United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VA. 22092

REPORT OF CALIBRATION
of Aerial Mapping Camera

May 2, 1983

Camera type: Wild RC8
Lens type: Wild Universal Aviogon
Nominal focal length: 153 mm

Camera serial no.: 486
Lens serial no.: UAg 251
Maximum aperture: f/5.6
Test aperture: f/5.6

Submitted by: U.S. Geological Survey, Office of International Activities
Reston, Virginia 22092

Reference: Routine Calibration for use in Antarctica.

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 three 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: 152.274 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	4	3	5	6
15	6	5	6	5	9
22.5	4	2	7	2	6
30	0	-4	0	0	4
35	-4	-6	-2	-7	-1
40	0	-3	4	-4	1

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 of the image from its ideal position for the calibrated focal length. A positive value indicates a 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: 67.5

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	95	95	113	57	95	80	17
Tangential lines	95	80	67	67	67	67	40

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 Wild 450 Pan No. 2416, the 500 Pan No. 2102, the 500 Pan (no number) filters and the clear filters No. 1895 and No. 4016 accompanying this camera are within ten seconds of being parallel. The 450 filter was used for the calibration.

V. Shutter Calibration

Indicated shutter speed	Effective shutter speed	Efficiency
1/200	4.75 ms = 1/210 s	83%
1/400	2.50 ms = 1/400 s	83%
1/600	1.67 ms = 1/600 s	83%
1/700	1.43 ms = 1/700 s	83%

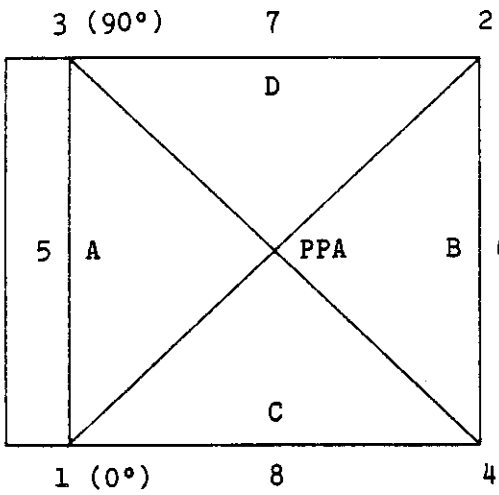
The effective shutter speeds were determined with the lens at aperture f/5.6. The method is considered accurate within 3%. The technique used is Method I described in American National Standard PH3.48-1972(R1978).

VI. Magazine Platen

The platens mounted in Wild RC8 film magazines No. 386, No. 387 and No. 609 do not depart from a true plane by more than 13 um (0.0005 in.).

The platens for two of these film magazines are equipped with identification markers that will register "P23" for magazine No. 386, and "P24" for magazine No. 387 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.

	X coordinate	Y coordinate
Indicated principal point, corner fiducials	0.000 mm	0.008 mm
Indicated principal point, midside fiducials	-0.003	0.010
Principal point of autocollimation	0.0	0.0
Calibrated principal point (point of symmetry)	-0.008	0.000

Fiducial Marks		
1	-105.999 mm	-105.986 mm
2	106.005	106.007
3	-106.004	106.012
4	105.993	-105.986
5	-110.001	0.011
6	109.990	0.009
7	0.001	110.012
8	-0.008	-110.995

VIII. Distances Between Fiducial Marks

Corner fiducials (diagonals)
1-2: 299.811 mm 3-4: 299.810 mm
Lines joining these markers intersect at an angle of 90° 00' 05"

Midside fiducials
5-6: 219.991 mm 7-8: 220.007 mm
Lines joining these markers intersect at an angle of 89° 59' 53"

Corner fiducials (perimeter)
1-3: 211.998 mm 2-3: 212.010 mm
1-4: 211.992 mm 2-4: 211.993 mm

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

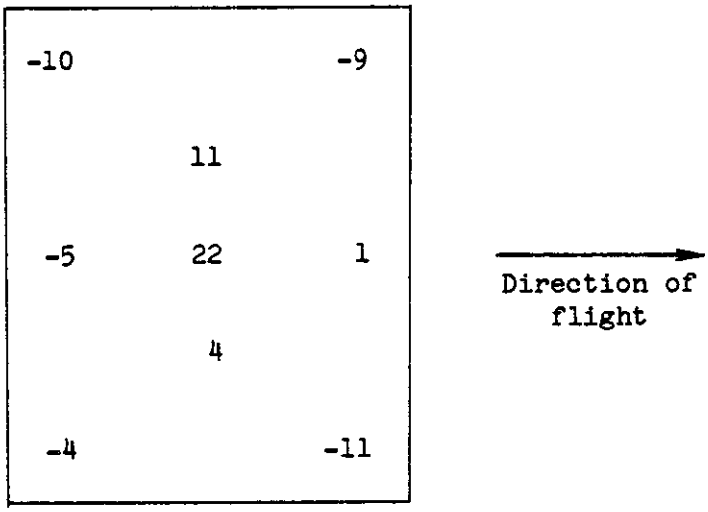
IX. Stereomodel Flatness

Magazine No.: 386

Platen ID: P23

Base/Height ratio: 0.6

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 um.

X. Resolving Power in cycles/mm

Area-weighted average resolution: 39.2

Film: Type 2405

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	67	67	57	34	40	57	20
Tangential lines	67	40	40	40	40	34	24

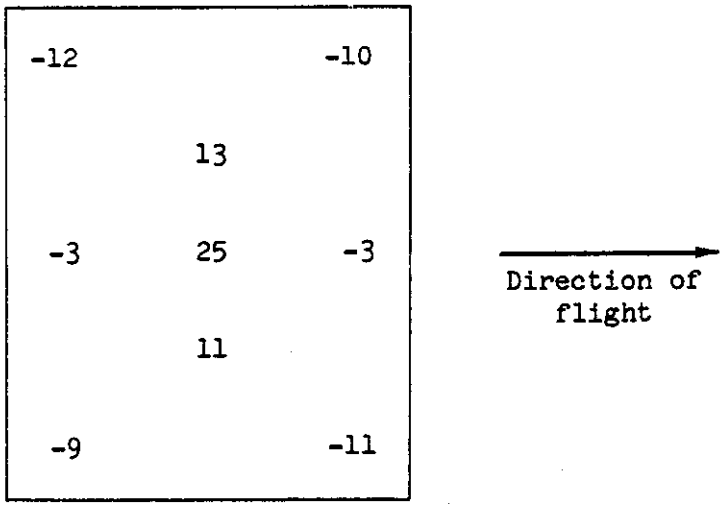
IX. Stereomodel Flatness

Magazine No.: 387

Platen ID: P24

Base/Height ratio: 0.6

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 um.

X. Resolving Power in cycles/mm

Area-weighted average resolution: 39.7

Film: Type 2405

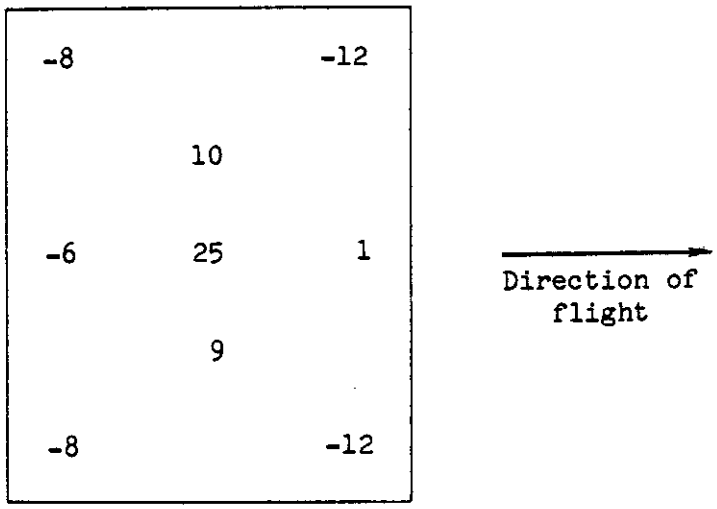
Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	67	57	57	34	40	57	20
Tangential lines	67	48	48	40	40	34	24

IX. Stereomodel Flatness

Magazine No.: 609

Base/Height ratio: 0.6

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 um.

X. Resolving Power in cycles/mm

Area-weighted average resolution: 39.9

Film: Type 2405

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	67	67	57	34	40	57	20
Tangential lines	67	48	48	40	40	34	24

This report supersedes the previous calibration of this camera contained in USGS Report of Calibration No. RT-R/725, dated July 20, 1981.

William P. Tayman
Chief, Optical Science Section
National Mapping Division

FILM RADIAL DISTORTION, STEREOMODEL FLATNESS AND RESOLUTION

Magazine No.: 386

Platen ID: P23

Base/Height ratio: 0.6

Maximum angle of field tested: 40°

Calibrated Focal Length

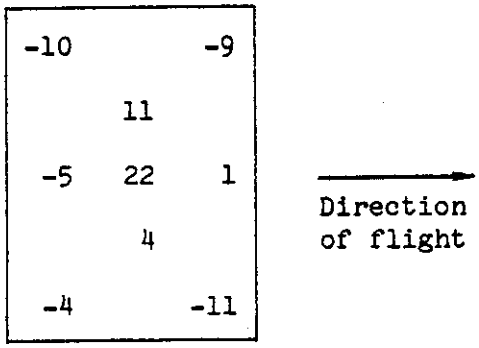
flash plate: 152.274 mm
film: 152.295 mm

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	6	4	8	6	8
15	11	9	13	8	14
22.5	8	4	11	5	10
30	4	-1	9	3	7
35	-3	-5	0	-8	0
40	-8	-12	-3	-12	-3

X. Stereomodel Flatness

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 um.



Stereomodel Test Point Array
(values in micrometers)

XI. Resolving Power in cycles/mm

Area-weighted average resolution: 39.2 Film: Type 2405

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	67	67	57	34	40	57	20
Tangential lines	67	40	40	40	40	34	24

FILM RADIAL DISTORTION, STEREOMODEL FLATNESS AND RESOLUTION

Magazine No.: 387

Platen ID: P24

Base/Height ratio: 0.6

Maximum angle of field tested: 40°

Calibrated Focal Length

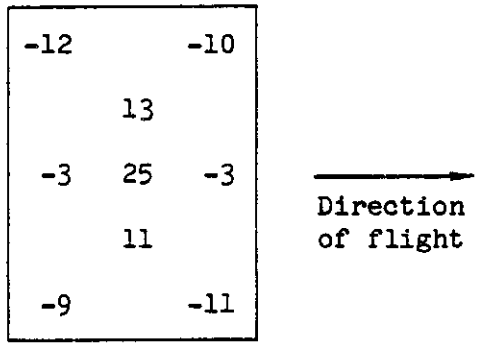
flash plate: 152.274 mm
film: 152.290 mm

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	6	5	6	7	7
15	11	8	10	10	14
22.5	8	5	10	8	11
30	4	-1	6	3	6
35	-4	-4	-3	-7	0
40	-7	-9	-3	-10	-5

X. Stereomodel Flatness

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 um.



Stereomodel Test Point Array
(values in micrometers)

XI. Resolving Power in cycles/mm

Area-weighted average resolution: 39.7 Film: Type 2405

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	67	57	57	34	40	57	20
Tangential lines	67	48	48	40	40	34	24

FILM RADIAL DISTORTION, STEREOMODEL FLATNESS AND RESOLUTION

Magazine No.: 609

Base/Height ratio: 0.6

Maximum angle of field tested: 40°

Calibrated Focal Length

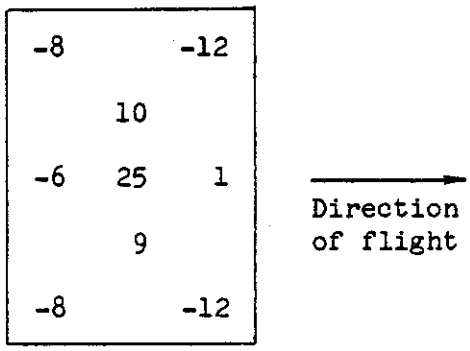
flash plate: 152.274 mm
film: 152.290 mm

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	7	6	6	7	7
15	11	9	11	8	14
22.5	8	6	10	7	10
30	3	-1	5	3	6
35	-3	-5	0	-7	1
40	-7	-10	-3	-10	-5

X. Stereomodel Flatness

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 um.



Stereomodel Test Point Array
(values in micrometers)

XI. Resolving Power in cycles/mm

Area-weighted average resolution: 39.9 Film: Type 2405

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°
Radial lines	67	67	57	34	40	57	20
Tangential lines	67	48	48	40	40	34	24

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