

Deutsche Akkreditierungsstelle GmbH

Annex to the Accreditation Certificate D-K-15074-01-00 according to DIN EN ISO/IEC 17025:2018

Valid from: 19.12.2019

Date of issue: 19.12.2019

Holder of certificate:

Mahr GmbH
Carl-Mahr-Straße 1, 37073 Göttingen

Calibration in the fields:

Dimensional quantities

Length

- **Roughness**
- **Form error**
- **Contours**
- **Stylus instruments ^{a)}**
- **Length measuring devices ^{a)}**

^{a)} also on-site calibration

Abbreviations used: see last page

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Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Length Groove depth P_t and d on depth setting standards	0.2 μm to 0.8 μm (7.9 μin) (31.5 μin) 0.8 μm to 1.5 μm (31.5 μin) (59,1 μin) 1.5 μm to 3.5 μm (59.1 μin) (137.8 μin) 3.5 μm to 12 μm (137.8 μin) (472.5 μin)	DIN EN ISO 3274:1998 DIN EN ISO 4287:2010 DIN EN ISO 5436-1:2000	0.03 μm (1.2 μin) 0.04 μm (1.6 μin) 0.04 μm (1.6 μin) 0.05 μm (2.0 μin)	
Roughness on extra fine roughness standards R_a R_z R_{max}	0.025 μm to 0.1 μm (1.0 μin) (3.9 μin) 0.15 μm to 0.8 μm (5.9 μin) (31.5 μin) 0.15 μm to 0.8 μm (5.9 μin) (31.5 μin)	DIN 4768:1990 DIN EN ISO 3274:1998 DIN EN ISO 4287:2010 DIN EN ISO 4288:1998 DIN EN ISO 16610-21:2013	0.08 · R_a 0.09 · R_z 0.10 · R_{max}	
Roughness on roughness standards R_a R_z R_{max}	0.1 μm to 4 μm (3.9 μin) (157.5 μin) 0.8 μm to 20 μm (31.5 μin) (787.5 μin) 0.8 μm to 20 μm (31.5 μin) (787.5 μin)	DIN 4768:1990 DIN EN ISO 3274:1998 DIN EN ISO 4287:2010 DIN EN ISO 4288:1998 DIN EN ISO 16610-21:2013	0.05 · R_a 0.05 · R_z 0.05 · R_{max}	
Roughness on roughness standards R_{pk} R_k R_{vk} $Mr1$ $Mr2$	On surfaces in the range 0.1 $\mu\text{m} \leq R_a \leq$ 4 μm (3.9 μin) (157.5 μin) 0.8 $\mu\text{m} \leq R_z \leq$ 20 μm (31.5 μin) (787.5 μin)	DIN 4768:1990 DIN EN ISO 13565-1:1998 DIN EN ISO 13565-2:1998	0.04 · R_z 0.05 · R_z 0.04 · R_z 4 % 6 %	Relative measuring uncertainty relative to R_z Absolute measuring uncertainty relative to 100% material ratio
Roughness on roughness standards R_a R_z R_{max}	0.1 μm to 4 μm (3.9 μin) (157.5 μin) 0.8 μm to 20 μm (31.5 μin) (787.5 μin) 0.8 μm to 20 μm (31.5 μin) (787.5 μin)	DIN 4768:1990 DIN EN ISO 3274:1998 DIN EN ISO 4287:2010 DIN EN ISO 4288:1998 DIN EN ISO 16610-21:2013	0.03 · R_a 0.03 · R_z 0.03 · R_{max}	If necessary, the filter cutoff wavelength λ_c can be used one level lower or higher than as per ISO 4288:1998

¹⁾ The expanded uncertainties according to EA-4/02 M:2013 are part of CMC and are the best measurement uncertainties within accreditation. They have a coverage probability of approximately 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks	
Stylus instruments to DIN EN ISO 3274:1998 <i>Pt</i> and <i>d</i> <i>Ra</i> <i>Rz</i> <i>Rmax</i>	0.2 µm to 12 µm (7.9 µin) (472.5 µin) 0.1 µm to 4 µm (3.9 µin) (157.5 µin) 0.8 µm to 20 µm (31.5 µin) (787.5 µin) 0.8 µm to 20 µm (31.5 µin) (787.5 µin)	DKD-R 4-2 part 2:2018 DIN EN ISO 12179:2000	$U_{\text{standard}} + 0.01 \mu\text{m}$ ($U_{\text{standard}} + 0.4 \mu\text{in}$) $U_{\text{standard}} + 0.01 \cdot Ra$ ($U_{\text{standard}} + 0.4 \mu\text{in} \cdot Ra$) $U_{\text{standard}} + 0.01 \cdot Rz$ ($U_{\text{standard}} + 0.4 \mu\text{in} \cdot Rz$) $U_{\text{standard}} + 0.01 \cdot Rmax$ ($U_{\text{standard}} + 0.4 \mu\text{in} \cdot Rmax$)	U_{standard} is the measuring uncertainty of the standards used. Smaller measuring ranges for which standards are available can also be calibrated.	
Roundness standards Roundness deviation	to 0.1 µm (3.9 µin)	DIN ISO 1101:2014	0.025 µm (1.0 µin)	Diameter: 3 mm to 100 mm (0.12 to 3.94 in)	
Magnification standards Roundness deviation for cylinder with flat area (flick)	0.5 µm to 20 µm (19.7 µin) (787.5 µin)		$0.05 \mu\text{m} + 2.5 \cdot 10^{-2} \cdot RONt$ ($2.0 \mu\text{in} + 2.5 \cdot 10^{-2} \cdot RONt$)	Diameter: 3 mm to 100 mm (0.12 to 3.94 in)	
Magnification standards Roundness deviation Multi-wave standard	to 20 µm (787.5 µin)		$0.1 \mu\text{m} + 2.5 \cdot 10^{-2} \cdot RONt$ ($3.9 \mu\text{in} + 2.5 \cdot 10^{-2} \cdot RONt$)	Diameter: 50 mm to 150 mm (1.97 to 5.91 in)	
Cylinder square Roundness deviation	to 20 µm (787.5 µin)	DIN ISO 1101:2014	$0.1 \mu\text{m} + 2.5 \cdot 10^{-2} \cdot RONt$ ($3.9 \mu\text{in} + 2.5 \cdot 10^{-2} \cdot RONt$)	Diameter: 3 mm to 100 mm (0.12 to 3.94 in)	
Straightness deviation of the generatrices	to 20 µm (787.5 µin)		$0.2 \mu\text{m} + 2.0 \cdot 10^{-2} \cdot STRt$ ($7.9 \mu\text{in} + 2.0 \cdot 10^{-2} \cdot STRt$)	Length: 10 mm to 400 mm (0.39 to 15.75 in)	
Parallelism deviation of the generatrices	to 20 µm (787.5 µin)		$0.3 \mu\text{m} + 1.5 \cdot 10^{-2} \cdot PART$ ($11.8 \mu\text{in} + 1.5 \cdot 10^{-2} \cdot PART$)	$RONt$ = roundness deviation $STRt$ = Straightness deviation	
Cylindricity deviation	to 20 µm (787.5 µin)		$0.4 \mu\text{m} + 3.0 \cdot 10^{-2} \cdot CYLt$ ($15.8 \mu\text{in} + 3.0 \cdot 10^{-2} \cdot CYLt$)	$STRt$ = Straightness deviation $PART$ = Parallelism deviation $CYLt$ = Cylindricity deviation	
Contour standards X length Lateral distances	5 mm to 100 mm (0.20 in) (3.94 in)	Substitution measurement with reference contour standard	0.6 µm (23.6 µin)		
Z length Vertical distances	to 10 mm (0.39 in)		Procedure according to DIN ISO/TS 15530-3:2008	0.75 µm (29.5 µin)	
Radii	2 mm to 12 mm (0.079 in) (0.47 in)		0.75 µm (29.5 µin)		
Angles	40° to 135°		0.01°		

¹⁾ The expanded uncertainties according to EA-4/02 M:2013 are part of CMC and are the best measurement uncertainties within accreditation. They have a coverage probability of approximately 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Dial gauge checkers	to 100 mm (3.94 in)	MK03/05:2014 Calibration with traceable electronic linear reference gauge	0.22 μm (8.7 μin)	
Horizontal Length measuring machines	0 mm to 1000 mm (0 μin) (39.37 in)	VDI/VDE/DGQ 2618 part 17.1:2014	0.08 μm + 0.7 · 10 ⁻⁶ · l (3.1 μin + 0.7 · 10 ⁻⁶ · l)	l = measured length The measurement uncertainty of the length measurement uncertainty in mechanical probing of gauge blocks and is valid for horizontal length measuring machines of the Mahr GmbH
	> 1000 mm to 2000 mm (> 39.37 in) (78.74 in)		0.1 μm + 0.5 · 10 ⁻⁶ · l (3.9 μin + 0.5 · 10 ⁻⁶ · l)	

On-site Calibration

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement ¹⁾	Remarks
Length Stylus instruments to DIN EN ISO 3274:1998 <i>Pt</i>	0.2 μm to 12 μm (7.9 μin) (472.5 μin)	DKD-R 4-2 part 2:2018 DIN EN ISO 12179:2000	$U_{\text{standard}} + 0.01 \mu\text{m}$ ($U_{\text{standard}} + 0.4 \mu\text{in}$)	U_{standard} is the measuring uncertainty of the standards used. Smaller measuring ranges for which standards are available can also be calibrated.
<i>Ra</i>	0.1 μm to 4 μm (3.9 μin) (157.5 μin)		$U_{\text{standard}} + 0.01 \cdot Ra$ ($U_{\text{standard}} + 0.4 \mu\text{in} \cdot Ra$)	
<i>Rz</i>	0.8 μm to 20 μm (31.5 μin) (787.5 μin)		$U_{\text{standard}} + 0.01 \cdot Rz$ ($U_{\text{standard}} + 0.4 \mu\text{in} \cdot Rz$)	
<i>Rmax</i>	0.8 μm to 20 μm (31.5 μin) (787.5 μin)		$U_{\text{standard}} + 0.01 \cdot Rmax$ ($U_{\text{standard}} + 0.4 \mu\text{in} \cdot Rmax$)	
Dial gauge checkers	to 100 mm (3.94 in)	MK03/05:2014 Calibration with traceable electronic linear reference gauge	0.22 μm (8.7 μin)	

¹⁾ The expanded uncertainties according to EA-4/02 M:2013 are part of CMC and are the best measurement uncertainties within accreditation. They have a coverage probability of approximately 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

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Horizontal Length measuring machines	0 mm to 1000 mm (0 µin)	VDI/VDE/DGQ 2618 part 17.1:2014	0.08 µm + 0.7 · 10 ⁻⁶ · l (3.1 µin + 0.7 · 10 ⁻⁶ · l)	l = measured length The measurement uncertainty of the length measurement uncertainty in mechanical probing of gauge blocks and is valid for horizontal length measuring machines of the Mahr GmbH
	> 1000 mm to 2000 mm (> 39.37 in)		0.1 µm + 0.5 · 10 ⁻⁶ · l (3.9 µin + 0.5 · 10 ⁻⁶ · l)	

Abbreviations used:

CMC	Calibration and measurement capabilities
DIN	Deutsches Institut für Normung e.V.
DKD-R	Guideline on Deutscher Kalibrierdienst (DKD), published by Physikalisch-Technischen Bundesanstalt
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik
VDI	Verein Deutscher Ingenieure
MK	Calibration instruction of the Mahr GmbH

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