



United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092
REPORT OF CALIBRATION

April 27, 1978

of Aerial Mapping Camera

Camera type	<u>Wild Heerbrugg RC10</u>	Camera serial no.	<u>2553</u>
Lens type	<u>Wild Universal Aviogon II</u>	Lens serial no.	<u>UAgII 3010</u>
Nominal focal length	<u>153 mm</u>	Maximum aperture	<u>f/4</u>
		Test aperture	<u>f/4</u>

Submitted by
Hogan & Olhausen Inc.
Loveland, Colorado 80537

Reference: Hogan & Olhausen Purchase order no. 758, dated April 17, 1978

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

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	μm -2	μm -3	μm -3	μm -2	μm -1
15	-2	-2	-2	-4	-1
22.5	-1	-4	0	-4	2
30	2	0	4	0	4
35	2	1	3	0	4
40	-1	-3	2	-2	1

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 μm .

III. Resolving power in cycles/mm Area-weighted average resolution 57.5

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	113	95	80	57	80	57	20
Tangential lines	113	80	57	48	57	57	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 420 Pan No. 4426 and 500 No. 3668 filters accompanying this camera are within ten seconds of being parallel. The 500 filter was used for the calibration.

V. Shutter Calibration

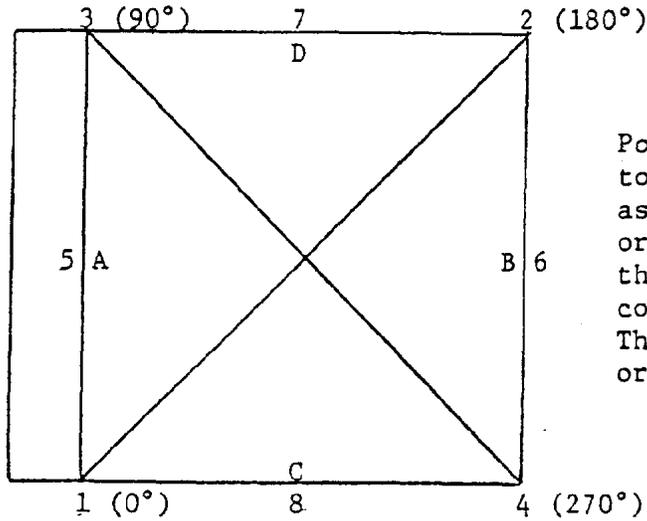
<u>Indicated shutter speed</u>	<u>Effective shutter speed</u>	<u>Efficiency</u>
1/200	4.2 ms = 1/240 s	78%
1/400	2.3 ms = 1/440 s	78%
1/600	1.5 ms = 1/670 s	78%
1/800	1.2 ms = 1/840 s	78%
1/1000	1.0 ms = 1/1000 s	78%

The effective shutter speeds were determined with the lens at aperture $f/4$. 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. 2553-266 does not depart from a true plane by more than 13 μ m (0.0005 in). This camera is equipped with a platen identification marker that will register No. 266 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	-0.005 mm	-0.006 mm
Indicated principal point, midside fiducials	0.001	0.003
Principal point of autocollimation	0.0	0.0
Calibrated principal point (point of symmetry)	0.001	0.000

Fiducial Marks

1	-106.004 mm	-106.003 mm
2	105.995	105.991
3	-105.992	105.992
4	105.981	-106.003
5	-110.002	0.011
6	109.988	-0.006
7	0.008	109.998
8	-0.005	-110.008

VIII. Distances Between Fiducial Marks

Corner fiducials (diagonals)

1-2 299.808 mm 3-4 299.791 mm

Lines joining these markers intersect at an angle of 89° 59' 52"

Midside fiducials

5-6 219.990 mm 7-8 220.006 mm

Lines joining these markers intersect at an angle of 90° 00' 04"

Corner fiducials (perimeter)

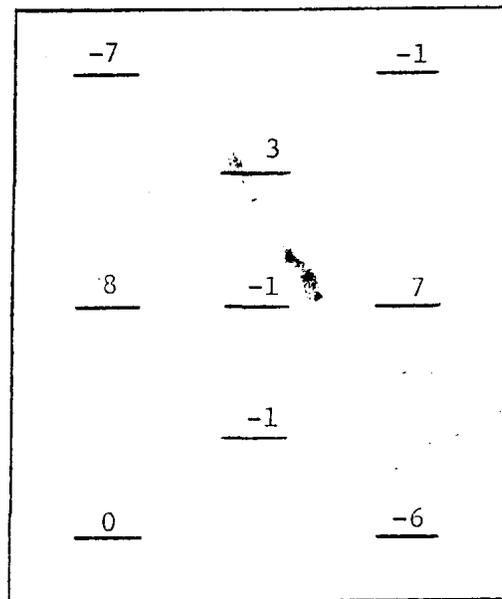
1-3 211.995 mm 2-3 211.987 mm

1-4 211.985 mm 2-4 211.994 mm

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

STEREOMODEL FLATNESS TEST AND FILM RESOLUTION

Camera No. 2553 Lens No. UAgII 3010 Magazine No. 2553-266
 Focal length 153.034 mm Maximum angle of field tested 40°
 Base-height ratio 0.6 Accuracy of determination 5 μm
 Platen ID No. 266



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 37.6
 Film: Type 2405

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

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