Application Note: Remote Pressure Sensor and Valve

The Problem

When using test instruments with automated machines, it is often necessary to place the tester as close as possible to the test head or to run pressure tubing to the measuring instrument.

Running pipe or tubing to the measuring instrument causes increased air volume which, in turn, lengthens the test cycle and reduces sensitivity.

An automated process typically cannot tolerate long test cycles, nor lower sensitivity caused by long lengths of pipe or tubing used to connect the measuring instrument.

The Solution

To eliminate problems caused by connecting test instruments far from the product, Uson recommends mounting a remote sensor close to the test head.

Because remote pressure sensors are mounted near test points, internal test volumes remain small and thus response time is very rapid: exactly what automated processes demand.

A remote valve traps air between the product under test and the remote sensor. The remote sensor returns its signals to the tester over wires, which can be shielded inside cable or metal conduit.

How It Works

A leak tester with remote valve and sensor works like this:

- Product is loaded into the test head (nest) on the automated machine and the test is started. (Figure 1)
- The part is pressurized through the remote valve **V1**.
- Trapped air inside the product under test and the test circuit is measured by the tester's remote pressure sensor **S**.
- If product exceeds the programmed leak tolerance (pressure drop over time), the tester sends a fail signal to the automated controller.
- At the end of test time, pressure can be vented to atmosphere through an optional dump valve **V2**, and the tester is ready to make the next test.

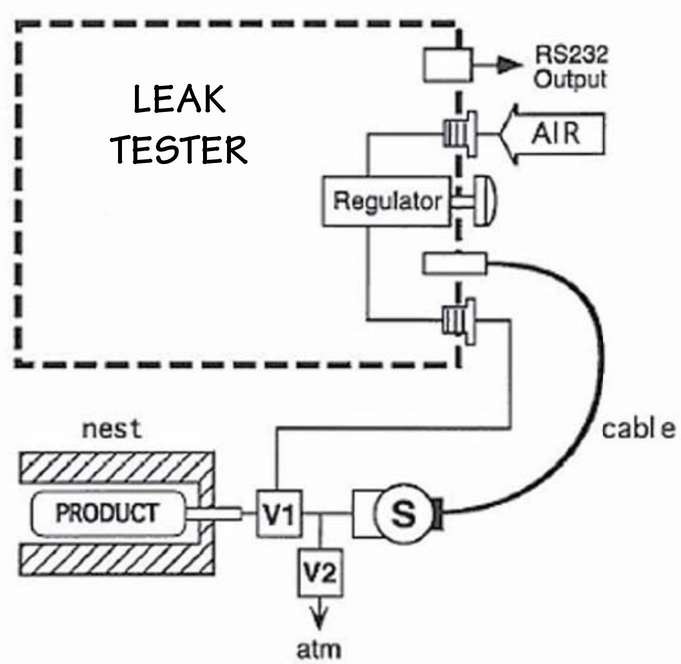

Figure 1
Simplified Test Circuit with Remote Sensor

AN-16 Dec2009

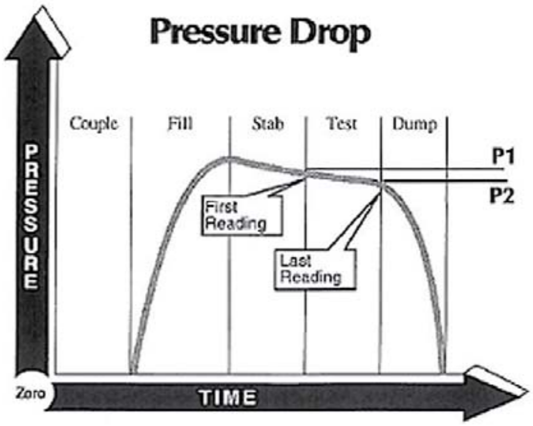

Figure 2
Typical Pressure Decay Test Curve

Pressure Drop Curve

Pressure drop is the amount of pressure change from the first pressure measurement in the test phase (P1), to the last pressure measurement in the test phase (P2). (See Figure 2)

P1 minus P2 = Pressure Change (ΔP)

The pressure change (ΔP) from first to final reading is the basis for all pressure and vacuum decay testing. The tester will normally show the delta (Δ) pressure number in its main display at the end of a pressure or vacuum decay test.

Leak Rate

To calculate leak rate, the total volume of the product under test and the instrument test circuit must bi included in the formula. The Leak Rate (L.R.) formula below excludes minor variables such as temperature change and part compliance.

$$\text{Leak Rate} = \frac{\text{Volume} \times \Delta P}{P_{atm} \times \text{Time}}$$

Now, we'll put in some typical numbers. The 14.7 psi represents ambient pressure at average sea level.

$$\text{Leak Rate} = \frac{500\text{ cc} \times .02\text{ psi}}{14.7\text{ psi} \times 3\text{ sec}}$$

$$\text{Leak Rate} = .227\text{ sccs}$$

NOTE: When using mass flow, volume is not a variable because the mass flow measurement technique is, in essence, counting molecules.

Test Time vs. Volume

As demonstrated below, the time required for testing decreases in direct proportion to the decrease in volume. In any pressure decay test, as volume goes down, required test time goes down.

$$\text{Time} = \frac{\text{Volume} \times \Delta P}{\text{L.R.} \times P_{atm}}$$

Using the same numbers in the Leak Rate example, we'll calculate the required test time.

$$\text{Time} = \frac{500\text{ cc} \times .02\text{ psi}}{.227\text{ sccs} \times 14.7\text{ psi}}$$

$$\text{Time} = 3\text{ sec.}$$

Now, lets reduce the volume from 500 cubic centimeters to 50 cubic centimeters and find out what happens to the required test time.

$$\text{Time} = \frac{50\text{ cc} \times .02\text{ psi}}{.227\text{ sccs} \times 14.7\text{ psi}}$$

$$\textbf{Time = 0.3 sec.}$$

uson
for good measure

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