Should Reynolds number Correction and Linearization of Flow Meters be Standardized

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Flowmeters are without exception controlled in their performance by Reynolds number. For many years it was considered, for example, that Positive Displacement meter performance was viscosity related, but now it is accepted that the real criteria is Reynolds number. The same is true of turbine meters. Modern meters such as USMs and Coriolis meters have for years hidden the fact that Reynolds number has an influence on meter calibration and performance by using sophisticated computational techniques, and presenting the user with a "black box" output. Unfortunately this approach hides from the user number of important issues that can affect the meter performance.

The usual method of accounting for the performance changes is by linearization, also called data fitting, of the calibration curve. Obviously to obtain a good fit it is essential that the base upon which the curve fit is achieved must be stable, accessible and easy to use. For flow meters the base is Reynolds number, which generally does not fit any of these criteria as it is a difficult criterion to determine. The variables required to determine Reynolds number are flow rate, viscosity, either kinematic or absolute and density. Often these are not available and so surrogates are used. So, for example, multi-path liquid USMs often use flow profile as the surrogate on the basis that there is a relationship between a fully developed profile and Reynolds number, a very fragile relationship relying on the installed quality of the flow profile in the meter.

API are now beginning to recognize the issue in some new standard updates, such as the new standard for allocation metering. But it is piecemeal and there is a good argument to have a separate standard dealing with the complete issue of data fitting of flow meters to ensure a commonality of methods, criteria and uncertainty calculation.

The paper considers the effect on different meters, the methods available and the potential problems resulting from linearizing meters. It considers the need for proper calibration, understanding of the operation of the meters and how a standard could be developed to alleviate the current issues resulting from the mis-application of data fitting. Also discussed are the further issue of taking the fit further and into the realms of extrapolation.