



# United States Department of the Interior

U.S. GEOLOGICAL SURVEY  
Reston, Virginia 20192

## REPORT OF CALIBRATION of Aerial Mapping Camera

December 01, 2016

**Camera type:** Zeiss RMK Top 30  
**Lens type:** Zeiss Topar A3  
**Nominal focal Length:** 305 mm

**Camera serial no.:** 143092  
**Lens serial no.:** 143122  
**Maximum aperture:** f/4  
**Test aperture:** f/5.6

**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: 305.101 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	$\mu\text{m}$	$\mu\text{m}$	$\mu\text{m}$	$\mu\text{m}$	$\mu\text{m}$
7.5	1	3	1	-1	1
15	1	-3	5	-2	3
22.7	-1	-6	4	-5	4

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 $\mu\text{m}$ .

**III. Lens Resolving Power in cycles/mm**

Area-weighted average resolution: 74

<u>Field angle:</u>	<u>0°</u>	<u>7.5°</u>	<u>15°</u>	<u>22.7°</u>
Radial Lines	68	96	81	57
Tangential Lines	68	81	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.

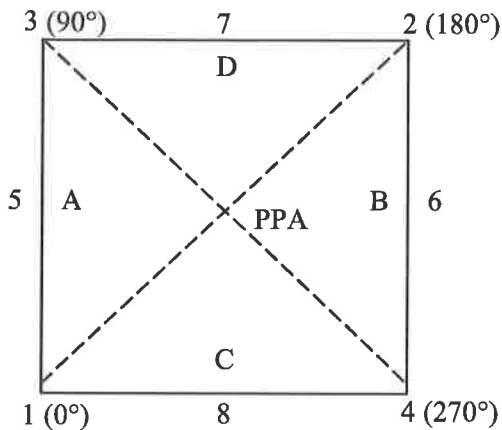
**V. Shutter Calibration**

<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	3587	3648	11.38	1/110	80
1/200	1756	1740	5.59	1/220	80
1/300	1242	1276	3.61	1/350	78
1/400	934	868	2.67	1/470	79
1/500	701	712	2.04	1/620	78

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. Magazine Platen**

N/A

**VII. Principal Point and Fiducial Mark Coordinates**d  
a  
t  
a  
  
s  
t  
r  
i  
p  
  
s  
i  
d  
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.

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>
0.007	-0.004
0.003	0.003
0.000	0.000
-0.015	0.002

**Fiducial Marks**

1	-112.993	-112.999
2	113.012	112.996
3	-112.992	113.002
4	112.995	-112.999
5	-112.992	0.011
6	113.005	-0.005
7	0.008	112.992
8	-0.002	-113.003

**VIII. Distances Between Fiducial marks**

Corner fiducials (diagonals)	1-2: 319.613 mm	3-4: 319.604 mm
Lines joining these markers intersect at an angle of 89° 59' 58"		
Midside fiducials	5-6: 225.996 mm	7-8: 225.995 mm
Lines joining these markers intersect at an angle of 90° 00' 07"		
Corner fiducials (perimeter)	1-3: 226.001 mm	2-3: 226.005 mm
	1-4: 225.988 mm	2-4: 225.995 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 284mm with a 10 mm filter thickness. Additional filter thickness will increase entrance pupil distance by 0.34 X added thickness.

  
 Ryan Longhenry  
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 Climate and Land Use Change