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TOP SECRET - GAMBIT

TECHNICAL EVALUATION REPORT
ON ORIGINAL NEGATIVES
FROM MISSION 4011
(SECTION III OF PET REPORT 4011/64)

4 DECEMBER 1964

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SPPL TECHNICAL REPORT NO. 101-1-34

FOREWORD

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

Preparing Unit:

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

BCS 24577-64

SPPL TECHNICAL REPORT NO. 101-1-34

PUBLICATION REVIEW

This report has been reviewed and is approved.

(b)(3)

Colonel, USAF
Commander

BCS 24577-64

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ABSTRACT

This report is Section III of the Performance Evaluation Team (PET) report. It presents the results of a detailed study on the photographic physical characteristics from Reconnaissance Satellite Mission 4011

The Technical Evaluation Report is based on analysis performed by the 6594th Test Squadron (AFSPPL). Approximately 2,790 feet of 9.5" original negative film comprised the total product used in this evaluation. The 243 feet of pre-flight film was not evaluated.

The satellite vehicle was launched from Pad No. 4 of the Point Arguello Launch Complex, Vandenber AFB, California, on 23 September 1964 (2005Z); in-flight recovery was made on 27 September 1964 (23202 Coverage was obtained from 47 revolutions which produced 614 frames of photographic imagery.

The film was inspected for imaged and superficial degradations. Density and Visual Reciprocal Edge Spread (V-RES) values were measured. Image analysis by edge spread techniques utilizing Micro-densitometer traces was accomplished by both the SPPL and Scientist/Consultant Teams.

Three of the programmed Controlled Range Network (CORN) target displays were covered. One of two scheduled RB-47 Blackbird Missions was successful. The best coverage was on Frame 045 (KA-2 Camera) which produced a ground resolution of less than one foot.

V-RES values averaged 44, which represents an approximate ground resolution of 7.5 feet. The Modulation Transfer Function/Aerial Image Modulation (MTF/AIM) values averaged 40 cycles/mm, or a ground resolution of approximately 8 feet. Mission 4011 received adequate exposure and was processed a the Intermediate (60%) and Full (40%) development levels. Continual image smearing throughout the Missi caused image edge spread measurement results to be abnormally low. The averages of Dmin, Dmax, $\bar{D}$, and ΔD values for 4011 are near the mean for this series of missions.

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SECTION I

INTRODUCTION

Reconnaissance Satellite Mission 4011 was launched on 23 September 1964 and recovered on 27 September 1964 after obtaining 3,033 feet of 9.5 inch film from the GAMBIT Camera. The physical characteristics of the original negatives were objectively analyzed and evaluated. The results of this evaluation are presented in the report which follows.

Paragraph A, Section II, "Known Information," outlines specific mission data, film data, a brief description of the GAMBIT Camera System, resolution capabilities, and subject environmental information (sun angle and latitude). Paragraph B, Section II, "Information Derived from Analysis," presents data derived from the film inspection, processing, laboratory evaluations, image analysis, and film format characteristics evaluation. The Controlled Range Network (CORN) and Blackbird operations were activated for this Mission, the results of which are also included in Paragraph B.

Section III is completely revised in this report and presents a concise description of test procedures, methods, and equipment used in the photographic analysis.

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

Section V lists all associated references.

Section VI, the Appendices, includes tabulations of density and edge analysis data, photographic enlargements, Micro-Analyzer traces, and Site Manning Reports.

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

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 4011.

A. Known Information

1. Mission Data

a. Mission Number: 4011

b. Dates of Photography:[1] 23 - 27 September 1964

c. Ephemeris: Final ephemeris was available.

d. Revs/Rolls/and Frames: See Table 1[2], Mission Data, Appendix 1, page 1-1. Except for the Stellar/Index film, the entire Mission was received for evaluation.

e. Footage Received: Approximately 3,033 feet (See Illustration 1, page 12).

2. Camera System

a. Camera

The GAMBIT Camera System used for this Mission includes two cameras: one Strip and one Stellar/Index. The objective of this satellite reconnaissance system is to photograph specific targets; it is not intended to obtain large area reconnaissance. The primary camera system consists of a single strip-type camera. Stereo pairs, lateral pairs, and continuous strip photography can be obtained. The vehicle can be rolled to obtain oblique as well as vertical photography in all three modes. It should be noted that since a single camera is used, truly vertical photography can be obtained only in the continuous strip mode. Movement of the camera mirror permits stereo photography. The camera continually exposes a narrow slit across the film as the vehicle passes over the area being photographed; the image is focused through a fixed-slit aperture onto a moving strip of film. Additional camera data is recorded in Table 2, Appendix 2, page 2-1.

b. Film[3]

The types of film and their physical characteristics are listed in Table 3, Appendix 3, page 3-1.

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[1] Messages, 23 and 28 September 1964.

[2] 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. Engineering Revs are indicated by the letter "E" after the Rev Number.

[3] Manual of Physical Properties of Kodak Aerial and Special Sensitized Materials, Eastman Kodak Co., Rochester, N. Y.

c. Resolution Capabilities

The GAMBIT Camera System is designed to obtain resolutions of 100-140 l/mm at 2:1 contrast (2-3 feet ground resolution).

3. Description of Subject Environment

a. Sun Angle

Photography from Mission 4011 was obtained with sun angles ranging from 88° to 5°.

b. Geographic Latitude

Photographic coverage from Mission 4011 ranged from 82° N to 10° S Latitude.

B. Information Derived from Analysis

1. Physical Degradations

The total Mission product, excluding the pre-flight portion and Stellar/Index camera film, was examined for physical degradations.

a. Imaged Degradations

(1) Minor static discharges appeared intermittently throughout the Mission.

(2) Each frame was slightly degraded by various flares and reflections.

(3) Cross-track image smear was evident throughout the Mission, particularly on Revs D04, Frames 001 and 002; D05, Frames 015, 016, 019, and 020; D08, Frame 011; D20, Frames 003 and 004; D21, Frame 010; D22, Frames 028 and 029; D26, Frames 001 and 002; D38, Frame 001; D42, Frames 023-025; D43, Frame 001; D44, Frame 014; and D59, Frame 001.

b. Superficial Degradations

(1) Small 1/8" digs occurred every 3" along the non-titled edge, on the base side, throughout the Mission.

(2) Irregular fine emulsion abrasions occurred primarily along the titled edge of the following Revs and Frames: D07, Frame 012; D08, Frame 001; D09, Frame 008, D10, Frames 002 and 003; D15E, Frame 002; D20, Frames 008 and 009; D22, Frames 010 and 024; D25, Frames 014 and 015; D58, Frame 013; D57, Frame 013; D63E, Frame 001; and D64E, Frame 008.

(3) Minus-density spots parallel to and 1.9" from the non-titled edge, occurred approximately every three inches on all frames of Revs D04, D11, D14E-D16E, and D19-D22.

(4) Numerous pinholes, abrasions, and scratches were noted throughout this Mission.

(5) A factory splice was observed on Rev D42, Frame 022.

2. Film Processing Data

a. The original negatives from Mission 4011 totaled approximately 3,033 feet, to include 243 feet of pre-flight.

b. Approximately 40% of the Mission was processed at the Full condition and 60% at the Intermediate development level. The standard processing control H&D curves for the three development

levels are shown in Illustration 2, page 13. The control curve from the beginning and the end of processing for the Mission is presented as Illustration 3, page 14.

3. Laboratory Evaluations

a. Sensitometric

One unexposed strip of Type 4404 Film from Mission 4011 was received for evaluation. Detailed sensitometric tests were performed on this strip and on a sample of SPPL control stock of the same emulsion type for comparison. The Eastman Kodak Intensity Scale Sensitometer, Type 1B, Model IV, was used for exposure and the strips were processed in D19 Developer. Sensitometric measurements and calculations were made according to USAF standards and are graphically presented in Illustrations 4 and 5, pages 15 and 16.

b. Chemical

A sample of the original negative film was tested for archival quality, resulting in 0.0025 milligrams per square inch of residual thiosulfate. This laboratory considers 0.005 milligrams per square inch as archival quality. Archival tests should be made within 24 hours after processing, and a test sample 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 evaluation consisted of densitometry and analysis by edge scan techniques, Controlled Range Network (CORN) operations, and Visual Reciprocal Edge Spread (V-RES).

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 21.

(1) Image Minimum Density Values (Dmin)

Image Dmin values ranged from 0.32 to 1.50 with an overall average of 0.74. The standard deviation (σ) of measured values is 0.23. The range and average for each Rev are shown in Illustration 6, page 17. The distribution of Dmin values is shown in Illustration 10, page 21.

(2) Image Maximum Density Values (Dmax)

Image Dmax values ranged from 0.74 to 2.32 with an overall average of 1.58. The standard deviation (σ) of measured values is 0.31. The range and average for each Rev are shown in Illustration 7, page 18. The distribution of Dmax values is shown in Illustration 10, page 21.

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

Image $\bar{D}$ values ranged from 0.57 to 1.75 with an overall average of 1.16. The standard deviation (σ) of measured values is 0.22. The range and average for each Rev are shown in Illustration 8, page 19. The distribution of $\bar{D}$ values is shown in Illustration 10, page 21.

(4) Image Density Difference Values (ΔD)

Image ΔD values ranged from 0.06 to 1.80 with an overall average of 0.83. The standard deviation (σ) of measured values is 0.32. The range and average for each Rev are shown in Illustration 9, page 20. The distribution of ΔD values is shown in Illustration 10, page 21.

(5) Gross Fog (Base plus Fog)

Gross Fog values ranged from 0.14 to 0.32 with an overall average of 0.25. The standard deviation (σ) of measured values is 0.04.

(6) Cloud Maximum Density Values (Dmax Clouds)

Dmax Cloud values ranged from 1.07 to 2.43 with an overall average of 2.14. The standard deviation (σ) of measured values is 0.24.

(7) Density versus Sun-Angle and Latitude

The average Dmin and Dmax values are plotted against each degree of sun angle and latitude in Illustration 11, page 22, and are correlated with density readings in Table 4, Appendix 4, pages 4-1 through 4-5.

(8) Density Tables

The complete listing of density data is presented in Table 4, Appendix 4, pages 4-1 through 4-5.

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-Read Reciprocal Edge Spread (M-RES). Two independently working teams: the AFSPPL Technical Evaluation Team and a group of industrial scientists and consultants perform these measurements.

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" 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.

The following are the results of this evaluation from both team efforts. Caution is advised in attempting to determine correlations at this time. Edge location by a grid system and by orientation should be used to insure that the edges being compared are the same. In this way a comparison of the measurements of the two teams can be made on edges with the same or similar environmental conditions.

(1) AFSPPL Team

(a) Fifty-two traces were accomplished on 26 edges from Mission 4011, using 1μ x 60μ and 1μ x 350μ slits, with the Mann-Data Micro-Analyzer. Results of the various methods of edge analyses are presented in Table 5, page 6. V-RES, Dmin, and Dmax values are included for reference purposes. Each 50% Spread value is recorded in microns and as the reciprocal of this measurement.

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TABLE 5 - EDGE SCAN DATA

Mission 4011

Mission Data			Machine RES		Spread Function Width at 50% Amplitude				MTF AIM		V-RES	Density		Subject		
Rev Nr.	Frame Nr.	Trace Nr.	1μ X 350μ	1μ X 80μ	1μ X 350μ Microns	1μ X 80μ Microns	1μ X 350μ Reciprocal	1μ X 80μ Reciprocal	1μ X 350μ	1μ X 80μ		1μ X 350μ Dmin	Dmax	Type	Grid	Axis
D32E	004	1	21	19	24.2	30.7	41	33	38	29	31	1.30	1.75	Ramp	D-5	43°
D32E	005	2	29	27	26.8	12.1	37	83	78	47	34	1.27	1.80	Ramp	G-7	36°
D49E	001	3	14	25	47.1	10.3	21	97	72	44	47	0.70	1.63	Bridge	E-2	177°
D49E	001	4	58	68	22.8	27.2	44	37	37	36	45	0.50	1.40	Bridge	C-2	83°
D49E	001	* 5	42	48	24.7	19.8	40	51	43	36	45	0.95	1.55	Runway	E-6	83°
D49E	002	6	23	23	29.3	23.3	34	43	34	54	50	0.77	1.67	Bridge	G-2	14°
D49E	002	7	32	41	27.1	19.9	37	50	41	33	47	0.65	1.60	Bridge	E-2	84°
D49E	002	* 8	32	33	29.2	24.1	34	41	47	27	52	0.98	1.66	Runway	G-6	83°
D58	015	9	18	11	22.7	12.2	44	82	60	34	57	0.83	1.39	Runway	F-4	40°
D58	015	10	33	40	30.5	21.8	33	46	41	35	55	0.80	1.50	Taxiway	F-4	84°
D58	016	11	19	14	36.3	14.4	28	70	38	27	55	0.80	1.44	Runway	F-5	32°
D58	016	12	27	31	34.1	36.2	29	28	38	23	55	0.87	1.52	Taxiway	G-4	85°
D05	012	13	20	28	51.1	49.3	20	20	54	22	72	0.80	1.65	Pier	F-5	41°
D05	013	14	20	34	46.4	24.2	22	41	26	23	70	0.93	1.72	Pier	G-5	28°
D10	007	15	46	50	16.4	15.8	61	64	61	60	55	0.98	1.72	Ramp	G-5	73°
D10	008	16	38	40	23.6	19.9	42	50	38	44	67	1.07	1.82	Ramp	E-4	75°
D42	017	17	27	28	25.6	25.2	39	40	36	33	72	0.80	1.43	Taxiway	F-4	81°
D42	018	18	21	18	34.1	35.8	29	28	57	23	63	0.96	1.50	Taxiway	H-4	81°
D54	012	19	25	26	19.5	18.2	51	55	44	49	72	0.87	1.52	Runway	E-5	122°
D54	013	20	27	25	38.1	24.8	26	40	24	26	94	1.03	1.57	Runway	G-7	125°
D47E	001	*ΔC-1	--	35	--	35.4	--	28	--	27	35	1.00	1.70	CORN	F-6	179°
D47E	001	*ΔC-2	--	55	--	16.1	--	62	--	60	43	1.00	1.67	CORN	F-6	80°
D47E	002	*ΔC-3	--	30	--	18.6	--	54	--	28	51	0.70	1.75	CORN	E-5	166°
D47E	002	*ΔC-4	--	32	--	29.2	--	34	--	37	55	0.67	1.80	CORN	E-5	76°
D64E	004	*ΔC-5	--	16	--	17.0	--	59	--	27	38	0.63	1.75	CORN	G-23	179°
D64E	004	*ΔC-6	--	35	--	22.9	--	44	--	45	52	0.62	1.80	CORN	G-23	90°
Average:			29	32	30.4	23.3	36	49	45	36	54					

* Photographic Enlargements and Micro-Analyzer Traces are shown in Appendix 6, pages 6-1 through 6-19.

Δ Controlled Range Network (CORN) Target (Controlled Scene Brightness Target)

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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 6 and 7, page 8, 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 170 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 and the MTF curve is the MTF/AIM value in cycles/mm that is recorded in the table. Approximately 2% of these intercept values could be determined only after visual smoothing of the MTF curves. For comparison purposes, the M-RES value, MTF/AIM value, and V-RES value should be compared to the reciprocal of the 50% Spread value. The average MTF curve and the $\pm$ 1 σ deviation of all edges for Mission 4011 are shown in Illustration 12 (1μ x 350μ slit), and Illustration 13 (1μ x 80μ slit), pages 23 and 24. The frequency distribution of M-RES, 50% Spread, MTF/AIM, and V-RES is portrayed in Illustration 14 (1μ x 350μ slit), and Illustration 15 (1μ x 80μ slit), pages 25 and 26.

(b) A summary of the SPPL edge analysis data from Mission 4011 is presented in Table 6, page 8.

(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 1μ x 80μ slit was used. The resulting edge data was analyzed by two methods. Data from the 50% Spread method is recorded in microns. The reciprocals of these values are also recorded to facilitate comparison with similar values of 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 5, pages 5-1 through 5-8. A summary of this data for Mission 4011 is presented in Table 7, page 8.

c. Controlled Range Network (CORN) Operations

(1) Ten "Mobile Target Displays" were programmed for this Mission; however, only seven were displayed. Of these seven targets, photographic coverage was obtained on three. In addition, the Mission covered an area of one additional scheduled target, but the target was not displayed.

(a) Rev D47E, Frame 001, covered the Air Mobile Unit at Wheeling Co. Airport, Ohio. It consisted of two "T" Bar Targets (low contrast), a Controlled Scene Brightness Target (80' edge), and the Tri-Color Target with "Point Source."

(b) Rev D47E, Frame 002, covered the Ground Mobile Unit No. 1, near Morgansville West Virginia. It consisted of two "T" Bar Targets (high contrast) and one Controlled Scene Brightness Target (40' edge).

TABLE 6 - Summary of Edge Scan Analysis (SPPL)

Mission 4011 No. of Edges - 26

Method of Analysis		Arithmetic Mean		Standard Deviation		Coefficient of Dispersion	
		350μ	80μ	350μ	80μ	350μ	80μ
Spread Function Width at 50% Amplitude	Width in Microns	30.4	23.3	9.4	8.8	31%	38%
	Reciprocal of Width	36	49	10.3	18.7	29%	39%
Machine-Read RES		29	32	10.8	13.2	38%	42%
MTF/AIM		45	36	14.2	11.8	31%	32%
Visual RES		54		14.2		26%	

TABLE 7 - Summary of Edge Scan Analysis
(Scientist & Consultant Team)

Mission 4011 No. of Edges - 30

Method of Analysis		Arithmetic Mean 1μ x 80μ	Standard Deviation 1μ x 80μ	Coefficient of Dispersion 1μ x 80μ
Spread Function Width at 50% Amplitude	Width in Microns	40.2	15.0	37%
	Reciprocal of Width	30	14.9	50%
MTF/AIM		33	11.1	33%

(c) Rev D64E, Frame 004, covered the Air Mobile Unit at Cherokee Airport, Iowa. It consisted of one "T" Bar Target (low contrast), the Controlled Scene Brightness Target (80' edge), and the Tri-Color Target with "Point Source."

(2) The Controlled Scene Brightness Targets were analyzed on the Mann-Data Micro-Analyzer utilizing a 1μ x 80μ slit. The measurements accomplished are included with the data on edge measurements presented in paragraph 4. b. (1) above, page 5.

(3) The resolution of the "T" Bar Targets (low and high contrast) was read by three observers and the results are shown in Table 8 below:

TABLE 8 - CORN Target Evaluation

MISSION 4011					OBSERVER NUMBER 1		NUMBER 2		NUMBER 3	
Rev	Frame	Target	Orientation		Bar Groups Read	Ground Resolution	Bar Groups Read	Ground Resolution	Bar Groups Read	Ground Resolution
D47E	001	(two) "T" Bar (low contrast)	A / B	line of flight ↑	A-3 B-3	A-8' B-8'	A-3 B-2	A-8' B-12'	A-3 B-3	A-8' B-8'
D47E	002	(two) "T" Bar (high contrast)	A / B	↑	A-0 B-0	8' plus	A-0 B-0	8' plus	A-0 B-0	8' plus
D64E	004	(one) "T" Bar (low contrast)	A / B	↑	3	8'	2	12'	3	8'

(4) Photographic enlargements (10X and 40X) are included in Appendix 6, pages 6-1 to 6-19, along with Micro-Analyzer traces and Site Manning Reports of the CORN displays.

d. Blackbird Missions

(1) Blackbird Missions were flown on 25 September 1964 to coincide with Rev D47E and on 27 September 1964 to coincide with Rev D64E, Mission 4011. No duplicate coverage was obtained from the mission on 25 September 1964, but was obtained on 27 September 1964 on the CORN Target at Cherokee Airport, Iowa (See paragraph c. above).

(2) The Blackbird Mission flown on 27 September 1964 used two different cameras containing different type film. See Table 9, page 10, for Blackbird Camera Data.

(3) The "T" Bar Target (low contrast) was read resulting in a ground resolution of less than one foot for the KA-2 Camera which contained the SO 190 film (Frame 045, approximate scale: 1:9,000) and a ground resolution of two feet for the KC-1 Camera containing the 5401 film (Frame 048, approximate scale: 1:18,000).

(4) Photographic enlargements of Mission 4011 (Rev D64E, Frame 004) and the Blackbird Mission (KA-2 Camera, Frame 045) are included in Appendix 6, pages 6-1 through 6-19, for comparison.

TABLE 9 - Blackbird Camera Data

	CAMERA	
	KA-2	KC-1
Film	SO 190	5401 (Plus X)
Focal Length	12"	6"
Filter	Wratten 12	Wratten 12
Exposure	1/500 at f/4	1/500 at f/8
Altitude	9,000' (mosaic) 17,000' (main line)	9,000' (mosaic) 17,000' (main line)

e. Visual Reciprocal Edge Spread (V-RES)

(1) V-RES data consisted of 444 measurements. The values ranged from 20 to 78 with an average of 44. V-RES measurements are recorded in Table 10, Appendix 7, page 7-1.

(2) The frequency distribution of V-RES values is presented in Illustration 16, page 27. Average V-RES values for each Rev were computed and are portrayed in Illustration 17, page 28. Illustration 18, page 29, 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 each degree of latitude in Illustration 19, page 30.

(4) Two measurements were made for each subject selected: one With the line of flight (W) and one Across the line of flight (A). These values are recorded by Mission, Camera Position, Rev, and Frame in Table 10, Appendix 7, page 7-1.

f. Image Motion

Comparison of V-RES values recorded under "W" and "A" in Table 10, Appendix 7, page 7-1, 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 SPPL Technical Report No. 101-1-24 (Mission 4008). An analysis of each mission in this series will be accomplished by the National Team responsible for the evaluation using GEMS. This data, when available, will be incorporated into the technical evaluation report series in order to permit a correlation with objective edge scan analysis data by engineers and scientists.

5. Analysis of Film Format Characteristics

a. Titling

Titling was fair to good throughout the 47 revolutions of this Mission with title smearing noted on Revs D08, Frames 004-013; D15, Frames 001-013; D25, Frames 001-037; and D44, Frames 017-022.

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

Yaw slit measurements were very difficult to make due to the double imagery caused by the yaw slit itself and the continual image smear.

e. Frame Size

Variable frame lengths were programmed throughout the Mission.

f. Overlap and Sidelap

Rev D42, Frames 017 and 018, were measured; overlap was 92%, and sidelap was 86%.

Text is continued on page 31.

ORIGINAL NEGATIVE FOOTAGE DIAGRAM

Stellar Camera
4401, 35mm x 66 ft.
Index Camera
4400, 70mm x 134 ft.

ILLUSTRATION 1

Date _____
UP No. _____
Prep.by _____
Type Process Control Stnd
Class _____
Mfgr. Eastman Kodak
Exp. date May 26, 1964
Emul. No. 4404-42
Lamp 1903
Exp. time 1/25 sec
Wedge No. 711-15
Dev. _____
Time _____
Temp. _____ °F

Total Densities

t	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 fact. _____ abs. log. E 7.80+10

Time	Gamma	Speed(B)	Base + Fog	Density 21st Step	Temp.
PRIMARY 2' 15"	2.14	1.90	.08	2.30	74° F
INTER. 25"	2.39	2.61	.10	2.37	67° F
FULL 1' 41"	2.18	4.16	.19	2.43	67° F

PRIMARY
INTERMEDIATE
FULL

RELATIVE LOG EXPOSURE

ILLUSTRATION 3

TOP SECRET GAMBIT

ILLUSTRATION 3

Mission 4011

Date 22 Oct 64
UP No.
Prep.by AFSPPL
Type 4404
Class Head & Tail
Mfgr. Eastman Kodak
Exp. date 26 May 64
Emul. No. 4404-42
Lamp 1903
Exp.time 1/25 sec.
Wedge No. 711-15
Dev. Full
Time 1' 41"
Temp. 67 °F

Total Densities

1	8	15	
1	9	17	
2	10	18	
3	11	19	
4	12	20	
5	13	21	2.43
6	14		Bse. Den. .21
7	15		

Sensitometric Prop.
Speed (B) 4.23
Gamma 2.05
Filter Daylight
Filter fact.

abs. log E 7.80 - 10

ILLUSTRATION 3

TOP SECRET GAMBIT
Handle via Byeman
Controls Only

SCS 24677-64
SPPL TECHNICAL REPORT NO. 101-1-34

Handle via Byeman Controls Only

TOP SECRET - GAMMA

ILLUSTRATION 4

Mission 4011

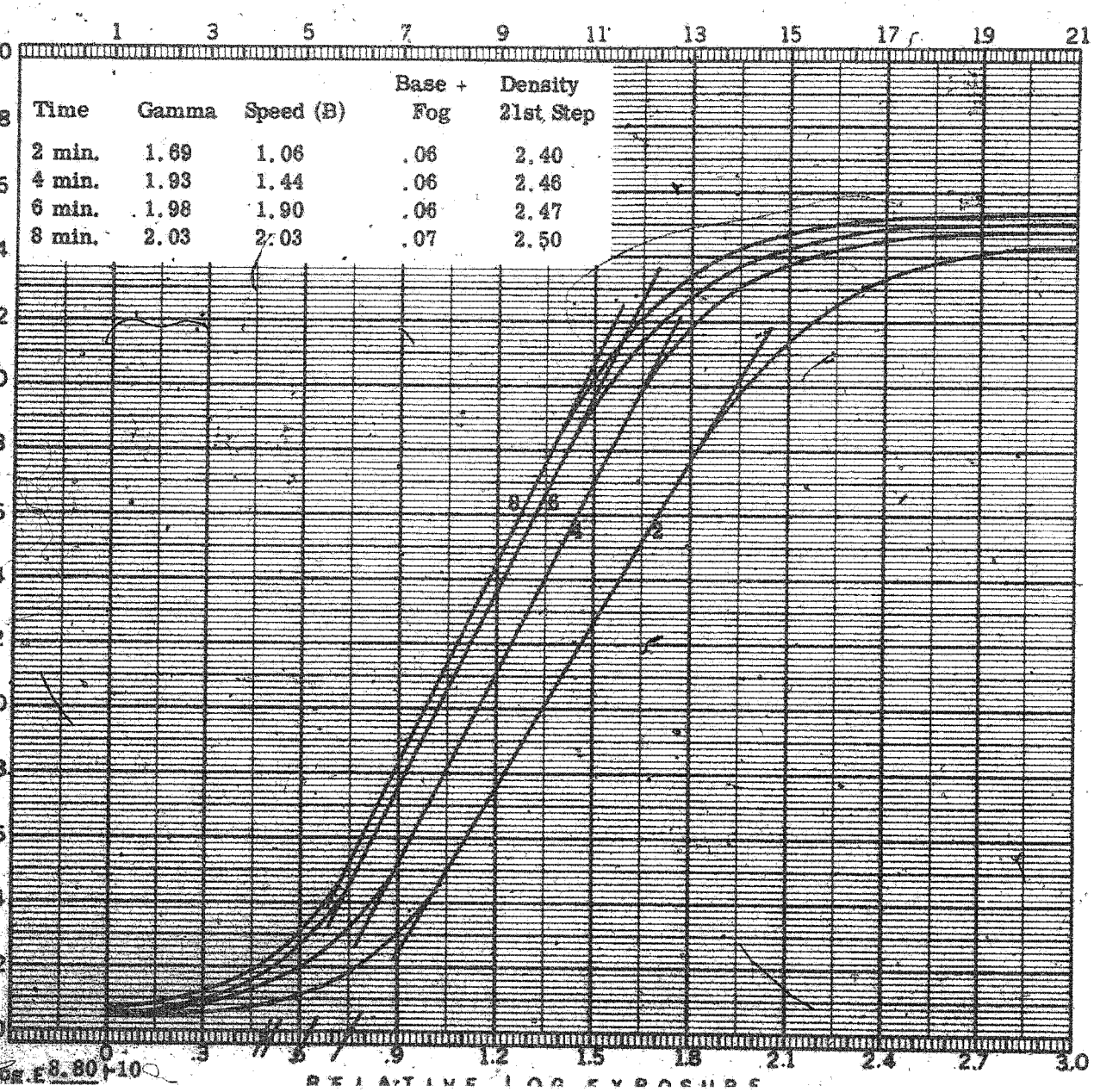
Date 27 Oct 64
UP No.
Prep.by AFSPPL
Type MS Control Stk
Class 4404
Mfgr. Eastman Kodak
Exp. date 19 Oct 64
Emul.No. 55-10-5-4
Lamp 500W 6100° Kelvin
Exp.time 1/2 sec.
Wedge No. 724-150
Dev. D-19
Time 2, 4, 6, 8 min.
Temp. 68 °F

Total Densities

0	8	16	
1	9	17	
2	10	18	
3	11	19	
4	12	20	
5	13	21	
6	14	Bse. Den.	
7	15		

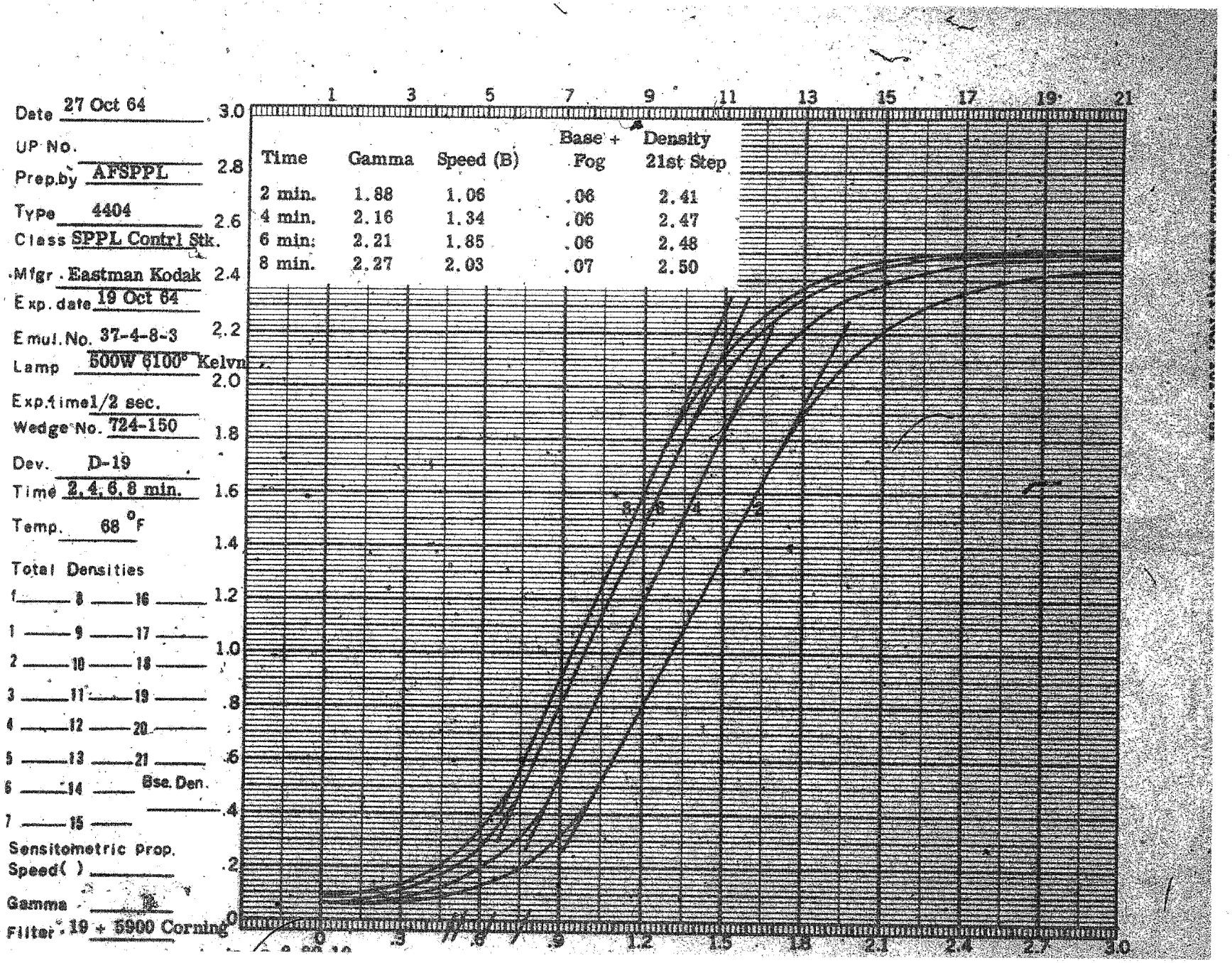
Sensitometric Prop.
Speed( )
Gamma
Filter 19 + 5900 Corning
Filter(s)

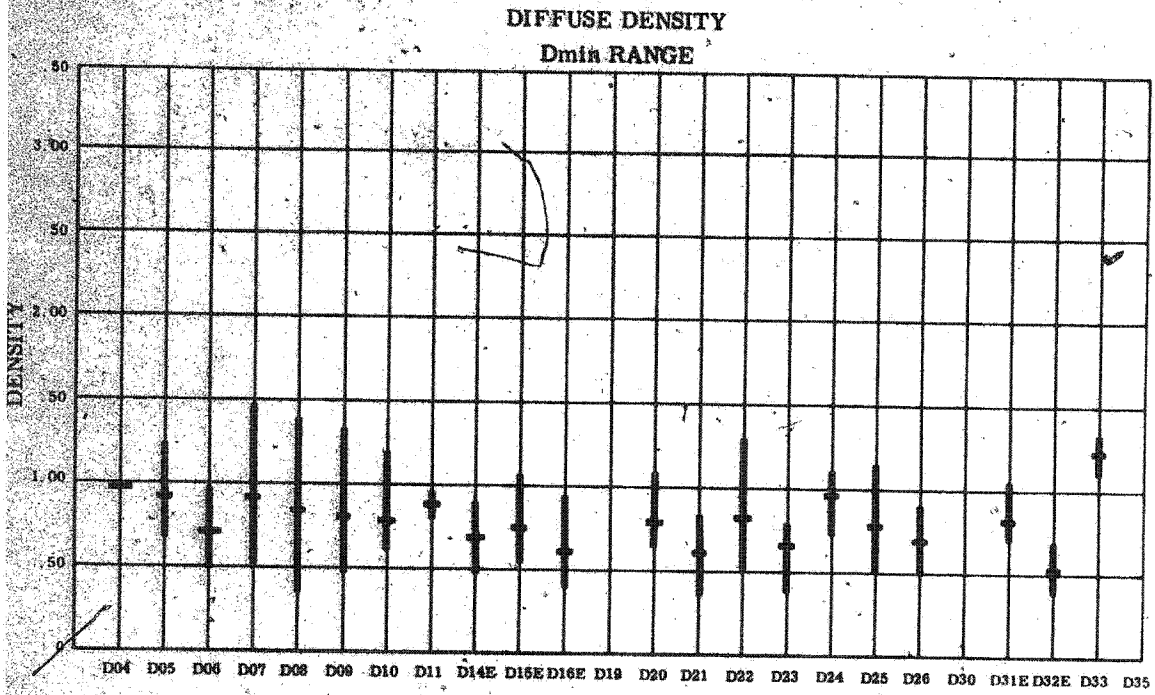
Time	Gamma	Speed (B)	Base + Fog	Density 21st Step
2 min.	1.69	1.06	.06	2.40
4 min.	1.93	1.44	.06	2.46
6 min.	1.98	1.90	.06	2.47
8 min.	2.03	2.03	.07	2.50



abs.log.E 8.80 -10

ILLUSTRATION 5





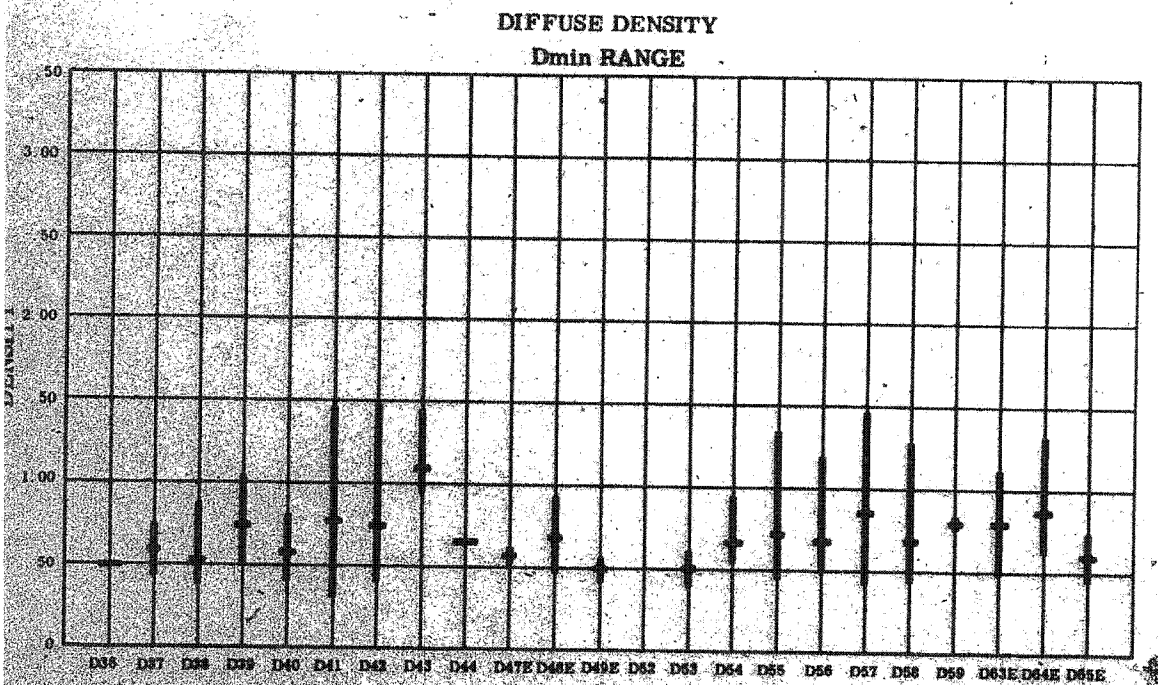
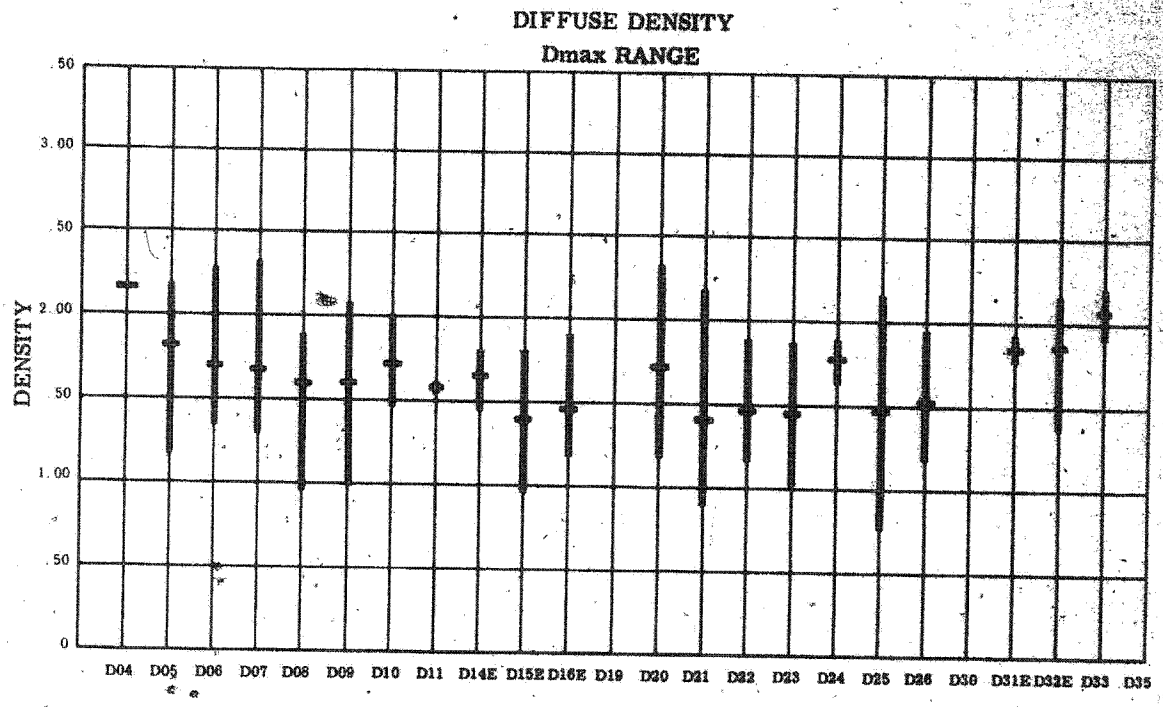
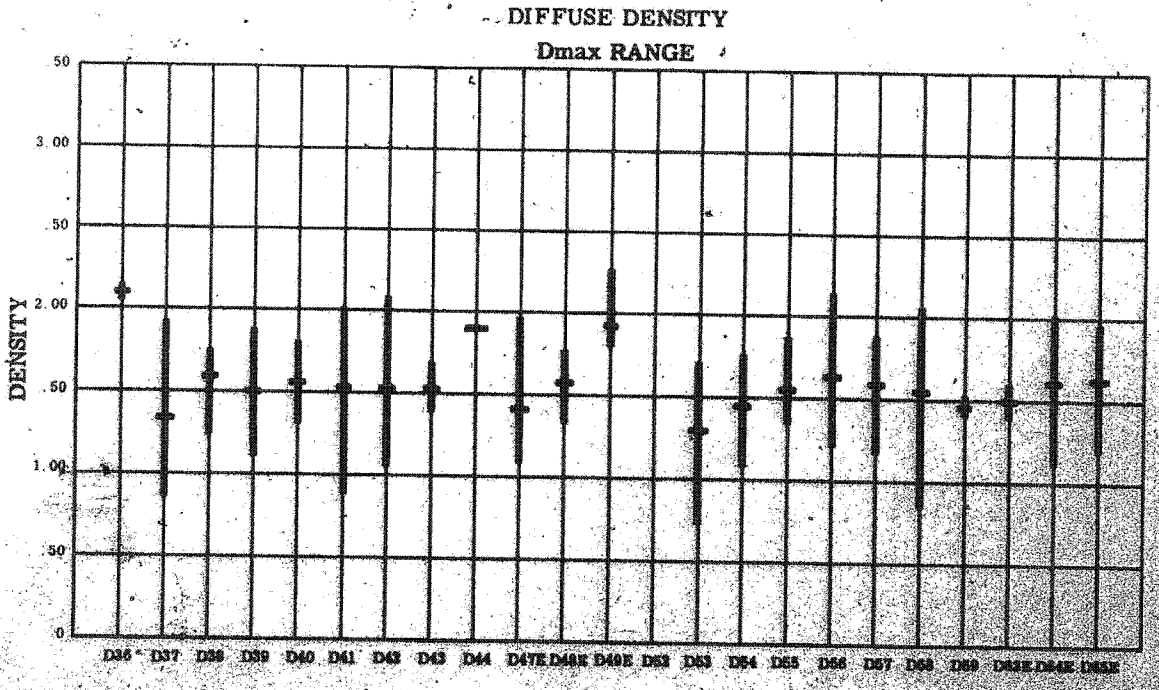


ILLUSTRATION 6

BCS 24577-64

SPPL TECHNICAL REPORT NO. 101-1-34



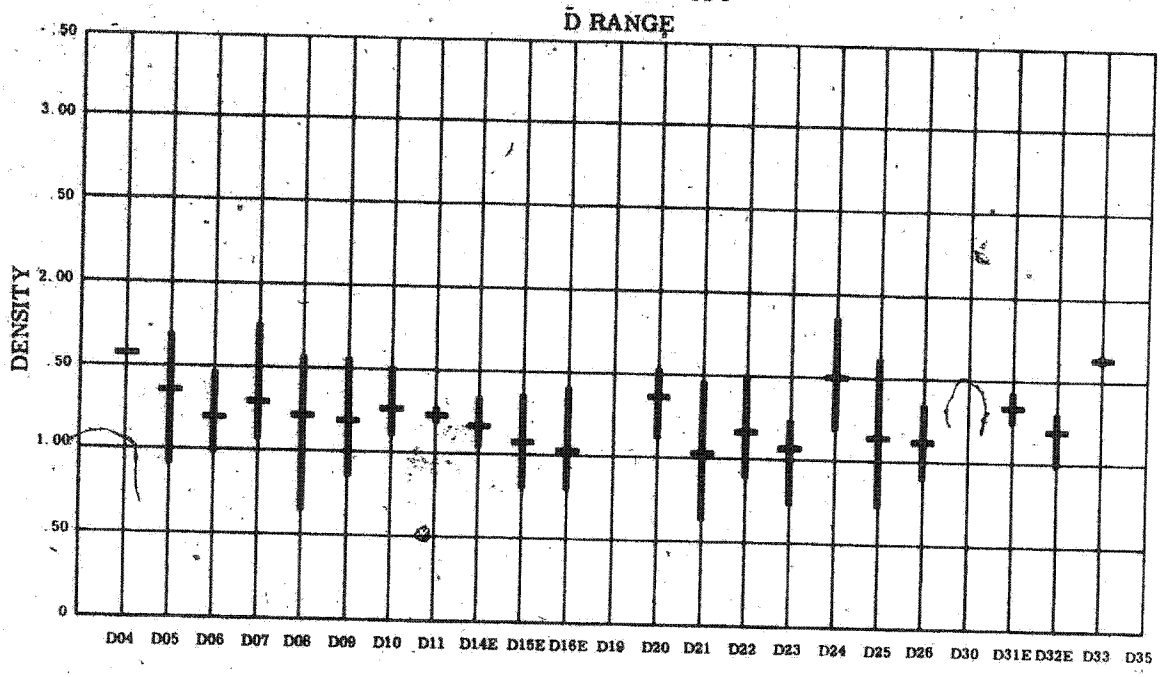


Handle via Byeman Controls Only

~~TOP SECRET - GAMBIT~~

ILLUSTRATION 7

DIFFUSE DENSITY
$\bar{D}$ RANGE



DIFFUSE DENSITY
$\bar{D}$ RANGE

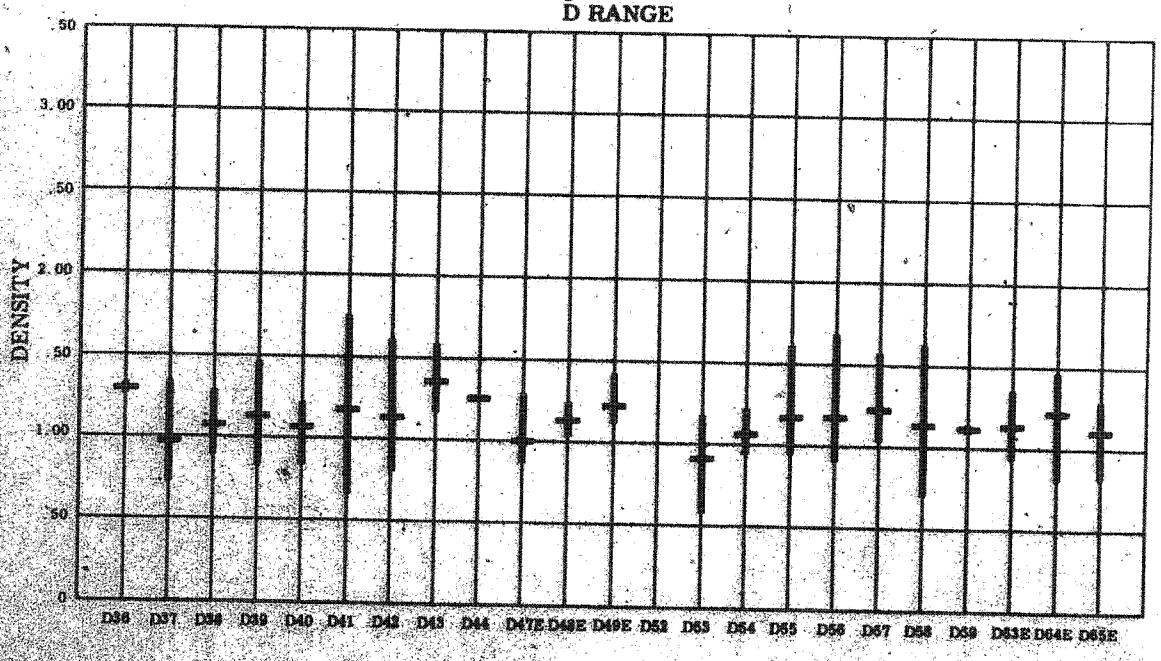
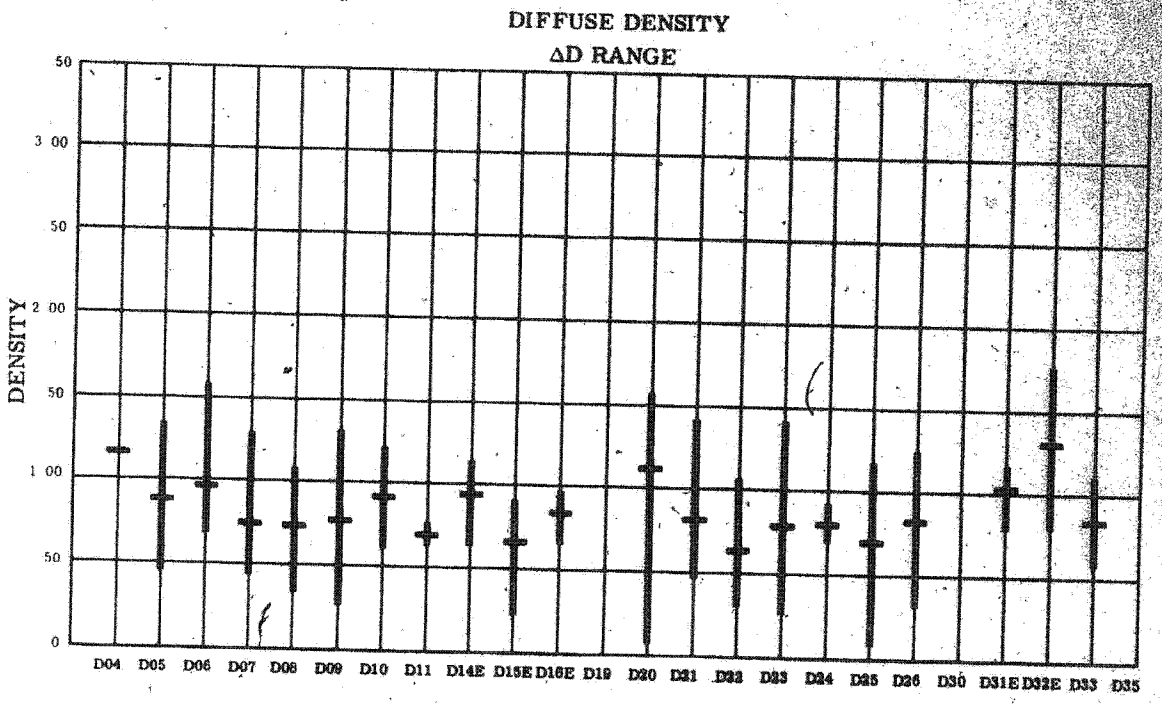


ILLUSTRATION 8



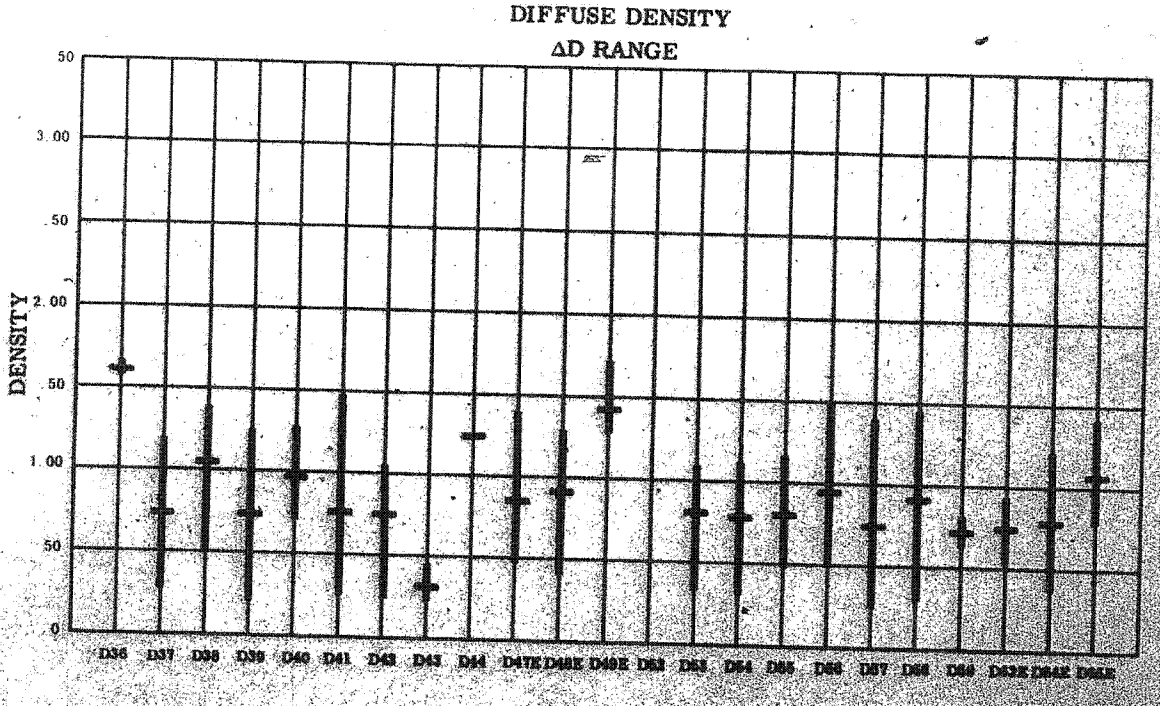


ILLUSTRATION 9

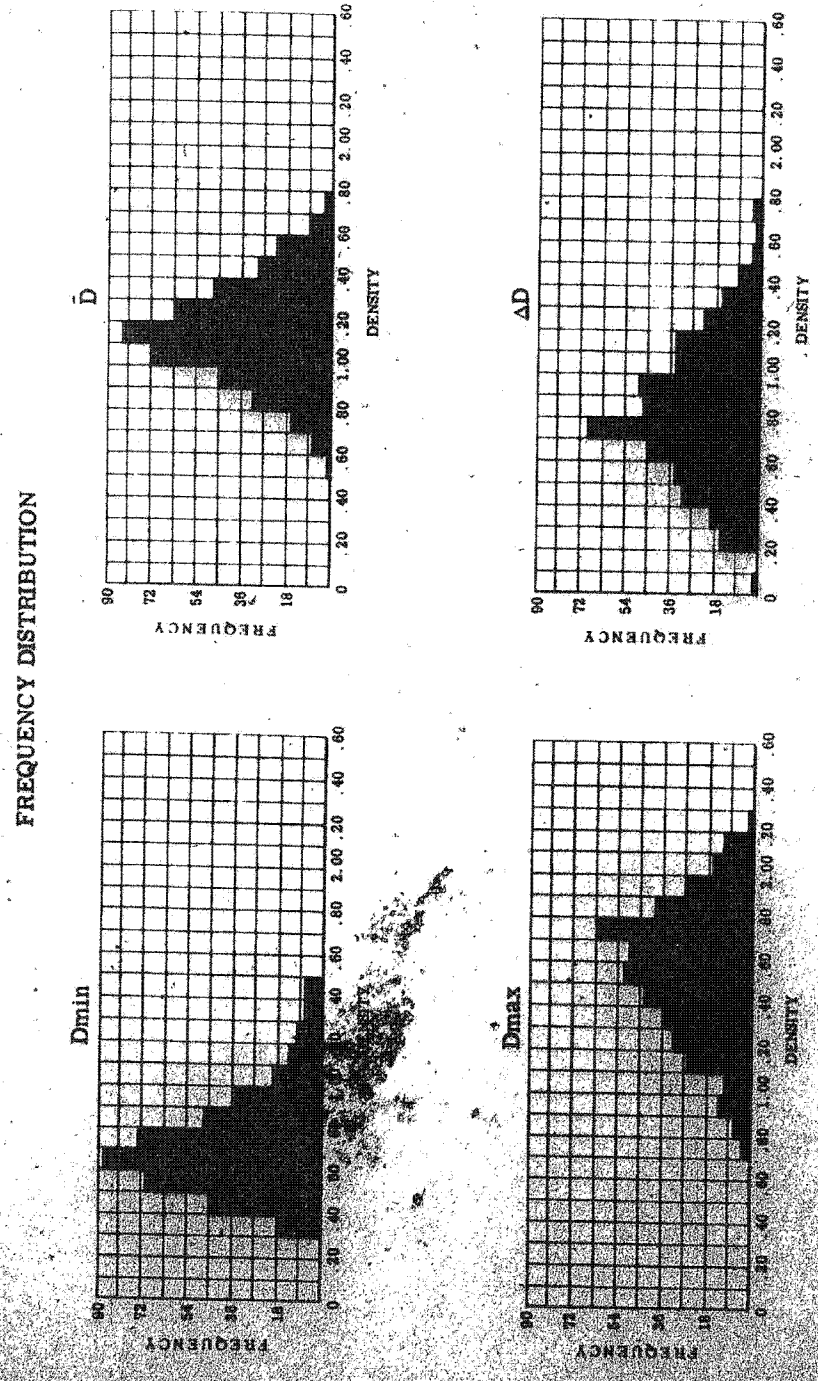
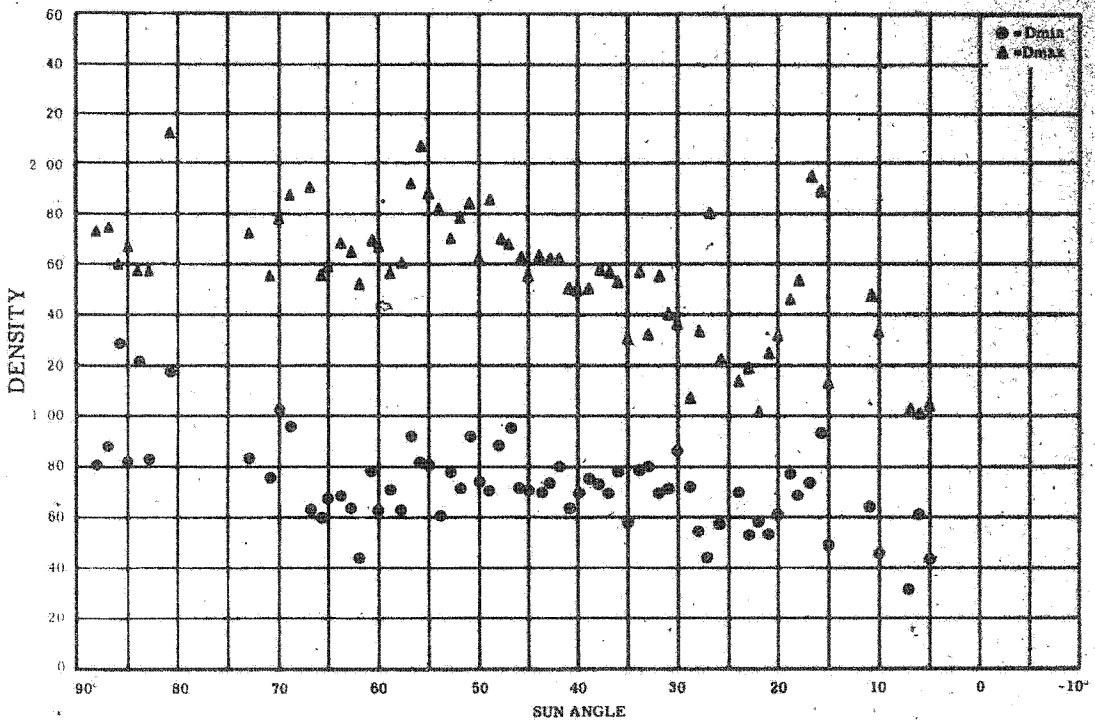


ILLUSTRATION 10

Approved for Release: 2021/05/17 C05134462

Dmin & Dmax AVERAGES VERSUS SUN ANGLE



Dmin & Dmax AVERAGES VERSUS LATITUDE

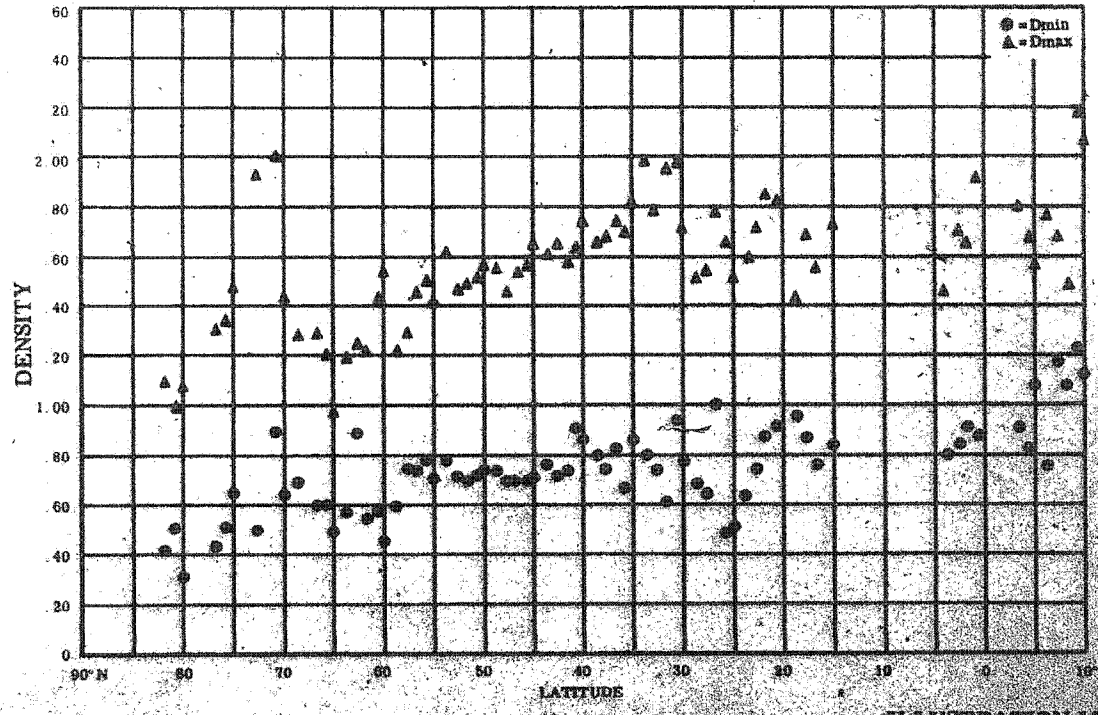


ILLUSTRATION 11

AVERAGE MTF CURVE

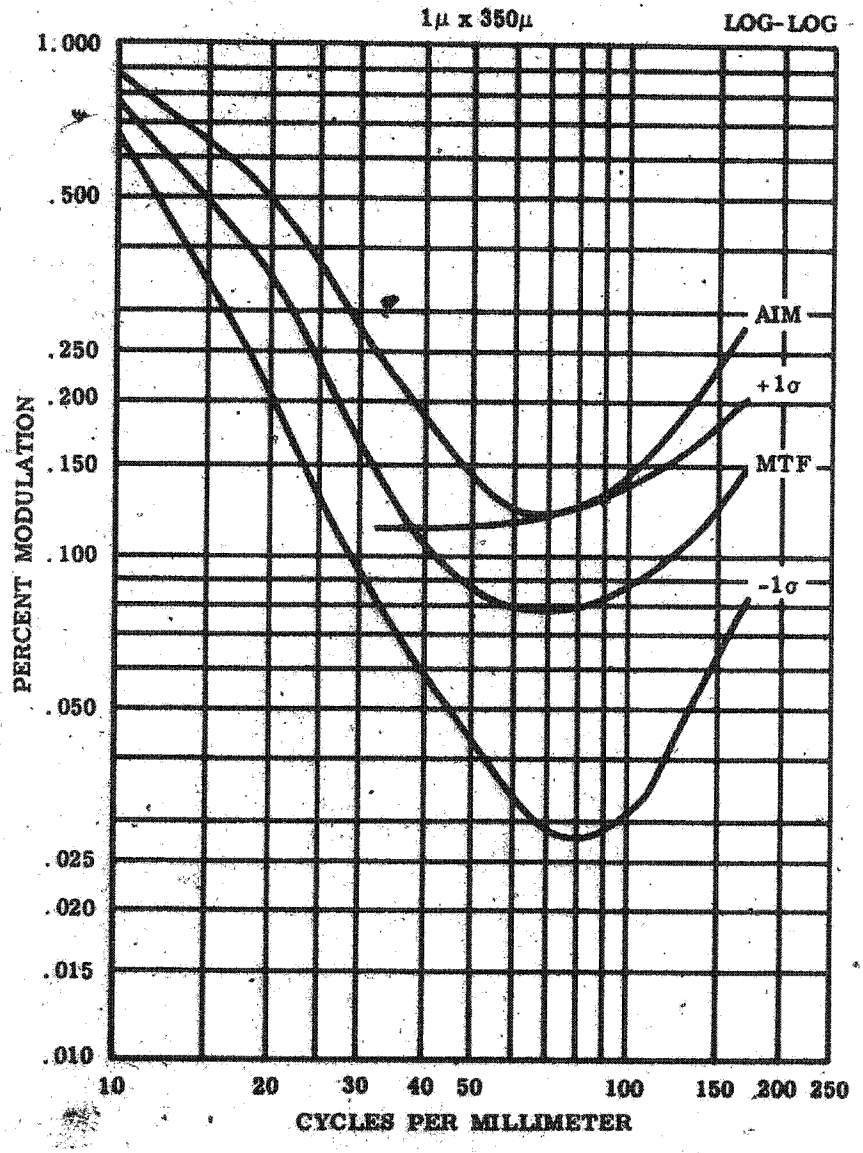


ILLUSTRATION 12

AVERAGE MTF CURVE

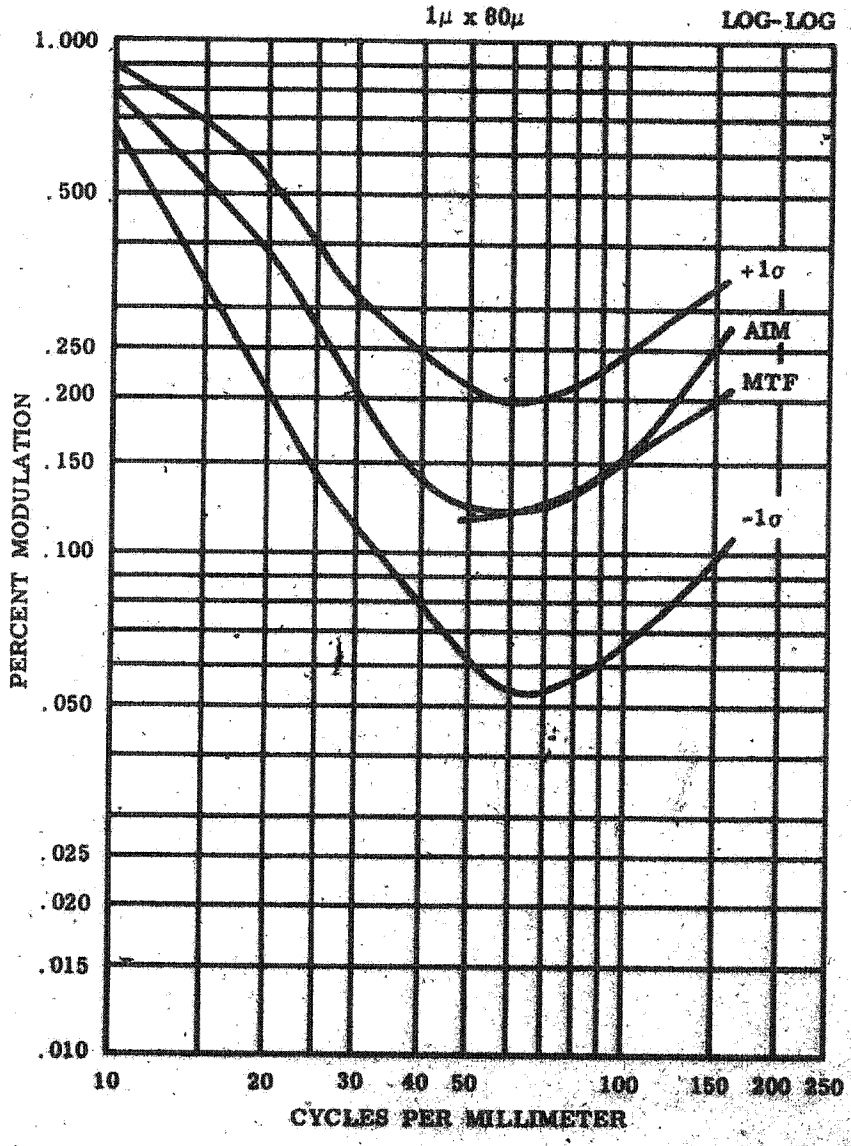


ILLUSTRATION 13

FREQUENCY DISTRIBUTION
MEASURES OF IMAGE QUALITY

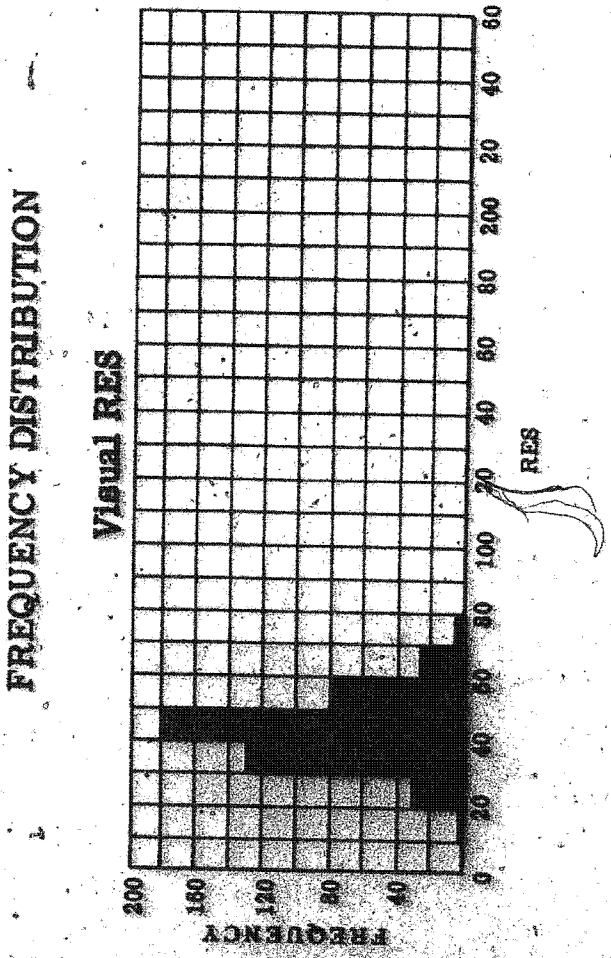
ILLUSTRATION 14

Handle via Byeman
Controls Only
TOP SECRET GAMBIT

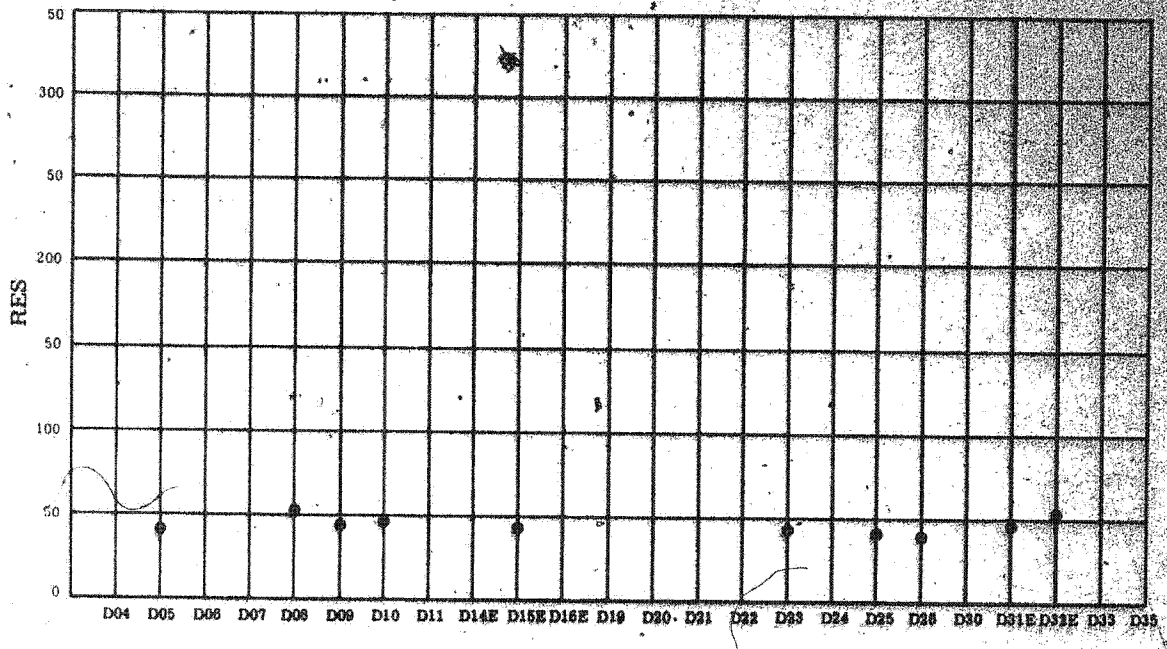
Handle via Byeman
Controls Only
TOP SECRET GAMBIT

FREQUENCY DISTRIBUTION
MEASURES OF IMAGE QUALITY

ILLUSTRATION 15



AVERAGE V-RES PER REV



AVERAGE V-RES PER REV

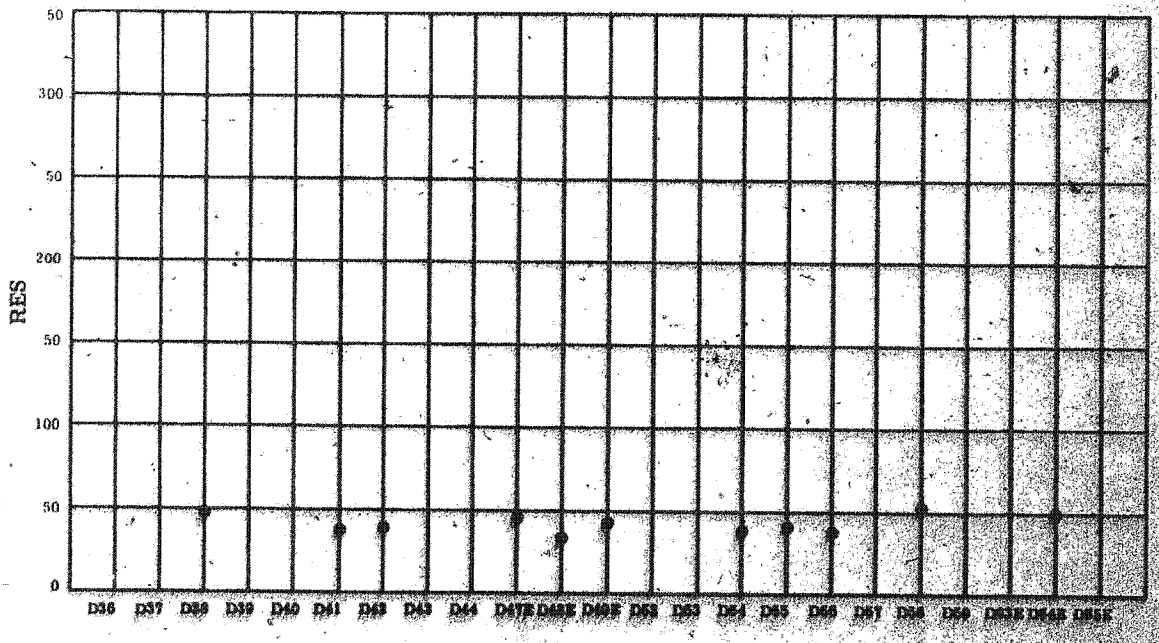


ILLUSTRATION 17

BCS 24577-64

SPPL TECHNICAL REPORT NO. 101-1-34

AVERAGE V-RES BY FRAME AREA

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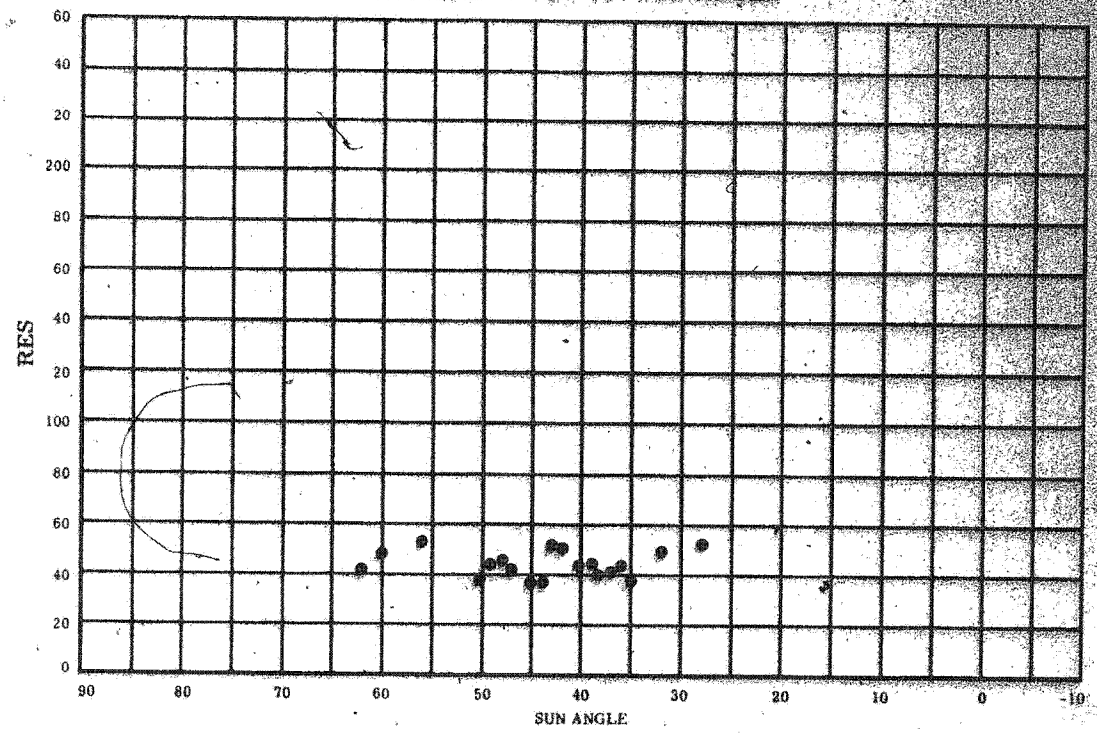
BCS 24577-64

SPPL TECHNICAL REPORT NO. 101-1-34

AVERAGE V-RES VS. SUN ANGLE



AVERAGE V-RES VS. LATITUDE

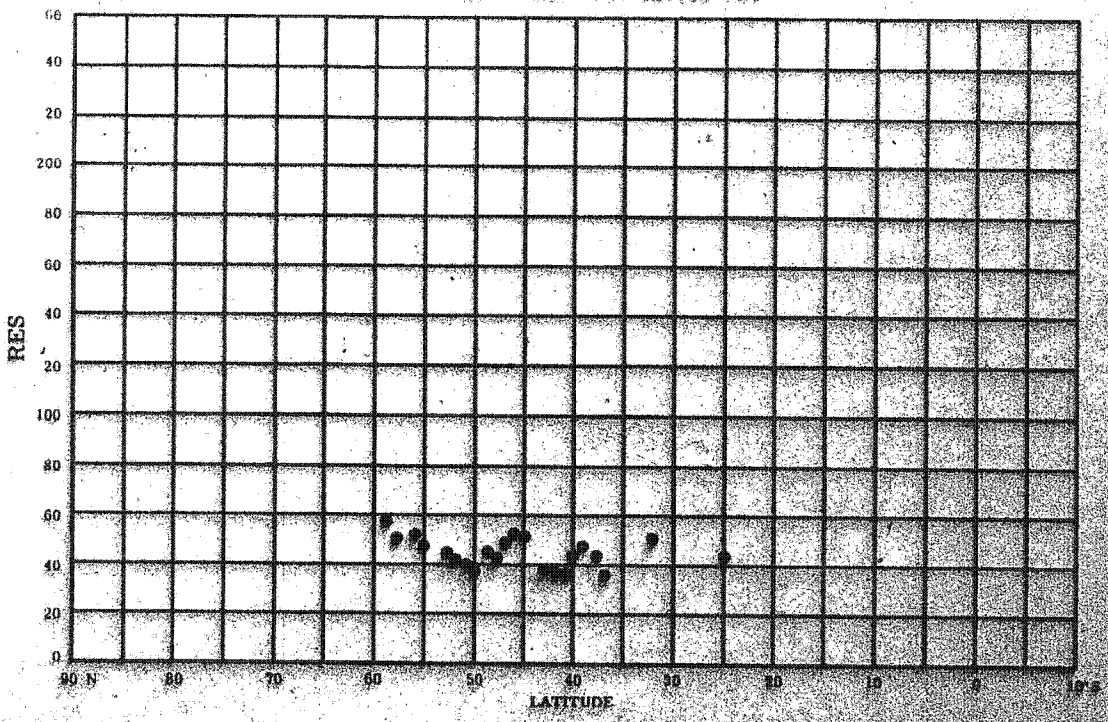


ILLUSTRATION 19

SECTION III

METHODS AND EQUIPMENT USED IN THE ANALYSIS

Section III presents a description of the test procedures, methods, and equipment used in conducting the photographic analysis of missions, results of which are recorded in par. B., Section II.

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 necessitate an explanation which is outlined in the appropriate paragraphs of Section III. When these revisions are minor in scope, they are noted in an abbreviated Section III with reference to the complete Section in an earlier report. The entire Section III is revised whenever the changes are numerous or of major importance.

The following is a complete revision of Section III for the 4000 Series missions. All changes which have occurred since the last major revision (SPPL Technical Report No. 101-1-22; Mission 4006) have been incorporated.

A. Physical Degradations

The entire mission is inspected for degradations exposed into the imagery such as fogging, streaking, or double images, and for degradations which are superficial to the imagery such as film tears, dirt, scratches, abrasions, or foreign marks. The degradations are described, and any notable defects are located by Rev, Roll, and Frame. No attempt is made to determine the source of each degradation as being due to improper camera operation, improper laboratory processing techniques, or other causes.

B. Laboratory Evaluations

Samples of unexposed sensitized material, several feet in length, are obtained from the supply spool immediately before actual flight and are used to produce sensitometric measurements and standards for comparison with the mission film after processing. A small sample of the processed mission material (non-image) is removed from one roll after processing, and a chemical evaluation is performed to determine archival quality. The following is a description of the tests.

1. Sensitometric

Sensitometric evaluations are performed with the Eastman Kodak Intensity Scale Sensitometer Type 1 B, Model IV. This instrument is constantly monitored for its calibration with a crossover between Eastman Kodak and the Reconnaissance Laboratory at Wright-Patterson AFB, Ohio.

a. For the measurement of gamma, only the straight line portion of the D Log E curve is used. The central portion of most characteristic curves between the toe and shoulder approximates a

straight line. The slope of a straight line which coincides as nearly as possible with this portion of the curve is termed gamma (γ).

b. Aerial Film Speed and other sensitometric parameters are measured in accordance with procedures described in "Federal Specification for Black and White Photographic Film No. L-F-330," dated 17 December 1956, as amended. The film speed utilized to measure the aerial reconnaissance film described herein is accomplished utilizing Method B of referenced specification where film speed is equal to one-half the exposure (E) in Meter Candle Seconds required at the point on the H&D curve where the slope is equal to one-half of the gamma of the curve.

2. Chemical

Determination of the amount of thiosulfate in a processed emulsion is of interest not only in connection with studies of rate, efficiency, and effectiveness of washing, but also with image stability with respect to storage or aging. Two analytic techniques are employed by this laboratory: the Kodak Hypo Estimator Test, applied for production testing, and the American Standard Association PH4. 8-1958 technique, periodically employed as a control reference.

a. Kodak Hypo Estimator Test

This rapid method is used for determining residual thiosulfate during negative and positive production.

(1) The test standard utilizes a sheet of film on which Eastman Kodak Company has placed four numbered color patches. The yellow-brown colors are arranged in varying densities and are standards for the test. Instructions and test solution formulation accompany the standard.

(2) The area of the sample film to be tested is not the final product, but rather a portion of the leader or trailer which "brackets" the final product.

(3) One drop of HT-2 test solution is applied to the emulsion to be tested and allowed to stand for two minutes before blotting off the excess reagent. The resulting stain is compared with the patches on the standard in subdued light and the matching patch number noted.

(4) Test spots matching the various patches on the standard correspond to the following hypo contents.

Density of Stain	Milligrams of Anhydrous Sodium Thiosulfate per Sq Inch
Patch 1	0.005
Patch 2	0.01
Patch 3	0.04
Patch 4	0.10

(5) Patch 1 (0.005 mg thiosulfate/sq in.) is considered archival quality by this laboratory (reference page 2 of instruction sheet accompanying standard).

b. American Standard Association PH4.8-1958 Technique

This technique is very sensitive to thiosulfate, but is not at all sensitive to sulfite, bisulfite, or thionates such as tetrathionates.

(1) The test depends upon the production of the degree of turbidity or opalescence in the test solution which is related to the amount of thiosulfate in the sample.

(2) The area of the sample film to be tested is not the final product but rather a portion of the leader or trailer which "brackets" the final product.

(3) A measured area of film (1 sq. in. ± 5%) is immersed for a sufficient time in a given test solution. At essentially the time of sample immersion, comparison solutions are prepared by adding thiosulfate solution of specified concentration and quantity to the required volumes of test solution. When thiosulfate is present, a precipitate is formed which rises to the upper part of the test solutions. After standing undisturbed for a given period of time, these tubes are agitated to distribute the precipitates uniformly. The turbidity of the sample tube is compared with the turbidity of the eight comparison tubes, and matching turbidities are found. Since the quantity of thiosulfate in all comparison tubes is known, the amount of thiosulfate in the sample is thus quantitatively determined.

Comparison Tube	Milligrams of Anhydrous Sodium Thiosulfate per Square Inch
1	0
2	0.0025 ± 0.001
3	0.005 ± 0.001
4	0.01 ± 0.002
5	0.02 ± 0.005
6	0.04 ± 0.010
7	0.1 ± 0.025
8	0.2 ± 0.050

(4) This laboratory considers 0.005 mg/sq in. as archival quality (reference American Standards Association Publication PH1.28-1957, "Photographic Films for Permanent Records," page 8, Table 2).

(5) Sample Age

It is to be noted that the effectiveness of this test decreases with the elapsed time after processing the film. The residual thiosulfate decomposes fairly rapidly into substances which are not detectable by this test. These decomposition products may cause image deterioration; for this reason, the performance of this test procedure should be conducted on samples within 24 hours after completion of processing.

C. Image Analysis

1. Densitometry

a. Density Values

All density measurements presented in this report are Visual Diffuse Density values as defined in American Standards Association Publication PH 2.19-1959, "Diffuse Transmission Density."

(1) Equipment

Values are determined using the Macbeth TD-100 QuantaLog Densitometer containing a 0.5mm diameter aperture disc on the light source.

(2) Measurements

Measurements are made on all frames of each Rev throughout the Mission. Values determined are: Image Minimum Density Values (Dmin) of terrain image; Image Maximum Density Values (Dmax) of terrain image; Cloud Maximum Density Values (Dmax Clouds); and Gross Fog Density Values (Base plus Fog) measured along the frame format edge outside the image area.

(3) Measurement Technique

The film is viewed subjectively, and terrain image areas representative of the density extremes (Dmin and Dmax) on each frame are determined by trial and error procedures, along with the Base plus Fog and Dmax Clouds. Cloud shadow areas (terrain) are considered; spectral reflections are not measured.

b. Computations

(1) The Image Density Difference values (ΔD) are computed for each frame by subtracting image Dmin from image Dmax: $Dmax - Dmin = \Delta D$

(2) The average Image Density values ($\bar{D}$) are computed for each frame by adding image Dmin and Dmax and dividing by two: $\frac{Dmin + Dmax}{2} = \bar{D}$

(3) The average of both Dmin and Dmax values is computed for each degree of sun angle and latitude.

(4) Standard Deviation (σ)

The standard deviation (σ) is calculated in the following manner:

$$\sigma = \sqrt{\frac{\Sigma X^2 - \frac{(\Sigma X)^2}{N}}{N-1}}$$

The value of sigma (σ), or standard deviation, for each of the measured density parameters is computed and reported.

2. Analysis by Edge Scan Techniques

In an attempt to evaluate the capability of photographic reconnaissance systems to store and retain image quality, a number of techniques have been suggested which deal with the analysis of the spread

function of an imaged edge. Several of these techniques have been applied to data obtained from selected edges in order that correlations with information content can be accomplished. The following is a description of each method of edge spread analysis, including the equipment used and the sampling procedures

a. Spread Function Width at 50% Amplitude (50% Spread)

(1) Equipment

(a) The edge traces used in the analysis are accomplished by the Mann-Data Micro Analyzer with slit sizes of 1μ x 80μ and 1μ x 350μ. A scan speed of 0.05mm/minute and a chart speed of 4 inches per minute are used for a ratio of 200:1. One inch on the graph equals the distance of 12.5 microns on the film. Values from electronic signals are recorded on a chart and digitized as density increments at the rate of 0.89 samples per micron and about 130 samples per edge trace. The digitizer further records density values on paper tape for direct readout analysis on the IBM 1710 Computer.

(b) The IBM 1710 Computer, and associated component gear, is used to process and output the various data. Fortran programming is used.

(2) Subject Selection

(a) The small photo scale and large slit lengths limit selection to subjects having long straight edges such as runways or extremely long buildings. These subjects are carefully selected as those having the cleanest edges possible (e.g., runway edges free of debris or other objects).

(b) Subjects selected are located on the frame by the master grid (See Illustration 20, page 47) and the coordinates are recorded in Section II, Table 5, Edge Scan Analysis Data. Edge orientation of the selected subject is also recorded by degree of inclination from the line of flight (See Illustration 21, page 48).

(3) Sampling

A minimum of 20-25 edges is selected for tracing throughout the Mission.

(4) Procedures

(a) Obtain processing (D-Log E) curve for the film and frame being analyzed and store relative Log E values for sufficient density points in computer. The anti-log of each point is obtained and stored to give a table of Relative Exposure values.

(b) Trace the selected edge, digitizing the density values onto paper tape at the established interval. Each edge should produce approximately 130 density points (Illustration 22, Diagram 1, page 49).

(c) Store the digitized density values into computer memory.

(d) Convert density points to corresponding Relative Exposure values to obtain the Relative Exposure curve for the edge: Relative E versus Distance (Illustration 22, Diagram 3, page 49).

(e) Smooth the resulting curve twice with a moving average of five data points.

(f) Measure the slopes between successive points of the Relative Exposure curve to obtain the derivative curve of slope versus distance (Illustration 22, Diagram 4, page 49).

(g) Smooth this curve three times with a moving average of five data points.

(h) Note the peak value of the curve before smoothing. One-half of this value is the 50% Amplitude of the Spread Function. The distance of separation between these 50% amplitude points on the slope curve is the value reported in microns as the "Spread Function Width at 50% Amplitude" (Illustration 22, Diagram 4a, page 49).

b. Machine-Read RES (M-RES)

(1) (2) (3) - same as Paragraph 2. a. above.

(4) Procedures

(a) Same as Paragraph 2. a. (4) (a) above.

(b) Same as Paragraph 2. a. (4) (b) above.

(c) Same as Paragraph 2. a. (4) (c) above.

(d) Same as Paragraph 2. a. (4) (d) above.

(e) The minimum and maximum E values are then normalized to the range of 0 to 1.0.

(f) The middle region of the curve is fitted to a straight line by a "least squares fit" procedure and a maximum slope is determined. The total sample length used in this fitting is on the order of eight microns.

(g) The slope of this line is computed and supplied as output. Since the Relative E axis has been normalized, this slope is identical to the reciprocal of the equivalent width of the edge corresponding to the linear slope computed. The slope value thus determined becomes "Machine RES" when multiplied by 1000 (Illustration 22, Diagram 3a, page 49).

c. Modulation Transfer Function (MTF)

(1) (2) (3) - same as Paragraph 2. a. above.

(4) Procedures

(a) Same as Paragraph 2. a. (4) (a) above.

(b) Same as Paragraph 2. a. (4) (b) above.

(c) Same as Paragraph 2. a. (4) (c) above.

(d) Same as Paragraph 2. a. (4) (d) above.

(e) The results are then normalized to the range of 0 to 1.0.

(f) The Exposure curve is differentiated to produce an estimate of the impulsive response (spread function) of the system (Illustration 22, Diagram 4, page 49).

(g) Transform smoothing is applied in the form of an arbitrary weighting function applied to the differentiated points. The result of such a multiplication in the distance plane is convolution

in the frequency plane which tends to produce a smoothed estimate of the transform. The weighting function is applied at the determined edge center, has a width equal to that of the sample set, and has suppressed side lobes (Illustration 22, Diagram 5, page 49).

(h) The Fourier transform of the differentiated edge response is computed in a manner whereby each sample is regarded as a rectangular pulse. Only the modulus of the Fourier transform is supplied as output (Illustration 22, Diagram 5a, page 49). A mathematical description of the Fourier transform is included in the next sub-paragraph.

(i) Given a function F (X) which represents the convolution of a step stimulus with a system spread function, the impulsive response of the system is given by:

$$I(X) = \frac{d}{dx} F(X)$$

and is representative of the convolution of the spread function with an impulsive function. Due to the sifting property of the impulsive function, this result is therefore the system spread function S (X). Since this function operates as a convolving operator,

$$F_1(X) = \int S(T-X)\ F_0(X)\, dx$$

the Fourier transform of an object distribution F_0 (X) is modified to a new transform by the relationship

$$F[F_1(X)] = F[F_0(X)] \cdot F(S)$$

and therefore the Fourier transform of the spread function represents, on the basis of a linear hypothesis, an effective filter which modifies the spatial properties of the object distribution.

Since the function I (X) is normally of finite length and contaminated by noise, it is possible to obtain a smoothed estimate of the transform by convolving the transform with an even function. Such an operation is equivalent to a multiplication in the spatial plane. We can therefore obtain this smoothed estimate by multiplying I (X) by a suitable even function. In the present program, this weighting function is of simple traingular shape although it will soon be modified to the conventional spectral analysis "hamming" function.

The location of the center of the weighting function is found by numerical integration of the step response, extended "ad infinitum" at a constant level for regions outside the measuring interval. The intersection of the extension of the linear portion of this integral to the X axis provides an improved estimate of the most central location of the spread function.

Fourier transformation, then, is accomplished by

$$F[I(X)] = \int_0^{X_0} I(X) \cdot W(X-T_0) \exp(-jwx),$$

which is accomplished in a straight-forward manner.

Output is the transform modulus:

$$T(W) = \left| F[\, I'(X) \,] \right|$$

(j) Aerial Image Modulation (AIM) curves for Type 4404 Film with 2:1 contrast are plotted against MTF values for each trace to determine the point of intersection. These values in cycles/mm, are recorded in the table of edge analysis values. In those cases where a normal intersection of these curves does not occur before noise disrupts the curve, the response curve is sometimes extrapolated in a normal course to determine the intersection. Should a large discrepancy exist which would make extension of the response curve uncertain, the data is declared invalid. The percentage of the number of edges which required such curve extension to determine the intersection point is always reported.

3. Controlled Range Network (CORN) Operations

The Controlled Range Network (CORN) is a program designed to measure and properly utilize a series of fixed resolution target displays of varying sizes and types located throughout the U. S. and Canada. In addition to these fixed sites, there are three ground mobile target units and two air mobile target units stationed at key points in the U. S. The complete description of this program and the targets used therein is found in the Controlled Range Network (CORN) Manual.[4]

a. Ground Mobile

(1) The transportation unit provided in support of the ground mobile target displays consists of a prime mover and an operations and residence trailer. The prime mover is a four-passenger 4' x 4' vehicle capable of cross-country operation with target units loaded thereon. The instrumentation and residence trailer is a standard trailer fully equipped for the self-sufficiency of a three-man crew. The transportation unit will permit off-road operations for periods up to six days in isolated areas with no demands for other ground or air support.

(2) Each unit consists of combinations of the following target arrays available upon request. The user may request the support of any part, any combination of parts, or the total display. The targets are:

(a) "T" Bar, low contrast
(b) Bull's-eye (available for use, but not normally included in operational display)
(c) "T" Bar, high contrast
(d) Modified MIL-STD 150A
(e) Tri-Color & Point Source
(f) Control Scene Brightness Target

[4] Manual, Controlled Range Network, published by Data Corporation for USAF, Contract AF33(657)-13720.

(3) Full instrumentation, in accordance with Controlled Range Network procedures, wil be operated in support of this unit.

b. Air Mobile

(1) Each unit is composed of six separate target arrays available for movement by air vehicle to a suitable site upon request. The user may request the support of any part, any combination of parts, or the total display. The targets are:

(a) "T" Bar, low contrast

(b) "T" Bar, high contrast

(c) Bull's-eye (available for use, but not normally included in operational display)

(d) Tri-Color & Point Source

(e) Control Scene Brightness Target (small sections only)

(2) Full instrumentation, in accordance with Controlled Range Network procedures, will be operated in support of this unit.

c. Site Instrumentation

The instruments used in support of a mobile display are identical to those used throughout the Controlled Range Network and will permit the reporting of:

(1) Atmospheric temperature

(2) Local barometric pressure

(3) Local humidity

(4) Wind speed and nature (gusty, steady, etc.)

(5) Wind direction

(6) Cloud cover in % (photo record)

(7) Cloud cover by type (visual and photo)

(8) Insolation

(9) Target component reflectance

(10) Other data (rain, snow, dust, etc.)

d. Canvas Target Displays

These mobile units consist of varying combinations of the following canvas target displays:

(1) Modified MIL-STD 150A Target

This target consists of high contrast three-bar groupings, horizontally and vertically displayed. The groupings have 4' x 20' bars as the largest element, and the bars decrease by the sixth root of two to a 6" x 30" bar as the smallest element.

In addition, this display has been modified to include three sine wave groupings composed of 1', 1.5', and 2' wide sine wave targets, plus two, 15' square, black and white, densitometer patches.

(2) Bull's-eye

The Bull's-eye target is a round display, 75' in diameter, consisting of four concentric rings, eight feet in width, with a 10' diameter center. The target is fabricated from material of five differing reflectances.

(3) "T" Bar Target (High Contrast)

The high contrast black and white "T" Bar Target consists of two legs, each 20' x 233', utilizing three bar groupings, beginning with a 4' wide bar and decreasing by the $\sqrt[6]{2}$, to a 6" wide bar. All bars are twenty feet long and are perpendicular to the long axis of the display. Each bar grouping consists of three black bars and two white bars. Each grouping is separated by a white patch equal to twice the width of the black bar element of the succeeding smaller grouping. The two legs are normally displayed in the form of a letter "T", with one leg parallel with the line of flight and one leg perpendicular to the line of flight. Currently these "T" Bar Targets are being modified to make all bars have a 5:1 length to width ratio for each bar in correspondence with past national standards for resolution targets instead of the constant 20' bar length discussed above. At such time as this modification is complete, the tables which follow will be changed.

Bar Group No.		Width	Length
1	Panel 1	4 ft.	20 ft.
2		3 ft., 6.75 in.	20 ft.
3	Panel 2	3 ft., 2.125 in.	20 ft.
4		2 ft., 9.937 in.	20 ft.
5	Panel 3	2 ft., 6.25 in.	20 ft.
6		2 ft., 2.937 in.	20 ft.
7		2 ft., 0 in.	20 ft.
8	Panel 4	1 ft., 9.375 in.	20 ft.
9		1 ft., 7.06 in.	20 ft.
10		1 ft., 5 in.	20 ft.
11	Panel 5	1 ft., 3.125 in.	20 ft.
12		1 ft., 1.5 in.	20 ft.

Bar Group No.		Width	Length
13		1 ft., 0 in.	20 ft.
14		10.687 in.	20 ft.
15		9.5 in.	20 ft.
16	Panel 6	8.5 in.	20 ft.
17		7.562 in.	20 ft.
18		6.75 in.	20 ft.
19		6.0 in.	20 ft.

(4) "T" Bar Target (Low Contrast)

The high contrast resolution targets currently in use are not entirely suitable for determining resolution of high altitude reconnaissance photography because normal camera exposure for terrain is not correct for the high contrast "T" Bar target which has an average reflectance of about 50%. The generally accepted scientific estimate of world-wide average terrain reflectance is approximately 20%. A "T" Bar target was developed having 37% reflectance on the lighter, gray bars and 3% reflectance on the black bars, for a target average of 20%. This new resolution target is called the "T" Bar Target (low contrast). The target consists of two legs, each 20' x 327', utilizing three bar groupings, beginning with an 8' wide bar group, a 6' wide bar group, and a 4' wide bar group, and then decreasing thereafter by the $\sqrt[6]{2}$, to a 6" wide bar group. All bars are twenty feet long and are perpendicular to the long axis of the display. Each bar grouping consists of three black bars and two gray bars. The bar groups are separated by a gray patch equal to twice the width of the black bar element of the succeeding smaller grouping. The two legs are normally displayed in the form of a letter "T", with one leg parallel and one leg perpendicular to the line-of-flight. Similarly, these low contrast "T" Bar targets are being modified to a standard 5:1 length to width ratio for each bar.

Bar Group No.		Width	Length
1	Panel 1	8 ft.	20 ft.
2	Panel 2	6 ft.	20 ft.
3	Panel 3	4 ft.	20 ft.
4		3 ft., 6.75 in.	20 ft.
5	Panel 4	3 ft., 2.125 in.	20 ft.
6		2 ft., 9.937 in.	20 ft.

Bar Group No.		Width	Length
7	Panel 5	2 ft., 6.25 in.	20 ft.
8		2 ft., 2.937 in.	20 ft.
9		2 ft., 0 in.	20 ft.
10	Panel 6	1 ft., 9.375 in.	20 ft.
11		1 ft., 7.06 in.	20 ft.
12		1 ft., 5 in.	20 ft.
13	Panel 7	1 ft., 3.125 in.	20 ft.
14		1 ft., 1.5 in.	20 ft.
15		1 ft., 0 in.	20 ft.
16		10.687 in.	20 ft.
17		9.5 in.	20 ft.
18	Panel 8	8.5 in.	20 ft.
19		7.562 in.	20 ft.
20		6.75 in.	20 ft.
21		6.0 in.	20 ft.

(5) Tri-Color

This target consists of three canvas panels, each 12' x 20', of solid red, white and blue color. These are normally displayed as a 12' wide unit, parallel to the line-of-flight, with the Point Source displayed in the center of the blue panel.

(6) Point Source

This target is a highly polished metal hemisphere, 19.5" in diameter, which is displayed on a blue canvas panel, 12' x 20'. When requested, the Point Source will be displayed in the center of the black patch of the Modified MIL-STD 150A Target.

(7) Controlled Scene Brightness Target

The design of this target is a result of recommendations from the Drell-Chapman Committee. It is constructed to have an average reflectance value of 20% and two extremely long edges arranged at right angles to each other. The complete target is handled by a ground mobile unit. The target consists of one hundred and two 40' x 20' panels grouped into three major panels which can be assembled into a single display, providing two perpendicular edges, each 200' long (see Illustration 23, page 50). The large "edge" target can be separated into multiple sets of shorter "edge" targets as shown, which then can be moved by airborne means.

e. CORN Activation

During the operational life of a mission, CORN targets are activated through the CORN communication network.[5] The activation of targets requires manning of fixed sites and dispersal of the mobile units at predesignated locations. During the activation period, the temperature, barometric pressure, humidity, air movement, haze, cloud cover, and spectral measurements are recorded.

f. Density Traces of CORN Targets

(1) In addition to those selected for edge analysis, special traces are accomplished on frames containing imagery of resolution targets. Traces and photo enlargements are included as illustrations to the report. The density measurements obtained with the Mann-Data Micro-Analyzer are read out as specular density values, but are correlated with diffuse density by calibration with diffuse density standards. The values are measured as the mean of the grain structure within the film being analyzed.

(2) Density traces of CORN targets are produced on the Mann-Data Micro-Analyzer containing a 5.8 micron spot, obtained by 40X optical reduction of an actual spot size measuring 0.0025". A scan speed of 0.5mm/min. and a chart speed of 101.6mm/min. are used for a ratio of 200:1. One inch on the graph equals a distance of 12.5 microns on the film. Values are recorded from electronic signals converted to the chart and digitizer as density. The digitizer further converts density values to paper tape for direct readout and analysis on the IBM 1710 Computer.

4. Visual Reciprocal Edge Spread (V-RES)

The visual method of measuring image edge spread, as an indicator of image quality in photographic evaluations described below, is an historic tool in the analysis of photographic reconnaissance satellite missions. This method determines the effectiveness of such missions to obtain maximum detail. Values obtained are called Visual Reciprocal Edge Spread (V-RES). Tests are presently being conducted to determine the value of V-RES compared to objective measures of edge spread (par. 2. above) in mission evaluation and to identify any limitations which may exist in this technique. Analysts are continually being trained and tested in edge spread measurement to improve validity of results. When the term "RES" is used alone, it refers to V-RES as described here.

a. Equipment

(1) V-RES measurements are made with an AO Spencer microscope containing 4X, 10X and 25X Zeiss Planapo objective lenses, and with either an 8X or a 16X Zeiss Screw Micrometer Eyepiece. The microscope is mounted on a quality inspection viewer and can be moved vertically or horizontally over the entire viewing area. It is equipped with a device which allows it to be locked into position. The Zeiss Screw Micrometer Eyepiece contains a moveable cross hair which bisects the viewing area. The entire

[5] Ibid, Footnote Nr. 4, page 38.

device, as described in Illustration 24, page 51, can be rotated 360°, allowing measurement of any edge of the subject.

(2) The calibrated indicator is divided into 100 units. Calibration for each power follows:

Objective	Eyepiece	Power	No. of Units	Calibration
4X	8X	32X	1	1/376 mm (Average)
4X	16X	64X	1	1/376 mm (Average)
10X	8X	80X	1	1/940 mm (Average)
10X	16X	160X	1	1/940 mm (Average)
25X	8X	200X	1	1/2350 mm (Average)
25X	16X	400X	1	1/2350 mm (Average)

b. Frame Sampling

V-RES measurements are accomplished on selected frames of each Rev throughout the mission. Each frame is divided into five areas from right to left when viewed facing the direction of flight (see Illustration 25, page 52). Two V-RES measurements are made on each subject selected as explained below.

c. Subject Selection

Subjects selected for V-RES measurements must have good relative contrast with their associated shadow image, and relatively straight lines or edges such as the edge of a building, aircraft, or road. Cultural features present the best edges for measurement, but certain natural features can be measured to some degree such as a river bank or mountain ridge. An object containing edges both parallel and perpendicular to the line of flight is preferred. If no entry appears on the frame selected for measurement, as recorded in the table of V-RES values, either no suitable subjects for measurement existed or measurement was impossible due to weather conditions or poor contrast.

d. V-RES Measurement

The object selected for measurement will have one or more relatively straight edges such as the sides of a building, road, or stream. Due to resolving power limitations of the film/camera system, each edge will consist of a line delineating the apparent edge of the object and a "fuzzy" area as shown in Illustration 26, page 53. The analyst places the microscope cross hair on one side of this "fuzzy" area and reads the indicator dial, then moves the cross hair to the other side of the "fuzzy" area and reads the indicator dial. The difference between these readings is the measurement of the "fuzzy" area or edge "spread." The reciprocal of this value (in thousandths of a millimeter) is described as the V-RES value for the edge measured.

5. Image Motion

a. Two V-RES measurements are accomplished in each area of a frame, where possible: one on an edge that is approximately parallel and the other on an edge that is approximately perpendicular to the line-of-flight (Illustration 26, page 53). A difference in the amount of degradation between the two directions (a difference in V-RES value) is considered to be an indication of the relative degree of image motion. The direction of image motion is perpendicular to the "edge" measuring the largest V-RES value. In the table of V-RES values, the measurements are recorded as follows: measurement of edge spread parallel to the line-of-flight is entered under the "W" column (With the line-of-flight), and edge spread perpendicular to the line-of-flight is entered under the "A" column (Across the line-of-flight). No attempt is made in this evaluation to determine whether the image motion is due to incorrect IMC settings or to vehicular motion, but merely to identify that some image motion does exist. The exact single direction in which motion occurred is not measured. The use of the word "direction" indicates the component of motion either parallel or perpendicular to the line-of-flight.

b. The accuracy of the edge spread measurement technique has not been firmly established Therefore, a small difference in V-RES values parallel and perpendicular to the line-of-flight in one area of a frame may not be a valid indication of image motion in that area due to measurement technique inaccuracies. As a result, identification of image motion, as discussed in Section II, will be considered significant only when a difference of more than 10 V-RES units is noted. Tests are presently being conducted to determine the accuracy of the edge spread technique, and the results will be applied to the study of image motion as soon as valid data is available.

6. Description of Subject Environment

a. Sun Angle

The sun angle for each frame evaluated is extracted from the ephemeris received for the mission and is entered in the table of diffuse density values.

b. Geographic Latitude

The geographic latitude for each frame evaluated is extracted from the ephemeris received for the mission and is entered in the table of diffuse density values.

c. Other Environmental Factors

Data is presently being gathered and recorded, and techniques are being established for the accurate correlation of environmental factors with the data measured as part of the photographic evaluation. These environmental factors include subject type [buildings, roads, runways, tanks, quonset huts (arched roof construction), etc.], climatic zones, weather conditions (atmospheric conditions), and terrain types (flat, hilly, and mountainous).

D. Analysis of Film Format Characteristics

1. Titling

The titling information throughout the mission is inspected for completeness and legibility, and defects are described.

2. Time Tracks

The time track is inspected for legibility throughout the Mission, and defects are described.

3. Fiducial Lines

The fiducial lines delineating the primary image zone are inspected and defects described.

4. Double Yaw Slits

The double yaw slits are inspected for quality and defects are described.

5. Overlap and Sidelap

One set of stereo pairs is selected, and the percentage of overlap and sidelap is measured.

E. Film Characteristics

1. The standard H&D curves for Types 4400, 4401, and 4404 are shown in Illustrations 27, 28, and 29, pages 54 through 56.

2. Film Types 4400, 4401, and 4404 have extended red sensitivity. They are sensitive to wave lengths up to approximately 720mμ, with a peak red sensitivity of approximately 690mμ. This extended red sensitivity means that any of the three films can be used with minus-blue haze reducing filters without excessive loss in film speed.

3. The absolute spectral sensitivity determinations are shown in Illustration 30, page 57. These graphs demonstrate the absolute spectral sensitivity of Types 4400, 4401, and 4404 Films at densities of 1.0 above Gross Fog. Following is a description of the graph: The spectral sensitometer method of determining the spectral sensitivity of a photographic material is a quantitative technique. Samples are exposed in a special sensitometer to monochromatic radiation. Characteristic curves are obtained for each exposure and can be used to determine the quantity of radiant energy required to produce a given density at each wave length. The data is presented as a curve showing the logarithm of the reciprocal of the number of ergs per square centimeter required to produce the stated density as a function of wave length.

F. Data Processing

The IBM 1710 Computer and associated components, including the 1443 High Speed Printer, is used for data computation, summaries, and frequency distributions described in Section II. The IBM 1443 High Speed Printer is used as an off-line unit in conjunction with the 1620 Data Processing System (the heart of the IBM 1710) for the tabulation of RES and density data which is included in the Appendices. The digitized paper tapes from the Mann-Data Micro-Analyzer traces are converted to punched cards, and all computations described in the edge scan analysis techniques are computed with this data processing system.

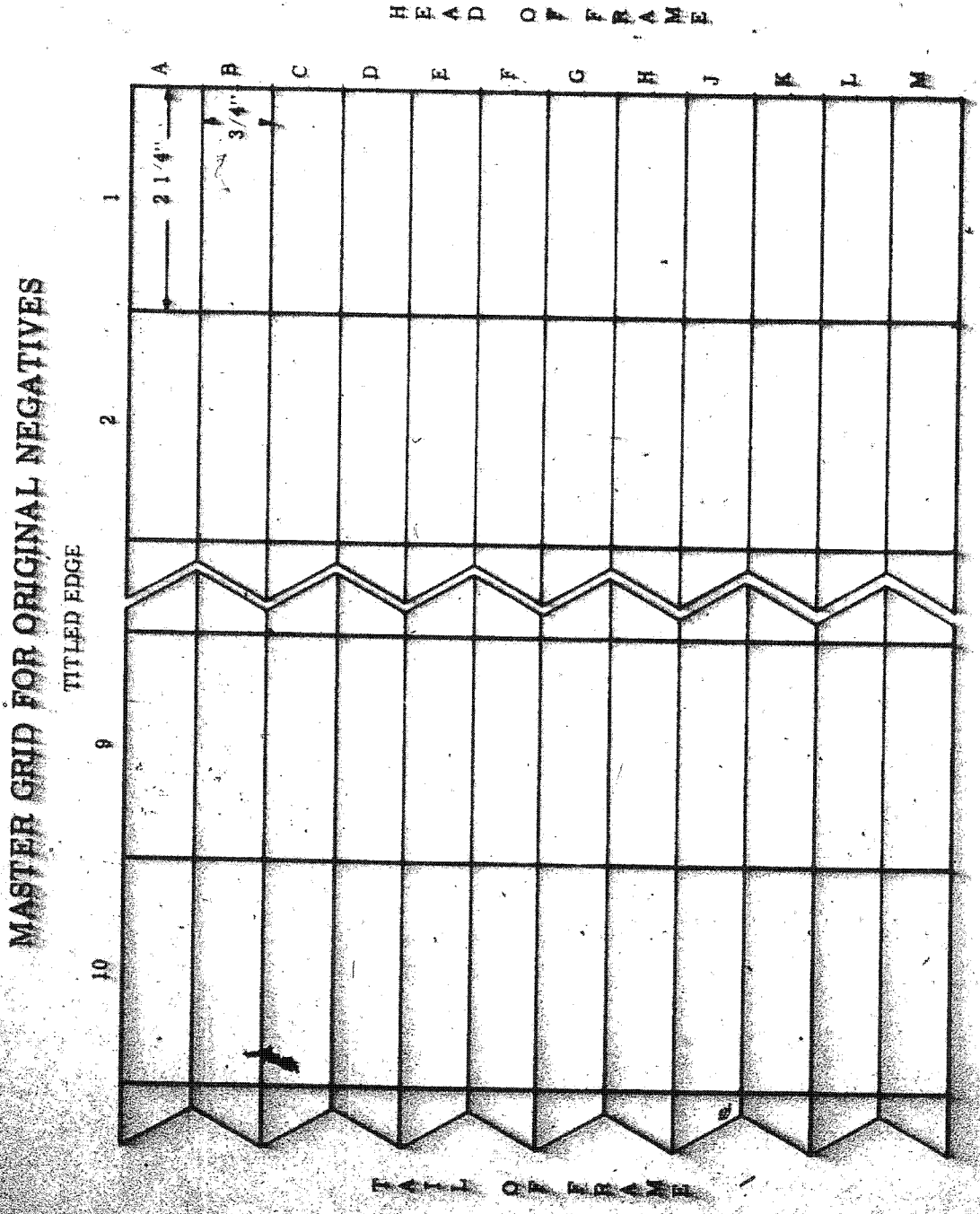


ILLUSTRATION 20

Approved for Release: 2021/05/17 C05134462

EDGE ORIENTATION

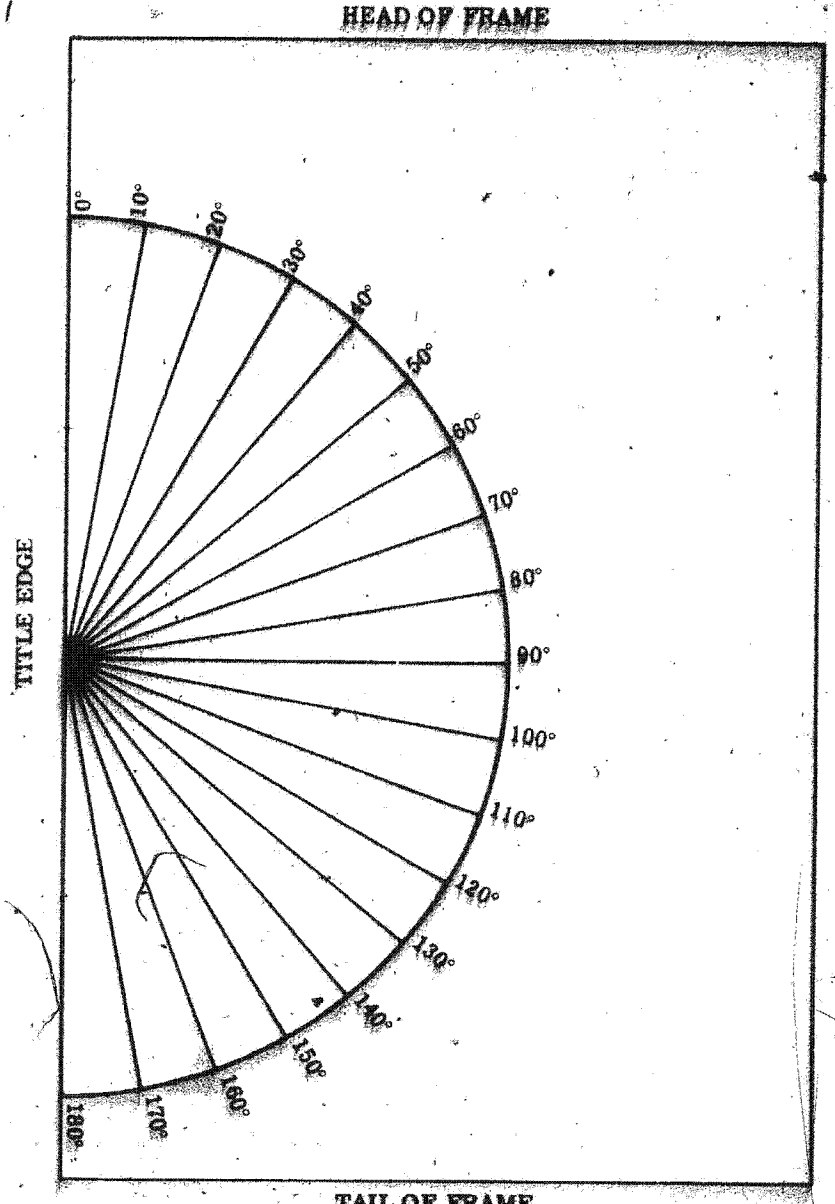


ILLUSTRATION 21

DESCRIPTIVE DIAGRAM OF ANALYSIS BY EDGE SCAN TECHNIQUES

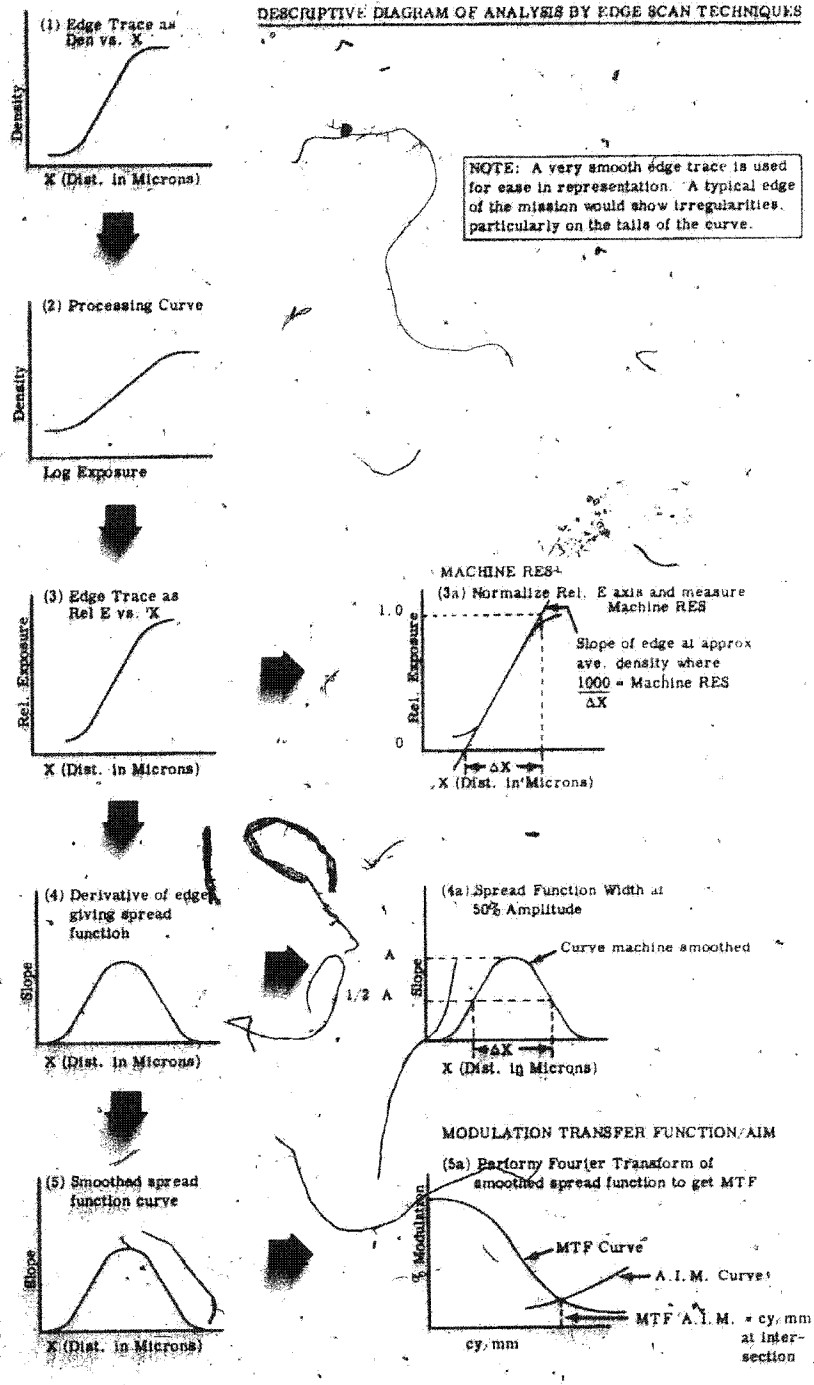
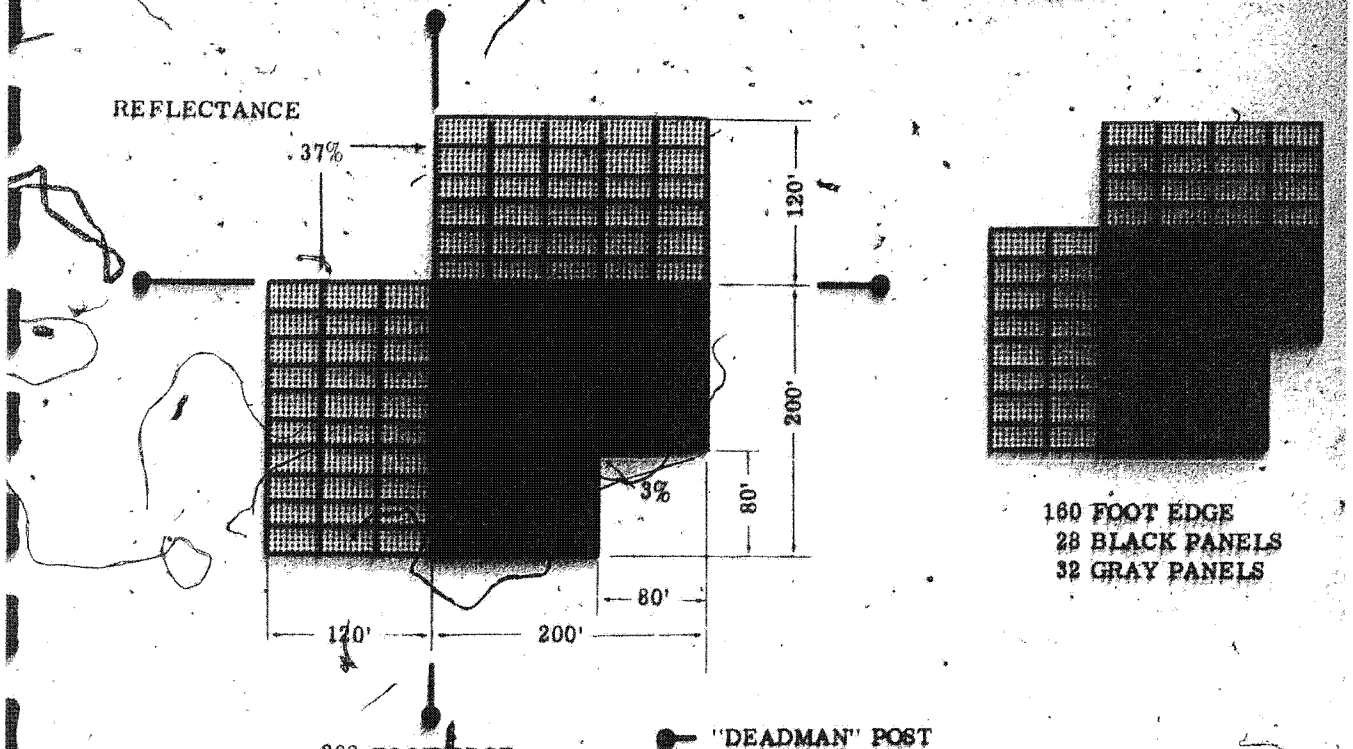
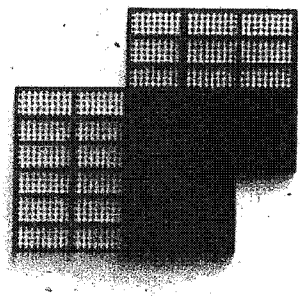


ILLUSTRATION 22

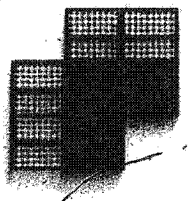
BCS 24577-64
SPPL TECHNICAL REPORT NO. 101-1-34

CONTROLLED SCENE BRIGHTNESS TARGET

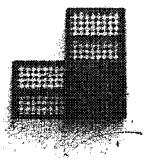




120 FOOT EDGE
15 BLACK PANELS
21 GRAY PANELS



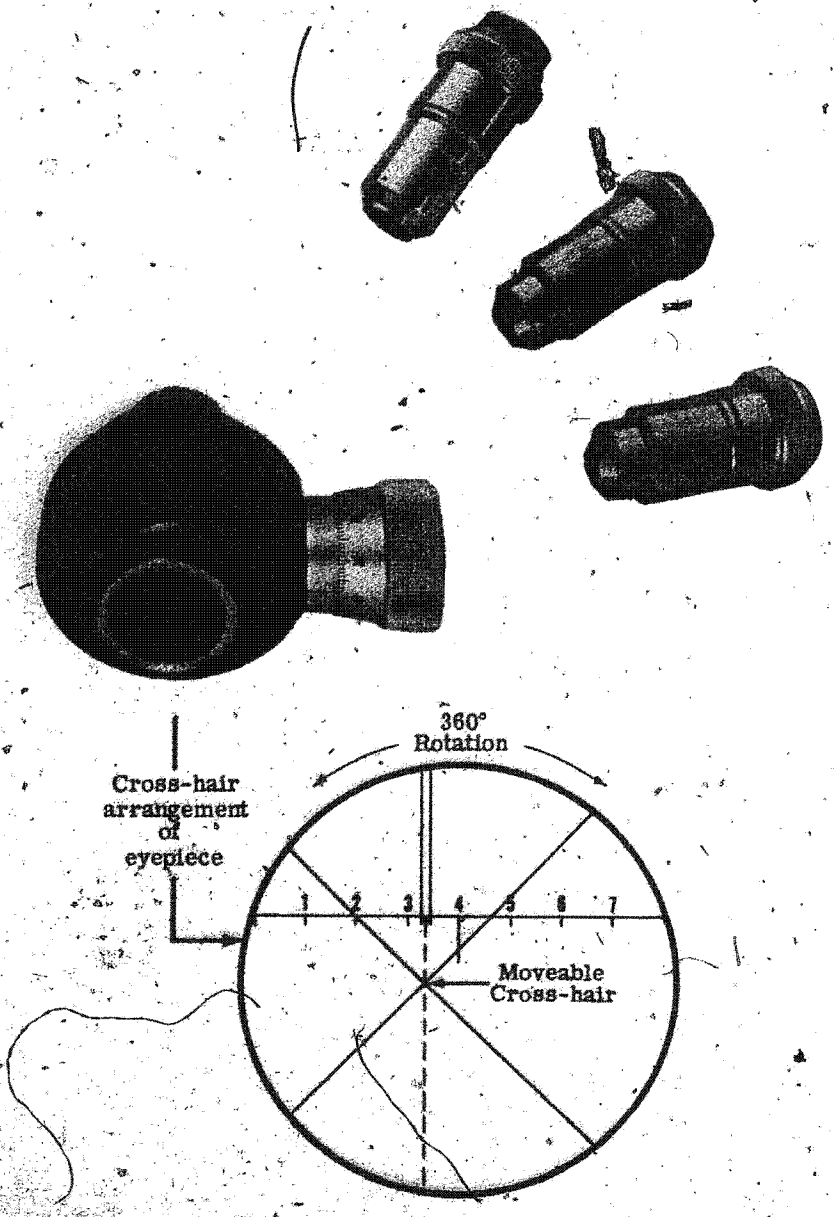
80 FOOT EDGE
6 BLACK PANELS
8 GRAY PANELS



40 FOOT EDGE
2 BLACK PANELS
4 GRAY PANELS

NOTE: Target fabricated of panels 20' x 40'

ILLUSTRATION 23



MENSURATION OPTICS

ILLUSTRATION 24

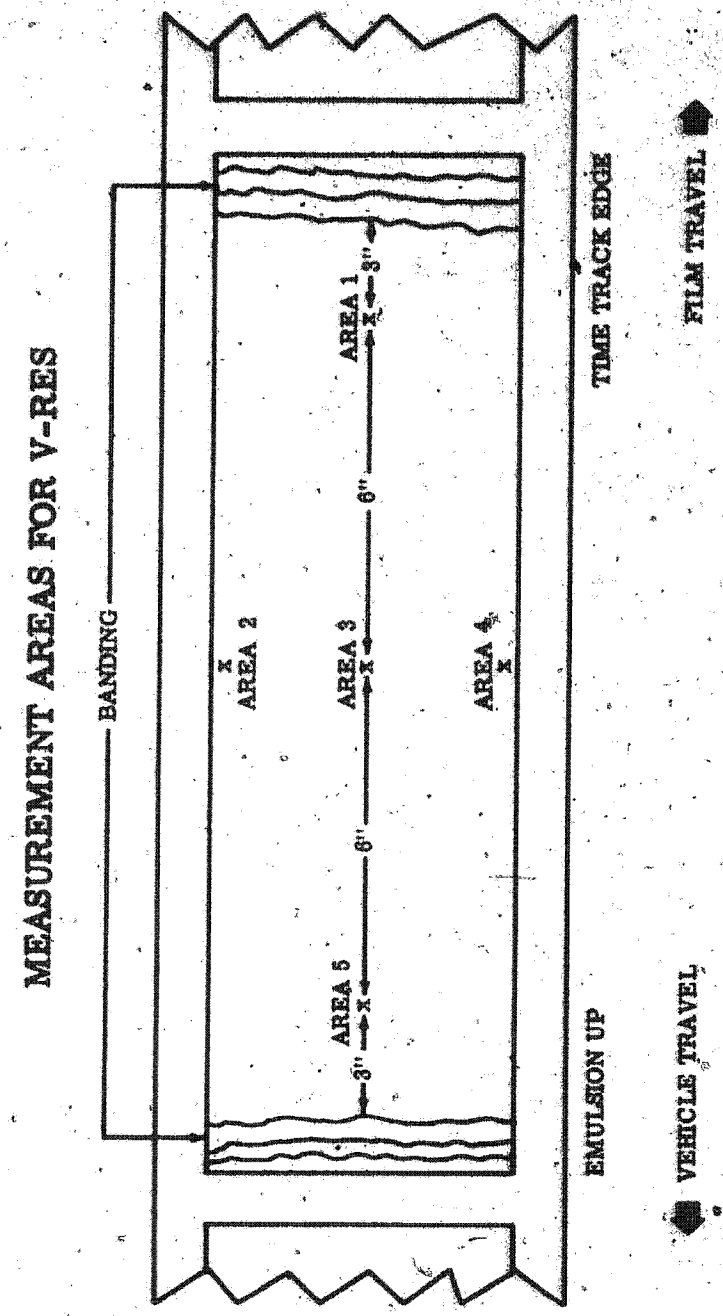


ILLUSTRATION 25

BCS 24577-64
SPPL TECHNICAL REPORT NO. 101-1-34

MEASUREMENT OF VISUAL-RECIPROCAL EDGE SPREAD (V-RES)

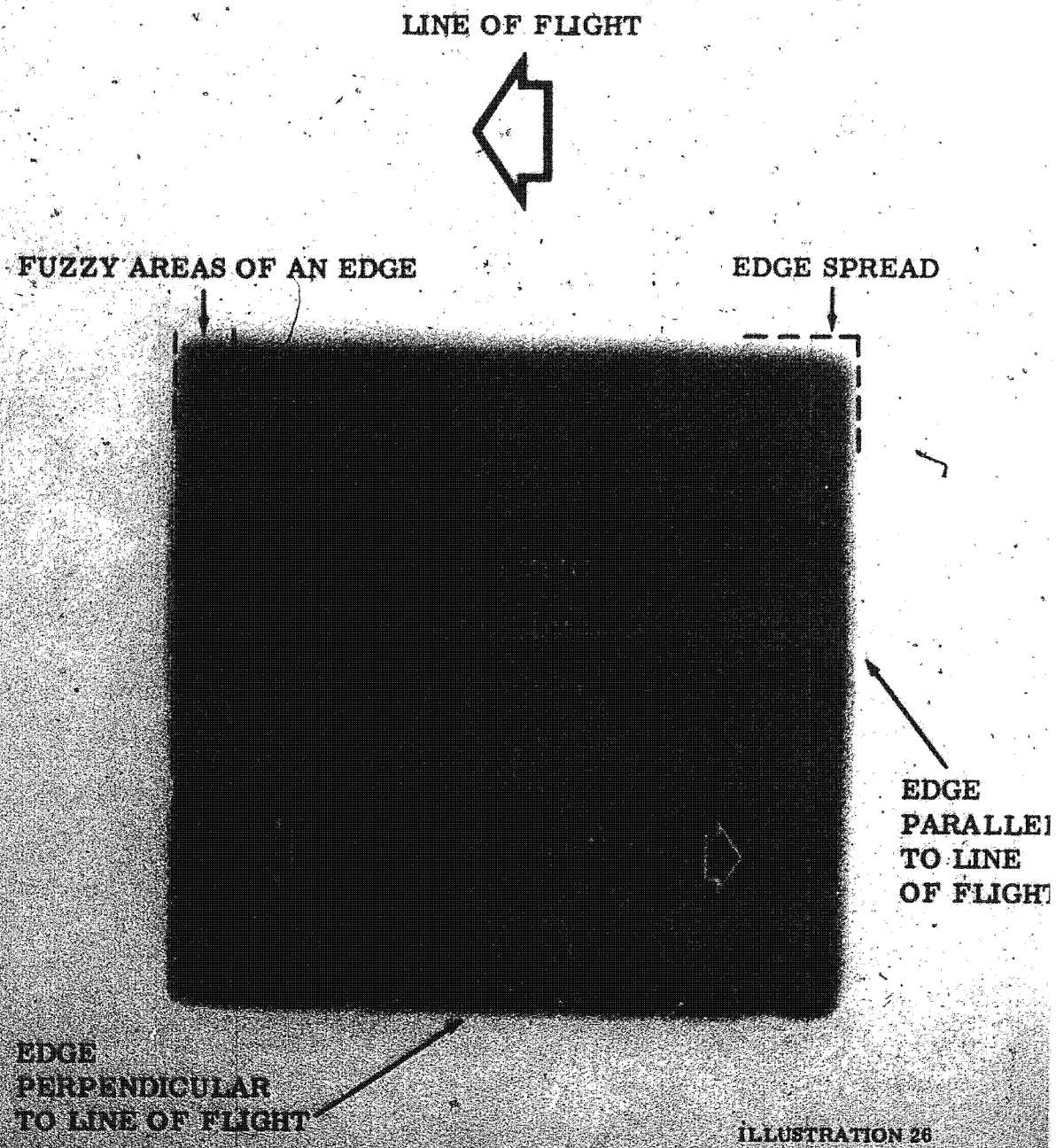


ILLUSTRATION 26

Aerial Panatomic-X
2.5 mil Estar Base
Date 20 April 1961
UP No. 62174D
Prep.by
Type 4400
Class
Mfgr. Eastman Kodak
Exp. date
Emul.No. 0-130-2-1
Lamp 5500°K
Exp.time 1/10 sec.
Wedge No. 227-150
Dev. D-19
Time 3, 5, 8, 12 min.
Temp. 68°F

Total Densities

1	8	16	
1	9	17	
2	10	18	
3	11	19	
4	12	20	
5	13	21	
6	14	Bse. Den. 0.07	
7	15		

Sensitometric Prop.
Speed( )
Gamma
Filter
Filter fact.

Time	Gamma	Speed (B)	Base + Fog	Density 21st Step
3 min.	1.90	8.89	.07	3.19
5 min.	1.98	13.44	.10	3.48
8 min.	2.02	20.32	.16	3.56
12 min.	1.98	25.00	.30	3.66

abs. log.E 7.63 - 10

ILLUSTRATION 27

BCS 24677-64
SPPL TECHNICAL REPORT NO. 101-1-34

Handle via Byeman
Controls Only

TOP SECRET - GAMBIT

ILLUSTRATION 29

5

Handle via Byeman
Controls Only

TOP SECRET - GAMBIT

ILLUSTRATION 28

55

Date 14 Feb 64/
UP No.
Prep.by
Type 4401
Class
Mfgr Eastman Kodak
Exp. date
Emul. No. 4401-8-5
Lamp 1B 6100°K
Exp.time 1/10
Wedge No.
Dev. D-19
Time 2-4-6-8 Min
Temp. 68 °F

Total Densities

1	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 1.54
Filter fact.

Time	Gamma	Speed (B)	Base + Fog	Density 21st Step
2 min.	1:40	27.47	.08	2.20
4 min.	1.72	42.37	.08	2.88
6 min.	1.88	52.30	.09	3. +
8 min.	1.88	54.80	.13	3. +

243 Type on 2.5 mil Estar Base

Date 20 April 1961

UP No. 62174D

Prep.by

Type 4404

Class

Mfgr. EK Co.

Exp.date

Emul.No. 0-132-3

Lamp 5500°K

Exp.time 2 sec.

Wedge No. 227-150

Dev. D-19

Time 3.5.8.12 min.

Temp. 68°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.	0.07
7	15		

Sensitometric Prop.

Speed( )

Gamma

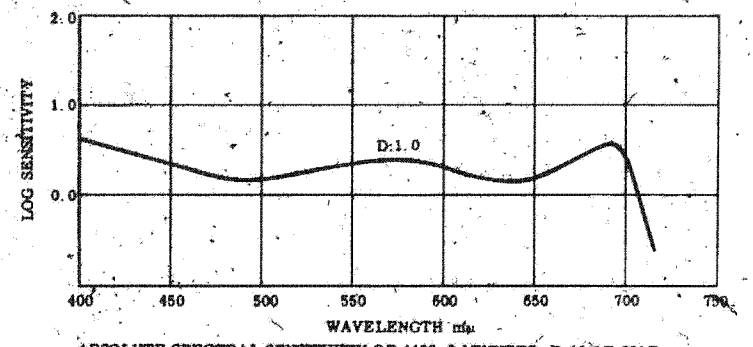
Filter

Filter fact. abs.log.E 8.93+10

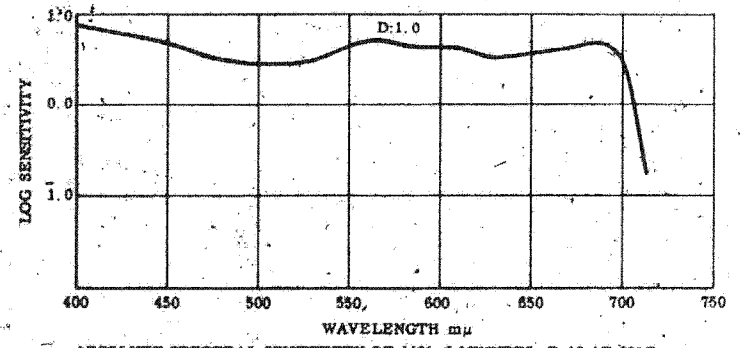
Time	Gamma	Speed (B)	Base + Fog	Density 21st Step
3 min.	2.20	0.83	.07	2.73
5 min.	2.16	1.15	.07	2.78
8 min.	2.28	1.40	.08	2.84
12 min.	2.26	1.50	.09	2.80

ILLUSTRATION 29

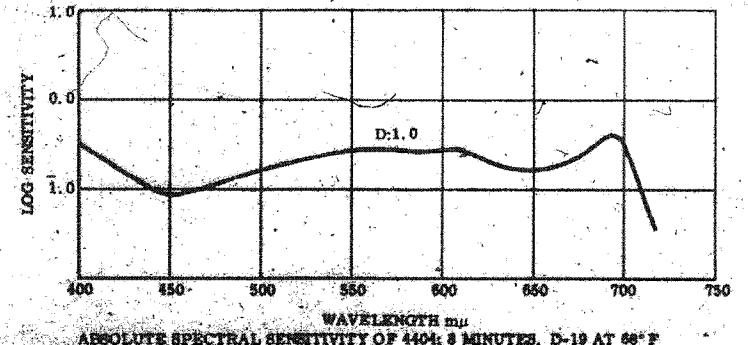
SPECTRAL SENSITIVITY GRAPHS



ABSOLUTE SPECTRAL SENSITIVITY OF 4400; 8 MINUTES, D-19 AT 68° F
SENSITIVITY: RECIPROCAL OF EXPOSURE (ergs/cm^2) REQUIRED TO PRODUCE D:1.0 ABOVE GROSS FOG.



ABSOLUTE SPECTRAL SENSITIVITY OF 4401; 8 MINUTES, D-19 AT 68° F
SENSITIVITY: RECIPROCAL OF EXPOSURE (ergs/cm^2) REQUIRED TO PRODUCE D-1.0 ABOVE GROSS FOG.



ABSOLUTE SPECTRAL SENSITIVITY OF 4404; 8 MINUTES, D-19 AT 68° F
SENSITIVITY: RECIPROCAL OF EXPOSURE (ergs/cm^2) REQUIRED TO PRODUCE D-1.0 ABOVE GROSS FOG.

ILLUSTRATION 30

SECTION IV

OBSERVATIONS AND SUMMARY

This section presents observations derived from data listed in detail in Section II. Subjects covered are Density Analysis, Analysis by Edge Scan Techniques, Visual Reciprocal Edge Spread (V-RES), Controlled Range Network (CORN) Activity, Blackbird Missions, and Physical Degradations. These values are then compared to other reports in the 4000 Series. Finally, a brief summary of the overall technical evaluation of Mission 4011 is presented.

A. Density Analysis

1. The table below is a summary of measured and computed image density values:

	Range	Average	Standard Deviation (σ)
Dmin	0.32 - 1.50	0.74	0.23
Dmax	0.74 - 2.32	1.58	0.31
$\bar{D}$	0.57 - 1.75	1.16	0.22
ΔD	0.06 - 1.80	0.83	0.32
Base + Fog	0.14 - 0.32	0.25	0.04
Dmax Clouds	1.07 - 2.43	2.14	0.24

2. The range of Dmin, Dmax, and $\bar{D}$ values for Mission 4011 is narrower than 4006 and 4007, wider than 4008 and 4009, and similar to 4010. The range of ΔD values for this Mission is similar to 4006 and 4007, but wider than 4008, 4009, and 4010.

3. The averages of Dmin, Dmax, and $\bar{D}$ values for Mission 4011 are near the mean for this series of missions and slightly higher than 4007, 4008, 4009, and 4010. The average ΔD value is near the series mean and slightly lower than 4010, but higher than 4007, 4008, and 4009.

B. Analysis by Edge Scan Techniques

The analysis by edge scan techniques produces values for the Modulation Transfer Function (MTF), Spread Function Width at 50% Amplitude (50% Spread), and Machine Reciprocal Edge Spread (M-RES). These measurements are performed by two independently working teams: the SPPL Technical Evaluation Team, and a group of scientists and consultants from industry. The average values for Mission 4011 from the SPPL Team are higher than corresponding values from the Scientist/Consultant Team. The Scientist/Consultant Team has maintained consistently higher average MTF/AIM and 50% Spread values than those from the SPPL Team for previous missions of this series.

1. AFSPPL Team

a. The SPPL Team used three methods of analysis: Modulation Transfer Function/Aerial Image Modulation (MTF/AIM), 50% Spread, and M-RES. Twenty-six edges were traced with the 1μ x 80μ

and 1μ x 350μ slits on the Mann-Data Micro-Analyzer. A summary of this data is presented below:

Summary of Edge Scan Analysis (SPPL)

Mission 4011 No. of Edges - 26

Method of Analysis		Arithmetic Mean		Standard Deviation		Coefficient of Dispersion	
		350μ	80μ	350μ	80μ	350μ	80μ
Spread Function Width at 50% Amplitude	Width in Microns	30.4	23.3	9.4	8.8	31%	38%
	Reciprocal of Width	36	49	10.3	18.7	29%	39%
Machine-Read RES		29	32	10.8	13.2	38%	42%
MTF/AIM		45	36	14.2	11.8	31%	32%
Visual RES		54		14.2		26%	

b. The average values for the three techniques (comparison made with the 1μ x 350μ slit only) from Mission 4011 were slightly lower than Mission 4010 except for the MTF/AIM value which is slightly higher. Average values were considerably lower for this Mission when compared to Missions 4006, 4007, and 4008.

2. Scientist and Consultant Team

a. The Consultant Team traced 30 edges on the original negatives with an Eastman Kodak Model 5 Microdensitometer using a 1μ x 80μ slit. The resulting edge data was analyzed by two methods: MTF and 50% Spread. Data from the 50% Spread is recorded in microns. The complete report of the Scientist/Consultant Team analysis is included as Appendix 5, pages 5-1 through 5-8. A summary is presented below:

Summary of Edge Scan Analysis-Scientist Consultant Team

Mission 4011 No. of Edges - 30

Method of Analysis		Arithmetic Mean 1μ x 80μ	Standard Deviation 1μ x 80μ	Coefficient of Dispersion 1μ x 80μ
Spread Function Width at 50% Amplitude	Width in Microns	40.2	15.0	37%
	Reciprocal of Width	30	14.9	50%
MTF/AIM		33	11.1	33%

b. The average values of the MTF/AIM and 50% Spread of Mission 4011 are considerably lower than Missions 4006, 4007, 4008, and 4010.

C. Controlled Range Network (CORN) Activity

1. Ten "Mobile Target Displays" were programmed for this Mission. However, only seven were displayed; of these seven targets, photographic coverage was obtained on three.

2. Targets covered were the Air Mobile Unit at Wheeling Co. Airport, Ohio (Rev D47E, Frame 001); Ground Mobile Unit No. 1 near Morgansville, West Virginia (Rev D47E, Frame 002); and Air Mobile Unit at Cherokee Airport, Iowa (Rev D64E, Frame 004).

3. The resolution of the "T" Bar Targets (low and and high contrast) were read resulting in a ground resolution of 8 to 12 feet. The Controlled Scene Brightness Targets were analyzed on the Mann-Data Micro-Analyzer, with a 1μ x 80μ slit, and measured values are included in the Edge Scan Analysis Table, page 8.

D. Blackbird Mission

1. Blackbird Missions were flown on 25 September 1964 to coincide with Rev D47E and on 27 September 1964 to coincide with Rev D64E of Mission 4011. No duplicate coverage was received from the Mission on 25 September 1964, but was obtained on 27 September 1964 of the CORN Target at Cherokee Airport, Iowa.

2. The "T" Bar Target (low contrast) was read, resulting in a ground resolution of less than one foot for the KA-2 Camera which contained SO 190 Film (Frame 045, approximate scale: 1:9,000). A ground resolution of two feet was attained for the KC-1 Camera containing the 5401 Film (Frame 048, approximate scale: 1:18,000).

E. Visual Reciprocal Edge Spread (V-RES)

1. V-RES data consisted of 444 measurements. The values ranged from 20 to 78 with an average of 44.

2. The average V-RES value is lower when compared to Mission 4010 which had an average of 68, and is less than half of the average V-RES reported for Missions 4006 (97), 4007 (91), 4008 (95).

F. Physical Degradations

1. Imaged Degradations

a. Cross-track image smear was evident throughout the Mission.

b. Each frame was slightly degraded by assorted flares and reflections.

2. Superficial Degradations

a. Irregular, fine, emulsion abrasions occurred primarily along the titled edge of approximately 16 frames.

b. Minus-density spots parallel to and 1.9" from the non-titled edge occurred approximately every three inches on all frames of Rev D04 - D22.

G. Summary

1. With the exception of cross-track image smearing, this Mission was relatively free from image degradations normally observed throughout the 4000 Series missions.

2. Exposure and processing was considered excellent.

3. The averages for Dmin, Dmax, $\bar{D}$, and ΔD values are near the mean for this series of missions.

4. Analysis by edge scan techniques shows this Mission to be of generally poorer quality than previous missions.

SECTION V

REFERENCES

1. Messages, 23 and 28 September 1964

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

3. Data Corporation, USAF Contract AF33(657)-12720, Dayton, Ohio, Controlled Range Network

SECTION VI

APPENDIX

TABLE 1 - Mission Data

Mission 4011

Rev	Roll	Frames	Rev	Roll	Frames
D04	1 of 1	001-002	D36	1 of 1	001-002
D05	1 of 1	001-020	D37	1 of 1	001-011
D06	1 of 1	001-016	D38	1 of 1	001-022
D07	1 of 1	001-012	D39	1 of 1	001-011
D08	1 of 1	001-013	D40	1 of 1	001-013
D09	1 of 1	001-027	D41	1 of 1	001-023
D10	1 of 1	001-015	D42	1 of 1	001-027
D11	1 of 1	001-002	D43	1 of 1	001-006
D14E	1 of 1	001-004	D44	1 of 1	001-022
D15E	1 of 1	001-013	D47E	1 of 1	001-006
D16E	1 of 1	001-008	D48E	1 of 1	001-015
D19	1 of 1	001-004	D49E	1 of 1	001-004
D20	1 of 1	001-011	D52	1 of 1	001-002
D21	1 of 1	001-013	D53	1 of 1	001-006
D22	1 of 1	001-031	D54	1 of 1	001-022
D23	1 of 1	001-010	D55	1 of 1	001-020
D24	1 of 1	001-012	D56	1 of 1	001-020
D25	1 of 1	001-037	D57	1 of 1	001-023
D26	1 of 1	001-023	D58	1 of 1	001-033
D30	1 of 1	001-002	D59	1 of 1	001-008
D31E	1 of 1	001-012	D63E	1 of 1	001-006
D32E	1 of 1	001-005	D64E	1 of 1	001-009
D33	1 of 1	001-002	D65E	1 of 1	001-007
D35	1 of 1	001-002			
TOTALS:	47 Revs	- 47 Rolls	- 814 Frames		

TABLE 2 - Camera Data

Mission 4011

Camera Nomenclature	Type	Titling	Lens	Focal Length	Slit Width	Filter Type	Aperture	Shutter Type	Shutter Speed	Obliquity Range	Stereo Aim Angle	Film Load	Format Size	Data Block	Grid
Gambit	Strip	Affixed After Processing Includes Rev Frame and Classification	Maksutov	77" (aprx.)	.0167"	B&L Y-10	F/3.95 Effective T-Stop 6.42 w/filter	Focal Plane Interchangeable Slit Widths	Variable with V/h	± 45°	± 15°	9 1/2" x 3000'	8.718" Scene Width, Scene Length Variable	Two Time Tracks, 23-bit Time Label Double Yaw Slit Image Area	Fiducial Lines
Stellar	Frame	Affixed After Processing Includes Frame Nr.	Canon	85mm (aprx.)	n/a	None	F/1.9	Between the Lens	2 sec.	n/a	n/a	35 mm x 80'	15/16" Diameter	None	Reseau
Index	Frame	Affixed After Processing. Includes Frame & Classification	Biogon	38mm (aprx.)	n/a	Schott OG-5	F/5.3	Between the Lens	1/550 sec.	n/a	n/a	70 mm x 135'	2 1/4" x 2 1/4"	None	Reseau

TABLE 3 - Film Data

Mission 4011

Camera	Film Type	Type of Base	Nominal Base Thickness	Aprx. Exp. Index Daylight	Typical Gel Layer Thickness		Resolution
					Emulsion	Gel Backing	
GAMBIT	(4404) Estar Thin Base	Estar Polyestar	2.5 mils	1.6	0.24 mils	0.27 mils (Dyed)	200 l/mm at T.O.C. 1.6:1 (D-19) 475 l/mm at T.O.C. 1000:1 (D-19)
Stellar	(4401) Estar Thin Base	Estar Polyestar	2.5 mils	64	0.31 mils	0.24 mils (Dyed)	40 l/mm at T.O.C. 1.6:1 (D-19) 105 l/mm at T.O.C. 1000:1 (D-19)
Index	(4400) Estar Thin Base	Estar Polyestar	2.5 mils	20	0.21 mils	0.18 mils (Dyed)	65 l/mm at T.O.C. 1.6:1 (D-19) 175 l/mm at T.O.C. 1000:1 (D-19)

TABLE 4 - DIFFUSE DENSITY READINGS

MISSION 4011

REV	FRAME	D/MIN	D/MAX	$\bar{D}$	ΔD	BASE FOG	D/MAX CLOUDS	LATITUDE (DEG)	SUN ANGLE
		1.34			1.08	.18		37N	41
0	8	.80	>1.48						
0	9					.27	1.07	82N	7
0	9					.28	1.16	81N	7
0	9	.72	.99	.85	.27	.28	1.96	70N	19
0	9	.86	1.13	.89	.47	.29	2.01	69N	19
0	9	.69	1.20	.94	.51	.29	2.29	67N	22
0	9	.70	1.09	.80	.39	.29	2.33	66N	22
0	9					.29	2.12	65N	23
0	9					.27	2.26	61N	28
0	9					.27	2.29	60N	28
0	9					.29	2.29	58N	31
0	9					.28	2.16	57N	32
0	9					.29	2.15	56N	32
0	9	1.34	1.79	1.56	.45	.29		54N	35
0	9	.59	1.59	1.09	1.00	.29		53N	36
0	9	.64	1.76	1.20	1.12	.29		53N	36
0	9	.65	1.76	1.20	1.11	.28		52N	36
0	9	.86	1.67	1.26	.81	.29		51N	37
0	9	.77	1.27	1.02	.50	.29	2.30	48N	40
0	9	.86	1.47	1.16	.61	.27	2.28	48N	40
0	9					.31	2.31	47N	41
0	9	.86	1.57	1.21	.71	.30	2.16	45N	43
0	9	.96	1.77	1.36	.81	.29	2.16	44N	43
0	9	.48	1.64	1.06	1.16	.29	2.26	43N	45
0	9	.51	1.79	1.15	1.28	.28	2.27	42N	46
0	9	1.27	1.67	1.47	.40	.26	2.34	41N	46
0	9	.62	1.93	1.27	1.31	.25		40N	47
0	9	1.06	2.04	1.55	.98	.21		36N	48
0	9	.96	2.06	1.51	1.10	.21		35N	53
0	10					.22	2.15	59N	29
0	10					.26	2.26	58N	29
0	10					.27		57N	32
0	10	.64	1.57	1.10	.93	.31	2.01	55N	34
0	10	.61	1.64	1.12	1.03	.28		56N	32
0	10	.68	1.64	1.16	.96	.30	2.09	54N	34
0	10	.79	1.60	1.23	.89	.31		53N	36
0	10	.65	1.86	1.25	1.21	.30		53N	36
0	10	.80	2.00	1.40	1.20	.31		52N	36
0	10	.86	1.67	1.16	.61	.31	2.30	50N	38
0	10	.94	1.61	1.27	.67	.30	2.28	49N	38
0	10	.63	1.75	1.19	1.12	.30	2.07	48N	41
0	10	.74	1.76	1.25	1.02	.31	2.23	47N	41
0	10	.87	1.80	1.33	.93	.30		45N	42
0	10	1.11	1.83	1.47	.72	.30	2.16	42N	47
0	10	1.20	1.82	1.51	.62	.30	2.18	41N	47
0	11	.82	1.54	1.18	.72	.28	2.34	53N	36
0	11	.96	1.60	1.28	.64	.27	2.35	52N	36
0	14	.80	1.44	1.12	.64	.30		47N	42
0	14	.90	1.80	1.35	.90	.31	2.24	46N	43
0	14	.48	1.62	1.05	1.14	.30		45N	43
0	14	.60	1.70	1.15	1.10	.30		43N	45
0	15					.27	2.24	50N	34
0	15	.62	.96	.80	.36	.27	2.26	50N	36
0	15	.72	.95	.83	.23	.30	2.10	48N	40
0	15	.75	1.18	.96	.43	.27	2.26	48N	40
0	15	.57	1.27	.92	.70	.27	2.34	47N	41
0	15	.85	1.35	1.00	.70	.27	2.30	43N	46
0	15	1.06	1.77	1.41	.71	.30	2.38	42N	46
0	15	.80	1.60	1.20	.80	.28		40N	47
0	15	.90	1.80	1.35	.90	.30		39N	50
0	15	.52	1.64	.84	.64	.28	1.30	36N	53
0	15	.64	1.65	1.05	.79	.28	1.96	35N	53
0	15	.82	1.55	1.18	.73	.28		33N	55

MISSION 4011

REV		FRAME	D/MIN	D/MAX	$\bar{D}$	ΔD	BASE FOG	D/MAX CLOUDS	LATITUDE (DEG)	SUN ANGLE
D	15E	13	.96	1.80	1.38	.84	.26	1.77	33N	55
D	16E	1					.27	2.28	53N	36
D	16E	2					.27	2.28	52N	36
D	16E	3	.50	1.16	.83	.66	.27		48N	41
D	16E	4	.40	1.20	.80	.80	.27	1.35	47N	41
D	16E	5	.39	1.30	.84	.91	.29	2.08	46N	41
D	16E	6	.68	1.58	1.13	.90	.27		38N	50
D	16E	7	.74	1.56	1.15	.82	.28		37N	51
D	16E	8	.94	1.90	1.42	.96	.28		37N	51
D	19	1					.20	1.40	72N	17
D	19	2					.20	1.50	71N	17
D	19	3					.18	1.70	69N	19
D	19	4					.18	1.60	69N	19
D	20	1					.18	1.84	69N	19
D	20	2					.18	1.86	69N	19
D	20	3					.22	2.00	62N	27
D	20	4					.24	1.98	61N	27
D	20	5					.26	2.18	58N	30
D	20	6	.64	2.14	1.39	1.50	.26	2.30	57N	32
D	20	7	.74	2.32	1.53	1.58	.28	2.30	56N	32
D	20	8	1.08	1.14	1.11	.06	.30	2.32	53N	36
D	20	9					.30	2.34	52N	36
D	20	10	.74	2.06	1.40	1.32	.30	2.30	51N	38
D	20	11	.82	1.92	1.37	1.10	.30	2.33	50N	38
D	21	1	.38	1.74	1.06	1.36	.19	1.68	70N	18
D	21	2	.56	1.20	.88	.64	.18	2.20	51N	38
D	21	3	.58	1.14	.86	.56	.18	2.18	50N	38
D	21	4	.36	.88	.62	.52	.18	2.14	48N	40
D	21	5	.49	1.10	.77	.65	.18	2.14	48N	40
D	21	6					.20	2.28	47N	42
D	21	7					.22	2.26	46N	43
D	21	8	.49	.96	.72	.47	.24	2.20	44N	44
D	21	9	.72	1.50	1.11	.78	.26	2.10	43N	44
D	21	10	.76	1.52	1.14	.76	.28	2.34	2N	87
D	21	11	.76	2.18	1.47	1.42	.30	2.33	1N	87
D	21	12	.80	1.86	1.33	1.06	.30	2.38	3S	88
D	21	13	.83	1.62	1.22	.79	.30	2.31	3S	88
D	22	1					.27	2.21	73N	15
D	22	2					.27	2.06	72N	15
D	22	3	.64	1.16	.90	.52	.27	2.08	53N	35
D	22	4	.58	1.18	.88	.60	.29	2.08	52N	35
D	22	5	.51	1.32	.91	.81	.28	2.20	52N	37
D	22	6	.54	1.42	.98	.88	.28	2.34	51N	37
D	22	7	.73	1.18	.95	.45	.30	2.25	41N	47
D	22	8	.87	1.35	1.11	.48	.28	2.28	40N	47
D	22	9					.27	2.32	38N	50
D	22	10					.28	2.30	38N	50
D	22	11					.28	2.28	36N	52
D	22	12					.27	2.33	35N	54
D	22	13					.28	2.33	34N	54
D	22	14					.27	2.29	31N	57
D	22	15					.29	2.34	30N	57
D	22	16					.27	2.31	29N	60
D	22	17					.28	2.36	28N	60
D	22	18	.60	1.56	1.08	.96	.28	2.29	26N	63
D	22	19	.69	1.75	1.22	1.06	.28	2.20	25N	63
D	22	20	.78	1.40	1.09	.62	.27	2.29	24N	65
D	22	21	.86	1.66	1.26	.80	.27	2.31	23N	65
D	22	22	.96	1.87	1.41	.91	.28	2.29	22N	69
D	22	23	1.12	1.88	1.50	.76	.28	2.27	21N	70
D	22	24	.96	1.43	1.19	.47	.27	2.36	19N	70

MISSION 4011

REV		FRAME	D/MIN	D/MAX	$\bar{D}$	ΔD	BASE FOG	D/MAX CLOUDS	LATITUDE (DEG)	SUN ANGLE
D	22	25	1.00	1.30	1.15	.30	.27	2.30	18N	70
D	22	26					.23	2.10	4N	84
D	22	27					.21	2.12	4N	94
D	22	28					.20	2.38	1S	89
D	22	29					.20	2.34	2S	89
D	22	30	1.26	1.58	1.42	.32	.18	2.11	5S	86
D	22	31	1.30	1.64	1.47	.34	.19	2.00	5S	86
D	23	1	.78	1.28	1.03	.50	.26	2.22	57N	32
D	23	2	.78	1.34	1.06	.56	.26	2.30	56N	32
D	23	3	.38	1.10	.74	.72	.26	2.14	53N	35
D	23	4	.60	1.86	1.23	1.26	.17		41N	47
D	23	5	.44	1.85	1.14	1.41	.18		40N	47
D	23	6	.76	1.02	.89	.26	.17	2.12	38N	50
D	23	7	.76	1.50	1.13	.74	.16	2.16	30N	59
D	23	8	.72	1.45	1.08	.73	.27	2.28	29N	59
D	23	9	.78	1.70	1.24	.92	.28	2.30	28N	61
D	23	10					.26	2.34	27N	61
D	24	1					.25	2.14	52N	36
D	24	2					.26	2.14	51N	37
D	24	3					.26	2.17	50N	37
D	24	4	.72	1.62	1.17	.90	.26		48N	40
D	24	5	.94	1.84	1.39	.90	.27		47N	41
D	24	6	.82	1.73	1.27	.91	.26		47N	41
D	24	7	1.02	1.78	1.40	.76	.27		43N	46
D	24	8	1.11	1.89	1.50	.78	.26		42N	46
D	24	9	.94	1.73	1.33	.79	.26		40N	48
D	24	10	1.04	1.72	1.38	.68	.26		39N	48
D	24	11	.98	1.78	1.38	.80	.26		38N	51
D	24	12	1.10	1.80	1.45	.70	.26	2.08	37N	51
D	25	1	.62	1.00	.81	.38	.28		81N	6
D	25	2	.62	1.00	.81	.38	.28		81N	6
D	25	3					.28	1.70	75N	13
D	25	4					.28	1.70	75N	13
D	25	5	.50	.93	.71	.43	.28	2.06	73N	15
D	25	6					.28	2.04	73N	15
D	25	7					.28	1.90	72N	16
D	25	8					.28	1.86	71N	16
D	25	9					.28	2.00	70N	19
D	25	10					.28	1.90	68N	20
D	25	11	.68	.75	.71	.07	.28	1.98	67N	20
D	25	12	.88	1.22	1.05	.34	.28	2.32	64N	24
D	25	13	.90	1.24	1.07	.34	.28	2.34	63N	24
D	25	14	.66	.95	.80	.29	.29	2.24	59N	29
D	25	15	.70	1.22	.96	.52	.30	2.22	59N	29
D	25	16	.66	1.37	1.01	.71	.30	2.20	56N	32
D	25	17	.67	1.54	1.10	.87	.30	2.25	56N	32
D	25	18	.78	1.20	.99	.42	.28		52N	36
D	25	19	.90	1.40	1.15	.50	.28		51N	36
D	25	20	.70	1.48	1.09	.78	.28		49N	39
D	25	21	.74	1.50	1.12	.76	.28		48N	39
D	25	22	.92	1.73	1.32	.81	.28		44N	42
D	25	23	.86	1.52	1.19	.66	.28	2.28	44N	42
D	25	24	.96	1.56	1.26	.60	.28	2.37	43N	42
D	25	25	.65	1.24	.94	.59	.28	2.24	42N	46
D	25	26	.62	1.27	.94	.65	.28	2.30	41N	46
D	25	27	.54	1.58	1.06	1.04	.28		39N	49
D	25	28	.66	1.82	1.24	1.16	.28		39N	49
D	25	29	.97	1.80	1.38	.83	.29		36N	52
D	25	30	1.14	1.94	1.54	.80	.28		35N	52
D	25	31	1.08	2.15	1.61	1.07	.26		34N	55
D	25	32	1.10	2.06	1.58	.96	.24		33N	55
D	25	33	.80	1.83	1.31	1.03	.22		18N	70
D	25	34	.83	1.96	1.39	1.13	.20		18N	70

MISSION 4011

REV	FRAME	D/MIN	D/MAX	$\bar{D}$	ΔD	BASE FOG	D/MAX CLOUDS	LATITUDE (DEG)	SUN ANGLE
D 25	35	.76	1.56	1.16	.80	[illegible]	2.16	17N	71
D 25	36	.82	1.60	1.21	.78	.20	2.21	15N	73
D 25	37	.85	1.88	1.36	1.03	.20	2.28	15N	73
D 26	1					.28	1.38	81N	7
D 26	2					.28	1.36	80N	7
D 26	3					.28	2.28	70N	19
D 26	4					.28	2.22	69N	19
D 26	5	.60	1.84	1.22	1.24	.28	2.24	67N	20
D 26	6	.58	1.16	.87	.58	.28	2.13	66N	21
D 26	7					.28	2.18	61N	27
D 26	8					.28	2.16	60N	27
D 26	9					.28	2.14	59N	27
D 26	10					.28	2.23	58N	29
D 26	11	.92	1.23	1.07	.31	.28	2.20	56N	32
D 26	12					.28	2.21	55N	32
D 26	13	.50	1.56	1.03	1.06	.28	2.27	53N	35
D 26	14	.92	1.67	1.09	1.15	.28	2.24	52N	35
D 26	15	.64	1.59	1.11	.95	.28		51N	38
D 26	16	.71	1.60	1.15	.89	.28		50N	38
D 26	17					.28	2.28	49N	40
D 26	18					.28	2.35	48N	40
D 26	19	.76	1.40	1.08	.64	.28	2.32	47N	42
D 26	20	.76	1.38	1.07	.62	.28	2.34	46N	42
D 26	21	.78	1.48	1.13	.70	.28	2.32	44N	45
D 26	22	.72	1.94	1.33	1.22	.28	2.32	43N	46
D 26	23	.80	1.30	1.05	.50	.28	2.36	42N	46
D 30	1					.27	2.26	14N	74
D 30	2					.27	2.28	13N	74
D 31E	1	.70	1.76	1.23	1.06	.26		39N	49
D 31E	2	.80	1.80	1.30	1.00	.26		38N	49
D 31E	3	.82	1.88	1.35	1.06	.26	1.90	34N	55
D 31E	4	.76	1.92	1.34	1.16	.26	1.88	33N	55
D 31E	5	1.05	1.82	1.43	.77	.26		31N	57
D 31E	6					.26		30N	59
D 31E	7					.26		29N	59
D 31E	8					.26	2.20	27N	62
D 31E	9					.26	2.20	26N	62
D 31E	10					.26	2.20	25N	62
D 31E	11					.26	2.26	24N	65
D 31E	12					.26	2.30	23N	65
D 32E	1	.68	1.76	1.22	1.08	.19	2.13	49N	40
D 32E	2	.55	1.82	1.18	1.27	.17	2.14	48N	40
D 32E	3	.57	1.35	.96	.78	.17	2.32	46N	42
D 32E	4	.44	2.12	1.28	1.68	.18		32N	56
D 32E	5	.39	2.15	1.27	1.76	.18		32N	60
D 33	1	1.34	1.90	1.62	.56	.30	2.30	21N	70
D 33	2	1.10	2.20	1.65	1.10	.30	2.28	22N	70
D 35	1					.22	2.12	65N	24
D 35	2					.20	2.20	64N	24
D 36	1	.47	2.06	1.26	1.59	.19		61N	27
D 36	2	.50	2.16	1.33	1.66	.21		60N	27
D 37	1	.74	1.94	1.34	1.20	.28		71N	17
D 37	2	.64	1.10	.87	.46	.22	2.28	53N	35
D 37	3	.68	1.26	.97	.58	.20	2.25	52N	35
D 37	4					.21	2.22	50N	38
D 37	5					.21	2.26	49N	38
D 37	6					.21	2.28	45N	40
D 37	7	.58	.86	.72	.28	.22	2.35	47N	41

MISSION 4011

REV	FRAME	D/MIN	D/MAX	$\bar{D}$	ΔD	BASE FOG	D/MAX CLOUDS	LATITUDE (DEG)	SUN ANGLE
D 37	8	.60	1.48	1.04	.88	.21	2.34	46N	41
D 37	9	.62	.92	.77	.30	.22	2.36	45N	42
D 37	10	.50	1.62	1.06	1.12	.21	2.31	36N	57
D 37	11	.44	1.62	1.03	1.18	.22	2.37	35N	52
D 38	1					.19	1.80	72N	16
D 38	2					.17	1.80	71N	16
D 38	3	.40	1.70	1.05	1.30	.19		49N	39
D 38	4	.40	1.70	1.05	1.30	.18		49N	39
D 38	5					.18	2.30	40N	48
D 38	6					.18	2.28	39N	48
D 38	7					.18	2.21	37N	51
D 38	8					.17	2.18	36N	51
D 38	9					.19	1.99	35N	53
D 38	10					.18	2.00	34N	53
D 38	11					.17	2.20	33N	55
D 38	12					.17	2.22	32N	55
D 38	13					.18	2.26	32N	56
D 38	14	.49	1.63	1.06	1.14	.17	2.28	29N	59
D 38	15	.38	1.49	.93	1.11	.17	2.33	28N	59
D 38	16	.37	1.77	1.07	1.40	.17	2.35	26N	62
D 38	17	.44	1.32	.88	.88	.17	2.34	25N	62
D 38	18	.53	1.62	1.07	1.09	.17	2.26	24N	64
D 38	19	.63	1.75	1.19	1.12	.19	2.34	23N	64
D 38	20	.76	1.77	1.26	1.01	.16	2.31	6S	85
D 38	21	.87	1.60	1.23	.73	.17	2.36	7S	85
D 38	22	.73	1.25	.99	.52	.18	2.34	8S	84
D 39	1	.96	1.18	1.07	.22	.20	2.06	57N	31
D 39	2	.88	1.30	1.09	.42	.21	2.08	56N	31
D 39	3	.55	1.12	.83	.57	.22	1.96	55N	33
D 39	4	.69	1.74	1.21	1.05	.25	2.12	42N	46
D 39	5	.74	1.54	1.14	.80	.25	2.20	40N	48
D 39	6	1.06	1.86	1.46	.80	.26	2.20	40N	48
D 39	7					.26	2.24	37N	51
D 39	8					.26	2.24	36N	51
D 39	9	.50	1.30	.90	.80	.27	2.23	30N	58
D 39	10	.63	1.90	1.26	1.27	.25	2.25	29N	58
D 39	11	.77	1.62	1.19	.85	.25	2.32	29N	58
D 40	1					.20	1.75	70N	18
D 40	2					.19	1.70	69N	17
D 40	3					.18	2.16	55N	33
D 40	4					.16	2.10	54N	33
D 40	5	.82	1.53	1.17	.71	.18	2.26	51N	37
D 40	6					.18	2.20	50N	37
D 40	7	.45	1.70	1.07	1.25	.18		47N	41
D 40	8	.55	1.83	1.19	1.28	.19		46N	41
D 40	9	.55	1.33	.94	.78	.19		44N	44
D 40	10	.76	1.64	1.20	.88	.18		43N	44
D 40	11	.40	1.35	.87	.95	.16		42N	45
D 40	12	.55	1.55	1.05	1.00	.17		41N	47
D 40	13	.60	1.60	1.10	1.00	.18		40N	47
D 41	1	.34	.98	.66	.64	.14		81N	7
D 41	2	.32	1.07	.69	.75	.17		80N	7
D 41	3	.41	.90	.65	.49	.18	2.10	77N	10
D 41	4	.64	.90	.77	.26	.18	1.93	76N	10
D 41	5					.22	1.40	75N	11
D 41	6	.88	1.62	1.25	.74	.23	2.10	70N	18
D 41	7	.92	1.58	1.25	.66	.23	2.02	69N	18
D 41	8					.24	2.10	64N	24
D 41	9					.24	2.16	63N	24
D 41	10					.24	2.16	59N	28
D 41	11					.25	2.14	58N	30
D 41	12					.25	2.16	57N	30

MISSION 4011

REV	FRAME	D/MIN	D/MAX	D	ΔD	BASE FOG	D/MAX CLOUDS	LATITUDE (DEG)	SUN ANGLE
0 41	13	.74	1.26	.92	.72	.24	2.14	55N	33
0 41	14	.64	1.80	1.24	1.16	.24	2.40	54N	34
0 41	15	.72	1.92	1.34	1.20	.29	2.06	53N	34
0 41	16	.70	1.52	1.11	.82	.24		52N	36
0 41	17	.64	1.62	1.23	.78	.25		51N	36
0 41	18	1.01	1.72	1.30	.71	.24		50N	40
0 41	19	1.02	1.12	1.37	.70	.24		49N	40
0 41	20	1.20	1.96	1.36	.76	.24		48N	44
0 41	21	1.50	1.98	1.24	1.48	.26		47N	46
0 41	22	1.48	2.02	1.75	.54	.25		46N	46
0 41	23	1.28	1.92	1.60	.64	.26		45N	48
0 42	1					.26	1.50	81N	7
0 42	2					.26	1.48	80N	7
0 42	3		1.42	1.02	.79	.26	2.26	79N	18
0 42	4	.63	1.55	1.09	.91	.26	2.24	69N	18
0 42	5	.54	1.52	1.03	.98	.26	2.20	67N	20
0 42	6	.63	1.20	.91	.57	.25	2.26	67N	20
0 42	7	.55	1.06	.80	.51	.25	2.16	66N	23
0 42	8	.46	1.26	.87	.78	.26	2.18	64N	23
0 42	9	.53	1.28	.90	.75	.26	2.20	62N	26
0 42	10	.54	1.10	.82	.56	.26	2.16	61N	26
0 42	11	.40	1.20	.80	.80	.26		60N	27
0 42	12					.26	2.28	58N	30
0 42	13					.27	2.20	57N	30
0 42	14	.72	1.54	1.13	.82	.27	2.22	54N	34
0 42	15	.82	1.64	1.23	.82	.26	2.24	53N	34
0 42	16	.80	1.68	1.24	.86	.27	1.54	52N	36
0 42	17	.82	1.54	1.08	.92	.28		51N	36
0 42	18	.68	1.62	1.15	.94	.28	1.45	50N	40
0 42	19	.75	1.40	1.07	.65	.26	1.84	49N	40
0 42	20	.78	1.60	1.19	.82	.26	2.25	48N	44
0 42	21	.58	1.42	1.00	.84	.26	2.12	47N	44
0 42	22	.65	1.50	1.07	.85	.27	1.40	46N	46
0 42	23	.95	1.66	1.30	.71	.30		45N	48
0 42	24	.94	2.00	1.47	1.06	.29	1.30	32N	56
0 42	25	1.10	2.10	1.60	1.00	.28	1.95	31N	56
0 42	26	1.50	1.75	1.62	.25	.28	1.93	31S	64
0 42	27	1.44	1.72	1.58	.28	.28	2.04	50N	64
0 43	1	.46	1.70	1.58	.24	.26	1.98	55N	33
0 43	2	.20	1.50	1.35	.30	.28	2.06	54N	34
0 43	3	.16	1.50	1.33	.34	.29	2.00	53N	34
0 43	4					.28	2.10	52N	36
0 43	5					.27	2.14	51N	37
0 43	6	.95	1.40	1.17	.45	.28	2.04	50N	37
0 44	1					.28	1.10	81N	6
0 44	2					.27	1.88	70N	17
0 44	3					.27	1.94	66N	21
0 44	4					.28	2.06	62N	26
0 44	5					.27	2.04	58N	30
0 44	6					.27	1.90	54N	34
0 44	7					.27	1.80	50N	38
0 44	8					.28	2.24	46N	42
0 44	9					.27	2.20	42N	46
0 44	10					.27	2.10	37N	50
0 44	11					.27	2.22	34N	54
0 44	12					.27	2.26	33N	54
0 44	13					.28	2.20	29N	58
0 44	14					.27		25N	58
0 44	15	.63	1.90	1.26	1.27	.28		21N	63
0 44	16					.27		17N	71
0 44	17					.28	1.94	13N	75
0 44	18					.27	2.30	8N	79
0 44	19					.28	2.26	4N	83

MISSION 4011

REV	FRAME	D/MIN	D/MAX	D	ΔD	BASE FOG	D/MAX CLOUDS	LATITUDE (DEG)	SUN ANGLE
0 44	20					.28	2.20	45N	87
0 44	21					.28	2.32	35	85
0 44	22					.27		25	85
0 47E	1	.57	1.99	1.28	1.42	.30		49N	46
0 47E	2	.60	1.36	.98	.76	.29		48N	48
0 47E	3	.62	1.10	.86	.48	.29	2.33	47N	48
0 47E	4	.52	1.30	.91	.78	.30	2.30	46N	50
0 47E	5					.30	2.28	25N	50
0 47E	6					.28	2.25	24N	53
0 48E	1	.93	1.35	1.14	.42	.29	2.21	69N	39
0 48E	2	.89	1.42	1.15	.53	.29	2.17	68N	39
0 48E	3					.29	2.27	67N	40
0 48E	4	.89	1.50	1.19	.61	.26	2.22	45N	43
0 48E	5	.83	1.60	1.21	.77	.24	2.27	44N	43
0 48E	6	.86	1.57	1.21	.71	.23	2.23	43N	43
0 48E	7	.56	1.79	1.17	1.23	.20	2.30	42N	46
0 48E	8	.75	1.97	1.16	.82	.20	2.18	41N	46
0 48E	9	.72	1.76	1.24	1.04	.19	2.10	40N	48
0 48E	10	.61	1.50	1.05	.89	.18	2.02	39N	48
0 48E	11	.50	1.58	1.08	1.08	.19		38N	50
0 48E	12	.56	1.70	1.13	1.14	.17		37N	50
0 48E	13	.52	1.74	1.13	1.22	.18	2.21	36N	52
0 48E	14	.46	1.75	1.10	1.29	.17	2.22	35N	52
0 48E	15	.48	1.78	1.13	1.30	.17	1.85	33N	54
0 49E	1	.55	2.28	1.41	1.73	.28		48N	40
0 49E	2	.56	1.85	1.00	1.29	.28		47N	40
0 49E	3	.42	1.84	1.13	1.42	.28		46N	44
0 49E	4	.48	1.82	1.15	1.34	.28		45N	44
0 52	1					.22	2.16	65N	23
0 52	2					.22	2.14	64N	23
0 53	1	.40	.74	.57	.34	.20	1.52	72N	15
0 53	2	.49	1.30	.89	.81	.21	1.50	65N	22
0 53	3	.48	1.38	.93	.90	.29	1.60	60N	28
0 53	4	.52	1.46	.99	.94	.30		59N	28
0 53	5	.62	1.72	1.17	1.10	.31	2.32	45N	43
0 53	6					.32	2.30	45N	43
0 54	1					.28	2.22	72N	16
0 54	2					.28	2.15	71N	16
0 54	3	.58	1.50	1.04	.92	.28	1.54	62N	26
0 54	4	.64	1.42	1.03	.78	.29	1.70	61N	26
0 54	5	.78	1.40	1.09	.94	.29	2.24	52N	36
0 54	6	.78	1.34	1.01	.82	.29	2.20	51N	36
0 54	7	.68	1.50	1.11	.86	.28		49N	38
0 54	8	.73	1.58	1.06	.77	.28	2.16	47N	38
0 54	9	.58	1.62	1.12	1.00	.28	2.20	46N	38
0 54	10	.62	1.62	1.12	1.00	.28		44N	42
0 54	11	.68	1.62	1.15	.94	.28		43N	42
0 54	12	.54	1.58	1.02	.96	.28		42N	42
0 54	13	.65	1.64	1.14	.99	.28		41N	46
0 54	14	.67	1.78	1.22	1.11	.28		40N	46
0 54	15	.64	1.76	1.20	1.12	.28		39N	46
0 54	16	.66	1.30	.98	.64	.28		38N	48
0 54	17					.28		37N	48
0 54	18					.28		36N	48
0 54	19	.94	1.30	1.12	.36	.26	2.26	29N	53
0 54	20	.80	1.34	1.07	.54	.25	2.30	28N	53
0 54	21	.58	1.40	.99	.82	.22	2.28	27N	53
0 54	22	.68	1.52	1.30	.84	.21	2.14	26N	57
0 55	1					.20	2.30	25N	57
						.18	2.18	24N	57
						.15	1.96	23N	61

MISSION 4011

REV	FRAME	D/MIN	D/MAX	$\bar{D}$	ΔD	BASE FOG	D/MAX CLOUDS	LATITUDE (DEG)	SUN ANGLE
D 55	2					.16	1.96	56N	31
D 55	3					.15	2.26	53N	35
D 55	4					.16	2.22	52N	35
D 55	5					.16	1.96	50N	37
D 55	6	1.32	1.80	1.56	.48	.16		41N	47
D 55	7	1.34	1.88	1.62	.52	.15		40N	47
D 55	8					.17	1.96	38N	49
D 55	9					.20	2.22	37N	51
D 55	10					.20	2.26	36N	51
D 55	11	.71	1.36	1.03	.65	.22	2.18	28N	60
D 55	12	.82	1.50	1.16	.68	.24	2.20	27N	60
D 55	13	.48	1.40	.94	.92	.25	2.18	25N	62
D 55	14	.47	1.64	1.05	1.17	.26	2.24	25N	62
D 55	15	.46	1.42	.94	.96	.27	2.24	24N	64
D 55	16	.51	1.47	.99	.96	.27	2.24	23N	64
D 55	17	.55	1.50	1.02	.95	.26	2.30	22N	66
D 55	18	.66	1.60	1.13	.94	.26	2.32	21N	66
D 55	19	.80	1.45	1.12	.65	.26	2.26	4N	83
D 55	20	.84	1.72	1.28	.88	.26	2.27	3N	83
D 56	1					.28	1.98	70N	18
D 56	2					.29	1.95	69N	18
D 56	3	.56	1.42	.99	.86	.30	2.32	57N	31
D 56	4	.50	1.31	.90	.81	.29	2.29	55N	32
D 56	5	.62	1.30	.96	.68	.29	2.14	55N	32
D 56	6	.61	1.21	.91	.60	.28		53N	35
D 56	7	.69	1.21	.95	.52	.29		52N	35
D 56	8	.64	1.70	1.17	1.06	.29	2.10	49N	38
D 56	9	.69	1.78	1.23	1.09	.30	2.12	48N	38
D 56	10	.56	1.70	1.13	1.14	.30		45N	32
D 56	11	.50	1.66	1.08	1.16	.28		45N	32
D 56	12					.29	2.22	41N	46
D 56	13					.30	2.32	41N	46
D 56	14	.98	1.60	1.29	.62	.29	2.25	37N	50
D 56	15	.82	1.73	1.27	.91	.30	2.29	37N	50
D 56	16	1.20	2.16	1.68	.96	.29		35N	51
D 56	17	.62	2.12	1.37	1.50	.28	2.18	34N	54
D 56	18	.57	1.81	1.19	1.24	.30	2.29	33N	54
D 56	19	.67	1.75	1.21	1.08	.30	2.35	32N	55
D 56	20	.85	1.97	1.41	1.12	.29	2.31	30N	57
D 57	1	.45	1.70	1.07	1.25	.28		77N	10
D 57	2	.40	1.80	1.10	1.40	.29		76N	10
D 57	3	.65	1.47	1.06	.82	.29	1.70	75N	11
D 57	4	.94	1.90	1.42	.96	.29	2.06	71N	16
D 57	5	.95	1.87	1.41	.92	.29	2.10	71N	16
D 57	6					.30	2.00	69N	18
D 57	7	.84	1.20	1.02	.36	.30	2.22	58N	29
D 57	8	.86	1.19	1.02	.33	.29	2.19	57N	30
D 57	9	.86	1.55	1.20	.69	.30	2.31	56N	30
D 57	10					.30	2.12	56N	32
D 57	11					.29	2.10	55N	32
D 57	12					.30	2.22	53N	34
D 57	13					.29	2.20	52N	34
D 57	14	.80	1.29	1.04	.49	.31	2.29	51N	36
D 57	15	.84	1.32	1.08	.48	.29	2.29	51N	36
D 57	16	1.27	1.76	1.51	.49	.29	2.23	49N	39
D 57	17	1.24	1.70	1.47	.46	.26	2.28	48N	39
D 57	18	.52	1.86	1.19	1.34	.22		45N	42
D 57	19	.66	1.76	1.21	1.10	.23		44N	42
D 57	20	1.26	1.59	1.42	.33	.19		40N	48
D 57	21	1.45	1.70	1.57	.25	.18		39N	47
D 57	22	.56	1.54	1.05	.98	.18		38N	50
D 57	23	.64	1.64	1.14	1.00	.18		37N	50
D 58	1	.41	1.09	.75	.68	.29	1.16	82N	5

MISSION 4011

REV	FRAME	D/MIN	D/MAX	$\bar{D}$	ΔD	BASE FOG	D/MAX CLOUDS	LATITUDE (DEG)	SUN ANGLE
D 58	2	.48	.98	.73	.50	.29	1.10	81N	5
D 58	3	.54	.88	.71	.34	.30	1.97	69N	19
D 58	4					.29	1.98	68N	19
D 58	5	.50	1.20	.85	.70	.30	1.82	67N	21
D 58	6	.52	1.40	.96	.88	.28	2.05	66N	21
D 58	7	.56	1.13	.84	.57	.29	2.28	65N	23
D 58	8	.80	1.33	.96	.73	.29	2.26	64N	23
D 58	9					.28	2.02	63N	25
D 58	10	.55	.85	.70	.30	.29	2.18	62N	26
D 58	11	.63	1.17	.90	.54	.29	2.24	61N	26
D 58	12	.56	1.33	.94	.77	.28		59N	28
D 58	13	.67	1.38	1.02	.71	.29		58N	28
D 58	14	.68	1.54	1.11	.86	.29		57N	31
D 58	15	.54	1.61	1.07	1.07	.29	2.02	56N	32
D 58	16	.56	1.71	1.13	1.15	.29	2.06	55N	32
D 58	17	.53	.96	.74	.43	.28		53N	34
D 58	18	.42	1.59	1.00	1.17	.28		52N	36
D 58	19	.46	1.78	1.12	1.32	.28		51N	36
D 58	20	.82	1.44	1.13	.62	.30	2.36	49N	39
D 58	21	.88	1.68	1.28	.80	.28	2.33	48N	39
D 58	22	.82	1.90	1.36	1.08	.28	2.30	45N	42
D 58	23	.91	2.08	1.49	1.17	.29	2.26	45N	42
D 58	24	.50	1.95	1.22	1.45	.30	2.33	36N	52
D 58	25	.76	2.00	1.38	1.24	.28	2.34	35N	52
D 58	26	.58	1.91	1.24	1.33	.24	2.31	33N	55
D 58	27	.56	1.94	1.25	1.38	.24	2.34	32N	55
D 58	28	.71	2.02	1.36	1.31	.22		31N	57
D 58	29	1.12	1.92	1.52	.80	.20		30N	57
D 58	30	.73	2.06	1.39	1.33	.19		28N	59
D 58	31	1.19	2.07	1.63	.88	.18		27N	59
D 58	32	.80	1.99	1.39	1.19	.18		24N	64
D 58	33	1.26	2.01	1.63	.75	.19		23N	64
D 59	1					.24	2.30	54N	33
D 59	2					.22	2.20	53N	33
D 59	3					.22	2.16	52N	36
D 59	4					.20	2.20	51N	36
D 59	5					.20	2.22	49N	38
D 59	6	.79	1.45	1.12	.66	.20	2.20	49N	38
D 59	7	.78	1.42	1.10	.64	.20	2.26	46N	41
D 59	8	.73	1.54	1.13	.81	.20	2.14	46N	41
D 63 E	1					.22	2.12	45N	42
D 63 E	2					.20	2.20	45N	42
D 63 E	3					.20	2.18	44N	33
D 63 E	4	.72	1.50	1.11	.78	.20	2.12	42N	45
D 63 E	5	.46	1.40	.93	.94	.20	2.12	41N	46
D 63 E	6	1.08	1.62	1.35	.54	.20	2.27	39N	48
D 64 E	1					.30	2.26	49N	39
D 64 E	2					.28	2.28	48N	40
D 64 E	3	.59	1.34	.96	.75	.29	2.21	47N	41
D 64 E	4	.59	1.12	.85	.53	.29	1.80	43N	44
D 64 E	5	.89	2.01	1.45	1.12	.30		38N	49
D 64 E	6	.78	1.99	1.38	1.21	.29	1.85	37N	50
D 64 E	7	1.29	1.65	1.47	.36	.30	2.30	35N	52
D 64 E	8					.29	2.33	33N	54
D 64 E	9					.28	2.31	31N	56
D 65 E	1	.40	1.20	.80	.80	.18	1.50	48N	39
D 65 E	2	.46	1.25	.85	.79	.19	1.35	48N	39
D 65 E	3	.46	1.88	1.17	1.42	.18		44N	44
D 65 E	4	.60	1.98	1.29	1.38	.17		43N	44
D 65 E	5	.70	1.80	1.25	1.10	.19		34N	53
D 65 E	6	.70	1.50	1.10	.80	.18	2.08	33N	54
D 65 E	7	.65	1.84	1.24	1.19	.20	2.15	32N	54

BCS 24577-64

SPPL TECHNICAL REPORT NO. 101-1-34

7 October 1964

TITLE:

Summary of Microdensitometer Derived Image Quality Data Collected from Mission 4011

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 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 4000 Missions traced to date. Image Quality Ranking of all 4000 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 in Section V. A diagram of the reference system used in describing the orientation of an edge and a temporary coordinate system used to locate the edges within a frame are presented as Appendix A.

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 0.840 microns,

(c) I.B.M. 1620 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.

Analysis of Photographic Image to Evaluate System Performance

SECTION II SUMMARY SHEET

Mission 4011

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

Arithmetic Mean	33.3
Standard Deviation	11.1
Coefficient of Dispersion	33%
Number of Edges	30

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

Arithmetic Mean	40.2
Standard Deviation	15.0
Coefficient of Dispersion	37%
Number of Edges	30

BCS 24577-64

SPPL TECHNICAL REPORT NO. 101-1-34

Analysis of Photographic Image to Evaluate System Performance

SECTION III - MISSION 4011

Summary of all 4000 Missions Traced to Date

Mission Number	Number of Edges	Spread Function Width at 50% Amplitude in Microns, Computer Calculations			Resolution in lines/mm for A.I.M. 4404 Curve, Computer Calculations		
		Arithmetic Mean	Standard Deviation	Coefficient of Dispersion	Arithmetic Mean	Standard Deviation	Coefficient of Dispersion
4001	15	16.5	5.1	31%	73.5	27.3	37%
4002	30	14.2	5.7	40%	74.7	26.1	35%
4003	32	12.3	2.9	24%	84.8	18.1	21%
4005	16	64.4	32.7	51%	19.3	8.5	44%
4006	106	13.6	6.1	45%	85.4	28.8	34%
4007	106	14.4	4.7	33%	70.5	21.0	30%
4008	32	9.5	2.7	29%	100.6	28.1	28%
4009	20	16.4	7.1	43%	28.4	11.1	39%
4010*	24	25.3	10.5	42%	54.4	23.7	44%
4011*	30	40.2	15.0	37%	33.3	11.1	33%

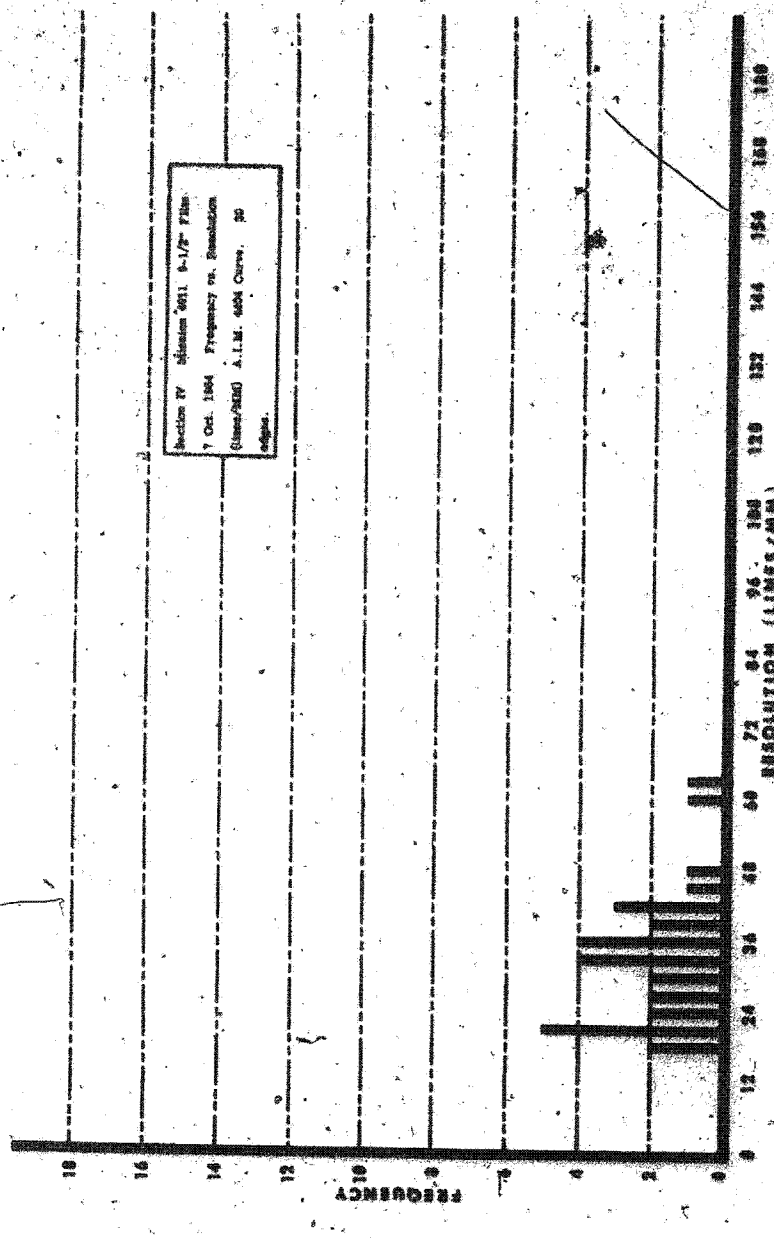
*A 1 x 80 micron slit was used.

Analysis of Photographic Image to Evaluate System Performance

SECTION 111A - MISSION 4011

Image Quality Ranking of all 4000 Missions Traced to Date

Mission Number	Average Resolution in lines/mm for A.I.M. 4404 Curve
4008	100.6
4006	85.4
4003	84.8
4002	74.7
4001	73.5
4007	70.5
4010	54.4
4011	33.3
4009	28.4
4005	19.3



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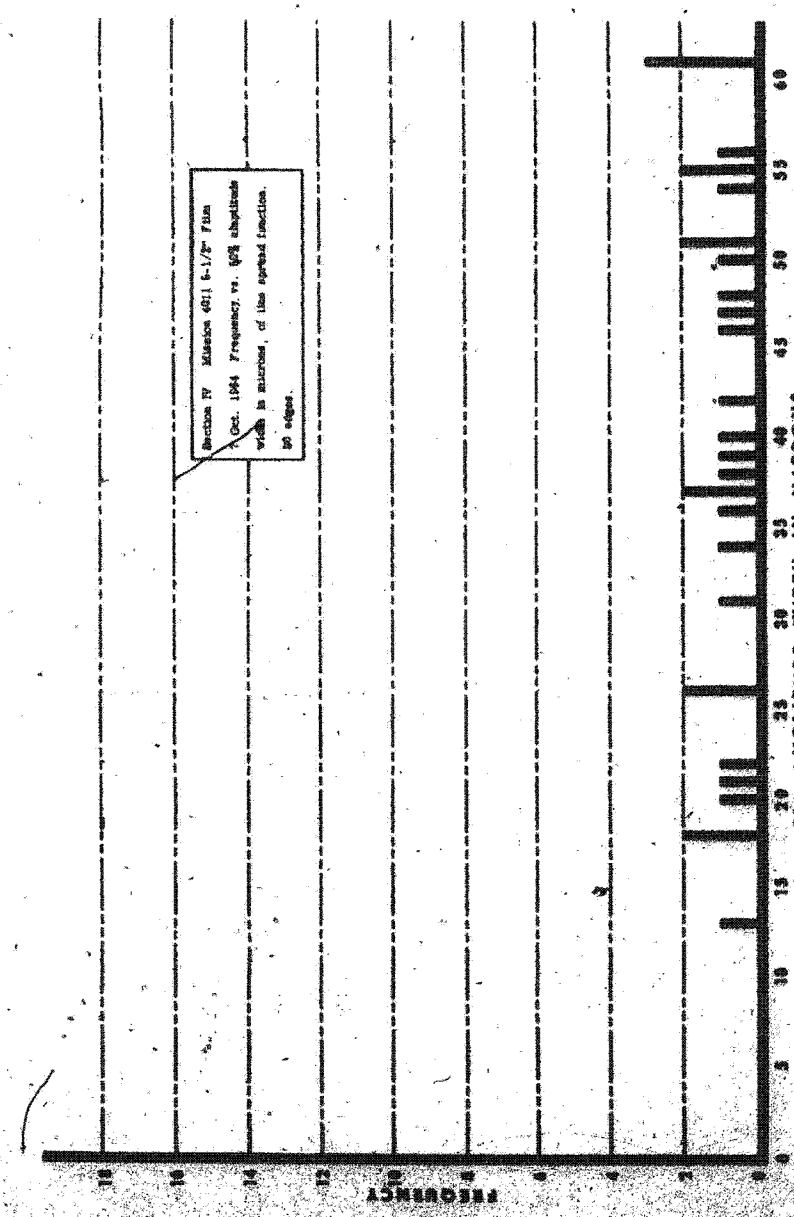

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Analysis of Photographic Image to Evaluate System Performance

Mission 4011

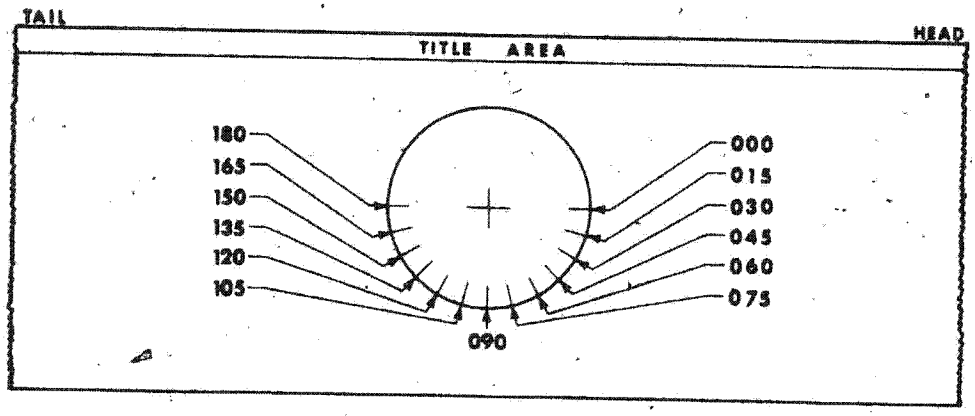
Section V

Edge No.	Pass	Frame	Index	Location	Orientation	Subject	50% Amplitude Spread Function Width (Microns)	A.I.M. Resolution
1	D-14	004	007	A-4	080	Buildings	56	23
2	D-14	004	007	A-5	088	Airfield	22	60
2A	D-14	004	007	A-5	088	Airfield	18	42
3	D-15	005	009	H-8	085	Buildings	26	34
4	D-15	006	011	C-8	085	Buildings	51	34
5	D-14	004	007	E-4	100	Buildings	50	20
6	D-07	007	012	H-3	100	Buildings	28	47
6A	D-07	007	012	H-3	100	Buildings	37	34
7	D-09	020	033	DE-5	095	Airfield	46	41
7A	D-09	020	033	DE-5	095	Airfield	42	18
8	D-09	015	024	C-3	095	Buildings	36	25
9	D-10	005	008	K-4	090	Buildings	48	20
9A	D-10	005	008	K-4	090	Buildings	13	62
10	D-10	006	010	J-5	085	Airfield	34	22
10A	D-10	006	010	J-5	085	Airfield	40	28
11	D-10	007	012	D-3	080	Airfield	55	35
11A	D-10	007	012	D-3	080	Airfield	47	29
12	D-37	011	038	E-1	075	Buildings	38	40
13	D-32	004	007	C-3	090	Buildings	66	22
14	D-32	005	009	C-4	085	Buildings	31	22
14A	D-32	005	009	C-4	085	Buildings	54	35
16	D-47	002	003	K-5	085	Ground Test Obj.	21	39
17	D-49	001	001	DE-2	088	Bridge	66	19
17A	D-49	001	001	DE-2	088	Bridge	55	32
18	D-49	001	001	E-3	085	Buildings	18	43
18A	D-49	001	001	E-3	085	Buildings	51	36
19	D-49	001	001	E-3	080	Buildings	61	28
20	D-64	006	015	C-2	080	Buildings	37	36
21	D-25	020	036	K-4	100	Buildings	39	30
21A	D-25	020	036	K-4	100	Buildings	20	44

APPENDIX "A"

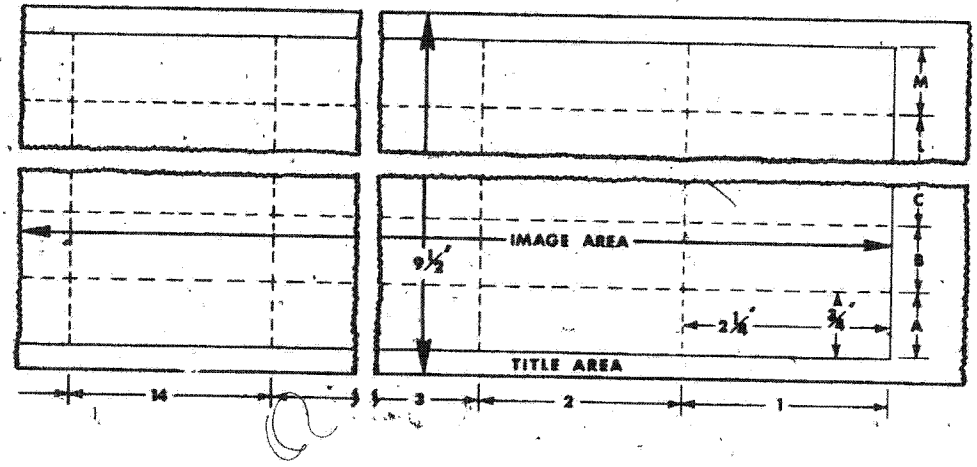
Reference System For Orientation Of "G" Mission Edges

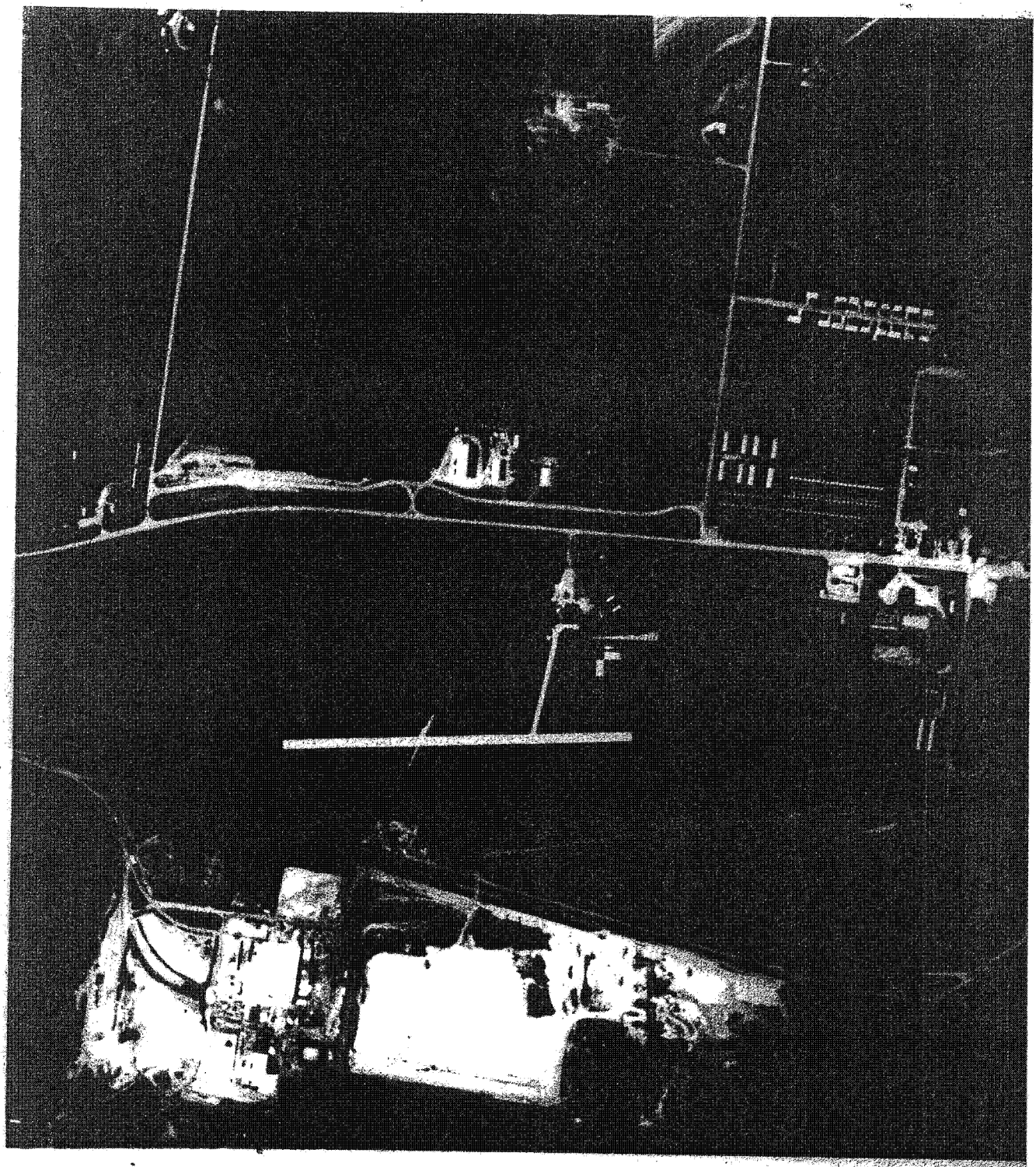
original negative - - emulsion up



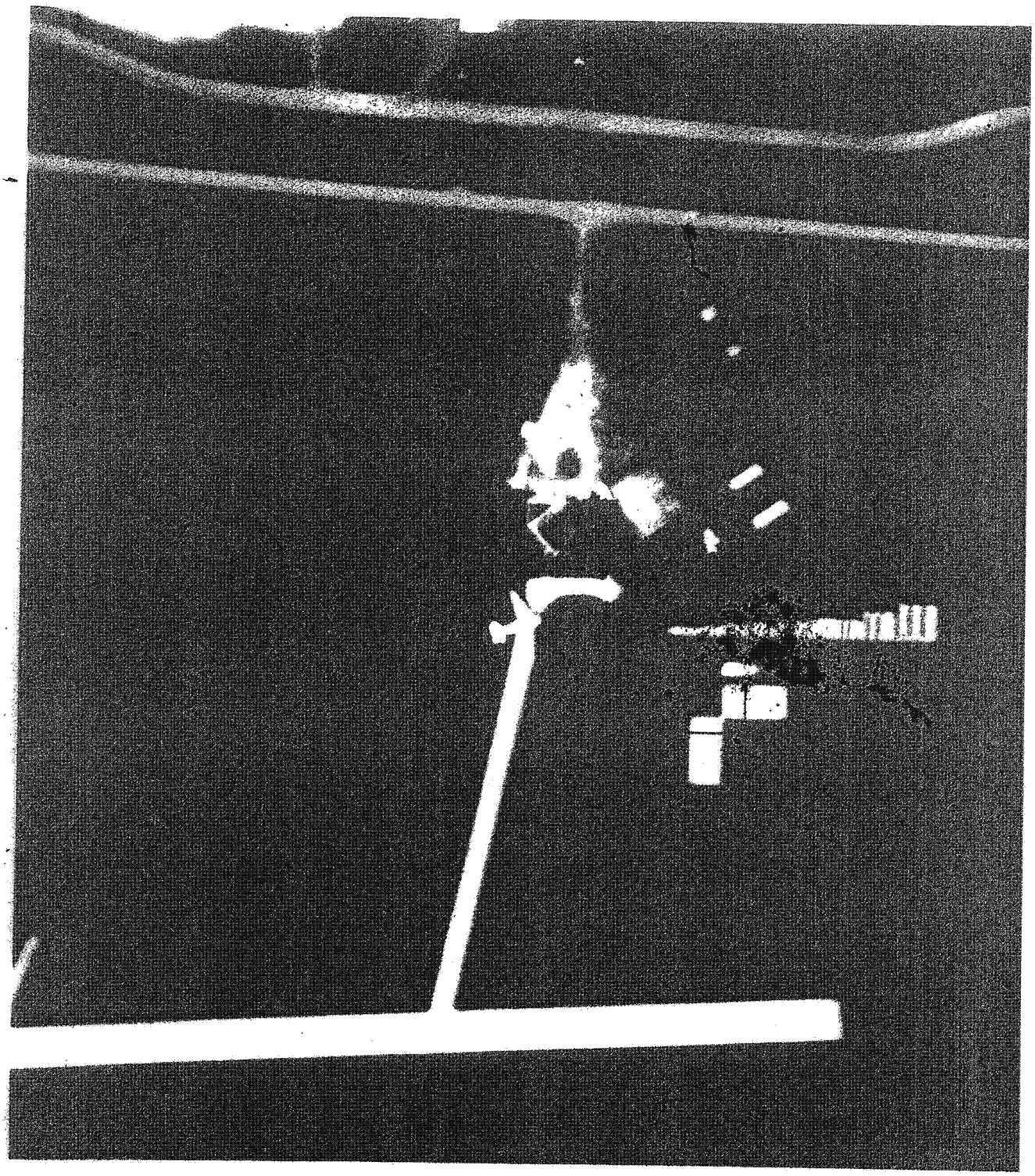
Grid For Position Of "G" Mission Edges

original negative - - emulsion up

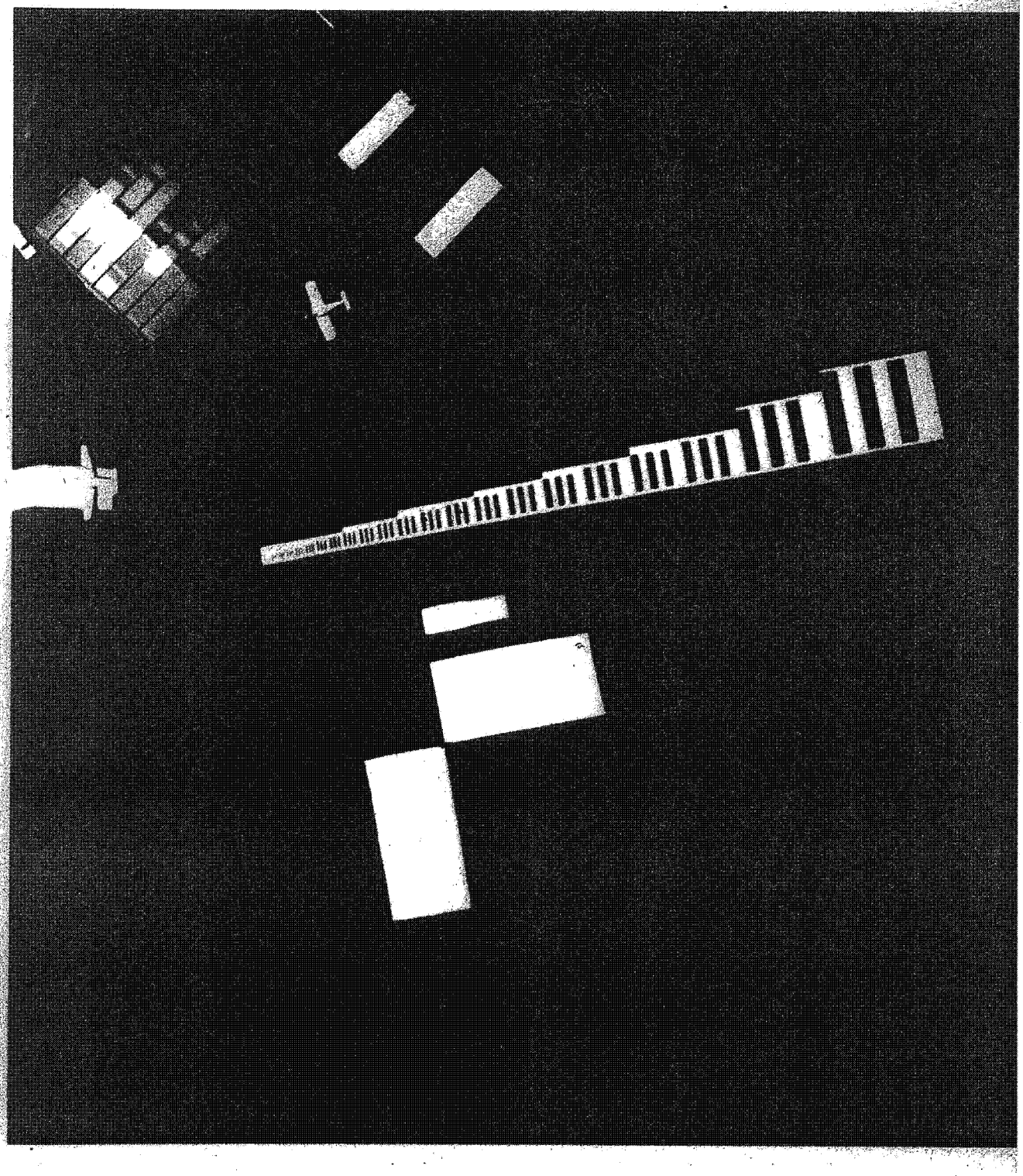




MISSION 4011 PASS D64 FRAME 004
10 DIA ENLG D. 85 RES: W038 A052
SUN ANGLE 44° LATITUDE 43

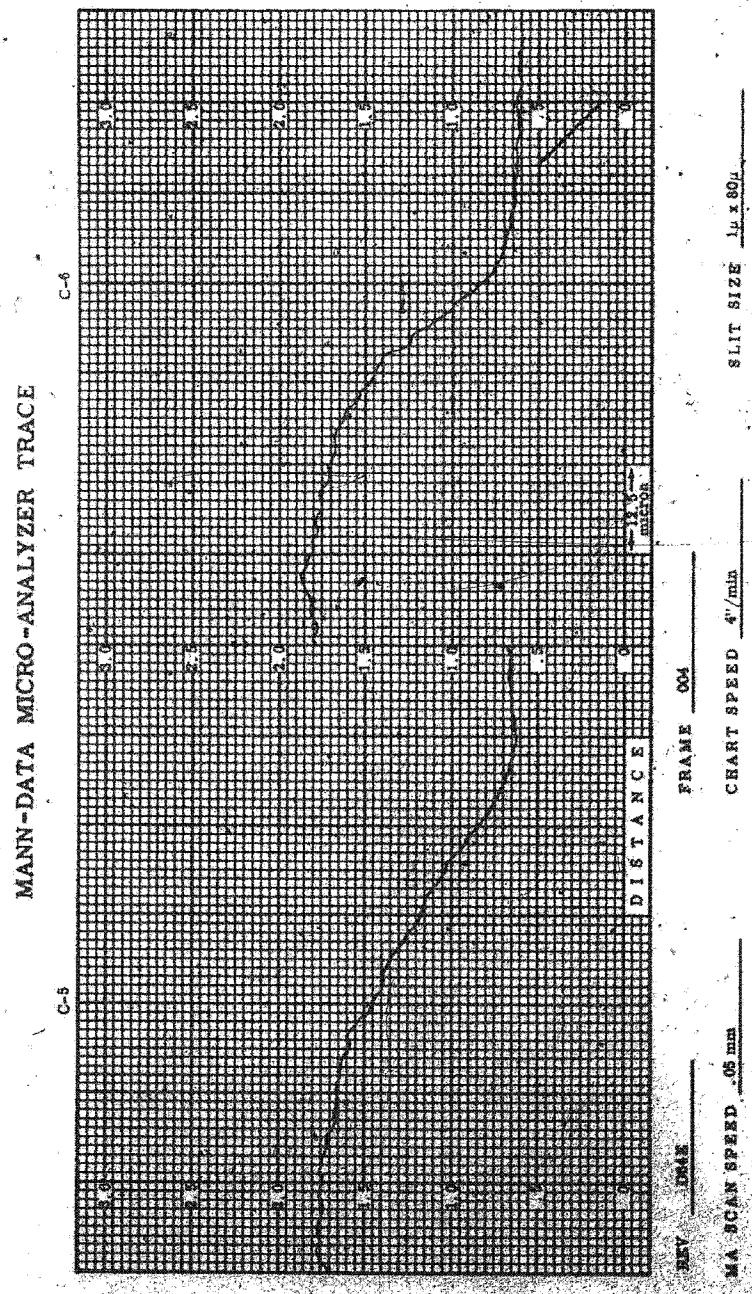


MISSION 4011 PASS D64 FRAME 004
40° DIA ENLG D .85 RES: W038 A052
SUN ANGLE 44° LATITUDE 43°



BLACKBIRD Mission - 27 Sep 64
Frame 045 10 DIA ENLG D 0.77
Ground Resolution:

(b)(1)
(b)(3)



Approved for Release: 2021/05/17 C05134462

MISSION 4011 SITE MANNING REPORT DATE 9/27/64

LOCATION Cherokee, Iowa TGT TYPE 80' Edge Low Contrast T Tri-Color OPERATOR Crum/Peterson CALIBRATED RP

Local Time CST	Temp. F°	Bar. Pr. In Hg.	Wind MPH	Wind DIR	% Rel. Hum.	Gnd. Haze	Est. Cloud Cover and Pix.		Target Brightness in Foot Lamberts: Mil. Std. 150 A Disc	Black	White	Tri-Color Red	White	Blue
11:00														
:15														
:30	51	30.34	10	NW	50	Lt.	5	5	9400			960	8100	540
:45	52		12	W		Lt.		6	9200			940	8050	510
12:00	52	30.34	10	W	51	Lt.	0	7	9200			950	7800	510
:15	52		5-11	NNW		Lt.		8	9200			950	8100	490
:30	54	30.34	5-10	NW	52	Lt.	0	10	9200			1000	8050	500
:45	54		7-12	NW		Lt.		11	9200			940	7800	510
13:00	54	30.33	7	NW	53	Lt.	0	12	8800			930	7400	500
:15	53		5-7	WNW		Lt.		13	8700			930	7400	540
:30	56	30.33	7	WNW	54	Lt.	0	14	8350			830	7100	460
:45														
:00														
:15														
:30														
:45														
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:15														
:30														
:45														
:00														

Notes: Four First Shots Not Sky - PIX No. 9 was TOT

Local Time	Target Brightness in Foot Lamberts: Low Contrast "T" Disc	Black	Gray	High Contrast "T" Black	White	Edge Analysis Black	Gray	Fixed/Permanent Sites Black	White	Gray	Additional Colors Grass	
11:00												
:15												
:30	9000	270	3540			260	3500					
:45	9200	290	3200			290	3300					
12:00	9300	285	3200			280	3300					
:15	9200	280	3100			280	3100				650	
:30	9300	230	3250			230	3300				580	
:45	9200	250	3100			250	3100					
13:00	8700	220	2950			230	3000					
:15	8700	260	3000			290	3000					
:30	8350	280	3000			260	3000					
:45												
:00												
:15												
:30												
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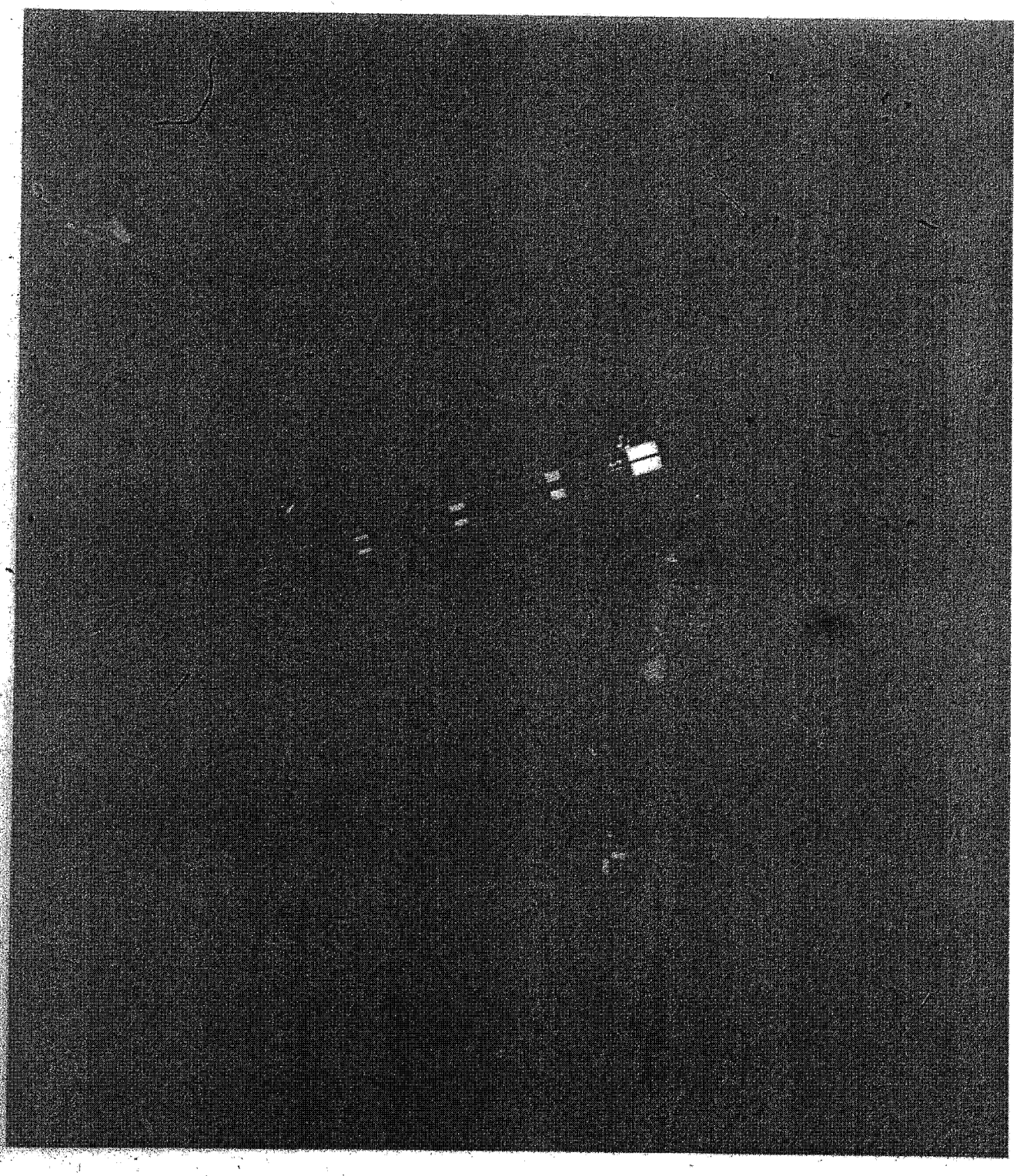
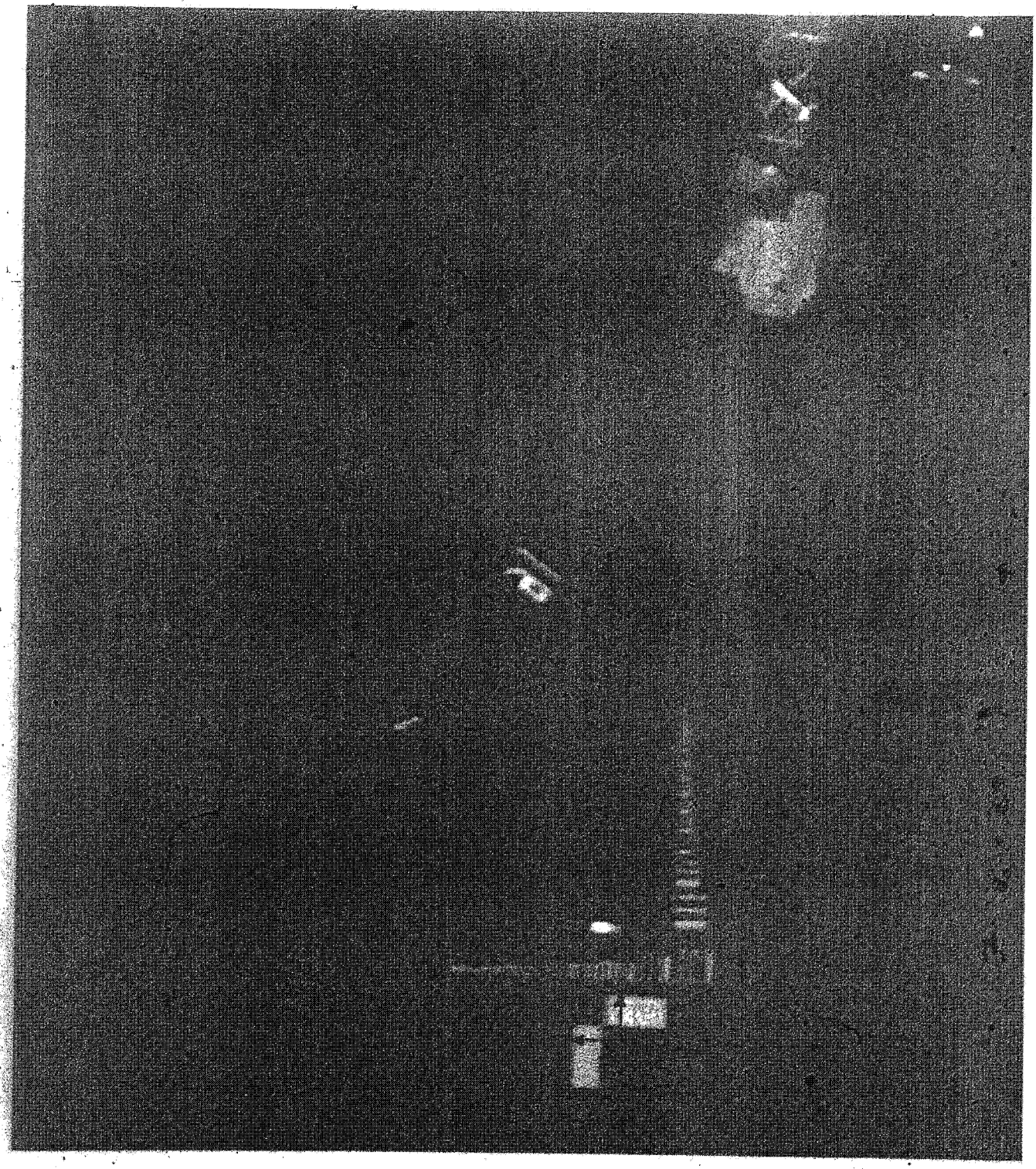
:15												
:30												
:45												
:00												



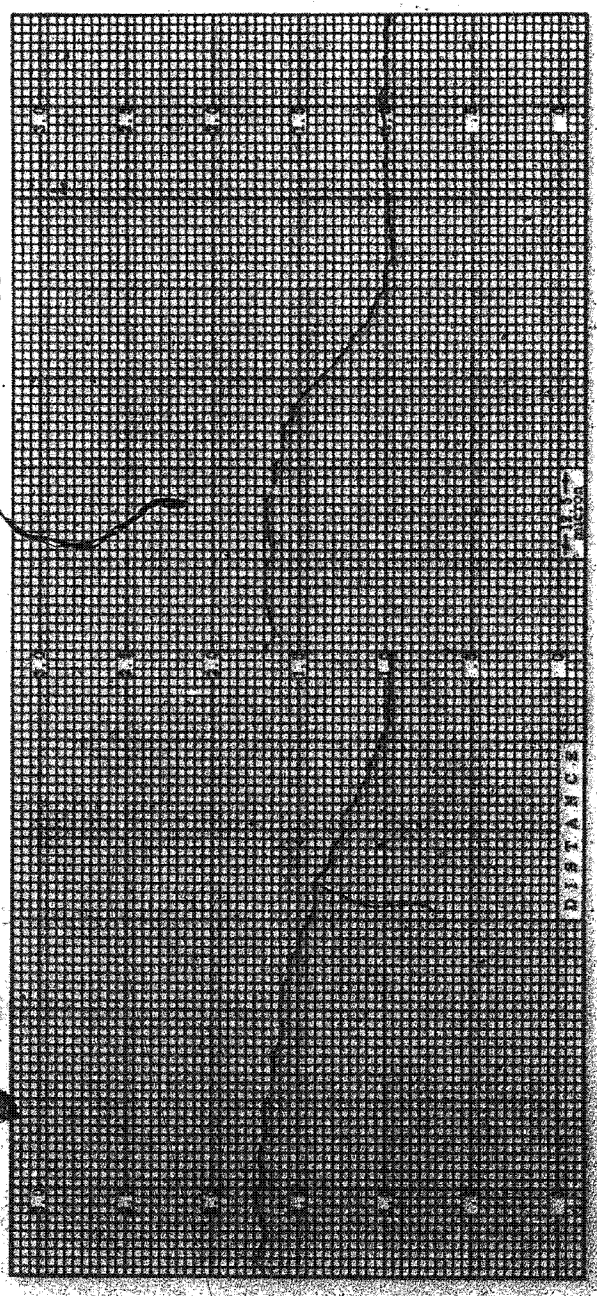
MISSION 4011 PASS D47 FRAME 001
10 DIA ENLG D 1.28 RES: W035 A043
SUN ANGLE 48° LATITUDE 40°



MISSION 4011 PASS D47 FRAME 001
40 DIA ENLG D 1.28 RES: W035 A043
SUN ANGLE 48° LATITUDE 40°

BCS 24577-64

SPPL TECHNICAL REPORT NO. 101-1-34



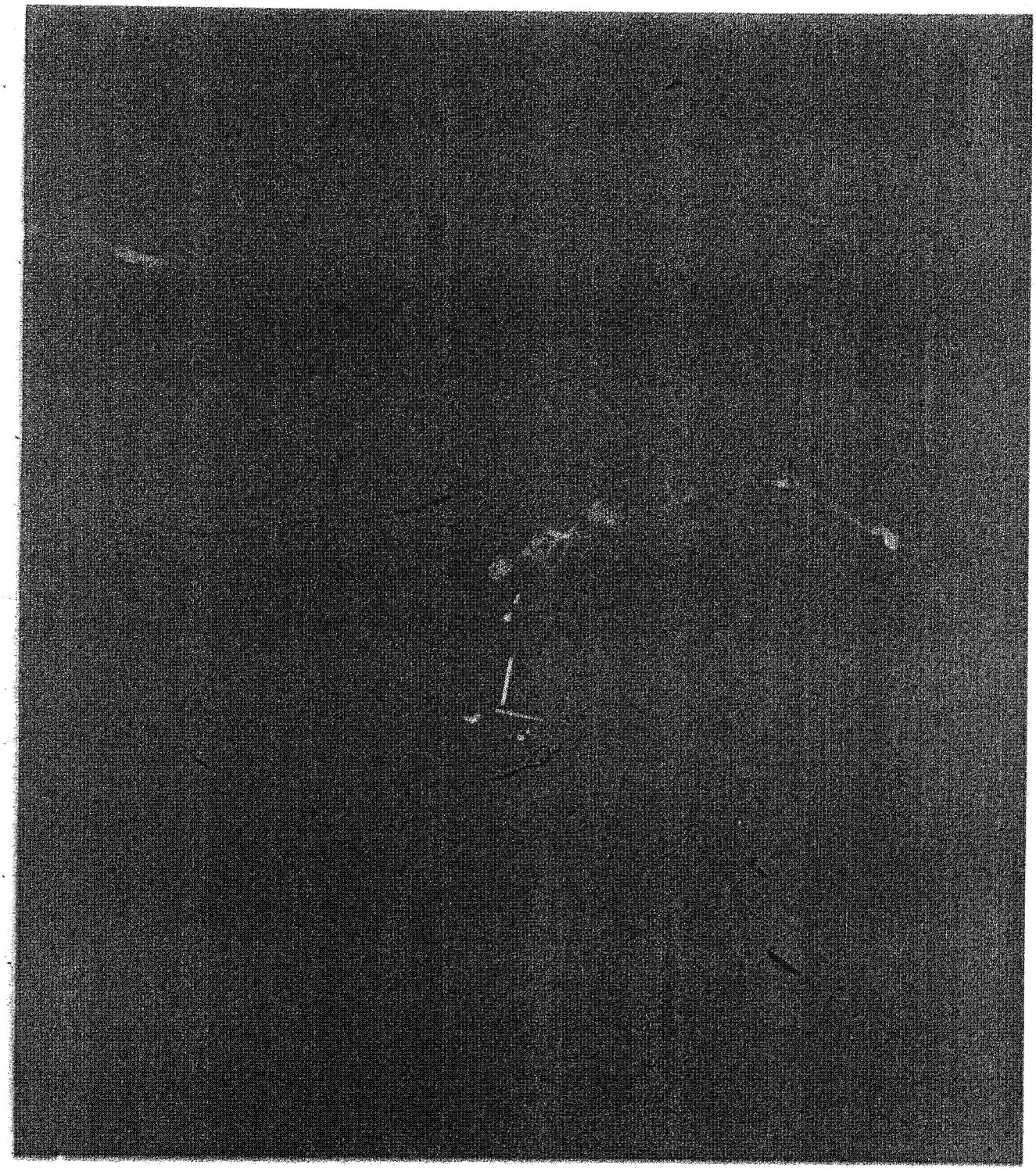
Approved for Release: 2021/05/17 C05134462

MISSION 4011 T Bar SITE MANNING REPORT DATE 9/28/64

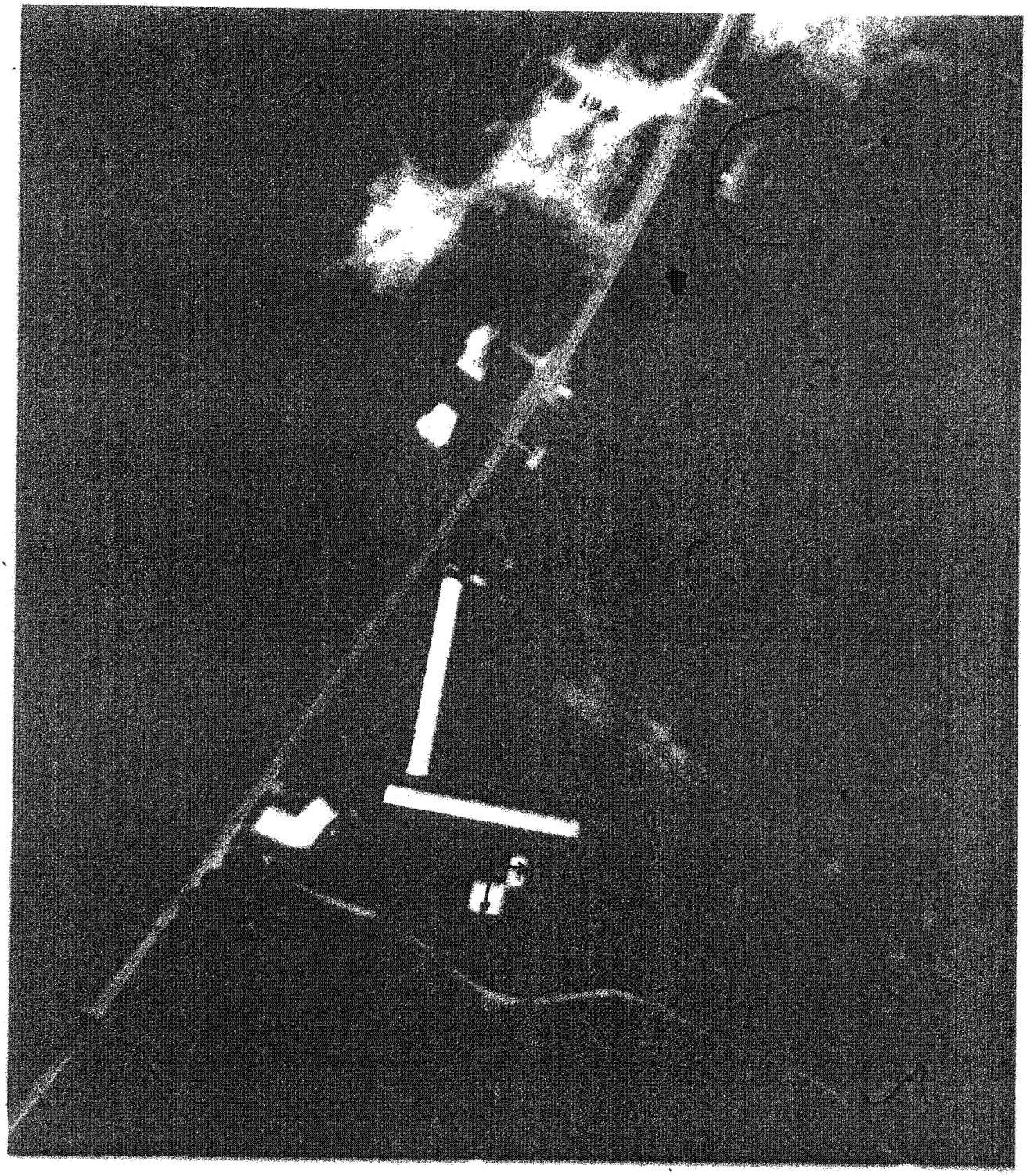
LOCATION Wheeling-Ohio Co TGT TYPE 80' Edge OPERATOR Crum/Newman CALIBRATED Yes B. C.

Local Time EST	Temp. F°	Bar. Pr. In Hg.	Wind MPH	Wind DIR	% Rel. Hum.	Gnd. Haze	Est. Cloud Cover	and Pix.	Target Brightness in Foot Lamberts: Mil. Std. 150 A Disc.	Black	White	Tri-Color Red	White	Blue
10:00														
:15														
:30	75	30.34	13	S	40	Lt	10	1				810	7100	620
:45	75		5	S				2				770	6600	580
11:00	76	30.34	8	SE	42	Lt	10	3				920	7800	530
:15	77		12-16	S				4				880	7500	560
:30	78	30.34	11	S	39	Lt	13	5				860	7700	580
:45	80		13	SW				6				1000	8600	530
12:00	80	30.35	10-13	S	38	Lt	20	7				1000	8200	620
:15	79		10	S				8				1000	7400	550
:30	80	30.31	15-18	S	36	Lt	25	9				970	7100	540
:45	79		10-13	SSE				10				1100	5700	630
13:00	81	30.29	9-13	S	35.5	Lt	40	11				1100	8500	610
:15	84		13-16	S				12				1100	7600	570
:30	84	30.28	15	SSW	33	Lt	30	13				1000	7600	580
:45	82		13-15	S				14				1000	7500	530
14:00	82	30.27	12-22	SSW	36	Lt	5	15				920	7000	510
:15	83		7-10	SSW				16				880	6600	490
:30	84	30.27	15	S	35.5	Lt	10	17				880	6450	490
:45														

Local Time EST	Low Contrast "T" Disc	Black	Grey	High Contrast "T" Black	White	Edge Analysis Black	Grey	Fixed/Permanent Sites Black	White	Grey	Additional Colors	
10:00												
:15												
:30	8200	300	3100			250	3100					
:45	8800	260	3100			240	3100					
11:00	8700	310	3300			290	3400					
:15	9100	310	3200			310	3100					
:30	8800	330	2900			290	2900					
:45	9400	340	3600			265	3200					
12:00	9400	300	3400			310	3500					
:15	9200	280	3200			270	3100					
:30	7800	280	2900			250	3100					
:45	9400	330	3900			290	3800					
13:00	8400	280	2700			350	2700					
:15	8900	290	3500			300	3400					
:30	9800	275	3400			280	3100					
:45	9300	285	3100			300	2900					
14:00	8500	350	3000			335	2900					
:15	7800	380	2850			260	2800					
:30	7600	340	2400			270	2800					
:45												



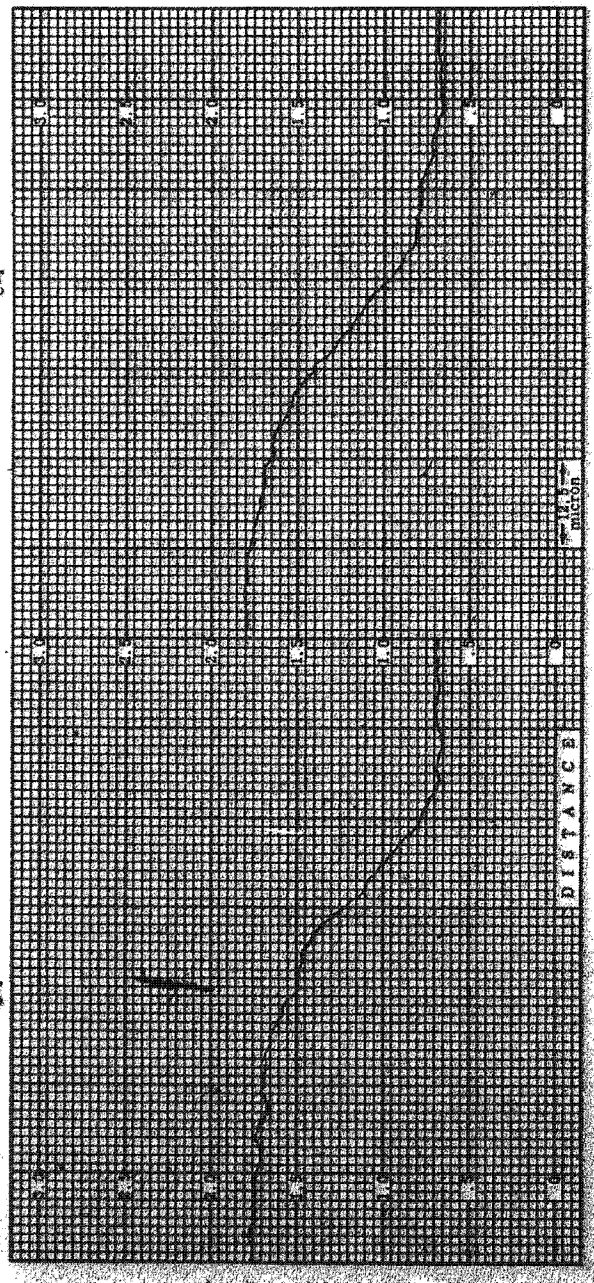
MISSION 4011 PASS D47 FRAME 002
10 DIA ENLG D 98 RES W051 A05[illegible]
SUN ANGLE 48° LATITUDE 39°



MISSION 4011 PASS D47 FRAME 002
40 DIA ENLG D 96 RES W051 A055
SUN ANGLE 48° LATITUDE 39°

BCS 24577-64

SPPL TECHNICAL REPORT NO. 101-1-34



Approved for Release: 2021/05/17 C05134462

MISSION 4011

SITE MANNING REPORT

DATE 8/26/64

LOCATION Morgansville, W. Va. TGT TYPE HiCont. "T"/40' Edge OPERATOR Huck, Rich, Michael CALIBRATED

Local Time EST	Temp. F°	Bar. Pr. In Hg.	Wind MPH	Wind DIR	% Rel. Hum.	Gnd. Haze	Est. Cloud Cover	and Pix.	Target Brightness in Foot Lamberts: Disc.	Black	White	Tri-Color: Red	White	Blue
11:00														
:15														
:30	78	30.35	7	W	34	V. Lt	40	1						
:45	78	—	8	W	—	V. Lt	—	2						
12:00	79	30.35	5	NW	33	V. Lt	45	3						
:15	79	—	5	NW	—	V. Lt	—	4						
:30	80	30.33	6	W	32	V. Lt	35	5						
:45	82	—	5	NW	—	V. Lt	—	6						
13:00	82	30.31	3	NW	31	V. Lt	20	7						
:15	82	—	2	SW	—	V. Lt	—	8						
:30	81	30.30	5	W	31	V. Lt	10	9						
:45														
:00														
:15														
:30														
:45														
:00														
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:00														
:15														
:30														
:45														
:00														

TARGET BRIGHTNESS IN FOOT LAMBERTS

Local Time	Low Contrast "T": Disc	Black	Gray	High Contrast "T": Black	White	Edge Analysis: Black	Gray	Fixed/Permanent Sites: Black	White	Gray	Additional Colors	
11:00												
:15												
:30	7400			375	8400	375	3300					
:45	7100			280	8000	280	2000					
12:00	9300			430	8100	430	3200					
:15	9400			350	8100	350	3300					
:30	9250			350	8000	350	3000					
:45	9350			375	8100	375	3100					
13:00	9100			360	7800	360	3000					
:15	8200			310	7150	310	2800					
:30	8500			320	7000	320	2800					
:45												
:00												
:15												
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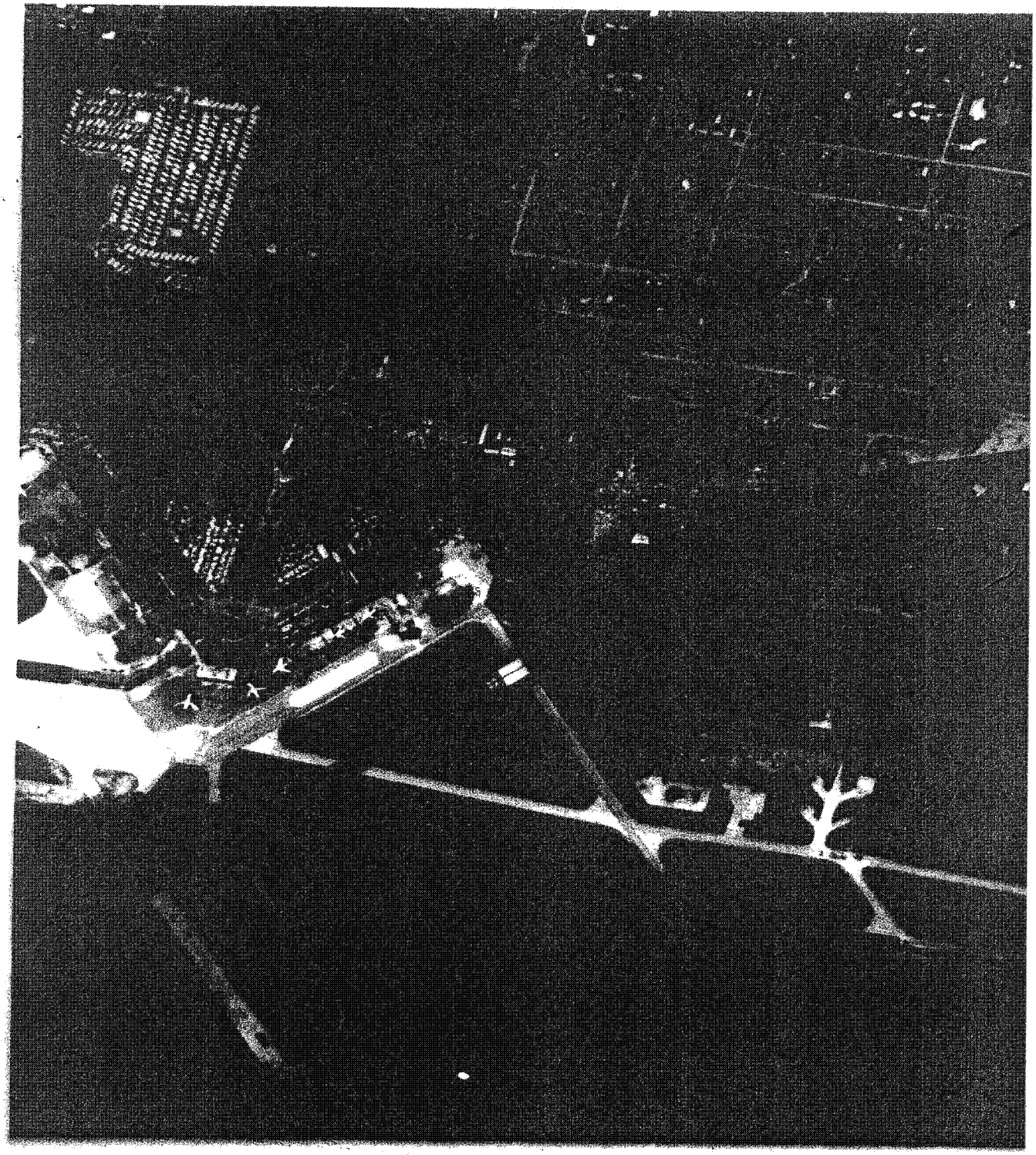
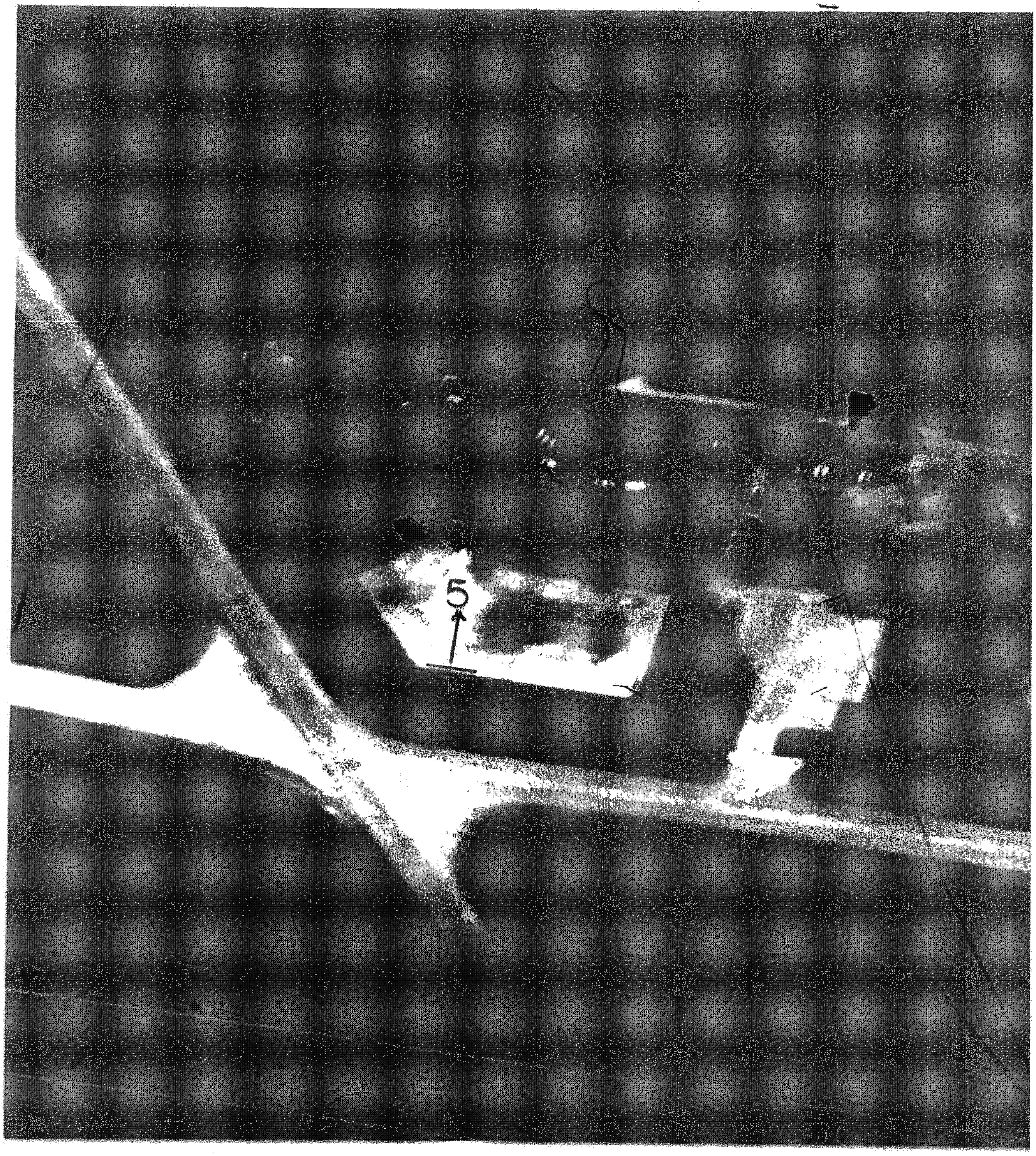
:30												
:45												
:00												

Time EST	Disc	Target Brightness in Ft. Lamberts: Black Tgt.	Black Patch	White Tgt.	White Patch	Dk. G Tgt.	Dk. G Patch	Med G Tgt.	Med G Patch	Lt. G Tgt.	Lt. G Patch	Remarks
1200	9300	[illegible]	[illegible]	[illegible]	[illegible]	—	—	—	—	[illegible]	[illegible]	Lt. Clouds Aloft
1300	9100	[illegible]	[illegible]	[illegible]	[illegible]	—	—	—	—	[illegible]	[illegible]	

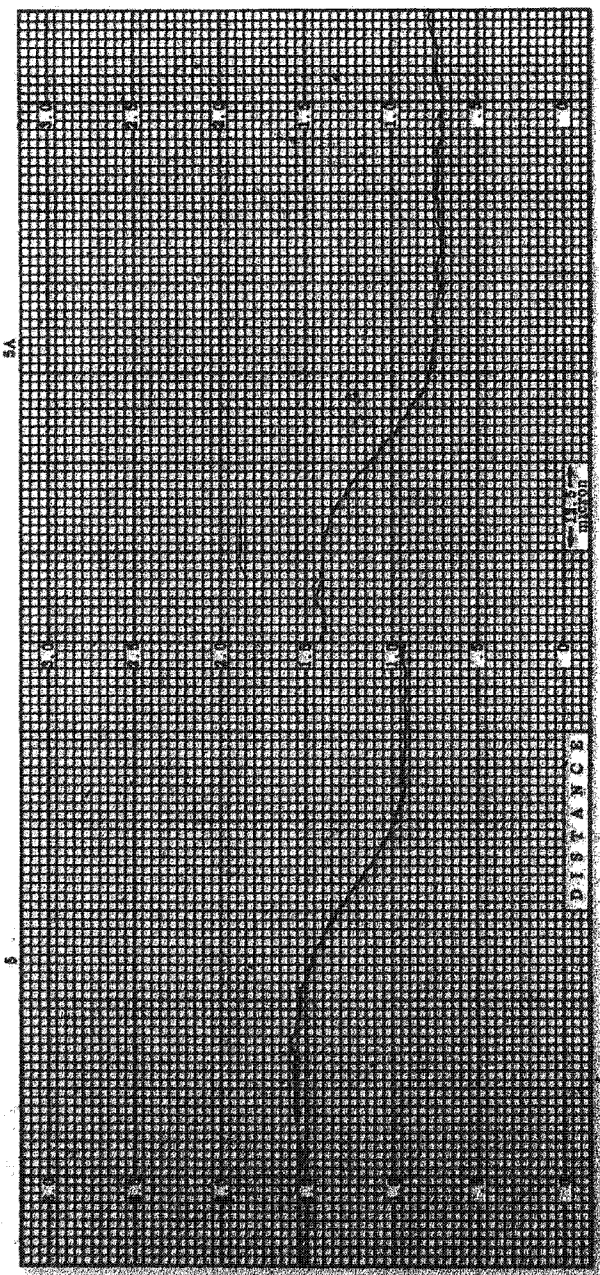
Note: Grass - 1145 - 500/Disk, 7100



MISSION 4011 PASS D49 FRAME 001
10 DIA ENLG D 1.22 RES 045
SUN ANGLE 40° LATITUDE 48°

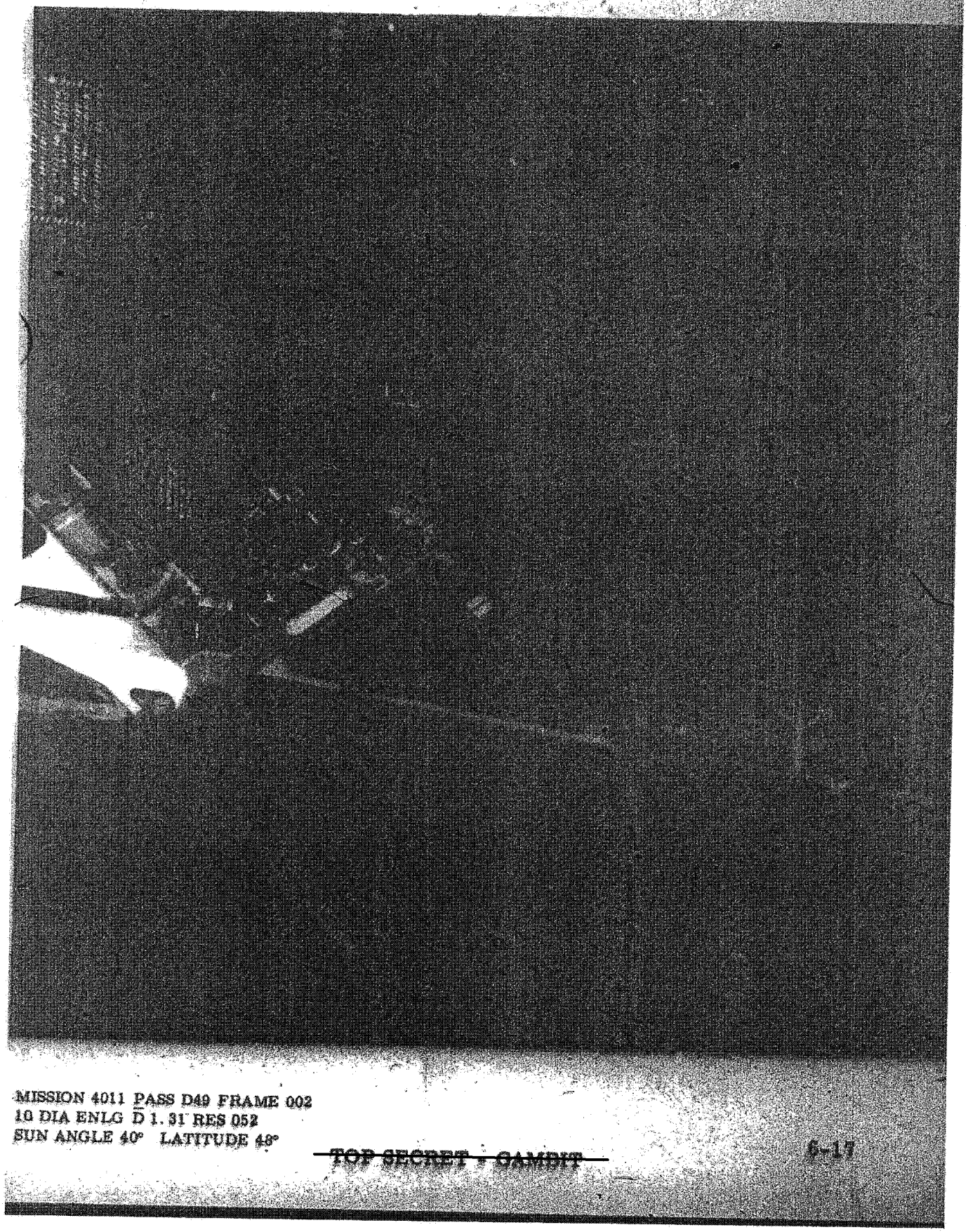


MISSION 4011 PASS D49 FRAME 001
40 DIA ENL. D.I. 22 RES 045
SUN ANGLE 40° LATITUDE 46

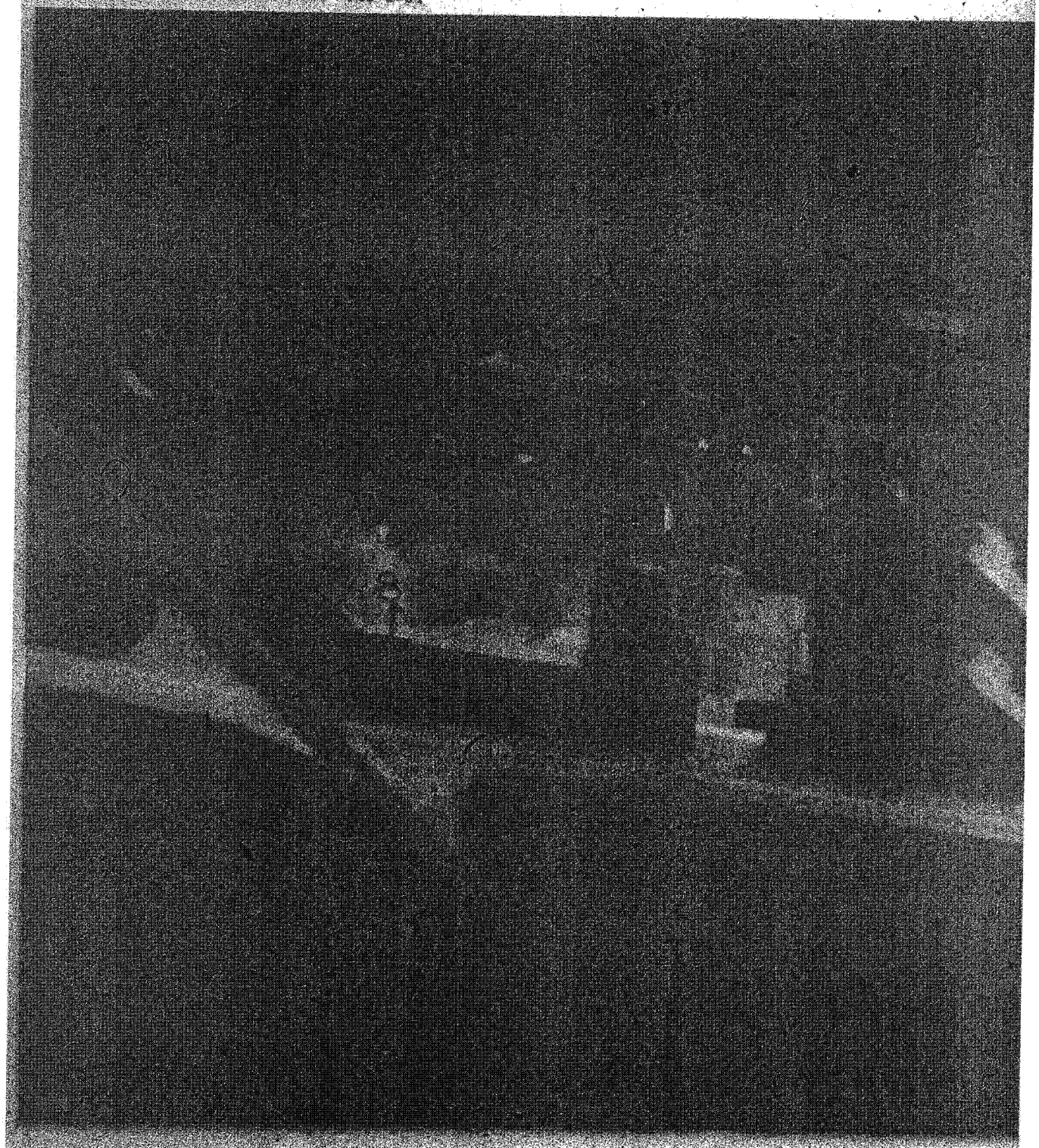


BCS 24577-64

SPPL TECHNICAL REPORT NO. 101-1-34



MISSION 4011 PASS D49 FRAME 002
10 DIA ENLG D 1.31 RES 052
SUN ANGLE 40° LATITUDE 48°



MISSION 4011 PASS D49 FRAME 002
40 DIA ENLG D 1.31 RES 052
SUN ANGLE 40° LATITUDE 48°

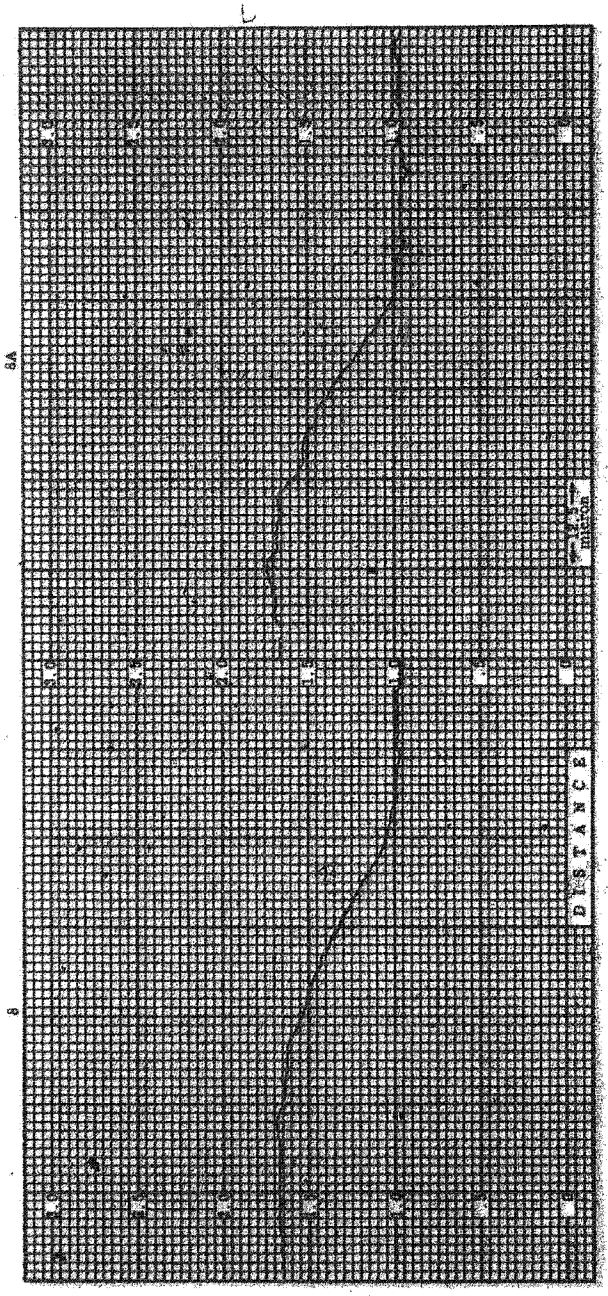


TABLE 10 - V-RES VALUES PER REV & FRAME

MISSION 4011

REV	FRAME	1 W	1 A	2 W	2 A	3 W	3 A	4 W	4 A	5 W	5 A
D041	16	39	41	36	47	41	43	29	35	28	32
D041	17	32	34	43	55	36	39	36	47	38	45
D042	17	36	40	52	67	29	38	31	27	47	37
D042	18	42	47	38	54	31	42	31	38	31	38
D047E	1	27	41	38	45	34	39	47	49	30	43
D047E	2	45	45	59	65	48	53	49	59	47	59
D048E	11	27	30	38	33	32	27	42	50	47	32
D048E	12	29	25	27	33	42	29	50	33	40	38
D049E	1	47	52	31	45	30	45	39	39	31	38
D049E	2	47	47	63	63	39	47	41	41	45	52
D054	7	50	42	47	47	43	36	38	31	42	35
D054	8	59	54	55	54	55	47	47	47	31	34
D054	12	40	37	36	47	40	44	29	40	24	42
D054	13	38	40	44	29	31	25	36	42	26	40
D055	13	38	47	47	34	54	54	63	42	31	36
D055	14	38	47	44	38	47	47	34	42	34	36
D056	6	29	40	36	47	42	31	38	42	47	42
D056	7	33	42	38	47	36	27	38	44	47	38
D058	12	68	57	59	54	49	47	67	72	43	58
D058	13	45	52	63	52	67	63	39	45	39	41
D058	15	59	65	47	52	55	55	55	52	38	45
D058	16	52	52	49	54	41	47	47	45	39	43
D064E	4	59	78	41	60	32	52	35	43	45	59

MISSION 4011

REV	FRAME	1 W	1 A	2 W	2 A	3 W	3 A	4 W	4 A	5 W	5 A
D058	18	45	45	41	47	38	42	32	35	36	36
D058	19	43	41	39	43	43	52	39	47	46	46
D060	9			55	59	45	49	43		57	59
D060	10			59	59	47	49	55	53	67	47
D060	14	41	47	43	47	51	55	30	34	33	39
D060	15	43	49	47	55	41	51	43	47	45	49
D061	7	43	47	47	47	53	57	45	51	45	47
D061	8	49	51	49	55	45	55	51	53	52	55
D061E	8	32	47	36	36	43	47	49	59	39	47
D061E	9	41	55	36	47	45	47	36	45	32	39
D063	4	20	22	54	63	31	39	31	42	33	38
D063	5	58	62	56	54	47	59	42	34	36	38
D065	20	41	49	51	34	30	47	33	39	31	43
D065	21	38	52		45	47	47	38	43	38	45
D066	15	26	38	45	47	29	43	36	45	41	45
D066	16	35	41	28	36	36	36	29	34	35	41
D081E	1	50	47	50	63	47	50	29	38	63	67
D081E	2	40	42	47	58	38	47	34	50	54	42
D082E	4	42	42	65	67	58	63	34	58	63	50
D082E	5	58	63	48	53	40	50	43	34	54	38
D086	3	38	56	54	47	63	50	50	54	42	63
D086	4	63	67	56	42	44	54	42	56	36	42

Handle via Byeman Controls Only

TOP SECRET - GAMBIT