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Values For Gas-Volume

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# GAS OIL PISTON PROVER, PRIMARY REFERENCE VALUES FOR GAS-VOLUME

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## Abstract

The paper describes the design, measurement results and uncertainty analyses of the hydraulic driven piston-prover system which has been in operation at VSL since 2008. The 12-meter long, 0.6m bore piston-prover is used for the realization of Reference Values for Gas-Volume at pressures between 1 and 65 bar(a) at several gases. The principle is based on the displacement of a piston acting as a Gas-Oil separator. The standard has a flow-rate range from 5 to 230 m<sup>3</sup>/h. The system is designed to calibrate reference meters. The Calibration and Measurement Capability (CMC) of the system is proven to be smaller than 0.1% (k=2). The paper also explains the coherence between the Gas-Oil Piston-Prover and other traceability generators and ‘flow rate bootstrapper systems’.

## Introduction

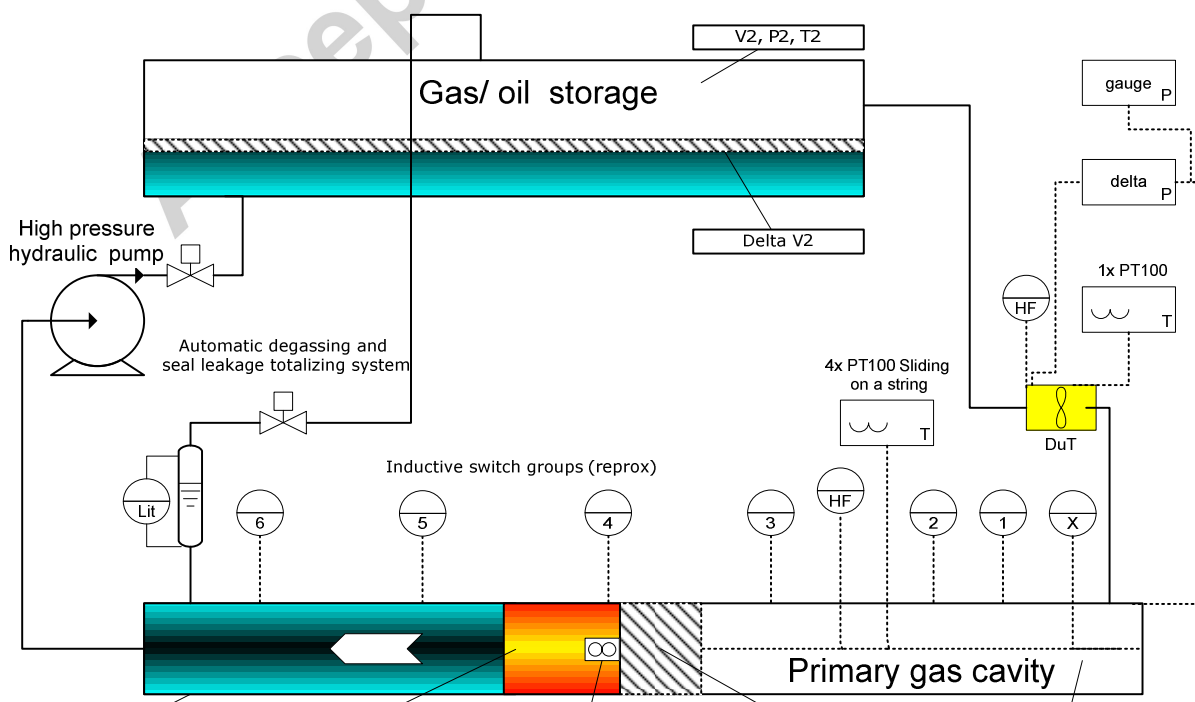
The Gas Oil Piston Prover, (GOPP) was designed in 2000 and built in 2003. The first results, shared at Flomeko 2003 [1] underpinned the metrological feasibility of the system. It took another 5 years to get the system into satisfactory operation. In 2010 the system and its uncertainty claim was approved under ISO17025 and accepted by PTB and LNE. It was important to ‘have PTB and LNE on board’ as these entities are partners in the ‘Eurega’[3] consortium for the Harmonized Reference Values of gas volume [4]

## Working Principle

The working principle is based on the displacement of a piston acting as a Gas-Oil separator. (See figure 1). The piston travels at a relatively low speed. A speed-controlled centrifugal pump generates an oil flow rate that moves the piston with a uniform velocity towards the left side of the cylinder, passing sensors indicating boundaries of discrete volumes. The oil & gas container at the top-side of the configuration, works also like a displacement system and the gas is forced towards the open outlet of the container flowing back into the cylinder.

During the gas transport from the container to the cylinder, the mounted gas-meter will indicate a passed actual volume that is matched with the known volume of the displaced piston. Obviously it is a process with two strokes, after the active measuring stroke (piston moves to the left end) the pump will be stopped and the oil returns (caused by a slight natural hydrostatic over-pressure) to the cylinder and forces the piston back to its starting terminal. Proximity switches take care of the comparison process. The HF pulses coming from the Meter- or Device under-Test (a Travelling Reference Meter) are compared with the reference LF pulses of the several reference volumes of the primary cylinder. In [1] a more extensive description of the design considerations was given.

The advantage of the concept is the closed circuit



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