Metering and Billing Vaporous Media

Why Good Measurements are Vital

Our experience has taught us that measurements which work on the differential pressure principle are best suited for accurate billing measurements as well as excellent assessment and control measurements. Vortex meter technology is also appropriate for steam applications; but further measures are, nonetheless, necessary for billing purposes.

The importance of steam must not be underestimated, particularly in the energy sector; small quantities of steam can convey enormous amounts of energy, e.g. as the working medium for steam turbines and heating purposes or as process steam in various sectors, ranging from the food and paper industries to the automotive engineering and process engineering industries. The demand for solutions to accurately meter and bill is increasing all the time as producers and consumers are not usually one and the same. However, fundamental billing principles are often very unclear in nature, because steam measurements cannot be calibrated. This is clearly defined in the German Calibration Ordinance (EO - Mess EV, Appendix 1). Experience shows that measurements which work on the differential pressure principle are best suited for accurate billing measurements as well as excellent assessment and control measurements.

Basically there are only a handful of metrological procedures suitable for steam applications. The most important of these are vortex metering, dynamic probe measurements or conventional differential pressure measurements to standard ISO 5167. In order to determine which of these is most appropriate, it is necessary to take a closer look at the requirements of steam suppliers and purchasers. Both obviously show great interest in an accurate and, above all, reliable and comprehensible measuring system. Besides a high level of availability, outstanding measuring accuracy is therefore required to achieve the best possible measuring dynamics. It is essential to be able to check the quality of the measured values on the spot so as to guarantee legal certainty and meet international rules and norms. METRA Energie-Messtechnik, given its almost thirty years of experience as a supplier of steam flow or steam energy meters, acknowledges that measurements based on the differential pressure principle (ISO 5167) along with harmonised equipment technology offer the best conditions.

Comparable to a calibrated measuring system

There are several reasons for this: one of the most important of these is the standardisation process which, apart from a few minor exceptions, ensures validity worldwide. This makes the differential pressure principle different from other measuring methods. The utilisation of dynamic probes for accurate metering and billing is only acceptable in exceptional cases due to lack of traceability to valid rules and norms combined with relatively low process-related measuring dynamics and uncertainties concerning the required lengths of straight inlet sections. A similar situation arises when using vortex meters as only data provided by the manufacturer is available for the necessary inlet and outlet sections. Generally applicable tests or standards do not exist. Testing under realistic conditions at accredited test benches - something that obviously requires a certain amount of knowledge and time - is essential to ensure continued and reliable operation. In comparison, differential pressure measurements based on ISO 5167 offer significantly better conditions. None of the other methods have been investigated to such

an extent and accredited by such a wide range of calibration activities at various test benches. The widespread assumption that differential pressure metering is only possible with low measuring dynamics and high measuring uncertainties no longer stands up to scrutiny. The advance of technological developments in recent years means modern equipment technology in conventional differential-pressure meters enables measuring ranges of up to 50:1 at a measuring uncertainty of 0.5% of the current value with regard to the mass and energy flow rate. In order to guarantee such extensive ranges along with minimum measuring uncertainties, a number of requirements are placed on individual components and on the test method of a pressure differential measurement chain. This applies to correct selection of the differential pressure device and the transmitter technology (differential-absolute pressure, temperature) as well as the steam flow or steam energy calculation unit. Additionally, precise evaluation and consideration of the inlet and outlet situation as well as the steam status (wet steam, saturated steam, superheated steam) are essential to ensure an ideal set-up. Yet another key factor is correct selection of an accredited institute of standards and technology that offers a variety of test and calibration equipment. This selection is based on the flow rate conditions when actually using steam measurement processes (the characteristic factor in this case is the Reynolds number ReD). A decisive advantage is that a current steam measurement can be easily verified. When correctly selecting the differential pressure device in terms of its application, the wear and tear of measurement relevant parts over the years is not something which has to be considered. The respective transmitter technology, such as differential pressure, temperature, absolute pressure or flow / energy calculation unit, can be simply checked on site using corresponding standards. When all these requirements are taken into account, it is possible to achieve more reliable and comprehensible steam measurements which are comparable with those obtained using a calibrated measuring system.

Accuracy is vital

A calculation example clearly shows the financial benefits such measurements can bring for steam suppliers and purchasers: When assuming the steam mass flow rate is 80 t/h at a steam price of 25 €/t over an operating period of 7,200 h/a, the annual costs would be €14.4 m. Measurement uncertainties now come into play. An assumed measuring uncertainty of +/- 5% (a value not uncommon in real-world applications) would result in cost fluctuations of +/- €720,000 a year under the same basic conditions. If a measuring uncertainty of +/- 2% were to be achieved, fluctuations would fall to +/- €288,000 a year and drop to just +/- €72,000 a year at a measuring uncertainty of +/- 0.5%. Measuring uncertainties above 0.9% may therefore result in costs totalling several hundred thousand euros a year. When using the said equipment technology, unnecessary expenditure caused by incorrect calculations can be reduced by up to a factor of 10. In terms of accurately metering and billing steam, conventional differential pressure metering to ISO 5167 is an extremely worthwhile method, irrespective of whether steam is used as a working medium for heating purposes or as process energy.

It is however vital that the entire measurement chain is viewed and tested as a single unit. Individual testing of components is definitely insufficient.

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