DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH attests that the calibration laboratory

Kessler QMP GmbH
Nisterberger Weg 16, 57520 Friedewald

is competent under the terms of DIN EN ISO/IEC 17025:2018 to carry out calibrations in the following fields:

Dimensional quantities

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

Thermodynamic quantities

Temperature quantities
- **Direct reading thermometers**

Electrical quantities
- **DC voltage** [b]
- **AC voltage** [b]
- **DC current** [b]
- **AC current** [b]
- **DC resistance** [b]

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

The accreditation certificate shall only apply in connection with the notice of accreditation of 30.03.2022 with the accreditation number D-K-15118-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 26 pages.

Registration number of the certificate: **D-K-15118-01-00**

Berlin, 30.03.2022	Dipl.-Ing. Gabriel Zrenner Head of Department	Translation issued: 30.03.2022	Head of Department

The certificate together with the annex reflects the status as indicated by the date of issue.
The current status of any given scope of accreditation can be found in the directory of accredited bodies maintained by Deutsche Akkreditierungsstelle GmbH at https://www.dakks.de/en/accredited-bodies-search.html.

This document is a translation. The definitive version is the original German accreditation certificate.

See notes overleaf.

Deutsche Akkreditierungsstelle GmbH

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The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

The up-to-date state of membership can be retrieved from the following websites:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

Deutsche Akkreditierungsstelle GmbH

Annex to the Accreditation Certificate D-K-15118-01-00 according to DIN EN ISO/IEC 17025:2018

Valid from: **30.03.2022**

Date of issue 30.03.2022

Holder of certificate:

Kessler QMP GmbH
Nisterberger Weg 16, 57520 Friedewald

Calibration in the fields:

Dimensional quantities

Length

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

Thermodynamic quantities

Temperature quantities

- **Direct reading thermometers**

Electrical quantities

- **DC voltage** [b)]
- **AC voltage** [b)]
- **DC current** [b)]
- **AC current** [b)]
- **DC resistance** [b)]

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

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

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Abbreviations used: see last page

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Length				
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 40:2020-01	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	
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} · $STRt$	

[1] The expanded uncertainties according to EA-4/02 M:2021 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.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
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	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) Exemplary of Uncertainty of measurement for a measuring problem: Taper plug gauge with a gap of 61 mm to the measuring high and a gap of 2 mm to the last measuring plane at the evaluation flat: U = 0.4 µm	
Angular deviation	to 5‘		0.6‘‘ + (0.03 · m/l)‘‘	Statement of l in mm
Roundness deviation	to 40 µm		0.5 µm	
Straigthness deviation	to 40 µm		0.5 µm	
Gap gauges	5 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.7:2005	3 µm + 10 · 10^{-6} · 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} · l	
Parallelism deviation			2.2 µm + 3.2 · 10^{-6} · l	
Knife straight edges	to 1000 mm	VDI/VDE/DGQ 2618 part 5.2:2013	1.1 µm + 1.6 · 10^{-6} · l	
Surface plates Flatness deviation	to 50 µm	VDI/VDE/DGQ 2618 part 6.2:2014 to 8 m edge length	1.1 µm + 2.7 · 10^{-6} · 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 + 1.6 · 10^{-6} · l	l = measured length
Angular deviation			3.1 µm + 5 · 10^{-6} · l	
Centring angles Flatness deviation	to 1000 mm	TK 90:2021-09	1.1 µm + 1.6 · 10^{-6} · l	
Angular deviation			3.1 µm + 5 · 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
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} · l	
	> 300 mm to 1500 mm		50 µm + 30 · 10^{-6} · l	
	> 1500 mm to 3000 mm		70 µm + 30 · 10^{-6} · l	
Depth calipers	0 mm to 300 mm	VDI/VDE/DGQ 2618 part 9.2:2006	30 µm + 30 · 10^{-6} · l	
	> 300 mm to 1500 mm		50 µm + 30 · 10^{-6} · l	
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 50 mm	VDI/VDE/DGQ 2618 part 10.4:2008	3 µm + 10 · 10^{-6} · l	l = measured length
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	
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

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Internal measuring instruments	3 mm to 200 mm	TK 57:2021-02	2 µm + 10 · 10^{-6} · d	d = measured diameter
Dial gauges Scale interval > 1 µm	to 100 mm	VDI/VDE/DGQ/DKD 2618 part 11.1:2021	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	
Dial gauges with digital display	to 100 mm	VDI/VDE/DGQ/DKD 2618 part 11.4:2020	3 µm + 10 · 10^{-6} · l	
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	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	TK 19:2021-02	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	
Setting dimension for height gauges	to 20 mm	TK 89:2020-01	0.5 µm	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Height gauges	0 mm to 1000 mm	VDI/VDE/DGQ 2618 part 16.1:2009	1.0 µm+ 1.4 · 10^{-6} · l	till 1000 mm lead length
Deviation from straightness and perpendicularity	to 40 µm		3 µm	l = measured length
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	with laser interferometer
	0 mm to 200 mm		0.12 µm + 0.6 · 10^{-6} · l	with gauge blocks
Thread gauges single-start cylindrical external and internal threads with straight flanks, symmetrical profile and nominal thread angle 55° to 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 1000 mm	TK 16:2021-05 pointwise measurement	2.4 µm	Angle auges of hard stone according to DIN 875-2:2008
Inclination measuring instruments elektronic and mechanical	± 20 mm/m	TK 56:2021-05	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 84:2021-08	2 µm	
Caliper for trailer artifice	to 120 mm	TK 83:2021-08	8 µm	
Layer thickness gauges	20 mm	TK 91:2021-07	0.7 µm + 180 · 10^{-6} · l	l = measured length
Calibration foil	20 mm	TK 70:2021-07	0.8 µm + 130 · 10^{-6} · l	
Micrometers according to DIN 863-3 form D10	0 mm to 100 mm	TK 2:2021-02	5 µm + 10 · 10^{-6} · d	d = measured diameter

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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	VDI/VDE 2612-1:2018 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
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	VDI/VDE 2612-1:2018 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	VDI/VDE 2612-1:2018 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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Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

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°	VDI/VDE 2612-1:2018 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
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°	VDI/VDE 2612-1:2018 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	
F_{β} $f_{f\beta}$ $f_{H\beta}$	10 mm ≤ d ≤ 500 mm L_{β} ≤ 200 mm β = 0°	VDI/VDE 2612-1:2018 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	

[1] The expanded uncertainties according to EA-4/02 M:2021 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.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Pitch deviation F_p f_p F_x	10 mm ≤ d ≤ 500 mm β = 0° m_n > 0.5 mm	VDI/VDE 2613:2003 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
F_p f_p F_x	10 mm ≤ d ≤ 500 mm β = 0° m_n > 0.5 mm	VDI/VDE 2613:2003 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	DIN 21773:2014 Measurement of M_{dK} on length comparator compared to traceable setting standard i	1.4 µm + 11 · 10^{-6} · l	Internal and external gears Symbols according to: ISO 1328-1:2013

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Calibration and Measurement Capabilities (CMC)

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.

[1)] The expanded uncertainties according to EA-4/02 M:2021 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
Radius gauges	1 mm to 2500 mm	TK 86:2020-01	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 88:2020-11		
	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 50 kN	DKD-R 3-3:2018	1 · 10^{-3}	Compression and tension force
Torque Manually triggering / indicative operated torque tools	0.1 N·m to 100 N·m	DIN EN ISO 6789-2:2017	5 · 10^{-3}	
	> 100 N·m to 3 kN·m		1 · 10^{-2}	
Torque measuring devices, torque measuring chain	0.1 N·m to 10 N·m	DIN 51309:2005	2 · 10^{-3}	
	> 10 N·m to 5 kN·m		8 · 10^{-4}	
Torque wrench calibration devices	1 N·m to 10 N·m	DKD-R 10-8:2020	6 · 10^{-3}	
	> 10 N·m to 3 kN·m		2 · 10^{-3}	

[1)] The expanded uncertainties according to EA-4/02 M:2021 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
Pressure						
Absolute pressure p_{abs}	0.7 bar	to	1.1 bar	DKD-R 6-1:2014 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	201 bar		10 mbar	
Positive gauge pressure p_e	0 bar	to	200 bar	DKD-R 6-1:2014	10 mbar	Pressure medium : gas
Absolute pressure p_{abs}	1 bar	to	101 bar	DKD-R 6-1:2014 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	$3.1 \cdot 10^{-3} \cdot p_e$ + 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 class E2
		to	100 kg		$6.6 \cdot 10^{-5}$	with weights OIML R 111-1:2004 according to class M1
Temperature quantities						
Direct reading thermometers with resistance sensor	0 °C	to	200 °C	DKD-R 5-1:2018	0.25 K	
	> 200 °C	to	400 °C		0.4 K	
Direct reading thermometers with thermocouple sensor	0 °C	to	200 °C	DKD-R 5-3:2018	0.4 K	
	> 200 °C	to	400 °C		0.5 K	
DC and low frequency quantities						
DC voltage Measuring instruments	1 mV	to	< 330 mV		$2.0\ \mu V + 35 \cdot 10^{-6} \cdot U$	U = measured value
	0.33 V	to	< 3.3 V		$3.0\ \mu V + 16 \cdot 10^{-6} \cdot U$	
	3.3 V	to	< 33 V		$24\ \mu V + 18 \cdot 10^{-6} \cdot U$	
	33 V	to	< 330 V		$0.2\ mV + 24 \cdot 10^{-6} \cdot U$	
	330 V	to	< 1000 V		$1.7\ mV + 24 \cdot 10^{-6} \cdot U$	

[1)] The expanded uncertainties according to EA-4/02 M:2021 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
DC voltage Sources	10 mV to 120 mV > 0.12 V to 1.2 V > 1.2 V to 12 V > 12 V to 120 V > 120 V to 1050 V		$2.0\ \mu V + 12 \cdot 10^{-6} \cdot U$ $2.0\ \mu V + 10 \cdot 10^{-6} \cdot U$ $2.5\ \mu V + 10 \cdot 10^{-6} \cdot U$ $35\ \mu V + 14 \cdot 10^{-6} \cdot U$ $0.1\ mV + 22 \cdot 10^{-6} \cdot U$	U = measured value
AC voltage Measuring instruments	1 mV to < 33 mV	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 500 kHz	$8\ \mu V + 1.0 \cdot 10^{-3} \cdot U$ $8\ \mu V + 0.2 \cdot 10^{-3} \cdot U$ $8\ \mu V + 0.25 \cdot 10^{-3} \cdot U$ $8\ \mu V + 1.3 \cdot 10^{-3} \cdot U$ $15\ \mu V + 4.2 \cdot 10^{-3} \cdot U$ $60\ \mu V + 10 \cdot 10^{-3} \cdot U$	
	33 mV to < 330 mV	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 500 kHz	$10\ \mu V + 0.4 \cdot 10^{-3} \cdot U$ $10\ \mu V + 0.2 \cdot 10^{-3} \cdot U$ $10\ \mu V + 0.2 \cdot 10^{-3} \cdot U$ $10\ \mu V + 0.43 \cdot 10^{-3} \cdot U$ $40\ \mu V + 0.95 \cdot 10^{-3} \cdot U$ $85\ \mu V + 2.5 \cdot 10^{-3} \cdot U$	
	0.33 V to < 3,3 V	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 500 kHz	$60\ \mu V + 0.4 \cdot 10^{-3} \cdot U$ $75\ \mu V + 0.2 \cdot 10^{-3} \cdot U$ $75\ \mu V + 0.24 \cdot 10^{-3} \cdot U$ $60\ \mu V + 0.35 \cdot 10^{-3} \cdot U$ $0.15\ mV + 0.85 \cdot 10^{-3} \cdot U$ $0.7\ mV + 3 \cdot 10^{-3} \cdot U$	
	3.3 V to < 33 V	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.75\ mV + 0.38 \cdot 10^{-3} \cdot U$ $0.7\ mV + 0.2 \cdot 10^{-3} \cdot U$ $0.7\ mV + 0.29 \cdot 10^{-3} \cdot U$ $0.7\ mV + 0.42 \cdot 10^{-3} \cdot U$ $1.9\ mV + 1.1 \cdot 10^{-3} \cdot U$	
	33 V to < 330 V	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$2.4\ mV + 0.24 \cdot 10^{-3} \cdot U$ $7\ mV + 0.25 \cdot 10^{-3} \cdot U$ $7\ mV + 0.31 \cdot 10^{-3} \cdot U$ $7\ mV + 0.37 \cdot 10^{-3} \cdot U$ $58\ mV + 2.4 \cdot 10^{-3} \cdot U$	
	330 V to < 1000 V	45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$13\ mV + 0.35 \cdot 10^{-3} \cdot U$ $13\ mV + 0.30 \cdot 10^{-3} \cdot U$ $13\ mV + 0.35 \cdot 10^{-3} \cdot U$	
AC voltage Sources	10 mV to 120 mV	10 Hz to 40 Hz > 40 Hz to 1 kHz > 1 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 300 kHz	$25\ \mu V + 0.11 \cdot 10^{-3} \cdot U$ $20\ \mu V + 0.11 \cdot 10^{-3} \cdot U$ $20\ \mu V + 0.19 \cdot 10^{-3} \cdot U$ $20\ \mu V + 0.38 \cdot 10^{-3} \cdot U$ $20\ \mu V + 1 \cdot 10^{-3} \cdot U$ $20\ \mu V + 4.2 \cdot 10^{-3} \cdot U$	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
AC voltage Sources	> 0.12 V to 1.2 V	10 Hz to 40 Hz	60 µV + 0.10 · 10^{-3} · U	U = measured value
		> 40 Hz to 1 kHz	40 µV + 0.10 · 10^{-3} · U	
		> 1 kHz to 20 kHz	40 µV + 0.18 · 10^{-3} · U	
		> 20 kHz to 50 kHz	40 µV + 0.37 · 10^{-3} · U	
		> 50 kHz to 100 kHz	40 µV + 1.15 · 10^{-3} · U	
		> 100 kHz to 300 kHz	0.15 mV + 4 · 10^{-3} · U	
		> 300 kHz to 1 MHz	0.15 mV + 17 · 10^{-3} · U	
	> 1.2 V to 12 V	10 Hz to 40 Hz	0.6 mV + 90 · 10^{-6} · U	
		> 40 Hz to 1 kHz	0.3 mV + 88 · 10^{-6} · U	
		> 1 kHz to 20 kHz	0.3 mV + 0.17 · 10^{-3} · U	
		> 20 kHz to 50 kHz	0.3 mV + 0.36 · 10^{-3} · U	
		> 50 kHz to 100 kHz	0.3 mV + 1.1 · 10^{-3} · U	
		> 100 kHz to 300 kHz	1.5 mV + 3.8 · 10^{-3} · U	
		> 300 kHz to 1 MHz	1.5 mV + 15 · 10^{-3} · U	
	> 12 V to 120 V	10 Hz to 40 Hz	6 mV + 0.25 · 10^{-3} · U	
		> 40 Hz to 1 kHz	3 mV + 0.25 · 10^{-3} · U	
		> 1 kHz to 20 kHz	3 mV + 0.25 · 10^{-3} · U	
		> 20 kHz to 50 kHz	3 mV + 0.45 · 10^{-3} · U	
		> 50 kHz to 100 kHz	3 mV + 1.6 · 10^{-3} · U	
	> 120 V to 700 V	10 Hz to 40 Hz	60 mV + 0.5 · 10^{-3} · U	
		> 40 Hz to 1 kHz	30 mV + 0.5 · 10^{-3} · U	
		> 1 kHz to 20 kHz	30 mV + 0.75 · 10^{-3} · U	
		> 20 kHz to 50 kHz	30 mV + 1.6 · 10^{-3} · U	
DC current Measuring instruments	10 µA to < 330 µA		0.1 µA + 0.22 · 10^{-3} · I	I = measured value
	0.33 mA to < 3.3 mA		0.1 µA + 0.15 · 10^{-3} · I	
	3.3 mA to < 33 mA		0.3 µA + 0.15 · 10^{-3} · I	
	33 mA to < 330 mA		3 µA + 0.15 · 10^{-3} · I	
	0.33 A to < 1.1 A		50 µA + 0.24 · 10^{-3} · I	
	1.1 A to < 3 A		50 µA + 0.45 · 10^{-3} · I	
	3 A to < 11 A		0.6 mA + 0.60 · 10^{-3} · I	
	11 A to < 20.5 A		1.8 mA + 1.3 · 10^{-3} · I	
DC current Sources	10 µA to 120 µA		1 nA + 24 · 10^{-6} · I	
	> 0.12 mA to 1.2 mA		6 nA + 24 · 10^{-6} · I	
	> 1.2 mA to 12 mA		60 nA + 24 · 10^{-6} · I	
	> 12 mA to 120 mA		0.6 µA + 42 · 10^{-6} · I	
	> 0.12 A to 1.05 A		60 µA + 0.12 · 10^{-6} · I	
	> 1.05 A to 20 A		0.3 mA + 18 · 10^{-6} · I	with Shunt of 10 mΩ
DC current Current clamps	0.1 A to < 20 A		2 mA + 2 · 10^{-3} · I	
	20 A to < 150 A		0.2 A + 5 · 10^{-3} · I	with coil with
	150 A to 1000 A		0.5 A + 5 · 10^{-3} · I	50 windings
AC current Measuring instruments	30 µA to < 330 µA	10 Hz to 20 Hz	0.3 µA + 2.4 · 10^{-3} · I	
		> 20 Hz to 45 Hz	0.3 µA + 1.8 · 10^{-3} · I	
		> 45 Hz to 1 kHz	0.3 µA + 1.5 · 10^{-3} · I	
		> 1 kHz to 5 kHz	0.3 µA + 3.6 · 10^{-3} · I	
		> 5 kHz to 10 kHz	0.4 µA + 9.5 · 10^{-3} · I	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
AC current Measuring instruments	0.33 mA to < 3.3 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3\ \mu A + 2.4 \cdot 10^{-3} \cdot I$ $0.3\ \mu A + 1.5 \cdot 10^{-3} \cdot I$ $0.3\ \mu A + 1.2 \cdot 10^{-3} \cdot I$ $0.4\ \mu A + 2.5 \cdot 10^{-3} \cdot I$ $0.5\ \mu A + 6.1 \cdot 10^{-3} \cdot I$	I = measured value
	3.3 mA to < 33 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$2.5\ \mu A + 2.1 \cdot 10^{-3} \cdot I$ $2.5\ \mu A + 1.2 \cdot 10^{-3} \cdot I$ $2.5\ \mu A + 0.5 \cdot 10^{-3} \cdot I$ $2.5\ \mu A + 1.1 \cdot 10^{-3} \cdot I$ $3.8\ \mu A + 2.6 \cdot 10^{-3} \cdot I$	
	33 mA to < 330 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$25\ \mu A + 2.1 \cdot 10^{-3} \cdot I$ $25\ \mu A + 1.2 \cdot 10^{-3} \cdot I$ $25\ \mu A + 0.5 \cdot 10^{-3} \cdot I$ $60\ \mu A + 1.3 \cdot 10^{-3} \cdot I$ $0.13\ mA + 2.8 \cdot 10^{-3} \cdot I$	
	0.33 A to < 1.1 A	10 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.13\ mA + 2.2 \cdot 10^{-3} \cdot I$ $0.13\ mA + 0.6 \cdot 10^{-3} \cdot I$ $1.2\ mA + 7 \cdot 10^{-3} \cdot I$ $5.9\ mA + 30 \cdot 10^{-3} \cdot I$	
	1.1 A to < 3 A	10 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.13\ mA + 2.2 \cdot 10^{-3} \cdot I$ $0.13\ mA + 0.7 \cdot 10^{-3} \cdot I$ $1.2\ mA + 7 \cdot 10^{-3} \cdot I$ $5.9\ mA + 30 \cdot 10^{-3} \cdot I$	
	3 A to < 11 A	45 Hz to 100 Hz > 100 Hz to 1 kHz > 1 kHz to 5 kHz	$2.4\ mA + 0.73 \cdot 10^{-3} \cdot I$ $2.4\ mA + 1.3 \cdot 10^{-3} \cdot I$ $2.4\ mA + 35 \cdot 10^{-3} \cdot I$	
	11 A to < 20.5 A	45 Hz to 100 Hz > 100 Hz to 1 kHz > 1 kHz to 5 kHz	$6\ mA + 1.6 \cdot 10^{-3} \cdot I$ $6\ mA + 1.8 \cdot 10^{-3} \cdot I$ $6\ mA + 35 \cdot 10^{-3} \cdot I$	
AC current Sources	10 µA to 120 µA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 1 kHz	$50\ nA + 4.9 \cdot 10^{-3} \cdot I$ $50\ nA + 4.9 \cdot 10^{-3} \cdot I$ $50\ nA + 4.9 \cdot 10^{-3} \cdot I$	
	> 0.12 mA to 1.2 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	$0.3\ \mu A + 4.8 \cdot 10^{-3} \cdot I$ $0.3\ \mu A + 1.9 \cdot 10^{-3} \cdot I$ $0.3\ \mu A + 0.72 \cdot 10^{-3} \cdot I$ $0.3\ \mu A + 0.41 \cdot 10^{-3} \cdot I$	
	> 1.2 mA to 12 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	$2.6\ \mu A + 4.7 \cdot 10^{-3} \cdot I$ $2.6\ \mu A + 1.8 \cdot 10^{-3} \cdot I$ $2.6\ \mu A + 0.71 \cdot 10^{-3} \cdot I$ $2.5\ \mu A + 0.4 \cdot 10^{-3} \cdot I$	
	> 12 mA to 120 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	$25\ \mu A + 4.7 \cdot 10^{-3} \cdot I$ $25\ \mu A + 1.8 \cdot 10^{-3} \cdot I$ $25\ \mu A + 0.71 \cdot 10^{-3} \cdot I$ $25\ \mu A + 0.4 \cdot 10^{-3} \cdot I$	

[1)] The expanded uncertainties according to EA-4/02 M:2021 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
AC current Sources	> 0.12 A	to	1.05 A	10 Hz > 20 Hz > 45 Hz > 100 Hz	to to to to	20 Hz 45 Hz 100 Hz 5 kHz	0.25 mA + 4.7 · 10^{-3} · I 0.25 mA + 1.9 · 10^{-3} · I 0.25 mA + 1.0 · 10^{-3} · I 0.25 mA + 1.3 · 10^{-3} · I	I = measured value
	> 1.05 A	to	20 A	10 Hz	to	1 kHz	10 mA + 0.15 · 10^{-3} · I	with Shunt of 10 mΩ
AC current Current clamps	0.1 A	to	< 20 A	45 Hz	to	1 kHz	8 mA + 3 · 10^{-3} · I	I = measured value
	20 A 150 A	to to	< 150 A < 1000 A	45 Hz	to	440 Hz	50 mA + 9 · 10^{-3} · I 0.12 A + 9 · 10^{-3} · I	with coil with 50 windings
DC resistance Measuring instruments	0.01 Ω 11 Ω 33 Ω 1.1 kΩ 11 kΩ 110 kΩ 1.1 MΩ 3.3 MΩ 11 MΩ 33 MΩ 110 MΩ 330 MΩ	to to to to to to to to to to to to	< 11 Ω < 33 Ω < 1.1 kΩ < 11 kΩ < 110 kΩ < 1.1 MΩ < 3.3 MΩ < 11 MΩ < 33 MΩ < 110 MΩ < 330 MΩ < 1.1 GΩ				2 mΩ + 50 · 10^{-6} · R 2 mΩ + 45 · 10^{-6} · R 2 mΩ + 40 · 10^{-6} · R 22 mΩ + 40 · 10^{-6} · R 0.22 Ω + 40 · 10^{-6} · R 2.2 Ω + 45 · 10^{-6} · R 32 Ω + 70 · 10^{-6} · R 60 Ω + 0.14 · 10^{-3} · R 2.5 kΩ + 0.27 · 10^{-3} · R 3.1 kΩ + 0.52 · 10^{-3} · R 0.12 MΩ + 5 · 10^{-3} · R 0.12 MΩ + 20 · 10^{-3} · R	R = measured value
DC resistance Sources	0.01 Ω > 12 Ω > 120 Ω > 1.2 kΩ > 12 kΩ > 120 kΩ > 1.2 MΩ > 12 MΩ > 120 MΩ	to to to to to to to to to	12 Ω 120 Ω 1.2 kΩ 12 kΩ 120 kΩ 1.2 MΩ 12 MΩ 120 MΩ 1.2 GΩ				0.1 mΩ + 18 · 10^{-6} · R 0.7 mΩ + 15 · 10^{-6} · R 0.7 mΩ + 13 · 10^{-6} · R 7 mΩ + 13 · 10^{-6} · R 70 mΩ + 13 · 10^{-6} · R 2.2 Ω + 18 · 10^{-6} · R 0.12 kΩ + 55 · 10^{-6} · R 1.2 kΩ + 0.55 · 10^{-3} · R 12 kΩ + 5.5 · 10^{-3} · R	

[1] The expanded uncertainties according to EA-4/02 M:2021 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	$1.1\ \mu m + 2.7 \cdot 10^{-6} \cdot l$	l = measured length with inclination measuring instruments
Height gauges	0 mm to 1000 mm	VDI/VDE/DGQ 2618 part 16.1:2009	$1.0\ \mu m + 1.4 \cdot 10^{-6} \cdot l$	till 1000 mm lead length
Deviation from straightness and perpendicularity	to 40 µm		3 µm	
Horizontal length measuring devices	0 mm to 5000 mm	VDI/VDE/DGQ 2618 part 17.1:2015	$0.12\ \mu m + 0.07 \cdot 10^{-6} \cdot l$	with laser interferometer
	0 mm to 200 mm		$0.12\ \mu m + 0{,}6 \cdot 10^{-6} \cdot l$	with gauge blocks
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 ≤ 900 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 size P_{SX} and P_{SY} with a graduated scale made of glass according to VDI/VDE 2617 part 6.1:2019	0.8 µm	
		The error of indication for size measurement E_{UX}, E_{UY} uand E_{UXY} is determined with a graduated scale made of glass according to DIN EN ISO 10360-7:2011	$1.6\ \mu m + 1 \cdot 10^{-6} \cdot l$	l = measured length
Torque				
Torque wrench calibration devices	1 N·m to 10 N·m	DKD-R 10-8:2020	$6 \cdot 10^{-3}$	
	> 10 N·m to 3 kN·m		$2 \cdot 10^{-3}$	
Manually triggering / indicative operated torque tools	0.1 N·m to 100 N·m	DIN EN ISO 6789-2:2017	$5 \cdot 10^{-3}$	
	> 100 N·m to 1 kN·m		$1 \cdot 10^{-2}$	

[1)] The expanded uncertainties according to EA-4/02 M:2021 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
Pressure				
Absolute pressure p_{abs}	0.7 bar to 1.1 bar	DKD-R 6-1:2014 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 201 bar		10 mbar	
Positive gauge pressure p_e	0 bar to 200 bar	DKD-R 6-1:2014	10 mbar	Pressure medium: gas
Absolute pressure p_{abs}	1 bar to 101 bar	DKD-R 6-1:2014 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	$3.1 \cdot 10^{-3} \cdot p_e$ + 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 class E2
	to 100 kg		$6.6 \cdot 10^{-5}$	with weights OIML R 111-1:2004 according to class M1

Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Length				
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 + $30 \cdot 10^{-6} \cdot l$	
	> 300 mm to 1500 mm		50 µm + $30 \cdot 10^{-6} \cdot l$	
Depth calipers	0 mm to 300 mm	VDI/VDE/DGQ 2618 part 9.2:2006	30 µm + $30 \cdot 10^{-6} \cdot l$	
	> 300 mm to 1000 mm		50 µm + $30 \cdot 10^{-6} \cdot l$	

[1] The expanded uncertainties according to EA-4/02 M:2021 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	
	> 500 mm to 1000 mm		5 µm + 10 · 10^{-6} · l	
Micrometers according to DIN 863-3 form D10	0 mm to 100 mm	TK 2:2021-02	5 µm + 10 · 10^{-6} · d	d = measured diameter
Reference gauges for micrometers	25 mm to 1000 mm	VDI/VDE/DGQ 2618 part 4.4:2009	2 µm + 20 · 10^{-6} · l	l = measured length
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 57:2021-02	2 µm + 10 · 10^{-6} · d	
Dial gauges Scale interval > 1 µm	to 100 mm	VDI/VDE/DGQ/DKD 2618 part 11.1:2021	3.2 µm + 10 · 10^{-6} · l	l = measured length
Scale interval ≤ 1 µm			2.8 µm + 11 · 10^{-6} · l	
Dial indicators	to 3 mm	VDI/VDE/DGQ 2618 part 11.2:2002	1.9 µm	
Lever gauges	to 1.6 mm	VDI/VDE/DGQ 2618 part 11.3:2002	2 µm	
Dial gauges with digital display	to 100 mm	VDI/VDE/DGQ/DKD 2618 part 11.4:2020	3 µm + 10 · 10^{-6} · l	
Thickness gauges Scale interval 1 µm	0 mm to 30 mm	VDI/VDE/DGQ 2618 part 12.1:2005	1.1 µm + 8 · 10^{-6} · l	l = measured length
Scale interval 10 µm			6 µm	
Feeler gauges	10 µm to 2 mm	TK 19:2021-02	1.7 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 1000 mm		5 µm + 10 · 10^{-6} · l	

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DAkkS Deutsche Akkreditierungsstelle

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Extensions for internal micrometers with two-point contact	25 mm to 1000 mm	VDI/VDE/DGQ 2618 part 10.7:2010	2 µm + 20 · 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 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 50 mm	VDI/VDE/DGQ 2618 part 10.4:2008	3 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	
Bore gauges with two-point contact Form I - III	1 mm to 800 mm	VDI/VDE/DGQ 2618 part 13.2:2005	2.3 µm	Measuring length up to 3 mm
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‘	
Setting plug gauges Diameter	1 mm to 500 mm	VDI/VDE/DGQ 2618 part 4.1:2006, option 3, option 4	0.8 µm + 3 · 10^{-6} · d	d = measured diameter
Setting ring gauges Diameter	2 mm to 200 mm	VDI/VDE/DGQ 2618 part 4.1:2006 option 3, option 4	0.8 µm + 3 · 10^{-6} · d	
Measuring pins / Pins for screw theads Diameterr	0.17 mm to 50 mm	VDI/VDE/DGQ 2618 part 4.2:2007, option 1	0.8 µm	
Electical probe and measuring device	0 mm to 10 mm	VDI/VDE/DGQ 2618 part 14.1:2010	2 µm	
Layer thickness gauges	20 mm	TK 91:2021-02	0.7 µm + 180 · 10^{-6} · l	l = measured length

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Calibration and Measurement Capabilities (CMC)

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° to 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	
Pressure				
Absolute pressure p_{abs}	0.7 bar to 1.1 bar	DKD-R 6-1:2014 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 201 bar		10 mbar	
Positive gauge pressure p_e	0 bar to 200 bar	DKD-R 6-1:2014	10 mbar	Pressure medium : gas
Absolute pressure p_{abs}	1 bar to 101 bar	DKD-R 6-1:2014 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	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	
Torque				
Torque wrench calibration devices	1 N·m to 10 N·m	DKD-R 10-8:2020	6 · 10^{-3}	
	> 10 N·m to 3 kN·m		2 · 10^{-3}	
Manually triggering / indicative operated torque tools	0.1 N·m to 100 N·m	DIN EN ISO 6789-2:2017	5 · 10^{-3}	
	> 100 N·m to 1 kN·m		1 · 10^{-2}	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
DC and low frequency quantities				
DC voltage Measuring instruments	1 mV to < 330 mV 0.33 V to < 3.3 V 3.3 V to < 33 V 33 V to < 330 V 330 V to < 1000 V		$2.0\ \mu V + 35 \cdot 10^{-6} \cdot U$ $3.0\ \mu V + 16 \cdot 10^{-6} \cdot U$ $24\ \mu V + 18 \cdot 10^{-6} \cdot U$ $0.2\ mV + 24 \cdot 10^{-6} \cdot U$ $1.7\ mV + 24 \cdot 10^{-6} \cdot U$	U = measured value
DC voltage Sources	10 mV to 120 mV > 0.12 V to 1.2 V > 1.2 V to 12 V > 12 V to 120 V > 120 V to 1050 V		$2.0\ \mu V + 12 \cdot 10^{-6} \cdot U$ $2.0\ \mu V + 10 \cdot 10^{-6} \cdot U$ $2.5\ \mu V + 10 \cdot 10^{-6} \cdot U$ $35\ \mu V + 14 \cdot 10^{-6} \cdot U$ $0.1\ mV + 22 \cdot 10^{-6} \cdot U$	
AC voltage Measuring instruments	1 mV to < 33 mV	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 500 kHz	$8\ \mu V + 1.0 \cdot 10^{-3} \cdot U$ $8\ \mu V + 0.2 \cdot 10^{-3} \cdot U$ $8\ \mu V + 0.25 \cdot 10^{-3} \cdot U$ $8\ \mu V + 1.3 \cdot 10^{-3} \cdot U$ $15\ \mu V + 4.2 \cdot 10^{-3} \cdot U$ $60\ \mu V + 10 \cdot 10^{-3} \cdot U$	U = measured value
	33 mV to < 330 mV	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 500 kHz	$10\ \mu V + 0.4 \cdot 10^{-3} \cdot U$ $10\ \mu V + 0.2 \cdot 10^{-3} \cdot U$ $10\ \mu V + 0.2 \cdot 10^{-3} \cdot U$ $10\ \mu V + 0.43 \cdot 10^{-3} \cdot U$ $40\ \mu V + 0.95 \cdot 10^{-3} \cdot U$ $85\ \mu V + 2.5 \cdot 10^{-3} \cdot U$	
	0.33 V to < 3,3 V	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz > 100 kHz to 500 kHz	$60\ \mu V + 0.4 \cdot 10^{-3} \cdot U$ $75\ \mu V + 0.2 \cdot 10^{-3} \cdot U$ $75\ \mu V + 0.24 \cdot 10^{-3} \cdot U$ $60\ \mu V + 0.35 \cdot 10^{-3} \cdot U$ $0.15\ mV + 0.85 \cdot 10^{-3} \cdot U$ $0.7\ mV + 3 \cdot 10^{-3} \cdot U$	
	3.3 V to < 33 V	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$0.75\ mV + 0.38 \cdot 10^{-3} \cdot U$ $0.7\ mV + 0.2 \cdot 10^{-3} \cdot U$ $0.7\ mV + 0.29 \cdot 10^{-3} \cdot U$ $0.7\ mV + 0.42 \cdot 10^{-3} \cdot U$ $1.9\ mV + 1.1 \cdot 10^{-3} \cdot U$	
	33 V to < 330 V	10 Hz to 45 Hz > 45 Hz to 10 kHz > 10 kHz to 20 kHz > 20 kHz to 50 kHz > 50 kHz to 100 kHz	$2.4\ mV + 0.24 \cdot 10^{-3} \cdot U$ $7\ mV + 0.25 \cdot 10^{-3} \cdot U$ $7\ mV + 0.31 \cdot 10^{-3} \cdot U$ $7\ mV + 0.37 \cdot 10^{-3} \cdot U$ $58\ mV + 2.4 \cdot 10^{-3} \cdot U$	
	330 V to < 1000 V	45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$13\ mV + 0.35 \cdot 10^{-3} \cdot U$ $13\ mV + 0.30 \cdot 10^{-3} \cdot U$ $13\ mV + 0.35 \cdot 10^{-3} \cdot U$	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
AC voltage Sources	10 mV to 120 mV	10 Hz to 40 Hz	25 µV + 0.11 · 10^{-3} · U	U = measured value
		> 40 Hz to 1 kHz	20 µV + 0.11 · 10^{-3} · U	
		> 1 kHz to 20 kHz	20 µV + 0.19 · 10^{-3} · U	
		> 20 kHz to 50 kHz	20 µV + 0.38 · 10^{-3} · U	
		> 50 kHz to 100 kHz	20 µV + 1 · 10^{-3} · U	
		> 100 kHz to 300 kHz	20 µV + 4.2 · 10^{-3} · U	
	> 0.12 V to 1,2 V	10 Hz to 40 Hz	60 µV + 0.10 · 10^{-3} · U	
		> 40 Hz to 1 kHz	40 µV + 0.10 · 10^{-3} · U	
		> 1 kHz to 20 kHz	40 µV + 0.18 · 10^{-3} · U	
		> 20 kHz to 50 kHz	40 µV + 0.37 · 10^{-3} · U	
		> 50 kHz to 100 kHz	40 µV + 1.15 · 10^{-3} · U	
		> 100 kHz to 300 kHz	0.15 mV + 4 · 10^{-3} · U	
		> 300 kHz to 1 MHz	0.15 mV + 17 · 10^{-3} · U	
	> 1.2 V to 12 V	10 Hz to 40 Hz	0.6 mV + 90 · 10^{-6} · U	
		> 40 Hz to 1 kHz	0.3 mV + 88 · 10^{-6} · U	
		> 1 kHz to 20 kHz	0.3 mV + 0.17 · 10^{-3} · U	
		> 20 kHz to 50 kHz	0.3 mV + 0.36 · 10^{-3} · U	
		> 50 kHz to 100 kHz	0.3 mV + 1.1 · 10^{-3} · U	
		> 100 kHz to 300 kHz	1.5 mV + 3.8 · 10^{-3} · U	
		> 300 kHz to 1 MHz	1.5 mV + 15 · 10^{-3} · U	
	> 12 V to 120 V	10 Hz to 40 Hz	6 mV + 0.25 · 10^{-3} · U	
		> 40 Hz to 1 kHz	3 mV + 0.25 · 10^{-3} · U	
		> 1 kHz to 20 kHz	3 mV + 0.25 · 10^{-3} · U	
		> 20 kHz to 50 kHz	3 mV + 0.45 · 10^{-3} · U	
		> 50 kHz to 100 kHz	3 mV + 1.6 · 10^{-3} · U	
	> 120 V to 700 V	10 Hz to 40 Hz	60 mV + 0.5 · 10^{-3} · U	
		> 40 Hz to 1 kHz	30 mV + 0.5 · 10^{-3} · U	
		> 1 kHz to 20 kHz	30 mV + 0.75 · 10^{-3} · U	
		> 20 kHz to 50 kHz	30 mV + 1.6 · 10^{-3} · U	
DC current Measuring instruments	10 µA to < 330 µA		0.1 µA + 0.22 · 10^{-3} · I	I = measured value
	0.33 mA to < 3.3 mA		0.1 µA + 0.15 · 10^{-3} · I	
	3.3 mA to < 33 mA		0.3 µA + 0.15 · 10^{-3} · I	
	33 mA to < 330 mA		3 µA + 0.15 · 10^{-3} · I	
	0.33 A to < 1.1 A		50 µA + 0.24 · 10^{-3} · I	
	1.1 A to < 3 A		50 µA + 0.45 · 10^{-3} · I	
	3 A to < 11 A		0.6 mA + 0.60 · 10^{-3} · I	
	11 A to < 20.5 A		1.8 mA + 1.3 · 10^{-3} · I	
DC current Sources	10 µA to 120 µA		1 nA + 24 · 10^{-6} · I	
	> 0.12 mA to 1.2 mA		6 nA + 24 · 10^{-6} · I	
	> 1.2 mA to 12 mA		60 nA + 24 · 10^{-6} · I	
	> 12 mA to 120 mA		0.6 µA + 42 · 10^{-6} · I	
	> 0.12 A to 1.05 A		60 µA + 0.12 · 10^{-6} · I	
	> 1.05 A to 20 A		0.3 mA + 18 · 10^{-6} · I	with Shunt of 10 mΩ

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
DC current Current clamps	0.1 A to < 20 A		$2\ \text{mA} + 2 \cdot 10^{-3} \cdot I$	
	20 A to < 150 A 150 A to 1000 A		$0.2\ \text{A} + 5 \cdot 10^{-3} \cdot I$ $0.5\ \text{A} + 5 \cdot 10^{-3} \cdot I$	with coil with 50 windings
AC current Measuring instruments	30 µA to < 330 µA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3\ \mu\text{A} + 2.4 \cdot 10^{-3} \cdot I$ $0.3\ \mu\text{A} + 1.8 \cdot 10^{-3} \cdot I$ $0.3\ \mu\text{A} + 1.5 \cdot 10^{-3} \cdot I$ $0.3\ \mu\text{A} + 3.6 \cdot 10^{-3} \cdot I$ $0.4\ \mu\text{A} + 9.5 \cdot 10^{-3} \cdot I$	I = measured value
	0.33 mA to < 3.3 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.3\ \mu\text{A} + 2.4 \cdot 10^{-3} \cdot I$ $0.3\ \mu\text{A} + 1.5 \cdot 10^{-3} \cdot I$ $0.3\ \mu\text{A} + 1.2 \cdot 10^{-3} \cdot I$ $0.4\ \mu\text{A} + 2.5 \cdot 10^{-3} \cdot I$ $0.5\ \mu\text{A} + 6.1 \cdot 10^{-3} \cdot I$	
	3.3 mA to < 33 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$2.5\ \mu\text{A} + 2.1 \cdot 10^{-3} \cdot I$ $2.5\ \mu\text{A} + 1.2 \cdot 10^{-3} \cdot I$ $2.5\ \mu\text{A} + 0.5 \cdot 10^{-3} \cdot I$ $2.5\ \mu\text{A} + 1.1 \cdot 10^{-3} \cdot I$ $3.8\ \mu\text{A} + 2.6 \cdot 10^{-3} \cdot I$	
	33 mA to < 330 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$25\ \mu\text{A} + 2.1 \cdot 10^{-3} \cdot I$ $25\ \mu\text{A} + 1.2 \cdot 10^{-3} \cdot I$ $25\ \mu\text{A} + 0.5 \cdot 10^{-3} \cdot I$ $60\ \mu\text{A} + 1.3 \cdot 10^{-3} \cdot I$ $0.13\ \text{mA} + 2.8 \cdot 10^{-3} \cdot I$	
	0.33 A to < 1.1 A	10 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.13\ \text{mA} + 2.2 \cdot 10^{-3} \cdot I$ $0.13\ \text{mA} + 0.6 \cdot 10^{-3} \cdot I$ $1.2\ \text{mA} + 7 \cdot 10^{-3} \cdot I$ $5.9\ \text{mA} + 30 \cdot 10^{-3} \cdot I$	
	1.1 A to < 3 A	10 Hz to 45 Hz > 45 Hz to 1 kHz > 1 kHz to 5 kHz > 5 kHz to 10 kHz	$0.13\ \text{mA} + 2.2 \cdot 10^{-3} \cdot I$ $0.13\ \text{mA} + 0.7 \cdot 10^{-3} \cdot I$ $1.2\ \text{mA} + 7 \cdot 10^{-3} \cdot I$ $5.9\ \text{mA} + 30 \cdot 10^{-3} \cdot I$	
	3 A to < 11 A	45 Hz to 100 Hz > 100 Hz to 1 kHz > 1 kHz to 5 kHz	$2.4\ \text{mA} + 0.73 \cdot 10^{-3} \cdot I$ $2.4\ \text{mA} + 1.3 \cdot 10^{-3} \cdot I$ $2.4\ \text{mA} + 35 \cdot 10^{-3} \cdot I$	
	11 A to < 20.5 A	45 Hz to 100 Hz > 100 Hz to 1 kHz > 1 kHz to 5 kHz	$6\ \text{mA} + 1.6 \cdot 10^{-3} \cdot I$ $6\ \text{mA} + 1.8 \cdot 10^{-3} \cdot I$ $6\ \text{mA} + 35 \cdot 10^{-3} \cdot I$	
AC current Sources	10 µA to 120 µA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 1 kHz	$50\ \text{nA} + 4.9 \cdot 10^{-3} \cdot I$ $50\ \text{nA} + 4.9 \cdot 10^{-3} \cdot I$ $50\ \text{nA} + 4.9 \cdot 10^{-3} \cdot I$	
	> 0.12 mA to 1,2 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	$0.3\ \mu\text{A} + 4.8 \cdot 10^{-3} \cdot I$ $0.3\ \mu\text{A} + 1.9 \cdot 10^{-3} \cdot I$ $0.3\ \mu\text{A} + 0.72 \cdot 10^{-3} \cdot I$ $0.3\ \mu\text{A} + 0.41 \cdot 10^{-3} \cdot I$	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
AC current Sources	> 1.2 mA to 12 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	2.6 µA + 4.7 · 10^{-3} · I 2.6 µA + 1.8 · 10^{-3} · I 2.6 µA + 0.71 · 10^{-3} · I 2.5 µA + 0.4 · 10^{-3} · I	I = measured value
	> 12 mA to 120 mA	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	25 µA + 4.7 · 10^{-3} · I 25 µA + 1.8 · 10^{-3} · I 25 µA + 0.71 · 10^{-3} · I 25 µA + 0.4 · 10^{-3} · I	
	> 0.12 A to 1.05 A	10 Hz to 20 Hz > 20 Hz to 45 Hz > 45 Hz to 100 Hz > 100 Hz to 5 kHz	0.25 mA + 4.7 · 10^{-3} · I 0.25 mA + 1.9 · 10^{-3} · I 0.25 mA + 1.0 · 10^{-3} · I 0.25 mA + 1.3 · 10^{-3} · I	
	> 1.05 A to 20 A	10 Hz to 1 kHz	10 mA + 0.15 · 10^{-3} · I	with Shunt of 10 mΩ
AC current Current clamps	0.1 A to < 20 A	45 Hz to 1 kHz	8 mA + 3 · 10^{-3} · I	I = measured value
	20 A to < 150 A 150 A to < 1000 A	45 Hz to 440 Hz	50 mA + 9 · 10^{-3} · I 0.12 A + 9 · 10^{-3} · I	with coil with 50 windings
DC resistance Measuring instruments	0.01 Ω to < 11 Ω 11 Ω to < 33 Ω 33 Ω to < 1.1 kΩ 1.1 kΩ to < 11 kΩ 11 kΩ to < 110 kΩ 110 kΩ to < 1.1 MΩ 1.1 MΩ to < 3.3 MΩ 3.3 MΩ to < 11 MΩ 11 MΩ to < 33 MΩ 33 MΩ to < 110 MΩ 110 MΩ to < 330 MΩ 330 MΩ to < 1.1 GΩ		2 mΩ + 50 · 10^{-6} · R 2 mΩ + 45 · 10^{-6} · R 2 mΩ + 40 · 10^{-6} · R 22 mΩ + 40 · 10^{-6} · R 0.22 Ω + 40 · 10^{-6} · R 2.2 Ω + 45 · 10^{-6} · R 32 Ω + 70 · 10^{-6} · R 60 Ω + 0,14 · 10^{-3} · R 2.5 kΩ + 0,27 · 10^{-3} · R 3.1 kΩ + 0,52 · 10^{-3} · R 0.12 MΩ + 5 · 10^{-3} · R 0.12 MΩ + 20 · 10^{-3} · R	R = measured value
DC resistance Sources	0.01 Ω to 12 Ω > 12 Ω to 120 Ω > 120 Ω to 1.2 kΩ > 1.2 kΩ to 12 kΩ > 12 kΩ to 120 kΩ > 120 kΩ to 1.2 MΩ > 1.2 MΩ to 12 MΩ > 12 MΩ to 120 MΩ > 120 MΩ to 1.2 GΩ		0.1 mΩ + 18 · 10^{-6} · R 0.7 mΩ + 15 · 10^{-6} · R 0.7 mΩ + 13 · 10^{-6} · R 7 mΩ + 13 · 10^{-6} · R 70 mΩ + 13 · 10^{-6} · R 2.2 Ω + 18 · 10^{-6} · R 0.12 kΩ + 55 · 10^{-6} · R 1.2 kΩ + 0,55 · 10^{-3} · R 12 kΩ + 5.5 · 10^{-3} · R	

[1] The expanded uncertainties according to EA-4/02 M:2021 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
DGQ	Deutsche Gesellschaft für Qualität e.V.
DIN	Deutsches Institut für Normung e.V.
DKD	Deutscher Kalibrierdienst
DKD-R	Guideline of Deutscher Kalibrierdienst, published by Physikalisch-Technische Bundesanstalt
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:2021 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.