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TECHNICAL EVALUATION REPORT

ON ORIGINAL NEGATIVES

FROM MISSION 4015

(SECTION III OF PET REPORT 4015/65)

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TECHNICAL EVALUATION REPORT
ON ORIGINAL NEGATIVES
FROM MISSION 4015
(SECTION III OF PET REPORT 4015/65)

12 MARCH 1965

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SPPL TECHNICAL REPORT NO. 101-1-43

FOREWORD

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

Preparing Unit:

6594th Test Squadron (AFSPPL) (AFSC)
Westover Air Force Base, Mass.

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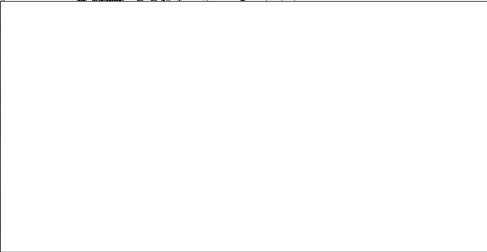
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PUBLICATION REVIEW

This report has been reviewed and is approved.



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ABSTRACT

The following report is Section III of the Performance Evaluation Team (PET) Report No. 4015/65 and is bound separately to enable interested parties to study in detail the photographic physical characteristics of Reconnaissance Satellite Mission 4015.

The vehicle for this Mission was launched from Point Arguello Launch Complex, Pad 4, Vandenberg AFB, California, on 23 January 1965 (2004.4Z). In-flight recovery was accomplished on 27 January 1965 (2343Z). The original negatives from the single Strip Camera totaled approximately 2,701 feet of 9.5 inch film, excluding the pre-flight portion. The 6594th Test Squadron (AFSPPL) performed an analysis of the film, and the results are outlined in this report.

The major evaluation procedures performed by the SPPL Team include inspecting the film for physical degradations, measuring density and Visual Reciprocal Edge Spread (V-RES) values, and analyzing images by edge scan techniques. In accomplishing the edge scan analysis, the SPPL Technical Evaluation Team used a $1\mu \times 80\mu$ slit on the 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 Micro-densitometer.

Under the Controlled Range Network (CORN) Program, three mobile resolution displays were activated. Photographic coverage was received on two of these three displays: one "T" Bar Target (high contrast), a Tri-Color and a Controlled Scene Brightness Target at Outlaw Field, Clarksville, Tennessee; and one "T" Bar Target (medium contrast) and a Controlled Scene Brightness Target 18 miles northwest of Tucson, Arizona. Ground resolution of imagery over these targets varies from 6.3 to greater than 8 feet (target resolving limit is 8 feet). Also included in this report is a tabulation of weather data recorded at Tucson, Arizona. This information was extracted from an instrumented weather balloon which is designed to produce temperature, humidity, dew point, wind, and pressure data. A Blackbird Mission flown 25 January 1965 covered the CORN display at Outlaw Field. Analysis of this target from the Blackbird film resulted in a ground resolution varying from 3.5 to 5.9 feet.

A variable exposure slit with four selective positions was utilized during this Mission. Mission 4015 was the first to use the R&D Slit (No. 4) with which a "Focus Test" was conducted. The ultimate goal of this test is the improvement of resolution.

The average Modulation Transfer Function/Aerial Image Modulation (MTF/AIM) value is 50 cycles per millimeter, representing an approximate ground resolution of 5.9 feet. Visual Reciprocal Edge Spread (V-RES) values range from 38 to 118 with an average of 70. Conversion of the V-RES values to ground resolution resulted in a range from 2.4' to 7.8' with an average of 4.2 feet. The average D_{min} , D_{max} , \bar{D} ,

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and AD values for Mission 4015 are similar to Missions 4010 and 4014 and lower than Mission 4011 with the exception of the AD value which is higher.

Physical degradations are minor. Mission 4015 was the first in this series to be processed with a frame-by-frame Yardleigh Processor. The overall exposure and processing of this Mission are considered very good although several cases of underexposure, underdevelopment, overexposure, and overdevelopment were noted.

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SECTION I

INTRODUCTION

The film from Reconnaissance Satellite Mission 4015 was objectively analyzed and evaluated. The vehicle was launched from Point Arguello, Vandenberg AFB, California, on 23 January 1965 and recovered on 27 January 1965. Photographic imagery was obtained on 43 of 64 revolutions. The results of the photographic physical characteristics evaluation are presented in this report.

Section II, Paragraph A, "Known Information," outlines specific Mission data, a brief description of the GAMBIT 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, film format characteristics, and all information pertaining to the Controlled Range Network (CORN) and Blackbird operations for this Mission.

Because there were no revised or additional procedures, methods, or equipment used in this evaluation, Section III of this report refers directly to Section III of SPPL Technical Report No. 101-1-34 (Mission 4014).

Section IV presents observations and summaries of data resulting from this evaluation and concludes with a brief recapitulation of the more important photographic physical characteristics of the Mission.

Section V lists all associated references.

Section VI, the Appendix, includes tabulations of density and edge analysis data, photographic enlargements (10X and 40X) with the respective Micro-Analyzer traces and Site Manning Reports, and a frame-by-frame processing profile.

Sections II, III, and IV are supplemented with tables, graphs, and illustrations to further clarify the evaluations from this Mission.

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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 Mission 4015.

A. Known Information

1. Mission Data

- a. Mission Number: 4015.
- b. Dates of Photography: 23 - 27 January 1965.¹
- c. Ephemeris: "Performance Estimate" data was available.²
- d. Mission Product: Revs, Rolls, Frames (See Table 1, Mission Data, Appendix 1, page 1-1). The entire Mission was received for evaluation.
- e. Footage Received: Approximately 2,940 feet, including pre-flight. (See Illustration 1, page 13).

2. Camera System

a. Camera

- (1) The GAMBIT System used on Mission 4015 contained one Strip-type Camera.

This camera continuously exposes a narrow band across the film as the vehicle passes over the area being photographed. The image is focused through a fixed-slit aperture onto the moving film. Exposure is determined by the width of the slit plus the speed at which the film moves past the slit. This System had a programmable slit with four selective positions: No. 1 (0.0083"), No. 2 (0.0169"), No. 3 (0.033"), and No. 4 (0.0169").

- (2) The objective of this satellite system is to photograph specific targets; it is not intended to obtain large area reconnaissance. Movement of the "Stereo Mirror" allows subjects to be photographed in stereo pairs, lateral pairs, or a continuous strip. The vehicle can be rolled to obtain photographs to the left or right of the ground track. Specific camera data pertaining to Mission 4015 is recorded in Table 2, Appendix 2, page 2-1.

b. Film³

The physical characteristics of the film type used on Mission 4015 are outlined in Table 3, Appendix 3, page 3-1.

¹ Messages: 23 and 26 January 1965.

² Mission Correlation Data: Mission 4015, 24-27 January 1965.

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

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c. Resolution Capabilities

The GAMBIT Camera System is designed to obtain resolutions of 100-140 lines per millimeter at a 2:1 contrast (2-3 feet ground resolution).

d. Exposure

This camera has four selective slit width positions. Three of these are operational slits, while the configuration of the fourth will vary from mission to mission in accordance with R&D requirements. Slit No. 3 was not used on this Mission due to a "lockout." Slit No. 4 had a seven-sector configuration which was utilized for a focus test. The following lists each selected slit by Rev and Frame for Mission 4015:

Slit No. 1 (0.0083")

<u>Rev</u>	<u>Frame</u>
D57	006-010
D58	019-028
D63	001-002
D64	001 and 008

Slit No. 2 (0.0169")

<u>Rev</u>	<u>Frame</u>
D04 - D56	all
D57	001-005
D58	001-018
D59	001-022

Slit No. 4 (0.0169")

<u>Rev</u>	<u>Frame</u>
D63	003
D64	002-005

3. Description of Subject Environment

a. Sun Angle

Photography from Mission 4015 was obtained with sun angles ranging from 1° to 75°.

b. Geographic Latitude

The photographic coverage from Mission 4015 ranges from 9° S to 68° N Latitude.

B. Information Derived from Analysis

1. Physical Degradations

The total Mission product obtained from the single Strip-type Camera, excluding the pre-flight portion, was examined for physical degradations.

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a. Imaged

(1) A fine, continuous, minus-density streak was observed approximately 2 1/4" from and parallel to the non-titled edge throughout this Mission.

(2) Fine minus-density lines, varying in numbers, are visible extending across the frame in areas of low density throughout the Mission.

b. Superficial

(1) A series of small chatter-like digs were noted at the titled edge, 18" from the head, extending 4" into the format area and curving off the tail of Frame 016, Rev D38.

(2) A deep emulsion scratch, approximately 7" in length, was observed 3 1/2" from and parallel to the titled edge on Frame 001, Rev D54.

(3) A Y-shaped, chatter-like scratch, starting 1/2" from the non-titled edge and extending approximately 2" into the image format area, was noted 6" from the head of Frame 011, Rev D09.

(4) A small processing comet was visible on Frame 003, Rev D24, and Frame 013, Rev D40.

(5) A 1" emulsion scratch was observed running parallel to the tail of Frame 017, Rev D58.

(6) A few minor abrasions, scratches, and pinholes were noted throughout this Mission.

2. Film Processing Data

a. Mission 4015 is the first mission in this series to be processed with the Yardleigh Frame Processor. This machine is a frame-by-frame processor which stabilizes within 1/2 inch. It employs infrared scanning to determine the proper level of development for each frame. All excessively long frames were scanned in five foot segments, with each segment being processed at the development level required.

b. Approximately 37% (198 frames) of Mission 4015 was processed at the Primary development level, 19% (101 frames) at the Intermediate level, 43% (231 frames) at the Full level, and the remaining 1% (6 frames) received more than one level of development.

c. Processing lines resulting from abrupt development level changes were noted on one or more frames of all revs except: D14, D20, D36, D46, and D52.

d. A complete listing of the development level for each frame is shown in Table 4, Appendix 4, pages 4-1 through 4-3. The standard processing control curves for the three development levels are shown in Illustration 2, page 14. The processing control curve for the head and tail of Mission 4015 is presented in Illustration 3, page 15.

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3. Laboratory Evaluations

a. Sensitometric

One unexposed strip of Type 4404 Film from Mission 4015 was received for evaluation. This strip, along with a sample of the SPPL Control Stock for comparison, was exposed on the Eastman Kodak Intensity Scale Sensitometer, Type 1B, Model IV. The two strips were processed in D-19 developer. The sensitometric measurements are graphically portrayed in Illustrations 4 and 5, pages 16 and 17.

b. Chemical

A sample of the original negative film was tested for archival quality resulting in 0.0 (± 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 are 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, Controlled Range Network (CORN) Operations, and Visual Reciprocal Edge Spread (V-RES) from the original negative.

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, Illustration 10, page 22.

(1) Image Minimum Density Values (D_{min})

The D_{min} values range from 0.19 to 1.68 with a standard deviation (σ) of 0.21 and an overall average of 0.58. The range and average for each rev are shown in Illustration 6, page 18. The distribution of D_{min} values is shown in Illustration 10, page 22.

(2) Image Maximum Density Values (D_{max})

The D_{max} values range from 0.31 to 2.35 with a standard deviation (σ) of 0.42 and an overall average of 1.53. The range and average for each rev are shown in Illustration 7, page 19. The distribution of D_{max} values is shown in Illustration 10, page 22.

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

The \bar{D} values range from 0.29 to 1.76 with a standard deviation (σ) of 0.25 and an overall average of 1.06. The range and average for each rev are shown in Illustration 8, page 20. The distribution of \bar{D} values is shown in Illustration 10, page 22.

(4) Image Density Difference Values (ΔD)

The ΔD values range from 0.04 to 1.92 with a standard deviation (σ) of 0.42 and an overall average of 0.95. The range and average for each rev are shown in Illustration 9, page 21. The distribution of ΔD values is shown in Illustration 10, page 22.

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(5) Gross Fog Values (Base plus Fog)

The Gross Fog values range from 0.07 to 0.26 with a standard deviation (σ) of 0.06 and an overall average of 0.17.

(6) Cloud Maximum Density Values (Dmax Clouds)

The Dmax Cloud values range from 0.40 to 2.40 with a standard deviation (σ) of 0.41 and an overall average of 1.75.

(7) 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 11 and 12, pages 23 and 24.

(8) Density Tables

The complete listing of density data is presented in Table 5, Appendix 5, pages 5-1 through 5-5.

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 Reciprocal Edge Spread (M-RE). This analysis is performed by two teams working independently: the SPPL Technical Evaluation Team and a group of scientists and consultants from Industry.

(1) SPPL Team.

(a) The computations, comparisons, and analyses of edge scan data are completely mechanical. The machine (IBM 1710 Computer) smoothing method of 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) Thirty-three traces were accomplished from Mission 4015, using a $1\mu \times 80$ slit with the Mann-Data Micro-Analyzer. Results of the various methods of edge analyses are presented in Table 6, Appendix 7, page 7-1. Visual Reciprocal Edge Spread (V-RES), Dmin, and Dmax values are included for reference purposes. The 50% Spread technique is recorded in microns and also as the reciprocal of this measurement. In using this table, it should be noted that the reciprocals listed for each individual 50% Spread value are correct. Caution is expressed, however, in expecting a valid correlation between the average 50% Spread value and the average of the individual reciprocal values since agreement in this case cannot be expected mathematically. In Tables 7 and 8, page 10, and the summary tables in Section IV, this same caution is expressed for all reciprocal values noted. MTF values were computed to a frequency of 160 cycles/mm. MTF curves are plotted against the manufacturer-furnished Aerial Image Modulation (AIM) curve (low contrast 2:1) for Type 4404 Film. The point of intersection for the AIM curve

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and the MTF curve is the MTF/AIM value in cycles/mm that is recorded in the table. Approximately 15% of these intercept values could be determined only after visual smoothing of the MTF curves. For comparison purposes, the M-RES, MTF/AIM, and V-RES values should be compared to the reciprocal of the 50% Spread. The average MTF curve and the $\pm 1\sigma$ of all edges for Mission 4015 are shown in Illustration 13, page 25. The frequency distribution of MTF/AIM, 50% Spread, and V-RES is portrayed in Illustration 14, page 26.

(c) A summary of the SPPL edge analysis data from Mission 4015 is presented in Table 7, page 10.

(2) Scientist and Consultant Team

The Consultant Team traced edges on the original negatives similar to those traced by SPPL. An Eastman Kodak Model 5 Microdensitometer with a $1\mu \times 80\mu$ slit was used. The resulting edge data was analyzed by two methods: MTF/AIM and 50% Spread. Data from the 50% Spread is recorded in microns. The reciprocal of these values is also recorded to facilitate a comparison with similar values of the SPPL data. The intersection of MTF and AIM curves is recorded as lines/mm. The complete report of the Consultant Team is included as Appendix 8, pages 8-1 through 8-10. A summary of this data for Mission 4015 is presented in Table 8, page 10.

c. Controlled Range Network (CORN) Operations

(1) Three mobile resolution displays were activated at the following locations:

(a) Outlaw Field, Clarksville, Tennessee, on 25 January 1965; consisting of one "T" Bar (high contrast) Target, one Controlled Scene Brightness Target, and a Tri-Color Target.

(b) Eighteen miles northwest of Tucson, Arizona, on 25 January 1965; consisting of one "T" Bar (medium contrast) Target and one Controlled Scene Brightness Target.

(c) Fifty miles east of El Paso, Texas, on 25 January 1965; consisting of one "T" Bar (medium contrast) Target, and one Controlled Scene Brightness Target.

(2) The CORN displays were covered at Outlaw Field, Clarksville, Tennessee, on Rev D31, Frame 009, and Tucson, Arizona, on Rev D32, Frame 006. The CORN display at El Paso, Texas, was missed due to a mission programming problem.

(3) The resolution of the "T" Bar Targets was interpreted by three observers, and their findings are listed in Table 9, page 11.

(4) The Controlled Scene Brightness Targets were traced with a $1\mu \times 80\mu$ slit on a Mann-Data Micro-Analyzer for analysis by edge scan techniques. The resultant data is portrayed in Table 10, page 11. The bar targets were traced for density analysis with a Mann-Data Micro-Analyzer utilizing a 5.8μ spot. Photographic enlargements, Micro-Analyzer traces, and Site Manning Reports for the displays covered are shown in Appendix 6, pages 6-1 through 6-11.

(5) An instrumented weather balloon, designed to measure temperature, relative humidity, wind, and pressure up to an approximate altitude of 75,000 feet, was launched by the Air Weather

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Service over the Tucson, Arizona, CORN display at 1830Z on 25 January 1965. Table 11, page 12, lists the weather data obtained from this operation. The pressure is recorded in millibars (standard sea level pressure is 1013.2 millibars); altitude recordings are in feet; temperature and dew point are in degrees centigrade; 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.

d. Blackbird Mission

(1) A Blackbird Mission (RB-47 Aircraft) was flown in conjunction with Reconnaissance Satellite Mission 4015 on 25 January 1965. This Blackbird Mission coincided with Rev D31, Frame 009, of Mission 4015, over the mobile CORN display located at Outlaw Field, Clarksville, Tennessee. Synchronized coverage of this resolution display was not achieved, however, the satellite vehicle did photograph the Blackbird Aircraft just north of the CORN display (Appendix 6, page 6-18). Page 6-19 shows a 10X enlargement of the Blackbird's photography at the time the satellite vehicle was photographing the RB-47. Page 6-8 portrays a 10X photographic enlargement of the CORN display taken from the Blackbird Aircraft.

(2) The Blackbird Aircraft contains two cameras, the KC-1 and the KA-2. Table 1 below, presents all camera and mission data.

(3) The resultant ground resolution determined from the "T" Bar Targets at Outlaw Field, Clarksville, Tennessee, CORN display averages: 5.9' (16,500 alt) and 3.5' (8,000 alt) for the KC-1 Camera and 3.4' (16,500' alt) and 1.6' (8,000 alt) for the KA-2 Camera.

TABLE 12 - Blackbird Camera and Mission Data

Aircraft Type	Date	Camera Type	F/L	Filter	Exposure	Film Type	Coordinates Over Midpoint	Time Over Midpoint	Altitude	Ground Speed
RB-47	25 JAN 1965	KC-1	6"	Wratten 12	1/500 sec F/8.3	SO-136	36° 37'N	1806.56Z	*8,000'	225 knots (8,000')
		KA-2	12"	None	1/700 sec F/4	SO-190	87° 24.5'W		**16,500'	425 knots (16,500')

* Mosaic Coverage

** Prime Run

e. Visual Reciprocal Edge Spread (V-RES)

(1) V-RES data consists of 872 measurements. The values range from 38 to 118 with an average of 70.

(2) The frequency distribution of V-RES values is presented in Illustration 15, page 27. Average V-RES values for each rev are shown in Illustration 16, page 28. Illustration 17, page 29, portrays the average V-RES for the five areas of the frame.

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(3) Average V-RES values are plotted against each degree of sun angle and latitude in Illustrations 18 and 19, pages 30 and 31.

(4) Two measurements were made for each subject selected: one "With the line-of-flight (W)," the other "Across the line-of-flight (A)." These values are recorded by rev and frame number in Table 13, Appendix 9, page 9-1.

f. Image Motion

Comparison of V-RES values recorded under "W" and "A" in Table 13, Appendix 9, page 9-1, will give an indication of image motion as explained in Section III.

g. 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. 101-1-24 (Mission 4006). 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 the objective method of image analysis by edge scan techniques.

h. "Focus Test" Evaluation

This Mission was the first to utilize the R&D Slit (No. 4). It was used for a "Focus Test" with the ultimate goal being improved resolution. (Reference: PET Report 4015/65, Section IV, para A. 6). Each of the following Frames was divided into seven sectors for this test: Revolutions D63, Frame 003, and D64, Frames 002-005. Edge trace data from Rev D64, Frame 004, has been processed. The MTF/AIM intersections obtained did not correlate with the subjective evaluation of image quality. It is not known at this time why the edges selected were not representative of the general level of imagery immediately surrounding these edges. It is tentatively planned to recall the original negatives and make a larger selection of edges for a more representative sampling of image quality from each sector.

5. Analysis of Film Format Characteristics

a. Titling

Titling was generally good; no flaking was noted.

b. Time Tracks

Timing tracks were clear and distinguishable throughout the Mission.

c. Fiducial Lines

Fiducial lines were distinct throughout the Mission.

d. Double Yaw Slits

Both double yaw slits functioned throughout the Mission.

e. Frame Size

Variable frame lengths were programmed throughout the Mission.

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SPPL TECHNICAL REPORT NO. 101-1-43

TABLE 7 - Summary of Edge Scan Analysis
(SPPL Team)

No. of Edges - 33

Method of Analysis		Arithmetic Mean	Standard Deviation	Coefficient of Dispersion
Spread Function Width at 50% Amplitude	Width in Microns	18.8	5.8	31%
	Reciprocal of Width	58	17.3	30%
Machine-Read RES		49	15.9	33%
MTF/AIM		50	12.7	26%
Visual RES		84	12.8	15%

TABLE 8 - Summary of Edge Scan Analysis
(S/C Team)

No. of Edges - 26

Method of Analysis		Arithmetic Mean	Standard Deviation	Coefficient of Dispersion
Spread Function Width at 50% Amplitude	Width in Microns	16.2	6.1	37%
	Reciprocal of Width	71	30.0	42%
MTF/AIM		71	20.7	29%

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BCS 39704-65

SPPL TECHNICAL REPORT NO. 101-1-43

TABLE 9 - CORN Target Evaluation

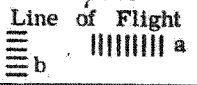
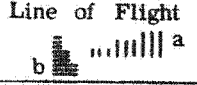
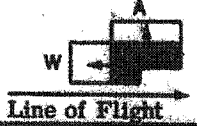
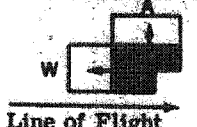
				OBSERVER					
				No. 1		No. 2		No. 3	
				BAR GROUPS READ/GROUND RESOLUTION					
Rev	Process. Level Frame	Subject	Target Orientation	A	B	A	B	A	B
D31	Full	High Contrast "T" Bar	Line of Flight 	3	2	0	0	3	2
	009			6' 4"	7' 1"	8' +	8' +	6' 4"	7' 1"
D32	Full	Medium Contrast "T" Bar	Line of Flight 	5	4	5	4	5	4
	006			6' 4"	7' 1"	6' 4"	7' 1"	6' 4"	7' 1"

TABLE 10 - Image Analysis of Controlled
Scene Brightness Targets

Rev	Frames	Analysis Techniques	Value / Ground Resol.		Target Orientation	Target Location
			A	W		
D31	009 *	MTF/AIM	48 / 5.2'	45 / 5.6'		Mobile CORN Display Outlaw Field Clarksville, Tenn.
		50% Spread	46 / 5.5'	43 / 5.8'		
		M-RES	40 / 6.3'	33 / 7.6'		
D32	006 **	MTF/AIM	42 / 6.4'	61 / 4.4'		Mobile CORN Display Tucson, Ariz.
		50% Spread	41 / 6.5'	60 / 4.4'		
		M-RES	32 / 8.4'	41 / 6.5'		

* Photo Scale Reciprocal (PSR) = 77,492

** Photo Scale Reciprocal (PSR) = 81,749

W - Edge oriented perpendicular to line-of-flight (smear "With" line-of-flight).

A - Edge oriented parallel to line-of-flight (smear "Across" line-of-flight).

See Section III, "Image Motion," for further discussion.

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BPPL TECHNICAL REPORT NO: 101-1-43

TABLE 11 - WEATHER DATA

Location: Tucson, Arizona

Time: 1830Z

Date: 25 January 1965

PRESSURE (millibars)	ALTITUDE (feet)	TEMPERATURE (C°)	DEW POINT (C°)	RELATIVE HUMIDITY (%)	WIND	
					Direction (0° - 360°)	Speed (knots)
932		8	-12	21%	260	8
891		4	-10			
854		0	-12			
850	5,052	0	-12	38%	280	6
811		-2	-15			
779		0	-20			
716		-5				
700	10,118	-5		15%	330	46
678		-6				
500	18,570	-21		18%	310	60
471		-25				
418		-30				
400	23,852	-32			290	76
300	30,315	-46			280	92
262		-52				
250	34,219	-50			260	99
245		-49				
203		-51				
200	39,009	-49			270	90
195		-48				
150	45,111	-55			250	88
108		-64				
100	53,412	-61			250	68
76		-56				
70	60,564	-65			250	26
59		-57				
50	67,487	-58			220	3
31		-58				
30	78,084	-57			270	4
28		-57				
26		-51				
23		-52				
21		-48				
20	86,712	-49			30	11
17		-51				
15		-48				

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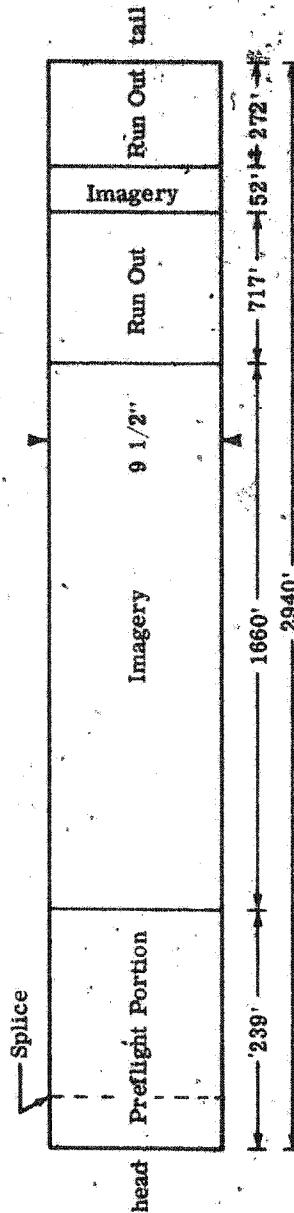
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SPPL TECHNICAL REPORT NO. 101-1-43

ORIGINAL NEGATIVE FOOTAGE DIAGRAM



Note: All of the above footage is machine measured.

ILLUSTRATION I

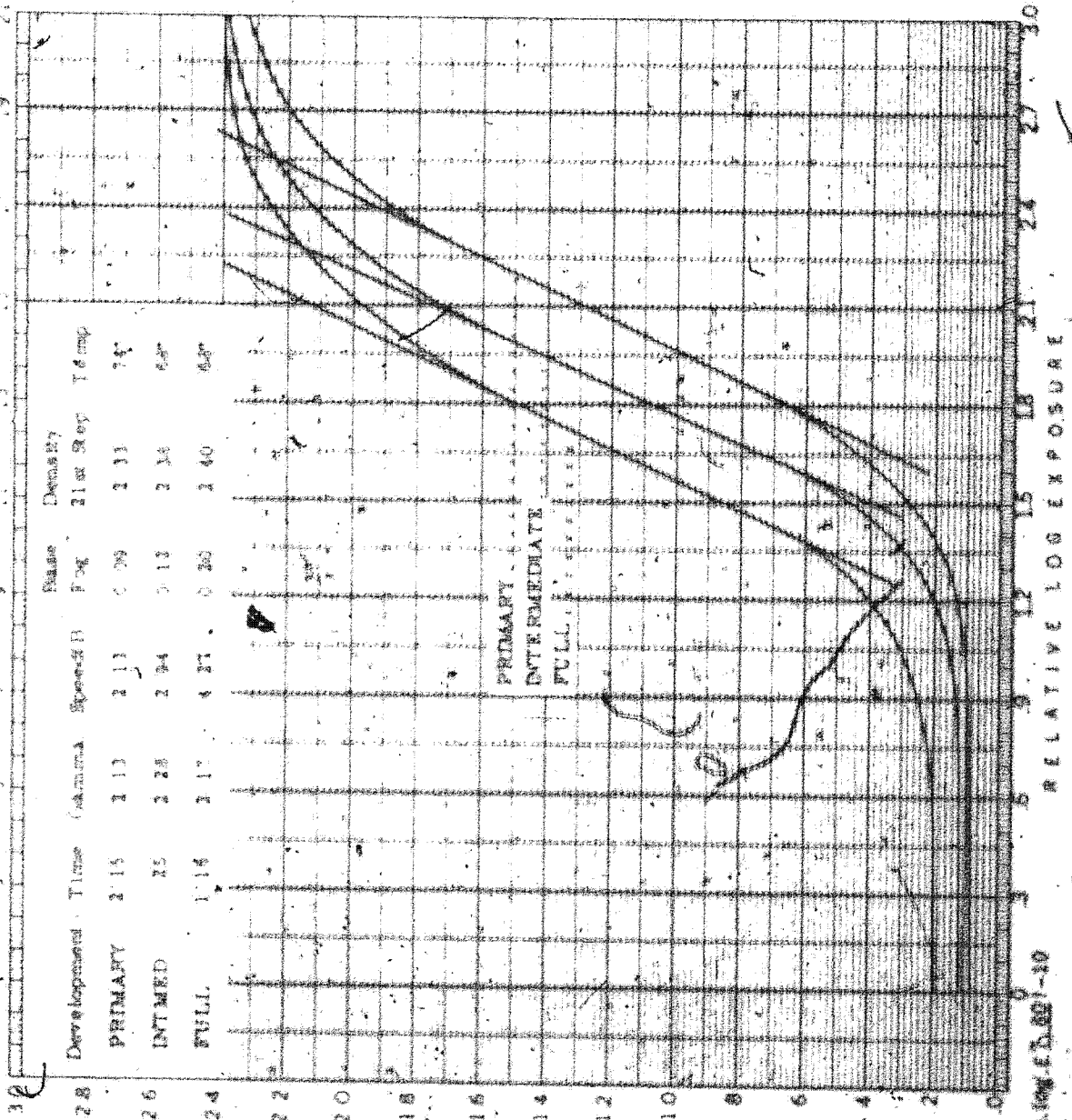
Handle via Byeman
Controls Only

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Controls Only

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STANDARD PROCESSING CONTROL CHART



Date _____
 UP No. _____
 Proby _____
 Type Process Control _____
 Mgr. Washington, Kodak
 Exp. date 3 Nov 1964
 Emul. No. 440M-07
 Lamp 2007
 Expt. time 1/35 sec.
 Wedge No. 711-15
 Dev. _____
 Time _____
 Temp. _____
 Total Densities _____
 1 _____
 2 _____
 3 _____
 4 _____
 5 _____
 6 _____
 7 _____
 Sensitometric Prop. _____
 Speed _____
 Gamma _____
 Filter _____
 Filter fact. _____

ILLUSTRATION 2

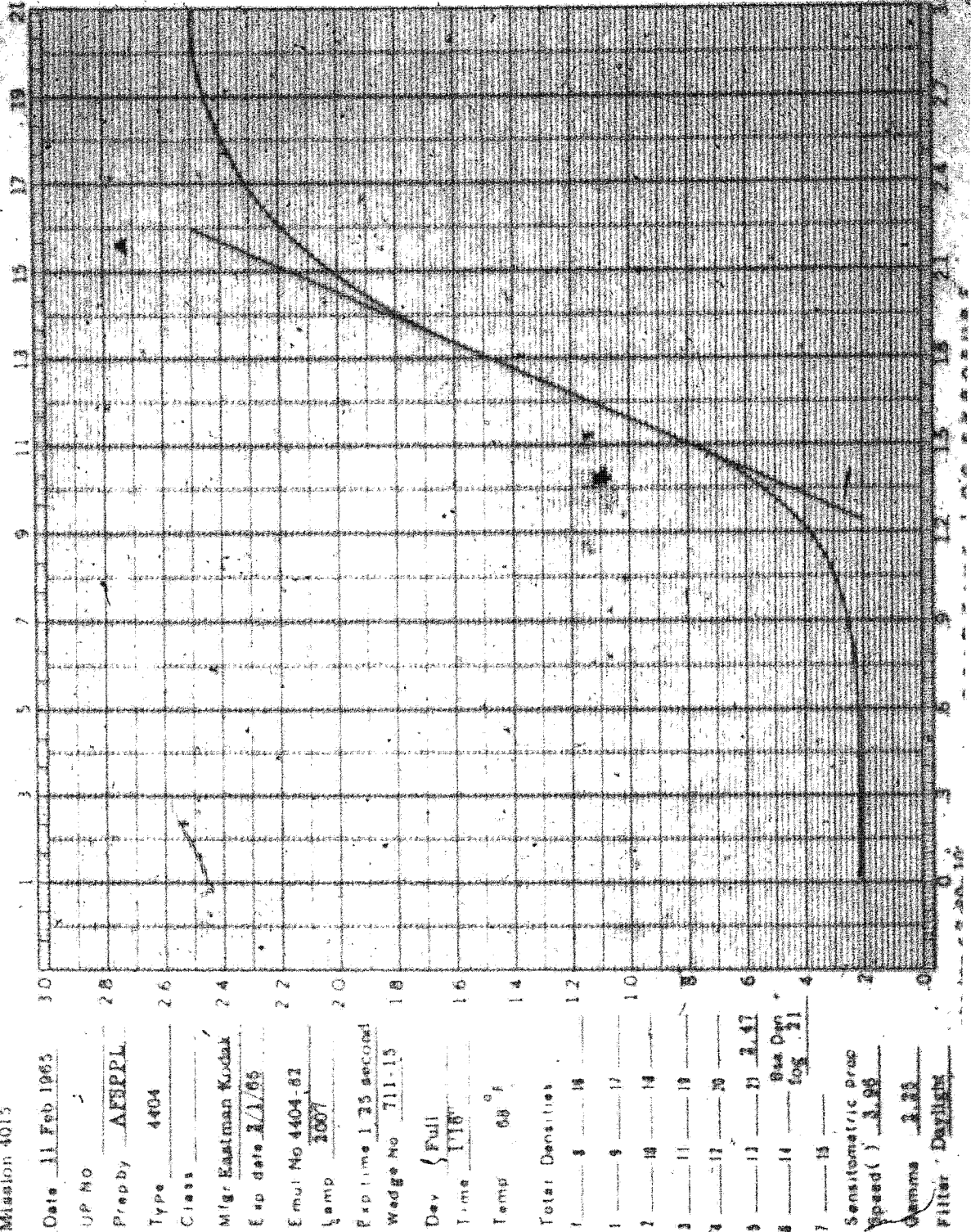
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APPL TECHNICAL REPORT NO. 101-1-43

Controls Only

PROCESSING CONTROL CURVE
(HEAD & TAIL)



Mission 4015

Date 11 Feb 1965

UP No

Prep by AFEPPL

Type 4404

Class

Mfg Eastman Kodak

Exp date 3/1/65

Emul No 4404-63

Lamp 3007

Exp time 1.25 second

Wedge No 711-15

Dev Full

Time 118"

Temp 68° f

Total Densities

1 8 16

2 9 17

3 10 14

4 11 19

5 12 20

6 13 21 2.47

7 14 Sea Dev

8 15 log 3.1

Sensitometric prop

Speed 3.86

Gamma 1.21

Filter Daylight

ILLUSTRATION 3

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SENSITOMETRIC CURVES
(SPPPL CONTROL STOCK)

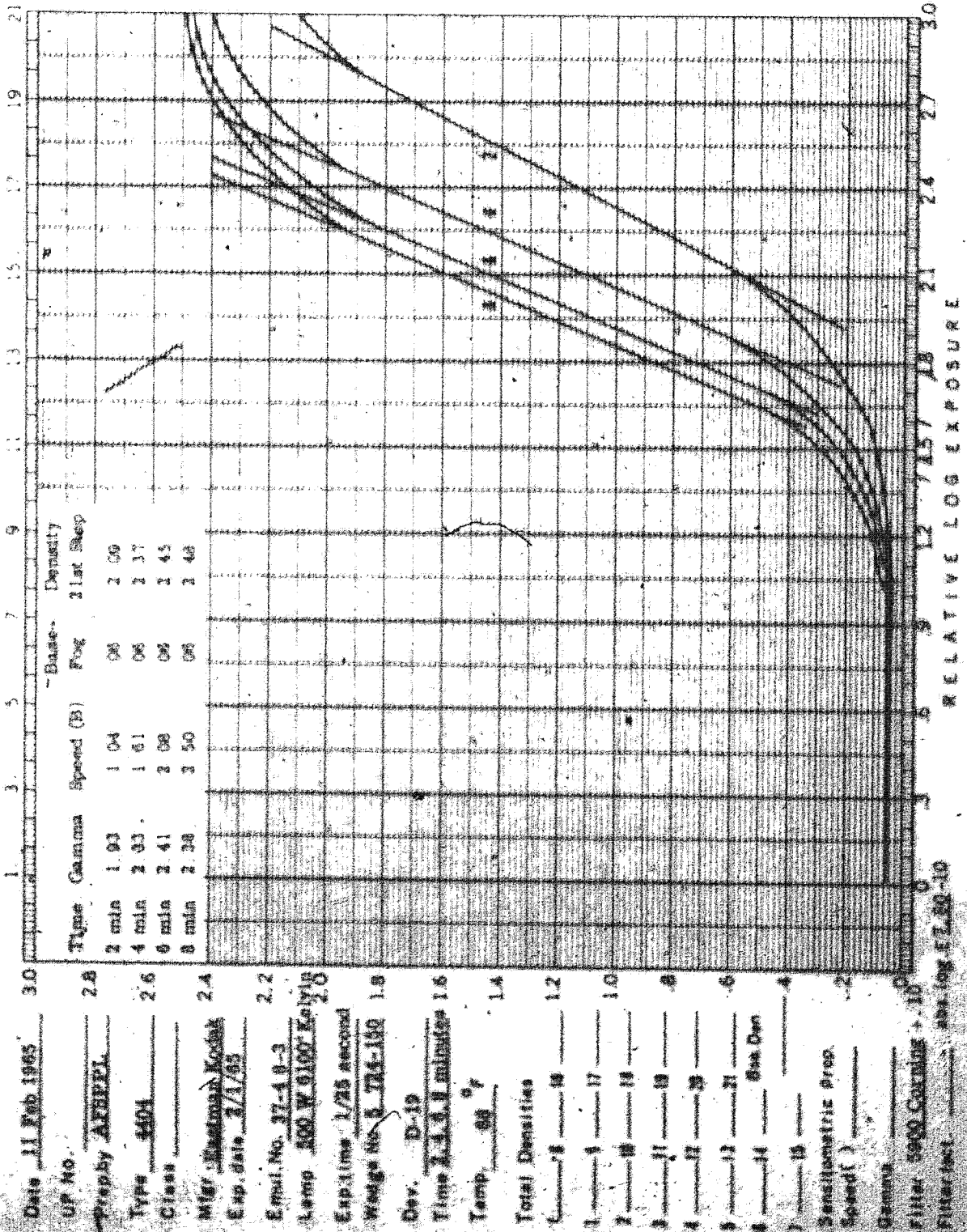


ILLUSTRATION 4

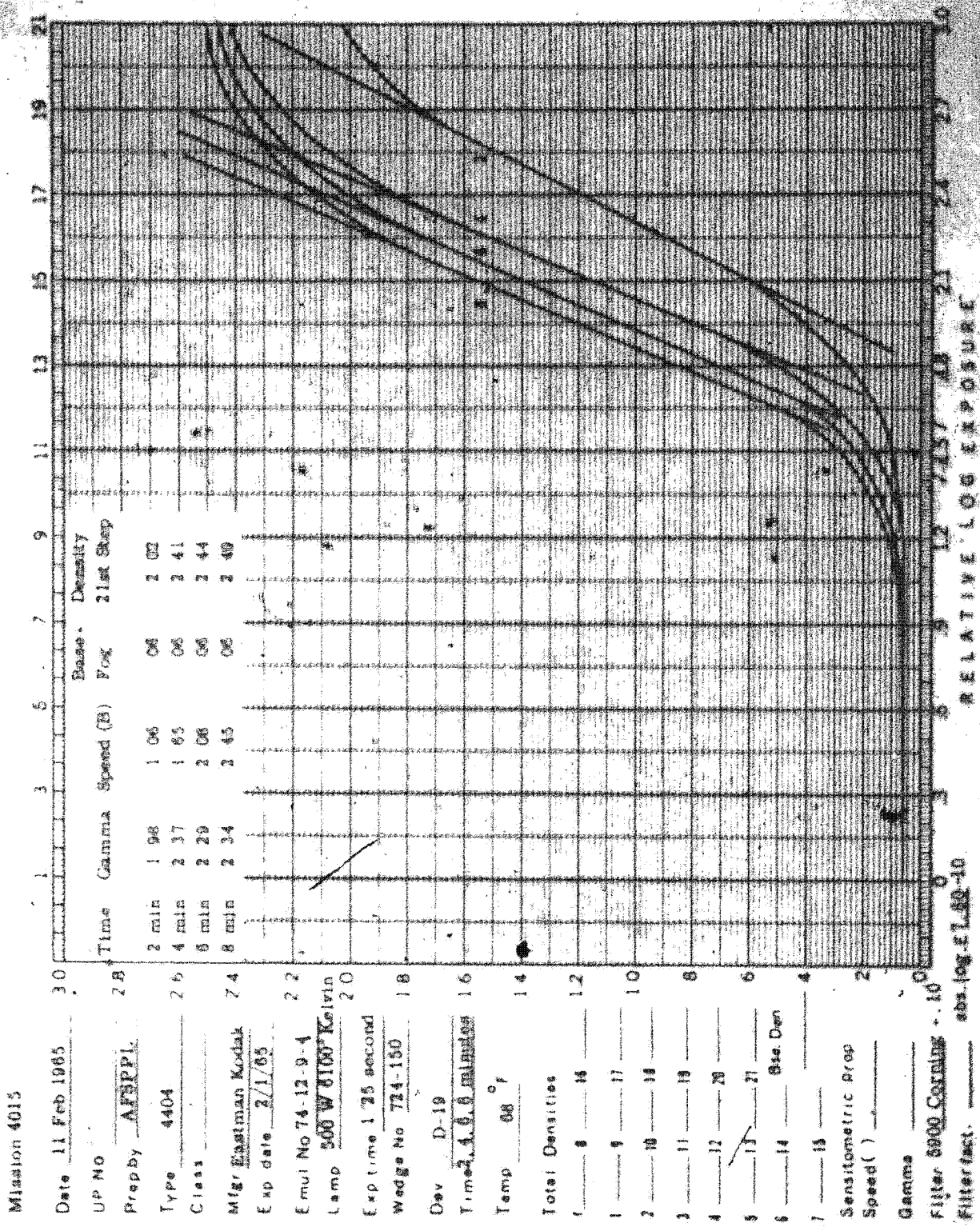
Handle via Byeman
Controls Only

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SPPL TECHNICAL REPORT NO. 161-1-43

Controls Only

SENSITOMETRIC CURVES



Mission 4015

Date 11 Feb 1965

UP NO _____

Prepby AFSPPL

Type 4404

Class _____

Mfr Eastman Kodak

Exp date 2/1/65

Emul No 74-12-9-1

Lamp 500 W 6100° Kelvin

Exptime 1.25 second

Wedge No 724-150

Dev D-19

Time 2.4.6.6 minutes

Temp 68° F

Total Densities

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

7 _____

Sensitometric Prop Speed () _____

Gamma _____

Filter 8900 Corning +.10

Filter fast. _____

ILLUSTRATION 5

Handle via Byeman
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Handle via ~~Byeman~~
Controls Only

~~TOP SECRET - GAMBIT~~

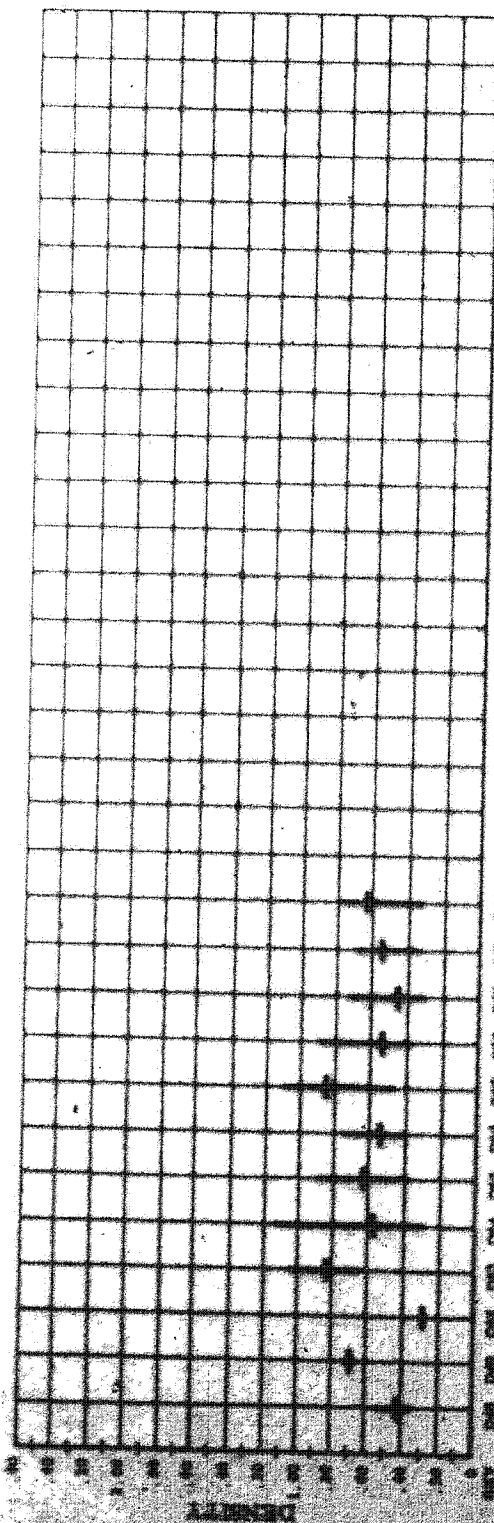
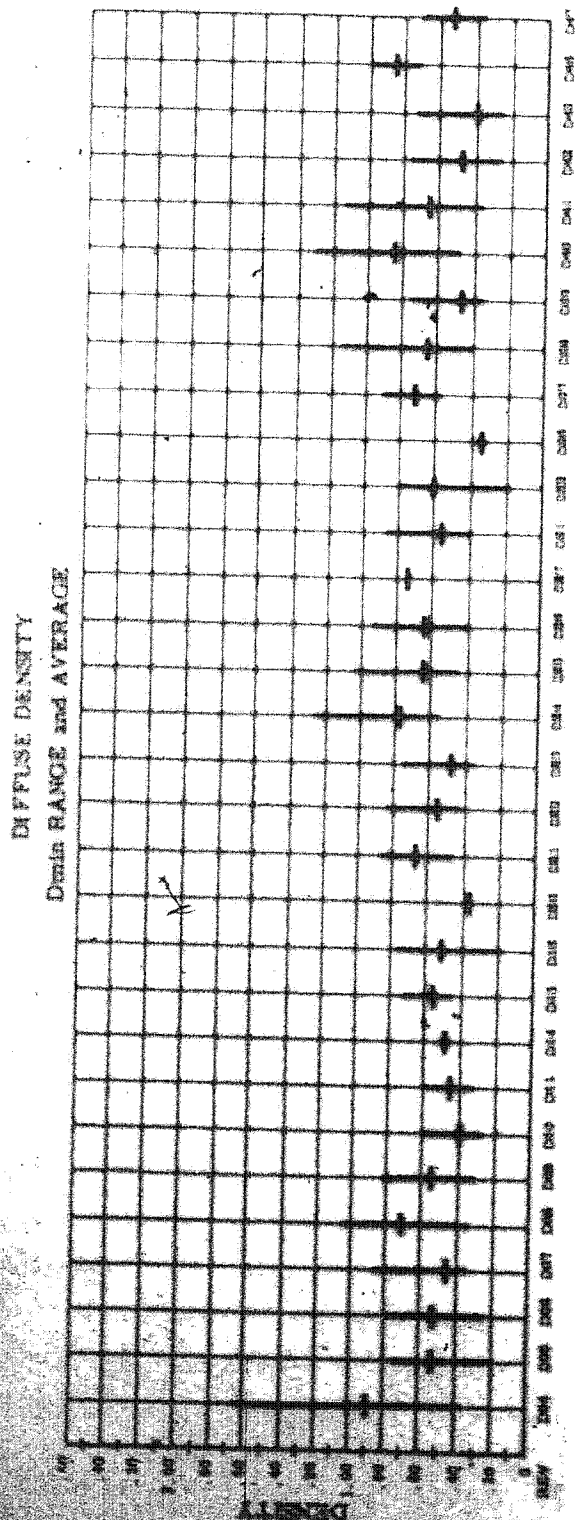


ILLUSTRATION 6

Handle via ~~Byeman~~
Controls Only

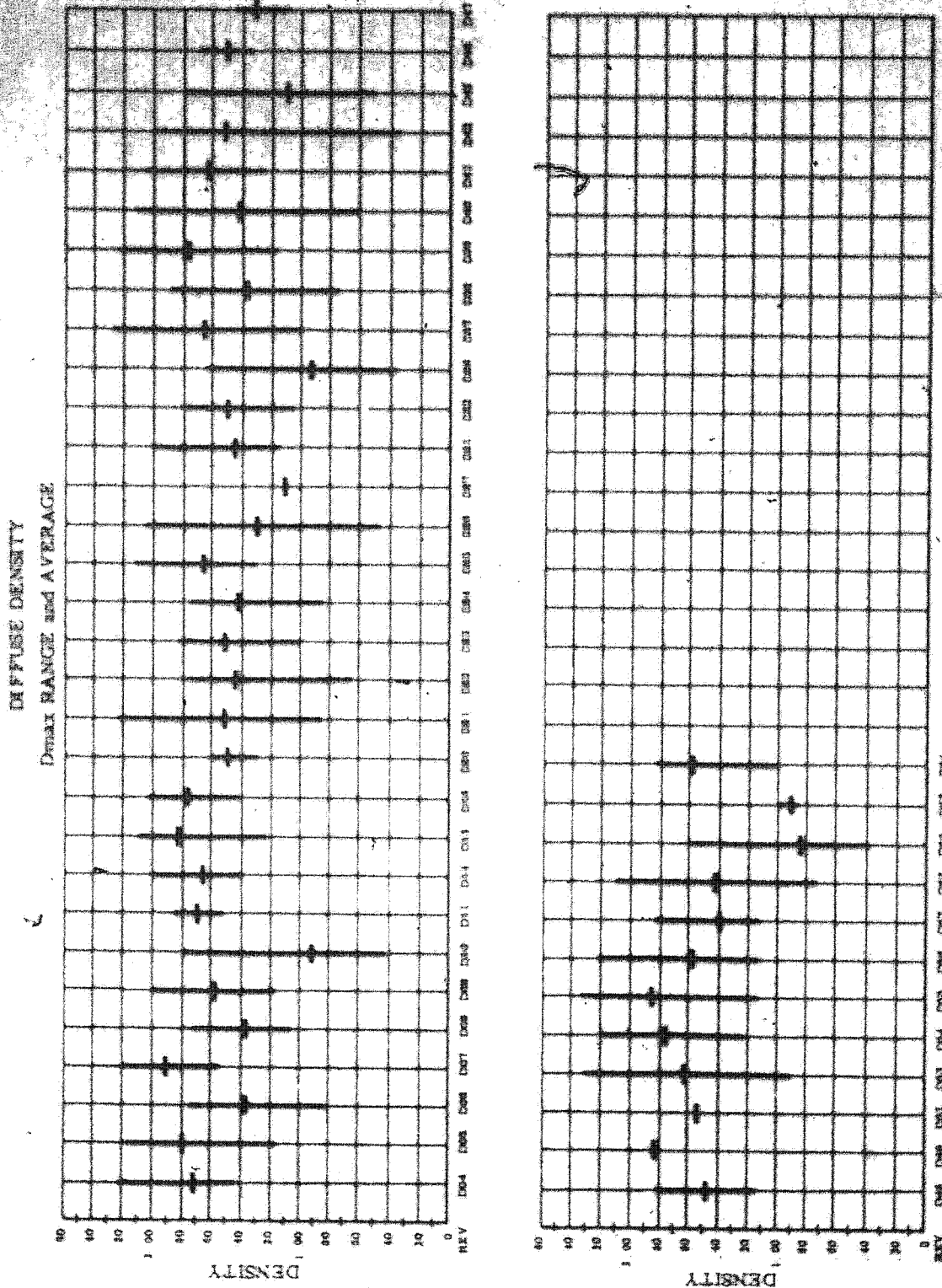
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DD FORM 101-43

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EPFL TECHNICAL REPORT NO. 101-1-43



DIFFUSE DENSITY
Dens. Range and Average

ILLUSTRATION 7

Handle via Byeman
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Controls Only

~~TOP SECRET - GAMBIF~~

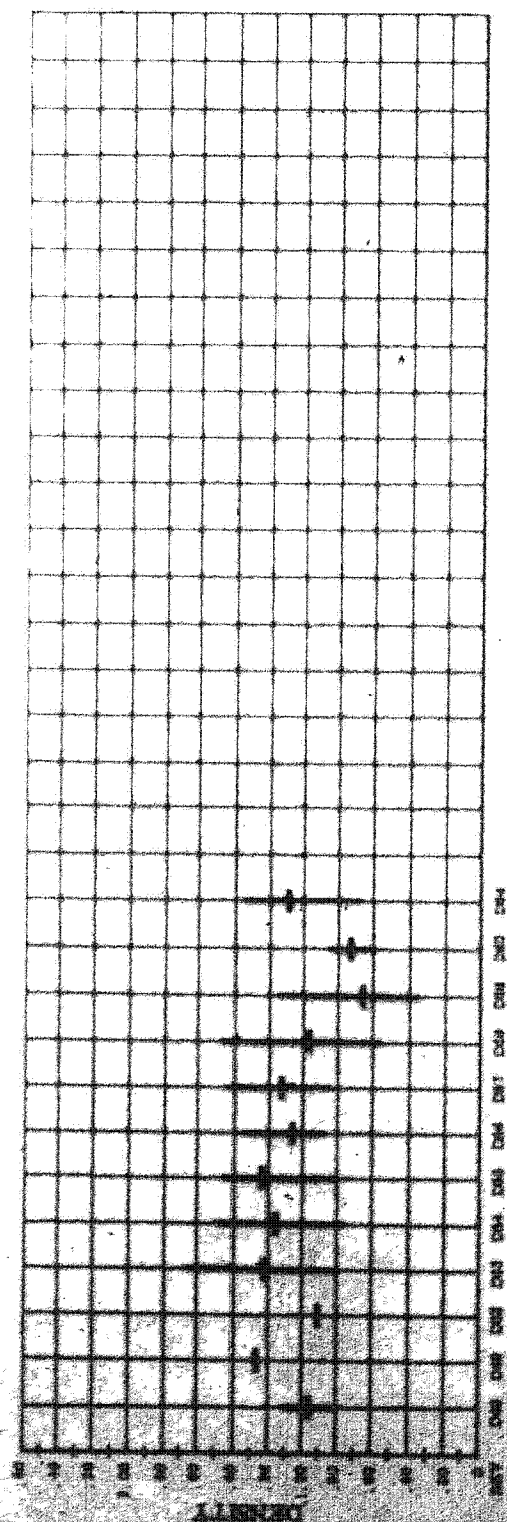
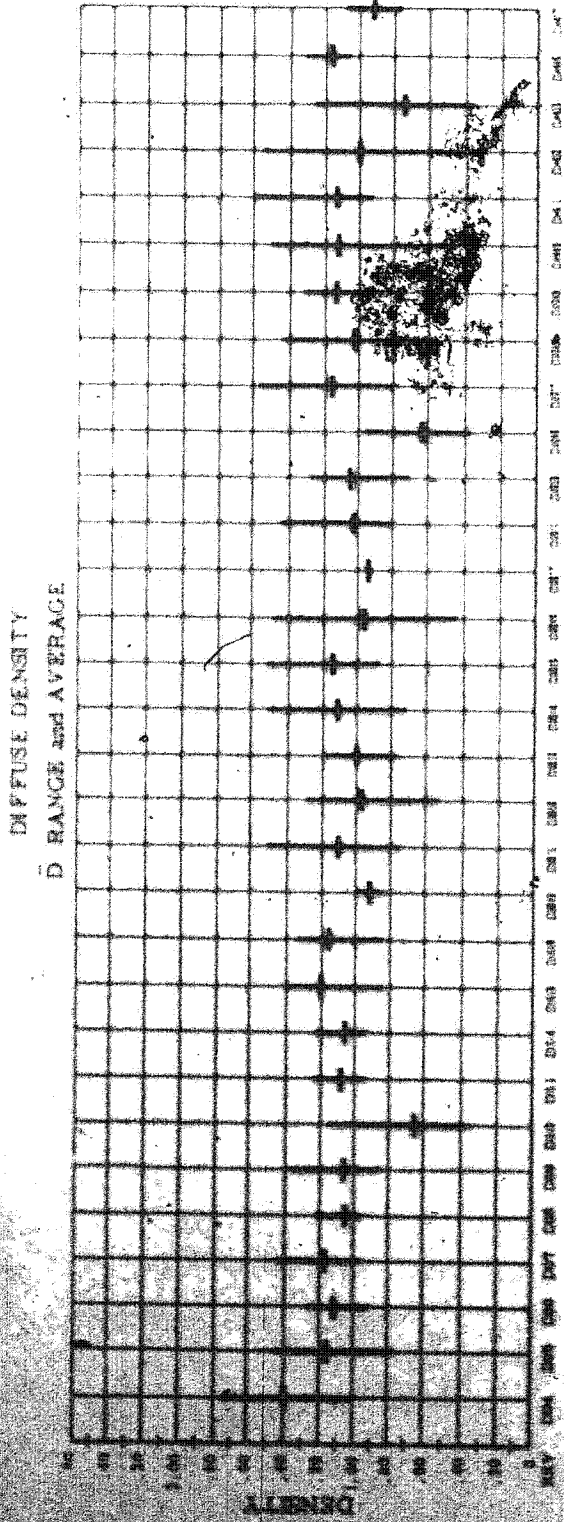


ILLUSTRATION 2

Handle via Byeman
Controls Only

~~TOP SECRET - GAMBIF~~

AFPL TECHNICAL REPORT NO. 101-1-43

Controls Only

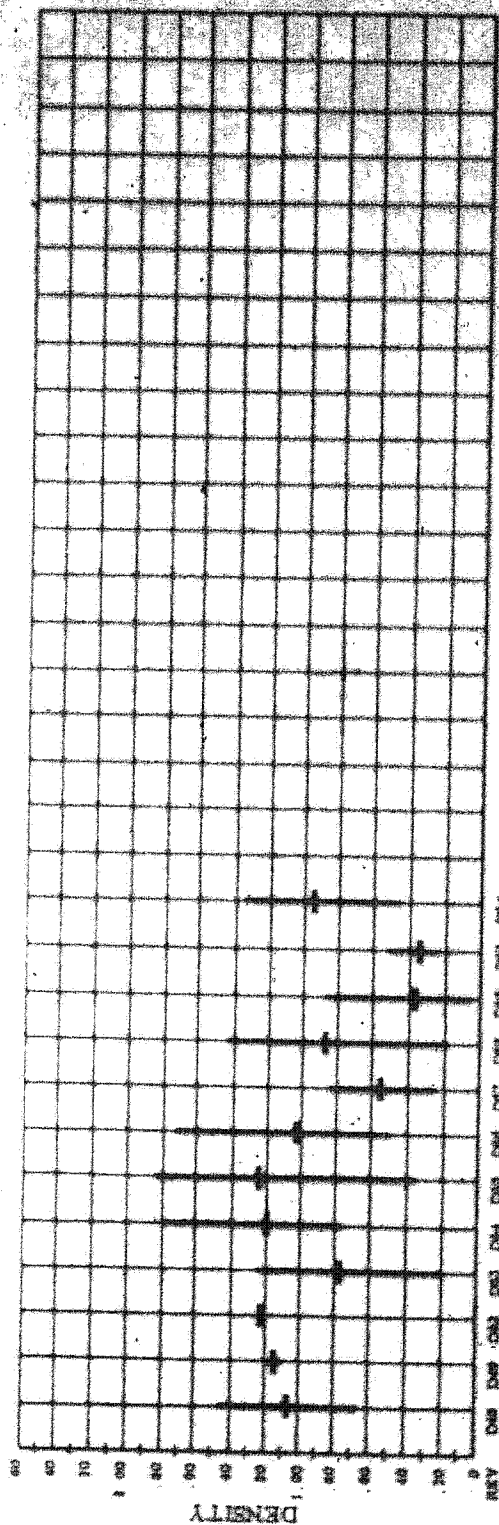
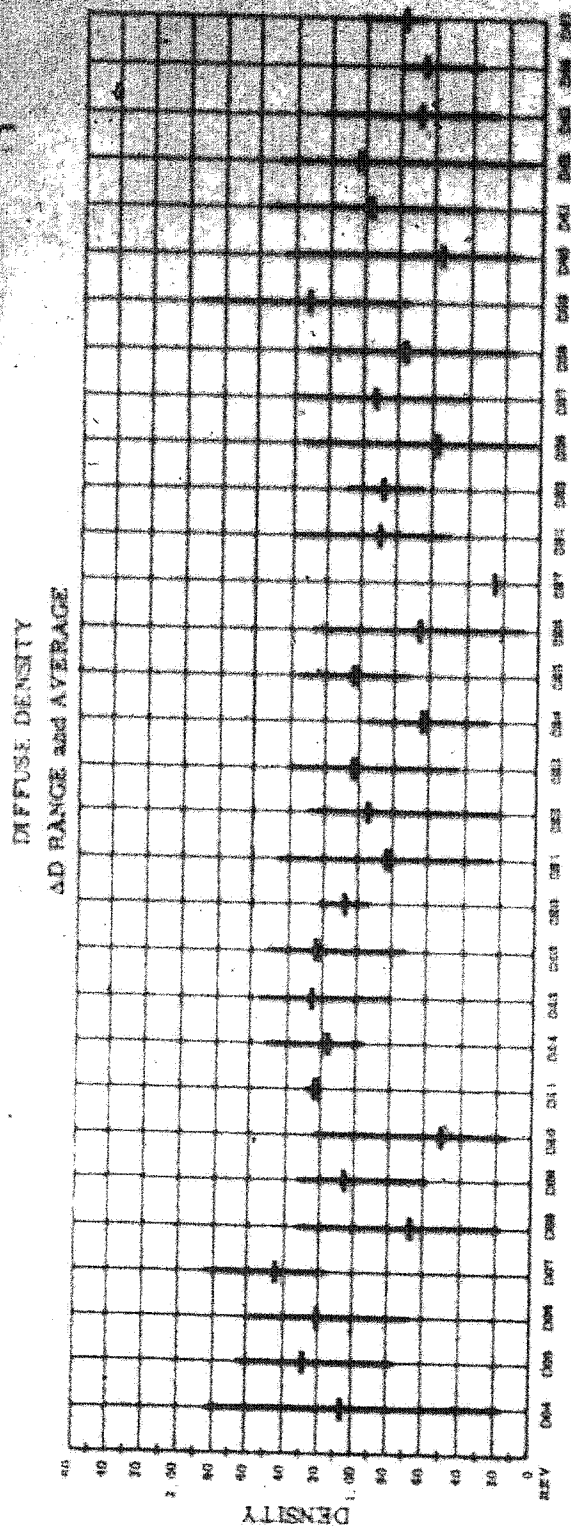


ILLUSTRATION 9

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SPPL TECHNICAL REPORT NO. 101-1-43

FREQUENCY DISTRIBUTION

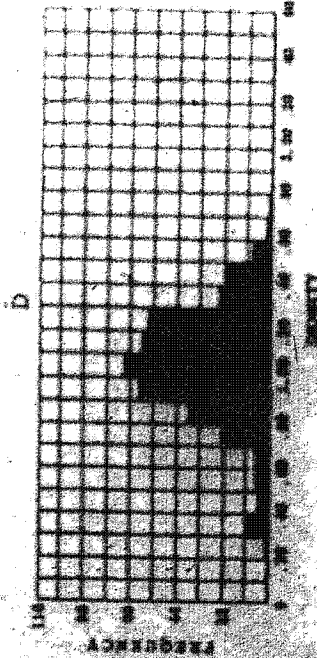
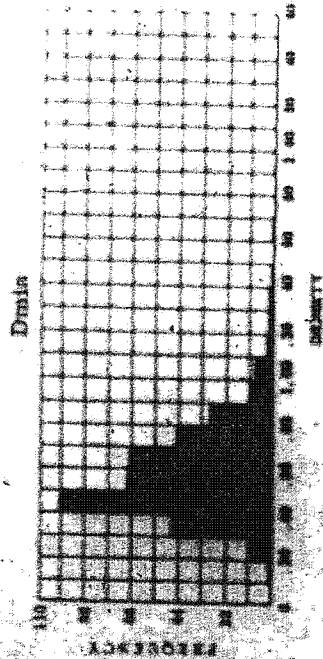
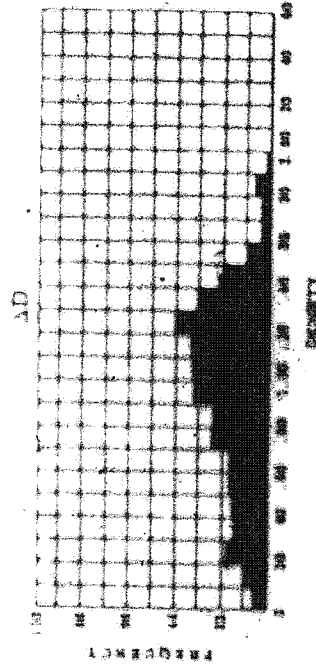
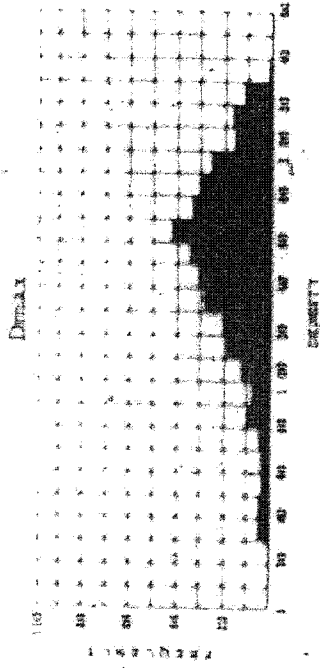


ILLUSTRATION 10

Handle via Eyeman
Controls Only

~~TOP SECRET - GAMBIT~~

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SPPL TECHNICAL REPORT NO. 101-1-43

Dmin & Dmax AVERAGES VERSUS SUN ANGLE

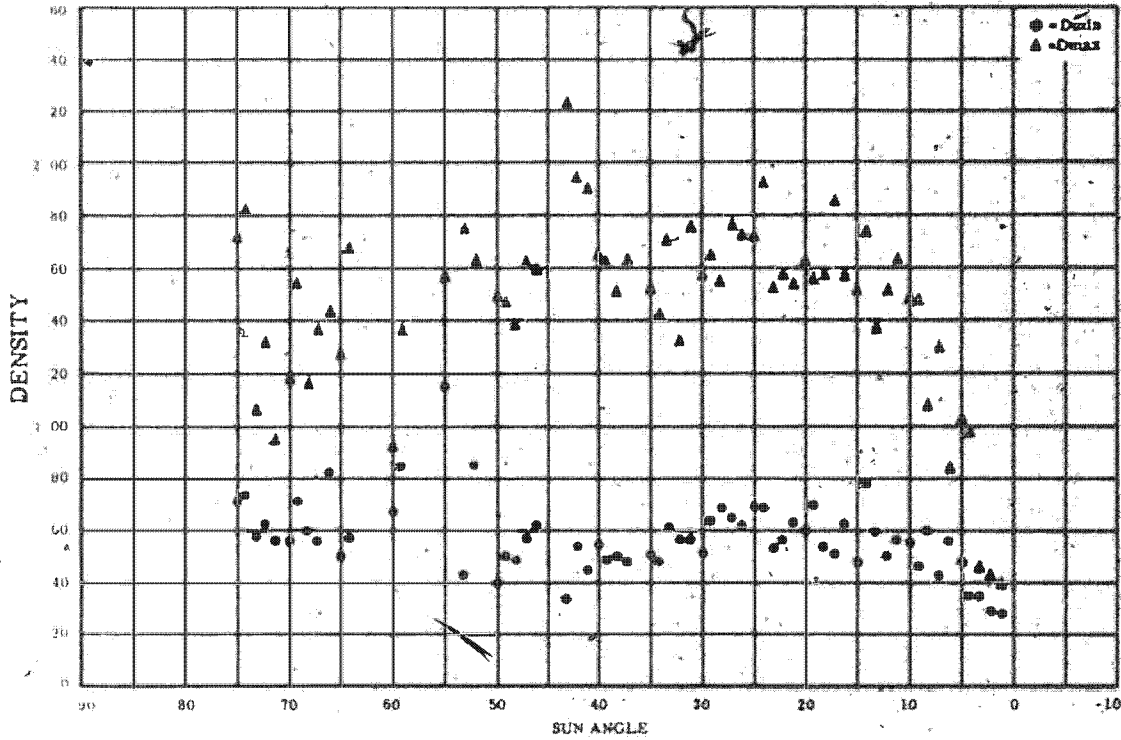


ILLUSTRATION 11

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Dmin & Dmax AVERAGES VERSUS LATITUDE

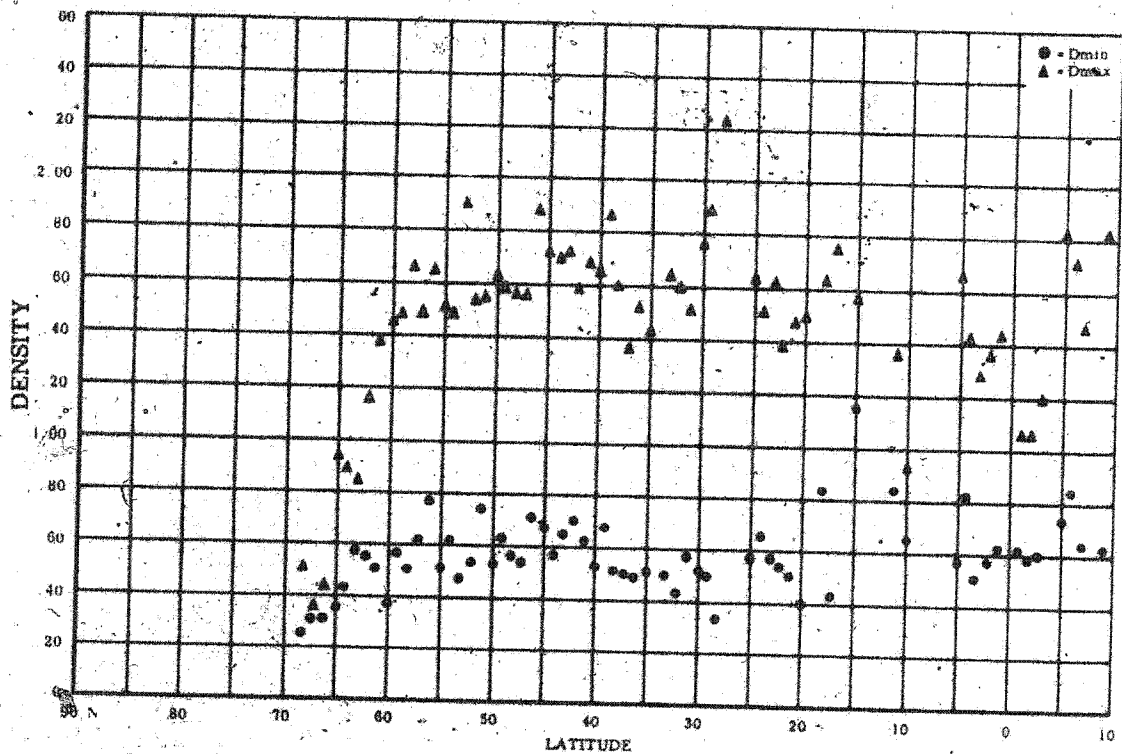


ILLUSTRATION 12

AVERAGE MTF CURVE

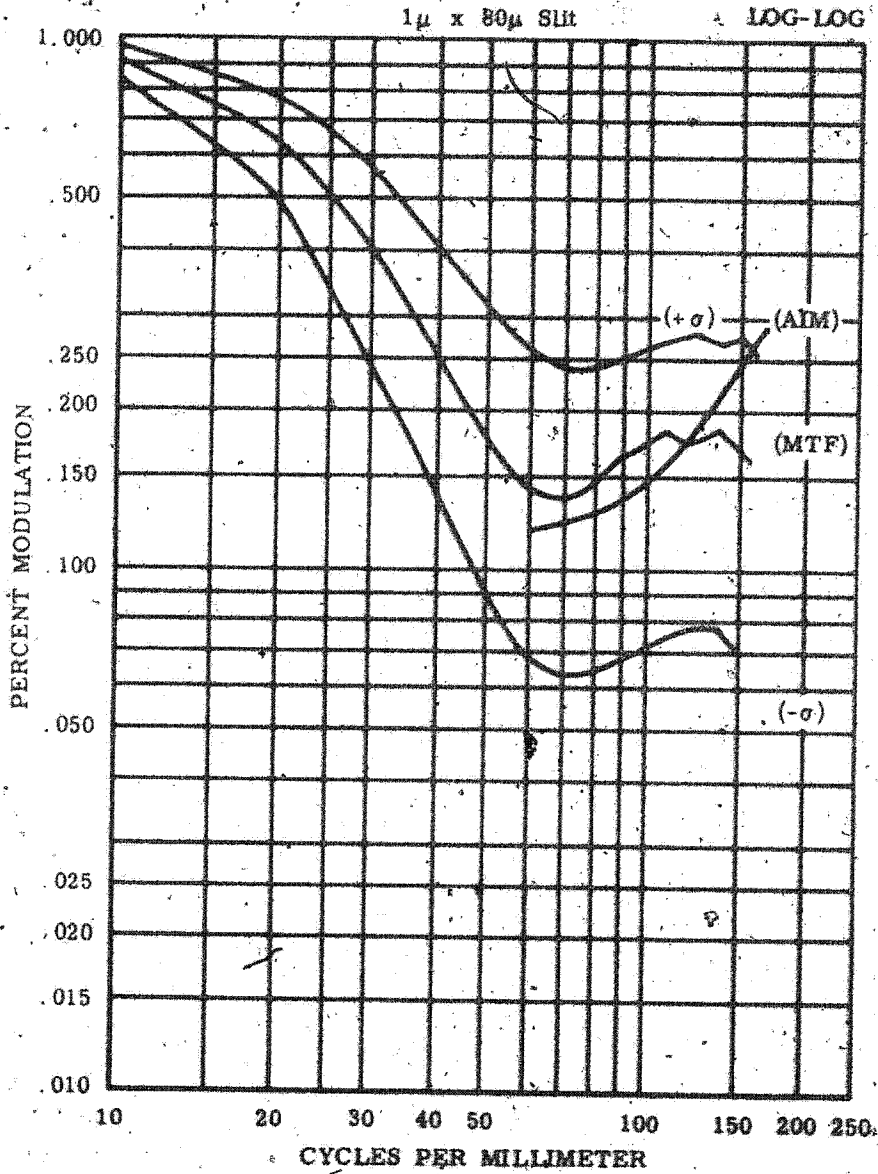


ILLUSTRATION 13

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~~TOP SECRET - GAMBIT~~

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SPPL TECHNICAL REPORT NO. 101-1-43

FREQUENCY DISTRIBUTION
IMAGE ANALYSIS TECHNIQUES

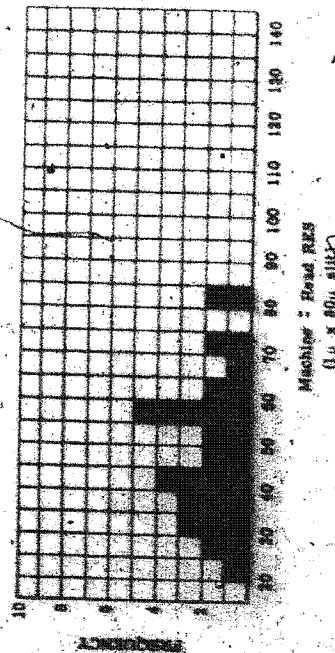
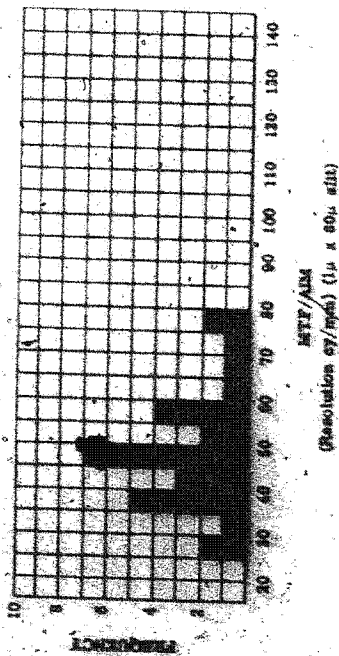
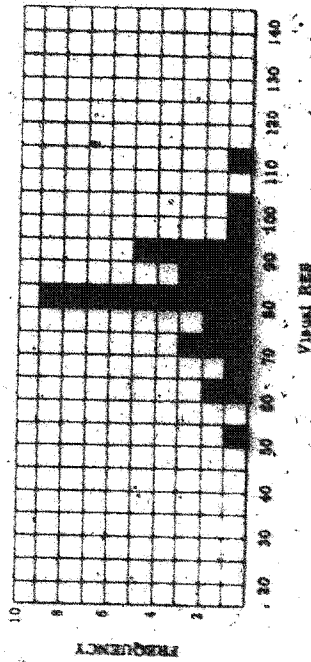
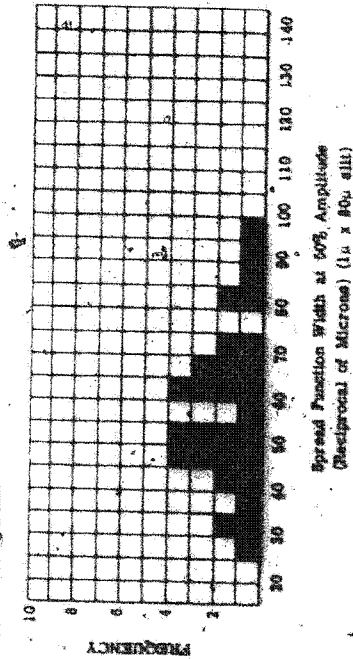


ILLUSTRATION 14

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SPPL TECHNICAL REPORT NO. 101-1-43

FREQUENCY DISTRIBUTION Visual RES

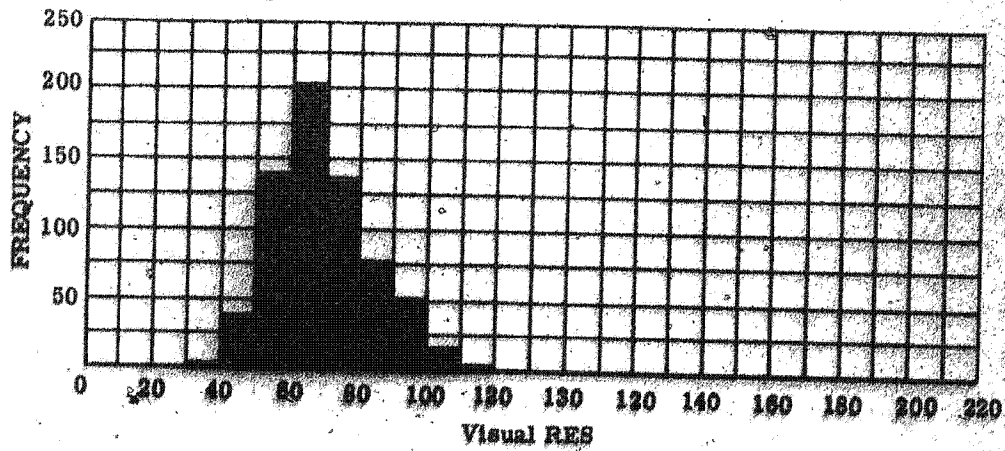


ILLUSTRATION 15

Handle via Byeman
Controls Only

~~TOP SECRET - GAMBIT~~

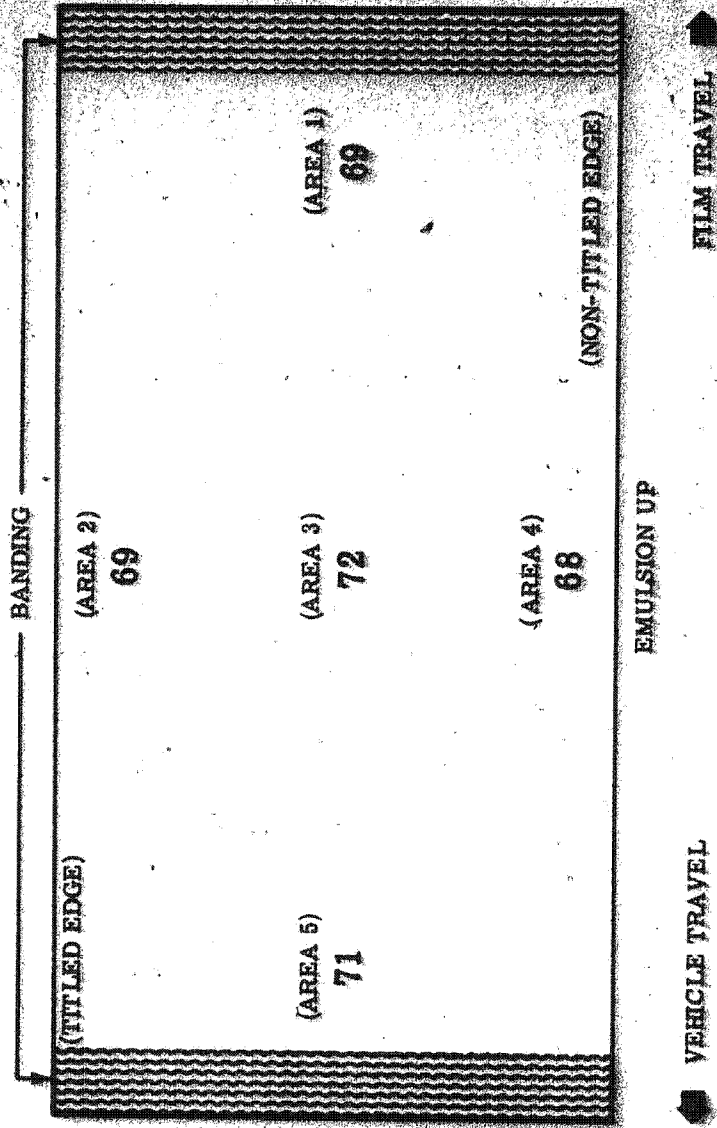
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SRPL TECHNICAL REPORT NO. 101-1-43

AVERAGE V-RES BY FRAME AREA



EMULSION UP

VEHICLE TRAVEL

FILM TRAVEL

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ILLUSTRATION 17

AVERAGE V-RES VERSUS SUN ANGLE.

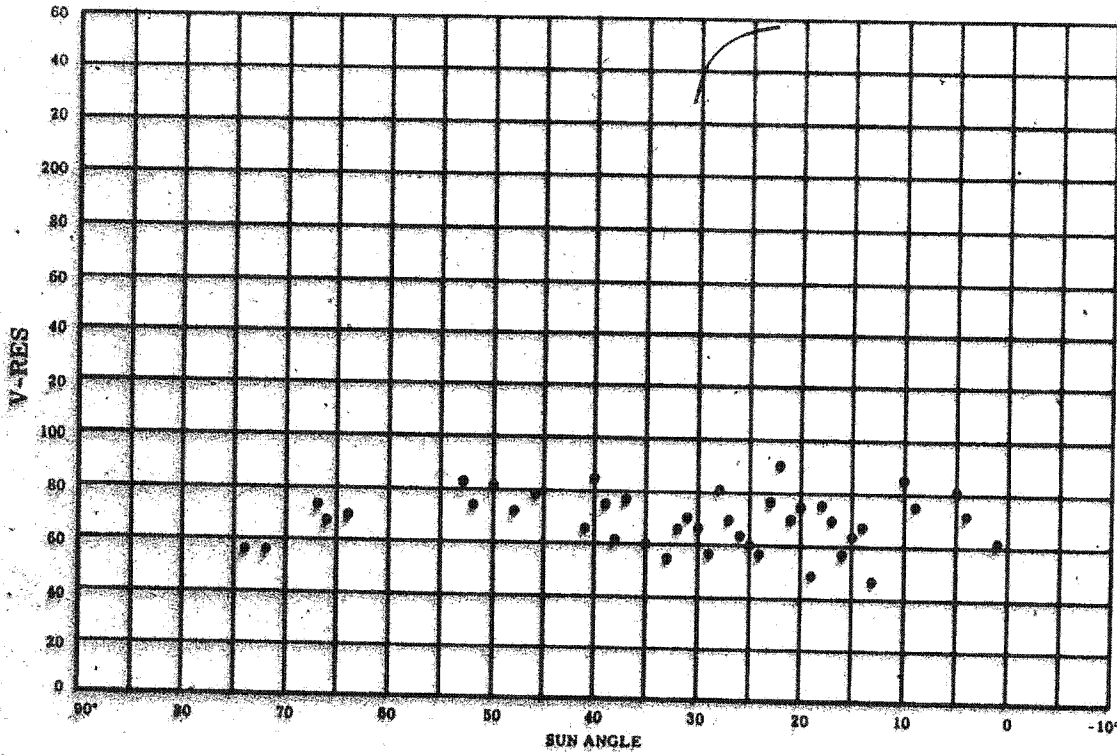


ILLUSTRATION 18

SPPL TECHNICAL REPORT NO. 101-1-43

AVERAGE V-RES VERSUS LATITUDE

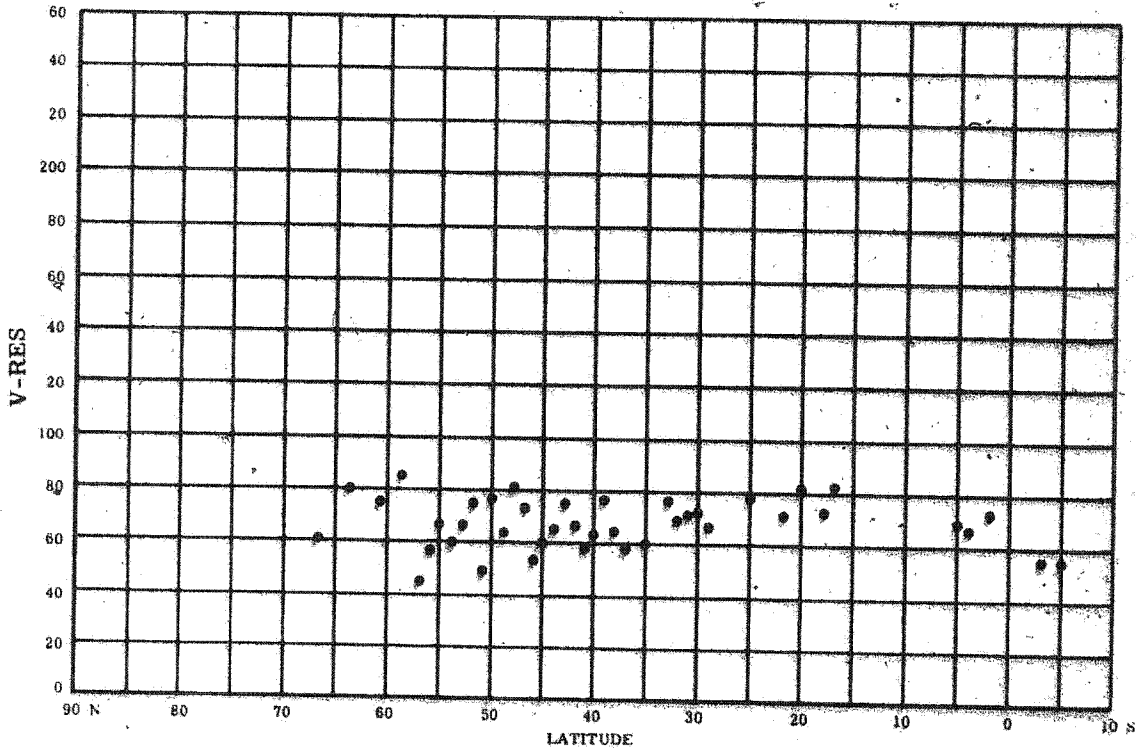


ILLUSTRATION 19

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SPPL TECHNICAL REPORT NO. 101-1-43

SECTION III

METHODS AND EQUIPMENT USED IN THE ANALYSIS

This section presents a description of the test procedures, methods, and equipment used in conducting the mission photographic analysis which produced the data recorded in Section II, Paragraph B.

A series of photographic missions obtaining products from the same camera system and under generally similar conditions are evaluated with identical equipment and techniques, where possible, in order that valid comparisons of individual missions can be accomplished. The report of the first mission evaluated in the series contains a complete detailed description of the evaluation techniques and equipment used. However, as refinements occur in photographic evaluation techniques, mensuration equipment, and methods of handling data, corresponding revisions are recorded in the appropriate paragraphs of this section. There were no revisions or changes in test procedures and equipment during the evaluation of Mission 4015. Refer to Section III of SPPL Technical Report No. 101-1-40 (Mission 4014) for a complete description of methods and equipment utilized in the analysis.

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SPPL TECHNICAL REPORT NO. 101-1-43

SECTION IV

OBSERVATIONS AND SUMMARY

Reconnaissance Satellite Mission 4015 obtained photographic coverage on 43 revolutions from 23 January 1965 through 27 January 1965. Approximately 2,400 measurements were accomplished during the photographic analysis on 2,701 feet of original negatives from this Mission. This evaluation consisted of inspecting, measuring, and compiling data on density, Visual Reciprocal Edge Spread (V-RES), analysis by edge scan techniques, Controlled Range Network (CORN) Operations, and film degradations. The observations and summaries presented in this section are based on a study of the data reported in Section II and a comparison with previous missions of this series.

A. Density Analysis

1. A summary of measured and computed densitometric values for Mission 4015 is presented below:

	<u>Range</u>	<u>Average</u>	<u>Standard Deviation (σ)</u>
Dmin	0.19 - 1.68	0.58	0.21
Dmax	0.31 - 2.35	1.53	0.42
\bar{D}	0.29 - 1.76	1.06	0.25
ΔD	0.04 - 1.92	0.95	0.42
Gross Fog	0.07 - 0.26	0.17	0.06
Dmax Clouds	0.40 - 2.40	1.75	0.41

2. The average Dmin, Dmax, \bar{D} , and ΔD values for Mission 4015 are similar to Missions 4010 and 4014 and lower than Mission 4011 with the exception of the ΔD value which is higher.

3. The ranges of Dmin, Dmax, \bar{D} , and ΔD values for Mission 4015 are greater than the three previous missions of this series.

B. Film Processing

1. Mission 4015 is the first in this series to be processed with the Yardleigh Frame Processor. This frame-by-frame processor is capable of stabilizing its development changes within 1/2 inch.

2. Processing lines resulting from abrupt development level changes were noted throughout the Mission.

3. Approximately 37% (198 frames) of Mission 4015 was processed at the Primary development level, 19% (101 frames) at the Intermediate level, 43% (231 frames) at the Full level, and 1% (6 frames) received more than one level of development.

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RCS 39704-65

SPPL TECHNICAL REPORT NO. 101-1-43

4. Use of the frame-by-frame processing technique and the availability of different exposure slit widths should have generally produced narrower ranges, a better control of density values, and a resultant higher overall quality for the Mission. However, ranges of density values increased over the previous three missions of this series. Also, when comparing density values with the processing profile, several cases of underexposure, underdevelopment, overexposure, and overdevelopment were noted.

C. Analysis by Edge Scan Techniques

The evaluation of scene edges through analysis techniques using microdensitometric traces was performed by two teams: the Technical Evaluation Team (SPPL Team) and a group of scientists and consultants from Industry (S/C Team). The values of Modulation Transfer Function/Aerial Image Modulation (MTF/AIM) and Spread Function Width at 50% Amplitude (50% Spread) for Mission 4015 and the past three missions of this series are tabulated below:

Mission	MTF/AIM		50% Spread (Reciprocal)	
	SPPL Team	S/C Team	SPPL Team	S/C Team
4010	41 (350 μ)	54 (80 μ)	42 (350 μ)	48 (80 μ)
4011	36 (80 μ)	33 (80 μ)	49 (80 μ)	30 (80 μ)
4014	99 (80 μ)	78 (80 μ)	103 (80 μ)	96 (80 μ)
4015	50 (80 μ)	71 (80 μ)	58 (80 μ)	71 (80 μ)

1. SPPL Team

a. The SPPL Team used three methods of analysis: MTF/AIM, 50% Spread, and Machine Reciprocal Edge Spread (M-RES). Edge traces were obtained with a Mann-Data Micro-Analyzer utilizing a $1\mu \times 80\mu$ slit. A summary of this data appears on page 36.

b. The average MTF/AIM, 50% Spread, and M-RES values show Mission 4015 to have a lower image quality than Mission 4014 and a higher quality than Missions 4010 and 4011.

c. Using a mean Photo Scale Reciprocal (PSR) of 90,500, the approximate ground resolution of the average values are: 5.9' for MTF/AIM, 5.1' for 50% Spread, and 6.0' for M-RES.

2. Scientist and Consultant Team

a. This group used two methods of edge analysis: MTF/AIM and 50% Spread. Edge traces were performed with the Eastman Kodak Model 5 Microdensitometer utilizing a $1\mu \times 80\mu$ slit. A summary of this data appears on page 36.

b. The average MTF/AIM and 50% Spread values show Mission 4015 to have a lower image quality than Mission 4014 and a higher quality than Mission 4010 and 4011.

c. Conversion of the average MTF/AIM and 50% Spread values to approximate ground resolution using a mean PSR of 90,500 resulted in 4.1' for both values.

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SPPL TECHNICAL REPORT NO. 101-1-43

D. Controlled Range Network (CORN) Operations

1. Mission 4015 covered the mobile CORN displays at Outlaw Field, Clarksville, Tennessee, on Rev D31, Frame 009, and Tucson, Arizona, on Rev D32, Frame 006.

2. The resultant ground resolution of the "T" Bar Targets ranges from 6' 4" to 8' plus (resolving limit is 8') for the Clarksville display and from 6' 4" to 7' 1" at Tucson.

E. Blackbird Mission

1. A Blackbird Mission (RB-47 Aircraft) was flown in conjunction with Reconnaissance Satellite Mission 4015. This Blackbird Mission coincided with Rev 31, Frame 009, of Mission 4015, over the mobile CORN display located at Outlaw Field, Clarksville, Tennessee.

2. The resultant ground resolution interpreted from the "T" Bar Target at the Clarksville CORN display averages: 5.9' (16,500' alt) and 3.5' (8,000' alt) for the KC-1 Camera and 3.4' (16,500' alt) and 1.6' (8,000' alt) for the KA-2 Camera.

3. Evaluation of resultant imagery, processing data, and the exposure data (extracted from the camera log) indicates the photography from both cameras used on the Blackbird Mission was underexposed.

F. Visual Reciprocal Edge Spread (V-RES)

Six hundred and seventy-two measurements of V-RES were accomplished on Mission 4015. The values range from 38 to 118 with an average of 70. Conversion of the V-RES values to ground resolution using a mean Photo Scale of 1:90,500 resulted in a range from 2.4' to 7.8' with an average of 4.2 feet. The average V-RES value shows a lower image quality for Mission 4015 than Mission 4014 and a higher quality than Missions 4010 and 4011.

G. Physical Degradations**1. Imaged**

Fine, continuous, minus-density streaks and/or lines were observed throughout this Mission.

2. Superficial

A few minor abrasions, scratches, and pinholes were noted throughout this Mission.

H. Summary

1. The results of the analysis by edge scan techniques by both Teams (SPPL and S/C) in addition to the resultant V-RES values show Mission 4015 to have lower image quality than Mission 4014 but higher quality than both Missions 4010 and 4011.

2. Mission 4015 was the first in this series to be processed with a frame-by-frame Yardleigh Processor. The overall exposure and processing of this Mission are considered very good although several cases of underexposure, underdevelopment, overexposure, and overdevelopment were noted.

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3. This is the first mission in which three slit widths were used for exposure. There were frequent occasions where the selection of a different slit would have resulted in a better exposure.
4. The use of the Yardleigh Processor to accomplish frame-by-frame processing and programmable slit variations for exposure correction should result in a lowering of the standard deviation values for \bar{D} , D_{min} , and D_{max} . This effect was not noted.
5. Only a few minor physical degradations were noted throughout this Mission.
6. The Blackbird Mission flown in conjunction with Mission 4015 is considered highly successful although the imagery was underexposed on both cameras.
7. The summary comments above which relate to exposure and processing may indicate possible causes for the low resolution reported for this Mission. Resultant ground resolution determined from all methods of image quality averages approximately 4.8 feet for Mission 4015.

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Summary of Edge Scan Analysis(SPPL Team)No. of Edges - 33

Method of Analysis		Arithmetic Mean	Standard Deviation	Coefficient of Dispersion
Spread Function Width at 50% Amplitude	Width in Microns	18.8	5.8	31%
	Reciprocal of Width	58	17.3	30%
Machine-Read RES		49	15.9	33%
MTF/AIM		50	12.7	26%
Visual RES		84	12.8	15%

Summary of Edge Scan Analysis(S/C Team)No. of Edges - 26

Method of Analysis		Arithmetic Mean	Standard Deviation	Coefficient of Dispersion
Spread Function Width at 50% Amplitude	Width in Microns	16.2	2.1	37%
	Reciprocal of Width	71	30.0	43%
MTF/AIM		71	30.7	43%

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SECTION V

REFERENCES

1. Messages: 23 and 28 January 1965.
2. Mission Correlation Data: 24 - 27 January 1965.
3. Eastman Kodak Company, Rochester, New York, Manual of Physical Properties of Kodak Aerial and Special Sensitized Materials.
4. Message: 21 January 1965.

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SECTION VI

APPENDIX

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TABLE 1 - MISSION DATA*

Rev	Roll	Frames	Rev	Roll	Frames
D04	1 of 1	001-009	D37	1 of 1	001-007
D05	1 of 1	001-020	D38	1 of 1	001-032
D06	1 of 1	001-015	D39	1 of 1	001-011
D07	1 of 1	001-008	D40	1 of 1	001-014
D08	1 of 1	001-014	D41	1 of 1	001-017
D09	1 of 1	001-022	D42	1 of 1	001-018
D10	1 of 1	001-027	D43	1 of 1	001-013
D11	1 of 1	001-003	D46	1 of 1	001-003
D14	1 of 1	001-003	D47	1 of 1	001-005
D15	1 of 1	001-009	D48	1 of 1	001-009
D16	1 of 1	001-009	D49	1 of 1	001-003
D20	1 of 1	001-007	D52	1 of 1	001
D21	1 of 1	001-011	D53	1 of 1	001-006
D22	1 of 1	001-021	D54	1 of 1	001-023
D23	1 of 1	001-009	D55	1 of 1	001-015
D24	1 of 1	001-011	D56	1 of 1	001-014
D25	1 of 1	001-017	D57	1 of 1	001-010
D26	1 of 1	001-026	D58	1 of 1	001-028
D27	1 of 1	001-010	D59	1 of 1	001-022
D31	1 of 1	001-014	D63	1 of 1	001-003
D32	1 of 1	001-007	D64	1 of 1	001-006
D36	1 of 1	001-004			
TOTALS:		43 Revs	43 Rolls	598 Frames	

* Under Rev, the letter "A" denotes ascending (south to north) vehicle travel, and "D" denotes descending (north to south) vehicle travel. A numbered Rev may include both ascending and descending photo coverage.

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APPENDIX 1

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TABLE 2 - CAMERA DATA *

Camera Nomenclature	Type	Tilting	Lens	Focal Length	**Silt Widths	Filter Type	Aperture	Shutter Type	Shutter Speed	Obliquity Range	Stereo Aim Angle	Film Load	Format Size	Data Block	Grid
GAMBIT Strip		Aligned After Processing Includes Rev. Frame, and Classification	Makotov	77" (aprx)	No. 1 .008" No. 2 .0169" No. 3 .033" No. 4 SILD SILD	B&L Y-10	F/5.8 Effect ive T-Stop w/filter	Focal Plane Interchange-able Silt Widths	Variable with V/h	± 45°	± 15°	9 1/2"	8 1/4" x 10" Scene Width Scene Length Variable	No Time Labels Time Labels Double Yaw Silt Image Area	

* Message: 21 January 1965.

** Mission Correlation Data: Mission 4015, 24-27 January 1965.

APPENDIX 2

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TABLE 3 - Film Data

Camera	Film Type	Type of Base	Nominal Base Thickness	Aprx. Exp. Index Daylight	Typical Gel Layer Thickness		Resolution
					Emulsion	Gel Backing	
GAMBIT	(4404)	Estar Polyester	2.5 mils	1.6	0.24 mils	0.27 mils (Dyed)	200 l/mm at T. O. C. 1.6:1 (D-19)
	Estar Thin Base						475 l/mm at T. O. C. 1000:1 (D-19)

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TABLE 4 - FRAME PROCESSING PROFILE

Rev	Frames	Process Level	Rev	Frames	Process Level	
D04	1, 2	Full	D10	13-21	Primary	
	3	Primary		22	Intermediate	
	4, 5	Intermediate		23-27	Primary	
	6, 7	Full	D11	1, 2	Full	
	8, 9	Intermediate		3	1/5 Intermediate	
D05	1, 2	Full	3	4/5 Full		
	3, 4	Intermediate	D14	1-3	Full	
	5, 6	Full		D15	1, 2	Full
	7, 8	Intermediate	3-6		Primary	
	9	Primary	7-9	Full		
	10	Full	D16	1-6	Primary	
	11-13	Intermediate		7-9	Full	
	14-16	Full	D20	1-7	Full	
	17, 18	Primary		D21	1, 2	Full
	19, 20	Intermediate			3	Intermediate
D06	1	Primary		4, 5	Primary	
	2, 3	Intermediate		6, 7	Full	
	4, 5	Full	8, 9	Primary		
	6-10	Primary	10, 11	Intermediate		
	11, 12	Full	D22	1-3	Full	
	13	Intermediate		4, 5	Intermediate	
14, 15, 16	Full	6		1/2 Primary		
D07	1, 2	Full		6	1/2 Intermediate	
	3, 4	Primary		7, 8	Full	
	5	Full	9, 10	Intermediate		
	6	Intermediate	11-16	Primary		
	7, 8	Primary	17	Full		
D08	1, 2	Full	18	Intermediate		
	3, 4	Intermediate	19, 20	Primary		
	5-14	Primary	21	Full		
D09	1, 2	Full	D23	1-4	Full	
	3	Intermediate		5, 6	Primary	
	4, 5	Primary	7	1/3 Intermediate		
	6	Full	7	2/3 Full		
	7-14	Primary	8, 9	Full		
	15, 16, 17	Intermediate	D24	1-11	Primary	
	18	Intermediate		D25	1-3	Full
19-22	Primary	4, 5			Intermediate	
D10	1-8	Full				
	9, 10	Intermediate				
	11	Primary				
	12	Intermediate				

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Rev	Frames	Process Level	Rev	Frames	Process Level	
D25	6	Primary	D39	1	Primary	
	7, 8	Intermediate		2	Full	
	9-11	Full		3, 4	Primary	
	12, 13	Primary		5	Full	
	14, 15	Intermediate		6-8	Intermediate	
	16, 17	Primary		9-11	Full	
D26	1-8	Full	D40	1	Full	
	9-13	Primary		2, 3	Intermediate	
	14-22	Full		4	Primary	
	23-26	Primary		5	Intermediate	
6-11				Primary		
D27	1-4	Full	12, 13	Full		
	5	Primary	D41	1-3	Full	
	6	Intermediate		4, 5	Intermediate	
	7-9	Primary		6-9	Primary	
	10	Intermediate		10	Full	
11				Intermediate		
D31	1-4	Primary	12, 13	Primary		
	5, 6	Intermediate	14-16	Intermediate		
	7-14	Full	17	Full		
D32	1-4	Primary	D42	1-4	Full	
	5	Intermediate		5, 6	Intermediate	
	6	Full		7, 8	Full	
	7	Intermediate		9-11	Primary	
D36	1-4	Full		12-15	Full	
				16	Primary	
D37	1-3	Full		17, 18	Full	
	4-7	Primary		D43	1-3	Full
D38	1	Intermediate	4, 5		Primary	
	2-4	Primary	6		Intermediate	
	5, 6	Intermediate	7, 8		Full	
	7, 8	Full	9		Intermediate	
	9	Intermediate	10, 11		Primary	
	10	Full	12		Primary	
	11	Intermediate	13		1/2 Full	
	12, 13	Full	13		1/2 Primary	
	14	Primary	D46		1, 2	Full
	15, 16	Intermediate			3	1/4 Intermediate
	17-20	Primary			3	3/4 Full
	21, 22	Full	D47		1	Full
	23, 24	Primary		2	Primary	
25	Intermediate	3-5		Full		
26-28	Primary	D48		1-6	Primary	
29	Intermediate			7, 8	Intermediate	
30, 31	Primary		9	Primary		
32	Full					

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Rev	Frames	Process Level	Rev	Frames	Process Level
D49	1, 2, 3	Primary	D57	1-3	Full
D52	1	Full		4, 5	Primary
D53	1-4	Full		6-8	Full
	5, 6	Primary		9, 10	Primary
D54	1-3	Full	D58	1-6	Full
	4, 5	Primary		7	Intermediate
	6-8	Intermediate		8, 9	Full
	9	Primary		10	Intermediate
	10, 11	Intermediate		11-18	Full
	12-14	Full		19	Primary
	15, 16	Primary		20-26	Full
	17	1/2 Primary		27, 28	Primary
	17	1/2 Intermediate	D59	1-9	Full
	18	Intermediate		10, 11	Intermediate
	19, 20	Full		12	Full
	21	Intermediate		13	Intermediate
	22, 23	Primary		14	Primary
D55	1-4	Full		15	Intermediate
	5, 6	Intermediate		16-19	Primary
	7	Primary		20	Intermediate
	8-13	Full		21, 22	Primary
	14	Full	D63	1, 2	Full
	15	Full		3	Intermediate
D56	1-3	Intermediate	D64	1	Intermediate
	4-6	Primary		2	Full
	7	Intermediate		3	Intermediate
	8	Full		4-6	Full
	9-11	Intermediate			
	12, 13	Full			
	14	Intermediate			

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TABLE 5 - DIFFUSE DENSITY READINGS (Cont'd)

REV	FRAME	D/MIN	D/MAX	D̄	AD	BASE FDG	D/MAX CLOUDS	LATITUDE (DEG)	SUN ANGLE	REV	FRAME	D/MIN	D/MAX	D̄	AD	BASE FDG	D/MAX CLOUDS	LATITUDE (DEG)	SUN ANGLE
D	11	1				.25		70N	-2	D	22	.50	.96	.73	.60	.12		54N	14
D	11	2			1.85	.24		70N	-2	D	22	.50	.96	.73	.60	.12		54N	14
D	11	3*	.47	2.32	1.30	.24		43N	27	D	22	.50	.96	.73	.60	.12		54N	14
D	11	3	.32	1.52	.92	.13		43N	27	D	22	.50	.96	.73	.60	.12		54N	14
D	11	3	.60	1.88	1.28	.24		43N	27	D	22	.50	.96	.73	.60	.12		54N	14
D	14	1	.64	1.40	.92	.24	2.12	21N	49	D	22	.50	.96	.73	.60	.12		54N	14
D	14	3	.60	1.50	1.02	.24	2.12	21N	49	D	22	.50	.96	.73	.60	.12		54N	14
D	14	3	.48	2.00	1.24	.24	2.36	20N	50	D	22	.50	.96	.73	.60	.12		54N	14
D	15	1	.54	2.10	1.32	.22	2.04	44N	24	D	22	.50	.96	.73	.60	.12		54N	14
D	15	2	.72	2.10	1.41	.22	1.96	44N	24	D	22	.50	.96	.73	.60	.12		54N	14
D	15	3				.21	1.70	38N	32	D	23	.46	1.30	.88	.84	.26	1.43	56N	13
D	15	4				.10	1.82	35N	35	D	23	.46	1.30	.88	.84	.26	1.43	56N	13
D	15	5				.10	1.80	35N	35	D	23	.46	1.30	.88	.84	.26	1.43	56N	13
D	15	6				.10	1.80	35N	35	D	23	.46	1.30	.88	.84	.26	1.43	56N	13
D	15	7	.44	1.24	.84	.22		32N	38	D	23	.46	1.30	.88	.84	.26	1.43	56N	13
D	15	8	.48	1.80	1.14	.22	1.80	29N	41	D	23	.46	1.30	.88	.84	.26	1.43	56N	13
D	15	9	.66	1.94	1.30	.22	1.70	29N	41	D	23	.46	1.30	.88	.84	.26	1.43	56N	13
D	16	1	.78	1.92	1.35	.09	2.08	48N	40	D	23	.46	1.30	.88	.84	.26	1.43	56N	13
D	16	2	.19	1.66	.92	.09	1.90	47N	23	D	23	.46	1.30	.88	.84	.26	1.43	56N	13
D	16	3	.20	1.48	.84	.09	1.82	47N	23	D	23	.46	1.30	.88	.84	.26	1.43	56N	13
D	16	4	.75	1.42	1.08	.09	1.74	41N	29	D	23	.46	1.30	.88	.84	.26	1.43	56N	13
D	16	5				.09	1.70	41N	29	D	23	.46	1.30	.88	.84	.26	1.43	56N	13
D	16	6				.09	1.78	40N	30	D	23	.46	1.30	.88	.84	.26	1.43	56N	13
D	16	7	.23	1.31	.77	.09	2.36	32N	37	D	24	.58	.85	.71	.27	.09	1.12	55N	14
D	16	7	.82	1.98	1.36	.21		32N	37	D	24	.58	.85	.71	.27	.09	1.12	55N	14
D	16	8	.50	2.01	1.25	.21	2.00	32N	38	D	24	.58	.85	.71	.27	.09	1.12	55N	14
D	16	9	.80	2.04	1.32	.21	1.85	32N	38	D	24	.58	.85	.71	.27	.09	1.12	55N	14
D	20	1				.21		67N	1	D	24	.58	.85	.71	.27	.09	1.12	55N	14
D	20	2				.21		67N	1	D	24	.58	.85	.71	.27	.09	1.12	55N	14
D	20	3				.22		67N	1	D	24	.58	.85	.71	.27	.09	1.12	55N	14
D	20	4				.22	.90	67N	5	D	24	.58	.85	.71	.27	.09	1.12	55N	14
D	20	5				.22	.85	67N	5	D	24	.58	.85	.71	.27	.09	1.12	55N	14
D	20	6	.38	1.30	.84	.22	1.90	67N	6	D	24	.58	.85	.71	.27	.09	1.12	55N	14
D	20	7	.38	1.60	.99	.22	1.72	67N	9	D	24	.58	.85	.71	.27	.09	1.12	55N	14
D	21	1	.72	1.30	1.01	.23	1.50	59N	10	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	21	2	.64	1.10	.88	.23	1.54	59N	10	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	21	3	.88	1.64	1.26	.14		51N	19	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	21	4	.46	1.70	1.08	1.24		49N	20	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	21	5	.72	2.10	1.41	1.38		49N	20	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	21	6	.88	2.14	1.51	1.26	.23	45N	25	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	21	7	.78	2.24	1.51	1.64	.23	45N	25	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	21	8	.82	.86	.74	.24	.12	45N	25	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	21	9	.60	1.94	.82	.44	.12	1.92	15	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	21	10	.65	1.89	.97	.64	.14	2.26	35	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	21	11	.60	1.36	.98	.76	.14	2.18	35	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	22	1	.45	1.48	.96	.24	1.03	62N	7	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	22	2	.62	1.48	.96	.24	1.02	62N	7	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	22	3	.66	1.48	.96	.24	1.00	61N	8	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	22	4	.72	1.60	1.01	.14	1.16	49N	21	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	22	5	.82	1.82	1.20	.14	1.20	49N	21	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	22	6*	.84	1.82	1.20	.12	1.00	45N	25	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	22	6	.44	1.52	.82	.12		45N	25	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	22	6	.74	1.70	1.21	.12		45N	25	D	25	.60	1.82	1.21	1.22	.24	1.30	58N	11
D	22	7	.42	1.62	1.02	.24		40N	30	D	26	.40	.52	.46	.12	.33	67N	11	
D	22	8	.50	1.78	1.14	.24		40N	30	D	26	.40	.52	.46	.12	.33	67N	11	
D	22	8*	.58	1.62	1.10	.14		40N	30	D	26	.40	.52	.46	.12	.33	67N	11	
D	22	9				.14	2.07	38N	32	D	26	.40	.52	.46	.12	.33	67N	11	
D	22	10				.12	1.86	38N	32	D	26	.40	.52	.46	.12	.33	67N	11	

*Camera "lock" action triggered a development level change within this frame. Density measurements within these areas, therefore, are not included in the summary averages of this report.

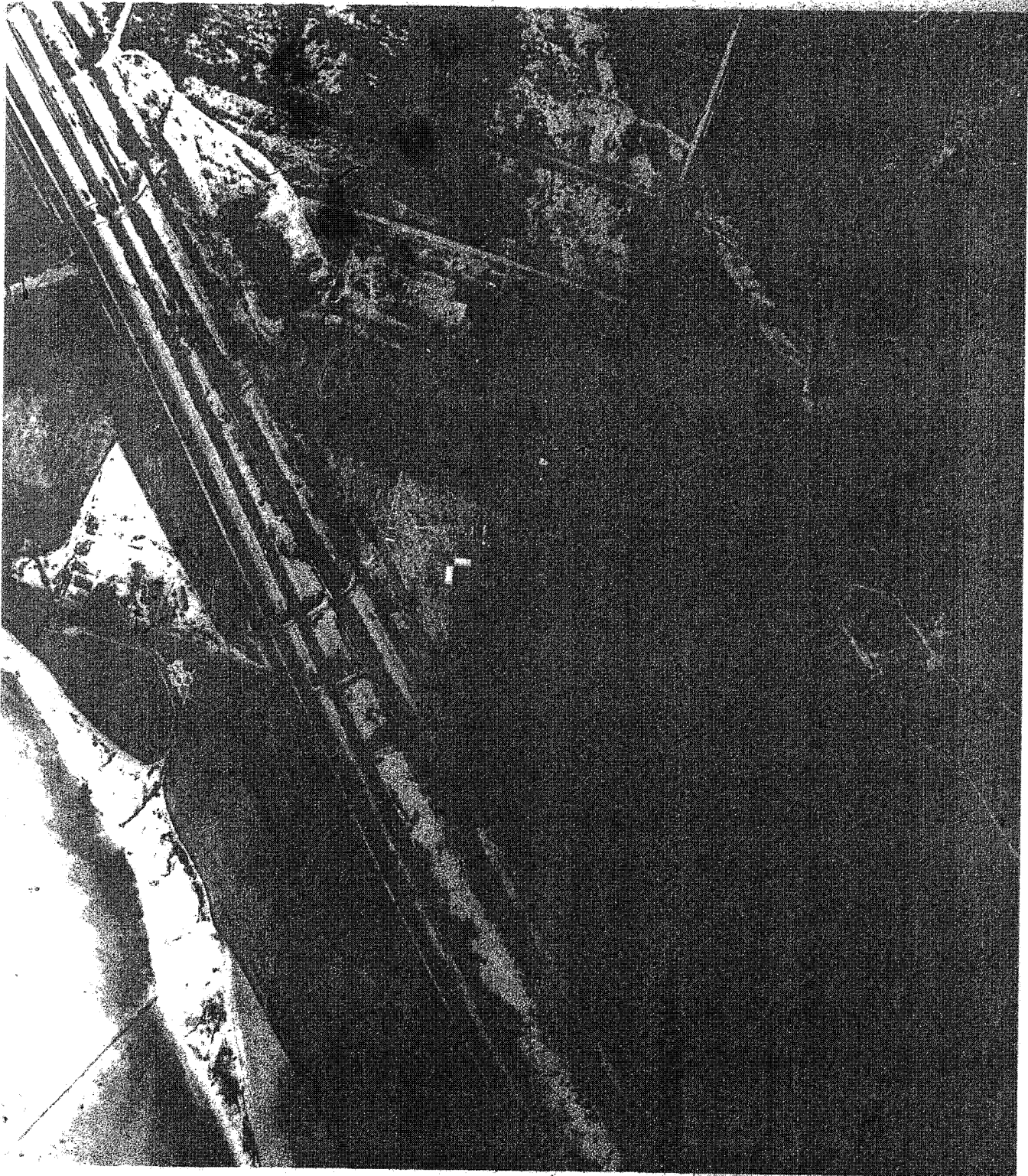
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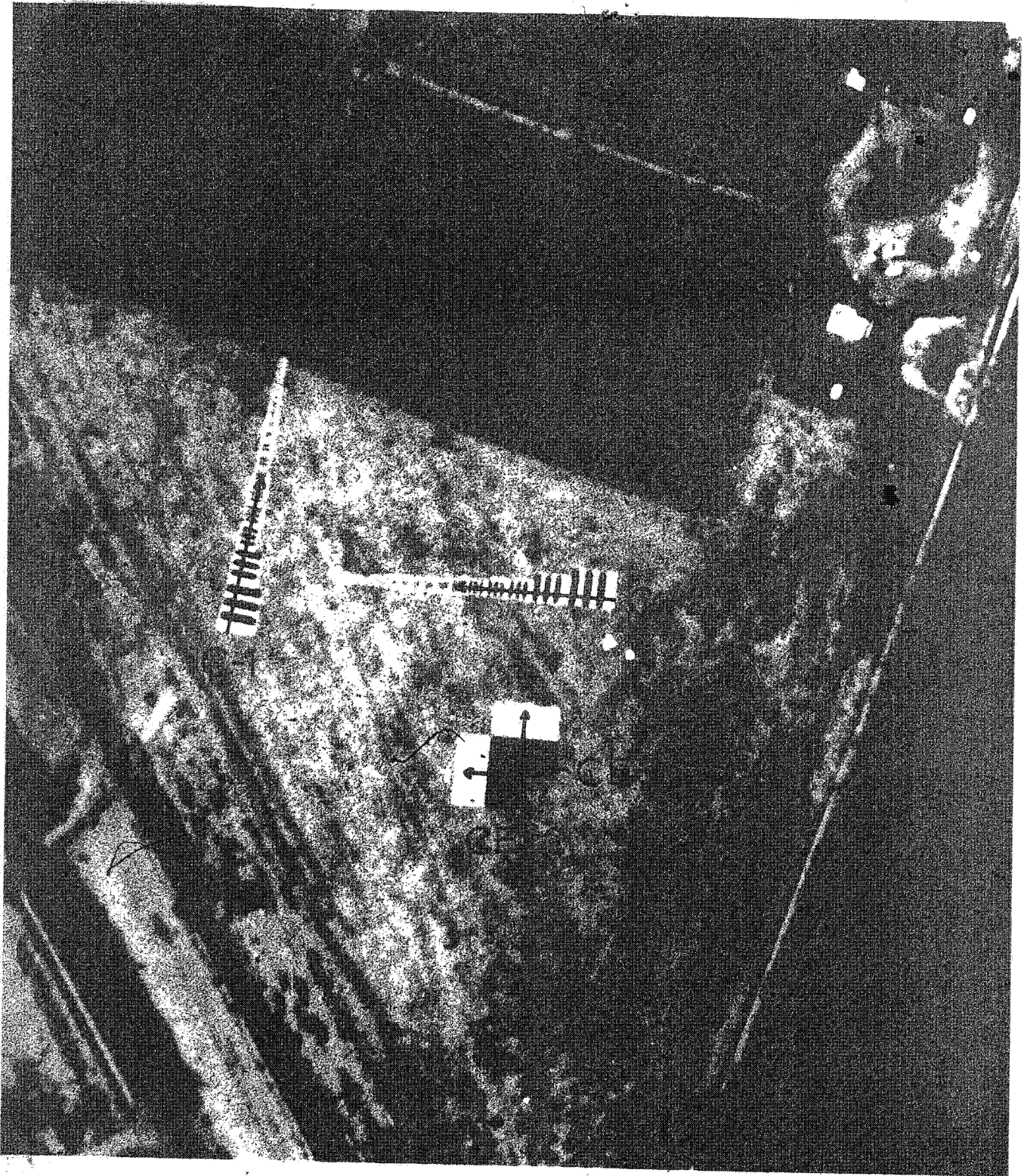


MISSION 4015 _ REV D32 FRAME 006
10 DIA ENLG D 1,34 / SUN ANGLE 38° LAT 32°
GROUND RESOLUTION W 7'11/2" A 6'41/8"

APPENDIX 6

~~TOP SECRET - GAMBIT~~

6-1



MISSION 4015 REV D32 FRAME 006
 0 DIA ENLG D 1.34 SUN ANGLE 38° LAT 32°
 ROUND RESOLUTION W 7'11/2" A 8'41/8"

~~TOP SECRET - GAMBIT~~

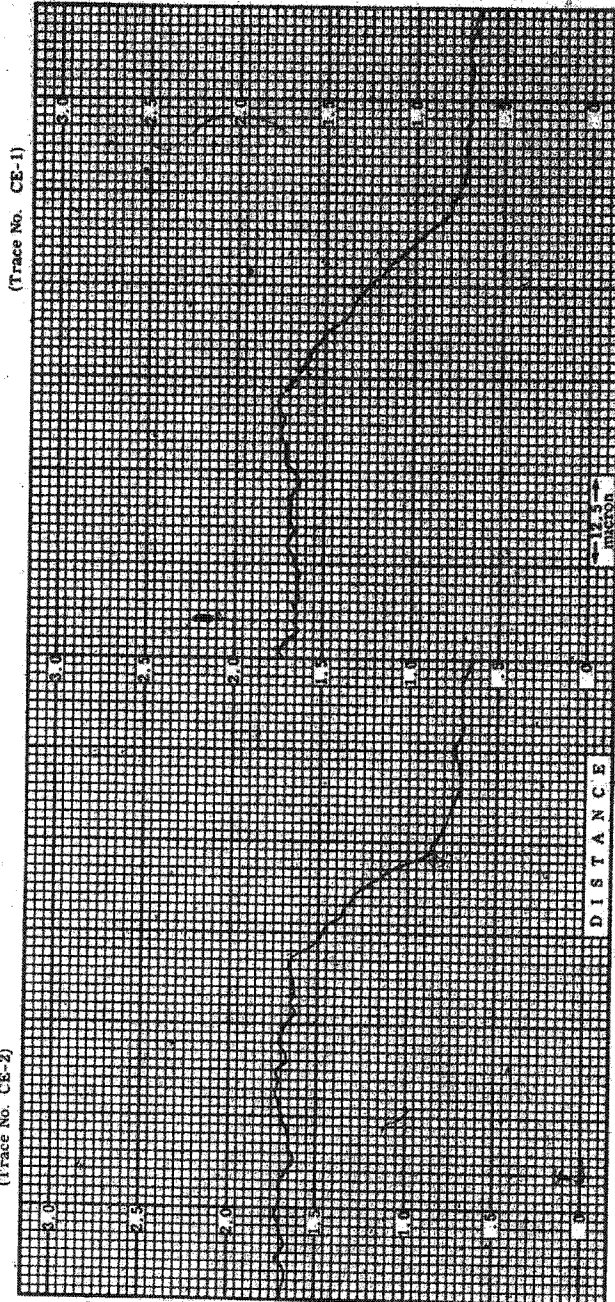
BCS 39704-65

~~TOP SECRET - GAMBIT~~

Handle via Byeman
Controls Only

SPPL TECHNICAL REPORT NO. 101-1-43

MANN-DATA MICRO-ANALYZER TRACE



REV DM FRAME 006 SLIT SIZE 1/4 x 5/8

MA SCAN SPEED 0.05 mm/min. CHART SPEED 4"/min.

Handle via Byeman
Controls Only

~~TOP SECRET - GAMBIT~~

BCS 39704-65

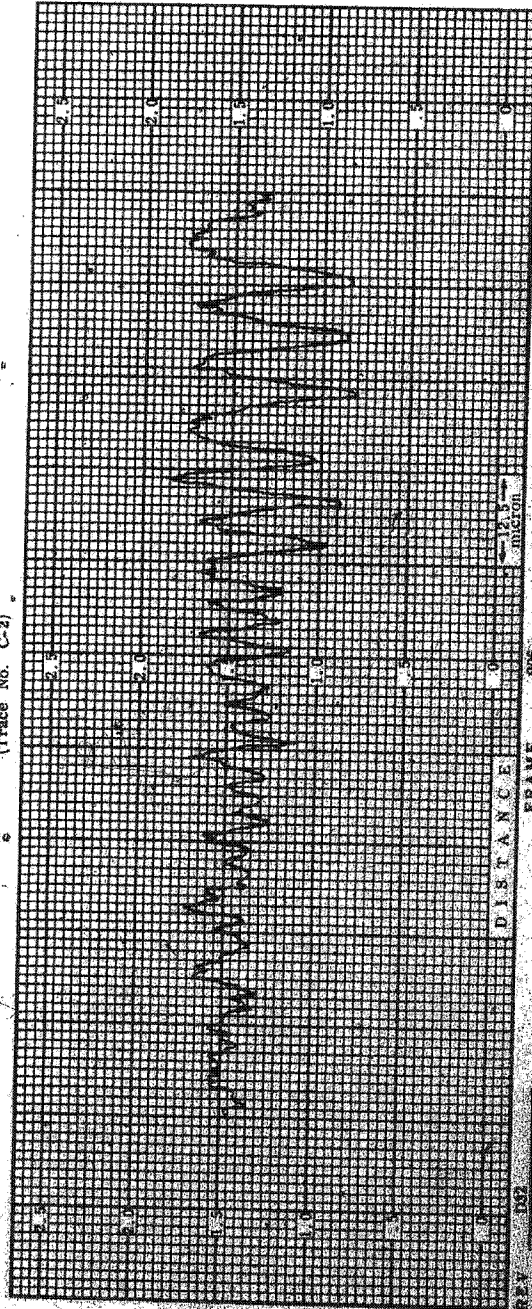
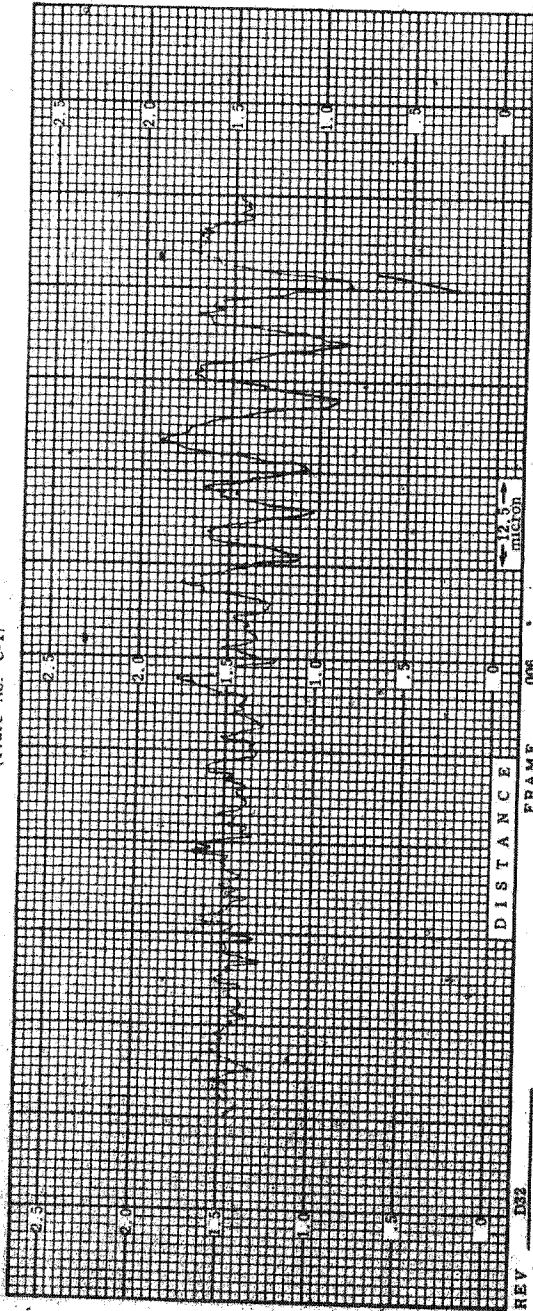
~~TOP SECRET - GAMBIT~~

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Controls Only

SPPL TECHNICAL REPORT NO. 101-1-43

MANN-DATA MICRO-ANALYZER TRACE

(Trace No. C-1)



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~~TOP SECRET - GAMBIT~~

SPPL TECHNICAL REPORT NO. 101-1-43

SITE MANNING REPORT

LOCATION Tucson, Arizona VGT TYPE Med. Contr. "T" Edge OPERATOR Engleman, DATE 1/22/65
 J. B. FISBECK, J. C. FISBECK CALIBRATED 100 1/24/65 JE

Local Time	Temp. F°	Bar. Pr. In Hg.	Wind		% Rel. Hum.	Cnd. Haze	Est. Cloud Cover and Pts.	TARGET BRIGHTNESS IN FOOT LAMBERTS					
			MPH	DIR				NH. Std. 120 A			Yn-Color		
M. S. T.								Disc.	Black	White	Red	Yk%	Blue
10:00													
10:15													
10:30	72	30.18	2	SW	39%	Med.	0	1					
10:45	70		0			Med.							
11:00	70	30.18	6	W	37%	Med.	0	2					
11:15	72		3	W		Med.							
11:30	72	30.18	10	W	30%	Med.	0	3					
11:45	72		4	W		Med.							
12:00	72	30.17	5	NW	35%	Med.	0	4					
12:15	72		6	NW		Med.							
12:30	72	30.15	9	NW	34%	Med.	0	5					
12:45	72		4	NW		Med-Low							
13:00	72	30.15	4	NW	33%	Med-Low	0	6					
13:15	72		8	NW		Med-Low							
13:30	72	30.14	2	NW	32%	Med-Low	0	7					
13:45	72		7	NW		Med-Low							
14:00	73	30.13	2	NNW	31%	Med-Low	0	8					
14:15	72		5	NNW		Med-Low							
14:30	72	30.12	5	W	30%	Med-Low	0	9					
14:45													
15:00													
15:15													
15:30													
15:45													
16:00													
16:15													
16:30													
16:45													
17:00													
17:15													
17:30													
17:45													
18:00													

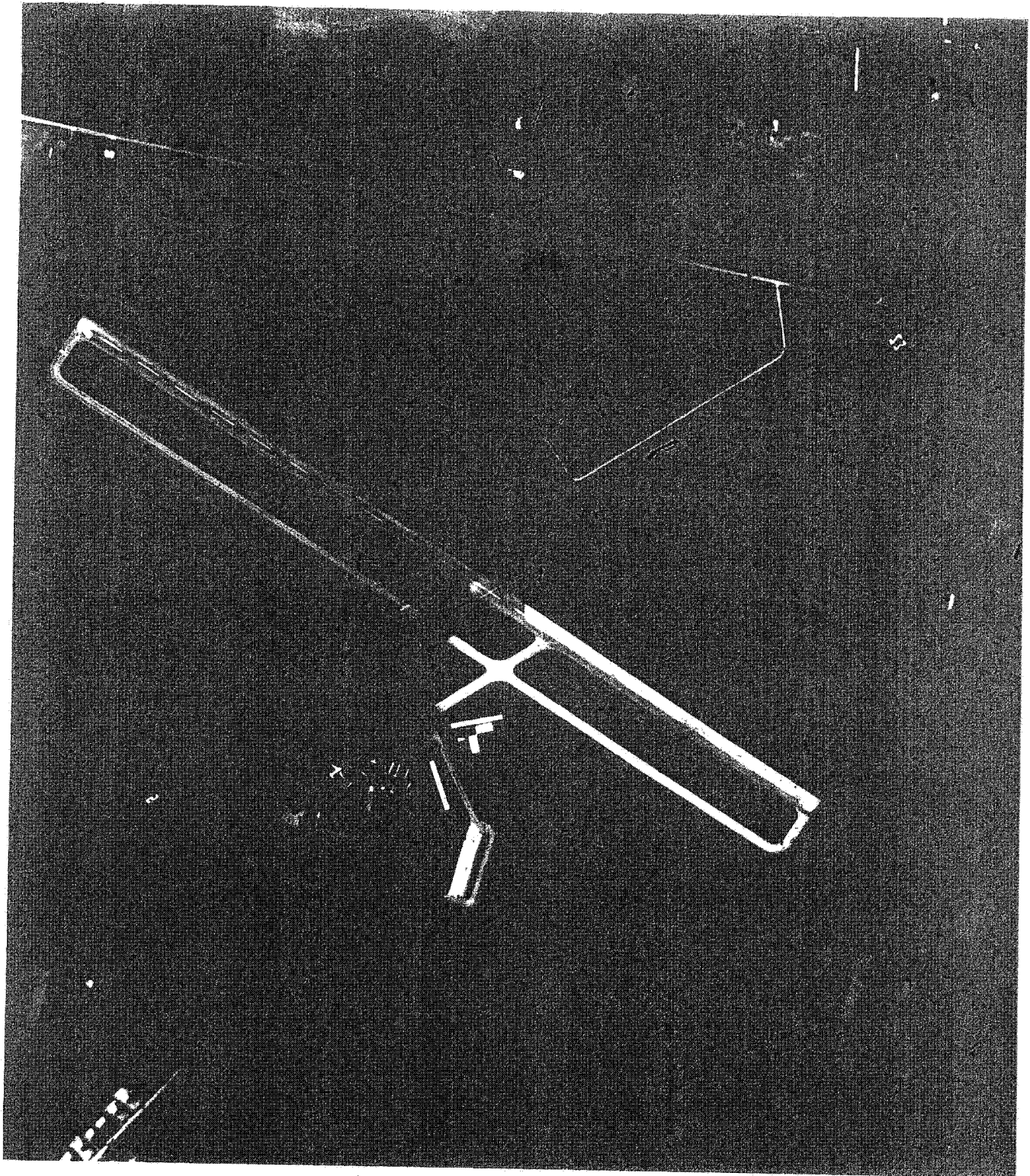
Local Time	TARGET BRIGHTNESS IN FOOT LAMBERTS										
	LOW CONTRAST "T"			HIGH CONTRAST "T"		EDGE ANALYSIS		FIXED/PERMANENT SITES			ADDITIONAL COLORS
	Disc	Black	Grey	Black	White	Black	Grey	Black	White	Grey	
10:00											
10:15											
10:30	5300	210	2000			230	1800				
10:45	5800	220	2200			250	2100				
11:00	6000	220	2400			260	2200				
11:15	6200	260	2400			260	2200				
11:30	6600	240	2400			290	2300				
11:45	6600	250	2300			300	2300				
12:00	6900	260	2400			320	2400				
12:15	7100	260	2500			310	2400				
12:30	7100	260	2500			320	2500				
12:45	7100	310	2400			320	2400				
13:00	6800	310	2500			320	2400				
13:15	6900	310	2400			320	2400				
13:30	6900	310	2400			290	2400				
13:45	6800	280	2300			280	2300				
14:00	6500	300	2300			280	2300				
14:15	6300	230	2200			270	2200				
14:30	6000	260	2300			260	2100				
14:45											
15:00											
15:15											
15:30											
15:45											
16:00											
16:15											
16:30											
16:45											
17:00											
17:15											
17:30											
17:45											
18:00											

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~~TOP SECRET GAMBIT~~

TOP SECRET

SPECIAL TECHNICAL REPORT

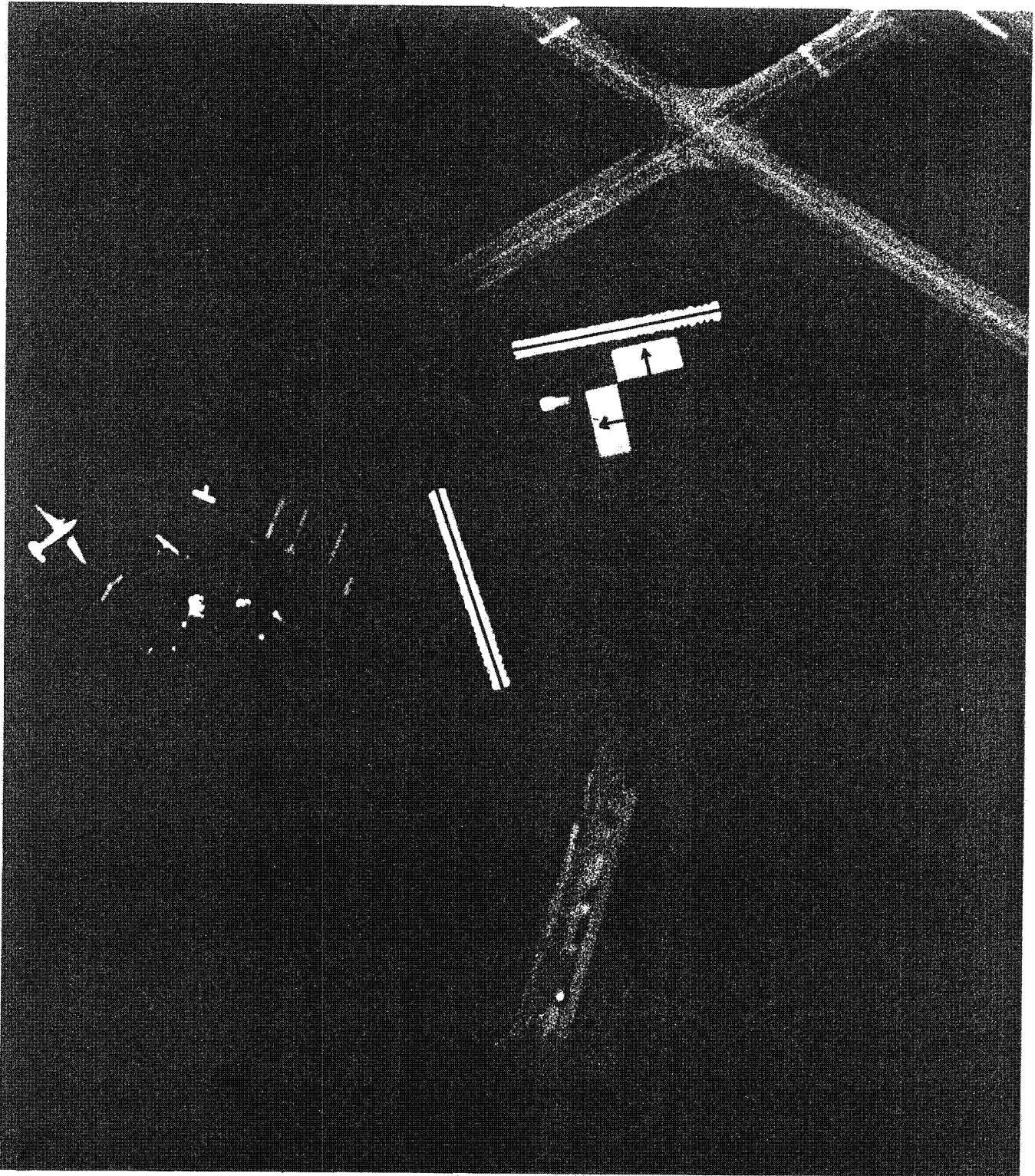


MISSION 4017 - REV. 001 - FRAME 001
10 DIA ENLARGED 70° SUN ANGLE 14° TILT
GROUND RESOLUTION 40 FT

~~TOP SECRET - DAMN~~

RCS 39704-65

SPPL TECHNICAL REPORT NO 101-1-43

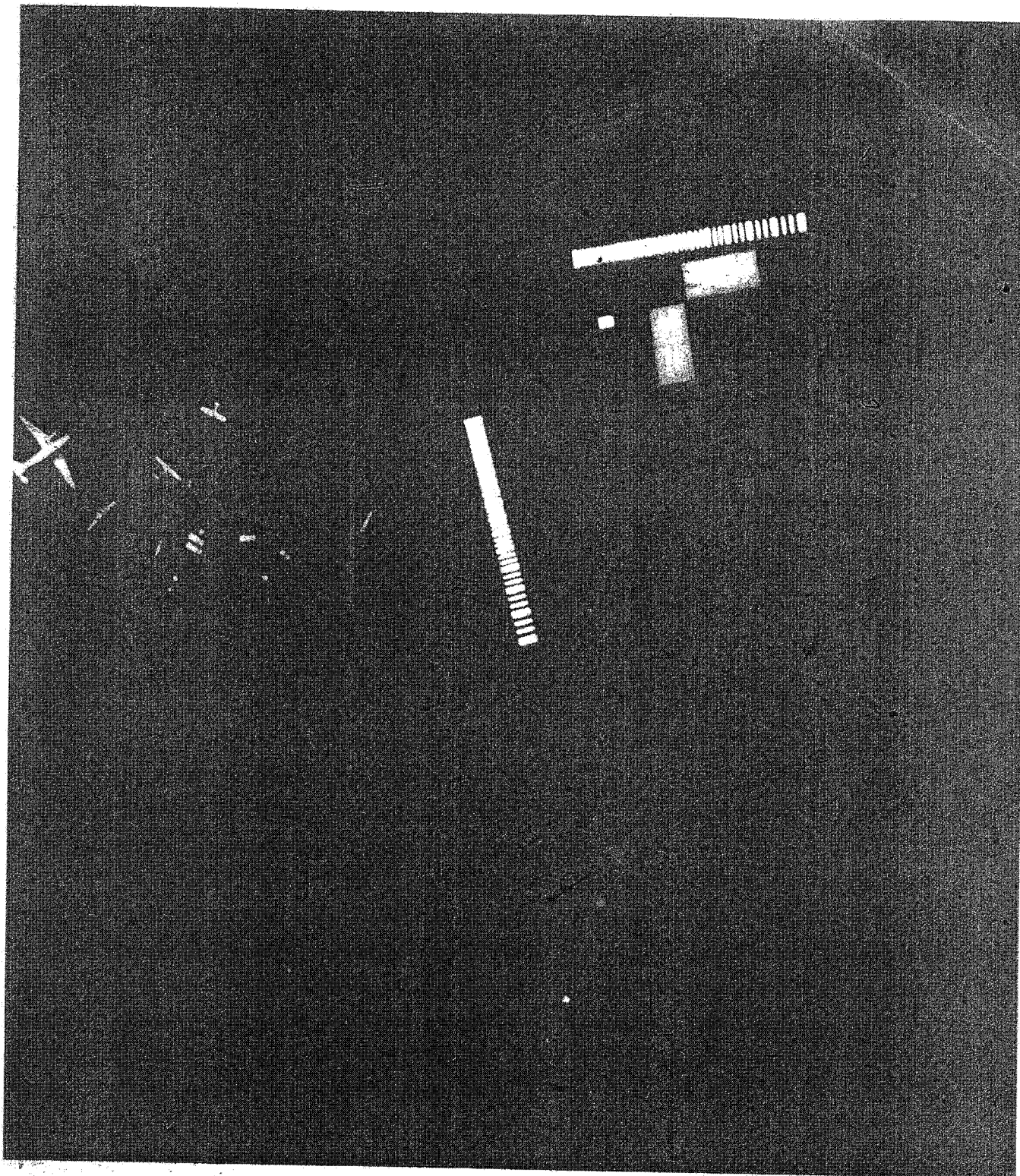


MISSION 4015 REV D31 FRAME 009
40 DIA ENLG D 1.88 SUN ANGLE 34 LAT 36
GROUND RESOLUTION W 8' A 8'

~~TOP SECRET - GAMBIT~~

6-7

SPPL TECHNICAL REPORT NO. 101-1-43



BLACKBIRD MSN, 25 JAN 1965, FRAME 015

10 DIA ENLG F/L 12" ALT 16,500'

GROUND RESOLUTION 2' 7" (AVG)

~~TOP SECRET - GAMBIT~~

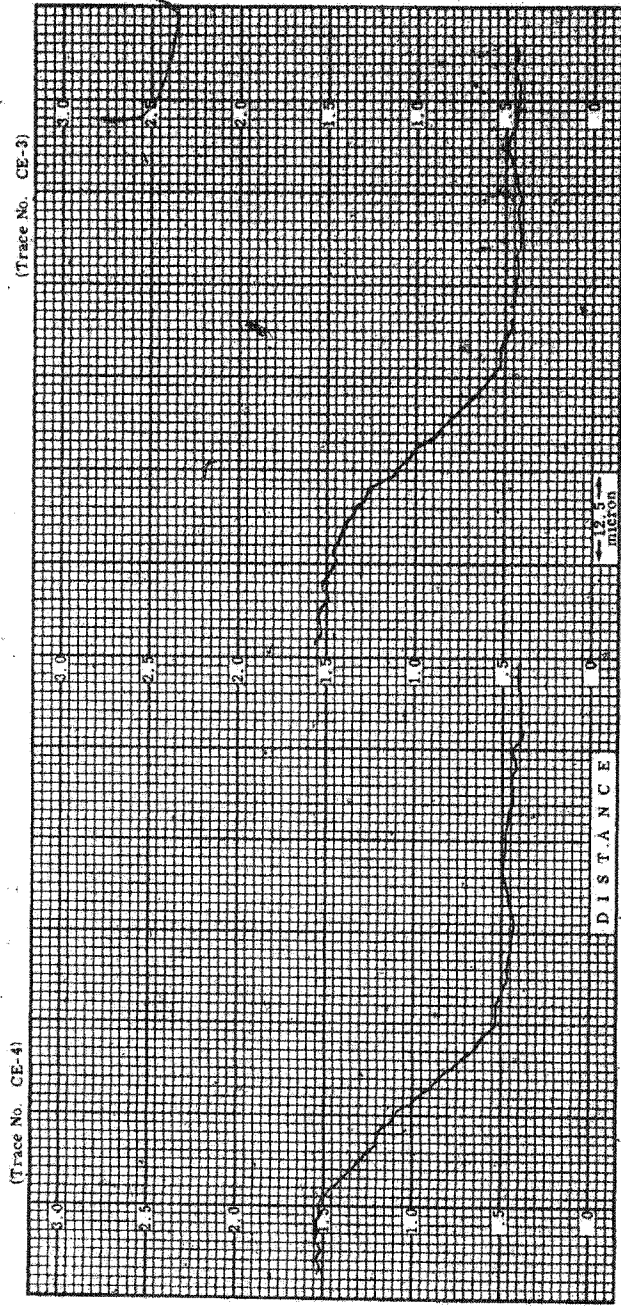
BCS 39704-85

~~TOP SECRET - GAMBIT~~

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SPPL TECHNICAL REPORT NO. 101-1-43

MANN-DATA MICRO-ANALYZER TRACE



REV DS1 FRAME 009 SLIT SIZE 14 x 80μ
 MA SCAN SPEED 0.05mm/min CHART SPEED 4"/min

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~~TOP SECRET - GAMBIT~~

BCS 39704-65

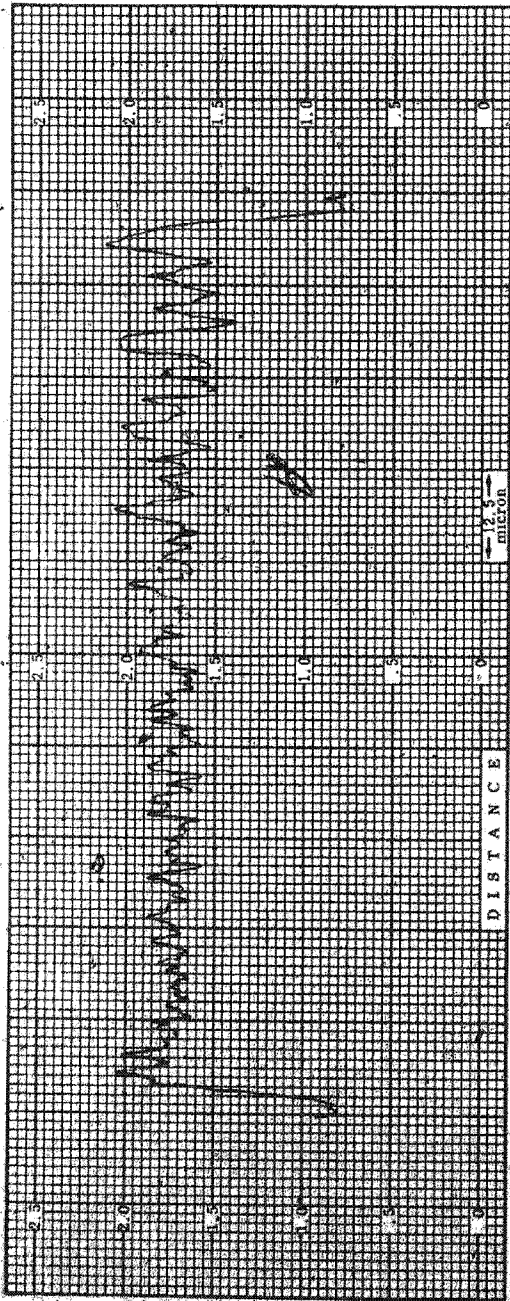
~~TOP SECRET - GAMBIT~~

Handle via Byeman
Controls Only

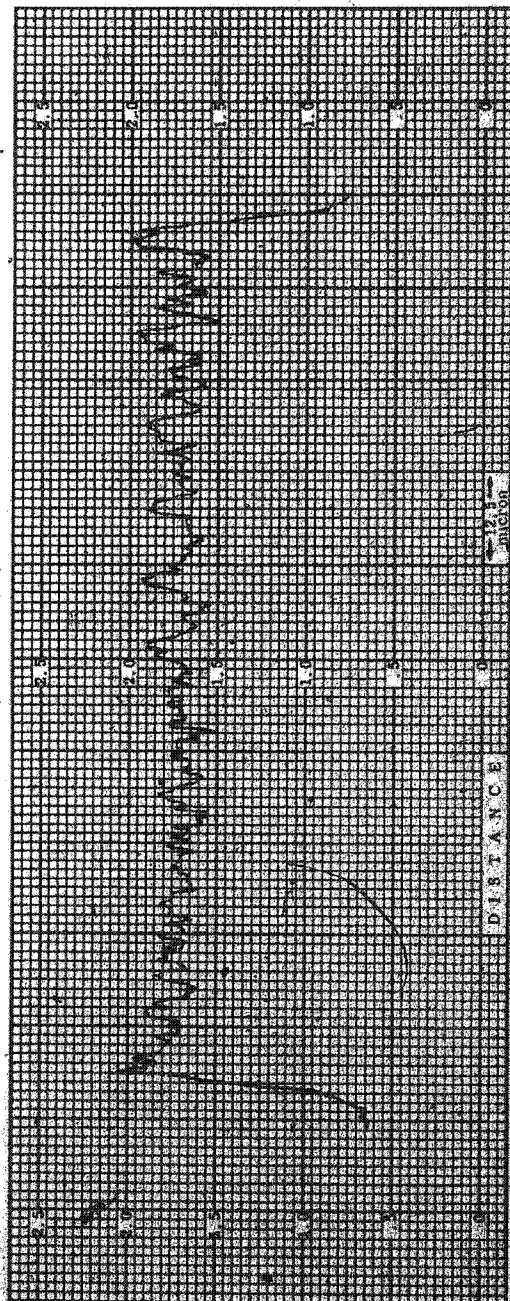
SPPL TECHNICAL REPORT NO. 101-1-43

MANN-DATA MICRO-ANALYZER TRACE

(Trace No. C-3)



(Trace No. C-4)



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~~TOP SECRET - GAMBIT~~

SPPL TECHNICAL REPORT NO. 101-1-43

LOCATION Outlaw Field Clarksville, Tenn. TGT TYPE Hi Cont. "T" & Edge OPERATOR Peterson/Newman DATE Jan 25, 1965
CALIBRATED Jan 23, 1965

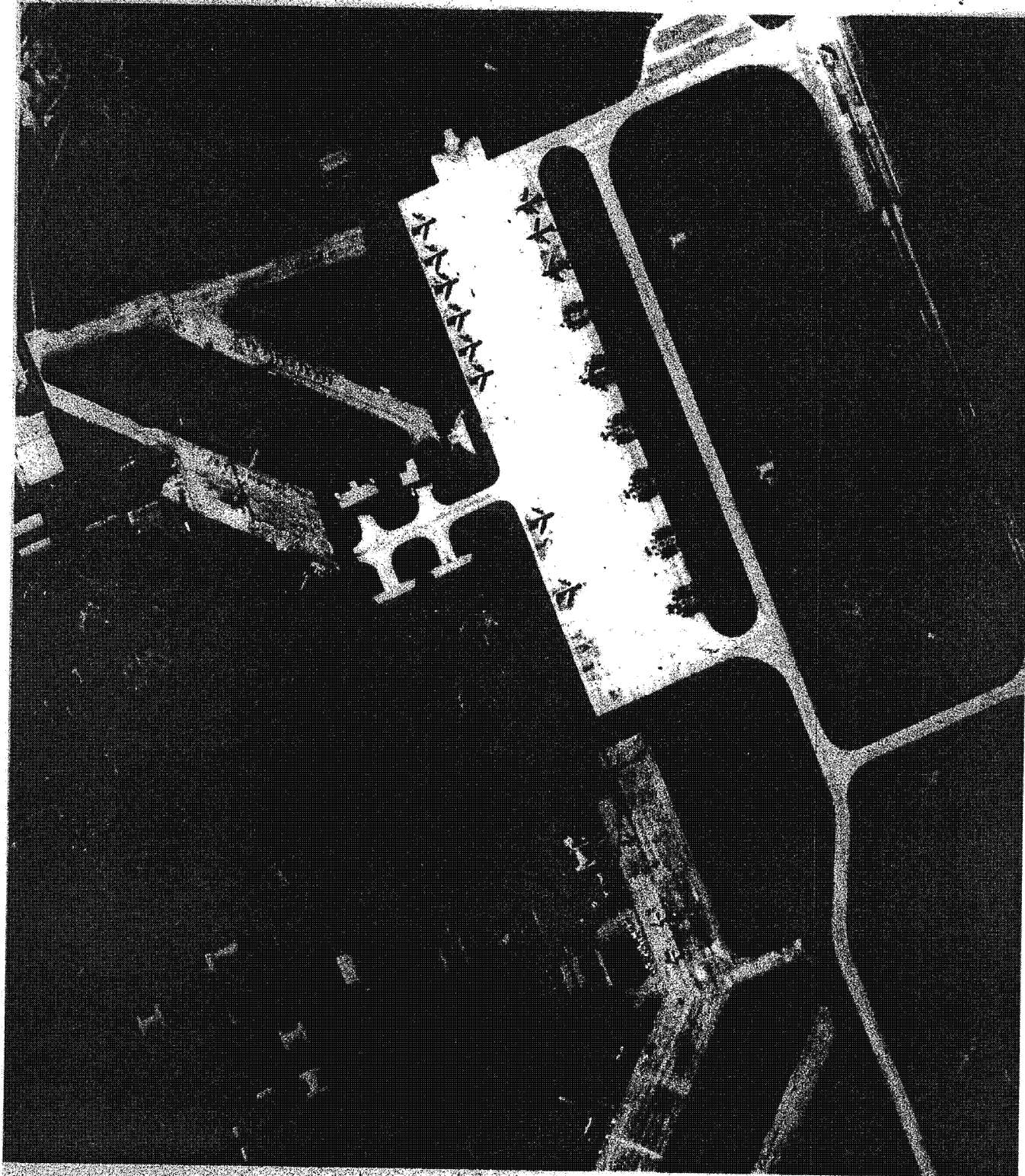
Local Time	Temp. F°	Bar. Pr. In Hg.	Wind		Rel. Hum.	Gnd. Haze	Est. Cloud Cover and Piz.	TARGET BRIGHTNESS IN FOOT LAMBERTS						
			MPH	DIR				MIL. STD. 150 A			Tri-Color			
								Disc.	Black	White	Red	White	Blue	
10:00	47	29.90	15G	S	65	L	0	1	5600			610	4700	380
10:15	46		13G	SSE		L		2	5700			640	4800	380
10:30	49	29.90	15G	S	60	L	0	3	8000			650	5000	350
10:45	51		15G	S		L			8100			680	5200	360
11:00	52	29.90	12G	SSW	61	L	0	4	5900			690	5200	380
11:15	53		17G	S		L			6600			750	5700	400
11:30	54	29.89	20G	S	50	L	0	5	5900			740	5900	400
11:45	55		15G	S		L			6800			730	6000	370
12:00	57	29.88	18G	S	45	L	0	6	8900			780	6200	440
12:15	58		19G	S		L			7000			780	6300	440
12:30	60	29.88	17G	SSW	42	L	0	7	6800			790	6200	440
12:45	61		17G	SSW		L			6500			780	6200	420
13:00	61	28.87	20G	S	41	L	0	8	6250			760	5300	410
13:15	62		19G	S		L			6000			740	5200	460
13:30	62	29.86	17G	S	42	L	0	9	5900			820	4900	400
13:45	62		12G	S		L			5800			630	4700	350
14:00	62	29.86	20G	SSW	44	L	0	10	5500			600	4500	310

Local Time	TARGET BRIGHTNESS IN FOOT LAMBERTS										
	LOW CONTRAST ***			HIGH CONTRAST ***		EDGE ANALYSIS		FIXED/PERMANENT SITES			ADDITIONAL COLORS
	Disc	Black	Grey	Black	White	Black	Grey	Black	White	Grey	
10:00				210	4700	200	2000				
10:15				200	4800	210	1900				
10:30				200	4950	180	1900				
10:45				205	5300	180	2000				
11:00				210	5100	180	2000				
11:15				220	5600	210	2300				
11:30				230	5800	230	2200				
11:45				240	6000	235	2350				
12:00				245	6200	240	2300				
12:15				250	6300	245	2350				
12:30				270	6200	260	2400				
12:45				270	6100	260	2350				
13:00				250	5800	250	2300				
13:15				245	5200	240	2100				
13:30				240	5000	230	2000				
13:45				220	4900	220	1900				
14:00				210	4600	210	1800				

BCS 39704-65

~~TOP SECRET - GAMBIF~~

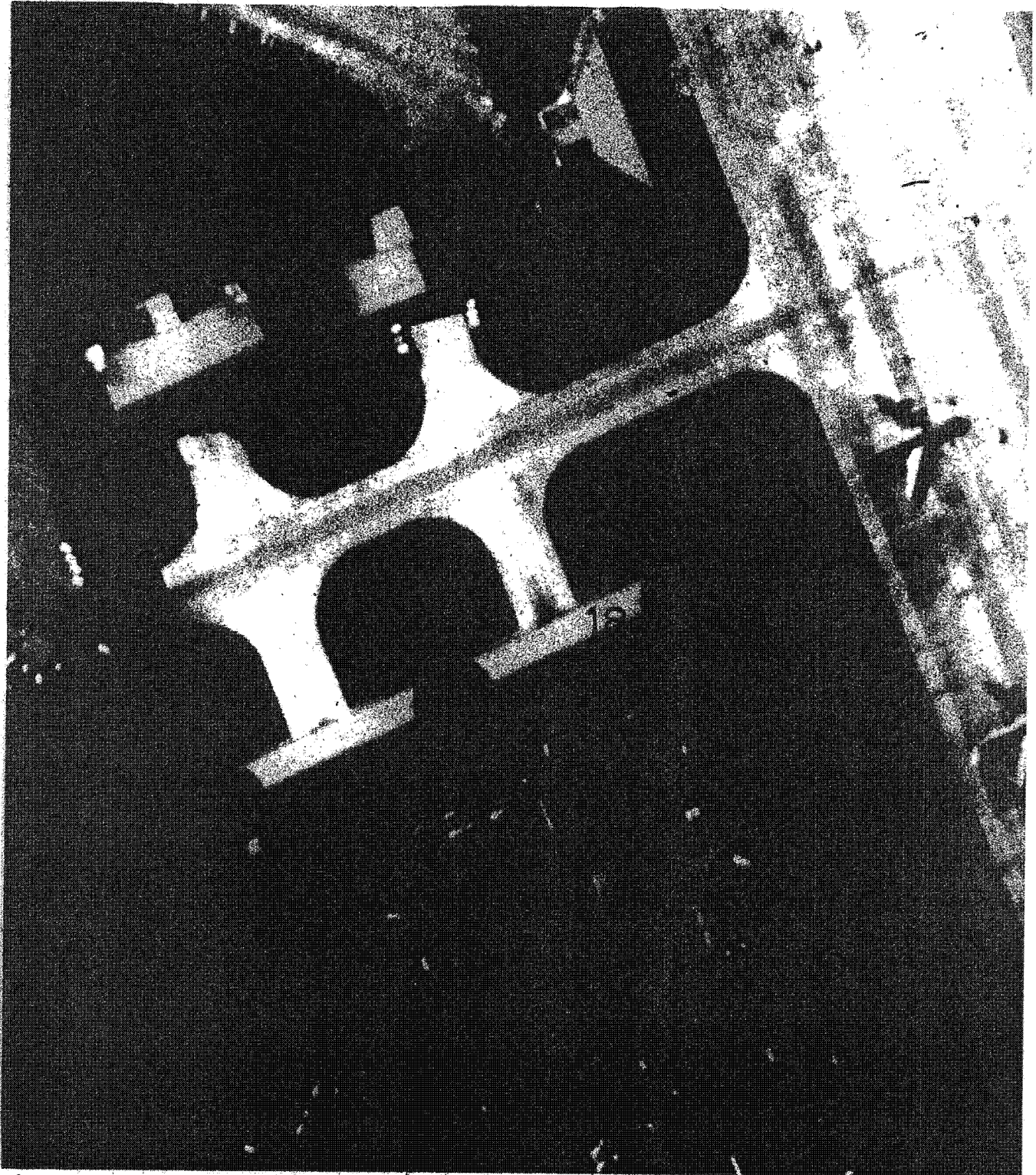
SPPL TECHNICAL REPORT NO. 101-1-43



MISSION 4015 REV-D31° FRAME 012
 10 DIA ENLG D .89 V-RES 082
 SUN ANGLE 37° LATITUDE 33°

6-12

~~TOP SECRET - GAMBIF~~



MISSION 4015 REV D31 FRAME 012
40 DIA ENLG D .89 V-RES 082
SUN ANGLE 37° LATITUDE 33°

~~TOP SECRET - GAMBIT~~

BCS 39704-65

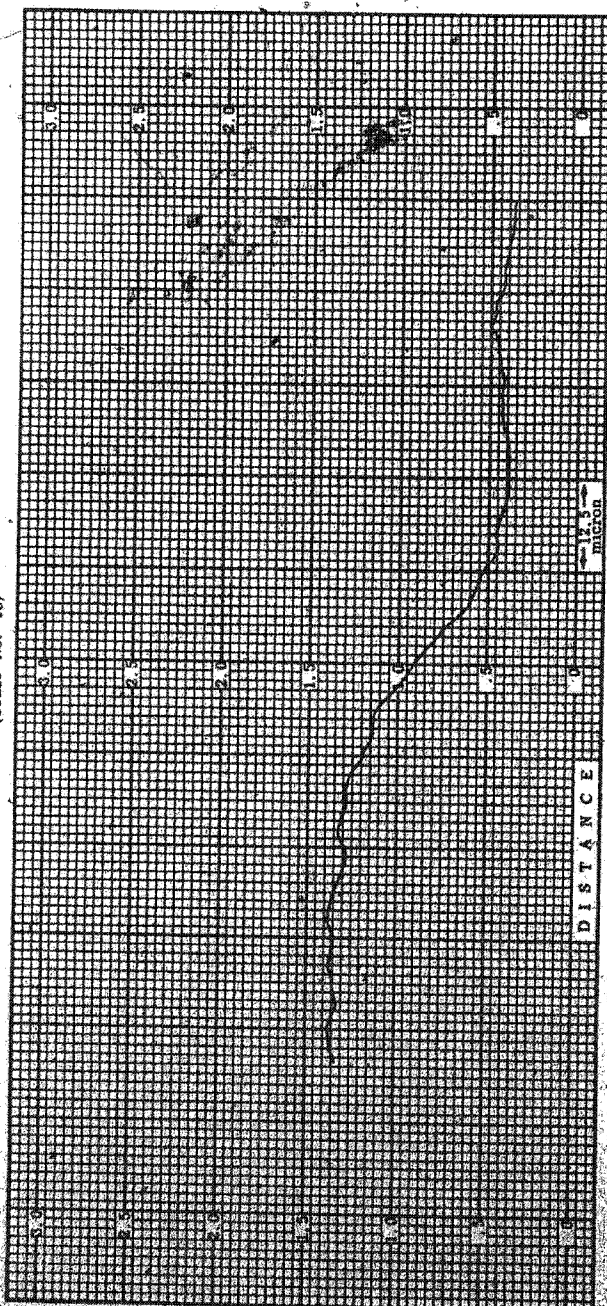
~~TOP SECRET - GAMBIT~~

Handle via Byeman
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SPPL TECHNICAL REPORT NO. 101-1-43

MANN-DATA MICRO-ANALYZER TRACE

(Trace No. 18)



REV 101

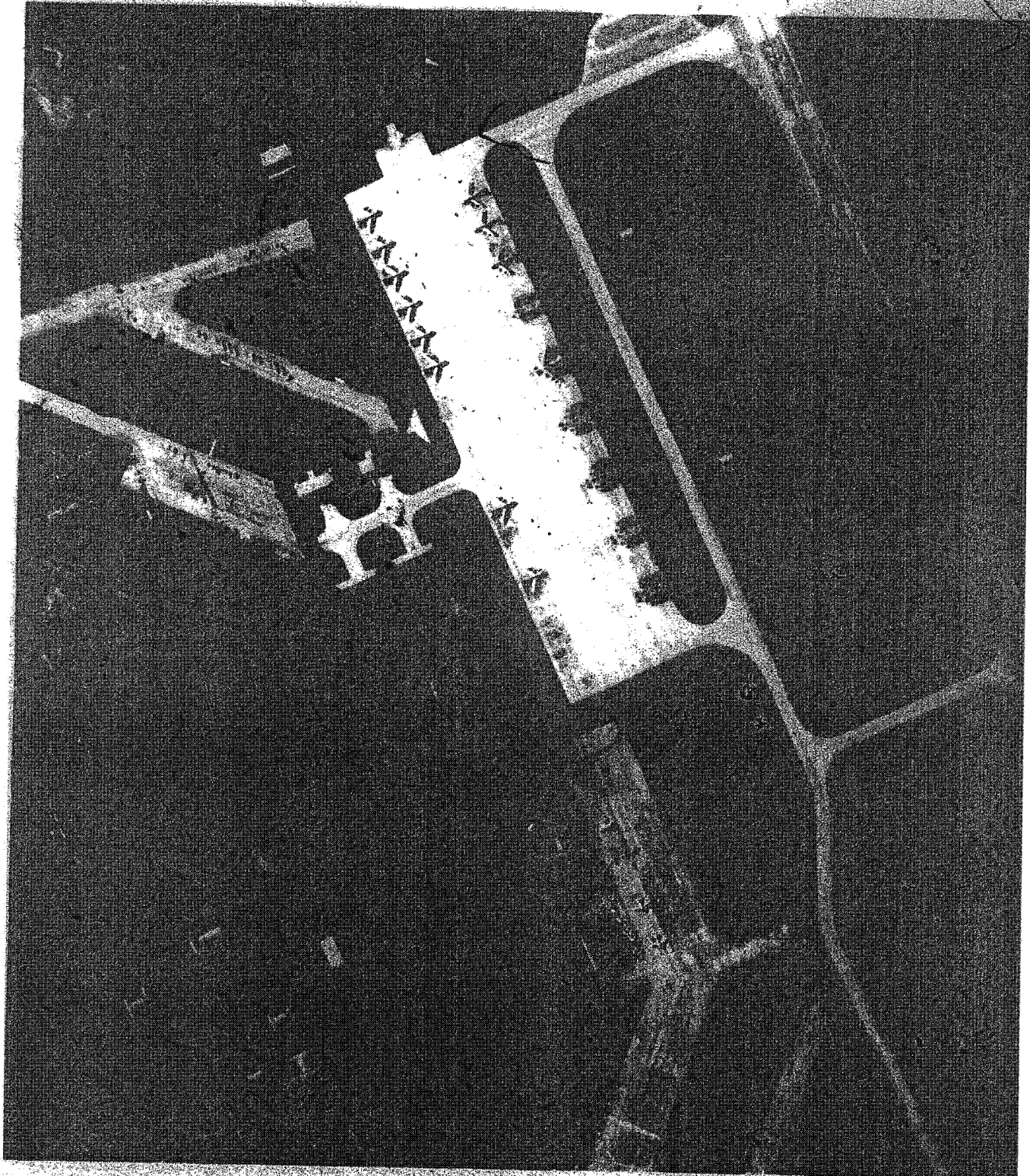
MA SCAN SPEED 0.05mm/min.

CHART SPEED 4"/min.

SLIT SIZE 14 x 80μ

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~~TOP SECRET - GAMBIT~~



MISSION 4015 REV D31 FRAME 011
10 DIA ENLG \bar{D} .86 V-RES 085
SUN ANGLE 37° LATITUDE 33°

~~TOP SECRET - GAMBIT~~

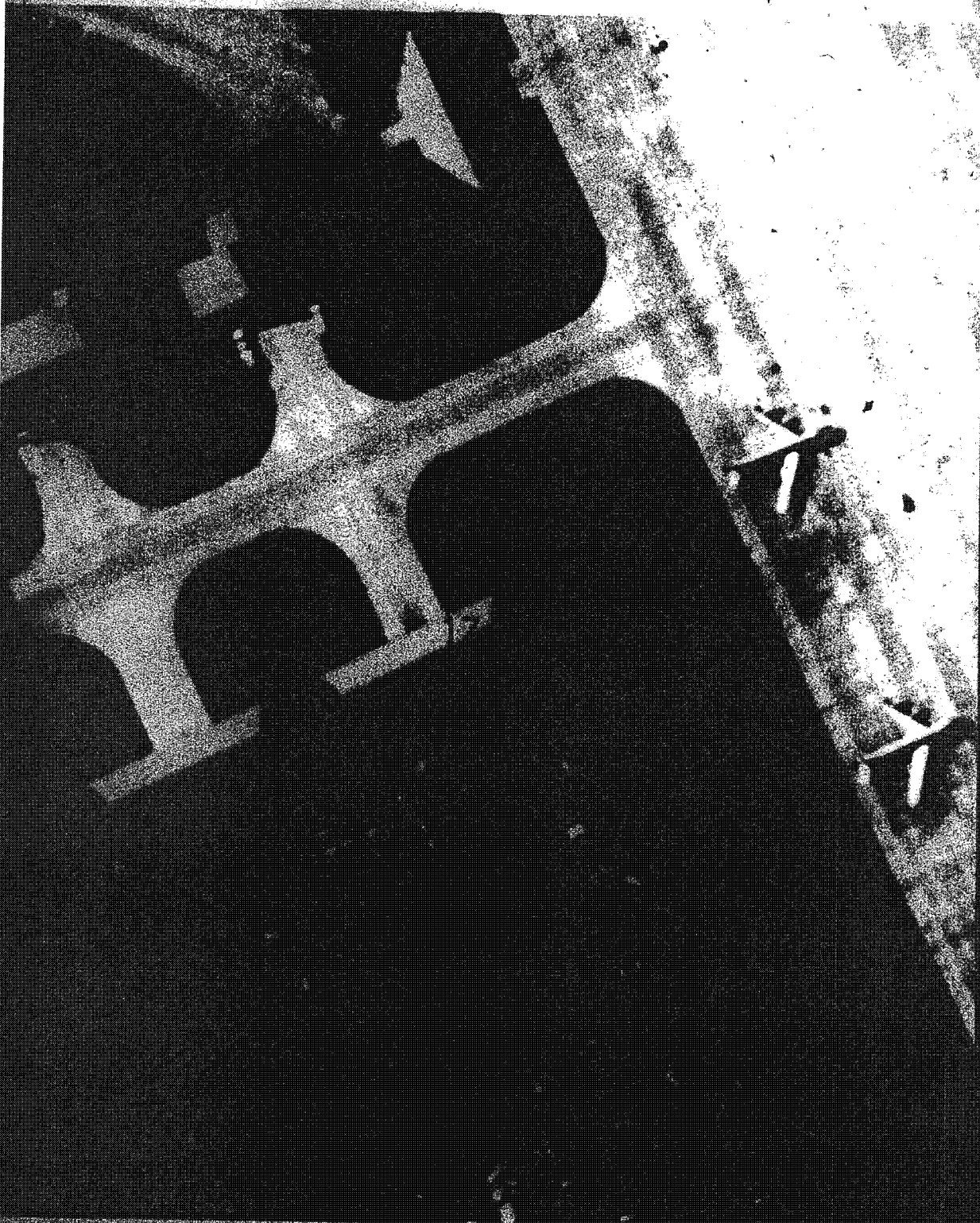
6-15

~~TOP SECRET - GAMBIT~~

ICAL REPORT NO. 101-1-43

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~~TOP SECRET - GAMBIT~~



REV 031 FRAME 011
D 36 V-RES 085
LATTITUDE 33°

~~TOP SECRET - GAMBIT~~

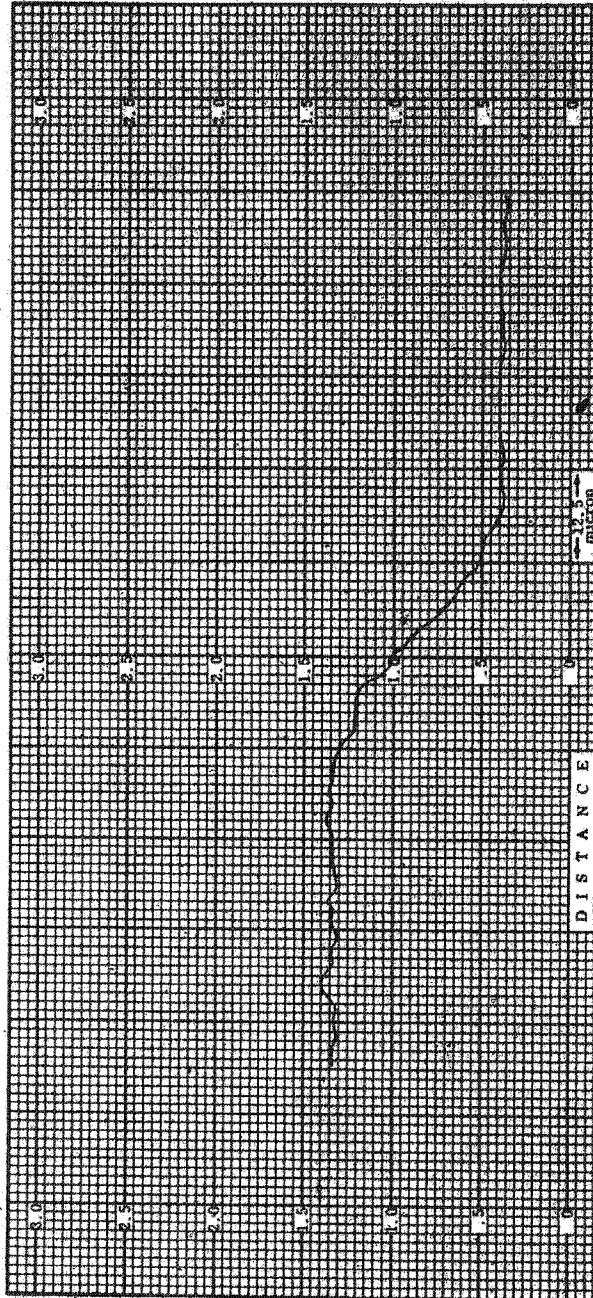
BCS 39704-05

~~TOP SECRET - GAMBIT~~

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SPPL TECHNICAL REPORT NO. 101-1-43

MANN-DATA MICRO-ANALYZER TRACE
(Trace No. 17)

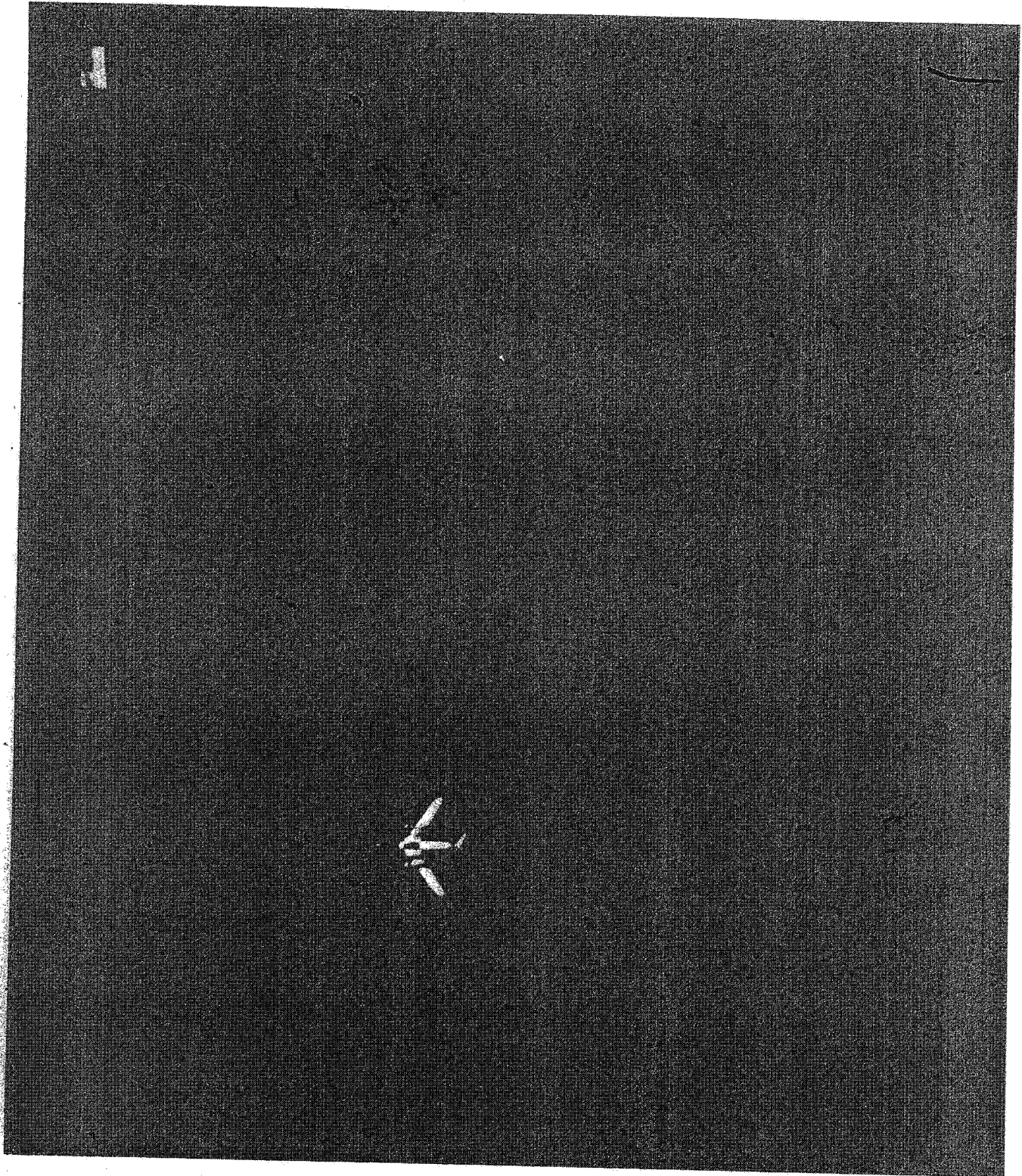


REV D31 FRAME 011 SLIT SIZE 14 x 80μ

MA SCAN SPEED 0.05mm/min. CHART SPEED 4"/min.

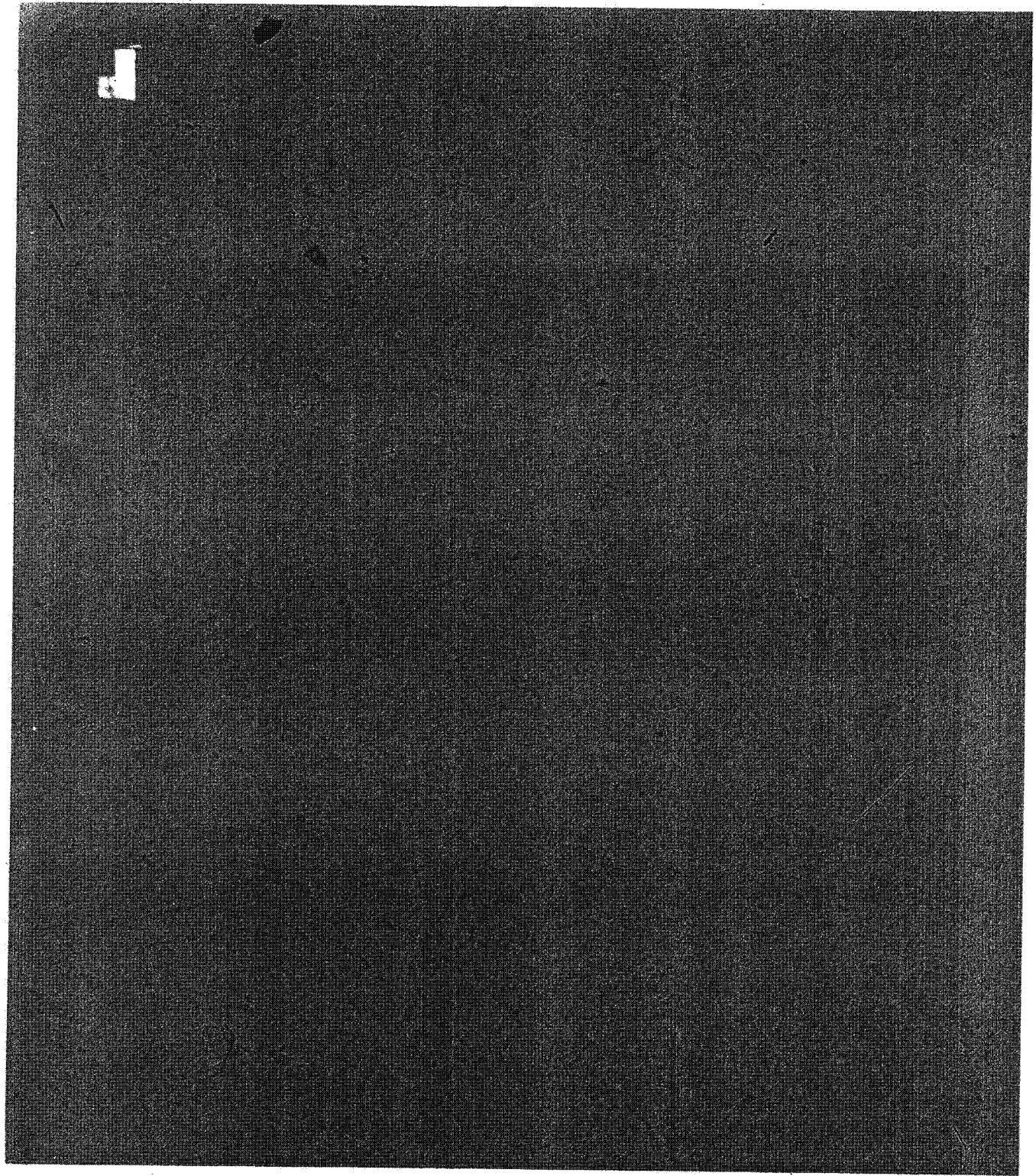
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Controls Only

SPPL TECHNICAL REPORT NO. 101-1-43



MISSION 4015 _ REV D31 FRAME 009
40 DIA ENLG D 1.88 SUN ANGLE 34° LAT 36°
BLACKBIRD AIRCRAFT IN FLIGHT

SPPL TECHNICAL REPORT NO. 101-1-43



BLACKBIRD MSN, 25 JAN 1965, FRAME 009
10 DIA ENLG F/L 12" ALT 16,500'
COINCIDENTAL COVERAGE OF
SATELLITE CAMERA

~~TOP SECRET GAMBIT~~

6-19

BCS 39704-65

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SPPL TECHNICAL REPORT NO. 101-1-43

TABLE 6 - EDGE SCAN DATA

Mission Data			MTT, AIM	Spread Function Width at 50% Amplitude		Machine RES	V-RES	Density		Subject	Crtd		Orientation
Trace Nr.	Rev Nr.	Frame Nr.		Microns	Reciprocal			Dmin	Dmax		Index No.	X	
1	D05	007	76	10.3	97	85	0.91	2.09	Building	013	44.2	12.1	112°
2	D05	008	69	13.6	73	85	0.96	2.07	Building	015	47.3	8.6	106°
3	D06	004	45	14.3	70	85	1.05	1.84	Building	007	58.6	3.3	99°
4	D07	005	68	11.3	89	94	0.81	1.83	Building	008	64.7	12.5	108°
5	D07	006	58	15.6	64	82	0.36	1.06	Building	010	68.5	7.4	110°
6	D08	003	72	10.8	92	74	0.65	1.45	Building	006	48.6	12.4	106°
7	D08	004	60	13.8	73	104	0.59	1.41	Building	007	29.8	8.2	99°
8	D14	001	50	15.2	66	89	0.55	1.50	Building	001	29.3	14.5	54°
9	D14	002	60	16.0	63	55	0.64	1.41	Building	003	28.0	9.6	63°
10	D14	003	80	12.2	82	111	0.72	1.78	Pier	006	55.3	10.3	101°
11	D22	007	62	14.9	67	72	0.61	1.56	Building	020	32.9	15.8	105°
12	D22	008	49	19.3	52	82	0.70	1.62	Building	022	35.0	11.0	114°
13	D22	007	47	21.8	46	75	0.86	1.54	Building	020	37.6	12.6	120°
14	D22	008	47	16.4	61	87	0.99	1.53	Building	022	40.2	7.7	127°
15	D31	007	53	18.3	55	90	0.44	1.63	Building	014	85.3	12.5	88°
16	D31	008	51	12.0	83	94	0.50	1.48	Building	016	67.0	7.8	57°
17*	D31	011	38	18.1	52	72	0.47	1.35	Building	021	28.9	9.3	154°
18*	D31	012	36	29.7	34	85	0.39	1.31	Building	024	57.5	4.2	153°
19	D41	001	45	21.8	46	82	0.70	1.81	Building	002	55.5	11.5	103°
20	D41	004	40	25.3	40	90	0.90	1.83	Building	007	42.9	9.3	144°
21	D41	005	42	18.1	62	78	0.87	1.64	Building	008	44.5	5.4	140°
22	D42	013	28	35.8	28	63	0.34	1.83	Building	033	42.4	2.2	116°
23	D46	001	48	19.9	50	90	0.76	1.79	Building	001	33.7	9.8	81°
24	D15	008	47	19.5	51	85	0.50	1.73	Building	016	38.3	3.3	93°
25	D15	009	48	17.5	57	85	0.61	1.69	Building	014	44.7	8.7	89°
27	D54	012	34	22.3	43	63	0.75	1.20	Building	043	44.9	20.3	112°
28	D54	013	38	22.8	44	94	0.82	1.39	Building	045	55.9	16.2	112°
29	D54	012	27	28.4	35	52	0.50	1.17	Building	043	41.2	9.6	137°
30	D54	013	39	21.0	48	72	0.85	1.18	Building	045	51.8	5.5	127°
CE-2-a	D33	006	61	16.8	60	41	0.71	1.66	CORN	012	59.6	14.5	95°
CE-1-a	D33	006	42	24.1	41	42	0.70	1.75	CORN	012	59.6	14.5	4°
CE-2-b	D31	009	45	23.5	43	33	0.44	1.54	CORN	017	25.4	21.2	77°
CE-3-a	D31	009	48	21.7	46	40	0.43	1.55	CORN	017	25.4	21.2	168°
AVERAGE			50	18.8	58	84	0.86	1.57					

Photographic Enlargements (10X and 40X), and Main-Data Micro-Analyzer Traces are shown in Appendix 6, pages 6-1 through 6-17.
*Edges Traced on Controlled Scene Brightness Target (CORN)

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SPPL TECHNICAL REPORT NO. 101-1-43

Analysis of Photographic Image
to Evaluate System Performance
Mission 4015

APPENDIX 8

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SPPL TECHNICAL REPORT NO. 101-1-43

TITLE:

Summary of Microdensitometer Derived Image Quality Data Collected from Mission 4015

SECTION I: INTRODUCTION

Microdensitometer tracing of scene edges has been used as an objective technique for evaluating photographic system performance. In this report, the evaluation data is presented as spread function width in microns and resolving power in lines per millimeter. A statistical summary of the edge data for this mission is presented in Section II, giving the arithmetic mean, standard deviation, coefficient of dispersion, and number of edges. Section III is a summary of all "G" Missions that have been recomputed with the new SWRDR computer program. Image Quality Ranking of all "G" Missions is listed in Section IIIA. Frequency plots of the spread function and resolving power data are presented as Section IV, to show the distribution of values. A tabulation of the location, description, and image quality data for each edge is presented as Section V.

Appendix A is included to show the edge orientation reference system and edge location grid. In use, the film is placed on an illuminator with the titling correct reading (i.e. emulsion up) with the camera take-up end at the right and the supply at the left. The orientation of an edge is described as 000 for longitudinal and 090 for transverse edges; the numbering system runs in a clockwise direction. The coordinate locator grid consists of centimeter squares numbered such that the center of the index is given as X46.0, Y12.0. X numbers increase toward the take-up and Y numbers increase toward the title.

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8-2

SPPL TECHNICAL REPORT NO. 101-1-43

-2-

The image quality data was obtained from sharp scene edges in the original negative by scanning with a Kodak Model 5 microdensitometer. A 1 x 80 micron slit was used. The data reduction consisted of the following steps:

- (a) hand smoothing of the microdensitometer strip chart recording,
- (b) key punching of chart (density) values at sample distance increments of 0.420 microns,
- (c) I.B.M. 7044 computer conversion of chart values to relative exposure values, and
- (d) computer conversion of exposure data to line spread function and modulation transfer function by numerical methods.

The edge resolving power was predicted graphically as the intersection of the MTF curve and the aerial image modulation curve for 4404 film at a test object contrast of 2:1. The spread function width was calculated from the first differences of relative exposure as the width at which the gradient became 50% of the maximum gradient.

Each edge was traced three to five times on the microdensitometer, and the average of the computed spread function and resolution is presented in Section V.

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8-3

Analysis of Photographic Image to Evaluate System Performance

SECTION II SUMMARY SHEET

Mission 4015

Resolution in lines/mm based on the aerial image modulation - 4404 curve from edge trace data reduced by computer techniques.

Arithmetic Mean	70.8 1/mm
Standard Deviation	20.7 1/mm
Coefficient of Dispersion	29%
Number of Edges	26

Spread function width at 50% amplitude in microns from edge trace data reduced by computer techniques:

Arithmetic Mean	16.2 μ
Standard Deviation	6.1 μ
Coefficient of Dispersion	37%
Number of Edges	26

BCS 38704-65

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SPPL TECHNICAL REPORT NO. 101-1-43

Analysis of Photographic Image to Evaluate System Performance

SECTION III - MISSION 4015

Summary of all "G" Missions Traced and Computed
with the New SWRDR Computer Program

Mission Number.	Number of Edges	Spread Function Width at 50% Amplitude in Microns, Computer Calculations			Resolution in lines/mm from A.I.M. 4404 Curve, Computer Calculations		
		Arithmetic Mean	Standard Deviation	Coefficient of Dispersion	Arithmetic Mean	Standard Deviation	Coefficient of Dispersion
4010	25	25.4	9.0	36%	52.8	22.3	42%
4011	30	40.2	15.0	37%	31.7	9.7	31%
4014	11	10.4	1.0	10%	78.0	6.4	08%
4015	26	16.2	6.1	37%	70.8	20.7	29%

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Analysis of Photographic Image to Evaluate System Performance

SECTION IIIA - MISSION 4015

Image Quality Ranking of "G" Missions

Mission Number	Average Resolution in lines/mm for A.I.M. 4404 Curve
4014	78.0 1/mm
4015	70.8 1/mm
4010	52.8 1/mm
4011	31.7 1/mm

Note: Since this is a research and development effort, modifications and improvements are continually being made in the methods of collecting edge data and in the computer data reduction. The quality rating of current missions may have a slightly different basis than earlier missions, which could affect the quality ranking.

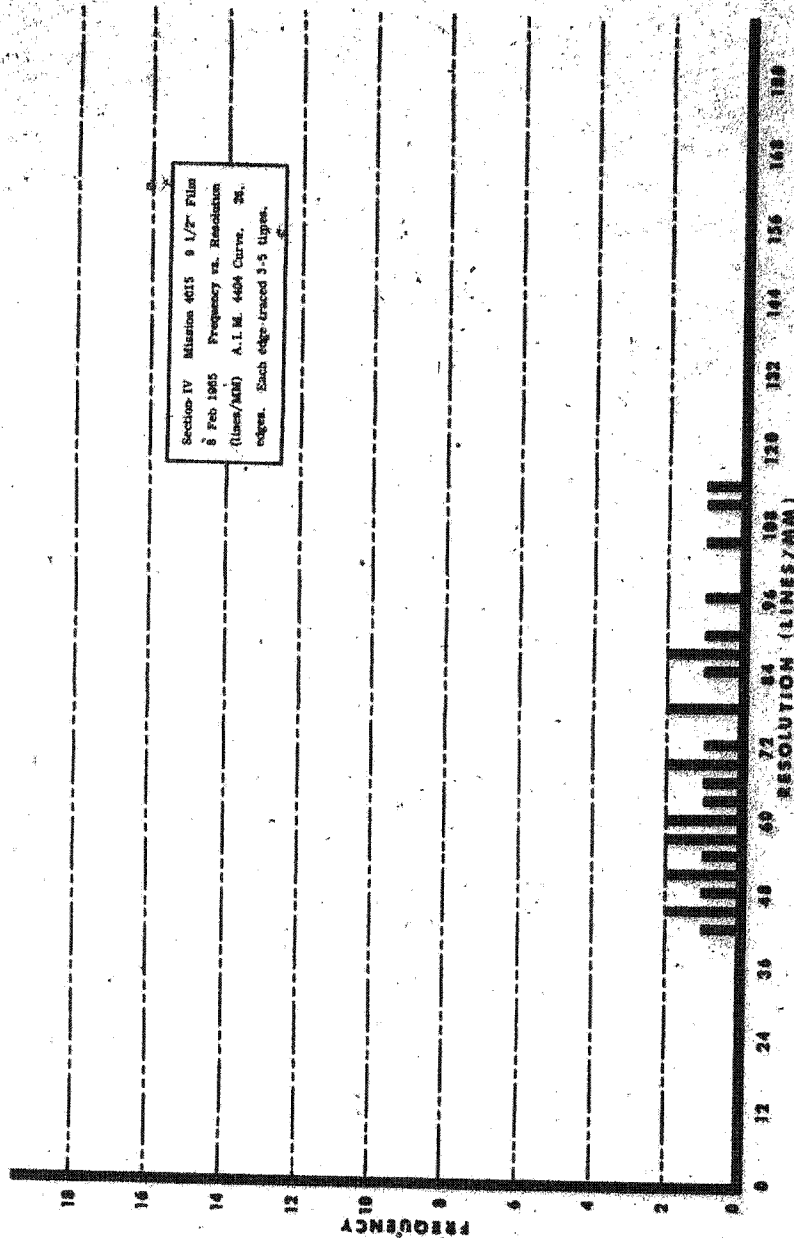
BCS 39704-05

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SECTION IV

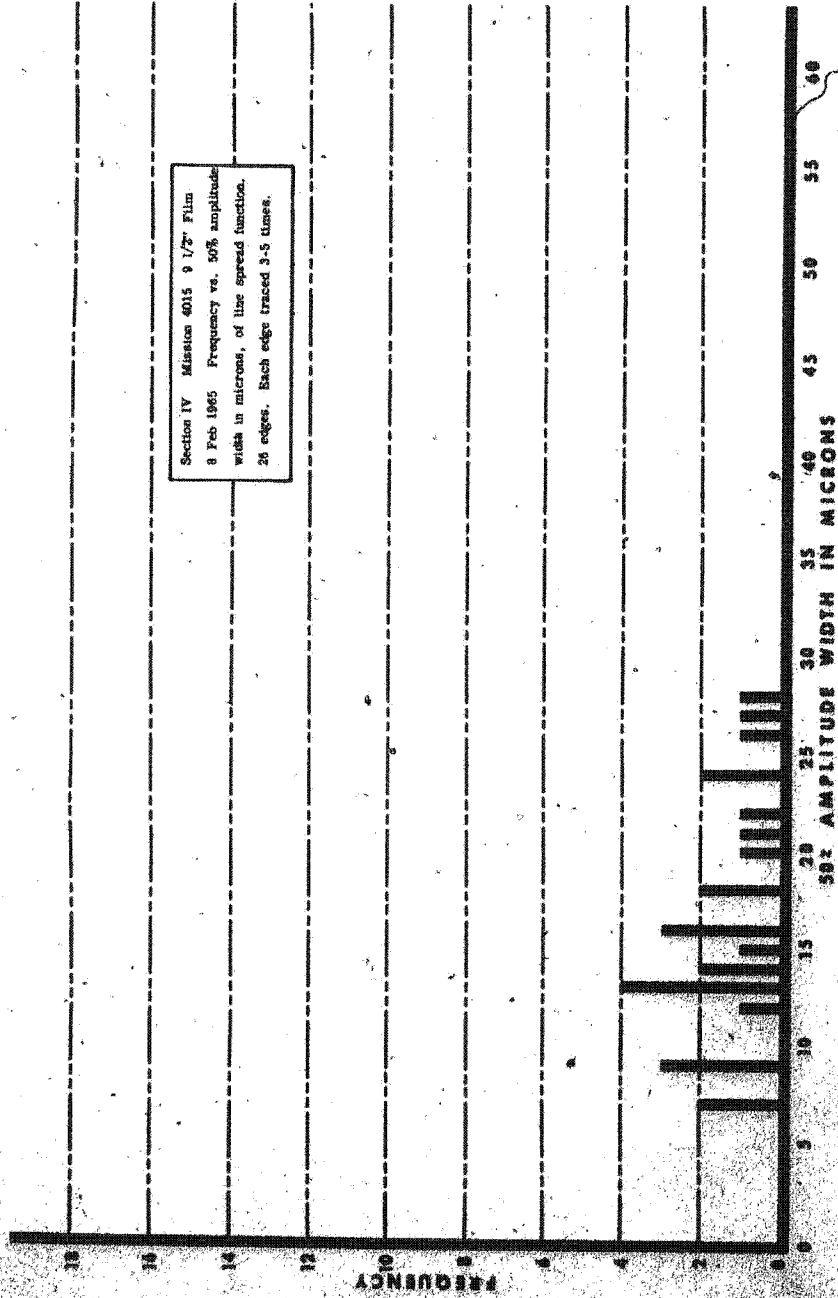


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Pass	Frame	Location	Index	Orientation	Subject	A. I. M. Resolution	Pass	Frame	Location	Index	Orientation	Subject	A. I. M. Resolution	SFS Amplitude Spread Function Width (microns)	A. I. M. Resolution
D-05	011	X46.7	Y17.3	081	Buildings	9.3	D-42	017	X46.0	Y30.0	044	Buildings	12.5	62	
D-08	013	X64.7	Y18.2	024	Buildings	6.9	D-43	013	X42.0	Y02.5	033	Buildings	22.6	61	
D-08	005	X50.3	Y21.3	009	Buildings	15.5	D-43	013	X44.5	Y06.5	035	Buildings	14.3	86	
D-07	006	X51.3	Y20.7	010	Buildings	7.2	D-48	003	X36.0	Y06.4	015	Buildings	24.7	45	
D-08	004	X53.0	Y08.2	008	Buildings	8.7	D-54	008	X58.5	Y05.5	028	Buildings	26.6	47	
D-14	001	X38.1	Y16.8	001	Buildings	9.1	D-58	015	X61.3	Y21.5	030	Buildings	17.8	50	
D-14	003	X37.5	Y07.8	006	Buildings	13.0	D-63	001	X58.2	Y17.3	002	Buildings	13.1	70	
D-15	008	X70.5	Y06.9	035	Buildings	22.0									
D-15	009	X67.6	Y08.0	017	Buildings	11.9									
D-22	007	X32.4	Y07.5	020	Buildings	20.1									
D-22	008	X32.5	Y03.7	022	Buildings	18.1									
D-31	006	X55.2	Y06.5	016	Buildings	15.1									
D-31	010	X44.6	Y04.8	020	Buildings	21.2									
D-31	011	X52.0	Y04.5	022	Buildings	28.0									
D-31	012	X57.6	Y03.6	024	Harbor	16.2									
D-32	007	X24.5	Y09.0	013	Buildings	14.0									
D-38	007	X41.1	Y06.2	014	Buildings	23.8									
D-42	015	X00.5	Y17.0	031	Buildings	13.1									
D-42	016	X67.6	Y07.5	031	Buildings	15.5									

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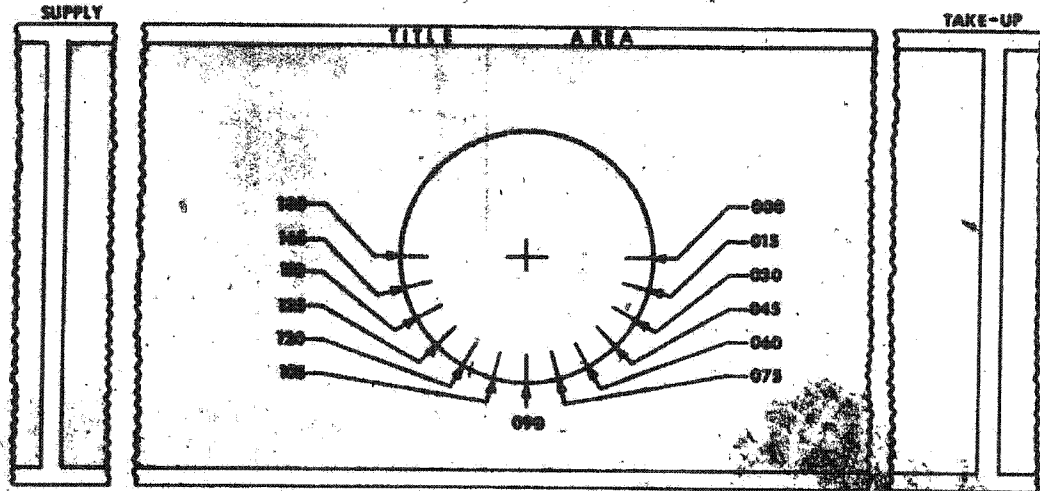
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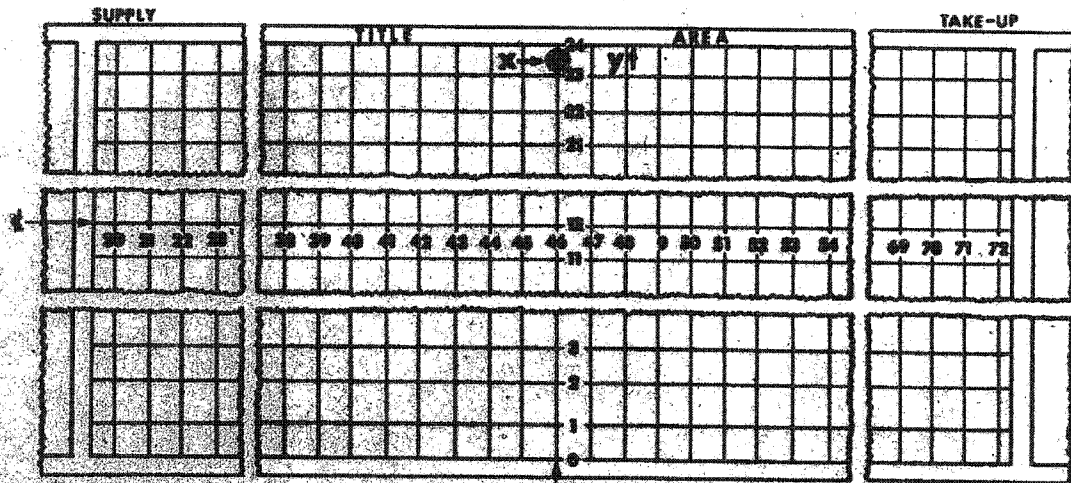
SPPL TECHNICAL REPORT NO. 101-1-43

APPENDIX "A"

Reference System For Orientation Of 'G' Mission Edges
original negative-emulsion up



Coordinate Locator Grid For 'G' Mission Edges
original negative-emulsion up



One Centimeter Squares

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SPPL TECHNICAL REPORT NO. 101-1-43

TABLE 13 - V-RES VALUES PER REV AND FRAME

REV	FRAME DIVISION					REV	FRAME DIVISION					REV	FRAME DIVISION				
	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5
0.4	55	64	63	78	55	72	72	63	63	63	59	57	54	54	51		
0.5	52	52	57	55	63	70	70	59	70	70	61	61	61	59	54		
0.6	60	61	59	61	59	61	72	58	58	58	61	61	61	59	54		
0.7	72	67	67	75	94	94	90	82	80	72	67	67	67	67	67		
0.8	94	94	82	85	82	99	90	104	94	94	82	82	82	82	82		
0.9	70	70	80	63	90	85	85	72	70	72	67	67	67	67	67		
1.0	67	75	63	63	65	72	78	70	61	49	63	63	63	63	63		
1.1	67	75	61	78	72	52	54	65	57	69	67	67	67	67	67		
1.2	67	65	70	65	78	72	55	65	63	59	67	67	67	67	67		
1.3	67	65	70	65	78	72	78	70	78	63	67	67	67	67	67		
1.4	72	61	70	63	75	70	85	78	67	63	67	67	67	67	67		
1.5	78	67	78	67	78	67	104	94	104	72	118	111	111	111	111		
1.6	75	72	61	75	61	72	82	85	82	82	82	82	82	82	82		
1.7	86	70	86	70	83	85	72	85	90	90	90	90	90	90	90		
1.8	55	52	55	52	54	57	49	52	47	49	49	49	49	49	49		
1.9	78	82	67	72	63	67	59	61	59	57	57	57	57	57	57		
2.0	94	94	85	72	104	94	82	85	85	94	85	85	85	85	85		
2.1	55	38	65	59	45	40	55	54	55	54	55	54	54	54	54		
2.2	72	85	85	78	90	78	70	67	72	70	72	70	72	70	72		
2.3	70	59	63	65	75	63	69	59	72	57	57	57	57	57	57		
2.4	72	75	78	70	70	72	63	57	62	75	62	75	62	75	62		
2.5	49	55	47	57	57	61	63	65	52	55	52	55	52	55	52		
2.6	35	49	35	49	63	70	57	52	59	63	59	63	59	63	59		
2.7	57	48	63	54	55	67	57	55	59	67	59	67	59	67	59		
2.8	67	62	52	54	61	55	70	53	62	70	62	70	62	70	62		
2.9	65	57	61	54	61	55	55	55	61	72	61	72	61	72	61		
3.0	67	78	94	78	94	78	75	72	75	72	63	63	63	63	63		
3.1	94	75	94	78	85	72	87	67	67	78	67	78	67	78	67		
3.2	55	49	52	47	52	47	52	47	52	47	52	47	52	47	52		
3.3	61	65	65	63	82	75	57	61	65	70	65	70	65	70	65		
3.4	52	55	55	52	78	85	52	55	65	70	65	70	65	70	65		
3.5	62	92	63	59	52	59	63	63	72	63	72	63	72	63	72		
3.6	78	70	87	54	70	59	54	55	61	55	61	55	61	55	61		
3.7	72	82	75	82	94	95	72	63	72	63	72	63	72	63	72		
3.8	72	63	65	55	72	61	59	52	64	49	64	49	64	49	64		
3.9	63	67	64	61	72	53	65	47	63	78	65	47	63	78	65		
4.0	49	47	49	47	67	53	54	63	67	67	67	67	67	67	67		
4.1	64	61	64	61	64	61	64	61	64	61	64	61	64	61	64		
4.2	63	67	63	67	63	67	63	67	63	67	63	67	63	67	63		
4.3	63	67	63	67	63	67	63	67	63	67	63	67	63	67	63		
4.4	63	67	63	67	63	67	63	67	63	67	63	67	63	67	63		
4.5	63	67	63	67	63	67	63	67	63	67	63	67	63	67	63		
4.6	63	67	63	67	63	67	63	67	63	67	63	67	63	67	63		
4.7	63	67	63	67	63	67	63	67	63	67	63	67	63	67	63		
4.8	63	67	63	67	63	67	63	67	63	67	63	67	63	67	63		
4.9	63	67	63	67	63	67	63	67	63	67	63	67	63	67	63		
5.0	63	67	63	67	63	67	63	67	63	67	63	67	63	67	63		

APPENDIX 9

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SPPL TECHNICAL REPORT NO. 101-1-43

TABLE 13 - V-RES VALUES PER REV AND FRAME

REV	FRAME	FRAME DIVISION					KEY	FRAME	FRAME DIVISION														
		1	2	3	4	5			1	2	3	4	5										
D. 4	8	53	69	63	78	55	72	72	63	63	63	59	57	51	41	52	59	59	63	55	51		
D. 5	5	52	57	57	55	63	70	70	59	70	70	59	61	70	40	104	67	104	67	59	49	70	47
D. 10	8	80	51	59	41	78	65	59	78	70	70	59	61	70	40	104	67	104	67	59	49	70	47
D. 15	15	59	72	59	72	59	61	72	58	70	70	59	61	70	40	104	67	104	67	59	49	70	47
D. 6	5	72	67	67	75	94	64	90	82	90	72	82	63	85	74	104	76	104	76	67	67	78	82
D. 6	11	94	94	82	85	82	99	90	104	94	94	94	94	94	94	94	94	94	94	94	94	94	94
D. 7	3	70	70	80	63	90	85	85	72	70	72	70	70	70	70	70	70	70	70	70	70	70	70
D. 7	6	78	67	80	63	90	85	85	72	70	72	70	70	70	70	70	70	70	70	70	70	70	70
D. 8	4	67	75	63	63	65	72	78	70	61	69	61	61	61	61	61	61	61	61	61	61	61	61
D. 8	10	61	78	61	78	72	52	54	65	57	69	57	69	57	69	57	69	57	69	57	69	57	69
D. 9	5	67	65	70	65	78	72	55	65	63	59	63	59	63	59	63	59	63	59	63	59	63	59
D. 9	10	67	59	70	75	72	72	78	70	78	63	63	63	63	63	63	63	63	63	63	63	63	63
D. 9	17	72	61	70	63	75	70	85	78	67	63	63	63	63	63	63	63	63	63	63	63	63	63
D. 10	5	78	67	80	63	90	85	85	72	70	72	70	70	70	70	70	70	70	70	70	70	70	70
D. 10	22	78	78	75	72	104	94	104	72	118	111	111	111	111	111	111	111	111	111	111	111	111	111
D. 11	3	65	72	61	75	61	72	82	85	82	82	82	82	82	82	82	82	82	82	82	82	82	82
D. 14	3	70	82	86	70	83	85	72	85	90	90	90	90	90	90	90	90	90	90	90	90	90	90
D. 15	2	55	52	54	57	54	57	59	52	47	49	49	49	49	49	49	49	49	49	49	49	49	49
D. 15	8	78	82	67	72	63	67	59	61	59	57	57	57	57	57	57	57	57	57	57	57	57	57
D. 16	7	94	94	85	72	104	94	82	85	85	94	94	94	94	94	94	94	94	94	94	94	94	94
D. 21	4	55	38	65	59	45	40	55	54	55	54	54	54	54	54	54	54	54	54	54	54	54	54
D. 21	11	92	48	92	48	61	63	61	63	61	63	61	63	61	63	61	63	61	63	61	63	61	63
D. 22	5	72	85	85	78	90	78	70	67	72	70	70	70	70	70	70	70	70	70	70	70	70	70
D. 23	1	70	59	63	65	75	63	69	59	72	57	57	57	57	57	57	57	57	57	57	57	57	57
D. 23	8	72	75	78	70	70	72	63	57	62	75	62	75	62	75	62	75	62	75	62	75	62	75
D. 24	5	49	55	47	57	57	61	63	65	52	55	52	55	52	55	52	55	52	55	52	55	52	55
D. 24	9	55	44	55	44	63	70	57	52	59	63	59	63	59	63	59	63	59	63	59	63	59	63
D. 25	4	57	68	63	54	55	67	57	55	59	67	59	67	59	67	59	67	59	67	59	67	59	67
D. 25	10	67	52	52	54	61	55	70	63	82	70	82	70	82	70	82	70	82	70	82	70	82	70
D. 25	15	65	57	61	54	61	55	55	59	61	72	61	72	61	72	61	72	61	72	61	72	61	72
D. 26	13	67	78	90	72	75	72	65	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63
D. 26	18	94	75	94	78	85	72	87	67	67	78	67	78	67	78	67	78	67	78	67	78	67	78
D. 27	10	55	48	52	47	52	47	52	47	52	47	52	47	52	47	52	47	52	47	52	47	52	47
D. 31	7	61	65	65	63	82	75	57	61	65	70	65	70	65	70	65	70	65	70	65	70	65	70
D. 31	11	52	55	55	52	78	85	52	55	65	70	65	70	65	70	65	70	65	70	65	70	65	70
D. 32	6	62	54	63	59	52	59	63	63	72	63	72	63	72	63	72	63	72	63	72	63	72	63
D. 34	7	78	70	57	54	70	59	54	55	61	55	61	55	61	55	61	55	61	55	61	55	61	55
D. 37	5	72	85	75	82	94	55	72	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63
D. 38	1	72	63	65	55	72	61	59	52	63	49	63	49	63	49	63	49	63	49	63	49	63	49
D. 38	11	65	61	49	61	67	63	54	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63
D. 38	20	67	72	64	61	58	47	63	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67
D. 38	31	64	61	58	47	63	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67
D. 39	1	55	67	57	54	63	47	63	45	43	45	43	45	43	45	43	45	43	45	43	45	43	45
D. 39	5	54	67	57	54	63	47	63	45	43	45	43	45	43	45	43	45	43	45	43	45	43	45
D. 39	14	54	67	57	54	63	47	63	45	43	45	43	45	43	45	43	45	43	45	43	45	43	45
D. 39	23	54	67	57	54	63	47	63	45	43	45	43	45	43	45	43	45	43	45	43	45	43	45
D. 39	31	54	67	57	54	63	47	63	45	43	45	43	45	43	45	43	45	43	45	43	45	43	45

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APPENDIX B