

## **Agilent 6000 Series LC/MS System**

### **Maintenance Guide**



**Agilent Technologies**

# Notices

© Agilent Technologies, Inc. 2014

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Agilent Technologies, Inc. as governed by United States and international copyright laws.

## Manual Part Number

G2581-90017

## Edition

Revision A, May 2014

Agilent Technologies, Inc.  
5301 Stevens Creek Blvd.  
Santa Clara, CA 95051

## Patents

Some technology described in this guide is covered by U.S. patents 6,107,628 and 6,803,565 licensed from Battelle Memorial Institute.

Some Ion Mobility technology is covered by patents US6,818,890; US6,967,325; US7,888,635.

## Note to Customer

This product may be used as a component of an in vitro diagnostic system if the system is registered with the appropriate authorities and complies with the relevant regulations. Otherwise, it is intended only for general laboratory use.

## Warranty

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

## Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

## Restricted Rights Legend

U.S. Government Restricted Rights. Software and technical data rights granted to the federal government include only those rights customarily provided to end user customers. Agilent provides this customary commercial license in Software and technical data pursuant to FAR 12.211 (Technical Data) and 12.212 (Computer Software) and, for the Department of Defense, DFARS 252.227-7015 (Technical Data - Commercial Items) and DFARS 227.7202-3 (Rights in Commercial Computer Software or Computer Software Documentation).

## Safety Notices

### CAUTION

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

### WARNING

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

# In This Guide...

This book contains procedures to clean and maintain your Agilent 6000 Series LC/MS instrument. This book applies to all 6100 Series, 6200 Series, 6400 Series and 6500 Series LC/MS instruments.

## 1 Startup and Shutdown

This chapter describes how to start up and shut down your LC/MS System.

## 2 Calibrant Delivery System and Divert Valve

This chapter describes maintenance tasks for the calibrant delivery system (CDS) and divert valve.

## 3 Sources

This chapter describes maintenance procedures for the components that make up the source.

## 4 Ion Transfer Capillary

This chapter describes the procedures to remove, clean and reinstall the ion transfer capillary. These procedures apply to both single- and multi-bore capillaries.

## 5 High Pressure Ion Funnel

With time and with heavy usage, the high pressure ion funnel needs to be cleaned to maintain its performance on the LC/MS instrument.

## 6 Desolvation Assembly and Vacuum Manifold

This chapter describes the steps to maintain the assemblies that are inside of the vacuum manifold. For most procedures, the desolvation assembly needs to be removed to get to the vacuum manifold.

## **7 Vacuum System**

This chapter includes procedures to maintain the vacuum system of the instrument. Do these steps according to the maintenance schedule or as indicated by instrument symptoms.

## **8 Reference**

This chapter contains safety information, parts lists, and other reference information for your Agilent 6000 Series LC/MS.

# Content

<b>1    Startup and Shutdown</b>	<b>9</b>
To start the system in Standby mode	12
To change between Standby and On	14
To shut down the instrument	15
Instrument Overview	16
Service Area	22
<b>2    Calibrant Delivery System and Divert Valve</b>	<b>25</b>
To prepare tuning mix	30
To prepare the reference mass solution	35
To check calibrant levels	39
To fill a calibrant bottle (6100 Series)	40
To fill a calibrant bottle (6200 Series, 6400 Series, and 6500 Series LC/MS)	42
To flush the calibrant delivery system	43
To check for leaks	45
To replace the inlet filter assembly	46
To replace the MS selection valve rotor seal	48
<b>3    Sources</b>	<b>51</b>
Changing Ion Sources	53
To remove an electrospray or Agilent Jet Stream source	53
To remove a multimode source	54
To remove an APCI or APPI source	54
To install an electrospray or Agilent Jet Stream source	55
To install an APCI source	57
To install an APPI source	58
To install the HPLC-Chip/MS interface	59
Source Maintenance	60
To flush the nebulizer	60

## Contents

To clean the spray chamber daily	61
To clean the spray chamber weekly	65
To remove the nebulizer	69
To inspect the nebulizer	70
To adjust or replace the nebulizer needle	73
To install the nebulizer	79
To clean the corona needle	80
To replace the corona needle	82
To change HPLC-Chip capillaries	84
<b>4 Ion Transfer Capillary</b>	<b>89</b>
To remove the capillary	90
To clean the capillary	92
To install the capillary	94
<b>5 High Pressure Ion Funnel</b>	<b>97</b>
To remove the high pressure ion funnel	98
To clean the high pressure ion funnel	100
To install the high pressure ion funnel	103
<b>6 Desolvation Assembly and Vacuum Manifold</b>	<b>105</b>
Desolvation Assembly	106
To remove the desolvation assembly	106
To install the desolvation assembly	109
Vacuum Manifold Cover	110
To open the vacuum manifold	110
To close the vacuum manifold	111
Ion Optics Assembly	112
To clean skimmer 1	112
To remove the ion optics assembly (6200 Series)	114
To clean the ion optics assembly (6200 Series)	117

To remove the ion optics assembly (6100 Series, 6400 Series, and 6500 Series)	125
To clean the ion optics assembly (6100 Series, 6400 Series and 6500 Series)	127
Beam-shaping assembly	137
To remove and clean the complete beam shaping assembly	137
To clean the beam-shaping slicer parts	148
Electron Multiplier	152
To replace the electron multiplier horn	152
To clean the high energy dynode	154
<b>7 Vacuum System</b>	<b>157</b>
To check the rough pump fluid level (Agilent MS40+)	158
To add rough pump fluid (Agilent MS40+)	159
To replace the rough pump fluid (Agilent MS40+)	162
To replace the fuses	164
To bake out the LC/MS	166
<b>8 Reference</b>	<b>167</b>
Safety	168
Symbols on instruments	168
General instrument safety	170
Physical hazard safety	171
General chemical safety	174
Chemical waste safety	175
Conformity and Standards	176
Safety and Regulatory Certifications	176
Electromagnetic Compatibility	177
Sound Emission Declaration	178
Environmental Conditions	178
Tools and Parts	179
Tools	179

## **Contents**

Parts and Supplies    181

## 1

# Startup and Shutdown

- To start the system in Standby mode 12
- To change between Standby and On 14
- To shut down the instrument 15
- Instrument Overview 16
- Service Area 22

This chapter describes how to start up and shut down your LC/MS System.

For more details, see the site preparation guide that is sent to customers before installation. If you move the instrument, you must follow and repeat the steps detailed in the site preparation guide.

### **WARNING**

**Always wear appropriate protection, including eye protection, lab coat, and gloves, when working with solvents and chemicals or when working with unassembled parts.**

---



Agilent Technologies

## 1 Startup and Shutdown

The LC/MS System instruments have three standard modes of operation that you can select from the software.

**On Mode** *On* is the fully operational status of the system. The instrument and the source are on. The LC/MS instrument icon indicates the state of the instrument:

**Table 1** Instrument icon color indication

Color	State
green	idle
blue	running, injecting
red	error
yellow	not ready
purple	pre-run, post-run
dark gray	offline
light gray	standby

Refer to the online Help to learn how to put the instrument in On mode.

**Standby Mode** In *Standby*, the source interface is on, the drying gas remains heated, and nebulizer flows are maintained. The source and **ion optics** voltages are turned off, and the mass spectrometer is not sending spectra to the computer. However, the LC/MS high voltage electronics are on.

**For APCI and multimode sources:** The vaporizer gas heaters are reduced.

**For an instrument with Agilent Jet Stream source:** The sheath gas temperature, drying gas flow, and drying gas temperatures are reduced.

This mode lets the instrument remain idle for periods lasting from minutes to days. You should place the instrument in Standby mode when it is not in use or when you want to change the ion source.

Refer to the online Help to learn how to put the instrument in Standby mode.

**Powered Off State** When the system is in the powered off state, the system is vented and the instrument is turned off to allow maintenance or to prepare for long periods when the instrument is not used.

Note that the only way to completely remove electrical power from the system is to unplug all power cords from the instrument.

**NOTE**

Before you move the instrument to another location, maintain it, or expect it to be idle for long periods of time, turn off both the front switch and the main power breaker switch behind the service panel.

**CAUTION**

If the LC/MS System is planned to be shut down for longer than one day, unplug the instrument from the wall outlet to prevent overheating of the turbo pump power supplies.

## 1 Startup and Shutdown

To start the system in Standby mode

### To start the system in Standby mode

This procedure brings the system from the powered off state to Standby mode.

- 1 Check that nitrogen gas for the drying gas is turned on. If equipped with a collision cell, check that nitrogen gas for the collision cell is turned on.

When you use an Agilent Jet Stream source (single or dual nebulizer), the nitrogen gas requirements are greater than when operating with electrospray, APCI, APPI, or multimode sources. The supply line must have two gas filters (part number BHT-4 or RMSN-4) plumbed in parallel to achieve these flows without triggering errors at the instrument. Refer to the *Installation Guide* for more details.

- 2 Check that the rough pump is properly connected to the LC/MS instrument.
  - a Check that rough pump power cable is connected to the **Foreline Pump** power receptacle.

**For instruments without a pump expander box:** The **Foreline Pump** power receptacle is behind the service panel.

**b For instruments with an ion funnel:** Check that the **ion funnel pump** is connected to the **Auxiliary Pump** power receptacle in the **pump expander box**.

**c** Check that the LC/MS mainframe pump has the correct voltage rating for your AC power (200 to 240 VAC).

**d** Check that the rough vacuum hose is connected to the **inlet port** of the **rough pump**.

**e For instruments with an ion funnel:** Check that the **ion funnel rough vacuum hose** is connected to the **ion funnel rough pump inlet**.

**f** Check that the switch on the **rough pump** (or pumps) is in the **On** position.
  - 3 Check that all foreline and **ion funnel** pumps and the **spray chamber exhaust** are vented outside the laboratory.

#### WARNING

Vent all exhausts external to the building where they cannot be recirculated by environmental control systems. Do not vent exhaust into your laboratory. The exhaust fumes from the vacuum pumps and spray chamber contains trace amounts of the chemicals you analyze. Health hazards include chemical toxicity from solvents, buffers, samples and pump fluid vapor, as well as potentially biohazardous aerosols of biological samples.

**CAUTION**

Do not connect the spray chamber exhaust bottle to the rough pump exhaust tubing or the rough pump exhaust tubing to the spray chamber exhaust tubing. Doing so can contaminate the instrument with rough pump fluid.

- 4** Turn on the power for the computer and monitor.
- 5** Check that the instrument is plugged into a power outlet.
- 6** **For instruments with a pump expander box only:** Check that the power switch on the **pump expander box** is connected to the wall outlet and is turned on. The switch is illuminated green when the power is on.

- 7** Turn on the **front power switch** of the LC/MS System.

This starts the pumping system and the electronics.

- 8** **For the 6200 Series and 6500 Series LC/MS instruments only:** In the TOF/Q-TOF Diagnostics program, connect to the system. Select the **Pump Down** and **HV Condition** options.

The system monitors the vacuum pressure. Once the vacuum pressure reaches  $3 \times 10^{-6}$  Torr, the system begins to condition the high voltage electronics.

When high voltage conditioning is complete, close the Diagnostics program.

- 9** Start the data acquisition program.

The system comes up in Standby mode.

**NOTE**

For the 6200 Series and 6500 Series LC/MS instruments only: You will not be able to set the flows while the LC/MS system is in a “Not Ready” state. The system will remain in the Not Ready state while the high vacuum pressure is above  $3.5 \times 10^{-6}$  Torr.

- 10 For the 6200 Series and 6500 Series LC/MS instruments only:** Let the instrument continue to pump down.

The Rough Vac (rough pump) pressure should be about 1.75 to 3.5 Torr, depending on the instrument type. The TOF Vac (flight assembly region) pressure reaches approximately  $3 \times 10^{-6}$  Torr within two to three hours. The TOF Vac reading reaches the  $10^{-7}$  Torr range after pumping overnight to several days.

Leave the instrument in Standby.

## 1 Startup and Shutdown

To change between Standby and On

### To change between Standby and On

Use this procedure when:

- The LC/MS System is in Standby mode and you need to bring it into the On mode.
- Sample analysis is complete and you want to put the LC/MS instrument in Standby mode.

Before you change the state from On to Standby:

- Check that you have completed tuning and data acquisition and you have saved all data as needed (described in later chapters).
- In the data acquisition program, right-click the instrument icon, and then change the instrument state to **Standby** or **On**.

Refer to the online Help.

You can only activate the Standby mode or On mode if the ion source is mounted and closed. You can now select parameters for your measurement.

In Standby mode:

- The drying gas flow, drying gas temperature, nebulizer pressure, vaporizer temperature, and sheath gas temperature are reduced.
- The spray chamber high voltages are turned off. For 6200 Series and 6500 Series LC/MS instruments, voltages in the flight tube remain **On** to maintain stable operating voltages.
- The mass spectrometer stops generating spectra.

## To shut down the instrument

You can turn off the LC/MS System when the instrument will be idle for an extended time or when you must do maintenance.

Before you begin, check that you have completed tuning and acquiring data, and that you have saved all data as needed.

### CAUTION

When you vent the system from the data acquisition program, the LC/MS instrument does not turn off. You must follow the entire shutdown procedure.

### WARNING

**The spray shield and related spray chamber components are likely to be hot. Do not touch them!**

**1** Turn off the solvent flow.

If you have analyte in any of the components in the sample delivery system, flush the delivery system with pure solvent before you continue.

**2** If equipped with a ballast valve, check that the ballast valve on the rough pump is closed.

**3** From the data acquisition program, vent the system.

When you vent the system, these parts are turned off: spray chamber high voltages, the drying gas heater, the nebulization flow, the detector, and other lens voltages. The drying gas flow is set to 3.5 L/minute. If the APCI source is installed, the vaporizer heater is also turned off. If the installed source is an Agilent Jet Stream source, the sheath gas heater is also turned off. The Rough Pump turns off when the turbo speed is below 20 percent.

**4** Wait until the instrument completely vents (reaching 760 Torr).

**For 6200 Series and 6500 Series LC/MS instruments:** This step ensures that the flight tube is filled with nitrogen to protect the detector from moisture damage.

**5** Turn off the front switch located in the lower left front corner of the instrument.

**6** Unplug the main power cable behind the service panel. If the instrument is equipped with a pump expander box, also unplug the pump expander cable behind the service panel.

## 1 Startup and Shutdown

### Instrument Overview

Do this to completely remove power from the instrument and to prevent the power supplies within the instrument from overheating.

You can also shut down the data acquisition program and computer.

The system is now shut down.

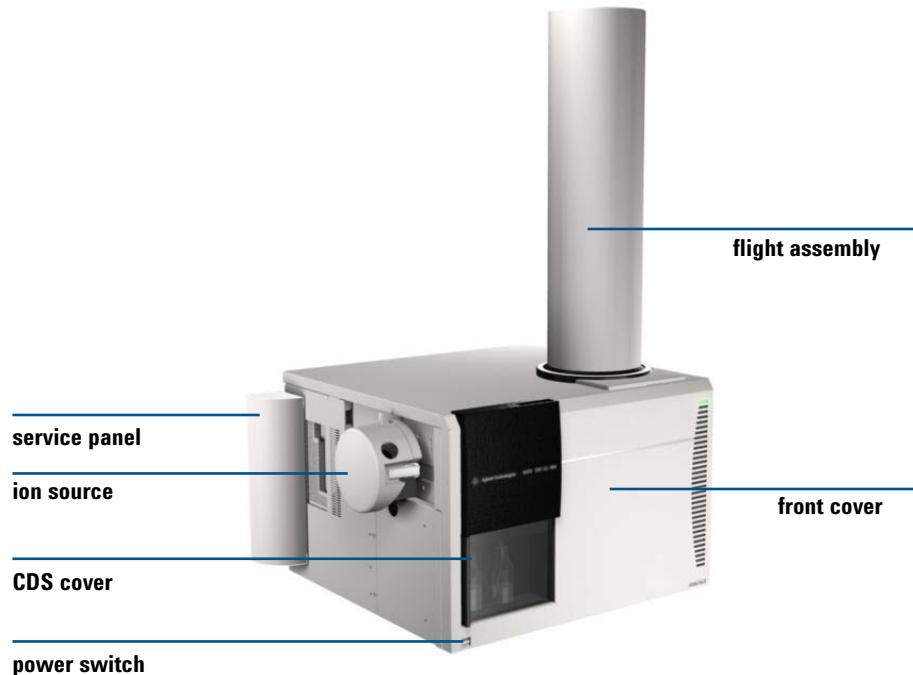
## Instrument Overview

These figures show you where the various switches, covers, and external parts are located.

### 6100 Series



**Figure 1** Standard 6100 Series cover design.

**6200 Series**

**Figure 2** Standard 6200 Series LC/MS cover design. The main power switch is located on the front lower left.

## 1 Startup and Shutdown

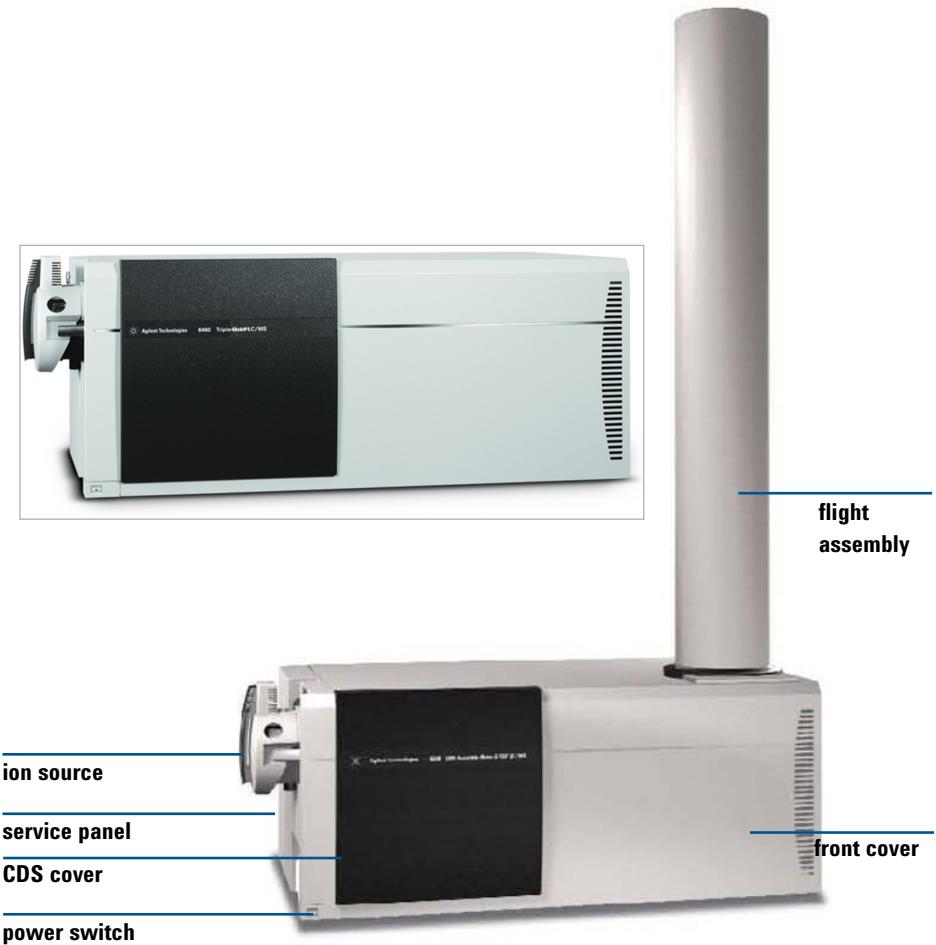
### Instrument Overview

#### 6400 Series and 6500 Series

These figures show the 6400 Series and 6500 Series LC/MS instruments. 6400 Series share the same base unit design as the 6500 Series, except for the inclusion of a flight assembly.



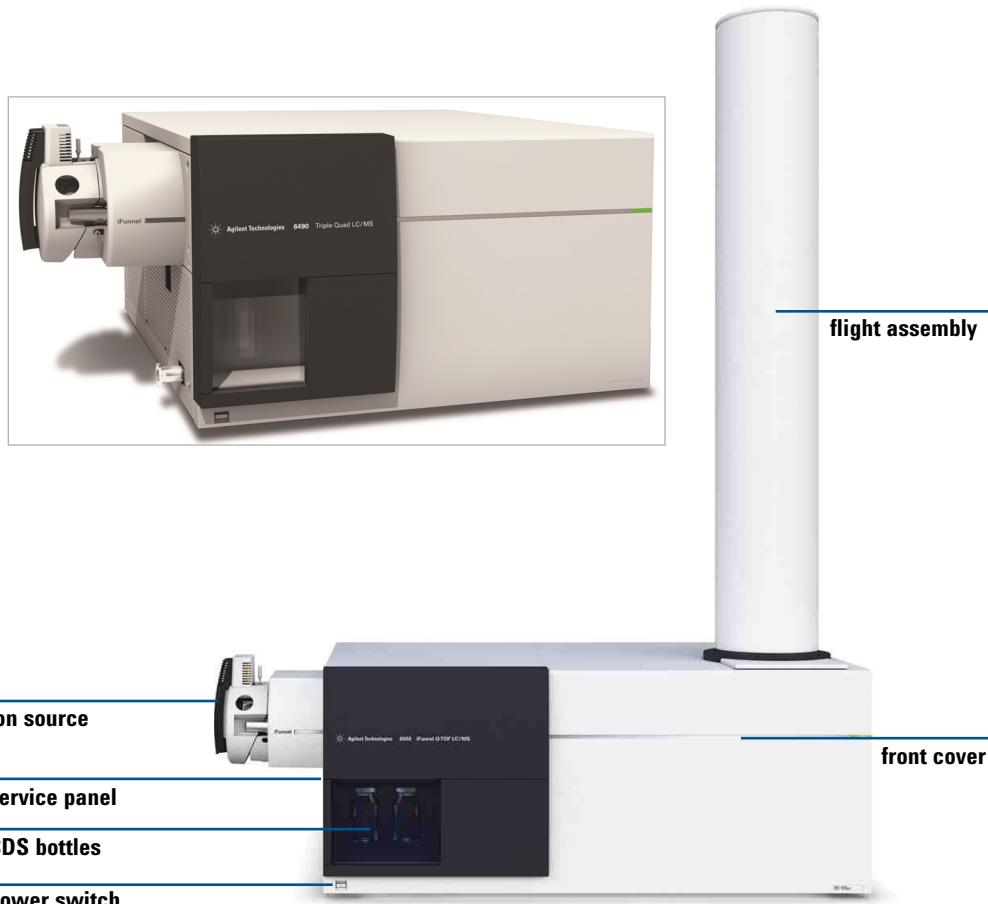
**Figure 3** 6400 Series (inset) and 6500 Series LC/MS system. The main power switch is behind the service panel.



**Figure 4** 6400 Series (inset) and 6500 Series LC/MS system.

## 1 Startup and Shutdown

### Instrument Overview



**Figure 5** 6400 Series (inset) and 6500 Series LC/MS with an iFunnel ion funnel



**Figure 6** Ion Mobility Q-TOF LC/MS

## 1 Startup and Shutdown

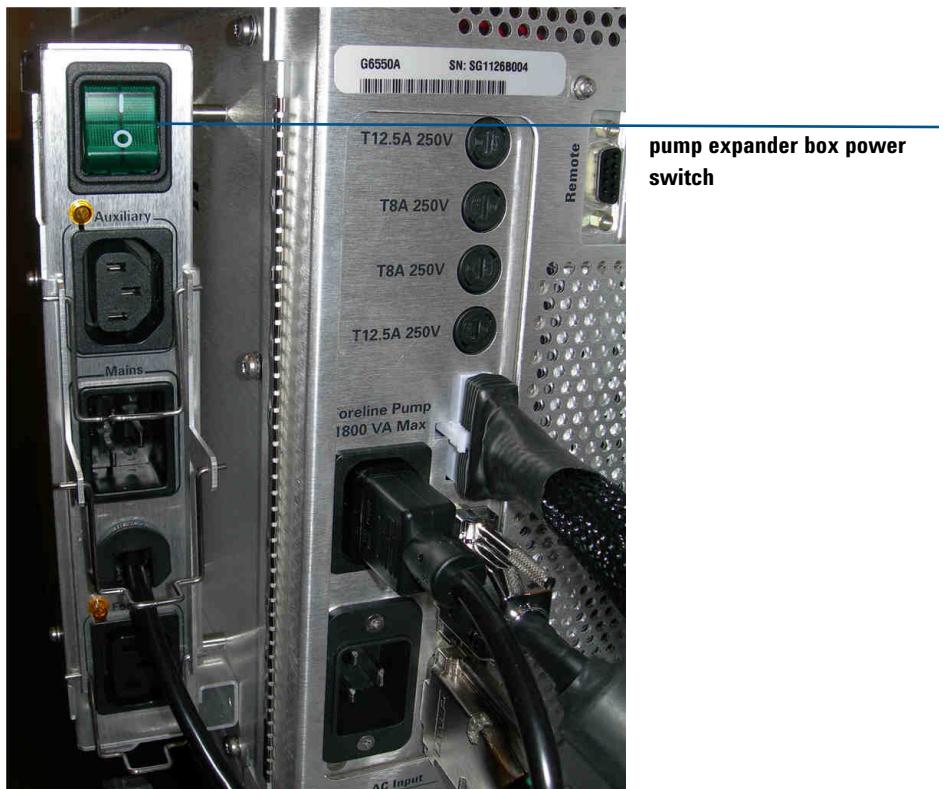
### Service Area

## Service Area

These pictures show you where various connectors are located.



**Figure 7** Gas, LAN, and power connections behind service panel for the 6400 Series and 6500 Series instruments without a pump expander box,



**Figure 8** Power connections and pump expander box behind service panel for 6400 Series and 6500 Series instruments with a pump expander box.

**opened service panel**

**LAN connection**



**Figure 9** Connections behind service panel for 6200 Series LC/MS  
This page intentionally left blank.

## 2

# Calibrant Delivery System and Divert Valve

- To prepare tuning mix 30
- To prepare the reference mass solution 35
- To check calibrant levels 39
- To fill a calibrant bottle (6100 Series) 40
- To fill a calibrant bottle (6200 Series, 6400 Series, and 6500 Series LC/MS) 42
- To flush the calibrant delivery system 43
- To check for leaks 45
- To replace the inlet filter assembly 46
- To replace the MS selection valve rotor seal 48

This chapter describes maintenance tasks for the calibrant delivery system (CDS) and divert valve.

When you do maintenance procedures on the divert valve:

- Do not bend any capillary line.
- The position of the divert valve can be set only in the On mode.
- Put the instrument in the Off mode.
- Remove the covers before you begin.
- Install the covers of the instrument after you finish.

### WARNING

**Always wear appropriate protection, including eye protection, lab coat, and gloves, when working with solvents and chemicals or when working with unassembled parts.**

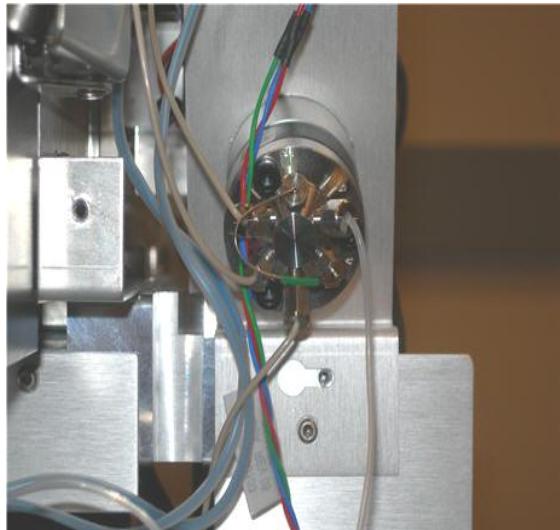


Agilent Technologies

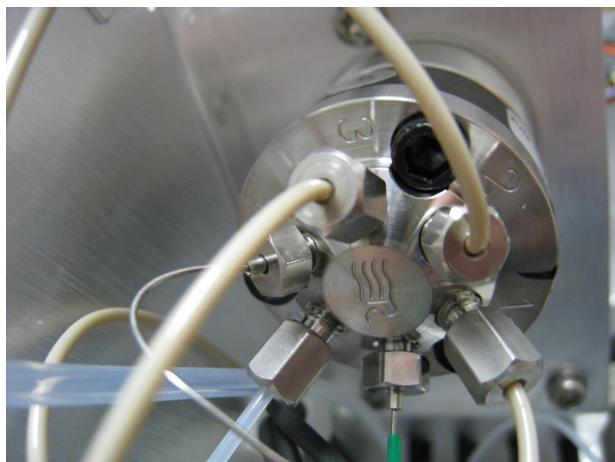
## 2 Calibrant Delivery System and Divert Valve

**Table 2** Divert Valve Connection (see Figure 10 through Figure 12)

No.	Port	Connection	User action
1	Inlet	from the front inlet union behind the inlet cover	none
2	Inlet	from CDS	none (permanent connection from calibrant delivery system)
3	Outlet	to the ion source	connect the flexible capillary to the ion source
4	Loop	loop to port 6	none (permanent connection)
5	Waste	to the drain bottle	none
6	Loop	loop to port 4	none (permanent connected)



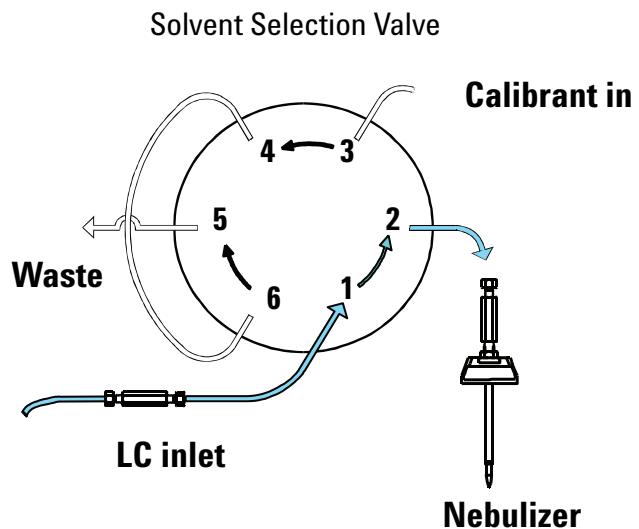
For 6100 Series, 6400 Series and 6500 Series LC/MS



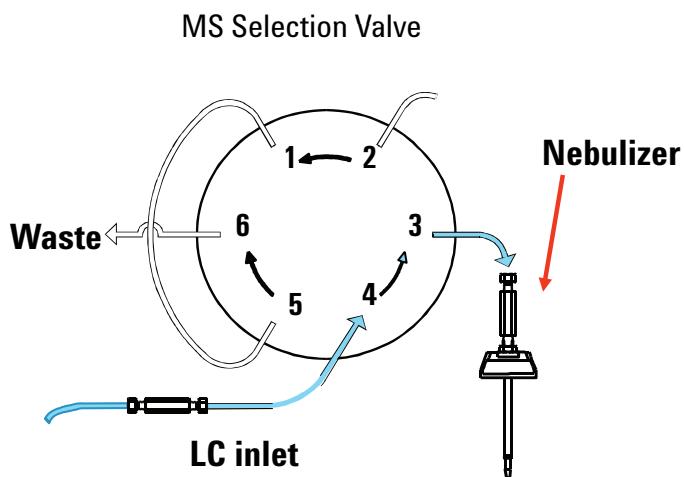
For 6200 Series LC/MS

**Figure 10** Divert valve with port position indicators

## 2 Calibrant Delivery System and Divert Valve



For 6100 Series, 6400 Series and 6500 Series LC/MS



For 6200 Series LC/MS

Figure 11 LC to LC/MS flow

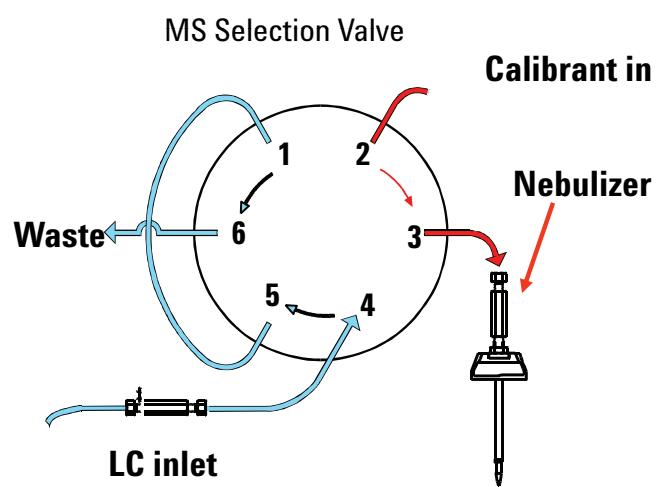
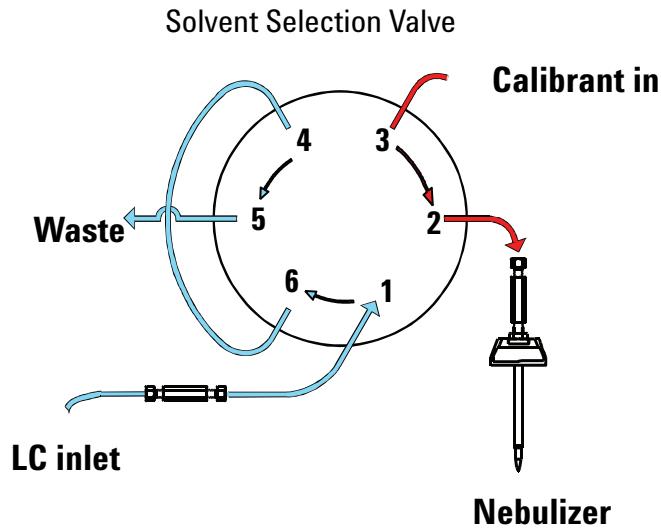


Figure 12 Calibrant to LC/MS flow

## 2 Calibrant Delivery System and Divert Valve

To prepare tuning mix

### To prepare tuning mix

*This topic applies to only the 6200 Series and 6500 Series LC/MS with an Agilent Jet Stream source.*

For many instruments, the standard tuning mix produces correct results. However, in some instances, a dilution is needed.

Dilute the tuning mix if:

- You get error messages that instruct you to dilute the calibrant.
- The tune report shows abundances greater than 750,000 counts. You need to dilute until the largest abundance is below 750,000 counts for a mass axis calibration. Typical tune mass abundances are in the range of 50,000 to 650,000 counts.

Do not dilute the tuning mix if:

- Your source is an APPI or APCI.

**Tools needed**

- LC/MS-grade acetonitrile
- deionized (18 MW-cm) water
- glass CDS bottle
- glass CDS bottle cap

**Parts needed**

- ESI-L Tuning Mix (for Dual ESI or Agilent Jet Stream)
- MMI-L Tuning Mix (for multimode source)
- Biopolymer Reference Mass Kit, which contains the HP-0321 solution (for Agilent Jet Stream)

The materials shipped with the instrument are of sufficient purity for this purpose.

These instructions make 100 mL of diluted tuning mix.

1 Add the components in the table below, *in the order listed*, to a clean [glass CDS bottle](#). Refer to the table that is appropriate for your source.

Make sure you add the components in the order listed below to avoid precipitation of any components of the tuning mix.

**Table 3** AJS and Dual AJS except 6550/6560

Source	Positive Mode	Negative Mode
Undiluted Tuning Mix	10 mL ESI-L	2.5 mL ESI-L
Acetonitrile	85.5 mL	95.6 mL
Water	4.5 mL	1.9 mL
0.1 mM HP-0321 (included in the Biopolymer Reference Mass Kit)	3 µL	N/A

**Table 4** 6550/6560 with Dual AJS ESI

Source	Positive and Negative Mode
Undiluted Tuning Mix	10 mL ESI-L
Acetonitrile	85.5 mL
Water	4.5 mL
0.1 mM HP-0321 (included in the Biopolymer Reference Mass Kit)	3 µL

**Table 5** Dual ESI

Components	Positive Mode	Negative Mode
Undiluted Tuning Mix	25 mL ESI-L	25 mL ESI-L
Acetonitrile	71.25 mL	71.25 mL
Water	3.75 mL	3.75 mL

**Table 6** Multimode

Components	Positive Mode	Negative Mode
Undiluted Tuning Mix	25 mL MMI-L	25 mL MMI-L
Acetonitrile	71.25 mL	71.25 mL
Water	3.75 mL	3.75 mL

## 2 Calibrant Delivery System and Divert Valve

To prepare tuning mix

- 2 Mix the contents thoroughly and install the **calibrant bottle** on the instrument.
- 3 Change to the **Tune** context, and then:
  - a Open the reference B valve.
  - b Allow at least one minute for the tuning mix to flush the previous solution from the calibrant system before you tune the instrument.

Store the custom tuning mix in the refrigerator when it is not being used for extended periods of time.

Use these guidelines to adjust the custom tuning mix:

- In the final tune report, make sure all abundances listed in the report are between 50,000 and 700,000 counts for proper calibration of the mass axis. Dilution of the tuning mix up to 200-fold can be needed for instruments with exceptional sensitivity. Be careful in your laboratory work when you dilute greater than 50-fold because contamination and sodium trifluoroacetate adducts can become problematic at higher dilutions.
- The amount of water added affects the response of 118 *m/z*, with higher amounts yielding a greater response and vice versa. You can add water up to the amount of 5% (v/v). Do not add more water than that because some components of the tuning mix can precipitate under these conditions.
- If tune mass abundances are less than 10,000 counts, the tuning mix is over-diluted. Dilutions at this level can result in poor mass accuracies.
- Use the HP-321 solution in a 2000:1 (v/v) ratio to the ESI-L Tuning Mix. (If 10 mL ESI-L Low Concentration tuning mix is used, add 5  $\mu$ L of the HP-321 solution.)
- Sodium TFA can cause problems during calibration, depending on how the calibrant is diluted and how much sodium is in the water. [Table 7](#) lists the ions that can result from sodium TFA (both positive and negative mode).\*

\* Source: Mehdi Moini, Bruce L. Jones, Robin M. Rogers, and Longfei Jiang, "Sodium Trifluoroacetate as a Tune/Calibration Compound for Positive- and Negative-Ion Electrospray Ionization Mass Spectrometry in the Mass Range of 100–4000 Da," *Journal of The American Society for Mass Spectrometry* Sept. 1998: 977–980.

**Table 7** Elemental compositions and calculated masses of sodium trifluoroacetate ion clusters by electrospray ionization under positive-ion ( $[(CF_3COONa)_nNa]_1$ ) and negative-ion ( $[(CF_3COONa)_nCF_3COO]_2$ ) modes

n	Positive-ion calculated mass	Negative-ion calculated mass
1	158.96458*	248.96036*
2	294.93939*	384.93466*
3	430.91420*	520.90947*
4	566.88900*	656.88427*
5	702.86381*	792.85908*
6	838.83862*	928.83389*
7	974.81343*	1064.80870
8	1110.78824*	1200.78351
9	1246.76305*	1336.75832
10	1382.73786	1472.73313
11	1518.71267	1608.70794
12	1654.68747	1744.68274
13	1790.66228	1880.65755
14	1926.63709	2016.63236
15	2062.61190	2152.60717
16	2198.58671	2288.58198
17	2334.56152	2424.55679
18	2470.53633	2560.53160
19	2606.51114	2696.50640
20	2742.48594	2832.48121
21	2878.46075	2968.45602
22	3014.43556	3104.43083
23	3150.41037	3240.40564
24	3286.38518	3376.38045

## 2 Calibrant Delivery System and Divert Valve

To prepare tuning mix

**Table 7** Elemental compositions and calculated masses of sodium trifluoroacetate ion clusters by electrospray ionization under positive-ion ( $[(CF_3COONa)_nNa]_1$ ) and negative-ion ( $[(CF_3COONa)_nCF_3COO]_2$ ) modes (continued)

n	Positive-ion calculated mass	Negative-ion calculated mass
25	3422.35999	3512.35526
26	3558.33480	3648.33007
27	3694.30961	3784.30487
28	3830.28441	3920.27968
29	3966.25922	4056.25449

\*Peaks marked with asterisks were also observed under chemical ionization mode using a direct insertion probe.

## To prepare the reference mass solution

This procedure applies to only the 6200 Series and 6500 Series LC/MS instrument.

The dilutions in this topic are used for installation and check-out. If needed, adjust the dilution for your own analysis.

- Tools needed**
- clean gloves
  - 1000-mL narrow mouth bottle, included with the LC/MS instrument

- Parts needed**
- ES-TOF Reference Mass Kit, which contains two ampoules each (2.2 mL/ampoule) of the following reference ions:
    - 100 mM (millimolar) ammonium trifluoroacetate in 90:10 acetonitrile:water. This solution is abbreviated 100 mM TFANH4.
    - 5 mM (millimolar) purine in 90:10 acetonitrile:water
    - 2.5 mM (millimolar) hexakis(1H, 1H, 3H-tetrafluoropropoxy)phosphazaine in 90:10 acetonitrile:water. This solution is abbreviated 2.5 mM HP-0921.
  - Acetonitrile UV
  - deionized (18 MW-cm) water

The reference solution provides internal reference masses for reference mass correction in positive and negative ion modes of operation. For the purposes of mass accuracy performance verification, make the following reference mass solution.

- 1 Put on protective clean gloves.
- 2 Using a graduated cylinder, pour 950 mL of Acetonitrile UV and 50 mL of deionized (18 MW-cm) water into the 1000-mL narrow mouth bottle.
- 3 Using a pipettor, add the following amounts of the individual calibrants to the 1000-mL narrow mouth bottle containing the Acetonitrile UV/deionized (18 MW-cm) water solution made in step 2.

**Table 8**

Calibrants	Volume
TFANH4	0.5 mL
Purine	1.0 mL
HP-0921	0.45 mL

## 2 Calibrant Delivery System and Divert Valve

To prepare the reference mass solution

**Table 9**

	Dual ESI	Agilent Jet Stream ESI
<b>TFANH4</b>	0.5 mL	
<b>Purine</b>	1.0 mL	0.4 mL
<b>HP-0921</b>	0.45 mL	1.0 mL

Before you break open each ampoule, invert the ampoule several times to mix. Inspect the ampoule's contents to ensure that all the solution is contained in the lower cylindrical base. Shake the ampoule, if needed, to dislodge any air pocket that can prevent solution from settling in the lower portion of the ampoule.

- 4 Cap and invert the bottle several times to thoroughly mix the reference mass solution.
- 5 Transfer 100 mL of this solution to CDS Reference Bottle "A".

### Use of ES-TOF Reference Mass Solution

Use these guidelines to adjust the amounts of IRM compounds to add to this preparation.

- IRM abundances less than 1000 counts generally do not yield acceptable ion statistics for good correction. Ideally, abundances will be at the level of 10,000 counts or greater at any point in the analysis where correction is desired.
- The abundances of the reference mass compounds change during an HPLC gradient, with lesser abundances occurring at higher organic compositions. This is especially true when using acetonitrile as the organic component. Make sure the abundances are high enough during the entire gradient.

- Interference at one of the reference masses can cause problem with mass accuracy, most likely the reference mass 121  $m/z$  at the low end of the scan range, where the background response is the highest. This causes an error in determining that reference mass value, leading to an error in assignment of other mass peaks in that scan. Sometimes, the problem can be lessened by increasing the amount of that reference mass component. Sometimes a different compound can be chosen to serve as the reference mass compound (e.g., a phthalate response at 391.284286  $m/z$ ). More often, the problem is remedied by altering the sample cleanup procedures to remove the interfering component(s).
- The values chosen for the reference mass correction depend on the adducts present during the analysis. Refer to the instruction sheet included with the internal reference mass kit for the accurate  $m/z$  values of the most common adducts.
- **For instruments with an Agilent Jet Stream source only:** Higher sheath gas temperatures and sheath gas flows will increase the response of the 922  $m/z$  reference mass compound.

The internal reference mass solution allows you to get accurate mass time-of-flight data. A minimum reference mass signal abundance of several thousand counts and maximum abundance of several hundred thousand counts will provide accurate reference mass corrections. If LC mobile phase modifiers are present (e.g. Na<sup>+</sup>, K<sup>+</sup>, acetate, formate), competition can cause multiple molecular species to attenuate the reference mass response. The actual concentrations of the mass reference compounds in the solution you prepare will depend upon several instrument operating parameters:

- LC gradient or isocratic operation
- LC flow rate, mobile phases and modifiers
- MS source settings including fragmentor and octopole RF voltages

The data acquisition mass range should be set wide enough to include all of the reference masses. For small molecule analysis, this range is typically  $m/z$  50 to 1000 for positive mode and  $m/z$  50 to 1100 for negative mode. Note that  $m/z$  1034 is the TFA adduct of HP-0921.

## 2 Calibrant Delivery System and Divert Valve

To prepare the reference mass solution

**Table 10** ES-TOF Reference Masses (shaded cells indicate principal ions)

Species	Positive Ion (m/z)	Negative Ion (m/z)	Formula Wt.	Molecular Formula
CF3 (TFA fragment)		68.995758		C F3
TFA anion		112.985587	131.06	C2 O2 F3 (N H4)
Purine	121.050873	119.036320	120.11	C5 H4 N4
HP-0921	922.009798	1033.988109	921.24	C18 H18 O6 N3 P3 F24
HP-0921 (+ formate)		966.000725		
HP-0921 (+ acetate)		980.016375		

## To check calibrant levels

**When needed** Monthly or weekly if you tune the instrument frequently

**Tools needed** None

**Parts needed** None

- 1 Examine each **calibrant bottle**. Enough tuning mix must be present to immerse the end of the intake tube.



**Figure 13** Calibrant bottle level

- 2 If the tuning mix level is within a few millimeters of the end of the intake tube, refill the **calibrant bottle**.

### NOTE

Record this procedure in the Maintenance Logbook.

Make sure to use the correct calibrant for designated source.

## 2 Calibrant Delivery System and Divert Valve

To fill a calibrant bottle (6100 Series)

### To fill a calibrant bottle (6100 Series)

**When needed** As needed.

**Tools needed** None

**Parts needed**

Source	Calibrant
electrospray	ESI-L Tuning Mix
Agilent Jet Stream	
multimode (6150 only)	
ESI (6120, 6130)	ESI Tuning Mix
APPI	APCI/APPI Calibrant
APCI (6120, 6130)	
multimode (6120, 6130)	
APCI (6150 only)	APCI-TOF Tune Mix

- 1 Turn the **calibrant bottle** to be refilled clockwise until it can be removed from the fixed bottle cap.
- 2 Refill **calibrant bottle** with the appropriate tuning mix.



**Figure 14** Calibrant bottle for tuning mix

- 3 Put the intake tube into the refilled **calibrant bottle** as you lift the **calibrant bottle** into position.

**CAUTION**

Tighten the bottle by hand. The bottle only needs to be snug. Do not over-tighten the bottle, or you can cause the bottle cap to crack and leak. A leaky bottle cap can prevent the bottle from pressurizing and can lead to the evaporation of the contents.

---

- 4** Attach the **calibrant bottle** onto the fixed bottle cap. Turn the **calibrant bottle** counterclockwise to tighten.
- 5** Select **Flush Calibrant System** from the **Instrument** menu in the Tune view.
- 6** Wait until the flush is completed.

**CAUTION**

The tuning mixes are not interchangeable, even though they will give similar mass spectra. Failure to change the tuning mix when the source or inlet assembly is changed can result in miscalibration of the instrument and errors in mass assignments.

---

**NOTE**

Record this procedure in the Maintenance Logbook.

---

## 2 Calibrant Delivery System and Divert Valve

To fill a calibrant bottle (6200 Series, 6400 Series, and 6500 Series LC/MS)

### To fill a calibrant bottle (6200 Series, 6400 Series, and 6500 Series LC/MS)

**When needed** As needed.

**Tools needed** None

**Parts needed**

- APCI/APPI Calibrant
- APCI-L Tuning Mix
- ESI-L Tuning Mix
- MMI-L Tuning Mix
- Reference Mix (created from [ES-TOF Reference Mass Kit](#))

Instruments with an Agilent Jet Stream source use diluted [ESI-L Tuning Mix](#). See “[To prepare tuning mix](#)” on page 30.

- 1 Turn the **calibrant bottle** to be refilled clockwise until it can be removed from the fixed bottle cap.
- 2 Refill the **calibrant bottle** with the appropriate tuning mix.
- 3 Put the intake tube into the refilled **calibrant bottle** as you lift the **calibrant bottle** into position.

#### CAUTION

Tighten the bottle by hand. The bottle only needs to be snug. Do not over-tighten the bottle, or you can cause the bottle cap to crack and leak. A leaky bottle cap can prevent the bottle from pressurizing and can lead to the evaporation of the contents.

- 4 Attach the **calibrant bottle** onto the fixed bottle cap. Turn the **calibrant bottle** counterclockwise to tighten.

#### CAUTION

The tuning mixes are not interchangeable, even though they will give similar mass spectra. Failure to change the tuning mix when the source or inlet assembly is changed can result in miscalibration of the instrument and errors in mass assignments.

#### NOTE

Record this procedure in the Maintenance Logbook.

## To flush the calibrant delivery system

**When needed** When symptoms indicate contamination in the calibrant delivery system (CDS). Especially when the contamination appears during tuning but not during data acquisition.

**Tools needed**

- LC/MS-grade acetonitrile
- LC/MS-grade water

**Parts needed** None

- 1 Remove the **calibrant bottle** that is contaminated.
- 2 Install a **calibrant bottle** containing the 90%/10% solution of LC/MS-grade acetonitrile and LC/MS-grade water.
- 3 **For the 6100 Series:**
  - a In the ChemStation data acquisition program, select **Flush calibrant system** from the **Instrument** menu in the MSD tune view.
  - b Specify a flush time of 10 minutes and click **OK**.
  - c Wait while the **calibrant delivery system** pumps the mixture of acetonitrile and water through the system. After 10 minutes the **calibrant delivery system** stops pumping.
- 4 **For the 6200 Series, 6400 Series and 6500 Series:**
  - a In the MassHunter data acquisition program, in the **Tune** view, click the **Manual Tune** tab.
  - b Mark the **Calibrant** check box and click **Apply**.<sup>1</sup>
  - c Wait while the **calibrant delivery system** pumps the mixture of acetonitrile and water through the system.
  - d After 10 minutes, clear the **Calibrant** check box and click **Apply** to stop the flow of calibrant.
- 5 Remove the **calibrant bottle** of acetonitrile and water.
- 6 Install a new **calibrant bottle** of calibrant depending on which source will be used.

### CAUTION

Do not reinstall the old bottle of calibrant. The old calibrant can be the source of the contamination.

## 2 Calibrant Delivery System and Divert Valve

To flush the calibrant delivery system

- 7 Flush this channel of the **calibrant delivery system** for 5 minutes with the new calibrant.

### NOTE

Record this procedure in the Maintenance Logbook.

---

## To check for leaks

**When needed** When the sensor indicates a leak has occurred.

**Tools needed**

- T10 Torx screwdriver
- clean lint-free cloth

**Parts needed** None

- 1 Remove the **front cover** and **top cover** from the instrument.
- 2 Remove the **calibrant bottle** or bottles.
- 3 Turn off the **spray chamber** nebulizer pressure, drying gas temp, and vaporizer temp (for APCI or multimode).
- 4 **For 6200 Series and 6500 Series LC/MS instruments:** Disconnect the nebulizer sample line and the sample nebulizer gas tubing from the nebulizer.

### WARNING

The spray chamber operates at very high temperatures. Do not continue until the spray chamber is cool.

- 5 Remove the **spray chamber** from the instrument.
- 6 Remove or loosen the two screws that attach the cover of the **calibrant delivery system**, and then remove the cover.
- 7 Check the catch tray. If you see liquid, the pump has a leak.
- 8 If a leak occurs during a long unattended run, the liquid from the leak can evaporate to give you the impression that no leak exists. Turn the system back on and make sure no leak exists.
- 9 If you find a leak, correct it and check the remaining locations.
- 10 Dry the catch tray and leak sensor with a **clean lint-free cloth**.
- 11 When the catch tray and leak sensor are thoroughly dry, reassemble the instrument.

### NOTE

Record this procedure in the Maintenance Logbook.

## 2 Calibrant Delivery System and Divert Valve

To replace the inlet filter assembly

### To replace the inlet filter assembly

**When needed** When back pressure is high on the LC pump or when the sensor indicates a leak has occurred.

**Tools needed**

- tweezers
- 1/2-inch × 9/16-inch open-end wrench
- 1/4-inch × 5/16-inch open-end wrench
- T20 Torx screwdriver

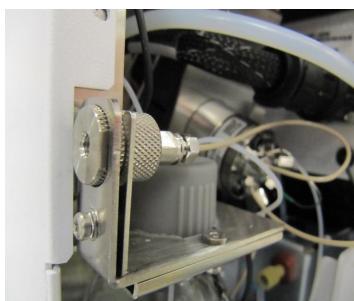
**Parts needed**

- [Universal Inlet Filter Replacement Kit](#), which includes:
  - inlet capillary adapter
  - inlet filter capillary

Use the capillary that is appropriate for your LC/MS model:

- **For 6100 Series:** 01090-87611 (105 mm)
- **For LC/MS instruments with an ion funnel:** G1316-87315 (130 mm)
- **For all other LC/MS instruments:** G1315-87312 (150mm)

- 1 Stop the flow of LC solvent to the instrument.
- 2 **For APCI or multimode:** Turn off the **spray chamber** nebulizer pressure, drying gas temp, and vaporizer temp.
- 3 Remove the **spray chamber**.
- 4 Remove the **front cover** and **top covers**.
- 5 **For 6200 Series, 6400 Series and 6500 Series:** Remove the upper left **front cover**.



**Figure 15** Inlet filter assembly for (from left) 6100 Series, 6200 Series, and 6400/6500 Series LC/MS.

- 6** Remove the **inlet filter assembly** (6100 Series):
  - a** Loosen the front screw of the clamp and remove the clamp.
  - b** Pull the **inlet filter assembly** backward out of the bracket.
  - c** Disconnect the **nut** and **ferrule** end of the **inlet filter capillary** from the **SSV port**.
- 7** Remove the **inlet filter assembly** (6200 Series, 6400 Series, and 6500 Series):
  - a** Remove the filter clip and the retaining screw at the top of the **inlet filter assembly**.
  - b** Pull the **inlet filter assembly** out of the bracket.
  - c** Disconnect the **nut** and **ferrule** end of the **inlet filter capillary** from the **SSV port**.
- 8** Install the new **inlet capillary adapter**:
  - a** Insert the new **inlet capillary adapter** into the bracket. Attach the filter clip that holds the dummy inlet filter.
  - b** Insert the union end of the new **inlet filter capillary** into the **inlet capillary adapter**. Make sure that the flat side faces towards the **M4 captive screw**.
  - c** Use a **T20 Torx screwdriver** to tighten the **M4 captive screw**.
  - d** Attach the ferruled end of the **inlet filter capillary** to the **SSV port**. Use a **1/4-inch × 5/16-inch open-end wrench** to tighten the fitting.
- 9** Reinstall all instrument covers, and the **spray chamber**.

**NOTE**

Record this procedure in the Maintenance Logbook.

## 2 Calibrant Delivery System and Divert Valve

To replace the MS selection valve rotor seal

### To replace the MS selection valve rotor seal

**When needed** Approximately annually or when no calibrant flow exists during tuning, or when the back pressure is high on the LC pump during acquisition.

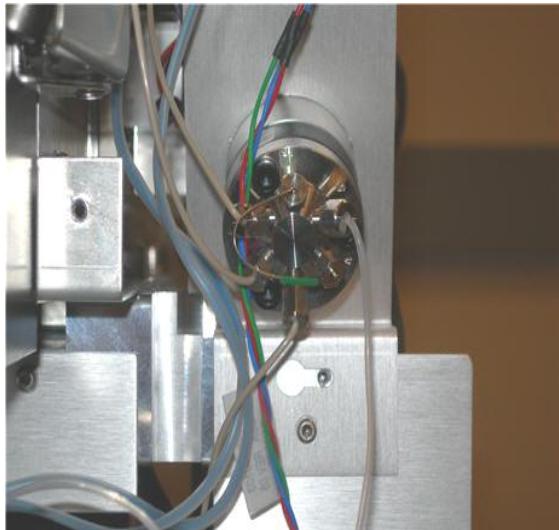
**Tools needed**

- 9/64-inch hex key

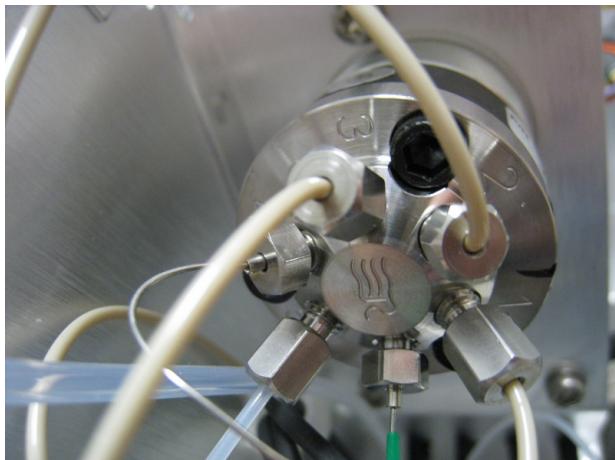
**Parts needed**

- rotor seal

- 1 Stop the flow of LC solvent to the instrument.
- 2 Remove the **front cover, top cover, and left side cover**.
- 3 **For the 6100 Series LC/MS:** Remove the **CDS cover**.
- 4 Make a note of which port is plumbed to which tubing.
- 5 Remove the tubing connections from the six-port **MS selection valve**.



For 6100 Series, 6400 Series and 6500 Series LC/MS



For 6200 Series LC/MS

**Figure 16** Six-port MS selection valve.

- 6 Use the [9/64-inch hex key](#) to remove the three hex head screws from the **stator face** of the **selection valve**.

## 2 Calibrant Delivery System and Divert Valve

To replace the MS selection valve rotor seal

- 7 Remove the **rotor seal** and replace it with a new one. Be sure to install it in the proper orientation.



**Figure 17** CDS rotor seal in its proper orientation

- 8 Install the **stator face assembly**.
- 9 Reconnect the tubing to the **selection valve**.
- 10 Install the **left side cover, top cover and front cover**.

### NOTE

Record this procedure in the Maintenance Logbook.

## 3 Sources

Changing Ion Sources	53
To remove an electrospray or Agilent Jet Stream source	53
To remove an APCI or APPI source	54
To remove a multimode source	54
To install an electrospray or Agilent Jet Stream source	55
To install an APCI source	57
To install an APPI source	58
To install the HPLC-Chip/MS interface	59
Source Maintenance	60
To flush the nebulizer	60
To clean the spray chamber daily	61
To clean the spray chamber weekly	65
To remove the nebulizer	69
To inspect the nebulizer	70
To adjust or replace the nebulizer needle	73
To install the nebulizer	79
To clean the corona needle	80
To replace the corona needle	82
To change HPLC-Chip capillaries	84

This chapter describes maintenance procedures for the components that make up the source.

**WARNING**

**Always wear appropriate protection, including eye protection, lab coat, and gloves, when working with solvents and chemicals or when working with unassembled parts.**



**Agilent Technologies**

### **3    Sources**

The sources covered in this chapter include:

- electrospray (ESI or Dual ESI)
- Agilent Jet Stream (AJS or Dual AJS)
- atmospheric pressure chemical ionization (APCI)
- multimode
- atmospheric pressure photoionization (APPI)
- HPLC-chip

# Changing Ion Sources

This section describes the steps to change from one ion source to another. First follow the procedure to remove your current source. Then follow the procedure to install the new source.

## To remove an electrospray or Agilent Jet Stream source

- 1 Put the instrument in standby mode.

If the source is at operating temperature (for example 400°C), it can take 20 to 30 minutes to cool down to a safe temperature.

- 2 If needed, slide open the **nebulizer cover**.
- 3 Disconnect the **nebulizer sample line** and **sample nebulizer gas tubing**.
- 4 **For the Dual ESI or the Dual AJS source:** Disconnect the **nebulizer reference mass line** and **reference nebulizer gas tubing**.
- 5 **For the Agilent Jet Stream source:**
  - Disconnect the heater and high voltage cables.
  - Disconnect the sheath gas line at the connector and unplug it.
- 6 Open the **spray chamber**.

### WARNING

The spray chamber operates at very high temperatures. Do not continue until the spray chamber is cool.

- 
- 7 **For the Dual ESI or Dual AJS source:** Plug the **reference nebulizer gas outlet** on the side of the instrument under the **service panel**.
  - 8 Remove the **spray chamber** by lifting it along the axis of its hinges.
  - 9 If you are changing to a different source type, replace the **spray shield** with one that is appropriate for the new source type.

### 3 Sources

To remove a multimode source

## To remove a multimode source

- 1 Put instrument in Standby mode.
- 2 Disconnect the electrical connectors to the multimode source.

### WARNING

The spray chamber operates at very high temperatures. Do not continue until the spray chamber is cool.

---

- 3 Disconnect the **nebulizer sample line** and **sample nebulizer gas tubing** from the **nebulizer**.
- 4 Open the **spray chamber**.
- 5 Remove the **spray chamber** by lifting it along the axis of its hinges.
- 6 If you are changing to a different source type, replace the **spray shield** with one that is appropriate for the new source type.

## To remove an APCI or APPI source

- 1 Put instrument in Standby mode.
- 2 Disconnect the APCI or APPI heater cable.
- 3 For APCI source only, disconnect the APCI high voltage cable.

### WARNING

The spray chamber operates at very high temperatures. Do not continue until the spray chamber is cool.

---

- 4 Disconnect the **nebulizer sample line** and **sample nebulizer gas tubing** from the **nebulizer**.
- 5 Open the **spray chamber**.
- 6 Remove the **spray chamber** by lifting it along the axis of its hinges.
- 7 If you are changing to a different source type, replace the **spray shield** with one that is appropriate for the new source type.

## To install an electrospray or Agilent Jet Stream source

- 1 Check that the standard **capillary cap** is installed.
- 2 Install the appropriate **spray shield**.
  - For ESI, install the ESI **spray shield**.
  - For Agilent Jet Stream, install the Agilent Jet Stream **spray shield**.

Make sure the small hole is at the top (“12 o'clock position”). If needed, use a [T10 Torx screwdriver](#) to loosen the two screws in the end plate, and rotate the ESI **spray shield** clockwise until the hole is in the correct position. Gently tighten the Torx screws again.
- 3 Install the **spray chamber**.
- 4 Close the **spray chamber**.
- 5 **For the Dual AJS source:**
  - a Remove the plug from the nebulizer reference mass line.
  - b Connect the sheath gas tubing to the gas line.
  - c Connect the electrical connections.
- 6 Connect the **nebulizer sample line** and **sample nebulizer gas tubing** to the analytical nebulizer.
- 7 **For the Dual ESI and Dual AJS:** Connect the **nebulizer reference mass line** and **reference nebulizer gas tubing** to the **reference nebulizer**.

### CAUTION

Do not hit the tip of the nebulizer needle. The needle is not protected. If you damage the needle, system performance can be affected.

- 
- 8 In the data acquisition program, update the method to specify the new source.
  - 9 In the data acquisition program, turn on the LC/MS instrument.
  - 10 While you wait for the source to reach its working temperature, continue to create the acquisition method, or load a previously stored method.

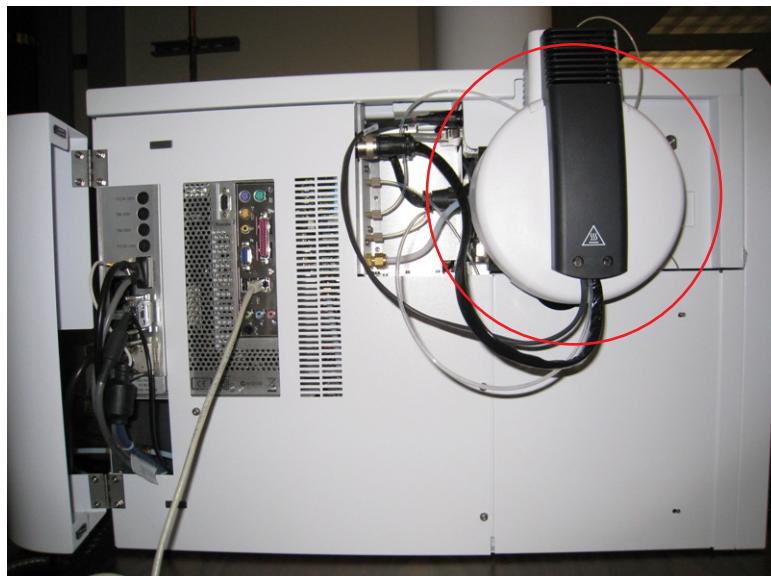
If you load a method that was stored when using a different ion source, the instrument status turns red.

When the source reaches its working temperature, you can use the instrument for analysis.

### 3 Sources

To install an electrospray or Agilent Jet Stream source

**11 For the Agilent Jet Stream source:** If needed, install the ESI-L Tuning Mix in the reference B port of the calibrant delivery system.



**Figure 18** 6230 with Agilent Jet Stream source (circled) attached. Note the open service panel on the left.

## To install an APCI source

### 1 Install the ESI spray shield.

Make sure the small hole is at the top (“12 o'clock position”). If needed, use a **T10 Torx screwdriver** to loosen the two screws in the end plate, and rotate the **ESI spray shield** clockwise until the hole is in the correct position. Gently tighten the Torx screws again.

### 2 Close the reference nebulizer gas tubing with a cap. A threaded plug is provided for this purpose.

### 3 Install the APCI spray chamber.

### 4 Close the spray chamber.

### 5 Connect the **nebulizer sample line** and **sample nebulizer gas tubing** to the **nebulizer**.

### 6 Connect the APCI heater cable and the APCI high voltage cable.

### 7 In the data acquisition program, update the method to specify the new source.

### 8 In the data acquisition program, turn on the LC/MS instrument.

### 9 While you wait for the source to reach its working temperature, continue to create the acquisition method, or load a previously stored method.

If you load a method that was stored when using a different ion source, the instrument status turns red.

When the source reaches its working temperature, you can use the instrument for analysis.

### 10 Let the source heat to its working temperature. Typically, about 15 minutes is needed.

### 11 Rinse a clean **calibrant bottle** with **LC/MS-grade acetonitrile**.

The ship kit comes with a **glass CDS bottle** and **glass CDS bottle cap**.

### 12 Pour the **APCI/APPI Calibrant** into the **calibrant bottle**.

### 13 Attach the **calibrant bottle** back onto the **calibrant delivery system**.

### 3 Sources

#### To install an APPI source

## To install an APPI source

- 1 Install the ESI spray shield.
- 2 Connect the SmartCard to the [APPI external power supply assembly](#):
  - **For 6100 Series:** Connect the **serial input** end of the **APPI serial cable** (attached to the **APPI power supply**) to the **RS-232 (D-SUB9)** port on the **SmartCard 3x** (back side of the LC/MS instrument). Connect the **serial output** end of the **APPI serial cable** to the [DSUB-9 extension cable](#).
  - **For 6200 Series and 6500 Series:** Connect the **serial input** end of the **APPI serial cable** (attached to the **APPI power supply**) to one end of the **APPI USB to serial converter cable**. Connect the other end of the **APPI USB to serial converter cable** to any **USB** port on the **SmartCard 4 Plus** (left side of the LC/MS instrument).
  - **For 6400 Series:** Connect the **serial input** end of the **APPI serial cable** to the **RS-232 (D-SUB9)** port on the **SmartCard 4** (left side of the LC/MS instrument).
- 3 Rinse a clean **calibrant bottle** with **LC/MS-grade acetonitrile**.  
The ship kit comes with a **glass CDS bottle** and **glass CDS bottle cap**.
- 4 Pour the [APCI/APPI Calibrant](#) into the **glass CDS bottle**.
- 5 Attach the **calibrant bottle** back onto the **calibrant delivery system**.
- 6 Remove the currently installed source and install the **APPI source** onto the **spray chamber** mounts.
- 7 Connect the **APPI vaporizer heater cable** to its connector on the left side of the LC/MS instrument.
- 8 Connect the **serial output** end of the **APPI serial cable** (with [DSUB-9 extension cable](#) for 6100 Series) to the **APPI source**.
- 9 In the data acquisition program, update the method to specify the new source.
- 10 In the data acquisition program, turn on the LC/MS instrument.
- 11 While you wait for the source to reach its working temperature, continue to create the acquisition method, or load a previously stored method.  
If you load a method that was stored when using a different ion source, the instrument status turns red.  
When the source reaches its working temperature, you can use the instrument for analysis.

## To install the HPLC-Chip/MS interface

- Refer to the *User Guide* for the interface.

### 3 Sources

#### Source Maintenance

## Source Maintenance

### To flush the nebulizer

**When needed** Check the nebulizer weekly. If needed, flush traces of samples and buffers out of the tubing, valves and nebulizer.

- Parts needed**
- LC/MS-grade acetonitrile
  - HPLC Flushing Solvent
  - LC/MS-grade cyclohexane
  - LC/MS-grade isoctane (optional)

- 1 On a weekly basis, inspect the **nebulizer**. See “[To inspect, adjust, or replace the nebulizer needle \(G1960-67470\)](#)” on page 70 or “[To inspect the nebulizer](#)” on page 70. If the **nebulizer** needs to be flushed, continue with this procedure.
- 2 Make sure [HPLC Flushing Solvent](#), [LC/MS-grade cyclohexane](#) (or [LC/MS-grade isoctane](#)), and [LC/MS-grade acetonitrile](#) are three of the solvents installed in your liquid chromatograph.
- 3 Pump [HPLC Flushing Solvent](#) for 10 minutes at 5 mL/minute.
- 4 Change to [LC/MS-grade cyclohexane](#), and pump for 10 minutes at 5 mL/minute.
- 5 Pump this mixture through the **nebulizer** for 3 minutes.
- 6 Prepare enough [LC/MS-grade acetonitrile](#) and flush overnight.

#### NOTE

This mixture is good for general-purpose flushing. If needed, adjust it based on the solvents, samples and buffers that you are using. A mixture of 50% LC/MS-grade acetonitrile and 50% LC/MS-grade water works well to remove salts.

#### NOTE

Record this procedure in the Maintenance Logbook.

## To clean the spray chamber daily

**When needed** Daily or at the end of each shift or anytime you suspect carryover contamination from one sample or analysis to another.

- Tools needed**
- [clean gloves](#)
  - [clean lint-free cloth](#)
  - [LC/MS-grade isopropanol](#)
  - [clean wash bottle](#)
  - [LC/MS-grade water](#)
  - [4000 grit abrasive paper](#)
  - [current mobile phase](#)

**Parts needed** None

### NOTE

Recent residue is soluble in the mobile phase. If you are not sure what mobile phase was used recently, a mixture of 50% LC/MS-grade isopropanol and 50% LC/MS-grade water works well as a general cleaning solution.

- 1 Put on [clean gloves](#).
- 2 In a [clean wash bottle](#), prepare the [current mobile phase](#) that you last used with the instrument. You can also use a mixture of [LC/MS-grade isopropanol](#) and [LC/MS-grade water](#).

### WARNING

**Some mobile phases are dangerous. Use the degree of caution appropriate for the mobile phase being used.**

- 3 Turn off the [spray chamber](#).

### WARNING

**The spray chamber operates at very high temperatures. Do not continue until the spray chamber is cool.**

### 3 Sources

To clean the spray chamber daily

**4 Remove nebulizers and other attachments:**

- a** Remove the electrospray, APCI, or APPI **nebulizer**. See “[To remove the nebulizer](#)” on page 69.
- b** **For Dual ESI or Dual AJS:** Remove the **reference nebulizer**.
- c** **For multimode or APCI:** Remove the APCI **corona needle**. When the APCI **corona needle** is cooled, carefully clean the needle with **4000 grit abrasive paper**.
- d** **For the multimode:** Remove the **cosmetic cover**. Remove the **thermocouple probe** if you need to wipe the **spray chamber**. Otherwise, leave the **thermocouple probe** intact.

**5 Open the spray chamber** ([Figure 19](#) and [Figure 20](#)).



**Figure 19** Opened ESI spray chamber for 6100 Series (left), 6200 Series (center) and 6400/6500 Series LC/MS.



**Figure 20** Opened AJS spray chamber for 6100 Series (left), 6400 Series (center) and 6500 Series (right) LC/MS.

**WARNING**

**Sharp edges can be found inside the spray chamber, such as the edge on the separator. Use caution when wiping the interior of the spray chamber.**

**6 Clean the interior of the spray chamber:**

- a** Rinse the interior of the **spray chamber** with the current mobile phase or with a mixture of LC/MS-grade isopropanol and LC/MS-grade water.
- b** Wipe the interior of the **spray chamber** with a **clean lint-free cloth**.
- c** **For APCI, multimode, or APPI:** Wipe the end of the **vaporizer** with a **clean lint-free cloth**.

**CAUTION**

Do not spray the mobile phase directly toward the tip of the capillary. This can cause pressure surges in the vacuum system.

**CAUTION**

Do not spray the mobile phase upward into the vaporizer. If the vaporizer is still hot, the mobile phase can cause the ceramic parts to shatter. Organic solvents can also catch fire.

**7 Clean the spray shield and surrounding area:**

- a** Rinse the area around the **spray shield**.
- b** Dampen a **clean lint-free cloth** with the **current mobile phase**.
- c** Wipe the **spray shield** and the area around the **spray shield**.

**8 Reinstall nebulizers and all other attachments:**

- a** Install all **nebulizers** that were removed. See “[To install the nebulizer](#)” on page 79.
- b** **For the APCI and multimode source:** Install the APCI corona needle.
- c** **For the multimode source:** Install the **cosmetic cover**. Install the thermocouple probe and adjust it so that it protrudes 15 mm from the inner **spray chamber** wall.

**9 Close the spray chamber.**

### **3    Sources**

To clean the spray chamber daily

#### **NOTE**

Use the weekly cleaning procedure if symptoms of contamination persist or if the spray shield or capillary cap show significant discoloration that cannot be removed by the regular, daily cleaning.

---

## To clean the spray chamber weekly

**When needed** Weekly or whenever symptoms indicate that contamination exists in the spray chamber and normal daily cleaning does not correct the problem.

- Tools needed**
- clean gloves
  - clean lint-free cloth
  - LC/MS-grade isopropanol
  - clean wash bottle
  - LC/MS-grade water
  - cotton swab
  - 4000 grit abrasive paper
  - current mobile phase

**Parts needed** None

**1** Prepare the **spray chamber** for cleaning.

Do [step 1](#) through [step 4](#) in “[To clean the spray chamber daily](#)” on page 61.

**2 For electrospray and Agilent Jet Stream sources:** Clean the interior of the **spray chamber**:

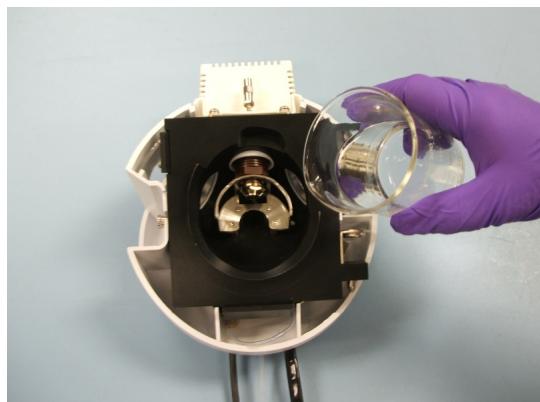
- a** Open the **spray chamber** and remove it from the instrument.
- b** Fill the **spray chamber** with clean [current mobile phase](#), or with a mixture of [LC/MS-grade isopropanol](#) and [LC/MS-grade water](#).

### 3 Sources

To clean the spray chamber weekly



**Figure 21** Filling the ESI spray chamber for 6100/6400 Series (left) and 6200/6500 Series LC/MS



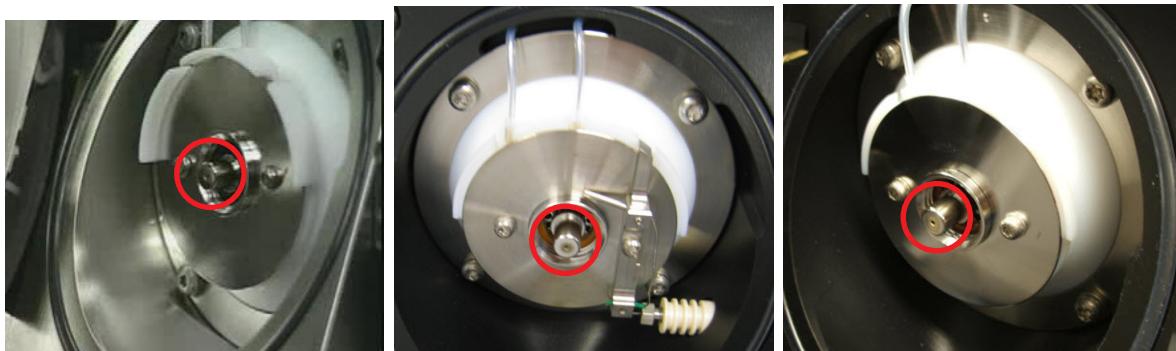
**Figure 22** Filling the Agilent Jet Stream spray chamber

- c Scrub the insulators and the interior of the **spray chamber** with a clean **cotton swab**.
  - d Empty the **spray chamber**.
  - e Reinstall the **spray chamber** on the instrument.
  - f Open the **spray chamber**.
- 3 For APCI, multimode, and APCI:** Clean the **spray chamber** as you do daily.  
Do [step 5](#) and [step 6](#) in “To clean the spray chamber daily” on page 61.

To clean the spray chamber weekly

**4 Clean the capillary cap:**

- a Remove the spray shield.**
- b Use 4000 grit abrasive paper to gently clean the end of the capillary cap.**
- c Dampen a clean lint-free cloth and wipe the end of the capillary cap.**
- d Reinstall the spray shield.**



**Figure 23** End of capillary cap (circled) for 6100 Series (left), 6200 Series (center) and 6400/6500 Series LC/MS.

**5 Clean the spray shield and surrounding area::**

- a Use abrasive paper to gently clean the spray shield.**
- b Dampen a clean lint-free cloth and wipe the spray shield.**
- c Rinse the area around the spray shield.**
- d Wipe the area around the spray shield.**

### 3 Sources

To clean the spray chamber weekly



**Figure 24** Rinsing the area around the spray shield for 6100 Series (left), 6200 Series (center) and 6400/6500 Series LC/MS

#### CAUTION

Do not spray the mobile phase directly toward the tip of the capillary. This can cause pressure surges in the vacuum system.

**6** Reinstall nebulizers and all other attachments:

- a** Install all **nebulizers** that were removed. See “[To install the nebulizer](#)” on page 79.
- b** **For the APCI and multimode source:** Install the APCI **corona needle**.
- c** **For the multimode source:** Install the **cosmetic cover**. Install the thermocouple probe and adjust it so that it protrudes 15 mm from the inner **spray chamber** wall.

**7** Close the **spray chamber**.

Refer to the *Multimode Source Maintenance Guide* to clean the multimode charging electrode assembly.

#### NOTE

Record this procedure in the Maintenance Logbook.

## To remove the nebulizer

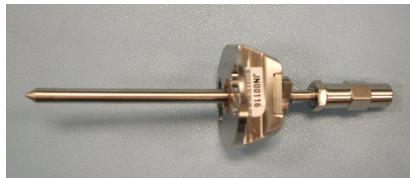
**When needed** When you need to access the nebulizer for maintenance.

**Tools needed** clean gloves

**Parts needed** None

### NOTE

Recent residue is soluble in the mobile phase. If you are not sure what mobile phase was used recently, a mixture of 50% LC/MS-grade isopropanol and 50% LC/MS-grade water works well as a general cleaning solution.



**Figure 25** ESI nebulizer (left) and APCI nebulizer

- 1 Put on [clean gloves](#).
- 2 Shut off the flow of LC solvent.
- 3 Shut off the flow of nebulizing gas.
- 4 Slide back the plastic cover from over the **nebulizer**.
- 5 Disconnect the **nebulizer sample line** and **sample nebulizer gas tubing** from the **nebulizer**.
- 6 Turn the **nebulizer** counterclockwise until it disengages from the retaining screws.

### WARNING

The tip of the nebulizer can be very hot. Do not touch the nebulizer until it is cool.

- 7 Gently lift the **nebulizer** out of the **spray chamber**.

### 3 Sources

To inspect the nebulizer

## To inspect the nebulizer

Do this procedure if you have the G1960-67470 Nebulizer Adjustment Kit.

### WARNING

**Wear safety glasses when you focus the magnifier. The magnifier can cause injury to your eye if the magnifier slips while you pull it out of the holder.**

---

**1 Insert the nebulizer into the [Nebulizer Adjustment Fixture](#):**

- a** Carefully insert the tip of the nebulizer into the end of the [Nebulizer Adjustment Fixture](#).
- b** Slide the heads of the two spring loaded socket head cap screws through the mounting holes on the body of the nebulizer.
- c** Turn the nebulizer body 1/8 turn counter-clockwise.

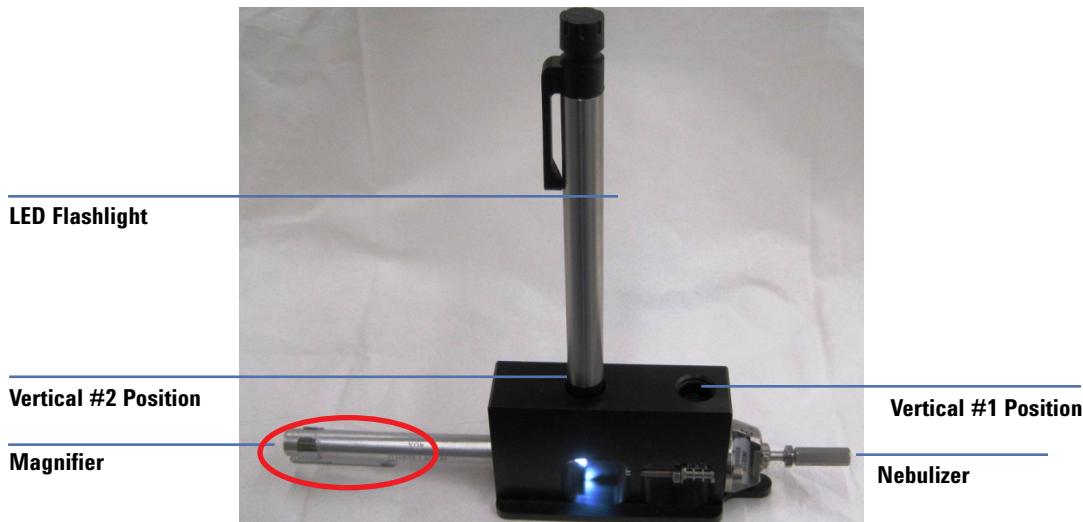
If the nebulizer is too tight or too loose, loosen or tighten the nut on the captured screws to adjust the tension on the spring.

**2 To inspect the *end* of the nebulizer for poor needle centering, plugged needles, or nozzle damage ([Figure 26](#)):**

- a** Gently push the [40x Magnifier](#) into the end horizontal position of the [Nebulizer Adjustment Fixture](#). The focal length approximately corresponds to the end of the magnifier.
- b** Push the [LED Flashlight](#) into the [Nebulizer Adjustment Fixture](#). No tool is needed.

For ES or ESI nebulizers, use Vertical #2 Position.

For APCI nebulizers, use Vertical #1 Position.

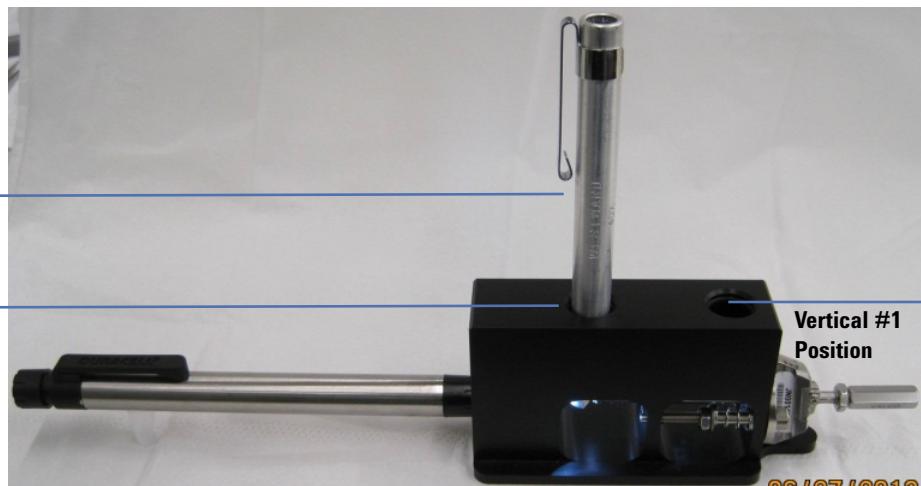


**Figure 26** Setup to inspect the end of the nebulizer. Pocket clip of the **40× Magnifier** is circled.

- 3 To inspect the *side* of the nebulizer for the correct needle adjustment length, damaged needle, or corroded nozzle (Figure 27):
  - a Gently push the **LED Flashlight** into the end horizontal position of the **Nebulizer Adjustment Fixture**.
  - b Push the **40× Magnifier** into the **Nebulizer Adjustment Fixture**. No tool is needed. The focal length approximately corresponds to the end of the magnifier.  
For ES or ESI nebulizers, use Vertical #2 Position.  
For APCI nebulizers, use Vertical #1 Position.

### 3 Sources

To inspect the nebulizer



**Figure 27** Setup to inspect the side of the nebulizer

- 4 Turn on the **LED Flashlight**. The on/off switch is at the end of the flashlight.

**CAUTION**

- Do not hit or touch the end of the nebulizer or you can damage the needle.

- 5 Gently slide and rotate the **40× Magnifier** into or out of the **Nebulizer Adjustment Fixture** to focus the magnifier on the end of the nebulizer nozzle and needle. For the APCI nebulizer, if needed, remove the pocket clip to focus properly. See **Table 12** for correct needle position.

If the needle is not in the correct position or shows signs of wear or damage, continue to “**To adjust or replace the nebulizer needle**” on page 73.

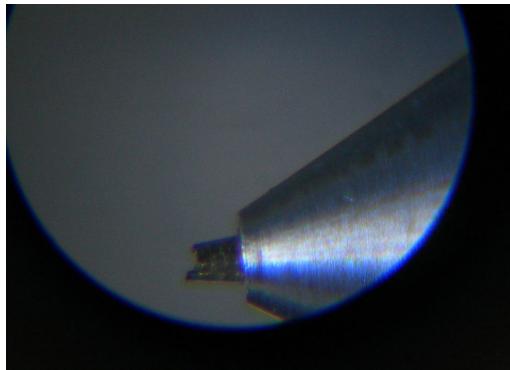
## To adjust or replace the nebulizer needle

### WARNING

Wear safety glasses when you focus the magnifier. The magnifier can cause injury to your eye if the magnifier slips while you pull it out of the holder.

#### When needed

- When the needle is plugged. Common symptoms of a plugged needle are:
  - increased LC back pressure
  - off-axis spraying
  - dripping from the nebulizer
  - reference nebulizer needle is not spraying.
- When the needle appears to be corroded or damaged. See [Figure 28](#).



**Figure 28** Corroded needle in nebulizer

#### Tools needed

- Nebulizer Adjustment Fixture
- clean gloves
- pliers or wrench, depending on nebulizer holder
  - long-nose pliers (p/n 7810-0004)
  - 3-mm open-end wrench (p/n 8710-2699)

### 3 Sources

To adjust or replace the nebulizer needle

- wrench or driver, depending on nebulizer style:
  - ¼-inch x 5/16-inch open-end wrench (p/n 8710-0510)
  - T6 Torx driver (p/n 8710-2548)
  - 1.5-mm ball driver (p/n 8710-1570)

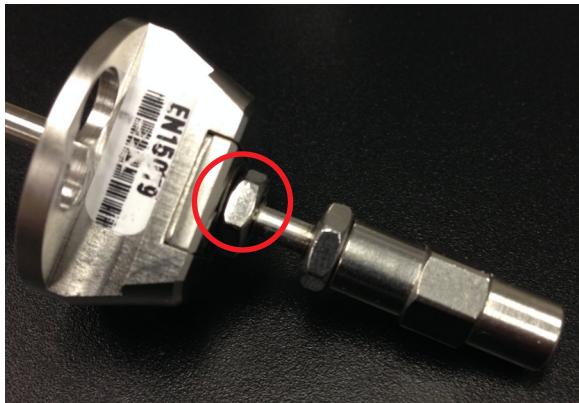
**Parts needed** nebulizer needle kit. See [Table 11](#). Each kit contains:

- needle
- ferrule
- needle holder

**Table 11** Needle replacement kits

Nebulizer	Part Number
ESI Nebulizer Replacement Kit used with ES Nebulizer	G1958-60137
ESI Nebulizer Accessory Ship Kit used with ESI Nebulizer	G1946-68703
APCI Nebulizer Accessory Ship Kit used with Tested APCI Nebulizer Assembly	G1946-68704

- 1 Put on [clean gloves](#).
- 2 Determine the nebulizer holder type from [Figure 29](#).



Nebulizer with locknut (original needle holder).



Nebulizer with T6 Torx screw (screw p/n 0515-0677)



Nebulizer with 1.5-mm hex screw.

**Figure 29** Nebulizer needle holders

- 3** Install the nebulizer in the [Nebulizer Adjustment Fixture](#).
- 4** Loosen the locknut next to the zero-dead-volume (ZDV) union.
- 5** Remove the union from the nebulizer [needle holder](#).
- 6** Loosen the fastener (locknut, 1.5-mm hex screw, or T6 Torx screw) that secures the [needle holder](#) in place.

### 3 Sources

To adjust or replace the nebulizer needle

7 If you need to replace the needle:

- a Loosen the **needle holder** and pull it out of the nebulizer body. Dispose of the used needle properly.
- b Rinse the inside of the nebulizer body with water and an organic solvent (methanol is preferred) to remove any contamination inside the nebulizer body.
- c Thread the new **needle holder** into the nebulizer body.
- d While holding the adjustment fixture in a vertical position, install the new **ferrule** in the needle holder. The wider end goes into the **needle holder**.
- e Carefully remove the new **needle** from the shipping tube and adhesive strip. Identify the sharp end of the needle.



**Figure 30** Blunt end of nebulizer needle



**Figure 31** Sharp end of nebulizer needle (zoomed)

#### CAUTION

Do not bend the needle as you slide it into the ferrule. The needle is fragile. A bent needle results in poor alignment with the nebulizer body.

- 
- f Carefully slide the sharp end of the **needle** through the **ferrule** until 1 cm of the **needle** remains at the ferrule.
  - g Push the **needle** into the **ferrule** until the needle is slightly visible flush with the ferrule.

## To adjust or replace the nebulizer needle

If the **needle** is pushed in too far, when the union is installed and the **ferrule** is compressed, the HPLC flow is restricted or blocked, which results in poor or no spray from the nebulizer.

- h** Reinstall the locknut and the union. Hand-tighten the union.
  - i** Hold the **needle holder** steady with a **3-mm open-end wrench** or **1/4-inch x 5/16-inch open-end wrench**, depending on your nebulizer holder style.
  - j** Tighten the union one-half to three quarters of a turn, or until an audible squeak is heard.  
The ferrule is now compressed.
- 8** Use a **1/4-inch x 5/16-inch open-end wrench** to adjust the top of the **needle** to the proper distance from the end of the nozzle. See **Table 12**.
- 9** Tighten the lock nut and verify adjustment while you view the nebulizer tip through the magnifier.

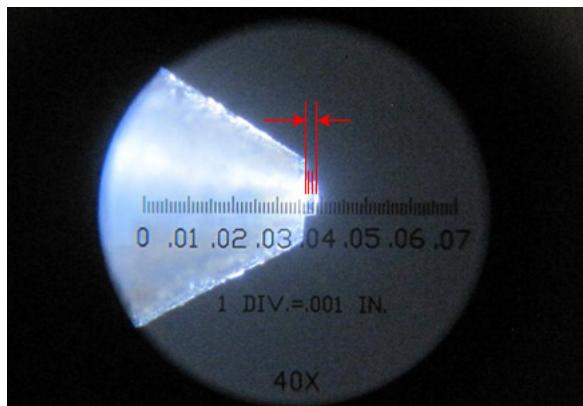
See [Figure 32](#) and [Figure 33](#) for images of correctly adjusted nebulizer needles.

**Table 12** Recommended Needle adjustment Distance

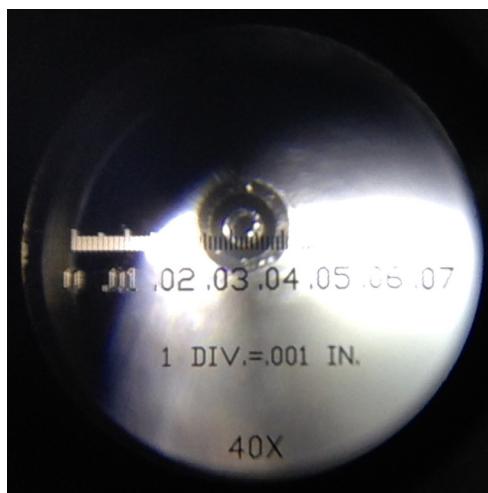
Nebulizer	Distance
Microflow Nebulizer Assembly	0.003 inch
ES Tested Nebulizer	0.000 (flush)
Tested ESI Nebulizer Assembly	0.003 inch
Tested APCI Nebulizer Assembly	0.000 (flush)

### 3 Sources

To adjust or replace the nebulizer needle



**Figure 32** Side view of a correctly adjusted Tested ESI Nebulizer, with 0.003-inch distance marked.



**Figure 33** Example of a centered needle.

#### NOTE

Record this procedure in the Maintenance Logbook.

## To install the nebulizer

**When needed** As needed.

**Tools needed** None

**Parts needed** None

- 1 Insert the **nebulizer** part way into the **spray chamber**.

### CAUTION

Do not hit the tip of the needle as you insert the nebulizer. The tip of the needle is easily damaged.

- 2 Connect the **sample nebulizer gas tubing** to the **nebulizer**.
- 3 Finish inserting the **nebulizer** into the **spray chamber**.
- 4 Turn the **nebulizer** clockwise and lock it in place.
- 5 Connect the **sample nebulizer gas tubing** to the **nebulizer**.

### CAUTION

Do not over-tighten the LC fitting. An over-tightened fitting can crush the tubing, which creates a restriction.

### NOTE

Record this procedure in the Maintenance Logbook.

### 3 Sources

To clean the corona needle

## To clean the corona needle

Do these steps for the APCI or multimode source. If system performance is not restored, replace the corona needle.

**When needed** When you observe decrease sensitivity, decreased signal stability, and increase corona voltage during APCI operation.

**Tools needed**

- 4000 grit abrasive paper
- clean lint-free cloth
- clean gloves
- LC/MS-grade isopropanol

**Parts needed** None

**1** Put on [clean gloves](#).

### WARNING

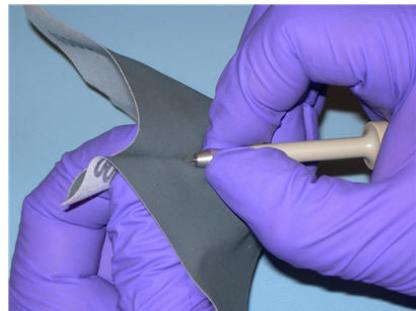
The needle and related parts can be very hot. Do not touch the needle or related parts until they are cool.

**2** Pull the **corona needle** assembly out of the **spray chamber**.



**Figure 34** Dirty APCI corona needle.

- 3** Fold a piece of [4000 grit abrasive paper](#) over the base of the needle.
- 4** Pull and twist the [4000 grit abrasive paper](#) along the needle and off the tip of the needle.



**Figure 35** Pulling and twisting abrasive paper along the tip of the needle.

**CAUTION**

Do not bend or blunt the tip of the needle, or it will decrease system performance. Sharpening the needle is not needed.

- 
- 5 Repeat [step 3](#) and [step 4](#) several times, or until the needle looks clean and shiny.
  - 6 Starting at the base of the needle, wipe the needle with a [clean lint-free cloth](#). The cloth can be dry or dampened with [LC/MS-grade isopropanol](#).



**Figure 36** APCI corona needle after cleaning.

**CAUTION**

Do not hit tip of the corona needle. The tip can bend, which can decrease system performance.

- 
- 7 Reinstall the **corona needle assembly** in the **spray chamber**.

**NOTE**

Record this procedure in the Maintenance Logbook.

### 3 Sources

To replace the corona needle

## To replace the corona needle

If this procedure fails to restore system performance, replace the corona needle.

### CAUTION

Do not hit tip of the corona needle. The tip can bend, which can decrease system performance.

**When needed** When symptoms indicate poor corona needle performance and cleaning the needle does not restore performance.

**Tools needed** • [clean gloves](#)

**Parts needed** • [corona needle](#)

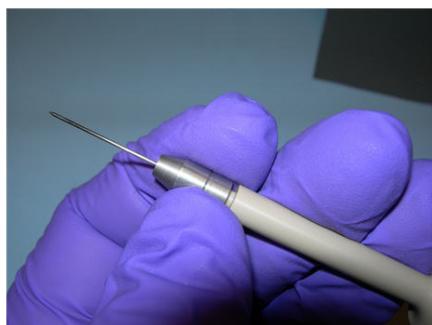
1 Put on [clean gloves](#).

### WARNING

The needle and related parts can be very hot. Do not touch the needle or related parts until they are cool.

2 Pull the **corona needle** assembly out of the **spray chamber**.

3 Remove the needle collar from the **corona needle** shaft.



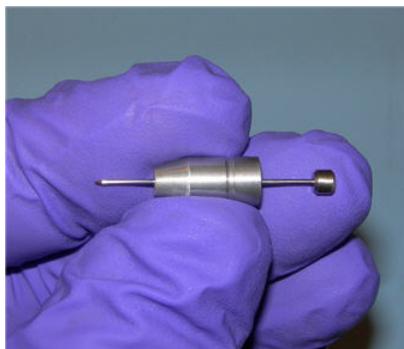
**Figure 37** Twist the corona needle to remove it from the shaft.

4 Remove the old **corona needle** from the collar.

- 5 Install a new **corona needle**, with its integral ferrule, in the collar.



**Figure 38** Installing a new needle into the collar



**Figure 39** Replace the APCI corona needle.

- 6 Turn the collar onto the needle holder and tighten by hand.  
7 Reinstall the **corona needle assembly** in the **spray chamber**.

**CAUTION**

Do not hit tip of the corona needle. The tip can bend, which can decrease system performance.

**NOTE**

Record this procedure in the Maintenance Logbook.

### 3 Sources

To change HPLC-Chip capillaries

## To change HPLC-Chip capillaries

**When needed** When broken, blocked or kinked

**Tools needed**

- cube wrench
- 3-mm hex key

**Parts needed**

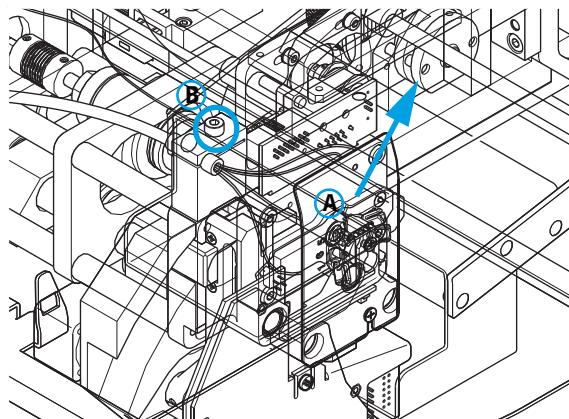
- Fused silica/PEEK capillary

1 Unload the HPLC-Chip.

### WARNING

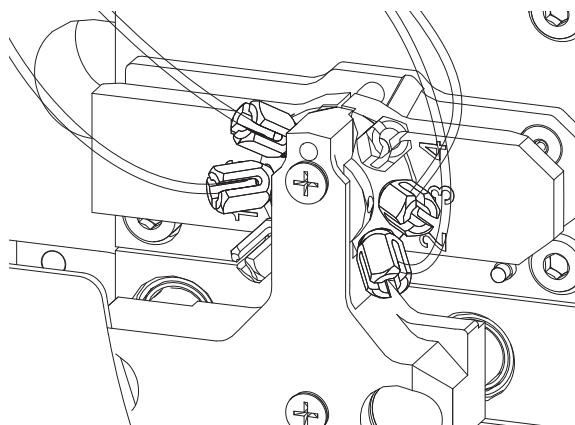
**Do this procedure only if the HPLC-Chip/MS Interface is mounted to the LC/MS or sits flat on a table. The center of gravity shifts during the procedure, and the instrument will tip over without adequate support.**

- 2 Press the cover release button once. When the lock opens, pull the front panel down.
- 3 Unlock the stages assembly and flip it out.
- 4 Remove the capillary cover (A) and open the thumb screw of the strain relief (B). See Figure 40.



**Figure 40** Stages assembly

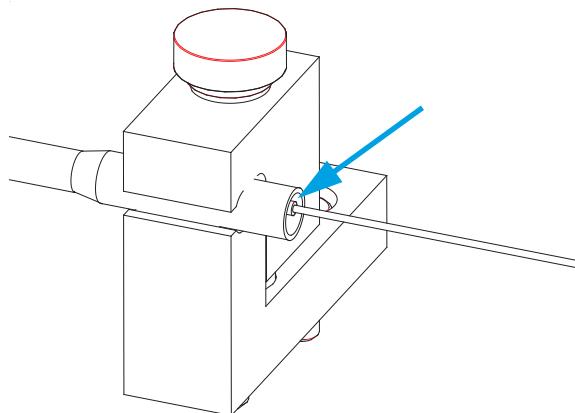
- 5 Loosen the slotted PEEK fitting using the cube wrench and pull the capillary out. See [Figure 41](#).



**Figure 41** Slotted PEEK fitting

- 6 Push the new Fused silica/PEEK capillary through the capillary guide until the stopper is flush with the end of the guide tube. Tighten the thumb screw firmly.

The strain relief will only function properly if all 4 capillaries are in place.



**Figure 42** New capillary in the capillary guide

### 3 Sources

To change HPLC-Chip capillaries

**7** Connect the capillaries as follows to the HPLC-Chip valve stator:

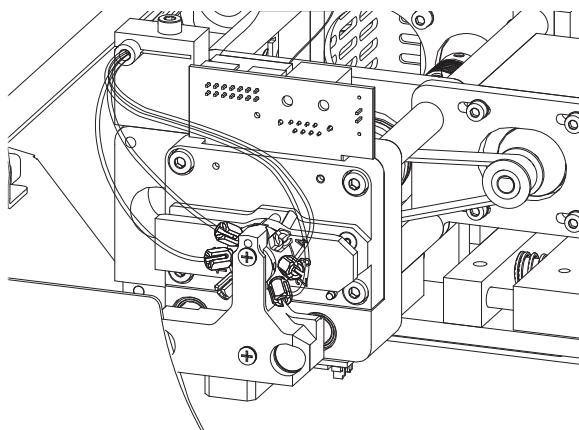
For forward-flush mode (default)

- port 1 - not used
- port 2 - 15 µm (orange) to nanopump
- port 3 - 75 µm (blue) to infusion pump
- port 4 - not used
- port 5 - 100 µm (black) to waste
- port 6 - 25 µm (yellow) to port 6 of the µ-WPS

For backflush mode

- port 1 - not used
- port 2 - 15 µm (orange) to nanopump
- port 3 - 75 µm (blue) to infusion pump
- port 4 - not used
- port 5 - 25 µm (yellow) to port 6 of the µ-WPS
- port 6 - 100 µm (black) to waste

**8** Route the capillaries exactly as shown in [Figure 43](#).

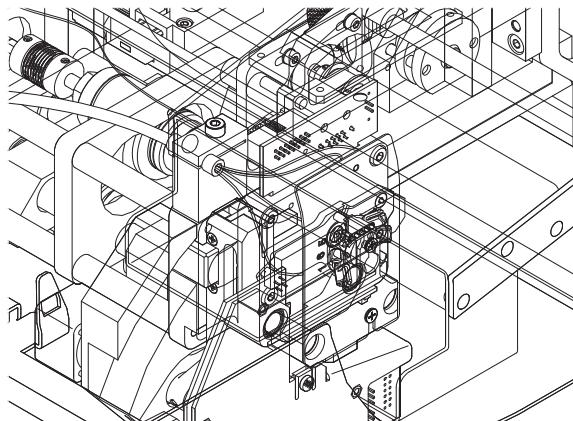


**Figure 43** Routing capillaries

**CAUTION**

Do not over-tighten the cover screws when you reinstall the capillary cover. You can strip the threads in the screw holes.

---

**9** Reinstall the capillary cover.**Figure 44****10** Flip the stages assembly up and close the front panel.**NOTE**

Record this procedure in the Maintenance Logbook.

---

**This page intentionally left blank.**

## 4 Ion Transfer Capillary

To remove the capillary 90

To clean the capillary 92

To install the capillary 94

This chapter describes the procedures to remove, clean and reinstall the ion transfer capillary. These procedures apply to both single- and multi-bore capillaries.

### **WARNING**

**Always wear appropriate protection, including eye protection, lab coat, and gloves, when working with solvents and chemicals or when working with unassembled parts.**

---



**Agilent Technologies**

#### 4 Ion Transfer Capillary

To remove the capillary

## To remove the capillary

**When needed** When you need to clean or replace the capillary.

**Tools needed** [clean gloves](#)

**Parts needed** None

- 1 Vent the system.
- 2 Put on [clean gloves](#).
- 3 Unplug the instrument power cord from the power outlet after venting is complete.

### WARNING

Some instruments use two external power cords to provide input power. Make sure you unplug the input power cord for the main power supply and the input power cord for the pump expander box (into which the two rough pumps are plugged) before you continue.

- 
- 4 Open the [spray chamber](#).

### WARNING

The spray chamber operates at very high temperatures. Do not continue until the spray chamber is cool.

---

- 5 Remove the [spray shield](#).
- 6 Remove the [capillary cap](#) from the end of the capillary.
- 7 Carefully pull the capillary out of the desolvation assembly.

### CAUTION

Carefully pull the capillary out along its long axis. The capillary is glass or of similar material, and you can break it by putting vertical or horizontal pressure on it.

---



**Figure 45** Pulling the capillary out of the desolvation assembly

#### 4 Ion Transfer Capillary

To clean the capillary

## To clean the capillary

**When needed** When you observe decreased sensitivity and decreased signal stability

**Tools needed**

- [clean gloves](#)
- [Alconox Powdered Precision Cleaner](#)
- [deionized \(18 MW-cm\) water](#)
- [LC/MS-grade isopropanol](#)
- graduated cylinder
  - [100-mL polypropylene graduated cylinder](#) for single-bore capillaries
  - [10-mL polypropylene graduated cylinder](#) for multi-bore capillaries, or
  - glass graduated cylinder and two 1 mL pipette tip

**Parts needed** [Alconox Powdered Precision Cleaner](#)

- 1 Put on [clean gloves](#).
- 2 Dissolve 1 gram of [Alconox Powdered Precision Cleaner](#) in 100 mL of [deionized \(18 MW-cm\) water](#).  
This concentration is the recommended concentration for “manual or ultrasonic cleaning”.
- 3 Place the ion transport capillary upright in a the [graduated cylinder](#) and fill with [Alconox Powdered Precision Cleaner](#) solution.
- 4 Sonicate the [graduated cylinder](#) that contains the ion transport capillary in an ultrasonic cleaner for 10 to 15 minutes.



If you use a glass graduated cylinder, cover the end of the ion transport capillary with a 1-mL pipette tip to protect the metalized plating. Trim the pipette tip to approximately 4 cm so that the capillary can be immersed in the cleaning solution.

To maintain proper cleanliness, handle the ion transport capillaries with **clean gloves**.



- 5 Rinse the ion transport capillary and **graduated cylinder** several times with **deionized (18 MW-cm) water**.
- 6 Fill the **graduated cylinder** with **deionized (18 MW-cm) water** and sonicate the **graduated cylinder** that contains the ion transport capillary for 10 to 15 minutes.
- 7 Remove the ion transport capillary from the **graduated cylinder** and remove the pipette tip (if one was used).
- 8 Blow out excess water from the ion transport capillary bore using an air sprayer or oil-free pressurized gas.

**NOTE**

Record this procedure in the Maintenance Logbook.

## 4 Ion Transfer Capillary

To install the capillary

### To install the capillary

**When needed** After cleaning the capillary or when installing a new capillary.

**Tools needed** clean gloves

**Parts needed** LC/MS-grade isopropanol

**1** Lubricate the capillary entrance end with LC/MS-grade isopropanol.

**2** Carefully insert the capillary straight into the desolvation assembly. Support the front and rear of the capillary and keep it level during installation.

Unlike the single bore capillary, the hexabore capillary has an orientation and can be inserted in one way only.

The capillary must be aligned correctly so that its end fits into a fixed **capillary cap** inside the desolvation assembly.

When 2 to 3 cm of the capillary remains extended from the desolvation assembly, the capillary “holds up” on the rear contact spring.

**3** Continue to apply pressure until approximately 1 cm remains extended from the desolvation assembly.



**Figure 46** Reinstalling the capillary

#### CAUTION

Do not put vertical or horizontal pressure on the capillary, or the capillary can break.

- 4 Lubricate the capillary tip with LC/MS-grade isopropanol.

**CAUTION**

Do not twist or turn the capillary cap when you install it or you can damage the metal plating.

---

- 5 Install the **capillary cap** over the outer end of the capillary.
- 6 Install the **spray shield**. Turn the **spray shield** clockwise to install.  
If you are installing the standard **spray shield**, make sure that the small hole is at the 12 o'clock (vertical) position.
- 7 Close the **spray chamber**.
- 8 Pump down the instrument.

**NOTE**

If a new capillary was installed, record this procedure in the Maintenance Logbook.

---

**This page intentionally left blank.**

## 5

# High Pressure Ion Funnel

To remove the high pressure ion funnel 98

To clean the high pressure ion funnel 100

To install the high pressure ion funnel 103

With time and with heavy usage, the high pressure ion funnel needs to be cleaned to maintain its performance on the LC/MS instrument.

Do the procedures in this chapter if your LC/MS instrument includes a high pressure ion funnel.

### WARNING

**Always wear appropriate protection, including eye protection, lab coat, and gloves, when working with solvents and chemicals or when working with unassembled parts.**



Agilent Technologies

## 5 High Pressure Ion Funnel

To remove the high pressure ion funnel

### To remove the high pressure ion funnel

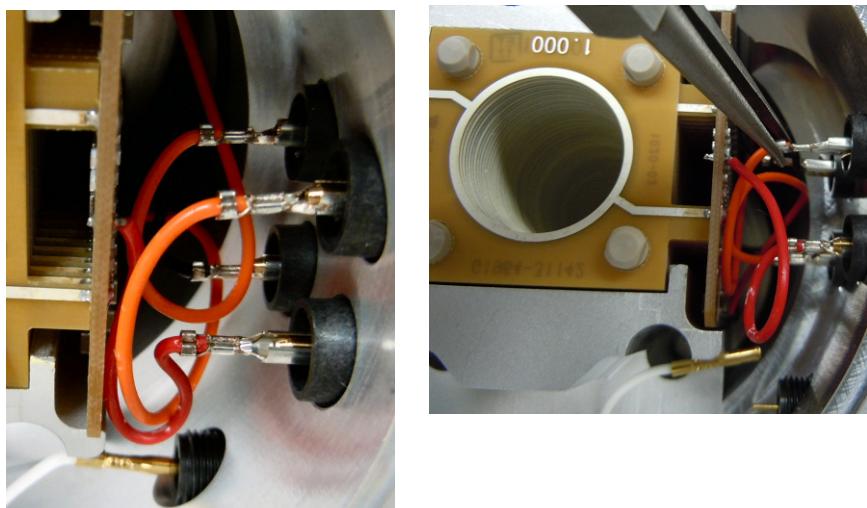
Do these steps for instruments that include a high pressure ion funnel.

#### Tools Needed

- long-nose pliers
- T20 Torx screwdriver

- 1 Vent the LC/MS and unplug the system.
- 2 Let the source cool down, and then remove it.
- 3 Use a [T20 Torx screwdriver](#) to remove the two M4 screws that hold down the desolvation assembly, and then remove the assembly.
- 4 Disconnect the five internal wires from the feed-throughs. Use a [long-nose pliers](#). See [Figure 47](#).

Connectors are fragile. Please be gentle when you remove these wires.

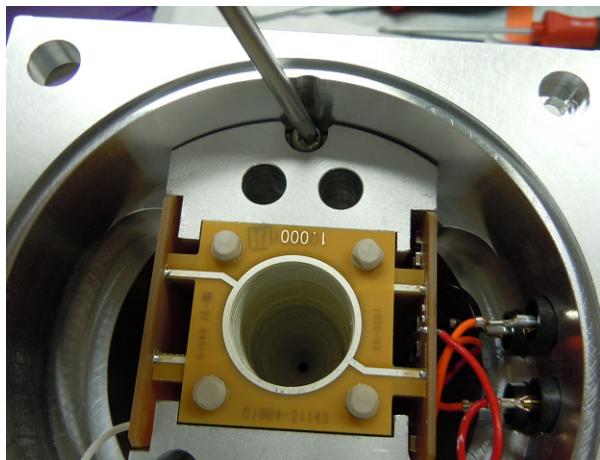


**Figure 47** Five internal wires from the feed-through.

- 5 Loosen the two captive screws that secure the ion funnel to the housing. See [Figure 48](#).

The screws are captive, so they will not come all the way out.

- 6 Remove the high pressure ion funnel from the housing. (You can grab onto the heat sinks and pull the funnel out of the housing.)



**Figure 48** Loosening captive screw on the high pressure ion funnel.

## 5 High Pressure Ion Funnel

To clean the high pressure ion funnel

### To clean the high pressure ion funnel

#### Tools Needed

- 2000-mL clean beaker
- LC/MS-grade isopropanol
- clean gloves

#### WARNING

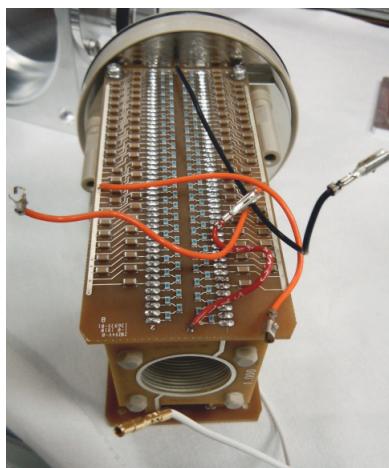
This cleaning procedure requires the use of a sonicator and isopropanol. You must clean the high pressure ion funnel in an approved fume hood with proper airflow (lift), or you can experience a flash fire or explosion. The front window sash must be in the closed position (down). All other electrical heating appliances such as hot plates must be turned off.

#### WARNING

Wear chemical-resistant gloves and safety glasses (goggles) for your safety.

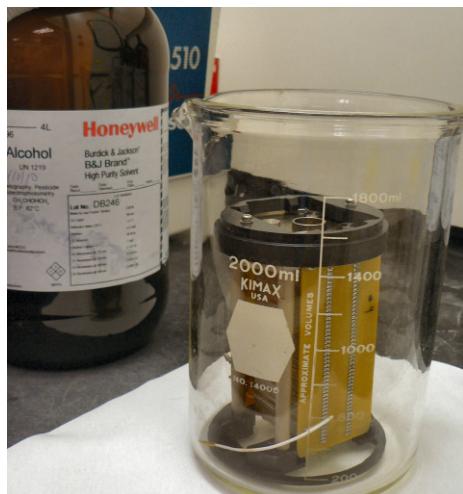
1 Put on [clean gloves](#).

2 Put the **ion funnel** on the table and on top of a [clean lint-free cloth](#). See [Figure 49](#).



**Figure 49** High pressure ion funnel on top of a clean cloth.

- 3 Slowly put the **ion funnel** in a glass beaker. See [Figure 50](#).



**Figure 50** High pressure ion funnel in a glass beaker.

- 4 Slowly pour water into the beaker until the solvent covers the **ion funnel** completely. Sonicate the **ion funnel** for 5 minutes to remove any built up salts or water soluble residue.
- 5 Pour the water out of the beaker and into an appropriate waste container.

## 5 High Pressure Ion Funnel

To clean the high pressure ion funnel

- 6 Slowly pour LC/MS-grade isopropanol into the beaker until the solvent covers the ion funnel completely.



**Figure 51** Pouring isopropanol into the glass beaker.

- 7 Sonicate the assembly in a beaker of LC/MS-grade isopropanol for 15 minutes.
- 8 Pour the LC/MS-grade isopropanol out of the beaker and into an appropriate waste container.
- 9 Remove the high pressure ion funnel from beaker and allow the LC/MS-grade isopropanol to drain off the entire assembly.
- 10 Put the **ion funnel** into the beaker. Slowly pour LC/MS-grade methanol into the beaker until the solvent covers the **ion funnel** completely. Sonicate the ion funnel for 5 minutes.
- 11 Use clean compressed nitrogen to blow out the remaining LC/MS-grade methanol from between the funnel plates.

### NOTE

Record this procedure in the Maintenance Logbook.

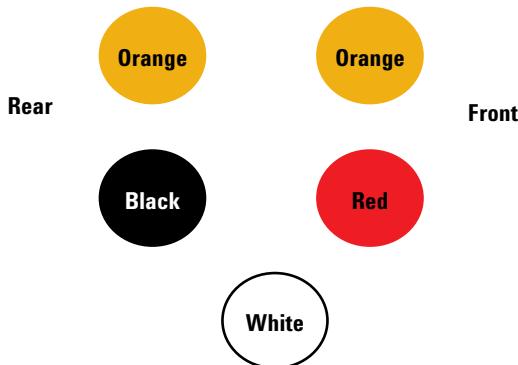
## To install the high pressure ion funnel

### Parts Needed

- long-nose pliers
- T20 Torx screwdriver

- 1 Install the **ion funnel** into the housing and secure with the two captive screws.
- 2 Connect the five internal wires to the feed throughs:
  - Connect the two orange wires to the top connectors.
  - Connect the black wire to the bottom-rear connector.
  - Connect the red wire to the front-rear connector.
  - Connect the white wire to the bottom-most connector.

See [Figure 52](#).



**Figure 52** Internal wires to the feed through.

- 3 Install the **desolvation assembly** with two **M4 captive screws**.
- 4 Install the **AJS source**.
- 5 Pump down the instrument.

**This page intentionally left blank.**

## 6

# Desolvation Assembly and Vacuum Manifold

## Desolvation Assembly 106

To remove the desolvation assembly 106

To install the desolvation assembly 109

## Vacuum Manifold Cover 110

To open the vacuum manifold 110

To close the vacuum manifold 111

## Ion Optics Assembly 112

To clean skimmer 1 112

To remove the ion optics assembly (6200 Series) 114

To clean the ion optics assembly (6200 Series) 117

To remove the ion optics assembly (6100 Series, 6400 Series, and 6500 Series) 125

To clean the ion optics assembly (6100 Series, 6400 Series and 6500 Series) 127

## Beam-shaping assembly 137

To remove and clean the complete beam shaping assembly 137

To clean the beam-shaping slicer parts 148

## Electron Multiplier 152

To replace the electron multiplier horn 152

To clean the high energy dynode 154

This chapter describes the steps to maintain the assemblies that are inside of the vacuum manifold. For most procedures, the desolvation assembly needs to be removed to get to the vacuum manifold.

## WARNING

**Always wear appropriate protection, including eye protection, lab coat, and gloves, when working with solvents and chemicals or when working with unassembled parts.**



Agilent Technologies

## Desolvation Assembly

### To remove the desolvation assembly

**CAUTION**

Use care when you do this procedure. Damages that you cause during maintenance are not covered under warranty. If you need assistance, contact Agilent.

**When needed** When you need to access the ion optics assembly.

**Tools needed**

- 1/2-inch × 9/16-inch open-end wrench
- T20 Torx screwdriver

**Parts needed** None

- 1 Vent the system.
- 2 Turn off the power.
- 3 Unplug the instrument **power cord** from the power outlet after venting is complete.
- 4 Remove the **front cover** and **top cover**.
- 5 **For the 6200 Series, 6400 Series and 6500 Series:** Also remove the **left side cover**.

**WARNING**

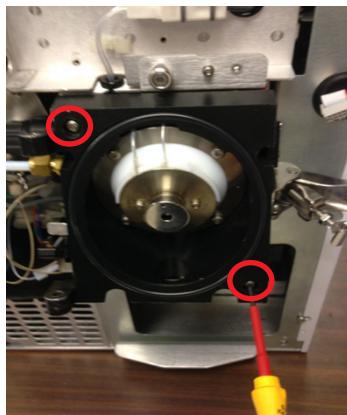
The spray chamber operates at very high temperatures. Do not continue until the spray chamber is cool.

The desolvation assembly operates at very high temperatures. Do not continue until the desolvation assembly is cool.

- 6 Remove the source. Put the storage cover on the source and set it aside.

**7** Disconnect all cables and tubings:

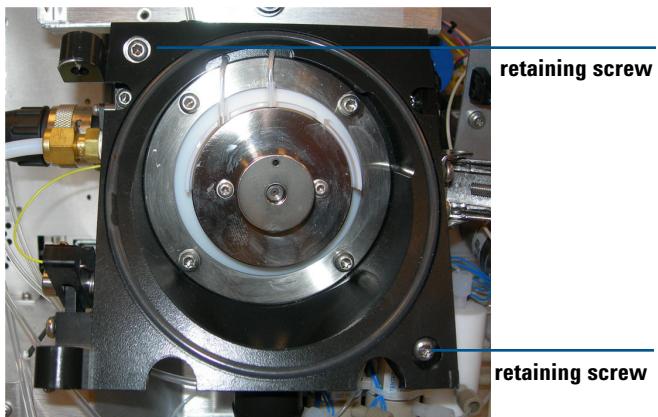
- a** Disconnect the connections to the **auxiliary module** on top of the **vacuum manifold**.
  - b** Disconnect the **drying gas tubing** from the **desolvation assembly**.
  - c** Disconnect the **drying gas heater cable** from the **desolvation assembly**.
  - d** Disconnect the **drain hose** from the **desolvation assembly**.
  - e** **For the 6500 Series LC/MS instrument:** Disconnect the PEEK nut on the tubing from the **calibrant delivery system** to the **desolvation assembly**.
  - f** Disconnect the **spray chamber high voltage cable** from the **desolvation assembly**.
  - g** Remove thumb screw from the front of the **auxiliary module**.
  - h** **For the 6200 Series:** Loosen the two **T10 Torx screw** at the bottom of the APCI power supply bracket. Do not remove the screws. Lift the **auxiliary module** up and off the **manifold cover**.
- 8** Fully loosen the captured retaining screw at the top of the **desolvation assembly**.
- 9** Remove the two **T20 Torx screw** that keep the **desolvation assembly** attached to the support rods.



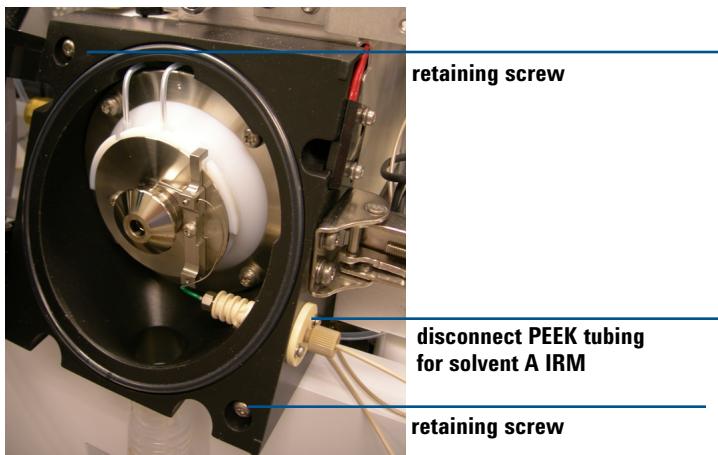
**Figure 53** Removing the desolvation assembly. Remove the screws that are circled in the figure.

## 6 Desolvation Assembly and Vacuum Manifold

To remove the desolvation assembly



**Figure 54** Remove retaining screws from desolvation assembly.



**Figure 55** Remove retaining screws from desolvation assembly (with IRM)

- i Slide the **desolvation assembly** off of the support rods. Be careful not to drop the **O-ring** on the **desolvation assembly**.

### NOTE

The capillary is contained in the desolvation assembly. It does not need to be removed when you remove the desolvation assembly.

## To install the desolvation assembly

### CAUTION

Use care when you do this procedure. Damages that you cause during maintenance are not covered under warranty. If you need assistance, contact Agilent.

**When needed** As needed.

**Tools needed** • 1/2-inch × 9/16-inch open-end wrench

**Parts needed** None

- 1 Put the **desolvation assembly** on the support rods and slide it back until it seals against the **vacuum manifold**.
- 2 Install the two retaining screws.
- 3 Reconnect the **drain hose** to the **desolvation assembly**.
- 4 Reconnect the **drying gas heater cable** to the **desolvation assembly**.
- 5 Reconnect the **sample nebulizer gas tubing** to the **desolvation assembly**.
- 6 Reinstall the **auxiliary module** on top of the **vacuum manifold**.
- 7 Fully tighten the captured retaining screw at the top of the **desolvation assembly**.
- 8 Reconnect the connections to the **auxiliary module**.

## 6 Desolvation Assembly and Vacuum Manifold

### Vacuum Manifold Cover

## Vacuum Manifold Cover

Before you can maintain the components in the vacuum manifold, you will need to remove the manifold cover.

### To open the vacuum manifold

**When needed** As needed for maintenance.

**Tools needed** • anti-static wrist strap

**Parts needed** None

- 1 Vent the system.
- 2 Unplug the instrument **power cord** from the power outlet after venting is complete.

#### WARNING

Some instruments use two external power cords to provide input power. Make sure you unplug the input power cord for the main power supply and the input power cord for the pump expander box (into which the two rough pumps are plugged) before you continue.

- 3 Remove the **front cover** from the instrument.
- 4 Remove the **top cover** from the instrument.
- 5 Put on an **anti-static wrist strap**. Attach the **anti-static wrist strap** to a grounded surface such as the back panel of the instrument.
- 6 **For the 6200 Series and 6500 Series:** Remove the **left side cover**.

#### CAUTION

When you disconnect cables from the auxiliary module, firmly hold the connectors while you gently unclip and pull the connectors apart. The cables from the auxiliary module can be easily damaged. You can also bend connector pins, which can cause incorrect error messages or communication with the main board to fail.

- 7 Disconnect all the connections to the **auxiliary module**, and lift off and remove the **auxiliary module**.
- 8 **For the 6200 Series, 6400 Series and 6500 Series:** Remove the thumb screws and two **T20 Torx screws**.
- 9 Lift off the **vacuum manifold** cover.

## To close the vacuum manifold

**When needed** As needed.

**Tools needed** None

**Parts needed** None

### NOTE

If you worked on any components in the vacuum manifold, check to be sure the electrical connections are correct before closing the vacuum manifold.

- 1 Position the **manifold cover** on the **vacuum manifold**.
- 2 Install any screws that were removed when the **manifold cover** was removed.
- 3 Install the **auxiliary module** on to the top of the **vacuum manifold**.
- 4 Connect all the cables to the **auxiliary module** that were previously disconnected.
- 5 For 6200 Series, 6400 Series, and 6500 Series LC/MS, install the **left side cover**.
- 6 Install the **front cover**.
- 7 Install the **top cover** of the LC/MS instrument.
- 8 Plug the **power cord** back to the system.
- 9 Pump down the instrument.

## Ion Optics Assembly

### To clean skimmer 1

**CAUTION**

Use care when you do this procedure. Damages that you cause during maintenance are not covered under warranty. If you need assistance, contact Agilent.

**When needed** When symptoms indicate that cleaning is needed.

**Tools needed**

- clean lint-free cloth
- clean gloves
- LC/MS-grade isopropanol
- LC/MS-grade water

**Parts needed** None

- 1 Put on [clean gloves](#).
- 2 Examine the **skimmer** for any visual contamination. See [Figure 56](#).



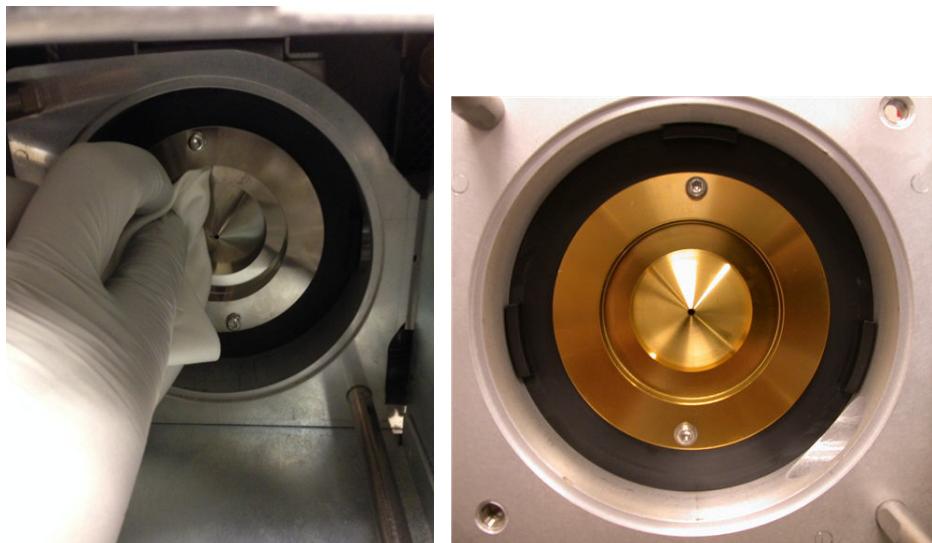
**Figure 56** Sample residue on skimmer

**3** Remove the **desolvation assembly**.

**4** Dampen a [clean lint-free cloth](#) with a mixture of LC/MS-grade isopropanol and LC/MS-grade water.

**5** Wipe the **skimmer**.

The **skimmer** must be shiny after it is wiped. If the contamination or sample residue on the **skimmer** cannot be removed, and then the **ion optics** must be removed and cleaned more thoroughly. Please contact Agilent Customer Service for more information.



**Figure 57** Wiping the skimmer (left) and an example of a clean **skimmer**.

### CAUTION

The tip of the skimmer is delicate. Do not damage it.

**6** Install the **desolvation assembly**. See “[To install the desolvation assembly](#)” on page 109.

### NOTE

Record this procedure in the Maintenance Logbook.

## 6 Desolvation Assembly and Vacuum Manifold

To remove the ion optics assembly (6200 Series)

### To remove the ion optics assembly (6200 Series)

This procedure is for 6200 Series LC/MS only. For all other instruments, see “[To remove the ion optics assembly \(6100 Series, 6400 Series, and 6500 Series\)](#)” on page 125.

#### CAUTION

Use care when you do this procedure. Damages that you cause during maintenance are not covered under warranty. If you need assistance, contact Agilent.

#### When needed

- When determined by an Agilent-trained Service Engineer to be absolutely necessary.
- When the ion optics assembly needs to be cleaned.

#### Tools needed

- [clean gloves](#)
- [clean lint-free cloth](#)
- [500-mL clean beaker, 2×](#)
- [tweezers](#)
- [T10 Torx screwdriver](#)
- [T15 Torx screwdriver](#)
- [1.5-mm ball driver](#)

#### Parts needed

- [LC/MS-grade methanol](#)
- [LC/MS-grade isopropanol](#)
- [LC/MS-grade acetone](#)

None

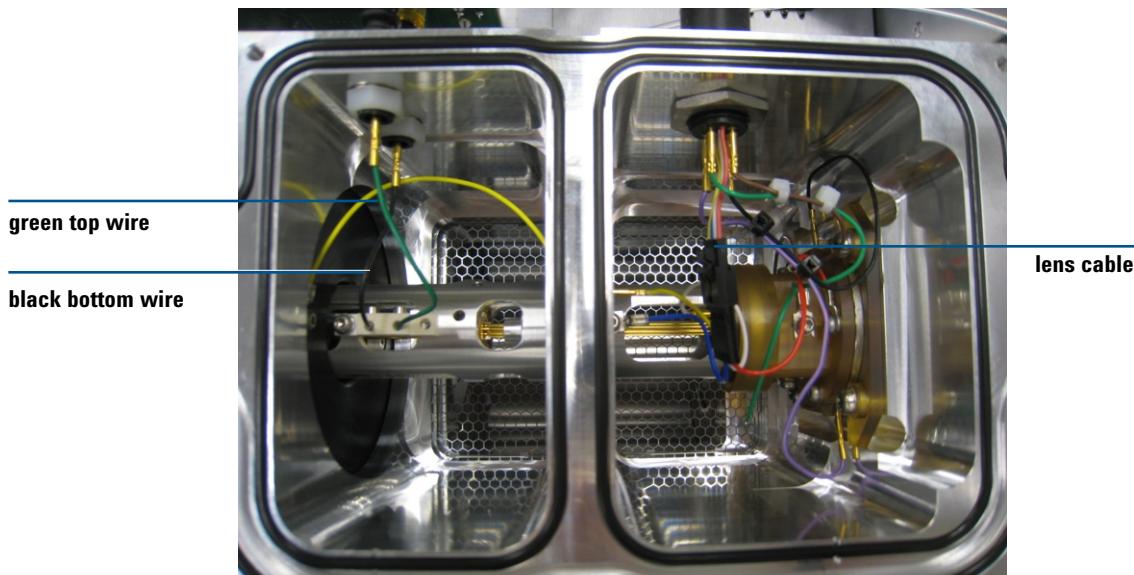
**1** Vent the instrument.

**2** Turn the front power switch off.

**3** Remove covers:

- Remove the **front cover** and disconnect the **status panel ribbon cable**.
- Remove the **top cover**. Remove the screws that secure the **top cover** from the back or front of the instrument, depending on the instrument model.
- Remove the **cosmetic cover** behind the **spray chamber** cover. Use the **T10 Torx screwdriver** to remove the four Torx screws.

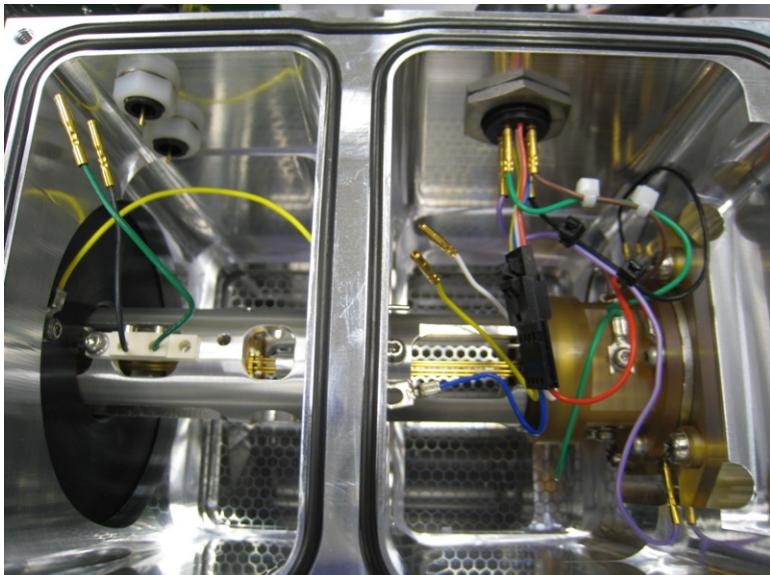
- 4 Remove gas and sample line connections from the nebulizer and gas supplies.
- 5 Remove all high voltage cables from their connectors.
- 6 Unlatch the **ion source** and swing open the door.
- 7 Remove the **desolvation assembly**. See “[To remove the desolvation assembly](#)” on page 106.
- 8 Remove the **ion optics assembly**:
  - a Remove the four **T20 Torx screw** that attach the **vacuum manifold** cover and remove the **manifold cover**.
  - b Wear [clean gloves](#). Remove the **green top wire** and the **vacuum manifold** bottom black wires of **ion optics 1** from the **vacuum manifold**.
  - c Disconnect the **yellow skimmer voltage wire** in the rear manifold connected to the **ion optics 1** partition.
  - d Remove the **T20 Torx screw** that holds the **blue wire** to the **ion optics 1** octopole housing in the rear chamber.
- 9 Disconnect the **white ion focus wire** in the rear manifold that is connected to the **ion optics ion focus lens**.



**Figure 58** Optics assembly, all cables connected

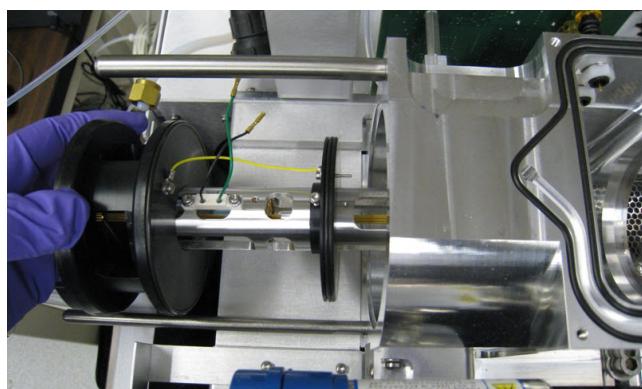
## 6 Desolvation Assembly and Vacuum Manifold

To remove the ion optics assembly (6200 Series)



**Figure 59** Optics assembly, all cables disconnected.

- 10** Press on the **skimmer spacer** with your right hand fingers while you hold the **skimmer** side with your left hand. This prevents the **ion optics assembly** from falling on the floor when it pops loose.
- 11** Put the **manifold cover** back on to keep dust out while you clean the **ion optics**.



**Figure 60** Removing the ion optics assembly

## To clean the ion optics assembly (6200 Series)

### CAUTION

Use care when you do this procedure. Damages that you cause during maintenance are not covered under warranty. If you need assistance, contact Agilent.

#### Tools needed

- clean gloves
- clean lint-free cloth
- 500-mL clean beaker, 2×
- tweezers
- T10 Torx screwdriver
- T15 Torx screwdriver
- 1.5-mm ball driver

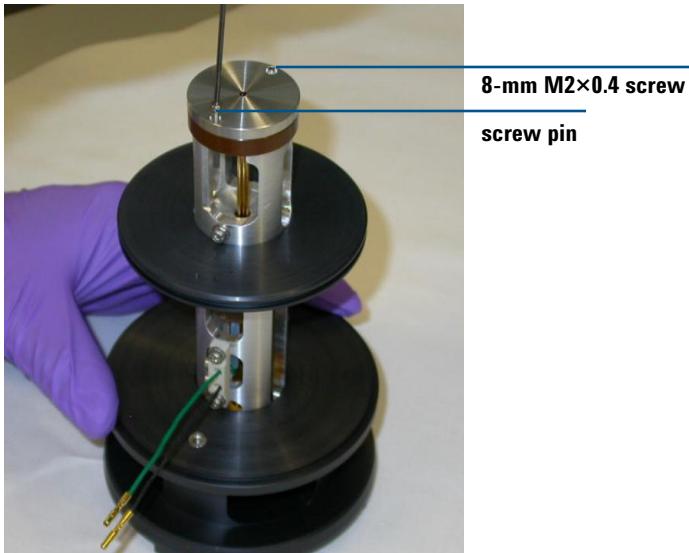
#### Parts needed

- LC/MS-grade methanol
- LC/MS-grade isopropanol
- LC/MS-grade acetone
- reagent-grade formic acid
- deionized (18 MW-cm) water
- Alconox Powdered Precision Cleaner

## 6 Desolvation Assembly and Vacuum Manifold

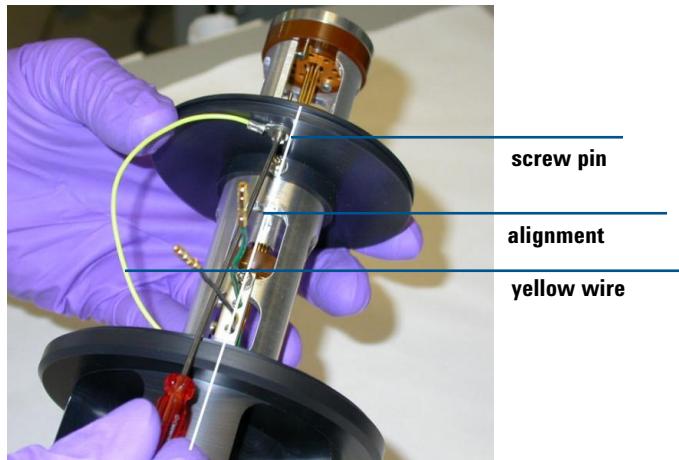
To clean the ion optics assembly (6200 Series)

- 1 Place the complete **ion optics assembly** under a fume hood on **clean lint-free cloth**.



**Figure 61** Ion focus lens removal

- 2 Remove the two **T6 Torx screw** on the **ion focus lens**.

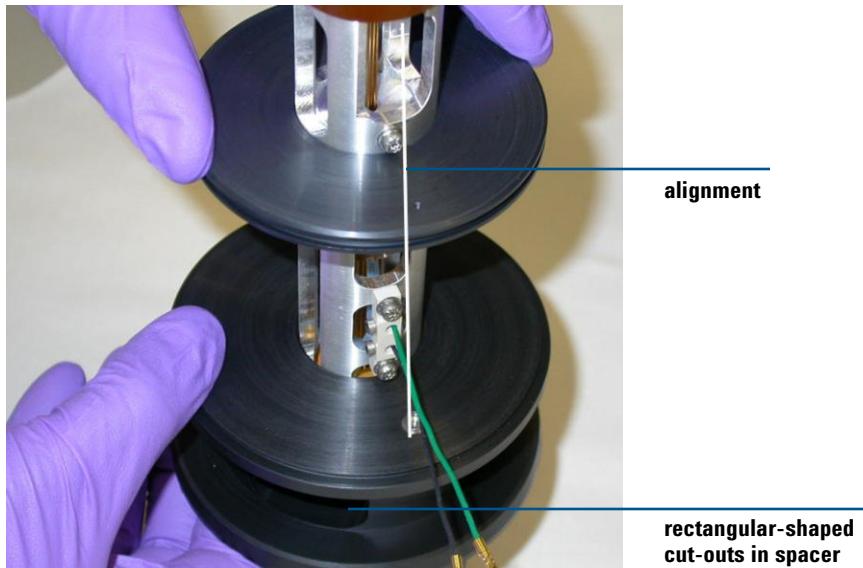


**Figure 62**

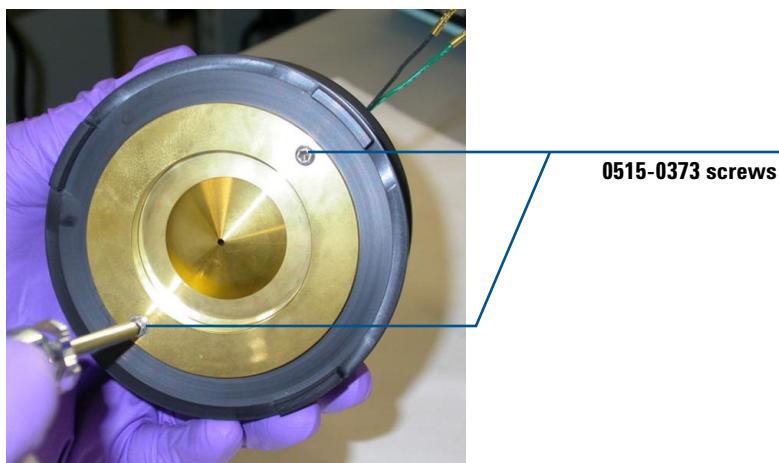
- 3 Remove the **skimmer O-ring** and **partition O-ring**, and then turn the **ion optics** on its side and remove the two **skimmer T10 Torx screw**.

## 6 Desolvation Assembly and Vacuum Manifold

To clean the ion optics assembly (6200 Series)



**Figure 63** Reference on alignment of the ion optics assembly partition and skimmer spacer if skimmer spacer is removed. Note the skimmer spacer can be removed to better clean octopole rods but is not recommended. The skimmer spacer can damage the octopole rods when you try to put it back on.



**Figure 64** Skimmer O-ring and partition O-ring removed



Align the Strain Relief Block/Wires with the extended area on the bottom of the skimmer spacer.

These wires must align with the foot on the spacer.

**Figure 65** Remove these two 8-mm T10 Torx screws to remove the skimmer for better access to the rods for cleaning.

**4 Remove the skimmer and skimmer O-ring.**

The **skimmer** can be hard to separate from the **skimmer spacer**. You can use one finger inserted into the **skimmer** space cutout to push on the opposite side of the **skimmer** to help pop it loose.

**CAUTION**

Do not let your finger come in contact with the octopole rods, or you can damage the octopole rods.

**CAUTION**

Never disassemble ion optics 1 further than instructed here. You can damage the ion optics assembly if you do.

## 6 Desolvation Assembly and Vacuum Manifold

To clean the ion optics assembly (6200 Series)



**Figure 66** Skimmer and ion focus removed for cleaning

### CAUTION

- Do not abrasively clean the skimmer because it is plated, and abrasive cleaning will damage the plating.
- Do not expose the skimmer to these solvents.
- Do not reuse the solvents between sets of components.
- Do not oversonicate the assembly or you will damage the octopole or octopole wires.

### 5 Clean the **octopole**:

- a Pull the **octopole** out of the **skimmer spacer**. The **octopole** is now ready to be sonicated. Do not disassemble the **octopole** any further.
- b Put entire **octopole assembly** into a beaker.
- c Sonicate the octopole assembly in each of these solvents, *in the order listed*. For each solvent, add the solvent to the beaker, sonicate for 5 minutes, and then pour out the solvent. Do this one solvent at a time.

LC/MS-grade isopropanol

0.1% reagent-grade formic acid in water

LC/MS-grade water

LC/MS-grade methanol

**6 Sonicate the skimmer and ion focus lens:**

- a** Put both the **skimmer** and **ion focus lens** into a clean beaker.
- b** Sonicate the parts in each of these solvents, *in the order listed*. For each solvent, add the solvent to the beaker, sonicate for 5 minutes, and then pour out the solvent. Do this one solvent at a time.

[LC/MS-grade isopropanol](#)

[LC/MS-grade acetone](#)

[LC/MS-grade methanol](#)

[1% solution of Alconox Powdered Precision Cleaner](#)

- c** Rinse the beaker with at least 10 volume washes using clean [LC/MS-grade water](#). Do not leave any detergent residue on the lens elements.
- d** Rinse the lens elements with [LC/MS-grade methanol](#) to remove any remaining water.
- e** Wipe the **skimmers** and lenses a with a [clean lint-free cloth](#) dampened with solvent ([LC/MS-grade methanol](#)).

**7 Reassemble the ion optics assembly:**

- a** Replace the **ion focus lens** on the **octopole assembly** with two **T6 Torx screws**.
- b** Place the **O-ring** back on the **skimmer**.
- c** Place the **skimmer** back on the **skimmer spacer** with two **T10 Torx screw** screws.
- d** Place the partition **O-ring** back on the partition.
- e** Place the **skimmer spacer O-ring** back on the **skimmer spacer**.
- f** Reinstall the **ion optics** into the **vacuum manifold** and reverse all disassembly procedures.
- g** Test for continuity before installing. Check that Negative on **green top wire** and Positive on Black Wire Readings are OL (over limit).

**NOTE**

Record this procedure in the Maintenance Logbook.

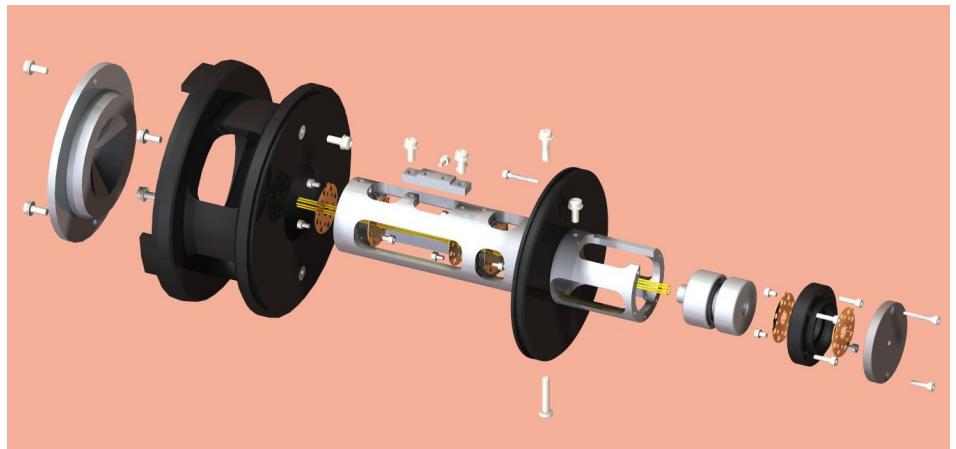
## 6 Desolvation Assembly and Vacuum Manifold

To clean the ion optics assembly (6200 Series)



**Figure 67** Testing for continuity.

Figure 68 shows the exploded view of the **ion optics assembly**.



**Figure 68** An exploded view of the ion optics assembly. Note that this picture is provided for reference only. The ion optics assembly is never to be disassembled to this level.

## To remove the ion optics assembly (6100 Series, 6400 Series, and 6500 Series)

### CAUTION

Use care when you do this procedure. Damages that you cause during maintenance are not covered under warranty. If you need assistance, contact Agilent.

- 1 Vent the system.
- 2 Remove the **ion source**.
- 3 Remove the **desolvation assembly**.
- 4 Remove the **vacuum manifold** cover.
- 5 Unplug all of the **ion optics** cables so that the **ion optics assembly** can be removed. Pay close attention to the orientation of the cables and their respective locations.

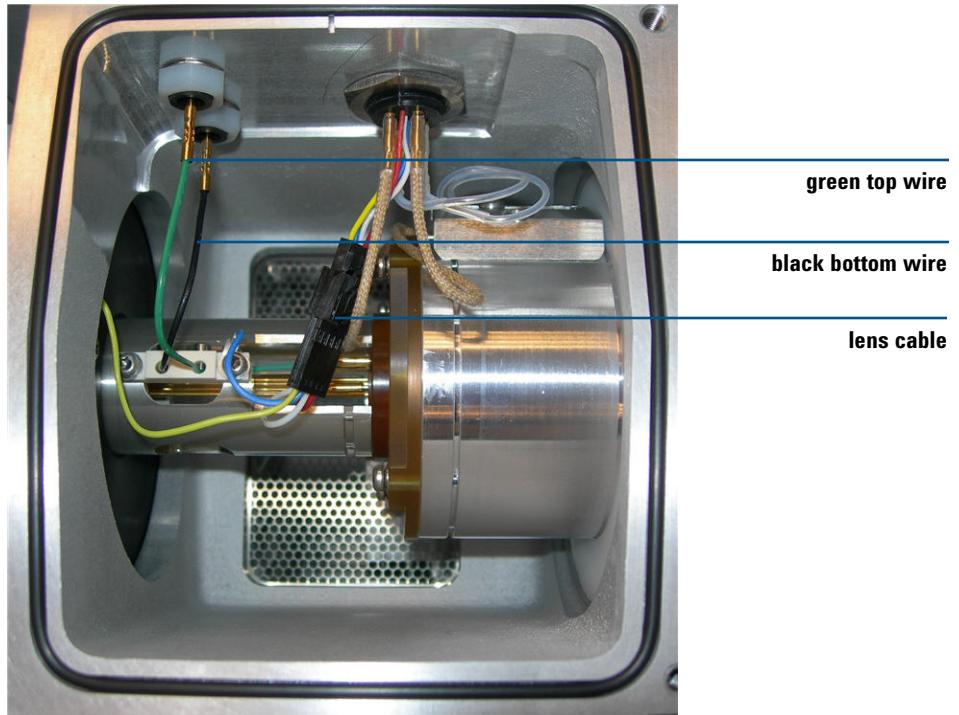
### WARNING

Some instruments use two external power cords to provide input power. Make sure you unplug the input power cord for the main power supply and the input power cord for the pump expander box (into which the two rough pumps are plugged) before you continue.

- 6 Use your finger to push on the **skimmer spacer** to get the **ion optics** to pop out of the instrument. Be careful to catch it so it doesn't fall on the floor. See [Figure 69](#).

## 6 Desolvation Assembly and Vacuum Manifold

To remove the ion optics assembly (6100 Series, 6400 Series, and 6500 Series)



**Figure 69** Optics assembly

## To clean the ion optics assembly (6100 Series, 6400 Series and 6500 Series)

### CAUTION

Use care when you do this procedure. Damages that you cause during maintenance are not covered under warranty. If you need assistance, contact Agilent.

#### Parts needed

- clean gloves
- clean lint-free cloth
- 500-mL clean beaker, 2×
- tweezers
- T10 Torx screwdriver
- T15 Torx screwdriver
- 1.5-mm ball driver
- LC/MS-grade methanol
- LC/MS-grade acetone
- LC/MS-grade isopropanol
- LC/MS-grade acetone
- reagent-grade formic acid
- deionized (18 MW-cm) water
- Alconox Powdered Precision Cleaner

- 1 Place the **ion optics assembly** under a fume hood on a [clean](#) lint-free cloth ([Figure 70](#)).
- 2 Remove the **skimmers**:
  - a Reposition the assembly that holds the **skimmer spacer**, and remove the two screws that hold **skimmer 1**.
  - b For 6120, after you remove **skimmer 1**, remove the two screws that hold **skimmer 2** to the black **skimmer spacer**. Then remove **skimmer 2**.
  - c Carefully remove **skimmer 1** ([Figure 71](#)). If needed, use a flat blade screwdriver to gently pry **skimmer 1** from its seat.

## 6 Desolvation Assembly and Vacuum Manifold

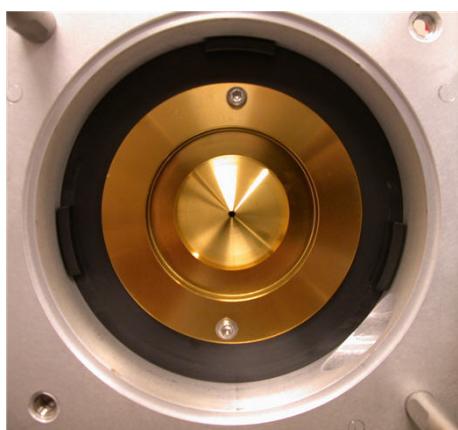
To clean the ion optics assembly (6100 Series, 6400 Series and 6500 Series)

### CAUTION

The screwdriver blade can damage the octopole rods. The octopole rods are damaged, you must replace the entire assembly.



**Figure 70** Ion optics assembly



**Figure 71** Skimmer 1. The hole in the skimmer varies by instrument type.

**3 Remove the lenses:**

- a** Remove the two screws that hold the **octopole** to the **skimmer spacer** ([Figure 72](#)). Be careful not to let the **ion optics** fall on the table. Support the **octopole** by holding it up by the **octopole** tube.

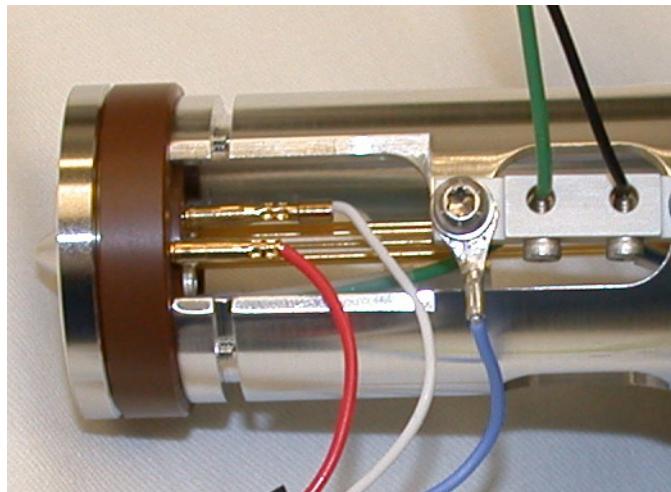


**Figure 72** Octopole rods extending through skimmer spacer.

- b** Disconnect wiring harness and connections ([Figure 73](#)). The red wire is for **lens 2** and the **white ion focus wire** is for **lens 1**.

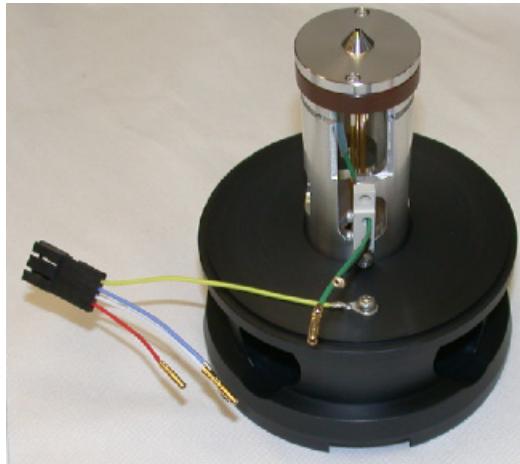
## 6 Desolvation Assembly and Vacuum Manifold

To clean the ion optics assembly (6100 Series, 6400 Series and 6500 Series)



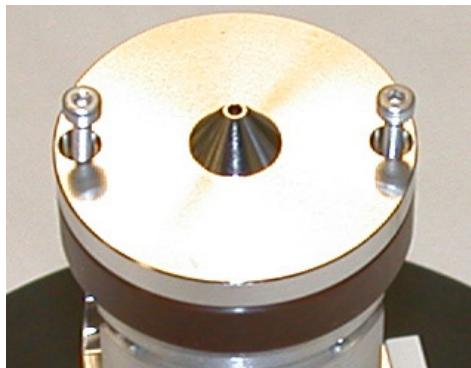
**Figure 73** Lens 1 and Lens 2 wires

- c Leave the yellow wires attached to **skimmer spacer** ([Figure 74](#)). Leave the **ion optics** in the **skimmer spacer** and use it as a stand to remove **lens 2, spacer insulator**, and **lens 1**. Be careful not to damage the **octopole rods**.



**Figure 74** Skimmer spacer

- d** Use the 1.5-mm ball driver to remove the two screws that hold **lens 2** (Figure 75).



**Figure 75** Lens 2

- e** Remove the **spacer insulator** (Figure 76).

## 6 Desolvation Assembly and Vacuum Manifold

To clean the ion optics assembly (6100 Series, 6400 Series and 6500 Series)



**Figure 76** Spacer insulator

**f Remove lens 1.**

**CAUTION**

- Do not abrasively clean the skimmer because it is plated, and abrasive cleaning will damage the plating.
- Do not expose the skimmer to these solvents.
- Do not reuse the solvents between sets of components.
- Do not oversonicate the assembly or you will damage the octopole or octopole wires.

**4 Clean the octopole:**

- a** Pull the **octopole** out of the **skimmer spacer**. The **octopole** is now ready to be sonicated. Do not disassemble the **octopole** any further.



**Figure 77** Octopole assembly

- b** Put entire **octopole assembly** into a beaker.
- c** Sonicate the octopole assembly in each of these solvents, *in the order listed*. For each solvent, add the solvent to the beaker, sonicate for 5 minutes, and then pour out the solvent. Do this one solvent at a time.

LC/MS-grade isopropanol

0.1% reagent-grade formic acid in water

LC/MS-grade water

LC/MS-grade methanol

**5 Clean the skimmer and lenses:**

- a** Put **skimmer**, **lens 1** and **lens 2** into a beaker.
- b** Sonicate the parts in each of these solvents, *in the order listed*. For each solvent, add the solvent to the beaker, sonicate for 5 minutes, and then pour out the solvent. Do this one solvent at a time.

LC/MS-grade isopropanol

LC/MS-grade acetone

LC/MS-grade methanol

## 6 Desolvation Assembly and Vacuum Manifold

To clean the ion optics assembly (6100 Series, 6400 Series and 6500 Series)

1% solution of [Alconox Powdered Precision Cleaner](#)

- c Rinse the beaker with at least 10 volume washes using clean [LC/MS-grade water](#). Do not leave any detergent residue on the lens elements.
  - d Rinse the lens elements with [LC/MS-grade methanol](#) to remove any remaining water.
  - e Wipe the **skimmers** and lenses a with a [clean lint-free cloth](#) dampened with solvent ([LC/MS-grade methanol](#)).
- 6 Remove the parts from the beaker, place them on a [clean lint-free cloth](#) and allow them to air dry.
- 7 Wipe the **skimmer spacer** completely with a [clean lint-free cloth](#) dampened with [LC/MS-grade methanol](#). Make sure to wipe off any oil droplets.
- 8 Inspect the **octopole rods**:
- a Check that the **octopole rods** are not broken.
  - b Using a small ball driver or pair of tweezers, gently touch each **octopole rod** on its end to make sure that it has not come detached from the connection on the end support. Do this on both ends of the **octopole rods**.

### NOTE

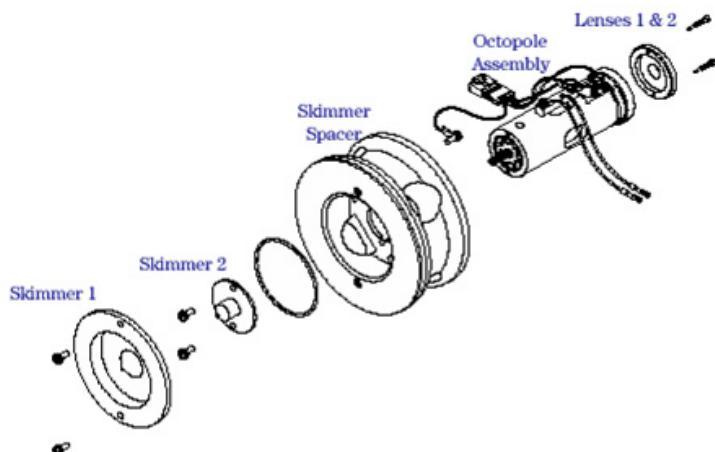
If any of the octopole rods are found to be damaged or detached, replace the ion optics assembly. Octopole rods cannot be reattached.

## 9 Assemble the ion optics assembly:

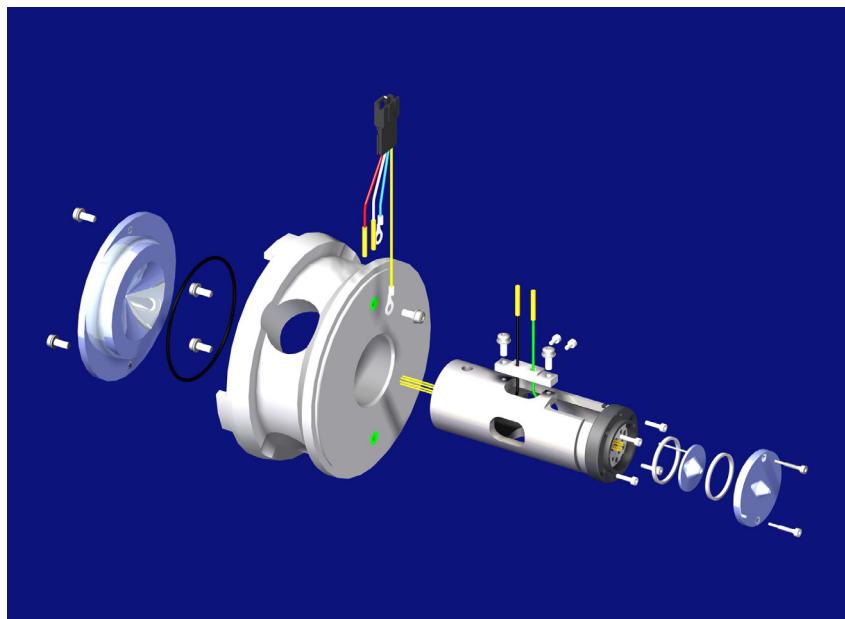
- a Install the **octopole assembly** into the **skimmer spacer**. Position the **octopole assembly** so that the screws on **skimmer side of skimmer spacer** can be installed.
- b For 6120, reinstall **skimmer 2**.
- c Install **skimmer 1**. Remember to install the black **O-ring** that goes behind **skimmer 1**.
- d Install **lens 1**, space insulator and **lens 2**.
- e Attach the wiring harness.
- f Connect all previously disconnected wires (see [Figure 70](#)).

[Figure 78](#) and [Figure 79](#) show shows the exploded view of the **ion optics assembly**.

To clean the ion optics assembly (6100 Series, 6400 Series and 6500 Series)



**Figure 78** An exploded view of the ion optics assembly for instruments with skimmer 2 (6120).



**Figure 79** An exploded view of the ion optics assembly (one skimmer only)

## 6 Desolvation Assembly and Vacuum Manifold

To clean the ion optics assembly (6100 Series, 6400 Series and 6500 Series)

### 10 Install the ion optics assembly:

- a Install the reassembled **ion optics assembly** (see Figure 80) into the **vacuum manifold**.
- b Connect the **green top wire** and black octopole leads.
- c Connect the lens cable connector.



**Figure 80** The re-assembled ion optics assembly

### 11 Reinstall the desolvation assembly.

See “[To install the desolvation assembly](#)” on page 109.

#### NOTE

Record this procedure in the Maintenance Logbook.

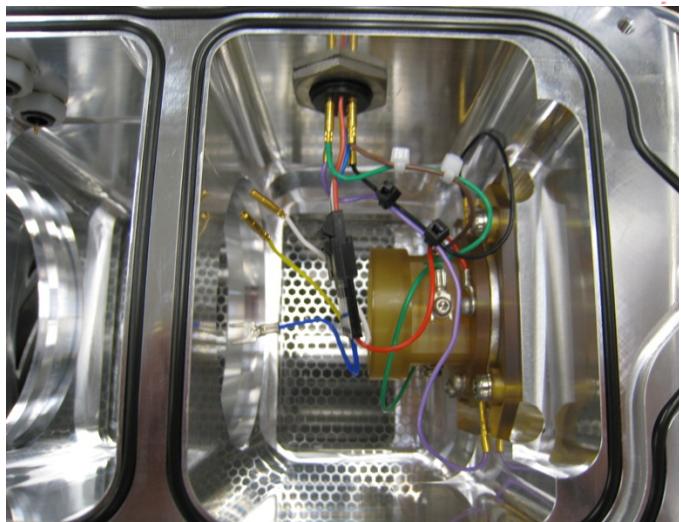
## Beam-shaping assembly

These procedures are for the 6200 Series LC/MS instruments only.

### To remove and clean the complete beam shaping assembly

#### CAUTION

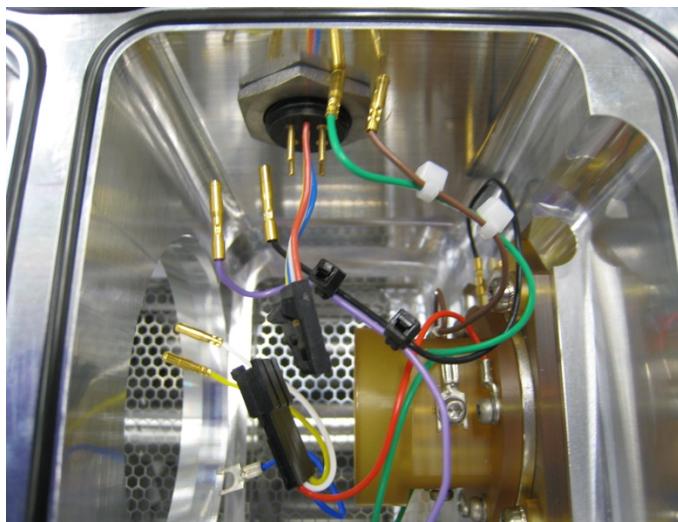
Use care when you do this procedure. Damages that you cause during maintenance are not covered under warranty. If you need assistance, contact Agilent.



- 1 Remove the **ion optics assembly**. See “To remove the ion optics assembly (6200 Series)” on page 114 or “To remove the ion optics assembly (6100 Series, 6400 Series, and 6500 Series)” on page 125.
- 2 If both the **ion optics assembly** and **beam-shaper slicer assembly** are going to be cleaned, do the steps in “To clean the ion optics assembly (6200 Series)” on page 117 through step 7 or “To clean the ion optics assembly (6100 Series, 6400 Series and 6500 Series)” on page 127 through step 9.
- 3 Disconnect the **green horizontal Q wire** and **brown vertical Q wire** from the **rear vacuum manifold cable harness feed-through**.

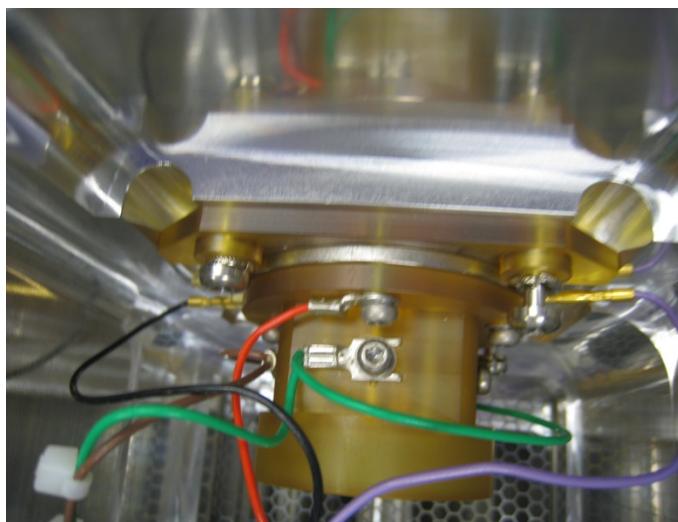
## 6 Desolvation Assembly and Vacuum Manifold

To remove and clean the complete beam shaping assembly



4 Disconnect the bottom left **purple top slit wire** and bottom **black bottom slit wire** from the **rear vacuum manifold cable harness feed-through**.

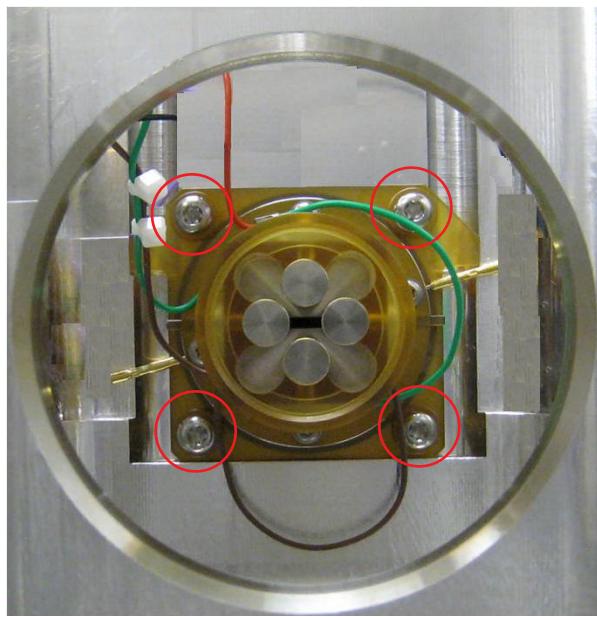
5 Disconnect the **black snap connector** with the **red slicer voltage wire**, **yellow skimmer voltage wire**, **blue octopole housing wire**, and **white ion focus wire**.



6 Use a pair of **tweezers** to remove the **black bottom slit wire** and **purple top slit wire** from the connections on the **beam-shaper slicer assembly**.

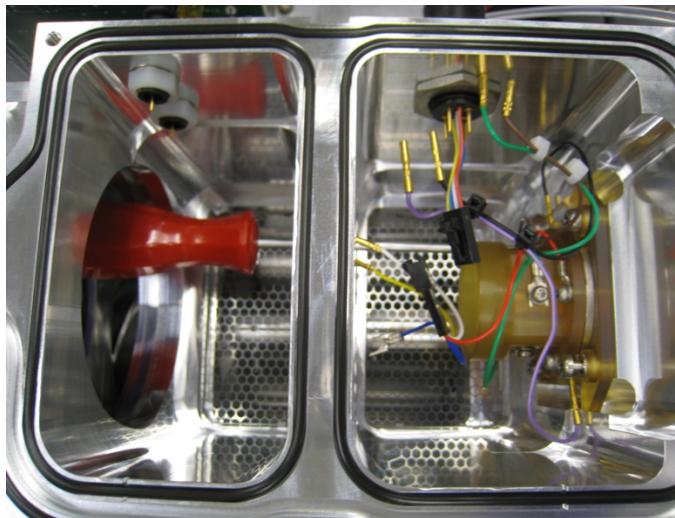
7 Remove the **purple top slit wire** and **black bottom slit wire** from the **rear vacuum manifold** and set it aside.

If these wires are not removed, the beam-shaper slicer assembly cannot be pulled through the **vacuum manifold** into the **ion optics** region and out the desolvation chamber attachment of the front manifold.



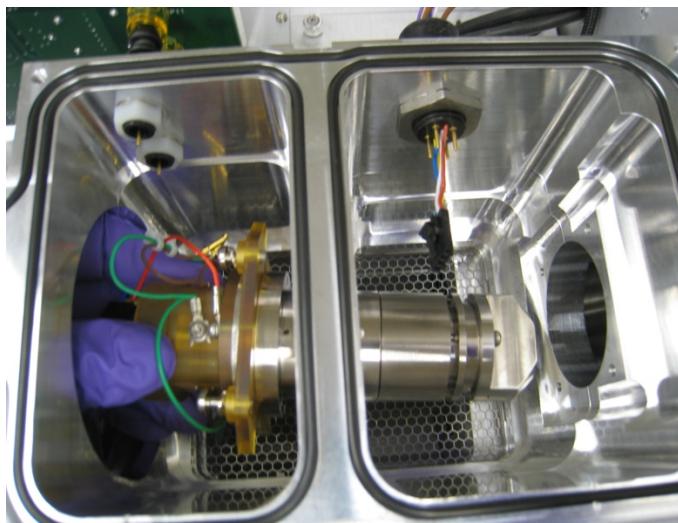
**8** Loosen the four **T20 Torx screw** (circled in the figure to the left) that hold the **beam-shaper slicer assembly** in place. Insert the **T20 Torx screwdriver** from the front of the manifold.

The screws are capture type and will not fall after they are loosened.

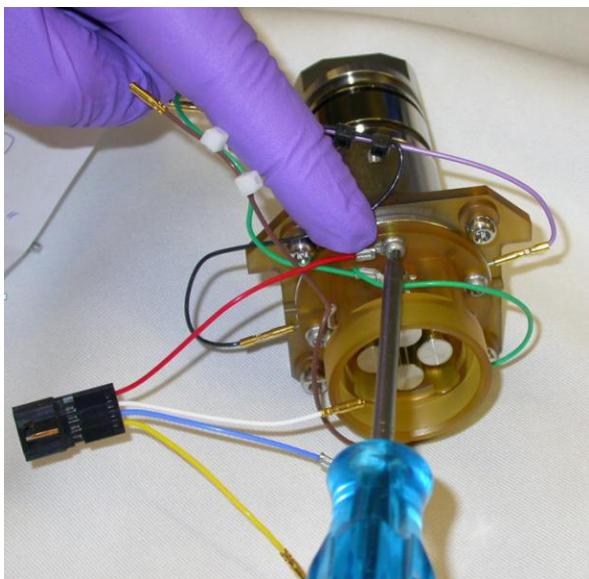


## 6 Desolvation Assembly and Vacuum Manifold

To remove and clean the complete beam shaping assembly



- 9 Remove the **beam-shaper slicer assembly** from the source side of the manifold.

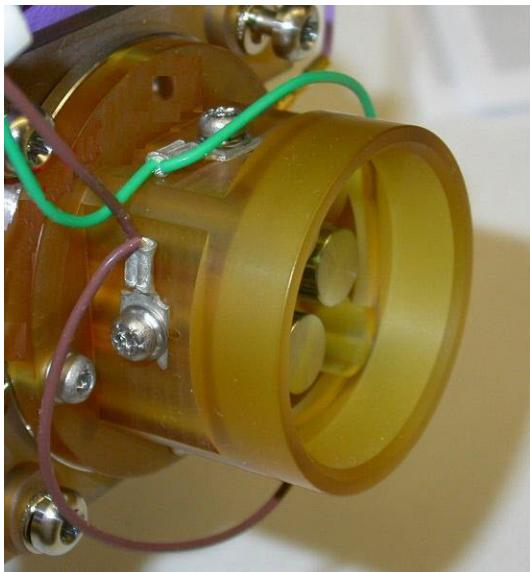


- 10 Place the complete **beam-shaper slicer assembly** under a fume hood on **clean lint-free cloth** for disassembly and cleaning.

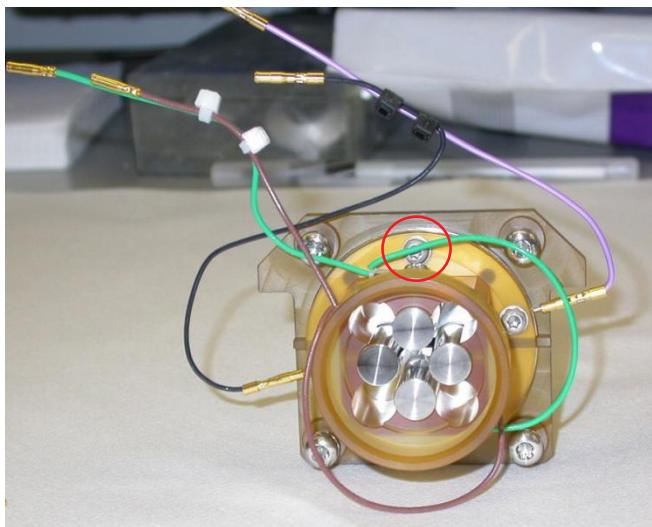
- 11 Inspect the correct wiring as shown in this picture. Remember that you removed the **purple top slit wire** **black bottom slit wire** harness before you removed it from manifold.

- 12 Remove the **red slicer voltage wire** with **black snap connector** from the **slicer housing**.

To remove and clean the complete beam shaping assembly



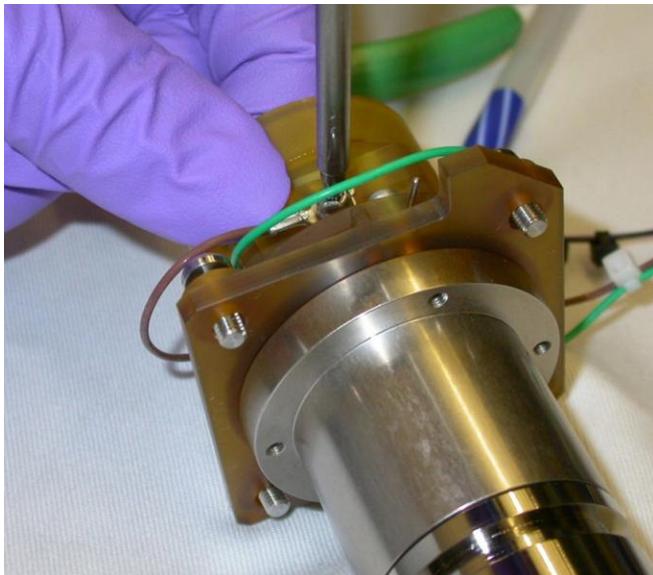
The figure to the left shows all wiring connections with the **purple top slit wire** and **black bottom slit wire** connected. Use this picture for reference when you reassemble the unit. You will reinstall the **purple top slit wire** and **black bottom slit wire** after the **purple top slit wire** and **beam-shaper slicer assembly** is placed back into the **vacuum manifold**.



The figure to the left shows the **red slicer voltage wire** removed. Note that the **red slicer voltage wire** is removed from the circled screw.

## 6 Desolvation Assembly and Vacuum Manifold

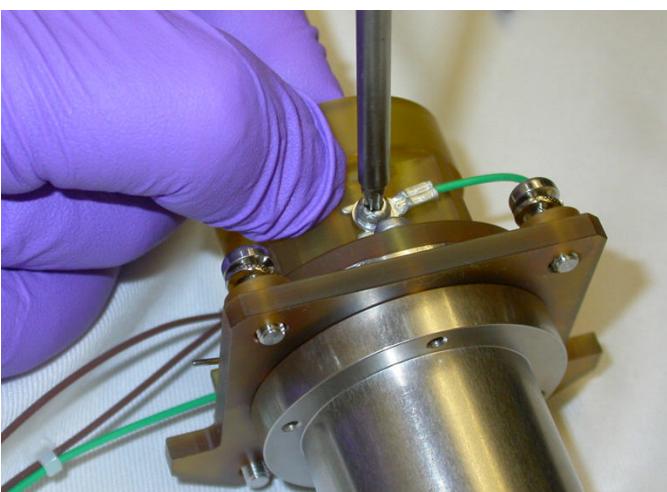
To remove and clean the complete beam shaping assembly



**13** Loosen the two **8-mm T10 Torx screw** that are attached to each of the two **brown wire**, and then remove the **brown wire** that connect the **slit cable assembly** to the “horizontal” **P-filter rods**. These wires are slotted so the **P-filter rods** can be left in place.

You can remove the **P-filter rods**, or leave them in the housing and just rinse them off with **LC/MS-grade methanol**.

**14** Gently push each **P-filter rod** against its reference “stop” when any **P-filter rod** screw has been loosened for any reason.

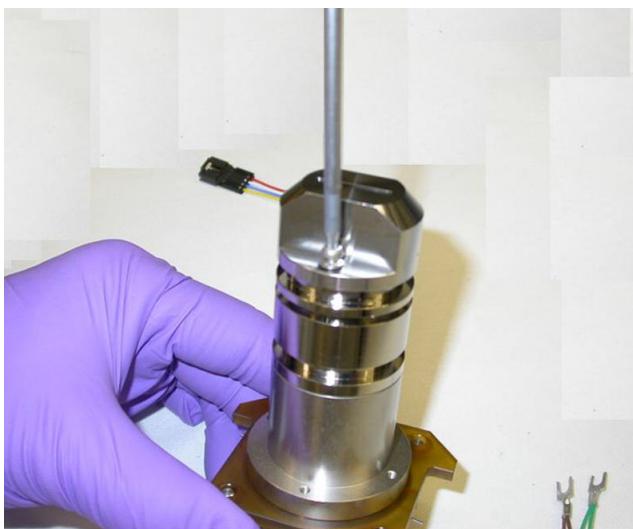


**15** Loosen the two **8-mm T10 Torx screw** that attach each of the two **green horizontal Q wire** to the **Quad holder** and the “vertical” **P-filter rod**. These wires are slotted so the **P-filter rods** can be left in place.

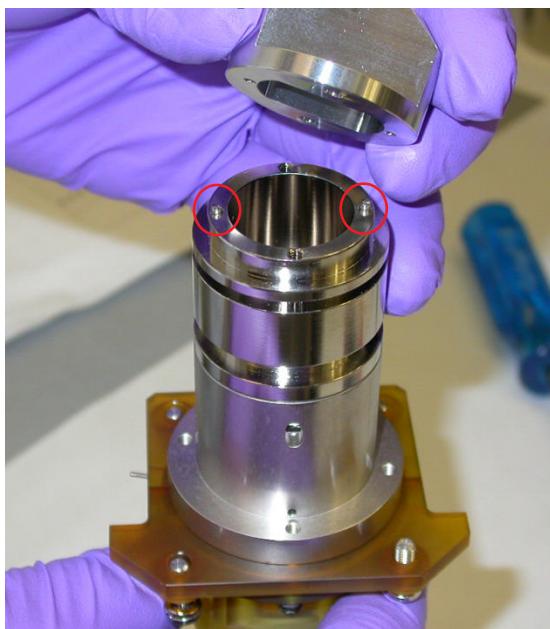
**16** Remove the **green horizontal Q wire**.

**17** Remove the complete **beam-shaper cable** with **green horizontal Q wire** and **brown vertical Q wire**. Tighten the screws if the **P-filter rods** will not be removed.

**18** Gently push each **P-filter rod** against its reference “stop” when the screw is tightened.



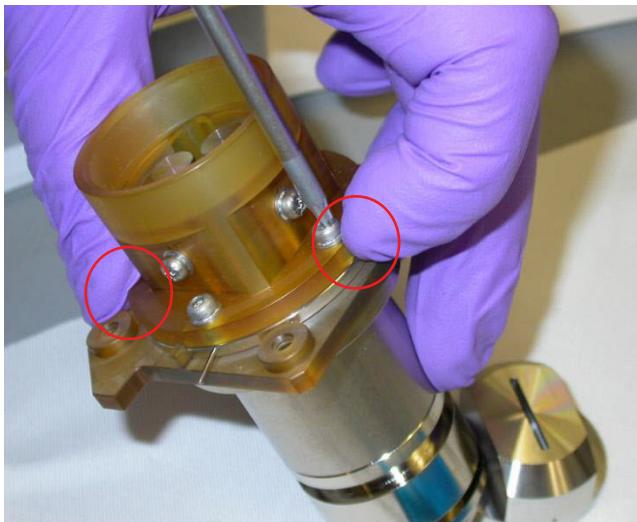
**19** Remove the **slicer exit** on the exit end of the **slicer body assembly**.



**20** Locate the two pins (circled in the figure to the left) in the **slicer body assembly** that align with the two small pin holes in the **slicer exit**. Remove the two **8-mm T10 Torx screw** to remove the **slicer exit**.

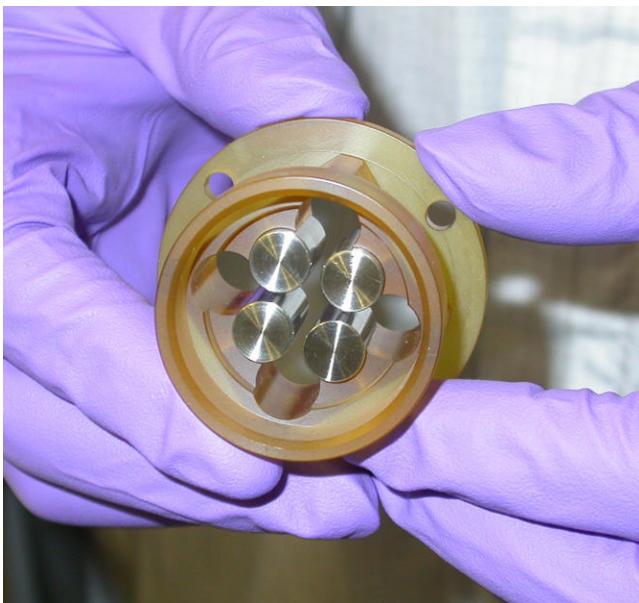
## 6 Desolvation Assembly and Vacuum Manifold

To remove and clean the complete beam shaping assembly

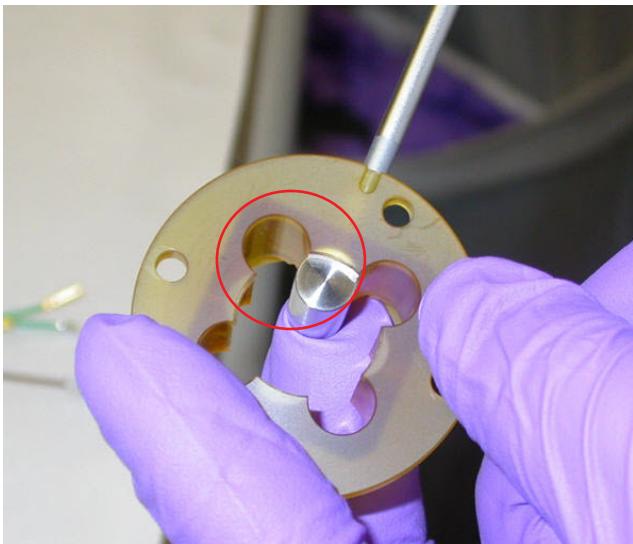


**21** Remove the **Quad holder** from the **slicer body assembly**. Remove the four **M3 screws** that fasten the two assemblies together.

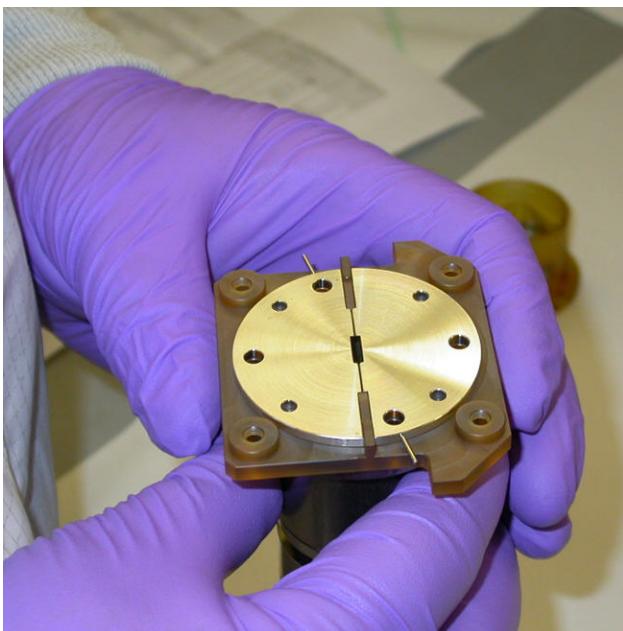
When re-assembling, make sure to tighten the screws completely. Make sure that each **slit plate** is pushed towards the center to assure that it is properly seated against the reference stops/features found on the **slit spacer**. The figure to the left shows the two **slit plate** being pressed to the center during reassembly.



The figure to the left shows 4 **P-filter rod** in the **Quad holder** separated from the **slicer body assembly**.



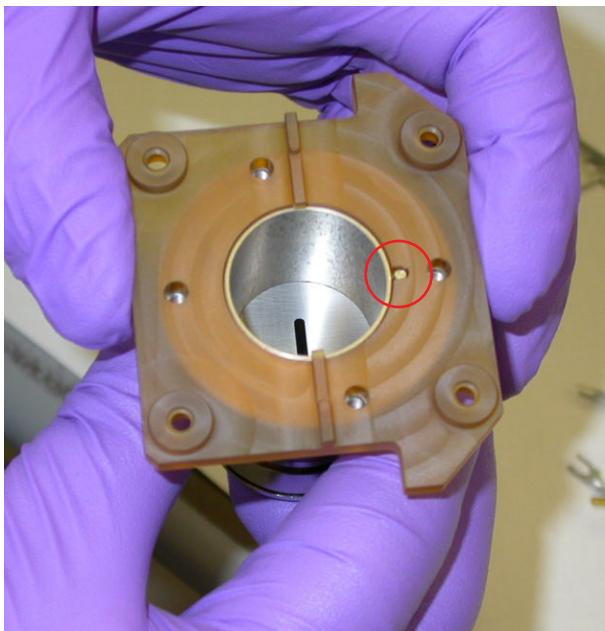
**22** Gently push each **P-filter rod** against its reference “stop” (circled in the figure to the left) when the screw is tightened.



**23** Lift and remove the **2 slit plate** from the **slit spacer**.

## 6 Desolvation Assembly and Vacuum Manifold

To remove and clean the complete beam shaping assembly

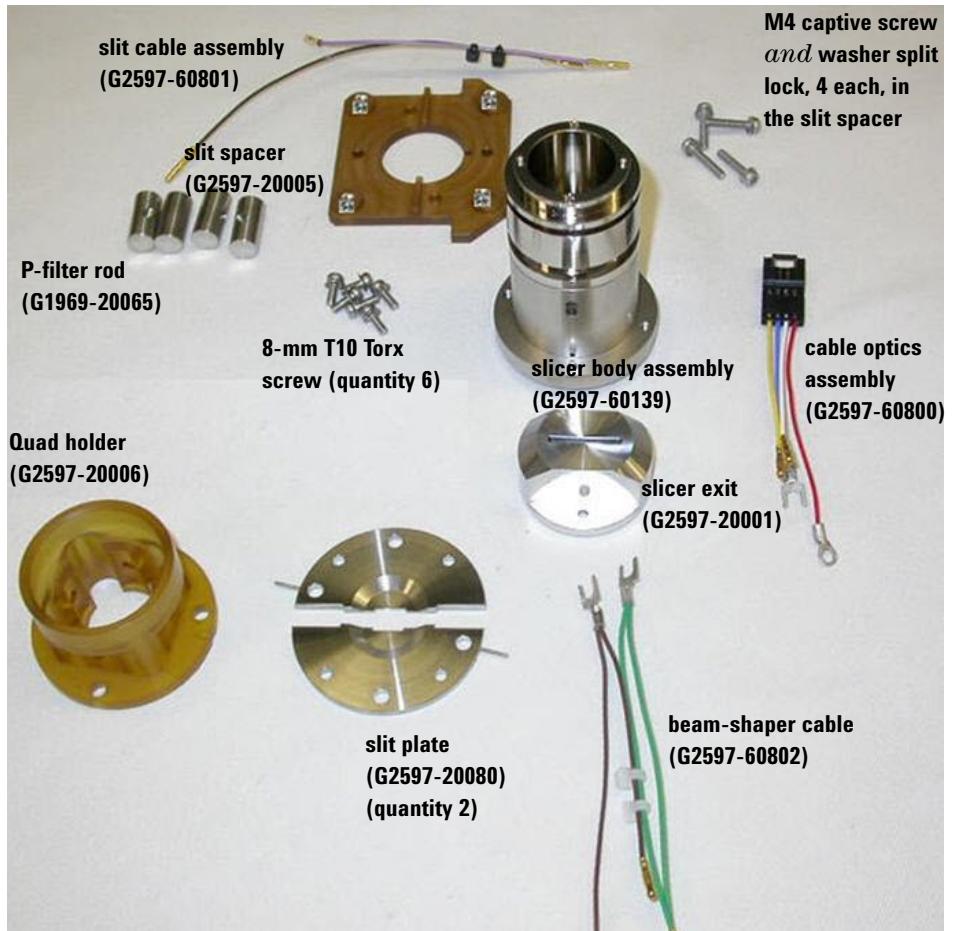


**24** Remove the plastic slit spacer from the [slicer body assembly](#).

When you reassemble the unit, note the small pin on the [slicer body assembly](#) (circle in the figure to the left) engaged in the hole of the [slit spacer](#).

Desolvation Assembly and Vacuum Manifold 6

To remove and clean the complete beam shaping assembly



**Figure 81** Slicer assembly part number identification.

**NOTE**

Record this procedure in the Maintenance Logbook.

## 6 Desolvation Assembly and Vacuum Manifold

To clean the beam-shaping slicer parts

### To clean the beam-shaping slicer parts

#### CAUTION

Use care when you do this procedure. Damages that you cause during maintenance are not covered under warranty. If you need assistance, contact Agilent.

#### Parts needed

- deionized (18 MW-cm) water
- Alconox Powdered Precision Cleaner
- LC/MS-grade isopropanol
- LC/MS-grade acetone
- LC/MS-grade methanol

- 1 Clean the two [slit plate, slicer exit, slicer body assembly](#), and the four [P-filter rod](#) with [deionized \(18 MW-cm\)](#) water and a small amount of [Alconox Powdered Precision Cleaner](#) in a clean beaker.  
Use a clean tech wipes to clean all metal surfaces.
- 2 Use [deionized \(18 MW-cm\)](#) water to rinse all of the [Alconox Powdered Precision Cleaner](#) off of the two [slit plate, slicer exit, slicer body assembly](#), and the four [P-filter rod](#).  
Be sure to rinse all [Alconox Powdered Precision Cleaner](#) off the parts.
- 3 Sonicate the beam-shaping slicer parts:
  - a Place the two [slit plate, slicer exit, slicer body assembly](#), and the four [P-filter rod](#) in a clean beaker.
  - b Sonicate for 5 minutes.
  - c Pour out the [LC/MS-grade isopropanol](#).
  - d Refill the beaker with 100% [LC/MS-grade acetone](#).
  - e Sonicate for another 5 minutes.
  - f Pour out the [LC/MS-grade acetone](#).
  - g Refill with 100% [LC/MS-grade methanol](#).
  - h Sonicate for another 5 minutes.
- 4 Rinse the quad holder slit spacer and screws with [LC/MS-grade methanol](#) and wipe clean.

- 5 Reassemble the **beam-shaper slicer assembly**. Do in reverse order the steps used to disassemble the part.
- 6 Check the **beam-shaper slicer assembly** for electric shorts:
  - a Use a multimeter to simultaneously touch the left pin coming off the **slit plate** and the body of the **slicer body assembly**.
  - b Check that the multimeter displays “OL”.
  - c Repeat this measurement on the right pin coming off the second **slit plate**.

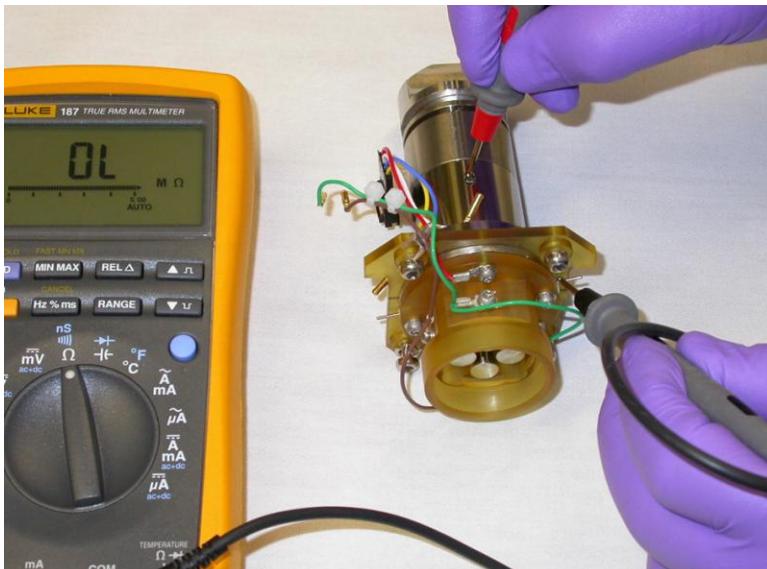
The **beam-shaper slicer assembly** is now clean and ready to install into the manifold.



**Figure 82** Testing the beam-shaping assembly with a multimeter.

## 6 Desolvation Assembly and Vacuum Manifold

To clean the beam-shaping slicer parts



**Figure 83**

### 7 Reinstall the beam-shaper slicer assembly into the vacuum manifold.

Do in reverse order the steps used to remove the **beam-shaper slicer assembly** from the **vacuum manifold**.

### 8 Reinstall the ion optics assembly into the vacuum manifold.

Make sure to keep the **ion optics assembly** and **beam-shaper slicer assembly** in the same physical orientation in the **vacuum manifold** as they were when they were removed.

### 9 Make sure all wiring connections are correct.

### 10 Do in reverse order the steps used to vent and remove the **ion optics assembly** and **beam-shaper slicer assembly** to prepare the instrument to pump down.

### 11 Turn on the instrument at the front power switch.

The instrument automatically starts the pump down process.

### 12 After the instrument starts up, start the Diagnostics program in the data acquisition program.

Connect the instrument from the menu in the Diagnostics program.

- 13 In the **Parameters** tab, check the rough pump vacuum and turbo speed to see the progress of the pump down.
- 14 Do a high voltage conditioning for a 2-Hour cycle (optics service). The high vacuum condition starts after the high vacuum has reached  $2.0 \times 10^{-6}$  Torr.
- 15 When the high voltage conditioning is done and the vacuum is acceptable ( $5.0 \times 10^{-7}$  Torr), tune the instrument:
  - Do initial positive and negative tune in 2 GHz Extended Dynamic range.
  - Do standard positive and negative polarity switching tunes.

**NOTE**

Record this procedure in the Maintenance Logbook.

---

## 6 Desolvation Assembly and Vacuum Manifold

### Electron Multiplier

## Electron Multiplier

These procedures are for the 6100 Series and the 6400 Series LC/MS instruments only.

### To replace the electron multiplier horn

#### CAUTION

Use care when you do this procedure. Damages that you cause during maintenance are not covered under warranty. If you need assistance, contact Agilent.

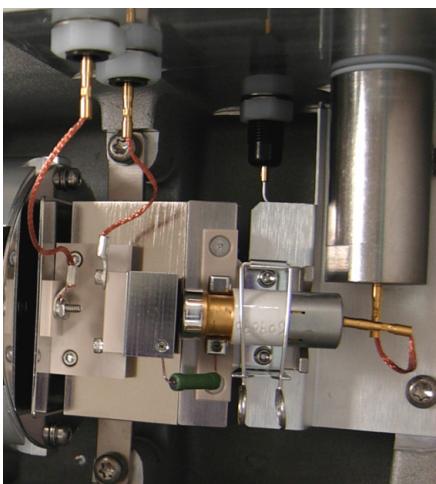
**When needed** When sensitivity or poor and autotune consistently sets the detector gain to its maximum value

**Tools needed**

- clean gloves
- long-nose pliers

**Parts needed**

- [electron multiplier replacement horn](#) (6100 Series)
- [high gain electron multiplier](#) (6400 Series)



- 1 Disconnect the signal wire from the **electron multiplier horn**.
- 2 Open the retaining clip.
- 3 Remove the **electron multiplier horn**.
- 4 Install a new **electron multiplier horn**.
- 5 Close the retaining clip.
- 6 Connect the signal wire to the pin on the **electron multiplier horn**.
- 7 Close the analyzer.

**NOTE**

Record this procedure in the Maintenance Logbook.

---

## 6 Desolvation Assembly and Vacuum Manifold

To clean the high energy dynode

### To clean the high energy dynode

#### CAUTION

Use care when you do this procedure. Damages that you cause during maintenance are not covered under warranty. If you need assistance, contact Agilent.

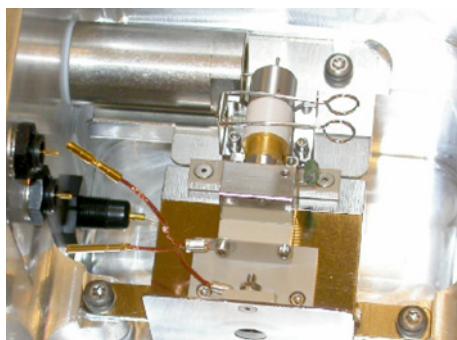
**When needed** When sensitivity is poor and autotune consistently sets the detector gain to its maximum value

**Tools needed**

- 500-mL clean beaker or larger, 2 required
- clean gloves
- 0.8 mm hex key
- LC/MS-grade isopropanol
- LC/MS-grade methanol
- long-nose pliers
- T20 Torx screwdriver

**Parts needed** None

- 1 Put on [clean gloves](#).
- 2 Disconnect the two braided wires from the **electron multiplier**.
- 3 Remove the two screws that hold the **electron multiplier** to the **vacuum manifold**.



**Figure 84** Electron multiplier exposed

- 4 Remove the **electron multiplier** and, at the same time, carefully disconnect the two remaining rigid wires.
- 5 Remove the **electron multiplier horn** from the **electron multiplier**.
- 6 Loosen the two small set screws that hold the **resistor** in place. Remove the **resistor**.

**CAUTION**

The electron multiplier horn and resistor must be removed before you put the electron multiplier in isopropanol. The isopropanol can damage the electron multiplier horn and resistor.

- 7 Place the **electron multiplier** (without the horn or **resistor**) into a beaker containing 200 mL of **LC/MS-grade isopropanol**. Make sure the **high energy dynode** is immersed.
- 8 Gently agitate the beaker by hand for 1 minute.

**CAUTION**

Do not use an ultrasonic bath. An ultrasonic bath can loosen screws or disrupt the precise alignment of electron multiplier components.

- 9 Transfer the **electron multiplier** to another beaker containing about 200 mL of **LC/MS-grade methanol**. Make sure the **high energy dynode** is immersed.
- 10 Gently agitate the beaker by hand for 1 minute. This helps to rinse off the **LC/MS-grade isopropanol**.
- 11 Remove the **electron multiplier** and allow it to dry. The methanol will dry quickly. Do not bake the **electron multiplier** or otherwise try to speed the drying process.
- 12 Reinstall the **resistor** and **electron multiplier horn**.
- 13 Reinstall the **electron multiplier** in the **vacuum manifold** and, at the same time, connect the two rigid wires to the **electron multiplier**.
- 14 Install and tighten the two screws that hold the **electron multiplier** in place. Reconnect the two braided wires to the **electron multiplier**.

**NOTE**

Record this procedure in the Maintenance Logbook.

**This page intentionally left blank.**

## 7

# Vacuum System

- To check the rough pump fluid level (Agilent MS40+) 158
- To add rough pump fluid (Agilent MS40+) 159
- To replace the rough pump fluid (Agilent MS40+) 162
- To replace the fuses 164
- To bake out the LC/MS 166

This chapter includes procedures to maintain the vacuum system of the instrument. Do these steps according to the maintenance schedule or as indicated by instrument symptoms.

## WARNING

**Always wear appropriate protection, including eye protection, lab coat, and gloves, when working with solvents and chemicals or when working with unassembled parts.**

---



Agilent Technologies

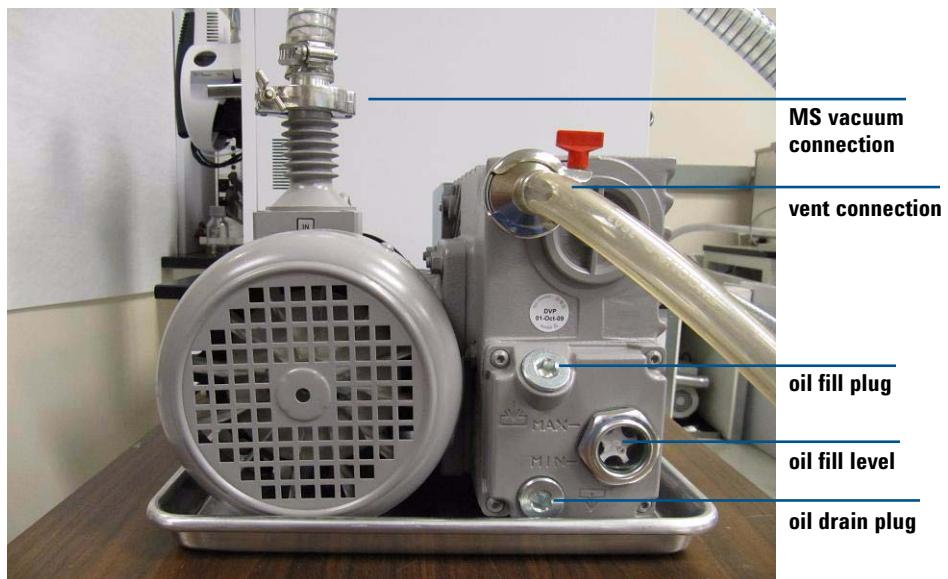
## 7 Vacuum System

To check the rough pump fluid level (Agilent MS40+)

### To check the rough pump fluid level (Agilent MS40+)

Check the level and color of the pump fluid weekly.

- Check the fluid level in the window of the rough pump. The fluid level should be between the marks for Max and Min (see [Figure 85](#)).
- Check that the color of the pump fluid is clear or almost clear with few suspended particles.
- If the pump fluid is dark or full of suspended particles, replace it.



**Figure 85** Fluid level window on the rough pump

## To add rough pump fluid (Agilent MS40+)

**When needed** Add pump fluid when the pump fluid level is low.

- Tools needed**
- funnel
  - clean chemical resistant gloves
  - 10 mm hex key

- Parts needed**
- SW60 oil

### WARNING

Wear chemical-resistant gloves and safety glasses (goggles) for your safety.

### WARNING

Never add or replace the rough pump fluid while the pump is on. Hot oil can splash out and cause harm.

### WARNING

The fill cap and pump can be dangerously hot. Do not touch the fill cup or pump until they are cool.

### CAUTION

Use only the rough pump fluid appropriate for your pump (SW60 oil for Agilent MS40+). Any other fluids can substantially reduce pump life and invalidates the pump warranty.

- 1 Put on clean chemical resistant gloves.
- 2 Vent and turn off the instrument.  
See “[To shut down the instrument](#)” on page 15.
- 3 Unplug the instrument **power cord** or cords from the electrical outlet.  
Leave the **power cord** or cords unplugged while you do this procedure.

## 7 Vacuum System

To add rough pump fluid (Agilent MS40+)

### WARNING

Some instruments use two external power cords to provide input power. Make sure you unplug the input power cord for the main power supply and the input power cord for the pump expander box (into which the two rough pumps are plugged) before you continue.

---

- 4 Remove the fill cap on the rough pump.
- 5 Add new **SW60 oil** until the fluid level is near, but not over the maximum mark beside the fluid level window (see [Figure 85](#)). Use a **funnel**.
- 6 Reinstall the fill cap.
- 7 Wipe off all excess oil around and underneath the pump.
- 8 Reconnect the **power cord** or cords.
- 9 Start up the instrument.

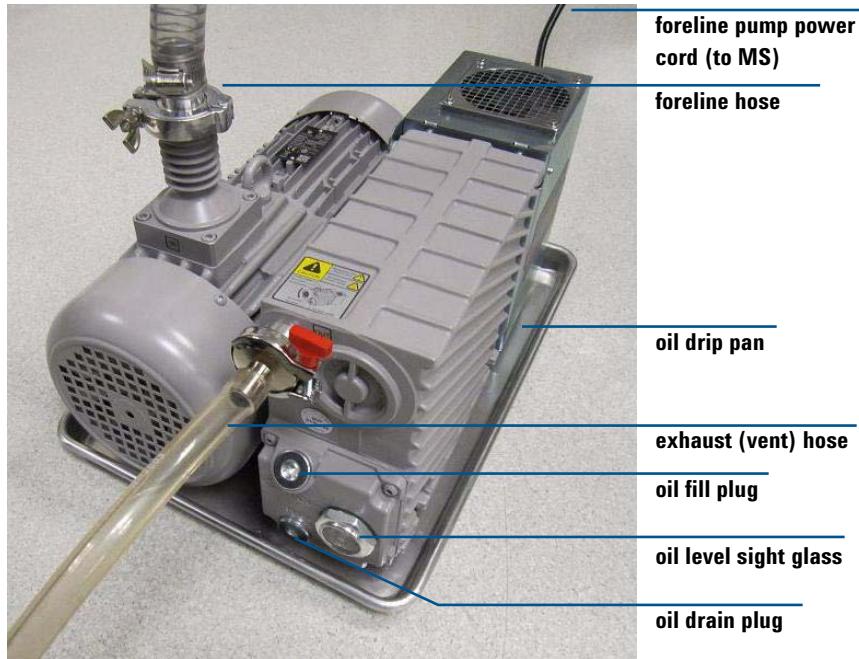
See “[To start the system in Standby mode](#)” on page 12.

### NOTE

Record this procedure in the Maintenance Logbook.

---

To add rough pump fluid (Agilent MS40+)



**Figure 86** Rough pump (Agilent MS40+).

## 7 Vacuum System

To replace the rough pump fluid (Agilent MS40+)

### To replace the rough pump fluid (Agilent MS40+)

Replace the pump fluid every six months. Replace it sooner if the fluid appears dark or cloudy.

- Tools needed**
- funnel
  - clean chemical resistant gloves
  - 10 mm hex key
  - container for catching old pump fluid
- Parts needed**
- SW60 oil

#### WARNING

**Wear chemical-resistant gloves and safety glasses (goggles) for your safety.**

#### WARNING

**Never add or replace the rough pump fluid while the pump is on. Hot oil can splash out and cause harm.**

#### WARNING

**The fill cap and pump can be dangerously hot. Do not touch the fill cup or pump until they are cool.**

#### WARNING

**Do not touch the fluid. The residue from some samples are toxic. Properly dispose of the fluid.**

#### CAUTION

Use only the rough pump fluid appropriate for your pump (SW60 oil for Agilent MS40+). Any other fluids can substantially reduce pump life and invalidates the pump warranty.

- 1 Turn off the instrument.

See “[To shut down the instrument](#)” on page 15.

- 2 Unplug the **power cord** or cords from the instrument

Leave the **power cord** or cords unplugged while performing this procedure.

**WARNING**

**Some instruments use two external power cords to provide input power. Make sure you unplug the input power cord for the main power supply and the input power cord for the pump expander box (into which the two rough pumps are plugged) before you continue.**

---

- 3** Place a container under the drain plug of the rough pump.
- 4** Remove first the fill cap (see [Figure 85](#) on page 158), and then open the drain plug.  
Allow the fluid to drain completely.
- 5** Reinstall the drain plug.
- 6** Pour in new pump fluid until the fluid level is near, but not above the maximum mark beside the fluid level window (see [Figure 85](#) on page 158).
- 7** Reinstall the fill cap.
- 8** Reconnect the **power cord** or cords.
- 9** Start up the instrument.  
See “[To start the system in Standby mode](#)” on page 12.
- 10** After 30 minutes pump down, inspect the pump for leak.  
Inspect for leak after overnight pump down.

**NOTE**

Record this procedure in the Maintenance Logbook.

---

## 7 Vacuum System

### To replace the fuses

## To replace the fuses

**When needed** As needed.

**Tools needed** • long flat-blade screwdriver

**Parts needed** • 8 Amp Fuse (2110-0969)  
• 12.5 Amp Fuse (2110-1398)

### WARNING

Never replace a fuse while the instrument is plugged into the power outlet. You run the risk of an electric shock and you will damage the instrument.

### CAUTION

If the instrument is plugged in and turned on when you change a fuse, the instrument begins to pump down immediately. If the system is not completely assembled when pump down begins, the vacuum system can be damaged.

- 1 Unplug the instrument **power cord** or cords from the power outlet.



**Figure 87** Disconnect the instrument power cable.

**WARNING**

**Some instruments use two external power cords to provide input power. Make sure you unplug the input power cord for the main power supply and the input power cord for the pump expander box (into which the two rough pumps are plugged) before you continue.**

- 2 Using a flat blade screw driver, remove the fuse holder of the blown fuse.



**Figure 88** AC Board fuses

- 3 Replace with the appropriate fuse. See “Replaceable Fuses” on page 181.
- 4 Reinstall the fuse holder.
- 5 Plug in the instrument.

For instruments with two external **power cords**, plug in both the cord for the main power supply cord and the cord for the pump expander box (to which the two rough pumps are connected).

- 6 Push the front power switch to start an automatic pump down sequence.

**NOTE**

Record this procedure in the Maintenance Logbook.

## 7 Vacuum System

### To bake out the LC/MS

## To bake out the LC/MS

**When needed** The system needs to bake out when the system is turned on for the first time or anytime system has been vented. Clean the source weekly if the daily cleaning procedure does not work.

**Tools needed** None.

**Parts needed** None

**1** In the data acquisition program, set these **Manual Tune** values:

- drying gas flow (without ion funnel) = 7 L/min
- drying gas flow (with ion funnel) = 11 L/min.
- nebulizer pressure = 40 psi.
- drying gas temperature = 300°C.
- vaporizer temperature = 250°C (when applicable).
- LC flow = 0.5 mL/minute. Use the solvent mixture appropriate for your instrument models.

**2** Make sure the position of the MS selection valve is set so that the LC flow is diverted to the **spray chamber**.

**3** Bake out the system for at least 2 hours.

### CAUTION

If the system has been exposed to humid conditions during shipping or storage, a minimum of 4 hours bake out is needed to prevent arcing of the quadrupole.

### NOTE

Record this procedure in the Maintenance Logbook.

## 8 Reference

Safety	168
Symbols on instruments	168
General instrument safety	170
Physical hazard safety	171
General chemical safety	174
Chemical waste safety	175
Conformity and Standards	176
Safety and Regulatory Certifications	176
Electromagnetic Compatibility	177
Environmental Conditions	178
Sound Emission Declaration	178
Tools and Parts	179
Tools	179
Parts and Supplies	181

This chapter contains safety information, parts lists, and other reference information for your Agilent 6000 Series LC/MS.

**WARNING**

**Always wear appropriate protection, including eye protection, lab coat, and gloves, when working with solvents and chemicals or when working with unassembled parts.**

---



Agilent Technologies

# Safety

## Symbols on instruments

### Electrical symbols

The following table describes the electrical symbols that can be displayed on the LC/MS instrument.

**Table 13** Electrical symbols

Symbol	Description
	Indicates a protected ground terminal. <i>Indique une borne de mise à la terre.</i>

### Safety symbols

The following table describes the safety symbols that can be displayed on the LC/MS instrument. Each symbol appears by itself or with text that explains the relevant hazard. These safety symbols can also appear next to DANGER, WARNING, or CAUTION.

**Table 14** Safety symbols

Symbol	Description
	The apparatus is marked with this symbol when the user should refer to the instruction manual in order to protect risk of harm to the operator and to protect the apparatus against damage. <i>Cet appareil porte ce symbole pour indiquer à l'utilisateur de consulter le manuel d'utilisation afin de se protéger contre tout danger et d'éviter d'endommager l'instrument.</i>

**Table 14** Safety symbols (continued)

Symbol	Description
	Indicates dangerous voltages. <i>Indique des tensions dangereuses.</i>
	The apparatus is marked with this symbol when hot surfaces are available and the user should not touch it when heated up. <i>L'appareil comporte ce symbole pour indiquer qu'il présente des surfaces chaudes et que l'utilisateur ne doit pas les toucher lorsqu'elles sont chaudes.</i>
	Electric discharge hazard. <i>Risque de décharge électrique</i>
	Do not discard this electrical/electronic product in domestic household waste. <i>Ne jetez pas ce produit électrique / électronique avec les ordures ménagères.</i>
	Two live circuits. Disconnect both power cords before maintenance. <i>Deux circuits sous tension. Débranchez les deux cordons d'alimentation avant l'entretien.</i>

## General instrument safety

### **WARNING**

**PHYSICAL INJURY HAZARD:** Use the LC/MS instrument only as specified in the user instructions. Using the system in a manner not specified by Agilent Technologies can result in personal injury or damage to the instrument.

---

### Moving or lifting the system

### **WARNING**

**PHYSICAL INJURY HAZARD:** The LC/MS instrument is heavy. The 6100 series LC/MS instruments require at least two people to lift the instrument. The 6200, 6400, and 6500 series LC/MS instruments require at least four people.

---

### Operating the instrument

Before you operate the instrument, make sure that you have:

- Been given instructions on general safety practices for laboratory and specific safety practices for the instrument.
- Read and understood all material safety data sheets (MSDS) for chemicals handled.

## Physical hazard safety

### Solvents

#### WARNING

**PHYSICAL INJURY HAZARD:** Always wear appropriate protection, including eye protection and gloves, when working with solvents and chemicals. Refer to the applicable MSDS for more information about the materials you are working with.

---

### Electrical safety

#### WARNING

When the LC/MS instrument is plugged into a power source, even if the power switch is off, dangerous voltages can exist:



- In the wiring between the LC/MS instrument power cord and the AC power supply.
  - The AC power supply
  - In the wiring from the AC power supply to the power switch.
- 

#### WARNING

Never remove a cover unless specifically instructed to do so. With the power switch on, potentially dangerous voltages can exist:



- On all electronics boards in the instrument.
  - In the internal wires and cables connected to these boards.
  - In the wires for any heater.
- 

#### WARNING

The printed circuit (PC) boards in the LC/MS instrument can be damaged by electrostatic discharge. Do not touch any of the boards unless absolutely necessary. If you must handle the PC boards, wear a grounded wrist strap and take other anti-static precautions. Wear a grounded wrist strap any time you must remove the LC/MS instrument covers.

---



## 8 Reference

### Physical hazard safety

#### WARNING

Severe electrical shock can result from operating the LC/MS instrument without its power cords in place.



Grounding circuit continuity is required for the safe operation of equipment.

Use properly configured and approved line cords for the voltage supply in your facility. Refer to the *Site Prep Guide* for details.

---

#### WARNING

If the power cord insulation is damaged, frayed, or worn, replace the cord. Contact your Agilent representative.



#### WARNING

Plug the LC/MS instrument AC input power cords into properly grounded receptacles with adequate current capacity. The branch circuit over-current protection Circuit Breakers protecting the building receptacles must be rated no more than 20A.



#### WARNING

Be sure that the LC/MS main supply cable is routed in such a way as to minimize the risk of a tripping hazard. Agilent Technologies recommends the use of mechanical protection, such as a rubberized cable guard on the floor to cover and protect the main supply cable.



#### WARNING

Make sure that the point at which the detachable power cords are connected to the LC/MS instrument is clear from clutter and that it is accessible at all times.



#### WARNING

Do not interrupt the protective conductor inside or outside the LC/MS system or disconnect the protective earth terminal. Such actions create a shock hazard for the operator and can damage the instrument.



**WARNING**

The use of incorrect or makeshift fuses or the short-circuiting of fuse holders creates a shock hazard for the operator and can damage the instrument. Replace fuses only with fuses of identical current rating and type. See “[Replaceable Fuses](#)” on page 181.

**WARNING**

Excessive fluctuations in the line voltage can create a shock hazard and can damage the instrument. This equipment must be installed in a Category II environment as defined in IEC 664.

For all instruments, the supply voltage must not fluctuate more than  $\pm 10\%$ .

For any instrument with an Agilent Jet Stream source, the line voltage must not fluctuate more than  $+10/-5\%$  from the rated voltage.

**Temperature safety****WARNING**

Some parts of the LC/MS instrument operate at temperatures high enough to cause serious burns. Always cool heated parts of the LC/MS down to room temperature before you work on them.

To cool the instrument faster, set the heated zone to room temperature. Turn the zone off after it has reached the set point.

If you must do maintenance work on a hot part, use a wrench and wear gloves.

## General chemical safety

### WARNING

**CHEMICAL HAZARD:** Before handling any chemicals, refer to the Material Safety Data Sheet (MSDS) provided by the manufacturer, and observe all relevant precautions.

---

To minimize the hazards of chemicals:

- Read and understand the MSDS provided by the manufacturer before you store, handle, or work with any chemicals or hazardous materials.
- Minimize contact with chemicals. Wear appropriate personal protective equipment when handling chemicals (for example, safety glasses, gloves, or protective clothing).
- Minimize the inhalation of chemicals. Do not leave chemical containers open. Use only with adequate ventilation (for example, fume hood).
- Check regularly for chemical leaks or spills. If either of those occur, follow the cleanup procedures from the manufacturer, as recommended in the MSDS.
- Comply with all local, state/provincial, or national laws and regulations related to chemical storage, handling, and disposal.

## Chemical waste safety

### CAUTION

**HAZARDOUS WASTE:** Refer to Material Safety Data Sheets and local regulations for handling and disposal.

### WARNING

**CHEMICAL WASTE HAZARD:** Wastes produced by the LC/MS System are potentially hazardous and can cause injury, illness, or death.

### WARNING

**CHEMICAL WASTE HAZARD:** The iFunnel pump, foreline pump, and source exhaust contain traces of the chemicals that you are analyzing. The exhaust products can be toxic. Vent the pump and source exhaust outside your laboratory or into a fume hood. Make sure to comply with all local environmental regulations.

To minimize the hazards of chemical waste:

- Read and understand the MSDS provided by the manufacturers of the chemicals in the waste container before you store, handle, or dispose of chemical waste.
- Provide primary and secondary waste containers. Both containers must be compatible with the waste material and meet federal, state/provincial, and local requirements for container storage.
- Minimize contact with chemicals. Wear appropriate personal protective equipment when handling chemicals (for example, safety glasses, gloves, or protective clothing).
- Minimize the inhalation of chemicals. Do not leave chemical containers open.
- Handle chemical wastes in a fume hood.
- After emptying a waste container, seal it with the cap provided.
- Dispose of the contents of the waste tray and waste bottle in accordance with good laboratory practices and local, state / provincial, or national environmental and health regulations.
- Ensure that the LC/MS instrument waste is stored, transferred, transported, and disposed of according to all local, state / provincial, and/or national regulations.

## Conformity and Standards

The Agilent 6000 Series LC/MS meets the following IEC (International Electro-technical Commission) classifications:

- Equipment Class: I (Laboratory Equipment)
- Installation Category: II
- Pollution Degree: 2

This unit has been designed and tested in accordance with recognized safety standards and is designed for use indoors. ***If the instrument is used in a manner not specified by Agilent Technologies, the protections provided by the instrument may be impaired.***

## Safety and Regulatory Certifications

The Agilent 6000 Series LC/MS conforms to the following safety standards:

- Canadian Standards Association (CSA): CAN/CSA-C22.2 No. 61010-1-04
- CSA/Nationally Recognized Test Laboratory (NRTL): UL 61010-1:2005
- International Electrotechnical Commission (IEC): 61010-1
- EuroNorm (EN): 61010-1

The Agilent 6000 Series LC/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
- Canada ICES-001 (Cet appareil ISM est conforme a la norme NMB-001 du Canada.)



The Agilent 6000 Series LC/MS is designed and manufactured under a quality system registered to ISO 9001.



## Electromagnetic Compatibility

Under CISPR11, operation of the LC/MS instrument is subject to the following two conditions:

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

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

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

Changes or modifications not expressly approved by Agilent Technologies could void the user's authority to operate the equipment.

## 8 Reference

### Sound Emission Declaration

## Sound Emission Declaration

### Sound pressure

Sound pressure L<sub>p</sub> < 70 dB according to EN 27779:1991.

### Schalldruckpegel

Schalldruckpegel LP < 70 dB nach EN 27779:1991.

## Environmental Conditions

Equipment Class	Class 1 Laboratory Equipment
Pollution Degree	2
Installation Category	II
Environment	Indoor Use
Altitude	Not to exceed 3000 m
Electrical supply	200 - 240 V AC, 50/60 Hz, maximum 2850 VA
Mains supply voltage	Fluctuations not to exceed 10% of nominal supply voltage
Operating Temperature	15 to 35°C (59 to 95°F)
Humidity	< 85% RH at 35°C

## Tools and Parts

The tools and parts used to maintain your LC/MS instrument are listed here.  
Except where noted, all part numbers are Agilent part numbers.

### Tools

Description	Part Number
1000-mL narrow mouth bottle	9301-6460
1.5-mm ball driver	8710-1570
1/4-inch × 5/16-inch open-end wrench	8710-0510
1/2-inch × 9/16-inch open-end wrench	8710-0877
1/2-inch wrench	
9/64-inch hex key	8710-2394
0.8 mm hex key	8710-1225
2 mm hex key	9810-0641
3-mm hex key, 12-cm long	8710-2411
3-mm open-end wrench	8710-2699
10 mm hex key	8710-2612
100-mL polypropylene graduated cylinder	
10-mL polypropylene graduated cylinder	
500-mL clean beaker	
2000-mL clean beaker	
4000 grit abrasive paper	8660-0827
clean gloves	8650-0030 (small) 8650-0029 (large)
clean chemical resistant gloves	9300-1751

## 8 Reference

### Tools

Description	Part Number
clean lint-free cloth	05980-60051
clean wash bottle	
cotton swab	5080-5400
cube wrench	G4240-83800
funnel	
glass CDS bottle	9300-2576
glass CDS bottle cap	9300-2575
long flat-blade screwdriver	8710-1029
long-nose pliers	7810-0004
Nebulizer Adjustment Kit	G1960-67470
T10 Torx screwdriver	8710-1623
T15 Torx screwdriver	8710-1622
T20 Torx screwdriver	8710-1615
tweezers	

## Parts and Supplies

### Replaceable Fuses

Description	Part Number
T8A 250V	2110-0969
T12.5A 250V	2110-1398

### Reagents

Description	Part Number
deionized (18 MΩ-cm) water	
HPLC Flushing Solvent	G1969-85026
LC/MS-grade acetonitrile	G2453-85060
LC/MS-grade acetone	
LC/MS-grade cyclohexane	
LC/MS-grade isoctane	
LC/MS-grade isopropanol	
LC/MS-grade methanol	8500-1867 (1 liter)
LC/MS-grade water	8500-2236 (4 liters)
reagent-grade formic acid	G2453-85060

### Common Parts

Description	Part Number
M3 screw	0515-0375
M4 captive screw	G2597-20007
T6 Torx screw	

## 8 Reference

### Parts and Supplies

#### Calibrant Delivery System

Description	Part Number
Acetonitrile UV	Burdick & Jackson catalog #015-4
APCI/APPI Calibrant	G2432A
APCI-L Tuning Mix	G1969-85010
APCI-TOF Tune Mix	G1969-85010
Biopolymer Reference Mass Kit	G1969-85003
ESI Tuning Mix	G2431A
ESI-L Tuning Mix	G1969-85000
ES-TOF Reference Mass Kit	G1969-85001
MMI-L Tuning Mix	G1969-85020
rotor seal	0100-1855
Universal Inlet Filter Replacement Kit	G1960-67100

#### Source

Description	Part Number
APCI Nebulizer Needle Kit	G2428A
APPI external power supply assembly	G1971-60024
APPI USB to serial converter cable	8121-1013
DSUB-9 extension cable	G1971-60500
corona needle	G1947-20029
Fused silica/PEEK capillary	

## Ion Transfer Capillary

Description	Part Number
Alconox Powdered Precision Cleaner	5190-1401

## Vacuum Manifold

Description	Part Number
8-mm M2×0.4 screw	0515-1046
electron multiplier replacement horn (for 6100 series)	05971-80103
high gain electron multiplier (for 6400 series)	G2571-80103
T10 Torx screw	
T20 Torx screw	
screw pin	G1946-20211
washer split lock	2190-0017
yellow wire	G1969-60804

**Vacuum System**

Description	Part Number
8 Amp Fuse	2110-0969
12.5 Amp Fuse	2110-1398
8-mm T10 Torx screw	0515-0372
beam-shaper cable	G2597-60802
beam-shaper slicer assembly	G2597-60200
cable optics assembly	G2597-60800
P-filter rod	G1969-20065
Quad holder	G2597-20006
slit cable assembly	G2597-60801
slicer body assembly	G2597-60139
slicer exit	G2597-20001
slit plate	G2597-20080
slit spacer	G2597-20005
SW60 oil	6040-1361



[www.agilent.com](http://www.agilent.com)

## In This Book

This book contains procedures to clean and maintain your Agilent 6000 Series LC/MS instrument. This book applies to all 6100 Series, 6200 Series, 6400 Series and 6500 Series LC/MS instruments.

© Agilent Technologies, Inc. 2014

Printed in USA  
Revision A, May 2014



G2581-90017



**Agilent Technologies**