



# United States Department of the Interior

GEOLOGICAL SURVEY  
RESTON, VIRGINIA 22092

## REPORT OF CALIBRATION

June 13, 1980

of Aerial Mapping Camera

Camera type	<u>Wild Heerbrugg RC10</u>	Camera serial no.	<u>1768</u>
Lens type	<u>Wild Universal Aviogon I</u>	Lens serial no.	<u>UAgI 6016</u>
Nominal focal length	<u>153 mm</u>	Maximum aperture	<u>f/5.6</u>
		Test aperture	<u>f/5.6</u>

Submitted by

Keystone Aerial Surveys, Inc.  
Philadelphia, Pennsylvania 19114

Reference: Keystone Purchase Order No. 1298, dated June 6, 1980

These measurements were made on Kodak micro flat glass plates, 0.25 inch thick with spectroscopic emulsion type V-F 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 3500K.

I. Calibrated Focal Length: 153.034 mm

This measurement is considered accurate within 0.005 mm

II. Radial Distortion:

Field angle (degrees)	$\bar{D}_c$	$D_c$ for azimuth angle			
		0° A-C	90° A-D	180° B-D	270° B-C
7.5	$\mu\text{m}$	$\mu\text{m}$	$\mu\text{m}$	$\mu\text{m}$	$\mu\text{m}$
7.5	-5	-5	-5	-5	-5
15	-7	-6	-8	-8	-7
22.5	-6	-6	-5	-9	-5
30	1	1	0	-2	3
35	3	3	4	0	6
40	4	-1	8	4	5

The radial distortion is measured for each of 4 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 micrometres 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  $\mu\text{m}$ .

III. Resolving power in cycles/mm      Area-weighted average resolution 54.6

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	113	113	57	57	67	67	20
Tangential lines	113	95	57	48	48	48	48

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 confidence. The series of patterns has spatial frequencies from 5 to 268 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 Wild 525 Pan No. 4728 filter accompanying this camera are within ten seconds of being parallel. This filter was used for the calibration.

V. Shutter Calibration

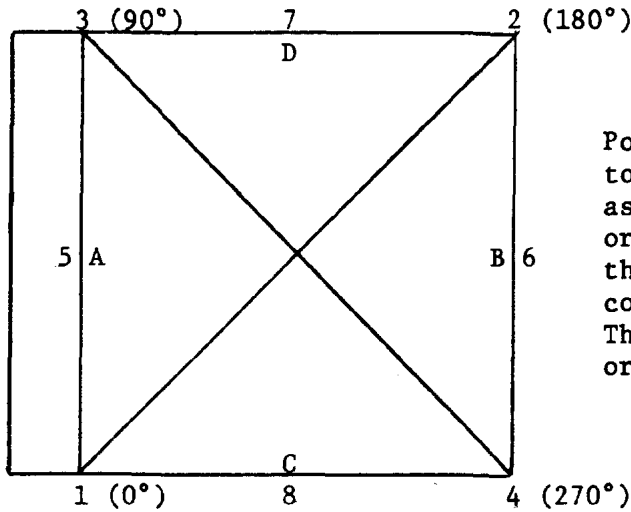
<u>Indicated shutter speed</u>	<u>Effective shutter speed</u>	<u>Efficiency</u>
1/200	4.25 ms = 1/240 s	77%
1/400	2.12 ms = 1/470 s	77%
1/600	1.42 ms = 1/700 s	77%
1/800	1.06 ms = 1/940 s	77%
1/1000	0.85 ms = 1/1180 s	77%

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

VI. Magazine Platen

The platen mounted in Wild RC10 film magazine No. 1768-135 does not depart from a true plane by more than 13 μm (0.0005 in). This camera is equipped with a platen identification marker that will register "135" in the data strip area for each exposure.

VII. Principal Point and Fiducial Coordinates



Positions of all points are referenced to the principal point of autocollimation 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 direction-of-flight fiducial marker or data strip is to the left.

	<u>X coordinate</u>	<u>Y coordinate</u>
Indicated principal point, corner fiducials	0.010 mm	0.002 mm
Indicated principal point, midside fiducials	0.007	0.005
Principal point of autocollimation	0.0	0.0
Calibrated principal point (point of symmetry)	-0.004	0.001

Fiducial Marks

1	-105.998 mm	-105.997 mm
2	106.018	106.001
3	-105.974	105.998
4	105.998	-105.997
5	-109.989	0.002
6	110.238	0.009
7	0.013	110.004
8	0.001	-109.998

VIII. Distances Between Fiducial Marks

Corner fiducials (diagonals)

1-2 299.823 mm      3-4 299.790 mm

Lines joining these markers intersect at an angle of 89° 59' 57"

Midside fiducials

5-6 220.226 mm      7-8 220.002 mm

Lines joining these markers intersect at an angle of 89° 59' 42"

Corner fiducials (perimeter)

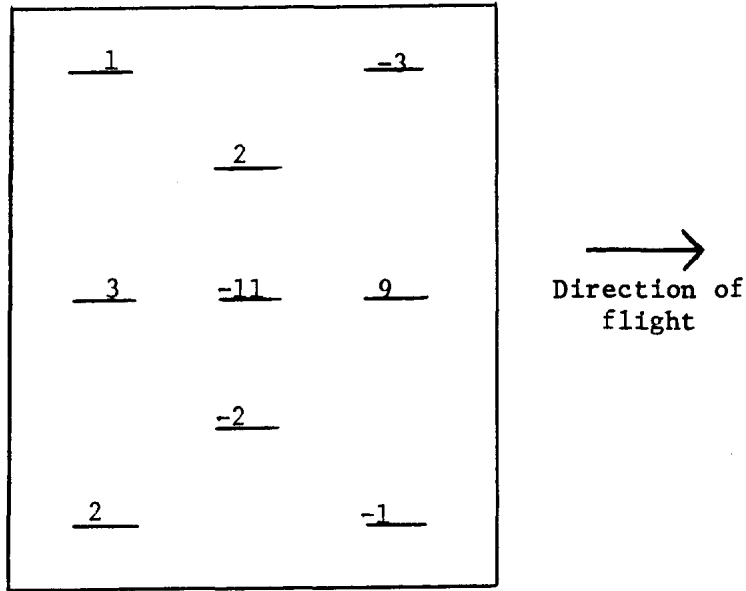
1-3 211.995 mm      2-3 211.992 mm

1-4 211.995 mm      2-4 211.998 mm

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

STEREOMODEL FLATNESS TEST AND FILM RESOLUTION

Camera No. 1768      Lens No. UAgI 6016      Magazine No. 1768-135  
 Focal length 153.034 mm      Maximum angle of field tested 40°  
 Base-height ratio 0.6      Accuracy of determination 5 $\mu$ m  
 Platen ID No. 135



Stereomodel  
 Test point array  
 (values in micrometres)

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 (Kodak micro flat) diapositives made from Kodak 2405 film exposures.

Resolving Power, in cycles/mm      Area-weighted average resolution 33.6

Film: Type 2405

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	67	57	34	28	40	34	17
Tangential lines	67	48	40	34	34	34	28

This report supersedes the previous calibration of this camera contained in USGS Report of Calibration No. RT-R/535, dated July 9, 1979.

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