Calibration Certificate

Lens cone

No.: 265 005 A

with lens

No.: 73 83 176 C

Date of calibration: 21.03.1985

Entries approved by:

VEB Carl Zeiss JENA
Department of Photogrammetry

Dr. Werner Marckwardt

1. General

The data given in this calibration certificate have been determined photographically with the yellow filter belonging to the equipment of the LMK.

Distortion and resolution refer to the respective maximum aperture ratio.

Calibration temperature is $22^\circ C \pm 1.5$ K.

The definition of the errors assigned to the measuring data corresponds to the GDR standard, TGL 0-1319 (identical to DIN 1319, issue in 1962).

The standard deviation s is related to a level of confidence of $P = 95\%$ and corresponds to double the value of the mean error usual in surveying, i.e. $P = 68.3\%$.

All data given without any additional explanations are guaranteed error limits within this standard.

Definition of the measured values (positive image):
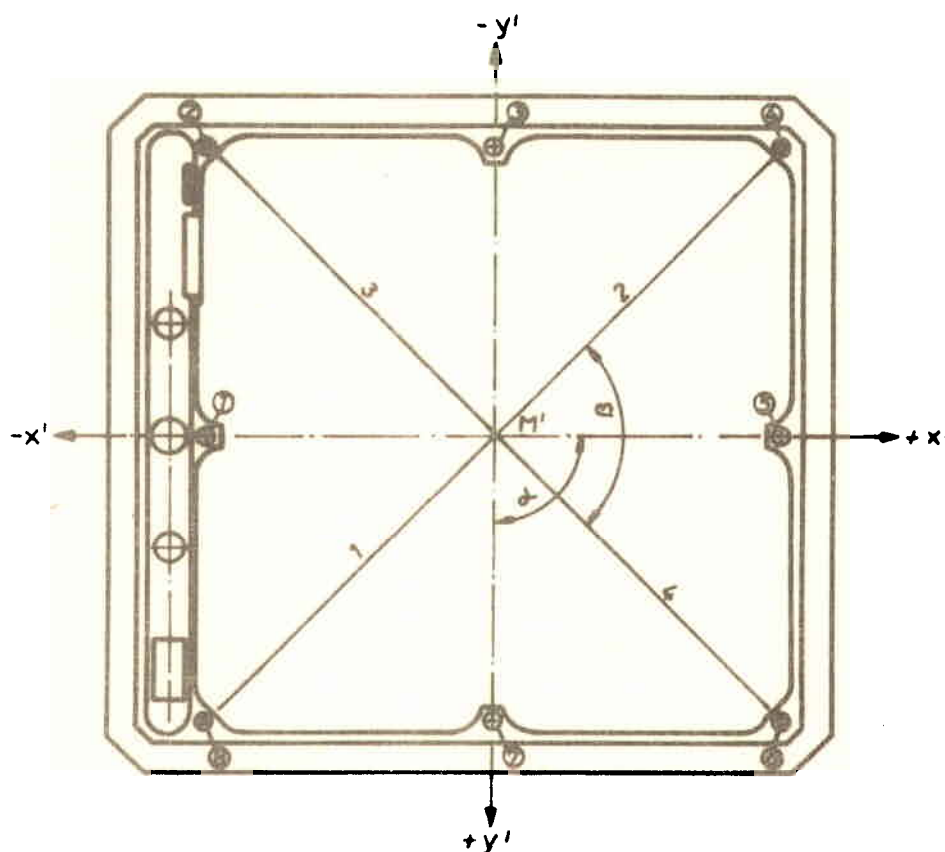
K $\hat{=}$ Temperature difference $t - t_0$, with $t_0 = 22\ ^\circ C$.

M'= Centre of fiducial mark (intersection point of the fiducial mark connecting lines in the centre of the format sides) = zero point of image coordinate system.

2. Data of interior orientation

Test emulsion: ORWO - LP 3

2.1. Calibrated focal length c_k = 152.21 mm ±0.01 mm

2.2. Position of other reference points in the image coordinate system

2.2.1. Intersection point of the connecting lines of the fiducial marks in the picture corners

x' = ± 0.00 mm ±0.01 mm

y' = ± 0.00 mm ±0.01 mm

2.2.2. Principal point

x' = + 0.01 mm ±0.01 mm

y' = + 0.01 mm ±0.01 mm

2.2.3. Symmetry point of distortion

x' = ± 0.00 mm, s = ±0.01 mm

y' = + 0.01 mm, s = ±0.01 mm

2.3. Intersection angle of the fiducial mark connecting lines

2.3.1. Fiducial marks in the centres of the format sides

α = 99.996 gon +), s = ±0.003 gon

2.3.2. Fiducial marks in the picture corners

β = 99.999 gon , s = ±0.003 gon

2.4. Radial distortion (μm)

A positive sign corresponds to an enlargement of the image radius.

Reference point	Measuring direction	LMK 9/15	Field angle in gon							
			8	16	24	32	40	48	56	64
		21	8	16	24	28	32	36		
		30	4	8	12	16	20	24	28	
Zero point of the image coordinate system	1		+ 2	+ 1	0	0	− 1	− 6		
	2		+ 2	+ 1	+ 1	0	0	+ 3		
	3		+ 2	+ 2	+ 2	+ 2	+ 3	+ 3		
	4		+ 2	+ 1	0	− 3	− 2	− 6		
Symmetry point of distortion	1		+ 2	+ 1	+ 1	+ 1	+ 1	− 3		
	2		+ 2	+ 1	0.	− 1	− 2	0		
	3		+ 2	+ 1	+ 1	0	+ 1	− 2		
	4		+ 2	+ 2	+ 1	− 1	0	− 1		
Average values			+ 2	+ 1	+ 1	0	0	− 1		

Standard deviation of the distortion values related to the symmetry point of distortion: $s = \pm (3.0 + 1.5 \cdot \tan \tau)$ (μm)

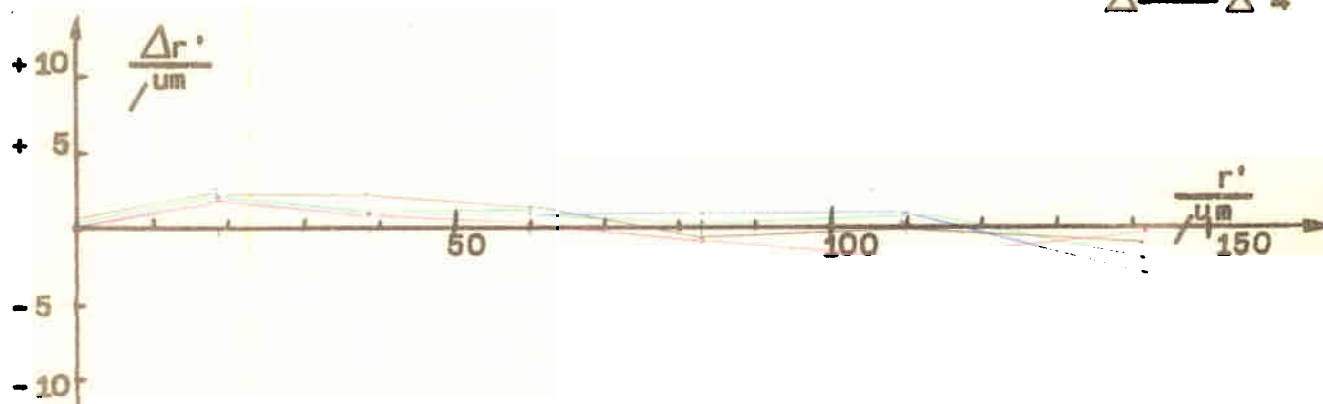
+) 1 gon = $\frac{\pi}{200}$ rad = $15.708 \cdot 10^{-3}$ rad

Mean distortion
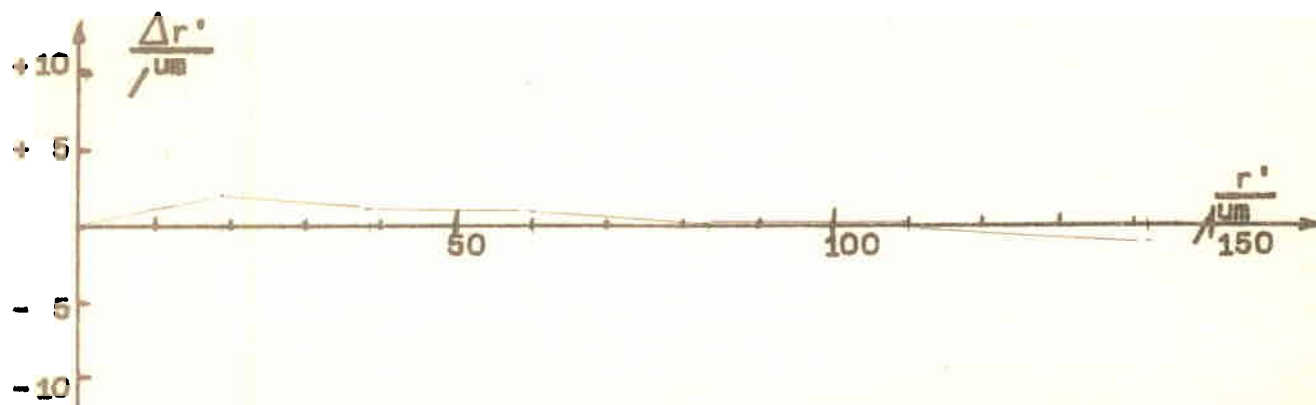
Distortion on the semidiagonals related to the symmetry point of distortion

●━━━● 1
○━━━○ 2
+━━━+ 3
△━━━△ 4

2.5. Tangential residual errors

Mean value for the largest field angle

Diagonal 1 - 2: $\pm$ 2 μm

Diagonal 3 - 4: $\pm$ 1 μm

3.   Image coordinates of the fiducial marks (mm)

Point No.	x'	y'
1	− 110.001	− 0.007
2	− 110.002	− 110.006
3	± 0.000	− 109.998
4	+ 110.003	− 109.993
5	+ 110.009	+ 0.006
6	+ 110.000	+ 110.007
7	± 0.000	+ 109.998
8	− 110.000	+ 109.991

Standard deviation of the image coordinates: s = $\pm$0.006 mm