

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON, D.C. 20234

November 3, 1972

REPORT OF CALIBRATION

of Aerial Mapping Camera

Camera Type	<u>Kargl K1C8</u>	Camera Serial No.	<u>627</u>
Lens Type	<u>C. P. Goerz Aerotar</u>	Lens Serial No.	<u>807217</u>
Nominal Focal Length	<u>8 ¹/₄ inch</u>	Maximum Aperture	<u>f/6.8</u>
		Test Aperture	<u>f/11</u>

Submitted by
Keystone Aerial Surveys, Inc.
Glenside, Pennsylvania 19038

Reference: Keystone Purchase Order No. 3782, dated October 18, 1972.

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 K-3 filters and an incandescent tungsten light source.

I. Calibrated Focal Length: 210.33 mm

This measurement is considered accurate within 0.03 mm.

II. Radial Distortion:

Field Angle	\bar{D}_c	D_c for azimuth angle			
		0° B-C	90° A-C	180° A-D	270° B-D
Degrees	μm	μm	μm	μm	μm
7.5	-3	-1	-5	-3	-4
15	-9	-10	-10	-8	-9
22.5	-13	-27	-18	-4	-6
30	11	-5	-2	27	27

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. \bar{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	7.5°	15°	22.5°	30°
Displacement in μm	1	2	4	12

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 Area Weighted Average Resolution 36.0

Field Angle:	0°	7.5°	15°	22.5°	30°	37.5°	45°
Tangential lines	55	55	46	34	24		
Radial lines	55	55	39	39	29		

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.

VI. Collimation Marker Separation

A - B	222.480 mm
C - D	222.422 mm

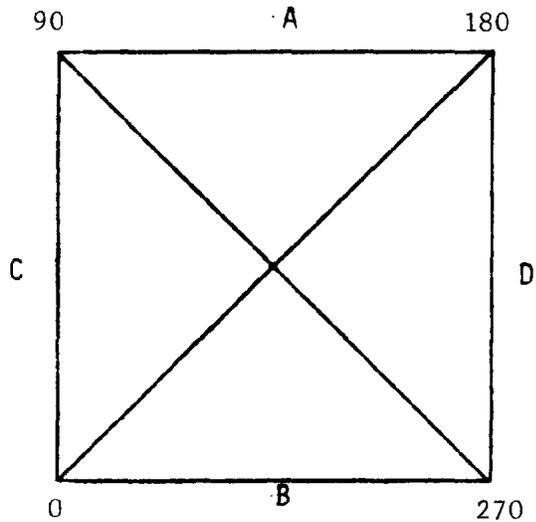
Markers A and B lie in the line of flight. The method of measuring these separations is considered accurate within 0.010 mm.

VII. Filter Parallelism

The two surfaces of the Goerz yellow filter accompanying this camera are within ten seconds of being parallel. This filter was used for the calibration.

VIII. Magazine Platen

The platen mounted in A-5A film magazine, No. K59-M30 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 Speed</u>	<u>Efficiency</u>
100	10.0 ms = 1/100 s	91%
200	5.2 ms = 1/192 s	81%
300	3.0 ms = 1/330 s	80%

The effective shutter speed was determined with the aperture set at f/11. The method is considered accurate within 3%. The technique used was a modification of the method described in American Standard PH3.4-1959.

In mechanical and optical characteristics this camera and magazine comply with the U. S. Department of Agriculture Specifications, No. ASCS-AP-201 (Revision 5) for a precision aerial camera dated July 1, 1971.

This report supersedes the previous calibration of this camera contained in NBS Report No. 188366, dated April 29, 1966.

For the Director,

Chris E. Kuyatt

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