

Calibration: an investment in operational excellence

Ensure quality standards and
optimize calibration processes





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Calibration service from Endress+Hauser

Comprehensive service from one of the world's leading suppliers of measurement and control technology ensures quality and saves resources

Do the devices required for your quality processes have to be checked and calibrated regularly? Do you need a service with short reaction time, high quality, traceability and approval? Rely on Endress+Hauser for these critical questions - we are your reliable partner and offer you competent advice and support on all aspects of calibration.

Increased plant availability We calibrate almost all parameters common in the process industry. Endress+Hauser is the first calibration service provider in Switzerland and Germany to be accredited for on-site flow calibrations according to ISO/IEC 17025 and to offer a patent-pending method for on-site density calibration..

→ Read more on page 16

Optimized calibration processes We support you throughout the entire process: from the creation of the calibration specification to the implementation of a complete calibration management solution including software and documentation system. You alone decide how and to what extent we can relieve you.

→ Read more on page 24

Many years of experience in many industries In many branches of industry, the demands on product quality and safety are constantly increasing. Whether in the life sciences industry or in the oil and gas sector, whether for balancing material flows or adding expensive active ingredients - the control of processes increasingly requires precise and long-term stable measuring instruments. In other areas, on the other hand, the focus is on the reproducibility of process sequences that require regular on-site calibrations due to legal regulations. Our long experience enables us to know the requirements of all industries, to offer suitable solutions and to fulfill them.

→ Read more on page 29



Manufacturer-independent calibration service from one source

Minimize your coordination effort and concentrate on your core competence



We offer you comprehensive support with our accredited calibration service for almost all physical, analytical and mechanical parameters common in the process industry. This means for you, only to have one contact person for all measured variables:

- Mass and volume flow (inline or offline)
- Energy measurement steam, cold, heat
- Airflow
- density
- Filling level without calibration
- Print
- Temperature
- pH value
- Conductivity
- Viscosity
- Concentration

Additional measurement parameters:

- Humidity
- Volume
- Gassing
- pO₂
- Speed (e.g. stirrer speed)
- Weight (e.g. scales)
- Media supply (e.g. peristaltic pumps)
- Electrical parameters
- and more

Calibration on demand Depending on your needs, we perform the calibration either directly at your site or in one of our accredited calibration laboratories. Our experts have the knowledge and equipment to perform the calibration according to your requirements and for all instruments. With more than one million calibrations for every parameter, in the laboratory or directly in the plants, Endress+Hauser has demonstrated the necessary know-how over many years.

A further advantage Our service is not limited to Endress+Hauser equipment, but also covers equipment from other manufacturers. You alone decide how and to what extent we support you.

i Calibration Determination and documentation of the difference between the displayed value and the value considered correct. The test equipment used for this purpose is traceable and subject to constant monitoring

Verification Verification describes the provision of objective proof that a measuring instrument meets the specific requirements. Accordingly, a verification corresponds to a qualitative test with the result that a concrete assumption is fulfilled / not fulfilled or passed / not passed (e.g.: measuring device corresponds / does not correspond to the specifications). Compared to calibration, therefore, there is no statement about the measurement uncertainty.

Official calibration is a special case of calibration. All measuring instruments whose results are used to determine prices are subject to calibration. Calibration is an official act of the authorities and may only be carried out by a calibration officer.



[www.ch.endress.com/
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Global calibration concept for maximum safety

Consistently high quality for customers around the world

Due to our global calibration concept, we ensure that the identical proof of accuracy is provided at all production sites worldwide. In addition, SOPs (Standard Operating Procedures) ensure that the calibrations we perform can be repeated worldwide and are performed to a uniform standard.

Fully traceable All our calibration facilities are accredited by different national metrology authorities according to ISO/IEC 17025 - for example by SAS (Switzerland), DAkkS (Germany), A2LA (USA) or CNAS (China). At the same time, these accreditations guarantee that all test equipment used in calibrations is fully traceable to the national reference standard of a country through an uninterrupted "chain" of comparative measurements.

Always in your proximity And if things have to be done quickly, our decentralized structure enables us to respond to your inquiries in the shortest possible time - whether for legally required laboratory calibrations or for an accredited on-site calibration directly at your plant. This saves time and reduces costs!

"Consistently high measurement quality for customers all over the world" - according to this motto, all measuring instruments at Endress+Hauser are tested, calibrated and adjusted on the world's most modern calibration facilities.



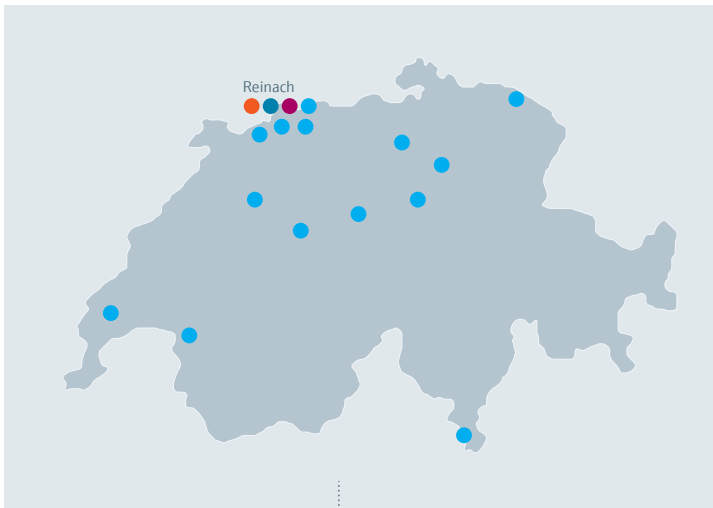
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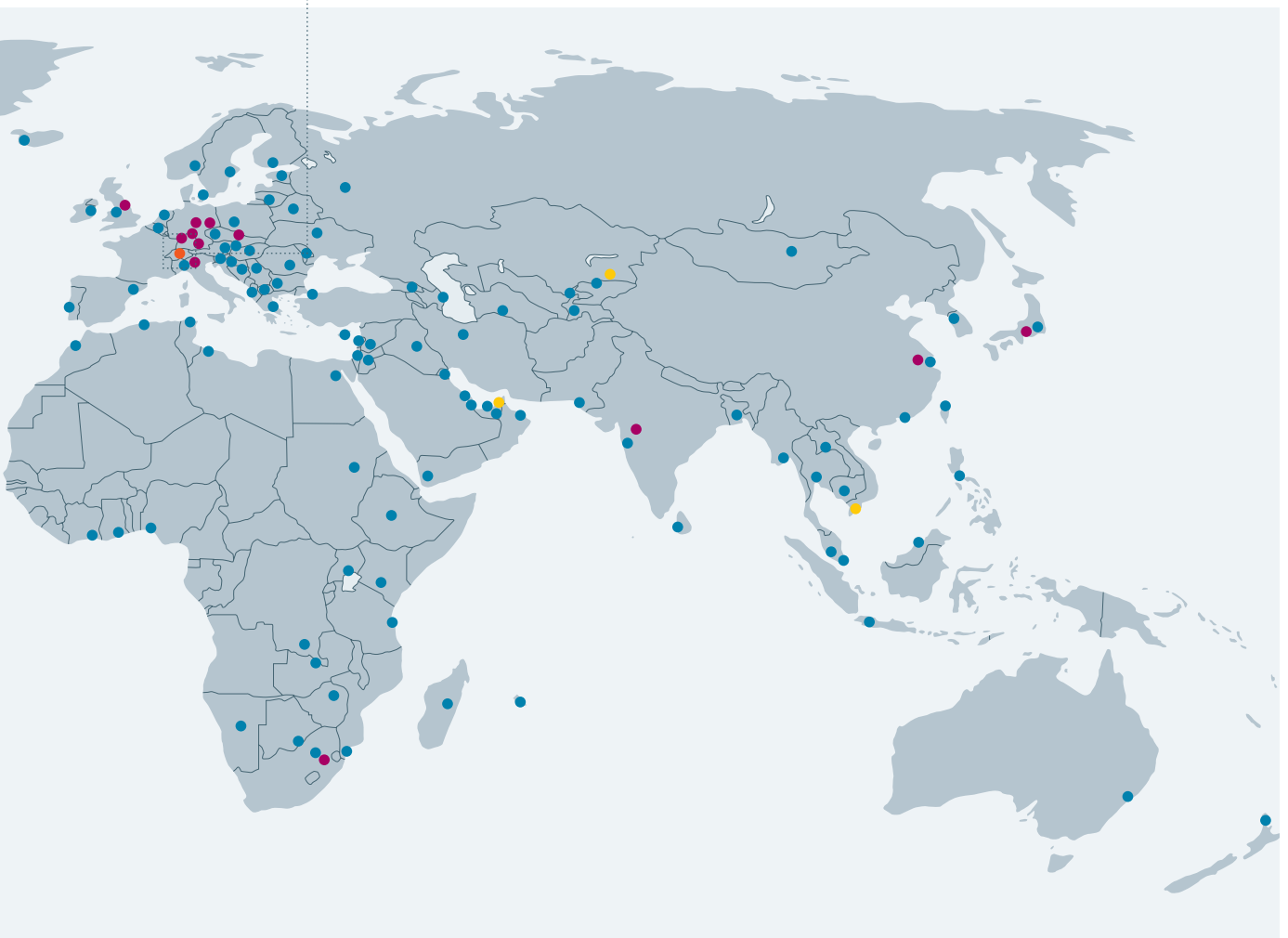


www.ch.endress.com/worldwide



✓ Your benefits

- Identical high-tech calibration systems worldwide ensure standardized quality statements
- Increased security through accreditation of all
- Calibration facilities according to ISO/IEC 17025 (worldwide)
- On-site calibration team with locally available engineers and calibration technicians in over 45 countries ensures short response time
- Highest measuring accuracy through fully traceable test equipment to national and international standards ensures product quality
- Short travel distances thanks to regional positioning of our technicians





Traceability

Reliable measurement results through traceable calibration

Traceability means that measurement results can be related to national or international comparison standards by means of an uninterrupted "chain of evidence" of comparative measurements or calibrations.

Bodies performing comparisons within this chain must prove the corresponding competence, e.g. by accreditation as a calibration laboratory.

Calibrations performed by other bodies not accredited as calibration laboratories are not considered traceable in the

sense of EN ISO 9001 or EN ISO/IEC 17025, as in this case the proof of technical competence is not given. The traceability is ensured by an official accreditation performed by an authority.

Further information on accreditation can be found on page 16.

Traceability by example: Our flow calibration can be traced back to trace back to the original kilogram



The measuring device in production operation

At customer

±0.05 %



The Calibration Facility

Endress+Hauser
Flow AG

±0.015 %



The gravimetric scale

Endress+Hauser
Flow AG

±0.0016 %



The National Standard

Swiss
Federal Office for
Metrology METAS

±0.0001 %



The "original kilo-gram" in Paris

Bureau International
des Poids et Mesures

±0.000001 %



Calibration certificate acc. to ISO/IEC 17025 vs. Calibration certificate acc. to ISO 9001

The main difference between calibration certificates according to ISO/IEC 17025 and calibration certificates according to ISO 9001 is the national and international recognition

Calibration certificate according to ISO/IEC 17025 (e.g. SAS calibration certificates) are subject to the supervision of the accreditation body (SAS, DAKkS, COFRAC, UKAS, ANSI, etc.) The structure, form and content of the calibration certificates are defined and controlled by the accreditation body. Based on this the conformity with DIN EN ISO/IEC 17025 is ensured. The calibration certificates are internationally recognized by the multilateral agreement of ILAC (MRA) and serve at the same time as proof of traceability. The traceability of the measured values contained therein to a national standard does not therefore have to be stated in detail, as this is guaranteed by the accreditation itself.

Druck/Vorgabe	Druck/Betriebsdruck	Druck/Kalibrierungswert	Abweichung	Erweiterte Messunsicherheit
0,000	0,000	0,010	0,011	0,010
0,000	0,000	0,010	0,010	0,010
0,000	0,000	0,010	0,010	0,010
0,000	0,000	0,010	0,010	0,010
0,000	0,000	0,010	0,010	0,010

Calibration certificate according to ISO 9001 (and factory calibration certificate)

ISO calibrations, on the other hand, are not checked by an external body. Rather, they are subject to the calibration laboratory's self-imposed obligation to provide a correct and expert statement of measurement uncertainty, conformity to standards, traceability and, ultimately, careful laboratory practice. In this case, the calibration laboratory is responsible for the conformity with the standard DIN EN ISO/IEC 17025. This type of calibration certificate may only be issued by those companies that are certified according to ISO 9001.

Temperatur	Beiwertwert	Ansprechwert IUT	Abweichung	±1σ UPE
1,0	202,35	203,12	0,28	1,00
2,0	199,33	199,11	0,08	1,00
3,0	206,01	207,11	0,05	1,00

Measurement uncertainty according to GUM

Information on the statement of uncertainty of measurement for calibrations

The evaluation and estimation of the measurement uncertainty is carried out according to ISO/IEC 17025, taking into account all uncertainty amounts relevant for the respective measurement. These are determined according to the GUM (Guide to the Expression of Uncertainty in Measurement, published in 1995 by ISO, BIPM, IEC, OIML) to a standard measurement uncertainty.

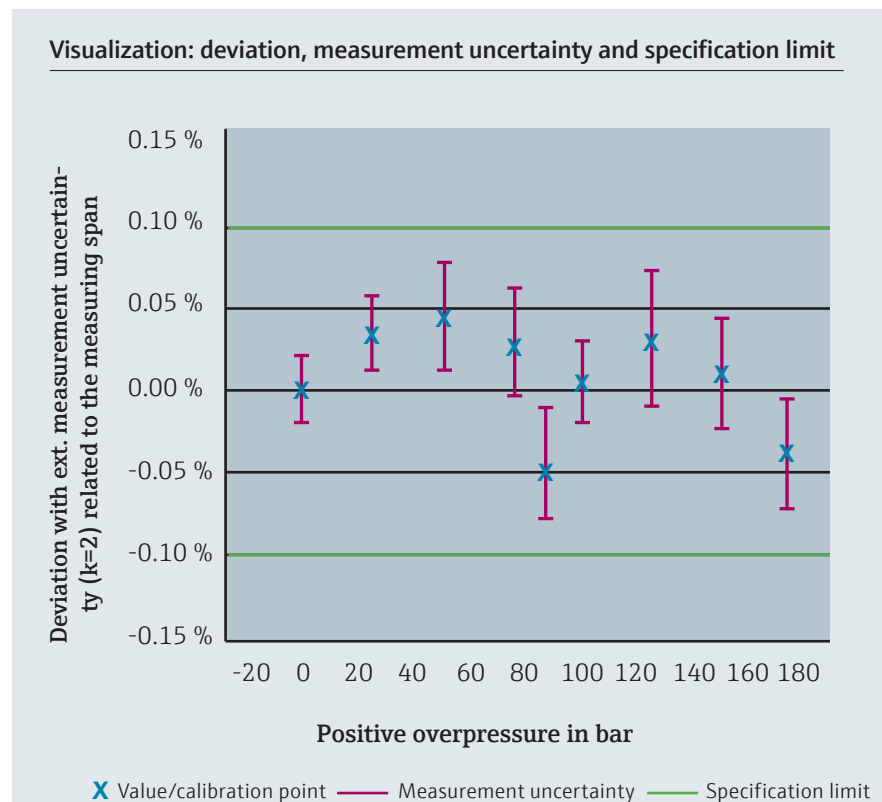
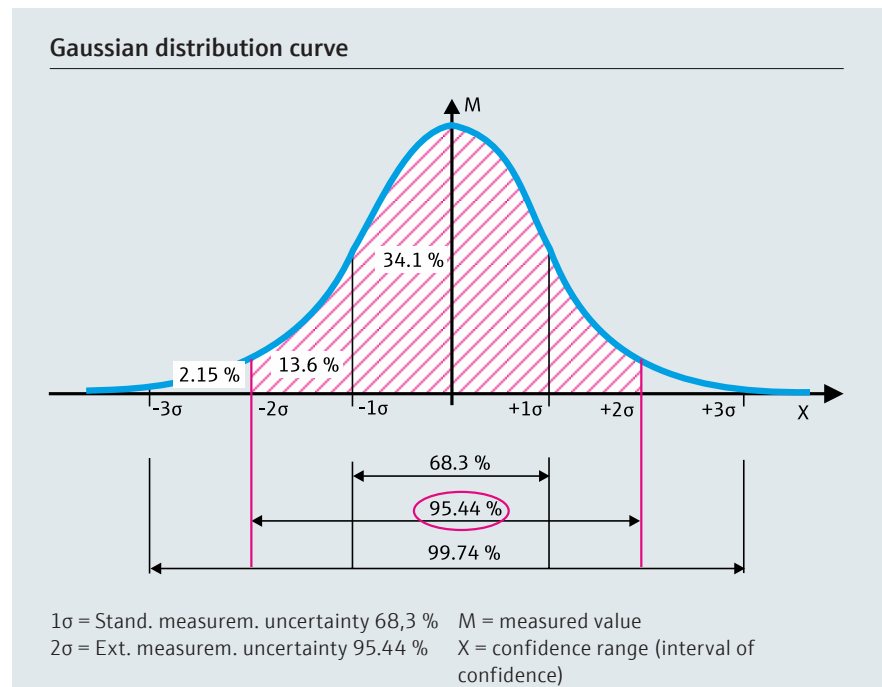
Manufacturer Specification

Manufacturer's specification means the manufacturer's statement on the accuracy/repeatability of a measuring instrument under reference/laboratory conditions. This information can be found in the technical documentation.

MPE (Maximum permissible Error; on the other hand, defines the accuracy of a measuring device under operating conditions at the place of use. The operating conditions have an influence on the behavior of the instrument. For this reason, the MPE for an on-site calibration should be selected so that it is greater than the manufacturer's specification. The MPE is defined by the customer.

Extended measurement uncertainty

The expanded uncertainty of measurement is given, which results from the standard uncertainty of measurement by multiplication with the coverage factor $k=2$. For a Gaussian normal distribution it corresponds to a coverage probability of approx. 95 %, i.e. the (unknown) true value of the measurand lies with a probability of approx. 95 % in the assigned value interval around the measured value.



Our calibration portfolio at a glance

From cost-effective verification concepts and accredited on-site calibrations to high-precision calibration at the manufacturer's plant

	Calibration range*	Smallest measurement uncertainty**	Displayed documents
Flow measurement			
On-site calibration	0.6 kg/h (L/h) to 140.000 kg/h (L/h) (DN 01 to DN 350) 50 kg/h (L/h) to 65,000 kg/h (L/h) (DN 04 to DN 80)	± 0.3 % v. M.	Calibration certificate (acc. to ISO 9001) or DAkkS calibration certificate (acc. ISO/IEC 17025)
Calibration at production center	0.4 kg/h to 5,760 t/h 0.4 dm ³ /h to 5,760 m ³ /h (DN 1 to DN 2400) other nominal sizes on request	Calibration method: Gravimetric: ± 0.015 % Volumetric: ± 0.022 % Master Meter: ± 0.08 %	Calibration certificate (acc. ISO 9001) or SCS calibration certificate (acc. ISO/IEC 17025)
Calibration at service center (D-Weil am Rhein)	36 kg/h to 100 t/h 36 dm ³ /h to 100 m ³ /h (DN 8 to DN 100) other nominal sizes on request	Calibration method: Gravimetric: ± 0.05 % Master Meter: ± 0.08 %	Calibration certificate (acc. to ISO 9001) or DAkkS calibration certificate (acc. ISO/IEC 17025)
Comparison measurement/calibration from outside (clamp-on ultrasonic flow measurement)	Depending on the plant	MPE or smallest measurement uncertainty on demand after technical check	Measurement protocol or calibration certificate (acc. ISO 9001)
Verification Fieldcheck (test/simulation measuring equipment) or Heartbeat Technology (integrated device function)	According to calibration object	MPE or smallest measurement uncertainty on demand after technical check	Verification report (acc. ISO 9001)
Pressure measurement			
On-site calibration	-1 bar to 20 bar (positive and negative overpressure) 1 µbar to 350bar (pressure absolute)	0.1 % v. E., jedoch nicht kleiner als 1 mbar	Calibration certificate (acc. to ISO 9001) or DAkkS calibration certificate (acc. ISO/IEC 17025)
Calibration at production center	-1 bar to 500 bar (positive and negative overpressure) 0.013 mbar to 501 bar (pressure absolute) 0 mbar to 70 bar (differential pressure)	0.0050 % (negative overpressure) 0.010 % (positive overpressure) 0.0045 % (pressure absolute) 0.0080 % (differential pressure)	Calibration certificate (acc. to ISO 9001) or DAkkS calibration certificate (acc. ISO/IEC 17025)
Calibration at service center (D-Weil am Rhein)	50 mbar to 40 bar (pressure absolute) -0.9 bar to 39 bar (overpressure)	0.04 % but not less than 0.02 mbar	Calibration certificate (acc. to ISO 9001) or DAkkS calibration certificate (acc. ISO/IEC 17025)

	Calibration range*	Smallest measurement uncertainty**	Displayed documents
pH value measurement			
On-site calibration	0 pH to 14 pH	MPE or smallest measurement uncertainty on demand after technical check	Calibration certificate (according to ISO 9001)
Calibration at production center	2 pH to 12,5 pH (pH buffer solutions)	0.02 (pH buffer solutions with pH 2 to 9,22) 0.05 (pH buffer solutions with pH 10 to 12) No information on pH sensors possible, since not accredited according to ISO/IEC 17025	pH buffer solutions: DAkkS-Kalibrierschein (nach ISO/IEC 17025) pH-Sensors: Producer test certificate (according to DIN 10204)
Oxygen measurement			
Calibration at production center	0 - 100 % Vol. oxgene	1.155 %	Calibration certificate (according to ISO 9001)
Density measurement			
On-site calibration	0.998 g/cm ³ to 1.20 g/cm ³ Ambient temperature to 60 °C	MPE or smallest measurement uncertainty on demand after technical check	Calibration certificate (according to ISO 9001)
Calibration at production center	Density range for water (accredited): 999.97 kg/m ³ to 970.53 kg/m ³ (5 °C bis 80 °C) Medium: 1.2 kg/m ³ to 1,800 kg/m ³ (at lab temperature conditions)	0.07 kg/m ³ to 0.3 kg/m ³	Spezielles Zertifikat zur Dichte-Kalibrierung (nach ISO 9001)
Calibration at service center (D-Weil am Rhein)	Standard density: 1.2 kg/m ³ for air 998.6 kg/m ³ - 995 kg/m ³ for water (depending on the water temperature)	MPE or smallest measurement uncertainty on demand after technical check	Calibration certificate (according to ISO 9001)
Level measurement			
On-site calibration	After consultation	MPE or smallest measurement uncertainty on demand after technical check	Calibration certificate (according to ISO 9001)
Calibration at production center	Bis 30 m (absolute measuring accuracy 0.1 mm)	MPE or smallest measurement uncertainty on demand after technical check	Calibration certificate (according to ISO 9001)
Viscosity measurement			
On-site calibration	After consultation	MPE or smallest measurement uncertainty on demand after technical check	Calibration certificate (according to ISO 9001)

*/** see page 15

Von kosteneffizienten Überprüfungskonzepten über akkreditierte Vor-Ort-Kalibrierungen bis hin zur hochpräzisen Kalibrierung im Herstellerwerk

	Calibration range*	Smallest measurement uncertainty**	Displayed documents
Temperature measurement			
On-site calibration	-30 °C to 650 °C	0.1 K (-20 °C to 50 °C) 0.15 K (50 °C to 150 °C)	Calibration certificate (acc. to ISO 9001) or DAkkS calibration certificate (acc. ISO/IEC 17025)
Calibration at production center	Resistance thermometer: -196 °C bis 660 °C Electronic contact thermometers, thermoelements: -196 °C to 1,550 °C	Resistance thermometer: 0.5 °C (-196 °C) 0.05 °C (-80 °C to -40 °C) 0.025 °C (-40 °C to 300 °C) 0.075 °C (300 °C to 650 °C) Electronic contact thermometers (digital): 0.1 °C (-196 °C) 0.08 °C (-80 °C to -40 °C) 0.022 °C (-40 °C to 300 °C) 0.060 °C (300 °C to 650 °C) 1.0 °C (650 °C to 1,100 °C) 2.5 °C (1100 °C to 1,550 °C) Electronic contact thermometers (analog): 0.1 °C (-196 °C) 0.08 °C (-80 °C to -40 °C) 0.04 °C (-40 °C to 300 °C) 0.15 °C (300 °C to 650 °C) 1.4 °C (500 °C to 1,100 °C) 1.0 °C (650 °C to 1,100 °C) 2.5 °C (1,100 °C to 1,550 °C) Thermoelements: 0.5 °C (-196 °C) 0.4 °C (-80 °C to 0 °C) 0.3 °C (0 °C to 500 °C) 1.0 °C (500 °C to 1,100 °C) 2.5 °C (1,100 °C to 1,550 °C)	Calibration certificate (acc. to ISO 9001) or DAkkS calibration certificate (acc. ISO/IEC 17025/SIT)
Conductivity measurement			
On-site calibration	0 µS/cm to 20 µS/cm 20 µS/cm to 2 S/cm	MPE or smallest measurement uncertainty on demand after technical check	Calibration certificate (acc. ISO 9001)
Calibration at production center	5 µS/cm to 50 µS/cm, 50 µS/cm to 5 mS/cm	MPE or smallest measurement uncertainty on demand after technical check	Producer test certificate (final inspection) or calibration certificate (acc. ISO 9001)



* Further calibration ranges after technical examination

** In Switzerland, the smallest specifiable measurement uncertainties according to SCS are defined. The stated expanded measurement uncertainty is the standard uncertainty of the measurement multiplied by a coverage factor $k=2$, which corresponds to a confidence level of about 95% for a normal distribution.

On-site calibration

Calibration directly at your plant increases the efficiency of your processes

Thanks to calibration directly at your premises, there is no need to dismantle and send in the device. This also ensures that the device is tested at the installation site and under the prevailing operating conditions. Furthermore, on-site calibration can be directly linked to any necessary adjustments, repairs, device replacement and other maintenance work. In doing so, we are guided by your time constraints so that your equipment is calibrated at the right time. This ensures optimal performance at minimal cost - and with only one contact person for all measured variables.

Calibration Know-how Our calibration technicians have a high level of metrological knowledge and many years of experience thanks to one million calibrations performed across all industries. This experience enables our technicians to solve almost any calibration task efficiently.

Unique calibration expertise In Switzerland and Germany Endress+Hauser is the calibration service provider with ISO/IEC 17025 accreditation for on-site flow calibrations. In addition, Endress+Hauser's on-site services density calibration, viscosity calibration and level calibration are available for Patent pending.



✓ Your benefits

- Accredited on-site calibration for flow, pressure and temperature ensures highest quality
- Calibration directly during operation saves time and reduces plant downtime
- Highest quality through industry-specific trained and experienced calibration technicians
- Increase of your plant availability (OEE Overall Equipment Effectiveness)
- Time-saving inline concepts without removal

i What is accreditation? Accreditation is the formal recognition of the technical competence of a body to provide specific services described in accredited fields of activity - for example, calibration - calibration of equipment, calibration of machinery, etc. to be performed. Accreditation involves rigorous on-site audits and test measurements by the accreditation authority. The following are tested as examples wise:

- Level of training and professional competence of the employees
- Technical infrastructure (guidelines, applied methods e.g. for calculation of measurement uncertainty, ...)
- Organizational structures (independence, quality management, ...)

 www.sas.ch



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Accredited on-site flow calibration according to ISO/IEC 17025 with the mobile calibration trolley reduces process interruptions and increases system availability.

Endress+Hauser is the first provider in Switzerland and Germany to be accredited for on-site flow calibration according to ISO/IEC 17025, which helps you to ensure your quality standards, minimize the need for audits and optimize plant availability. With the help of an Endress+Hauser mobile calibration trolley, calibrations can be performed on site in a short time - even directly in the installed state, upstream or downstream. This eliminates the need to remove and install your equipment, thus greatly reducing process interruptions. A mobile and accredited calibration facility with traceably calibrated Coriolis measuring instruments serves as a reference standard.

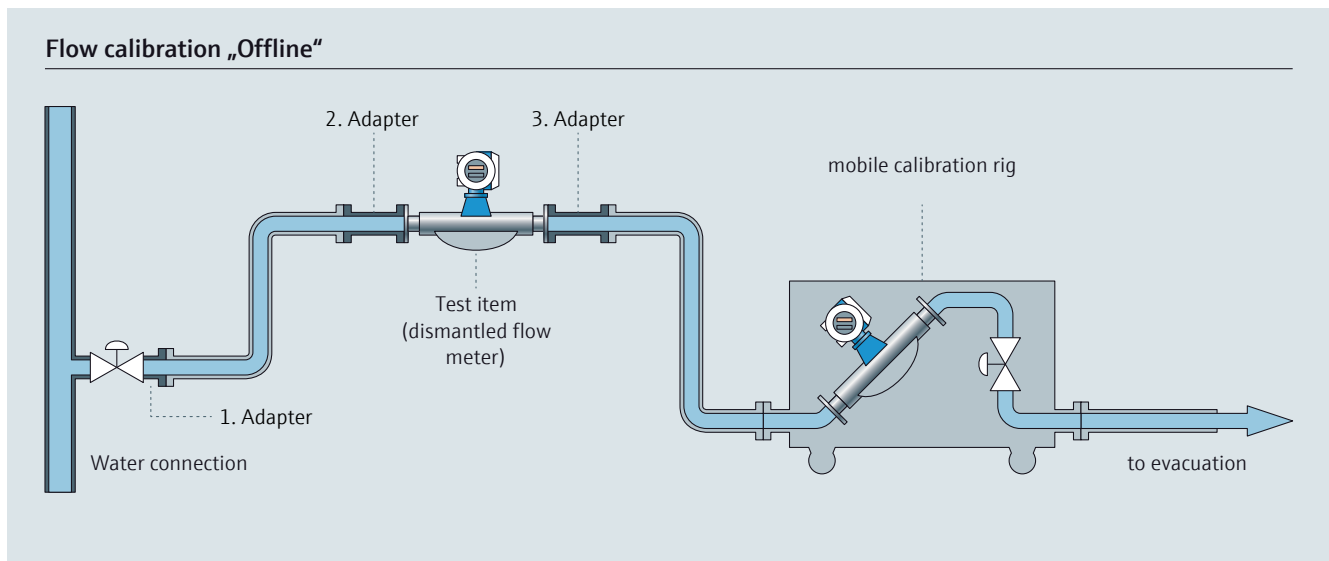
i Advantages of accredited calibrations:

- Traceability to national standards (e.g. METAS, PTB, NPL, LNE, NIST, CN)
- Worldwide recognition thanks to ILAC MRA (worldwide association for the cooperation of accreditation bodies)
- Certainty of high quality of calibration activities
- Guarantee of the professional and technical know-how and the level of training of the employees
- Reliable, traceable measurement results

Highest quality through accredited on-site flow calibration according to ISO/IEC 17025

On-site procedure for flow calibration

Offline calibration The removal of the test sample is carried out by you in advance. You will also ensure the provision of an adequate water supply and provide a drain.

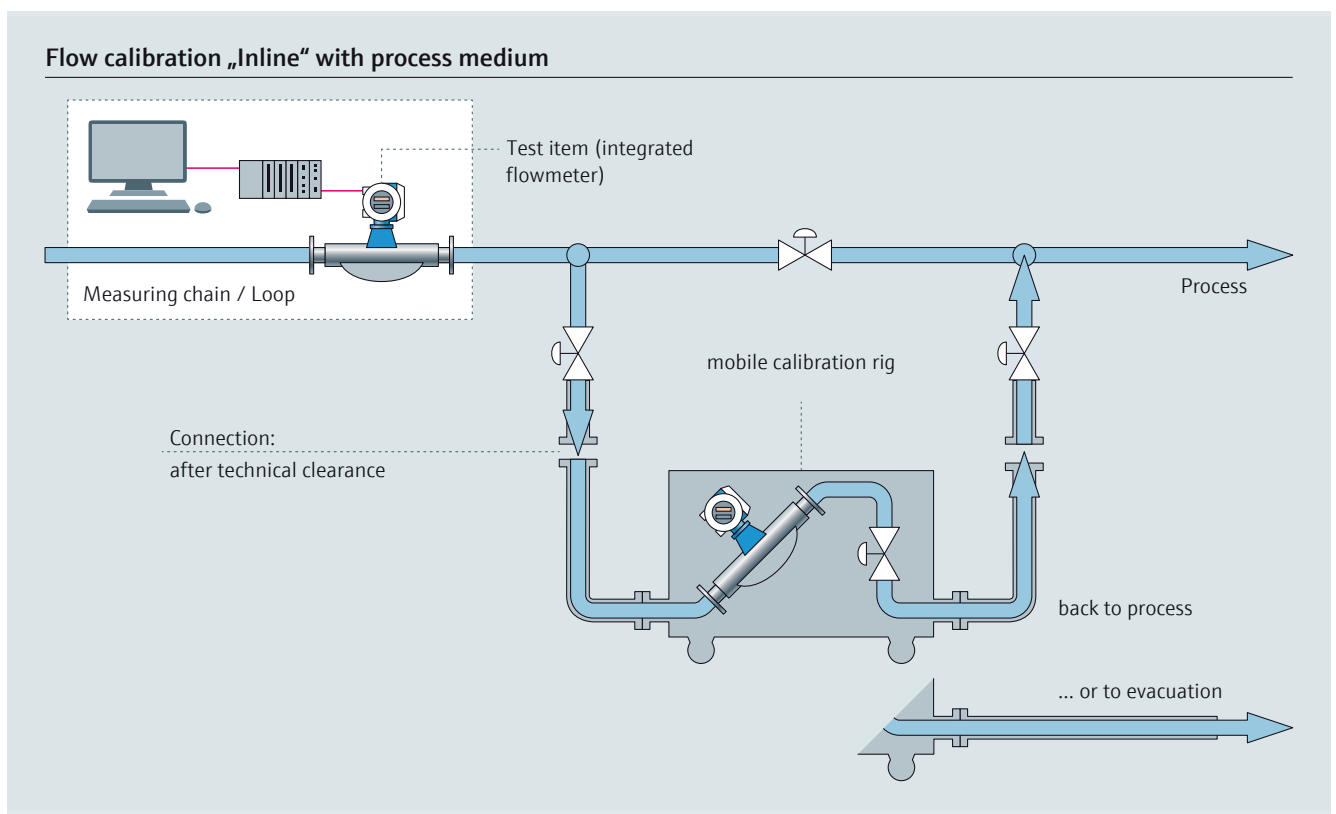
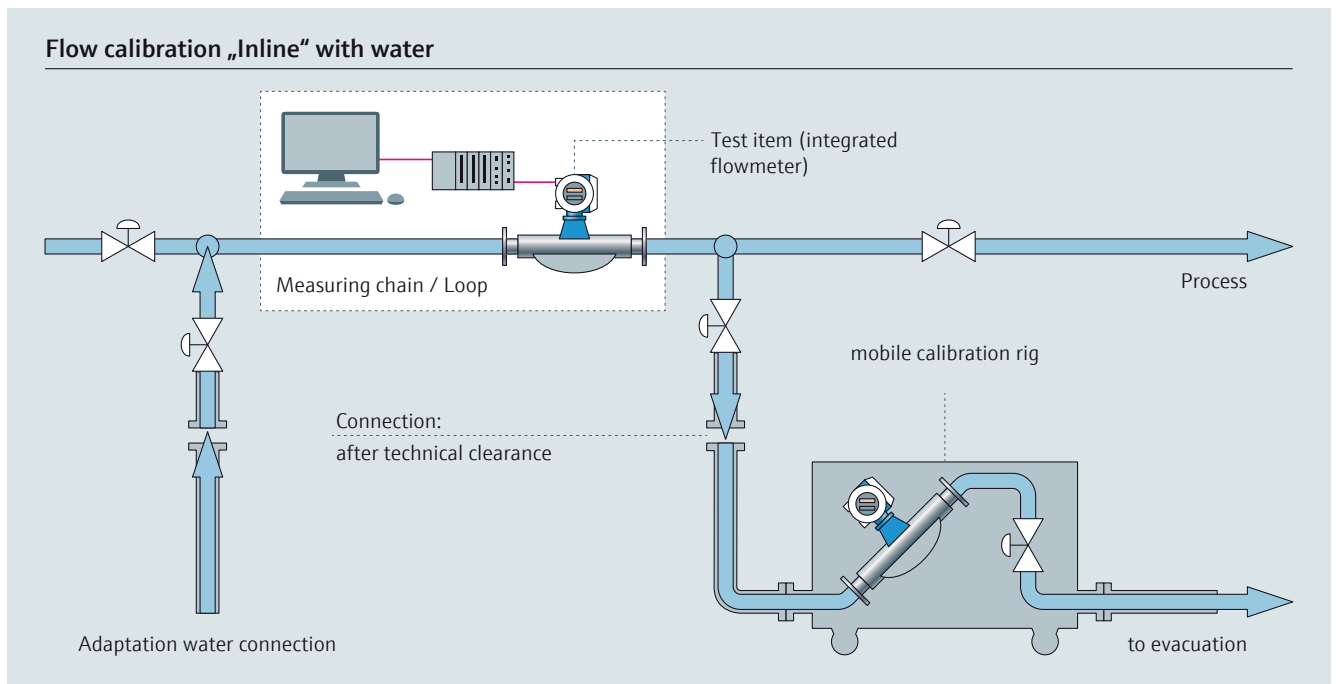


Time-saving inline procedure for on-site flow calibration increases your system availability

On-site procedure for flow calibration

Inline calibration The test sample remains at the installation location. Optionally, the calibration of the entire loop is performed.

It is calibrated either with the process medium or with water. In case of calibration with the process medium, the medium is discarded afterwards or fed into the process according to your wishes.



Patent pending, innovative processes

On-site density calibration

For on-site density calibration, the calibration service team uses the mobile device developed by Endress+Hauser with Promass F (special density calibrated) as a highly accurate reference instrument. Consequently, you benefit from the most accurate density measurement under real process conditions directly in your plant.

Endress+Hauser's traceable on-site density calibration is unique worldwide. A further plus: This service is not limited to Endress+Hauser's density meters (Liquiphant Density and Promass), but is performed independently of the manufacturer.



Endress+Hauser is a provider of a procedure for on-site density calibration - for example Promass density meters.

On-site viscosity calibration

The mobile device for on-site viscosity calibration developed by Endress+Hauser (patent pending) uses the traceably calibrated Promass I as reference instrument. The calibration is performed offline with a glycerin-water mixture in a viscosity range from approx. 1 mPa*s to 75 mPa*s. The calibration points can be determined individually within this range. This procedure is an ideal alternative to calibration in the manufacturer's factory. Consequently, you now benefit from calibration under real process conditions directly in your plant.



Patent pending viscosity calibration method on site.

On-site level calibration without calibration

The innovative method for on-site calibration of level measuring instruments was developed by Endress+Hauser calibration experts and eliminates the need to calibrate tanks. Calibration is performed using a reference laser in a calibration range from 0.5 m to 1.8 m. The calibration points in this range can be selected individually. This procedure reduces your calibration effort for level measuring instruments enormously.



The calibration of level measuring instruments is possible on site without calibration.



Further possibilities for verification of flowmeters on site

Comparison measurement versus on-site verification

On-site comparison measurement with ultrasonic clamp-on Without interrupting the process, regular checks can be carried out without much effort or existing systems can be reviewed. With an accuracy of approx. 2% of the measured value, a check can be performed with ultrasonic clamp-on devices. This method is often used for simple plausibility checks or for repeat tests.

Your benefits:

- No process interruption and removal of the test specimen necessary
- Cost-effective through flexible use
- Subsequent assembly without product contact



Ultrasonic clamp-on: comparative measurement without interrupting the process

On-site verification with Fieldcheck As an economically interesting and efficient alternative for all applications where ISO 9001 certification requires frequent calibration and test cycles, the Fieldcheck test and simulation measuring instrument is recommended. The calibrated reference system allows a traceable verification directly in the plant in the installed state. The constant measuring accuracy can be ensured by regular checks during operation.

Your benefits:

- Increase of plant availability through preventive monitoring (verification of the manufacturer's specification)
- Early detection of possible device defects
- Simple simulation and verification of measuring devices without removing the measuring device from the pipeline

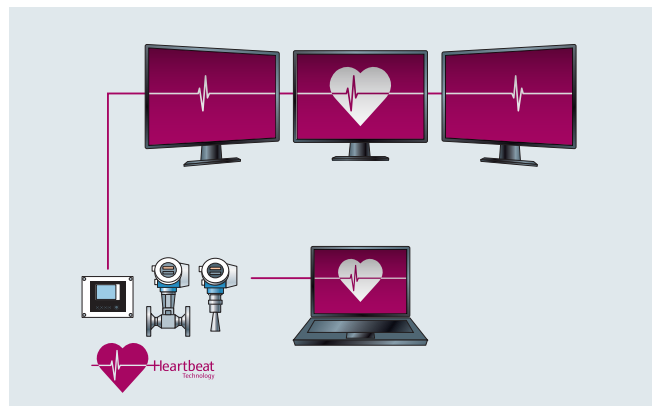


Fieldcheck: traceable verification in installed condition.

On-site verification using Heartbeat Technology With Heartbeat Technology, the new Proline generation offers diagnostic coverage from sensor to output. Heartbeat thus ensures continuous device function testing without process interruption. The heartbeat verification function allows the status of the device to be documented quickly and easily at the touch of a button.

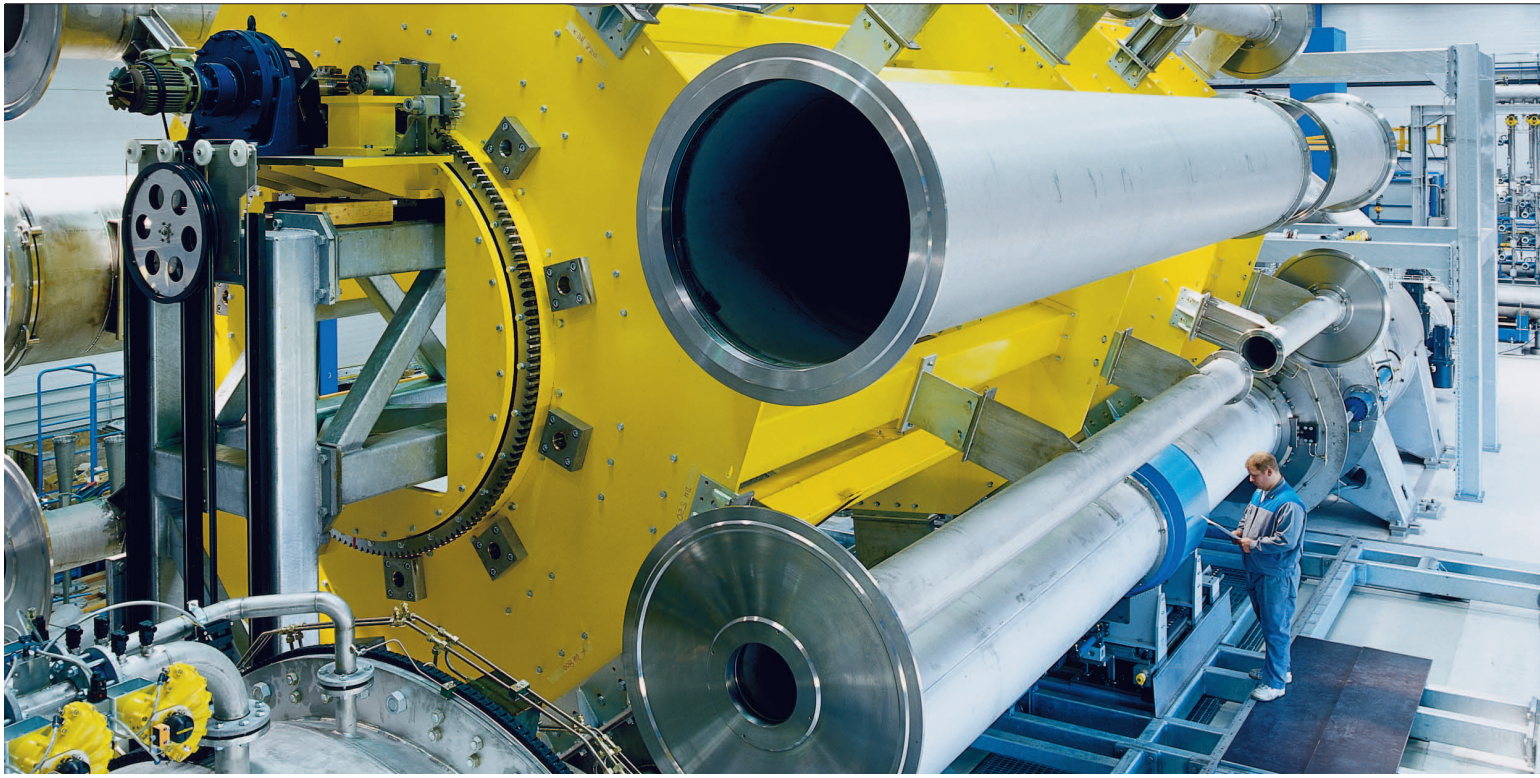
Your benefits:

- Optimization of test intervals for repeat testing
- Testing in conformity with regulations through traceable references in the device according to ISO 9001
- Increase of system availability (testing without approaching the trigger point)



Heartbeat Technology: On-site verification without process interruption.





Highest measurement accuracy through laboratory calibration

Completely traceable calibration according to ISO/IEC 17025

All our primary facilities are accredited acc. ISO/IEC 17025 and traceable to national and international standards. No other manufacturer of measuring instruments has this quality certificate.

Extensive support The multitude of our calibration facilities in Switzerland, France, United Kingdom, India, China, the USA and Japan are just one example. There is no other calibration service provider where you will receive such comprehensive support as at Endress+Hauser. Our calibration laboratories are located all over the world to provide you with the best possible service anytime and anywhere.

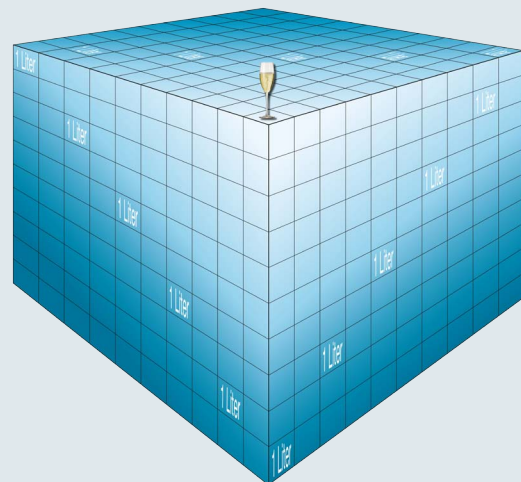
✓ Your benefits

- Increased safety through global calibration concept with globally identical, high-tech systems accredited to ISO/IEC 17025 (unique worldwide)
- Highest measuring accuracy of your devices (0.05 %) due to the most accurate production calibration system (0.015 %)
- Assured quality through fully traceable test equipment

i Did you know ...

... that the measurement uncertainty of the Premi-Cal is only 0.015 %?

That corresponds to a champagne glass per 1,000 liters. Internationally an absolute top value!



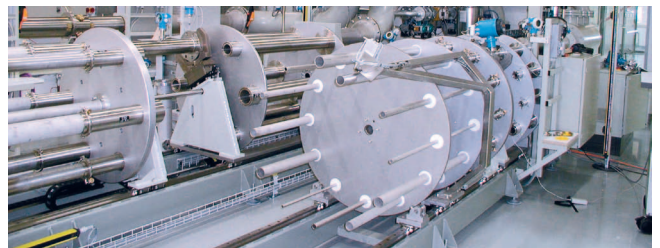
Calibration of your instruments with highest accuracy in the laboratory: An extract from our portfolio

Flow calibration with unique weighing technology

PremiumCal, the world's best calibration system under production conditions, has high-precision load cells of the latest generation (Class 6/5). Even weight differences from less than 1 g to 400 kg can be measured perfectly - an absolute top value internationally!



Flow calibration using air Several fitting piece turrets enable a precise and almost fully automatic clamping of the test pieces into the measuring section. Three reference devices such as nozzles, rotary piston meters and turbine gas meters ensure that the results are accurate to $\pm 0.3\%$ over the entire measuring range. A special air-conditioning system continuously keeps the air in the calibration room at exactly 24 °C and 40 % humidity.



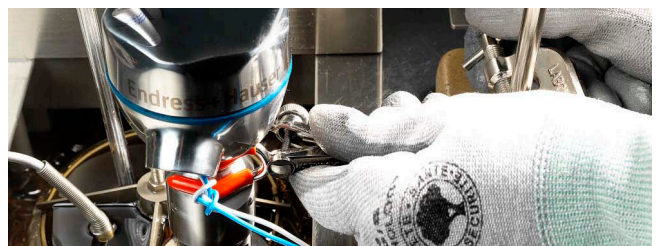
Special density calibration Endress+Hauser offers an accredited special density calibration on request, which is carried out in a special laboratory. Media with different densities (0.8 g/cm^3 to 1.8 g/cm^3) are used. After a field density adjustment, measuring accuracies of $\pm 0.0005 \text{ g/cm}^3$ can be achieved.



Pressure calibration Your pressure equipment is precisely calibrated in the laboratory at Endress+Hauser in strict compliance with specifications. Calibration is performed at evenly distributed measuring points over the entire calibration range. Depending on the desired measurement uncertainty, one or more series of measurements are performed.



Temperature calibration The calibration of thermometers in the laboratory is carried out, for example, with the comparison procedure in the calibration bath/oven. Here the calibration is carried out against a reference or standard thermometer, which has been calibrated directly or indirectly via further comparison thermometers at fixed point temperatures of the ITS-90 scale.



Quality assurance through calibration management

From optimized calibration methods and risk-based calibration intervals to organized test equipment management



Our experts trained in calibration and data integration help you optimize the time required for instrument calibration and the quality of your calibration.

Calibration Management Including test equipment management goes beyond mere calibration and is becoming increasingly relevant in order to be compliant and competitive. Nevertheless, there is often uncertainty in the organization of calibration processes, especially in the execution and documentation of calibration. This is underpinned, among other things, by the increasing number of warning letters issued by the FDA.

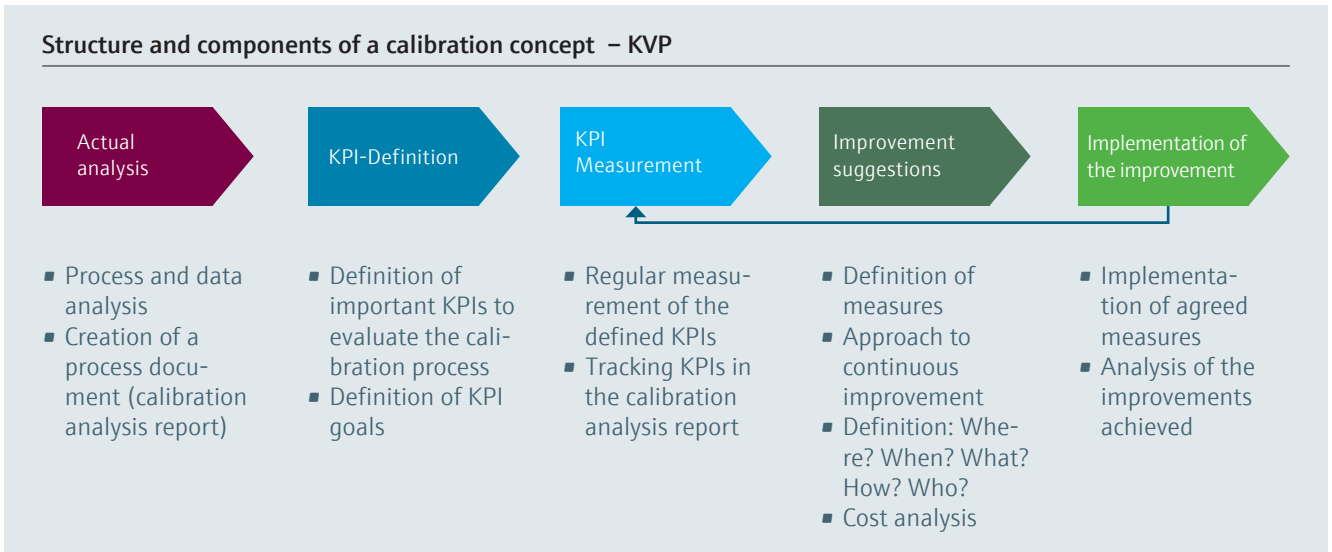
Kalibriermanagementlösungen: maßgeschneidert und individuell No matter whether you want to perform calibration with optimized calibration methods such as time-saving inline concepts, define risk-based calibration intervals or discover potentials for optimizing your calibration process - we support you so that on the one hand your plant availability is increased by efficient calibration concepts and on the other hand your compliance and audit reliability is ensured. In doing so, we take your individual requirements into account.

In addition, our specialists also develop, optimize and harmonize specific SOPs for your calibration in accordance with the regulations and our general standard operating procedures (SOP). You alone decide how and to what extent we can support you.

✓ Your benefits

- Cost savings through optimized calibration planning based on KPI analyses
- Review, revision and/or new creation of SOPs increases the efficiency of your calibration processes
- Increased transparency and security through regular reporting of KPIs
- Continuous identification of improvements and development of measures reduces costs
- Consistent gauge management ensures your compliance

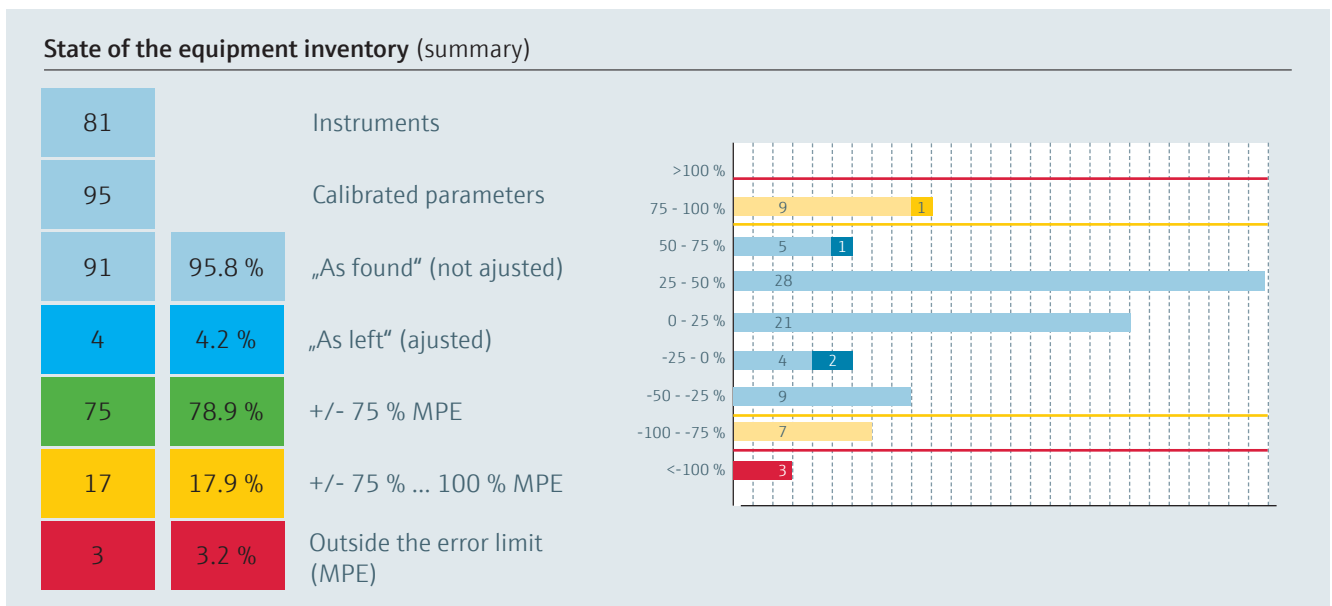
Continuous improvement through analysis of existing calibration processes



The practice-proven continuous improvement process (KVP)

The basis for a continuous improvement process (KVP)

Der praxisbewährte kontinuierliche Verbesserungsprozess (KVP) Sämtliche Prozessschritte werden entlang zuvor definierter Key Performance Indicators (KPI) kontinuierlich in einem Analyseberichtssystem verfolgt und dokumentiert. Die Dokumentation enthält Gesamtübersichten über alle vorgenommenen Kalibrierungen einer durchgeführten Kalibrierkampagne. KPI-Dashboards und Geräteübersichtstabellen zeigen den Zustand der kalibrierten Geräte im Hinblick auf Messabweichungen zu definierten Fehlergrenzen. Auf Basis der Analyse von Abweichungen sind Handlungsempfehlungen in Bezug auf Präventiv- und Korrekturmaßnahmen des Kalibrierprozesses formuliert.



Calibration optimization with iTHERM TrustSens

No system downtime - reducing the risk of undetected drift

100% Compliance – 0% effort The new iTHERM TrustSens enables a complete, traceable monitoring thanks to its completely automated self-calibration function during the running process. This results in a high product safety and an increase of plant availability. The hygienic thermometer is intended for users in the pharmaceutical, food and beverage industries who require complete compliance with FDA or GMP regulations or with international standards such as IFS, BRC, ISO22000. The result: less effort and reduced costs.

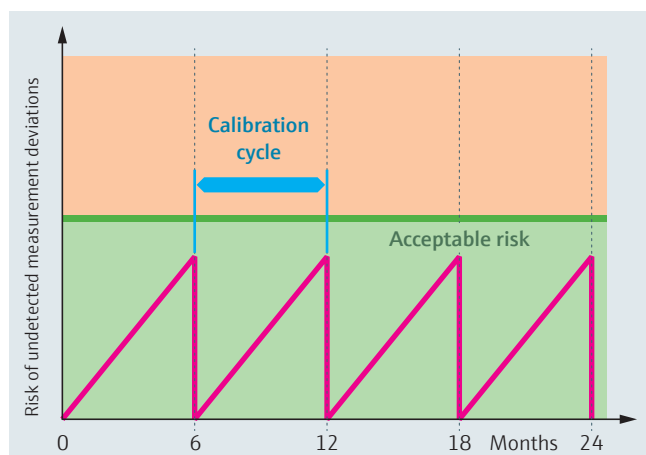
At the heart of the temperature sensor is a highly developed sensor unit consisting of a primary Pt100 temperature sensor and a highly accurate, long-term stable integrated reference. The reference sensor uses a physical fixed point based on the Curie temperature and thus serves for regular calibration of the primary sensor. The self-calibration is triggered fully automatically at a temperature of 118 °C (Curie point of the integrated reference). This process takes place, for example, at every steam sterilization of the system. Thus, the constantly high measuring accuracy of the temperature sensor is permanently monitored during the entire service life.

 More information on iTHERM TrustSens TM37x: www.ch.endress.com/trustsens

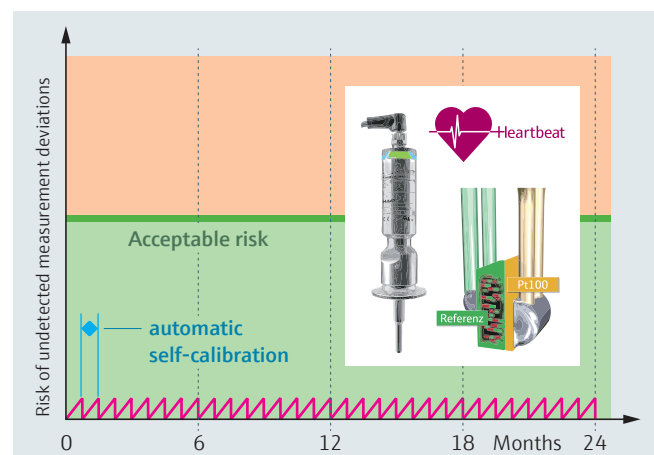
Heartbeat Technology also in temperature measurement The integrated intelligent electronics has a wide range of diagnostic functions, which are categorized according to NAMUR recommendation NE107 and transmitted via HART® communication. In addition, status signals are signaled locally via the LED integrated in the device. In addition to the automated calibration itself - and thus checking the measuring accuracy of the thermometer - the data of the last 350 calibrations are stored directly in the device. This allows access to a long-term device and process history, which can be used as a basis for early trend determination.

Checked, tested, approved Trust is good, control is better! Therefore iTHERM TrustSens TM37x is delivered ex works with a calibration certificate for the fixed point reference integrated in the sensor, which guarantees the traceability of the calibration chain up to the International Temperature Scale ITS-90. Many years of extensive stress tests over many thousands of cycles, both in the laboratory and in the field, confirm a mature solution.

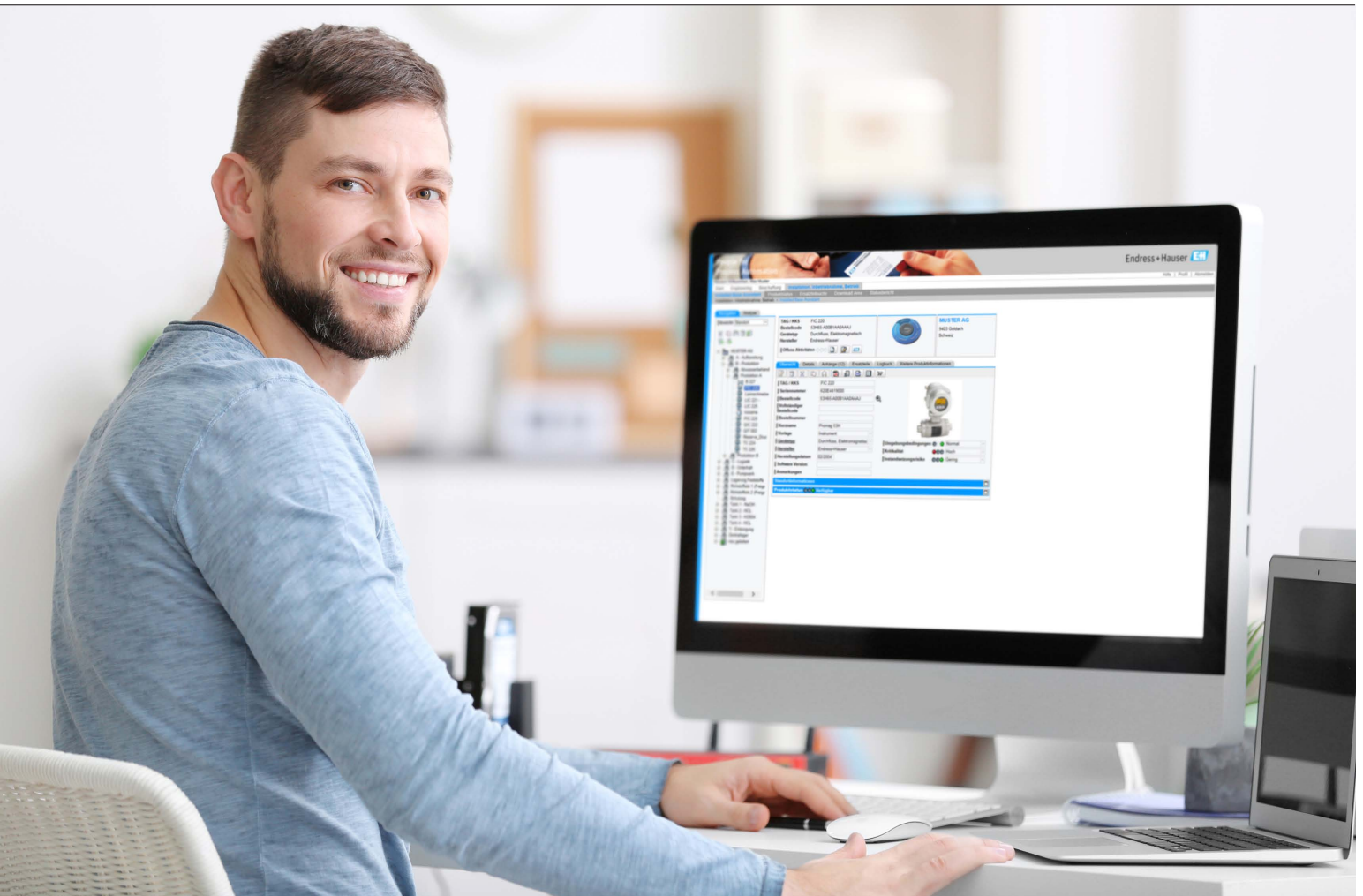
Audit-compliant calibration data are available at any time for complete documentation: In future, a valid calibration certificate (e.g. with the FieldCare Software from Endress+Hauser) can be issued at the click of a mouse.



Typical are - depending on the measuring point - calibration intervals between six months and two years. But what if after six months it is determined that the sensor is outside the specification?



The new iTHERM TrustSens calibrates itself automatically before each batch - without process interruption and without manual effort. This reduces the risk of undetected sensor drifts to virtually zero.



W@M Portal: Audit-proof documentation management

Data management made easy Information is needed and generated in every phase of the life cycle of a plant. The W@M Portal is an open and flexible platform for your plant life cycle.

Thanks to online connection to Endress+Hauser's product database you automatically benefit from up-to-date information on your measuring instruments, such as

- on product availability
- to spare parts lists and
- to calibration certificates

Your benefits

- Time savings through automatically stored device documentation such as calibration certificates, operating manuals and certificates
- Planning, documentation and reminder function for calibration, repair and maintenance events
- reduces effort and increases security
- Quick overview of process criticality and maintenance risk of the installed technology saves time



More information:

www.ch.endress.com/wam_portal

Competence for all industries and applications

No matter what your specific requirements are - Endress+Hauser offers you the right support

At Endress+Hauser you always benefit from having a contact person who knows your industry or your applications and speaks your language. Tailored to your needs, we offer you individual calibration services.

Comprehensive Portfolio We are constantly expanding our range of services so that you always have access to a service offer that meets your needs. For services that lie outside our core competence, we work together with

experienced partners. Thus we also have the necessary industry-specific know-how for specific special solutions.

Certified processes Our processes are certified according to ISO 9001, OHSAS 18001 and ISO/IEC 17025, allowing you to benefit not only from product quality but also from standardized company procedures in compliance with all standards and, consequently, from a high calibration execution quality.



www.ch.endress.com/industry-expertise



Life Sciences industry

Meet your quality requirements and ensure compliance

The challenge in the production of pharmaceuticals is to produce economically despite high regulatory requirements and strict quality standards for the drug. Endress+Hauser offers you an accredited calibration service for all relevant measurement parameters so that you can ensure your quality requirements in a GMP environment and at the same time minimize qualification and regular calibration efforts. Endress+Hauser ensures that its calibration technicians are trained in the processes and regulations worldwide. Our accredited calibration service with individual calibration concepts and management solutions, our standard operating procedures and our many years of experience in the GMP environment make us a competent and reliable partner who sees cost, quality and compliance as links to the market.

Calibration in GMP environment The challenge in the production of pharmaceuticals is to produce economically despite high regulatory requirements and strict quality standards for the drug. Endress+Hauser offers you an accredited calibration service for all relevant measurement parameters so that you can ensure your quality requirements in a GMP environment and at the same time minimize qualification and regular calibration efforts. Endress+Hauser ensures that its calibration technicians are trained in the processes and regulations worldwide.

Our accredited calibration service with individual calibration concepts and management solutions, our standard operating procedures and our many years of experience in the GMP environment make us a competent and reliable partner who sees cost, quality and compliance as links to the market.



From the calibration of individual measuring instruments to the implementation of a complete calibration management solution - we support you throughout the entire process.

Your benefit

- Many years of experience in the GMP environment as well as calibration technicians specially trained according to GMP ensure highest quality
- Development and optimization of SOPs increases the efficiency of your calibration processes
- Increased security through transparent documentation to safeguard audits

Inspection concepts for steam measuring points

Verification of quantity measurements and verifiable calculation of measurement uncertainties

Steam is a major cost driver for companies. Due to the exclusion of steam from the calibration regulations, discussions often arise between the producer and the purchaser of steam regarding correct quantity balancing. Furthermore the ISO 50001 a check of steam measuring points.

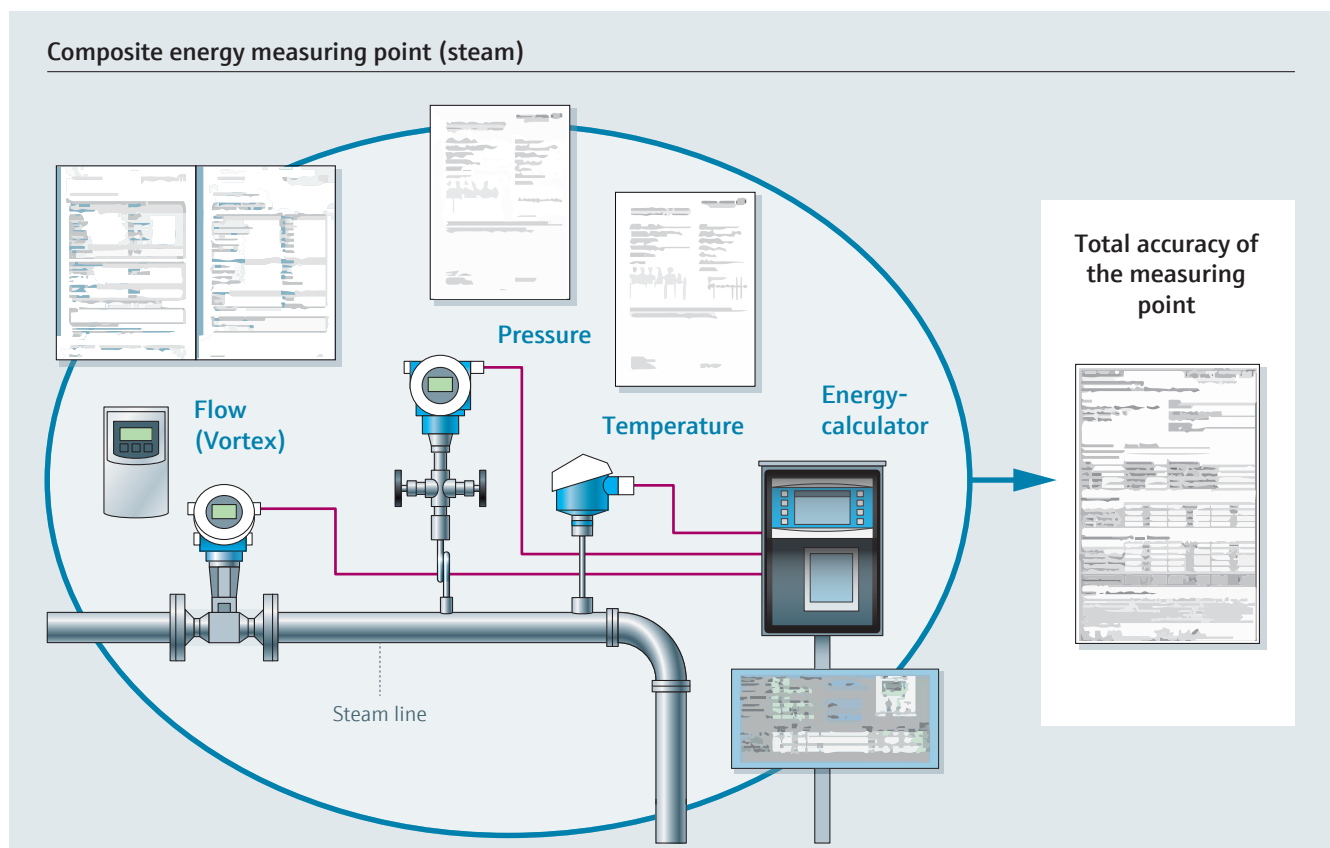
Verifiable steam calculation If a calculation is doubted or if the calculated total accuracy is far beyond the accepted error level, the theoretically calculated accuracy of steam measuring points can be practically remeasured. For this purpose Endress+Hauser offers an integrated verification concept. Each component of a steam measuring point can be verified by individual calibrations with traceable calibrators.

Calculation, validation and documentation of measurement accuracy After verification of the entire measurement system, the specific measurement uncertainties of the individual measurement components are calculated and included in your individual verification report, including a statement of conformity. This report contains a detailed

description of the measuring system and the verification concept as well as the presentation of the results.

✓ Your benefits

- Consideration of practical measurement uncertainties in the calculation of the total uncertainty of the measurement system
- Cost transparency for billing
- Audit-proof documentation for the fulfilment of Standards within the framework of quality assurance-systems
- Information basis for the introduction of measures for optimization
- Calculation of measurement uncertainty for energy measurements (hot and cold water), compressed air, natural gas and CO₂-relevant substance quantity measurements



At your service

Endress+Hauser has developed an extensive portfolio of services around the core of process instrumentation that help improve efficiency, safeguard quality and reduce risks.



ISO/IEC 17025
All calibration services, whether stationary or mobile, are internationally accredited

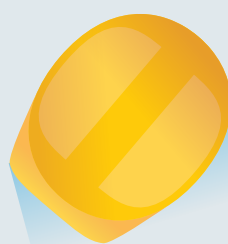
Highest accuracy

Quality-relevant measurement points must be tested and calibrated on a regular basis. Endress+Hauser offers calibration services consistent with global standards for nearly all physical and analytical parameters, regardless if performed in our facilities or on-site at the customer.

>1 mil.
Installments calibrated each year

Global support

The People for Process Automation have comprehensive expertise in the field of measurement technology, in addition to an in-depth understanding of the special requirements of various industries and processes. This knowledge is available to customers at every stage of their plant's life cycle.



150,000

service inquiries per year



>60
countries with added-value service offerings



>60
years of experience in on-site services

Switzerland

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