High-Stability Transfer Standard for the Barometric Pressure Range of 100 Pa to 130 kPa

NIST has developed a new pressure transfer standard capable of absolute-mode and differential-mode operation in the range of 100 Pa to 130 kPa. This important pressure range spans the barometric pressure range, and it ties into higher pressure metrology work at the upper end and vacuum metrology work at the lower end. The transfer standard is based on a relatively new MEMS (Micro-Electro-Mechanical System) pressure sensor known specifically as an RSG (Resonant Silicon Gauge). The new transfer standard will provide U.S. Government, military, and industry customers with a high-stability transfer standard across the barometric pressure range that is directly traceable to NIST. We anticipate that the new high-stability transfer standard will play a role in future International Key Comparisons with other National Metrology Institutes (NMIs) that enable mutual recognition and degrees of equivalence for international trade.

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The Resonant Silicon Gauge (RSGs) used in the transfer standard are of the same type used to provide superior calibration stability in recent Consultative Committee for Mass and Related Quantities (CCM) Key Comparisons of absolute and differential pressure standards which covered pressures up to 1 kPa. The newly constructed, highstability transfer standard package consists of an instrument package and a support electronics package that are both suitable for shipment around the world. The instrument package consists of two 10 kPa RSGs, two

130 kPa RSGs, an ion pump, and a temperaturecontrolled enclosure. The electronics support package contains all electronics necessary to operate the equipment package along with a computer and custom software to run the system. The pairs of RSGs in the instrument package provide redundant data needed to identify systematic differences between pressure standards via a Youden analysis. The RSG transfer standard package has demonstrated good short-term zero instability and pressure resolution over the range of operation. It has demonstrated long term instability of a few ppm at 130 kPa, increasing to 0.01% at 100 Pa (see Figure). The longterm instability of the NIST transfer standard package is nominally commensurate with piston gauges between pressures of 130 kPa down to 10 kPa, and extends measurement capability down to 100 Pa.

Impact: The development of a high-stability transfer standard for the pressure range 100 Pa to

130 kPa will enable the low uncertainty of the NIST Ultrasonic Interferometer Manometer (UIM) primary pressure standard to be transferred to NIST customers. Furthermore, the package will enable NIST to perform Bilateral and International Key Comparisons with other NMIs with long term instability of a few ppm at 130 kPa, increasing to 0.01% at 100 Pa.

A bilateral comparison between NIST and NPL-India has been scheduled for FY06. It will test the long term stability of the new transfer standard package under real-world conditions in preparation for using the package for future international Key Comparisons of the barometric pressure range.

References:

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The long- term instability of the newly constructed NIST high-stability transfer standard based on resonant silicon gauges for the range of 100 Pa to 130 kPa.

Long Term Instability: April 2004 to August 2005

Metrologia, 2002, 39, Tech. Suppl., 07002.

