



United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

REPORT OF CALIBRATION of Aerial Mapping Camera

April 13, 2015

Camera type:	Wild RC30*	Camera serial no.:	5046
Lens type:	Universal Aviogon /4	Lens serial no.:	13086
Nominal focal Length:	153 mm	Maximum aperture:	f/4
		Test aperture:	f/4
Submitted by:	Richard Crouse & Associates Frederick, Maryland		

Reference:

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: 152.922 mm

II. Lens Distortion

Field angle:	7.5°	15°	22.7°	30°	35°	40°
Symmetric radial (µm)	-4	-6	-6	-3	2	6
Decentering tangential (µm)	0	0	0	0	1	1

<u>Symmetric radial distortion</u>		<u>Decentering distortion</u>		<u>Calibrated principal point</u>	
K_0	= 0.1869E-03	P_1	= 0.2135E-09	x_p	= 0.003 mm
K_1	= -0.2522E-07	P_2	= -0.6352E-07	y_p	= 0.003 mm
K_2	= 0.6621E-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: 86

<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	95	95	95	95	95	80	67
Tangential Lines	95	80	80	95	95	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 525 filter No. 7628 accompanying this camera are within 10 seconds of being parallel. This 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</u> <u>Time (μ</u>	<u>½ Width Time</u> <u>(ms)</u>	<u>Nom. Speed</u> <u>(sec)</u>	<u>Efficiency</u> <u>(%)</u>
1/125	811	812	9.06	1/120	94
1/250	402	401	4.74	1/220	95
1/500	200	205	2.38	1/440	95
1/1000	104	100	1.21	1/880	95

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 drive unit 5046 does not depart from a true plane by more than 13 μm (0.0005 in).

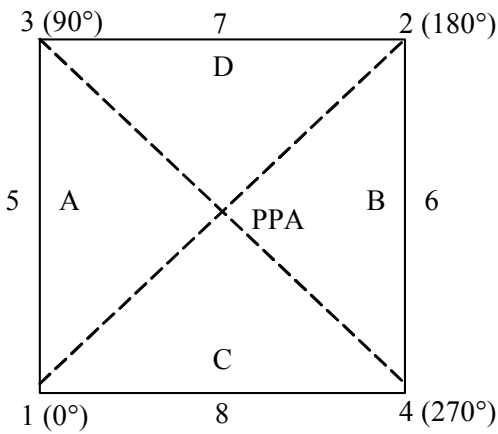
This camera is equipped with a platen identification marker that will register "460" in the data strip area for each exposure.

VII. Principal Point and Fiducial Mark Coordinates

d
a
t
a

s
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r
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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	0.007	0.005
Indicated principal point, midside fiducials	0.001	0.003
Principal point of autocollimation (PPA)	0.000	0.000
Calibrated principal point (point of symmetry)	0.003	0.003
<u>Fiducial Marks</u>		
1	-105.998	-105.998
2	106.010	106.007
3	-105.989	106.004
4	106.006	-105.998
5	-109.999	0.005
6	110.005	0.001
7	0.005	110.009
8	-0.003	-109.995

VIII. Distances Between Fiducial marks

Corner fiducials (diagonals)	1-2: 299.822 mm	3-4: 299.811 mm
Lines joining these markers intersect at an angle o	89° 59' 58"	
Midside fiducials	5-6: 220.004 mm	7-8: 220.004 mm
Lines joining these markers intersect at an angle o	89° 59' 56"	
Corner fiducials (perimeter)	1-3: 212.002 mm	2-3: 211.999 mm
	1-4: 212.004 mm	2-4: 212.005 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 282mm.

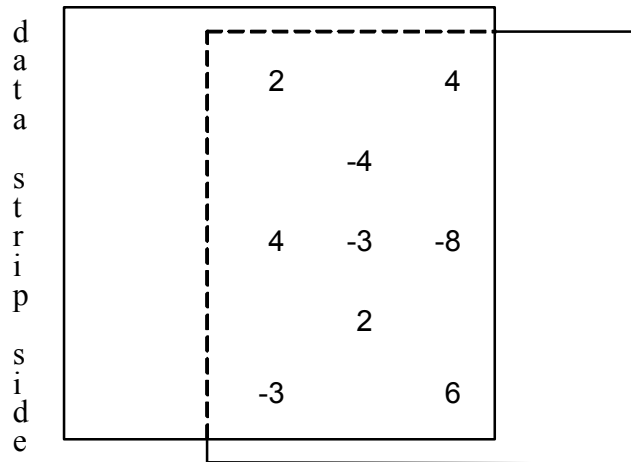
IX. Stereomodel Flatness

FMC Drive Unit No: 5046

Base/Height ratio: 0.6

Platen ID: 460

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 Agfa Avitone P3p copy film made from Agfa Aviphot Pan 200 film exposures. These measurements are considered accurate to within 5 µm.

X. System Resolving Power on film in cycles/mm

Area-weighted average resolution: 50

Film: Pan 200

Field angle:	0°	7.5°	15°	22.7°	30°	35°	40°
Radial Lines	48	48	48	70	78	48	40
Tangential Lines	48	40	40	70	40	34	34

This aerial mapping camera calibration report supersedes the previously issued USGS Report No. OSL/3506, dated February 17, 2010.

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Climate and Land Use Change