Calibration Certificate

Lens cone

> **No.:**   264 650 A

with lens

> **No.:**   73 81 365

Date of calibration: 10.07.1986

Entries approved by:
VEB Carl Zeiss JENA
Department of Photogrammetry

2. Data of interior orientation

Test emulsion: ORWO — WP 1

2.1. Calibrated focal length c_k = 88.63   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' = ± 0.00   mm ±0.01 mm

y' = ± 0.00   mm ±0.01 mm

2.2.3. Symmetry point of distortion

x' = − 0.01   mm, s = ±0.01 mm

y' = ± 0.00   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 = 99.995   gon +), s = ±0.003 gon

2.3.2. Fiducial marks in the picture corners
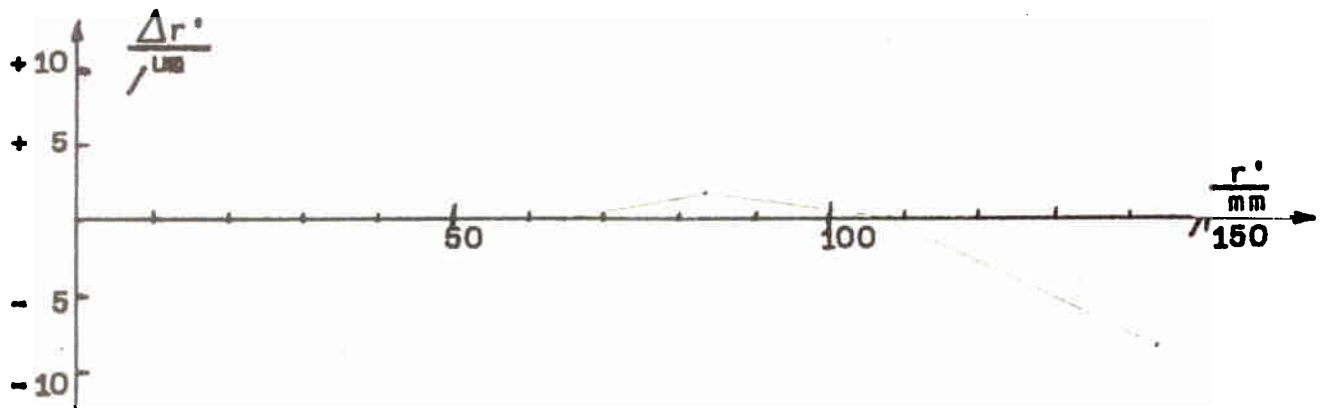
β = 100.000   gon , s = ±0.003 gon

2.4. Radial distortion (μm)
A positive sign corresponds to an enlargement of the image radius.

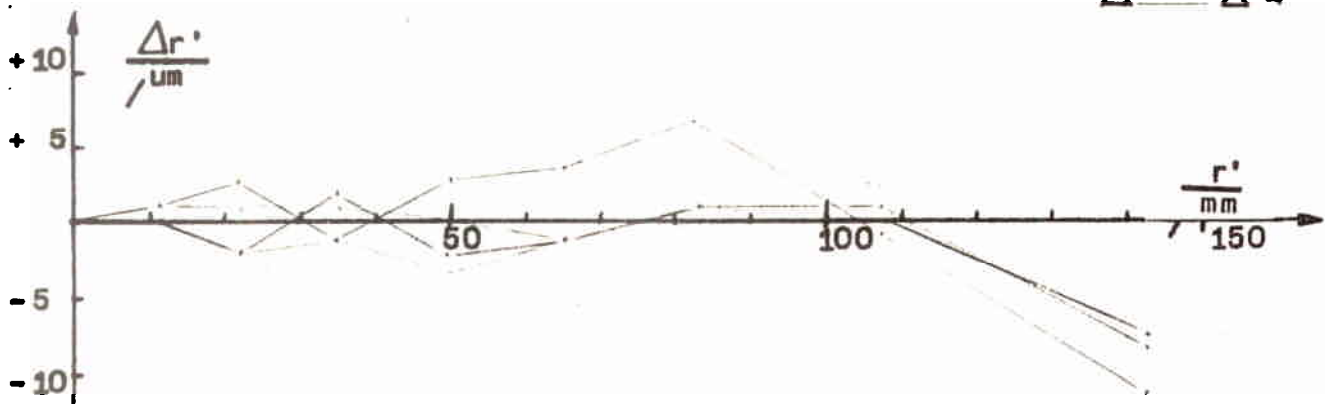| Reference point | Measuring direction | LMK 9/15 | Field angle in gon |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 |
| | | 21 | 8 | 16 | 24 | 28 | 32 | 36 | | |
| | | 30 | 4 | 8 | 12 | 16 | 20 | 24 | 28 | |
| Zero point of the image coordinate system | 1 | | 0 | −2 | −2 | −5 | −5 | −6 | −10 | −24 |
| | 2 | | +1 | +1 | +2 | +2 | +3 | +7 | +10 | +10 |
| | 3 | | 0 | −2 | +1 | −3 | −3 | −2 | −5 | −18 |
| | 4 | | +1 | +3 | 0 | +4 | +6 | +10 | +5 | −1 |
| Symmetry point of distortion | 1 | | 0 | −2 | −1 | −3 | −1 | 0 | 0 | −7 |
| | 2 | | +1 | +1 | +1 | 0 | −1 | +1 | 0 | −7 |
| | 3 | | 0 | −2 | +2 | −2 | −1 | +1 | +1 | −8 |
| | 4 | | +1 | +3 | −1 | +3 | +4 | +7 | −1 | −11 |
| Average values | | | 0 | 0 | 0 | 0 | 0 | +2 | 0 | −8 |

Standard deviation of the distortion values related to the symmetry point of distortion: s = ± (3.0 + 1.5 · tan τ) (μm)

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

Mean distortion

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

●———● 1
○———○ 2
+———+ 3
△———△ 4

2.5. <u>**Tangential residual errors**</u>

Mean value for the largest field angle

Diagonal 1 - 2: ± 1 /um

Diagonal 3 - 4: ± 4 /um

3. <u>**Image coordinates of the fiducial marks (mm)**</u>

Point No.	x'	y'
1	− 109.999	− 0.008
2	− 110.000	− 110.009
3	± 0.000	− 110.004
4	+ 110.000	− 109.996
5	+ 110.011	+ 0.008
6	+ 110.003	+ 110.005
7	± 0.000	+ 110.012
8	− 110.001	+ 109.997

Standard deviation of the image coordinates: s = ±0.006 mm

4. <u>Fiducial mark spacings</u>

1 - 5	220.010	mm
3 - 7	220.016	mm
2 - 6	311.139	mm
4 - 8	311.123	mm

The distances have been derived from the image coordinates
of the fiducial marks.

5. <u>Photographic resolution</u>

The photographic resolution has been determined on the basis
of the recommendations of the International Society of Photo-
grammetry.

Test pattern: Three-line target with high contrast (log k = 2.0)
Test emulsion: ORWO - NP 15
Developer: ORWO - A 71
Developing time: 2 min
Developing temperature: 20 ^{o}C
Gradation γ = 1.0

Mean values of the photographic resolution in lines/mm from
the two image diagonals:

Test position	LMK 9/15	Field angles in gon								
		0	8	16	24	32	40	48	56	64
	21	0	8	16	24	32	38			
	30	0	4	8	12	16	20	24	28	
radial		83	84	74	63	49	49	50	25	21
tangential		83	82	83	84	84	81	72	51	37

6. <u>Filter parallelism</u>

The LMK 9 No. 264 650 A comprises the following
filters:

350/ 33 / 9	No. 50 698/A	(clear)
500/ 33 / 9	No. 50 708/A	(yellow)
550/ 33 / 9	No. 50 717/A	(orange)

The parallelism of the filter surfaces is ≤ 5"

7. <u>Flatnes of the film pressure plate</u>

The deviation of the film pressure plate surface from an ideal plane is $\leq \pm$ 0.008 mm.

8. <u>Notes:</u>