Deutsche Akkreditierungsstelle GmbH

Annex to the Accreditation Certificate D-K-15089-01-00 according to DIN EN ISO/IEC 17025:2018

Valid from: **04.12.2020**

Date of issue 07.01.2021

Holder of certificate:

Perschmann Calibration GmbH
Hauptstraße 46d, 38110 Braunschweig

Calibration in the fields:

Dimensional quantities
Length
- **Gauge blocks**
- **Length measuring instruments**
- **Line scales, distances**
- **Length measuring devices** [a)]
- **Diameter**
- **Form error**
- **Flatness** [a)]
- **Straightness** [a)]
- **Thread**

Coordinate measuring technology
- **Coordinate measuring machines** [b)]

Mechanical quantities
- **Torque** [c)]
- **Pressure**
- **Weighing instruments** [a)]
- **Material testing machines (MTM)**
  - **Hardness (MTM)**

Electrical quantities
DC and low frequency
- **DC voltage**
- **AC voltage**
- **DC current**
- **AC current**
- **DC resistance**

Time and frequency
- **Frequency**

Thermodynamic quantities
Temperature quantities
- **Temperature indicators and simulators**
- **Resistance thermometers**
- **Radiation thermometers**
- **Temperature transmitters, data loggers**
- **Thermocouples**
- **Direct reading thermometers**

Humidity quantities
- **Devices for relative humidity**

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

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

Abbreviations used: see last page

Within the measurands/calibration items marked with with *, the calibration laboratory is permitted, without being required to inform and obtain prior approval from DAkkS, to use calibration standards or equivalent calibration procedures listed here with different issue dates.

The calibration laboratory maintains a current list of all calibration standards / equivalent calibration procedures within the flexible scope of accreditation.

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 standards	DKD-R 4-3 part 3.1:2018 Measurement of the deviation of the central length l_c from the nominal value l_n by comparison measurement	For the central length: $0.05\ \mu m + 0.5 \cdot 10^{-6} \cdot l$ For the deviations f_0 and f_u from the central length: 0.05 µm	Measuring surface quality as stated in QMH rsp. in the test specifications l = gauge block length
	> 100 mm to 150 mm featuring the nominal values of the standards	Measurement of the deviations f_0 and f_u from the central length by 5 points comparison 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: $0.05\ \mu m + 0.7 \cdot 10^{-6} \cdot l$ For the deviations f_0 and f_u from the central length: 0.07 µm	
Gauge blocks * made of ceramics according to DIN EN ISO 3650:1999	0.5 mm to 100 mm featuring the nominal values of the standards		For the central length: $0.07\ \mu m + 0.6 \cdot 10^{-6} \cdot l$ For the deviations f_0 and f_u from the central length: 0.05 µm	
	> 100 mm to 150 mm featuring the nominal values of the standards		For the central length: $0.07\ \mu m + 0.8 \cdot 10^{-6} \cdot l$ For the deviations f_0 and f_u from the central length: 0.07 µm	

[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.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Gauge blocks * made of steel with special cross section (round or square), also with drilling in the middle	0.5 mm to 100 mm	DKD-R 4-3 part 3.1:2018 Measurement of the deviation of the central length l_c from the nominal value l_n by comparison measurement	For the central length: 0.1 µm + 0.5 · 10^{-6} · l For the deviations f_0 and f_u from the central length: 0.1 µm	At square gauge blocks with drillings the mean size is substituted by ANSI-ASME B89.1.9M measured between hole and front side
Gauge blocks * made of tungsten carbide according to DIN EN ISO 3650:1999	0.5 mm to 100 mm featuring the nominal values of the standards	Measurement of the deviations f_0 and f_u from the central length by 5 points comparison 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 + 1.2 · 10^{-6} · l For the deviations f_0 and f_u from the central length: 0.05 µm	
Gauge blocks * made of steel	> 150 mm to 1000 mm in the nominal dimensions, which differ of the standard with a max. of 50 mm	DKD-R 4-3 part 3.1:2018 Measurement of the deviation of the central length l_c from the nominal value l_n by comparison measurement	For the central length: 0.2 µm + 0.7 · 10^{-6} · l	
Setting ring gauges * made of steel Diameter	2 mm to 200 mm	DKD-R 4-3 part 4.1:2018	0.4 µm + 2 · 10^{-6} · d	The measurement uncertainty applies to the complete calibration of diameter, roundness, straightness and parallelism. For the calibration of the diameter without form measurement, the best measurement uncertainty increases by 0.2 µm d = measured diameter
Setting plug gauges * made of steel Diameter	1 mm to 200 mm	DKD-R 4-3 part 4.1:2018	0.4 µm + 2 · 10^{-6} · d	
Measuring pins * made of steel Diameter	0.17 mm to 20 mm	DKD-R 4-3 part 4.2:2018	0.4 µm	
Roundness deviation * of abovementioned rings, inside cylinders, plugs or outside cylinders	to 40 µm	DKD-R 4-3 part 4.1:2018	0.2 µm + 1 · 10^{-2} · $RONt$	Diameter: 2 mm to 200 mm
Straigthness deviation * of abovementioned rings, inside cylinders, plugs or outside cylinders	to 10 µm	DKD-R 4-3 part 4.1:2018	0.5 µm	axial length: to 30 mm
Setting dimension *	25 mm to 900 mm	VDI/VDE/DGQ 2618 part 4.4:2009	0.7 µm + 1,5 · 10^{-6} · l	l = measured length
Caliper gauge *	5 mm to 170 mm	DKD-R 4-3 part 4.7:2018	1.5 µm + 10 · 10^{-6} · l	

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Reference- and Setting gauge	to 12 mm	Annex F/43:2017-11	3 µm	Feeler gauge, gap gauge of plastic, delrin, teflon, brass or steal
Radius gauge	to 40 mm	Annex F/42:2018-01	3 µm	to 40 mm radii
Angle meter *	0° to 360°	DKD-R 4-3 part 7.2:2018	1‘ 30‘‘	
Graduator	0° to 180°	Annex F/46:2017-11	12‘	
Measuring tape Circumference tape measure	0 m to 50 m	Annex F/47-1:2017-12 Annex F/47-2:2017-12	50 µm + 15 · 10^{-6} · l	l = measured length
Diameter tape measure	0 m to 10 m	Annex F/47-2:2017-12	50 µm + 15 · 10^{-6} · d	d = measured diameter
Rules	0 m to 10 m	Annex F/47-3:2017-12 Annex F/47-4:2017-11	50 µm + 15 · 10^{-6} · l	l = measured length Graduated metal rules, reference- and plotting scale, rules, folding rules
Calipers for external, internal and depth dimensions *	0 mm to 1000 mm	DKD-R 4-3 part 9.1:2018	30 µm + 30 · 10^{-6} · l	l = measured length
Depth calipers *	0 mm to 1000 mm	DKD-R 4-3 part 9.2:2018	30 µm + 30 · 10^{-6} · l	
Height gauge *	0 mm to 1000 mm	DKD-R 4-3 part 9.3:2018	20 µm + 10 · 10^{-6} · l	with contact help
Micrometers *	0 mm to 600 mm	DKD-R 4-3 part 10.1:2018	3 µm + 10 · 10^{-6} · l	600 mm = final value of the measuring range
Indicating caliper micrometers *	0 mm to 100 mm	DKD-R 4-3 part 10.3:2018	2 µm + 10 · 10^{-6} · l	l = measured length
Indicating caliper gap gauge	0 mm to 100 mm	Annex F/39:2017-12	2 µm + 10 · 10^{-6} · l	
Depth micrometers *	0 mm to 300 mm	Annex F/36:2018-05	3 µm + 10 · 10^{-6} · l	with interchangeable contact points
Internal micrometers with two-point contact *	25 mm to 950 mm	DKD-R 4-3 part 10.7:2018	3.5 µm + 5 · 10^{-6} · d	d = measured diameter
Internal micrometers with jaws	5 mm to 100 mm	Annex F/37:2017-11	5 µm + 5 · 10^{-6} · d	
Internal micrometers with three-point contact *	3 mm to 200 mm	DKD-R 4-3 part 10.8:2018	3 µm + 5 · 10^{-6} · d	
Dial gauges with scales * Scale interval > 1 µm	to 100 mm	DKD-R 4-3 part 11.1:2018	3 µm + 10 · 10^{-6} · l	l = measured length
Dial gauges with scales * Scale interval 1 µm	to 5 mm		1.5 µm	error of measurement y_i
			2 µm	deviation span f_e, f_{ges}, f_u, f_t and f_w

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1]	Remarks
Dial gauges with scales * Scale interval > 1 µm	to 100 mm	VDI/VDE/DGQ 2618 part 11.1:2014	3 µm + 10 · 10^{-6} · l	l = measured length
Dial gauges with scales * Scale interval 1 µm	to 5 mm		1.5 µm	error of measurement y_i
			2 µm	deviation span MPE_r, MPE_e, MPE_{ges}, $MPE_{1/1}$, $MPE_{1/2}$, $MPE_{1/10}$, MPE_u
Dial gauges with digital display Numerical interval 0.1 µm	to 25 mm	Annex F/04-2:2014-12	0.6 µm + 10 · 10^{-6} · l	error of measurement y_i
			0.8 µm + 10 · 10^{-6} · l	deviation span f_e, f_i and f_w
Dial gauges with digital display Numerical interval 1 µm	to 100 mm		1 µm + 10 · 10^{-6} · l	error of measurement y_i
			1.5 µm + 10 · 10^{-6} · l	deviation span f_e, f_i and f_w
Dial indicators * Scale interval > 0.5 µm	to 3 mm	DKD-R 4-3 part 11.2:2018	0.6 µm	
Lever gauges *	to 1.6 mm	DKD-R 4-3 part 11.3:2018	1 µm	
Lever gauges for external measurements *	0 mm to 70 mm	DKD-R 4-3 part 12.1:2018	7 µm + 10 · 10^{-6} · l	up to a probe length of 200 mm
Lever gauges for internal measurements *	2.5 mm to 80 mm	DKD-R 4-3 part 13.1:2018	7 µm + 10 · 10^{-6} · l	l = measured length
Thickness gauges *	0 mm to 30 mm	DKD-R 4-3 part 12.1:2018	7 µm + 10 · 10^{-6} · l	l = measured length up to a measuring depth of 200 mm
Bore gauges with two-point contact *	1 mm to 3 mm	VDI/VDE/DGQ 2618 part 13.2:2005 (image 1)	0.8 µm	range of application: with gauge slider d = 1.75 mm to d = 25 mm
		VDI/VDE/DGQ 2618 part 13.2:2005 (image 2)	0.8 µm	range of application: to d = 300 mm
			1.2 µm	range of application: d > 300 mm to d = 600 mm
		VDI/VDE/DGQ 2618 part 13.2:2005 (image 3)	0.8 µm	range of application: plug gauge to d = 100 mm
Height gauges *	0 mm to 1000 mm	VDI/VDE/DGQ 2618 part 16.1:2009	1.5 µm + 3 · 10^{-6} · l	l = measured length
Deviation from straightness and Perpendicularity	to 30 µm	to 800 mm lead length	2.5 µm + 1 · 10^{-6} · l_z	l_z = lead length

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Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
90° Squares Perpendicularity	to 30 µm	Annex F/12:2017-02 to 750 mm leg length	2 µm + 2 · 10^{-6} · l_z	l_z = length of form respectively position embodiment
Deviation from straightness and parallelism	to 30 µm	to 750 mm length	1 µm + 2 · 10^{-6} · l_z	
Flatness deviation	to 30 µm	to 750 mm edge length	1 µm + 2 · 10^{-6} · l_z	
Deviation from flatness Horizontal flatness standard, e.g. surface plates as per DIN 876:1984	to 50 µm	Annex F/13:2020-10 to 2 m edge length electronic inclination measuring	0.9 µm + 1.7 · 10^{-6} · l	l = longest edge length of the measuring standard For calibration in the permanent calibration laboratory, the uncertainty increases starting by an edge length l > 1 m by a factor of 1.2
Deviation from straightness Horizontal flatness standard, e.g. surface plates as per DIN 876:1984	to 50 µm	Annex F/13:2020-10 to 3 m edge length electronic inclination measuring	2.2 µm + 1.7 · 10^{-6} · l	
Thread gauges * (single-start and multi-start cylindrical and conical external and internal threads with straight flanks, symmetrical and asymmetrical profile)				
External thread	3 mm to 150 mm			
Simple pitch diameter	Nominal diameter	Scanning method	2.5 µm + 5 · 10^{-6} · d	d = measured diameter
Outside diameter		DKD-R 4-3 part 4.8:2018, Option 1 to option 4	2 µm	
Core diameter or recess diameter		(Specifying the thread angle α)	5 µm	
Lead or pitch	0.5 mm to 8 mm		1 µm	
Thread angle α	≥ 27°		(1.2 + 3 mm / l_F)', but not lower at 6'	l_F = side length
Internal thread	3 mm to 160 mm			
Simple pitch diameter	Nominal diameter	Scanning method	2.5 µm + 5 · 10^{-6} · d	
Outside diameter or recess diameter		DKD-R 4-3 part 4.9:2018, Option 1 to option 4	5 µm	
Core diameter		(Specifying the thread angle α)	2 µm	
Lead or pitch	0.5 mm to 8 mm		1 µm	
Thread angle α	≥ 27°		(1.2 + 3 mm / l_F)', but not lower at 6'	
Stand off	3 mm to 150 mm	Annex F/09-3:2020-08	50 µm	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range			Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Thread plug gauge * Simple pitch diameter	1.4 mm	to	150 mm	VDI/VDE/DGQ 2618 part 4.8:2006, option 1 (Three wire procedure)	2.5 µm + 7.5 · 10^{-6} · d	d = measured diameter P_h = lead P_h ≥ 0.3 mm to ≤ 6 mm
Torque * Hand torque assembly tools	1 N·m	to	1000 N·m	DIN EN ISO 6789-2:2017	5 · 10^{-3}	only operated torque tools
Torque wrench calibration devices	4 N·m	to	1000 N·m	DKD-R 3-8:2018	2 · 10^{-3}	
Pressure * gauge pressure p_e	1 bar ≥ 700 bar	to	700 bar 800 bar	DIN EN 837:1997 DKD-R 6-1:2014	0.2 bar 0.5 bar	Pressure medium: oil
gauge pressure p_e	1 bar	to	30 bar		0.01 bar	Pressure medium: gas
Weighing instruments * Nonautomatic weighing instruments		to	≤ 50 kg	EURAMET Calibration Guide No. 18 version 4.0 (11/2015)	1,2 · 10^{-5}	with weights OIML R 111-1:2004 according to the class F1
Material testing machines (MTM) Hardness (MTM) * Hardness Testers according to hardness scales Shore A, AO and D	0 Shore	to	100 Shore	DIN ISO 7619-1:2012 DIN ISO 18898:2014	1 Shore	Direct measurement with reference standards for travel and power. Optical calibration of the geometrical measure-ments with optical and tactile coordinate measuring machines
Measuring range		to	2.5 mm		6 µm	
Diameter, radii, lengths		to	27 mm		3.5 µm	
Area		to	600 mm²		5 µm²	
Angle	28°	to	37°		0.1°	
Elastic force	0 N	to	44.5 N		0.5 % of final value	
Shore A, AO and D Measuring path standard	0.5 mm	to	2.5 mm	Annex F/34:2020-04	0.8 µm	

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Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Temperature quantities				
Temperature indicators for thermocouples *	-200 °C to 1300 °C	DKD-R 5-5:2018	0.5 K	Simulation of the thermo-electric voltage with multifunction generator (input in temperature units (°C)) Electric consideration of the reference junction
Temperature indicators for resistance thermometers with sensor type PT100 *	-100 °C to 800 °C		0.2 K	Simulation of the resist-ance value on multifunc-tion calibrator (input in temperature units (° C))
Resistance thermometers and direct reading thermometers with resistance sensor *	-25 °C to 140 °C > 140 °C to 300 °C > 300 °C to 400 °C > 400 °C to 500 °C	DKD-R 5-1:2018 in temperature block calibrator	0.2 K 0.4 K 0.6 K 0.8 K	Comparison with resistance thermometers
	0 °C	DKD-R 5-1:2018 Ice point	50 mK	
Radiation thermometers *	5 °C to 120 °C > 120 °C to 500 °C	Black body radiators VDI/VDE 3511 part 4.4:2005	1.5 K 3 K	Calibration with plate radiators
Thermometers for air temperature (Data loggers)	10 °C to 50 °C	Annex F/22-BS:2019-10 in climatic chambers	0.3 K	Comparison with resistance thermometers
Thermocouples *	-25 °C to 140 °C > 140 °C to 500 °C	DKD-R 5-3:2018 in temperature block calibrator	1 K 2.2 K	Comparison with resistance thermometers
Humidity quantitities *				
Devices for relative humidity in air no psychrometer	7 % to 90 %	DKD-R 5-8:2019 in humidity generator temperature: 23 °C	1.5 %	Comparison with reference humidity sensor Measurement uncertainty given in percent relative humidity
DC and low frequency quantities				
DC voltage Measuring instruments	0 mV to 220 mV > 0.22 V to 2.2 V > 2.2 V to 11 V > 11 V to 22 V > 22 V to 220 V > 220 V to 1100 V	Annex F/23-1:2020-05	$0.65\ \mu V + 6.6 \cdot 10^{-6} \cdot U$ $1.2\ \mu V + 4.7 \cdot 10^{-6} \cdot U$ $2.6\ \mu V + 3.5 \cdot 10^{-6} \cdot U$ $4\ \mu V + 3.5 \cdot 10^{-6} \cdot U$ $5\ \mu V + 5 \cdot 10^{-6} \cdot U$ $0.4\ mV + 6.5 \cdot 10^{-6} \cdot U$	U = measuring value

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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	0 V to 0.2 V > 0.2 V to 2 V > 2 V to 20 V > 20 V to 200 V > 200 V to 1000 V	Annex F/29-1:2020-05	0.53 µV + 2.9 · 10^{-6} · U 1 µV + 2.7 · 10^{-6} · U 4.1 µV + 3.0 · 10^{-6} · U 40 µV + 4.5 · 10^{-6} · U 0.5 mV + 4.5 · 10^{-6} · U	U = measuring value
DC current Measuring instruments	0 µA to 220 µA > 0.22 mA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 0,22 A to 2.2 A > 2.2 A to 3 A > 3 mA to 11 A > 11 A to 20.5 A	Annex F/23-2:2020-05	6 nA + 40 · 10^{-6} · I 9.3 nA + 34 · 10^{-6} · I 40 nA + 35 · 10^{-6} · I 0.7 µA + 45 · 10^{-6} · I 13 µA + 79 · 10^{-6} · I 31 µA + 0.29 · 10^{-3} · I 0.39 mA + 0.39 · 10^{-3} · I 0.58 mA + 0.78 · 10^{-3} · I	I = measuring value
DC current sources	10 µA to 200 µA > 0.2 mA to 2 mA > 2 mA to 20 mA > 20 mA to 200 mA > 0.2 A to 2 A > 2 A to 20 A	Annex F/29-2:2020-05	0.4 nA + 12 · 10^{-6} · I 8.9 nA + 10 · 10^{-6} · I 41 nA + 13 · 10^{-6} · I 0.8 µA + 36 · 10^{-6} · I 17 µA + 0.17 · 10^{-3} · I 0.4 mA + 0.38 · 10^{-3} · I	I = measuring value
DC current clamps	0.2 A to < 10 A 10 A to 100 A > 100 A to 1000 A	Annex F/23-2:2020-05	10 mA + 2 · 10^{-3} · I 0.1 A + 2 · 10^{-3} · I 0.8 A + 2.5 · 10^{-3} · I	I = measuring value with current coil with 2, 10 and 50 windings
AC voltage		Annex F/23-3:2020-05		
AC voltage Measuring instruments	0.02 V to 0.22 V	40 Hz to 20 kHz	4 µV + 80 · 10^{-6} · U	U = measuring value
	> 0.22 V to 2.2 V	40 Hz to 20 kHz	8 µV + 42 · 10^{-6} · U	
	> 2.2 V to 22 V	40 Hz to 20 kHz	50 µV + 0.24 · 10^{-3} · U	
	> 22 V to 220 V	40 Hz to 20 kHz	0.64 mV + 60 · 10^{-6} · U	
	> 220 V to 1100 V	50 Hz to 1 kHz	3.5 mV + 70 · 10^{-6} · U	
AC voltage Sources	10 mV to 200 mV	Annex F/29-3:2020-05 40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz > 10 kHz to 30 kHz	 4 µV + 0.11 · 10^{-3} · U 2 µV + 0.11 · 10^{-3} · U 4 µV + 0.13 · 10^{-3} · U 8 µV + 0.34 · 10^{-3} · U	
	> 0.2 V to 2.0 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz > 10 kHz to 30 kHz	20 µV + 90 · 10^{-6} · U 20 µV + 75 · 10^{-6} · U 20 µV + 0.11 · 10^{-3} · U 40 µV + 0.22 · 10^{-3} · U	
	> 2.0 V to 20 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz > 10 kHz to 30 kHz	0.2 mV + 90 · 10^{-6} · U 0.2 mV + 75 · 10^{-6} · U 0.2 mV + 0.11 · 10^{-3} · U 0. mV + 0.22 · 10^{-3} · 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	> 20 V to 200 V	40 Hz to 100 Hz > 100 Hz to 2 kHz > 2 kHz to 10 kHz > 10 kHz to 30 kHz	$2\ mV + 90 \cdot 10^{-6} \cdot U$ $2\ mV + 75 \cdot 10^{-3} \cdot U$ $2\ mV + 0.11 \cdot 10^{-3} \cdot U$ $4\ mV + 0.22 \cdot 10^{-3} \cdot U$	U = measuring value
	> 200 V to 1000 V	40 Hz to 10 kHz > 10 kHz to 30 kHz	$20\ mV + 0.11 \cdot 10^{-3} \cdot U$ $40\ mV + 0.22 \cdot 10^{-3} \cdot U$	
AC current Measuring instruments		Annex F/23-4:2020-05		
	20 µA to 220 µA	40 Hz to 1 kHz	$8\ nA + 0.12 \cdot 10^{-3} \cdot I$	I = measuring value
	> 0.22 mA to 2.2 mA	40 Hz to 1 kHz	$36\ nA + 0.1 \cdot 10^{-3} \cdot I$	
	> 2.2 mA to 22 mA	40 Hz to 1 kHz	$0.35\ µA + 0.1 \cdot 10^{-3} \cdot I$	
	> 22 mA to 220 mA	40 Hz to 1 kHz	$2.5\ µA + 0.1 \cdot 10^{-3} \cdot I$	
	> 0.22 A to 2.2 A	40 Hz to 1 kHz	$36\ µA + 0.24 \cdot 10^{-3} \cdot I$	
	> 2.2 A to 3 A	45 Hz to 1 kHz	$78\ µA + 0.47 \cdot 10^{-3} \cdot I$	
	> 3 A to 11 A	45 Hz to 100 Hz	$1.6\ mA + 0.78 \cdot 10^{-3} \cdot I$	
	> 11 A to 20.5 A	45 Hz to 100 Hz	$3.9\ mA + 1.2 \cdot 10^{-3} \cdot I$	
AC current clumps		Annex F/23-4:2020-05		
	0.2 A to < 10 A	50 Hz	$10\ mA + 2 \cdot 10^{-3} \cdot I$	I = measuring value with current coil with 2, 10 and 50 windings
	10 A to 100 A	50 Hz	$0.1\ A + 2 \cdot 10^{-3} \cdot I$	
	> 100 A to 500 A	50 Hz	$0.4\ A + 2.5 \cdot 10^{-3} \cdot I$	
	> 500 A to 1000 A	50 Hz	$0.8\ A + 2.5 \cdot 10^{-3} \cdot I$	
AC current sources		Annex F/29-4:2020-05		
	0.2 mA to 2.0 mA	10 Hz to 10 kHz	$0.2\ µA + 0.3 \cdot 10^{-3} \cdot I$	I = measuring value
	> 2.0 mA to 20 mA	10 Hz to 10 kHz	$2\ µA + 0.3 \cdot 10^{-3} \cdot I$	
	> 20 mA to 200 mA	10 Hz to 10 kHz	$20\ µA + 0.29 \cdot 10^{-3} \cdot I$	
	> 0.2 A to 2 A	10 Hz to 2 kHz	$0.2\ mA + 0.62 \cdot 10^{-3} \cdot I$	
	> 2 A to 20 A	10 Hz to 2 kHz	$2\ mA + 0.82 \cdot 10^{-3} \cdot I$	
DC resistance Measuring instruments 4-wire connection	0 Ω 1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ	Annex F/23-5:2020-05	2.3 mΩ 2.4 mΩ 2.8 mΩ 4.8 mΩ 37 mΩ 0.37 Ω 3.7 Ω	Fixed resistors
DC resistances 4-wire connection	0 Ω to 2 Ω > 2 Ω to 20 Ω > 20 Ω to 200 Ω > 200 Ω to 2 kΩ > 2 kΩ to 20 kΩ	Annex F/30:2020-05	$0.11\ mΩ + 3 \cdot 10^{-6} \cdot R$ $0.1\ mΩ + 6.1 \cdot 10^{-6} \cdot R$ $91\ µΩ + 7.8 \cdot 10^{-6} \cdot R$ $0.12\ Ω + 0.59 \cdot 10^{-3} \cdot R$ $0.11\ Ω + 4.4 \cdot 10^{-6} \cdot R$	R = measuring value
Measuring instruments 2-wire connection	1 MΩ 10 MΩ 100 MΩ	Annex F/23-5:2020-05	0.06 kΩ 1.8 kΩ 0.24 MΩ	Fixed resistors

[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.

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
DC resistance DC resistances 2-wire connection	> 20 kΩ to 200 kΩ > 200 kΩ to 2 MΩ > 2 MΩ to 20 MΩ > 20 MΩ to 200 MΩ > 200 MΩ to 2 GΩ	Annex F/30:2020-05	91 mΩ + 7.8 · 10^{-6} · R 0.12 kΩ + 0.77 · 10^{-3} · R 0.14 kΩ + 0.81 · 10^{-3} · R 10 kΩ + 0.12 · 10^{-3} · R 1 MΩ + 0.51 · 10^{-3} · R	R = measuring value
Time and frequency				
Frequency Measuring instruments	0.01 Hz to 120 Hz > 120 Hz to 1.2 kHz > 1.2 kHz to 12 kHz > 12 kHz to 120 kHz > 120 kHz to 1.2 MHz	Annex F/23-6:2020-05	12 mHz + 50 · 10^{-6} · F 0.12 Hz + 50 · 10^{-6} · F 1.2 Hz + 50 · 10^{-6} · F 12 Hz + 50 · 10^{-6} · F 0.12 kHz + 50 · 10^{-6} · F	F = measuring value
Revolution speed Revolution counter optical	120 min^{-1} to 100000 min^{-1}	Annex F/24:2020-05	0.05 min^{-1} + 18 · 10^{-6} · n	direct optical excitation n = measuring value

On-site Calibration

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Length				
Deviation from flatness Horizontal flatness standard, e.g.surface plates as per DIN 876:1984	to 50 µm	Annex F/13:2020-10 to 2 m edge length electronic inclination measuring	0.9 µm + 1.7 · 10^{-6} · l	l = longest edge length of the measuring standard
Deviation from straightness Horizontal flatness standard, e.g.surface plates as per DIN 876:1984	to 50 µm	Annex F/13:2020-10 to 3 m edge length electronic inclination measuring	2.2 µm + 1.7 · 10^{-6} · l	
Height gauges *	0 mm to 600 mm	VDI/VDE/DGQ 2618 part 16.1:2009	2.5 µm + 5 · 10^{-6} · l	l = measured length

[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
Coordinate measuring technology * Measuring projectors Measuring microscopes	Devices featuring a measuring surface with a face diagonal ≤ 530 mm	Calibration of metro-logical characteristics according to 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-1D(OT)* with a graduated scale made of glass according to VDI/VDE 2617 part 6.1:2007	0.4 µm	Measuring projectors and measuring Microscopes with visual probing with crosshairs or electronic edge detection
		The error of indication for size measurement *E-1D(OT)* and *E-2D(OT)* is determined with a graduated scale made of glass according to VDI/VDE 2617 part 6.1:2007	0.5 µm + 0.5 · 10^{-6} · L	L = measured length
Weighing instruments * Nonautomatic weighing instruments	to ≤ 50 kg	EURAMET Calibration Guide No. 18 version 4.0 (11/2015)	1 · 10^{-5}	with weights OIML R 111-1:2004 according to the class F1
Torque * Hand torque assembly tools	1 N·m to 1000 N·m	DIN EN ISO 6789-2:2017	5 · 10^{-3}	only operated torque tools

Mobile Laboratory

Calibration and Measurement Capabilities (CMC)

Measurement quantity / Calibration item	Range	Measurement conditions / procedure	Expanded uncertainty of measurement [1)]	Remarks
Torque * Hand torque assembly tools	1 N·m to 1000 N·m	DIN EN ISO 6789-2:2017	5 · 10^{-3}	only operated torque tools

[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 (Kalibrier- und Messmöglichkeiten)
DIN	Deutsches Institut für Normung e.V.
DKD-R	Guideline of Deutschen Kalibrierdienstes (DKD), published by Physikalisch-Technischen Bundesanstalt
EURAMET	European Association of National Metrology Institutes
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik e.V.
VDI	Verein Deutscher Ingenieure e.V.
DGQ	Deutsche Gesellschaft für Qualität e.V.
Annex F	Calibration Guide of Perschmann Calibration GmbH

[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.