Calibration of Vacuum Gauges in the Range 13 Pa to 133 kPa (0.1 torr to 1000 torr) Using Resonant Silicon Gauges as Transfer Standards

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Abstract

Many industrial processes rely on accurate pressure measurement in the range of 13 Pa to 133 kPa (0.1 to 1000 torr). The most commonly used gauges for measuring pressures in this range are capacitance diaphragm gauges (CDG's) and thermal conductivity gauges (TCG's) of several different designs including thermocouple and Pirani gauges. Calibration of these gauges is usually accomplished using one or more calibrated CDG's. However, these "transfer standard" CDG's must be calibrated themselves about once per year owing to the limitation on their stability. A relatively recent type of pressure transducer based on the resonance frequency of a micro-machined, 3-dimensional element has proved to have superior long-term stability compared with CDG's. In the recent CCM Key comparisons[1,2] of international pressure standards of absolute and differential pressure up to 1 kPa (7.5 torr), the resonance silicon gauge (RSG) technology provided superior long-term calibration stability. In this paper, it is shown how a simple "transfer standard package" based on RSG's may be assembled for the purpose of calibrating vacuum gauges between 13 Pa and 133 kPa (0.1 torr to 1000 torr). The advantages of this system are much better uncertainty and long-term stability when compared with similar CDG-based transfer standards. Calibration data is shown for the calibration of common gauges against the RSG transfer standard package.

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2. Miiller, A.P., Cignolo, G. Fitzgerald, M. P., and Perkin, M. P., Final report on key comparison CCM.P-K5 of differential pressure standards from 1 Pa to 1000 Pa, Metrologia, 2002, 39, Tech. Suppl., 07002.