

Traceability and Field Measurement Results of Large Capacity Gas Ultrasonic Meters

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This paper presents years of field measurement results for large capacity ultrasonic flow meters, through a well-maintained, from NMi to the field, measurement infrastructure. From 2008-2013, Center for Measurement Standards (CMS) maintained an un-broken chain of traceability for the on-site calibration of six 600 mm USM at 55 bars, located at Da-Tan power plant. A total of eight USM, 150 and 300 mm respectively, were used as transfer standards. In addition, 17 high-pressure custody meters, 250 and 300 mm, from gas distribution stations were calibrated at Chinese Petroleum Corporation (CPC) using the same traceability chain. Due to limitation of flow rate and pressure range at CMS, the four 150mm Instromet meters could be calibrated up to 1000 m³/h around 10-12 bars only. The rationale is based on the design principle that USM measured only transient time and should not be affected by pressure effect, or gas properties. Manufacturer specification also claims a four times pressure difference should not affect its measurement accuracy for industrial applications. Meanwhile, ISO 17089 standards stated an $\pm 0.7\%$ unadjusted meter error band for large capacity class I meters, $\pm 1\%$ for smaller ones.

Data accumulated in that period indicated these 600 mm USM and 17 meters calibrated meet the custody transfer regulation set forth by CPC and Tai-Power Company. However, the low-pressure traceability scheme is not without its risk. Therefore, starting 2014-2015, a set of five 50 mm *Itron* gas meters are used, in parallel, to calibrate an in-house 150 mm SICK USM at 55, 38, and 16 bars, up to 550m³/h at the re-circulation system in CMS. The SICK meter is then used at CPC as transfer standards, for calibration of four 150 mm Instromet meters and compared with a 150 mm Q-Sonic Plus meter, which was calibrated at *pigsar*.

In addition, to verify the pressure effect, the SICK meter was tested with CMS blow-down facility at 10 bars, and also at re-circulation system at 55 bars. In 2016, to further verify the effect, the Sick meter was also calibrated at PTB, *pigsar*, at 1, 20, and 50 bars. Test results relating to some years of traceability and field calibration, pressure effect, and from 17 meters calibrated in past years will be presented.
