Burst and Overpressure Specifications Explained

For Sensirion Differential Pressure Sensors

Introduction

Sensirion's Differential Pressure sensors are most commonly used for measuring air-flow in a bypass configuration over a pressure drop element or orifice. In applications at ambient atmospheric pressure, the sensor is operating well within the overpressure specifications.

There are also applications where the flow needs to be measured at much higher pressures than normal ambient atmospheric pressures, or where the sensors are used in applications where the differential pressure between two spaces is measured and sometimes pressure peaks can occur. In those applications it is important to understand the overpressure specifications.

1 Sensor Working Principle

To understand the overpressure and burst pressure specifications, it is important to first look at the working principle of Sensirion's Differential Pressure Sensors (SDP). The SDP works with a so-called dynamic or thermal flow through principle. This means that the differential pressure is measured by letting a small air flow go through the sensor. This air flow is heated by a very small heater on the sensor chip. Two temperature sensors on both sides of the heater measure a differential temperature, depending on the amount and direction of the differential pressure. This differential temperature is then translated to a linearized and temperature compensated differential pressure.

I.e., the SDP has a small leak between the pressure ports. This is different from a membrane sensor, which is leak tight between the ports.

2 Definitions of Specifications

2.1 Maximum Overpressure

The maximum overpressure of an SDP sensor is specified in the datasheet. The maximum overpressure defines the maximum allowable pressure difference between each port and the outside of the housing. A differential pressure below this maximum overpressure will not damage the sensor.

If differential pressure is measured at an absolute pressure below or beyond ambient atmospheric pressure, it might require a pressure compensation. Mass flow measurement in a bypass system does not need an additional pressure compensation. See the "SDP selection guide" for more information.

Sudden increases or decreases of absolute pressure might also result in dynamic effects on the sensor signal.

2.2 Burst Pressure

Above the burst pressure, the sensor can burst open and start to leak significantly and will be irreversibly damaged.

Between the maximum overpressure and the burst pressure the sensor might drift and small leaks can occur.

2.3 Common Mode Pressure

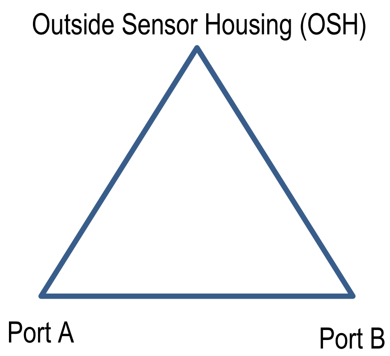
A common mode pressure is often specifically defined for membrane sensors, but is not relevant for thermal flow through sensors. The maximum overpressure specification covers this for the SDP sensors.

2.4 Comparison Membrane and Thermal Flow-Through Technology

	Membrane		SDP	
Use case	Mechanical effect	Effect on application	Mechanical effect	Effect on application
Pressure below allowable overpressure	None	Sensor is gas tight	None	Sensor operates within specifications
Pressure exceeds allowable overpressure	Membrane is deforming	Sensor drifts irreversible but is gas tight	Stress on package	Sensor can drift irreversible, small leaks between ports and ambient might occur
Pressure exceeds burst pressure	Membrane or sensor housing bursts	Sensor is not air tight anymore	Cap comes off or sensor element bursts.	Sensor is damaged irreversible and leaks significantly

2.5 Visual Representation of Burst and Overpressure Specification

The specifications for the burst and overpressure can be visualized by a triangle.



In this triangle, the differential pressure on any leg (i.e., A-OSH, B-OSH, A-B) must not exceed the overpressure or burst pressure defined in the product datasheet.

3 Examples

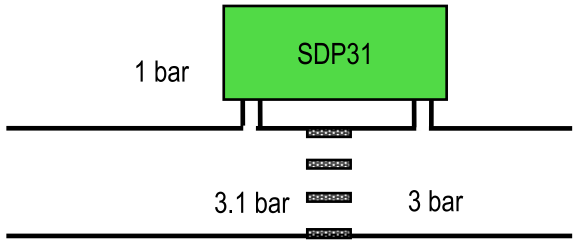
Two different implementations for the same use-case will be shown. The first implementation is out of specifications, the second is within specifications.

3.1 Example 1: Implementation Outside Specifications

In this example the SDP31 is placed over a pressure drop element in a flow channel where there is an absolute pressure of 3.1 bar on one port, and 3 bar on the other port. The sensor itself is placed in ambient, where the absolute pressure is 1 bar.

The specifications for the SDP31 are the following:

- Allowable overpressure: 1 bar
- Burst pressure 3 bar
- Maximum measurement range 500Pa



When we analyze the system, we see the following:

- The absolute pressure of port A minus port B results in 3.1 bar – 3 bar equals 10kPa. This is out of range of the sensor, which will bring the sensor in saturation. The sensor will output 546.1Pa.
  The 10kPa difference between sensor port A and B is smaller than the allowable over pressure, so this will not damage the sensor.
- The absolute pressure of port A minus the absolute pressure outside the housing results in 3.1 bar – 1 bar, which is 2.1 bar. This pressure difference exceeds the allowable overpressure by 1.1bar. However, the burst pressure of 3 bar is not exceeded.
- The absolute pressure of port B minus the absolute pressure outside the housing results in 3 bar – 1 bar, which is 2 bar. This pressure difference exceeds the allowable overpressure by 1 bar. However, the burst pressure of 3 bar is not exceeded.

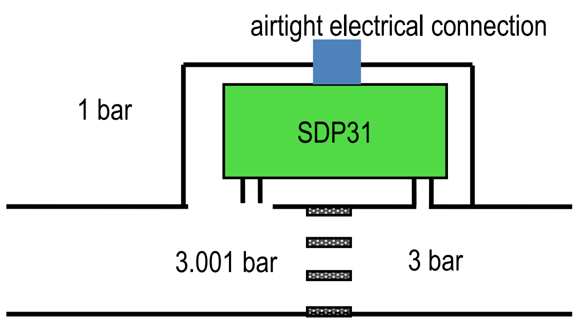
Conclusion: the implementation of the SDP3x needs to change. The overpressure specification is exceeded by the pressure difference between the ports and the outside housing. The burst pressure is not exceeded.

3.2 Example 2: Implementation Inside Specifications

In this example the SDP31 is placed over a pressure drop element in a flow channel where there is an absolute pressure of 3.001 bar on one port, and 3 bar on the other port. The difference in this example is that the sensor is not in ambient, but is airtight encapsulated and pneumatically connected with the flow channel.

The specifications for the SDP31 are the following:

- Allowable overpressure: 1 bar
- Burst pressure 3 bar
- Maximum measurement range 500Pa



When we analyze the system, we see the following:

- The absolute pressure of port A minus port B results in 3.001 bar – 3 bar equals 100Pa. Assuming a gas temperature of 25 °C the sensor will output: 310.6Pa. See the "SDP selection guide" for more details.
  The 100Pa difference between sensor port A and B is much smaller than the allowable over pressure, so this is no problem.
- The absolute pressure of port A and the outside of the housing results is both 3.001 bar. This means that the differential pressure between those is zero, and thus does not exceed the allowable over pressure and burst pressure.
- The absolute pressure of port B minus the absolute pressure outside the housing results in 3.001 bar – 3 bar, which is 0.001bar. This pressure difference is much smaller than the allowable overpressure by 1 bar. The burst pressure of 3 bar is also not exceeded.

Conclusion: This is a good implementation of the SDP3x. Both the overpressure and burst pressure specifications are met.

Revision history

Date	Version	Author	Changes
Dec 2018	V0.1	ANB	First version
Jan 2019	V0.2	ANB	Minor changes after review