Application Note

Achieving High Accuracy for High Static Differential Pressure Measurements

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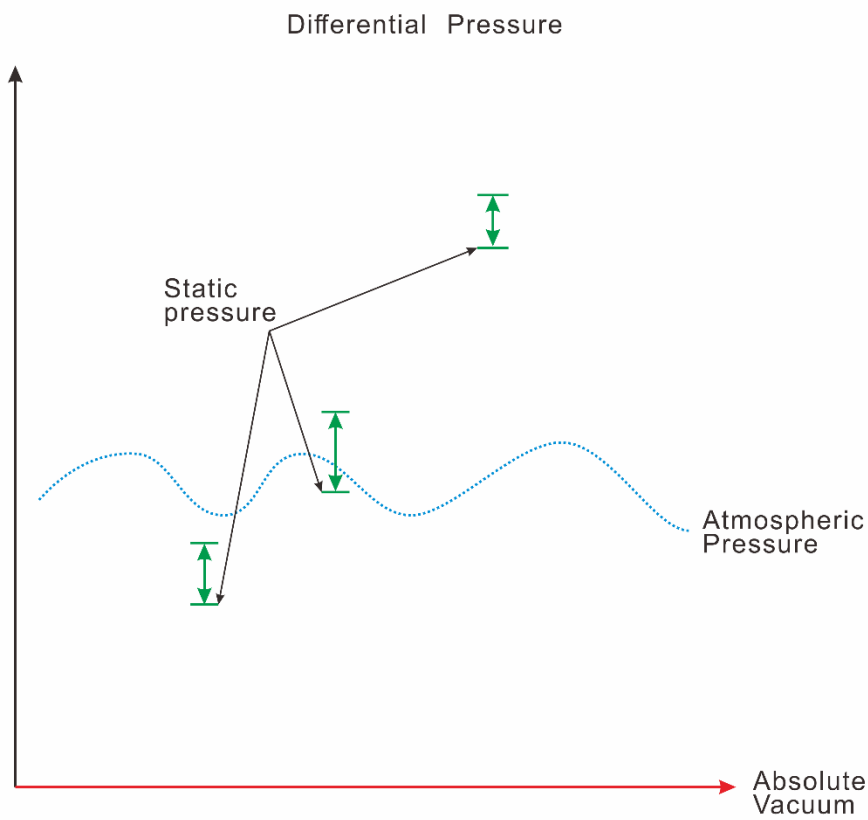
This application note describes the instrumentation and method used to achieve high accuracy differential pressure measurements at high static pressures.

Differential Pressure Measurement

Differential pressure measurement provides a comparative measurement between two points of a system. Differential pressure (DP) sensors typically utilize a single diaphragm design where the two pressures are applied to opposite sides of the diaphragm. Unlike gauge pressure, differential pressure is independent of atmosphere pressure. Highly accurate DP sensors have sensitive measuring capability to determine the deflection of the diaphragm converting it to positive or negative pressure depending on the diaphragm's common state.

Differential pressure can also be determined by measuring two independent sensors and calculating the difference between each sensor. Where possible, each sensor should be of similar construction and range to provide a meaningful measurement. Uncertainties for each sensor need to be considered when calculating the accuracy of this type of measurement.



What is static pressure?

Static pressure typically refers to the common pressure that both the high line and low line pressures experience. For example, on one side of an orifice the pressure may be 50 psi and the other side of the orifice may be 60 psi. The static pressure is 50 psi.

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Method to Achieve 0.002%FS Accuracy at High Static Pressure

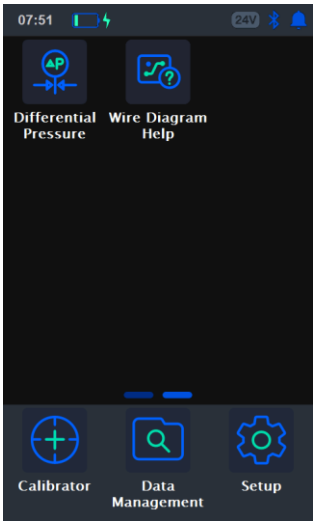
Precision DP measurements are often difficult to achieve at high static pressures. The following method is used to obtain 0.002% full span or 0.0003 psi (whichever is greater) accuracy when making a DP measurement at or above 15 psi (1 bar). A few assumptions should be noted to understand how we can claim such an accurate measurement.

Assumptions

1. Static measurement will be made at or above 15 psi (1 bar) to achieve 0.002%FS or 0.0003 psi, whichever is greater. (Note: when used below 15 psi (1 bar) the accuracy will be 0.0003 psi).
2. Static measurement will be made measuring the difference of two sensors with same range, accuracy and construction.
3. The two sensors used will have very small zero drift and excellent short-term stability. The Additel 161 series pressure modules meet these criteria.
4. The prescribed method is followed.

Recommended equipment

1. Additel 227, 226 or Additel pressure readout device that includes Additel's differential pressure application.
2. Two Additel 161 Intelligent Digital Pressure Modules (ADT161 series) with and an accuracy of 0.02% FS and similar pressure range. Ideally, they would be the same pressure range.
3. Additel 129 Differential Pressure Manifold (ADT129) (This is not required but very convenient when doing the DP pressure zero at the static pressure).



Additel 227 Menu Screenshot

The Method

Have both ADT161 sensors connected to the Additel readout device and select the differential pressure application in the home menu. Connect the Additel 129 Differential Pressure Manifold to the high line and low line (static pressure) port of the system to be measured. Ensure the ADT161 sensors are connected the differential pressure manifold.

Additel 227 *Additel 129 Manifold & ADT161 Modules*

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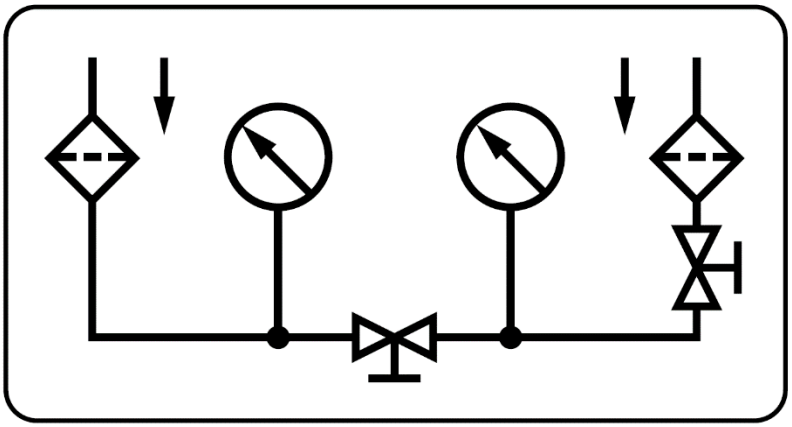
Using the ADT129, close off the high-pressure port valve on the right side of the manifold. Open the main valve on the front of the ADT129. Now Both ADT161 sensors are seeing the low line or static pressure. Then zero the differential pressure measurement. After the zero is complete, close the main valve on the front of the ADT129 to isolate the low-pressure port from the high-pressure port. Next, open the high-pressure port valve of the ADT129. Now the static pressure is exposed to one sensor and the high line pressure is exposed to another sensor. And the Additel pressure readout is displaying the difference between the two.

Accuracy calculation



Employing this method and using the Additel equipment is necessary to achieve the accuracy of 0.002%FS or 0.0003 psi, whichever is greater. In a normal measurement, one would be required to consider combining the full accuracy of each ADT161 sensor. The full accuracy includes calibration uncertainty, hysteresis, linearity, long-term drift and short-term stability. Because we are using the same sensors (range and construction) and we perform the DP zero at the static pressure, we only need to consider the sensor short term stability. The nature of the differential measurement will cancel out a lot of the contribution from calibration uncertainty. Long-term drift is not a contributor because the method requires that the measurement is made right after the DP zeroing at the static pressure. As the pressure sensors are not being exposed to a wide pressure range, hysteresis and linearity are not contributors to the measurement uncertainty.

To apply the calculation to a measurement, the accuracy of 0.002% should be applied to the full span of the ADT161. For example, when using two ADT161-02-GP500 (0-500 psi range) sensors, the differential accuracy after zeroing at the static pressure is 0.01 psi (500 x 0.002%=0.01 psi).

We hope you found this application note to be helpful. For more information, please contact us at (PH: 1-714-998-6899, Email: sales@additel.com) or visit us on the web at www.additel.com