



United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Reston, Virginia 20192

REPORT OF CALIBRATION of Aerial Mapping Camera

November 19, 2015

Camera type:	Zeiss RMK Top 30*	Camera serial no.:	144171
Lens type:	Zeiss Topar A3	Lens serial no.:	144186
Nominal focal Length:	305 mm	Maximum aperture:	f/5.6
		Test aperture:	f/5.6

Submitted by: Institut National de Cartographie et de Teledectio
Alger, Algeria

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: 305.528 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	4	5	5	1	5
15	4	0	9	2	5
22.7	-3	-8	1	-8	2

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 5 μm .

* Equipped with Forward Motion Compensation

III. Lens Resolving Power in cycles/mm

Area-weighted average resolution: 76

<u>Field angle:</u>	<u>0°</u>	<u>7.5°</u>	<u>15°</u>	<u>22.7°</u>
Radial Lines	81	96	81	57
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

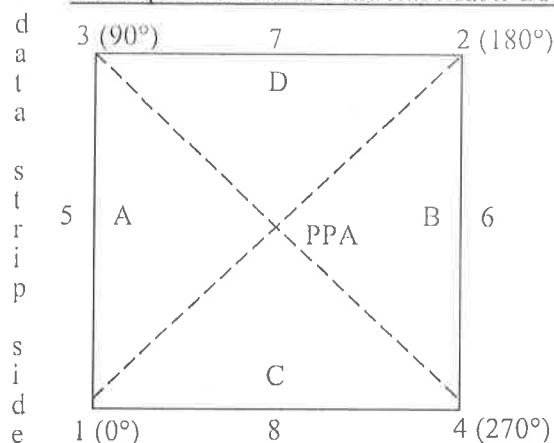
<u>Indicated Time</u> <u>(sec)</u>	<u>Rise Time</u> <u>(μ sec)</u>	<u>Fall</u> <u>Time (μ</u>	<u>½ Width Time</u> <u>(ms)</u>	<u>Nom. Speed</u> <u>(sec)</u>	<u>Efficiency</u> <u>(%)</u>
1/100	4135	4141	10.94	1/120	76
1/200	1847	1868	5.33	1/240	78
1/300	1143	1161	3.68	1/340	78
1/400	881	912	2.67	1/470	79
1/500	679	706	2.12	1/590	80

The effective exposure times were determined with the lens at aperture 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.

Indicated principal point, corner fiducials
 Indicated principal point, midside fiducials
 Principal point of autocollimation (PPA)
 Calibrated principal point (point of symmetry)

<u>X coordinate (mm)</u>	<u>Y coordinate (mm)</u>
0.003	0.003
-0.007	-0.009
0.000	0.000
-0.043	0.009
<u>Fiducial Marks</u>	
1	-112.999
2	112.999
3	-112.990
4	113.006
5	-112.994
6	112.994
7	-0.002
8	-0.012

113.002
 113.002
 112.999
 -113.002
 -0.007
 -0.011
 112.995
 -112.987

VIII. Distances Between Fiducial marks

Corner fiducials (diagonals)	1-2:	319.614 mm	3-4:	319.610 mm
Lines joining these markers intersect at an angle of 89° 59' 55"				
Midside fiducials	5-6:	225.988 mm	7-8:	225.982 mm
Lines joining these markers intersect at an angle of 89° 59' 55"				
Corner fiducials (perimeter)	1-3:	226.001 mm	2-3:	225.990 mm
	1-4:	226.005 mm	2-4:	226.004 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 262mm 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