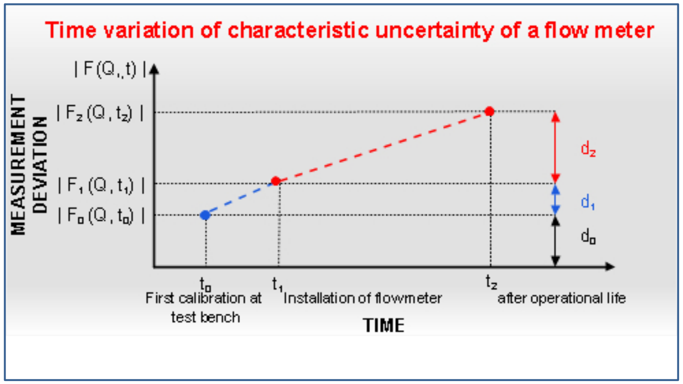
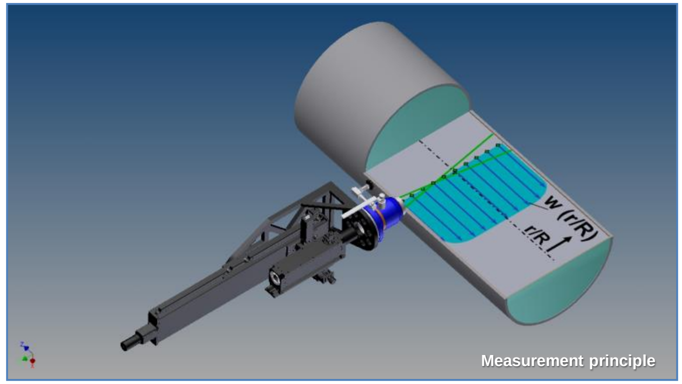
OPTOLUTION

DAkkS Deutsche Akkreditierungsstelle D-K-20427-01-00

On-site calibration of flow sensors

LASER OPTICAL FLOW MEASUREMENT





Measurement principle


Hot-tapping by certified partner

Precision for flow sensor data –
On-site calibration of flow sensors

Large heat and water meters are often used continuously for decades after their first calibration and installation without any recalibration. On-site calibration of flow sensors is rather limited until today and often-times lackluster in precision. Therefore in most cases, the flow sensors are demounted and recalibrated on external test benches. The drawbacks of this procedure are an unavoidable interruption of supply and the physical pipe system, with all its implications, which add up to the already high costs of the demounting and recalibration procedure.

Even if the flow sensor is externally recalibrated, the ideal flow conditions in test benches often times differ significantly from the operation conditions of the on-site flow meter installation. These variations range from temperature shifts, different flow conditions or even electromagnetic differences. The resulting measurement error due to stated reasons remains unknown and could generate major impacts – ranging from technical difficulties in control systems to accounting fairness between involved parties. Accurate measurement results allow examining saving potentials in heat grids and more precise calculations of key performance indicators leading to increased energy efficiency.

Accounting reliability–
Optical On-site calibration within real operation conditions

The patented measurement technology (co-owner ILA R&D GmbH) is based on the optical measurement principle of Laser Doppler Velocimetry (LDV). With this principle and our measurement technology, local flow velocities are measured across one or multiple pipe diameter paths. By integration of this measured cross section velocity profile you can create a referencing volume flow to test the flow meter against.

The necessary optical access to the flowing fluid is realized by hot-tapping without the need to interrupt pipe operations. The safety of this process is reviewed and certified by TÜV Rheinland. During calibration process, measurement values of the flow sensor are logged with the highest possible temporal resolution.

The measurement error is calculated through a comparison between the calculated LDV volume flow and a time averaged volume flow of the test device on various test points. Based on the on-site specific measurement uncertainty budget and calibrated measurement-tools, the calibration results are traceable to national measurement standards of the Physikalisch Technische Bundesanstalt PTB (German National Metrology Institute).

Various advantages –
Accredited, traceable, independent and without interruption of supply

- On-site calibration under operational conditions
- No interruption of supply while preparation and calibration procedure
- Traceabillity to national measurement standards of the German National Metrology Institute (PTB) via calibration of the measurement equipment and an on-site specific budget of the measurement uncertainty
- Guaranteed quality and international recognition via accreditation based on DIN EN ISO/IEC 17025 at Deutsche Akkreditierungsstelle (DAkkS)
- Neutral and independent calibration.

Examplary calculation:

Energy per year	50 MW * (120 d * 24 h) = 144´000 MWh
Price for district heating	50 Euro/MWh (e. g.)
Annual value	7.20 Mio. Euro
Uncertainty of 1 % flow meter result leads to	72´000 Euro p.a.

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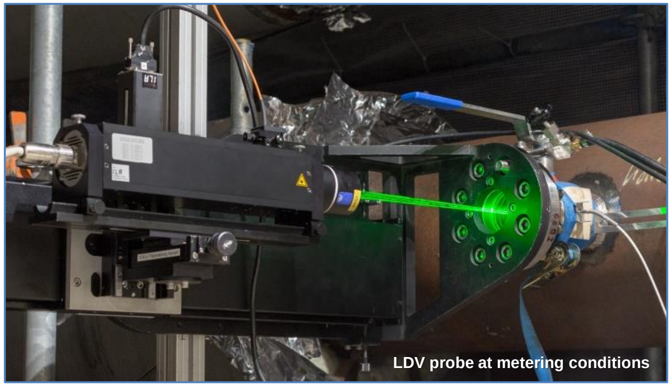
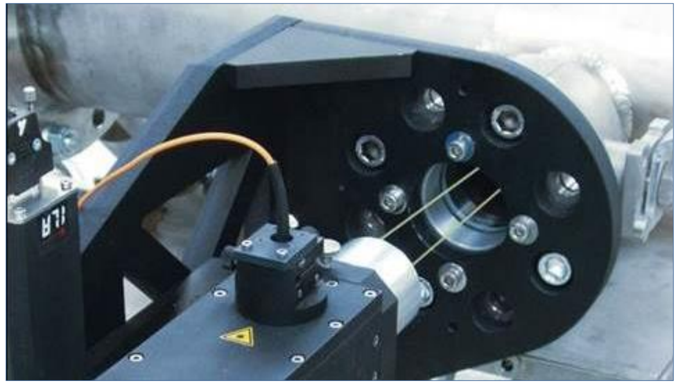

LDV probe at metering conditions




Outside measurement site

Application areas

- Transparent fluids (e. g. drinking water, pre-cleaned sewage, long-distance heating, district cooling)
- Cast and steel pipes with dimensions ranging from DN 150 up to ca. DN 1000 and PN 25 (40)
- Undisturbed inlet length of at least 5 to 10 D and
- Fluid temperatures up to T_{max} = 180°C.

Selected references

- Bremerhavener Entsorgungsgesellschaft mbH (Germany)
- Energie Wasser Bern AG (Switzerland)
- Fernwärme Wien GmbH (Austria)
- GHD & Queensland Urban Utilities (Brisbane, Australia)
- GMB GmbH, Senftenberg (Germany)
- Stadtwerke Cottbus GmbH (Germany)
- Stadtwerke Flensburg GmbH (Germany) and
- VATTENFALL Europe Wärme AG (Germany).

Measurement uncertainty – in practice

The actual measurement uncertainty of the calibration depends on the on-site flow conditions. Hence the position of the ball valve in regards to the flow situation is critical and must be chosen well. For the characterization of the flow conditions, we developed a key coefficient modell resulting in five velocity profile classes. The following table shows the achievable measurement uncertainties for each one of these profile classes. These numbers are based on the measured value with a coverage factor of k = 2 for resulting 95 % confidence interval.

Profile class „fully developed“	Profile class „symmetric“	Profile class „slightly disturbed“	Profile class „highly turbulent“	Profile class „highly asymmetric“
± 0.7 %	**± 1.4 %**	**± 2.3 %**	**± 2.7 %**	**± 4.2 %**

ilac-MRA

DAkkS Deutsche Akkreditierungsstelle D-K-20427-01-00

TÜVRheinland® Genau. Richtig.

Prüfbericht Nr.: 160480

Our experience

Until summer 2020 more than 200 flow sensors of district-heating and drink water supply were calibrated on-site. A quarter of the calibrated flow sensors showed a significant or rather high measurement error. These numbers confirm the importance and the benefit of the on-site calibration method for flow sensors.


Various measurement situations

Are you interested? Please contact us!

[Link for further techical information…]

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