

# Application note

## Pressure sensitivity of the VPFlowMate and VPFlowScope

Thermal mass flow sensors can measure mass flow independent of pressure. How good is the performance in practice?

### The pressurized calibration process

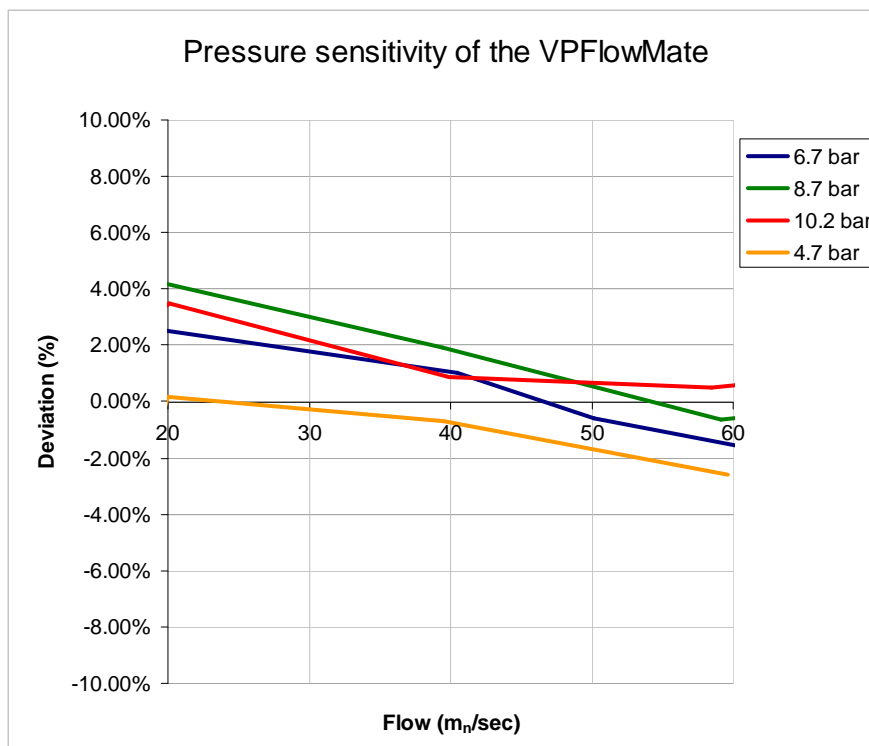
The VPFlowScope insertion probes are calibrated on our proprietary pressurized test system. Pressurized calibration has many advantages:

- For mass flow generation, the required amount of power is a function of the total pressure drop and thus has a quadratic relation with the actual air velocity. It would be very costly to generate 150 m/sec at atmospheric pressure. Calibration at 10 bar reduces the actual velocity to 15 m/sec.
- All flow meters deviate from their ideal behaviour when the actual process conditions differ from the calibration conditions. It is best practice to calibrate flow meters as close as possible to the actual process conditions.
- The flow profile in a tube is dependent of the Reynolds number. It is good practice to calibrate a flow meter near the Reynolds number at actual operating conditions.

As a result, the pressurized calibration process leads to the lowest possible measurement uncertainty.

### Pressure tests from 4.7 bar abs up to 10.2 bar abs

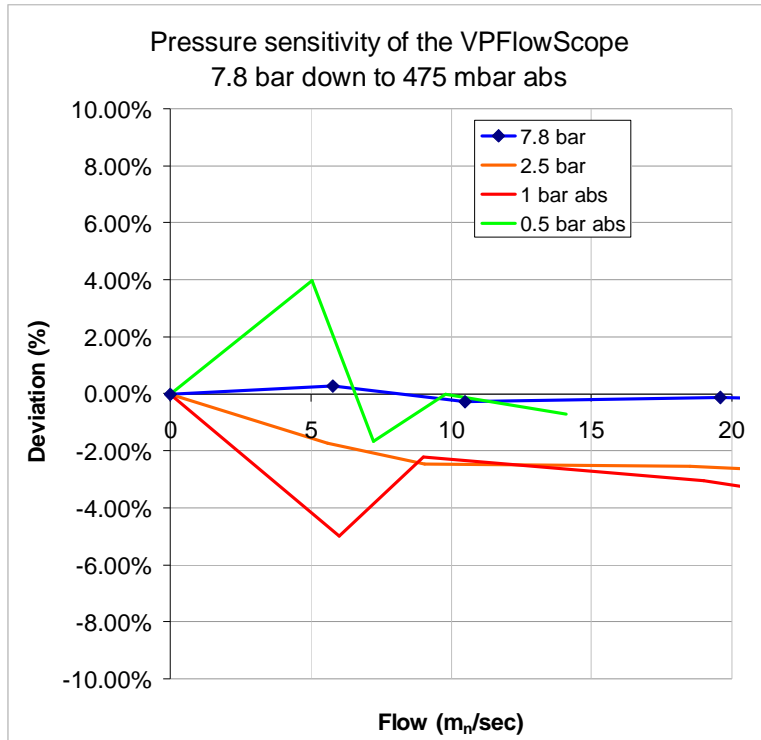
These tests have been performed on the Boreas calibration bench. Device under test was a VPFlowMate insertion probe. The deviation is within +/- 2% bandwidth over a pressure range of 5 bar.



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## Pressure tests from 475 mbar abs up to 7.8 bar abs

We have performed air flow tests under four different pressures in the Zephyrus wind tunnel. Device under test was a VPFlowScope. The results are shown in the graph. The test region is limited, due to limitations of the Air pump in the Zephyrus wind tunnel. It cannot generate flow above 15 m/sec when the pressure is 500 mbar.



## Conclusions

Pressure errors are within +/- 2 % over a test range of 475 mbar up to 7.8 bar. The VPFlowScope performs better than the VPFlowMate, even at low velocities thanks to the use of a high resolution lookup table.

In vacuum systems, one should be aware of temperature effects. The thermal conductivity is longer than under pressurized conditions, so a longer response time can be expected.

The normal VPFlowScope has a 0...15 bar gage sensor. For Vacuum measurement, a special version can be made to order.