



United States Department of the Interior

GEOLOGICAL SURVEY RESTON, VIRGINIA 22092 REPORT OF CALIBRATION

June 1, 1978

of Aerial Mapping Camera

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

Camera serial no. 1470
Lens serial no. UA II 3011
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: 153.193 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	-1	-3	-1	-2	1
15	-2	-1	-2	-2	0
22.5	1	-1	2	-3	4
30	3	1	5	2	6
35	2	0	4	-1	4
40	-3	-7	1	-6	0

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 57.4

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	80	80	95	67	80	57	20
Tangential lines	80	67	48	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 520 Pan No. 5219 filter accompanying this camera are within ten seconds of being parallel. This filter was used for the calibration.

V. Shutter Calibration

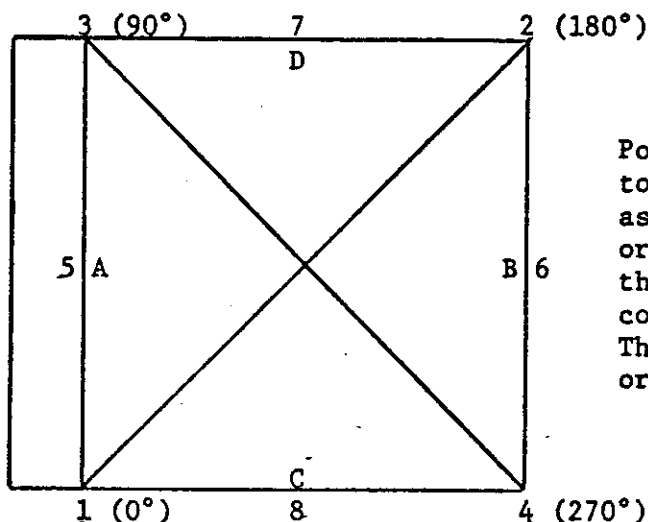
<u>Indicated shutter speed</u>	<u>Effective shutter speed</u>	<u>Efficiency</u>
1/200	4.0 ms = 1/250 s	76%
1/400	2.0 ms = 1/500 s	76%
1/600	1.3 ms = 1/750 s	76%
1/800	1.0 ms = 1/1000 s	76%
1/1000	0.8 ms = 1/1250 s	76%

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. 1470-120 does not depart from a true plane by more than 13 μ m (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.

	<u>X coordinate</u>	<u>Y coordinate</u>
Indicated principal point, corner fiducials	0.014 mm	0.002 mm
Indicated principal point, midside fiducials	0.014	0.006
Principal point of autocollimation	0.0	0.0
Calibrated principal point (point of symmetry)	-0.015	-0.001

Fiducial Marks

1	-105.974 mm	-105.991 mm
2	106.005	105.999
3	-105.982	105.999
4	106.005	-105.991
5	-109.983	0.009
6	110.005	0.003
7	0.019	109.992
8	0.010	-109.989

VIII. Distances Between Fiducial Marks

Corner fiducials (diagonals)

1-2 299.791 mm 3-4 299.797 mm

Lines joining these markers intersect at an angle of 89° 59' 53"

Midside fiducials

5-6 219.988 mm 7-8 219.981 mm

Lines joining these markers intersect at an angle of 89° 59' 58"

Corner fiducials (perimeter)

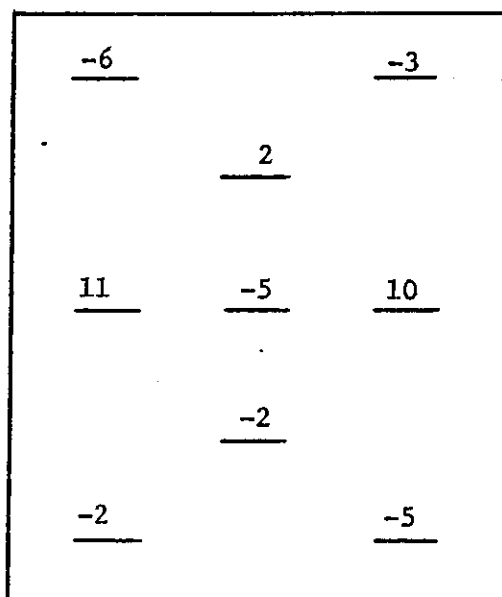
1-3 211.990 mm 2-3 211.987 mm

1-4 211.980 mm 2-4 211.989 mm

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

STEREOMODEL FLATNESS TEST AND FILM RESOLUTION

Camera No. 1470 Lens No. UAg II 3011 Magazine No. 1470-120
 Focal length 153.193 mm Maximum angle of field tested 40
 Base-height ratio 0.6 Accuracy of determination 5 μ m



→
Direction of
flight

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 35.4
 Film: Type 2405

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

This report supersedes the previous calibration of this camera contained in USGS Report of Calibration No. RT-R/9, dated July 11, 1973.

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