Copy [redacted] of [redacted] copies

This document contains 14 pages

Analysis of Photographic Image to Evaluate System Performance Mission 1007-1

24 July 1964

Analysis of Photographic Image to Evaluate System Performance

SECTION II SUMMARY SHEET

Mission 1007-1

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

Arithmetic Mean	89.7
Standard Deviation	22.2
Coefficient of Dispersion	25%
Number of edges	107

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

Arithmetic Mean	11.9
Standard Deviation	3.6
Coefficient of Dispersion	30%
Number of Edges	107

July 24, 1964

TITLE:

Summary of Microdensitometer Derived Image Quality Data Collected from Mission 1007-1

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 tabulation of the location, description, and image quality data for each edge. Frequency plots of the spread function and resolving power data are presented as Section IV to show the distribution of values. Summary of all C/M/J Missions traced to date is presented in Section V. Section VI is included to show the sensitometric data for this mission. 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 320 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 0.277 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

Mission 1007-1

Section III

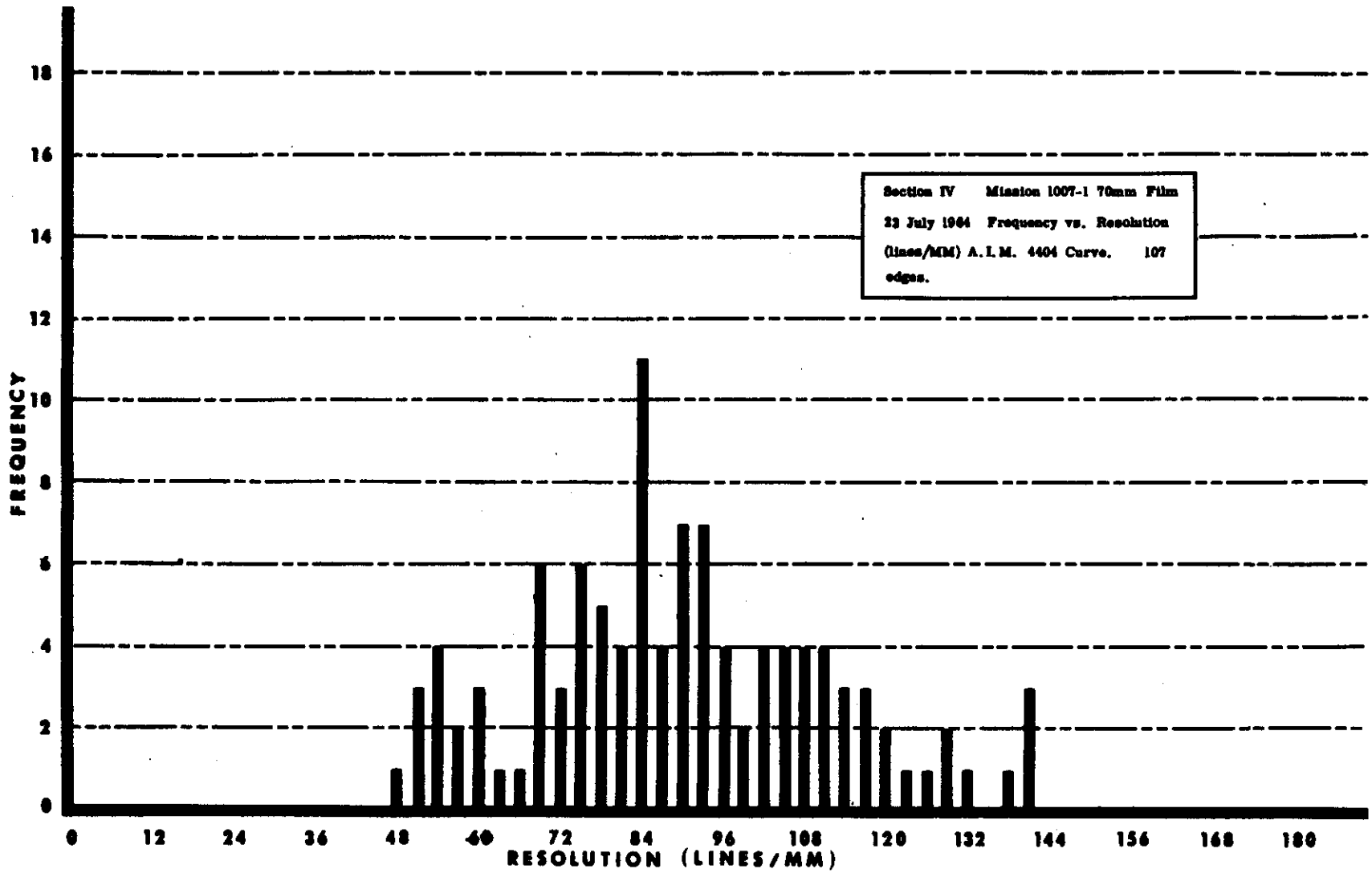
Edge No.	Camera	Pass	Frame	Location	Orientation	Subject	50% Amplitude Spread Function Width (Microns)	A.I.M. Resolution
1	Aft	D09	040	C-12	075	Airfield	11.5	80
1A	Aft	D09	040	C-12	075	Airfield	8.7	95
2	Aft	D09	047	A-4	009	Airfield	13.9	84
2A	Aft	D09	047	A-4	009	Airfield	9.5	106
2B	Aft	D09	047	A-4	009	Airfield	12.5	75
2C	Aft	D09	047	A-4	009	Airfield	11.9	77
3	Aft	D09	051	B-10	175	Airfield	9.7	110
3A	Aft	D09	051	B-10	175	Airfield	12.6	84
3B	Aft	D09	051	B-10	175	Airfield	8.5	117
4	Aft	D09	052	A-4	018	Airfield	8.0	114
4A	Aft	D09	052	A-4	018	Airfield	7.8	107
4B	Aft	D09	052	A-4	018	Airfield	10.0	102
4C	Aft	D09	052	A-4	018	Airfield	9.3	97
5	Aft	D09	058	B-3	115	Airfield	13.6	68
5A	Aft	D09	058	B-3	115	Airfield	13.9	55
5B	Aft	D09	058	B-3	115	Airfield	8.6	113
5C	Aft	D09	058	B-3	115	Airfield	14.6	55
6	Aft	D09	058	B-C-9	160	Airfield	9.7	115
6A	Aft	D09	058	B-C-9	160	Airfield	11.4	111
7	Aft	D09	071	A-5	156	Airfield	9.4	87
7A	Aft	D09	071	A-5	156	Airfield	7.5	140

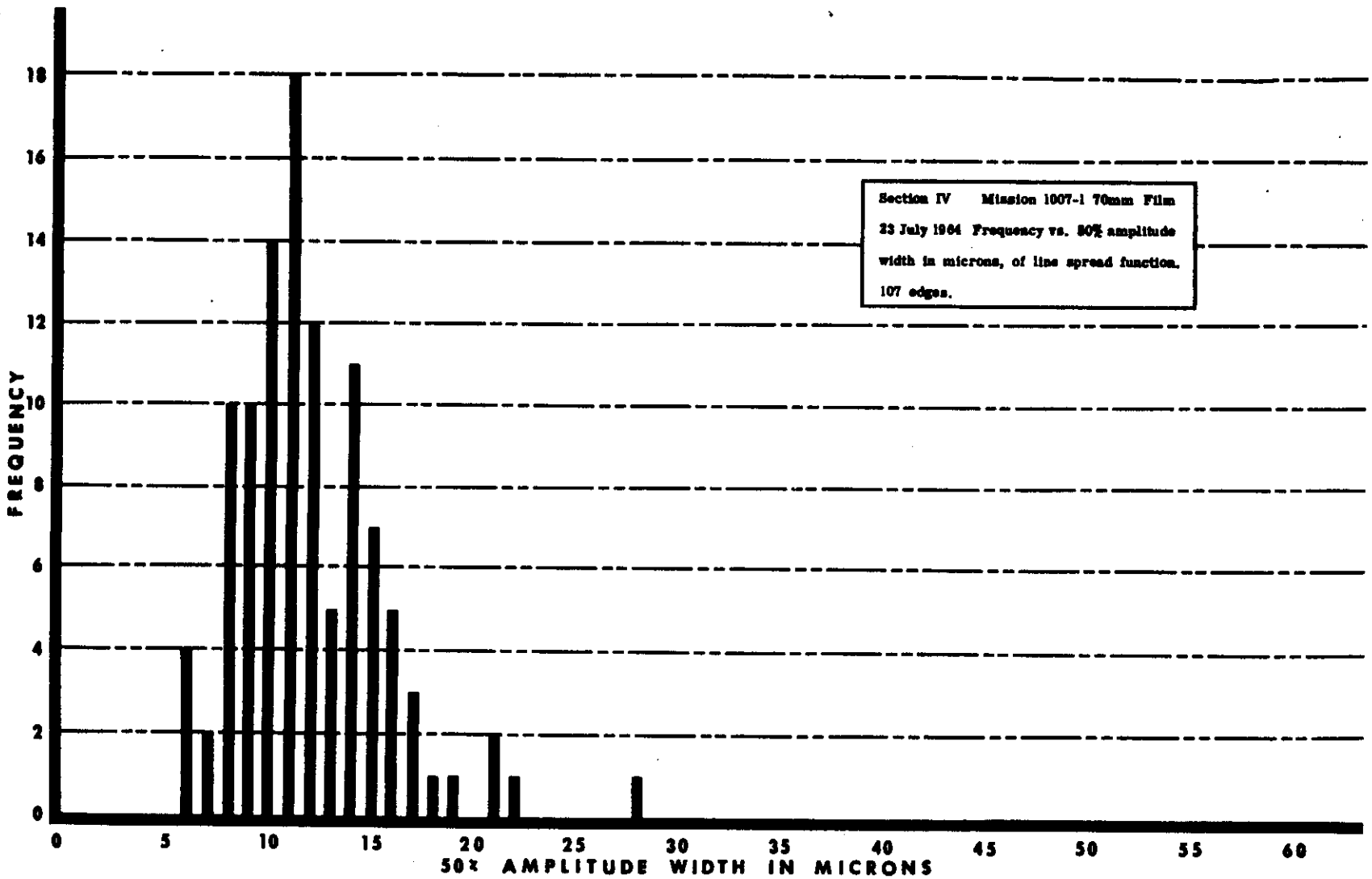
Edge No.	Camera	Pass	Frame	Location	Orientation	Subject	50% Amplitude Spread Function Width (Microns)	A.I.M. Resolution
8	Aft	D09	075	C-7	072	Airfield	8.4	111
8A	Aft	D09	075	C-7	072	Airfield	9.8	102
8B	Aft	D09	075	C-7	002	Airfield	11.1	85
8C	Aft	D09	075	C-7	002	Airfield	10.6	95
10	Aft	D09	101	A-6	025	Airfield	11.6	83
10A	Aft	D09	101	A-6	025	Airfield	10.9	83
11	Aft	D09	101	B-5	119	Bridge	7.8	138
12	Aft	D09	097	B-3	116	Airfield	6.0	140
12A	Aft	D09	097	B-3	116	Airfield	14.2	90
13	Aft	D09	096	A-B-12	089	Airfield	12.1	104
14	Aft	D09	091	B-8	160	Airfield	11.3	127
14A	Aft	D09	091	B-8	160	Airfield	10.3	86
15	Aft	D09	088	A-B-11	090	Break-Water	9.0	106
16	Aft	D09	086	B-C-10	145	Break-Water	10.1	92
17	Aft	D09	085	B-C-7	032	Bridge	10.4	90
18	Fwd	D09	066	C-9	158	Airfield	8.4	110
18A	Fwd	D09	066	C-9	158	Airfield	14.8	83
19	Fwd	D09	061	C-9	158	Airfield	14.4	54
19A	Fwd	D09	061	C-9	158	Airfield	15.3	81
20	Fwd	D09	053	B-12	127	Airfield	12.2	70
20A	Fwd	D09	053	B-12	127	Airfield	14.7	77
21	Fwd	D09	047	B-11	019	Airfield	10.8	88

Edge No.	Camera	Pass	Frame	Location	Orientation	Subject	50% Amplitude Spread Function Width (Microns)	A.I.M. Resolution
21A	Fwd	D09	047	B-11	019	Airfield	11.4	85
22	Fwd	D09	046	A-5	175	Airfield	17.6	47
22A	Fwd	D09	046	A-5	175	Airfield	11.8	92
23	Fwd	D09	034	C-3	060	Airfield	15.8	73
23A	Fwd	D09	034	C-3	060	Airfield	9.7	92
24A	Fwd	D21	115	B-8	095	Airfield	11.3	90
25	Fwd	D21	116	C-6-7	115	Harbor	8.5	107
25A	Fwd	D21	116	C-6-7	078	Harbor	17.2	52
26	Fwd	D21	117	B-5	100	Airfield	12.6	71
26A	Fwd	D21	117	B-5	100	Airfield	16.2	70
27	Fwd	D21	118	A-3	093	Airfield	28.1	52
28	Fwd	D21	118	C-2	091	Airfield	15.5	56
29	Fwd	D21	119	C-7	082	Airfield	15.2	55
29A	Fwd	D21	119	C-7	082	Airfield	13.6	63
29B	Fwd	D21	119	C-7	082	Airfield	12.2	75
29C	Fwd	D21	119	C-7	082	Airfield	10.7	82
30	Aft	D21	119	B-13	140	Airfield	10.4	95
30A	Aft	D21	119	B-13	140	Airfield	17.3	90
31	Aft	D21	120	B-7	095	Airfield	13.9	89
31A	Aft	D21	120	B-7	095	Airfield	10.1	83
32	Aft	D21	121	A-B-8	120	Harbor	9.5	92
33	Aft	D21	122	B-9	108	Airfield	9.9	108
33A	Aft	D21	122	B-9	108	Airfield	9.7	104

Edge No.	Camera	Pass	Frame	Location	Orientation	Subject	50% Amplitude Spread Function Width (Microns)	A.I.M. Resolution
34	Aft	D21	124	A-B-8	080	Airfield	10.7	76
34A	Aft	D21	124	A-B-8	080	Airfield	10.8	83
35	Fwd	D56	044	B-7-8	160	Airfield	5.7	130
35A	Fwd	D56	044	B-7-8	160	Airfield	11.7	75
36	Fwd	D56	062	C-11	058	Airfield	8.6	119
36A	Fwd	D56	062	C-11	058	Airfield	12.8	90
37	Fwd	D56	090	B-7-8	123	Airfield	16.7	70
37A	Fwd	D56	090	B-7-8	123	Airfield	14.0	80
38	Fwd	D56	102	C-4	126	Airfield	7.4	118
38A	Fwd	D56	102	C-4	126	Airfield	10.9	94
39	Fwd	D56	103	A-4	092	Airfield	22.3	60
39A	Fwd	D56	103	A-4	092	Airfield	21.5	53
40	Fwd	D56	103	C-9	025	Airfield	11.9	94
40A	Fwd	D56	103	C-9	025	Airfield	14.6	68
41	Fwd	D56	109	B-2	153	Airfield	12.9	71
41A	Fwd	D56	109	B-2	153	Airfield	13.0	78
42	Fwd	D56	120	B-C-5	065	Airfield	10.2	121
42A	Fwd	D56	120	B-C-5	065	Airfield	16.2	100
43	Fwd	D56	142	A-9	083	Airfield	14.2	65
43A	Fwd	D56	142	A-9	083	Airfield	18.5	70
44	Fwd	D57	043	A-11	148	Airfield	10.9	77
44A	Fwd	D57	043	A-11	148	Airfield	11.0	75
45	Fwd	D57	039	B-C-7	125	Airfield	8.1	118

Edge No.	Camera	Pass	Frame	Location	Orientation	Subject	50% Amplitude Spread Function Width (Microns)	A.I.M. Resolution
45A	Fwd	D57	039	B-C-7	125	Airfield	11.0	83
46	Fwd	D57	037	C-11	140	Airfield	10.6	87
46A	Fwd	D57	037	C-11	140	Airfield	20.9	50
47	Fwd	D57	034	C-9	168	Airfield	10.6	91
47A	Fwd	D57	034	C-9	168	Airfield	14.0	61
48	Fwd	D57	031	A-5	171	Airfield	6.4	131
48A	Fwd	D57	031	A-5	171	Airfield	14.7	103
49A	Fwd	D57	030	C-12	038	Airfield	15.8	79
50	Aft	D57	042	A-6	170	Airfield	10.2	98
50A	Aft	D57	042	A-6	170	Airfield	9.2	103
51	Aft	D57	040	C-5	170	Airfield	14.4	56
51A	Aft	D57	040	C-5	170	Airfield	6.9	124
52	Aft	D57	036	B-2	032	Airfield	11.6	75
52A	Aft	D57	036	B-2	032	Airfield	7.7	130
53	Aft	D57	041	C-1	170	Airfield	8.8	94
53A	Aft	D57	041	C-1	170	Airfield	11.9	85
54	Aft	D57	038	B-13	160	Airfield	10.6	108
54A	Aft	D57	038	B-13	160	Airfield	6.1	140


Section IV Mission 1007-1 70mm Film
23 July 1964 Frequency vs. Resolution
(lines/MM) A.I.M. 4404 Curve. 107
edges.
FREQUENCY
0
2
4
6
8
10
12
14
16
18
0
12
24
36
48
60
72
84
96
108
120
132
144
156
168
180
RESOLUTION (LINES/MM)


Section IV Mission 1007-1 70mm Film
23 July 1964 Frequency vs. 80% amplitude
width in microns, of line spread function.
107 edges.
FREQUENCY
0
2
4
6
8
10
12
14
16
18
0
5
10
15
20
25
30
35
40
45
50
55
60
50x AMPLITUDE WIDTH IN MICRONS

SECTION V

Mission Number	Number of Edges	Spread Function Width at 50% Amplitude in Microns, Computer Calculations			Resolution in lines/mm from A.I.M. 4404 Curve, Computer Calculations		
		Arithmetic Mean	Standard Deviation	Coefficient of Dispersion	Arithmetic Mean	Standard Deviation	Coefficient of Dispersion
9054	12	14.3	4.6	32%	81.7	27.9	34%
9057	35	12.0	4.1	34%	81.3	30.2	37%
9062	69	12.0	4.5	37%	89.4	30.3	34%
1001	117	25.6	11.3	44%	45.9	16.8	37%
1004-1	60	10.1	5.6	56%	115.7	38.8	34%
1004-2	69	12.6	4.9	39%	84.6	31.3	37%
1006-1	93	12.0	4.3	36%	85.3	26.4	31%
1006-2	109	11.4	3.3	29%	85.5	22.1	26%
1007-1	107	11.9	3.6	30%	89.7	22.2	25%

	Head and Tail Forward Camera		Head and Tail Aft Camera		Mission
	Head	Tail	Head	Tail	Mat'l
Fog	.19	.19	.19	.18	None Received
1					
2					
3					
4	.19	.20	.19	.20	
5	.21	.21	.20	.21	
6	.22	.22	.21	.22	
7	.24	.23	.24	.24	
8	.30	.29	.30	.30	
9	.40	.40	.40	.40	
10	.58	.58	.58	.58	
11	.83	.84	.83	.84	
12	1.15	1.14	1.13	1.14	
13	1.49	1.48	1.47	1.49	
14	1.79	1.78	1.76	1.78	
15	2.01	2.00	2.00	2.01	
16	2.21	2.20	2.19	2.20	
17	2.33	2.33	2.32	2.32	
18	2.40	2.39	2.38	2.39	
19	2.44	2.44	2.44	2.44	
20	2.47	2.47	2.47	2.47	
21	2.49	2.49	2.49	2.49	
f	2.15	2.05	2.10	2.10	
0.6G/Speed	1.11	1.09	1.11	1.00	

Sensitometric Data

	Process Control Standard			Start Up		
	Primary	Intermed.	Full	Primary	Intermed.	Full
Fog	.08	.10	.19	.07	.09	.19
1						
2						
3						
4						.20
5			.19		.11	.21
6		.10	.20	.09	.13	.22
7	.08	.12	.23	.10	.14	.25
8	.10	.14	.27	.11	.17	.31
9	.12	.18	.34	.14	.20	.40
10	.16	.26	.50	.18	.29	.58
11	.24	.42	.79	.26	.44	.82
12	.38	.67	1.10	.42	.70	1.14
13	.62	1.03	1.43	.64	1.03	1.47
14	.93	1.40	1.72	.93	1.42	1.76
15	1.26	1.71	1.95	1.27	1.71	1.98
16	1.55	1.95	2.13	1.56	1.95	2.16
17	1.83	2.10	2.24	1.85	2.11	2.28
18	2.04	2.22	2.30	2.03	2.24	2.36
19	2.17	2.29	2.35	2.17	2.32	2.40
20	2.25	2.34	2.39	2.26	2.34	2.42
21	2.30	2.37	2.43	2.33	2.39	2.43
γ	2.15	2.38	2.20	2.00	2.31	2.04
0.6G/Speed	$\bar{1}$.48	$\bar{1}$.30	$\bar{1}$.13	$\bar{1}$.48	$\bar{1}$.34	$\bar{1}$.10

Sensitometric Data

Mission 1007-1

Film Manufacturer: Eastman Kodak Company

Exposure Date: May 26, 1964

Emulsion No.: 4404-42

Lamp No.: 1903

Exposure Time: 1/25 second

Wedge No.: 711-15

Filter: Daylight

Development Conditions:

Primary: P-693, 2' 15", 74°F

Intermediate: Primary Development Plus 12DX90, 25", 67°F

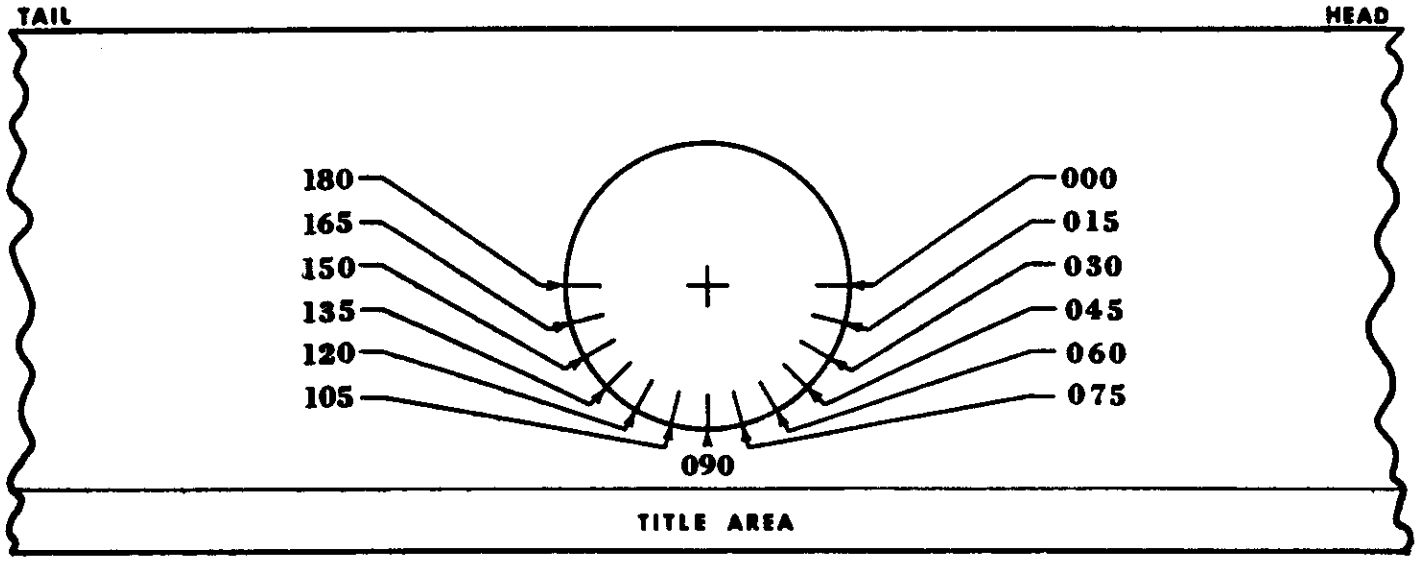
Full: Primary Development Plus 12DX90, 1' 41", 67°F

Absolute Log E 11th Step: 1.30 M.C.S.

APPENDIX "A"

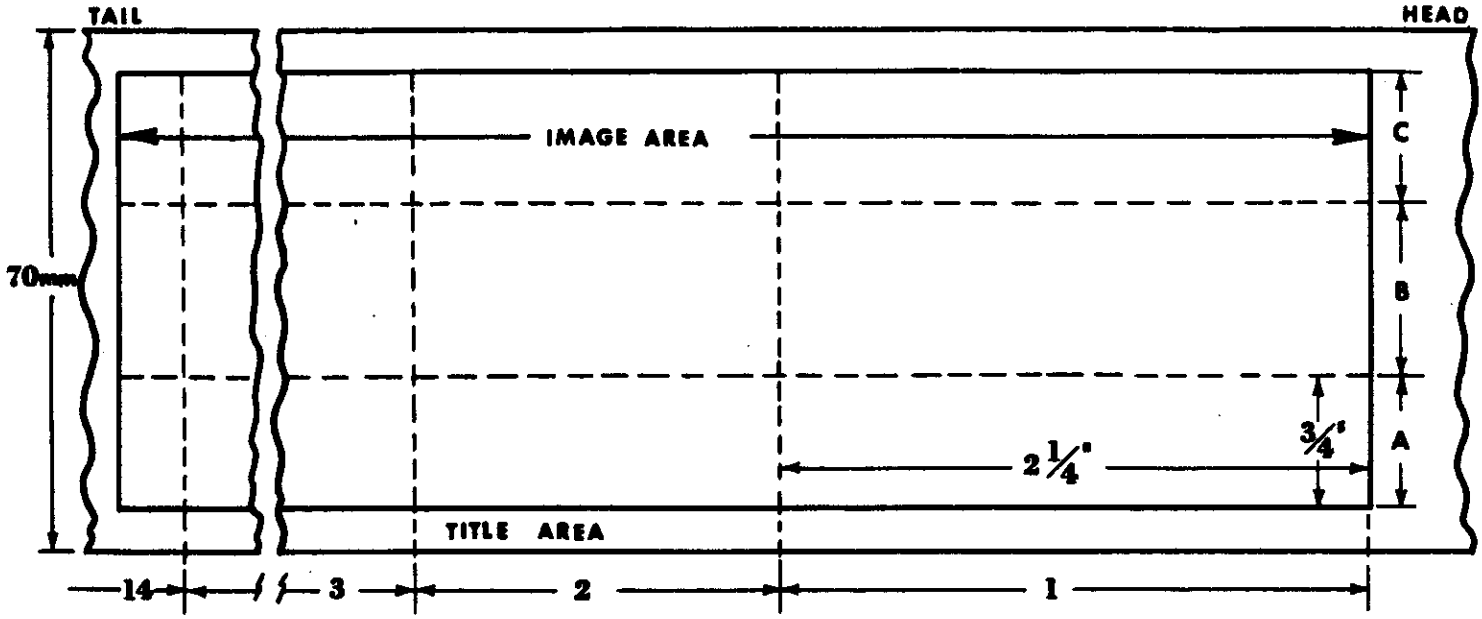
Reference System For Orientation Of C/M/J Mission Edges

original negative - - emulsion up



Grid For Position Of C/M/J Mission Edges

original negative - - emulsion up



Distribution List

[redacted]