



# National Institute of Standards & Technology

## Specifications

### Standard Reference Instrument Series 6003

#### Portable Vacuum Standard

**Description:** The Portable Vacuum standard (PVS) is an instrument that measures pressures with accuracy approaching that achieved at national standards laboratories. The PVS utilizes commercial gauges with slight modifications to improve the uncertainty to better disseminate pressure for laboratories without access to a primary standard. Additionally, the PVS can be used to replace mercury manometers that are being phased out due to the hazards and complications of using this type of standard. This device is a transfer standard and must be recalibrated at NIST periodically (NIST recommends every two years, see [http://www.nist.gov/calibrations/low\\_pressure\\_vacuum\\_leak.cfm](http://www.nist.gov/calibrations/low_pressure_vacuum_leak.cfm)) to maintain its accuracy and traceability.

The PVS can provide high accuracy calibrations or measurements directly at a customer's facility or even be used as an artifact in inter-laboratory comparisons (ILC). The system can be setup onsite with relative ease and little technical expertise and can be used to calibrate sensors without removing them from operation. This provides a method to calibrate sensors such as CDGs that are prone to damage or sensor drift from vibration or shock that is common during the removal procedure or shipping. The PVS obtains its direct NIST traceability and traceability to the International System of Units (SI) via calibrations against the Ultrasonic Interferometer Manometer (UIM) primary standard or through a piston gauge which is dimensionally characterized by the UIM.

The PVS uncertainty can depend on several factors such as temperature stability, pressure range, zero instability, long term stability. An estimate of the overall uncertainty of the device ranges from 50 parts in  $10^6$  at high pressures to 0.5% at 1 Pa.

Design, assembly and technical measurements leading to the production of this SRI were performed by J.E. Ricker, NIST Sensor Science Division.

Support aspects involved in the issuance of this SRI were coordinated through the NIST Office of Reference Materials.

**Specifications:** NIST provides the PVS as a Standard Reference Instrument (SRI) with performance that has the lowest uncertainty possible in a portable package. The NIST PVS SRI is offered in several different configurations (SRI 6003a – SRI 6003d), these options specify ranges of typical PVS systems. The PVS systems are packaged by NIST and are constructed primarily from commercially available components and include software, electronics, and tools that optimize the system performance. The overall uncertainty of the PVS system is directly linked to the operator training/capability, laboratory environment, and ability to regularly recalibrate the PVS at NIST. It is recommended that the operators follow the provided best practices and perform regular inter-comparisons.

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Certificate Issue Date: 29 April 2016

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NIST researchers continue to develop and improve the PVS systems and measurement techniques.

The PVS systems have the following specifications and features.<sup>1</sup>

- A) High accuracy pressure gauges including capacitance diaphragm gauges and resonance silicon gauges to cover the complete range.
- B) Temperature enclosure with custom electronics, platinum resistance thermometer, and LED display to control pressure sensor environment to 0.05 °C.
- C) Ion pump to maintain low base pressures when absolute pressures are required or when zero procedures are being completed.
- D) Mounting and leveling hardware to ensure level and stable mounting of gauges during use and protect gauges during shipment
- E) Custom shipping container for PVS.
- F) Electronics and gauge controllers permanently mounted in specialized shipping container for easy portability and storage.
- G) Light and portable laptop to collect data from gauges.

**Delivery and Shipping:** Unless otherwise agreed by the parties, shipping terms shall be [EXW \(Incoterms 2010\)](#). NIST will prepare packaging for shipment of the PVS SRI. Shipping crate dimensions and weight are listed below. Customers are responsible for arrangement of shipping pickup at NIST as well as all customs duties and import fees (HTC 9026.20.4000).

**Installation:** Customer is responsible for setup at their location. Manuals and/or quick start guides will be provided for setup procedures.

**Support:** NIST staff will provide manuals for training and will respond to any questions or assistance needed during the setup or initial operation of the PVS.

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<sup>1</sup> Commercial equipment, instruments or materials used in this SRI were found to meet requirements specified. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

**Technical requirements at installation site:** Customers must provide the following:

- A) A laboratory that is temperature stabilized to  $\pm 2$  °C.
- B) Flat surface for resting/leveling PVS using built in three contact design.
- C) Plumbing, tubing, or bellows to an appropriate vacuum line that is compatible with the VCR-4 connector on the PVS.
- D) Location for storage of electronics case that is within 6 ft of the PVS mounting location.
- E) Appropriate power connection for North America 110 V AC, 15 A, 60 Hz.
- F) Any documentation required for transfer of property or receiving of property/freight at your facility.

**Standard Configurations**

**6003a** Pressure standard for barometric and vacuum applications 1 Pa to 130 kPa

- a. 1 Torr CDG w/Controller
- b. 10 Torr CDG w/Controller
- c. 10 kPa RSG w/RS-232 Output
- d. 130 kPa RSG w/RS-232 Output
- e. Miniature Ion Pump
- f. Digital Cold Cathode with display
- g. Custom temperature enclosure with PID controller and display
- h. Custom made ruggedized shipping containers
- i. Computer with custom software to read and display pressures
- j. System shipped from NIST in a calibrated state. Recertification can be obtained by contacting NIST Calibration Program 301-975-5454 (calibration ID 30040S).
- k. Crate 1: 77 cm x 66 cm x 79 cm; 68 kg  
Crate 2: 61 cm x 40 cm x 48 cm; 23 kg  
Total weight: 91 kg

**6003b** Pressure standard for full range applications 1 Pa to 700 kPa  
(Commercial Mercury Manometer Replacement)

- a. 1 Torr CDG w/Controller
- b. 10 Torr CDG w/Controller
- c. 10 kPa RSG w/RS-232 Output
- d. 700 kPa RSG w/RS-232 Output
- e. Miniature Ion Pump
- f. Digital Cold Cathode with display
- g. Custom temperature enclosure with PID controller and display
- h. Custom made ruggedized shipping containers
- i. Computer with custom software to read and display pressures
- j. System shipped from NIST in a calibrated state. Recertification can be obtained by contacting NIST Calibration Program 301-975-5454 (calibration ID 30040S).
- k. Crate 1: 77 cm x 66 cm x 79 cm; 68 kg  
Crate 2: 61 cm x 40 cm x 48 cm; 23 kg  
Total weight: 91 kg

**6003c** Pressure standard for vacuum applications 1 Pa to 10 kPa

- a. 1 Torr CDG w/Controller
- b. 10 Torr CDG w/Controller
- c. 10 kPa RSG w/RS-232 Output
- d. Miniature Ion Pump
- e. Digital Cold Cathode with display
- f. Custom temperature enclosure with PID controller and display
- g. Custom made ruggedized shipping containers
- h. Computer with custom software to read and display pressures

- i. System shipped from NIST in a calibrated state. Recertification can be obtained by contacting NIST Calibration Program 301-975-5454 (calibration ID 30040S).
- j. Crate 1: 77 cm x 66 cm x 79 cm; 68 kg  
Crate 2: 61 cm x 40 cm x 48 cm; 23 kg  
Total weight: 91 kg

**6003d** Pressure standard for vacuum applications (with Youden analysis) 100 Pa to 130 kPa

- a. Two 10 kPa RSG w/RS-232 Output
- b. Two 130 kPa RSG w/RS-232 Output
- c. Pairs of gauges to allow Youden Analysis of gauge drift
- d. All electronics will be CE certified and can come with several electrical plug standards.
- e. Miniature Ion Pump
- f. Digital Cold Cathode with display
- g. Custom temperature enclosure with PID controller and display
- h. Custom made ruggedized shipping containers
- i. Computer with custom software to read and display pressures
- j. System shipped from NIST in a calibrated state. Recertification can be obtained by contacting NIST Calibration Program 301-975-5454 (calibration ID 30040S).

*Users of this SRI should ensure that the Specifications Certificate in their possession is current. This can be accomplished by contacting the Office of Reference Materials: telephone (301) 975-2200; fax (301) 948-3730; e-mail [srminfo@nist.gov](mailto:srminfo@nist.gov); or via the Internet at <http://www.nist.gov/sri>.*