

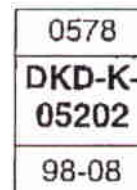
# DEUTSCHER KALIBRIERDIENST (DKD)

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

AKKREDITIERT DURCH DIE PHYSIKALISCH-TECHNISCHE BUNDESANSTALT (PTB)



OBS!  
 GÄLLER FRÅN OCH MED 1998 DKD3



## 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	141 288
Auftraggeber Customer	FJELLANGER WIDERROE A/S ROLFSTANGVEIEN 12 N-1331 OSLO
Auftragsnummer Order No.	659 1 5308
Anzahl der Seiten des Kalibrierscheines Number of pages of the certificate	4
Datum der Kalibrierung Date of calibration	03.08.98

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.


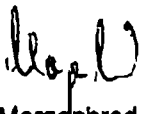

This calibration certificate documents the traceability to national standards, which realize the physical units of measurement according to the International System of Units (SI).

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

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.

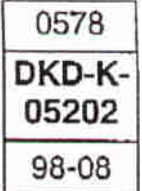
Stempel Seal	Datum Date	Leiter der Kalibrierstelle Head of the calibration laboratory	Bearbeiter Person responsible
	04.08.98	 Morgenbrod	 Sauer

Carl Zeiss  
 Servicebereich Qualität  
 Meß-/Kalibrierzentrum  
 73446 Oberkochen

Telefon 07364-20-3731  
 Telefax 07364-20-4511  
 Telex 713751-55

**DEUTSCHER KALIBRIERDIENST (DKD)**

Page 2 of the certificate dated 04.08.98



CAMERA TYPE: RMK TOP 15 SERIAL NO. 141288  
 LENS TYPE: PLEOGON A3 SERIAL NO. 141312  
 MAX. APERTURE: F/4 NOM. FOCAL LENGTH 153 MM

1) CALIBRATED FOCAL LENGTH = 153.689 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	0	0	-1	0	0	-1	-1	-1	-1	-1	0	4	8
6	0	-1	-2	-2	-1	-1	1	0	-1	1	0	0	0	1	5	5
7	0	0	-1	-1	-2	-1	1	-1	-1	-1	-3	-4	-3	-1	0	2
8	0	-1	-2	-2	-2	-2	0	-1	-1	-1	-2	-2	-3	-2	0	1
AV.	0	-1	-1	-1	-1	-1	0	0	-1	-1	-1	-2	-2	0	2	4

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

P.P. OF AUTOCOLLIMATION PPA	X=	.002	Y=	.020	MM
FIDUCIAL CENTRE FC	X=	.002	Y=	.024	MM
CORNER FIDUCIAL CENTRE FCC	X=	.002	Y=	.024	MM

4) FIDUCIAL MARKS, REFERRING TO PPS

X1=	113.012	X2=-	112.992	X3=	.001	X4=	.004	MM
Y1=	.022	Y2=	.025	Y3=	113.025	Y4=-	112.973	MM
DISTANCES	1-2=	226.004	3-4=	225.997	MM			
X5=	112.998	X6=-	112.997	X7=-	112.998	X8=	113.010	MM
Y5=	113.026	Y6=-	112.981	Y7=	113.016	Y8=-	112.977	MM

5) PHOTOGRAPHIC RESOLVING POWER, IN CYCLES PER MM  
 (AS PER DEFINITION, R. P. IS NOT A CALIBRATED DATUM)  
 AREA WEIGHTED AVERAGE RESOLUTION 90

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

RADIAL LINES	129	102	112	121	102	75	76
TANGENTIAL LINES	115	90	97	113	90	77	64

FILM: KODAK PANATOMIC X 3412 SPEED 40 AFS  
 DEVELOPED IN VERSAMAT

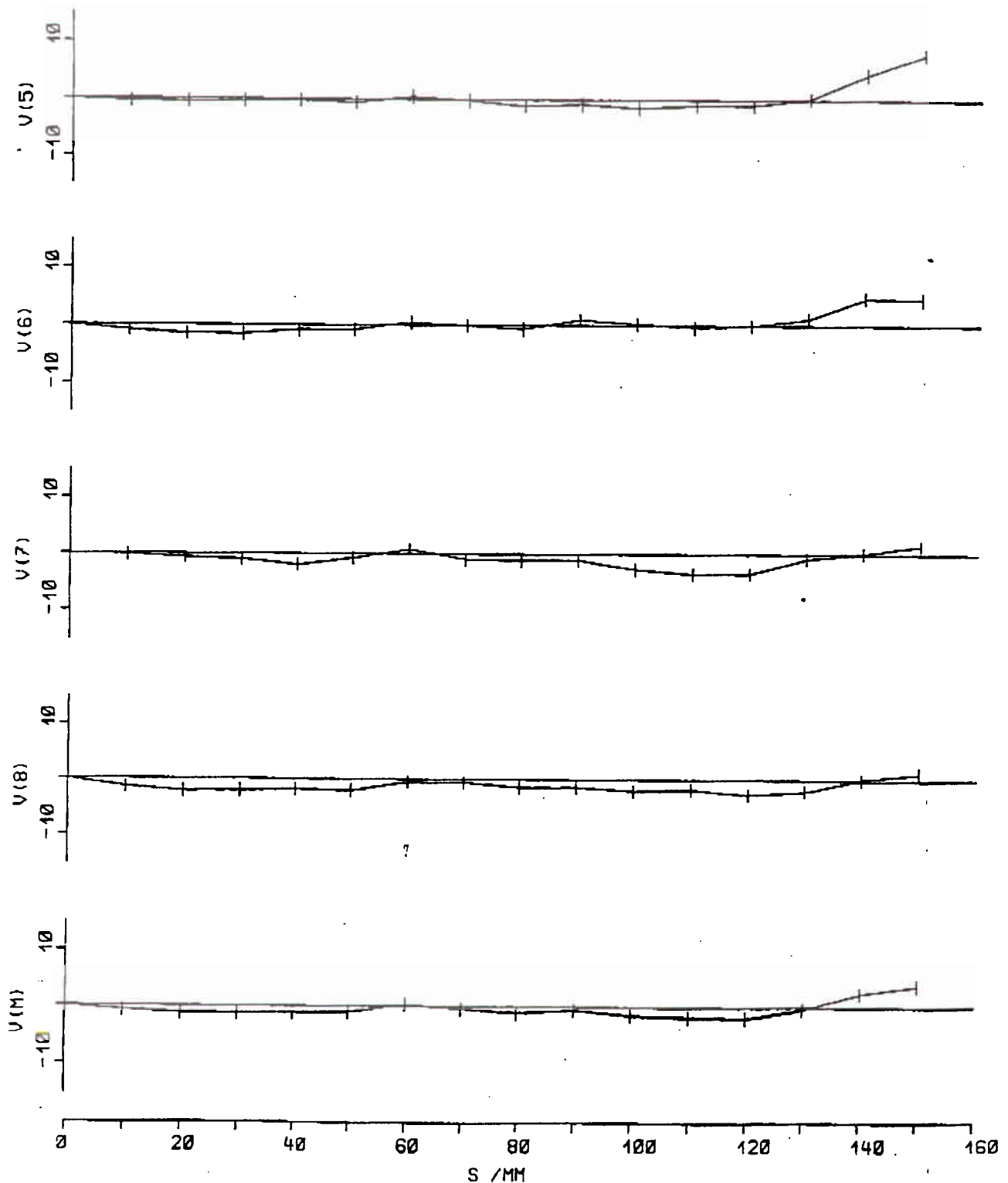
**DEUTSCHER KALIBRIERDIENST (DKD)**

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0578
DKD-K-05202
98-08

RMK TOP 15 NO. 141288  
 PLEOGON A3 4/153 NO. 141312  
 CFL=153.689 MM

DISTORTION /0.001 MM, REFERRING TO PPS



**DEUTSCHER KALIBRIERDIENST (DKD)**

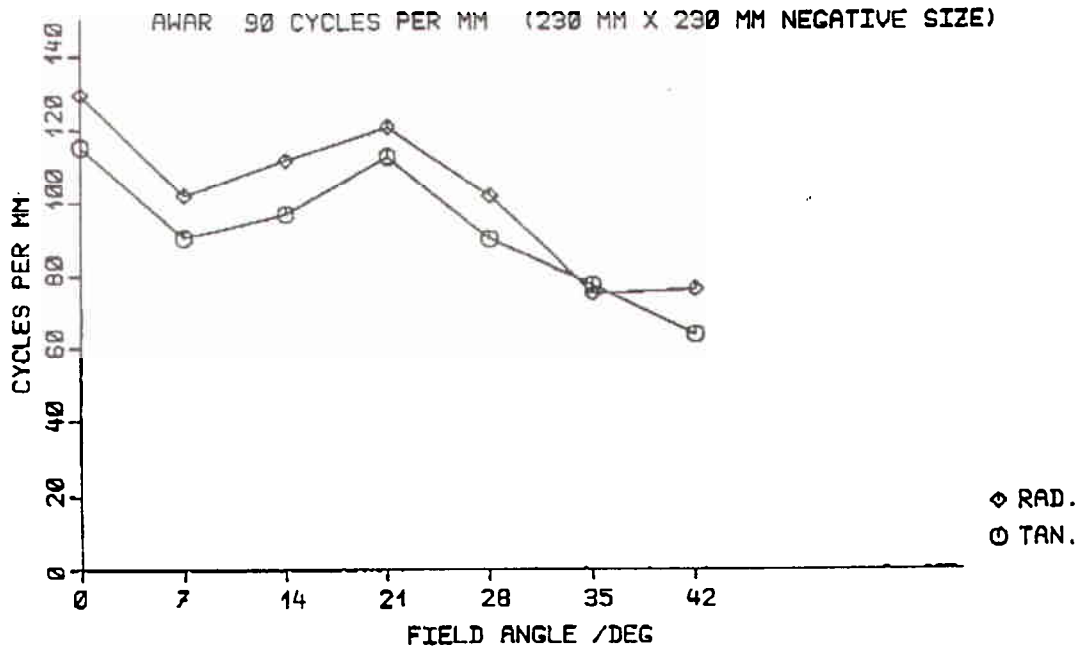
Page 4 of the certificate dated 04.08.98

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DKD-K-05202
98-08

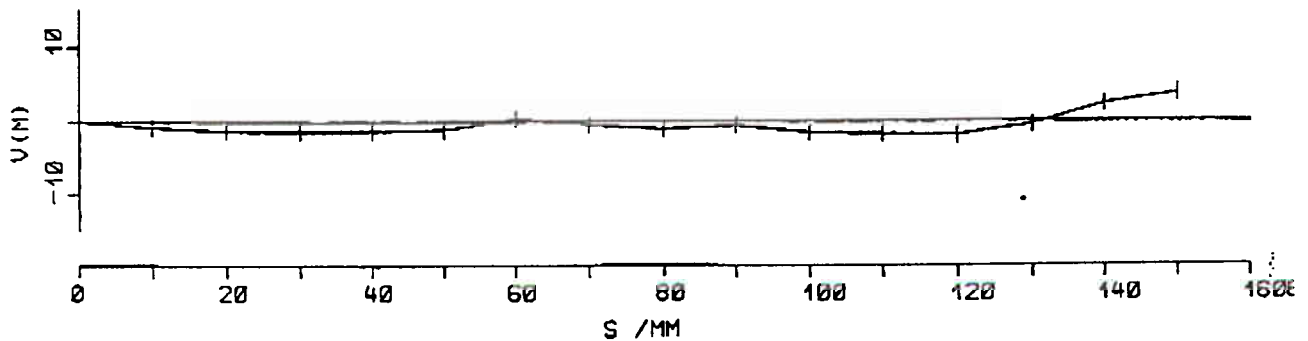
RMK TOP 15

NO. 141288

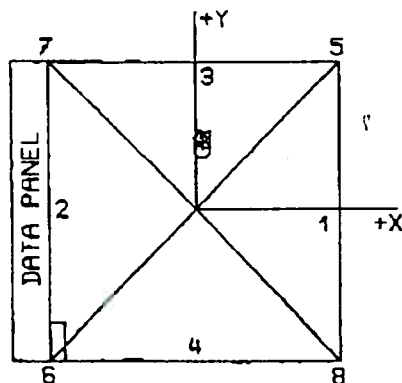
**PHOTOGRAPHIC RESOLVING POWER**



**DEPARTURE OF AVERAGE DISTORTION FROM ZERO REFERENCE**



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



COORDINATES, REFERRING TO PPS

	X / MM	Y / MM
○ PPA	0.002	0.020
□ FC	0.002	0.024
◇ FCC (CORNER FIDUCIAL CENTRE)	0.002	0.024

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

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

#### 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  $90^\circ$ .
- 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 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.

## 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 gonimeter 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.