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Experimental Approach to Equalizing the Orifice Method with the Throughput One for the Measurement of TMP Pumping Speed

J. Y. Lim[1], S. B. Kang[2], J. H. Shin[3], D. Y. Koh[4], W. Cheung[1]

[1]Korea Research Institute of Standards and Science, [2]Kunsan National University,
[3]Konyang University, [4]Korea Institute of Machinery & Materials

Methods of the characteristics evaluation of turbo-molecular pumps (TMP) are well-defined in the international measurement standards such as ISO, PNEUROP, DIN, JIS, and AVS. The Vacuum Center in the Korea Research Institute of Standards and Science has recently designed, constructed, and established the integrated characteristics evaluation system of TMPs based on the international documents by continuously pursuing and acquiring the reliable international credibility through measurement perfection.

The measurement of TMP pumping speed is normally performed with the throughput and orifice methods dependent on the mass flow regions. However, in the UHV range of the molecular flow region, the high uncertainties of the gauges, mass flow rates, and conductance are too critical to precisely accumulate reliable data. With UHV gauges of uncertainties less than 15% and a calculated conductance of the orifice, about 35% of pumping speed uncertainties are experimentally derived in the pressure range of less than 10^{-6} mbar. In order to solve the uncertainty problems of pumping speeds in the UHV range, we introduced an SRG with 1% accuracy and a constant volume flow meter (CVFM) to measure the finite mass flow rates down to 10^{-3} mbar-L/s with 3% uncertainty for the throughput method. In this way we have performed the measurement of pumping speed down to less than 10^{-6} mbar with an uncertainty of 6% for a 1000 L/s TMP. In this article we suggest that the CVFM has an ability to measure the conductance of the orifice experimentally with flowing the known mass through the orifice chambers, so that we may overcome the discontinuity problem encountering during introducing two measurement methods in one pumping speed evaluation sequence.