

XVIII IMEKO WORLD CONGRESS  
Metrology for a Sustainable Development  
September, 17 – 22, 2006, Rio de Janeiro, Brazil

**CHARACTERIZATION OF A PRIMARY STANDARD CONTROLLED CLEARANCE PRESSURE  
BALANCE USING HEYDEMANN AND WELCH MODEL**

*Alaaeldin A.E. Eltawil<sup>1</sup>, Douglas Olson<sup>2</sup>*

<sup>1</sup> Mass, Density and Pressure laboratory - National Institute of Standards NIS-Giza – Egypt – eltaweel38@yahoo.com

<sup>2</sup> Pressure and Vacuum group - National Institute of Standards and technology NIST- USA – Douglas.olson@nist.gov

**Abstract**

For a traceable measurement to be verified and meaningful, it is important that all the measuring apparatus have to be calibrated against standards that are traceable to National/ International Standards. Calibration is a process that determines the operational integrity of measuring instruments by determining their measurement uncertainties. In order to ensure the calibration of a measuring instrument traceable to National Standards, a hierarchy of standards and standards laboratories are established. A primary pressure standard that can metrologically characterized in a complete and an independent way with reference only to the basic units of the S.I. system, is defined as force per unit area (pressure balance) or the height of a liquid column (liquid manometer). Pressure balances are excellent primary standards for measuring pressure with high resolution and high accuracy. Characterization of primary standard pressure balance (controlled clearance) will be presented in this work.

Study of the metrological characteristics of a controlled clearance pressure balance, PG-67, has been carried out according to Heydemann and Welch model using di-

ethyl-hexyl-sebacate as a working fluid is presented through this work. To attain this, the short term pressure stability was determined at all applicable jacket pressure and pressure points. The effects of jacket pressures on the pressure stability as well as the optimum jacket pressure that could be used to provide the lowest pressure scattering at each pressure point were determined. On the other hand, to improve the pressure stability a pressure balance was used to generate, control and measure the jacket pressure instead of pressure sensor. A procedure to determine the coefficient “d” in Heydemann and Welch model was proposed and implemented and with little modifications it was used to measure the zero pressure effective area for NIS 200 PCA.

The procedure is faster than the normal cross floating procedure and it does not suffer from the personal error since the balancing point is determined through pressure sensor and computer program. Comparing its results with the normal procedure shows the advantage of the new procedure in eliminating the drift and reducing the instability of the oil temperatures comes from the long operating time besides saving the timing of the experimental work.