85.03° N

Photographic Operations

Operational Passes	38
Domestic Passes	5
Engineering Passes	5
Recovery Revolutions	80

PART I. CAMERA OPERATION

1. Master (FWD) Panoramic Camera No 118:

The instrument was operational throughout the mission and camera-induced film degradations consist primarily of various light-struck areas at the beginning and end of each pass record. Their appearances on the film conform to the following repetitive pattern:

(a) 1st frame: an equipment shadowgraph, not readily detectable in all passes.

(b) 5th-from-last frame: an edge-to-edge area of uniform fog, approximately 6 inches wide. This is reported to result from light passing through the vehicle's ablative shield.

(c) Next-to-last frame: a small light trace of irregular configuration, generally found on the fiducial edge at the take-up end of the format. This is the result of light passing through a drum leak and reflecting onto the film from a high-finish thermal surface in the barrel of the camera.

(d) Last frame: An equipment shadowgraph, present in most passes. Degradation of imagery within the affected areas is not severe except in the fifth-from-last frame where the uniform fogging occurs. The degree of degradation depends on solar elevation and azimith and on the length of the camera-off period following termination of a photographic pass.

Intermittent minus-density streaks are noted in passes 1D and 3D. Their cause is unknown. Most of these streaks run roughly parallel to the major film axis through (or near) the frame centers. Some of the streak paths appear to coincide with field flattener movements, but others do not as readily conform to a possible relationship between the streaks and action of the field flattener.

Continuous rail scratches are present on both film edges. Most frames contain a group of short, fine, longitudinal emulsion scratches under the camera number and similar heavier scratches that extend from the take-up of the frame to the vicinity of the camera number. Although the latter are more prominent than have been observed in previous missions, degradation remains slight. Both types of scratches are tentatively identified as scan head roller scratches, caused during film transport as the scan arm returns to its start position.

2. Slave (AFT) Panoramic Camera No 119:

The unit was operational throughout the mission, and the majority of the camera-induced degradations are on the order of those noted in the fwd. panoramic record. The most notable exception is the reappearance of an

out-of-focus condition which has not been observed since Mission 1015. Details of the more common light leaks, scratches, and so forth will be cited after discussion of the focus anomaly.

The degraded areas are on the fiducial edge of the formats, in the vicinity of the shrinkage markers at the take-up and supply ends of the frames. Degradation is more consistent and prominent at take-up. However, degradation at both ends of the formats is sometimes so subtle that detection is difficult, particularly when the imagery in the affected area does not contain sufficient culture for reference and comparison purposes. The size and contour of the out-of-focus areas vary but the estimated total image degradation within the individual frames does not exceed 1 percent. Obviously, however, the presence of a focus problem merits attention without regard to the physical extent of the degradation. Precise determination of the initial appearance of the out-of-focus condition in this mission was hampered by cloud cover and/or lack of culture in the early photographic passes, but there is evidence that the anomaly already existed in pass 5D and was possibly present as early as pass 2D.

Extensive investigation of previous mission records that contained similar degradations, such as Missions 1004, 1007, 1010, 1011, and 1015, indicates a possible relationship between format pitch (the alignment of the individual formats relative to the major axis of the film) and the presence of the out-of-focus condition. Apparently, pitch variations are a significant factor. In addition, it appears that a critical displacement between the pitch of the supply and take-up format ends must occur in order to induce degradation.

No focus anomaly is detectable in the fwd panoramic record acquired in this mission. The format pitch measurements are relatively stable throughout the entire record, and the difference between the pitch measurement at supply and pitch value at take-up of any individual frame seldom exceeds 0.010 inch. (Pitch is measured from the fiducial edge of the format to the edge of the film, at points immediately adjacent to and inboard of the end shrinkage markers.)

The aft pitch measurements exhibit considerable instability, as does the differential between the supply and take-up ends of the formats. Sample pitch values and pertinent comments follow:

Pass	Average Pitch At Take-up (inches)	Average Pitch At Supply (inches)	Average Differential (inches)	Comments
1D	0.24	0.255	0.010	Imagery does not permit positive detection of degradation.
2D	0.235	0.245	0.010	
5D	0.230	0.245	0.015	Small degradation at take-up.
8D	0.230	0.245	0.015	Same as in 5D.
9D	0.230	0.245	0.015	Same as in 5D and 8D.
13D	0.232	0.247	0.015	Degradation slightly larger.
19D	0.240	0.250	0.010	Degradation decreased.
21D	0.230	0.245	0.015	Degradation increased.
22D	0.232	0.247	0.015	Same as in 21D.
23D	0.230	0.247	0.017	Degradation slightly more prominent.
24D	0.235	0.252	0.017	Same as in 23D.
25D	0.242	0.253	0.011	No apparent change.
30D	0.242	0.257	0.015	Small degradation detectable both ends.
41D	0.237	0.257	0.020	Degradation more pronounced at supply.
57D	0.240	0.255	0.015	Degradation at take-up much increased, extends approximately 4 inches along format edge and intrudes ½ inch into format at maximum penetration point.
62D	0.245	0.257	0.012	Degradation reverts to previous small extent.
63D	0.242	0.255	0.013	No apparent change at take-up or supply.

Certain conclusions may be drawn from the above tabulations and comments but caution is advised. The pitch measurements were obtained with a 7X monocular fitted with a 0.005 inch reticle. In addition to the obvious limitations of the instrument itself, there is the possibility of human error in taking off the values. Furthermore, it is difficult to detect the presence of degradation and even more difficult to assess its extend where no culture or prominent terrain features are imaged. Bearing these factors in mind, the following conclusions are offered:

(a) There is a critical displacement ratio (pitch at take-up versus pitch at supply) which must be attained in order to induce a detectable out-of-focus condition. Maximum degradation in this mission is observed in pass 57D (which, coincidentally, contains a high culture content) and the pitch readings at take-up averaged 0.240 inch while the supply pitch values averaged 0.255 inch. Although the differential between take-up and supply (0.015 inch) is present in other passes, in no other case is the degradation observed to be as extensive.

(b) The differential between the 2 ends of the format is also a potent factor. Refer to pass 41D, where the difference is 0.020 inch and degradation is not only readily detectable at both ends but now appears to be more prominent at supply.

(c) Finally, it appears that pitch displacement ratio and pitch differential must combine in a critical relationship of values in order to induce maximum degradation. A shift in this relationship will alter the degree and even the location of the out-of-focus condition within a frame.

The aft panoramic record contains a number of light-struck areas similar to those present in the fwd material. However, the repetition pattern differs slightly:

(a) 1st frame: an equipment shadowgraph appears in a few passes.

(b) 6th-from-last frame: an edge-to-edge area of uniform fog, approximately 6 inches wide.

(c) 2nd/3rd-from-last frames: a light trace between the frames which may shift into the supply end of the 3rd-from-last frame or to take-up of the 2nd-from-last frame. An equipment shadowgraph occasionally appears in the 2nd-from-last frame.

(d) Last frame: an equipment shadowgraph is present in a number of passes, and a bar-type light trace is detectable in a few passes.

The same camera-induced scratches noted in the fwd panoramic record are present in the aft material. A continuous plus-density streak runs through the frame-centers of pass 4D. Minus-density streaks are intermittent and few.

[redacted]

transverse banding is detectable in pass 2-D and becomes progressively greater in subsequent passes. As in previous missions, the banding is most prominent at the start of the scan action and is derived from non-linear movement of the scan head with relation to the film. Degradation is not severe.

3. Master (Port) Horizon Cameras:

The port (supply) and starboard (take-up) horizon cameras were operational throughout the mission. Exposure was adequate except where low solar elevations precluded effective horizon photography. Image quality is good.

4. Slave (AFT) Horizon Cameras:

The port (take-up) and starboard (supply) horizon cameras functioned satisfactorily. Exposure was adequate except where low solar elevations prevailed. Image quality is similar to that obtained with the master horizon cameras.

5. Stellar Camera No 35:

The instrument performed without malfunction and produced good-quality images. All of the stellar frames were used to advantage in the vehicle attitude analysis. It is believed that the attitude values obtained from each frame are correct. As a matter of interest, it is noted that the horizon reduced values do not square with the stellar reductions. With reference to roll, for example, the horizon reductions indicate twice as much roll (in terms of actual minutes of arc) as the stellar reductions reveal.

The geometric distribution of the stellar images (approximately 30 readily identifiable stars) is good. Images are detectable even in the format areas degraded by earth albedo. Albedo degradation, incidentaly, appears to be of less magnitude than in most previous missions.

Approximately 25 frames contain stellar images which are distorted to some degree. The factors which contribute to the distortions (streaking, elongation, and so forth) are not precisely known, but it is currently felt that timing conditions in the panoramic cameras and monoscopic operations in certain circumstances are involved.

6. Index Camera No D25:

The unit was operational throughout the mission and produced good-quality photography, perhaps the best obtained to date.

7. Associated Equipment:

The binary data block failed to record on 6 frames, as follows:

Pass 8D, frame 31 (fwd)
Pass 21D, frame 103 (fwd)
Pass 30D, frame 17 (fwd)
Pass 68D, frame 15 (aft)
Pass 72D, frame 70 (aft)
Pass 74D, frame 12 (aft)

In addition, the uniform fog present in certain frames of the panoramic photography (See Items 1 and 2 of this part) caused the dot reader to make erroneous interpretations of the binary data a number of times during the binary readout.

The frequency marks are flared, but the marks and attendant reflected images are recorded outside of the formats. However, intensity of the marks is not consistent, and they often range from underexposed to adequately exposed within a pass. The end-of-pass markers are heavily overexposed. The horizon format fiducials are slightly flared throughout the fwd panoramic material. One of the horizon fiducials is similarly affected in the aft panoramic record (the fiducial adjacent to the panoramic frames in the starboard horizon formats). The camera number is slightly flared, and the adjacent binary index lamp is considerably bloomed.

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. The suffix D indicates that the photography was acquired during the descending portion. Suffix A indicates that the photography was acquired during the ascending portion, and 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.

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.

FIGURE 2. EXAMPLE OF HORIZON CAMERA PHOTOGRAPHY

NPIC K-9029 (10/69)

Pass	57D FWD
Frame	15
Date of Photography	3 May 1965
Universal Grid Coordinates	Starboard Horizon
Enlargement Factor	3X
Pan Format Geographic Coordinates	52-16N 13-30E
Altitude (feet)	631, 605
Camera Attitude	
Pitch	14°56'
Roll	00°10'
Yaw	00°13'
Local Sun Time	1309 hours
Solar Elevation	50°59'
Solar Azimuth	153°
Exposure	f/3.0 @ 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.

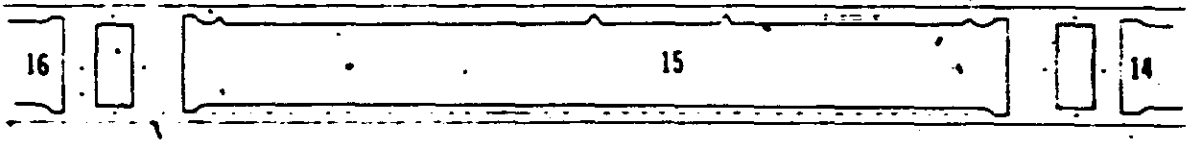

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FIGURE 3. EXAMPLE OF STELLAR CAMERA PHOTOGRAPHY

NPIC K-9030 (10 69)

Stellar Frame Number	308
Correlates with FWD Camera:	
Pass	57D
Frame	15
Date of Photography	3 May 1965
Enlargement Factor	3X
Pan Camera Attitude:	
Pitch	14°56'
Roll	00°10'
Yaw	00°18'
Exposure Time	1/1.3 @ 2 sec

[redacted]

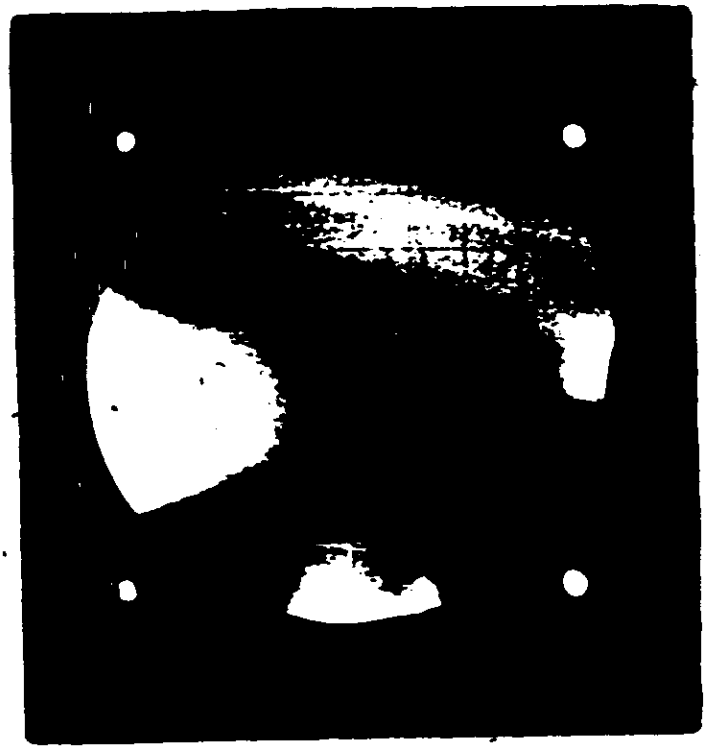

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FIGURE 4. EXAMPLE OF INDEX CAMERA PHOTOGRAPHY

NPIC R-0031 (10/68)

[redacted]

Index Frame Number 306
Correlates with FWD Camera:
Pass. . . . . 5[illegible]
Frame 15
Date of Photography. . . . . 3 May 1965
Enlargement Factor 3X
Pan Camera Attitude:
Pitch . . . . . 14°56'
Roll. . . . . 00°10'
Yaw . . . . . 00°15'
Exposure . . . . . f/4.5 @ 1/500 sec

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

NPIC R-0032 (10/68)

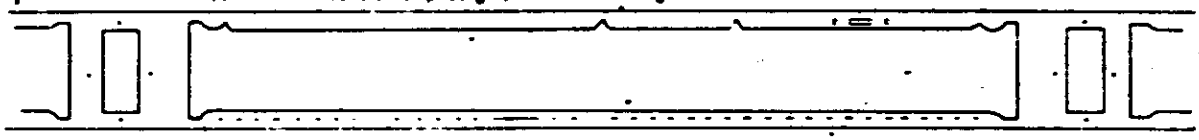
Pass	57D AFT
Frame	25
Date of Photography	3 May 1965
Universal Grid Coordinates	62.5 - Take-up End of Frame
Enlargement Factor	Contact
Geographic Coordinates	51-36N 13-33E
Altitude (feet)	627, 442
Camera Attitude Vehicle:	
Pitch	Not Available
Roll	Not Available
Yaw	Not Available
Local Sun Time	1310 hours
Solar Elevation	51°33'
Solar Azimuth	153°
Exposure	1/376 sec

The overlay defines the approximate contour of the out-of-focus condition in this frame. Precise outline of the degradation is difficult to accomplish, due to the illumination fall-off in this area, with resultant general loss of image quality.

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/Frame Totals:

The film footage/frame totals for Mission 1019-1 are as follows:

Master (FWD) Panoramic Camera	7,254 ft/2,829 frames
Slave (AFT) Panoramic Camera	7,842 ft/2,779 frames
Stellar Camera	54 ft/ 401 frames
Index Camera	90 ft/ 401 frames
Total Panoramic Footage/Frames	15,096 ft/5,608 frames

(Note: All footage figures are process machine footages.)

2. Film Processing:

This section provides evaluation of processing, 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 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 negative 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 heavy. The majority of the density values (approximately 50 percent) fall in the medium category. Similarly, most of the photography contains medium-contrast imagery.

The following development levels were employed in processing the film:

	Master	Slave
Primary	22%	26%
Intermediate	32%	55%
Full	46%	19%

Sixty-four processing level changes were required for the master (fwd) panoramic record and 41 changes for the slave (aft) material. Three parts required special printing.

3. Physical Film Degradations:

Pass 5D, frame 112 (fwd) contains numerous transverse emulsion scratches. Similar, heavier scratches are present in pass 23D, frame 45 (fwd) near frame-center. In pass 21D (fwd), frames 20-137 are degraded by numerous, small longitudinal emulsion scratches. Continuous heavy, parallel base scratches are present in pass 41D, frames 46-50 (aft).

4. Film Processing Curves:

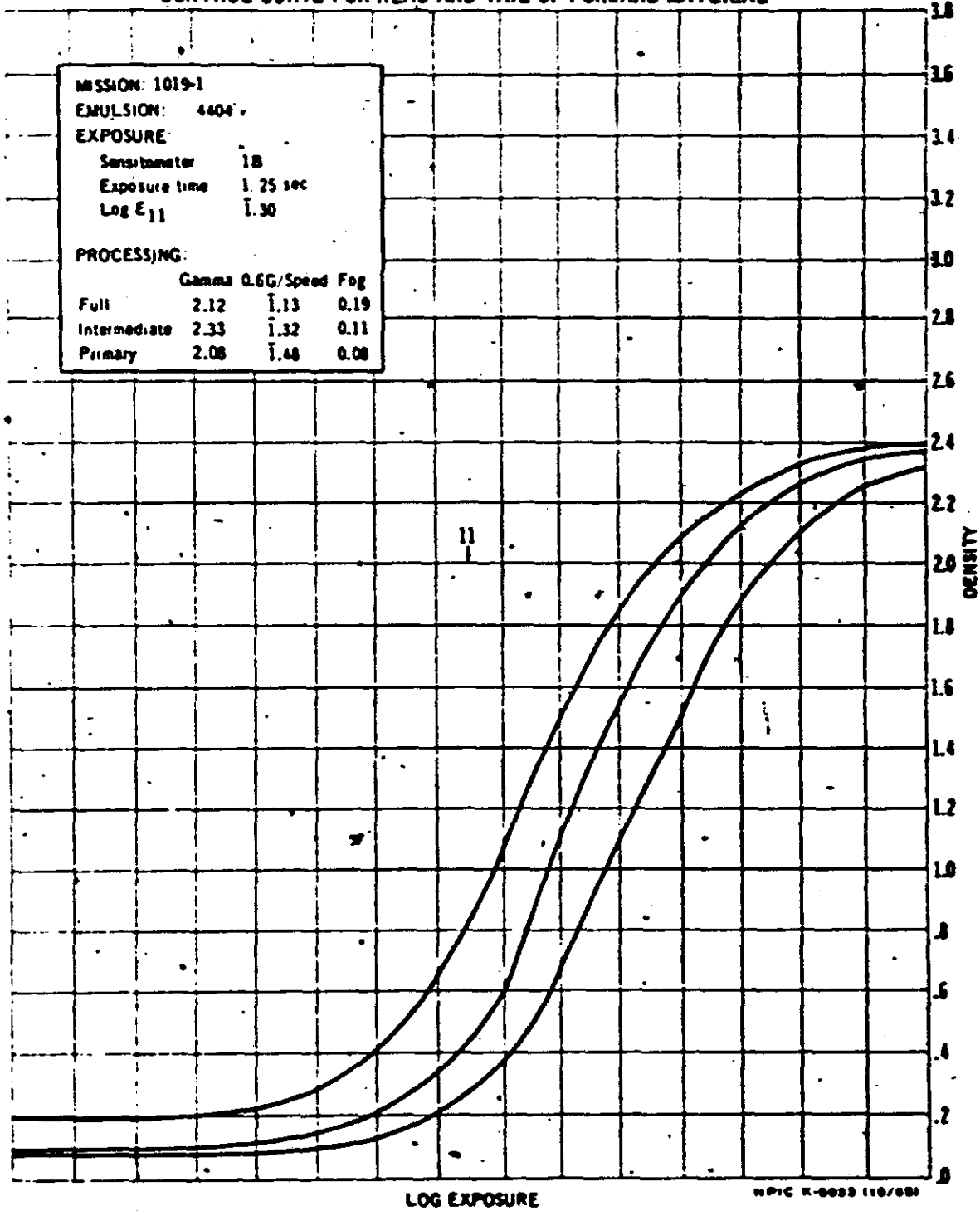
The following graphs are reproductions of the film processing curves provided by the processing contractor for Mission 1019-1.

CONTROL CURVE FOR HEAD AND TAIL OF FORWARD MATERIAL

MISSION: 1019-1
EMULSION: 4404
EXPOSURE
Sensitometer 1B
Exposure time 1.25 sec
Log E_{11} 1.30

PROCESSING

	Gamma	0.6G/Speed	Fog
Full	2.12	1.13	0.19
Intermediate	2.33	1.32	0.11
Primary	2.08	1.48	0.08



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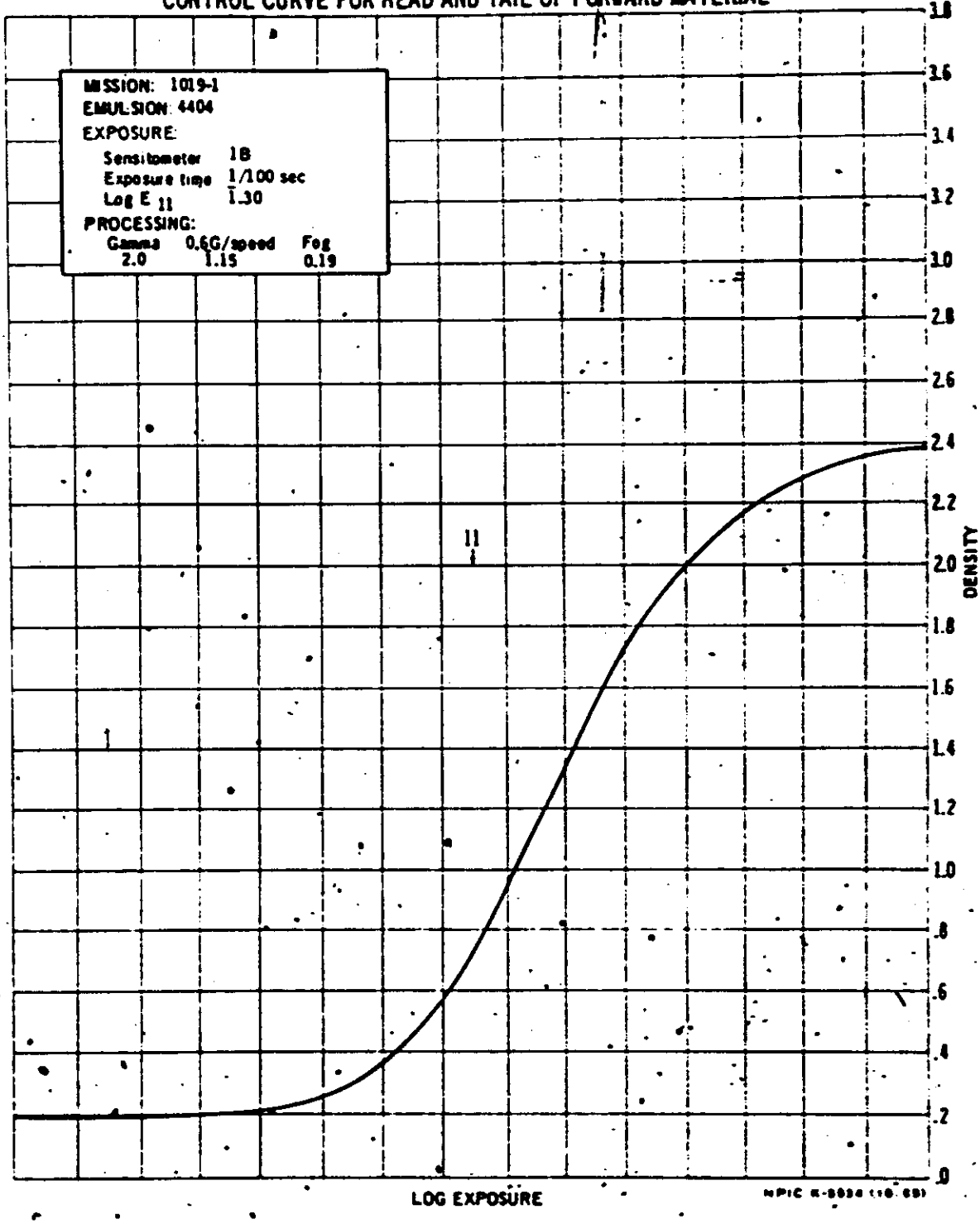
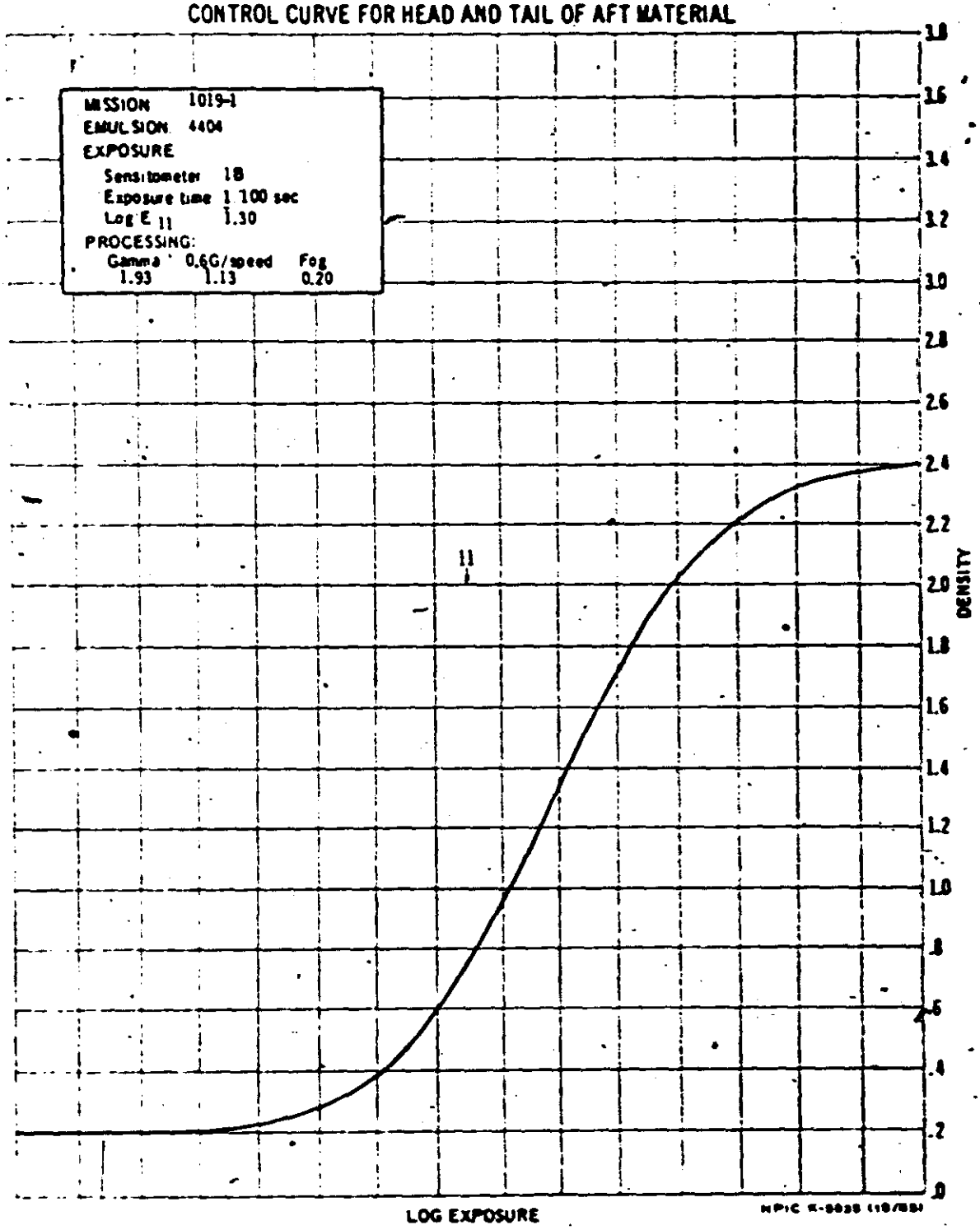
CONTROL CURVE FOR HEAD AND TAIL OF FORWARD MATERIAL

MISSION: 1019-1
EMULSION: 4404
EXPOSURE:
Sensitometer 1B
Exposure time 1/100 sec
Log E 11 1.30
PROCESSING:
Gamma 2.0 0.6G/speed 1.15 Fog 0.19



CONTROL CURVE FOR HEAD AND TAIL OF AFT MATERIAL



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SENSITOMETRIC CURVE FROM MISSION MATERIAL

MISSION: 1019-1
EMULSION: 4404
EXPOSURE:
Sensitometer 1B
Exposure time 1/100 sec
Log E 11 1.30
PROCESSING:
Gamma 0.6G/speed Fog
1.91 1.10 0.19