

# OPERATION OF THREE ELECTRONIC LEAK DETECTORS

J. C. Schuchman

October 1965

Collider Accelerator Department  
**Brookhaven National Laboratory**

**U.S. Department of Energy**

USDOE Office of Science (SC)

Notice: This technical note has been authored by employees of Brookhaven Science Associates, LLC under Contract No.AT-30-2-GEN-16 with the U.S. Department of Energy. The publisher by accepting the technical note for publication acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this technical note, or allow others to do so, for United States Government purposes.

## **DISCLAIMER**

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Accelerator Department  
BROOKHAVEN NATIONAL LABORATORY  
Associated Universities, Inc.

AGS DIVISION TECHNICAL NOTE

No. 7

J.C. Schuchman  
October 19, 1965

OPERATION OF THREE ELECTRONIC LEAK DETECTORS

Introduction

Electronic leak detectors are devices which measure the current change in a sputter ion pump or a pressure gauge caused by a gas entering the system through a leak. The probe gas displaces the air passing thru the leak and because of the different leak molecular conductance, the ionization probability, and the pumping speed of the gas, a change in pump (or gauge) current is registered. The electronic leak detector amplifies this change in current. Since different gases have different conductance, ionization and pumping characteristics it is possible, by using two gases to have the leak detector first read in one direction and then in the other thus confirming a leak location.

Apparatus

The test apparatus is shown in Fig. 1. The three leak detectors tested were:

- a) General Electric, model 22HG100, audible leak detector.
- b) Ultek, Model 60-412, leak detector.
- c) Varian, Model 911-5021, leak detector ion pump power supply combination.

All of the above units are portable and simply plug into either a sputter ion pump power supply or a gauge power supply. For this test the Varian and Ultek leak detectors were used with their respective ion pump controls and the General Electric unit was plugged into a GE cold cathode "trigger" gauge control.

The Varian and the Ultek units both display the current changes on a meter while the GE leak detector only has an audio output.

Procedure

With all pumps and gauges operating the base pressure was recorded. Then an air leak was opened raising the system pressure. Helium, Argon and Carbon Dioxide were alternately bled into the system through the air leak. The leak detector signals were recorded. The above procedure was repeated for different pressures. All pressures were recorded on a Veeco RG-21A ion gauge circuit.

Results

System Pressure(torr)	Probe Gas	L.D. Signal -		Scale deflection	
		GE	Ultek	Varian	
$4.2 \times 10^{-8}$	-	-	-	-	-
$1 \times 10^{-7}$	He	null	up		down
	CO <sub>2</sub>	high freq.	up		up
	Ar	"	"		"
$4 \times 10^{-7}$	He	null	up		down
	Ar	high freq.	"		up
$5-8 \times 10^{-6}$	He	null	down		down
	CO <sub>2</sub>	high freq.	up		up
	Ar	"	"		"
$1-9 \times 10^{-4}$	He	null	down		down
	CO <sub>2</sub>	-	-		-
	Ar	high freq.	up		up

Discussion

The response time for this or any type leak detector is stated as the time required for 63% of the maximum indication and is given as:

$$\text{Response time (sec)} = \frac{\text{Volume (liters)}}{\text{Pumping speed for gas (liters) in question} \times \text{sec}}$$

An attempt was made to measure unknown leak rates with the Varian leak detector and the CVC leak detector as a reference. Three measurements were made and are listed as follows:

Test	<u>Leak Rate std cc/sec He</u>	
	CVC	Varian
1	$2-3 \times 10^{-6}$	$6-8 \times 10^{-4}$
2	$1.8 \times 10^{-6}$	$2.9 \times 10^{-4}$
3	$2.4 \times 10^{-7}$	$5.2 \times 10^{-5}$

For each of the tests the Varian leak detector read consistently higher by a factor of about 200. I do not think that the above figures should be taken as anything more than an indication of possible differences and that a more refined test should be made if more accurate data is required.

Manufacturer's claims on sensitivity (minimum detectable leak) is one percent of total gas load (Q). Since  $Q = PS$ , (where P = pressure and S = pumping speed), it can be seen that the sensitivity decreases at high pressure and increases at good vacuums.

### Conclusion

A general understanding of the electronic leak detection process helps in interpreting the results. This point can easily be seen in the test results. At low pressures the Ultek signal for helium is "up" while at higher pressures it is reversed.

A real advantage of this type leak detector over the conventional mass spectrometer type is that no direct connection to the vacuum system is required. Therefore, any sputter ion pumped system can be leak checked at any time without disturbing the system. All that is required is to spray the system with a probe gas either locally or remotely.

### References

- A. Varian Associated, Vacuum Products Division, 611 Hansen Way, Palo Alto, California.
  - 1. "Leak Detection Using Current Changes in Ionization Gauges and Sputter-Ion Pumps". R.L. Ackley, A.E. Barrington, A.B. Francis, R.L. Jepsen, C.F. Lothrop, and H. Mandoli.
  - 2. Model 975-0000 Vac-Ion Pump Leak Detector Instruction Manual.
  - 3. Vac-Ion Pump Leak Detector Application Bulletin.
- B. Ultek Corporation, P.O. Box 10920, Palo Alto, California.
  - 1. "Simplifying Leak Detection" D.F. Munro.
  - 2. Model 60-412 Leak Detector Operating and Maintenance Manual.
- C. General Electric Company, Vacuum Products Division, Schenectady, N.Y.
  - 1. Bulletin GEZ-4030 Audible Leak Detector.

### Distribution:

- A. van Steenberg
- J. Grisoli
- C. Gould
- R. Dryden
- C. Lasky
- V. Buchanan
- D. Hooper
- I. Polk

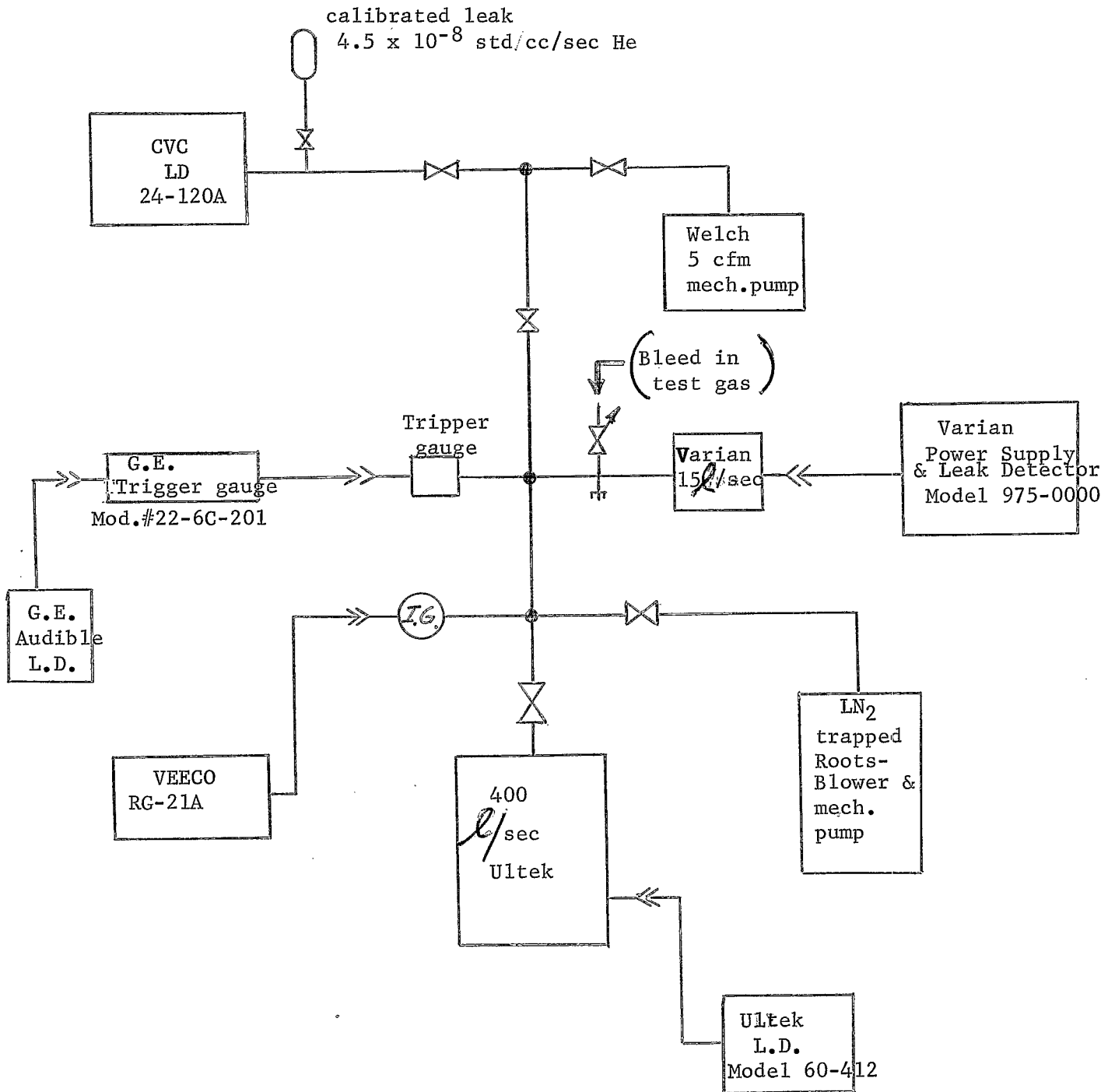


FIG. 1 Schematic of Test System