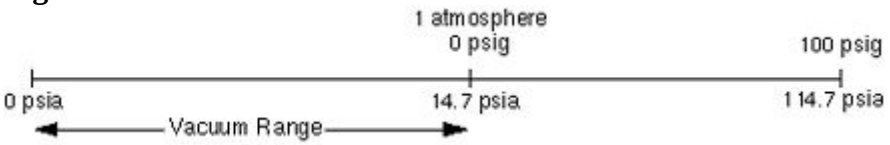
Vacuum Measurements

The term vacuum is often misunderstood and consequently misapplied when discussing pressure measurements and choosing pressure transducers. By definition vacuum is a space that is partially exhausted (as to the highest degree possible) by artificial means (as an air pump). This definition is referring to a high or hard vacuum. Figure 1 illustrates that relationship of absolute and gage pressure with 0 psia equal to a high or hard vacuum.

Figure 1:



Remember, **gage pressure** is pressure measured relative to ambient atmospheric pressure (approximately 14.7 psia). It is referred to as pounds per square inch (gage) or psig. The electrical output of a gage pressure transducer is 0 VDC at 0 psig (14.7 psia) and full scale output (typically 5 VDC) at full scale pressure (in psig).

Absolute pressure is measured relative to high vacuum (0 psia). It is referred to as pounds per square inch (absolute) or psia. The electrical output of an absolute pressure transducer is 0 VDC at 0 psia and full scale output (typically 5 VDC) at full scale pressure (in psia).

As you can see vacuum can refer to any pressure between 0 psia and 14.7 psia and consequently must be further defined. For applications concerned with measuring vacuum pressures over this full range two different approaches are often taken. Figure 2 illustrates the relationship of absolute and vacuum pressures.

Figure 2:

Vacuum pressure is measured relative to ambient atmospheric pressure. It is referred to as pounds per square inch (vacuum) or psiv. The electrical output of a vacuum pressure transducer is 0 VDC at 0 psiv (14.7 psia) and full scale output (typically 5 VDC) at full scale vacuum, 14.7 (0 psia).

The vacuum pressure transducer gives an increased positive voltage output proportional to decreasing pressure (increasing vacuum). The absolute pressure transducer gives an increased positive voltage output proportional to increasing pressure (decreasing vacuum).

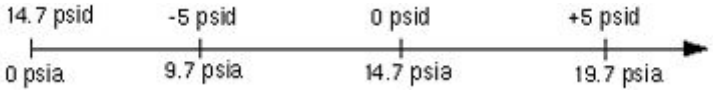
Example: Vacuum Transducer

Range: 0 to 14.7 psiv
Output: 0 to 5 VDC

Absolute Transducer
Range: 0 to 14.7 psia
Output: 0 to 5 VDC

Vacuum also is often referred to as negative pressure (or soft vacuum). This occurs when the application requires monitoring both decreases in pressure below atmospheric pressure and increases in pressure above atmospheric bidirectional differential pressure.

Figure 3:



Here differential pressure is pressure measured relative to a reference pressure. It is referred to as pounds per square inch (differential) or psid. If the reference pressure is one atmosphere the differential pressure range is equal to gage pressure range. The electrical output of a bidirectional differential pressure transducer is typically 0 VDC at one atmosphere with increased positive voltage output proportional to increased positive pressure and increased negative voltage output proportional to increased negative pressure.

Example: Bidirectional differential pressure transducer

Range: 0 to ±5 psid
Output: 0 to ±2.4 VDC

Bidirectional differential pressure transducers are used for soft or low vacuum measurements (typically greater than 5 psia) while low absolute pressure transducers are used for hard or high vacuum measurements (typically less than 5 psia).

Figure 4 illustrate soft and hard vacuums.

Figure 4: