

Characterization of ultra high vacuum system

(- by gas accumulation and SRG methods)

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This Master's thesis was carried out in Borås at RISE *Research Institutes of Sweden*. RISE is a governmentally owned research institute with a national directive to perform research and offer services, which are not financially sustainable but essential to the Swedish industry. One such service is provided by the department of Measurement Technology/National Metrology Institute, where the Pressure and Vacuum group is currently working on improving their capabilities to measure high and ultra-high vacuum.

Accurate and precise vacuum measurement is of importance to several stakeholders, such as the life-science industry, semi-conductor manufacturing, and the process industry. An incorrectly measured vacuum can lead to a quality reduction of the product or, in the worst case the process may stop caused by the measurement uncertainty. Calibration of vacuum gauges are necessary to maintain high quality vacuum measurements. The calibration of gauges are necessary to e.g. achieve stable products, detect error in the production, fulfill quality requirements or to display correct values on meter.

To produce precisely known pressures in the medium, high, and ultra-high vacuum range for gauge calibrations, the volume expansion system is often used for that purpose, see figure 1 below. There are different methods to determine the volume or the expansion ratios in such system. The two methods used during the characterization process are the SRG *Spinning Rotor Gauge* and the gas accumulation, by measuring the pressure before and after an expansion.

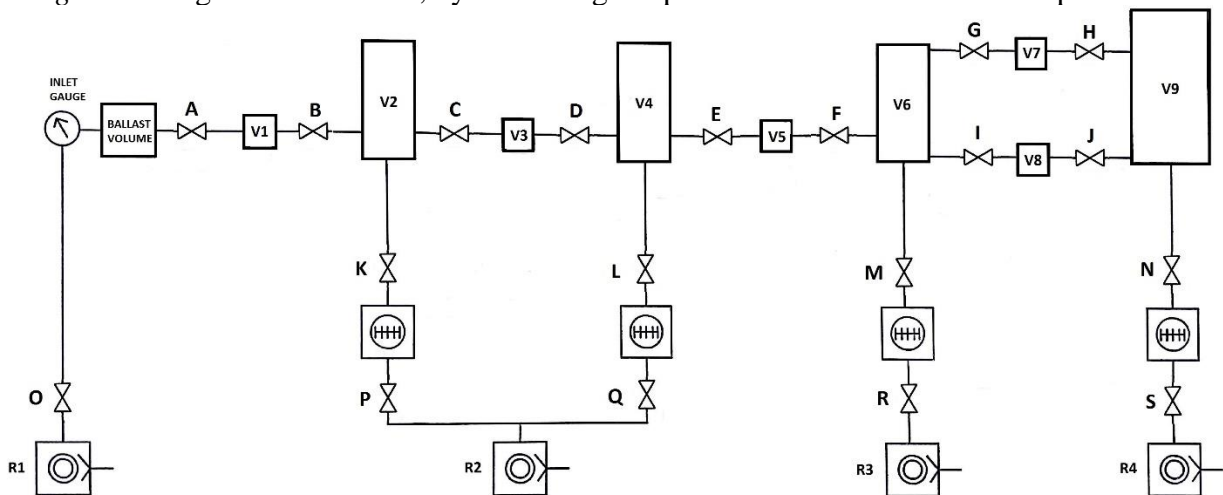


Figure 1: SEA5 at RISE. The gas inlet starts from the left side of the figure through V1, and the finale low pressure is generated at V9.

The aim of the project is to develop a method of characterization for SEA5 Serial Expansion Apparatus 5, based on current best practice standards. SEA5 has five specific expansions ratios.

- R1, the ratio for an expansion from: $V1 \rightarrow (V2 + V3)$
- R2, the ratio for an expansion from: $V3 \rightarrow (V4 + V5)$
- R3, the ratio for an expansion from: $V5 \rightarrow (V6 + V7 + V8)$
- R4n, the ratio for an expansion from: $V7 \rightarrow V9$
- R4d, the ratio for an expansion from: $V8 \rightarrow V9$

The purpose is to characterize them by mentioned methods. When the ratios have been determined, the methods should also be included in the control software to allow for an automatic self-characterization.

The achieved results by the methods where not completely in agreement with each other, that caused by different reasons. According to the obtained results, the gas accumulation method generated a more stable values during characterization than SRG. This has to do with the meter's measuring range and the structure of the method.