

Application Note for SDP600 Series Differential Pressure Sensor Selection Guide

Summary

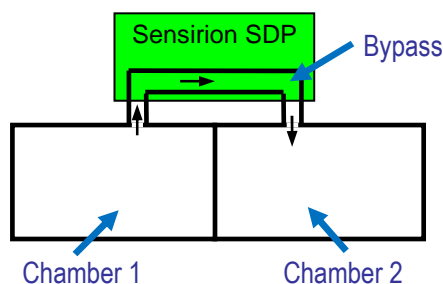
Specific applications demand for specific sensor solutions. Depending on the measurement set-up, Sensirion's thermal flow-through differential pressure sensors behave differently and offer considerable advantages compared to

common diaphragm type sensors. This application note explains how to select the appropriate SDP600 series differential pressure sensor for a specific application.

1. Typical measurement configurations

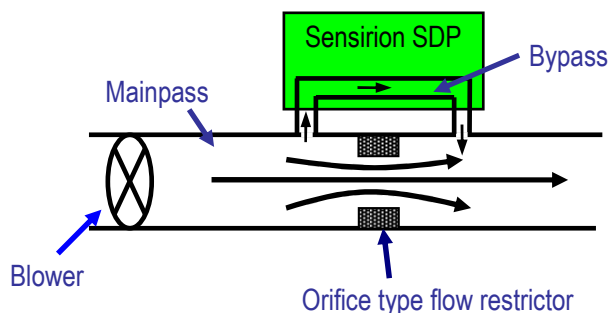
1.1. Differential pressure measurement

In some applications the *differential pressure* between two chambers (or rooms) is measured. The measurement is commonly expressed in the SI unit "Pascal" or in "inch of water column".



1.2. Flow measurement

In other applications the differential pressure is measured in a bypass over an orifice in order to derive the *air flow* in the mainpass. The air flow can either be measured in *standard volume flow*, *mass flow* or as *actual volume flow*.



1.2.1. Actual volume flow

Actual volume flow refers to the gas volume per time. The most common units are "liters per minute [l/min]" or "actual cubic feet per minute [acfm]".

1.2.2. Standard volume flow

Standard volume flow refers to the volume flow at given standard conditions for temperature and pressure. Common units are "standard liters per minute [SLM]", "standard cubic centimeters per minute [sccm]" or "norm liters per minute [ln/min]".

Because standard volume flow is referenced to a defined temperature T and pressure p , the number of molecules n in the volume V can be calculated using the ideal gas law ($pV=nkT$).

Or in other words, standard volume flow refers to the number of molecules per time and therefore to the mass per time. For a given gas, a sensor measuring standard volume flow is a mass flow sensor.

In many applications the mass flow or standard volume flow needs to be known instead of the actual volume flow. For example the amount of oxygen molecules delivered to a patient or ventilated into a room is more important than the actual air volume flow. Also in heating applications the calorimetric heating value, i.e. the number of gas molecules, is more important than the actual gas volume flow.

Because of its thermal measurement principle Sensirion's SDP600 series is ideally suited to measure mass flow.

Measuring dp or flow with SDP600 series sensors

The output signal of all SDP600 series sensor versions can easily be converted into the desired unit of measure. Depending on which physical quantity (differential pressure, standard or actual volume flow) is finally needed, either SDP600/SDP610 or SDP601/611 models are suggested. The SDP6x1 series are ideally suited for air flow measurements, while the SDP6x0 series are perfectly suited for differential pressure measurement applications.

In summary (refer to table 1):

- SDP600/SDP610 is suggested, if differential pressure is the final value needed.
- SDP601/611 is suggested, if the sensor output shall be converted to standard or actual volume flow.

Measure dp or flow?	Measure dp	Measure air flow
Which output needed?	Differential pressure	flow
Proposed product	SDP600/SDP610	SDP601/SDP611

Table 1 Sensor selection guide

2. Compensation formulas

The flow restrictor used in a mainpass/bypass configuration usually has a specific dp vs. flow characteristic $F(dp_{sensor})$, which needs to be measured once in order to establish the dp versus flow relationship of the complete sensor/mainpass system.

Measure dp or flow?	Measure dp	Measure air flow	Measure air flow
Which output needed?	Differential pressure	Standard volume flow	Actual volume flow
Proposed product	SDP600/SDP610	SDP601/SDP611	SDP601/SDP611
Temperature compensation necessary?	No (sensor features automatic internal temperature compensation)	No (sensor features automatic internal temperature compensation)	No (sensor features automatic internal temperature compensation)
Pressure compensation necessary?	Yes	No	Yes
Compensation formula	$dp_{eff} = dp_{sensor} \times \frac{966\text{mbar}}{P_{actual}}$ <p>dp_{eff} real dp in Pascal [Pa] dp_{sensor} sensor output in Pascal [Pa] P_{actual} actual system pressure in Pascal [Pa]</p>	<p>No compensation needed.</p> $Q_s = F(dp_{sensor})$ <p>Q_s Actual standard vol. flow $F(dp)$ Flow_{in mainpass} vs. dp_{sensor}</p>	$Q = F(dp_{sensor}) \cdot \frac{\rho_{char}}{\rho_{actual}}$ <p>Q Actual volume flow $F(dp)$ Flow_{in mainpass} vs. dp_{sensor} ρ_{char} density of air at characterization conditions ρ_{actual} actual density of air in system</p> <p>Note: air density can be derived from known absolute pressure and temperature</p>

Table 2 Sensor selection guide including compensation formulas

3. Comparison with diaphragm-type differential pressure sensors

The measurement principle of the Sensirion differential pressure sensors is different to most other sensors available on the market. While common diaphragm-type sensors use the mechanical deformation of a membrane to measure the pressure difference, Sensirion's SDP series sensors thermally measure a small air flow passing through the sensor.

This thermal measurement principle offers a number of advantages. Sensirion SDP series sensors feature high repeatability and a 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.

However, different measurement principles ask for different compensation. To help selecting the best sensor solution for a specific application, the following table shows the needed compensation with standard diaphragm-type differential pressure sensors.

Measure dp or flow?	Measure dp	Measure air flow	Measure air flow
Which output needed?	Differential pressure	Standard volume flow	Actual volume flow
Temperature compensation necessary?	Yes (if the sensor features no internal compensation)	Yes (for the temperature dependence of the sensor AND for the temperature dependence of the dp/flow characteristics)	Yes (for the temperature dependence of the sensor AND for the temperature dependence of the dp/flow characteristic)
Pressure compensation necessary?	No	Yes	Yes (if the flow restrictor has a non-linear characteristic) No (if the flow restrictor has a pure linear characteristic)

Table 3 Compensation needed with standard diaphragm-type differential pressure sensors

Revision history

Date	Version	Author	Changes
November 2010	V1.0	PHA/PHU/SAW	Initial release

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