

Application Note for SDP600 and SDP1000 Series

Measuring Flow in a Bypass Configuration

Summary

The Sensirion differential pressure sensors of the SDP600 and SDP1000 series are often used to measure flow in a bypass configuration. This application note provides a

short and easy to understand explanation of how the sensors may be used to measure flow.

1. Theory

An orifice or linear flow restrictor generates a pressure difference if placed in the air flow inside a tube. The pressure difference correlates with the amount of flow in the tube, obeying the specific characteristics of the flow restrictor element.

By measuring the pressure drop, i.e. pressure difference over the flow restrictor, the flow in the tube can be measured. The Sensirion differential pressure sensors are

well suitable to measure flows in such a configuration, as the sensors are extremely sensitive and stable. They measure the differential pressure by means of a small flow through the sensor, thus the SDP600 and SDP1000 series sensors can also be considered as flow sensors in this context. Using them to measure the differential pressure over an orifice or linear flow element creates a so-called bypass system.

2. Flow measurements with SDP sensors

What do you need for measuring flow?

- Main pass channel
 - Flow orifice
 - Bypass channel with SDP
- } Bypass configuration

Why using Sensirion sensors for a bypass configuration?

Sensirion SDP sensors have high repeatability and small sensor to sensor variation. The measurement of the zero flow point is extremely accurate and stable, making re-zeroing obsolete and leading to an outstanding dynamic range of the measurement.

If used in a bypass configuration, these sensors allow measuring the standard volume flow or the mass flow in the tube with high precision.

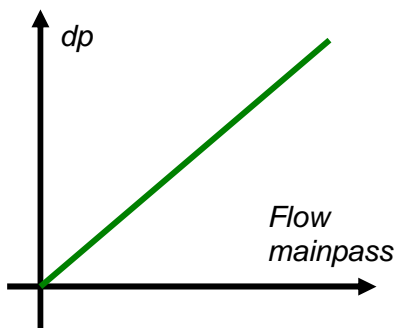
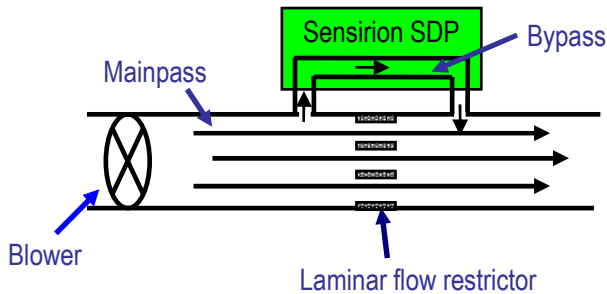
What is measured finally?

Sensirion SDP sensors are suited to measure mass flow or standard volume flow in a bypass configuration. Of each sensor model, there are two different versions available, optimized to measure differential pressure and optimized to measure mass flow or standard volume flow in a bypass configuration respectively. Choose the SDP1000 or the SDP6x0 for differential pressure measurements and the SDP1000-MF or SDP6x1 for mass flow or standard volume flow measurements.

3. Possible bypass configurations

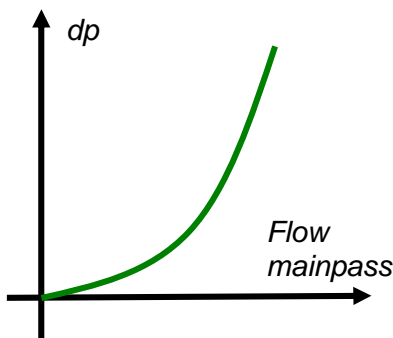
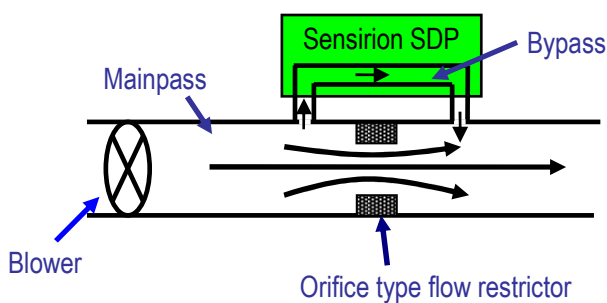
Laminar flow restrictor in main pass

The differential pressure versus flow characteristic of the laminar flow restrictor is linear.



Orifice type flow restrictor in main pass

The differential pressure characteristic of the flow restrictor depends on the orifice and the main pass dimensions. Orifice type flow restrictors tend to have a non-linear (often close to quadratic) flow characteristic.

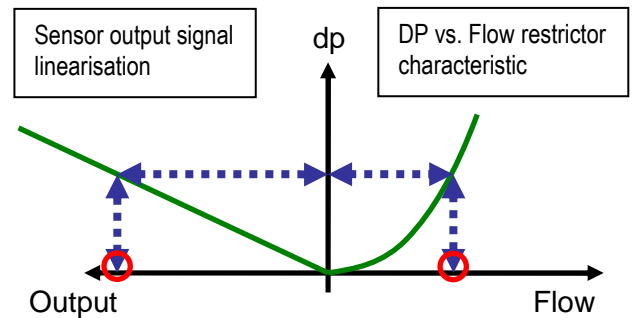


Correlation of differential pressure (dp) vs. flow

Sensirion SDP sensors have a linearized output signal measuring the differential pressure between its two ports. The user of a bypass system has to characterize his flow orifice. Once the dp vs. flow curve is determined, no further calibration is needed in most cases due to the high repeatability and small sensor to sensor variation.

In case of exceptionally high accuracy requirements a single-point calibration of the system is usually sufficient to account for tolerances of the flow restrictor.

Because the Sensirion SDP sensors are calibrated for differential pressures, fluctuations in the bypass/main pass split ratio (due to material variations, dimension tolerances) have no influence on the measurement.

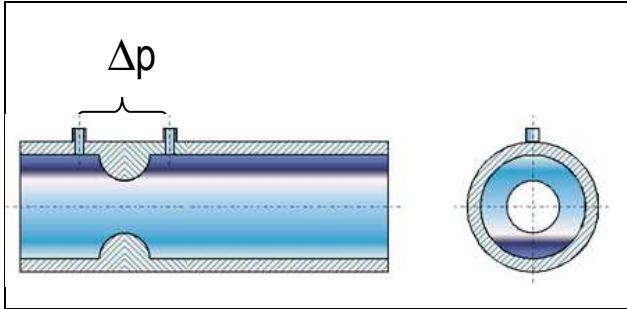


4. Possible pressure drop elements

Basically every flow element inducing a pressure drop can be used to measure flow in a bypass constructions. Choose one of the following 4 possibilities depending on your application.

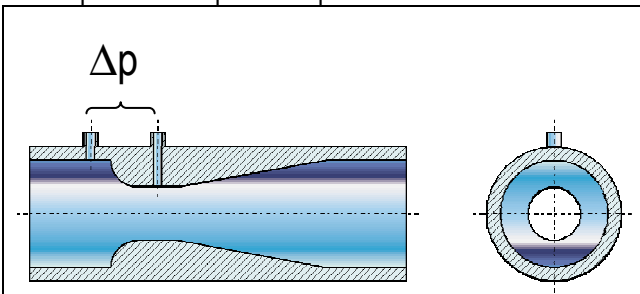
Simple orifice

Quadratic characteristic. Simple construction.



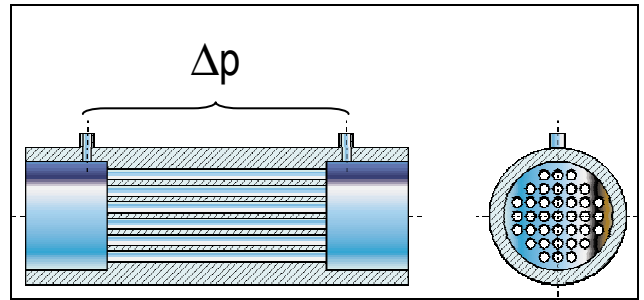
Venturi

Quadratic characteristic. Suitable if easy construction and small pressure drops are required.



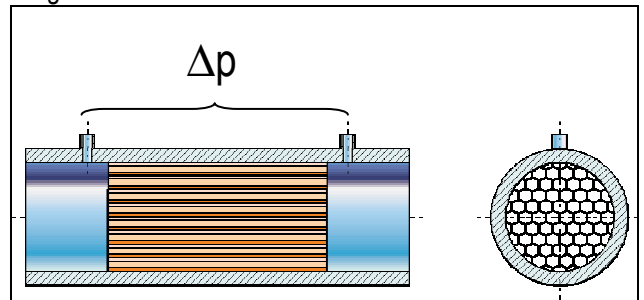
Bundle of tubes

Characteristic has linear and quadratic part. Good trade-off between low production costs and high dynamic measurement range. Can be adjusted by changing number of tubes and tube inner diameters.



Honeycomb, laminar flow element

Linear characteristic. Recommended for highest dynamic ranges.



5. Revision history

Date	Version	Author	Changes
November 2010	v1.0	PHU/PHA	Release

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