



TECHNICAL EVALUATION REPORT  
ON ORIGINAL NEGATIVES

FROM

MISSION 1017-1 AND 1017-2

30 APRIL 1965

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FOREWORD

THIS REPORT PREPARED FOR AND BY DIRECTION OF  
THE UNDER SECRETARY OF THE AIR FORCE

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ABSTRACT

Reconnaissance Satellite Mission 1017 was launched on 25 February 1965 from Point Arguello, Vandenberg AFB, California. The first segment, Mission 1017-1, was recovered on 2 March 1965. The System was reactivated for another five days, and the second segment, Mission 1017-2, was recovered on 6 March 1965. Photographic imagery was obtained from 69 of 145 passes.

The original negatives from the two Panoramic Cameras totaled approximately 30,944 feet of 70mm film, excluding the pre-flight portion. A photographic analysis was performed on this film and the results are presented in the following report.

The evaluation by the SPPL Team includes inspecting the film for physical degradations, measuring density and Visual-Reciprocal Edge Spread (V-RES) values, and analyzing imagery by edge scan techniques. In the accomplishment of edge scan analysis, a  $1\mu \times 80\mu$  slit was used on a Mann-Data Micro-Analyzer. An additional analysis by edge scan techniques was performed by the Scientist/Consultant Team using a  $1\mu \times 80\mu$  slit on the Eastman Kodak Model 5 Microdensitometer.

Under the Controlled Range Network (CORN) Program, four resolution displays were activated. Photographic coverage was received on all displays which were located as follows: A mobile and a fixed target at Wright-Patterson AFB, Ohio; a mobile 200' Controlled Scene Brightness edge, and a fixed target at Fort Huachuca, Arizona. A fixed high contrast bar target (Type "C") at Edwards AFB, California, was also covered although it was not activated for this Mission. The ground resolution read from the bar targets ranged from approximately 10 to 12 feet. Analysis of the 200' Controlled Scene Brightness Target by edge scan techniques resulted in the following average values: 71 for MTF/AIM; 86 for 50% Spread, and 77 for M-RES. Included in this report is a tabulation of weather data recorded at the Wright-Patterson AFB, Ohio, and Fort Huachuca, Arizona, CORN displays. The data was obtained from an instrumented weather balloon which is designed to record temperature, humidity, wind, dew point, and pressure data.

A Wratten 25 Filter experiment similar to that accomplished on Missions 1007 and 1014-1016 was also conducted on this Mission. This experiment was based on the utilization of a Wratten 25 Filter on the Forward Camera. The Wratten 25 (red) Filter was used primarily to compensate for the "facing-illumination" condition encountered during the winter months. The Wratten 21 Filter was still retained on the Aft Camera.

An analysis by edge scan techniques produced the following results when converted to ground resolution: 17.4' for MTF/AIM, 15.2' for 50% Spread, and 17.2' for M-RES on the Forward Camera; 14.9' for MTF/AIM, 13.1' for 50% Spread, and 14.9' for M-RES on the Aft Camera.

The V-RES values range from 45 to 118 with an average of 73. This V-RES average value represents a ground resolution of 14.3 feet.

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Physical degradations are minor. Density averages are similar to Mission 1016 and higher than Missions 1014 and 1015. Both over and underexposure were noted on Mission 1017. Overall processing of this Mission is considered very good.

The overall image quality of Mission 1017 is higher than Mission 1016 and lower than Missions 1014 and 1015.

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SECTION I

INTRODUCTION

A technical photographic analysis was performed on the original negatives from Reconnaissance Satellite Mission 1017. The results of this photographic evaluation are presented in the following report.

The "J" Modification of the CORONA Camera System used for this Mission was designed to obtain stereo coverage from the two Panoramic Cameras. This System incorporates two separate film recoveries, with one supply source for each Panoramic Camera. The vehicle for Mission 1017 was launched from Point Arguello, Vandenberg AFB, California, on 25 February 1965. The first film recovery, designated Mission 1017-1, was accomplished in flight after 81 orbits. The second segment, Mission 1017-2, was recovered in flight after 56 orbits.

Section II, para A., "Known Information," outlines specific Mission data, a brief description of the CORONA Camera System, resolution capabilities, and subject environmental information (sun angle and latitude). Paragraph B., "Information Derived from Analysis," includes data derived from the film inspection, processing, laboratory evaluations, image analysis, Wratten 25 Filter experiment, film format characteristics, and all information pertaining to the Controlled Range Network (CORN) Operations for this Mission.

There were no additional or revised procedures, methods, or equipment used in the evaluation of Mission 1017; hence Section III refers to the descriptions outlined in the corresponding section of SPPL Technical Report No. 101-1-42 (Mission 1016).

Section IV presents observations and summaries of data resulting from the mission analysis and concludes with a brief description of the more important photographic physical characteristics.

Section V lists all referenced messages and documents.

Section VI, the Appendix, includes tabulations of density and edge analysis data, photographic enlargements (10X and 40X) with the respective Micro-Analyzer traces, CORN weather data, and a processing profile for all frames.

Sections II, III, and IV are supplemented with graphs, tables, and illustrations which further clarify the Mission evaluation.

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SECTION II  
TECHNICAL DATA AND RESULTS

This section presents information obtained from associated mission documents concerning the camera system and data derived from the photographic physical characteristics evaluation of the original negatives from Mission 1017-1 and 1017-2.

A. Known Information

1. Mission Data

a. Mission Number and Dates of Photography:<sup>1</sup>

1017-1: 25 February 1965 (2146Z) - 2 March 1965 (2350Z)

1017-2: 2 March 1965 - 6 March 1965 (2343Z)

b. Ephemeris: "Performance Estimate" data was available.<sup>2</sup>

c. Mission Product: Listed by Mission, Camera Positions, Passes, Rolls, and Frames (Table 1, Appendix 1, pages 1-1 and 1-2).

d. Footage Received:

1017-1: 16,466 feet (approximate), including 919 feet of pre-flight.

1017-2: 15,397 feet (approximate). See Illustration 1, page 21.

2. Camera System

a. Camera

(1) The "J" Modification of the CORONA Camera System used for this Mission included ten cameras: two Panoramic Cameras (Fwd and Aft), four Horizon Cameras (a pair mounted to each Panoramic Camera), two Stellar and two Index Cameras (one Stellar/Index for each film recovery). The System incorporates two separate film recoveries with one supply spool for each Panoramic Camera. The first film load was recovered in flight after five days of operation. This package recovery is designated Mission 1017-1. Reactivated on 2 March 1965, the System operated for another five days before in-flight recovery of the remaining film load which was designated Mission 1017-2. The CORONA Camera System is designed to obtain stereo coverage from the two Main Panoramic Cameras. The Horizon and Stellar/Index Cameras obtain vehicle attitude and positional data. For specific information on this Camera System, see Table 2, Appendix 2, pages 2-1 and 2-2.

(2) A Wratten 25 Filter was used on the Forward Camera and a Wratten 21 Filter on the Aft Camera of this Mission. Normally in this System the Wratten 21 Filter is used for both Cameras.

<sup>1</sup> Messages: 25 February 1965, 2 and 6 March 1965.

<sup>2</sup> Messages: 3 March 1965 (1017-1) and 7 March 1965 (1017-2).

The Wratten 25 is a red filter used primarily to reduce glare and haze. The exposure setting for the Forward Camera on Mission 1017 was adjusted to compensate for this filter by increasing the exposure time and the slit width.

b. Film<sup>3</sup>

Types of film used on Mission 1017-1 and 1017-2 are listed in Table 3, Appendix 3, page 3-1.

c. Resolution Capabilities<sup>4</sup>

Prior to launch, photographic resolution testing is conducted on all lenses except the Stellar lens. The two Panoramic Cameras are tested dynamically in flight configuration while the remaining lenses are statically bench-tested as components. The high contrast photographic resolution test results are indicated in the following table:

TABLE 4 - Camera Resolution Capabilities										
	Panoramic		Horizon Fwd		Horizon Aft		Index		Stellar	
	Fwd	Aft	Take-up	Supply	Take-up	Supply	-1	-2	-1	-2
Film	4404	4404	4404	4404	4404	4404	4400	4400	4401	4401
Camera Resolution	171 1/mm (Avg)	182 1/mm (Avg)	79 1/mm (Avg)	112 1/mm (Avg)	88 1/mm (Avg)	104 1/mm (Avg)	70 1/mm (Avg)	71.7 1/mm (Avg)	n/a	n/a

3. Description of Subject Environment

a. Sun Angle

Sun angles of the frames evaluated from Mission 1017 range from 0° to 79° and are correlated with the density readings in Table 6, Appendix 5, pages 5-1 through 5-10, and Illustration 14, pages 50 and 51. Sun angles are correlated with V-RES values in Illustration 21, pages 62 and 63.

b. Geographic Latitude

Geographic latitude of the frames evaluated from Mission 1017 range from 9° S to 74° N and are correlated with the density readings in Table 6, Appendix 5, pages 5-1 through 5-10, and Illustration 15, pages 52 and 53. Latitude is correlated with V-RES values in Illustration 22, pages 64 and 65.

<sup>3</sup> Manual of Physical Properties of Kodak Aerial and Special Sensitized Materials, Eastman Kodak Co., Rochester, New York.

<sup>4</sup> Message: 26 February 1965.

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B. Information Derived from Analysis

1. Physical Degradations

a. Mission 1017-1: One hundred and twenty-five rolls of original negative film comprising the total product of the Panoramic and Horizon Cameras, excluding the pre-flight portion, were examined for physical degradations.

(1) Imaged

(a) Forward Panoramic Camera

1 Equipment shadow graphs were noted on the following Passes: D02, Frames 001, 003, and 006; D10, Frame 075; D16, Frame 016; D20, Frame 058; D21, Frame 102; D22, Frame 117; D25, Frames 107 and 110; D30, Frame 024; D35, Frame 001; D36, Frame 067; D39, Frame 101; D41, Frame 058; D52, Frames 001 and 135; D55, Frame 092; D62, Frame 024; D68, Frames 084, 086, and 087; D72, Frame 129; and D78, Frame 024.

2 A fogged area, approximately 6" long, and located near the data block is visible extending the entire width at the tail of the sixth frame from the last frame on all passes except D04, A09E, A25E, and D81.

3 Dendritic fogging was observed along the titled and/or non-titled edge of the following Passes: D21, Frames 001-038; D54, Frames 005, 015, 022, 029, 030, 033, 034, and 037; D55, Frames 006-078; D56, Frames 009, 010, 019-022, 024-027, 035, 037, and 052; and D70, Frames 010-048.

4 Several, parallel, minus-density streaks, varying in length, were noted intermittently throughout Passes D02, D06, D22, and D35, and on Frames 001-003 of Pass D52.

5 A fogged area, 1/4" wide, occurs along the titled edge approximately 3" from the head of the second to last frame on the following Passes: D10, D16, D22, D25, D30, D39, D41, D48, D52, D55, D56, D63, and D78.

6 A diagonal, fine-lined, plus-density streak appears on Frames 014, 017, 023, 026, 067, and 086 of Pass D54, and Frames 072-078 of Pass D81.

(b) Aft Panoramic Camera

1 Equipment shadow graphs were noted on the third from the last frame on all passes except D01, D04, D06-D08, A09E, D20, D22, A25E, D33, D35, D52, D54, D67; the second frame of Passes D41, D48, D50, D67, D78; and the last frame of Passes D02, D09, D32, D33, D48, D67, D68, and D78.

2 A fogged area, approximately 3" long, and located near the data block is visible extending the entire width at the head of the seventh from the last frame on all passes except A09E, A25E, and D81.

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3 Dendritic fogging was observed along the titled and/or non-titled edge on the following Passes: D22, Frames 029-052; D55, Frames 014-017 and 029-046; D68, Frames 042-045, 047-056, and 058; and randomly throughout Passes D52 and D70.

4 Parallel, minus-density streaks, varying in length, were noted on the following Passes: D04, Frame 005; D21, Frames 001, 002, 014 and 015; D56, Frame 074; D68, Frames 058-072, and 084; D70, Frames 001 and 002; and intermittently throughout Passes D05 and D06.

5 A 1" band of fog is visible extending across the entire width of the image format at the center of the first frame on all passes except D01, D04, A09E, D09, A25E, D35, D36, D52, and D68.

6 A fogged area, varying in width, was observed extending from format edge to format edge approximately 8 1/2" from the head of the second to last frame on all passes except D01, D04, D07, D08, A09E, D20, D22, D25, D33, D35, D36, D50, D54, D67, and D81.

7 Crescent-shaped, minus-density spots appear randomly throughout Passes D01 and D02.

8 Two, continuous, parallel, minus-density streaks were noted extending the entire length of Frames 028-030, 033, and 034 of Pass D02; Frame 002, Pass D04; and Frames 008 and 009 of Pass D08.

9 A diagonal, fine-lined, plus-density streak appears on Frames 050, 054, and 056 of Pass D81.

(2) Superficial

(a) Forward Panoramic Camera

1 Several, fine-lined, short, parallel, emulsion scratches were noted along each format edge throughout this segment of the Mission.

2 Several, faint, emulsion scratches are visible on Frame 001-023 and 035-053 of Pass D09.

3 A processing comet is visible on the following Passes: D07, Frame 087; D30, Frame 023; and D32, Frame 014.

4 A pre-processing splice was observed on the following Passes: D02, Frame 026; D52, Frame 130; and D81, Frame 040.

5 Approximately 85% of the last Frame (078), Pass D81, is missing.

6 Foreign matter and several minor abrasions, scratches, and pinholes were noted throughout this Mission.

(b) Aft Panoramic Camera

1 Several, fine-lined, short, parallel, emulsion scratches were noted along each format edge throughout Passes D04-D07, D09, D16, D20, D25, D52, D67, D68, D70, D72 and D78.

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2 A 1 1/2" emulsion scratch is visible 6 1/2" from the head and 7/8" from the titled edge of Frame 118, Pass D72.

3 Several, small, emulsion scratches were found intermittently throughout Pass D39.

4 A pre-processing splice was observed on Frame 009, Pass D22; Frame 091, Pass D52; and Frame 028, Pass D81.

5 A processing comet is visible on Frame 036, Pass D06; Frame 005, Pass D41; and Frames 028 and 030, Pass D67.

6 Foreign matter and several minor abrasions, scratches, and pinholes were noted throughout this Mission.

(c) Forward Horizon Camera

Film transport fogging completely obliterated Frames 120 and 121 of Pass D05.

(d) Aft Horizon Camera

The Horizon Camera format image, adjacent to the tail of each frame, is very faint and sometimes non-existent beginning after the second frame and continuing through the end of Passes D01 and D02.

b. Mission 1017-2: One hundred and sixteen rolls of original negative film comprising the total product of the Panoramic and Horizon Cameras, excluding the pre-flight portion, were examined for physical degradations.

(1) Imaged

(a) Forward Panoramic Camera

1 Equipment shadow graphs were noted on the first frame of the following Passes: D101, A104E, D116, D130, and D131; and the last frame of Passes: D83-D87, A88E, D93, D97-D99, D101, D102, D104, D111, D118, D120, D127, and D132.

2 Dendritic fogging was observed along the non-titled edge extending into the format area from 1/8" to 1/2" on the following Frames: 014, 016-019, 022, 031, 032, 056, and 071, Pass D84; 009-011, 019, 028-032, 039-048, 066, and 072-079, Pass D85; and 018, 020, 022, 032, 034, and 079 of Pass D86.

3 A small area of fog was noted extending across the entire image format width at the tail of the next to last frame on Passes D84, D86, A88E, D93, D95, D101, D104, D111, D120, D132, and on Frames 024, 056, and 058 of Pass D137.

4 A diagonal, fine-lined, plus-density streak, extending from format edge to format edge, appears across the center of Frames 031 and 056-061 of Pass D137.



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(b) Aft Panoramic Camera

1 Equipment shadow graphs were noted on the third from the last frame on all passes except D81, D84, D85, D99, D102, A104E, D117, A120E, D130, D133, D135, D137, and on the last frame of Passes D134-D136.

2 A 1" band of fog is visible extending across the entire width of the image format at the center of the first frame on Passes D84-D87, A88E, D95, D101-D103, D111, D117, D127, D133, and D137.

3 Intermittent fogging, extending the entire width of the image format area and varying in length, was observed throughout Passes D133-D137.

4 A few short minus-density streaks appear intermittently throughout Passes D131 and D133.

5 Dendritic fogging was observed along the titled or non-titled edge extending into the format area from 1/8" to 1/2" on the following Frames: 021-029, 042-047, 051-053, Pass D83; 011-018, 027-052, Pass D84; 027, 028, 030, 032, 040, 048-050, 053, 062-069, Pass D85; 007, 009, 011, 015, 017, 018, 020, 021, 023, 025, 065, Pass D86; and 082, 084, and 088 of Pass D134.

6 A small, fogged area, approximately 1/2" in circumference, was found 1/2" from the non-titled edge at the tail of Frame 014 on Pass D103.

(2) Superficial

(a) Forward Panoramic Camera

1 Several, fine-lined, short, parallel, emulsion scratches are visible along each format edge throughout Passes D82-D84, D86, D87, D100, D101, D103, A104E, D116, D118, D120, and D131.

2 Several, fine-lined, short, parallel, emulsion scratches were noted near the tail of all frames on Passes D83, D86, D101, and D103.

3 Two, parallel, chatter-like, emulsion scratches, approximately 1/2" long, were noted on Frames 001 and 002 of Pass D84.

4 Several, parallel, emulsion scratches, approximately 3" long, were observed on all frames of Pass D100.

5 Several, continuous, parallel, fine-lined, emulsion scratches were noted extending through the format area on all frames of Pass D132.

6 The titling edge is "ragged" between the data block and the head of each frame throughout this segment of the Mission.

7 A pre-processing splice was observed on Frame 046, Pass D101, and between Frames 045 and 046, Pass D135. A post-processing splice was found on Frame 021, Pass D101.

8 A processing comet is visible on Frame 144, Pass D100, and Frame 073, Pass D118.

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9 Foreign matter and several minor abrasions, scratches, and pinholes were noted throughout this Mission.

(b) Aft Panoramic Camera

1 Several, fine-lined, short, parallel, emulsion scratches are visible along each format edge throughout Passes D85-D87, D100, D102, D104, D111, D117, D120, D130-D132, and D134-D136.

2 Several, fine-lined, short, parallel, emulsion scratches were noted near the tail of all frames on Passes D134 and D136.

3 The titling edge is "ragged" between the data block and the head of each frame throughout this segment of the Mission.

4 A pre-processing splice was observed on Frame 024, Pass D101, and Frame 046, Pass D135.

5 Foreign matter and several minor abrasions, scratches, and pinholes were noted throughout this Mission.

2. Film Processing Data

In order to control density, 62 development level changes were made on the Forward and 47 on the Aft Camera for Mission 1017-1; 51 changes were made on the Forward and 46 on the Aft Camera for Mission 1017-2. The following table shows the percentage of the original negatives processed at the three levels of development:

<u>Mission</u>	<u>Development Level</u>	<u>Forward Camera</u>	<u>Aft Camera</u>
1017-1	Primary	13%	24%
	Intermediate	63%	58%
	Full	24%	18%
1017-2	Primary	5%	18%
	Intermediate	63%	62%
	Full	32%	20%

A complete listing of the development level for each frame is shown in Table 5, Appendix 4, pages 4-1 through 4-8. The standard processing curves for the three development levels are shown in Illustration 2, page 22. The control curves for the head and tail of each mission and camera position are shown in Illustration 3, pages 23 through 26.

3. Laboratory Evaluations

a. Sensitometric

Two unexposed 70mm strips of Type 4404 Film from Mission 1017 (one from each

Panoramic Camera) were received for evaluation. These two unexposed strips, along with a sample of the SPPL Control Stock for comparison, were exposed on the Eastman Kodak Intensity Scale Sensitometer, Type 1 B, Model IV. These three strips were processed in D-19 Developer. The sensitometric measurements are graphically presented in Illustrations 4 and 5, pages 27 through 29.

b. Chemical

A sample of the original negative film was tested for archival quality resulting in 0.0025 ( $\pm 0.001$ ) milligrams per square inch of residual thiosulfate. Archival tests should be made within 24 hours after processing, and a test sample should be chosen from an image area. Although these two conditions were not met, the resultant test values were sufficiently low to indicate with reasonable confidence that the processed film is of archival quality.

4. Image Analysis

Image analysis consists of densitometry, analysis by edge scan techniques, analysis of Controlled Range Network (CORN) targets, Visual Reciprocal Edge Spread (V-RES), and image motion evaluations from the original negatives.

a. Densitometry

Specific information as to the number of values included in the density data summaries can be found by referring to the frequency distribution graphs, Illustrations 10 through 13, pages 46 through 49.

(1) Image Minimum Density Values (Dmin)

Image Dmin values for all negatives examined on Mission 1017 range from 0.20 to 1.65 with a 0.23 standard deviation ( $\sigma$ ) and an overall average of 0.63. The average, range, and standard deviation data as computed for each Mission by camera position are as follows:

<u>Mission</u>	<u>Camera Position</u>	<u>Range</u>		<u>Average</u>	<u>Standard Deviation (<math>\sigma</math>)</u>
		<u>From</u>	<u>To</u>		
1017-1	Fwd	0.20	1.65	0.66	0.24
	Aft	0.20	1.62	0.64	0.24
1017-2	Fwd	0.22	1.22	0.58	0.21
	Aft	0.20	1.54	0.64	0.23

The range and average of Dmin by mission, camera position, and pass are shown in Illustration 6, pages 30 through 33. The distribution of Dmin values is shown by mission and camera position in Illustration 10, page 46.

(2) Image Maximum Density Values (Dmax)

Image Dmax values for all negatives examined on Mission 1017 range from 0.30 to 2.30 with a 0.33 standard deviation ( $\sigma$ ) and an overall average of 1.71. The average, range, and standard

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deviation data as computed for each Mission by camera position are as follows:

<u>Mission</u>	<u>Camera Position</u>	<u>Range</u>		<u>Average</u>	<u>Standard Deviation (<math>\sigma</math>)</u>
		<u>From</u>	<u>To</u>		
1017-1	Fwd	0.46	2.23	1.74	0.31
	Aft	0.60	2.29	1.75	0.28
1017-2	Fwd	0.37	2.30	1.70	0.35
	Aft	0.30	2.30	1.62	0.35

The range and average of Dmax by mission, camera position, and pass are shown in Illustration 7, pages 34 through 37. The distribution of Dmax values is shown by mission and camera position in Illustration 11, page 47.

(3) Image Average Density Values ( $\bar{D}$ )

Image  $\bar{D}$  values for all negatives examined on Mission 1017 range from 0.25 to 1.87 with a 0.22 standard deviation ( $\sigma$ ) and an overall average of 1.17. The average, range, and standard deviation data as computed for each Mission by camera position are as follows:

<u>Mission</u>	<u>Camera Position</u>	<u>Range</u>		<u>Average</u>	<u>Standard Deviation (<math>\sigma</math>)</u>
		<u>From</u>	<u>To</u>		
1017-1	Fwd	0.43	1.83	1.20	0.21
	Aft	0.43	1.87	1.20	0.20
1017-2	Fwd	0.31	1.67	1.14	0.22
	Aft	0.25	1.82	1.13	0.23

The range and average of  $\bar{D}$  by mission, camera position, and pass are shown in Illustration 8, pages 38 through 41. The distribution of  $\bar{D}$  values is shown by mission and camera position in Illustration 12, page 48.

(4) Image Density Difference Values ( $\Delta D$ )

Image  $\Delta D$  values for all negatives examined on Mission 1017 range from 0.05 to 2.03 with a 0.37 standard deviation ( $\sigma$ ) and an overall average of 1.08. The average, range, and standard deviation data as computed for each Mission by camera position are as follows:

<u>Mission</u>	<u>Camera Position</u>	<u>Range</u>		<u>Average</u>	<u>Standard Deviation (<math>\sigma</math>)</u>
		<u>From</u>	<u>To</u>		
1017-1	Fwd	0.06	2.00	1.09	0.36
	Aft	0.21	2.03	1.12	0.34
1017-2	Fwd	0.11	1.88	1.12	0.38
	Aft	0.05	1.82	0.98	0.37

The range and average of  $\Delta D$  by mission, camera position, and pass are shown in Illustration 9, pages 42 through 45. The distribution of  $\Delta D$  values is shown by mission and camera position in Illustration 13, page 49.

(5) Gross Fog Values (Base plus Fog)

Gross Fog values for all negatives examined on Mission 1017 range from 0.07 to 0.21 with a 0.03 standard deviation ( $\sigma$ ) and an overall average of 0.13. The average, range, and standard deviation data as computed for each Mission by camera position are as follows:

<u>Mission</u>	<u>Camera Position</u>	<u>Range</u>		<u>Average</u>	<u>Standard Deviation (<math>\sigma</math>)</u>
		<u>From</u>	<u>To</u>		
1017-1	Fwd	0.10	0.21	0.14	0.03
	Aft	0.09	0.21	0.12	0.02
1017-2	Fwd	0.07	0.20	0.13	0.03
	Aft	0.08	0.19	0.12	0.02

(6) Cloud Maximum Density Values (Dmax Clouds)

The Dmax Cloud values for all negatives examined on Mission 1017 range from 0.38 to 2.37 with a 0.30 standard deviation ( $\sigma$ ) and an overall average of 1.90. The average, range, and standard deviation data as computed for each Mission by camera position are as follows:

<u>Mission</u>	<u>Camera Position</u>	<u>Range</u>		<u>Average</u>	<u>Standard Deviation (<math>\sigma</math>)</u>
		<u>From</u>	<u>To</u>		
1017-1	Fwd	0.60	2.32	1.93	0.27
	Aft	1.18	2.36	1.89	0.27
1017-2	Fwd	0.86	2.37	1.93	0.28
	Aft	0.38	2.34	1.85	0.34

(7) Density Tables

A complete listing of density values is presented in Table 6, Appendix 5, pages 5-1 through 5-10.

(8) Dmin and Dmax Averages Versus Sun Angle and Latitude

The average Dmin and Dmax values are plotted against each degree of sun angle and latitude in Illustrations 14 and 15, pages 50 through 53.

b. Analysis by Edge Scan Techniques

Analysis by edge scan techniques produced values for the Modulation Transfer Function (MTF), Spread Function Width at 50% Amplitude (50% Spread), and Machine-Read Reciprocal Edge Spread

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(M-RES). This analysis is performed by two teams: the SPPL Technical Evaluation Team (SPPL Team), and a group of scientists and consultants from Industry (S/C Team).

(1) SPPL Team

(a) The computations, comparisons, and analyses of edge scan data are completely mechanical. The IBM 1710 Computer method for smoothing edge analysis curves is described in Section III. Although no "hand-smoothing" of the edge traces is accomplished, some visual smoothing of MTF curves is necessary for determining the MTF/AIM intersection. Edge scan data is reduced by an IBM computer programmed to perform these tasks. This function is also described in Section III.

(b) One hundred and nineteen traces were accomplished from Mission 1017, using a  $1\mu \times 80\mu$  slit, with a Mann-Data Micro-Analyzer.

(c) A complete tabulation of data from the various methods of edge analyses is listed in Table 7, Appendix 7, pages 7-1 through 7-4.

1 The MTF curves are plotted against the Aerial Image Modulation (AIM) curve (low contrast 2:1) for Type 4404 Film. The intersection of the MTF and AIM curves is the MTF/AIM value recorded in cycles/mm. Approximately 26% of these values could be determined only after smoothing the MTF curves.

2 The 50% Spread value extracted from the exposure curve is recorded in microns and also as the reciprocal of this measurement.

3 The M-RES value computed from the edge slope of the exposure curve is recorded as a reciprocal edge spread measurement.

4 Table 7, Edge Scan Data, includes MTF/AIM, 50% Spread, M-RES, Visual-Reciprocal Edge Spread (V-RES), Dmin and Dmax values, location of subject on the frame, subject type, and the orientation of each scene edge traced. For comparison purposes, the MTF/AIM, 50% Spread (reciprocal of width), M-RES, and V-RES values are equivalent measures of image quality.

(d) The average MTF curve with a  $\pm 1\sigma$  of all edges for Mission 1017 is shown in Illustration 16, page 54. The frequency distribution bar graphs of MTF/AIM, 50% Spread, M-RES, and V-RES are portrayed in Illustration 17, page 55. A summary of the SPPL edge analysis data is presented in Table 8, page 18.

(2) Scientist and Consultant Team

(a) An Eastman Kodak Model 5 Microdensitometer with a  $1\mu \times 80\mu$  slit was utilized to trace 87 edges similar to those selected and measured by the SPPL Team. This team used only two methods (MTF/AIM and 50% Spread) in accomplishing their edge analysis. The MTF/AIM intersection values are listed as lines/mm, and the 50% Spread values are recorded in microns. The complete report of the Scientist/Consultant Team analysis is included as Appendix 8, pages 8-1 through 8-20.

(b) To facilitate a comparison of similar values from both teams, the reciprocal of the 50% Spread values (width in microns) is computed by SPPL and the resultant average of these values recorded in the summary tables. A summary of data from the Scientist/Consultant Team for Mission 1017 is presented in Table 9, page 19.

c. Controlled Range Network (CORN) Operations

(1) Six CORN resolution displays (four mobile and two fixed) were scheduled for Mission 1017. Of these six displays only two mobile and two fixed were activated. They consist of and are located as follows:

(a) A mobile medium contrast "T" Bar Target and a fixed high contrast Bar Target at Wright-Patterson AFB, Ohio, on 27 February 1965.

(b) A mobile 200' Controlled Scene Brightness Target and fixed low and high contrast Bar Targets at Fort Huachuca, Arizona, on 1 March 1965. A medium contrast "T" Bar was also scheduled as part of this mobile target; however, it was not displayed.

(2) All CORN Operations for Mission 1017-2 were cancelled because the recovery was made one day earlier than scheduled.

(3) The Wright-Patterson displays were covered on Pass D30, Frames 009 (Fwd) and 015 (Aft). The Fort Huachuca mobile display was covered on Pass D63, Frames 008 (Fwd) and 014 (Aft) with the fixed display being covered on Pass D63, Frames 009 (Fwd) and 015 (Aft).

(4) Although not activated for this Mission, a fixed high contrast Bar Target located at Edwards AFB, California, was covered on Pass D95, Frame 020 (Fwd) of Mission 1017-2.

(5) The Controlled Scene Brightness Target (200' edge) at Fort Huachuca, Arizona, was traced with a  $1\mu \times 80\mu$  slit on a Mann-Data Micro-Analyzer. The traces were then evaluated by edge scan techniques. The results of this analysis are portrayed in Table 10, page 20.

(6) The resolutions of the mobile and fixed Bar Targets were determined by three observers, and their findings are recorded in Table 11, page 20.

(7) The mobile and fixed Bar Targets were traced with a  $1.58\mu$  spot size on a Mann-Data Micro-Analyzer for density analysis. These traces are included in Appendix 6, pages 6-1 through 6-48.

(8) The 200' Controlled Scene Brightness Target displayed at Fort Huachuca, Arizona, was approximately 80% displayed.

(9) An instrumented weather balloon, designed to measure temperature, humidity, wind, and pressure up to an approximate altitude of 75,000 feet, was launched by the Air Weather Service over the Wright-Patterson AFB display at 1800Z on 27 February 1965 and over the Fort Huachuca display at 2000Z on 1 March 1965. Included in Appendix 6, pages 6-16 and 6-29 is the weather data obtained from these operations. The pressure is recorded in millibars (standard sea level pressure is 1013.2 mbs), and

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altitude recordings are in feet. The temperature and dew point are recorded in degrees centigrade. The winds are expressed in direction (0° - 360°) and speed (knots). The dew point is frequently missing due to a lack of instrument response at low temperatures.

(10) Photographic enlargements (10X and 40X) of the CORN displays covered, in addition to Micro-Analyzer traces and other significant data pertaining to the photographing and processing of the CORN targets, are presented in Appendix 6, pages 6-1 through 6-48.

d. Blackbird Mission

No Blackbird Missions were scheduled.

e. Visual Reciprocal Edge Spread (V-RES)

(1) V-RES data consists of 1,017 measurements. The values range from 45 to 118 with an average of 73. V-RES measurements are recorded in Table 12, Appendix 9, pages 9-1 through 9-6. The range, average, and number of measurements by mission and camera position are listed below:

<u>Mission</u>	<u>Camera Position</u>	<u>Range</u>	<u>Average</u>	<u>No. of Measurements</u>
1017-1	Fwd	45 - 104	69	260
	Aft	49 - 111	74	267
1017-2	Fwd	49 - 118	73	248
	Aft	51 - 118	77	242

(2) The frequency distribution of V-RES values is presented in Illustration 18, page 56. Average V-RES values for each pass were computed and are portrayed in Illustration 19, pages 57 to 60. Illustration 20, page 61, shows the average V-RES for the five areas of the frame.

(3) Average V-RES values are plotted against each degree of sun angle and latitude in Illustrations 21 and 22, pages 62 through 65.

(4) Two measurements were made for each subject selected: one "With the line-of-flight (W)" and the other "Across the line-of-flight (A)." These values are recorded by mission, camera position, and frame in Table 12, Appendix 9, pages 9-1 through 9-6.

f. Image Motion

Comparison of V-RES values recorded under "W" and "A" in Table 12, Appendix 9, pages 9-1 through 9-6, will give an indication of image motion as explained in Section III.

g. Wratten 25 Filter Experiment on CORONA Missions

(1) Mission 1017 is the fifth in a series of missions which are experimenting in the use of a Wratten 25 Filter to compensate for the "facing-illumination" condition existing during the winter months.



(2) The illumination of subjects photographed by CORONA missions varies significantly from winter to summer. The satellite vehicle normally travels in a polar orbit. One end of each panoramic frame from both the Forward and Aft Cameras virtually faces the sub-solar point during the summer months while, during the winter months, only the Forward Camera frames face the sub-solar point (Illustration 23, page 66). When a lens faces the source of illumination, it is extremely difficult to obtain a good exposure. Due to this situation, the Forward Camera photography has been generally inferior to Aft Camera imagery during winter months. Previous missions of this series, with the exception of 1007 and 1014-1016, have used a Wratten 21 Filter on both Panoramic Cameras. In an attempt to improve the quality of imagery, a series of experiments were initiated in which a Wratten 25 (red) Filter was used on the Forward Camera. The Wratten 21 (orange) Filter was retained on the Aft Camera. A summary of pertinent data resulting from the analysis of this Mission is presented in Table 13 below:

TABLE 13 - SUMMARY DATA FOR FILTER EXPERIMENT (MISSION 1017)

Mission & Date	Camera Position	Filter	Exposure Size Width	Exposure Time (avg)	Sun Angle	Latitudes	Density				*Processing			Image Quality			
							Dmin Average	Dmax Average	D̄ Average	ΔD Average	P	I	F	MTF/AD	50% Spread	M-RES	V-RES
1017-1 & -2 25 February through 6 March 1965	Fwd	Wratten 25	0.250"	1/250 (sec)	1° - 78°	8°S - 74°N	0.62	1.72	1.17	1.10	9	63	28	60	60	61	78
	Aft	Wratten 21	0.175"	1/357 (sec)	0° - 78°	9°S - 74°N	0.64	1.69	1.16	1.05	21	60	19	70	80	70	80

\* Percentage of Primary, Intermediate, and Full Processing.

h. Subjective Evaluation of Imagery Using "Graded Estimated Measuring Samples"(GEMS)

A subjective method for photographic evaluation utilizing "Graded Estimated Measuring Samples" (GEMS) was recommended by the Drell-Chapman Committee. A brief description of this technique was introduced in Section II, para 4. g. of SPPL Technical Report No. [REDACTED] (Mission 1006). An analysis of each mission in this series will be accomplished by the National Team responsible for the evaluation using GEMS. The GEMS data, when available, will be incorporated into the technical evaluation report series in order to permit a correlation with an objective method of image analysis by edge scan techniques.

5. Analysis of Film Format Characteristics

a. Titling

(1) Mission 1017-1, Forward Camera: A double image of titling appears on Pass A09E, Frames 007 and 009-011, and Pass D52, Frame 130.

(2) Mission 1017-2, Aft Camera: Smearred titling occurs on Pass D133, Frame 015.

b. Data Block

(1) Mission 1017-1, Forward Camera: The data block is incorrectly positioned in

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the margin area with approximately 1/16 of an inch missing on all frames throughout this segment of the Mission.

(2) Mission 1017-2, Forward Camera: The data block is "bloomed" on all frames throughout this segment of the Mission.

c. Frequency Marks

Frequency marks are distinct throughout this Mission.

d. Fiducial Marks

Mission 1017-1, Forward Camera: The first fiducial mark on Passes D67 and D78 is double-exposed with the reproduction approximately 2 1/2" from the original position.

e. Frame Size

Every tenth frame was measured on Mission 1017-1, Pass D68, starting with Frame 005 and ending with Frame 065 of the Forward Camera position. Frames vary in half-length from 14.949" to 14.963". Area one varies in width from 2.196" to 2.205"; area three varies in width from 2.193" to 2.201"; and area five varies in width from 2.199" to 2.208". On Mission 1017-2, Pass D117, every tenth frame from 005 through 065 of the Aft Camera was measured resulting in a half-length variation from 14.905" to 14.913". Area one varies in width from 2.158" to 2.171"; area three varies in width from 2.150" to 2.165"; and area five varies in width from 2.151" to 2.166".

f. Overlap

Average overlap for Mission 1017 is 6.5% for 406 measurements. The average overlap and number of measurements by mission and camera position are listed below:

<u>Mission</u>	<u>Camera Position</u>	<u>Average Overlap</u>	<u>No. of Measurements</u>
1017-1	Fwd	7.1%	105
	Aft	6.8%	109
1017-2	Fwd	6.9%	92
	Aft	5.0%	100

**TABLE 8 - Summary of Edge Scan Analysis**  
 (SPPL Team)

Mission 1017-1

No. of Edges 61

Method of Analysis		Arithmetic Mean		Standard Deviation		Coefficient of Dispersion	
		Fwd	Aft	Fwd	Aft	Fwd	Aft
Spread Function Width at 50% Amplitude	Width in Microns	17.0	13.2	5.3	3.3	31%	25%
	Reciprocal of Width	64	80	17.2	19.9	27%	25%
Machine-Read RES		59	71	14.0	15.6	24%	22%
MTF/AIM		57	70	12.6	17.4	22%	25%
Visual RES		72	75	8.5	10.0	12%	13%

Mission 1017-2

No. of Edges 58

Method of Analysis		Arithmetic Mean		Standard Deviation		Coefficient of Dispersion	
		Fwd	Aft	Fwd	Aft	Fwd	Aft
Spread Function Width at 50% Amplitude	Width in Microns	14.5	13.5	4.2	3.6	29%	26%
	Reciprocal of Width	74	79	20.4	19.9	28%	25%
Machine-Read RES		63	69	19.2	16.2	31%	23%
MTF/AIM		65	69	16.8	16.5	26%	24%
Visual RES		85	85	8.6	15.0	10%	18%

Mission 1017-1 and 1017-2 combined

No. of Edges - 119

Method of Analysis		Arithmetic Mean		Standard Deviation		Coefficient of Dispersion	
		Fwd	Aft	Fwd	Aft	Fwd	Aft
Spread Function Width at 50% Amplitude	Width in Microns	15.8	13.3	4.9	3.4	31%	25%
	Reciprocal of Width	69	80	19.4	19.7	28%	25%
Machine-Read RES		61	70	16.7	15.7	28%	22%
MTF/AIM		60	70	15.2	16.8	25%	24%
Visual RES		78	80	10.9	13.5	14%	17%

TABLE 9 - Summary of Edge Scan Analysis  
(S/C Team)

Mission 1017-1

No. of Edges - 42

Method of Analysis		Arithmetic Mean		Standard Deviation		Coefficient of Dispersion	
		Fwd	Aft	Fwd	Aft	Fwd	Aft
Spread Function Width at 50% Amplitude	Width in Microns	11.9	8.7	3.9	2.3	33%	26%
	Reciprocal of Width	93	121	32.0	27.4	34%	23%
MTF/AIM		78	94	18.5	16.1	24%	17%

Mission 1017-2

No. of Edges - 45

Method of Analysis		Arithmetic Mean		Standard Deviation		Coefficient of Dispersion	
		Fwd	Aft	Fwd	Aft	Fwd	Aft
Spread Function Width at 50% Amplitude	Width in Microns	12.0	10.6	4.1	2.7	34%	25%
	Reciprocal of Width	93	100	31.0	24.4	33%	25%
MTF/AIM		80	86	17.7	17.9	22%	21%


Mission 1017-1 and 1017-2 combined

No. of Edges - 87

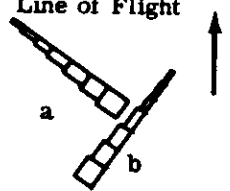
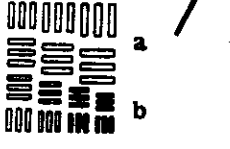


Method of Analysis		Arithmetic Mean		Standard Deviation		Coefficient of Dispersion	
		Fwd	Aft	Fwd	Aft	Fwd	Aft
Spread Function Width at 50% Amplitude	Width in Microns	11.9	9.6	4.0	2.6	33%	27%
	Reciprocal of Width	93	111	31.1	27.9	33%	25%
MTF/AIM		79	90	17.8	17.3	23%	19%

**TABLE 10 - Image Analysis of Controlled Scene Brightness Targets**

Mission 1017

Pass	Frames	Analysis Techniques	Value / Ground Resol.		Target Orientation	Target Type and Location
			Trace No. 1	Trace No. 2		
D63	008 (Fwd)	MTF/AIM	65/16.1'	62/16.9'		Fort Huachuca Arizona 200' Controlled Scene Brightness Target
		50% Spread	76/13.8'	93/11.3'		
		M-RES	73/14.3'	79/13.3'		
D63	014 (Aft)	MTF/AIM	89/11.8'	68/15.4'		
		50% Spread	102/10.1'	74/13.8'		
		M-RES	84/12.4'	73/14.3'		

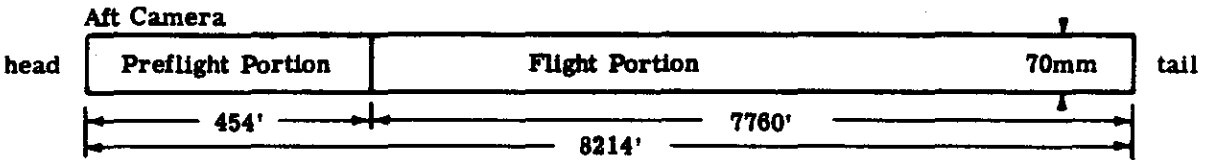
**TABLE 11 - CORN TARGET EVALUATION**

Pass	Frame	Subject and Location	Target Orientation	OBSERVER					
				No. 1		No. 2		No. 3	
				BAR GROUPS READ/GROUND RESOLUTION					
				A	B	A	B	A	B
D30	009 (Fwd)	Med. Contrast "T" Bar Wright-Patterson AFB, Ohio (Mobile)		2	2	2	2	2	2
	015 (Aft)			12'	12'	12'	12'	12'	12'
	009 (Fwd)	High Contrast Bar Target Wright-Patterson AFB, Ohio (Fixed)		2	2	1	1	2	2
	015 (Aft)			10'1"	10'1"	11'4"	11'4"	10'1"	10'1"
D63	009 (Fwd)	High and Low Contrast Bar Target Fort Huachuca Arizona (Fixed)		7	7	7	7	6	6
	015 (Aft)			10'	10'	10'	10'	11'2"	11'2"
D95	020 (Fwd)	High Contrast Bar Target Edwards AFB Calif. (Fixed)		The resolution of this photograph exceeds that of the Bar Target. The smallest bar represents a ground resolution of 12'9".					

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ORIGINAL NEGATIVE FOOTAGE DIAGRAM

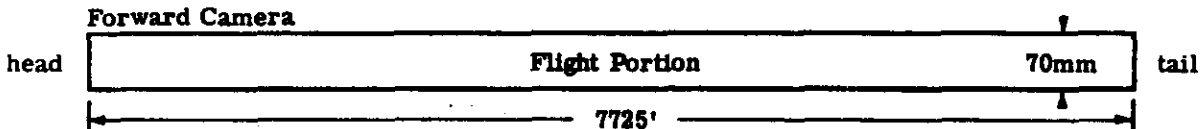
Mission 1017-1



Stellar Camera  
4401, 35mm x 66'

Index Camera  
4400, 70mm x 94'

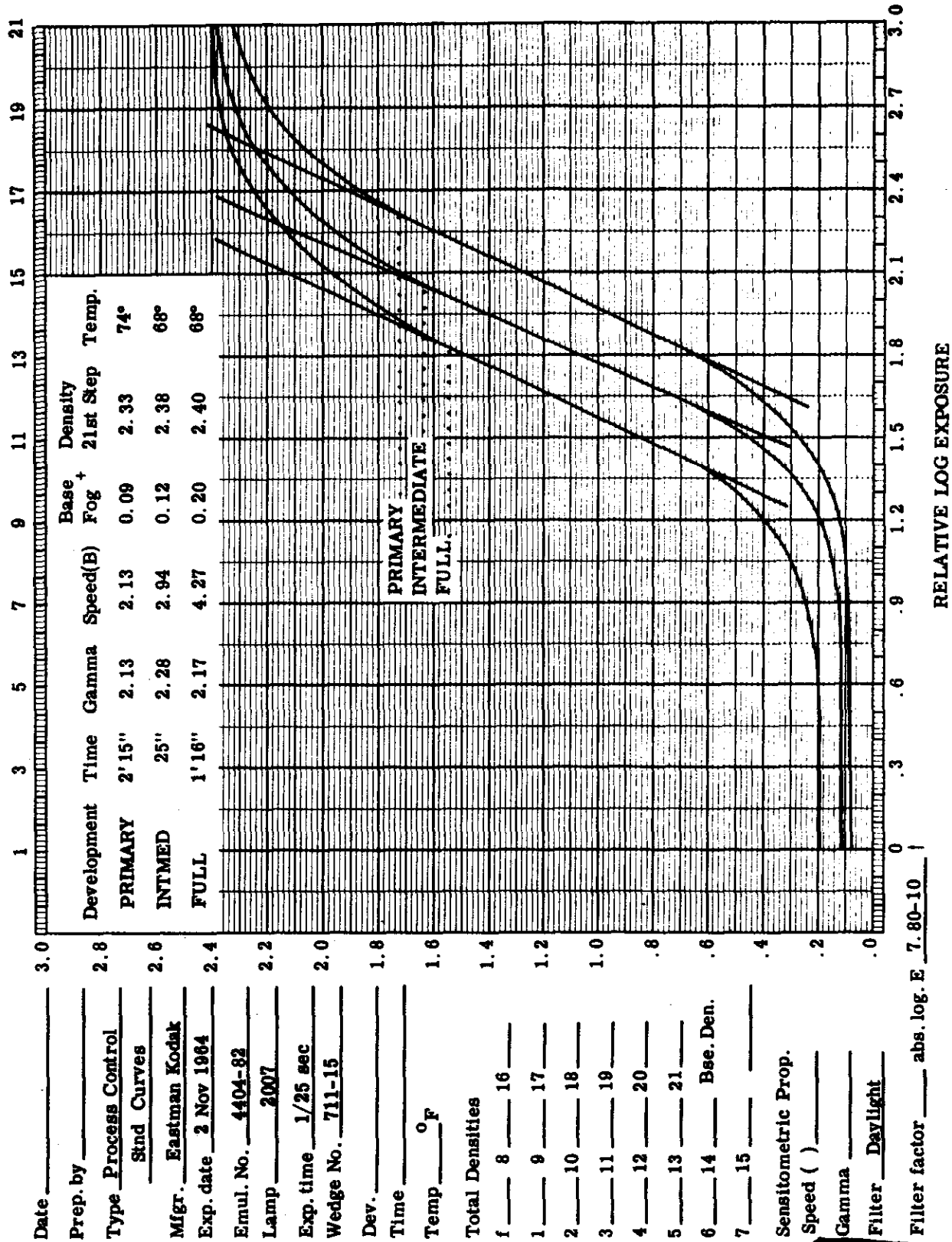
Mission 1017-2



Stellar Camera  
4401, 35mm x 5'

Index Camera  
4400, 70mm x 6'

STANDARD PROCESSING CONTROL CURVES

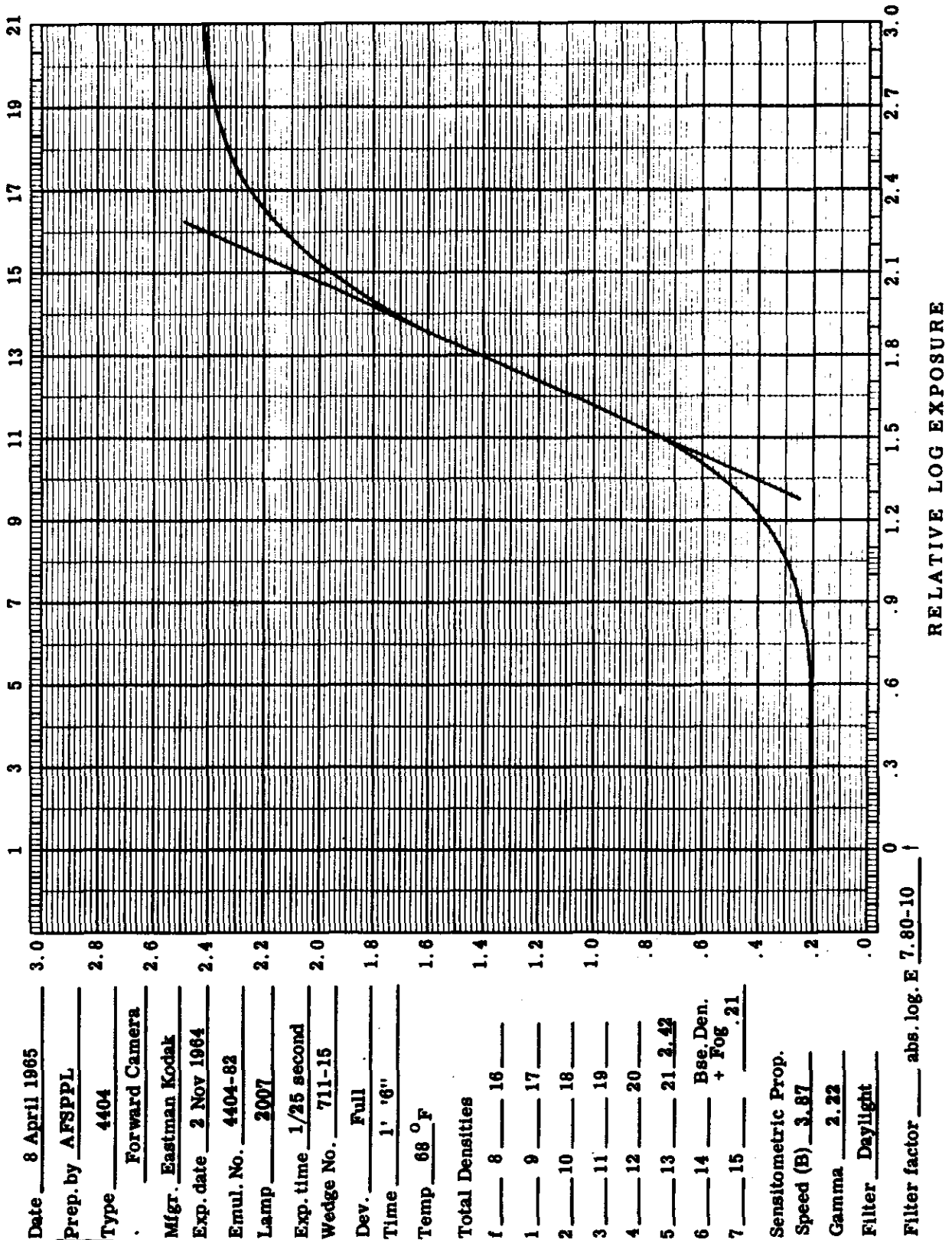


Date \_\_\_\_\_  
 Prep. by \_\_\_\_\_  
 Type Process Control  
     Std Curves  
 Migr. Eastman Kodak  
 Exp. date 2 Nov 1964  
 Emul. No. 4404-82  
 Lamp 2007  
 Exp. time 1/25 sec  
 Wedge No. 711-15  
 Dev. \_\_\_\_\_  
 Time \_\_\_\_\_  
 Temp \_\_\_\_\_ °F  
 Total Densities  
 f 8 16  
 1 9 17  
 2 10 18  
 3 11 19  
 4 12 20  
 5 13 21  
 6 14 Bse. Den.  
 7 15 \_\_\_\_\_  
 Sensitometric Prop.  
 Speed ( ) \_\_\_\_\_  
 Gamma \_\_\_\_\_  
 Filter Daylight  
 Filter factor \_\_\_\_\_ abs. log. E 7.80-10

ILLUSTRATION 2

SPPL TECHNICAL REPORT NO [redacted]

PROCESSING CONTROL CURVE (HEAD AND TAIL)



MISSION 1017-1

Date 8 April 1965  
 Prep. by AFSPPL  
 Type 4404  
Forward Camera  
 Mfr. Eastman Kodak  
 Exp. date 2 Nov 1964  
 Emul. No. 4404-82  
 Lamp 2007  
 Exp. time 1/25 second  
 Wedge No. 711-15  
 Dev. Full  
 Time 1' 6"  
 Temp 68 °F

Total Densities  
 f 8 16  
 1 9 17  
 2 10 18  
 3 11 19  
 4 12 20  
 5 13 21 2.42  
 6 14 Bse. Den.  
 7 15 + Fog .21

Sensitometric Prop.  
 Speed (B) 3.87  
 Gamma 2.22  
 Filter Daylight

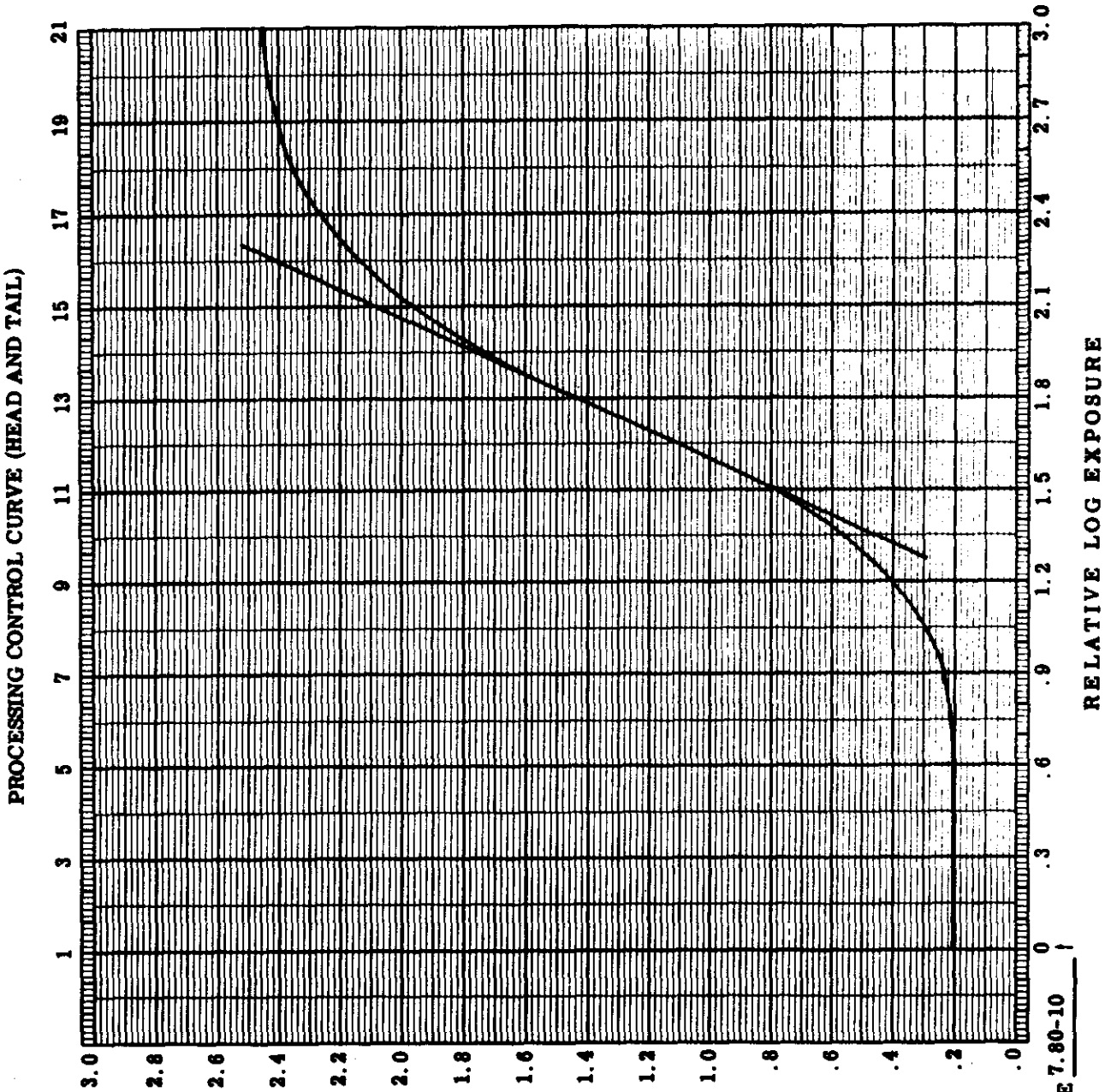
Filter factor abs. log. E 7.80-10



Handle via [redacted]  
Controls Only

~~TOP SECRET~~ - CORONA

SPPL TECHNICAL REPORT NO [redacted]



MISSION 1017-1

Date 8 April 1965  
 Prep. by AFSPPL  
 Type 4404  
Aft Camera  
 Mfr. Eastman Kodak  
 Exp. date 2 Nov 64  
 Emul. No. 4404-83  
 Lamp 2007  
 Exp. time 1/25 second  
 Wedge No. 711-15  
 Dev. Full  
 Time 1' 16"  
 Temp 68 °F

Total Densities

f 8 16  
 1 9 17  
 2 10 18  
 3 11 19  
 4 12 20  
 5 13 21 2.45  
 6 14 Bse. Den.  
 7 15 + Fog .21

Sensitometric Prop.  
 Speed (B) 4.16  
 Gamma 2.17  
 Filter Daylight  
 Filter factor abs. log. E 7.80-10

ILLUSTRATION 3

~~TOP SECRET~~ - CORONA

Handle via [redacted]  
Controls Only