

Evaluation of Accelerators by Spinning Rotor Vacuum Gauge (SRG) and Standard Leak

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Standard calibrated leaks have been widely used with the types which permit permeation of Helium gas through glass material. Lately Crimped Calibrated leaks are being popularly used for every gas besides Helium. They have metal leak elements which are made from crimped stainless tubes and are calibrated by NIST traceable standard. The calibration methods and Measuring systems for Accelerators are described with illustrations.

1. Description of Leaks

As much as 200-230 sets of SRG have been widely used for Vacuum science since 1980 around. Using SRG and Standard calibrated leaks can make it easy to calibrate the vacuum gauges in HV or UHV, residual gas analyzers and He leak detectors, or to measure pumping speed. The results enable to easily evaluate the Accelerators.

Calibrated standard leaks are described here which are traceable under the range from \sim Pa to 10^{-6} Pa to the National Institute of Science and Technology(NIST) via a spinning rotor

gauge with a traceable rotor, a traceable volume calibration, a traceable thermometer and a time checked with the nation time standard. This is the original method by Vacuum Technology Inc.

2. Characteristics of Leaks

Characteristics of leak element types are described on Table 1, which shows Permeation type and Physical leaks type. Permeation leak is made from a material which permits diffusion of one or more species of gas through it.

Table 1. Some characteristics of leak element types. ^[1]

Leak element	Gases	Temperature coefficient %/°C	Flow rate range mol/s 2.44Pa·m ³ /sec(20°C)
Permeation			
Glass	Helium	2~7	$10^{-15} \sim 10^{-9}$
Paladium	Hydrogen	3~7	
Plastic	Water, SO ₂ , NO ₂	10~20	$10^{-13} \sim 10^{-8}$
Physical	Any		$10^{-12} \sim >10^{-6}$
Capillary		<0.5	
Crimped tube		<0.3	
Sintered			
Orifice		<0.3	

Helium gas permeation leaks made from glass are generally used for Helium leak detectors, however the use range is limited.

In Physical leaks, Crimpt calibrated leaks are popularly used for any gas besides Helium gas. They have metal leak elements which are made from crimped stainless tubes, and calibrated by NIST traceable standard.

They can be applied for calibration of vacuum gauges, measurements of the pumping speed and measurements of outgassing from materials for evaluation of Accelerators.

NIST traceable calibration system (Fig.3) is an UHV system of all metal with a turbo-molecular pump. [2]

3. Methods

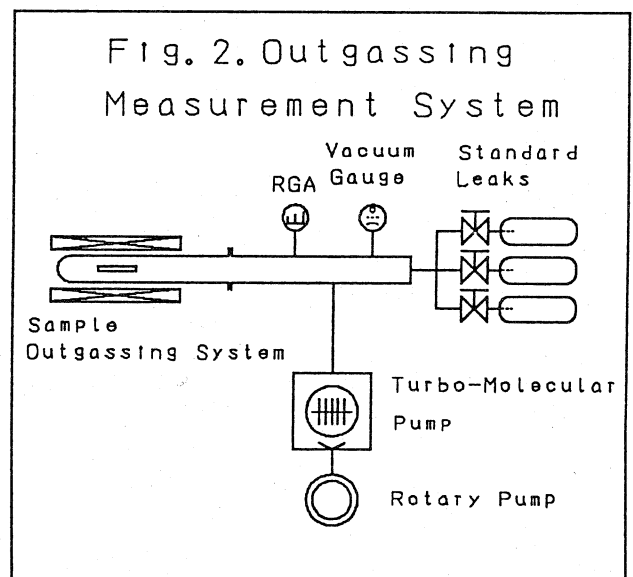
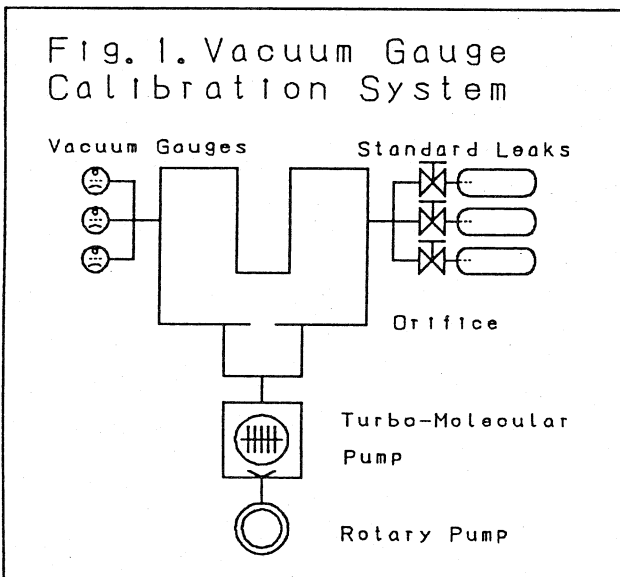
Calibration method for a standard leak is a rate of rise technique using SRG performed by a NIST traceable standard.

The leak to be calibrated is valved into a system with a known calibrated volume. A rate of rise is performed with the calibrated volume valved in and out.

4. Traceability

The 1000cc stainless steel volume has an uncertainty of 0.1%. The thermometer is accurate to 0.1°C. For Helium at pressures less than 0.1 Pa, the total estimated uncertainty SRG of calibration by NIST is estimated as 1%. The timing error is estimated as 0.026%.

Using the Standard leaks calibrated as mentioned above, Simple vacuum gauge calibration system (Fig.1), Measuring system of outgases (Fig.2) and Measuring system of pumping speed are possible to be precisely made.

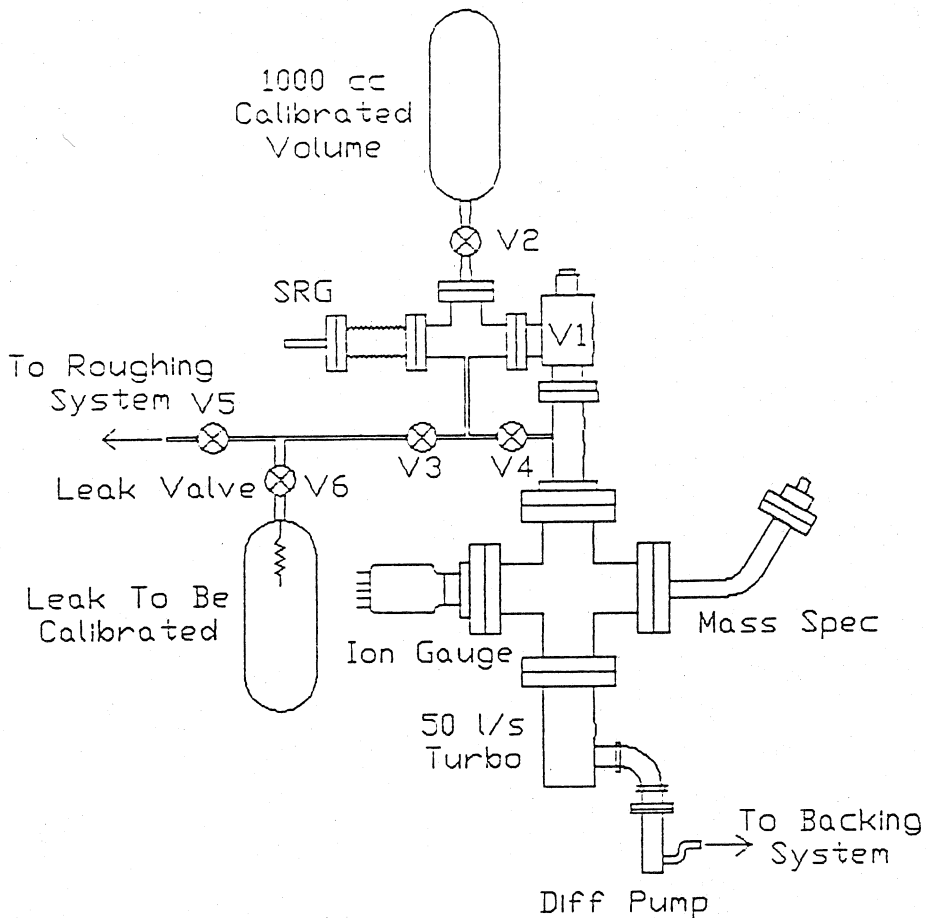


REFERENCES

- [1] C. D. Ehrlich, et al., J. Vac. Sci. Technol. A10(1), Jan/Feb 1992, pp1-17
- [2] Vacuum Technology Inc's, NIST Traceable Calibration Method & Error Analysis.

Fig. 3.

NIST Traceable Calibration System



- V1 - Main SRG Pump Valve
- V2 - Cal Volume Isolation Valve
- V3 - Cal System Inlet Valve
- V4 - Accumulated Gas Sampling Valve
- V5 - Roughing/Outgassing System Iso Valve
- V6 - Leak Isolation Valve