

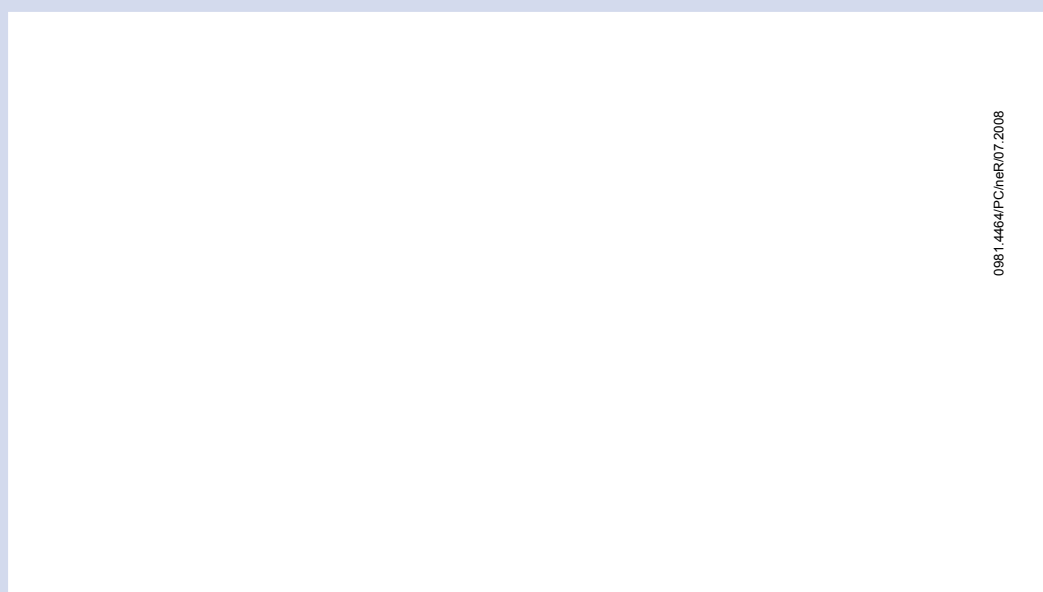
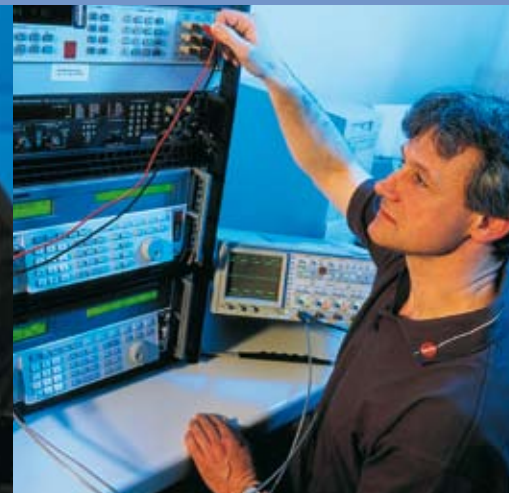
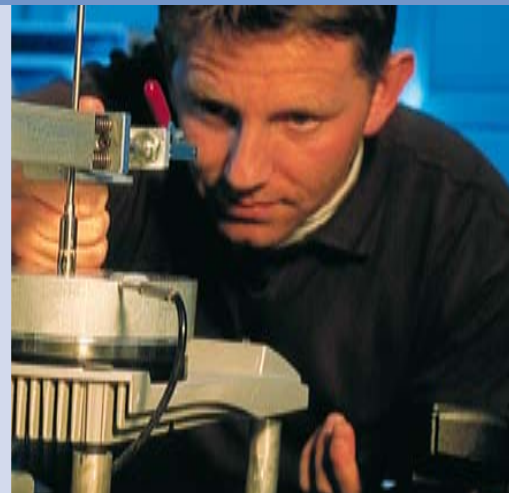
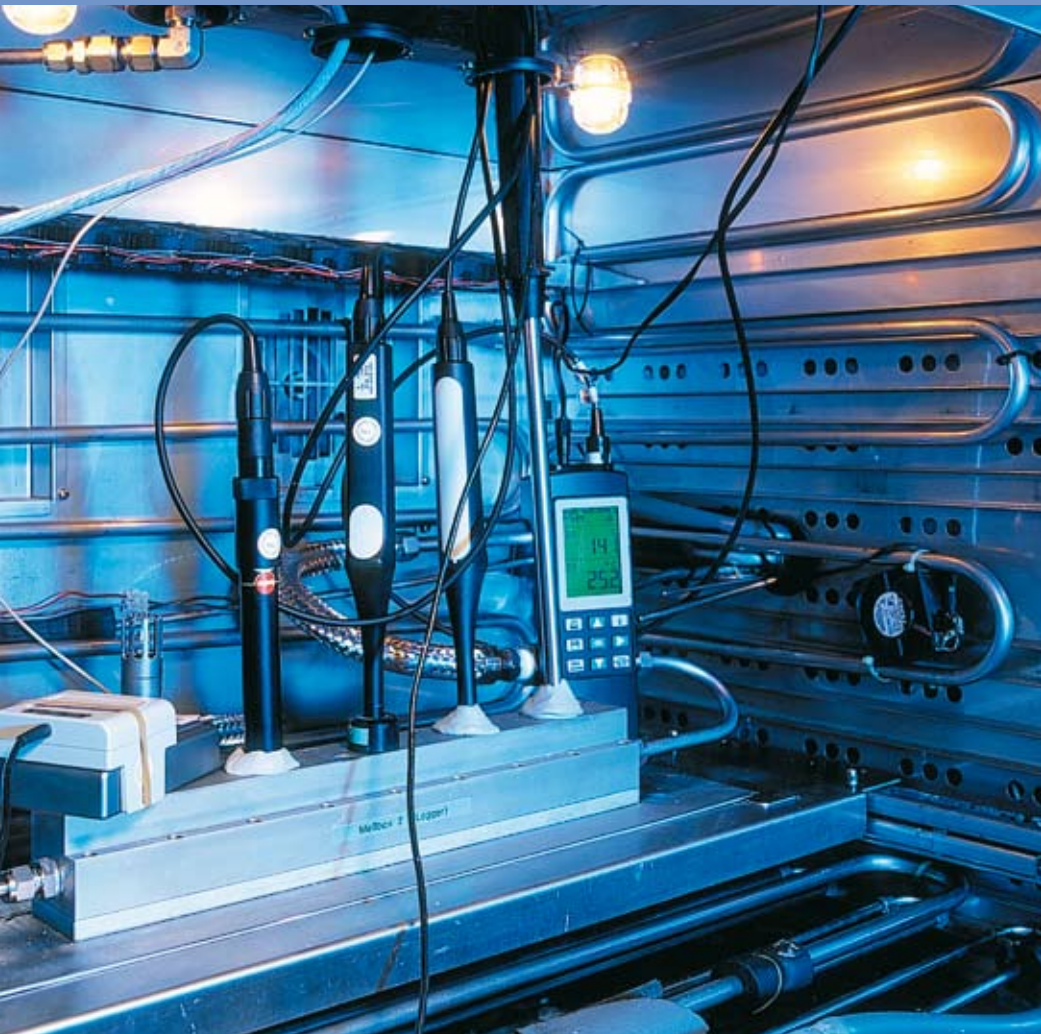


● industrial services



● industrial services

Calibration in accredited laboratories



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Why calibrate?

Calibration and test equipment management play a major part in the quality of production and in avoiding waste and additional work/reworking nowadays. Therefore miscellaneous standards and regulations require the test equipment management respective calibrations. The Product liability law demand that a quality-related measuring task has to be done with suitable and faultless/intact test equipment devices. Only systematic monitoring, regular calibration and the complete documentation protect against any possible claims.

Your benefits of Testo industrial services...

- Independent documents by a certified (ISO 9001:2000) and accredited (DKD; ISO /IEC 17025) service provider; guarantees you the required assurance for your next audit.
- Quick accomplishment of calibration and maintenance orders, raises the availability of your instruments and facilities, which means an increase in productivity.
- No expenses for own calibration standards, which means money saved in this manner can be invested otherwise.
- The calibration and validation is carried out in accordance with the existing regulations. It can also be customized to your specific needs, thus you can proceed as normal.
- Standardized templates/master documents assure fast handling and cost effective conditions.
- No downtime of devices during the onsite calibrations, raises the availability.
- No time-consuming collecting and shipping of instruments - saves time and money!
- Laboratory authorizations offer you a highly qualified calibration laboratory with all quality guidelines needed, which means competent and reliable working.
- You only need one partner for complete calibration and validation service.
- One competent and trustable partner means more concentration for you in your core business.

The choice of the right calibration partner is not simply a question of price. Service (customized solutions, consulting), reliability (accuracy, experience, competence) should also be taken into account.

Testo industrial services offers a variety of services in the field of test equipment management - from the calibration of portable and stationary measuring systems in the laboratories or onsite onto the complete test equipment management.

More assurance...

- Certified according to ISO 9001:2000
- Accredited according to DIN EN ISO/IEC 17025
- Traceable to national and international standards
- Highly qualified and individual skilled staff
- Integrated in the Testo Group
- More than 50 years experience in measuring technique
- Cooperation with different study-groups of PTB, DKD, AVP, ISO

Better service...

- Calibration and validation onsite and in accredited laboratories
- Individually adapted services for the automotive, pharmaceutical and food market
- Integrated test equipment monitoring system
- Independent of manufacturer
- Consulting, training, education
- Laboratory authorization according to ISO/IEC 17025
- Customized solutions
- Internet based administration of your test equipment

Contents

Why calibrate	2	Luminous intensity	18	Validation & Qualification	28
Contents	3	Sound pressure	18		
Uniquely accredited laboratories	5	pH	18	General validation scheme	29
Calibration process	5	Conductivity	18	Validation of clean rooms	30
Variations of laboratory calibration	6	TPM	18		
Service options	7				
Accreditations	8				
		Mechanical calibration laboratory	19		
Physical calibration laboratories	10				
		Pressure	19		
Temperature	12	Absolute pressure measuring devices	19		
Air and immersion probes	12	Measuring devices for low pressure	19		
Data loggers/transformers	12	Differential pressure and overpressure measuring devices	20		
Block calibrators/ circulating thermostats	13				
		Other mechanical parameters	20		
Surface temperature	14	Torque	20		
Contact surface temp. probes	14	Draft & pressure, load cell (Force)	21		
Infrared measuring devices	14	Scales	21		
		Hardness	21		
		rpm	21		
Velocity	15			Dimensional calibration laboratory	22
Anemometers/pitot tubes	15				
Volumetric flow measuring devices	15	Abridgement of the calibration spectrum	23		
Flow rate measuring devices	15				
Humidity	16	Electrical calibration laboratory	24		
Electronic hygrometers	16				
Pressure dew point/ dew point measuring devices	16	Abridgement of the calibration spectrum	25		
Mechanical hygrometers	17			Onsite Service	26
Other physical parameters	17	Calibration with a minimum of downtime for your test equipment	27		
CO/CO2	17	Calibration directly at the premises of Robert Bosch in Bühl	27		
Time	18				



Testo industrial services

The service provider subsidiary of Testo AG

Testo AG is a world market leader in portable measuring instruments with 50 years' experience and 130 Mio. Euro turnover. Testo is known for innovation, reliability and quality. Headquarters is in Lenzkirch (Schwarzwald/Black Forest). Testo has been calibrating measuring instruments since 1990. Testo industrial services was founded as an independent subsidiary in 1999. Testo industrial services calibrates measuring and inspection equipment from all manufacturers and for various measurement parameters in accredited laboratories and on location.

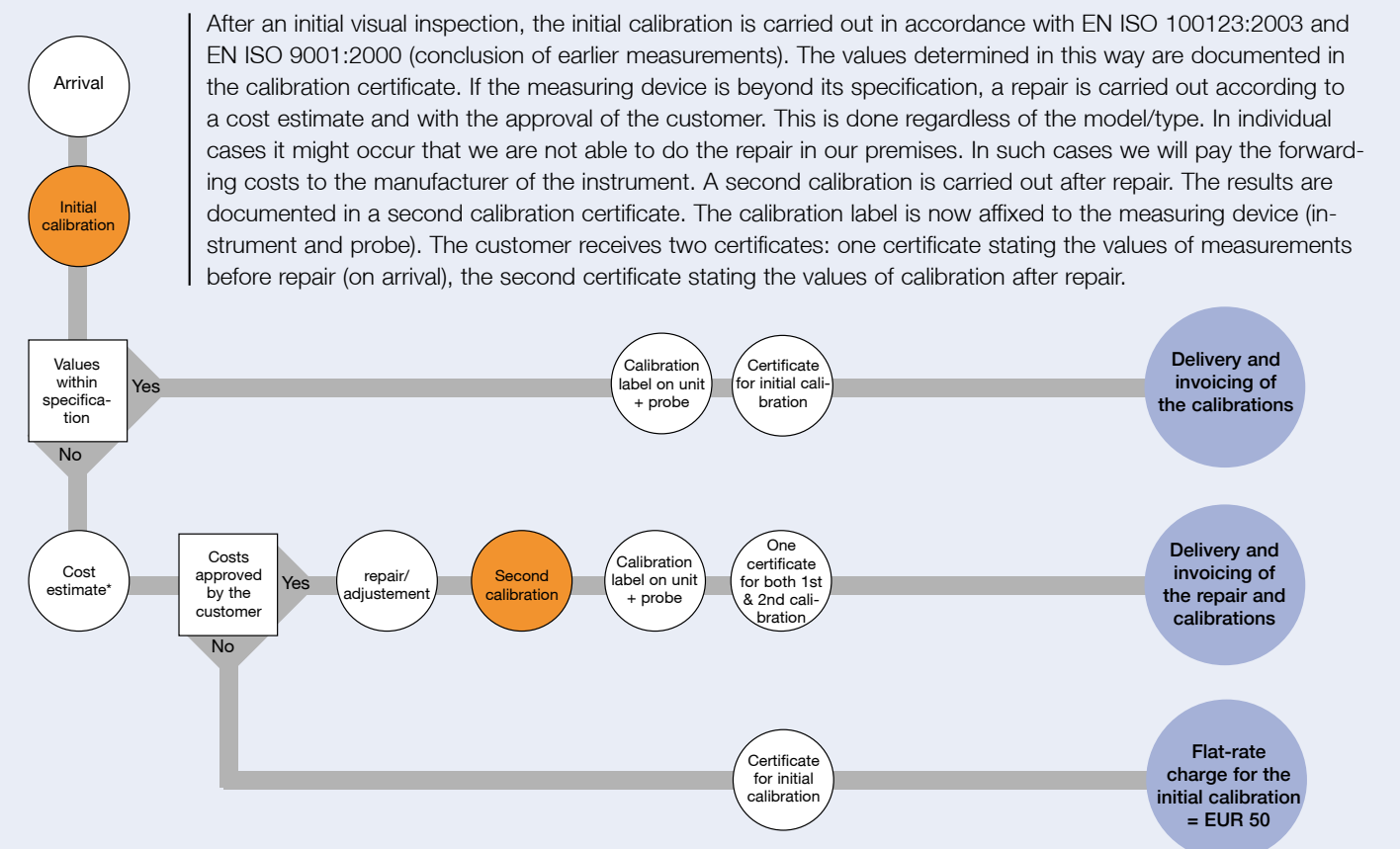
Uniquely accredited laboratories

DIN EN ISO/IEC 17025 is the standard, applicable worldwide, which enables you to verify the competence of a calibration laboratory. Calibration laboratories accredited to this standard have had their processes and measuring results officially validated by an independent and officially recognised licensing authority. In many industries, particularly in the automotive sector (ISO TS 16949, QS9000), accreditation is the fundamental requirement for an external calibration laboratory,

i.e. unaccredited laboratories are not allowed to calibrate in this industry. The Testo industrial services laboratories, accredited to DIN EN ISO/IEC 17025, are unique throughout the world in their combination.



Calibration process



* Necessary "midjet" repairs and adjustments will be done without cost estimate due to a ratio calibration procedure

Amount of DKD-accreditations

	measurand respectively calibration object	measuring range	measuring conditions	expanded measuring uncertainty
Abstract of the accreditation amount DKD–11201				
Temperature	Electrical resistance thermometer and electronic thermometers	0,00°C	Freezing point	10 mK
		0,01°C	Water triple point	5 mK
		–196°C	Liquid nitrogen	50 mK
		–80°C...0°C	Liquid bath with stability block	20 mK
		> 0°C...100°C		10 mK
		> 100°C...200°C	Silicone oil bath	30 mK
		> 200°C...400°C	Salt bath	30 mK
		> 400°C...500°C		50 mK
		> 500°C...660°C	Tube furnace with Na–heat pipe	from 0,2 K
	Noble metal–thermal elements	–40°C...1000°C	Thermostated baths	from 0,8 K
	Non noble metal–thermal elements	–196°C...1000°C		from 0,02 K
	Temperature block calibrators	–40...1000°C		from 0,2 K
	Surface temperature probes	50°C...500°C		from 0,8 K
> 100°C ...500°C			from 0,008K · t/°C	
Humidity	Hygrometer with direct measurement of the dew point temperature	–20°C...85°C	2–pressure/2–temperature generator	from 0,05 K
	Relative humidity, hygrometer, humidity probe with transducer, no psychrometer	5%...<40%	2–pressure/2–temperature generator Temperature range: 5°C up to 90°C	0,2%
		40%...<80%		0,3%
		80%...95%		0,4%
Fixed point cell		in temperature chamber		
Velocity	Flow rate of gases, calibration of anemometers	0,1 m/s...50 m/s	with laser–doppler–anemometer calibrated free jet	from 0,5%; however not lower than 0,1 m/s
Abstract of the accreditation amount DKD–05031				
Mechanical	Negative and positive Overpressure p _e	–1,0 bar...0,0 bar	Pressure–medium: gas DIN EN 837, DKD–R 6–1, EA–10/17	1·10 ^{–4} ; however not lower than 20 µbar
		> 0,0 mbar...0,2 mbar		0,5 µbar + 0,01 · p _e
		>0,2 mbar...160 mbar		2·10 ^{–4} ; however not lower than 01, µbar
		> 20 bar...70 bar		7·10 ^{–5}
		0,5 bar...55 bar	Pressure–medium: oil DIN EN 834, DKD–R 6–1 EA–10/17	7·10 ^{–5} p _e ; however not lower than 0,34 mbar
		> 55 bar...1100 bar		7·10 ^{–5} p _e ; however not lower than 7,5 mbar
	Absolute pressure p _{abs}	0,03 bar...20 bar	Pressure–medium: gas	6·10 ^{–5} p _{abs} ; however not lower than 0,012 mbar
		> 20 bar...70 bar		7·10 ^{–5} p _{abs}
		1 bar...56 bar		7·10 ^{–5} p _{abs} ; however not lower than 0,34 mbar
		> 56 bar...1101 bar		7·10 ^{–5} p _{abs} ; however not lower than 7,5 mbar
	Force	0–20 kN	Comparative measurement	0,1% of measured value
	Torque	0,2...1.000 Nm right and left	Comparative measurement	0,2% of measured value

	measurand respectively calibration object	measuring range	measuring conditions	expanded measuring uncertainty
Abstract of the accreditation amount DKD–05031				
Electrical	DC voltage	1µV to 1.000 V		from 0,5 · 10 ^{–6}
	DC current	> 100 nA to 100 A		from 15 · 10 ^{–6}
	DC resistance	100µOhm to 1 GOhm		from 0,5 · 10 ^{–6}
	DC power	10 mW to 100 kW		from 0,2 · 10 ^{–3}
	frequency	1 mHz to 1 GHz		from 5 · 10 ^{–11} · f (f=current value)
	time interval	1 µs to 10000s		from 2 · 10 ^{–9} · t + ns (t=current value)
	AC voltage	100 mV to 1.000 V		from 20 · 10 ^{–6}
	AC current	100 µA bis 20 A		from 40 · 10 ^{–6}
	inductance	100 µH to 10 H		from 0,4 · 10 ^{–3}
	capacitance	1 pF to 1 µF (50 Hz...10 kHz)		from 1 · 10 ^{–3}
	oscilloscope	5 mV to 200 V		from 3 · 10 ^{–3}
	oscilloscope calibrator	5 mV to 200 V		30 · 10 ^{–6} U _{SS} + 3 µV
	rise time	180 ps to 10 ms		from 30 · 10 ^{–3} t _r + 6,5 ps
	HF– power	1 mW (100 kHz...4GHz)		0,015
	HF– power generator	1 mW (50 MHz)		0,006
	reflection coefficient	0 to 0,3 (100 kHz ...4 GHz)		0,038
Dimensional	caliper gauge	0 mm to 500 mm	DKD–R 4–3, sheet 9.1	30 µm + 30 · 10 ^{–6} · l
	micrometer	0 mm to 150 mm	DKD–R 4–3, sheet 10.1	3 µm + 10 · 10 ^{–6} · l
	dial indicator	0 mm to 50 mm	DKD–R 4–3, sheet 11.1	3 µm + 10 · 10 ^{–6} · l
	lever gauge	0 mm to 1,6 mm	DKD–R 4–3, sheet 11.3	1,0 µm
	vernier depth gauge	0 mm to 500 mm	DKD–R 4–3, sheet 9.1	30 µm + 30 · 10 ^{–6} · l
	dial comparator	0 mm to 3 mm	DKD–R 4–3, sheet 11.2	0,6 µm
	test pin	1 mm to 20 mm	DKD–R 4–3, sheet 4.2	0,8 µm + 2 · 10 ^{–6} · l
	diameter/gauge	3 mm to 150 mm	DKD–R 4–3, sheet 4.1	0,8 µm + 2 · 10 ^{–6} · l
	ring gauge	3 mm to 150 mm	DKD–R 4–3, sheet 4.1	0,8 µm + 2 · 10 ^{–6} · l
	thread limit plug gauge	1 mm to 150 mm	DKD–R 4–3, sheet 4.8	3 µm + 10 · 10 ^{–6} · l
	thread ring gauge	1 mm to 150 mm	DKD–R 4–3, sheet 4.9	3 µm + 10 · 10 ^{–6} · l

Physical Laboratories

Unique combination of physical laboratories in Kirchzarten

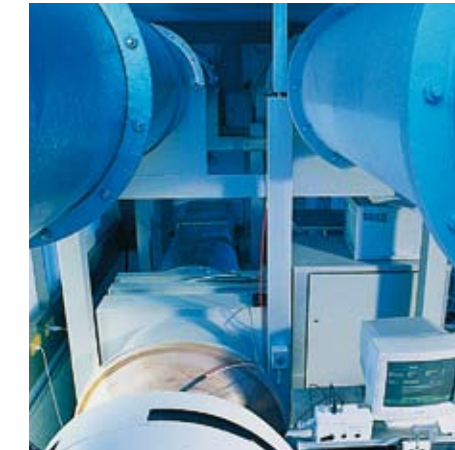
The combination of accredited calibration laboratories for physical and mechanical measured variables such as temperature, relative humidity, velocity and pressure is unique throughout the world. These laboratories stand out due to their extraordinarily wide range of accreditation and highest accuracy. Testo industrial services does not only calibrate Testo-measuring devices, but calibrate and adjust/repair measuring devices and probes of all other manufacturers as well!

Temperature laboratory



Select the appropriate calibration points for the operating range of your devices within the range of $-196... +1300^{\circ}\text{C}$. All electronic temperature measuring devices, resistance thermometers and thermal elements are being calibrated in the salt bath (Hart Scientific 2016), in the liquid bath (Lauda UB 40 J, Lauda K 6 R-S, Heto KB 25, Julabo F25) or in the pipe kiln with Heat Pipe (Gero WRO 100-380). The equipment and procedures are aligned with the reliable and low-cost issue of DKD and ISO calibration certificates and these are subject to constant enhancement. The reference systems consist of several precision Pt 100-probes, a Prema 6048 multimeter as well as several Testo 950 reference measuring instruments. The calibration bench for surface temperature, developed by Testo in cooperation with the PTB and the University of Ilmenau, set new standards in the calibration of surface temperature probes. Select the appropriate calibration points for your instruments in the range of $+50...+500^{\circ}\text{C}$. Contact surface temperature probes are being calibrated, according to your choice of various surfaces (steel, copper, aluminium) by means of a specific procedure. The reference is a Prema 3040 precision thermometer connected with several reference thermal elements.

Velocity laboratory



The essential requirement in the calibration of velocity measuring devices is a flow of air with a preferably laminar flow rate. The calibration takes place in the centre of the free jet in a specially developed wind tunnel and done with the most accurate and reliable measurement method at present, the Laser Doppler Anemometry (LDA). LDA is a non-contact – and thus interference-free – measurement process which offers a high accuracy of measurement extending to just a few m/s in velocity. Testo industrial services uses a LDA measuring system made by the company Dantec.

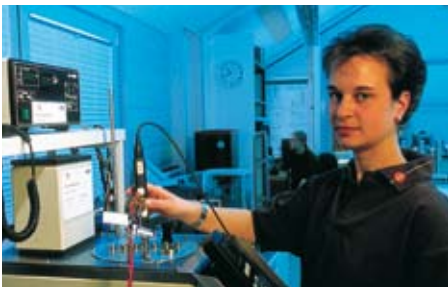
Humidity laboratory



In the humidity laboratory, the world-wide highest accuracies of 0.2%RH and a measuring range of 5-95% ($-18... +90^{\circ}\text{C}$) can be achieved with the two-pressure humidity generator. The generator is subdivided in a high pressure part (up to 8 bar) and a low pressure part (atmospheric pressure). The compressed, dry air flows into a humidifier, in which it is saturated with up to 100% water. Then the air in the saturator is being dehumidified of excess water at exactly determined temperature- and pressure values. The water content of the air can now be determined accurately respectively be adjusted accurately.

Temperature

Air & immersion probes



Choose the right calibration points for the operating range of your units from -196...+1300 °C. All electronic temperature measuring devices, resistance thermometers and thermal elements are calibrated in the salt bath (Hart Scientific 2016), the liquid bath (Lauda UB 40 J, Lauda K 6 RS, Heto KB 25, Julabo F25) or the tube furnace with heat pipe (Gero WRO 100-380). The equipment and processes are designed to ensure the reliable and low-cost creation of DKD/ISO-calibration certificates and are subject to constant enhancement. The reference systems consist of several precision Pt 100 probes, a Prema 6048 multimeter and several Testo 950 reference measuring units.

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Immersion, penetration and air probes	Resistance thermometers, thermal elements	DKD	Freezing point 0.00 °C Water triple point 0.01 °C	min. ±0.01 K min. ±0.005 K	Calibration at fixed temperature points
		DKD	(-196...0) °C (> 0...+100) °C (>+100...+400) °C (>+400...+500) °C (>+500...+660) °C (>+600...+1000) °C	min. ±0.02 K min. ±0.01 K min. ±0.03 K min. ±0.05 K min. ±0.2 K min. ±0.8 K	Comparative measurement with normal resistance thermometers/normal thermal elements
		ISO	(-196...+200) °C (>+200...+500) °C (>+500...+1000) °C (>+1000...+1300) °C	min. ± 0.05 K ±0.1 K ±2.0 K ±3.0 K	Comparative measurement in suitable baths, dry calibrators and tube furnaces

Data loggers/transformers

The best method for calibrating a data logger with an internal sensor is to use circulating air, as provided in a temperature or air conditioning cabinet. The spatial temperature distribution in the test room needs to be determined using a wide range of measurements. Several programmable CTS temperature cabinets (CTS T-40/25) are used in the temperature laboratory of Testo industrial services. The reference system uses Pt 100 sensors in conjunction with a Testo 400 or Testo 950 reference measuring unit.



See list on page 13

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Data loggers/transformers without display, transmitters	External probes	DKD	(-196...+1000) °C	min. ±0.02 K	Comparative measurement with normal resistance thermometers or thermal elements
		ISO	(-196...+200) °C (> +200...+500) °C (> +500...+1000) °C (> +1000...+1300) °C	min. ± 0.05 K ± 0.1 K ± 2.0 K ± 3.0 K	Comparative measurement in suitable baths, dry calibrators and tube furnaces
	Internal probes	DKD	in temperature cabinet (-30...+120) °C	min. ±0.3 K	Comparative measurement with resistance thermometer in the temperature cabinet
		ISO	(-40...+180) °C	from ± 0.35 K	Comparative measurement with resistance thermometer in the temperature cabinet

Block calibrators/circulating thermostats



Block calibrators and liquid baths are measured in our laboratories with suitable reference probes and devices. For these calibrations, Testo industrial services uses several precision Pt 100 probes together with a Prema 6048 multimeter or Testo 454 reference measuring unit.

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Block calibrators		DKD	(-40...+1000) °C	min. ±0.02 K	Comparative measurement
		ISO	(-40...+1000) °C	from ± 0.03 K	Comparative measurement
Circulating thermostats		DKD	(-80...+200)°C (>200...+300) °C	min. ± 0.2 K min. ± 0.5 K	Comparison with resistance thermometers
		ISO	(-80...+200)°C (>200...+300) °C	min. ± 0.3 K min. ± 0.6 K	Comparison with resistance thermometers

Contact surface temperature probes



The calibration bench for surface temperature, developed by Testo in collaboration with the PTB and the University of Illmenau, sets new standards in the calibration of surface temperature probes. Choose the appropriate calibration points for your units in the range from +50...+500 °C. Contact surface temperature probes are calibrated by means of a specific process of your choice and on a variety of surfaces (steel, copper, aluminium). The reference is provided by a Prema 3040 precision thermometer connected with several reference thermal elements.

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Contact surface temperature probes		DKD	Copper: (+50...+200) °C Aluminium: (+50...+300) °C Steel: (+50...+480) °C	0.8 % of m.v. min. ± 0.8 K	Comparative measurement with reference thermal elements on a variety of surfaces
		ISO	(-15...+180) °C (> +180...+480) °C	1 % of m.v. min. ±1 K	Comparative measurement on bare aluminium surface
Temperature indicators		ISO	(-25...+200) °C	±0.2 K	Comparative measurement in thermostatised baths

m.v. = measured value

Infrared measuring devices



The calibration of an IR temperature measuring device is carried out on a “black body”. Depending on the generator design, the radiation temperature is generated using a heating system or, as in the laboratory of Testo industrial services, a tempered liquid bath. The calibration bench at Testo industrial services comprises the “black body” made by Mester, type ME 20.01 and ME 20.02, and a liquid bath made by Thermo Electron, model K 50.

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Infrared measuring devices		ISO	(-18...+250) °C	±0.8 K	Comparative measurement on the black body with emittance $\epsilon = 1$

Velocity

Anemometers/pitot tubes

The essential requirement in the calibration of velocity measuring devices is a defined flow of air with a preferably laminar flow rate. Calibration takes place in the centre of the free jet in a specially developed wind tunnel and uses what is currently the most accurate and reliable measurement method, Laser Doppler Anemometry (LDA). LDA is a non-contact - and hence interference-free - measurement process which offers a high accuracy of measurement extending to just a few m/s in velocity. Testo industrial services uses an LDA measuring system made by the company Dantec.



Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Anemometers/pitot tubes	Hot wire anemometer, Hot ball anemometer, Vane anemometer, Shell anemometer, Pitot tube inc. difference pressure measuring device	DKD	(0.1...50) m/s	0.05% of m.v. at least 0.01 m/s	With laser doppler anemometer, calibrated free jet
	All velocity probes	ISO	(0.3...50) m/s at +25°C	1,5% of m.v., at least 0.03 m/s	Comparative measurement in wind tunnel with free jet Ø 350 mm

m.v. = measured value

Volumetric flow measuring devices

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Volumetric flow measuring devices	Funnel size from 610 x 610 mm to 900 x 900 mm	ISO	(50...3000) m³/h blowing (50...3000) m³/h sucking	2.5% of m.v.	Comparative measurement in calibration unit

m.v. = measured value

Flow rate measuring devices

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Flow rate measuring devices		ISO	1.7... 1000 ml/min	0,5% of end value	Comparative measurement with reference standard

Humidity

Electronic hygrometers



A hygrometer measures relative humidity in the air. This value indicates the quantity of water that is contained in the air. The value is called relative because this quantity depends on the temperature. The warmer the air, the more water it can absorb. Relative humidity (RH) is defined as the quotient of water vapour partial pressure p_{WS} and saturation vapour pressure p_{WS} (over water) at the respective gas temperature T . The Testo industrial services Huminator, the Testo 650 with high-precision 1 % humidity probe and the Thunder 2500 are used to calibrate the relative humidity, with a reference system consisting of various pressure and temperature sensors.

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Electronic hygrometers	Humidity data logger, transmitter, hygrometer without display	DKD	<i>In the generator:</i> (5...40) % RH > 40...80) % RH > 80...95) % RH max. dew point betw. -20...+85 °C	from 0.2 % RH (abs. MU) from 0.3 % RH (abs. MU) from 0.4 % RH (abs. MU)	Comparative measurement in generator: temperature range (5...90) °C
		ISO	<i>In the air conditioning cabinet:</i> (5...30) % RH > 30...60) % RH > 60...95) % RH max. dew point betw. -20...+70 °C	from 0.6 % RH (abs. MU) from 1.1 % RH (abs. MU) from 1.8 % RH (abs. MU)	Comparative measurement in air conditioning cabinet: temperature range -18...+80 °C
		ISO	(5...95) % RH max. dew point between (-30...+70) °C	from ±0.5 % RH from ±0.2 K	Comparative measurement in air conditioning cabinet or HUMINATOR, with dew point mirror and reference unit in the temperature range -18...+80 °C

Pressure dew point/dew point measuring devices

Dew point mirrors are a very precise means of measurement for determining relative humidity. The process involves analysing the condensation of water vapour when the dew point is undershot. The temperature of a reflected surface (mirror) is cooled down until it just about begins to precipitate. The temperature measured at that moment by means of a Pt 100 resistance thermometer corresponds to the dew point temperature from which the relative humidity can then be calculated as a function of the saturation pressure and the measured air temperature. Calibration takes place in the accredited two-pressure humidity generator (same design as the generator of the PTB).



Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Hygrometers with direct recording of the dew point temperature (dew point mirror)		DKD	(-35...+85) °C dew point	from 0.05 K (abs. MU)	in the temperature range (5...85)°C
		ISO	(-20...+70) °C dew point	from ±0.2 K	Comparative measurement
Pressure dew point measuring devices		ISO	(-60...0) °C at 6 bar	from ±0.2 K	Comparative measurement in the calibration device with dew point mirror

Mechanical hygrometers



Mechanical hygrometers and hygrographs are used to measure relative humidity. The measuring principle is based on the hygroscopic properties of hairs or specially treated synthetic fibres which expand as humidity increases. Psychrometers determine relative humidity from the difference in temperature between a dry and a moist temperature probe. Because the devices are usually quite large, calibration takes place in the air conditioning cabinet (Weiss AB 160/20). A dew point mirror (MBW DP3-D) is used as the reference.

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Psychrometers		ISO	(5...95) % RH max. dew point between (-20...+70)°C	from ±0.6% RH from ±0.2 K	Comparative measurement in air conditioning cabinet with dew point mirror
Mechanical hygrometers	Thermal hygrograph, drum recorder	DKD	5...95% RH	from ±0.6% RH (abs. MU)	Comparative measurement in air conditioning cabinet: temperature range with dew point mirror -18...+80 °C
		ISO	5...95% RH	from ±0.6% RH (abs. MU)	Comparative measurement in air conditioning cabinet: temperature range with dew point mirror -18...+80 °C

Other physical parameters

CO/CO₂

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
CO ₂ probes		ISO	0; 1000; 5000 ppm	±2 %	Comparative measurement
CO probes		ISO	0 / 80 ppm	±2 %	Comparative measurement

Time

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
All types of clocks		DKD	Depends on type		Comparative measurement at 3 calibration points
		ISO	Depends on type		Comparative measurement at 3 calibration points

Luminous intensity

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Lux probes		ISO	0/500/1000/2000/4000lx	±4%	Comparative measurement

Sound pressure

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Sound pressure measuring devices, microphone diameter 1/4" ... 1/2" (7..13 mm)		ISO	94 dB(A) at 63/125/250/500 Hz 1/2/4/8 kHz	1 dB(A)	Comparative measurement with working standard
Sound pressure calibrators		ISO	94 dB(A)/104 dB(A) at 1 kHz	1 dB(A)	Comparative measurement with working standard

pH

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
pH buffer solution from Testo	only first calibration!	ISO	4 pH or 7 pH or 10 pH	± 0.01pH at 25°C	NIST traceable
pH measuring devices		ISO	2; 4; 7; 9 or 11 pH	± 0.01 pH at 25°C	Comparative measurement/NIST traceable

Conductivity

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Conductivity solution from Testo	only first calibration!	ISO	1,413 mS/cm	±0.05 % at 25°C	NIST traceable
conductivity measuring devices		ISO	5; 15; 100; 706; 1413 µS or 100 mS	from 1 µS/cm ⁻¹ at 25°C	Comparative measurement/NIST traceable

TPM

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Cooking oil tester from Testo		ISO	4...24% TPM at 50°C		

Mechanical calibration laboratory

Pressure laboratory

One of the most reliable industrial methods is the pressure calibration with a deadweight tester. Therefore Testo industrial services uses deadweight testers of most various types/models within the range of -1... 1100 bar as reference standard in the DKD laboratories. The entire measuring range of our laboratory is from -1... 5000 bar.

Absolute pressure measuring devices



The most absolute reference pressure is zero pressure, which prevails in that part of the universe without air. A pressure that is related to this reference pressure is known as absolute pressure. To differentiate it from other types of pressure, it is identified by the index abs. The reference pressure of 0 mbar is generated in the pressure laboratory of Testo industrial services by means of a vacuum pump and vacuum chamber. Ultra-precise piston manometers (Wika A 6100) with the corresponding dimensioning kit guarantee minimum measuring uncertainties. Alternatively, reference measuring devices with electronic pressure sensors (Druck DPI 605, Wika CPG 8000) can be used as well.

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Absolute pressure measuring devices	Manometers, electr. pressure measuring devices, pressure transmitters, liquid manometers	DKD	(0.03...20) bar	±0.007% of m.v. min.±0.012 mbar	Medium: air, nitrogen, comparison with pressure balance or electronic pressure sensor
		ISO	(> 20...70) bar	±0.008% of m.v.	
			(0...70) bar	from 0.01% of m.v.	Medium: air, nitrogen, comparison with pressure balance or calibrator

m.v. = measured value

Measuring devices for low pressure

Low pressure is a special area of overpressure that is applied primarily for measuring clean room conditions. Clean rooms require special pressures which must be slightly above or below the ambient pressure. In the laboratory these slight overpressures are recorded with special piston manometers or a special Testo industrial services calibration unit.



Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Measuring devices for low pressure (clean room pressures)	Manometers, electr. pressure measuring devices, pressure transmitters, liquid manometers	ISO	1 Pa...20Pa	± 3% of m.v.	Comparison with Testo industrial services calibration unit

m.v. = measured value

Differential pressure and overpressure measuring devices

The most frequent pressure to be measured in the industrial environment is the atmospheric differential pressure p_e (e = exends = exceeding). This is the difference between an absolute pressure p_{abs} and the respective (absolute) atmospheric pressure. Excess pressures are generated in Testo industrial services' pressure laboratory with ultra-precise piston manometers and precision weights (Wika V 1600/1, Wika 6100, Wika M 2800, Wika HD 5000). Alternatively, reference measuring devices with electronic pressure sensors (Druck DPI 605, Wika CPG 8000) can also be used.



Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Differential pressure measuring devices, measuring devices for pos. overpressure	Manometers, electr. pressure measuring devices, pressure transmitters, liquid manometers	DKD	0.2 mbar...160 mbar	$\pm 0.02\%$ of m.v. min. $\pm 1 \mu\text{bar}$	Medium: air, nitrogen, comparison with piston manometer or electronic pressure sensor
			> 160 mbar...20 bar	$\pm 0.007\%$ of m.v., min. $\pm 0.012 \text{ mbar}$	
			> 20 bar...70 bar	$\pm 0.008\%$ of m.v.	
			0.2 bar...55 bar	$\pm 0.007 \%$ of m.v., min. $\pm 0.34 \text{ mbar}$	
			> 55 bar...1100 bar	$\pm 0.007 \%$ of m.v., min. $\pm 7.5 \text{ mbar}$	
Measuring devices for neg. overpressure	Manometers, electr. pressure measuring devices, pressure transmitters, liquid manometers	DKD	-1 bar...70 bar	$\pm 0.01 \%$ of m.v., min. $\pm 20 \mu\text{bar}$	Medium: air, comparison with piston manometer or electronic pressure sensor
Differential pressure measuring devices, measuring devices for pos. and neg. overpressure	All pressure measuring devices and probes with pressure connection	ISO	0...250 bar positive overpressure -1...0 bar negative overpressure 0...5000 bar positive overpressure	from $\pm 0.01\%$ of m.v.	Medium: air, nitrogen, oil, comparison with piston manometer or electronic pressure sensor

m.v. = measured value

Other mechanical parameters

Torque

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
torque wrench / torque screwdriver, torque measuring instruments and calibrators, torque sensors		DKD	0,1...1000 Nm right and left		Comparative measurement
		ISO	0,1...1000 Nm right and left		Comparative measurement

Draft & pressure, load cell (Force)

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Load cells (draft-/pressure testing instruments)		DKD	0...20 kN		Comparative measurement
		ISO	0...100 kN		Comparative measurement

Scales

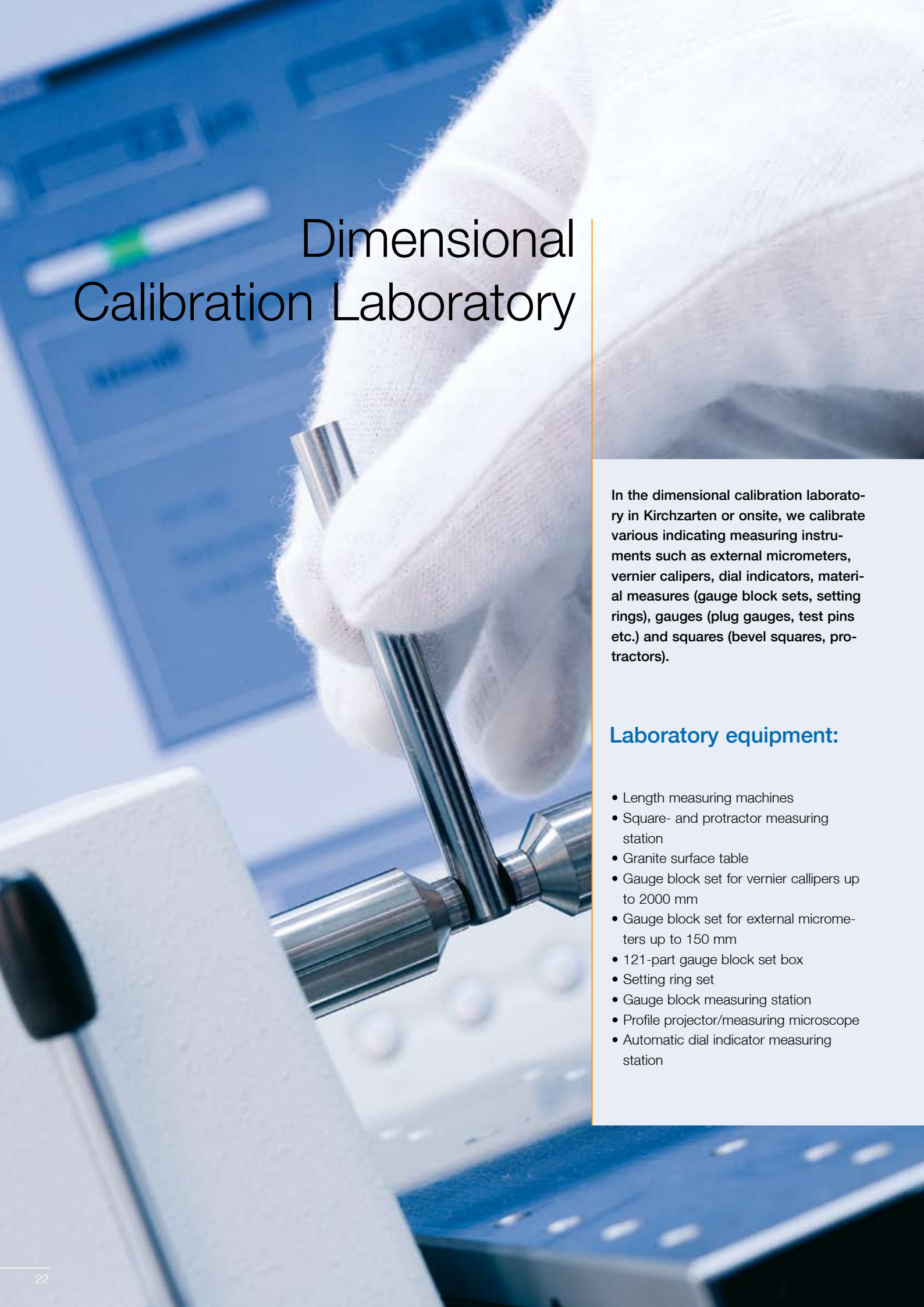
Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Spring scale, precision scale (mechanical/electric), industrial scales, analytic scale		ISO	up to 200 kg		Comparative measurement

Hardness

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Hardness tester	Rockwell, Vickers, Brinell, Shore hardness tester	ISO			

rpm

Object to be calibrated	Details	DKD/ISO	Calibration range	Measuring uncertainty	Conditions/measuring process
Mechanical rpm probes		DKD	20...9000 rpm	$1 \cdot 10^{-4}$	Comparative measurement with working standard
		ISO	20...9000 rpm	$1 \cdot 10^{-4}$	Comparative measurement with working standard
Optical rpm probes		DKD	1...99,999 rpm	$1 \cdot 10^{-4}$	Comparative measurement with working standard
		ISO	1...200,000 rpm	$1 \cdot 10^{-4}$	Comparative measurement with working standard



Dimensional Calibration Laboratory

In the dimensional calibration laboratory in Kirchzarten or onsite, we calibrate various indicating measuring instruments such as external micrometers, vernier calipers, dial indicators, material measures (gauge block sets, setting rings), gauges (plug gauges, test pins etc.) and squares (bevel squares, protractors).

Laboratory equipment:

- Length measuring machines
- Square- and protractor measuring station
- Granite surface table
- Gauge block set for vernier callipers up to 2000 mm
- Gauge block set for external micrometers up to 150 mm
- 121-part gauge block set box
- Setting ring set
- Gauge block measuring station
- Profile projector/measuring microscope
- Automatic dial indicator measuring station



Abridgement of the calibration spectrum

Object to be calibrated	Calibration range
Vernier calipers / depth gauges	0...2000 mm
Height gauges	0...1000 mm
Dial indicators	0...100 mm
External micrometers	0...500 mm
Depth micrometers	all types
Indicator micrometers	0...150 mm
Thread limit plug gauges (go- or not go)	1...300 mm
Setting rings / ring gauges	0,5...300 mm
Thread Go- or no Go ring gauges	>5...300 mm

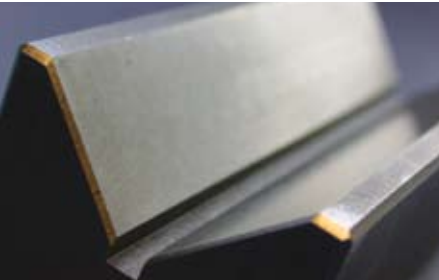
Indicating measuring instruments

By indicating measuring instruments we mean measuring instruments, from which the indicator value can be directly read after touching. The wear of the mechanical elements results from the way of application, frequency of use, maintenance and care in handling.



Material measures

Material measures are reference- and working standards, at which the most various test equipment is being calibrated.



Gauges

Gauges are material measures for fast testing of the tolerance durability of bores, threads, shafts and grooves. Therefore they have to be within their specification with their absolute measures. Wear, due to use as well as structure changes can only be determined by permanent control and regular calibrations.



Electrical calibration laboratory

Electrical measurements in the LF and HF ranges

Calibrations in the LF and HF range are done in the accredited DKD-lab in Munich, in Kirchzarten and onsite. Especially the DC-resistor measuring station, direct current voltage station and the high frequency measuring station are remarkable.

Abridgement of the calibration spectrum

Object to be calibrated	Details
Analog meter	One range-analog meter, Multi range-analog meter, Misc. analog meter
Digital multimeter	Digital multimeter 3,5 digit, Digital multimeter 4,5 digit, Digital multimeter 5,5 digit, Digital multimeter 6,5 digit, Digital multimeter 7,5 digit, Digital multimeter 8,5 digit
Oscilloscope	2-channel-oscilloscope, 3-channel-oscilloscope, 4-channel-oscilloscope
Scopemeter	
Frequency counter	Frequency counter 1-channel, Frequency counter 2-channel, Frequency counter 3-channel
Clamp-on ammeter	Clamp-on ammeter, Pincermultimeter
Stand resistor	Sensor resistor
Resistance decade	Resistance decade, Accuracy-resistance decade
Capacitance	Measure capacitor
Inductance	
Analyzer	Spectrum-, Network-, Modulations-, Logicanalyzer

DC resistor measuring station

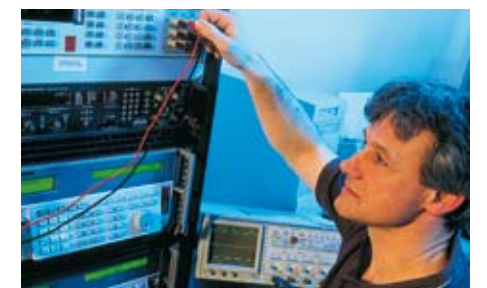
A particular speciality of the electrical laboratory is the calibration of DC resistors with a very small measuring uncertainty. DC resistance measurements can be done from 100 $\mu\Omega$ up to 1 Gohm with the lowest accredited measuring uncertainty of 0,5 ppm.

DC voltage low frequency measuring station

The measuring station is aligned for the calibration of electrical calibrators and digital multimeters with the largest accuracy. The smallest accredited measuring uncertainty is e.g. for D.C. voltage $<1\mu V$. In addition to the high accuracy, the measuring station has also been automated with the aid of suitable programs and equipment. This guarantees the efficient and fast issuing of calibration certificates.

High frequency measuring station

The measuring station enables the calibration of HF devices of up to 18 GHz.



Onsite Service

Calibration at the customer's

Several test devices in the procedure and process measuring technique require an onsite calibration. In order to calibrate outside an air-conditioned laboratory, a high degree of metrological/measurement expertise and experience is required. Especially for these difficult and complex onsite calibrations you need a competent partner. One possibility of the onsite calibration is our mobile calibration container. Portable and stationary test and measurement systems can be calibrated directly on your premises. Another possibility is that the technician calibrates directly in the facilities or at the plants of the customer with the appropriate calibration equipment.

As one of few companies in Germany, Testo industrial services is accredited for onsite calibrations according to DKD!

Calibration with a minimum of downtime for your test equipment

The management and controlling of test equipment of miscellaneous standards require a regular calibration of the measuring and test equipment. So far, the portable measuring instruments were collected and sent to various calibration laboratories. This resulted in e.g. long downtimes, high transportation risk, complex collecting and delivering of the instruments. Testo industrial services provides the solution: The onsite service comes to you and calibrates the portable measuring instruments according to the standards of laboratories. Thus the delivery time is reduced, the transportation risk is minimized, the administrative expenditure is lower (no delivery notes, order- or freight documents) and it increases the availability of the test devices. The price for the onsite calibration is the same as the price for a laboratory calibration.



Calibration container for calibrations directly at customer's location

Calibration directly at the premises of Robert Bosch in Bülh



Robert Bosch in Bülh and Bülhertal has found the ideal calibration solution. At two or three fixed dates per year, electrical test equipment is being calibrated at the factory premises. With the mobile, acclimatised calibration container, Testo industrial services offers the possibility of calibration onsite. Various test equipment, from the simple hand multimeter up to high grade storage oscilloscope can be calibrated without any difficulty. The measuring and test equipment can be calibrated onsite — quick, low at cost,

without order-, freight or packing time and effort.

Test equipment, which require a DKD calibration, can be calibrated highly accurate in our laboratory during the weekend without any major downtime. A certificate and a calibration label is issued for each instrument, even when calibrating a large amount of instruments. If requested, the individual date of the recalibration can be marked in the certificate and on the calibration label. The certificates are also available as a PDF file.

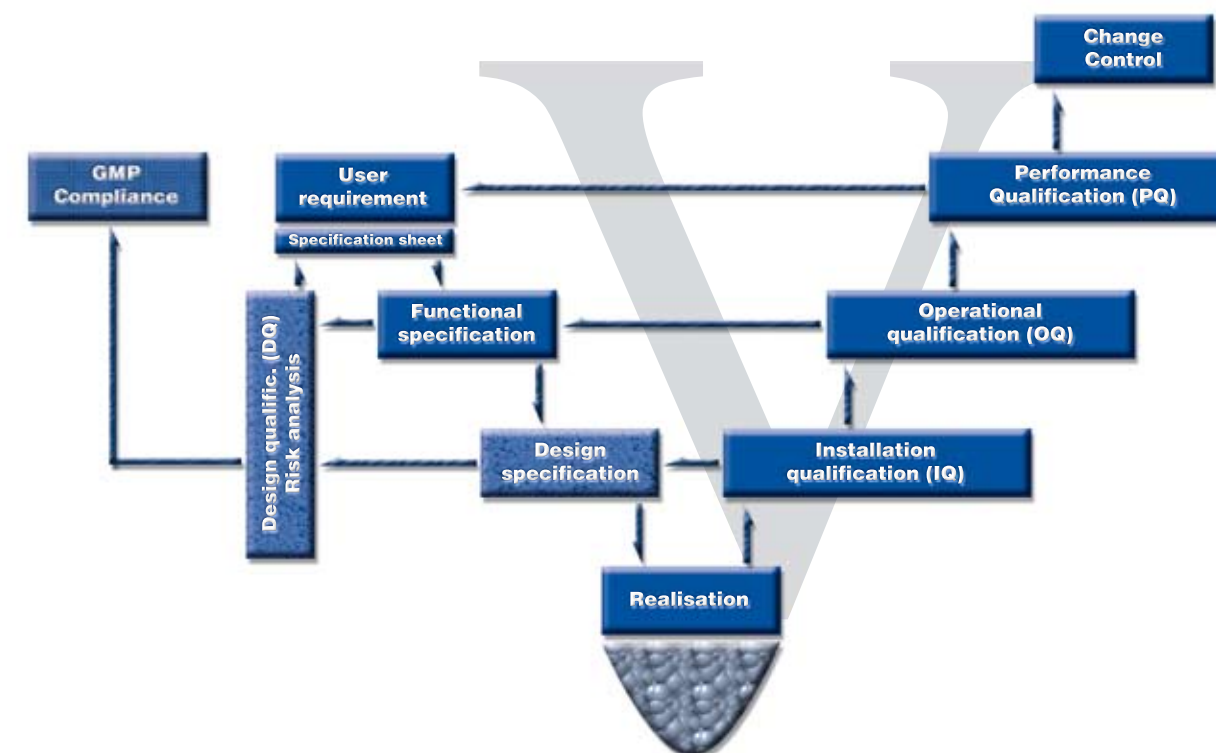
All measuring instruments can be collected directly at the user's and brought back according to the defined lead time. Depending on the cost centre, department or area, a separate calculation is done.

By the accreditation of Testo industrial services in the HF (high frequency)- and LF (low frequency) range of electrical measurands, the requirements of the ISO TS 16949 are fulfilled for the automobile industry.

Onsite calibration report

Validation and Qualification

General validation scheme



* Calibration is often part of the IQ or it is one of the first steps of the OQ during the qualification/validation.

Validation and Qualification conform to GMP/CFR

Through the globalization of the markets, the continual increase of inspection pressure of national and international authorities and the very high claim of quality of internal quality assurance departments, it becomes ever more important to convert the existing laws, guidelines and standards. In order to fulfil these legislations and guidelines, all ranges of an enterprise, which handle with research, production and packing of pharmaceutical products and medicines or whose active substances are meant for human and animal, have to be regularly examined, controlled and supervised. This documented argumentation is de-

scribed with the umbrella term validation, in accordance with the present valid laws and guidelines, that means that systems and articles of equipment fulfil their tasks and that processes are proceeded reproducible as intended. For these reasons, processes and methods (analysis/cleaning) are being validated regularly nowadays. Technical articles of equipment such as plants, devices, measuring systems of all kinds and their automation systems/computers are being calibrated and qualified regularly.

Your benefits

- Independent documents by a certified (ISO 9001:2000) and accredited (DKD; ISO /IEC 17025) service provider guarantees you the required assurance for your next audit
- Standardized templates/master documents assure fast handling and cost effective conditions
- All from one source – that means one competent partner for:
 - Complete validation plans
 - Test measurements
 - Calibration services
- Modular range of individual services: complete validation; part validation; risk analyses; DQ, IQ, OQ, PQ
- Individual customized documentation, thus you can proceed as normal
- Complete validation documentations (incl. a validation master plan) offer you the highest quality assurance
- No downtime of devices during the on-site calibrations/validations
- No time-consuming collecting and shipping of instruments – saves time and money
- Quick realization of customer's validation and maintenance requirements, raises the availability of your facilities and clean rooms which means an increase of your productivity

Validation of clean rooms

Clean room definition...

According to DIN EN ISO 14644, a clean room is defined as follows:

„A room with a defined concentration of airborne particles, which is constructed and used in such a way, that the amount of the particles introduced respectively the particles emerging and circulating remain as small as possible and in which other relevant cleanliness parameters...are regulated as required.“

„...the task/requirement of the clean room technique...is to enable process cycles, which require a defined protection against the influence of environment. As an operator you have to verify, by the validation, that the regulatory requirements are fulfilled.

Testo industrial services GmbH supports you from the planning to the final inspection!

Clean room services...

- preparation/issuing of the complete validation documentation: risc analyses, DQ, IQ, OQ, PQ
- clean room class determination
- filter integrity test
- air velocity measurements
- recovery time measurements
- air change determination
- calibration of temperature / relative humidity / pressure
- air velocity visualization (smoke studies)
- bacterial count determination
- validation of microbiological cabinets

Your benefits...

- documentation is clear and conforming to standards, which guarantees you the necessary assurance during your next audit
- consulting from the planning stage, offers you complete services from one competent contact partner
- existing company specifications will be taken over, respectively will be included, that gives you the chance to work in your familiar structure
- highly skilled employees (regular trainings in the company-owned clean room) enables high qualified work and services
- use of high precision, modern and traceable measuring equipment assures you reliable measured values and results — this is the basis for right decisions
- an accredited service provider for laboratory calibrations as well as for onsite services guarantees you the necessary traceability

