Agilent 5975/5977 MSD for OpenLAB CDS

Operation Manual

Agilent Technologies

Notices

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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.

About This Manual

This manual contains information for operating and maintaining the Agilent 5975 through 5977 series of MSD with OpenLAB CDS software. Agilent OpenLAB CDS is a new operating system for Agilent instruments.

The Agilent 5977B Series Mass Selective Detector (MSD) is the base instrument described in this manual. Agilent instruments manufactured prior to the 5977B share many features and hardware with this new instrument. Where older Agilent models differ from the 5977B, that difference is usually noted. Please refer to the operating and maintenance documentation that was delivered with your instrument if other hardware differences are found.

1 "Introduction"

Chapter 1 describes general information about the 5977B Series MSDs, including a hardware description, general safety warnings, and hydrogen safety information.

2 "Installing GC Columns"

Chapter 2 shows you how to prepare a capillary column for use with the MSD, install it in the GC oven, and connect it to the MSD using the GC/MSD interface.

3 "Operating in Electron Ionization (EI) Mode"

Chapter 3 describes basic tasks such as setting temperatures, monitoring pressures, tuning, venting, and pumpdown. Much of the information in this chapter also applies to CI operation.

4 "General Maintenance"

Chapter 4 describes maintenance procedures common to both EI and CI instruments.

Hardware User Information

5977B MSD

Accompanying your hardware and software, is a comprehensive collection of manuals, videos, user applications, and method development tools. These are located on the Agilent GC and GC/MS User Manuals and Tools DVD set.

See the Agilent 5977B MSD System Quick Start document (G7077-90103) for more details on how to install this information on your computer.

5975/5977 Series MSD prior to the 5977B MSD

Users of Agilent MSD instruments manufactured prior to the 5977B should refer to the documentation delivered to them when their MSD was purchased. The information in this manual is intended to supplement that documentation. Information included here will help you more effectively use the OpenLAB CDS operating system with your instruments.

Additionally, there is extensive online Help and Learning material provided with OpenLAB.

Contents

1 Introduction

This chapter describes general information about the MSD, including a hardware description, general safety warnings, and hydrogen safety information.

5977B Series MSD Version

The 5977B Series MSDs are equipped with a turbomolecular (turbo) pump and a choice of four foreline pumps or a diffusion pump paired with a Pfeiffer DUO 2.5 foreline pump. There are two types of EI sources, a standard stainless steel EI source and an extraction EI source available on the Inert Plus MSD model. A CI ion source includes a reagent flow control system, a CI calibration system, and other required hardware features. The serial number label displays a product number (Table 1) that indicates what type of MSD you have.

Table 1 Available high vacuum pumps

Model name	Product number	Description	Ionization mode/Type
5977B MSD Diff Pump	G7080B	Diffusion pump	Electron ionization (EI)/Stainless Steel
5977B MSD Turbo Pump	G7081B	Turbo pump	Electron ionization (EI)/Stainless Steel
5977B Inert+ MSD EI Turbo	G7077B	Turbo pump MSD	Electron ionization (EI)/Extractor
5977B EI/CI MSD*	G7078B	Turbo pump MSD	Electron ionization (EI)/Extractor Chemical ionization /PCI, NCI

* Operation in CI mode is not supported on the initial version of OpenLAB CDS

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)
CI	Chemical ionization
DC	Direct current
DFTPP	Decafluorotriphenylphosphine (calibrant)
DIP	Direct insertion probe
DS	Data System
EI	Electron 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)
Inert	Standard EI source constructed from inert materials
Inert+	Extractor EI source constructed from inert materials
id	Inside diameter
LAN	Local Area Network
m/z	Mass to charge ratio
MFC	Mass flow controller

Table 2 Abbreviations (continued)

Abbreviation	Definition
MSD	Mass selective detector
NCI	Negative CI
OFN	Octafluoronaphthalene (calibrant)
PCI	Positive CI
PFDTD	Perfluoro-5,8-dimethyl-3,6,9-trioxydodecane (calibrant)
PFHT	2,4,6-tris(perfluoroheptyl)-1,3,5-triazine (calibrant)
PFTBA	Perfluorotributylamine (calibrant)
Quad	Quadrupole mass filter
RF	Radio frequency
RFPA	Radio frequency power amplifier
Torr	Unit of pressure, 1 mm Hg
Turbo	Turbomolecular (pump)

The 5977B Series MSD

The 5977B Series MSD is a stand-alone capillary GC detector for use with either an Agilent 7890B Series or an Agilent 7820 Gas Chromatograph. The MSD features:

- WEB User Interface (WUI) for locally monitoring and operating the MSD
- A turbo vacuum pump with one of four different foreline pumps
- A diffusion vacuum pump with a Pfeiffer DUO 2.5 foreline pump
- Three different types of independently heated MSD electron-ionization (EI) sources available: standard source in both stainless steel and inert material, and an extractor source.
- Independently MSD heated hyperbolic quadrupole mass filter
- High-energy dynode (HED) electron multiplier detector
- Independently GC heated GC/MSD interface

Physical description

The 5977B Series MSD housing is approximately 41 cm high, 30 cm wide, and 54 cm deep. The weight is 39 kg for the diffusion pump model, 44 kg for the turbo pump model (EI), and 46 kg for the turbo pump model (EI/CI). The foreline (roughing) pump weighs an additional 11 kg and is usually located on the floor behind the MSD.

The basic components of the instrument are: the frame/cover assemblies, the vacuum system, the GC interface, the electronics, and the analyzer.

Vacuum gauge

The MSD may be equipped (or ordered) with an ion vacuum gauge. The OpenLAB CDS Acquisition software can be used to read the pressure (high vacuum) in the vacuum manifold. Operation of the gauge controller is described in this manual.

Table 3 5977B Series MSD features

Feature		
High vacuum pump	Diffusion	Turbo
Optimal He column flow mL/min	1	1 to 2
Maximum recommended gas flow mL/min*	1.5	4
Maximum gas flow, mL/min†	2	6.5
Max column id	0.25 mm (30 m)	0.53 mm (30 m)
Inert ion sources available	Yes	Yes
Foreline pumps available	Pfeiffer Duo 2.5	Pfeiffer Duo 2.5, MVP-070-3, MVP-070-3C, IDP3 24V
DIP‡ capability (3rd party)	Yes	Yes

* Total gas flow into the MSD: column flow plus reagent gas flow (if applicable). Based on helium gas use. For other gases the maximum flow will vary.

† Expect degradation of spectral performance and sensitivity.

‡ Direct insertion probe.

MSD Hardware Description

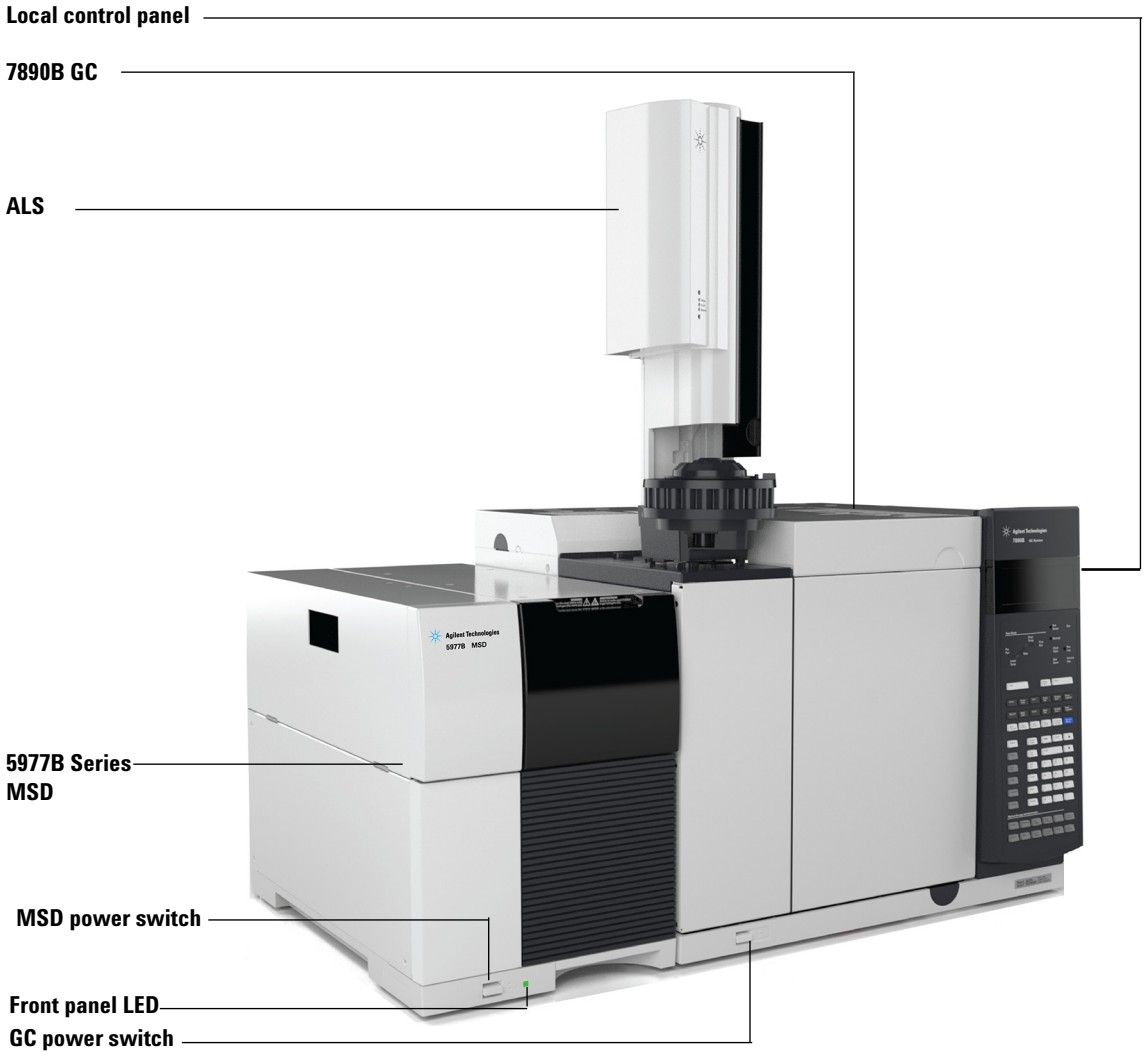


Figure 1 5977B Series GC/MSD system, shown with Agilent 7890B GC

Important Safety Warnings

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

Many internal parts of the MSD carry dangerous voltages

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

- The wiring between the 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, inlet, or valve box)

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.**

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

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

Electrostatic discharge is a threat to MSD electronics

The printed circuit boards in the 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.

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 GC inlets
- The GC oven and its contents including the column nuts attaching the column to a GC inlet, GC/MS interface, or GC detector
- The GC detector
- The GC valve box
- The foreline pump
- The diffusion pump
- The heated MSD ion source, interface, and quadrupole

Always cool these areas of the system to room temperature before working on them. They will cool faster if you first set the temperature of the heated zone to room temperature. Turn the zone off after it has reached the setpoint. 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 **Be careful when working behind the instrument. During cool-down cycles, the GC emits hot exhaust which can cause burns.**

WARNING **The insulation around the GC 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, and do not leave absorbent material such as paper towels in it.**

Hydrogen Safety

WARNING **Using hydrogen as a GC carrier gas is potentially dangerous.**

WARNING **When using hydrogen (H_2) as the carrier gas or fuel gas, be aware that hydrogen can flow into the GC oven and create an explosion hazard. Therefore, be sure that the supply is turned off until all connections are made and ensure that the inlet and detector column fittings are either connected to a column or capped at all times when hydrogen 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 non luminous flame which can be invisible under bright light.

GC precautions

When using hydrogen as a carrier gas, remove the large round plastic cover for the MSD transfer line located on the GC left side panel. In the unlikely event of an explosion, this cover may dislodge.

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 GC oven and subsequent combustion (see your GC documentation and the label on the top edge of the GC oven door)
- Accumulation of hydrogen in the MSD and subsequent combustion

Hydrogen accumulation in an MSD

WARNING **The MSD 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 4 on page 19) 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 MSD.

Table 4 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. There is a safety feature that will shut down the flow of carrier gas in the event of an MSD foreline pump shut down. However, if this feature fails, hydrogen may slowly accumulate in the mass spectrometer.
Mass spectrometer automated shutoff valves closed	Some mass spectrometers are equipped with automated diffusion pump shutoff valves. In these instruments, deliberate operator action or various failures can cause the shutoff valves to close. Shutoff valve closure does not shut off the flow of carrier gas. As a result, hydrogen may slowly accumulate in the mass spectrometer.

Table 4 Hydrogen accumulation mechanisms (continued)

Mechanism	Results
Mass spectrometer manual shutoff valves closed	Some mass spectrometers are equipped with manual diffusion 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.
GC off	A GC can be shut down deliberately. It can also be shut down accidentally by an internal or external failure. Different GCs react in different ways. If a 7890 Series GC equipped with Electronic Pressure Control (EPC) is shut off, the EPC stops the flow of carrier gas. If a GC's carrier flow is **not** under EPC control, the flow increases to its maximum. This flow may be more than some mass spectrometers can pump away, resulting in the accumulation of hydrogen in the mass spectrometer. If the mass spectrometer is shut off at the same time, the accumulation can be fairly rapid.
Power failure	If the power fails, both the GC and mass spectrometer shut down. The carrier gas, however, is not necessarily shut down. As described previously, in some GCs, a power failure may cause the carrier gas flow to be set to maximum. As a result, hydrogen may 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.**

You must remove the plastic cover over the glass window on the front of a 5977B Series MSD. In the unlikely event of an explosion, this cover may dislodge.

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 GC or MSD.
- 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 GC.
  3. Turn off the MSD and allow it to cool for 1 hour.

4 Eliminate ***all*** potential sources of ignition in the room.

5 Open the vacuum manifold of the MSD to atmosphere.

6 Wait at least 10 minutes to allow any hydrogen to dissipate.

7 Start up the GC and MSD as normal.

When using hydrogen, 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 foreline pump exhaust and GC injection port vents are both vented into a fume hood.

Safety and Regulatory Certifications (5977B)

For models other than the 5977B, see the documentation that was delivered with your MSD for these certifications.

The 5977B Series 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 5977B Series 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 5977B Series MSD is designed and manufactured under a quality system registered to ISO 9001.

The 5977B Series MSD is RoHS compliant.

Information

The Agilent Technologies 5977B Series 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 MSD 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.

or

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 on and off, 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. Ensure that all peripheral devices are also certified.
5. Ensure 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.

Sound pressure Lp <70 dB according to EN ISO 3744:1995 (5977B only)

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 MSD.

Moving or Storing the MSD

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

To Replace the Primary Fuses

Materials needed

- Fuse, T12.5A, 250 V (2110-1398) – 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 MSD will already be off, but for safety you should switch off the MSD and unplug the power cord. It is not necessary to allow air into the analyzer chamber.

WARNING **Never replace the primary fuses while the MSD 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 18.**

2 Turn one of the fuse holders (Figure 2 on page 28) 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.

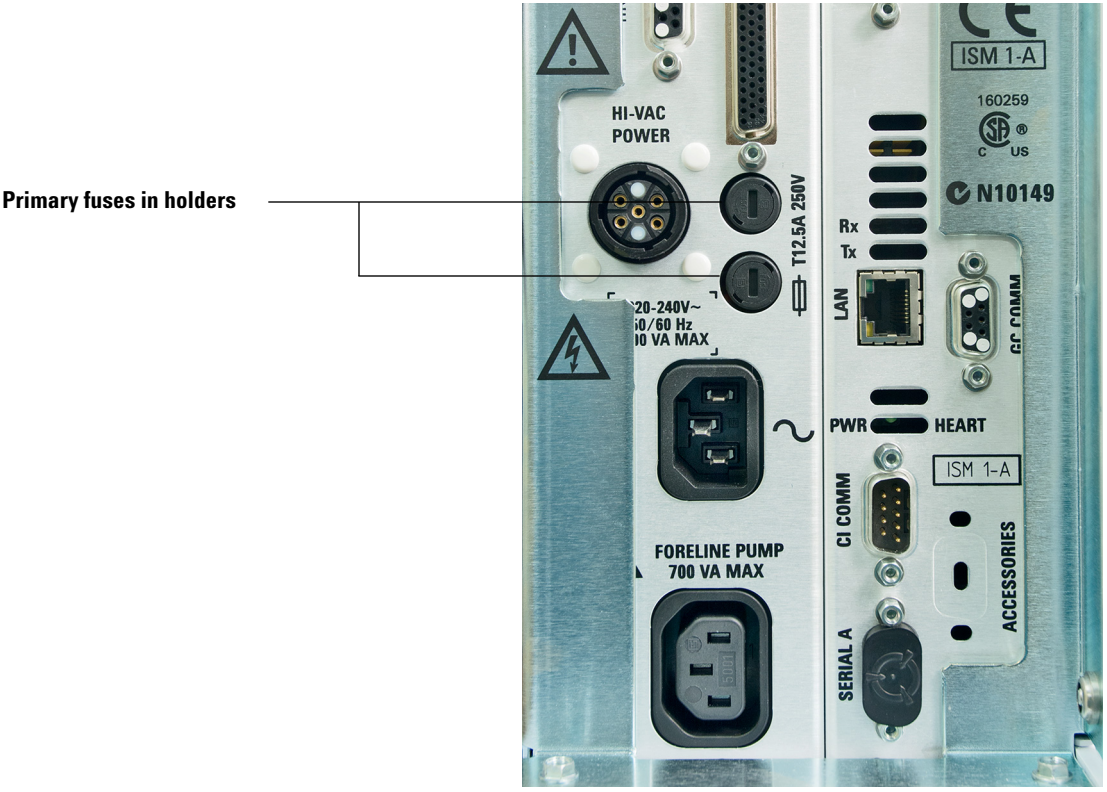


Figure 2 Primary fuses

6 Repeat steps 3 through 5 for the other fuse. Always replace both fuses.

7 Reconnect the MSD power cord to the electrical outlet.

8 Pump down the MSD.

2
Installing GC Columns

Before you can operate your GC/MSD system, you must select, install, and condition a GC column. This chapter shows you how to install and condition a column. For correct column and flow selection, you must know what type of vacuum system your MSD has.

Columns

Many types of GC columns can be used with the MSD but there are some restrictions.

During tuning or data acquisition, the rate of column flow into the MSD should not exceed the maximum recommended flow. Therefore, there are limits to column length, diameter, and flow. Exceeding recommended flow results in degradation of mass spectral and sensitivity performance.

Remember that column flows vary greatly with oven temperature. See "To Calibrate Column Flow Linear Velocity" on page 72 for instructions on how to measure actual flow in your column.Use the Flow Calculation software and Table 5 to determine whether a given column will give acceptable flow with realistic head pressure.

Table 5 Gas flows

Feature		
High vacuum pump	Diffusion	Turbo
Optimal He column flow mL/min	1	1 to 2
Maximum recommended gas flow mL/min*	1.5	4
Maximum gas flow, mL/min†	2	6.5
Max column id	0.53 mm (30 m)	0.53 mm (30 m)
CI capability‡	No	Yes

* Total gas flow into the MSD: column flow plus reagent gas flow (if applicable). Based on helium gas use. For other gases the maximum flow will vary.

† Expect degradation of spectral performance and sensitivity.

‡ Operation in CI mode is not supported on the initial version of OpenLAB CDS.

Conditioning columns

Conditioning a column before it is connected to the GC/MSD interface is essential. See "To Condition a Capillary Column" on page 36.

A small portion of the capillary column stationary phase is often carried away by the carrier gas. This is called column bleed. Column bleed deposits traces of the stationary phase in the MSD ion source. This decreases MSD sensitivity and makes cleaning the ion source necessary.

Column bleed is most common in new or poorly crosslinked columns. It is much worse if there are traces of oxygen in the carrier gas when the column is heated. To minimize column bleed, all capillary columns should be conditioned ***before*** they are installed in the GC/MSD interface.

Conditioning ferrules

Heating ferrules to their maximum expected operating temperature a few times before they are installed can reduce chemical bleed from the ferrules. Thermal cycling ferrules to their maximum operating temperatures, prior to running your application, will help reduce leaks from the assembly.

Tips and hints

- The column installation procedures for the 5977B Series MSDs may be different from that for previous MSDs. Using the procedure from another instrument may ***not*** work and may damage the column or the MSD.
- Always use carrier gas that is at least 99.9995% pure.
- Because of thermal expansion, new ferrules may loosen after heating and cooling a few times. Check for tightness after two or three heating cycles or use the self tightening column nuts.
- Always wear clean gloves when handling columns, especially the end that will be inserted into the GC/MSD interface.

WARNING **If you are using hydrogen as a carrier gas, do not start carrier gas flow until the column is installed in the MSD and the MSD has been pumped down. If the vacuum pumps are off, hydrogen will accumulate in the MSD and an explosion may occur. See "Hydrogen Safety" on page 18.**

WARNING **Always wear safety glasses when handling capillary columns. Use care to avoid puncturing your skin with the end of the column.**

To Install a Capillary Column in a Split/Splitless Inlet

Materials needed

- Gloves, clean
  - Large (8650-0030)
  - Small (8650-0029)
- Metric ruler
- Wrench, open-end, 1/4-inch and 5/16-inch (8710-0510)
- Capillary column
- Column cutter, ceramic (5181-8836) or diamond (5183-4620)
- Ferrules
  - 0.27-mm id, for 0.10-mm id columns (5062-3518)
  - 0.37-mm id, for 0.20-mm id columns (5062-3516)
  - 0.40-mm id, for 0.25-mm id columns (5181-3323)
  - 0.5-mm id, for 0.32-mm id columns (5062-3514)
  - 0.8-mm id, for 0.53-mm id columns (5062-3512)
- Inlet column nut (5181-8830 for Agilent 7890 Series and 7820)
- Magnifying loupe
- Septum (may be old, used inlet septum)

To install columns in other types of inlets, refer to your Gas Chromatograph User Information.

WARNING **The GC operates at high temperatures. In order to avoid burns, do not touch any parts of the GC until you are sure they are cool.**

WARNING **Always wear safety glasses when handling capillary columns. Use care to avoid puncturing your skin with the end of the column.**

CAUTION Always wear clean gloves while handling any parts that go inside the GC or analyzer chambers.

Procedure

1. Cool the oven and inlet to room temperature.
2. Wearing clean gloves, press the column through the septum (this takes a bit of pressure). Then slide the column nut and conditioned ferrule onto the free end of the column (Figure 3). The tapered end of the ferrule should point away from the column nut.

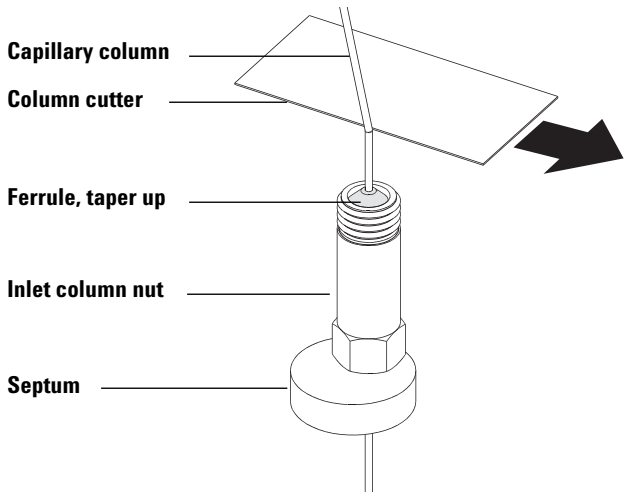


Figure 3 Preparing a capillary column for installation

3. Use the column cutter to score the column 2 cm or more from the end.
4. While holding the column, break the column end off at the score.
5. Inspect the end for jagged edges or burrs. If the break is not clean and even, repeat steps 3 and 4.
6. Wipe the outside of the free end of the column with a lint-free cloth moistened with methanol.

7 Position the column so it extends 4 to 6 mm past the end of the ferrule (Figure 4).

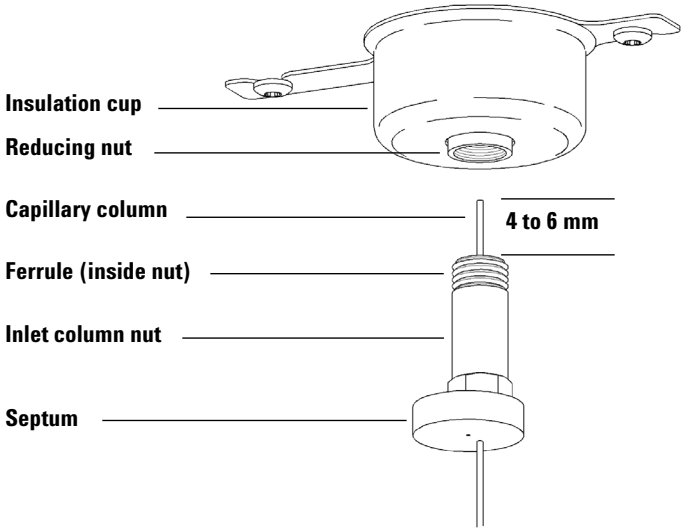


Figure 4 Installing a capillary column for a split/splitless inlet

8 Slide the septum up to the bottom of the nut to fix the correct column insertion length.

9 Insert the column in the inlet.

10 Slide the nut up the column to the inlet base and finger-tighten the nut.

11 Adjust the column position so the septum is even with the bottom of the column nut.

12 Tighten the column nut an additional 1/4 to 1/2 turn. The column should not slide with a gentle tug.

13 Start carrier gas flow.

14 Verify flow by submerging the free end of the column in isopropanol. Look for bubbles.

See also

For more information about installing a capillary column, refer to *Optimizing Splitless Injections on Your GC for High Performance MS Analysis*, Agilent Technologies publication number 5988-9944EN.

To Condition a Capillary Column

Materials needed

- Carrier gas, (99.9995% pure or better)
- Wrench, open-end, 1/4-inch and 5/16-inch (8710-0510)

WARNING **Do not condition your capillary column with hydrogen. Hydrogen accumulation in the GC oven can result in an explosion. If you plan to use hydrogen as your carrier gas, first condition the column with ultrapure (99.999% or better) inert gas such as helium, nitrogen, or argon.**

WARNING **The GC operates under high temperatures. To avoid burns, do not touch any GC parts unless you are certain they are cool.**

Procedure

1. Install the column in the GC inlet. (See "To Install a Capillary Column in a Split/Splitless Inlet" on page 33.)
2. Set a minimum velocity of 30 cm/s, or as recommended by the column manufacturer. Allow the carrier gas to flow through the column at room temperature for 15 to 30 minutes to remove air.
3. Program the oven from room temperature to the maximum temperature limit for the column.
4. Increase the temperature at a rate of 10 to 15 °C/min.
5. Hold at the maximum temperature for 30 minutes.

CAUTION Never exceed the maximum column temperature, either in the GC/MS interface, the GC oven, or the inlet.

6. Set the GC oven temperature to 30 °C and wait for the GC to become ready.
7. Attach the column to the GC interface. (See "To Install a Capillary Column in the GC/MS Interface Using the Self-Tightening Column Nut" on page 37.)

To Install a Capillary Column in the GC/MS Interface Using the Self-Tightening Column Nut

This procedure is for the installation of a capillary column directly into the analyzer using the Agilent recommended self-tightening column nut.

Materials needed

For the GCMS transfer line tip seals required for models with CI and extraction ion sources see "GCMS transfer line tip seals" on page 41.

- Column cutter, ceramic (5181-8836) or diamond (5183-4620)
- Flashlight
- Magnifying loupe
- Gloves, clean
  - Large (8650-0030)
  - Small (8650-0029)
- Self Tightening column nut for GC\MS interface (5190-5233)
- Ferrules, Vespel
  - 0.27 mm id, for 0.10 mm id columns (5062-3518)
  - 0.37 mm id, for 0.20 mm id columns (5062-3516)
  - 0.40 mm id, for 0.25 mm id columns (5181-3323)
  - 0.5 mm id, for 0.32 mm id columns (5062-3514)
  - 0.8 mm id, for 0.53 mm id columns (5062-3512)
- Septum (may be old, used inlet septum)
- Safety glasses

CAUTION Always wear clean gloves while handling any parts that go inside the GC or the analyzer chambers.

Procedure

1 Condition the column. (See "To Condition a Capillary Column" on page 36.)

WARNING **The analyzer, GC/MS interface, and other components in the analyzer chamber operate at very high temperatures. Do not touch any part until you are sure it is cool.**

WARNING **Dangerous voltages exist inside the analyzer chamber, which can result in fatal injury. Do not open the analyzer chamber door for any reason. If access is ever required, trained service personnel must first disconnect the instrument from the building power source.**

2 If you are not using Quick Swap, vent the MS. To vent the MS, see "Vent the MSD" on page 77.

WARNING **The GC operates under high temperatures. To avoid burns, do not touch any GC parts until you are certain they are cool.**

3 Slide an interface nut and conditioned ferrule onto the free end of the GC column. The tapered end of the ferrule must point towards the nut.

4 Use the column cutter to score the column 2 cm from its end.

5 While holding the column against the column cutter with your thumb, break the column against the edge of the column cutter.

6 Inspect the end for jagged edges or burrs. If the break is not clean and even, repeat steps 4 and 5.

7 Wipe the end with alcohol.

8 Slide the column into the GC/MS interface. For an EI Source Installation (Figure 5), the column extends 1 to 3 mm. Use the flashlight and magnifying loupe, if necessary, to see the end of the column inside the analyzer chamber. Do not use your finger to feel for the column end.

Figure 5 Installing a capillary column in the GC/MS interface for an EI source.

9 Hand-tighten the nut. Ensure the position of the column does not change as you tighten the nut.

10 Tighten the nut in the clockwise direction. Continue to tighten until you feel the ferrule grip the column.

11 Check the GC oven to ensure that the column does not touch the oven walls.

Figure 6 Installing a capillary column in the GC/MS interface

CAUTION Use care when placing the isolation tip on the end of the GC/MS interface to avoid damaging the column.

12 Install the isolation tip on end of the GC/MS interface. For the CI GC/MS interface and the EI GCMS interface with an extractor EI source (Figure 5) install the tip seal spring, then align and gently slide the tip with knurled nut over the column end, and screw the knurled nut onto the end of the interface. For the EI GC/MS interface with a standard or inert EI source, a tip seal is not needed.

13 ***Gently*** check the alignment of the ion source and the interface tip seal.

When the ion source is aligned correctly, the front analyzer chamber can be closed all the way with no resistance except the spring tension from the interface tip seal.

CAUTION Forcing the analyzer door closed if these parts are misaligned will damage the seal or the interface or the ion source, or will keep the sideplate from sealing.

14 You can align the ion source and interface tip seal by wiggling the side plate on its hinge. If the door still will not close, contact your Agilent Technologies service representative.

15 Close the analyzer chamber door. (See "To Close the Analyzer Chamber" on page 125.)

GCMS transfer line tip seals

Table 6 EI GCMS interface transfer line tip seal for extractor ion sources

Model	5977A	5977B
Tip seal	G3870-20542	G3870-20542
Spring	G7005-20024	G1999-20023
Tip cap	G3870-20543	G3870-20547
Tip base	----------	G3870-20548

Table 7 CI GCMS transfer line tip seals for CI and extraction ion sources

Model	5975	5977A	5977B
Tip seal	G1099-60412	G1999-60412	G1999-60412
Tip cap	----------	G3870-20543	G3870-20547
Tip base	----------	----------	G3870-20548

To Install a Capillary Column in the GC/MS Interface Using a Standard Column Nut

This procedure is for the installation of a capillary column directly into the analyzer. There are two types of column nuts that can be used in the GC/MS interface: The standard column nut explained here, and the self tightening column nut explained in the next section.

Materials needed

For the GCMS transfer line tip seals required for models with CI and extraction ion sources see "GCMS transfer line tip seals" on page 41.

- Column cutter, ceramic (5181-8836) or diamond (5183-4620)
- Flashlight
- Magnifying loupe
- Gloves, clean
  - Large (8650-0030)
  - Small (8650-0029)
- Interface column nut (05988-20066)
- Ferrules
  - 0.3 mm id, for 0.10 mm id columns (5062-3507)
  - 0.4 mm id, for 0.20 and 0.25 mm id columns (5062-3508)
  - 0.5 mm id, for 0.32 mm id columns (5062-3506)
  - 0.8 mm id, for 0.53 mm id columns (5062-3512)
- Septum (may be old, used inlet septum)
- Safety glasses
- Wrench, open-end, 1/4-inch and 5/16-inch (8710-0510)

Procedure

CAUTION Always wear clean gloves while handling any parts that go inside the GC or the analyzer chambers.

WARNING **The analyzer, GC/MS interface, and other components in the analyzer chamber operate at very high temperatures. Do not touch any part until you are sure it is cool.**

1. Condition the column. (See "To Condition a Capillary Column" on page 36.)
2. Vent the MS (See "Vent the MSD" on page 77) and open the front analyzer chamber (See "To Open the Analyzer Chamber" on page 94). Be sure you can see the end of the GC/MS interface.

WARNING **The GC operates under high temperatures. To avoid burns, do not touch any GC parts unless you are certain they are cool.**

3. Slide an interface nut and conditioned ferrule onto the free end of the GC column. The tapered end of the ferrule must point towards the nut.
4. Use the column cutter to score the column 2 cm from the end.
5. While holding the column against the column cutter with your thumb, break the column against the edge of the column cutter.
6. Inspect the end for jagged edges or burrs. If the break is not clean and even, repeat steps 5 and 6.
7. Slide the column into the GC/MS interface. For an EI Source Installation (Figure 5), the column extends 1 to 3 mm. Use the flashlight and magnifying loupe if necessary to see the end of the column inside the analyzer chamber. Do not use your finger to feel for the column end.
8. Hand-tighten the nut. Ensure the position of the column does not change as you tighten the nut, and be sure to not over tighten the nut.
9. Check the GC oven to be sure that the column does not touch the oven walls.

10 Tighten the nut 1/4 to 1/2 turn.

11 Check the nut's tightness after one or two heat cycles; tighten additionally as appropriate.

CAUTION Use care when placing the isolation tip on the end of the GC/MS interface to avoid damaging the column.

12 Install the isolation tip on end of the GC/MS interface. For the EI GC/MS interface with a standard or inert EI source, a tip seal is not needed.

13 ***Gently*** check the alignment of the ion source and the interface tip seal.

When the ion source is aligned correctly, the front analyzer chamber can be closed all the way with no resistance except the spring tension from the interface tip seal.

CAUTION Forcing the analyzer door closed if these parts are misaligned will damage the seal or the interface or the ion source, or will keep the sideplate from sealing.

14 You can align the ion source and interface tip seal by wiggling the side plate on its hinge. If the door still will not close, contact your Agilent Technologies service representative.

15 Close the analyzer chamber door. (See "To Close the Analyzer Chamber" on page 125.)

3 Operating in Electron Ionization (EI) Mode

This chapter describes how to perform some basic operating procedures for the Agilent 5975/5977 series GC/MSD using electron ionization.

Operating the MSD from the Data System

The Agilent OpenLAB CDS software automates tasks such as pumping down, monitoring settings, setting temperatures, tuning, and venting the MSD. These tasks are described in this chapter. Additional information is described in the manuals and online help supplied with the OpenLAB CDS software.

CAUTION The software and firmware are revised periodically. If the steps in these procedures do not match your OpenLAB CDS, refer to the manuals and online help supplied with the software for more information.

Operating the MSD from the GC control panel

This section only applies to the 5977B MSD. For earlier 5975/5977 MSD models, refer to "Operating the 5975/5977 MSD from the local control panel (LCP)"on page 54.

The 7890B GC control panel can show the actual temperature and pressure of the MSD or initiate a task on the MSD without using the Agilent OpenLAB CDS software. You can access functions, such as venting and setting temperatures, right from the GC control panel. Limited features are available from the GC control panel. The OpenLAB CDS software is the full-featured controller for most instrument control operations.

MSD designated key on the GC control panel

The **MS/Aux Det** key on the 7890B GC control panel allows access to control and configuration parameters on the MSD. For older 7890 models with updated firmware, this key is labeled **Aux Det #**. which can be substituted for the **MS/Aux Det** key in the procedures that follow.

To change MSD temperatures from the GC control panel

1. Press **MS/Aux Det** to display the 5977B MSD menu.
2. Press the down arrow to scroll to **Quad temp**, **Source temp** or **Transfer line.**
3. Use GC keypad to enter the desired temperature.

4 Press **Enter** to apply the changes.

To view MSD vacuum pressure and Turbo speed/Foreline Pressure from the GC control panel

1 Press **MS/Aux Det** to display the 5977B MSD menu.

2 Press the down arrow to scroll to **HiVac Pressure**, or **Turbo Speed % of full / Foreline Pressure**.

To vent the MSD from the GC control panel

1 With the MSD pumped down, press **MS/Aux Det** to bring up the 5977B MSD menu.

2 Press the down arrow to scroll to **Start MSD Vent?**. (Press **Off/No** to cancel the vent cycle and pump down the MS).

3 Press **ON/Yes** to start the venting cycle.

4 When prompted open the vent valve.

To pump down the MSD from the GC control panel

1 With the MSD vented, press **MS/Aux Det** to bring up the 5977B MSD menu.

2 Press the down arrow to scroll to **Start MSD Vent?**.

3 Press **ON/Yes** to start the pump down cycle.

4 When prompted open the vent valve.

To view the firmware version of the MSD from the GC control panel

1 Press **MS/Aux Det** to bring up the 5977B MSD menu.

2 Press the down arrow to scroll to **Firmware**.

To view the serial number of the MSD from the GC control panel

1 Press **MS/Aux Det** to bring up the 5977B MSD menu.

2 Press the down arrow to scroll to **Serial#**.

To configure the network settings for the MSD from the GC control panel

1. Press **Config,** and then press **MS/Aux Det** to bring up the CONFIGURE MS DETECTOR menu.
2. To configure the **IP:** parameter, use the GC keypad to enter the new IP address for the MSD, then press **Enter** to complete the entry.
3. Wait for the GC to display the new IP address. Reboot the MSD or proceed to the gateway address with the down arrow button
4. Press the down arrow to scroll to **GW:** and use the GC keypad to enter the new gateway address for the LAN and press **Enter** to complete the entry.
5. Press the down arrow to scroll to **SW:** and use the GC keypad to enter the new subnet mask for the LAN and press **Enter** to complete the entry.
6. Reboot the MSD. (See below)

To reboot the MSD from the GC control panel

1. Press **Config,** and then press **MS/Aux Det** to bring up the CONFIGURE MS DETECTOR menu.
2. Press the down arrow to scroll to **Request MSD Reboot?**.
3. Press **On/Yes** to reboot the MSD and wait for the MSD to complete this cycle before trying to access it.

To enable/disable BOOTP on MSD

By default the BOOTP is disabled. If your LAN uses a BootP server, Enabling BOOTP causes the server to automatically assign an IP address to the MSD.

1. Press **Config,** and then press **MS/Aux Det** to bring up the CONFIGURE MS DETECTOR menu.
2. Press the down arrow to scroll to **MSD BOOTP**.
3. To enable BOOTP, press **On/Yes**.
   To disable BOOTP, press **Off/No**.
4. Wait for the MSD to confirm the change on the GC control panel.
5. Reboot the MSD. See above.

To enable/disable LVDS on MSD

1. Press **Config,** and then press **MS/Aux Det** to bring up the CONFIGURE MS DETECTOR menu.
2. Press the down arrow to scroll to **Lvds communication**.
   If you want to enable the LVDS, press **On/Yes**.
   If you want to disable the LVDS, press **Off/No**.
3. Wait for the MSD to confirm the change on the GC control panel.

Configuring the MSD through the Web User Interface (WUI)

If your MSD does not support LVDS communications with an Agilent GC you can use the WUI to configure the MSD network settings. Reasons that a GC does not support configuring a 5977B MSD's network settings from the GC control panel include any of the following:

- LVDS communication cable does not exist between the GC and MSD
- LVDS communication is disabled in the SmartCard
- The GC is not an Agilent 7890 model with the correct firmware

To change the network settings of the MSD

This procedure assumes that the operator has access to a PC located on the same LAN subnet as the MSD.

1. Open the top hinged cover on the MSD for accessing the analyzer to view the eModule mini display readout.
2. Press the MSD start/stop button to start the instrument. When the instrument has completed its startup initialization it displays the current IP address information in the mini display readout and cycles through it for about 10 minutes.

3 Copy down the IP address, gateway, and subnet mask from the mini display readout.

4 Enter the IP address into a PC web browser URL to display the web user interface (WUI) page shown here.

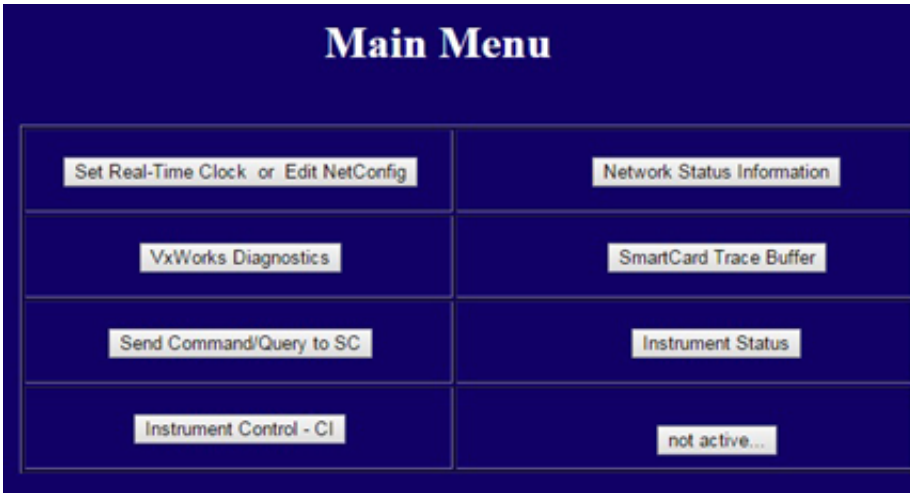


Figure 7 WEB User Interface

5 Click **Set Real-Time Clock or Edit NetConfig** and go to **Edit NetConfig (MSD network configuration)** section.

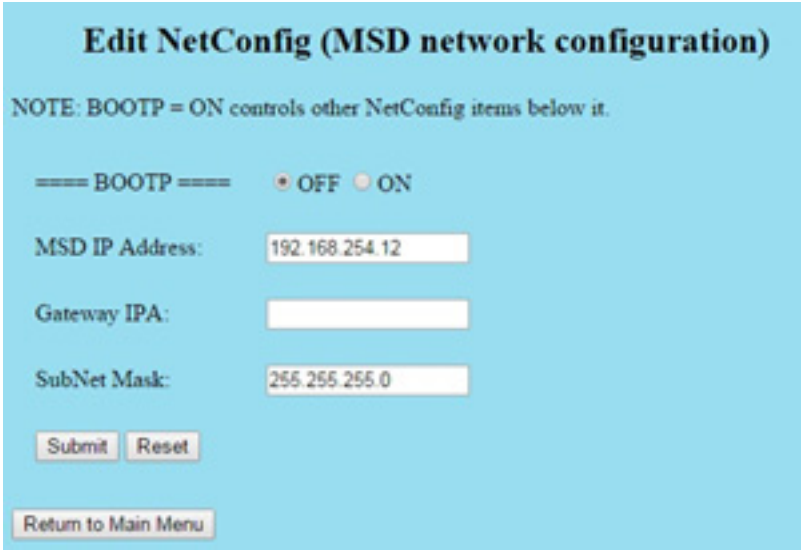


Figure 8 WUI Edit NetConfig

6 Confirm that **BootP** is set to **OFF**. If your LAN assigns IP addresses using a BootP server click **ON** and skip the next step.

7 To update the **MSD IP address**, **Gateway IPA**, and **SubNet Mask** enter the new values. Before clicking submit, you can recover the previous settings by clicking **Return to Main Menu** and then returning to here.

8 Click **Submit** to upload this net configuration to the MSD.

A dialog opens to confirm that the network configuration process has started.

9 Click **OK** to close the dialog and wait for the prompt requesting to **Manually reboot of the MSD/SmartCard to activate the new Settings**.

10 Use the MSD start/stop button to reboot the MSD SmartCard.

Operating the 5975/5977 MSD from the local control panel (LCP)

Agilent 5975 and 5977 MSD models introduced before the 5977B MSD have a local control panel (LCP). The LCP shows the status of the MSD or initiates a task on the MSD without using the data acquisition software.

Only certain features are available from the LCP. The data acquisition software is the full-featured controller for most instrument control operations.

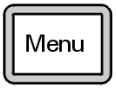
Modes of operation

The LCP has two modes of operation: Status and Menu.

Status mode requires no interaction and simply displays the current status of the MSD instrument or its various communication connections. If you select [**Menu**], then [**No/Cancel**], you will be returned to the Status mode.

Menu mode allows you to query various aspects of the GC/MSD and to initiate some actions like running a method or sequence or preparing to vent the system.

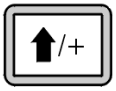
To access a particular menu option:



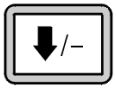
Press [**Menu**] until the desired menu appears.

Press [**Item**] until the desired menu item appears.

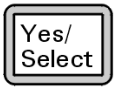
Use one or more of the following keys as appropriate to respond to prompts or select options:



Use [**Up**] to increase the displayed value or to scroll up (such as in a message list).



Use [**Down**] to decrease the displayed value or to scroll down (such as in a message list).



Use [**Yes/Select**] to accept the current value.

Use [**No/Cancel**] to return to the Status mode.

After you make your selection, or if you cycle through all available menus, the display automatically returns to Status mode.

Pressing [**Menu**], then [**No/Cancel**], will always display the Status mode.

Pressing [**No/Cancel**] twice will always return to the Status mode.

LCP Status Messages

The following messages may be displayed on the LCP to inform you of the status of the MSD system. If the LCP is currently in Menu mode, cycle through the menus to return to Status mode. No messages will be displayed if data acquisition software is not controlling the MSD.

ChemStation Loading <timestamp>

The Agilent OpenLAB CDS software is starting up.

Executing <type>tune

A tuning procedure is in progress (type = QuickTune or Autotune).

Instrument Available <timestamp>

The Agilent OpenLAB CDS software is not running.

Loading Method <method name>

Method parameters are being sent to the MSD.

Loading MSD Firmware

The MSD's firmware is being initialized.

The following messages alternately appear on the LCP if the MSD does *NOT* complete its bootup sequence properly:

Server not Found
Check LAN Connection

Seeking Server
Bootp Query xxx

These messages indicate that the MSD has not received its unique IP address from the Windows Service. If the messages persist after you have logged onto your account in the Agilent OpenLAB CDS program, consult the Troubleshooting section of the Software Installation manual.

Loading OS

The operating system of the instrument controller is being initialized.

<method> Complete <timestamp>

The run and subsequent data processing are done. The same message appears even if the run was terminated prematurely.

Method Loaded <method name>

Method parameters were sent to the MSD.

MS locked by <computer name>

MS parameters can only be changed from the Agilent OpenLAB CDS software.

Press Sideplate

A reminder during startup to press the MSD sideplate to ensure an adequate vacuum seal.

Run: <method> Acquiring <datafile>

A run is in progress; data is being acquired to the designated data file.

To view system status during startup

1 The following messages are displayed on the LCP display during startup:
   - **Press sideplate**
   - **Loading OS**
   - **Press sideplate**
   - **Loading MSD Firmware**

2 Continue to press the sideplate of the MSD until the **MSD Ready** message appears. This helps the instrument to pump down more quickly.

LCP Menus

To access a particular menu option, press [**Menu**] until the desired menu appears, then press [**Item**] until the desired menu item appears. Table 8 through Table 13 list the menus and selections.

NOTE Many menu items, especially on the ChemStation, MS Parameters, and Maintenance menus, have no effect when the instrument is acquiring data.

Table 8 ChemStation menu

Action	Description
Run Method	Displays the current method name and starts an analysis.
Run Sequence	Displays the current sequence and starts a sequence.
Run Current Tune	Displays the current tune file and starts an autotune
# of Messages	Displays the number of messages and the text of the most recent message. Use the arrow keys to scroll through previous messages (up to 20).
Release ChemStation	Disassociates OpenLAB CDS from the MSD.
Connection Status	Displays the LAN connection status for the MSD. Remote = connected to an OpenLAB CDS online session Local = not connected to an OpenLAB CDS online session
Name of Instrument	Displays the name of the instrument if connected to an OpenLAB CDS online session. The name of the instrument is the name assigned to the MSD by OpenLAB CDS.

Table 9 Maintenance menu

Action	Description
Prepare to vent	Reminds you to shut down the GC then prepares the instrument for venting when **[Yes/Select]** is pressed.
Pumpdown	Initiates a pumpdown sequence.

Table 10 MS Parameters menu

Action	Description
High Vacuum Pressure	Only with Micro-Ion vacuum gauge installed.

Table 10 MS Parameters menu (continued)

Action	Description
Turbo Pump Speed	Displays the turbo pump speed.
Foreline Pressure	Displays the foreline pressure.
MSD Fault Status	Reports a summary fault status code (number) in 'dec' (decimal) and 'hex' (hexadecimal) format covering all possible fault combinations.
Ion Source Temp, °C	Displays and sets the ion source temperature.
Mass Filter Temp, °C	Displays and sets the mass filter temperature.
CI Reagent	Displays CI reagent gas and flow rate (if installed).

NOTE MS parameters cannot be set from the LCP while an online OpenLAB CDS session is connected to the MSD.

Table 11 Network menu

Action	Description
MSD IP via BootP	Displays the IP address for the MSD.
Gateway IP Address	Displays the gateway IP address for the MSD.
Subnet Mask	Displays the subnet mask for the MSD.
ChemStation IP	Displays the IP address for the OpenLAB CDS PC.
GC IP Address	Displays the IP address for the GC.
Ping gateway	Checks communication with the gateway.
Ping ChemStation	Displays the IP address for the OpenLAB CDS PC.
Ping GC	Checks communication with the GC.
MS Controller MAC	Displays the MAC address of the SmartCard in the MSD.

Table 12 Version menu

Action	Description
Control firmware	Displays the MSD firmware version.

Table 12 Version menu (continued)

Action	Description
Operating system	Displays the OpenLAB CDS operating system version.
Front panel	Displays the version of the LCP.
Log amplifier	Displays version information.
Sideboard	Displays the sideboard type.
Mainboard	Displays the mainboard type.
Serial number	Is assigned to the MSD by OpenLAB CDS.

Table 13 Controller menu

Action	Description
Reboot controller	Starts the LAN/MS control card.
Test LCP?	Initiates a diagnostic test of the two-line display.
Test HTTP link to GC/MSD ChemStation?	Checks the status of the HTTP server.

eModule mini display readout

This section only applies to the 5977B MSD. Earlier 5975/5977 MSD models do not have this feature.

The eModule mini display, accessible when the analyzer door cover is open, allows the operator to view the LAN configuration of the instrument including its IP address, subnet mask, default gateway, and MAC address. This LAN configuration can be changed using the GC control panel or the web user interface (WUI) from a web browser.

Front Panel Instrument Status LED

This section only applies to the 5977B MSD. Earlier 5975/5977 MSD models do not have this feature.

Through the front panel Instrument Status LED, the operator can view the current status of the instrument using color codes and LED on/off timing.

Table 14 Front panel Instrument Status LED codes

Instrument Status	LED code
Ready	Solid green
Acquiring data	Blinking green (<2 sec)
Not ready	Solid yellow
Not connected to DS	Blinking yellow (<2 sec)
Ready and not connected to DS	Solid yellow for 3 sec, quick double blink
Start up (prior to FW load)	Blinking Red (<2 sec)
Fault	Solid red

The GC/MSD Interface

The GC/MSD interface (Figure 9 on page 63) is a heated conduit into the MSD for the capillary column. It is bolted onto the right side of the analyzer chamber, with an O-ring seal. It has a protective cover which should be left in place.

One end of the GC/MSD interface passes through the side of the gas chromatograph and extends into the GC oven. This end is threaded to allow connection of the column with a nut and ferrule. The other end of the interface fits into the ion source. The last 1 to 2 mm of the capillary column extend past the end of the guide tube and into the ionization chamber.

The GC/MSD interface is heated by an electric cartridge heater. Normally, the heater is powered and controlled by Thermal Aux #2 heated zone of the GC. The interface temperature can be set from OpenLAB or from the gas chromatograph. A sensor (thermocouple) in the interface monitors the temperature.

The GC/MSD interface should be operated in the 250 ° to 350 °C range. Subject to that restriction, the interface temperature should be slightly higher than the maximum GC oven temperature, but ***never*** higher than the maximum column temperature.

The extractor ion source requires a tip seal (G3870-20542). The standard EI sources constructed of stainless steel or inert material do not need a tip seal.

See also

"To Install a Capillary Column in the GC/MS Interface Using the Self-Tightening Column Nut"on page 37.

WARNING **The GC/MSD interface operates at high temperatures. If you touch it when it is hot, it will burn you.**

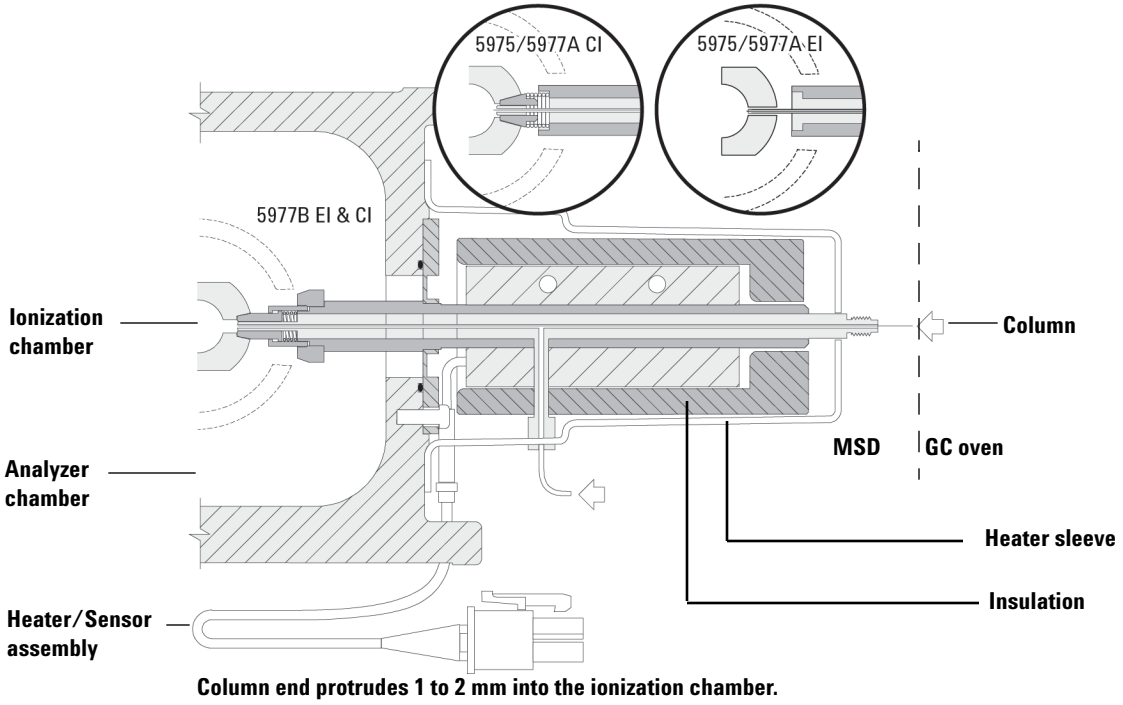


Figure 9 The GC/MSD interface

Before You Turn On the MSD

Verify the following ***before*** you turn on or attempt to operate the MSD.

- The vent valve must be closed (the knob turned all the way clockwise).
- All other vacuum seals and fittings must be in place and fastened correctly. The front side plate screw should not be tightened, unless hazardous carrier or reagent gases are being used.
- The MSD is connected to a grounded power source.
- The GC/MSD interface extends into the GC oven.
- A conditioned capillary column is installed in the GC inlet and in the GC/MSD interface.
- The GC is on, but the heated zones for the GC/MSD interface, the GC inlet, and the oven are off.
- Carrier gas of at least 99.9995% purity is plumbed to the GC with the recommended traps.
- If hydrogen is used as carrier gas, carrier gas flow must be off and the front sideplate thumbscrew must be loosely fastened.
- The foreline pump exhaust is properly vented.

WARNING **The exhaust from the foreline pump contains solvents and the chemicals you are analyzing. If using the standard foreline pump, it also contains traces of pump oil. If you are using toxic solvents or analyzing toxic chemicals, remove the oil trap/mist filter (standard pump) and install a hose (11-mm id) to take the foreline pump exhaust outside or to a fume (exhaust) hood. Be sure to comply with local regulations. The oil trap supplied with the standard pump stops only pump oil. It does not trap or filter out toxic chemicals.**

WARNING **If you are using hydrogen as a carrier gas, do not start carrier gas flow until the MSD has been pumped down. If the vacuum pumps are off, hydrogen will accumulate in the MSD and an explosion may occur. Read "Hydrogen Safety" on page 18 before operating the MSD with hydrogen carrier gas.**

Pumping Down

The data system helps you pump down the MSD. The process is mostly automated. Once you close the vent valve and turn on the main power switch (while pressing on the sideplate), the MSD pumps down by itself. The data system software monitors and displays system status during pumpdown. When the pressure is low enough, the program turns on the ion source and mass filter heaters and prompts you to turn on the GC/MSD interface heater. The MSD will shut down if it cannot pump down correctly.

From the Instrument Status Dashboard, OpenLAB CDS can display:

- Motor speed for turbo pump MSDs (percent spin speed)
- Foreline pressure for diffusion pump MSDs
- Analyzer chamber pressure (vacuum) for MSDs equipped with the optional Micro-Ion Gauge Controller (G3397A for the 5975 and G3397B for the 5977).

Controlling Temperatures

MSD temperatures are controlled through the data system. The MSD has independent heaters and temperature sensors for the ion source and quadrupole mass filter. You can adjust the setpoints and view these temperatures from the data system or from the local control panel.

Normally, the GC/MSD interface heater is powered and controlled by the Thermal Aux #2 heated zone of the GC. The GC/MSD interface temperature can be set and monitored from the data system or from the 7890B GC control panel.

Controlling Column Flow

Carrier gas flow is controlled by inlet pressure in the GC. For a given inlet pressure, column flow will decrease as the GC oven temperature increases. With electronic pneumatic control (EPC) and the column mode set to **Constant Flow**, the same column flow is maintained regardless of temperature.

The MSD can be used to measure actual column flow. You inject a ***small*** amount of air or other unretained chemical and time how long it takes to reach the MSD. With this time measurement, you can calculate the column flow. See "To Calibrate Column Flow Linear Velocity" on page 72.

Venting the MSD

A program in the data system guides you through the venting process. It turns off the GC and MSD heaters and diffusion pump heater or the turbo pump at the correct time. It also lets you monitor temperatures in the MSD and indicates when to vent the MSD.

The MSD ***will*** be damaged by incorrect venting. A diffusion pump will backstream vaporized pump fluid onto the analyzer if the MSD is vented before the diffusion pump has fully cooled. A turbo pump will be damaged if it is vented while spinning at more than 50% of its normal operating speed.

WARNING **Make sure the GC/MSD interface and the analyzer zones are cool (below 100 °C) before you vent the MSD. A temperature of 100 °C is hot enough to burn skin; always wear cloth gloves when handling analyzer parts.**

WARNING **If you are using hydrogen as a carrier gas, the carrier gas flow must be off before turning off the MSD power. If the foreline pump is off, hydrogen will accumulate in the MSD and an explosion may occur. Read "Hydrogen Safety" on page 18 before operating the MSD with hydrogen carrier gas.**

CAUTION Never vent the MSD by allowing air in through either end of the foreline hose. Use the vent valve or remove the column nut and column.

Do not vent while the turbo pump is still spinning at more than 50%.

Do not exceed the maximum recommended total gas flow. See "5977B Series MSD features" on page 14.

Set MS Analyzer Temperatures

Setpoints for the MSD ion source and mass filter (quad) temperatures are stored in the current tune (*.u) file. When a method is loaded, the setpoints in the tune file associated with that method are downloaded automatically.

1 Enable Tune Control and click **Manual Tune > Parameters**.

2 Enter the Source temp (°C) and Quad temp (°C) (mass filter).

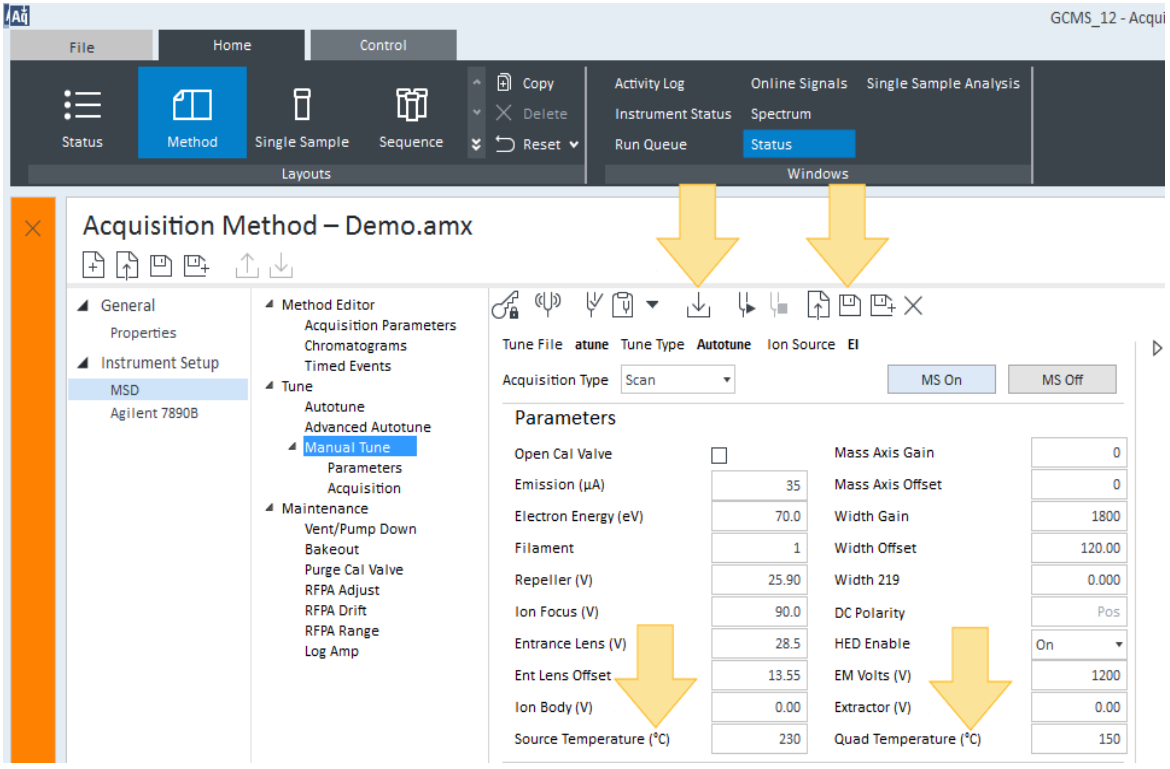
The GC/MSD interface, ion source, and quadrupole heated zones interact. The analyzer heaters may not be able to accurately control temperatures if the setpoint for one zone is much different from that of an adjacent zone.

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

3 Click **Download tune file** to download these temperature setpoints to the MS and change the current control temperatures to these values.

4 Click **Save the tune parameters** to make these temperature settings part of this tune file or click **Save tune file as** to create a new tune file with these values.

5 Run an autotune if you want these new temperatures in an autotune file.



6 Release Tune Control.

Enable the GC/MS Interface and Oven

Procedure

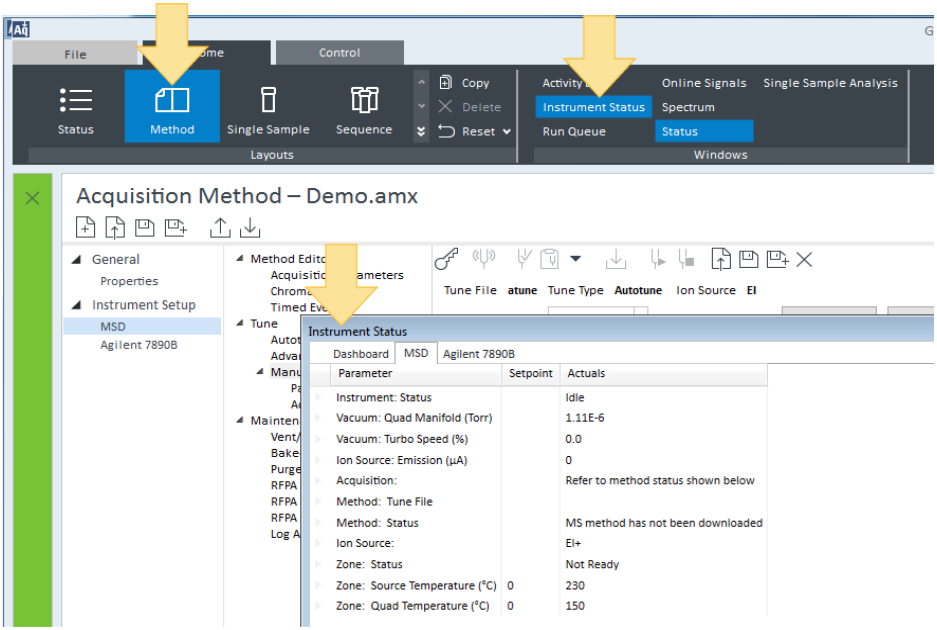
1. Click **Method > Instrument Setup > GC > Aux Heaters**.
2. Select **On** for **Thermal Aux 2**.
3. Click **Oven** and select **On**.
4. Click **Download Method** to enable these temperature zones in the GC.
5. Save the method.

View MSD Temperatures and Vacuum

Pressure monitoring requires an optional Micro-Ion vacuum gauge (G3397A for the 5975 and G3397B for the 5977)..

WARNING **If you are using hydrogen as a carrier gas, do not turn on the Micro-Ion vacuum gauge if there is any possibility that hydrogen has accumulated in the analyzer chamber. Read "Hydrogen Safety" on page 18 before operating the MSD with hydrogen carrier gas.**

Select **Instrument Status** in the windows area and click **MSD** to display the MSD's actuals values including the source and quad temperatures and quad manifold vacuum pressure.



The largest influence on operating pressure in EI mode is the carrier gas (column) flow. Table 15 lists typical pressures for various helium carrier gas flows. These pressures are approximate and will vary from instrument to instrument by as much as 30%.

Table 15 Ion vacuum gauge reading

Column flow rate, mL/min	Optional Gauge reading, Torr *Performance* turbo pump	Gauge reading, Torr *Diffusion* pump	Foreline reading, mTorr *Diffusion* pump
0.5	3.18E–06	2.18E–05	34.7
0.7	4.42E–06	2.59E–05	39.4
1	6.26E–06	3.66E–05	52.86
1.2	7.33E–06	4.46E–05	60.866
2	1.24E–05	7.33E–05	91.784
3	1.86E–05	1.13E–04	125.76
4	2.48E–05		
6	3.75E–05		

If the pressure is consistently higher than those listed, refer to the online help in the Data Acquisition software for information on troubleshooting air leaks and other vacuum problems.

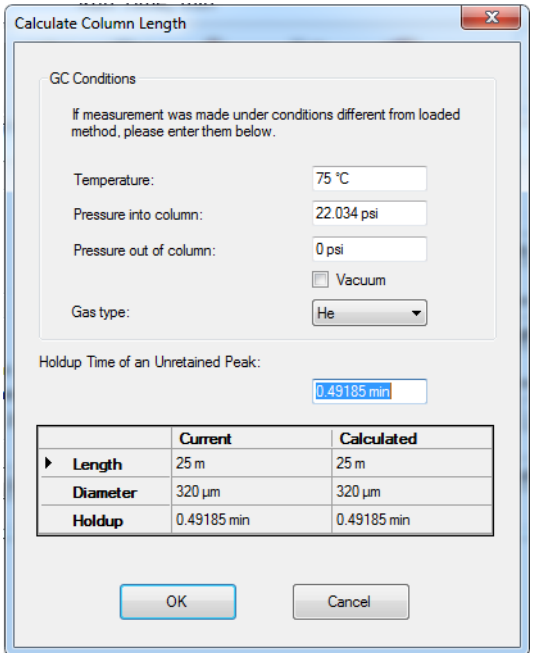
The vacuum can also be read on the 7890B GC control panel or from the Manual Tune > Parameters view in OpenLAB.

To Calibrate Column Flow Linear Velocity

Capillary columns must be calibrated prior to use with the MS.

Procedure

1. Set Data Acquisition for splitless manual injection and set up a real time plot to monitor *m/z* 28.
2. Press **[Prep Run]** on the GC keypad.
3. Inject 1 µL of air into the GC inlet and press **[Start Run]**
4. Wait until a peak elutes at *m/z* 28. Note the retention time.
5. In OpenLAB, select Method layouts, and click **Agilent GC > Configuration > Columns**.
6. Select your installed column from the table.
7. Click the **Calibrate** button to display the **Calibrate Column** dialog.
8. Click the **Calc Length** button in the **If unretained peak holdup time is known** section to display the **Calculate Column Length** dialog.



9 Verify that the parameters listed (temperature, inlet and outlet pressures, and gas type) are those used in the method to determine the holdup time. Change any parameters that are different than those used in your method.

10 Enter the recorded retention time in the **Holdup Time** field. Move the cursor to another parameter's field and the calibrated column length appears.

11 Click **OK** to save the changes and exit the dialog.

12 Click **OK** on the **Calibrate Columns** dialog to save the calibration.

With capillary columns, such as those used with the MSD, linear velocity is often measured rather than volumetric flow rate.

Calculation for average linear velocity

$$\textit{Average linear velocity (cm/s)} = \frac{100\ L}{t}$$

where:

L = Length of the column in meters

t = Retention time in seconds

Calculation for volumetric flow rate

$$\textit{Volumetric flow rate (mL/min)} = \frac{0.785\ D^2\ L}{t}$$

where:

D = Internal column diameter in millimeters

L = Column length in meters

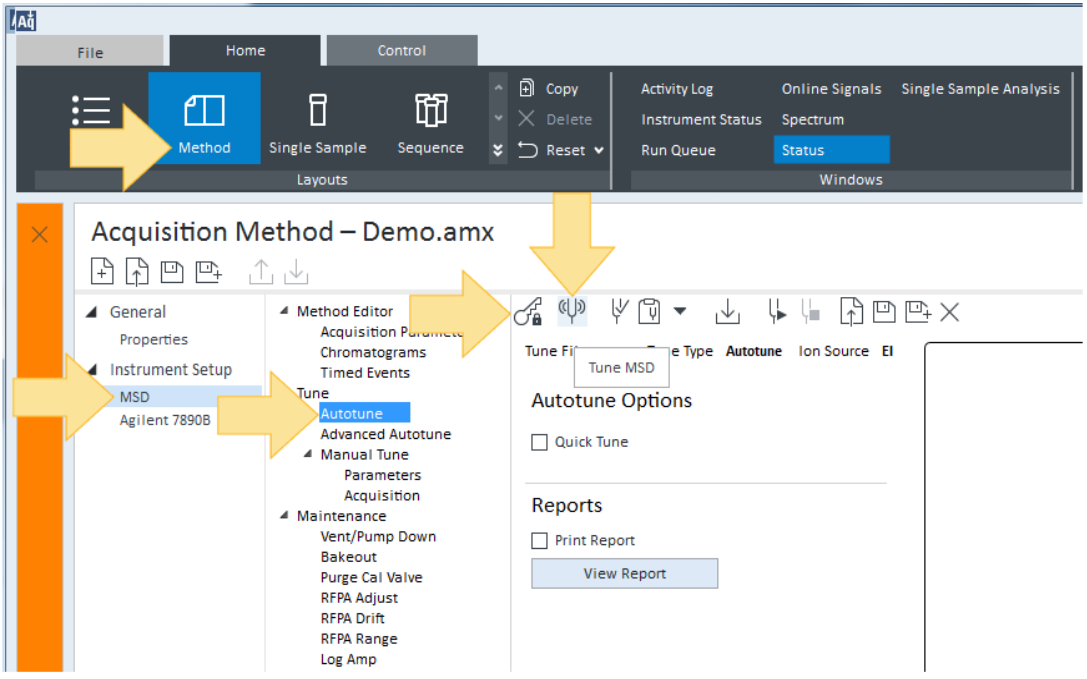
t = Retention time in minutes

To Run an Autotune

A full autotune run takes about 15 to 20 minutes. When the **Quick Tune** option is not selected, the autotune requires less than five minutes. Alternatively, you can run an autotune from the dashboard.

Procedure

1. Enable Tune Control and select **Tune > Autotune**. The tune file used by the current method is loaded.
2. To use a different tune file, click **Open a tune file** and select it.
3. Check **Quick Tune**, if relative abundances of the 3 masses are at acceptable values, unless a full autotune is needed.
4. Optionally, to send the Autotune report to the printer, in the **Reports** area, select **Print Report**.
5. Click **Start autotune**. The autotune procedure runs.



6 Release Tune Control.

7 As needed, generate an Evaluate Tune Report.

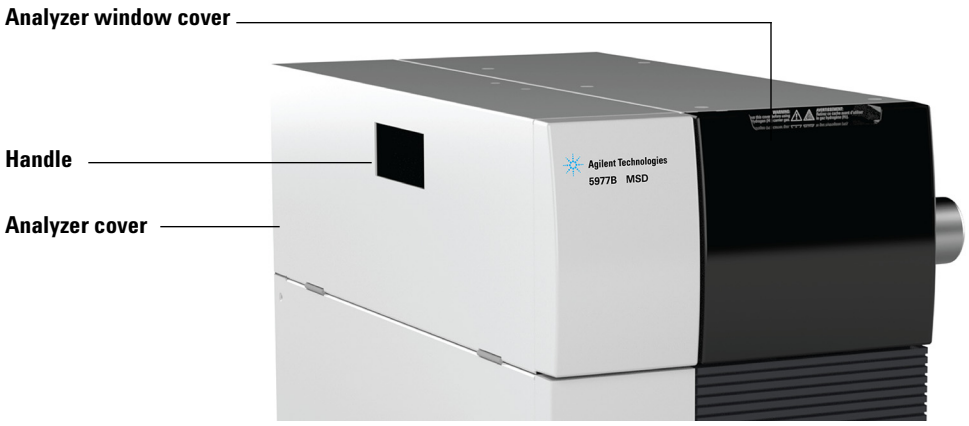
To Open the MSD Covers

If you need to open one of the MSD covers, follow these procedures.

To remove the analyzer window cover

Press down on the rounded area on the top of the window, tilt the window slightly forward and lift off the MSD.

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



To open the analyzer cover

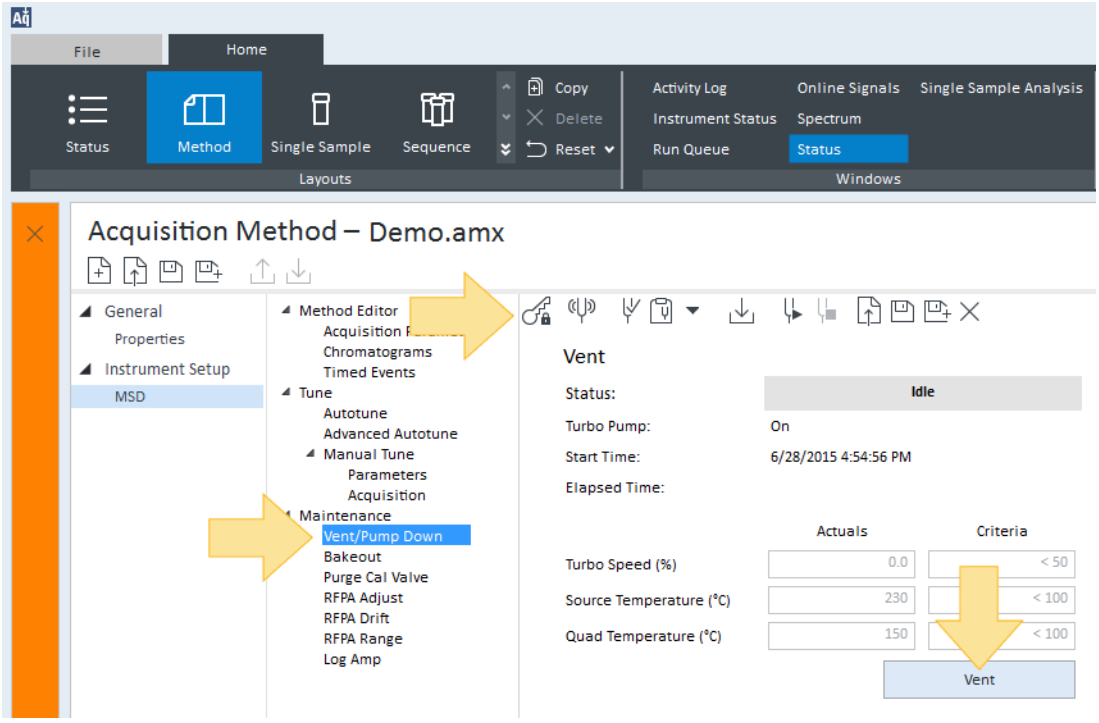
Pull the handle on the side of the MSD to the left and down to release the magnetic latch and open the cover. The cover is held in place by its hinges.

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

Vent the MSD

Procedure

1 Select **Method > MSD > Maintenance > Vent/Pump Down** and click **Vent** to begin the process. Follow the instructions presented.



2 When prompted, turn the vent valve knob counterclockwise only 3/4 turns or until you hear the hissing sound of air flowing into the analyzer chamber.

WARNING **If you are using hydrogen as a carrier gas, the carrier gas flow must be off before turning off the MSD power. If the foreline pump is off, hydrogen will accumulate in the MSD and an explosion may occur. Read "Hydrogen Safety" on page 18 before operating the MSD with hydrogen carrier gas.**

CAUTION Be sure the GC oven and the GC/MSD interface are cool before turning off carrier gas flow to prevent damage to the column.

To Pump Down the MS

You can also use the 7890B GC control panel to perform this task. See "Operating the MSD from the GC control panel"on page 47.

WARNING **Make sure your MSD meets all the conditions listed in the introduction to this chapter (page 62) before starting up and pumping down the MSD. Failure to do so can result in personal injury.**

WARNING **If you are using hydrogen as a carrier gas, do not start carrier gas flow until the MSD has been pumped down. If the vacuum pumps are off, hydrogen will accumulate in the MSD and an explosion may occur. Read "Hydrogen Safety" on page 18 before operating the MSD with hydrogen carrier gas.**

Procedure

1 Remove the analyzer window cover (see "To Open the MSD Covers"on page 76).

2 Close the MS vent valve by turning it clockwise. .

3 Plug the MS power cord into a grounded electrical outlet.

4 Turn on the MS power switch.

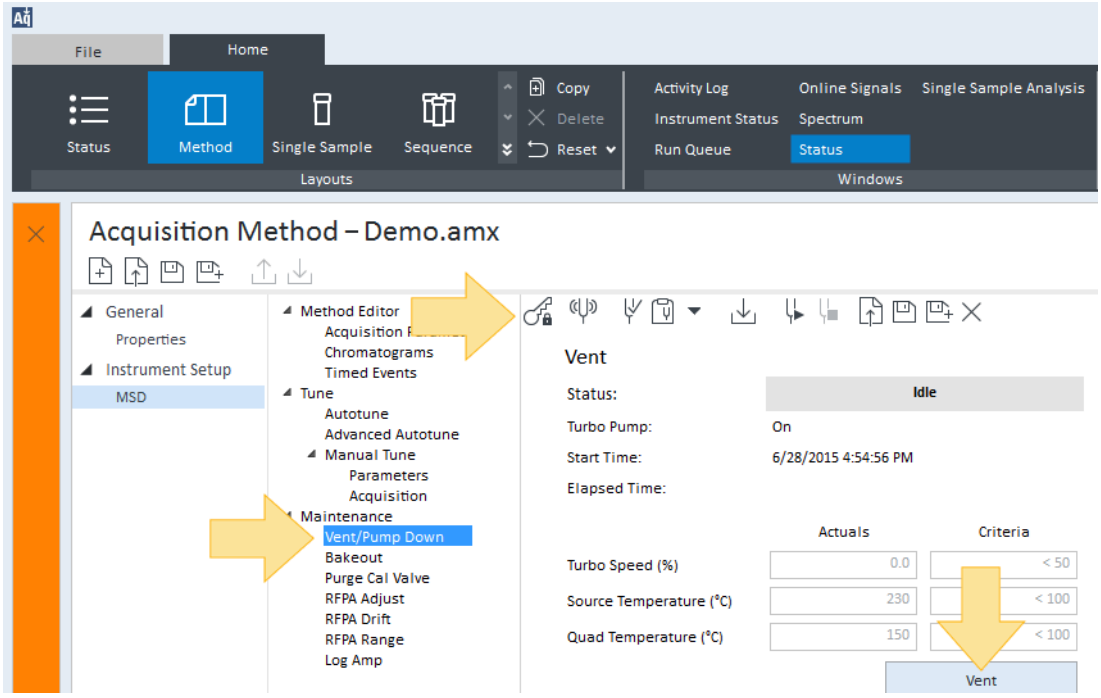
5 Press lightly on the metal box of the analyzer quad driver board to ensure a correct seal.

6 Start the OpenLAB Data Acquisition program. If the MS was configured for multiple ion source types, you are prompted for the ion source type that is currently installed. Click on the installed source type if prompted.

7 If the selected ion source in the previous step does not match the source used in the current method's tune file, you are prompted to enter a method with the correct ion source type. Load the correct method for an EI, PCI, or NCI source type.

8 Enable Tune Control and click **Maintenance.**

9 Click **Pump Down** to start this procedure.



CAUTION Do not turn on any GC heated zones until carrier gas flow is on. Heating a column with no carrier gas flow will damage the column.

10 You are prompted to turn on the transfer line heater and the GC oven. Click **OK** when you have done so.

11 The software will turn on the ion source and mass filter (quad) heaters. The temperature setpoints are stored in the current autotune file. The pump down status and "the MSD actual parameters" in comparison to "criteria required for pump down completion" is shown.

12 Wait for the MS to reach thermal equilibrium.

After the message **Okay to run** appears, wait 2 hours for the MS to reach thermal equilibrium. Data acquired before the MS has reached thermal equilibrium may not be reproducible.

13 When the pumpdown is finished, click **OK** to clear the pump down status window.

14 Tune the MS.

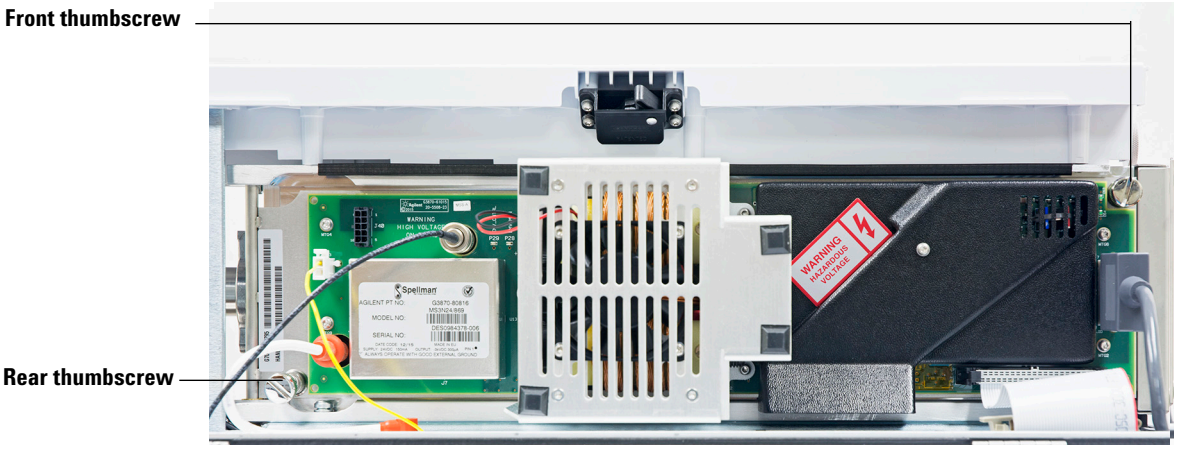
To Move or Store the MSD

Materials needed

- Ferrule, blank (5181-3308)
- Interface column nut (05988-20066)
- Wrench, open-end, 1/4-inch × 5/16-inch (8710-0510)

Procedure

1. Vent the MSD (See "Vent the MSD"on page 77).
2. Remove the column and install a blank ferrule and interface nut.
3. Tighten the vent valve.
4. Move the MSD away from the GC (see the 5977B Series MSD Troubleshooting and Maintenance Manual).
5. Unplug the GC/MSD interface heater cable and LVDS cable `if used` from the GC.
6. Open the analyzer cover (See "To Open the MSD Covers"on page 76).
7. Finger-tighten the side plate thumbscrews.



CAUTION Do not overtighten the side plate thumbscrews. Overtightening will strip the threads in the analyzer chamber. It will also warp the side plate and cause leaks.

8 Plug the MSD power cord in.

9 Switch the MSD on to establish a rough vacuum. Verify that the turbo pump speed is greater than 50%, or that the foreline pressure is ~1 Torr.

10 Switch the MSD off.

11 Close the analyzer cover.

12 Disconnect the LAN, remote, and power cables.

The MSD can now be stored or moved. The foreline pump cannot be disconnected; it must be moved with the MSD. Make sure the MSD remains upright and is never tipped on its side or inverted.

CAUTION The MSD must remain upright at all times. If you need to ship your MSD to another location, contact your Agilent Technologies service representative for advice about packing and shipping.

4
General Maintenance

Before Starting

You can perform much of the maintenance required by your MSD. For your safety, read all of the information in this introduction before performing any maintenance tasks.

Table 16 Maintenance schedule

Task	Every week	Every 6 months	Every year	As needed
Tune the MSD				X
Check the foreline pump oil level	X			
Check the calibration vial(s)		X		
Replace the foreline pump oil		X		
Replace the diffusion pump fluid			X	
Check the dry foreline pump				X
Change the dry foreline pump tip seal			X	
Change the foreline pump exhaust filter				X
Clean the ion source				X
Check the carrier gas trap(s) on the GC and MSD				X
Replace the worn out parts				X
Lubricate sideplate or vent valve O-rings*				X
Replace GC 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.

Scheduled maintenance

Common maintenance tasks are listed in Table 16. 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.

Tools, spare parts, and supplies

Some of the required tools, spare parts, and supplies are included in the GC shipping kit, MSD shipping kit, or MSD tool kit. You must supply others yourself. Each maintenance procedure includes a list of the materials required for that procedure.

High voltage precautions

Whenever the MSD 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 back panel of the MSD
- Some connectors on the back 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 MSD 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 MSD operate at, or reach, temperatures high enough to cause serious burns. These parts include, but are not limited to:

- GC inlet
- GC oven and its contents
- GC detector
- GC valve box
- Foreline pump
- Heated MSD ion source, interface, and quadrupole

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

WARNING **The GC/MSD interface heater is powered by a thermal zone on the GC. The interface heater can be on, and at a dangerously high temperature, even though the MSD is off. The GC/MSD interface is well insulated. Even after it is turned off, it cools very slowly.**

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 and GC oven also operate at very high temperatures. Use the same caution around these parts. See the documentation supplied with your GC for more information.

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. Do not use the trap if you have a CI MSD. Install a hose to take the foreline pump exhaust outside or to a fume hood.**

The fluids in the diffusion pump and 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.**

WARNING **Always perform any maintenance procedures using hazardous solvents under a fume hood. Be sure to operate the MS in a well-ventilated room.**

Electrostatic discharge

All of the printed circuit boards in the 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 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.

Maintaining the Vacuum System

Periodic maintenance

As listed earlier in Table 16 on page 86, some maintenance tasks for the vacuum system must be performed periodically. These include:

- Checking the foreline pump fluid (every week)
- Checking the calibration vial(s) (every 6 months)
- Replacing the foreline pump oil (every 6 months)
- Tightening the foreline pump oil box screws (first oil change after installation)
- Replacing the diffusion pump fluid (once a year)
- Replacing the dry foreline pump seals (once a year)

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 foreline vacuum gauge or Micro-Ion vacuum gauge should be performed only when needed. See the *5977B Series MSD Troubleshooting and Maintenance* manual and see the online help in OpenLAB CDS GCMS Acquisition software for symptoms that indicate this type of maintenance is required. See the *5977B Series MSD Troubleshooting and Maintenance* manual and see the online help in MassHunter GCMS Acquisition 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 the *MSD Troubleshooting and Maintenance* manual that was shipped with your 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

The *Agilent 5977B Series MSD Troubleshooting and Maintenance Manual* provides information about symptoms that indicate the need for analyzer maintenance. The troubleshooting material in the online help in the OpenLAB CDS 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 90 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 90) 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 the *Agilent 5977B Series MSD Troubleshooting and Maintenance Manual.*

Many procedures in this chapter are illustrated with video clips.

To Open the Analyzer Chamber

The analyzer chamber should only be opened to clean or replace the ion source, change the detector's EM, or to change a filament.

Materials needed

- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Wrist strap, antistatic
  - Small (9300-0969)
  - Medium (9300-1257)
  - Large (9300-0970)

CAUTION Electrostatic discharges to analyzer components are conducted to the quad driver board, where they can damage sensitive components. Wear a grounded antistatic wrist strap and take other antistatic precautions (see "Electrostatic discharge" on page 90) before you open the analyzer chamber.

Procedure

1 Vent the MS. (See "Pumping Down" on page 65.)

2 Open the left side panel. (See "To Open the Analyzer Chamber" on page 94.)

WARNING **The analyzer, GC/MS interface, and other components in the analyzer chamber operate at very high temperatures. Do not touch any part until you are sure it is cool.**

CAUTION Always wear clean gloves to prevent contamination when working in the analyzer chamber.

3 Loosen the front analyzer side plate thumbscrews (Figure 10) if they are fastened.

The bottom thumbscrew on the front analyzer side plate should be unfastened during normal use. It is only fastened during shipping. The top thumbscrew on the front side plate should only be fastened if hydrogen or other flammable or toxic substances are used for carrier gas.

CAUTION In the next step, if you feel resistance, *stop*. Do not try to force the side plate open. Verify that the MS is vented. Verify that both the front and rear side plate screws are completely loose.

4 *Gently* swing the side plate out.

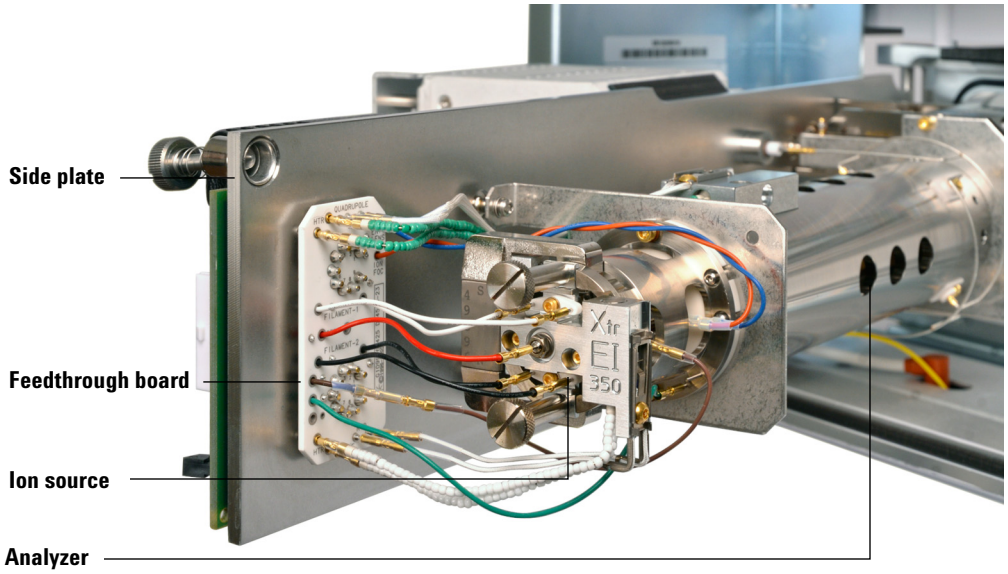


Figure 10 The analyzer chamber

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 MSD. See "Vent the MSD" on page 77.

WARNING **The analyzers, GC/MS interface, and other components in the analyzer chamber operate at very high temperatures. Do not touch any part until you are sure it is cool.**

CAUTION Always wear clean gloves to prevent contamination when working in the analyzer chamber

2 Open the analyzer chamber. See "To Pump Down the MS" on page 79.

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

CAUTION When disconnecting leads, pull on the connectors, not the wires.

3 If you are using a standard or inert EI ion source, disconnect the seven wires from the ion source. Do not bend the wires any more than necessary (See Figure 11 and Table 17).

Table 17 Standard and inert EI 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

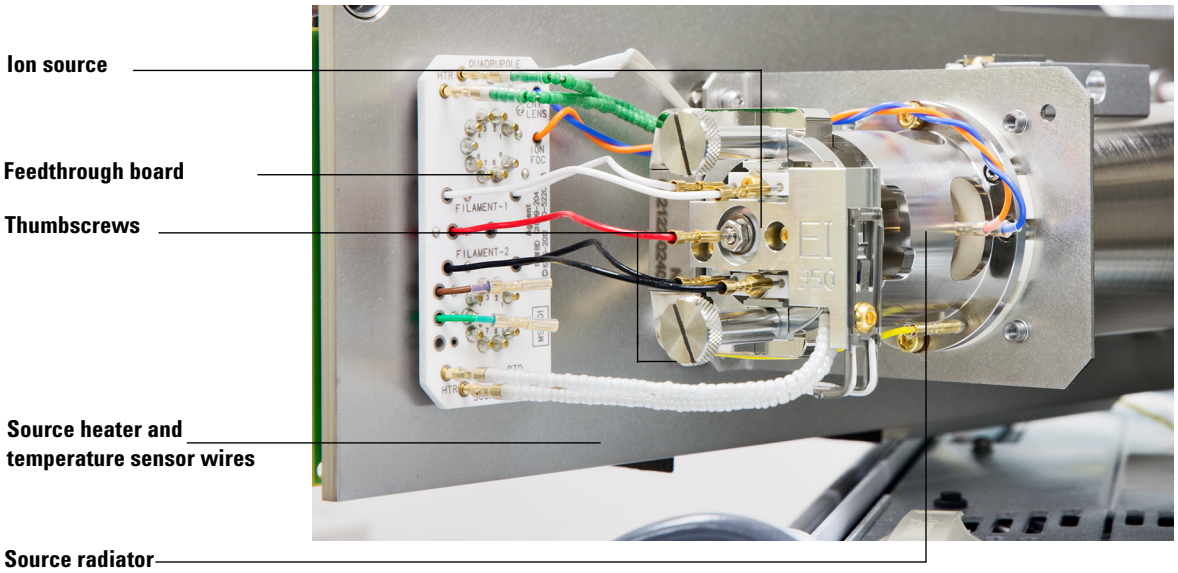


Figure 11 Removing the standard EI ion source

4 If you are using an extractor ion source, disconnect the eight wires from the ion source. Do not bend the wires any more than necessary (See Figure 12 on page 98).

Table 18 Extractor EI (inert+) 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
Brown	Extractor lens	1

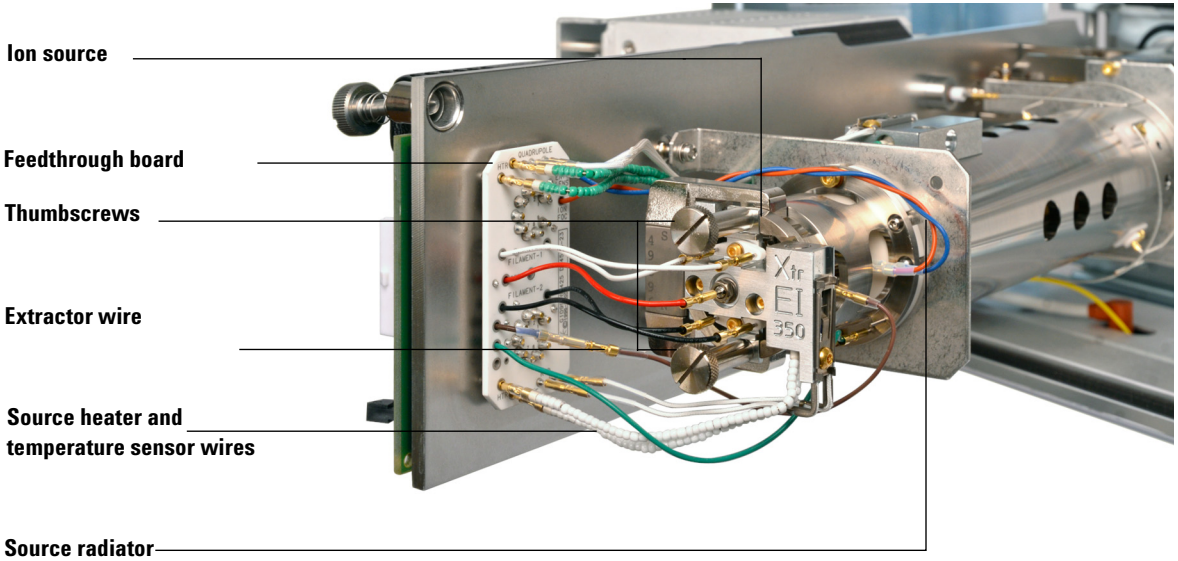


Figure 12 Removing the Extractor ion source

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.

To Disassemble the Standard or Inert 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 "To Remove the EI Ion Source" on page 96.
2. Remove the two gold plated screws from the filaments and remove the filaments from the source. See Figure 13 on page 100.
3. Loosen the two gold plated screws from the source heater block assembly, and separate the repeller assembly from the source body. The repeller assembly includes the source heater block assembly, repeller, and related parts.
4. Remove the repeller nut and washers, then remove the repeller from the source heater block assembly.
5. Remove the repeller insulators and the repeller block insert from the source heater block assembly.
6. Remove the gold plated setscrew from the side of the source body.
7. Push on the drawout plate to remove the entrance lens, ion focus lens, drawout cylinder, and drawout plate from the other end of the source body.
8. Unscrew the interface socket. A 10-mm open-end wrench fits the flats on the interface socket.
9. Remove the entrance lens and ion focus lens from the lens insulator.

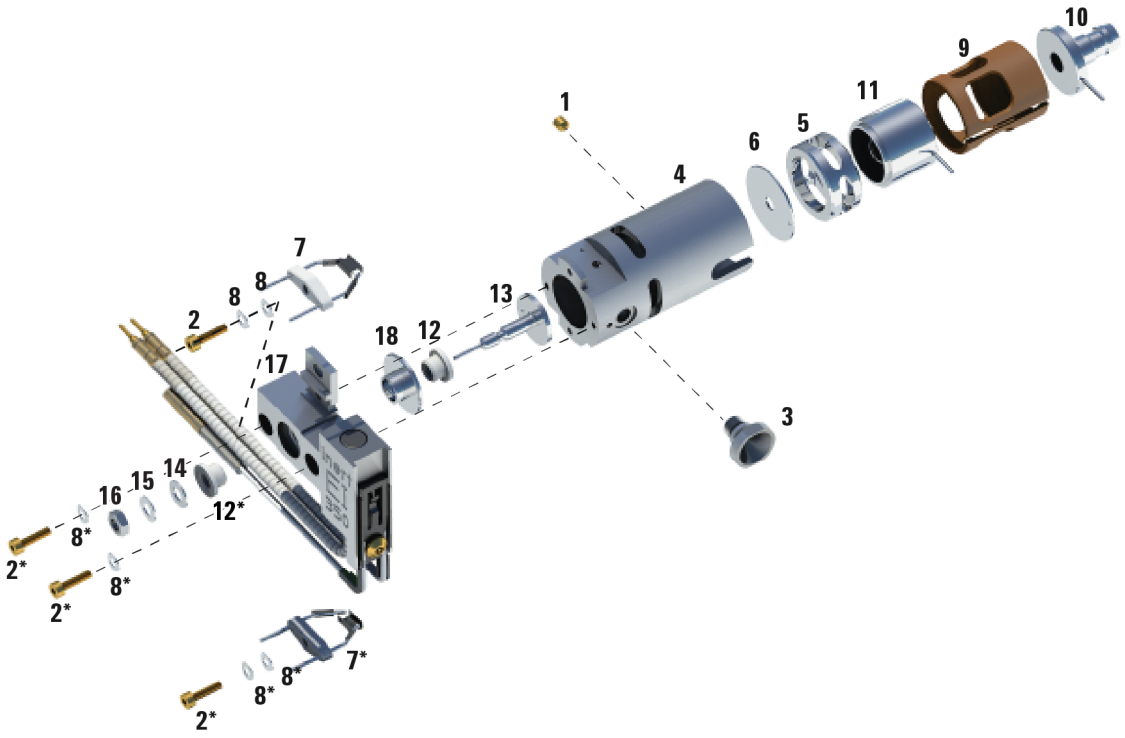


Figure 13 Disassembling the standard or inert EI ion source

Table 19 Parts list for the standard or inert EI ion source (Figure 16)

Item number	Item description	Part number (SSL)	Part number (Inert)
1	Gold plated set screw	G1999-20022	G1999-20022
2	Gold plated screw	G3870-20021	G3870-20021
3	Interface socket	G1099-20136	G1099-20136
4	Source body	G1099-20130	G2589-20043
5	Drawout cylinder	G1072-20008	G1072-20008
6	Drawout plate	05971-20134	G2589-20100
7	4-turn filament	G7005-60061	G7005-60061

Table 19 Parts list for the standard or inert EI ion source (Figure 16) (continued)

Item number	Item description	Part number (SSL)	Part number (Inert)
8	Spring washer and flat washer	3050-1374 and 3050-0982	3050-1374 and 3050-0982
9	Lens insulator	G3170-20530	G3170-20530
10	Entrance lens	G3170-20126	G3170-20126
11	Ion focus lens	05971-20143	05971-20143
12	Repeller insulator	G1099-20133	G1099-20133
13	Repeller	G3870-60172	G3870-60173
14	Flat washer	3050-0627	3050-0627
15	Belleville spring washer	3050-1301	3050-1301
16	Repeller nut	0535-0071	0535-0071
17	Source heater block assembly	G3870-60180	G3870-60179
18	Repeller block insert	G3870-20135	G3870-20135

To Disassemble the Extractor 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 "To Remove the EI Ion Source" on page 96.
2. Remove the filaments by removing the two gold plated screws and separating the filaments from the source. See Figure 14 on page 103.
3. Loosen the two gold plated screws on the source heater block assembly, and separate the repeller assembly from the source body. The repeller assembly includes the source heater block assembly, repeller, and related parts.
4. Remove the gold plated setscrews from the side of the source body.
5. Pull the entrance lens and ion focus lens to remove them from the source body.
6. Remove the extractor lens and insulator.
7. Separate the entrance lens and ion focus lens from the lens insulator.
8. Remove the repeller nut, washers, and insulators from the source heater block assembly, then remove the repeller.

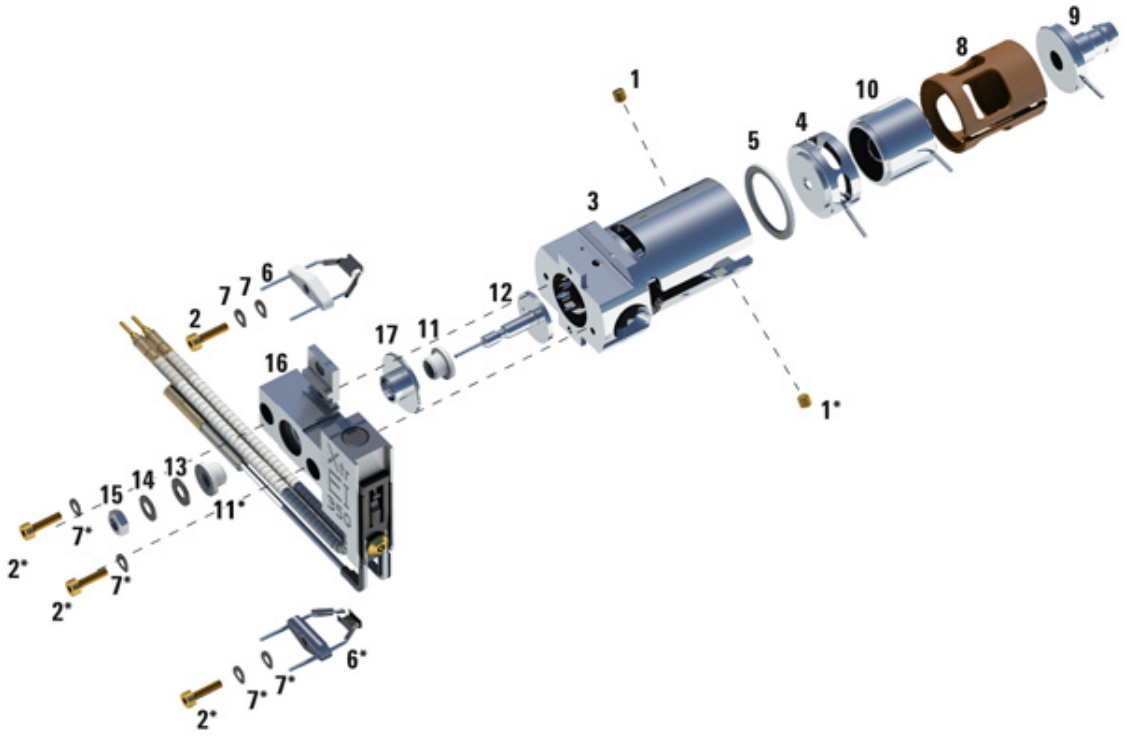


Figure 14 Disassembling the extractor EI ion source

Table 20 Parts list for the extractor EI ion source (Figure 17)

Item number	Item description	Part number
1	Setscrews	G3870-20446
2	Screws	G3870-20021
3	Source body	G3870-20440
4	Extractor lens	G3870-20444
5	Extractor lens insulator	G3870-20445
6	Filaments	G7005-60061

Table 20 Parts list for the extractor EI ion source (Figure 17) (continued)

Item number	Item description	Part number
7	Spring washer and flat washer	3050-1301and 3050-0982
8	Lens insulator	G3870-20530
9	Entrance lens	G3170-20126
10	Ion focus lens	05971-20143
11	Repeller insulator	G3870-20133
12	Repeller	G3870-60171
13	Flat washer	3050-0891
14	Belleville spring washer	3050-1301
15	Repeller nut	0535-0071
16	Source heater block assembly	G3870-60177
17	Insulator	G1099-20133

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 "To Disassemble the Standard or Inert EI Ion Source" on page 99 or "To Disassemble the Extractor EI Ion Source" on page 102.
2. Collect the following parts to be cleaned for a standard or inert EI ion source: (See Figure 15 on page 107.)
   - Repeller
   - Interface socket
   - Source body
   - Drawout plate
   - Drawout cylinder
   - Ion focus lens
   - Entrance lens

3 Collect the following parts to be cleaned for an extractor EI ion source: (See Figure 15 on page 107.)

- Repeller
- Insulator
- Source body
- Extractor lens
- 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 15 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.

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

2 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.

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

Ensure ***all*** abrasive residue is rinsed ***before*** ultrasonic cleaning. If the methanol becomes cloudy or contains visible particles, rinse again three times.

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

5 Ultrasonically clean the parts (each group separately) for 15 minutes. For dirty parts, use all three solvents in the order shown, cleaning 15 minutes with each of the following solvents:

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

For routine cleaning, cleaning with methanol is sufficient.

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

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

7 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 Assemble a Standard or Inert 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. Assemble the repeller assembly.
   a. Install the repeller block insert into the source heater block assembly. (See Figure 16 on page 111.)
   b. Install the repeller insulators into the source heater block assembly and repeller block insert.
   c. Install the repeller through the repeller insulators, then put the flat washer followed by the belleville spring washer onto the end of the repeller shaft and secure finger tight with the repeller nut.
2. Insert the drawout plate and the drawout cylinder into the source body. (See Figure 16 on page 111.)
3. Assemble the ion focus lens, entrance lens, and lens insulators.
4. Slide these assembled parts into the source body.
5. Install the setscrew that holds the lenses in place.

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. Install the interface socket.
7. Attach the repeller assembly to the source body using the two gold plated screws and spring washers.
8. Install the filaments using the two gold plated screws and spring washers.

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

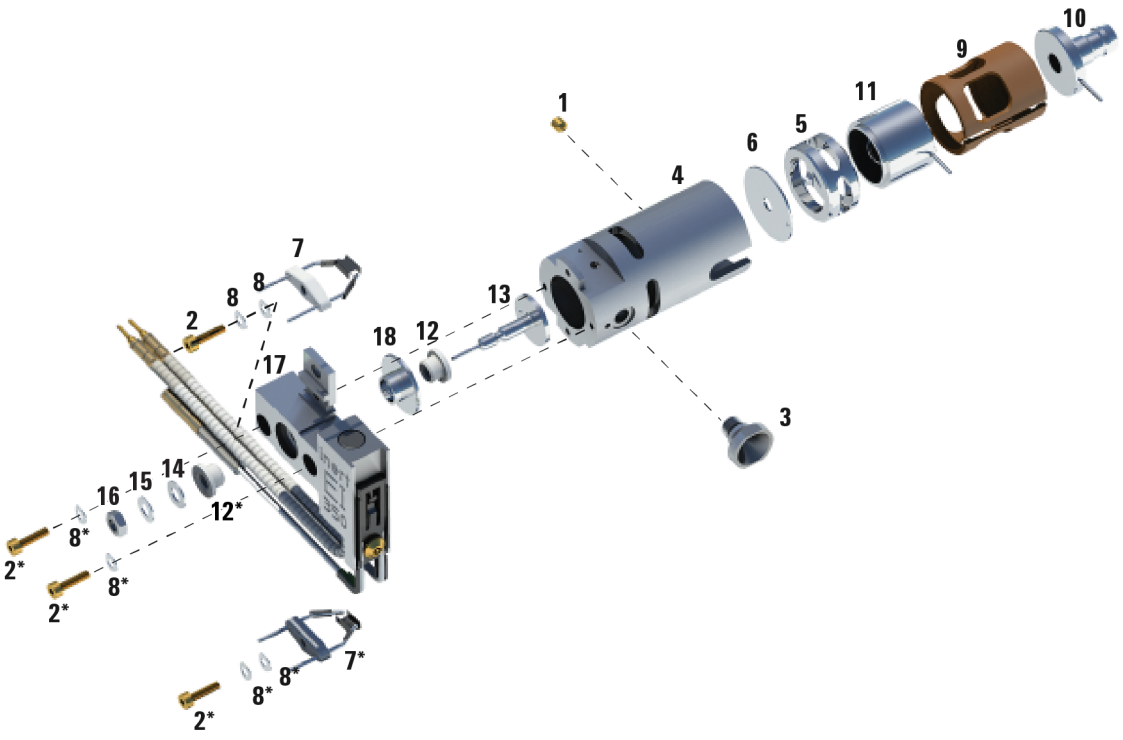


Figure 16 Assembling the standard or inert EI ion source

Table 21 Parts list for the standard or inert EI ion source (Figure 16)

Item number	Item description	Part number (SSL)	Part number (Inert)
1	Gold plated set screw	G1999-20022	G1999-20022
2	Gold plated screw	G3870-20021	G3870-20021
3	Interface socket	G1099-20136	G1099-20136

Table 21 Parts list for the standard or inert EI ion source (Figure 16) (continued)

Item number	Item description	Part number (SSL)	Part number (Inert)
4	Source body	G1099-20130	G2589-20043
5	Drawout cylinder	G1072-20008	G1072-20008
6	Drawout plate	05971-20134	G2589-20100
7	4-turn filament	G7005-60061	G7005-60061
8	Spring washer and flat washer	3050-1374 and 3050-0982	3050-1374 and 3050-0982
9	Lens insulator	G3170-20530	G3170-20530
10	Entrance lens	G3170-20126	G3170-20126
11	Ion focus lens	05971-20143	05971-20143
12	Repeller insulator	G1099-20133	G1099-20133
13	Repeller	G3870-60172	G3870-60173
14	Flat washer	3050-0627	3050-0627
15	Belleville spring washer	3050-1301	3050-1301
16	Repeller nut	0535-0071	0535-0071
17	Source heater block assembly	G3870-60180	G3870-60179
18	Repeller block insert	G3870-20135	G3870-20135

To Assemble the Extractor 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 ceramic washer into the source body.
2. Insert the extractor lens into the source body, flat side first (See Figure 17 on page 114).
3. Insert the entrance lens and ion focus lens into the insulator in the order shown (Figure 17 on page 114).
4. Slide the insulator containing the ion focus and entrance lens into the source body, with the ion focus lens against the extractor lens (See Figure 17 on page 114).
5. Install the two gold plated setscrews that holds the lenses in place.
6. Assemble the repeller assembly.
   a. Install the repeller block insert into the source heater block assembly. (See Figure 16 on page 111.)
   b. Install the repeller insulators into the source heater block assembly and repeller block insert.
   c. Install the repeller through the repeller insulators, then put the flat washer followed by the belleville spring washer onto the end of the repeller shaft and secure finger tight with the repeller nut.

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.

7 Attach the repeller assembly to the source body using the two gold plated screws and spring washers.

8 Install the filaments using the two gold plated screws and spring washers.

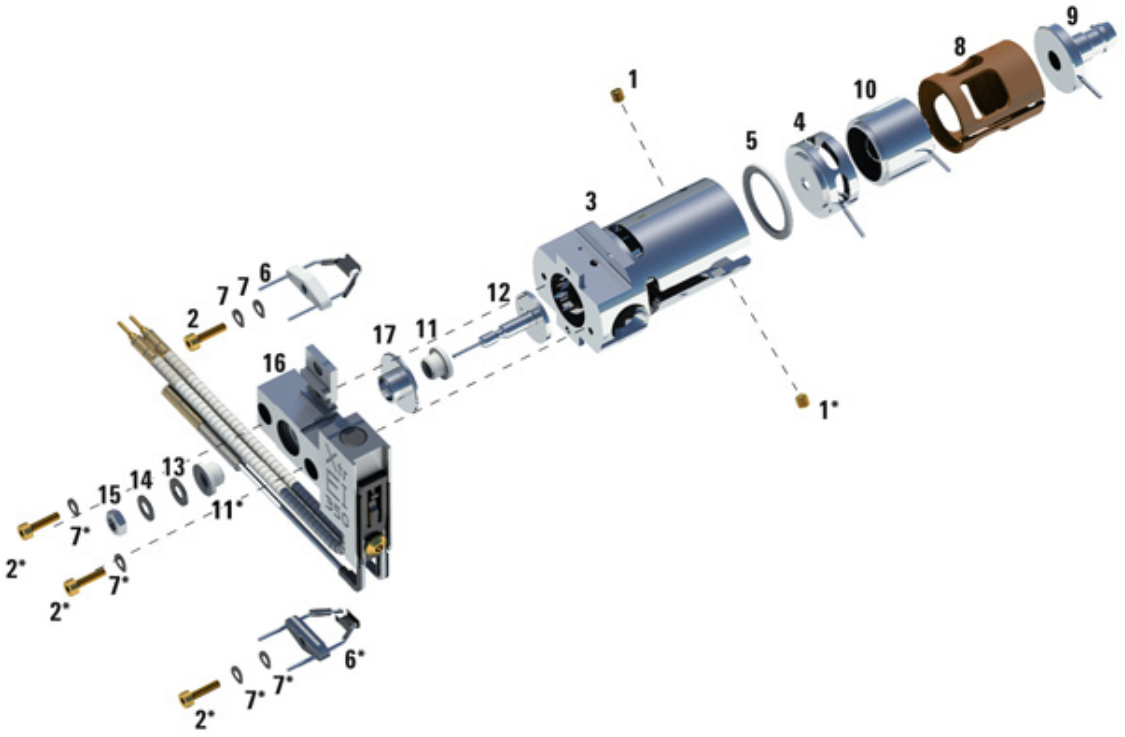


Figure 17 Assembling the extractor EI ion source

Table 22 Parts list for the extractor EI ion source (Figure 17)

Item number	Item description	Part number
1	Setscrews	G3870-20446
2	Screws	G3870-20021
3	Source body	G3870-20440

Table 22 Parts list for the extractor EI ion source (Figure 17) (continued)

Item number	Item description	Part number
4	Extractor lens	G3870-20444
5	Extractor lens insulator	G3870-20445
6	Filaments	G7005-60061
7	Spring washer and flat washer	3050-1301and 3050-0982
8	Lens insulator	G3870-20530
9	Entrance lens	G3170-20126
10	Ion focus lens	05971-20143
11	Repeller insulator	G3870-20133
12	Repeller	G3870-60171
13	Flat washer	3050-0891
14	Belleville spring washer	3050-1301
15	Repeller nut	0535-0071
16	Source heater block assembly	G3870-60177
17	Insulator	G1099-20133

To Replace a Filament in an EI Ion Source

Materials needed

- Filament assembly (G7005-60061)
- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Hex ball driver, 1.5-mm (8710-1570)

Procedure

1 Vent the MSD. See "Venting the MSD" on page 66.

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

2 Open the analyzer chamber. See "To Pump Down the MS" on page 79.

3 Remove the ion source. See "To Remove the EI Ion Source" on page 96.

4 Remove the gold plated screw and washer for the filament(s).

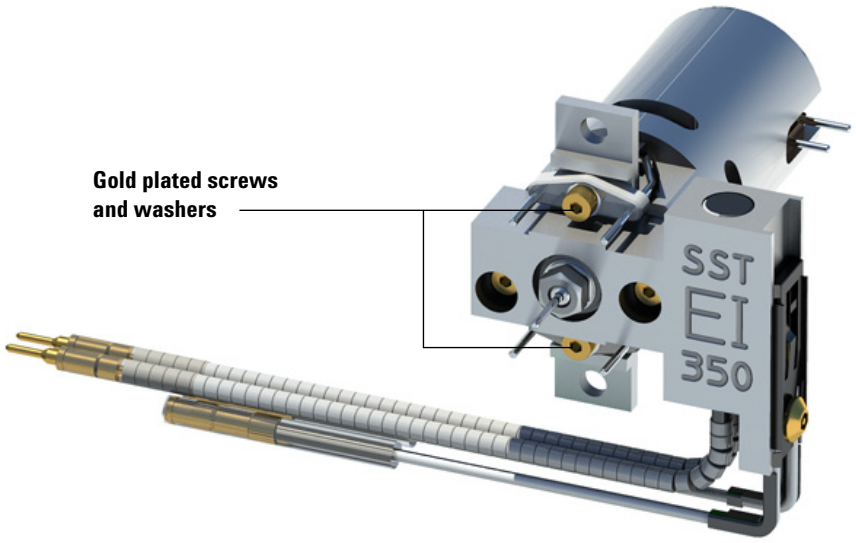


Figure 18 Changing the filament - standard source shown, Extractor source similar

5 Secure the new filament(s) with the gold plated screw and washer.

6 After installing the filament, verify that it is not grounded to the source body.

7 Install the ion source. See "To Install the EI Ion Source" on page 118.

8 Close the analyzer chamber. See "To Close the Analyzer Chamber" on page 125.

9 Pump down the MSD. See "To Pump Down the MS" on page 79.

10 Autotune the MSD. See "To Run an Autotune" on page 74.

11 In the Manual Tune dialog, the **Filament** parameter allows you to enter **1** or **2** for the filament number. Whichever number was present during the previous autotune enter the other filament number.

12 Autotune the MSD again.

13 Enter the filament number that gave the best results.

If you decide to use the first filament number, run Autotune again to make sure the tune parameters are compatible with the filament.

14 Select **Save Tune Parameters** from the **File** menu.

To Install 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.

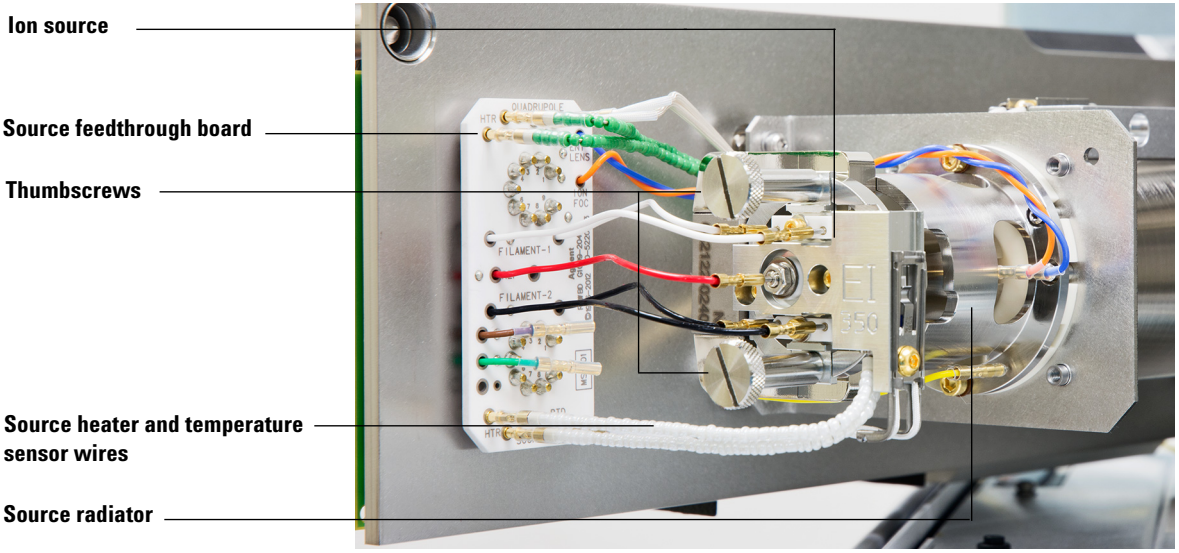


Figure 19 Installing the EI ion source

2 Install and hand tighten the source thumbscrews. Do not overtighten the thumbscrews.

3 Connect the ion source wires as shown in Figure 21 on page 121. The extractor source has an additional brown extractor wire that is missing from the standard source.

4 Close the analyzer. See "To Close the Analyzer Chamber" on page 125.

To Attach Wiring from the Ion Source to the feedthrough board

Materials needed

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

Procedure

Attach the internal front analyzer electrical leads to the pins specified in Table 23 on page 119. The extractor source has an additional brown extractor wire that is missing from the standard source.

The wiring is described in Table 23 and illustrated in Figure 20 on page 120 and Figure 21 on page 121. The term “Board” in the table refers to the feedthrough board located next to the ion source.

Table 23 EI source board wiring

Wire description	Feedthrough board label	Connects to source/quad
Green beaded (2)	Board, top left (HTR)	Quad heater
White with braided cover (2)	Board, top (RTD)	Quad sensor
White (2)	Board, center (FILAMENT-1)	Filament 1 (top)
Red (1)	Board, center left (REP)	Repeller
Black (2)	Board, center (FILAMENT-2)	Filament 2 (bottom)
Orange (1)	Board, top right (ION FOC)	Ion focus lens
Blue (1)	Board, top right (ENTR LENS)	Entrance lens
White beaded (2)	Board, bottom left (HTR)	Ion source heater
White (2)	Board, bottom (RTD)	Ion source sensor
Brown (1)	Board, middle left	Extractor lens (Extractor EI ion source only)

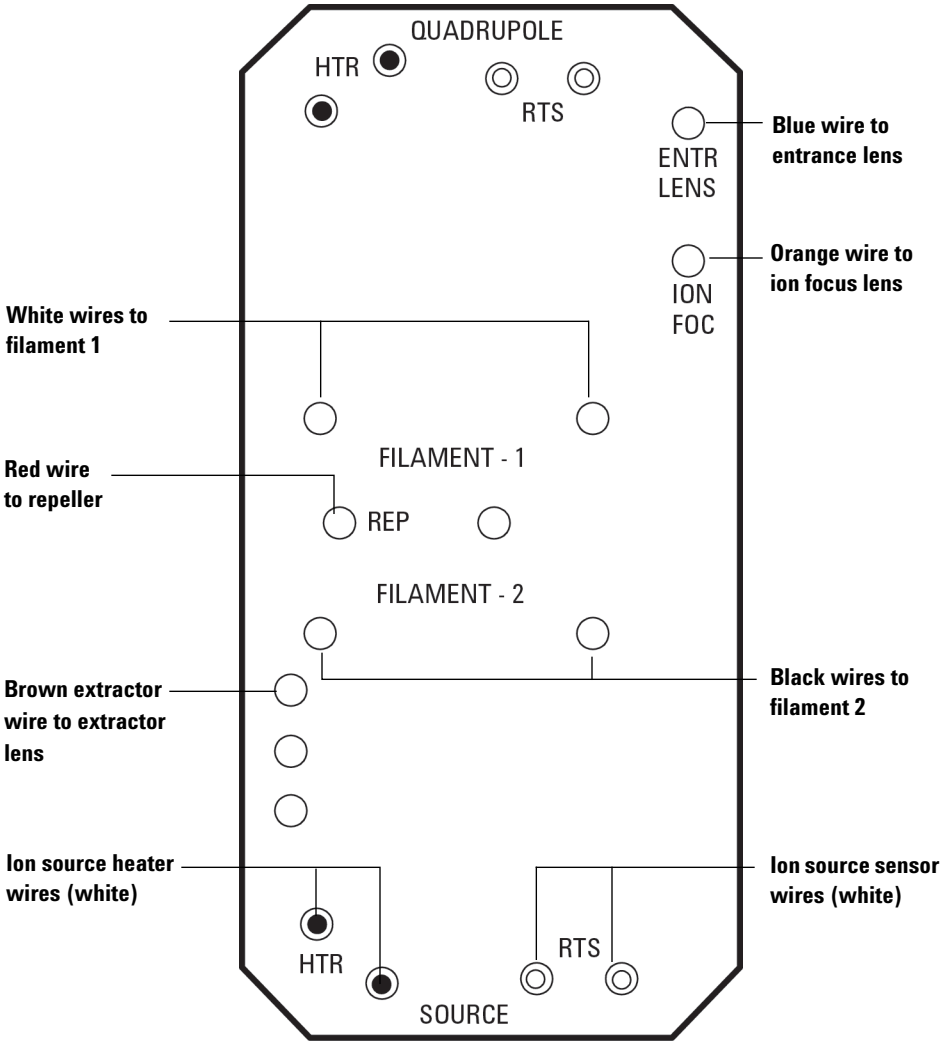


Figure 20 Feedthrough board wiring

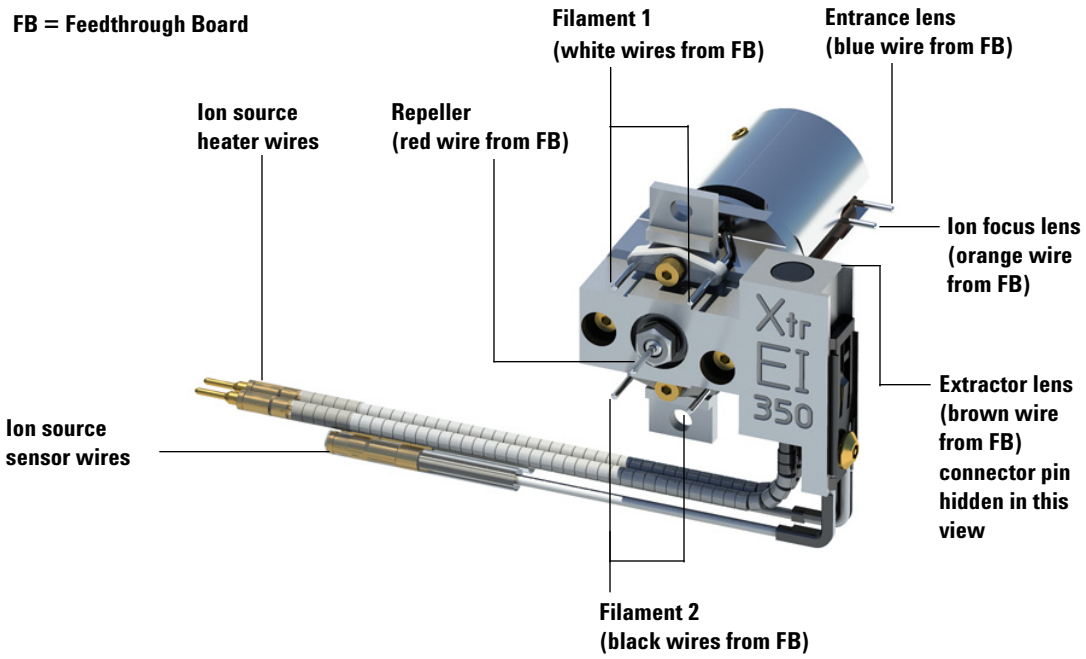


Figure 21 Ion source wiring - Extraction source shown, standard ion source similar

To Replace the Electron Multiplier Horn

The replacement EM horn part number for this Series 2 detector is stamped on the front face of the detector.Through OpenLAB CDS, you can determine which series detector you have without having to directly check the detector. The detector series is displayed as “Triple Axis Series 2” or “Triple Axis Series 1” in the detector tab of manual tune, in the detector section on the second page of the tune report, and in the pump down window.

Materials needed

- Electron multiplier horn (Series 2 Detector G7002-80103)
- Electron multiplier horn (Series 1 Detector G3170-80103)
- Gloves, clean, lint-free
  - Large (8650-0030)
  - Small (8650-0029)
- Pliers, long-nose (8710-1094)

Procedure

1 Vent the MS. (See“Vent the MSD” on page 77.)

WARNING **The analyzer, GC/MS interface, and other components in the analyzer chamber operate at very high temperatures. Do not touch any part until you are sure it is cool.**

CAUTION Always wear clean gloves to prevent contamination when working in the analyzer chamber.

2 Open the analyzer chamber. (See “To Open the Analyzer Chamber” on page 94.)

3 Open the retaining clip (Figure 22). Lift the arm of the clip up and swing the clip away from the electron multiplier horn.

4 Remove the electron multiplier horn.

5 Slide the signal wire from the connector in the sideplate.

6 Hold the new horn with the signal wire end down, and attach the signal wire to the connector in the sideplate.

7 Slide the electron multiplier horn into position.

8 Close the retaining clip.

9 Close the rear analyzer chamber. (See "To Close the Analyzer Chamber" on page 125.)

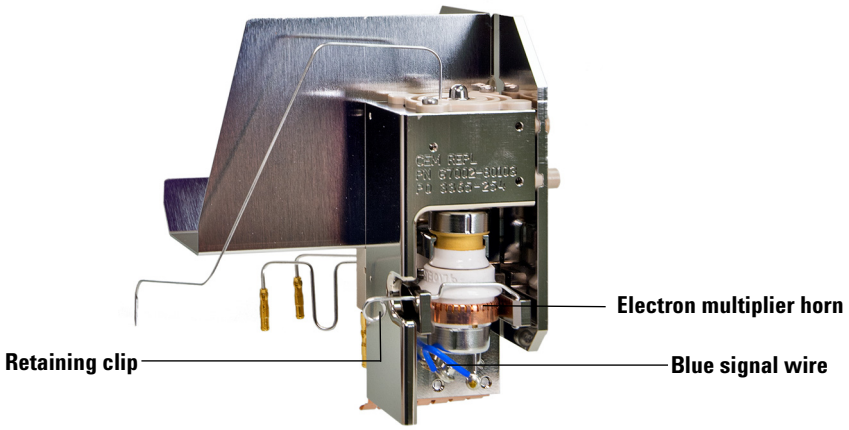


Figure 22 Replacing the EM horn (Series 2 shown) Series 1 similar

Figure 23 Electron multiplier horns

To Close the Analyzer Chamber

Procedure

1 Ensure all the internal analyzer electrical leads are correctly attached. Wiring is not the same for both the EI and CI ion sources. The wiring is described in "To Attach Wiring from the Ion Source to the feedthrough board" on page 119.

Check the side plate O-ring.

Make sure the O-ring has a *very* light coat of Apiezon L high vacuum grease. If the O-ring is very dry, it may not seal well. If the O-ring looks shiny, it has too much grease on it. (Refer to the *5977 Series MS Troubleshooting and Maintenance Manual* for lubricating instructions.)

CAUTION Do not force the analyzer door when closing, or you may damage the collision cell or quadrupole.

2 Swing the analyzer side plate closed.

The post-filter on the exit side of the quad helps to position the collision cell when the analyzer door is closed. When closing, the door should give minimal resistance while the quad is reseating the collision cell. The analyzer should slide into place with minimal pressure.

3 Ensure the vent valve is closed.

4 If hydrogen or other flammable or toxic substance is used for carrier gas, *gently* hand-tighten the top thumbscrew on the front analyzer side plate.

5 Pump down the MS. (See "To Pump Down the MS" on page 79.)

WARNING **The top thumbscrew must be fastened if hydrogen (or other hazardous gas) is being used as the GC carrier gas. In the unlikely event of an explosion, it may prevent the side plate from opening.**

CAUTION Do not overtighten the thumbscrew; it can cause air leaks or prevent successful pumpdown. Do not use a screwdriver to tighten the thumbscrew.

6 Once the MS has pumped down, close the left analyzer cover and replace the window cover.

7 Tune the MS.

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