

# DEUTSCHER KALIBRIERDIENST **DKD**

Kalibrierlaboratorium / Calibration laboratory

Akkreditiert durch die / accredited by the

Akkreditierungsstelle des Deutschen Kalibrierdienstes



DKD-K-05201



Kalibrierschein  
Calibration certificate

Kalibrierzeichen  
Calibration mark

15018
DKD-K-05201
2009-02

Gegenstand  
Object Aerial Survey Camera

Hersteller  
Manufacturer Carl Zeiss  
D-73446 Oberkochen

Typ  
Type RMK TOP 30

Fabrikat/Serien-Nr.  
Serial number 143093

Auftraggeber  
Customer TERRA-Bildmessflug GmbH & CoKG  
Schumannstrasse 21  
71672 Marbach

Auftragsnummer  
Order No. 41 694

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

Datum der Kalibrierung  
Date of calibration 27.02.09

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

Der DKD ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) 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 DKD is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) 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 Akkreditierungsstelle des DKD 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 Accreditation Body of the DKD and the issuing laboratory. Calibration certificates without signature and seal are not valid.*

Stempel Seal	Datum Date	Stellv. Leiter des Kalibrierlaboratoriums Deputy Head of the calibration laboratory	Bearbeiter Person in charge
	27.02.09	 Ripberger	 Müller

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CAMERA TYPE: RMK TOP 30 SERIAL NO. 143093  
 LENS TYPE: Topar A3 SERIAL NO. 143120  
 MAX. APERTURE: F/5.6 NOM. FOCAL LENGTH 305 MM

1) CALIBRATED FOCAL LENGTH = 305.077 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	-1	-1	-1	0	0	0	0	0	1	-1	-1	-1	2	6
6	0	1	0	-1	-1	0	0	0	0	1	1	-1	-1	0	2	5
7	0	0	-1	-1	-1	-1	-2	0	-1	0	-1	-3	-3	-1	1	3
8	0	0	-2	-2	-1	-2	0	0	0	0	-1	-2	-3	-2	0	3
AV.	0	0	-1	-1	-1	-1	-1	0	0	0	0	-2	-2	-1	1	4

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

P.P. OF AUTOCOLLIMATION PPA	X=	0.041	Y=	-0.010	MM
FIDUCIAL CENTRE FC	X=	0.046	Y=	-0.005	MM
CORNER FIDUCIAL CENTRE FCC	X=	0.049	Y=	-0.010	MM

4) FIDUCIAL MARKS, REFERRING TO PPS

X1=	113.039	X2=	-112.957	X3=	0.048	X4=	0.044	MM
Y1=	-0.003	Y2=	-0.007	Y3=	112.990	Y4=	-113.011	MM
DISTANCES	1-2=	225.996	3-4=	226.001	MM			
X5=	113.049	X6=	-112.955	X7=	-112.951	X8=	113.044	MM
Y5=	112.985	Y6=	-113.010	Y7=	112.992	Y8=	-113.006	MM

5) PHOTOGRAPHIC RESOLVING POWER, IN CYCLES PER MM  
 (AS PER DEFINITION, R. P. IS NOT A CALIBRATED DATUM)  
 AREA WEIGHTED AVERAGE RESOLUTION 94

FIELD ANGLE /DEG = 0 7 14 24

RADIAL LINES	116	103	100	75
TANGENTIAL LINES	116	114	97	86

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

6) Filter

7) Magazines

8) Measuring uncertainty

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

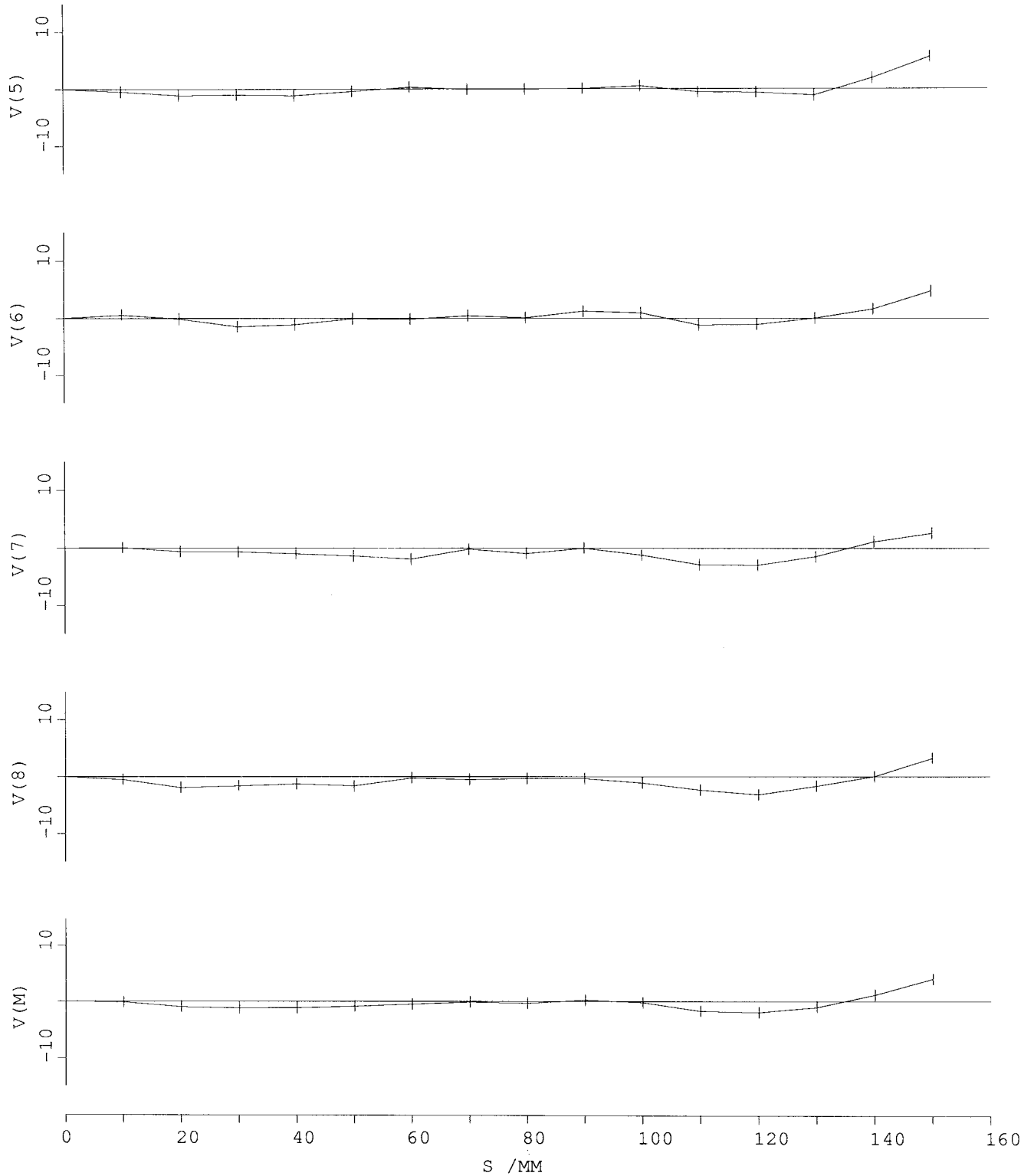
The specification indicates the upgraded measuring uncertainty resulting from the multiplication of the standard measuring uncertainty by the factor k = 2. It was determined in conformity with DKD-3. The values of the measurement parameter lie within the specified range with a probability of 95%.



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RMK TOP 30 NO. 143093  
Topar A3 5.6/305 NO. 143120  
CFL=305.077 MM

DISTORTION /0.001 MM, REFERRING TO PPS



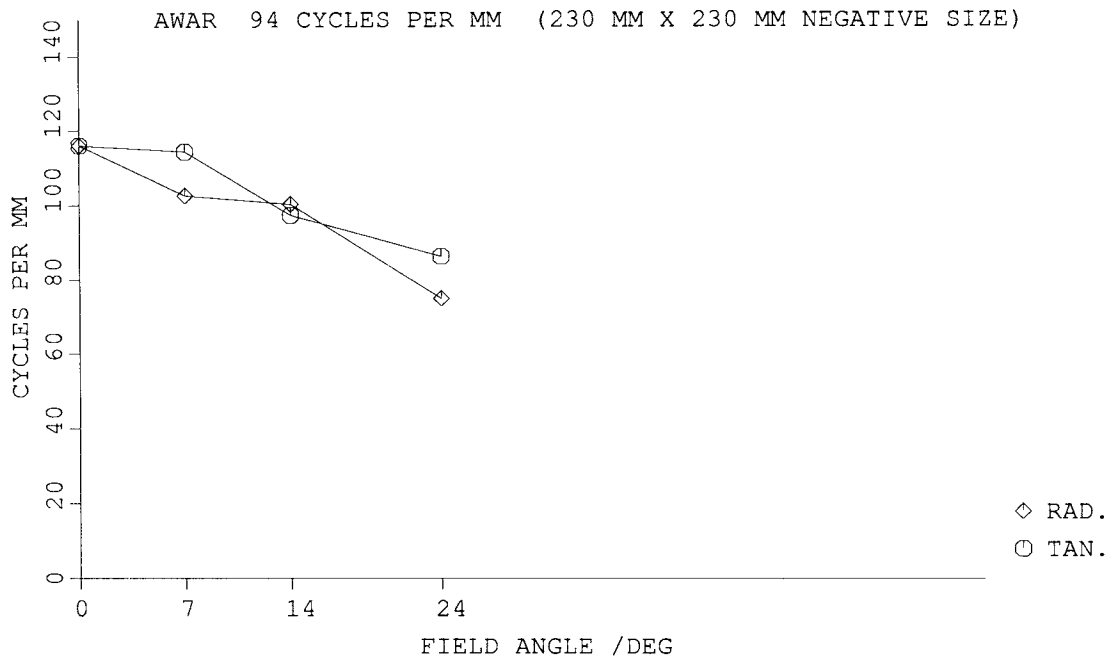


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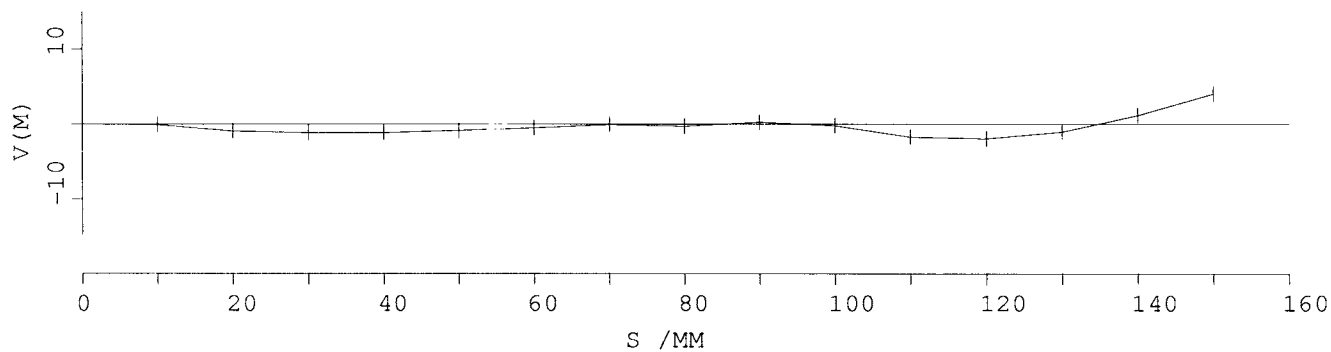
RMK TOP 30

NO. 143093

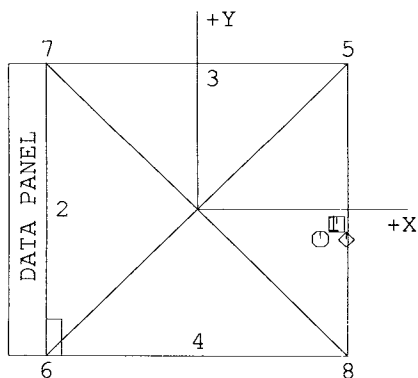
PHOTOGRAPHIC RESOLVING POWER



DEPARTURE OF AVERAGE DISTORTION FROM ZERO REFERENCE



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



COORDINATES, REFERRING TO PPS

	X /MM	Y /MM
$\circ$ PPA	0.041	-0.010
$\square$ FC	0.046	-0.005
$\diamond$ FCC (CORNER FIDUCIAL CENTRE)	0.049	-0.010

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 10mm 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.

### **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.