EMPIR Call 2015 – Health, SI, Normative and Research Potential

Selected Research Topic number: **SRT-n10**
Version: 1.0

Title: Extending ISO/TR 11583 wet-gas flow measurement to cover installation and 3rd-component effects

Abstract

Wet-gas flow measurement is vital to enable produced natural gas (containing small quantities of water and oil) to be measured accurately. To bring smaller gas fields (including shale gas) into service and improve European energy security it is necessary to measure gas flow rate without additional phase separation, which is prohibitively expensive for small gas fields. ISO/TR 11583:2012 [1] covers wet-gas measurement using Venturi tubes (the most common method) and orifice plates, but it has limitations. Proposals in response to this SRT should remove those limitations, by providing the data and the analysis required to extend ISO/TR 11583 to cover 3-component wet-gas flow and vertical flow and to include guidance on upstream straight-length requirements.

Keywords

Wet gas, allocation, fiscal, Venturi, orifice plate, differential pressure, meter, natural gas, flow metering

Background to the Metrological Challenges

Flow measurement is crucial to the European economy as not only does it underpin the valuation of most traded fluids but it is vital for process, quality and environmental measurement and control. ISO/TC 30 identified a shortage of data and understanding to account for 3-component (oil/water/gas) wet-gas flow and specific, industrially relevant installation effects. Wet-gas flow measurement is extremely important to industry (such as sub-sea engineering) to enable produced gas (flowing with small quantities of water and oil) to be measured accurately. Wet-gas metering is also required for monitoring production and changes within reservoirs, as well as process control of the downstream fluids, at the lowest possible cost per unit of gas produced. To bring smaller gas fields into service it is necessary to measure the gas flowrate without having to provide additional costly separators, thereby improving European energy security. Accurate wet-gas measurement is also required to ensure fair allocation of gas production in shared pipeline systems at minimal financial exposure. Finally, it may be required for equitable fiscal allocation for taxation purposes. ISO/TR 11583:2012 covers wet-gas measurement using Venturi tubes (the most common method of measuring wet gas) and orifice plates, but it has limitations.

ISO/TR 11583 only covers 2-component flow through horizontal Venturi tubes rather than 3-component flow. There is also a need for greater harmonisation between the outputs of ISO TC 30 (Measurement of fluid flow in closed conduits) and ISO TC 193 (Natural Gas), which will be greatly assisted by addressing some of the data gaps identified here. Moreover, some Venturi tubes in wet-gas flow have been installed vertically (for example to save space), and more would be installed vertically if accurate and reliable equations were available. This work may show which orientation is better. Moreover, there may be errors in measurements in the field due to inadequate upstream lengths, but at present there are no data to quantify this effect. Orifice plates give smaller uncertainties in horizontal wet-gas flow than Venturi tubes, but there is no text in ISO/TR 11583 on orifice plates in vertical flow. The required upstream lengths are also unknown. The main reason that orifice plates are not chosen for wet-gas flow is the risk that they might be deformed by the impact of liquid slugs if the flow turns out to be wetter than expected. A possible solution to this problem is to use thicker orifice plates than those normally specified but these need to be tested. It is thought the ratio of the pressure loss to the differential pressur) can be even more useful for orifice plates than for Venturi tubes in giving the Lockhart-Martinelli parameter without a separate measurement of liquid flowrate, however, validation data is required. Pressure-loss ratio is a diagnostic measurement used in determining the Lockhart-Martinelli parameter which, in turn, is essential in the application of correction factors.

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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 metrology research necessary to support standardisation in ISO/TR 11583 by extending ISO/TR 11583 to cover 3-component wet-gas flow and vertical flow and to include guidance on upstream straight-length requirements.

The specific objectives are

1. To provide data and methods for 3-component (oil/water/gas) wet-gas flow through Venturi tubes positioned in the horizontal and vertical orientation across a range of features and parameters deemed important by end users and ISO/TC 30/SC 2.
2. To provide data and validated methods on the required upstream straight lengths for wet-gas flow through Venturi tubes.
3. To provide data and validated methods on the behaviour of different Venturi tubes for a two component (oil/gas) flow across a range of features and parameters deemed important by end users and ISO/TC 30/SC 2.
4. To provide similar data for orifice plates as for Venturi tubes (as specified in Objectives 1 to 3).
5. To contribute to a revision of ISO/TR 11583:2012 by providing data, methods and recommendations to ISO/TC30/SC2.

The proposed research shall be justified by clear reference to the measurement needs within strategic documents published by the relevant Standards Developing Organisation or by a letter signed by the convenor of the respective TC/WG. EURAMET encourages proposals that include representatives from industry, regulators and standardisation bodies actively participating in the projects.

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 0.4 M€, and has defined an upper limit of 0.5 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 deviation from this must be justified.

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 energy 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.

Additional information

This topic is in response to needs identified by CEN/CENELEC published at http://msu.euramet.org/pre_norm_2015/index.html#stage1-orientation (priority 17: Precise wet gas flow 3-component (oil/water/gas) measurement).

The references were provided by PRT submitters; proposers should therefore establish the relevance of any references.

[1] ISO/TR 11583:2012 - Measurement of wet gas flow by means of pressure differential devices inserted in circular cross-section conduits