DEUTSCHER KALIBRIERDIENST (DKD)

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

AKKREDITIERT DURCH DIE PHYSIKALISCH -TECHNISCHE BUNDESANSTALT (PTB)

ZEISS

0460
DKD-K-05202
97-02

Kalibrierschein
Calibration Certificate

Kalibrierzeichen
Calibration mark

Gegenstand *Object*	Aerial Survey Camera
Hersteller *Manufacturer*	Carl Zeiss D-73446 Oberkochen
Typ *Type*	RMK TOP 15
Fabrikate/Serien-Nr. *Serial number*	144 125
Auftraggeber *Customer*	Kampax Geoplan Stamholmen 112 Postbox 1138 DK - 2650 HVIDOVRE
Auftragsnummer *Order No.*	659 1 5044
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	4
Datum der Kalibrierung *Date of calibration*	06.02.97

Der Deutsche Kalibrierdienst ist Unterzeichner des multilateralen Übereinkommens der Western European Calibration Cooperation (WECC) zur gegenseitigen Anerkennung der Kalibrierscheine.
Die Kalibrierung erfolgt auf der Grundlage des zwischen der Physikalisch-Technischen Bundesanstalt und dem Träger abgeschlossenen Vertrages.
Dieser Kalibrierschein dokumentiert die Rückführbarkeit auf nationale Normale zur Darstellung der physikalischen Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

The Deutscher Kalibrierdienst is signatory to the multilateral agreement of the Western European Calibration Cooperation (WECC) for the mutual recognition of calibration certificates.
The calibration is performed according to the stipulations of the contract between the Physikalisch-Technische Bundesanstalt and the holder of the calibration laboratory.
This calibration certificate documents the traceability to national standards, which realize the physical units of measurement according to the International System of Units (SI).
The user is obliged to have the object recalibrated at appropriate intervals.

Stempel *Seal*	Datum *Date*	Leiter der Kalibrierstelle *Head of the calibration laboratory*	Bearbeiter *Person responsible*
Deutscher DKD-K-05202 Kalibrierdienst	10.02.97	Morgenbrod	Müller

Carl Zeiss
Servicebereich Qualität
Meß-/Kalibrierzentrum
73446 Oberkochen

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CAMERA TYPE: RMK TOP 15 SERIAL NO. 144125
LENS TYPE: PLEOGON A3 SERIAL NO. 145911
MAX.APERTURE: F/4 NOM. FOCAL LENGTH: 153 MM

1) CALIBRATED FOCAL LENGTH = 152.665 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	1	1	0	2	2	2	-2	-2	-2	-1	0	3	0
6	0	0	0	1	0	1	2	1	1	-1	-2	-4	-1	0	2	3
7	0	-1	-1	-1	0	0	2	0	1	-1	-2	-3	-2	0	2	2
8	0	0	-1	0	0	1	2	2	1	-1	-3	-3	-2	-1	2	2
AV.	0	0	0	0	1	1	2	1	1	-1	-2	-3	-2	0	2	2

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

P.P. OF AUTOCOLLIMATION	PPA	X=	-.001	Y=	-.002 MM
FIDUCIAL CENTRE	FC	X=	.009	Y=	-.006 MM
CORNER FIDUCIAL CENTRE	FCC	X=	.002	Y=	-.002 MM

4) FIDUCIAL MARKS, REFERRING TO PPS

X1= 113.005	X2=-112.990	X3= .011	X4= .008 MM
Y1= -.005	Y2= -.008	Y3= 113.001	Y4=-113.006 MM
DISTANCES	1-2= 225.994		3-4= 226.007 MM
X5= 112.998	X6=-112.996	X7=-113.001	X8= 113.007 MM
Y5= 113.005	Y6=-113.012	Y7= 112.992	Y8=-112.998 MM

5) PHOTOGRAPHIC RESOLVING POWER, IN CYCLES PER MM
(AS PER DEFINITION, R. P. IS NOT A CALIBRATED DATUM)
AREA WEIGHTED AVERAGE RESOLUTION 98

FIELD ANGLE /DEG =	0	7	14	21	28	35	42
RADIAL LINES	92	103	126	136	129	107	86
TANGENTIAL LINES	103	102	97	101	91	78	57

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

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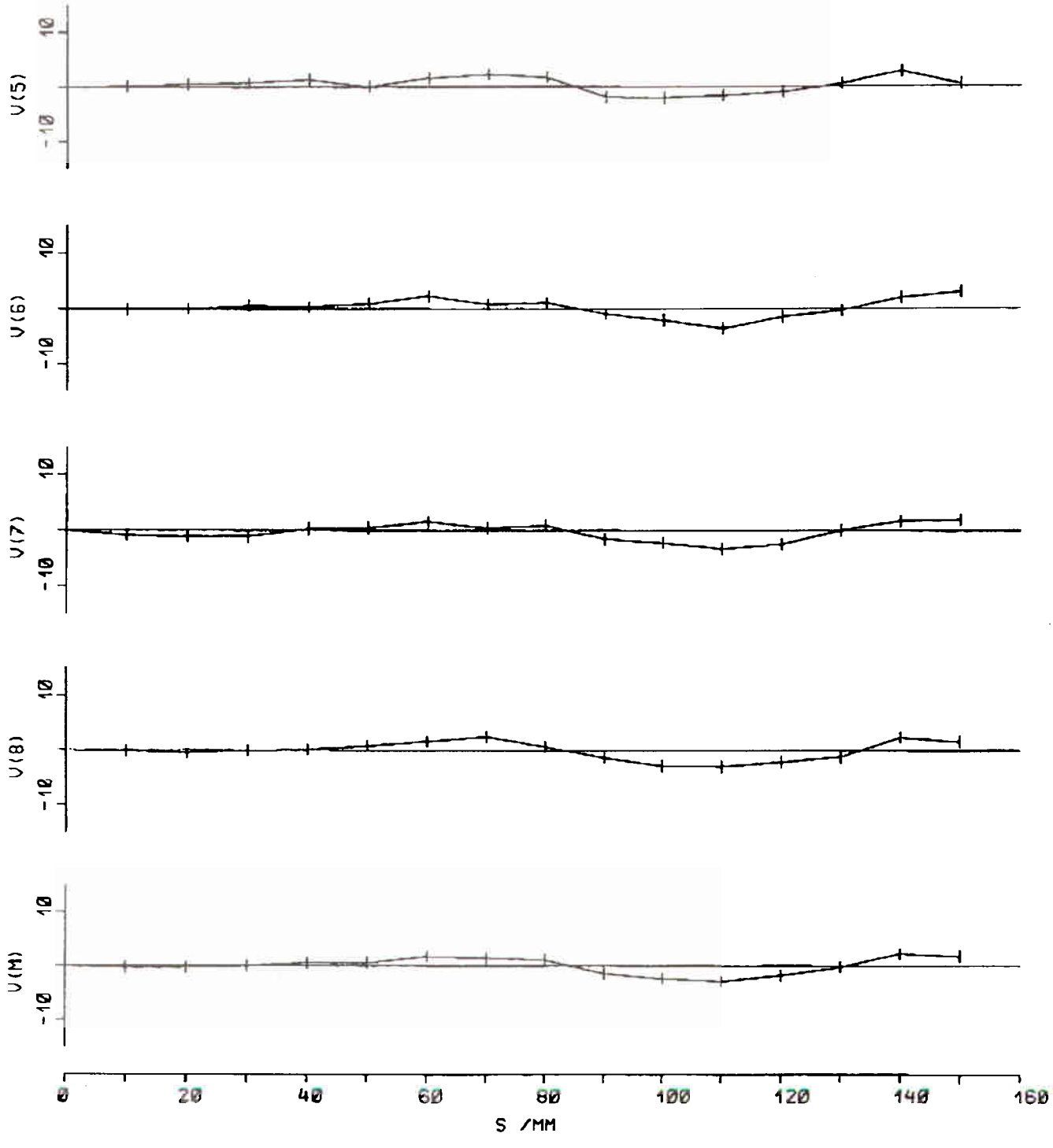
RMK TOP 15 NO. 144125
PLEOGON A3 4/153 NO. 145911
CFL=152.665 MM

DISTORTION /0.001 MM, REFERRING TO PPS



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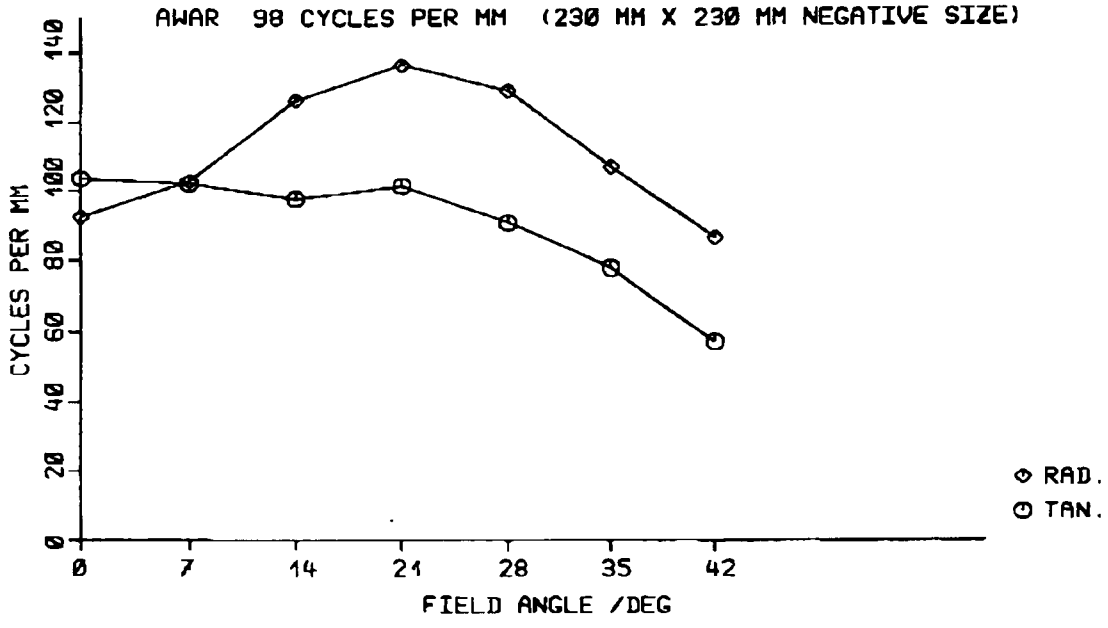
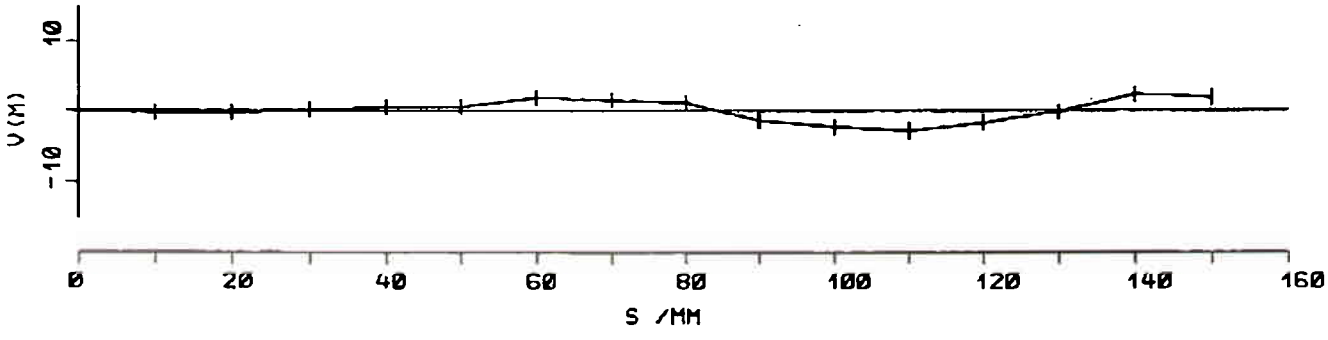
RMK TOP 15 NO. 144125

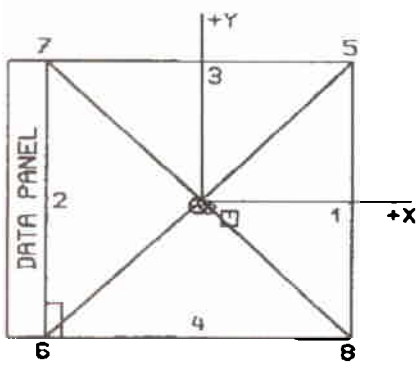
PHOTOGRAPHIC RESOLVING POWER



DEPARTURE OF AVERAGE DISTORTION FROM ZERO REFERENCE



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



COORDINATES, REFERRING TO PPS

	X /MM	Y /MM
⊙ PPA	-0.001	-0.002
⊡ FC	0.009	-0.006
⊙ FCC	0.002	-0.002

(CORNER FIDUCIAL CENTRE)

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

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

Appendix

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 standard deviation of the distortion values given can be assumed to be less than 0.002 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 positions 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 sterecscopic 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 setting 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.