



# United States Department of the Interior

GEOLOGICAL SURVEY  
RESTON, VA. 22092

## REPORT OF CALIBRATION of Aerial Mapping Camera

March 22, 1985

Camera type: Zeiss RMK A 15/23	Camera serial no.: 127783
Lens type: Zeiss Pleogon A2/4	Lens serial no.: 127829
Nominal focal length: 153 mm	Maximum aperture: f/4
	Test aperture: f/4

Submitted by: James W. Sewall Company  
Old Town, Maine

Reference: James W. Sewall Company purchase order No. 2329,  
dated January 21, 1985.

These measurements were made on Kodak Micro-flat glass plates, 0.25 inch thick, with spectroscopic emulsion type V-F 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: 153.282 mm

This measurement is considered accurate within 0.005 mm

### II. Radial Distortion

Field angle	$\bar{D}_c$	$D_c$ for azimuth angle			
		0° A-C	90° A-D	180° B-D	270° B-C
degrees	um	um	um	um	um
7.5	-2	0	-2	-2	-3
15	-2	-1	-3	-4	-1
22.5	-5	-5	-3	-7	-5
30	-3	-3	-3	-4	-4
35	1	-1	2	-1	2
40	5	4	6	5	6

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.  $\bar{D}_c$  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 um.

### III. Resolving Power in cycles/mm

Area-weighted average resolution: 92.9

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	159	159	134	113	95	80	80
Tangential lines	159	134	113	95	95	67	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 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 B No. 127896, the D No. 127966 and the KL No. 127862 filters accompanying this camera are within 10 seconds of being parallel. The B filter was used for the calibration.

### V. Shutter Calibration

<u>Indicated shutter speed</u>	<u>Effective shutter speed</u>	<u>Efficiency</u>
1/200	3.75 ms = 1/270 s	71%
1/400	1.88 ms = 1/530 s	71%
1/600	1.25 ms = 1/800 s	71%
1/800	0.94 ms = 1/1060 s	71%
1/1000	0.75 ms = 1/1330 s	71%

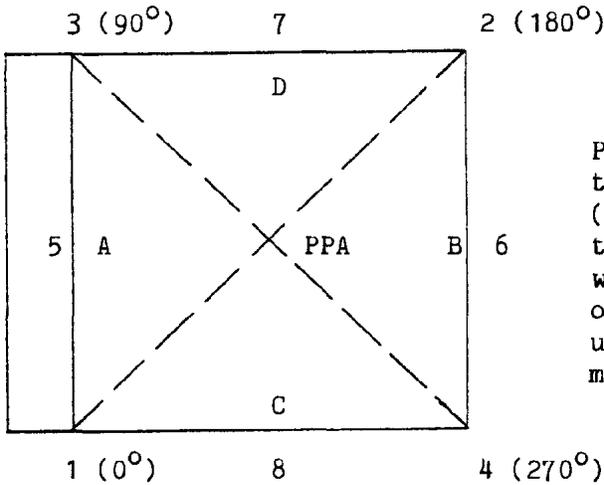
The effective shutter speeds were determined with the lens at aperture f/4. The method is considered accurate within 3 percent. The technique used is Method I described in American National Standard PH3.48-1972(R1978).

### VI. Magazine Platen

The platen mounted in FK 24/120 film magazine No. 36280 does not depart from a true plane by more than 13  $\mu\text{m}$  (0.0005 in).

The platen for this film magazine is equipped with an identification marker that will register "CZ125" in the data strip area for each exposure.

VII. Principal Point and Fiducial 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 direction-of-flight fiducial marker or data strip is to the left.

	<u>X coordinate</u>	<u>Y coordinate</u>
Indicated principal point, corner fiducials	0.003 mm	-0.005 mm
Indicated principal point, midside fiducials	0.002	-0.001
Principal point of autocollimation	0.0	0.0
Calibrated principal point (point of symmetry)	0.000	0.001

Fiducial Marks

1	-103.940 mm	-103.951 mm
2	103.942	103.936
3	-103.937	103.932
4	103.952	-103.951
5	-113.003	0.001
6	113.005	-0.004
7	0.002	113.000
8	0.002	-113.006

VIII. Distances Between Fiducial Marks

Corner fiducials (diagonals)

1-2: 293.992 mm                      3-4: 293.995 mm

Lines joining these markers intersect at an angle of 90° 00' 00"

Midside fiducials

5-6: 226.008 mm                      7-8: 226.006 mm

Lines joining these markers intersect at an angle of 90° 00' 04"

Corner fiducials (perimeter)

1-3: 207.883 mm                      2-3: 207.878 mm

1-4: 207.891 mm                      2-4: 207.887 mm

The method of measuring these distances is considered accurate within 0.005 mm

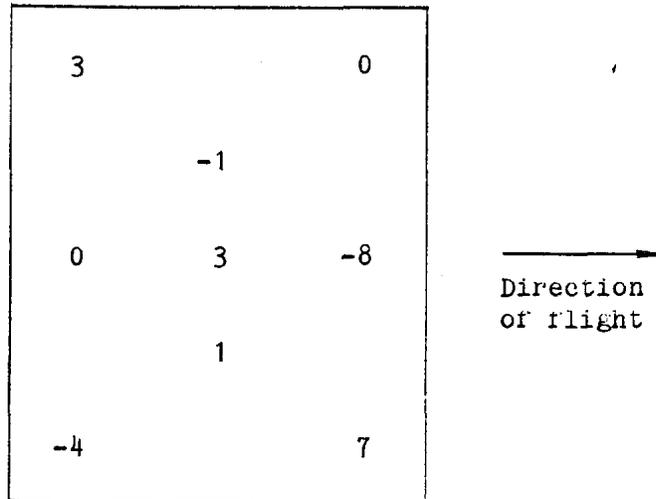
IX. Stereomodel Flatness

Magazine No.: 36280

Base/Height ratio: 0.6

Platen ID: CZ125

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 stereomodels based on comparator measurements on contact glass (Kodak Micro-flat) diapositives made from Kodak 2405 film exposures. These measurements are considered accurate within 5  $\mu\text{m}$ .

X. Resolving Power in cycles/mm

Area-weighted average resolution: 52.0

Film: Type 2405

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	80	80	67	57	57	48	40
Tangential lines	80	67	57	57	57	40	34

This report supersedes the previous calibration of this camera contained in USGS Report of Calibration No. RSAS/786, dated March 10, 1982.

*Eberhard G. Schirmacher*

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National Mapping Division

FILM RADIAL DISTORTION, STEREOMODEL FLATNESS AND RESOLUTION

Magazine No.: 36280  
Platen ID: CZ125

Base/Height ratio: 0.6  
Maximum angle of field tested: 40°

Calibrated Focal Length

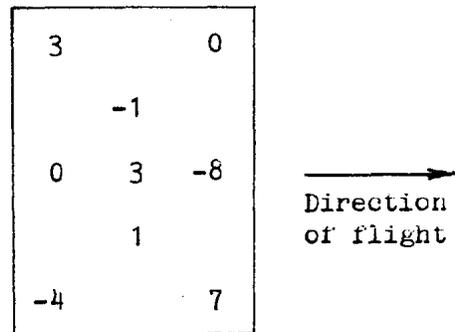
flash plate: 153.282 mm  
film: 153.305 mm

IX. Radial Distortion

Field angle	$\bar{D}_c$	$D_c$ for azimuth angle			
		0° A-C	90° A-D	180° B-D	270° B-C
degrees	um	um	um	um	um
7.5	1	3	1	0	-1
15	1	2	-1	-1	4
22.5	1	2	2	-1	1
30	0	1	-1	1	-1
35	-1	-1	-2	-1	0
40	0	0	1	1	-1

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Stereomodel test point array  
(values in micrometers)

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