United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

REPORT OF CALIBRATION
of Aerial Mapping Camera

June 09, 2016

Camera type:	Zeiss RMK Top 30*	**Camera serial no.:**	143095
Lens type:	Zeiss Topar A3	**Lens serial no.:**	143123
Nominal focal Length:	305 mm	**Maximum aperture:**	f/5.6
		Test aperture:	f/6.6

Submitted by: RIGC (NI)
Crumlin Co., Antrim, Northern Ireland

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: 305.550 mm

This measurement is considered accurate within 0.005 mm

II. Radial Distortion:

Field angle	$\overline{D}_C$	D_C for azimuth angle			
		0° A-C	90° A-D	180° B-D	270° B-C
degrees	µm	µm	µm	µm	µm
7.5	0	2	0	-2	2
15	1	0	4	-3	2
22.7	0	-4	2	-2	3

The radial distortion is measured for each of four radii of the focal plane separated by 90° in azimuth. To minimize plotting error due to distortion, a full least-squares solution is used to determine the calibrated focal length. $\overline{D}_C$ is the average distortion for a given field angle. Values of distortion D_C based on the calibrated focal length referred to the calibrated principal point (point of symmetry) are listed for azimuths 0°, 90°, 180°, and 270°. The radial distortion is given in micrometers and indicates the radial displacement away from the center of the field. These measurements are considered accurate within 5µm.

* Equipped with Forward Motion Compensation

III. Lens Resolving Power in cycles/mm

Area-weighted average resolution: 81

Field angle:	0°	7.5°	15°	22.7°
Radial Lines	81	96	96	68
Tangential Lines	81	96	81	57

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 2.5 to 135 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 USGS TOP 15 test filter KL-F (60%) No. 142399 are within 10 seconds of being parallel. This filter, in conjunction with the internal "B" filter, was used for the calibration.

V. Shutter Calibration

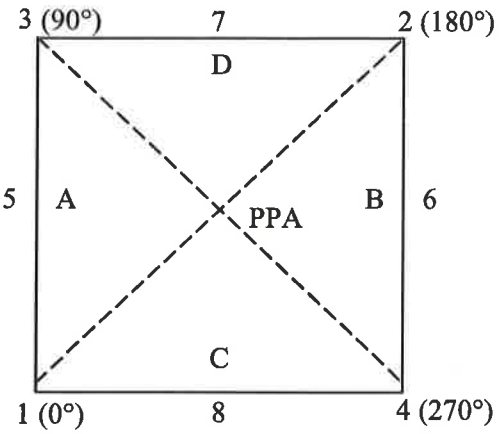
Indicated Time (sec)	Rise Time (μ sec)	Fall Time (μ	½ Width Time (ms)	Nom. Speed (sec)	Efficiency (%)
1/100	4020	4577	10.68	1/130	75
1/200	1665	1957	5.27	1/240	79
1/300	1249	1125	3.53	1/360	79
1/400	886	884	4.10	1/490	79
1/500	711	722	2.07	1/78	79

The effective exposure times were determined with the lens at aperature f/5.6. The method is considered accurate within 3 percent. The technique used is described in International Standard ISO 516:1999(E).

VI. Magazine 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	0.022	0.008
Indicated principal point, midside fiducials	0.021	0.001
Principal point of autocollimation (PPA)	0.000	0.000
Calibrated principal point (point of symmetry)	-0.034	0.015
Fiducial Marks		
1	-112.963	-112.991
2	113.010	113.009
3	-112.978	112.997
4	113.032	-112.991
5	-112.970	-0.003
6	113.022	0.006
7	0.017	112.999
8	0.025	-113.003

VIII. Distances Between Fiducial marks

Corner fiducials (diagonals)	1-2:	319.593 mm	3-4:	319.611 mm
Lines joining these markers intersect at an angle o 89° 59' 58"				
Midside fiducials	5-6:	225.993 mm	7-8:	226.003 mm
Lines joining these markers intersect at an angle o 89° 59' 59"				
Corner fiducials (perimeter)	1-3:	225.988 mm	2-3:	225.987 mm
	1-4:	225.995 mm	2-4:	226.000 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 262 mm with a 10 mm filter thickness. Additional filter thickness will increase entrance pupil distance by 0.34 X added thickness.

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