Analysis of Baffle Plate Geometry on High-Vacuum Chamber Pressure Distribution

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Introduction

Problem: Pressure variation across measurement ports due to chamber geometry is a relevant uncertainty contributor in high-vacuum calibrations.

Goal: Minimize the pressure variation between test ports on the newly acquired high-vacuum calibration system through the optimal baffle geometry.

HiVacII System

The HiVacII system calibrates spinning rotor gauges and ion gauges in the E-09 to E-03 torr pressure range across its 10 measurement ports on the spherical chamber.

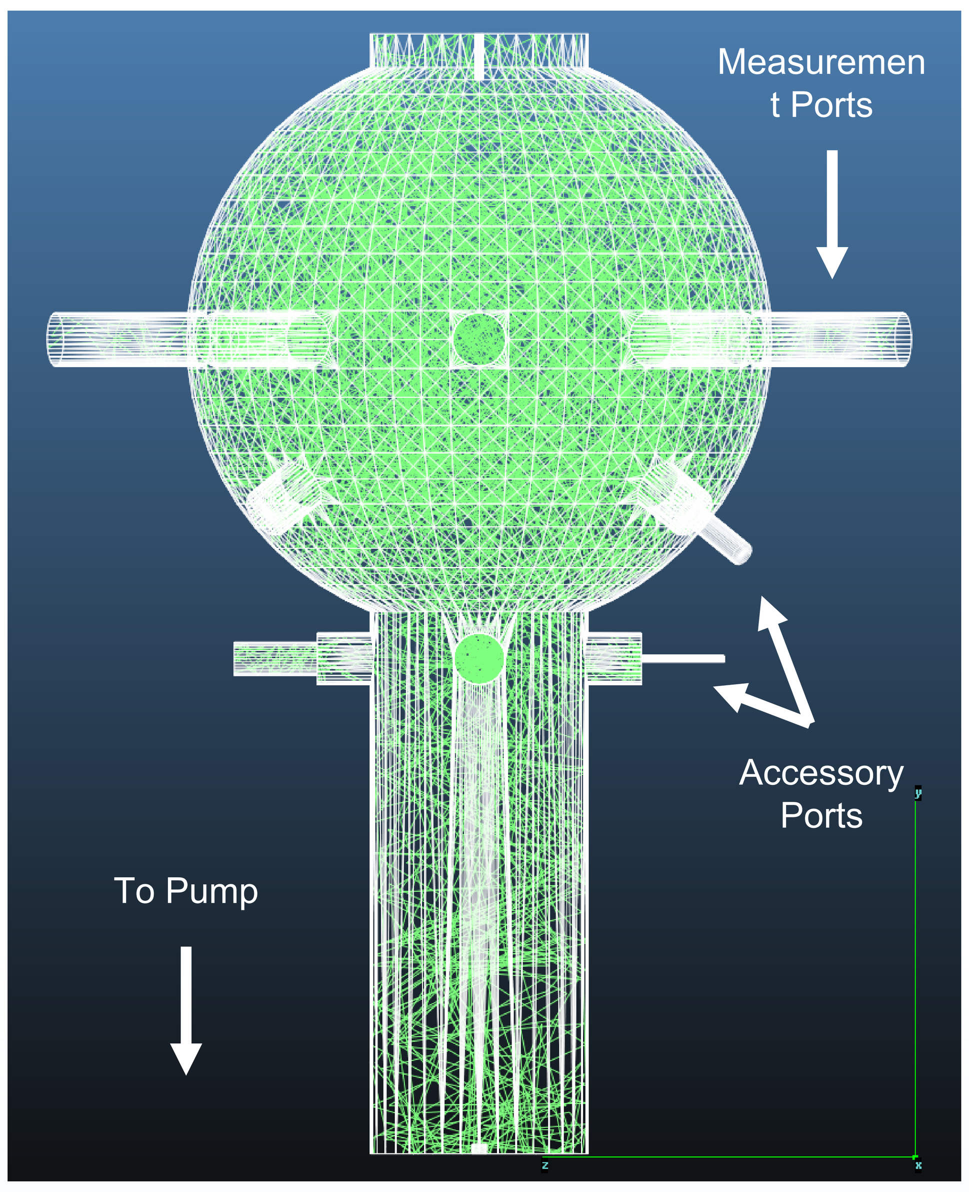
Background

Ion gauges are the primary instrument used to make high-vacuum measurements. Unfortunately, the manufacturer-specified repeatability (3%) and measurement uncertainty (0.5–2% time-of-test from a National Metrological Institute [NMI]) for ion gauges is too high to resolve chamber pressure variation.

The current best practice for determining chamber pressure variation is to import the chamber geometry into a Monte Carlo simulating software such as MolFlow.

Khan et. al. (1) found that baffle plate geometry affects vacuum chamber pressure distribution in the transitional and laminar flow regimes.

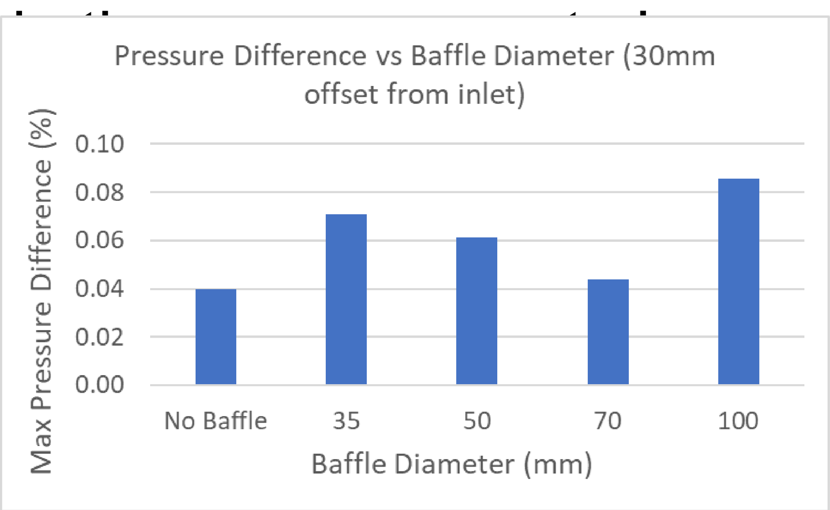
Various baffle plate diameters and distances from the gas inlet were simulated to determine their effect on pressure variation at the measurement ports of the high-vacuum chamber.



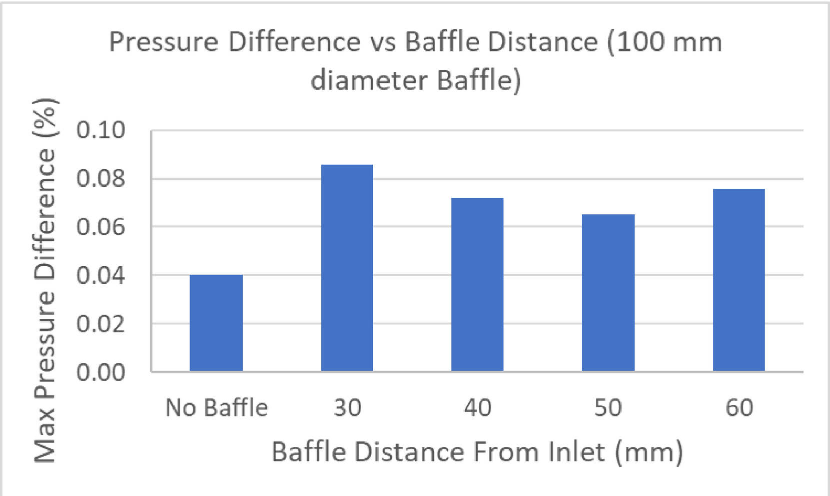
Results

MolFlow simulations revealed that using baffle plates had a minimal effect on pressure variation at the measurement ports.

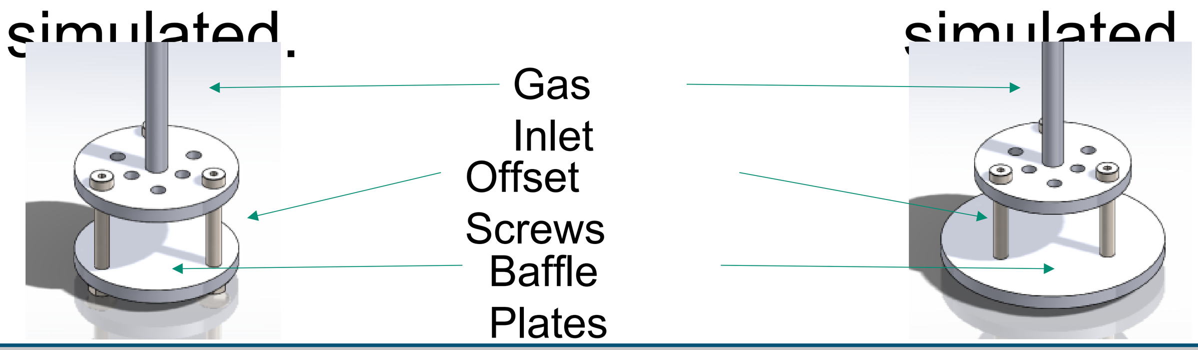
This may be due to the symmetry of the system, particularly



While holding the distance from the gas inlet constant, various baffle diameters were simulated.



While holding the baffle diameter constant, various distances from the gas inlet were simulated.



Conclusions

Given that the lowest pressure variation resulted without a baffle plate, the system will be left with no baffle installed.

The resulting pressure variation with no baffle plate installed (0.04%, k=1) will be used in the uncertainty analysis for the system.

Future Work

Reproducibility studies will be performed to verify the output of the simulations.

This methodology can also be used in the design phase of a fundamental high-vacuum system as chamber geometry decisions are made.

Acknowledgements

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References

(1) Khan et. al., *Effects Of Baffle Size On Pressure Distribution In Vacuum Chamber During Dynamic Gas Flow*, 2009