

Deutsche Akkreditierungsstelle GmbH

Annex to the accreditation certificate D-K-15070-01-08
according to DIN EN ISO/IEC 17025:2018

Valid from: 21.07.2021

Date of issue: 21.07.2021

Certificate holder:

Testo Industrial Services GmbH

With their calibration laboratory

Calibration laboratory Munich

Nikolaus-Otto-Straße 2, 85221 Dachau

The German original version
„Anlage zur Akkreditierungsurkunde D-K-15070-01-08 nach DIN EN ISO/IEC 17025:2018“
is valid.

The requirements for the management system in DIN EN ISO/IEC 17025 are written in a language relevant for calibration laboratories and are overall 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 the Deutsche Akkreditierungsstelle GmbH (DAkkS).
<https://www.dakks.de/content/datenbank-akkreditierter-stellen>*

Annex to the accreditation certificate D-K-15070-01-08

Calibrations in the areas:

Electrical measurands

Direct current and low frequency measurands

- DC voltage
- AC voltage
- DC current
- AC power
- DC resistance
- Electrical power
- Capacity
- Stress ratio

Time and Frequency

- Time interval
- Frequency

High-frequency measurands

- Oscilloscope measures
- Rise time

Dimensional measurands

Length

- Length measuring equipment
- Diameter
- Thread

Angle

- Angle of rotation

Mechanical measurands

- Pressure
- Acceleration
- Force
- Torque

Flow measurands

- Mass of flowing gases
- Volume of flowing gases
- Mass of flowing liquids
- Volume of flowing liquids

Thermodynamic measurands

Temperature measurands

- Temperature indicators and simulators

Within the measurands/calibration items marked with *) , the calibration laboratory is permitted to apply the standards/calibration guidelines listed here with different issue statuses without requiring prior information and approval by the DAkkS. The calibration laboratory has an up-to-date list of all standards/calibration guidelines in the flexible accreditation area.

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Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurand / calibration item	Measuring range /	Measuring conditions / Procedures	Expanded uncertainty of measurement ¹⁾	Remarks
DC voltage Measuring instruments	0 V		0.1 μ V	U - measured value
	0,01 V up to 0,22 V		$7 \cdot 10^{-6} U$ 1 μ V	
	> 0,22 V up to 2,2 V		$7 \cdot 10^{-6} U$ 1 μ V	
	> 2,2 V up to 11 V		$9 \cdot 10^{-6} U$	
	> 11 V up to 22 V		$8 \cdot 10^{-6} U$	
	> 22 V up to 220 V		$12 \cdot 10^{-6} U$	
DC voltage Sources	0 V		0.1 μ V	
	1 mV up to 100 mV		$8 \cdot 10^{-6} U$ 1 μ V	
	> 100 mV up to 1 V		$11 \cdot 10^{-6} U$	
	> 1 V up to 10 V		$9 \cdot 10^{-6} U$	
	> 10 V up to 100 V		$13 \cdot 10^{-6} U$	
	> 100 V up to 1000 V		$16 \cdot 10^{-6} U$	
DC current Measuring instruments	0 A		0.2 nA	I - Measured value
	10 μ A up to 220 μ A		$50 \cdot 10^{-6} I$ 8 nA	
	> 220 μ A up to 2.2 mA		$87 \cdot 10^{-6} I$	
	> 2.2 mA up to 22 mA		$87 \cdot 10^{-6} I$	
	> 22 mA up to 220 mA		$89 \cdot 10^{-6} I$	
	> 220 mA up to 2,2 A		$0.2 \cdot 10^{-3} I$	
	> 2,2 A up to 11 A		$0.55 \cdot 10^{-3} I$	
	> 11 A up to 20 A		$1.2 \cdot 10^{-3} I$	
	> 20 A up to 200 A	Voltage drop with Normal resistance	$1.0 \cdot 10^{-3} I$	
DC current Sources	0 A		0.2 nA	
	0.1 μ A up to 1 μ A		$0.4 \cdot 10^{-3} I$	
	> 1 μ A up to 10 μ A		$0.12 \cdot 10^{-3} I$	
	> 10 μ A up to 100 μ A		$0.10 \cdot 10^{-3} I$	
	> 100 μ A up to 1 mA		$70 \cdot 10^{-6} I$	
	> 1 mA up to 10 mA		$70 \cdot 10^{-6} I$	
	> 10 mA up to 100 mA		$85 \cdot 10^{-6} I$	
	> 100 mA up to 1 A		$0.2 \cdot 10^{-3} I$	
	> 1 A up to 10 A	Voltage drop with Normal resistance	$0.5 \cdot 10^{-3} I$	
DC current Current clamps	> 10 A up to 200 A	Voltage drop with Normal resistance	$1 \cdot 10^{-3} I$	
	1 mA up to 2,2 A		$1 \cdot 10^{-3} I$	
	> 2,2 A up to 20 A		$2 \cdot 10^{-3} I$	
	> 20 A up to 1000 A		$3 \cdot 10^{-3} I$	

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Measurand / calibration item	Measuring range /	Measuring conditions / Procedures	Expanded uncertainty of measurement ¹⁾	Remarks
DC power	1 mW up to 300 W > 300 W up to 20 kW		$0.5 \cdot 10^{-3}P$ $1.0 \cdot 10^{-3}P$	P - Measured value
DC resistance Measuring instruments	0 Ω 1 Ω 1,9 Ω 10 Ω 19 Ω 100 Ω 190 Ω 1 kΩ 1.9 kΩ 10 kΩ 19 kΩ 100 kΩ 190 kΩ 1 MΩ 1.9 MΩ 10 MΩ 19 MΩ 100 MΩ		50 μΩ $95 \cdot 10^{-6}R$ $95 \cdot 10^{-6}R$ $28 \cdot 10^{-6}R$ $27 \cdot 10^{-6}R$ $17 \cdot 10^{-6}R$ $17 \cdot 10^{-6}R$ $13 \cdot 10^{-6}R$ $13 \cdot 10^{-6}R$ $12 \cdot 10^{-6}R$ $12 \cdot 10^{-6}R$ $14 \cdot 10^{-6}R$ $14 \cdot 10^{-6}R$ $20 \cdot 10^{-6}R$ $21 \cdot 10^{-6}R$ $40 \cdot 10^{-6}R$ $48 \cdot 10^{-6}R$ $0.11 \cdot 10^{-3}R$	R - Measured value
DC resistance Sources	0 Ω 1 Ω up to 10 Ω > 10 Ω up to 100 Ω > 100 Ω up to 1 kΩ > 1 kΩ up to 10 kΩ > 10 kΩ up to 100 kΩ > 100 kΩ up to 1 MΩ > 1 MΩ up to 10 MΩ > 10 MΩ up to 100 MΩ > 100 MΩ up to 1 GΩ		100 μΩ $16 \cdot 10^{-6}R$ 50 μΩ $12 \cdot 10^{-6}R$ 500 μΩ $15 \cdot 10^{-6}R$ $15 \cdot 10^{-6}R$ $15 \cdot 10^{-6}R$ $35 \cdot 10^{-6}R$ $0.15 \cdot 10^{-3}R$ $0.6 \cdot 10^{-3}R$ $5 \cdot 10^{-3}R$	
DC resistance	0,001 Ω up to 0.1 Ω > 0,1 Ω up to 1 MΩ > 1 MΩ up to 100 MΩ	Substitution procedure with normal resistance	$50 \cdot 10^{-6} \cdot R$ $20 \cdot 10^{-6} \cdot R$ $30 \cdot 10^{-6} \cdot R$	
AC resistance	0,1 Ω up to 2 Ω	50 Hz to 400 Hz	$10 \cdot 10^{-3} \cdot R$	

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DC resistance ranges Measuring instruments and Sources	1 Ω up to < 11 Ω		$0.12 \cdot 10^{-3}R$	R - Measured value	
	11 Ω up to < 33 Ω		$33 \cdot 10^{-6}R$		
	33 Ω up to < 110 Ω		$29 \cdot 10^{-6}R$		
	110 Ω up to < 330 Ω		$28 \cdot 10^{-6}R$		
	330 Ω up to < 1.1 kΩ		$28 \cdot 10^{-6}R$		
	1.1 kΩ up to < 3.3 kΩ		$28 \cdot 10^{-6}R$		
	3.3 kΩ up to < 11 kΩ		$28 \cdot 10^{-6}R$		
	11 kΩ up to < 33 kΩ		$28 \cdot 10^{-6}R$		
	33 kΩ up to < 110 kΩ		$28 \cdot 10^{-6}R$		
	110 kΩ up to < 330 kΩ		$32 \cdot 10^{-6}R$		
	330 kΩ up to < 1.1 MΩ		$33 \cdot 10^{-6}R$		
	1.1 MΩ up to < 3.3 MΩ		$62 \cdot 10^{-6}R$		
	3.3 MΩ up to < 11 MΩ		$0.13 \cdot 10^{-3}R$		
	11 MΩ up to < 33 MΩ		$0.25 \cdot 10^{-3}R$		
	33 MΩ up to < 110 MΩ		$0.5 \cdot 10^{-3}R$		
110 MΩ up to < 330 MΩ		$3 \cdot 10^{-3}R$			
330 MΩ up to < 1.1 GΩ		$15 \cdot 10^{-3}R$			
AC voltage Measuring instruments and Sources	1 mV	2.2 mV	10 Hz up to 20 Hz	$0.52 \cdot 10^{-3}U$	U - measured value
			> 20 Hz up to 40 Hz	$0.52 \cdot 10^{-3}U$	
			> 40 Hz up to 20 kHz	$0.40 \cdot 10^{-3}U$	
			> 20 kHz up to 50 kHz	$0.40 \cdot 10^{-3}U$	
			> 50 kHz up to 100 kHz	$0.41 \cdot 10^{-3}U$	
			> 100 kHz up to 300 kHz	$0.46 \cdot 10^{-3}U$	
			> 300 kHz up to 500 kHz	$0.55 \cdot 10^{-3}U$	
			> 500 kHz up to 1 MHz	$0.60 \cdot 10^{-3}U$	
	> 2.2 mV	up to 7 mV	10 Hz up to 20 Hz	$0.22 \cdot 10^{-3}U$	
			> 20 Hz up to 40 Hz	$0.22 \cdot 10^{-3}U$	
			> 40 Hz up to 20 kHz	$0.16 \cdot 10^{-3}U$	
			> 20 kHz up to 50 kHz	$0.16 \cdot 10^{-3}U$	
			> 50 kHz up to 100 kHz	$0.20 \cdot 10^{-3}U$	
			> 100 kHz up to 300 kHz	$0.22 \cdot 10^{-3}U$	
			> 300 kHz up to 500 kHz	$0.33 \cdot 10^{-3}U$	
		> 500 kHz up to 1 MHz	$0.45 \cdot 10^{-3}U$		

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AC voltage Measuring instruments and sources	> 7 mV up to 22 mV	10 Hz up to 20 Hz > 20 Hz up to 40 Hz > 40 Hz up to 20 kHz > 20 kHz up to 50 kHz > 50 kHz up to 100 kHz > 100 kHz up to 300 kHz > 300 kHz up to 500 kHz > 500 kHz up to 1 MHz	$80 \cdot 10^{-6} U$ $80 \cdot 10^{-6} U$ $65 \cdot 10^{-6} U$ $75 \cdot 10^{-6} U$ $75 \cdot 10^{-6} U$ $95 \cdot 10^{-6} U$ $0.19 \cdot 10^{-3} U$ $0.21 \cdot 10^{-3} U$	<i>U</i> - measured value
	> 22 mV up to 70 mV	10 Hz up to 20 Hz > 20 Hz up to 40 Hz > 40 Hz up to 20 kHz > 20 kHz up to 50 kHz > 50 kHz up to 100 kHz > 100 kHz up to 300 kHz > 300 kHz up to 500 kHz > 500 kHz up to 1 MHz	$70 \cdot 10^{-6} U$ $58 \cdot 10^{-6} U$ $35 \cdot 10^{-6} U$ $35 \cdot 10^{-6} U$ $45 \cdot 10^{-6} U$ $55 \cdot 10^{-6} U$ $0.11 \cdot 10^{-3} U$ $0.13 \cdot 10^{-3} U$	
	> 70 mV up to 220 mV	10 Hz up to 20 Hz > 20 Hz up to 40 Hz > 40 Hz up to 20 kHz > 20 kHz up to 50 kHz > 50 kHz up to 100 kHz > 100 kHz up to 300 kHz > 300 kHz up to 500 kHz > 500 kHz up to 1 MHz	$39 \cdot 10^{-6} U$ $35 \cdot 10^{-6} U$ $25 \cdot 10^{-6} U$ $25 \cdot 10^{-6} U$ $28 \cdot 10^{-6} U$ $42 \cdot 10^{-6} U$ $85 \cdot 10^{-6} U$ $0.1 \cdot 10^{-3} U$	
	> 220 mV up to 700 mV	10 Hz up to 20 Hz > 20 Hz up to 40 Hz > 40 Hz up to 20 kHz > 20 kHz up to 50 kHz > 50 kHz up to 100 kHz > 100 kHz up to 300 kHz > 300 kHz up to 500 kHz > 500 kHz up to 1 MHz	$25 \cdot 10^{-6} U$ $22 \cdot 10^{-6} U$ $12 \cdot 10^{-6} U$ $12 \cdot 10^{-6} U$ $13 \cdot 10^{-6} U$ $14 \cdot 10^{-6} U$ $27 \cdot 10^{-6} U$ $40 \cdot 10^{-6} U$	

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Measurand / calibration item	Measuring range /	Measuring conditions / Procedures	Expanded uncertainty of measurement ¹⁾	Remarks
AC voltage Measuring instruments and sources	> 700 mV up to 2.2 V	10 Hz up to 20 Hz	$20 \cdot 10^{-6} U$	<i>U</i> - measured value
		> 20 Hz up to 40 Hz	$14 \cdot 10^{-6} U$	
		> 40 Hz up to 20 kHz	$10 \cdot 10^{-6} U$	
		> 20 kHz up to 50 kHz	$10 \cdot 10^{-6} U$	
		> 50 kHz up to 100 kHz	$11 \cdot 10^{-6} U$	
		> 100 kHz up to 300 kHz	$11 \cdot 10^{-6} U$	
		> 300 kHz up to 500 kHz	$22 \cdot 10^{-6} U$	
		> 500 kHz up to 1 MHz	$68 \cdot 10^{-6} U$	
	> 2.2 V up to 7 V	10 Hz up to 20 Hz	$18 \cdot 10^{-6} U$	
		> 20 Hz up to 40 Hz	$12 \cdot 10^{-6} U$	
		> 40 Hz up to 20 kHz	$11 \cdot 10^{-6} U$	
		> 20 kHz up to 50 kHz	$11 \cdot 10^{-6} U$	
		> 50 kHz up to 100 kHz	$13 \cdot 10^{-6} U$	
		> 100 kHz up to 300 kHz	$13 \cdot 10^{-6} U$	
		> 300 kHz up to 500 kHz	$30 \cdot 10^{-6} U$	
		> 500 kHz up to 1 MHz	$95 \cdot 10^{-6} U$	
	> 7 V up to 22 V	10 Hz up to 20 Hz	$17 \cdot 10^{-6} U$	
		> 20 Hz up to 40 Hz	$16 \cdot 10^{-6} U$	
		> 40 Hz up to 20 kHz	$11 \cdot 10^{-6} U$	
		> 20 kHz up to 50 kHz	$11 \cdot 10^{-6} U$	
		> 50 kHz up to 100 kHz	$11 \cdot 10^{-6} U$	
		> 100 kHz to 300 kHz	$25 \cdot 10^{-6} U$	
		> 300 kHz up to 500 kHz	$30 \cdot 10^{-6} U$	
		> 500 kHz up to 1MHz	$0.11 \cdot 10^{-3} U$	
	> 22 V up to 70 V	10 Hz up to 20 Hz	$18 \cdot 10^{-6} U$	
		> 20 Hz up to 40 Hz	$16 \cdot 10^{-6} U$	
		> 40 Hz up to 20 kHz	$15 \cdot 10^{-6} U$	
		> 20 kHz up to 50 kHz	$15 \cdot 10^{-6} U$	
		> 50 kHz up to 100 kHz	$25 \cdot 10^{-6} U$	
		> 100 kHz up to 300 kHz	$25 \cdot 10^{-6} U$	
		> 300 kHz up to 500 kHz	$40 \cdot 10^{-6} U$	
		> 500 kHz up to 1 MHz	$0.13 \cdot 10^{-3} U$	

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Calibration and Measurement Capabilities (CMC)

Measurand / calibration item	Measuring range /	Measuring conditions / Procedures	Expanded uncertainty of measurement ¹⁾	Remarks
AC voltage Measuring instruments and Sources	> 70 V up to 220 V	10 Hz up to 20 Hz > 20 Hz up to 40 Hz > 40 Hz up to 20 kHz > 20 kHz up to 50 kHz > 50 kHz up to 100 kHz	$19 \cdot 10^{-6}U$ $18 \cdot 10^{-6}U$ $17 \cdot 10^{-6}U$ $17 \cdot 10^{-6}U$ $32 \cdot 10^{-6}U$	U - measured value
	> 220 V up to 1000 V	10 Hz up to 20 Hz > 20 Hz up to 40 Hz > 40 Hz up to 20 kHz > 20 kHz up to 50 kHz > 50 kHz up to 100 kHz	$25 \cdot 10^{-6}U$ $27 \cdot 10^{-6}U$ $45 \cdot 10^{-6}U$ $45 \cdot 10^{-6}U$ $65 \cdot 10^{-6}U$	
AC power Sources and measuring instruments	100 μ A up to 1 mA	10 Hz up to 40 Hz > 40 Hz up to 1 kHz; > 1 kHz up to 10 kHz;	$120 \cdot 10^{-6}I$ $160 \cdot 10^{-6}I$ $60 \cdot 10^{-6}I$	I - Measured value
	> 1 mA up to 10 mA	10 Hz up to 40 Hz > 40 Hz up to 1 kHz; > 1 kHz up to 10 kHz;	$46 \cdot 10^{-6}I$	
	> 10 mA up to 1 A	10 Hz up to 40 Hz > 40 Hz up to 1 kHz; > 1 kHz up to 10 kHz;	$17 \cdot 10^{-6}I$	
	> 1 A up to 10 A	10 Hz up to 40 Hz > 40 Hz up to 1 kHz; > 1 kHz up to 10 kHz;	$32 \cdot 10^{-6}I$	
	> 10 A up to 20 A	10 Hz up to 40 Hz > 40 Hz up to 1 kHz; > 1 kHz up to 10 kHz;	$39 \cdot 10^{-6}I$	
AC power Current clamps	1 mA up to 2.2 A	40 Hz up to 5 kHz	$2 \cdot 10^{-3}I$	
	> 2.2 A up to 20 A	40 Hz up to 5 kHz	$3 \cdot 10^{-3}I$	
	> 20 A up to 800 A	40 Hz by 65 Hz	$4 \cdot 10^{-3}I$	
Frequency	1 MHz up to 10 MHz	in 1 MHz Step size	$5 \cdot 10^{-11} \cdot f$	f = current measured value
	1 mHz up to 1 GHz		$2 \cdot 10^{-9} \cdot f \cdot UTF$	U_{Tr} = Trigger uncertainty
Time interval	1 μ s up to 10000 s		$2 \cdot 10^{-9} \cdot t \cdot 2 \text{ ns}$	t = current measured value
AC active power Measuring devices		33 mV up to 1000 V 45 Hz up to 65 Hz PF = 1		P = preset power
	109 μ W up to < 11 kW	33 mA up to < 11 A	$1.4 \cdot 10^{-3}P$	
	363 mW up to 20 kW	11 A up to 20 A	$2.0 \cdot 10^{-3}P$	

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Measurand / calibration item	Measuring range /	Measuring conditions / Procedures	Expanded uncertainty of measurement ¹⁾	Remarks
Oscilloscopes				<i>U</i> - measured value
Vertical deflection	5 mV up to 5 V 5 mV up to 120 V	$R_i = 50 \Omega$ $R_i = 1 M\Omega$	$3.5 \cdot 10^{-3} U$ 35 μV $2.4 \cdot 10^{-3} U$ 40 μV	Square wave voltage 10 Hz to 10 kHz
Horizontal deflection	5 ns up to 520 ms > 20 ms up to 5 s		$3 \cdot 10^{-6} T$ 1 ns $30 \cdot 10^{-6} T$ 1.2 · $10^{-4} T^2$	
Rise time	180 ps up to 10 ms	25 mV to 1 V $R_i = 50 \Omega$	$40 \cdot 10^{-3} \cdot tr$ 7 ps	tr: current rise time
Temperature indicators and -simulators for resistance thermometer *)	-200 °C up to 850 °C	DKD-R 5-5:2018	0,016 K	Characteristic according to DIN EN 60751:2009
Temperature indicators and -simulators for Resistance thermometer *)	-200 °C up to 850 °C		0,03 K	
Temperature indicators and -simulators for Precious Metals Thermocouples *)	-200 °C up to 1750 °C	DKD-R 5-5:2018	0,1 K	Characteristic according to DIN EN 60584-1:1998
Temperature indicators and -simulators for Non-Precious Metals Thermocouples *)	-200 °C up to 1300 °C	DKD-R 5-5:2018	0,05 K	Characteristic according to DIN EN 60584-1:1998
Temperature indicators				
Voltage ratio	± 2 mV/V	Bridge voltage: 5 V Measuring frequency 225 Hz Measuring frequency 600 Hz Measuring frequency 4.8 kHz	0.04 $\mu V/V$ 0.05 $\mu V/V$ 1.0 $\mu V/V$	Calibration of 350 Ω bridge standards and the associated indicators
		Measuring frequency 225 Hz Measuring frequency 600 Hz Measuring frequency 4.8 kHz		at discrete points in step of 10%
		Bridge voltage: 5 V Measuring frequency 225 Hz Measuring frequency 4.8 kHz	0.15 $\mu V/V$ 1.0 $\mu V/V$	
		Bridge voltage: 5 V Measuring frequency 225 Hz Measuring frequency 4.8 kHz	0.10 $\mu V/V$ 0.30 $\mu V/V$	

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Voltage ratio	± 5 mV/V	Bridge voltage: 2,5 V Measuring frequency 225 Hz Measuring frequency 600 Hz Measuring frequency 4.8 kHz	0.1 µV/V 0.1 µV/V 1.0 µV/V	Calibration of 350Ω bridge standards and the associated indicators at discrete points in steps of 10%
	± 10 mV/V	Bridge voltage: 2,5 V Measuring frequency 225 Hz Measuring frequency 600 Hz Measuring frequency 4.8 kHz	0.4 µV/V 0.4 µV/V 0.4 µV/V	
	± 10 mV/V	Bridge voltage: 1 V Measuring frequency 600 Hz	0.40 µV/V	
	± 20 mV/V	Bridge voltage: 1 V Measuring frequency 4.8 kHz	0.60 µV/V	
	± 100 mV/V	Bridge voltage: 1 V Measuring frequency 4.8 kHz	5.0 µV/V	
	± 100 mV/V	Bridge voltage: 2,5 V Measuring frequency 4.8 kHz	5.0 µV/V	
Voltage ratio DC voltage Bridge standards	0 mV/V	Bridge voltage:	2.0 µV/V	
	-2 mV/V up to 2 mV/V		2.5 µV/V	
	-5 mV/V up to 5 mV/V	0,5 V	2.5 µV/V	
	-10 mV/V up to 10 mV/V		2.5 µV/V	
	-20 mV/V up to 20 mV/V		2.5 µV/V	
	-100 mV/V up to 100 mV/V		2.5 µV/V	
	0 mV/V	Bridge voltage:	1.0 µV/V	
	-2 mV/V up to 2 mV/V		2.0 µV/V	
	-5 mV/V up to 5 mV/V	1,0 V	2.0 µV/V	
-10 mV/V up to 10 mV/V		2.0 µV/V		
-20 mV/V up to 20 mV/V		2.0 µV/V		
-100 mV/V up to 100 mV/V		2.0 µV/V		
0 mV/V	Bridge voltage:	0.5 µV/V		
-2 mV/V up to 2 mV/V		0.5 µV/V		
-5 mV/V up to 5 mV/V	2,5 V	0.5 µV/V		
-10 mV/V up to 10 mV/V		0.5 µV/V		
-20 mV/V up to 20 mV/V		0.5 µV/V		
-100 mV/V up to 100 mV/V		1.5 µV/V		

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Voltage ratio DC voltage Bridge standards	0 mV/V -2 mV/V up to 2 mV/V -5 mV/V up to 5 mV/V -10 mV/V up to 10 mV/V -20 mV/V up to 20 mV/V -100 mV/V up to 100 mV/V	Bridge voltage: 5,0 V	0.3 µV/V 0.25 µV/V 0.25 µV/V 0.25 µV/V 0.35 µV/V 1.5 µV/V	
	0 mV/V -2 mV/V up to 2 mV/V -5 mV/V up to 5 mV/V -10 mV/V up to 10 mV/V -20 mV/V up to 20 mV/V -100 mV/V up to 100 mV/V	Bridge voltage: 7,5 V	0.2 µV/V 0.2 µV/V 0.2 µV/V 0.2 µV/V 0.3 µV/V 1.5 µV/V	
	0 mV/V -2 mV/V up to 2 mV/V -5 mV/V up to 5 mV/V -10 mV/V up to 10 mV/V -20 mV/V up to 20 mV/V -100 mV/V up to 100 mV/V	Bridge voltage: 10,0 V	0.1 µV/V 0.15 µV/V 0.15 µV/V 0.2 µV/V 0.3 µV/V 1.5 µV/V	
Voltage ratio DC voltage bridges, measuring instruments, measuring amplifiers	-2 mV/V up to 2 mV/V -5 mV/V up to 5 mV/V -10 mV/V up to 10 mV/V -20 mV/V up to 20 mV/V -100 mV/V up to 100 mV/V	Bridge voltage: 0,5 V	0.35 µV/V 0.35 µV/V 0.40 µV/V 0.55 µV/V 2.5 µV/V	With K148
	-2 mV/V up to 2 mV/V -5 mV/V up to 5 mV/V -10 mV/V up to 10 mV/V -20 mV/V up to 20 mV/V -100 mV/V up to 100 mV/V	Bridge voltage: 1 V	0.20 µV/V 0.20 µV/V 0.30 µV/V 0.50 µV/V 2.5 µV/V	
Voltage ratio DC voltage bridges, measuring instruments, measuring amplifiers	-2 mV/V up to 2 mV/V -5 mV/V up to 5 mV/V -10 mV/V up to 10 mV/V -20 mV/V up to 20 mV/V -100 mV/V up to 100 mV/V	Bridge voltage: 2.5 V; 5 V; 7.5 V; 10 V	0.10 µV/V 0.15 µV/V 0.25 µV/V 0.45 µV/V 2.5 µV/V	

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Calibration and Measurement Capabilities (CMC)

Measurand / calibration item	Measuring range /	Measuring conditions / Procedures	Expanded uncertainty of measurement ¹⁾	Remarks
Capacity Measuring instruments	190 pF up to < 400 pF	10 Hz up to 10 kHz	$4 \cdot 10^{-3} C$ 8 pF	C = measured value
	400 pF up to < 1.1 nF	10 Hz up to 10 kHz	$4.5 \cdot 10^{-3} C$ 8 pF	
	1.1 nF up to < 3.3 nF	10 Hz up to kHz	$4.0 \cdot 10^{-3} C$ 8 pF	
	3.3 nF up to < 11 nF	10 Hz up to 1 kHz	$2.5 \cdot 10^{-3} C$ 8 pF	
	11 nF up to < 33 nF	10 Hz up to 1 kHz	$2.5 \cdot 10^{-3} C$ 80 pF	
	33 nF up to < 110 nF	10 Hz up to 1 kHz	$2.5 \cdot 10^{-3} C$ 80 pF	
	110 nF up to < 330 nF	10 Hz up to 1 kHz	$4.5 \cdot 10^{-3} C$	
	330 nF up to < 1.1 μF	10 Hz up to 600 Hz	$4.5 \cdot 10^{-3} C$	
	1.1 μF up to < 3.3 μF	10 Hz up to 300 Hz	$4.5 \cdot 10^{-3} C$	
	3.3 μF up to < 11 μF	10 Hz up to 150 Hz	$4.5 \cdot 10^{-3} C$	
	11 μF up to < 33 μF	10 Hz up to 120 Hz	$6.0 \cdot 10^{-3} C$	
	33 μF up to < 110 μF	10 Hz up to 80 Hz	$6.5 \cdot 10^{-3} C$	
	110 μF up to < 330 μF	DC up to 50 Hz	$6.0 \cdot 10^{-3} C$	
	330 μF up to < 1.1 mF	DC up to Hz	$6.0 \cdot 10^{-3} C$	
	1.1 mF up to < 3.3 mF	DC up to 6 Hz	$6.0 \cdot 10^{-3} C$	
	3.3 mF up to < 11 mF	DC up to 2 Hz	$6.0 \cdot 10^{-3} C$	
11 mF up to < 33 mF	DC up to 200.6 Hz	$8.0 \cdot 10^{-3} C$		
33 mF up to 110 mF	DC up to 0,2 Hz	$11 \cdot 10^{-3} C$		
Acceleration vibration transducer, vibration measuring instrument, vibration calibrators	0.1 m/s ² up to 20 m/s ²	Sinus excitation frequency: 0.2 Hz up to < 0.4 Hz 0.4 Hz up to < 1 Hz 1 Hz up to < 16 Hz 16 Hz > 16 Hz up to 63 Hz > 63 Hz up to 160 Hz	2,5 % / 1,6 ° 1,5 % / 1,6 ° 0,8 % / 0,8 ° 0,55 % / 0,6 ° 0,8 % / 0,8 ° 1,0 % / 1,1 °	Complex transmission coefficient (magnitude / phase). Transducer mass up to 0.9 kg, path amplitude up to 100 mm
		1 m/s ² by 200 m/s ²	Sinusoidal excitation frequencies: 10 Hz up to < 20 Hz 20 Hz up to < 80 Hz 80 Hz > 80 Hz up to 1 kHz > 1 kHz up to 5 kHz > 5 kHz up to 9 kHz > 9 kHz to 10 kHz	

¹⁾ The CMCs contain the extended measurement uncertainties according to EA-4/02 M:2013. Within the framework of accreditation, these are the smallest measurement uncertainties that can be specified with a coverage probability of about 95 % and, unless otherwise specified, have the coverage factor k = 2. Uncertainties of measurement without indication of units are relative values related to the measured value, unless otherwise stated.

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Calibration and Measurement Capabilities (CMC)

Measurand / calibration item	Measuring range /	Measuring conditions / Procedures	Expanded uncertainty of measurement ¹⁾	Remarks
Torque				
hand-operated torque screwdriver triggering / indicating	1 N·m up to 1000 N·m	DIN EN ISO 6789:2017	$2 \cdot 10^{-3}$	
	1 N·m up to 1000 N·m	DKD-R 3-7:2018	$2 \cdot 10^{-3}$	
Calibration equipment	1 N·m up to 1000 N·m	DKD-R 3-8:2018	$2 \cdot 10^{-3}$	
Torque transducer, -sensors, Torque measurement chains	1 N·m up to 1000 N·m	DIN 51309	$2 \cdot 10^{-3}$	
Angle of rotation				
Direct rotary encoders	0° up to 360°	VDI/VDE 2648 Sheet 1	0,06°	
Indirect rotary encoders	0° up to 360°	VDI/VDE 2648 Sheet 2 Rotation speed > 0.21/min	0,5°	
Indirect rotary encoders	0° up to 360°	VDI/VDE 2648 Sheet 2 Rotation speed < 0.21/min	1,0°	
Force				
Tensile Force, compressive force, Force gauges, force transducers *)	10 N up to 100 kN	DKD-R 3-3:2018	$1 \cdot 10^{-3}$	

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Calibration and Measurement Capabilities (CMC)

Measurand / calibration item	Measuring range /	Measuring conditions / Procedures	Expanded uncertainty of measurement ¹⁾	Remarks
Flow rate Liquids				Measuring instruments with Analog output, Frequency output, visual indication
Volume flow rate dV/dt of flowing Liquids	0.8 mL/min up to 40 L/min	Piston calibrator Volumetric measurement	0,08 %	
	10 mL/min up to 300 L/min	Liquids with a density of 700kg/m ³ to 1100kg/m ³ Viscosity between 0.3 mm ² /s to 1600 mm ² /s	0,08 %	
	1 L/min up to 1200 L/min		0,05 %	
Mass flow rate dm/dt of flowing Liquids	0.6 g/min up to 32 kg/min		0,12 %	
	8 g/min up to 240 kg/min		0,12 %	
	0.8 kg/min up to 1000 kg/min		0,09 %	
Volume V of flowing Liquids	25 mL up to 2,5 L	Flow rates not less than 0.5 mL/min	0,08 %	
	190 mL up to 19 L	Flow rates not less than 1 mL/min		
	410 mL up to 41 L	Flow rates not less than 10 mL/min		

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Calibration and Measurement Capabilities (CMC)

Measurand / calibration item	Measuring range /	Measuring conditions / Procedures	Expanded uncertainty of measurement ¹⁾	Remarks
Volume flow rate dV/dt of flowing gases	1ml/min up to <3ml/min	Critical nozzles dry air (dew point lower than -15°C)	0,40 %	Measuring instruments with analog output, frequency output, visual display nominal state $p_N = 1013.25 \text{ mbar}$ $T_N = 0^\circ\text{C}$
	$\geq 3 \text{ ml/min}$ up to to 1000 l/min		0,33 %	
	8 l/min up to 15000 l/min	Critical nozzles dry air (dew point lower than -15°C)	0,24 %	
Mass flow rate dM/dt of flowing gases	1.3 g/min up to < 3.9 g/min	Laminar flow elements dry air (dew point lower than -15°C)	0,42 %	
	$\geq 3.9 \text{ g/min}$ up to < 1300 g/min		0,36 %	
	10 g/min up to 1500 g/min	Critical nozzles dry air (dew point lower than -15°C)	0,24 %	
Absolute pressure p_{abs}	0.03 bar up to 10 bar	DKD-R 6-1:2014	$0.2 \text{ mbar} \cdot 1 \cdot 10^{-4} \cdot p_{abs}$	Pressure Medium: Gas The measurement uncertainty of the barometer must be considered.
	> 10 bar up to 251 bar	$P_{abs} = p_e \cdot p_{amb}$	$2 \cdot 10^{-4} \cdot p_{abs}$	
Negative and positive	-1 bar up to 0.0 bar	DKD-R 6-1:2014	$50 \mu\text{bar} \cdot 1 \cdot 10^{-4} \cdot p_e$	
Overpressure p_e	> 0 bar up to 10 bar		$0.2 \text{ mbar} \cdot 1 \cdot 10^{-4} \cdot p_e$	
	> 10 bar up to 250 bar		$2 \cdot 10^{-4} \cdot p_e$	

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Calibration and Measurement Capabilities (CMC)

Measurand / calibration item	Measuring range /	Measuring conditions / Procedures	Expanded uncertainty of measurement ¹⁾	Remarks
Length Cylindrical setting standards, ring gauges: Diameter	1 mm up to 200 mm	VDI/VDE/DGQ 2618 Sheet 4.1:2006	$0.8 \mu\text{m} \cdot 2 \cdot 10^{-6} \cdot d$	d = is the measured Diameter
Plug gauges: Diameter	1 mm up to 200 mm	Point 3.3.4 (Opt. 3), Point 3.3.5 (Opt. 4)	$0.8 \mu\text{m} \cdot 2 \cdot 10^{-6} \cdot d$	
Test Probes: Diameter	0.1 mm up to 30 mm	VDI/VDE/DGQ 2618 Sheet 4.2:2007 Point 3.2.2 (Opt. 1)	$0.8 \mu\text{m} \cdot 2 \cdot 10^{-6} \cdot d$	
Thread gauges (single and multiple-start cylindrical external and internal threads with straight flanks, symmetrical profile) Threaded mandrels: single Flank diameter	1.4 mm up to 200 mm Nominal slope: 0.3 mm up to 6 mm	VDI/VDE/DGQ 2618 Sheet 4.8:2006 Point 3.2.2 (Opt. 1)	$3 \mu\text{m} \cdot 10 \cdot 10^{-6} \cdot d$	Three-wire method d = is the measured diameter
Threaded rings: single Flank diameter	3 mm up to 200 mm Nominal slope: 0.5 mm up to 6 mm	VDI/VDE/DGQ 2618 Sheet 4.9:2006 Point 3.2.2 (Opt. 1)	$3 \mu\text{m} \cdot 10 \cdot 10^{-6} \cdot d$	Two-ball method d = is the measured diameter
Length of plane-parallel, spherical or cylindrical Measuring surfaces	0.01 mm up to 500 mm	VDI/VDE/DGQ 2618 Sheet 19.1:2014	$1.5 \mu\text{m} \cdot 2 \cdot 10^{-6} \cdot l$	l is the measured Length
Diameter	0.01 mm up to 200 mm	VDI/VDE/DGQ 2618 Sheet 4.1:2006 Point 3.3.4 (Opt. 3), Point 3.3.5 (Opt. 4)	$1.5 \mu\text{m} \cdot 2 \cdot 10^{-6} \cdot d$	d is the measured Diameter
Feeler gauges	0.03 mm up to 2.00 mm	DIN 2275:2014	$1.5 \mu\text{m} \cdot 2 \cdot 10^{-6} \cdot l$	l is the measured length
Setting dimensions for Outside micrometers	25 mm up to 500 mm	VDI/VDE/DGQ 2618 Sheet 4.4:2009	$1.5 \mu\text{m} \cdot 2 \cdot 10^{-6} \cdot l$	

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Calibration and Measurement Capabilities (CMC)

Measurand / calibration item	Measuring range /	Measuring conditions / Procedures	Expanded uncertainty of measurement ¹⁾	Remarks
Throat gauges	3 mm up to 200 mm	VDI/VDE/DGQ 2618 Sheet 4.7:2005 Point 3.3.2 (Opt. 2)	$0.8 \mu\text{m} \cdot 2 \cdot 10^{-6} \cdot d$	<i>d</i> is the measured Diameter
Caliper for Outside, inside and Depth measurements	0 mm up to 500 mm	VDI/VDE/DGQ 2618 Sheet 9.1:2006	$30 \mu\text{m} \cdot 30 \cdot 10^{-6} \cdot l$	<i>l</i> is the measured Length
Depth calipers,	>500 mm up to 1000 mm	VDI/VDE/DGQ 2618 Sheet 9.2:2006	$50 \mu\text{m} \cdot 30 \cdot 10^{-6} \cdot l$	
Vertical caliper		VDI/VDE/DGQ 2618 Sheet 9.3:2006		
Outside micrometres	0 mm up to 500 mm	VDI/VDE/DGQ 2618 Sheet 10.1:2001	$3 \mu\text{m} \cdot 10 \cdot 10^{-6} \cdot l$	
Precision micrometres	0 mm up to 200 mm	VDI/VDE/DGQ 2618 Sheet 10.3:2002	$3 \mu\text{m} \cdot 10 \cdot 10^{-6} \cdot l$	
Micrometre head	0 mm up to 50 mm	VDI/VDE/DGQ 2618 Sheet 10.4:2008	$3 \mu\text{m} \cdot 10 \cdot 10^{-6} \cdot l$	
Depth micrometres	0 mm up to 300 mm	VDI/VDE/DGQ 2618 Sheet 10.5:2010	$3 \mu\text{m} \cdot 10 \cdot 10^{-6} \cdot l$	
Inside micrometres with 2-point contact on the object to be calibrated	13 mm up to 300 mm > 300 mm up to 500 mm	VDI/VDE/DGQ 2618 Sheet 10.7:2010	$3 \mu\text{m} \cdot 10 \cdot 10^{-6} \cdot l$ $5 \mu\text{m} \cdot 10 \cdot 10^{-6} \cdot l$	
Inside micrometres with 3-line contact on the object to be calibrated	3 mm up to 100 mm	VDI/VDE/DGQ 2618 Sheet 10.8:2002	$3 \mu\text{m} \cdot 10 \cdot 10^{-6} \cdot d$	<i>d</i> is the measured diameter
Lever measuring instruments (quick switch) for outside measurements	up to 200 mm	VDI/VDE/DGQ 2618 Sheet 12.1:2005	$7 \mu\text{m} \cdot 10 \cdot 10^{-6} \cdot l$	<i>l</i> is the measured length
Lever gauges (quick switch) for Inside measurements	2 mm up to 200 mm	VDI/VDE/DGQ 2618 Sheet 13.1:2005	$7 \mu\text{m} \cdot 10 \cdot 10^{-6} \cdot l$	
Dial gauges	0 mm up to 100 mm	VDI/VDE/DGQ/DKD 2618 Sheet 11.1:2021	$3 \mu\text{m} \cdot 10 \cdot 10^{-6} \cdot l$	mechanical dial indicators
		VDI/VDE/DGQ/DKD 2618 Sheet 11.4:2020	$3 \mu\text{m} \cdot 10 \cdot 10^{-6} \cdot l$	electronic digital dial gauges
Fine pointer	0 mm up to 3 mm	VDI/VDE/DGQ 2618 Sheet 11.2:2002	0.6 μm	
Feeler level measuring instruments	0 mm up to 1.6 mm	VDI/VDE/DGQ 2618 Sheet 11.3:2002	1.0 μm	

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Abbreviations used:

CMC Standardization e.V.	Calibration and measurement capabilities DIN German Institute for
DGQ	German Society for Quality e.V.
DKD	Guideline of the German Calibration Service (DKD), published by the Physikalisch-Technische Bundesanstalt (PTB)
VB	Self-developed calibration method of the laboratory
VDE	Association for Electrical, Electronic & Information Technologies e.V.
VDI	Verein of German Engineers e.V.
VDI/VDE/DGQ 2618	VDI guideline series for test equipment monitoring

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