United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

REPORT OF CALIBRATION June 7, 2000
of Aerial Mapping Camera

Camera type: Zeiss RMK A 21/23
Lens type: - Zeiss Toparon
Nominal focal length: 210 mm

Camera serial no.: 20208
Lens serial no.: 98308
Maximum aperture: f/5.6
Test aperture: f/4.6*

Submitted by: Pacific Aerial Surveys
Oakland, California

Reference: Fax cover sheet dated June 5, 2000, from Mr. Fred Benton.

These measurements were made on Kodak Micro-flat glass plates, 0.25 inch thick, with spectroscopic emulsion type 157-01 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: 208.335 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	-4	-5	-4	-6	-3
15	-8	-8	-7	-7	-8
22.7	-3	-4	0	-7	1
30	6	2	10	3	10

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.

* Limitation imposed by collimator aperture

III. Lens Resolving Power in cycles/mm

Area-weighted average resolution: 77

Field angle:	0°	7.5°	15°	22.7°	30°
Radial Lines	82	98	82	82	82
Tangential lines	82	82	69	69	69

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 3 to 195 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. 14107, the D No. 14170, and the KL No. 126974 filters accompanying this camera are within 10 seconds of being parallel. The B filter was used for the calibration.

V. Shutter Calibration

Indicated time (sec)	Rise time (μ sec)	Fall Time (μ sec)	½ width time (ms)	Nom. Speed (sec.)	Efficiency (%)
1/200	798	781	4.09	1/280	88
1/400	448	441	2.28	1/500	88
1/600	277	274	1.40	1/810	88
1/800	214	205	1.06	1/1080	88
1/1000	167	163	0.98	1/1280	88

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 Method I described in American National Standard PH3.48-1972(R1978).

VI. Magazine Platen

The platen mounted in FK 24/120 film magazine No. 110044 does not depart from a true plane by more than 13 um (0.0005 in).