USGS Report No. RT-R/401

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

REPORT OF CALIBRATION April 12, 1978

of Aerial Mapping Camera

Camera type Wild Heerbrugg RC10
Lens type Wild Universal Aviogon II
Nominal focal length 153 mm

Camera serial no. 1384
Lens serial no. UAg II 3026
Maximum aperture f/4
Test aperture f/4

Submitted by
NASA Ames Research Center
Moffett Field, California 94035
Reference: Letter dated January 20, 1978 from Mr. Thomas R. Pochari

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: 153.045 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
	µm	µm	µm	µm	µm
7.5	-3	-4	-3	-4	-2
15	-4	-3	-4	-6	-3
22.5	-3	-4	-3	-5	-2
30	1	0	2	-1	2
35	2	3	2	0	3
40	1	0	2	3	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 57.2

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	113	113	67	57	80	67	20
Tangential lines	113	67	57	48	48	57	57

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 500 Pan filter accompanying this camera are within ten seconds of being parallel. This filter was used for the calibration.

V. Shutter Calibration

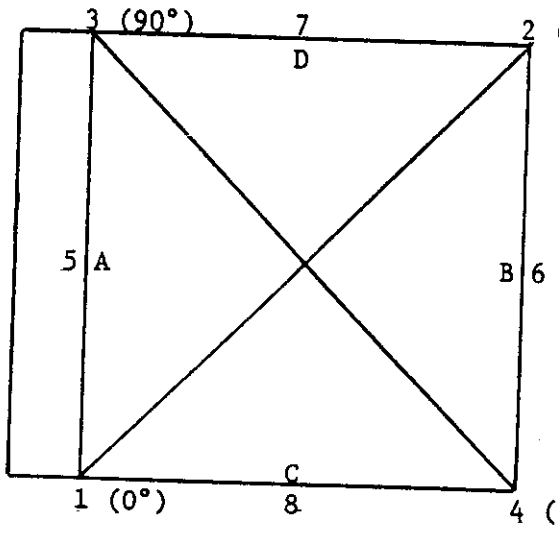
Indicated shutter speed	Effective shutter speed	Efficiency
1/200	4.0 ms = 1/250 s	76%
1/400	2.0 ms = 1/500 s	76%
1/600	1.3 ms = 1/750 s	76%
1/800	1.0 ms = 1/1000 s	76%
1/1000	0.8 ms = 1/1250 s	76%

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. 1384-64 does not depart from a true plane by more than 13 μm (0.0005 in).

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.

	X coordinate	Y coordinate
Indicated principal point, corner fiducials	-0.004 mm	-0.009 mm
Indicated principal point, midside fiducials	-0.007	0.005
Principal point of autocollimation	0.0	0.0
Calibrated principal point (point of symmetry)	0.002	0.001

Fiducial Marks		
1	-105.996 mm	-106.001 mm
2	105.991	105.986
3	-106.012	105.989
4	105.997	-106.001
5	-109.995	-0.015
6	110.016	0.024
7	-0.006	109.984
8	-0.008	-109.996

VIII. Distances Between Fiducial Marks

Corner fiducials (diagonals)

1-2 299.795 mm 3-4 299.812 mm

Lines joining these markers intersect at an angle of 90° 00' 10"

Midside fiducials

5-6 220.011 mm 7-8 219.980 mm

Lines joining these markers intersect at an angle of 89° 59' 22"

Corner fiducials (perimeter)

1-3 211.990 mm 2-3 212.003 mm

1-4 211.993 mm 2-4 211.987 mm

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

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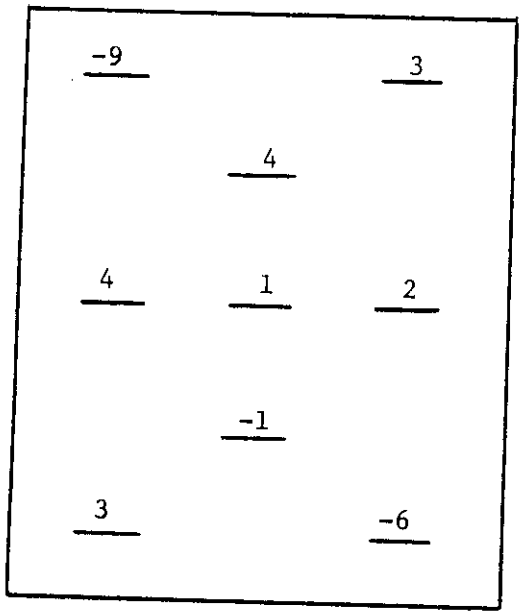
STEREOMODEL FLATNESS TEST AND FILM RESOLUTION

Camera No. 1384 Lens No. UAg II 3026 Magazine No. 1384-64

Focal length 153.045 mm Maximum angle of field tested 40°

Base-height ratio 0.6 Accuracy of determination 5 µm



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 36.1
Film: Type 2405

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

This report supersedes the previous calibration of this camera contained in USGS Report of Calibration No. RT-R/26, dated October 9, 1973.

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