WHAT IS VACUUM?

The earth's atmosphere exerts a pressure upon us, known as the atmospheric pressure, which can be measured in a number of ways. At sea level, the standard pressure is 14.7 psia or 29.92" of mercury (Hg) or 760 mm of mercury (Torr). Because the barometric pressure varies, the above "sea level" pressures are used as a reference point.

There is 14.7 psia pressure being exerted on us by the atmosphere, but there is also 14.7 psia inside of us pushing out, given the fact to that for every action there is an equal but opposite reaction. Thus, we do not feel discomfort from the atmospheric pressure. Another way to state this is that there is no differential pressure between the inside and outside of our bodies.

To use an example of a vacuum application such as CNC wood routers, the work piece, i.e., the sheet of wood, lies on a CNC router table with the atmospheric pressure of 14.7 psia pushing down and an equal pressure of 14.7 psia pushing upward. The vacuum pump removes some of the atmospheric pressure from under the work piece, reducing the 14.7 psia pressure that existed. This reduction of the pressure from under the board creates a differential pressure with the greatest pressure above the board, pushing it downward, holding the work piece in place, therefore, (in retrospect), vacuum does not hold the work piece in place, but reduces the pressure under the work piece, allowing atmospheric pressure to hold the work piece in place.

The term "vacuum" is used to describe the zone of pressure below atmospheric pressure. Vacuum is a negative gauge pressure, usually referenced to the existing standard barometric pressure where the equipment will operate. This means vacuum is a differential reading between the surrounding atmospheric pressure and the pressure in the system evacuated. In all instances when given a vacuum condition, the question should be asked, at what elevation the pump will operate, since the barometric pressure varies with altitude above or below sea level.

In the U.S., the common standard to measure rough vacuum is inches of mercury ("Hg), which can be measured in two different ways. One method is as "Hg gauge ("HgV), where the scale starts at 0" Hg (atmospheric pressure) and goes up to 29.92" Hg, which is perfect vacuum. The other way is to measure in "Hg absolute ("HgA), which is a gauge with a reversed scale. In this case, the scale on the gauge reads 29.92" Hg at atmospheric pressure and 0" Hg would be perfect vacuum. Please note that a perfect vacuum is not possible on earth, no matter which vacuum pump is used.

To show the relationship between "Hg gauge and "Hg absolute, we can use the following example: 26" Hg gauge at sea level would be 29.92 - 26 = 3.92" Hg absolute. Because of the two different ways of measurement, the customer should be asked if they mean "gauge" or "absolute". It is important to know which scale is used because the wrong assumption can mean a large error.

When we operate in the higher vacuum range (low absolute pressure), it is more common to measure in Torr. 1 Torr is equal to 1 mm Hg and is always an absolute pressure.

There are 25.4 mm to one inch, which calculates the barometric pressure as 29.92 X 25.4 = 760 Torr. An absolute pressure gauge reading in torr reads 760 Torr at atmospheric pressure, which is zero vacuum and would read 0 Torr at perfect vacuum.

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