

Development of Large Gravimetric Flow Rigs for High Capacity Coriolis Flowmeters

Tao Wang¹

¹*KROHNE Ltd, Wellingborough, UK
E-mail (corresponding author): t.wang@krohne.com*

In recently developments, the flow range of Coriolis flowmeters has been extended to higher capacity beyond 2,000 t/h. The accuracy specification of these high capacity flowmeters has also been improved to $\pm 0.05\%$ as an option by manufacturers. In order to provide traceable calibrations to meet both high capacity and high accuracy requirements, it presents a considerable challenge, in particular, under a manufacturing environment. This paper describes the principle and development of a large-scale flow calibration facility which includes two water flow rigs of nominal pipe diameters 12" and 14" respectively.

A gravimetric weighing system together with a standing start and stop procedure is employed as the primary calibration reference. The weighing system consists of four strain gauge based load cells and specially built weighing frames. The weighing frame design is optimized to minimise deflection under loading conditions so as to improve the weighing system's linearity performance. In order to control the uncertainty of the weighing system, an integrated weighing calibration system has been developed and is compactly located underneath the weighing frames. The weighing calibration system further consists of several calibration weights over a lifting device, and each calibration weight has a 1 t nominal value. By adopting a substitution method, weighing capacity more than 20 t can be calibrated with multiple steps. Other uncertainty components for the rigs are also carefully considered. Among these components, air buoyancy correction becomes important and real time monitoring of air temperature at multiple locations around the weigh tank has been implemented. Buoyancy correction of the weighing result and its related uncertainty can, therefore, be evaluated in real time.

The combined uncertainties for both flow rigs have been evaluated and verified by a number of tests and the resulted CMC (Calibration and Measurement Capability) is better than 0.017%, which is suitable to calibrate flowmeters with an accuracy specification of $\pm 0.05\%$. Cross-comparison tests with an existing internal flow rig and other external flow rigs have also been conducted and the comparison results support the claimed CMC. As a result of the development, both rigs were successfully accredited.
