



# Primary Standards Laboratory Metrology Program

## Fact Sheet

### Vacuum

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

Transfer vacuum standards consist of capacitance diaphragm gages (CDGs), spinning rotor gages (SRGs) and ionization gages (IGs) with direct traceability to the National Institute of Standards and Technology (NIST).

Primary calibrations are performed using an automated Forced-Balance Piston Gauge to calibrate transducers such as CDGs in differential or absolute mode. Above a base pressure of  $10^{-6}$  Pa ( $10^{-8}$  torr), pressures can be generated with most inert gases. We perform calibrations on this system for pressures ranging from 1 Pa to 1 kPa (0.01 to 1000 torr).

Direct comparison calibrations for SRGs and IGs are made on an automated high-vacuum calibration system in the high-to-intermediate-vacuum regime with NIST-calibrated spinning rotor gages and ionization gages using an orifice flow technique. Pressures are generated above a base of  $10^{-9}$  Pa ( $10^{-11}$  torr), calibrations can be performed with nitrogen for pressures ranging from  $10^{-6}$  to 10 Pa ( $10^{-8}$  to  $10^{-2}$  torr).

Currently under development is a fundamental orifice flow system. The system was designed and built by NIST and is being modified to operate under full computer control.

#### Ionization Gage Reference for direct comparison

Range	Best Uncertainty ( $\pm$ ) %, k=2	Remarks
$1.3 \times 10^{-6}$ Pa < reading $\leq 1.3 \times 10^{-5}$ Pa	4.8	N <sub>2</sub> ; $10^{-8}$ torr range
$1.3 \times 10^{-5}$ Pa < reading $\leq 1.3 \times 10^{-4}$ Pa	4.7	N <sub>2</sub> ; $10^{-7}$ torr range
$1.3 \times 10^{-4}$ Pa < reading $\leq 1.3 \times 10^{-3}$ Pa	4.7 - 2.5	N <sub>2</sub> ; $10^{-6}$ torr range

#### Spinning Rotor Gage Reference for direct comparison

Range	Best Uncertainty ( $\pm$ ) %, k=2	Remarks
$1.3 \times 10^{-4}$ Pa < reading $\leq 1.3 \times 10^{-3}$ Pa	4.3 - 2.1	N <sub>2</sub> ; $10^{-6}$ torr range
$1.3 \times 10^{-3}$ Pa < reading $\leq 1.3$ Pa	2.1	N <sub>2</sub> ; $10^{-5}$ torr to $10^{-3}$ torr range
$1.3$ Pa $\leq$ reading $\leq 13$ Pa	2.2	N <sub>2</sub> ; $10^{-3}$ torr range

#### Capacitance Diaphragm Gages Reference for direct comparison

Range	Best Uncertainty ( $\pm$ ) %, k=2	Remarks
$1.3 \times 10^{-1}$ Pa $\leq$ reading $\leq 13.3$ Pa	2.1 - 0.7%	N <sub>2</sub> ; 0.1 torr range

#### Capacitance Diaphragm Gages Reference using Forced-Balance & Dead Weight Piston Gauges

Range	Best Uncertainty ( $\pm$ ) %, k=2	Remarks
$0.3$ Pa $\leq$ reading $\leq 6.0$ Pa	30 ppm + 0.025 Pa	N <sub>2</sub> ; 0.1 torr range
$6.0$ Pa $\leq$ reading $\leq 15.0$ kPa	30 ppm + 0.008 Pa	N <sub>2</sub> ; 0.1, 1, 10, and 100 torr ranges
$15$ kPa $\leq$ reading $\leq 133.3$ kPa	31 ppm	N <sub>2</sub> ; 1000 torr range



## **Capabilities**

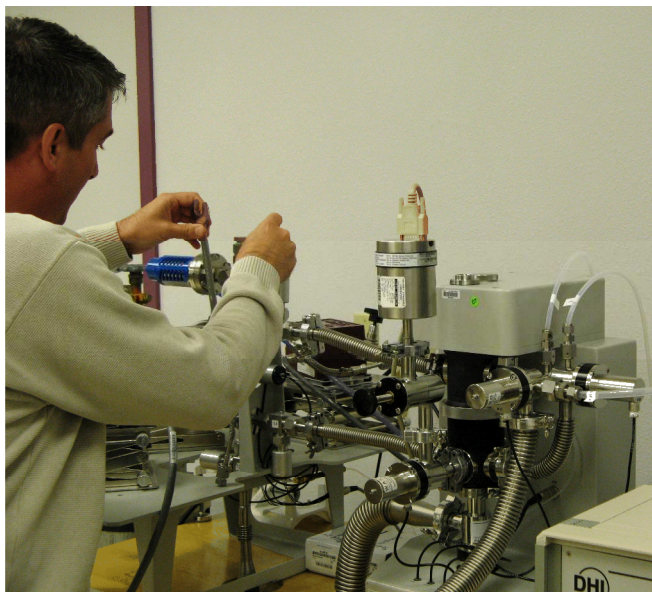
Below is a representative sample of our uncertainties. We are accredited under Lab Code 105002-0 by the National Institute of Standards and Technology/National Voluntary Laboratory Accreditation Program (NIST/NVLAP) in most of our capabilities. For full details see <http://ts.nist.gov/standards/scopes/1050020.pdf>

The vacuum lab can accommodate one-of-a kind calibrations. We provide consultation to our customers on proper selection, maintenance, and use of standards and transducers.

## **Major Resources**

- Semi-automated, direct-comparison high-vacuum system
- Fundamental multi-orifice, high vacuum to intermediate vacuum system
- DHI FPG8601, forced balance piston gauge covers a range of 13 Pa to 15 kPa
- High Vacuum, orifice flow, comparison system covers a range of  $1 \times 10^{-6}$  Pa to 13 Pa
- High Vacuum, orifice flow, fundamental system covers range of  $1 \times 10^{-6}$  Pa to 13 Pa

### **Forced Balance Piston Gauge**



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