SECTION II

DESCRIPTION

2-1 SCOPE

Varian's 956 portable helium mass spectrometer leak detector is a microprocessor-controlled leak detector utilizing state-of-the-art technology for easy operator interface. A 48-character alpha-numeric display on the front panel is used to spell out information to alert the operator of the current status of the leak detector. The alpha-numeric displays also interact with the front panel keys enhancing the user-friendly environment. Control keys such as START, VENT, AUDIO, and AUTO/MAN keys appear on the right side of the front panel for easy access while programming or special function keys are on the left side under a cover.

Necessary valving takes place automatically as the leak detector moves through various ranges tracking the helium signal and the test port pressure. Additional features such as Auto Calibration, Gross Leak, large rough pumps, etc., make this portable leak detector a completely integrated package.

For unique applications and for the expert user, critical system parameters are programmable to make the 956 portable leak detector fit any leak detection application.

Figures 2-1 and 2-2 show the physical dimensions of the two models of the leak detector, both front and side views. Figure 2-3 shows the cabinet exposed, the vacuum system, and power controls.

2-2 SPECIFICATIONS

Table 2-1 lists the operating specifications of the Model 956 portable leak detector.

Table 2-1. Operating Specifications

Sensitivity	2×10^{-10} atm cc/sec - He
	8×10^{-11} atm cc/sec - air
Response time	<2 seconds-He
Amplifier drift	<2% of the most sensitive scale per AVS std 2.1
Noise level	<2% of the most sensitive scale per AVS std 2.1
Cycle time	mechanical pump dependent
Power	115 V, 50/60 Hz, single phase*
	Basic module requires 10-amp service
Startup time	8 minutes
Operating Temperatures	5 °C (41° F) low
	50 °C (122 °F) high

* The 956 is also available in 100V, 200V, 230V, and 240V models.

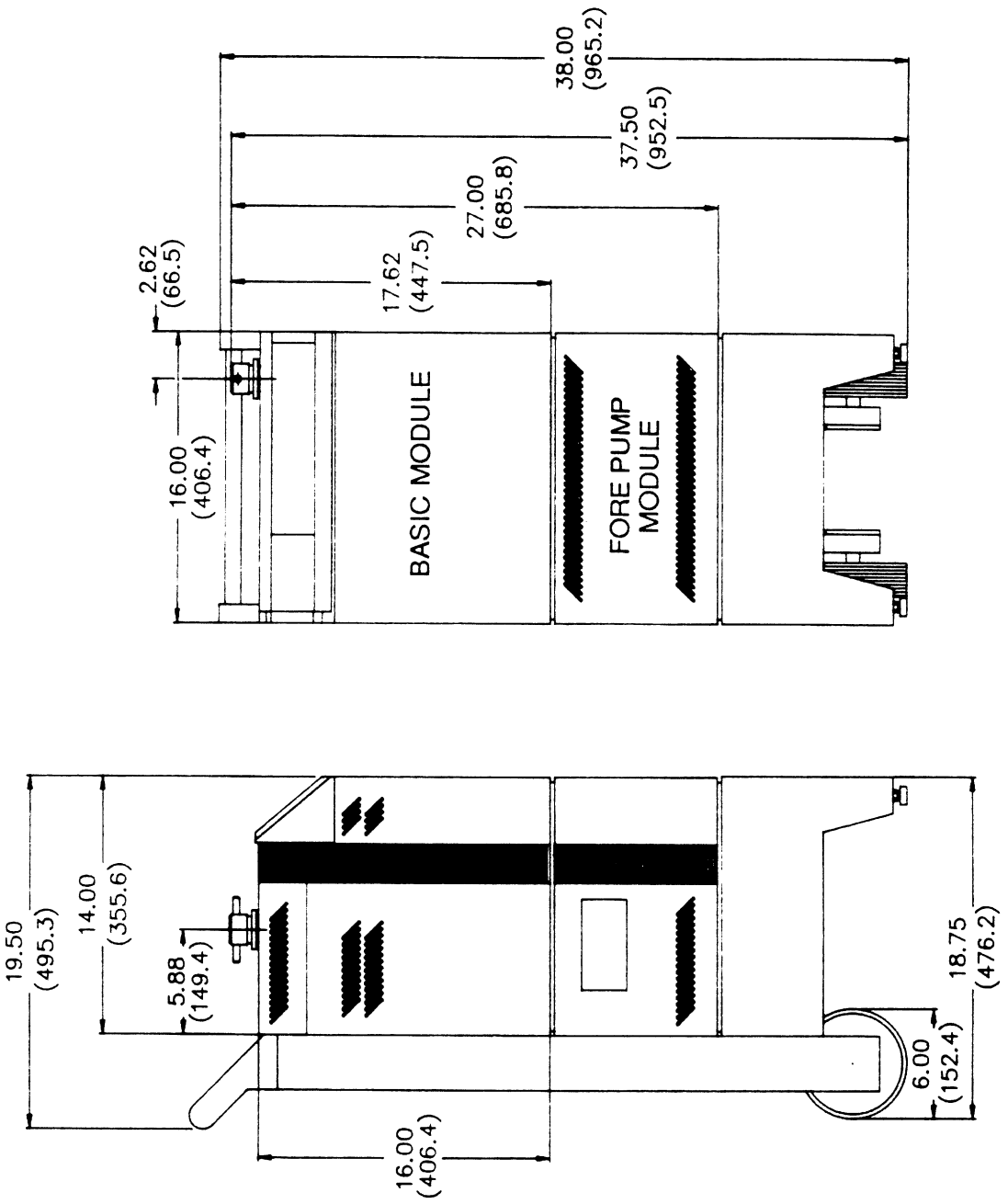


Figure 2-1. Varian 956 Leak Detector showing basic module with 1.2-cfm fore pump module and small cart

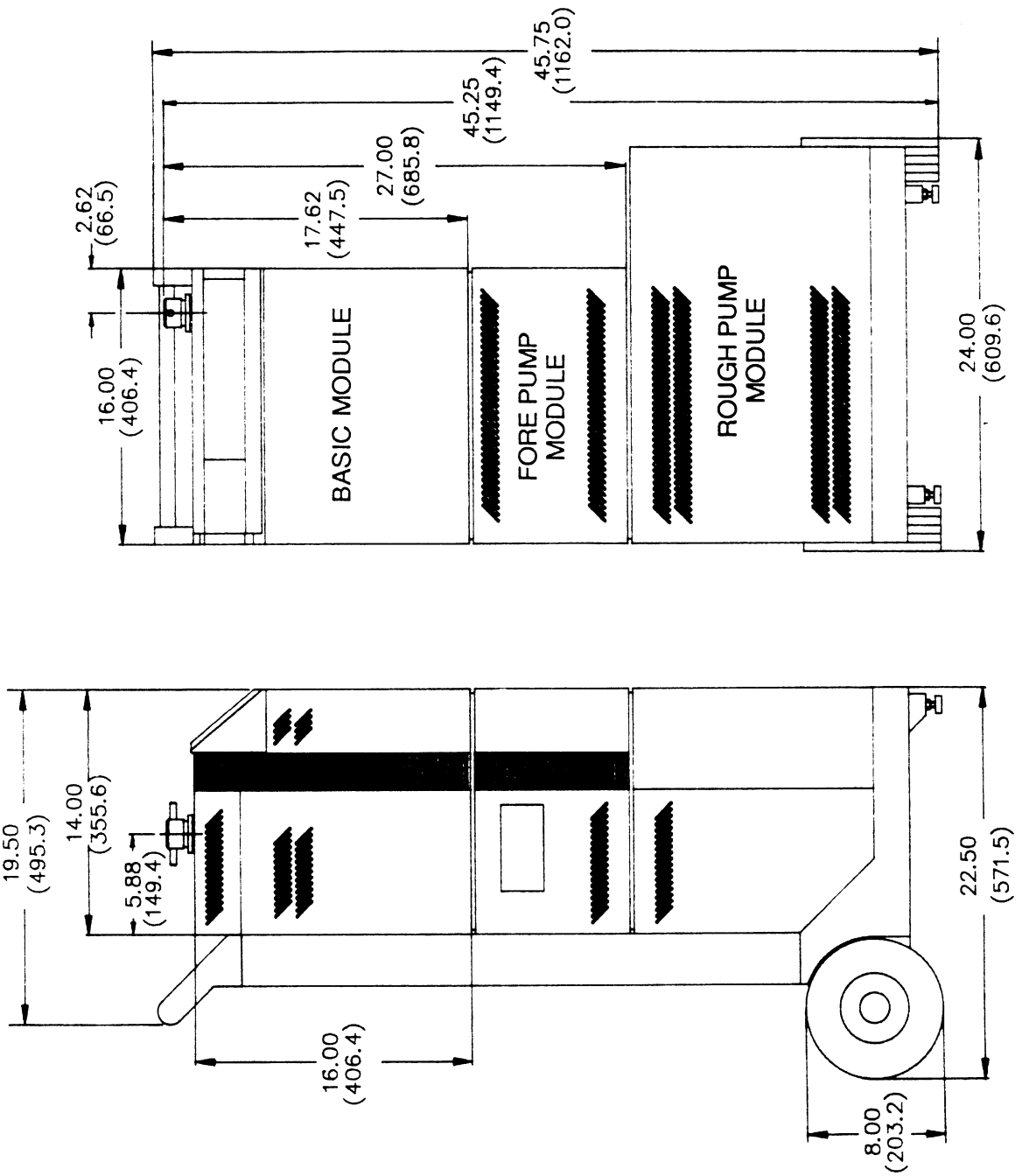


Figure 2-2. Varian 956 Leak Detector showing basic module, 1.2-cfm fore pump, 7-cfm roughing pump module, and large cart

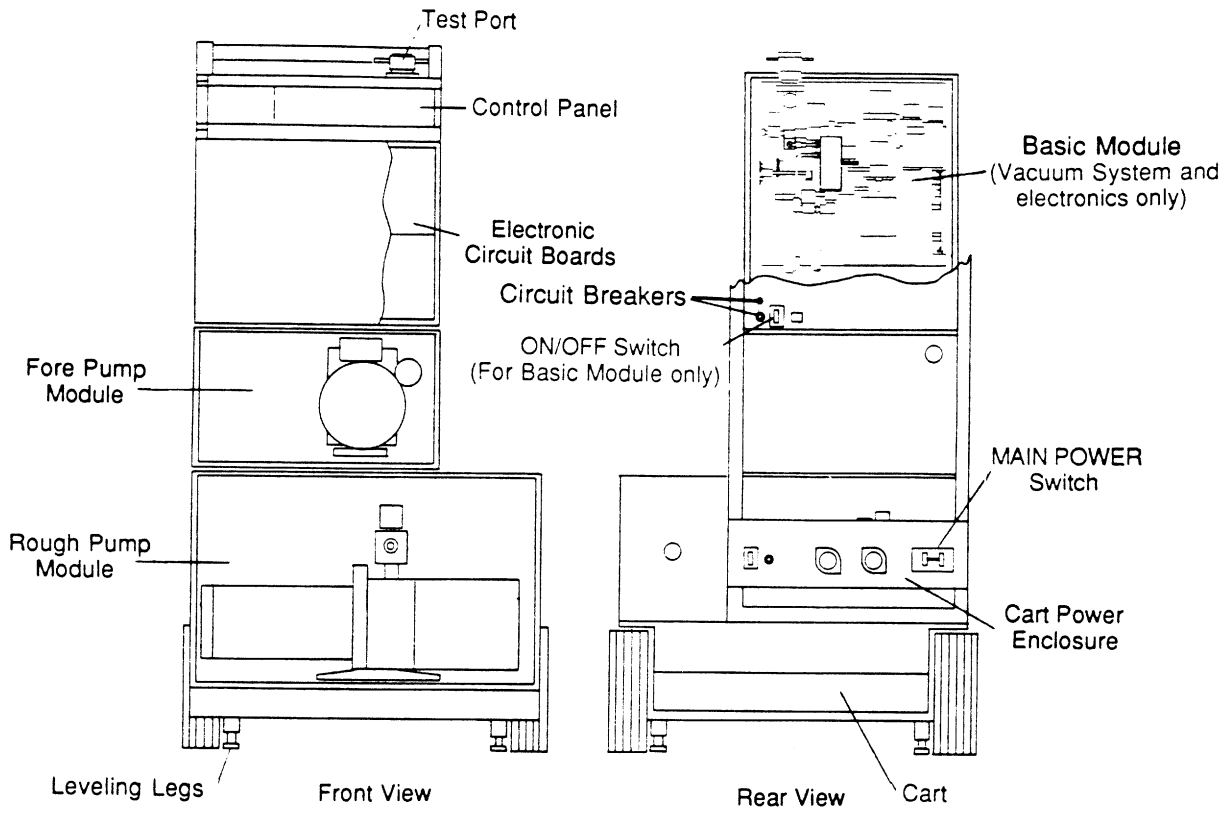


Figure 2-3. Varian 956 Leak Detector

2-3 MODULES

The 956 is available in the following five models:

Basic module (vacuum system and control panel)
Basic module plus an integral 1.2 cfm fore pump module
Basic module plus an integral 1.2 cfm fore pump module, cart-mounted (small cart)
Basic module plus a 7 cfm rough pump module, cart-mounted (large cart) (an 11 cfm pump is an option)
Basic module plus an integral 1.2 cfm fore pump module and a 7 cfm rough pump module, cart-mounted (large cart) (an 11 cfm pump is an option)

1 The basic module consists of the vacuum system, diffusion pump, spectrometer tube, power supply, and main electronics. This module can have the following options:

- a Gross leak (for testing 10^{-4} to 10 atm cc/sec) - requires both fore pump and rough pump modules
- b Built-in calibrated leak
- c Remote controller

2 The fore pump module is a 1.2-cfm mechanical pump used as a combination fore pump and rough pump.

3 The rough pump module is used as a rough pump only if a fore pump module is present, and as a fore pump if a fore pump module is not present. This pump can be turned on and off by a logic signal from the 956 leak detector and contains an electronic valve to isolate the vacuum system from the pump (also controlled by the basic module). This pump always requires the large cart for portability.

Note
Both the fore pump module and rough pump module are required for use when the gross leak option is purchased.

4 The carts come in two sizes: the small cart holds the basic module and the fore pump module and is ideal for a small, portable, complete package; the large cart can easily accomodate all five modules and has a convenient power strip to supply power to all the modules. This strip requires 30-ampere service.

2-4 VACUUM SYSTEM

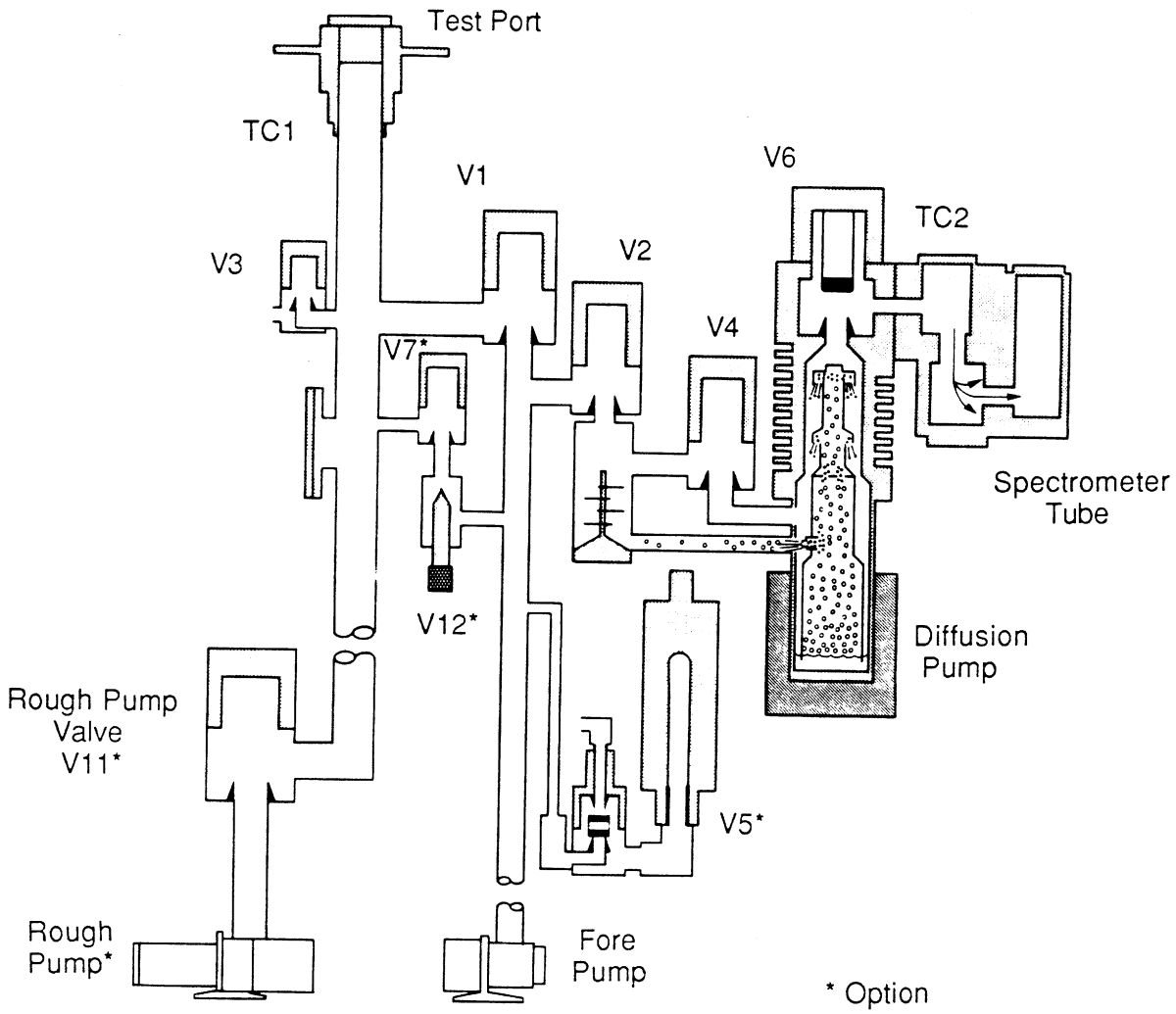
The vacuum system provides the necessary vacuum, and the valving system, with the roughing pump, evacuates the object to be tested and properly sequences the testing operation. The vacuum system (see Figure 2-4) consists of a diffusion pump, one or two mechanical pumps, a spectrometer tube, valves, and interconnecting pipes. The system serves three functions: it maintains the required vacuum in the spectrometer tube, it connects the customers part or system to the spectrometer tube, and it removes helium after a test. Additionally, Contraflow ™, an innovation of Varian, is utilized.

Referring to Figure 2-4, the ejector stage of the diffusion pump exhausts into the lower foreline which is directly connected to the ballast tank. The upper foreline bypasses the ejector stage and is connected through Ejector Bypass valve V4 to the tank. Under most conditions of leak testing, the valve will be open. If the valve is closed, the sensitivity of the leak detector is reduced by a factor of 100. This is because the helium must penetrate the ejector stage which has a higher compression ratio than the upper stages. When large leaks are encountered, the leak detector automatically reduces its sensitivity by closing the ejector bypass valve V4.

2-4-1 Diffusion Pump

The diffusion pump (shown in cutaway view in Figure 2-5) removes gases from the spectrometer tube to a pressure of less than 2×10^{-4} Torr. It operates by utilizing a series of vapor jets of specially refined oils to remove air and other gases from the tube, including helium.

Developed by Varian, the Contraflow technique takes advantage of the differences in compression ratios (outlet pressure divided by inlet pressure) produced by the diffusion pump for gases of different molecular weights. For example, the maximum compression ratio of helium may be 10 or 100, while for oxygen, nitrogen, and other gases contained in air, the ratios are normally far in excess of one million. This principle is implemented in the leak detector by introducing helium into the diffusion pump outlet (foreline) rather than into the



V1	Roughing valve	V6	Isolation valve
V2	Test valve	V7	Gross leak valve
V3	Vent valve	V11	External rough pump flow split valve (part of option)
V4	Ejector bypass valve		
V5	Calibrated leak valve	V12	Gross leak metering valve (manual adjust) (part of option)

Figure 2-4. Varian 956 Leak Detector Vacuum System

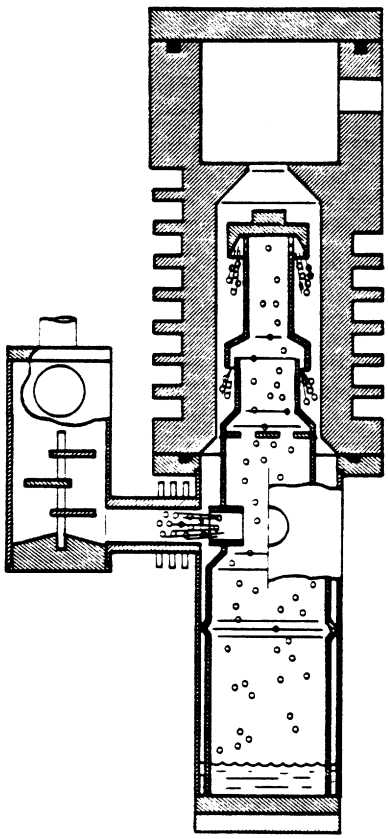


Figure 2-5. 956 Leak Detector Diffusion Pump (cutaway view)

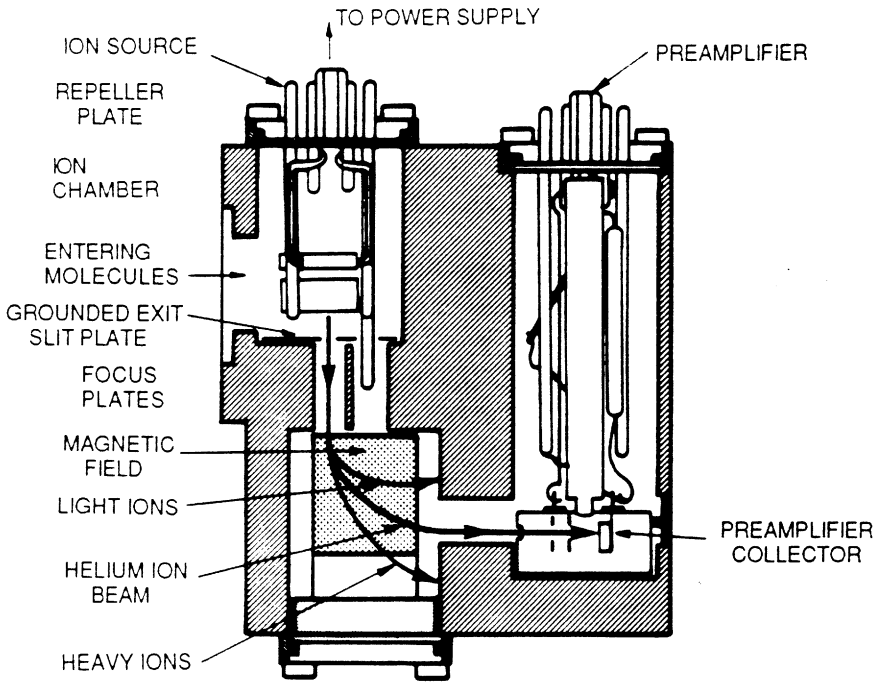


Figure 2-6. Cutaway View of 956 Spectrometer Tube

"normal" pump inlet as in conventional leak detectors. Helium, having a much lower maximum compression ratio than other gases contained in air, diffuses backwards through the diffusion pump to reach the spectrometer tube where it is detected in the normal manner. Although the mechanical forepump is also attached to the diffusion pump foreline and removes all inlet gases, including some helium, there is no appreciable loss of sensitivity in the Contra-flow™ leak detector. In fact, at higher test pressures, it is more sensitive than the conventional method.

2-4-2 Mechanical Pumps

The two mechanical pumps serve as the fore pump and the rough pump. The 1.2-cfm fore pump maintains the proper low pressure for the discharge of the diffusion pump. The rough pump (7 or 11 cfm) evacuates the test port and the test piece to the appropriate transfer pressure.

2-4-3 Spectrometer Tube

The spectrometer tube, Figure 2-6, is the heart of the leak detector. The spectrometer tube and the leak rate indicator provide a visual representation of the helium concentration in the vacuum system. The spectrometer tube consists of the following components.

Iridium Ion source	Preamplifier Assembly
Analyzing magnets	Enhancement magnets

Iridium Ion Source

The ion source consists of two filaments, two halves of an ion chamber, a pair of focus plates, and a grounded exit slit (the exit slit is a removable part of the spectrometer tube).

The top half of the ion chamber (the repeller plate) is held at a positive potential (repeller voltage) with respect to the bottom half of the ion chamber.

The bottom half of the ion chamber is held at a positive potential (ion voltage) with respect to the grounded exit slit. Two focus plates are also held positive (variable focus and fixed focus) with respect to the grounded exit slit.

When the filament is electrically heated, electron emission with help of the enhancement magnets divides the electrons into the ion chamber. Electrons colliding with molecules produce positive ions. These ions are forced through the bottom of the ion chamber, the grounded potential exit slit, and enter the analyzing magnetic field. This magnetic field separates and allows only the helium ions to reach the preamplifier.

The repeller, variable focus, and ion chamber require adjustment when ion sources are changed. This fine-tuning procedure will produce an efficient, helium-sensing spectrometer tube.

Preamplifier Assembly

The preamplifier assembly consists of an ion collector assembly and a sensitive electrometer amplifier.

The ion collector assembly includes:

a) Ground potential electrodes to guide the beam of helium ions.
b) A suppressor electrode to exclude any other ions.
c) An ion collector electrode mounted on a low-leakage feed-through.

Analyzing Magnets

The magnetic field is generated by two blocks of Alnico VIII magnet material which are bonded to a mild steel yoke. The yoke connects the two pole pieces that define the magnetic field which separates the helium ions from the other ions.

Enhancement Magnets

External magnetic pole pieces on each side of the ion source enclosure direct the electron beam for maximum ionization and sensitivity.

2-4-4 Remote Controller Option (See Figure 2-7)

The hand-held remote controller option allows the operator to leak-test components/systems in areas where remote operation is desired. The operator has control of the leak detector, and can start, vent, and zero the leak detector up to 25 feet away from the hand-held, compact controller which is fitted with an audible signal to indicate the presence of a leak in the tested unit.

Note
The remote controller may display a "No Link" message on rare occasions. To remedy this, simply unplug and replug the connector into the remote controller.

2-5 ELECTRONICS

The electronics of the 956 leak detector supplies the proper operating voltages to the spectrometer tube, provides those signals necessary for denoting quantitatively the presence of helium in the spectrometer tube, and controls all valve sequencing.

The new and automatic features of the 956 leak detector are accomplished by the microprocessor. This automatic distribution of internal signals not only enhances the leak detector's wide range of testing parameters but gives greater flexibility and reliability to the user.

The microprocessor also stores key tuning parameters in memory and retains them via an internal battery-operated circuit after a loss of power. This provides for fast recovery after a momentary loss of line voltage. Through the microprocessor, the leak detector will automatically search for all operating parameters stored in memory, start and warm up the leak detector, and bring it to the STANDBY stage ready for operation.

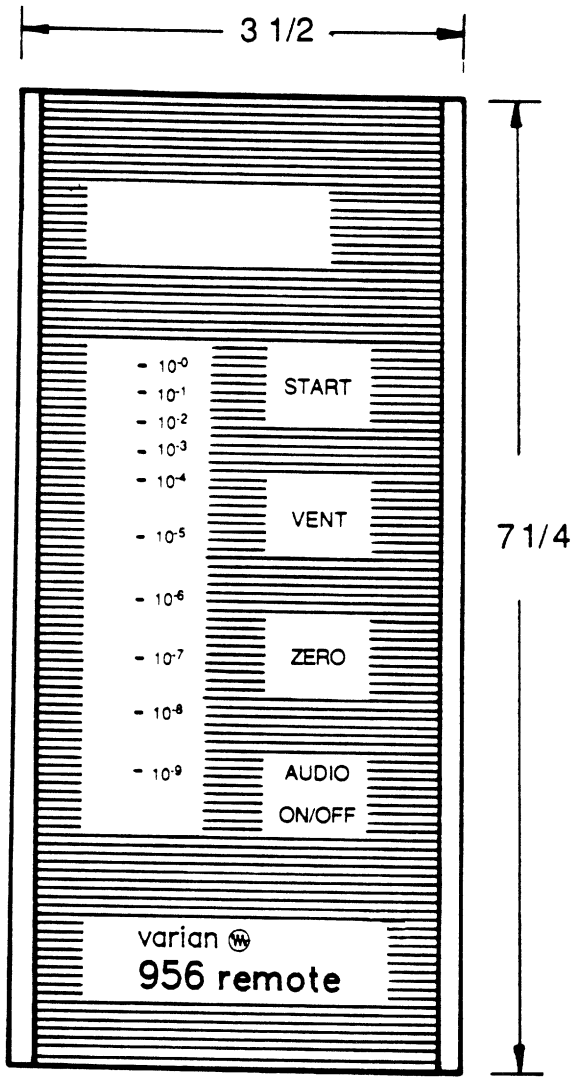


Figure 2-7. Remote Controller for 956 Leak Detector