



# Agilent 7000/7010 MassHunter GC/MS Triple Quadrupole

## Operating Manual



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# About This Manual

This manual contains information for operating and maintaining the Agilent 7000/7010 Series Triple Quad (TQ) Mass Spectrometer (MS) system.

## **1 “Introduction”**

Chapter 1 describes general information about the 7000/7010 Series TQ GC/MS, including a hardware description, general safety warnings, and hydrogen safety information.

## **2 “Installing 8890 GC Columns”**

Chapter 2 shows you how to prepare Agilent 8890 GC capillary columns for use with the MS, install it in the GC oven, and connect it to the MS using the GC/MS interface.

## **3 “Installing Intuvo 9000 GC Column”**

Chapter 3 shows you how to install an Agilent Intuvo column, connect a flow path from the column through the MS transfer line and into the ion source, and maintain the column guard chip.

## **4 “Installing 7890 GC Columns”**

Chapter 4 shows you how to prepare Agilent 7890 GC capillary columns for use with the MS, install it in the GC oven, and connect it to the MS using the GC/MS interface.

## **5 “Operating in EI Mode”**

Chapter 5 describes routine operations in EI mode such as setting temperatures, monitoring pressures, tuning, venting, and pumpdown.

## **6 “Operating in CI Mode”**

Chapter 6 describes additional tasks necessary to operate in CI mode.

## **7 “General Maintenance”**

Chapter 7 describes general maintenance procedures for the 7000/7010 Series TQ GC/MS.

## **8 “CI Maintenance”**

Chapter 8 describes maintenance procedures unique to CI MS.

# Where to Find More Information

Accompanying your hardware and software is a comprehensive collection of manuals, videos, user applications, and method development tools.

## To access your GC Hardware Library

- 1 Open a browser on a computer or other device that shares the same gateway as the GC.
- 2 Enter this URL `http://xxx.xxx.xxx.xxx/info`, where `xxx.xxx.xxx.xxx` is the IP address or host name of the GC. For example, Enter `http://10.1.1.101/info`.
- 3 When the GC **Help & Information Home** screen opens, select **Knowledgebase**, then scroll down and select **User Manual PDFs**.
- 4 Select a GC manual from the **PDF User Manuals** screen.

## To access your GC/MS 7000/7010 Series TQ Hardware Library

- 1 If necessary, install your Hardware Library by inserting the GC/MS Hardware User Info USB into your PC and following the prompts. This can be installed by anyone who has authority to copy information onto the receiving computer.
- 2 Select and open the desktop icon for your instrument's documentation library.
- 3 Select the MassHunter instrument manual or video to view.

See the Agilent 7000/7010 Series TQ GC/MS System Quick Start document for information on finding and installing the documentation located on these USBs.

## To access your GC/MS MassHunter software documentation

The software documentation is located in your MassHunter software's online Help that installed on your instrument's PC.

From the MassHunter online Help home screen, click **Getting Started** and select **Quick Start** for an overview of the Help system.

The common procedures used with your instrument are also found in this Operating manual in **Chapter 5**, "Operating in EI Mode" and **Chapter 6**, "Operating in CI Mode".

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# 1

## Introduction

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This section provides general information about the 7000/7010 Series Triple Quad (TQ) Gas Chromatograph (GC) / Mass Spectrometer (MS), including a hardware description, general safety warnings, and hydrogen safety information.

# Abbreviations Used

The abbreviations in **Table 1** are used in discussing this product. They are collected here for convenience.

**Table 1**    **Abbreviations**

Abbreviation	Definition
AC	Alternating current
ALS	Automatic liquid sampler
CC	Collision cell
CI	Chemical ionization
CID	Collision induced dissociation
CSB	Ceramic source board
DC	Direct current
EI	Electron impact
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)
HES	High Efficiency Source
HES 2.0	High Efficiency Source 2.0
id	Inside diameter
Inert	Standard EI source constructed of inert materials
LAN	Local Area Network
LCP	Local control panel
<i>m/z</i>	Mass-to-charge ratio
MFC	Mass flow controller
MRM	Multiple reaction monitoring

**Table 1** Abbreviations (continued)

Abbreviation	Definition
MS	Mass spectrometer
MS1	Front quadrupole
MS2	Rear quadrupole
NCI	Negative chemical ionization
OFN	Octafluoronaphthalene (sample)
PCI	Positive chemical ionization
PFDTD	Perfluoro-5,8-dimethyl-3,6,9-trioxydodecane (calibrant)
PFTBA	Perfluorotributylamine (calibrant)
Quad	Quadrupole mass filter
RF	Radio frequency
RFPA	Radio frequency power amplifier
Torr	Unit of pressure, 1 mm Hg
TQ	Triple Quad (quadrupole)
Turbo	Split flow turbomolecular vacuum pump
XTR	EI Extractor source

# The 7000/7010 Series TQ GC/MS

The 7000/7010 Series TQ GC/MS is a standalone capillary GC detector for use with the Agilent 8890, 9000, or 7890 GCs. (See **Figure 1** on page 18.) The TQ GC/MS features:

- One split flow turbomolecular vacuum pump
- Rotary vane or optional dry scroll foreline pump
- A choice of two independently MS-heated high sensitivity EI sources
- An optional JetClean system for cleaning the ion source in place under vacuum
- CI and EI modes available (PCI/NCI/EI)
- Two independently MS-heated hyperbolic Quads
- Single hexapole CC
- HED EM
- Independently GC-heated GC/MS interface with interface tip seal
- Independently GC-controlled CC gas flows

## Physical description

The 7000/7010 Series TQ GC/MS is a rectangular box, approximately 47 cm high, 35 cm wide, and 86 cm deep. The weight is 59 kg for the turbo pump mainframe and 64 kg for the mainframe with CI. The attached foreline (roughing) pump weighs an additional 22.2 kg.

The basic components of the instrument are:

- Frame/cover assemblies
- Vacuum system
- GC/MS interface
- Ion source
- Electronics
- CC
- Detector
- Front and rear analyzers

### Vacuum gauge

The 7000/7010 Series TQ GC/MS is equipped with two ion vacuum gauges. The Agilent MassHunter GC/MS Acquisition software can be used to read the pressure (high vacuum) in the vacuum manifold and at the turbomolecular vacuum pump discharge.

### 7000/7010 EI HES and HES 2.0 Systems

There are two versions of this instrument.

### 7000/7010 CI MS System

In this manual, the term "CI MS" refers to the 7000/7010 Series TQ GC/MS CI source system. It also applies, unless otherwise specified, to the mass flow controller (MFC) for these instruments.

The 7000/7010 Series TQ GC/MS CI source system (preconfigured or upgrade kit) adds to the 7000/7010 TQ MS:

- EI/CI GC/MS interface
- CI source
- Reagent gas MFC system
- JetClean option available that shares the same MFC system
- HED with high sensitivity electronics
- Bipolar HED power supply for PCI and NCI operation

A required methane/isobutane gas purifier is provided. It removes oxygen, water, hydrocarbons, and sulfur compounds.

The CI MS system has been optimized to achieve the relatively high source pressure required for CI while still maintaining high vacuum in the CC, quadrupoles, and detector. Special seals along the flow path of the reagent gas and very small openings in the ion source keep the source gases in the ionization volume long enough for the appropriate reactions to occur.

The CI interface has special plumbing for reagent gas. A spring-loaded insulating seal fits onto the tip of the interface.

Switching back and forth between CI and EI sources takes about 1 hour, however, a 1- to 2-hour wait is required to purge the reagent gas lines and bake out water and other contaminants. Switching from PCI to NCI requires about 2 hours for the ion source to cool.

# 7000/7010 Triple Quadrupole Hardware Description

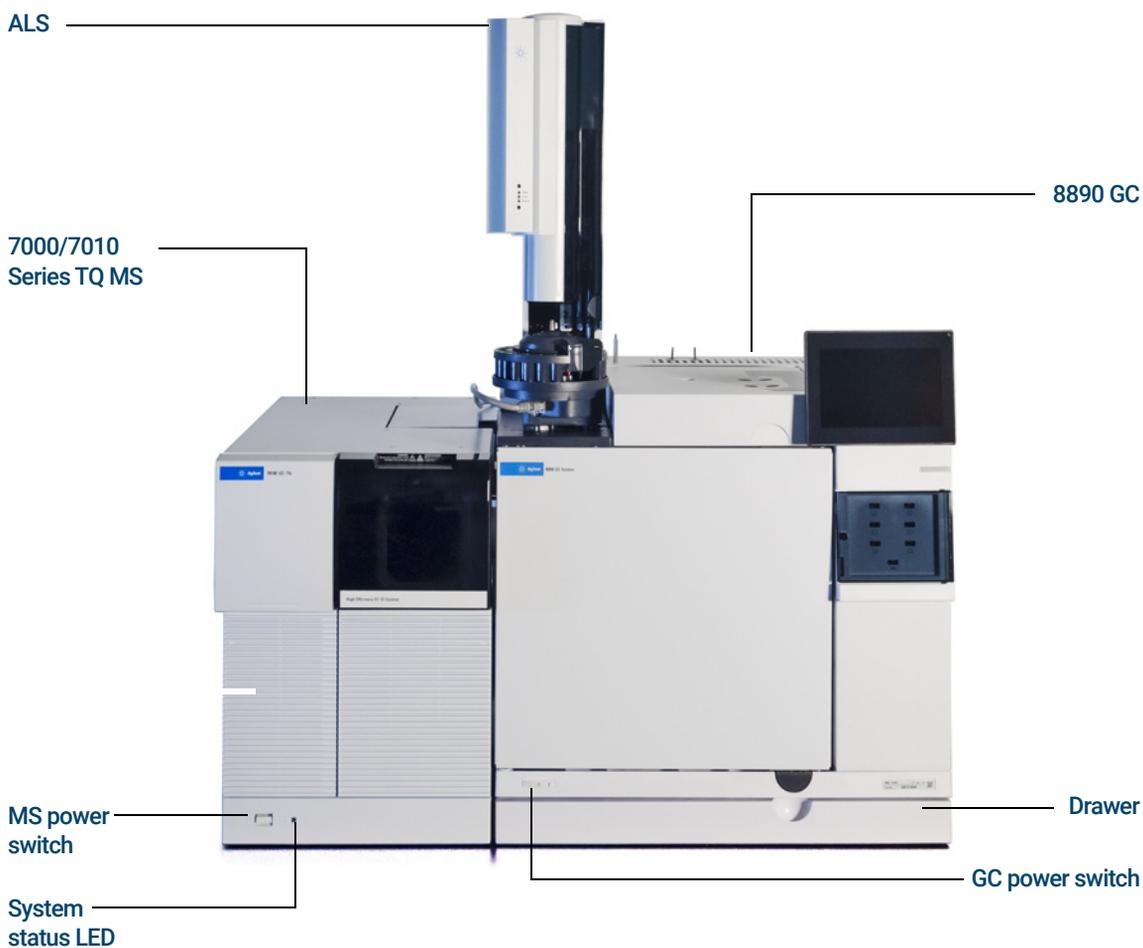


Figure 1. 7000/7010 Series TQ GC/MS system with 8890 GC

## Important Safety Warnings

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

### Many internal parts of the MS carry dangerous voltages

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

- The wiring between the MS power cord and the AC power supply
- The AC power supply itself
- 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, and oven are turned off.**

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

#### **WARNING**

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

#### **WARNING**

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

## Electrostatic discharge is a threat to MS electronics

The printed circuit boards in the MS can be damaged by electrostatic discharge (ESD). 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/MS operate at temperatures high enough to cause serious burns. These parts include, but are not limited to the:

- Inlet
- Oven and its contents
- Valve box
- Detectors
- Column nuts attaching the column to an inlet or detector
- Foreline pump
- GC/MS transfer line
- Quadrupole
- Ion source

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 that can cause burns.**

### WARNING

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

The oil pan under the rotary vane 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 MS.

**WARNING**

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

# Hydrogen Safety

## WARNING

The use of hydrogen as a GC carrier gas, detector fuel gas, or in the optional JetClean system, is potentially dangerous.

## WARNING

When using hydrogen (H<sub>2</sub>) as the carrier gas or fuel gas, be aware that hydrogen gas can flow into the GC oven and create an explosion hazard. Therefore, ensure that the hydrogen 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 gas is supplied to the instrument.

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

Hydrogen is a commonly used GC carrier gas, detector fuel gas, and reactive cleaning gas for the optional JetClean system. Hydrogen is potentially explosive and has other dangerous characteristics.

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

Hydrogen presents a number of dangers. Some are general, others are unique to GC or GC/MS 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 MS and subsequent combustion

## Hydrogen accumulation in an MS

### WARNING

The MS cannot detect leaks in inlet 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.

### WARNING

The MS cannot detect leaks in the valves for the optional JetClean system. It is possible that hydrogen can leak into the MS from this cleaning system. Always turn off the JetClean system and close the manual hydrogen shutoff valve to the JetClean MFC and ensure good vacuum before venting the MS.

All users should be aware of the mechanisms by which hydrogen can accumulate, and know what precautions to take if they are certain or suspect that hydrogen has accumulated. (See [Table 2](#).) Note that these mechanisms apply to *all* MSs.

**Table 2** Hydrogen accumulation mechanisms

Mechanism	Results
MS turned off	A MS can be shut down deliberately. It can also be shut down accidentally by an internal or external failure. A MS shutdown does not shut off the flow of carrier gas. As a result, hydrogen may slowly accumulate in the MS.
MS automated shutoff valves closed	The MSs are equipped with automated shutoff valves for the calibration vial, optional JetClean system, and the reagent gases. 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 MS.

## 1 Introduction

Table 2 Hydrogen accumulation mechanisms (continued)

Mechanism	Results
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 an 8890/9000/7890 Series GC equipped with Electronic Pressure Control (EPC) is shut off, the EPC stops the flow of carrier gas. If the carrier flow is <i>not</i> under EPC control, the flow increases to its maximum. This flow may be more than some MSs can pump away, resulting in the accumulation of hydrogen in the MS. If the MS is shut off at the same time, the accumulation can be fairly rapid.
Power failure	If the power fails, both the GC and MS shut down. The flow of 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 MS.

### WARNING

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

### WARNING

After a power failure, the MS 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/MS system with hydrogen carrier gas, or when operating the MS with the JetClean option that supplies hydrogen to the MS from a MFC located on the analyzer.

### Equipment precautions

### WARNING

You **MUST** ensure the top thumbscrew on the front analyzer side plate and the top thumbscrew on the rear analyzer side plate are both fastened finger-tight. Do not over tighten the thumbscrews; this can cause air leaks.

You **MUST** leave the CC chamber top plate shipping brackets fastened. Do not remove the shipping brackets from the top plate for normal operation; they secure the top plate in the event of an explosion.

You **MUST** remove the plastic cover over the glass window on the front of the analyzer. In the unlikely event of an explosion, this cover may dislodge.

### WARNING

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

### WARNING

If hydrogen is plumbed to any connection on the GC or MS:

- The hydrogen supply to the system entry connection(s), such as from the hydrogen gas cylinder, hydrogen generator or other hydrogen supply, must be shut off when the system is powered off/vented.
- During the venting process it is important to open the manual vent valve.
- Before pumping the MS system down: Open the analyzer/sideplate door(s) 45 degrees or more for 10 minutes before powering the MS system on to begin the pump down process. This action is intended to prevent accumulation of hydrogen within the MS analyzer before MS power on in the event of a hydrogen leak..

### WARNING

MS Gas Flow:

Never exceed 50 mL/min of total H<sub>2</sub>/methane flow to the MS, including column and/or reagent gas.

### WARNING

Foreline Pumps:

- Use only Agilent approved pumps.
- Agilent IDP pumps must be purchased through Agilent with GC/MS part numbers (i.e., part number begins with "G") reflecting their compatible use with Agilent GC/MS systems. Pumps ordered directly through Agilent Vacuum division or another provider may not have the correct gas ballast installed.
- Agilent IDP pumps must be fitted with the supplied inlet valve that will close in a power outage.
- Pfeiffer Duo and MVP pumps should be operated with gas ballast closed with Agilent GC/MS systems.
- Edwards RV5 pumps should be operated with gas ballast closed with Agilent GC/MS systems.

### WARNING

#### GC configuration:

- Ensure hydrogen is configured in the firmware for all gas channels using hydrogen. An EPC that is not configured for hydrogen when hydrogen is used could affect the hydrogen safety portion of the GC.
- Ensure all column connection(s) are configured correctly on the GC firmware, especially for any connection(s) to the MS system.
- When available, ensure LVDS cable is connected to GC. This tells the GC to shut off carrier gas if the MS has a pump failure or is powered off.

#### General laboratory precautions

- Turn off the hydrogen as well as any other gas supply every time you shut down either the GC or the MSD. The supply should be turned off at the source of the gas supply.
- Avoid leaks in the carrier gas, fuel gas, and in the optional JetClean system lines. Use leak-checking equipment to periodically check for hydrogen leaks.
- Eliminate from your laboratory as many ignition sources as possible (for example, open flames, devices that can spark and sources of static electricity).
- 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 MS.
- Do not use hydrogen as a CC gas.
- Turn off the hydrogen at its source every time you vent the MS. (Do not heat the capillary column without carrier gas flow.)
- Turn off the hydrogen at its source every time shutoff valves in the MS 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/MS 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 MS and allow it to cool for 1 hour.

## 1 Introduction

- 4 Eliminate all potential sources of ignition in the room.
- 5 Open the vacuum manifold of the MS to atmosphere.
- 6 Wait at least 10 minutes to allow any hydrogen to dissipate.
- 7 Start up the GC and MS as normal.

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

# Safety and Regulatory Certifications

Certifications listed in this section are applicable to products bearing the corresponding regulatory mark.

The 7000/7010 Series TQ GC/MS 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 7000/7010 Series TQ GC/MS is designed and manufactured under a quality system registered to ISO 9001.

## EMC

The 7000/7010 TQ MS 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.



### South Korean Class A EMC Declaration

A 급 기기 ( 업무용 방송통신기자재 )

This equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home.

이 기기는 업무용 (A 급 ) 전자파적합기기로서 판 매자 또는 사용자는 이 점을 주의하시기 바라 며 , 가정외의 지역에서 사용하는 것을 목적으로 합니다 .

The 7000/7010 Series TQ GC/MS is designed and manufactured under a qualitysystem registered to ISO 9001.

### Information

The Agilent Technologies 7000/7010 Series TQ GC/MS meets the following IEC classifications: Equipment Class I, Laboratory Equipment, Installation Category II, and 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 MS has been compromised, disconnect the unit from all power sources and secure the unit against unintended operation.

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

## Symbols

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

See accompanying instructions for more information.



Indicates a hot surface.



Indicates hazardous voltages.



Indicates earth (ground) terminal.



Indicates potential explosion hazard.



Indicates radioactivity hazard.



Indicates electrostatic discharge hazard.



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



## Electromagnetic compatibility

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

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

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

- Relocate the radio or antenna.
- Move the device away from the radio or television.
- Plug the device into a different electrical outlet, so that the device and the radio or television are on separate electrical circuits.
- Ensure that all peripheral devices are also certified.
- Ensure that appropriate cables are used to connect the device to peripheral equipment.
- Consult your equipment dealer, Agilent Technologies, or an experienced technician for assistance.

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  $L_p < 70$  dB according to EN 27779:1991 and EN ISO 3744:1995.

### Schalldruckpegel

Schalldruckpegel  $LP < 70$  dB nach EN 27779:1991 und EN ISO 3744:1995.

# Intended Use

Agilent products must only be used in the manner described in the Agilent product user guides. Any other use may result in damage to the product or personal injury. Agilent is not responsible for any damages caused, in whole or in part, by improper use of the products, unauthorized alterations, adjustments or modifications to the products, failure to comply with procedures in Agilent product user guides, or use of the products in violation of applicable laws, rules or regulations.

# 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.

Agilent recommends you retain the original packaging that your product arrived in so it can be used to ensure the safe movement or transport of your product in the future. If you must discard any of the packaging, we recommend following local waste disposal regulations to ensure the largest amount of material is recycled and diverted from a landfill or incineration. For additional guidance, please refer to your local waste disposal authority.

# Accidental Liquid Spill

In case of an accidental liquid spill, first turn off the MS and remove the power cord from the buildings electrical power supply. Then call your local Agilent service representative for assistance.

Only Agilent trained technicians should service the electrical components inside an MS.

## Moving or Storing the MS

The best way to keep your MS functioning properly is to keep it pumped down and hot, with carrier gas flow. If you plan to move or store your MS, a few additional precautions are required. The MS must remain upright at all times; this requires special caution when moving. The MS should not be left vented to atmosphere for long periods. (See **“Moving or Storing the MS”** in the *7000/7010 Series TQ GC/MS Troubleshooting and Maintenance Manual*.)

## 2

# Installing 8890 GC Columns

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To Condition a Capillary Column 39

To Install a Capillary Column in the GC/MS Interface Using the Self-Tightening Column Nut 40

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This chapter shows you how to select, install, and condition a GC column, which must be performed before you operate your MS.

# Columns

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

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

Remember that column flows vary greatly with oven temperature, requiring measurements of the actual flow to be taken. Use the flow calculator in the Agilent Instrument Utilities software, and **Table 3** to determine an acceptable column flow. EI and CI systems also have different column outlet flow pressures. (See **Table 7** on page 106 for EI mode and **Table 10** on page 130 for CI mode.)

**Table 3 Gas flows**

Feature	Gas flows
High-vacuum pump	Split flow turbo
Optimal He column gas flow, mL/min (carrier gas)	1 to 2
Reagent gas flow, mL/min	1 to 2
CC gas flow	3 to 4
Maximum recommended gas flow, mL/min*	4 to 6
Maximum gas flow, mL/min <sup>†</sup>	6.5
Maximum column id	0.53 mm (30 m length)
JetClean option H <sub>2</sub> flow,	0.4 mL/min

\* Total gas flow into the MS = column flow + CC gas flow + reagent gas flow (if applicable) + JetClean H<sub>2</sub> flow (if applicable)

† Expect degradation of spectral performance and sensitivity.

### Conditioning columns

Conditioning a column before it is connected to the GC/MS interface is essential.

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 MS ion source. This decreases MS sensitivity and makes cleaning the ion source necessary.

Column bleed is most common in new or poorly cross-linked 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/MS 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 procedure for the 7000/7010 Series TQ GC/MS is different from that for previous MSs. Using the procedure from another instrument may *not* work and may damage the column or the MS.
- You can remove old ferrules from column nuts with an ordinary pushpin.
- 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. Agilent recommends use of their new self-tightening nuts on the MS transfer line, inlet, and GC detector.
- Always wear clean gloves when handling columns, especially the end that will be inserted into the GC/MS interface.

#### WARNING

If you are using hydrogen as a carrier gas or for the JetClean system, the hydrogen gas flow must be off before turning off the MS power. If the foreline pump is off, hydrogen will accumulate in the MS and an explosion may occur. Read “[Hydrogen Safety](#)” on page 22 before operating the MS with hydrogen gas.

#### 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, lint-free (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)
- Self-tightening column nut (5190-6194)
- Alternate: Standard Inlet column nut (5181-8830, for use with Vespel ferrules)
- 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)
- Magnifying loupe
- Septum (may be old, used inlet septum)

To install columns in other types of inlets, refer to your GC user information.



### Procedure

#### **WARNING**

The GC operates at high temperatures. Do not touch any parts of the GC until you are sure they are cool.

- 1 Cool the oven to room temperature.

#### **WARNING**

Always wear safety glasses when handling capillary columns. 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.

- Wearing clean gloves, slide a septum, column nut, and conditioned ferrule onto the free end of the column. **Figure 2** shows a standard inlet column nut, but the nut is similarly positioned for a self-tightening column nut. The tapered end of the ferrule should point away from the column nut for a column attachment to an inlet.

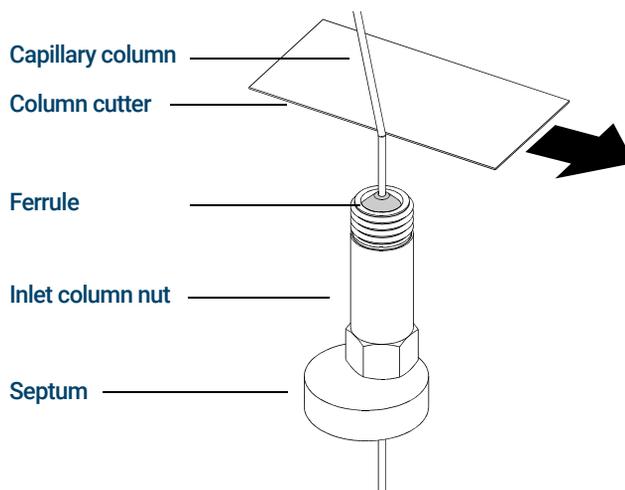


Figure 2. Preparing a capillary column for installation (standard inlet column nut shown)

- Use the column cutter to score the column 2 cm from the end.
- While holding the column against the column cutter with your thumb, break the column against the edge of the column cutter.
- Inspect the end for jagged edges or burrs. If the break is not clean and even, repeat steps 3 and 4.
- Wipe the outside of the free end of the column with a lint-free cloth moistened with methanol.
- Position the septum under the column nut so that the column extends 4 to 6 mm past the end of the ferrule. (See **Figure 3** on page 38.)
- Insert the column in the inlet.
- Slide the nut up the column to the inlet base and finger-tighten the nut.

## 2 Installing 8890 GC Columns

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

### CAUTION

Never use a wrench to tighten a self-tightening nut. This may result in damage to the nut or instrument.

- For the self-tightening column nut, finger-tighten until it begins to grip the column, then turn an additional 30 to 60 degrees until tight.

For the standard column nut, (shown in **Figure 3**) tighten the nut an additional 1/4 to 1/2 turn. The column should not slide with a gentle tug.

- Start the carrier gas flow.
- Verify flow by submerging the free end of the column in isopropanol. Look for bubbles.

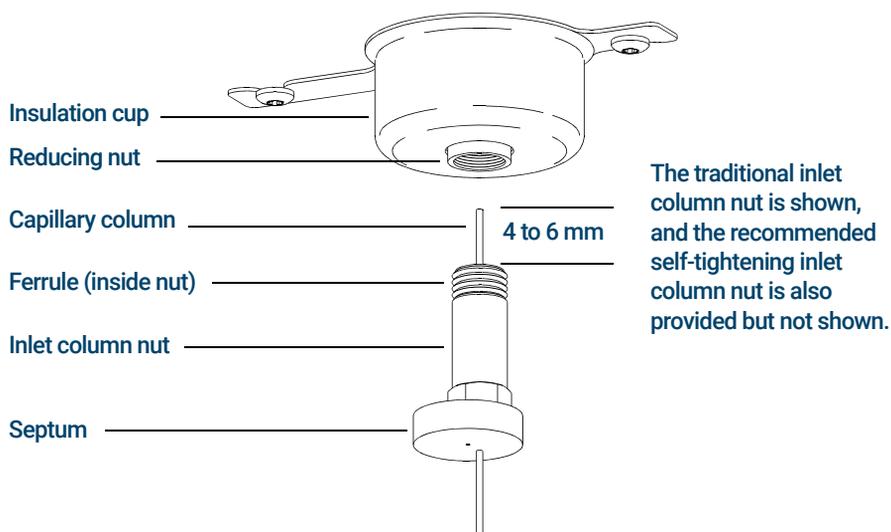


Figure 3. Installing a capillary column for a split/splitless inlet

# 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 (99.9995% or better) inert gas such as helium, nitrogen, or argon.

### WARNING

The GC operates under high temperatures. 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 36.)
- 2 Set a minimum velocity of 30 cm/s, or as recommended by the column manufacturer. Allow 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, 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 Install the column in the GC/MS interface.

### 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 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

- Interface tip seal (G3870-20542) (See **Figure 4** and **Figure 5** on page 42.)
- Knurled tip seal retainer (G3870-20547)
- Tip seal spring (G7005-20024)
- Column cutter, ceramic (5181-8836) or diamond (5183-4620)
- Flashlight
- Magnifying loupe
- Gloves, clean, lint-free (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



### 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 39.)

#### CAUTION

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

- 2 Vent the MS (See [“To Vent the MS”](#) on page 124.) and open the front analyzer chamber. (See [“To Open the Front Analyzer Chamber”](#) on page 159.) Ensure you can see the end of the GC/MS interface.

#### WARNING

The GC operates under high temperatures. Do not touch any GC parts unless you are certain they are cool.

- 3 Remove the interface tip seal, spring, and knurled tip seal retainer from the GC/MS interface. (See [Figure 4](#) and [Figure 5](#) on page 42.)
- 4 Slide the self-tightening column nut and conditioned ferrule onto the free end of the GC column. The tapered end of the ferrule must point towards the nut.
- 5 Slide the column into the GC/MS interface.
- 6 Lightly thread the self-tightening column nut onto the GC/MS interface.
- 7 Use the column cutter to score the column 2 cm from the end.

#### CAUTION

Do not break the column off inside the vacuum manifold. Pieces of column could fall or be pulled into the turbo pump and damage it.

- 8 While holding the column against the column cutter with your thumb, break the column against the edge of the column cutter.
- 9 Inspect the end for jagged edges or burrs. If the break is not clean and even, repeat steps 6 and 7.

## 2 Installing 8890 GC Columns

- 10** Adjust the column so it extends this specified distance from the end of the transfer line. (See **Figure 4** and **Figure 5** on page 42.)

**For an EI XTR or CI Source Installation**, the column extends about 1 to 2 mm. (See **Figure 4**.)

**For an EI HES or HES 2.0 Installation**, the column extends about 4 to 5 mm. (See **Figure 5**.)

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 4. Installing a capillary column in the GC/MS interface for an EI XTR or a CI source



Figure 5. Installing a capillary column in the GC/MS interface for an EI HES or HES 2.0

## 2 Installing 8890 GC Columns

- 11 Hand-tighten the nut. (See **Figure 6**.) Ensure the position of the column does not change as you tighten the nut.
- 12 Tighten the nut in the clockwise direction. Continue to tighten until you feel the ferrule grip the column.
- 13 Check the GC oven to ensure that the column does not touch the oven walls.

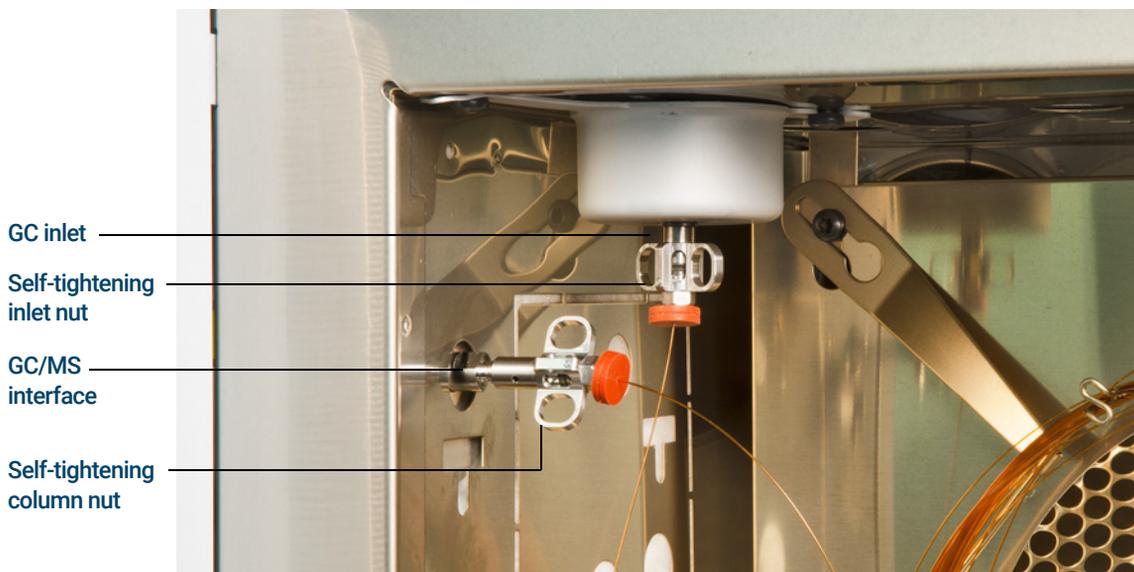


Figure 6. Installing a capillary column in the GC/MS interface

### CAUTION

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

- 14 Install the tip seal, spring, and knurled tip seal retainer on the GC/MS interface. Align, gently slide, and screw the knurled tip seal retainer into the tip seal holder. (See **Figure 4** and **Figure 5** on page 42.)

### CAUTION

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

## 2 Installing 8890 GC Columns

- 15 **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.
- 16 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.
- 17 Close the front analyzer chamber. (See **“To Close the Front Analyzer Chamber”** on page 218.)

# 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 previous section.

### Materials needed

- Interface tip seal (G3870-20542) (See **Figure 4** and **Figure 5** on page 42.)
- Tip seal spring (G7005-20024)
- Knurled tip seal retainer (G3870-20547)
- Column cutter, ceramic (5181-8836) or diamond (5183-4620)
- Flashlight
- Magnifying loupe
- Gloves, clean, lint-free (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 39.)

#### CAUTION

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

- 2 Vent the MS and open the front analyzer chamber. (See **“To Vent the MS”** on page 124 and **“To Open the Front Analyzer Chamber”** on page 159.) Ensure you can see the end of the GC/MS interface.

#### WARNING

The GC operates under high temperatures. Do not touch any GC parts unless you are certain they are cool.

- 3 Remove the interface tip seal, spring, and knurled tip seal retainer from the GC/MS interface. (See **Figure 4** and **Figure 5** on page 42.)
- 4 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.
- 5 Slide the column into the GC/MS interface.
- 6 Hand-tighten the nut.
- 7 Use the column cutter to score the column 2 cm from the end.

#### CAUTION

Do not break the column off inside the vacuum manifold. Pieces of column could fall or be pulled into the turbo pump and damage it.

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

## 2 Installing 8890 GC Columns

- 9 Inspect the end for jagged edges or burrs. If the break is not clean and even, repeat steps 6 and 7.
- 10 Adjust the column so it extends this specified distance from the end of the transfer line. (See **Figure 4** and **Figure 5** on page 42.)

**For an EI XTR or CI Source Installation** (see **Figure 4** on page 42), the column extends about 1 to 2 mm.

**For an EI HES or HES 2.0 Installation** (see **Figure 5** on page 42), the column extends about 4 to 5 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.

- 11 Tighten the nut 1/4 to 1/2 turn. Ensure the position of the column does not change as you tighten the nut. Do not over tighten the nut.
- 12 Check the GC oven to be sure that the column does not touch the oven walls.
- 13 Check the nut's tightness after one or two heat cycles; retighten as appropriate.

### CAUTION

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

- 14 Install the tip seal, spring, and knurled tip seal retainer on the GC/MS interface. Align, gently slide, and screw the knurled tip seal retainer into the tip seal holder. (See **Figure 4** and **Figure 5** on page 42.)

### CAUTION

**Forcing the analyzer door closed if these parts are misaligned will damage the tip seal or the interface or the ion source, or will keep the side plate from sealing.**

- 15 **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.
- 16 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.
- 17 Close the front analyzer chamber. (See **"To Close the Front Analyzer Chamber"** on page 218.)

## To Install the GC/MS Interface Tip Seal

### Materials needed

- Interface tip seal (G3870-20542)
- Tip seal spring (G7005-20024)
- Knurled tip seal retainer (G3870-20547)
- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)

The interface tip seal must be in place for the CI source, the EI XTR source, and HES.

### CAUTION

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

### CAUTION

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



### Procedure

- 1 Verify that the CI source, EI XTR source, HES, or HES 2.0 is installed. (See **Figure 7** on page 49.)
- 2 Remove the interface tip seal, spring, and knurled tip seal retainer from the ion source storage box. In this order, slide the spring, tip seal, and knurled tip seal retainer over the column sleeve.
- 3 Thread the knurled tip seal retainer into the tip seal holder finger tight.

## 2 Installing 8890 GC Columns



Figure 7. GC/MS interface tip seal

### CAUTION

**Forcing the analyzer closed if these parts are misaligned will damage the seal or the interface or the ion source, or keep the side plate from sealing.**

- 4 Gently** check the alignment of the analyzer and the interface.  
When the analyzer is aligned correctly, the analyzer can be closed all the way with no resistance except the spring tension from the interface tip seal.
- 5** You can align the analyzer and interface by wiggling the side plate on its hinge. If the analyzer still will not close, contact your Agilent Technologies service representative.

## The GC/MS Interface for an 8890 Series GC

The GC/MS interface is a heated conduit into the MS for the capillary column. (See **Figure 8**.) It is bolted onto the right side of the analyzer chamber, with an O-ring seal and has a protective cover which should be left in place.

One end of the interface passes through the side of the GC and extends into the 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 end of the capillary column extends slightly past the end of the column guide tube and into the ionization chamber.

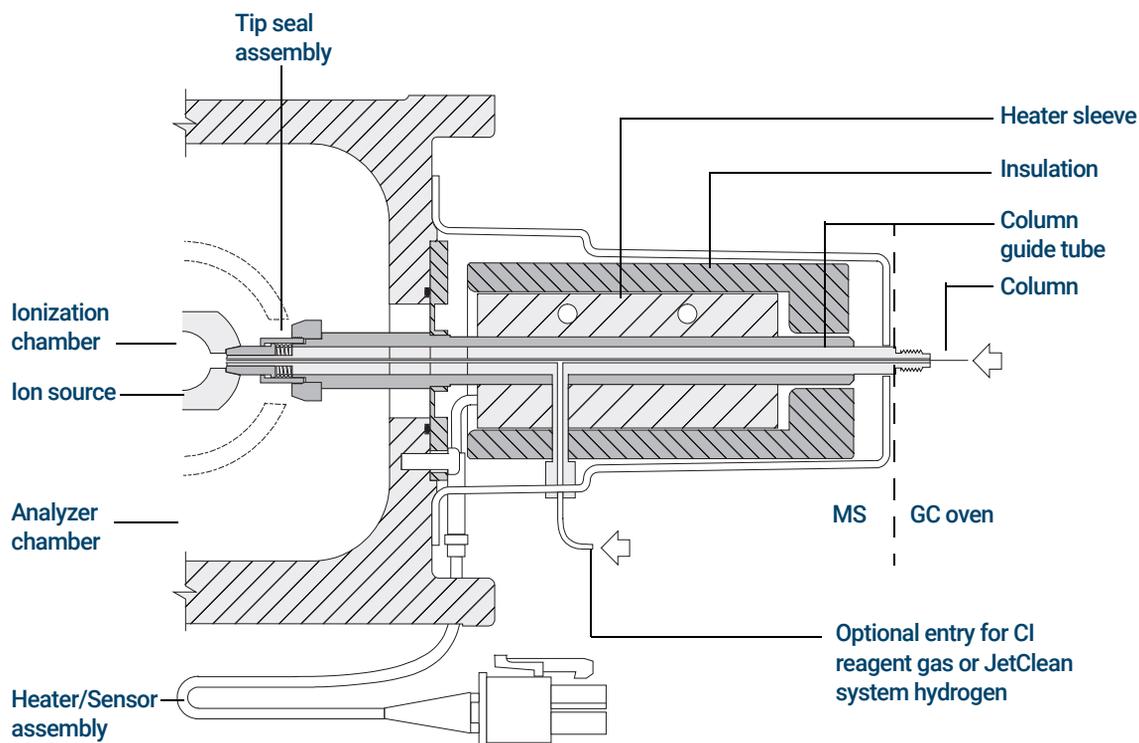


Figure 8. The GC/MS interface for an 8890 Series GC

## 2 Installing 8890 GC Columns

When operating in CI mode, reagent gas is plumbed into the interface. The interface assembly extends into the ionization chamber. A spring-loaded seal helps to keep reagent gases inside the source. The reagent gas enters the interface body and mixes with carrier gas and sample in the ion source.

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

The interface tip seal assembly is also required when using the EI XTR source or the HES.

The 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. When operating in CI mode, 280 °C is the recommended temperature for the GC/MS interface.

(See “[To Install a Capillary Column in the GC/MS Interface Using the Self-Tightening Column Nut](#)” on page 40 and “[To Install a Capillary Column in the GC/MS Interface Using a Standard Column Nut](#)” on page 45.)

### CAUTION

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

### WARNING

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

## 2 Installing 8890 GC Columns

# 3

## Installing Intuvo 9000 GC Column

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To Install a Column Guard or Jumper Chip 62

To Replace the 9000 GC/MS Tail 66

To Condition an Intuvo Capillary Column 70

To Install the GC/MS Interface Tip Seal 72

The GC/MS Interface for a 9000 GC 74

This chapter shows you how to install an Agilent Intuvo column, connect a flow path through the GC/MS Interface into the ion source, and maintain the column guard chip.

If you are using the *Agilent Intuvo 9000 Gas Chromatograph* with your MS, Chemical Ionization (CI) is not currently supported.

## Columns

Many types of Intuvo 9000 GC columns can be used with the MS, but there are some restrictions.

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

Remember that column flows vary greatly with temperature, requiring measurements of the actual flow to be taken. Use **Table 4** to determine an acceptable column flow and also refer to **Table 7**, "Influence of carrier and CC gas flows on ion vacuum gauge readings," on page 106.

**Table 4 Gas flows**

Feature	Gas flows
High-vacuum pump	Split flow turbo
Optimal He column gas flow, mL/min (carrier gas)	1 to 2
CC gas flow	3 to 4
Maximum recommended gas flow, mL/min*	4 to 6
Maximum gas flow, mL/min†	6.5
Maximum column id	0.53 mm (30 m length)
JetClean option H <sub>2</sub> flow	0.4 mL/min

\* Total gas flow into the MS = column flow + CC gas flow + JetClean H<sub>2</sub> flow (if applicable)

† Expect degradation of spectral performance and sensitivity

## Conditioning Intuvo columns

An Intuvo column is checked for column bleed as part of the manufacturing process. This eliminates the need for conditioning of an Intuvo column before it is connected to the GC/MS interface. When first connected to the GC/MS interface, Agilent recommends running a short column conditioning procedure. This procedure reduces initial column bleed to an insignificant amount that won't adversely contaminate the ion source. (See **"To Condition an Intuvo Capillary Column"** on page 70.)

## Tips and hints

- Always use carrier gas that is at least 99.9995% pure.
- Always wear clean gloves when handling a component's click and run connectors.
- Always wear clean gloves when handling a gasket.
- Always wear clean gloves when handling the 9000 GC/MS Tail.

### **WARNING**

**If you are using hydrogen as a carrier gas, the hydrogen gas flow must be off before turning off the MS power. If the foreline pump is off, hydrogen will accumulate in the MS and an explosion may occur. Read **"Hydrogen Safety"** on page 22 before operating the MS with hydrogen gas.**

## Handling the Intuvo 9000 GC Column and Bus Components

The Agilent Intuvo 9000 Gas Chromatograph (Intuvo 9000 GC) does not use traditional ferrules and nuts for most column and flow path seals. In a traditional gas chromatography connection, the seal is made by deforming a soft ferrule around the periphery of a column or tube, with a second seal made between the ferrule and the fitting. Instead, the Intuvo 9000 GC click and run connections use a sealing system based on contact between flat surfaces. Compared to traditional ferrule seals, these connections are leak-free and easy to make.

When making these seals, follow a few simple guidelines:

- Do not touch the click and run sealing surfaces with bare skin or dirty gloves. Skin oils and dirt can contaminate the flow path surfaces.
- Use only the provided Intuvo 9000 GC torque driver to tighten Intuvo compression bolts.
- Avoid scratching or deforming click and run sealing surfaces.
- If you need to clean a sealing surface, use clean, compressed air.
- Use a new gasket each time you install a column or Intuvo chip.

# To Replace an Intuvo GC Column

This procedure applies to GCs with a single column. For a 2 column replacement see the *Agilent Intuvo 9000 Gas Chromatograph Maintaining Your GC* manual.

## Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)
- Intuvo gasket, polyimide 5/pk, for temperatures < 350 °C (5190-9072)
- Intuvo gasket, nickel 5/pk, for temperatures 350 °C to 450 °C (5190-9073)
- Intuvo torque driver stored on oven door (5190-9571)



## Procedure

### WARNING

The inlet, detector, bus components, and column can be hot enough to cause burns. Cool heated zones to a safe handling temperature before continuing.

### CAUTION

Always wear clean gloves while handling any parts that are in the flow path going to the analyzer or parts that are located inside the analyzer.

- 1 Prepare the GC for maintenance.  
From the GC panel select **Maintenance > Column > Perform Maintenance > Install Column > Start Maintenance**. This procedure cools the inlet, detector, column, Guard Chip, and other components in the flow path heated zones to < 40 °C and configures the GC. Follow the on-screen GC prompts.
- 2 From MassHunter Data Acquisition, Vent the MS (See **“To Vent the MS”** on page 124.)
- 3 If you are using hydrogen or other flammable gas as a carrier gas, close the manual gas supply valve to the instrument before turning off the MS power.
- 4 Open the GC front door. (See **Figure 9** on page 58.)

### 3 Installing Intuvo 9000 GC Column

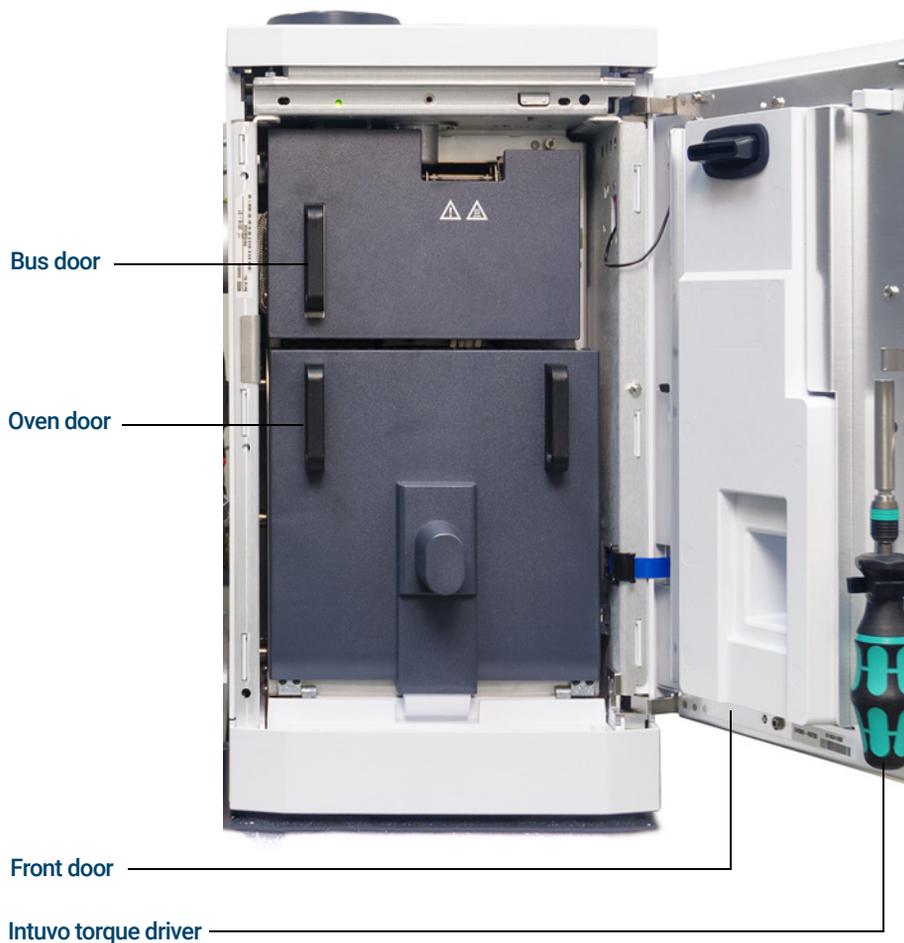


Figure 9. 9000 GC front door, bus door, oven door, and Intuvo torque driver

- 5 Open the bus door and remove it by lifting the door vertically off its hinge pins.
- 6 Lower the oven door.
- 7 Using the Intuvo torque driver, rotate all four column clamps off the column's retainer ring. (See **Figure 10.**)

### 3 Installing Intuvo 9000 GC Column

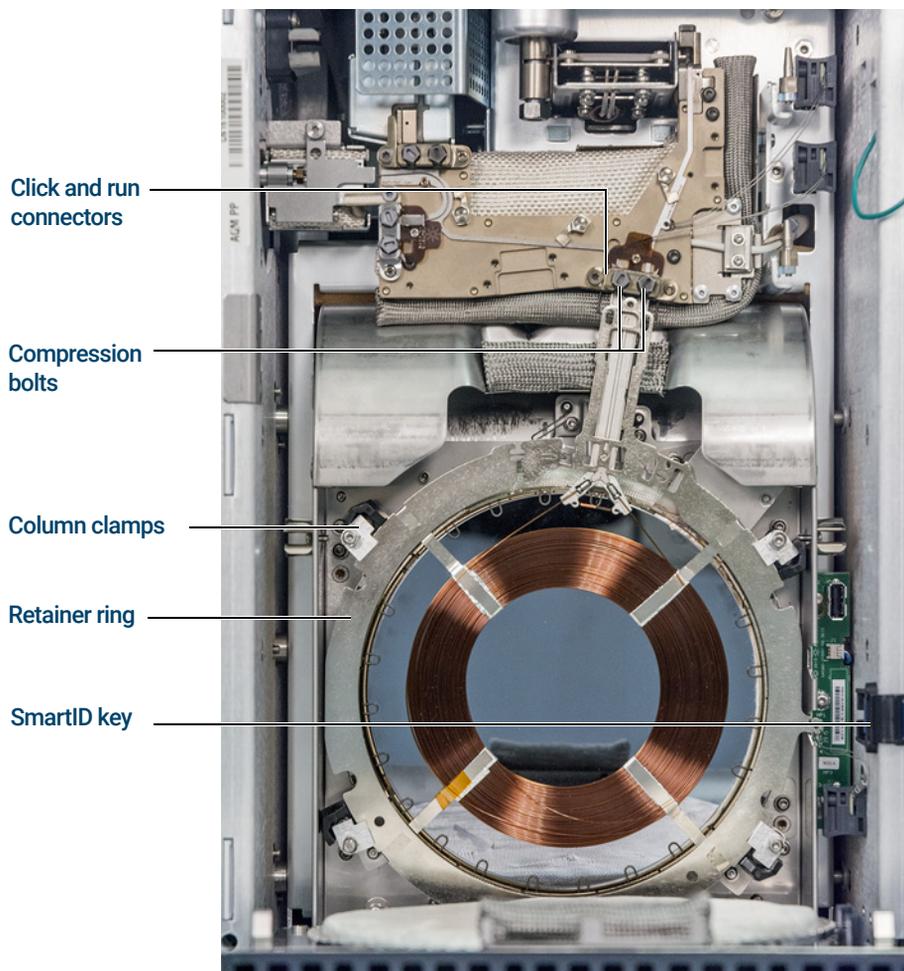


Figure 10. 9000 GC column and related parts

- 8 Unplug the column SmartID key from the lower USB port.
- 9 Using the Intuvo torque driver, remove the two compression bolts that seal the column's click and run connectors to the bus and store for later use.
- 10 Remove and store the column for later use in accordance with the column manufacturer's recommendations.
- 11 Replace the gasket with a new gasket rated for the maximum column temperature expected with your method. (See **"To Replace an Intuvo 9000 GC Gasket"** on page 61.)

### 3 Installing Intuvo 9000 GC Column

- 12 Verify that all Intuvo gaskets in the flow path are rated for the maximum column temperature expected with your method. Replace any gaskets that have a lower temperature rating with one that has a temperature rating that is compatible with your method.
- 13 Place the column's click and run connectors into the single column (right) bus fitting. See the GC manual for installing 2 columns in the GC.
- 14 Insert the column's attached Intuvo SmartID Key into the lower USB connection shown.
- 15 Secure the new column by rotating the **1 c** tab of the 4 column clamps over the column retaining ring using the Intuvo torque driver.
- 16 Verify that the column's click and run fittings sit flat against the gasket.
- 17 Loosely install the two compression bolts.

#### CAUTION

**Use the Intuvo torque driver to tighten the compression bolt until you hear one click. Over-tightening can damage the flow path, strip the fittings, and cause leaks.**

- 18 Tighten the compression bolts until you hear a click from the Intuvo torque driver.
- 19 Close the column door.
- 20 Install the bus door.
- 21 Close the GC front door.

## To Replace an Intuvo 9000 GC Gasket

This procedure assumes you have already removed the column, 9000 GC/MS Tail, or other part that sits on top of the gasket and that the instrument components are below 40 °C.

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)
- Intuvo gasket, polyimide 5/pk, for temperatures < 350 °C (5190-9072)
- Intuvo gasket, nickel 5/pk, for temperatures 350 °C to 450 °C (5190-9073)

### Procedure

#### WARNING

The inlet, detector, bus components, and column can be hot enough to cause burns. Cool heated zones to a safe handling temperature before continuing.

#### CAUTION

Always wear clean gloves while handling any parts that are in the flow path going to the analyzer or parts that are located inside the analyzer.

- 1 Remove the gasket tab from the alignment stud and discard the old gasket. Tweezers help when you are wearing the required gloved.
- 2 If needed, install any inlet or detector chips. All chips must be installed before installing the new gasket.
- 3 Carefully remove the new gasket from its packaging. Inspect the gasket to be sure it is not deformed. The two round lobes are the sealing surfaces.
- 4 Carefully insert the round gasket lobes into the bus click and run fitting. Note that the gasket is double-sided.
- 5 Place the hole in the gasket over the alignment stud in the bus fitting, and press the gasket body flat against the bus.
- 6 Check that the gasket's round lobes fit flat against the bus click and run fitting.

The new gasket is ready for the chip or column attachment.

## To Install a Column Guard or Jumper Chip

The column Guard Chip and the Jumper Chip are both single-use, consumable parts. Installation deforms part of the Chip to make a good seal, so that a mis-installed Chip cannot be re-used. The Guard Chip cannot be cleaned or conditioned.

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)
- Split/Splitless inlet Intuvo guard chip, 2/pk (G4587-60565)
- Multimode inlet Intuvo guard chip, 2/pk (G4587-60665)
- Split/Splitless inlet Intuvo jumper chip, 2/pk (G4587-60575)
- Multimode Inlet Intuvo jumper chip, 2/pk (G4587-60675)
- Intuvo gasket, polyimide 5/pk, for temperatures < 350 °C (5190-9072)
- Intuvo gasket, nickel 5/pk, for temperatures 350 °C to 450 °C (5190-9073)
- Intuvo torque driver stored on oven door (5190-9571)
- 7/16-inch open-end wrench



### Procedure

#### WARNING

The inlet, detector, bus components, and column can be hot enough to cause burns. Cool heated zones to a safe handling temperature before continuing.

#### CAUTION

Always wear clean gloves while handling any parts that are in the flow path going to the analyzer or parts that are located inside the analyzer.

- 1 Prepare the GC for maintenance. From the GC panel select **Maintenance > Inlets > Guard Chip > Prepare for Maintenance > Replace Liner and Guard Chip > Start Maintenance**. This procedure cools the inlet, detector, column, Guard Chip, and other components in the flow path heated zones to < 40 °C and configures the GC. Follow the on-screen GC prompts.
- 2 From MassHunter Data Acquisition, Vent the MS (See **"To Vent the MS"** on page 124.)

### 3 Installing Intuvo 9000 GC Column

- 3 Wait until the GC reaches the ready state indicating the components are cooled below 40 °C and the instrument is vented before continuing the steps in this procedure.
- 4 If you are using hydrogen or other flammable gas as a carrier gas or for the JetClean system, close the manual gas supply valve to the instrument before turning off the MS power.
- 5 If installed, remove the ALS injector from the inlet.
- 6 Remove the inlet cover. (See **Figure 11**.)

GC inlet cover removed

Compression bolt access plate

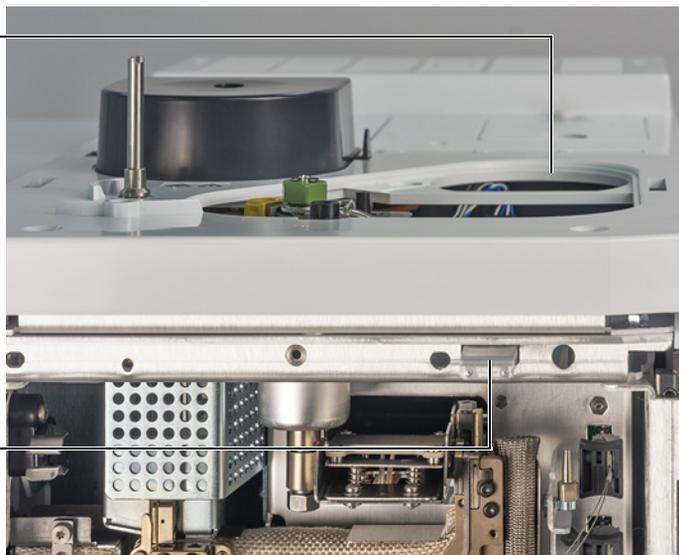


Figure 11. GC inlet cover and compression bolt access plate

- 7 Open the GC front door.
- 8 Open the bus door and remove it by lifting the door vertically off its hinge pins.
- 9 Pull the compression bolt access plate out to allow the torque driver to access the Guard chip compression bolt. (See **Figure 12** on page 64.)

### 3 Installing Intuvo 9000 GC Column

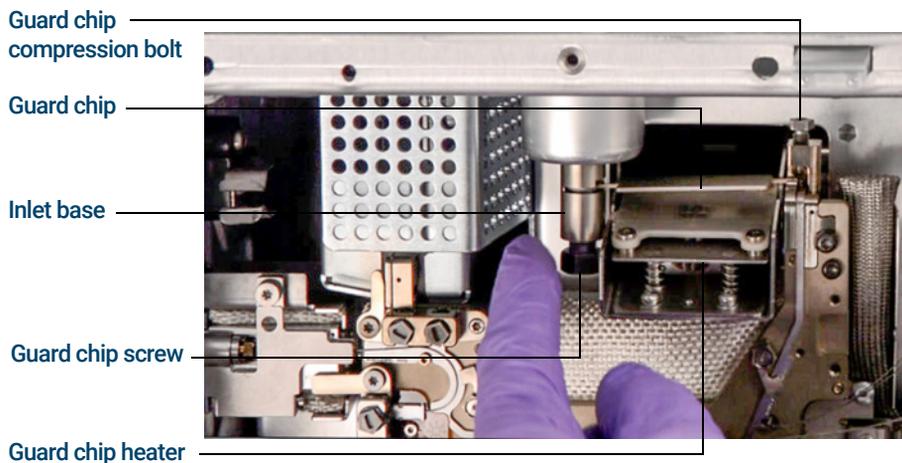


Figure 12. Guard chip and related parts

- 10 Use a 7/16-inch open-end wrench to loosen the Guard Chip screw at the base of the inlet.
- 11 Use your finger to gently rotate the front of the Guard Chip heater assembly down and expose the Guard Chip.
- 12 Loosen the Guard Chip compression bolt with the Intuvo torque driver.
- 13 Lift the right side of the Guard Chip tab over the boss then rotate it out of the bus connection.
- 14 Remove the left side of the Guard Chip from the inlet base.
- 15 Install a new Guard Chip. The larger end of the Guard Chip inserts into the inlet base first, then the smaller end is rotated into the bus connection, lifting its tab over the boss and into the bus mounting slot.
- 16 Finger tighten the compression bolt.
- 17 Raise the Guard Chip heater.
- 18 Finger tighten the Guard Chip screw in the inlet base.
- 19 Tighten the Guard Chip screw in the inlet base with a 7/16-inch open end wrench.

#### CAUTION

Use the Intuvo torque driver to tighten the compression bolt until you hear one click. Over-tightening can damage the flow path, strip the fittings, and cause leaks.

### 3 Installing Intuvo 9000 GC Column

- 20 Tighten the Guard Chip compression bolt using the provided torque driver until you hear one click.
- 21 Install the inlet cover.
- 22 Install the bus door on its hinges and close it.
- 23 Close the GC front door.
- 24 If removed, install the ALS injector.

## To Replace the 9000 GC/MS Tail

This procedure is necessary if you are switching to a source that requires a different 9000 GC/MS Tail, replacing a leaking gasket or a contaminated 9000 GC/MS Tail, or separating the 9000 GC from the MS.

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)
- 9000 GC/MS Tail, used with a standard source (G4590-60009)
- 9000 GC/MS Tail, used with a HES (G4590-60109)
- Intuvo gasket, polyimide 5/pk, for temperatures < 350 °C (5190-9072)
- Intuvo gasket, nickel 5/pk, for temperatures 350 °C to 450 °C (5190-9073)
- Intuvo torque driver stored on oven door (5190-9571)
- 7/16-inch open-end wrench



### Procedure

#### WARNING

The inlet, detector, bus components, and column can be hot enough to cause burns. Cool heated zones to a safe handling temperature before continuing.

#### CAUTION

Always wear clean gloves while handling any parts that are in the flow path going to the analyzer or parts that are located inside the analyzer.

- 1 Vent the MS (See **“To Vent the MS”** on page 124.) When prompted, set the temperature for the ion source, quads, inlet, detector, column, Guard Chip, 9000 GC/MS Tail, and other components in the flow path heated zones to < 40 °C.
- 2 If you are using hydrogen or other flammable gas as a carrier gas, close the manual gas supply valve to the instrument before turning off the MS power.
- 3 Wait until the GC reaches the ready state indicating the components are cooled below 40 °C before continuing the steps in this procedure.
- 4 Open the front analyzer chamber. (See **“To Open the Front Analyzer Chamber”** on page 159.)

### 3 Installing Intuvo 9000 GC Column

- 5 Unscrew the knurled tip seal retainer from the tip seal holder and remove the tip seal, spring, and knurled tip seal retainer from the GC/MS interface. (See **"GC/MS interface tip seal"** on page 73.)
- 6 Ensure the MS is properly aligned with the GC. If the GC/MS is not properly aligned, the transfer line clamp screw will be difficult to tighten.
- 7 Open the GC front door.
- 8 Open the bus door and remove it by lifting the door vertically off its hinge pins.
- 9 Using the Intuvo torque driver, remove the compression bolt that secures the 9000 GC/MS Tail click and run bus connection. Also remove the bolt from the empty bus connection. (See **Figure 13.**)

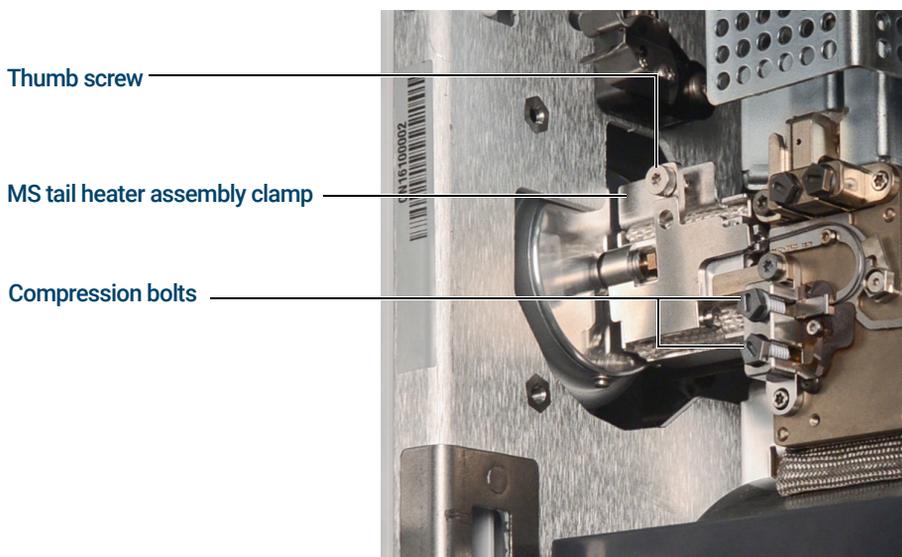


Figure 13. MS tail heater assembly clamp closed

- 10 Open the MS tail heater assembly by loosening the thumb screw at the top of the clamp and rotating the clamp down.
- 11 Push the MS tail heater assembly back a few millimeters. A magnet will hold the heater assembly away from the 9000 GC/MS Tail.
- 12 Remove the 9000 GC/MS Tail from the transfer line and bus. (See **Figure 14** on page 68 and **Figure 15** on page 68.) If the ferrule becomes stuck, press a pointed object, like a paper clip, into the ferrule release hole at the end of the transfer line.

### 3 Installing Intuvo 9000 GC Column

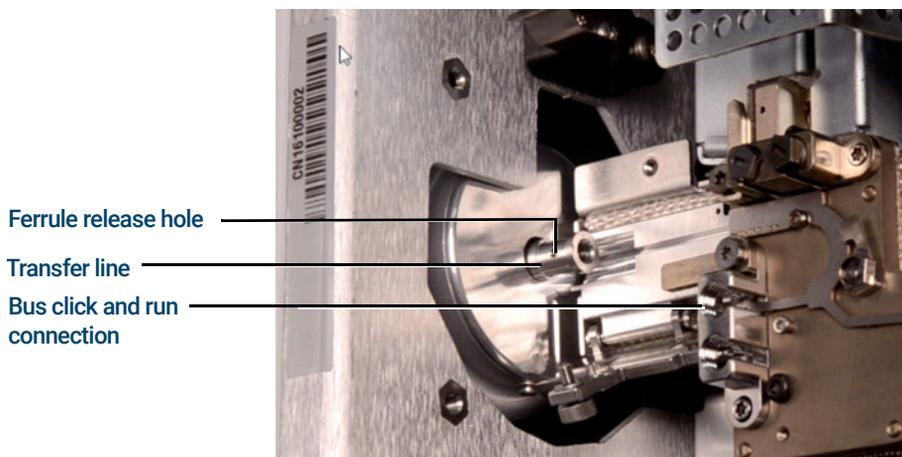


Figure 14. MS tail heater assembly clamp open with 9000 GC/MS Tail removed



Figure 15. 9000 GC/MS Tail removed from GC/MS Interface

- 13 Replace the gasket. (See **“To Replace an Intuvo 9000 GC Gasket”** on page 61.)
- 14 Carefully slide the 9000 GC/MS Tail into the GC/MS interface, and gently place the click and run connection into the bus connection.
- 15 Check that the 9000 GC/MS Tail click and run fitting sits flat against the gasket in the bus connection.
- 16 Screw the 9000 GC/MS Tail column nut to the transfer line threaded connector finger tight, then use a ¼-inch wrench to tighten the nut an additional 20 to 30 degrees.
- 17 Loosely install the two compression bolts.

#### CAUTION

Use the Intuvo torque driver to tighten the compression bolt until you hear one click. Over-tightening can damage the flow path, strip the fittings, and cause leaks.

### 3 Installing Intuvo 9000 GC Column

- 18 Tighten the single compression bolt until you hear a click from the Intuvo torque driver.
- 19 Loosely install the other compression bolt on the empty click and run bus connector.
- 20 Pull the MS tail heater assembly a few millimeters towards the 9000 GC/MS Tail until contact is made.
- 21 Close the MS tail heater assembly clamp, and hand tighten the thumb screw to secure it.
- 22 Install the bus door on its hinges and close it.
- 23 Close the GC front door.
- 24 Install the tip seal and spring on the GC/MS interface. Align, gently slide, and screw the tip seal into the tip seal holder. (See **“To Install the GC/MS Interface Tip Seal”** on page 72.)
- 25 **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 tip seal or the interface or the ion source, or will keep the side plate from sealing.**

- 26 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.
- 27 Close the front analyzer chamber. (See **“To Close the Front Analyzer Chamber”** on page 218.)

## To Condition an Intuvo Capillary Column

### Materials needed

- Carrier gas, (99.9995% pure or better)
- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)
- Intuvo torque driver stored on oven door (5190-9571)
- Intuvo gasket, polyimide 5/pk, for temperatures < 350 °C (5190-9072)
- Intuvo gasket, nickel 5/pk, for temperatures 350 °C to 450 °C (5190-9073)
- Wrench, open-end, 1/4-inch and 5/16-inch (8710-0510)

### Procedure

#### WARNING

The inlet, detector, bus components, and column can be hot enough to cause burns. Cool heated zones to a safe handling temperature before continuing.

#### CAUTION

Always wear clean gloves while handling any parts that are in the flow path going to the analyzer or parts that are located inside the analyzer.

- 1 Install the column that requires conditioning. (See [“To Replace an Intuvo GC Column”](#) on page 57.)
- 2 Set a minimum velocity of 30 cm/s, or as recommended by the column manufacturer. Allow carrier gas to flow through the column at room temperature for 5 minutes.
- 3 Increase the column temperature to 120 °C.
- 4 Hold at the this temperature for 30 minutes.
- 5 Use MassHunter to run an air and water check. Proceed to the next step if the air and water are within limits.
- 6 Program the column temperature to increase from 120 °C to the maximum temperature limit for the column at a rate of 10 to 15 °C/min.

#### CAUTION

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

### 3 Installing Intuvo 9000 GC Column

7 Hold at the maximum temperature for 30 minutes.

The column is conditioned and ready to be used with your method.

## To Install the GC/MS Interface Tip Seal

### Materials needed

- Interface tip seal (G3870-20542)
- Tip seal spring (G7005-20024)
- Knurled tip seal retainer (G3870-20547)
- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)

The interface tip seal must be in place for the CI source, the EI XTR source, and HES and HES 2.0 sources.

### CAUTION

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

### CAUTION

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



### Procedure

- 1 Verify that the CI source, EI XTR source, HES, or HES 2.0 is installed. (See [Figure 16](#) on page 73.)
- 2 Remove the interface tip seal, spring, and knurled tip seal retainer from the ion source storage box. In this order, slide the spring, tip seal, and knurled tip seal retainer over the column sleeve.
- 3 Thread the knurled tip seal retainer into the tip seal holder finger tight.

### 3 Installing Intuvo 9000 GC Column



Figure 16. GC/MS interface tip seal

#### CAUTION

**Forcing the analyzer closed if these parts are misaligned will damage the seal or the interface or the ion source, or keep the side plate from sealing.**

- 4 Gently** check the alignment of the analyzer and the interface.

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

- 5** You can align the analyzer and interface by wiggling the side plate on its hinge. If the analyzer still will not close, contact your Agilent Technologies service representative.

## The GC/MS Interface for a 9000 GC

The GC/MS Interface is a heated conduit into the MS for maintaining MS vacuum and a suitable column effluent temperature. (See **Figure 17.**) The GC/MS Interface is bolted onto the right side of the analyzer chamber, with an O-ring seal and has a protective cover which should be left in place.

One end of the interface passes through the side of the GC and is accessed from inside the GC front door. This allows connection of the 9000 GC/MS Tail column nut. The 9000 GC/MS Tail includes a swagged ferrule and column nut for attaching to the GC end of the GC/MS Interface. The 9000 GC/MS Tail transports the column effluent from a heated column bus connector in the GC, through the heated GC/MS Interface, and exits slightly past the end of the column guide tube and into the ionization chamber. The 9000 GC/MS Tail maintains temperature at several points along its length by a heated bus, an MS tail heater assembly, and the GC/MS Interface.

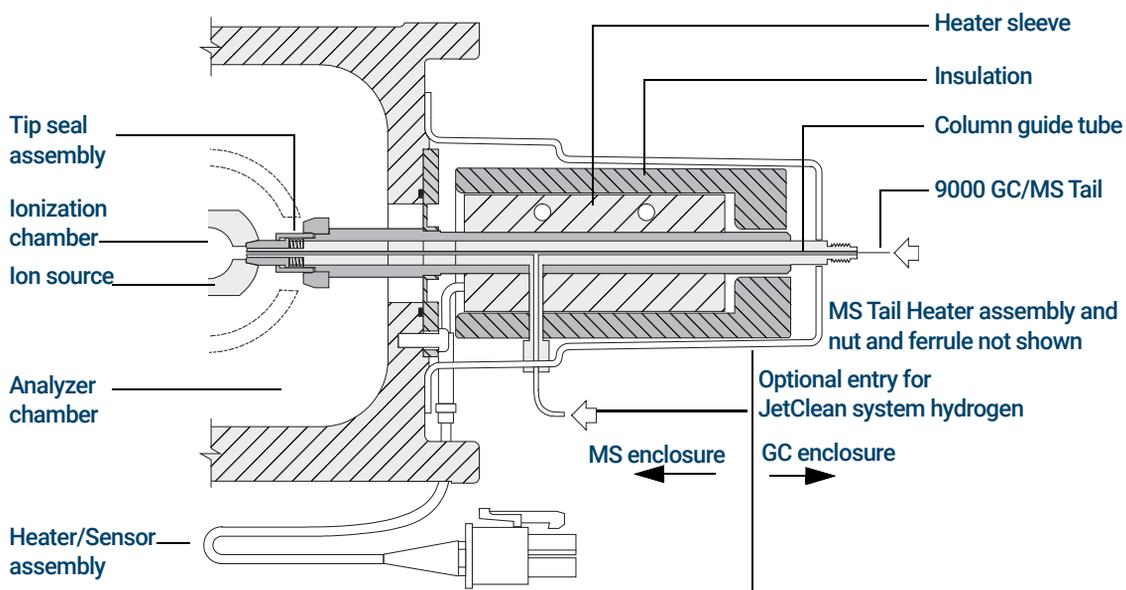


Figure 17. The GC/MS Interface for a 9000 GC (not to scale)

### 3 Installing Intuvo 9000 GC Column

The 9000 GC/MS Tail is heated by an electric cartridge heater. The heater is powered and controlled by a heated zone of the 9000 GC. The 9000 GC/MS Tail temperature can be set from the Agilent MassHunter GC/MS Acquisition software or from the GC. A sensor (thermocouple) in the interface monitors the temperature.

The GC/MS interface tip seal assembly is required when using the EI XTR source or the HES.

The 9000 GC/MS Tail should be operated in the 250 ° to 350 °C range. Subject to that restriction, the GC/MS interface temperature should be slightly higher than the column temperature.

### 3 Installing Intuvo 9000 GC Column

## 4

# Installing 7890 GC Columns

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To Install a Capillary Column in a Split/Splitless Inlet 80

To Condition a Capillary Column 83

To Install a Capillary Column in the GC/MS Interface Using the Self-Tightening Column Nut 85

To Install a Capillary Column in the GC/MS Interface Using a Standard Column Nut 90

To Install the GC/MS Interface Tip Seal 93

The GC/MS Interface for an 7890 Series GC 95

To Calibrate the Column 97

This chapter shows you how to select, install, and condition a GC column, which must be performed before you operate your MS.

# Columns

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

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

Remember that column flows vary greatly with oven temperature, requiring measurements of the actual flow to be taken. Use the flow calculator in the Agilent Instrument Utilities software, and **Table 5** to determine an acceptable column flow. EI and CI systems also have different column outlet flow pressures. (See **Table 7** on page 106 for EI mode and **Table 10** on page 130 for CI mode.)

**Table 5 Gas flows**

Feature	Gas flows
High-vacuum pump	Split flow turbo
Optimal He column gas flow, mL/min (carrier gas)	1 to 2
Reagent gas flow, mL/min	1 to 2
CC gas flow	3 to 4
Maximum recommended gas flow, mL/min*	4 to 6
Maximum gas flow, mL/min <sup>†</sup>	6.5
Maximum column id	0.53 mm (30 m length)
JetClean option H <sub>2</sub> flow,	0.4 mL/min

\* Total gas flow into the MS = column flow + CC gas flow + reagent gas flow (if applicable) + JetClean H<sub>2</sub> flow (if applicable)

† Expect degradation of spectral performance and sensitivity.

### Conditioning columns

Conditioning a column before it is connected to the GC/MS interface is essential.

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 MS ion source. This decreases MS sensitivity and makes cleaning the ion source necessary.

Column bleed is most common in new or poorly cross-linked 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/MS 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 procedure for the 7000/7010 Series TQ GC/MS is different from that for previous MSs. Using the procedure from another instrument may *not* work and may damage the column or the MS.
- You can remove old ferrules from column nuts with an ordinary pushpin.
- 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. Agilent recommends use of their new self-tightening nuts on the MS transfer line, inlet, and GC detector.
- Always wear clean gloves when handling columns, especially the end that will be inserted into the GC/MS interface.

#### WARNING

If you are using hydrogen as a carrier gas or for the JetClean system, the hydrogen gas flow must be off before turning off the MS power. If the foreline pump is off, hydrogen will accumulate in the MS and an explosion may occur. Read “[Hydrogen Safety](#)” on page 22 before operating the MS with hydrogen gas.

#### 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, lint-free (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)
- Self-tightening column nut (5190-6194)
- Alternate: Standard Inlet column nut (5181-8830, for use with Vespel ferrules)
- 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)
- Magnifying loupe
- Septum (may be old, used inlet septum)

To install columns in other types of inlets, refer to your GC user information.



### Procedure

#### **WARNING**

The GC operates at high temperatures. Do not touch any parts of the GC until you are sure they are cool.

- 1 Cool the oven to room temperature.

#### **WARNING**

Always wear safety glasses when handling capillary columns. 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.

- 2 Wearing clean gloves, slide a septum, column nut, and conditioned ferrule onto the free end of the column. **Figure 18** shows a standard inlet column nut, but the nut is similarly positioned for a self-tightening column nut. The tapered end of the ferrule should point away from the column nut for a column attachment to an inlet.

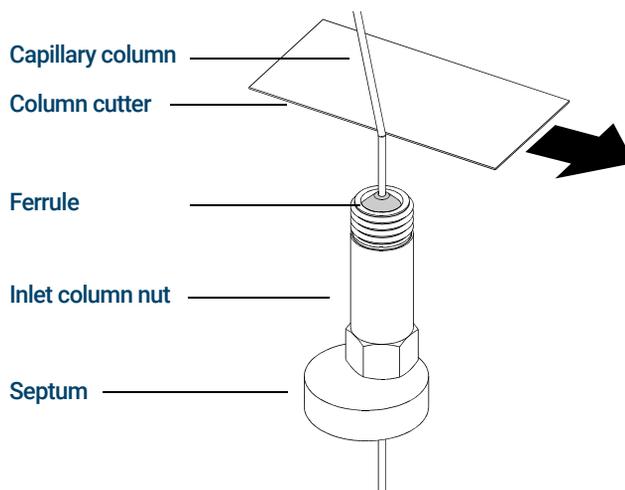


Figure 18. Preparing a capillary column for installation (standard inlet column nut shown)

- 3 Use the column cutter to score the column 2 cm from the end.
- 4 While holding the column against the column cutter with your thumb, break the column against the edge of the column cutter.
- 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 septum under the column nut so that the column extends 4 to 6 mm past the end of the ferrule. (See **Figure 19** on page 82.)
- 8 Insert the column in the inlet.
- 9 Slide the nut up the column to the inlet base and finger-tighten the nut.

## 4 Installing 7890 GC Columns

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

### CAUTION

Never use a wrench to tighten a self-tightening nut. This may result in damage to the nut or instrument.

- For the self-tightening column nut, finger-tighten until it begins to grip the column, then turn an additional 30 to 60 degrees until tight.

For the standard column nut, (shown in **Figure 19**) tighten the nut an additional 1/4 to 1/2 turn. The column should not slide with a gentle tug.

- Start the carrier gas flow.
- Verify flow by submerging the free end of the column in isopropanol. Look for bubbles.

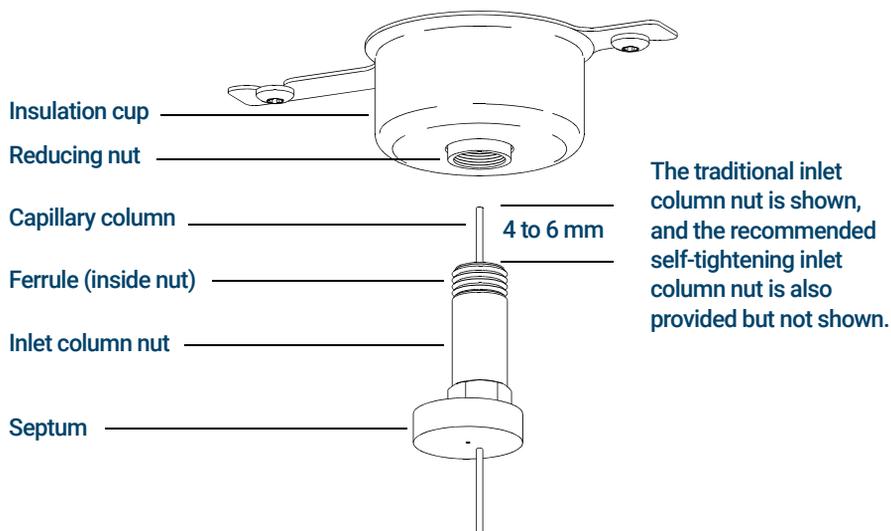


Figure 19. Installing a capillary column for a split/splitless inlet

## 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 (99.9995% or better) inert gas such as helium, nitrogen, or argon.

### WARNING

The GC operates under high temperatures. 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 80.)
- 2 Set a minimum velocity of 30 cm/s, or as recommended by the column manufacturer. Allow 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, 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 Install the column in the GC/MS interface.

## 4 Installing 7890 GC Columns

### 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 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

- Interface tip seal (G3870-20542) (See **Figure 20** and **Figure 21** on page 87.)
- Knurled tip seal retainer (G3870-20547)
- Tip seal spring (G7005-20024)
- Column cutter, ceramic (5181-8836) or diamond (5183-4620)
- Flashlight
- Magnifying loupe
- Gloves, clean, lint-free (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



### 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 83.)

#### CAUTION

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

- 2 Vent the MS (See **“To Vent the MS”** on page 124.) and open the front analyzer chamber. (See **“To Open the Front Analyzer Chamber”** on page 159.) Ensure you can see the end of the GC/MS interface.

#### WARNING

The GC operates under high temperatures. Do not touch any GC parts unless you are certain they are cool.

- 3 Remove the interface tip seal, spring, and knurled tip seal retainer from the GC/MS interface. (See **Figure 20** and **Figure 21** on page 87.)
- 4 Slide the self-tightening column nut and conditioned ferrule onto the free end of the GC column. The tapered end of the ferrule must point towards the nut.
- 5 Slide the column into the GC/MS interface.
- 6 Lightly thread the self-tightening column nut onto the GC/MS interface.
- 7 Use the column cutter to score the column 2 cm from the end.

#### CAUTION

Do not break the column off inside the vacuum manifold. Pieces of column could fall or be pulled into the turbo pump and damage it.

- 8 While holding the column against the column cutter with your thumb, break the column against the edge of the column cutter.
- 9 Inspect the end for jagged edges or burrs. If the break is not clean and even, repeat steps 6 and 7.

## 4 Installing 7890 GC Columns

- 10** Adjust the column so it extends this specified distance from the end of the transfer line. (See **Figure 20** and **Figure 21** on page 87.)

**For an EI XTR or CI Source Installation**, the column extends about 1 to 2 mm. (See **Figure 20**.)

**For an EI HES or HES 2.0 Installation**, the column extends about 4 to 5 mm. (See **Figure 21**.)

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 20. Installing a capillary column in the GC/MS interface for an EI XTR or a CI source

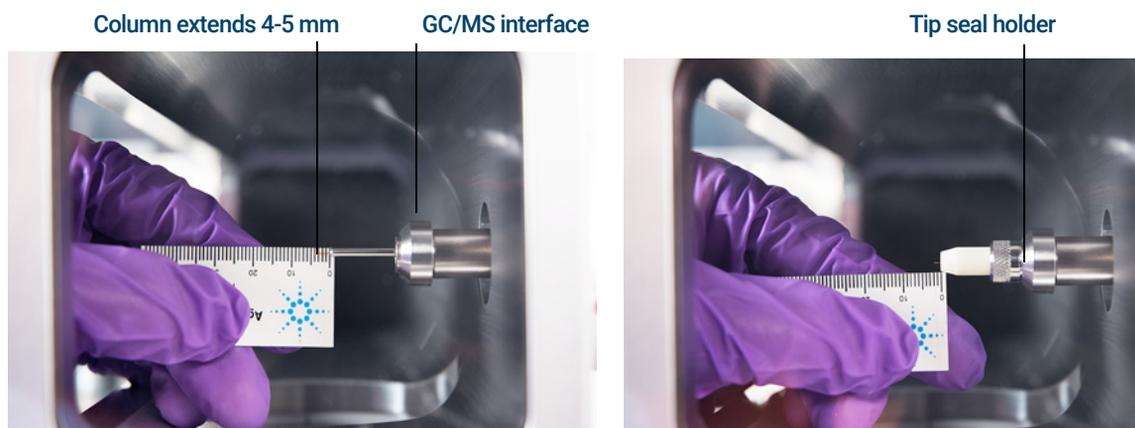


Figure 21. Installing a capillary column in the GC/MS interface for an EI HES or HES 2.0

## 4 Installing 7890 GC Columns

- 11 Hand-tighten the nut. (See **Figure 22**.) Ensure the position of the column does not change as you tighten the nut.
- 12 Tighten the nut in the clockwise direction. Continue to tighten until you feel the ferrule grip the column.
- 13 Check the GC oven to ensure that the column does not touch the oven walls.

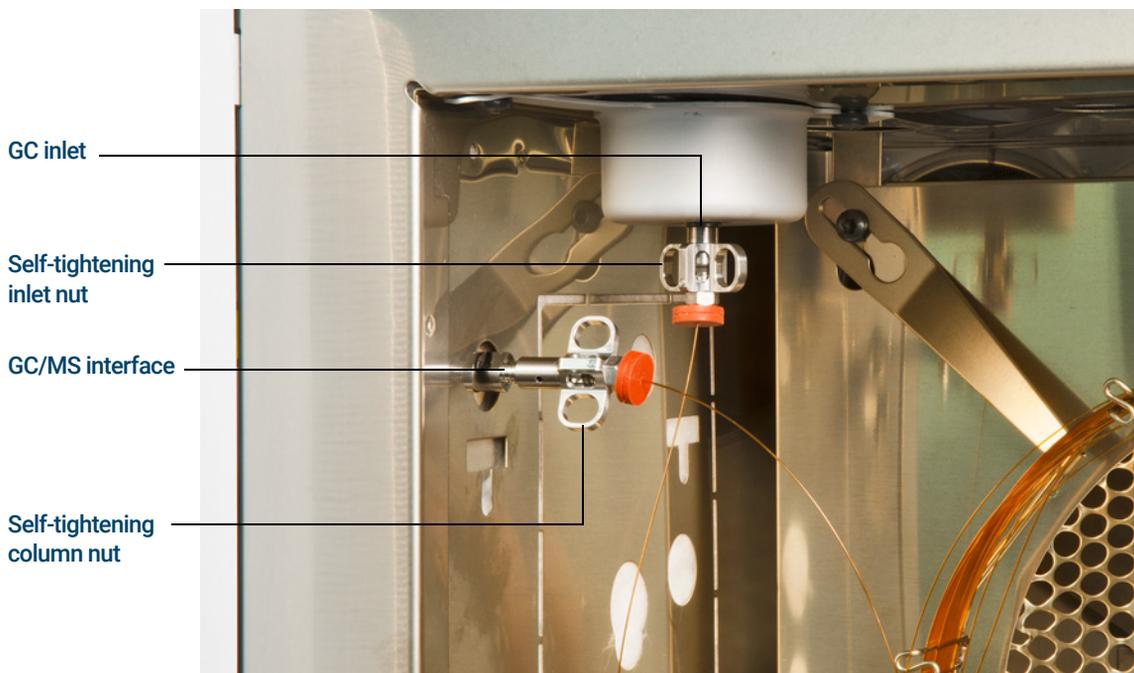


Figure 22. Installing a capillary column in the GC/MS interface

### CAUTION

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

- 14 Install the tip seal, spring, and knurled tip seal retainer on the GC/MS interface. Align, gently slide, and screw the knurled tip seal retainer into the tip seal holder. (See **Figure 20** and **Figure 21** on page 87.)

### CAUTION

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

## 4 Installing 7890 GC Columns

- 15 **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.
- 16 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.
- 17 Close the front analyzer chamber. (See **“To Close the Front Analyzer Chamber”** on page 218.)

# 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 previous section.

### Materials needed

- Interface tip seal (G3870-20542) (See **Figure 20** and **Figure 21** on page 87.)
- Tip seal spring (G7005-20024)
- Knurled tip seal retainer (G3870-20547)
- Column cutter, ceramic (5181-8836) or diamond (5183-4620)
- Flashlight
- Magnifying loupe
- Gloves, clean, lint-free (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 83.)

#### CAUTION

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

- 2 Vent the MS and open the front analyzer chamber. (See [“To Vent the MS”](#) on page 124 and [“To Open the Front Analyzer Chamber”](#) on page 159.) Ensure you can see the end of the GC/MS interface.

#### WARNING

The GC operates under high temperatures. Do not touch any GC parts unless you are certain they are cool.

- 3 Remove the interface tip seal, spring, and knurled tip seal retainer from the GC/MS interface. (See [Figure 20](#) and [Figure 21](#) on page 87.)
- 4 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.
- 5 Slide the column into the GC/MS interface.
- 6 Hand-tighten the nut.
- 7 Use the column cutter to score the column 2 cm from the end.

#### CAUTION

Do not break the column off inside the vacuum manifold. Pieces of column could fall or be pulled into the turbo pump and damage it.

- 8 While holding the column against the column cutter with your thumb, break the column against the edge of the column cutter.
- 9 Inspect the end for jagged edges or burrs. If the break is not clean and even, repeat steps 6 and 7.

## 4 Installing 7890 GC Columns

- 10 Adjust the column so it extends this specified distance from the end of the transfer line. (See **Figure 20** and **Figure 21** on page 87.)

**For an EI XTR or CI Source Installation** (see **Figure 20** on page 87), the column extends about 1 to 2 mm.

**For an EI HES or HES 2.0 Installation** (see **Figure 21** on page 87), the column extends about 4 to 5 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.

- 11 Tighten the nut 1/4 to 1/2 turn. Ensure the position of the column does not change as you tighten the nut. Do not over tighten the nut.
- 12 Check the GC oven to be sure that the column does not touch the oven walls.
- 13 Check the nut's tightness after one or two heat cycles; retighten as appropriate.

### CAUTION

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

- 14 Install the tip seal, spring, and knurled tip seal retainer on the GC/MS interface. Align, gently slide, and screw the knurled tip seal retainer into the tip seal holder. (See **Figure 20** and **Figure 21** on page 87.)

### CAUTION

**Forcing the analyzer door closed if these parts are misaligned will damage the tip seal or the interface or the ion source, or will keep the side plate from sealing.**

- 15 **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.
- 16 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.
- 17 Close the front analyzer chamber. (See **"To Close the Front Analyzer Chamber"** on page 218.)

## To Install the GC/MS Interface Tip Seal

### Materials needed

- Interface tip seal (G3870-20542)
- Tip seal spring (G7005-20024)
- Knurled tip seal retainer (G3870-20547)
- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)

The interface tip seal must be in place for the CI source, the EI XTR source, and HES.

### CAUTION

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

### CAUTION

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



### Procedure

- 1 Verify that the CI source, EI XTR source, HES, or HES 2.0 is installed. (See **Figure 23** on page 94.)
- 2 Remove the interface tip seal, spring, and knurled tip seal retainer from the ion source storage box. In this order, slide the spring, tip seal, and knurled tip seal retainer over the column sleeve.
- 3 Thread the knurled tip seal retainer into the tip seal holder finger tight.

## 4 Installing 7890 GC Columns



Figure 23. GC/MS interface tip seal

### CAUTION

**Forcing the analyzer closed if these parts are misaligned will damage the seal or the interface or the ion source, or keep the side plate from sealing.**

- 4 Gently** check the alignment of the analyzer and the interface.  
When the analyzer is aligned correctly, the analyzer can be closed all the way with no resistance except the spring tension from the interface tip seal.
- 5** You can align the analyzer and interface by wiggling the side plate on its hinge. If the analyzer still will not close, contact your Agilent Technologies service representative.

## The GC/MS Interface for an 7890 Series GC

The GC/MS interface is a heated conduit into the MS for the capillary column. (See **Figure 24.**) It is bolted onto the right side of the analyzer chamber, with an O-ring seal and has a protective cover which should be left in place.

One end of the interface passes through the side of the GC and extends into the 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 end of the capillary column extends slightly past the end of the column guide tube and into the ionization chamber.

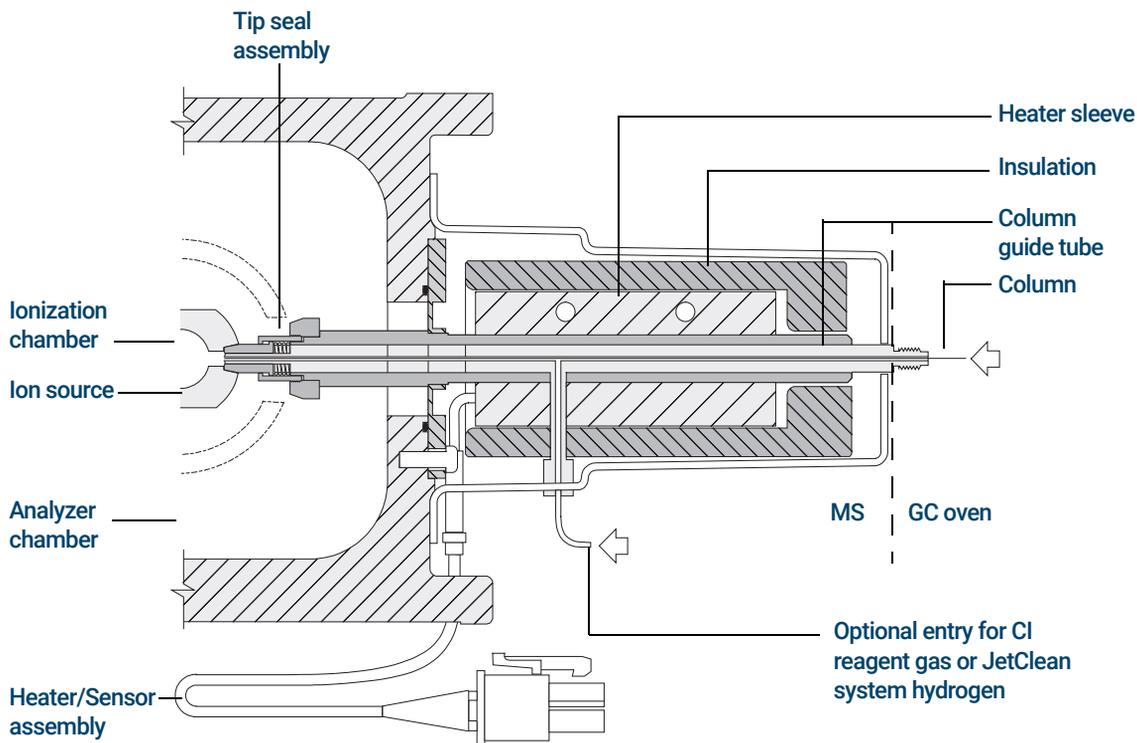


Figure 24. The GC/MS interface for an 8890 Series GC

## 4 Installing 7890 GC Columns

When operating in CI mode, reagent gas is plumbed into the interface. The interface assembly extends into the ionization chamber. A spring-loaded seal helps to keep reagent gases inside the source. The reagent gas enters the interface body and mixes with carrier gas and sample in the ion source.

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

The interface tip seal assembly is also required when using the EI XTR source or the HES.

The 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. When operating in CI mode, 280 °C is the recommended temperature for the GC/MS interface.

(See “[To Install a Capillary Column in the GC/MS Interface Using the Self-Tightening Column Nut](#)” on page 85 and “[To Install a Capillary Column in the GC/MS Interface Using a Standard Column Nut](#)” on page 90.)

### CAUTION

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

### WARNING

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

# To Calibrate the Column

Capillary columns must be calibrated prior to use with the MS. This procedure applies only to the 7890 GC.

### Procedure

- 1 Set Data Acquisition for splitless manual injection and selected ion monitoring (SIM) of  $m/z$  28.
- 2 Press **[Prep Run]** on the GC keypad.
- 3 Inject 1  $\mu\text{L}$  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 the **Instrument Control** panel, select **Instrument > GC Configuration**.
- 6 Select the **Configuration** tab.
- 7 Select the **Column** tab, click **Inventory**, and verify that the column you are using is in inventory. Select the column to be calibrated and click **Install Selected Column**.
- 8 Highlight the column in the inventory list and select **Calibrate**.
- 9 Select **Calc Length**.
- 10 In the **Calculate Column Length** dialog, enter the recorded retention time in the **Holdup Time** field. Verify that the other 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. (See **Figure 25** on page 98.)

## 4 Installing 7890 GC Columns

Calculate Column Length

GC Conditions

If measurement was made under conditions different from loaded method, please enter them below.

Temperature: 45 °C

Pressure into column: 9.4667 psi

Pressure out of column: 0 psi

Vacuum

Gas type: He

Holdup Time of an Unretained Peak: 1.2555 min

	Current	Calculated
▶ Length	30 m	30 m
Diameter	250 µm	250 µm
Holdup	1.2555 min	1.2555 min

OK Cancel

Figure 25. Calculate Column Length dialog

**11** When the new column length appears, click **OK** to save the changes.

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

## 5

# Operating in EI Mode

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This chapter explains how to perform some routine operating procedures for the 7000/7010 Series TQ GC/MS in EI mode.

## Operating the MS from the Data System

The Agilent MassHunter GC/MS Acquisition software performs tasks such as pumping down, monitoring pressures, setting temperatures, tuning, and preparing to vent. These tasks are described in this chapter. Additional information is described in the manuals and online help supplied with the MassHunter GC/MS Acquisition software.

Your 7000 TQ operates in EI mode using the EI XTR Ion Source Assembly, and your 7010 TQ operates in EI mode using the EI HES or HES 2.0 Source Assembly, which provides higher sensitivity when ionizing the sample.

### CAUTION

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

## Front Panel Instrument Status LED

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. (See **Table 6**.)

**Table 6** Front panel Instrument Status LED codes

Instrument status	LED code
Ready	Solid green
Acquiring data	Blinking green (<2 sec)
Not ready	Solid yellow
JetClean <b>Acquire &amp; Clean</b> operation	Blinking magenta
JetClean <b>Clean Only</b> operation	Solid magenta
Ready and not connected to DS	Solid blue
Start up (prior to FW load)	Blinking red (<2 sec)
Fault	Solid red

## Before You Turn On the MS

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

- The vent valve must be closed (the knob turned all the way clockwise). (See **“To Pumpdown the MS”** on page 120.)
- All other vacuum seals and fittings must be in place and fastened correctly. All analyzer plate thumbscrews should be open, unless hazardous carrier, JetClean system hydrogen, or reagent gases are being used.
- The MS is connected to a grounded power source.
- The GC/MS interface extends into the GC oven.
- A conditioned capillary column is installed in the GC inlet and in the GC/MS interface.
- The GC is on, but the heated zones for the GC/MS 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 or JetClean system supply, the carrier gas and JetClean system supply shutoff valves must be closed. The top thumbscrew on the front analyzer side plate and the top thumbscrew on the rear analyzer side plate must both 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 (standard pump), and install a hose to take the foreline pump exhaust outside or to a fume (exhaust) hood. 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 hydrogen is used as a carrier gas or JetClean system supply, the carrier and JetClean system supply shutoff valves must be closed before turning off the MS power. If the foreline pump is off, hydrogen will accumulate in the MS and an explosion may occur. Read **“Hydrogen Safety”** on page 22 before operating the MS with hydrogen gas.

### CAUTION

When hydrogen is used as a carrier gas or during the JetClean system acquire and clean mode, do not use helium in the collision cell.

## Pumping Down

The data system helps you pumpdown the MS. The process is primarily automated. After you turn on the MS by pushing the **On/Off** switch, close the analyzer door, and close the vent valve once you hear hissing (while pressing on both analyzer side plates), the MS pumps down by itself. The Agilent MassHunter GC/MS Acquisition 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/MS interface heater. The MS will shut down if it cannot pumpdown correctly.

Using the MS monitors, the data system can display:

- Motor speed for turbo pump MS
- Analyzer chamber pressure (vacuum)
- Foreline pump pressure

## Controlling Temperatures

MS temperatures are controlled through the data system. The MS has independent heaters and temperature sensors for the ion source, the MS1 mass filter, and the MS2 mass filter. You can adjust the setpoints and view these temperatures from the data system.

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

## Controlling Column Flow

Carrier gas flow is controlled by column inlet pressure in the GC. Set the column mode to **Constant Pressure** to maintain a constant inlet pressure, and the column flow will decrease as the GC oven temperature increases. With EPC and the column mode set to **Constant Flow**, the same column flow is maintained regardless of temperature.

The MS can be used to measure actual column flow. Inject a **small** amount of air or other unretained chemical, and time how long it takes to reach the MS. With this time measurement, you can calculate the column flow. (See **“To Calibrate the Column”** on page 97.)

## Controlling CC Flow

The CC gas flow rate is controlled by an EPC module located in the GC. The CC gas flow is a combination of two gases mixed at the EPC outlet and sent in a single tubing line to the MS. Typically, these two gases are nitrogen and helium, though only nitrogen is used when hydrogen is the carrier gas. The gas flow rates to the GC CC EPC are controlled by the Agilent MassHunter GC/MS Acquisition software or directly at the GC panel. (See **“To Set the CC Gas Flow Rates”** on page 116.)

## Controlling JetClean Hydrogen Flow

The JetClean option uses hydrogen gas for cleaning the ion source. The JetClean system MFC sends hydrogen to the annular space surrounding the column in the GC/MS interface where it then enters the ion source body. The flow rate is controlled by the MassHunter GC/MS Acquisition software. (See **“To Set the Mode for the Optional JetClean System”** on page 114.) For a low cost JetClean flow control option, set the JetClean operation mode to **Clean Only**. (See **“To Set the JetClean Parameters for the Clean Only Mode”** on page 115.)

## Venting the MS

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

The Fast Vent feature loads a user-defined GC method that sets an oven temperature, turns off the transfer line heater, and sets the column flow to a user predefined level.

The MS *will* be damaged by incorrect venting. A turbo pump will be damaged if it is vented while spinning at more than 50% of its normal operating speed.

### WARNING

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

### WARNING

If hydrogen is used as a carrier gas or JetClean system supply, the carrier and JetClean system supply shutoff valves must be closed before turning off the MS power. If the foreline pump is off, hydrogen will accumulate in the MS and an explosion may occur. Read “[Hydrogen Safety](#)” on page 22 before operating the MS with hydrogen gas.

### WARNING

Never open the vent valve or shutdown the vacuum pumps without first closing the shutoff valves for all hydrogen flows to the analyzer. This includes hydrogen carrier gas and hydrogen for the JetClean system.

### CAUTION

Never vent the MS 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 [Table 3](#) on page 34.)

For complete venting instructions, see “[To Vent the MS](#)” on page 124.

## High Vacuum Pressure in EI Mode

The largest influences on operating pressure in EI mode are the carrier gas (column) and CC gas flows. **Table 7** lists typical pressures for various helium and nitrogen CC gas flows. These pressures are approximate and will vary from instrument to instrument by as much as 30%.

**Table 7** Influence of carrier and CC gas flows on ion vacuum gauge readings

Column Flow (mL/min)	CC Gas On N <sub>2</sub> = 1.5, He = 2.25		CC Gas Off		CC Gas On N <sub>2</sub> = 1.5, He off	
	Rough Vac	High Vac	Rough Vac	High Vac	Rough Vac	High Vac
0.5	1.58 * 10 <sup>-1</sup>	1.11 * 10 <sup>-4</sup>	8.82 * 10 <sup>-2</sup>	6.05 * 10 <sup>-7</sup>	1.36 * 10 <sup>-1</sup>	1.31 * 10 <sup>-4</sup>
0.7	1.61 * 10 <sup>-1</sup>	1.10 * 10 <sup>-4</sup>	9.92 * 10 <sup>-2</sup>	7.75 * 10 <sup>-7</sup>	1.39 * 10 <sup>-1</sup>	1.31 * 10 <sup>-4</sup>
1	1.66 * 10 <sup>-1</sup>	1.10 * 10 <sup>-4</sup>	1.00 * 10 <sup>-1</sup>	8.38 * 10 <sup>-7</sup>	1.44 * 10 <sup>-1</sup>	1.31 * 10 <sup>-4</sup>
1.2	1.69 * 10 <sup>-1</sup>	1.10 * 10 <sup>-4</sup>	1.05 * 10 <sup>-1</sup>	9.38 * 10 <sup>-7</sup>	1.47 * 10 <sup>-1</sup>	1.31 * 10 <sup>-4</sup>
2	1.80 * 10 <sup>-1</sup>	1.11 * 10 <sup>-4</sup>	1.22 * 10 <sup>-1</sup>	1.36 * 10 <sup>-6</sup>	1.60 * 10 <sup>-1</sup>	1.32 * 10 <sup>-4</sup>
3	1.95 * 10 <sup>-1</sup>	1.12 * 10 <sup>-4</sup>	1.41 * 10 <sup>-1</sup>	1.82 * 10 <sup>-6</sup>	1.75 * 10 <sup>-1</sup>	1.32 * 10 <sup>-4</sup>
4	2.10 * 10 <sup>-1</sup>	1.12 * 10 <sup>-4</sup>	1.57 * 10 <sup>-1</sup>	2.33 * 10 <sup>-6</sup>	1.90 * 10 <sup>-1</sup>	1.31 * 10 <sup>-4</sup>
6	2.37 * 10 <sup>-1</sup>	1.13 * 10 <sup>-4</sup>	1.89 * 10 <sup>-1</sup>	3.29 * 10 <sup>-6</sup>	2.18 * 10 <sup>-1</sup>	1.34 * 10 <sup>-4</sup>

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

# To Set Monitors for MS Temperature and Vacuum Status

A monitor displays the current value of a single instrument parameter. They can be added to the standard instrument control window. Monitors can be set to change color if the actual parameter varies beyond a user-determined limit from its setpoint.

## Procedure

- 1 Select **Instrument > Edit Monitors** to display the **Select Monitors** dialog. (See [Figure 26](#).)

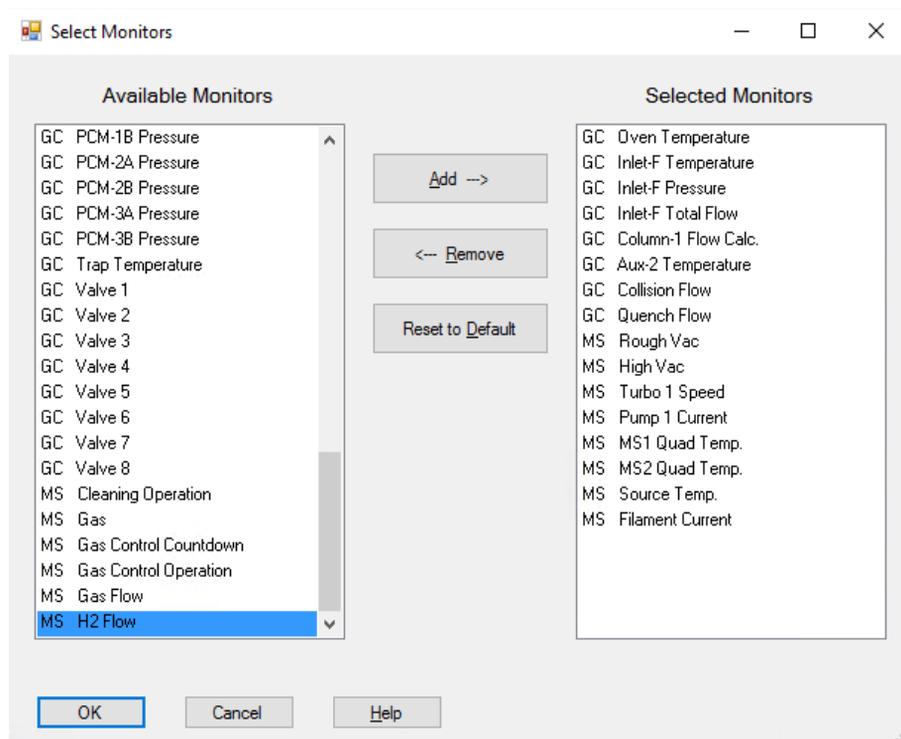


Figure 26. Select Monitors dialog box

The available monitors may change due to the configuration of the GC and MS.

## 5 Operating in EI Mode

- 2 In the **Available Monitors** column, select **MS High Vac** and click **Add** to move the selection to the **Selected Monitors** column.
- 3 In the **Available Monitors** column, select **MS 1 Quad Temp**, and click **Add** to move the selection to the **Selected Monitors** column.
- 4 In the **Available Monitors** column, select **MS 2 Quad Temp**, and click **Add** to move the selection to the **Selected Monitors** column.
- 5 In the **Available Monitors** column, select **MS Turbo 1 Speed**, and click **Add** to move the selection to the **Selected Monitors** column.
- 6 In the **Available Monitors** column, select **MS Source Temp**, and click **Add** to move the selection to the **Selected Monitors** column.
- 7 In the **Available Monitors** column, select **RoughVac**, and click **Add** to move the selection to the **Selected Monitors** column.
- 8 Select any other monitors you want, and **add them** to the **Selected Monitors** column.
- 9 Click **OK** to close the **Select Monitors** dialog. The newly added monitors are added to the window.
- 10 If needed, select **Window > Arrange Monitors**, or click and drag each monitor to the desired position. See [Figure 27](#) for one way of arranging the monitors.

## 5 Operating in EI Mode

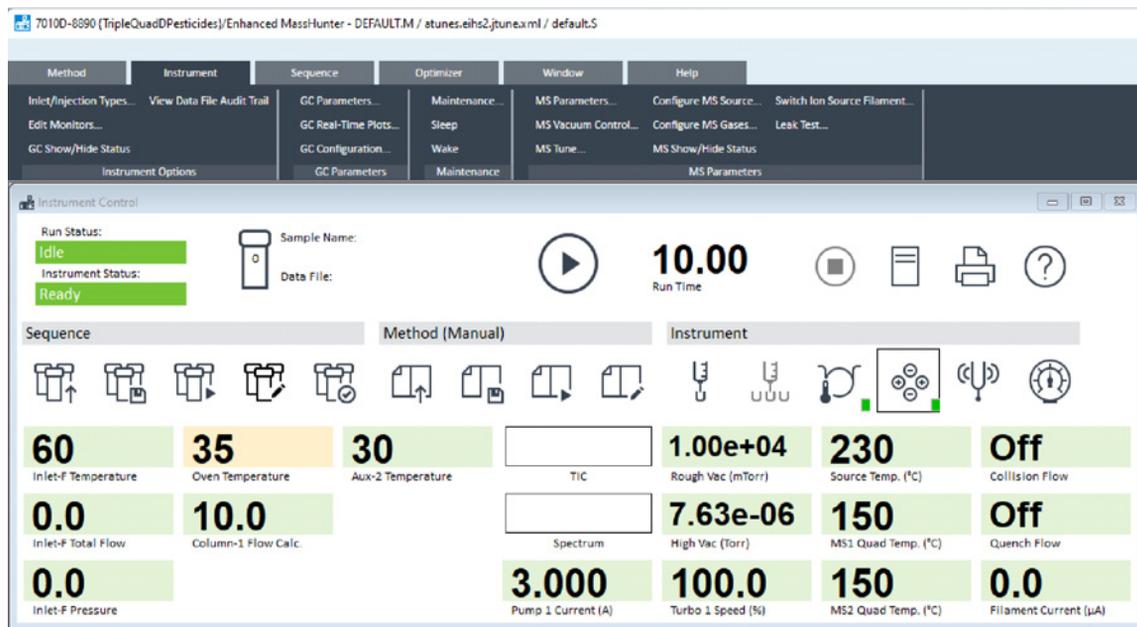


Figure 27. Arranging monitors

- To make the new settings part of the method, select **Save** from the **Method** menu.

# To Set the MS Analyzer's Temperatures

Setpoints for the MS ion source, front quad (MS1), rear quad (MS2), and temperatures are stored in the current tune file. When a method is loaded, the setpoints in the tune file associated with that method are downloaded automatically.

## Procedure

- 1 In **Instrument Control** view, select the **MS Tune** icon to display the **MS Tune and Maintenance** window. Click the **Set Temperatures** icon to display the **MS Temperatures** dialog.

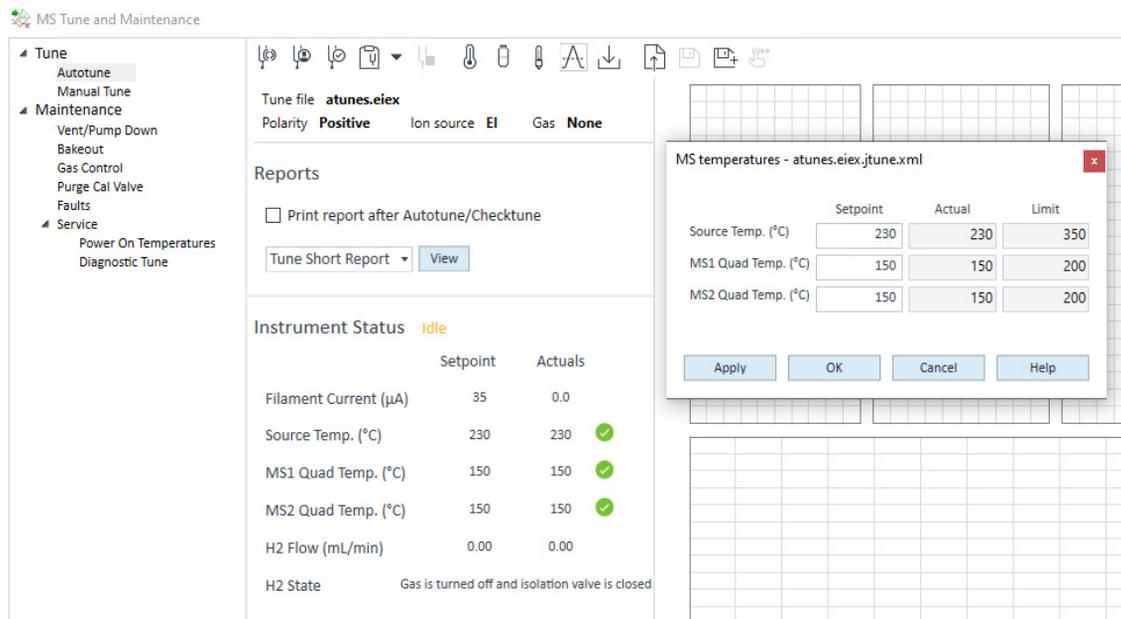


Figure 28. MS Temperatures dialog

- 2 Enter the temperature setpoint in the **Source Temp** field. See [Table 8](#) for recommended setpoints.
- 3 Enter the temperature setpoint in the **MS1 Quad Temp** field. See [Table 8](#) for the recommended setpoint.
- 4 Enter the temperature setpoint in the **MS2 Quad Temp** field. See [Table 8](#) for recommended setpoint.

## 5 Operating in EI Mode

- 5 Click **OK** to close the **MS Temperatures** dialog.
- 6 Click the **Save tune parameters** icon to save these new temperature settings.

**Table 8 Recommended temperature settings**

Zone	EI operation
MS Source	230 °C default. High limit 350 °C. Application dependent.
MS Quad 1	150 °C
MS Quad 2	150 °C

The GC/MS interface, ion source, and the MS1 quadrupole heated zones interact. The analyzer heater may not be able to accurately control temperature if the setpoint for one zone is much different from that of an adjacent zone.

The software will not allow you to exceed 200 °C for the quadrupole or 350 °C for the source.

# To Set the GC/MS Interface Temperature from MassHunter

You can also use the **GC Control** panel to perform this task.

## Procedure

- 1 Select **Instrument > GC Parameters** from the Instrument Control panel.
- 2 In the left column select **Aux Heaters** to display the **MS Transfer Line Temperature** settings. (See [Figure 29](#).)

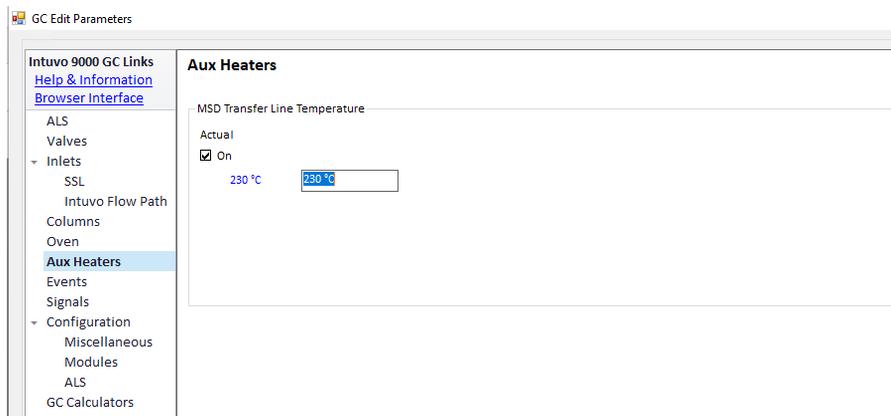


Figure 29. Setting the interface temperature

### CAUTION

Ensure that the carrier gas is turned on and the column has been purged of air before heating the GC/MS interface or the GC oven.

### CAUTION

When setting the GC/MS interface temperature, never exceed the maximum for your column.

- 3 Click the heater **On** check box, and enter the setpoint in the temperature field. The typical setpoint is 280 °C. The limits are 0 °C to 400 °C. A setpoint below ambient temperature turns off the interface heater.
- 4 Click **Apply** to download setpoints or click **OK** to download setpoints, and close the window.
- 5 To make the new settings part of the method, select **Save Method** from the **Method** menu.

## To Configure CC Gas

- 1 Configure the use of **Quench Gas** and **Collision Gas**. (See “**To Set the CC Gas Flow Rates**” on page 116.)
- 2 Select **Instrument > GC Parameters** from the **Instrument Control** panel.
- 3 Select **Configuration > Modules** to display the screen. (See **Figure 30**.)

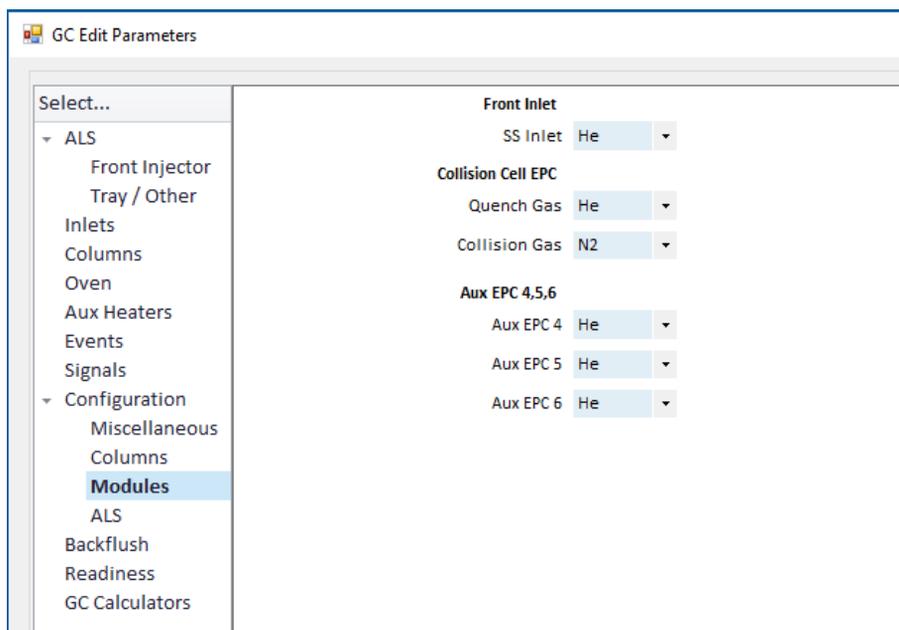


Figure 30. Configure CC gas

- 4 From the **Collision Cell/EPC >Quench Gas** drop-down menu, select the quench gas.
- 5 From the **Collision Cell/EPC > Collision Gas** drop-down menu, select the collision gas.
- 6 Click **OK** to save the configuration.

## To Set the Mode for the Optional JetClean System

- 1 Click the **MS Parameters** icon in the **Instrument Control** view.
- 2 Click **JetClean** from the **Triple Quadrupole MS Method Editor** navigation panel.
- 3 Select a mode from the **Operation** dropdown menu. (See **Figure 31**.)



Figure 31. TQ MS Method Editor JetClean panel

For detailed information on the JetClean system see the *JetClean Operating manual*.

# To Set the JetClean Parameters for the Clean Only Mode

- 1 Click the **MS Parameters** icon in the **Instrument Control** view.
- 2 Select **JetClean** from the **Triple Quadrupole MS Method Editor** navigation panel.
- 3 Select **Clean Only** from the **Operation** dropdown menu. (See **Figure 32.**)

The screenshot shows the 'Triple Quad MS Method Editor' window. On the left is a navigation panel with the following items: Acquisition, Chromatograms, Timed Events, Instrument Curves, Tune File Parameters, and JetClean (which is highlighted in blue). The main area is titled 'Operation' and has a dropdown menu set to 'Clean Only'. Below this, there are two sections: 'Cleaning' and 'Post Cleaning'. The 'Cleaning' section contains several input fields: Hydrogen Flow (mL/min) with a value of 0.67 and a note '(Limited to steps of 0.0666 mL/min)'; Filament with a dropdown menu set to 2; Emission (μA) with a value of 10; Source Temperature (°C) with a value of 230; Quadrupole Temperature (°C) with a value of 150; and Duration (min) with a value of 1.3. The 'Post Cleaning' section contains a text box with the instruction: 'For Post Cleaning, the Source and Quadrupole temperatures are derived from the temperature settings in the Tune File associated with this method.' and a field for 'Stabilization Duration (min)' with a value of 10.

Figure 32. JetClean set to Clean Only mode

- 4 Enter the parameters supplied by your method developer.
- 5 Save the method.

## To Set the CC Gas Flow Rates

- 1 From the Agilent **MassHunter GC/MS Acquisition software Instrument Control** panel, select **Instrument > GC Parameters**.
- 2 Click the **Columns** icon to display the control parameter entry screen for column and Aux flow modules. (See **Figure 33** on page 116.)
- 3 Select **Collision Cell EPC** in the description list.
- 4 Enter the required gas flow rates in the appropriate field.

### NOTE

Helium should only be used as a quench gas in the CC when it is also used as the carrier gas. When hydrogen is being used as the carrier gas, turn off the helium flow to the CC, and cap off the helium input line with a leak-tight fitting.

### NOTE

You must manually set the collision gas flow to on when in manual tune. Set the system to the same conditions [Column flow(s), Collision Cell flows, and MS analyzer temperatures] that will be used for data acquisition. Wait sufficient time for system thermal equilibrium.

- 5 Select the **Quench Gas He** check box to allow the He quench gas flow. Select the **Collision Gas N2** check box to allow the N2 collision gas flow.
- 6 Click **Apply** to download the setpoints or **OK** to download the setpoints and close the window.
- 7 To make the new settings part of the method, select **Save Method** from the **Method** menu.

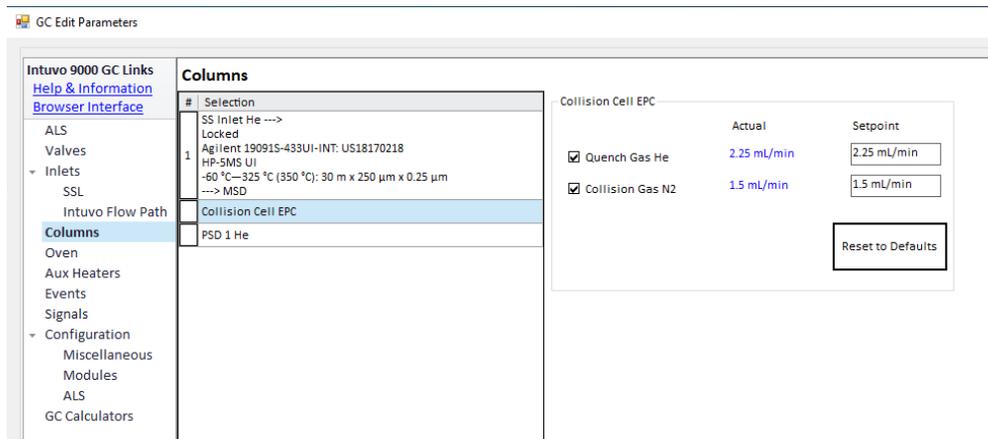


Figure 33. Setting CC gas flow rate

## To Autotune the MS for EI Mode

The MS can be tuned using the Agilent MassHunter GC/MS Acquisition software.

### Procedure

- 1 Set the system to the same conditions (column flow and MS analyzer temperatures) that will be used for data acquisition. Since the GC temperature varies throughout the run, select a temperature in the mid range.
- 2 In the **Instrument Control** panel, click the **MS Tune** icon to display the **MS Tune and Maintenance** window.
- 3 The current tune file is displayed in the upper left corner of the **MS Tune and Maintenance** window. Verify that the correct tune file is loaded.
- 4 If necessary, load a new tune file by clicking on the **Open a Tune File** icon. Select an etune.u based tune file for an EI XTR source or an HES\_atune.U based tune file for a HES. Select the required tune file, then click **Select**.
- 5 Select the **Print autotune report after Autotune/Checktune** check box and from the dropdown select the type of report required.
- 6 If using a new tune file click the **Full Autotune** icon. If a full autotune was already run on a tune file you can click the **Autotune Options** icon and select a **Tune level** to run **Detector Gain** only, **Mass Axis and Detector gain** only, or a **Full Autotune**. You can also select a **Tune type** of **Standard** or **High sensitivity**. (See [Figure 34](#) on page 117.)

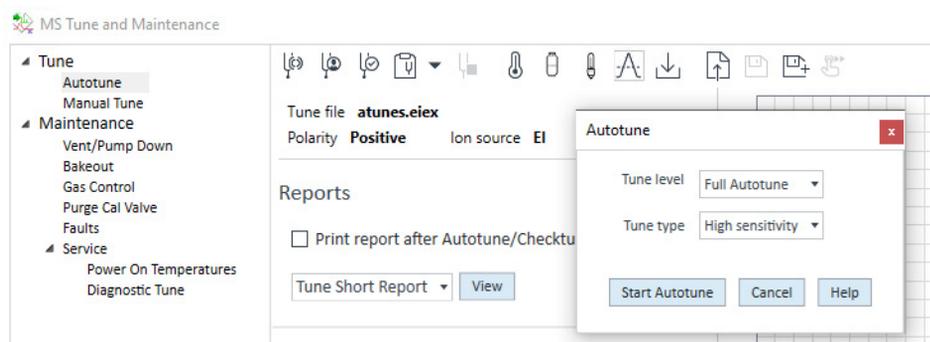


Figure 34. Setting up for autotune.

## 5 Operating in EI Mode

- 7 Click **Start Autotune** to start the autotune. The **Status** line displays the current step in the autotune process, and the plot of the tuned parameter for that step is shown in the top graph. If specified above, at the completion of the autotune, a Tune Report is printed.

To stop the autotune before it completes the automatic parameter selection, click **Stop Tune**. The parameters from the last successful autotune are used.

- 8 Review the Tune Report. If the results are acceptable, save the autotune by clicking the **Save tune parameters** icon.

Refer to the manuals or online help provided with your Agilent MassHunter GC/MS Acquisition software for additional information about tuning.

## To Open Left Side Panel for Access to the Analyzer Chambers

The left side panel should only be opened to access the front and rear analyzer chambers or the analyzer side plates. This is necessary to pumpdown, clean or change the ion source, replace a filament, or replace the EM horn. If you need to open the left side panel follow this procedure. (See **Figure 35**.)



### Procedure

Pull gently on the front left window, and allow the left side panel to slide forward and down.

Left side panel

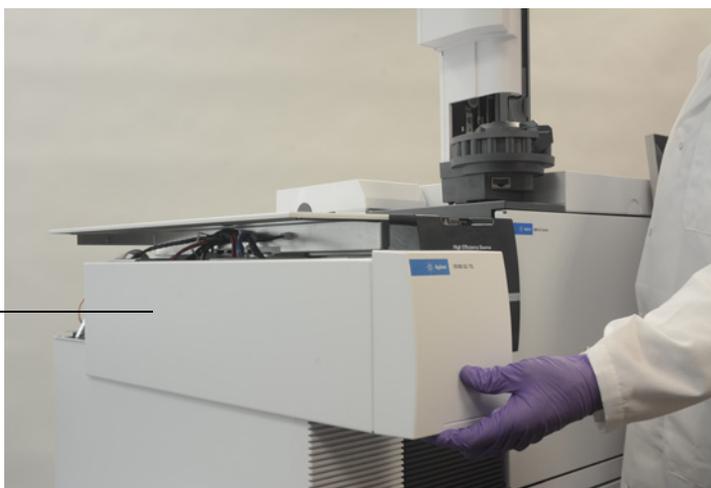


Figure 35. The left side panel

## To Pumpdown the MS

### WARNING

Ensure your MS meets all the conditions listed in the introduction to this chapter before starting up and pumping down the MS. Failure to do so can result in personal injury.

### WARNING

If hydrogen is used as a carrier gas or JetClean system supply, the carrier and JetClean system supply shutoff valves must be closed before turning off the MS power. If the foreline pump is off, hydrogen will accumulate in the MS and an explosion may occur. Read [“Hydrogen Safety”](#) on page 22 before operating the MS with hydrogen gas.



### Procedure

- 1 Remove the analyzer window cover, and open the left analyzer panel to access the vent valve and the analyzer quad driver boards. (See [“To Open Left Side Panel for Access to the Analyzer Chambers”](#) on page 119.)
- 2 Verify that the foreline pump inlet valve is open.

### WARNING

Do not open the vent valve without verifying that the hydrogen supply shutoff valve is closed if the optional JetClean system is installed. Refer to the JetClean Operating manual for warnings regarding hydrogen safety when the hydrogen shutoff valve is open.

- 3 Verify that the vent valve is open by turning it clockwise until closed. (See [Figure 36](#) on page 121.)



Vent valve knob

Figure 36. Vent valve knob

- 4 Open the vent valve by turning it counterclockwise 45 degrees.
- 5 Verify that the MS power cord is plugged into a grounded building's mains receptacle.
- 6 Turn on the MS by pressing the On/Off switch on the front of the MS.
- 7 Press lightly on the front and rear analyzer quad driver boards to ensure a correct seal. Press on the metal box on the quad driver board.

### CAUTION

**Do not push on the filament board safety cover while pressing on the analyzer boards. This cover was not designed to withstand this type of pressure.**

- 8 Close the vent valve when it makes a hissing sound. (See [Figure 36](#).)  
The foreline pump will make a gurgling noise. This noise should stop within a minute. If the noise continues, there is a *large* air leak in your system, probably at the side plate seal, the interface column nut, or the vent valve.
- 9 Start the Agilent MassHunter GC/MS Acquisition software. If the TQ was configured for both an EI and a CI source, you are prompted for the ion source type that is currently installed. Click on an EI or CI source type if prompted.

## 5 Operating in EI Mode

- 10 Select the **MS Tune** icon from the **Instrument Control** panel to open the **MS Tune and Maintenance** dialog.
- 11 Select **Maintenance > Vent/Pump Down**.
- 12 Click **Pumpdown**. You are prompted if you want to load high temperature settings for the ion source and MS1 and MS2 quads.
- 13 Click **Yes** to set the source/MS1/MS2 at 230/150/150 or click **No** to set them at 100/100/100.
- 14 The **Pumpdown** dialog displays. (See **Figure 37**.) You are prompted to make sure the vent valve is closed.
- 15 Click **OK** to close the Pumpdown manual step dialog and start the Pumpdown.

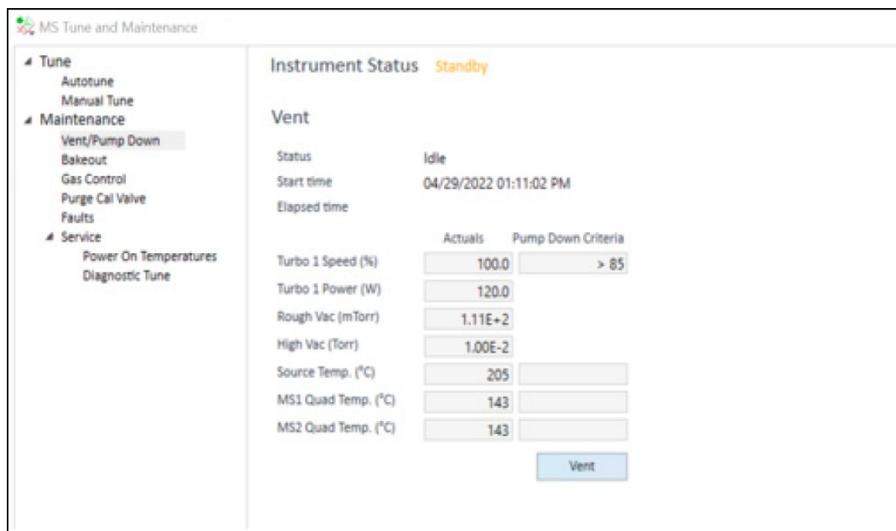


Figure 37. Pumpdown status

### CAUTION

Within 10 to 15 minutes, the turbo pump speed should be up to 80%. The pump speed should eventually reach 95%. If these conditions are not met, the MS electronics will shut off the foreline pump. To recover from this condition, you must power cycle the MS. If the MS does not pumpdown correctly, refer to the manual or online help for information on troubleshooting air leaks and other vacuum problems.

### 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.**

- 16** When prompted, turn on the GC/MS interface heater and GC oven. Click **OK** when you have done so. The software will turn on the ion source and mass filter (quad) heaters. The temperature setpoints are stored in the current tune file.
- 17** 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.
- 18** Tune the MS. (See **“To Autotune the MS for EI Mode”** on page 117 or **“To Perform a CI Autotune”** on page 141.)
- 19** If using the JetClean system, prepare the hydrogen system for use. Refer to the *JetClean Operating manual* for warnings regarding hydrogen safety.

## To Vent the MS

Agilent MassHunter GC/MS Acquisition software allows you to specify parameters in a GC method that will automate and speed up the vent process if direct communication (DCOMM) with the GC is established. You must predefine a Fast Vent method to use this option. Refer to the MassHunter GC/MS Acquisition software Online Help for information on how to configure a Fast Vent method.

### Procedure

- 1 Click the **MS Tune icon** from the **Instrument Control** panel to open the **MS Tune and Maintenance** dialog.
- 2 **Select Maintenance > Vent/Pump Down.**

If LVDS communication is enabled, the carrier gas will be turned off during a vent cycle once the heated zones reach 100 °C and the turbo speed reaches 0%. After powering the MS back on after an automated carrier gas shut off, be sure to re-enable the carrier gas and allow time for the carrier gas to equilibrate before performing any MS procedures.

### WARNING

If hydrogen is used as a carrier gas or JetClean system supply, the carrier and JetClean system supply shutoff valves must be closed before turning off the MS power. If the foreline pump is off, hydrogen will accumulate in the MS and an explosion may occur. Read **"Hydrogen Safety"** on page 22 before operating the MS with hydrogen gas.

### CAUTION

Ensure the GC oven and the GC/MS interface are cool before turning off carrier gas flow.

- 3 Click **Vent** to begin the venting process. If prompted, you must set the GC/MS interface heater and the GC oven temperatures to ambient (room temperature).
- 4 Turn off the MS by pressing the power switch. (See **Figure 1** on page 18.)
- 5 Unplug the MS power cord. In addition to being a safety requirement, this also causes the GC to reset, which is required when changing sources.

## 5 Operating in EI Mode

### WARNING

When the MS is vented, do not put the MassHunter software into Instrument Control view. Doing so will turn on the interface heater.

- 6 Remove the analyzer window cover. (See [“To Open Left Side Panel for Access to the Analyzer Chambers”](#) on page 119.)
- 7 Turn the vent valve knob counterclockwise **only** 3/4 turn or until you hear the hissing sound of air flowing into the analyzer chamber. (See [Figure 38](#).)  
Do **not** turn the knob too far or the O-ring may fall out of its groove.

### WARNING

Allow the analyzers to cool to near room temperature before touching them.

### CAUTION

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

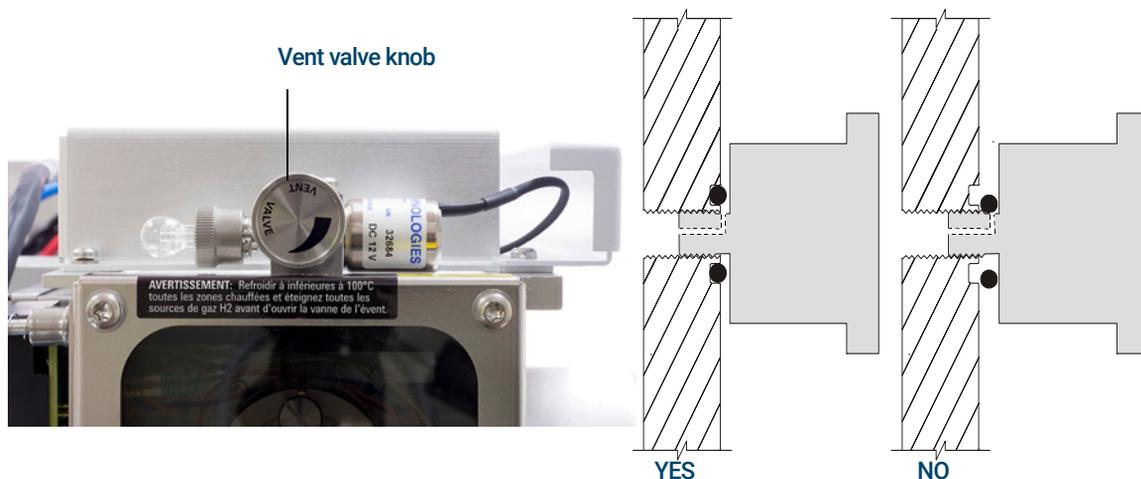


Figure 38. The MS vent valve knob

## 5 Operating in EI Mode

## 6

# Operating in CI Mode

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This chapter provides information and instructions for operating the 7000/7010 Series TQ GC/MS system in CI mode. Most of the information in the preceding chapter is also relevant.

Most of the material is related to methane CI, but one section discusses the use of other reagent gases.

The software contains instructions for setting the reagent gas flow and for performing CI autotunes. Autotunes are provided for positive CI (PCI) with methane reagent gas and for negative CI (NCI) with any reagent gas.

If you are using the *Agilent Intuvo 9000 Gas Chromatograph* with your MS, Chemical Ionization (CI) is not currently supported.

## Setting Up Your MS to Operate in CI Mode

Setting up your MS for operation in CI mode requires special care to avoid contamination and air leaks.

- If hydrogen is used as a carrier gas, it is recommended to configure LVDS communication between the GC and MS.
- Always use the highest purity methane (and other reagent gases, if applicable). Methane must be at least 99.9995% pure.
- Always verify the MS is performing well in EI mode before switching to CI.
- Ensure the CI source and GC/MS interface tip seal are installed.
- Ensure the reagent gas plumbing has no air leaks. This is determined in PCI mode, checking for  $m/z$  32 after the methane pretune.
- Ensure the reagent gas inlet line(s) are equipped with gas purifiers (not applicable for ammonia).
- If LVDS communication is enabled, the hydrogen carrier gas will be turned off during a vent cycle once the heated zones reach 100 °C and the turbo speed reaches 0%. After powering the MS back on after an automated carrier gas shut off, be sure to re-enable the carrier gas and allow time for the carrier gas to equilibrate before performing any MS procedures.

## Operating the CI MS

Operating your GC/MS in the CI mode is slightly more complicated than operating in the EI mode. After tuning, gas flow, source temperature, and electron energy may need to be optimized for your specific analyte. (See **Table 9**.)

**Table 9** Temperatures for CI operation

	Ion source	Front analyzer	Rear analyzer	GC/MS interface
PCI	300 °C	150 °C	150 °C	280 °C
NCI	150 °C	150 °C	150 °C	280 °C

### Start the system in CI mode

When starting up the system, you may begin in either PCI or NCI mode. Depending upon the application, use the following reagent gas flowrates during system startup:

- PCI mode set reagent gas flow to 20 (1 mL/min)
- NCI mode set reagent gas flow to 40 (2 mL/min)

## High Vacuum Pressure in CI Mode

The largest influences on operating pressure in CI mode are the reagent and CC gas flows. **Table 10** lists typical pressures for various reagent gas flows, depending upon the CC gas flowrate. Familiarize yourself with the measurements on **your** system under operating conditions, and watch for **changes** that may indicate a vacuum or gas flow problem. Measurements will vary by as much as 30% from one MS to the next.

### Analyzer vacuum with reagent gas flowing

Note that the MFC is calibrated for methane and the vacuum gauge is calibrated for nitrogen, so these measurements are not accurate, but are intended as a guide to typical observed readings. (See **Table 10.**) They were taken with the following set of conditions. Note that these are typical PCI temperatures:

Source temperature	300 °C
Front quad temperature	150 °C
Rear quad temperature	150 °C
Interface temperature	280 °C to 320 °C
Helium carrier gas flow	1 mL/min

**Table 10** Typical analyzer vacuum with reagent gas flow

MFC (%)	CC gas flow on N <sub>2</sub> = 1.5, He = 2.25		CC gas flow off	
	Rough vac	High vac	Rough vac	High vac
10	$1.77 \times 10^{-1}$	$7.15 \times 10^{-5}$	$1.33 \times 10^{-1}$	$2.56 \times 10^{-6}$
15	$1.86 \times 10^{-1}$	$7.19 \times 10^{-5}$	$1.43 \times 10^{-1}$	$3.00 \times 10^{-6}$
20	$1.94 \times 10^{-1}$	$7.23 \times 10^{-5}$	$1.53 \times 10^{-1}$	$3.45 \times 10^{-6}$
25	$2.02 \times 10^{-1}$	$7.27 \times 10^{-5}$	$1.63 \times 10^{-1}$	$3.86 \times 10^{-6}$
30	$2.10 \times 10^{-1}$	$7.31 \times 10^{-5}$	$1.71 \times 10^{-1}$	$4.30 \times 10^{-6}$
35	$2.18 \times 10^{-1}$	$7.39 \times 10^{-5}$	$1.80 \times 10^{-1}$	$4.76 \times 10^{-6}$
40	$2.25 \times 10^{-1}$	$7.43 \times 10^{-5}$	$1.88 \times 10^{-1}$	$5.18 \times 10^{-6}$

## Other Reagent Gases

This section describes the use of isobutane or ammonia as the reagent gas. You should be familiar with operating the CI-equipped 7000/7010 Series TQ GC/MS with methane reagent gas before attempting to use other reagent gases.

### CAUTION

**Do not use nitrous oxide as a reagent gas. It radically shortens the life span of the filament.**

Changing the reagent gas from methane to either isobutane or ammonia changes the chemistry of the ionization process and yields different ions. The principal CI reactions encountered are described in general in the *Agilent 7000/7010 Series Triple Quadrupole GC/MS Concepts Guide*. If you are not experienced with CI, we suggest reviewing that material before you proceed.

### Isobutane CI

Isobutane ( $C_4H_{10}$ ) is commonly used for CI when less fragmentation is desired in the CI spectrum. This is because the proton affinity of isobutane is higher than that of methane; hence less energy is transferred in the ionization reaction.

Addition and proton transfer are the ionization mechanisms most often associated with isobutane. The sample itself influences which mechanism dominates.

## Ammonia CI

Ammonia ( $\text{NH}_3$ ) is commonly used for CI when less fragmentation is desired in the CI spectrum. This is because the proton affinity of ammonia is higher than that of methane; hence less energy is transferred in the ionization reaction.

Because many compounds of interest have insufficient proton affinities, ammonia CI spectra often result from the addition of  $\text{NH}_4^+$  and then, in some cases, from the subsequent loss of water. Ammonia reagent ion spectra have principal ions at  $m/z$  18, 35, and 52, corresponding to  $\text{NH}_4^+$ ,  $\text{NH}_4(\text{NH}_3)^+$ , and  $\text{NH}_4(\text{NH}_3)_2^+$ .

### CAUTION

**Use of ammonia affects the maintenance requirements of the MS. (See Chapter 7, "General Maintenance," starting on page 149 for more information.)**

### CAUTION

**The pressure of the ammonia supply must be less than 5 psig. Higher pressures can result in ammonia condensing from a gas to a liquid.**

**Always keep the ammonia tank in an upright position, below the level of the flow module. Coil the ammonia supply tubing into several vertical loops by wrapping the tubing around a can or bottle. This will help keep any liquid ammonia out of the flow module.**

Ammonia tends to break down vacuum pump fluids and seals. Ammonia CI makes more frequent vacuum system maintenance necessary. Refer to the *7000/7010 Series Triple Quad GC/MS Troubleshooting and Maintenance Manual*.

### CAUTION

**When running ammonia for 5 or more hours a day, the foreline pump must be ballasted (flushed with air) for at least 1 hour a day to minimize damage to pump seals. Always purge the MS with methane after flowing ammonia.**

Frequently, a mixture of 5% ammonia and 95% helium or 5% ammonia and 95% methane is used as a CI reagent gas. This is enough ammonia to achieve good CI while minimizing its negative effects.

## Carbon Dioxide CI

Carbon dioxide is often used as a reagent gas for CI. It has obvious advantages of availability and safety.

## CI Autotune

After the reagent gas flow is set, the lenses and electronics of the MS should be tuned. (See [Table 11](#).) Perfluoro-5,8-dimethyl-3,6,9-trioxidodecane (PFDTD) is used as the calibrant. Instead of flooding the entire vacuum chamber, the PFDTD is introduced directly into the ionization chamber through the GC/MS interface by means of the gas flow control module.

### CAUTION

**After the source is changed from EI to CI or vented for any other reason, the MS must be purged and baked out for at least 2 hours before tuning. Longer bakeout is recommended before running samples requiring optimal sensitivity.**

There are no tune performance criteria. If CI autotune completes, it passes.

EMV at or above 2600 V, however, indicates a problem. If your method requires EMV set at +400, you may not have adequate sensitivity in your data acquisition.

### CAUTION

**Always verify MS performance in EI before switching to CI operation.**

**Table 11** CI tune default settings

Parameter	Methane		Isobutane		Ammonia	
Ion polarity	Positive	Negative	Positive	Negative	Positive	Negative
Emission	150 $\mu$ A	50 $\mu$ A	150 $\mu$ A	50 $\mu$ A	150 $\mu$ A	50 $\mu$ A
Electron energy	150 eV					
Filament	1	1	1	1	1	1
Repeller	3 V	3 V	3 V	3 V	3 V	3 V
Ion focus	130 V					
Entrance lens offset	20 V					
EM volts	1200	1400	1200	1400	1200	1400
Shutoff valve	Open	Open	Open	Open	Open	Open
Gas select	A	A	B	B	B	B
Suggested flow	20%	40%	20%	40%	20%	40%
Source temp	250 $^{\circ}$ C	150 $^{\circ}$ C	250 $^{\circ}$ C	150 $^{\circ}$ C	250 $^{\circ}$ C	150 $^{\circ}$ C

## 6 Operating in CI Mode

Table 11 CI tune default settings (continued)

Parameter	Methane		Isobutane		Ammonia	
Front quad temp	150 °C	150 °C	150 °C	150 °C	150 °C	150 °C
Rear quad temp	150 °C	150 °C	150 °C	150 °C	150 °C	150 °C
Interface temp	280 °C	280 °C	280 °C	280 °C	280 °C	280 °C
Autotune	Yes	Yes	No	Yes	No	Yes

## The CI Flow Control Module

The CI reagent gas flow control module regulates the flow of reagent gas through the GC/MS interface and into the CI source. (See **Figure 39** and **Table 12** on page 136.) The CI option consists of the MFC, gas select valves, CI calibration valve, shutoff valve, control electronics, plumbing, tip seal assembly, and CI source.

The back panel provides Swagelok inlet fittings for methane (**CH<sub>4</sub>**) and one **other** gas. The software refers to them as **Gas A** and **Gas B**, respectively. If you are not using a second gas, cap the **other** fitting to prevent accidental admission of air to the analyzer. Supply reagent gases at 25 to 30 psi (170 to 205 kPa).

The shutoff valve prevents contamination of the flow control module by atmosphere while the MS is vented or by PFTBA during EI operation. The MS monitors will reflect **On** as **1** and **Off** as **0**. (See **Table 12** on page 136.)

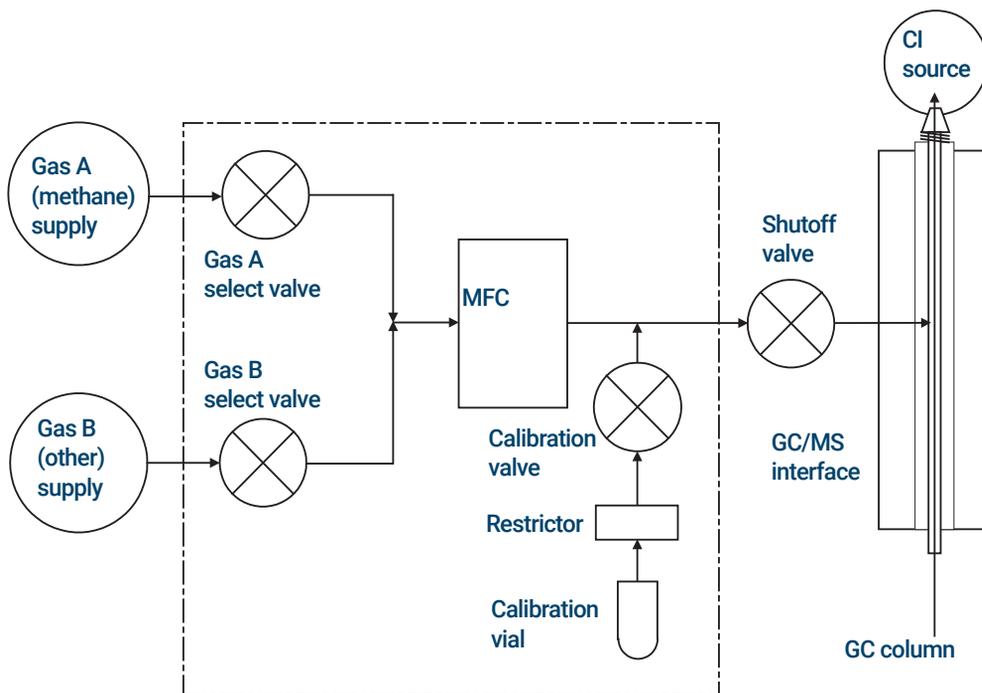


Figure 39. Reagent gas flow control module schematic

## 6 Operating in CI Mode

When a CI system is installed along with a JetClean system, the MFC is shared by both systems. By design, its use is restricted to one of these systems at a time. In this case, the Gas B supply is dedicated to hydrogen used for source cleaning. For detailed information on the JetClean system refer to the *JetClean Operating manual* installed on your PC along with this manual.

**Table 12** CI system MFC state

Result	Gas A flow	Gas B flow	Purge with Gas A	Purge with Gas B	Pump out flow module	Standby, vented, or EI mode
Gas A	Open	Closed	Open	Closed	Closed	Closed
Gas B	Closed	Open	Closed	Open	Closed	Closed
MFC	On → setpoint	On → setpoint	On → 100%	On → 100%	On → 100%	Off → 0%
Shutoff valve	Open	Open	Open	Open	Open	Closed

The **Open** and **Closed** states are shown in the monitors as **Opened** and **Closed**.

# To Operate the Reagent Gas Flow Control Module

In CI mode, a reagent gas purge will automatically be performed the first time a CI flow is set. This purge is required each time the instrument is restarted.

## Procedure

- 1 In **Instrument Control** panel, click the **MS Tune** icon to display the **MS Tune and Maintenance** window. Select **Maintenance Gas > Control** to display the Gas Control settings. (See [Figure 40](#).)

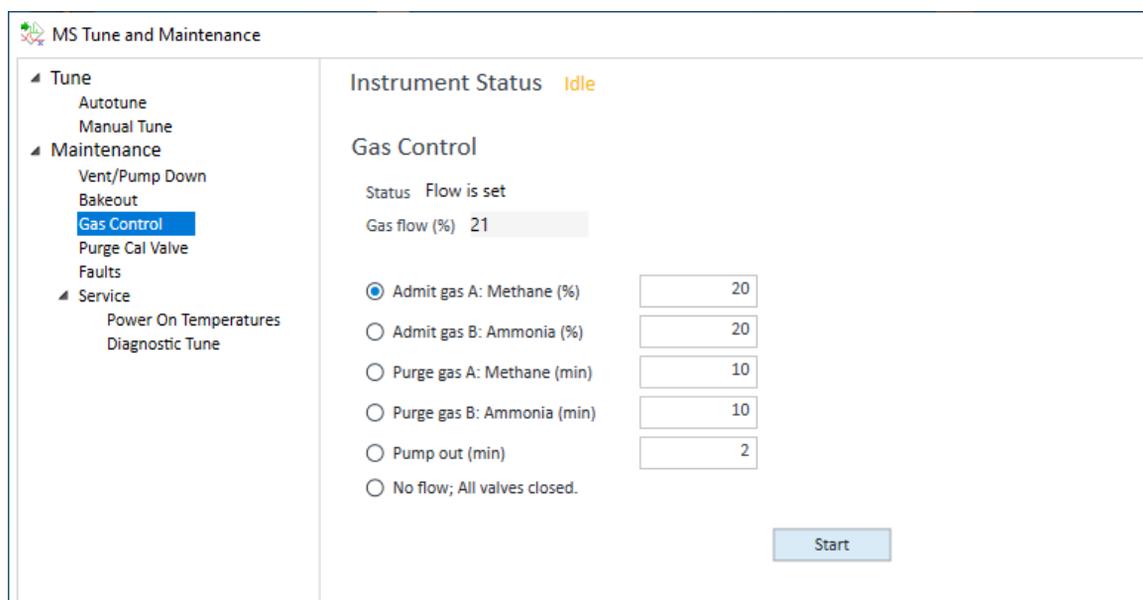


Figure 40. CI Gas Control

## 6 Operating in CI Mode

- 2 Select to control **gas A** and **gas B** valves to allow gas flow to a specified % of full open or full open for gas line purge. For your selected gas enter the time for the gas valve to be opened or closed or specify the % of full opening for the selected valve. You can also select to evacuate both gas flow lines for a specified number of minutes or constantly.

**Admit gas A:** Selects **gas A** as the reagent gas

**Admit gas B:** Selects **gas B** as the reagent gas

**Purge gas A:** Opens the **gas A** flow valve for the number of minutes entered to clear the system of unwanted compounds.

**Purge gas B:** Opens the **gas B** flow valve for the number of minutes entered to clear the system of unwanted compounds.

**Pump out (min):** Closes both reagent gas valves for 4 minutes, and evacuates the system of reagent gases. At the end of the pumpout time, the selected reagent gas valve opens.

No Flow; All Valves closed

These reagent gas selections and flow rates are not saved with your tune file. See **“To Set a Reagent Gas Flow”** on page 139 to save reagent gas and flow settings to the tune file.

## To Set a Reagent Gas Flow

### CAUTION

After the system has been switched from EI to CI mode, or vented for any other reason, the MS must be baked out for at least 26 hours before tuning. For a switch from EI to CI mode, or if CI mode was not used for an extended time, Agilent highly recommends doing a bake-out overnight for 12 or more hours.

### CAUTION

Continuing with CI autotune if the MS has an air leak or large amounts of water will result in severe ion source contamination. If this happens, you will need to *vent the MS and clean the ion source*.

### Procedure

- 1 In **Instrument Control** panel, select the **MS Tune** icon to display the **MS Tune and Maintenance** window. With **Autotune** selected, click the **Set gas settings** icon.

	Setting	Actual
Gas channel	(A) Methane	None
Gas flow (%)	21	0

CI State Gas is pumped out

Apply OK Cancel Help

Figure 41. Gas Settings

- 2 Under **Setting**, select the **Gas Channel** you want to use.

## 6 Operating in CI Mode

- 3 Under **Setting**, enter your desired **Gas Flow (%)**. This is the percent of maximum volumetric flow for the selected reagent gas. The actual % transmitted by the flow controller is shown next to this entry. A good value for PCI is 20%, and 40% is a good value for NCI.
- 4 Click **Apply**. The new flow rate will be sent to the instrument. When the actual flow matches the setting, click **OK** to close the dialog.
- 5 Click the **Save tune parameters** icon. The changed parameters are saved in the tune file. The system prompts to see if you want to run a tune with these new tune settings. The system does not force you to run a new tune.

## To Perform a CI Autotune

If you are switching from an EI to a CI source, do not use this procedure. See **“To Pumpdown and Switch from EI to CI Mode”** on page 143.

### Procedure

**CAUTION**

Always verify MS performance in EI before switching to CI operation.

**CAUTION**

Avoid tuning more often than is absolutely necessary; this will minimize PFDTD background noise, and help prevent ion source contamination.

- 1 Verify that the MS performs correctly in EI mode first.
- 2 Click the **MS Tune** icon in the **Instrument Control** panel to display the **MS Tune and Maintenance** window.
- 3 If necessary, load a new tune file by clicking the **Load Tune file** icon. If you are restarting the system after a system vent, major servicing, or a power outage you should tune from the factory default settings. To tune from default settings, load a default PCI or a default NCI tune file and save it with a new name. Select a tune file and click **Select**.

The tune file must match the type of ion source in the analyzer. For a CI source, select a tune file created for a positive or negative CI source.

- 4 With **Autotune** selected, click the **Set gas settings** icon.
- 5 Under **Setting**, select the **Gas Channel** you want to use.
- 6 Under **Setting**, enter your desired **Gas Flow (%)**. This is the percent of maximum volumetric flow for the selected reagent gas. The actual % transmitted by the flow controller is shown next to this entry. A good value for PCI is 20%, and 40% is a good value for NCI.
- 7 Click **Apply**. The new flow rate will be sent to the instrument. When the actual flow matches the setting, click **OK** to close the dialog.
- 8 Select the **Print autotune report** check box to automatically print a tune report.

## 6 Operating in CI Mode

- 9 Click the **Save tune parameters** icon. The changed parameters are saved in the tune file. The system prompts to see if you want to run a tune with these new tune settings. If you started with a factory default tune file you must run a full autotune.

The Status line displays the current step in the autotune process, and the plot of the tuned parameter for that step is shown in the top graph. If specified, at the completion of the autotune a Tune Report is printed.

To stop the autotune before it completes the autotune parameter selection, click **Abort Autotune**. The parameters from the last successful autotune are used.

## To Pumpdown and Switch from EI to CI Mode

This procedure assumes that the instrument is switching from EI to CI mode, and will be PCI tuned using methane after the system is stable.

### Procedure

- 1 Follow the instructions for the EI MS pumpdown. (See **“To Pumpdown the MS”** on page 120.)

After the software prompts you to turn on the GC/MS interface heater and GC oven, perform the following steps.

- 2 From the Instrument Control panel click the **Instrument MS Tune** icon to display the **MS Tune and Maintenance** window with **Tune > Autotune** selected.
- 3 With **Autotune** selected, click the **Open a tune file** icon to display the **Tune Files** dialog. Select the default PCI tune file and click **Select** to load **default.pci**.

Always start up and verify system performance in PCI mode before switching to NCI.

- 4 Click **Save tune parameters with new tune file name**.

## 6 Operating in CI Mode

- 5 In **Instrument Control** view, select **Instrument > Configure MS Gases** to display the Gas Controller Configuration dialog. (See **Figure 42**.)

Gas Control Configuration

**Controller Type**

None

JetClean - EI only system

CI/JetClean - EI/CI system

---

**Gas Configuration**

Channel A gas:  Other:

Channel B gas:  Other:

Turn off hydrogen gas if inactive (min):

Figure 42. Gas controller configuration for CI

- 6 Select **CI/JetClean - EI/CI system** since this controller is installed for the CI control option.
- 7 For **Channel A gas**, select **Methane**. Click **OK**.

If gas B is not hydrogen the **Turn off hydrogen gas if inactive (min)** field is grayed out.

If gas B is hydrogen, to automatically turn off hydrogen after a set purge time, select **Turn off hydrogen gas if inactive (min)**, and enter a time in minutes to purge with hydrogen after the system state is idle.

It is also common practice to not enable this feature and run a method that allows hydrogen flow when required.

- 8 Click the MS Tune icon in the **Instrument Control** panel to display the **MS Tune and Maintenance** window, and select **Maintenance > Pumpdown** to monitor that the pressure is decreasing.

## 6 Operating in CI Mode

- 9 With **Autotune** selected, click the **Set Gas Settings** icon. Under **Setting**, select the **Gas Channel** to use. Under **Setting**, enter your desired **Gas Flow (%)**. This is the percent of maximum volumetric flow for the selected reagent gas. The actual % transmitted by the flow controller is shown next to this entry. A good value for PCI is 20%, and 40% is a good value for NCI. (See **Figure 43**.)

	Setting	Actual
Gas channel	(A) Methane	None
Gas flow (%)	21	0
CI State	Gas is pumped out	

Buttons: Apply, OK, Cancel, Help

Figure 43. Gas Settings

- 10 Click **Apply**. The new flow rate will be sent to the instrument. When the actual flow matches the setting, click **OK** to close the dialog.

- 11 With **Autotune** selected, click the **Set Temperatures** icon to display the **MS temperatures** dialog.

	Setpoint	Actual	Limit
Source Temp. (°C)	300	230	350
MS1 Quad Temp. (°C)	150	150	200
MS2 Quad Temp. (°C)	150	150	200

Buttons: Apply, OK, Cancel, Help

Figure 44. MS temperatures dialog.

- 12 Set the GC/MS interface to 280 °C and click **Apply**. When the actual temperature reaches this setting click **OK** to close the dialog.
- 13 Let the system bake out and purge for at least 4 to 6 hours. If you will be running NCI, for best sensitivity, bake out the MS overnight.
- 14 With **Autotune** selected, note that **Instrument Status** displays the correct PCI or NCI source and reagent gas settings for this tune.
- 15 Select the **Print autotune report** check box to automatically print a tune report.
- 16 Click the **Start Full Autotune** icon and run a full autotune from factory defaults with adjusted gas and temperature settings. At the completion of the autotune a Tune Report is printed.

17 Review the Tune Report. Default tune control limits are shown in **Table 13**.

**Table 13 Default Tune Control Limits, used by CI autotune only**

Reagent gas	Methane		Ammonia	
	Positive	Negative	Positive	Negative
Ion polarity	Positive	Negative	Positive	Negative
Abundance target	$1 \times 10^6$	$1 \times 10^6$	N/A	$1 \times 10^6$
Peak width target	0.7	0.7	N/A	0.7
Maximum repeller	4	4	N/A	4
Maximum emission current, $\mu\text{A}$	240	50	N/A	50
Max electron energy, eV	240	240	N/A	240

**Notes for Table 13:**

- N/A: Not available.
- Abundance target: Adjust higher or lower to get desired signal abundance. Higher signal abundance also gives higher noise abundance. This is adjusted for data acquisition by setting the EMV in the method.
- Peakwidth target: Higher peakwidth values give better sensitivity, lower values give better resolution.
- Maximum emission current: Optimum emission current maximum for NCI is very compound-specific and must be selected empirically. Optimum emission current for pesticides, for example, may be about 200  $\mu\text{A}$ .



# 7

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## Before Starting

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

### Scheduled maintenance

Performing common maintenance tasks when scheduled can reduce operating problems, prolong system life, and reduce overall operating costs. (See **Table 14.**)

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

**Table 14 Maintenance schedule**

Task	Frequency
Check the foreline pump oil level	Every week
Check the calibration vial(s)	Every 6 months
Replace the foreline pump oil*	Every 6 months
Replace dry scroll pump tip seals	Every year
Tune the MS	As needed
Check the foreline pump	As needed
Clean the ion source	As needed
Check the carrier gas trap(s) on the GC and MS	As needed
Replace the worn out parts	As needed
Lubricate side plate or vent valve O-rings <sup>†</sup>	As needed
Replace GC gas supplies	As needed
Leak check the system	As needed

\* Or as needed.

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

## Tools, spare parts, and supplies

Some of the required tools, spare parts, and supplies are included in the GC shipping kit, MS shipping kit, or MS 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 MS 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 the boards
- Wires and cables between the boards and the connectors on the back panel of the MS
- 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 MS turned on or plugged into its power source unless you are instructed to do so by one of the procedures in this chapter.**

Some procedures in this chapter require access to the inside of the MS 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 MS operate at, or reach, temperatures high enough to cause serious burns. These parts include, but are not limited to:

- GC/MS interface
- Analyzer parts
- Vacuum pumps

### WARNING

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

### WARNING

**The GC/MS 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 MS is off. The GC/MS 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 could have an optional 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. Install a hose to take the exhaust from the foreline pump outdoors or into a fume hood vented to the outdoors. This requires removing the oil trap. 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.

The fluids in the 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 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

The optional dry scroll foreline pump may contain significant quantities of dust. This dust can contain traces of the chemicals analyzed by the mass spectrometer. When replacing the pump's tip seal, do NOT use compressed air to blow out this dust. Using compressed air will contaminate your laboratory with potentially hazardous dust.

## Ion source cleaning

The main effect of operating the MS in CI mode is the need for more frequent ion source cleaning. In CI operation, the ion source chamber is subject to more rapid contamination than in EI operation because of the higher source pressures required for CI.

### WARNING

Always perform any maintenance procedures using hazardous solvents under a fume hood. Operate the MS in a well-ventilated room.

## Ammonia

Ammonia, used as a reagent gas, increases the need for foreline pump maintenance. Ammonia causes foreline pump oil to break down more quickly. Therefore, the oil in the standard foreline vacuum pump must be checked and replaced more frequently.

Always purge the MS with methane after using ammonia.

Install the ammonia so the tank is in an upright position. This will help prevent liquid ammonia from getting into the flow module.

## Electrostatic discharge

All of the printed circuit boards in the MS contain components that can be damaged by 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) and CC contact wires which can carry ESD to sensitive components on the quad driver board. ESD damage may not cause immediate failure, but it will gradually degrade the performance and stability of your MS.

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 MS. This includes the analyzers.

### 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

Some maintenance tasks for the vacuum system must be performed periodically. (See **Table 14** on page 151.) 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 or as needed)
- Tightening the foreline pump oil box screws (first oil change after installation)
- Replacing the foreline pump (typically, every 3 years)
- Replacing the tip seals in the optional dry scroll pump (every year)
- Checking the system for leaks (On a monthly basis for safety, or as needed depending upon the type of gases being used in the lab.)

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 an ion vacuum gauge should be performed only when needed. Refer the *Agilent 7000/7010 Series Triple Quad GC/MS Troubleshooting and Maintenance Manual* and the online help in the MassHunter WorkStation 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, refer the *Agilent 7000/7010 Series Triple Quad GC/MS Troubleshooting and Maintenance Manual*.

Most of the procedures in this chapter are illustrated with video clips on the Agilent GC/MS Hardware User Information & Instrument Utilities DVD.

# Maintaining the Analyzer

## Scheduling

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

- Cleaning the ion sources
- Replacing filaments
- Replacing the EM horn

The *Agilent 7000/7010 Series Triple Quad GC/MS Troubleshooting and Maintenance Manual* provides information about symptoms that indicate the need for analyzer maintenance. The troubleshooting material in the online help in the MassHunter Workstation software provides more extensive information.

## Precautions

### Cleanliness

Keep components clean during analyzer maintenance. Analyzer maintenance involves opening either analyzer chamber, and removing parts from the analyzers. During analyzer maintenance procedures, avoid contaminating the analyzers or interior of the analyzer chambers. 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 MS.**

#### WARNING

**The analyzers operate at high temperatures. Do not touch any part until you are sure it is cool.**

### Electrostatic discharge

The wires, contacts, and cables connected to the analyzer components can carry ESDs to the electronics boards to which they are connected. This is especially true of the mass filter (quadrupole) and CC contact wires which can conduct ESD to sensitive components on the quad driver board. ESD damage may not cause immediate failure but will gradually degrade performance and stability. (See **“Electrostatic discharge”** on page 155 for more information.)

#### 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. (See **“Electrostatic discharge”** on page 155.) Take other antistatic precautions *before* you open the analyzer chambers.**

### Analyzer parts that should not be disturbed

The mass filters (quadrupoles) and the CC require no periodic maintenance. In general, the mass filters should never be disturbed. In the event of extreme contamination, they can be cleaned, but such cleaning should only be done by a trained Agilent Technologies service representative.

#### 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 7000/7010 Series Triple Quad GC/MS Troubleshooting and Maintenance Manual*.

# To Open the Front Analyzer Chamber

The front analyzer chamber should only be opened to clean or replace the ion source, 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 before you open the analyzer chamber. (See “[Electrostatic discharge](#)” on page 155.)



## Procedure

- 1 Vent the MS. (See “[Venting the MS](#)” on page 105.)
- 2 Open the left side panel. (See “[To Open Left Side Panel for Access to the Analyzer Chambers](#)” on page 119.)

### 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 if they are fastened. (See [Figure 45](#) on page 161.)

## 7 General Maintenance

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, or during CI operation.

### 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. (See **Figure 45** on page 161.)

## 7 General Maintenance

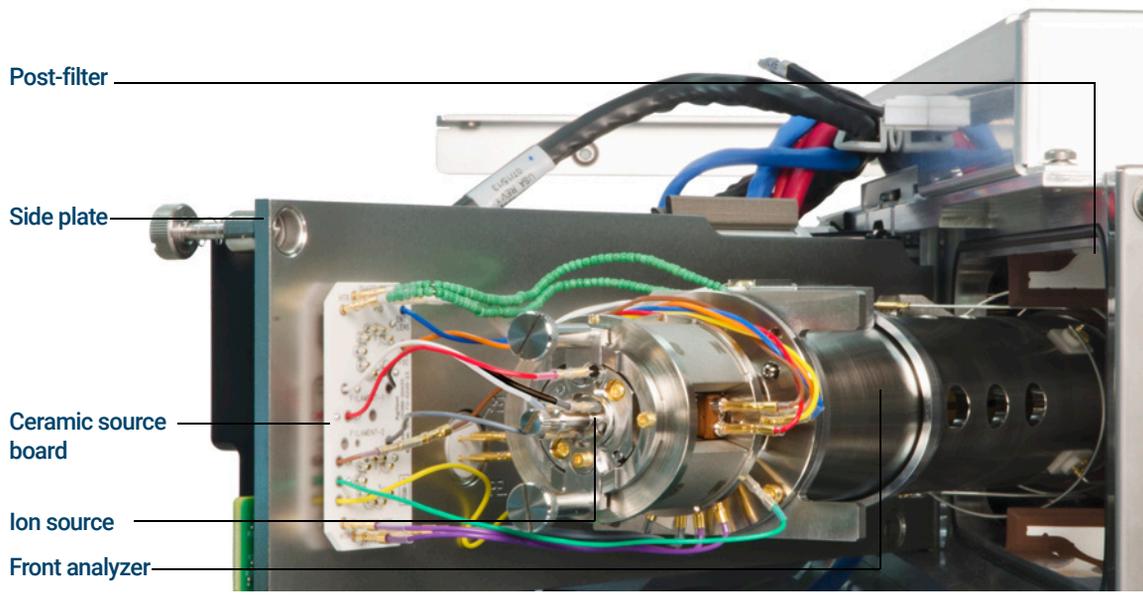
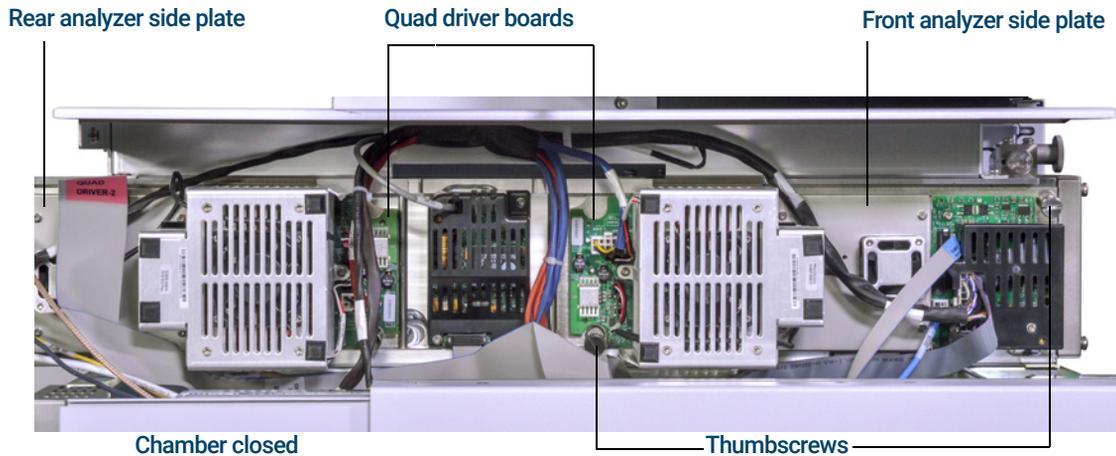


Figure 45. The front analyzer chamber on a 7010 MS

## To Remove the EI HES or HES 2.0

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)



### Procedure

- 1 Vent the MS. (See **“To Vent the MS”** on page 124.)

#### 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.

#### CAUTION

Use an antistatic wrist strap, and take other antistatic precautions before touching analyzer components.

#### CAUTION

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

- 2 Open the front analyzer chamber. (See **“To Open the Front Analyzer Chamber”** on page 159.)
- 3 Remove the two large thumbscrews that hold the ion source in place. (See **Figure 46** on page 163.)
- 4 Disconnect wiring from the source. Do not bend the wires any more than necessary. (See **“To Connect or Disconnect Wiring to the EI HES or HES 2.0”** on page 164.)

## 7 General Maintenance

- 5 Using the source finger grip, pull the ion source out of the source radiator.

The source contacts have spring loaded pins so some force must be applied to pull the source out. (See [Figure 46.](#))

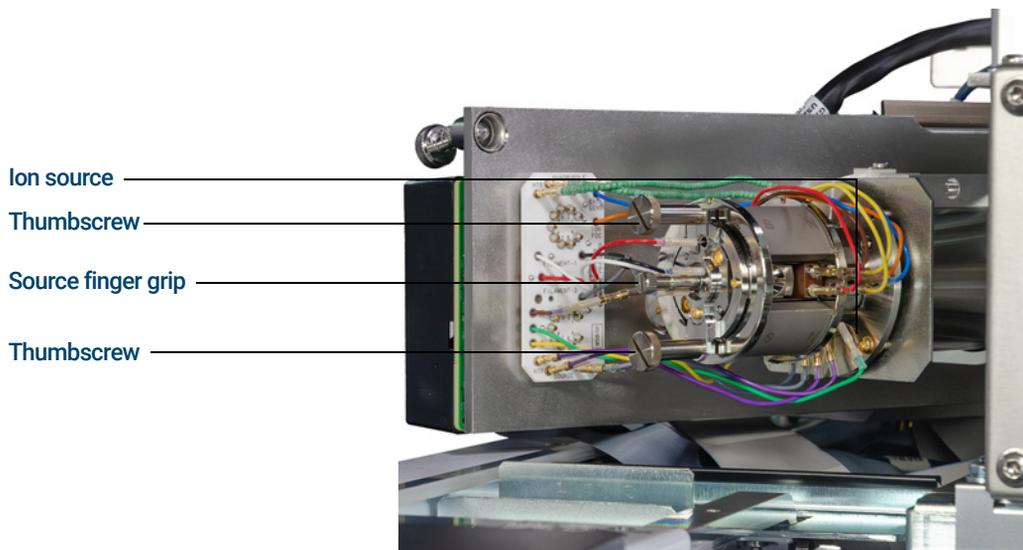


Figure 46. The EI HES 2.0 before removal

# To Connect or Disconnect Wiring to the EI HES or HES 2.0

This topic is used to identify the wiring connections to the ion source. (For detailed procedures and videos, see **“To Remove the EI HES or HES 2.0”** on page 162 or **“To Install the EI HES or HES 2.0”** on page 208.)

## Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Pliers, long-nose (8710-1094)
- Tweezers (8710-2460)

## Procedure

Use tweezers or pliers to connect or disconnect the ceramic board wire leads (red, white, black, and gray) at the source connectors. (See **Figure 47**.)

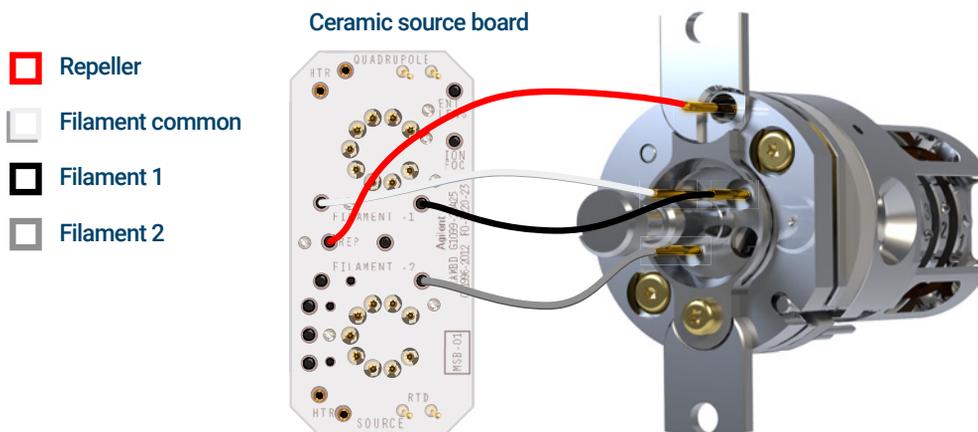


Figure 47. Wiring for the EI HES

## To Remove the EI XTR or HydroInert Source

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)



### Procedure

- 1 Vent the MS. (See **“To Vent the MS”** on page 124.)

#### 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.

#### CAUTION

Use an antistatic wrist strap, and take other antistatic precautions before touching analyzer components.

#### CAUTION

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

- 2 Open the front analyzer chamber. (See **“To Open the Front Analyzer Chamber”** on page 159.)

## 7 General Maintenance

- 3 Disconnect wiring from the EI source. Do not bend the wires any more than necessary. (See **“To Connect or Disconnect Wiring to the EI XTR Source”** on page 167 or **“To Connect or Disconnect Wiring to the EI HydroInert Source”** on page 168.)
- 4 Remove the thumbscrews that hold the ion source in place. (See **Figure 48.**)
- 5 Pull the ion source out of the source radiator.

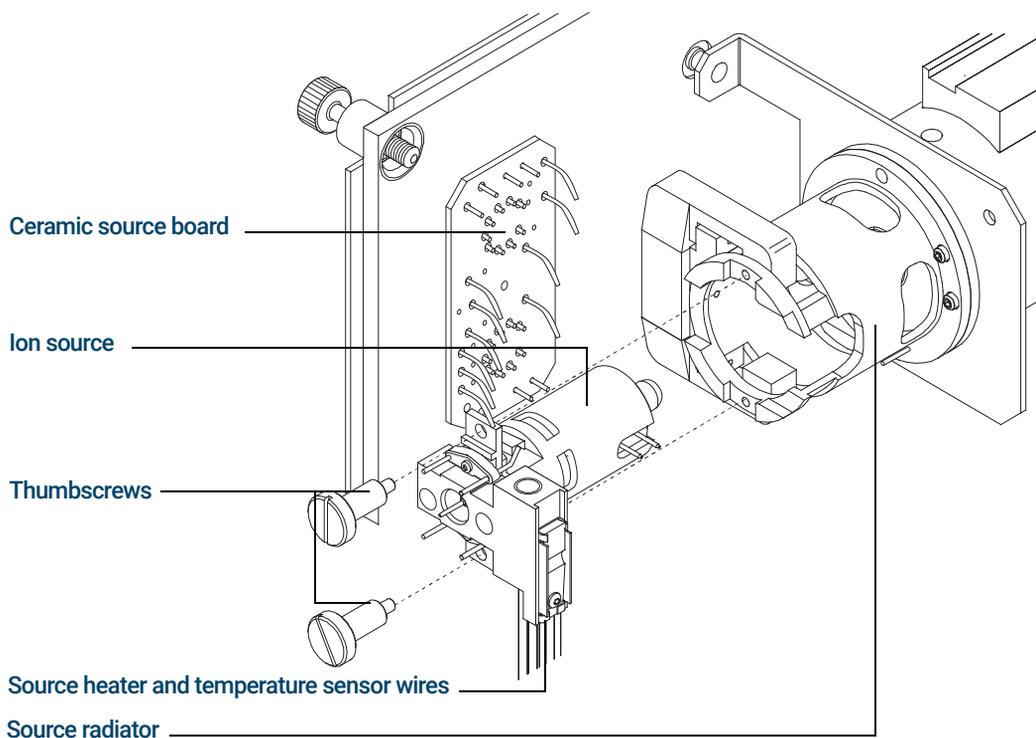


Figure 48. Removing the EI XTR or HydroInert source

# To Connect or Disconnect Wiring to the EI XTR Source

This topic is used to identify the wiring connections to the ion source. (For detailed procedures and videos, see **“To Remove the EI XTR or HydroInert Source”** on page 165 or **“To Install the EI XTR or HydroInert Source”** on page 210.

## Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Pliers, long-nose (8710-1094)
- Tweezers (8710-2460)

## Procedure

- 1 Use tweezers or pliers to connect or disconnect the ceramic board wire leads at the source connectors.
- 2 Use tweezers or pliers to connect or disconnect the source heater wire leads at the ceramic source board (CSB). (See **Figure 49**.)

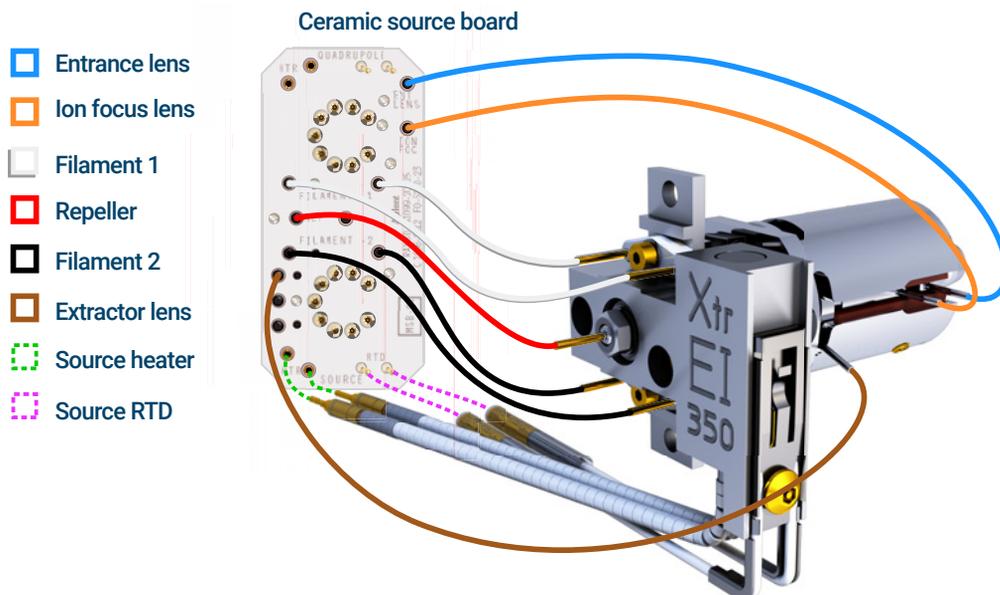


Figure 49. Wiring for the EI XTR

# To Connect or Disconnect Wiring to the EI HydroInert Source

This topic is used to identify the wiring connections to the ion source. (For detailed procedures and videos, see **“To Remove the EI XTR or HydroInert Source”** on page 165 or **“To Install the EI XTR or HydroInert Source”** on page 210.

## Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Pliers, long-nose (8710-1094)
- Tweezers (8710-2460)

## Procedure

- 1 Use tweezers or pliers to connect or disconnect the ceramic board wire leads at the source connectors.
- 2 Use tweezers or pliers to connect or disconnect the source heater wire leads at the ceramic source board (CSB). (See **Figure 49**.)

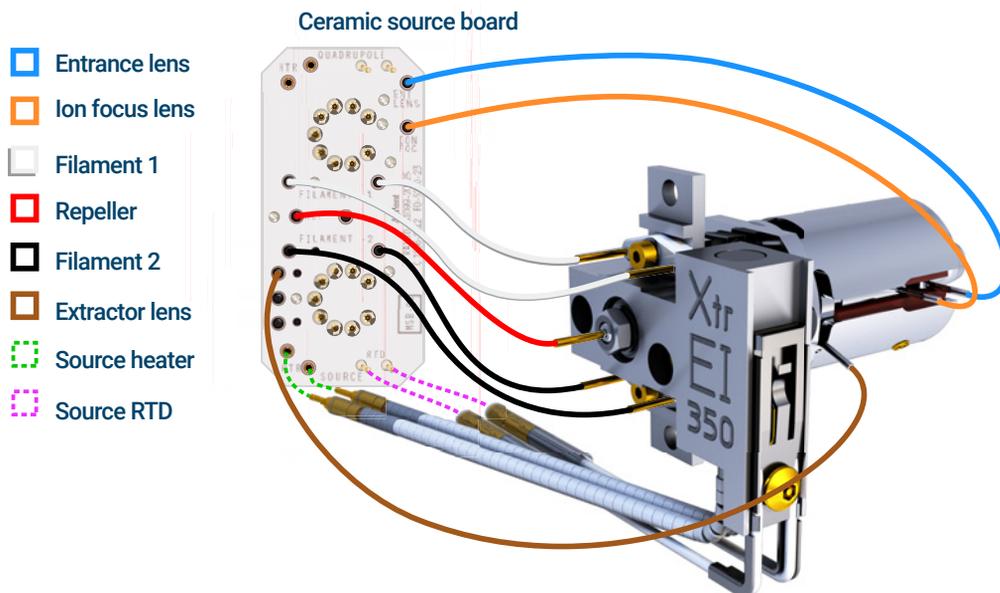


Figure 50. Wiring for the EI HydroInert source

# To Disassemble the EI HES

## Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Cloths, clean (05980-60051)
- T6 Torx driver, (8710-2548)
- Tweezers (8710-2460)



## Procedure

Refer to the exploded parts view and the EI HES parts list while using this procedure. (See **Figure 51** on page 170 and **Table 15** on page 170.)

- 1 Place a clean cloth on your work surface to hold the ion source parts.
- 2 Use a T6 Torx screwdriver to remove the screw securing the filament block to the source mount and using the finger grip, remove the filament block.

### CAUTION

**Use care when removing the filament from the filament block. Putting excessive stress on this can break or crack it. If this happens, do not attempt to operate with a defective filament, it must be replaced.**

- 3 Remove the dual filament from the filament block by lifting the source body up off of the filament block, while holding the filament block so that the dual filament will not fall and become damaged.
- 4 Remove the finger grip from the filament block.
- 5 Use a T6 Torx screwdriver to remove the two screws securing the source mount to the source body.
- 6 Use the finger grip to remove the source mount from the lens body.
- 7 Remove the repeller and ring heater sensor assembly from the source body.
- 8 Separate the repeller from the ring heater assembly.
- 9 Use a T6 Torx screwdriver to remove the screw and locking ring for the lens insulator that secures the lens stack in the source body, then remove the lens stack.
- 10 If necessary, use gravity to remove the lens stack ceramic insulator from the source body.

**CAUTION**

Use care when removing the lenses from the lens insulator casing. Putting excessive stress on this casing can break or crack it. If this happens, do not attempt to operate with a defective lens insulator, it must be replaced.

11 Remove the five lenses from the lens insulator/holder.

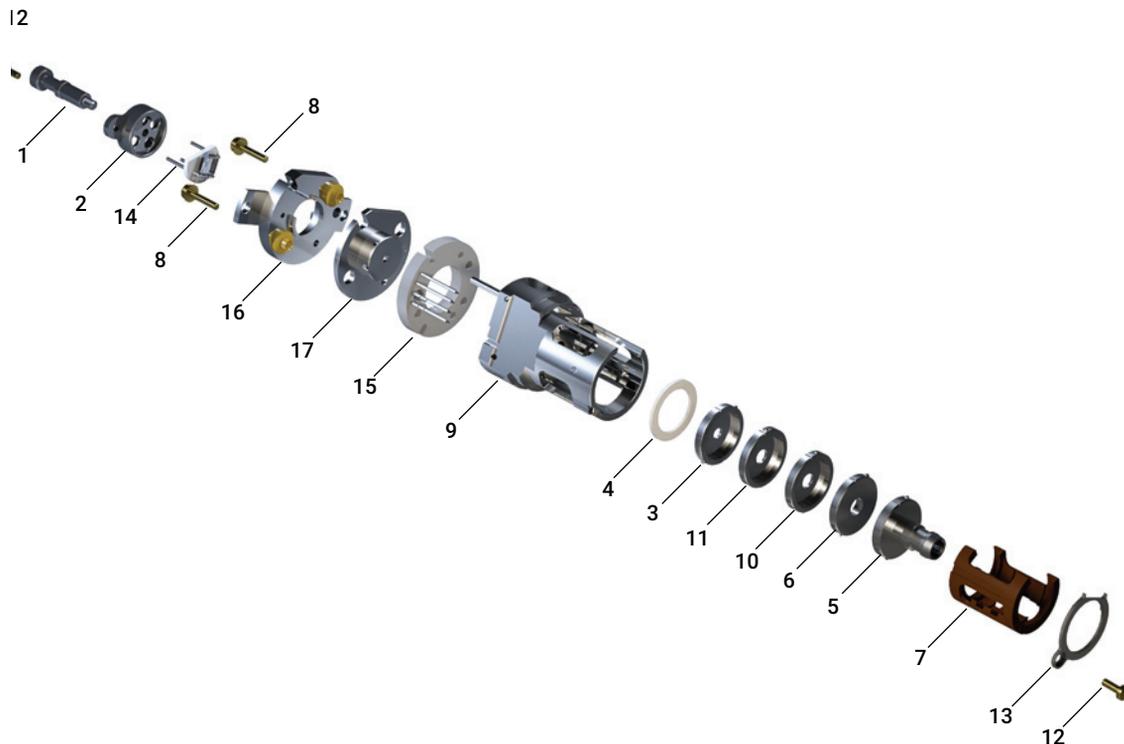


Figure 51. Exploded parts view of the EI HES

**Table 15** Parts list for EI HES (Figure 51)

Item number	Item description	Part number
1	Source finger grip	G7002-20008
2	Filament block	G7002-20019
3	Extractor lens (5)*, with 3 mm opening	G7004-20061
4	Ceramic insulator for extractor	G7002-20064

## 7 General Maintenance

**Table 15 Parts list for EI HES (Figure 51) (continued)**

Item number	Item description	Part number
5	Entrance lens assembly, Extended, HES (1)*	Gxxxx-xxxxx
6	Ion focus lens (2)*	G7004-20068
7	Lens insulator/holder	G7002-20074
8	M2 x 0.4 screw x 12 mm long gold plated screw	G7002-20083
9	Source body	G7002-20084
10	Post extractor lens 2 (3)*	G7004-20090
11	Post extractor lens 1 (4)*	G7004-20004
12	M2 x 6 mm gold plated screw	G7002-20109
13	Locking ring lens insulator	G7002-20126
14	High efficiency dual filament	G7002-60001
15	Ring heater/sensor assembly	G7002-60043
16	Source mount 1.5 mm	G7002-60053
17	Repeller assembly	G7002-60057
Not shown	HES assembly	Gxxxx-xxxxx

\* The number in parenthesis is the number engraved on the lens

## To Disassemble the EI HES 2.0

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Cloths, clean (05980-60051)
- T6 Torx driver, (8710-2548)
- Tweezers (8710-2460)



### Procedure

Refer to the exploded parts view and the EI HES 2.0 parts list while using this procedure. (See **Figure 52** on page 173 and **Table 16** on page 174.)

- 1 Place a clean cloth on your work surface to hold the ion source parts.
- 2 Use a T6 Torx screwdriver to remove the screw securing the filament block to the source mount, invert the source, and using the finger grip, remove the washer and filament block.

### CAUTION

**Use care when removing the filament from the filament block. Putting excessive stress on this can break or crack it. If this happens, do not attempt to operate with a defective filament, it must be replaced.**

- 3 Remove the dual filament from the filament block by lifting the source body up off of the filament block, while holding the filament block so that the dual filament will not fall and become damaged.
- 4 Use a T6 Torx screwdriver to remove the two screws securing the source mount to the source body.
- 5 Remove the source mount from the lens body.
- 6 Remove the repeller and ring heater sensor assembly from the source body.
- 7 Separate the repeller from the ring heater assembly.
- 8 Use a T6 Torx screwdriver to remove the screw and locking ring for the lens insulator that secures the lens stack in the source body, then remove the lens stack.
- 9 If necessary, use gravity to remove the lens stack ceramic insulator from the source body.

**CAUTION**

Use care when removing the lenses from the lens insulator casing. Putting excessive stress on this casing can break or crack it. If this happens, do not attempt to operate with a defective lens insulator, it must be replaced.

**10** Remove the five lenses from the lens insulator/holder.

Start with item 3 in [Figure 52](#), followed by items 11, 10, 6, and 5. When you remove the split extractor lens with insulator (item 10), detach the insulator from the metal lens halves.

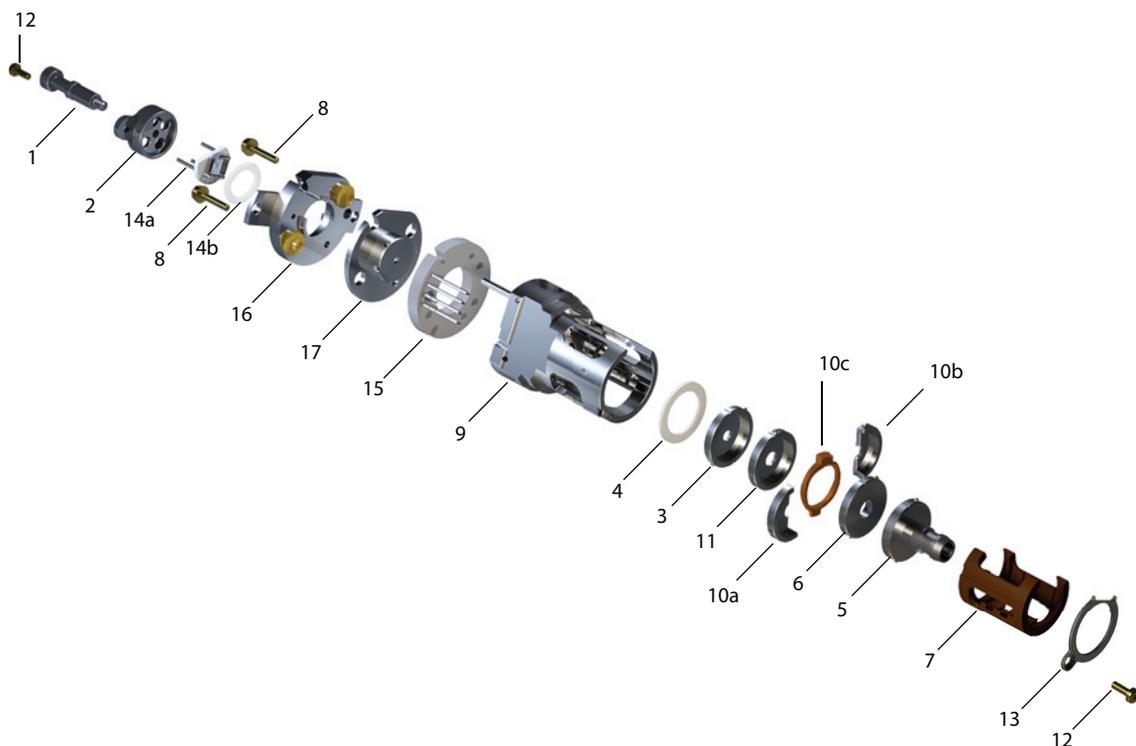


Figure 52. Exploded parts view of the EI HES 2.0

Table 16 Parts list for EI HES 2.0 (Figure 52)

Item number	Item description	Part number
1	Source finger grip	G7002-20008
2	Filament block, Offset	G7007-20019
3	Extractor lens (5)*, with 3 mm opening	G7004-20061
4	Ceramic insulator for extractor	G7002-20064
5	Entrance lens assembly, Extended, HES (1)*	Gxxxx-xxxxx
6	Ion focus lens (2)*	G7004-20068
7	Insulated lens holder – accepts Split Lens 10	G7007-20074
8	M2 x 0.4 screw x 12 mm long gold plated screw	G7002-20083
9	Source body	G7002-20084
10a	Post extractor lens 2, Split-left (3)*	G7007-20090
10b	Post extractor lens 2, Split-right (3)*	G7007-20091
10c	Post extractor insulator for lens 3 (3)*	G7007-20092
11	Post extractor lens 1 (4)*	G7004-20004
12	M2 x 6 mm gold plated screw	G7002-20109
13	Locking ring lens insulator	G7002-20126
14a	High efficiency dual filament	G7002-60001
14b	Filament spacer, 1 mm	G7007-20023
15	Ring heater/sensor assembly	G7002-60043
16	Source mount assembly	G7007-60053
17	Repeller assembly	G7002-60057
Not shown	HES 2.0 assembly	G7007-67056

\* The number in parenthesis is the number engraved on the lens

## To Disassemble the EI XTR 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)
- Nut driver, 5.5 mm (8710-1220)
- Tweezers (8710-2460)



### Procedure

Refer to the exploded parts view and the EI XTR parts list while using this procedure. (See **Figure 53** and **Table 17** on page 176.)

- 1 Remove the ion source. (See **“To Remove the EI XTR or HydroInert Source”** on page 165.)
- 2 Remove the filaments. (See **“To Remove a Filament from the EI XTR or HydroInert Source”** on page 212.)
- 3 Separate the source heater assembly from the source body by removing the two screws. The source heater assembly includes the source heater, repeller, and related parts. (See **Figure 53** and **Table 17** on page 176.)
- 4 Disassemble the repeller assembly by removing the repeller nut, washers, ceramic insulators and repeller. (See **Figure 53** on page 176.)
- 5 Remove the setscrew securing the lenses to the source body.
- 6 Pull the lenses out of the source body and separate the lens insulator, ion focus lens, extractor lens, extractor lens insulator, and extended entrance lens. (See **Figure 53** on page 176.)

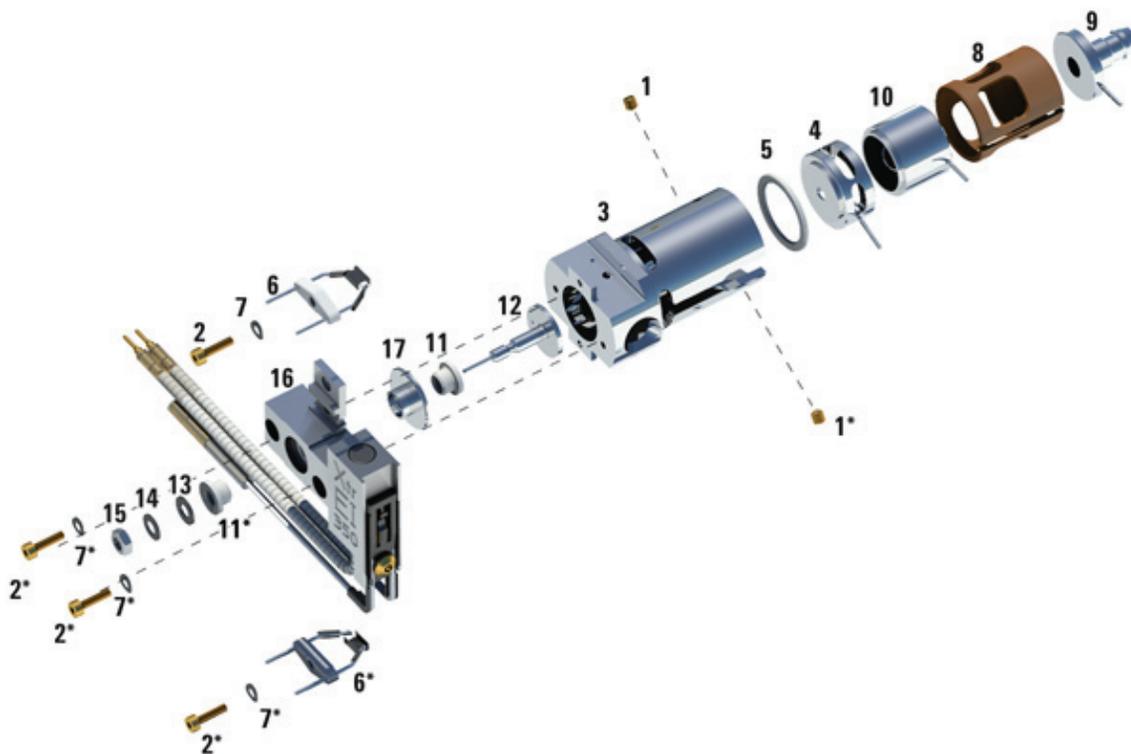


Figure 53. Disassembling the EI XTR source

Table 17 Parts list for EI XTR source (Figure 53)

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
7	Spring washer	3050-1301
7	Flat washer	3050-0982

Table 17 Parts list for EI XTR source (Figure 53) (continued)

Item	Description	Part number
8	Lens insulator	G3870-20530
9	Entrance lens assembly, Extended	G7000-20026
10	Ion focus lens	05971-20143
11	Repeller insulator	G1099-20113
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	Repeller block insert	G3870-20135
Not shown	EI XTR source assembly	G7003-67720

# To Disassemble the EI HydroInert 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)
- Nut driver, 5.5 mm (8710-1220)
- Tweezers (8710-2460)



## Procedure

Refer to the exploded parts view and the HydroInert parts list while using this procedure. (See **Figure 54** and **Table 18** on page 179.)

- 1 Remove the ion source. (See **“To Remove the EI XTR or HydroInert Source”** on page 165.)
- 2 Remove the filaments. (See **“To Remove a Filament from the EI XTR or HydroInert Source”** on page 212.)
- 3 Separate the source heater assembly from the source body by removing the two screws. The source heater assembly includes the source heater, repeller, and related parts. (See **Figure 54** and **Table 18** on page 179.)
- 4 Disassemble the repeller assembly by removing the repeller nut, washers, ceramic insulators and repeller. (See **Figure 54** on page 179.)
- 5 Remove the setscrew securing the lenses to the source body.
- 6 Pull the lenses out of the source body and separate the lens insulator, ion focus lens, extractor lens, extractor lens insulator, and extended entrance lens. (See **Figure 54** on page 179.)

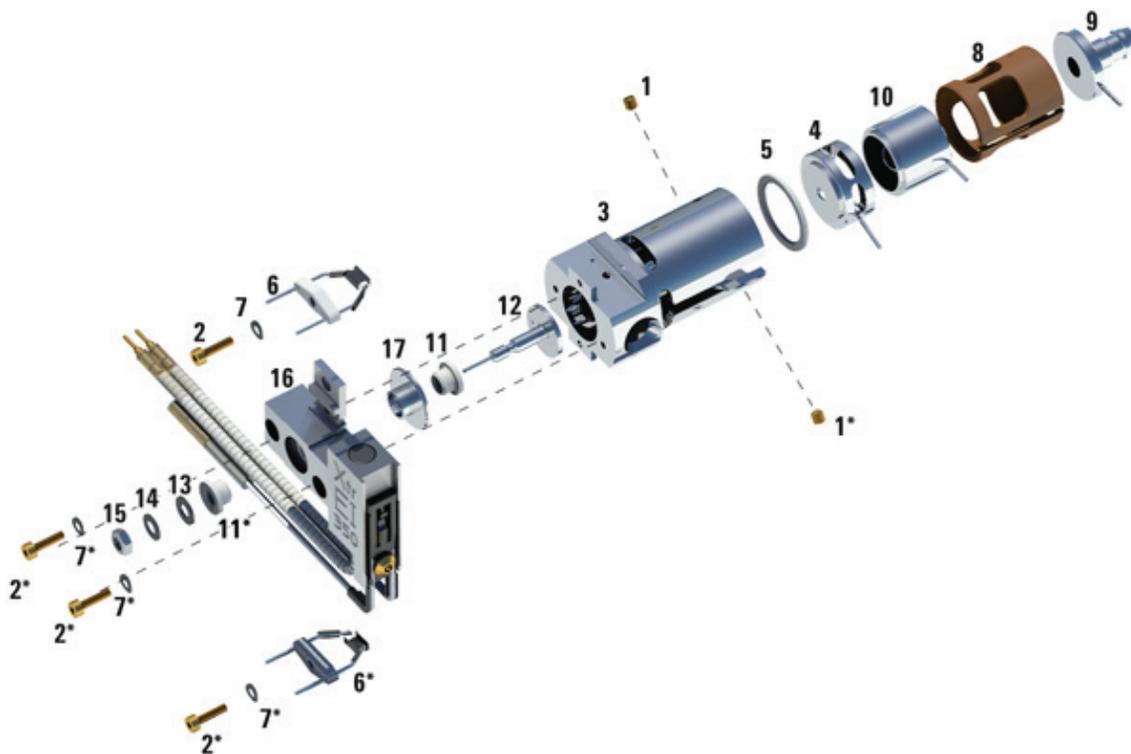


Figure 54. Disassembling the EI HydroInert source

**Table 18** Parts list for EI HydroInert source (Figure 54)

Item	Description	Part number
1	Setscrews	G3870-20446
2	Screws	G3870-20021
3	Source body, Coated	G7078-20903
4	Extractor lens, Coated	G7078-20909
5	Extractor lens insulator	G3870-20445
6	Filaments	G7005-60061
7	Spring washer	3050-1301
7	Flat washer	3050-0982

Table 18 Parts list for EI HydrolInert source (Figure 54) (continued)

Item	Description	Part number
8	Lens insulator	G3870-20530
9	Entrance lens assembly, Extended, Coated	G7006-60926
10	Ion focus lens, Coated	G7078-20905
11	Repeller insulator	G1099-20133
12	Repeller, Coated	G7078-20902
13	Flat washer	3050-0891
14	Belleville spring washer	3050-1301
15	Repeller nut	0535-0071
16	Source heater block assembly	G7078-20910
17	Repeller block insert, Coated	G7078-20901
Not shown	HydrolInert Ext Source TQ Assy	G7006-67930
Not shown	Wire, Extractor Lens	G7000-60827
Not shown	HydrolInert GC/TQ Upgrade	5505-0084

# To Clean the EI HES

## Materials needed

- Abrasive paper (5061-5896)
- Alumina abrasive powder, 100 g (393706201)
- 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
  - Methanol (reagent-grade)
  - Methylene chloride (reagent-grade)
  - Acetone (reagent-grade)
- Ultrasonic bath



## Procedure

- 1 Disassemble the ion source. (See **“To Disassemble the EI HES”** on page 169 or **“To Disassemble the EI XTR Source”** on page 175.)
- 2 Collect the following parts to be cleaned if you are cleaning an EI HES: (See **Figure 55** on page 182.)
  - Repeller
  - Source body
  - Extractor lens (5)
  - Post extractor lens 1 (4)
  - Post extractor lens 2 (3)
  - Ion focus lens (2)
  - Extended entrance lens (1)

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.

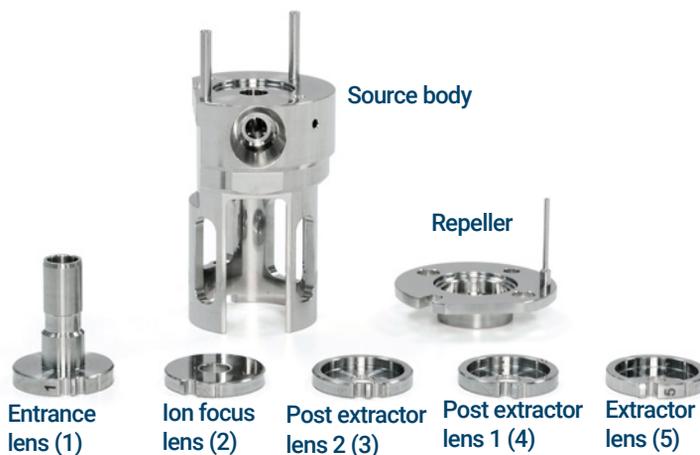


Figure 55. EI HES parts to be cleaned

**CAUTION**

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

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

**CAUTION**

**Do not use the abrasive slurry on the source mount bushings.**

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

## 7 General Maintenance

- 5 Rinse away all abrasive residue with reagent-grade methanol.  
Ensure *all* abrasive residue is rinsed away *before* ultrasonic cleaning. If the methanol becomes cloudy or contains visible particles, rinse again.
- 6 Separate the parts that were abrasively cleaned from the parts that were not abrasively cleaned.

### CAUTION

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

### WARNING

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

- 7 Ultrasonically clean the parts (each group separately) for 15 minutes in each of the following solvents:
  - Methylene chloride (reagent-grade)
  - Acetone (reagent-grade)
  - Methanol (reagent-grade)
- 8 Place the parts in a clean beaker. **Loosely** cover the beaker with clean aluminum foil (dull side down).
- 9 Dry the cleaned parts in an oven at 100 °C for 5–6 minutes.

## To Clean the EI HES 2.0

### Materials needed

- Abrasive paper (5061-5896)
- Alumina abrasive powder, 100 g (393706201)
- 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
  - Methanol (reagent-grade)
  - Methylene chloride (reagent-grade)
  - Acetone (reagent-grade)
- Ultrasonic bath



### Procedure

- 1 Disassemble the ion source. (See **“To Disassemble the EI HES 2.0”** on page 172 .)
- 2 Collect the following parts to be cleaned if you are cleaning an EI HES 2.0: (See **Figure 56** on page 185.)
  - Repeller
  - Source body
  - Extractor lens (5)
  - Post extractor lens 1 (4)
  - Split extractor lens (3)
  - Ion focus lens (2)
  - Extended entrance lens (1)

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.

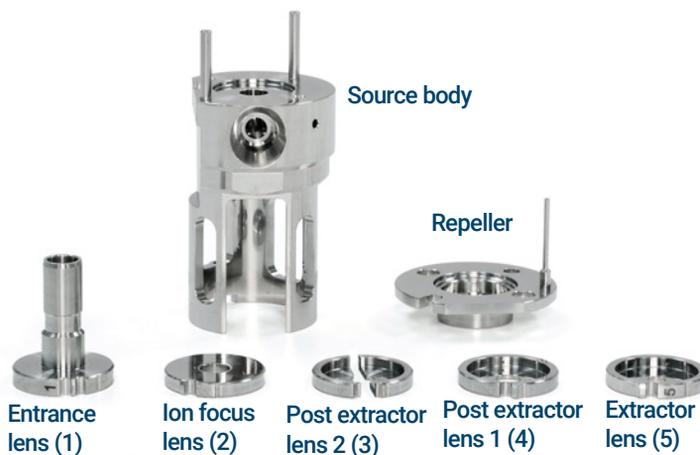


Figure 56. EI HES 2.0 parts to be cleaned

**CAUTION**

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

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

**CAUTION**

Do not use the abrasive slurry on the source mount bushings.

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

## 7 General Maintenance

- 5 Rinse away all abrasive residue with reagent-grade methanol.  
Ensure *all* abrasive residue is rinsed away *before* ultrasonic cleaning. If the methanol becomes cloudy or contains visible particles, rinse again.
- 6 Separate the parts that were abrasively cleaned from the parts that were not abrasively cleaned.

### CAUTION

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

### WARNING

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

- 7 Ultrasonically clean the parts (each group separately) for 15 minutes in each of the following solvents:
  - Methylene chloride (reagent-grade)
  - Acetone (reagent-grade)
  - Methanol (reagent-grade)
- 8 Place the parts in a clean beaker. **Loosely** cover the beaker with clean aluminum foil (dull side down).
- 9 Dry the cleaned parts in an oven at 100 °C for 5–6 minutes.

## To Clean the EI XTR Source

### Materials needed

- Abrasive paper (5061-5896)
- Alumina abrasive powder, 100 g (393706201)
- 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 EI XTR source. (See **"To Disassemble the EI XTR Source"** on page 175.)
- 2 Collect the following parts to be cleaned for an EI XTR source: (See **Figure 57** on page 188.)
  - Repeller
  - Repeller block insert
  - Entrance lens
  - Ion focus lens
  - Extractor lens
  - Source body

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.

### CAUTION

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



Figure 57. EI XTR source parts to be cleaned



### Procedure

- 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.

## 7 General Maintenance

- 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.

### WARNING

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

- 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.
- 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 five to six minutes.

### WARNING

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

### NOTE

**Take care to avoid contaminating 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 Clean the EI Hydrolnert Source

**CAUTION**

**Do not abrasively clean the coated parts of the source. Abrasives will destroy the coating and require a new part to be purchased.**

Replacement of Hydrolnert source parts is recommended if a reduction in sensitivity is observed that cannot be recovered by performing maintenance on the GCMS system. This maintenance should include items known to cause sensitivity problems such as syringe replacement, syringe wash replacement, inlet cleaning, inlet consumables replacement, column replacement, and rough pump maintenance.

The coated parts of the Hydrolnert source shown in the figure below are the parts labeled 17, 12, 3, 4, 10 and 9. After disassembly, if an examination of the 12-Repeller and 4-extractor lens shows a buildup of residue, replace these parts. Additionally, replacement of the insulators, 5-Extractor Lens insulator and 11-Repeller Insulator, is recommended. See **Table 19** on page 191 for a list of part numbers.

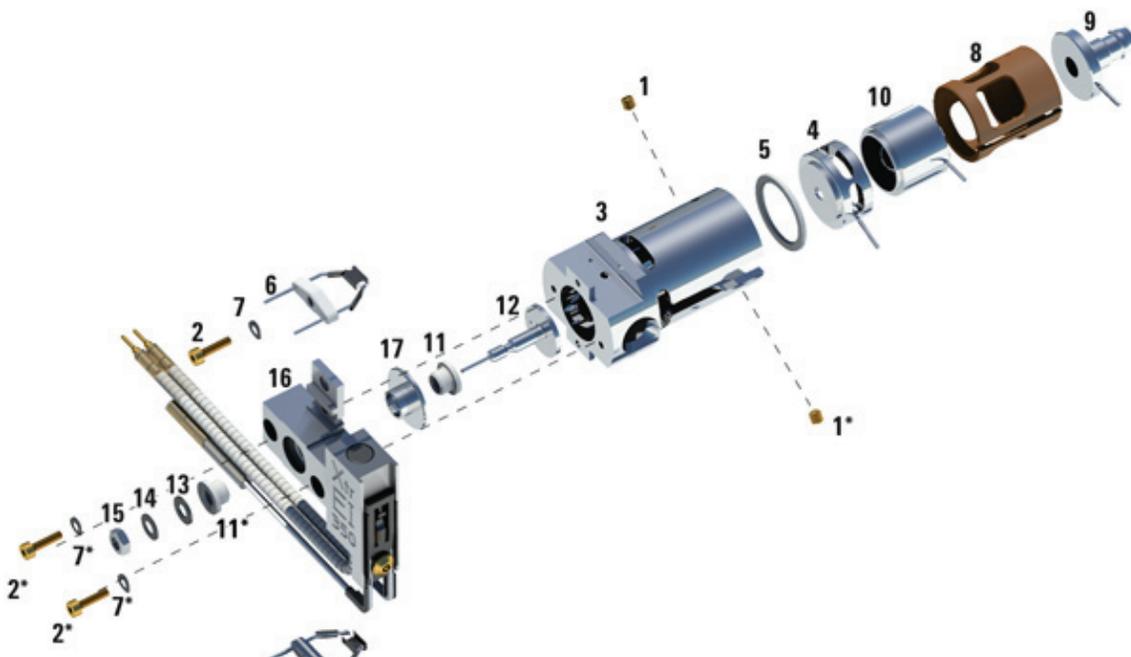


Figure 58. Cleaning the EI Hydrolnert source

Table 19 Parts list for EI HydroInert source (Figure 54)

Item	Description	Part number
1	Setscrews	G3870-20446
2	Screws	G3870-20021
3	Source body, coated	G7078-20903
4	Extractor lens, coated	G7078-20909
5	Extractor lens insulator	G3870-20445
6	Filaments	G7005-60061
7	Spring washer	3050-1301
7	Flat washer	3050-0982
8	Lens insulator	G3870-20530
9	Entrance lens assembly, Extended, coated	G7006-60926
10	Ion focus lens, coated	G7078-20905
11	Repeller insulator	G1099-20133
12	Repeller, coated	G7078-20902
13	Flat washer	3050-0891
14	Belleville spring washer	3050-1301
15	Repeller nut	0535-0071
16	Source heater block assembly	G7078-20910
17	Repeller block insert, coated	G7078-20901
Not shown	HydroInert Ext Source TQ Assy	G7006-67930
Not shown	Wire, Extractor Lens	G7000-60827
Not shown	HydroInert GC/TQ Upgrade	5505-0084

## To Assemble the EI HES

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- T6 Torx driver, (8710-2548)
- Tweezers (8710-2460)



### Procedure

#### CAUTION

**Always wear clean gloves when working in the analyzer chamber to avoid contamination.**

Refer to the exploded parts view and the EI HES parts list while using this procedure. (See [Figure 61](#) and [Table 20](#) on page 195.)

#### CAUTION

**Use care when inserting the lenses into the lens insulator casing. Putting excessive stress on this casing can break or crack it. If this happens, do not attempt to operate with a defective lens insulator, it must be replaced.**

- 1 Assemble the five lenses inside the lens insulator. (See [Figure 59](#).) The lens number is engraved into the outer circumference of each lens.
  - a Starting with the extended entrance lens 1, set the lens into the end groove in the lens insulator and rotate the lens until you feel the ball seat into the circular recess on the back of the lens insulator.
  - b Insert the next 4 lenses, in numerical order, into the lens insulator. The lens chamber open end always faces the extended entrance lens 1. Rotate each lens until you feel the ball seat into the circular recess.

It is easier to insert lens 5 on an angle because the lens stack at this point makes the lens insulator less flexible.

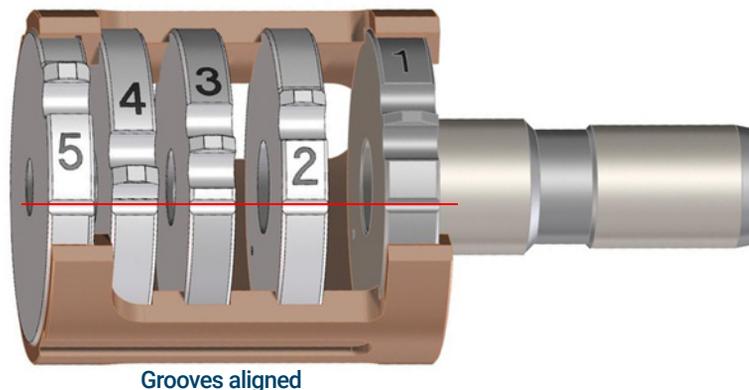


Figure 59. Assembled EI HES lens stack

- 2 Insert the extractor ceramic insulator into the source body.

**CAUTION**

**The ceramic insulator must be positioned flat against the source body when inserting the lens stack in the next step.**

- 3 Insert the lens stack encased in the insulator into the source body. (See **Figure 61** on page 195.) The engraved numbers face the full opening extending to the end of the source body. Verify that the ceramic is sitting flush at the end of the source body.
- 4 Using the T6 Torx driver, install and secure the gold plated setscrew and lock ring lens insulator that holds the lens assembly in place. (See **Figure 60**.)



Figure 60. Secure the lens screw and locking ring insulator

- 5 Place the heater/sensor assembly over the guide pins on the source body with the four electrical pins oriented down the flat side of the source body.
- 6 Place the repeller onto the heater/sensor assembly with the flat side of the repeller circumference aligned with the interface socket in the source body.
- 7 Place the source mount over the repeller.
- 8 Finger tighten the two gold plated screws using a T6 Torx screwdriver to secure the source mount to the source body.

### CAUTION

**Do not overtighten the screws in the source body. Damage may occur to the repeller.**

- 9 Thread the finger grip into the filament block. (See [Figure 61](#) and [Table 20](#) on page 195.)
- 10 On the side of the filament block opposite the finger grip, orient the dual filament ceramic holder so that it lines up with the flat of the filament block. Fully insert the three filament leads into the filament block.
- 11 Inset the filament block into the source holder, and use a T6 Torx screwdriver to secure it to the holder with the gold plated screw.

## 7 General Maintenance

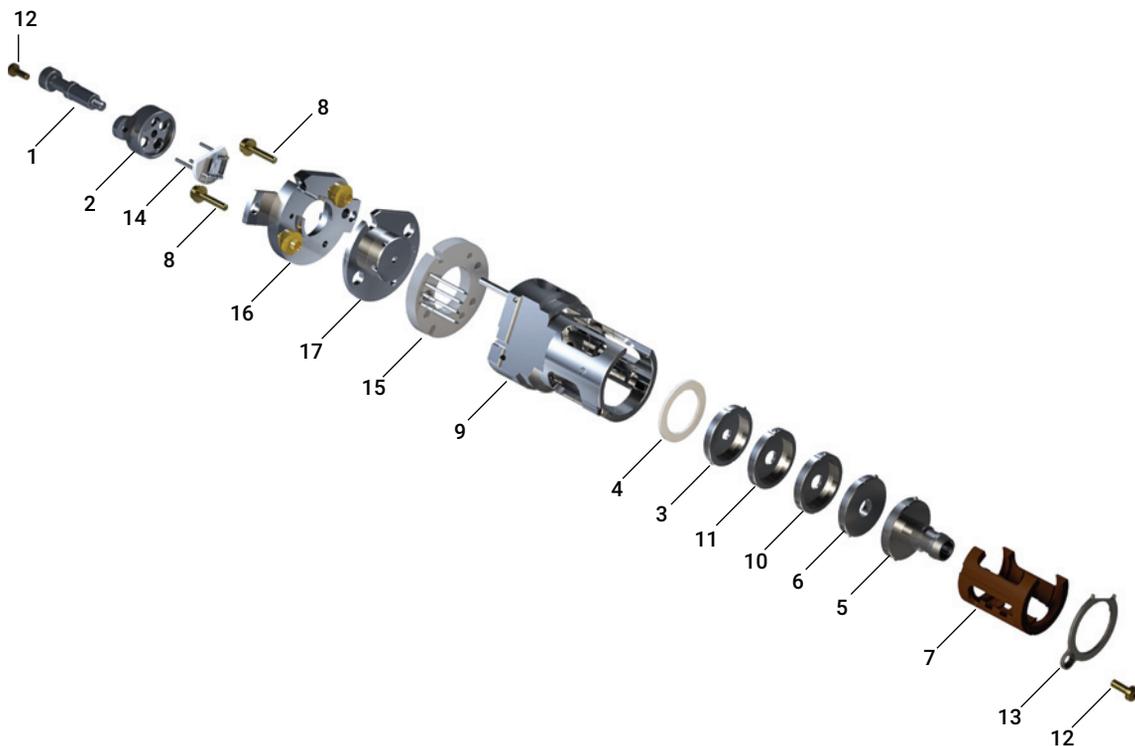


Figure 61. Assembling the EI HES

**Table 20** Parts list for EI HES (Figure 61)

Item number	Item description	Part number
1	Source finger grip	G7002-20008
2	Filament block	G7002-20019
3	Extractor lens (5)*, with 3 mm opening	G7004-20061
4	Ceramic insulator for extractor	G7002-20064
5	Entrance lens assembly, Extended, HES (1)*	Gxxxx-xxxxx
6	Ion focus lens (2)*	G7004-20068
7	Lens insulator/holder	G7002-20074
8	M2 × 0.4 screw × 12 mm long gold plated screw	G7002-20083
9	Source body	G7002-20084

Table 20 Parts list for EI HES (Figure 61) (continued)

Item number	Item description	Part number
10	Post extractor lens 2 (3)*	G7004-20090
11	Post extractor lens 1 (4)*	G7004-20004
12	M2 x 6 mm gold plated screw	G7002-20109
13	Locking ring lens insulator	G7002-20126
14	High efficiency dual filament	G7002-60001
15	Ring heater/sensor assembly	G7002-60043
16	Source mount 1.5 mm	G7002-60053
17	Repeller assembly	G7002-60057
Not shown	HES assembly	Gxxxx-xxxxx

\* The number in parenthesis is the number engraved on the lens

# To Assemble the EI HES 2.0

## Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- T6 Torx driver, (8710-2548)
- Tweezers (8710-2460)



## Procedure

### CAUTION

**Always wear clean gloves when working in the analyzer chamber to avoid contamination.**

Refer to the exploded parts view and the EI HES 2.0 parts list while using this procedure. (See [Figure 64](#) on page 200 and [Table 21](#) on page 200.)

### CAUTION

**Use care when inserting the lenses into the lens insulator casing. Putting excessive stress on this casing can break or crack it. If this happens, do not attempt to operate with a defective lens insulator, it must be replaced.**

- 1 Assemble the five lenses inside the lens insulator. (See [Figure 62](#).) The lens number is engraved into the outer circumference of each lens.
  - a Starting with the extended entrance lens (1), set the lens into the end groove in the lens insulator and rotate the lens until you feel the ball seat into the circular recess on the back of the lens insulator.

For lenses (2) – (5), the lens chamber open end always faces the extended entrance lens (1). Rotate each lens until you feel the ball seat into the circular recess.
  - b Insert the ion focus lens (2) into the lens insulator.
  - c Assemble the left and right post extractor split halves onto post extractor insulator for lens (3), then install the assembled post extractor lens (3) into the lens insulator.
  - d Insert the remaining lenses, in numerical order, into the lens insulator.

It is easier to insert lens 5 on an angle because the lens stack at this point makes the lens insulator less flexible.

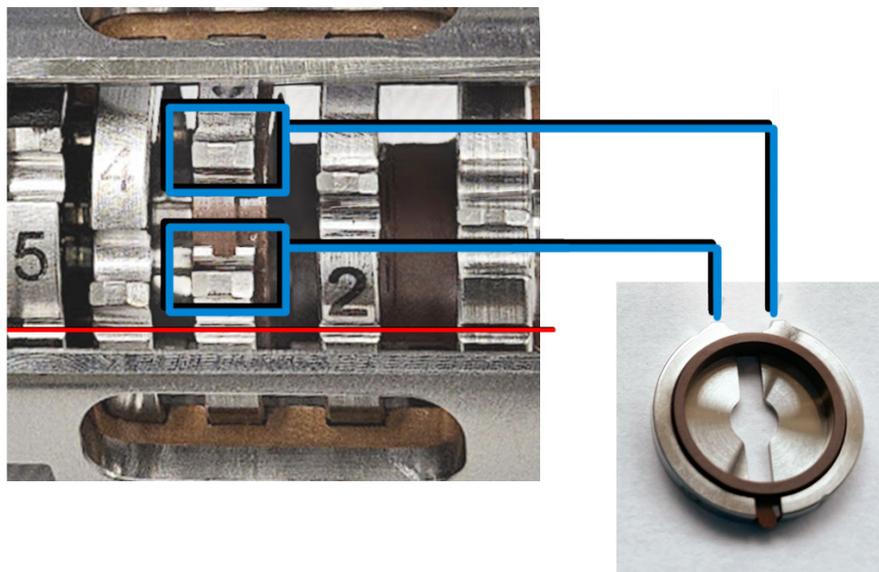


Figure 62. Assembled EI HES 2.0 lens stack

- 2 Insert the extractor ceramic insulator into the source body.

**CAUTION**

**The ceramic insulator must be positioned flat against the source body when inserting the lens stack in the next step.**

- 3 Insert the lens stack encased in the insulator into the source body. (See [Figure 64](#) on page 200.) The engraved numbers face the full opening extending to the end of the source body. Verify that the ceramic is sitting flush at the end of the source body.
- 4 Using the T6 Torx driver, install and secure the gold plated setscrew and lock ring lens insulator that holds the lens assembly in place. (See [Figure 63](#).)



Figure 63. Secure the lens screw and locking ring insulator

- 5 Place the heater/sensor assembly over the guide pins on the source body with the four electrical pins oriented down the flat side of the source body.
- 6 Place the repeller onto the heater/sensor assembly with the flat side of the repeller circumference aligned with the interface socket in the source body.
- 7 Place the source mount over the repeller.
- 8 Finger tighten the two gold plated screws using a T6 Torx screwdriver to secure the source mount to the source body.

### CAUTION

**Do not overtighten the screws in the source body. Damage may occur to the repeller.**

- 9 Thread the finger grip into the filament block. (See [Figure 64](#) and [Table 21](#) on page 200.)
- 10 On the side of the filament block opposite the finger grip, orient the dual filament ceramic holder so that it lines up with the flat of the filament block. Fully insert the three filament leads into the filament block.
- 11 Inset the filament block into the source holder, and use a T6 Torx screwdriver to secure it to the holder with the gold plated screw.

## 7 General Maintenance

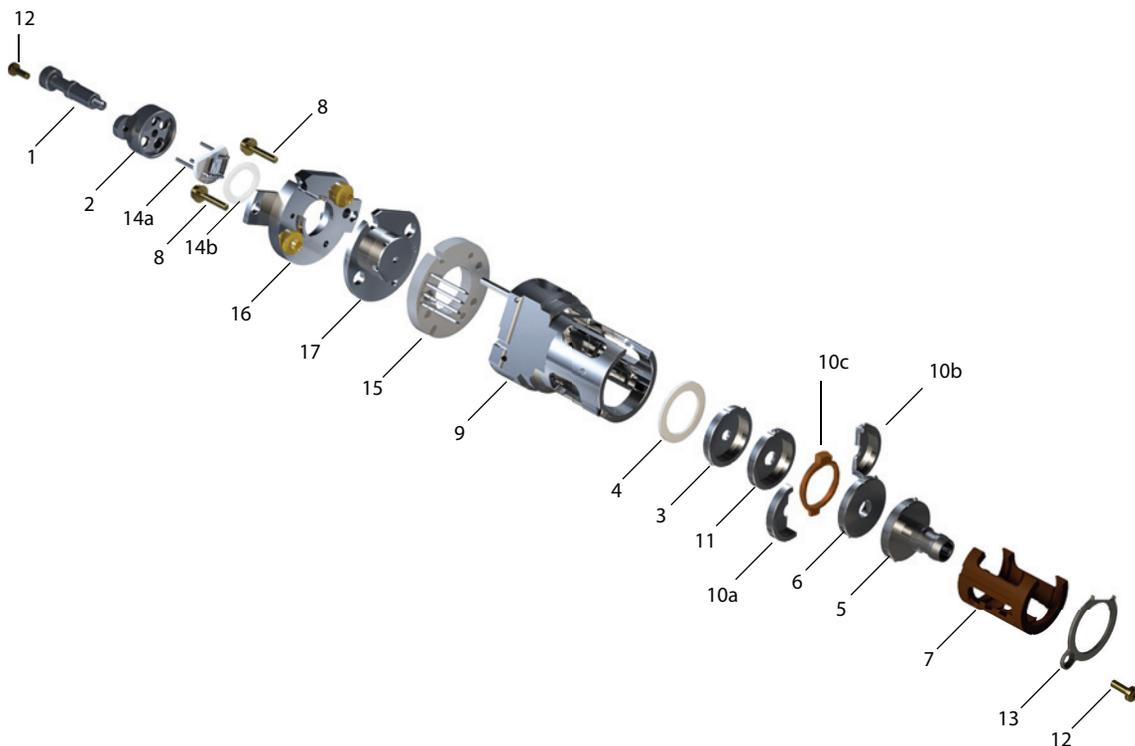


Figure 64. Assembling the EI HES 2.0

**Table 21** Parts list for EI HES 2.0 (Figure 64)

Item number	Item description	Part number
1	Source finger grip	G7002-20008
2	Filament block	G7007-20019
3	Extractor lens (5)*, with 3 mm opening	G7004-20061
4	Ceramic insulator for extractor	G7002-20064
5	Entrance lens assembly, Extended, HES (1)*	Gxxxx-xxxxx
6	Ion focus lens (2)*	G7004-20068
7	Insulated lens holder – accepts Split Lens 10	G7007-20074
8	M2 × 0.4 screw × 12 mm long gold plated screw	G7002-20083
9	Source body	G7002-20084

## 7 General Maintenance

**Table 21** Parts list for EI HES 2.0 (Figure 64) (continued)

Item number	Item description	Part number
10a	Post extractor lens 2, Split-left 2 (3)*	G7007-20090
10b	Post extractor lens 2, Split-right (3)*	G7007-20091
10c	Post extractor insulator for lens 3 (3)*	G7007-20092
11	Post extractor lens 1 (4)*	G7004-20004
12	M2 × 6 mm gold plated screw	G7002-20109
13	Locking ring lens insulator	G7002-20126
14a	High efficiency dual filament	G7002-60001
14b	Filament spacer, 1 mm	G7007-20023
15	Ring heater/sensor assembly	G7007-60043
16	Source mount assembly	G7007-60053
17	Repeller assembly	G7002-60057
Not shown	HES 2.0 assembly	G7007-67056

\* The number in parenthesis is the number engraved on the lens

# To Assemble the EI XTR 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

### CAUTION

**Always wear clean gloves when working in the analyzer chamber to avoid contamination.**

Refer to the exploded parts view and the EI XTR parts list while using this procedure. (See **Figure 65** and **Table 22** on page 203.)

- 1 Assemble the ion focus lens, extended entrance lens, and lens insulator. (See **Figure 65** and **Table 22** on page 203.)
- 2 Attach the extractor lens insulator to the extractor lens, and slide them into the source body. (See **Figure 65** on page 203.)
- 3 Slide the parts assembled in step 1 into the source body.
- 4 Install the setscrew that holds the lenses in place.

### CAUTION

**While installing, 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.**

- 5 Assemble the repeller assembly by attaching the repeller, repeller insulators, washers, and repeller nut onto the source heater assembly.
- 6 Attach the repeller assembly to the source body with two screws and washers.
- 7 Install the filaments. (See **“To Install a Filament on the EI XTR or HydroInert Source”** on page 214.)

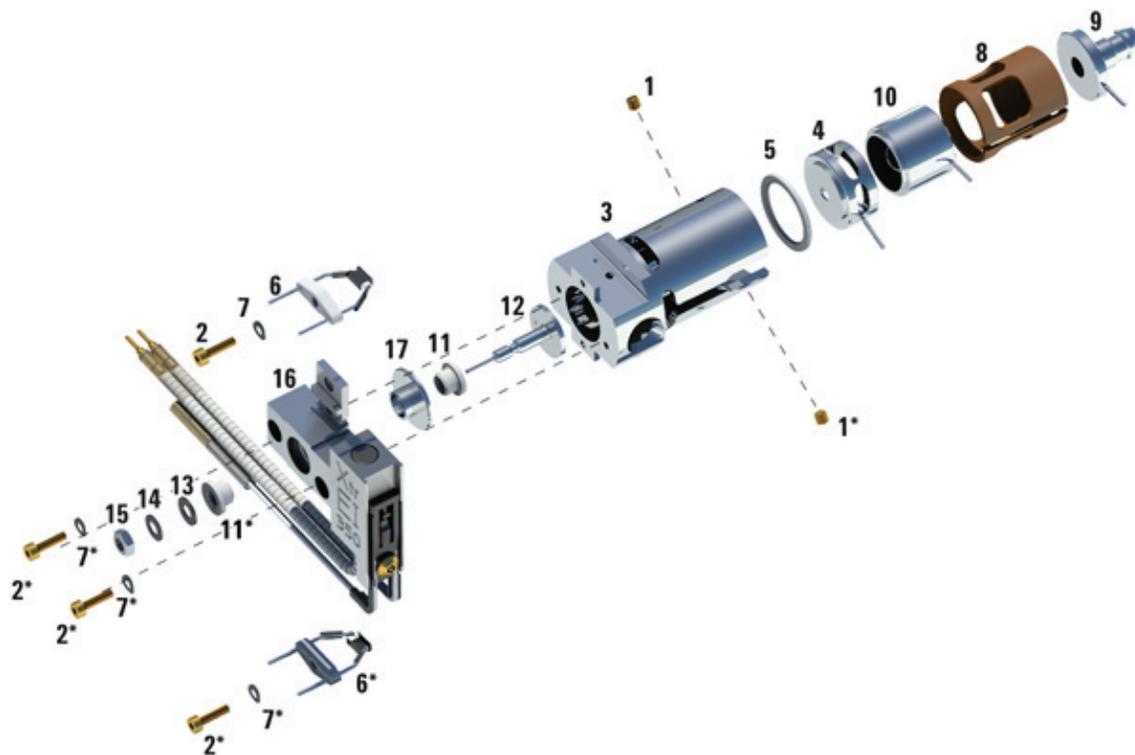


Figure 65. Assembling the EI XTR source

Table 22 Parts list for EI XTR source (Figure 65)

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
7	Spring washer	3050-1301
7	Flat washer	3050-0982

Table 22 Parts list for EI XTR source (Figure 65) (continued)

Item	Description	Part number
8	Lens insulator	G3870-20530
9	Entrance lens assembly, Extended	G7000-20026
10	Ion focus lens	05971-20143
11	Repeller insulator	G1099-20113
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	Repeller block insert	G3870-20135
Not shown	EI XTR source assembly	G7003-67720

# To Assemble the EI HydroInert 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

### CAUTION

**Always wear clean gloves when working in the analyzer chamber to avoid contamination.**

Refer to the exploded parts view and the EI XTR parts list while using this procedure. (See **Figure 66** and **Table 23** on page 206.)

- 1 Assemble the ion focus lens, extended entrance lens, and lens insulator. (See **Figure 66** and **Table 23** on page 206.)
- 2 Attach the extractor lens insulator to the extractor lens, and slide them into the source body. (See **Figure 66** on page 206.)
- 3 Slide the parts assembled in step 1 into the source body.
- 4 Install the setscrew that holds the lenses in place.

### CAUTION

**While installing, 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.**

- 5 Assemble the repeller assembly by attaching the repeller, repeller insulators, washers, and repeller nut onto the source heater assembly.
- 6 Attach the repeller assembly to the source body with two screws and washers.
- 7 Install the filaments. (See **“To Install a Filament on the EI XTR or HydroInert Source”** on page 214.)

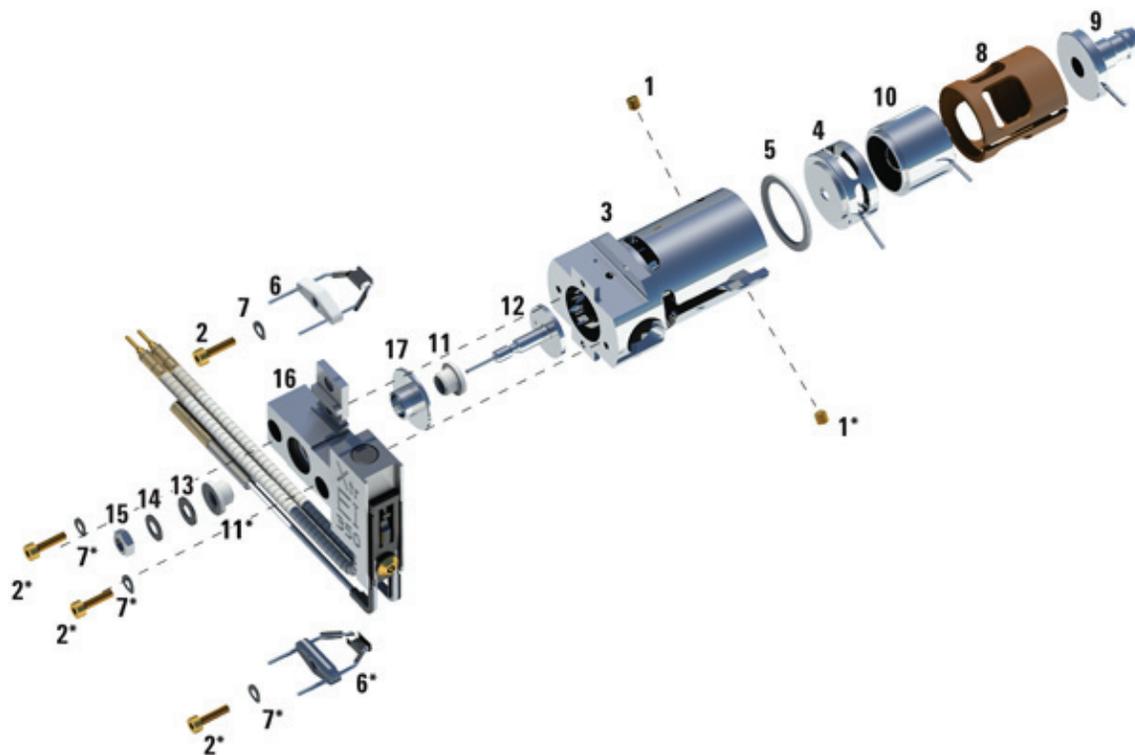


Figure 66. Assembling the EI HydroInert source

**Table 23** Parts list for EI HydroInert source (Figure 66)

Item	Description	Part number
1	Setscrews	G3870-20446
2	Screws	G3870-20021
3	Source body	G7078-20903
4	Extractor lens	G7078-20909
5	Extractor lens insulator	G3870-20445
6	Filaments	G7005-60061
7	Spring washer	3050-1301
7	Flat washer	3050-0982

Table 23 Parts list for EI HydroInert source (Figure 66) (continued)

Item	Description	Part number
8	Lens insulator	G3870-20530
9	Entrance lens assembly, Extended	G7006-60926
10	Ion focus lens	G7078-20905
11	Repeller insulator	G1099-20133
12	Repeller	G7078-20902
13	Flat washer	3050-0891
14	Belleville spring washer	3050-1301
15	Repeller nut	0535-0071
16	Source heater block assembly	G7078-20910
17	Repeller block insert	G7078-20901
Not shown	EI XTR source assembly	

## To Install the EI HES or HES 2.0

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460), Pliers, long-nose (8710-1094)



### Procedure

#### CAUTION

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

- 1 Vent the MS. (See **“To Vent the MS”** on page 124.)
- 2 Open the front analyzer chamber. (See **“To Open the Front Analyzer Chamber”** on page 159.)
- 3 Align the ion source so that the slotted opening for the lens stack, where the lens numbers are visible, is on the right side. Also, position it so the two attachment tabs of the source mount align with the corresponding slots in the source radiator. (See **Figure 67**). Slide the ion source into the source radiator until resistance is felt.

EI HES  
thumbscrew  
attachment

Slots for source  
mount alignment

EI HES thumbscrew  
attachment

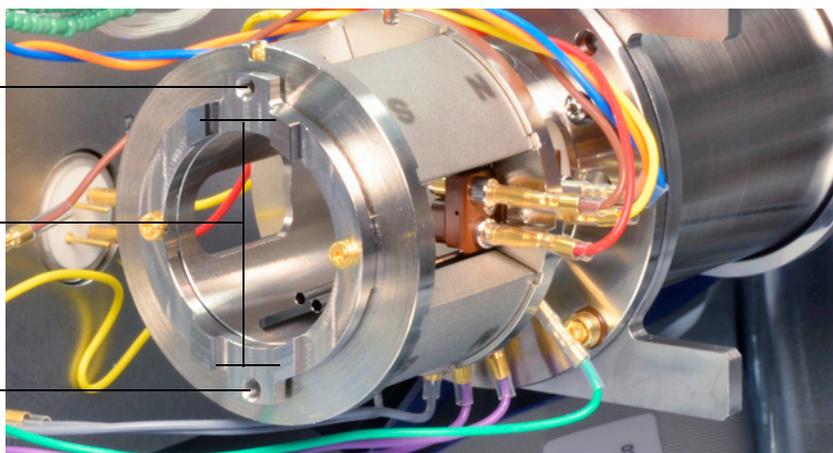


Figure 67. The EI HES radiator

## 7 General Maintenance

- 4 Snap the source into place so that the source mount tabs are flush against the source mount attachment surface of radiator. Some force is required to overcome the resistance of the electrical contacts, spring loaded surfaces.
- 5 Connect the ion source wires. (See **“To Connect or Disconnect Wiring to the EI HES or HES 2.0”** on page 164.)
- 6 Install and hand-tighten the source thumbscrews. Do not overtighten the thumbscrews. (See **Figure 67** on page 208.)
- 7 Close the front analyzer chamber. (See **“To Close the Front Analyzer Chamber”** on page 218.)
- 8 Pumpdown the MS. (See **“To Pumpdown the MS”** on page 120.)
- 9 Tune the MS. (See **“To Autotune the MS for EI Mode”** on page 117.)

## To Install the EI XTR or HydroInert Source

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)
- Pliers, long-nose (8710-1094)



### Procedure

#### CAUTION

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

- 1 Vent the MS. (See **"To Vent the MS"** on page 124.)
- 2 Open the front analyzer chamber. (See **"To Open the Front Analyzer Chamber"** on page 159.)
- 3 Slide the ion source into the source radiator. (See **Figure 68** on page 211.)
- 4 Install and hand-tighten the source thumbscrews. Do not overtighten the thumbscrews. (See **Figure 68** on page 211.)
- 5 Connect the ion source wires. (See **"To Connect or Disconnect Wiring to the EI XTR Source"** on page 167 or **"To Connect or Disconnect Wiring to the EI HydroInert Source"** on page 168.)

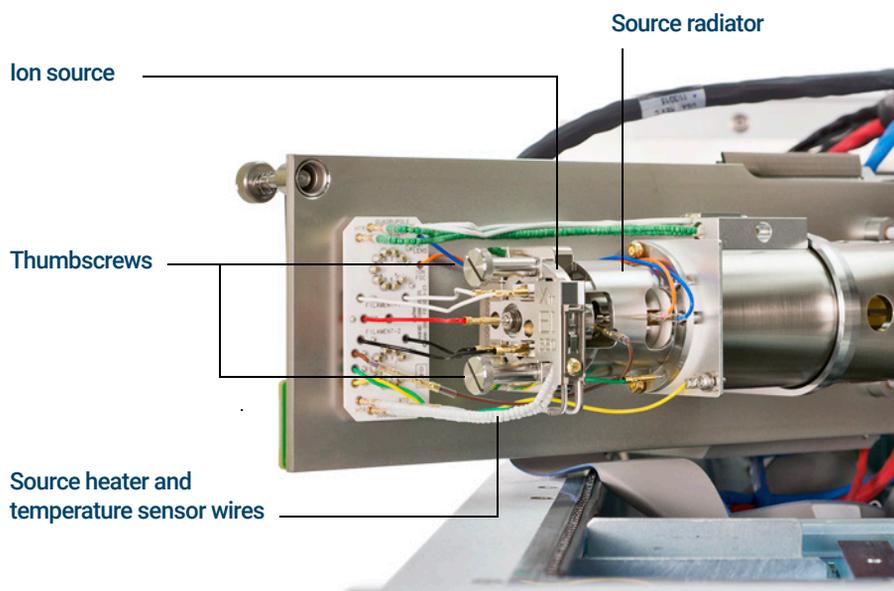


Figure 68. Installing the EI XTR or HydroInert source on a 7000 Series MS

- 6 Close the front analyzer chamber. (See **“To Close the Front Analyzer Chamber”** on page 218.)
- 7 Pumpdown the MS. (See **“To Pumpdown the MS”** on page 120.)
- 8 Tune the MS. (See **“To Autotune the MS for EI Mode”** on page 117.)

# To Remove a Filament from the EI XTR or HydroInert Source

## Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Hex ball driver, 1.5 mm (8710-1570)
- Tweezers (8710-2460)



## Procedure

- 1 Vent the MS. (See **“To Vent the MS”** on page 124.)

### CAUTION

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

### 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.

- 2 Open the front analyzer chamber. (See **“To Open the Front Analyzer Chamber”** on page 159.)
- 3 Remove the ion source. (See **“To Remove the EI XTR or HydroInert Source”** on page 165.)
- 4 Remove the screws holding the filaments to the ion source body. (See **Figure 69** on page 213.)
- 5 Slide the filaments off the ion source assembly. (See **Figure 69** on page 213.)

## 7 General Maintenance

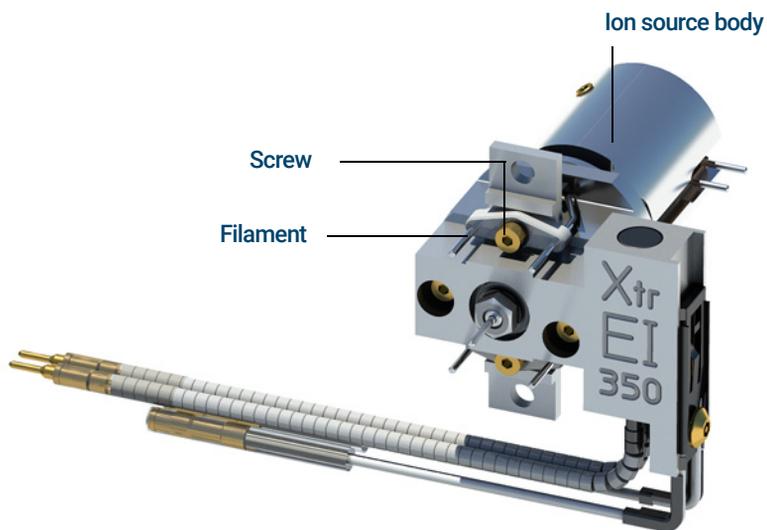


Figure 69. Changing the EI XTR or HydroInert Source filament

# To Install a Filament on the EI XTR or HydroInert Source

## Materials needed

- Filament assembly, EI (G7005-60061)
- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)



## Procedure

- 1 Remove the old filament. (See **“To Remove a Filament from the EI XTR or HydroInert Source”** on page 212.)
- 2 Place the new filament into its position on the ion source body. (See **Figure 69** on page 213.)
- 3 Secure the filament to the ion source body with the screw.
- 4 After installing the filament, verify that it is not grounded to source body.
- 5 Reinstall the ion source. (See **“To Install the EI XTR or HydroInert Source”** on page 210.)
- 6 Close the front analyzer chamber. (See **“To Close the Front Analyzer Chamber”** on page 218.)
- 7 Pumpdown the MS. (See **“To Pumpdown the MS”** on page 120.)
- 8 Autotune the MS. (See **“To Autotune the MS for EI Mode”** on page 117.)

# To Remove the EI HES or HES 2.0 Filaments

## Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Cloths, clean (05980-60051)
- T6 Torx driver, (8710-2548)



## Procedure

- 1 Vent the MS. (See **“To Vent the MS”** on page 124.)

### CAUTION

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

### 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.

- 2 Open the front analyzer chamber. (See **“To Open the Front Analyzer Chamber”** on page 159.)
- 3 Remove the ion source, and place it on a clean cloth on your work surface. (See **“To Remove the EI HES or HES 2.0”** on page 162.)
- 4 Remove the screw securing the filament block to the source mount. (See **Figure 70.**)

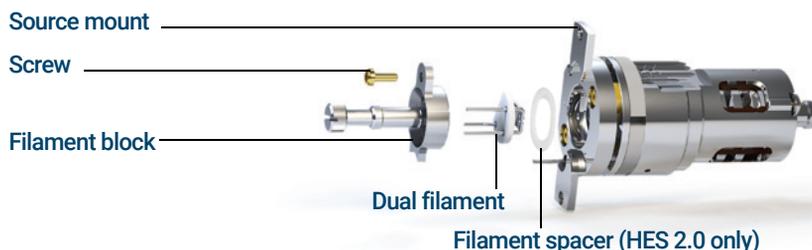


Figure 70. Replacing the dual filament

- 5 Use the hand grip on the filament block to remove the filament block from the source.

### CAUTION

**Use extra caution when removing the dual filament, as it is extremely brittle.**

- 6 Remove the filament spacer from the filament assembly (HES 2.0 only).
- 7 Remove the dual filament from the filament block by lifting the source body up off of the filament block, while holding the filament block so that the dual filament will not fall and become damaged.

## To Install the EI HES or HES 2.0 Filaments

### Materials needed

- Filament assembly, high efficiency dual filament (G7002-60001)
- Hex ball driver, 1.5 mm (8710-1570)
- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- T6 Torx driver, (8710-2548)



### Procedure

- 1 Remove the old filament. (See **“To Remove the EI HES or HES 2.0 Filaments”** on page 215.)
- 2 Insert the three pins on the dual filament through the rear of the filament block. (See **Figure 70** on page 215.)
- 3 Place the filament spacer on top of the filament assembly (HES 2.0 only).
- 4 Place the filament block in the source mount.
- 5 Use a T6 Torx screwdriver to tighten the screw securing the filament block to the source mount.
- 6 Reinstall the ion source. (See **“To Install the EI HES or HES 2.0”** on page 208.)
- 7 Close the front analyzer chamber. (See **“To Close the Front Analyzer Chamber”** on page 218.)
- 8 Pumpdown the MS. (See **“To Pumpdown the MS”** on page 120.)
- 9 Autotune the MS. (**“To Autotune the MS for EI Mode”** on page 117.)

# To Close the Front Analyzer Chamber



## Procedure

- 1 Check the side plate O-ring.

Ensure 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 *7000/7010 Series MS Troubleshooting and Maintenance Manual* for lubricating instructions.

### CAUTION

**Do not force the analyzer door when closing, or you may damage the CC or quadrupole.**

- 2 Swing the front analyzer side plate closed.

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

- 3 Ensure the rear analyzer door is closed.
- 4 Ensure the vent valve is closed.

### WARNING

**The top thumbscrew must be fastened if hydrogen (or other hazardous gas) is being used as the GC carrier gas or if hydrogen is used for the JetClean system. 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.**

- 5 If hydrogen or an other flammable or toxic substance is used for carrier gas, *gently* hand-tighten the top thumbscrew on the front analyzer side plate.
- 6 Pumpdown the MS. (See **“To Pumpdown the MS”** on page 120.)
- 7 Once the MS has pumped down, close the left analyzer cover and replace the window cover.
- 8 Tune the MS.

## To Remove Left Rear Cover

The rear cover should be removed to open the rear analyzer side plate. This is necessary when replacing the electron multiplier horn. If you need to access the rear analyzer chamber, follow these procedures to remove the rear cover. (See **Figure 71** on page 220.)

### Materials needed

- Screwdriver, Torx T-10 and T-20



### Procedure

- 1 Loosen the top screw of the rear cover. It is captive so you will not be able to remove it entirely. (See **Figure 71** on page 220.)
- 2 Lift the bottom flap of the cover out of the groove in the back of the MS to free the cover.

### WARNING

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

## 7 General Maintenance

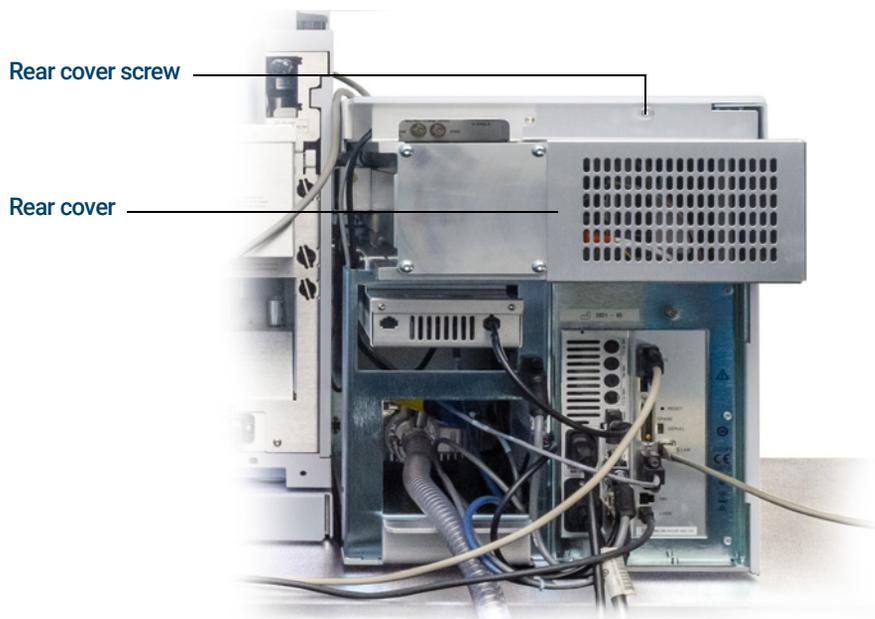


Figure 71. Removing covers

## To Open the Rear Analyzer Chamber

The rear analyzer chamber should only be opened to change the EM horn.

### 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 before you open the analyzer chamber. (See [“Electrostatic discharge”](#) on page 155.)

### Procedure

- 1 Vent the MS. (See [“To Vent the MS”](#) on page 124.)
- 2 Remove the analyzer window cover. (See [“To Remove Left Rear Cover”](#) on page 219.)
- 3 Open the left side panel. (See [“To Open Left Side Panel for Access to the Analyzer Chambers”](#) on page 119.)

### 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.

- 4 Loosen the rear analyzer side plate thumbscrews, if they are fastened. (See [Figure 72](#) on page 223.)

## 7 General Maintenance

Both thumbscrews for the rear analyzer side plate should have their threads engaged during normal operation.

### 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.

5 ***Gently*** swing the side plate out.

## 7 General Maintenance

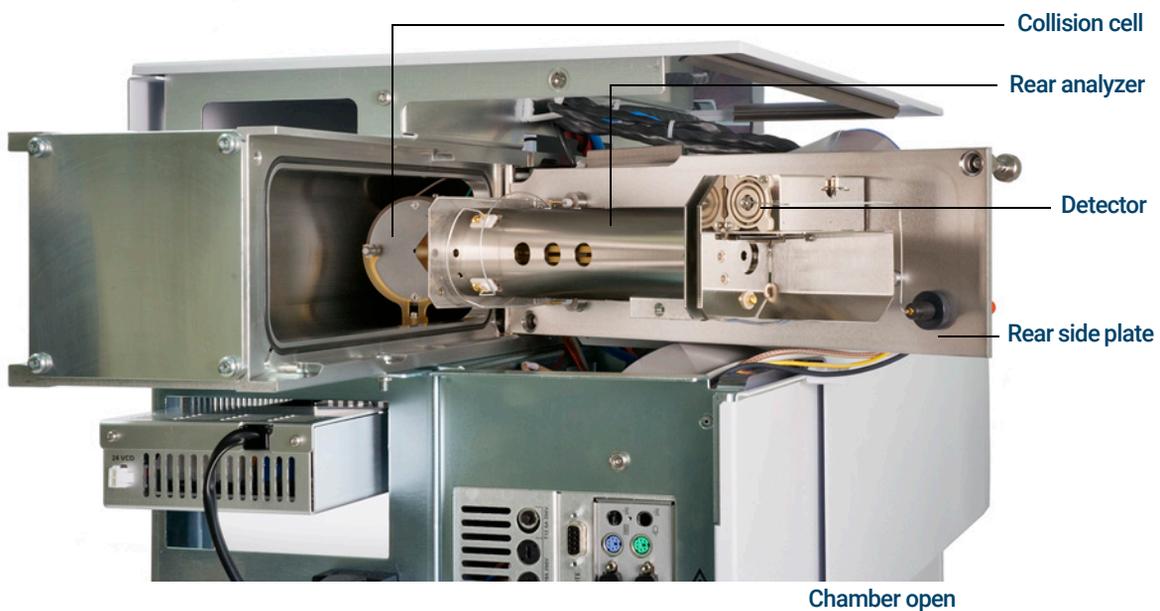


Figure 72. The rear analyzer chamber

## To Replace the EM Horn

The replacement EM horn part number for this Series 2 detector is stamped on the front face of the detector. Through MassHunter, 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** in the detector tab of manual tune, in the detector section on the second page of the tune report, and in the pumpdown dialog.

### Materials needed

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



### Procedure

- 1 Vent the MS. (See **“To Vent the MS”** on page 124.)

### 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 rear analyzer chamber. (See **“To Open the Rear Analyzer Chamber”** on page 221.)
- 3 Slide the blue signal wire from the connector in the side plate. (See **Figure 73** on page 225.)
- 4 Open the retaining clip. (See **Figure 73** on page 225.) Lift the arm of the clip up, and swing the clip away from the EM horn.
- 5 Remove the EM horn.
- 6 Hold the new horn with blue signal wire end down, and attach the signal wire to the connector in the side plate. (See **Figure 74** on page 225.)
- 7 Slide the EM horn into position.
- 8 Close the retaining clip.

## 7 General Maintenance

- 9 Close the rear analyzer chamber. (See **“To Close the Rear Analyzer Chamber”** on page 226.)

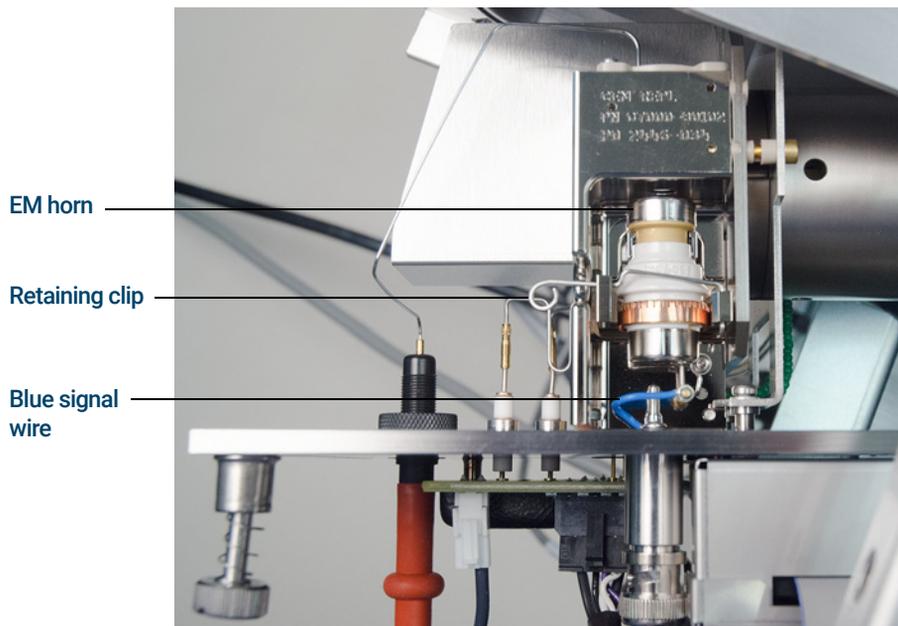


Figure 73. Replacing the EM horn (on a Series 2 detector)



Figure 74. EM horn for a Series 2 detector

## To Close the Rear Analyzer Chamber

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)

### Procedure

- 1 Check the side plate O-ring.

Ensure 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 *7000/7010 Series MS Troubleshooting and Maintenance Manual* for lubrication instructions.

### CAUTION

**Do not force the analyzer side plate when closing, or you may damage the CC or quadrupole.**

- 2 Close the rear analyzer side plate. The prefilter on the entrance side of the quad helps to position the CC when the analyzer door is closed. When closing, the door should give minimal resistance while the quad is reseating the CC. The analyzer should slide into place with minimal pressure.
- 3 Engage both rear analyzer side panel thumbscrews and gently hand tighten them. Do not over tighten the thumbscrews; this can cause air leaks.
- 4 Ensure the front analyzer side plate is closed.
- 5 Ensure the vent valve is closed.
- 6 Pumpdown the MS. (See **"To Pumpdown the MS"** on page 120.)

### WARNING

**The top thumbscrews on both analyzer side plates must be loosely fastened if hydrogen (or other hazardous gas) is being used as the GC carrier gas. In the unlikely event of an explosion, they may prevent the side plates from opening.**

### CAUTION

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

- 7 If hydrogen or any other flammable material is used for the carrier gas, gently hand-tighten the top thumbscrew on the front analyzer side plate.
- 8 Once the MS has pumped down, close the left side panel, replace the rear cover, and replace the analyzer window cover.
- 9 Tune the MS.

## 8

# CI Maintenance

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## 8 CI Maintenance

To Install a CI Source Filament 275

This chapter describes maintenance procedures and requirements that are unique to 7000/7010 Series MS equipped with the CI hardware.

If you are using the *Agilent Intuvo 9000 Gas Chromatograph* with your MS, Chemical Ionization (CI) is not currently supported.

## General Information

### Ion source cleaning

The main effect of operating the MS in CI mode is the need for more frequent ion source cleaning. In CI operation, the ion source chamber is subject to more rapid contamination than in EI operation because of the higher source pressures required for CI.

**WARNING**

**Always perform any maintenance procedures using hazardous solvents under a fume hood. Operate the MS in a well-ventilated room.**

### Ammonia

Ammonia, used as a reagent gas, increases the need for foreline pump maintenance. Ammonia causes foreline pump oil to break down more quickly. Therefore, the oil in the standard foreline vacuum pump must be checked and replaced more frequently.

Always purge the MS with methane after using ammonia.

Install the ammonia with the tank in an upright position. This will help prevent liquid ammonia from getting into the flow module.

### To set up your MS for CI operation

Setting up your MS for operation in CI mode requires special care to avoid contamination and air leaks.

### Guidelines

- Before venting in EI mode for the installation of the CI source, verify that the GC/MS system is performing correctly.
- Ensure the reagent gas inlet line(s) are equipped with gas purifiers (not applicable for ammonia).
- Use extra-high purity reagent gases; 99.99% or better for methane and as pure as is available for other reagent gases.

## To Switch from an EI XTR Source to the CI Source

### CAUTION

Always verify MS performance in EI before switching to CI operation.

Always set up the CI MS in PCI first, even if you are going to run NCI.

### Procedure

- 1 Vent the MS. (See **"To Vent the MS"** on page 124.)

### 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 **"Electrostatic discharge"** on page 155.) Take antistatic precautions *before* you open the analyzer chamber.

- 2 Open the analyzer. (See **"To Open the Front Analyzer Chamber"** on page 159.)
- 3 Remove the EI XTR source. (See **"To Remove the EI XTR or HydroInert Source"** on page 165.)
- 4 Remove the brown extractor wire from the CSB and store it with the EI extractor storage box. (See **"To Connect or Disconnect Wiring to the EI XTR Source"** on page 167.)
- 5 Install the CI source. (See **"To Install the 7010 Series CI Source"** on page 239.)
- 6 Close the analyzer. (See **"To Close the Front Analyzer Chamber"** on page 218.)
- 7 Pumpdown and switch from EI to CI mode. (See **"To Pumpdown and Switch from EI to CI Mode"** on page 143.)

# To Remove the EI HES Radiator

## Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)
- T10 Torx screwdriver (5182-3466)



## Procedure

- 1 Vent the MS. (See **“To Vent the MS”** on page 124.)

### 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.

### CAUTION

Use an antistatic wrist strap, and take other antistatic precautions before touching analyzer components.

### CAUTION

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

- 2 Open the front analyzer chamber. (See **“To Open the Front Analyzer Chamber”** on page 159.)
- 3 Remove the EI HES source. (See **“To Remove the EI HES or HES 2.0”** on page 162.)
- 4 Disconnect the wires from the radiator or Ceramic Source Board. Do not bend the wires any more than necessary. (See **“To Connect or Disconnect EI HES Radiator Wiring”** on page 235.)
- 5 Use a T10 Torx screwdriver to loosen the two screws that secure the radiator to the analyzer and place the radiator in its storage container. (See **Figure 75** on page 232.)

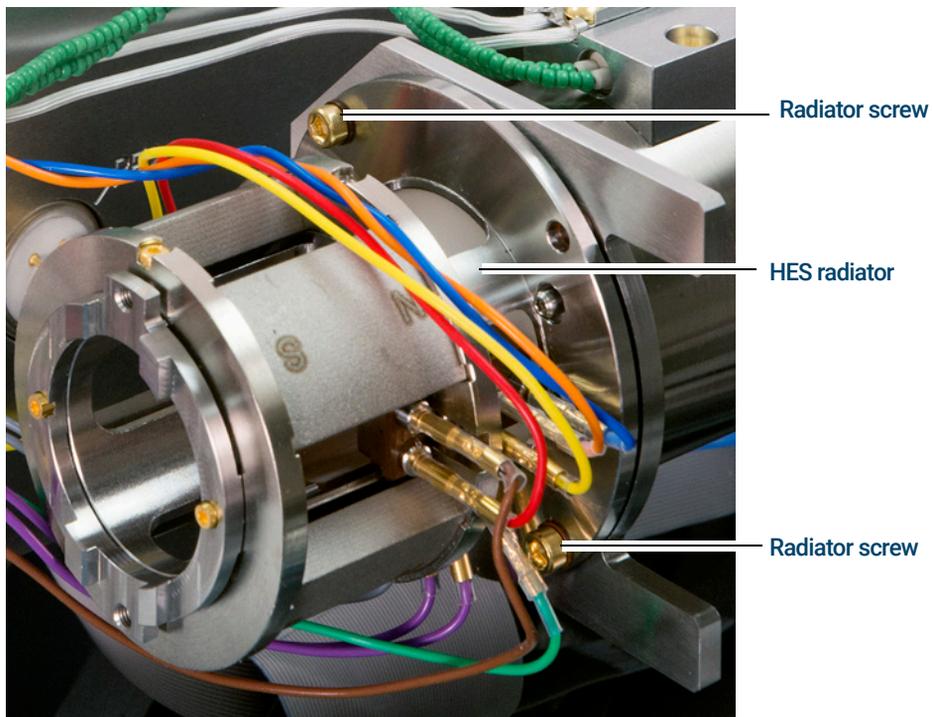


Figure 75. Removing the EI HES radiator

# To Remove the EI HES 2.0 Radiator

## Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)
- T10 Torx screwdriver (5182-3466)



## Procedure

- 1 Vent the MS. (See **“To Vent the MS”** on page 124.)

### 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.

### CAUTION

Use an antistatic wrist strap, and take other antistatic precautions before touching analyzer components.

### CAUTION

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

- 2 Open the front analyzer chamber. (See **“To Open the Front Analyzer Chamber”** on page 159.)
- 3 Remove the EI HES 2.0 source. (See **“To Remove the EI HES or HES 2.0”** on page 162.)
- 4 Disconnect the wires from the radiator or CSB. Do not bend the wires any more than necessary. (See **“To Connect or Disconnect EI HES 2.0 Radiator Wiring”** on page 237.)
- 5 Use a T10 Torx screwdriver to loosen the two screws that secure the radiator to the analyzer and place the radiator in its storage container. (See **Figure 76** on page 234.)

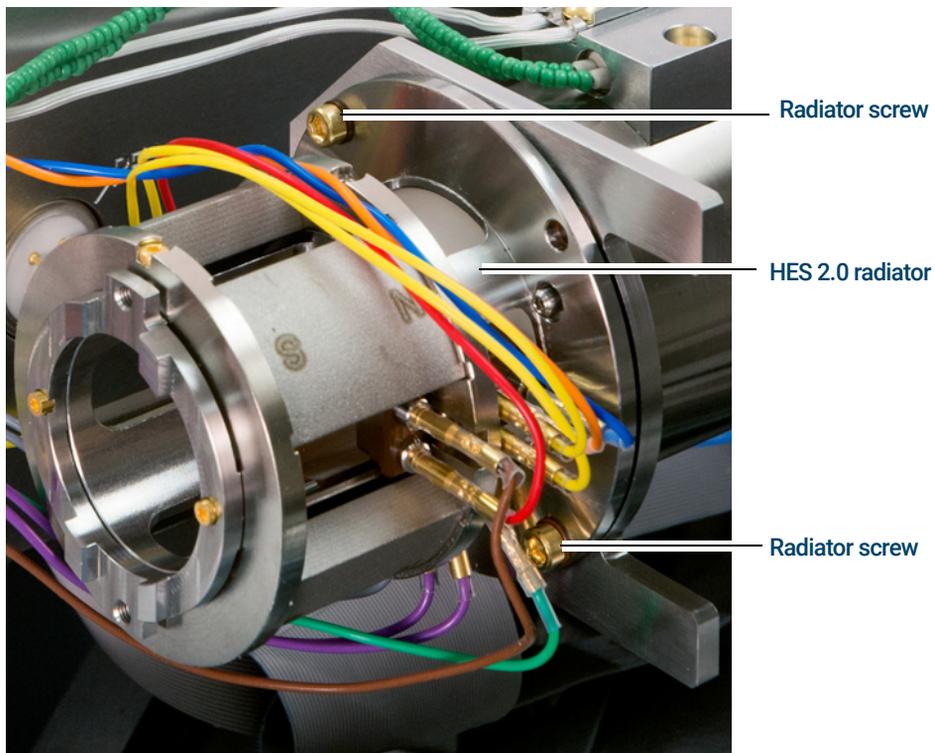


Figure 76. Removing the EI HES 2.0 radiator

## To Connect or Disconnect EI HES Radiator Wiring

This topic is used to identify the wiring connections to the ion source. (For detailed procedures and videos, see **“To Remove the EI HES Radiator”** on page 231 or **“To Install the EI HES Radiator”** on page 244.)

### Materials needed

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

### Procedure

- 1 Use tweezers or needle nose pliers to connect or disconnect the green ground wire and the five lens wires from the radiator. Do not bend the wires any more than necessary. (See **Figure 77**.)
- 2 Use tweezers or needle nose pliers to connect or disconnect the two purple source heater wires and the two gray RTD wires from the CSB.



## To Connect or Disconnect EI HES 2.0 Radiator Wiring

This topic is used to identify the wiring connections to the ion source. (For detailed procedures and videos, see **“To Remove the EI HES 2.0 Radiator”** on page 233 or **“To Install the EI HES 2.0 Radiator”** on page 246.)

### Materials needed

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

### Procedure

- 1 Use tweezers or needle nose pliers to connect or disconnect the green ground wire and the six lens wires from the radiator. Do not bend the wires any more than necessary. (See **Figure 78**.)
- 2 Use tweezers or needle nose pliers to connect or disconnect the two purple source heater wires and the two gray RTD wires from the CSB.

## 8 CI Maintenance

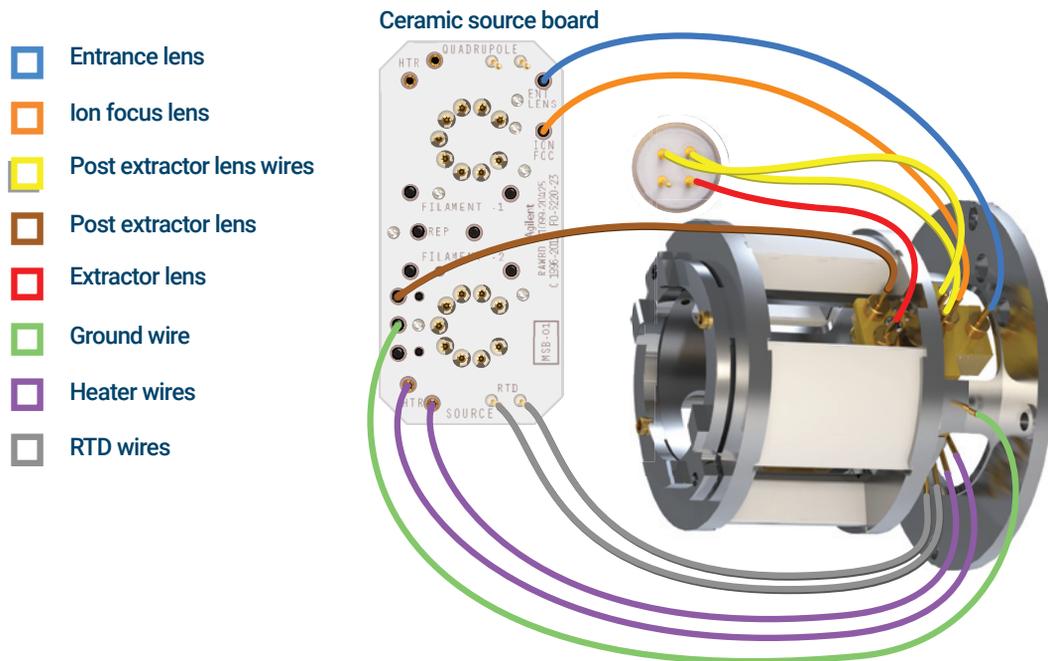


Figure 78. HES 2.0 radiator wiring

# To Install the 7010 Series CI Source

## CAUTION

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



### Procedure

- 1 Vent the MS. (See **"To Vent the MS"** on page 124.)
- 2 Open the front analyzer chamber. (See **"To Open the Front Analyzer Chamber"** on page 159.)
- 3 Slide the CI source into the radiator.
- 4 Install the thumbscrews. (See **Figure 79.**)
- 5 Connect the wiring to the CI source. (See **"To Connect or Disconnect 7010 Series CI Source Wiring"** on page 249.)

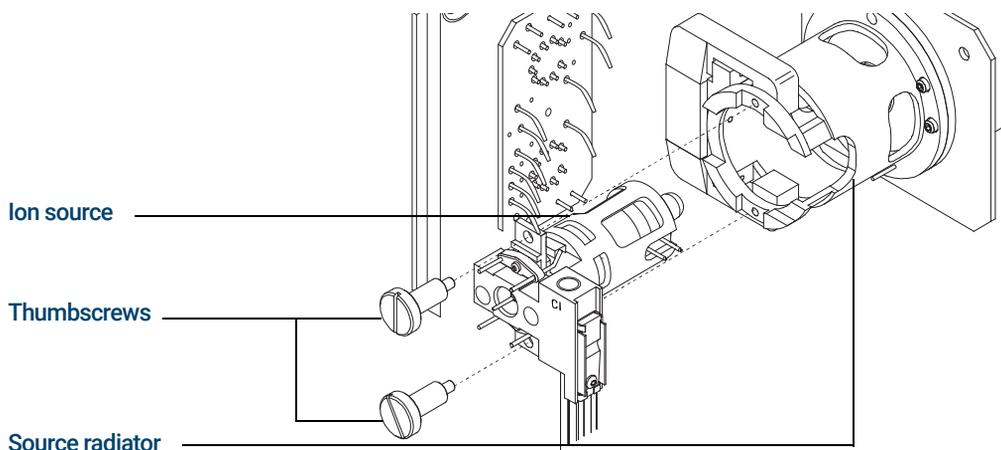


Figure 79. Installing the CI source

- 6 Close the analyzer door. (See **"To Close the Front Analyzer Chamber"** on page 218.)
- 7 Pumpdown the MS. (See **"To Pumpdown the MS"** on page 120.)
- 8 Tune the MS. (See **"CI Autotune"** on page 133.)

# To Install the 7000 Series CI Source

## CAUTION

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



### Procedure

- 1 Vent the MS. (See **"To Vent the MS"** on page 124.)
- 2 Open the front analyzer chamber. (See **"To Open the Front Analyzer Chamber"** on page 159.)
- 3 Slide the CI source into the radiator.
- 4 Install the thumbscrews. (See **Figure 80.**)
- 5 Connect the wiring to the CI source. (See **"To Connect or Disconnect 7000 Series CI Source Wiring"** on page 250.)

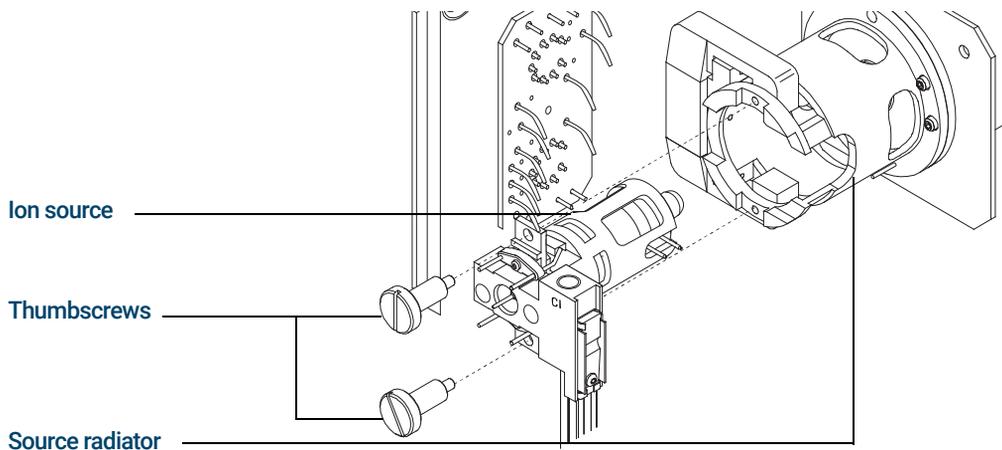


Figure 80. Installing the CI source

- 6 Close the analyzer door. (See **"To Close the Front Analyzer Chamber"** on page 218.)
- 7 Pumpdown the MS. (See **"To Pumpdown the MS"** on page 120.)
- 8 Tune the MS. (See **"CI Autotune"** on page 133.)

# To Switch from the CI Source to the EI HES

## Procedure

- 1 Vent the MS. (See **"To Vent the MS"** on page 124.) The software will prompt you for the appropriate actions.

### CAUTION

Always wear clean gloves while touching the analyzer or any other parts that go inside the analyzer chamber.

### CAUTION

Electrostatic discharges to analyzer components are conducted to the side board where they can damage sensitive components. Wear a grounded antistatic wrist strap and take other antistatic precautions **before** you open the analyzer chamber. (See **"Electrostatic discharge"** on page 155.)

- 2 Open the left side access panel. (See **"To Open Left Side Panel for Access to the Analyzer Chambers"** on page 119).
- 3 Open the front analyzer chamber. (See **"To Open the Front Analyzer Chamber"** on page 159.)
- 4 Remove the CI source. (See **"To Remove the 7000 Series CI Source"** on page 252.)
- 5 Place the CI source in the storage container.
- 6 Remove the CI source radiator. The Radiator should not be removed or installed with the CI source in place. (See **"To Remove the CI Source Radiator from the 7010 Series TQ"** on page 262.)
- 7 Place the CI source radiator in the storage container.
- 8 Loosen the column nut and remove the column from the GC/MS Interface.
- 9 Cut the column on the tapered side of the ferrule to remove the ferrule.
- 10 Install the column into the GC/MS interface. (See **"To Install a Capillary Column in the GC/MS Interface Using the Self-Tightening Column Nut"** on page 40 or **"To Install a Capillary Column in the GC/MS Interface Using a Standard Column Nut"** on page 45.)
- 11 Remove the EI HES radiator from the storage container.
- 12 Install the EI HES radiator. (See **"To Install the EI HES Radiator"** on page 244.)
- 13 Remove the EI HES from the storage container.
- 14 Install the EI HES. (See **"To Install the EI HES or HES 2.0"** on page 208.)
- 15 Pumpdown the MS. (See **"To Pumpdown the MS"** on page 120.)

# To Switch from the CI Source to the EI HES 2.0

## Procedure

- 1 Vent the MS. (See **"To Vent the MS"** on page 124.) The software will prompt you for the appropriate actions.

### CAUTION

Always wear clean gloves while touching the analyzer or any other parts that go inside the analyzer chamber.

### CAUTION

Electrostatic discharges to analyzer components are conducted to the side board where they can damage sensitive components. Wear a grounded antistatic wrist strap and take other antistatic precautions **before** you open the analyzer chamber. (See **"Electrostatic discharge"** on page 155.)

- 2 Open the left side access panel. (See **"To Open Left Side Panel for Access to the Analyzer Chambers"** on page 119).
- 3 Open the front analyzer chamber. (See **"To Open the Front Analyzer Chamber"** on page 159.)
- 4 Remove the CI source. (See **"To Remove the 7000 Series CI Source"** on page 252.)
- 5 Place the CI source in the storage container.
- 6 Remove the CI source radiator. The Radiator should not be removed or installed with the CI source in place. (See **"To Remove the CI Source Radiator from the 7010 Series TQ"** on page 262.)
- 7 Place the CI source radiator in the storage container.
- 8 Loosen the column nut and remove the column from the GC/MS Interface.
- 9 Cut the column on the tapered side of the ferrule to remove the ferrule.
- 10 Install the column into the GC/MS interface. (See **"To Install a Capillary Column in the GC/MS Interface Using the Self-Tightening Column Nut"** on page 40 or **"To Install a Capillary Column in the GC/MS Interface Using a Standard Column Nut"** on page 45.)
- 11 Remove the EI HES 2.0 radiator from the storage container.
- 12 Install the EI HES 2.0 radiator. (See **"To Install the EI HES 2.0 Radiator"** on page 246.)
- 13 Remove the EI HES 2.0 from the storage container.

## 8 CI Maintenance

- 14 Install the EI HES 2.0. (See **"To Install the EI HES or HES 2.0"** on page 208.)
- 15 Pumpdown the MS. (See **"To Pumpdown the MS"** on page 120.)

## To Install the EI HES Radiator

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- T10 Torx screwdriver (5182-3466)
- Tweezers (8710-2460)



### Procedure

#### 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.

#### CAUTION

Use an antistatic wrist strap, and take other antistatic precautions before touching analyzer components.

- 1 Place the radiator over the guide pins on the analyzer support and use a T10 Torx screwdriver to secure it using the (2) M3 × 12 gold plated screws (G7002-20110). (See **Figure 81** on page 245.)
- 2 Attach the wires to the radiator or Ceramic Source Board. Do not bend the wires any more than necessary. (See **“To Connect or Disconnect EI HES Radiator Wiring”** on page 235.)

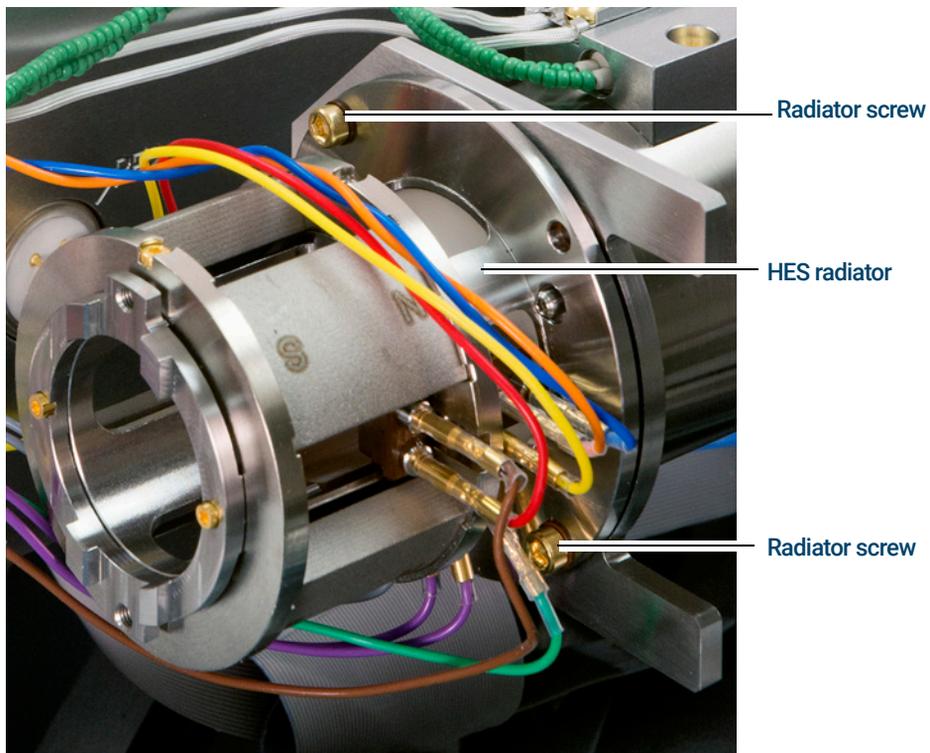


Figure 81. Securing the EI HES radiator

## To Install the EI HES 2.0 Radiator

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- T10 Torx screwdriver (5182-3466)
- Tweezers (8710-2460)



### Procedure

#### 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.

#### CAUTION

Use an antistatic wrist strap, and take other antistatic precautions before touching analyzer components.

- 1 Place the radiator over the guide pins on the analyzer support and use a T10 Torx screwdriver to secure it using the (2) M3 × 12 gold plated screws (G7002-20110). (See **Figure 82** on page 247.)
- 2 Attach the wires to the radiator or Ceramic Source Board. Do not bend the wires any more than necessary. (See **“To Connect or Disconnect EI HES 2.0 Radiator Wiring”** on page 237.)

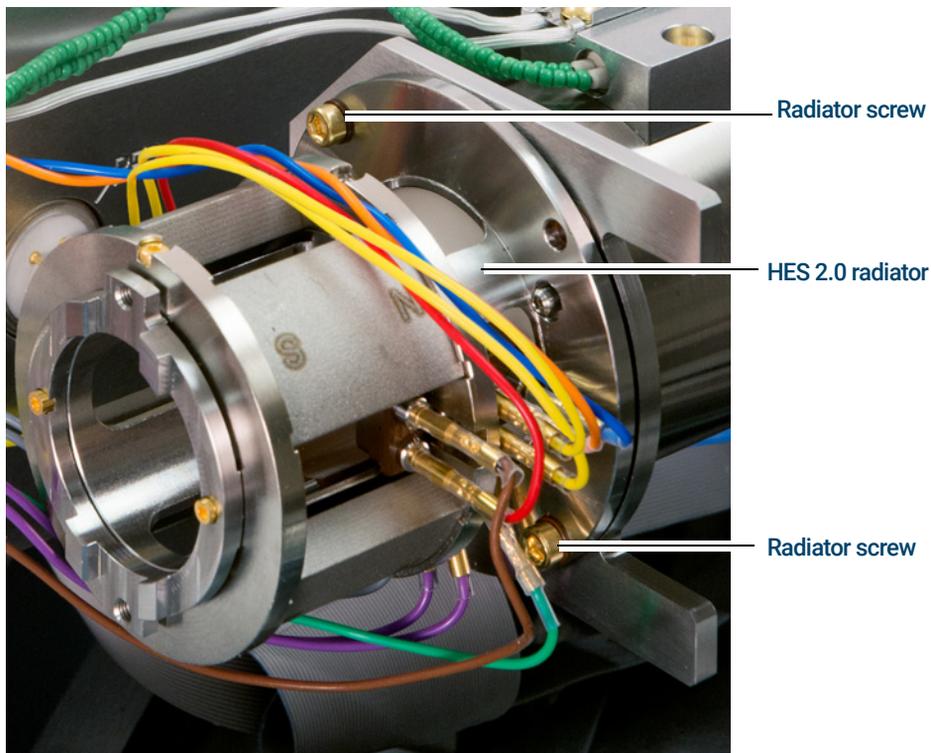


Figure 82. Securing the EI HES 2.0 radiator

## To Switch from the CI Source to the EI XTR Source

### Procedure

- 1 Vent the MS. (See **“To Vent the MS”** on page 124.) The software will prompt you for the appropriate actions.

#### CAUTION

Always wear clean gloves while touching the analyzer or any other parts that go inside the analyzer chamber.

#### CAUTION

Electrostatic discharges to analyzer components are conducted to the side board where they can damage sensitive components. Wear a grounded antistatic wrist strap, and take other antistatic precautions **before** you open the analyzer chamber. (See **“Electrostatic discharge”** on page 155.)

- 2 Open the left side access panel. (See **“To Open Left Side Panel for Access to the Analyzer Chambers”** on page 119).
- 3 Open the front analyzer chamber. (See **“To Open the Front Analyzer Chamber”** on page 159.)
- 4 Remove the CI source. (See **“To Remove the 7000 Series CI Source”** on page 252.)
- 5 Install the EI XTR source. (See **“To Install the EI XTR or HydroInert Source”** on page 210.)
- 6 Place the CI source in the storage container.
- 7 Pumpdown the MS. (See **“To Pumpdown the MS”** on page 120.)

# To Connect or Disconnect 7010 Series CI Source Wiring

This topic is used to identify the wiring connections to the ion source. (For detailed procedures and videos, see **“To Remove the 7000 Series CI Source”** on page 252 or **“To Install the 7010 Series CI Source”** on page 239.)

## Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Pliers, long-nose (8710-1094)
- Tweezers (8710-2460)

## Procedure

- 1 Use tweezers or pliers to connect or disconnect the ceramic board wire leads (red, white, black, and gray) at the source connectors. (See **Figure 83**.)
- 2 Use tweezers or pliers to connect or disconnect the source heater wire leads at the CSB.

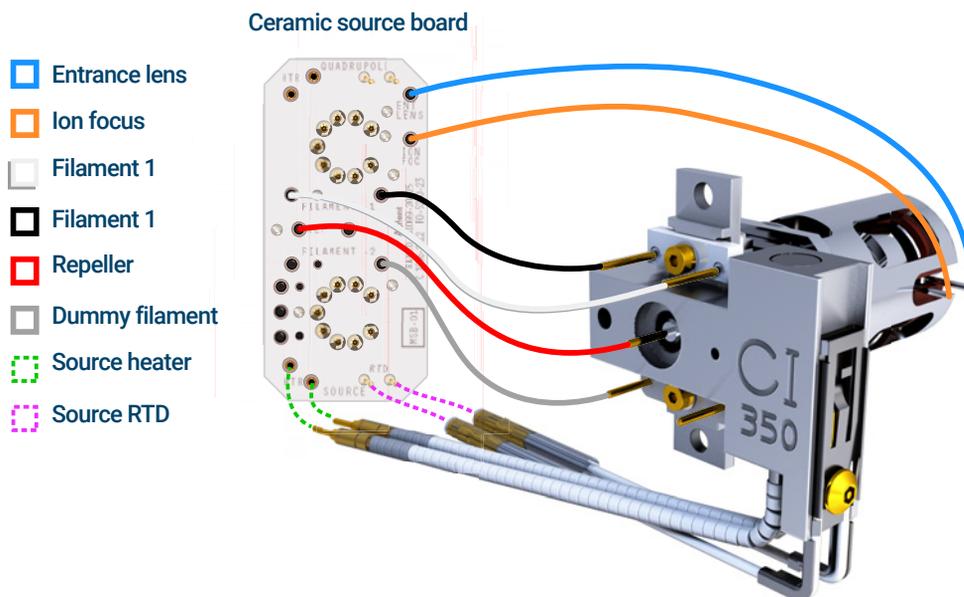


Figure 83. Wiring between the CSB and the source

# To Connect or Disconnect 7000 Series CI Source Wiring

This topic is used to identify the wiring connections to the ion source. (For detailed procedures and videos, see **“To Remove the 7000 Series CI Source”** on page 252 or **“To Install the 7000 Series CI Source”** on page 240.)

## Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Pliers, long-nose (8710-1094)
- Tweezers (8710-2460)

## Procedure

- 1 Use tweezers or pliers to connect or disconnect the ceramic board wire leads at the source connectors. (See **Figure 84.**)
- 2 Use tweezers or pliers to connect or disconnect the source heater wire leads at the CSB.

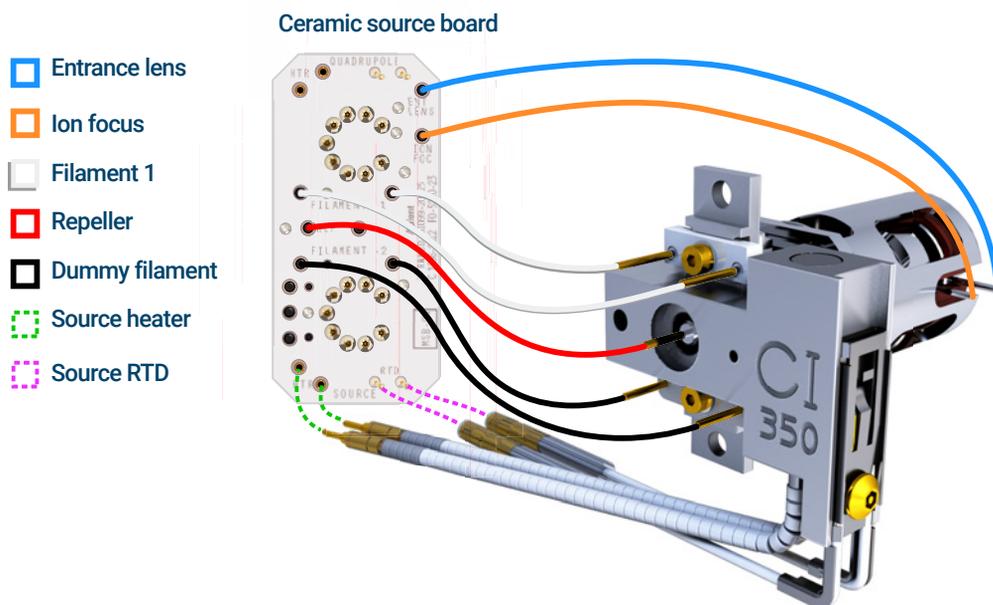


Figure 84. Wiring between the CSB and the CI source

# To Switch from the CI Source to an EI XTR Source

## Procedure

### CAUTION

Always wear clean gloves while touching the analyzer or any other parts that go inside the analyzer chamber.

### CAUTION

Electrostatic discharges to analyzer components are conducted to the side board where they can damage sensitive components. Wear a grounded antistatic wrist strap, and take other antistatic precautions **before** you open the analyzer chamber. (See “[Electrostatic discharge](#)” on page 155.)

- 1 From the Tune and Vacuum Control view, vent the MS. (See “[To Vent the MS](#)” on page 124.) The software will prompt you for the appropriate actions.
- 2 Open the analyzer. (See “[To Open the Front Analyzer Chamber](#)” on page 159.)
- 3 Remove the CI source. (See to “[To Remove the 7000 Series CI Source](#)” on page 252.)
- 4 Install the EI XTR source. (See “[To Install the EI XTR or HydroInert Source](#)” on page 210.)
- 5 Place the CI source in the ion source storage box.
- 6 If installing an EI SS or Inert source, remove the interface tip seal and put it in the CI storage container.
- 7 Pumpdown the MS. (See “[To Pumpdown the MS](#)” on page 120.)
- 8 Load your EI tune file and Tune the MS.

## To Remove the 7000 Series CI Source

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)



### Procedure

- 1 Vent the MS. (See **“To Vent the MS”** on page 124.)

### 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 Open the Front Analyzer Chamber”** on page 159.)

### CAUTION

Use an antistatic wrist strap, and take other antistatic precautions before touching analyzer components.

### CAUTION

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

- 3 Disconnect the wires from the ion source. (See **“To Connect or Disconnect 7000 Series CI Source Wiring”** on page 250.)
- 4 Remove the two large thumbscrews that hold the ion source in place.
- 5 Pull the ion source out of the source radiator, and place it in its storage container.

## To Remove the 7010 Series CI Source

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)



### Procedure

- 1 Vent the MS. (See **“To Vent the MS”** on page 124.)

### 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 Open the Front Analyzer Chamber”** on page 159.)

### CAUTION

Use an antistatic wrist strap, and take other antistatic precautions before touching analyzer components.

### CAUTION

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

- 3 Disconnect the wires from the ion source. (See **“To Connect or Disconnect 7010 Series CI Source Wiring”** on page 249.)
- 4 Remove the two large thumbscrews that hold the ion source in place.
- 5 Pull the ion source out of the source radiator, and place it in its storage container.

# To Switch from the EI HES to the CI Source

## Procedure

### CAUTION

Always verify GC/MS performance in EI before switching to CI operation.

- 1 Vent the MS. (See **“To Vent the MS”** on page 124.) The software will prompt you for the appropriate actions.
- 2 Open the left side access panel. (See **“To Open Left Side Panel for Access to the Analyzer Chambers”** on page 119.)

### 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 **“Electrostatic discharge”** on page 155.) Take antistatic precautions *before* you open the analyzer chamber.

- 3 Open the analyzer chamber. (See **“To Open the Front Analyzer Chamber”** on page 159.)
- 4 Remove the EI HES. (See **“To Remove the EI HES or HES 2.0”** on page 162.)
- 5 Place the EI HES in the storage container.
- 6 Remove the EI HES radiator. (See **“To Remove the EI HES Radiator”** on page 231.)
- 7 Place the EI HES radiator in the storage container.
- 8 Remove the CI source radiator from the storage container.
- 9 Install the CI source radiator. (See **“To Install the CI/EI XTR Source Radiator”** on page 256.)
- 10 Remove CI source from the storage container.
- 11 Install the CI source. This requires shortening the column so that it protrudes from the transfer line by 1 to 2 mm. (See **“To Install the 7010 Series CI Source”** on page 239.)
- 12 Pumpdown and switch from EI to CI mode. (See **“To Pumpdown and Switch from EI to CI Mode”** on page 143.)

# To Switch from the EI HES 2.0 to the CI Source

## Procedure

### CAUTION

Always verify GC/MS performance in EI before switching to CI operation.

- 1 Vent the MS. (See **"To Vent the MS"** on page 124.) The software will prompt you for the appropriate actions.
- 2 Open the left side access panel. (See **"To Open Left Side Panel for Access to the Analyzer Chambers"** on page 119.)

### 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 **"Electrostatic discharge"** on page 155.) Take antistatic precautions *before* you open the analyzer chamber.

- 3 Open the analyzer chamber. (See **"To Open the Front Analyzer Chamber"** on page 159.)
- 4 Remove the EI HES 2.0. (See **"To Remove the EI HES or HES 2.0"** on page 162.)
- 5 Place the EI HES 2.0 in the storage container.
- 6 Remove the EI HES 2.0 radiator. (See **"To Remove the EI HES 2.0 Radiator"** on page 233.)
- 7 Place the EI HES 2.0 radiator in the storage container.
- 8 Remove the CI source radiator from the storage container.
- 9 Install the CI source radiator. (See **"To Install the CI/EI XTR Source Radiator"** on page 256.)
- 10 Remove CI source from the storage container.
- 11 Install the CI source. This requires shortening the column so that it protrudes from the transfer line by 1 to 2 mm. (See **"To Install the 7010 Series CI Source"** on page 239.)
- 12 Pumpdown and switch from EI to CI mode. (See **"To Pumpdown and Switch from EI to CI Mode"** on page 143.)

## To Install the CI/EI XTR Source Radiator

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)
- T10 Torx screwdriver (5182-3466)



### Procedure

#### 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.

#### CAUTION

Use an antistatic wrist strap, and take other antistatic precautions before touching analyzer components.

#### CAUTION

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

- 1 Align the radiator over the two guide pins on the analyzer support, and secure it using the two retained screws with a number T10 Torx screwdriver. Make sure the insulators are in place under the screws.

## 8 CI Maintenance

- 2 Connect the green ground wire to the radiator. (See **Figure 85**.)

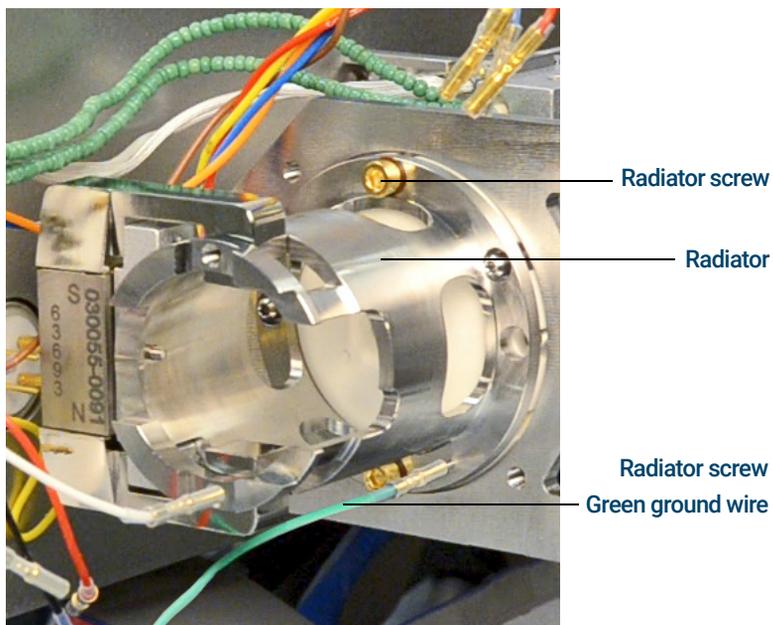


Figure 85. CI Source radiator

# To Switch from the CI Source to the EI HES

## Procedure

- 1 Vent the MS. (See **“To Vent the MS”** on page 124.) The software will prompt you for the appropriate actions.

### CAUTION

Always wear clean gloves while touching the analyzer or any other parts that go inside the analyzer chamber.

### CAUTION

Electrostatic discharges to analyzer components are conducted to the side board where they can damage sensitive components. Wear a grounded antistatic wrist strap, and take other antistatic precautions *before* you open the analyzer chamber. (See **“Electrostatic discharge”** on page 155.)

- 2 Open the left side access panel. (See **“To Open Left Side Panel for Access to the Analyzer Chambers”** on page 119).
- 3 Open the analyzer chamber door. (See **“To Open the Front Analyzer Chamber”** on page 159.)
- 4 Remove the CI source. (See **“To Remove the 7010 Series CI Source”** on page 253.)
- 5 Place the CI source in the storage container.
- 6 Remove the CI source radiator. The Radiator should not be removed or installed with the CI source in place. (See **“To Remove the CI Source Radiator from the 7010 Series TQ”** on page 262.)
- 7 Place the CI source radiator in the storage container.
- 8 Loosen the column nut and remove the column from the GC/MS Interface.
- 9 Cut the column on the tapered side of the ferrule to remove the ferrule.
- 10 Install the column into the GC/MS interface extending 4 to 5 mm past the analyzer end of the transfer line. (See **“To Install a Capillary Column in the GC/MS Interface Using the Self-Tightening Column Nut”** on page 40 or **“To Install a Capillary Column in the GC/MS Interface Using a Standard Column Nut”** on page 45.)
- 11 Remove the EI HES radiator from the storage container.
- 12 Install the EI HES radiator. (See **“To Install the EI HES Radiator”** on page 244.)
- 13 Remove the EI HES from the storage container.
- 14 Install the EI HES. (See **“To Install the EI HES or HES 2.0”** on page 208.)
- 15 Pumpdown the MS. (See **“To Pumpdown the MS”** on page 120.)

# To Switch from the CI Source to the EI HES 2.0

## Procedure

- 1 Vent the MS. (See **"To Vent the MS"** on page 124.) The software will prompt you for the appropriate actions.

### CAUTION

Always wear clean gloves while touching the analyzer or any other parts that go inside the analyzer chamber.

### CAUTION

Electrostatic discharges to analyzer components are conducted to the side board where they can damage sensitive components. Wear a grounded antistatic wrist strap, and take other antistatic precautions *before* you open the analyzer chamber. (See **"Electrostatic discharge"** on page 155.)

- 2 Open the left side access panel. (See **"To Open Left Side Panel for Access to the Analyzer Chambers"** on page 119).
- 3 Open the analyzer chamber door. (See **"To Open the Front Analyzer Chamber"** on page 159.)
- 4 Remove the CI source. (See **"To Remove the 7010 Series CI Source"** on page 253.)
- 5 Place the CI source in the storage container.
- 6 Remove the CI source radiator. The Radiator should not be removed or installed with the CI source in place. (See **"To Remove the CI Source Radiator from the 7010 Series TQ"** on page 262.)
- 7 Place the CI source radiator in the storage container.
- 8 Loosen the column nut and remove the column from the GC/MS Interface.
- 9 Cut the column on the tapered side of the ferrule to remove the ferrule.
- 10 Install the column into the GC/MS interface extending 4 to 5 mm past the analyzer end of the transfer line. (See **"To Install a Capillary Column in the GC/MS Interface Using the Self-Tightening Column Nut"** on page 40 or **"To Install a Capillary Column in the GC/MS Interface Using a Standard Column Nut"** on page 45.)
- 11 Remove the EI HES 2.0 radiator from the storage container.
- 12 Install the EI HES 2.0 radiator. (See **"To Install the EI HES 2.0 Radiator"** on page 246.)

## 8 CI Maintenance

- 13 Remove the EI HES 2.0 from the storage container.
- 14 Install the EI HES 2.0. (See **"To Install the EI HES or HES 2.0"** on page 208.)
- 15 Pumpdown the MS. (See **"To Pumpdown the MS"** on page 120.)

## To Install a CI Source Filament

### Materials needed

- Filament assembly, 2-pk, CI (G7005-60072)
- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)
- Hex ball driver, 1.5 mm (8710-1570)



### Procedure

- 1 Remove the old filament. (See **“To Remove the CI Source Filament”** on page 273.)
- 2 Place the new filament into its position on the ion source body. (See **Figure 90** on page 274.)
- 3 Secure the filament to the ion source body with the screw.
- 4 After installing the filament, verify that it is not grounded to source body.
- 5 Reinstall the CI source. (See **“To Install the 7010 Series CI Source”** on page 239 or see **“To Remove the CI Source Filament”** on page 273.)
- 6 Pumpdown the MS. (See **“To Pumpdown the MS”** on page 120.)
- 7 Autotune the MS.

# To Remove the CI Source Radiator from the 7010 Series TQ

## Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)
- T10 Torx screwdriver (5182-3466)



## Procedure

### 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.

### 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 on the wires.

This procedure is only applicable if you are using the 7010 side plate.

- 1 Remove the CI source. (See **“To Remove the 7010 Series CI Source”** on page 253.)

## 8 CI Maintenance

- 2 Disconnect the green ground wire from the radiator. (See **Figure 86**.)
- 3 Use a T-10 Torx screwdriver to loosen the two retained screws that secure the radiator to the analyzer and place the radiator in its storage container.

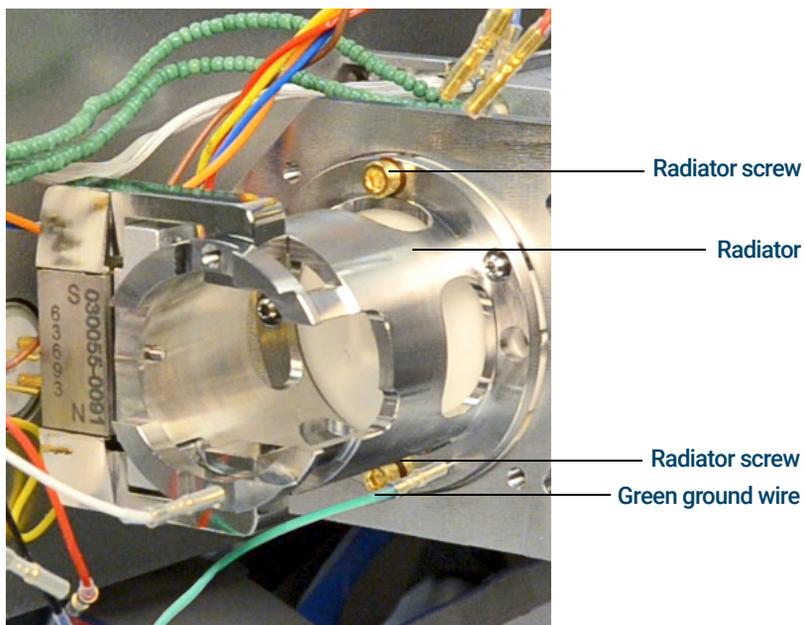


Figure 86. CI/EI XTR Source radiator

## To Disassemble the CI 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)
- Nut driver, 5.5 mm (8710-1220)
- Tweezers (8710-2460)



### Procedure

Refer to the exploded parts view and the CI source parts list while using this procedure. (See **Figure 87** and **Table 24** on page 265.)

- 1 Remove the CI source. (See **“To Remove the 7000 Series CI Source”** on page 252.)
- 2 Remove the filaments. (See **“To Remove the CI Source Filament”** on page 273.)
- 3 Separate the source heater assembly from the source body. The source heater assembly includes the source heater, repeller, and related parts. (See **Figure 87** and **Table 24** on page 265.)
- 4 Disassemble the repeller assembly by removing the ceramic insulator from the repeller. (See **Figure 87** on page 265.)
- 5 Remove the setscrew securing the lenses to the source body.
- 6 Pull the lenses out of the source body and separate the lens insulator, ion focus lens, drawout cylinder, drawout lens, and entrance lens. (See **Figure 87** on page 265.)

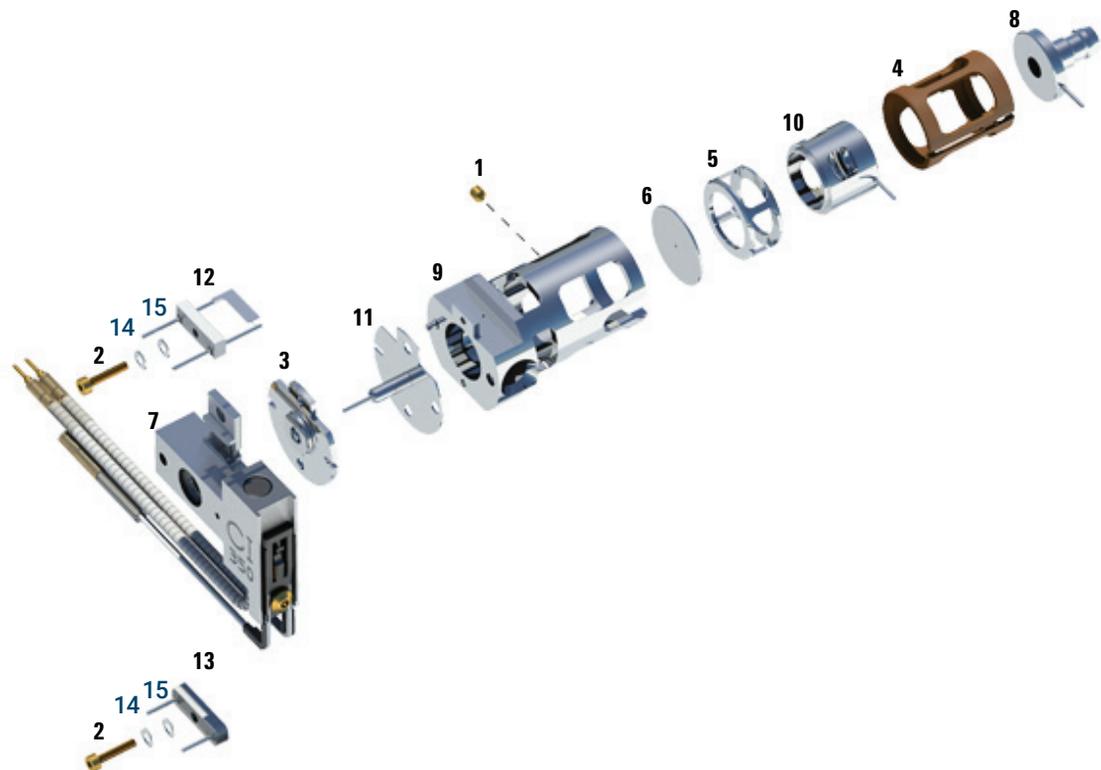


Figure 87. Disassembling the CI source

Table 24 Parts list for CI source (Figure 87)

Item	Description	Part number
1	Set screw	G1999-20022
2	Filament screw	G1999-20021
3	CI repeller insulator	G1999-20433
4	CI lens insulator	G3170-20540
5	CI drawout cylinder	G1999-20444
6	CI drawout plate	G1999-20446
7	CI source heater block assembly	G3870-60415
8	Entrance lens	G7000-20026

Table 24 Parts list for CI source (Figure 87) (continued)

Item	Description	Part number
9	CI source body	G3170-20430
10	Ion focus lens	G1999-20443
11	CI repeller	G7077-20432
12	CI filament- 2PK	G7005-60072
13	Dummy filament	G1999-60454
14	Washer spring curved 2.2 mm-ID 4.5 mm-OD, Qty. 2	3050-1374
15	Flat washer	3050-9082
Not shown	Package, GC/MS source Clamshell	G7002-80008
Not shown	Bracket, GC/MS source, Clamshell	G7002-00008
Not shown	CI source assembly	G7002-67404
Not shown	CI source assembly (without tip seal)	G7077-67404

## To Clean the CI Source

### Materials needed

- Abrasive paper (5061-5896)
- Alumina abrasive powder, 100 g (393706201)
- 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 CI source. (See **“To Disassemble the CI Source”** on page 264.)
- 2 Collect the following parts to be cleaned for a CI source: (See **Figure 88** on page 268.)
  - Repeller
  - Source body
  - Drawout plate
  - Drawout cylinder
  - Ion focus lens
  - Entrance lens

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

**CAUTION**

If the CI lens insulator is dirty, clean it with a cotton swab dampened with reagent-grade methanol. If that does not clean it, replace it. Do not abrasively or ultrasonically clean this insulator. Do not attempt to clean other ceramic insulators in the source.



Figure 88. CI source parts to be cleaned

**Procedure**

- 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.  
Make sure **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.

### WARNING

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

- 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.
- 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 five to six minutes.

### WARNING

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

### NOTE

**Take care to avoid contaminating 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 the CI 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

### CAUTION

**Always wear clean gloves when working in the analyzer chamber to avoid contamination.**

Refer to the exploded parts view and the CI source parts list while using this procedure. (See **Figure 89** and **Table 25** on page 271.)

- 1 Assemble the ion focus lens, entrance lens, and lens insulator. (See **Figure 89** and **Table 25** on page 271.)
- 2 Slide the drawout plate and the drawout cylinder into the source body. (See **Figure 89** on page 271.)
- 3 Slide the parts assembled in step 1 into the source body.
- 4 Install the setscrew that holds the lenses in place.
- 5 Attach the ceramic disk to the repeller and place on top of the source body.
- 6 Place the heater block assembly on top of the source body.
- 7 Reinstall the dummy filament, and the filament and attach with the setscrews.

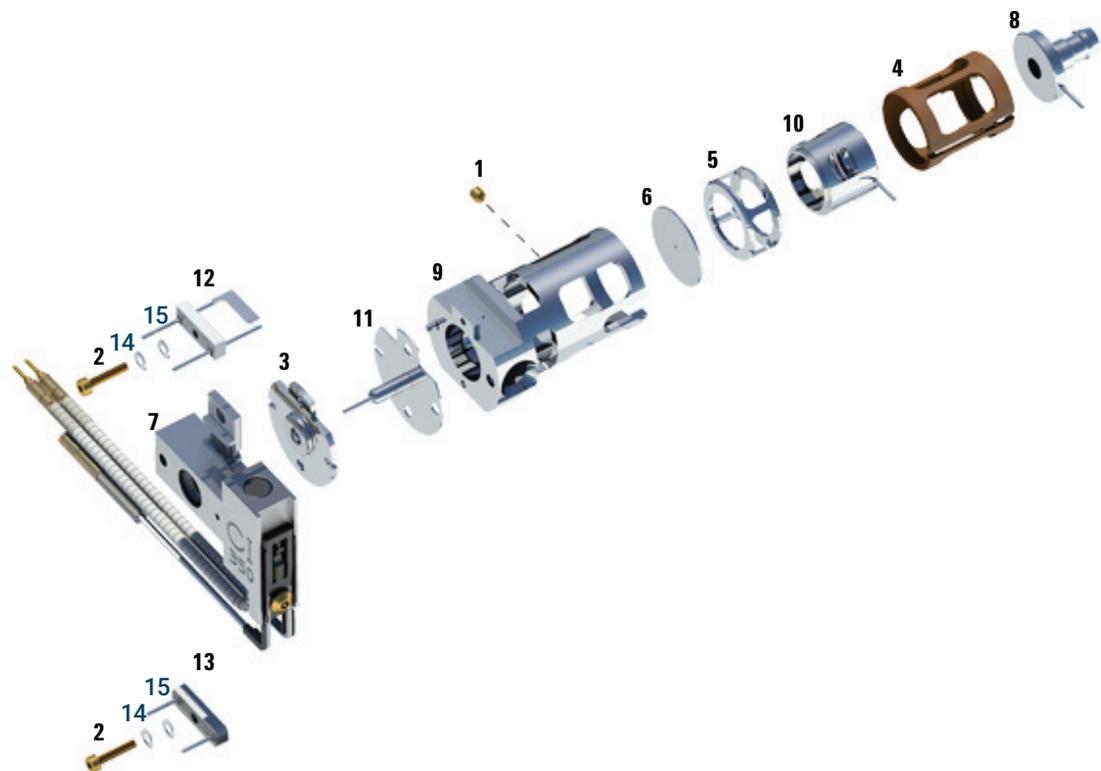


Figure 89. CI source exploded view

Table 25 Parts list for CI source (Figure 89)

Item	Description	Part number
1	Set screw	G1999-20022
2	Filament screw	G1999-20021
3	CI repeller insulator	G1999-20433
4	CI lens insulator	G3170-20540
5	CI drawout cylinder	G1999-20444
6	CI drawout plate	G1999-20446
7	CI source heater block assembly	G3870-60415
8	Entrance lens	G7000-20026

Table 25 Parts list for CI source (Figure 89) (continued)

Item	Description	Part number
9	CI source body	G3170-20430
10	Ion focus lens	G1999-20443
11	CI repeller	G7077-20432
12	CI filament- 2PK	G7005-60072
13	Dummy filament	G1999-60454
14	Washer spring curved 2.2 mm-ID 4.5 mm-OD, Qty. 2	3050-1374
15	Flat washer	3050-9082
Not shown	Package, GC/MS source Clamshell	G7002-80008
Not shown	Bracket, GC/MS source, Clamshell	G7002-00008
Not shown	CI source assembly	G7002-67404
Not shown	CI source assembly (without tip seal)	G7077-67404

## To Remove the CI Source Filament

### Materials needed

- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Hex ball driver, 1.5 mm (8710-1570)
- Tweezers (8710-2460)



### Procedure

- 1 Vent the MS. (See **“To Vent the MS”** on page 124.)

### CAUTION

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

### 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.

- 2 Open the front analyzer chamber. (See **“To Open the Front Analyzer Chamber”** on page 159.)
- 3 Remove the CI source. (See **“To Remove the 7000 Series CI Source”** on page 252.)
- 4 Remove the screw holding the filament to the CI source body. (See **Figure 90** on page 274.)
- 5 Slide the filament off the CI source assembly. (See **Figure 90** on page 274.)

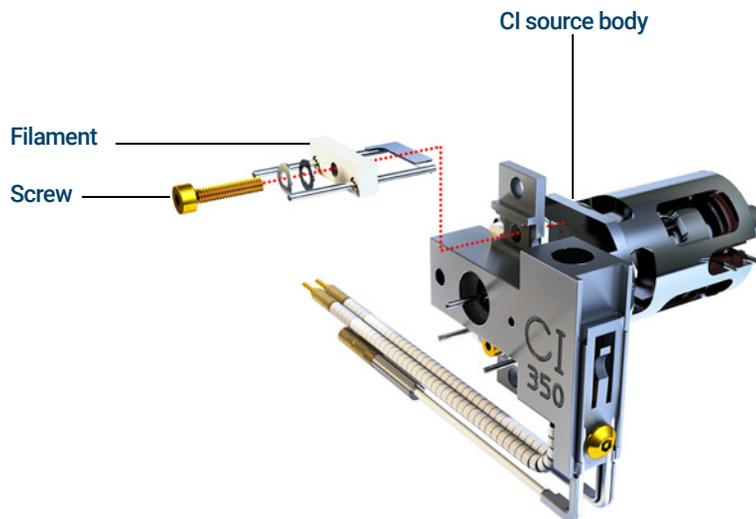


Figure 90. Changing the CI source filament

## To Install a CI Source Filament

### Materials needed

- Filament assembly, 2-pk, CI (G7005-60072)
- Gloves, clean, lint-free (Large 8650-0030) (Small 8650-0029)
- Tweezers (8710-2460)



### Procedure

- 1 Remove the old filament. (See **"To Remove the CI Source Filament"** on page 273.)
- 2 Place the new filament into its position on the ion source body. (See **Figure 90** on page 274.)
- 3 Secure the filament to the ion source body with the screw.
- 4 After installing the filament, verify that it is not grounded to source body.
- 5 Reinstall the CI source. (See **"To Install the 7010 Series CI Source"** on page 239.)
- 6 Pumpdown the MS. (See **"To Pumpdown the MS"** on page 120.)
- 7 Autotune the MS.

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