

Title: SPECIFICATION FOR RESIDUAL GAS ANALYZER (RGA) CALIBRATION

SPECIFICATION FOR
 RESIDUAL GAS ANALYZER (RGA) CALIBRATION
 FOR
 LIGO VACUUM EQUIPMENT

Hanford, Washington
 and
 Livingston, Louisiana

PREPARED BY: S. Moten

PROCESS ENGINEER: R. Ther

QUALITY ASSURANCE: Alan L. Boudhoo

TECHNICAL DIRECTOR: D. A. Williams

PROJECT MANAGER: Burt Bay

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1.0 PURPOSE

The purpose of this document is to define a system and procedure to be used for the calibration of a residual gas analyzer (RGA) or ion gauge to a NIST traceable standard.

2.0 GENERAL

This procedure applies to the calibration of quadrupole mass spectrometers with electron multipliers such as the Balzers QMS 200. This procedure is used to determine RGA sensitivities for various gasses. As a minimum the following gasses should be used: H₂, He, CH₄, N₂, Ar, CO₂. Gas sensitivities will be determined in the Faraday cup mode for pressures between 10⁻⁴ and 10⁻³ Torr and in the electron multiplier mode for pressures between 10⁻⁶ and 10⁻⁸ Torr. A Capacitance Manometer Gauge (CMG) will be used as the NIST traceable standard for this procedure.

This procedure is to be used for factory and field testing programs. In general, calibration is to be performed whenever the RGA has been exposed to the atmosphere or if the recent operating "history" of the RGA is unknown and the calibration is thus suspect.

3.0 REFERENCE DOCUMENTS

Operating manuals for: Balzers QMS200 RGA, MKS Baratron Capacitance Manometer, Granville Philips Stabil Ion Gauge, Edwards Vacuum Pumps, Varian Ion Pump.

PSI Specification V049-2-014, LEAK CHECK PLAN FOR LIGO VACUUM EQUIPMENT.

4.0 RESPONSIBILITY

This procedure is applicable to PSI personnel. the calibration will be performed by the assigned test engineer. Calibration records will be maintained by the PSI QA department.

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5.0 BASIC CALIBRATION METHOD; RGA IN FARADAY CUP MODE

Pressure readings from the Stabil Ion gauge and ion current readings from the RGA in the Faraday mode are compared to pressure readings from the MKS Baratron Capacitance Manometer Gauge (CMG) in the pressure range of 10^{-4} to 10^{-5} Torr for each gas species.

Pressure correction curves for each gas species used will then be developed for the Stabil Ion Gauge.

Sensitivities factors (Torr/Amp) for each gas species used will then be developed for the QMS 200 RGA in the Faraday mode.

LINEARITY CHECK using calibrated leak

To check linearity of the RGA in the high vacuum range below 10^{-6} Torr, the pumping speed needs to be determined. The check will be carried out using nitrogen as the gas. The pump speed is determined in the pressure range 5×10^{-4} Torr to 5×10^{-5} Torr using calibrated leak and the baratron. The RGA reading is compared at a lower pressure using a smaller calibrated leak and the determined pump speed for nitrogen.

6.0 BASIC CALIBRATION METHOD; RGA IN ELECTRON MULTIPLIER MODE

Ion current readings from the RGA in the electron multiplier mode will be compared to pressure readings from the calibrated Stabil Ion gauge (see above) in the pressure range 10^{-6} to 10^{-8} Torr for each gas species.

Sensitivities factors (Torr/Amp) for each gas species used will then be developed for the QMS 200 RGA in the electron multiplier mode.

LINEARITY CHECK using calibrated leak

To check linearity of the RGA in the high vacuum range below 10^{-6} Torr, the pumping speed needs to be determined. The check will be carried out using nitrogen as the gas. The pump speed is determined in the pressure range 5×10^{-4} Torr to 5×10^{-5} Torr using calibrated leak and the baratron. The RGA reading is compared at a lower pressure using a smaller calibrated leak and the determined pump speed for nitrogen.

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7.0 RGA CALIBRATION ACCURACY

The contribution of the uncertainty in accuracy for the primary and secondary calibration standards are currently estimates until a more accurate number is obtained from the instrument vendor.

Stabil Ion gauge; assumes linear behaviour from 1×10^{-4} Torr to 1×10^{-8} Torr.

	Uncertainty 1×10^{-4} Torr	Uncertainty 5×10^{-5} Torr	Uncertainty 1×10^{-6} Torr	Uncertainty 1×10^{-8} Torr
PRIMARY STANDARD	3% estimate	3% estimate	3% estimate	3% estimate
CALIBRATION STANDARD 2nd	3% (SRG or DWT)	3% (SRG or DWT)	3% (SRG or DWT)	3% (SRG or DWT)
CAPACITANCE MANOMETER	1.2%	2.4%	1.2%	1.2%
STABIL ION GAUGE G-P			6%	6%
Temperature correction	0.3%	0.3%	0.3%	0.3%
TOTAL : RGA	7.5%	8.7%	13.5%	13.5%

SRG: Spinning Rotor Gauge

DWT: Dead Weight Tester

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