PRODUCT INFORMATION

THE EFFECTS OF ADIABATIC HEATING ON PRESSURE MEASUREMENT AND CALIBRATION

How does *adiabatic heating* affect pressure measurement?

Secondary standards, such as digital Indicators, dial gauges and transducers are often used as "master gauges" in calibration applications. To perform the calibration, a pressure source (may be liquid or gas) supplies pressure to both the master instrument and the device under test. Since the "system" (consisting of the pressure source, hoses, master instrument and devices under test) is dead-ended or "closed," the pressure medium is compressed only within the volumetric confines of the system. In this type of application, it is not unusual that users complain of "downward drift," often *mistakenly attributing the cause to a leak in the system,* when in fact the *actual cause is a phenomenon known as "adiabatic heating."*

What is adiabatic heating?

As it pertains to pressure applications, adiabatic heating is the heat that is generated as a fluid (defined as either a liquid or gas) is being compressed during pressurization. As the pressure is being generated, more of the fluid is being forced into a constant volume which forces the molecules closer together. The result is an increase in the fluid's thermal energy *which causes the fluid to expand, thus further increasing the pressure.* When the action to increase pressure has ceased (i.e. when the operator has stopped actuating the pump), the fluid will immediately begin to dissipate the heat that had been generating during pressure-up. Thus, the fluid will begin to contract, and the pressure of the fluid in the system will begin to drop. Eventually, the decreasing pressure will stabilize as the temperature of the fluid equals the room temperature.

This phenomenon is the result of principles of physics, not an unfavorable attribute of any particular pump or pressure measurement instrument. Adiabatic heating will result during both hydraulic and pneumatic pressure generation, but may prove to be especially troublesome in pneumatic applications.

Therefore, it may not be practical to attempt to calibrate ultra-low pneumatic pressures (below 20 In.H_2O) in a simple closed system. More complicated, custom designed systems utilizing dynamic flow or dual closed chambers are necessary to accomplish this. For more information, visit this NASA website:

http://technology.ksc.nasa.gov/WWWaccess/Opport/lowdiff.html