RGA Usage at Jefferson Laboratory

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Abstract

Over the past 10 years, quadrupole residual gas analyzers (RGA) have become common vacuum diagnostic instruments. Much of the proliferation of this technology throughout the scientific community is due to the high reliability and relatively low cost of modern RGA.

Jefferson Lab uses over 70 of these devices for vacuum leak detection, to diagnose vacuum system contamination, and for fundamental power processing of SRF power couplers.four different heads for helium partial pressures even after N3 exposure and electronics head refurbishment.

Calibrate RGA before trusting CEM pressure readings. Use mass 28 unbaked or use mass 2 if system is baked.

A comparison of an RGA with two UHV gauges finds that the total pressure agrees quite well across systems.

RGA is useful for measurements such as gauge calibration, ion pump systems show that this is not necessarily the case.

The degas cycle is not necessary in a clean system. Partial pressure readings should be taken at least 2 hours after turning on the RGA.

An RGA with a calibrated leak can be used to determine quantitative He leak rates, and can detect hydrocarbon contamination during coupler production.

RF coupler test stand

Calibrated pumping system for leak checking and of gas evolution during RF conditioning of fundamental power couplers.

RGA traces during initial RF processing of SRF power couplers for the SNS project. Different species are released from coupler surface, mostly hydrogen.

When conditioned, RGA traces are flat indicating minimum evolution of gas from clean surface.

Conclusions

RGA comparison

Four Stanford Research Systems (SRS) RGA's installed on test stand with ion pumps. Compare performance of older units with repaired electronics heads to a newer unit.

Helium partial pressure on standard leak in iod and unbaked chambers. All four gauges read similar pressure within a factor of 3. Good agreement between paired and new RGA.

Filament Current

Variation in RGA filament current between 1 and 0.1 mA to determine if lowering filament current lowers electron stimulated desorption (ESD). Two systems: NEG/ion vs. Turbo.

Baked turbo pump system:
- Decreasing filament current increases pressure reading.
- Supports theory that electron stimulated desorption (ESD) can be lowered with lower current

Unbaked Ion pump system:
- Decreasing filament current increases pressure reading.
- Confusing: Gauge pumping and ESD are in competition, and pumping wins here?

Baked Ion/NEG system:
- Decreasing filament current increases pressure reading.

Conclusion: Changing filament current affects pressure readings in an RGA, and RGA responds differently in turbo vs. ion pump systems.

Degas vs. Warm-up

- RGA do not read accurately when first turned on.
- Degas cycle can generate gas load from which the chamber takes many hours to recover
- Degas cycle also may shorten the filament lifetime
- RGA can be used for a rough leak check immediately
- Let your RGA warm up for ~3 hours before trusting total pressure data.

RGA vs. Total Pressure Gauges

- Total pressure measured by the RGA agrees well with the Extractor and Axtran Gauges
- RGA pressure was obtained by adding up all peak pressures in CEM mode with CEM calibrated for mass 2
- Both Extractor and Axtran gauge need correction factors for the difference in ionization cross section between nitrogen and hydrogen. The Axtran factor for hydrogen is 2 (from the CEM mode).

We find that the total pressure from the RGA correlates well with the Extractor and Axtran, without any corrections to the individual peak heights for sensitivities or ionization cross sections.

Conclusion: The RGA works adequately as a total pressure gauge at UHV pressures.