USGS Report No. OSL/2661

# United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

REPORT OF CALIBRATION
of Aerial Mapping Camera

June 27, 2000

Camera type: Wild RC30*
Lens type: Wild Normal Aviotar /4-S
Nominal focal length: 305 mm

Camera serial no.: 5062
Lens serial no.: 17126
Maximum aperture: f/4
Test aperture: f/6.6**

Submitted by: Air Photographics, Inc.
Martinsburg, West Virginia

Reference: Air Photographics, Inc., purchase order No. 0755, dated June 26, 2000.

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: 303.377 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 | 0 | -2 | 2 | -1 | 0 |
| 15 | -3 | -3 | -3 | -3 | -3 |
| 22.7 | 2 | -1 | 5 | -1 | 5 |

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.

* Equipped with forward motion compensation
** 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° |
|---|---|---|---|---|
| Radial Lines | 81 | 96 | 81 | 68 |
| Tangential lines | 81 | 96 | 68 | 68 |

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 Wild 420 No. 7624 and the 525 No. 7654 filters accompanying this camera are within 10 seconds of being parallel. The 525 filter was used for the calibration.

## V. Shutter Calibration

| Indicated time (sec) | Rise time ($\mu$ sec) | Fall Time ($\mu$ sec) | ½ width time (ms) | Nom. Speed (sec.) | Efficiency (%) |
|---|---|---|---|---|---|
| 1/125 | 2437 | 2375 | 7.79 | 1/160 | 81 |
| 1/250 | 1260 | 1257 | 4.07 | 1/300 | 81 |
| 1/500 | 640 | 637 | 2.07 | 1/600 | 81 |
| 1/1000 | 324 | 310 | 1.03 | 1/1200 | 81 |

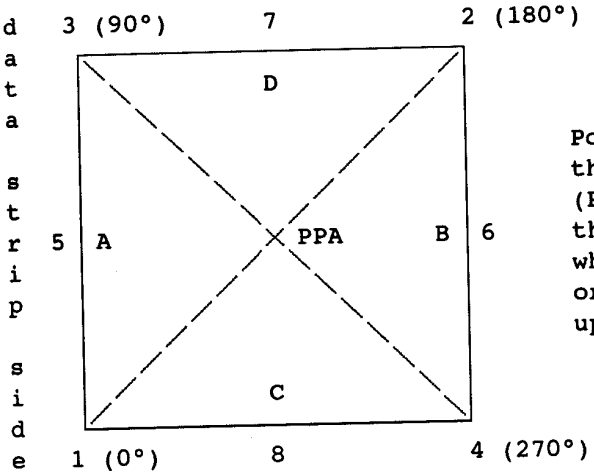
The effective exposure times were determined with the lens at aperture f/4. The method is considered accurate within 3 percent. The technique used is Method I described in American National Standard PH3.48-1972(R1978).

## VI. Film Platen

The film platen mounted in Wild RC30 drive unit No. 5062-481 does not depart from a true plane by more than 13 um (0.0005 in).

This camera is equipped with a platen identification marker that will register "481" in the data strip area for each exposure.

## VII. Principal Points 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 data strip is to the left.

| | X coordinate | Y coordinate |
|---|---|---|
| Indicated principal point, corner fiducials | -0.002 mm | 0.015 mm |
| Indicated principal point, midside fiducials | -0.005 | 0.015 |
| Principal point of autocollimation | 0.0 | 0.0 |
| Calibrated principal point (point of symmetry) | 0.006 | 0.024 |

| Fiducial Marks | | |
|---|---|---|
| 1 | -106.012 mm | -105.989 mm |
| 2 | 106.005 | 106.014 |
| 3 | -106.000 | 106.017 |
| 4 | 105.998 | -105.989 |
| 5 | -112.006 | 0.015 |
| 6 | 112.007 | 0.015 |
| 7 | 0.000 | 112.012 |
| 8 | -0.010 | -111.987 |

## VIII. Distances Between Fiducial Marks

Corner fiducials (diagonals)

1-2: 299.827 mm 3-4: 299.815 mm

Lines joining these markers intersect at an angle of 90° 00' 03"

Midside fiducials

5-6: 224.012 mm 7-8: 223.999 mm

Lines joining these markers intersect at an angle of 89° 59' 52"

Corner fiducials (perimeter)

1-3: 212.005 mm 2-3: 212.004 mm

1-4: 212.010 mm 2-4: 212.003 mm

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

This aerial mapping camera calibration report supersedes the previously issued USGS Report No. OSL/2332, dated June 27, 1997.

Frank C. Maccue

Frank C. Maccue
Chief, Optical Science Laboratory
National Mapping Division