



United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

REPORT OF CALIBRATION of Aerial Mapping Camera

July 09, 2007

Camera type:	Wild RC20*	Camera serial no.:	5062
Lens type:	Wild Universal Aviogon /4-S	Lens serial no.:	13420
Nominal focal Length:	153 mm	Maximum aperture:	f/4
		Test aperture:	f/4
Submitted by:	Air Photographics, Inc. Martinsburg, West Virginia		
Reference:	Air Photographics, Inc. purchase order No. 276541, dated July 23, 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: 153.768 mm

II. Lens Distortion

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

Symmetric radial distortion	Decentering distortion	Calibrated principal point
$K_0 = 0.1703\text{E-}03$	$P_1 = -0.6212\text{E-}07$	$x_p = 0.010 \text{ mm}$
$K_1 = -0.1947\text{E-}07$	$P_2 = 0.1293\text{E-}06$	$y_p = 0.007 \text{ mm}$
$K_2 = 0.3890\text{E-}12$	$P_3 = 0.0000$	
$K_3 = 0.0000$	$P_4 = 0.0000$	
$K_4 = 0.0000$		

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: 111

Field angle:	0°	7.5°	15°	22.7°	30°	35°	40°
Radial Lines	113	134	134	113	134	113	95
Tangential Lines	113	113	113	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 525 filter No. 7389 accompanying this camera are within 10 seconds of being parallel. This 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	1615	1627	8.19	1/140	88
1/250	842	848	4.25	1/270	88
1/500	413	419	2.13	1/540	88
1/1000	222	217	1.07	1/1070	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 described in International Standard ISO 516:1999(E).

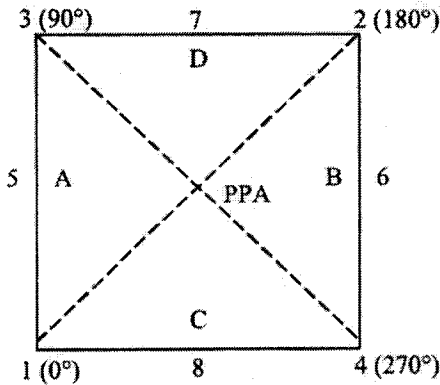
VI. Film Platen

The platen mounted in Wild drive unit No. 5062-481 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 "481" in the data strip area for each exposure.

VII. Principal Point and Fiducial Mark Coordinates

data strip side



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	.004	.011
Indicated principal point, midside fiducials	.001	.009
Principal point of autocollimation (PPA)	.000	.000
Calibrated principal point (point of symmetry)	.010	.007

Fiducial Marks

1	-105.992	-105.988
2	105.999	106.008
3	-105.993	106.007
4	106.004	-105.988
5	-111.991	.008
6	111.994	.009
7	.000	112.017
8	.003	-111.992

VIII. Distances Between Fiducial marks

Corner fiducials (diagonals)	1-2: 299.804 mm	3-4: 299.807 mm
Lines joining these markers intersect at an angle of	89° 59' 59"	
Midside fiducials	5-6: 223.985 mm	7-8: 224.009 mm
Lines joining these markers intersect at an angle of	90° 00' 01"	
Corner fiducials (perimeter)	1-3: 211.994 mm	2-3: 211.992 mm
	1-4: 211.996 mm	2-4: 211.996 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.

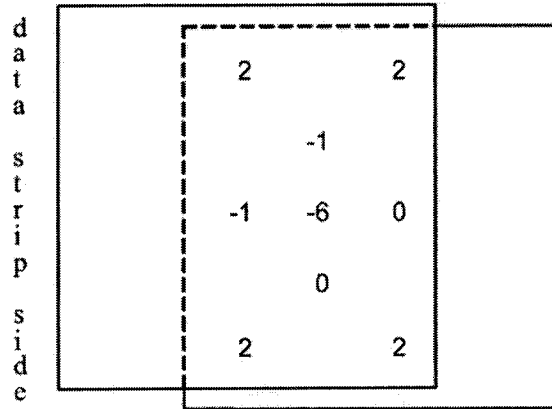
IX. Stereomodel Flatness

FMC Drive Unit No: 5062-481

Base/Height ratio: 0.6

Platen ID: 481

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	57	57	57	57	57	57	48
Tangential Lines	57	57	48	57	57	48	40

This aerial mapping camera calibration report supersedes the previously issued USGS Report No. OSL/3053, dated June 24, 2004.

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