

Deutsche Akkreditierungsstelle GmbH

Annex to the Accreditation Certificate D-K-17589-01-00 according to DIN EN ISO/IEC 17025:2018

Valid from: 04.08.2020

Date of issue: 04.08.2020

Holder of certificate:

TetraTec Instruments GmbH
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Calibration in the fields:

Fluid quantities

- Gas flow rate ^{a)}
- Mass of flowing gases ^{a)}
- Volume of flowing gases ^{a)}

Mechanical quantities

- Pressure

Electrical quantities

DC and low frequency quantities

- DC voltage
- DC current
- DC resistance

Thermodynamic quantities

Temperature quantities

- Resistance thermometers
- Direct reading thermometers

Humidity quantities

- Relative humidity

^{a)} also on site calibration

Abbreviations used: see last page

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>

Annex to the accreditation certificate D-K-17589-01-00

Permanent Laboratory

Calibration and Measurement Capabilities (CMC)

| Measurement quantity / Calibration item | Range | Measurement conditions / procedure | Expanded uncertainty of measurement ¹⁾ | Remarks |
|--|---|---|---|--|
| Fluid quantities Volume flow rate or volume of flowing gases | 0.01 m ³ /h to 6 m ³ /h | Drum-type gas meter | 0.33 % | Calibration medium: - atmospheric air - decompressed air - synthetic air to max. 30 m ³ /h |
| | 39 mL/h to 27 L/h | Sonic nozzle gallery | 0.31 % | |
| | 27 L/h to 60 m ³ /h | | 0.24 % | |
| | 60 m ³ /h to 1920 m ³ /h | | 0.24 % | Calibration medium: - atmospheric air - decompressed air |
| | 3 m ³ /h to 1000 m ³ /h | Low pulsation rotary piston gas meter | 0.26 % | |
| | 13 m ³ /h to 10000 m ³ /h | Turbine gas meter | 0.26 % | |
| | 10 L/h to 6000 L/h | Drum-type gas meter Calibration medium: - Nitrogen N ₂ - Hydrogen H ₂ - Helium He - Argon Ar under ambient conditions | 0.46 % | |
| | 10 L/h to 1500 L/h | Drum-type gas meter Calibration medium: - Carbon monoxide CO under ambient conditions | 0.46 % | |
| | 0.5 L/h to 190 L/h | Laminar flow elements: Calibration medium: - Propane C ₃ H ₈ under ambient conditions | 0.40 % | |
| Mass flow rate or mass of flowing gases | 12 g/h to 7.2 kg/h | Drum-type gas meter | 0.32% | Calibration medium: - atmospheric air - decompressed air - synthetic air to max. 36 kg/h |
| | 47 mg/h to 32 g/h | Sonic nozzle gallery | 0.30 % | |
| | 32 g/h to 72 kg/h | | 0.22 % | |
| | 72 kg/h to 2300 kg/h | | 0.22 % | Calibration medium: - atmospheric air |
| | 3.6 kg/h to 1200 kg/h | Low pulsation rotary piston gas meter | 0.25 % | |
| | 15 kg/h to 12000 kg/h | Turbine gas meter | 0.25 % | |

¹⁾ The expanded uncertainties according to EA-4/02 M:2013 are part of CMC and are the best measurement uncertainties within accreditation. They have a coverage probability of approximately 95 % and have a coverage factor of $k = 2$ unless stated otherwise. Uncertainties without unit are relative uncertainties referring to the measurement value unless stated otherwise.

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| Measurement quantity / Calibration item | Range | Measurement conditions / procedure | Expanded uncertainty of measurement ¹⁾ | Remarks |
|---|--|--|--|---|
| Fluid quantities Mass flow rate or mass of flowing gases | 12 g/h N ₂ to 7 kg/h N ₂ 0.9 g/h H ₂ to 0.5 kg/h H ₂ 1.7g/h He to 1 kg/h He 17 g/h Ar to 10 kg/h Ar 12 g/h CO to 1.7 kg/h CO | Drum-type gas meter Calibration medium - Nitrogen N ₂ - Hydrogen H ₂ - Helium He - Argon Ar - Carbon monoxide CO under ambient conditions | 0.46 % | |
| | 1 g/h to 350 g/h | Laminar flow elements Calibration medium - Propane C ₃ H ₈ under ambient conditions | 0.40 % | |
| Pressure Negative and positive gauge pressure p_e | -1000 mbar to -14 mbar | DKD-R 6-1:2014 | $5 \cdot 10^{-3} \cdot \text{mbar} + 4.9 \cdot 10^{-5} \cdot p_e $ | Pressure medium: dried compressed air or nitrogen |
| | -10 mbar to 14 mbar | | $4 \cdot 10^{-4} \cdot p_e $, but not smaller than 0.003 mbar | |
| | > 14 mbar to 1700 mbar | | $3.4 \cdot 10^{-3} \cdot \text{mbar} + 2.9 \cdot 10^{-5} \cdot p_e$ | |
| | > 1.7 bar to 7 bar | | $14 \cdot 10^{-3} \cdot \text{mbar} + 3.2 \cdot 10^{-5} \cdot p_e$ | |
| | > 7 bar to 70 bar | | $0.14 \cdot \text{mbar} + 3.3 \cdot 10^{-5} \cdot p_e$ | |
| Absolut pressure p_{abs} | 14 mbar to 1700 mbar | DKD-R 6-1:2014 | $3.4 \cdot 10^{-3} \cdot \text{mbar} + 3.1 \cdot 10^{-5} \cdot p_{\text{abs}}$ | Pressure medium: dried compressed air or nitrogen The uncertainty of the measured residual gas pressure U_{rest} has to be taken into account. |
| | > 1.7 bar to 7 bar | | $14 \cdot 10^{-3} \cdot \text{mbar} + 3.4 \cdot 10^{-5} \cdot p_{\text{abs}}$ | |
| | > 7 bar to 70 bar | | $0.14 \cdot \text{mbar} + 3.5 \cdot 10^{-5} \cdot p_{\text{abs}}$ | |
| Temperature quantities Resistance thermometers, direct reading thermometers and measuring transducers with resistance sensors | 0 °C to 90 °C | DKD-R 5-1:2018 Comparison measurement | 17 mK | Comparison with standard resistance thermometers in thermostatic stirred liquid bath. |
| | 21 °C to 25 °C | DKD-R 5-1:2018 Comparison measurement | 0.15 K | Comparison with standard resistance thermometers in air channel. |
| | 0.01 °C | Triple point of water | 5 mK | Calibration at fixed points temperatures. |
| Simulators for resistance thermometers | 0 °C to 90 °C | DKD-R 5-5:2018 | 5 mK | Comparison with standard DC resistances. |
| Indicators for resistance thermometers | 0 °C to 90 °C | DKD-R 5-5:2018 | 5 mK | Comparison with reference resistances (fixed resistances of 100 Ω, 110 Ω, 120 Ω, 130 Ω and 140 Ω). |

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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 |
|--|---|--|---|--|
| Relative humidity Hygrometers, hygrometric sensors and measuring transducers | 10 % to 95 % | Calibration with humidity generator at room temperature Measuring medium: air | $0.1 \% + 7.5 \cdot 10^{-3} \cdot rF$ | Comparison with dew point mirror Uncertainty as absolute value of relative humidity. rF = measured value |
| Electrical quantities DC voltage Measuring devices and sources | 0 mV to 120 mV > 120 mV to 1.2 V > 1.2 V to 12 V > 12 V to 60 V | with system multimeter | $50 \cdot 10^{-6} \cdot U + 3.5 \mu V$ $40 \cdot 10^{-6} \cdot U + 7 \mu V$ $45 \cdot 10^{-6} \cdot U + 50 \mu V$ $45 \cdot 10^{-6} \cdot U + 0.6 mV$ | U = measured value |
| DC current Measuring devices and sources | 0 mA to 12 mA > 12 mA to 20 mA > 20 mA to 120 mA > 120 mA to 1 A > 1 A to 3 A | with system multimeter | $50 \cdot 10^{-6} \cdot I + 1 \mu A$ $30 \cdot 10^{-6} \cdot I + 1.4 \mu A$ $0.5 \cdot 10^{-3} \cdot I + 5.0 \mu A$ $1 \cdot 10^{-3} \cdot I + 0.1 mA$ $1.2 \cdot 10^{-3} \cdot I + 0.6 mA$ | I = measured value |
| DC resistance Resistances | 0 Ω to 120 Ω > 120 Ω to 150 Ω > 150 Ω to 1.2 k Ω > 1.2 k Ω to 12 k Ω > 12 k Ω to 120 k Ω > 120 k Ω to 1.2 M Ω > 1.2 M Ω to 12 M Ω | with system multimeter or resistance meter | $2 \cdot 10^{-6} \cdot R + 0.75 m\Omega$ $5 \cdot 10^{-6} \cdot R + 0.75 m\Omega$ $0.1 \cdot 10^{-3} \cdot R + 100 m\Omega$ $0.1 \cdot 10^{-3} \cdot R + 100 m\Omega$ $0.1 \cdot 10^{-3} \cdot R + 1 \Omega$ $0.1 \cdot 10^{-3} \cdot R + 10 \Omega$ $0.4 \cdot 10^{-3} \cdot R + 100 \Omega$ | R = measured value |
| DC resistance Measuring devices | 50 Ω 100 Ω ; 110 Ω ; 120 Ω ; 130 Ω ; 140 Ω | with fixed resistances | 0.25 m Ω 0.50 m Ω | |

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On-site Calibration

| Measurement quantity / Calibration item | Calibration and Measurement Capabilities (CMC) | | | Expanded uncertainty of measurement ¹⁾ | Remarks |
|--|---|------------------------------------|--|---|---|
| | Range | Measurement conditions / procedure | | | |
| Fluid quantities Volume flow rate or volume of flowing gases | 160 m ³ /h to 1600 m ³ /h | Turbine gas meter | | 0.34 % | Calibration medium: - atmospheric air - decompressed air Medium supply must be provided by customer. |
| | 1.6 m ³ /h to 250m ³ /h | Rotary piston gas meter | | 0.34 % | |
| | > 530 m ³ /h to 4700 m ³ /h | Laminar flow elements | | 0.39 % | |
| | 10 L/h to 530 m ³ /h | | | 0.38 % | |
| | 60 mL/h to < 10 L/h | | | 0.43 % | |
| Mass flow rate or mass of flowing gases | 192 kg/h to 1920 kg/h | Turbine gas meter | | 0.33 % | |
| | 1.9 kg/h to 300 kg/h | Rotary piston gas meter | | 0.33 % | |
| | > 635 kg/h to 5640 kg/h | Laminar flow elements | | 0.39 % | |
| | 12 g/h to 635 kg/h | | | 0.37 % | |
| | 72 mg/h to < 12 g/h | | | 0.42 % | |

Abbreviations used:

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

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