

Attachment to accreditation certificate D-K-15105-01-00
according to DIN EN ISO/IEC 17025:2005

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Certificate holder:

WIKA Alexander Wiegand SE & Co. KG
Alexander-Wiegand-Straße, 63911 Klingenberg

Supervisor:	Harald Hartl
Representatives:	Christian Elbert
	Johannes Münch
	Roland Schüßler
	Danica Schwarzkopf
	Heiko Gerhart

Accredited as calibration laboratory since: 24.01.1992

Calibrations in the areas:

Mechanical indicators

- Pressure a), b)

Electrical indicators

Direct current and low frequency indicators

- direct current voltage
- direct current amperage
- direct current resistance

Thermodynamical indicators

Temperature indicators

- resistance thermometers
- thermocouple, thermal elements
- direct reading thermometers
- mechanical thermometers
- temperature dry well calibrators
- temperature transmitter, data logger

Shortcuts used: see last page

a) also On-site-calibrations

b) also calibrations in a mobile laboratory

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Permanent Laboratory

Indicator / calibration object	Measuring range / Measuring span	Measurement conditions / method	Best measurement capability ¹⁾	Comments
Pressure Positive and negative overpressure p_e	-1 bar to -0,03 bar	DIN EN 837:1997	$5,0 \mu\text{bar} + 5,0 \cdot 10^{-5} \cdot p_e$	Pressure medium: gas
	>-0,03 bar to 0,15 bar	DAkks-DKD-R 6-1:2014	$0,25 \mu\text{bar} + 3,3 \cdot 10^{-5} \cdot p_e$	
	>0,15 bar to 1,8 bar	EURAMET cg-3. Version 1.0	$3,4 \mu\text{bar} + 1,9 \cdot 10^{-5} \cdot p_e$	
	>1,8 bar to 7 bar	EURAMET cg-17, Version 2.0	$14 \mu\text{bar} + 1,9 \cdot 10^{-5} \cdot p_e$	
	>7 bar to 70 bar		$0,14 \text{ mbar} + 2,6 \cdot 10^{-5} \cdot p_e$	
	>70 bar to 200 bar		$18 \mu\text{bar} + 3,5 \cdot 10^{-5} \cdot p_e$	
	>200 bar to 400 bar		$0,58 \text{ mbar} + 3,9 \cdot 10^{-5} \cdot p_e$	
	400 bar to 1000 bar		$0,65 \text{ mbar} + 4,4 \cdot 10^{-5} \cdot p_e$	
Overpressure p_e	0 bar	DIN EN 837:1997	$0,12 \text{ mbar} + 3,3 \cdot 10^{-5} \cdot p_e$	Reference value ($p_e = 0$ bar)
	4 bar to 100 bar	DAkks-DKD-R 6-1:2014	$0,12 \text{ mbar} + 3,3 \cdot 10^{-5} \cdot p_e$	Pressure medium: oil
	>100 bar to 400 bar	EURAMET cg-3. Version 1.0	$0,57 \text{ mbar} + 3,5 \cdot 10^{-5} \cdot p_e$	
	>400 bar to 1000bar	EURAMET cg-17, Version 2.0	$1,2 \text{ mbar} + 4,7 \cdot 10^{-5} \cdot p_e$	
	>1000 bar to 2000 bar		$1,2 \text{ mbar} + 6,0 \cdot 10^{-5} \cdot p_e$	
	>2000 bar to 5000 bar		$3,0 \text{ mbar} + 9,5 \cdot 10^{-5} \cdot p_e$	
	>5000 bar to 8000 bar		7,0 bar	
Absolute pressure p_{abs}	>0 bar to 0,15 bar	DIN EN 837:1997	$0,25 \mu\text{bar} + 3,3 \cdot 10^{-5} \cdot p_{abs} + U_{rest}$	Pressure medium: gas
	>0,15 bar to 1,8 bar	DAkks-DKD-R 6-1:2014	$3,4 \mu\text{bar} + 2,3 \cdot 10^{-5} \cdot p_{abs} + U_{rest}$	The uncertainty of measurement of the residual gas measurement U_{rest} and of the barometer U_{baro} has to be considered.
	>1,8 bar to 7 bar	EURAMET cg-3. Version 1.0	$14 \mu\text{bar} + 2,3 \cdot 10^{-5} \cdot p_{abs} + U_{rest}$	
	>7 bar to 70 bar	EURAMET cg-17, Version 2.0	$0,14 \text{ mbar} + 3,1 \cdot 10^{-5} \cdot p_{abs} + U_{rest}$	
	>70 bar to 201 bar	Calibration method: $p_{abs} = p_e + p_{amb}$	$18 \mu\text{bar} + 3,5 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	
	>201 bar to 401 bar		$0,58 \text{ mbar} + 3,4 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	
	401 bar to 1001 bar		$0,65 \text{ mbar} + 4,4 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	
Absolute pressure p_{abs}	1 bar	DIN EN 837:1997	$0,12 \text{ mbar} + 3,3 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	Reference value ($p_{abs} = p_{amb}$)
	5 bar to 101 bar	DAkks-DKD-R 6-1:2014	$0,12 \text{ mbar} + 3,3 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	Pressure medium: Oil
	>101 bar to 401 bar	EURAMET cg-3. Version 1.0	$0,57 \text{ mbar} + 3,5 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	
	>401 bar to 1001 bar	EURAMET cg-17, Version 2.0	$1,2 \text{ mbar} + 4,7 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	The uncertainty of measurement of the barometer U_{baro} has to be considered.
	>1001 bar to 2001 bar	Calibration method: $p_{abs} = p_e + p_{amb}$	$1,2 \text{ mbar} + 6,0 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	
	>2001 bar to 5001 bar		$3,0 \text{ mbar} + 9,5 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	
	>5001 bar to 8001 bar		$7,0 \text{ bar} + U_{baro}$	

Indicator / calibration object	Measuring range / Measuring span	Measurement conditions / method	Best measurement capability ¹⁾	Comments
Differential pressure	0 bar to 10 bar	DIN EN 837:1997 DAkks-DKD-R 6-1:2014 EURAMET cg-3, Version 1.0 EURAMET cg-17, Version 2.0	$10 \text{ Pa} + 1,0 \cdot 10^{-4} \cdot \Delta p_e + 5,0 \cdot 10^{-6} \cdot p_{\text{stat}}$	Pressure medium: gas Maximum pressure to perform: $p_{\text{stat}} = 250 \text{ bar}$
Temperature Resistance thermometers (with or without display *)	0,000 °C	Freezing point	5 mK	Calibration at temperature fixed points.
	0,01 °C	Water triple point	2 mK	
Resistance thermometers (with or without display *)	-196 °C	DAkks-DKD-R 5-1:2010 Liquid nitrogen	50 mK	Comparison with standard resistance thermometers
	-80 °C to 30 °C	DAkks-DKD-R 5-1:2010 Overflow calibration bath	15 mK	Comparison with standard resistance thermometers. Determination of characteristics according to DAkks-DKD-R 5-6.
	> 30 °C to 80 °C	DAkks-DKD-R 5-1:2010 Water bath	10 mK	
	> 80 °C to 200 °C	DAkks-DKD-R 5-1:2010 Oil bath	10 mK	
	> 200 °C to 500 °C	DAkks-DKD-R 5-1:2010 Salt bath	20 mK	Comparison with resistance thermometers / standard thermocouples
	> 500 °C to 650 °C	DAkks-DKD-R 5-1:2010 Tube furnaces	0,8 K	
	> 650 °C to 950 °C		1,0 K	
> 950 °C to 1200 °C		2,5 K		
Noble-metal thermocouples (with or without display *)	0 °C to 400 °C	DAkks-DKD-R 5-1:2010 Calibration baths	0,4 K	Comparison with standard resistance thermometers in thermostatic baths. Determination of characteristics according to DAkks-DKD-R 5-6.
	> 400 °C to 500 °C		0,5 K	
	200 °C to 1000 °C	DAkks-DKD-R 5-1:2010 Tube furnaces	1,0 K	Comparison with standard thermocouples. Determination of characteristics according to DAkks-DKD-R 5-6.
	> 1000 °C to 1200 °C		1,5 K	
Non-noble-metal thermocouples (with or without display *)	-40 °C to 200 °C	DAkks-DKD-R 5-1:2010 Calibration baths	0,2 K	Comparison with standard resistance thermometers. Determination of characteristics according to DAkks-DKD-R 5-6.
	> 200 °C to 400 °C		0,4 K	
	> 400 °C to 500 °C		0,5 K	
	200 °C to 1000 °C	DAkks-DKD-R 5-1:2010 Tube furnaces	1,5 K	Comparison with standard thermocouples. Determination of characteristics according to DAkks-DKD-R 5-6.
	> 1000 °C to 1200 °C		2,5 K	
Mechanical thermometers	0,0 °C	Freezing point	0,3 K	Comparison with standard resistance thermometers.
	-196 °C	Liquid nitrogen	0,5 K	
	80 °C bis 30 °C	Overflow calibration bath	0,3 K	
	> 30 °C bis 80 °C	Water bath	0,3 K	
	> 80 °C bis 200 °C	Oil bath	0,3 K	
	> 200 °C bis 500 °C	Salt bath	1,5 K	
	> 500 °C bis 700 °C	Tube furnaces	3 K	Comparison with standard resistance thermometers and thermocouples
Temperature dry well calibrator	-55 °C to 133 °C	DAkks-DKD-R 5-1:2010	0,20 K	Comparison with standard resistance thermometers. $t = \text{measured value in } ^\circ\text{C}$
	> 133 °C to 233 °C		$1,5 \text{ mK} \cdot t / ^\circ\text{C}$	
	> 233 °C to 600 °C		0,35 K	
	> 600 °C to 660 °C		0,4 K	Comparison with standard thermocouples.
	0 °C to 660 °C		1,5 K	
	> 660 °C to 1000 °C		2,5 K	
	> 1000 °C to 1300 °C		4,5 K	

Indicator / calibration object	Measuring range / Measuring span	Measurement conditions / method	Best measurement capability ¹⁾	Comments
Temperature transmitter with resistance thermometer *)	-80 °C to 500 °C	DAkKS-DKD-R 5-1:2010 With calibration baths	UPRT + 0,10 K	Comparison with standard resistance thermometers. UPRT and UTE are the expanded uncertainties of the calibration of the resistance thermometer/thermocouple
Temperature transmitter with thermocouple *)	0 °C to 500 °C	DAkKS-DKD-R 5-3:2010 With calibration baths	UTE + 0,50 K	
	> 500 °C to 1200 °C		UTE + 0,50 K	Comparison with thermocouples
Indicator and simulator for resistance thermometers *)	-200 °C to 660 °C	DAkKS-DKD-R 5-5:2010 Electrical simulation	0,2 K	Simulation of the sensor
Indicator and mV(μV) or Ω simulator for noble/non-noble thermocouples *)	-200 °C to 1700 °C	DAkKS-DKD-R 5-5:2010 Electrical simulation without reference cold junction	0,3 K	Simulation equivalent to temperature in mV(μV) or Ω
Direct current and low frequency measurand	0 V to 0,2 V		$20 \cdot 10^{-6} \cdot U + 1 \mu\text{V}$	With Fluke 8508 A U = measured value
	> 0,2 V to 2,3 V		$11 \cdot 10^{-6} \cdot U + 2 \mu\text{V}$	
	> 2,3 V to 20 V		$12 \cdot 10^{-6} \cdot U + 20 \mu\text{V}$	
	> 20 V to 100 V		$18 \cdot 10^{-6} \cdot U + 150 \mu\text{V}$	
Direct current voltage	> 20 V to 100 V			
Equipment and sources	0 mA to 20 mA		$13 \cdot 10^{-6} \cdot I + 50 \text{ nA}$	With Fluke 8508 A. I = measured value
	>20 mA to 100 mA		$36 \cdot 10^{-6} \cdot I + 0,9 \mu\text{A}$	
Direct current amperage	>20 mA to 100 mA			
Equipment and sources	0 Ω to 110 Ω		$40 \cdot 10^{-6} \cdot R + 1,5 \text{ m}\Omega$	With Fluke 8508 A R = measured value
	> 110 Ω to 1,1 kΩ		$28 \cdot 10^{-6} \cdot R + 2 \text{ m}\Omega$	
	>1,1 kΩ to 10 kΩ		$28 \cdot 10^{-6} \cdot R + 20 \text{ m}\Omega$	
Direct current resistance	>1,1 kΩ to 10 kΩ			

On-site-Calibration

Indicator / calibration object	Measuring range / Measuring span	Measurement conditions / method	Best measurement capability ¹⁾	Comments
Pressure Positive and negative overpressure p_e	-1 bar to -0,03 bar	DIN EN 837:1997	$5,3 \mu\text{bar} + 5,3 \cdot 10^{-5} \cdot p_e$	Pressure medium: gas
	>-0,03 bar to 0,15 bar	DAkKS-DKD-R 6-1:2014	$0,27 \mu\text{bar} + 3,5 \cdot 10^{-5} \cdot p_e$	
	>0,15 bar to 1,8 bar	EURAMET cg-3, Version 1.0	$3,6 \mu\text{bar} + 2,0 \cdot 10^{-5} \cdot p_e$	
	>1,8 bar to 7 bar	EURAMET cg-17, Version 2.0	$15 \mu\text{bar} + 2,0 \cdot 10^{-5} \cdot p_e$	
	>7 bar to 70 bar		$0,15 \text{ mbar} + 2,8 \cdot 10^{-5} \cdot p_e$	
	>70 bar to 200 bar		$19 \mu\text{bar} + 3,7 \cdot 10^{-5} \cdot p_e$	
	>200 bar to 400 bar		$0,61 \text{ mbar} + 4,1 \cdot 10^{-5} \cdot p_e$	
	400 bar to 1000 bar		$0,72 \text{ mbar} + 4,9 \cdot 10^{-5} \cdot p_e$	
Overpressure p_e	0 bar	DIN EN 837:1997	$0,14 \text{ mbar} + 3,7 \cdot 10^{-5} \cdot p_e$	Reference value ($p_e = 0$ bar) Pressure medium: oil
	4 bar to 100 bar	DAkKS-DKD-R 6-1:2014	$0,14 \text{ mbar} + 3,7 \cdot 10^{-5} \cdot p_e$	
	>100 bar to 400 bar	EURAMET cg-3, Version 1.0	$0,63 \text{ mbar} + 3,9 \cdot 10^{-5} \cdot p_e$	
	>400 bar to 1000 bar	EURAMET cg-17, Version 2.0	$1,4 \text{ mbar} + 5,2 \cdot 10^{-5} \cdot p_e$	
	>1000 bar to 2000 bar		$1,4 \text{ mbar} + 6,6 \cdot 10^{-5} \cdot p_e$	
	>2000 bar to 5000 bar		$3,3 \text{ mbar} + 1,1 \cdot 10^{-5} \cdot p_e$	
	>5000 bar to 8000 bar		7,5 bar	
Absolute pressure p_{abs}	> 0 bar to 0,15 bar	DIN EN 837:1997 DAkKS-DKD-R 6-1:2014	$0,27 \mu\text{bar} + 3,5 \cdot 10^{-5} \cdot p_{abs} + U_{rest}$	Pressure medium: gas

Indicator / calibration object	Measuring range / Measuring span	Measurement conditions / method	Best measurement capability ¹⁾	Comments
	>0,15 bar to 1,8 bar	EURAMET cg-3, Version 1.0 EURAMET cg-17, Version 2.0 Calibration method: $p_{abs} = p_e + p_{amb}$	$3,6 \mu\text{bar} + 2,5 \cdot 10^{-5} \cdot p_{abs} + U_{rest}$	The uncertainty of measurement of the residual gas measurement U_{rest} and of the barometer U_{baro} has to be considered.
	>1,8 bar to 7 bar		$15 \mu\text{bar} + 2,5 \cdot 10^{-5} \cdot p_{abs} + U_{rest}$	
	>7 bar to 70 bar		$0,15 \text{ mbar} + 3,3 \cdot 10^{-5} \cdot p_{abs} + U_{rest}$	
	> 70 bar to 201 bar		$19 \mu\text{bar} + 3,7 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	
	> 201 bar to 401 bar		$0,61 \text{ mbar} + 4,1 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	
	> 401 bar to 1001 bar		$0,72 \text{ mbar} + 4,9 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	
Absolute pressure p_{abs}	1bar	DIN EN 837:1997 DAkKS-DKD-R 6-1:2014 EURAMET cg-3, Version 1.0 EURAMET cg-17, Version 2.0 Calibration method: $p_{abs} = p_e + p_{amb}$	$0,14 \text{ mbar} + 3,7 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	Reference value ($p_{abs} = p_{amb}$)
	5 bar to 101 bar		$0,14 \text{ mbar} + 3,7 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	Pressure medium: oil
	>101 bar to 401 bar		$0,63 \text{ mbar} + 3,9 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	The uncertainty of measurement of the barometer U_{baro} has to be considered.
	>401 bar to 1001 bar		$1,4 \text{ mbar} + 5,2 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	
	>1001 bar to 2001 bar		$1,4 \text{ mbar} + 6,6 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	
	> 2001 bar to 5001 bar		$3,3 \text{ mbar} + 1,1 \cdot 10^{-5} \cdot p_{abs} + U_{baro}$	
	> 5001 bar to 8001 bar		$7,0 \text{ bar} + U_{baro}$	

Mobile pressure laboratory

Indicator / calibration object	Measuring range / Measuring span	Measurement conditions / method	Best measurement capability ¹⁾	Comments
Pressure	0 bar to 60 bar	DIN EN 837:1997 DAkKS-DKD-R 6-1:2014 EURAMET cg-3, Version 1.0 EURAMET cg-17, Version 2.0	0,01% from the end value of the used measurement standard	Pressure medium: gas
Absolute pressure p_{abs}			0,01% from the end value of the used measurement standard	Pressure medium: gas
Positive and negative overpressure p_e	-1 bar to 60 bar		0,025% from the end value of the used measurement standard	Pressure medium: oil
	> 60 bar to 300 bar		0,025% from the end value of the used measurement standard	
Overpressure p_e	0,2 bar to 1600 bar		0,1% from the end value of the used measurement standard	Pressure medium: oil
	> 1600 bar to 4000 bar		0,1% from the end value of the used measurement standard	

Shortcuts used:

DAkKS-DKD-R Calibration guideline of the German Accreditation Body once German Calibration Service
 DKD-R Calibration guideline of German Calibration service
 EURAMET European Association of National Metrology Institutes

¹⁾ The best measurement capabilities are specified according to DAkKS-DKD-3 (EA-4/02). These are the extended uncertainties of measurement with a coverage probability of 95 % and have the coverage factor $k=2$, as far as nothing deviating is specified. Uncertainties of measurement without unit specification are relative values based on the measured value, as far as nothing deviating is mentioned.