

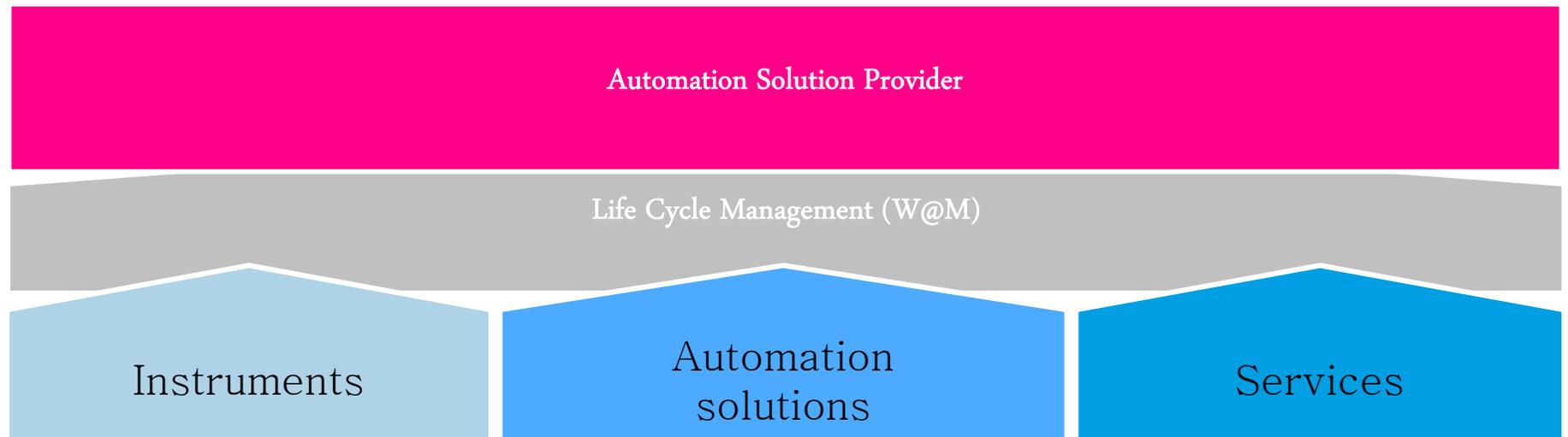
Endress+Hauser at a glance

‘People for Process Automation’



Our offering – Products / Solutions / Services

Endress+Hauser is focused on the process automation market. We strive to be the 'People for Process Automation'.



- Industry and application know-how
- Understanding of customer requirements
- Integration capabilities

Our offering – Products

We provide instruments and systems for tasks in the field of

- Level measurement
- Flow measurement
- Pressure measurement
- Temperature measurement
- Analytics
- Data acquisition
- Sampling



Our offering – Solutions and services

Our range of services and software solutions help to make our customers' processes work at optimum efficiency

- Commissioning
- Operation
- Maintenance
- Calibration
- Repair

We support our customers with comprehensive solutions for process engineering

- System integration
- Inventory maintenance
- Process control

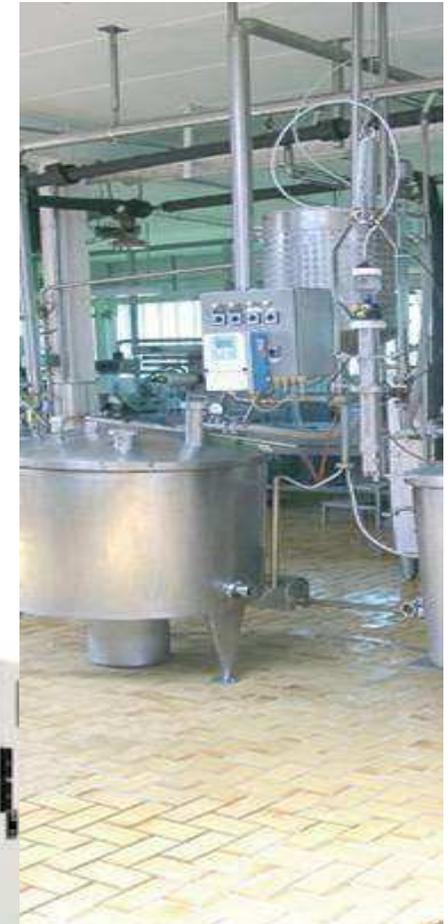


Analysis instrumentation

- Products and solutions to measure the important process variables



- Wide range of sensors, fittings, transmitters and automatic sampling systems



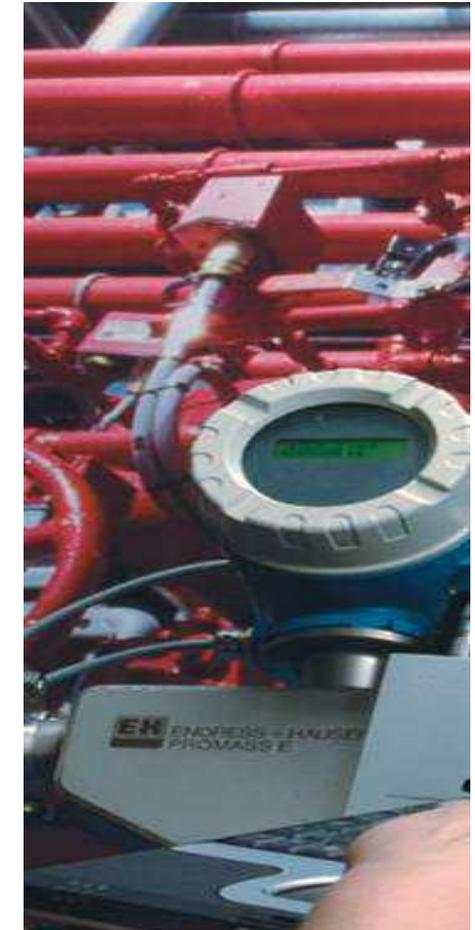
Pressure measurement

- Two sensor technologies (ceramic-capacitive, piezoresistive)
- Transmitter concepts for applications from simple pressure monitoring to measurements under difficult process conditions



Flow measurement

- Five innovative technologies
- Instruments without any moving parts for measurements in liquids, gas and steam



Level measurement

- Application of 10 physical measuring principles
- Application solutions for continuous level measurement and level limit detection
- Measurements in liquids and solids



Temperature measurement

- Wide range from one source, from thermocouples and thermometers to different transmitter variants
- Engineering of temperature measuring points for difficult process industry applications



Data recorders

- Critical process data is secured by a wide range of chart recorders, paperless recorders, data loggers and data management systems



Automation components

- Everything from one source:
From the power pack and different gateways
through to fieldbus components as well as
process and asset management software



For Food & Beverage, we provide instruments for...

- CIP Control
- Pasteurization & aseptic systems
- Blending/mixing concentration
- Tank level
- Bulk solids & liquids
- Inventory monitoring
- Inline quality measurement



Flow Calibration Technology at Endress+Hauser

Quality – Compliance – Cost savings



ur calibration is worth
s weight in gold.

Will Staudt
Product Manager Controls

Endress+Hauser Consult AG
Kägenstrasse 7
4153 Reinach
Schweiz

Telefon +41 01 715 01 11
Fax +41 01 715 00 89
info@flowtec.endress.com
www.endress.com

Endress+Hauser
People for Process Automation

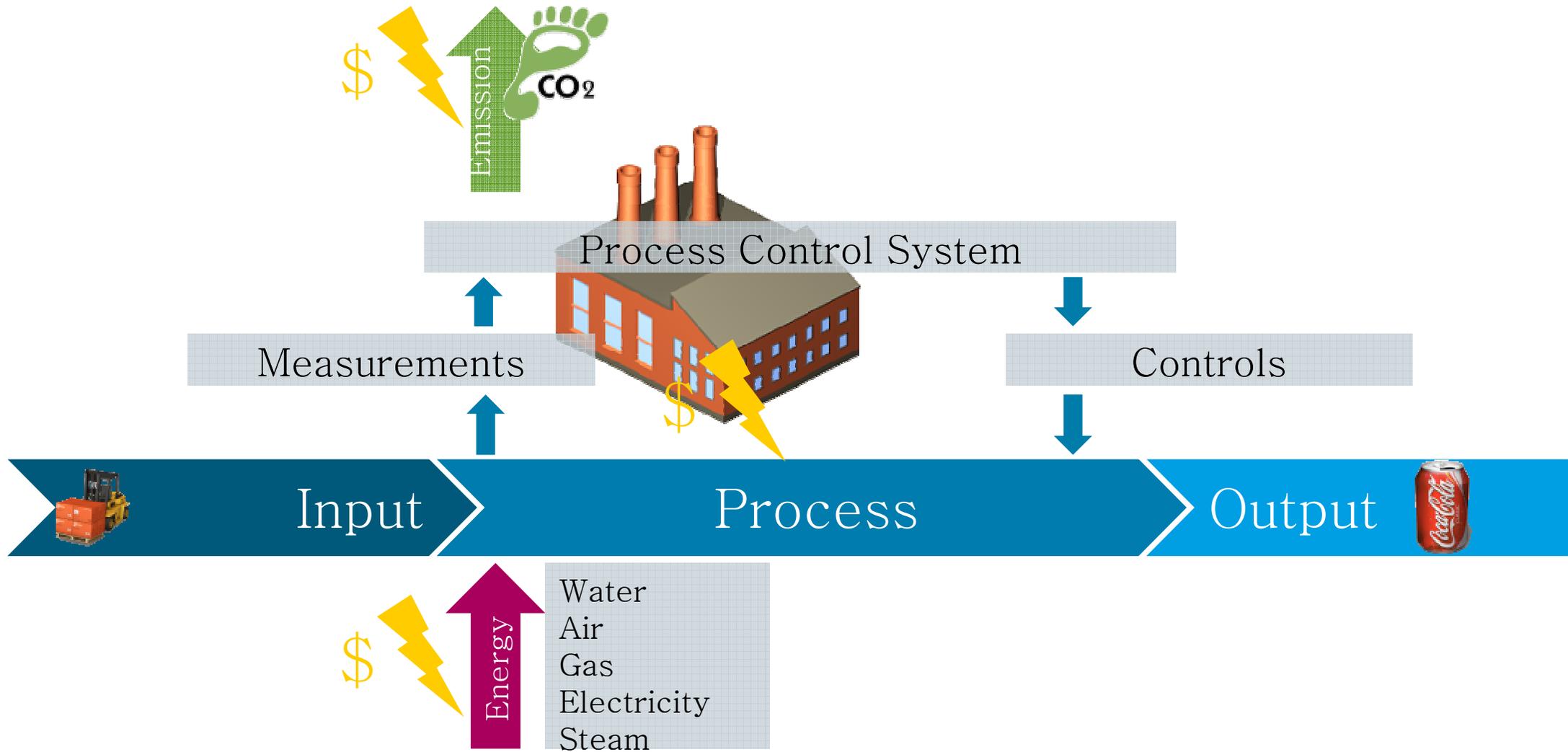
Agenda

- Importance of calibration
- Calibration basics
- Endress+ Hauser calibration competence
- Best practices

Importance of calibration

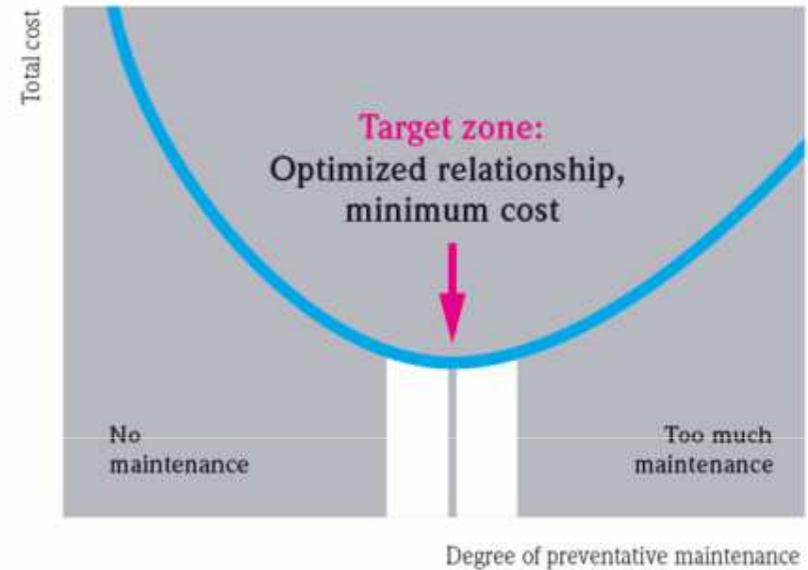


Why to measure?



The customer's challenges

- Reduce business costs
- Ensure constant quality of the final product
- Minimize emissions of greenhouse gases
- Improve plant safety
- Improve energy efficiency
- Compliance with quality standards and regulations



Why to calibrate?

Calibration

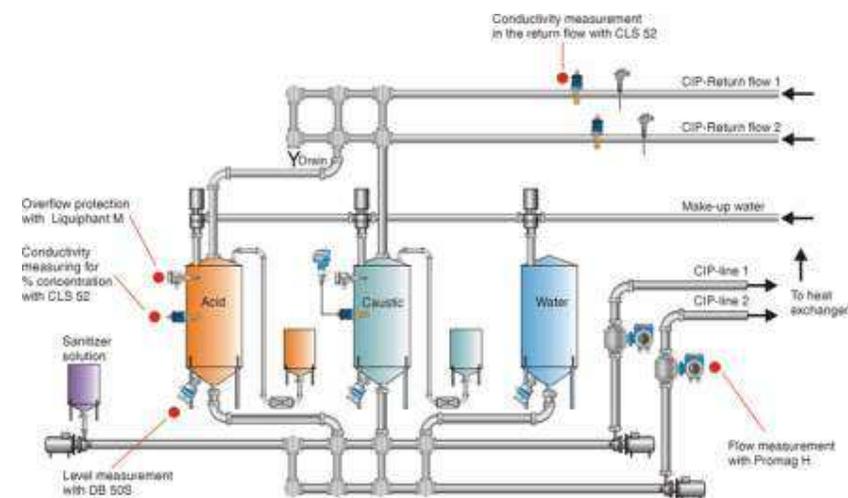
Minimizes
quantity
fluctuations

Avoids energy
losses

Keeps the
quality level
constant

Avoids human and
environmental
damages

Cost savings



- Cleaning In Place (CIP)
- Flowmeter
- Flowrate: 20ton / h
- Deviation: 0.1%



Product	Price / ton	Related production costs (Operation:	
		8h x 5d)	24h x 7d)
Peracetic Acid	63,00 €	2.620,80 €	11.007,36 €
Nitric Acid	350,00 €	14.560,00 €	61.152,00 €
Phosphoric Acid	760,00 €	31.616,00 €	132.787,20 €
Caustic Soda	200,00 €	8.320,00 €	34.944,00 €
Sodium Hypochlorite	150,00 €	6.240,00 €	26.208,00 €

Please create a marketing story



- Tetra Pak Ultra-High Temperature (UHT) treatment module
- 5000 hours / year in operation
- Temperature transmitter
- Output value: 140°C
- True value: 142°C
- Deviation: 2°C
- 2°C = 30kg steam per hour



Energy Efficiency



- (UH)
- Ultra-High Temperature (UHT) treatment module
 - 5000 hours / year in operation
 - Temperature transmitter
 - Output value: 140°C
 - True value: 142°C
 - Deviation: 2°C
 - 2°C = 30kg steam per hour



$$30 \text{ kg} \times 5000 \text{ h} \times 0.04 \text{ €/kg} = 6000 \text{ € per year}$$



- The temperature deviation of 2°C results in an additional steam consumption of 150tons / year !
- This corresponds to approximately 20 kg CO2 emissions !
- Costs could have been reduced by performing calibration !

Some organizations that define the rules



- API – American Petroleum Institute



- EI – Energy Institute (formerly Institute of Petroleum – UK)



- ISPE – International Society for Pharmaceutical Engineering



- FDA – Food and Drug Administration (USA)



- EMA – European Medicines Agency (European Union)



- OIML – International Organization of Legal Metrology



- ...

Industry standards

• ISO 9001	Quality management systems -- Requirements
• ISO 14001	Environmental management systems -- Requirements with guidance for use
• ISO 22000	Food safety management systems -- Requirements for any organization in the food chain
• ...	

ISO 9001

7.6 Control of monitoring and measuring devices

...

Where **necessary to ensure valid results**, measuring equipment shall

- be **calibrated or verified, or both**, at **specified intervals** or prior to use, **against measurement standards traceable** to international or national measurement standards; where no such standards exist, the basis used for calibration or verification shall be recorded (see 4.2.4);
- be adjusted or re-adjusted as necessary;
- have **identification in order to determine its calibration status**;
- be safeguarded from adjustments that would invalidate the measurement result;
- be protected from damage and deterioration during handling, ~~maintenance and storage.~~

Calibration basics



Source: National Institute of Standards and Technology (NIST) -

What a calibration is... and what it isn't

- Calibration is the comparison of an instrument to a known standard.
- Calibration is attempting to determine measurement errors coming from the calibrated instruments.
- Calibration is not an adjustment, only a comparison.
- After a calibration a device could be adjusted, the device must be recalibrated.



The calibration concept (pressure calibration)

Reference standard
Beamex MC6 calibrator



Unit Under Test (UUT)



Input value (pressure)

Output v

Calibration procedure (SOP)

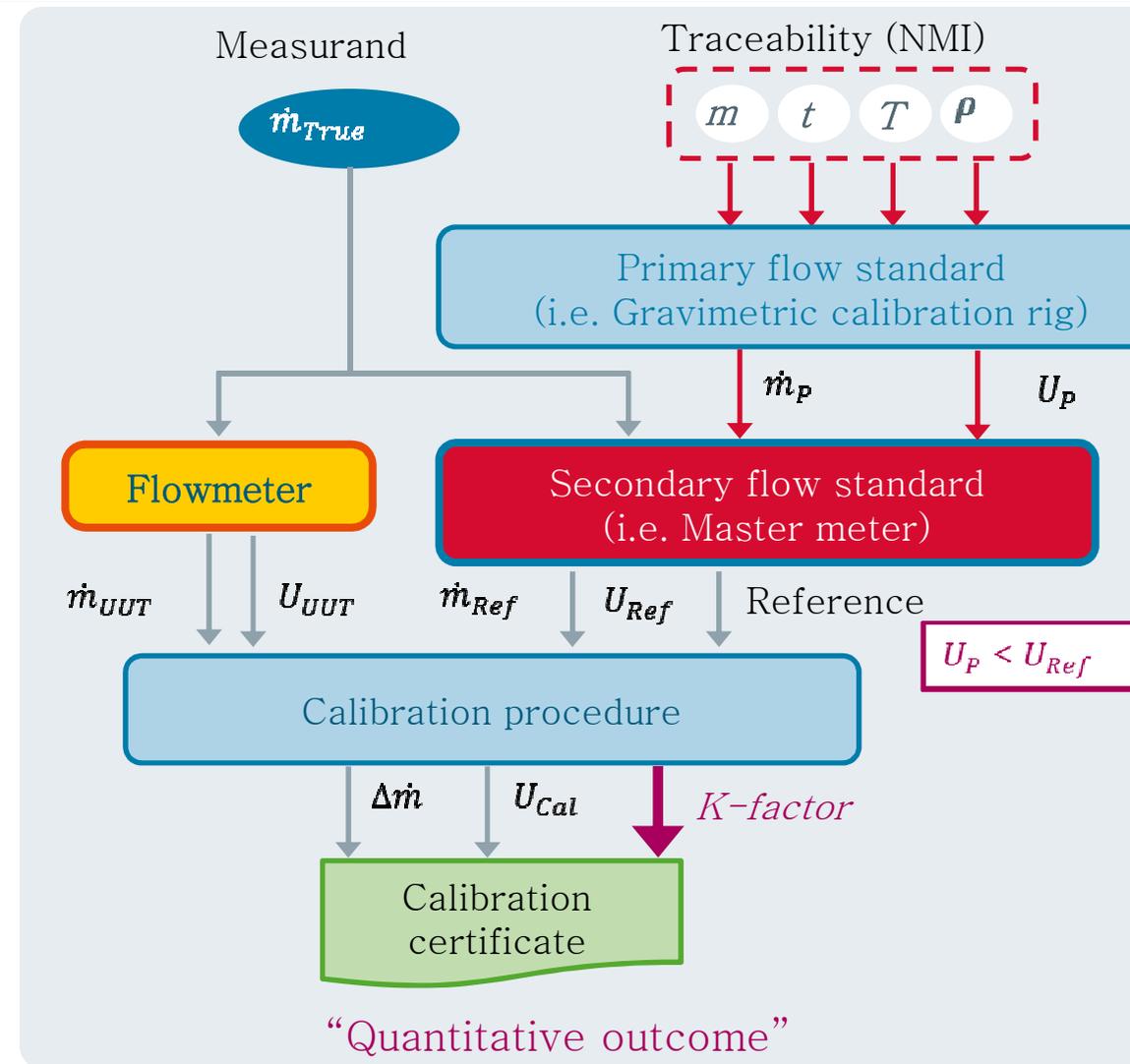
Information about
"true value"

Calibration
certificate

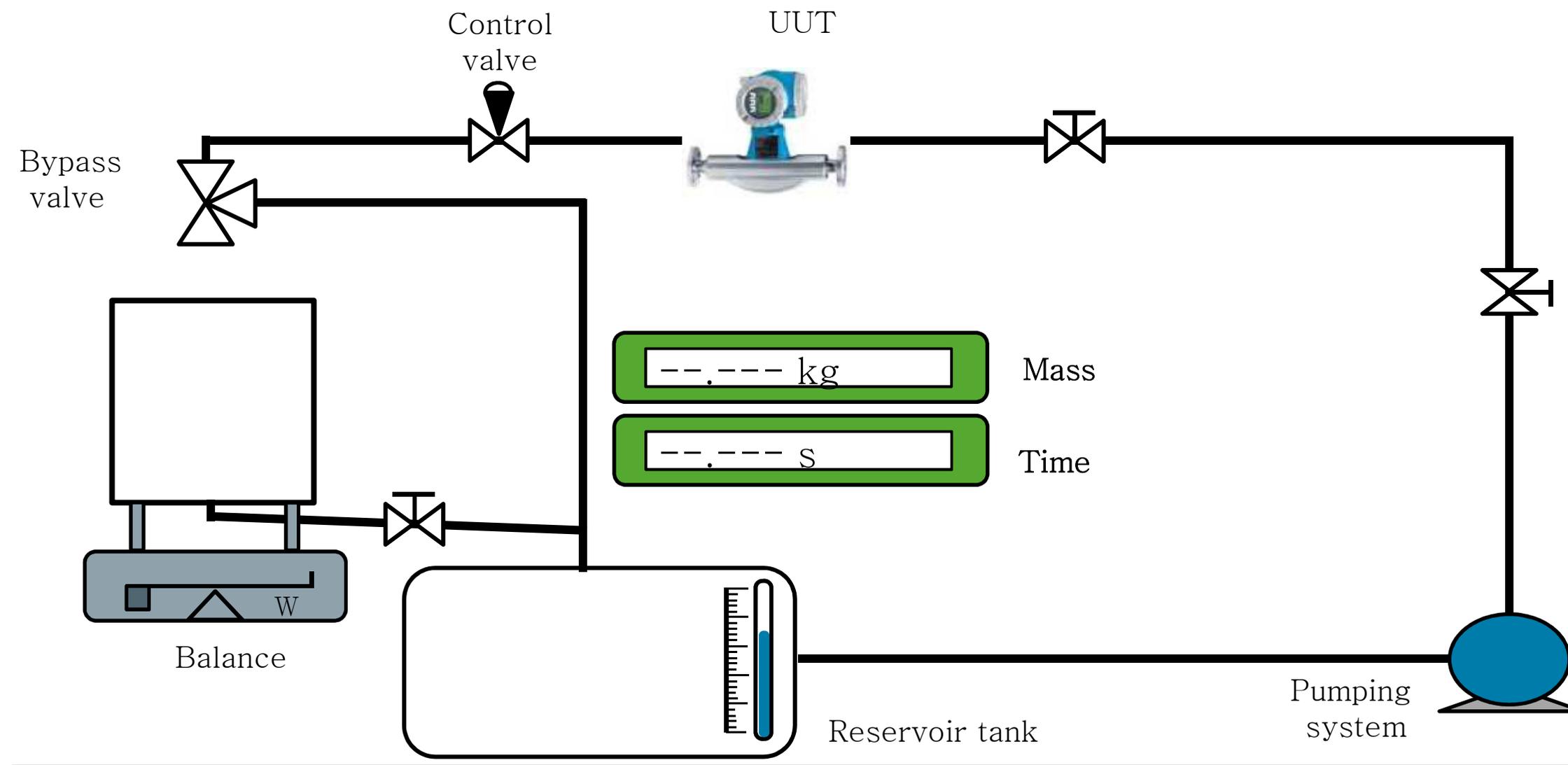
"Quantitative outcome"



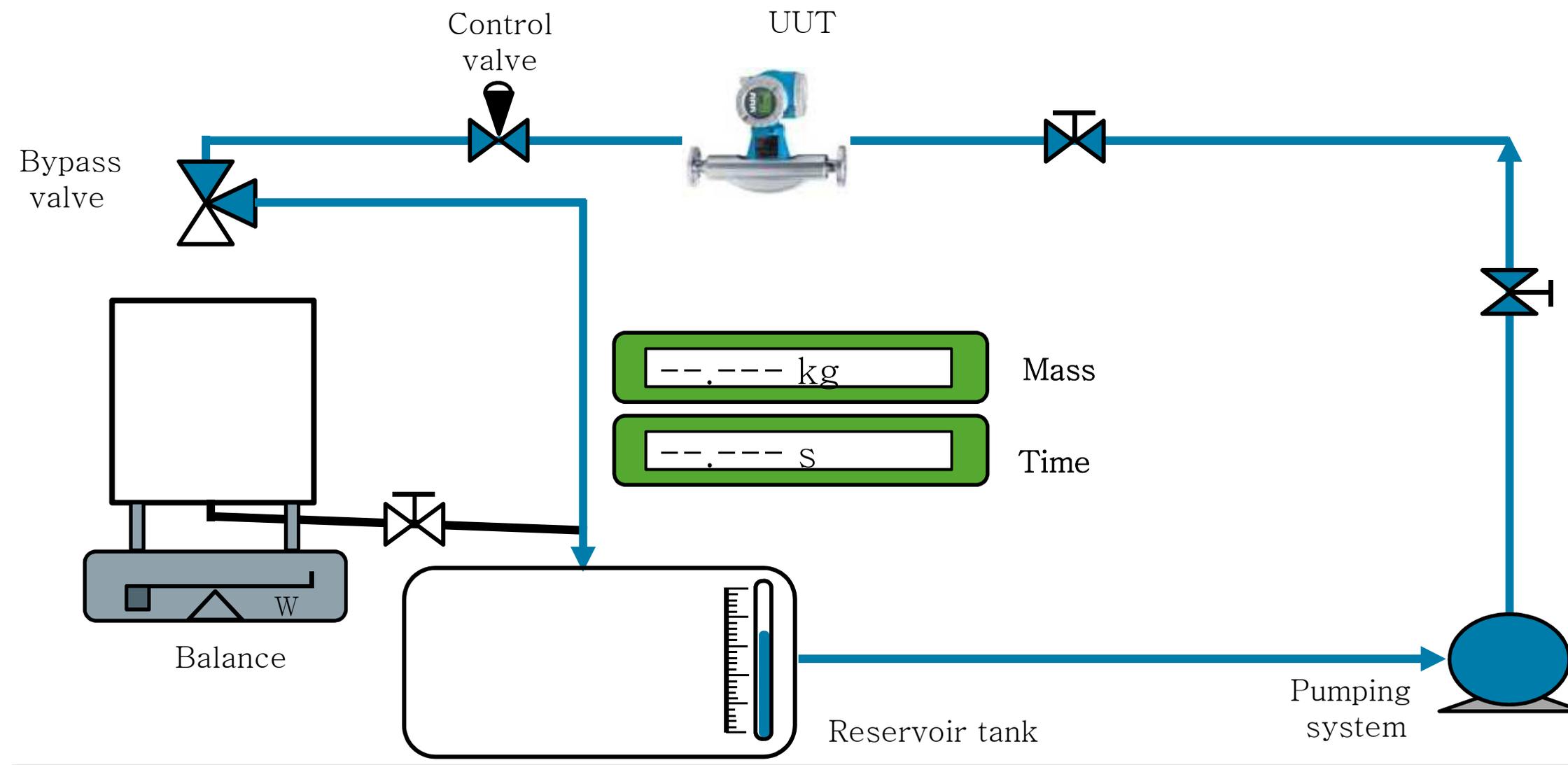
The calibration concept (master meter calibration)



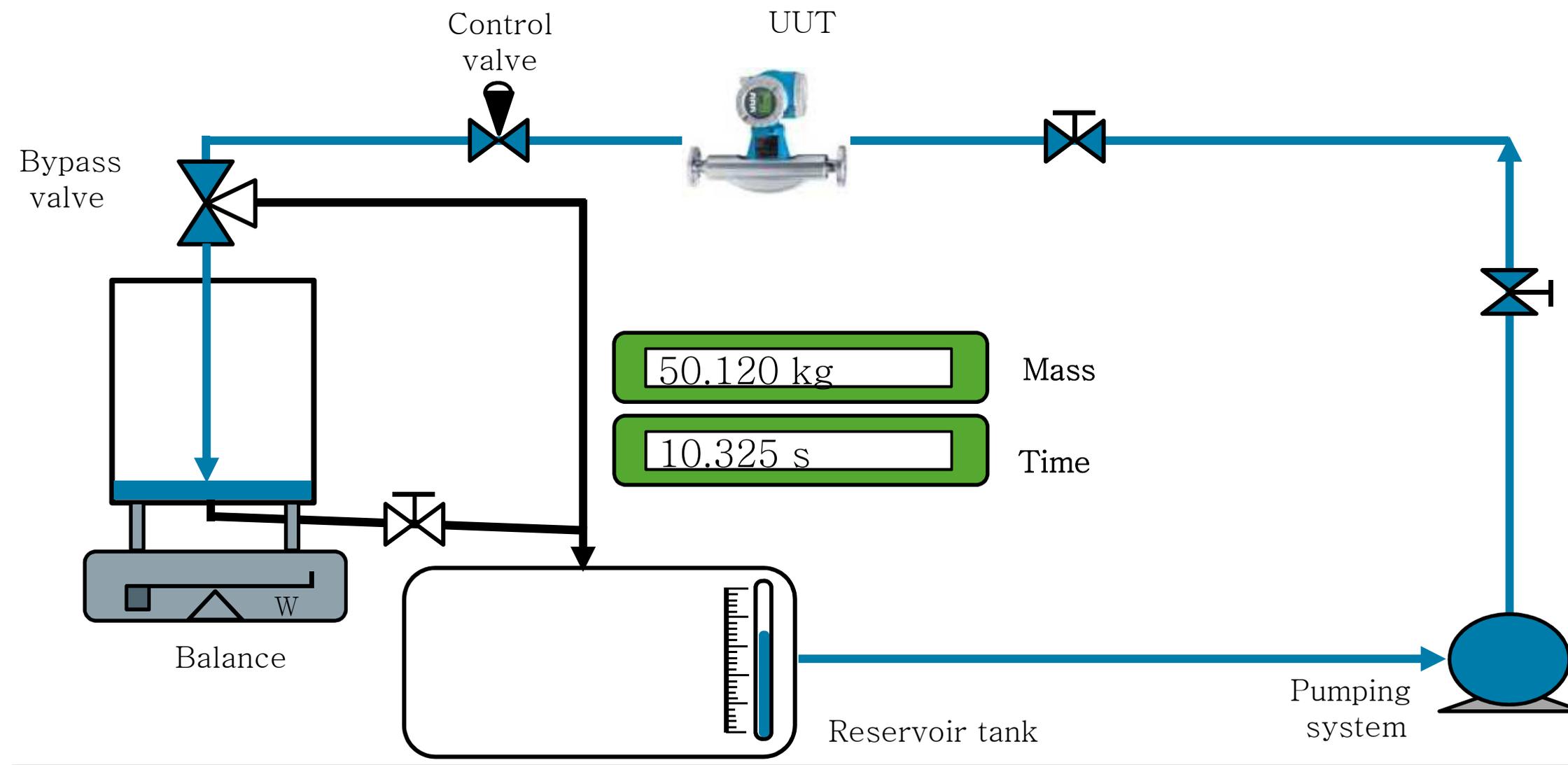
Gravimetric calibration (Gravimetric)



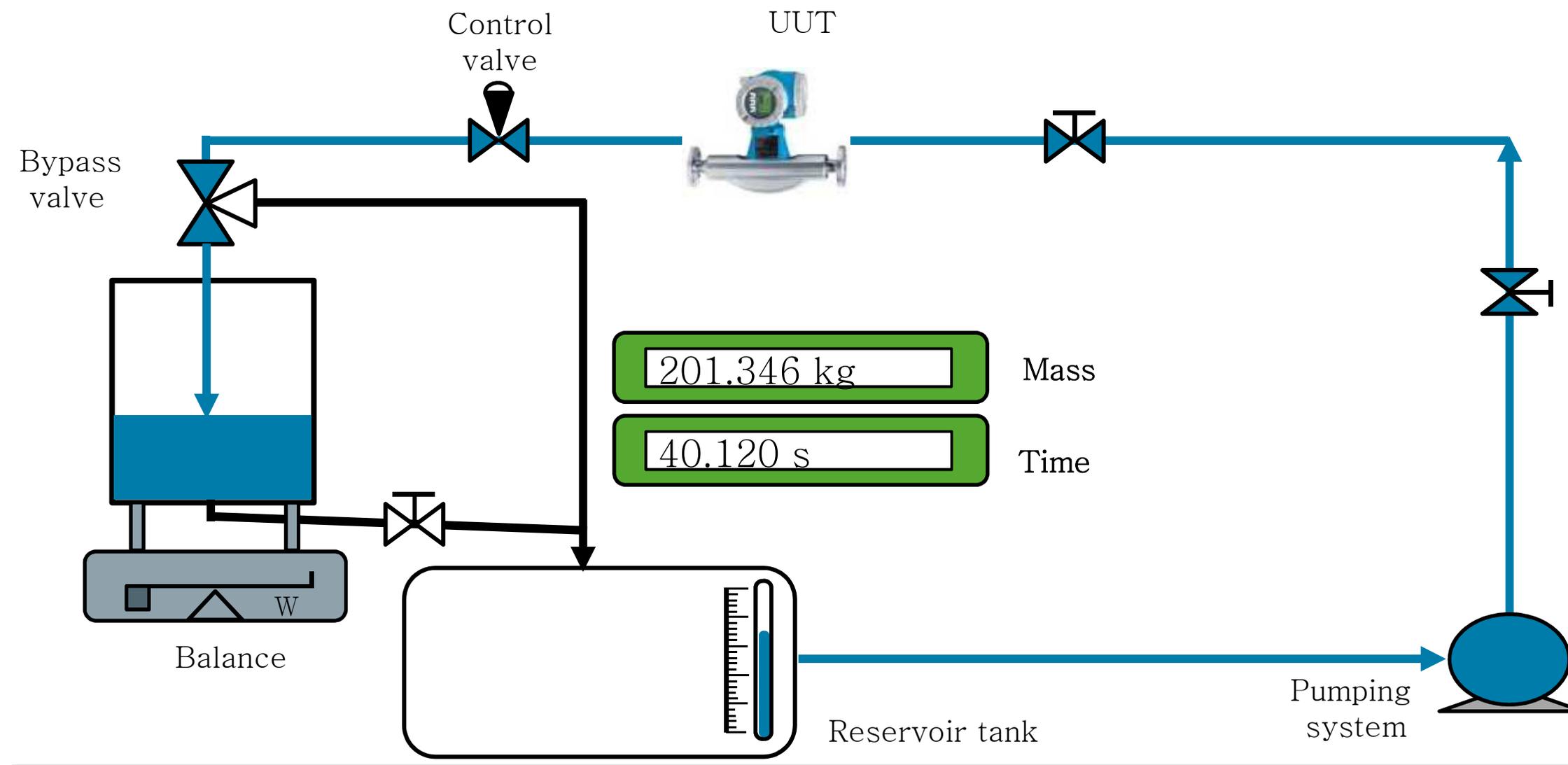
Gravimetric calibration (Gravimetric)



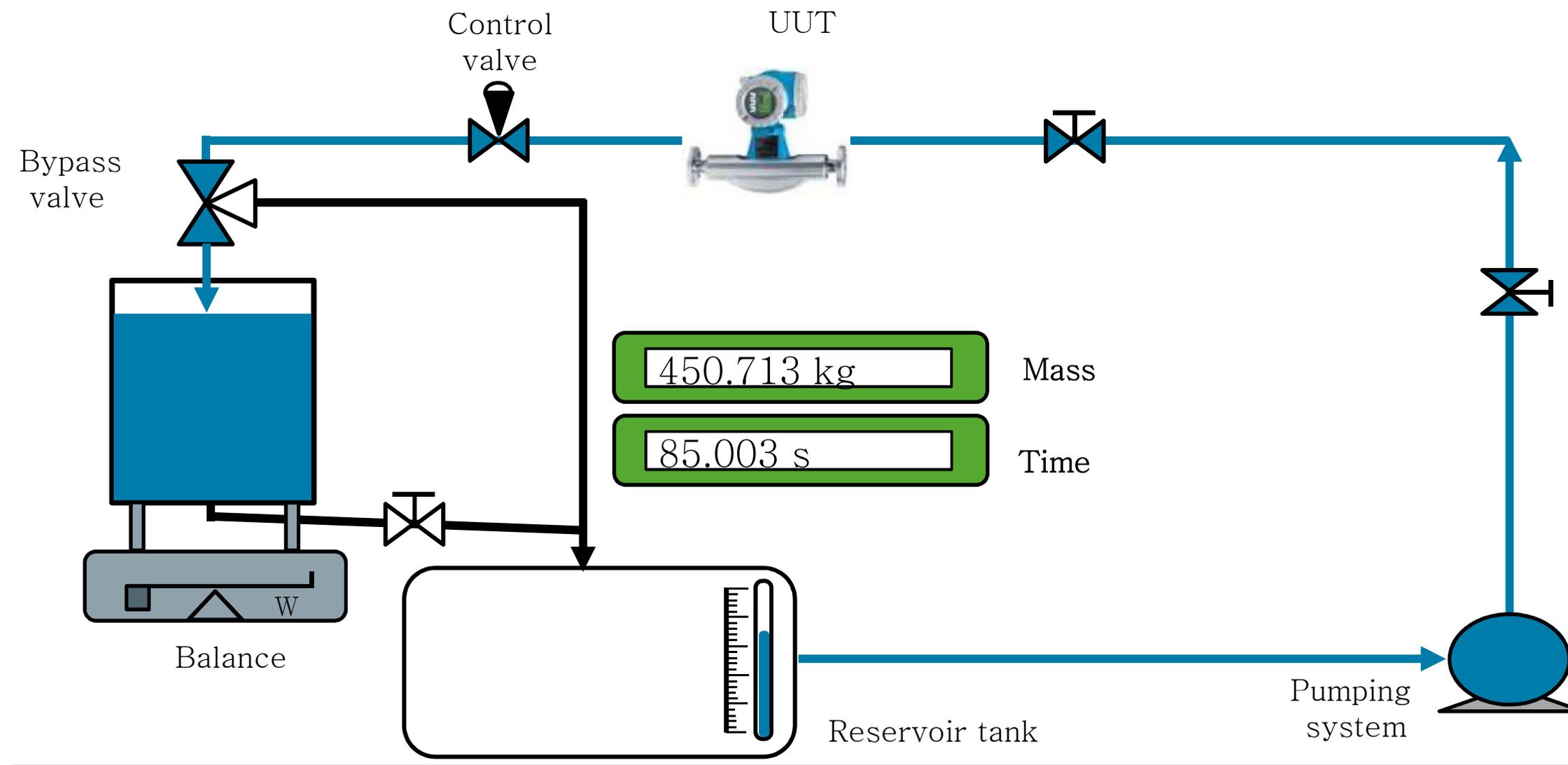
Gravimetric calibration (Gravimetric)



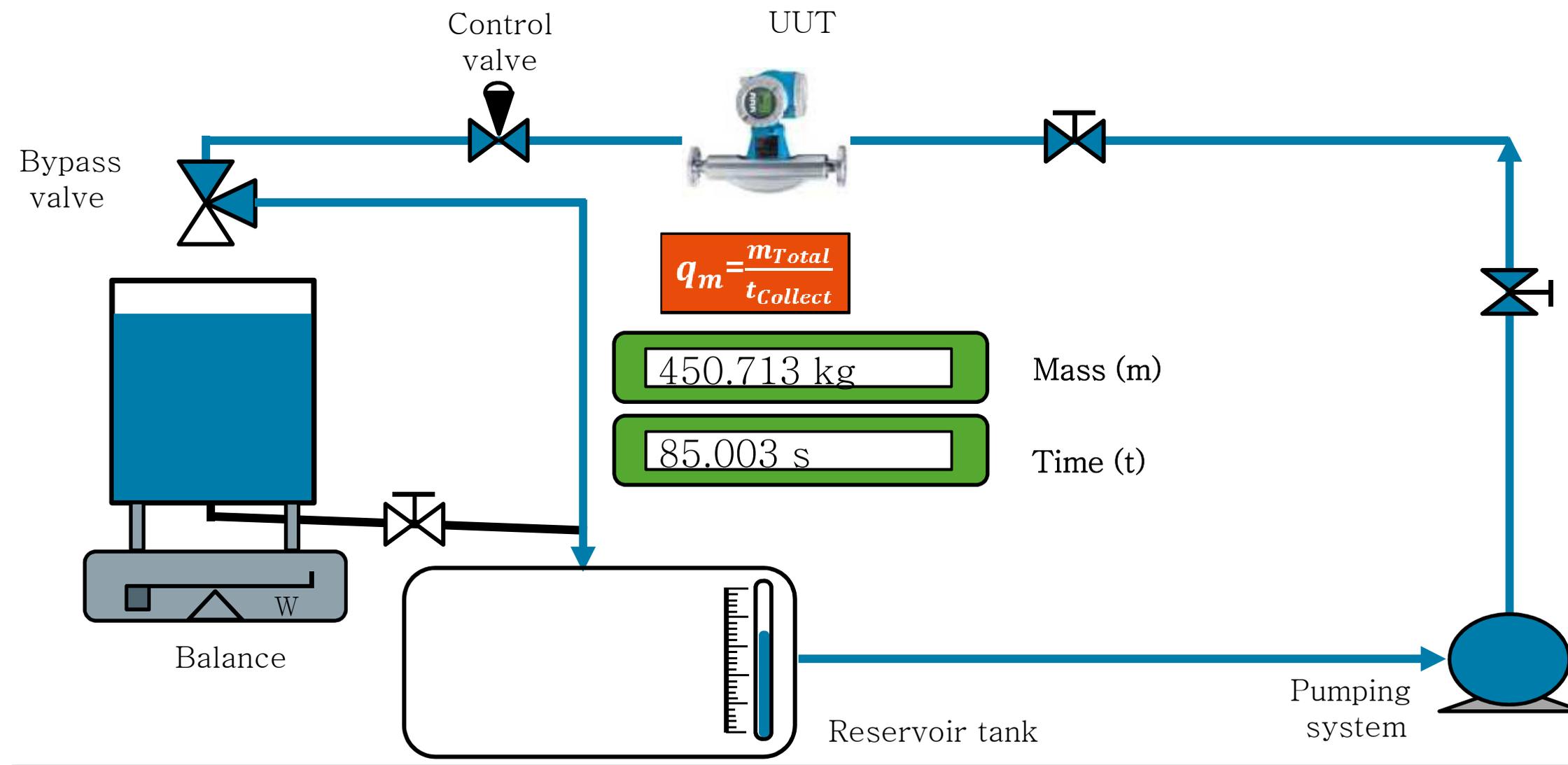
Gravimetric calibration (Gravimetric)



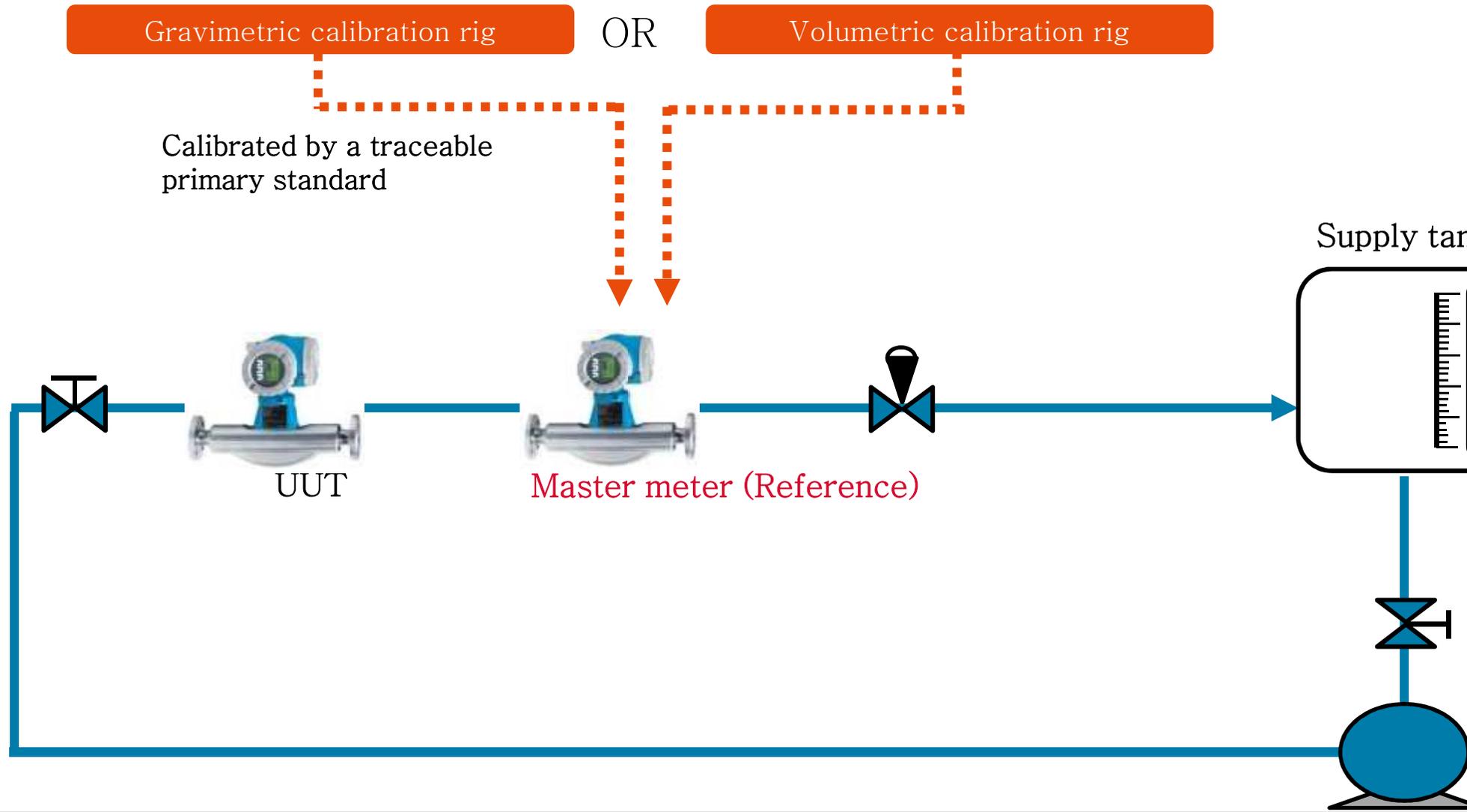
Gravimetric calibration (Gravimetric)



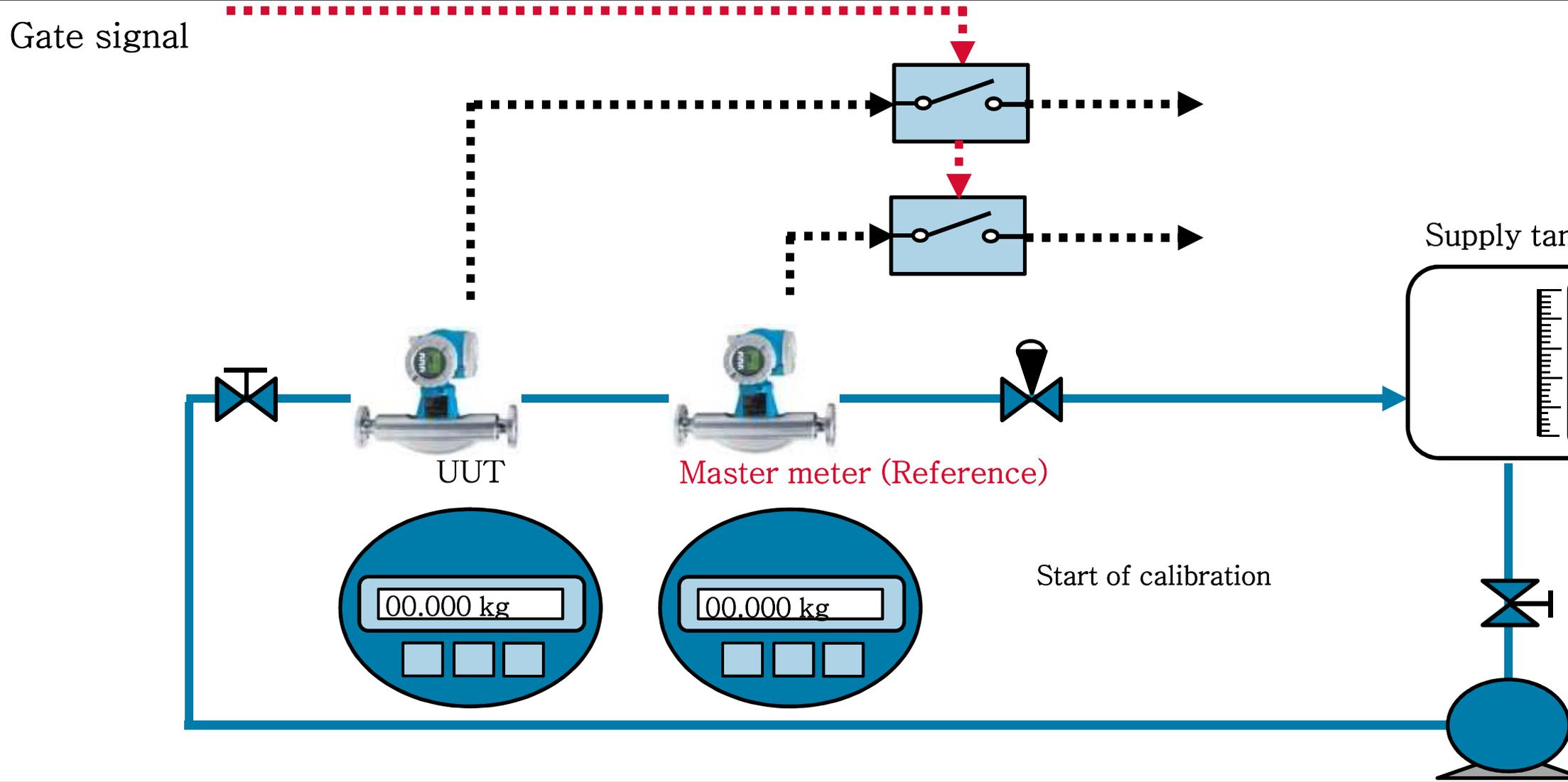
Gravimetric calibration (Gravimetric)



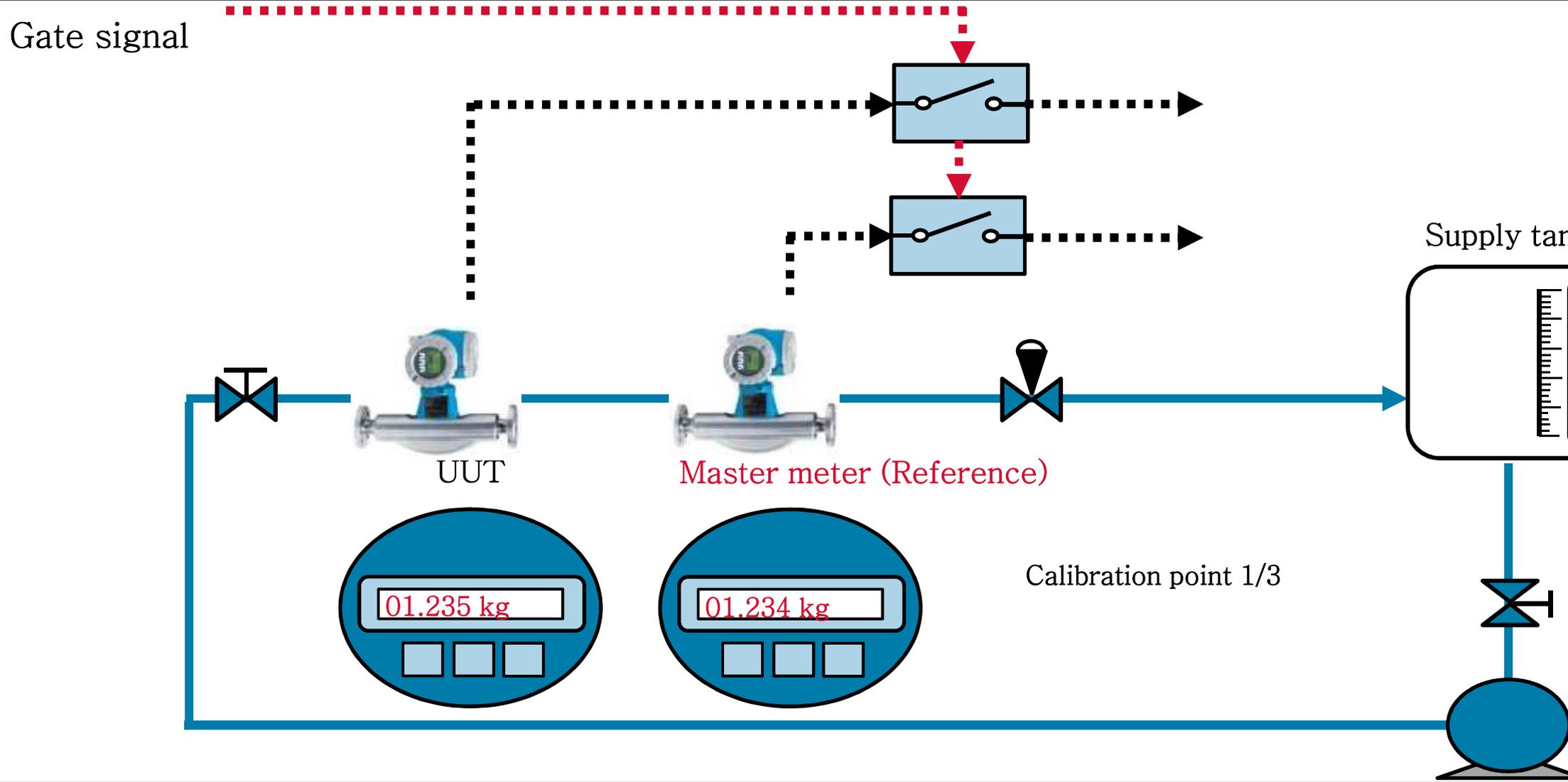
Master meter calibration



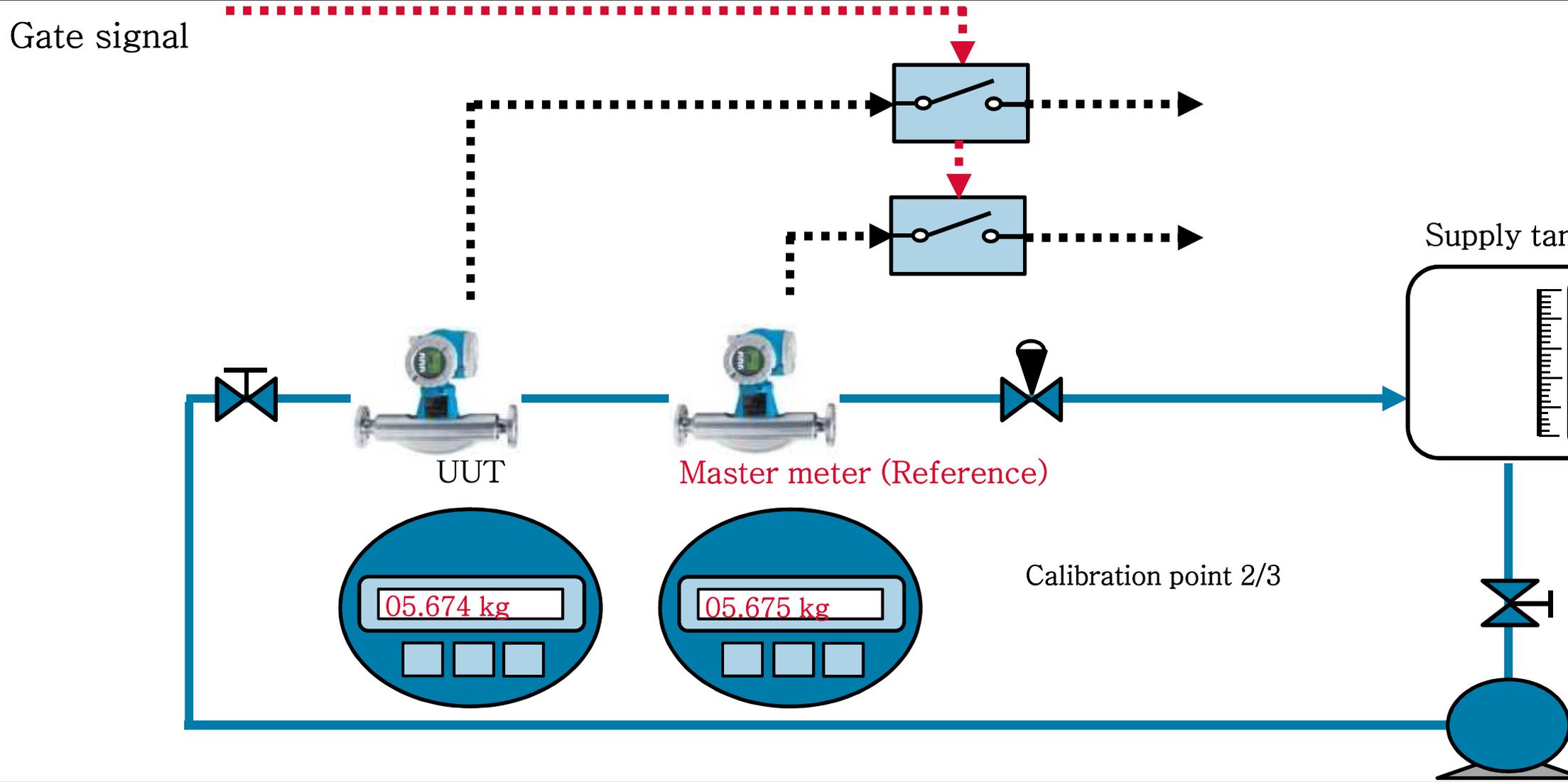
Master meter calibration



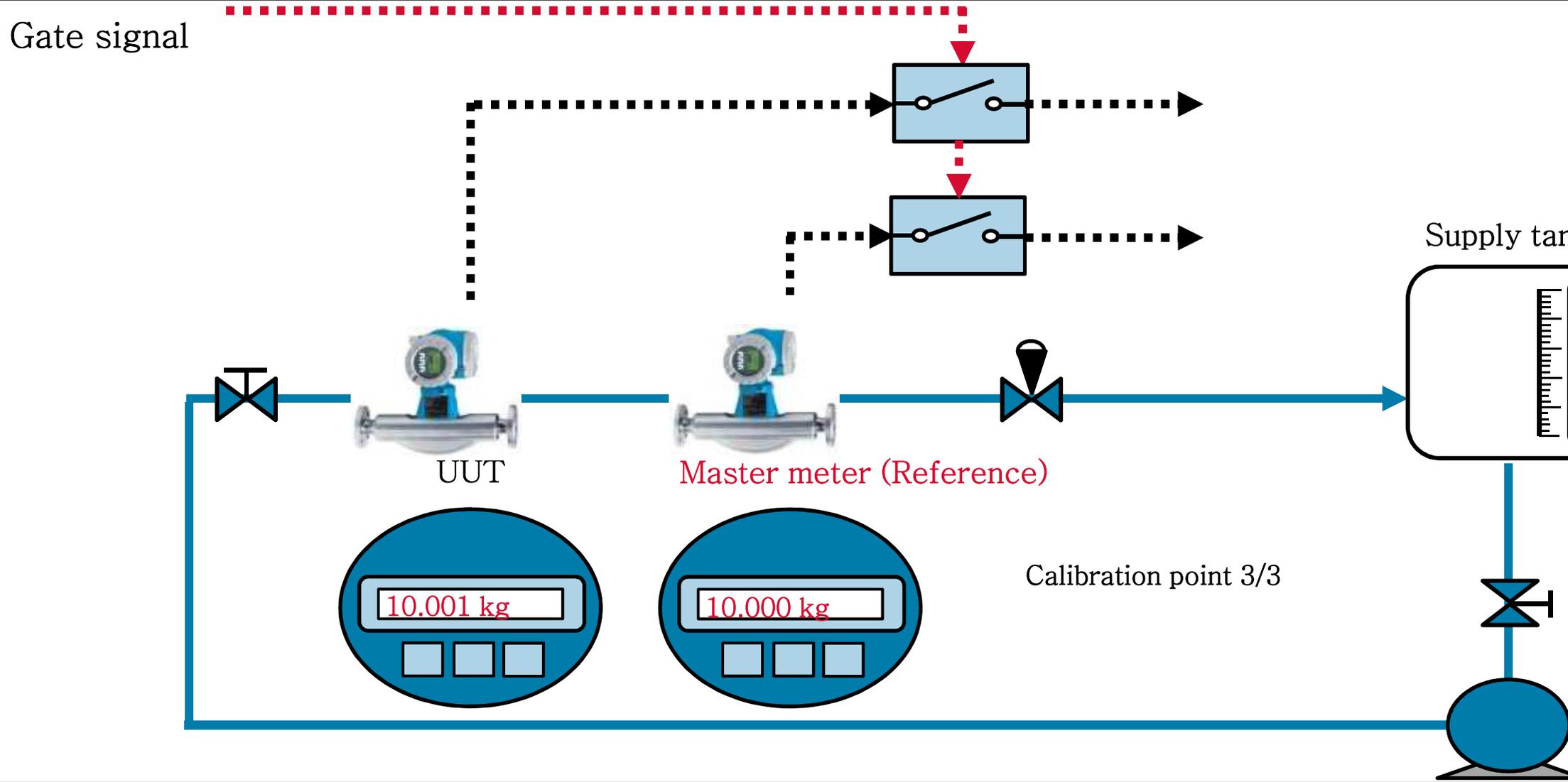
Master meter calibration



Master meter calibration



Master meter calibration



Welcome to Heartbeat Technology!



Heartbeat Technology



The basis for all: Heartbeat Technology



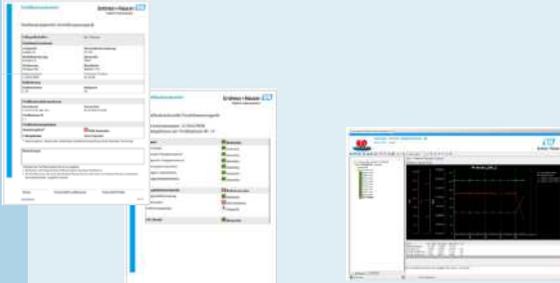
Diagnostics



Reliable self-monitoring

- Continuous, built-in diagnostic functionality
- Broadest test coverage
- Quick, concise guidance in case of errors (NE 107)

Verification



Compliant testing

- On-demand, effortless procedure
- Easy handling, no process interruption
- Electronic quality reporting

Monitoring

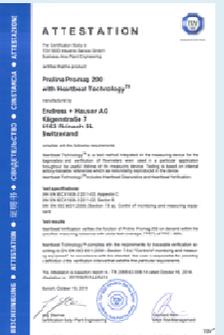


Condition-based maintenance

- Permanent reading of process-related variables
- Impact assessment
- External trend analysis

Designed for safety with Heartbeat Technology

Built-in self monitoring and verification capability ensures reliable flow measurement throughout the lifetime of the device.

<p>Reliability</p>  <p>Audited and attested: Traceable, redundant references inside the device</p>	<p>Seamless integration</p> <p>"No man in the field" No need to open the device</p>   <p>Large variety of fieldbus options</p>	<p>Uniform handling</p>   <p>For all new Proline flowmeters</p>
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Embedded Heartbeat Verification guarantees a traceable and attested means of in-situ testing of measurement quality without process interruption.

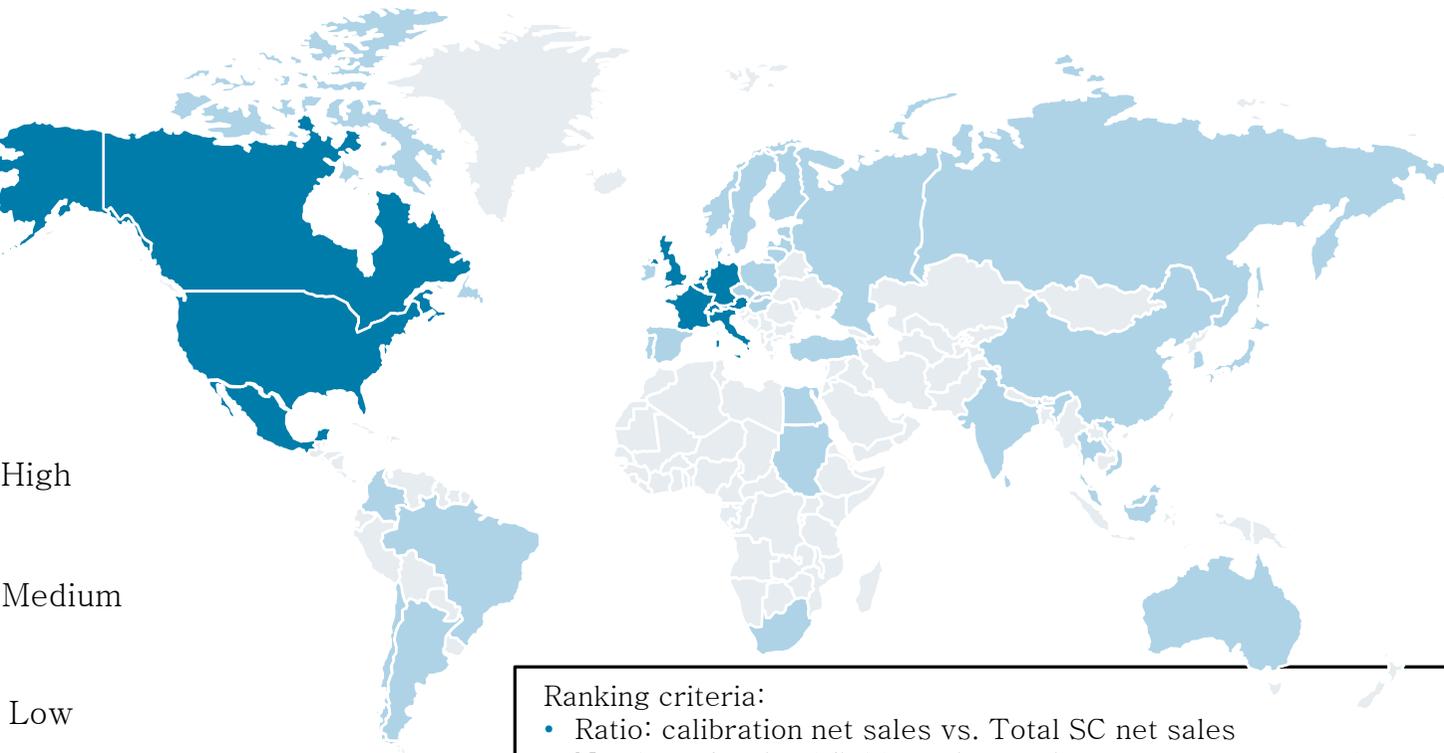
[Attestation E+ H Promass 200 PC.209.03.144.06.14 - Rev.0 engl](#)

Endress+Hauser calibration competence



Worldwide calibration capabilities

- Calibration in 60 countries
- > 250 qualified calibration technicians
- > 50'000 on-site calibrations
- > 1500 calibration tools in the operations
- Various ISO 17025 accreditations in 6 countries
- Unified Calibration certificates in 16 languages



High

Medium

Low

Status: April 2014

Ranking criteria:

- Ratio: calibration net sales vs. Total SC net sales
- Number of trained field service engineers, parameters and calibration tools
- Accreditations in place

Core calibration parameters

- Flow
- Pressure
- Temperature
- pH
- Conductivity

Additional parameters

- Volume
- Level
- Electrical parameters
- Density
- Rotational Speed
- Energy transfer
- Other liquid analysis

Worldwide calibration capabilities

Status: April 2013

SC Canada – A2LA Accreditation

- Lab: Flow, Pressure, Temperature

SC USA – A2LA Accreditation

- On-site: Flow, Pressure, Temperature
- Lab: Flow, Pressure, Temperature

SC Mexico – ema Accreditation

- Lab: Flow, Pressure, Temperature, Density, Volume

SC Germany – DAkkS Accreditation

- On-site: Flow, Pressure, Temperature
- Lab: Flow, Pressure

SC France – COFRAC Accreditation

- Lab: Flow, Temperature, Electricity, Humidity

SC Japan – IA Japan Accreditation

- Lab: Flow

- > 50'000 calibrations per year
- Worldwide calibration network, sales: 27Mio € in 2013
- > 150 trained calibration technicians
- > 1500 calibration tools
- Total SC investments in calibration: >2.5Mio € in 2013
- ISO 17025 accreditation for all SCs

High

Medium

Low/Nothing

E+ H Calibration capability breakdown

Factory Calibration

- + Wide measuring range
- Distance, turnaround time



Workshop Calibration

- + Faster turnaround, less cost
- Smaller ranges



On-site Calibration

- + Fastest turnaround
- + On-site preconditions, know-how
- + Direct communication, least down-time



Measurement Uncertainty (%)

Certification vs. accreditation

Certification

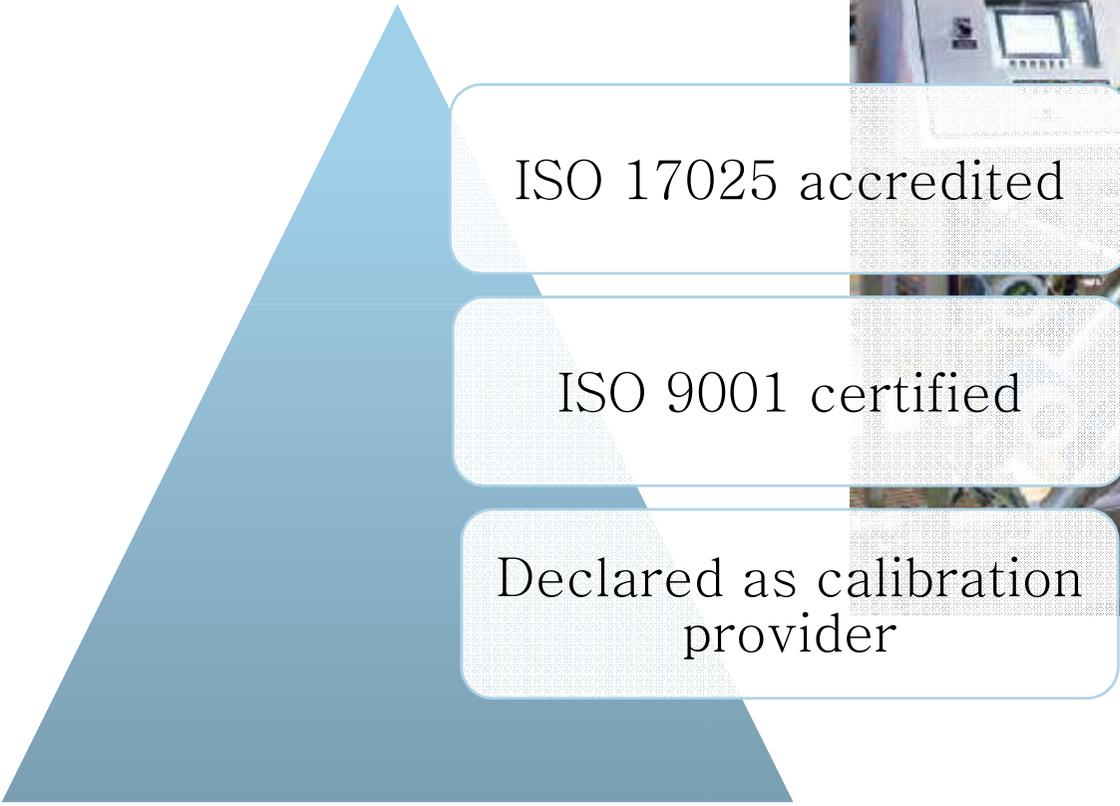
Issuing of written assurance (the certificate) by an independent external body that it has audited a management system and verified that it conforms to the requirements specified in the standard

Accreditation

Formal recognition process where an authoritative body reviews and approves a calibration lab's quality management system and technical competence

Subcontractors for calibration

- Types of providers



ISO 17025 accredited

ISO 9001 certified

Declared as calibration provider



Calibration providers ranking

Provider level	Quality management system	Metrological traceability of references	Competent staff in calibration
ISO 17025 Accredited	Validated by external audit	Validated by external audit	Validated by external audit
ISO 9001 Certified	Validated by external audit	Expected but not Validated	No information
Declared as calibration provider	No information	No information	No information

ISO 17025 Recognition structure

International recognition



International Laboratory Accreditation Cooperation

- 135 bodies – 88 countries
- > 6000 accredited inspection bodies

Regional recognition



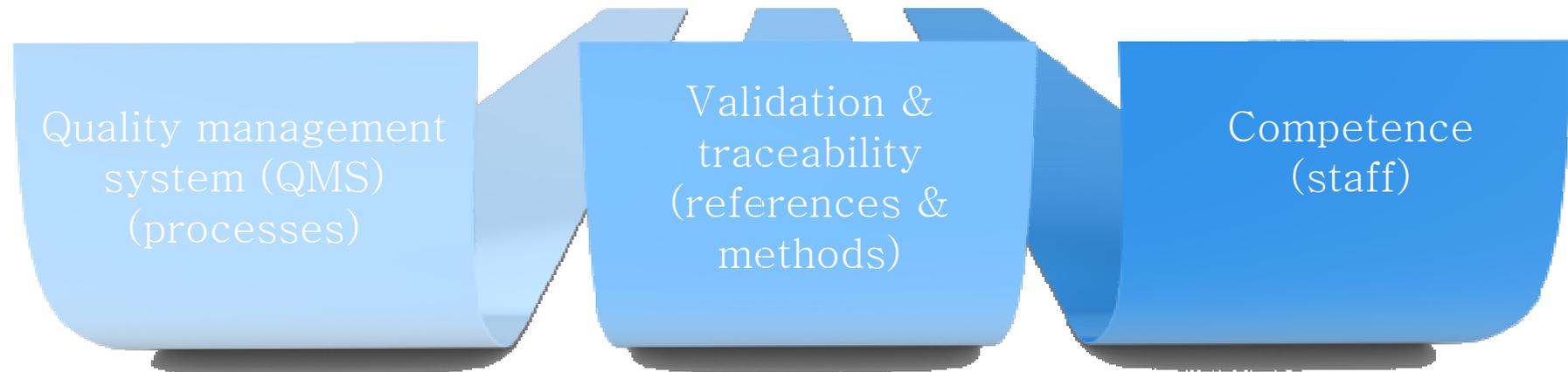
National recognition



Pillars of ISO 17025

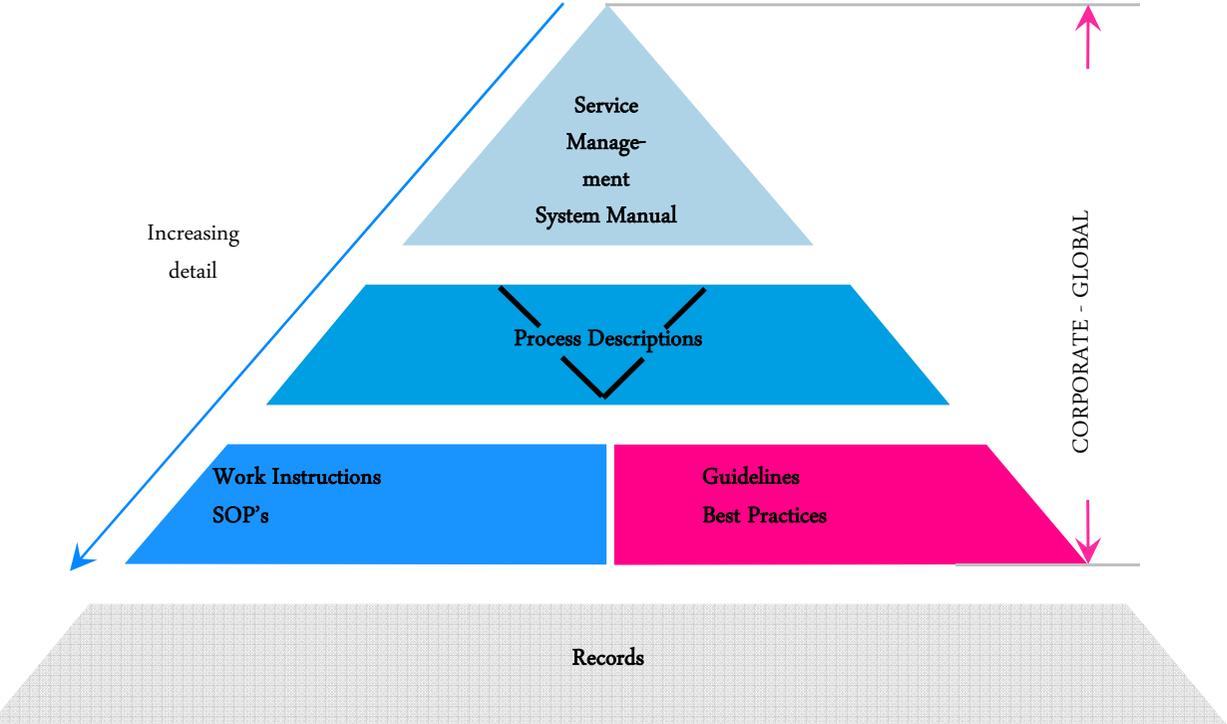
ISO/CEI 17025

General requirements for the competence of testing and calibration laboratories



Pillar 1: Quality Management System

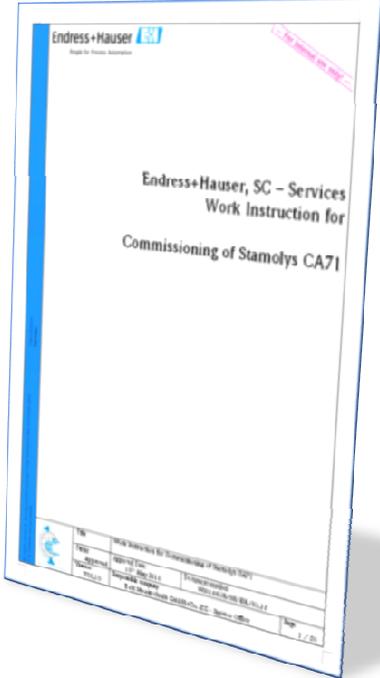
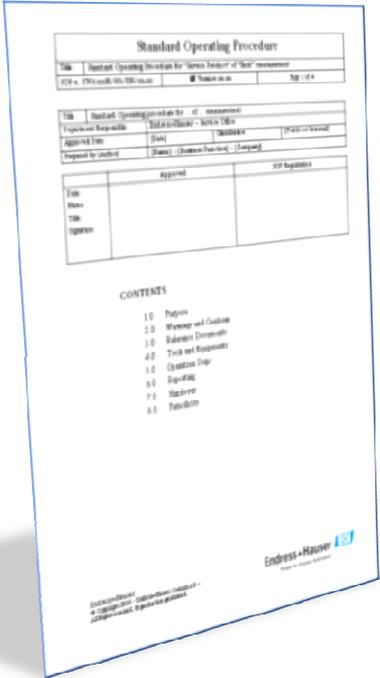
- Endress+ Hauser Service Management System



Pillar 1: Quality Management System

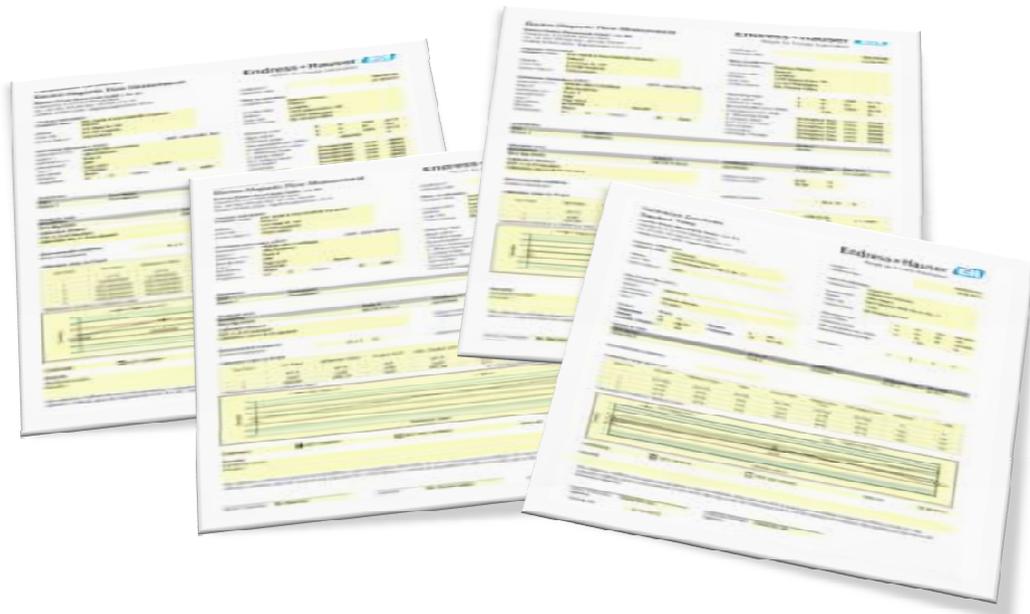
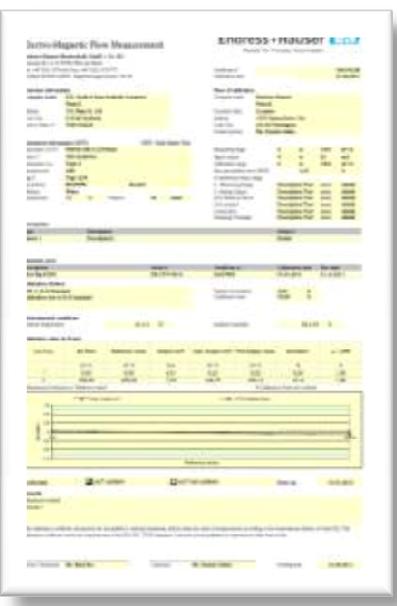
- Standard Operating Procedure (SOP)
 - Generic instructions which have to be followed
- Work Instructions (WI)
 - Detailed instructions which have to be followed

SOP's and WI's ensure that calibrations can be repeated anywhere and at any time !



Pillar 1: Quality Management System

- Calibration results in a standardized calibration certificate
- Instant printout on-site possible
- Available in various languages



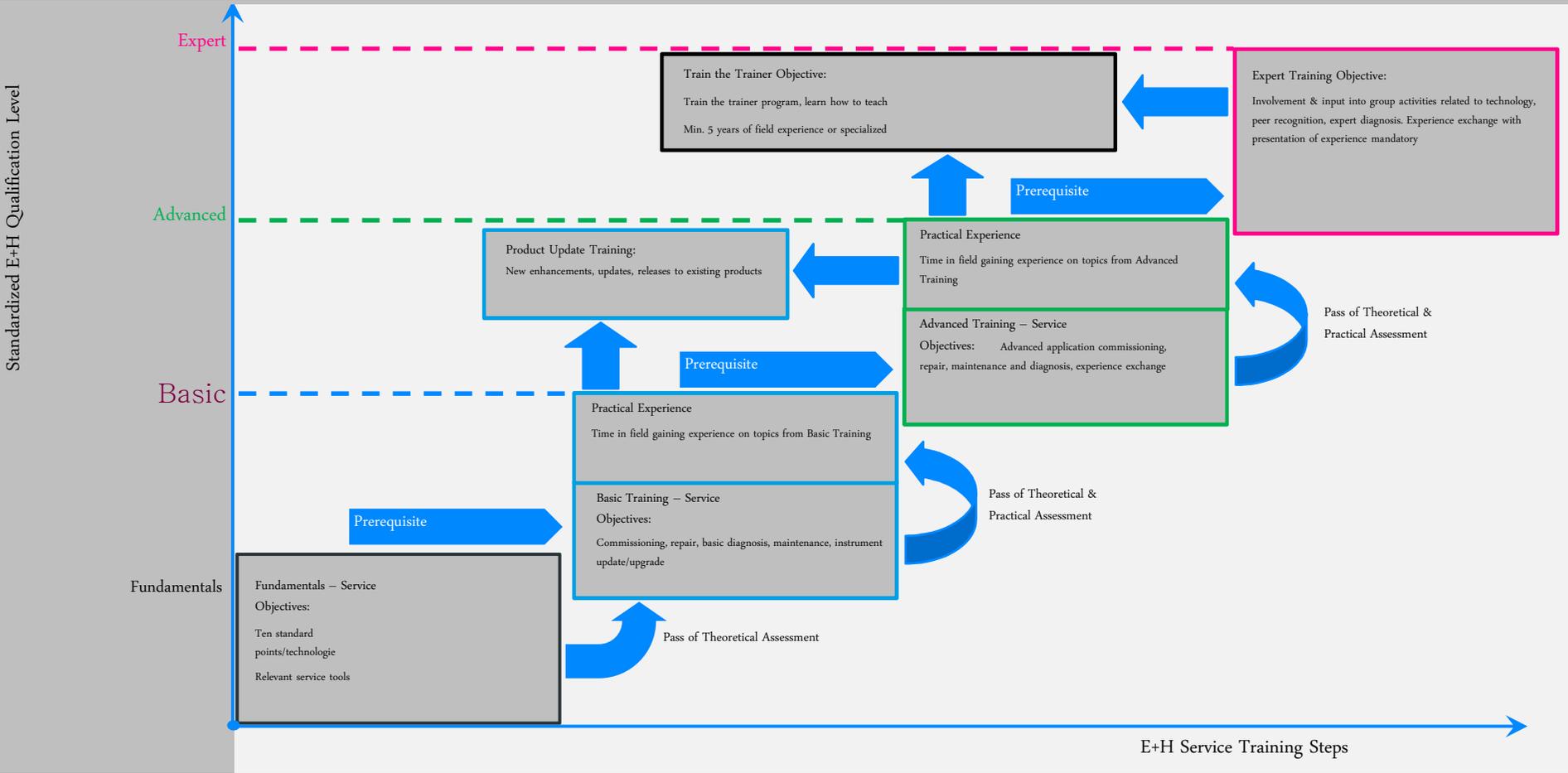
- English
- German
- French
- Dutch
- Italian
- Spanish
- Portuguese
- Czech
- Polish
- Russian
- Slovenes
- Turkish
- Hungarian
- Japanese
- others on request

Pillar 2: Validation & Traceability

Standardized calibration equipment (reference standards) for various parameters:

Flow	Pressure	Temperature
 <p>Flow Calibration Rig with Promass 83F</p>	 <p>Beamex MC6 with different pressure modules</p>	 <p>Beamex MC6 + FB150 with PT100 reference probe</p>
<ul style="list-style-type: none"> Measuring range*: 0 ... 70000 kg/h <p>*with Promass 83F DN50 2" Different ranges available</p>	<ul style="list-style-type: none"> Measuring range*: - 1 ... + 20 bar <p>*Different ranges available</p>	<ul style="list-style-type: none"> Measuring range*: - 25 ... + 150 °C <p>*Different ranges available</p>

Pillar 3: Competence



Summary

- Calibration is the comparison of an instrument to a known standard.
- Calibration is attempting to determine measurement errors coming from the calibrated instruments.
- Calibration is not an adjustment, only a comparison.
- After a calibration a device could be adjusted, the device must be recalibrated.

Key offering

Factory Calibration

- + Wide measuring range
- Distance, turnaround time



Workshop Calibration

- + Faster turnaround, less cost
- Smaller ranges



On-site Calibration

- + Fastest turnaround
- + On-site preconditions, know-how
- + Direct communication, least down-time



Measurement Uncertainty (%)

Any questions?

