Deutsche Akkreditierungsstelle GmbH

Annex to the Accreditation Certificate D-K-15074-01-00 according to DIN EN ISO/IEC 17025:2005

Period of validity: 16.09.2016 to 15.09.2021   Date of issue: 16.09.2016

Holder of certificate:

Mahr GmbH
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Head: Dipl.-Ing. (FH) Christoph Müller
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Accredited as calibration laboratory since: 02.04.1990

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

Annex to the accreditation certificate D-K-15074-01-00

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Permanent Laboratory

Measured quantity / Calibration item	Range		Measurement conditions / procedure	Best measurement capability [1]	Remarks
Length					
Groove depth Pt on depth setting standards	0.2 µm to (7.9 µin)	0.8 µm (31.5 µin)	DIN EN ISO 3274:1998 DIN EN ISO 4287:2010 DIN EN ISO 5436-1:2000	0.03 µm (1.2 µin)	
	0.8 µm to (31.5 µin)	1.5 µm (59,1 µin)		0.04 µm (1.6 µin)	
	1.5 µm to (59.1 µin)	3.5 µm (137.8 µin)		0.04 µm (1.6 µin)	
	3.5 µm to (137.8 µin)	12 µm (472.5 µin)		0.05 µm (2.0 µin)	
Roughness on extra fine roughness standards Ra	0.025 µm to (1.0 µin)	0.1 µm (3.9 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	$0.08 \cdot Ra$	
Rz	0.15 µm to (5.9 µin)	0.8 µm (31.5 µin)		$0.09 \cdot Rz$	
$Rmax$	0.15 µm to (5.9 µin)	0.8 µm (31.5 µin)		$0.10 \cdot Rmax$	
Roughness on roughness standards Ra	0.1 µm to (3.9 µin)	4 µm (157.5 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	$0.05 \cdot Ra$	
Rz	0.8 µm to (31.5 µin)	20 µm (787.5 µin)		$0.05 \cdot Rz$	
$Rmax$	0.8 µm to (31.5 µin)	20 µm (787.5 µin)		$0.05 \cdot Rmax$	
Roughness on roughness standards Rpk Rk Rvk	On surfaces in the range 0.1 µm $\leq Ra \leq$ (3.9 µin)	4 µm (157.5 µin)	DIN 4768:1990 DIN EN ISO 13565-1:1998 DIN EN ISO 13565-2:1998	$0.04 \cdot Rz$ $0.05 \cdot Rz$ $0.04 \cdot Rz$	Relative measuring uncertainty relative to Rz
$Mr1$ $Mr2$	0.8 µm $\leq Rz \leq$ (31.5 µin)	20 µm (787.5 µin)		4 % 6 %	Relative measuring uncertainty relative to 100% material ratio
Roughness on roughness standards Ra	0.1 µm to (3.9 µin)	4 µm (157.5 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	$0.03 \cdot Ra$	If necessary, the filter cutoff wavelength λc can be used one level lower or higher than as per ISO 4288:1998
Rz	0.8 µm to (31.5 µin)	20 µm (787.5 µin)		$0.03 \cdot Rz$	
$Rmax$	0.8 µm to (31.5 µin)	20 µm (787.5 µin)		$0.03 \cdot Rmax$	

[1] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 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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Measured quantity / Calibration item	Range			Measurement conditions / procedure	Best measurement capability [1]	Remarks
Stylus instruments to DIN EN ISO 3274:1998 Pt	0.2 µm (7.9 µin)	to	12 µm (472.5 µin)	DAkkS-DKD-R 4-2 part 2:2010 DIN EN ISO 12179:2000	$U_{standard}$ + 0.01 µm ($U_{standard}$ + 0.4 µin)	$U_{standard}$ is the measuring uncertainty of the standards used. Smaller measuring ranges for which standards are available can also be calibrated.
Ra	0.1 µm (3.9 µin)	to	4 µm (157.5 µin)		$U_{standard}$ + 0.01 · Ra ($U_{standard}$ + 0.4 µin · Ra)	
Rz	0.8 µm (31.5 µin)	to	20 µm (787.5 µin)		$U_{standard}$ + 0.01 · Rz ($U_{standard}$ + 0.4 µin · Rz)	
$Rmax$	0.8 µm (31.5 µin)	to	20 µm (787.5 µin)		$U_{standard}$ + 0.01 · $Rmax$ ($U_{standard}$ + 0.4 µin · $Rmax$)	
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 (19.7 µin)	to	20 µm (787.5 µin)		0.05 µm + 2.5 · 10^{-2} · RONt (2.0 µin + 2.5 · 10^{-2} · 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 µm + 2.5 · 10^{-2} · RONt (3.9 µin+ 2.5 · 10^{-2} · 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 µm + 2.5 · 10^{-2} · RONt (3.9 µin + 2.5 · 10^{-2} · RONt)	Diameter: 3 mm to 100 mm (0.12 to 3.94 in) Length: 10 mm to 400 mm (0.39 to 15.75 in) RONt = roundness deviation STRt = Straightness deviation PARt = Parallelism deviation CYLt = Cylindricity deviation
Straightness deviation of the generatices		to	20 µm (787.5 µin)		0.2 µm + 2.0 · 10^{-2} · STRt (7.9 µin + 2.0 · 10^{-2} · STRt)	
Parallelism deviation of the generatices		to	20 µm (787.5 µin)		0.3 µm + 1.5 · 10^{-2} · PARt (11.8 µin + 1.5 · 10^{-2} · PARt)	
Cylindricity deviation		to	20 µm (787.5 µin)		0.4 µm + 3.0 · 10^{-2} · CYLt (15.8 µin + 3.0 · 10^{-2} · CYLt)	
Contour standards X length Lateral distances	5 mm (0.20 in)	to	100 mm (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 (0.079 in)	to	12 mm (0.47 in)		0.75 µm (29.5 µin)	
Angles	40 °	to	135 °		0.01 °	
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 best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 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.

Measured quantity / Calibration item	Range		Measurement conditions / procedure	Best measurement capability [1]	Remarks
Horizontal Length measuring machines	0 mm to (0 µin)	1000 mm (39.37 in)	VDI/VDE/DGQ 2618 part 17.1:2014	$0.08~\mu m + 0.7 \cdot 10^{-6} \cdot l$ $(3.1~\mu in + 0.7 \cdot 10^{-6} \cdot l)$	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 (> 39.37 in)	2000 mm (78.74 in)		$0.1~\mu m + 0.5 \cdot 10^{-6} \cdot l$ $(3.9~\mu in + 0.5 \cdot 10^{-6} \cdot l)$	

On-site calibration

Measured quantity / Calibration item	Range		Measurement conditions / procedure	Best measurement capability [1]	Remarks
Length 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)	
Stylus instruments to DIN EN ISO 3274:1998 Pt Ra Rz $Rmax$	0.2 µm to (7.9 µin) 0.1 µm to (3.9 µin) 0.8 µm to (31.5 µin) 0.8 µm to (31.5 µin)	12 µm (472.5 µin) 4 µm (157.5 µin) 20 µm (787.5 µin) 20 µm (787.5 µin)	DAkkS-DKD-R 4-2 part 2:2010 DIN EN ISO 12179:2000	$U_{standard} + 0.01~\mu m$ $(U_{standard} + 0.4~\mu in)$ $U_{standard} + 0.01 \cdot Ra$ $(U_{standard} + 0.4~\mu in \cdot Ra)$ $U_{standard} + 0.01 \cdot Rz$ $(U_{standard} + 0.4~\mu in \cdot Rz)$ $U_{standard} + 0.01 \cdot Rmax$ $(U_{standard} + 0.4~\mu in \cdot Rmax)$	$U_{standard}$ is the measuring uncertainty of the standards used. Smaller measuring ranges for which standards are available can also be calibrated.
Horizontal Length measuring machines	0 mm to (0 µin)	1000 mm (39.37 in)	VDI/VDE/DGQ 2618 part 17.1:2014	$0.08~\mu m + 0.7 \cdot 10^{-6} \cdot l$ $(3.1~\mu in + 0.7 \cdot 10^{-6} \cdot l)$	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 (> 39.37 in)	2000 mm (78.74 in)		$0.1~\mu m + 0.5 \cdot 10^{-6} \cdot l$ $(3.9~\mu in + 0.5 \cdot 10^{-6} \cdot l)$	

Abbreviation used:

DAkkS-DKD-R	Guideline on Deutsche Akkreditierungsstelle GmbH
VDI/VDE/DGQ 2618	VDI-Inspection of measuring and test equipment
MK	Calibration instruction Mahr

[1] The best measurement capabilities are stated according to DAkkS-DKD-3 (EA-4/02). These are expanded uncertainties of measurement with a coverage probability of 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.