

Calibration Laboratories for Pressure and Temperature in the German Calibration Service (DKD)

Technical Information

Quality and reliability by supervised and calibrated testing equipment

In public tendering, export, in technological cooperation and for the evidence of an established quality assurance the connection of the testing facilities is demanded to be subject to national standards according to EN 29 000 ff., DIN ISO 9000 ff. For this reason, the importance of pressure gauges and thermometers with calibration certificates made out in official accredited calibration laboratories increases constantly in international competition.

WIKA supports its customers through calibration laboratories which have been accredited by the Physikalisch-Technische-Bundesanstalt (PTB) for the measured variable pressure (since 1982) and temperature (since 1992). The accreditation is also the evidence that these independent WIKA testing laboratories meet the European standard EN 45 001 "General criteria for the operation of testing laboratories".

What is the DKD ?

The German Calibration Service guarantees the connection of the testing facilities of the industrial measuring organizations to the national standards of the Physikalisch-Technische-Bundesanstalt (PTB). It consists of the calibration laboratories which are accredited and supervised according to the contractual basis established by the PTB. The German Calibration Service belongs to the European Cooperation for Accreditation of Laboratories (EAL) which was founded in Paris on 31 May 1994. The EAL is a cooperation of the Western European Calibration Cooperation (WECC) with the Western European Laboratory Accreditation Cooperation (WELAC). The aim of the EAL is to facilitate free trade. This is to be accomplished by agreements for the mutual recognition of calibration certificates and has already been signed by 11 European member countries. That means the recognition of DKD-calibration certificates in nearly all important European countries. You can also notice an increasing world-wide acceptance of the DKD on a not contractual basis.

What does the DKD do ?

In contrast to the testing according to the calibration law (for a fixed period), the calibration concerns the testing in the industrial measuring system.

Calibration means the ascertainment of the present relation between readings and measured variable (see DIN 1319). The results of the test are documented in the calibration certificate. The test specimen gets a calibration mark. In general, the testing is carried out according to legal SI-units. $N/m^2 = Pa$ or bar applies for pressure and °C, K for temperature. According to a special agreement, foreign customary units are possible, e.g. psi in the USA.

Normally, complete measuring chains are calibrated as a whole according to the applicable guide line of the DKD. With special agreements also parts of the measuring chain, e.g. transducer, can be calibrated alone. This has to be stated in the calibration certificate as well as the calibration method, the test assembly and the total uncertainty of the measuring gauges used. In general, the uncertainty in measuring stated on the reverse can be transmitted only on special conditions. Therefore, when using mechanical pressure gauges and Thermometers, a higher measuring uncertainty is passed according to type models.

WIKA calibration laboratories calibrate measuring equipment of WIKA-manufacture as well as measuring instruments of other manufacturers according to customer's order. More and more WIKA-customers use this special service to provide their measuring gauges with a DKD-certificate to reach international respected standards and thus to gain a cross-frontier acceptance.

For how long is the calibration certificate valid ?

The calibration certificate states the measuring result on the reference conditions mentioned during calibration. For other conditions or after special loads the gauges can also show results which deviate from the calibration. That means it depends on the case of application for how long the confirmed measuring result and the uncertainty in measuring is suitable for reprocessing. It is therefore not possible to state the period of validity in the calibration certificate. As the individual load of a measuring instrument can be very different it is customary to stipulate the repeating testing time in the users quality management system.

Due to our experience we can recommend, as a guide line, an annual recalibration of the pressure gauges and Thermometers.

Calibration of pressure gauges in the WIKA-Calibration Laboratory DKD-K-03701

Ranges

The WIKA pressure calibration laboratory is accredited for positive and negative overpressures as well as for absolute pressure and differential pressure. The uncertainties in measuring stated for most of the customary ranges are $< 0.01\%$. You can see the exact outline in the table 1 on page 2.

Calibration methods

The calibration rules to which the calibration is carried out are the DKD-calibration standard DKD-R-3-4 June 1984 for piston manometer and DKD-R-3-2 November 1987 for the remaining measuring instruments. To meet special requirements of WIKA-customers, calibrations can also be arranged according to the following standards: EN 837, EN 10 204.

The calibration of mechanical and electrical measuring instruments for absolute pressure, differential pressure, positive and negative overpressures is carried out on measuring points spread evenly over the whole range in direction of the rising pressure (with rising value) up to measuring final value and afterwards in direction of the falling pressure (with falling value). At the same time the readings of the calibration object (test specimen) are compared with the test result of the PTB-supervised reference standard.

The results of the testings are documented in a calibration certificate and the test sample gets a calibration mark.

According to DIN 1314 the overpressures refer to the atmospheric pressure. When the pressure is higher than the atmospheric pressure one speaks of positive overpressure. One speaks of negative overpressure (also vacuum section) when the pressure is smaller than the atmospheric pressure. Corresponding values are marked with a negative sign.

The absolute pressure is the pressure with regard to pressure zero in the vacuum.

Calibration equipment

As reference standards for precise measuring piston manometers are available. The deviation from the normal acceleration due to gravity and the pressure-responsive piston deformation are taken into consideration for the piston manometers by appropriately established correction factors.

In addition to mathematical-scientific methods electrical pressure transmitters with minimal measuring uncertainty in measuring, connected in a PC based environment, can be used to achieve precise calibration. Fully air conditioned laboratories enable the highest standards of accuracy to be maintained.

Table 1: Measured variable pressure (DKD-K-03701)

Measured variable	Range	Uncertainty in measurement ¹⁾
absolute pressure p_{abs} in gases	0.02 bar to 7 bar	$5 \cdot 10^{-5} \cdot p_{abs}$, but minimum 0.006 mbar
	7 bar to 70 bar	$6 \cdot 10^{-5} \cdot p_{abs}$
negative and positive overpressure p_e in gases	-1 bar to -0.015 bar	$1 \cdot 10^{-4} \cdot p_e$, but minimum 0.1 mbar
	-15 mbar to +30 mbar	$4 \cdot 10^{-4} \cdot p_e$, but minimum 0.003 mbar
	0.015 bar to 7 bar	$5 \cdot 10^{-5} \cdot p_e$, but minimum 0.006 mbar
positive overpressure p_e in oil	7 bar to 70 bar	$6 \cdot 10^{-5} \cdot p_e$
	70 bar to 400 bar	$8 \cdot 10^{-5} \cdot p_e$
	4 bar to 80 bar	$1 \cdot 10^{-4} \cdot p_e$, but minimum 0.8 mbar
differential pressure Δp	80 bar to 1000 bar	$8 \cdot 10^{-5} \cdot p_e$
	1000 bar to 2000 bar	$1 \cdot 10^{-4} \cdot p_e$
	2000 bar to 10000 bar	$6.5 \cdot 10^{-4} \cdot p_e$
differential pressure Δp	0 bar to 4 bar with static overpressure up to 400 bar	$1 \cdot 10^{-4} \cdot \Delta p + 0.1 \text{ mbar}$

1) Uncertainty in measurement determined by the PTB. Depending on the kind of test specimen the passed uncertainty in measurement is higher.

Calibration of thermometers in the WIKA-Calibration Laboratory DKD-K-03702

Ranges

In the WIKA calibration laboratory for the measured variable temperature contact thermometers are calibrated between - 80 °C to 660 °C. These are thermometers which are in direct contact with the measured media, inter alia resistance thermometers, thermoelements, electrical thermometers with the corresponding measuring equipment and mechanical thermometers.

Details are referred to in table 2.

The calibration of thermometers is carried out within their specified working scope or within a section scope agreed on by the customer.

Calibration methods

Each calibration of thermometer is preceded by a testing of the calibration ability of the test specimen. The requirements for the test specimen are stipulated in the appropriate DKD-standards.

The calibration is carried out according to the comparison method and at the water triple point.

When calibrating according to the comparing method the test specimens are taken to a constant temperature together with the normal thermometer. The temperature measured with the normal Thermometer is compared with the readings resp. output-signals of the test specimens for the determination of the measuring deviation.

Calibrated water-triple-point-cells are at disposal for the calibration of precision thermometers and especially for the regular checking of the measuring instruments in the calibration laboratory.

All temperature calibrations carried out at WIKA refer to the current legal temperature scale, the international temperature scale ITS 90.

Calibration equipment

Comparison measurements are carried out in stirred liquid baths with methanol, water, oil and salts as tempering fluids for temperatures in the range between -80°C and 500°C. Due to the aggressive nature of the liquid, the thermometers are placed in thin stainless steel thermowells before immersion in a salt bath. For all other liquids they are immersed directly in the bath. Both test specimen and normal thermometer are precisely located within the bath to ensure repeatability of test results.

Above 500°C the thermometers are tempered in a bath of fluidicent solids. The heated internal case of this bath is filled with very fine aluminium oxide powder which is permanently streamed through with dry, warm air from the bottom. The powder filling fluidises at a fixed streaming speed, i.e. it takes the physical characteristic of a liquid. Good heat transfer to the thermometer is thus guaranteed.

For comparison measurement purposes, precise platinum resistance thermometers are used as references. They meet the requirements of ITS 90 and are attributable to national standards.

The measurements of the electrical measuring variables resistance and thermoelectric voltage are carried out with digital multimeters and measuring bridges.

Table 2: Measured variable temperature (DKD-K-03702)

Range resp. temperature value	Measuring method and calibration object	Uncertainty in measurement ¹⁾
ice point 0.000 °C	calibration of contact thermometers fixed	0.010 K
water triple point 0.010 °C	temperature points	0.005 K
-80 °C to < 0 °C (overflow calibration bath)	calibration of contact thermometers (beside thermoelements)	0.020 K
0 °C to < 90 °C (water bath)	through comparison with normal resistance	0.020 K
90 °C to < 200 °C (oil bath)	thermometers in thermostatic bathes	0.030 K
200 °C to < 400 °C (salt bath)		0.030 K
400 °C to < 500 °C (salt bath)		0.050 K
500 °C to 660 °C (fluid bath)		0.100 K
0 °C to 660 °C precious metal thermoelements	calibration of thermoelements comparison with normal resistance	0.5 K
0 °C to 660 °C non-precious metal thermoelements	thermometers in thermostatic bathes	1.0 K

1) Uncertainty in measurement determined by the PTB. Depending on the kind of test specimen the passed uncertainty in measurement is higher.



WIKA Alexander Wiegand GmbH & Co.
Alexander-Wiegand-Straße · 63911 Klingenberg
☎ (0 93 72) 132-0 · ☎ (0 93 72) 132-406/414
http://www.wika.de · E-mail: info@wika.de