

DEUTSCHER KALIBRIERDIENST **DKD**

(B5-200)

Top-2

Kalibrierlaboratorium für die Meßgröße der geometrischen Optik
Calibration laboratory for measured quantities geometric optics

AKKREDITIERT DURCH DIE

PHYSIKALISCH-TECHNISCHE BUNDESANSTALT (PTB)



Kalibrierschein
Calibration Certificate

Kalibrierzeichen
Calibration mark

0775
DKD-K-05202
09-01

Gegenstand
Object Aerial Survey Camera

Hersteller
Manufacturer Carl Zeiss
D-73446 Oberkochen

Typ
Type RMK TOP 15

Fabrikat/Serien-Nr.
Serial number 149 986

Auftraggeber
Customer Agricultural And Forestry
Aerial Survey Institute
No. 61-3, Chao Chow Street
Taipei, Taiwan

Auftragsnummer
Order No.

Anzahl der Seiten des Kalibrierscheines
Number of pages of the certificate 4

Datum der Kalibrierung
Date of calibration 18.09.01

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).

Der Deutsche Kalibrierdienst ist Unterzeichner des multilateralen Übereinkommens der European co-operation for Accreditation of Laboratories (EA) zur gegenseitigen Anerkennung der Kalibrierscheine.

Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).


The Deutscher Kalibrierdienst is signatory to the multilateral agreement of the European co-operation for Accreditation of Laboratories (EA) for the mutual recognition of calibration certificates.

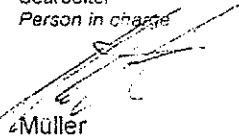
The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung sowohl der Physikalisch-Technischen Bundesanstalt als auch des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift und Stempel haben keine Gültigkeit.

This calibration certificate may not be reproduced other than in full except with the permission of both the Physikalisch-Technische Bundesanstalt and the issuing laboratory. Calibration certificates without signature and seal are not valid.

Stempel
Seal  Datum
Date 05.12.01

Leiter des Kalibrierlaboratoriums
Head of the calibration laboratory

Dr. Wiedenmann

Bearbeiter
Person in charge

Müller

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Industrielle Messtechnik GmbH
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E-Mail kalibrieren@zeiss.de

CAMERA TYPE: RMK TOP 15 SERIAL NO. 149986
 LENS TYPE: PLEOGON A3 SERIAL NO. 150025
 MAX. APERTURE: F/4 NOM. FOCAL LENGTH: 153 MM

- 1) CALIBRATED FOCAL LENGTH = 152.242 MM
 2) DISTORTION /0.001 MM, REFERRING TO P.P. OF SYMMETRY PPS

S/MM=	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
5	0	0	0	2	2	2	2	1	0	-1	-4	-4	-4	-4	-1	2
6	0	0	1	1	2	2	2	2	2	-1	-2	-2	-3	-3	-1	-2
7	0	1	1	1	1	2	2	1	0	-1	-2	-3	-2	-1	4	6
8	0	0	0	1	2	4	4	3	3	2	1	-1	-1	0	2	2
AV.	0	0	1	1	2	3	3	2	1	0	-2	-3	-2	-2	1	2

- 3) P.P. OF AUTOCOLLIMATION AND FIDUCIAL CENTRE, REFERRING TO PPS

P.P. OF AUTOCOLLIMATION PPA X= 0.000 Y= 0.011 MM
 FIDUCIAL CENTRE FC X= 0.005 Y= 0.012 MM
 CORNER FIDUCIAL CENTRE FCC X= 0.005 Y= 0.017 MM

- 4) FIDUCIAL MARKS, REFERRING TO PPS

X1= 113.009 X2=-112.986 X3= 0.008 X4= 0.002 MM
 Y1= 0.015 Y2= 0.009 Y3= 113.008 Y4=-112.988 MM
 DISTANCES 1-2= 225.994 3-4= 225.996 MM
 X5= 113.013 X6=-112.995 X7=-112.991 X8= 113.004 MM
 Y5= 113.019 Y6=-112.978 Y7= 113.010 Y8=-112.980 MM

- 5) PHOTOGRAPHIC RESOLVING POWER, IN CYCLES PER MM
 (AS PER DEFINITION, R. P. IS NOT A CALIBRATED DATUM)
 AREA WEIGHTED AVERAGE RESOLUTION 103

FIELD ANGLE /DEG = 0 7 14 21 28 35 42

RADIAL LINES 147 146 142 137 115 107 87
 TANGENTIAL LINES 147 144 123 114 102 78 51

FILM: KODAK PANATOMIC X 3412 SPEED 40 AFS
 DEVELOPED IN AGFA G 74 C AVIPHOT

- 6) Filter KL-F 36% No.: 151 506
 7) Magazines T-MC No.: 150 618 / 150 622
 8) Measuring uncertainty

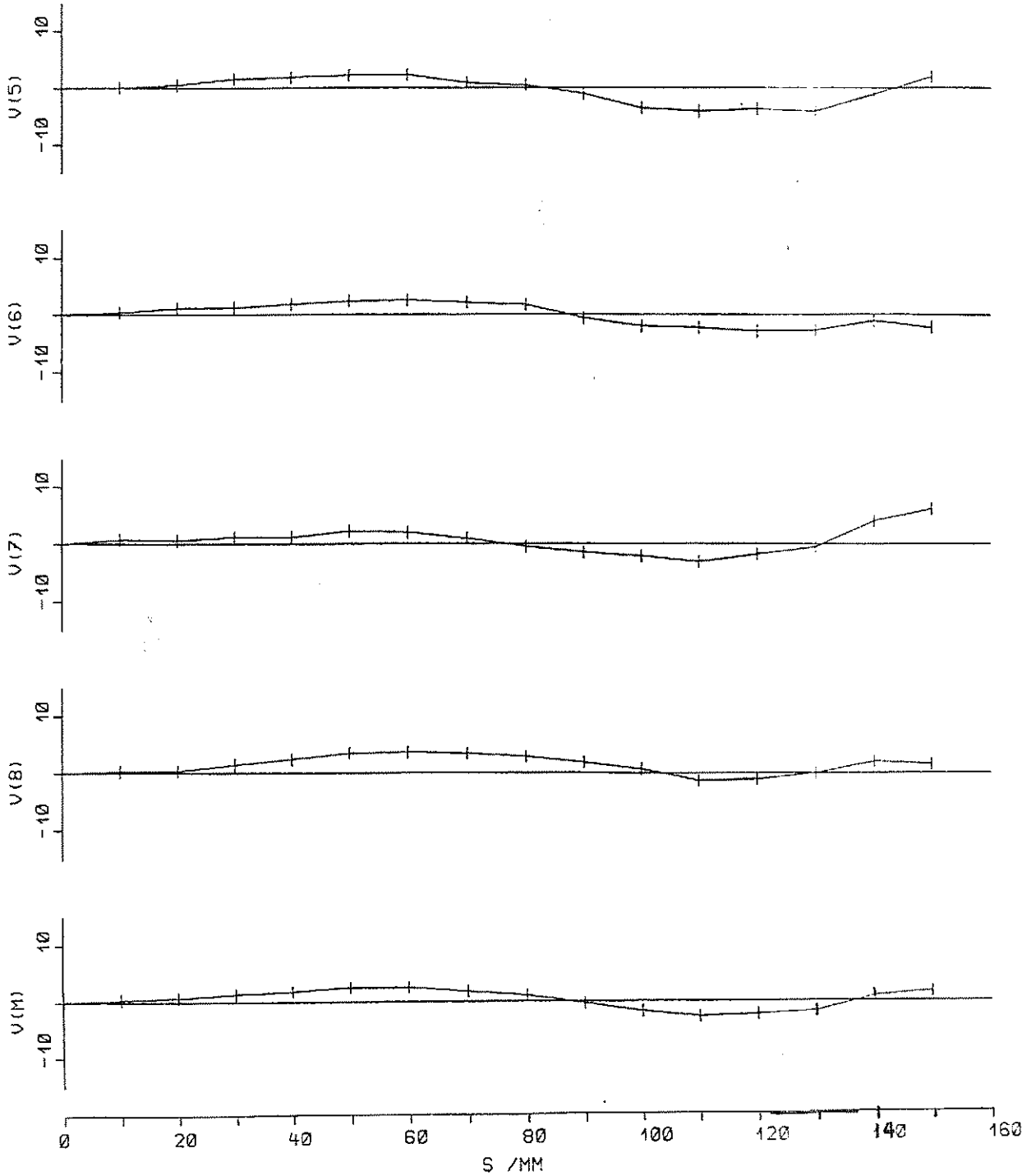
Distortion: U = 3 µm ; Point of symmetrie and collimation: U = 3 µm ; Image center: U = 5 µm ; Camera constant: U = 5 µm

The specification indicates the upgraded measuring uncertainty resulting from the multiplication of the standard measuring uncertainty by the factor k = 2. It was determined in conformity with DKD-3. The values of the measurement parameter lie within the specified range with a probability of 95%.

0775
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RMK TOP 15 NO. 149986
PLEOGON A3 4/153 NO. 150005
CFL=152.242 MM

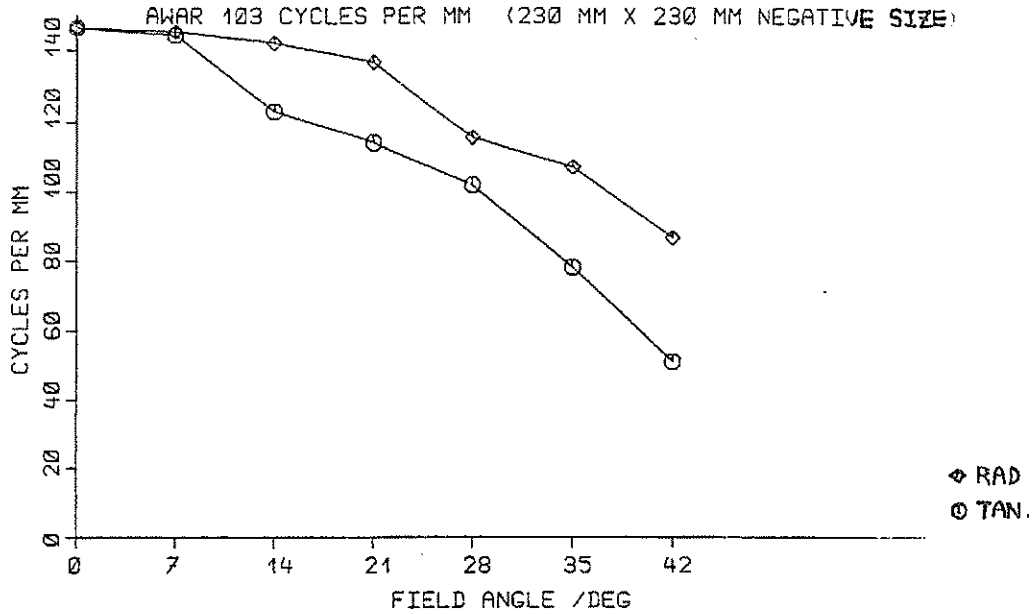
DISTORTION /0.001 MM, REFERRING TO PPS



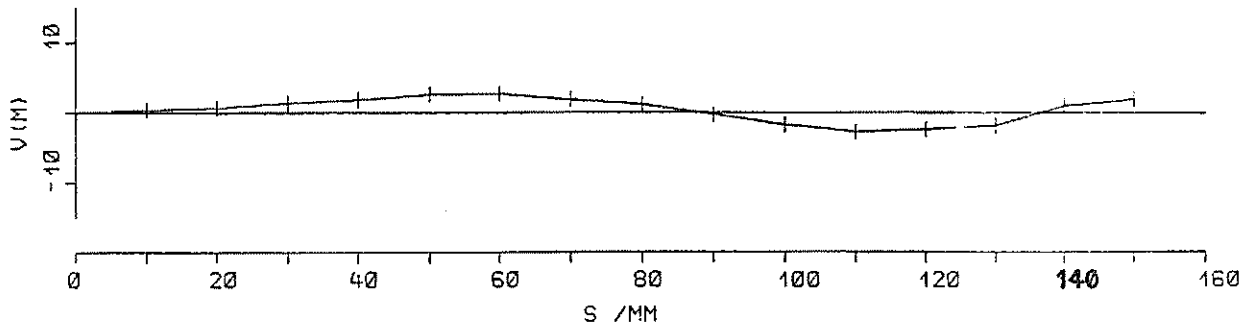
RMK TOP 15

NO. 149986

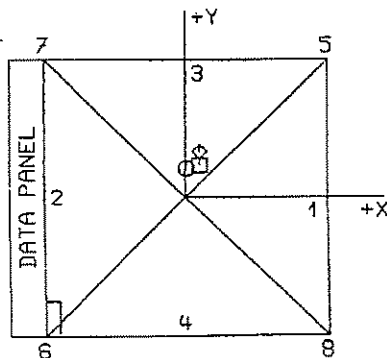
PHOTOGRAPHIC RESOLVING POWER



DEPARTURE OF AVERAGE DISTORTION FROM ZERO REFERENCE



PRINCIPAL POINT (PPA, PPS) AND FIDUCIAL CENTRE (FC)



COORDINATES, REFERRING TO PPS

	X /MM	Y /MM
○ PPA	0.000	0.011
□ FC	0.005	0.012
◇ FCC (CORNER FIDUCIAL CENTRE)	0.005	0.017

┆ 0.01 MM, X-AXIS AS DEFINED BY FIDUCIAL MARK COORDINATES

$\alpha(6) = 0.0^\circ$ $\alpha(8) = \alpha(6) + 90^\circ$

This camera has been, tested in accordance with the existing regulations. The methods used are based on the Recommended Procedures for Calibrating Photogrammetric Cameras and for Related Optical Tests (International Society of Photogrammetry, 1960, reaffirmed 1964). The optical performance and the external construction are in accordance with our terms of delivery.

1. Calibrated Focal Length

The calibrated focal length is chosen so as to minimize the square sum of the radial measured distortion.

2. Distortion

The values of radial distortion refer to the calibrated focal length and to the principal point of symmetry (Section 3). Regarding the origin for distortion values it must be realized that in the photogrammetric process, the asymmetry due to a displacement of that point is eliminated together with the asymmetry introduced by camera tilt. The principal point of symmetry is chosen as origin for distortion, because only this residual asymmetry cannot be eliminated by simple compensation.

The radial distortion is measured for points of the focal plane separated by **10** mm from the axis for each of the four radii 5, 6, 7 and 8. AV is the average radial measured distortion at a given radial distance. A positive value indicates that the image is further from the centre than its distortionfree position. Measurements are made at maximum aperture on the goniometer by attaching the filter D (cut-off wavelength 535 nm at transmittance 50%). The measuring uncertainty (95%; $k=2$) 0.003 mm.

The maximum tangential distortion, i.e. the displacement of the central image from a straight line connecting corresponding image points at equal but opposite angular separations from the axis, does not exceed 0.005 mm.

3. Principal Point and Fiducial Centre

The position of the principal point of autocollimation and of the fiducial centre (Section 4) are given in a rectangular coordinate system as indicated in the plot, with the principal point of symmetry as origin.

4. Fiducial Marks

For coordinate measurements the fiducial marks are recorded on photographic glass plates. Coordinates of the fiducial marks are given in a rectangular system as shown in the plot, with the principal point of symmetry as origin. Fiducial marks 1 and 2 lie in the line of flight. The location of the fiducial marks can be assumed to be accurate within 0.005 mm.

In the course of camera assembly and maintenance the fiducial marks are adjusted to meet the following specifications:

- The lines joining opposite pairs of fiducial marks intersect at an angle within 30 seconds of 90°.
- The point of intersection (fiducial centre) is within 0.02 mm of the principal point of autocollimation.

5. Photographic Resolving Power

The resolving power is obtained by photographing a series of three line high contrast test figures. The photographs are taken under the recommended standard illumination by using the filter B (cut-off wavelength 490 nm at transmittance 50%). The camera is used at full aperture. The resulting image is examined with a low power stereoscopic microscope to find the spatial frequency of the finest pattern resolved. The values of resolving power are reduced to the image plane and refer to the focus settings as used for determining the calibrated focal length.

6. Filters

The two surfaces of the filters listed in the certificate are within 5 seconds of being parallel.

7. Magazine Platen

The platen mounted in the film magazine, serial no. as indicated in the certificate, does not depart from a true plane by more than 0.010 mm.