EMPIR Call 2017 – Industry, Fundamental, Normative and Research Potential

Selected Research Topic number: **SRT-i13**
Version: 1.0

Title: Metrology for real-world domestic water metering

Abstract

A reliable and affordable water supply is vital for our quality of life yet becoming more scarce as population growth and climate change continue. Control of scarce resources requires accurate measurement and in the case of water meters this requires them to operate well under real-world conditions and not just controlled laboratory environments. A metrological infrastructure is needed for the assessment of water meters under varying dynamic load, installation conditions and water quality and the associated measurement uncertainties. This should improve the monitoring of water consumption, provide input to relevant standardisation bodies e.g. WELMEC WG-11 and OIML and enable the objectives set out in the Water Framework Directive (2000/60/EC) to be met.

Keywords

Domestic water metering, dynamic loads, installation conditions, virtual flow meter, smart water meter, measurement uncertainty, WELMEC WG-11, water quality

Background to the Metrological Challenges

Global challenges such as climate change and increased water demand (in 2030 water demand in Europe is likely to exceed water supply by 40 %) are driving a pressing need in Europe to increase the quality of monitoring water consumption. In the Water Framework Directive (2000/60/EC), the EC requested its member states to ensure that water pricing policies provided incentives for users to consume water efficiently and that the different industries contribute to the full cost recovery including environmental cost. Domestic water metering, which represents a billion € business, is one active part in this effort. Nevertheless there are deficiencies in current meter assessment and improved knowledge about meter performance under realistic conditions is required to help water suppliers better assess metering quality.

The effects of dynamic load changes can significantly influence the performance of domestic water meters however existing documents in legal metrology (e.g. OIML R49 and ISO 4064) currently prescribe well-defined laboratory conditions which differ significantly from the actual consumption profiles under real world conditions. When studying the effect of dynamic load changes promising approaches have been demonstrated for the development of test rigs but these still need more work and transferring to practical applications through the development of protocols and an uncertainty assessment. In addition, the characteristics of consumption profiles have been derived from limited data (300 households in Germany), and there are still issues concerning the derivation of one or more reference profiles and their applicability to a greater number of regions across different countries.

Current deficiencies in assessing the performance of domestic water meters stem from a large range of studies typically addressing one moment in time and often using different procedures. Progress has been made in the manufacturing of water meters and as a result there are high expectations on meter performance however, this requires further assessment of the influence of installation conditions, in particular the influence of factors such as water quality, particles and vibrations.

The knowledge acquired on meter performance in a virtual flow meter would facilitate the uptake of results by the stakeholder community. Such a comprehensive tool will also enable stakeholders to quantitatively assess metering quality at arbitrary installation conditions and periods, based on specific input parameters.

Developments towards smart water metering are already under way, however they currently lack a dedicated assessment of the requirements for a real-time monitoring of water consumption with commonly used domestic water meters. Intelligent algorithms for leakage and use pattern detection are required.

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Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The JRP shall focus on the measurement infrastructure to assess and calibrate domestic water meters close to real-world conditions. The specific objectives are:

1. To develop improved (beyond the specifications in OIML R49) test rigs and protocols for the calibration and verification of domestic water meters under dynamic loads. This should include the determination of typical consumption profiles and associated reference profiles, inter-comparisons and an uncertainty analysis.
2. To assess, both experimentally and using Computational Fluid Dynamic (CFD) modelling, the performance of domestic water meters under realistic installation conditions. This should include water quality, particles and vibrations and the determination of the related uncertainties.
3. To develop a virtual flow meter to simulate the effects of installation conditions on the performance of water meters. This virtual flow meter should estimate the uncertainty and predict the effects of ageing and wear of water meters.
4. To determine the requirements for real-time monitoring of water consumption including the development of intelligent algorithms for the detection of leaks. In addition, to perform a feasibility study for a domestic water meter suitable for the detection of small flow rates.
5. To facilitate the take up of the technology and measurement infrastructure developed in the project by end users (water meter manufacturers and water suppliers) and standards developing organisations (e.g. OIML, WELMEC WG-11, CEN/TC92 and ISO/TC 30/SC 7).

Proposers shall give priority to work that meets documented industrial needs and include measures to support transfer into industry by cooperation and by standardisation. An active involvement of industrial stakeholders is expected in order to align the project with their needs – both through project steering boards and participation in the research activities.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 1.5 M€, and has defined an upper limit of 1.8 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 30 % of the total EU Contribution to the project.

Any industrial partners that will receive significant benefit from the results of the proposed project are expected to be unfunded partners.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the “end user” community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Feed into the development of urgent documentary standards through appropriate standards bodies,
- Transfer knowledge to the water metering sector.

You should detail other impacts of your proposed JRP as specified in the document “Guide 4: Writing Joint Research Projects (JRPs)”

You should also detail how your approach to realising the objectives will further the aim of EMPIR to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards

- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of up to 3 years duration.