Agilent 5975T LTM GC/MSD

Troubleshooting and Maintenance Guide

Agilent Technologies

Notices

Manual Part Number

G4360-90008

Edition

First edition, December 2010

Printed in USA

Agilent Technologies, Inc.
5301 Stevens Creek Boulevard
Santa Clara, CA 95052

Warranty

The material contained in this document is provided "as is," and is subject to being changed, without notice, in future editions. Further, to the maximum extent permitted by applicable law, Agilent disclaims all warranties, either express or implied, with regard to this manual and any information contained herein, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Agilent shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein. Should Agilent and the user have a separate written agreement with warranty terms covering the material in this document that conflict with these terms, the warranty terms in the separate agreement shall control.

Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Contents

1
Introduction

This manual describes the troubleshooting and maintenance of the Agilent Technologies 5975T LTM GC/MSD. It assumes familiarity with the procedures and information detailed in the *5975T LTM GC/MSD Operation Manual* and with the Agilent MSD ChemStation software.

Overview

The 5975T LTM GC/MSD is a stand-alone instrument combining a GC and an MSD (Table 1). The instrument features:

- LTM GC column with rapid heating and cooling capabilities
- Two capillary guard columns to minimize contamination of the LTM column
- Local Control Panel (LCP) for locally monitoring the instrument
- Choice of foreline pump - rotary vane (wet), scroll (dry), or diaphragm (dry)
- Heated electron-ionization ion source
- Heated hyperbolic quadrupole mass filter
- High-energy dynode (HED) electron multiplier detector
- Heated GC/MSD interface
- ChemStation control for operating the GC/MSD

Physical description

The 5975T LTM GC/MSD is a rectangular box, approximately 41 cm high, 60 cm wide, and 54 cm deep. The weight is 46.5 kg for the mainframe. The attached foreline (roughing) pump weighs an additional 15 kg (standard pump) for wet and 4.5 kg for dry.

The basic components of the instrument are: the frame/cover assemblies, the local control panel, the vacuum system, the EPC, the GC/MSD interface, the split/splitless inlet, the LTM column module, the electronics, and the analyzer.

Local control panel

The local control panel displays the status of the instrument, displays error messages, and allows setting and display of some instrument parameters for the Agilent 5975T LTM GC/MSD. These parameters are normally controlled using the Agilent ChemStation.

Vacuum gauge

The 5975T LTM GC/MSD may be equipped with an optional external vacuum gauge. Installation of the gauge controller is described in this manual. Operation of the vacuum gauge is described in the *5975T LTM GC/MSD Operation Manual.*

Table 1 5975T LTM GC/MSD model and features

Model	**G3880A**
Feature	
High vacuum pump	Standard turbo
Optimal He column flow mL/min	1.2
Maximum recommended gas flow mL/min*	2.0
Maximum gas flow, mL/min†	2.4
Max column id	0.32 mm (30 m)

* Total gas flow into the MSD: column flow.
† Expect degradation of spectral performance and sensitivity.

Hardware Description

Figure 1 is an overview of a typical 5975T LTM GC/MSD system.

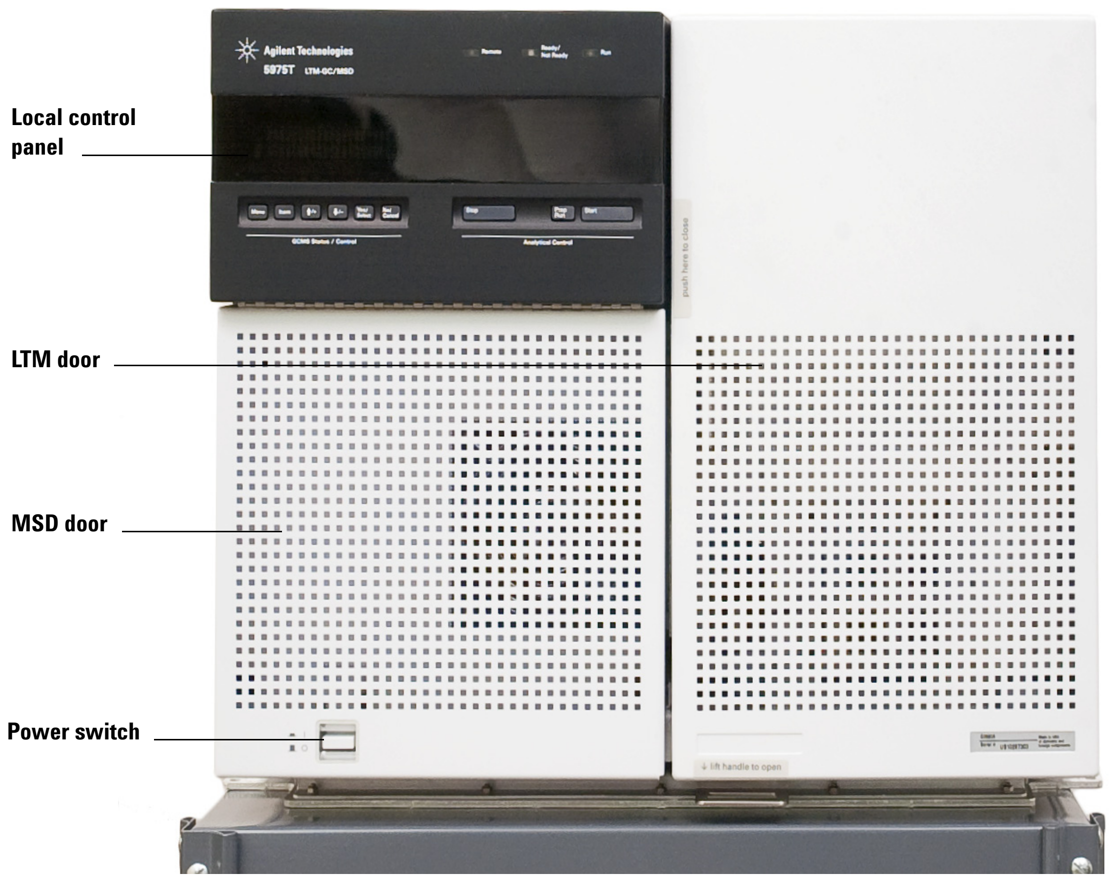


Figure 1 5975T LTM GC/MSD system

Electron Ionization (EI) systems

EI systems ionize sample molecules by bombarding them with electrons. The ions, including fragments, are drawn into the quadrupole analyzer where they are separated by their mass-to-charge (*m/z*) ratios and detected.

Abbreviations Used

The abbreviations in Table 2 are used in discussing this product. They are collected here for convenience.

Table 2 Abbreviations

Abbreviation	Definition
AC	Alternating current
ALS	Automatic liquid sampler
BFB	Bromofluorobenzene (calibrant)
CFT	Capillary flow technology
DC	Direct current
DFTPP	Decafluorotriphenylphosphine (calibrant)
DIP	Direct insertion probe
EI	Electron impact ionization
EM	Electron multiplier (detector)
EMV	Electron multiplier voltage
EPC	Electronic pneumatic control
eV	Electron volt
GC	Gas chromatograph
HED	High-energy dynode (refers to detector and its power supply)
id	Inside diameter
LAN	Local area network
LCP	Local control panel (on the MSD)
LTM	Low thermal mass
m/z	Mass to charge ratio
MFC	Mass flow controller
MSD	Mass selective detector
OFN	Octafluoronaphthalene (calibrant)
PFHT	2,4,6-tris(perfluoroheptyl)-1,3,5-triazine (calibrant)
PFTBA	Perfluorotributylamine (calibrant)
Quad	Quadrupole mass filter
RF	Radio frequency

Table 2 Abbreviations (continued)

Abbreviation	Definition
RFPA	Radio frequency power amplifier
Torr	Unit of pressure, 1 mm Hg
Turbo	Turbomolecular (pump)

Important Safety Warnings

There are several important safety notices to always keep in mind when using the GC/MSD.

Many internal parts of the GC/MSD carry dangerous voltages

If the GC/MSD is connected to a power source, even if the power switch is off, potentially dangerous voltages exist on:

- The wiring between the GC/MSD power cord and the AC power supply, the AC power supply itself, and the wiring from the AC power supply to the power switch.

With the power switch on, potentially dangerous voltages also exist on:

- All electronics boards in the instrument.
- The internal wires and cables connected to these boards.
- The wires for any heater (oven, detector, or inlet).

WARNING **All these parts are shielded by covers. With the covers in place, it should be difficult to accidentally make contact with dangerous voltages. Unless specifically instructed to, never remove a cover unless the detector, inlet, or oven are turned off.**

WARNING **If the power cord insulation is frayed or worn, the cord must be replaced. Contact your Agilent service representative.**

Electrostatic discharge is a threat to GC/MSD electronics

The printed circuit boards in the GC/MSD can be damaged by electrostatic discharge. Do not touch any of the boards unless it is absolutely necessary. If you must handle them, wear a grounded wrist strap and take other antistatic precautions. Wear a grounded wrist strap any time you must remove the instrument side covers.

Many parts are dangerously hot

Many parts of the GC/MSD operate at temperatures high enough to cause serious burns. These parts include but are not limited to:

- The inlet

- The guard column heated zone and its contents
- The guard column nuts attaching the guard columns to the inlet, LTM column, and MSD.
- The foreline pump

Always cool these areas of the system to room temperature before working on them. If you must perform maintenance on hot parts, use a wrench and wear gloves. Whenever possible, cool the part of the instrument that you will be maintaining before you begin working on it.

WARNING **The insulation around the inlets, detectors, valve box, and the insulation cups is made of refractory ceramic fibers. To avoid inhaling fiber particles, we recommend the following safety procedures: ventilate your work area; wear long sleeves, gloves, safety glasses, and a disposable dust/mist respirator; dispose of insulation in a sealed plastic bag; wash your hands with mild soap and cold water after handling the insulation.**

The oil pan under the standard foreline pump can be a fire hazard

Oily rags, paper towels, and similar absorbents in the oil pan could ignite and damage the pump and other parts of the MSD.

WARNING **Combustible materials (or flammable/non-flammable wicking material) placed under, over, or around the foreline (roughing) pump constitutes a fire hazard. Keep the pan clean, but do not leave absorbent material such as paper towels in it.**

Hydrogen Safety

WARNING **The use of hydrogen as a carrier gas is potentially dangerous.**

WARNING **When using hydrogen (H_2) as the carrier gas or fuel gas, be aware that hydrogen gas can flow into the guard column heated zone and create an explosion hazard. Therefore, be sure that the supply is turned off until all connections are made and ensure that the inlet, MSD, and column fittings are either connected to a column or capped at all times when hydrogen gas is supplied to the instrument.**

Hydrogen is flammable. Leaks, when confined in an enclosed space, may create a fire or explosion hazard. In any application using hydrogen, leak test all connections, lines, and valves before operating the instrument. Always turn off the hydrogen supply at its source before working on the instrument.

Hydrogen is a commonly used GC carrier gas. Hydrogen is potentially explosive and has other dangerous characteristics.

- Hydrogen is combustible over a wide range of concentrations. At atmospheric pressure, hydrogen is combustible at concentrations from 4% to 74.2% by volume.
- Hydrogen has the highest burning velocity of any gas.
- Hydrogen has a very low ignition energy.
- Hydrogen that is allowed to expand rapidly from high pressure can self-ignite.
- Hydrogen burns with a nonluminous flame which can be invisible under bright light.

Dangers unique to GC/MSD operation

Hydrogen presents a number of dangers. Some are general, others are unique to GC or GC/MSD operation. Dangers include, but are not limited to:

- Combustion of leaking hydrogen.
- Combustion due to rapid expansion of hydrogen from a high-pressure cylinder.
- Accumulation of hydrogen in the guard column heated zone and subsequent combustion.
- Accumulation of hydrogen in the MSD and subsequent combustion.

Hydrogen accumulation in a GC/MSD

WARNING **The instrument cannot detect leaks in inlet and/or detector gas streams. For this reason, it is vital that column fittings should always be either connected to a column or have a cap or plug installed.**

All users should be aware of the mechanisms by which hydrogen can accumulate (Table 3) and know what precautions to take if they know or suspect that hydrogen has accumulated. Note that these mechanisms apply to *all* mass spectrometers, including the GC/MSD.

Table 3 Hydrogen accumulation mechanisms

Mechanism	Results
Mass spectrometer turned off	A mass spectrometer can be shut down deliberately. It can also be shut down accidentally by an internal or external failure. A mass spectrometer shutdown does not shut off the flow of carrier gas. As a result, hydrogen may slowly accumulate in the mass spectrometer.

Table 3 Hydrogen accumulation mechanisms (continued)

Mechanism	Results
Mass spectrometer manual shutoff valves closed	Some mass spectrometers are equipped with manual foreline pump shutoff valves. In these instruments, the operator can close the shutoff valves. Closing the shutoff valves does not shut off the flow of carrier gas. As a result, hydrogen may slowly accumulate in the mass spectrometer.

WARNING **Once hydrogen has accumulated in a mass spectrometer, extreme caution must be used when removing it. Incorrect startup of a mass spectrometer filled with hydrogen can cause an explosion.**

WARNING **After a power failure, the mass spectrometer may start up and begin the pumpdown process by itself. This does not guarantee that all hydrogen has been removed from the system or that the explosion hazard has been removed.**

Precautions

Take the following precautions when operating a GC/MSD system with hydrogen carrier gas.

Equipment precaution

You MUST make sure the front side-plate thumbscrew is fastened finger-tight. Do not overtighten the thumbscrew; it can cause air leaks.

WARNING **Failure to secure your MSD as described above greatly increases the chance of personal injury in the event of an explosion.**

General laboratory precautions

- Avoid leaks in the carrier gas lines. Use leak-checking equipment to periodically check for hydrogen leaks.

- Eliminate from your laboratory as many ignition sources as possible (open flames, devices that can spark, sources of static electricity, etc.).
- Do not allow hydrogen from a high pressure cylinder to vent directly to atmosphere (danger of self-ignition).
- Use a hydrogen generator instead of bottled hydrogen.

Operating precautions

- Turn off the hydrogen at its source every time you shut down the instrument.
- Turn off the hydrogen at its source every time you vent the MSD (do not heat the capillary column without carrier gas flow).
- Turn off the hydrogen at its source every time shutoff valves in an MSD are closed (do not heat the capillary column without carrier gas flow).
- Turn off the hydrogen at its source if a power failure occurs.
- If a power failure occurs while the GC/MSD system is unattended, even if the system has restarted by itself:
  1. Immediately turn off the hydrogen at its source.
  2. Turn off the instrument and allow it to cool for 1 hour.
  3. Eliminate **all** potential sources of ignition in the room.
  4. Open the vacuum manifold to atmosphere.
  5. Wait at least 10 minutes to allow any hydrogen to dissipate.
  6. Start up the instrument as normal.

When using hydrogen gas, check the system for leaks to prevent possible fire and explosion hazards based on local Environmental Health and Safety (EHS) requirements. Always check for leaks after changing a tank or servicing the gas lines. Always make sure the vent line is vented into a fume hood.

Safety and Regulatory Certifications

The 5975T LTM GC/MSD conforms to the following safety standards:

- Canadian Standards Association (CSA): CAN/CSA-C222 No. 61010-1-04
- CSA/Nationally Recognized Test Laboratory (NRTL): UL 61010–1
- International Electrotechnical Commission (IEC): 61010–1
- EuroNorm (EN): 61010–1

The 5975T LTM GC/MSD conforms to the following regulations on Electromagnetic Compatibility (EMC) and Radio Frequency Interference (RFI):

- CISPR 11/EN 55011: Group 1, Class A
- IEC/EN 61326
- AUS/NZ

This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB—001 du Canada.

The 5975T LTM GC/MSD is designed and manufactured under a quality system registered to ISO 9001.

Information

The Agilent Technologies 5975T LTM GC/MSD meets the following IEC (International Electro-technical Commission) classifications: Equipment Class I, Laboratory Equipment, Installation Category II, Pollution Degree 2.

This unit has been designed and tested in accordance with recognized safety standards and is designed for use indoors. If the instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired. Whenever the safety protection of the instrument has been compromised, disconnect the unit from all power sources and secure the unit against unintended operation.

Refer servicing to qualified service personnel. Substituting parts or performing any unauthorized modification to the instrument may result in a safety hazard.

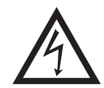
Symbols

Warnings in the manual or on the instrument must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions violates safety standards of design and the intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

See accompanying instructions for more information.

Indicates a hot surface.

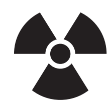
Indicates hazardous voltages.



Indicates earth (ground) terminal.

Indicates potential explosion hazard.

Indicates radioactivity hazard.



Indicates electrostatic discharge hazard.

Indicates that you must not discard this electrical/electronic product in domestic household waste.

Electromagnetic compatibility

This device complies with the requirements of CISPR 11. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try one or more of the following measures:

1 Relocate the radio or antenna.
2 Move the device away from the radio or television.
3 Plug the device into a different electrical outlet, so that the device and the radio or television are on separate electrical circuits.
4 Make sure that all peripheral devices are also certified.
5 Make sure that appropriate cables are used to connect the device to peripheral equipment.
6 Consult your equipment dealer, Agilent Technologies, or an experienced technician for assistance.
7 Changes or modifications not expressly approved by Agilent Technologies could void the user's authority to operate the equipment.

Sound emission declaration

Sound pressure

Sound pressure Lp <70 dB according to EN 27779:1991.

Schalldruckpegel

Schalldruckpegel LP <70 dB am nach EN 27779:1991.

Cleaning/Recycling the Product

To clean the unit, disconnect the power and wipe down with a damp, lint-free cloth. For recycling, contact your local Agilent sales office.

Liquid Spillage

Do not spill liquids on the instrument.

Moving or Storing the GC/MSD

The best way to keep your GC/MSD functioning properly is to keep it pumped down and hot, with carrier gas flow. If you plan to move or store your instrument, a few additional precautions are required. The instrument must remain upright at all times; this requires special caution when moving. The MSD should not be left vented to atmosphere for long periods.

2
Concepts and General Tasks

This chapter tells you how to identify the symptoms and causes of problems in your GC/MSD.

This is a quick reference to symptoms and possible causes of the most common problems experienced by users. For each symptom, one or more possible causes are listed. In general, the causes listed first are the most likely causes or the easiest to check and correct.

NOTE

This chapter does not include corrective actions for the possible causes listed. Some of the corrective actions required may be dangerous if performed incorrectly. Do not attempt any corrective actions unless you are sure you know the correct procedure and the dangers involved. See the Troubleshooting section in the online help and the other chapters in this manual for more information.

If the material in this chapter and in the online help proves insufficient to help you diagnose a problem, contact your Agilent Technologies service representative.

Troubleshooting Tips and Tricks

Rule 1: "Look for what has been changed."

Many problems are introduced accidentally by human actions. Every time any system is disturbed, there is a chance of introducing a new problem.

- If the MSD was just pumped down after maintenance, suspect air leaks or incorrect assembly.
- If carrier gas or helium gas purifier were just changed, suspect leaks or contaminated or incorrect gas.
- If the LTM column was just replaced, suspect air leaks or contaminated or bleeding column.

Rule 2: "If complex isn't working, go back to simple."

A complex task is not only more difficult to perform but also more difficult to troubleshoot. If you're having trouble detecting your sample, verify that autotune is successful.

Rule 3: "Divide and conquer."

This technique is known as "half-split" troubleshooting. If you can isolate the problem to only part of the system, it is much easier to locate.

To determine whether an air leak is in the GC or the MSD, you can vent the MSD, remove the column, and install the blank interface ferrule. If the leak goes away, it was in the GC.

Concepts

This manual provides lists of symptoms and corresponding tasks to perform should you experience errors associated with hardware or chromatographic output, Not Ready messages, and other common issues.

Each section describes a problem and provides a bulleted list of possible causes for you to troubleshoot. These lists are not intended for use in the development of new methods. Proceed with troubleshooting under the assumption that method(s) are working properly.

This manual also includes common troubleshooting tasks as well as information needed prior to calling Agilent for service.

How to troubleshoot using this manual

Use the following steps as a general approach to troubleshooting:

1. Observe the symptoms of the problem.
2. Look up the symptoms in this manual using the Table of Contents or the Search tool. Review the list of possible causes of the symptom.
3. Check each possible cause or perform a test that narrows the list of possible causes until the symptom is resolved.

Configurable Items to Always Keep Current

Certain configurable items in the GC must always be kept current. Failure to do so will lead to reduced sensitivity, chromatographic errors, and possible safety concerns.

Column configuration

Reconfigure the instrument every time a LTM column is trimmed or changed. Also verify that the data system reflects the correct column type, length, id, and film thickness. The instrument relies on this information to calculate flows. Not updating the instrument after altering a column causes incorrect flows, changed or incorrect split ratios, retention time changes, and peak shifts.

Automatic Liquid Sampler configuration

Keep the Automatic Liquid Sampler (ALS) configuration up-to-date to ensure proper operation. ALS items to keep current include injector position, installed syringe size, and solvent and waste bottle usage.

Gas configuration

WARNING **Always configure the GC appropriately when working with hydrogen. Hydrogen leaks quickly and poses a safety concern if too much of it is released into the air or into the GC oven.**

Reconfigure the GC every time the gas type is changed. If the GC is configured to a gas other than what is actually being plumbed, incorrect flow rates will result.

Information to Obtain Before Calling Agilent for Service

Gather the following information before contacting Agilent for service:

- Symptoms
- Problem description
- Hardware installed and parameters/configuration when the error occurred (sample, supply gas type, gas flow rates, detectors/inlets installed, and so forth)
- Any messages that appear on the display
- Results of any troubleshooting tests you have run
- Instrument details. Obtain the following information:
    - Instrument serial number
    - GC firmware revision (on the LCP press [Menu], [Version], then [Items])
    - GC power configuration
    - Key status should be OK after validation
- Updates from LCP, if necessary

To obtain service/support contact numbers, see the Agilent Web site at www.agilent.com/chem.

3
Chromatographic Symptoms

Chromatographic Symptoms

These are symptoms you may observe in the chromatograms generated by data acquisition. In general, these symptoms do not prevent you from operating your GC/MSD system. They indicate, however, that the data you are acquiring may not be the best data obtainable. These symptoms can be caused by instrument malfunctions but are more likely caused by incorrect chromatographic technique.

Two of the symptoms: *If sensitivity is low* and *If repeatability is poor*, also apply to mass spectral data.

Retention Times Not Repeatable

- Replace the septum. (See the *5975T LTM GC/MSD Operation Manual.*)
- Check for leaks in the inlet, liner (as applicable), and column connection. (See “Checking for Leaks” on page 99.)
- Check for sufficient carrier gas supply pressure. The pressure delivered to the instrument must be at least 40 kPa (10 psi) greater than the maximum inlet pressure required at final LTM column temperature.
- Run replicates of known standards to verify the problem.
- Verify that you are using the correct liner type for the sample being injected.
- Consider if this is the first run. (Has the instrument stabilized?)

Peak Areas Not Repeatable

Check the ALS syringe operation. (See the Troubleshooting section of the *7683 Automatic Liquid Sampler Installation, Operation and Maintenance* manual.)

- Replace the syringe.
- Check for leaks in the inlet, liner (as applicable), and column connection. (See "Checking for Leaks" on page 99.)
- Check sample level in vials.
- Run replicates of known standards to verify the problem.
- Consider if this is the first run. (Has the instrument stabilized?)

Poor repeatability

- Dirty syringe needle
- Dirty GC inlet
- Leaking GC inlet*
- Injection is too large
- Loose column connections
- Variations in pressure, column flow, and temperature
- Dirty ion source
- Loose connections in the analyzer
- Ground loops

* This could cause a fault condition in the GC that would prevent the GC from operating.

Contamination or Carryover

If your output has contamination or unexpected peaks, do the following:

Isolate the source

1. Perform a solvent blank run using a new, pure source of solvent. If the contamination disappears, the problem may be either in the sample or solvent-related.
2. Perform a blank run (remove the syringe from the injector and start a run). If the contamination disappears, the problem is in the syringe.
3. Remove the column from the detector and cap the detector fitting. Perform another blank run. If the contamination disappears, the problem is in the inlet or column. If the contamination remains, the problem is in the detector.

Check possible causes—all inlet and detector combinations

- Check the septum type and installation.
- Perform complete inlet maintenance: Replace all consumable parts and bake out the inlet.
- Perform column maintenance: Bake out contaminants, replace the inlet section of the guard column, and reverse and bake out the column as needed.
- Check for sample carryover from previous runs. Make several no-injection blank runs and see if the ghost peaks go away or get smaller.
- Check the septum purge flow. If it is too low, the septum may have collected contamination or condensate may be clogged in the purge line.
- Check all gas trap indicators and dates.
- Verify the gas purity. Check for supply tubing and fitting contamination.
- Verify that the LTM column program temperature and time are sufficient for the samples being injected.
- Check the solvent level in the ALS wash bottles.
- Replace the ALS syringe if necessary.
- Check the sample injection volume.

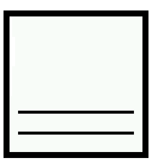
Larger Peaks Than Expected

- Check each configured column's dimensions against the actual column dimensions. (See "Configurable Items to Always Keep Current" on page 30.)
- Check the autosampler injection volume.
- Check the vial caps.
- Check configured syringe size. Some syringe sizes are specified at half-capacity. If the maximum syringe volume is marked at half-height on the barrel, not at the top of the barrel, enter **twice** the labeled volume when configuring the syringe size.

Peaks Not Displayed/No Peaks

- If using an autosampler:
  - Ensure that there is sample in the vial.
  - Verify that the ALS plunger carriage is secured to the syringe plunger.
  - Check that the syringe is installed correctly and draws sample.
  - Verify that the turret is loaded correctly and injections are not from out-of-sequence vials.
  - Watch to see that the sample is pulled into the syringe.
- Check the column for proper installation.
- Ensure that the column is not plugged. Perform column maintenance.
- Check for leaks. (See “Checking for Leaks” on page 99.)

No peaks



If an analysis shows no chromatographic peaks, only a flat baseline or minor noise, run one of the automated tune programs. If the MSD passes tune, the problem is most likely related to the GC. If the MSD does not pass tune, the problem is most likely in the MSD.

Passes tune

- Incorrect sample concentration
- No analytes present
- Syringe missing from the ALS or not installed correctly
- Injection accidentally made in split mode instead of splitless mode
- Empty or almost empty sample vial
- Dirty GC inlet
- Leaking GC inlet*
- Loose column nut at the GC inlet*

* These could cause a fault condition in the GC that would prevent the GC from operating.

Does not pass tune

- Calibration vial is empty

- Excessive foreline or analyzer chamber pressure
- Very dirty ion source
- Calibration valve is not working correctly
- Bad signal cable connection
- Filament has failed or is not connected correctly
- Bad ion source wiring connection
- Bad detector wiring connection
- Failed electron multiplier horn

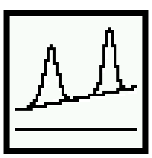
Low Boiler Peaks Present/High Boiler Peaks are Missing

- Cold spot at the point where the LTM transfer line touches the LTM column toroid.

Baseline Rise During LTM Column Temperature Program

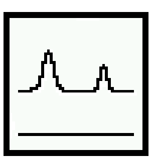
- Inspect the column for bleed.
- Check for leaks/oxygen in carrier gas supply.
- Check gas supply oxygen trap indicator or date.
- Make solvent blank runs to evaluate baseline without sample.
- Make "no injection" blank runs (remove the syringe from the injector and start a run) to evaluate baseline without solvent.
- Check for contamination. (See "Contamination or Carryover" on page 37.)
- Consider the effect of column film thickness on bleed.
- Check for leaks at the column fittings. (See "Checking for Leaks" on page 99.)
- Prepare and use a column compensation profile.

Baseline is rising



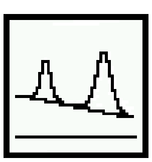
- Column bleed
- Other contamination

Baseline is high



- Column bleed
- Other contamination
- Electron multiplier voltage is too high

Baseline is falling

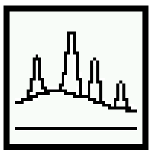


A falling baseline indicates contamination is being swept away. Wait until the baseline reaches an acceptable level. Common causes include:

- Residual water air and water from a recent venting
- Column bleed
- Septum bleed

- Splitless injection time too long (inlet is not properly swept, resulting in excess solvent on the column and slow solvent decay)

Baseline wanders



- Insufficient carrier gas supply pressure*
- Malfunctioning flow or pressure regulator*
- Intermittent leak in the GC inlet*

* These could cause a fault condition in the GC that would prevent the GC from operating.

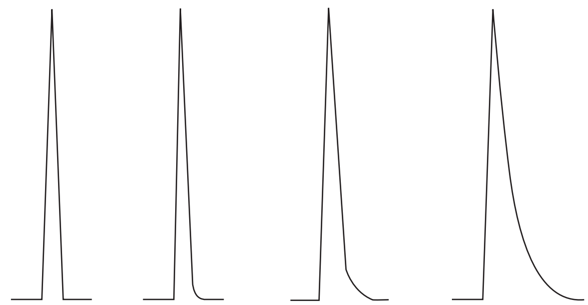
Poor Peak Resolution

- Set column flow to optimum linear velocity.
- Install and use deactivated consumable parts in the inlet (for example, a liner).
- Perform column maintenance: Bake out contaminants, replace the inlet guard column, and reverse and bake out the column as needed.
- Check column installation at both ends.
- Select a higher resolution column.

Peak Tailing

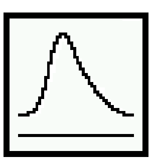
The figure below shows an example of tailing peaks. When troubleshooting tailing peaks, consider:

- Which peaks are tailing?
- Are the tailing peaks active compounds, all compounds, or are there trends (such as early eluters or late eluters)?



- Check the column for severe contamination.
- Consider the column stationary phase (active column).
- Verify that the column was cut and installed properly.
- Consider the type of adapter, liner, and inlet seal being used. One or all of these may be contaminated or active.
- Check adapters (if installed) and liner for solid particles.
- For splitless injection, consider compatibility between the solvent and column.
- Verify that the injection technique is adequate.
- Verify the inlet temperature.
- Check for dead volume in the system. Check for correct column installation at both ends.
- Inspect any transfer lines for cold spots.

Peaks are tailing



- Active sites in the sample path
- Injection is too large
- Incorrect GC inlet temperature
- Insufficient column flow
- GC/MSD interface temperature is too low
- Ion source temperature is too low

Peak Boiling Point or Molecular Weight Discrimination Poor

If you have trouble with peak boiling point or molecular weight discrimination (inlet discrimination), do the following:

- Check the inlet for contamination. Clean and change the liner if necessary. Replace all inlet consumable parts.
- Adjust the inlet temperature.
- Run standards against a known method to determine expected performance.

For any inlet operating in split mode

- Check liner type.
- Increase the inlet temperature and verify that the insulation cup is installed and contains insulation.
- Check column cut and installation into the inlet.

For any inlet operating in splitless mode

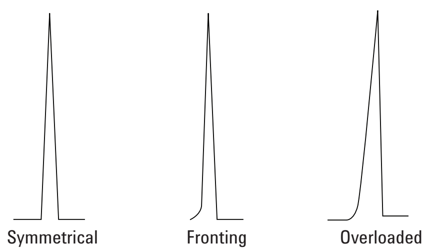
- Check the inlet for leaks. (See “Checking for Leaks” on page 99.)
- Check liner type.
- Verify that the LTM column starting temperature is less than the solvent boiling point.
- Check column cut and installation into the inlet.
- Check that the solvent vapor volume does not exceed the liner capacity.
- Check for appropriate purge delay time.

Sample Decomposition in Inlet/Missing Peaks

- Lower the inlet temperature.
- Check for air or water in the carrier gas; verify gas purity and functionality of traps.
- Verify that the liner is appropriate for the sample being run.
- Perform complete inlet maintenance: Replace all consumable parts and bake out the inlet.
- Install a deactivated liner.
- Check for leaks at the septum, liner, and column fittings. (See “Checking for Leaks” on page 99.)
- Install an Agilent Direct Connect liner.
- Use a pulsed pressure method for quicker sample transfer to column.
- Bake out the inlet.

Peak Fronting

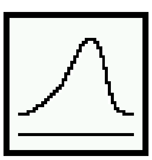
The figure below shows examples of the three types of peaks: symmetric, fronting, and overloaded.



If peak fronting or overloading occurs, try the following:

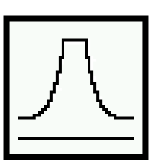
- Verify that the injection volume is appropriate.
- Ensure that the column is installed properly.
- Verify that the appropriate injection technique is being used.
- If using capillary splitless injection, consider the compound solubility in the injection solvent. Try changing the solvent.
- Check purity of sample solvent.

Peaks are fronting



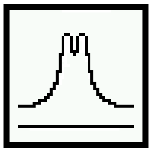
- Column film thickness mismatched with analyte concentration (column overload)
- Initial column temperature is too low
- Active sites in the sample path
- Injection is too large
- GC inlet pressure too high
- Insufficient column flow

Peaks have flat tops



- Insufficient solvent delay
- Incorrect scale on the display
- Injection is too large
- Electron multiplier voltage is too high

Peaks have split tops

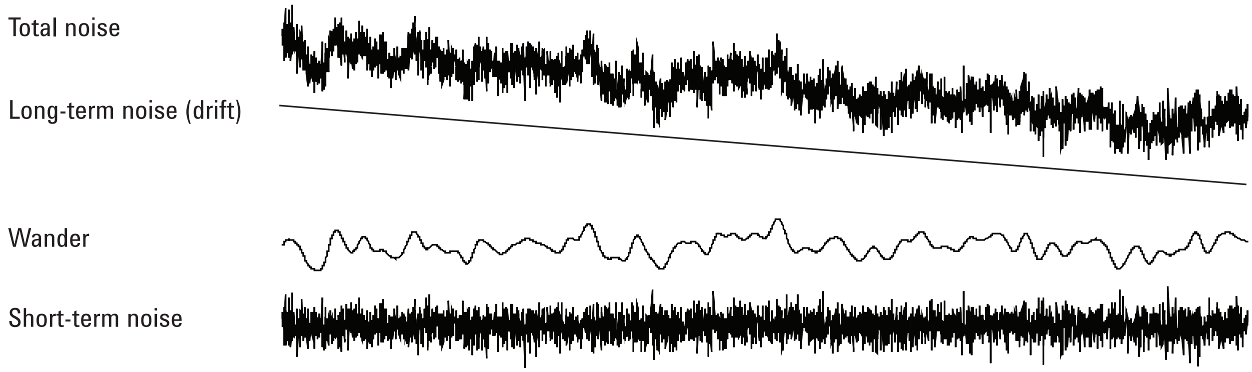


- Bad injection technique
- Injection is too large

Noisy Signal, Including Wander, Drift, and Baseline Spikes

Noise should be measured under “normal” operating conditions, with a column connected and carrier gas on. Noise typically has a high frequency component (electronic in origin) and lower frequency components that are referred to as wander and drift.

Wander is random in direction but at a lower frequency than the short-term electronic noise. Long-term noise (drift) is a monotonic change in signal over a period that is long compared to the wander and electronic noise (see below). Terms like “short” and “long” are relative to the width of the chromatographic peaks.



Noisy baseline

A noisy baseline or high detector output can indicate leaks, contamination, or electrical problems. Some noise is inevitable with any detector, although high attenuations can mask it. Since noise limits useful detector sensitivity, it should be minimized.

- For all detectors, check for leaks at the column fittings. (See “Checking for Leaks” on page 99.)

If noise appears suddenly on a previously clean baseline, do the following:

- Consider recent changes made to the system.
- Bakeout the inlet. See the *5975T LTM GC/MSD Operation Manual* for this procedure.
- Verify the purity of carrier gases.
- Verify proper reassembly after recent maintenance.
- Inspect the ion source for contamination.

If noise increases gradually to an unacceptable level, check the following possible causes:

- Inspect the ion source for contamination.
- Inspect the column and inlet for contamination.

Other factors that can contribute to noise:

- Column installed too high into detector.
- Oven temperature exceeds column maximum recommended temperatures.

Baseline wander and drift

Baseline wander or drift can occur when a flow or temperature setting is changed. If the system has not stabilized at the new conditions before it starts a run, some baseline changes are to be expected.

If experiencing baseline wander, check for leaks, especially at the septum and at the column. (See "Checking for Leaks" on page 99.) Baseline drift is most often seen during temperature programming. To correct baseline drift, do the following:

- Verify that column compensation is used and the profile is current. (To compensate for bleed.)
- Verify that the column is conditioned.
- Check column bleed while at operating temperature.
- Check the signal mode assigned to the column in the data system.

Baseline spiking

There are two types of spiking on the baseline output: cyclic and random.

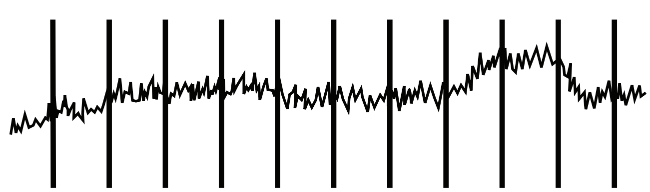


Figure 2 Cyclic spiking

Cyclic spiking can be caused by the following:

- An electric motor

- Building heating/cooling system
- Other electronic interferences in the lab

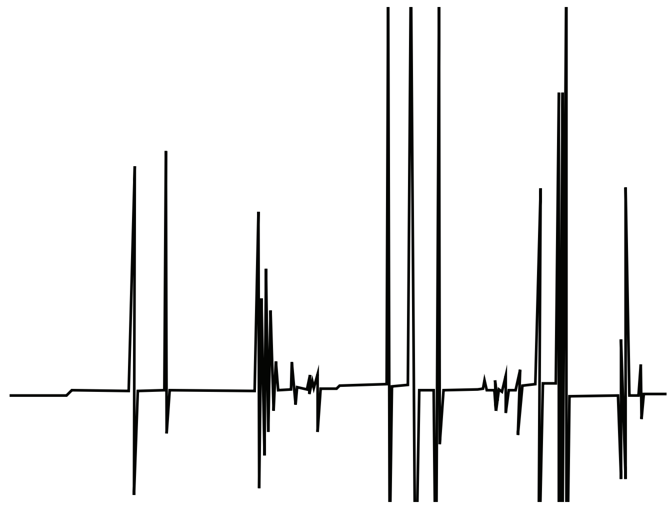
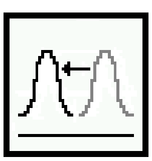


Figure 3 Random spiking

Spikes are isolated baseline disturbances, usually appearing as sudden (and large) upscale movements. If accompanied by noise, resolve the noise problem first since spiking may disappear at the same time.

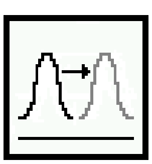
- Check for a contaminated ion source.
- Check for the correct jet.

Retention times for all peaks drift – shorter



- Column has been shortened
- Initial column temperature was increased
- Column is getting old

Retention times for all peaks drift – longer



- Column flow has been reduced
- Initial column temperature was decreased
- Active sites in the sample path
- Leaks in the GC inlet*

* This could cause a fault condition in the GC that would prevent the GC from operating.

Poor sensitivity

- Incorrect tuning
- Tune file that does not match the type of analysis
- Repeller voltage is too low
- Incorrect temperatures (column, GC/MSD interface, ion source, or mass filter)
- Incorrect sample concentration
- Leaking GC inlet*
- Dirty GC inlet
- Incorrect split ratio
- Purge off time in splitless mode is too short
- Excessive pressure in the MSD
- Dirty ion source
- Air leak
- Poor filament operation
- Detector (HED electron multiplier) is not working correctly
- Incorrect mass filter polarity

* This could cause a fault condition in the GC that would prevent the GC from operating.

Low Peak Area or Height (Low Sensitivity)

- If using an inlet in split mode, check the split ratio.
- Check for leaks. (See "Checking for Leaks" on page 99.)
- Check the inlet for contamination. (See "Contamination or Carryover" on page 37.)
- Check each column and verify that it was cut and installed properly at each end.
- Verify that the column type is correct.
- Perform column maintenance: Bake out contaminants, replace the inlet guard column, and reverse and bake out the column as needed.
- Verify that the liner type is appropriate for the sample.
- Check the supply gas purity.
- Check all trap indicators and dates.
- Verify that the method parameters are correct.
- Check sample stability.
- Check configured syringe size. Some syringe sizes are specified at half-capacity. If the maximum syringe volume is marked at half-height on the barrel, not at the top of the barrel, enter **twice** the labeled volume when configuring the syringe size.

Mass Spectral Symptoms

This section describes symptoms you might observe in mass spectra. Some of these symptoms will appear in the mass spectra of samples. Others you will observe only in a tune report. Some of these symptoms have causes that can be corrected by the operator. Others, however, require service by an Agilent Technologies service representative.

Two symptoms listed under Chromatographic symptoms: *If sensitivity is poor* and *If repeatability is poor*, also apply to mass spectra.

No peaks

- Ion source cables not connected
- Bad connections to or from the detector
- HED power supply output cable has failed
- Other electronics failure

Isotopes are missing or isotope ratios are incorrect

- Peaks are too wide or too narrow
- Scan speed is too high (scan mode)
- Dwell time is too short (SIM mode)
- Electron multiplier voltage is too high
- Repeller voltage is too high
- High background
- Dirty ion source

High background

- Pressure in the analyzer chamber is too high
- Air leak
- Contamination

High abundances at *m/z* 18, 28, 32, and 44 or at *m/z* 14 and 16

- System was recently vented (residual air and water)
- Air leak. Large peaks at *m/z* 14 and 16 are symptomatic of especially large leaks.

Mass assignments are incorrect

Small shape changes at the top of the mass peaks can cause 0.1 *m/z* shifts in mass assignments. Shifts greater than 0.2 *m/z* indicate a possible malfunction.

- MSD has not had enough time to reach thermal equilibrium
- Large variations in the temperature of the laboratory
- MSD has not been tuned recently, or at the temperature at which it is operating
- Incorrect tune file (inappropriate parameters)

Peaks have precursors

The tune report lists the size of the precursors for the tune masses. Small precursors are not unusual. If the precursors are unacceptably large for your application, one of the following may be responsible:

- Repeller voltage is too high
- Peaks are too wide
- Incorrect DC polarity on the quadrupole mass filter
- Dirty quadrupole mass filter

Peak widths are inconsistent

- MSD has not had enough time to reach thermal equilibrium
- Large variations in the temperature of the laboratory
- Incorrect tuning
- Calibration vial empty or almost empty
- Calibration valve not working correctly
- Dirty ion source
- Electron multiplier is nearing the end of it useful lifetime
- Ground loop problems

Relative abundance of *m/z* 502 is less than 3%

Autotune should give an *m/z* 502 relative abundance greater than 3%. The relative abundance of *m/z* 502 can, however, vary a great deal depending on column flow, ion source temperature, and other variables. As long as relative abundance is above 3%, the stability of the relative abundance is more important than the absolute value. If you observe significant changes in the relative abundance of *m/z* 502 for a fixed set of operating parameters, there may be a problem. The charts in the MSD ChemStation software are useful for identifying changes. Select **View Tunes** from the **Checkout** menu in the **Instrument Control** view.

Low ***relative*** abundance of *m/z* 502 should not be confused with low ***absolute*** abundances at high masses. Sensitivity at high masses can be excellent even if the relative abundance of *m/z* 502 is near 3%. If your MSD produces low absolute abundances at high masses, refer to the symptom *High mass sensitivity is poor*.

Tune programs other than autotune have different relative abundance targets. The DFTPP and BFB target tune programs tune the MSD to achieve about a 0.8% ratio of *m/z* 502/69.

- Tune program/tune file has a different relative abundance target
  (3% only applies to Autotune)
- Not enough time for the MSD to warm up and pump down
- Analyzer chamber pressure is too high
- Ion source temperature is too high
- Column (carrier gas) flow is too high
- Poor filament operation
- Dirty ion source
- Air leak
- Incorrect DC polarity on the quadrupole mass filter

Spectra look different from those acquired with other MSDs

Ion ratios are different from those in older models MSDs. This is due to the HED detector, and is normal. To get spectra similar to older MSDs, use **Standard Spectra Tune**, available in the **Manual Tune** view. Note that this tune takes much longer to complete than **Autotune.**

High mass sensitivity is poor

This refers to a condition where the ***absolute*** abundance at the upper end of the mass range is poor. Absolute abundance should not be confused with the ***relative*** abundance (percentage) of *m/z* 502 to *m/z* 69. Sensitivity at high masses can be excellent even if the relative abundance of *m/z* 502 is low.

- Wrong tune program
- Wrong tune file

- Repeller voltage is too low
- Not enough time for the MSD to warm up and pump down
- Analyzer chamber pressure is too high
- Column (carrier gas) flow is too high
- Poor filament operation
- Dirty ion source
- Air leak
- Incorrect DC polarity on the quadrupole mass filter

Pressure Symptoms

This section describes unusual pressure readings and their possible causes. The symptoms in this section are based on typical pressures. At typical column flow rates (0.1 to 2.0 mL/minute), the foreline pressure will be approximately 20 to 100 m Torr. The analyzer chamber pressure will be approximately 1×10^{-6} to 1.4×10^{-4} Torr. These pressures can vary widely from instrument to instrument so it is very important that you are familiar with the pressures that are typical for your instrument at given carrier gas flows. Turbo pumps are controlled according to their speed and do not have foreline pressure gauges. The analyzer chamber pressures can only be measured if your system is equipped with the optional gauge controller.

Foreline pressure is too high

If the pressure you observe for a given column flow has increased over time, check the following:

- Column (carrier gas) flow is too high
- Air leak (usually the sideplate is not pushed in or vent valve is open)
- Foreline pump oil level is low or oil is contaminated (wet foreline pump)
- Foreline hose is constricted
- Foreline pump is not working correctly
- Foreline pump tip seal may need to be replaced (dry foreline pump)

Analyzer chamber pressure is too high (EI operation)

If the pressure you observe is above 1.0×10^{-4} Torr, or if the pressure you observe for a given column flow has increased over time, check the following:

- Column (carrier gas) flow is too high
- Air leak
- Foreline pump is not working correctly (see *Foreline pressure is too high*)
- Turbo pump is not working correctly

Foreline pressure is too low

If the pressures you observe are below 20 m Torr, check for the following:

- Column (carrier gas) flow is too low
- Column plugged or crushed by an overtightened nut
- Empty or insufficient carrier gas supply*
- Bent or pinched carrier gas tubing*
- Foreline gauge is not working correctly

* These could create a fault condition in the GC that would prevent the GC from operating.

Analyzer chamber pressure is too low

If the pressures you observe are below 1×10^{-6} Torr, check for the following:

- Column (carrier gas) flow is too low
- Column plugged or crushed by overtightened nut
- Empty or insufficient carrier gas supply*
- Bent or pinched carrier gas tubing*

* These could create a fault condition in the GC that would prevent the GC from operating.

Gauge controller displays 9.9+9 and then goes blank

This indicates the pressure in the analyzer chamber is above 8×10^{-3} Torr.

- Solvent peak from an on-column injection
- MSD has not had enough time to pump down
- Excessive foreline pressure
- Vacuum gauge has failed
- Line voltage too low
- Turbo pump is not working correctly

Power indicator on the gauge controller does not light

- Unplugged gauge controller power cord
- Incorrect or inadequate line voltage (24 V supply)
- Failed gauge controller fuse

Temperature Symptoms

The instrument has the following heated zones:

- Ion source (**Source** in the MSD ChemStation software)
- Mass filter (**Quad** in the MSD ChemStation software)
- GC/MSD interface **Thermal Aux #2** in the MSD ChemStation software
- LTM column module
- Heated guard column enclosure
- Inlet

Each heated zone has a heater and temperature sensor.

Ion source will not heat up

- High vacuum pump is off or has not reached normal operating conditions*
- Incorrect temperature setpoint
- Ion source has not had enough time to reach temperature setpoint
- Ion source heater cartridge is not connected*
- Ion source temperature sensor is not connected*
- Ion source heater failed (burned out or shorted to ground)*
- Ion source temperature sensor failed*
- Source power cable is not connected to the side board*
- MSD electronics are not working correctly

* These will cause an error message.

Mass filter (quad) heater will not heat up

- High vacuum pump is off or has not reached normal operating conditions*
- Incorrect temperature setpoint
- Mass filter has not had enough time to reach temperature setpoint
- Mass filter heater cartridge is not connected*
- Mass filter temperature sensor is not connected*
- Mass filter heater failed (burned out or shorted to ground)*
- Mass filter temperature sensor failed*

- Source power cable is not connected to the sideboard*
- MSD electronics are not working correctly

* These will cause an error message.

GC/MSD interface will not heat up

- Incorrect setpoint(s)
- Setpoint entered in wrong heated zone
- GC/MSD interface has not had enough time to reach temperature setpoint
- GC experienced a fault and needs to be reset*
- GC/MSD interface heater/sensor cable is not connected*
- GC/MSD heater failed (burned out)*
- GC/MSD sensor failed*
- Electronics are not working correctly*

* These will cause a GC error message. GC error messages are described in the documentation supplied with your GC.

Inlet will not heat up

- Incorrect setpoint
- Setpoint entered in wrong heated zone
- Inlet has not had enough time to reach temperature setpoint
- Inlet experienced a fault and needs to be reset
- Inlet heater/sensor cable is not connected
- Inlet heater failed (burned out)
- Inlet sensor failed
- Inlet electronics not working correctly

LTM column module will not heat up

- Incorrect setpoint
- Setpoint entered in wrong heated zone
- LTM heaters have not had enough time to reach temperature setpoint
- LTM heaters experienced a fault and need to be reset
- LTM heater cable are not connected
- LTM sensor cables are not connected

- LTM heater or heaters failed (burned out)
- LTM sensor failed
- Electronics are not working correctly

Heated guard column enclosure will not heat up

- Incorrect setpoint
- Setpoint entered in wrong heated zone
- Enclosure has not had enough time to reach temperature setpoint
- Enclosure heater not connected
- Enclosure temperature sensor is not connected
- Enclosure heater has failed
- Enclosure temperature sensor failed
- Electronics not working correctly

Analyzer Error Messages

Sometimes, a problem in your MSD will cause an error message to appear in the MSD ChemStation software. Some error messages appear only during tuning. Other messages may appear during tuning or data acquisition.

Some error messages are “latched.” These messages remain active in your data system even if the condition that caused the message has corrected itself. If the cause is removed, these messages can be removed by checking instrument status through the data system.

Difficulty in mass filter electronics

- Pressure in the analyzer chamber is too high
- RFPA is not adjusted correctly
- Mass filter (quad) contacts are shorted or otherwise not working correctly
- Mass filter is not working correctly
- MSD electronics are not working correctly

Difficulty with the electron multiplier supply

- Large peak, such as the solvent peak, eluted while the analyzer was on
- Pressure in the analyzer chamber is too high
- MSD electronics are not working correctly

Difficulty with the fan

If a cooling fan fault occurs, the vacuum control electronics automatically shut off the high vacuum pump and the ion source and mass filter heaters. Therefore, the message: *The system is in vent state* may also appear. It is important to note that even though the high vacuum pump is off, the analyzer chamber may not actually be vented. See *The system is in vent state* in this section for precautions to take.

- One of the fans is disconnected
- One of the fans has failed
- MSD electronics are not working correctly

Difficulty with the HED supply

The only time this error occurs is if the output of the supply cannot get to its destination (the HED).

- Large peak, such as the solvent peak, eluted while the analyzer was on
- Pressure in the analyzer chamber is too high
- Detector is not working correctly
- MSD electronics are not working correctly

Difficulty with the high vacuum pump

This indicates the pump failed to reach 50% of full speed within 7 minutes or experienced a fault.

You must switch the MSD off and back on to remove this error message. Be sure the turbo pump has slowed down before switching off the MSD. The message will reappear if the underlying problem has not been corrected.

Turbo pump

- Large vacuum leak is preventing the turbo pump from reaching 50% of full speed
- Foreline pump is not working correctly
- Turbo pump is not working correctly
- Turbo pump controller is not working correctly
- MSD electronics are not working correctly

High foreline pressure

- Excessive carrier gas flow (typically > 5 mL/min)
- Excessive solvent volume injected
- Large vacuum leak
- Severely degraded foreline pump oil (standard foreline pump)
- Collapsed or kinked foreline hose
- Foreline pump is not working correctly

Internal MS communication fault

- MSD electronics are not working correctly

Lens supply fault

- Electrical short in the analyzer
- MSD electronics are not working correctly

Log amplifier ADC error

- MSD electronics are not working correctly

No peaks found

- Emission current was set to 0
- Electron multiplier voltage is too low
- Amu gain or offset is too high
- Poor mass axis calibration
- Amu gain or offset is too high
- Calibration vial(s) empty or almost empty
- Excessive pressure in the analyzer chamber
- Air leak
- Electron multiplier voltage is too low
- Signal cable is not connected
- Electrical leads to the detector are not connected correctly
- HED power supply output cable failed
- Electrical leads to the ion source are not connected correctly
- Filament shorted to the source body

Temperature control disabled

- One of the heater fuses has failed
- MSD electronics are not working correctly

Temperature control fault

This indicates that something has gone wrong with the temperature control of either the ion source or mass filter (quad) heater. The cause can be further isolated by selecting **Status/MS Temp Ctlr Status** in the **Tune and Vacuum Control** view. One of the following should be displayed as the cause:

- Source temperature sensor is open

- Source temperature sensor is shorted
- Mass filter (quad) temperature sensor is open
- Mass filter (quad) temperature sensor is shorted
- No heater voltage (heater fuse has probably failed)
- Heater voltage is too low
- Temperature zone has timed out (heater failed, bad heater wiring, or loose temperature sensor)
- Problem with the temperature control electronics
- Source heater is open
- Source heater is shorted
- Mass filter heater is open
- Mass filter heater is shorted

The high vacuum pump is not ready

- Turbo pump is on but has not had enough time (5 minutes) to reach 80% of its normal operating speed
- Turbo pump is not working correctly
- MSD electronics are not working correctly

The system is in standby

This message is triggered by a shutdown signal on the remote start cable. It is usually caused by a GC fault, an ALS fault, or a bad cable connection. Once the cause of the fault is corrected, selecting **MS ON** or checking MSD status should remove the message.

The system is in vent state

The message says the system is vented, but if the fault has just occurred it may still be under vacuum and the turbo pump may still be at high speed. Wait at least 30 minutes after seeing this message before you actually vent the MSD.

CAUTION Venting the MSD too soon after this message appears can damage a turbo pump.

- System was vented on purpose (no problem)

- Fan fault has turned off the high vacuum pump (power cycle the MSD to clear the fault)
- Fuse for the high vacuum pump has failed
- MSD electronics are not working correctly

There is no emission current

- Filament is not connected properly; try the other filament
- Filament has failed; try the other filament
- MSD electronics are not working correctly

There is not enough signal to begin tune

- Corrupted tune file
- Poor mass axis calibration
- Amu gain or offset is too high
- Calibration vial(s) empty or almost empty
- Excessive pressure in the analyzer chamber
- Air leak
- Electron multiplier voltage is too low
- Signal cable is not connected
- Electrical leads to the detector are not connected correctly
- Electrical leads to the ion source are not connected correctly
- Filament shorted to the source body

Air Leaks

Air leaks are a problem for any instrument that requires a vacuum to operate. Leaks are generally caused by vacuum seals that are damaged or not fastened correctly. Symptoms of leaks include:

- Higher than normal analyzer chamber pressure or foreline pressure
- Higher than normal background
- Peaks characteristic of air (*m/z* 18, 28, 32, and 44 or *m/z* 14 and 16)
- Poor sensitivity
- Low relative abundance of *m/z* 502 (this varies with the tune program used)

Leaks can occur in either the GC or the MSD. The most likely point for an air leak is a seal you recently opened.

In the GC, most leaks occur in:

- GC inlet septum
- GC inlet column nut
- Broken or cracked capillary column

Leaks can occur in many more places in the MSD:

- GC/MSD interface column nut
- Side plate O-ring (all the way around)
- Vent valve O-ring
- Calibration valve
- GC/MSD interface O-ring (where the interface attaches to the analyzer chamber)
- Front and rear end plate O-rings
- Turbo pump O-ring

Contamination

Contamination is usually identified by excessive background in the mass spectra. It can come from the GC or from the MSD. The source of the contamination can sometimes be determined by identifying the contaminants. Some contaminants are much more likely to originate in the GC. Others are more likely to originate in the MSD.

Contamination originating in the GC typically comes from one of these sources:

- Column or septum bleed
- Dirty inlet
- Inlet liner
- Contaminated syringe
- Poor quality carrier gas
- Dirty carrier gas tubing
- Fingerprints (improper handling of clean parts)

Contamination originating in the MSD typically comes from one of the following sources:

- Air leak
- Cleaning solvents and materials
- Foreline pump oil (standard foreline pump)
- Fingerprints (improper handling of clean parts)

Table 4 lists some of the more common contaminants, the ions characteristic of those contaminants, and the likely sources of those contaminants.

Table 4 Common contaminants

Ions (*m/z*)	Compound	Possible source
18, 28, 32, 44 or 14, 16	H_2O, N_2, O_2, CO_2 or N, O	Residual air and water, air leaks, outgassing from Vespel ferrules
31, 51, 69, 100, 119, 131, 169, 181, 214, 219, 264, 376, 414, 426, 464, 502, 576, 614	PFTBA and related ions	PFTBA (tuning compound)
31	Methanol	Cleaning solvent
43, 58	Acetone	Cleaning solvent
78	Benzene	Cleaning solvent

Table 4 Common contaminants (continued)

Ions (*m/z*)	Compound	Possible source
91, 92	Toluene or xylene	Cleaning solvent
105, 106	Xylene	Cleaning solvent
151, 153	Trichloroethane	Cleaning solvent
69	Foreline pump oil or PFTBA	Foreline pump oil vapor or calibration valve leak
73, 147, 207, 221, 281, 295, 355, 429	Dimethylpolysiloxane	Septum bleed or methyl silicone column bleed
149	Plasticizer (phthalates)	Vacuum seals (O-rings) damaged by high temperatures, vinyl gloves
Peaks spaced 14 *m/z* apart	Hydrocarbons	Fingerprints, foreline pump oil

4
Not Ready Symptoms

This section includes faults and symptoms that will occur when the instrument is on but cannot perform analyses. This is indicated by a “Not Ready” warning, by fault messages, or by other symptoms.

Instrument Never Becomes Ready

Normally the instrument becomes ready after flows and temperatures reach setpoint. If the instrument does not become ready after a long period of time, perform the following using the LCP:

- Press **[Status]** or a component key (for example, **[Front inlet]**) to see which setpoints or conditions are not ready.
- Check for a sampler problem.
- Check for a data system problem.
- If performing manual injections in splitless or gas-saver mode, you may need to press **[Prep Run]** to prepare the inlet for the injection. Do this, for example:
  - To toggle the inlet purge valve before a splitless injection
  - To prepare for a pulsed injection
  - To turn off gas saver.

  For more information on **[Prep Run]**, see the *5975T LTM GC/MSD Operation Manual*

Flow Never Becomes Ready

If the gas flow never becomes ready, check for the following:

- Check the supply gas for sufficient delivery pressure.
- Check the restrictors installed in the Aux EPC module. See Restrictors in the Advanced User Guide.
- Check the configured gas type. The configured gas type must match the actual gas plumbed to the GC.
- Check for leaks in the gas delivery plumbing and the capillary column system from the inlet to the GC/MSD transfer line. (See Chapter 8, “Checking for Leaks”.)

Temperature Never Becomes Ready

To be considered ready, a temperature must be at setpoint ±1 °C for 30 s. If a temperature never becomes ready, do the following:

- Check for a missing insulation cup on an inlet.
- Check for a very large temperature difference between the LTM column, guard column enclosure, and inlet.
- Check for missing insulation around the inlet.

Cannot Set a Flow or Pressure

If you cannot set a flow or pressure using the split/splitless, inlet, do the following:

- Check the column mode.
- Check that a capillary column is configured to the correct inlet.
- Check the configured column dimensions.
- Check that the flow is turned on.

A Gas Does Not Reach Setpoint Pressure or Flow

If an inlet does not reach its pressure setpoint, it will shut down. Do the following:

- Check for sufficient gas supply delivery pressure. The pressure at the supply should be at least 10 psi greater than the desired setpoint.
- Check for leaks. (See Chapter 8, “Checking for Leaks”.) If using gas saver, be sure that the gas saver flow rate is high enough to maintain the highest column-head pressure used during a run.
- Check for an incorrectly installed column.

A Gas Exceeds Pressure Setpoint or Flow

If a gas exceeds its pressure or flow setpoint, do the following:

- Decrease the split ratio.
- Replace the split vent filter.
- Verify that the correct liner is selected.
- Check the gold seal for contamination.

The Inlet Pressure or Flow Fluctuates

A fluctuation in inlet pressure causes variations in the flow rate and retention times during a run. Do the following:

- Check if the gas purifier or gas generator is operating at or near capacity.
- Check the supply gas for sufficient delivery pressure.
- Verify that the supply pressure regulator is functioning properly.
- Check for leaks. (See Chapter 8, “Checking for Leaks”.)
- Check for large restrictions in the inlet liner or split vent trap.
- Verify that the correct liner is installed.
- Check for a restriction in headspace, purge and trap, and any other external sampling devices.

Cannot Maintain a Pressure as Low as the Setpoint on a Split Inlet

If the instrument cannot maintain a pressure as low as the setpoint, check for the following:

- Consider using a liner designed for split analysis.
- Check for a plugged liner.
- Check for contamination in the split vent line. Contact Agilent service to replace, if necessary.
- Replace gold seal.

The Measured Column Flow Does Not Equal the Displayed Flow

If the actual column flow does not match the calculated flow displayed on the GC, do the following:

- Verify that the measured flows are corrected to 25 °C and 1 atmosphere.
- Verify that the correct column dimensions are configured accurately, including the actual (trimmed) column length.
- The split vent line or trap may be partly plugged, creating an actual inlet pressure higher than the setpoint pressure.

5
ALS Symptoms

Plunger Errors

If the 7693 ALS reports a plunger error, see if the syringe plunger is sticking or is not securely connected to the plunger carrier.

Syringe Needle Bends During Injection into Inlet

WARNING **When troubleshooting the injector, keep your hands away from the syringe needle. The needle is sharp and may contain hazardous chemicals.**

Refer to your *7693 Automatic Liquid Sampler Installation, Operation and Maintenance Manual* for additional information.

- Check that the GC septum nut is not too tight.
- Check that the syringe is installed correctly into the syringe carriage.
- Check that the needle support and guide are clean. Remove any residue or septum deposits.
- Check that you are using the proper syringe. The combined length of the syringe barrel and needle should be approximately 126.5 mm.

6
Shutdown Symptoms

Column Shutdowns

The instrument monitors inlet and auxiliary gas streams. If a carrier gas (which can include an auxiliary flow module or pneumatics control module) is unable to reach its flow or pressure setpoint, the instrument assumes that a leak exists. It will warn you with a beep after 25 seconds, and it will continue to beep in intervals. After about 5 minutes, the instrument will shut down components to create a safe state. The instrument:

- Displays **Front inlet pressure shutdown**.
- Turns off to avoid column damage.
- Flashes LTM column temperature setpoint **Off**.
- Turns off all flows for the column. When viewed, their parameters flash **Off**. For example, the septum purge and column flows would turn off.
- Turns off all other heaters. When viewed, their temperature parameters flash **Off**.
- Attempts to turn on a shut-down zone fail with an error message.

To recover from this state.

1 Fix the cause of the shutdown.
    - Check for a broken column near the inlet.
    - Check for leaks.
    - Replace the inlet septum.
    - Replace the inlet O-ring.
    - Check the supply pressure.
2 Press the key for the device that initiated the shutdown. Scroll to the pneumatic parameter that is flashing **Off**, then press **[On]** or **[Off]**.

    For example, if the inlet ran out of carrier gas, click **[Inlet]** from the electronic keypad, scroll to the pressure or flow parameter, then click **[On]**.

Hydrogen Shutdowns

Hydrogen gas may be used as a carrier gas. When mixed with air, hydrogen can form explosive mixtures.

The instrument monitors inlet and auxiliary gas streams. If a stream is unable to reach its flow or pressure setpoint and if that stream is configured to use hydrogen, the instrument assumes that a leak exists. It will warn you with a beep after 25 seconds, and it will continue to beep in intervals. After about 5 minutes, the instrument will shut down components to create a safe state. The instrument:

- Displays **Hydrogen Safety Shutdown**.
- Closes the carrier supply valve to the inlet and closes and turns off both pressure and flow controls. When viewed, these parameters will flash **Off**.
- Opens the split vent valve in the inlet.
- Turns off the LTM column heaters.
- Turns off the inlet, guard column enclosure, and GC/MSD transfer line heaters. When viewed, these parameters will flash **Off**.
- Sounds an alarm.

To recover from this state:

1. Fix the cause of the shutdown:
   - Replace the inlet septum.
   - Replace the inlet O-ring.
   - Check for broken column.
   - Check the supply pressure.
   - Check the system for leaks. See Checking for Leaks.
2. Power cycle the instrument.
3. After the instrument powers back on, from the electronic keypad click the key for the device that initiated the shutdown. Scroll to the pneumatic parameter that is flashing **Off**, then click **[On]** or **[Off]**. For example, if the inlet ran out of carrier gas, click **[Inlet]**, scroll to the pressure or flow parameter, then click **[On]**.

Thermal Shutdowns

A thermal fault means that the oven or another heated zone is not within its allowable temperature range (lower than minimum temperature or higher than maximum temperature).

To recover from this state:

1 Fix the cause of the shutdown:
   - Check for missing insulation.
2 Most thermal shutdowns can be cleared by shutting off the thermal zone using the ChemStation.

7
Instrument Power On and Communication Symptoms

Instrument does not turn on

Nothing happens when the instrument is switched on. The foreline pump does not start. The cooling fan for the high vacuum pump does not turn on. The local control panel is not on.

- Disconnected power cord
- No voltage or incorrect voltage at the electrical outlet
- Failed primary fuses
- Electronics are not working correctly

Foreline pump is not operating

The instrument is receiving power (the fan is operating and the local control panel is lit) but the foreline pump is not operating.

- Large air leak (usually the analyzer door open) has caused pumpdown failure. You must power cycle the instrument to recover from this state.
- Disconnected foreline pump power cord
- Malfunctioning foreline pump
- Check power switch on foreline pump

MSD turns on but then the foreline pump shuts off

MSDs will shut down both the foreline pump and the high vacuum pump if the system fails to pump down correctly. This is usually because of a large air leak: either the sideplate has not sealed correctly or the vent valve is still open. This feature helps prevent the foreline pump from sucking air through the system, which can damage the analyzer and pump.

You must power cycle the instrument to recover from this state.

Local control panel says “No server found”

- Disconnected LAN cable between MSD and the switch, or the switch and the PC
- PC is turned off

Holding the No/Cancel key down for 5 seconds will bypass error and allow the user to look at the LCP.

Instrument Turns On, Then Stops During Startup (During Self-Test)

If the instrument turns on but the normal display does not appear:

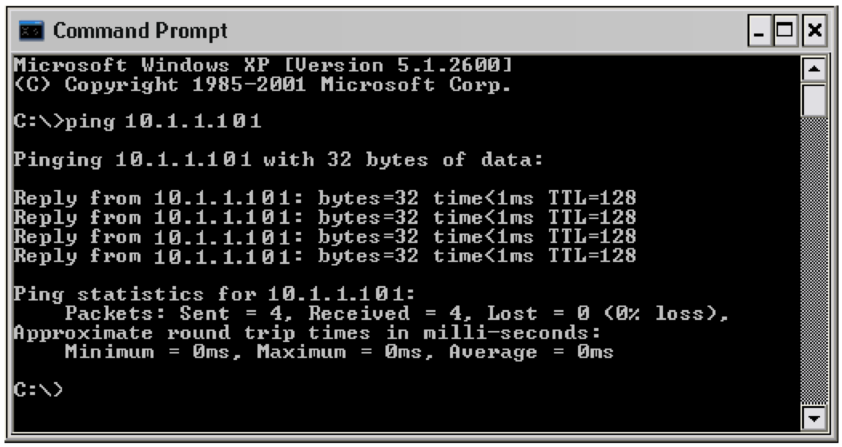
1 Turn the power switch **Off**. Wait one minute, then turn the power **On**.

2 If the instrument does not return to normal, record any messages that appear on the display and LED.

PC Cannot Communicate with Instrument

- Run a **ping** test

  The MS-DOS **ping** command verifies communications across a TCP/IP connection. To use it, open the command prompt window. Type **ping** followed by an IP address. For example, if the IP address is 10.1.1.101, enter **ping 10.1.1.101**. If LAN communications are working properly, you will see a successful reply. For example:



If the ping test is successful, check the software configuration.

If the ping test is unsuccessful, do the following:

- Check the LAN cabling.
- Verify the IP address, subnet mask, and gateway addresses.
- Check that a crossover cable for single instrument to computer direct connection is installed.

8
Checking for Leaks

Leak Check Tips

When checking for leaks, consider the system in two parts: external leak points and instrument leak points.

- **External leak points** include the gas cylinder (or gas purifier), regulator and its fittings, supply shutoff valves, and connections to the GC supply fittings.
- **Instrument leak points** include inlets, LTM column connections, GC/MSD transfer line connection, and connections between flow modules and inlets.

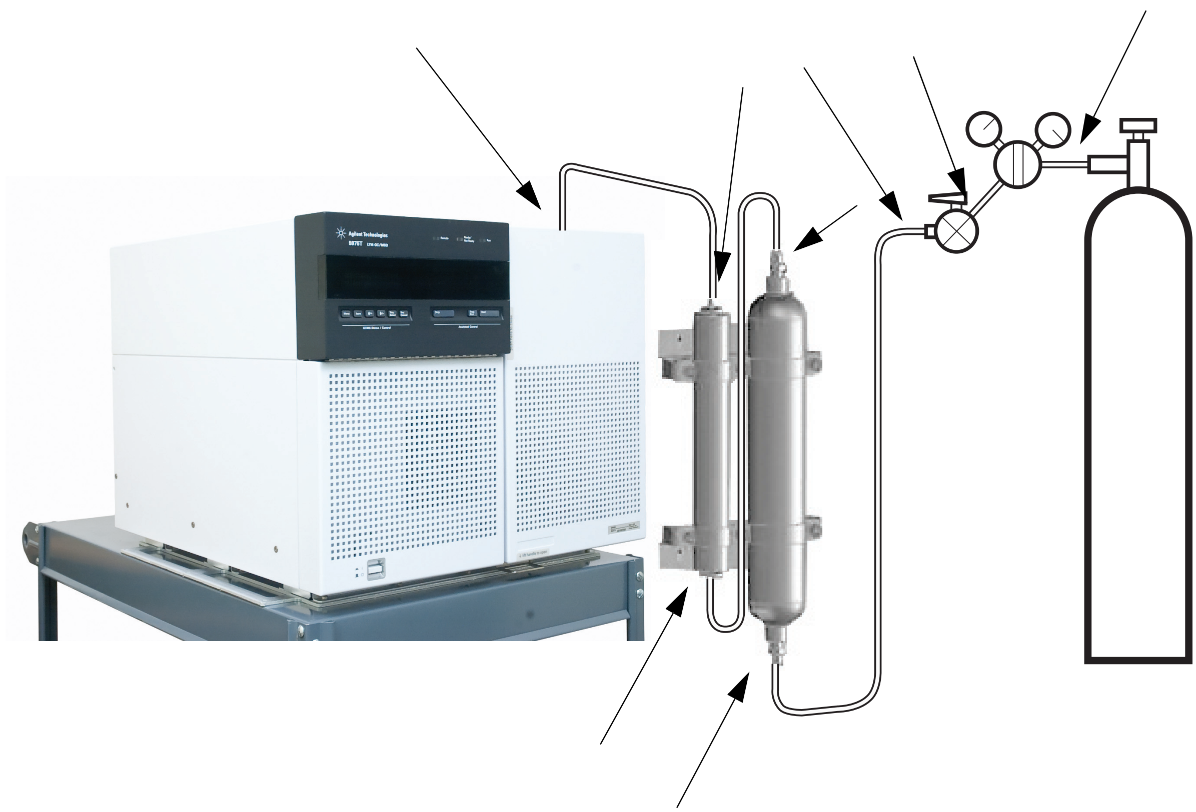
WARNING **Hydrogen (H_2) is flammable and is an explosion hazard when mixed with air in an enclosed space (for example, a flow meter). Purge flowmeters with inert gas as needed. Always measure gases individually.**

WARNING **Hazardous sample gases may be present.**

1 Gather the following:
   - Electronic leak detector capable of detecting the gas type
   - 7/16-in, 9/16-in, and 1/4-in wrenches for tightening Swagelok and column fittings
2 Check any potential leak points associated with any maintenance recently performed.
3 Check instrument capillary fittings and connections that undergo thermal cycling, since thermal cycling tends to loosen some fitting types. Use the electronic leak detector to determine if a fitting is leaking.
   - Start by checking any newly made connections first.
   - Remember to check connections in the gas supply lines after changing traps or supply cylinders.

To Check for External Leaks

Check for leaks at these connections:



- Gas supply bulkhead fittings
- Gas cylinder fitting
- Regulator fittings
- Traps
- Shut-off valves
- T-fittings

Perform a pressure drop test.

1 Turn off the instrument.

2 Set the regulator pressure to 415 kPa (60 psi).

3 Fully turn the regulator pressure adjustment knob counterclockwise to shut the valve.

4 Wait 5 min. If there is a measurable drop in pressure, there is a leak in the external connections. No drop in pressure indicates that the external connections are not leaking.

To Check for Instrument Leaks

Check for leaks at these connections:

- Inlet septum, septum head, liner, split vent trap, split vent trap line, and purge vent fittings
- LTM column connections to inlets, GC/MSD transfer line, and unions
- Fittings from the flow modules to the inlets
- Column adapters
- Agilent capillary flow fittings

Leaks in Capillary Flow Fittings

For capillary flow fittings, a leak usually indicates that the fitting has been overtightened. Unless the fitting is obviously loose, do not tighten it further. Instead, remove the connection, trim the column end, and install it again. (See "To Attach a Capillary Column Using SilTite Metal Fittings" on page 114)

Also inspect the plate and connection for a broken column tip.

WARNING **Be careful! The LTM column, inlet, guard column heated enclosure, GC/MSD transfer line may be hot enough to cause burns. If hot, wear heat-resistant gloves to protect your hands.**

9
Troubleshooting Tasks

To Measure a Split Vent or Septum Purge Flow

Note that the GC reports flows calibrated to 25 °C and 1 atmosphere. Correct flowmeter results accordingly.

WARNING

Hydrogen (H_2) is flammable and is an explosion hazard when mixed with air in an enclosed space (for example, a flow meter). Purge flowmeters with inert gas as needed. Always measure gases individually.

Septum purge and split vent flows exit through the pneumatic module at the top rear of the instrument. See Figure 4.

Figure 4 Top rear view of the instrument

To measure split vent or septum purge flows, attach the flowmeter to the appropriate tube.

- The split vent has a 1/8-in Swagelok threaded fitting. Create and use a 1/8-in tub adapter (as shown above) to covert the 1.8-in threaded fitting into a 1/8-tube. This prevents the rubber flowmeter tubing from leaking around the threads, which will result in leakage and thus an incorrect flow reading.

- The septum purge is a 1/8-in tube. Use the red rubber adapter shown to measure flows.

10
General Maintenance

Before Starting

For your safety, read all of the information in this introduction before performing any maintenance tasks.

Scheduled maintenance

Common maintenance tasks are listed in Table 5. Performing these tasks when scheduled can reduce operating problems, prolong system life, and reduce overall operating costs.

Keep a record of system performance (tune reports) and maintenance operations performed. This makes it easier to identify variations from normal operation and to take corrective action.

Table 5 Maintenance schedule

Task	Every week	Every 6 months	Every year	As needed
Vacuum System				
Check the foreline pump oil level	X			
Replace the foreline pump oil		X		
Check the dry foreline pump diaphragms				X
Change scroll pump seals			X	
Lubricate sideplate or vent valve O-rings*				X
MSD				
Tune the MSD				X
Clean the ion source				X
Check the calibration vial(s)	X			
GC				
Check the carrier gas trap(s) on the GC				X
Trim or replace the guard columns				X
Replace inlet septum, liner, and o-ring				X
Change inlet gold seal				X
Replace GC carrier gas supplies				X

* Vacuum seals other than the side plate O-ring and vent valve O-ring do not need to be lubricated. Lubricating other seals can interfere with their correct function.

Tools, spare parts, and supplies

Some of the required tools, spare parts, and supplies are included in the shipping kit. You must supply others yourself. Each maintenance procedure includes a list of the materials required for that procedure. “Consumables and Maintenance Supplies” on page 260 summarizes these.

High voltage precautions

Whenever the instrument is plugged in, even if the power switch is off, potentially dangerous voltage (120 VAC or 200/240 VAC) exists on:

- The wiring and fuses between where the power cord enters the instrument and the power switch

When the power switch is on, potentially dangerous voltages exist on:

- Electronic circuit boards
- Toroidal transformer
- Wires and cables between these boards
- Wires and cables between these boards and the connectors on the side panel of the instrument
- Some connectors on the side panel (for example, the foreline power receptacle)

Normally, all of these parts are shielded by safety covers. As long as the safety covers are in place, it should be difficult to accidentally make contact with dangerous voltages.

WARNING **Perform no maintenance with the MSD turned on or plugged into its power source unless you are instructed to by one of the procedures in this chapter.**

Some procedures in this chapter require access to the inside of the instrument while the power switch is on. Do not remove any of the electronics safety covers in any of these procedures. To reduce the risk of electric shock, follow the procedures carefully.

Dangerous temperatures

Many parts in the instrument operate at, or reach, temperatures high enough to cause serious burns. These parts include, but are not limited to:

- GC/MSD interface
- Analyzer parts
- Vacuum pumps
- Inlet
- LTM column
- Guard column heated enclosure

WARNING **Never touch these parts while your instrument is on. After the instrument is turned off, give these parts enough time to cool before handling them.**

WARNING **The foreline pump can cause burns if touched when operating. It has a safety shield to prevent the user from touching it.**

The GC inlets, guard column heated enclosures, and LTM column also operate at very high temperatures. Use the same caution around these parts.

Chemical residue

Only a small portion of your sample is ionized by the ion source. The majority of any sample passes through the ion source without being ionized. It is pumped away by the vacuum system. As a result, the exhaust from the foreline pump will contain traces of the carrier gas and your samples. Exhaust from the standard foreline pump also contains tiny droplets of foreline pump oil.

An oil trap is supplied with the standard foreline pump. This trap stops ***only*** pump oil droplets. It ***does not*** trap any other chemicals. If you are using toxic solvents or analyzing toxic chemicals, do not use this oil trap. For all foreline pumps, install a hose to take the exhaust from the foreline pump outdoors or into a fume hood vented to the outdoors. For the standard foreline pump, this requires removing the oil trap. Be sure to comply with your local air quality regulations.

WARNING **The oil trap supplied with the standard foreline pump stops only foreline pump oil. It does not trap or filter out toxic chemicals. If you are using toxic solvents or analyzing toxic chemicals, remove the oil trap and install a hose to take the foreline pump exhaust outside or to a fume hood.**

The oil in the standard foreline pump also collect traces of the samples being analyzed. All used pump fluid should be considered hazardous and handled accordingly. Dispose of used fluid correctly, as specified by your local regulations.

WARNING **When replacing pump fluid, use appropriate chemical-resistant gloves and safety glasses. Avoid all contact with the fluid.**

Electrostatic discharge

All of the printed circuit boards in the instrument contain components that can be damaged by electrostatic discharge (ESD). Do not handle or touch these boards unless absolutely necessary. In addition, wires, contacts, and cables can conduct ESD to the electronics boards to which they are connected. This is especially true of the mass filter (quadrupole) contact wires which can carry ESD to sensitive components on the side board. ESD damage may not cause immediate failure but it will gradually degrade the performance and stability of your MSD.

When you work on or near printed circuit boards or when you work on components with wires, contacts, or cables connected to printed circuit boards, always use a grounded antistatic wrist strap and take other antistatic precautions. The wrist strap should be connected to a known good earth ground. If that is not possible, it should be connected to a conductive (metal) part of the assembly being worked on, but ***not*** to electronic components, exposed wires or traces, or pins on connectors.

Take extra precautions, such as a grounded antistatic mat, if you must work on components or assemblies that have been removed from the MSD. This includes the analyzer.

CAUTION To be effective, an antistatic wrist strap must fit snugly (not tight). A loose strap provides little or no protection.

Antistatic precautions are not 100% effective. Handle electronic circuit boards as little as possible and then only by the edges. Never touch components, exposed traces, or pins on connectors and cables.

To Attach a Capillary Column Using SilTite Metal Fittings

This procedure is used to attach a capillary column to the Ultimate Union.

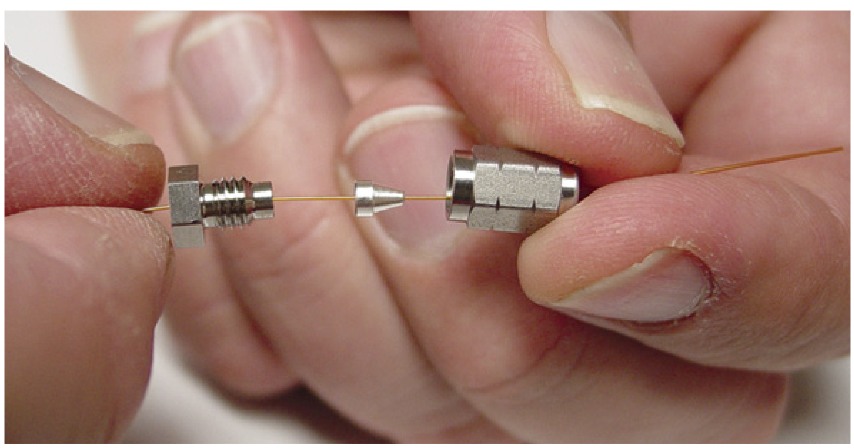
1 Gather the following:
   - SilTite ferrules (see Table 6)
   - Swaging nut for SilTite ferrules (G2855-20555)
   - Two 1/4-inch open-end wrenches
   - One 7/16-inch open-end wrench
   - Column cutting tool (5181-8836)
   - Internal nut (G2855-20530)
   - Lint free gloves

Table 6 Available SilTite metal ferrule packages

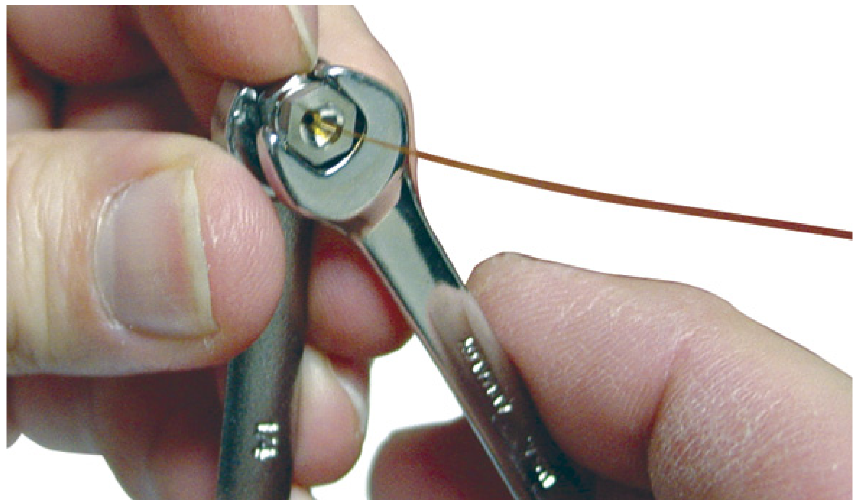
Part number	SilTite ferrule description
5188-5361	For 0.2- to 0.25-mm columns
5188-5362	For 0.32-mm columns

CAUTION Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

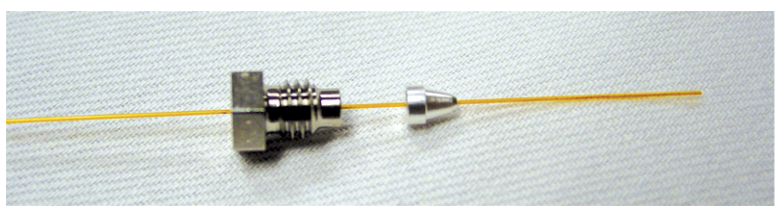
2 Pass the tubing end through the internal nut and SilTite ferrule leaving approximately 1 cm of fused silica tubing protruding beyond the ferrule. Thread the swaging nut onto the internal nut with the tube protruding.



3 Using two wrenches against each other, tighten the two nuts together a little at a time, occasionally checking to see if the ferrule is gripping the tube. When the ferrule just starts to grip, notice position of the nuts and then tighten one of the nuts by turning 45 to 60 degrees of rotation, but no more than 60 degrees (one flat).



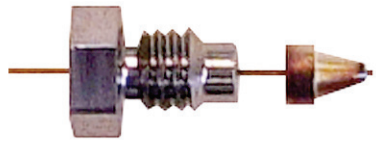
4 Remove the swaging nut.



5 Using a wafer column cutter, trim the tubing at the small end of the ferrule, leaving approximately 0.3 mm of tubing extending beyond the ferrule.

Check the end of the tube with a magnifier. The end of the tube need not be perfectly square, but should not have cracks that extend under the ferrule.

NOTE It is important that the tube end does not extend beyond 0.5 mm from the end of the ferrule.



6 Insert the assembled ferrule and nut into the SilTite fitting. Tighten with a wrench by only 15 to 20 degrees of rotation.

To Disconnect Fused Silica Tubing From a SilTite Fitting

Loosen and remove the internal nut. If tubing and ferrule do not come free, insert a pointed object (pen, paper clip) into the ferrule release hole and press firmly. You will hear a click as the ferrule releases.

The SilTite ferrule seal should remain leak-free for many disconnections and reconnections.

Maintaining the Vacuum System

Periodic maintenance

As listed earlier in Table 5, some maintenance tasks for the vacuum system must be performed periodically. These include:

- Checking the foreline pump fluid (every week)
- Checking the calibration vial (every 6 months)
- Ballasting the foreline pump
- Replacing the foreline pump oil every 6 months
- Tightening the foreline pump oil box screws (first oil change after installation, standard foreline pump)
- Checking the dry foreline pump diaphragms (typically every 3 years)

Failure to perform these tasks as scheduled can result in decreased instrument performance. It can also result in damage to your instrument.

Other procedures

Tasks such as replacing a Micro-Ion vacuum gauge should be performed only when needed. See Chapter 3 or the online help in the GC/MSD ChemStation software for symptoms that indicate this type of maintenance is required.

More information is available

If you need more information about the locations or functions of vacuum system components, See “Vacuum System” on page 181.

Most of the procedures in this chapter are illustrated with video clips on this 5975 Series MSD User Information DVD.

To Check and Add Foreline Pump Oil

Standard foreline pump only

Materials needed

- Foreline pump oil (6040-0621)
- Funnel (9301-6461)
- Hex key, 5-mm, to remove drain plug (8710-1838)
- Screwdriver, flat-blade, to remove top fill cap

Procedure

WARNING **The foreline pump can cause burns if touched when operating. It has a safety shield to prevent the user from touching it.**

1 Examine the oil level window (Figure 5).

Note the two lines on the pump left of the window. The oil level should be between the lines. The foreline pump oil should be almost clear. If the oil level is near or below the lower line, follow steps 2 through 6 to add foreline pump oil.

WARNING **Never add oil while the foreline pump is on.**

If your instrument is nearing its scheduled time for replacement of the foreline pump oil, replace the oil instead of adding oil. If the oil is dark or cloudy, replace it. See “To Drain the Foreline Pump” on page 121 for instructions about replacing the foreline pump oil.

2 Vent the instrument.

3 Remove the foreline pump fill cap.

4 Add pump fluid until the oil level in the window is near, but not above, the upper line.

5 Reinstall the fill cap.

6 Pump down the instrument.

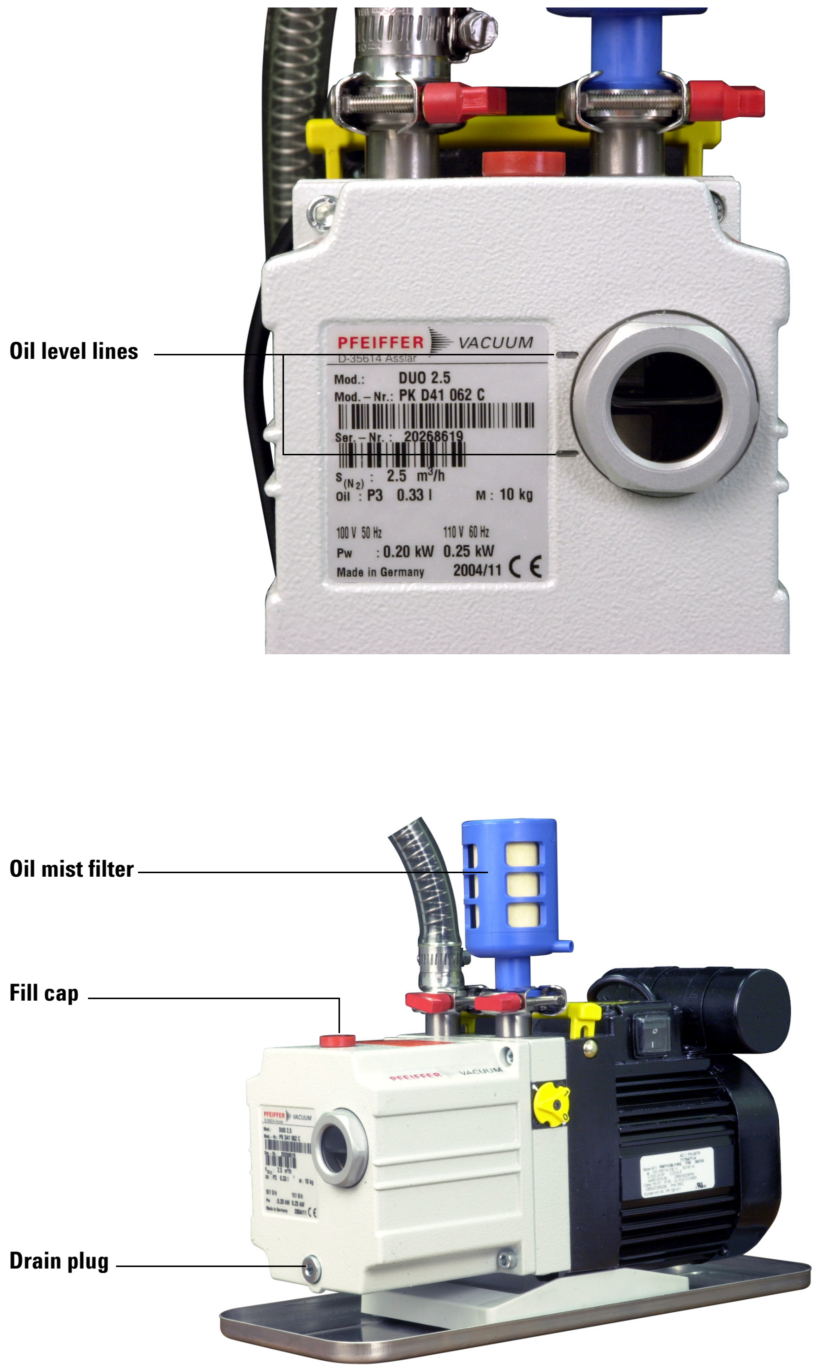


Figure 5 Foreline pump (standard pump shown without safety cage)

To Drain the Foreline Pump

Standard foreline pump only

Materials needed

- Book or other solid object approximately 5 cm thick
- Container for catching old pump oil, 500 mL
- Gloves, oil- and solvent-resistant
- Screwdriver, flat-blade, large (8730-0002)
- Hex key, 5-mm (8710-1838)

Procedure

WARNING **The foreline pump can cause burns if touched when operating. It has a safety shield to prevent the user from touching it.**

1 Vent the instrument.

2 If necessary, slide the foreline pump to a safe, accessible location.

The foreline pump may be located on the floor or on the lab bench next to the GC/MSD.

WARNING **The foreline pump may be hot.**

3 Place a book or other object under the pump motor to tilt it up slightly. Remove the fill cap. See Figure 5.

4 Place a container under the drain plug.

5 Remove the drain plug. Allow the pump oil to drain out. The oil drains faster if it is still warm.

WARNING **The old pump oil may contain toxic chemicals. Treat it as hazardous waste.**

6 Replace the drain plug after draining the oil.

7 Refill the foreline pump until the oil level is between the two fill marks in the site window.

8 Replace the fill cap.

To Refill the Foreline Pump

Standard foreline pump only

Materials needed

- Foreline pump oil (6040-0621) – approximately 0.28 L required
- Funnel (9301-6461)
- Gloves, oil- and solvent-resistant
- Screwdriver, flat-blade, large (8730-0002)
- Drain plug O-ring (if required) (0905-1515)
- Hex key, 5-mm (8710-1838)

Procedure

WARNING **The foreline pump can cause burns if touched when operating. It has a safety shield to prevent the user from touching it.**

1. Drain the foreline pump. See page 121.
2. Reinstall the drain plug. If the old O-ring appears worn or damaged, replace it.
3. Remove the propping object from under the pump motor.
4. Add foreline pump oil until the oil level in the window is near, but not above, the upper line. The foreline pump requires approximately 0.28 L of oil.
5. Wait a few minutes for the oil to settle. If the oil level drops, add oil to bring the oil level near the upper line.
6. Reinstall the fill cap.
7. If necessary, slide the foreline pump back into position.

   The foreline pump may be located on the floor or on the lab bench next to the GC/MSD.
8. Pump down the instrument.
9. Reposition the pump as needed to provide slack in the tubing and cables.

To Maintain the Dry Vacuum Pump

Materials needed

- Replacement tip seal kit (IDP3TS)
- Wrench, open-end, 1/4-inch × 5/16-inch (8710-0510)
- Razor blade or side-cutting pliers
- Compressed air (optional)

Procedure

WARNING **The foreline pump can cause burns if touched when operating. It has a safety shield to prevent the user from touching it.**

1. Vent the instrument.
2. If necessary, slide the foreline pump to a safe, accessible location.

   The foreline pump may be located on the floor or on the lab bench next to the GC/MSD.

WARNING **The foreline pump may be hot.**

3. Disconnect the pump from electrical power.
4. Remove the four M5 socket head bolts from the front cowling, disconnect the electrical connector, and set the cowling aside. See Figure 6.
5. Remove the four M5 bolts from the outboard housing and take it axially off the frame.
6. Remove the worn tip seals and discard.
7. If compressed air is available, blow any remaining tip seal debris from the scroll parts. If seal debris is attached to the sides, use a razor blade to scrape it off.
8. Remove the new tip seals from the packaging. There should be two tip seals in the kit: one for the orbiting scroll and one for the outboard housing scroll.
9. Install the correct tip seal into the groove of the orbiting scroll, and trim about 3 mm off the seal from the outer end of the groove. See Figure 6.
10. Install the correct tip seal into the groove of the outboard housing scroll and trim as in step 9. See Figure 6.

11 Place the new main 0-ring into the groove in the pump frame, ensuring first that the groove is clean.

12 Replace the outboard housing, ensuring that the tip seal has not fallen out of its groove. See Figure 6.

13 Replace the four M5 bolts in the outboard housing. See Figure 6.

14 Reconnect the electrical connector at the front cowling.

15 Replace the front cowling and the four M5 bolts that hold it in place. See Figure 6.

16 Reconnect the pump to electrical power.

17 Reposition the foreline pump, providing slack in the tubing and cables.

The foreline pump may be located on the floor or on the lab bench next to the GC/MSD.

18 Pump down the instrument.

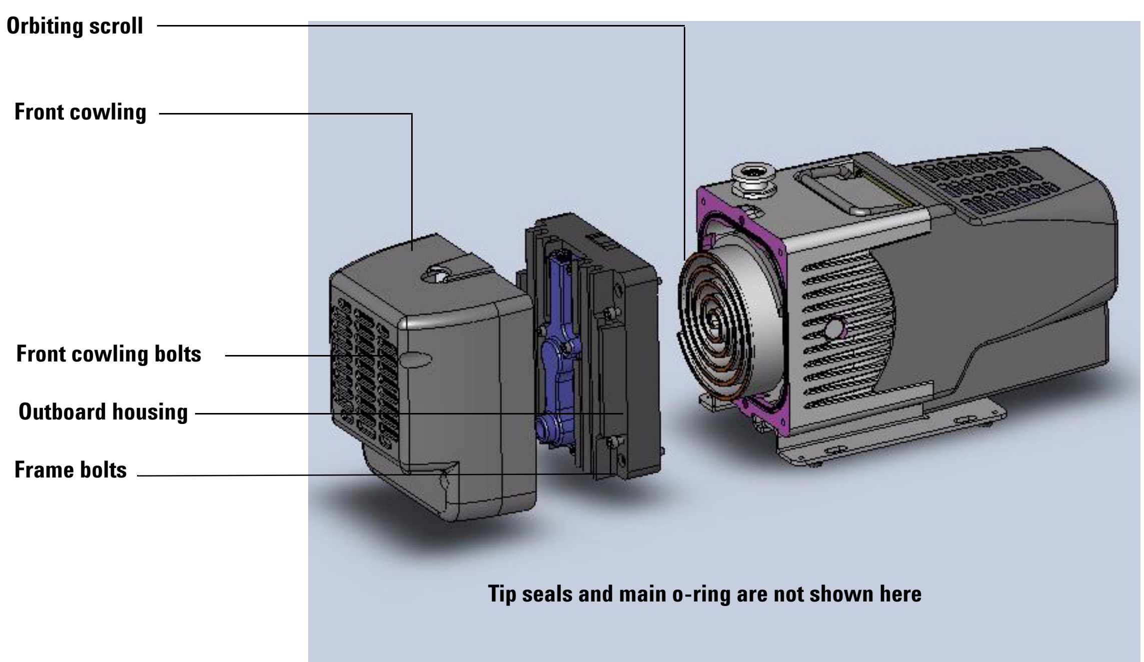


Figure 6 Changing the dry pump tip seal

To Refill the EI Calibration Vial

Materials needed

- PFTBA (05971-60571)

Procedure

1. Stop any tuning or data acquisition.
2. Turn off the analyzer. There are several ways to do this:
   - In the **Tune and Vacuum Control** view, select **MS OFF** from the **Execute** menu.
   - In the **Instrument Control** view in the **Edit Parameters** dialog box, select **MS OFF** from the **Execute** menu.
3. Remove the analyzer window cover.
4. Loosen the calibration vial collar (Figure 7). Do not remove the collar.
5. Pull the calibration vial out. You may feel some resistance due to residual vacuum.

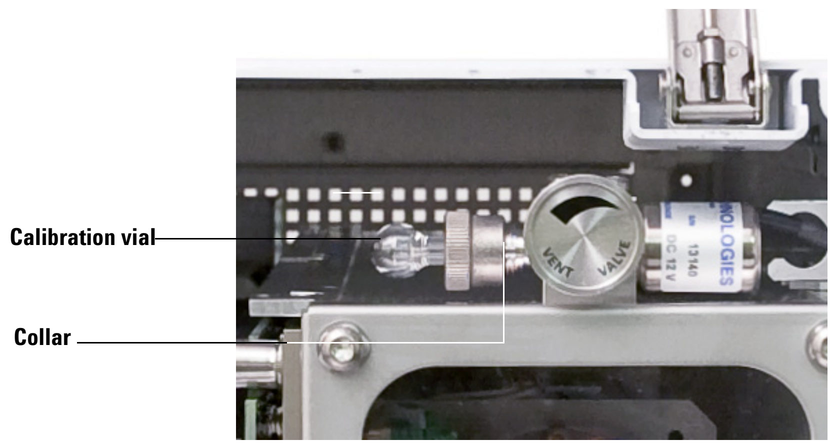


Figure 7 Removing the EI calibration vial

6. Syringe or pipette PFTBA into the vial. With the vial vertical, the liquid should be just below the end of the internal tube, approximately 70 µL of sample.
7. Push the calibration vial into the valve as far as possible.
8. Withdraw the vial 1 mm. This prevents damage when you tighten the collar.
9. Turn the collar clockwise to tighten it.

The collar should be snug but not overly tight. Do ***not*** use a tool to tighten the collar. It does not require that much force.

10 Reinstall the analyzer window cover.

11 Select **Purge Calibrant Valve** from the **Vacuum** menu in the **Tune and Vacuum Control** view.

CAUTION Failure to purge the calibration valve will result in damage to the filaments and detector.

To Purge the Calibration Valves

CAUTION

After removing a calibrant vial, you ***must*** purge the calibration valve. Failure to do so will result in damage to the filaments and the electron multiplier.

EI calibration valve

After adding new PFTBA to the calibrant vial, you must purge the air out of the vial and valve.

1 If the vacuum gauge controller is on, turn it off.

2 In **Tune and Vacuum Control** view, select **Purge Calibrant Valve** under the **Vacuum** menu.

   This will open the CI calibration valve for several minutes with all analyzer voltages turned off.

To Remove the EI Calibration and Vent Valve Assembly

Materials needed

- Screwdriver, Torx T-15 (8710-1622)

Procedure

1. Vent the instrument.
2. Trace the calibration valve cable to the connector next to the fan and disconnect it.
3. Loosen the collar and remove the calibration vial (Figure 7). Just loosen the collar, do not remove it.

CAUTION Removing the valve with the vial installed can result in liquid calibrant getting into the restrictor of the valve. Liquid in the restrictor will prevent diffusion of PFTBA into the analyzer chamber for tuning. Replace the valve if this happens.

4. Remove the two screws holding the valve assembly to the top of the analyzer chamber. Do not lose the O-ring under it.

To Reinstall the EI Calibration and Vent Valve Assembly

Materials needed

- Calibration valve (G3170-60204)
- O-ring for calibration valve (0905-1217)
- PFTBA (05971-60571) or other tuning compound
- Screwdriver, Torx T-15 (8710-1622)

Procedure

1. Remove the old valve assembly. See page 128 and Figure 7.
2. Be sure the valve O-ring is in place. If it is worn or damaged, replace it.
3. Install the calibration and vent valve assembly and tighten the screws that hold it in place.
4. Reconnect the calibration valve cable to the connector next to the fan.
5. Remove the vial from the new calibration valve. See page 128. The valve is supplied with a vial already installed.
6. Fill and reinstall the calibration vial. See page 125.
7. Pump down the MSD.
8. Select **Purge Calibrant Valve** from the **Vacuum** menu in the **Tune and Vacuum Control** view.

CAUTION Failure to purge the calibration valve will damage the filaments and detector.

To Install a Micro-Ion Vacuum Gauge

The Micro-Ion vacuum gauge is optional for EI operation.

Materials needed

- KF16 O-ring 0905-1463
- Micro-Ion vacuum gauge (G3397A)
- Power cord
- Micro-Ion vacuum gauge cable (G3170-60805)
- Screwdriver, Torx T-15 (8710-1622)

Procedure

1 Vent the instrument.

2 Loosen the six captive screws on the back of the rear MSD cover.

3 Pull the cover forward and off the MSD. See Figure 8.

WARNING **Do not remove any other covers. Dangerous voltages are present under other covers.**

CAUTION Do not use excessive force or the plastic tabs that hold the cover to the mainframe will break off.

4 Detach the provided KF-16 clamp from the analyzer chamber flange.

5 Place the KF16 O-ring in the groove on the analyzer chamber flange. Replace it if it is worn or damaged.

6 Hold the gauge flange against the chamber flange with the O-ring. Push the KF-16 clamp over both flanges.

7 Insert the long screw, add the thumbnut, and tighten.

8 Attach the cable to the back of the gauge.

9 Replace the MSD back cover.

10 Pump down the MSD.

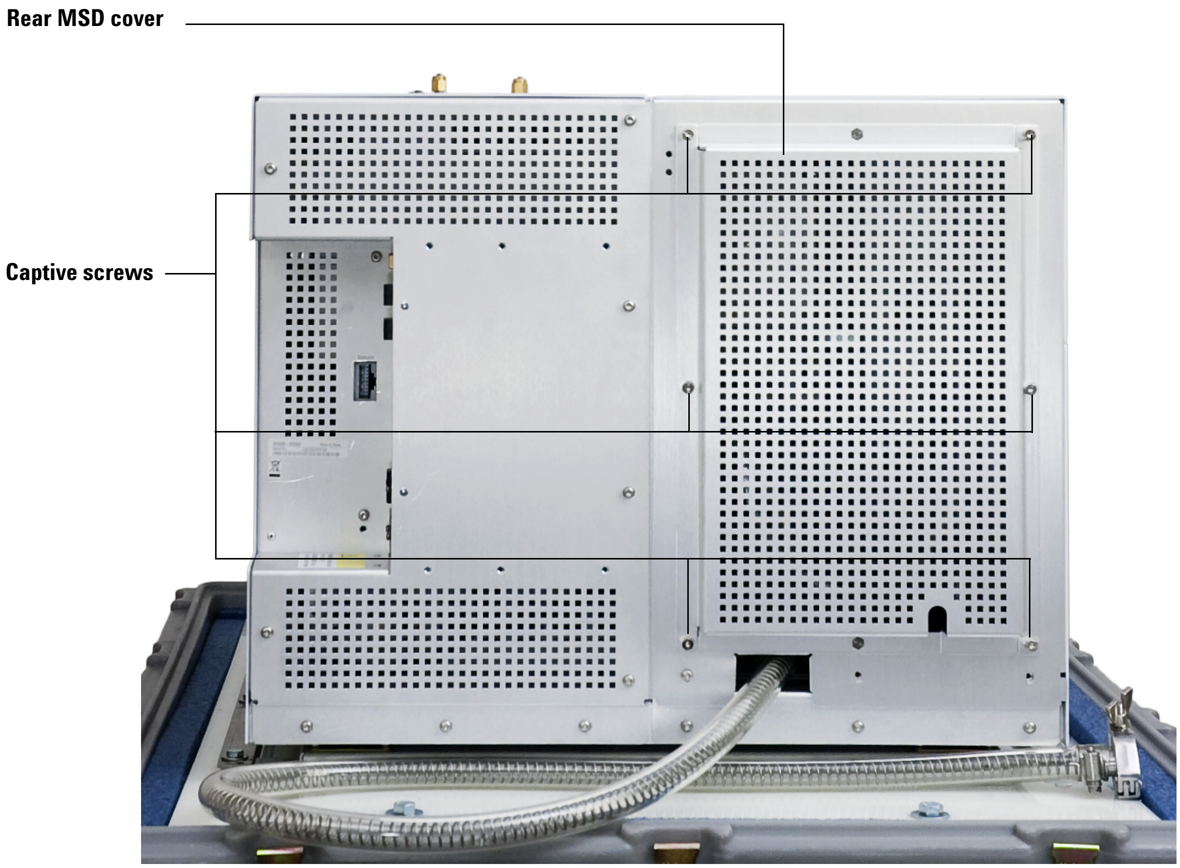


Figure 8 Removing MSD rear cover

To Remove the Micro-Ion Vacuum Gauge

Procedure

1 Vent the instrument.
2 Remove the MSD back cover.
3 Disconnect the cable on the back of the Micro-Ion vacuum gauge.
4 Unscrew the large thumbnut on the gauge clamp.
5 Remove the long screw from the clamp.
6 While supporting the gauge body, remove the clamp from the mounting flange.
7 Remove the gauge.
8 If you will not be replacing the gauge soon, install the blanking plate provided with the gauge and secure it with the clamp, screw, and thumbnut.
9 Replace the rear MSD cover. See Figure 8.

To Lubricate the Side Plate O-Ring

Materials needed

- Cloths, clean (05980-60051)
- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Grease, Apiezon L, high vacuum (6040-0289)

The side plate O-ring needs a thin coat of grease to ensure a good vacuum seal. If the side plate O-ring appears dry or does not seal correctly, lubricate it using this procedure. A good test is to wipe off the side plate with methanol, then close the analyzer chamber. If the O-ring has enough grease on it, it will leave a faint trace on the side plate.

CAUTION Vacuum seals other than the side plate O-ring and vent valve O-ring do not need to be lubricated. Lubricating other seals can interfere with their correct function.

Procedure

1. Vent the instrument.
2. Open the analyzer chamber. (See the *5975T LTM GC/MSD Operation Manual*).
3. Remove the analyzer by disconnecting the source wiring, and loosening the sideboard from the hinge. (See the *5975T LTM GC/MSD Operation Manual*).
4. Use a clean, lint-free cloth or glove to spread a *thin* coat of high vacuum grease only on the exposed surface of the O-ring (Figure 9).

CAUTION Do not use anything except the recommended vacuum grease. Excess grease can trap air and dirt. Grease on surfaces of the O-ring other than the exposed surface can trap air, resulting in air spikes during operation.

5. Use a clean, lint-free cloth or glove to wipe away excess grease. If the O-ring looks shiny, there is too much grease on it.

6 Close the analyzer chamber.

7 Pump down the MSD.

Figure 9 Side plate O-ring

To Lubricate the Vent Valve O-Ring

Materials needed

- Cloths, clean (05980-60051)
- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Grease, Apiezon L, high vacuum (6040-0289)
- O-ring, vent valve (0905-1217). Replace if the old O-ring is worn or damaged

The vent valve O-ring needs a thin coat of lubrication to ensure a good vacuum seal and smooth operation. If the vent valve O-ring does not turn smoothly or does not seal correctly, lubricate it using this procedure.

CAUTION Vacuum seals other than the side plate O-ring and vent valve O-ring do not need to be lubricated. Lubricating other seals can interfere with their correct function.

Procedure

1. Vent the instrument.
2. Completely remove the vent valve knob (Figure 10).
3. Inspect the O-ring. If the O-ring appears damaged, replace it.
4. Use a clean, lint-free cloth or glove to spread a *thin* coat of high vacuum grease on the exposed surface of the O-ring.

CAUTION Excess grease can trap air and dirt. Grease on surfaces of the O-ring other than the exposed surface can trap air, resulting in air spikes during operation.

5. Use a clean, lint-free cloth or glove to wipe away excess grease. If the O-ring looks shiny, there is too much grease on it.

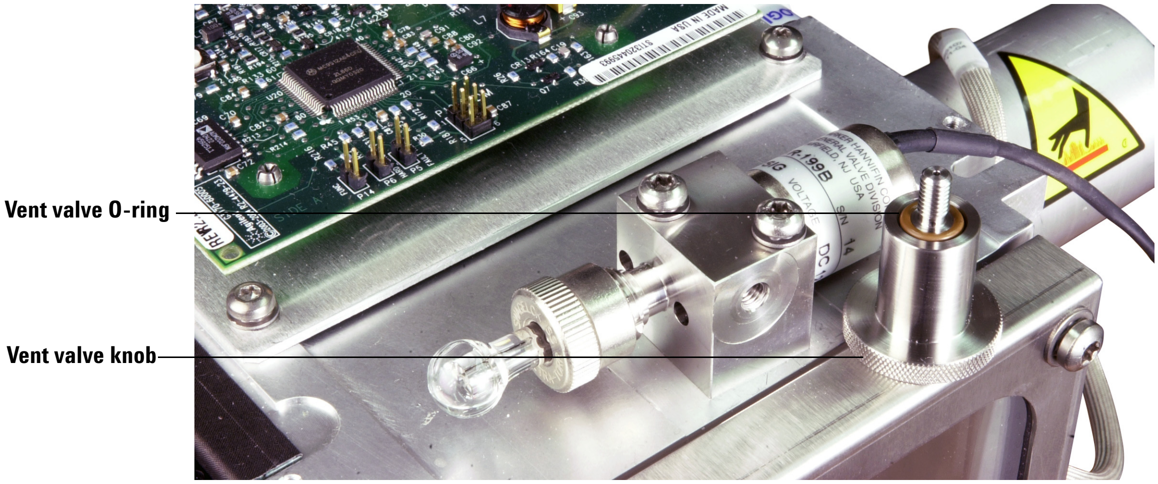


Figure 10 Vent valve O-ring

6 Reinstall the vent valve knob.

CAUTION

Be very careful when reinstalling the vent valve knob. It is possible to cross thread the knob and damage the threads in the valve body. Be sure the O-ring stays in place.

7 Pump down the instrument.

Maintaining the Analyzer

Scheduling

None of the analyzer components require periodic maintenance. Some tasks, however, must be performed when MSD behavior indicates they are necessary. These tasks include:

- Cleaning the ion source
- Replacing filaments
- Replacing the electron multiplier horn

Chapter 3 provides information about symptoms that indicate the need for analyzer maintenance. The troubleshooting material in the online help in the GC/MSD ChemStation software provides more extensive information.

Precautions

Cleanliness

Keep components clean during analyzer maintenance. Analyzer maintenance involves opening the analyzer chamber and removing parts from the analyzer. During analyzer maintenance procedures, take care to avoid contaminating the analyzer or interior of the analyzer chamber. Wear clean gloves during all analyzer maintenance procedures. After cleaning, parts must be thoroughly baked out before they are reinstalled. After cleaning, analyzer parts should be placed only on clean, lint-free cloths.

CAUTION If not done correctly, analyzer maintenance can introduce contaminants into the MSD.

WARNING **The analyzer operates at high temperatures. Do not touch any part until you are sure it is cool.**

Some parts can be damaged by electrostatic discharge

The wires, contacts, and cables connected to the analyzer components can carry electrostatic discharges (ESD) to the electronics boards to which they are connected. This is especially true of the mass filter (quadrupole) contact wires which can conduct ESD to sensitive components on the side board. ESD damage may not cause immediate failure but will gradually degrade performance and stability. See page 113 for more information.

CAUTION

Electrostatic discharges to analyzer components are conducted to the side board where they can damage sensitive components. Wear a grounded antistatic wrist strap (see page 113) and take other antistatic precautions ***before*** you open the analyzer chamber.

Some analyzer parts should not be disturbed

The mass filter (quadrupole) requires no periodic maintenance. In general, the mass filter should never be disturbed. In the event of extreme contamination, it can be cleaned, but such cleaning should only be done by a trained Agilent Technologies service representative. The HED ceramic insulator must never be touched.

CAUTION

Incorrect handling or cleaning of the mass filter can damage it and have a serious, negative effect on instrument performance. Do not touch the HED ceramic insulator.

More information is available

If you need more information about the locations or functions of analyzer components, refer to Chapter 13, “Analyzer” on page 199.

Many procedures in this chapter are illustrated with video clips.

To Remove the EI Ion Source

Materials needed

- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Pliers, long-nose (8710-1094)

Procedure

1 Vent the instrument.

2 Open the analyzer chamber. See the *5975T LTM GC/MSD Operation Manual*.

3 Make sure you use an antistatic wrist strap and take other antistatic precautions before touching analyzer components.

4 Disconnect the seven wires from the ion source. Do not bend the wires any more than necessary (Figure 11 and Table 7).

Table 7 Ion source wires

Wire color	Connects to	Number of leads
Blue	Entrance lens	1
Orange	Ion focus	1
White	Filament 1 (top filament)	2
Red	Repeller	1
Black	Filament 2 (bottom filament)	2

CAUTION Pull on the connectors, not on the wires.

5 Trace the wires for the ion source heater and temperature sensor to the feedthrough board. Disconnect them there.

6 Remove the thumbscrews that hold the ion source in place.

7 Pull the ion source out of the source radiator.

WARNING **The analyzer operates at high temperatures. Do not touch any part until you are sure it is cool.**

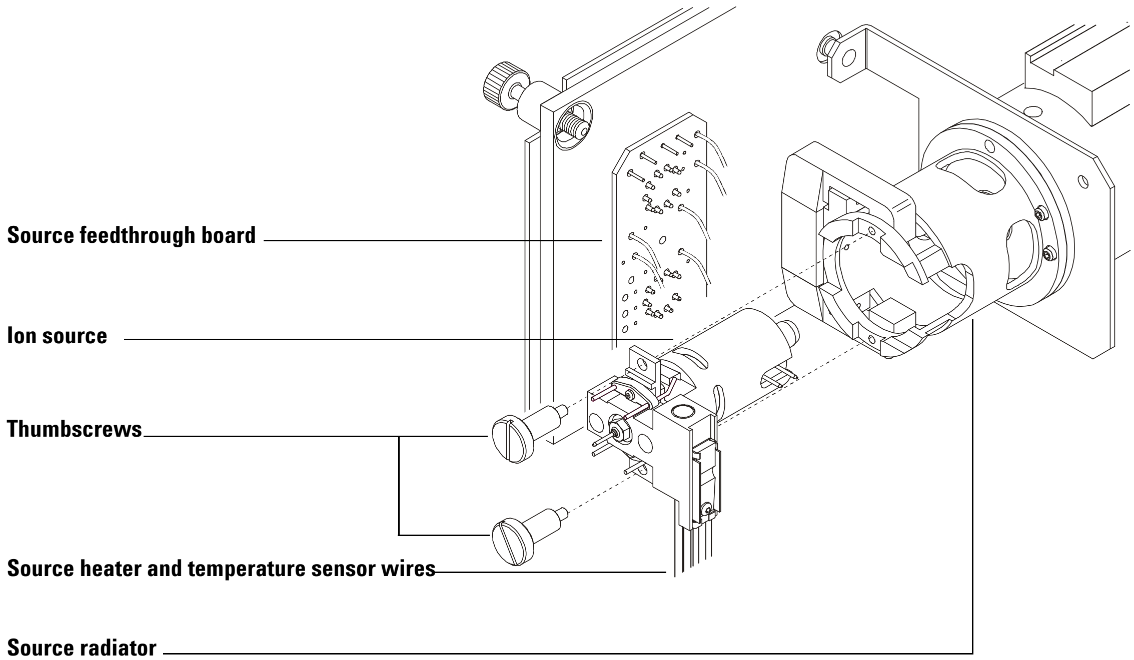


Figure 11 Removing the ion source

To Disassemble the EI Ion Source

Materials needed

- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Hex ball driver, 1.5 mm (8710-1570)
- Hex ball driver, 2.0 mm (8710-1804)
- Wrench, open-end, 10 mm (8710-2353)

Procedure

1. Remove the ion source. See the "To Remove the EI Ion Source" on page 139.
2. Remove the filaments (Figure 12).
3. Separate the repeller assembly from the source body. The repeller assembly includes the source heater assembly, repeller, and related parts.
4. Remove the repeller.
5. Unscrew the interface socket. A 10-mm open-end wrench fits the flats on the interface socket.
6. Remove the setscrew for the lenses.
7. Push the lenses out of the source body.

NOTE Video shows the standard Ion Source Assembly procedures.

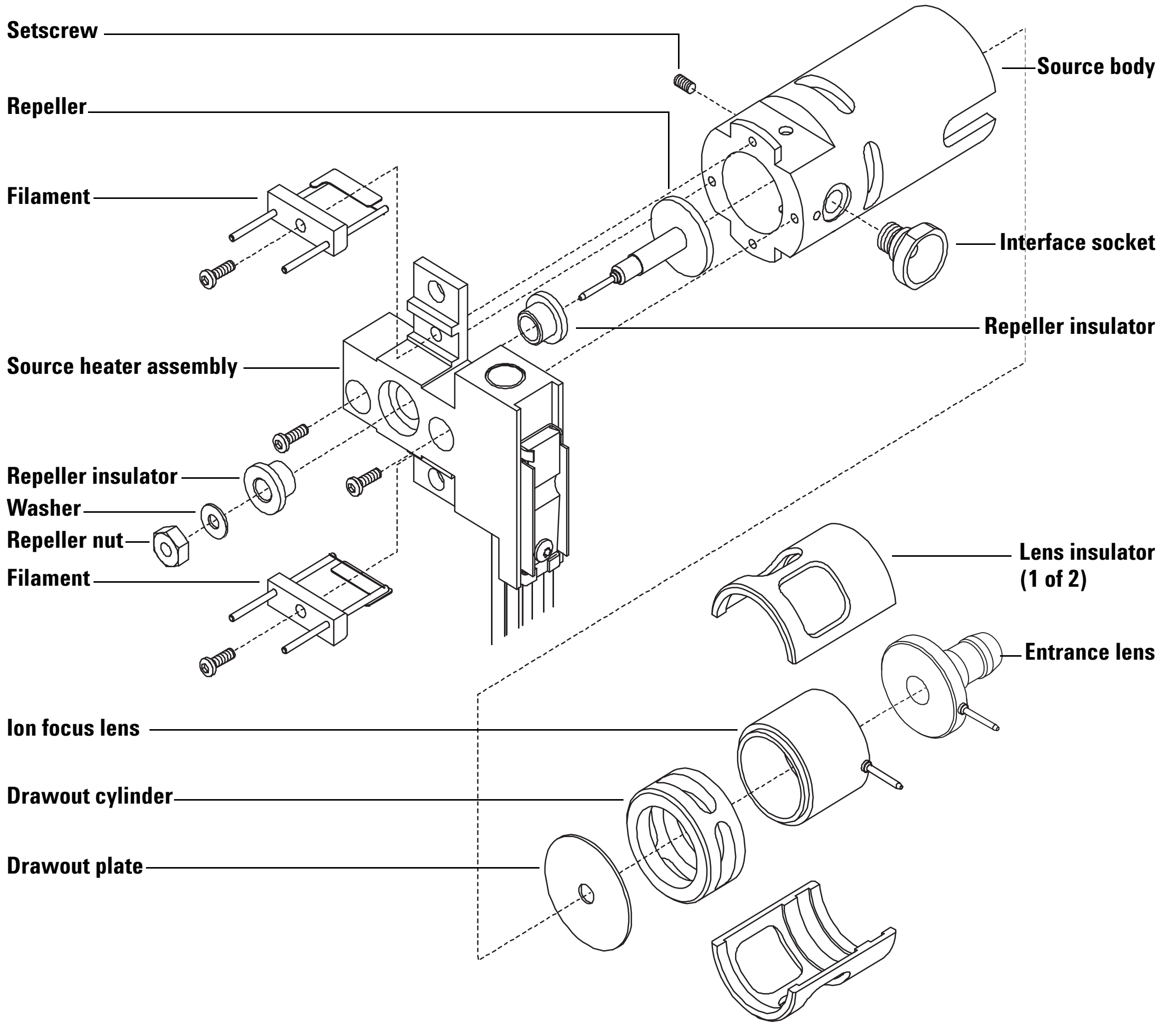


Figure 12 Disassembling the EI ion source

To Clean the EI Ion Source

Materials needed

- Abrasive paper (5061-5896)
- Alumina abrasive powder (8660-0791)
- Aluminum foil, clean
- Cloths, clean (05980-60051)
- Cotton swabs (5080-5400)
- Glass beakers, 500 mL
- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Solvents
  - Acetone, reagent grade
  - Methanol, reagent grade
  - Methylene chloride, reagent grade
- Ultrasonic bath

Preparation

1 Disassemble the ion source. See page 141.

2 Collect the following parts to be cleaned: (Figure 13)
  - Repeller
  - Interface socket
  - Source body
  - Drawout plate
  - Drawout cylinder
  - Ion focus lens
  - Entrance lens

These are the parts that contact the sample or ion beam. The other parts normally should not require cleaning.

CAUTION

If insulators are dirty, clean them with a cotton swab dampened with reagent-grade methanol. If that does not clean the insulators, replace them. Do not abrasively or ultrasonically clean the insulators.

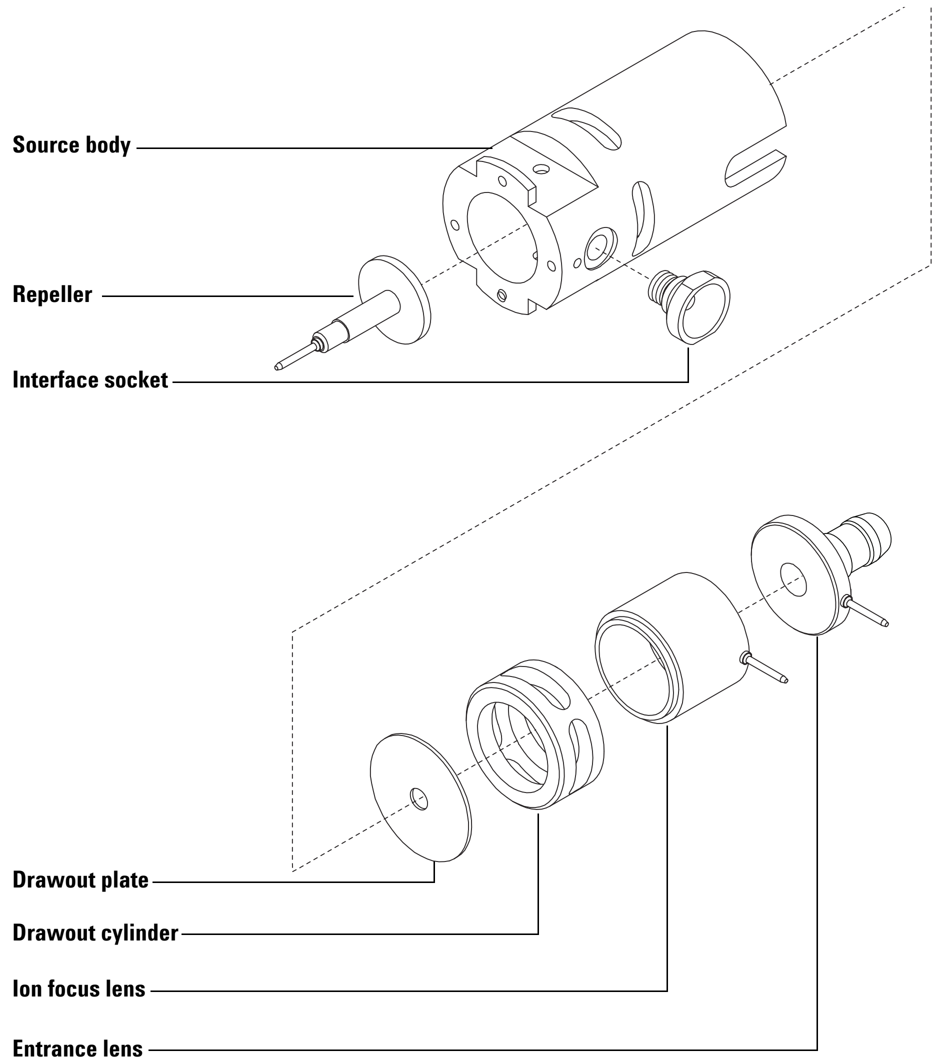


Figure 13 Source parts to be cleaned

Procedure

CAUTION

The filaments, source heater assembly, and insulators cannot be cleaned ultrasonically. Replace these components if major contamination occurs.

3 If the contamination is serious, such as an oil backflow into the analyzer, seriously consider replacing the contaminated parts.

4 Abrasively clean the surfaces that contact the sample or ion beam.

Use an abrasive slurry of alumina powder and reagent-grade methanol on a cotton swab. Use enough force to remove all discolorations. Polishing the parts is not necessary; small scratches will not harm performance. Also abrasively clean the discolorations where electrons from the filaments enter the source body.

5 Rinse away all abrasive residue with reagent-grade methanol.

Make sure ***all*** abrasive residue is rinsed way ***before*** ultrasonic cleaning. If the methanol becomes cloudy or contains visible particles, rinse again.

6 Separate the parts that were abrasively cleaned from the parts that were not abrasively cleaned.

7 Ultrasonically clean the parts (each group separately) for 15 minutes in each of the following solvents:

- Methylene chloride (reagent-grade)
- Acetone (reagent-grade)
- Methanol (reagent-grade)

WARNING **All of these solvents are hazardous. Work in a fume hood and take all appropriate precautions.**

8 Place the parts in a clean beaker. ***Loosely*** cover the beaker with clean aluminum foil (dull side down).

9 Dry the cleaned parts in an oven at 100 °C for 5–6 minutes.

WARNING **Let the parts cool before you handle them.**

NOTE Take care to avoid recontaminating cleaned and dried parts. Put on new, clean gloves before handling the parts. Do not set the cleaned parts on a dirty surface. Set them only on clean, lint-free cloths.

To Reassemble the EI Ion Source

Materials needed

- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Hex ball driver, 1.5 mm (8710-1570)
- Hex ball driver, 2.0 mm (8710-1804)
- Wrench, open-end, 10 mm (8710-2353)

Procedure

1. Slide the drawout plate and the drawout cylinder into the source body (Figure 14).
2. Assemble the ion focus lens, entrance lens, and lens insulators.
3. Slide the assembled parts into the source body.
4. Install the setscrew that holds the lenses in place.
5. Reinstall the repeller, repeller insulators, washer, and repeller nut into the source heater assembly.

   The resulting assembly is called the repeller assembly.

CAUTION Do not overtighten the repeller nut or the ceramic repeller insulators will break when the source heats up. The nut should only be finger-tight.

6. Reconnect the repeller assembly to the source body. The repeller assembly includes the source heater assembly, repeller, and related parts.
7. Reinstall the filaments.
8. Reinstall the interface socket

CAUTION Do not overtighten the interface socket. Overtightening could strip the threads.

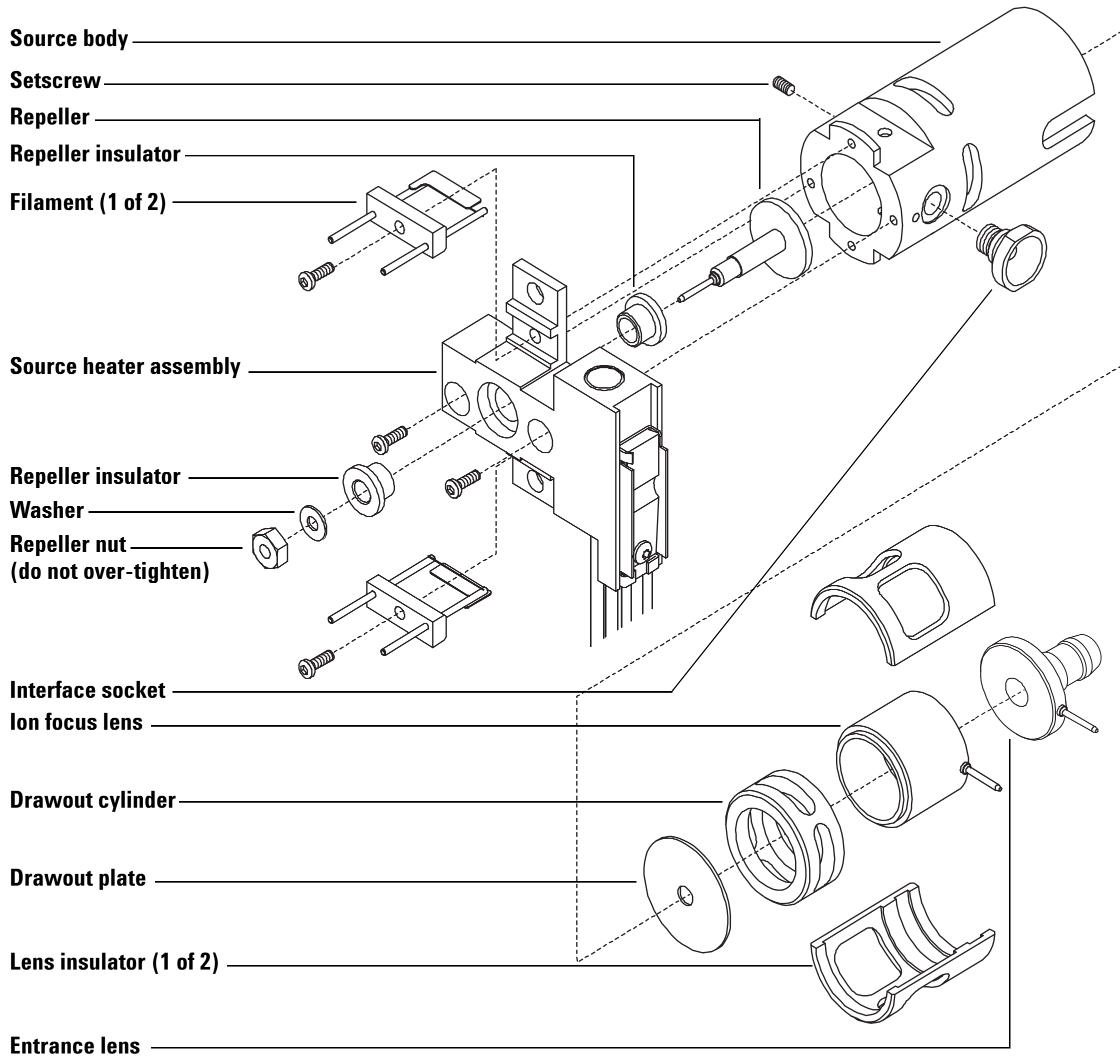


Figure 14 Assembling the ion source

To Reinstall the EI Ion Source

Materials needed

- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Pliers, long-nose (8710-1094)

Procedure

1. Slide the ion source into the source radiator (Figure 15).
2. Install and hand tighten the source thumbscrews. Do not overtighten the thumbscrews.
3. Connect the ion source wires as shown in "To Remove the EI Ion Source" on page 139.
4. Close the analyzer chamber.
5. Pump down the instrument. See the *5975T LTM GC/MSD Operation Manual*.

To Remove a Filament

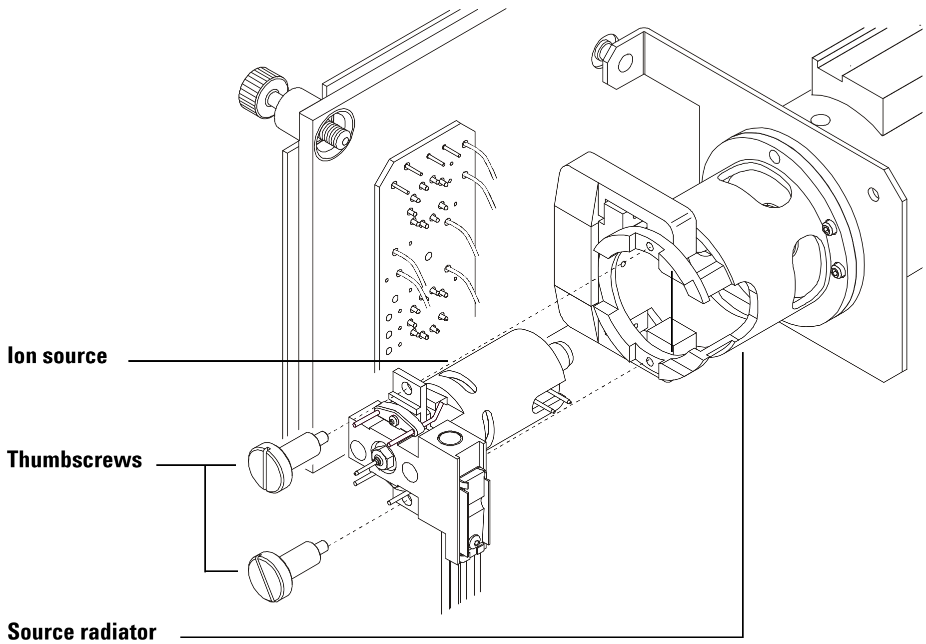


Figure 15 Installing the EI ion source

Materials needed

- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Hex ball driver, 1.5-mm (8710-1570)

Procedure

1. Vent the MSD.
2. Open the analyzer chamber.
3. Remove the ion source. See the "To Remove the EI Ion Source" on page 139.
4. Remove the filament(s) to be replaced (Figure 16).

WARNING **The analyzer operates at high temperatures. Do not touch any part until you are sure it is cool.**

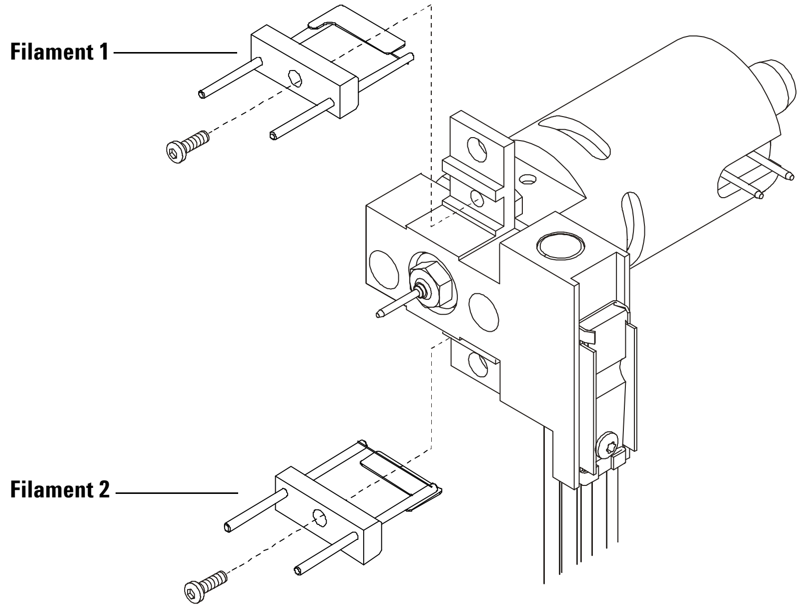


Figure 16 Replacing filaments

To Reinstall a Filament

Materials needed

- Filament assembly (G2590-60053)
- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Hex ball driver, 1.5 mm (8710-1570)

Procedure

1. Install the new filament (Figure 16).
2. Remove the screw holding the filament to the ion source body.
3. Slide off the filament assembly.
4. Orient the assembly so that the filament is next to the ion source body.
5. Replace the screw to the ion source body.
6. After installing the filament, verify that it is not grounded to source body.
7. Reinstall the ion source. See the “To Reinstall the EI Ion Source” on page 148.
8. Close the analyzer chamber.
9. Pump down the MSD.
10. Autotune the MSD.
11. In the **Edit Parameters** dialog box (**Instrument/Edit MS Tune Parameters**), select the other filament.
12. Autotune the MSD again.
13. Select and use the filament that gives the best results.

    If you decide to use the first filament, run Autotune again to make sure the tune parameters are compatible with the filament.
14. Select **Save Tune Parameters** from the **File** menu.

To Remove the Heater and Sensor from the Ion Source

Materials needed

- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Hex ball driver, 1.5 mm (8710-1570)
- Hex ball driver, 2.0 mm (8710-1804)
- Hex nut driver, 5.5 mm (8710-1220)

Procedure

1. Vent the MSD.
2. Open the analyzer chamber.
3. Remove the ion source from the source radiator. See the “To Remove the EI Ion Source” on page 139.
4. Remove the filaments.
5. Remove the repeller assembly (Figure 17). The repeller assembly includes the source heater assembly, repeller, and related parts.
6. Remove the repeller nut, washer, repeller insulators, and repeller.

   You do not need to remove the heater and temperature sensor from the heater block. The new source heater assembly includes all three parts already assembled.

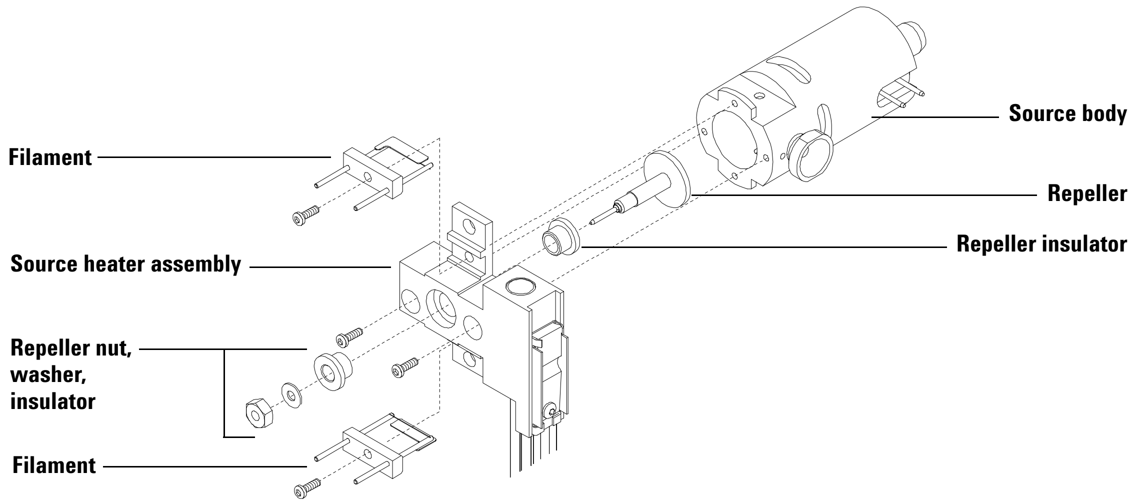


Figure 17 Replacing the heater and sensor

To Reinstall the Heater and Sensor in the Ion Source

Materials needed

- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Hex ball driver, 1.5 mm (8710-1570)
- Hex ball driver, 2.0 mm (8710-1804)
- Hex nut driver, 5.5 mm (8710-1220)
- Source heater assembly (G3169-60177)

Procedure

1 Unpack the new source heater assembly. The heater, temperature sensor, and heater block are already assembled.

2 Reinstall the repeller, repeller insulators, washer, and repeller nut (Figure 17). The resulting assembly is called the repeller assembly.

CAUTION Do not overtighten the repeller nut or the ceramic repeller insulators will break when the source heats up. The nut should only be finger-tight.

3 Connect the repeller assembly to the source body.

4 Reinstall the filaments.

5 Reinstall the ion source in the source radiator. See the “To Reinstall the EI Ion Source” on page 148.

6 Reconnect the wires from the feedthrough board to the ion source.

7 Reconnect the heater and temperature sensor wires to the feedthrough board.

8 Close the analyzer chamber.

9 Pump down the MSD.

To Remove the Heater and Sensor from the Mass Filter

Materials needed

- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Hex ball driver, 1.5 mm (8710-1570)
- Hex ball driver, 2.0 mm (8710-1804)

Procedure

1. Vent the instrument.
2. Open the analyzer chamber.
3. Disconnect the mass filter heater and temperature sensor wires from the feedthrough board.
4. Remove the mass filter heater assembly from the mass filter radiator.

CAUTION Do not touch the mass filter contact leads. This could cause ESD damage to the side board.

To Reinstall the Heater and Sensor in the Mass Filter

Materials needed

- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Hex ball driver, 1.5 mm (8710-1570)
- Hex ball driver, 2.0 mm (8710-1804)
- Mass filter heater assembly (G1099-60172)

Procedure

1. Unpack the new mass filter heater assembly (Figure 18). The heater, temperature sensor, and heater block are already assembled.
2. Install the heater assembly on top of the mass filter radiator.
3. Connect the heater and temperature sensor wires to the feedthrough board.
4. Close the analyzer chamber.
5. Pump down the MSD.

CAUTION Do not touch the mass filter contact leads. This could cause ESD damage to the side board.

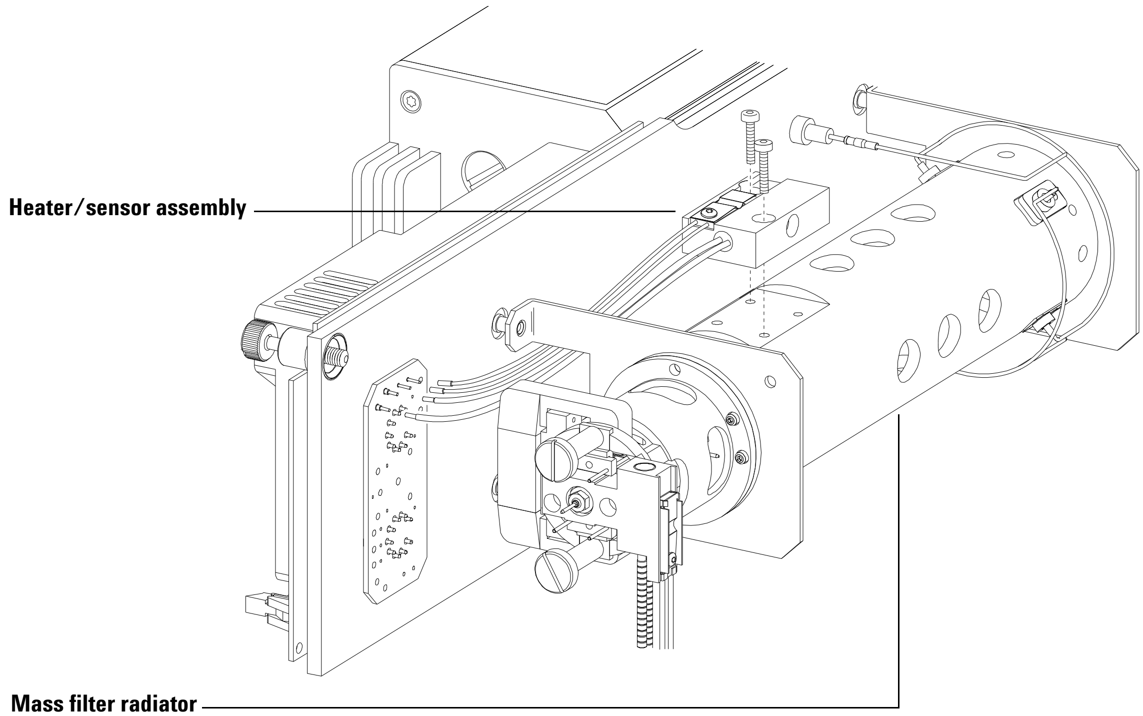


Figure 18 Mass filter heater and sensor

To Replace the Electron Multiplier Horn

Materials needed

- Electron multiplier horn (G3170-80103)
- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)

Procedure

1. Vent the instrument.
2. Open the analyzer chamber.
3. Open the retaining clip (Figure 19). Lift the arm of the clip up and then swing the clip away from the electron multiplier horn.
4. Remove the electron multiplier horn.
5. Install the new electron multiplier horn.
6. Close the retaining clip.

   The signal pin on the horn must rest ***on the outside*** of the loop in the contact strip. ***Do not*** put the signal pin on the inside of the loop in the contact strip. Incorrect installation will result in poor sensitivity or no signal.
7. Close the analyzer chamber.

8 Pump down the MSD.

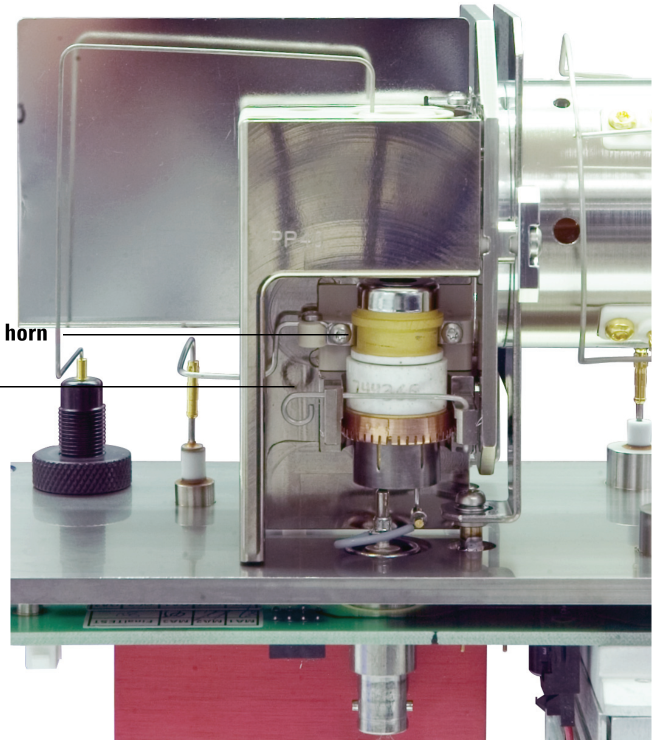


Figure 19 Replacing the electron multiplier horn

Maintaining the Electronics

Scheduled maintenance

None of the instrument's electronic components need to be replaced on a regular schedule. None of the electronic components in the MSD need to be adjusted or calibrated on a regular schedule. Avoid unnecessary handling of the MSD electronics.

Electronic components

Very few of the electronic components are operator serviceable. The primary fuses can be replaced by the operator. The RF coils can be adjusted by the operator. All other maintenance of the electronics should be performed by your Agilent Technologies service representative.

WARNING **Improper use of these procedures could create a serious safety hazard. Improper use of these procedures could also result in serious damage to, or incorrect operation of, the MSD.**

WARNING **Vent the MSD and disconnect its power cord before performing any of these procedures *except* adjusting the RF coils.**

Electrostatic precautions

All of the printed circuit boards in the GC/MSD contain components that can be damaged by electrostatic discharge (ESD). Do not handle or touch these boards unless absolutely necessary. In addition, wires, contacts, and cables can conduct ESD to the printed circuit boards to which they are connected. This is especially true of the mass filter (quadrupole) contact wires which can carry ESD to sensitive components on the side board. ESD damage may not cause immediate failure but it will gradually degrade the performance and stability of your MSD.

When you work on or near printed circuit boards, or when you work on components with wires, contacts, or cables connected to printed circuit boards, always use a grounded antistatic wrist strap and take other antistatic precautions. The wrist strap should be connected to a known good earth ground. If that is not possible, it should be connected to a conductive (metal) part of the assembly being worked on, but ***not*** to electronic components, exposed wires or traces, or pins on connectors.

Take extra precautions, such as a grounded antistatic mat, if you must work on components or assemblies that have been removed from the MSD. This includes the analyzer.

CAUTION In order to be effective, an antistatic wrist strap must fit snugly (not tight). A loose strap provides little or no protection.

CAUTION Antistatic precautions are not 100% effective. Handle electronic circuit boards as little as possible and then only by the edges. Never touch the components, exposed traces, or pins on connectors and cables.

More information is available

If you need more information about the functions of electronic components, refer to Chapter 14, “Electronics” on page 215.

Most of the procedures in this chapter are illustrated with video clips.

To Adjust the Quad Frequency

Materials needed

- Screwdriver, flat-blade, large (8730-0002)

Procedure

1 Make sure the MSD is at thermal equilibrium. It takes at least 2 hours ***after*** all heated zones have reached their setpoints for the MSD to reach thermal equilibrium.

2 Open the analyzer cover.

WARNING **Do not remove any other covers. Dangerous voltages are present under these covers.**

3 Make sure the RF cover on the side board is secure and no screws are missing. A loose RF cover or missing screw can ***significantly*** affect coil adjustment.

4 In the **Tune and Vacuum Control** view, select **Optimize Quadropole Frequency** from the **Execute** menu.

5 Enter an *m/z* value of 100.

6 Slowly turn the quad frequency adjustment screws to minimize the voltage displayed (Figure 20).

Turn the adjustment screws alternately. Turn each screw only a little bit at a time. Keep the screws at ***equal*** extension. The minimum voltage is typically between 50 and 70 mV.

CAUTION Do not use a coin to adjust the screws. If you drop it, it could fall into the electronics fan and cause significant damage.

7 When the voltage is minimized, click **Stop**.

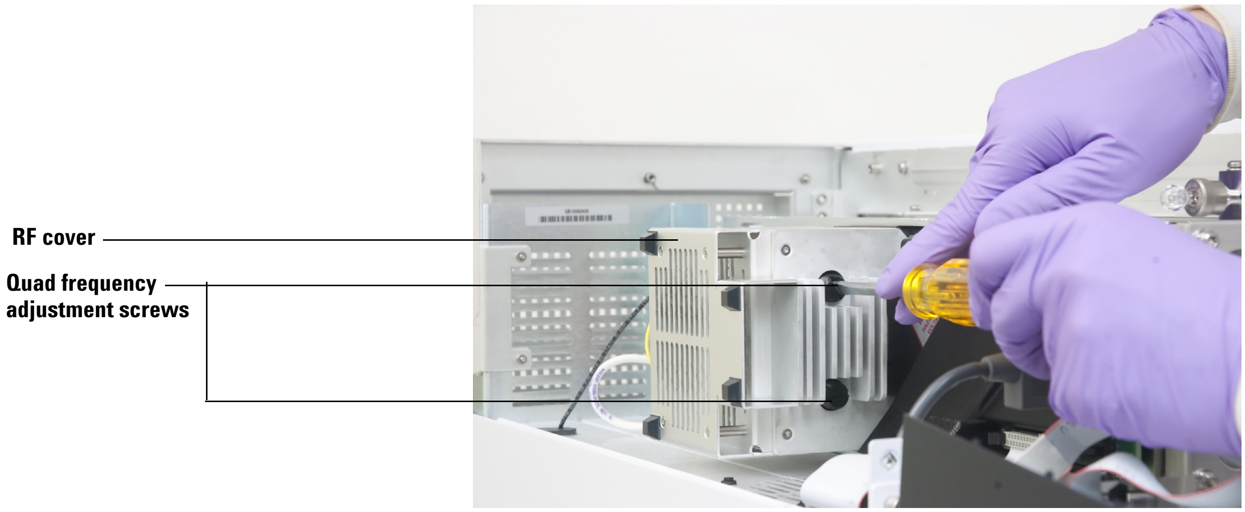


Figure 20 Adjusting the quad frequency

8 Repeat steps 4 through 7 for *m/z* 650. The minimum voltage is typically between 300 and 340 mV.

9 Exit the Set Optimize Quadrupole Frequency program.

10 Select **MS OFF** from the **Execute** menu.

11 Close the analyzer cover.

12 Tune the MSD.

To Replace the Primary Fuses

Materials needed

- Fuse, T8 A, 250 V (2110-0969) – 2 required
- Screwdriver, flat-blade (8730-0002)

The most likely cause of failure of the primary fuses is a problem with the foreline pump. If the primary fuses in your MSD fail, check the foreline pump.

Procedure

1 Vent the MSD and unplug the power cord from the electrical outlet.

If one of the primary fuses has failed, the instrument will already be off, but for safety you should switch off the instrument and unplug the power cord. It is not necessary to allow air into the analyzer chamber.

WARNING **Never replace the primary fuses while the instrument is connected to a power source.**

WARNING **If you are using hydrogen as a GC carrier gas, a power failure may allow it to accumulate in the analyzer chamber. In that case, further precautions are required. See "Hydrogen Safety" on page 19.**

2 Turn one of the fuse holders (Figure 21) counterclockwise until it pops out. The fuse holders are spring loaded.

3 Remove the old fuse from the fuse holder.

4 Install a new fuse in the fuse holder.

5 Reinstall the fuse holder.

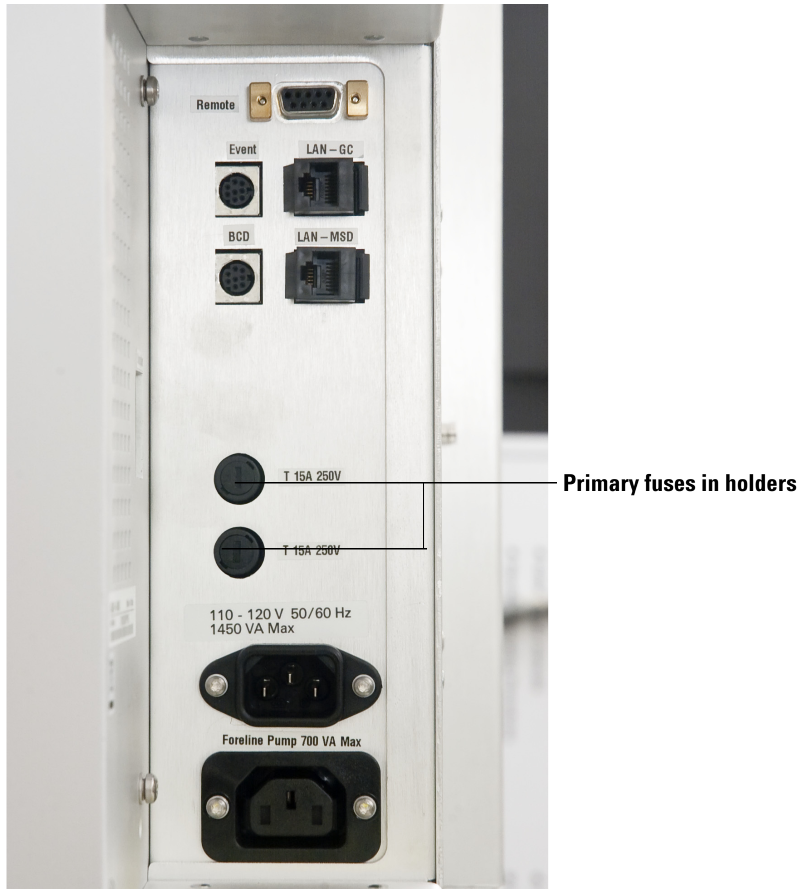


Figure 21 Primary fuses (turbo model shown)

6 Repeat steps 3 through 6 for the other fuse. Always replace both fuses.

7 Reconnect the instrument power cord to the electrical outlet.

8 Pump down the MSD.

11
Maintaining the Split/Splitless Inlet

Consumables and Parts for the Split/Splitless Inlet

See the Agilent catalog for consumables and supplies for a more complete listing, or visit the Agilent Web site for the latest information (www.agilent.com/chem/supplies).

Table 8 Split, splitless, direct, and direct connect inlet liners

Mode	Description	Deactivated	Part number
Split	Low-pressure drop, glass wool, single taper, 870 µL	Yes	5183-4647
Split	Glass wool, 990 µL	No	19251-60540
Split—Manual only	Empty pin and cup, 800 µL	No	18740-80190
Split—Manual only	Packed pin and cup, 800 µL	No	18740-60840
Splitless	Single taper, glass wool, 900 µL	Yes	5062-3587
Splitless	Single taper, no glass wool, 900 µL	Yes	5181-3316
Splitless	Dual taper, no glass wool, 800 µL	Yes	5181-3315
Splitless—Direct inject	2-mm id, quartz, 250 µL	No	18740-80220
Splitless—Direct inject	2-mm id, 250 µL	Yes	5181-8818
Direct inject —Headspace or purge and trap	1.5-mm id, 140 µL	No	18740-80200
Direct column connect	Single taper, splitless 4-mm id	Yes	G1544-80730
Direct column connect	Dual taper, splitless 4-mm id	Yes	G1544-80700

Table 9 Nuts, ferrules, and hardware for capillary columns

Column id (mm)	Description	Typical use	Part number/quantity
.530	Ferrule, Vespel/graphite, 0.8-mm id	0.45-mm and 0.53-mm capillary columns	5062-3512 (10/pk)
	Ferrule, graphite, 1.0-mm id	0.53-mm capillary columns	5080-8773 (10/pk)
	Column nut, finger-tight (for 0.53-mm columns)	Connect column to inlet or detector	5020-8293
.320	Ferrule, Vespel/graphite, 0.5-mm id	0.32-mm capillary columns	5062-3514 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292

Table 9 Nuts, ferrules, and hardware for capillary columns (continued)

Column id (mm)	Description	Typical use	Part number/quantity
.250	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
.100 and .200	Ferrule, Vespel/graphite, 0.37-mm id	0.1-mm and 0.2-mm capillary columns	5062-3516 (10/pk)
	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet or detector	5020-8292
All	Ferrule, no-hole	Testing	5181-3308 (10/pk)
	Capillary column blanking nut	Testing—use with any ferrule	5020-8294
	Column nut, universal	Connect column to inlet or detector	5181-8830 (2/pk)
	Column cutter, ceramic wafer	Cutting capillary columns	5181-8836 (4/pk)

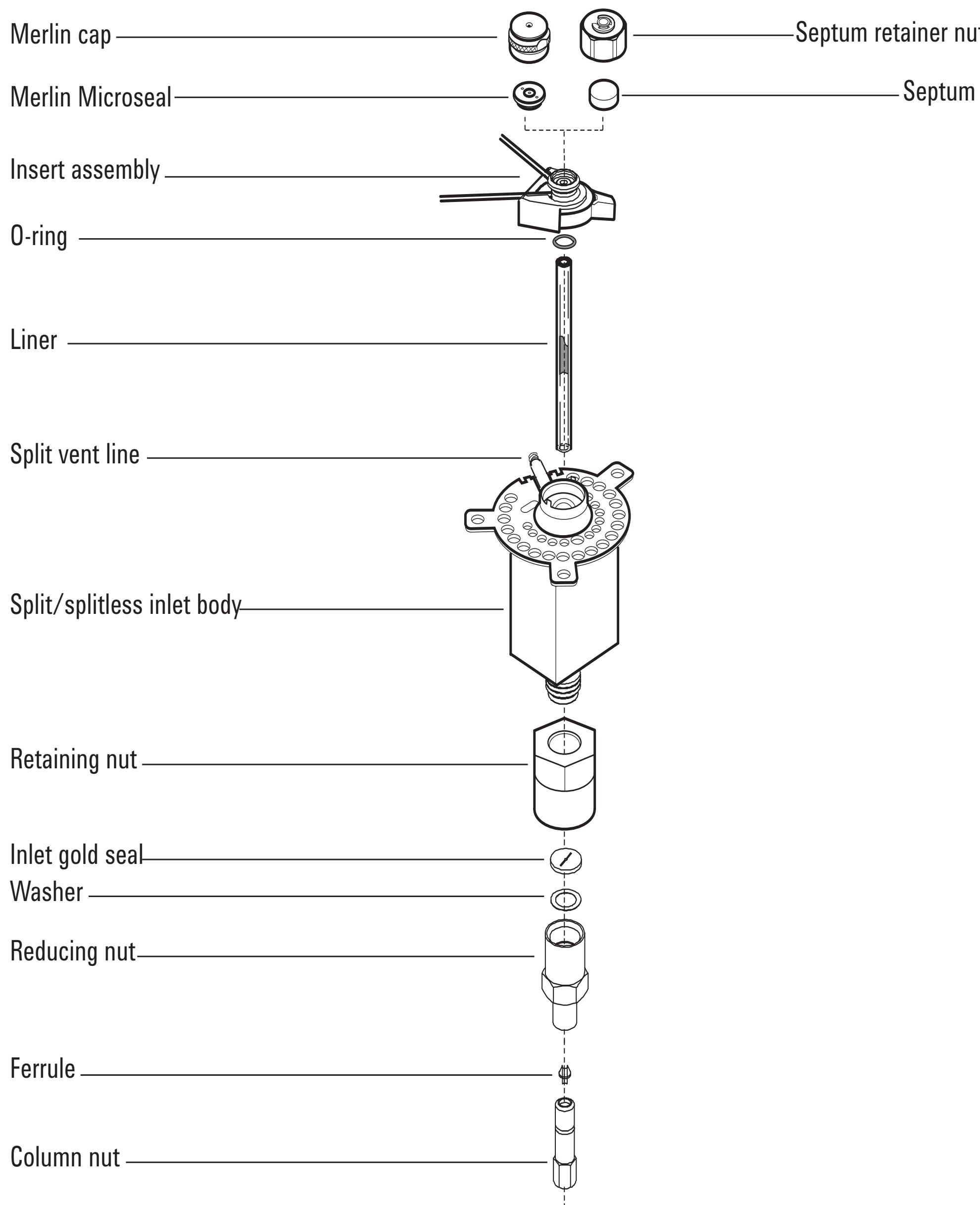
Table 10 Other consumables and parts for the split/splitless inlet

Description/quantity	Part number
Septum retainer nut for headspace	18740-60830
Septum retainer nut	18740-60835
11-mm septum, high-temperature, low-bleed, 50/pk	5183-4757
11-mm septum, prepierced, long life, 50/pk	5183-4761
Merlin Microseal septum (high-pressure)	5182-3444
Merlin Microseal septum (30 psi)	5181-8815
Nonstick fluorocarbon liner O-ring (for temperatures up to 350 °C), 10/pk	5188-5365
Graphite O-ring for split liner (for temperatures above 350 °C), 10/pk	5180-4168
Graphite O-ring for splitless liner (for temperatures above 350 °C), 10/pk	5180-4173
Split vent trap PM kit, single cartridge	5188-6495
Retaining nut	G1544-20590

Table 10 Other consumables and parts for the split/splitless inlet (continued)

Description/quantity	Part number
Gold-plated seal (standard application)	5188-5367
Gold-plated seal with cross (high split flows) (includes SS washer)	5182-9652
Stainless steel washer (0.375-inch od), 12/pk	5061-5869
Reducing nut	18740-20800
Column nut, blanking plug	5020-8294
Capillary inlet preventative maintenance kit, split	5188-6496
Capillary inlet preventative maintenance kit, splitless	5188-6497

Exploded Parts View of the Split/Splitless Inlet



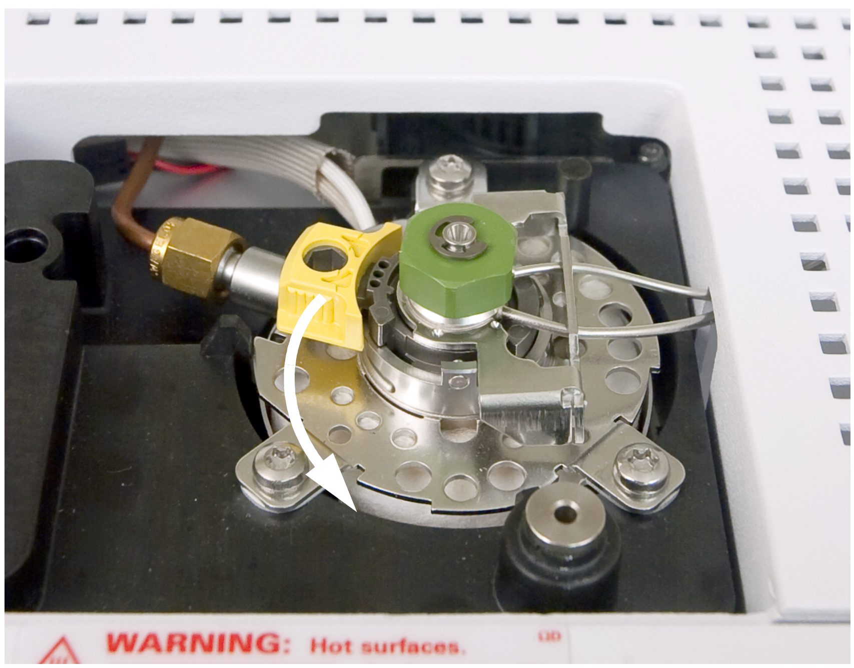
To Clean the Septum Seat in the Insert Assembly of the Split/Splitless Inlet

1 Gather the following:
   - Replacement septum (See “Consumables and Parts for the Split/Splitless Inlet” on page 168.)
   - Wrench, hex for changing septum
   - 0- or 00-grade steel wool (optional)
   - Tweezers
   - Compressed, filtered, dry air or nitrogen
   - Wrench, capillary inlet (optional)

2 Load the maintenance method (see the *5975T LTM GC/MSD Operation Manual*) and wait for the GC to become ready.

WARNING **Be careful! The oven and/or inlet may be hot enough to cause burns. If either is hot, wear heat-resistant gloves to protect your hands.**

3 Slide the locking tab forward (counterclockwise). Lift the septum assembly straight up and away from the inlet to avoid chipping or breaking the liner.



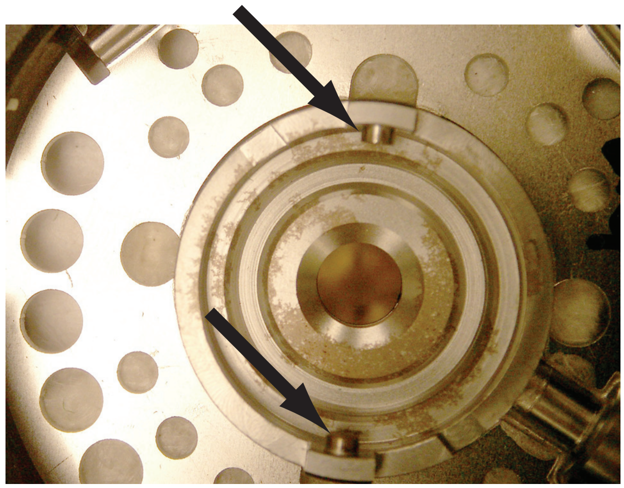
4 Remove the septum retainer nut or Merlin cap.

5 Use tweezers to remove the septum or Merlin Microseal from the retainer nut. (See "To Clean the Septum Seat in the Insert Assembly of the Split/Splitless Inlet" on page 172.)

6 Scrub the residue from the retainer nut and septum holder with a small piece of rolled-up steel wool and tweezers. Do not do this over the inlet.

7 Use compressed air or nitrogen to blow away the pieces of steel wool and septum.

8 Line up the tab on the bottom of the septum assembly with the slot on the insert assembly and push down to connect. Slide the locking tab to the left.



9 Firmly press the new septum or Merlin Microseal into the fitting. (See "To Clean the Septum Seat in the Insert Assembly of the Split/Splitless Inlet" on page 172.)

10 Replace the septum retainer nut or Merlin cap and finger-tighten. (See "To Clean the Septum Seat in the Insert Assembly of the Split/Splitless Inlet" on page 172.)

11 Restore the analytical method.

12 Reset the septum counter.

To Replace the Gold Seal on the Split/Splitless Inlet

1 Gather the following:
   - Replacement gold seal (See "Consumables and Parts for the Split/Splitless Inlet" on page 168.)
   - Replacement washer
   - 1/4-inch wrench (for column)
   - 1/2-inch wrench
   - Lint-free gloves

2 Load the maintenance method and wait for the GC to become ready.

WARNING **Be careful! The oven and/or inlet may be hot enough to cause burns. If either is hot, wear heat-resistant gloves to protect your hands.**

3 Open the Guard Column enclosure door.

4 Remove the inlet guard column from the inlet. Cap the open end of the column to prevent contamination.

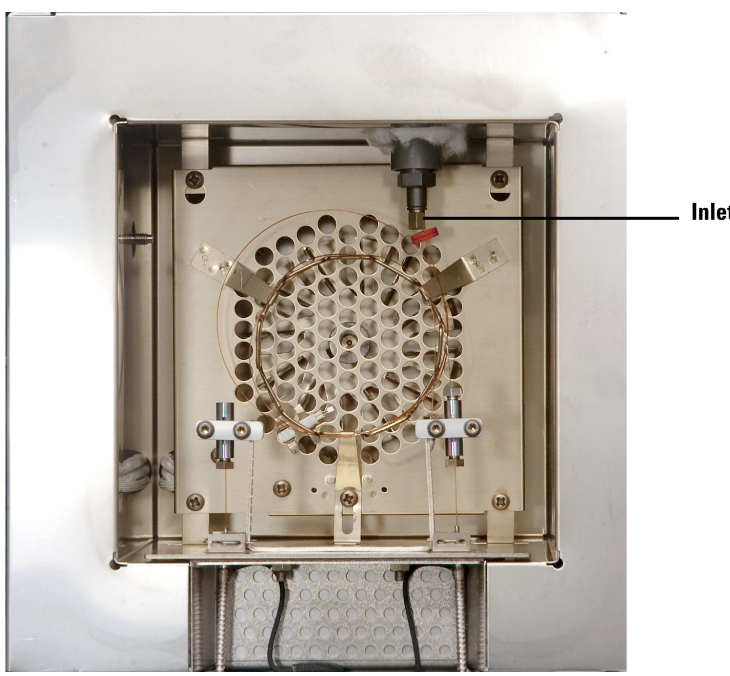
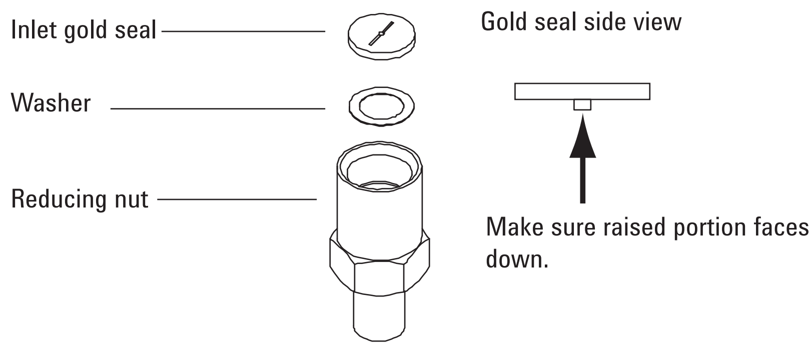


Figure 22 Inlet

5 Loosen and remove the reducing nut. Remove the washer and seal inside the reducing nut.

CAUTION Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

6 Put on gloves to protect the new gold seal and washer from contamination. Put a new washer in the reducing nut and place the new gold seal on top of it (raised portion facing down).



7 Replace the reducing nut and tighten securely with a wrench.

8 Install the inlet guard column.

9 Bakeout contaminants. (See the *5975T LTM GC/MSD Operation Manual.*)

10 Restore the analytical method.

11 Reset the EMF counter.

12 Check for leaks.

To Replace the Filter in the Split Vent Line for the Split/Splitless Inlet

1 Gather the following:
   - New filter cartridge. (See “Consumables and Parts for the Split/Splitless Inlet” on page 168.)
   - T-20 Torx screwdriver

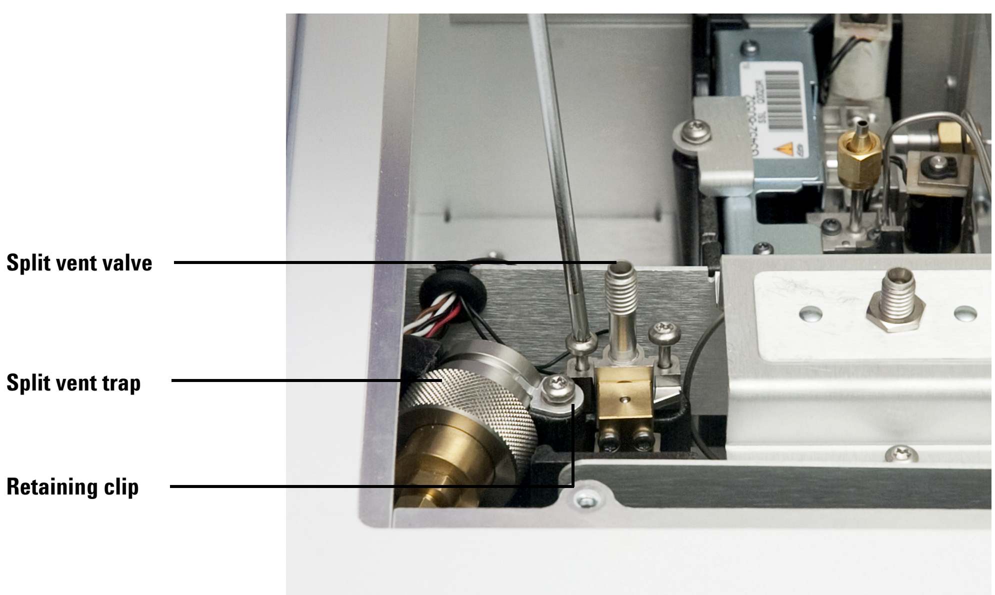
2 Load the maintenance method and wait for the GC to become ready.

WARNING **Be careful! The oven and/or inlet may be hot enough to cause burns. If either is hot, wear heat-resistant gloves to protect your hands.**

WARNING **The split vent trap may contain residual amounts of any samples or other chemicals you have injected into the GC. Follow your company’s safety procedures for handling these types of substances while replacing the trap filter cartridge.**

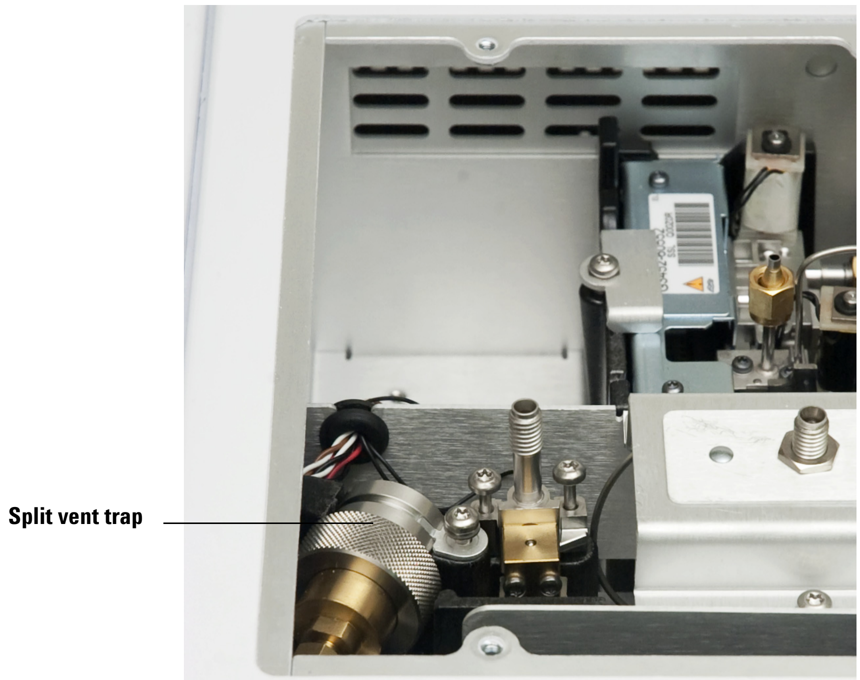
3 Remove the pneumatics cover on the top of the instrument.

4 Loosen the screws on the retaining clip.

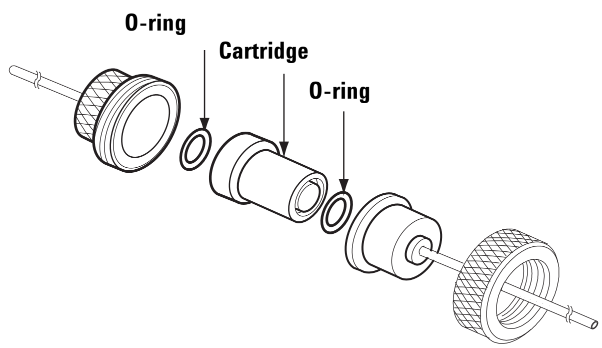


5 Completely loosen the two screws that secure the split vent valve in place.

6 Lift the filter trap assembly and split vent valve from the mounting bracket together and unscrew the split vent front weldment on the filter trap assembly. Be careful not to stress the tubing between the split vent valve and the trap.



7 Remove the old filter cartridge and two O-rings.



8 Verify the new O-rings are seated properly on the new filter cartridge.

9 Install the new filter cartridge then reassemble the trap. Do not fully tighten yet.

10 Place the filter trap assembly in the mounting bracket and install the retaining clip.

11 Install the split vent valve.

12. Fully tighten the split vent front weldment onto the trap.
13. Check for leaks.
14. Restore the analytical method.
15. Reset the split vent trap counter.
16. Install the pneumatics cover.

To Clean the Split/Splitless Inlet

1 Gather the following:
   - Replacement septum (See "Consumables and Parts for the Split/Splitless Inlet" on page 168.)
   - Replacement liner
   - Replacement O-ring
   - Replacement gold seal
   - Replacement washer
   - Solvent that will clean the type of deposits in your inlet
   - Compressed, filtered, dry air or nitrogen
   - Beaker
   - Cleaning brushes—The FID cleaning kit (part number 9301-0985) contains appropriate brushes
   - Lint-free gloves

2 Load the maintenance method and wait for the GC to become ready.

WARNING **Be careful! The oven and/or inlet may be hot enough to cause burns. If the inlet is hot, wear heat-resistant gloves to protect your hands.**

3 Remove the inlet liner.

4 Disconnect the column from the inlet.

5 Remove the reducing nut and gold seal. (See "To Replace the Gold Seal on the Split/Splitless Inlet" on page 174.)

6 Place a beaker in the oven under the inlet to catch the solvent.

CAUTION Wear clean, lint-free gloves to prevent contamination of parts with dirt and skin oils.

7 Soak a cleaning brush in the solvent and scrub the inside of the inlet weldment. Repeat 10 times.

8 Rinse the inlet with the solvent.

9 Blow the inside of the inlet dry with compressed air or nitrogen.

10 Install the gold seal and reducing nut.

11 Install the liner and O-ring.

12 Install the column. (See the *5975T LTM GC/MSD Operation Manual*.)

13 Check for leaks.

14 Bakeout contaminants. (See *5975T LTM GC/MSD Operation Manual*.)

15 Restore the analytical method.

16 Reset the septum and liner EMF counters.

12
Vacuum System

This chapter describes components of the GC/MSD vacuum system.

Overview

The vacuum system creates the high vacuum (low pressure) required for the instrument to operate. Without the vacuum, the molecular mean free path would be very short and ions would collide with air molecules before they could reach the detector operation at high pressures also would damage analyzer components.

The instrument uses two vacuum pumps to obtain the vacuum levels needed. One of two types of foreline pumps (standard or dry) creates a low vacuum, then a high vacuum standard turbomolecular (turbo) pump engages to create the vacuum needed for operation.

Table 11 Recommended maximum flow rates per high vacuum pump

Model number	Description	Maximum recommended column flow
G4362A	Standard turbo pump, EI	2.0 mL/min

Most vacuum system operation is automated. Operator interaction is through the data system or control panel. Monitor the vacuum system through the data system and/or local control panel.

Vacuum System Components

The parts of the vacuum system are identified in Figure 23.

- Foreline (rough) pump
- High vacuum pump (turbo pump)
- Analyzer chamber
- Side plate (analyzer door), and front and rear end plates
- Vacuum seals
- Calibration valve(s) and vent valve
- Vacuum control electronics
- Vacuum gauges and gauge control electronics

Each of these is discussed in more detail in this chapter.

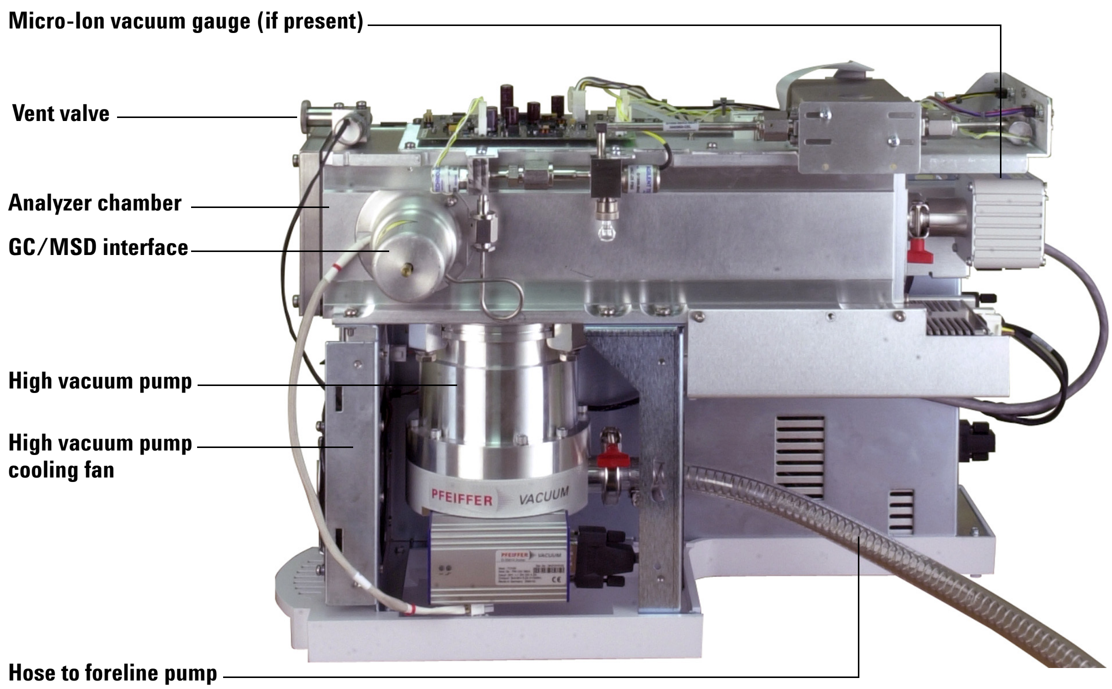


Figure 23 Example vacuum system components (MSD with turbo pump shown)

Common Vacuum System Problems

Air leak symptoms

The most common problems associated with any vacuum system are air leaks. Symptoms of air leaks include:

- Loud gurgling noise from the foreline pump (very large leak.)
- Inability of the turbo pump to reach 95% speed
- Higher than normal high vacuum gauge controller readings

The 5975T LTM GC/MSD will *not* pump down successfully unless you press on the side plate (analyzer door) when you turn on the instrument power. Continue to press until the sound from the foreline pump becomes quieter.

Pumpdown failure shutdown

The system will shut down both the high vacuum and the foreline pump if the turbo pump speed is below 80% after 7 minutes.

This is usually because of a ***large*** air leak: either the side plate has not sealed correctly or the vent valve is still open. This feature helps prevent the foreline pump from sucking air through the system, which can damage the analyzer and pump.

To restart the instrument, find and correct the air leak, then switch the power off and on. Be sure to press on the side plate when turning on the instrument power to ensure a good seal.

Foreline Pump

The foreline pump (Figure 24) reduces the pressure in the analyzer chamber so the high vacuum pump can operate. It also pumps away the gas load from the high vacuum pump. The foreline pump is connected to the high vacuum pump by a 130-cm hose called the foreline hose.

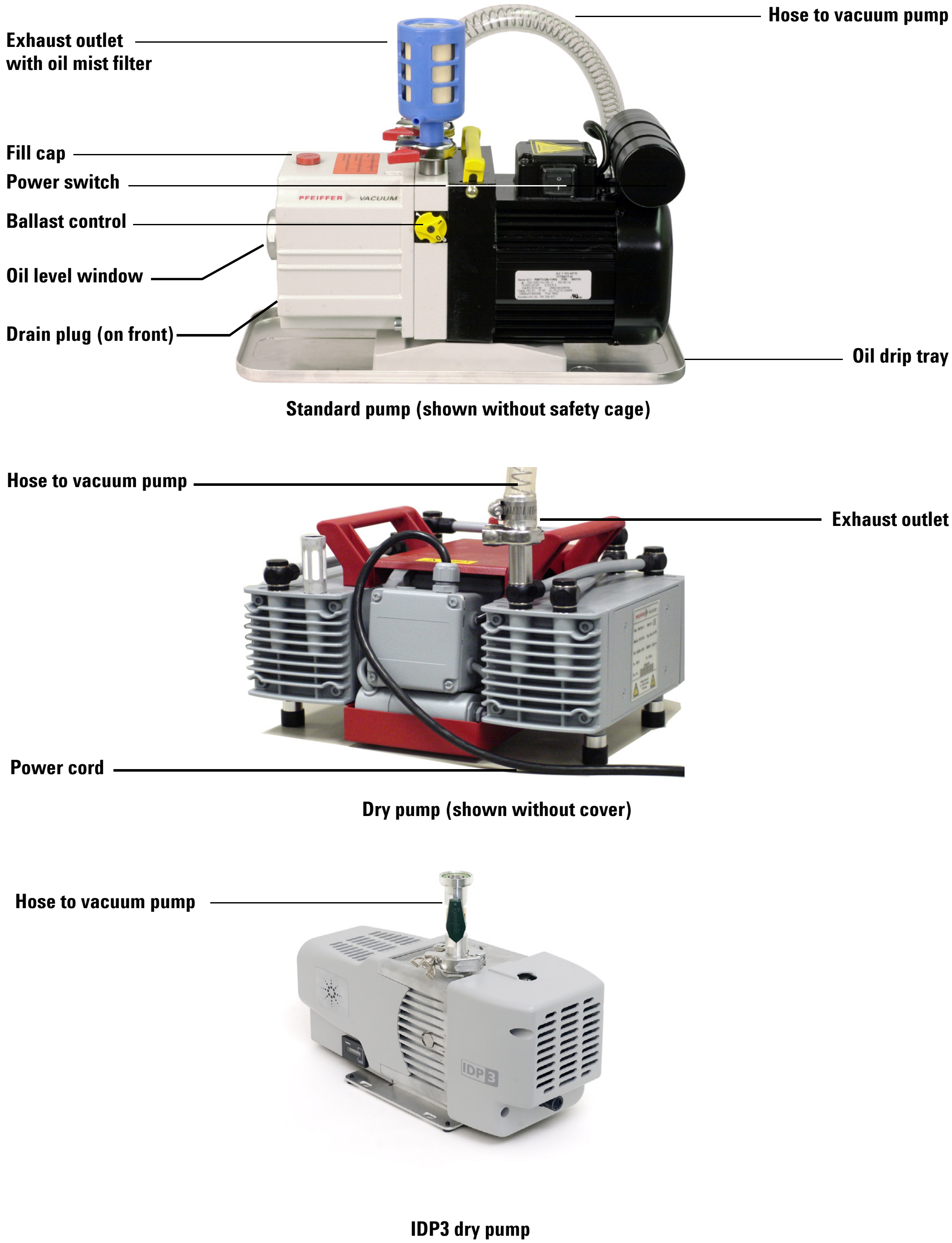


Figure 24 Standard foreline pumps

The standard foreline pump is a two-stage rotary-vane pump. An optional dry pump is also available. The pump turns on when the instrument power is turned on. The foreline pump has a built-in antisuckback valve to help prevent backstreaming in the event of a power failure.

The foreline pump can be placed on the bench beside the instrument (with the exhaust outlet to the rear) or on the floor below the instrument.

An oil trap (not shown) is available for the standard wet pump that can be used to filter pump oil out of the foreline pump exhaust. This trap stops ***only*** pump oil. Do not use the trap if you are analyzing toxic chemicals or using toxic solvents. Instead, install an 11-mm id hose to remove the exhaust from your lab.

WARNING **The oil trap supplied with the standard foreline pump stops only foreline pump oil. It does not trap or filter out toxic chemicals. If you are using toxic solvents or analyzing toxic chemicals, remove the oil trap and install a hose to take the foreline pump exhaust outside or to a fume hood.**

CAUTION Do not place the foreline pump near any equipment that is sensitive to vibration.

CAUTION The ballast control knob controls the amount of air allowed into the pump. Keep the ballast control closed (fully clockwise) at all times, except when ballasting the pump.

A window (sight glass) in the front of the standard foreline pump shows the level of the foreline pump oil. There are two marks next to the window. The level of the pump oil should never be above the upper mark or below the lower mark. If the level of pump oil is near the lower mark, add foreline pump oil.

The oil pan under the foreline pump can be a fire hazard (standard pump)

Oily rags, paper towels, and similar absorbents in the oil pan could ignite and damage the pump and other parts of the MSD.

WARNING

Combustible materials (or flammable/non-flammable wicking material) placed under, over, or around the foreline (roughing) pump constitutes a fire hazard.
Keep the pan clean, but do not leave absorbent material such as paper towels in it.

High Vacuum Pump

Turbo pump system

The 5975T LTM GC/MSD has a turbo pump with a screen to keep debris out of the pump, but no baffle is necessary. Pump speed is controlled by the turbo controller; there is no foreline gauge.

Analyzer Chamber

The analyzer chamber (Figure 25) is where the analyzer operates. The manifold is extruded and machined from an aluminum alloy. Large openings in the side, front, and rear of the analyzer chamber are closed by plates. O-rings provide the seals between the plates and the manifold. Ports in the manifold and the plates provide attachment points for the Micro-Ion vacuum gauge, calibration valve, vent valve, GC/MSD interface, and high vacuum pump.

Turbo pump version

The turbo pump and the mounting bracket for the turbo controller are clamped directly to the manifold.

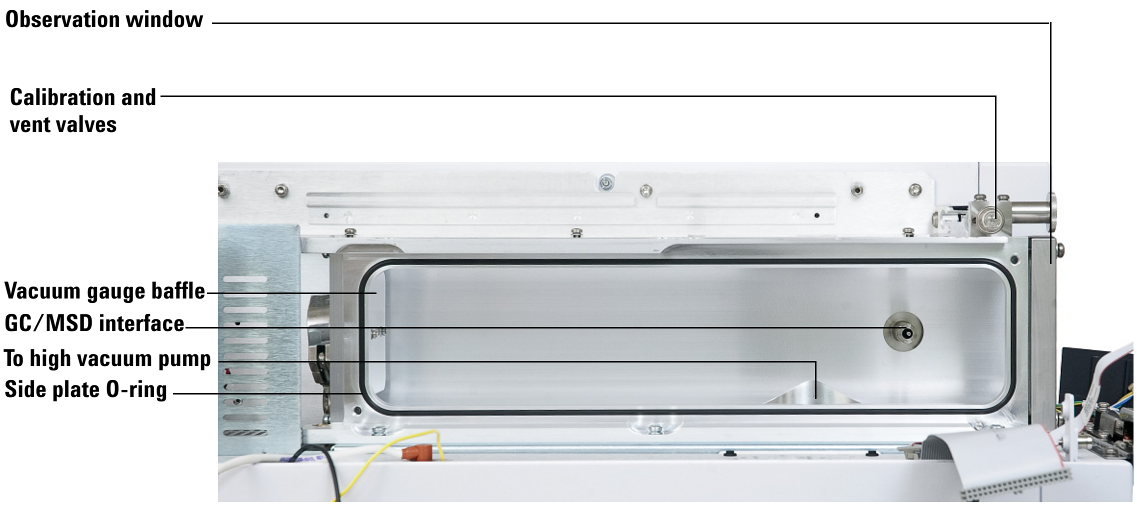


Figure 25 Analyzer chamber

Side Plate

The side plate (Figure 26) covers the large opening in the side of the analyzer chamber. It is attached to the manifold with a hinge. The analyzer assembly is attached to the side plate inside the analyzer chamber. The hinge allows the side plate to swing away from the manifold for easy access to the analyzer.

Several electrical feedthroughs are built into the side plate. Wires connect the feedthroughs to analyzer components. The electronic side board is mounted on the atmospheric side of the side plate.

Thumbscrews are located at each end of the side plate.

CAUTION Fasten both side plate thumbscrews for shipping or storage only. For normal operation, both thumbscrews should be loose. For operation with hydrogen carrier gas, or with flammable or explosive CI reagent gases, the front thumbscrew should be fastened just finger-tight. Overtightening will warp the side plate and cause air leaks. Do not use a tool to tighten the side plate thumbscrews.

CAUTION When you turn on the power to pump down the MSD, be sure to press on the side board to ensure a good seal.

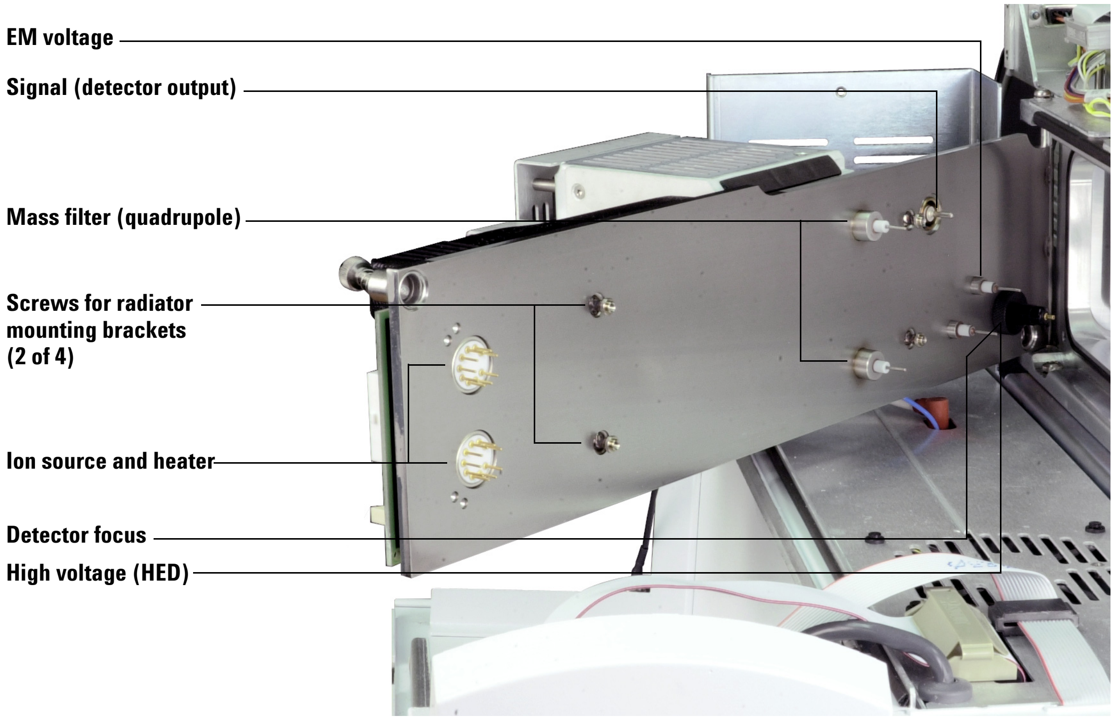


Figure 26 Side plate feedthroughs

Vacuum Seals

Vacuum seals are shown in Figure 27.

Several types of Viton elastomer O-ring seals are used to prevent air leaks into the analyzer chamber. All these O-rings, and the surfaces to which they seal, must be kept clean and protected from nicks and scratches. A single hair, piece of lint, or scratch can produce a serious vacuum leak. Two of the O-rings are ***lightly*** lubricated with Apiezon-L vacuum grease: the side plate O-ring and the vent valve O-ring.

Face seals

A face seal is an O-ring that fits in a shallow groove. The sealing surface is usually a flat plate. The manifold side plate and end plate O-rings fit into grooves around the large openings in the analyzer chamber. The side plate swings into place against the side plate O-ring, and must be held in place when the MSD is turned on for pump down to assure a good seal.

The front and rear end plates are screwed onto the manifold and should not need to be removed. The GC/MSD interface fastens to the manifold with three screws.

The calibration valve assembly is fastened onto the front end plate by two screws. The vent valve knob threads into the front end plate. Small O-rings in grooves in the front end plate provide vacuum seals.

The diffusion pump baffle adapter has a groove for its O-ring. The baffle adapter is clamped to the manifold with four claw grips.

KF (NW) seals

Most of the seals for the high vacuum pumps, foreline gauge, and foreline pump are KF seals. KF seals have an O-ring supported by a centering ring. The centering ring can be either on the inside or the outside of the O-ring. The clamp presses two flanges against the O-ring, making a seal. KF clamps must not be overtightened.

Compression seals

A compression fitting consists of a threaded fitting on the analyzer chamber and a threaded collar with a ferrule and O-ring. A cylindrical part fits inside the collar. Tightening the collar presses the ferrule, compressing the O-ring around the part. The calibration vials use compression seals.

High voltage feedthrough seal

The high voltage (HED) feedthrough seal is an O-ring that is compressed against the side plate by a threaded collar.

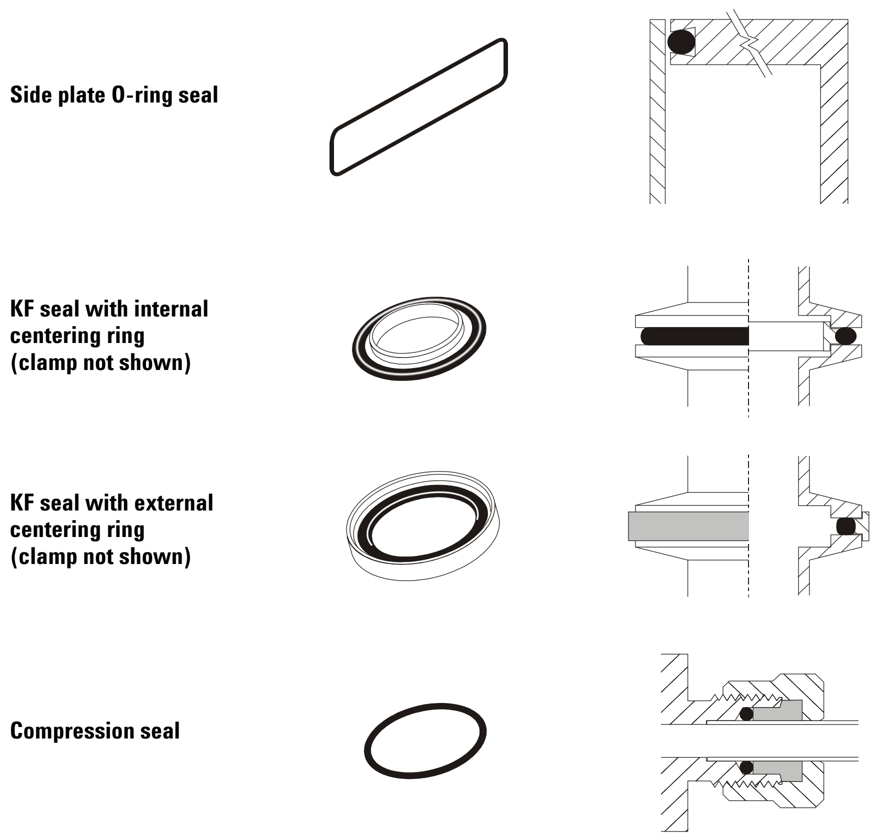


Figure 27 Vacuum seals

Turbo Pump and Fan

The turbo pump is clamped directly to the bottom of the analyzer chamber.

The turbo pump has a cylindrical body with its inlet open to the interior of the analyzer chamber. Inside the pump body is a central shaft or cylinder. Sets of small blades (airfoils) radiate from the central shaft. The shaft spins at up to 90,000 rpm in the standard turbo pump.

Turbo pumps move gas by momentum transfer. The turbine blades are angled so that when they strike a gas molecule it is deflected downward. Each set of blades pushes the gas molecules further down toward the pump outlet.
The foreline pump is connected by a hose to the outlet of the turbo pump.
It removes the gas molecules that reach the outlet.

A controller regulates current to the pump and monitors pump motor speed and temperature. A cooling fan is located between the turbo pump and the front panel of the MSD. The fan draws air from outside the MSD and blows it over the pump.

The turbo pump turns on automatically when the MSD power is switched on. The system allows the analyzer to be turned on when the turbo pump is greater than 80% speed, but the pump normally operates at 100% speed. The turbo pump maintains an indicated pressure below 8×10^{-5} Torr for helium column flows up to 2 mL/minute. Pressure (vacuum) can only be measured if your MSD is equipped with the optional gauge controller.

The turbo pump spins up (starts) and spins down (stops) quickly. This simplifies pumpdown and venting. From initial power-on, the system can pump down to operating pressure in 5 to 10 minutes.

See Also

- *To pump down the MSD*
- *To vent the MSD*
- *Turbo pump control*, page 220.

Calibration Valve and Vent Valve

Calibration valve

A calibration valve (Figure 28) is an electromechanical valve with a vial to hold the tuning compound. When a calibration valve is opened, tuning compound in the vial diffuses into the ion source. The valve is controlled by the MSD ChemStation.

EI calibration valve

The EI calibration valve is held onto the top of the analyzer chamber by two screws. A small O-ring provides a face seal.

Perfluorotributylamine (PFTBA) is the most commonly used tuning compound for EI operation. PFTBA is required for automatic tuning of the MSD. Other compounds can be used for manual tuning.

Vent valve

The vent valve knob (Figure 29) screws into a threaded port in the front of the calibration valve. An O-ring is compressed between the knob and the valve to form a seal. The threaded end of the knob has an air passage inside it, allowing air to flow into the manifold when the knob is partially unscrewed. If you turn the knob too far, the O-ring can come out of its slot.

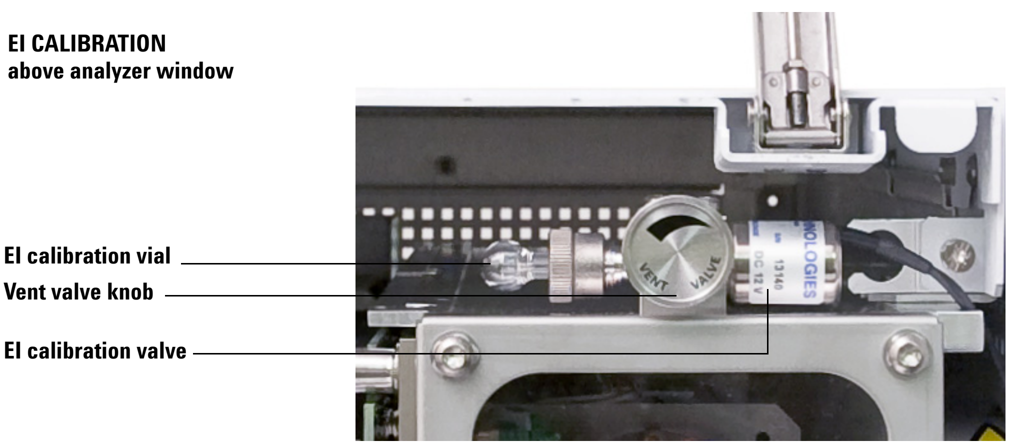


Figure 28 Calibration valve

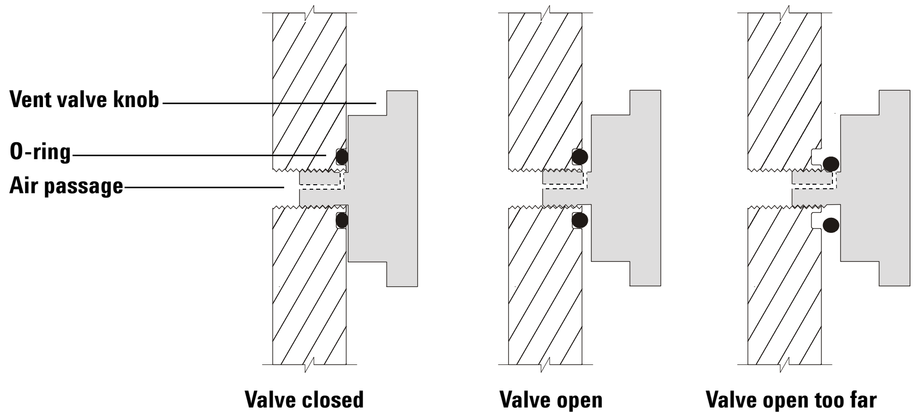


Figure 29 Vent valve

Micro-Ion Vacuum Gauge

The G4363A Micro-Ion vacuum gauge is optional. It consists of the sensing element (an ionization-type gauge) and the necessary electronics to support it.

WARNING

If you are using H_2 as a carrier gas, do not turn on the Micro-Ion vacuum gauge if there is any possibility that H_2 has accumulated in the analyzer chamber. Read **"Hydrogen Safety" on page 19** **before operating the instrument with hydrogen carrier gas. Pump down for 25 minutes before you turn on the vacuum gauge.**

The ionization gauge creates a current when energized electrons collide with gas molecules. The electronics provide the voltages required, measure the current produced, and produce an output signal that is used by the readout installed on top of the instrument.

The Micro-Ion vacuum gauge mounts on the end of the analyzer chamber and is open to it. This allows you to monitor chamber pressure in daily operation and in troubleshooting.

The gauge is calibrated for nitrogen (N_2). The carrier gas is usually helium, which does not ionize as readily as nitrogen. Therefore, the ***indicated*** pressure for helium is approximately six times lower than the absolute pressure. For example, a reading of 2.0×10^{-5} Torr versus an absolute pressure of 1.2×10^{-4} Torr.

The distinction between indicated and absolute pressure is not important for normal operation of the instrument. Of greater concern are changes in pressure from hour to hour or day to day. These changes can indicate air leaks or other problems with the vacuum system. All the pressures listed in this manual are indicated pressures for helium carrier gas. The gauge controller setpoints are also indicated pressures.

13
Analyzer

This chapter describes the parts of the analyzer.

Overview

The analyzer (Figure 30) is the heart of the MSD. It ionizes the sample, filters the ions, and detects them. The sample components exiting the GC column flow into the ion source. In the ion source, the sample molecules are ionized and fragmented. The resulting ions are repelled from the ion source into the quadrupole mass filter. The mass filter allows selected ions to pass through the filter and strike the detector. The detector generates a signal current proportional to the number of ions striking it.

The analyzer is attached to the vacuum side of the side plate. The side plate is hinged for easy access. The ion source and the mass filter are independently heated. Each is mounted inside a radiator for correct heat distribution.

Each of the parts of the analyzer is discussed in the following material.

The analyzer has four basic components

The analyzer consists of the following components (Figure 30):

- Ion source
- Mass filter
- Detector
- Heaters and radiators

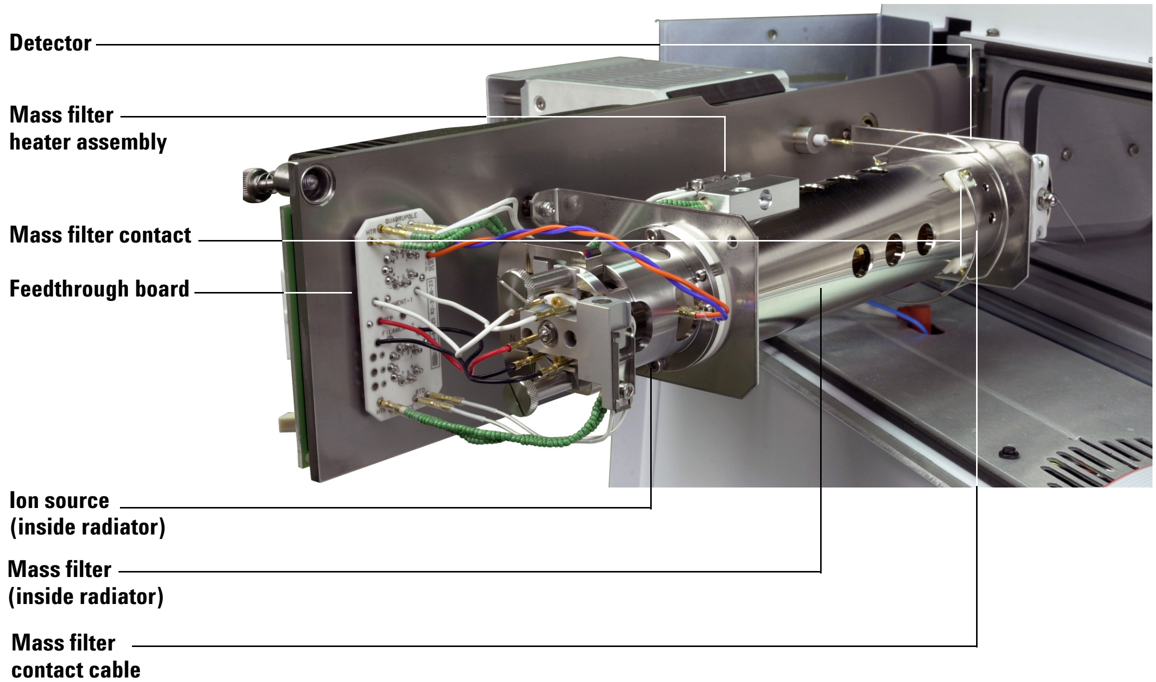


Figure 30 The analyzer

EI Ion Source

The EI ion source (Figure 31) operates by electron ionization. The sample enters the ion source from the GC/MSD interface. Electrons emitted by a filament enter the ionization chamber, guided by a magnetic field. The high-energy electrons interact with the sample molecules, ionizing and fragmenting them. The positive voltage on the repeller pushes the positive ions into the lens stack, where they pass through several electrostatic lenses. These lenses concentrate the ions into a tight beam, which is directed into the mass filter.

Ion source body

The ion source body (Figure 31) is a cylinder.It holds the other parts of the ion source, including the lens stack. With the repeller and the drawout plate, it forms the ionization chamber. The ionization chamber is the space where the ions are formed. Slots in the source body help the vacuum system to pump away carrier gas and un-ionized sample molecules or fragments.

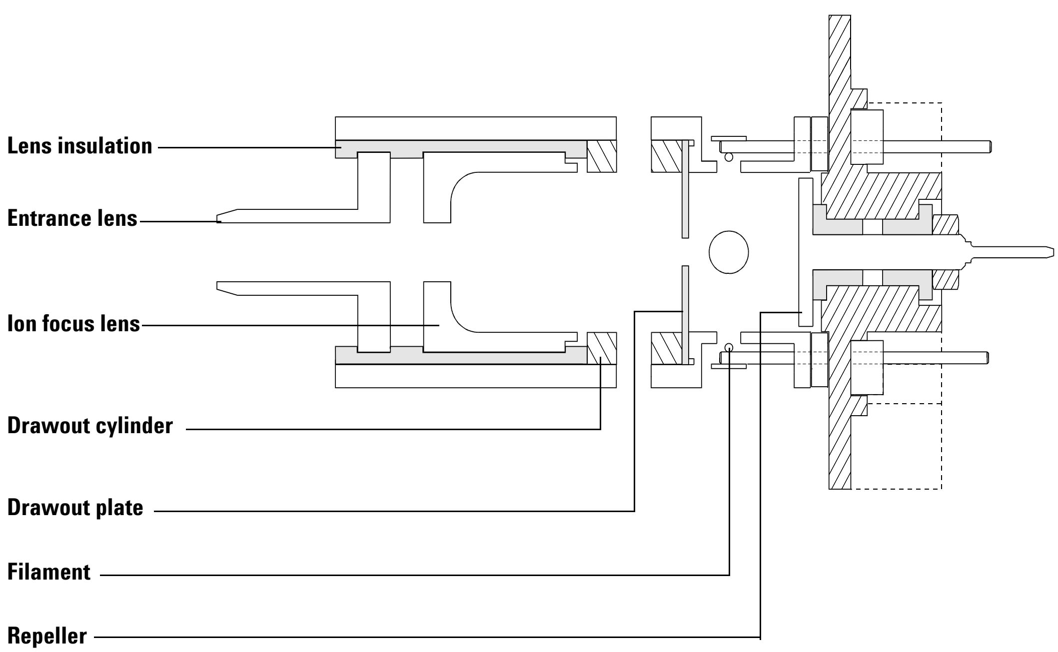


Figure 31 Ion source structure

Filaments

Two filaments (Figure 31) are located on opposite sides of the outside of the EI ion source. The ***active*** filament carries an adjustable AC emission current. The emission current heats the filament causing it to emit electrons which ionize the sample molecules. In addition, ***both*** filaments have an adjustable DC bias voltage. The bias voltage determines the energy on the electrons, usually –70 eV.

The filament is shut off automatically if there is a general instrument shutdown. Three parameters affect the filaments: filament selection (Filament), filament emission (Emission) current, and electron energy (EIEnrgy).

Filament selection

The filament selection parameter (Filament) selects which filament in the ion source is active.

Sometimes, one EI filament will give better performance than the other. To select the better of the two filaments, run two autotunes, one with each filament. Use the filament that gives the best results.

Emission current

The filament emission current (Emission) is variable between 0 and –315 µA, but should be set to the software default for normal operation.

Electron energy

The electron energy (EIEnrgy) is the amount of energy on the ionizing electrons. It is determined by the bias voltage; –70 VDC bias on the filament causes emitted electrons to possess –70 eV (electron volts). This value is adjustable from –5 to –241 VDC, but for normal operation, set this parameter to –70.

Filament care

Like the filaments in incandescent light bulbs, the ion source filaments will eventually burn out. Certain practices will reduce the chance of early failure:

- If you have an optional G3397A Micro-Ion vacuum gauge, use it to verify that the system has an adequate vacuum before turning on the analyzer, especially after any maintenance was performed.

- If you are controlling your MSD from the Edit Parameters screen, always select MSOff before changing any of the filament parameters.
- When setting up data acquisition parameters, set the solvent delay so that the analyzer will ***not*** turn on while the solvent peak is eluting.
- When the software prompts Override solvent delay? at the beginning of a run, ***always*** select NO.
- Higher emission current will reduce filament life.
- Higher electron energy will reduce filament life.
- Leaving the filament on for short times (≤1 minute) during data acquisition will reduce filament life.

Other Source Elements

Magnet

The field created by the magnet directs the electrons emitted by the filament into and across the ionization chamber. The magnet assembly is a permanent magnet with a charge of 350 gauss in the center of the field.

Repeller

The repeller (Figure 31) forms one wall of the ionization chamber. A positive charge on the repeller pushes positively-charged ions out of the source through a series of lenses. The repeller voltage is also known as the ion energy, although the ions only receive about 20% of the repeller energy. The repeller voltage can be varied from 0 to +42.8 VDC. Some tune programs use a fixed repeller voltage. Others ramp the repeller voltage to find the optimum setting.

- Setting repeller voltage too low results in poor sensitivity and poor high mass response.
- Setting repeller voltage too high results in precursors (poor mass filtering) and poor low mass resolution.

Drawout plate and cylinder

The drawout plate (Figure 31) forms another wall of the ionization chamber. The ion beam passes through the hole in the drawout plate and into the drawout cylinder. The drawout cylinder is slotted. The slots correspond to slots in the source body. These slots allow carrier gas and un-ionized sample molecules or fragments to be pulled away by the vacuum system. The drawout plate and drawout cylinder are both at ground potential.

Ion focus

The voltage on the ion focus lens (Figure 31) can be varied from 0 to –127 VDC. A typical voltage is between –70 and –90 VDC. In general:

- Increasing the ion focus voltage improves sensitivity at lower masses.
- Decreasing the ion focus voltage improves sensitivity at higher masses.
- Incorrect ion focus adjustment results in poor high mass response.

Entrance lens

The entrance lens (Figure 31) is at the entrance to the quadrupole mass filter. This lens minimizes the fringing fields of the quadrupole which discriminate against high-mass ions. There is a permanent +4.4 volt voltage added to the entrance lens. The total voltage applied to the entrance lens is the sum of the entrance lens offset and entrance lens gain and the +4.4 volt permanent offset.

Entrance lens voltage = +4.4 VDC + offset + (gain × mass)

Entrance lens offset

The entrance lens offset (EntOff) controls the fixed voltage applied to the entrance lens. It can be varied from 0 to –64 VDC (–20 V is typical). Increasing the entrance lens offset generally increases the abundance of ions at low masses without substantially decreasing the abundance of high mass ions.

Entrance lens gain

Entrance lens gain (EntLens) controls the variable voltage applied to the entrance lens. It determines how many volts are applied for each *m/z*. It can be varied from 0 to –128 mV/(*m/z*). A typical range is 0 to –40 mV/amu.

Quadrupole Mass Filter

The mass filter separates ions according to their mass-to-charge ratio (*m/z*). At a given time, only ions of a selected mass-to-charge ratio can pass through the filter to the detector. The mass filter in the MSD is a quadrupole (Figure 32).

The quadrupole is a fused-silica (quartz) tube coated with a thin layer of gold. The four hyperbolic surfaces create the complex electric fields necessary for mass selection. Opposing segments are connected; adjacent segments are electrically isolated. One pair has positive voltages applied, the other negative.

A combined direct current (DC) and radio frequency (RF) signal is applied to the two pairs of segments. The magnitude of the RF voltage determines the mass-to-charge ratio of the ions that pass through the mass filter and reach the detector. The ratio of DC-to-RF determines the resolution (widths of the mass peaks). There are several parameters that control the DC and RF voltages. All these parameters are set by Autotune, but also can be manually adjusted in the Edit Parameters window:

- AMU gain (AmuGain)
- AMU offset (AmuOffs)
- 219 width (Wid219)
- DC polarity (DC Pol)
- Mass (axis) gain (MassGain)
- Mass (axis) offset (MassOffs)

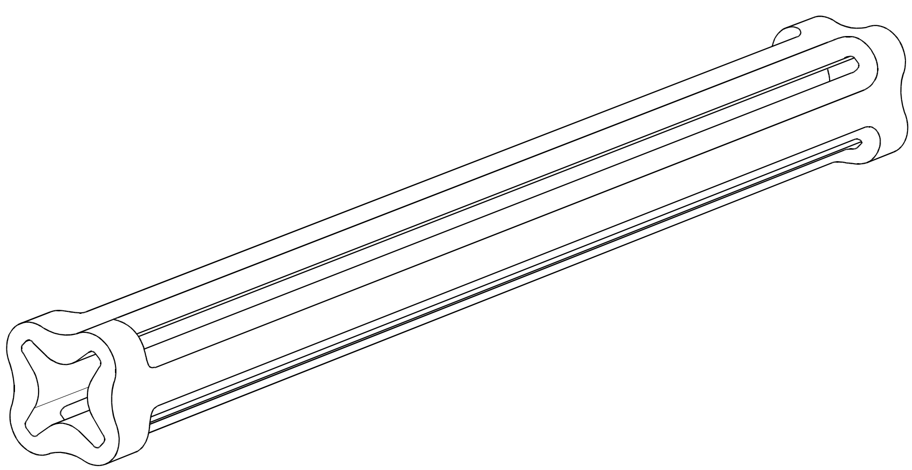


Figure 32 Quadrupole mass filter

AMU gain

AMU gain (AmuGain) affects the ratio of DC voltage to RF frequency on the mass filter. This controls the widths of the mass peaks.

- Higher gain yields narrower peaks.
- AMU gain affects peaks at high masses more than peaks at low masses.

AMU offset

AMU offset (AmuOffs) also affects the ratio of DC voltage to RF frequency on the mass filter.

- Higher offset yields narrower peaks.
- AMU offset generally affects peak widths equally at all masses.

219 width

m/z 219 is a prominent ion near the middle of the mass range of PFTBA. The width parameter (Wid219) makes small corrections to the *m/z* 219 peak width. Amu gain and amu offset must be readjusted after the 219 width is changed. If you are tuning with a compound other than PFTBA, there may not be an ion at *m/z* 219. In that case, set the 219 width to the last value found for it by Autotune or set it to 0.

DC polarity

The DC polarity (DC Pol) parameter selects the orientation of the direct current applied to the quadrupole mass filter. The DC polarity that works best for your MSD is determined at the factory. It is listed on the final test sheet accompanying your MSD. It is also listed on a label on the cover over the RF coils. This cover can be viewed by removing the upper MSD cover.

CAUTION Using the nonpreferred DC polarity may result in very poor performance. Always use the factory-specified polarity.

Mass (axis) gain

Mass gain (MassGain) controls the mass assignment, that is, assignment of a particular peak to the correct *m/z* value.

- A higher gain yields higher mass assignment.
- Mass gain affects peaks at high masses more than peaks at low masses.

Mass (axis) offset

Mass offset (MassOffs) also controls the mass assignment.

- A higher offset yields higher mass assignment.
- Mass offset generally affects peaks equally at all masses.

Quadrupole maintenance

The mass filter requires no periodic maintenance. It should not be removed from the radiator. If ***absolutely*** necessary (that is, if the only alternative is replacement), the quadrupole can be cleaned. Cleaning *must* be performed by Agilent Technologies service personnel.

CAUTION

Never put the quadrupole in an ultrasonic cleaner.

Never change the physical orientation of the quadrupole mass filter.

The fused-quartz quadrupole is fragile and will break if dropped or handled roughly.

The material in the cusps of the quadrupole is very hygroscopic. If exposed to water, the quadrupole must be dried very slowly to prevent damage.

Detector

The detector (Figure 33) in the MSD analyzer is a high energy conversion dynode (HED) coupled to an electron multiplier (EM). The detector is located at the exit end of the quadrupole mass filter. It receives the ions that have passed through the mass filter. The detector generates an electronic signal proportional to the number of ions striking it. The detector has three main components: the detector ion focus, the HED and the EM horn.

Detector ion focus

The detector ion focus directs the ion beam into the HED, which is located off axis. The voltage on the detector focus lens is fixed at –600 V.

High energy dynode

The HED operates at –10,000 volts for EI. It is located off-axis from the center of the quadrupole mass filter to minimize signals due to photons, hot neutrals, and electrons coming from the ion source. When the ion beam hits the HED, electrons are emitted. These electrons are attracted to the more positive EM horn. Do not touch the insulator.

EM horn

The EM horn carries a voltage of up to –3000 volts at its opening and 0 volts at the other end. The electrons emitted by the HED strike the EM horn and cascade through the horn, liberating more electrons as they go. At the far end of the horn, the current generated by the electrons is carried through a shielded cable outside the analyzer to the signal amplifier board.

The voltage applied to the EM horn determines the gain. The voltage is adjustable from 0 to –3000 VDC. Use the EM voltage found in autotune as a baseline for the EM voltage setting.

- To increase signal gain, increase the EM voltage.
- For concentrated samples where less signal gain is needed, decrease the EM voltage.

As the EM horn ages, the voltage (EMVolts) required increases over time. If the EM voltage must always be set at or near –3000 VDC to complete Autotune, with no other probable cause, it may need to be replaced. Check your tune charts for gradual degradation, which indicates wearing out. Select **View Tunes** from the **Checkout** menu in the **Instrument Control** view to see the tune charts. Sudden changes usually indicate a different type of problem.

See Also

- *Troubleshooting in the online help for more information about symptoms that may indicate EM problems.*

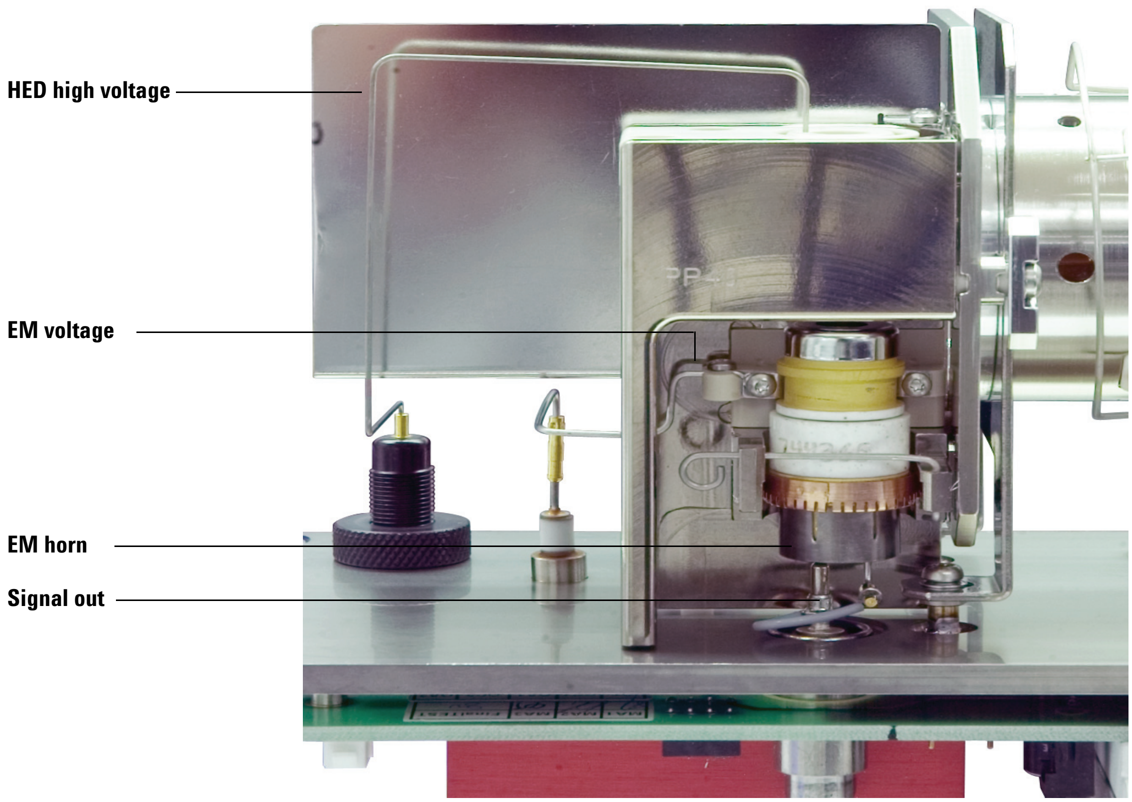


Figure 33 The detector

Analyzer Heaters and Radiators

The ion source and mass filter are housed in cylindrical aluminum tubes called radiators (Figure 34). The radiators control the distribution of heat in the analyzer. They also provide electrical shielding for analyzer components. The source heater and temperature sensor are mounted in the source heater block. The mass filter (quad) heater and temperature sensor are mounted on the mass filter radiator. Analyzer temperatures can be set and monitored from the MSD ChemStation.

In selecting the temperatures to use, consider the following:

- Higher temperatures help keep the analyzer clean longer.
- Higher ion source temperatures result in more fragmentation and therefore lower high-mass sensitivity.

After pumpdown, it takes at least 2 hours for the analyzer to reach thermal equilibrium. Data acquired sooner may not be reproducible.

Recommended settings (for EI operation):

- Ion source 230 °C
- Quadrupole 150 °C

CAUTION Do not exceed 200 °C on the quadrupole or 350 °C on the ion source.

The GC/MSD interface, ion source, and mass filter (quad) heated zones interact. The analyzer heaters may not be able to accurately control temperatures if the setpoint for one zone is much lower than that of an adjacent zone.

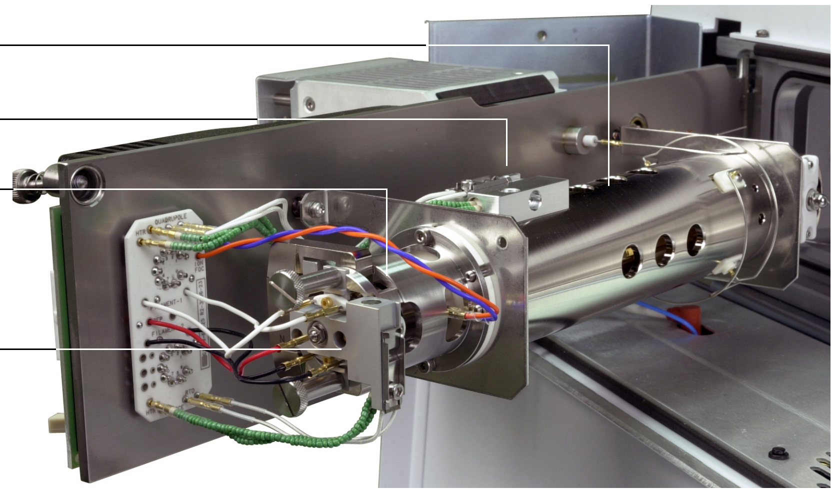


Figure 34 Heaters and radiators

14
Electronics

Except for the *Side panel and connectors*, *Local Control Panel and power switch*, and *Interfacing to other devices* sections, most of this material is not essential for day-to-day operation of the GC/MSD. It may be of interest to persons responsible for servicing the GC/MSD (Figure 35).

WARNING **Dangerous voltages are present under the safety covers. Do not remove safety covers. Refer servicing to your Agilent Technologies service representative.**

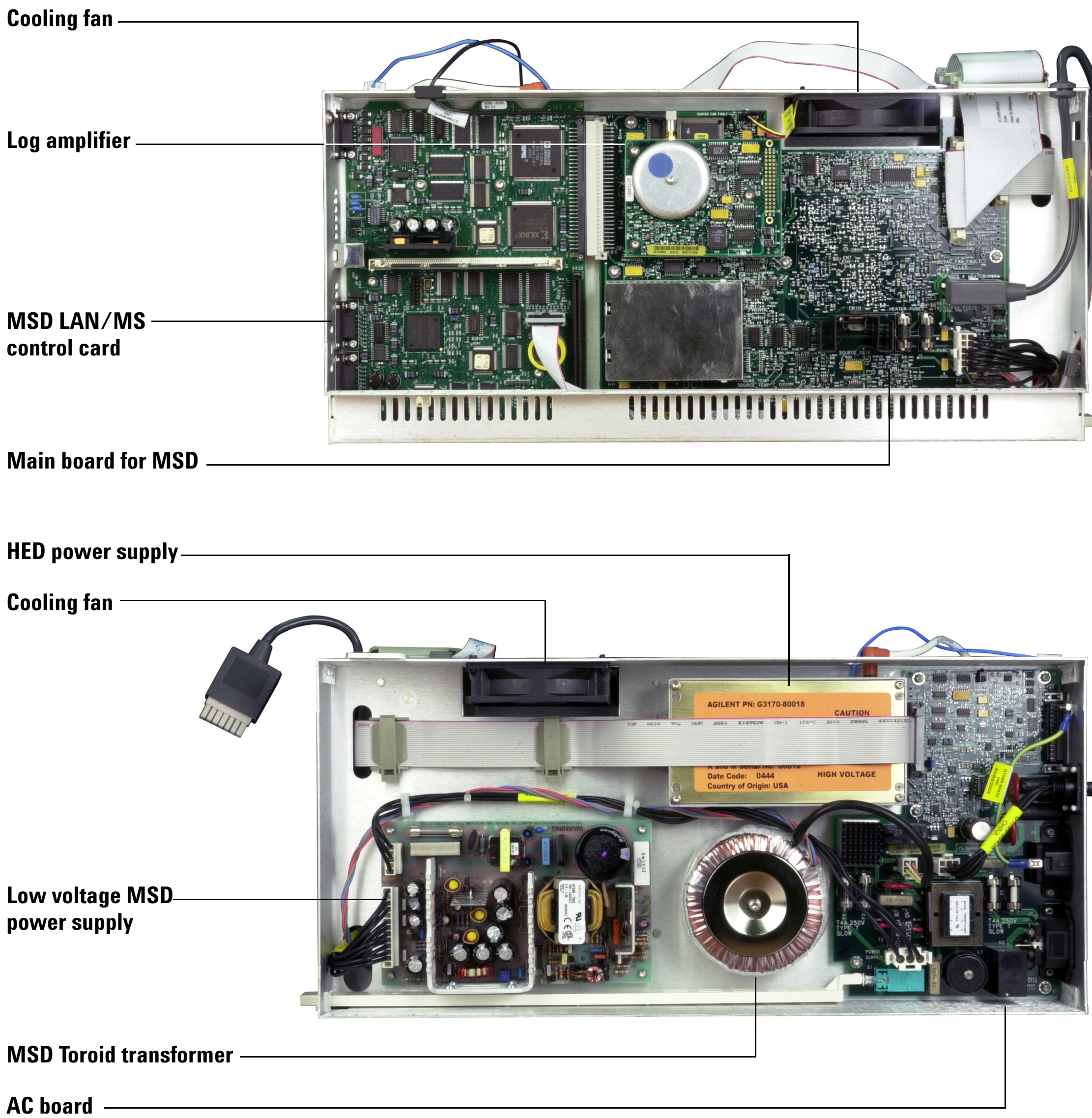


Figure 35 MSD electronics module

Local Control Panel and Power Switch

Local Control Panel (LCP)

You can view system status and perform some control functions from the local control panel on the front of the instrument.

Functions available through the local control panel include:

- Set IP address for MSD and GC
- Prepare to vent (cool analyzer and turn off high vacuum pump)
- Monitor instrument status
- Run autotune
- Run method
- Run sequence
- View and set analyzer temperatures
- View LTM column temperature, inlet temperature and GC/MSD interface temperature
- View inlet flows
- Display error messages

See also

The G1701EA *GC/MSD ChemStation Getting Started* manual.

Power switch

The power switch is part of the electronics module and is located on the lower left of the front of the instrument. It is used to turn the instrument and foreline pump on and off.

CAUTION Do not switch the instrument off unless it has completed the vent program. Incorrect shutdown can seriously damage the MSD.

MSD Side Board

The MSD side board is mounted on the side plate. It performs these functions:

- Provides the 1 MHz reference clock for the RF amplifier.
- Generates the RF component of the voltage applied to the quadrupole mass filter according to a signal from the main board. The amplitude of this voltage is proportional to the mass selected.
- Generates the DC component of the voltage applied to the quadrupole mass filter. The magnitude of this voltage is proportional to the RF voltage.
- Passes voltages generated on the main board and the detector focus voltage from the HED power supply to elements in the ion source and the detector.
- Generates and adjusts filament emission current and electron energy as controlled by the main board.
- Switches the filament power from one filament to the other.
- Monitors for RF faults and shuts down the analyzer if one is detected.

Electronics Module

Most of the electronics in the MSD are contained in the electronics module. The whole electronics module can be replaced, if necessary, by your Agilent Technologies service representative.

The electronics module contains:

- Main board
- Signal amplifier board
- LAN/MS control card
- AC board (power distribution / vacuum control board)
- Low voltage (AC-DC) MSD power supply
- High voltage (HED) power supply
- Toroid transformer assembly

MSD main board

The MSD main board is mounted on the outer side of the MSD electronics module. The MSD main board performs these functions:

- Receives and decodes digital instructions from the LAN/MS control card.
- Sends digital information to the LAN/MS control card.
- Generates voltages for the ion source lenses.
- Generates control signals for filament selection, filament emission current, and electron energy. Generates control signals for quadrupole RF drive, quad frequency adjustment, DC polarity selection, and all detector voltages.
- Performs analog-to-digital conversion for the Direct signal, ion source and mass filter temperature signals, and foreline pressure or turbo pump speed signal.
- Monitors the signals from the vacuum system and fans and the filament status, HV fault and RF fault signals from the side board. Activates the shutdown line when the analyzer electronics must be disabled.
- Generates the control signals (on and off) used by the AC board for the high vacuum pump and calibration valve.
- Generates ±280 VDC (nominal) power for main board lens amplifiers and side board DC amplifiers.

- Supplies and controls the power for the ion source and quadrupole (mass filter) heaters.
- Provides 24 VDC power for the cooling fans.

Signal amplifier board

The signal amplifier board amplifies the output of the detector. It produces an output voltage of 0 to 10 volts DC, proportional to the logarithm of the input current of 3 picoamps to 50 microamps.

An analog-to-digital converter converts the amplifier output voltage to digital information. The LAN/MSD control card converts the data into abundance counts proportional to the detector signal current.

MSD AC board

The MSD AC board is mounted on the opposite side of the MSD electronics panel from the LAN/MSD control card. The AC board is also sometimes called the power distribution/vacuum control board. It performs these functions:

- Provides input voltage transparency for the MSD.
- Distributes AC line power to the AC/DC power supply, the foreline pump, and the turbo pump controller.
- Turns the calibration valve on or off as directed by the main board.
- Provides the voltage for the calibration valve.
- Provides a logic interface to turbo controller.
- Passes the turbo pump speed and other vacuum status information to the main board.
- Turns off the foreline pump in case of a problem with pumpdown.

Turbo pump control

Your instrument is equipped with a turbo pump with an integrated controller.

The MSD AC board sends control signals to, and receives turbo pump status information from, the turbo pump controller. The turbo pump controller provides power to the turbo pump and regulates pump speed. If the pump fails to reach 80% speed within 7 minutes after beginning pumpdown or if the speed drops below 50% during operation, the controller shuts off the turbo pump and the AC board shuts off the foreline pump.

Pumpdown failure shutdown

The MSD AC board will shut down both the high vacuum and the foreline pump if the system fails to pump down correctly. One condition that triggers shutdown is turbo pump speed below 80% after 7 minutes.

This is usually because of a ***large*** air leak: either the sideplate has not sealed correctly or the vent valve is still open. This feature helps prevent the foreline pump from sucking air through the system, which can damage the analyzer and pump.

To correct the problem, power cycle the instrument and troubleshoot. You have 7 minutes to find and correct the air leak before the system shuts down again. Be sure to press on the side plate when turning on the instrument power to ensure a good seal.

LAN/MS Control Card

The LAN/MS control card is located to the left of the MSD main board on the electronics panel. The LAN/MS control card has two main functions:

- Providing a communication interface between the MSD and the data system.
- Providing real-time control of the MSD, freeing the data system for other tasks.

Functional areas of the LAN/MS control card include:

- Instrument controller
- Data processor
- Main processor
- Serial communication processor
- Network communication controller
- Remote start processor
- Random access memory (RAM)
- Status LEDs
- Local Control panel firmware

LEDs on the LAN/MS control card are visible on the rear panel. The upper two LEDs indicate network communication.

The two bottom LEDs are the power (On, digital 5V) and the “heartbeat” indicator. The flashing heartbeat LED indicates that the operating system of the MSD is functioning. In case of catastrophic loss of flash memory, the heartbeat flashes in an SOS (• • •– – – • • •) pattern.

MSD Power Supplies

Low voltage (AC-DC) MSD power supply

The low voltage MSD power supply is mounted next to the MSD toroid transformer in the MSD electronics module. A universal input power supply, it converts AC line voltage into the DC voltages used by the rest of the electronics. The power supply generates the following DC voltages:

- +24 V (nominal)
- +15 V (nominal)
- –15 V (nominal)
- +5 V (nominal)

High voltage (HED) power supply

The high voltage power supply provides the –10,000 volts DC for the high energy dynode (HED) in the detector for the EI MSD. The HED power supply also provides 600 VDC for the detector focus lens. Due to the high impedance of this circuit, measuring the detector focus voltage with a handheld voltmeter will give a typical reading of 90 to 100 volts where the polarity matches that of the HED voltage.

MSD toroid transformer

The MSD toroid transformer is mounted next to the AC board. It provides 24 VAC for the mass filter and source heater circuits. The input wires take 120 VAC or 200 to 260 VAC from the AC board. The AC board samples the line voltage and uses a relay to appropriately strap the toroid primary. The output wires connect to the main board.

Side Panel Connectors

The side panel (Figure 36) contains several connectors, the primary fuses, and several status LEDs. Most of these components are part of the AC board or the LAN/MS control card and extend through the side panel.

High vacuum power (HIVAC POWER) connector

The high vacuum power connector carries power for the turbo controller from the AC board.

Primary fuses

The primary fuses limit current into the MSD in case of a short circuit in the foreline pump. The primary fuses are on the AC board.

Power cord receptacle

The AC power cord brings in all electrical power for the MSD. The power cord can be detached from the instrument.

Foreline pump power cord receptacle

The foreline pump power cord receptacle provides AC power for the foreline pump. If the power switch is off, no power is supplied to the foreline pump.

Remote start connector

The remote start connector is the external connector for the remote start circuitry on the LAN control card. It combines the readiness condition and start/stop events signals from the GC control system and the MSD control system for synchronized communications with other instruments.

GC-LAN and MSD-LAN (I/O) connectors

The GC and MSD LAN cables from the data system are connected to the I/O LAN connectors. These cables carry all data communication between the PC and the instrument.

Event connector

This connector provides two passive contact closures and two 24-volt outputs for controlling external devices. The outputs are controlled by valve drivers 5 through 8.

BCD connector

This connector provides two control relays and a BCD input for a stream selection valve.

CAUTION This connector is similar to the Event connector. Plugging a non BCD cable into the BCD connector can damage the GC.

Sampler connector

This connector provides an injector, usually the front injector. (For 7693A, the configuration does not matter.)

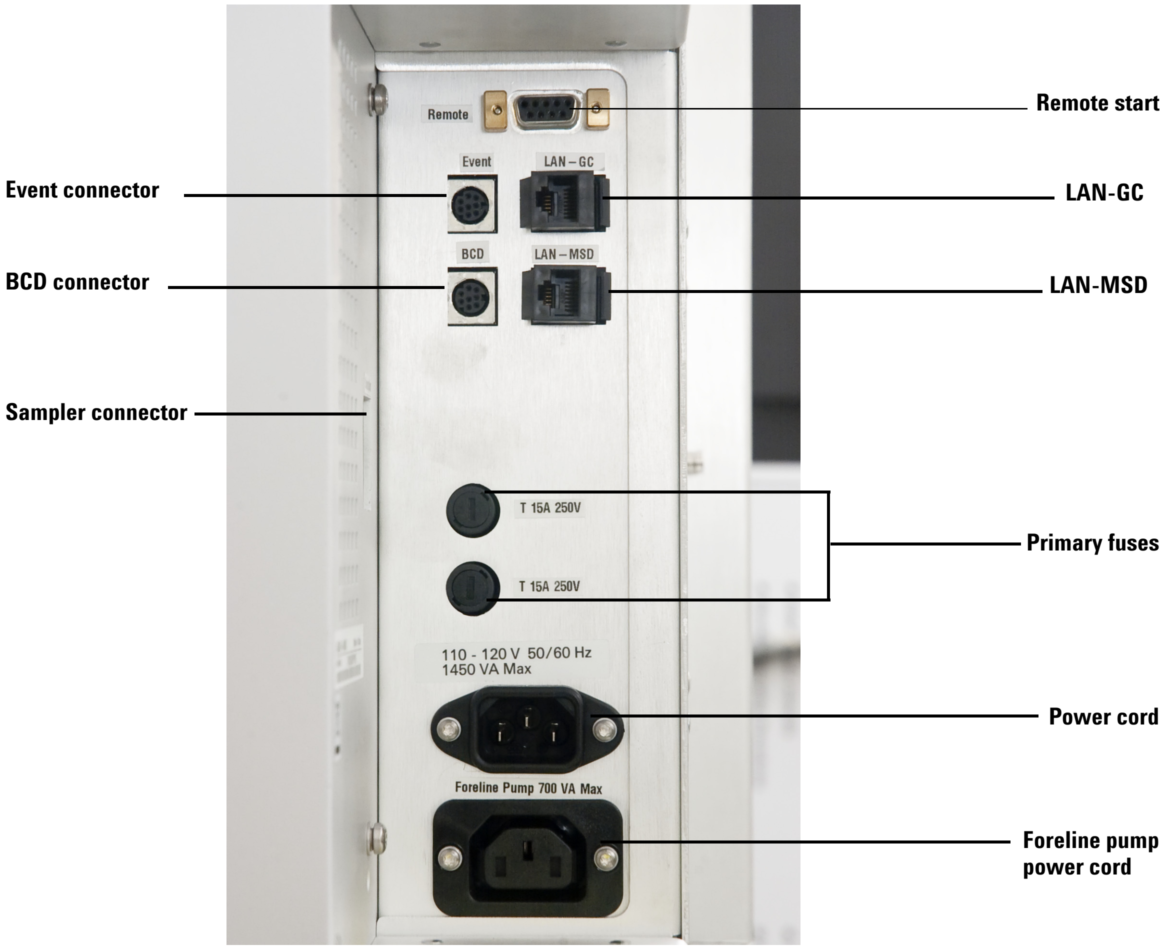


Figure 36 Side panel connections (High vacuum power connector not shown)

Interfacing to External Devices

Remote control processor

The remote control processor on the LAN/MS control card synchronizes start-run signals with external devices. The functions of the remote control processor are extended to the remote start (Remote) connector (Figure 37) on the side panel of the instrument. The remote start cable connects the external devices and the GC/MSD.

Remote start signals

It is often necessary to communicate with external devices (for example, a purge-and-trap) during a run. Typically, these communications are requests to send a system-ready signal. They also include:

- Receive a start run signal from an external device
- Program the timing of events during a run

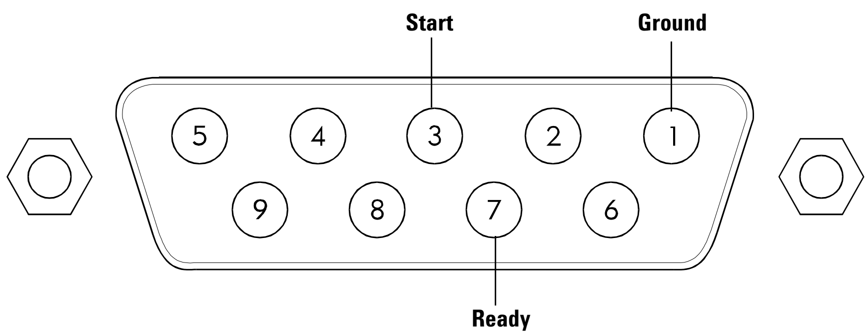


Figure 37 Remote start connector

System ready

When interfacing to an external device, it is often desirable to send a system-ready signal to the device. In the case of a multisample Tekmar purge-and-trap, each sample is purged onto a trap where it waits for a ready signal. On receipt of the ready signal, the desorbtion cycle begins. When a specific temperature is reached, the purge-and-trap closes a contact to indicate the run has started.

The ready pin on the remote start connector on the instrument is held low at all times except when the GC, MSD, and data system are all ready. On system ready, a logic high of 5 VDC is present between that pin and any ground. This same high can be detected between the ready and ground pins on the remote start connector on the instrument.

Start run input

The best way to generate a start run signal is to use the remote start connector on the instrument. Since remote start cables are made for most common devices, this is often the simplest way. A general-purpose remote start cable (05890-61080), is also available which terminates in spade lugs. Care must be taken to ensure that the system is actually ready before the start run signal is sent.

If necessary, the remote start connector on the back of the instrument can be used to send the start run signal. A contact closure between the start and ground pins will start the run if the system is ready.

15
Parts

This chapter lists parts that can be ordered for use in maintaining your instrument. It includes most of the parts or assemblies in the MSDs and some parts in the GC.
This chapter is organized so that related parts are grouped together.

Some of the parts listed are not user-replaceable. They are listed here for use by Agilent Technologies service representatives.

To Order Parts

To order parts for your GC/MSD, address the order or inquiry to your local Agilent Technologies office. Supply them with the following information:

Model and serial number of your instrument, located on a label on the lower left side near the front of the instrument.

- Part number(s) of the part(s) needed
- Quantity of each part needed

Some parts are available as rebuilt assemblies

Rebuilt assemblies pass all the same tests and meet all the same specifications as new parts. Rebuilt assemblies can be identified by their part numbers.
The first two digits of the second part of the part number are 69 or 89 (such as xxxxx-69xxx or xxxxx-89xxx). Rebuilt assemblies are available on an exchange-only basis. When you return the original part to Agilent Technologies (after you receive the rebuilt assembly) you will receive a credit.

If you cannot find a part you need

If you need a part that is not listed in this chapter, check the Agilent Technologies Analytical Supplies Catalog or the on-line catalogue on the worldwide web at http://www.agilent.com/chem. If you still cannot find it, contact your Agilent Technologies service representative or your Agilent Technologies office.

Electronics

The printed circuit boards in the GC/MSD are available only as complete assemblies. Individual electronic components are not available. This section contains the following parts: cables (Tables 12 and 13), printed circuit boards (Table 14 and Figure 38), and fuses and switches (Table 16).

Cables

Table 12 External cables

Description	Part number
Remote Start-Stop cable*	G1530-60930
Y-Remote Start-Stop cable*	G1530-61200
H-Remote Start-Stop cable*	35900-60800
LAN cable (shielded)	8121-0008
Power cord, Taiwan/South America, C19, 20A	8120-6360
Power cord, US, 120V, C19, 20 amp	8120-6894
Power cord, Japan, C19, 20 amp	8120-6903
Power cord, Australia, C19, 16 amp	8120-8619
Power cord, GB/HJK/SG/MY, C19, 13 amp	8120-8620
Power cord, Europe, C19, 16 amp	8120-8621
Power cord, Swiss/DK, C19, 16 amp	8120-8622
Power cord, China, C19, 15 amp, Fast	8121-0070
Power cord, Israel, C19, 16 amp	8121-0161
Power cord, Argentina, C19, 20 amp	8121-0675
Power cord, India/South Africa, C19, 15 amp	8121-0710
Power cord, Korea, C19, 16 amp	8121-1222
Power cord, Thai, 220V, 15A, 1.8M, C19	8121-1301
Power cord, Brazil, C19, 250V max	8121-1787
Triode gauge cable – ion gauge tube	G3880-80012
BCD cable	G1530-60590
Analog signal cable	G1530-60560

* Only one cable can be used at a time

Table 13 Internal cables

Description	Part number
AC board control cable (AC board to main board)	G1099-60422
Chassis ground wire	G1099-60433
Control panel ribbon cable (SC3 to LCP)	G3170-60830
Electronics module fan cable	G1099-60560
Fan (high vacuum) cable	G1099-60561
Feedthrough board – Source board	G1099-60425
HED control cable	G1099-60430
HED power cable	G1099-60431
High Vacuum power extender cable (AC – back panel)	G1099-60436
Low voltage power supply input cable (AC – LVPS)	G1099-60426
Low voltage power supply output cable (LVPS – main board)	G1099-60427
Mass filter contact cable kit (inside analyzer)	G3170-60130
Side board control (ribbon) cable (main board – side board)	G1099-60410
Signal cable (signal feedthrough on side plate to signal amp board)	G1099-60416
Source power cable (main board to side board)	G1099-60428
Turbo pump wiring harness (emod – separate turbo control and ps)	G3170-60034
with new 24V power supply	G3170-60835
Turbo pump power cable (panel to turbo control)	
integrated into new 24V power supply	G3170-60833
GC to MS cables	
GC LAN cable	G4360-60521
MS LAN cable	G4360-60522
LUI Key LED harness	G4360-60515
GC AC-DC power input harness	G4360-60502
MS power connection cable	G4360-60504
MS pump power cable assembly	G4360-60505
AC power cable assembly	G1530-61550
DC power harness	G4360-60511

Table 13 Internal cables (continued)

Description	Part number
GC/MS RS232 communication cable, 650 mm, 9F/9F	G4360-60520
LAN connector	1252-6152
5975T LTM GC/MSD Remote controlling Y cable	G4360-60531
GC Module internal cables	
Oven door sensor assembly	G4360-60410
RVM heater harness	G4360-60509
Inlet/EPC fan harness	G4360-60512
LVDS harness	G4360-60513
Keyboard ribbon cable	G4360-60514
EPC extension harness	G4360-60503
BCD/EVENT harness	G4360-60516
MS DC 24V harness	G4360-60517
Side fan Y cable	G4360-60523
Inlet/Detector heater harness	G4360-60535

Printed circuit boards

Table 14 Printed circuit boards (Figure 38)

Description	Part number
E-Module – 110V*	G3170-61100
E-Module – 240V*	G3170-61200
AC board	G3170-65006
Fan for electronics module	3160-1038
Snap-on rivets (4) may be required if old ones are broken by the removal process	0361-1341
Unipolar HED power supply	G3170-80017
Bipolar HED power supply	G3170-80018
LAN/MS Control card – SC3+	G3170-61430
Low voltage (AC-DC) power supply	0950-3067
Main board	G3170-65010

Table 14 Printed circuit boards (Figure 38) (continued)

Description	Part number
Log Amp Fast Electronics†	G3170-65001
Toroid transformer	G1099-60229
LUI panel PCA subassy	G3880-60011
Side board, new	G3170-65015
Side board, rebuilt	G3170-69015
Turbo pump TMH control	G3170-65020
5975T AC board (PCA)	G4360-65050
5975T Column and transfer PCA	G4360-65004
5975T ALS controller assembly	G4360-67529
5975T Power module assembly	G4360-67200
5975T AP board PCA	G4360-65100
5975T Connector board PCA	G4360-65003
5975T LTM logic PCA	G4360-65101

* non-orderable

† Fast electronic boards need to be matched

Table 15 PC related items

Description	Part number
Rugged laptop	HP 8730w
Power adapter for laptop	
LAN switch	G1680-63718
Cable, w/conn, 80-1000V, telecom	8121-0940
Power adapter for switch	
LAN cables	8121-0008

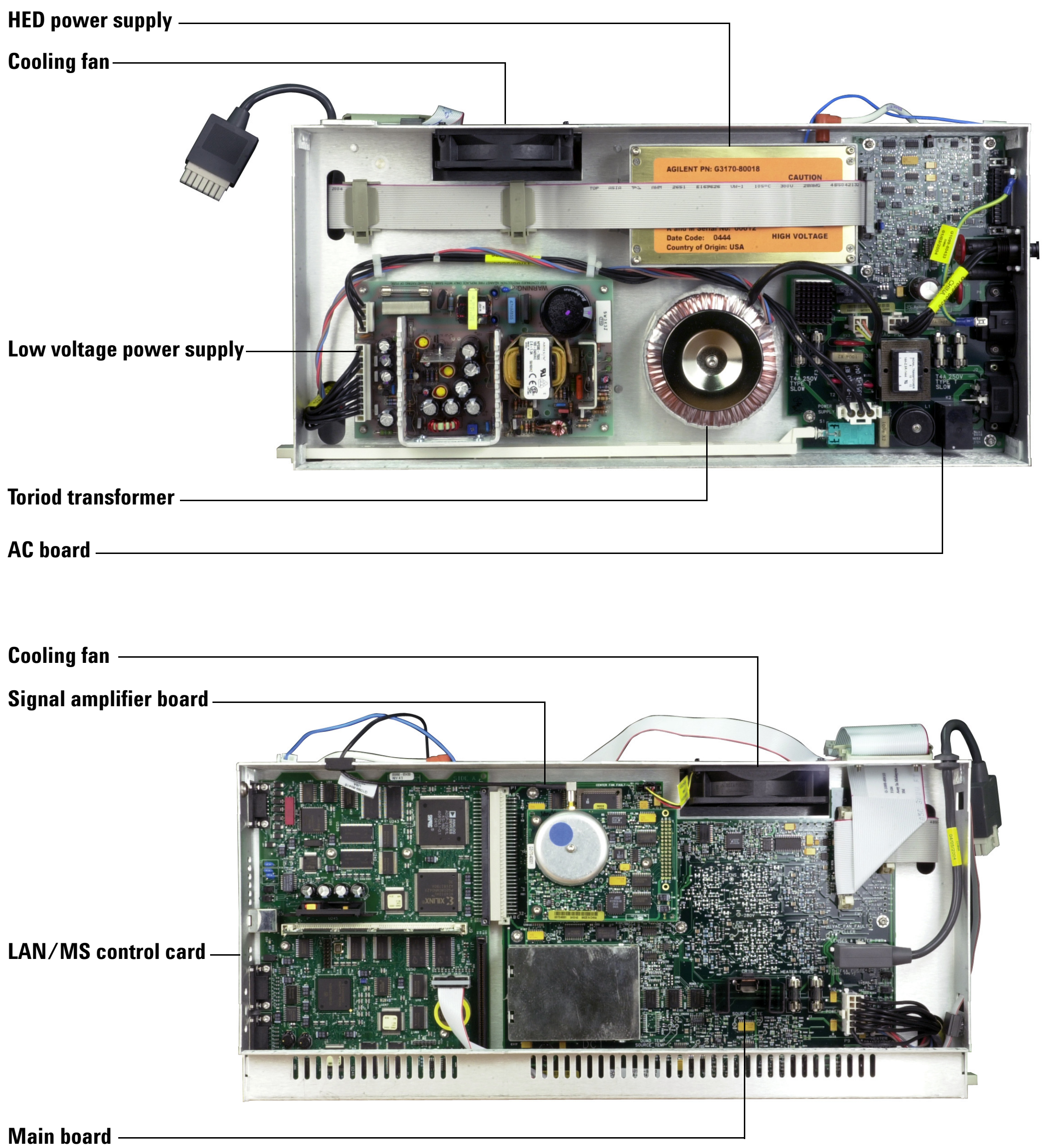


Figure 38 Electronics module

Fuses and power switch

Table 16 Fuses and power switches

Description	Part number
Fuse 8A, 250V	2110-0969
Fuse 15A (2/set)	G4360-67160

Table 16 Fuses and power switches (continued)

Description	Part number
Power button	5041-1203
Power switch extender rod	G3170-40007

Covers

Table 17 5975T LTM GC/MSD covers

Description	Part number
Side panel lower assembly	G3880-60070
PANEL-SUB-REAR	G3880-00030
Front panel grill assembly	G3880-60060
Side panel upper assembly	G3880-60080
PANEL-REAR	G3880-00026
GC Module side	
5975T main cover	G4360-67381
Small top GC cover	G4360-67760
5975T rear panel	G4360-67440

Local Control Panel

This section lists replaceable parts for the LCP and related covers. See Table 18.

Table 18 LCP and related parts (Figure 39)

Item	Description	Part number
1	LCP fascia	G3880-60000
2	LCP fascia assembly	G3880-60011

Figure 39 LCP replacement parts

Vacuum System

This section lists replacement parts available for the vacuum system. It includes clamps, O-rings and seals (Table 19), standard foreline pump and related components (Table 20 and Figure 40), dry foreline pump and related components (Table 21 and Figure 41), and turbo pump vacuum system components (Table 23 and Figure 43).

O-rings and seals

Table 19 O-rings and seals

Description	Part number
Calibration valve O-ring (1/4-inch)	5180-4182
End plate O-ring (for front and rear end plates)	0905-1441
GC/MSD interface O-ring	0905-1405
HED feedthrough	G1099-80012
HED feedthrough O-ring	0905-0490
KF10/16 seal (foreline pump inlet)	0905-1463
KF25 O-ring assembly (turbo pump outlet)	0100-1551
KF elbow adapter for standard turbo pump outlet	G2589-20041
O-ring for diffusion pump baffle adapter and standard turbo pump inlet	0905-1443
Seal, performance turbo pump inlet	0100-1879
Side plate O-ring	0905-1442
Vent valve O-ring (1/4-inch)	5180-4182
G 1/8-inch drain plug, 5 mm hex recess, steel, Pfeiffer	0100-2452
O-ring for foreline pump drain plug	0905-1619
Fill plug	0100-2451
O-ring for foreline pump fill plug	0905-1620
GC/MS vacuum valve assembly (isolation valve)	G3880-60587

Standard foreline pump and related parts

Table 20 Standard foreline pump and related parts (Figure 40)

Item	Description	Part number
	Foreline hose assembly (hose and internal spring)	05971-60119
	• Hose Clamp* used with 05971-60119	1400-3241
1	Standard foreline pump – 120V – Pfeiffer Duo 2.5	G3170-89025
1	Standard foreline pump – 220V – Pfeiffer Duo 2.5	G3170-89026
1	Standard foreline pump – 200V – Pfeiffer Japanese Version	G3170-89024
	Foreline pump inlet seal (KF10/16)	0905-1463
	KF10/16 Clamp (foreline inlet), Micro-Ion vacuum gauge	0100-1397
	Foreline Hose packaging cap – flange	G3170-40132
	KF16 Hose adapter	G1099-20531
	KF25 Clamp (tp end of hose – not shown)	0100-0549
	KF25 Hose adapter (tp end of hose – not shown)	G1099-20532
	Oil drip tray	G1099-00015
	Drain plug for foreline pump	0100-2452
	O-ring for foreline pump drain plug	0905-1619
	Fill plug	0100-2451
	O-ring for foreline fill plug	0905-1620
	Oil mist filter	G1099-80039
	Hose barb adapter (exhaust fitting)	G3170-80006
	O-ring for oil mist filter and hose barb adapter	0905-1193
	Foreline pump oil	6040-0621
	Safety Cage kit, Foreline pump	G3170-60028
	Safety Cage, Foreline pump Qty. 1	
2	Sheetmetal	
3	Warning sticker	
4	Rubber grommet	0400-0965
5	Standoff, Pump Cage Qty. 4	G3170-20035
6	M6 Acorn Cap Hex nut Qty. 4	0535-1041
7	M4 Internal Star washer Qty. 4	2190-0009

* Hose clamps are interchangeable, but give an optimum fit if they are matched

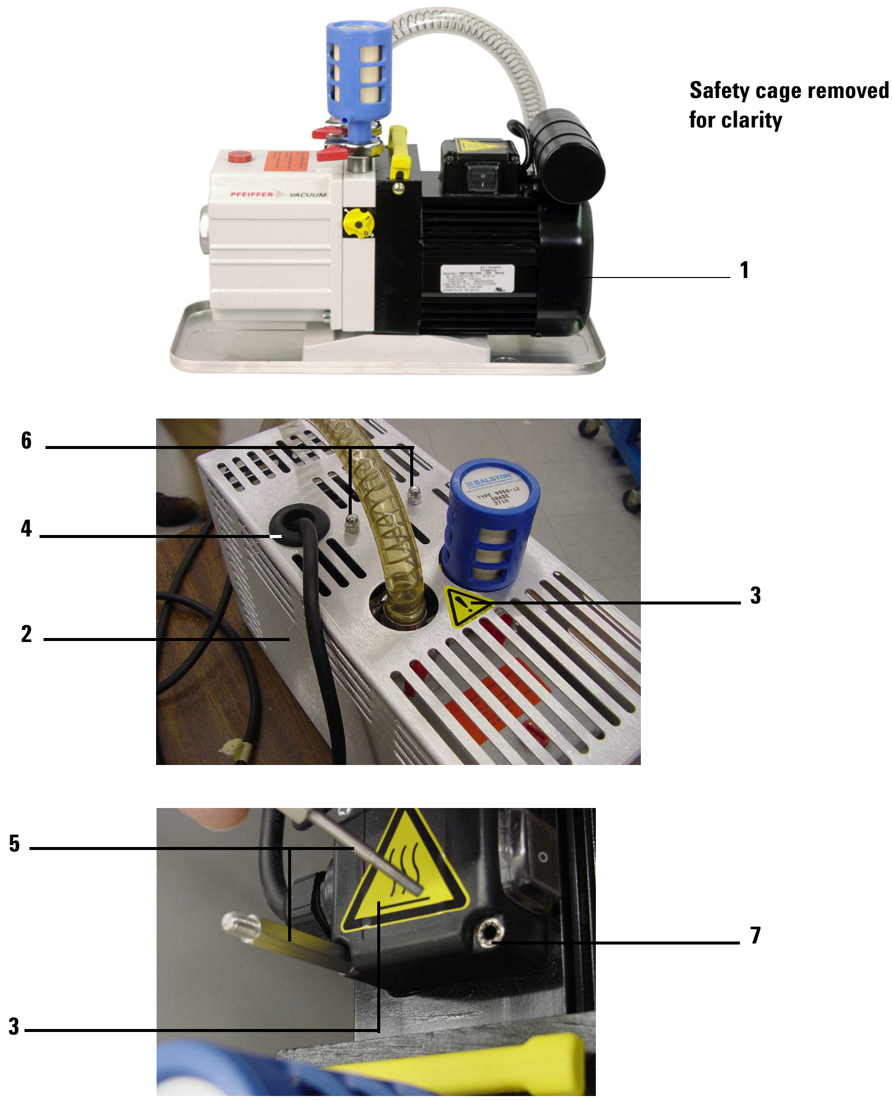


Figure 40 Foreline pump and related parts

Dry foreline pump and related parts

Table 21 Dry foreline pump and related parts (Figure 41)

Description	Part number
Foreline hose assembly (hose and internal spring)	05971-60119
• Hose Clamp* used with 05971-60119	1400-3241
Dry foreline pump	G3170-80028
Dry foreline pump (exchange)	G3170-89028
Foreline pump inlet seal (KF10/16)	0905-1463
KF10/16 Clamp (foreline inlet), Micro-Ion vacuum gauge	0100-1397
KF16 Hose adapter	G1099-20531
KF25 Clamp (tp end of hose – not shown)	0100-0549
KF25 Hose adapter (tp end of hose – not shown)	G1099-20532
Silencer filter	G3170-80030
Exhaust hose	G3170-60100
Exhaust adapter	G3170-80029
Safety cage	G3170-60033

* Hose clamps are interchangeable, but give an optimum fit if they are matched

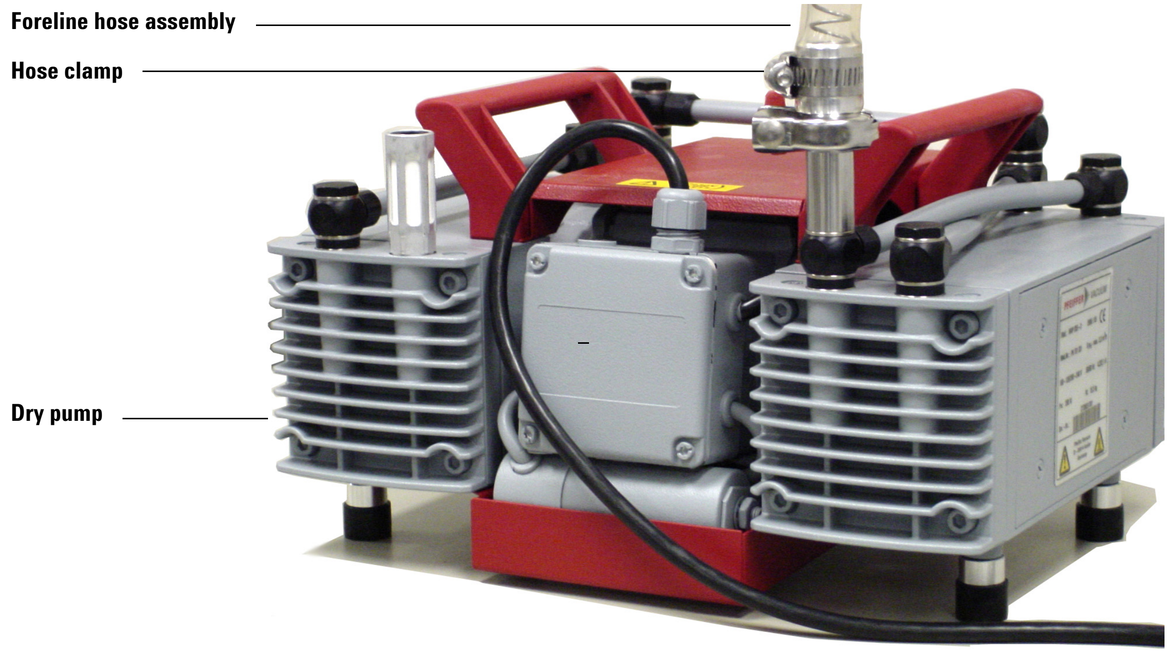


Figure 41 Dry foreline pump and related parts

Table 22 IDP3 Dry pump and related parts (Figure 42)

Description	Part number
NW16 Inlet trap with HEPA filter insert	SCRINTRPNW16
Replacement HEPA filter element (NW16)	REPLHEPAFILTER2
Exhaust silencer kit for IDP Series	EXSLRIDP3
Replacement filter element for IDP Series silencer	REPLSLRFILTER2
Vibration isolation kit for IDP Series	IDP3VIBISOKIT
Isolation valve retrofit kit for IDP Series, 115 VAC	VPI16IDP115
Isolation valve retrofit kit for IDP Series, 100 VAC	VPI16IDP100
Isolation valve retrofit kit for IDP Series, 200 VAC	VPI16IDP200
IDP Series tip seal kit	IDP3TS
IDP Series replacement module	IDP3
New foreline pump - 120V	G3170-80025
New foreline pump - 220V	G3170-80026
New foreline pump - 200V - Pfeiffer Japanese	G3170-80024
New dry “oil-less” pump	G3170-80028

Table 22 IDP3 Dry pump and related parts (Figure 42) (continued)

Description	Part number
Rebuilt foreline pump - 120V	G3170-89025
Rebuilt foreline pump - 220V	G3170-89026
Rebuilt foreline pump - 200V - Pfeiffer Japanese	G3170-89024
Rebuilt dry "oil-less" pump	G3170-89028
Dry scroll pump, IDP3 220v	G3170-80036
Dry scroll pump, IDP3 115v	G3170-80035
Rebuilt dry scroll pump, IDP3 220v	G3170-89036
Rebuilt dry scroll Pump, IDP3 115v	G3170-89035
Foreline hose assembly (hose & int. spring)	05971-60119
Hose clamp* used with 05971-60119	1400-3241
Hose clamp* used with G1099-80045	
Foreline pump inlet seal (KF10/16)	0905-1463
KF10/16 clamp (Foreline inlet)	0100-1397
KF16 hose adapter	G1099-20531
KF25 clamp (tp end of hose - not shown)	0100-0549
KF25 hose adapter (tp end of hose - not shown)	G1099-20532
Exhaust oil mist trap (threaded)	G1099-80039
Hose barb adapter (exhaust fitting)	G3170-80006
O-ring for oil mist filter and hose barb adapter	0905-1193
Foreline pump tray	G1099-00015
Foreline pump oil	6040-0621
Foreline pump cage	
Dry pump cage	
Exhaust hose for oil-less pump	G3170-60100
Oil-less pump exhaust adapter	G3170-80029
Oil-less pump exhaust adapter O-ring	
Oil-less pump exhaust silencer	
IDP3 Replaceable vacuum seal	
IDP3 Pumping module	
IDP3 Motor	
GCMS Vacuum valve assembly	G3880-60587

* Hose clamps are interchangeable, but gives an optimum fit if they are matched.

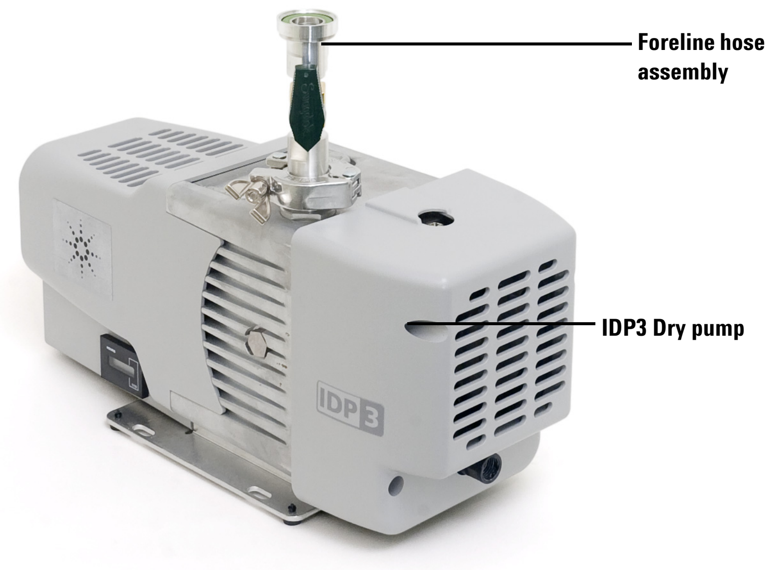


Figure 42 IDP3 Dry pump and related parts

Turbo pump and related parts

Table 23 Turbo pump MSD vacuum system components (Figure 43)

Item	Description	Part number
	Claw clamps for baffle adapter, standard turbo	G3170-60590
	Clamp for vacuum gauging	0100-1397
1	Fan (for high vacuum pump)	G1099-60564
	KF25 clamp (for turbo pump outlet)	0100-0549
	KF25 O-ring assembly (for turbo pump outlet)	0100-1551
4	Micro-Ion Vacuum Gauge vacuum gauging electronics	G3170-80001
2	Standard turbomolecular pump (new)	G3170-80061
	Standard turbomolecular pump (rebuilt)	G3170-89061

Table 23 Turbo pump MSD vacuum system components (Figure 43) (continued)

Item	Description	Part number
3	Turbo power supply only	G3170-60600
	Turbo separate power supply-control wiring harness	G3170-60835
5	Analyzer chamber (manifold)	G3170-20560
	Manifold EMC gasket	G3170-80031

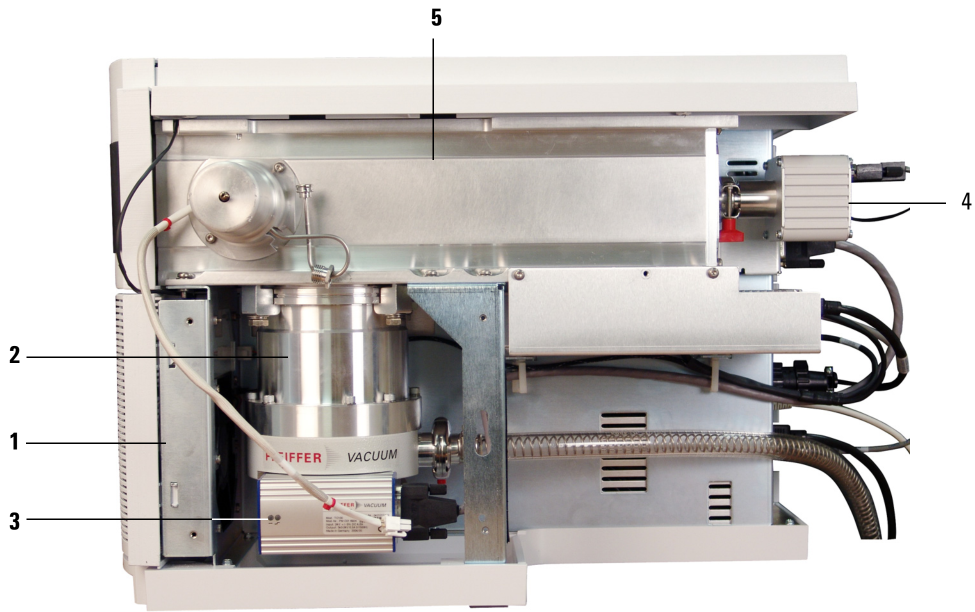


Figure 43 Turbo pump and related parts

Analyzer

Table 24 and Figure 44 show the analyzer chamber and associated parts.

Table 24 Analyzer chamber and related parts (Figure 44)

Item	Description	Part number
1	Shield/plate for ion gauge port	G3170-00003
	Micro-Ion Vacuum Gauge Baffle	G3170-00015
	• M3X12 TX T10 PN SQ Cone SS (qty 2)	0515-0664
2	EI Calibration valve assembly Turbo pump MSDs	G3170-60204
3	Calibration vial	G3170-80002
4	End plate front glass	G3170-20552
4	End plate front acrylic	G3170-20022
	Washer between glass and acrylic	3050-0376
5	End plate front frame	G3170-00001
	End plate rear cap	G3170-20553
	Shield/plate for ion gauge port	G3170-00003
	Side plate (includes feedthrough and thumbscrews)	G3170-60021
6	Vent valve knob	G3170-20554

Figure 44 Analyzer chamber and related parts

Table 25 and Figure 45 show the replacement parts for the analyzer. Analyzer screws (Table 26) and the individual ion source parts (Table 27) are listed in the tables that follow.

Table 25 Analyzer parts (Figure 45)

Item	Description	Part number
	Analyzer, new Turbo	 G3170-20560
	Analyzer, rebuilt Inert analyzer	 G3170-69770
	Detector, HED	G3170-80100
7	Electron multiplier horn	G3170-80103
	Feedthrough board (source board)	G1099-60425
	HED feedthrough	G1099-80012
	O-ring, Viton for HED feedthrough	0905-0490
4	EI 350 ion source, new Turbo - inert	 G3170-65760
4	EI 350 ion source, rebuilt Turbo - inert	 G3170-69760
6	Magnet assembly	05971-60160
	Low gauss magnet assembly	G3163-60560
	Mass filter cable kit	G3170-60130
	Mass filter contacts (4)	G1099-60142
	Mass filter canted coil support, detector end	G3170-20025
	Mass filter canted coil spring	G1460-2724
	Mass filter ceramic support, source end	G1099-20123
3	Mass filter heater assembly	G1099-60172
	Mass filter radiator	G3170-20121
	Mounting bracket, detector end	G3170-00040
	Mounting bracket, source end	G1099-00001
	Pins for source and detector end mounting brackets	G1099-20137
	Side plate (includes thumbscrews)	G3170-60021
5	Source radiator	G1099-20122
	Side board, new	G3170-65015
	Side board, rebuilt	G3170-69015

Table 25 Analyzer parts (Figure 45) (continued)

Item	Description	Part number
	RFPA fan assembly	G3170-60023
	Quad Stops (need 2)	G3170-20023

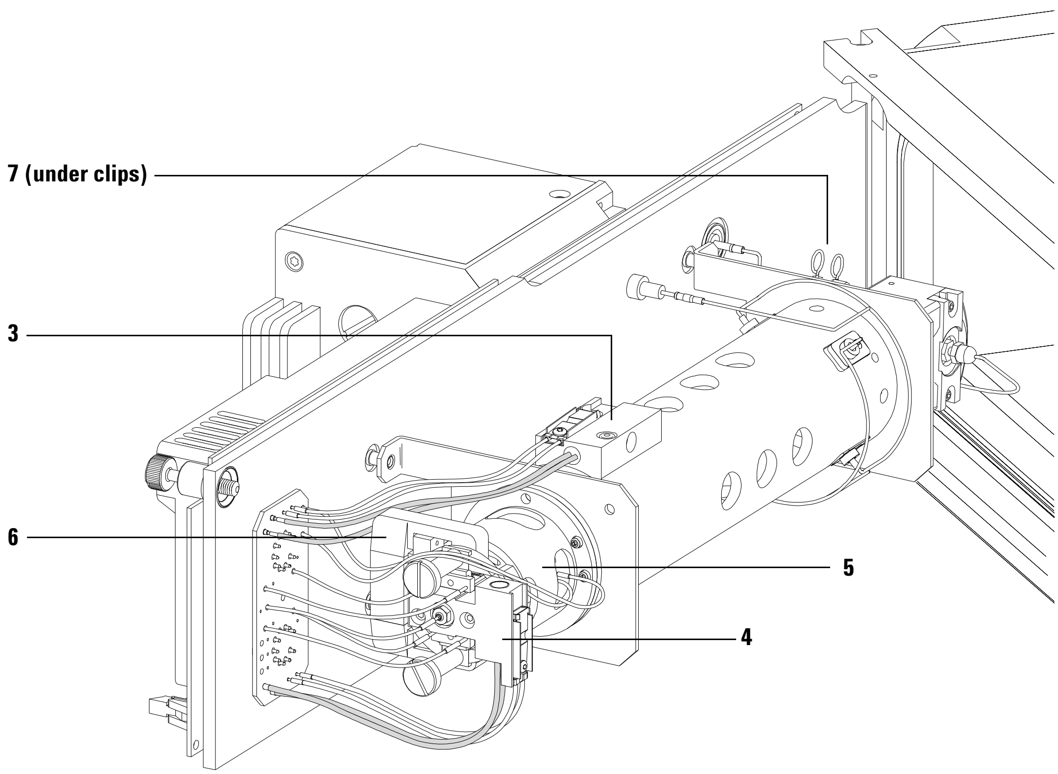


Figure 45 Analyzer parts

Table 26 Analyzer screws

Description	Part number
Heater/Sensor (quad) setscrew	0515-1446
Ion source thumbscrew	G1099-20138
Magnet mounting screws	0515-1046
Screw – magnet bracket to source radiator	0515-1602
Screws – source radiator and detector to quad radiator	G3170-20123
Screws – mass filter contact assembly/heater block	G3170-20122
Screws – radiator. Mounting brackets side board	0515-0430
Source radiator screws	0515-1052
Screws for Quad Stop	0515-0221

EI source

Table 27 lists the parts for the EI source suitable for the 5975T. Inert parts are the default parts for this product, they may not be interchanged.

Table 27 EI ion source (Figure 46)

	Description	Part number
	Ion source, new Turbo - inert	G3170-65760
	Ion source, rebuilt Turbo - inert	G3170-69760
11	Drawout cyclinder	G1072-20008
12	Drawout plate – 3 mm Inert	G2589-20100
12	Drawout plate – 3 mm Stainless Steel - Standard	05971-20134
12	Drawout plate – 6 mm Inert*	G2589-20045
12	Drawout plate – 6 mm Stainless Steel	G3163-20530
9	Entrance lens	G3170-20126
3	EI filament	G2590-60053
4	Interface socket	G1099-20136
10	Ion focus lens	05971-20143
8	Lens insulator (one piece)	G3170-20530
5	EI 350 Anodized Repeller assembly	G3170-60172
	Inert EI 350 Anodized Repeller assembly	G3170-60171
7	Screws for filament	G1999-20021
6	Screw to hold repeller assembly on source	G1999-20021
2	Setscrew for lens stack	G1999-20022
1	Source body – Inert	G2589-20043
1	Source body – Stainless Steel	G1099-20130
	Ion source – Storage box	G1999-65001

* Used in G2860A and G2860B extended linearity kits

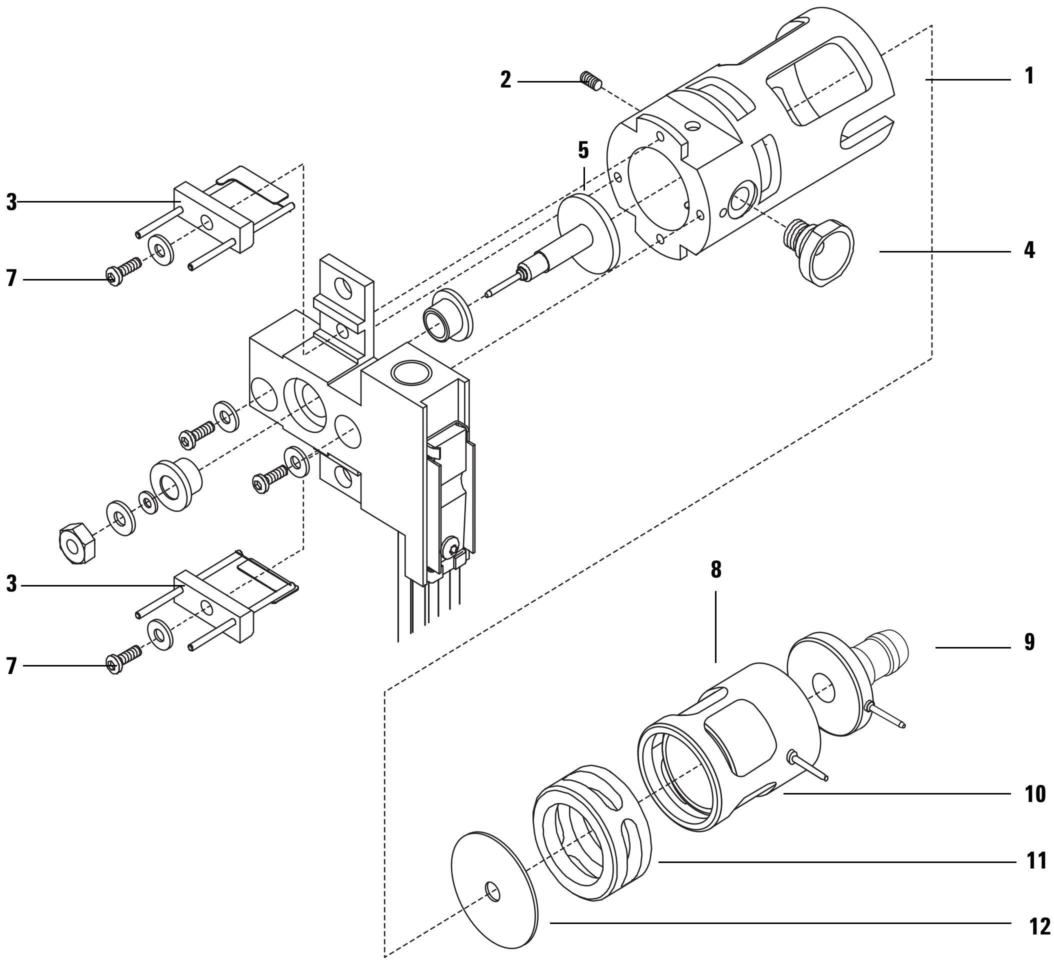


Figure 46 EI source

Repeller assembly

Table 28 Repeller assembly

Description	Part number
EI 350 Anodized Repeller assembly	G3170-60172
Inert EI 350 Anodized Repeller assembly	G3170-60171
Insulator (2 required)	G1099-20133
Nut, 5.5-mm	0535-0071
Repeller - Inert	G2589-20044

Table 28 Repeller assembly (continued)

Description	Part number
Repeller - Stainless Steel	G1099-20132
Setscrew	0515-1446
Anodized Source Heater Assembly	G3169-60177
Washer for repeller	3050-0891

Heater sensor assembly

Table 29 Heater sensor block assembly

Description	Part number
EI 350 Anodized Source Heater Assembly	G3170-60180
Inert EI 350 Anodized Source Heater Assembly	G3170-60177
EI 350 Anodized Source Heater Assembly, Japan	G3170-60178
Inert EI 350 Anodized Source Heater Assembly, Japan	G3170-60179
Setscrew	0515-1446
M3 x 0.56-mm long screw	0515-0430
350 Repeller Block Turbo	G3170-20131
Heater, Repeller	G1099-60103
Heater, Repeller, Japan	G3170-60103
High Temp Source Sensor	G3170-60104

EI GC/MSD Interface

Table 30 lists the replacement parts related to the EI GC/MSD interface.

Table 30 EI GC/MSD interface

Description	Part number
GC/MSD interface (complete)	G1099-60300
Interface column nut	05980-20066
Heater sleeve	G1099-20210
Heater/Sensor assembly	G1099-60107
Insulation	G1099-20301
Setscrew for heater/sensor assembly	0515-0236
Screws, M4x0.7 panhead, for heater sleeve	0515-0383
Welded interface assembly	G1099-60301
RTGA Welded interface assembly	G2589-60060
GC/MSD interface O-ring	0905-1405
Interface cover	G1099-00005
Transfer line cover	G3170-00405
Screws for mounting interface and cover to analyzer chamber	0515-0380

Table 31 Ferrules for GC/MSD interface

Description	Part number
Preconditioned 85% Vespel, 15% Graphite	
Ferrules Long (10 pack)	
0.1-0.25 mm id column	5062-3508
0.32 mm id column	5062-3506

LTM System

Table 32 Split/Splitless inlet

Description	Part number
5975T S/SL-EPC INJ 0-100 PSIG	G4360-67600
5975T S/SL weldment tubing + bulkhead+nut+ferrule	G4360-67730
5975T S/SL weldment assembly with standard liner	G4360-67530
5975T Inlet bulkhead	G4360-67540
5975T 1/8-inch bulkhead union, 316 SST	G4360-67133
5975T Inj fan assembly	G4360-67320

Table 33 GC module mainframe

Description	Part number
5975T Latching block	G4360-67020
5975T Cooling fan	G4360-67049
5975T Door latch	G4360-67391
5975T Oven door latch spring	G4360-67040
5975T Oven shroud assembly (with sensor, heater, hook, screws)	G4360-67703
5975T New guard bracket	G4360-67302
5975T Door assembly	G4360-67508
5975T Power module assembly	G4360-67200
5975T Fuse	G4360-67160

Table 34 Gas filter holder

Description	Part number
Bracket assembly	G4360-60801
Screw (order 7 screws for one bracket assembly)	0515-0382
Traps holder assembly	G4360-63010

Table 35 LTM module parts

Description	Part number
CPM union, Inert	G3182-60580
5975T Column module fan assembly	G3900-60019

Automatic Liquid Sampler

Table 36 7693 Automatic Liquid Sampler

Description	Part number
ALS tower	G4513-64000
Syringe, 10 µL 23/26 ga, GT, FN, Taper	5181-3354
Spot Hi-Density turret	G4513-40532
ALS main cable assembly	G4514-60610
ALS consumables and supplies	
Vial kit	07673-80090
Diffusion caps for 4 mL vials, 12/pk	07673-40180
Snap/Crimp vial + cap INTERNAL USE ONLY	5182-0862
Needle support insert, on column, 7693	G4513-40529

Reusable Shipping Containers

Table 37 Reusable shipping container parts

Description	Part number
5975T Metal strap kit, (2/pk)	G3880-80018
5975T Reusable container package base	G3880-80019

Figure 47 Reusable shipping container

Consumables and Maintenance Supplies

This section (Tables 38 through 46) lists parts available for cleaning and maintaining your MSD.

Table 38 Maintenance supplies

Description	Part number
Abrasive paper, 30 µm	5061-5896
Alumina powder, 1 kg	8660-0791
Cloths, clean (qty 300)	05980-60051
Cloths, cleaning (qty 300)	9310-4828
Cotton swabs (qty 100)	5080-5400
Foreline pump oil, P3, 0.5 L	6040-0621
Gloves, clean – Large	8650-0030
Gloves, clean – Small	8650-0029
Grease, Apiezon L, high vacuum	6040-0289

Table 39 GC consumables

Description	Part number
Column nut fitting	05988-20066
Ferrules, 0.4 mm; 200, 250 µm,10/pk	5062-3508
1/16 Ferrule no-hole graphitized, Vespel	0100-0691
Column nut 2/pk	5181-8830
O-ring, 2-010, fluoroelastomer, 5/pk	5188-6405
Gold plated inlet seal with washer	5188-5367
Screw cap vial 100/pk	5182-0715
Liner, direct, 2 mm ID, non-deactivated	18740-80220
Liner, MS certified, spltls, sngl tpr, D, GW	5188-6568
11 mm LOWBLD SEPTA 5/pk	5182-3413
Ferrule Vespel/Graphite 250 µ, 10/pk	5181-3323
Blue screw caps 100/pk	5182-0717
SilTite ferrules, 0.1-0.25 mm column, 10/pk	5188-5361
FS, deactivated -0.250 mm × 1 m	160-2255-1

Table 39 GC consumables (continued)

Description	Part number
Internal nut for micro fluidic products	G2855-20530
SS wire 0.015-inch Dia × 40 mm 10/pk	G2855-60593
Magnifier, 3x, 6x, paddle, plastic	G2855-40001
Column storage fitting	G2855-20590

Table 40 Frequently used item

Description	Part number
Button, syringe plunger	19245-40030
Syringe 10 µL straight, FN 23/42/HP	9301-0713
Injector mounting post for 7693	G4513-20561
RP-Wrench, angled	19251-00100

Table 41 Tools

Description	Part number
Column cutter	5181-7487
Column installation tool	G1099-20030
Ferrule, pre-swage tool, capillary flow	G2855-20530
Funnel	9301-6461
Hex key, 5 mm	8710-1838
Tool Kit	G1099-60566
Ball drivers, 1.5-mm	8710-1570
Ball drivers, 2.0-mm	8710-1804
Ball drivers, 2.5-mm	8710-1681
Hex nut driver, 5.5-mm	8710-1220
Pliers, long-nose (1.5-inch nose)	8710-1094
Screwdrivers Flat-blade, large	8730-0002
Screwdrivers Torx, T-10	8710-1623
Screwdrivers Torx, T-15	8710-1622
Screwdrivers Torx. T-20	8710-1615

Table 41 Tools (continued)

Description	Part number
Swagelock tool for SilTite ferrules	G2855-60200
GC module shipping kit	G3880-60585
MSD shipping kits	G3170-60501
5975T Mainframe shipping kit	G3880-68501
Tweezers, non-magnetic	8710-0907
Wrenches, open-end 1/4-inch x 5/16-inch	8710-0510
Wrenches, open-end 10-mm	8710-2353
Wrist strap, antistatic, small	9300-0969
Wrist strap, antistatic, medium	9300-1257
Wrench, angled, septum nut[*]	19251-00100
Wrench, open-end, 9/16-inch and 7/16-inch[*]	8710-0803
Wrench, capillary inlet[*]	G3452-20512
Column cutter, wafer (4/pk)[*]	5181-8836
Driver, nut, 1/4-inch[*]	8710-1561
T-20 Torx key or screwdriver[*]	8710-1807
T-10 Torx key or screwdriver[*]	8710-2140
3-mm hex key wrench	8710-2411
Electronic flow meter(s) or bubble meter(s) capable of calibrated measurements at 1, 10, and 100 mL/min flow ranges.	
Electronic leak detector	
Magnifying loupe, 20X	430-1020
Metric ruler	
Bench vise (for setting Swagelok fittings)	
Razor or sharp knife	
Tweezers or Thin needle-nose pliers	8710-0007 8710-0004
Needle-nose pliers	
ESD wrist strap (for installing new components)	
Gloves, heat-resistant (for handling hot parts)	
Tools and materials for cleaning procedures	

Table 41 Tools (continued)

Description	Part number
Cleaning brushes—The FID cleaning kit (9301-0985) contains appropriate brushes for cleaning inlets	
Cleaning brushes—(8710-1346) For cleaning split/splitless inlet split vent fitting	
Jet cleaning wire (.010 inch)	
Small ultrasonic cleaning bath with aqueous detergent (for cleaning inlet parts)	
Gloves, clean, lint-free, nylon (for handling contamination-sensitive parts)	8650-0030 (large) 8650-0029 (small)
Steel wool, 0- or 00-grade (for cleaning an inlet's septum seating surfaces)	
Wrench, angled, septum nut[†]	19251-00100
Wrist strap, antistatic, large	9300-0970

* Included with the GC ship kits

† Included with the GC ship kits

Table 42 GC Column modules

Col Module/Col Toroid Description	Column module Part number	Toroid Part number
HP-5msUI 30m,.25mm,.25µm	G3900-63001	19091S-433UILTM
DB-1 30m, 0.25mm, 0.25µm	G3900-63002	122-0132LTM
DB-1701 30m,.25mm,.25µm	G3900-63003	122-0732ELTM
DB-5ms 30m,0.25mm,0.25µm	G3900-63004	122-5532LTM
DB-5msUI 30m,.25mm,.25µm	G3900-63005	122-5532UILTM
DB-VRX 20m,0.18mm,1.0µm	G3900-63006	121-1524LTM
HP-5ms 30m,0.25mm,0.25µm	G3900-63007	19091S-433LTM
HP-INNOWax 30m x 0.25 x 0.25	G3900-63008	19091N-133LTM
DB-1ms 20m,0.18mm,0.18µm	G3900-63009	221-0122LTM
DB-624 20m,0.18mm,1.0µm	G3900-63010	221-1324LTM
DB-35ms 20m,.18mm,.18µm	G3900-63011	221-3822LTM
DB-17ms 20m,.18mm,.18µm	G3900-63012	221-4722LTM
DB-5ms 20m,0.18mm,0.18µm	G3900-63013	221-5522LTM
DB-5msUI 20m,.18mm,.18µm	G3900-63014	221-5522UILTM
DB-608 20m,0.18mm,0.18µm	G3900-63015	221-6822LTM
DB-1ms 15m,0.25mm,0.25µm	G3900-63016	222-0112LTM
DB-1ms 30m,0.25mm,0.25µm	G3900-63017	222-0132LTM
DB-1ht 15m,0.25mm,0.10µm	G3900-63018	222-1111LTM
DB-1ht 30m,0.25mm,0.10µm	G3900-63019	222-1131LTM
DB-624 30m,0.25mm,1.40µm	G3900-63020	222-1334LTM
DB-VRX 30m,0.25mm,1.40µm	G3900-63021	222-1534LTM
DB-225ms 15m,.25mm,.25µm	G3900-63022	222-2912LTM
DB-225ms 30m,.25mm,.25µm	G3900-63023	222-2932LTM
DB-FFAP 15m,.25mm,.25µm	G3900-63024	222-3212LTM
DB-FFAP 30m,.25mm,.25µm	G3900-63025	222-3232LTM
DB-35ms 15m,.25mm,.25µm	G3900-63026	222-3812LTM
DB-35ms 30m,.25mm,.25µm	G3900-63027	222-3832LTM
DB-17ms 15m,.25mm,.25µm	G3900-63028	222-4712LTM
DB-17ms 30m,.25mm,.25µm	G3900-63029	222-4732LTM

Table 42 GC Column modules (continued)

Col Module/Col Toroid Description	Column module Part number	Toroid Part number
DB-5ms 15m,0.25mm,0.25µm	G3900-63030	222-5512LTM
DB-5msUI 15m,.25mm,.25µm	G3900-63031	222-5512UILTM
DB-5ht 15m,0.25mm,0.10µm	G3900-63032	222-5711LTM
DB-5ht 30m,0.25mm,0.10µm	G3900-63033	222-5731LTM
DB-WAX 15m,0.25mm,0.50µm	G3900-63034	222-7013LTM
DB-WAX 30m,0.25mm,0.50µm	G3900-63035	222-7033LTM
INNOWax 20m,.18mm,.18µm	G3900-63036	29091N-577LTM
HP-VOC 30m,0.20mm,1.12µm	G3900-63037	29091R-303LTM
HP-5msUI 15m,.25mm,.25µm	G3900-63038	29091S-431UILTM
HP-5msUI 20m,.18mm,.18µm	G3900-63039	29091S-577UILTM
HP-1ms 20m,0.18mm,0.18µm	G3900-63040	29091S-677LTM
HP-1ms 30m,0.25mm,0.10µm	G3900-63041	29091S-833LTM
HP-1ms 15m,0.25mm,0.25µm	G3900-63042	29091S-931LTM

Table 43 Ferrules

Description	Part number
For the GC/MSD interface	
• Blank, graphite-vespel	5181-3308
• 0.3-mm id, 85%/15% for 0.10-mm id columns	5062-3507
• 0.4-mm id, 85%/15%, for 0.20 and 0.25-mm id columns	5062-3508
• 0.5-mm id, 85%/15%, for 0.32-mm id columns	5062-3506
For the GC inlet	
• 0.27-mm id, 90%/10%, for 0.10-mm id columns	5062-3518
• 0.37-mm id, 90%/10%, for 0.20-mm id columns	5062-3516
• 0.40-mm id, 90%/10%, for 0.25-mm id columns	5181-3323
• 0.47-mm id, 90%/10%, for 0.32-mm id columns	5062-3514
For the Ultimate Union to guard column to LTM column	
SilTite metal ferrules 1/16 inch (10 ferrules and 2 nuts)	5184-3571
SilTite metal ferrules for 0.4-mm id columns	5184-3569
SilTite metal ferrules for 0.5-mm id columns	5184-3570

Table 44 Nuts, ferrules, and hardware for capillary columns to inlet

Column id (mm)	Description	Typical use	Part number/quantity
.320	Ferrule, Vespel/graphite, 0.5-mm id	0.32-mm capillary columns	5062-3514 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet	5020-8292
.250	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet	5020-8292
.100 and .200	Ferrule, Vespel/graphite, 0.37-mm id	0.1-mm and 0.2-mm capillary columns	5062-3516 (10/pk)

Table 44 Nuts, ferrules, and hardware for capillary columns to inlet (continued)

Column id (mm)	Description	Typical use	Part number/quantity
	Ferrule, Vespel/graphite, 0.4-mm id	0.1-mm, 0.2-mm, and 0.25-mm capillary columns	5181-3323 (10/pk)
	Ferrule, graphite, 0.5-mm id	0.1-mm, 0.2-mm, 0.25-mm, and 0.32-mm capillary columns	5080-8853 (10/pk)
	Column nut, finger-tight (for .100- to .320-mm columns)	Connect column to inlet	5020-8292
All	Ferrule, no-hole	Testing	5181-3308 (10/pk)
	Capillary column blanking nut	Testing–use with any ferrule	5020-8294
	Column nut, universal	Connect column to inlet	5181-8830 (2/pk)
	Column cutter, ceramic wafer	Cutting capillary columns	5181-8836 (4/pk)

Table 45 Swag nuts

Description	Part number
Stainless steel	
J20” 1/8 inch ID stainless steel	7157-0210
Swag - Ferrule, front 1/8 inch (10/pk)	5180-4110
Swag - Ferrule, rear, 1/8 inch (10/pk)	5180-4116
Swag - Nut, for 1/8 inch (10/pk)	5180-4104
Swag - Nut and ferrules (10 set/pk)	5080-8751
Tubing cutter for SS tubing	8710-1709
Tubing cutter replacement blades	8710-1710
Brass	
1/8 Union Tee Brass Swagelok	0100-0090
1/8 Nut and Ferrule Set Brass Swagelok	5181-7481
1/8-inch Brass Nut/Ferrules 10pk	5181-7479

Table 46 Miscellaneous parts and samples

Description	Part number
EM Horn	G3170-80103
Filament assembly (High temperature EI for GCMS)	G3170-60050
Foreline pump oil (1 liter), P3	6040-0621
Foreline exhaust oil mist trap	G1099-80039
Heater/Sensor GC/MSD interface	G1099-60107
Benzopheone 100 pg/µL	8500-5440
Octafluoronaphthalene, OFN, 1pg/µL	5188-5348
OFN 100 fg/µL	5188-5347
PFHT, 100 pg/µL	5188-5357
PFTBA, 10 gram	8500-0656
PFTBA sample kit	05971-60571
Foreline pump tray	G1099-00015
Eval A, hydrocarbons	05971-60045
Micro-Ion gauge electronics	G3170-89001
Methane/isobutane gas purifier	G1999-80410
J20′ 1/8-inch id stainless steel	7157-0210
Wipes (qty 300)	9310-4828
Swagelok ferrule, front, 1/8-inch, 10/package	5180-4110
Swagelok ferrule, rear, 1/8-inch, 10/package	5180-4116
Swagelok nut, for 1/8-inch fitting, 10/package	5180-4104
Swagelok nut and ferrules, 10 set/package	5080-8751
Triode gauge tube	G3880-80011
Tubing cutter for SS tubing	8710-1709
Tubing cutter replacement blades	8710-1710
He Gas Filter	RNSH-2
Traps/Filter bracket assembly	G4360-60801

Table 47 5975T Mainframe shipping kit (G3880-68501)

Description	Part number
SilTite ferrules,0.1-0.25 mm column,10 pk	5188-5361
Ferrule Pre-Swage tool, capillary flow	G2855-60200
FS, deactivated -.250mm × 1m	160-2255-1
Internal nut for micro fluidic products	G2855-20530
Column installation tool for 5975T	G3880-20030
SilTite nut	G2855-20555
Plug for micro fluidic manifold or unions	G2855-60570
CPM union, inert	G3182-60580
10-PK, SS wire .015” Dia X 40mm	G2855-60593
Magnifier, 3x, 6x, paddle, plastic	G2855-40001
Column storage fitting	G2855-20590

Table 48 5975T GC module shipping kit (G3880-60585)

Description	Part number
Button, syringe plunger	19245-40030
Syringe 10 µL straight, FN 23/42/HP	9301-0713
RP-Wrench, angled	19251-00100
Column nut 2/PK	5181-8830
O-ring, 2-010, fluoroelastomer, 5PK	5188-6405
Gold plated inlet seal with washer	5188-5367
Screw cap vial 100/PK	5182-0715
Liner, MS certified, spltls, sngl tpr, D, GW	5188-6568
11MM LOWBLD SEPTA 5 PK	5182-3413
Ferrule Vespel/Graphite 250 µ 10/PK	5181-3323
Blue screw caps 100/PK	5182-0717
Cable, w/conn,80-1000V,telecom	8121-0940
Cable, Y-remote start stop, NON APG	G1530-61200
1/8 inch ODX250cm Cu Tubing coil assembly	G1530-61100
Column cutter	5181-7487

Table 48 5975T GC module shipping kit (G3880-60585) (continued)

Description	Part number
Tool, wrench 1/4 inch to 5/16 inch	8710-0510
Wrench	G3452-20512