

Deutsche Akkreditierungsstelle GmbH

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

Valid from: 14.04.2020

Date of issue: 14.04.2020

Certificate holder:

Testo Industrial Services GmbH

With their calibration laboratory

Kalibrierlabor München

Nikolaus-Otto-Straße 2. 85221 Dachau

Areas of calibration:

Electrical measurands

Direct current and low frequency measurands

- DC voltage
- AC voltage
- DC current
- AC current
- DC resistance
- Electrical power
- Capacitance
- Voltage ratio

Time and Frequency

- Time interval
- Frequency

High frequency measurands

- Oscilloscope measures
Rise time *)

Thermodynamic measurands

Temperature measurands

- Temperature indicators und -simulators *)

Dimensional measurands

Length

- Length measurements *)
- 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

The German original version "Anlage zur Akkreditierungsurkunde D-K-15070-01-08 nach DIN EN ISO/IEC 17025:2005" is valid.

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.

The certificate together with the attachment of the certificate shows the stand at the time of the issue date. The current status 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

Abbreviations used: see last page

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurand / Calibration item	Measuring range	Measuring conditions /procedures	Extended 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		$7 \cdot 10^{-6} U + 1 \mu$ V	
	> 0.22 V up to 2.2 V		$7 \cdot 10^{-6} U + 1 \mu$ 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 Source	0 V		0.1 μ V	
	1 mV up to 100 mV		$8 \cdot 10^{-6} U + 1 \mu$ 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		$0.2 \cdot 10^{-3} I$	
DC current Source	> 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 Source	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		$70 \cdot 10^{-6} I$	
DC current Source	> 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 Source	> 10 A up to 200 A		$1 \cdot 10^{-3} I$	
	1 mA up to 2.2 A		$1 \cdot 10^{-3} I$	

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.

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

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurand / Calibration item	Measuring range	Measuring conditions /procedures	Extended uncertainty of measurement ¹⁾	Remarks
Current clamps	> 2.2 A up to 20 A > 20 A up to 1000 A		$2 \cdot 10^{-3} I$ $3 \cdot 10^{-3} I$	
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 Source	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 $16 \cdot 10^{-6} R + 50 \mu\Omega$ $12 \cdot 10^{-6} R + 500 \mu\Omega$ $15 \cdot 10^{-6} R$ $15 \cdot 10^{-6} R$ $15 \cdot 10^{-6} R$ $35 \cdot 10^{-6} R$ $0.15 \cdot 10^{-3} R$ $0.6 \cdot 10^{-3} R$ $5 \cdot 10^{-3} R$	
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 up to 400 Hz	$10 \cdot 10^{-3} \cdot R$	

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

Permanent Laboratory

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

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

Permanent Laboratory

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Measurand / Calibration item	Measuring range	Measuring conditions / procedures	Extended uncertainty of measurement ¹⁾	Remarks
AC voltage Measuring instruments and Source	> 7 mV up to 22 mV	10 Hz up to 20 Hz	$80 \cdot 10^{-6} U$	U - Measured value
		> 20 Hz up to 40 Hz	$80 \cdot 10^{-6} U$	
		> 40 Hz up to 20 kHz	$65 \cdot 10^{-6} U$	
		> 20 kHz up to 50 kHz	$75 \cdot 10^{-6} U$	
		> 50 kHz up to 100 kHz	$75 \cdot 10^{-6} U$	
		> 100 kHz up to 300 kHz	$95 \cdot 10^{-6} U$	
		> 300 kHz up to 500 kHz	$0.19 \cdot 10^{-3} U$	
		> 500 kHz up to 1 MHz	$0.21 \cdot 10^{-3} U$	
	> 22 mV up to 70 mV	10 Hz up to 20 Hz	$70 \cdot 10^{-6} U$	
		> 20 Hz up to 40 Hz	$58 \cdot 10^{-6} U$	
		> 40 Hz up to 20 kHz	$35 \cdot 10^{-6} U$	
		> 20 kHz up to 50 kHz	$35 \cdot 10^{-6} U$	
		> 50 kHz up to 100 kHz	$45 \cdot 10^{-6} U$	
		> 100 kHz up to 300 kHz	$55 \cdot 10^{-6} U$	
		> 300 kHz up to 500 kHz	$0.11 \cdot 10^{-3} U$	
		> 500 kHz up to 1 MHz	$0.13 \cdot 10^{-3} U$	
> 70 mV up to 220 mV	10 Hz up to 20 Hz	$39 \cdot 10^{-6} U$		
	> 20 Hz up to 40 Hz	$35 \cdot 10^{-6} U$		
	> 40 Hz up to 20 kHz	$25 \cdot 10^{-6} U$		
	> 20 kHz up to 50 kHz	$25 \cdot 10^{-6} U$		
	> 50 kHz up to 100 kHz	$28 \cdot 10^{-6} U$		
	> 100 kHz up to 300 kHz	$42 \cdot 10^{-6} U$		
	> 300 kHz up to 500 kHz	$85 \cdot 10^{-6} U$		
	> 500 kHz up to 1 MHz	$0.1 \cdot 10^{-3} U$		
> 220 mV up to 700 mV	10 Hz up to 20 Hz	$25 \cdot 10^{-6} U$		
	> 20 Hz up to 40 Hz	$22 \cdot 10^{-6} U$		
	> 40 Hz up to 20 kHz	$12 \cdot 10^{-6} U$		
	> 20 kHz up to 50 kHz	$12 \cdot 10^{-6} U$		
	> 50 kHz up to 100 kHz	$13 \cdot 10^{-6} U$		
	> 100 kHz up to 300 kHz	$14 \cdot 10^{-6} U$		
	> 300 kHz up to 500 kHz	$27 \cdot 10^{-6} U$		
	> 500 kHz up to 1 MHz	$40 \cdot 10^{-6} U$		

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

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurand / Calibration item	Measuring range	Measuring conditions /procedures	Extended uncertainty of measurement ¹⁾	Remarks
AC voltage Measuring instruments and Source	> 700 mV up to 2.2 V	10 Hz up to 20 Hz	$20 \cdot 10^{-6} U$	U - 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 up 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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Annex to the Accreditation certificate D-K-15070-01-08

Permanent Laboratory

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Measurand / Calibration item	Measuring range	Measuring conditions /procedures	Extended uncertainty of measurement ¹⁾	Remarks
AC voltage Measuring instruments and Source	> 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 current Source 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 current 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 up to 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		$2 \cdot 10^{-9} \cdot f + U_{TF}$	U_{TF} = Trigger uncertainty
Time interval	1 μ s up to 10000 s		$2 \cdot 10^{-9} \cdot t + 2 \text{ ns}$	t = current Measured value
AC active power Measuring instruments	33 mV up to 1000 V 45 Hz up to 65 Hz PF = 1	33 mA up to < 11 A	$1.4 \cdot 10^{-3} P$	P = preset power
	109 μ W up to < 11 kW 363 mW up to 20 kW	11 A up to 20 A	$2.0 \cdot 10^{-3} P$	

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

Permanent Laboratory

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Measurand / Calibration item	Measuring range	Measuring conditions / procedures	Extended uncertainty of measurement ¹⁾	Remarks
Oscilloscopes Vertical deflection	5 mV up to 5 V	$R_i = 50 \Omega$	$3.5 \cdot 10^{-3} U + 35 \mu V$	Square wave voltage 10 Hz up to 10 kHz
	5 mV up to 120 V	$R_i = 1 M\Omega$	$2.4 \cdot 10^{-3} U + 40 \mu V$	
Horizontal deflection	5 ns up to 520 ms > 20 ms up to 5 s		$3 \cdot 10^{-6} T + 1 \text{ ns}$ $30 \cdot 10^{-6} T + 1.2 \cdot 10^{-4} T^2$	
Rise time	180 ps up to 10 ms	25 mV up to 1 V $R_i = 50 \Omega$	$40 \cdot 10^{-3} \cdot tr + 7 \text{ ps}$	tr: aktuelle 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 metal 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 metal 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		Bridge voltage: 5 V		Calibration of 350Ω bridge standards and associated indicators At discrete points in steps of 10%
	± 2 mV/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 $\mu V/V$	
	± 2 mV/V	Bridge voltage: 2.5 V Measuring frequency 225 Hz Measuring frequency 600 Hz Measuring frequency 4.8 kHz	0.05 $\mu V/V$ 0.05 $\mu V/V$ 1.0 $\mu V/V$	
	± 5 mV/V	Bridge voltage: 5 V Measuring frequency 225 Hz Measuring frequency 4.8 kHz	0.15 $\mu V/V$ 1.0 $\mu V/V$	
	± 10 mV/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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Annex to the Accreditation certificate D-K-15070-01-08

Permanent Laboratory

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

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

Permanent Laboratory

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Voltage ratio DC voltage Bridge standards	0 mV/V	Bridge voltage:	0.3 µV/V	
	-2 mV/V up to +2 mV/V	5.0 V	0.25 µV/V	
	-5 mV/V up to +5 mV/V		0.25 µV/V	
	-10 mV/V up to +10 mV/V		0.25 µV/V	
	-20 mV/V up to +20 mV/V		0.35 µV/V	
	-100 mV/V up to +100 mV/V		1.5 µV/V	
	0 mV/V	Bridge voltage:	0.2 µV/V	
	-2 mV/V up to +2 mV/V	7.5 V	0.2 µV/V	
	-5 mV/V up to +5 mV/V		0.2 µV/V	
-10 mV/V up to +10 mV/V	0.2 µV/V			
-20 mV/V up to +20 mV/V	0.3 µV/V			
-100 mV/V up to +100 mV/V	1.5 µV/V			
0 mV/V	Bridge voltage:	0.1 µV/V		
-2 mV/V up to +2 mV/V	10.0 V	0.15 µV/V		
-5 mV/V up to +5 mV/V		0.15 µV/V		
-10 mV/V up to +10 mV/V		0.2 µV/V		
-20 mV/V up to +20 mV/V		0.3 µV/V		
-100 mV/V up to +100 mV/V		1.5 µV/V		
Voltage ratio DC voltage Bridges. Measuring instruments, measuring amplifiers	-2 mV/V up to +2 mV/V	Bridge voltage: 0.5	0.35 µV/V	With K148
	-5 mV/V up to +5 mV/V	V	0.35 µV/V	
	-10 mV/V up to +10 mV/V		0.40 µV/V	
	-20 mV/V up to +20 mV/V		0.55 µV/V	
	-100 mV/V up to +100 mV/V		2.5 µV/V	
	-2 mV/V up to +2 mV/V		Bridge voltage:	
-5 mV/V up to +5 mV/V	1 V	0.20 µV/V		
-10 mV/V up to +10 mV/V		0.30 µV/V		
-20 mV/V up to +20 mV/V		0.50 µV/V		
-100 mV/V up to +100 mV/V		2.5 µV/V		
Voltage ratio DC voltage Bridges. Measuring instruments,measuring amplifiers		-2 mV/V up to +2 mV/V	Bridge voltage: 2.5	0.10 µV/V
	-5 mV/V up to +5 mV/V	V; 5 V; 7.5 V; 10 V	0.15 µV/V	
	-10 mV/V up to +10 mV/V		0.25 µV/V	
	-20 mV/V up to +20 mV/V		0.45 µV/V	
	-100 mV/V up to +100 mV/V		2.5 µV/V	

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

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurand / Calibration item	Measuring range	Measuring conditions / procedures	Extended uncertainty of measurement ¹⁾	Remarks
Capacitance Measuring instruments	190 pF up to < 400 pF	10 Hz up to 10 kHz	$4 \cdot 10^{-3} C + 8 \text{ pF}$	
	400 pF up to < 1.1 nF	10 Hz up to 10 kHz	$4.5 \cdot 10^{-3} C + 8 \text{ pF}$	
	1.1 nF up to < 3.3 nF	10 Hz up to 3 kHz	$4.0 \cdot 10^{-3} C + 8 \text{ pF}$	
	3.3 nF up to < 11 nF	10 Hz up to 1 kHz	$2.5 \cdot 10^{-3} C + 8 \text{ pF}$	
	11 nF up to < 33 nF	10 Hz up to 1 kHz	$2.5 \cdot 10^{-3} C + 80 \text{ pF}$	
	33 nF up to < 110 nF	10 Hz up to 1 kHz	$2.5 \cdot 10^{-3} C + 80 \text{ pF}$	
	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 20 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 0.6 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		Sinus Exzitation		Complex transmission coefficient (Magnitude/ phase). Transducer mass up to 0.9 kg. path amplitude to 100 mm.
Vibration- Transducer	0.1 m/s ² up to 20 m/s ²	Frequency: 0.2 Hz up to < 0.4 Hz 0.4 Hz up to < 1 Hz 1 Hz up to < 16 Hz 16 Hz	2.5 % / 1.6 ° 1.5 % / 1.6 ° 0.8 % / 0.8 ° 0.55 % / 0.6 °	
Vibration- Measuring instrument		> 16 Hz up to 63 Hz > 63 Hz up to 160 Hz	0.8 % / 0.8 ° 1.0 % / 1.1 °	
Vibration- calibrator	1 m/s ² up to 200 m/s ²	Sinus Exzitation		Complex transmission coefficient (Magnitude/ phase). Transducer mass up to 0.9 kg. path amplitude to 100 mm.
		Frequency: 10 Hz up to < 20 Hz 20 Hz up to < 80 Hz 80 Hz	1.0 % / 1.5 ° 0.8 % / 0.8 ° 0.55 % / 0.6 °	
		> 80 Hz up to 1 kHz	0.8 % / 0.8 °	
		> 1 kHz up to 5 kHz > 5 kHz up to 9 kHz	1.0 % / 1.1 ° 2.0 % / 2.1 °	
		> 9 kHz up to 10 kHz	3.0 % / 2.1 °	

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

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurand / Calibration item	Measuring range	Measuring conditions /procedures	Extended 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 Nm up to 1000 Nm	DIN 51309	$2 \cdot 10^{-3}$	
angle of rotation direct rotary encoders	0° up to 360°	VDI/VDE 2648 Sheet 1 VDI/VDE 2648 Sheet 2	0.06°	
direct rotary encoders	0° up to 360°	Rotation speed 0.2 1/min VDI/VDE 2648 Sheet 2	0.5°	
direct rotary encoders	0° up to 360°	Rotation speed < 0.2 1/min	1.0°	
Force Tensile force. compressive force Force gauges. force transducer	10 N up to 10 kN	DKD-R 3-3:2018	$1 \cdot 10^{-3}$	
Length Cylindrical setting standards Setting standards. Ring gauges: Diameter Plug gauges: Diameter Test pins: Diameter	1 mm up to 200 mm 1 mm up to 200 mm 0.1 mm up to 30 mm	DKD-R 4-3 Sheet 4.1:2018. Pkt. 5.3.3. 5.3.4 DKD-R 4-3 Sheet 4.2:2018. Pkt. 5.3.3	$0.8 \mu\text{m} + 2 \cdot 10^{-6} \cdot d$ $0.8 \mu\text{m} + 2 \cdot 10^{-6} \cdot d$ $0.8 \mu\text{m} + 2 \cdot 10^{-6} \cdot d$	<i>d</i> is the measured Diameter

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

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurand / Calibration item	Measuring range	Measuring conditions /procedures	Extended uncertainty of measurement ¹⁾	Remarks
Length Thread gauges (single And multi-start cylindrical external and internal threads with straight flanks. symmetrical profile) Threaded mandrels: single Flank Diameter Threaded ring single Flank diameter	1.4 mm up to 200 mm Nominal gradient: 0.3 mm up to 6 mm	DKD-R 4-3 Sheet 4.8:2018 Option 1	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	
	3 mm up to 200 mm Nominal gradient: 0.5 mm up to 6 mm	DKD-R 4-3 Sheet 4.9:2018 Option 1	$3 \mu\text{m} + 10 \cdot 10^{-6} \cdot d$	
Length of plane-parallel. spherical or cylindrical Measuring surfaces Diameter	0.01 up to 500 mm mm	VDI/VDE/DGQ 2618 Sheet 19.1:2014	$1.5 \mu\text{m} + 2 \cdot 10^{-6} \cdot d$	
	0.01 up to 200 mm mm	DKD-R 4-3 Sheet 4.1:2018. Pkt. 5.3.3. 5.3.4	$1.5 \mu\text{m} + 2 \cdot 10^{-6} \cdot d$	
Feeler gauges	0.03 up to 2.00 mm mm	DIN 2275:2014	$1.5 \mu\text{m} + 2 \cdot 10^{-6} \cdot l$	
Setting dimensions for Outside micrometers	25 mm up to 500 mm	DKD-R 4-3 Sheet 4.4:2018	$1.5 \mu\text{m} + 2 \cdot 10^{-6} \cdot l$	

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

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

Measurand / Calibration item	Measuring range	Measuring conditions /procedures	Extended uncertainty of measurement ¹⁾	Remarks
Length Caliper for Outside, inside and Depth measurements, Depth calipers. Vertical caliper	0 mm up to 500 mm > 500 mm up to 1000 mm	DKD-R 4-3 Sheet 9.1:2018 Sheet 9.2:2018 Sheet 9.3:2018	30 µm + 30 · 10 ⁻⁶ · l 50 µm + 30 · 10 ⁻⁶ · l	
Outside micrometers	0 mm up to 500 mm	DKD-R 4-3 Sheet 10.1:2018	3 µm + 10 · 10 ⁻⁶ · l	
Precision micrometers	0 mm up to 200 mm	DKD-R 4-3 Sheet 10.3:2018	3 µm + 10 · 10 ⁻⁶ · l	
Micrometer head	0 mm up to 50 mm	VDI/VDE/DGQ 2618 Sheet 10.4:2008	3 µm + 10 · 10 ⁻⁶ · l	
Depth micrometers	0 mm up to 300 mm	VDI/VDE/DGQ 2618 Sheet 10.5:2010	3 µm + 10 · 10 ⁻⁶ · l	
Inside micrometers with 2-point Touch at calibration object	13 mm up to 300 mm > 300 mm up to 500 mm	DKD-R 4-3 Sheet 10.7:2018	3 µm + 10 · 10 ⁻⁶ · l 5 µm + 10 · 10 ⁻⁶ · l	l = Length of the dimension
Inside micrometers with 3-point Touch at calibration object	3 mm up to 100 mm	DKD-R 4-3 Sheet 10.8:2018	3 µm + 10 · 10 ⁻⁶ · d	d = measured Diameter
Length Lever measuring instruments (quick switch) for External measurements	up to 200 mm	DKD-R 4-3 Sheet 12.1:2018	7 µm + 10 · 10 ⁻⁶ · l	l is the measured Length
Level measuring instruments (quick switch) for Inside measurements	2 mm up to 200 mm	DKD-R 4-3 Sheet 13.1:2018	7 µm + 10 · 10 ⁻⁶ · l	
Dial indicators	up to 100 mm	DKD-R 4-3 Sheet 11.1:2018	3 µm + 10 · 10 ⁻⁶ · l	
fine pointer	up to 3 mm	DKD-R 4-3 Sheet 11.2:2018	0.6 µm	
Feeler level measuring instruments	up to 1.6 mm	DKD-R 4-3 Sheet 11.3:2018	1.0 µm	

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Annex to the Accreditation certificate D-K-15070-01-08
Permanent Laboratory
Calibration and Measurement Capabilities (CMC)

Measurand / Calibration item	Measuring range	Measuring conditions /procedures	Extended uncertainty of measurement ¹⁾	Remarks
Flow of liquids Volumen flow rate dV/dt of flowing liquids	0.8 mL/min up to 40 L/min	Piston calibrator Volumetric measurement	0.08%	Measuring instruments with analog output, frequency output, visual display
	10 mL/min up to 300 L/min	Liquids with a density of	0.08%	
	1 L/min up to 1200 L/min	700kg/m ³ up to 1100kg/m ³ Viscosity between 0.3 mm ² /s up to 1600 mm ² /s	0.05%	
Mass flow m/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 rate not less than 0.5 mL/min	0.08%	
	190 mL up to 19 L	flow rate not less than 1 mL/min		
	410 mL up to 41 L	flow rate not less than 10 mL/min		

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

Measurand / Calibration item	Measuring range	Measuring conditions / procedures	Extended uncertainty of measurement ¹⁾	Remarks
Volumen flow rate dV/dt of flowing gases	1 m ³ /min up to <3m ³ /min	critical nozzles	0.40%	Measurement instruments with analog output. frequency output. visual display nominal state. $p_N = 1013.25 \text{ mbar}$ $T_N = 0^\circ\text{C}$
	≥3 m ³ /min up to 1000 l/min	dry air (dew point lower than -15°C)	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 <3.9g/min	critical nozzles	0.42%	
	≥3.9g/min up to <1300 g/min	dry air (dew point lower than -15°C)	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	$0.2 \text{ mbar} + 1 \cdot 10^{-4} \cdot p_{abs}$	Pressure medium: Gas The measurement uncertainty of the barometer must be considered.
	> 10 bar up to 251 bar	$p_{abs} = p_e + p_{amb}$	$2 \cdot 10^{-4} \cdot p_{abs}$	
Negative and positive overpressure p_e	-1 bar up to 0.0 bar	DKD-R 6-1:2014	$50 \mu\text{bar} + 1 \cdot 10^{-4} \cdot p_e$	
	>0 bar up to 10 bar		$0.2 \text{ mbar} + 1 \cdot 10^{-4} \cdot p_e$	
	> 10 bar up to 250 bar		$2 \cdot 10^{-4} \cdot p_e$	

verwendete Abkürzungen:

CMC	Calibration and measurement capabilities (Kalibrier- und Messmöglichkeiten)
DIN	Deutsches Institut für Normung e.V.
DKD-R	Richtlinie des Deutschen Kalibrierdienstes (DKD). herausgegeben von der Physikalisch-Technischen Bundesanstalt

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