Deutsche Akkreditierungsstelle GmbH

Annex to the Accreditation Certificate D-K-15118-01-01 according to DIN EN ISO/IEC 17025:2018

Valid from: **22.10.2020**

Date of issue 22.10.2020

Holder of certificate:

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Calibration in the fields:

Dimensional quantities

Length

- **Length gauges**
- **Diameter**
- **Form error**
- **Length measuring instruments** [b)]
- **Length measuring devices** [a)]
- **Flatness** [a)]
- **Straightness**
- **Line scales, distances**
- **Thread**
- **Gear quantities**

Coordinate measuring technology

- **Application coordinate measuring machines**
- **Coordinate measuring machines** [c)]

Angle

- **Angle gauges**
- **Inclination measuring instruments**

Mechanical quantities

- **Force**
- **Weighing instruments** [a)]
- **Torque** [a)]
- **Pressure** [a), b)]

Thermodynamic quantities

Temperature quantities

- **Direct reading thermometers**

[a)] also on-site-calibration
[b)] also calibration in the mobile laboratory
[c)] only on-site-calibration

The management system requirements in DIN EN ISO/IEC 17025 are written in language relevant to operations of calibration laboratories and operate generally in accordance with the principles of DIN EN ISO 9001.

The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH. https://www.dakks.de/en/content/accredited-bodies-dakks

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Länge				
Gauge blocks made of steel according to DIN EN ISO 3650:1999	0.5 mm to 100 mm featuring the nominal values of the steel standards	VDI/VDE/DGQ 2618 part 3.1:2004 Measurement of the deviation of the central length l_c from the nominal value l_n by comparison measurement Measurement of the deviations f_o and f_u from the central length by 5 points comparison measurement For the smallest measurement uncertainties, the wringability and the wringing characteristics of both measuring surfaces must be checked using an appropriate optical flat	For the central length: 0.08 µm + 0.8 · 10^{-6} · l For the deviations f_o and f_u from the central length: 0.05 µm	l = gauge block length
Gauge blocks made of ceramics according to DIN EN ISO 3650:1999			For the central length: 0.1 µm + 1.1 · 10^{-6} · l For the deviations f_o and f_u from the central length: 0.07 µm	
Gauge blocks made of tungsten carbite according to DIN EN ISO 3650:1999			For the central length: 0.1 µm + 3.3 · 10^{-6} · l For the deviations f_o and f_u from the central length: 0.07 µm	
Setting plug gauges Diameter	1 mm to 500 mm	VDI/VDE/DGQ 2618 part 4.1:2006, option 1, option 2	0.4 µm + 4 · 10^{-6} · d	d = measured diameter
		Option 3, option 4	0.8 µm + 3 · 10^{-6} · d	
Roundness deviation	to 40 µm	VDI/VDE/DGQ 2618 part 4.1:2006	0.3 µm + 2.5 10^{-2} · $RONt$	
Straigthness deviation	to 40 µm		0.4 µm + 2.5 10^{-2} · $STRt$	
Parallelism deviation	to 40 µm		0.7 µm + 2.5 10^{-2} · $PARt$	
Setting ring gauges Diameter	2 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.1:2006 option 1, option 2	0.6 µm + 3 · 10^{-6} · d	d = measured diameter
		Option 3, option 4	0.8 µm + 3 · 10^{-6} · d	
Roundness deviation	to 40 µm	VDI/VDE/DGQ 2618 part 4.1:2006	0.3 µm + 2.5 10^{-2} · $RONt$	
Straigthness deviation	to 40 µm		0.4 µm + 2.5 10^{-2} · $STRt$	
Parallelism deviation	to 40 µm		0.7 µm + 2.5 10^{-2} · $PARt$	
Roundness deviation	to 40 µm	TK 40:2016-12	0.3 µm + 2.5 10^{-2} · $RONt$	
Straigthness deviation	to 40 µm		0.4 µm + 2.5 10^{-2} · $STRt$	
Parallelism deviation	to 40 µm		0.7 µm + 2.5 10^{-2} · $PARt$	
Measuring pins / Pins for screw theads Diameterr	1 mm to 50 mm	VDI/VDE/DGQ 2618 part 4.2:2007, option 1, option 2	0.6 µm	
	0.17 mm to 50 mm	Option 3	0.8 µm	

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Roundness deviation	to 40 µm	VDI/VDE/DGQ 2618 part 4.1:2006	0.3 µm + 2.5 $10^{-2} \cdot RONt$	
Straigthness deviation	to 40 µm		0.4 µm + 2.5 $10^{-2} \cdot STRt$	
Taper gauges Taper plug gauges and Taper ring gauges Diameter	1 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.12:2007, option 1 and 2	0.8 µm + 3 · $10^{-6} \cdot d$	d = measured diameter
Angular deviation	to 5‘		2‘‘	
Roundness deviation	to 40 µm		0.3 µm + 2.5 $10^{-2} \cdot RONt$	
Straigthness deviation	to 40 µm		0.6 µm	
Gap gauges	5 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.7:2005	3 µm + 10 · $10^{-6} \cdot l$	l = measured length
Straight edges Flatness deviation	to 1000 mm	VDI/VDE/DGQ 2618 part 5.1:2013	1.1 µm + 1.6 · $10^{-6} \cdot l$	
Parallelism deviation			2.2 µm + 3.2 · $10^{-6} \cdot l$	
Knife straight edges	to 1000 mm	VDI/VDE/DGQ 2618 part 5.2:2013	1.1 µm + 1.6 · $10^{-6} \cdot l$	
Surface plates Flatness deviation	to 50 µm	VDI/VDE/DGQ 2618 part 6.2:2014 to 8 m edge length	1.3 µm + 1.3 · $10^{-6} \cdot l$	l = measured length with inclination measuring instruments
Steel squares Flatness deviation	to 1000 mm	VDI/VDE/DGQ/DKD 2618 part 7.1:2019	1.1 µm + 0.8 · $10^{-6} \cdot l$	l = measured length
Angular deviation			3.1 µm + 5 · $10^{-6} \cdot l$	
Centring angles Flatness deviation	to 1000 mm	TK 90:2020-01	1.1 µm + 0.8 · $10^{-6} \cdot l$	
Angular deviation			3.1 µm + 5 · $10^{-6} \cdot l$	
Protractors Flatness deviation	0° to 360°	VDI/VDE/DGQ 2618 part 7.2:2008	5 µm	
Parallelism deviation			5 µm	
Angle Scale interval 5‘	0° to 360°		4‘	
Scale interval 1°	0° to 180°		24‘	
Calipers for external, internal and depth dimensions	0 mm to 300 mm	VDI/VDE/DGQ 2618 part 9.1:2006	30 µm + 30 · $10^{-6} \cdot l$	
	> 300 mm to 1500 mm		50 µm + 30 · $10^{-6} \cdot l$	
	> 1500 mm to 3000 mm		70 µm + 30 · $10^{-6} \cdot l$	
Depth calipers	0 mm to 300 mm	VDI/VDE/DGQ 2618 part 9.2:2006	30 µm + 30 · $10^{-6} \cdot l$	
	> 300 mm to 1500 mm		50 µm + 30 · $10^{-6} \cdot l$	

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Height calipers with analogue display	0 mm to 600 mm	VDI/VDE/DGQ 2618 part 9.3:2006	30 µm + 30 · 10^{-6} · l	
with digital display			20 µm + 30 · 10^{-6} · l	
Micrometers	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.1:2001	3 µm + 10 · 10^{-6} · l	l = final value of the measuring range
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
	> 500 mm to 1000 mm	TK 2:2020-02	5 µm + 10 · 10^{-6} · l	
	> 1000 mm to 1500 mm		6 µm + 10 · 10^{-6} · l	
Reference gauges for micrometers	25 mm to 500 mm	VDI/VDE/DGQ 2618 part 4.4:2009	2 µm + 5 · 10^{-6} · l	
	> 500 mm to 1500 mm		3 µm + 5 · 10^{-6} · l	
Micrometers with interchangeable inserts	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.2:2010	3 µm + 10 · 10^{-6} · l	
	> 100 mm to 300 mm		5 µm + 10 · 10^{-6} · l	
Micrometers with dial indicator	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.3:2002	3 µm + 10 · 10^{-6} · l	
Micrometers heads	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.4:2008	3 µm + 10 · 10^{-6} · l	l = measured length
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
	> 500 mm to 1000 mm		5 µm + 10 · 10^{-6} · l	
Depth micrometers	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.5:2010	3 µm + 10 · 10^{-6} · l	
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
	> 500 mm to 1000 mm		5 µm + 10 · 10^{-6} · l	
Internal micrometers with two-point contact	25 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.7:2010	3 µm + 10 · 10^{-6} · l	
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
	> 500 mm to 1000 mm		5 µm + 10 · 10^{-6} · l	
	> 1000 mm to 1500 mm		6 µm + 10 · 10^{-6} · l	
Extensions for internal micrometers with two-point contact	25 mm to 500 mm	VDI/VDE/DGQ 2618 part 10.7:2010	2 µm + 5 · 10^{-6} · l	
	> 500 mm to 1500 mm		3.5 µm + 5 · 10^{-6} · l	
Internal micrometers with three-point contact	3 mm to 200 mm	VDI/VDE/DGQ 2618 part 10.8:2002	4 µm + 10 · 10^{-6} · d	d = measured diameter
Internal measuring instruments	3 mm to 200 mm	TK 57:2017-03	2 µm + 10 · 10^{-6} · d	
Dial gauges Scale interval > 1 µm	to 100 mm	VDI/VDE/DGQ 2618 part 11.1:2014	3 µm + 10 · 10^{-6} · l	l = measured length
Scale interval ≤ 1 µm			2 µm + 10 · 10^{-6} · l	
Dial indicators	to 3 mm	VDI/VDE/DGQ 2618 part 11.2:2002	1.1 µm	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Lever gauges	to 1.6 mm	VDI/VDE/DGQ 2618 part 11.3:2002	1.2 µm	
Lever gauges (quicktests) for external measurements	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 12.1:2005	6 µm	
Thickness gauges Scale interval 1 µm	0 mm to 30 mm	VDI/VDE/DGQ 2618 part 12.1:2005	1.3 µm + 10 · 10^{-6} · l	l = measured length
Scale interval 10 µm			6 µm + 10 · 10^{-6} · l	
Lever gauges (quicktests) for internal measurements	2.5 mm to 500 mm	VDI/VDE/DGQ 2618 part 13.1:2005	6 µm	
Bore gauges with two-point contact Form I - III	1 mm to 800 mm	VDI/VDE/DGQ 2618 part 13.2:2005	1.8 µm + 10 · 10^{-6} · l	Measuring length up to 3 mm
Electical probe and measuring device	0 mm to 10 mm	VDI/VDE/DGQ 2618 part 14.1:2010	1.4 µm	
Feeler gauges	10 µm to 2 mm	DIN 2275:2014	1 µm	
Measuring tape, Circumference tape measure	0 m to 100 m	TK 85:2020-01	56 µm + 46 · 10^{-6} · l	l = measured length
Rules	0 m to 5 m	TK 85:2020-01	56 µm + 46 · 10^{-6} · l	Graduated metal rules, reference- and plotting scale, rules, folding rules
Diameter tape measure	0 m to 10 m	TK 85:2020-01	56 µm + 46 · 10^{-6} · l	
Height gauges	0 mm to 1000 mm	VDI/VDE/DGQ 2618 part 16.1:2009	1.7 µm + 1.2 · 10^{-6} · l	l = measured length
Setting dimension for height gauges	to 20 mm	TK 89:2020-01	0.5 µm	
Height gauges	0 mm to 1000 mm	VDI/VDE/DGQ 2618 part 16.1:2009	0.9 µm	till 1000 mm lead length
Deviation from straightness and perpendicularity	to 40 µm		4 µm	
Horizontal length measuring device	0 mm to 5000 mm	VDI/VDE/DGQ 2618 part 17.1:2015	0.12 µm + 0.07 · 10^{-6} · l	l = measured length

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Thread gauges single-start cylindrical external and internal threads with straight flanks, symmetrical profile and nominal thread angle 55° bis 60°				
External thread with nominal lead 0.25 mm to 5.5 mm Simple pitch diameter	Nominal diameter: 2 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.8:2006 (option 1) Three wire procedure (vertical to thread axis)	2.8 µm + 10 · 10^{-6} · d	d = pitch diameter
Internal thread with nominal lead 0.7 mm to 6.0 mm Simple pitch diameter	Nominal diameter: 4 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.9:2006 (option 1) Two ball procedure (vertical to thread axis)	2.8 µm + 10 · 10^{-6} · d	d = Pitch diameter
Angle gauges 90 °	Leg length 40 mm to 500 mm	TK 16:2020-01 pointwise measurement	2.4 µm	
Inclination measuring instruments elektronic mechanical	± 20 mm/m	TK 56:2020-01	2.4 µm + 10 · 10^{-6} ·α	α = Nominal angle
	± 50 mm/m		21 µm/m	
	2.866° to 45°		0.01°	
	± 90°		2.3 µm/m	
	Zero point deviation		1.5 µm/m	
Caliper for trailer artifice	to 60 mm	TK 84:2017-03	2 µm	
Caliper for trailer artifice	to 120 mm	TK 83:2017-04	8 µm	
Layer thickness gauges	20 mm	TK 91:2020-01	0.7 µm + 180 · 10^{-6} · l	l = measured length
Calibration foil	20 mm	TK 70:2020-01	0.8 µm + 130 · 10^{-6} · l	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Gear quantities Profile deviation F_α $f_{f\alpha}$ $f_{H\alpha}$	10 mm ≤ d_b ≤ 55 mm L_α ≤ 4 mm	TK 18.2:2020-02 Substitution measuring with 3D coordinate measuring machines Correction of F_α and $f_{H\alpha}$ by comparison against gear measurement standard with d_b = 29.88 mm L_α = 4 mm or rather with d_b = 122.192 mm L_α = 24 mm	1.6 µm 0.6 µm 1.4 µm	Internal and external gears Symbols according to: ISO 1328-1:2013 Evaluation according to: VDI/VDE 2612-1:2018
F_α $f_{f\alpha}$ $f_{H\alpha}$	100 mm ≤ d_b ≤ 150 mm L_α ≤ 24 mm		1.6 µm 0.6 µm 1.4 µm	
F_α $f_{f\alpha}$ $f_{H\alpha}$	10 mm ≤ d_b ≤ 150 mm L_α ≤ 24 mm	TK 18.2:2020-02 Measurement with 3D coordinate measuring machines without correction; traceability proved by involute measurement standard with d_b = 29.88 mm L_α = 4 mm or rather with d_b = 122.192 mm L_α = 24 mm	2.7 µm 1.0 µm 1.7 µm	
F_α $f_{f\alpha}$ $f_{H\alpha}$	10 mm ≤ d_b ≤ 500 mm L_α ≤ 50 mm	TK 18.1:2020-02 Measurement with 3D coordinate measuring machines without correction; traceability proved by involute measurement standard with d_b = 29.88 mm L_α = 4 mm or rather with d_b = 122.192 mm L_α = 24 mm	3.4 µm 1.0 µm 3.3 µm	

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Helix deviation F_{β} $f_{f\beta}$ $f_{H\beta}$	10 mm ≤ d ≤ 55 mm L_{β} ≤ 40 mm 0° < β ≤ 5°	TK 18.2:2020-02 Substitution measuring with 3D coordinate measuring machines Correction of F_{β} and $f_{H\beta}$ by comparison against gear measurement standard with d = 34.5 mm L_{β} = 30 mm β = 0° or rather with d = 104 mm L_{β} = 64 mm β = 0° β = 15° r+l β = 30° r+l	1.5 µm 0.7 µm 1.3 µm	Internal and external gears Symbols according to: ISO 1328-1:2013 Evaluation according to: VDI/VDE 2612-1:2018
F_{β} $f_{f\beta}$ $f_{H\beta}$	100 mm ≤ d ≤ 150 mm L_{β} ≤ 64 mm 0° < β ≤ 5°		1.5 µm 0.7 µm 1.3 µm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	100 mm ≤ d ≤ 150 mm L_{β} ≤ 64 mm 10° < β ≤ 20°		1.6 mm 0.7 mm 1.4 mm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	100 mm ≤ d ≤ 150 mm L_{β} ≤ 40 mm 25° < β ≤ 35°		1.9 µm 0.7 µm 1.7 µm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	10 mm ≤ d ≤ 150 mm L_{β} ≤ 40 mm 0° < β ≤ 10°	TK 18.2:2020-02 Measurement with 3D coordinate measuring machines without correction; traceability proved by helix measurement standard with d = 34.5 mm L_{β} = 30 mm β = 0° or rather with d = 104 mm L_{β} = 64 mm β = 0° β = 15° r+l β = 30° r+l	2.8 µm 1.0 µm 2.6 µm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	100 mm ≤ d ≤ 150 mm L_{β} ≤ 64 mm 5° < β ≤ 10°		2.8 µm 1.0 µm 2.6 µm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	100 mm ≤ d ≤ 150 mm L_{β} ≤ 64 mm 20° < β ≤ 25°		2.8 µm 1.0 µm 2.6 µm	
F_{β} $f_{f\beta}$ $f_{H\beta}$	100 mm ≤ d ≤ 150 mm L_{β} ≤ 64 mm 35° < β ≤ 45°		3.6 µm 1.0 µm 3.4 µm	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
F_β $f_{f\beta}$ $f_{H\beta}$	10 mm ≤ d ≤ 500 mm L_β ≤ 200 mm β = 0°	TK 18.1:2020-02 Measurement with 3D coordinate measuring machines without correction; traceability proved by helix measurement standard with d = 34.5 mm L_β = 30 mm β = 0° or rather with d = 104 mm L_β = 64 mm β = 0° β = 15° r+l β = 30° r+l	3.4 µm 1.0 µm 3.2 µm	
F_β $f_{f\beta}$ $f_{H\beta}$	10 mm ≤ d ≤ 500 mm L_β ≤ 200 mm 0° < β ≤ 35°		3.9 µm 1.0 µm 3.7 µm	
F_β $f_{f\beta}$ $f_{H\beta}$	10 mm ≤ d ≤ 500 mm L_β ≤ 200 mm 35° < β ≤ 45°		4.3 µm 1.0 µm 4.2 µm	
Pitch deviation F_p f_p F_x	10 mm ≤ d ≤ 500 mm β = 0° m_n > 0.5 mm	TK 18.2:2020-02 Measurement according to „Rosette method“ with 3D coordinate measuring machines	1.0 µm 0.9 µm 1.1 µm	Internal and external gears Symbols according to: ISO 1328-1:2013 Evaluation according to: VDI/VDE 2613:2003
F_p f_p F_x	10 mm ≤ d ≤ 500 mm β = 0° m_n > 0.5 mm	TK 18.1:2020-02 Measurement with 3D coordinate measuring machines without correction; traceability proved by pitch measurement standard with d = 67 mm m_n = 1 mm	5.1 µm 2.2 µm 5.2 µm	
Dimension over balls M_{dK}	10 mm ≤ M_{dK} ≤ 150 mm β = 0° m_n > 0.5 mm	TK 18.1:2020-02 Measurement of M_{dK} with 3D coordinate measuring machines	1.4 µm + 11 · 10^{-6} · l	Internal and external gears Symbols according to: ISO 1328-1:2013

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Coordinate measuring technology				
Prismatic, tapered and ball-shaped workpieces	Coordinate measuring machine with calibrated measuring volume of: X = 1200 mm Y = 1000 mm Z = 700 mm	TK 55:2020-02 Tactile measurements with single point probing with a coordinate measuring machine and determination of regular geometries through geometrical parameters (single-points, straight lines, planes, circles, balls, cylinders, tapers, toroid's) using the evaluation software of the coordinate measuring machine. Single-point measuring is carried out with fixed, predefined measuring force. Single point measurements in the form of „Self-centering measurements" are not used within the accreditation. For ensuring metrlogical traceability calibration of a simlar standard will be realized. Beyond that following limitations should be considered: - Measuring points have to be evenly distributed over the form element; - The calibration values can be determined in a multilayer method by averaging in order to reduce the measurement uncer-tainty.	The uncertainty of measurement is determined with a uncertainty measurement balance sheet on the basis of the guideline VDI/VDE 2617 part 11:2011. The uncertainty of measurement for specific feedings is specified with a coverage probability of approximately 95 % (coverage factor k = 2) Exemplary measurement uncertainty for a described measuring tasks: Gauge block with a nominal value of 1000 mm, determined is the expanded uncertainty of the inspection feature „Distance": U = 4.8 µm	For general measuring tasks the measuring uncertainty could be significant differently from the exemplary specified.

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Radius gauges	1 mm to 2500 mm	TK 86:2020-02	The uncertainty of measurement is determined with a uncertainty measurement balance sheet on the basic of the guideline VDI/VDE 2617 part 11:2011. The uncertainty of measurement is specified with a coverage probability of approximately 95 % (coverage factor k = 2) Uncertainty of measurement for a measuring problem: Radius with nominal value of 4 mm and an arc of 70°: U = 10 µm	
Calibration of control geometries of test and setting gauges with utilities		TK 88:2020-02		
	0 mm to 2000 mm		38 µm + 26 · 10^{-6} · l	Calipers, height gauges
	0 mm to 50 mm		4.9 µm + 2 · 10^{-6} · l	Micrometers
	0 mm to 1500 mm		0.2 µm + 4 · 10^{-6} · l	Horizontal and vertical length measuring device
	15 mm to 150 mm		2.5 µm + 2.7 · 10^{-6} · l	Bore gauges
	0° to 360°		0.08°	Universal angle meter, protractors
Force				
Force measuring devices	0.1 kN to 5 kN	DKD-R 3-3:2018	3 · 10^{-3}	
	> 5 kN to 50 kN		3 · 10^{-3}	
Torque				
Manually triggering / indicative operated torque tools	0.1 N·m to 10 N·m	DIN EN ISO 6789-2:2017	5 · 10^{-3}	Calibration with calibration device
	10 N·m to 500 N·m		1 · 10^{-2}	
Manually triggering / indicative operated torque tools	300 N·m to 3 kN·m	DIN EN ISO 6789-2:2017	1 · 10^{-2}	

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Torque measuring devices, torque measuring chain	0.1 N·m	to	10 N·m	DIN 51309:2005	$5 \cdot 10^{-3}$	
Torque wrench calibration devices	10 N·m	to	3 kN·m	DKD-R 3-8:2018	$8 \cdot 10^{-3}$	with torque transfer wrench
Pressure						
Absolute pressure p_{abs}	0.7 bar	to	1.1 bar	DKD-R 6-1:2014 DIN EN 837:1997 Method of calibration: $p_{abs} = p_e + p_{amb}$	1.5 mbar	Pressure medium : gas The measurement uncertainty of the barometer U_{baro} is taken into account
	> 1.1 bar	to	61 bar		10 mbar	
Positive gauge pressure p_e	0 bar	to	60 bar	DKD-R 6-1:2014 DIN EN 837:1997	10 mbar	Pressure medium : gas
Absolute pressure p_{abs}	1 bar	to	101 bar	DKD-R 6-1:2014 DIN EN 837:1997 Method of calibration: $p_{abs} = p_e + p_{amb}$	$3.1 \cdot 10^{-3} \cdot p_{abs}$ + 0.01 bar	Pressure medium: oil p_{amb} = barometric pressure The measurement uncertainty of the barometer U_{baro} is taken into account
	> 101 bar	to	1001 bar		$2.9 \cdot 10^{-3} \cdot p_{abs}$ + 0.07 bar	
	> 1001 bar	to	7001 bar		$2.7 \cdot 10^{-3} \cdot p_{abs}$ + 0.8 bar	
Positive gauge pressure p_e	0 bar	to	100 bar	DKD-R 6-1:2014 DIN EN 837:1997	$3.1 \cdot 10^{-3} \cdot p_e$ + 0.01 bar	Pressure medium: oil
	> 100 bar	to	1000 bar		$2.9 \cdot 10^{-3} \cdot p_e$ + 0.07 bar	
	> 1000 bar	to	7000 bar		$2.7 \cdot 10^{-3} \cdot p_e$ + 0.8 bar	
Weighing instruments						
Nonautomatic weighing instruments		to	30 kg	EURAMET cg 18 version 4.0	$1.3 \cdot 10^{-6}$	with weights OIML R 111-1:2004 according to the class E2
		to	100 kg		$6.6 \cdot 10^{-5}$	with weights OIML R 111-1:2004 according to the class M1
Temperature quantities						
Resistance thermometers with display unit	0 °C	to	200 °C	DKD-R 5-1:2018	0.25 K	
	> 200 °C	to	400 °C		0.4 K	
Thermocouples with display unit	0 °C	to	200 °C	DKD-R 5-3:2018	0.4 K	
	> 200 °C	to	400 °C		0.5 K	

[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.

On-site Calibration

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Length				
Surface plates Flatness deviation	to 50 µm	VDI/VDE/DGQ 2618 part 6.2:2014 to 8 m edge length	$1.3\ \mu m + 1.3 \cdot 10^{-6} \cdot l$	l = measured length with inclination measuring instruments
Height gauges	0 mm to 1000 mm	VDI/VDE/DGQ 2618 part 16.1:2009	$1.7\ \mu m + 1.2 \cdot 10^{-6} \cdot l$	l = measured length
Height gauges	0 mm to 1000 mm	VDI/VDE/DGQ 2618 part 16.1:2009	0.9 µm	till 1000 mm lead length
Deviation from straightness and perpendicularity	to 40 µm		4 µm	
Horizontal length measuring devices	0 mm to 5000 mm	VDI/VDE/DGQ 2618 part 17.1:2015	$0.12\ \mu m + 0.07 \cdot 10^{-6} \cdot l$	l = measured length
Height calipers with analogue display	0 mm to 600 mm	VDI/VDE/DGQ 2618 part 9.3:2006	$30\ \mu m + 30 \cdot 10^{-6} \cdot l$	
with digital display			$20\ \mu m + 30 \cdot 10^{-6} \cdot l$	
Coordinate measuring technology Measuring projectors Measuring microscopes	Devices featuring a measuring plane with a face diagonal ≤ 450 mm	Calibration of metrological characteristics according to guideline DKD-R 4-3 part 18.1:2018, and the following standards and guidelines DIN EN ISO 10360 VDI/VDE 2617		
		Determination of probing error $PS\text{-}1D(OT)$ with a graduated scale made of glass according to VDI/VDE 2617 part 6.1:2007	0.8 µm	
		The error of indication for size measurement $E\text{-}1D(OT)$ is determined with a graduated scale made of glass according to VDI/VDE 2617 part 6.1:2007	$1.6\ \mu m + 1 \cdot 10^{-6} \cdot l$	l = measured length
Torque				
Torque wrench calibration devices	10 N·m to 3 kN·m	DKD-R 3-8:2018	$8 \cdot 10^{-3}$	with torque transfer wrench
Manually triggering / indicative operated torque tools	10 N·m to 500 N·m	DIN EN ISO 6789-2:2017	$1 \cdot 10^{-2}$	Calibration with calibration device
	300 N·m to 3 kN·m		$1 \cdot 10^{-2}$	

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On-site Calibration

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Druck				
Absolute pressure p_{abs}	0.7 bar to 1.1 bar	DKD-R 6-1:2014 DIN EN 837:1997 Method of calibration: $p_{abs} = p_e + p_{amb}$	1.5 mbar	Pressure medium: gas The measurement uncertainty of the barometer U_{baro} is taken into account
Positive gauge pressure p_e	0 bar to 60 bar	DKD-R 6-1:2014 DIN EN 837:1997	10 mbar	Pressure medium: gas
Absolute pressure p_{abs}	1 bar to 101 bar	DKD-R 6-1:2014 DIN EN 837:1997 Method of calibration: $p_{abs} = p_e + p_{amb}$	$3.1 \cdot 10^{-3} \cdot p_{abs}$ + 0.01 bar	Pressure medium: oil p_{amb} = atmosphärischer Luftdruck The measurement uncertainty of the barometer U_{baro} is taken into account
	> 101 bar to 1001 bar		$2.9 \cdot 10^{-3} \cdot p_{abs}$ + 0.07 bar	
	> 1001 bar to 7001 bar		$2.7 \cdot 10^{-3} \cdot p_{abs}$ + 0.8 bar	
Positive gauge pressure p_e	0 bar to 100 bar	DKD-R 6-1:2014 DIN EN 837:1997	$3.1 \cdot 10^{-3} \cdot p_e$ + 0.01 bar	Pressure medium: oil
	> 100 bar to 1000 bar		$2.9 \cdot 10^{-3} \cdot p_e$ + 0.07 bar	
	> 1000 bar to 7000 bar		$2.7 \cdot 10^{-3} \cdot p_e$ + 0.8 bar	
Weighing instruments Nonautomatic weighing instruments	to 30 kg	EURAMET cg 18 Version 4.0	$1.3 \cdot 10^{-6}$	with weights OIML R 111-1:2004 according to the class E2
	to 100 kg		$6.6 \cdot 10^{-5}$	with weights OIML R 111-1:2004 according to the class M1

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Länge				
Gap gauges	5 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.7:2005	3 µm + $10 \cdot 10^{-6} \cdot l$	l = measured length
Calipers for external, internal and depth dimensions	0 mm to 300 mm	VDI/VDE/DGQ 2618 part 9.1:2006	30 µm + $30 \cdot 10^{-6} \cdot l$	
Depth calipers	0 mm to 300 mm	VDI/VDE/DGQ 2618 part 9.2:2006	30 µm + $30 \cdot 10^{-6} \cdot l$	

[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
Height calipers with analogue display	0 mm to 600 mm	VDI/VDE/DGQ 2618 part 9.3:2006	30 µm + 30 · 10^{-6} · l	l = measured length
with digital display			20 µm + 30 · 10^{-6} · l	
Micrometers	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.1:2001	3 µm + 10 · 10^{-6} · l	l = final value of the measuring range
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
Internal micrometers with three-point contact	3 mm to 200 mm	VDI/VDE/DGQ 2618 part 10.8:2002	4 µm + 10 · 10^{-6} · d	d = measured diameter
Internal measuring instruments	3 mm to 200 mm	TK 57:2017-03	2 µm + 10 · 10^{-6} · d	
Dial gauges Scale interval > 1 µm	to 100 mm	VDI/VDE/DGQ 2618 part 11.1:2014	3 µm + 10 · 10^{-6} · l	l = measured length
Scale interval ≤ 1 µm			2 µm + 10 · 10^{-6} · l	
Dial indicators	to 3 mm	VDI/VDE/DGQ 2618 part 11.2:2002	1.1 µm	
Lever gauges	to 1.6 mm	VDI/VDE/DGQ 2618 part 11.3:2002	1.2 µm	
Thickness gauges Scale interval 1 µm	0 mm to 30 mm	VDI/VDE/DGQ 2618 part 12.1:2005	1.3 µm + 10 · 10^{-6} · l	l = measured length
Scale interval 10 µm			6 µm + 10 · 10^{-6} · l	
Feeler gauges	10 µm to 2 mm	DIN 2275:2014	1 µm	
Lever gauges (quicktests) for external measurements	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 12.1:2005	6 µm	
Lever gauges (quicktests) for internal measurements	2.5 mm to 500 mm	VDI/VDE/DGQ 2618 part 13.1:2005	6 µm	
Internal micrometers with two-point contact	25 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.7:2010	3 µm + 10 · 10^{-6} · l	
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
	> 500 mm to 800 mm		5 µm + 10 · 10^{-6} · l	
Extensions for internal micrometers with two-point contact	25 mm to 500 mm	VDI/VDE/DGQ 2618 part 10.7:2010	2 µm + 5 · 10^{-6} · l	
	> 500 mm to 800 mm		3.5 µm + 5 · 10^{-6} · l	
Micrometers with interchangeable inserts	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.2:2010	3 µm + 10 · 10^{-6} · l	
	> 100 mm to 300 mm		5 µm + 10 · 10^{-6} · l	

[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
Micrometers with dial indicators	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.3:2002	3 µm + 10 · 10^{-6} · l	l = measured length
Micrometers heads	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.4:2008	3 µm + 10 · 10^{-6} · l	
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
	> 500 mm to 800 mm		5 µm + 10 · 10^{-6} · l	
Depth micrometers	0 mm to 100 mm	VDI/VDE/DGQ 2618 part 10.5:2010	3 µm + 10 · 10^{-6} · l	
	> 100 mm to 500 mm		4 µm + 10 · 10^{-6} · l	
	> 500 mm to 800 mm		5 µm + 10 · 10^{-6} · l	
Reference gauges for micrometers	25 mm to 800 mm	VDI/VDE/DGQ 2618 part 4.4:2009	3 µm + 5 · 10^{-6} · l	
Protractors Flatness deviation	0° to 360°	VDI/VDE/DGQ 2618 part 7.2:2008	5 µm	
Parallelism deviation			5 µm	
Angle Scale interval 5‘	0° to 360°		4‘	
Scale interval 1°	0° to 180°		24‘	
Druck Absolute pressure p_{abs}	0.7 bar to 1.1 bar	DKD-R 6-1:2014 DIN EN 837:1997 Method of calibration: $p_{abs} = p_e + p_{amb}$	1.5 mbar	Pressure medium : gas The measurement uncertainty of the barometer U_{baro} is taken into account
	> 1.1 bar to 61 bar		10 mbar	
Positive gauge pressure p_e	0 bar to 60 bar	DKD-R 6-1:2014 DIN EN 837:1997	10 mbar	Pressure medium : gas
Absolute pressure p_{abs}	1 bar to 101 bar	DKD-R 6-1:2014 DIN EN 837:1997 Method of calibration: $p_{abs} = p_e + p_{amb}$	3.1 · 10^{-3} · p_{abs} + 0.01 bar	Pressure medium: oil p_{amb} = barometric pressure The measurement uncertainty of the barometer U_{baro} is taken into account
	> 101 bar to 1001 bar		2.9 · 10^{-3} · p_{abs} + 0.07 bar	
	> 1001 bar to 7001 bar		2.7 · 10^{-3} · p_{abs} + 0.8 bar	
Positive gauge pressure p_e	0 bar to 100 bar	DKD-R 6-1:2014 DIN EN 837:1997	3.1 · 10^{-3} · p_e + 0.01 bar	Pressure medium: oil
	> 100 bar to 1000 bar		2.9 · 10^{-3} · p_e + 0.07 bar	
	> 1000 bar to 7000 bar		2.7 · 10^{-3} · p_e + 0.8 bar	

[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.

Abbreviations used:

CMC	Calibration and measurement capabilities
DIN	Deutsches Institut für Normung e.V.
DKD-R	Guideline of Deutscher Kalibrierdienst (DKD), published by Physikalisch-Technische Bundesanstalt
DGQ	Deutsche Gesellschaft für Qualität e.V.
EURAMET	European Association of National Metrology Institutes
TK	Calibration Guide of Kessler-QMP GmbH
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik e.V.
VDI	Verein Deutscher Ingenieure e.V.

β	Helix angle	$f_{f\beta}$	Helix form deviation
d	Reference diameter	$f_{H\beta}$	Helix slope deviation
d_b	Base diameter	F_p	Cumulative pitch deviation
F_α	Total profile deviation	f_p	Single pitch deviation
$f_{H\alpha}$	Profile slope deviation	L_α	Profile evaluation range
$f_{f\alpha}$	Profile form deviation	L_β	Helix evaluation range
F_β	Total helix deviation	m_n	Normal module

[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.