



United States Department of the Interior

GEOLOGICAL SURVEY

January 25, 1974

REPORT OF CALIBRATION

of Aerial Mapping Camera

Form 9-1780
(Rev. Aug. 1973)

Camera Type	<u>Zeiss RMK A 15/23</u>	Camera Serial No.	<u>119018</u>
Lens Type	<u>Zeiss Pleogon A4</u>	Lens Serial No.	<u>118969</u>
Nominal Focal Length	<u>153 mm</u>	Maximum Aperture	<u>f/4</u>
		Test Aperture	<u>f/8</u>

Submitted by

Keystone Aerial Surveys

Glenside, Pennsylvania 19038

Reference: Keystone Purchase Order No. 7106, dated January 10, 1974

These measurements were made using Kodak Micro Flat Glass Plates, 0.25 inch thick with Spectroscopic emulsion type V-F Panchromatic, developed in D-19 at 68°F for three minutes, with continuous agitation. These photographic plates were exposed on a multicollimator camera calibrator using a white light source rated at approximately 3500°K.

I. Calibrated Focal Length: 152.97 mm

This measurement is considered accurate within 0.02 mm.

II. Radial Distortion:

Field Angle	D_c	D_c for azimuth angle			
		0° A-C	90° A-D	180° B-D	270° B-C
Degrees	μm	μm	μm	μm	μm
7.5	0	-2	1	0	2
15	-3	-3	-2	-2	-4
22.5	-4	-5	-3	-3	-5
30	-3	-6	5	-4	-6
35	-2	-6	8	-5	-7
40	-5	-9	9	-9	-10
45	*	*	*	*	*

* Fiducial marks in the corners prevented measurements at 45°

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, the calibrated focal length is derived to equalize the absolute values of the maximum positive and maximum negative distortions. D_c is the average distortion for a given field angle. Values of distortion D_c based on the calibrated focal length are listed for azimuth angles 0, 90, 180, and 270 degrees. The radial distortion is given in micrometers and indicates the radial displacement of the image from its ideal position for the calibrated focal length. A positive value indicates a displacement away from the center of the field. These measurements are considered accurate within 5 μm .

III. Tangential Distortion

Field Angle	22.5°	30°	35°	40°
Displacement in μm	0	1	2	3

The values reported are displacements from the center image point of a straight line connecting corresponding image points at equal field angles along opposite radii of the focal plane. The method of measurement is considered accurate within 5 μm .

IV. Resolving Power, in cycles/mm

Field Angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Tangential lines	113	113	113	95	80	67	57
Radial lines	113	113	113	113	95	80	67

The resolving power is obtained by photographing a series of test bars and examining the resulting image with appropriate magnification to find the spatial frequency of the finest pattern in which the bars can be counted with reasonable assurance. The series of patterns has spatial frequencies in a geometric series having a ratio of the fourth root of two. Tangential lines are those perpendicular to the radius from the center of the field. Radial lines are those lying parallel to the radius.

V. Principal Point of Autocollimation

The lines joining opposite pairs of collimation index markers intersect at an angle within 1 minute of 90° and their intersection indicates the location of the principal point of autocollimation within 0.03 mm. This condition is true for both the corner and mid-side fiducials.

VI. Collimation Marker Separation

A-B	226.000 mm	1-3	209.998 mm
C-D	226.000 mm	3-2	210.019 mm
1-2	296.986 mm	2-4	210.017 mm
3-4	297.003 mm	4-1	209.995 mm

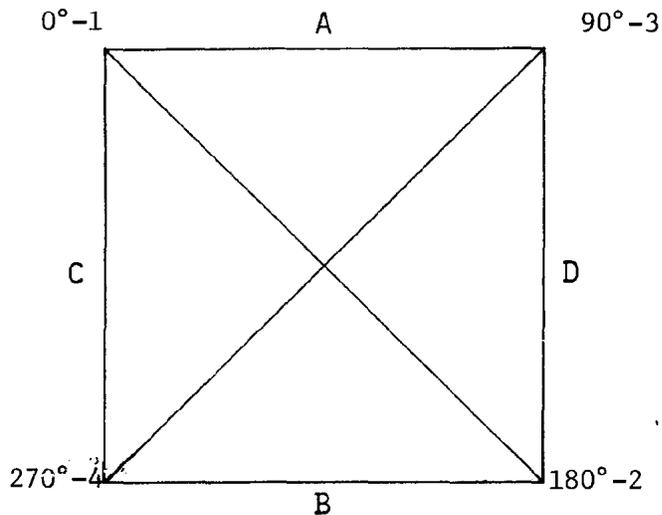
Markers A and B lie in the line of flight. The method of measuring these separations is considered accurate within 0.005 mm.

VII. Filter Parallelism

The two surfaces of the B No. 119067, D No. 119125, and KL No. 118919 filters accompanying this camera are within ten seconds of being parallel. The B filter was used for the calibration.

VIII. Magazine Platen

The platen mounted in FK 24/120 film magazine, No. 118778 does not depart from a true plane by more than 13 micrometers (0.0005 inch).



The diagram indicates the orientation of the reference points when the camera is viewed from the back. The direction of flight fiducial marker or data strip is at the top.

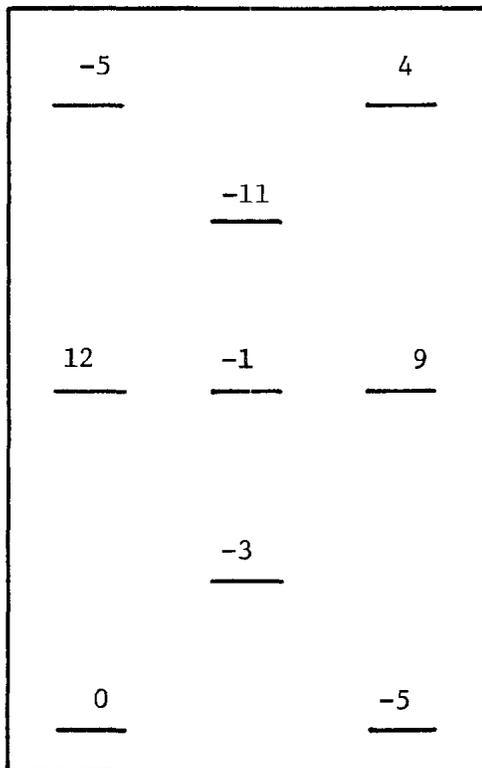
IX. Shutter Calibration

<u>Indicated Shutter Settings</u>	<u>Effective Shutter Speeds</u>	<u>Efficiency</u>
1/200	4.5 ms = 1/220 s	87%
1/400	2.2 ms = 1/445 s	92%
1/600	1.5 ms = 1/665 s	77%
1/800	1.1 ms = 1/890 s	75%
1/1000	0.9 ms = 1/1110 s	73%

The effective shutter speeds were determined with the lens at aperture f/8. The method is considered accurate within 3%. The technique used was a modification of the method described in American Standard PH3.4-1959.

STEREOMODEL FLATNESS TEST

Camera No. 119018 Lens No. 118969 Magazine No. 118778
 Focal Length 152.97 Maximum Angle of Field Tested 40°
 Base-height Ratio 0.6 Accuracy of Determination 5 μm



Stereomodel
 Test point array
 (values in micrometers)

The values shown on the diagram are the average departures from flatness (at negative scale) for two computer-simulated stereomodels based on comparator measurements on contact glass diapositives made from film exposures.

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