



United States Department of the Interior



GEOLOGICAL SURVEY
RESTON, VA 22092

REPORT OF CALIBRATION
of Aerial Mapping Camera

January 21, 1992

Camera type: Zeiss RMK A 21/23	Camera serial no.: 115738
Lens type: Zeiss Toparon	Lens serial no.: 116227
Nominal focal length: 210 mm	Maximum aperture: f/5.6
	Test aperture: f/5.6

Submitted by: James W. Sewall Company
Old Town, Maine

Reference: James W. Sewall Company purchase order
No. 16740, dated January 15, 1992.

These measurements were made on Kodak Micro-flat glass plates, 0.25 inch thick, with spectroscopic emulsion type 157-01 Panchromatic, developed in D-19 at 68° F for 3 minutes with continuous agitation. These photographic plates were exposed on a multicollimator camera calibrator using a white light source rated at approximately 5200K.

I. Calibrated Focal Length: 207.919 mm

This measurement is considered accurate within 0.005 mm

II. Radial Distortion

Field angle	\bar{D}_c	D_c for azimuth angle			
		0° A-C	90° A-D	180° B-D	270° B-C
degrees	um	um	um	um	um
7.5	-8	-10	-8	-7	-8
15	-10	-10	-10	-9	-10
22.7	-1	-2	0	1	-1
30	7	6	8	4	9

The radial distortion is measured for each of four radii of the focal plane separated by 90° in azimuth. To minimize plotting error due to distortion, a full least-squares solution is used to determine the calibrated focal length. \bar{D}_c is the average distortion for a given field angle. Values of distortion D_c based on the calibrated focal length referred to the calibrated principal point (point of symmetry) are listed for azimuths 0°, 90°, 180° and 270°. The radial distortion is given in micrometers and indicates the radial displacement away from the center of the field. These measurements are considered accurate within 5 um.

AWAR

74-75.2

93-72.7 98

94-62 82
69

III. Resolving Power in cycles/mm

Area-weighted average resolution: 52

Field angle:	0°	7.5°	15°	22.7°	30°
Radial lines	58	58	69	58	58
Tangential lines	58	49	49	58	29

The resolving power is obtained by photographing a series of test bars and examining the resultant image with appropriate magnification to find the spatial frequency of the finest pattern in which the bars can be counted with reasonable confidence. The series of patterns has spatial frequencies from 3 to 195 cycles/mm in a geometric series having a ratio of the 4th root of 2. Radial lines are parallel to a radius from the center of the field, and tangential lines are perpendicular to a radius.

IV. Filter Parallelism

The two surfaces of the B No. 116623 and the KL No. 116636 filters accompanying this camera are within 10 seconds of being parallel. The B filter was used for the calibration.

V. Shutter Calibration

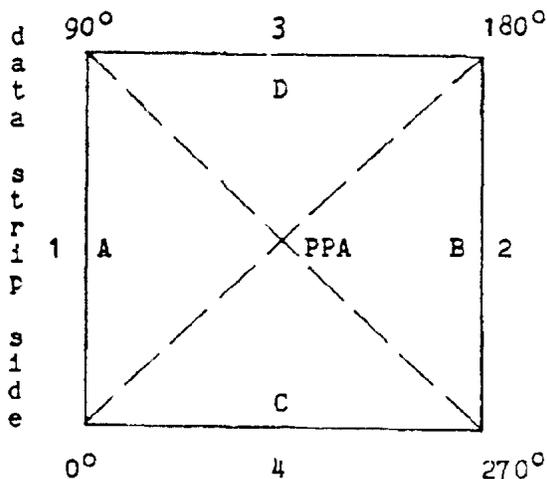
<u>Indicated shutter speed</u>	<u>Effective shutter speed</u>	<u>Efficiency</u>
1/200	4.70 ms = 1/215 s	81%
1/400	2.16 ms = 1/465 s	81%
1/600	1.40 ms = 1/715 s	81%
1/800	1.05 ms = 1/950 s	81%
1/1000	0.80 ms = 1/1250 s	81%

The effective shutter speeds were determined with the lens at aperture f/5.6. The method is considered accurate within 3 percent. The technique used is Method I described in American National Standard PH3.48-1972(R1978).

VI. Magazine Platen

The platen mounted in FK 24/120 film magazine No. 3564 does not depart from a true plane by more than 13 um (0.0005 in).

VII. Principal Points and Fiducial Coordinates



Positions of all points are referenced to the principal point of autocollimation (PPA) as origin. The diagram indicates the orientation of the reference points when the camera is viewed from the back, or a contact positive with the emulsion up. The data strip is to the left.

	<u>X coordinate</u>	<u>Y coordinate</u>
Indicated principal point, midside fiducials	-0.018 mm	0.011 mm
Principal point of autocollimation	0.0	0.0
Calibrated principal point (point of symmetry)	-0.010	-0.013

Fiducial Marks

1	-113.011 mm	0.011 mm
2	112.984	0.011
3	-0.013	113.001
4	-0.023	-112.987

VIII. Distances Between Fiducial Marks

Midside fiducials

1-2: 225.995 mm 3-4: 225.989 mm

Lines joining these markers intersect at an angle of 89° 59' 50"

The method of measuring these distances is considered accurate within 0.005 mm.

This aerial mapping camera calibration report supersedes the previously issued USGS Report No. OSL/1426, dated April 5, 1989.

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