

Title: Supporting Industrial Scope-Extension for ISO Wet-Gas Flow Measurement Standards

Abstract

Wet-gas flow measurement is an enabling metrology in European natural gas production, custody transfer and supply. Greater use of marginal or sub-sea gas fields is increasing the need to meter wet-gas i.e. gas that contains small quantities of liquid (typically <5 %). Most field measurements of wet gas use Venturi tubes, deployed according to ISO/TR 11583 and/or ISO/TR 12748. However, these standards rely on data that covers only a limited range of conditions and errors resulting from data extrapolations to industrial conditions often exceed 10 %. Based on an annual European gas production of € 40 billion and assuming 50 % is wet-gas, this mis-measurement exceeds € 2 billion. Therefore there is an urgent need for traceable data and models relating to 3-component wet-gas flows, together with clearer recommendation supporting standardisation in the measurement of wet-gas flow rate.

Keywords

Wet-gas, supply, Venturi tubes, differential pressure, meter, natural gas, flow, errors, standards, ISO.

Background to the Metrological Challenges

Natural gas production has a major role to play in the security, sustainability and diversity of energy production and supply within Europe. Therefore it is imperative that the recovery of gas from European fields is maximised and that production costs are reduced in order to retain EU production competitiveness and reduce dependence on imported gas. As oil and gas exploration moves to more marginal or remoter and deeper subsea fields, wet-gas metering is increasingly being used for cost-effective monitoring of production and reservoir changes, as well as for process control of downstream fluids.

The potential financial impact of improving wet-gas measurement is substantial, for example a reduction in uncertainty of only a few percent in a small proportion (say 1 in 10) of existing wet-gas metering situations could save tens of millions of Euros during custody transfers. However, in order to improve wet-gas measurements, field measurements errors, such as those introduced by installation effects caused by inadequate upstream tubing lengths, or from using vertical Venturi tubes need to be addressed.

Given the importance of wet-gas flow measurement, it is vital that the standards that govern it are accurate and trusted, however, these standards currently rely on limited data and understanding. A need has been expressed for greater harmonisation between the outputs of ISO/TC 30/SC 2 (Measurement of fluid flow in closed conduits- Pressure differential devices) and ISO/TC 193/SC 3 (Natural Gas- Upstream area), and includes an extension and improvement of the current evidence-base i.e. the data and the correlations and models based on them that underpins ISO recommendations on the measurement of wet-gas. Existing recommendations are incorporated in two key ISO publications: TR 11583:2012 and TR 12748:2015 but these only cover 2-component flow (gas/oil or gas/water), and there is almost no public-domain 3-component (gas/oil/water) data in existence. This currently hampers the development of a 3-component equations and leads to the use of 2-component equations with errors up to 10 %. Further to this, there is very little public-domain data available for vertical Venturi tubes which leads to installation errors of up to 9 % if an equation derived for horizontal Venturi tubes is used.

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 metrology research necessary to support standardisation in the measurement of wet-gas flow rate in order to enable extension of the applicability of ISO and other standards to an increased number of industrially-relevant conditions.

The specific objectives are

1. To determine differential pressure and pressure loss to differential pressure ratio measurement data for 3-component (gas/oil/water) wet-gas using Venturi tubes, in order to meet end-user and ISO/TC 30/SC 2 and ISO/TC 193/SC 3 requirements. This should include the use of Venturi tubes in both the horizontal and vertical positions.
2. To determine correction factors and derive recommendations for matching measurement uncertainties to the influence of upstream straight-length tubing runs during 3-component (gas/oil/water) wet-gas flow measurements using Venturi tubes. This should include establishing the influence of upstream straight-length runs on over-readings generated for these measurements depending on Venturi tube orientation.
3. To develop numerical models based on analysis of the data from objectives 1 & 2 and then apply these models to field conditions.
4. To contribute to future revisions of ISO/TR 11583:2012 and/or ISO/TR 12748:2015 by providing the data, methods, guidelines and recommendations necessary for the standardisation of wet-gas flow using Venturi tubes, to both ISO committees (ISO/TC 30/SC 2 and ISO/TC 193/SC 3).

Proposers should establish the current state of the art, and explain how their proposed research goes beyond this. In particular, proposers should outline the achievements of the EMRP project ENG58 MultiFlowMet and EMPIR JRP 16ENG07 MultiFlowMet II and how their proposal will build on these.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 0.6 M€, and has defined an upper limit of 0.8 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.

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. The proposal must name a “Chief Stakeholder”, not a member of the consortium, but a representative of the user community that will benefit from the proposed work. The “Chief Stakeholder” should write a letter of support explaining how their organisation will make use of the outcomes from the research, be consulted regularly by the consortium during the project to ensure that the planned outcomes are still relevant, and be prepared to report to EURAMET on the benefits they have gained from the project.

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

[1] CEN/CENELEC identified this topic as one of their priorities. Details are available at: https://msu.euramet.org/current_calls/pre_norm_2017/documents/SRT_related_CEN_priorities/cen_priority_17_2015.doc