



THE DIFFERENCE BETWEEN CALIBRATION, VERIFICATION AND ADJUSTMENT

Understanding the full spectrum
of measurement integrity

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This guide outlines the distinctions and interrelationships between verification, calibration and adjustment of measurement instruments. It supports informed service planning and more effective instrumentation lifecycle management by clarifying the purpose, timing and outcome of each activity. It explains how these services combine to deliver consistent accuracy, regulatory traceability and operational reliability across process industries.



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PURPOSE

This guide offers an insight into matters relating to Verification, Calibration & Adjustment in terms of measurement devices.

It describes each one, defining their meanings and respective differences, and demonstrates the interrelationship between each activity in ensuring optimum device performance.

CONTEXT

Engineers and plant operators in the utility and process industries often manage extensive instrument fleets. To keep plants running smoothly, efficiently and safely, precise measurement of flow, pressure and temperature instrumentation across these fleets is required. Precise measurement ensures anomalies are detected before they escalate, guarantees product consistency through accurate dosing, and drives efficiency by optimizing resource use and reducing waste. Accurate measurement underpins safety, quality and profitability at every stage of process operation.

High functioning instruments can gradually lose precision and accuracy over time, leading to errors that can compromise safety, waste resources and eventually

impact profitability. Ensuring a consistent level of measurement reliability requires numerous crucial checks to be carried out regularly. These include calibration to set baseline accuracy, verification to monitor that baseline in the field, and adjustment to correct deviations as they occur. Together, these services deliver end-to-end measurement assurance preventing unplanned shutdowns, maintaining product consistency, and maximizing operational efficiency.

This document explains ABB's verification, calibration and adjustment services, how they interrelate, and why deploying the right combination is essential for reliable operations.





WHAT IS VERIFICATION?

Verification is a proactive field assessment that compares live instrument readings against calibration baselines to detect drift, vibration anomalies or sensor degradation without interrupting operations. In situations where speed of response is important and to avoid costly errors, ABB's SRV500 Software Verification (SRV Verification) performs these checks remotely in under 60 minutes.

Premium Service Verification supplements software routines with selective onsite loop tests using portable reference meters and calibrated test rigs. These combined services deliver deeper validation and comprehensive performance reporting. Carried out at regular intervals, generally twice a year or annually, these assessments enable plant operators to transition from reactive maintenance to predictive asset management.

Central to effective verification is instrument fingerprinting, which captures each device's unique performance profile during initial calibration by recording its response across flow rate, pressure and temperature. This fingerprint serves as the reference baseline for verification checks, enabling precise comparison of live data against original performance and highlighting deviations from baseline behavior. Over time, ABB's analytics platform aggregates these comparisons to identify trends and predict maintenance requirements before performance declines.

ABB's SRV verification tool supports all major measurement types, including vortex and swirl flow meters for wear detection, Coriolis meters for mass flow and density checks, thermal mass meters for heat transfer comparisons, electromagnetic meters for coil integrity and conductivity validation, pressure transmitters for pressure range stability, and temperature sensors for response time and accuracy.

WHAT IS CALIBRATION?

Over typical service intervals, instrument drift and component wear can introduce measurement errors that jeopardize plant safety, compliance and profitability. Calibration quantifies accuracy by comparing each device's output with certified reference standards and reestablishing a traceable performance baseline. Where deviations exceed accepted limits, targeted adjustment can restore measurement accuracy by fine-tuning key instrument parameters. Precise measurements underpin operational integrity, so regular calibration, with adjustment where necessary, provides the documented traceability required for mission-critical applications.

To verify performance, calibration compares the instrument under test against a known reference which can be either a master meter of certified accuracy or a calibrated physical device and yields one of three outcomes:

- The instrument shows no significant error.
- The instrument exhibits a significant error but remains within tolerance without adjustment.
- The instrument requires fine tuning or configuration to correct the error to an acceptable level.

To ensure confidence in results, the reference standard must be traceably certified and typically have a measurement uncertainty at least 4 to 10 times lower than the device being calibrated.

Typical calibration schedules reflect different industry demands. Annual calibration of thermal mass flow meters and temperature sensors in emissions testing ensures compliance with governmental protocols. Biannual calibration of custody transfer meters and pressure transmitters maintains transactional accuracy and mitigates fiscal risk. Process quality control systems often require quarterly or half-year calibration of dosing and blending instruments to preserve product consistency.

ABB's calibration services support every major instrumentation technology. These services cover the following instrument types:

Flowmeters: Calibrated using UKAS-accredited gravimetric, volumetric and comparison methods. ABB supports wet calibration across a full flow range, including electromagnetic, mass, and air flowmeters.

Pressure transmitters: Verified using high-accuracy deadweight testers or oil/gas-based pressure balances, depending on pressure range. Includes absolute, gauge and differential pressure.

Temperature instruments: Calibrated in dry-block baths and thermostatic environments. Includes thermocouples, resistance thermometers (RTDs), and temperature transmitters.

Level instruments: Depending on type (hydrostatic, radar, ultrasonic), calibration may be performed via simulated input signals or comparison with traceable standards.

Analytical sensors: Includes pH, conductivity, dissolved oxygen and turbidity. Typically calibrated using certified buffer or standard solutions.

Gas flow instruments: Calibrated using critical Venturi nozzles or positive displacement devices with traceable air/gas standards. Suitable for mass flow, laminar flow and thermal meters.



TYPE OF CALIBRATION METHOD

	Gravimetric	Volumetric	Comparison
Maximum run time	Limited by size of tank/scale	Limited by size of tank	Unlimited
Minimum run time	Fixed by size of tank/scale	Fixed by size of tank	Unlimited
Uncertainty	Depends on scale uncertainty, density uncertainty, buoyancy uncertainty and temperature uncertainty. Run time at maximum flowrates is governed by the time taken to fill the tank.	Depends on volumetric tank calibration uncertainty, temperature uncertainty and timing uncertainty. Run time at maximum flowrates is governed by the time taken to fill the tank.	Depends only on the reference meter uncertainty.
Limits on run time	Run time at minimum flowrates is governed by the amount of water required to be put into the tank to ensure that the weight can be measured with an acceptable uncertainty (normally around 25% of its capacity).	Run time at minimum flowrates is governed by the amount of water required to be put into the tank to ensure that the volume can be measured with an acceptable uncertainty (normally 100% of its capacity).	Unlimited
Effects of run times at low flowrates	Can make run times very long, introducing uncertainties (e.g. evaporation).	Can make run times very long, introducing uncertainties (e.g. evaporation).	No effect
Effects of run times at high flowrates	Tank capacity can make run times very short – they must be ≥ 30 seconds.	Tank capacity can make run times very short – they must be ≥ 30 seconds.	No effect



All calibration activities are carried out in accordance with internationally recognized accreditation frameworks.

ABB operates DAkkS-accredited air flow calibration rigs within selected regional centers and via mobile units. These use a primary standard gravimetric method to measure the actual mass of air, delivering uncertainties as low as 0.1%. Flowmeters can be sent to the nearest facility or calibrated on-site. In both cases, ABB provides a DAkkS-traceable certificate, removing the need for international shipping and ensuring confidence in performance.

High-pressure gas calibration is available for testing up to 600 bar, alongside integrated multi-parameter setups that calibrate pressure, temperature and flow in combination. This approach delivers uncertainties down to 0.05% for Coriolis meters and pressure transmitters, and 0.1% for vortex, swirl, electromagnetic meters and temperature sensors.



WHAT IS ADJUSTMENT?

Adjustment restores instrument performance on site by fine tuning internal settings such as zero offset, span gain and linearization curves whenever measurement accuracy is at risk. It most often follows verification or calibration when those checks flag readings outside tolerance, but it can also be performed proactively on a scheduled basis or on demand whenever accuracy concerns arise.

Instruments may require adjustment to address a variety of factors that can alter performance over time. Changes in environmental conditions such as temperature swings or increased vibration may push devices beyond their original calibration envelope. Sensor fouling from particulates, corrosion or buildup can obstruct flow or pressure pathways and mechanical impacts like piping modifications or connector realignment can shift zero offset. Updates to electronics or firmware may also change how data is processed and require span or linearization tweaks. All of these are addressed through adjustment of the instrument.

Measurement drift remains the most common trigger for adjustment. Drift occurs when an instrument's readings gradually diverge from true values, leading to inaccurate process measurements. The most

effective form of adjustment is carried out with diagnostic tools which are used to reset parameters in real time and confirm the results through test readings. Performing adjustment promptly prevents drift from impacting process control and avoids costly downtime, lost production and compliance risks. By correcting small deviations on site, adjustment can extend the interval until the next full calibration, reducing overall service costs.

ABB provides adjustment services through regional centers in major industrial hubs and mobile support teams that can arrive on site with calibrated equipment to perform routine adjustments in as little as twenty four hours for emergency situations. Adjustments can be made either on site or at our calibration facilities.

This proactive maintenance approach typically restores accuracy to within 0.02% for Coriolis meters and pressure transmitters and 0.1% for vortex, swirl, electromagnetic meters and temperature sensors.

Each adjustment event is documented and fed into trend analysis to support proactive maintenance planning and audit readiness.

VERIFICATION VS CALIBRATION VS ADJUSTMENT

Together, verification, calibration and adjustment form a lifecycle approach that ensures sustained instrument reliability, optimizes maintenance effort and supports operational continuity. Each step plays a different role, from health monitoring and traceability to pre-cision tuning.

The table below outlines how they differ in purpose, method and scheduling.

	Verification	Calibration	Adjustment
Purpose	Check instrument health and detect drift or faults during operation	Quantify measurement error and establish traceable baseline accuracy	Correct internal settings to bring performance back within acceptable limits
What it does	Compares live readings with OEM baselines and design parameters	Compares output to certified reference under controlled conditions	Tunes parameters such as zero, span or damping when calibration alone is insufficient
Outcome	Pass/fail verification report with any deviations noted	Calibration certificate detailing pre- and post-calibration data and traceability to national/ international standards	Adjustment log with before/ after values, accuracy checks and parameter changes
When performed	While the instrument is in use; no need to remove it from process	In accredited calibration centers or mobile labs, or occasionally on-site	On-site or at vendor; performed as needed between full calibrations or when calibration flags deviation
Frequency	Typically biannually or after process upset	Scheduled according to regulatory or quality system requirements	As needed, based on calibration results or observed drift
Relation to others	May trigger need for calibration if anomalies found	May include adjustment, but often kept separate to preserve traceability	May follow calibration if error is outside tolerance and correction is authorized



ABB VERIFICATION & CALIBRATION

Drawing on decades of instrumentation expertise, ABB delivers a global service network for verification and calibration. All operations adhere to internationally recognized accreditation standards and best-practice methodologies, ensuring that every verification report and calibration certificate meets the traceability requirements of quality management systems and regulatory frameworks.

Facilities are accredited by national bodies including the United Kingdom Accreditation Service (UKAS), DAkkS in Germany, the National Association of Testing Authorities (NATA) in Australia, the National Institute of Standards and Technology (NIST) in the United States, and SIMT in China, as well as other authorities operating under the ILAC Mutual Recognition Arrangement (MRA).

ABB service centers and mobile support teams span every continent and bring skilled technicians and purpose-built equipment directly on-site for

routine verification visits, comprehensive calibration campaigns and urgent adjustment interventions. This flexible deployment model minimizes downtime, keeps processes running smoothly and allows plant operators to focus on core production and safety priorities.

ABB also invests in continuous training and certification programs for field engineers. By upskilling the next generation of technicians in advanced diagnostic and adjustment techniques, ABB helps close the industry skills gap and maintain high levels of service consistency and measurement confidence.

ABB's Verification and Calibration services extend to flow measurement, pressure transmitters, temperature sensors and other critical instrumentation. Uniting these services under a single provider reduces total cost of ownership, streamlines vendor management and helps plant operators maintain the highest standards of safety, quality and productivity across every measurement application.





ABB Measurement & Analytics

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