INTRODUCTION

Most people are typically accustomed to dealing in gage pressure, that is, pressure relative to the normal atmospheric pressure which surrounds us. As such. “absolute” pressure and absolute pressure sensor which measure pressure relative to a perfect can be somewhat confusing Also, because zero absolute pressure (a perfect vacuum) is impossible to achieve, it is much harder to measure and calibrate absolute pressure sensors. This application will discuss what absolute pressure is, how it is best measured and how to calibrate absolute pressure sensors. .

DIFFERNTIAL (GAGE) PRESSURE

It is often easier to understand absolute pressure if we have a clear understanding of differential and gage pressure which we are generally more familiar with.

Differential pressure is the pressure difference measured between two pressure sources. This is usually expressed in pounds per inch differentia; (psid). When one source is the ambient pressure, this is then called gage or relative pressure and is typically expressed in pounds per square inch gage (psig). Therefore, gage pressure is simpler a special case of differential pressure with pressures measured differentially but always relative to the local ambient pressure. In the same respect, absolute pressure can be considered a differential where the measured pressure is compared to a vacuum.

ABSOLTUE PRESSURE

Absolute pressure sensors are most commonly used to measured changes in barometric pressure or as altimeters. The application requires reference to a fixed pressure as they cannot be simply referenced to the surrounding ambient pressure.

Absolute pressure is defined as the pressure measured relative to a perfect vacuum. For example, 10lbs per square inch absolute pressure (psia) would be 10psi above a perfect vacuum. This is roughly 4.7psia below the standard atmospheric pressure at sea level of 14.7pisa. 0 psia is then the pressure of a perfect vacuum.**

AV Sensors, Advanced absolute pressure sensors are made by hermetically sealing a vacuum reference chamber on one side of the etch silicon sensing element. (See Figure 1). Pressures to be measured are then measured relative to this vacuum reference. The actual “vacuum” which is sealed into the sensor is approximately 0.0005 psia (25millitor). Using this near vacuum as a reference eliminates any potential thermal errors which would occur if any gas was trapped in the reference chamber as it would exert pressure during expansion and contraction in temperature in accordance with Boyle’s law. One of the advantages of silicon sensing elements is the small volume of trapped vacuum reference which, in conjunction, with a reliable silicon to silicon hermetic sea, makes these devices time and temperature stable.

**The unit, pounds per square inch (psi) is used as the unit fo pressure measurement. This unit is arbitrary and other common pressure units such as mmHg, kpa, mbar can be used.

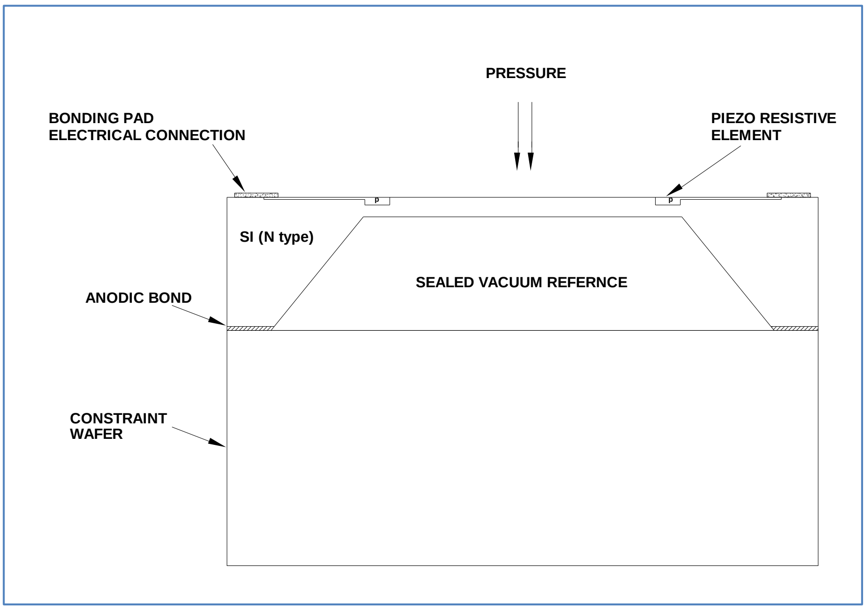

Figure 1

Cross Sectional View of Sensing Element

CALIBRATING ABSOLTUE PRESSURE

To use any sensor in an absolute application, we must be able to accurately calibrate the device for offset and span. This requires understanding offset and span in terms of absolute pressure.

OFFSET VOLTAGE

The Offset voltage is defined as the sensors output at zero differential pressure. For gage sensors, this the output with ambient pressure (0psig) applied to the sensor. As such, offset voltages are relatively easy to measure for gage sensors. However, for an absolute device, the offset voltage is the output voltage of the sensor with a perfect vacuum (0 psia) applied to the sensor. This means that with normal atmospheric pressures applied to the absolute sensors, there will be an output voltage which corresponds to approximately +14.7 psia at sea level.

Because a perfect vacuum is impossible or at least impractical to obtain, measuring the actual offset voltage for absolute sensors is not possible. At AV Sensors, we draw a vacuum to 0.25psia and then in combination with the output at full scale, use a straight line approximation to calculate the 0psia output or offset voltage. This same technique can be applied using any pressure points provided the sensor is perfect linear. The on-linearity induced will vary depending on the pressure point used but can easily be limited to less than 0.1% if the 10% full scale output (FSO) and 90% FSO reference points are used for the straight line approximation of 0Psia.

SPAN VOLTAGE

Span is defined as the full scale output (FS)) voltage minus the offset voltage. For example, if at 15 pisa an output of 101mV was obtained and at 0pisa the offset voltage was 1mv, the span would be 100mV (101mV (FSO) – 1mV (Offset) = 100mV full scale span. It is important to note that for an absolute sensor, span is also defined relative to a perfect vacuum.

Measuring the span of absolute sensors has similar problems associated with as those of measuring the offset voltage and would require a calibrated perfect vacuum source as preference. When calibrating the span or offset, the absolute pressure reference point most often used in atmospheric pressure. An accurate reading of atmospheric pressure can be obtained by checking local airport website. Any other available pressure reference within the sensors range can then be used as the second pressure point to allow accurate calibration of span off offset. he offset voltage and the related offset temperature errors can be critical error parameters for some applications. However since the method of excitation, constant current or constant voltage, will not significantly impact these parameters, they will not be covered in this discussion.