United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

REPORT OF CALIBRATION
of Aerial Mapping Camera

January 12, 2017

Camera type:	Wild RC30*	**Camera serial no.:**	5259
Lens type:	Wild Universal Aviogon /4-S	**Lens serial no.:**	13334
Nominal focal Length:	153 mm	**Maximum aperture:**	f/4
		Test aperture:	f/4

Submitted by: Williams Aerial & Mapping, Inc.
South Bend, Indiana

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: 153.682 mm

II. Lens Distortion

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

Symmetric radial distortion		Decentering distortion		Calibrated principal point	
K_0	= 0.7383E-04	P_1	= -0.2100E-07	x_p	= -0.012 mm
K_1	= -0.1670E-07	P_2	= -0.7280E-07	y_p	= 0.004 mm
K_2	= 0.7550E-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	134	134	159	134	113	95	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 525 filter No. 7699 accompanying this camera are within 10 seconds of being parallel. This filter was used for the calibration.

V. Shutter Calibration

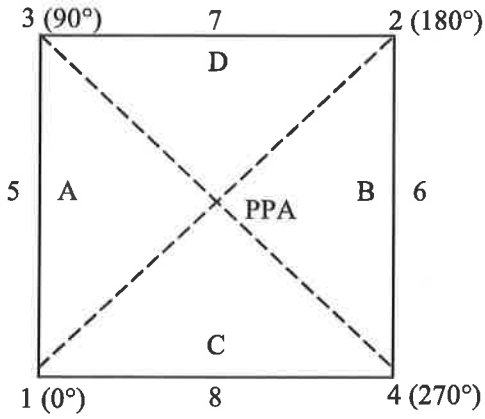
Indicated Time (sec)	Rise Time (μ sec)	Fall Time (μ	½ Width Time (ms)	Nom. Speed (sec)	Efficiency (%)
1/125	1080	1065	9.00	1/120	93
1/250	580	559	4.65	1/230	92
1/500	296	310	2.34	1/470	92
1/1000	150	152	1.17	1/930	92

The effective exposure times were determined with the lens at aperature 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

N/A

VII. Principal Point and Fiducial Mark 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.

	X coordinate (mm)	Y coordinate (mm)
Indicated principal point, corner fiducials	-0.006	0.007
Indicated principal point, midside fiducials	-0.011	0.007
Principal point of autocollimation (PPA)	0.000	0.000
Calibrated principal point (point of symmetry)	-0.012	0.004

Fiducial Marks		
1	-106.006	-105.992
2	105.995	106.006
3	-106.003	106.007
4	105.991	-105.992
5	-112.002	0.008
6	112.001	0.005
7	-0.007	112.005
8	-0.015	-112.001

VIII. Distances Between Fiducial marks

Corner fiducials (diagonals)	1-2:	299.813 mm	3-4:	299.808 mm
Lines joining these markers intersect at an angle o 90° 00' 00"				
Midside fiducials	5-6:	224.003 mm	7-8:	224.007 mm
Lines joining these markers intersect at an angle o 89° 59' 56"				
Corner fiducials (perimeter)	1-3:	211.998 mm	2-3:	211.998 mm
	1-4:	211.998 mm	2-4:	211.998 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 277mm.

This aerial mapping camera calibration report supersedes the previously issued USGS Report No. OSL/3636, dated April 18, 2013.

Ryan Longhenry
Long Term Archive Project Manager
Climate and Land Use Change