



United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

REPORT OF CALIBRATION of Aerial Mapping Camera

December 19, 2000

Camera type:	Wild RC30*	Camera serial no.:	5334
Lens type:	Wild Universal Aviogon /4-S	Lens serial no.:	13374
Nominal focal length:	153 mm	Maximum aperture:	f/4
		Test aperture:	f/4

Submitted by: Us Imaging, Inc.
Bartow, Florida

Reference: LH Systmes, LLC purchase order No.
9726, dated August 9, 2000.

These measurements were made on Kodak Micro-flat glass plates, 0.25 inch thick, with spectroscopic emulsion type 157-01 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: 153.672 mm

II. Lens Distortion

Field angle:	7.5°	15°	22.7°	30°	35°	40°
Symmetric radial (um)	-1	-2	-1	0	2	1
Decentering (um)	0	0	1	1	2	3

Symmetric radial
distortion parameters

Decentering
distortion parameters

Calibrated
principal point

$$\begin{aligned} K_0 &= 0.6060 \times 10^{-4} \\ K_1 &= -0.1209 \times 10^{-7} \\ K_2 &= 0.4817 \times 10^{-12} \\ K_3 &= 0.0000 \\ K_4 &= 0.0000 \end{aligned}$$

$$\begin{aligned} P_1 &= 0.1023 \times 10^{-6} \\ P_2 &= 0.1458 \times 10^{-6} \\ P_3 &= 0.0000 \\ P_4 &= 0.0000 \end{aligned}$$

$$\begin{aligned} x_p &= -0.006 \text{ mm} \\ y_p &= -0.009 \text{ mm} \end{aligned}$$

The values and parameters for Calibrated Focal Length (CFL), Symmetric Radial Distortion (K_0, K_1, K_2, K_3, K_4), Decentering Distortion (P_1, P_2, P_3, P_4), and Calibrated Principal point (point of symmetry) (x_p, y_p) were determined through a least-squares Simultaneous Multiframe Analytical Calibration (SMAC) adjustment. The x and y-coordinate measurements utilized in the adjustment of the above parameters have a standard deviation (σ) of ± 3 microns.

* Equipped with Forward Motion Compensation

III. Lens Resolving Power in cycles/mm

Area-weighted average resolution: 114

Field Angle:	0°	7.5°	15°	22.7°	30°	35°	40°
Radial Lines	134	134	134	134	134	113	95
Tangential lines	134	134	134	113	113	95	80

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 No. 7849, and the 525 No. 1850 filters accompanying the camera are within 10 seconds of being parallel. The 525 filter was used for the calibration.

V. Shutter Calibration

Indicated time (sec)	Rise time (μ sec)	Fall Time (μ sec)	$\frac{1}{2}$ width time (ms)	Nom. Speed (sec.)	Efficiency (%)
1/125	1625	1588	8.06	1/140	87
1/250	844	825	4.23	1/270	87
1/500	436	426	2.16	1/520	87
1/1000	229	221	1.10	1/1030	87

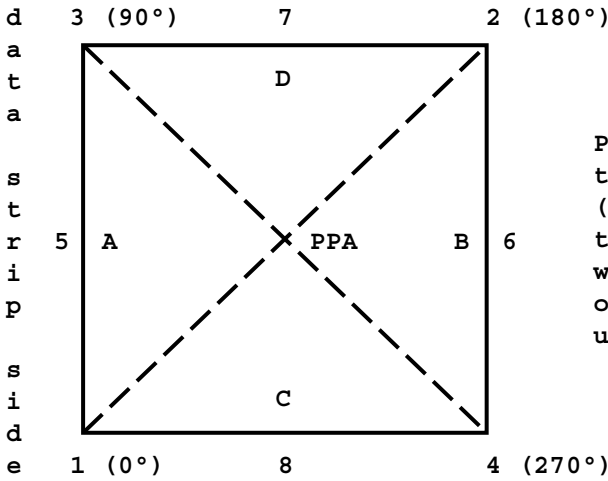
The effective exposure times were determined with the lens at aperture f/4. The method is considered accurate within 3 percent. The technique used is Method I described in American National Standard PH3.48-1972 (R1978).

VI. Film Platen

The film platen mounted in Wild RC30 drive unit No. 5334-716 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 "716" in the data strip area for each exposure.

VII. Principal Points 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	-0.003 mm	0.002 mm
Indicated principal point, midside fiducials	-0.005	0.005
Principal point of autocollimation (PPA)	0.0	0.0
Calibrated principal point (pt. of sym.) x_p, y_p	-0.006	-0.009

Fiducial Marks

1	-106.001 mm	-105.995 mm
2	105.994	105.999
3	-106.006	106.003
4	105.998	-105.995
5	-112.003	0.006
6	111.993	0.003
7	-0.007	112.004
8	-0.003	-111.995

VIII. Distances Between Fiducial Marks

Corner fiducials (diagonals)

1-2: 299.805 mm 3-4: 299.814 mm

Lines joining these markers intersect at an angle of 90° 00' 03"

Midside fiducials

5-6: 223.996 mm 7-8: 223.999 mm

Lines joining these markers intersect at an angle of 90° 00' 11"

Corner fiducials (perimeter)

1-3: 211.998 mm 2-3: 212.000 mm

1-4: 211.999 mm 2-4: 211.994 mm

The method of measuring these distances is considered accurate within 0.003 mm

Note: For GPS applications, the nominal entrance pupil distance from the focal plane is 278 mm.

