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Agilent Technologies

CE

Model 979 Series Helium Mass Spectrometer Leak Detector

OPERATIONS MANUAL

Manual No. 699909979
Revision L
March 2005

Model 979 Series
Helium Mass Spectrometer Leak Detector



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Examples of items not normally covered under warranty include ion sources, TC gauges, O-rings, spectrometer tube cleaning and overhaul, mechanical pump oils, vacuum system overhauls, and obvious abuse or customer error. These items are considered normal maintenance for this type of equipment.

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Declaration of Conformity
Konformitätserklärung
Déclaration de Conformité
Declaración de Conformidad
Verklaring de Overeenstemming
Dichiarazione di Conformità

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Model 979 Series Helium Mass Spectrometer Leak Detector

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72/23/EEC. . . . . Low Voltage Directive
89/336/EEC. . . . . Electromagnetic Compatibility Directive
EN61010-1 (2001) . . . . . Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory use. Part 1. General Requirements
CSA C22.2 No. 1010-1 (1992) . . . . . Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use. Part 1. General Requirements.
UL 3101-1 (1993) . . . . . Standard for Safety. Electrical Equipment for Laboratory Use. Part 1.
EN61326 (1997) . . . . . Measurement Control and Laboratory Equipment EMC Requirements

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CE

Preface

Hazard and Safety Information

Some common international symbols used in this manual and the equipment itself are shown below.


OFF Power Switch Position


Earth Ground

ON Power Switch Position


Hot Surface


AC – Alternating Current


Dangerous Voltage, Risk of Electrical Shock

This manual uses the following standard safety protocol:

NOTE



The notes contain important information taken from the text.

CAUTION



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

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.

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 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 Vacuum Technologies office.

Solvents

CAUTION



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 work in a large, well-ventilated room.

Alcohol, methanol, or other solvents are irritants, narcotics, depressants and/or carcinogens. 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.

CAUTION



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.

Equipment, General

WARNING



The leak detector is not designed for use with hazardous gases. Verify that the system to be tested has been purged of all hazardous gases prior to using the leak detector.When testing a system that contained hazardous gases, the exhaust of the leak detector should be connected to a scrubbed or toxic containment exhaust. Exposure to hazardous gases could result in serious injury or death.

WARNING



Equipment tightness is guaranteed for normal operating conditions when the equipment leaves the factory. It is the user's responsibility to maintain the level of tightness particularly when pumping dangerous products.

CAUTION



The performance and operating safety of this equipment can only be guaranteed if it is operated according to normal conditions of use.

CAUTION



Always allow at least 4 inches of clearance adjacent to the ventilation holes at the front, back and bottom of the equipment enclosure.

Power and Static

WARNING



Electrical insulation must include the appropriate branch circuit (at least 20 A), with long time delay and a reliable earth ground. Do not use an extension cord.

Disconnect power from the 979 before performing any maintenance procedure that requires physically disconnecting any part of the system.

Use only the power cord that was provided with your leak detector. The use of extension cords is not recommended and could result in damage to the equipment and loss of warranty.

To avoid electric shock, connect the product power cord to a grounded power receptacle. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

CAUTION



Vacuum Technologies strongly recommends the use of surge protection to improve the immunity of the 979 Series leak detectors against unidirectional transients caused by the following phenomena:

- *Switching phenomena in the power network (e.g., switching of capacitor banks)*
- *Faults in the power network*
- *Indirect lightning strokes*

CAUTION



Many components of the 979 are static sensitive devices. Vacuum Technologies recommends that you wear a grounding device when performing any maintenance on the 979 and especially when performing maintenance of static sensitive parts.

WARNING



This equipment is designed to meet current EEC regulations: LVD (Low Voltage Directive, 73/23/EEC) and EMC (Electromagnetic Compatibility, 89/336/EEC Directive) for Installation Category II, Pollution Degree II environment for Industrial, Scientific, Measuring and Process Control electrical equipment.

- ❑ Any modifications on the part of the user are liable to cause non-compliance with regulations or affect the EMC performance and the safety of the product. Vacuum Technologies cannot be held responsible for consequences resulting from such intervention.
- ❑ The equipment can be damaged by incorrect mains AC supply voltages, the Radio Frequency (RF) and Electrostatic Discharge (ESD) energy inputs that can exceed the maximum ratings, operating in very high temperatures or without adequate ventilation, immersion in liquids, and physical abuse.
- ❑ All electrical connections must be performed by a qualified electrician and must comply with national and local codes.
- ❑ Ensure that the electrical installation conforms with your local safety requirements.
- ❑ Electrical installation must include the appropriate branch circuit (at least 20 A) with long time delay and reliable earth ground. Do not use an extension cord.
- ❑ Use only the power cord that was provided with your leak detector. The use of extension cords is not recommended and could result in damage to the equipment and loss of warranty.
- ❑ To avoid electric shock, connect the product power cord to a grounded power receptacle. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.
- ❑ Before powering the unit the first time, verify that the unit is configured to operate for the local mains supply voltage.
- ❑ Opening the enclosure may expose hazardous voltages. Always disconnect the power cord and interface cables before opening the enclosure. Do not touch the power inlet's contacts for at least 10 seconds after disconnecting the power cord.

CAUTION



This equipment generates, uses, and can radiate RF energy and if not installed and used in accordance with the instructional manual, may cause harmful interference to radio communications.

When this equipment is operated in a commercial environment operation is subject to the following two conditions:

- ❑ This equipment may not cause harmful interference, and
- ❑ This equipment must accept any interference received, including interference (RF and ESD) that may cause undesired operation.

This equipment may need to be reset after RF and/or ESD events by cycling the Power Switch/Circuit Breaker on the back panel of the unit.

Operation of this equipment in a residential area is also likely to cause harmful radio communications interference in which case the user will be required to correct the interference at his own expense.

Vacuum Equipment and Cleanliness

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

CAUTION



Do not use silicone oil or silicone grease.

Use powder-free butyl or polycarbonate gloves to prevent skin oils from getting on vacuum surfaces.

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

NOTE



Normally, it is unnecessary to use vacuum grease. However, if it must be used, avoid silicone types, and use it sparingly. Apiezon® L grease is recommended (Vacuum Technologies Part No. 695400004).

O-ring Care

When removing, checking or replacing O-rings, keep in mind the following:

NOTE



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

CAUTION



Remove O-rings carefully with your fingers. Do not use metal tools for this task. This prevents scratching of any sealing surfaces.

- ❑ *Wipe all O-rings clean with a lint-free cloth before installation to ensure that no foreign matter is present to impair the seal.*
- ❑ *Do not use grease or other substance on O-rings that will come in contact with the spectrometer tube.*
- ❑ *Do not use alcohol, methanol or other solvents on O-rings. To do so causes deterioration and reduces their ability to hold a vacuum.*
- ❑ *If applicable, apply a small amount of Apiezon® L grease and wipe the O-rings "shiny" dry.*

NOTE



Due to the effective cleaning nature of VacuSolv solvent and its residue-free properties, 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 (chlorofluorocarbons).

Spectrometer Tube

CAUTION



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.

CAUTION



Do not use grease or other substance on O-rings that will come in contact with the spectrometer tube.

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.

WARNING



Store the Ion Source in a cool, dry area in a tightly sealed container. Wash hands thoroughly after handling the Ion Source and especially before smoking or eating.

Gross Leak Option

If the Gross Leak option is installed, heed the following:

CAUTION



Do not make any alterations to the Gross Leak. Do not touch the knurled nut on the Gross Leak.

The Gross Leak is calibrated at the factory and if any alteration is made, the Gross Leak must be returned to the factory for recalibration. For returns, contact Vacuum Technologies Customer Service at 1-800-8VARIAN.

Pumps

WARNING



To avoid injury, use proper lifting techniques when moving pumps. Your system may have pumps that require two people to move them safely.

WARNING



The vacuum pumps are also compressors; incorrect operation may be dangerous. Study the "Mechanical Pump Operation Manual" enclosed with your pump before starting pumps.

The pumps are designed to prevent any thermal risk for user safety. However, specific operating conditions may generate temperatures >70 °C.

Hot oil will burn the skin. Service of the pumps in this area must be performed by authorized personnel only. Stand back from mechanical pump before starting.

CAUTION



*Check the oil level often. Do not allow oil-based mechanical pumps to run when oil level is below **LOW** mark. Damage to pumps can occur if operated with no oil.*

WARNING



To avoid injury, wait until the turbo pump is completely stopped before disconnecting it from the vacuum system.

Vacuum Technologies Services

The following are two of the many services that Vacuum Technologies offers its customers. Please see our catalog, or contact us to learn of the services that are available. Contact Vacuum Technologies Customer Service at 1-800-8VARIAN for details.

- ❑ Rebuilt spectrometer tubes are available on an exchange basis.
- ❑ NIST-traceable calibrated leak testing and verification services.

Contacting Vacuum Technologies

In the United States, you can contact Vacuum Technologies Customer Service at 1-800-8VARIAN.

Internet users:

- ❑ Send email to Customer Service & Technical Support at vpl.customer.support@varianinc.com
- ❑ Visit our web site at www.varianinc.com/vacuum
- ❑ Order on line at www.evarian.com

See the back cover of this manual for a listing of our sales and service offices.

Section 1. Introduction to the Model 979 Series

1.1 The Model 979

The Model 979 is a wide-range Helium Mass Spectrometer Leak Detector. It is comprised of a turbomolecular high vacuum pump, spectrometer tube, valve block, Vacuum Technologies' Platform leak detector electronics, and an operator interface in a stylish, yet rugged housing. The 979 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. Outline drawings for each configuration are shown in Section 1.1.1 "Model 979 Series Configurations".

The 979 uses 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.

1.1.1 Model 979 Series Configurations

This section contains outline drawings of the various configurations of the 979 Series leak detector.

Figure 1-1 shows the outline drawing and physical dimensions of the stand-alone, bench-mount 979 Series Leak Detector.

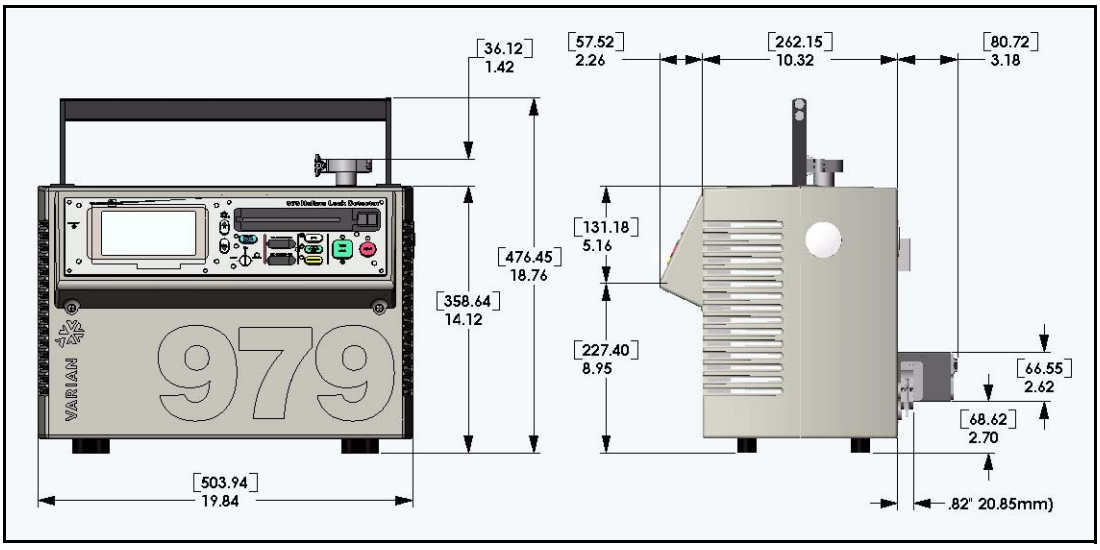


Figure 1-1 979 Bench Mount Unit

Figure 1-2 shows the outline drawing and physical dimensions of a single, oil sealed mechanically pumped leak testing station with the 979 Series Leak Detector on a two-wheel cart.

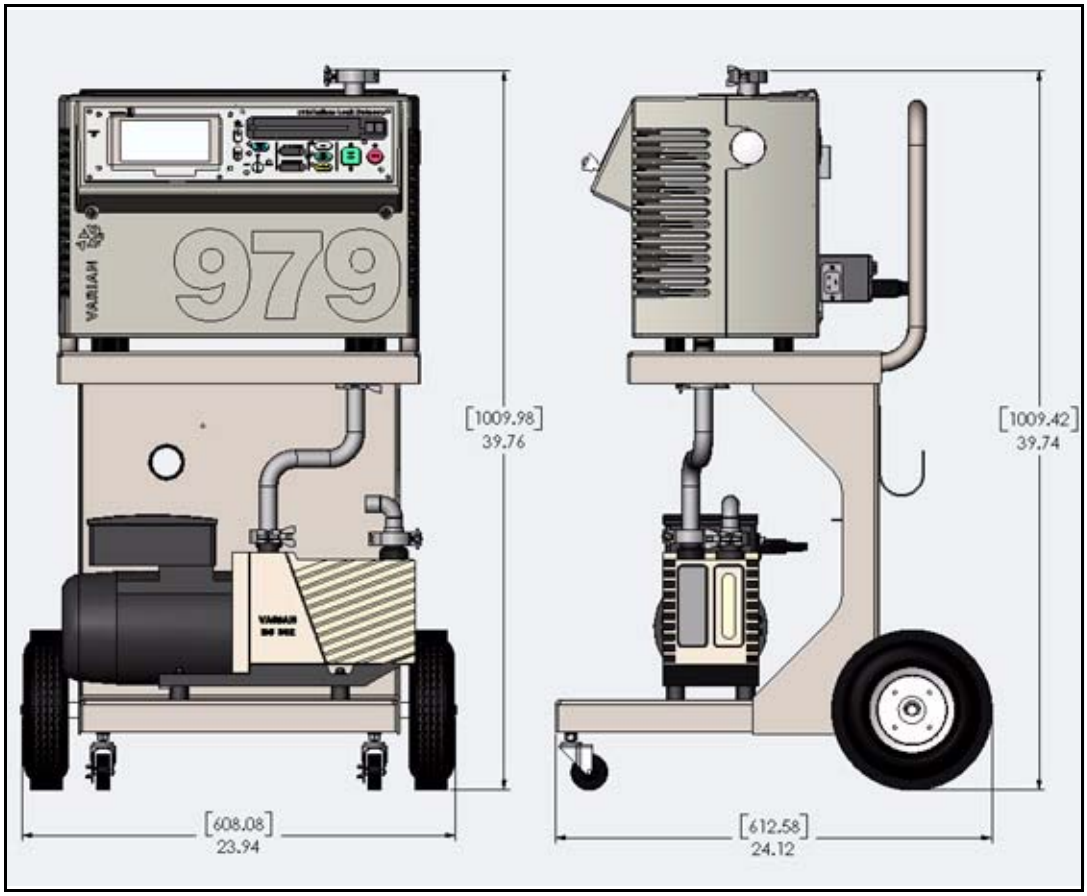


Figure 1-2 Single, Oil-Sealed Mechanical Pump Configuration on Two-Wheel Cart

Figure 1-3 shows the outline drawing and physical dimensions of a single, dry mechanically pumped leak testing station with the 979 Series Leak Detector mounted on a two-wheel cart.

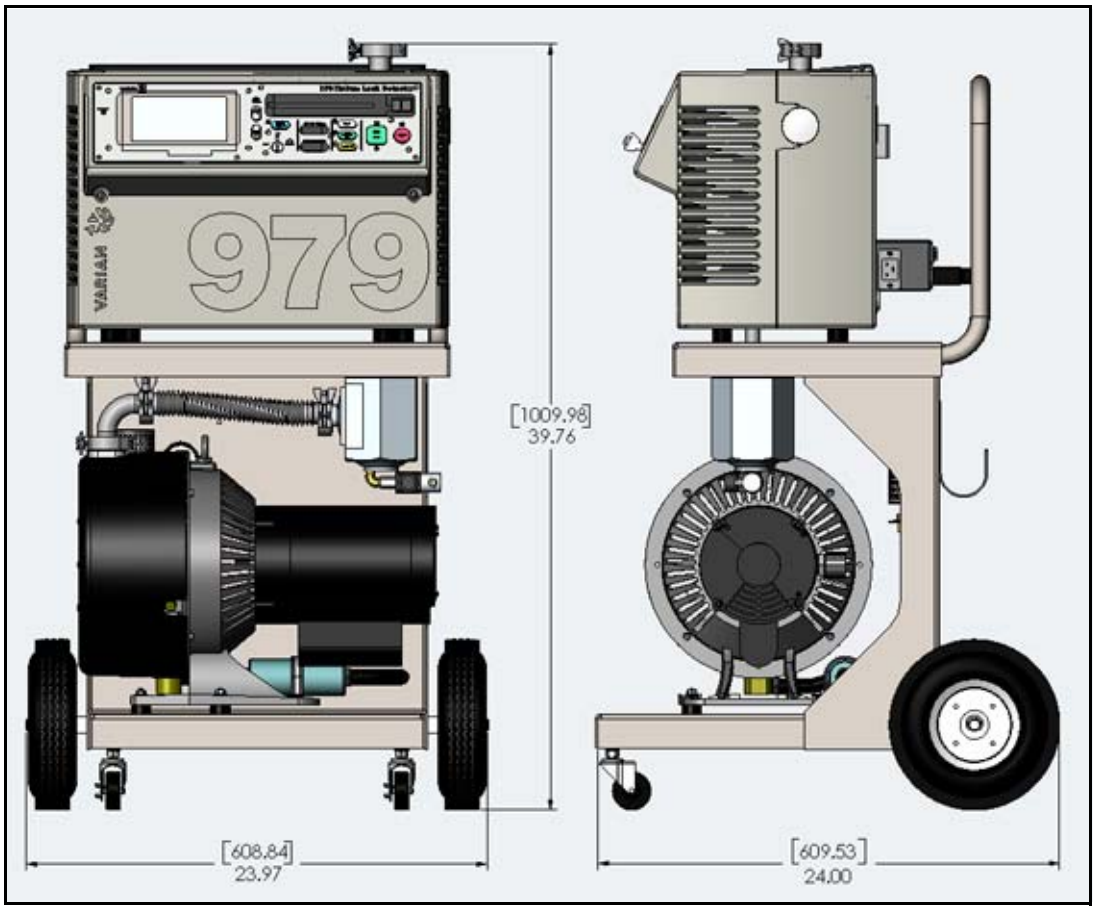


Figure 1-3 Single, Dry Mechanical Pump Configuration on Two-Wheel Cart

Figure 1-4 shows the outline drawing and physical dimensions of a single, dry mechanically pumped leak testing station with the 979 Series Leak Detector on a four-wheel cart.

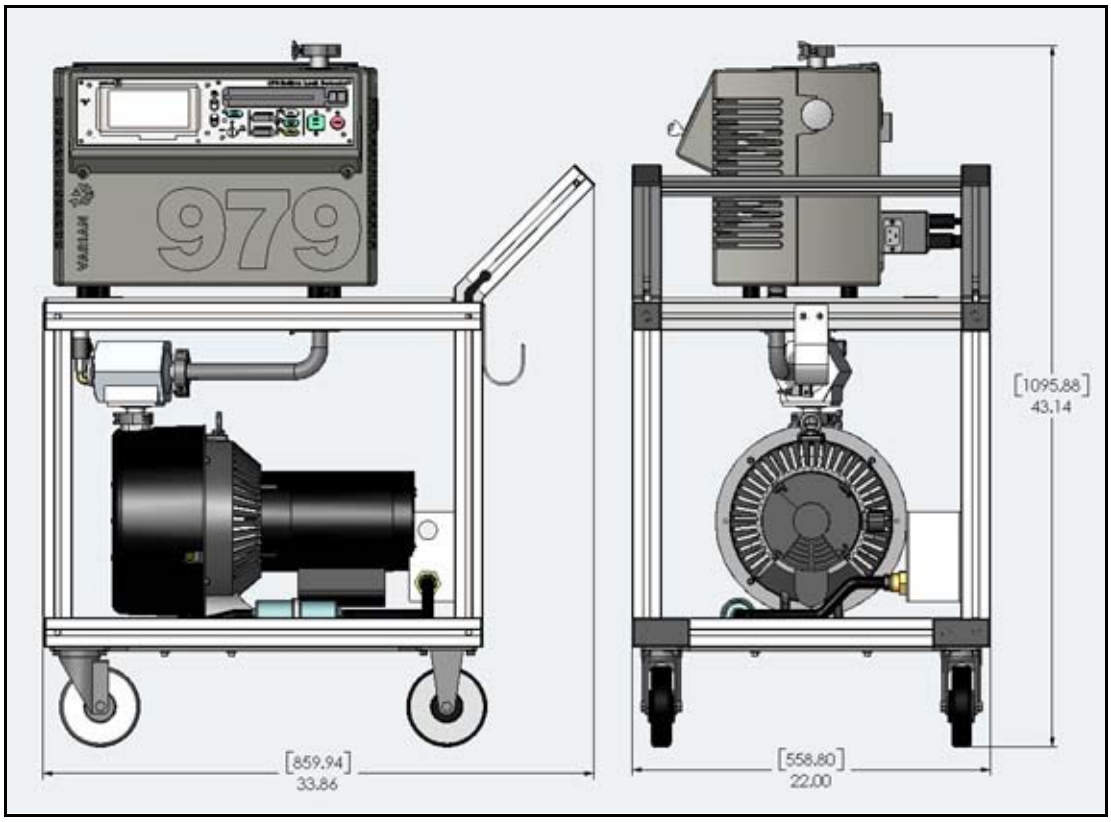


Figure 1-4 Single, Dry Mechanical Pump Configuration on Four-Wheel Cart

Figure 1-5 shows the outline drawing and physical dimensions of a dual, oil sealed mechanically pumped leak testing station with the 979 Series Leak Detector on a four-wheel cart.

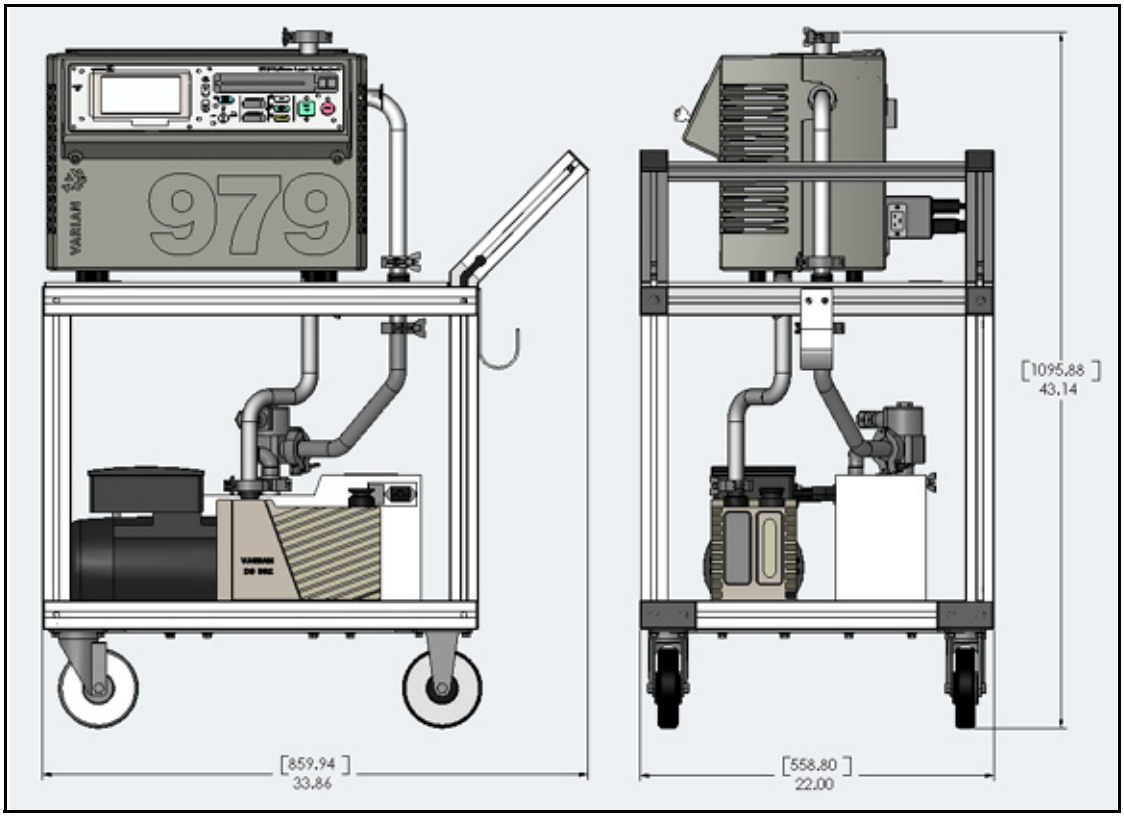


Figure 1-5 Dual, Oil-Sealed Mechanical Pump Configuration on Four-Wheel Cart

Figure 1-6 shows the outline drawing and physical dimensions of a dual, dry mechanically pumped leak testing station with the 979 Series Leak Detector on a four-wheel cart.

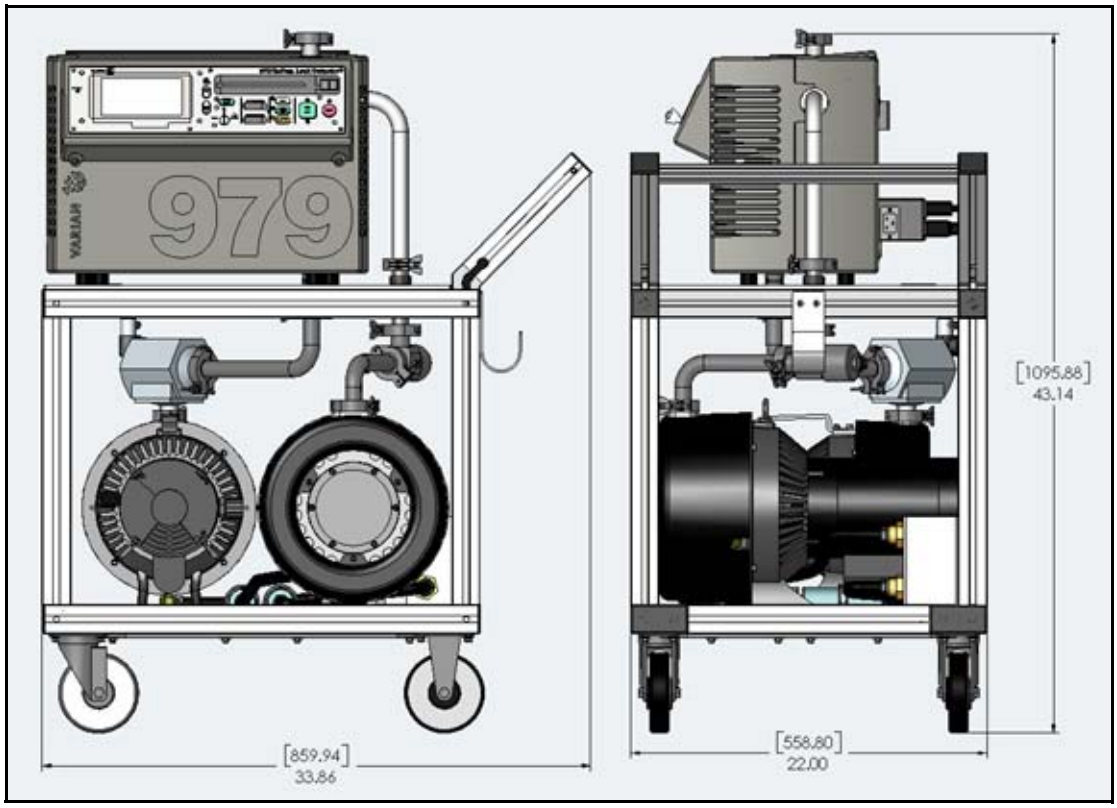


Figure 1-6 Dual, Dry Mechanical Pump Configuration on Four-Wheel Cart

1.2 Unpacking the 979

The 979 leak detector is carefully packed onto a resiliently mounted skid and enclosed by a heavy cardboard container banded to the skid. Upon receipt, inspect the container for evidence of damage in shipment. Do not discard any evidence of rough handling. When opening the container, refer to the unpacking instructions located on the outside of the shipping container. Factory packing provides for maximum protection during shipment. However, inspect the leak detector and related items immediately. Report any damage to the carrier without delay.

The following items are included in the shipment:

- ❑ *Model 979 Series Operations Manual*
- ❑ Model 979 leak detector configured and completely assembled as ordered
- ❑ All necessary power cords
- ❑ Pump manuals (for the purchased configuration)
- ❑ Any optional equipment ordered
- ❑ Any manuals for optional equipment purchased.

1.2.1 Unpacking Instructions

To unpack the 979 leak detector and remove it from the skid:

1. Inspect the container for evidence of damage in shipment. Do not discard any evidence of rough handling.

   Report any damage to the carrier and to Vacuum Technologies Customer Service at 1-800-8VARIAN without delay.
2. Carefully remove the outer shipping container.
3. Inspect the leak detector and related items immediately for any indication of shipping damage.
4. Carefully cut the strapping holding the leak detector on the skid.
5. Remove any loose boxes or packages and put them aside.

   Keep the original packing for re-use in the event that it is necessary to return the leak detector to Varian Vacuum Technologies.
6. Carefully remove the front brace by removing the two lag bolts.
7. Carefully remove the plastic bag covering the leak detector.

   The leak detector can now be removed from the skid.

1.2.2 Removing the 979 from the Skid

There are two methods for removing the 979 from the skid. Both methods require two people. The second method involves removing the *Skid-Mates* (the blue donut-shaped mounts at the front of the skid) from the skid.

WARNING



Handle the leak detector carefully and properly in the following steps. Personal injury or damage to the leak detector could result from improper handling. The 979 is heavy and can cause personal injury if not handled carefully when removing it from the skid.

Method 1

1. With the assistance of a helper, carefully roll the leak detector toward the front of the skid.
2. Lift the front end of the unit and *gently* lower it onto the floor.
3. Lift the rear of the unit and roll it on the front casters until it is clear of the skid.
4. *Gently* lower the rear end onto the floor.

Method 2

1. Using the brace removed in Step 6 of Section 1.2.1 “Unpacking Instructions” as a lever, carefully raise the front edge of the skid between 1" and 2".
2. While a helper holds the leak detector against the back brace, unscrew and remove the front two Skid-Mates by turning them in a counterclockwise direction.
3. Make sure the helper is still holding the leak detector against the back of the skid, then gently lower the front of the skid to the floor.
4. Carefully and slowly roll the leak detector off the skid and onto the floor.

1.2.3 Removing Loose Packing

Once the 979 is off the skid, take out and remove all loose packing from the leak detector.

1.3 Services Required for Operation

1.3.1 Power

Depending upon the configuration you ordered, the mains power supply requirements for the 979 Series leak detector are:

- ❑ 100 VAC, 20 A, 50 Hz / 115 VAC, 20 A, 60 Hz, or
- ❑ 230 VAC, 20 A, 50/60 Hz

CAUTION



Mains supply voltage fluctuations shall not exceed ±10% of the nominal voltage.

Transient overvoltages shall not exceed values according to Installation Category (Overvoltage Category) II of the UL3101-1 Standard.

Fixed mains socket-outlet shall be connected to PROTECTIVE EARTHING system.

For indoor use only, Pollution Degree II in accordance with UL3101-1 Standard.

CAUTION



Vacuum Technologies strongly recommends the use of surge protection to improve the immunity of the 979 Series leak detectors against unidirectional transients caused by the following phenomena:

- ❑ *Switching phenomena in the power network (e.g., switching of capacitor banks)*
- ❑ *Faults in the power network*
- ❑ *Indirect lightning strokes*

WARNING



Use only the power cord that was provided with your leak detector. The use of extension cords is not recommended and could result in damage to the equipment and loss of warranty.

1.3.2 Helium

For testing products, or leak checking the 979, welding grade helium in a standard cylinder with pressure regulating valve and hose is required.

1.3.3 Recommended Additional Services

The following additional services are recommended, especially in the case of clean room use:

- A roughing/foreline pump exhaust hose to the outside of the room using the connection on pump exhausts. This can help reduce the particulate count and the helium background signal.
- When using oil lubricated mechanical pumps, an oil mist eliminator can be used on the exhaust port of the mechanical pump to reduce the oil mist from the exhaust. Oil mist eliminators can, however, become saturated with oil causing slower pumping speeds and higher helium backgrounds in the leak detector. The replacement time interval of the oil mist eliminator is determined by whether the user frequently operates at elevated roughing pressures, pumps on large volumes, or frequently cycles the system. Refer to Section 4.6 “979 Spare Parts List” on page 4-22 and Section 4.7 “979 Accessory Item List” on page 4-24 for the mist eliminator and replacement cartridge part number.

1.4 Preparation for Operation

Pre-operational set up is minimal for the 979 Series leak detector.

Oil sealed vacuum pumps are shipped with the proper initial charge of oil. On the front of the roughing and forepumps is an oil level sight glass. The oil level should be in the middle of the glass when the pump is not running. Check the oil level after running the pump for at least 10 minutes. For additional information, see the *Mechanical Pump Operation Manual* that was enclosed with your pump.

1.5 Installation

The 979 Series leak detector is delivered completely assembled as ordered. Locate the 979 close to its power source and be sure there is at least four inch clearance for proper ventilation, and sufficient room for the operator to safely maneuver to perform testing. Additional ventilation requirements for your specific application as discussed in Section 1.3.3 “Recommended Additional Services” on page 1-10 must also be provided at this point.

NOTE

Refer to Section 1.5.1 “Bench System Installations” on page 1-11 for instructions on bench system installations, which require some customer configuration.

1.5.1 Bench System Installations

Figure 1-7 represents the process for installation of a bench system version of the 959/959D. Note, cut the 3/4" black tubing into 2 equal lengths for use as shown.

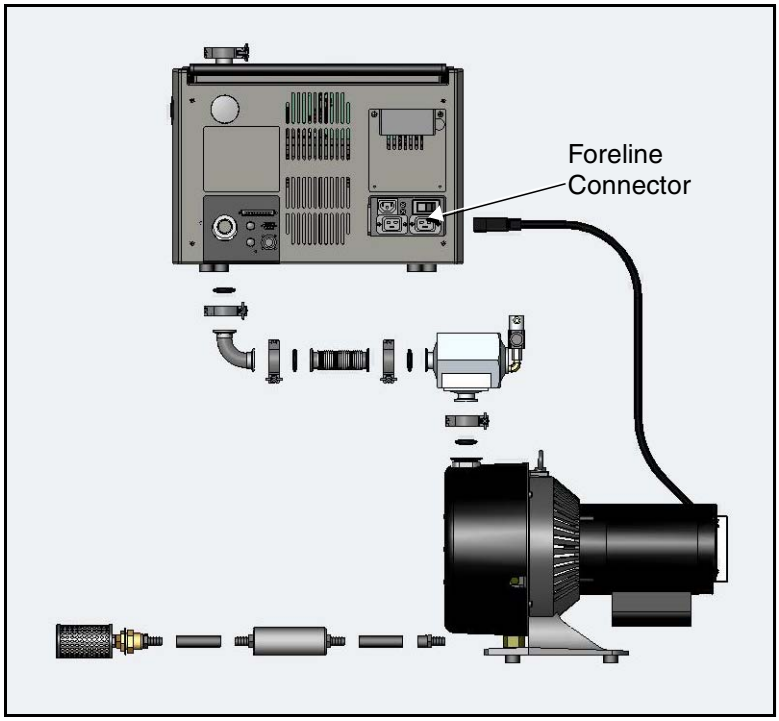


Figure 1-7 970 Bench System Installation

1.6 Storage

If the leak detector is not used immediately, it can be stored as received without special precautions. A dry, relatively dust-free area is preferred. The required environmental conditions for storage are:

- ❑ 0% to 95% relative humidity, non-condensing
- ❑ –20 °C (–4 °F) to +60 °C (+140 °F) ambient temperature

1.7 Front Panel Displays and Controls

The 979 front panel leak rate display and control buttons are located on the front right-hand side of the leak detector (Figure 1-8). 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 2 “Operating the 979 Leak Detector” on page 2-1.

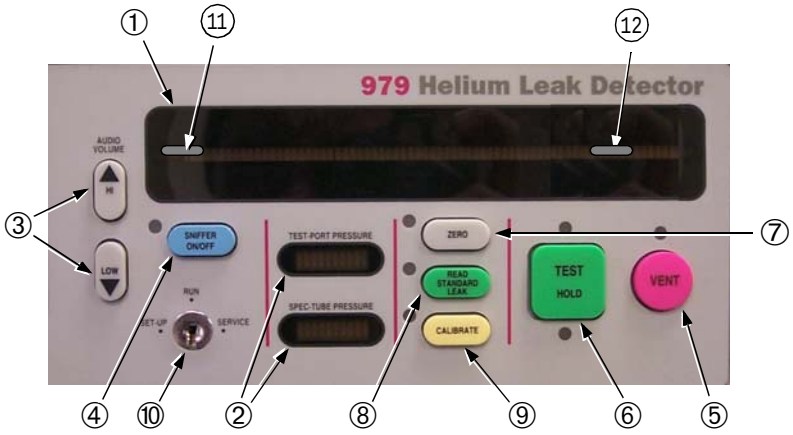


Figure 1-8 Front Panel Displays and Controls

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 979 into and out of SNIFFER mode. The LED illuminates when SNIFFER mode is enabled.
⑤ Vent	The VENT button advances the 979 to the vented state. The LED indicator illuminates while the 979 is in the vented state.
⑥ Test/Hold	When in VENT or HOLD, pressing the TEST/HOLD button automatically advances the 979 through roughing, then through the various test states, depending on the achievable test port pressures and leak rates. The green LED above the button illuminates when the 979 is in a test state. When in TEST, pressing the TEST/HOLD button automatically advances the 979 to the HOLD state. The yellow LED below the button illuminates when the 979 is in the HOLD 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 initiates the 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 2.6.1 “Calibrated Leak Set-Up” on page 2-14). The LED illuminates to indicate that calibration is taking place.
⑩ Key Switch	This three-position key switch, SET-UP/RUN/SERVICE, allows for access and control of operational parameters, as well as service related functions.

⑪ Under

The UNDER range light indicates that the measured helium leak rate is currently less than the minimum displayable value. The light may flash briefly as the system recovers from a leak indication and the displayable leak rate approaches zero. If the AUTO-ZERO < 0 is turned on, the UNDER light may also flash briefly as the system resets the zero point to a lower value. Refer to Section 3.1.1.1 “AUTO-ZERO < 0” on page 3-3.

The 979 does not display a leak rate while the UNDER light is on. If this light stays on for more than a few seconds, recalibrate the system to set operating parameters to the correct zero value. This situation can take place if the 979 was not fully warmed up before calibration was initiated.

⑫ Over

The OVER range light indicates that the system is saturated with helium and the measured leak rate is higher than the maximum displayable value.

1.8 Rear Panel Controls

1.8.1 System Control and Communication Panel

The system control and communication panel (Figure 1-9) is located on the lower left section of the rear panel.

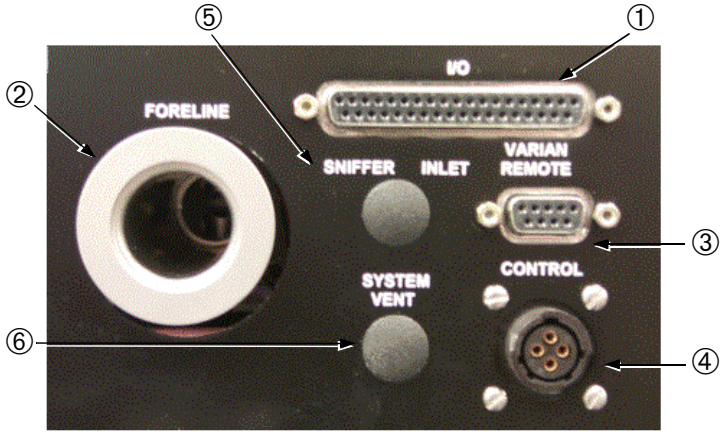


Figure 1-9 System Control and Communication Panel

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 “Communications Protocol”.
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.
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 Control Logic	Not currently used.
⑤ Sniffer Inlet	Not currently used.
⑥ System Vent Port	Not currently used.

1.8.2 Power Control and Circuit Breakers

The 979 power entry control and circuit breaker module is located on the lower right section of the rear panel (Figure 1-10). The label above this panel contains information regarding the connections on this panel.

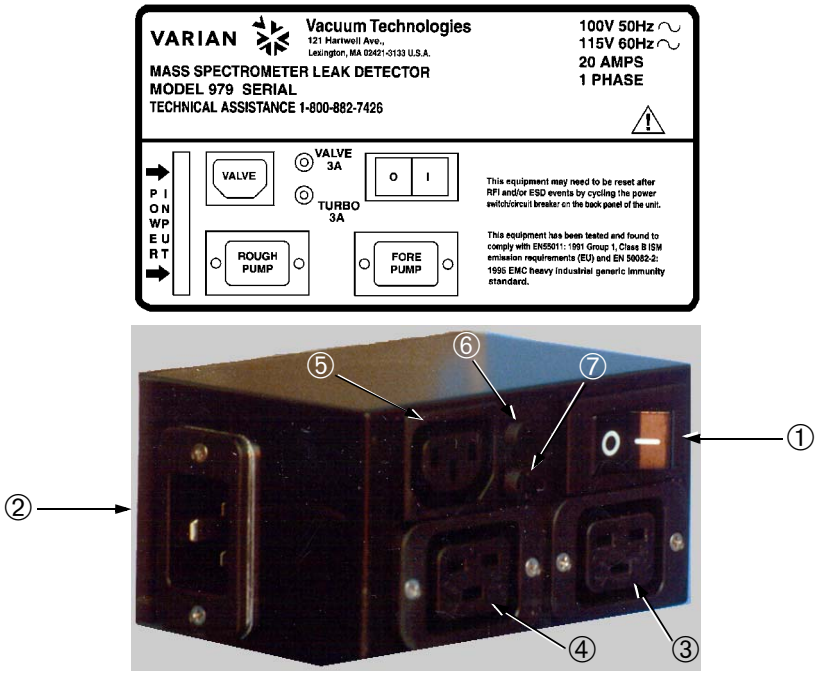


Figure 1-10 Power Control and Circuit Breakers

① Main Power Switch/Circuit Breaker	The power entry module contains the main power ON/OFF switch/ circuit breaker. The 979 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 Filter 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 20 A 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 20 A 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 connector from the roughing valve in dual mechanical pump configurations.
⑥ Rough Valve Circuit Breaker	❑ *3.0 A (100 VAC / 115 VAC)* ❑ *1.5 A (230 VAC)*
⑦ Turbo Pump Circuit Breaker	❑ *3.0 A (100 VAC / 115 VAC)* ❑ *1.5 A (230 VAC)*

1.9 Universal Remote Option

The Universal Remote shown in Figure 1-11 allows the operator limited control of the 979 Series Leak Detector at a distance of up to 25 feet from the unit. The Universal Remote is connected through the port labeled Varian Remote Control on the rear panel (see Figure 1-9 on page 1-14). For operation instructions, refer to the Universal Remote *Instruction Manual* provided with the remote.



Figure 1-11 Universal Remote Option

1.10 Specifications

The specifications for the 979 Series Leak Detector are provided in Table 1-1.

Table 1-1 979 Series Specifications

Specifications	979 Helium Mass Spectrometer Versions							
System Sensitivity	Standard Sensitivity				High Sensitivity			
High Vacuum Pump Type, Air-cooled, maintenance-free	Vacuum Technologies Turbomolecular Pump							
Rough/Fore Pump	Wet (Oil-sealed)		Dry (TriScroll™)		Wet (Oil-sealed)		Dry (TriScroll™)	
Rough Pump Type	—	SD-451	—	TS-620	—	SD-451	—	TS-620
Free Air Displacement l/min, 60/50 Hz	—	410/342	—	500/420	—	410/342	—	500/420
Fore Pump Type	DS-302	DS-302	TS-620	TS-320	DS-302	DS-302	TS-620	TS-320
Free Air Displacement, l/min, 60/50 Hz	285/237	285/237	500/420	250/210	285/237	285/237	520/420	250/210
Minimum Detectable Leak, atm-cc/sec	5×10^{-10}				5×10^{-11}			
Leak Units	atm-cc/sec, mbar-l/sec, torr-l/sec, Pa-m^3/sec							
Response Time	Less than 0.5 second, in accordance with AVS Standard 2.1.							
Amplifier Drift	Less than 5% of full scale of the most sensitive range, in accordance with AVS Standard 2.1.							
Noise Level	Less than 5% of full scale, peak-to-peak, in accordance with AVS Standard 2.1.							
Calibration	Fully automated tuning and calibration using the internal or external calibrated leak. The fast calibrate feature allows the standard version to calibrate in less than 20 seconds and the high sensitivity version to calibrate in less than 1 minute.							
Zero Control	Selectable mode background elimination with unique AUTOZERO<0 feature.							
Leak Indication	A 50-segment bar graph (linear or log) indicator displays leak rates automatically; alphanumeric indication on LCD display. A leak can also trigger an audible alarm frequency that varies in proportion to the size of the leak, dedicated volume control and programmable audio threshold. Analog voltage is proportional to the leak rate.							

Table 1-1 979 Series Specifications (Continued)

Specifications	979 Helium Mass Spectrometer Versions
Pressure Indication	Test port and spectrometer pressure bar graph displays and test port pressure alphanumeric indication on LCD display.
Spectrometer Tube	Sensitivity optimized design, header mounted ion source with dual thoria-coated iridium filament, preamplifier, ConvecTorr®, and vacuum gauge.
Automatic Valve Sequencing	Microprocessor-controlled valve operation provides automatic system cycling.
Safety Interlocks	A valve system design that completely protects the high-vacuum system under test against pressure surge and power interruption.
Cycle Time	Blanked port can be cycled to the fine leak test in 4 seconds. An auto sequencer feature provides clear accept/reject signals and allows programming of a complete test cycle (START/ROUGH/TEST/VENT).
Test Port	NW25; A $1^1/_8$" (28 mm) ID Compression Port is available as an accessory.
Remote I/O Capabilities	Interface (DB-37S) with optically isolated (5-24 VDC) outputs and inputs, Non-isolated Serial RS-232 interface, and Non-isolated Analog output (0-10 V). Non-isolated Remote Control (DB-9S) interface.
Accessories (optional)	Universal Remote (part # L9558301) with 25 foot cord, External Calibrated Leak, and Power Probe.
Recommended Operating Ambient Conditions	
Installation	Indoor use only. Altitude up to 2000 m (6,400 feet). Installation (Overvoltage) Category II, Pollution Degree II according to UL3101-1 Standard
Temperature	+12 °C (54 °F) to +40 °C (104 °F) for Wet Version (w/oil-sealed mechanical pumps) +5 °C (41 °F) to +40 °C (104 °F) for Dry Version (w/TriScroll™ mechanical pumps)
Humidity	Maximum relative humidity (HR) 80% for temperatures up to +31 °C (88 °F) decreasing linearly to 50% HR at +40 °C (104 °F). No hoarfrost, dew, percolating water, rain, solar irradiation, etc.
Air Pressure	75 kPa (563 Torr) to 106 kPa (795 Torr)
Storage Ambient Conditions	Relative humidity: 0% to 95%, non-condensing. Temperature: –20 °C (–4 °F) to +60 °C (140 °F)
Power Requirements	100 VAC, 20 A, 50 Hz / 115 VAC, 20 A, 60Hz or 230 VAC, 20 A, 50/60 Hz. Start-Up current for “Wet” version up to 85 A peak for up to 10 seconds at temperature less then 20 °C (68 °F). *Note: 1. Input voltage cannot be modified by customer* *Note: 2. No extension cord can be used.*

Table 1-1 979 Series Specifications (Continued)

Specifications	979 Helium Mass Spectrometer Versions
EMC	89/392/EEC Directive; EN61326:1997.
Dimensions	See Outline Drawings (Figure 1-1 on page 1-1 to Figure 1-6 on page 1-6).
Weight	50 lb. (23 kg) net – stand-alone, bench-mount unit. 180 lb. (82 kg.) net – wet 1-pump 979 version with DS-302 oil-sealed pump on a two wheel cart. 243 lb. (111 kg) net – wet 2-pump 979 version with DS-302 and SD-451 oil-sealed pumps on a four-wheel cart.

Section 2. Operating the 979 Leak Detector

2.1 Initial Startup and Shutdown

2.1.1 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 979 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.

2.1.2 Calibration

The 979 is capable of performing an automated calibration routine using either an internal calibrated leak (factory installed), or an external calibrated leak placed into the test port. Refer to Section 2.6.1 “Calibrated Leak Set-Up” on page 2-14 for proper set-up of the 979 for auto-calibration.

After starting the 979, a calibration routine must be executed. If using the 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 can 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. Verify the correct leak rate value for the external leak by going to the Calibrated Leak Set-Up screen (Section 2.6.1 “Calibrated Leak Set-Up” on page 2-14). Once in Fine Test, press the CALIBRATE button to perform an automated calibration.

When calibration is complete, the leak detector reverts to a Fine Test mode of operation to allow for calibration verification.

2.1.3 Shutdown

Shutting down the 979 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 remains under vacuum and may be difficult to open.

2.2 Operator Interface

The front panel of the Model 979 is shown in Figure 2-1. 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 979 utilizes a touch panel display for the initial set-up of the leak detector. An access key switch is also provided to prevent unauthorized changes to the system set-up variables.



Figure 2-1 979 Front Panel



Press the TEST/HOLD button when in VENT mode to automatically advance the 979 through roughing and then into the test state. The optimum sampling mode is automatically selected, depending on the system configuration and set-up, and the achievable test port pressure and leak rate. The TEST indicator LED, located above TEST, illuminates when the 979 is in a test state.

If the TEST/HOLD button is pressed while the 979 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 979 is in the vented state.



The ZERO button is only active while the leak detector is in the test state. Press the ZERO button to cause the 979 to read the background leak rate signal plus electronic noise signal for the current flow rate (for example, mid-stage), 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.

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

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.

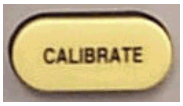
When used correctly, the ZERO capability of the 979 is very powerful. It allows for testing to sensitivity levels that are below the system background. This feature also reduces test cycle times by reducing the amount of time required for background levels to naturally clean up or by allowing for testing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



The READ STANDARD LEAK button is only functional while the leak detector is in a 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 spectrometer 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 2.6.1 “Calibrated Leak Set-Up” on page 2-14). CALIBRATE causes the 979 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 variable focus is scanned, then the ion voltage 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 2.7.1 “Units Set-Up” on page 2-28), 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 979 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.

2.2.1 Sniffer Set-Up Procedure

1. Vent the 979 and insert a Vacuum Technologies Power Probe (Part Number K9565306) into the test port. Refer to the product catalog for additional Power Probe configurations.
2. Set **Range Stop** to 10 - 07 (See Figure 2-12 on page 2-20).
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 2-1 shows sniffer mode sensitivity.

Table 2-1 Sniffer Mode Sensitivity Range (Full Scale)

Standard Sensitivity	High Sensitivity
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.

2.2.2 Key Switch

The 979 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 979 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.

2.3 Touch Panel Menus

The 979 Leak Detector uses a touch panel display for the initial set-up 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 2-2 and discussed in detail in Section 2.4 “979 Touch Panel Home Screen” on page 2-8.

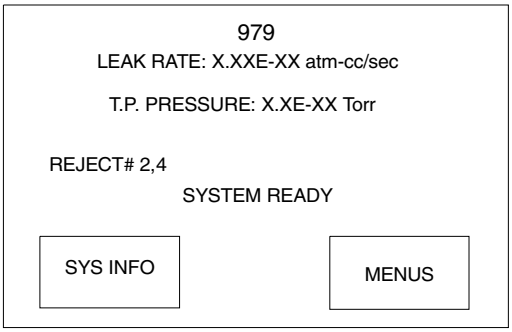


Figure 2-2 979 Touch Panel Home Screen

2.3.1 Contrast Adjustment of the Touch Panel Display

Press the upper left or right corner of the Touch Panel Home Screen to change the contrast.

2.3.2 Changing Variables in Touch Panel Screens

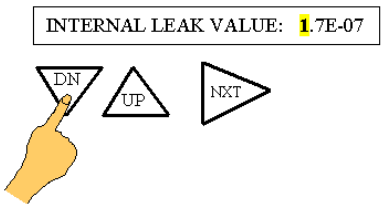
Touching the box that contains the variable to be changed causes the first digit of the variable to be highlighted.

To change a variable in the Touch Panel Screens:

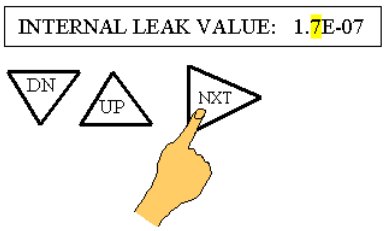
1. Touch the box for the parameter you want to change to highlight the digit.



2. Touch the **UP** or **DN** arrow to change the value of the highlighted digit.



3. Touch the **NXT** arrow to select the next digit to be changed and set its value by repeating step 2.



4. Touch the **OK** box to accept changes and store 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.

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

NOTE



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

2.3.3 Selecting Options in Touch Panel Screens

Many parameters are set via toggle boxes that you touch to switch between values or modes. For example, Manual Range can be set to ON or OFF by touching the toggle box to switch between displaying ON and OFF. In all cases, the information displayed in the box is the selected value. Most screen values do not change until you press OK, but some changes are immediate, such as the selection of units from the UNITS Set-Up screen or the selection of the Linear or Logarithmic display from the OUTPUT CONTROL Set-Up screen.

2.4 979 Touch Panel Home Screen

The 979 Touch Panel Home Screen displays a summary of the following status and configuration settings:

- ❑ 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

Two touch screen buttons, SYS INFO and MENUS, access or change the configuration as shown in Figure 2.3.

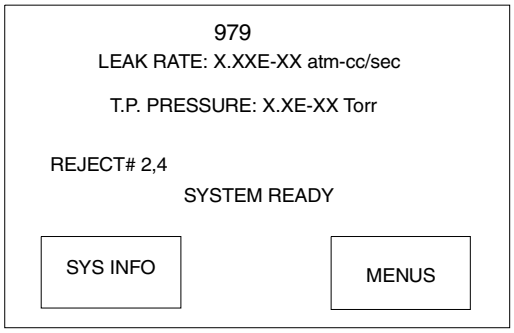


Figure 2-3 979 Touch Panel Home Screen

2.4.1 Digital Leak Rate

The Digital Leak Rate (Figure 2.4) displayed on the touch panel Home screen correlates directly with the bar graph leak rate display (Figure 2.5). The units for the measurements are user selectable from the Units Set-Up screen (see Section 2.7.1 “Units Set-Up” on page 2-28).

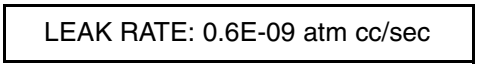


Figure 2-4 Leak Rate Displayed on Home Screen: 0.6E-09 atm cc/sec

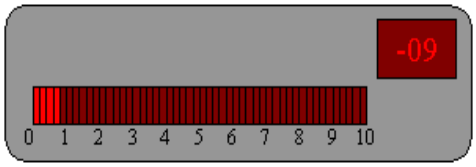


Figure 2-5 Bar Graph Display: 0.6 x 10^{-09} atm cc/sec

2.4.2 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 2.7.1 “Units Set-Up” on page 2-28).

2.4.3 Leak Detector Status

Leak Detector Status (not shown in Figure 2.4) is displayed just below the test port pressure reading and indicates the current operating state of the 979. The normal operating states are detailed in Table 2-2 on page 2-10.

2.4.4 Leak Detector Condition

The Leak Detector Condition (not shown in Figure 2.4) 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 979 leak detector conditions are detailed in Table 2-3 on page 2-10.

2.4.5 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 2.6.2 “Reject and Audio Set Points” on page 2-16). If all set points are disabled or are not active, then this indicator is not present.

2.4.6 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 2.6 “First Menu Selection Screen” on page 2-14.

Table 2-2 979 Operating States

Display	Description
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.
FINE TEST	Indicates that the leak detector is in FINE TEST mode. When in FINE TEST mode the test port valve opens and the leak detector is ready for fine leak testing.
GROSS TEST	Indicates that the leak detector is in GROSS TEST mode. When in GROSS TEST mode the test port valve closes and the GROSS LEAK valve 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.
HOLD	Indicates that the leak detector is in HOLD mode. When in HOLD mode the test port valve 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 the test port and any attached test objects or fixturing attached to the test port.
STD LEAK	Indicates that the optional internal calibrated leak standard valve opens and the leak detector is reading the leak value. The leak detector reverts to HOLD mode while reading the internal leak standard.
VENTED	Indicates that the test port is vented to atmosphere. The test port and all objects attached to the test port are isolated from the internal vacuum system of the 979.

Table 2-3 979 Condition States

Display	Description
[BLANK]	This line is blank under normal operating conditions.
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 pump configurations.
BOTH FILAMENTS BURNT OUT	Indicates that both filament 1 and filament 2 of the ion source have burnt out.
CAL OK	Indicates that the calibration routine was executed successfully.
CALIBRATION PREP	Indicates that the leak detector is preparing for a calibration routine.
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.

Table 2-3 979 Condition States (Continued)

Display	Description
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.
FILAMENT WAIT	Indicates that the system is lighting the filament.
Flashing **C** on exponent display	Indicates that the leak detector requires calibration.
GAIN TOO HIGH	Indicates that the gain value required to calibrate the leak detector during the calibration routine is greater than the maximum 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 minimum allowable value. This is generally the result of the system sensitivity being too high.
NO FOCUS PEAK	Indicates a tuning/calibration failure due to the system not detecting a focus peak during the auto-tuning routine.
NO ION PEAK	Indicates a tuning/calibration failure due to the system not detecting an ion peak during the auto-tuning routine.
OFFSET WAIT	Indicates that the system is setting the OFFSET value.
REJECT	Indicates a test object failure during an Auto Sequencer Test cycle. See Section 2.6.3 “Auto Sequencer Set-Up” on page 2-17.
STABILIZATION WAIT	Indicates that the system is waiting for the electronics to stabilize before completing the start-up routine.
STD LEAK PREP	Indicates that the optional internal calibrated leak is being roughed before it is introduced directly to the system for calibration verification.
SWITCHING FILAMENTS	Indicates that the system is momentarily in the process of switching from a burnt out filament to the next available filament.
SYSTEM PRESSURE WAIT	Indicates that the system (spectrometer tube) pressure is too high to light the ion source filament.
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.
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.
ZEROING WAIT	Indicates that the system is setting the initial zero values during the start-up routine.

2.5 979 System Information Screen

The System Info screen, shown in Figure 2-6, displays details of the current leak detector set-up and operating conditions. The left-hand column displays filament status, reject set point status, turbo status, gross leak configuration, auxiliary rough pump set-up, 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 2-4 describes the displayed system information in detail.

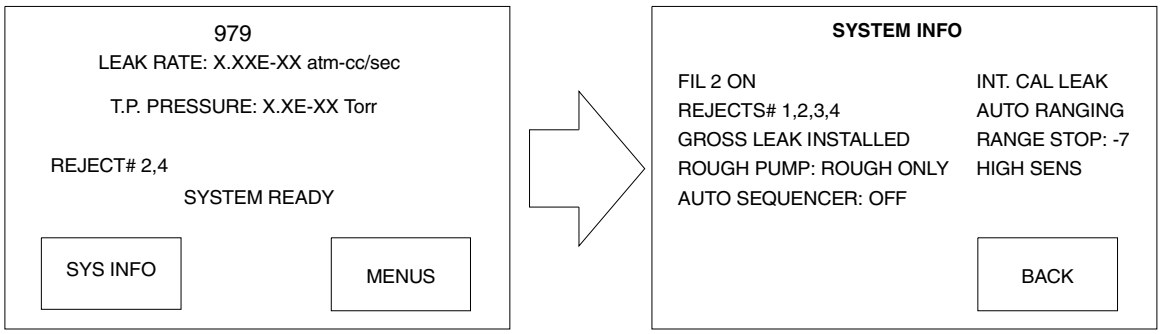


Figure 2-6 System Information Screen, Typical Display

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 979 Home screen.

Table 2-4 System Information Screen Conditions

CONDITION	DISPLAY	DESCRIPTION
AUDIO SET POINT	AUDIO SET POINT: ACTIVE	Audio Set Point is active.
	AUDIO SET POINT: INACTIVE	Audio Set Point is inactive.
AUTO SEQUENCER	AUTO SEQUENCER: ON	Auto Sequencer (automatic test cycle) is enabled.
	AUTO SEQUENCER: OFF	Auto Sequencer (automatic test cycle) is disabled.
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.

Table 2-4 System Information Screen Conditions (Continued)

CONDITION	DISPLAY	DESCRIPTION
GROSS LEAK	GROSS LEAK: INSTALLED	Gross leak installed–standard on dual pump configurations.
	GROSS LEAK: NOT INSTALLED	Gross leak not installed.
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.
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 $10^{-[EXP]}$.
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.
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.
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.

2.6 First Menu Selection Screen

Touch the MENUS box on the Home screen to display the Main Menu screen (Figure 2-7). The Main Menu screen displays the screens available for performing general set-up of the 979. Touching the BACK box from this screen displays the Home screen. Touching the NEXT box calls up the Second Menu screen. Many menus contain toggle boxes that switch between selections each time you touch them. The value or selection that is displayed when you touch OK is what is set (Section 2.3.3 “Selecting Options in Touch Panel Screens” on page 2-7). Other menus contain parameters. Change their values by following the procedure in Section 2.3.2 “Changing Variables in Touch Panel Screens” on page 2-6.

The screens available through the Main Menu screen are described in this section.

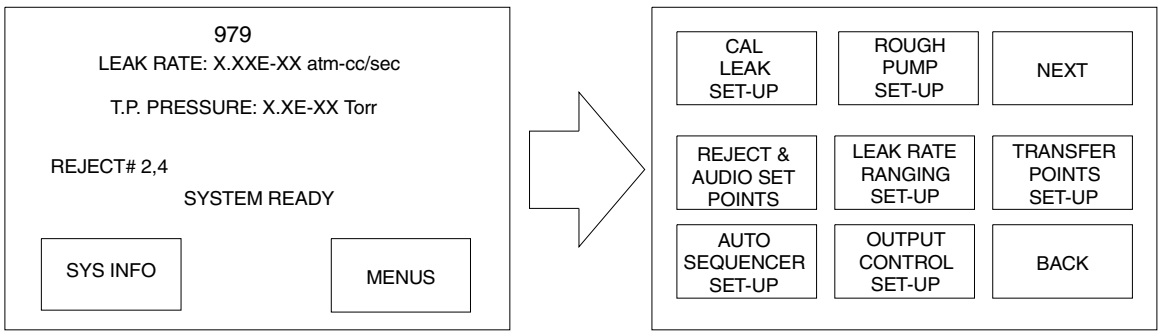


Figure 2-7 First Menu Selection Screen

2.6.1 Calibrated Leak Set-Up

Touch the CAL LEAK SET-UP box to display the Calibrated Leak Set-Up screen, shown in Figure 2-8. 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 either FULL or FAST CALIBRATION mode.

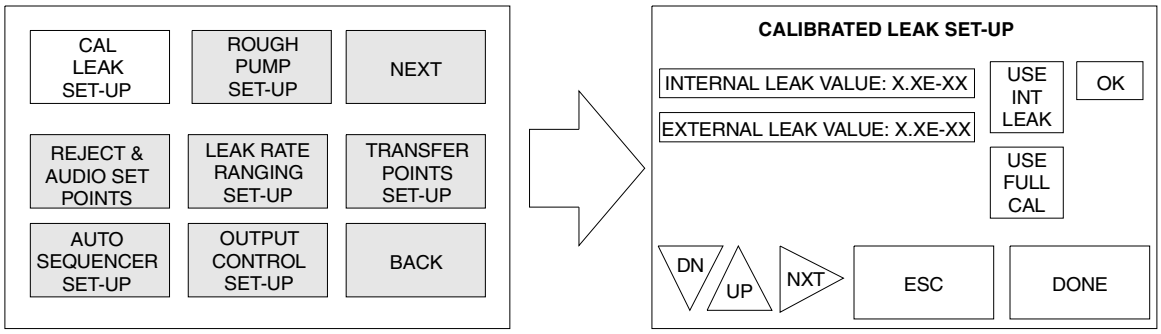


Figure 2-8 Calibrated Leak Set-Up Screen

2.6.1.1 Selecting Internal or External Calibrated Leak for Calibration

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

2.6.1.2 Selecting Full or Fast Calibration Routine

Touch the USE FULL/FAST CAL box to switch between FULL CALIBRATION and FAST CALIBRATION modes.

FULL 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 system 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



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

2.6.2 Reject and Audio Set Points

Touch the REJECT & AUDIO SET POINTS box to display the Reject and Audio Set Points screen (Figure 2-9). 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.

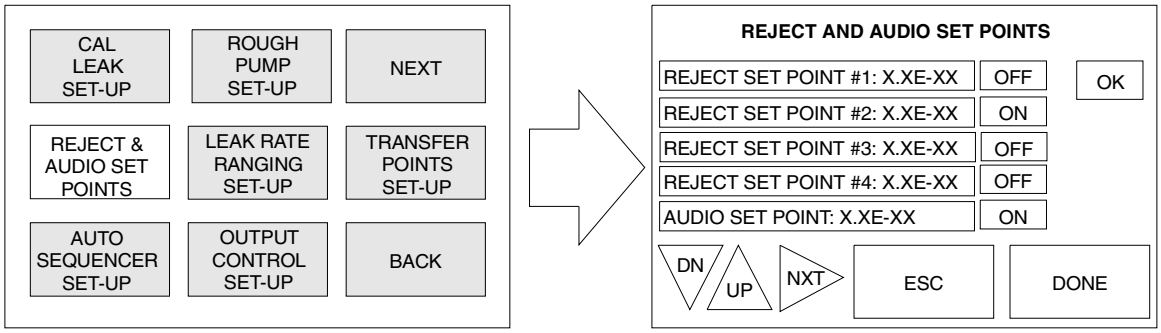


Figure 2-9 Reject and Audio Set Points Screen

2.6.2.1 Changing and Enabling Set Point Values

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 "Communications Protocol"). 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 1-8 on page 1-12) and is discussed in Section 2.2 "Operator Interface" on page 2-2.

2.6.3 Auto Sequencer Set-Up

Touch the AUTO SEQUENCER SET-UP box to display the Auto Sequencer Set-Up screen Figure 2-10. Auto sequencer provides the ability to set up the 979 so that it automatically runs through a complete test cycle (START/ROUGH/TEST/VENT), 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.

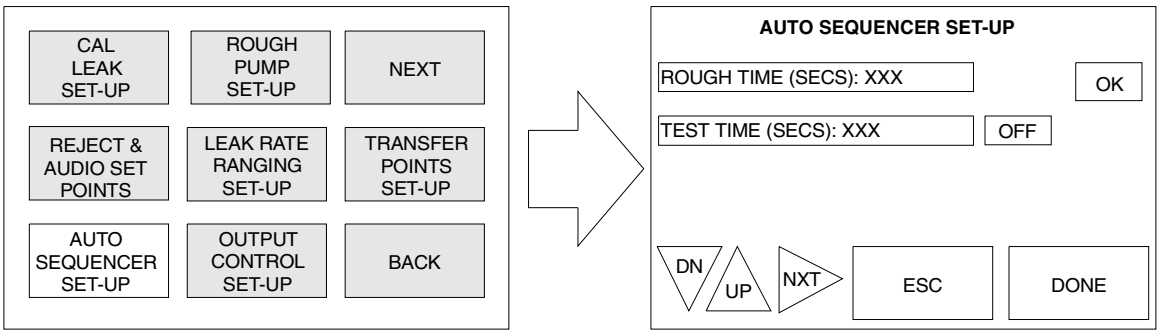


Figure 2-10 Auto Sequencer Set-Up Screen

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 port and upon inquiry through the RS-232 line (see Appendix B “Communications Protocol”).

Upon the completion of an automated test cycle, the 979 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 I/O port on the back of the leak detector until the next test cycle is initiated. This allows the end user to record the actual leak rate value for each test object.

2.6.3.1 Auto Sequencer Set-Up Controls

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 979 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 979 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.

2.6.4 Rough Pump Set-Up

Touch the ROUGH PUMP SET-UP box to display the Rough Pump Set-Up screen (Figure 2-11), 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 979 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.

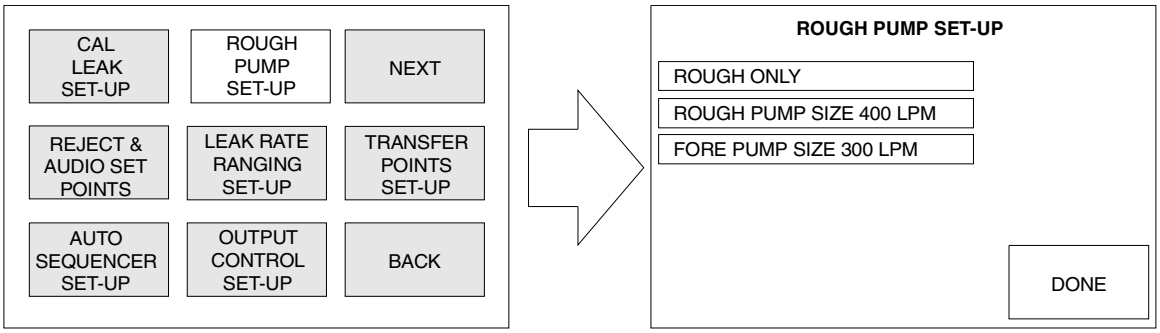


Figure 2-11 Rough Pump Set-Up Screen

2.6.4.1 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 a test port cap 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.

2.6.4.2 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 400 LPM or 600 LPM.
- ❑ Touch the **FORE PUMP SIZE** box to select 300 LPM or 600 LPM.

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

2.6.4.3 VENT LOCK Function

Turning the VENT LOCK function ON disables the VENT button. This ensures that a user does not vent a system unintentionally. The function status remains unchanged after a system power down. The VENT LOCK function is inactive when the AUTO SEQUENCER feature is enabled.

- ❑ Touch the **VENT LOCK** box to toggle the status to ON or OFF.
- ❑ Touch **DONE** to return to the previous menu screen.

2.6.5 Leak Rate Ranging Set-Up

Touch the LEAK RATE RANGING SET-UP box to display the Leak Rate Ranging Set-Up screen (Figure 2-12). From this screen, set up and enable the RANGE STOP and MANUAL RANGE functions and select USE FINE TEST or GROSS TEST ONLY.

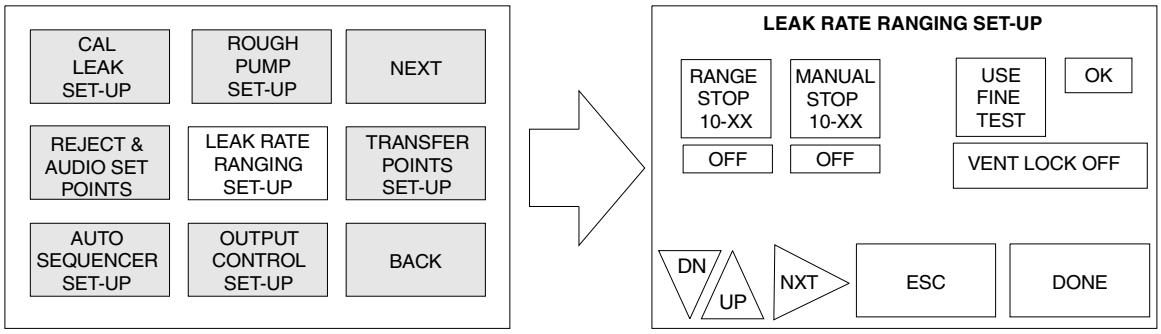


Figure 2-12 Leak Rate Ranging Set-Up Screen

2.6.5.1 Range Stop and Manual Range Set-Up and Control

RANGE STOP

The RANGE STOP feature configures the 979 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} atm 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} atm cc/sec but the test specification is only in the 10^{-7} atm cc/sec range, then setting the range stop to 10-08 atm 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 979 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 atm 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.

2.6.5.2 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.

2.6.5.3 System Sensitivity

Table 2-5 and Table 2-6 show sensitivity matrixes for performing Fine and Gross tests using standard and high sensitivity configurations.

High Sensitivity System	The High Sensitivity 979 system can achieve 10^{-10} atm cc/sec (5E-11 MDL) sensitivity. This sensitivity can be achieved at a transfer pressure of 100 mTorr. High ambient helium background conditions may prevent 10^{-10} atm cc/sec testing at relatively high pressures. The maximum detectable leak capability in the CONTRA-FLOW mode for single rough/forepump configurations is 9.9×10^{-5}atmc/sec (full-scale reading on 10^{-5} range).
Standard Sensitivity System	The Standard Sensitivity 979 System can achieve 10^{-9} atm cc/sec (5E-10 MDL) sensitivity. This sensitivity can be achieved at a transfer pressure of 100 mTorr. High ambient helium background conditions may prevent 10^{-9} atm cc/sec testing at relatively high pressures. The maximum detectable leak capability in the CONTRA-FLOW mode for single rough/forepump configurations is 9.9×10^{-4} atm cc/sec (full-scale reading on 10^{-4} range).

Table 2-5 979 Standard Sensitivity Leak Detector

	Test								
	Fine					Gross (2 Pump)			
Range	–9	–8	–7	–6	–5	–4	–3	–2	–1
Valve Path	MS*	MS	MS/CF	MS/CF	CF**	CF/GL	GL***	GL	GL
Transfer Pressure	100 mTorr	100 mTorr	100 mTorr / 5 Torr	100 mTorr / 5 Torr	5 Torr	5 Torr	atm	atm	atm

*MS – MIDSTAGE

**CF – CONTRA-FLOW

***GL – GROSS LEAK

Table 2-6 979 High Sensitivity Leak Detector

	Test								
	Fine					Gross (2 Pump)			
Range	–10	–9	–8	–7	–6	–5	–4	–3	–2
Valve Path	MS[1]	MS	MS/CF	MS/CF	CF[2]	CF/GL	CF/GL	GL[3]	GL
Transfer Pressure 1 Pump[4]	100 mTorr	100 mTorr	100 mTorr/ 5 Torr	100 mTorr / 5 Torr	5 Torr	5 Torr			
Transfer Pressure 2 Pump[4]	100 mTorr	100 mTorr	100 mTorr/ 2 Torr	100 mTorr / 2 Torr	2 Torr	2 Torr / atm	atm	atm	atm

[1] MS – MIDSTAGE

[2] CF – CONTRA-FLOW

[3] GL – GROSS LEAK

[4] Contra-flow tranfers settings are as follows:

- ❑ Single pump systems (no gross test): 5 Torr max.
- ❑ Two pumps (has gross test): 2 Torr max.

2.6.6 Output Control Set-Up

Touch the OUTPUT CONTROL SET-UP box to display the Output Control Set-Up screen (Figure 2-13). From this screen, select the desired leak rate output, BARGRAPH DISPLAY mode, and the RS-232 communication protocol.

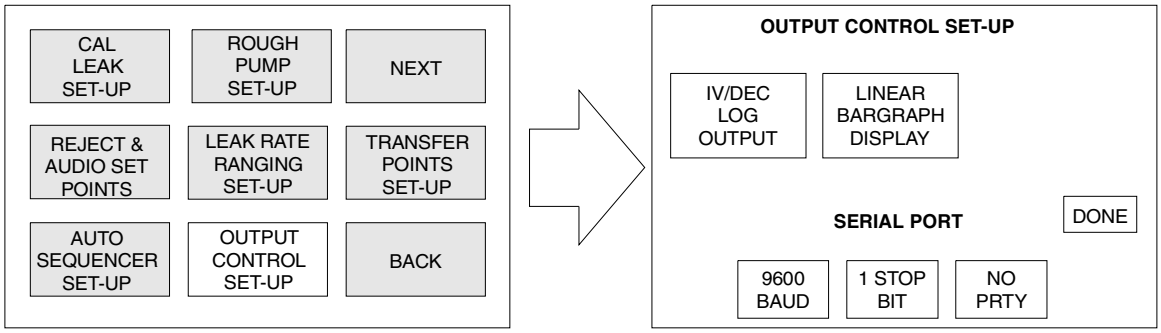


Figure 2-13 Output Control Set-Up Screen

2.6.6.1 Leak Rate Analog Output Voltage Selection

Touch the 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 and LINEAR ANALOG OUTPUT.

1V/DEC LOG OUTPUT	The output voltage conversion chart is displayed in Figure 2-14.
LINEAR ANALOG OUTPUT	The output voltage conversion chart is displayed in Figure 2-15.

2.6.6.2 Bargraph Display Set-Up

Touch the 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} atm cc/sec to 10^{0} atm 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.

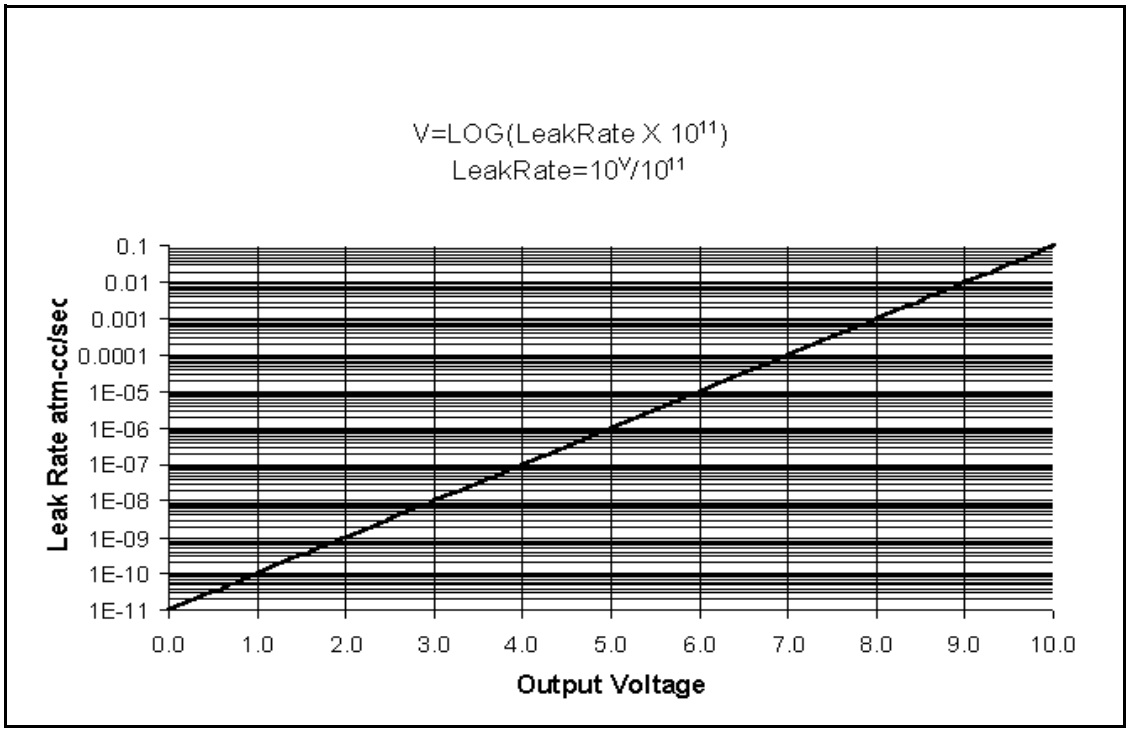


Figure 2-14 Leak Detector Logarithmic Output Voltage

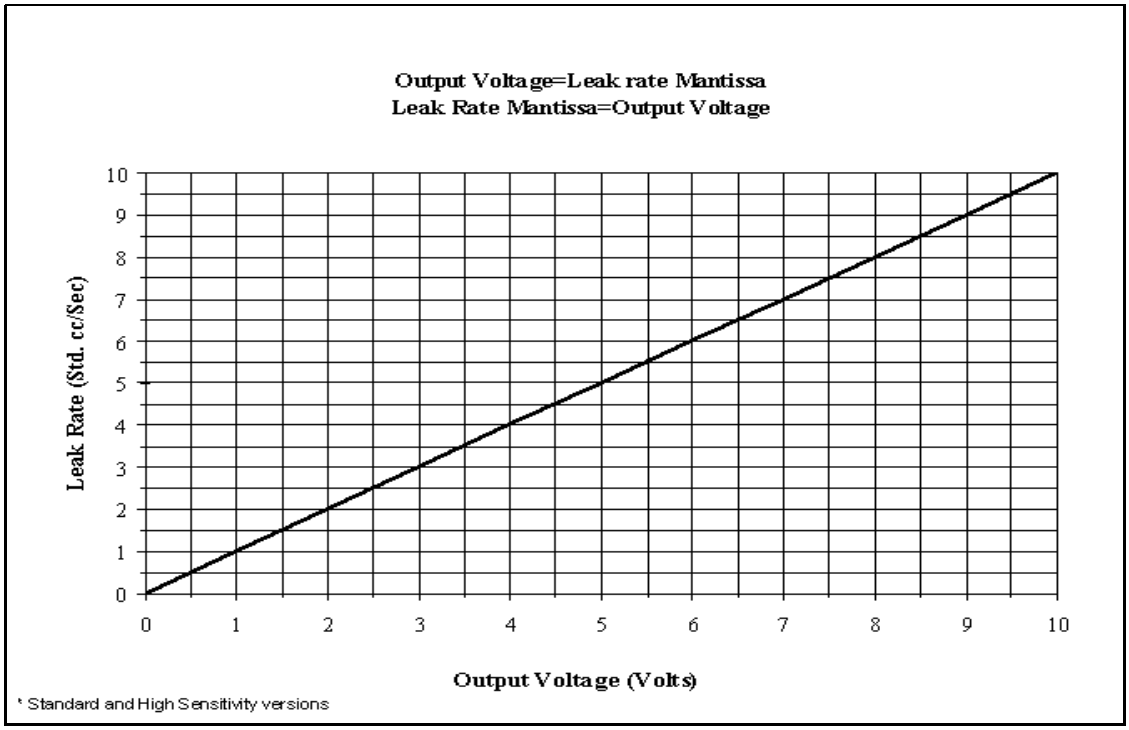


Figure 2-15 Leak Detector Linear Output Voltage

2.6.6.3 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 "Communications Protocol").

2.6.7 Transfer Pressure Set-Up

Touch the TRANSFER POINTS SET-UP selection box to display the Transfer Pressure Set-Up screen (Figure 2-16). From this screen set the test transfer pressures for each testing mode. The factory default settings are shown in Figure 2-16.

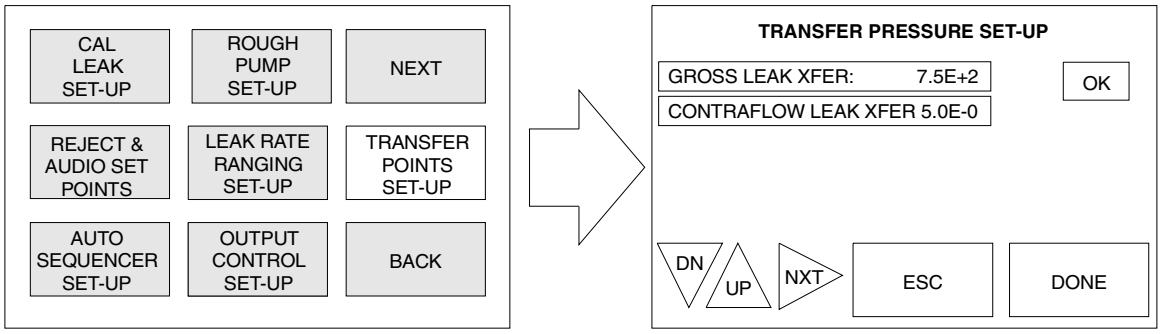


Figure 2-16 Transfer Pressure Set-Up Screen

The transfer pressure settings may be adjusted to lower values for specific applications. The 979 has pre-programmed upper transfer pressure limits that are slightly greater than the default settings. These limits prevent the operator from inadvertently setting the 979 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 979 transfers into the GROSS LEAK TEST mode from Roughing 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 979 transfers into the CONTRA-FLOW LEAK test mode from Roughing mode or Gross 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.

2.6.8 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 2.7 “Second Menu Selection Screen”. Touch the BACK box to return to the Home screen.

2.7 Second Menu Selection Screen

The Second Menu screen (Figure 2-17) displays the screens available for performing general set-up 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 3 “Service”. These menus include procedures that are generally performed outside of day-to-day operations.

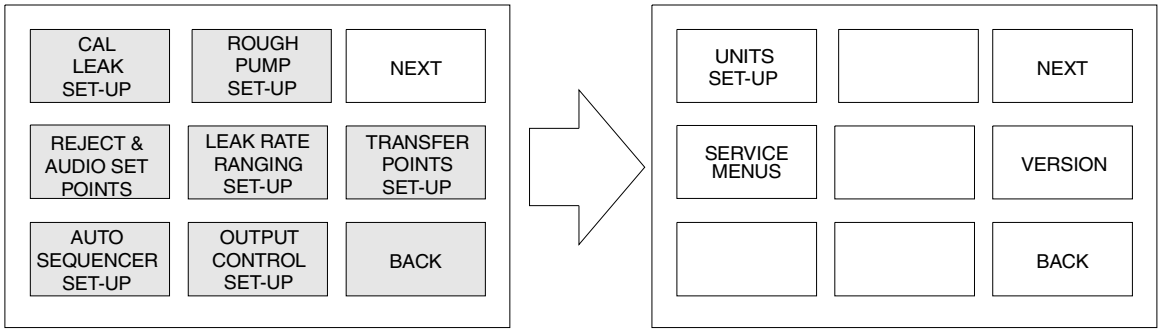


Figure 2-17 Second Menu Screen

2.7.1 Units Set-Up

Touch the UNITS SET-UP box to display the Units Set-Up screen (Figure 2-18).

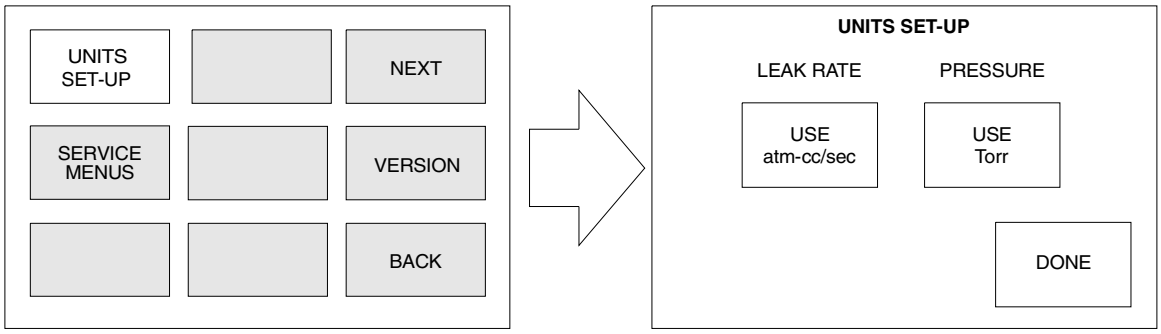


Figure 2-18 Units Set-Up Screen

2.7.1.1 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 3. Service

This section discusses the VERSION and SERVICE menus, which are accessed from the Second Menu screen (Figure 3-1). 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 979.

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

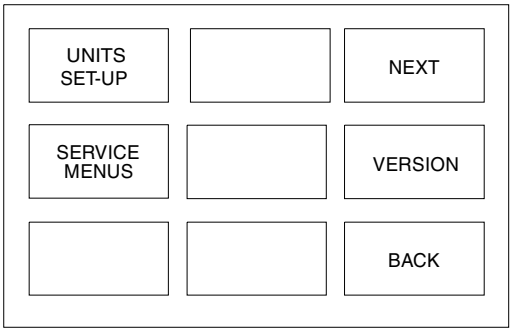


Figure 3-1 Second Menu Screen

3.1 Version

The VERSION screen (Figure 3-2) provides system software revision information.

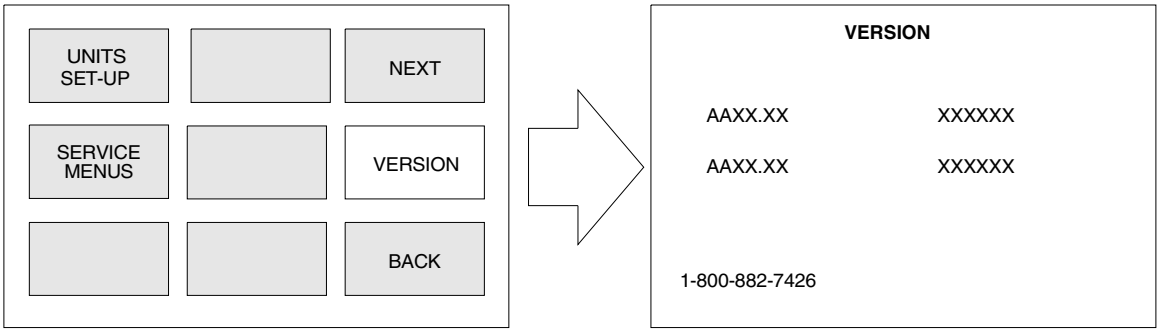


Figure 3-2 Version Screen

Touch the VERSION box to display the revision and checksum of the main CPU and the front panel CPU software. Inquiry of the checksum information takes several seconds.

Approximately 15 seconds after the revision data is displayed in full, the VERSION screen automatically reverts to the Second Menu screen.

CAUTION



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

CAUTION



Many of the values for the parameters included in the Service Menus are calculated when the 979 performs functions such as CALIBRATE and ZERO. Changing these values can cause unreliable test results.

Touch the SERVICE MENUS box to display the Service Menu screen (Figure 3-3). This screen shows the functions that may be performed as part of a troubleshooting or maintenance routine. To return to the Second Menu screen, touch the BACK box from the Service Menu screen. Values and options are changed in the same manner as the First Menu screens. For review, see Section 2.3.2 “Changing Variables in Touch Panel Screens” on page 2-6 and Section 2.3.3 “Selecting Options in Touch Panel Screens” on page 2-7.

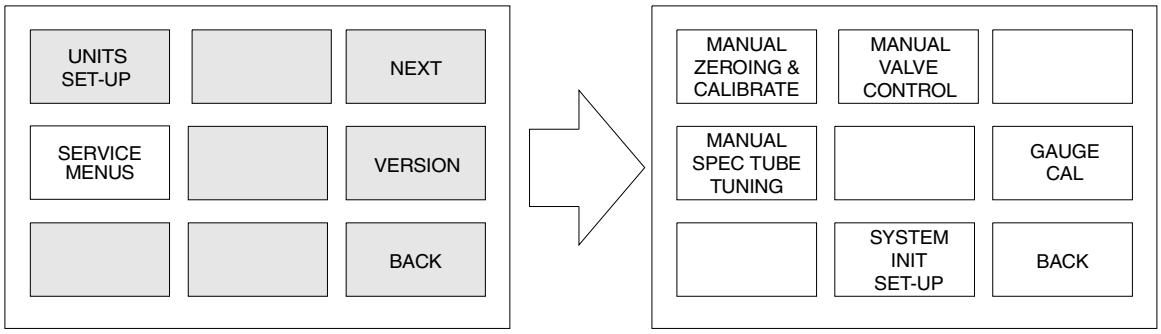


Figure 3-3 Service Menu Screen

3.1.1 Manual Zeroing and Calibrate

Touch the MANUAL ZEROING and CALIBRATE box to display the Manual Zeroing and Cal screen (Figure 3-4), which provides control over the leak detector AUTO-ZERO < 0 feature and allows for viewing and adjusting the spectrometer tube Gain.

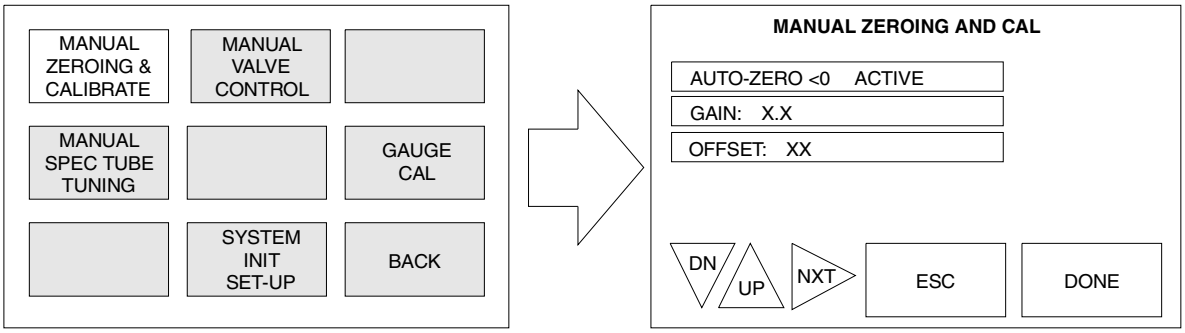


Figure 3-4 Manual Zeroing and Cal Screen

3.1.1.1 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. This light indicates that the measured helium leak rate is currently less than the minimum displayable value. The light may flash briefly as the system recovers from a leak indication and the displayable leak rate approaches zero. If the AUTO-ZERO < 0 is turned on, the UNDER light may also flash briefly as the system resets the zero point to a lower value. The 979 does not display a leak rate while the UNDER light is on. If this light stays on for more than a few seconds, recalibrate the system to set operating parameters to the correct zero value. This situation can take place if the 979 had not been fully warmed up before a previous calibration was initiated.

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.

3.1.1.2 Gain

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

Typical gain values range from 0.5 to 5.0. The gain value is automatically set during the Calibration routine. The higher the gain, the more noise shows up in the least sensitive range.

3.1.1.3 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 Vacuum Technologies service representative.

3.1.2 Manual Spectube Tuning

Touch the MANUAL SPECTUBE TUNING box to display the Manual Spectube Tuning screen (Figure 3-5). This screen is used to manually adjust the parameters of the Ion Source in the spectrometer tube for a maximum helium signal.

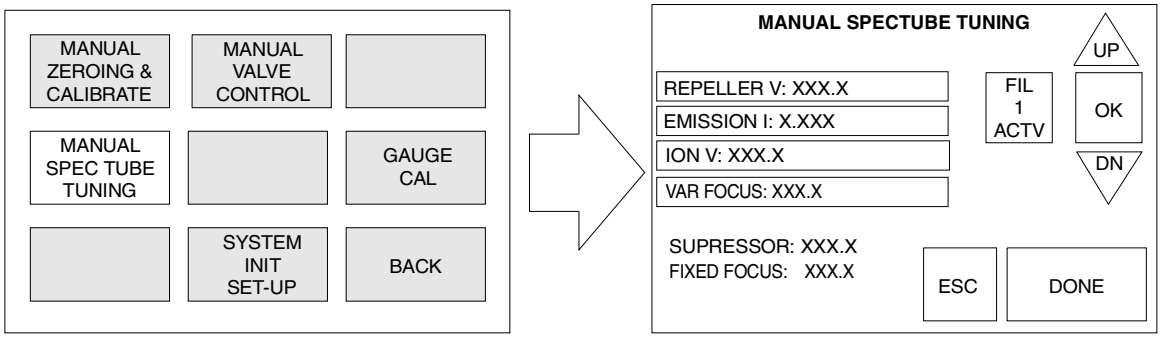


Figure 3-5 Manual Spectube Tuning Screen

3.1.2.1 Changing Manual Tuning Parameters

To change a manual tuning parameter:

1. Touch the box for the desired parameter.

   When you touch the box containing the desired variable, a highlighted indicator appears to the right of the numbers.

2. Touch the **UP** or **DN** arrow to change the parameter value.

NOTE



*Do not touch the **ESC** box before touching the **OK** box. This causes the selected parameter to revert to its previously stored value.*

3. Touch the **OK** box to accept the changes and to store the new parameter value in the leak detector memory.
4. Touch **DONE** to exit the screen and return to the previous menu screen.

3.1.2.2 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.

3.1.2.3 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. This parameter is not adjusted automatically during the Calibration routine.

Typical Emission current values range from .7 mA to 1.4 mA.

NOTE



To obtain a maximum Helium peak signal, adjust emission current during a manual tune.

3.1.2.4 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.

3.1.2.5 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.

3.1.2.6 Suppressor Voltage

The SUPPRESSOR indicator displays the current Suppressor Voltage value in the preamplifier in the spectrometer tube. The suppressor voltage parameter is not variable. This parameter cannot be changed by the operator.

3.1.2.7 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 not variable and cannot be changed by the operator.

3.1.2.8 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.

FILAMENT SELECTION

In the event that the current operating filament burns out, the 979 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 4.4 "Ion Source Replacement Outside of Annual Maintenance" on page 4-20.

3.1.3 Manual Valve Control

Touch the MANUAL VALVE CONTROL box to display the Manual Valve Control screen (Figure 3-6), which provides manual control of the valves in the 979 vacuum system for troubleshooting purposes. See Figure 3-7 on page 3-8 for an illustration of the 979 Vacuum System.

CAUTION



Manipulation of the valves through the Manual Valve Control screen should only be done by persons who are extremely familiar with the 979 Series leak detector as damage to critical components (e.g., spectrometer tube) could occur.

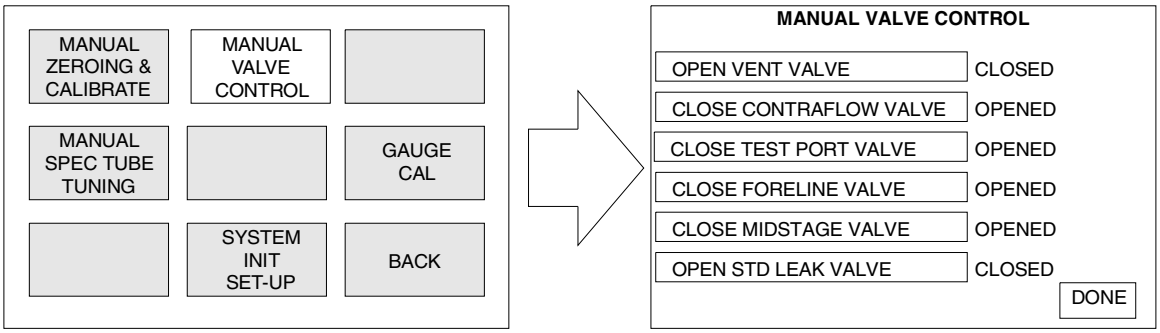


Figure 3-6 Manual Valve Control Screen

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 valves for single mechanical and dual pump systems are provided in Table 3-1 and Table 3-2 on page 3-8, respectively.

Table 3-1 979 Valve State Table - Single Mechanical Pump System

979 Operating State	V1	V2	V4	V5	V6	V7
VENT	O*	C**	C	O	C	C
ROUGH	C	O	C	C	O	C
CONTRA-FLOW	C	O	C	O	O	C
MIDSTAGE	C	C	O	O	O	C
SNIFF MODE	C	O	C	O	O	C
*O – Open **C – Closed						

Table 3-2 979 Valve State Table - Dual Mechanical Pump System

979 Operating State	V1	V2	V4	V5	V6	V7	V8
VENT	O*	C**	C	O	C	C	C
ROUGH	C	O	C	C	C	C	C
GROSS TEST	C	O	C	O	C	C	O
CONTRA-FLOW	C	O	C	O	O	C	C
MIDSTAGE	C	C	O	O	O	C	C
SNIFF MODE	C	O	C	O	O	C	C
*O – Open **C – Closed							

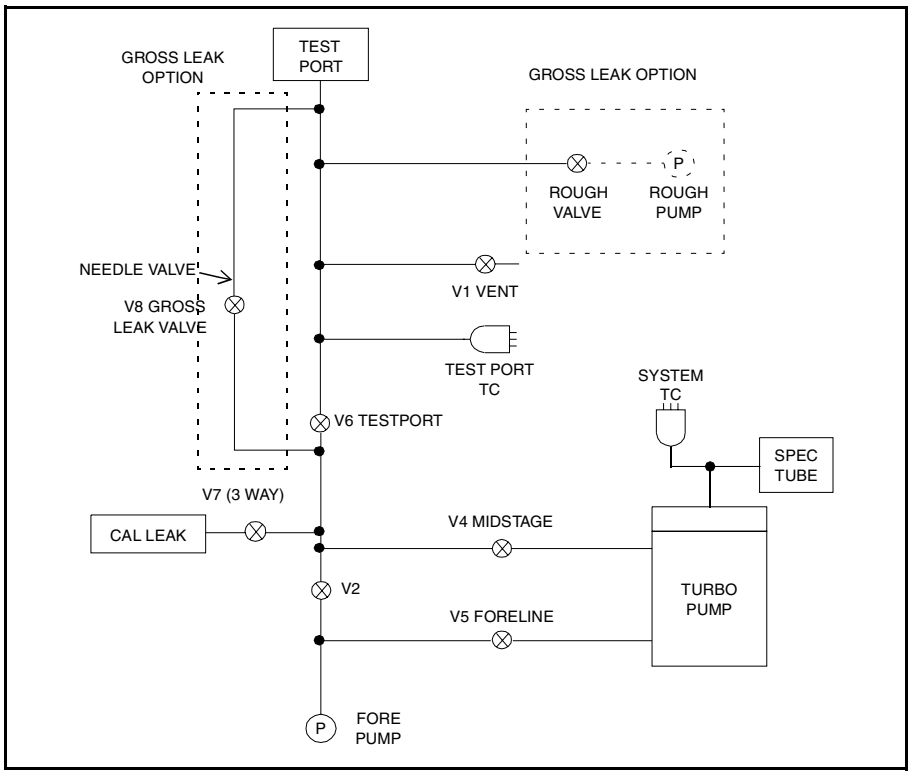


Figure 3-7 979 Vacuum System Diagram

3.1.4 System Initialize Set-Up

Touch the SYSTEM INIT SET-UP box to display the System Initialize Set-Up screen (Figure 3-8), which allows for the front panel push buttons to be enabled or disabled, and displays the current status of the buttons.

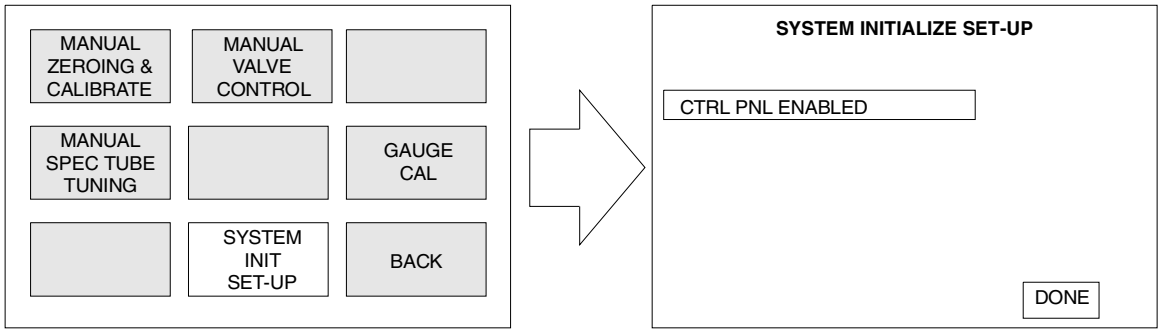


Figure 3-8 System Initialize Set-Up Screen

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.

3.1.5 Gauge Calibration Procedures

Touch the GAUGE CAL box to display the Gauge Calibration screen (Figure 3-9), which provides the ability to perform a calibration on either the system pressure thermocouple (button TC) or the test port thermocouple gauge.

NOTE

The calibration of the test port thermocouple (TC) gauge is factory set and requires the use of a reference TC and a PC.

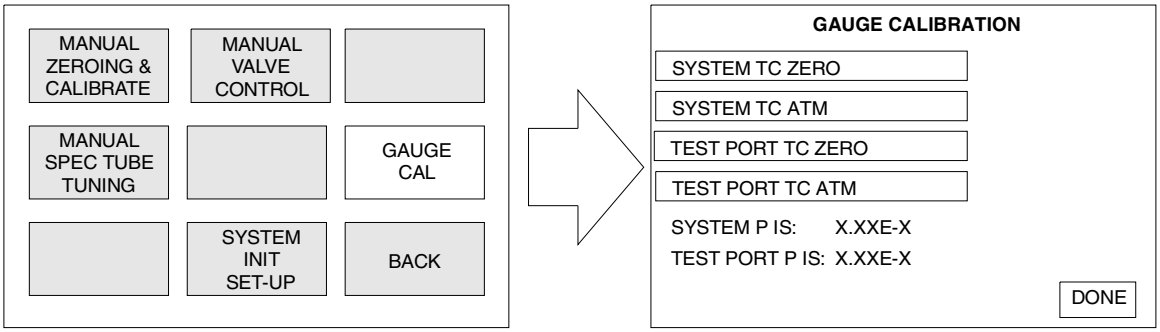


Figure 3-9 Gauge Calibration Screen

3.1.5.1 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.g

3.1.5.1.1 Vacuum (Low Pressure) Calibration

1. Verify that the leak detector is in the SYSTEM READY condition on the Home Screen (Figure 3-10) and that a test port cap is in place.

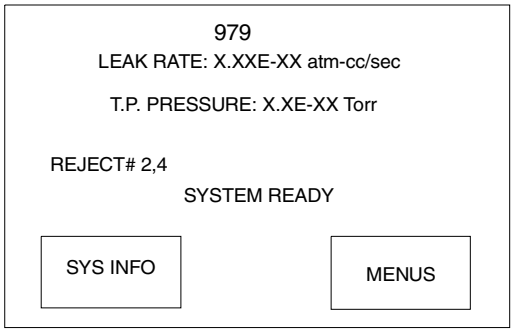


Figure 3-10 979 Touch Panel Home Screen

2. Place the service key (T009) into the key switch and set the key switch to the SERVICE position (see Figure 1-8 on page 1-12).
3. If the system is not already in VENT mode, press the **VENT** button.
4. Press the **TEST** button and verify that the leak detector transfers to FINE TEST mode, displaying 10^{-9} atm cc/sec or lower.
5. Wait approximately five minutes for the vacuum system pressure to stabilize.
6. Move to the GAUGE CALIBRATION screen (Figure 3-9 on page 3-9) if you are not already there.
7. 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 FAILED message indicates 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 mTorr.
8. Touch **DONE** to leave the screen and return to the previous menu.

3.1.5.1.2 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 979 before powering up the leak detector.
2. Turn the power ON to the 979 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 FAILED message indicates 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.

3.1.5.2 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. The vacuum calibration is factory set. Do not change this setting unless you have the appropriate equipment.

NOTE



The calibration of the test port thermocouple (TC) gauge is factory set and requires the use of a reference TC and a PC.

3.1.5.2.1 Vacuum (Low Pressure) Calibration

1. Verify that the leak detector is in the SYSTEM READY condition (Figure 3-10 on page 3-10) and that a test port cap 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. Press the **TEST** button and verify that the leak detector transfers to FINE TEST mode, displaying 10^{-9} atm cc/sec or lower.
5. Wait approximately 15 minutes for the vacuum system pressure to stabilize.
6. Touch the **TEST PORT TC ZERO** box.
   - ❑ A CAL OK indicator, to the right of the TEST PORT TC ZERO box confirms that the calibration was successful.
   - ❑ A FAILED message indicates that the calibration was not successful.

     A FAILED message can result from a defective or contaminated thermocouple gauge, or the fact that the actual pressure was not at or near zero.
7. Touch the **DONE** button to leave the screen and return to the previous menu.

3.1.5.2.2 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. Move to the Gauge Calibration screen (Figure 3-9 on page 3-9).
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 FAILED message indicates 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 4. Maintenance

Like other sensitive test equipment, a mass spectrometer leak detector requires periodic maintenance to ensure continued reliable operation. After prolonged use, the leak detector accumulates 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, restores normal operation. 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 Vacuum Technologies under the terms of a service contract.

This maintenance section does not cover overhaul of the entire vacuum system. It does cover maintenance that may have to be performed on a daily or as-required basis or, if the item has not required maintenance, on an annual preventive basis.

If your 979 leak detector requires service that is not covered in this section, contact Vacuum Technologies Customer Service at 1-800-8VARIAN.

Important Reminders

In addition to the safety notes at the beginning of this manual, heed the following notes, cautions, and warnings when performing maintenance.

WARNING



Disconnect power from the 979 before performing any maintenance procedure that requires physically disconnecting any part of the system.

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:

CAUTION



Do not use silicone oil or silicone grease.

Use powder-free butyl or polycarbonate gloves to prevent skin oils from getting on vacuum surfaces.

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

NOTE



Normally, it is unnecessary to use vacuum grease. However, if it must be used, avoid silicone types, and use it sparingly. Apiezon® L grease is recommended (Vacuum Technologies Part No. 695400004).

When removing, checking or replacing O-rings:

CAUTION



Remove O-rings carefully with your fingers. Do not use metal tools for this task. This prevents scratching of any sealing surfaces.

Wipe all O-rings clean with a lint-free cloth before installation to ensure that no foreign matter is present to impair the seal.

Do not use grease or other substance on O-rings that will come in contact with the spectrometer tube.

Do not use alcohol, methanol or other solvents on O-rings. To do so causes deterioration and reduces their ability to hold a vacuum.

NOTE



If applicable, apply a small amount of Apiezon® L grease and wipe the O-rings "shiny" dry.

NOTE



Due to the effective cleaning nature of VacuSolv solvent and its residue-free properties, 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 (chlorofluorocarbons).

For simplicity, the maintenance functions in this section are grouped by recommended frequency, as shown in Table 4-1, based on assumed everyday use.

Table 4-1 Scheduled Maintenance

Description	Daily	12 Months	Refer to
Calibration check	X		Section 4.1 “Daily Maintenance” on page 4-4
Recalibrate the internal calibrated leak		X	Section 4.2 “Recalibrate the Internal Calibrated Leak” on page 4-4
Spectrometer tube overhaul		X	Section 4.3 “Spectrometer Tube Overhaul” on page 4-4

These functions can be carried out at routine intervals, as indicated. The 979 must be calibrated to verify sensitivity at least once a day. However, other functions may be carried out either more or less often, depending on the frequency of use.

Maintenance functions that may be required on a demand basis, such as changing an Ion Source after filament failure, are listed in Table 4-2.

Table 4-2 As-Required Maintenance

Function	Most Common Symptom	Refer to
Spectrometer tube cleaning	Loss of sensitivity, increase in background, high ion voltage (> 300 VDC), required to tune the leak detector.	Section 4.3 “Spectrometer Tube Overhaul” on page 4-4
Ion source replacement	Filament failure (as soon as convenient after second filament is in use).	Section 4.4 “Ion Source Replacement Outside of Annual Maintenance” on page 4-20
Tuning adjustments	Use of a calibrated leak in the field other than the one tested at the factory, or if calibration is not successful.	Section 3.1.2 “Manual Spectube Tuning” on page 3-4
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).	Section 4.5 “Mechanical Pump” on page 4-22
Mechanical Pump Tip Seal Replacement	Pump base pressure has risen to an unacceptable high level for the particular application.	Section 4.5 “Mechanical Pump” on page 4-22

4.1 Daily Maintenance

4.1.1 Sensitivity Check

1. Press the READ STANDARD LEAK button.
2. Compare the value displayed on the HOME screen (Section 2.4 “979 Touch Panel Home Screen” on page 2-8) to the value of the known calibrated leak displayed on the SYSTEM INFORMATION screen (Section 2.5 “979 System Information Screen” on page 2-12) or in the CALIBRATED LEAK Set-Up screen (Figure 2-6 on page 2-12).
3. If the values do not match, press the CALIBRATE button to perform an automated calibration and then repeat step 1. If specification is still not met, Manual Tuning may be required. See Section 3.1.2 “Manual Spectube Tuning” on page 3-4.

4.2 Recalibrate the Internal Calibrated Leak

Helium calibrated leaks typically degrade at 3 percent per year. The calibrated leak supplied with your 979 must be checked at least once a year to ensure it is at the value stated on its tag. Failure to check the leak could result in unreliable testing. You can arrange for testing and re-calibration at a lab of your choice.

Vacuum Technologies provides NIST-traceable calibrated leak testing and verification services. You can contact Customer Service at 1-800-8VARIAN to arrange for recalibration.

4.3 Spectrometer Tube Overhaul

Spectrometer tube overhaul consists of removing, cleaning, and re-installing the 979 Spectrometer Tube. There are four basic sub-assemblies in the spectrometer tube. Table 4-3 lists the tools and parts required during overhaul. Removal instructions follow in the order below.

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

Table 4-3 Tools and Parts Required for Spectrometer Tube Overhaul

Tools	
Screwdrivers	Slotted and Phillips
Gloves	Butyl or polycarbonate, powder-free
Parts	
Part Number	Description
82850302	Ion Source
R1266301	Button TC
670029096	Vacuum Technologies Spectrometer Tube Cleaning Kit
	O-rings (Parker 2-025 V747-75 Black) – (supplied with Ion Source, Button TC and Preamplifier)

CAUTION



Use powder-free butyl or polycarbonate gloves to prevent skin oils from getting on vacuum surfaces.

4.3.1 Removing the Spectrometer Tube Assembly

WARNING



Disconnect power from the 979 before performing any maintenance procedure that requires physically disconnecting any part of the system.

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 2 Phillips screws from the front panel and dropping the top of the front panel down.

NOTE



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

1. Remove the 2 Phillips screws ① from the Model 979 front panel (Figure 4-1).



Figure 4-1 Front Panel

2. Lean the top of the front panel forward ② 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 979 just behind the front panel (Figure 4-2).



Figure 4-2 Front View of the Spectrometer Tube Assembly

In addition to the three connectors on the top of the unit, indicated by ① in Figure 4-2, 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 4-3). The connector cables are labeled TC, Ion Source, and Preamplifier. If the cables are not labeled, label them now for future reference.

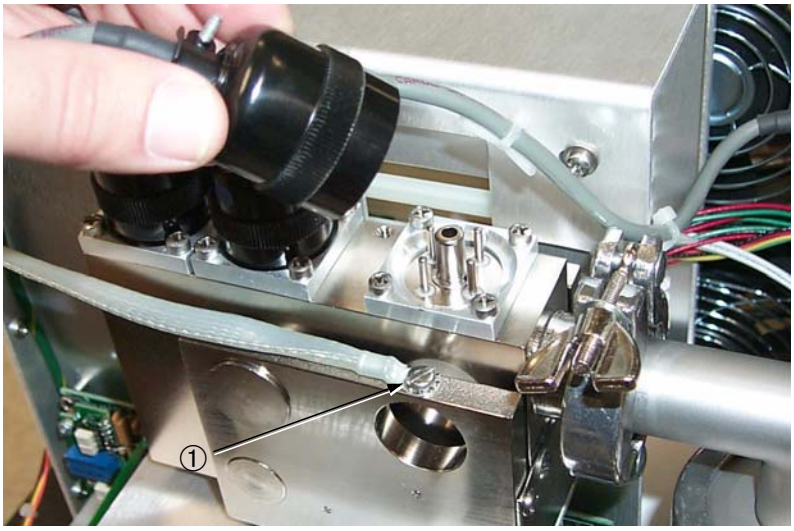


Figure 4-3 Removing the Connectors

5. Disconnect the ground cable from the spectrometer tube magnet by removing the screw ① with a slotted screwdriver (Figure 4-3 on page 4-7).
6. Remove the wing nut ① located underneath the shelf below the spectrometer tube (Figure 4-4).

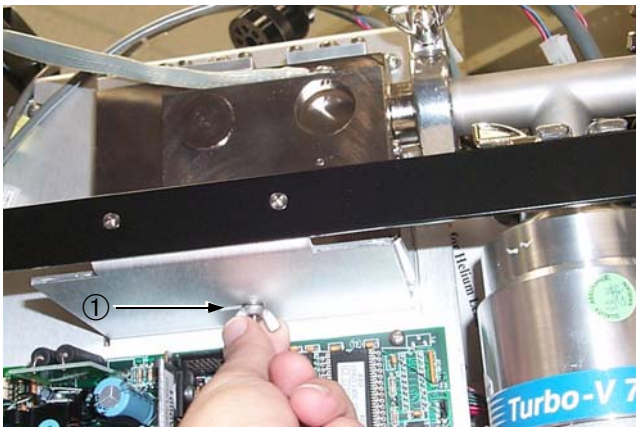


Figure 4-4 Wing Nut

7. Remove the KF-25 (ISO NW-25) quick clamp ① to disconnect the spectrometer tube from the 979 vacuum system (Figure 4-5).

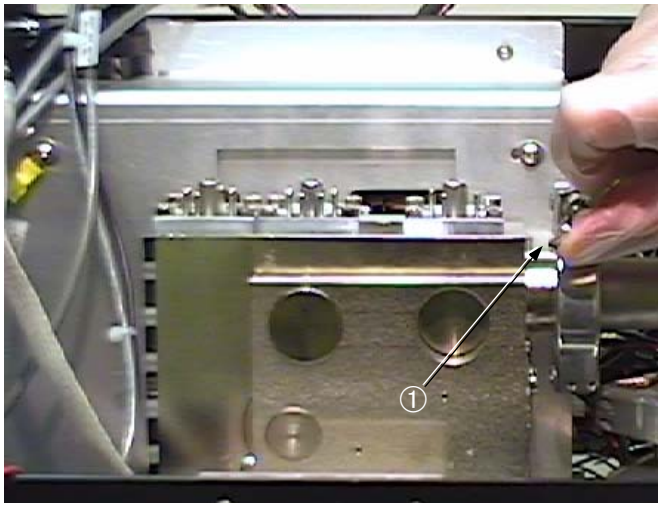


Figure 4-5 KF-25 Quick Clamp

8. Lift the spectrometer tube up and off of the tray and lay it down on a clean non-magnetic surface.

CAUTION



If the spectrometer tube magnet comes in contact with a magnetic surface, it may become de-magnetized causing the spectrometer tube to lose sensitivity.

CAUTION



Do not remove the 6 magnet body bracket screws ① shown in Figure 4-6 while performing maintenance on the spectrometer tube.

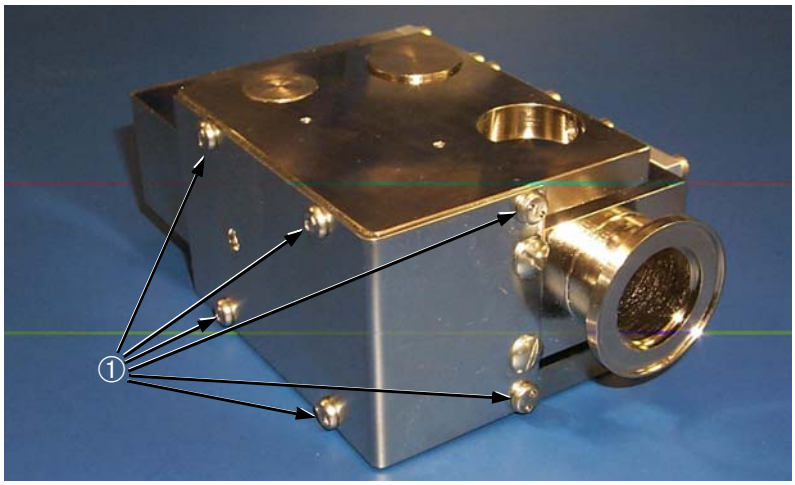


Figure 4-6 Magnet Body Bracket Screws

9. Remove the 2 slotted screws ① that mount the spectrometer tube magnet assembly to the spectrometer tube body (Figure 4-7).



Figure 4-7 Magnet Assembly Slotted 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 set screws ② located on both sides of the assembly (Figure 4-8). Do not remove the set screws and tuning magnets completely.

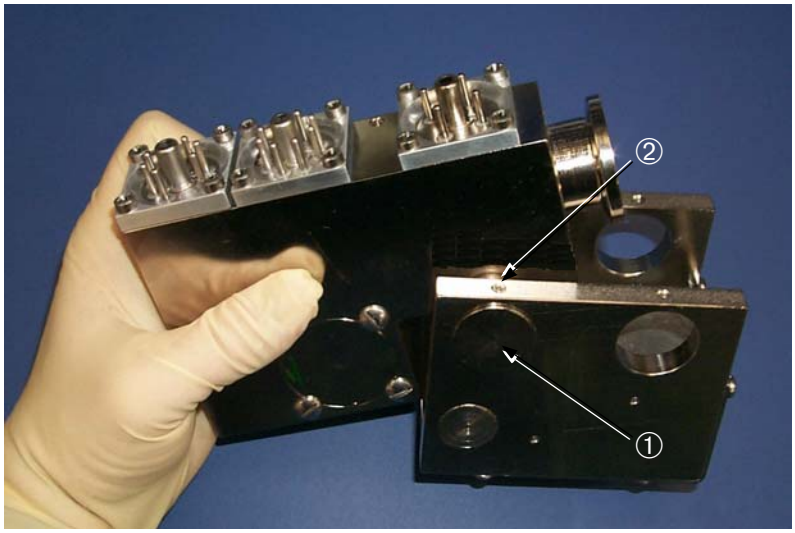


Figure 4-8 Tuning Magnet Set Screws

4.3.2 Removing the Button TC

1. Remove the 4 Phillips screws ① that hold the Button TC header (Figure 4-9).

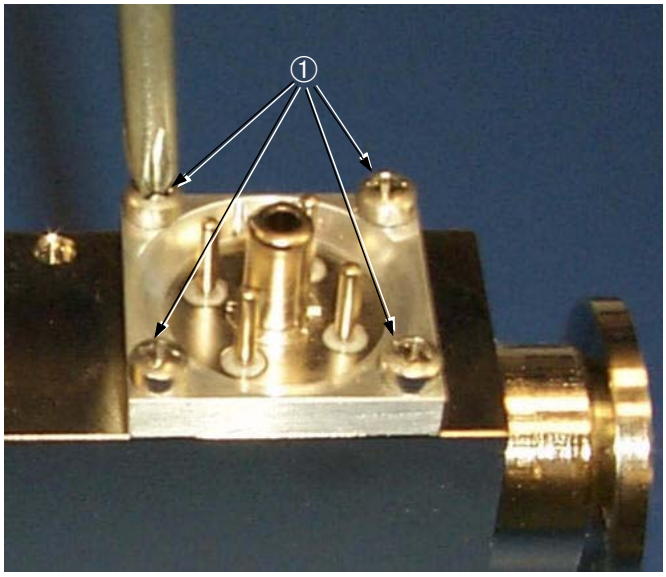


Figure 4-9 Button TC Assembly

2. Remove the Button TC header ② (Figure 4-10) by pressing down on the Button TC center post ① and lifting the header ② up and off of the Button TC ③.

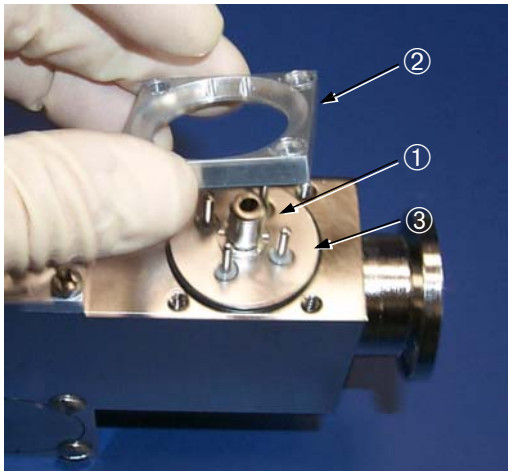


Figure 4-10 Removing the Button TC

3. If the header and Button TC come up together, hold one hand under the Button TC to catch it, and push down on the center post to remove the header from the Button TC. Be careful not to damage the sensing wire.

CAUTION



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

4. Remove the Button TC carefully and place it sensing wire ① side up as shown in Figure 4-11, (contact pin side down) on a clean surface.

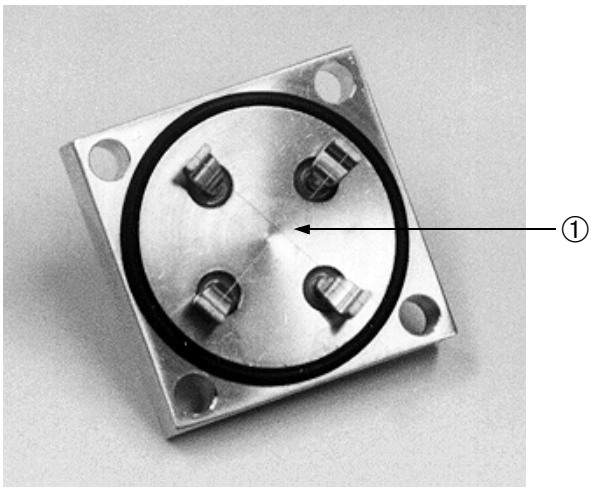


Figure 4-11 Button TC Wires (View with Header on)

5. Carefully remove the O-ring.

4.3.3 Removing the Ion Source

WARNING



Store the Ion Source in a cool, dry area in a tightly sealed container. Wash hands thoroughly after handling the Ion Source and especially before smoking or eating.

CAUTION



Use powder-free butyl or polycarbonate gloves to prevent skin oils from getting on vacuum surfaces.

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 Section 4.4 "Ion Source Replacement Outside of Annual Maintenance" on page 4-20 when replacing the ion source outside of annual maintenance.

1. Remove the 4 Phillips screws that hold the ion source header piece, repeating steps 1, 2, and 3 (Section 4.3.2 "Removing the Button TC" on page 4-11) to release the ion source.
2. Remove the ion source from the spectrometer tube body (Figure 4-12).

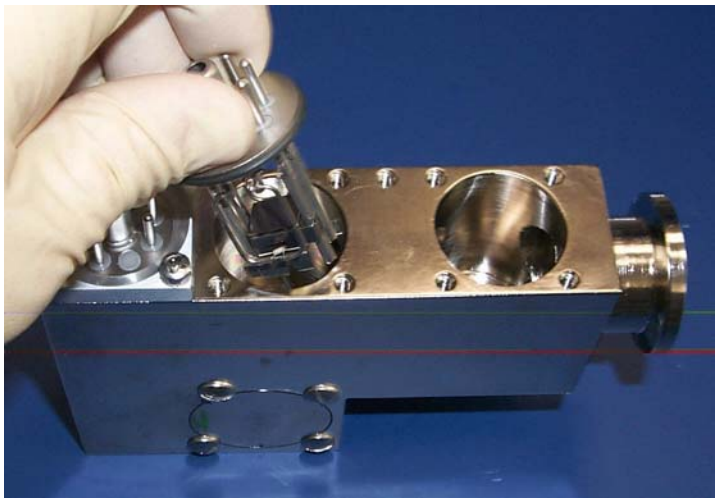


Figure 4-12 Removing the Ion Source

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 from transferring into test at too high a pressure.

3. Examine the ion source (Figure 4-13) and cavity (Figure 4-14) for deposits and discoloration. When examination is completed, dispose of it properly or return it to Vacuum Technologies for exchange.

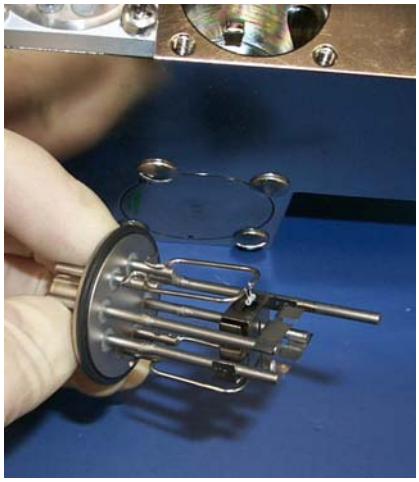


Figure 4-13 The Ion Source

4. Looking into the ion source cavity (Figure 4-14) you will see the ground slit plate ①.

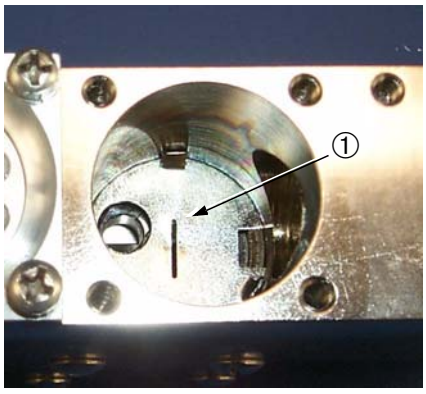


Figure 4-14 Ion Source Cavity

5. Remove the ground slit plate (Figure 4-15) by placing a thin, slotted screwdriver snug into the slot and carefully twisting and prying with the screwdriver.

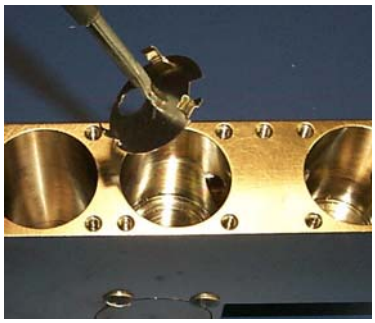


Figure 4-15 Ground Slit Plate

NOTE

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

4.3.4 Removing the Preamplifier

CAUTION

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

1. Remove the 4 Phillips screws that hold the preamplifier header piece, repeating steps 1, 2, and 3 to release the preamplifier (Section 4.3.2 “Removing the Button TC” on page 4-11) to release the preamplifier.
2. Carefully remove the preamplifier from the spectrometer tube body (Figure 4-16) and place it carefully on a clean, safe, non-magnetic surface.



Figure 4-16 Removing the Preamplifier

4.3.5 Remove the Magnetic Poles

1. Remove the 4 slotted screws ① to free the magnet pole piece ② (Figure 4-17).

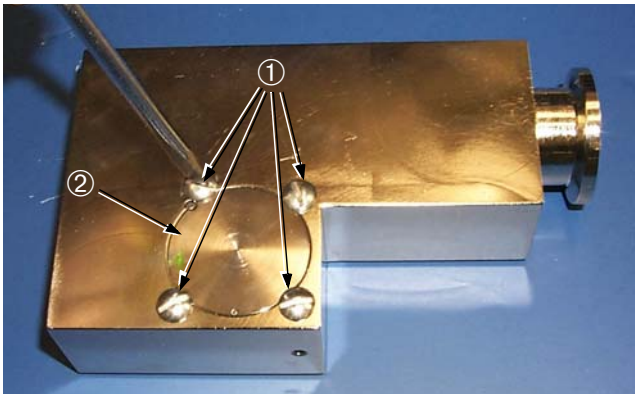


Figure 4-17 Magnetic Pole Piece

2. Pick up the spectrometer tube body and tilt it over to remove the magnetic pole piece.
3. 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 4-18).

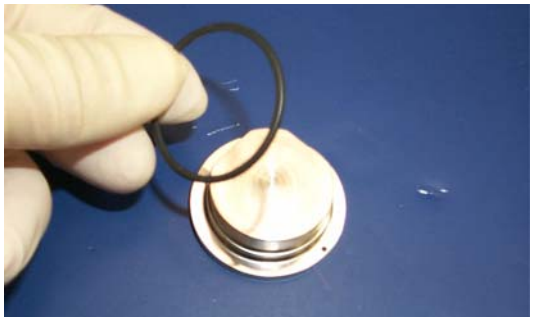


Figure 4-18 Removing the O-ring from Magnetic Pole Piece

4. Repeat steps 1, 2, and 3 (Section 4.3.5 “Remove the Magnetic Poles” on page 4-16) to remove the second magnetic pole piece (Figure 4-19) from the other side of the spectrometer tube body.



Figure 4-19 Removing the Second Magnetic Pole Piece

4.3.6 Examining and Cleaning the Spectrometer Parts

1. Using the Scotch-Brite™ pad from the spectrometer tube cleaning kit, polish away any discolored areas inside the spectrometer tube cavity.
2. Using the Scotch-Brite pad, polish away any discolored areas of the ground slit plate (Figure 4-20).

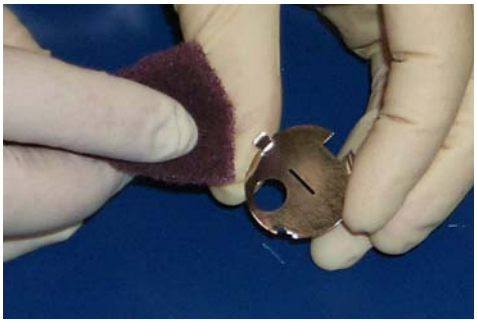


Figure 4-20 Discolored Ground Slit Plate

CAUTION



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

3. Using the Scotch-Brite pad, polish away any discolored areas of the magnetic pole pieces (Figure 4-21).



Figure 4-21 Discolored Ground Magnet Pole Piece

4. Using the VacuSolv presaturated cleaning wipes and swabs (Figure 4-22), thoroughly wipe down all surfaces of the spectrometer tube body, magnetic pole pieces, and ground slit plate.



Figure 4-22 VacuSolv Cleaning Wipe

CAUTION



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

5. Examine the Button TC, taking care not to damage the wires. If there is no damage, it may be reused after it is properly cleaned.

NOTE



If you were seeing false system pressure readings prior to overhaul, it may be best to replace the Button TC whether or not you detect any physical signs of damage.

6. To clean the Button TC properly, soak it in liquid VacuSolv (or acetone) followed by an isopropyl alcohol rinse. Air dry the Button TC thoroughly before re-assembling into spectrometer tube.

7. Carefully wipe down and inspect all O-rings before reusing. Replace all damaged O-rings (Figure 4-23).



Figure 4-23 Inspecting the O-ring

NOTE

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

4.3.7 Reassembly

1. Carefully reassemble the spectrometer tube (Figure 4-24) 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.

CAUTION

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

A short could result at power up if the alignment pin touches the sides of the alignment hole.

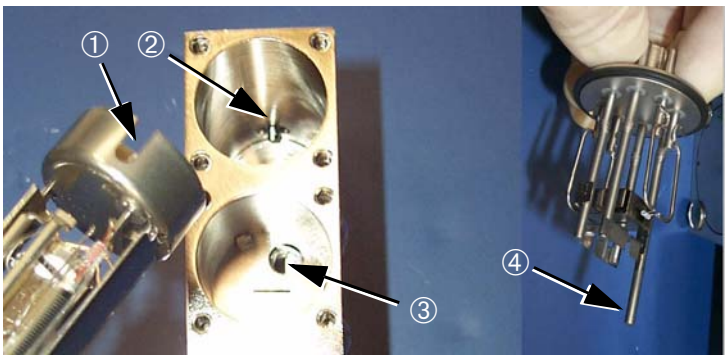


Figure 4-24 Spectrometer Tube Reassembly

4.4 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 3-5 on page 3-4). 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.

WARNING



Store the Ion Source in a cool, dry area in a tightly sealed container. Wash hands thoroughly after handling the Ion Source and especially before smoking or eating.

CAUTION



Use powder-free butyl or polycarbonate gloves to prevent skin oils from getting on vacuum surfaces.

Tools: Phillips screwdriver
Parts: Ion Source

1. Turn off the main power switch located on the back of the 979 leak detector.
2. Remove the 2 Phillips screws from the front panel of the leak detector and drop the top of the front panel down (Figure 4-1 on page 4-6). Be careful not to place tension on the PCB harness.
3. Remove the ion source connector at the spectrometer tube.
4. Vent the spectrometer tube by turning the knurled nut on the turbo pump 1/4 turn counterclockwise.
5. Remove the 4 Phillips screws that secure the ion source header (Figure 4-9 on page 4-11).
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 4-12 on page 4-13).

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. Examine the ion source (Figure 4-13 on page 4-14) and cavity for deposits and discoloration. If either is discolored or dirty contact Vacuum Technologies Customer Service at 1-800-8VARIAN.

   If Customer Service recommends a complete spectrometer tube overhaul, follow the procedure in Section 4.3 “Spectrometer Tube Overhaul” on page 4-4.

9. When examination is completed, properly dispose of the ion source or return it to Vacuum Technologies for exchange.

4.4.1 Reassembly

1. Replace the ion source (see Figure 4-24 on page 4-19).

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 4-24).

CAUTION

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

A short could result at power up if the alignment pin touches the sides of the alignment hole.

2. Replace the ion source header. Align the grooves with the legs on either side of the center post and to the back of the spectrometer tube. Tighten the 4 Phillips screws.
3. Replace the ion source connector. It is keyed to go on only one way.
4. Close the vent on the turbo pump by turning the knurled nut 1/4 turn clockwise.
5. Close the front cover being careful not to pinch any wires. Replace and tighten the 2 Phillips screws.

4.5 Mechanical Pump

Most pumps require regular maintenance. Oil gets contaminated over time and has to be replaced. In a system with dry pumps, tip seals have to be checked for wear. The roughing and forepumps of the system must be maintained at the intervals recommended to ensure reliable leak detection by the Model 979.

4.5.1 Oil-Sealed Pump Fluid Change

Refer to the *Mechanical Pump Operation Manual,* provided with the Model 979 Leak Detector. See Section 4.7 “979 Accessory Item List” for the replacement oil part number.

4.5.2 TriScroll Pump Tip Seal Replacement

Refer to the *TriScroll Tip Seal Replacement Manual,* provided with the tip seal set. See Section 4.6 “979 Spare Parts List” for the appropriate tip seal set part number. When performing a tip seal replacement, the exhaust filter should also be replaced. See Section 4.6 “979 Spare Parts List” for the replacement exhaust filter part number.

4.6 979 Spare Parts List

Table 4-4 979 Spare Parts

Assembly	Part Number
Ion Source	82850302
Button TC (System)	R1266301
Preamplifier	L9030301 (Std Sensitivity) R1003301 (High-Sensitivity)
Test Port Thermocouple Gauge (TC), Model 531	F0472301
Spectrometer Tube Magnet Assembly	K3023301
Spectrometer Tube Assembly Exchange Program	EXL9713302 (Standard Sensitivity) EXL9713303 (High Sensitivity)
Spectrometer Tube Cleaning Kit	670029096
Calibrated Leak (Low 7 Range)	Call Vacuum Technologies

Table 4-4 979 Spare Parts (Continued)

Assembly	Part Number
Calibrated Leak (Low 8 Range)	Call Vacuum Technologies
Main Power Supply	659077039
Ion Source Controller PCB	L9539302
Digital Interface PCB	L9536301
Preamplifier Driver PCB	L9524301
Gauges PCB	R0395301
Brain PCB	Call Vacuum Technologies.
Power Supply PCB	L9255301
979 I/O PCB	Call Vacuum Technologies
Touch Screen Assembly	Call Vacuum Technologies
Front Housing	Call Vacuum Technologies
Rear Housing	Call Vacuum Technologies
V70D Turbo Pump Exchange Program	Call Vacuum Technologies
V70LP Turbo Pump Exchange Program	Call Vacuum Technologies
Tip Seal Set, TriScroll 300 Series Primary Pump	PTSS0300TS*
Maintenance Tool Kit, TriScroll Primary Pump	PTSS0600TK
Tip Seal Set, TriScroll 600 Series Primary Pump	PTSS0600TS*
Exchange TriScroll 620 Pump Module	EXPTS0620SC
Exchange TriScroll 320 Pump Module	EXPTS0320SC
Oil Mist Eliminator Cartridge (Qty: 2)	949-9394
Exhaust Filter	110420110

**Requires Maintenance Tool Kit for installation.*

4.7 979 Accessory Item List

Table 4-5 979 Accessory Item List

Assembly	Part Number
LDNW25 Inlet Adapter Kit	LDNW25INADKIT
Flapper Box, NW25 Flange	L6241302
Power Probe, 10’ Length (NW25 Flange)	K9565306
Power Probe, 25’ Length (NW25 Flange)	K9565307
Spare Tip Filters for Power Probe (Qty: 10)	K9565303
Throttle Valve (NW25 Flange)	R1947301
Elite-Z Mechanical Pump Fluid	695409005
Calibrated Leak, 10^{-5}, 10^{-6} (NW25 Flange)	F8473320
Calibrated Leak, 10^{-7} (NW25 Flange)	F8473321
Calibrated Leak, 10^{-8} (NW25 Flange)	F8473322
Calibrated Leak, 10^{-9} (NW25 Flange)	F8473323
Calibrated Leak, 10^{-10} (NW25 Flange)	F8473324
Oil Mist Eliminator (NW25 Flange)	949-9395

Appendix A. Rear Panel Interface Connectors

The system control and communication panel (Figure A-1) is located on the lower left section of the rear panel. This appendix discusses the I/O ① and the Remote Control ② interfaces.

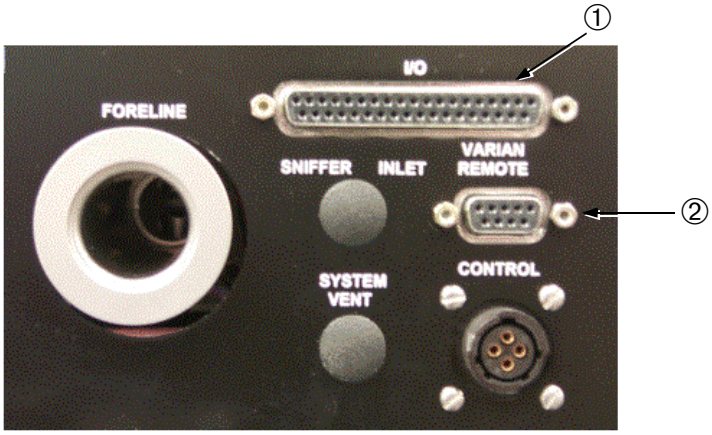


Figure A-1 System Control and Communication Panel

The I/O connector provides:

- ❑ Optically isolated (5 VDC to 24 VDC) discrete I/O interface
- ❑ Non-isolated Serial RS-232 interface
- ❑ Non-isolated analog (0 V to 10 V) output for the 979 Series Leak Detectors.

The Remote Control connector provides:

- ❑ Non-isolated serial interface and power connection for the Universal Remote

A.1 Optically Isolated Outputs

Table A-1 on page A-2 provides the output information for the I/O discrete connections.

Figure A-2 on page A-2 shows the output circuit sketch. Level outputs are optically isolated emitter followers with 10 Ohm series resistors, and a 14 mA max drive current (24 VDC max).

Table A-1 Summary Table of Optically Isolated Outputs

Pin	Output Name	Momentary or Level	Description
2	PWR	NA	Customer-supplied +5 VDC to +24 VDC for all P101 outputs.
3	REJ 1	Level	Active when Leak Rate is greater than set point #1.
4	REJ 2	Level	Active when Leak Rate is greater than set point #2.
5	REJ 3	Level	Active when Leak Rate greater than set point #3.
6	REJ 4	Level	Active when Leak Rate greater than set point #4.
7	START OUT	Level	Active High when 979 in Rough Mode.
8	VENT OUT	Level	Active High when 979 in Vent Mode.
9	TEST OUT	Level	Active High when 979 in Test Mode.
10	BUSY OUT	Level	Active High when 979 in Busy Mode.
11	WAKE UP OUT	Level	Active High when 979 in Wake Up Mode.
12	NOT READY OUT	Level	Active High when 979 in Not Ready Mode.
13	SPARE OUT	Level	Spare Output.

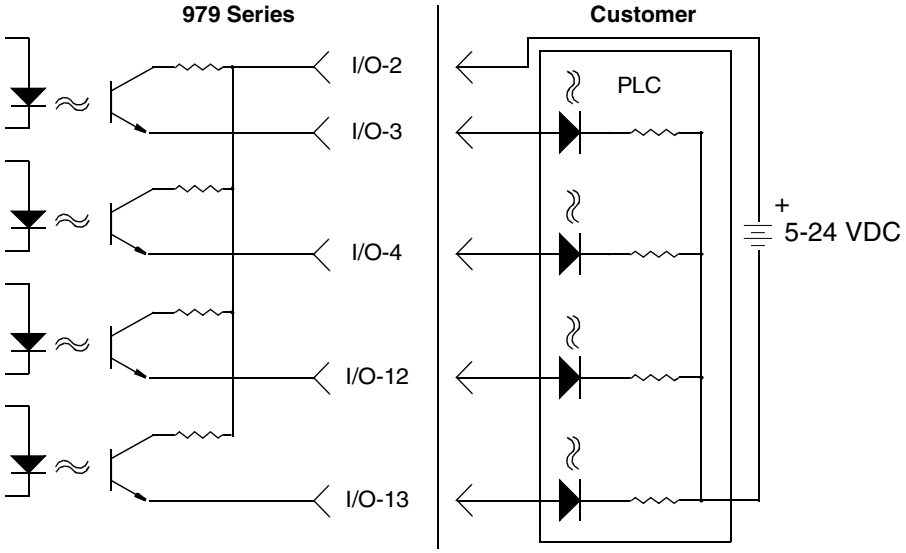


Figure A-2 Optically Isolated Output Circuit Sketch

A.2 Optically Isolated Inputs

Table A-2 provides the input information for the I/O discrete connections.

Figure A-3 shows the input circuit sketch. Level inputs are optically isolated 5 VDC to 24 VDC, 3600 Ohm resistive loads, and require a 200 ms minimum pulse width.

Table A-2 Summary Table of Optically Isolated Inputs

Pin	Input Name	Momentary or Level	Description
1	Input Common	N/A	Customer-supplied GND for all P101 inputs.
21	START IN	Momentary	>200 ms High Pulse to initiate 979 Roughing Mode.
22	VENT IN	Momentary	>200 ms High Pulse to initiate 979 Vent Mode.
23	HOLD IN	Momentary	>200 ms High Pulse to initiate 979 Hold Mode.
20	SPARE_IN_5		Spare input 5.
24	AUTOCAL	Momentary	>200 ms High Pulse to initiate an AUTOCAL cycle.
25	ZERO	Momentary	>200 ms High Pulse to initiate a ZERO function.
26	SPARE_IN_3		Spare input 3.
27	SPARE_IN_4		Spare input 4.

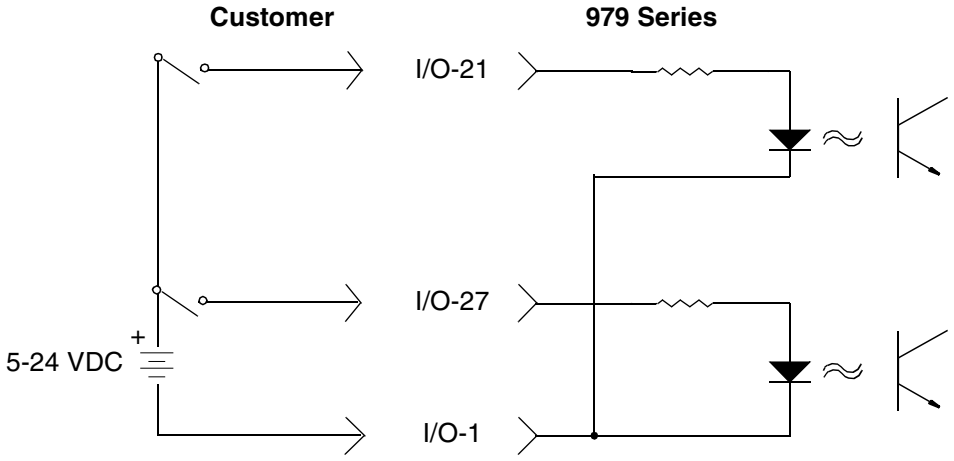


Figure A-3 Optically Isolated Input Circuit Sketch

A.3 Non-Isolated Serial and Analog Interfaces

Table A-3 provides non-isolated RS-232 serial interface and non-isolated analog output information. Figure A-4 shows the cable wiring diagram from a standard RS-232 9 Pin connection to the 979 D Sub 37P.

RS-232 serial I/O connections are referenced to the chassis ground and are not isolated. Electrical characteristics comply with EIA/TIA Standard EIA/TIA-232-E.

Table A-3 Summary Table of Non-Isolated I/O

Pin	Input Name	Signal Spec	Description
15	RxD	RS-232 Spec	Receiving Data to the 979.
16	RTS	RS-232 Spec	Request to Send from the 979.
17	TxD	RS-232 Spec	Transmitted Data from the 979.
18	CTS	RS-232 Spec	Clear to Send to the 979.
19	GND	RS-232 Spec	Signal Common.
33	Analog Output	0-10 VDC	Analog voltage updated in Test mode.
34	Analog Ground	AGND	Return for analog voltage.

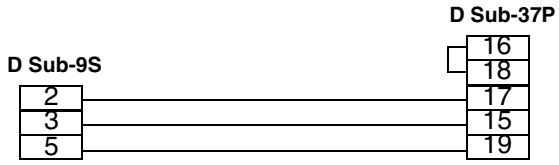


Figure A-4 979 COM Cable Wiring Diagram

A.4 Remote Control Connector

The D Sub 9S connector provides a non-isolated serial interface and a power connection for the Universal Remote unit.

Table A-4 provides non-isolated serial and power information.

Table A-4 Summary Table of Non-Isolated Serial and Power

Pin	Input Name	Signal Spec	Description
2	RxD2	RS-232 Spec	Receiving Data from the Universal Remote.
3	TxD2	RS-232 Spec	Transmitted Data to the Universal Remote.
5	+24 RET	PWR GND	Common for power and signals.
9	+24 V	PWR	+24 VDC power for the Universal Remote.

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Appendix B. Communications Protocol

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

B.1 Protocol (RS-232)

RS-232 ports 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 both commands and inquiries must be terminated by a carriage return <CR>; 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 80th character, execution of the command string begins anyway. 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 **PUT** 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 and do not begin with any special character(s).

Successful inquiries respond with data, followed by a space, then: **ok**<CR><LF>, as specified in the tables of this appendix. Unsuccessful inquiries respond with the offending inquiry followed by a space, then: **#?**<CR><LF> (line feed, <LF>).

Inquiries, parameters, and commands can be concatenated. Each word or numeric parameter is followed by one or more spaces. The string is terminated by a <CR>, which causes execution to begin. Successful strings respond with the specified data for the input inquiries in the order the inquiries were issued, followed by: **ok**<CR><LF>. Unsuccessful strings respond with the *first* offending command followed by a space, then: **#?**<CR><LF>. All commands and inquiries following the failed word are ignored; all parameters are discarded.

Table B-1 on page B-5, Table B-2 on page B-7, Table B-3 on page B-9, and Table B-4 on page B-9 outline the available control and query commands.

B.2 Communicating with RS-232

The RS232 Protocol is intended for diagnostic purposes and initial set-up inquires. The RS232 connection is located on the rear D-sub 37 pin connector (refer to Table A-3 on page A-4 and Figure A-4 on page A-4).

The 979 RS232 port is not an interrupt-driven port. It is configured as DTE (Data Terminal Equipment), therefore the 979's RS232 Protocol cannot be sent as strings.

NOTE



When programming with virtual instrumentation programs such as LabView, TestPoint, or Visual Basic, try one the following two methods:

- ❑ The intended command must be transmitted one character at a time with a minimal delay time of 50 milliseconds between each character and terminating the command with a carriage return (CR).
- ❑ The intended command must be transmitted one character at a time, then wait for the echoed response from the 979 before transmitting the next character and then terminating the command with a carriage return (CR).

Windows 95 and later versions contain a serial communications program called HyperTerminal, a useful tool in establishing communication between the 979 and a PC.

B.2.1 Windows HyperTerminal Set-Up Instructions

To set up Windows HyperTerminal:

1. Click **Start**.
2. Select **Programs>Accessories>Communications>HyperTerminal**.
3. Double-click **Hypertrm.exe**.

   The Connection Description dialog box appears.
4. Enter a name and choose an icon for the connection, for example: 979 RS232.
5. Click **OK**.

   The Connect To dialog box appears.
6. Select a COM port from the *Connect Using*: the pull down list.

   The Com Properties/Port Setting dialog box appears.

7. Configure the following settings:
   - ❑ Bits per second (baud rate) – **9600**
   - ❑ Data bits: – **8**
   - ❑ Parity: – **None**
   - ❑ Stop bits: – **1**
   - ❑ Flow Control: – **None**
8. Click **OK**.
9. Select **Properties** from the File menu.

   The Properties window appears.
10. Configure the following settings on the Connect To tab:
    - ❑ Connect using – Verify the COM port is correct.
    - ❑ Click **Configure** and verify the port settings are correct.
11. Ensure that the Settings tab is configured as follows:
    - ❑ Terminal keys radio button selected.
    - ❑ Ctrl+H radio button selected.
    - ❑ Auto detect selected from the Emulation pull-down list.
    - ❑ ANSI entered in the Telnet terminal ID.
    - ❑ 500 set in the Background buffer lines field.
12. Click **ASCII Set-Up**.

    The ASCII Set-Up dialog box appears.
13. Ensure that the settings are as follows:
    - ❑ Line delay – **0 milliseconds**
    - ❑ Character delay - **0 milliseconds**
    - ❑ ASCII Receiving – **Wrap lines that exceed terminal width**

    The cursor begins blinking.
14. Type some simple commands:
    - ❑ ?LEAK
    - ❑ ?ALL
    - ❑ ?SETUP

B.2.2 Printing with HyperTerminal

The easiest way to print information captured in HyperTerminal is to choose Print from the File menu. However, this method only prints information currently displayed on the screen. Screen information can also be highlighted, copied and pasted into Microsoft Word or Excel.

To capture large amounts of data that exceeds the terminal screen limits, use the Transfer menu Capture Text option:

1. Select **Transfer>Capture text**.

   The Capture text dialog box appears.

2. Click **Browse**.

   The Select Capture File dialog box appears.

3. Navigate to a location, enter a file name and select a file type:

   - ❑ .txt text file (Notepad)
   - ❑ .doc (Word)
   - ❑ .xls (Excel)

4. Click **Save**.

   The Capture Text dialog box reappears.

5. Click **Start** to log data.
6. Select **Transfer>Capture Text>Stop** to end text capture.
7. Open the file where the data was stored and select **File>Print**.

Example

You can use the above procedures to poll the 979 leak rate using HyperTerminal and capture the text. To do this:

1. Type the command: **XYZZY**.

   If received correctly, the 979 responds ok.

2. Type the command: **?LEAK 1 SECS CR ?ESC**.

   This command polls the leak rate every second. The time is set in seconds.

3. Press **ESC** to abort polling.
4. Select **Transfer>Capture Text**.
5. Browse to a folder and file using the Capture Text dialog box and click **Start**.
6. Select **Transfer>Capture Text> Stop** to abort data logging.

Table B-1 lists inquiries that are used to determine internal operating parameters. All inquiries, except VER, begin with **?** and end with <CR>.

Table B-1 Internal Operating Parameters

Inquiry	Response
?ALL	Nine 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 value of the offset variable. The ninth line reports the gain value.
?AZ<0	Reports the status of the Auto-zero < 0 function. Enabled or Disabled.
?BACKGROUND	Reports the value of the helium background.
?CALOK	Reports the status of the last calibration.
?CL-XFER	Reports the currently stored contra-flow mode crossover pressure.
?EMISSIONCURRENT	Reports the emission current.
?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.
?EXTLEAK	Reports the currently stored value of the external standard leak.
?FILAMENTBIAS	Reports the filament bias voltage.
?FIXEDFOCUS	Reports the fixed focus voltage.
?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 gain.
?GL-XFER	Reports the currently stored gross leak crossover pressure.
?INTEXT	Indicates which leak, INTERNAL or EXTERNAL has been selected for use during calibration.
?IONCHAMBER	Reports the ion chamber voltage.
?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).
?LPV	Reports the current Leak Rate, Pressures and Valve state.
?OFFSET	A number representing the offset value as a percent of full scale. 50 represents mid-scale.

Table B-1 Internal Operating Parameters (Continued)

Inquiry	Response
?PRESSURES	Two lines. Each begins with a <cr><lf>. The first line consists of the words **test port TC** followed by a number in milliTorr. The second line consists of the words **system TC** followed by a number in mTorr.
?RANGE	A two-character (minus followed by one digit) number indicating the current 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.
?RANGESTOP	Reports the value of the Rangestop variable.
?REJECT	A seven-character number consisting of a two-digit reject leak rate mantissa with a decimal point after the first digit followed by **E**– then a two-digit exponent (e.g., 7.0E–05). This inquiry is used for reporting the reject leak rate most recently input using INIT-REJECT.
?>REJECT	Reports the status of reject set point #1.
?xREJECT	(Where x is a number from 1 to 4 or the letter **A**) a seven-character number consisting of a two-digit reject leak rate mantissa with a decimal point after the first digit followed by **E** – then a two-digit exponent (e.g., 7.0E–05). 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.
?REPELLER	Reports the repeller voltage.
?ROUGH	Reports the currently stored Test Sequencer rough time.
?RSONOFF	Reports the status of the Rangestop function. Enabled or Disabled.
?SEQONOFF	Reports the status of the Auto Sequencer. Enabled or Disabled.
?SETUP	Seven lines. Each begins with a <cr><lf>. The first line reports the turbo pump speed as **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**.
?STDLEAK	A seven-character number consisting of a two-digit calibration standard leak rate mantissa with a decimal point after the first digit followed by **E–**, and then by a two-digit exponent (e.g., 1.3E-07). This inquiry is used for reporting the calibration standard leak rate most recently input using INIT-STDLEAK.
?SUPPRESSOR	Reports the suppressor voltage.
?TEST	Reports the currently stored Test Sequencer test time.

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** or **Slow**.
?VALVESTATE	Reports the current mode of the valves: Vent, Hold, Rough, etc.
?VARIABLEFOCUS	Reports the variable focus voltage.
VER	One line, which reports a date in the form **LA02.00** followed by a six-digit hexadecimal checksum.
WHYNOCAL	Reports the calibration failure diagnostics.

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-AZ<0	Preceded by 0 or 1, sets the status of Auto-zero < 0. 0 = off, 1 = on.
INIT-CL-XFER	Preceded by **X.XE-XX**, sets the value of the contra-flow mode crossover pressure in Torr.
INIT-DAC	Preceded by a number 0 to 255, sets the offset of the leak rate output voltage DAC.
INIT-DISPLAY	Preceded by LOG or LINEAR, sets the large bar graph to a log or linear display.
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-FILAMENT	A single digit, either 1 or 2, which sets the operating filament in 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-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.
INIT-GL-XFER	Preceded by **X.XE-XX**, sets the value of the gross leak crossover pressure in Torr.

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-LINEAR	None. The leak rate analog output voltage becomes linear. See Section 2.6.6 “Output Control Set-Up” on page 2-24 and Figure 2-15 on page 2-25.
INIT-1LOG	None. The leak rate analog output voltage becomes logarithmic at 1 volt per decade. See Section 2.6.6 “Output Control Set-Up” on page 2-24 and Figure 2-14 on page 2-25.
INIT-2LOG	None. The leak rate analog output voltage becomes logarithmic at 2 volts per decade.
INIT-3LOG	None. The leak rate analog output voltage becomes logarithmic at 3 volts per decade.
INIT-OFFSET	A two-digit number, in the range 00 to 99, which sets the percentage of the offset variable used for nulling the preamplifier.
INIT-RANGESTOP	Preceded by **XX**, sets the value of the most sensitive range exponent.
INIT-REJECT	A two-digit leak rate mantissa with a decimal point after the first digit followed by **E–**, and then by a two-digit exponent: the helium leak rate number in atm cc/sec. Values outside the working range of the leak detector are not 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-REPELLER	A three-digit number of volts, in the range 300 to 600, which sets the repeller voltage of the ion source.
INIT-ROUGH	Preceded by **XXX**, sets the Auto Sequencer rough time in seconds.
INIT-STDLEAK	A two-digit leak rate mantissa with a decimal point after the first digit followed by **E–**, and then by a two-digit exponent: the helium leak rate number in atm cc/sec of the calibration standard leak. Values outside the working range of the leak detector are not stored.
INIT-TCTPZERO	Preceded by a number (**XXX**) of mTorr representing the test port pressure at the time of the command. Used to calibrate the low-pressure end of the test port TC to a known pressure higher than zero.
INIT-TEST	Preceded by **XXX**, sets the Auto Sequencer test time in seconds.

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-EMISSION	A four-digit number of microamps, in the range 0300 to 2000, which sets the emission current of the ion source.
PUT-EXPONENT	A three-character number indicating the exponent of the range of leak in MANUAL mode. Acceptable values are 0 through –10. Unacceptable values are not stored.
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-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.
PUT-ION	A three-digit number of volts, in the range 200 to 350, which sets the ion voltage of the ion source.
PUT-OFFSET	A two-digit number, in the range 00 to 99, which sets the percentage of an offset variable.
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 are not stored.
PUT-REPELLER	A three-digit number of volts, in the range 300 to 600, which sets the repeller voltage of the ion source.

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

Table B-4 Leak Detection Actions

Command	Action
AUTO	Initiates auto-ranging mode. Success is indicated by the normal **ok** response.
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.
DECREMENT	Subtracts 1 from the Manual Ranging 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.
DISABLE-RANGESTOP	Disables the Rangestop function.
ENABLE-RANGESTOP	Enables the Rangestop function.

Table B-4 Leak Detection Actions (Continued)

Command	Action
EXTERNAL	Uses an external Calibrated Leak (in the test port). For Autocalibrate operations.
FPEAK	Adjusts the variable focus voltage to cause a maximum response to helium.
IDLE	Turns off the turbo and spectube and waits for a RUN command.
INCREMENT	Adds 1 to the Manual Ranging 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.
INTERNAL	Uses an internal Calibrated Leak. For calibrate operations.
KEEP	Causes the leak detector to close most valves and enter the HOLD state.
MANUAL	Sets to manual ranging mode. Success is indicated by the normal **ok** response.
NOSNIFF	Disables the internal sniffer mode.
ROUGH	Causes the leak detector to begin a roughing and testing sequence.
RUN	Starts the turbo and spectube after IDLE command.
SNIFF	Enables the internal sniffer mode.
SYTCATM	Sets 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.
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.
TUNE	Adjusts the ion source voltage to cause a maximum response to helium.
VENT	Causes the leak detector to vent the test port to the atmosphere.
ZERO	Sets the current leak rate measurement to be 0.0 atm cc/sec in the most sensitive range.

Appendix C. Introduction to Leak Detection

C.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 979 Series 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.

C.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).

C.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 atm cc/sec9.7 x 10^4 micron cubic feet per hour or practically 10^5 micron CFH (µCFH) 1 µCFH or 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 an std cc/sec. Therefore negative powers of ten are used as a convenient system of numerical shorthand.

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

Table C-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

C.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.

C.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.

C.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.

C.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.

C.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.

C.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.

C.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.

C.6.1 Test Piece Evacuated (Figure C-1a and Figure C-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.

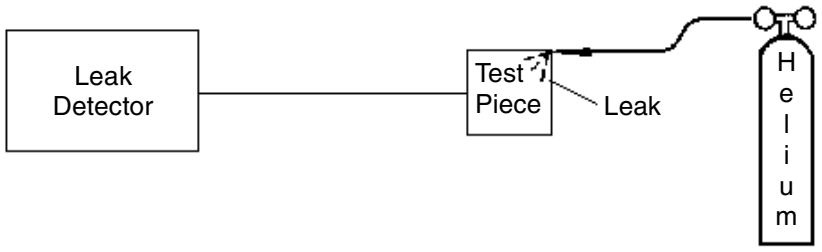


Figure C-1a Test Piece Evacuated: Tracer Probe Used to Locate Leak

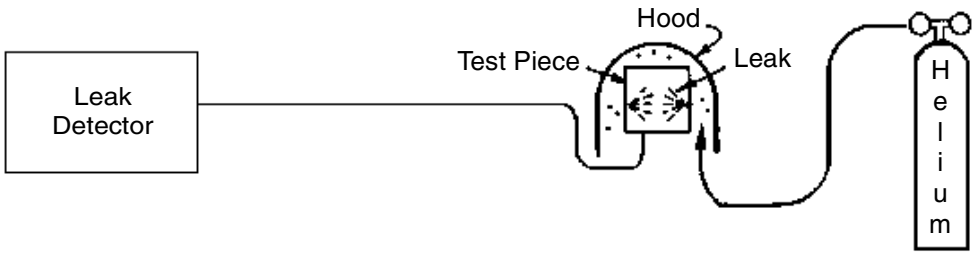


Figure C-1b Test Piece Evacuated and Hooded with Helium Atmosphere to Determine Overall Leak Rate

C.6.2 Test Piece Pressurized (Figure C-2)

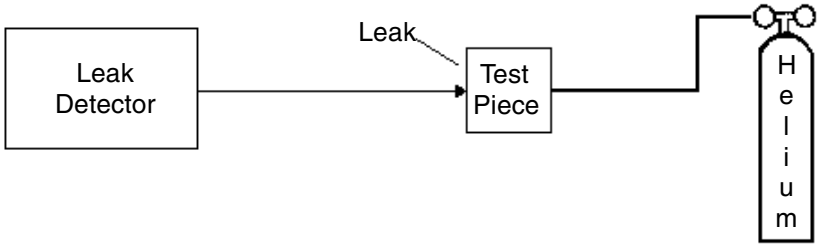


Figure C-2 Test Piece Pressurized: Detector Probe Used to Locate Leak

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.

C.6.3 Test Piece Already Sealed (Figure C-3)

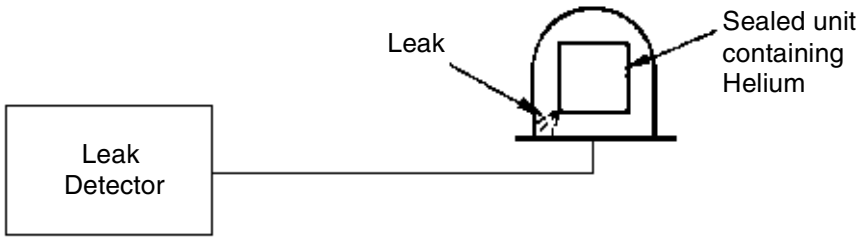


Figure C-3 Test Piece Sealed with Helium or Mixture of Helium and Other Gases: Bell Jar Used to Determine Overall Leak Rate

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.

C.7 Mass Spectrometer Leak Detector—Simplified Description

Each Model 979 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 C-4).

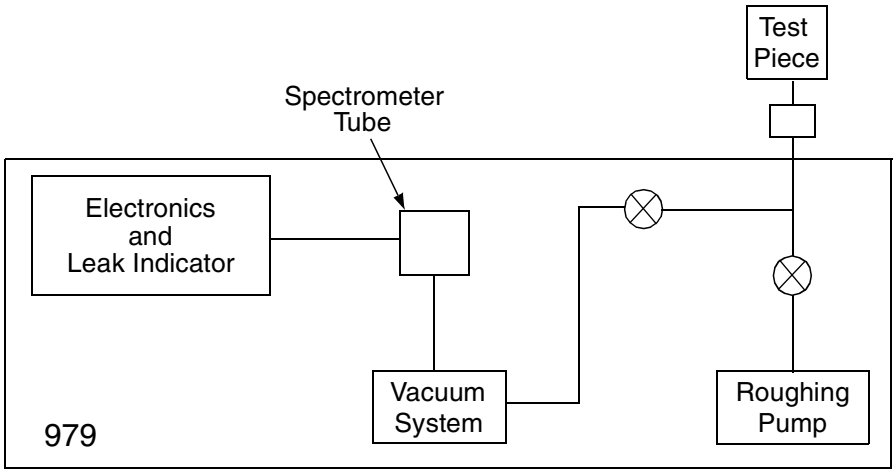


Figure C-4 Mass Spectrometer Leak Detector

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 C-5). 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.

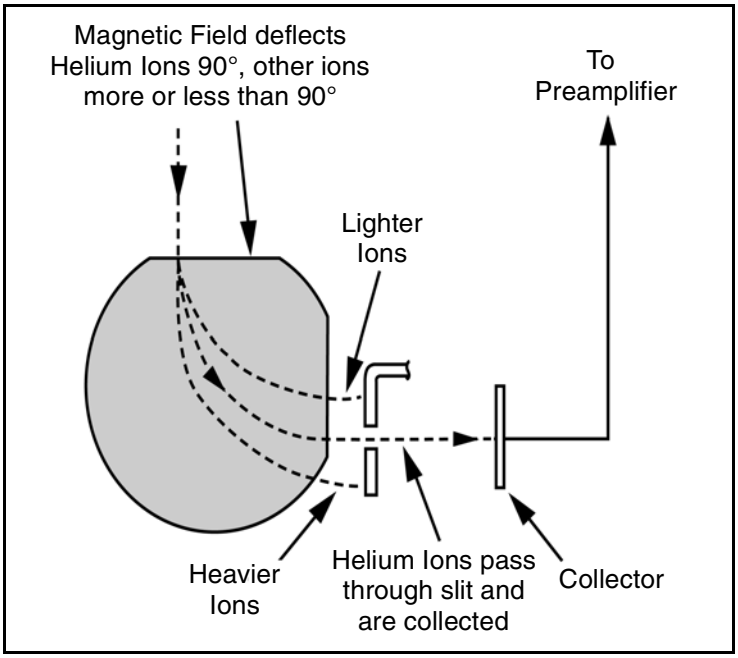


Figure C-5 Magnetic Separation Principle

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