



United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VA. 22092

REPORT OF CALIBRATION of Aerial Mapping Camera

November 21, 1986

Camera type:	Wild RC10	Camera serial no.:	3311
Lens type:	Wild Universal Aviogon/4	Lens serial no.:	13020
Nominal focal length:	153 mm	Maximum aperture:	f/4
		Test aperture:	f/4

Submitted by: Keystone Aerial Surveys, Inc.
Philadelphia, Pennsylvania

Reference: Keystone purchase order No. 3145, dated November 19, 1986.

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 5200K.

I. Calibrated Focal Length: 153.464 mm

This measurement is considered accurate within 0.005 mm

II. Radial Distortion

Field angle	\bar{D}_c	D_c for azimuth angle			
		0° A-C	90° A-D	180° B-D	270° B-C
degrees	um	um	um	um	um
7.5	-2	-3	-2	0	-1
15	-3	-5	-3	-4	-2
22.5	-5	-5	-4	-5	-4
30	-1	-1	-1	0	0
35	2	1	3	3	3
40	2	3	2	1	2

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, 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 micrometers and indicates the radial displacement away from the center of the field. These measurements are considered accurate within 5 um.

III. Resolving Power in cycles/mm

Area-weighted average resolution: 76.2

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	113	113	67	57	80	80	80
Tangential lines	113	95	80	67	80	80	67

The resolving power is obtained by photographing a series of test bars and examining the resultant 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. 5913 and the 525 Pan No. 5818 filters accompanying this camera are within 10 seconds of being parallel. The 525 filter was used for the calibration.

V. Shutter Calibration

<u>Indicated shutter speed</u>	<u>Effective shutter speed</u>	<u>Efficiency</u>
1/200	5.25 ms = 1/190 s	78%
1/400	2.62 ms = 1/380 s	78%
1/600	1.75 ms = 1/570 s	78%
1/800	1.31 ms = 1/760 s	78%
1/1000	1.05 ms = 1/950 s	78%

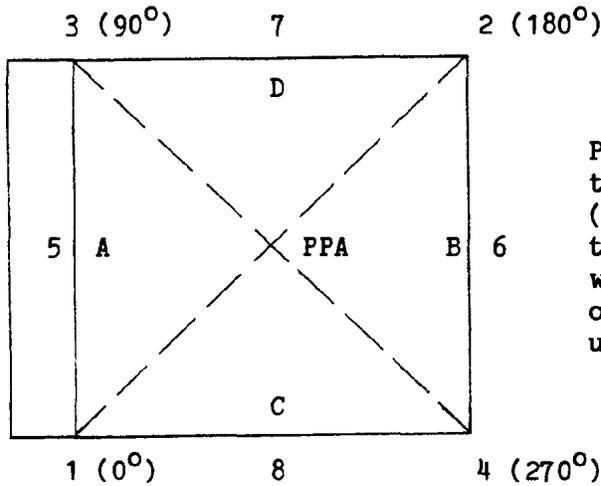
The effective shutter speeds were determined with the lens at aperture f/4. The method is considered accurate within 3 percent. The technique used is Method I described in American National Standard PH3.48-1972(R1978).

VI. Film Platen

The film platen mounted in Wild RC10 drive unit No. 3311-366 does not depart from a true plane by more than 13 um (0.0005 in).

This camera is equipped with a platen identification marker that will register "366" 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 (PPA) 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 data strip is to the left.

	<u>X coordinate</u>	<u>Y coordinate</u>
Indicated principal point, corner fiducials	0.005 mm	0.002 mm
Indicated principal point, midside fiducials	0.005	0.001
Principal point of autocollimation	0.0	0.0
Calibrated principal point (point of symmetry)	0.008	0.003

Fiducial Marks

1	-105.998 mm	-106.000 mm
2	106.005	106.002
3	-105.992	105.998
4	106.007	-106.000
5	-110.008	-0.004
6	110.009	0.007
7	0.007	110.001
8	0.003	-110.014

VIII. Distances Between Fiducial Marks

Corner fiducials (diagonals)

1-2: 299.816 mm 3-4: 299.812 mm

Lines joining these markers intersect at an angle of 90° 00' 01"

Midside fiducials

5-6: 220.017 mm 7-8: 220.015 mm

Lines joining these markers intersect at an angle of 89° 59' 46"

Corner fiducials (perimeter)

1-3: 211.998 mm 2-3: 211.998 mm

1-4: 212.005 mm 2-4: 212.002 mm

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

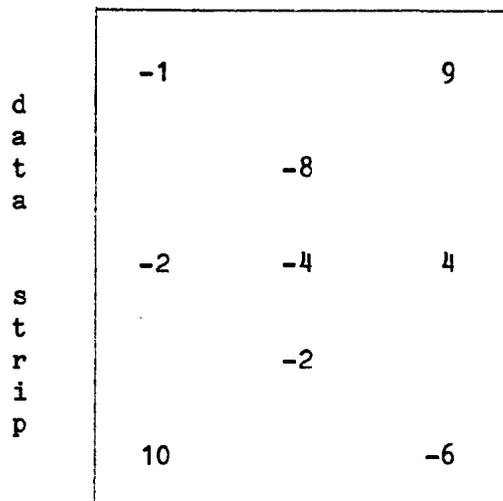
IX. Stereomodel Flatness

Drive unit No.: 3311-366

Base/Height ratio: 0.6

Platen ID: 366

Maximum angle of field tested: 40°



Stereomodel
Test point array
(values in micrometers)

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. These measurements are considered accurate within 5 um.

X. Resolving Power in cycles/mm

Area-weighted average resolution: 38.5

Film: Type 2405

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

This aerial mapping camera calibration report supersedes the previously issued USGS Report No. RSAS/912, dated October 20, 1983.

Eberhard G. Schirmacher
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Chief, Optical Science Section
National Mapping Division

FILM RADIAL DISTORTION, STEREOMODEL FLATNESS AND RESOLVING POWER

Drive unit No.: 3311-366
Platen ID: 366

Base/Height ratio: 0.6
Maximum angle of field tested: 40°

Calibrated Focal Length

flash plate: 153.464 mm
film: 153.471 mm

IX. Radial Distortion

Field angle	\bar{D}_c	D_c for azimuth angle			
		0° A-C	90° A-D	180° B-D	270° B-C
degrees	um	um	um	um	um
7.5	2	1	1	4	0
15	1	1	1	3	1
22.5	2	0	1	4	3
30	-1	2	2	-4	-2
35	1	-2	4	1	2
40	-2	-3	-3	-3	0

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d		
a	-1	9
t		
a		-8
s	-2	-4
t		4
r		-2
i		
p	10	-6

Stereomodel test point array
(values in micrometers)

XI. Resolving Power in cycles/mm

Area-weighted average resolution:	38.5						Film: Type 2405
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