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OPERATION OF THREE ELECTRONIC LEAK DETECTORS

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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 22HC100, 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 - GE	Ultek	Scale deflection Varian
4.2×10^{-8}	-	-	-	-
1×10^{-7}	He	null	up	down
	CO_2	high freq.	up	up
	Ar	"	"	"
4×10^{-7}	He	null	up	down
	Ar	high freq.	"	up
$5\text{-}8 \times 10^{-6}$	He	null	down	down
	CO_2	high freq.	up	up
	Ar	"	"	"
$1\text{-}9 \times 10^{-4}$	He	null	down	down
	CO_2	-	-	-
	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:

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

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:

Leak Rate std cc/sec He

Test	CVC	Varian
1	$2\text{-}3 \times 10^{-6}$	$6\text{-}8 \times 10^{-4}$
2	1.8×10^{-6}	2.9×10^{-4}
3	2.4×10^{-7}	5.2×10^{-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 sensitivty 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.

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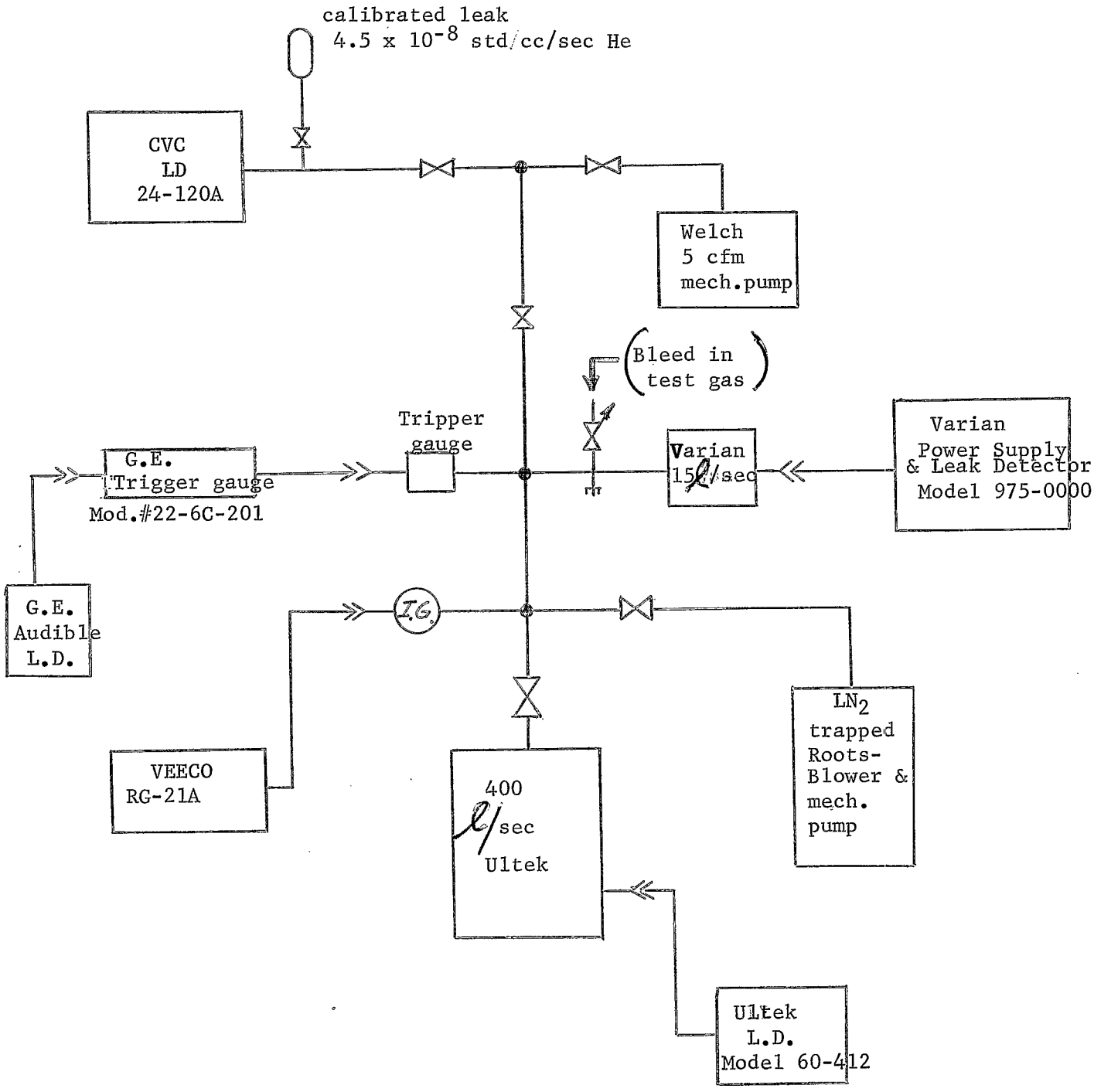

FIG. 1 Schematic of Test System