

Modeling of the German National Standard for High Pressure Natural Gas Flow Metering in Modelica[®]

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The German national primary standard for high pressure natural gas flow metering is a High Pressure Piston Prover (HPPP). It is used to calibrate transfer or working standards for high pressure natural gas flow metering and is traceable to the standards of length and time. The HPPP is operated and owned by the German national metrological institute Physikalisch-Technische Bundesanstalt (PTB) and currently installed on the calibration site for gas flow meters pigsar[™] in Dorsten, Germany. The uncertainty of high pressure natural gas flow meters and therefore also the uncertainty of the HPPP as their primary standard in Germany is of major importance for the trade with natural gas. Figure 1 shows a picture of the HPPP.



Figure 1. Picture of the High Pressure Piston Prover (PTB , 2009)

The HPPP consists basically of a piston in a cylinder. The gas flow rate is measured using the time the piston needs to displace a defined enclosed volume of gas. Fluctuating piston velocity during measurement can be a significant source of uncertainty if not considered in an appropriate way (Mickan et al., 2010). A computational model was developed to investigate measures for the reduction of this uncertainty. It is written in Modelica[®]. The model validation shows good accordance of the piston velocity fluctuations in the model with measurement data for certain volume flow rates. Three independent ways to reduce the piston velocity fluctuations were demonstrated using the developed model. A significant reduction of the piston velocity fluctuations was achieved in the model by lowering the piston weight, controlling the start valve switching time and integrating a flow straightener.

References

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