LOW REFERENCE PRESSURE DISCIPLINE

By

L R Harris
Scanivalve Corp
Abstract

Low pressure measurements from inches H₂O to 15 psig are a large segment of the pressure measuring market. It is, unfortunately, very difficult to make accurate pressure measurements without taking barometric pressure into consideration. This paper discusses some problems and solutions in taking these differential/gauge measurements.

Introduction

Differential pressure measurements determine the pressure differential between 2 pressures. The sense, or positive, side of the sensor is connected to one pressure and the reference, or negative, side of the sensor is connected to the other pressure. Typically:

1) Both inputs are elevated above atmospheric pressure such as pressures across an orifice plate, or pressures referenced to a “line” pressure. Pressure sensors used for this measurement must have connections on both sides of the sensor. They are referred to as “differential” transducers.

2) One input is greater than, or less than ambient pressure, and the other input is open to ambient pressure. Pressure sensors used for this measurement may or may not have a connection on the low, or negative side of the sensor. These sensors are referred to as “gauge” transducers. A differential transducer may also be used for this measurement. Errors can occur in these measurements or during calibration if the reference (ambient) pressure is not stable.

This technical paper will deal with case 2 above.

Considerations

Differential pressure sensors have a simple linear equation. When the low side of the pressure sensor is open to the atmosphere, the equation is \[ \Delta P = P_1 - P_2 \]

P1 is the unknown pressure to be measured.

P2 is the atmospheric (barometric) pressure.

Barometric pressure is not constant. It is a function of atmospheric conditions. Normal Barometric pressure will change in the course of a day. Normally these changes occur very slowly. However, Barometric pressure inside a facility can change quickly when an HVAC system cycles on or off, when a door opens or closes, or a fan turns on or off.

Barometric pressure has a negligible effect on high pressure differential measurements, but has a large effect on low pressure differential measurements. The examples below illustrate this effect on measurement accuracy for both low and high pressure measurements.

Example 1—Low Pressure measurement of 0.5 psid (13.842 inches H₂O/1.27 cm H₂O)

\[ \Delta P = P_1 - P_2 \quad P_1 = 13.842 \text{ inches H}_2\text{O measurement} \quad P_2 = \text{zero (barometric pressure)} \]
DeltaP= 13.842 inches H₂O – 0 = 13.842 inches H₂O

If the barometric pressure in the room were to change by 2 inch H₂O when the HVAC system cycles on, the differential measurement the user would see is:

DeltaP = 13.842 inches H₂O – 2 inches H₂O = 11.842 inches H₂O which is a 14% error in the measurement.

When the HVAC system cycles off, the value of DeltaP would return to 13.842 inches H₂O.

Example 2 – High pressure measurement of 100 psid

DeltaP = P₁ – P₂  P₁ equals 100 psi  P₂ = zero (baseline baro)

DeltaP = 100 psi – 0 = 100 psid

If the barometric pressure in the room were to change by 2 inches H₂O when the HVAC system cycles on, the measurement the user would see is:

DeltaP = 100 psi – 2 inches H₂O (0.072 psid) = 99.928 psid which is an error of .07% in the measurement.

As you can see from these examples, the barometric line pressure changes for low pressure sensors are more critical than it is for higher pressures by a factor of 200 times. So for this paper, we will be working with low pressure measurements of 15 psid and less.

Solution

The solution for good accurate low pressure measurements is to take control of the reference side of the pressure sensor or pressure scanner. There are several things the user can do to control and minimize Barometric changes. The first thing is to place the pressure scanner or pressure transducer in a pneumatically benign location that is not near a fan, room doors, or air conditioning systems.

When this is not possible, the next choice would be to run a tube from the common reference port on the pressure sensor and route this tubing to a pneumatically benign location.

This is not always practical. A good solution would be to connect the reference input to a static basket, or static bottle, to minimize the potential for measurement errors.
**Pressure Static Bottle**

A simple method that can be assembled as shown in Scanivalve drawing 81263-1 (Figure 1) would be using a 3 inch ABS pipe with caps on both ends. Fill the tube with over the counter fiberglass batting, steel wool or equivalent non-corrosive expanded mesh. One end of the static bottle cap should have a .020 inch diameter hole as a vent. The opposite end cap should have a 1/8 inch pipe thread tapped hole to receive a compression fitting. This bottle should be mounted somewhere accessible to the reference side of the pressure sensor, or pressure scanner. The end result is a quiet barometric immune to small changes in the room ambient.

![Figure 1 – Pressure Static Bottle](image.png)
Pressure Static Basket

For larger facilities where many pressure measurements are made and multiple static lines may be used, a static basket may be the preferred choice. Scanivalve Corp offers a pressure static basket, Scanivalve part number 80893 (Figure 2). A drawing may be found on our website at http://www.scanivalve.com/pdf/prod_80893-1staticbasket.pdf

Figure 2 – Pressure Static Basket
Conclusions

Good static discipline is essential for accurate low pressure measurements. This is also true during calibration of differential pressure scanners. The static bottle, or static basket, provides a stable ambient reference pressure that is immune to pressure changes due to HVAC systems, people movement, and doors opening and closing.

It is important to consider static reference discipline on all pressure measurements, but it is critical for pressures 15 psi and below.