



United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

REPORT OF CALIBRATION of Aerial Mapping Camera

February 13, 2007

Camera type: Wild RC30* **Camera serial no.:** 5335
Lens type: Wild Universal Aviogon /4-S **Lens serial no.:** 13367
Nominal focal Length: 153 mm **Maximum aperture:** f/4
Test aperture: f/4

Submitted by: I.K. Curtis Services, Inc.
Burbank, California

Reference: I.K. Curtis Services, Inc. letter of authorization dated February 13, 2007.

These measurements were made on Agfa glass plates, 0.19 inch thick, with spectroscopic emulsion type APX 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: 153.191 mm

II. Lens Distortion

Field angle:	7.5°	15°	22.7°	30°	35°	40°
Symmetric radial (μm)	0	0	0	0	0	0
Decentering tangential (μm)	0	0	1	2	3	5

<u>Symmetric radial distortion</u>		<u>Decentering distortion</u>		<u>Calibrated principal point</u>	
K_0	= -0.1246E-04	P_1	= 0.1272E-06	x_p	= 0.003 mm
K_1	= 0.3302E-08	P_2	= 0.2477E-06	y_p	= 0.010 mm
K_2	= -0.1639E-12	P_3	= 0.0000		
K_3	= 0.0000	P_4	= 0.0000		
K_4	= 0.0000				

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

<u>Field angle:</u>	<u>0°</u>	<u>7.5°</u>	<u>15°</u>	<u>22.7°</u>	<u>30°</u>	<u>35°</u>	<u>40°</u>
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 filter No. 7935 and the 525 filter No. 7142 accompanying this camera are within 10 seconds of being parallel. The 525 filter was used for the calibration.

V. Shutter Calibration

<u>Indicated Time</u> <u>(sec)</u>	<u>Rise Time</u> <u>(μ sec)</u>	<u>Fall Time</u> <u>(μ sec)</u>	<u>½ Width Time</u> <u>(ms)</u>	<u>Nom. Speed</u> <u>(sec)</u>	<u>Efficiency</u> <u>(%)</u>
1/125	1707	1720	8.45	1/140	87
1/250	859	856	4.25	1/270	87
1/500	430	427	2.17	1/520	88
1/1000	225	222	1.01	1/1150	86

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 described in International Standard ISO 516:1999(E).

VI. Film Platen

The platen mounted in Wild RC30 drive unit No. 5335-717 does not depart from a true plane by more than 13 μm (0.0005 in).

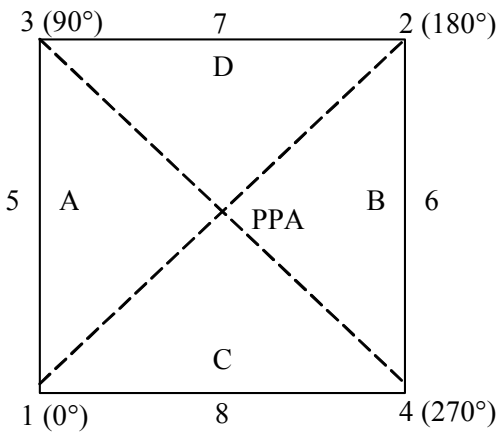
This camera is equipped with a platen identification marker that will register 717 in the data strip area for each exposure.

VII. Principal Point and Fiducial Mark Coordinates

d
a
t
a

s
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p

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i
d
e



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 (mm)</u>	<u>Y coordinate (mm)</u>
Indicated principal point, corner fiducials	.007	.011
Indicated principal point, midside fiducials	.005	.009
Principal point of autocollimation (PPA)	.000	.000
Calibrated principal point (point of symmetry)	.003	.010
<u>Fiducial Marks</u>		
1	-105.990	-105.986
2	106.003	106.006
3	-105.989	106.008
4	106.002	-105.986
5	-111.992	.012
6	112.005	.006
7	.005	112.011
8	.004	-111.989

VIII. Distances Between Fiducial marks

Corner fiducials (diagonals)	1-2: 299.803 mm	3-4: 299.803 mm
Lines joining these markers intersect at an angle o	89° 59' 59"	
Midside fiducials	5-6: 223.996 mm	7-8: 224.000 mm
Lines joining these markers intersect at an angle o	90° 00' 04"	
Corner fiducials (perimeter)	1-3: 211.994 mm	2-3: 211.992 mm
	1-4: 211.992 mm	2-4: 211.992 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 277 mm.

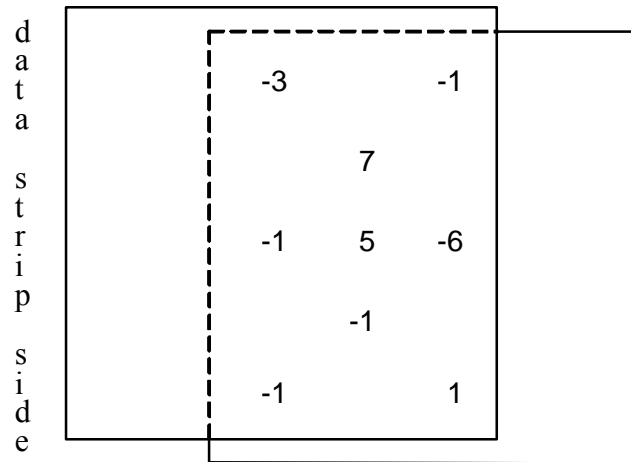
IX. Stereomodel Flatness

FMC Drive Unit No: 5335-717

Base/Height ratio: 0.6

Platen ID: 717

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 stereo models. The values are based on comparator measurements on Kodak 4425 copy film made from Kodak 2405 film exposures. These measurements are considered accurate to within 5 μm.

X. System Resolving Power on film in cycles/mm

Area-weighted average resolution: 53

Film: Type 2405

Field angle:	0°	7.5°	15°	22.7°	30°	35°	40°
Radial Lines	67	57	57	57	57	57	48
Tangential Lines	67	57	57	57	48	48	40

This aerial mapping camera calibration report supersedes the previously issued USGS Report No. OSL/3012, dated February 9, 2004.

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