Model 979C Helium Mass Spectrometer Leak Detector

OPERATIONS MANUAL

Manual No. 699909980
Revision A
February 2001

Model 979 Series
Helium Mass Spectrometer Leak Detector

Contra-Flow, MacroTorr and ConvecTorr are trademarks or registered trademarks of Varian Vacuum Technologies.

Alconox is a registered trademark of Alconox, Inc.; Apiezon is a registered trademark of M&I Materials Ltd.; Scotchbrite is a registered trademark of 3M.

Declaration of Conformity
Konformitätserklärung
Déclaration de Conformité
Declaración de Conformidad
Verklaring de Overeenstemming
Dichiarazione di Conformità
We/Wir/Nous/Nosotros/Wij/Noi: Varian, Inc.

Varian Vacuum Technologies
121 Hartwell Avenue
Lexington, MA, 02421-3133 USA

VARIAN

declare under our sole responsibility that the product,
erklären, in alleniniger Verantwortung, daß dieses Produkt,
déclarons sous notre seule responsabilité que le produit,
declaramos, bajo nuestra sola responsabilidad, que el producto,
verklaren onder onze verantwoordelijkheid, dat het product,
dichiariamo sotto nostra unica responsabilità, che il prodotto,

979 Series Portable Leak Detector

to which this declaration relates is in conformity with the following standard(s) or other normative documents.
auf das sich diese Erklärung bezieht, mit der/den folgenden Norm(en) oder Richtlinie(n) übereinstimmt.
auquel se réfère cette déclaration est conforme à la (auz) norme(s) ou au(x) document(s) normatif(s).
al que se refiere esta declaración es conforme a la(s) norma(s) u otro(s) documento(s) normativo(s).
waamaar deze verklaring verwijst, aan de volende norm(en) of richtlijn(en) beantwoodt.
a cui se rifersce questa dichiarazione è conforme alla/e sequente/I norma/o documento/I normativo/i.

89/336/EEC . . . . Electromagnetic Compatibility Directive
EN55011:1991 Class B. . . . . EMC/Limits for Radiated Emissions
EN55022:1995 Class A . . . . EMC/Limits for Conducted Emissions

IEC 1000-4-2/IEC 1000-4-3 . . . . EMC/Limits for Electrostatic Emissions
IEC 1000-4-4/IEC 1000-4-6

IEC 801-2 Crit B . . . . EMC/Immunity to Electromagnetic Fields
IEC 801-3 Crit A and Transient Burst
IEC 801-4 Crit B

Frederick C. Campbell
Operations Manager
Varian Vacuum Technologies
Lexington, Massachusetts, USA

CE

February 2001

Warranty

Products manufactured by Seller are warranted against defects in materials and workmanship for twelve (12) months from date of shipment thereof to Customer, and Seller's liability under valid warranty claims is limited, at the option of Seller, to repair, to replace, or refund of an equitable portion of the purchase price of the Product. Items expendable in normal use are not covered by this warranty. All warranty replacement or repair of parts shall be limited to equipment malfunctions which, in the sole opinion of Seller, are due or traceable to defects in original materials or workmanship. All obligations of Seller under this warranty shall cease in the event of abuse, accident, alteration, misuse, or neglect of the equipment. In-warranty repaired or replaced parts are warranted only for the remaining unexpired portion of the original warranty period applicable to the repaired or replaced parts. After expiration of the applicable warranty period, Customer shall be charged at the then current prices for parts, labor, and transportation.

Reasonable care must be used to avoid hazards. Seller expressly disclaims responsibility for loss or damage caused by use of its Products other than in accordance with proper operating procedures.

Except as stated herein, Seller makes no warranty, express or implied (either in fact or by operation of law), statutory or otherwise; and, except as stated herein, Seller shall have no liability under any warranty, express or implied (either in fact or by operation of law), statutory or otherwise. Statements made by any person, including representatives of Seller, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon Seller unless reduced to writing and approved by an officer of Seller.

Warranty Replacement and Adjustment

All claims under warranty must be made promptly after occurrence of circumstances giving rise thereto, and must be received within the applicable warranty period by Seller or its authorized representative. Such claims should include the Product serial number, the date of shipment, and a full description of the circumstances giving rise to the claim. Before any Products are returned for repair and/or adjustment, written authorization from Seller or its authorized representative for the return and instructions as to how and where these Products should be returned must be obtained. Any Product returned to Seller for examination shall be prepaid via the means of transportation indicated as acceptable by Seller. Seller reserves the right to reject any warranty claim not promptly reported and any warranty claim on any item that has been altered or has been returned by non-acceptable means of transportation. When any Product is returned for examination and inspection, or for any other reason, Customer shall be responsible for all damage resulting from improper packing or handling, and for loss in transit, notwithstanding any defect or non-conformity in the Product. In all cases, Seller has the sole responsibility for determining the cause and nature of failure, and Seller's determination with regard thereto shall be final.

If it is found that Seller's Product has been returned without cause and is still serviceable, Customer will be notified and the Product returned at its expense; in addition, a charge for testing and examination may be made on Products so returned.

3/1/00

Hazard and Safety Information

This manual uses the following standard safety protocol:

WARNING *The warning messages are for attracting the attention of the operator to a particular procedure or practice which, if not followed correctly, could lead to serious injury.*

CAUTION *The caution messages are displayed before procedures, which if not followed, could cause damage to the equipment.*

NOTE *The notes contain important information taken from the text.*

Operators and service personnel must be aware of all hazards associated with this equipment. They must know how to recognize hazardous and potentially hazardous conditions, and know how to avoid them. The consequences of unskilled, improper, or careless operation of the equipment can be serious. This product must only be operated and maintained by trained personnel. Every operator or service person must read and thoroughly understand operation/maintenance manuals and any additional information provided by Varian Vacuum Technologies. All warning and cautions should be read carefully and strictly observed. Consult local, state, and national agencies regarding specific requirements and regulations. Address any safety, operation, and/or maintenance questions to your nearest Varian Vacuum Technologies office.

WARNING *The mechanical components of leak detectors are typically cleaned with alcohol, methanol, or other solvents.*

When heated, sprayed, or exposed to high-temperature equipment, these solvents become flammable and explosive, causing serious injury or death. Do not use these solvents near a high-temperature source. Ventilate the working area with a blower and use in a large, well-ventilated room.

Alcohol, methanol, or other solvents are irritants, narcotics, depressants and/or carcinogenics. Their inhalation and/or ingestion may produce serious side effects. Prolonged or continued contact with the skin will result in absorption through the skin and moderate toxicity. Always ensure that cleaning operations are carried out in large, well-ventilated rooms, and wear eyeshields, gloves, and protective clothing.

NOTE

Do not clean any aluminum parts with Alconox®. Alconox is not compatible with aluminum and will cause damage.

NOTE

During reassembly, always use Loctite PST (teflon-impregnated pipe thread compound) on pipe threads.

NOTE

Where applicable, inspect for any damage to retaining rings and O-rings. Remove them carefully with your fingers. Do not use any metal tools for this task. This prevents scratching of any sealing surfaces.

NOTE

To clean O-rings, wipe them with a clean, lint-free cloth or paper. If vacuum grease is required, apply Apiezon® L lightly; remove excess grease until only a shiny, thin film remains.

Contents

Figures

Tables

This page intentionally left blank.

Section 1. Introduction

1.1 Leak Testing—Why is it Needed?

Even with today's complex technology, it is, for all practical purposes, impossible to manufacture a sealed enclosure or system that can be guaranteed leak proof without first being tested. Through the use of modern mass spectrometer leak testing techniques, as implemented by the Varian 979C Helium Leak Detector, leak rates in the 10^{-9} std cc/sec range can be reliably detected. The discussion that follows provides a brief summary of specific information pertinent to the overall subject of leak detection.

1.2 Classes of Leak Detection

There are four general classes of leak detection:

Hermetic Enclosures (or parts thereof) — These are tested to prevent entrance of contaminants or loss of fluid that would affect performance of the enclosed unit. Examples: electronic devices, integrated circuits, sealed relays, motors, ring pull tab can ends, and multipin feedthroughs.

Hermetic Systems — These are tested to prevent loss of fluid or gas within. Examples: hydraulic systems and refrigeration systems.

Evacuated Enclosures (or parts thereof) — These are tested to prevent too-rapid deterioration of vacuum with age. Examples: TV picture tubes, bellows sensing elements, full-panel opening can ends, etc.

Vacuum Systems — These are tested to minimize inleakage and allow attainment of better vacuum or higher gas removal ability at any given vacuum (absolute pressure).

1.3 Terminology

The following terminology has application throughout this manual:

Flow

std cc/sec — One cubic centimeter of gas per second at a pressure differential of one standard atmosphere (760 torr at 0° C).

atm cc/sec — One cubic centimeter of gas per second at ambient atmospheric pressure and temperature (used interchangeably with *std cc/sec* because the difference is insignificant for leak testing purposes).

Rate-of-Rise In vacuum systems, this is defined as the rate of increase of absolute pressure per unit time with the vacuum pump isolated from the system, and is the sum of actual inleakage and internal outgassing. Rate of rise is usually expressed in torr or microns (millitorr) per hour. The flow rate should be expressed in torr-liters/second.

Conversions

1 std cc/sec*	0.76 torr-liter/sec
1 torr-liter sec*	1.3 std cc/sec
1 std cc/sec	9.7 x 10^4 micron cubic feet per hour or practically 10^5 micron CFH (µCFH)
1 µCFH	practically 10^{-5} std cc/sec

**for practical purposes, equal*

Numerical Notation-Exponential System Most leak rates of commercial significance are very small fractions of a std cc/sec. Therefore minus powers of ten are used as a convenient system of numerical shorthand.

Table 1-1 shows the relationship of exponents and multipliers (to the base 10) to the arithmetic form, and the equivalent result.

Table 1-1 Decimal Notation

Multiplier x 10^n		Arithmetic Form		Result
1 x 10^2	=	1 x 10 x 10	=	100
1 x 10^1	=	1 x 10	=	10
1 x 10^o	=	1	=	1
1 x 10^{-1}	=	1 x 1/10	=	.1
1 x 10^{-2}	=	1 x 1/10 x 1/10	=	.01
5 x 10^{-3}	=	5 x 1/10 x 1/10 x 1/10	=	.005
1 x 10^{-3}	=	1 x 1/10 x 1/10 x 1/10	=	.001

1.4 Various Methods of Testing for Leaks

There are many methods of testing for leaks in enclosures—either systems or containers. The more commonly used methods along with the range of accuracy provided are listed below:

Water Immersion (Air Bubble Observation) This method is good to approximately 10^{-3} std cc/sec, and can be more sensitive if internal pressure is increased or vacuum is created above water pressure. This method is limited because of the difficulty in differentiating between leakage bubbles and surface desorption bubbles. It is used to test industrial items such as valves, hydraulic components, castings, automotive and air conditioning components.

Dye Penetrant	A special dye, applied to one side of a surface suspected to contain a leak, seeps through the leak and appears on the other side. This method can take an hour or more for a 10^{-4} std cc/sec leak to show up. This test is inexpensive but destructive in some applications, as well as slow and messy.
Ultrasonic	This method is good to approximately 10^{-3} std cc/sec. This method tests for ultrasonic sounds coming from a gas leak and is used for testing of high pressure lines.
Halogen (sensitive to halogen elements or compounds, especially refrigerant gases)	This method is good to approximately 10^{-5} std cc/sec in most current applications, but extendable to 10^{-9} std cc/sec under some limited situations. It is critically dependent on operator judgement if leaks are below 10^{-5} std cc/sec and requires constant flow of fresh air in the test area because of the tendency of trace gas to *hang* in the area. The detector used in this method is sensitive to a variety of gases from external sources such as cigarette smoke and solvent fumes.
Radioisotope	This method is useful only for testing hermetically sealed cavities. It has approximately the same range as the helium method but it involves an expensive installation (from four to ten times the cost of a helium installation depending on the degree of isolation of radiation required). It also requires a radiation safety officer.
Helium	This method is good to 10^{-11} std cc/sec, and is capable of finding leaks of any size larger. It is useful for testing hermetic seals, vacuum enclosures, and vacuum systems, and is the most versatile of industrial and laboratory leak detection testing methods.

1.5 Helium Mass Spectrometer Leak Detection (MSLD)

Helium is an excellent trace gas because it is the lightest of the inert gases and as a consequence readily penetrates small leaks. In addition, its presence in the atmosphere is minute (5 PPM or 4 millitorr absolute). Helium is easily detected by a simple mass spectrometer (helium has a mass of 4 so that adjacent *peaks* of 3 and 6 are easily separated by this technique). Also, helium is readily available at reasonable cost, and is completely non-toxic and non-reactive. The basic principles of the helium MSLD technique are discussed below.

1.5.1 Principles of Mass Spectrometry

A mass spectrometer sorts gases by their molecular weights (mass number) to determine the quantity of each gas present. With the helium MSLD, the point of interest is primarily in helium and the mass spectrometer tube is relatively simple. The principle is to ionize the gases in vacuum, accelerate the various ions through a fixed voltage, and then separate the ions by passing them through a magnetic field. A slit, properly placed, allows only helium ions to pass through and be collected. The resulting current is amplified and a leak rate bar graph indicates the presence and amount of helium.

1.5.2 Application as a Leak Detector

A mass spectrometer leak detector consists of a spectrometer tube, the electronics to operate and interpret it, and a high vacuum system to maintain proper vacuum. In addition, means are provided for connecting a test object, a *rough vacuum* pump, and a system of *roughing* and *test* valves is provided to evacuate the test object for connection to the spectrometer tube; or, if it is a sealed object containing helium, to evacuate a chamber containing the test object.

1.5.3 The Nature of Flow in a Vacuum

It should be noted that the purpose of the vacuum system is to support operation of the analyzing spectrometer tube. Helium molecules entering through a leak individually reach the spectrometer tube in a few milliseconds. Helium molecules as well as molecules of other gases are continuously removed by the vacuum system turbo pump. If helium is continuously applied to a leak, the concentration in the spectrometer tube will rise sharply at first, then reach equilibrium when it is being pumped out at the same rate as it is entering. When helium is completely removed from the leak, the input will drop to zero while the residual helium is pumped out of the system. Thus, a leak is indicated by a rise in the output signal of the spectrometer tube.

1.5.4 Facts About Leak Rates

Visualizing Leaks in Everyday Terms	10^{-5} std cc/sec: approximately 1 cc/day 10^{-7} std cc/sec: approximately 3 cc/year
Audible or Visual Detection by Observer	
a. Bubbles rising in water	10^{-4} std cc/sec or larger
b. Audible Leaks	10^{-1} std cc/sec or larger
Sizes of Leaks in Man-Made Joints	Studies indicate that almost all leaks at joints are about 5×10^{-7} std cc/sec (about 1 cc/month) or larger. This is true of ceramic-to-metal, plastic-to-metal seals, welded, soldered and brazed joints. Some long-path leaks may be slightly smaller. Diffusion of helium through glass may be as high as 10^{-8} std cc/sec per square centimeter of surface area.
Variation in Leak Sizes	Leaks unintentionally *built-in* at joints during manufacture may vary from hour to hour and day to day. Breathing on a 10^{-6} std cc/sec leak provides enough moisture to close it temporarily; perhaps for several days. Atmospheric particles can close a leak of this size. Never depend on an *accidentally made* leak to remain constant. Manufacturing standard leaks for calibration purposes requires special techniques.

1.6 Leak Detection Methods

Most leak detection methods depend on the use of a tracer gas passing through the leak and being detected on the other side (for example, visual detection of air bubbles in water).

The mass spectrometer leak detector operates with helium as a tracer and is widely used because it combines high sensitivity with production testing capability. The three basic methods in common use are described below.

1.6.1 Test Piece Evacuated (Figure 1-1a and Figure 1-1b)

The object to be tested is evacuated by the leak detector roughing pump, then valved into the spectrometer vacuum system. The surface of the test object is then probed with a small jet of helium to locate individual leaks, or surrounded by helium (hooded) for an overall leak check.

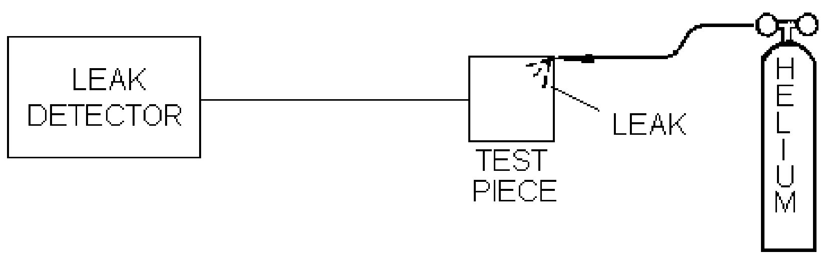


Figure 1-1a Test Piece Evacuated: Tracer Probe Used to Locate Leak

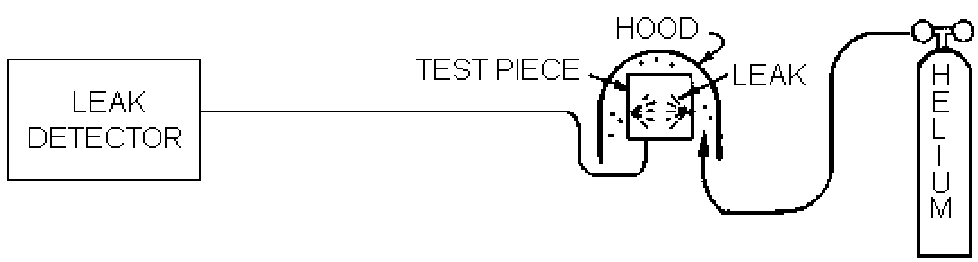


Figure 1-1b Test Piece Evacuated and Hooded with Helium Atmosphere to Determine Overall Leak Rate

1.6.2 Test Piece Pressurized (Figure 1-2)

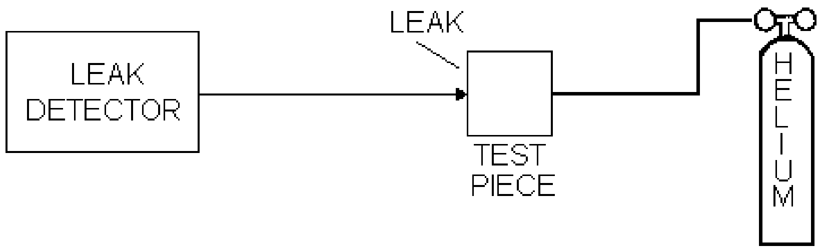


Figure 1-2 Test Piece Pressurized: Detector Probe Used to Locate Leak

A sampling probe is connected to the leak detector. The object to be tested is filled with helium at the desired test pressure and the probe is moved over its surface. Some of the helium escaping from a leak is captured through the probe and enters the leak detector, thus locating the leak.

Sensitivity of this type of testing is limited to about 10^{-7} std cc/sec, since most of the escaping helium diffuses into the surrounding atmosphere. The sensitivity is also limited by operator technique and variation in ambient helium concentration in the vicinity of the testing.

An alternative to probing is to enclose the object and probe the enclosure for a change in helium content.

1.6.3 Test Piece Already Sealed (Figure 1-3)

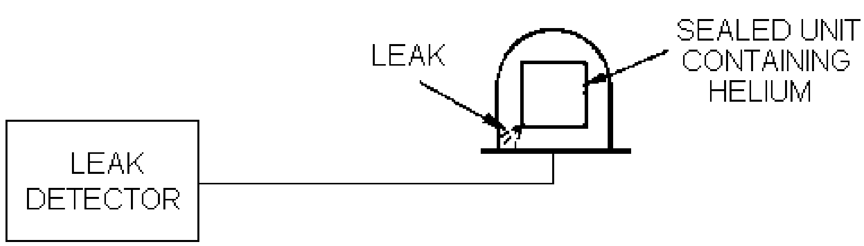


Figure 1-3 Test Piece Sealed with Helium or Mixture of Helium and Other Gases Bell Jar Used to DetermIne Overall Leak Rate

Sometimes it is necessary to leak check a completely sealed object. This may be done by placing helium inside the object before sealing (either 100% or mixed with other gas used for backfilling). The object is then placed in a vacuum chamber connected to the leak detector. Helium escaping from the object into the vacuum chamber is detected by the spectrometer tube. Sensitivity depends on the partial pressure of helium in the object.

If the presence of helium in the finished object is undesirable, units already sealed may first be placed in a container that is then pressurized with helium for a specific time at a known pressure. Helium will enter the object through any leaks and may be detected later, as described in the previous paragraph. Gross leaks may sometimes not be detected, since all helium entering through a large leak may be lost prior to testing. Also, spurious signals may be given by helium not entering the object, but entering surface fissures and remaining long enough to be detected.

1.7 Mass Spectrometer Leak Detector—Simplified Description

Each Model 979C consists basically of an analytical sensing tube called a *spectrometer tube*, electronics to operate the tube, and a vacuum system to maintain a very high vacuum within this tube (usually less than 0.1 millitorr or about one ten-millionth of ordinary atmospheric pressure). In addition, a rough vacuum pump and a system of valves is provided to enable test cycles to be carried out (see Figure 1-4).

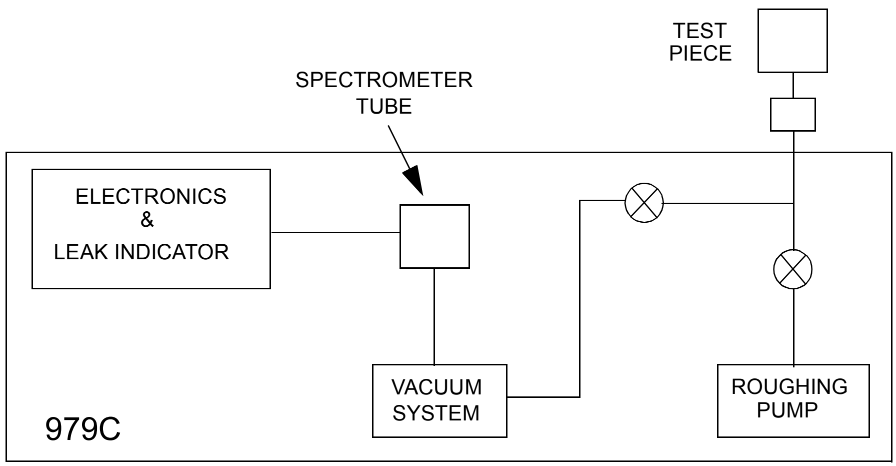


Figure 1-4 Mass Spectrometer Leak Detector

In the spectrometer tube, gas molecules are ionized (given a positive electrical charge) by bombarding them with electrons from a hot thoriated iridium filament. The ions, thus formed, are accelerated into a magnetic field where the mass 4 (helium) ions are deflected 90 degrees (see Figure 1-5 on page 1-8). Only helium ions reach the collector.

An extremely stable electrometer provides an electron current to the collector, which neutralizes the current produced by the collection of helium ions. The *feedback* current is presented on the leak rate bar graph. Since this current is directly proportional to the number of helium ions striking the collector per unit time, the panel leak rate bar graph directly reflects the concentration of helium in the vacuum system at any time. Any helium entering the system causes an increased concentration of helium within the spectrometer tube, which is reflected as an increase on the leak rate bar graph. In addition to the electrometer, the electronics also provides suitable voltages to operate the spectrometer tube and controls and instrumentation for the vacuum system.

Test pieces are generally *rough* pumped (or, if pressurized, the chamber in which they are to be tested is *rough* pumped) by a mechanical vacuum pump before they are connected to the spectrometer tube. This prevents overloading the vacuum pumping system.

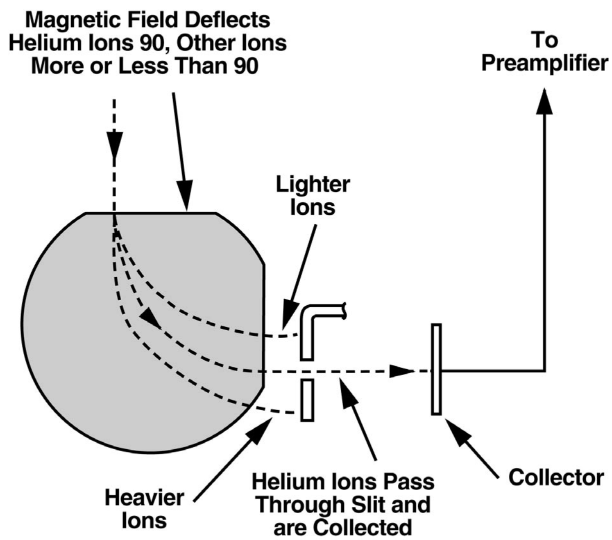


Figure 1-5 Magnetic Separation Principle

Section 2. Getting Started

2.1 The Varian Model 979C

The Model 979C is a wide-range Helium Mass Spectrometer Leak Detector. It is comprised of a turbomolecular high vacuum pump, spectrometer tube, valve block, Varian Vacuum Technologies' Platform leak detector electronics, and an operator interface in a stylish, yet rugged housing. The 979C is available as a stand-alone, bench-mount unit or as a single or dual, dry or oil sealed mechanically pumped leak testing station on a cart.

The 979C uses Varian Vacuum Technologies' Platform leak detector electronics architecture to operate the spectrometer assembly, control the mechanical and high vacuum pumps, control the valve block, and provide leak rate and system status information to the operator interface. The Platform is a collection of printed circuit boards that operate using the PC/104 Bus structure to perform the various functions of a helium mass spectrometer leak detector.

2.2 Initial Startup and Shutdown

2.2.1 Startup

Plug the leak detector power cord into an appropriate receptacle and place the power switch on the rear power control panel in the **I** position.

When the SYSTEM READY indication appears on the home screen, the leak detector is ready for operation. If the 979C is being started after a long period of being off (several hours), it may take up to 30 minutes to stabilize and provide reliable, quantitative leak rate readings.

2.2.2 Calibration

The 979C is capable of performing an automated calibration routine using either an optional internal calibrated leak (factory installed), or an external calibrated leak placed into the test port. Refer to "Calibrated Leak Set-up" on page 3-13 for proper setup of the 979C for auto-calibration.

After starting the 979C, a calibration routine must be executed. If using the optional internal calibrated leak, a calibration is performed by pressing the TEST button on the front panel to place the system in test mode, then pressing the CALIBRATE button on the front panel to perform an automated calibration of the system.

Calibration may be verified by pressing the READ STANDARD LEAK button on the front panel when in TEST mode. Press the READ STANDARD LEAK button again to return to TEST mode.

If an external leak is to be used, first press the VENT button to vent the leak detector and then install a calibrated leak into the test port. Press the TEST button to place the leak detector in Fine Test mode. Once in Fine Test, press the CALIBRATE button to perform an automated calibration.

When the calibration has been completed, the leak detector will revert to a Fine Test mode of operation to allow for calibration verification.

2.2.3 Shutdown

Shutting down the 979C is as simple as moving the power switch on the rear panel to the **O** position. The system may be in any mode when shut down. It bears noting, however, that when the system is shut down, all valves in the system close, so if the system is not in VENT mode, the test port will remain under vacuum and may be difficult to open.

2.3 Front Panel Displays and Controls

The 979C front panel leak rate display and control buttons are located on the front right-hand side of the leak detector (Figure 2-1). The panel features large, color coded and clearly labeled buttons, and a large, easy to read bar graph display. A brief description of the control buttons follows. A more detailed discussion is included in Section 3, “Operating the 979C Leak Detector”.

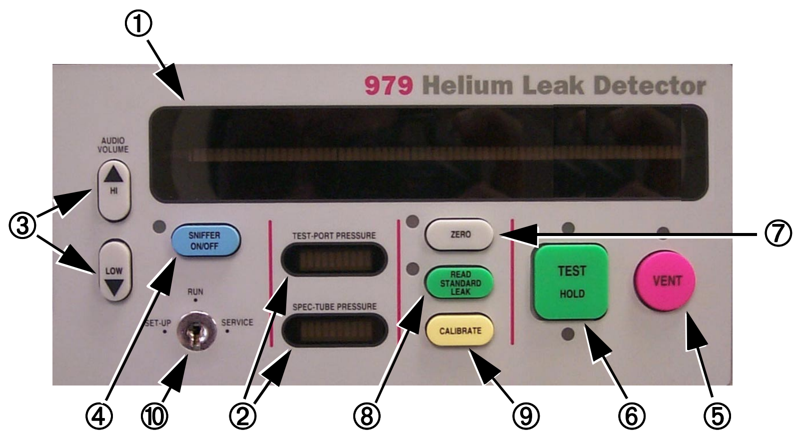


Figure 2-1 Front Panel Displays and Controls

①	Leak Rate Display	The large bar graph displays the leak rate in one of two forms: ❑ A mantissa on the bar and a numerical exponent ❑ Just the bar as a logarithmic bar graph display The label for the bar graph changes to indicate the current mode of operation.
②	Pressure Displays	Two smaller bar graphs display the pressures in the spectrometer tube and the test port. The small bar graphs change color to indicate more or less favorable conditions.
③	Audio Volume Control	A pair of buttons are provided to change the volume level of the audio leak rate indication.
④	Sniffer On/Off	The SNIFFER ON/OFF button toggles the 979C into and out of SNIFFER mode. The LED illuminates when SNIFFER mode is enabled.
⑤	Vent	The VENT button advances the 979C to the vented state. The LED indicator illuminates while the 979C is in the vented state.
⑥	Test/Hold	When in VENT, pressing the TEST/HOLD button automatically advances the 979C through roughing, then through the various test states, depending on the achievable test port pressures and leak rates. The LED illuminates when the 979C is in a test state.
⑦	Zero	The ZERO button is functional only in the test state. The ZERO function zeros the leak rate in the current valve test state. The LED illuminates while the zero function is taking place.
⑧	Read Standard Leak	The READ STANDARD LEAK button is functional only in the test state. This function is used to verify calibration by exposing the optional internal calibrated leak or the external calibrated leak to the system.
⑨	Calibrate	The CALIBRATE button is used to initiate a calibrate function using either the optional internal calibrated leak or an external leak in the test port, as dictated by the parameters set on the Calibrated Leak Set-up screen (see Section 3.5.1, "Calibrated Leak Set-up"). The LED illuminates to indicate that calibration is taking place.
⑩	Key Switch	The three-position key switch, SET-UP/RUN/SERVICE, allows for access and control of operational parameters, as well as service related functions.

2.4 Rear Panel Controls

2.4.1 System Control and Communication Panel

The system control and communication panel (Figure 2-2) is located on the lower left section of the rear panel.

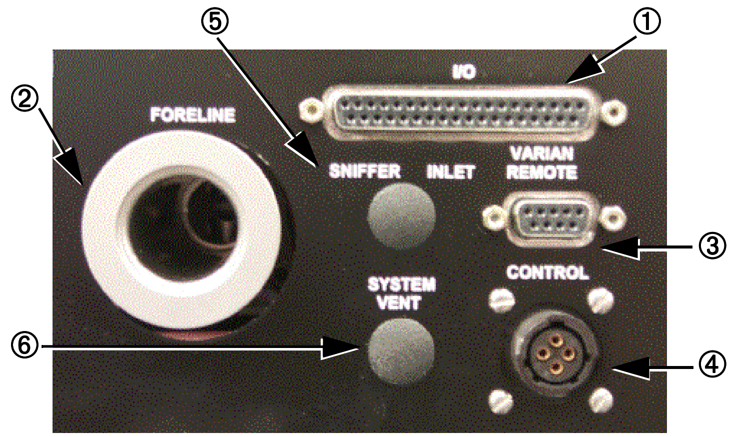


Figure 2-2 System Control and Communication Panel

① I/O connector	The I/O connector is a 37-pin female D-type connector. Access to all discrete input/output functions, RS-232, reject set points, and analog leak rate output signals are available at this connector. A detailed summary of information related to I/O communications is provided in Appendix B.
② Foreline Pump Connection	The KF25 foreline pump connection is used to connect the fore/roughing pump of a single mechanical pump configuration, or the dedicated forepump of a dual pump configuration to the leak detector base unit.
③ Remote Control Input	A 9-pin female D-type connector is provided to connect the optional remote control device (Part Number L9558301). The operation procedure for the optional remote is outlined in the remote control operation manual (Part Number 699909915).
④ Rough Valve Control	The rough pump valve control connection is used on dual pump configurations.
⑤ Sniffer Inlet	Not currently used.
⑥ System Vent Port	Not currently used.

2.4.2 Power Control and Fuses

The 979C power control and fuse panel is located on the lower right section of the rear panel (Figure 2-3). The label above this panel (shown on the right in this figure) contains information regarding the connections on this panel.

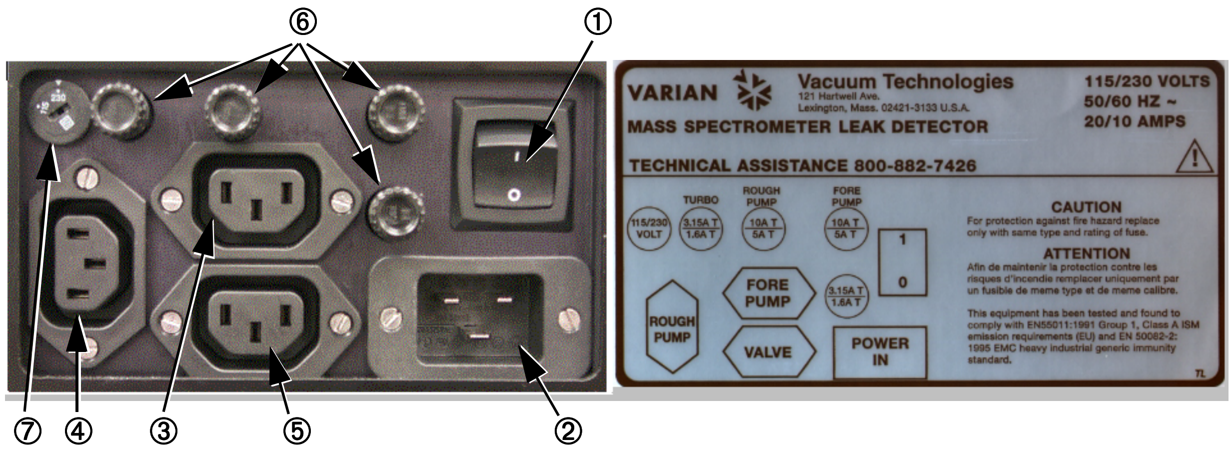


Figure 2-3 Power Control and Fuse Panel

① Power ON/OFF Switch	The power control and fuse panel contains the main power ON/OFF switch. The 979C may be powered down in any state. Upon power down, all internal valves close in order to protect and maintain the cleanliness of the vacuum system.
② Power Input Connector	The main power input connector accepts the power cord that is provided with the leak detector. The power cord is rated for 20 A service and must not be modified to plug into a lower rated receptacle.
③ Forepump Power	The forepump power output connector accepts the mating connector from the fore/roughing pump of a single mechanical pump configuration, or the mating connector from the dedicated forepump of a dual mechanical pump configuration.
④ Rough Pump Power	The rough pump power output connector accepts the mating connector from the dedicated roughing pump of a dual mechanical pump configuration. This connection is not used on the single mechanical pump configuration.
⑤ Roughing Valve Power	The roughing valve power output connector accepts the mating control connector from the electro-magnetic aluminum block valve mounted on the inlet of the dedicated roughing pump.

⑥ Power Fuses

The 979C leak detector utilizes four independent power fuses. Turn off the main power switch and disconnect the main power plug before checking or replacing fuses. Fuse sizes are as follows:

Rough Pump and Forepump Fuse (1 each)

- ❑ 10 A SloBlo 5 x 20 mm, Littelfuse # 215-010 (120 VAC)
- ❑ 5 A SloBlo 5 x 20 mm, Littelfuse # 218-005 (220 VAC)

Turbo Pump and Rough Valve Fuse (1 each):

- ❑ 3.15 A SloBlo 5 x 20 mm, Littelfuse # 218-3.15 (120 VAC)
- ❑ 1.6 A SloBlo 5 x 20 mm, Littelfuse # 218-01.6 (220 VAC)

⑦ Voltage Change Over Switch

The operating voltage change over switch provides the ability to quickly switch the operating voltage of the basic unit between 120 VAC and 220 VAC, 50/60 Hz.

NOTE

If your leak detector is equipped with a turbo compression enclosure box (attached below the leak detector basic unit), the operating voltage cannot be switched over. Contact the factory in the event that the operating voltage needs to be changed.

2.4.2.1 Changing the Operating Voltage

To change the operating voltage:

1. Turn off the power to the leak detector.
2. Change the operating voltage switch to the desired voltage setting.
3. Change the power fuses (described above) to the appropriate values.
4. Rewire the mechanical pump(s) for the desired operating voltage.

The mechanical pump operating voltage wiring diagram is located in the mechanical pump operating manual supplied with the leak detector, and is also printed on the mechanical pump.

NOTE

If your leak detector is equipped with a turbo compression enclosure box (attached below the leak detector basic unit), the operating voltage cannot be switched over. Contact the factory in the event that the operating voltage needs to be changed.

Section 3. Operating the 979C Leak Detector

3.1 Operator Interface

The front panel of the Model 979C is shown in Figure 3-1. Operation controls include buttons for AUDIO VOLUME, SNIFFER, ZERO, READ STANDARD LEAK, CALIBRATE, TEST, HOLD and VENT functions. In addition to the basic control buttons, the 979C utilizes a touch panel display for the initial setup of the leak detector. An access key switch is also provided to prevent unauthorized changes of the system setup commands.

Figure 3-1 979C Front Panel

Press the **TEST/HOLD** button when in VENT mode to automatically advance the 979C through roughing and then into the test state. The optimum sampling mode (Gross Leak or Fine Test) is automatically selected, depending on the system configuration and setup, and the achievable test port pressure and leak rate. The TEST indicator LED, located above TEST, illuminates when the 979C is in a test state.

If the TEST/HOLD button is pressed while the 979C is in the test state, the unit advances to the HOLD state and the HOLD indicator LED, located below HOLD, illuminates. When in HOLD mode, the test port valve V6 is closed, isolating the test port and any test objects or fixturing from the leak detector vacuum system. The test port pressure gauge is located on the test port side of V6 and subsequently a rise in test pressure may be observed while in this mode.

While in TEST or HOLD, pressing the **TEST/HOLD** button causes the machine to alternate between the two states.

Press the **VENT** button to isolate the test port from the leak detector vacuum system and vent the test port to the atmosphere. The VENT indicator LED, located above VENT, remains lit while the 979C is in the vented state.

Subsequent test measurements include both helium from the real leak and helium from background conditions. The 979C automatically subtracts the recorded background signal from the measurement and displays the real leak rate only.

The ZERO button is only active while the leak detector is in the test state. Press the **ZERO** button to cause the 979C to read the background leak rate signal, store the reading in memory, and then reset the zero reference point on the leak rate display. The ZERO indicator LED lights while zeroing is taking place.

Pressing the ZERO button also momentarily displays the total background signal on the leak rate bar graph. This is a fast and effective method for checking your system background.

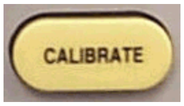
NOTE *Pressing the ZERO button while you are introducing helium tracer gas to the test object could result in the suppression of a real leak. Only use the ZERO button after the helium tracer gas source has been removed.*

When used correctly, the ZERO capability of the 979C is very powerful. It allows for testing to sensitivity levels that are below the system background. This feature also reduces test cycle times by reducing the amount of time required for background levels to naturally clean up or by allowing for testing to begin at relatively high test pressures.

The READ STANDARD LEAK button is only functional while the leak detector is in the test state. The READ STANDARD LEAK button activates the optional internal calibrated leak, allowing verification of the system calibration. When the system is in READ STANDARD LEAK mode, its LED indicator lights.

Press the **READ STANDARD LEAK** button to isolate the test port from the system, evacuate the calibrated leak manifold, and expose the leak to the analyzer tube. Compare the *displayed* leak rate value to the *calibrated* leak value.

Because the test port is isolated from the forepump and rough pump in this mode, a slight increase in test port pressure may be indicated on the test port pressure bar graph display.



The CALIBRATE button is used to perform an automated calibration based upon the parameters set on the Calibrated Leak Set-up screen (Section 3.5.1). CALIBRATE causes the 979C to rough out and expose the internal standard leak to the system or, if EXTERNAL LEAK is set during configuration, verifies that the test port is roughed out and exposed to the system. The ion voltage is scanned, then the variable focus is scanned to find the peak signal. The system notes the leak rate reading, then the leak is turned off and the system is zeroed. Finally, a gain is calculated from the leak rate reading to make the signal match the value of the calibrated leak and the system is returned to TEST mode. The CALIBRATE indicator LED lights while calibration is taking place.

The Audio leak rate indication volume is controlled by the two buttons labeled HI and LOW and with up and down arrows. Press the **HI** arrow button to increase the volume of the tone. Press the **LOW** arrow button to decrease the volume of the tone.

When the leak rate bar graph display is set to LINEAR mode (Section 3.6.1), the audio signal increases from a low to high pitch as the leak rate increases within each decade. The pitch cycles low to high as it passes through each decade.

When the leak rate bar graph display is set to LOG mode, the audio signal increases from a low to high pitch as the leak rate increases through the entire bar graph scale. The LOG mode display setting is often desirable in sniffer applications so the audio response corresponds directly to the size of the leak.

The SNIFFER ON/OFF button is used to toggle the 979C leak detector in and out of SNIFFER mode. The SNIFFER indicator LED illuminates when SNIFFER mode is enabled.

When the leak detector is in VENT mode, press the **SNIFFER ON/OFF** button to start the test cycle. This automatically locks the leak detector into CONTRA-FLOW™ LEAK mode, auto-ranging through four decades down to the most sensitive range available for the current leak detector configuration.

If the leak detector is in TEST mode, pressing the SNIFFER ON/OFF button performs the same function, with the exception of performing the test cycle start sequence.

When in SNIFFER mode, press the **SNIFFER ON/OFF** button to switch the leak detector back into the currently configured normal TEST mode.

3.1.1 Sniffer Set-up Procedure

1. Vent the 979C and insert a Varian Vacuum Technologies Power Probe (Part Number K9565301) into the test port. Refer to the product catalog for additional Power Probe configurations.
2. Set **Range Stop** to 10 - 07 (See Figure 3-12 on page 3-18).
3. Monitor the test port pressure reading on the touch panel display and adjust the Power Probe flow valve for a test port pressure of 1 to 2 Torr.
4. Press **ZERO** to suppress the helium background signal.

Table 3-1 shows sniffer mode sensitivity based upon the type of turbo pump (V70D, V70LP) installed in the 979C in conjunction with the turbo pump speed selected in "Leak Rate Ranging Set-up" on page 3-18.

Table 3-1 Sniffer Mode Sensitivity Range (Full Scale)

	Standard Sensitivity	High Sensitivity
Slow Speed	10^{-5} to 10^{-8}	10^{-6} to 10^{-9}
Fast Speed	10^{-4} to 10^{-7}	10^{-5} to 10^{-8}

All values in this table are at test port pressures between 1 and 2 Torr.

3.1.2 Key Switch

The 979C Key Switch allows three different levels of access to the touch panel system controls—RUN, SET-UP or SERVICE. Two different keys are provided with the leak detector:

- ❑ Key T008 operates the switch in either the RUN or SET-UP positions.
  The T008 key is intended for use by a line supervisor or engineer and allows most parameters to be changed, but does not allow any operation that could damage the unit.
- ❑ Key T009 operates the switch in RUN, SET-UP or SERVICE positions.
  The T009 key is intended for service personnel and those who are very familiar with the operation of the unit. Operations such as manually changing the valves can only be performed when the key switch is in the SERVICE position. A first-level operator would not have a key and would be able to operate the 979C with the key switch in the RUN position only (key removed). No changes to the operating parameters are allowed when the key switch is in the RUN position.

3.2 Touch Panel Menus

The 979C Leak Detector uses a touch panel display for the initial setup and configuration of the leak detector. Once the leak detector is set up and configured for a specific application, basic operation is controlled primarily by the clearly labeled buttons described in the previous section. The touch panel Home screen is shown below in Figure 3-2 and discussed in detail in Section 3.3.

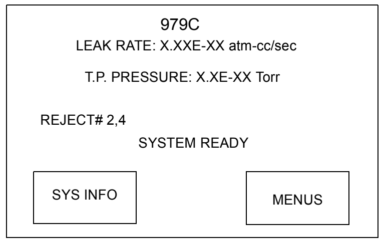


Figure 3-2 979C Touch Panel Home Screen

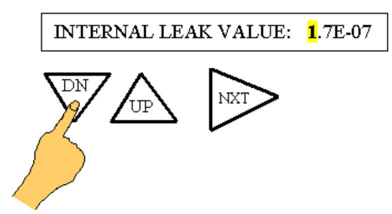
3.2.1 Changing Variables in Touch Panel Screens

Pressing the box that contains the variable to be changed causes the first digit of the variable to be highlighted.

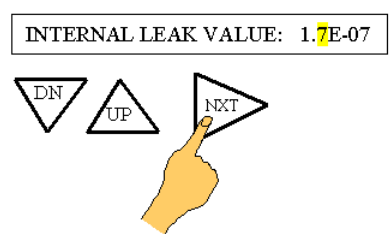
For example:

1. Touch the box to highlight the digit.

2. Press the **UP** or **DN** arrow buttons to change the highlighted digit.



3. Press the **NEXT** arrow button to select the next digit to be changed and set its value by repeating step 2.



4. Touch the **OK** button to accept changes. The OK button is located in the upper-right corner of the touch screen.

To change any digit, press the box containing the parameter you want to change and then touch the **NEXT** arrow to scroll to that digit and change it, as indicated in step 2.

3.3 979C Touch Panel Home Screen

The 979C Touch Panel Home Screen, Figure 3.3, displays a summary of the status and configuration that has been set, and has two touch screen buttons to access or change the configuration. The information provided is:

- ❑ Digital Leak Rate Display
- ❑ Leak Detector Status (not shown)
- ❑ Reject Status Indicator
- ❑ SYS INFO touch screen box
- ❑ Test Port Pressure
- ❑ Condition Indication (not shown)
- ❑ System Ready Indicator
- ❑ MENUS touch screen box

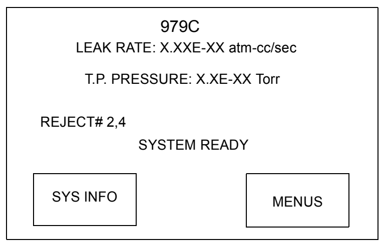


Figure 3-3 979C Touch Panel Home Screen

3.3.1 Digital Leak Rate

The Digital Leak Rate displayed on the touch panel Home screen correlates directly with the bar graph leak rate display when the mantissa value of the leak rate is greater than one. Leak rate readings with a mantissa value of less than one on the bar graph display are shown on the touch panel Home screen with an exponent that is one decade below the bar graph display exponent. The units for the measurements are user selectable from the Units Set-up screen (see Section 3.6.1).

For example, if the leak rate displayed on the bar graph is 0.6 x 10^{-09} std cc/sec (Figure 3-4), then the leak rate displayed on the touch panel Home screen will be 6.00E-10 std cc/sec (Figure 3-5). This feature provides exceptional leak rate resolution.

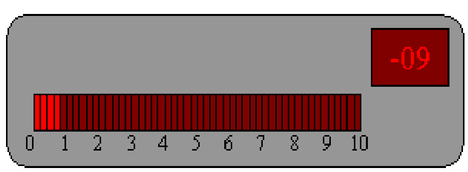


Figure 3-4 Bar Graph Display: 0.6 x 10^{-09} std cc/sec

LEAK RATE: 6.00E-10 atm cc/sec

Figure 3-5 Leak Rate Displayed on Home Screen: 6.00E-10 atm cc/sec

3.3.2 Test Port Pressure

The Test Port Pressure value displayed on the touch panel Home screen represents the test port pressure as measured by a thermocouple device mounted on the valve block just below the test port. The pressure transducer and associated electronics provide reliable and repeatable measurements, protecting the leak detector from damage due to over-pressure conditions. The test port pressure gauge is not intended to provide precise, absolute pressure measurements. Use an external pressure transducer if the test process requires accurate monitoring of the test object pressure. The units for the measurements are user selectable from the Units Set-up screen (Section 3.6.1).

3.3.3 Leak Detector Status

Leak Detector Status (not shown in Figure 3.3) is displayed just below the test port pressure reading and indicates the current operating state of the 979C. The normal operating states are listed and described in Table 3-2 on page 3-8.

3.3.4 Leak Detector Condition

The Leak Detector Condition (not shown in Figure 3.3) is displayed below the Leak Detector Status and indicates the current condition of the leak detector. Under normal operating conditions this line is blank. The 979C leak detector conditions are listed and described in Table 3-3 on page 3-9.

3.3.5 Reject Status Indicator

A REJECT status indicator displays below the Leak Detector Condition on the left-hand center of the Home screen when any of the four independent set points are enabled and have been activated (see Section 3.5.2). If all set points are disabled or are not active, then this indicator is not present.

3.3.6 SYS INFO and MENUS Touch Screen Boxes

Two touch screen boxes are displayed on the bottom of the Home screen. Touch the **SYS INFO** box on the left-bottom of the Home screen to display the System Info screen, which is discussed in the next section.

Touch the **MENUS** box on the right-bottom of the Home screen to display the First Menu Selection screen. The First Menu Selection screen is discussed in Section 3.5.

Table 3-2 979C Operating States

Display	Description
VENTED	Indicates that the test port is vented to atmosphere (i.e., V1 vent valve is open). The test port and all objects attached to the test port are isolated from the internal vacuum system of the 979C.
HOLD	Indicates that the leak detector is in HOLD mode. When in HOLD mode the test port valve V6 and the roughing valve are closed, isolating the test port and any test objects or fixturing from the leak detector vacuum system.
ROUGHING	Indicates that the leak detector is currently ROUGHING on the test port and any attached test objects or fixturing attached to the test port.
GROSS TEST	Indicates that the leak detector is in GROSS TEST mode. When in GROSS TEST mode the test port valve V6 is closed and the GROSS LEAK valve V8 and ROUGHING valves are open. While testing in this mode, the majority of the gas introduced into the test port is swept away through the roughing pump, and a small sample is introduced to the system through the GROSS LEAK needle valve. Gross leak testing capability is only provided on dual pump configurations.
FINE TEST	Indicates that the leak detector is in FINE TEST mode. When in FINE TEST mode the test port valve V6 is open and the leak detector is ready for fine leak testing.
CALIBRATING	Indicates that the leak detector is currently performing a calibration routine. The leak detector reverts to HOLD mode while calibrating to the internal leak standard.
STD LEAK	Indicates that the optional internal calibrated leak standard valve V7 is open and the leak detector is reading the leak value. The leak detector reverts to HOLD mode while reading the internal leak standard.

Table 3-3 979C Condition States

Display	Description
[BLANK]	This line is blank under normal operating conditions.
CAL OK	Indicates that the calibration routine was executed successfully.
NO ION PEAK	Indicates a tuning/calibration failure due to the system not detecting an ion peak during the auto-tuning or calibration routine.
NO FOCUS PEAK	Indicates a tuning/calibration failure due to the system not detecting a focus peak during the auto-tuning or calibration routine.
GAIN TOO HIGH	Indicates that the gain value required to calibrate the leak detector during the calibration routine is greater than the allowable value. This is generally the result of the system sensitivity being too low.
GAIN TOO LOW	Indicates that the gain value required to calibrate the leak detector during the calibration routine is less than the allowable value. This is generally the result of the system sensitivity being too high.
REJECT	Indicates a test object failure during an Auto Sequencer Test cycle. See “Auto Sequencer Set-up” on page 3-15.
FILAMENT 1 BURNT OUT	Indicates that filament 1 of the ion source has burnt out. Filament 2 will automatically light, if it is still good, and the leak detector will display a flashing **C** in the leak rate exponent indicating that a calibration routine is required.
FILAMENT 2 BURNT OUT	Indicates that filament 2 of the ion source has burnt out. Filament 1 will automatically light, if it is still good, and the leak detector will display a flashing **C** in the leak rate exponent indicating that a calibration routine is required.
BOTH FILAMENTS BURNT OUT	Indicates that both filament 1 and filament 2 of the ion source have burnt out.
SWITCHING FILAMENTS	Indicates that the system is momentarily in the process of switching from a burnt out filament to the next available filament.
ZEROING	Indicates that the leak detector is in the process of *Zeroing* out a background signal. The *Zero* routine is only initiated automatically during the start up and calibration routines, or manually when the operator presses the ZERO button on the front control panel.
STD LEAK PREP	Indicates that the optional internal calibrated leak is being pre-roughed before it is introduced directly to the system for calibration verification.
CALIBRATION PREP	Indicates that the leak detector is preparing for a calibration routine.

Table 3-3 979C Condition States (Continued)

Display	Description
BACKING	Indicates that the leak detector is momentarily backing the foreline of the high vacuum pump during an extended rough period. This condition will only be present on single rough pump configurations.
SYSTEM PRESSURE WAIT	Indicates that the system (spectrometer tube) pressure is too high to light the filament.
STABILIZATION WAIT	Indicates that the system is waiting for the electronics to stabilize before completing the start-up routine.
OFFSET WAIT	Indicates that the system is setting the OFFSET value during the start-up routine.
FILAMENT WAIT	Indicates that the system is lighting the filament.
ZEROING WAIT	Indicates that the system is setting the initial zero values during the start-up routine.
SYSTEM READY	Indicates that the system is ready for testing. This message will only be present during the initial start-up and is cleared after the first test cycle.
Flashing **C** on exponent display	Indicates that the leak detector requires calibration.

3.4 979C System Information Screen

The System Info screen, shown in Figure 3-6, displays details of the current leak detector setup and operating conditions. The left-hand column displays filament status, reject set point status, turbo status, gross leak configuration, auxiliary rough pump setup, auto sequencer status, and audio set point status. The right-hand column displays the calibrated leak setting, leak rate range settings, and the sensitivity configuration. Table 3-4 describes the displayed system information in detail.

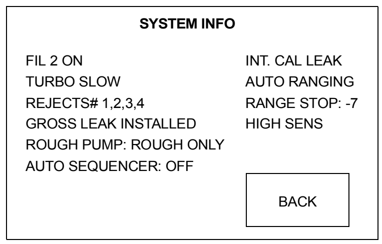


Figure 3-6 System Information Screen, Typical Display

A touch screen box labeled **BACK** is located on the lower right-hand of the System Info screen. Touch this box to return to the 979C Home screen.

Table 3-4 System Information Screen Conditions

CONDITION	DISPLAY	DESCRIPTION
ION SOURCE FILAMENT	FIL 1 OFF	Filament 1 is selected and not lit.
	FIL 1 ON	Filament 1 is selected and lit.
	FIL 2 OFF	Filament 2 is selected and not lit.
	FIL 2 ON	Filament 2 is selected and lit.
TURBO PUMP	TURBO FAST	System turbo pump is operating at high speed.
	TURBO SLOW	System turbo pump is operating at slow speed.
REJECT SET POINT	REJECT# 1,2,3,4 ACTIVE	Reject set points displayed are active; this line is blank when all set points are disabled or inactive.
GROSS LEAK	GROSS LEAK: INSTALLED	Gross leak installed–standard on dual pump configurations.
	GROSS LEAK: NOT INSTALLED	Gross leak not installed.

Table 3-4 System Information Screen Conditions (Continued)

CONDITION	DISPLAY	DESCRIPTION
AUXILIARY ROUGH PUMP (Dual pump configuration only)	ROUGH PUMP: ROUGH ONLY	Dedicated rough pump is connected to the test port only during the roughing cycle.
	ROUGH PUMP: SPLIT FLOW	Dedicated rough pump is connected to the test port during rough and test cycles, providing additional pumping capacity during test.
AUTO SEQUENCER	AUTO SEQUENCER: ON	Auto Sequencer (automatic test cycle) is enabled.
	AUTO SEQUENCER: OFF	Auto Sequencer (automatic test cycle) is disabled.
AUDIO SET POINT	AUDIO SET POINT: ACTIVE	Audio Set Point is active.
	AUDIO SET POINT: INACTIVE	Audio Set Point is inactive.
CALIBRATED LEAK	INT CAL LEAK	System is set up to calibrate to the internal standard leak.
	EXT CAL LEAK	System is set up to calibrate to an external standard leak.
LEAK RATE RANGE	AUTO RANGING	System is set up to auto range through leak rate scale.
	MANUAL RANGING	System is set up for manual range control.
RANGE STOP	RANGE STOP -[EXP]	System is set up so that the most sensitive leak rate range displayed is $10^{-[EXP]}$.
SYSTEM SENSITIVITY	HIGH SENS	Leak detector is configured for high sensitivity testing. This line is blank when the leak detector is configured for standard sensitivity testing.

3.5 First Menu Selection Screen

Touching the **MENUS** box on the Home screen causes the First Menu screen (Figure 3-7) to appear. The First Menu screen displays a list of screens available for performing general set up of the 979C. Touching the **BACK** box from this screen calls up the Home screen. Touching the **NEXT** box calls up the Second Menu screen. The screens available through this menu are described in this section.

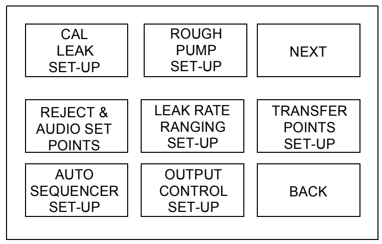


Figure 3-7 First Menu Selection Screen

3.5.1 Calibrated Leak Set-up

Touch the **CAL LEAK SET-UP** box to display the Calibrated Leak Set-up screen, shown in Figure 3-8. It is used to set the values of the Internal and External Calibrated leaks, to select whether to use an internal or external calibrated leak standard for calibration, and to select NORMAL or FAST CALIBRATION mode.

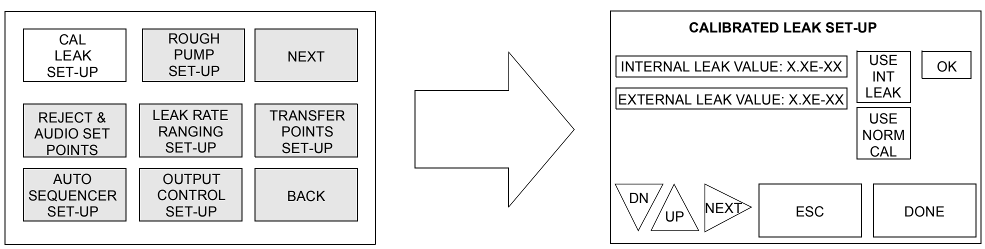


Figure 3-8 Calibrated Leak Set-up Screen

3.5.1.1 Setting the Values of the Internal and External Calibrated Leaks

To alter leak values:

1. Touch the box containing the parameter you want to change.
2. Use the UP or DN buttons to change the value of the highlighted digit and the NEXT button to select the next digit.
3. Touch **OK** to load the new value of the parameter into the memory of the leak detector. Touch **DONE** to exit the screen and return to the previous menu screen.

Touching the **ESC** box before touching OK or DONE causes the selected parameter to revert to its previously stored value.

3.5.1.2 Selecting Internal or External Calibrated Leak for Calibration

Touch the **USE INT/EXT LEAK** box to switch between selecting whether the 979C performs an automated calibration to the optional internal calibrated leak or to an external calibrated leak placed in the test port.

3.5.1.3 Selecting Normal or Fast Calibration Routine

Touch the **USE NORM/FAST CAL** box to switch between NORMAL CALIBRATION and FAST CALIBRATION modes.

NORMAL CALIBRATION	The calibration routine performs a thorough tuning process and a system gain adjustment (calibration). The full tuning process involves independently scanning the ion source chamber voltage and the variable focus voltage, optimizing each value for a maximum helium signal. Once the tuning process is complete, the preamplifier gain is adjusted to bring the leak detector into calibration.
FAST CALIBRATION	During fast calibration, the leak detector compares the leak rate signal with the calibrated leak value and, if the gain adjustment required to bring the system into calibration is within the allowable value, the full tuning operation is omitted.

The Calibration routine may be executed without removing the test object or test fixture from the test port on single mechanical pump configurations, and on dual mechanical pump configurations set in ROUGH ONLY mode.

NOTE

The test port plug must be in place (isolating the test port) while performing the Calibration routine on Dual Mechanical Pump Configurations set in SPLIT FLOW mode.

3.5.2 Reject and Audio Set Points

Touch the **REJECT & AUDIO SET POINTS** box to display the Reject and Audio Set Points screen (Figure 3-9). From this screen set the parameters to enable/disable, display and/or change the value of the four reject set points and the audio set point.

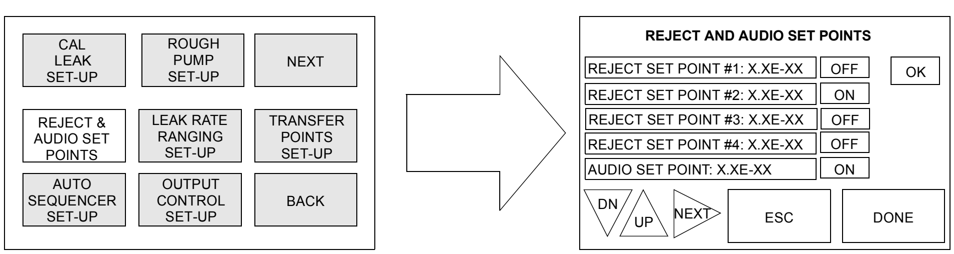


Figure 3-9 Reject and Audio Set Points Screen

3.5.2.1 Changing and Enabling Set Point Values

To change the set point values:

1. Touch the box containing the parameter you want to change.
2. Use the UP or DN buttons to change the value of the highlighted digit and the NEXT button to select the next digit.
3. Touch **OK** to load the new value into the memory of the leak detector. Touch **DONE** to exit the screen and return to the previous menu screen.

Touching the **ESC** box before touching OK or DONE causes the selected parameter to revert to its previously stored value.

REJECT SET POINTS	Set REJECT SET POINTS 1 through 4 so that the set points activate when the measured leak rate value exceeds the set point value. When a reject set point activates, the word REJECT is displayed on the Home screen of the touch panel along with the number of the reject set point that has been activated. The status of the reject set points are also available at the I/O communications port and upon inquiry through the RS-232 line (see Appendix B). Disable individual reject set points using the ON/OFF buttons located to the right of each set point field.
AUDIO SET POINT	The AUDIO SET POINT control is used to activate the audio tone when the measured leak rate value exceeds the threshold value (leak rate pass/fail specification) set by the operator. When the audio set point control is set to ON, the audio tone frequency increases as the size of the measured leak increases beyond the set point. The audio volume control is located on the front panel (see Figure 2-1 on page 2-2) and is discussed in "Operator Interface" on page 3-1.

3.5.3 Auto Sequencer Set-up

Touch the **AUTO SEQUENCER SET-UP** box to display the Auto Sequencer Set-up screen Figure 3-10 on page 3-16. Auto sequencer provides the ability to set up the 979C so that it automatically runs through a complete test cycle (START/ROUGH/TEST EVENT), passing or failing the test part per the test specification entered by the user. The auto sequencer set-up controls include test object rough time, test time, and auto sequencer on/off. A Pass or Fail condition is determined based upon the reject set point selected by the user and/or achievement of the pressure transfer set points within the period of time specified in Rough Time.

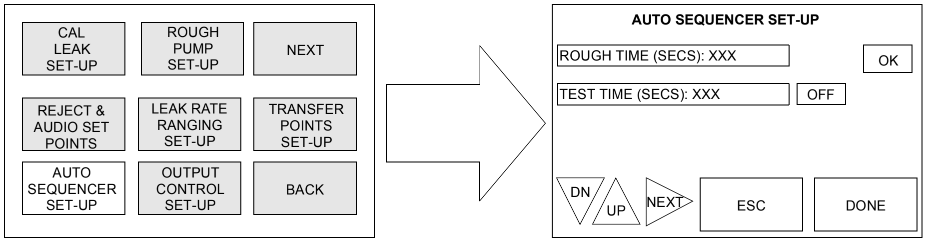


Figure 3-10 Auto Sequencer Set-up Screen

The auto sequencer pass or fail leak rate value is selected through the Reject Set Point screen. The pass/fail criterion is based on the reject set point that is enabled (ON). If more than one set point is enabled, then the pass/fail criterion is based on the most stringent reject set point value.

A *Pass* condition is indicated by the system reverting to the VENT mode upon completion of the test cycle. A *Fail* condition is indicated by the system reverting to the HOLD mode, and all operating buttons being disabled except VENT. A failed condition also results in REJECTED being displayed on the Home screen of the touch panel, and a reject set point activation upon completion of the test cycle. The status of the reject set points are available at the I/O communications port and upon inquiry through the RS-232 line (see Appendix B).

Upon the completion of an automated test cycle, the 979C captures the leak rate signal measured just prior to the end of the automated test cycle. This leak rate is displayed on the front panel and held at the analog output communications port until the next test cycle is initiated. This allows the end user to record the actual leak rate value for each test object.

3.5.3.1 Auto Sequencer Set-up Controls

To alter Auto Sequencer parameters:

1. Touch the box containing the parameter you want to change.
2. Use the UP, DN and NEXT buttons to set the value of the parameter to the desired value.
3. Touch **OK** to load the new value into the memory of the leak detector and return to the previous menu. Touch **DONE** to exit the screen and return to the previous menu screen.

Touching the **ESC** box before touching OK or DONE causes the selected parameter to revert to its previously stored value.

ROUGH TIME	The ROUGH TIME variable determines the amount of time that the leak detector is allowed to evacuate the test object to the tolerable test transfer pressure. In AUTO SEQUENCER mode, the 979C transfers into test as soon as the tolerable transfer pressure is met. It does not wait for the total rough time allotted if it is not required. If the tolerable test transfer pressure is not achieved within the pre-selected rough time, the system aborts the cycle and goes into HOLD mode.

The ROUGH TIME value can be determined empirically and should reflect the typical time required to rough your test object to the tolerable test pressure. Failure to achieve the tolerable test pressure within the pre-selected rough time is an indication of a gross leak in your test object or test fixturing or that time allowed was insufficient.

TEST TIME — The TEST TIME variable determines the amount of time that the leak detector remains in test before it compares the measured leak rate with the selected reject set point. Sufficient time must be allowed for the leak rate reading to stabilize before the system makes a pass/fail decision. This is a function of the part configuration and the leak rate specification. In AUTO SEQUENCER mode, the 979C remains in test for the entire duration of the preselected test time.

The ON/OFF box located to the right of the TEST TIME box provides the capability to enable and disable the Auto Sequencer feature.

3.5.4 Rough Pump Set-Up

Touch the **ROUGH PUMP SET-UP** box to display the Rough Pump Set-up screen (Figure 3-11), which provides the end user with the ability to select the function of the dedicated rough pump on a dual pump system. The dual pump version of the 979C can be configured so that the dedicated rough pump is connected to the test port only during the roughing cycle, or so that it is connected to the test port during the rough and test cycles.

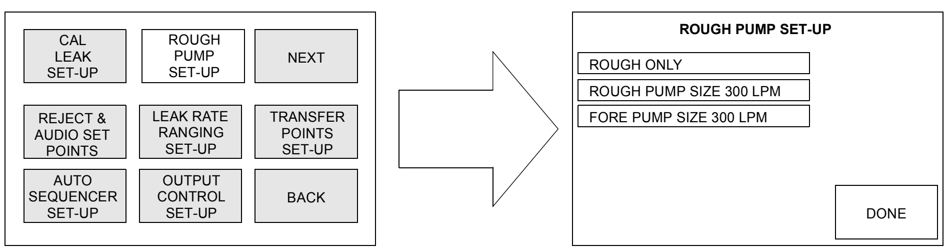


Figure 3-11 Rough Pump Set-up Screen

3.5.4.1 Selecting Rough Only or Split Flow Mode

The first toggle box in the Rough Pump Set-up screen is used to select the function of the dedicated rough pump: ROUGH ONLY, SPLIT FLOW, and NOT INSTALLED.

ROUGH ONLY — In ROUGH ONLY mode, the dedicated roughing pump pumps on the test port only during the roughing phase of the test cycle. Once the test object reaches the tolerable test transfer pressure, the roughing valve closes and the dedicated rough pump is isolated from the test object.

SPLIT FLOW	In SPLIT FLOW mode, the dedicated rough pump continues to pump on the test object after the tolerable test transfer pressure has been achieved. Split flow testing provides additional pumping capacity on the test object during the test cycle. Use this mode for systems with potentially high gas load or net volumes greater than a few liters. In SPLIT FLOW MODE the test port plug must be in place (isolating the test port) while performing an autocalibration routine to the optional internal calibrated leak.
NOT INSTALLED	Always select this mode for single mechanical pump systems.

To change the rough pump operation, the system must be in VENT mode and the front panel key switch in the SET-UP or SERVICE position.

3.5.4.2 Inputting the Rough Pump and Forepump Sizes

The next two toggle boxes are used to select the ROUGH PUMP SIZE and the FORE PUMP SIZE on dual mechanical pump systems.

- ❑ Touch the **ROUGH PUMP SIZE** box to select either 200 LPM, 300 LPM, 450 LPM, or 600 LPM.
- ❑ Touch the **FORE PUMP SIZE** box to select 200 LPM or 300 LPM.

It is important to set these values correctly when the 979C is configured for split-flow testing. This allows for direct readings of leak rate.

Touch **DONE** to return to the previous menu screen.

3.5.5 Leak Rate Ranging Set-up

Touch the **LEAK RATE RANGING SET-UP** box to display the Leak Rate Ranging Set-up screen (Figure 3-12). From this screen, set up and enable the RANGE STOP and MANUAL RANGE functions, select USE FINE TEST or GROSS TEST ONLY, and control the TURBO speed.

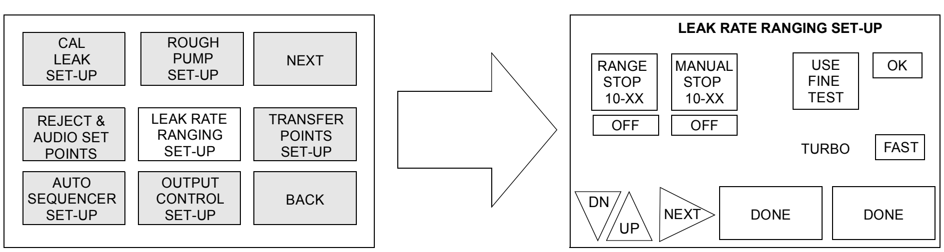


Figure 3-12 Leak Rate Ranging Set-up Screen

3.5.5.1 Range Stop and Manual Range Set-Up and Control

To alter range set-up parameters:

1. Touch the box containing the parameter you want to change.
2. Use the UP, DN and NEXT buttons to set the value of the parameter to the desired value.

3. Touch **OK** to load the new value into the memory of the leak detector. Touch **DONE** to exit the screen and return to the previous menu screen.

Touching the **ESC** box before touching OK or DONE causes the selected parameter to revert to its previously stored value.

RANGE STOP

The RANGE STOP feature configures the 979C so that it only auto-ranges down to the pre-selected decade entered in the range stop variable field. For example, if range stop was enabled and the range stop setting was 10-07, then the most sensitive range that the leak detector displays is full-scale 10^{-7} std cc/sec.

This feature is useful when a product specification is more than one decade less stringent than the actual sensitivity of the leak detector. If the leak detector is capable of displaying full scale 10^{-9} std cc/sec but the test specification is only in the 10^{-7} std cc/sec range, then setting the range stop to 10-08 std cc/sec reduces the test cycle time by eliminating the need for the leak detector to reach its most sensitive scale during each test cycle.

To enable or disable RANGE STOP, touch the **ON** or **OFF** box under the desired function.

MANUAL RANGE

The MANUAL RANGE feature configures the 979C so that it only displays the pre-selected decade entered in the manual range variable field. For example, if the manual range feature was enabled and the manual range variable was set to 10-06, then the leak rate decade displayed on the LED bar graph during testing will be the 10-06 std cc/sec range only. This feature is useful when the test operator is only concerned with monitoring the leak rate measurement within a single decade.

To enable or disable MANUAL RANGE, touch the **ON** or **OFF** box under the desired function.

3.5.5.2 Selecting Fine Test or Gross Test Only Mode

Touch the **USE FINE TEST** (**GROSS TEST ONLY**) box to toggle the leak detector between a fine test (normal) operating mode and a gross leak test only mode.

FINE TEST MODE

When USE FINE TEST (normal operating mode) is displayed, the leak detector automatically tests for gross leaks and then transfers into fine test if no gross leaks are detected.

GROSS TEST ONLY

When GROSS TEST ONLY is displayed (this feature is only available on dual mechanical pump configurations), the leak detector does not transfer into FINE TEST mode. This feature is useful for qualifying parts that have an unusually high rate of gross leak failures prior to fine leak testing.

3.5.5.3 Selecting Turbo Fast or Turbo Slow Mode

Touch the Turbo **FAST** (**SLOW**) toggle box to switch between SLOW and FAST and change the speed of the 979C turbo pump accordingly. The mode displayed indicates the current speed of the turbo. To change the turbo speed the system must be in VENT mode and the front panel key switch must be in the SET-UP or SERVICE position. Table 3-5 show sensitivity matrixes for performing Fine and Gross tests in both SLOW and FAST modes.

NOTE *The 979C must be placed in VENT mode in order to change the Turbo Pump speed.*

TURBO SLOW: Operating in TURBO SLOW mode allows the 979C to achieve full scale 10^{-9} std cc/sec (2E-10 MDL) sensitivity. This sensitivity can be achieved at a transfer pressure of 5 Torr. This feature provides high sensitivity testing at maximum test pressures. High ambient helium background conditions may prevent 10^{-9} std cc/sec testing at relatively high pressures. SLOW speed operation limits the maximum detectable leak capability to 1×10^{-5} std cc/sec (full-scale reading on 10^{-6} range) single rough/forepump configurations.

TURBO FAST: Operating in TURBO FAST mode allows the 979C to achieve full scale 10^{-8} std cc/sec (2E-09 MDL) sensitivity. HIGH speed operation limits the maximum detectable leak capability to 1×10^{-4} std cc/sec (full-scale reading on 10^{-5} range) for single rough/forepump configurations.

Table 3-5 979C Turbo FAST/SLOW Mode Sensitivity Matrix

	Fine Test					Gross Test (2 Pump)			
Turbo FAST									
Range (std cc/sec)		–8	–7	–6	–5	–4	–3	–2	–1
Valve Path		CF*	CF	CF	CF	GL**	GL	GL	GL
Transfer Pressure (Torr)		5	5	5	5	760	760	760	760
Turbo SLOW									
Range (std cc/sec)	–9	–8	–7	–6	–5	–4	–3	–2	
Valve Path	CF	CF	CF	CF	GL	GL	GL	GL	
Transfer Pressure (Torr)	5	5	5	5	760	760	760	760	
*CF – CONTRA-FLOW **GL – GROSS LEAK									

3.5.6 Output Control Set-up

Touch the **OUTPUT CONTROL SET-UP** box to display the Output Control Set-up screen (Figure 3-13). From this screen, select the desired leak rate output, BARGRAPH DISPLAY mode, and the RS-232 communication protocol.

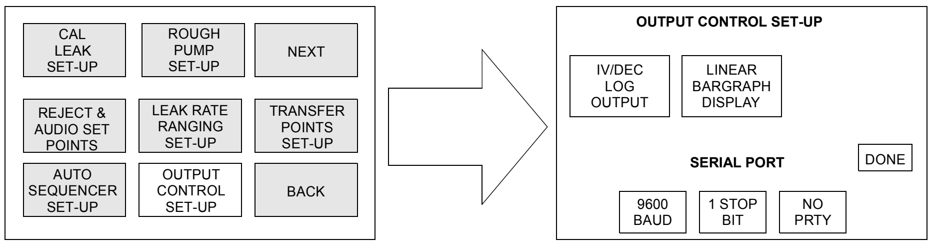


Figure 3-13 Output Control Set-up Screen

3.5.6.1 Leak Rate Analog Output Voltage Selection

Touch the **Leak Rate Output** toggle box located at the top left of Output Control Set-up screen to switch the output voltage at the I/O port on the back of the leak detector between 1V/DEC LOG OUTPUT (decade) and LINEAR ANALOG OUTPUT (linear).

1V/DEC LOG OUTPUT	The output voltage conversion chart is displayed in Figure 3-14.
LINEAR ANALOG OUTPUT	The output voltage conversion chart is displayed in Figure 3-15.

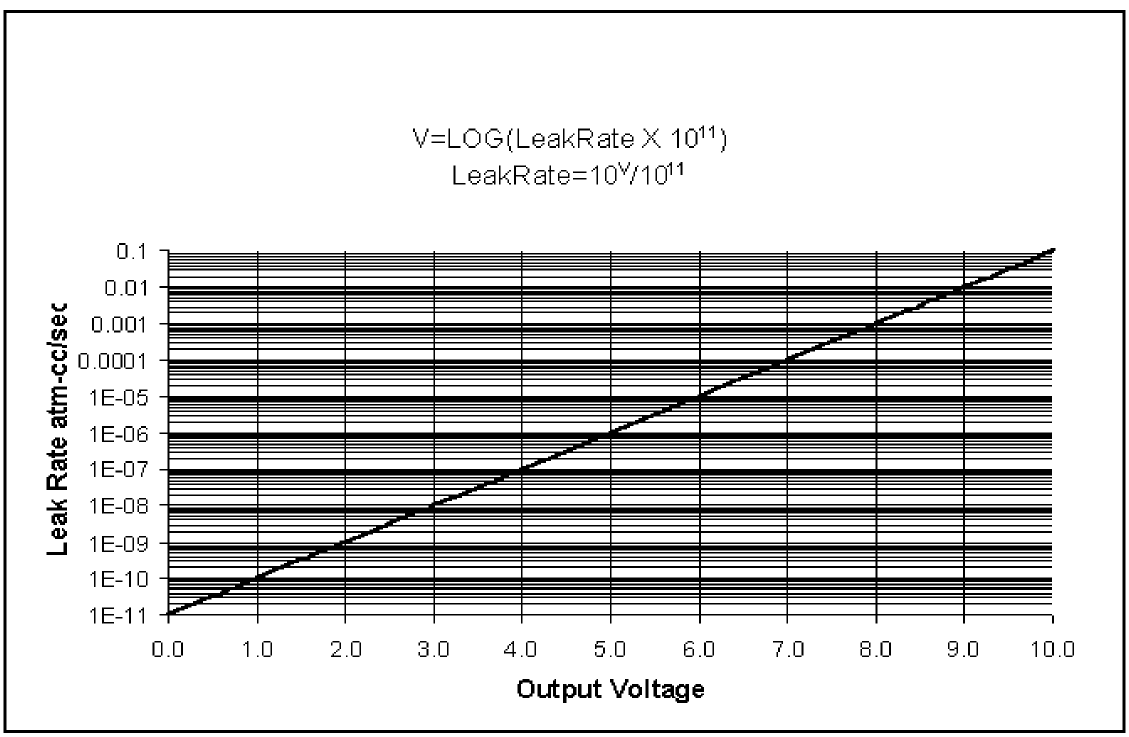


Figure 3-14 Leak Detector Logarithmic Output Voltage

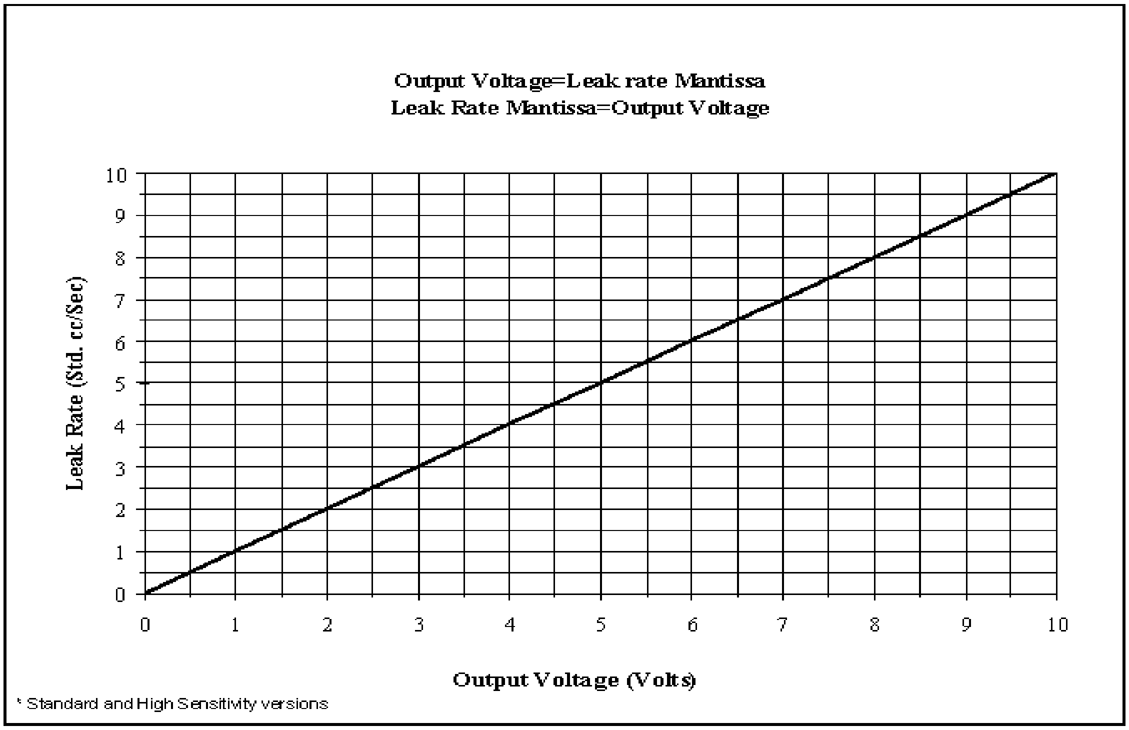


Figure 3-15 Leak Detector Linear Output Voltage

3.5.6.2 Bargraph Display Set-up

Touch the **LINEAR BARGRAPH DISPLAY** toggle box to switch the bar graph display between LOG BARGRAPH DISPLAY mode and LINEAR BARGRAPH DISPLAY mode.

LOG BARGRAPH DISPLAY	In the LOG BARGRAPH DISPLAY mode, the 50-segment bar graph display represents the entire leak rate range of the leak detector, spanning from 10^{-11} std cc/sec to 10^{0} std cc/sec. The numerical display, located to the upper right of the bar graph, is not lit in this mode.
LINEAR BARGRAPH DISPLAY	In the LINEAR BARGRAPH DISPLAY mode, the 50-segment bar graph display represents the mantissa value of the leak rate, spanning from 0 to 10. The numerical display, located to the upper right of the bar graph, indicates the leak rate exponent value. This mode offers exceptional resolution within a decade.

3.5.6.3 Serial Communications Protocol Set-up

The Output Control Set-up screen also allows for the selection of RS-232 communication parameters, BAUD RATE, STOP BITS, and PARITY (see Appendix B).

3.5.7 Transfer Pressure Set-up

Touch the **TRANSFER POINTS SET-UP** selection box to display the Transfer Pressure Set-up screen (Figure 3-16). From this screen set the test transfer pressures for each testing mode. The factory default settings are shown in Figure 3-16.

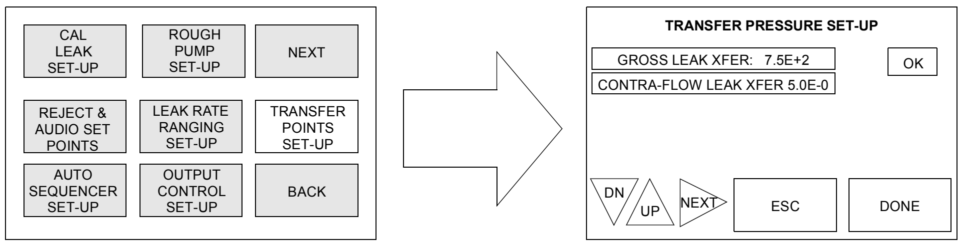


Figure 3-16 Transfer Pressure Set-up Screen

The transfer pressure settings may be adjusted to lower values for specific applications. The 979C has pre-programmed upper transfer pressure limits that are slightly greater than the default settings. These limits prevent the operator from inadvertently setting the 979C to transfer into test at too high a pressure, resulting in excessive spectrometer tube contamination or ion source filament failure. Touch **DONE** to return to the previous menu.

If you make changes to the settings, touch **OK** to load the new values into memory and then touch **DONE** to return to the previous menu.

Touching the **ESC** box before touching OK or DONE causes the selected parameter to revert to its previously stored value.

GROSS LEAK XFER	The GROSS LEAK XFER set point determines the test pressure cross over point at which the 979C transfers into the GROSS LEAK TEST mode. In the GROSS LEAK TEST mode, the majority of the sampled gas is pumped away through the dedicated roughing pump while a small sample of gas is introduced into the leak detector through a throttle valve. Gross leak testing is a standard feature available on dual mechanical pump configurations only.
CONTRA-FLOW LEAK XFER	The CONTRA-FLOW LEAK XFER set point determines the test pressure cross over point at which the 979C transfers into the CONTRA-FLOW LEAK test mode. In the CONTRA-FLOW LEAK test mode, the gas sample is pumped through the leak detector and swept across the high vacuum pump foreline. The CONTRA-FLOW LEAK test mode allows for relatively high sensitivity testing at exceptionally high test pressures.

3.5.8 NEXT and BACK Boxes

Touch the **NEXT** box on the First Menu screen to display the Second Menu selection screen. The operations of the Second Menu screen are discussed in Section 3.6. Touch the **BACK** box to return to the Home screen.

3.6 Second Menu Selection Screen

The Second Menu screen (Figure 3-17) displays the screens available for performing general setup and service functions. Touch the **BACK** box from this screen to display the First Menu screen. Touch the **NEXT** box to display the Home screen. UNITS SET-UP is described in this section. The VERSION and SERVICE menus are discussed in Section 4, “Service”. These menus include procedures that are generally performed outside of day-to-day operations.

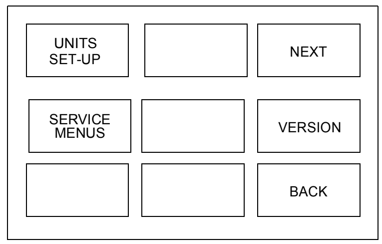


Figure 3-17 Second Menu Screen

3.6.1 Units Set-up

Touch the **UNITS SET-UP** box to display the Units Set-up screen (Figure 3-18).

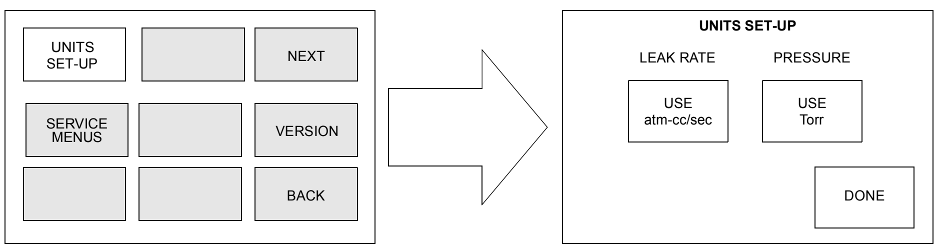


Figure 3-18 Units Set-up Screen

3.6.1.1 Leak Rate and Test Port Pressure Units Selection

Select the leak rate and test port pressure units to be displayed on the leak rate bar graph and the digital touch screen display.

LEAK RATE UNITS	Touch the **LEAK RATE** units toggle box to switch the leak rate units between atm-cc/sec, mbar-l/sec, Torr-l/sec, and Pa-m^3/sec.
PRESSURE UNITS	Touch the **PRESSURE** units toggle box to switch the test port pressure units between Torr, mbar, and Pa.

Section 4. Service

This section discusses the VERSION and SERVICE menus, which are accessed from the Second Menu screen (Figure 4-1). These menus provide access to information and procedures that are generally outside of day-to-day operations. Most of these functions should be performed by trained service personnel as they significantly affect the performance of the Model 979C.

Touch the **BACK** box from this screen to display the First Menu screen. Touch the **NEXT** box to display the Home screen.

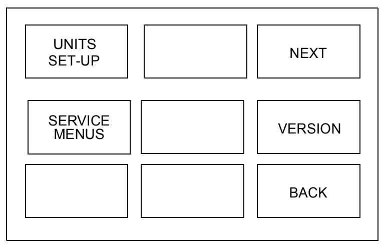


Figure 4-1 Second Menu Screen

4.1 Version

The VERSION screen (Figure 4-2) provides system software revision information.

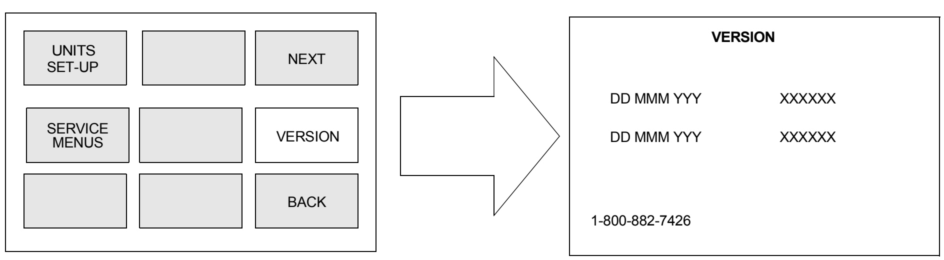


Figure 4-2 Version Screen

Touch the **VERSION** box to display the revision date and checksum of the main CPU and the front panel CPU software. Inquiry of the checksum information takes a few minutes.

This screen automatically reverts to the Second Menu screen approximately 15 seconds after the revision data is displayed in full.

4.2 Service Menus

CAUTION *The controls available through the Service Menu screens significantly affect the performance of the 979C and must only be accessed by trained service personnel.*

Touch the **SERVICE MENUS** box to display the Service Menu screen (Figure 4-3). This screen shows the functions that may be performed as part of a troubleshooting or maintenance exercise. To return to the Second Menu screen, touch the **BACK** box from the Service Menu screen.

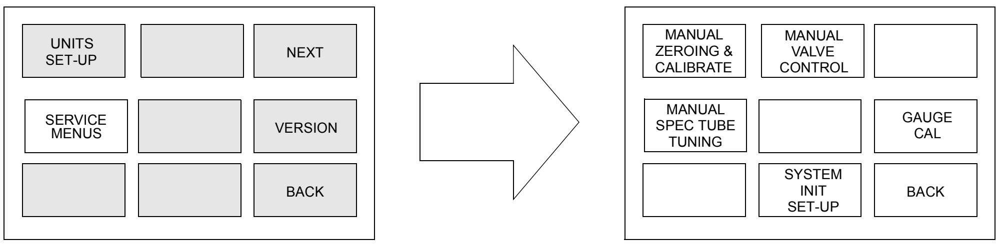


Figure 4-3 Service Menu Screen

4.2.1 Manual Zeroing and Calibrate

Touch the **MANUAL ZEROING and CALIBRATE** box to display the Manual Zeroing and Cal screen (Figure 4-4), which provides control of the leak detector AUTO-ZERO < 0 feature, and allows for viewing and adjusting the spectrometer tube Gain and Ion Voltage variables.

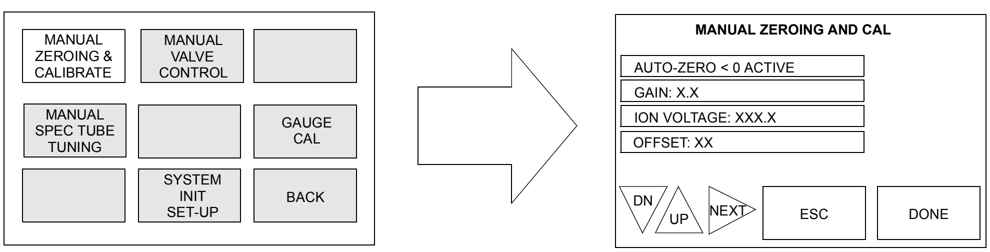


Figure 4-4 Manual Zeroing and Cal Screen

To alter Zero and Cal parameters:

1. Touch the box containing the parameter you want to change.
2. Use the UP, DN and NEXT buttons to set the value of the parameter to the desired value.
3. Touch **DONE** to load the new value into the memory of the leak detector and return to the previous menu.

Touching the **ESC** box before touching DONE causes the selected parameter to revert to its previously stored value.

4.2.1.1 AUTO-ZERO < 0

Touch the **AUTO-ZERO < 0** toggle box to switch the Auto Zero < 0 feature between Active and Inactive. The display in the touch screen box indicates the current setting.

ACTIVE	AUTO-ZERO < 0, when activated, automatically adjusts the zero reference point back up to zero when the helium background level drops below the previously set zero reference point. This feature ensures that the leak detector maintains calibration after a previously zeroed background signal naturally cleans up.

When the AUTO-ZERO < 0 feature is in the process of re-adjusting the zero reference point, the UNDER light indicator located on the left end of the bar graph illuminates.

The duration of time that the UNDER light stays on during this process is a function of how much helium is cleaning up and how fast it is cleaning up. If the magnitude of helium clean up is great, the UNDER light remains lit until the clean up rate has slowed or stabilized. Although leaks may be located in this state, quantitative testing must not be performed until the UNDER light is off. Occasional flashing of the UNDER light indicates normal minor adjustments to small changes in background. This does not impact the leak detector's ability to accurately locate and measure leaks.

INACTIVE	When AUTO-ZERO < 0 is inactive, the leak detector does not automatically adjust the zero reference point back up to zero when the helium background level drops below the previously set zero reference point. When this occurs, the UNDER light remains lit, indicating that the background level is below the previously set zero reference point. Press the **ZERO** button on the front panel to readjust the zero reference point manually. This clears the UNDER light indication.

4.2.1.2 Gain

Touch the **GAIN** box to manually adjust the calibration gain factor. The gain parameter is used to calibrate the leak detector to a known helium calibration source. The gain parameter is adjusted after the leak detector has been tuned to helium.

Typical gain values ranges from 0.5 to 5.0. The gain value is automatically set during the Calibration routine.

4.2.1.3 Ion Voltage

Touch the **ION VOLTAGE** box to display the current ion voltage value of the Ion Source in the spectrometer tube. This value can also be manually adjusted. The ion voltage parameter is used to tune the leak detector, maximizing the leak detector output for a peak helium signal. The ion voltage parameter is adjusted before the leak detector is calibrated to helium.

Typical ion voltage values range from 230 VDC to 270 VDC. The ion voltage value is automatically adjusted and set during the Calibration routine.

4.2.1.4 Offset

The variable displayed in the OFFSET box represents the current value of the preamplifier offset. This value is used by the service technician to evaluate the condition of the preamplifier. The normal operating range is between 35 and 80. If this value is outside of the range, contact your local Varian Vacuum Technologies service representative.

4.2.2 Manual Spectube Tuning

Touch the **MANUAL SPECTUBE TUNING** box to display the Manual Spectube Tuning screen (Figure 4-5). This screen is used to manually adjust the parameters of the Ion Source in the spectrometer tube for a maximum helium signal.

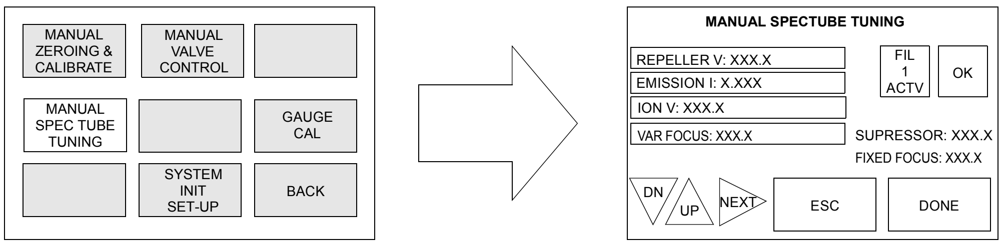


Figure 4-5 Manual Spectube Tuning Screen

To alter Manual Spectube parameters:

1. Touch the box containing the parameter you want to change.
2. Use the UP, DN and NEXT buttons to set the value of the parameter.
3. Touch **OK** to load the new value into the parameter.

Touching the **ESC** box before touching OK or DONE causes the selected parameter to revert to its previously stored value.

4.2.2.1 Repeller

The REPELLER (Voltage) box displays the current Repeller Voltage value of the Ion Source in the spectrometer tube and allows for manual adjustment of this parameter. The repeller voltage parameter is used to tune the leak detector, maximizing the leak detector output for a peak helium signal. The repeller voltage parameter is adjusted before the leak detector is calibrated to helium. This parameter is *not* adjusted automatically during the Calibration routine.

Typical Repeller Voltage values range from 320 VDC to 360 VDC.

4.2.2.2 Emission Current

The EMISSION adjustment box displays the value of the existing Emission current of the Ion Source in the spectrometer tube and allows for the adjustment of this parameter. The emission current parameter is used to tune the leak detector, maximizing the leak detector output for a peak helium signal. The emission current parameter is adjusted before the leak detector is calibrated to helium.

Typical Emission current values range from 0.07 A to 1.0 A.

4.2.2.3 Variable Focus Voltage

The VAR FOCUS Voltage adjustment box displays the current Variable Focus Voltage value of the ion source in the spectrometer tube and allows for the adjustment of this parameter. The variable focus voltage parameter is used to tune the leak detector, maximizing the leak detector output for a peak helium signal. The variable focus voltage parameter is adjusted before the leak detector is calibrated to helium.

Typical Variable Focus Voltage values range from 180 VDC to 200 VDC.

4.2.2.4 Suppressor Voltage

The SUPPRESSOR indicator displays the current Suppressor Voltage value of the ion source in the spectrometer tube. The suppressor voltage parameter is a function of the other ion source voltages. This parameter cannot be changed by the operator.

4.2.2.5 Fixed Focus Voltage

The FIXED FOCUS Voltage indicator displays the current Fixed Focus Voltage value of the ion source in the spectrometer tube. The fixed focus voltage parameter is a function of the other ion source voltages. This parameter cannot be changed through the touch panel screen.

4.2.2.6 Filament Selection

The FILAMENT SELECTION box switches between **FIL 1 ACTIVE** and **FIL 2 ACTIVE**. The filament selection can be performed manually, or it will occur automatically in the event that the current operating filament burns out. Execute a calibration routine each time the operating filament is changed.

AUTO-FILAMENT SELECTION

In the event that the current operating filament burns out, the 979C automatically switches over to the next available filament. The change is indicated on the touch screen display and the leak rate exponent display flashes a **C**, indicating that calibration is required.

NOTE

We recommended that you replace the ion source as soon as it is convenient after the spare filament has been put into use. See Section 5.4, "Ion Source Replacement Outside of Annual Maintenance".

4.2.3 Manual Valve Control

Touch the **MANUAL VALVE CONTROL** box to display the Manual Valve Ctrl screen (Figure 4-6), which provides manual control of valves in the 979C vacuum system for troubleshooting purposes. A diagram of the 979C Vacuum System is shown in Figure 4-7.

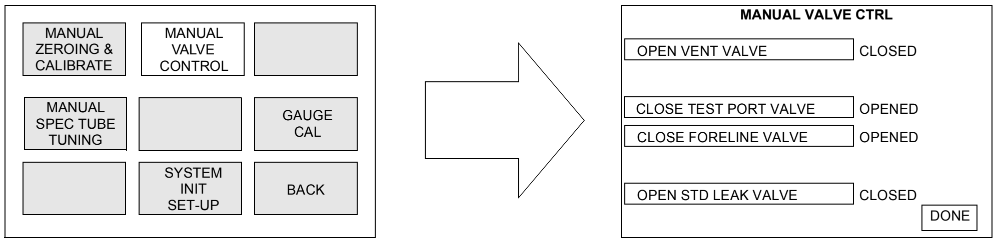


Figure 4-6 Manual Valve Control Screen

To change the state of a specific valve, touch the box corresponding to that valve. The valve changes state and the box changes from OPEN to CLOSE. Touch **DONE** to return to the maintenance menu screen. The valve state displayed to the right of each valve control box represents the current state of the corresponding valve. The normal operating states of the 979C valves are shown in Table 4-6.

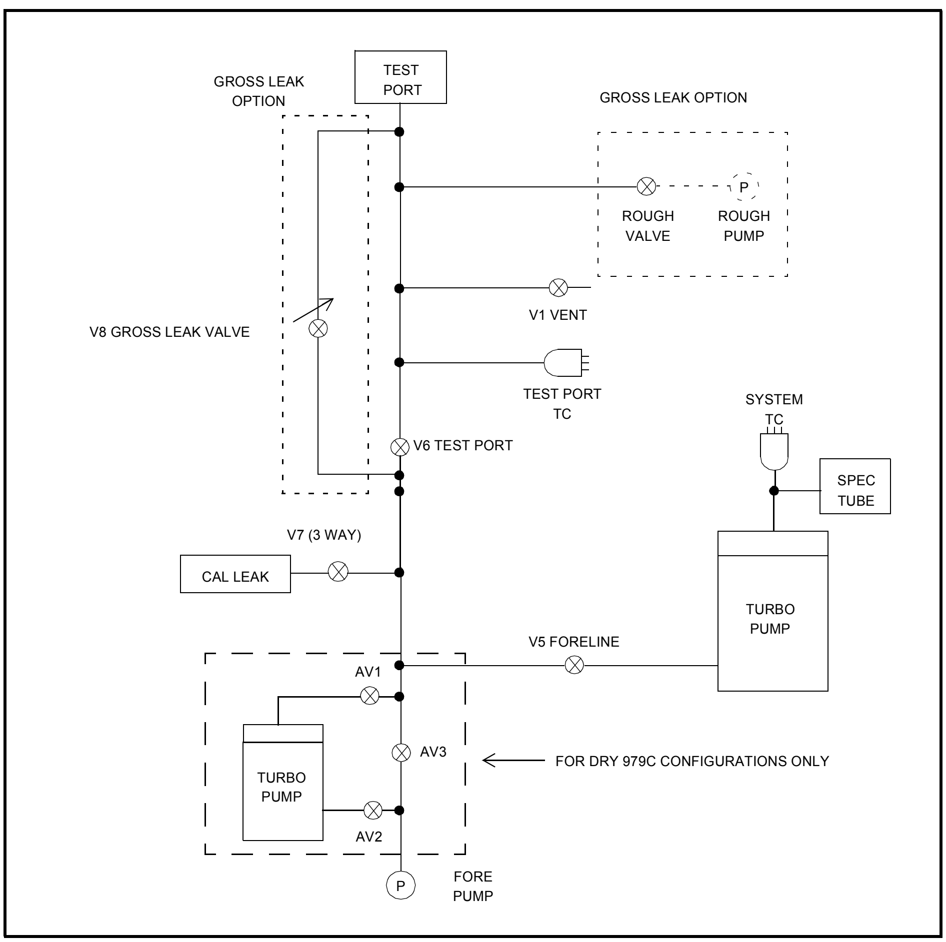


Figure 4-7 979C Vacuum System Diagram

Table 4-6 979C Valve States

	V1	V5	V6	V7	V8	AV1	AV2	AV3
						For Dry 979C Configurations Only		
VENT	O	O	C	C	C	C	C	O
ROUGH	C	C	O	C	C	C	C	O
GROSS TEST	C	O	O	C	O	C	C	O
FINE TEST	C	O	O	C	C	O	O	C
SNIFF MODE	C	O	O	C	C	C	C	O

4.2.4 System Initialize Set-up

Touch the **SYSTEM INIT SET-UP** box to display the System Initialize Set-up screen (Figure 4-8), which allows for the front panel push buttons to be enabled or disabled, and displays the current status of the buttons.

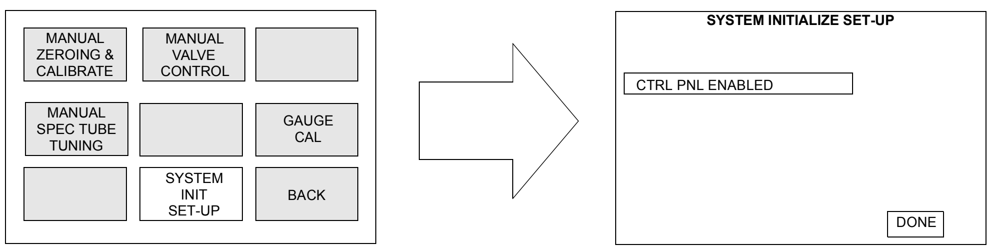


Figure 4-8 System Initialize Set-up Screen

The CTRL PNL ENABLED toggle box switches between enabling and disabling the front panel push buttons. Touch the **CTRL PNL ENABLED** box to disable the front panel push buttons. Touch the box a second time to enable the push buttons. Touch **DONE** to exit the current screen and return to the previous menu.

4.2.5 Gauge Calibration Procedures

Touch the **GAUGE CAL** box to display the Gauge Calibration screen (Figure 4-9), which provides the ability to perform a calibration on either the system pressure thermocouple (TC) or the test port thermocouple (TC) gauge.

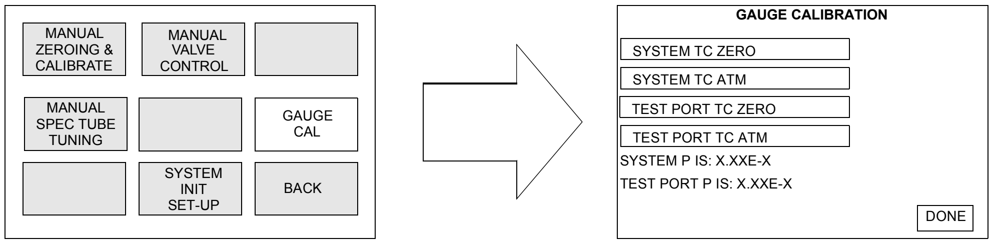


Figure 4-9 Gauge Calibration Screen

4.2.5.1 System Pressure Gauge Calibration Procedure

This procedure allows for calibration of the system pressure thermocouple gauge. Both the Vacuum and Atmospheric Calibrations procedures must be performed in the order written.

4.2.5.1.1 Vacuum (Low Pressure) Calibration

1. Verify that the leak detector is in the SYSTEM READY condition on the Home Screen (Figure 4-10) and that the test port plug is in place.

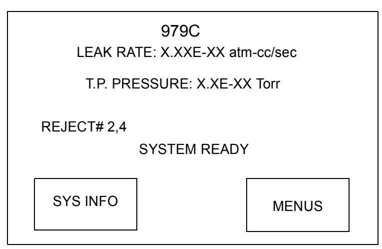


Figure 4-10 979C Touch Panel Home Screen

2. Place the service key (T009) into the key switch and set the key switch to the SERVICE position (see Figure 2-1 on page 2-2).
3. If the system is not already in VENT mode, press the **VENT** button.
4. Change the turbo pump speed to FAST from the Leak Rate Ranging Set-up screen (see Section 3.5.5 on page 3-18.).
5. Press the **TEST** button and verify that the leak detector transfers to FINE TEST mode, displaying 10^{-9} std cc/sec or lower.
6. Wait approximately five minutes for the vacuum system pressure to stabilize.
7. Move to the GAUGE CALIBRATION screen (Figure 4-9) if you are not already there.

8. Touch the **SYSTEM TC ZERO** box.
   - ❑ A CAL OK indication, to the right of the SYSTEM TC ZERO box, confirms that the calibration was successful.
   - ❑ A CAL NOT OK display is an indication that the calibration was not successful. This could be the result of a defective or contaminated thermocouple gauge, or that the actual pressure was substantially greater than 1 millitorr.
9. Touch **DONE** to leave the screen and return to the previous menu.

4.2.5.1.2 Atmospheric Calibration

Calibration of the system pressure thermocouple (TC) gauge to atmosphere is only required if the system TC gauge tube is replaced or if calibration appears to be off.

1. Upon replacement of the system TC, unplug the mechanical pump(s) from the back of the 979C before powering up the leak detector.
2. Turn the power ON to the 979C and go to the Gauge Calibration touch screen menu.
3. Place the service key (T009) into the key switch and set the key switch to the SERVICE position.
4. Touch the **SYSTEM TC ATM** box.
   - ❑ A CAL OK indication to the right of the SYSTEM TC ATM box confirms that the calibration was successful.
   - ❑ A CAL NOT OK display is an indication that the calibration was not successful. This could be the result of a defective or contaminated thermocouple gauge, or that the actual pressure was not at or near atmosphere.
5. Power down the leak detector.
6. Plug the mechanical pumps into the appropriate receptacles and turn the power back on.
7. Touch **DONE** to leave the screen and return to the previous menu.

4.2.5.2 Test Port Pressure Gauge Calibration Procedure

This procedure allows for calibration of the test port pressure thermocouple gauge. Both the Vacuum and Atmospheric Calibrations procedures must be performed in the order written.

4.2.5.2.1 Vacuum (Low Pressure) Calibration

1. Verify that the leak detector is in the SYSTEM READY condition (Figure 4-10) and that the test port plug is in place.
2. Place the service key (T009) into the key switch and set the key switch to the SERVICE position.
3. If the system is not already in VENT mode, press the **VENT** button.
4. Change the turbo pump speed to FAST from the Leak Rate Ranging Set-up screen (see Section 3.5.5 on page 3-18).
5. Press the **TEST** button and verify that the leak detector transfers to FINE TEST mode, displaying 10^{-9} std cc/sec or lower.
6. Wait approximately five minutes for the vacuum system pressure to stabilize.
7. Move to the GAUGE CALIBRATION screen (Figure 4-9 on page 4-8) if you are not already there.
8. Touch the **TEST PORT TC ZERO** box.
   - ❑ A CAL OK indication to the right of the TEST PORT TC ZERO box confirms that the calibration was successful.
   - ❑ A CAL NOT OK display is an indication that the calibration was not successful. This could be the result of a defective or contaminated thermocouple gauge, or that the actual pressure was substantially greater than 1 millitorr.
9. Touch **DONE** to leave the screen and return to the previous menu.

4.2.5.2.2 Atmospheric Calibration

1. Place the service key (T009) into the key switch and set the key switch to the SERVICE position.
2. If the system is not already in VENT mode, press the **VENT** button.
3. Wait approximately ten seconds for the test port pressure to stabilize.
4. Touch the **TEST PORT TC ATM** box.
   - ❑ A CAL OK indication, to the right of the TEST PORT TC ATM box, confirms that the calibration was successful.
   - ❑ A CAL NOT OK display is an indication that the calibration was not successful. This could be the result of a defective or contaminated thermocouple gauge, or that the actual pressure was not at or near atmosphere.
5. Touch **DONE** to leave the screen and return to the previous menu.

Section 5. Maintenance

NOTE

Due to the effective cleaning nature of VacuSolv solvent and its residue-free properties, Varian Vacuum Technologies' Component and Spectrometer Tube Cleaning Kit (Part Number 670029096), used in accordance with the kit instructions, is recommended for cleaning the spectrometer tube components. The kit can also be used for fine cleaning of other parts in the leak detector's vacuum system such as valves and fittings. No rinsing steps or high-temperature drying is required following cleaning with VacuSolv. Although appropriate precautions are advised, VacuSolv is compatible with most materials and does not contain toxic chemicals or CFCs (chlorofluorocarbon).

CAUTION

Do not use alcohol, methanol or other solvents on O-rings. To do so causes deterioration and reduces their ability to hold a vacuum. Wipe with a clean, lint-free cloth and use a small amount of Apiezon® L grease, just enough to make the O-rings shiny.

Do not clean any aluminum parts with Alconox®. Alconox is not compatible with aluminum and will cause damage.

NOTE

When cleaning the Spectrometer Tube, inspect for any damage to O-rings. Remove them carefully with your fingers. Do not use any metal tools for this task. This prevents scratching of any sealing surfaces.

5.1 Introduction

Like other sensitive test equipment, a mass spectrometer leak detector requires periodic maintenance to ensure continued reliable operation. For simplicity, the maintenance functions in this section are grouped by recommended frequency, as shown in Table 5-2, based on assumed everyday use.

Table 5-1 Scheduled Maintenance

Description	Daily	12 Months
Calibration check and tuning adjustments	X	
Complete overhaul, including spectrometer tube		X

These functions are self-explanatory and can be carried out at routine intervals, as indicated. Check the sensitivity at least once a day. However, other functions may be carried out either more or less often, depending on the frequency of use.

Some maintenance functions may be required on a demand basis; for example, changing an Ion Source after filament failure. These are listed in Table 5-2. These maintenance functions are also part of a complete overhaul.

Table 5-2 As-required Maintenance

Function	Most Common Symptom
Spectrometer tube cleaning	Loss of sensitivity, increase in background, high ion voltage required to tune leak detector (> 300 VDC).
Ion source replacement	Filament failure (as soon as convenient after second filament is in use)
Mechanical Pump Fluid Change	Persistent, high helium background signal. Fluid contamination (dirty brown color indicates burnt or contaminated fluid, milky white consistency indicates high water vapor content in fluid).

NOTE

Cleanliness is vital when servicing the leak detector or any vacuum equipment. There are some techniques more important in leak detector servicing than in general vacuum work:

- ❑ *Do not use silicone oil or silicone grease.*
- ❑ *Wipe all O-rings clean with a lint-free cloth before installation to ensure that no foreign matter is present to impair the seal.*

Normally, it is unnecessary to use vacuum grease. However, if vacuum grease must be used, avoid silicone types, use sparingly, and wipe the O-rings "shiny" dry. Apiezon® L (Varian Vacuum Technologies Part No. 695400004) is recommended. Prevent skin oils from getting on vacuum surfaces by using powder-free rubber gloves.

5.1 Daily Maintenance

5.1.1 Sensitivity Check

1. Perform a calibration check by pressing the READ STANDARD LEAK button or utilizing an external standard leak mounted at the test port (see Section 3.5.1 on page 3-13).
2. If specification cannot be met, press the CALIBRATE button to perform an automated calibration and then repeat step 1.

5.2 Annual Maintenance (Complete Overhaul)

5.2.1 General

After prolonged use, the leak detector will accumulate contaminants from even the cleanest of products tested. These contaminants eventually impair operation. A thorough disassembly and cleaning of the entire vacuum system, which includes the valve block and spectrometer tube, will restore normal operation.

The following procedures, if done annually (for a leak detector in daily use), will prevent deterioration and maintain a high level of performance. For heavy production use, more frequent overhauls may be needed. Conversely, lighter use may permit a longer period between overhauls. In most cases, this work is done by user maintenance personnel, but it may also be done by Varian Vacuum Technologies under the terms of a service contract.

The following tools and parts are required during overhaul:

Tools

Screwdrivers (Straight and Phillips-head)

Parts

Part Number	Description
82850302	Ion Source
R1266301	Button TC
670029096	Varian Vacuum Technologies Spectrometer Tube Cleaning Kit
K7516301	Varian Vacuum Technologies GP Mechanical Pump Fluid for SD Series mechanical pumps
	O-rings (Parker 2-025 V747-75 Black) – (supplied with Ion Source, button TC and Preamplifier)

5.3 Removing, Cleaning, and Re-installing the Spectrometer Tube Assembly

There are four basic sub-assemblies in the 979C Spectrometer tube. Removal instructions follow in the order below.

- ❑ Thermocouple Button (TC)
- ❑ Ion Source
- ❑ Preamplifier
- ❑ Magnetic Poles

5.3.1 Removing the Spectrometer Tube Assembly

The spectrometer tube operates at a very high vacuum produced by the high vacuum pump. Service of the spectrometer tube requires that this vacuum be vented to the atmosphere. Perform this procedure every twelve months, or sooner if required. Access to the spectrometer tube is gained by removing the two (2) Phillips-head screws from the front panel and dropping the top of the front panel down.

NOTE

Rebuilt spectrometer tubes are available from Varian Vacuum Technologies on an exchange basis. Contact the Varian Vacuum Technologies Service Center (1-800-8-VARIAN) for details.

1. Loosen the test port nut ① and remove the two (2) Phillips-head screws ② from the Model 979C front panel (Figure 5-1).

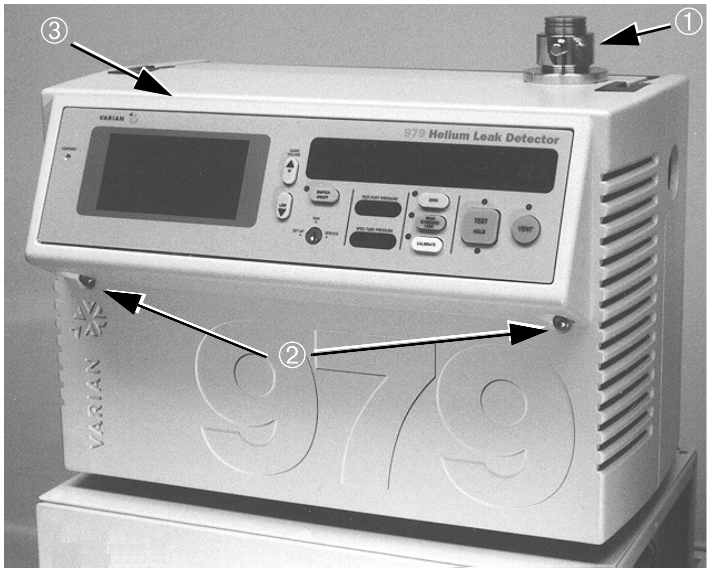


Figure 5-1 Front Panel

2. Lean the top of the front panel forward ③ to allow access to the spectrometer tube assembly. Be careful not to place tension on the front panel display PCB harness.

3. The spectrometer tube is located in the center front of the 979C just behind the front panel (Figure 5-2).

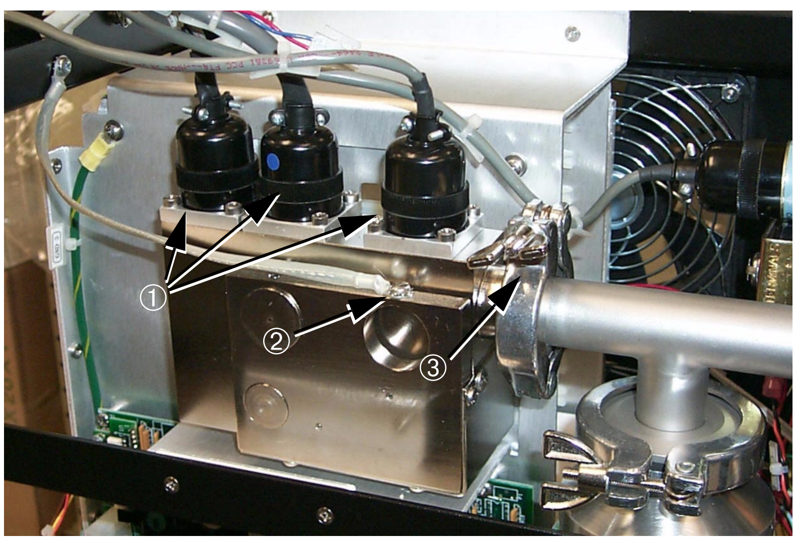


Figure 5-2 Front View of the Spectrometer Tube Assembly

In addition to the three connectors on the top of the unit, indicated by ① in Figure 5-2, and the ground cable ②, the spectrometer tube is attached by a KF-25 (ISO NW-25) quick clamp ③ and a wing nut located below the tube (not shown in this view).

4. Remove the three connectors from the top of the spectrometer tube (Figure 5-3). The connector cables are labeled TC, Ion Source, and Preamplifier. If the cables are not labeled, make a note of the order in which they are connected.

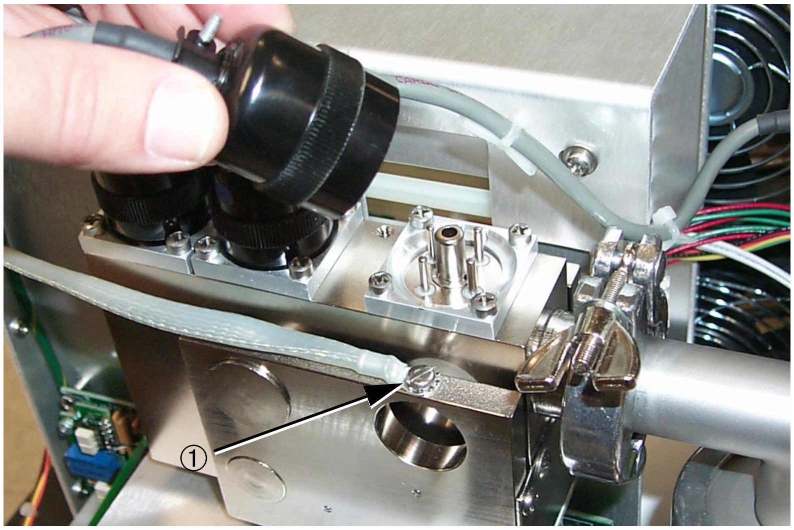


Figure 5-3 Removing the Connectors

5. Disconnect the ground cable from the spectrometer tube magnet by removing the screw ① with a straight screwdriver.

6. Remove the wing nut ① located underneath the shelf below the spectrometer tube (Figure 5-4).

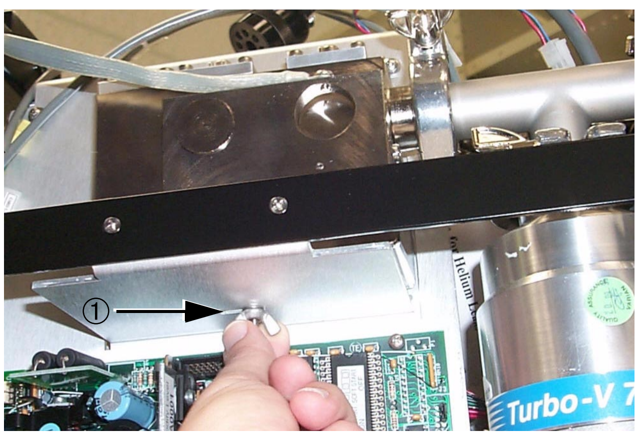


Figure 5-4 Wing Nut

7. Remove the KF-25 (ISO NW-25) quick clamp ① to disconnect the spectrometer tube from the 979C vacuum system (Figure 5-5).

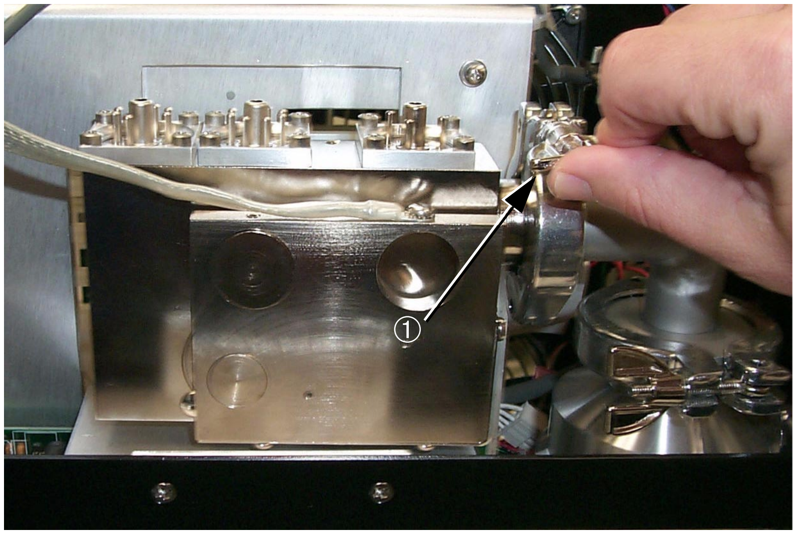


Figure 5-5 KF-25 Quick Clamp

8. Lay the spectrometer tube down on a clean non-magnetic surface.

CAUTION *If the spectrometer tube magnet comes in contact with a magnetic surface, the magnet may lose its gauss, causing the spectrometer tube to lose sensitivity.*

CAUTION

Do not remove the six (6) magnet body bracket screws ① shown in Figure 5-6 while performing maintenance on the spectrometer tube.

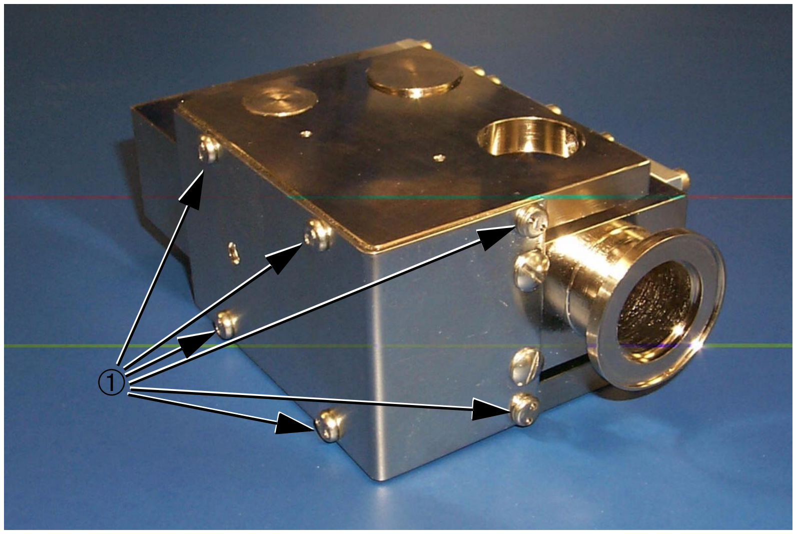


Figure 5-6 Magnet Body Bracket Screws

9. Remove the two (2) straight screws ① that mount the spectrometer tube magnet assembly to the spectrometer tube body (Figure 5-7).

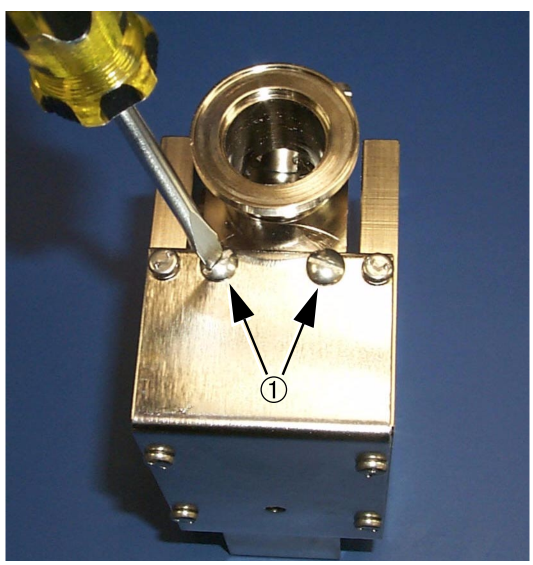


Figure 5-7 Straight Screws

10. Carefully slide the magnet assembly off of the spectrometer tube body.

If the magnet assembly does not slide off easily, it may be necessary to loosen the tuning magnets ① by backing out the allen-head set screws ② located on both sides of the assembly (Figure 5-8). Do not remove the set screws and tuning magnets completely.

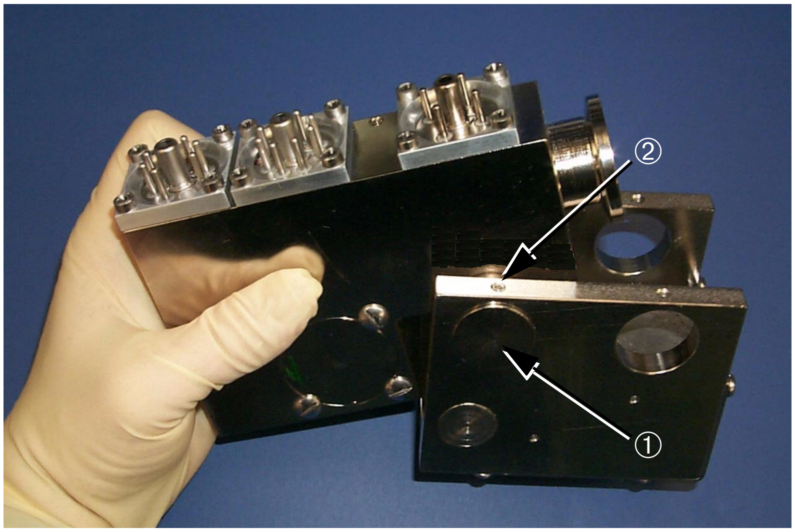


Figure 5-8 Allen-head Screws

5.3.1 Removing the Button TC

11. Remove the four (4) Phillips-head screws ① that hold the button TC header (Figure 5-9).

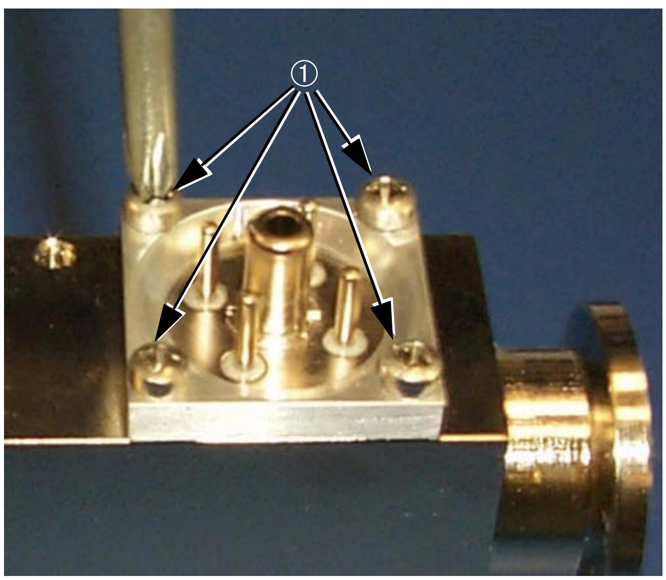


Figure 5-9 Button TC Assembly

12. Remove the button TC header ② (Figure 5-10) by pressing down on the button TC center post ① and lifting the header ② up and off of the button TC ③.

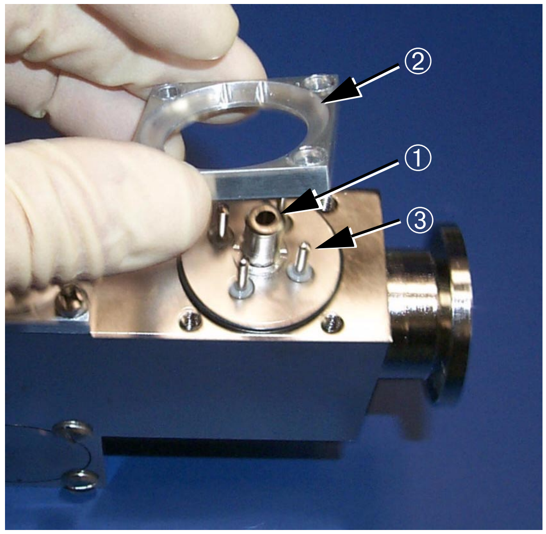


Figure 5-10 Removing the Button TC

13. Remove the button TC ③ carefully and place it sensing wire side up (contact pin side down) on a clean surface.

CAUTION

The sensing wire on the bottom side of the TC is approximately 3 mils thick. Care must be taken not to damage this wire.

5.3.2 Removing the Ion Source

NOTE

The ion source is typically replaced during the normal maintenance procedure. A new and clean ion source provides optimum sensitivity and system performance.

See "Ion Source Replacement Outside of Annual Maintenance" on page 5-18 when replacing the ion source outside of annual maintenance.

14. Remove the four Phillips-head screws that hold the ion source header piece, repeating steps 11 and 12 to release the ion source.

15. Remove the ion source from the spectrometer tube body (Figure 5-11).

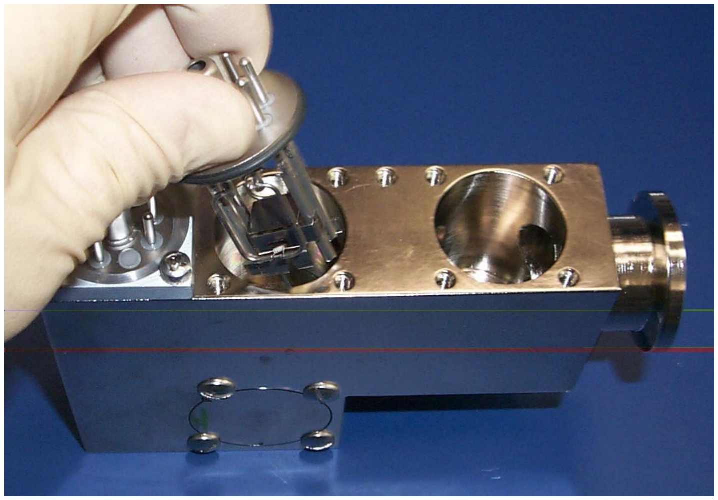


Figure 5-11 Removing the Ion Source

NOTE *Dark carbon-like deposits around the ion source filament and/or a rainbow-like discoloration on the inside walls of the ion source cavity indicate that the spectrometer tube has been operated at too high a pressure. This can occur from a system pressure leak or transferring into test at too high a pressure.*

16. Examine the ion source (Figure 5-12) and cavity (Figure 5-13) for deposits and discoloration. When examination is completed, dispose of it properly or return it to Varian Vacuum Technologies for exchange.

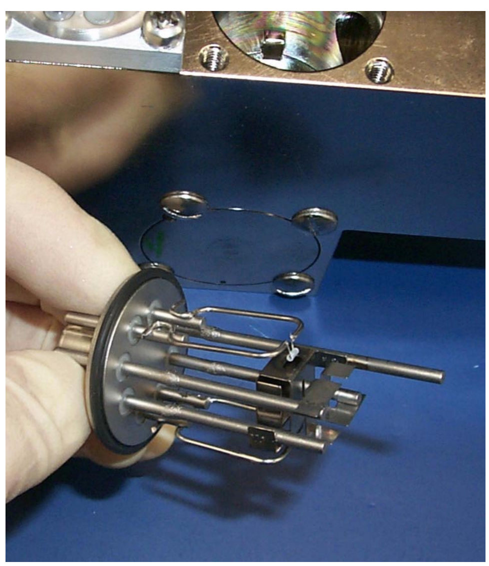


Figure 5-12 The Ion Source

17. Looking into the ion source cavity (Figure 5-13) you will see the ground slit plate ①.

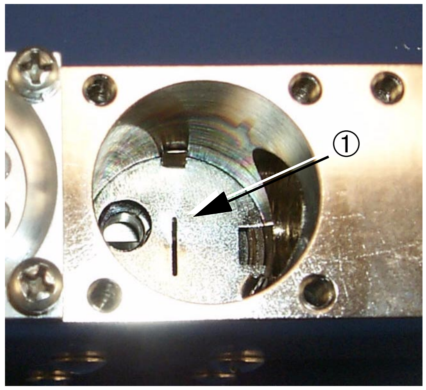


Figure 5-13 Ion Source Cavity

18. Remove the ground slit plate (Figure 5-14) by placing a thin, straight screwdriver snug into the slot and carefully twisting and prying with the screwdriver.

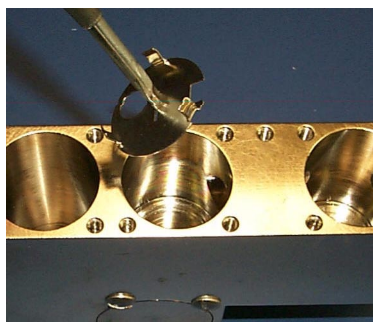


Figure 5-14 Ground Slit Plate

NOTE

A locking screwdriver designed to grab onto the slot of a screw will work very well for this procedure.

5.3.3 Removing the Preamplifier

CAUTION

The preamplifier is a static sensitive device. Wear a grounding device while the preamplifier is being handled.

19. Remove the four (4) Phillips-head screws that hold the preamplifier header piece, repeating steps 11 and 12 to release the preamplifier.

20. Carefully remove the preamplifier from the spectrometer tube body (Figure 5-15) and place it carefully on a clean, safe, non-magnetic surface.

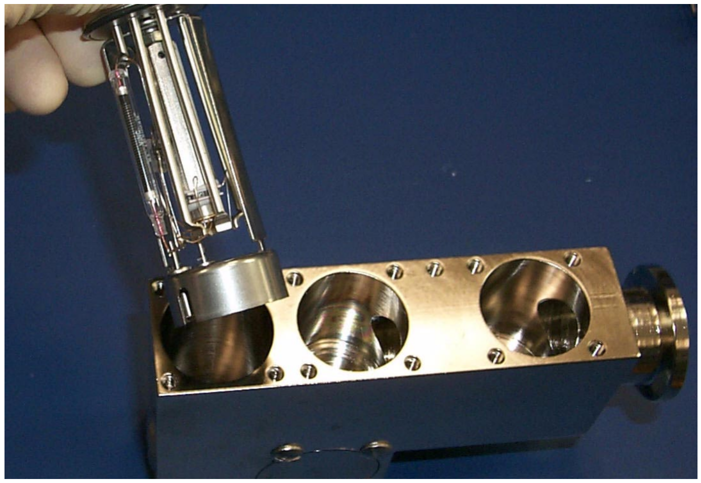


Figure 5-15 Removing the Preamplifier

5.3.4 Remove the Magnetic Poles

21. Remove the four (4) straight screws ① to free the magnet pole piece ② (Figure 5-16).

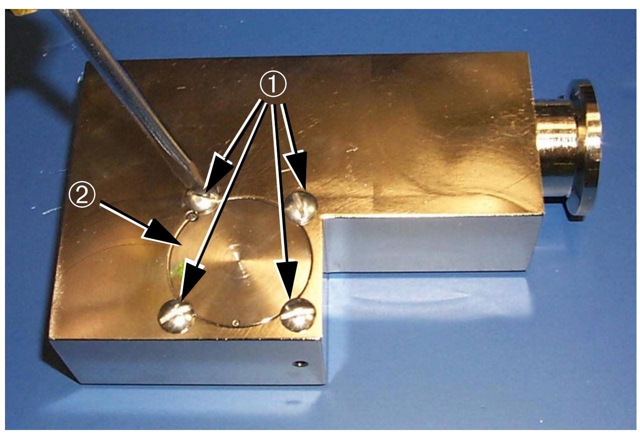


Figure 5-16 Magnetic Pole Piece

22. Pick up the spectrometer tube body and tilt the side over to remove the magnetic pole piece.

23. Remove the O-ring from the magnetic pole piece and place both the O-ring and the magnetic pole piece on a clean surface (Figure 5-17).

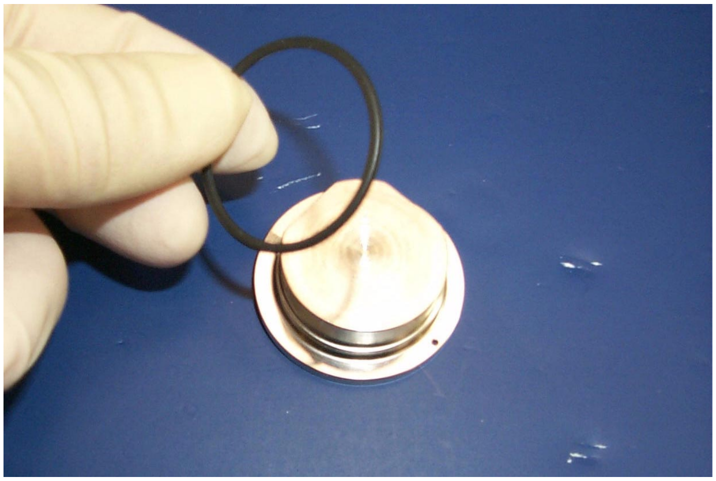


Figure 5-17 Removing the O-ring from Magnetic Pole Piece

24. Repeat steps 21 through 23 to remove the second magnetic pole piece (Figure 5-18) from the other side of the spectrometer tube body.

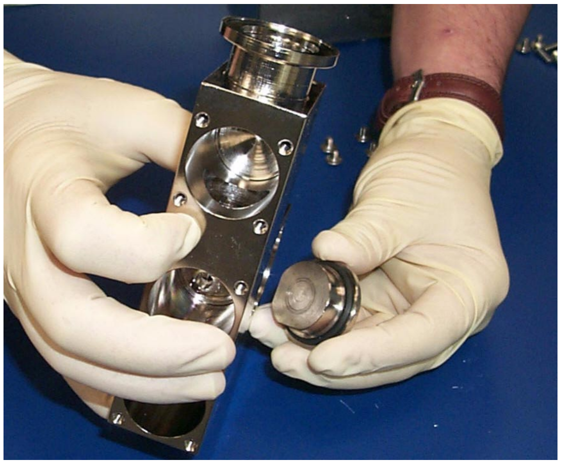


Figure 5-18 Removing the Second Magnetic Pole Piece

5.3.5 Examining and Cleaning the Spectrometer Parts

25. Using the Scotchbrite® pad from the spectrometer tube cleaning kit, polish away any discolored areas inside the spectrometer tube cavity (Figure 5-19).

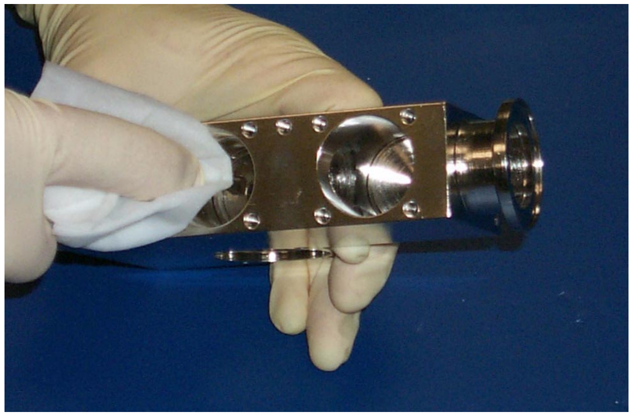


Figure 5-19 Discolored Spectrometer Tube Cavity

26. Using the Scotchbrite pad, polish away any discolored areas of the ground slit plate (Figure 5-20).

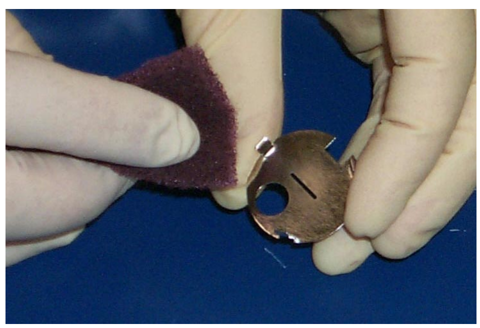


Figure 5-20 Discolored Ground Slit Plate

CAUTION *The ground slit plate is very thin. Take care not to bend or disfigure it during cleaning.*

27. Using the Scotchbrite pad, polish away any discolored areas of the magnetic pole pieces (Figure 5-21).

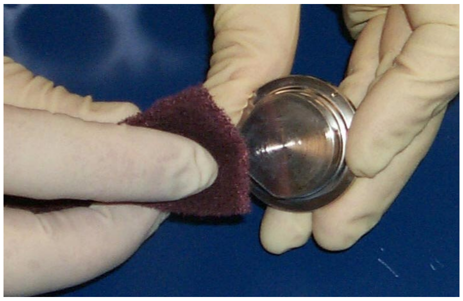


Figure 5-21 Discolored Ground Magnet Pole Piece

28. Using the VacuSolv presaturated cleaning wipes and swabs (Figure 5-22), thoroughly wipe down all surfaces of the spectrometer tube body, magnetic pole pieces, and ground slit plate.

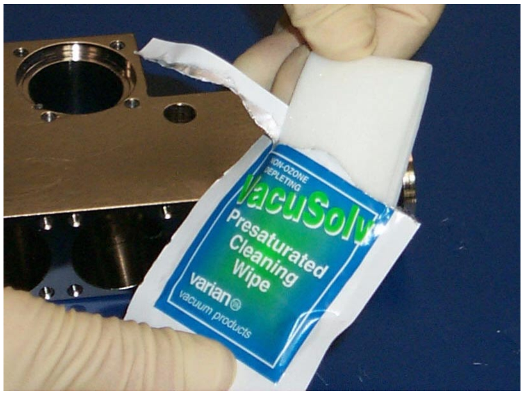


Figure 5-22 VacuSolv Cleaning Wipe

NOTE

If the button TC does not appear to be contaminated, it may be reused after it is properly cleaned. To clean the button TC properly, soak it in liquid VacuSolv (or Acetone) followed by an Isopropyl Alcohol rinse. Dry the button TC thoroughly before re-assembling into spectrometer tube.

29. Carefully wipe down and inspect all O-rings before reusing. Replace all damaged O-rings (Figure 5-23).

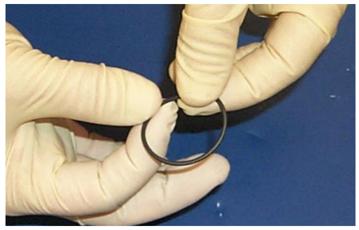


Figure 5-23 Inspecting the O-ring

NOTE

Varian Vacuum Technologies recommends replacing all O-rings during routine maintenance or during any maintenance procedure requiring that the O-rings be removed.

5.3.6 Reassembly

30. Carefully reassemble the spectrometer tube (Figure 5-24) in the reverse order of these instructions.

NOTE

The preamplifier assembly has a slot ① that must be aligned with the alignment pin ② in the preamplifier cavity of the spectrometer tube body.

The ground slit plate has a hole in it that must be aligned with the hole on the bottom of the spectrometer tube body ion source cavity ③.

The ion source must be aligned so that its alignment pin ④ falls in the center of this hole.

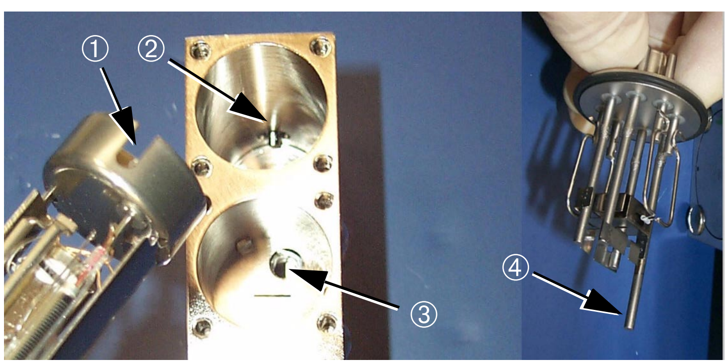


Figure 5-24 Spectrometer Tube Reassembly

5.4 Ion Source Replacement Outside of Annual Maintenance

The ion source has two filaments. The spare is automatically turned on when Filament 1 burns out, or manually by touching the filament selector box located on the MANUAL SPECTUBE TUNING screen (Figure 4-5 on page 4-4). Calibration may be necessary to obtain maximum sensitivity after changing filaments. It is recommended that the ion source be replaced as soon as convenient after the spare filament has been put into use. Replacement takes about 3 minutes.

Tools: Phillips-head screwdriver

Parts: Ion Source

1. Turn off the main power switch located on the back of the 979C leak detector.
2. Remove the two (2) Phillips-head screws from the front panel of the leak detector and drop the top of the front panel down (Figure 5-1 on page 5-5).
3. Remove the ion source connector at the spectrometer tube.
4. Vent the spectrometer tube by loosening the KF-25 flange clamp and tipping the spectrometer tube away from the high vacuum system manifold.
5. Remove the four (4) Phillips-head screws that secure the ion source header (Figure 5-9 on page 5-9).
6. Remove the ion source header by pressing down on the center post and lifting the header up and off of the ion source.
7. Gently slide the ion source out of the spectrometer tube body (Figure 5-11 on page 5-11).

NOTE *Dark carbon-like deposits around the ion source filament and/or a rainbow-like discoloration on the inside walls of the ion source cavity indicate that the spectrometer tube has been operated at too high a pressure. This can occur from a system pressure leak or transferring into test at too high a pressure.*

8. Remove the ground slit plate (Figure 5-14 on page 5-12) by placing a thin, straight screwdriver snug into the slot and carefully twisting and prying with the screwdriver.
9. Examine the ion source (Figure 5-12 on page 5-11) and cavity for deposits and discoloration. When examination is completed, discard the ion source or return it to Varian Vacuum Technologies for exchange.
10. Inspect the ground slit plate (Figure 5-20 on page 5-15) and ion source cavity (Figure 5-13 on page 5-12) to verify that they are clean. If not, follow applicable instructions in Section 5.3.5 to clean the spectrometer body and ground slit plate.

5.4.7 Reassembly

11. Replace the ground slit plate (see Figure 5-24).
12. Replace the ion source (see Figure 5-24).
13. Carefully reassemble the spectrometer tube assembly in the reverse order of these instructions.

NOTE

The ground slit plate has a hole in it that must be aligned with the hole on the bottom of the spectrometer tube body ion source cavity ③ (Figure 5-24 on page 5-17).

The ion source must be aligned so that its alignment pin ④ (Figure 5-24) falls in the center of this hole.

5.5 Mechanical Pump Fluid Change

Refer to the *Mechanical Pump Operation Manual*, provided with the Model 979C Leak Detector.

5.6 979C Spare Parts List

Table 5-3 979C Spare Parts

Assembly	Part Number
Ion Source	82850302
Button TC	R1266301
Preamplifier	L9030301 (Std Sensitivity) R1003301 (High-Sensitivity)
Thermocouple Gauge (TC), Model 531	F0472301
Spectrometer Tube Magnet Assembly	K3023301
Spectrometer Tube Assembly Exchange Program	EXL9713301
Spectrometer Tube Cleaning Kit	670029096
Calibrated Leak (Low 7 Range)	Call Varian Vacuum Technologies
Calibrated Leak (Low 8 Range)	Call Varian Vacuum Technologies
Back Panel Fuses	115 V:3.15 Amp 6453-00-048 H2183.15 5 x 20 mm 10.0 Amp 6453-00-049 H215010 5 x 29 mm 220 V:1.6 Amp 6453-00-047 5.0 Amp 6453-00-044
Main Power Supply	659077039
Ion Source Controller PCB	L9539301
Digital Interface PCB	L9536301
Preamplifier Driver PCB	L9524301
Gauges PCB	R10414031
Brain PCB	670079050
Power Supply PCB	L9255301
979C I/O PCB	Call Varian Vacuum Technologies
Touch Screen Assembly	Call Varian Vacuum Technologies
Front Housing	Call Varian Vacuum Technologies
Rear Housing	Call Varian Vacuum Technologies
V70D Turbo Pump Exchange Program	Call Varian Vacuum Technologies
V70LP Turbo Pump Exchange Program	Call Varian Vacuum Technologies

Table 5-3 979C Spare Parts (Continued)

Assembly	Part Number
Tip Seal Set, Triscroll 300 Primary Pump	PTSS0300TS*
Maintenance Kit, Triscroll 300 Primary Pump	PTSS0300MK*
Maintenance Tool Kit, Triscroll 300 Primary Pump	PTSS0300TK
**Requires Maintenance Tool Kit for installation.*	

This page intentionally left blank.

Appendix A. Rear Panel Interface Connectors

Table A-1 Rear Panel Interface Connectors

Signal Name	Description	Input/Output	Momentary/Level	I/O Connector
Reject Set Point #1	Active When Set Point #1 Tripped	Output	Active High	I/O pin 3
Reject Set Point #2	Active When Set Point #2 Tripped	Output	Active High	I/O pin 4
Reject Set Point #3	Active When Set Point #3 Tripped	Output	Active High	I/O pin 5
Reject Set Point #4	Active When Set Point #4 Tripped	Output	Active High	I/O pin 6
START Out	Active When 979C in Roughing Mode	Output	Active High	I/O pin 7
VENT Out	Active When 979C in Vent Mode	Output	Active High	I/O pin 8
TEST Out	Active When 979C in Test Mode	Output	Active High	I/O pin 9
GND	Return for all Inputs	GND	GND	I/O pin 1
VCC	5 – 24 VDC for Outputs	PWR	PWR	I/O pin 2
START In	Initiates Roughing Mode	Input	200 msec High Pulse	I/O pin 21
VENT In	Initiates Vent Mode	Input	200 msec High Pulse	I/O pin 22
HOLD In	Initiates Hold Mode	Input	200 msec High Pulse	I/O pin 23
Analog Leak Rate	0 – 10 VDC signal updated in Test mode	Output	Analog Voltage	I/O pin 33
Analog Leak Rate	Return for above	Output	Analog Voltage	I/O pin 34
RxD	RS-232 Data	Input	EIA RS-232 SPEC	I/O pin 15

Table A-1 Rear Panel Interface Connectors (Continued)

Signal Name	Description	Input/Output	Momentary/Level	I/O Connector
TxD	RS-232 Data	Output	EIA RS-232 SPEC	I/O pin 17
CTS	RS-232 Flow Control	Input	EIA RS-232 SPEC	I/O pin 18
RTS	RS-232 Flow Control	Output	EIA RS-232 SPEC	I/O pin 16
GND	RS-232 Ground	GND	EIA RS-232 SPEC	I/O pin 19

Appendix B. Communications Protocol

This appendix defines the technical specifications for the RS-232 protocol to be used with the 979C Leak Detector.

B.1 Protocol (RS-232)

The RS-232 communication link will operate at 9600 baud, 8 bits, no parity, and one stop bit.

All characters transmitted to the leak detector are echoed by the leak detector. Commands, inquiries, and strings of commands and inquiries are terminated by a carriage return; the carriage return is echoed as a space character. The maximum length of the input is 80 characters; if no carriage return has been received before the 80^{th} character, execution of the command string will begin anyway. Do not explore this feature.

Words that begin with the **?** character are inquiries for the controlling device to determine the current state or value of a leak detector parameter. Words that begin with the **!** character are commands for the controlling device to set the current state or value of a volatile leak detector parameter. Words that begin with **INIT-** are commands for the controlling device to set non-volatile leak detector parameters. Other commands do not require a parameter, do not begin with any special character(s), and simply do what they say they do.

Successful inquiries will respond with data as specified in the following tables. Successful inquiries will additionally respond with: **ok**, a carriage return, and then a linefeed. Unsuccessful inquiries will respond with the offending inquiry followed by a space, then: **#?**, a carriage return, and a linefeed.

Some commands require a numeric parameter, followed by a space and the command word. Other commands do not require a parameter, but cause the specified action. Successful commands will respond with: **ok**, then a carriage return, and a linefeed. Unsuccessful commands will respond with the offending command followed by a space, then **#?**, a carriage return, and a linefeed. Certain commands are restricted from use while the back panel I/O is in control; these commands will respond **cant**.

Inquiries, parameters, and commands may be concatenated. Each word or numeric parameter is followed by one or more spaces. The string is terminated by a carriage return, which causes execution to begin. Successful strings will respond with the specified data for the input inquiries (in the order the inquiries were issued), followed by: **ok**, a carriage return, and a linefeed. Unsuccessful strings will respond with the FIRST offending command followed by a space and four more characters: **#?**, followed by carriage return, followed by linefeed. All commands and inquiries following the failed word will be ignored; all parameters will be discarded.

Table B-1 through Table B-4 outline the available control and query commands.

Table B-1 Internal Operating Parameters

Inquiry	Response
?LEAK	A six-character number consisting of a two-digit leak rate mantissa with decimal point after the first digit followed by **E** – then a single digit, which is the leak rate range exponent (e.g., 1.3E–4).
?REJECT	A six-character number consisting of a two-digit reject leak rate mantissa with a decimal point after the first digit followed by **E**– then a single digit, which is the reject leak rate range exponent (e.g., 7.0E–5). This inquiry used for reporting the reject leak rate most recently input using INIT-REJECT.
?xREJECT	(Where x is a number from 1 to 4 or the letter **A**) a six-character number consisting of a two-digit reject leak rate mantissa with a decimal point after the first digit followed by **E** – then a single digit, which is the reject leak rate range exponent (e.g., 7.0E–5). This inquiry is used for reporting the reject leak rate most recently input using INIT-xREJECT. NOTE:?REJECT and ?1REJECT refer to the same variable.
?>REJECT	Reports the status of reject set point #1.
?>xREJECT	(Where x is a number from 1 to 4 or the letter **A**.) Reports the status of the reject set point as indicated by the number or letter.
?RANGE	A two-character (minus followed by one digit) number indicating the exponent of the least sensitive range of detectable leak. The reported leak rates are in this range and three lower (more negative exponent) ranges. See also INIT-RANGE.
?EXPONENT	A two-character (minus followed by one digit) number indicating the current manual-mode exponent. The exponent is within the least sensitive range (as reported by ?RANGE) and the three lower (more negative exponent) ranges. See also INIT-EXPONENT.
?STDLEAK	A six-character number consisting of a two-digit calibration standard leak rate mantissa with a decimal point after the first digit followed by **E–** then a single digit, which is the calibration standard leak rate range exponent (e.g., 1.3E-7). This inquiry is used for reporting the calibration standard leak rate most recently input using !STDLEAK.
?GAIN	A three-character number consisting of a two-digit gain factor with a decimal point after the first digit. This inquiry is used for reporting the value of the variable gain (digi-pot) device.
?OFFSET	A number representing the position of the variable offset (digi-pot) device as a percent of full scale. 50 represents mid-scale.
?PRESSURES	Two lines. Each begins with a <cr><lf>. The first line consists of the words **system TC** followed by a number of milliTorr. The second line consists of the words **system BA** followed by a number of microTorr.

Table B-1 Internal Operating Parameters (Continued)

Inquiry	Response
?TURBO	Three lines. Each begins with a <cr><lf>. The first line consists of the words **turbo** followed by either **Ok** or **Not Ok**. The second line consists of the words **turbo** followed by either **Fault** or **No Fault**. The third line consists of the words “turbo speed” followed by **Off**, **Fast**, or **Slow**.
?ALL	Ten lines. Each begins with a <cr><lf>. The first line reports the filament bias voltage. The second line reports the ion chamber voltage. The third line reports the variable focus voltage. The fourth line reports the repeller voltage. The fifth line reports the fixed focus voltage. The sixth line reports the suppressor voltage. The seventh line reports the emission current. The eighth line reports the position of the variable offset (digi-pot) device. The ninth line reports the gain factor value of the variable gain (digi-pot) device. The tenth line reports the leak rate.
?SETUP	Seven lines. Each begins with a <cr><lf>. The first line reports the turbo pump speed as **High**, **Low**, or **Off**. The second line reports the selected manual leak rate range, and the ranging method as auto or manual. The third line reports the least sensitive leak rate range. The fourth line reports the reject set point leak rate. The fifth line reports the calibration standard leak rate. The sixth line reports the DAC output method as Linear, Log(2V), or Log(3V). The seventh line reports the active filament status as **One** or **Two**, followed by **Lit** or **Out**.
?FILAMENTBIAS	Reports the filament bias voltage.
?IONCHAMBER	Reports the ion chamber voltage.
?VARIABLEFOCUS	Reports the variable focus voltage.
?REPELLER	Reports the repeller voltage.
?FIXEDFOCUS	Reports the fixed focus voltage.
?SUPPRESSOR	Reports the suppressor voltage.
?EMISSIONCURRENT	Reports the emission current.
?EXTLEAK	Reports the currently stored value of the external standard leak.
?INTEXT	Indicates which leak, INTERNAL or EXTERNAL has been selected for use during calibration.
?VALVESTATE	Reports the current mode of the valves (Vent, Hold, Rough, etc.).
?GL-XFER	Reports the currently stored gross leak crossover pressure.
?CL-XFER	Reports the currently stored contra-flow mode crossover pressure.
?ROUGH	Reports the currently stored Test Sequencer rough time.
?TEST	Reports the currently stored Test Sequencer test time.

Table B-1 Internal Operating Parameters (Continued)

Inquiry	Response
?SEQONOFF	Reports the status of the Auto Sequencer. Enabled or Disabled.
?AZ<0	Reports the status of the Auto-zero < 0 function. Enabled or Disabled.
?RANGESTOP	Reports value of Rangestop variable.
?RSONOFF	Reports status of Rangestop function. Enabled or Disabled.
?BACKGROUND	Reports value of the helium background.
?CALOK	Reports status of the last calibration.
WHYNOCAL	Reports calibration failure diagnostics.
?LPV	Reports the current Leak Rate, Pressures and Valvestate.
?VALVESTATE	Reports current valve state.
VER	One line, which reports a date in the form **30 AUG 1995** followed by a six digit hexadecimal checksum.

The commands listed in Table B-2 are used to set NON-VOLATILE operating parameters. The current value of the operating parameter is changed to the new value.

Table B-2 Non-Volatile Operating Parameters

Command	Parameter
INIT-REJECT	A two-digit leak rate mantissa with a decimal point after the first digit followed by **E–** followed by a single digit, which is the leak rate range exponent: the helium leak rate number in std cc/sec. Values outside the working range of the leak detector will not be stored.
INIT-1REJECT	Same as INIT-REJECT.
INIT-2REJECT	Same as INIT-1REJECT, but for Reject Set Point #2.
INIT-3REJECT	Same as INIT-1REJECT, but for Reject Set Point #3.
INIT-4REJECT	Same as INIT-1REJECT, but for Reject Set Point #4.
INIT-AREJECT	Same as INIT-1REJECT, but for the Audio Reject Set Point.
INIT-STDLEAK	A two-digit leak rate mantissa with a decimal point after the first digit followed by **E–** followed by a single digit, which is the leak rate range exponent: the helium leak rate number in std cc/sec of the calibration standard leak. Values outside the working range of the leak detector will not be stored.
INIT-LINEAR	None. The leak rate analog output voltage will become linear. See Section 3.5.6 on page 3-21 and Figure 3-15 on page 3-22.
INIT-1LOG	None. The leak rate analog output voltage will become logarithmic at 1 volt per decade. See Section 3.5.6 on page 3-21 and Figure 3-14 on page 3-21.
INIT-2LOG	None. The leak rate analog output voltage will become logarithmic at 2 volts per decade.
INIT-3LOG	None. The leak rate analog output voltage will become logarithmic at 3 volts per decade.
INIT-FILAMENT	A single digit, either 1 or 2, to set the operating filament in the ion source.
INIT-SPEED	A single digit, either 0 (for slow) or 1 (for fast), to set the operating speed of the turbo pump.
INIT-OFFSET	A two-digit number, in the range 00 to 99, which sets the percentage position of a variable offset (digi-pot) device used which sets the percentage position of a variable offset (digi-pot) device used for adjusting the helium signal to zero in the presence of background helium.
INIT-GAIN	A two-digit number with a decimal point after the first digit, in the range 1.0 to 6.0, which sets the position of a variable gain (digi-pot) device used for adjusting the helium signal to match a calibration standard leak.

Table B-2 Non-Volatile Operating Parameters (Continued)

Command	Parameter
INIT-ION	A three-digit number of volts, in the range 200 to 350, which sets the ion voltage of the ion source.
INIT-FOCUS	A three-digit number of volts, in the range 150 to 400, which sets the variable focus voltage of the ion source.
INIT-REPELLER	A three-digit number of volts, in the range 300 to 600, which sets the repeller voltage of the ion source.
INIT-EMISSION	A four-digit number of microamps, in the range 0300 to 2000, which sets the emission current of the ion source.
INIT-EXTLEAK	Same as INIT-STDLEAK, but for the value of the external leak.
INIT-GL-XFER	Preceded by **X.XE-X**, Sets the value of the gross leak crossover pressure in Torr.
INIT-CL-XFER	Preceded by **X.XE-X**, Sets the value of the contra-flow mode crossover pressure in Torr.
INIT-ROUGH	Preceded by **XXX**, sets the Auto Sequencer rough time in seconds.
INIT-TEST	Preceded by **XXX**, sets the Auto Sequencer test time in seconds.
INIT-DAC	Preceded by a number 0 to 255, sets the offset of the leak rate output voltage DAC.
INIT-RANGESTOP	Preceded by **XX**, sets the value of the most sensitive range exponent.
INIT-AZ<0	Preceded by 0 or 1, sets the status of Auto-zero < 0. 0 = off, 1 = on.
INIT-DISPLAY	Preceded by LOG or LINEAR, sets the large bar graph to a log or linear display.

The commands listed in Table B-3 are used to cause an immediate change in the spectrometer operating parameters. *These Commands Do Not Change The Non-volatile Operating Parameters.*

Table B-3 Spectrometer Operating Parameters

Command	Parameter
PUT-RANGE	A two-character number indicating the exponent of the least sensitive range of detectable leak. Acceptable values are 0 through –6. Unacceptable values will not be stored.
PUT-EXPONENT	A two-character number indicating the exponent of the range of leak in MANUAL mode. Acceptable values are 0 through –10. Unacceptable values will not be stored.
PUT-ION	A three-digit number of volts, in the range 200 to 350, which sets the ion voltage of the ion source.
PUT-FOCUS	A three-digit number of volts, in the range 150 to 400, which sets the variable focus voltage of the ion source.
PUT-REPELLER	A three-digit number of volts, in the range 300 to 600, which sets the repeller voltage of the ion source.
PUT-EMISSION	A four-digit number of microamps, in the range 0300 to 2000, which sets the emission current of the ion source.
PUT-OFFSET	A two-digit number, in the range 00 to 99, which sets the percentage position of a variable offset (digi-pot) device used for adjusting the helium signal to zero.
PUT-GAIN	A two-digit number with a decimal point after the first digit, in the range 1.0 to 6.0, which sets the position of a variable gain (digi-pot) device used for adjusting the helium signal to match a calibration standard leak.

The commands listed in Table B-4 are used to cause certain leak detection actions.

Table B-4 Leak Detection Actions

Command	Action
INTERNAL	Use internal Calibrated Leak for Auotcalibrate operations.
EXTERNAL	Use an external Calibrated Leak (in the test port) for Autocalibrate operations.
AUTO	Initiates auto-ranging mode. Success is indicated by the normal **ok** response. When using back panel control, the response is **cant**.
MANUAL	Sets to manual ranging mode. Success is indicated by the normal **ok** response. When using back panel control, the response is **cant**.
INCREMENT	Add 1 to the displayed leak rate exponent (making it less negative). Success is indicated by the normal **ok** response. Does nothing in auto-ranging mode. Does nothing upon reaching the least sensitive range. When using back panel control, the response is **cant**.
DECREMENT	Subtract 1 from the displayed leak rate exponent (making it more negative). Success is indicated by the normal **ok** response. Does nothing in auto-ranging mode. Does nothing upon reaching the most sensitive range. In back panel control, the response is **cant**.
ZERO	Set the current leak rate measurement to be 0.0 std cc/sec. in the most sensitive range. In back panel control, the response is **cant**.
TUNE	Adjust ion source voltage to cause a maximum response to helium. In back panel control, the response is **cant**.
CALIBRATE	TUNES, then adjusts the gain so that the current helium signal causes the current leak rate measurement to be the same as was most recently input using INIT-STDLEAK. Success is indicated by the normal **ok** response. In back panel control, the response is **cant**.
LOUD	Increase the audio level to the next higher level. There are about 15 loudness levels. Success is indicated by the normal **ok** response.
SOFT	Decrease the audio level to the next lower level. There are about 15 loudness levels. Success is indicated by the normal **ok** response.
SYTCATM	Set the current system thermocouple reading to represent atmospheric pressure. Success is indicated by the normal **ok** response.
SYTCZERO	Sets the current system thermocouple reading to represent a pressure that is too low for a thermocouple to read. Success is indicated by the normal **ok** response.
TPTCATM	Sets the current test port thermocouple reading to represent atmospheric pressure. Success is indicated by the normal **ok** response.

Table B-4 Leak Detection Actions (Continued)

Command	Action
TPTCZERO	Sets the current test port thermocouple reading to represent a pressure which is too low for a thermocouple to read. Success is indicated by the normal **ok** response.
FPEAK	Adjusts variable focus voltage to cause a maximum response to helium. In back panel control, the response is **cant**.
NOSNIFF	Disables the internal sniffer mode.
SNIFF	Enables the internal sniffer mode.
IDLE	Turns off the turbo and spectube and waits for a RUN command.
RUN	Starts turbo and spectube after IDLE command.
ENABLE-RANGESTOP	Enables the Rangestop function.
DISABLE-RANGESTOP	Disables the Rangestop function.

This page intentionally left blank.

Index

This page intentionally left blank.

Sales and Service Offices

Argentina
Varian Argentina Ltd.
Sucursal Argentina
Av. Ricardo Balbin 2316
1428 Buenos Aires
Argentina
Tel: (54) 1 783 5306
Fax: (54) 1 786 5172

Australia
Varian Australia Pty Ltd.
679-701 Springvale Road
Mulgrave, Victoria ZZ 3170
Australia
Tel: (61) 395607133
Fax: (61) 395607950

Benelux
Varian Vacuum Technologies
Rijksstraatweg 269 H,
3956 CP Leersum
The Netherlands
Tel: (31) 343 469910
Fax: (31) 343 469961

Brazil
Varian Industria e Comercio Ltda.
Avenida Dr. Cardoso de Mello 1644
Vila Olimpia
Sao Paulo 04548 005
Brazil
Tel: (55) 11 3845 0444
Fax: (55) 11 3845 9350

Canada
Central coordination through:
Varian Vacuum Technologies
121 Hartwell Avenue
Lexington, MA 02421
USA
Tel: (781) 861 7200
Fax: (781) 860 5437
Toll Free: (800) 882 7426

China
Varian Technologies - Beijing
Room 1201, Jinyu Mansion
No. 129A, Xuanwumen Xidajie
Xicheng District
Beijing 1000031 P.R. China
Tel: (86) 10 6641 1530
Fax: (86) 10 6641 1534

France and Wallonie
Varian s.a.
7 avenue des Tropiques
Z.A. de Courtaboeuf – B.P. 12
Les Ulis cedex (Orsay) 91941
France
Tel: (33) 1 69 86 38 13
Fax: (33) 1 69 28 23 08

Germany and Austria
Varian Deutschland GmbH
Alsfelder Strasse 6
Postfach 11 14 35
64289 Darmstadt
Germany
Tel: (49) 6151 703 353
Fax: (49) 6151 703 302

India
Varian India PVT LTD
101-108, 1st Floor
1010 Competent House
7, Nangal Raya Business Centre
New Delhi 110 046
India
Tel: (91) 11 5548444
Fax: (91) 11 5548445

Italy
Varian Vacuum Technologies
Via F.lli Varian, 54
10040 Leini, (Torino)
Italy
Tel: (39) 011 997 9111
Fax: (39) 011 997 9350

Japan
Varian Vacuum Technologies
Sumitomo Shibaura Building, 8th Floor
4-16-36 Shibaura
Minato-ku, Tokyo 108
Japan
Tel: (81) 3 5232 1253
Fax: (81) 3 5232 1263

Korea
Varian Technologies Korea, Ltd.
Shinsa 2nd Bldg. 2F
966-5 Daechi-dong
Kangnam-gu, Seoul
Korea 135-280
Tel: (82) 2 3452 2452
Fax: (82) 2 3452 2451

Mexico
Varian S.A.
Concepcion Beistegui No 109
Col Del Valle
C.P. 03100
Mexico, D.F.
Tel: (52) 5 523 9465
Fax: (52) 5 523 9472

Taiwan
Varian Technologies Asia Ltd.
18F-13 No.79, Hsin Tai Wu Road
Sec. 1, Hsi Chih
Taipei Hsien
Taiwan, R.O.C.
Tel: (886) 2 2698 9555
Fax: (886) 2 2698 9678

UK and Ireland
Varian Ltd.
28 Manor Road
Walton-On-Thames
Surrey KT 12 2QF
England
Tel: (44) 1932 89 8000
Fax: (44) 1932 22 8769

United States
Varian Vacuum Technologies
121 Hartwell Avenue
Lexington, MA 02421
USA
Tel: (781) 861 7200
Fax: (781) 860 5437
Toll Free: (800) 882 7426

Other Countries
Varian Vacuum Technologies
Via F.lli Varian, 54
10040 Leini, (Torino)
Italy
Tel: (39) 011 997 9111
Fax: (39) 011 997 9350

Internet Users:

Customer Service & Technical Support:
vpl.customer.support@varianinc.com

Worldwide Web Site:
www.varianinc.com/vacuum

Order On-line:
www.evarian.com

Representatives in most countries

VARIAN