Primary Standards Laboratory

Metrology Program

Fact Sheet

Gas Leaks

The Primary Standards Laboratory (PSL) maintains a wide variety of primary vacuum gas leak standards to assure accurate and traceable measurements for its customers.

Capabilities include both fundamental and direct comparison leak measurements for any non-reactive, non-toxic, non-radioactive gas from 2 to 200 atomic mass units (range of mass spectrometers). In addition, the Leak Project will measure temperature coefficients for permeation leaks and measure either open or closed reservoir leaks.

A fundamental leak measurement uses a calibration technique whose measured quantities are units of time, pressure, temperature, and volume. The Leak Project uses two techniques for making fundamental leak rate measurements: The PΔV method and the Accumulate-Dump (AD) method.

Direct comparison measures an unknown artifact relative to a calibrated gas leak standard. Comparisons are made using either a helium leak detector (LD) or a quadrupole residual gas analyzer (RGA).

Major Resources

- Accumulate-dump system uses a VG MM14-80 (14cm, 80° magnetic sector) mass spectrometer, inlet and gas fill system.
- PΔV system uses dual MKS capacitance diaphragm gages (1 torr and 10 torr) and calibrated volumes.
- Leak Compare II system uses Leybold Ultratest F helium leak detector, inlet manifold and temperature chambers.
- Leak Compare-III system designed by the National Institute of Standards and Technology (NIST) uses a quadrupole gas analyzer (Extrel EX-200/C), inlet system, and temperature control chambers.
- A set of Brooks precision bore tubes are used for calibrating volumes from 10 to 4000 cc.

Capabilities

Below is a representative sample of our uncertainties. We are NVLAP accredited under Lab Code 105002-0 by the National Institute of Standards and Technology/National Voluntary Laboratory Accreditation Program (NIST/NVLAP) in most of our capabilities. For full details see http://ts.nist.gov/standards/scopes/1050020.pdf

Gas Leak - PΔV Technique

Range	Best Uncertainty in % (±), k=2	Remarks
$1x10^{-7}$ moles/s	0.7	Total Gas Measurement
$1x10^{-8}$ moles/s	0.9	Total Gas Measurement
$1x10^{-9}$ moles/s	1.0	Total Gas Measurement
$1x10^{-10}$ moles/s	1.0	Total Gas Measurement

Gas Leak - Accumulate-Dump Technique

Range	Best Uncertainty in % (±), k=2	Remarks
$1x10^{-10}$ moles/s - $1x10^{-14}$ moles/s	1.0	1-200 Atomic Mass Units for any non-reactive, non-hazardous, non-radioactive gas

Gas Leak - Comparison Technique

Range	Best Uncertainty in % (±), k=2	Remarks
$1x10^{-10}$ moles/s	2.5	Helium
$1x10^{-11}$ moles/s	2.4	Helium
$1x10^{-12}$ moles/s	2.3	Helium
$1x10^{-13}$ moles/s	2.3	Helium
$1x10^{-14}$ moles/s	7.0	Helium

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Selected Accomplishments

- Developed first primary leak standards in the 1960's in response to demands from Atomic Energy Commission for precision measure ments of leaks in the vacuum flow regime. Pioneered developments in field of leak calibration technology.
- Instrumental in teaming with NIST in the development of the RGA leak comparison calibration method, leading to time-efficient, computer-controlled leak calibrations.
- Participated with NIST and industry in a round-robin leak calibration study.
- Provided technical consultation in the leak rate testing of seals for nuclear waste shipping containers.

Leak Compare II Calibration System

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