APPARATUS FOR THE CALIBRATION OF GASEOUS LEAKS INTO ATMOSPHERIC PRESSURE

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Abstract

Leak artifacts are used to provide a known, steady flow of gas for the purpose of calibrating leak detection devices such as mass spectrometer-based helium leak detectors. For capillary leak artifacts, the gas flow rate depends on the pressure drop across the capillary and the resulting flow regime (i.e., molecular vs. viscous flow). Therefore, a capillary leak artifact may produce a significantly different flow of gas when it is flowing into a vacuum environment than when it is flowing into atmospheric pressure.

There is a large class of users, including the air-conditioning, refrigeration, and nuclear containment industries, which use mass-spectrometer based leak detectors. These instruments operate at medium vacuum (10^{-3} Pa or 10^{-5} Torr), but the "sniffing" technique permits leak detection in an environment that is nominally at atmospheric pressure (100 kPa or 760 Torr). There are also non-mass spectrometer-based sniffing leak detectors. Very often, sniffing instruments are calibrated using transfer standard leak artifacts whose gas flow rate has been measured into vacuum. The artifact's flow rate into atmospheric pressure is estimated using a simple theoretical model. This estimation can lead to large errors in the calibration of the leak detector.

A system for the calibration of leak artifacts into atmospheric pressure has been developed based on the pressure rate-of-rise technique. Challenges to minimizing the measurement uncertainty, such as temperature regulation and accurate differential pressure measurement with respect to atmospheric pressure, will be discussed along with preliminary results.