

**Xcalibur**

# **Ion Trap Series**

**Hardware Manual**

120425-00HW Revision B

November 30, 2009

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**Ion Trap Series Hardware Manual, 120425-00HW, Revision B**

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The manual is clearly written.	1	2	3	4	5
The manual contains all the information I need.	1	2	3	4	5
The instructions are easy to follow.	1	2	3	4	5
The instructions are complete.	1	2	3	4	5
The technical information is easy to understand.	1	2	3	4	5
Examples of operation are clear and useful.	1	2	3	4	5
The figures are helpful.	1	2	3	4	5
I was able to operate the system using this manual.	1	2	3	4	5

**If not, please comment below.** Attach additional sheets if necessary.

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## Regulatory Compliance

Thermo Fisher Scientific performs complete testing and evaluation of its products to ensure full compliance with applicable domestic and international regulations. When the system is delivered to you, it meets all pertinent electromagnetic compatibility (EMC) and safety standards as described below.

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EMC compliance has been evaluated by Professional Testing.

- PolarisQ, ITQ, and Ion Trap Series standards: EMC EN 55011:1998 + EN 50082-1:1998, Safety EN 61010-1:1990 + A1:1992 + A2:1995
- DSQ standards: EMC EN 61326-1:1998 + A1:1998. Safety EN 61010-1:1990 + A1:1992 + A2:1995
- DSQ II standards: EMC EN 61326-1:1997 + A1:1998 + A2:2001. Safety EN 61010-1:2001
- Direct Probe Controller (DPC) standards: EMC EN 55011:1991 + EN 50082-1:1992. Safety EN 61010-1:1994

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## Preface

This guide contains instructions to operate and maintain the instrument. It is also designed to increase understanding and knowledge of the mass spectrometer assembly and theory of operations.

## About Your System

Thermo Fisher Scientific systems provide the highest caliber gas chromatography/mass spectrometry (GC/MS) instrumentation available on today's market.

GC/MS represents a combination of two powerful analytical techniques: GC, which acts as a separation technique and MS, which acts as a detection technique. Complex mixtures of individual compounds can be injected into the GC, either manually or through the use of an optional autosampler, and then separated for presentation to the MS. The MS will then generate a mass spectrum of the GC eluent and its components, which can be used for qualitative identification as well as accurate and precise quantification of the individual compounds present in the sample.

**IMPORTANT** Thermo Fisher Scientific systems are designed to optimize both the separation and detection capabilities of GC/MS techniques and combine them in a synergistic fashion to provide high performance analytical capabilities for both research and routine applications. More information on the use of this system can be found in related documentation sources and through the provided contact information.



**WARNING** Thermo Fisher Scientific systems operate safely and reliably under carefully controlled environmental conditions. If the equipment is used in manner not specified by the manufacturer, the protections provided by the equipment may be impaired. If you maintain a system outside the specifications listed in this guide, failures of many types, including personal injury or death, may occur. The repair of instrument failures caused by operation in a manner not specified by the manufacturer is specifically excluded from the Standard Warranty and service contract coverage.

## Power Ratings

### *Mass Spectrometer (MS)*

- 120 V ac +6/-10%, 50/60 Hz, 15 A max
- 230 V ac  $\pm$ 10%, 50/60 Hz, 10 A max

### Gas Chromatograph (GC)

- 120 V ac +6/-10%, 50/60 Hz, 16 A max
- 230 V ac  $\pm$ 10%, 50/60 Hz, 16 A max

Detailed instrument specifications are in the Product Specification or Product Brochure.

## Safety Alerts and Special Notices

Make sure you follow the precautionary notices presented in this guide. Safety and other special notices appear in boxes and include the following:



**WARNING** A warning safety alert is used to prevent actions that *could* cause personal injury. It highlights hazards to humans or the environment. When you see a safety alert on your instrument or in the documentation, carefully follow the safety instructions before proceeding.

**CAUTION** A cautionary safety alert is used to prevent actions that *may* cause personal injury or instrument damage. We use it to highlight information necessary to prevent personal injury or damage to software, loss of data, or invalid test results; or might contain information that is critical for optimal system performance. When you see a safety alert on your instrument or in the documentation, carefully follow the safety instructions before proceeding.

**IMPORTANT** Highlights information necessary to prevent damage to software, loss of data, or invalid test results; or might contain information that is critical for optimal performance of the system.

**Note** Emphasizes important information about a task.

**Tip** Helpful information that can make a task easier.

## Safety Symbols and Signal Words

All safety symbols are followed by **WARNING** or **CAUTION**, which indicates the degree of risk for personal injury and/or instrument damage. Cautions and warnings are following by a descriptor, such as **BURN HAZARD**. A **WARNING** is intended to prevent improper actions that *could* cause personal injury. Whereas, a **CAUTION** is intended to prevent improper actions that *may* cause personal injury and/or instrument damage. The following safety symbols may be found on your instrument and/or in this guide:



**BURN HAZARD.** This symbol indicates a hot surface that *could* or *may* cause burn injuries.



**ELECTRICAL SHOCK HAZARD.** This symbol indicates that an electrical shock *could* or *may* occur.



**FIRE HAZARD.** This symbol indicates a risk of fire or flammability, or that fire/flammability damage *could* or *may* occur.



**FLAMMABLE GAS HAZARD.** This symbol alerts you to gases that are compressed, liquefied or dissolved under pressure and can ignite on contact with an ignition source. This symbol indicates this risk *could* or *may* cause physical injury.



**GLOVES REQUIRED.** This symbol indicates that you must wear gloves when performing a task or else physical injury *could* or *may* occur.



**HAND AND CHEMICAL HAZARD.** This symbol indicates that chemical damage or physical injury *could* or *may* occur.



**INSTRUMENT DAMAGE.** This symbol indicates that damage to the instrument or module *may* occur. This damage may not be covered under the standard warranty.



**LIFTING HAZARD.** This symbol indicates two or more people are required to lift the object to prevent a physical injury that *could* or *may* occur.



**MATERIAL AND EYE HAZARD.** This symbol indicates that eye damage *could* or *may* occur.



**RADIOACTIVE.** This symbol indicates the presence of radioactive material *could* or *may* occur.



**READ MANUAL.** This symbol alerts you to carefully read your instrument's operational instructions before usage to ensure your safety and the instrument's operational ability. Failing to carefully read the instructions *could* or *may* put you at risk for a physical injury.



**TOXIC SUBSTANCES HAZARD.** This symbol indicates that exposure to a toxic substance *will*, *could*, or *may* cause personal injury or death.



This is the general warning symbol that the ISO 3864-2 standard refers to as the general warning signal to prevent personal injury. It is a triangle with an exclamation mark that precedes the **WARNING** safety alert word. In the vocabulary of ANSI Z535 signage, this symbol indicates a possible personal injury hazard exists if the instrument is improperly used or if unsafe actions occur. We use this symbol and another appropriate safety symbol to alert to an imminent or potential hazard that *could cause personal injury*.

## Contacting Us

There are several ways to contact Thermo Fisher Scientific.

### ❖ To contact Technical Support

Phone	800-532-4752
Fax	561-688-8736
E-mail	US.Techsupport.Analyzer@thermofisher.com

Find software updates and utilities to download at <http://mssupport.thermo.com>.

### ❖ To contact Customer Service for ordering information

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Web site	<a href="http://www.thermo.com/com/cda/resources/resources_detail/1,,12512,00.html">http://www.thermo.com/com/cda/resources/resources_detail/1,,12512,00.html</a>

### ❖ To suggest changes to documentation or to Instrument Help

- Fill out a reader survey online at [www.thermo.com/lcms-techpubs](http://www.thermo.com/lcms-techpubs).
- Send an e-mail message to the Technical Publications Editor at [techpubsaustin@thermofisher.com](mailto:techpubsaustin@thermofisher.com).

## Related Documentation

In addition to this guide, Thermo Scientific provides the following documents for the ITQ Series. These documents are also available on a “Print-By-Request” basis.

*Ion Trap Series Document Set, PN 120425-0ALL*

- *ITQ Preinstallation Guide*, PN 120425-00PI
- *Ion Trap Series Hardware Manual*, PN 120425-00HW
- *Ion Trap Series User’s Guide*, PN 120425-USER

*Instrument Help* is available from within the software.



# Routine Operations

This chapter describes how to use the Ion Trap Series mass spectrometer. This mass spectrometer uses ion trap technology that gives analysts, technicians, and technical directors a powerful tool for mass spectrometry and complete control when using the Xcalibur software.

## Contents

- “Installing a GC Column” on page 2
- “Removing a GC Column” on page 13
- “Starting Up” on page 14
- “Shutting Down” on page 16

## Installing a GC Column

To install a column, you will need:

- Capillary column, 5MS, 30 m, 0.25 mm i.d., 0.25  $\mu\text{m}$  (PN A0012-08143), or similar
- Column measuring tool (PN 119640-0550), optional
- Gloves, clean, lint- and powder-free
- Injector ferrule, for 0.25 mm column (PN 290 134 88)
- Leak detector (Thermo Scientific GLD Pro PN 66002-001 or equivalent)
- Lint-free tissue
- Magnifying glass
- Methanol or other suitable solvent
- Scoring wafer (or sapphire scribe) to cut capillary column
- Transfer Line ferrule, 0.4 mm i.d. (PN A0101-18100)
- Wrench, open-ended, 5/16-in.
- Wrench, two, open-ended, 7/16-in.
- Wrench, open-ended, 6 mm

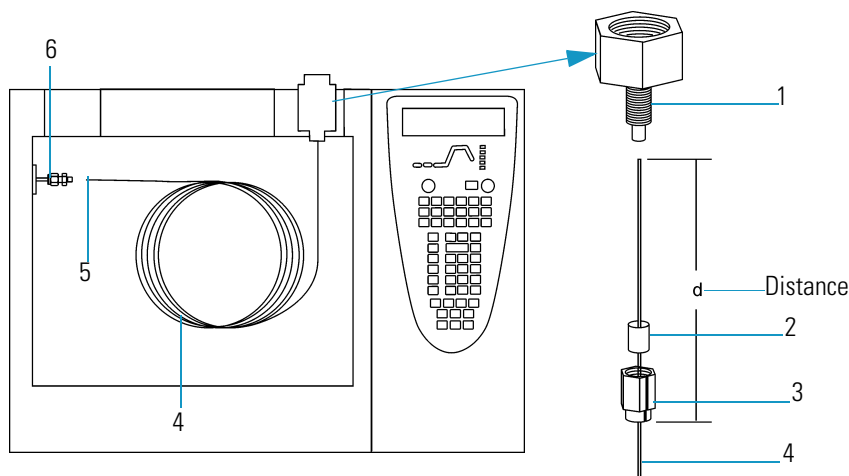
Refer to the documentation supplied with your GC for additional setup information.



**WARNING - BURN HAZARD.** The injector, oven, and transfer line may be hot. Allow them to cool to room temperature before touching them.

1. Connect the column to the injector, as shown in [Figure 1](#).

**Figure 1.** GC Injector (Front)



1	Injector	4	Column
2	Injector Ferrule	5	Column Outlet
3	Injector Nut	6	Transfer Line

**Note** Wear clean, lint- and powder-free gloves when you handle the column and injector ferrule.

- a. Unwind about half a turn of the column.
- b. Wipe about 100 mm (4 in). of the column with a tissue soaked in methanol.
- c. Insert the column through the injector nut and ferrule (open end up).

**Note** Sliding a septum on the column before the injector nut will help you measure the proper distance between the nut and the end of the column.

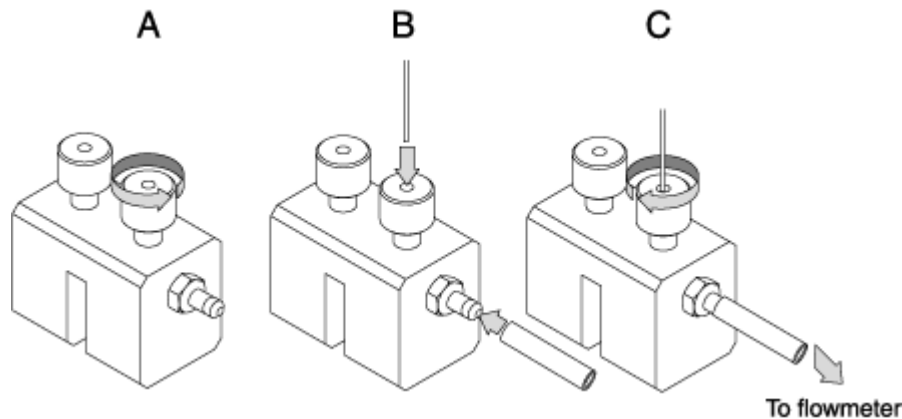
- d. Wipe the column again with a tissue soaked in methanol.
  - e. Score and then break the column about 2.5 cm (1 in). from the end with a scoring wafer. With the magnifying glass, check for an even, flat cut. Repeat if necessary.
  - f. Insert the column into the injector so that the end of the column is the proper distance from the back of the injector nut. Proper distances are as follows:  
splitless = 64 mm, split = 40 mm, PTV = 30 mm.
  - g. Tighten the injector nut by hand and then turn it an additional quarter turn with the wrench.
  - h. Turn on the gas chromatograph.
2. Set up the gas chromatograph.
    - a. Set the oven and injector temperatures to 40 °C.
    - b. Set the injector flow to 1.0 mL/min.
    - c. Turn off vacuum compensation (under the right or left carrier menu).
    - d. Dip the column outlet in a small vial of methanol. Bubbles indicate there is flow through the column.
    - e. Allow the column to purge for at least 10 minutes.
  3. Perform column characterization.
    - a. Raise the oven and injector temperatures to 50 °C and allow them to stabilize. Then confirm that the carrier gas is on.



**CAUTION - INSTRUMENT DAMAGE.** Do not allow the clear plastic component to exceed 80 °C. Otherwise, it will melt and damage the instrument.

- b. Carefully push the capillary column end into the flowmeter section of the column-flow meter connector, as shown in [Figure 2](#).

**Figure 2.** Flow Measure



- c. Connect the flowmeter to the dedicated fitting on the column flow meter connector.

**Note** The available options (Right column or Left column) will differ depending on the configuration of your GC.

- d. Press **Column Eval** to open the following menu:

COLUMN INFORMATION	
Right column	
Left column	<

**Note** Make sure the Vacuum Compensation parameter is set to OFF in the Carrier menu, which is accessed by pressing the **Left Carrier** or **Right Carrier** button. Otherwise an accurate column evaluation cannot be performed.

- e. Scroll to the Right or Left column to evaluate and press **Enter**. The following menu appears if you select the left column and use the settings below to set the physical characteristics of the column.

LEFT <sup>1</sup> COLUMN INFO	
Length (m)	15.00
ID (mm)	0.25
Film th. (um)	0.25

1. These settings could also apply to a right column.

f. Select **Pre/post column? yes (Y) or no (N)**.

- If a pre-/post-column is not present, select **N**.
- If a pre-/post-column is present, select **Y**. You must set the length and nominal internal diameter of the pre-/post-column in the same valid ranges for the column. The following two lines are added to the menu.

Pre/post column?	Y
P/p col. L	10.00
P/p col. ID	0.530

g. According to the physical characteristics of the column, the system calculates and displays the relevant Column K-factor.

LEFT <sup>1</sup> COLUMN INFO	
Column K=	(0.8087)
Calc'd ID	(0.0000)
Run Column eval?	

1. These settings could also apply to a right column.

h. To evaluate the column, scroll to **Run column eval.?** and press **ENTER**.

The system will set the Column K factor by pressurizing the column to obtain a nominal carrier flow of 5 mL/min. The display shows the pressure.

i. Using the flowmeter, measure the carrier gas flow at the outlet of the column. Scroll to **Measured Flow** and set the value of the flow.

EVALUATING L COLUMN	
Pressure	(162)
Measured Flow:	4.90
Use <STOP> to abort	

**Note** To abort column evaluation, you can press **STOP**.

j. The following message will display if the operation was successful.

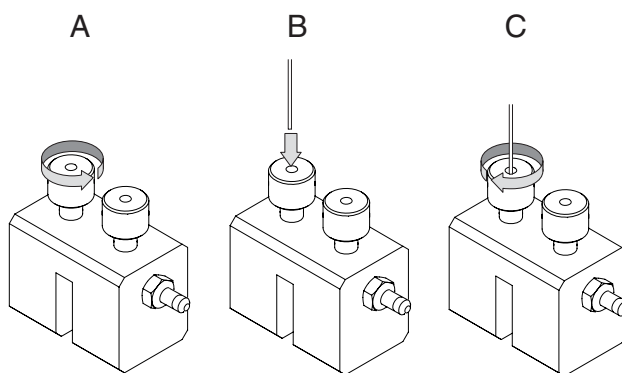
L. COL. EVALUATION
COMPLETED
Calc'd ID 0.242
K. 0.9020

- k. Expect a K-factor of about 0.7 – 0.9 for a 15 m, 0.25 mm i.d. column (1.3 – 2.0 for a 30 m, 0.25 mm i.d. column). If the column does not report a K-factor within this range or within 0.1 units of the previous stored value, check for a leak or broken column using the leak detector. The K-factor is a measured resistance for the column. A K-factor that is too low may indicate a leak in the system, while a K-factor that is too high may indicate a blockage.
4. Perform a column leak check.
- a. Carefully push the capillary column end into the column section of the column-flow meter connector, as shown in [Figure 3](#).



**CAUTION - INSTRUMENT DAMAGE.** Do not allow the clear plastic component to exceed 80 °C. Otherwise, it will melt and damage the instrument.

**Figure 3.** Leak Check



- b. Press **Leak Check** to access the **Leak Check Columns** menu.

**Note** The available options (Right column or Left column) will differ depending on the configuration of your GC.

LEAK CHECK COLUMN	
Right column	
Left column	<

1. This item appears if the relevant channel is present and configured.

- c. Scroll to a channel to open the left or right column's leak check menu.

L. COL. LEAK CHECK
Start Leak Check
Leak Check Settings

- d. Scroll to **Leak Check Settings**.

L. COL. SETT.	
Check Leak press	200
Sensitivity	5.0

- e. In the **Check at press** line, set the pressure at which the leak check will be performed. The value must be between 10 and 999 kPa (1.45 and 145 psi).
- f. In the **Sensitivity** line, set the maximum pressure drop that is allowed during the test. The value must be between 1 and 10 kPa (0.145 and 1.45 psi).
- g. Press **CLEAR** to exit the Leak Check Settings menu and return to the previous menu.

L. COL. LEAK CHECK	
Start leak check	
Leak Check settings	

- h. Select **Start leak check** to begin operation. The split and purge valves of the selected channel are automatically closed and the channel is pressurized with carrier gas to the leak check set point.

CHECKING L COLUMN	
Pressure	(200)
Elapsed time	0.90
Use <STOP> to abort	

**Note** To abort a leak check, you can press **STOP**.

- i. The system monitors the pressure for one minute. If the pressure does not drop more than the maximum allowed sensitivity value, then the leak check will pass.

R/L. LEAK CHECK
COMPLETED
SUCCESSFULLY
Leak check passed.

If the leak check did not pass, you should use the leak detector to find and fix the leaks.

**Tip** Leaks can be caused by not tightening the fitting on the clear plastic component. We recommend that you check that fitting before looking elsewhere.

- j. Repeat the column evaluation and leak check until no leaks are indicated.

5. Disconnect the column from the clear plastic component.
6. Remove the clear plastic component, including its fittings, from the oven and set it aside.
7. Condition the column before inserting it into the mass spectrometer.



**CAUTION INSTRUMENT DAMAGE.** The material released from the column during the conditioning (column bleed) will contaminate the ion source if the column is inserted into the transfer line. The ion source must then be cleaned.

- a. Raise the injector temperature to the desired temperature (normally 250 °C).
- b. Run the slow temperature program that is recommended by the manufacturer. For example, hold the column at 40 °C for 15 minutes, then ramp it to 10 °C per minute up to 10 °C above the maximum temperature at which you will operate the column (normally 300+10 °C = 310 °C). Hold the column at this temperature for two hours.



**CAUTION INSTRUMENT DAMAGE.** Never exceed the column manufacturer's maximum operating temperature.

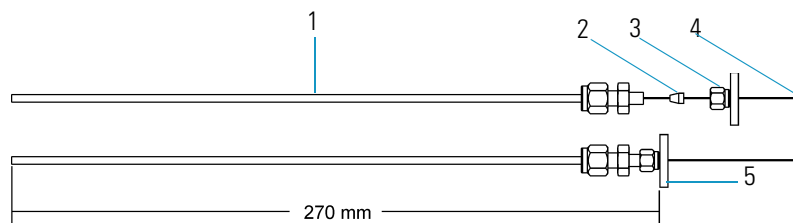
8. Connect the column to the transfer line.
  - a. Shut down and vent the mass spectrometer, as described in “Shutting Down” on page 16.
  - b. Lower the oven temperature to 40 °C and allow it to cool before continuing.



**WARNING - BURN HAZARD.** The injector, oven, and transfer line may be hot. Allow them to cool to room temperature before touching them.

- c. Unwind about one turn of the column (shown in Figure 4) from the column outlet end.

**Figure 4.** Column Measuring Tool



1	Column Measuring Tool*	4	Column
2	Transfer Line Ferrule	5	Septum
3	Transfer Line Nut		

\* The Column Measuring Tool is sold separately and can be purchased through Thermo Fisher Scientific using part number 119640-0550.



**Note** Wear clean, lint- and powder-free gloves when you handle the column and transfer line ferrule.

- d. Wipe about 300 mm (12 in). of the column with a tissue soaked in methanol.
- e. Insert the column through the septum, transfer line nut, and ferrule. Wipe the column again with a tissue soaked in methanol.

**Note** Sliding a septum on the column before the transfer line nut will help you measure the proper distance between the nut and the end of the column. The column should extend approximately 1–2 mm past the end of the transfer line.

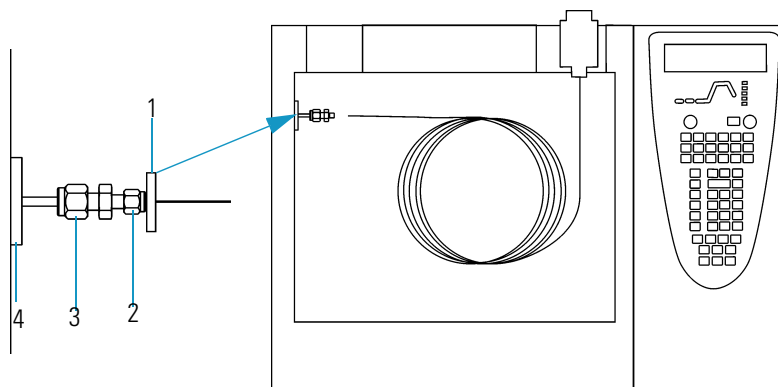
- f. Score and break the end of the column with a scoring wafer. With the magnifying glass, check for an even, flat cut. Repeat, if necessary.
- g. Insert the column into the transfer line using one of the following methods: Method One, Method Two, or Method Three.

## Method One

If you have a column measuring tool, follow these steps to insert the column:

1. Screw the transfer line nut onto the column measuring tool<sup>1</sup>.
2. Push the column past the end of the column measuring tool and score and break the end of the column with a scoring wafer. With the magnifying glass, check for an even, flat cut. Repeat if necessary.
3. Pull the column back so that it is flush with the end of the column measuring tool and tighten the transfer line nut.
4. Slide the septum up to the back of the transfer line nut.
5. Remove the column, transfer line nut and ferrule from the column measuring tool, as shown in [Figure 5](#).

**Figure 5.** Transfer Line (Front)



<sup>1</sup>Purchase the Column Measuring Tool PN 119640-0550 from Thermo Fisher Scientific.

**Figure 5.** Transfer Line (Front)

1	Septum	5	Transfer Line Union
2	Transfer Line Nut	4	Transfer Line

- a. Insert the column into the transfer line. Be careful not to move the septum.
  - b. Tighten the transfer line nut and the transfer line union.
6. Condition the transfer line ferrule. Graphite/vespel ferrules like the transfer line ferrule require conditioning to ensure a leak-tight seal.
- a. Raise the oven temperature to the maximum temperature you will operate the column (normally 300 °C).
  - b. Wait 10 minutes.
  - c. Lower the oven temperature to 40 °C and allow it to cool before continuing.



**WARNING - BURN HAZARD.** The injector, oven, and transfer line may be hot. Allow them to cool to room temperature before touching them.

- d. Re-tighten the transfer line nut and the transfer line union.
7. Set up the gas chromatograph.
- a. Make sure the column does not have any sharp bends and that it does not touch any metal objects or walls inside the oven.
  - b. Raise the oven temperature to the initial temperature you will use (normally 40 °C).
  - c. Turn on the vacuum compensation (under the right or left carrier menu).

## Method Two

If you have the optional inlet valve, follow these steps to insert the column:

**Tip** Slide a septum on the column before adding the transfer line nut to make it easier to measure the proper distance between the nut and the end of the column. You can also use a white marker to mark the position of the column and nut.

1. Remove the mass spectrometer front cover so you can get a better view of the column.
2. Using the I/R tool, remove the ion volume, as described in “[Cleaning the Ion Source Components](#)” on [page 37](#).
3. Insert the column into the transfer line and tighten the transfer line nut by hand.
4. Push the column in until you can see it through the inlet valve.
5. Pull the column back just far enough that you cannot see it.
6. Tighten the transfer line nut and transfer line union.

7. Using the I/R tool, replace the ion volume, as described in “[Cleaning the Ion Source Components](#)” on [page 37](#).
8. Condition the transfer line ferrule. Graphite/vespel ferrules like the transfer line ferrule require conditioning to ensure a leak-tight seal.
  - a. Raise the oven temperature to the maximum temperature you will operate the column (normally 300 °C).
  - b. Wait 10 minutes.
  - c. Lower the oven temperature to 40 °C and allow it to cool before continuing.



**WARNING - BURN HAZARD.** The injector, oven, and transfer line may be hot. Allow them to cool to room temperature before touching them.

- d. Re-tighten the transfer line nut and the transfer line union.
9. Set up the gas chromatograph.
  - a. Make sure the column does not have any sharp bends and that it does not touch any metal objects or walls inside the oven.
  - b. Raise the oven temperature to the initial temperature you will use (normally 40 °C).

**Note** Turn on vacuum compensation (under the Right or Left Carrier menu).

## Method Three

If you do not have an inlet valve, follow these steps to insert the column:

1. Remove the front and top covers so you can get a better view of the column.
2. Remove the vacuum manifold cover, as described in “[Removing the Vacuum Manifold Cover](#)” on [page 28](#).
3. Remove the ion source assembly, as described in “[Cleaning the Ion Source Components](#)” on [page 37](#).
4. Adjust the column so that it extends 1–2 mm past the end of the transfer line.
5. Tighten the transfer line nut and transfer line union.
6. Condition the transfer line ferrule. Graphite/vespel ferrules like the transfer line ferrule require conditioning to ensure a leak-tight seal.
  - a. Raise the oven temperature to the maximum temperature you will operate the column (normally 300 °C).
  - b. Wait 10 minutes.
  - c. Lower the oven temperature to 40 °C and allow it to cool before continuing.



**WARNING - BURN HAZARD.** The injector, oven, and transfer line may be hot. Allow them to cool to room temperature before touching them.

- d. Re-tighten the transfer line nut and the transfer line union.
7. Replace the ion source assembly, as described in “[Cleaning the Ion Source Components](#)” on [page 37](#).
8. Replace the vacuum manifold cover.
9. Replace the front and top covers.
10. Condition the transfer line ferrule. Graphite/vespel ferrules like the transfer line ferrule require conditioning to ensure a leak-tight seal.
  - a. Raise the oven temperature to the maximum temperature you will operate the column (normally 300 °C).
  - b. Wait 10 minutes.
  - c. Lower the oven temperature to 30 °C and allow it to cool before continuing.



**WARNING - BURN HAZARD.** The oven may be hot. Allow it to cool to room temperature before opening it. The injector will still be hot, so do not touch it.

- d. Re-tighten the transfer line nut and the transfer line union.
11. Set up the gas chromatograph.
  - a. Make sure the column does not have any sharp bends and that it does not touch any metal objects or walls inside the oven.
  - b. Raise the oven temperature to the initial temperature you will use (normally 40 °C).

**Note** Turn on vacuum compensation (under the Right or Left Carrier menu).

## Removing a GC Column

To remove a GC column, you will need:

- Gloves, clean, lint- and powder-free
- Wrench, open-ended, 5/16-in.
- Wrench, open-ended, 7/16-in.
- Wrench, open-ended, 6 mm

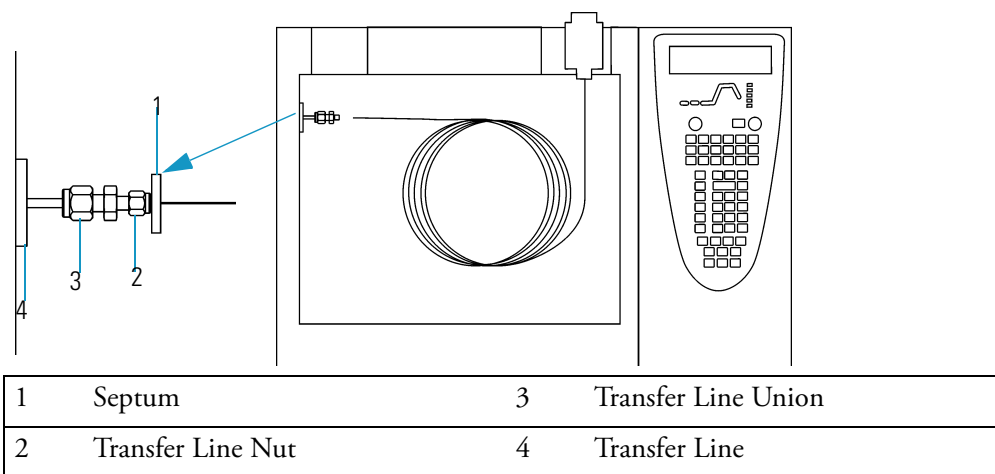
1. Shut down the mass spectrometer.
  - a. Shut down and vent the mass spectrometer, as described in “Shutting Down” on page 16.
  - b. Lower the oven, injector, and transfer line temperatures to 30 °C and allow them to cool before continuing.



**WARNING - BURN HAZARD.** The injector, oven, and transfer line may be hot. Allow them to cool to room temperature before touching them.

- c. Once the oven, injector, and transfer line are cool, turn off the gas chromatograph.
2. Remove the column from the transfer line, as shown in Figure 6.

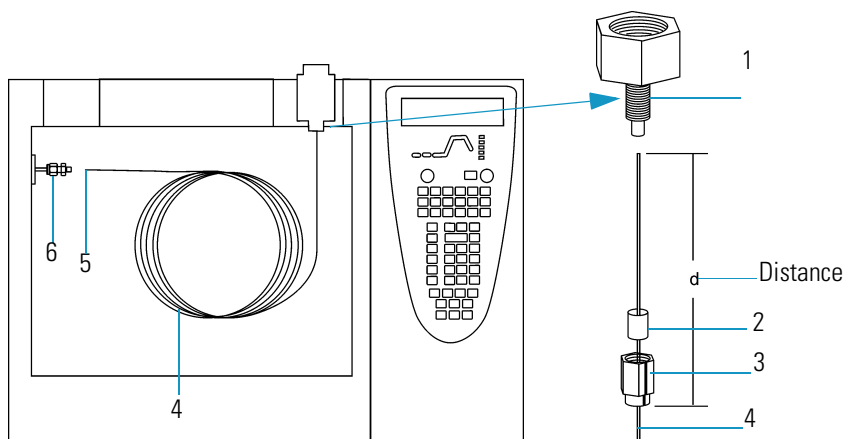
**Figure 6.** Transfer Line (Front)



- a. Unscrew the transfer line nut.
- b. Remove the column from the transfer line.

3. Remove the column from the injector, as shown in [Figure 7](#).

**Figure 7.** Injector (Front)



1	Injector	4	Column
2	Injector Ferrule	5	Column Outlet
3	Injector Nut	6	Transfer Line

- a. Unscrew the injector nut.
- b. Remove the column from the injector.

## Starting Up

1. Set up the mass spectrometer.
  - a. Install the GC column, as described in [“Installing a GC Column”](#) on [page 2](#).
  - b. Verify that the gas chromatograph is on and there is carrier gas flowing through the column into the mass spectrometer.

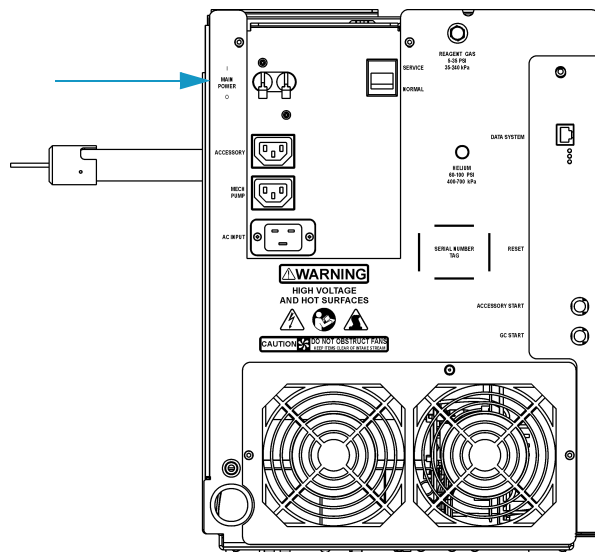


**WARNING - INSTRUMENT DAMAGE.** Damage may occur if you turn on the mass spectrometer without column flow. This forces air to be drawn through the column. This large air leak into the mass spectrometer may cause the ion source to require cleaning as well as potentially damaging the column.

- c. Plug in the mass spectrometer power cord.

2. Turn on the mass spectrometer.
  - a. Switch the main circuit breaker (shown in [Figure 8](#)) to ON (I), which causes:
    - The rotary-vane pump to power on
    - The fore pressure to reach the proper operating pressure
    - The turbomolecular pump to power on

**Figure 8.** Main Circuit Breaker (Rear)



- b. Set the transfer line to the desired operating temperature (normally 300 °C).
3. Start Xcalibur.
  - a. Check the heater status shown in the heater tab of the mass spectrometer status window. If the ion source is not set to the desired temperature (normally 200 °C), change it in Tune.
  - b. Check the vacuum status shown in the Vacuum tab of the mass spectrometer status window. Within 10 minutes of powering on the detector, vacuum should read OK. If it does not read OK, refer to [“Troubleshooting”](#) on [page 123](#).
  - c. Allow the mass spectrometer to stabilize for at least 30 minutes before running samples.

## Shutting Down

1. Cool the gas chromatograph.

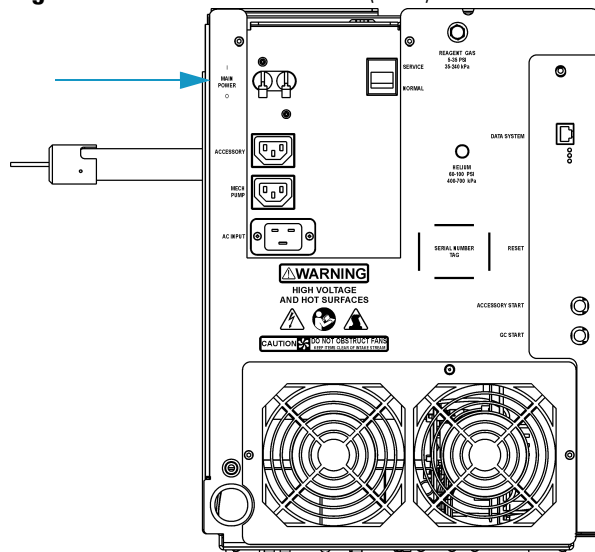
**Note** If you do not plan to change the column or perform maintenance on the gas chromatograph, you do not have to lower the injector temperature.

2. Lower the oven, injector, and transfer line temperatures to 30 °C.
3. Shut down the mass spectrometer.
  - a. From the Instrument Setup window, click Tune to display the Tune window.
  - b. Choose Instrument | Shutdown to start the automatic shutdown procedure:
    - Tune Shut Down screen displays
    - Calibration gas and CI reagent gas are turned off
    - Voltages are turned off to the ion source, ion trap, and ion detector assembly
    - Ion source heater turns off
    - Turbomolecular pump turns off
    - Tune waits ten minutes for the turbomolecular pump to slow down
    - Tune waits for the ion source to cool to < 175 °C to prevent oxidizing the hot parts when they are exposed to air
4. Wait for the transfer line to cool below < 175 °C



5. Turn off the mass spectrometer.
  - a. Look for a prompt indicating that it is safe to turn off the main power to the mass spectrometer and then click OK.
  - b. Switch the main circuit breaker (shown in [Figure 9](#)) to OFF (0), which turns off the rotary-vane pump. Approximately three seconds later, the vent valve opens and the vacuum manifold vents to atmospheric pressure. This takes approximately three to four minutes.

**Figure 9.** Main Circuit Breaker (Rear)



- c. Unplug the mass spectrometer power cord.
  - d. **STOP HERE** if you are planning to perform system maintenance on only the mass spectrometer (for example, to clean the ion source). You do not need to turn off the gas chromatograph, data system and autosampler. In this case, the shutdown procedure is complete.
6. Wait for the GC oven, injector, and transfer line to cool to room temperature.
7. Turn off all instruments.
  - a. Turn off the gas chromatograph using the GC main circuit breaker.
  - b. Turn off the GC helium supply at the tank.
  - c. Turn off the optional autosampler by using the main power On/Off switch.

## **1 Routine Operations**

### Shutting Down

# Maintenance

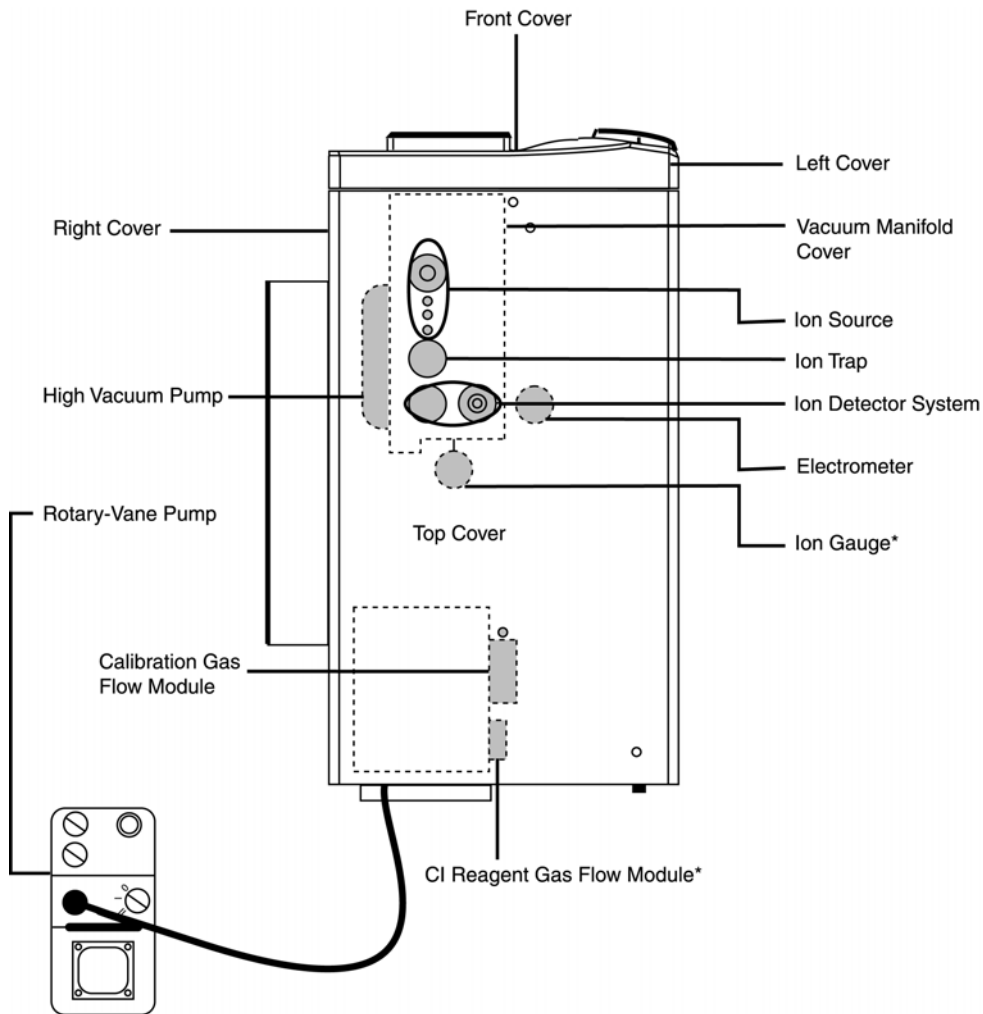
This chapter describes how to maintain the essential components of the mass spectrometer. Performing periodic maintenance increases laboratory productivity and helps you get the most out of your instrument.

## Contents

- “Main Components” on page 20
- “Recommended Maintenance Schedule” on page 21
- “Removing the Covers” on page 24
- “Removing the Vacuum Manifold Cover” on page 28
- “Assembling the Ion Source and Ion Trap” on page 30
- “Cleaning Parts” on page 32
- “Stainless Steel Parts” on page 33
- “Non-Stainless Steel or Hybrid Parts” on page 35
- “Cleaning the Ion Source Components” on page 37
- “Cleaning the Ion Trap” on page 61
- “Maintaining the Ion Detector System” on page 65
- “Maintaining a High-Vacuum Pump” on page 70
- “Maintaining a Rotary-Vane Pump” on page 71
- “Finding Components and Assemblies” on page 75

# Main Components

Figure 10. Maintenance Components (Top View)



\* Upgrade Option

## Recommended Maintenance Schedule

You can perform most maintenance yourself. For your safety, be sure to read the instructions carefully before using any procedure.

The frequency of maintenance depends on the types and amounts of sample and solvents you use. See [Table 1](#) for more information. To perform maintenance, you will need:

- Clean, dry gas
- Gloves, clean, lint- and powder-free
- Gloves, latex, impermeable
- Lint-free cloth or paper
- Nut driver, 5.5 mm
- Protective eyewear
- Screwdriver, Phillips #2
- Screwdriver, flat blade
- Wrench, adjustable
- Wrench, Allen, 2 mm, 2.5 mm, 3 mm, 4 mm, 5/32-in., 5/64-in., 1/16-in.
- Wrench, open-ended, 1/4-in., 5/16-in., 7/16-in. (2), 1/2-in., 9/16-in.
- Wrench, socket, 1/2-in.

## 2 Maintenance

### Recommended Maintenance Schedule

Table 1 contains a recommended routine maintenance schedule. Time estimates are based on running multiple samples in an 8-hour day. Adapt the schedules according to how clean your samples are and how many analyses you plan to conduct per day. Keep a record of system maintenance and performance to identify deviations from normal operation, which can be used to determine how to take corrective action.

**Table 1.** Recommended Routine Maintenance Schedule

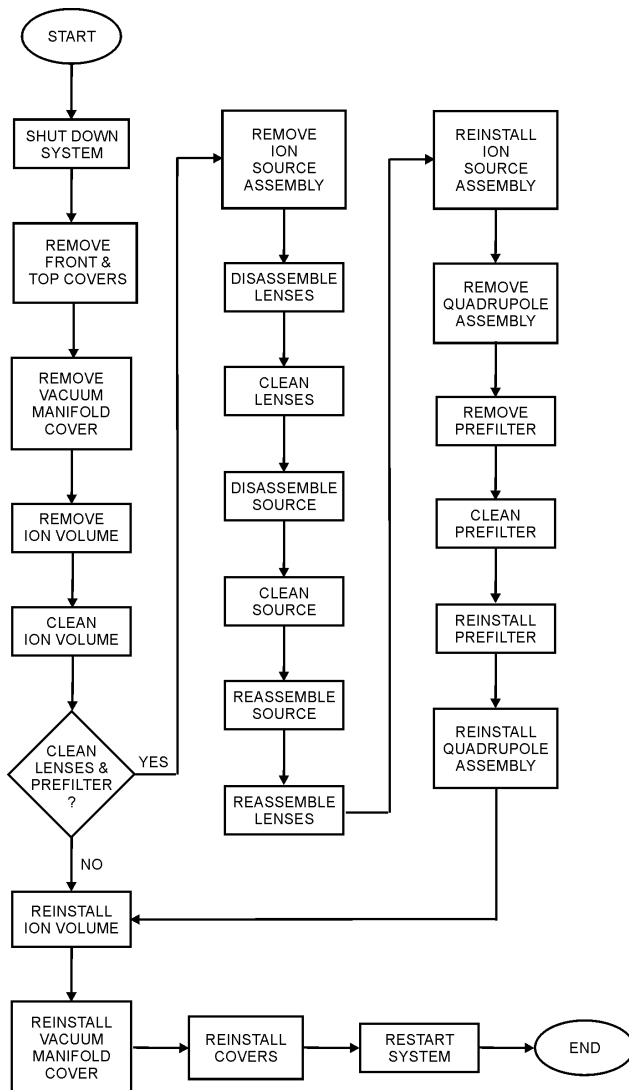
Item	1 Mth	4 Mth	1 Y	2 Y	*As needed
<b>Ion Source Components</b>					
“Cleaning the Ion Source Components” on page 37.					✓
“Cleaning the Ion Volume with an Inlet Valve” on page 38.					✓
“Cleaning the Ion Source Lenses” on page 53.					✓
“Cleaning the Ion Source” on page 56.					✓
“Replacing the Ion Source Filament” on page 59.					✓
<b>Ion Trap Components</b>					
“Cleaning the Ion Trap” on page 61.					✓
<b>Ion Detector System Components</b>					
“Cleaning the Ion Detector System” on page 66.					✓
“Cleaning or Replacing the Anode” on page 67 or “Maintaining a High-Vacuum Pump” on page 70.					✓
<b>Rotary Vane Pump</b>					
“Checking the Oil Level of a Rotary-Vane Pump” on page 71.	✓				
“Adding Oil to a Rotary-Vane Pump” on page 72		✓			
“Purging Gas from the Oil in a Rotary-Vane Pump” on page 73.**		✓			
<b>Miscellaneous</b>					
“Adding Calibration Compound” on page 85.			✓		
“Replacing the Rear Cooling Fans” on page 108.		✓			

\* *As needed* depends on how close the component is to the sample introduction point. For example, the Ion Volume is closer to the sample introduction point than any other component and requires the most frequent cleaning.

\*\* Perform every month if you use ammonia as a chemical ionization reagent gas.

Figure 11 illustrates the sequence to follow when performing routine maintenance on the mass spectrometer.

Figure 11. Sequence of Routine Maintenance (no inlet valve)



## Removing the Covers

Disassembling the mass spectrometer to access internal components requires removing the necessary covers. The covers overlap each other, so you must first remove the front cover, then the top cover, and finally the right and/or left cover. In some cases, you need only remove the cover concealing the components you wish to service.

### Removing the Front Cover

To remove the front cover:

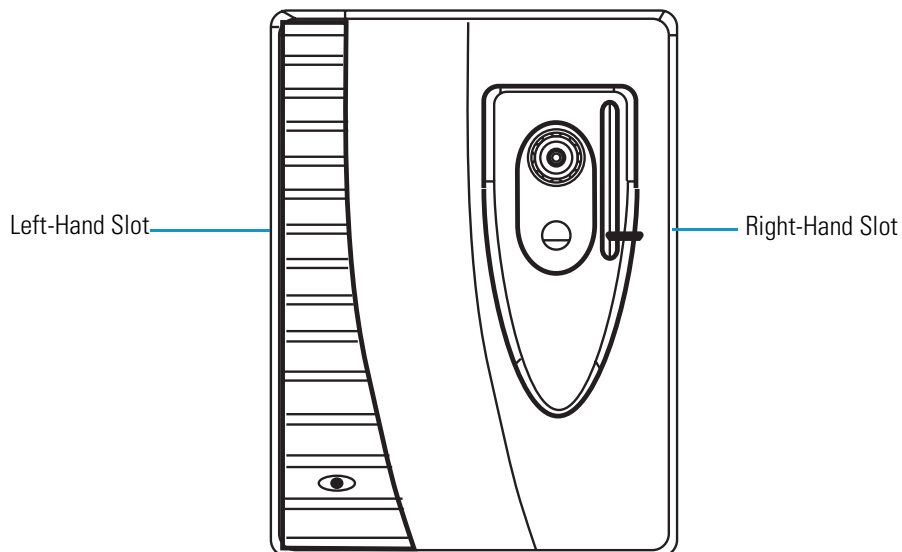
1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

2. If your system is equipped with an inlet valve, remove the inlet valve lever by pulling it free.
3. Grasp the cover by the left- and right-hand slots, as indicated in [Figure 12](#). Pull the cover toward you and it will snap out of the connectors located on the top and bottom of the mass spectrometer.

**Figure 12.** Removing the Front Cover



4. Reverse these steps to reinstall the cover.



## Removing the Top Cover

To remove the top cover, you will need a Phillips #2 screwdriver.

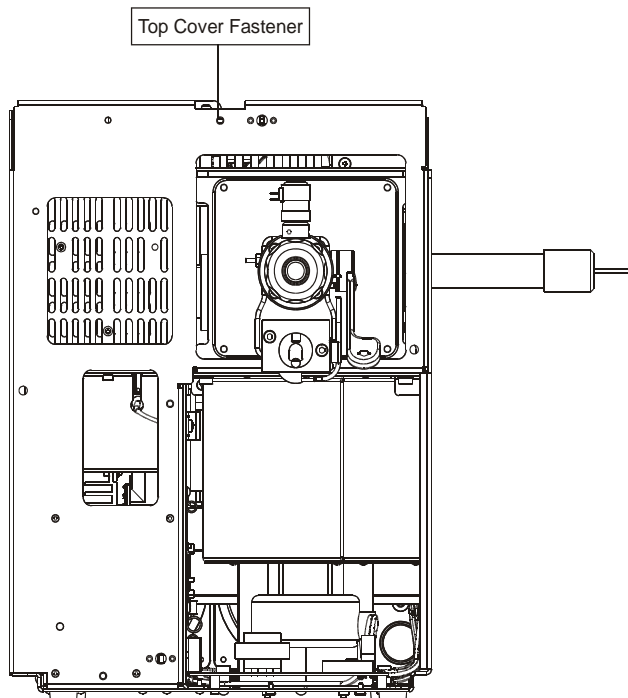
1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

2. Remove the front cover.
3. Loosen the fastener located on the front of the mass spectrometer that attaches the top cover to the chassis, as illustrated in [Figure 13](#).

**Figure 13.** Removing the Top Cover



4. Slide the top cover forward about 2.5 cm (1-inch).
5. Lift the top cover up and away from the mass spectrometer.
6. Reverse these steps to reinstall the mass spectrometer top cover.

## Removing the Right Cover

To remove the right cover, you will need a Phillips #2 screwdriver and a 2.5 mm Allen wrench.

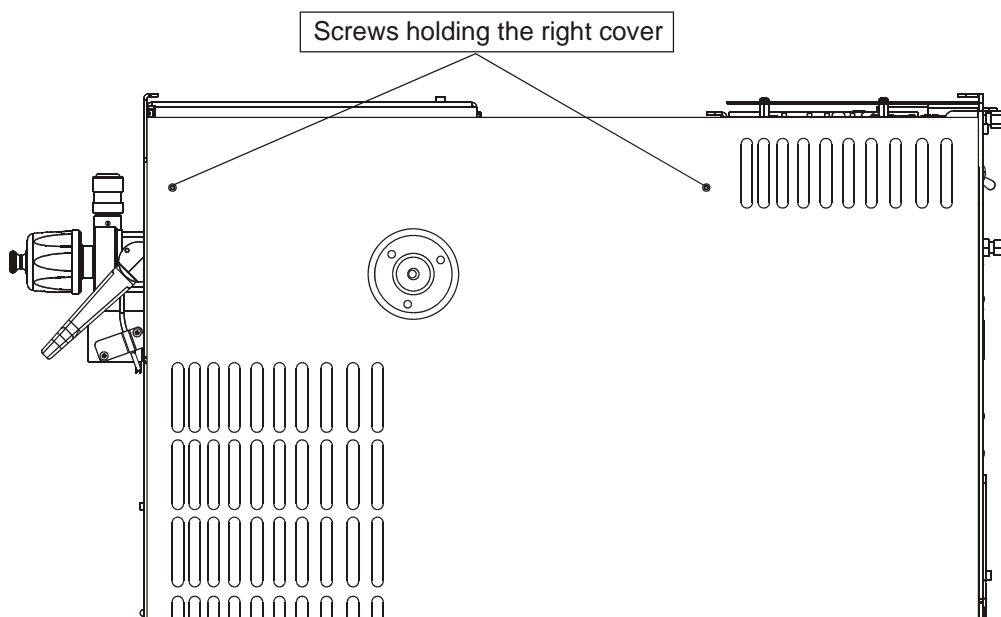
1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

2. Remove the front and top covers.
3. Remove the capillary column, as described in “[Removing a GC Column](#)” on [page 13](#).
4. Remove the two screws holding the top cover to the chassis ([Figure 14](#)).

**Figure 14.** Removing the Right Cover



5. Slide the cover towards the back and pull it away from the instrument.
6. Reverse these steps to reinstall the mass spectrometer right cover.

## Removing the Left Cover

To remove the left cover, you will need a Phillips #2 screwdriver.

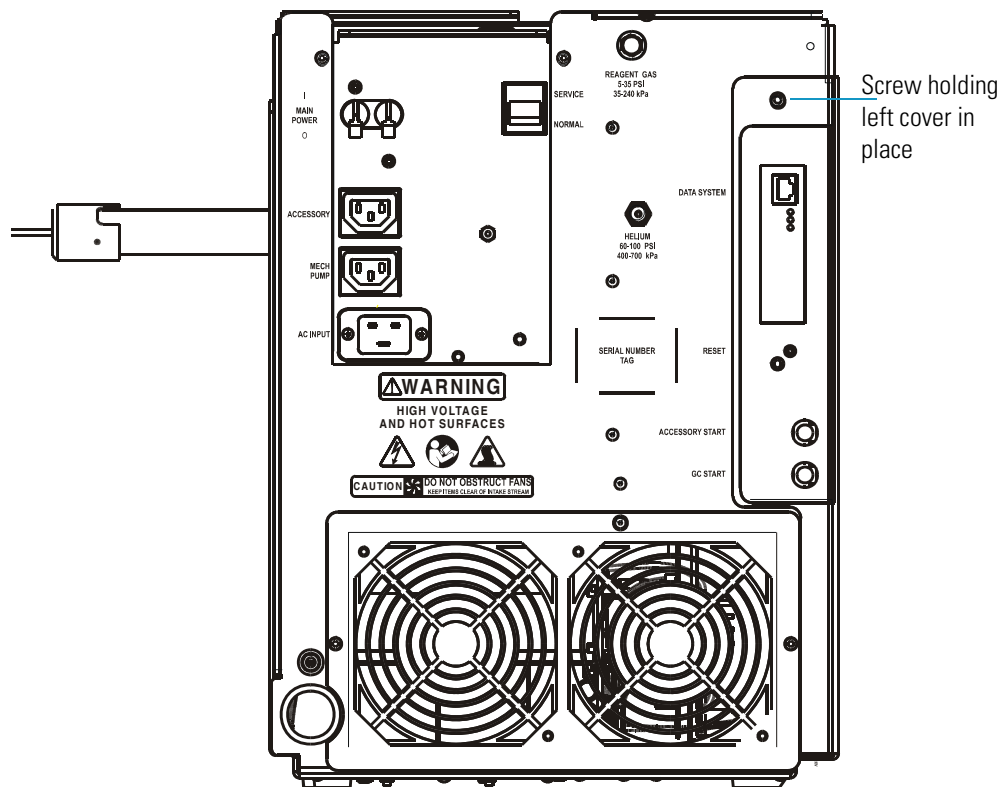
1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“Shutting Down” on page 16).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

2. Remove the front and top covers.
3. Remove the single screw located at the rear of the mass spectrometer that holds the left cover against the chassis (Figure 15).

**Figure 15.** Removing the Left Cover



- Slide the cover toward the rear of the mass spectrometer until the tabs come to the end of the grooved slots and then pull the cover away from the mass spectrometer.



**CAUTION INSTRUMENT DAMAGE.** The analog and digital PCBs are behind the left cover, so the left cover is significantly heavier than the right cover. Also, several cables connect the PCBs to other parts of the instrument. Do not pull the cover too far away from the instrument or damage to cables may occur.

- Reverse these steps to reinstall the mass spectrometer left cover.

## Removing the Vacuum Manifold Cover

Located inside the vacuum manifold are the ion source, ion trap, and ion detector system. To perform maintenance inside the vacuum manifold, you must remove the vacuum manifold cover, ion source and ion trap assembly.

To remove the vacuum manifold cover, you will need:

- Clean, dry gas
- Gloves, clean, lint- and powder-free
- Lint-free cloth
- Screwdriver, Phillips #2



**CAUTION INSTRUMENT DAMAGE.** You should always put the vacuum manifold cover back in place to prevent dust and debris from collecting in the vacuum manifold. Even small amounts of dust on the electron multiplier and conversion dynode feedthrough can cause excessive noise in the mass spectra.

- Prepare the mass spectrometer for maintenance.
  - Prepare a clean work area by covering the area with lint-free cloth.
  - Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



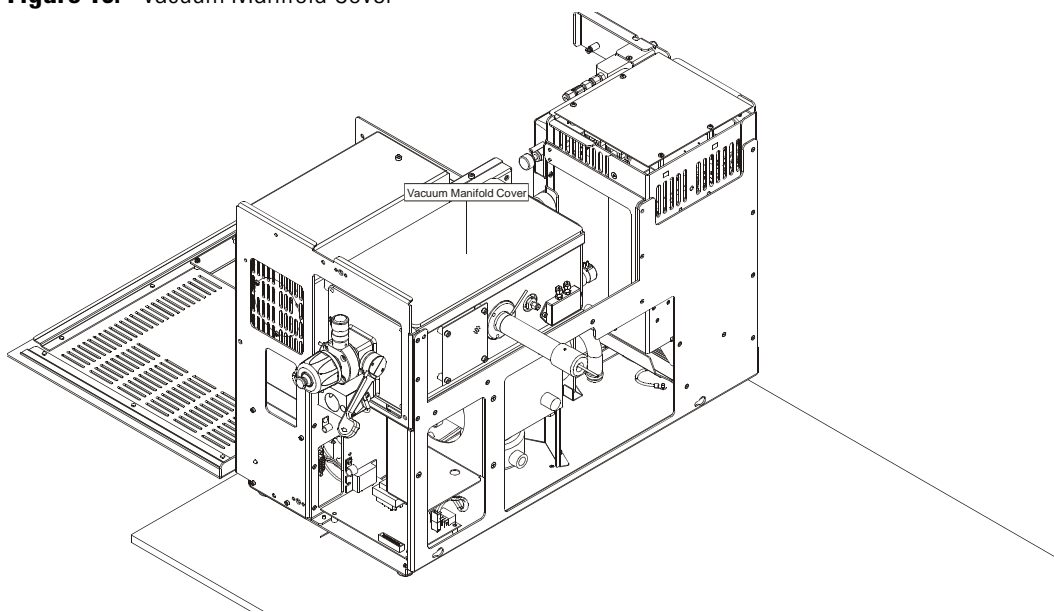
**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- Remove the front and top covers, as described in “[Removing the Covers](#)” on [page 24](#).

**Note** Completely vent the instrument to atmospheric pressure for approximately four minutes, or the cover will be difficult to remove.

- d. Remove the vacuum manifold cover (Figure 16).

**Figure 16.** Vacuum Manifold Cover



2. Reattach the vacuum manifold cover.
  - a. Check the O-ring (PN 3814-6500) for signs of wear and replace if necessary.
  - b. Verify that there are no particles on the O-ring. Wipe it off with a lint-free cloth, if necessary.
  - c. Clean the electron multiplier and ion trap with clean, dry gas. Do not use liquids to clean the ion detector System.



**CAUTION INSTRUMENT DAMAGE.** Even the smallest amount of dust or lint on the electron multiplier, or ion trap can cause spectral noise or instrument damage.

3. Replace the vacuum manifold cover.
4. Replace the covers.
5. Restart your system.

# Assembling the Ion Source and Ion Trap

This procedure contains instructions on how to assemble and disassemble the ion source and ion trap.

To disassemble/assemble the ion source and ion trap, you will need:

- Clean, dry gas
- Gloves, clean, lint- and powder-free
- Lint-free cloth
- Screwdriver, Phillips #2

1. Remove the ion source and ion trap assembly.

- a. Shut down and vent the mass spectrometer, as described in “[Shutting Down](#)” on [page 16](#).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

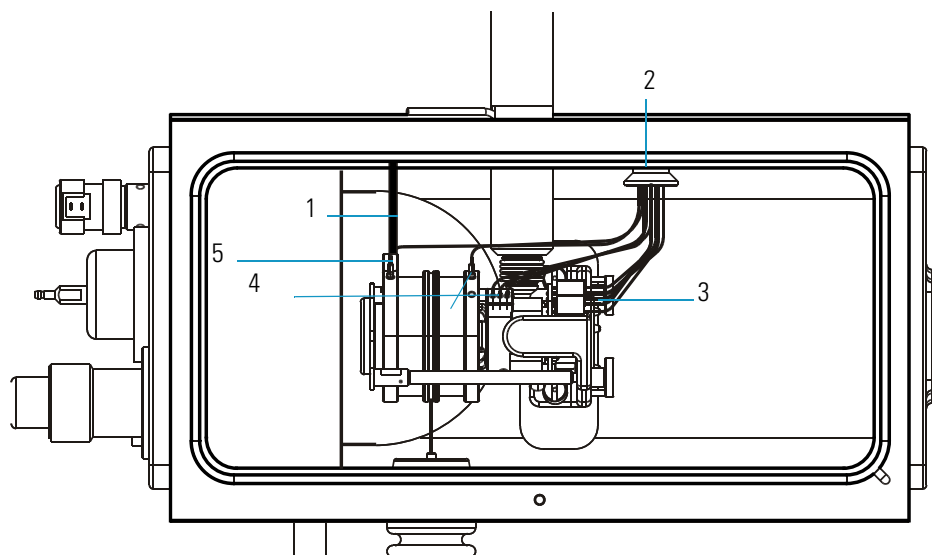
- b. Remove the front and top covers, as described in “[Removing the Covers](#)” on [page 24](#).
- c. Remove the vacuum manifold cover, as described in “[Removing the Vacuum Manifold Cover](#)” on [page 28](#).
- d. Remove the 8-pin cable from the ion source and the 3-pin lens cable. Be careful not to pull the cable by the wires.

**Note** Wear clean, lint- and powder- free gloves when you handle parts inside the vacuum manifold.

- e. Use your left hand to apply pressure to the base of the magnet yoke and slide it towards the left of the mass spectrometer. With your right hand, grasp the exit lens mounting bracket and move it left and right as you slide the magnet yoke to the left.

2. Replace the ion source and ion trap.

**Figure 17.** Ion Source and Ion Trap Assembly



1	Helium Supply Line	4	3-Pin Lens Cable
2	12-Pin Cable	5	Exit and Entrance Endcap Cables
3	8-Pin Source Cable		

- a. Loosen the two thumbscrews holding the ion source and ion trap together.
- b. Rotate the exit endcap so the helium supply is pointing directly to the right.
- c. Place the ring electrode groove over the RF Pin and make sure the pin does not scratch the spacers.
- d. Slide the ion source into its space in the vacuum manifold by applying pressure to the base of the magnet yoke with your left hand and sliding it towards the right of the mass spectrometer.
- e. Align the helium supply with the helium inlet on the exit endcap and the transfer line with the ion source.
- f. Tighten the two thumbscrews just enough so that the exit and entrance endcaps cannot be easily rotated.
- g. Connect the 12-pin cable to the right side of the vacuum manifold.



**CAUTION INSTRUMENT DAMAGE.** Overtightening the thumbscrews can cause the ion trap spacers or the ceramic lens holders to crack when the ion source is heated. The thumbscrews should only be tight enough to prevent the endcap electrodes from rotating.

## Cleaning Parts

A large part of maintaining your mass spectrometer consists of making sure that all the components are clean. Use the cleaning procedures listed in this section to clean stainless steel and non-stainless steel parts. However, use caution when doing so, as some components can be damaged by exposure to liquids.

When your mass spectrometer is clean and in good working order, perform benchmark tests and record the results. A good benchmark test is a solution of octafluoronaphthalene (OFN) for EI Systems or decafluorobenzophenone (DFBZ) for CI systems. Both are available from Thermo Fisher Scientific. When the tested performance of your system decreases significantly from your benchmark test results, clean the ion volume. If this does not restore performance, clean the lenses.

How often you clean the mass spectrometer depends on the types and amounts of samples and solvents you introduce into the system. In general, the closer a component is to the sample introduction point, the more rapidly it becomes dirty. For example, you will clean the ion volume more often than other parts. If you just want to change or clean the ion volumes and the mass spectrometer is equipped with an inlet valve, there is no need to shut down the system.

Many parts can be removed and disassembled by hand. Make sure you have all the tools needed before using each procedure. You can purchase items without part numbers at a local hardware store.

**Note** This section is not intended to relate strictly to the parts and components in this chapter. These procedures can be used to clean other stainless steel, ceramic, aluminum, and gold-plated parts within the mass spectrometer. However, use caution when doing so, as some components can be damaged when exposed to liquids.



## Stainless Steel Parts

Stainless steel parts located on your mass spectrometer require special cleaning to enhance and ensure quality performance.

To clean stainless steel parts, such as the ion volume, ion source, and lenses you will need:

- Acetone, reagent grade (or other suitable polar solvent)
- Aluminum oxide abrasive, number 600 (PN 32000-60340)
- Applicators, cotton-tipped (PN A0301-02000)
- Beaker, 450 mL
- Clean, dry gas
- De-ionized water
- Detergent (Alconox, Micro, or equivalent)
- Dremel rotary tool or equivalent (recommended)
- Foil, aluminum
- Forceps
- Gloves, clean, lint- and powder-free
- Gloves, latex, impermeable
- Glycerol, reagent grade
- Lint-free cloth
- Protective eyewear
- Tap water
- Toothbrush, soft
- Ultrasonic cleaner



**CAUTION INSTRUMENT DAMAGE.** Please do **NOT** use this procedure to clean ceramic, aluminum, or gold plated parts. Also, this procedure should not be used on the ion trap, electron multiplier, conversion dynode feedthrough, or anode feedthrough.



**WARNING - MATERIAL AND EYE HAZARD.** Wear impermeable laboratory gloves and eye protection when performing cleaning procedures.

1. Remove contamination from all the surfaces you are cleaning.
  - a. Use a slurry of number 600 aluminum oxide in glycerol and a cleaning brush or cotton-tipped applicator. Contamination usually appears as dark or discolored areas, but sometimes is not visible. The heaviest contamination is usually found around the apertures, such as the electron entrance hole on an ion volume.
  - b. Clean each part thoroughly, even if no contamination is visible.
  - c. Use the wooden end of an applicator cut at an angle to clean the inside corners.

- d. Use a Dremel® tool at its lowest speed with an applicator to increase cleaning efficiency. To prevent personal injury, be sure to keep the Dremel tool away from possible hazards, such as standing water or flammable solvents.



**WARNING - BURN HAZARD.** The Dremel tool uses an electric motor that may generate sparks. These sparks can set solvents on fire. Do not use flammable solvents with the Dremel tool.



**WARNING - ELECTRICAL SHOCK HAZARD.** The Dremel tool is an electrically powered device. Do not get the Dremel tool wet. Make sure the outlet is properly grounded and in compliance with the local electrical codes.

2. Rinse the parts with clean water. Use a clean applicator or toothbrush to remove the aluminum oxide slurry. Do not let the slurry dry on the metal; dried aluminum oxide is difficult to remove.
3. Sonicate the parts in a warm detergent solution.
  - a. Using forceps, place the parts in a beaker containing warm detergent solution.
  - b. Place the beaker and contents in an ultrasonic bath for five minutes.
  - c. Rinse the parts with tap water to remove the detergent.
4. Sonicate the parts in deionized water.
  - a. Using forceps, rinse the parts with deionized water.
  - b. Place the beaker and contents in an ultrasonic bath for five minutes.
  - c. If the water is cloudy after sonicating, pour off the water, add fresh water, and place the beaker and its contents in a ultrasonic bath again for five minutes. Repeat until the water is clear.
5. Sonicate the parts in acetone.
  - a. Using forceps, rinse the parts with acetone.
  - b. Using forceps, transfer the parts to another beaker containing fresh acetone.
  - c. Place the beaker and contents in an ultrasonic bath again for five minutes.
6. Using forceps remove and blow-dry the parts immediately. Use clean, dry gas to blow the acetone off the parts.
7. Using forceps, place the parts in a clean, dry beaker, cover the beaker with aluminum foil, and put the beaker in the GC oven.
8. Dry the parts in an oven set at 100 °C for 30 minutes.
9. Allow the parts to cool before putting them back together.

## Non-Stainless Steel or Hybrid Parts

Non-stainless steel or hybrid parts also require periodic cleaning to ensure and enhance quality performance.



**CAUTION INSTRUMENT DAMAGE.** Do **NOT** use this procedure to clean the electron multiplier, or ion trap.

To clean non-stainless or hybrid parts, such as the lens holder and spacer, filament spacer, and heater ring, you will need:

- Acetone, reagent grade (or other suitable polar solvent)
- Aluminum oxide abrasive, number 600 (PN 32000-60340)
- Applicators, cotton-tipped (PN A0301-02000)
- Beaker, 450 mL
- Clean, dry gas
- De-ionized water
- Detergent (Alconox, Micro, or equivalent)
- Dremel rotary tool or equivalent (recommended)
- Forceps
- Gloves, clean, lint- and powder-free
- Gloves, latex, impermeable
- Glycerol, reagent grade
- Lint-free cloth
- Protective eyewear
- Tap water
- Toothbrush, soft



**WARNING - MATERIAL AND EYE HAZARD.** Wear impermeable laboratory gloves and eye protection when performing cleaning procedures.

1. Remove contamination from stainless steel surfaces. It is only necessary to clean a surface that comes in contact with the ion beam.
  - a. Use a slurry of number 600 aluminum oxide in glycerol and a cleaning brush or cotton-tipped applicator. Contamination usually appears as dark or discolored areas, but sometimes is not visible.
  - b. Clean each part thoroughly, even if no contamination is visible.
  - c. Use the wooden end of an applicator cut at an angle to clean the inside corners.
  - d. Use a Dremel tool at its lowest speed with an applicator to increase cleaning efficiency. To prevent personal injury, be sure to keep the tool away from possible hazards, such as standing water or flammable solvents.



**WARNING - BURN HAZARD.** The Dremel tool uses an electric motor that may generate sparks. These sparks can set solvents on fire. Do not use flammable solvents with the Dremel tool.



**WARNING - ELECTRICAL SHOCK HAZARD.** The Dremel tool is an electrically powered device. Do not get the Dremel tool wet. Make sure the outlet is properly grounded and in compliance with the local electrical codes.

2. Rinse the parts with clean water. Use a clean applicator or toothbrush to remove the aluminum oxide slurry. Do not let the slurry dry on the metal; dried aluminum oxide is difficult to remove.
3. Scrub all of the parts with a warm detergent solution.
  - a. Scrub the parts with a toothbrush or clean applicator. Do not soak or sonicate the parts in detergent.
  - b. Using forceps, rinse the parts thoroughly with tap water to remove the detergent.



**CAUTION INSTRUMENT DAMAGE.** Do not leave aluminum parts, such as the heater ring, in the detergent. Basic solutions, like detergent, discolor aluminum.

4. Rinse the parts in deionized water. Using forceps, dip the parts in a beaker of deionized water. Change the water if it becomes cloudy. Do not soak or sonicate the parts.
5. Rinse the parts with acetone. Using forceps, dip the parts in a beaker of acetone. Change the acetone if it becomes cloudy. Do not soak or sonicate the parts.
6. Blow-dry the parts immediately. Use clean, dry gas to blow the acetone off the parts.

## Cleaning the Ion Source Components

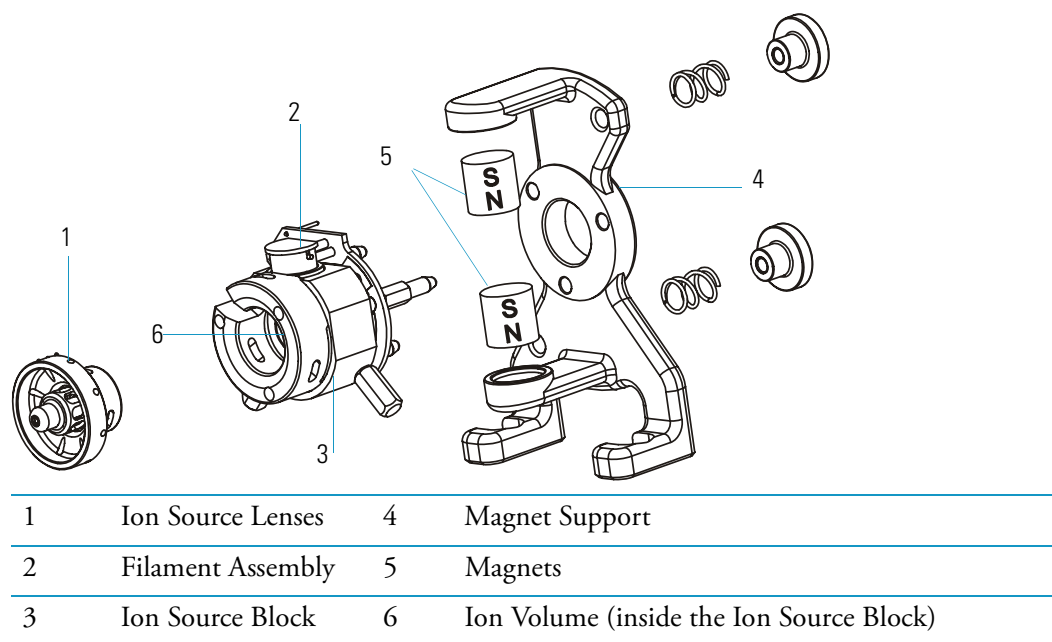
The ion source consists of an ion volume, filament, and ion source lenses. Because the ion volume is exposed directly to samples introduced into the mass spectrometer, it requires the most frequent cleaning. You can access the ion volume assembly with or without an inlet valve. If cleaning the ion volume does not restore system performance then clean the ion source lenses. If cleaning either of these components does not restore system performance, try cleaning the entire ion source.

This section contains information about:

- “Cleaning the Ion Volume with an Inlet Valve” on page 38
- “Replacing the Inlet Valve Seal” on page 46
- “Replacing the Ball Valve Seal and O-Ring” on page 48
- “Cleaning the Ion Volume without an Inlet Valve” on page 49
- “Cleaning the Ion Source Lenses” on page 53
- “Cleaning the Ion Source” on page 56
- “Replacing the Ion Source Filament” on page 59

Figure 18 illustrates the ion source.

**Figure 18.** Ion Source Components (Left View)



## Cleaning the Ion Volume with an Inlet Valve

The ion volume is where molecules interact with energetic electrons to form ions. Because the ion volume is exposed directly to samples introduced into the mass spectrometer, you will clean it more frequently than other parts. How often you clean the ion volume assembly will depend on the types and amounts of samples.

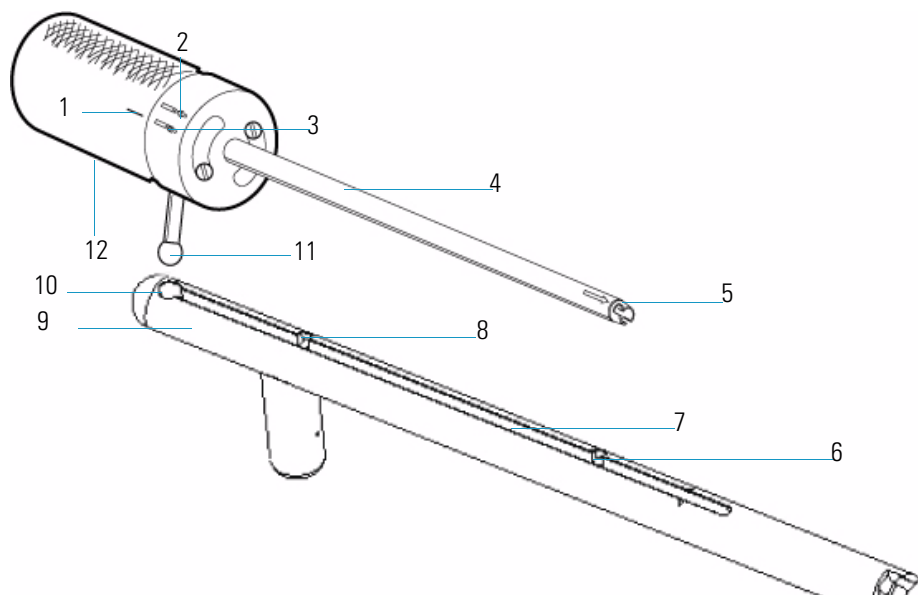
Using an I/R tool allows you to access the ion volume by entering the vacuum manifold through the inlet valve without venting the instrument.

To clean the ion volume with an inlet valve, you will need:

- Cleaning supplies for stainless steel parts
- Gloves, clean, lint- and powder-free
- Insert/Removal (I/R) Tool and Guide Bar
- Lint-free cloth

1. In Xcalibur, open the Insert/Remove Probe window.
  - a. From the Xcalibur home page, click mass spectrometer from the Status tab.
  - b. Click **Insert/Remove Probe** in the mass spectrometer Status tab.

**Figure 19.** I/R Tool and Guide Bar

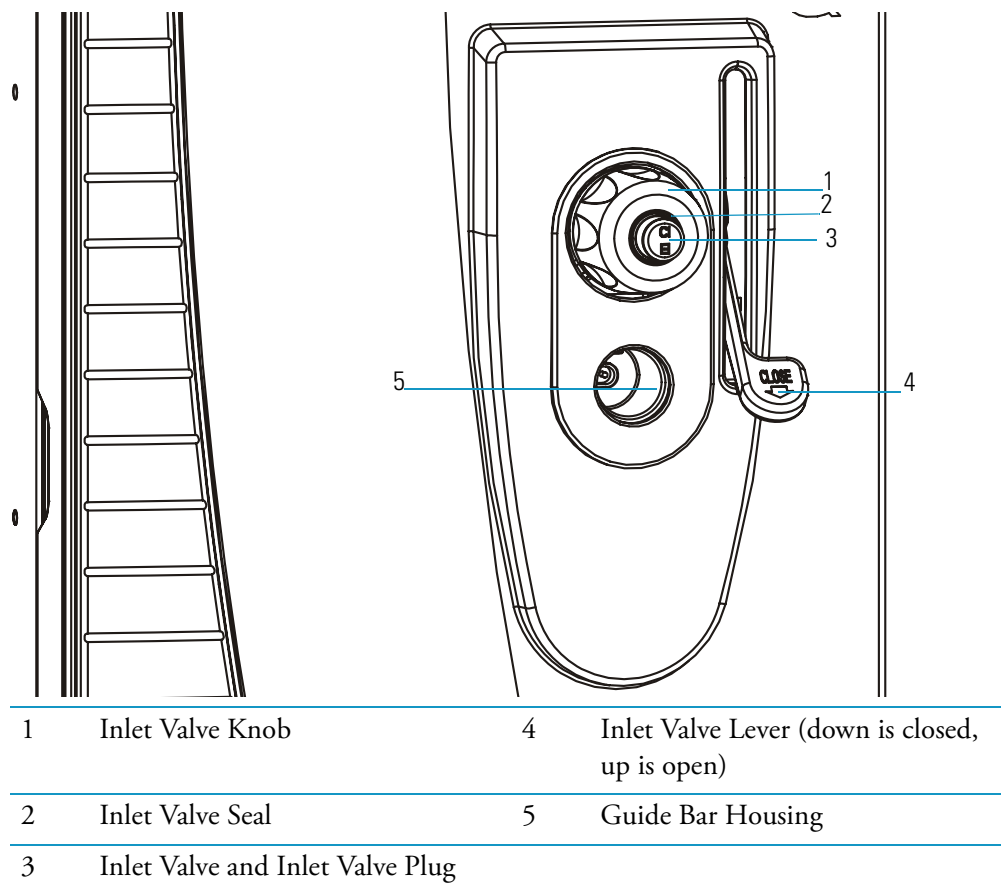


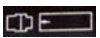
1	Alignment Line	7	Guide Bar Track
2	Lock Position	8	First Stop
3	Unlock Position	9	Guide Bar
4	I/R Tool	10	Guide Ball Hole
5	Bayonet Lock	11	Guide Ball
6	Second Stop	12	Handle

2. Prepare the inlet valve and I/R tool for insertion.

Make sure the inlet valve is closed (inlet valve lever is down, as shown in [Figure 20](#)) and remove the inlet valve plug. The inlet valve plug prevents air from entering the vacuum manifold in case the inlet valve is inadvertently opened.

**Figure 20.** Inlet Valve Components



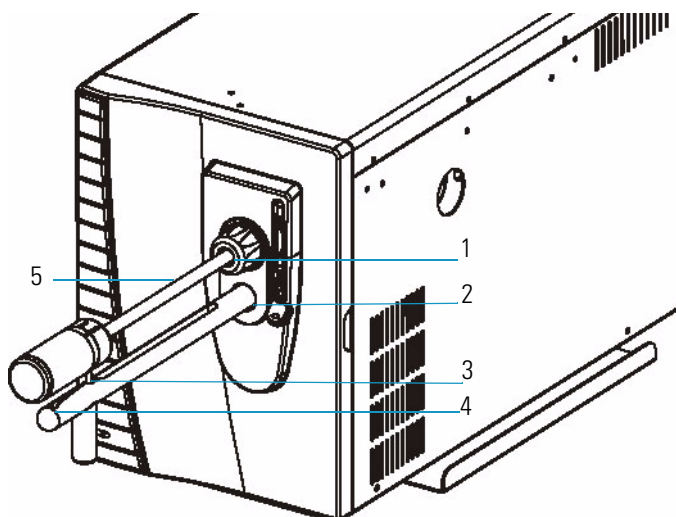
3. Turn the I/R tool to the unlock position , which indicates the I/R tool is in position to accept the ion volume.
4. Insert the I/R tool and evacuate the inlet valve.
  - a. Insert the guide bar into the guide bar opening. With the guide ball track facing left, insert the guide bar into the entry housing, which is shown in [Figure 19](#). Push the guide bar in as far as it will go, then rotate it 90-degrees counter-clockwise to lock the guide bar in position.

## 2 Maintenance

### Cleaning the Ion Source Components

- b. Insert the guide ball into the guide ball hole. Slide the I/R tool forward in the guide bar track until the guide ball is at the guide bar's first stop, which is shown in Figure 21.

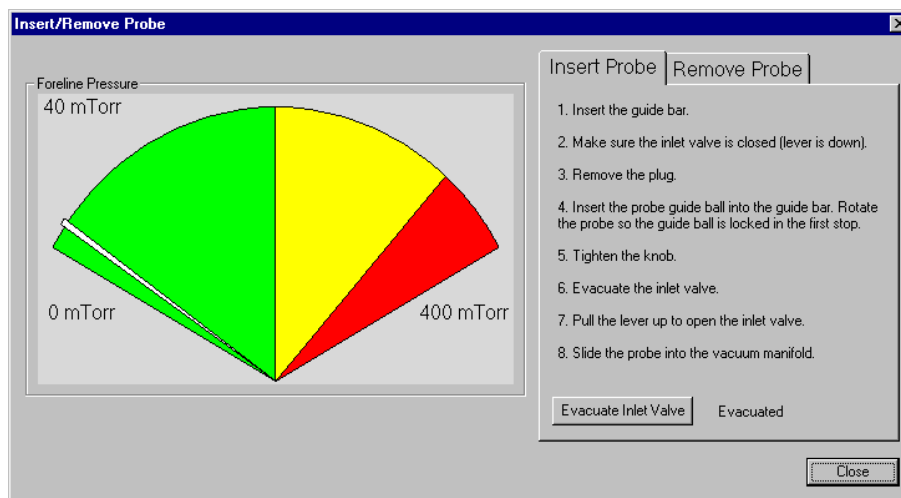
**Figure 21.** I/R Tool at Guide Bar First Stop



1	Inlet Valve Opening	4	Guide Bar
2	Guide Bar Housing	5	I/R Tool
3	Second Stop		

- c. Turn the I/R tool so the guide ball is in the groove at the first stop. This prevents the probe from being pulled forward when the inlet valve is evacuated.
- d. Tighten the inlet valve knob to ensure a leak-tight seal.
- e. In Xcalibur's Insert/Remove Probe window, click the Evacuate Inlet Valve button.

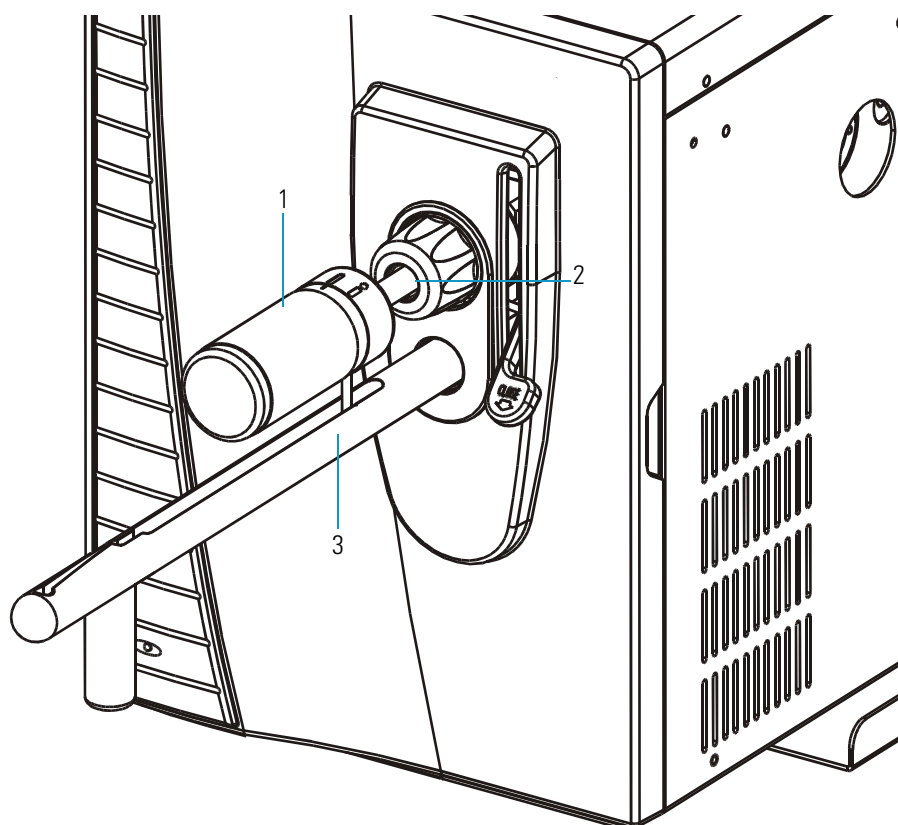
**Figure 22.** Insert/Remove Probe Window






- f. Monitor the foreline pressure while evacuating the inlet valve. The pressure should not remain beyond 350 mTorr. If this occurs, the inlet valve seal must be replaced, as described in “To replace the inlet valve seal, you will need:” on page 46.
  - g. Once evacuation is complete, pull the inlet valve lever up to open the inlet valve.
5. Remove the ion volume.
    - a. Slide the I/R tool into the vacuum manifold until the tip of the I/R tool is fully inserted into the ion volume holder, as shown in Figure 23. The guide ball will be slightly beyond the second stop on the guide bar.

**Figure 23.** I/R Tool Inserted into the Inlet Valve



1	I/R Tool	3	Guide Bar
2	Inlet Valve Opening		

- b. Turn the I/R tool handle counterclockwise to put the I/R tool into lock position . Listen for a click indicating the handle is fully engaged in the lock position and is holding the ion volume.
- c. Withdraw the I/R tool (the ion volume is attached) until the guide ball reaches the first stop (see Figure 21).

## 2 Maintenance

### Cleaning the Ion Source Components

- d. Close the inlet valve by pulling the lever down.



**CAUTION INSTRUMENT DAMAGE.** Do not withdraw the I/R tool beyond the point where the guide ball reaches the first stop in the guide bar until the inlet valve is closed. Otherwise, the system vents to the atmosphere, and cleaning may be required.

- e. Loosen the inlet valve knob.
- f. Continue withdrawing the I/R tool completely from the inlet valve by sliding the I/R tool through the guide ball track in the guide bar.

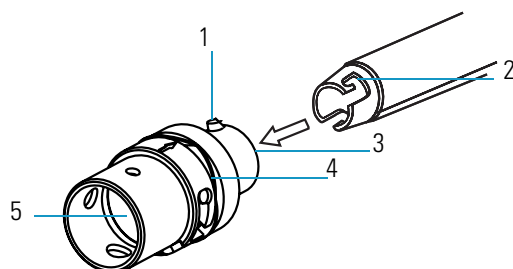


**WARNING - BURN HAZARD.** The ion volume may be too hot to touch. Let it cool to room temperature before handling it.

6. Clean the ion volume.

- a. Remove the ion volume from the I/R tool. Using clean gloves, press the ion volume forward into the tip of the I/R tool and rotate it to disconnect the bayonet pins from the pin guides. Pull the ion volume out of the I/R tool, as illustrated in [Figure 24](#).

**Figure 24.** I/R Tool Inserted into the Inlet Valve

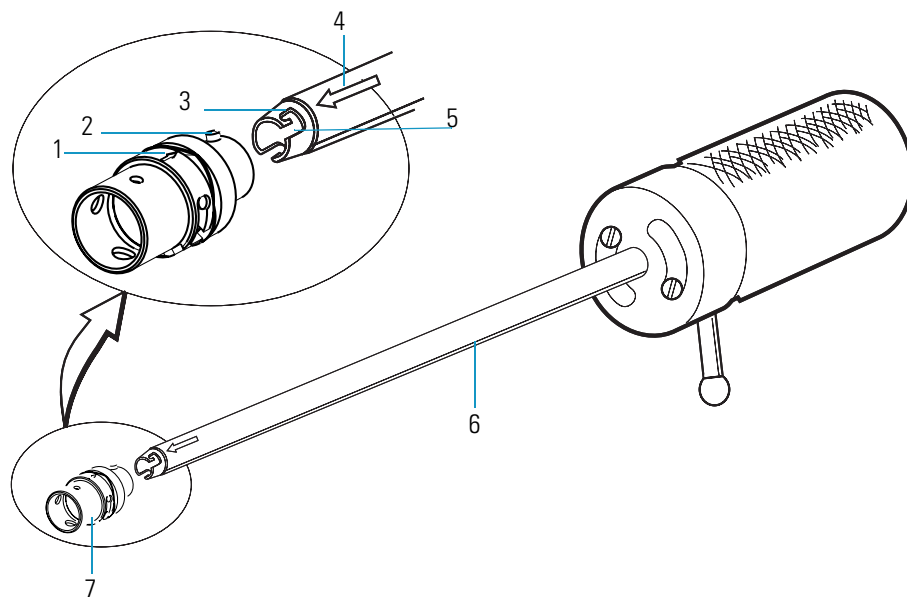


1	Bayonet Pin	4	Spring Washer
2	Bayonet Pin Guide	5	Ion Volume
3	Ion Volume Holder		

- b. Clean the ion volume by using the instructions in [“Stainless Steel Parts”](#) on [page 33](#). If you are cleaning a CI ion volume, be sure to clean out the small electron entrance hole. Aluminum oxide can get trapped in this hole, which can adversely affect sensitivity. Use a dental pick or old syringe needle to clean the hole.


7. Place the clean ion volume on the I/R tool.
  - a. Place the ion volume into the bayonet lock located on the I/R tool. Make sure the alignment arrows on the ion volume and I/R tool are facing each other.

**Figure 25.** Placing the Ion Volume on the I/R Tool



1	Ion Volume Alignment Arrow	5	Bayonet Guide
2	Bayonet Pin	6	I/R Tool
3	Bayonet Lock	7	Ion Volume
4	I/R Tool Alignment Arrow		

**Note** Wear clean, lint- and powder- free gloves when you handle parts inside the vacuum manifold.

- b. Turn the I/R tool handle to the lock position .



**CAUTION INSTRUMENT DAMAGE.** The arrows on the I/R tool and ion volume must be aligned to avoid damage to the ion source.

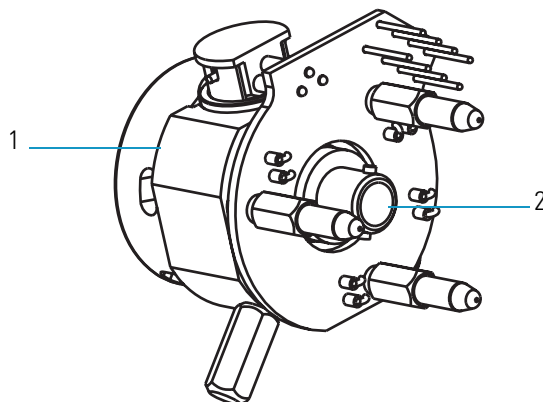
8. Insert the I/R tool and evacuate the inlet valve.
  - a. Insert the guide ball into the guide ball hole and slide the I/R tool forward in the guide bar track until the guide ball is at the guide bar's first stop (see [Figure 21](#)).
  - b. Turn the I/R tool so the guide ball is in the groove at the first stop. This prevents the probe from being pulled forward when the inlet valve is evacuated.
  - c. Tighten the inlet valve knob to ensure a leak-tight seal.
  - d. In Xcalibur's Insert/Remove Probe window, select Evacuate Inlet Valve.

## 2 Maintenance


### Cleaning the Ion Source Components

- e. Monitor the foreline pressure while evacuating the inlet valve. The pressure should not remain beyond 350 mTorr. If this occurs, the inlet valve seal must be replaced, as described in “To replace the inlet valve seal, you will need:” on page 46.
- f. Once evacuation is complete, pull the inlet valve lever up to open the inlet valve.

**Figure 26.** Ion Volume Connected to the Ion Source Block



1	Ion Source Block	2	Ion Volume
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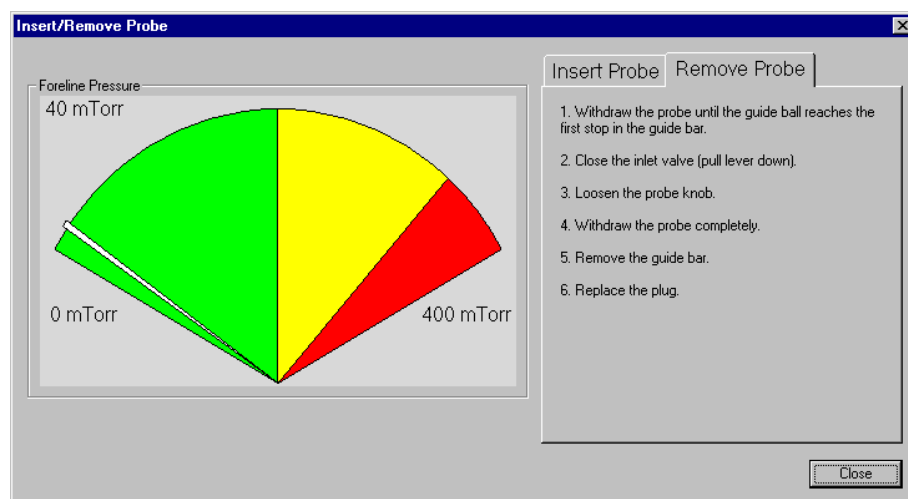
9. Reinsert the ion volume.
  - a. Slide the I/R tool into the vacuum manifold.
  - b. Listen for a click indicating that the ion volume has connected with the ion source block. The guide ball will be slightly beyond the second stop on the guide bar.
  - c. Turn the I/R tool handle to the unlock position .
  - d. Verify that the ion volume is fully seated in the ion source block:
    - Withdraw the I/R tool away from the ion volume about 2.5 cm (1 in). and turn the I/R tool handle to the lock position.
    - Slide the I/R tool back into the vacuum manifold until the end of the I/R tool just touches the ion volume.
    - If the I/R tool does not go back to the second stop on the guide bar completely, the ion volume is seated properly.
  - e. Withdraw the I/R tool until the guide ball reaches the first stop.
  - f. Close the inlet valve by pulling the lever down.



**CAUTION INSTRUMENT DAMAGE.** Do not withdraw the I/R tool beyond the point where the guide ball reaches the first stop in the guide bar until the inlet valve is closed. Otherwise, the system vents to the atmosphere and cleaning may be required.

- g. Loosen the inlet valve knob.
  - h. Continue withdrawing the I/R tool completely from the inlet valve by sliding the I/R tool through the guide ball track in the guide bar.
10. Remove the I/R tool and guide bar from the vacuum manifold.
- a. Remove the guide bar by rotating it 90-degrees counter-clockwise and sliding it out of the entry housing.
  - b. Replace the inlet valve plug.
  - c. In Xcalibur's Insert/Remove Probe window, click the Close button.

**Figure 27.** Insert/Remove Probe Window



## 2 Maintenance

Cleaning the Ion Source Components

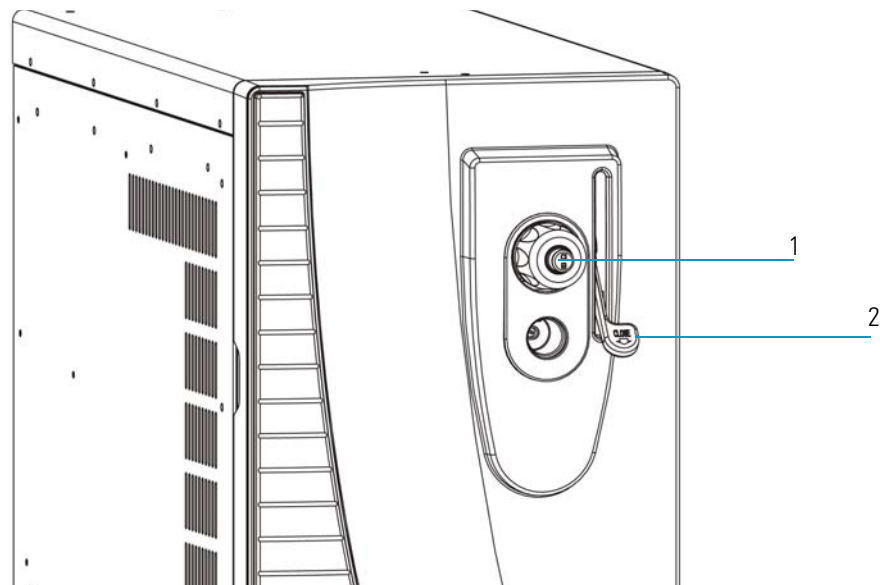
### Replacing the Inlet Valve Seal

To replace the inlet valve seal, you will need:

- Lint-free cloth
- Screwdriver, Phillips #2
- Wrench, open-ended, 5/16-in.
- Wrench, Allen, 4 mm

1. Close the inlet valve by pulling the inlet valve lever down, as shown in [Figure 28](#).

**Figure 28.** Inlet Valve Seal

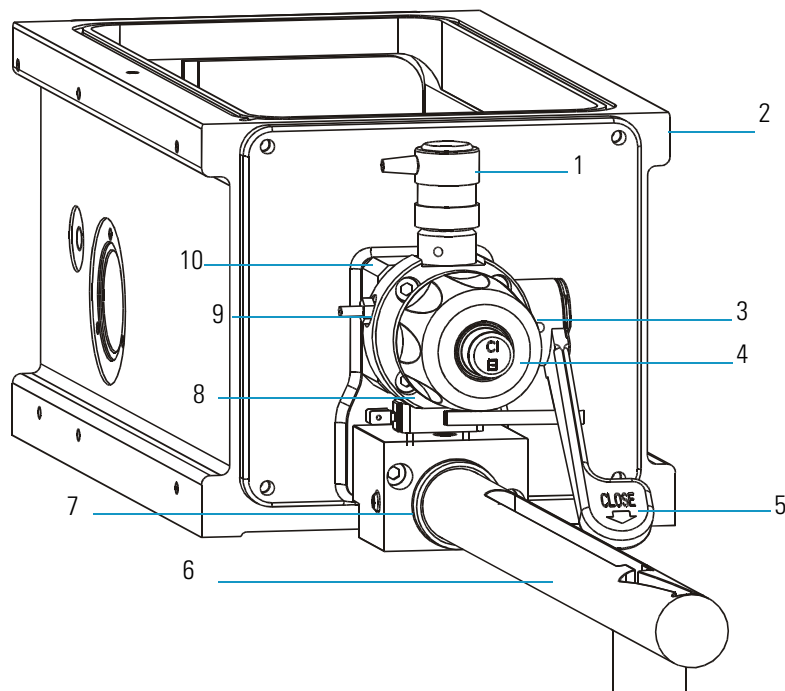


1 Inlet Valve Seal

2 Inlet Valve Lever

2. Remove the inlet valve plug and knob, which are shown in [Figure 29](#).

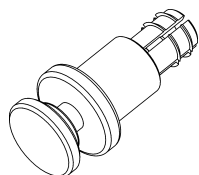
**Figure 29.** Inlet Valve Components (I/R Tool Not Shown)



1	Inlet Valve Solenoid	6	Guide Bar
2	Vacuum Manifold	7	Guide Bar Housing
3	Inlet Valve Knob	8	Inlet Valve Block
4	Inlet Valve Plug	9	Foreline Hose Connection
5	Ball Valve Lever	10	Ball Valve Housing

3. Remove the metal ferrule, which is located behind the inlet knob. Pay careful attention to the way the ferrule is in the inlet. Do not put the ferrule on backwards.
4. Remove the existing inlet valve seal.
  - a. Insert the inlet valve removal tool ([Figure 30](#)) into the inlet valve.

**Figure 30.** Inlet Valve Seal Removal Tool (PN 119283-0001)



- b. Press the button on the tool to engage the seal.
- c. Pull out the seal and discard it.

5. Replace the inlet valve seal with a new one.



**CAUTION INSTRUMENT DAMAGE.** Do not scratch the surface of the seal. Only use the supplied tool when placing a new seal in the inlet valve.

6. Put the ferrule, knob and plug back into the inlet valve opening.

## Replacing the Ball Valve Seal and O-Ring

To replace the ball valve seal and O-ring, you will need:

- Ball Valve, complete (PN A0101-02530)
- Inlet Valve Seal Kit (PN 119265-0003)
- Lint-free cloth
- Replacement Ball Valve O-ring and Seal Kit (PN 76461-2002)
- Screwdriver, Phillips #2
- Wrench, open-ended, 5/16-in.
- Wrench, Allen, 4 mm

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer, as described in “[Shutting Down](#)” on [page 16](#).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front and top covers, as described in “[Removing the Covers](#)” on [page 24](#).
2. Remove the inlet valve.
    - a. Remove the inlet valve plug, knob, and ferrule ([Figure 29](#)).
    - b. Disconnect the foreline hose connection from the inlet valve.
    - c. Disconnect the inlet valve solenoid from the vacuum control PCB.
    - d. Remove the four hex-socket screws that hold the Inlet valve entry housing to the vacuum manifold.
    - e. Remove the inlet valve from the vacuum manifold and place it on a clean surface.



3. Replace the inlet valve.
  - a. Insert the new inlet valve into the vacuum manifold.
  - b. Verify that the entry housing, ball valve, and O-ring are intact. Check the O-ring for wear and replace it if necessary.
  - c. Use the four hex-socket screws to reattach the entry housing to the vacuum manifold.
  - d. Reconnect the foreline hose connection to the inlet valve.
  - e. Reconnect the inlet valve solenoid to the vacuum control PCB.
4. Restore the mass spectrometer for operation.
  - a. Replace the covers.
  - b. Restart the system.

## Cleaning the Ion Volume without an Inlet Valve

To clean the ion volume without an inlet valve, you will need:

- Cleaning supplies for stainless steel parts
- Gloves, clean, lint- and powder-free
- Ion Volume Tool (PN 119270-0001)
- Lint-free cloth
- Screwdriver, Phillips #2

The ion volume is where molecules interact with energetic electrons to form ions. Because the ion volume is exposed directly to samples introduced into the mass spectrometer, you need to clean it more frequently than other components. How often you clean the ion volume depends on the types and amounts of samples you use with the mass spectrometer.

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. )Remove the front and top covers, as described in “[Removing the Covers](#)” on [page 24](#).
- d. Remove the vacuum manifold cover, as described in “[Removing the Vacuum Manifold Cover](#)” on [page 28](#).

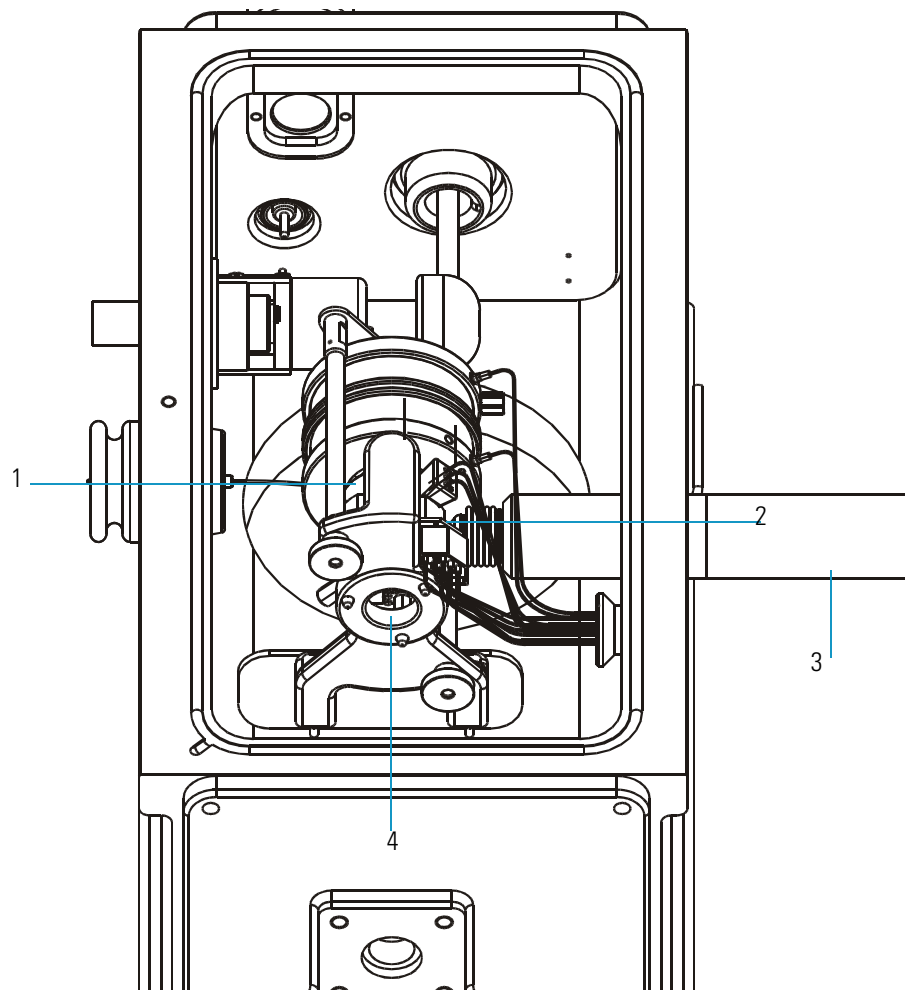
**Note** Wear clean, lint- and powder- free gloves when you handle parts inside the vacuum manifold.

## 2 Maintenance

### Cleaning the Ion Source Components

2. Remove the ion volume.
  - a. Insert the ion volume tool into the ion volume holder through the opening in the Ion source PCB (Figure 31).

**Figure 31.** Removing the Ion Volume (Top View)

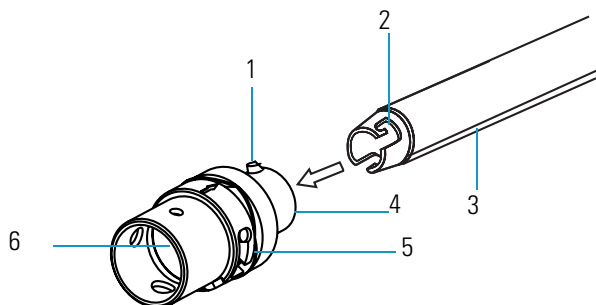


1	Ion Source Lenses	3	Transfer Line
2	Ion Source PCB	4	Ion Volume Holder (not shown)

- b. Turn the ion volume tool handle 30° counter-clockwise to engage the ion volume holder.
- c. Use the ion volume tool to pull the ion volume straight back and through the opening in the ion source PCB.

3. Clean the ion volume.
  - a. Using clean, lint- and powder-free gloves, press the ion volume forward into the tip of the ion volume tool and rotate it to disconnect the bayonet pin from the bayonet guide.
  - b. Pull the ion volume out of the ion volume tool (Figure 32).

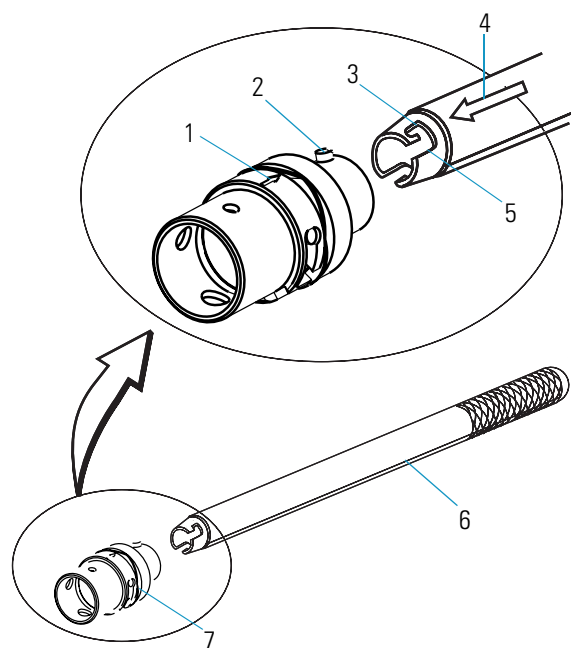
**Figure 32.** Ion Volume



1	Bayonet Pin	4	Ion Volume Holder
2	Bayonet Guide	5	Spring Washer
3	Ion Volume Tool	6	Ion Volume

- c. Clean the ion volume using the instructions described in “[Stainless Steel Parts](#)” on [page 33](#). If you are cleaning a CI ion volume, be sure to clean out the small electron entrance hole. Aluminum oxide can get trapped in this hole, which can adversely affect sensitivity. Use a dental pick or old syringe needle to clean the hole.
4. Replace the ion volume.
  - a. Insert the ion volume holder onto the end of the ion volume tool, as shown in [Figure 33](#).

**Figure 33.** Inserting the Ion Volume on the Ion Volume Tool



1	Ion Volume Alignment Arrow	5	Bayonet Guide
2	Bayonet Pin	6	Ion Volume Tool
3	Bayonet Lock	7	Ion Volume Holder
4	Ion Volume Tool Alignment Arrow		

**Note** Wear clean, lint- and powder- free gloves when you handle parts inside the vacuum manifold.

- b. Use the ion volume tool to push the ion volume straight back through the opening in the ion source PCB. Turn the ion volume tool handle 30° clockwise to disengage the ion volume. Be sure the ion volume is oriented with the arrow up and that the ion volume goes all the way into the ion source block and snaps into place.



**CAUTION INSTRUMENT DAMAGE.** Make sure the arrows on the ion volume tool and ion volume are aligned to avoid damaging the ion source.

5. Restore the mass spectrometer for operation.
  - a. Replace the vacuum manifold cover.
  - b. Replace the covers.
  - c. Restart the system.

## Cleaning the Ion Source Lenses

If cleaning the ion volume did not restore system performance, try cleaning the ion source lenses. The ion source lenses come in direct contact with samples introduced into the mass spectrometer and need to be cleaned periodically (though not as often as the ion volume).

To clean the ion source lenses, you will need:

- Cleaning supplies for stainless steel parts
- Gloves, clean, lint- and powder-free
- Lint-free cloth
- Screwdriver, Phillips #2

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front and top covers, as described in “[Removing the Covers](#)” on [page 24](#).
- d. Remove the vacuum manifold cover (“[Removing the Vacuum Manifold Cover](#)” on [page 28](#)).

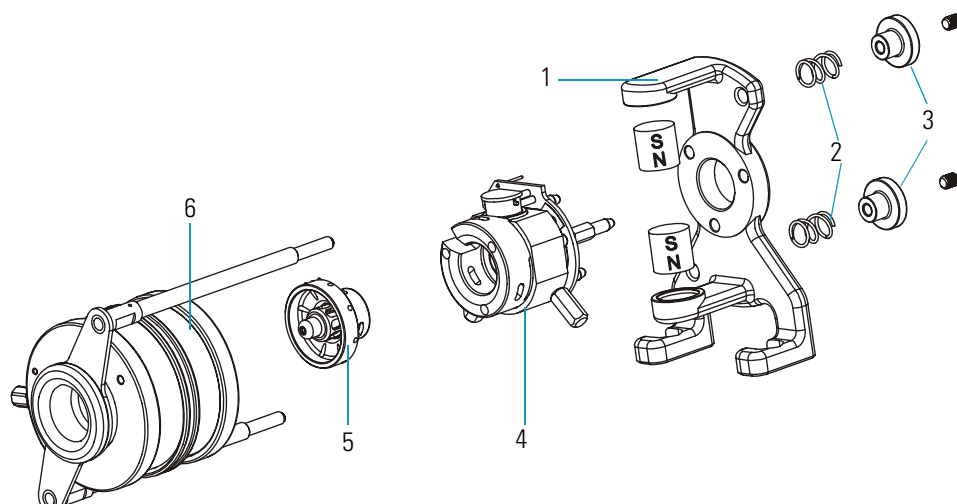
**Note** Wear clean, lint- and powder- free gloves when you handle parts inside the vacuum manifold.

2. Remove the ion source.
  - a. Remove the ion source and ion trap (“[To disassemble/assemble the ion source and ion trap, you will need:](#)” on [page 30](#)).
  - b. Remove the two thumbscrews holding the ion trap and ion source together, as shown in [Figure 34](#).

## 2 Maintenance

### Cleaning the Ion Source Components

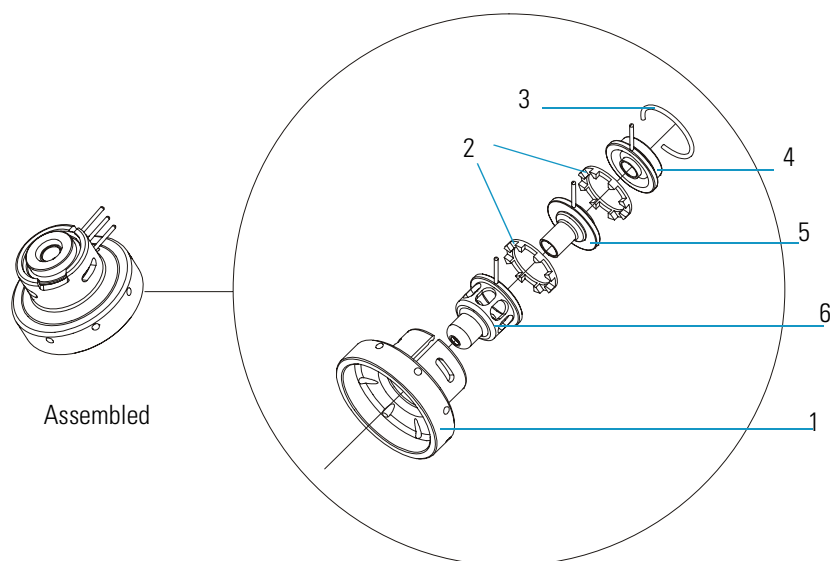
**Figure 34.** Removing the ion source and ion trap



1	Magnet Yoke	4	Ion Source
2	Springs	5	Ion Source Lenses
3	Two thumbscrews holding the Ion Trap and Ion Source	6	Ion Trap

- c. Remove the magnet yoke and ion source.
- d. Remove the lenses from the ceramic lens holder.

**Figure 35.** Ion Source Assembly



1	Lens Holder	4	Lens 1
2	Lens Spacer	5	Lens 2
3	Lens Clip	6	Lens 3

- i. Remove the ion source lens assembly (Figure 35).
  - ii. Remove the lens clip by pinching the ends with your fingers or a pair of tweezers.
3. Clean the ion source lenses according to the procedure in “Stainless Steel Parts” on page 33. Pay particular attention to the areas inside the tube and around the hole in each lens.
  4. Replace the ion source.
    - a. Insert the lenses and lens spacers into the ceramic lens holder.
    - b. Install the lens clip by pinching the ends or a pair of tweezers.
    - c. Insert the ion source lenses into the heater ring on the ion source.
    - d. Reassemble the ion source and ion trap.
    - e. Reinstall the ion source and ion trap into the vacuum manifold, as described in “To disassemble/assemble the ion source and ion trap, you will need:” on page 30.
  5. Restore the mass spectrometer for operations.
    - a. Replace the vacuum manifold cover.
    - b. Replace the covers.
    - c. Restart the system.

## Cleaning the Ion Source

If cleaning the ion volume and ion source lenses do not restore system performance, clean the ion source.

To clean the ion source, you will need:

- Cleaning supplies
- Gloves, clean, lint- and powder-free
- Lint-free cloth
- Screwdriver, Phillips #2

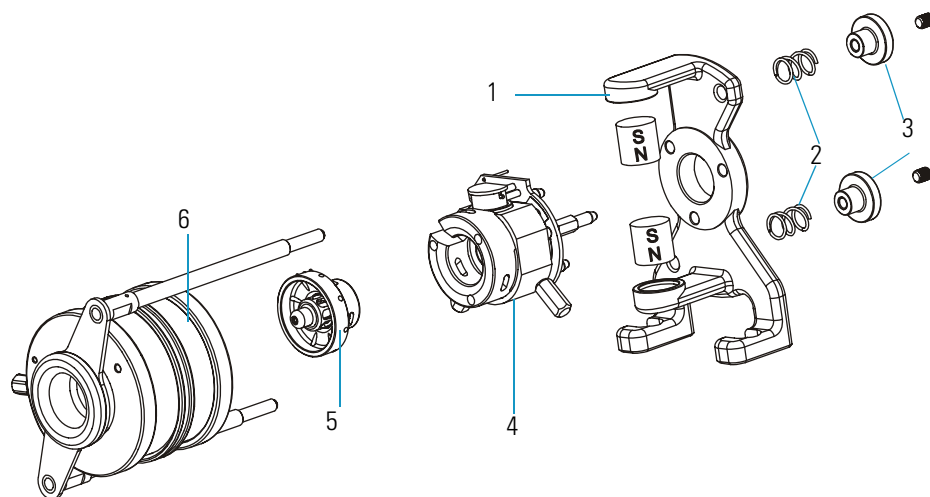
1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on page 16).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front and top covers, as described in “[Removing the Covers](#)” on page 24.
- d. Remove the vacuum manifold cover, as described in “[Removing the Vacuum Manifold Cover](#)” on page 28.
- e. Remove the ion source and ion trap, which are shown below in [Figure 36](#) and described in “[Removing the Vacuum Manifold Cover](#)” on page 28.

**Figure 36.** Removing the ion source and ion trap



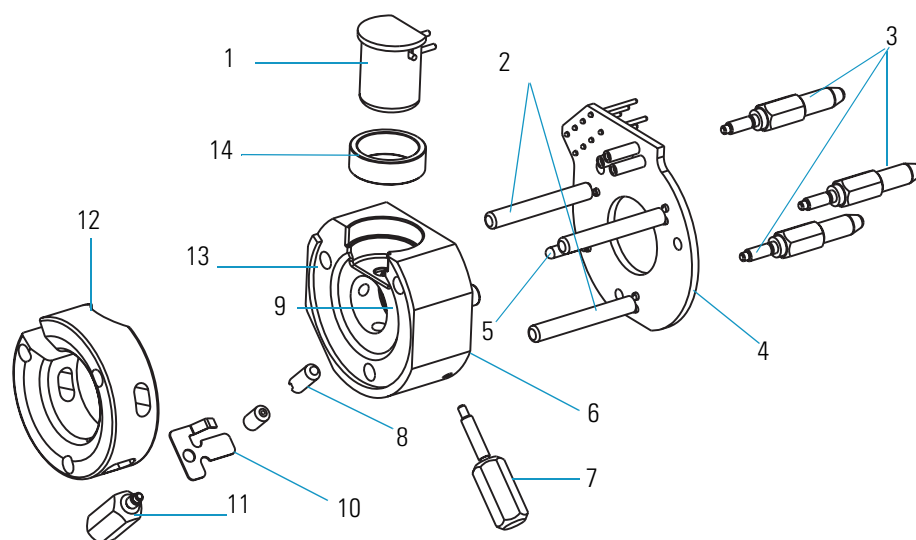
1	Magnet Yoke	4	Ion Source
2	Two Springs	5	Ion Source Lenses
3	Two thumbscrews holding the Ion Trap and Ion Source	6	Ion Trap



**Note** Wear clean, lint- and powder- free gloves when you handle parts inside the vacuum manifold.

2. Disassemble the ion source.
  - a. Remove the two thumbscrews holding the ion trap and ion source together.
  - b. Remove the magnet yoke and the ion source.
  - c. Remove the ion source lenses.
  - d. Remove the spring thumbscrew (shown in [Figure 37](#)) from the ion source block.

**Figure 37.** Ion Source Block Assembly



1	Ceramic Spacer	8	Ion Volume Pin
2	Cartridge Heaters	9	Ion Volume
3	Base-Studs	10	Spring
4	Ion Source Block PCB	11	Spring Thumbscrew
5	Temperature Sensor	12	Heater Ring
6	Ion Source Block	13	Sample Inlet Aperture
7	Ion Volume Key Thumbscrew	14	Filament Spacer

- e. Remove the three base-studs, but be careful not to damage the leads on the ion source PCB.
- f. Gently remove the ion source PCB from the ion source by sliding the three cartridge heaters and temperature sensor off the ion source and pulling the filament straight away from the three filament connectors on the ion source block PCB.

## 2 Maintenance

### Cleaning the Ion Source Components



**CAUTION INSTRUMENT DAMAGE.** Do not bend or twist the cartridge heaters or temperature sensor.

- g. Remove the filament and ceramic spacer (shown in [Figure 37](#)) from the ion source block.
- h. Remove the ion volume key thumbscrew.

**Note** It is not necessary to remove the ion volume pin. If you remove it, you should reinsert it just far enough so the ball will keep an ion volume from falling out. If the ball extends too far, the ion volume will be difficult to insert or remove.

3. Clean and replace the ion source.
  - a. Clean each component, as described in [“To clean stainless steel parts, such as the ion volume, ion source, and lenses you will need:”](#) on page 33 and [“To clean non-stainless or hybrid parts, such as the lens holder and spacer, filament spacer, and heater ring, you will need:”](#) on page 35.
  - b. Reassemble the ion source.
  - c. Insert the ion source and ion trap into the vacuum manifold, as described in [“To disassemble/assemble the ion source and ion trap, you will need:”](#) on page 30.
4. Restore the mass spectrometer for operation.
  - a. Replace the vacuum manifold cover.
  - b. Replace the covers.
  - c. Restart the system.

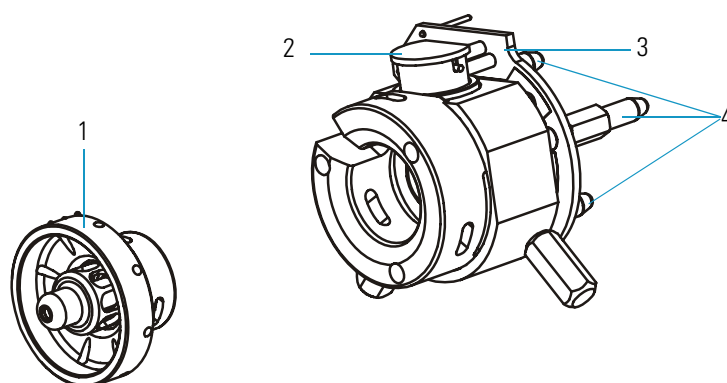
## Replacing the Ion Source Filament

The number of ions produced in the ion source is approximately proportional to the filament emission current. If you notice a lack in ion production, this might indicate that the filament has failed and needs to be replaced. If the measured emission current is substantially less than the value that the emission current is set to, or if the measured emission current is decreasing over time, then the filament has failed or is failing and needs to be replaced.

To replace the ion source filament, you will need:

- Filament (PN 119701-60287)
- Gloves, clean, lint- and powder-free
- Lint-free cloth
- Screwdriver, Phillips #2

**Figure 38.** Ion Source Filament Assembly



1	Ion Source Lenses	3	Ion Source PCB
2	Ion Source Filament	4	Three Base Studs

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer system described in “[Shutting Down](#)” on [page 16](#).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, and top covers as described in “[Removing the Covers](#)” on [page 24](#).
- d. Remove the vacuum manifold cover.
- e. Remove the ion source and ion trap.

**Note** Wear clean, lint- and powder- free gloves when you handle parts inside the vacuum manifold.

## 2 Maintenance

### Cleaning the Ion Source Components

2. Disassemble the ion source and ion trap.
  - a. Remove the ion source lenses.
  - b. Remove the three base-studs.
  - c. Remove the filament assembly and ion source block from the three filament connectors and cartridge heaters on the ion source PCB.

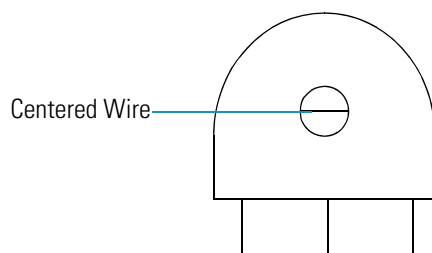


**CAUTION INSTRUMENT DAMAGE.** Do not bend or twist the cartridge heaters or temperature sensor.

**Note** Now is a good time to clean the ion volume and ion source lenses.

3. Inspect and install a new filament assembly.
  - a. Verify that the filament wire is centered in the electron lens hole. See [Figure 39](#) for a view of a centered wire.

**Figure 39.** Ion Source Filament

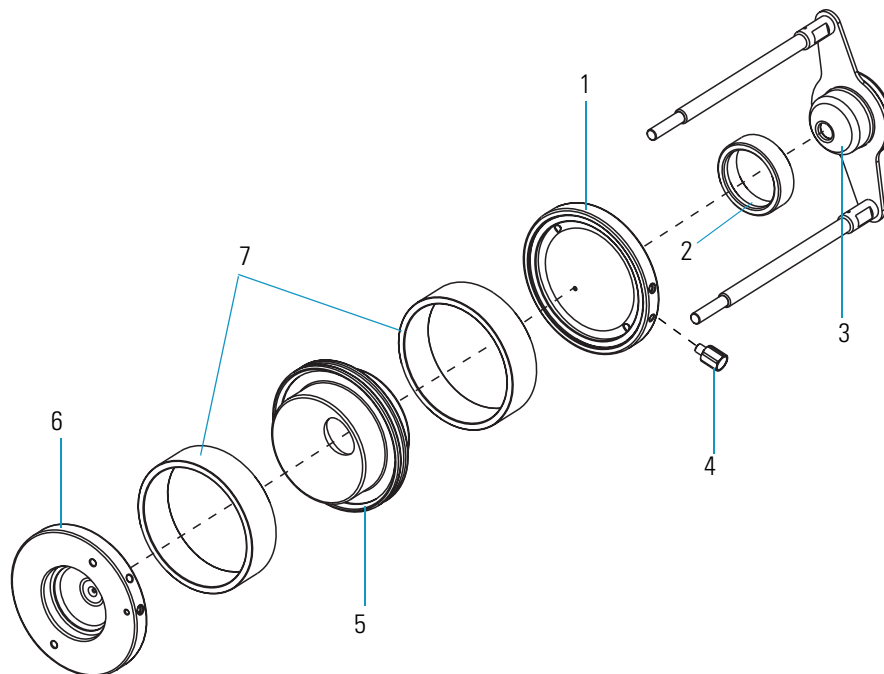


- b. Insert the filament into the spacer of the ion source block.
    - c. Align the filament leads with the ion source PCB connectors and gently press the leads into the connectors. Normally, there is a small gap about 0.5 mm (0.020 in) between the filament and the connectors. The gap allows the ceramic filament centering ring to properly position and align the electron lens hole with the ion volume.
    - d. Reinstall the three base-studs.
4. Reassemble and reinstall the ion source and ion trap.
  - a. Reassemble the ion source.
  - b. Insert the ion source and ion trap into the vacuum manifold.
5. Restore the mass spectrometer for operation.
  - a. Replace the vacuum manifold cover.
  - b. Replace the covers.
  - c. Restart the system.

## Cleaning the Ion Trap

An ion trap (also known as the mass analyzer) is an assembly composed of an entrance endcap, ring, and exit endcap. The ions that enter the ion trap are created in an external ionization source and are transferred into the ion trap through three lenses, and are separated according to mass-to-charge ( $m/z$ ) ratios. [Figure 40](#) shows a detailed view of the ion trap.

**Figure 40.** Ion Trap (Top View)



1	Exit Endcap	5	Ring
2	Exit Lens Spacer	6	Entrance Endcap
3	Exit Lens	7	Electrode Spacers
4	Helium Inlet		

A clean, dust-free ion trap is essential for good quality spectra. The ion trap requires less cleaning than the ion volume and the ion source lenses. Cleaning frequency depends on the type and quantity of the compounds that you analyze. With normal use, you do not have to clean the ion trap more than once every two years.

To clean the ion trap, you will need:

- Acetone, reagent grade
- Beaker, 450 mL
- Clean, dry gas
- Gloves, clean, lint- and powder-free
- Gloves, latex, impermeable
- Lint-free cloth
- Protective eyewear
- Screwdriver, Phillips #2
- Ultrasonic cleaner

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer system described in [“Shutting Down”](#) on [page 16](#).



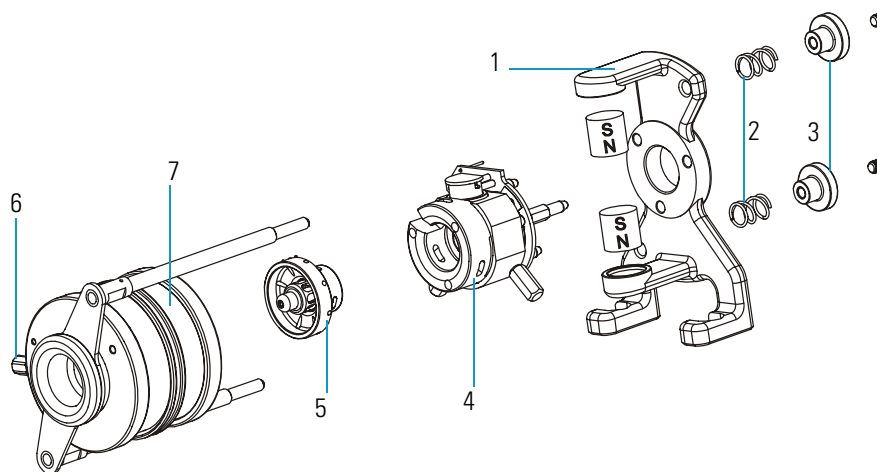
**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front cover, top cover, and vacuum manifold cover, as described in [“Removing the Covers”](#) on [page 24](#).
- d. Remove the ion source and ion trap.

**Note** Wear clean, lint- and powder- free gloves when you handle parts inside the vacuum manifold.

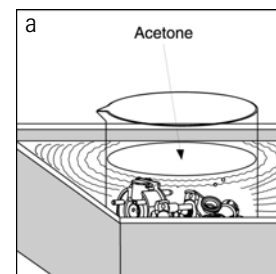
2. Disassemble the ion source (Figure 41).

**Figure 41.** Removing the ion source and ion trap



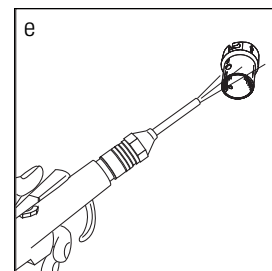
1	Magnet Yoke	5	Ion Source Lenses
2	Two Springs	6	Helium Inlet
3	Two thumbscrews holding the Ion Trap and Ion Source	7	Ion Trap
4	Ion Source		

- a. Remove the two thumbscrews holding the ion trap and ion source together.
  - b. Remove the magnet yoke, ion source, and ion source lenses.
3. Disassemble the ion trap, as shown in Figure 40, by removing each component and placing it on the lint-free cloth.
    - a. Remove the entrance endcap.
    - b. Remove the two spacers and the ring.
    - c. Remove the exit endcap.
  4. Clean the ion trap components.
    - a. Place the components in a beaker and cover them with acetone.
    - b. Place the beaker in an ultrasonic bath for about 10 minutes.
    - c. Pour the acetone out of the beaker.
    - d. Rinse the components with fresh acetone.

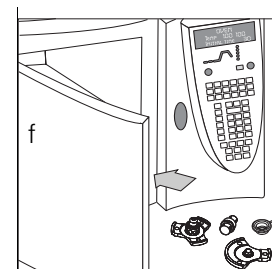




**CAUTION INSTRUMENT DAMAGE.** Do not clean the inside surfaces of the ion trap with aluminum oxide. This could damage the inside surfaces. However, if a black ion burn has formed around the ion entrance hole in the entrance endcap electrode, remove it using the procedure “Stainless Steel Parts” on page 33.



- e. Remove the components from the beaker. Use clean, dry gas to blow the acetone off the components.
- f. Dry the components in the GC oven set at 100 °C for 30 minutes. Allow the components to cool before reassembling.



**WARNING - BURN HAZARD.** Allow the components to cool before reassembling.

5. Reassemble the ion source and ion trap.
  - a. Reattach the exit lens spacer so that it lays flat against the exit lens. Be careful not to put it on backwards.
  - b. Reattach the entrance and exit endcaps, spacers and ring. The helium inlet should be oriented to the right.



**CAUTION INSTRUMENT DAMAGE.** Handle the spacers carefully and do not scrape them against any metal surfaces. If you do, you can use acid to remove the metal deposits.

**Note** Use clean, dry gas to remove all dust from the ion trap. Dust, especially on the inside of the ion trap, will cause spectral noise.

- c. Reattach the ion source lenses and ion source.
  - d. Reattach the magnet yoke and secure it with the two thumbscrews.
6. Insert the ion source and ion trap into the vacuum manifold, as described in “To disassemble/assemble the ion source and ion trap, you will need:” on page 30.
  7. Restore the mass spectrometer for operation.
    - a. Replace the vacuum manifold cover.
    - b. Replace the covers.
    - c. Restart the system.



## Maintaining the Ion Detector System

The ion detector system consists of a conversion dynode feedthrough, and an electron multiplier. This system must be kept clean and free of dust. Even the smallest amount of lint on the electron multiplier can cause spectral noise or static discharge, which could lead to power supply failure. This section describes how to replace the electron multiplier, clean the ion detector system, and clean or replace the anode.

### Replacing the Electron Multiplier

To replace the electron multiplier, you will need:

- Electron Multiplier (PN A0022-14633)
- Gloves, clean, lint- and powder-free
- Screwdriver, Phillips #2

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front and top covers as described in “[Removing the Covers](#)” on [page 24](#).
- d. Remove the vacuum manifold cover.

**Note** Wear clean, lint- and powder- free gloves when you handle parts inside the vacuum manifold.

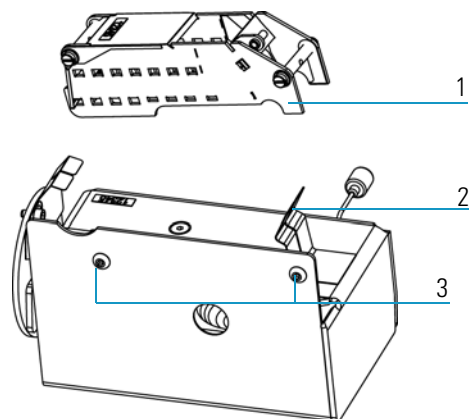
2. Remove old electron multiplier
  - a. Press spring tables on right side of multiplier
  - b. Pull up on right side of electron multiplier
  - c. Slide electron multiplier out of the clip on the left side
3. Install new electron multiplier
  - a. Slide electron multiplier into the clip on the left side

## 2 Maintenance

### Maintaining the Ion Detector System

- b. Push down on right side of electron multiplier until it is fully seated.

**Figure 42.** Electron Multiplier Assembly



1	Electron Multiplier	3	Button-head screws
2	Spring clip		

4. Reinstall the ion source and ion trap.
5. Restore the mass spectrometer for operation.
  - a. Replace the vacuum manifold cover.
  - b. Replace the covers.
  - c. Restart the system.

## Cleaning the Ion Detector System

To clean the ion detector system, you will need:

- Clean, dry gas
- Gloves, clean, lint- and powder-free
- Screwdriver, Phillips #2
- Wrench, Allen, 2 mm

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front and top covers as described in “[Removing the Covers](#)” on [page 24](#).
- d. Remove the vacuum manifold cover.

- e. Remove the ion source and ion trap.

**Note** Wear clean, lint- and powder- free gloves when you handle parts inside the vacuum manifold.

2. Spray the ion detector system with clean dry gas. This should remove any dust or particles on the surface.
3. Reinstall the ion source and ion trap.
4. Restore the mass spectrometer for operation.
  - a. Replace the vacuum manifold cover.
  - b. Replace the covers.
  - c. Restart the system.

## Cleaning or Replacing the Anode

To clean or replace the anode, which is located on the left side of the vacuum manifold under the electron multiplier, you will need:

- Anode (PN 120252-0001)
- Gloves, clean, lint- and powder-free
- Lint-free cloth
- Screwdriver, Phillips #1
- Screwdriver, Phillips #2
- Wrench, Allen, 3 mm
- Wrench, open-ended, 17 mm
- Wrench, open-ended, 9/16-in.

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

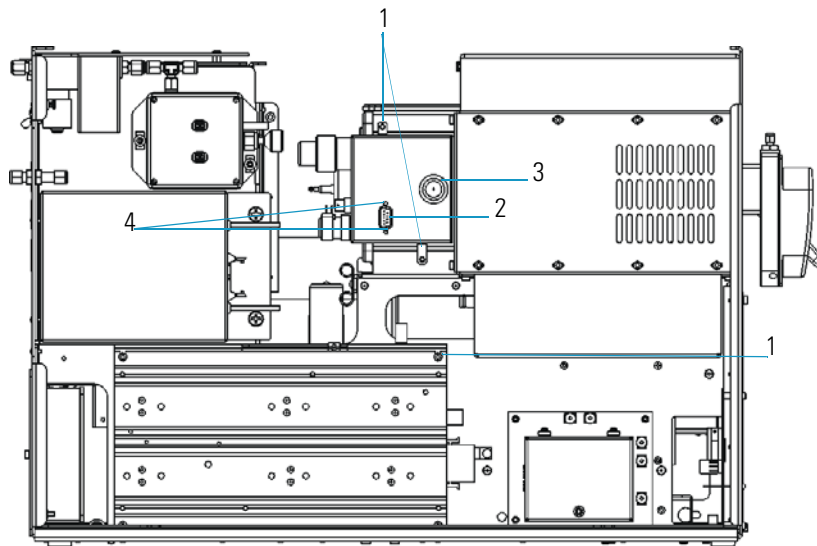
- c. )Remove the front, top, and left covers as described in “[Removing the Covers](#)” on [page 24](#).

## 2 Maintenance

### Maintaining the Ion Detector System

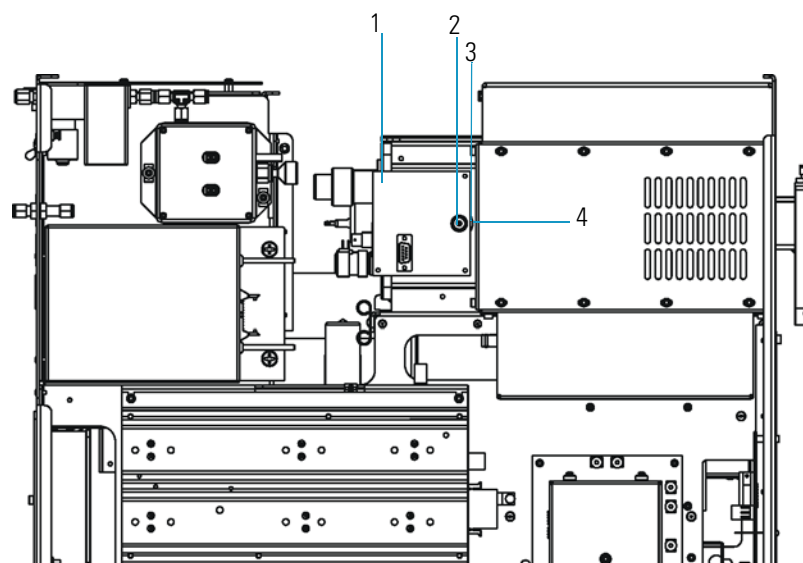
2. Remove the electrometer PCB from the vacuum manifold, which is shown in [Figure 43](#).

**Figure 43.** Electrometer PCB with Cover Attached (Left Side)



1	Two Hex-Socket screws holding the Electrometer PCB Cover	3	Electrometer PCB Cover
2	Electrometer PCB Cable Connector	4	Two nuts holding the Electrometer PCB Connector

- a. Disconnect the electrometer PCB cable.
- b. Remove the two nuts and two hex-socket screws holding the electrometer PCB cover in place ([Figure 43](#)) and then remove the cover.
- c. Remove the screw holding the electrometer PCB wire to the anode feedthrough, which is shown in [Figure 44](#).

**Figure 44.** Electrometer PCB with Cover Removed (Left Side)

1	Electrometer PCB	3	Nut holding the Electrometer PCB to the Anode Feedthrough
2	Screw holding the Electrometer PCB Wire to the Anode Feedthrough	4	Anode Feedthrough

- d. Remove the nut holding the electrometer PCB to the anode feedthrough.
3. Remove the anode feedthrough by unscrewing it from the vacuum manifold.

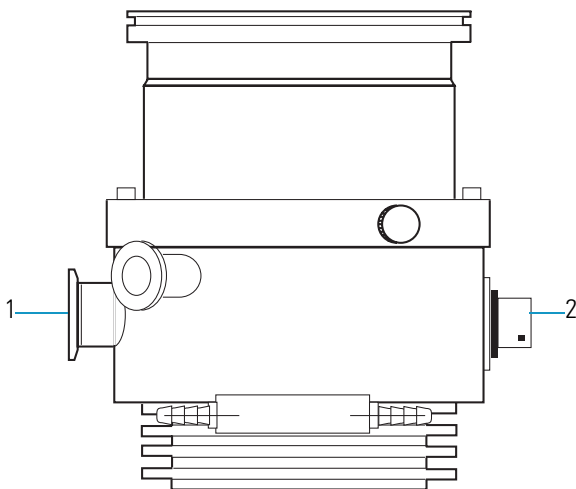
**Note** Wear clean, lint- and powder- free gloves when you handle parts inside the vacuum manifold.

4. Attach the new anode feedthrough by screwing it into the vacuum manifold.
5. Reattach the electrometer PCB to the vacuum manifold.
  - a. Use the nut to reattach the electrometer PCB to the anode feedthrough.
  - b. Use the screw to reattach the electrometer PCB wire to the anode feedthrough.
  - c. Use the two nuts and two screws to reattach the electrometer PCB cover to the vacuum manifold.
  - d. Reconnect the electrometer PCB cable.
6. Restore the mass spectrometer for operation.
  - a. Replace the vacuum manifold cover.
  - b. Replace the covers.
  - c. Restart the system.

## Maintaining a High-Vacuum Pump

The high-vacuum pump is located directly under the vacuum manifold. It provides the high vacuum that is necessary for ion detection. There are two types of high-vacuum pumps available for the Ion Trap Series—a 250 L/s or a 70 L/s turbomolecular pump. Each contains a lifetime supply of lubricant for the bearings. [Figure 45](#) illustrates a 250 L/s turbomolecular pump. The turbomolecular pump requires no maintenance.

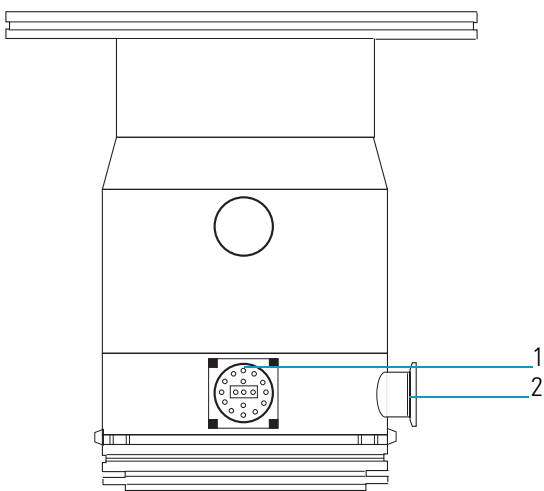
**Figure 45.** 250 L/s Turbomolecular Pump (Left Side View)



1	Backing Port (Outlet Flange)	2	Electrical Supply Connector
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[Figure 46](#) illustrates a 70 L/s Turbomolecular Pump.

**Figure 46.** 70 L/s Turbomolecular Pump



1	Electric Supply Connector	2	Backing Port (Outlet Flange)
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## Maintaining a Rotary-Vane Pump

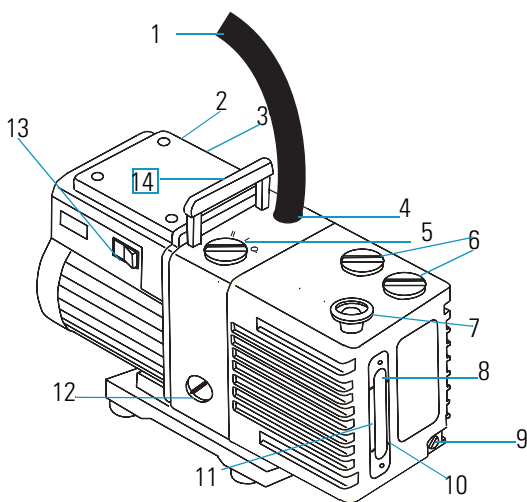
The rotary-vane pump is located under the mass spectrometer work table. All that is required to maintain the rotary-vane pump is to inspect, add, purge, and change the oil.

### Checking the Oil Level of a Rotary-Vane Pump

Rotary-vane pump oil (PN A0301-15101) is a translucent light amber color and it should be checked often. During normal operation, oil must always be visible in the oil level sight glass between the MIN and MAX marks. If the oil level is below the MIN mark, add oil. If the oil level is cloudy or discolored, purge the oil to decontaminate dissolved solvents. If the pump oil is still discolored, change it. You should change the pump oil every 3,000<sup>1</sup> hours (about four months) of operation.

This section describes how “To add oil to the rotary-vane pump” on page 72, “Purging Gas from the Oil in a Rotary-Vane Pump” on page 73, and “Changing the Oil in a Rotary-Vane Pump” on page 73.

**Figure 47.** Rotary Vane Pump



1	Foreline Vacuum Hose	8	MAX Mark
2	Electrical Inlet Connector	9	Oil Drain Plug
3	Voltage Indicator	10	MIN Mark
4	Inlet Port	11	Oil Level Sight Glass
5	Gas Ballast Control	12	Mode Selector
6	Oil Filler Plugs	13	On/Off Switch
7	Outlet Port	14	Lifting Handle

<sup>1</sup>Every 1,000 hours if using ammonia as a reagent gas for CI.

**Note** During normal operation, the mode selector switch is set to high-vacuum mode (turned fully clockwise) and the gas-ballast control is closed (0).

## Adding Oil to a Rotary-Vane Pump

To add oil to the rotary-vane pump



### Tools Needed

- Rotary-Vane Pump Oil (PN A0301-15101)



### Frequency

As needed when the oil level is below the MIN mark on the oil level sight glass.

**Note** The pump oil level must be between the MIN and MAX marks on the oil level sight glass for the pump to operate properly.

Check the oil level by looking at the oil level sight glass (Figure 47). If the oil level is low, add more oil using this procedure.

1. Shut down and vent the mass spectrometer system described in “Shutting Down” on page 16.



**WARNING - ELECTRICAL SHOCK HAZARD.** Shut down and unplug the mass spectrometer and rotary-vane pump before adding oil.

2. Remove one of the oil filler plugs from the rotary-vane pump.



**WARNING - BURN HAZARD.** Use only factory-approved rotary-vane pump oil. Using unapproved rotary-vane pump oil may result in a fire or explosion.

3. Add fresh oil to the reservoir until the oil is half way between the MIN and MAX level marks. If the oil level goes above the MAX level mark, remove the drain plug and drain the excess oil into a suitable container.
4. Insert the oil filler plug back into the rotary-vane pump.
5. Plug in the rotary-vane pump and mass spectrometer.
6. Restart the system.

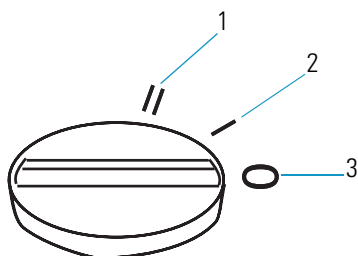


## Purging Gas from the Oil in a Rotary-Vane Pump

When the rotary-vane pump oil becomes cloudy or discolored, it is time to purge the oil. Purging (or decontaminating) the oil removes dissolved gases and low boiling-point liquids. You can purge the oil without interrupting system operation, but do not purge it during an acquisition or while the electron multiplier or filament is powered on the system.

1. Set the gas ballast control to low flow (I).
2. Operate the pump for 10 minutes or until the oil is clear. If the oil remains cloudy or discolored after 10 minutes, replace the oil.
3. Set the gas ballast control to closed (O), as shown in [Figure 48](#).

**Figure 48.** Gas Ballast Control Positions



1	High Flow (Position II)	3	Closed (Position O)
2	Low Flow (Position I)		

## Changing the Oil in a Rotary-Vane Pump

You should change the rotary-vane pump oil every four months (about 3,000 hours of operation). If you use ammonia as a chemical ionization reagent gas, change the oil every month. Ammonia is highly basic and can damage seals in the rotary-vane pump. Purging the oil with the gas ballast control can remove dissolved ammonia from the oil.

To change the rotary-vane pump oil:

**Note** For best results, change the oil while the rotary-vane pump is still warm after operation. Be careful, however, as the oil can still be very hot at this time.

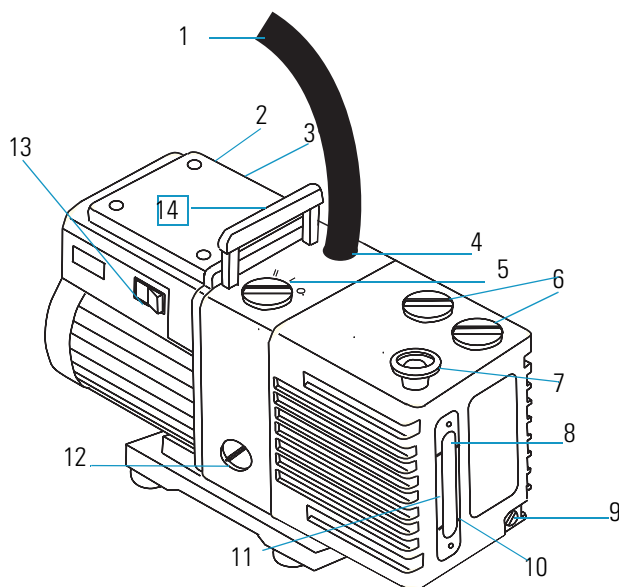
1. Shut down and vent the mass spectrometer system described in [“Shutting Down”](#) on [page 16](#).



**WARNING - ELECTRICAL SHOCK HAZARD.** Shut down and unplug the mass spectrometer and rotary-vane pump before adding oil.

2. Disassemble the rotary-vane pump.
  - a. Disconnect the foreline vacuum hose.

**Figure 49.** Rotary-Vane Pump



1	Foreline Vacuum Hose	8	MAX Mark
2	Electrical Inlet Connector	9	Oil Drain Plug
3	Voltage Indicator	10	MIN Mark
4	Inlet Port	11	Oil Level Sight Glass
5	Gas Ballast Control	12	Mode Selector
6	Oil Filler Plugs	13	On/Off Switch
7	Outlet Port	14	Lifting Handle

- b. Place the rotary-vane pump on a bench.



**WARNING - LIFTING HAZARD.** To prevent injury use a proper lifting technique or precaution to lift the rotary-vane pump. It weighs approximately 50 pounds (~23 kg).

- c. Drain the spent oil.
      - i. Remove one of the oil filler plugs.
      - ii. Remove the oil drain plug and allow the oil to drain into a suitable container.
      - iii. Dispose of the spent oil according to local environmental regulations.
      - iv. Replace the oil drain plug.

3. Add fresh oil.
  - a. Add fresh oil to the reservoir until the oil is half way between the MIN and MAX level marks.
  - b. If the oil level goes above the MAX level mark, remove the drain plug and drain the excess oil from the pump.
4. Reassemble the rotary-vane pump.
  - a. Replace the oil filler plug.
  - b. Return the rotary-vane pump to the floor.
  - c. Reconnect the foreline vacuum hose to the rotary-vane pump.
  - d. Plug in the rotary-vane pump and the mass spectrometer.
  - e. Restart the system.

## Finding Components and Assemblies

Components and assemblies are located in four sections, the front cover, the left cover, the right cover, and behind the mass spectrometer.

**Note** Keep the mass spectrometer packing materials in case defective parts must be returned to Thermo Fisher Scientific.



**CAUTION INSTRUMENT DAMAGE.** Only use fuses specified in [Table 2](#). Never replace a fuse with a fuse of a different type, voltage, or current rating. Fuses protect circuits by opening the circuits when an over-current occurs.

**Table 2.** Components and Current Ratings

Component	Fuse	Circuit	Type/Voltage/Current Rating	Part Number
Analog PCB	F1	Ion Source Heater	2 A, very fast microfuse, 125 V	76339-0008
HV Regulator PCB	F1, F2	Transformer Secondary	0.315 A, 5 x 20 mm, 250 V	A0006-04550
HV Regulator PCB	F3	Transformer Primary	800 mA, 5 x 20 mm, 250 V	A0006-06075
Power Module	F1, F2	In-line fuses +5 V, +36 V	3.15 A, SB, 5 x 20 mm, 250 V	A0006-10510
RF Generator PCB	F1	36 V	0.5 A, Quick Act, 5 x 20 mm, 250 V	A0006-07608
RF Generator PCB	F2	28 V	1.0 A, Quick Act, 5 x 20 mm, 250 V	A0006-07610

Replace a fuse only when indicated by the Tune Diagnostics, Thermo Fisher Scientific Technical Support, or a Thermo Fisher Scientific Customer Service Engineer.



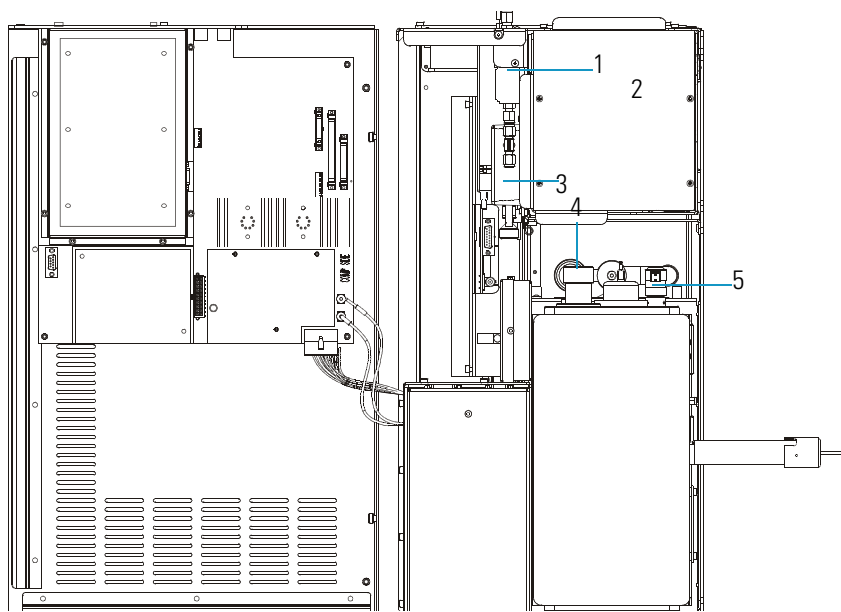
**CAUTION INSTRUMENT DAMAGE.** Avoid damaging the PCBs with electrostatic discharge by attaching a properly grounded electrostatic discharge (ESD) strap to your wrist before replacing fuses.

Table 3 lists the replaceable parts (in alphabetical order) that do not require a routine maintenance schedule and may be replaced as needed.<sup>1</sup>

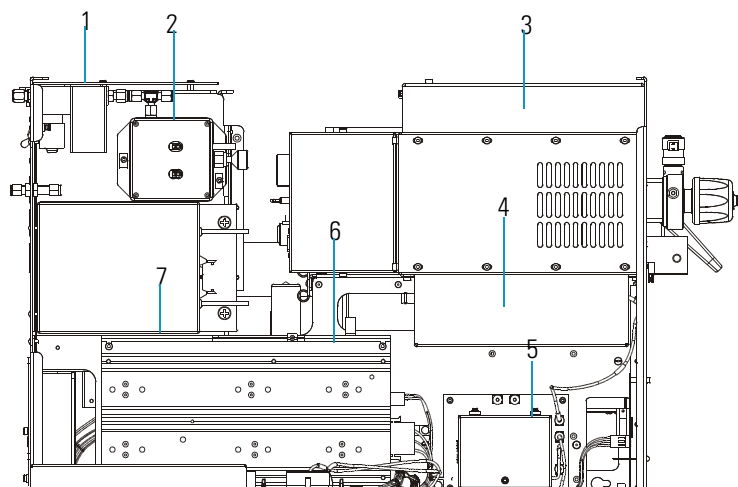
**Table 3.** Replaceable Parts List

<b>Replaceable Parts</b>
“Replacing the Analog PCB” on page 79.
“Balun PCB” on page 82.
“Replacing the Calibration Gas Flow Module” on page 83.
“Replacing the CI Reagent Gas Flow Module” on page 87.
“Replacing the Conversion Dynode/Electron Multiplier Power Supply” on page 88.
“Replacing the Convectron Gauge and Foreline Adapter” on page 90.
“Replacing the Digital PCB” on page 92.
“Replacing the Electrometer PCB” on page 93.
“Replacing the Variable Damping Gas Regulator” on page 95
“Replacing the Damping Gas Flow Module” on page 97
“Replacing the Ion Gauge” on page 99.
“Replacing the Lens Interface PCB” on page 101.
“Replacing the Low Pass Filter PCB” on page 102.
“Replacing the Power Module” on page 106.
“Replacing the Rear Cooling Fans” on page 108.
“Replacing the RF Detector PCB” on page 111.
“Replacing the RF Generator PCB” on page 113.
“Replacing the Transfer Line” on page 115
“Replacing the Turbomolecular Pump Power Supply” on page 117
“Replacing the Vacuum Control PCB” on page 119
“Replacing the Vent Valve Solenoid” on page 120

<sup>1</sup>*As needed* means you should only replace the part when instructed by Tune Diagnostics, Thermo Fisher Scientific Technical Support or a Thermo Fisher Scientific Customer Service Engineer.

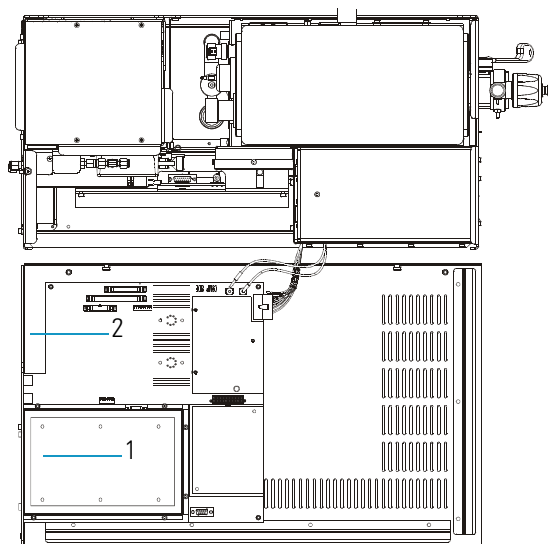
**Figure 50.** Replaceable Parts under the Top Cover

1	CI Reagent Gas Flow Module	4	Ion Gauge
2	Power Module	5	Vent Valve Solenoid
3	Calibration Gas Flow Module		

**Figure 51.** Replaceable Parts behind the Left Cover

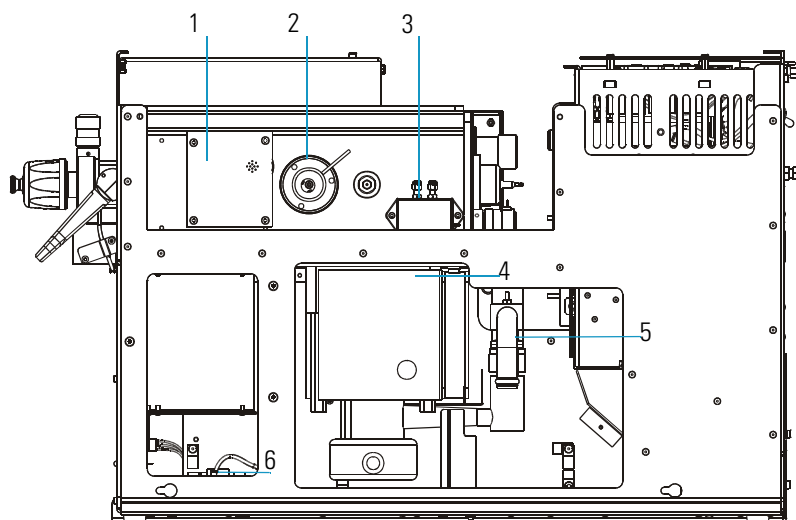
1	CI Reagent Gas Flow Module	5	Balun PCB
2	Calibration Gas Flow Module	6	RF Generator PCB
3	RF Detector PCB (covered)	7	Conversion Dynode and Electron Multiplier Power Supply
4	Low Pass Filter PCB (covered)		

**Figure 52.** Replaceable Parts on the Left Cover



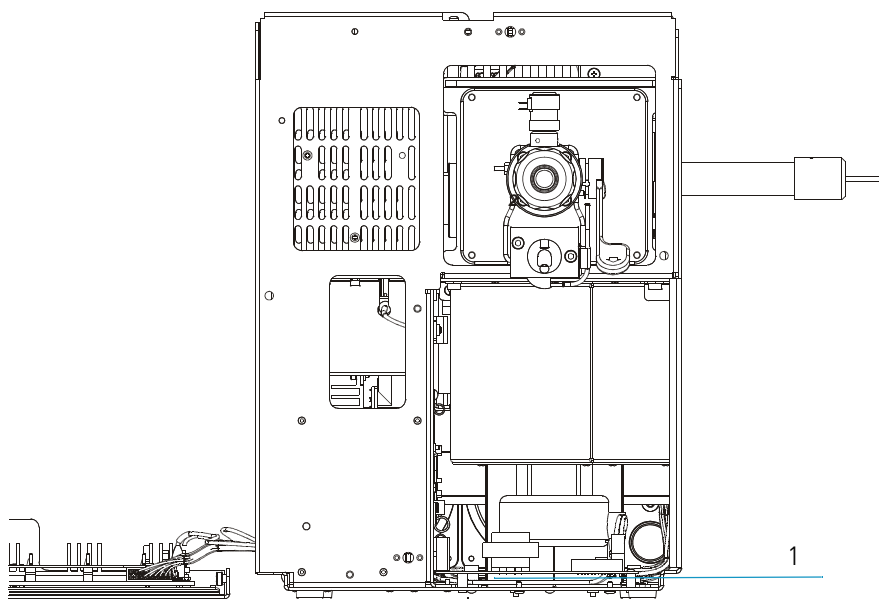
- |   |             |   |            |
|---|-------------|---|------------|
| 1 | Digital PCB | 2 | Analog PCB |
|---|-------------|---|------------|

**Figure 53.** Replaceable Parts behind the Right Cover



- |   |                         |   |                                       |
|---|-------------------------|---|---------------------------------------|
| 1 | Lens Interface PCB      | 4 | High-Vacuum Pump                      |
| 2 | Transfer Line           | 5 | Convectron Gauge and Foreline Adapter |
| 3 | Damping Gas Flow Module | 6 | Turbo Pump Power Supply               |

**Figure 54.** Replaceable Parts behind the Front Cover



1 Turbomolecular Pump Power Supply

## Replacing the Analog PCB

To replace the analog PCB, you will need:

- Analog PCB (PN 119590-0021)
- Nut driver, 5.5 mm
- Screwdriver, Phillips #2

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

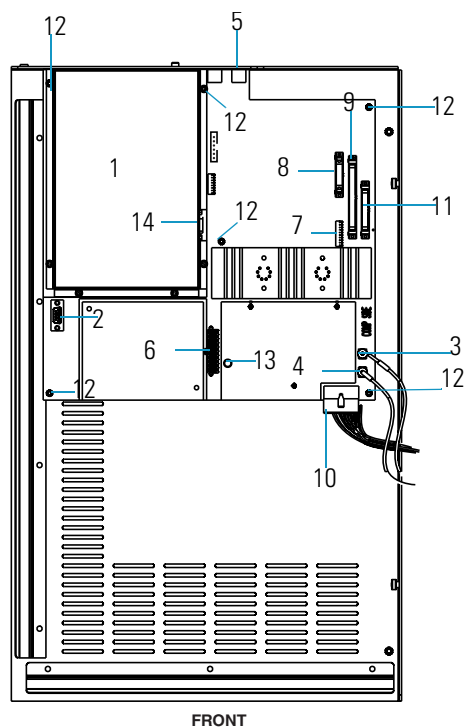
- c. Remove the front, top and left side covers as described in “[Removing the Covers](#)” on [page 24](#).
2. Remove the analog PCB.
    - a. To get access to the analog PCB, you must remove the digital PCB. The removal process is described in “[Replacing the Digital PCB](#)” on [page 92](#).
    - b. Disconnect the remaining cables from the analog PCB.

## 2 Maintenance

### Replacing the Analog PCB

- c. Remove the six nuts holding the analog PCB to the left side cover, as shown in [Figure 55](#).
- d. Remove the analog PCB and set it aside.

**Figure 55.** Analog PCB (Left Side Panel, Top Down View)



1	Digital PCB	8	Electron Multiplier/Conversion Dynode Power Supply Cable Connector
2	RF Control PCB Cable Connector	9	RF Generator PCB Cable Connector
3	Balun PCB Cable Connector	10	Power Module Cable Connector
4	Balun PCB Cable Connector	11	Vacuum Control PCB Cable Connector
5	GC Start Cable Connector	12	Six nuts holding the Analog PCB to the left cover
6	Lens Interface PCB Cable Connector	13	Fuse
7	CI Reagent Gas Flow Module Cable Connector	14	Digital PCB Cable Connector



3. Replace the analog PCB.
  - a. Position the new analog PCB so that the six nuts will fit through the board.
  - b. Use four of the six nuts to reattach the analog PCB to the cover. The last two nuts are attached after the digital PCB cover is installed.
  - c. Reinstall the digital PCB and reconnect the digital PCB cable to the analog PCB.
  - d. Reconnect all the remaining cables to the analog PCB.
4. Restore the mass spectrometer for operation.
  - a. Replace the covers.
  - b. Restart the system.
5. Run Tune Diagnostics to verify that your system is operational.

## Replacing a Fuse on the Analog PCB

To replace a fuse on the analog PCB, you will need:

- Analog PCB (PN 119590-0021)
- Nut driver, 5.5 mm
- Screwdriver, Phillips #2

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the the covers, as described in “[Removing the Covers](#)” on [page 24](#).
2. Locate and replace the defective fuse with a fuse of the same type, voltage, and current rating, as indicated in [Table 4](#).

**Table 4.** Component and Current Rating

Component	Fuse	Circuit	Type/Voltage/Current Rating	Part Number
Analog PCB	F1	Ion Source Heater	2 A, very fast microfuse, 125 V	76339-0008

3. Restore the mass spectrometer for operation.
  - a. Replace the covers.
  - b. Restart the system.
  - c. Run Tune diagnostics to verify that your system is operational.

## Balun PCB

The balun PCB requires replacement only when specified by an authorized Thermo Fisher Scientific representative.

To replace the balun PCB, you will need:

- Balun PCB (PN 119590-0090)
- Screwdriver, Phillips #2
- Wrench, Allen, 2.5 mm

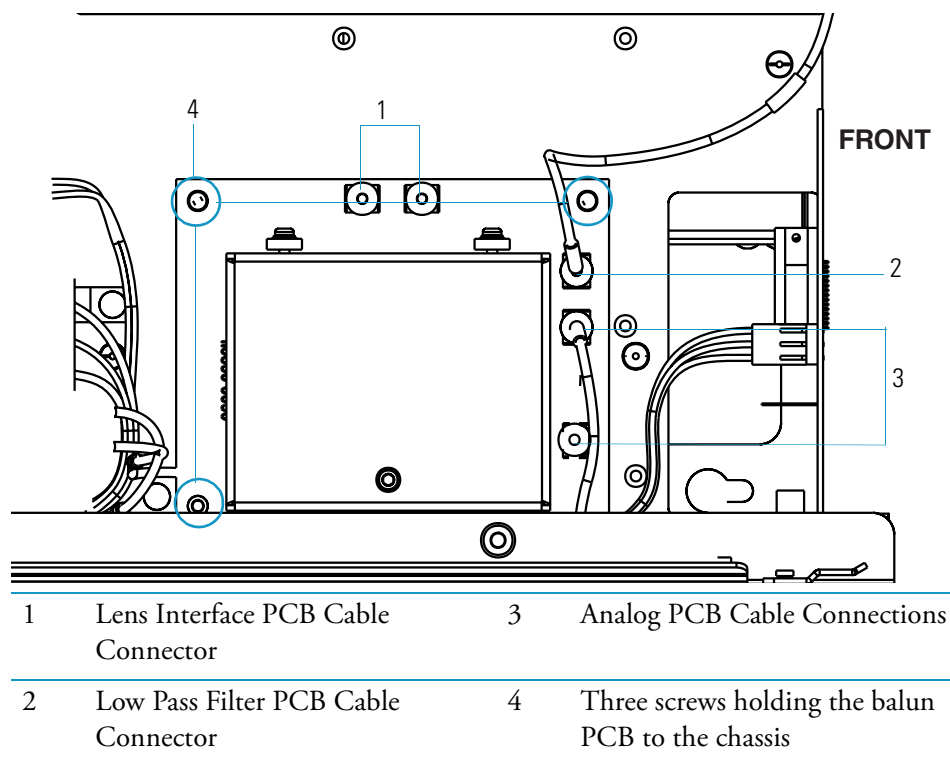
1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, top, and left covers as described in “[Removing the Covers](#)” on [page 24](#).
2. Remove the balun PCB.
    - a. Disconnect all the cables from the balun PCB.

**Figure 56.** Balun PCB (Side View)



- b. Use a 2.5 mm Allen wrench to remove the three screws holding the balun PCB to the chassis.
    - c. Remove the balun PCB from the chassis.
3. Replace the balun PCB.
  - a. Use the three screws to attach the new balun PCB to the chassis and ensure the P1 and P2 connectors are aligned towards the top.
  - b. Reconnect all the cables.
4. Restore the mass spectrometer for operation.
  - a. Replace the covers.
  - b. Restart the system.
  - c. Run Tune Diagnostics to verify that your system is operational.

## Replacing the Calibration Gas Flow Module

To replace the calibration gas flow module (CGFM), you will need:

- Calibration Gas Flow Module (PN 119246-0001)
- Lint-free paper
- Screwdriver, Phillips #2
- Syringe
- Wrench, Allen, 3 mm
- Wrench, open-ended, 7/16-in.
- Wrench, open-ended, 9/16-in.

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

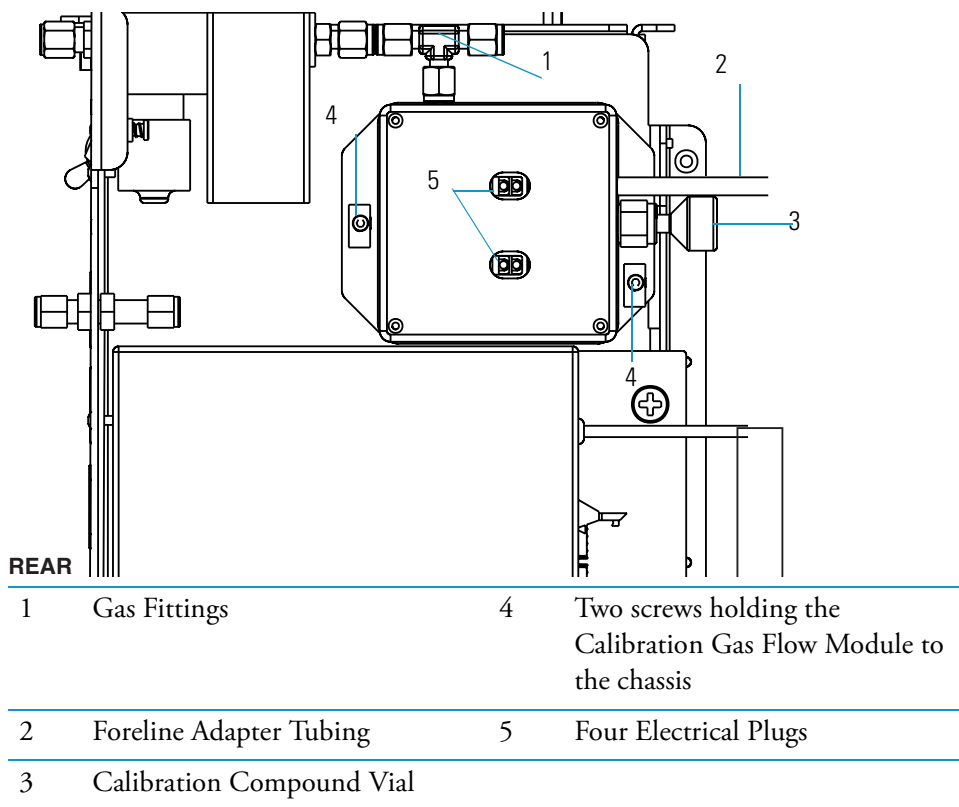
- c. Remove the front, top, and left covers as described in “[Removing the Covers](#)” on [page 24](#).
2. If you have the optional CI module then turn off the CI reagent gas supply.
3. Remove the calibration gas flow module.

## 2 Maintenance

### Replacing the Calibration Gas Flow Module

- a. Disconnect the gas fittings from the top of the module, as shown in [Figure 57](#).

**Figure 57.** Calibration Gas Flow Module (Side View)



- b. Disconnect the clear tubing from the foreline adapter.
  - c. Disconnect the four electrical plugs.
  - d. Remove the two screws holding the calibration gas flow module to the chassis.
  - e. Remove the calibration gas flow module from the chassis.
4. Replace the calibration gas flow module.
    - a. Position the calibration gas flow module so that the gas fitting is on top and the tubing and cable are positioned towards the front of the mass spectrometer.
    - b. Tighten the gas fittings with a 7/16-in. open-ended wrench.
    - c. Use the two screws to attach the calibration gas flow module to the chassis.
    - d. Reconnect the tubing and the cables.
    - e. Turn on the CI reagent gas supply (if present).
    - f. Add a calibration compound to the vial.
  5. Restore the mass spectrometer for operation.
    - a. Replace the covers.
    - b. Restart the system.

## Adding Calibration Compound

The calibration compound is a liquid whose mass spectrum of ions is used to tune and calibrate the mass spectrometer. The mass spectrometer uses FC-43 as its calibration compound. Although you cannot *visually* determine when a calibration compound needs to be added to the mass spectrometer, Xcalibur Automatic Tune will produce an error message indicating that “the intensity of calibration gas ions is too low.” This message indicates that calibration compound may need to be added. However, there are many factors other than a decrease in the calibration compound that can cause a shortage of calibration gas ions. As a rule, you should not have to add a calibration compound to the mass spectrometer more than once a year.

To add calibration compound, you will need:

- FC-43 Calibration Compound (PN 50010-30059)
- Lint-free paper
- Screwdriver, Phillips #2
- Syringe
- Wrench, Allen, 3 mm
- Wrench, open-ended, 7/16-in.
- Wrench, open-ended, 9/16-in.

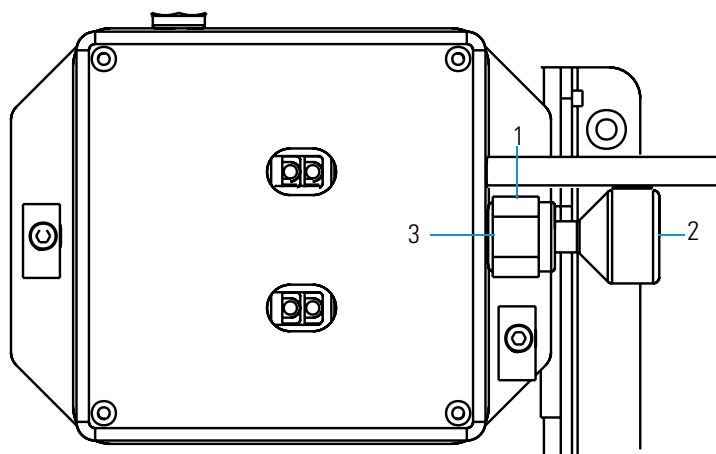
1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, top, and left covers as described in “[Removing the Covers](#)” on [page 24](#).
2. Remove the calibration compound vial from the calibration gas flow module.
    - a. Use a 9/16-in. wrench to remove the nut from the calibration compound vial.
    - b. Slide the vial away from the calibration valve fitting with the ferrule and nut attached.
    - c. Remove the ferrule and nut.

**Figure 58.** Calibration Compound (Side View)



1	Ferrule and Nut	3	Calibration Valve Fitting
2	Calibration Compound Vial		

3. Add the calibration compound.
  - a. Draw up no more than 0.1 mL of calibration compound into a clean syringe.
  - b. Insert the syringe in the calibration compound vial until it comes in contact with the white frit at the bottom of the vial.
  - c. Inject no more than 0.1 mL of calibration compound into the white frit. The frit absorbs the calibration compound, so if the calibration compound is pooled (calibrant covers the top of the frit), then you have too much in the vial. Immediately pour out the excess calibrant and dispose of according to local environmental regulations.
  - d. Remove the syringe from the calibration compound vial.



**CAUTION INSTRUMENT DAMAGE.** Adding more than 0.1 mL of the calibration compound can damage the calibration gas flow module. Be sure not only that you are adding the correct amount of calibrant to the chamber, but that the mass spectrometer truly needs the additional calibrant.

4. Reinstall the calibration compound vial into the module.
  - a. Hold the vial vertically and place the nut on the neck of the vial.
  - b. Place the 1/4-in. ferrule over the neck of the vial and into the nut.
  - c. Connect the vial to the calibration valve fitting with the nut and ferrule.
5. Restore the mass spectrometer for operation.
  - a. Replace the covers.
  - b. Restart the system.

## Replacing the CI Reagent Gas Flow Module

This item is available as an upgrade option. This item is repaired only when specified by an authorized Thermo Scientific representative.

To replace the CI reagent gas flow module, you will need:

- CI Reagent Gas Flow Module (PN 23331-0091)
- Electronic Leak Detector (GL Sciences, Inc., model LD-228, or equivalent)
- Screwdriver, Phillips #2
- Wrenches, two, open-ended, 7/16-in.

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

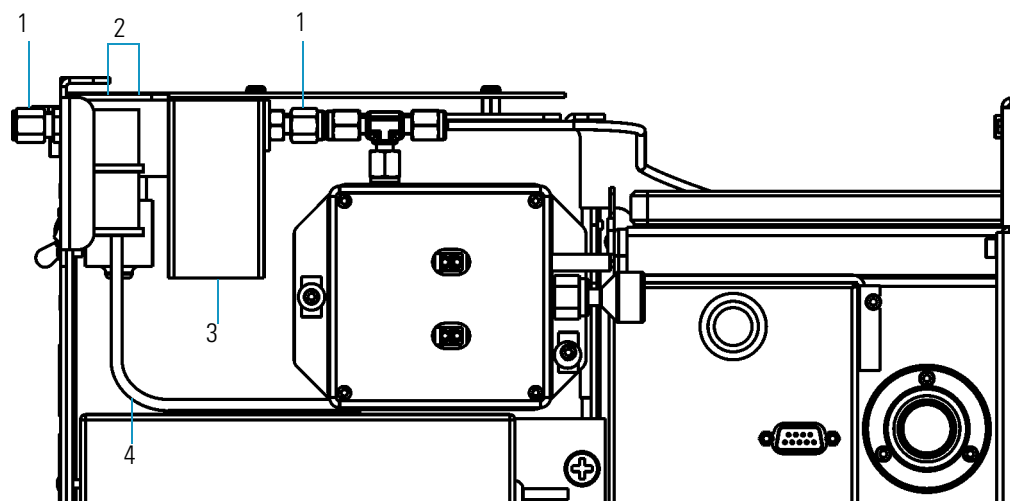
- c. Remove the top, front, and left covers.
- d. Turn off the CI reagent gas supply.



**WARNING - FLAMMABLE GAS HAZARD.** CI reagent gases are often flammable or corrosive. For safety purposes, vent the gas to a fume hood or other suitable exhaust. Also, ensure that the CI reagent gas supply line is leak-tight.

2. Remove the CI reagent gas flow module.

**Figure 59.** CI Reagent Gas Flow Module (Left Side)



1	Two gas fittings	3	Analog PCB Cable Connector
2	Two screws holding the CI Reagent Gas Flow Module	4	Foreline Adapter Tubing

## 2 Maintenance

### Replacing the Conversion Dynode/Electron Multiplier Power Supply

- a. Disconnect the analog PCB cable from the module.
  - b. Disconnect the two gas fittings.
  - c. Disconnect the foreline adapter tubing.
  - d. Remove the two screws holding the CI reagent gas flow module.
3. Install the new CI reagent gas flow module.
    - a. Use the two screws to attach the new CI reagent gas flow module.
    - b. Reconnect the foreline adapter tubing.
    - c. Reconnect the two gas fittings.
    - d. Reconnect the analog PCB cable.
  4. Test the gas fittings for leaks.
    - a. Turn on the CI reagent gas supply.
    - b. Use a detector to check each fitting for leaks.



**CAUTION INSTRUMENT DAMAGE.** Do not use liquid soap leak detectors (such as Snoop) to check for leaks. It may contaminate your system.

- c. Repair leaks by tightening or replacing the connections until everything is leak-free.
5. Restore the mass spectrometer for operation.
    - a. Replace the covers.
    - b. Restart the system.
    - c. Once the mass spectrometer has pumped down and is operational, check for vacuum leaks using the Automatic Tune.

## Replacing the Conversion Dynode/Electron Multiplier Power Supply

To replace the conversion dynode and electron multiplier power supply, you will need:

- Conversion Dynode and Electron Multiplier Power Supply (PN 119377-0001)
- Screwdriver, Phillips #2

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



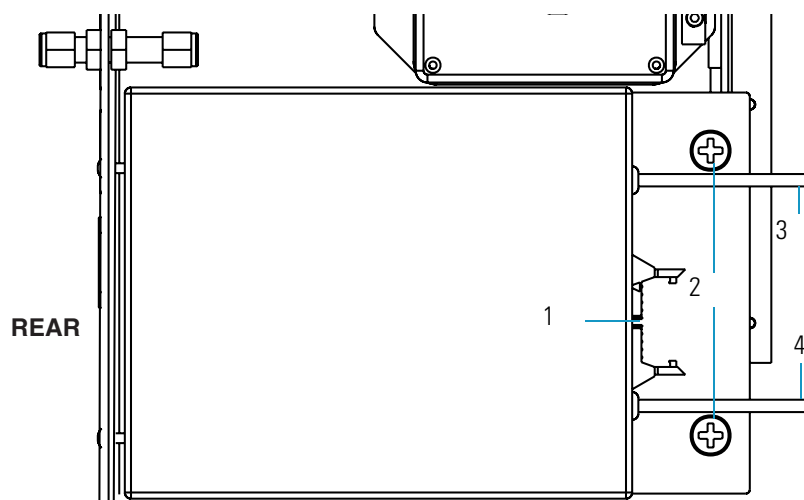
**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, top, and left covers as described in “[Removing the Covers](#)” on [page 24](#).



2. Remove the conversion dynode and electron multiplier power supply.
  - a. Disconnect the power supply ribbon cable.

**Figure 60.** Conversion Dynode and Electron Multiplier Power Supply



1	Power Supply Ribbon Cable Connector	3	Electron Multiplier Cable Connector
2	Two screws holding the Power Supply to the chassis	4	Conversion Dynode Cable Connector

- b. Disconnect the conversion dynode cable from the vacuum manifold.
- c. Disconnect the electron multiplier cable from the vacuum manifold.
- d. Remove the two screws holding the power supply to the chassis.

## 2 Maintenance

### Replacing the Convector Gauge and Foreline Adapter

3. Replace the conversion dynode and electron multiplier power supply.
  - a. Use the two screws to install the new electron multiplier and conversion dynode power supply.
  - b. Reconnect the power cables.
4. Restore the mass spectrometer for operation.
  - a. Replace the covers.
  - b. Restart the system.
  - c. Run Tune Diagnostics to verify that your system is operational.

## Replacing the Convector Gauge and Foreline Adapter

To replace the convector gauge and foreline adapter, you will need:

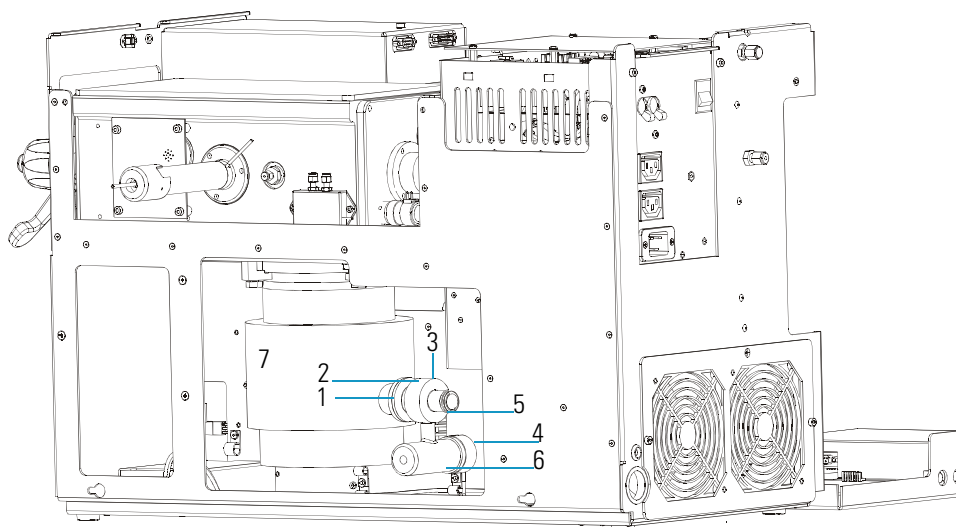
- Convector Gauge and Foreline Adapter - 250 L/s Turbomolecular Pump System (PN 119259-0002) or Convector Gauge and Foreline Adapter - 70 L/s Turbomolecular Pump System (PN 119259-0003)
- Lint-free paper
- Screwdriver, Phillips #2
- Screwdriver, flat blade
- Wrench, adjustable

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, top, and left covers as described in “[Removing the Covers](#)” on [page 24](#).
2. Remove the convector gauge and foreline adapter.
  - a. Disconnect the convector gauge cable from the foreline adapter.

**Figure 61.** Convectron Gauge and Foreline Adapter

1	Foreline Adapter Clamp (not shown)	4	Convectron Gauge Cable from the Vacuum Control PCB (not shown)
2	Foreline Adapter	5	Foreline Hose Clamp (not shown)
3	Gold fitting and tubing behind the Foreline Adapter	6	Convectron Gauge

- b. Disconnect both pieces of tubing from the gold fitting behind the foreline adapter.
  - c. Disconnect the foreline adapter clamp that holds the foreline adapter to the pump.
  - d. Remove the foreline hose clamp that holds the foreline hose to the foreline adapter.
  - e. Remove the convectron gauge and foreline adapter (simultaneously) from the chassis.
3. Replace the convectron gauge and foreline adapter.
    - a. Use the foreline hose clamp to attach the foreline hose to the new foreline adapter.
    - b. Attach the foreline adapter clamp to the pump.
    - c. Reconnect the tubing and the convectron gauge cable.
  4. Restore the mass spectrometer for operation.
    - a. Replace the covers.
    - b. Restart the system.
    - c. Run Tune Diagnostics to verify that your system is operational.

## Replacing the Digital PCB

To replace the digital PCB, you will need:

- Digital PCB (PN 119590-0010)
- Nut driver, 5.5 mm
- Screwdriver, Phillips #2
- Wrench, Allen, 2.5 mm
- Wrench, Allen, 3 mm

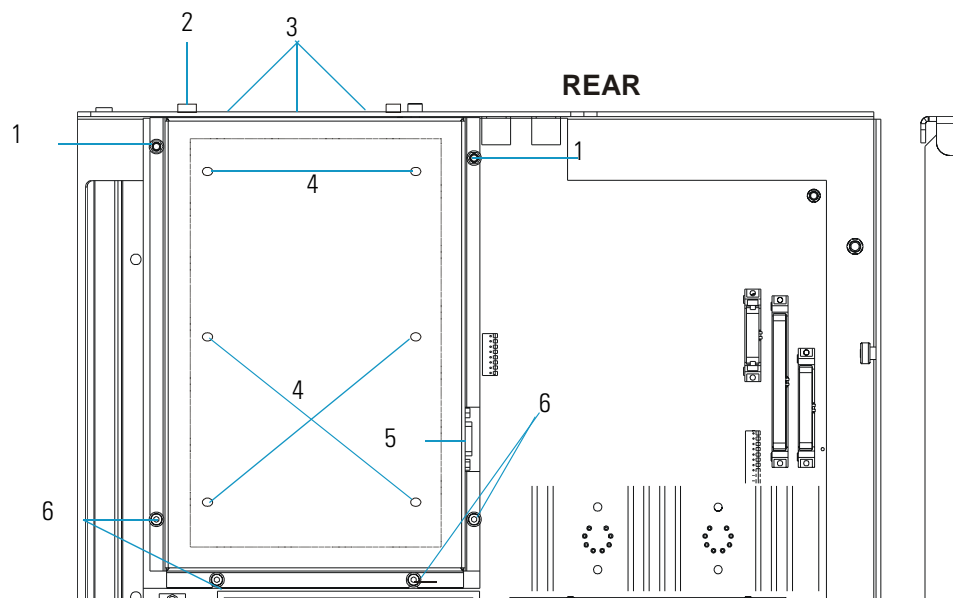
1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on page 16).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, top, and left covers as described in “[Removing the Covers](#)” on page 24.
2. Disconnect the digital PCB from the analog PCB.
    - a. Disconnect the digital PCB Cable..

**Figure 62.** Digital PCB (Top Down View)



1	Two nuts holding the Digital PCB cover to the Analog PCB	4	Six nuts holding the Digital PCB to the Analog PCB
2	Digital PCB Ethernet Cable Connector	5	Digital PCB Cable Connector
3	Three screws holding the Digital PCB Cover to the Left Side Panel	6	Four screws holding the Digital PCB Cover to the Analog PCB

- b. Remove the ethernet cable from the back of the digital PCB.
  - c. Remove the three screws holding the digital PCB cover to the left side panel.
  - d. Remove the four screws and two nuts holding the digital PCB cover to the analog PCB.
  - e. Remove the cover and set it aside.
  - f. Remove the six nuts holding the digital PCB to the analog PCB.
3. Remove the digital PCB by lifting it away from the connection on the analog PCB.
  4. Reconnect the digital PCB to the analog PCB.
    - a. Plug the digital PCB into the analog PCB. Push on the front edge of the digital PCB to ensure the electrical connection is secure.
    - b. Use the six nuts to reattach the digital PCB to the analog PCB.
    - c. Use the two nuts and four screws to reattach the digital PCB Cover.
    - d. Use the three screws to reattach the digital PCB to the left side panel.
    - e. Reconnect the ethernet cable and digital PCB cable.
  5. Restore the mass spectrometer for operation.
    - a. Replace the covers.
    - b. Restart the system.
    - c. Run Tune Diagnostics to verify that your system is operational.

## Replacing the Electrometer PCB

To replace the electrometer PCB, you will need:

- Electrometer PCB (PN 119590-0101)
- Screwdriver, Phillips #2
- Wrench, Allen, 3 mm
- Wrench, open-ended, 17 mm
- Wrench, open-ended, 9/16-in.

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

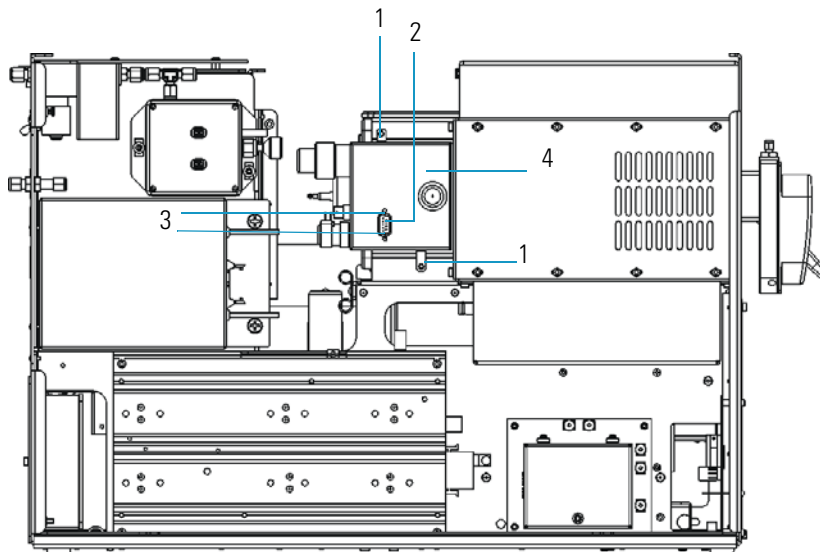
- c. Remove the front, top, and left covers as described in “[Removing the Covers](#)” on [page 24](#).

## 2 Maintenance

### Replacing the Electrometer PCB

2. Remove the electrometer PCB.

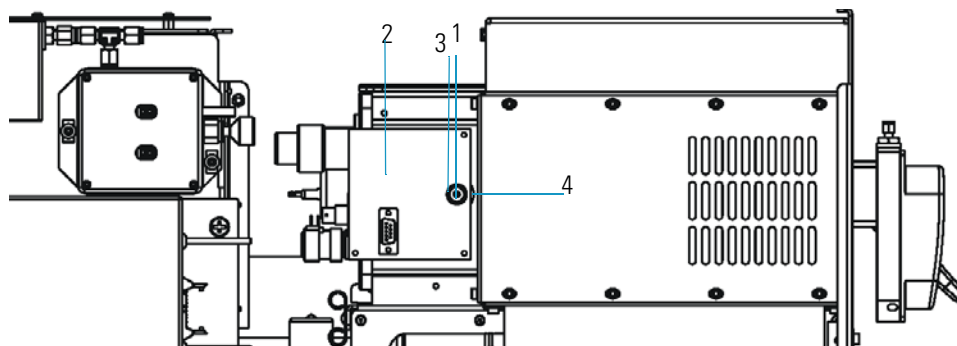
**Figure 63.** Electrometer PCB with Cover Attached (Left Side)



1	Two Hex-Socket screws holding the Electrometer PCB Cover	3	Two nuts holding the Electrometer PCB Cover
2	Electrometer PCB Cable Connector	4	Electrometer PCB Cover

- Disconnect the electrometer PCB cable.
- Remove the two screws and two nuts holding the electrometer PCB cover in place.
- Remove the electrometer PCB cover and set it aside.

**Figure 64.** Electrometer PCB with Cover Removed (Left Side)



1	Screw holding the Electrometer PCB Wire to the Anode Feedthrough	3	Nut holding the Electrometer PCB to the Anode Feedthrough
2	Electrometer PCB	4	Anode Feedthrough

- d. Remove the screw holding the electrometer PCB wire to the anode feedthrough.
  - e. Remove the nut holding the electrometer PCB to the anode feedthrough.
3. Replace the electrometer PCB.
    - a. Use the nut to attach the new electrometer PCB to the anode feedthrough.
    - b. Use the screw to attach the new electrometer PCB wire to the anode feedthrough.
    - c. Use the two nuts and two screws to reattach the electrometer PCB cover.
    - d. Reconnect the electrometer PCB cable.
  4. Restore the mass spectrometer for operation.
    - a. Replace the covers.
    - b. Restart the system.

## Replacing the Variable Damping Gas Regulator

To replace the variable damping gas regulator, you will need:

- Electronic Leak Detector, GL Sciences, Inc., Model LD-228 or equivalent
- Screwdriver, Phillips #2
- Variable Damping Gas Regulator (PN 23331-0100)
- Wrench, open-ended, 7/16-in.

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, top, and left covers as described in “[Removing the Covers](#)” on [page 24](#).

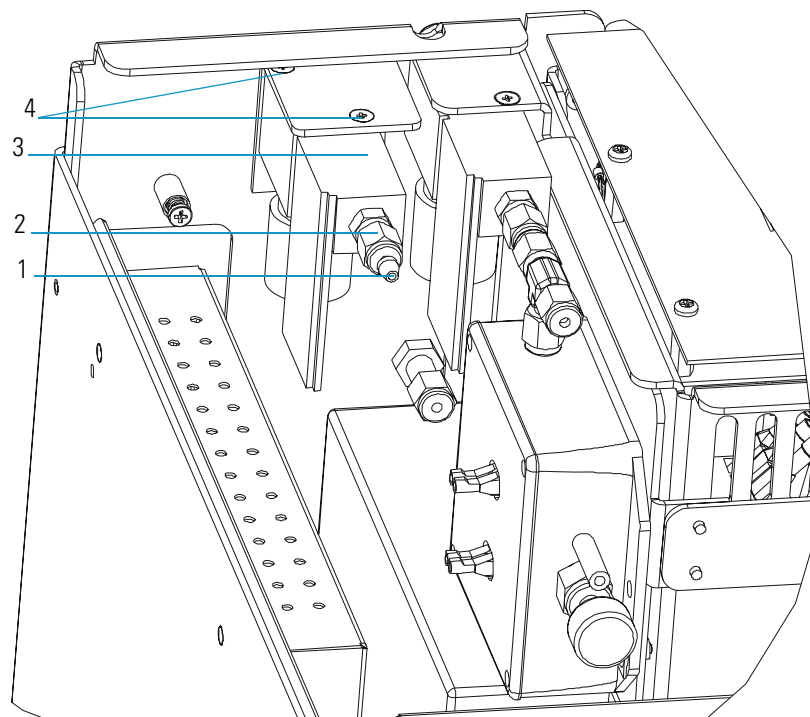
**Note** If the mass spectrometer and gas chromatograph share a gas line, you must also shut down the gas chromatograph.

## 2 Maintenance

### Replacing the Variable Damping Gas Regulator

2. Remove the variable damping gas regulator.
  - a. Use a 7/16-in. open-ended wrench to disconnect the orange gas line from the variable damping gas regulator.

**Figure 65.** Variable Damping Gas Regulator (Right Side View)



1	Orange gas line (not shown)	3	Variable Damping Gas Regulator
2	Gas Fitting	4	Two screws holding the Variable Damping Gas Regulator to the chassis

- b. Disconnect the variable damping gas regulator cable.
  - c. Remove the two screws holding the variable damping gas regulator to the chassis.
  - d. Remove the variable damping gas regulator from the chassis.
3. Replace the variable damping gas regulator.
  - a. Use the two screws to attach the new variable damping gas regulator to the chassis.
  - b. Reconnect the variable damping gas regulator cable.
  - c. Use the wrench to reconnect the orange gas line to the variable damping gas regulator.
4. Test the gas line fitting for leaks.
  - a. Use an electronic leak detector to check each fitting for leaks.





**CAUTION INSTRUMENT DAMAGE.** Do not use liquid soap leak detectors (such as Snoop) to check for leaks. They may contaminate your system.

**Note** It is normal for Helium to flow out of the vent on the back of the Variable Damping Gas Regulator.

- b. Correct leaks by tightening or replacing the connections until everything is leak-free.
5. Restore the mass spectrometer for operation.
- a. Replace the covers.
  - b. Restart the system.
  - c. Once the mass spectrometer has pumped down and is operational, check the Air/Water Spectrum for vacuum leaks. See the topic *Testing the Air/Water* in the Xcalibur Tune Online Help for more information.

## Replacing the Damping Gas Flow Module

This procedure contains instructions to replace the damping gas flow module.

To replace the damping gas flow module, you will need:

- Electronic Leak Detector (GL Sciences, Inc., Model LD-288 or equivalent)
- Damping Gas Flow Module, Standard (PN 119247-0001) or Damping Gas Flow Module, Adjustable (PN 119247-0002)
- Screwdriver, Phillips #2
- Wrench, Allen, 2.5 mm
- Wrench, open-ended, 5/16-in.

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, top, and right covers as described in “[Removing the Covers](#)” on [page 24](#).

**Note** If the mass spectrometer and gas chromatograph share a single Helium gas line, you must also shut down the gas chromatograph.

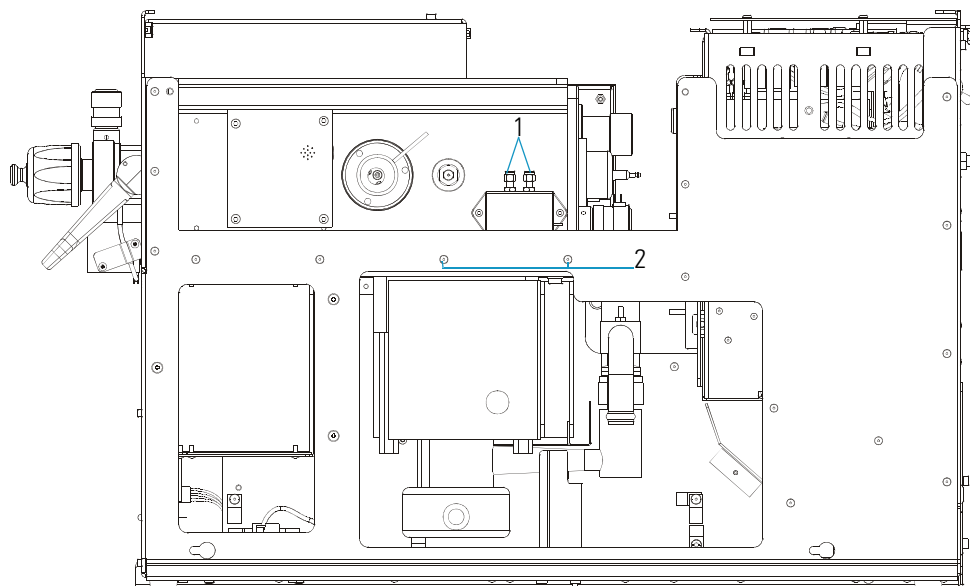
- d. Turn off the damping gas supply.

## 2 Maintenance

### Replacing the Damping Gas Flow Module

2. Remove the damping gas flow module.
  - a. Use a 5/16-in. open-ended wrench to disconnect the two gas line fittings from the damping gas flow module.

**Figure 66.** Damping Gas Flow Module (Right Side View)



1 Two gas line fittings

2 Two screws holding the damping gas flow module to the chassis

- b. If you have the adjustable damping gas upgrade option, remove the end of the orange tube from the variable damping gas regulator. Otherwise, continue to the next step.
      - c. Remove the two screws holding the damping gas flow module to the chassis.
      - d. Remove the damping gas flow module from the chassis.
3. Replace the damping gas flow module.
  - a. Use the two screws to attach the new damping gas flow module to the chassis.
  - b. Use the wrench to reconnect the two gas line fittings to the damping gas flow module.
  - c. If you have the adjustable damping gas upgrade option, insert the end of the orange tube into the variable damping gas regulator. Otherwise, continue to the next step.
4. Test the two gas line fittings for leaks.
  - a. Use an electronic leak detector to check each fitting for leaks.



**CAUTION INSTRUMENT DAMAGE.** Do not use liquid soap leak detectors (such as Snoop) to check for leaks. They may contaminate your system.

**Note** It is normal for gas to flow out of the vent on the back of the damping gas flow module. If you have the adjustable damping gas option, it is normal for gas to flow out of the back of the variable damping gas regulator.

- b. Correct leaks by tightening or replacing the connections until everything is leak-free.
5. Restore the mass spectrometer for operation.
    - a. Replace the covers.
    - b. Restart the system.
    - c. Once the mass spectrometer has pumped down and is operational, check the Air/Water Spectrum for vacuum leaks.

## Replacing the Ion Gauge

To replace the ion gauge, you will need:

- Gloves, clean, lint- and powder-free
- Ion Gauge (PN A0105-06003)
- Screwdriver, Phillips #2
- Wrench, Allen, 3 mm

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



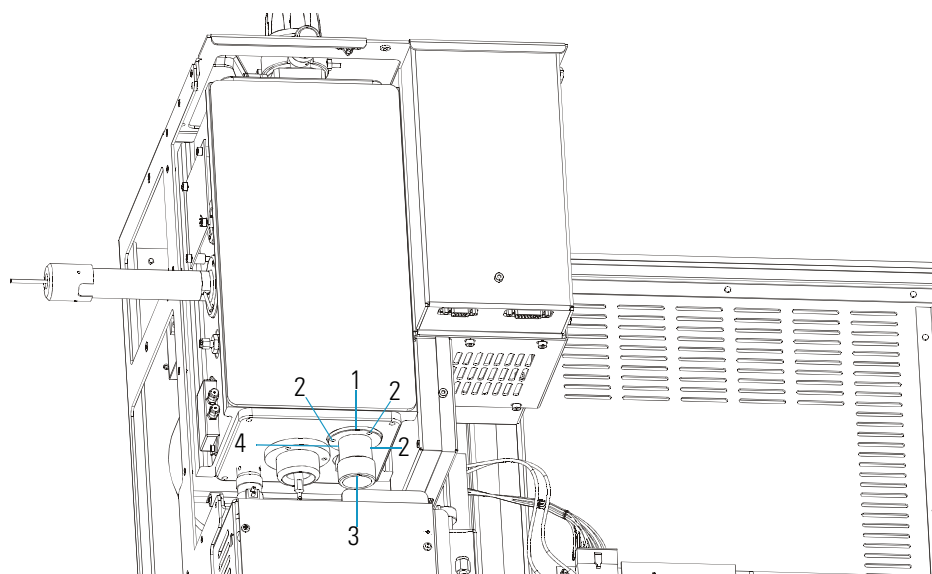
**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, top, and left covers as described in “[Removing the Covers](#)” on [page 24](#).
2. Remove the ion gauge.
  - a. Disconnect the ion gauge control PCB cable.

## 2 Maintenance

### Replacing the Ion Gauge

**Figure 67.** Ion Gauge and Vacuum Manifold (back view)



1	Ion Gauge housing (119605-0005)	3	Ion Gauge Control PCB cable (119378-0033 not shown)
2	Three screws holding the ion gauge housing to the vacuum manifold	4	O-ring (A0107-10056 not shown)

- b. Remove the three screws (shown in [Figure 67](#)) holding the ion gauge collar to the vacuum manifold.
  - c. Remove the ion gauge and ion gauge housing by tilting them outward, but do not let the O-ring fall down into the chassis.
  - d. Wearing clean gloves, remove the O-ring from the ion gauge and slide the ion gauge out of the ion gauge housing.
3. Replace the ion gauge.
- a. Insert the new ion gauge into the ion gauge housing and slip the O-ring over the end.
  - b. Push the ion gauge all the way into the end plate and turn the glass plug so that the ion gauge control PCB cable hangs straight down.
  - c. Use the three screws to attach the new ion gauge to the vacuum manifold.
  - d. Reconnect the ion gauge control PCB cable.
4. Restore the mass spectrometer for operation.
- a. Replace the covers.
  - b. Restart your system.

## Replacing the Lens Interface PCB

To replace the lens interface PCB, you will need:

- Lens Interface PCB (PN 119590-0110)
- Screwdriver, Phillips #2
- Wrench, Allen, 3 mm

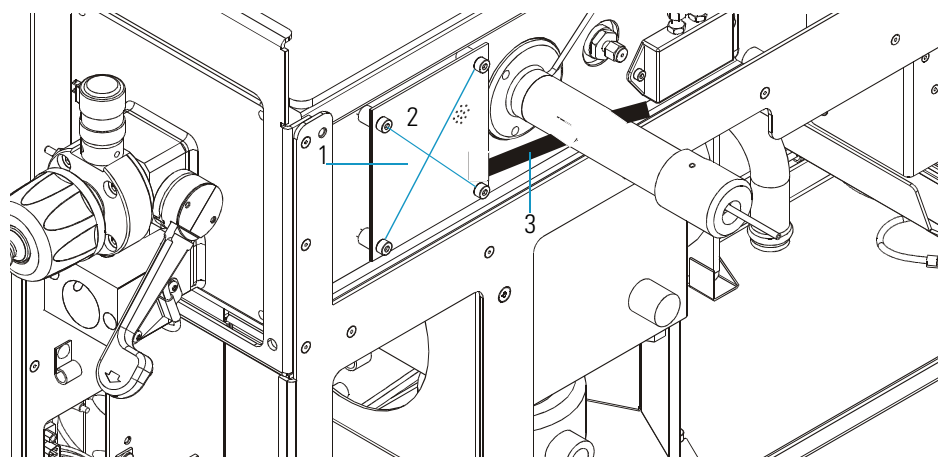
1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, top, and right covers as described in “[Removing the Covers](#)” on [page 24](#).
2. Remove the lens interface PCB.
    - a. Disconnect the lens interface PCB cable from the analog and balun PCBs.
    - b. Remove the four screws holding the lens interface PCB to the vacuum manifold.
    - c. Remove the lens interface PCB from the chassis.
  3. Replace the lens interface PCB.
    - a. Use the four screws to attach the new lens interface PCB to the chassis.
    - b. Reconnect the lens interface PCB cable to the analog and balun PCBs.

**Figure 68.** Lens Interface PCB (Right Side View)



- |       |   |   |                                    |
|-------|---|---|------------------------------------|
| 1     | Lens Interface PCB  | 3 | Lens Interface PCB Cable Connector |
| <hr/> |   |   |                                    |
| 2     | Four screws holding the lens interface PCB to the chassis |   |                                    |

## 2 Maintenance

### Replacing the Low Pass Filter PCB

4. Restore the mass spectrometer for operation.
  - a. Replace the covers.
  - b. Restart the system.

## Replacing the Low Pass Filter PCB

Use this procedure to replace the low pass filter PCB.

To replace the low pass filter PCB, you will need:

- Low Pass Filter PCB (PN 119590-0080)
- Screwdriver, Phillips #2
- Wrench, Allen, 2.5 mm
- Wrench, Allen, 3 mm

**Note** The RF Detector, RF Coil, and Low Pass Filter are individually covered and connected to each other. Together, they are referred to as the RF Module.

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).

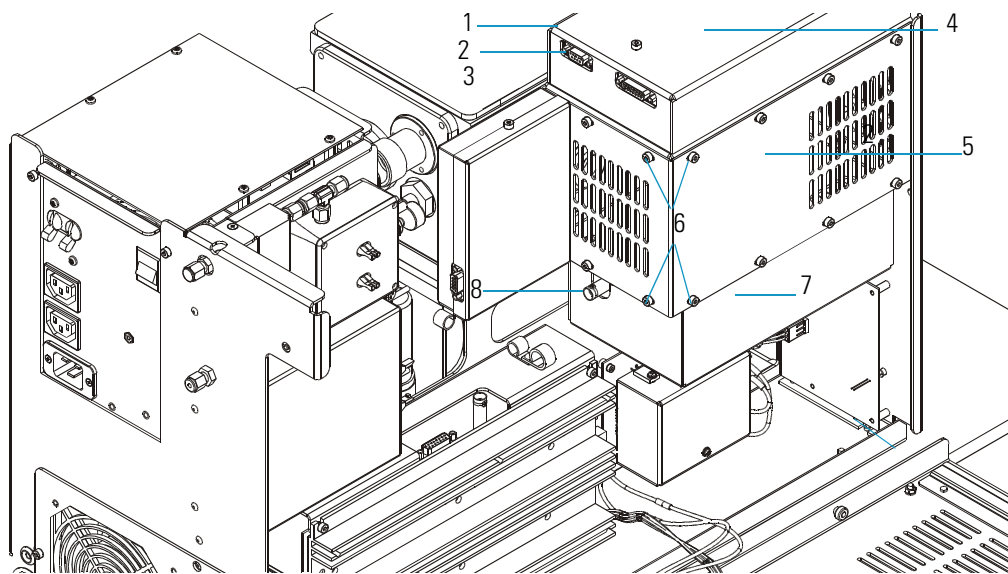


**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, top, and left covers as described in “[Removing the Covers](#)” on [page 24](#).

2. Disconnect all the cables from the RF module.

**Figure 69.** RF Module (Left Side View)



1	RF Module	5	RF Coil Cover
2	9-pin RF Detector PCB Cable connector	6	12 screws holding the RF Coil cover to the RF Module
3	15-pin RF Detector PCB Cable connector	7	Low Pass Filter cover
4	RF Detector PCB Cover	8	Low-Pass Filter PCB Cable connector

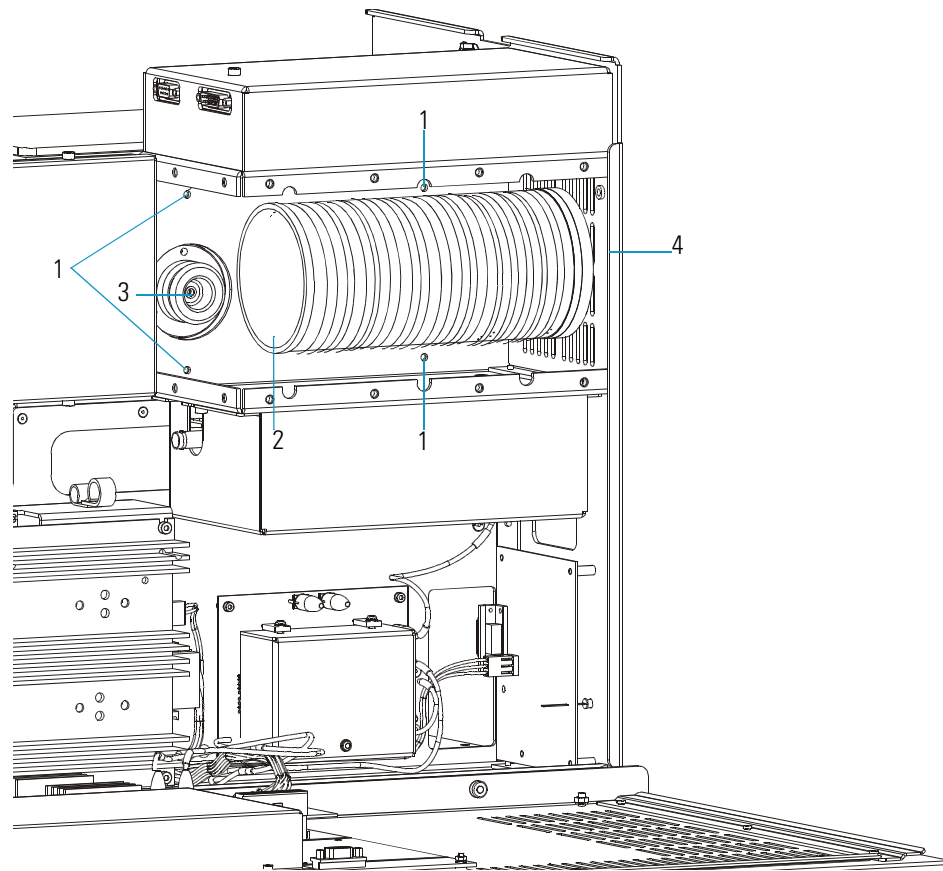
3. Remove the RF coil cover.
  - a. Remove the 12 screws holding the RF coil cover to the RF module.
  - b. Remove the RF coil cover and set it aside.

## 2 Maintenance

### Replacing the Low Pass Filter PCB

4. Remove the RF module from the vacuum manifold.
  - a. Disconnect the RF feedthrough connector.
  - b. Remove the bottom two screws that hold the RF module to the vacuum manifold and then loosen the top two screws.

**Figure 70.** Screws behind the RF Coil (Left Side View)



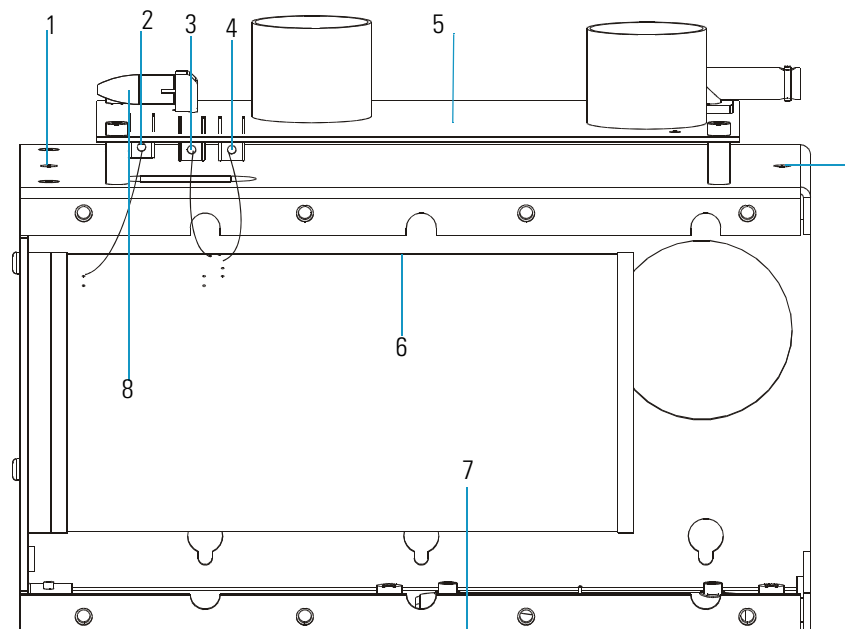
1	Four screws holding the RF module to the vacuum manifold	3	RF Feedthrough Connector
2	RF Coil	4	Two screws holding the RF module to the front of the chassis

- c. Remove the two screws holding the RF module to the front of the chassis.
- d. Remove the RF module from the chassis.



5. Remove the low pass filter PCB cover.
  - a. Turn the RF module over and set it on its top.
  - b. Remove the two screws holding the low pass filter cover to the RF module.

**Figure 71.** RF Module with Low Pass Filter Uncovered (Upside Down)



1	Two screws holding the Low Pass Filter cover to the RF Module	5	Low Pass Filter PCB
2	J1 Terminal Lug Connector	6	RF Coil
3	J2 Terminal Lug Connector	7	RF Detector PCB Cover
4	J3 Terminal Lug Connector	8	Balun PCB Cable Connector

- c. Remove the low pass filter PCB cover and set it aside.
6. Remove the low pass filter PCB.
  - a. Unscrew the terminal lugs from the low pass filter PCB.
  - b. Disconnect the balun PCB cable.
  - c. Remove the four screws holding the low pass filter PCB to the RF module.
  - d. Remove the low pass filter PCB from the RF module.
7. Replace the low pass filter PCB.
  - a. Reconnect the terminal lugs to the low pass filter PCB.
  - b. Reconnect the balun PCB cable.
  - c. Use the four screws to attach the new low pass filter PCB to the RF module.

8. Reattach the low-pass filter PCB cover.
  - a. Use the two screws to reattach the low pass filter PCB cover to the RF module.
  - b. Turn the RF module over and set it right-side up.
9. Return the RF module to the chassis.
  - a. Place the RF module in its slots on the vacuum manifold.
  - b. Tighten the four screws located behind the RF Coil.
  - c. Use the two screws to reattach the RF module to the front of the chassis.
  - d. Reconnect the RF feedthrough connector.
10. Use the 12 screws to reattach the RF coil cover to the RF module.
11. Reconnect all the cables to the RF module.
12. Restore the mass spectrometer for operation.
  - a. Replace the covers.
  - b. Restart the system.
  - c. Run Tune Diagnostics to verify that your system is operational.

## Replacing the Power Module

To replace the power module, you will need:

- 115 V Power Module (PN 119655-1115 or 230 V Power Module PN 119655-1230)
- Screwdriver, Phillips #2
- Wrench, Allen, 3 mm

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).

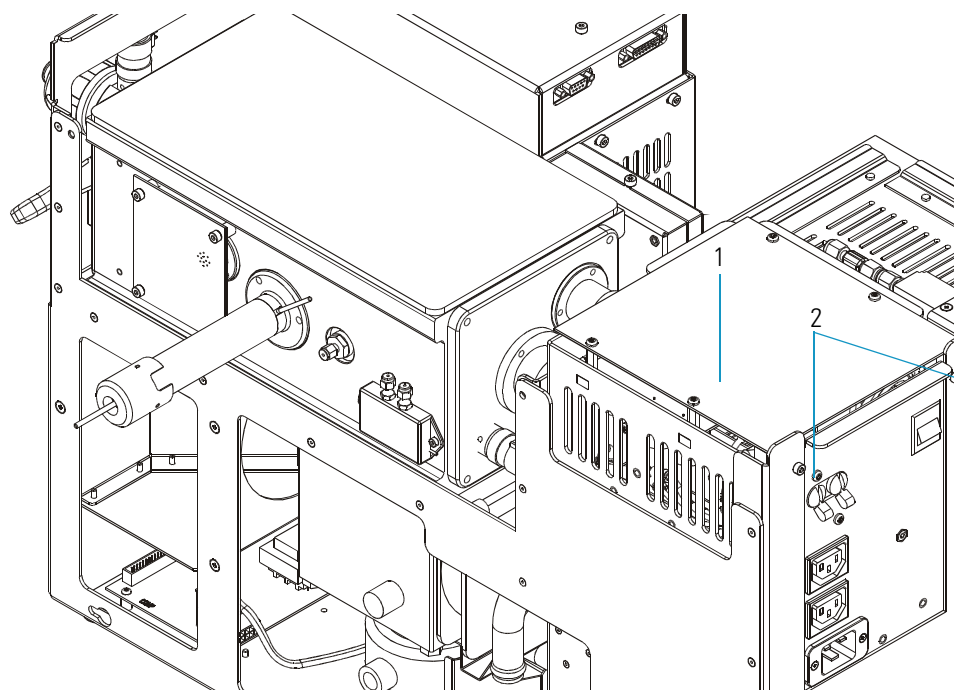


**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, top, and left covers as described in “[Removing the Covers](#)” on [page 24](#).

2. Remove the power module.
  - a. Remove the two screws holding the power module to the chassis.

**Figure 72.** Power Module (Back View)



1 Power Module      2 Two screws holding the Power Module to the chassis

- b. Use the handles on the power module to remove it from the chassis.
3. Replace the power module.
  - a. Insert the new power module in the chassis and align the connector on the bottom of the module with the plug at the bottom of the slot.
  - b. Use the two screws to attach the new power module to the chassis.
4. Restore the mass spectrometer for operation.
  - a. Replace the covers.
  - b. Restart the system.
  - c. Run Tune Diagnostics to verify that your system is operational.

# Replacing the Rear Cooling Fans

The rear cooling fans provide the necessary airflow that keeps the mass spectrometer cool. Clean them every four months by wiping them with a damp cloth. This helps prevent dust from accumulating inside the instrument. Use this procedure to replace a rear cooling fan.

To replace the rear cooling fans, you will need:

- Rear Cooling Fans (PN 119253-0001)
- Screwdriver, Phillips #2
- Wrench, Allen, 3 mm
- Wrench, open-ended, 1/4-in.

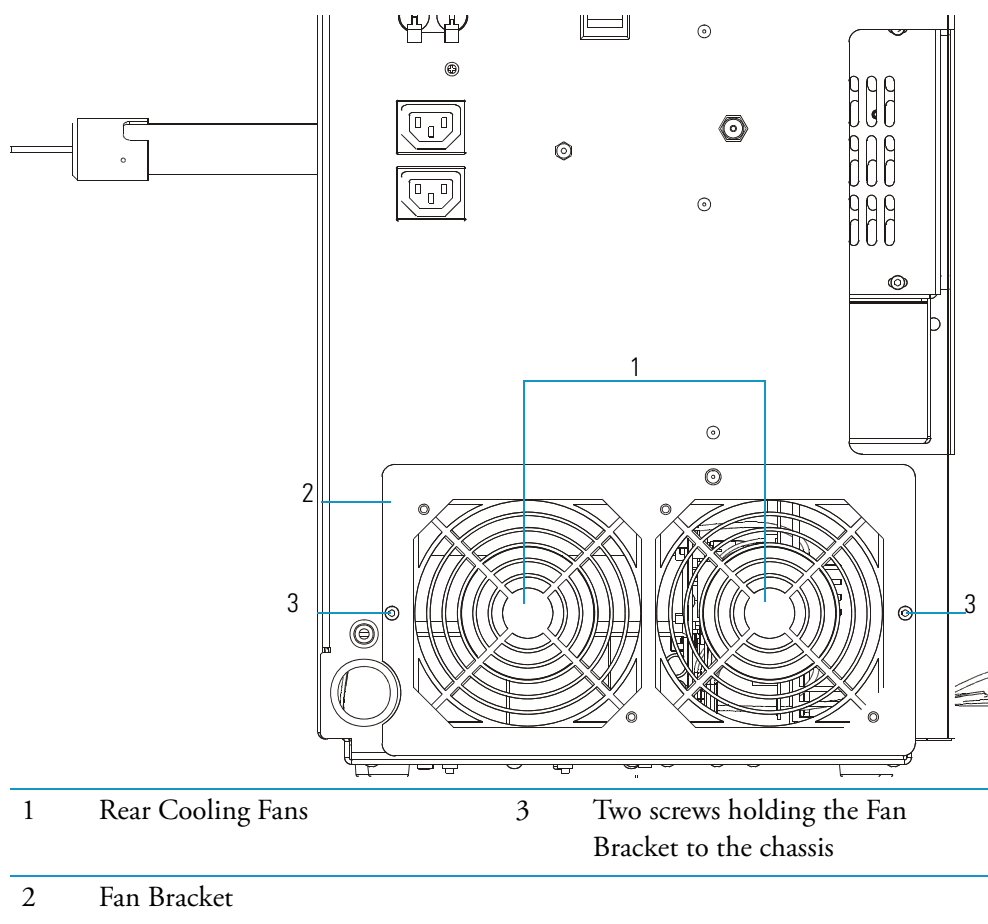
1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, top, and left covers as described in “[Removing the Covers](#)” on [page 24](#).
2. Remove the fan bracket.
    - a. Remove the two screws holding the fan bracket to the chassis.
    - b. Remove the rear cooling fans and the fan bracket.

**Figure 73.** Rear Cooling Fans (Back View)

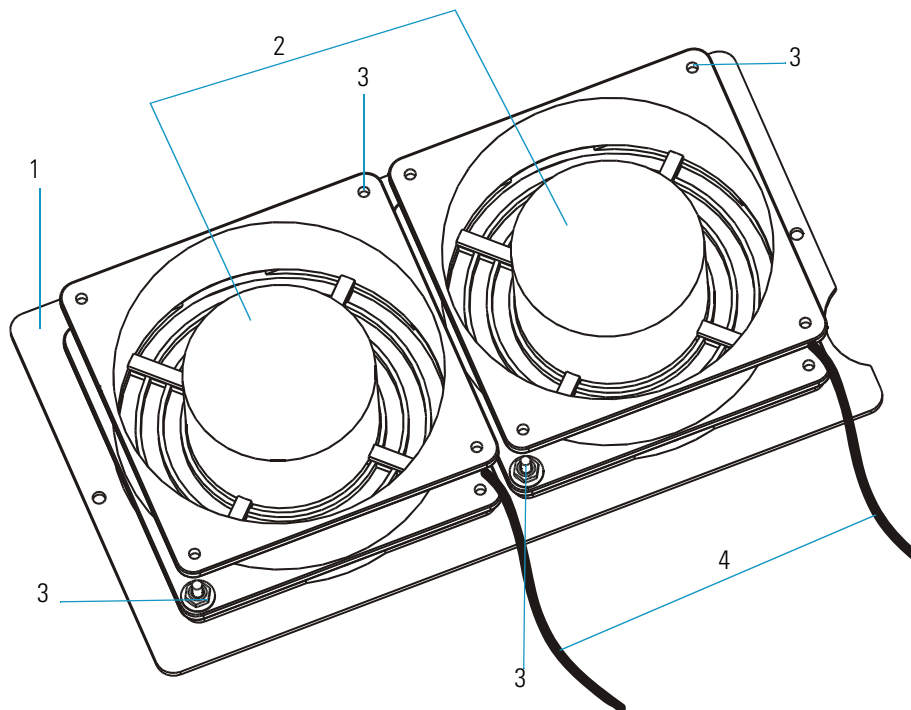


3. Remove the rear cooling fans from the fan bracket.
  - a. Disconnect the two fan cables.
  - b. Remove the four nuts holding the rear cooling fans to the fan bracket.
  - c. Remove the fans and set them aside.

## 2 Maintenance

### Replacing the Rear Cooling Fans

**Figure 74.** Rear Cooling Fans Removed (Top Down)



1	Fan Bracket	3	Four nuts holding the Rear Cooling Fans to the Fan Bracket
2	Two Rear Cooling Fans	4	Two Fan Cables

4. Replace the rear cooling fans.
  - a. Use the four nuts to attach the new rear cooling fans to the fan bracket. Make sure the airflow indicator arrow points into the mass spectrometer chassis and the wires are facing down.
  - b. Reconnect the two fan cables and make sure they face down.
  - c. Insert the rear cooling fans and fan bracket in the chassis.
  - d. Use the screws to attach the fan bracket to the chassis.
5. Restore the mass spectrometer for operation.
  - a. Replace the covers.
  - b. Restart the system.

## Replacing the RF Detector PCB

To replace the RF detector PCB, you will need:

- RF Detector PCB (PN 119590-0070)
- Screwdriver, Phillips #2
- Wrench, Allen, 2.5 mm
- Wrench, Allen, 3 mm

**Note** The RF detector, RF coil, and low pass filter are individually covered and connected to each other. Together, they are referred to as the RF module.

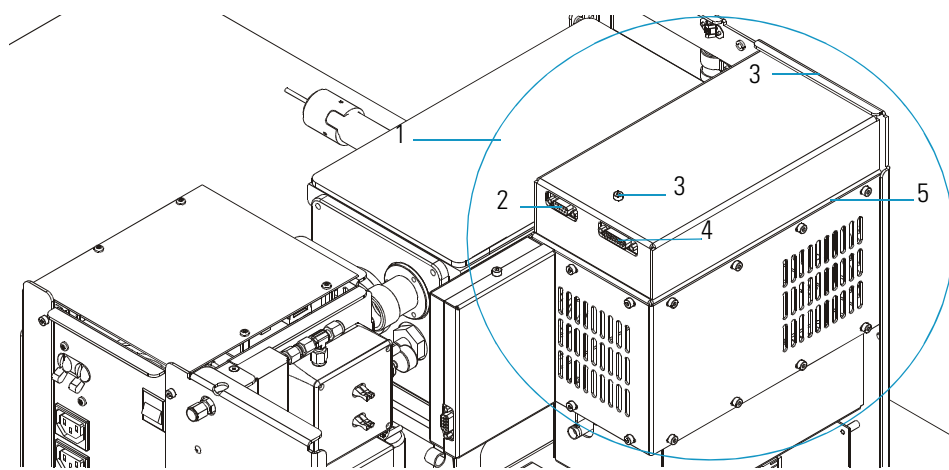
1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“Shutting Down” on page 16).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, top, and left covers as described in “Removing the Covers” on page 24.
2. Remove the RF detector PCB cover.
    - a. Disconnect the RF detector PCB cables.

**Figure 75.** RF Module (Left Side View)



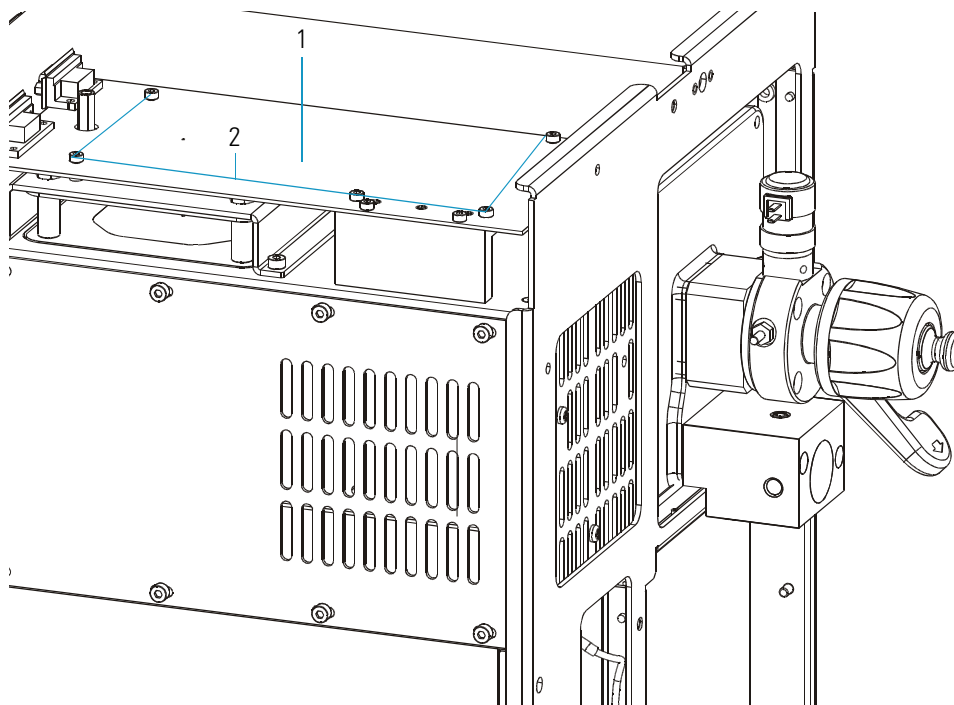
1	RF Module	4	15-pin RF Detector PCB Cable Connector
2	9-pin RF Detector PCB Cable Connector	5	RF Detector PCB Cover
3	Two screws holding the RF Detector PCB Cover to the RF Module and chassis		

## 2 Maintenance

### Replacing the RF Detector PCB

- b. Remove the two screws holding the RF detector PCB cover to the RF module and chassis.
  - c. Remove the cover and set it aside.
3. Remove the RF detector PCB.
- a. Remove the five screws holding the RF detector PCB to the RF module.

**Figure 76.** RF Detector PCB Cover Removed (Left Side View)



- |   |                 |   |  |
|---|-----------------|---|--|
| 1 | RF Detector PCB | 2 | Five screws holding the RF Detector PCB to the RF Module |
|---|-----------------|---|--|

- b. Remove the RF detector PCB from the RF module.
4. Replace the RF detector PCB.
- a. Insert the new RF detector PCB in the RF module, but make sure to maintain the same alignment as the old PCB.
  - b. Use the five screws to attach the new RF detector PCB to the RF module.
5. Use the two screws to reattach the RF detector PCB cover to the RF module.
6. Reconnect the RF detector PCB cables.
7. Restore the mass spectrometer for operation.
- a. Replace the covers.
  - b. Restart your system.
  - c. Run Tune diagnostics to verify your system is operational.



## Replacing the RF Generator PCB

To replace the RF generator PCB, you will need:

- RF Generator PCB (PN 119590-0060)
- Screwdriver, Phillips #2
- Wrench, Allen, 3 mm

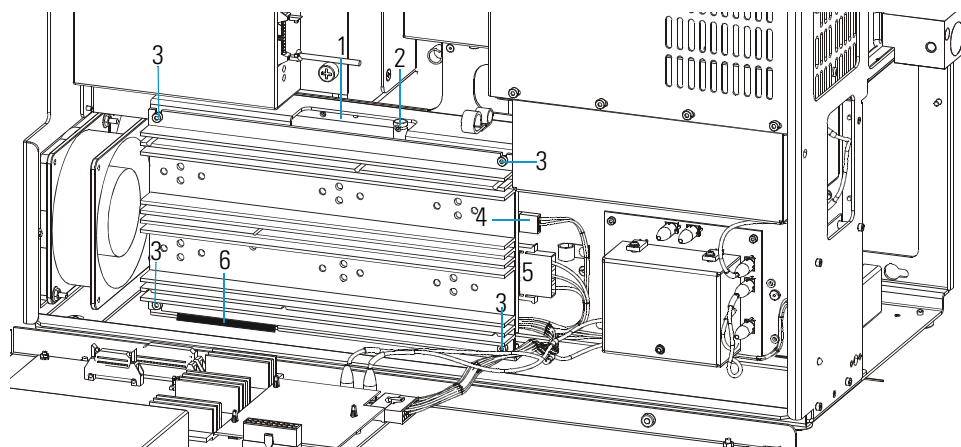
1. Prepare the mass spectrometer for maintenance.
  - a. Shut down and vent the mass spectrometer system described in “[Shutting Down](#)” on [page 16](#).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- b. Remove the front, top, and left covers as described in “[Removing the Covers](#)” on [page 24](#).
2. Remove the RF generator PCB.
    - a. Disconnect the 15-pin cable, coaxial cable, 3-pin cable, and 3-pin power cable from the RF generator PCB.

**Figure 77.** RF Generator PCB (Left Side View)



1	15-pin Cable Connector (not shown)	4	3-pin Cable Connector
2	Coaxial Cable Connector	5	3-pin Power Cable Connector
3	Four screws holding the RF Generator PCB to the chassis	6	50-pin Ribbon Cable Connector

- b. Remove the top two screws and loosen the bottom two screws holding the RF generator PCB to the chassis.
- c. Disconnect the 50-pin ribbon cable from the RF generator PCB.
- d. Remove the RF generator PCB from the chassis.

## 2 Maintenance

### Replacing a Fuse on the RF Generator PCB

3. Replace the RF generator PCB:
  - a. Reconnect the 50-pin ribbon cable from the RF generator PCB.
  - b. Insert the new RF generator PCB in the chassis, but be sure to maintain the same alignment as the old PCB.
  - c. Use the four screws to attach the new RF generator PCB to the chassis.
  - d. Reconnect the 15-pin cable, coaxial cable, 3-pin cable, and 3-pin power cable to the RF generator PCB.
4. Restore the mass spectrometer for operation.
  - a. Replace the covers.
  - b. Restart the system.
  - c. Run Tune diagnostics to verify that your system is operational. If the RF Gain Calibration fails, contact Thermo Fisher Scientific Technical Support.

## Replacing a Fuse on the RF Generator PCB

To replace a fuse inside the RF generator PCB, you will need:

- RF Generator PCB (PN 119590-0060)
- Screwdriver, Phillips #2
- Wrench, Allen, 3 mm

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer ([“Shutting Down”](#) on [page 16](#)).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front, top, and left covers as described in [“Removing the Covers”](#) on [page 24](#).
2. Remove the RF generator PCB.
    - a. Disconnect the 15-pin cable, coaxial cable, 3-pin cable, and 3-pin power cable from the RF generator PCB.
    - b. Remove the top two screws and loosen the bottom two screws holding the RF generator PCB to the chassis.
    - c. Disconnect the 50-pin ribbon cable from the RF generator PCB.
    - d. Remove the RF generator PCB from the chassis.

3. Locate and replace the defective fuse on the RF generator PCB with a fuse of the same type, voltage, and current rating, which are shown in [Table 5](#).

**Table 5.** Component and Current Ratings

Component	Fuse	Circuit	Type/Voltage/Current Rating	Part Number
RF Generator PCB	F1	36 V	0.5 A, Quick Act, 5 x 20 mm, 250 V	A0006-07608
RF Generator PCB	F2	28 V	1.0 A, Quick Act, 5 x 20 mm, 250 V	A0006-07610

4. Reinstall the RF generator PCB.
  - a. Reconnect the 50-pin ribbon cable to the RF generator PCB.
  - b. Insert the new RF generator PCB in the chassis, but be sure to maintain the same alignment as the old PCB.
  - c. Use the four screws to attach the new RF generator PCB to the chassis.
  - d. Reconnect the 15-pin cable, coaxial cable, 3-pin cable, and 3-pin power cable to the RF generator PCB.
5. Restore the mass spectrometer for operation.
  - a. Replace the covers.
  - b. Restart the system.
  - c. Run Tune Diagnostics to verify that your system is operational.

## Replacing the Transfer Line



**WARNING BURN HAZARD.** The transfer line and ion source can be as hot as 350 °C. Do not open or work inside the mass spectrometer before you ensure that the system is off, unplugged, and cool to the touch. This may take as long as one hour after Tune prompts you to turn off the mass spectrometer.

To replace the transfer line, you will need:

- Gloves, clean, lint- and powder-free
- Screwdriver, Phillips #2
- Transfer Line (PN 119640-1005)
- Wrench, Allen, 3 mm
- Wrench, open-ended, 5/16-in.
- Wrenches, two, open-ended, 7/16-in.

## 2 Maintenance

### Replacing the Transfer Line

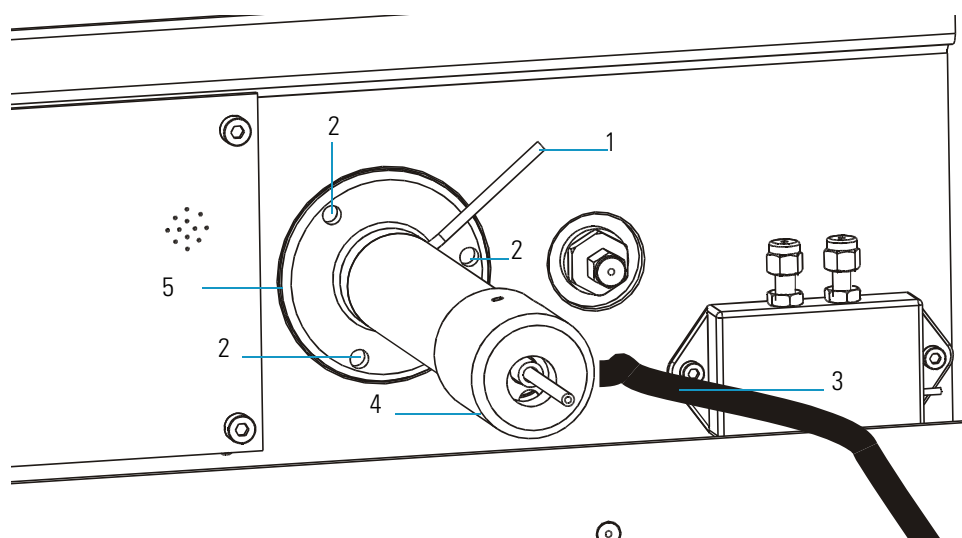
1. Prepare the mass spectrometer for maintenance.
  - a. Shut down and vent the mass spectrometer system described in “Shutting Down” on page 16.



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- b. Remove the front, top, and right side covers as described in “Removing the Covers” on page 24.
2. Remove the transfer line from the vacuum manifold.
  - a. Disconnect the GC column from the transfer line.
  - b. Disconnect the transfer line heater/sensor cable from the gas chromatograph.

**Figure 78.** Transfer Line (Right Side View)



1	Transfer Line Gas Fitting	4	Transfer Line
2	Three screws holding the transfer line to the vacuum manifold	5	O-ring (not shown)
3	Transfer Line Heater/Sensor Cable		

- c. Loosen the transfer line gas fitting.
  - d. Remove the three screws holding the transfer line to the vacuum manifold.
  - e. Remove the transfer line from the vacuum manifold.
3. Replace the transfer line.
  - a. Check the O-ring for damage and replace, if necessary.
  - b. Insert the new transfer line into the vacuum manifold.
  - c. Use the three screws to reattach the transfer line to the vacuum manifold.

- d. Reconnect the transfer line gas fittings.
  - e. Reconnect the transfer line heater/sensor cable.
4. Restore the mass spectrometer and gas chromatograph for operation.
    - a. Replace the covers.
    - b. Reconnect the GC column to the transfer line.
    - c. Restart the system.

## Replacing the Turbomolecular Pump Power Supply

To replace the turbomolecular pump power supply, you will need:

- Screwdriver, Phillips #2
- Turbomolecular Pump Power Supply (PN 76330-0100)

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



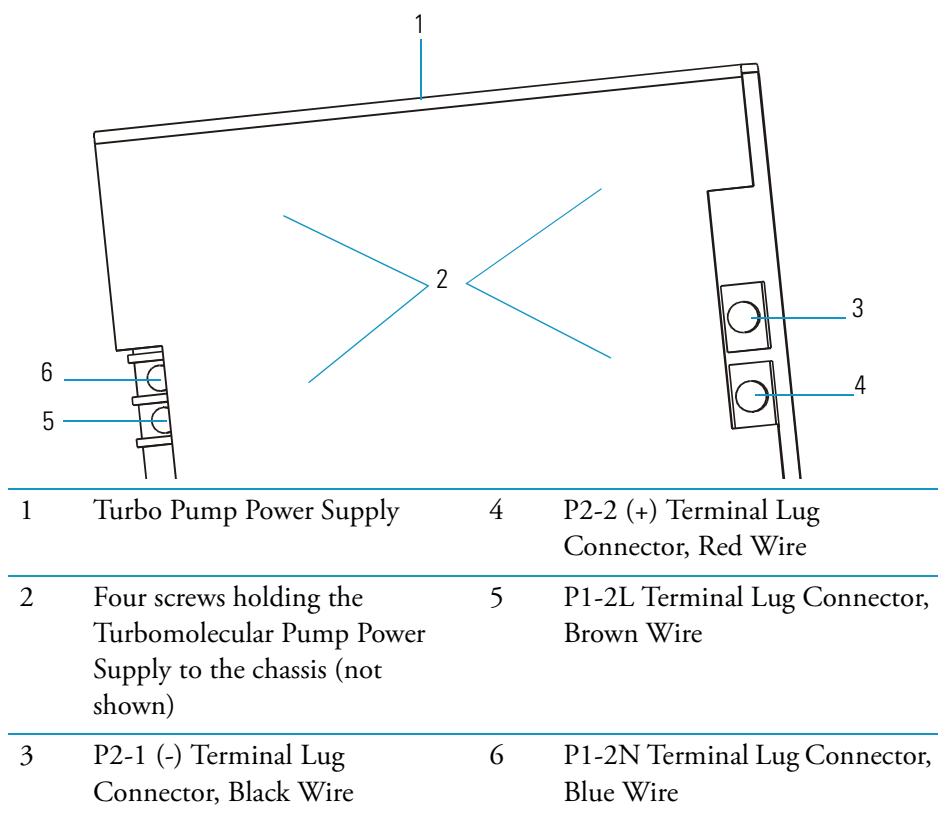
**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Disconnect the GC column from the transfer line.
  - d. Remove the front cover as described in “[Removing the Covers](#)” on [page 24](#).
  - e. Remove the two screws from the metal safety cover.
  - f. Remove the cover and set it aside.
2. Remove the turbomolecular pump power supply.
    - a. Unscrew the P2-1 (-), P2-2 (+), P1-2N and P1-2L terminal lugs from the turbomolecular pump power supply.

## 2 Maintenance

### Replacing the Turbomolecular Pump Power Supply

**Figure 79.** Turbomolecular Pump Power Supply (Top Down View)



- b. From the bottom of the mass spectrometer, remove the four screws holding the turbomolecular pump power supply to the chassis.



**CAUTION INSTRUMENT DAMAGE.** If you must slide the mass spectrometer forward off your work area to reach the screws, be careful not to drop the instrument or let it fall.

- c. Remove the turbomolecular pump power supply from the chassis.
3. Replace the turbomolecular pump power supply.
  - a. Insert the new turbomolecular pump power supply in the chassis.
  - b. Use the four screws to attach the turbomolecular pump power supply to the chassis.
  - c. Reconnect the terminal lugs.
4. Restore the mass spectrometer for operation.
  - a. Use the two screws to reattach the metal safety cover.
  - b. Replace the front cover.
  - c. Reconnect the GC column to the transfer line.
  - d. Restart the system.
  - e. Run Tune diagnostics to verify that your system is operational.

## Replacing the Vacuum Control PCB

To replace the vacuum control PCB, you will need:

- Screwdriver, Phillips #2
- Vacuum Control PCB (PN 119590-0031)
- Wrench, Allen, 2.5 mm

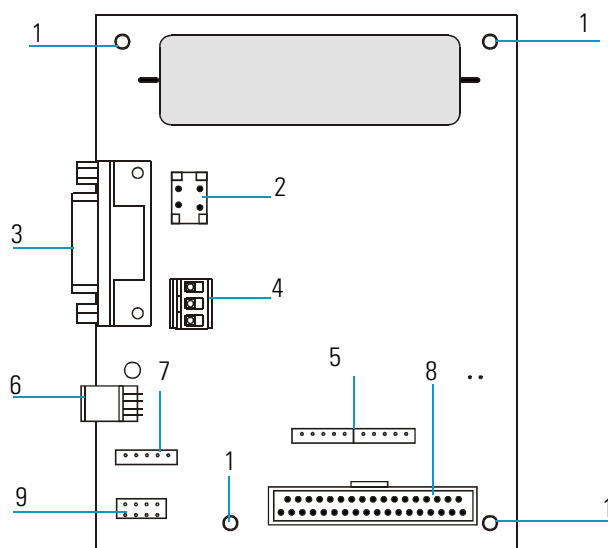
1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on page 16).



**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove all the covers as described in “[Removing the Covers](#)” on page 24.
2. Remove the vacuum control PCB.
    - a. Disconnect all the cables from the vacuum control PCB.

**Figure 80.** Vacuum Control PCB (Top Down View)



1	Four screws holding the Vacuum Control PCB to the chassis	6	8-pin Power Cable Connector
2	4-pin Cable Connector	7	8-pin Cable Connector
3	15-pin Cable Connector (if present)	8	30-pin Ribbon Cable Connector
4	3-pin Cable Connector	9	6-pin Cable Connector
5	Ion Gauge Control PCB Connector		

## 2 Maintenance

### Replacing the Vent Valve Solenoid

- b. From the front of the mass spectrometer, remove the four screws holding the vacuum control PCB to the chassis.
  - c. Remove the vacuum control PCB from the chassis.
3. Replace the vacuum control PCB.
    - a. Insert the new vacuum control PCB in the chassis and make sure the 30-pin ribbon cable is positioned towards the bottom.
    - b. Use the four screws to attach the new vacuum control PCB to the chassis.
    - c. Reconnect the vacuum control PCB cables.
  4. Restore the mass spectrometer for operation.
    - a. Replace the covers.
    - b. Restart the system.

## Replacing the Vent Valve Solenoid

To replace the vent valve solenoid, you will need:

- Lint-free paper
- Screwdriver, Phillips #2
- Vent Valve Solenoid (76461-1003)
- Wrench, adjustable

1. Prepare the mass spectrometer for maintenance.
  - a. Prepare a clean work area by covering the area with lint-free cloth.
  - b. Shut down and vent the mass spectrometer (“[Shutting Down](#)” on [page 16](#)).



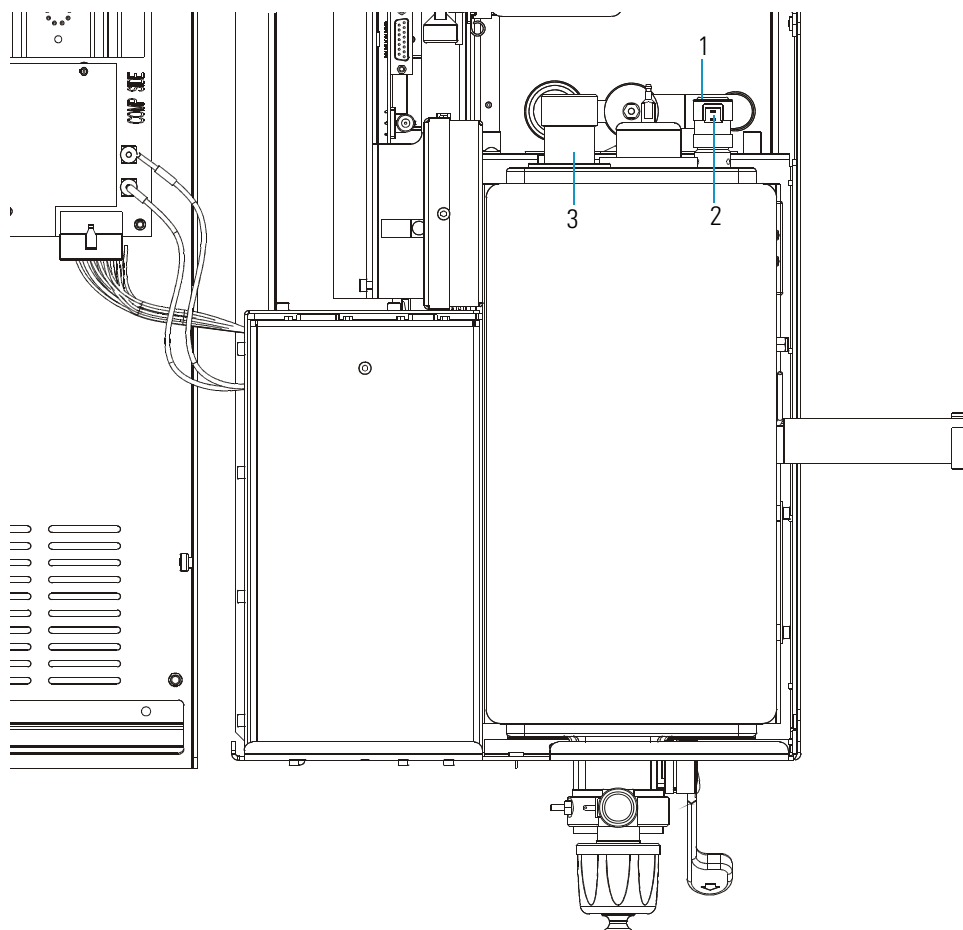
**WARNING - ELECTRICAL SHOCK HAZARD.** Unplug the mass spectrometer before proceeding.

- c. Remove the front and top covers as described in “[Removing the Covers](#)” on [page 24](#).



2. Remove the vent valve solenoid.
  - a. Disconnect the vent valve cable.

**Figure 81.** Vent Valve Solenoid (Top Down View)



---

1	Vent Valve Solenoid	3	Ion Gauge
2	Vent Valve Cable Connector (not shown)		

---

- b. Unscrew the vent valve solenoid and remove it.
3. Replace the vent valve solenoid.
  - a. Screw in the new vent valve solenoid.
  - b. Reconnect the vent valve cable.
4. Restore the mass spectrometer for operation.
  - a. Replace the covers.
  - b. Restart the system.

## **2 Maintenance**

Replacing the Vent Valve Solenoid

# Troubleshooting

This chapter provides quick reference to identify symptoms, causes, and solutions for poor instrument performance or malfunction. Typically, Tune Diagnostics will display a failure read-back on the instrument Status tab, then using this chapter you locate the matching diagnosis and solution. If the material in this chapter is insufficient to help you troubleshoot the problem, contact Thermo Fisher Scientific Technical support.

## Contents

- “Diagnostics” on page 123
- “Communication Symptoms” on page 125
- “Contamination Symptoms” on page 129
- “Filament and Lens Control Symptoms” on page 132
- “Heated Zone Symptoms” on page 133
- “High Vacuum Symptoms” on page 135
- “Linearity Symptoms” on page 137
- “Power Supply Symptoms” on page 138
- “RF Control Symptoms” on page 140
- “Sensitivity Symptoms” on page 142
- “Stability Symptoms” on page 145
- “Tuning Symptoms” on page 146

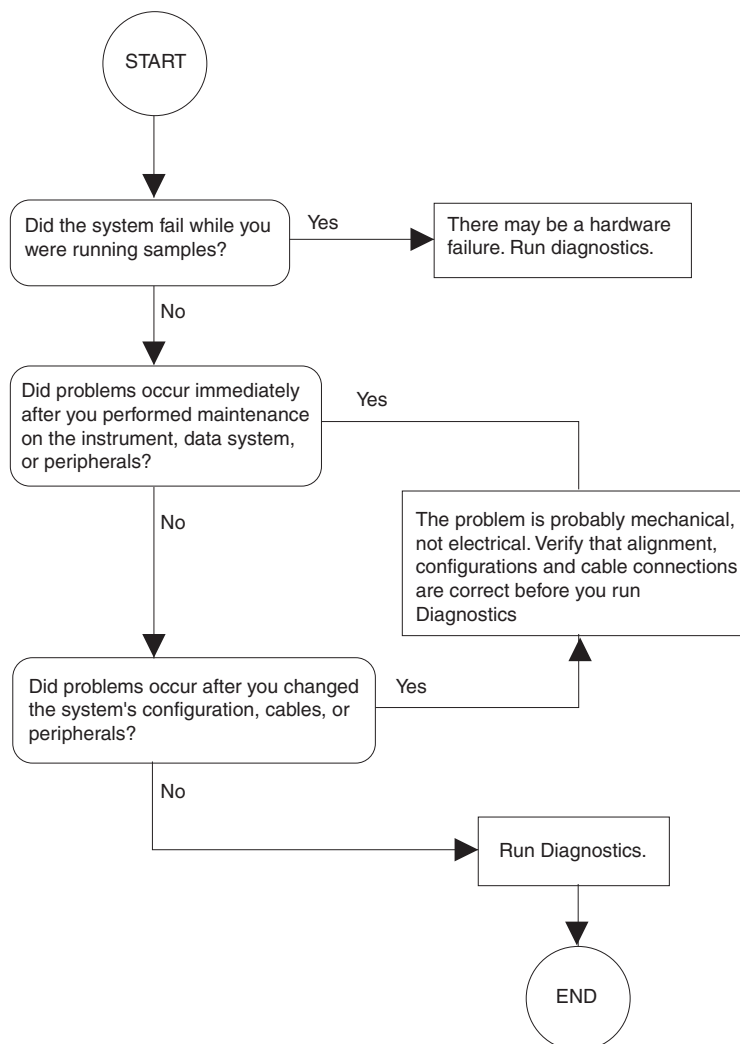
## Diagnostics

If your instrument is running poorly or suspiciously, Tune Diagnostics will help detect the problem and recommend a solution. Diagnostics tests electronic circuits and reports whether the circuits pass or fail. However, problems in sensitivity due to misalignment, dirty components, or improper tuning are not detected by Diagnostics.

## Running Diagnostics

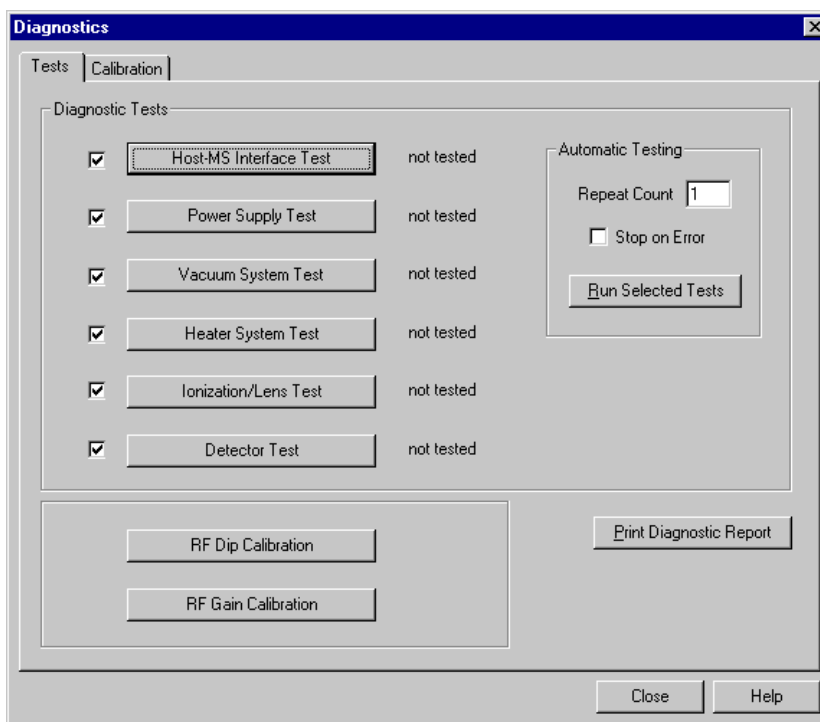
1. Before running the Diagnostics, refer to the flowchart in [Figure 82](#) to determine solutions outside of Tune Diagnostics.

**Figure 82.** Diagnostics Flowchart



2. Navigate to the Diagnostics window.
  - a. From the Xcalibur Home-Page, select Instrument Setup.
  - b. Open the mass spectrometer Method Editor and click the Tune button.
  - c. From Tune, select Diagnostics | Run Tests to display the Diagnostics window, which is shown in [Figure 83](#).

**Figure 83.** Diagnostics Window



3. Run diagnostic tests that may be related the instrument symptom. If you are unsure of which test to run, you can run all of them.

## Communication Symptoms

Communication symptoms likely involve links between the data system and the mass spectrometer, the gas chromatograph, and the autosampler. This section only addresses communication symptoms between the data symptom and the mass spectrometer.

Communication symptoms may occur during:

- Data transfer between the mass spectrometer and the data system
- Mass spectrometer, gas chromatograph and autosampler current status readbacks
- Instrument control, method downloading and uploading
- Start, stop, pause and initialize functions
- Error messages

## How does the MS communication work?

The flow of digital information in the mass spectrometer system is bi-directional; the data system downloads analytical methods to the instrument and activates functions to start, stop, shutdown, startup, and initialize. The mass spectrometer reports its readiness state and current tasks, various voltages, heated zones, and pressure readings. It also delivers a steady stream of mass spectral data during acquisition.

## Why does the MS have communication symptoms?

Some communication symptoms are due to mechanical faults—for instance, a cable may be unplugged, or a device may be turned off. In other cases, the instrument method could be incorrect for mass spectrometer operations. Less common communication symptoms are due to defective electronic hardware components.

## How do I detect communication symptoms?

Communication symptoms may be detected from an error message delivered by the data system or they may be noticed from the failure to perform some expected task. The Host-MS Interface Test will also detect a communication problem.

## Data system is unable to initiate communication with mass spectrometer.

### Possible Solutions

- The software is not configured correctly. Select the mass spectrometer from the Instrument Configuration window.
- The ethernet cable is unplugged. Verify that the ethernet cable is connected to the data system port on the mass spectrometer.
- The communication circuits on the digital PCB are faulty. Check connections to digital PCB. Replace if necessary.
- The ethernet card in the PC is not configured or is faulty. Check configuration, replace if necessary.
- The system is in service mode. Check if green power LED on front cover is flashing; return service switch to normal position if necessary.
- The incorrect ethernet cable is used for the MS. Use the supplied 10 Base-T Category 5 crossover cable.

**Note** The length of the ethernet cable may be extended by plugging a standard Category 5 cable in series with the supplied crossover cable.

## **Computer intermittently loses communication with mass spectrometer.**

### **Possible Solutions**

- The ethernet cable is loose or damaged. Inspect cable and replace if necessary.
- The communication circuits on the digital PCB are faulty. Check connections to digital PCB. Replace if necessary.

## **Unable to download methods to the mass spectrometer.**

### **Possible Solution**

The software is not properly configured. Verify correct settings in Instrument Configuration.

## **Acquisition does not begin as expected.**

### **Possible Solutions**

- The mass spectrometer start mode is not properly configured. Verify that the instrument is configured properly. Refer to Xcalibur online help for more information.
- The mass spectrometer Instrument Setup file has incorrect settings. Check start time in mass spectrometer Instrument Setup file.
- The forepressure is too high due to solvent peak. Reduce injection volume or extend filament/multiplier delay time until after solvent peak. See [“High Vacuum Symptoms”](#) on [page 135](#) for more information.
- The remote start cable to the GC is disconnected or damaged. Inspect and connect remote start cable. Replace the cable if necessary.
- The GC did not start. Verify GC methods and configuration. Verify connection between autosampler and GC.
- The autosampler did not start. Verify autosampler methods and configuration. Verify that the sample is present.
- The heated zone did not reach the set temperature. Refer to section on [“Heated Zone Symptoms”](#) on [page 133](#).

## **Unstable instrument read-back.**

### **Possible Solutions**

- There is a faulty cable connection. Check connections to the analog PCB.
- The digital PCB is faulty. Reseat connector between analog and digital PCB; replace if necessary.
- The analog PCB is faulty. Check connections to the analog PCB; replace if necessary.

## **Acquisition terminates unexpectedly.**

### **Possible Solutions**

- The End Run time in the mass spectrometer Instrument Setup file is incorrect. Check the Instrument Setup files for the GC and the MS.
- The data system is out of disk space. Check disk space; back up and remove files.

## **Unable to initialize the gas chromatograph.**

### **Possible Solutions**

- The GC is not turned on. Turn on the GC.
- The GC is not configured properly in Xcalibur. Check Instrument Configuration.
- The cable between the data system and GC is disconnected or damaged. Verify connection and cable integrity.
- The communication port on the data system is not configured properly. Verify communication port configuration.

## **Unable to download methods to the gas chromatograph.**

### **Possible Solutions**

- There is a discrepancy between method and configuration. Verify consistency between method and instrument configuration.
- The GC is not turned on. Turn on the GC.
- The GC is not configured properly in Xcalibur. Check Instrument Configuration.
- The cable between the data system and GC is disconnected or damaged. Verify connection and cable integrity.
- The communication port on the data system is not configured properly. Verify communication port configuration.



## Unable to initialize the autosampler.

### Possible Solutions

- Autosampler not turned on. Turn on the autosampler.
- Autosampler not configured properly in Xcalibur software. Check Instrument Configuration.
- Disconnected cable between autosampler and GC or data system. Verify connection.

## Unable to download methods to the autosampler.

### Possible Solutions

- Discrepancy between method and configuration. Verify consistency between method and instrument configuration.
- Autosampler not turned on. Turn on the autosampler.
- Autosampler not configured properly in Xcalibur software. Check Instrument Configuration.
- Disconnected cable between autosampler and GC or data system. Verify connection.

## Contamination Symptoms

Chemical noise is always present in any mass spectrometer. The high sensitivity of the ion trap can cause new users to confuse background with a contamination problem. Additionally, the spectra shown in Tune and Xcalibur Real-Time Display are auto-normalized, which can make small background peaks appear large.

Some chemical noise does present itself, such as septum bleed after a series of injections, vial sample bleed (which occurs if more than one injection is made from a sample vial), and peaks that appear in the chromatogram at regular intervals from focusing at the head of the column or in the injector.

Other possible contamination sources include hydrocarbon contamination of the carrier gas, or instrument cleaning solvents.

Always wear clean, lint- and powder- free gloves when handling ion source and mass analyzer components, and assure that the carrier gas filter, carrier gas lines, and gas regulators are free of contamination and leaks.

## **Excessive chemical background due to column bleed (m/z 429, 355, 281).**

### **Possible Solutions**

- Capillary column has not been properly conditioned. Condition the capillary column.
- Capillary column is damaged as a result of exposure to oxygen. Find the source of the oxygen in the carrier gas or air leak. Recondition or replace the capillary column.

## **There is excessive injection port septum bleed (typical m/z 207, 429, 355, 281).**

### **Possible Solutions**

- The septum is worn out or damaged. Replace the septum.
- Small pieces of septum are in the injection port liner. Replace the injection port liner, condition the capillary column.

## **There is phthalate background manifest in chromatograms (m/z 149, 167, 279).**

### **Possible Solution**

- Phthalate contamination has occurred due to sample handling or solvent contamination.
- Phthalates may be observed from packaging materials.
- Isolate source of phthalates such as vial lids or plastic solvent containers and remedy.

## **There is excessive hydrocarbon contamination manifest in chromatograms (typical ions are m/z 43, 57, 71, 85, 99).**

### **Possible Solution**

- Carrier gas tubing is contaminated.
- Isolate source of hydrocarbon contamination and remedy.
- Replace carrier gas tubing.
- Change carrier gas filters.

## There is chemical background due to rhenium oxide (m/z 185/187, 201/203, 217/219, 233/235, 250/252).

### Possible Solution

- These series of rhenium oxide ions come from oxidation of the rhenium filament wire due to the introduction of air into the ion source while the filament is on.
- Check for air leaks and remedy.
- See “[High Vacuum Symptoms](#)” on [page 135](#) for more information.

## Spectra are observed due to solvents:

### Possible Solutions

- There is residual solvent from a cleaning procedure or laboratory background contamination. Some common solvents and their EI ions are listed in [Table 6](#). When you finish performing a cleaning procedure, allow cleaned components to dry thoroughly. Warm parts in the GC oven to drive off residual solvent.
- The observed compounds have been introduced through sample injection. Ultimate source is either a sample solvent or the autosampler rinsing solvent. Optimize GC method to separate solvent peak from area of interest in the chromatogram.

**Table 6.** Solvent Spectra:

Solvent
Acetone (m/z 43, 58, 59)
Hexane (m/z 41, 43, 56, 57, 58, 85, 86)
Methanol (m/z 31)
Methylene chloride (m/z 84/86)
Toluene (m/z 91, 92)
Trichloroethane (m/z 151, 153)
Xylene (m/z 105, 106)

## Filament and Lens Control Symptoms

The lifetime of a filament depends on its exposure to oxygen and solvent vapors.

Tune Diagnostics tests the filament for continuity and current regulation. This test occurs before every Xcalibur acquisition and is designed to ensure data integrity.

Diagnostics tests the lenses of the mass spectrometer. A straight line should be seen, which indicates that the predicted voltage matches the actual voltage. If the curve is flat, absent or is not a line, then a lens or other control fault may be present.

Be careful to handle the lenses with care, and do not use harsh cleaning techniques. Damaged lenses cause short circuits, which in turn can cause damage to the lens drivers.

### Diagnostics indicate that the filament is open.

#### Possible Solution

- The filament is open. Vent the system and remove the filament as indicated in “[Cleaning the Ion Source](#)” on [page 56](#). The resistance of a working filament is about 1  $\Omega$ . If the measured value is very large, then the filament should be replaced.

### Inspection indicates that the filament is good, but the diagnostics still indicates the filament is open.

#### Possible Solutions

- The connection between the analog and lens interface PCB is defective. Check the connection.
- There is a fault in the source heater PCB. Replace the source heater PCB.
- There is a problem with the analog PCB. Replace if necessary.

### Unstable emission current.

#### Possible Solutions

- The filament is near the end of its life span. Replace the filament.
- There is a fault in the source heater PCB. Replace the source heater PCB.
- There is a problem with the analog PCB. Replace if necessary.

## Short filament lifetime.

### Possible Solutions

- There is an air leak contributing to short filament lifetime. Check for leaks; repair if any are found. See “[High Vacuum Symptoms](#)” on [page 135](#) for more information.
- The filament is on during solvent peak. Increase acquisition delay time until solvent peak has passed.
- High emission current is being used. Use lower emission current to extend lifetime.

## Diagnostics indicate a flat lens response.

### Possible Solutions

- There is a faulty connection or a short circuit to the lens. Remedy the fault.
- The power supply to the lens has a fault. Check the power module and replace if necessary.
- There is a fault with the lens drivers. Replace the analog PCB.

## Diagnostics indicate a trap offset issue.

### Possible Solution

- Cables J3 and J4 on the analog PCB are reversed. Check the cables and correct if necessary.

## Heated Zone Symptoms

The ion source and transfer line are heated zones related to the mass spectrometer. The ion source heater is controlled by the mass spectrometer and the transfer line heater is controlled by the Aux1 heated zone of the TRACE GC.

Often, a heated zone problem is the result of downloading a method to the mass spectrometer that has a different setpoint from the current setting, causing a delay while the heated zone heats or cools.

Component failures are less common, but can occur. These are usually related to open circuits in heater cartridges or faulty temperature sensors.

Heated zones in the gas chromatograph are not discussed in this manual.

## Excessive chromatographic peak tailing.

### Possible Solutions

- The ion source and/or transfer line are not hot enough. Increase the transfer line temperature. It should be at least as hot as the highest GC oven temperature. Increasing the ion source temperature may also help.
- Sample analyte is adsorbing in the GC injector. Clean and deactivate the injection liner. You can also try liners made of different materials.
- GC oven is not ramped to a high enough temperature. Extend the upper oven temperature.
- GC column needs to be replaced or does not have the appropriate stationary phase for your application. Change GC column.
- GC column does not extend at least 1 mm past the end of the transfer line tip. Insert GC column in transfer line so it extends 1 mm past the end of the tip.

## Source heater will not heat.

### Possible Solutions

- The ion source heater fuse (F1) is blown on the analog PCB. Replace the ion source heater fuse on the analog PCB. See [“Replacing a Fuse on the Analog PCB”](#) on page 81.
- The ion source heater cartridge is not connected. Check the connections between the analog and lens interface PCBs and lens interface PCB and ion source PCB.
- The 24 V dc power supply is not operable. Replace the power module if necessary.
- One or more heater cartridges on the ion source heater PCB is defective. Vent the system and check that the resistance of the heater circuit is about 24  $\Omega$ . Replace the source heater PCB if necessary.
- The source temperature sensor (RTD) is defective. Vent the system and check the resistance of the RTD. The resistance should be 108  $\Omega$  at 20 °C. Replace the source heater PCB if necessary.

## Source heater overheats.

### Possible Solutions

- The source temperature sensor (RTD) is defective. Vent the system and check the resistance of the RTD. The resistance should be 108  $\Omega$  at 20 °C. Replace the source heater PCB if necessary.
- There is a problem with the analog PCB. Replace if necessary.

## Transfer line will not heat.

### Possible Solutions

- Aux1 zone of GC is not configured for the MS transfer line. Configure Aux1 zone of GC and set the transfer line temperature in GC Method Editor.
- The measured resistance between the pins of the transfer line connector should be about 180  $\Omega$  between pins 2-4 and 3-4. The resistance is about 360  $\Omega$  between pins 2-3. If the measured values are incorrect, then the transfer line may need replacement.
- The transfer line temperature sensor (RTD) is defective. Measure resistance of RTD across pins 5-6. The resistance should be 108  $\Omega$  at 20 °C. Replace the transfer line if necessary.

## Transfer line overheats.

### Possible Solutions

- The transfer line temperature sensor is defective. Turn off the GC. Unplug the transfer line connector. Measure resistance of RTD across pins 5-6. The resistance should be 108  $\Omega$  at 20 °C. Replace the transfer line if necessary.

## High Vacuum Symptoms

High vacuum problems can manifest themselves in two ways. First if the vacuum pressure in the vacuum manifold fluctuates intermittently, the chromatographic signals may drop out, or if the pressures exceed the maximum allowed pressures by Xcalibur, then the MS may shut down. Second, if the vacuum pressure does not fluctuate intermittently, but is still a problem, then non-reproducible false chromatographic peaks can be generated in the chromatogram.

Typical forepressure readbacks are 30–40 mTorr (in EI mode), and typical manifold pressure (ion gauge readback) is  $1-5 \times 10^{-5}$  Torr. For CI mode, forepressure is usually 60-90 mTorr, with manifold pressures no greater than  $9 \times 10^{-4}$  Torr.

The most reliable way to find vacuum leaks is to spray a gas around the vacuum manifold and look for the characteristic ions in full-scan EI. Argon produces m/z 40. Alternatively, compressed electronic dusting spray containing an HFC can be used. For example, Falcon® Dust-Off® and MicroCare® Micro-Blast™ contain tetrafluoroethane, which produces ions at m/z 69 and 83.

## **Rotary-vane pump will not turn on.**

### **Possible Solutions**

- The rotary-vane pump is off. Check the rotary-vane pump switch.
- The rotary-vane pump power cable from the mass spectrometer is not connected. Connect the power cable.
- The rotary-vane pump is configured for incorrect line voltage. Configure the rotary-vane pump for proper line voltage.
- The rotary-vane pump is faulty. Replace the rotary-vane pump.

## **The rotary-vane pump powers on, but will not pump down.**

### **Possible Solutions**

- A large leak is present. Check for leaks and correct.
- The oil level in the rotary-vane pump is insufficient. Check oil level and add if necessary.
- The foreline hose is leaking. Check the clamps and connectors. Replace the foreline hose if a hole is found.
- The vacuum manifold top cover is leaking. Press down on the top cover to make sure it is seated properly.
- The rotary-vane pump is faulty. Replace the forepump.

## **Turbo pump will not power on.**

### **Possible Solutions**

- The forepressure is not low enough. Check the forepump and foreline plumbing for leaks and proper operation. Correct as necessary.
- The vacuum ready signal is not being transmitted by the vacuum control PCB. Check cable connections between vacuum control PCB and turbo pump controller. Also check the cable between the convectron gauge and the vacuum control PCB. Replace if necessary.
- The laboratory environment is too hot. Bring the laboratory environment to within mass spectrometer specifications.
- The line voltage is out of tolerance. Check the line voltage; correct as necessary.



## Unexpected full ventilation occurs.

### Possible Solutions

- A large leak is present. Check for leaks and correct.
- The system was vented through the inlet valve, there was a GC column break at the transfer line or the foreline was cut. Shut off the mass spectrometer main circuit breaker. Allow system to vent and cool to room temperature. Find and correct the cause.

## Vacuum fault.

### Possible Solutions

- A large leak is present. Check for leaks and correct as necessary.
- If your system is equipped with the optional ion gauge, then the manifold pressure must read less than  $1 \times 10^{-3}$  Torr for normal operation. If the pressure is too high then find and fix the leak.

## Linearity Symptoms

Linearity symptoms are manifest when a plot of intensity versus concentration of a known compound varies from the expected values. Poor instrument operating conditions can cause linearity problems. Additionally, certain compounds do not give a desired linear response due to chromatographic activity.

A well-maintained instrument will provide good linear response over a wide range of concentrations for most compounds. Like any instrument, however, the mass spectrometer has a saturation point.

Perform routine injector and column maintenance to minimize linearity problems. Keep the injected sample concentration within the system's working range. Usually, a hardware fault that affects linearity will show different symptoms than those which might be attributed to concentration.

## Calibration plots not sufficiently linear.

### Possible Solutions

- High-end standards are too concentrated for the ion trap. Use a split injection technique to decrease amount of sample or lower emission current to reduce MS sensitivity.
- Ion volume and lenses are dirty. Clean ion volume and lenses.
- Multiplier setting is incorrect. Run automatic tune.
- Injection port liner or capillary column is dirty. Change the injection port liner and trim the capillary column.
- Capillary column stationary phase is too thin for the high concentration samples. Use a higher capacity capillary column with a thicker stationary phase or use a split injection technique.
- The capillary column is bad, or has an inappropriate stationary phase for your analysis. Replace the capillary column.

## Power Supply Symptoms

Tune Diagnostics detects most power supply symptoms. Power supply problems often involve a blown fuse, faulty electronic components, or even something as simple as a disconnected cable. Use extreme care when you replace a fuse or electronic component. Turn off the mass spectrometer and unplug the instrument before removing the covers.



**WARNING - ELECTRICAL SHOCK HAZARD.** Use extreme care when replacing a fuse or electrical component. Turn off and unplug the mass spectrometer before removing the covers.

## **The mass spectrometer will not power on.**

### **Possible Solutions**

- Disconnected power cord. Verify that the power cord is plugged in.
- Voltage not coming from the electrical outlet. Verify that the electrical outlet is operational.
- Improper voltage at the electrical outlet. Verify that the outlet is using the correct voltage for your system.
- System is not switched on. Turn the system on.
- Faulty power module. Replace the power module.

## **The mass spectrometer powers on, but trips the circuit breaker.**

### **Possible Solutions**

- Faulty power module. Replace power module.
- Rotary-vane pump causes circuit breaker to trip. Check that the rotary-vane pump is configured for the correct line voltage. Replace if necessary.

## **The mass spectrometer powers on, but there are no voltages available.**

### **Possible Solutions**

- If there is no +5, +/- 15, +24 V power, then the power module fuse F1 may be blown or the power module may be faulty. Replace if necessary.
- If there is no +28 V power, then check the fuse on the RF generator and replace if necessary. If the fuse blows again after replacement, replace RF generator.
- If there is no +/- 150 V power, then check the power module PCB and replace if necessary.
- If there is no 28 V current then check the connections to the RF generator, RF control PCB, coil, and RF feedthrough.
- If there is no + 28 V current, -28 V, or +36 V, then the system may be off. Turn on the system by going to the Tune window and selecting Instrument | System On.

## **A 28 V current is below the acceptable range.**

### **Possible Solution**

- There is a bad connection in the RF circuit. Check the connections on the RF generator, low pass filter, RF coil, RF control, RF feedthrough, and ion trap ring electrode.

## **A 28 V current is above the acceptable range.**

### **Possible Solutions**

- The RF frequency is not calibrated. Calibrate the RF frequency using automatic tune.
- The RF generator overheated. Check the fans on the back of the mass spectrometer; clean or replace as necessary. Verify that there is adequate ventilation around the mass spectrometer. Verify that the lab temperature is within the operating limits of the mass spectrometer. Verify that the RF frequency is calibrated using automatic tune.
- The RF generator is faulty. Replace the RF generator PCB.
- The RF control assembly is faulty. Check the capacitor plate for high-voltage arcing; replace if necessary.
- There is a short circuit to ground in the RF feedthrough. Replace the RF feedthrough.
- There is a short circuit in the RF coil. Replace the RF coil.

## **RF Control Symptoms**

Automatic RF frequency calibration or RF dip and gain problems can be caused by several things. Begin troubleshooting ion trap control problems by using Tune Diagnostics.

Diagnostics helps you identify whether the fault is due to a power supply problem, a break in the RF signal path, or a faulty component.

## The RF dip calibration indicates random noise, instead of a smooth RF dip.

### Possible Solutions

- There is a loose cable. Check these cables:

#### Analog PCB to RF Detector PCB

Analog PCB to RF Generator PCB

RF Coil to RF Detector capacitor or RF feedthrough

RF Generator to Low Pass Filter

Lens Interface PCB to Balun PCB

Low Pass Filter to Balun PCB

RF Generator to RF Detector PCB

- The ring electrode is not contacting the RF feedthrough pin. Vent the system and check the pin for correct contact.
- The RF feedthrough is arcing. Replace the RF feedthrough.
- There is a fault with the RF generator power supply (28 V power supply). Check the fuse on the RF generator PCB; replace if necessary.
- The RF generator is faulty. Replace the RF generator PCB.

## An RF Dip is present, but outside the acceptable range.

### Possible Solutions

- There is high voltage arcing within the ion trap. Vent the system and disassemble the ion trap. Check for burn marks or evidence of arcing. Clean components and carefully reassemble. Replace the components if problems persist.

## The Det RF line (RF Gain Calibration screen) is not a smooth, straight line out to the instrument's maximum mass.

### Possible Solutions

- High voltage arcing is present. Check the RF coil, RF capacitor plate, RF feedthrough, and ion trap mass analyzer for evidence of high voltage arcing (discoloration or burn marks). Clean or replace affected parts as necessary.

## The Det RF and RF Mod lines are erratic.

### Possible Solutions

- There is a loose cable. Check the following cables:

#### Analog PCB to RF Detector PCB

Analog PCB to RF Generator PCB

RF Coil to RF Detector capacitor or RF feedthrough

RF Generator to Low Pass Filter

Lens Interface PCB to Balun PCB

Low Pass Filter to Balun PCB

RF Generator to RF Detector PCB

- High voltage arcing is present. Check the RF coil, RF capacitor plate, RF feedthrough, and ion trap mass analyzer for evidence of high voltage arcing (discoloration or burn marks). Clean or replace affected parts as necessary.

## Sensitivity Symptoms

If you observe a drop in instrument sensitivity, you should determine if the sensitivity drop was sudden or if it occurred gradually. A sudden loss of sensitivity can be the result of sudden component failure or an unnoticed change in the analytical method. Simple errors such as a plugged autosampler syringe or an empty sample vial can give the appearance of instrument failure.

Gradual drops in sensitivity are usually the result of source or lens contamination, and may be remedied by cleaning the ion volume or lenses.

The electron multiplier influences sensitivity and has a limited lifetime. Eventually it will need to be replaced. Improper GC maintenance is another cause of diminished sensitivity. It is important to establish a routine maintenance program for the GC. See the maintenance manual for your GC for more information on establishing a maintenance program.

## The chromatogram has a low total ion current signal.

### Possible Solutions

- The GC temperature ramp does not continue to a high enough temperature to elute high boiling point compounds. Extend the upper temperature or time at the upper temperature in GC oven ramp.
- The instrument is out of tune, or the tune file is incorrect. Select the correct tune file for the method or run automatic tune.
- The ion volume is contaminated. Clean the ion volume.
- The ion volume is incorrectly positioned. Position the ion volume properly.
- The magnets above and below the ion source are installed incorrectly. position both magnets so the south pole is on top. Electrons will not be focused into the ion volume if one magnet is upside down.
- The emission current is set too low. Check the setting listed for the emission current. The default emission current value is 250  $\mu$ A. See Tune | Manual and select the Controls tab.
- Cables J3 and J4 on the analog PCB are reversed. Check the cables and correct if necessary.
- Faulty ground connection between electrometer PCB and anode feedthrough. Check that the spring under the electrometer PCB is making good contact between the ground ring on the electrometer PCB and the anode feedthrough.
- The filament or the lens is not being properly controlled. Check for proper performance.
- The source heater PCB is faulty, allowing the emission current to leak to ground. Replace the source heater PCB.
- Reagent gas is leaking into the analyzer, suppressing EI signal. Check for the presence of CI reagent ions in spectrum. Replace the CI gas flow module if necessary.

## Poor compound sensitivity.

### Possible Solutions

- Incorrectly matched syringe, injection port liner, and column depth in injector. See the GC manuals for the correct combination.
- Insufficient sample delivery due to a plugged syringe needle. Clean or replace syringe.
- The injection port liner is contaminated. Clean or replace the injection port liner.
- Graphite or septa particles contaminate the injection port. Clean the injection port.
- The injector or septum is leaking. Replace the septum and perform leak check on GC.
- The capillary column is at the end of its life span. Replace the capillary column.

## Sensitivity is unstable or shows decrease with repeated injections.

### Possible Solutions

- The GC temperature ramp does not continue to a high enough temperature to elute high boiling point compounds. Extend the upper temperature or the time at upper temperature in the GC oven ramp.
- The ion volume or lenses are contaminated. Clean the ion volume and lenses.
- The ion source temperature is too low and causes the source to contaminate too quickly. Clean the ion volume and lenses and then raise the ion source temperature.
- The filament or the lens is not being properly controlled. Check for proper performance.
- The injection port liner or capillary column are contaminated. Replace the injection port liner and trim the capillary column.
- The multiplier gain is incorrect. Run the gain calibration from Tune by selecting Tune | Automatic Tune and then select the multiplier gain checkbox.

## Poor sensitivity in CI mode.

### Possible Solutions

- An EI ion volume is installed. Install a CI ion volume.
- The small hole in the CI ion volume is plugged. Use a dental pick or old syringe needle to clear it.
- The filament is not aligned. Remove the ion volume and check if the ion burn is centered around the small electron entrance hole. Be sure the filament is properly inserted into the connector. Carefully bend the filament wire to better align it with the ion volume.



- The ion volume is not inserted properly. While running the instrument, you can push on the ion volume with the I/R tool. Be sure to monitor the pressure to ensure that you get a good seal around the I/R tool. Otherwise, you may damage the filament. An increase in signal as you push on the ion volume usually indicates that the filament is not aligned properly.



**CAUTION INSTRUMENT DAMAGE.** Failure to ensure a good vacuum seal around the I/R tool will leak air into the mass spectrometer. This air leak could damage the filament if it is on.

## Stability Symptoms

Stability is concerned with consistent instrument precision and reproducible, accurate results. Good operating conditions for the mass spectrometer, gas chromatograph, and autosampler contribute to instrument stability.

Sample preparation errors, sample injection errors, and lack of routine maintenance on the instruments may cause stability symptoms.

When hardware faults affect instrument stability, investigate simple solutions first, such as cleaning the ion volume and lenses, or checking for air leaks. Usually, a hardware fault that affects stability will show different symptoms than those which might be attributed to software.

### Unstable mass assignment.

#### Possible Solution

- There is a problem with the RF control. See “[RF Control Symptoms](#)” on [page 140](#) for more information.

## The signal response is unstable or drops out unexpectedly.

### Possible Solutions

- There is a problem with the filament or lens control. Find and fix any problems. See “[Filament and Lens Control Symptoms](#)” on [page 132](#) for more information.
- There is an air leak. Check for leaks. Find and fix any problems. See “[High Vacuum Symptoms](#)” on [page 135](#) for more information.
- There is a high vacuum problem. Find and fix any problems. See “[High Vacuum Symptoms](#)” on [page 135](#) for more information.
- There is a contamination problem. Find and fix any problems. See “[Contamination Symptoms](#)” on [page 129](#) for more information.
- Dust has collected in the electron multiplier. Dust the electron multiplier with clean, dry gas.

## Tuning Symptoms

Symptoms when tuning the ion trap and lens may be the result of a misadjusted manual tune parameter. If Autotune fails, then the problem may be diagnosed by using the error messages or the instrument behavior.

### “Cannot find Calibration Gas” error message received.

#### Possible Solutions

- There is a mechanical problem with the ion source or lenses. Verify that an EI ion volume is installed. Verify correct orientation and cleanliness of ion volume. Verify cleanliness and correct operation of lenses.
- There is a problem with the RF control. See “[RF Control Symptoms](#)” on [page 140](#) for more information.
- The tune file settings are out of the usable range. Restore the default tune and calibration settings. Run automatic tune.
- The calibration gas vial is empty. Add 100  $\mu\text{L}$  (max) of the calibration compound to calibration gas vial.

## The multiplier gain calibration fails.

### Possible Solutions

- The multiplier is near the end of its lifetime. Multipliers typically last about 2-3 years before they are too noisy for the gain to be set accurately. Replace the multiplier.
- The electron multiplier has not been given sufficient time to outgas since venting. Allow more time to pump out.
- The GC column flow is too high. Lower it to 1 mL/min.
- There is dust on dynode or multiplier. Remove dust with dry gas.
- The multiplier anode is loose. Inspect and tighten anode.
- The multiplier power supply is faulty. Replace the multiplier power supply.
- The filament is the source of too much background noise. Find and fix the problems. See “[Filament and Lens Control Symptoms](#)” on [page 132](#) for more information.
- Chemical background in the manifold is elevated. Remedy leaks and sources of contamination in the carrier gas. See “[High Vacuum Symptoms](#)” on [page 135](#) for more information.
- The difference between the electron energy and the setpoint is greater than 5V. Contact technical support for assistance.

## Poor high mass resolution or resonant ejection calibration lines are always flat.

### Possible Solutions

- No helium buffer gas. Replace helium tank and remove air from the gas lines.
- No resonant ejection signal on endcap electrodes. Check all cables between analog PCB, balun PCB, and lens interface PCB. Replace the analog PCB.

## “Cannot perform waveform calibration” error message received.

### Possible Solutions

- There is poor high mass response. The waveform calibration may be too far off to be calibrated. Try restoring the default calibration and rerunning the Automatic Tune. If this does not work, run mass calibration and use the Estimate Waveform Calibration function in Diagnostics. Then, re-run the automatic tune.
- The cable connecting the analog PCB to the balun PCB is disconnected. Check and repair cable connections.
- The analog PCB is faulty. Replace the analog PCB.

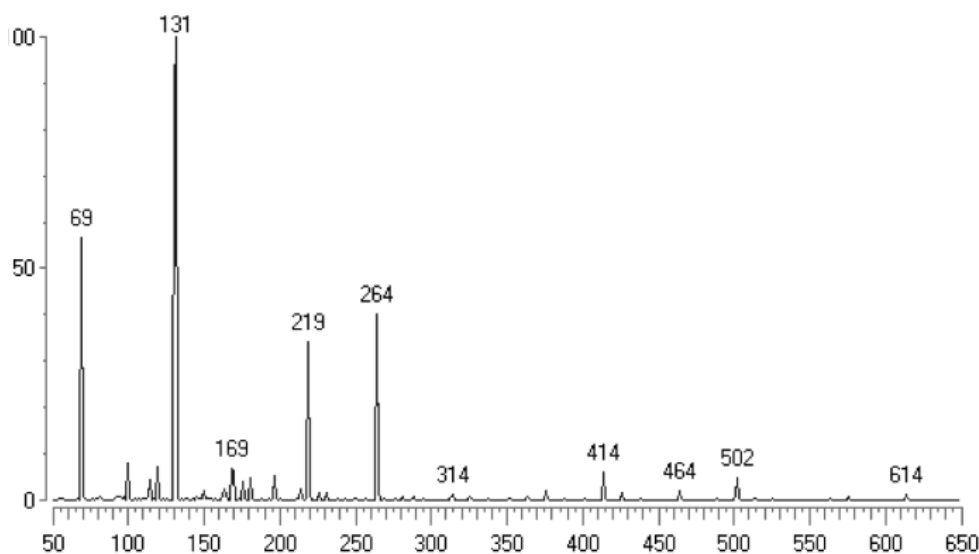
## Ion Ration Response.

Figure 84 shows a calibration gas spectrum.

**Figure 84.** Typical Calibration Gas Spectrum

Scan: 10288 IonTime: 0.235 ms TIC: 7.2e+6

3.1e+6



Because calibration gas levels are sensitive to instrument parameters, the ion ratios you see on your instrument may be different. However, if you use the experimental parameters found in Table 8, then your ion ratios should be similar to those found in Table 7.

**Table 7.** Operating Parameters For Spectrum Shown in Figure 84

Transfer line	200 °C
Filament	70 eV, 250 $\mu$ A
Lenses	-25, -100, -25 V
Trap Offset	-10 V
Injection RF Mode	Automatic
AGC Target	50
Injection Waveforms	Off
Environmental Tune	None
Ion Source	200 °C
GC	1.0 mL/min

Follow these steps to check ion ratios on your instrument.

1. Set the instrument to the operating parameters shown in [Table 7](#).

**Table 8.** Typical Observed Ion Ratios (normalized intensities)

m/z 69	54% $\pm$ 20%
m/z 131	100%
m/z 264	45% $\pm$ 20%
m/z 414	8% $\pm$ 5%
m/z 502	6% $\pm$ 4%
m/z 614	0.7% $\pm$ 0.5%

2. Make sure you have helium and there are no leaks in the gas lines. Use a hand-held leak detector (GL Sciences Inc. model LD-228) to check for helium leaks.
3. Check for vacuum leaks by scanning from m/z 80-90 in Tune while spraying tetrafluoroethane (Falcon® Dust-Off or MicroCare® MicroBlast™) around the vacuum manifold. Spikes in m/z 69 and 83 intensity indicate a vacuum leak. Alternatively, you can spray Argon gas while looking for spikes in m/z 40 intensity. Fix any leaks you find.
4. Allow the instrument to stabilize and pump for at least 8 hours before continuing.
5. Run Diagnostics and make sure no problems are reported.
6. Turn on EI/NICI calibration gas and allow it to stabilize for several minutes.
7. Run the automatic tune selecting all available options. It is very important to run all the automatic tune procedures including multiplier gain calibration.
8. Turn off the calibration gas.

## Poor High Mass Response

### Possible Solutions

- The RF control is not tuned correctly. Find and correct any problems. See “[RF Control Symptoms](#)” on [page 140](#) for more information.
- The dc trap offset is disconnected from the ring electrode. Check cable from P3 of the balun PCB to the low pass filter PCB. Repair or replace cable, if needed.
- The ion source temperature is too high. Reduce the ion source temperature to reduce the amount of thermal decomposition and fragmentation of your analyte.
- Lens 1 is too positive. High  $m/z$  ion intensities increase as Lens 1 is made more negative. Set to -25 V and use automatic injection RF mode to reduce this effect.
- The trap offset is too negative. High  $m/z$  ion intensities increase as the trap offset is made more positive. Set to -10 V and use automatic injection RF Mode to reduce this effect.
- Helium pressure in the ion source is incorrect. Optimize helium pressure in the source for your high  $m/z$  requirements. In most cases, adequate high  $m/z$  sensitivity is achieved with a column flow rate of 1.0 mL/min of helium.
- There is a vacuum leak. Find and repair any leaks. Be sure to check the transfer line fitting in the GC oven. See “[High Vacuum Symptoms](#)” on [page 135](#) for more information.
- There is an excess amount of low  $m/z$  ions. There is a limited capacity in the ion trap. If that capacity is used by low mass ions, there is no room for high mass ions. The low mass ions may be coming from solvents, hydrocarbon background, column bleed, or other sources of contamination. Remove the source of contamination. If the contamination can not be removed, try using segmented scans. Alternatively, if the contamination is in a mass range that you do not need to use, try turning on injection waveforms.
- The ion volume or lenses are contaminated. Clean the ion volume or lenses.
- The  $m/z$  131 is not base peak because the AGC target is too high. Use an AGC target of 50.
- The  $m/z$  131 is not base peak because the multiplier gain is incorrect. Run the multiplier gain calibration in automatic tune. A multiplier near the end of its useful life, which is typically 2–3 years, may be too noisy for the gain calibration to successfully run. If this is the case, then replace the multiplier.
- The injection RF is not calibrated. Run a complete automatic tune.
- There is a problem with the filament or lens control. Find and correct any problems. See “[Filament and Lens Control Symptoms](#)” on [page 132](#) for more information.
- The ion trap electrodes and/or spacers are contaminated. Clean the ion trap components.
- CI reagent gas is leaking into the analyzer, which suppresses the EI signal. Check for presence of CI reagent ions in the spectrum. Replace the CI reagent gas flow module if necessary.

## Weak signal.

### Possible Solutions

- The ion volume, ion source lenses, or ion trap is dirty. Clean the contaminated component(s).
- The multiplier gain is set incorrectly. Run the multiplier gain calibration in automatic tune. A multiplier near the end of its useful life, which is typically 2–3 years, may be too noisy for the gain calibration to successfully run. If this is the case, then replace the multiplier.
- The wrong type of ion volume is installed. EI and CI require different ion volumes. They may not be used interchangeably. Make sure the EI ion volume is installed.
- The ion volume is absent or incorrectly positioned. Verify that the ion volume is positioned correctly.
- There is a problem with the filament or lens control. Find and correct any problems. See “[Filament and Lens Control Symptoms](#)” on [page 132](#) for more information.
- CI reagent gas is leaking into the analyzer, which suppresses the EI signal. Check for presence of CI reagent ions in the spectrum. Replace the CI reagent gas flow module if necessary.

### **3 Troubleshooting**

Tuning Symptoms



# Vacuum System and Gas Inlets

This chapter discusses the vacuum system and gas inlets.

## Contents

- “Vacuum System Components” on page 153
- “Convectron Gauge and Foreline Adapter” on page 155
- “High Vacuum Pump” on page 156
- “Turbomolecular Pumps” on page 156
- “Ion Gauge (Upgrade Option)” on page 158
- “Rotary-Vane Pump” on page 159
- “Expansion Volume (Upgrade Option)” on page 160
- “Vacuum Manifold” on page 161
- “Gas Inlets” on page 162
- “Calibration Gas Flow Module” on page 163
- “CI Reagent Gas Flow Module (Upgrade Option)” on page 164
- “Damping Gas Flow Module” on page 165
- “Vent Valve Solenoid” on page 166

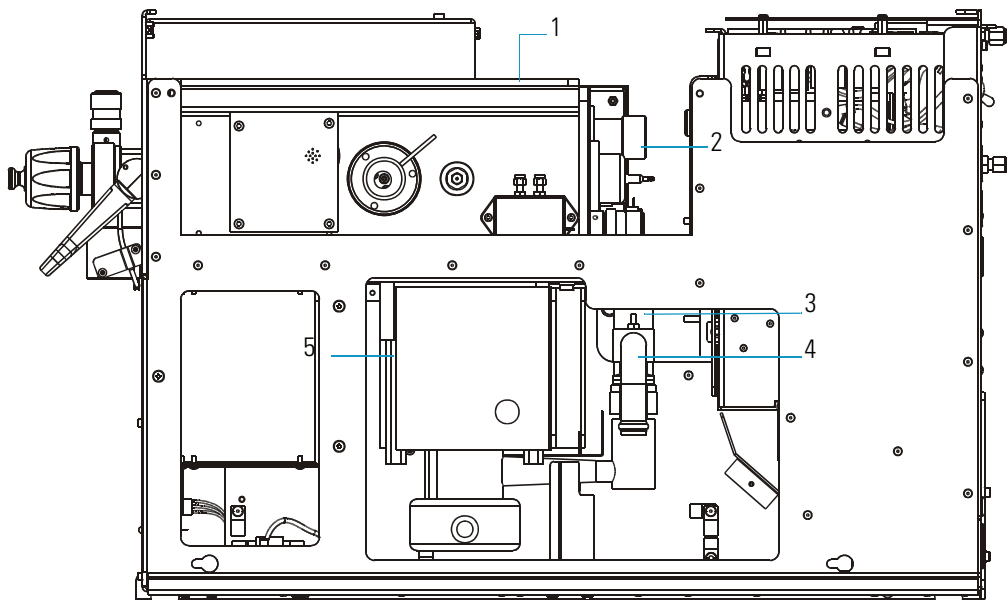
## Vacuum System Components

The vacuum system includes these components:

- Convectron gauge
- High-vacuum pump (turbomolecular)
- Ion gauge (upgrade option)
- Rotary-vane pump (and optional expansion volume)
- Vacuum manifold

## Description

Figure 85. Vacuum System Components



1	Vacuum Manifold	4	Foreline Adapter connects to the Foreline Hose
2	Ion Gauge	5	High-Vacuum Pump (Turbomolecular)
3	Convectron Gauge		

Vacuum system components lower the pressure within the mass spectrometer. The principal components include: the convectron gauge, high-vacuum pump, ion gauge, rotary-vane pump (and optional expansion volume), and the vacuum manifold. This also includes valves, gauges, and associated electronic and other control devices. All but the rotary-vane pump and expansion volume are located around the vacuum manifold.

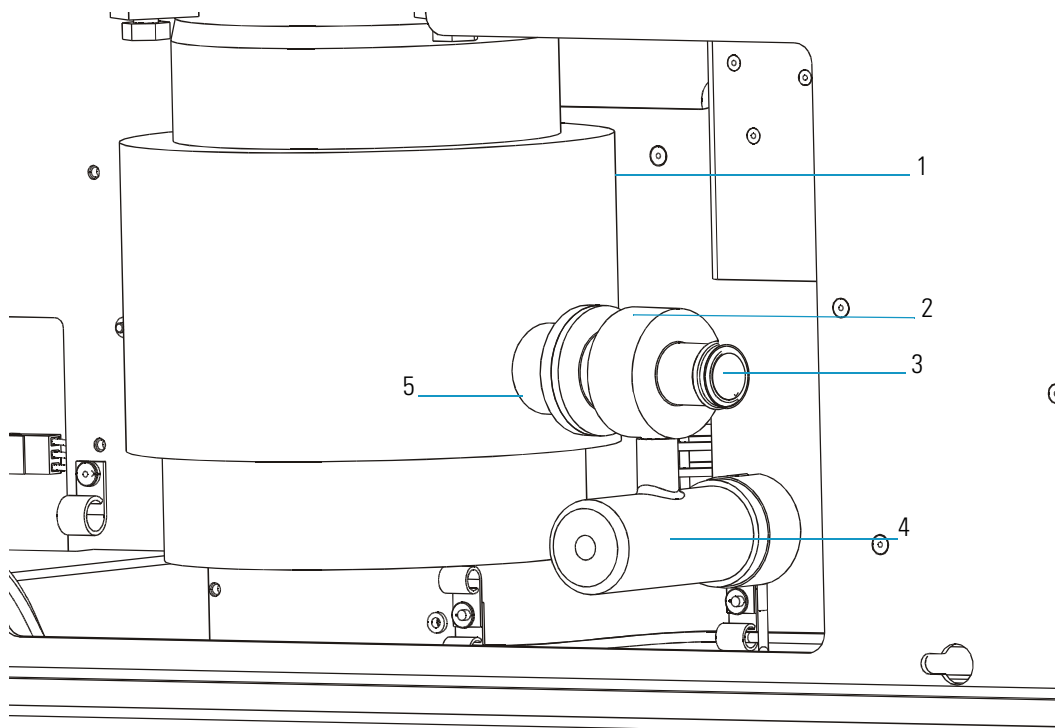
## Theory of Operations

These components maintain low pressure necessary for the ion source, ion trap, and ion detector system to operate properly. The vacuum manifold, which houses the ion source, ion trap, and ion detector system, is pumped (or evacuated) by the high-vacuum pump. The rotary-vane pump reduces the foreline pressure enough for the high-vacuum pump to operate.

## Convectron Gauge and Foreline Adapter

The convectron gauge and foreline adapter connect between the foreline hose and high-vacuum pump, which are shown in [Figure 86](#).

**Figure 86.** Convectron Gauge (right side view)



1	High-Vacuum Pump	4	Convectron Gauge
2	Foreline Adapter	5	High Vacuum Pump Outlet
3	Foreline Hose Outlet		

The convectron gauge measures the pressure in the foreline connecting the high-vacuum pump and the rotary-vane pump. If the foreline pressure inside becomes too high, the vacuum control PCB removes power to the high-vacuum pump.

The foreline adapter connects the foreline hose from the rotary-vane pump to the high-vacuum pump outlet.

## High Vacuum Pump

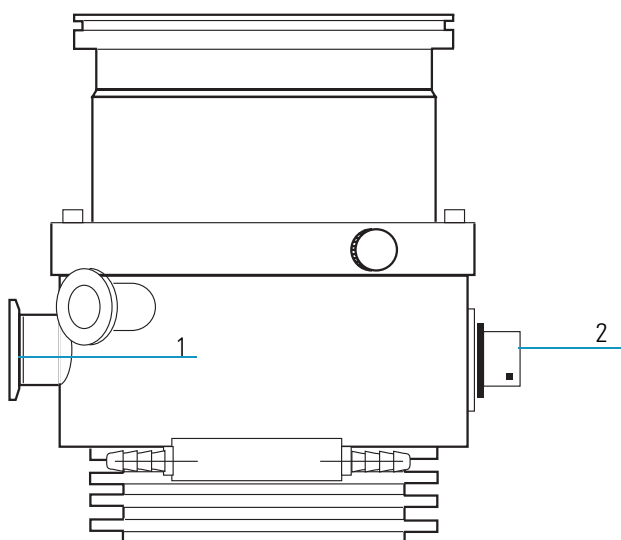
The mass spectrometer can be equipped with one of two types of high-vacuum pumps: a 250 L/s or 70 L/s turbomolecular pump.

## Turbomolecular Pumps

Two turbomolecular pump types are available: a 250 L/s or a 70 L/s. Turbomolecular pump operation is purely mechanical and does not require oil to create a high vacuum. This type of pump does not require maintenance.

The 250 L/s turbomolecular pump (shown in [Figure 87](#)) is a multi-stage axial-flow turbine in which high speed rotating blades provide compression by increasing the probability of gas molecules moving in the pumping direction. The 250 L/s turbomolecular pump is optimized for molecular flow conditions and requires the use of a rotary-vane pump to exhaust to atmosphere.

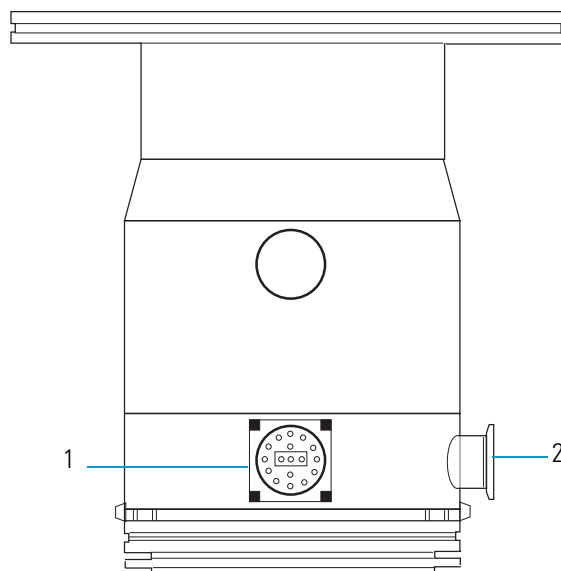
**Figure 87.** 250 L/s Turbomolecular Pump (left side view)



- |                                |                                     |
|--------------------------------|-------------------------------------|
| 1 Backing Port (Outlet Flange) | 2 Turbo Pump Power Supply Connector |
|--------------------------------|-------------------------------------|

The 70 L/s turbomolecular pump (shown in [Figure 88](#)) combines bladed turbomolecular stages with molecular drag stages on the same rotor. This design allows for operation even with high foreline pressures.

**Figure 88.** 70 L/s Turbomolecular Pump (left side view)

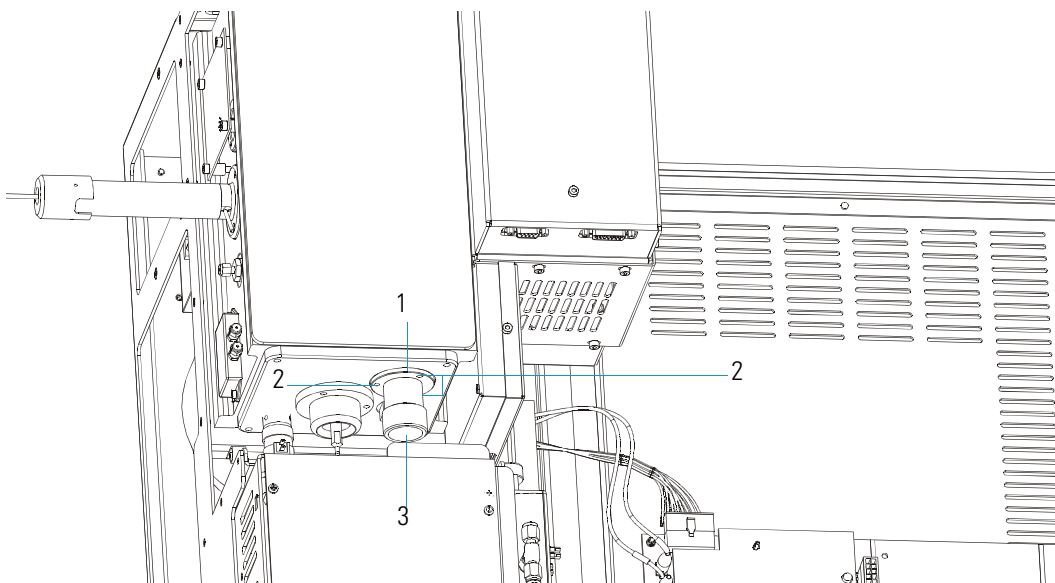


- |                                     |                                |
|-------------------------------------|--------------------------------|
| 1 Turbo Pump Power Supply Connector | 2 Backing Port (Outlet Flange) |
|-------------------------------------|--------------------------------|

## Ion Gauge (Upgrade Option)

The ion gauge, shown in [Figure 89](#), mounts outside and to the back of the vacuum manifold

**Figure 89.** Ion Gauge (top down view)



1	Flange Collar	3	Ion Gauge Control PCB Cable Connector (not shown)
2	Three screws holding the Ion Gauge Collar to the vacuum manifold		

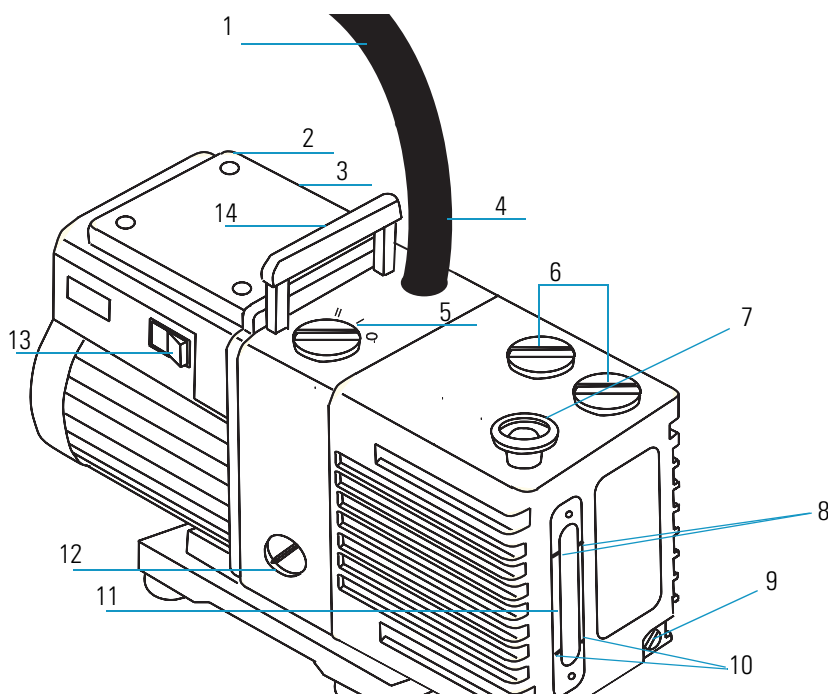
An ion gauge measures the pressure inside the vacuum manifold. The ion gauge measures pressures up to  $1 \times 10^{-3}$ .

If you have an ion gauge, it must measure a pressure below  $1 \times 10^{-3}$  Torr for the filament, electron multiplier, or conversion dynode to be turned on.

## Rotary-Vane Pump

The rotary-vane pump, shown in Figure 90, is typically located on the floor behind the mass spectrometer. It is a two-stage forepump that connects to the outside of the mass spectrometer. The pump establishes the vacuum necessary for properly operating the turbomolecular pump.

**Figure 90.** Rotary-Vane Pump (right, back side view)



1	Foreline Vacuum Hose	8	MAX Marks
2	Electrical Inlet Connector	9	Oil Drain Plug
3	Voltage Indicator	10	MIN Marks
4	Inlet Port	11	Oil Level Sight Glass
5	Gas Ballast Control	12	Mode Selector
6	Oil Filler Plugs	13	On/Off Switch
7	Outlet Port	14	Lifting Handle

The rotary-vane pump connects to a high-vacuum pump (Turbomolecular) by a piece of 0.75 in. i.d. tubing. The power cord plugs into the rear of the mass spectrometer in the outlet labeled MECH PUMP. This outlet powers the pump and is controlled by the main circuit breaker and not by the service switch.

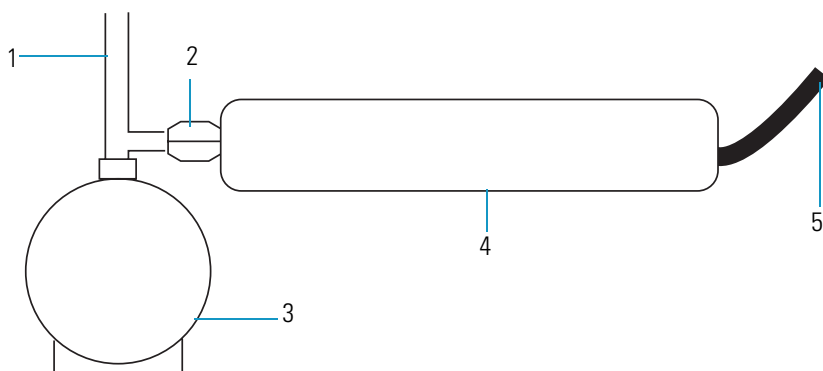


**CAUTION INSTRUMENT DAMAGE.** Always make sure the voltage indicator on the rotary vane pump matches the line voltage that is used. Always plug the rotary-vane pump power cord into the outlet on the rear of the mass spectrometer and never into a wall outlet. This prevents the rotary-vane pump from operating when the mass spectrometer is switched off.

## Expansion Volume (Upgrade Option)

As an upgrade option, the rotary-vane pump can include an expansion volume, which is shown in [Figure 91](#).

**Figure 91.** Expansion Volume (right side view)



1	To the mass spectrometer	4	Expansion Volume
2	Restrictor	5	To the inlet valve
3	Rotary-Vane Pump		

The expansion volume connects to the inlet port of the rotary-vane pump (shown in [Figure 91](#)). This reduces a device foreline pressure surges when an inlet valve is evacuated.

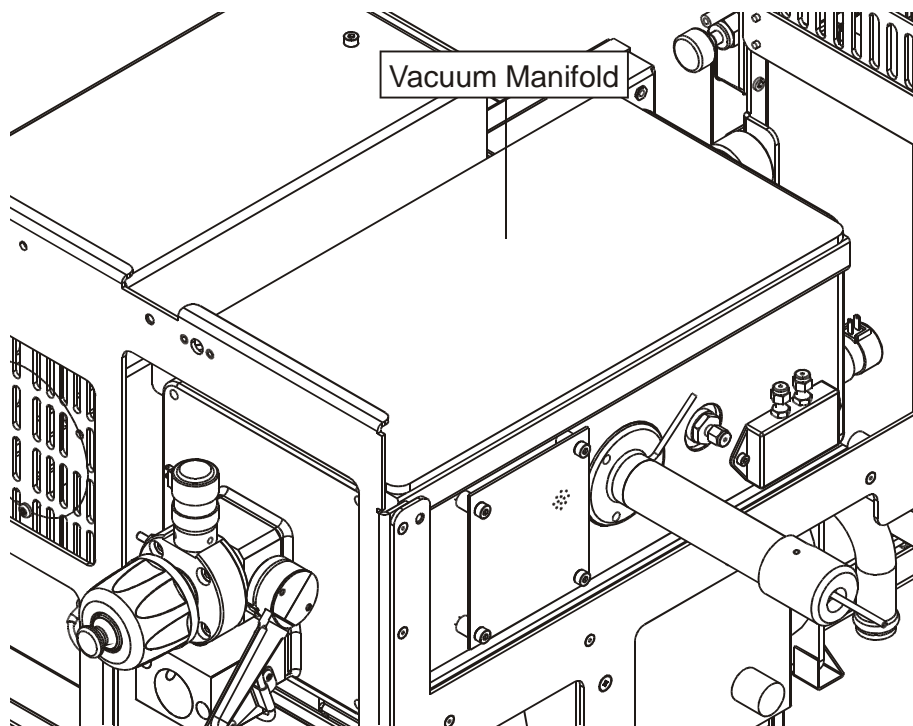
The smoothing of the foreline pressure prevents the vacuum control PCB from temporarily removing power from the high-vacuum pump when the inlet valve is evacuated.



## Vacuum Manifold

The vacuum manifold, shown in [Figure 92](#), is located on the top right side of the mass spectrometer, directly above the high vacuum pump.

**Figure 92.** Vacuum Manifold (top, right view)

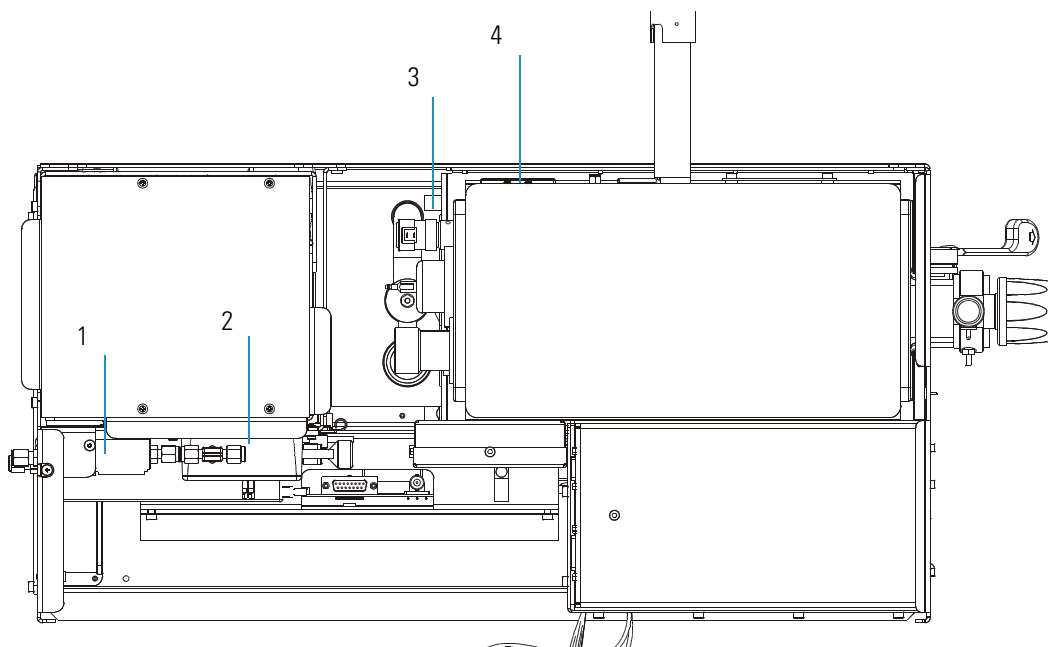


The vacuum manifold is a thick walled, aluminum chamber that encases the ion source, the ion trap, and the ion detector system. The vacuum manifold has a removable cover, machined flanges on the front and rear, and various electrical feedthroughs and gas inlets.

## Gas Inlets

Gas inlets, shown in [Figure 93](#), control flow to the vacuum manifold.

**Figure 93.** Gas Inlets (top down view)



1	CI Reagent Gas Flow Module (optional)	3	Vent Valve Solenoid
2	Calibration Gas Flow Module	4	Damping Gas Flow Module

## Description

There are four gas inlets to the vacuum manifold: a calibration gas flow module for calibration compound control, an optional CI reagent gas flow module that regulates the flow of CI reagent gas into the ion source, the damping gas flow module that regulates damping gas flow into the ion trap, and a vent valve solenoid for venting the vacuum manifold to atmosphere.

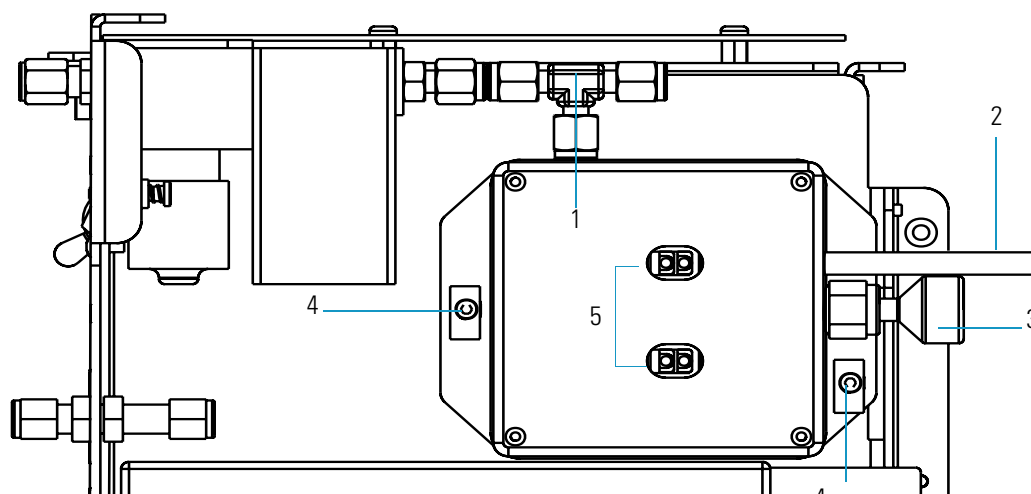
## Theory of Operations

These components allow for the control of gases into the vacuum manifold to allow for tuning, the proper operation of the ion trap, the proper venting of the vacuum manifold, and optionally the creation of a CI region.

## Calibration Gas Flow Module

The calibration gas flow module, shown in [Figure 94](#), controls the flow of calibration compound into the ion source and is mounted on the left rear of the mass spectrometer.

**Figure 94.** Calibration Gas Flow Module (left side view)



1	Gas Fittings	4	Screws holding the Calibration Gas Flow Module to the chassis
2	Foreline Adapter Tubing	5	Electrical Plugs
3	Calibration Compound Vial		

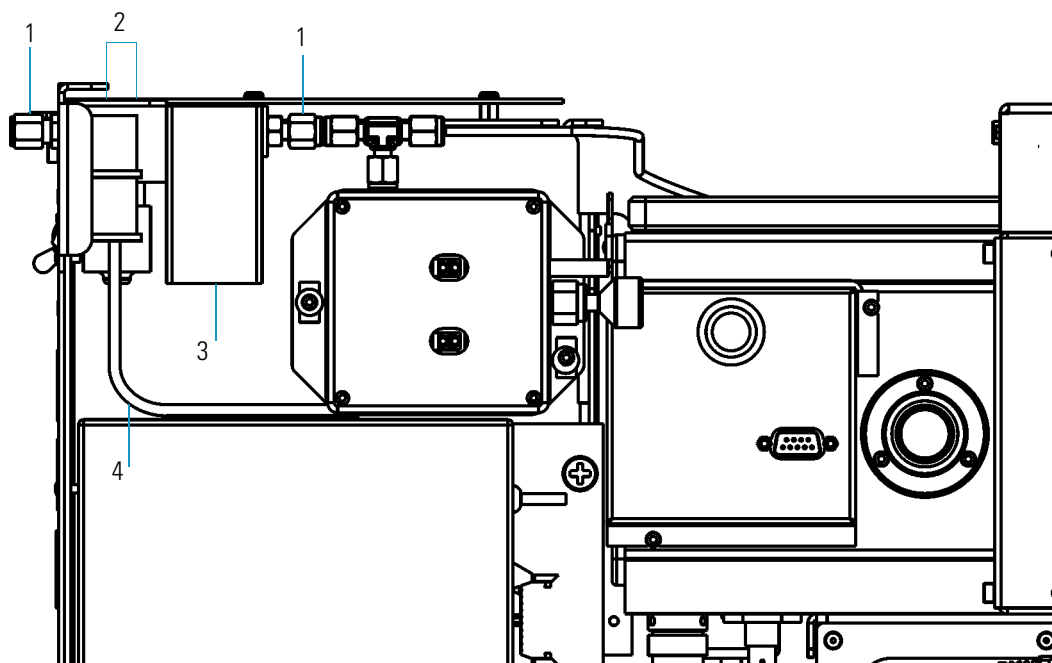
The module can deliver two different flows of calibration compound. The lower flow is used both for EI and negative ion CI. The higher flow is used for positive ion CI. The module permits calibration compound to enter the ion source through 1/8 in. o.d. tubing.

The module is factory charged with 0.1 mL of perfluorotributylamine, which is adequate for approximately one year of operation.

## CI Reagent Gas Flow Module (Upgrade Option)

The optional CI reagent gas flow module shown in [Figure 95](#), controls reagent gas flow into the ion source. The flow is under computer control for repeatable CI experiments.

**Figure 95.** CI Reagent Gas Flow Module (Left Side)

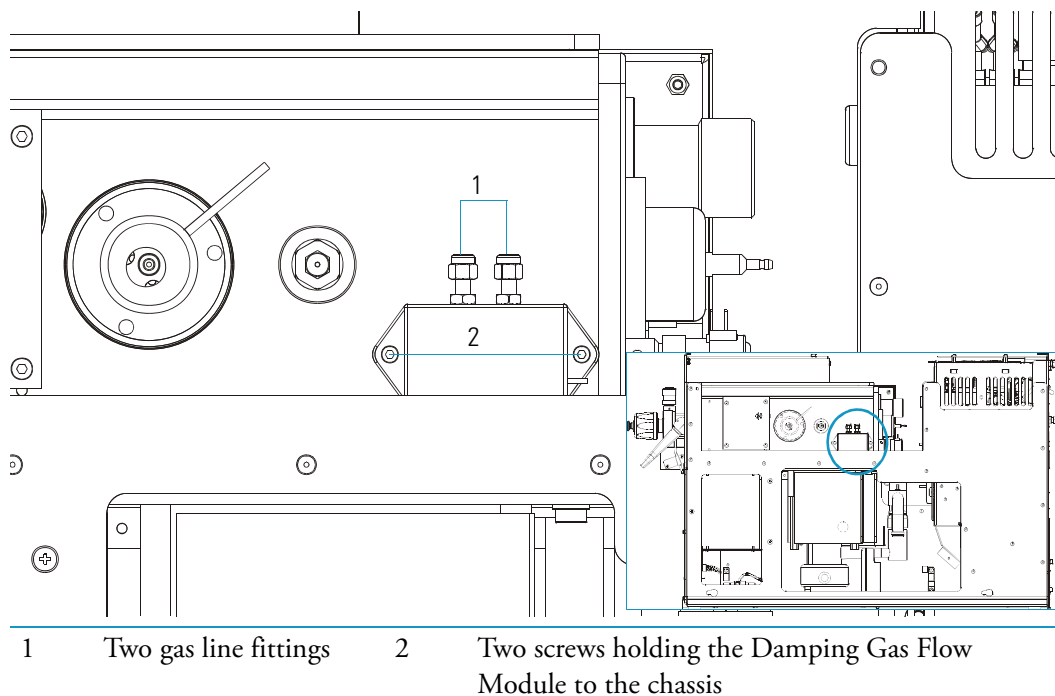


1	Two gas fittings	3	Analog PCB Cable Connector (not shown)
2	Two screws holding the Module	4	Foreline Adapter Tubing

## Damping Gas Flow Module

The damping gas flow module, shown in [Figure 96](#), controls the flow of helium into the ion trap cavity and is located on the right side of the vacuum manifold.

**Figure 96.** Damping Gas Flow Module (right side view)

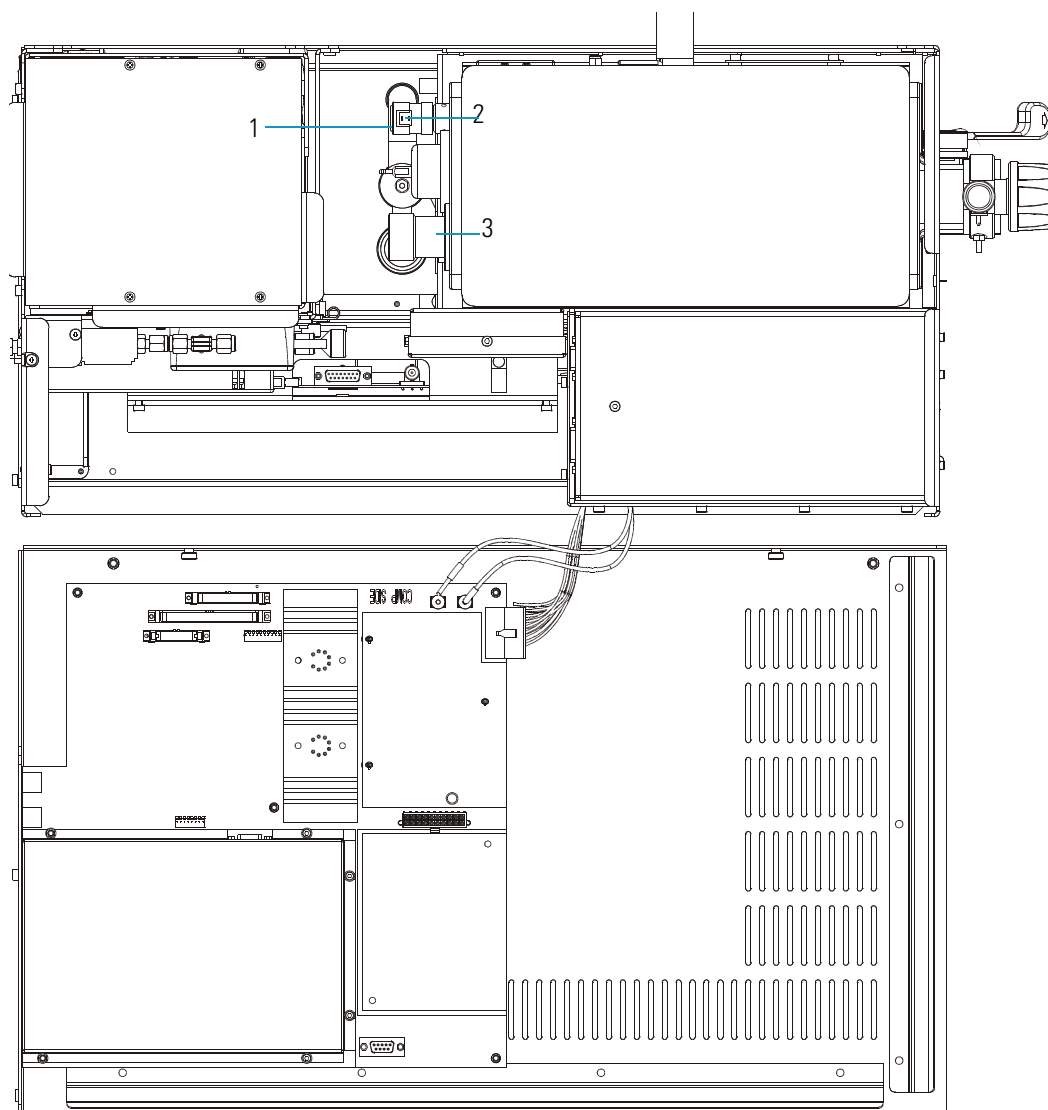


The damping gas flow module regulates helium flow into the ion trap. Helium in the ion trap improves the analytical performance of the mass spectrometer as well as providing a gas for collision induced dissociation (CID) if your system is equipped with the MSn upgrade.

## Vent Valve Solenoid

The vent valve solenoid, shown in [Figure 97](#), allows the vacuum manifold to vent to atmospheric pressure and is mounted outside and on the rear of the vacuum manifold. It is controlled by the vacuum control PCB.

**Figure 97.** Vent Valve Solenoid



1	Vent Valve Solenoid	3	Ion Gauge (optional)
2	Vacuum Control PCB Cable (not shown)		

When the main power is on, the vacuum control PCB supplies power to the vent valve solenoid to keep it closed. Approximately three seconds after the main power is turned off, air is allowed into the manifold. The manifold will be completely filled with air about four minutes after the main power is turned off.

## Ion Source Components and Inlet Valve

This chapter discusses ion source components and the inlet valve.

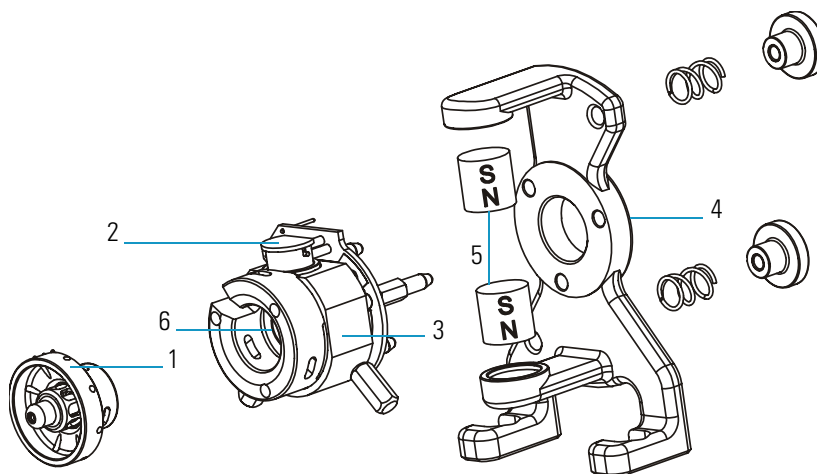
### Contents

- “Ion Source Components” on page 168
- “Filament Assembly” on page 169
- “Ion Source Block Assembly” on page 170
- “Ion Volume Assembly” on page 171
- “Ion Source Lenses” on page 172
- “Magnets and Magnet Support” on page 173
- “Inlet Valve (Upgrade Option)” on page 174
- “Ball Valve” on page 177
- “Guide Bar Housing” on page 178
- “I/R Tool and Guide Bar” on page 179
- “Inlet Valve Plug” on page 180
- “Inlet Valve Seal” on page 181

## Ion Source Components

The ion source has six main components, which are shown in [Figure 98](#).

**Figure 98.** Ion Source Components



1	Ion Source Lenses	4	Magnet Support
2	Filament Assembly	5	Magnets
3	Ion Source Block	6	Ion Volume (inside Ion Source Block)

## Description

The ion source is the part of the mass spectrometer where ions are formed. It is located inside and to the front of the vacuum manifold.

The ion source is designed to allow the conversion from EI to CI by only changing the ion volume. The ion volume sits inside the ion source block, which can be heated up to 350 °C. Three lenses at the exit of the ion volume draw out ions from the ion volume and focus them into the ion trap.

## Theory of Operations

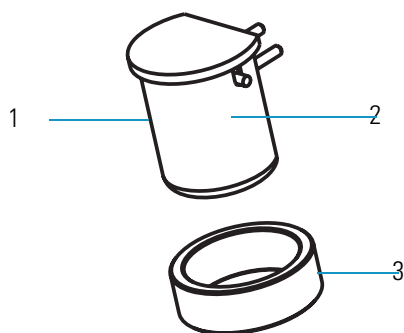
An ion source has two main functions: to generate a beam of electrons and to provide a site for these electrons to interact with sample or CI reagent gas molecules to form ions. Once formed, these ions are then focused by the ion source lenses into the ion trap for mass analysis.



## Filament Assembly

A filament assembly contains an electron lens, filament, filament spacer, and reflector, as shown in [Figure 99](#). It is positioned on top of the ion source block and plugs into on the ion source PCB.

**Figure 99.** Filament Assembly (exploded view)



1	Electron Lens	3	Filament Spacer
2	Filament and Reflector (inside Electron Lens)		

An electron lens (the metal cylinder enclosing the filament and reflector) prevents positive ions from traveling up the electron beam, extending the life of the filament. It is located between the filament and the ion volume. The voltage applied to the electron lens affects the number of electrons that enter the ion volume.

The filament is a rhenium wire inside the electron lens that is electrically heated to produce electrons by thermionic emission.

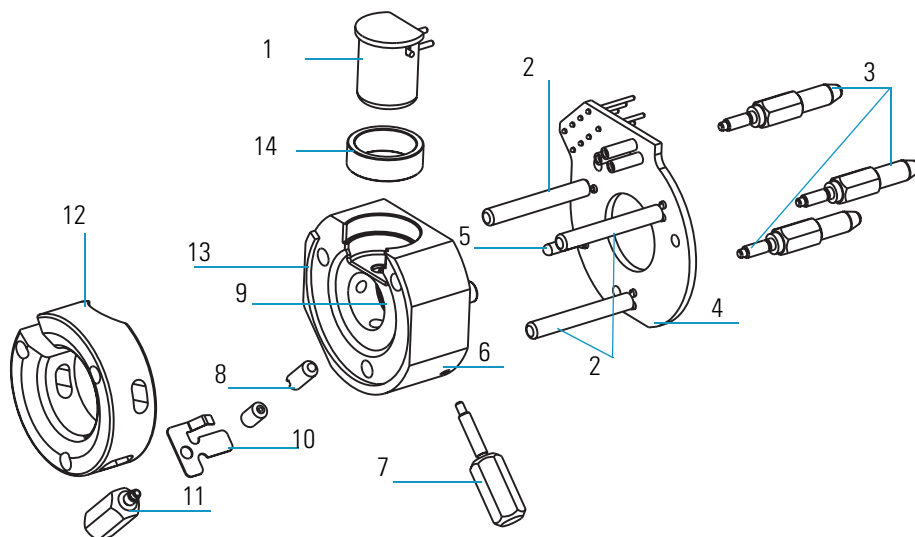
The reflector is located inside the electron lens and focuses electrons emitted by the filament into the ion volume. Filaments and reflectors are maintained at negative potential (-70 V) relative to the ion volume. The electrons emitted by the filament are accelerated by the potential difference into the ion volume.

The filament spacer is a ceramic ring that aligns the filament with the electron entrance hole in the ion source and ion volume.

## Ion Source Block Assembly

An ion source block assembly (shown in [Figure 100](#)) consists of an ion source block, ion source PCB, three base studs, three cartridge heaters, and a temperature sensor.

**Figure 100.** Ion Source Block Assembly



1	Filament Assembly	8	Ball Plunger
2	Cartridge Heaters	9	Ion Volume (inside the ion source block)
3	Base-studs	10	Spring
4	Ion Source PCB	11	Spring Thumbscrew
5	Temperature Sensor	12	Heater Ring
6	Ion Source Block	13	Sample Inlet Aperture
7	Ion Volume Key Thumbscrew	14	Filament Spacer

During operation, the ion source block holds an ion volume in its center. It is aligned by the ion volume key thumbscrew and secured by the ball plunger. Samples are introduced from a GC through the transfer line into the sample inlet aperture located on the side of the ion source block. Calibration compound and chemical ionization reagent gas also enter the ion volume through the transfer line.

Three cartridge heaters and a temperature sensor are mounted on the ion source PCB. Cartridge heaters pass through and heat the ion source block.

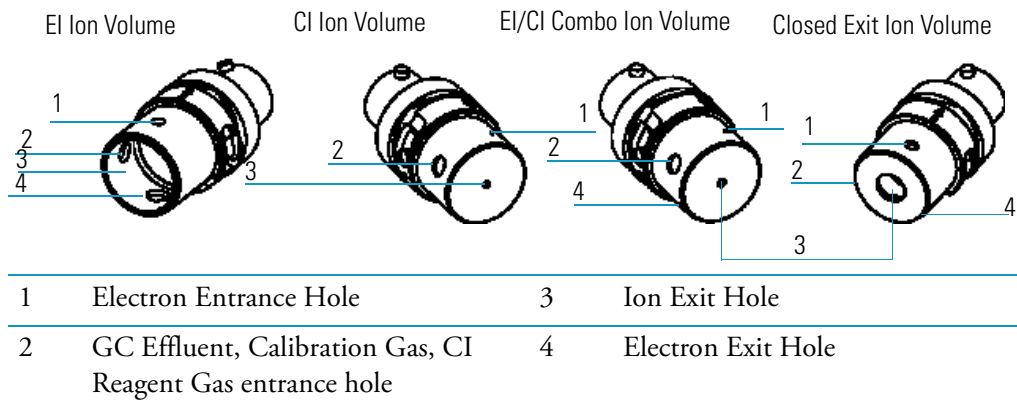
The heater ring slips over the cartridge heaters and transfers heat to the lenses. The temperature sensor monitors the temperature of the ion source block.

Three base studs hold the ion source PCB to the ion source block. These studs slip into the magnet support and position the ion source block between two permanent magnets.

## Ion Volume Assembly

The ion volume assembly (shown in [Figure 101](#)) consists of the ion volume holder and the ion volume. The ion volume assembly is located in the center of the ion source.

**Figure 101.** EI, CI, and EI/CI Combo Ion Volume Assemblies

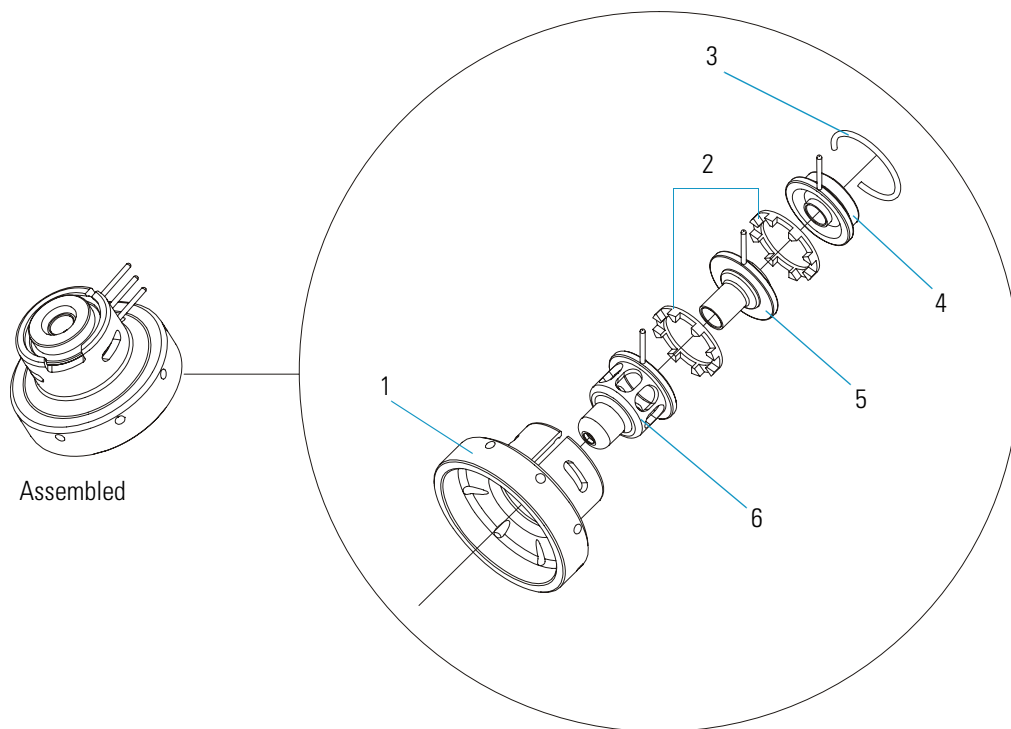


The ion volume assembly is the site where the molecules interact with energetic electrons to form ions. The ion volume geometries that generate the maximum sensitivity are different for EI and CI. In addition to the optimal EI and CI geometries, there is an EI/CI combination ion volume that allows for switching between EI and CI without changing ion volumes. A closed exit ion CEI volume is made from a special metal. This ion volume is used in the analysis of highly acidic compounds, such as nitrophenols.

## Ion Source Lenses

Ion source lenses, shown in [Figure 102](#), are connected to the front of the ion source block.

**Figure 102.** Ion Source Lenses



1	Lens Holder	4	Lens 1
2	Lens Spacer	5	Lens 2
3	Lens Clip	6	Lens 3

Ion source lenses transmit the ions formed in the ion volume to the ion trap. The lenses are stainless steel plates and tubes to which voltages are applied.

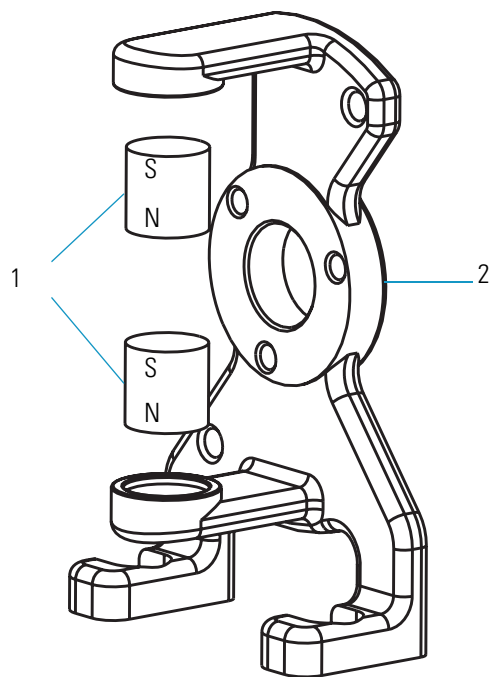
The electrical connections are made through stainless steel pins protruding from the edge of the lenses. A small connector attaches to these pins and carries the voltage from the electrical feedthrough.

## Magnets and Magnet Support

Two magnets, shown in [Figure 103](#), focus emitted electrons into a beam that spirals through the ion volume. The spiraling of the beam ensures optimum ionization of the sample. The magnet support holds the two magnets in the proper position above and below the ion source block.

For optimal sensitivity, position both magnets so the south pole is on top. Electrons are focused into the ion volume only when opposite poles face each other (N faces S).

**Figure 103.** Magnets and Magnet Support



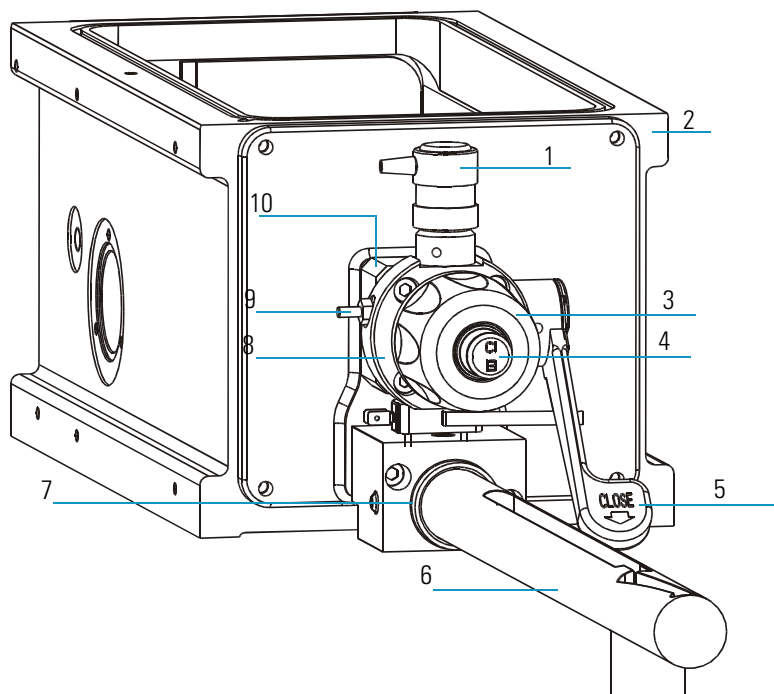
1 Magnets

2 Magnet Support

## Inlet Valve (Upgrade Option)

The primary inlet valve components are shown in [Figure 104](#).

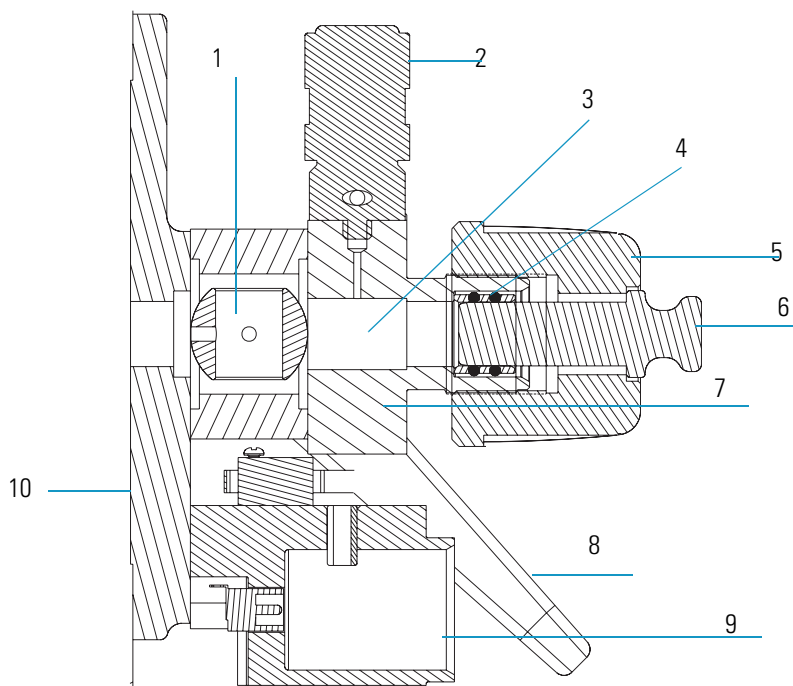
**Figure 104.** Inlet Valve Components (l/R tool not shown)



1	Inlet Valve Solenoid	6	Guide Bar
2	Vacuum Manifold	7	Guide Bar Housing
3	Inlet Valve Knob	8	Inlet Valve Block
4	Inlet Valve Plug	9	Foreline Hose Connection
5	Ball Valve Lever	10	Ball Valve Housing

[Figure 105](#) illustrates a cross section of internal and external inlet valve components.

**Figure 105.** Inlet Valve Components (left view)



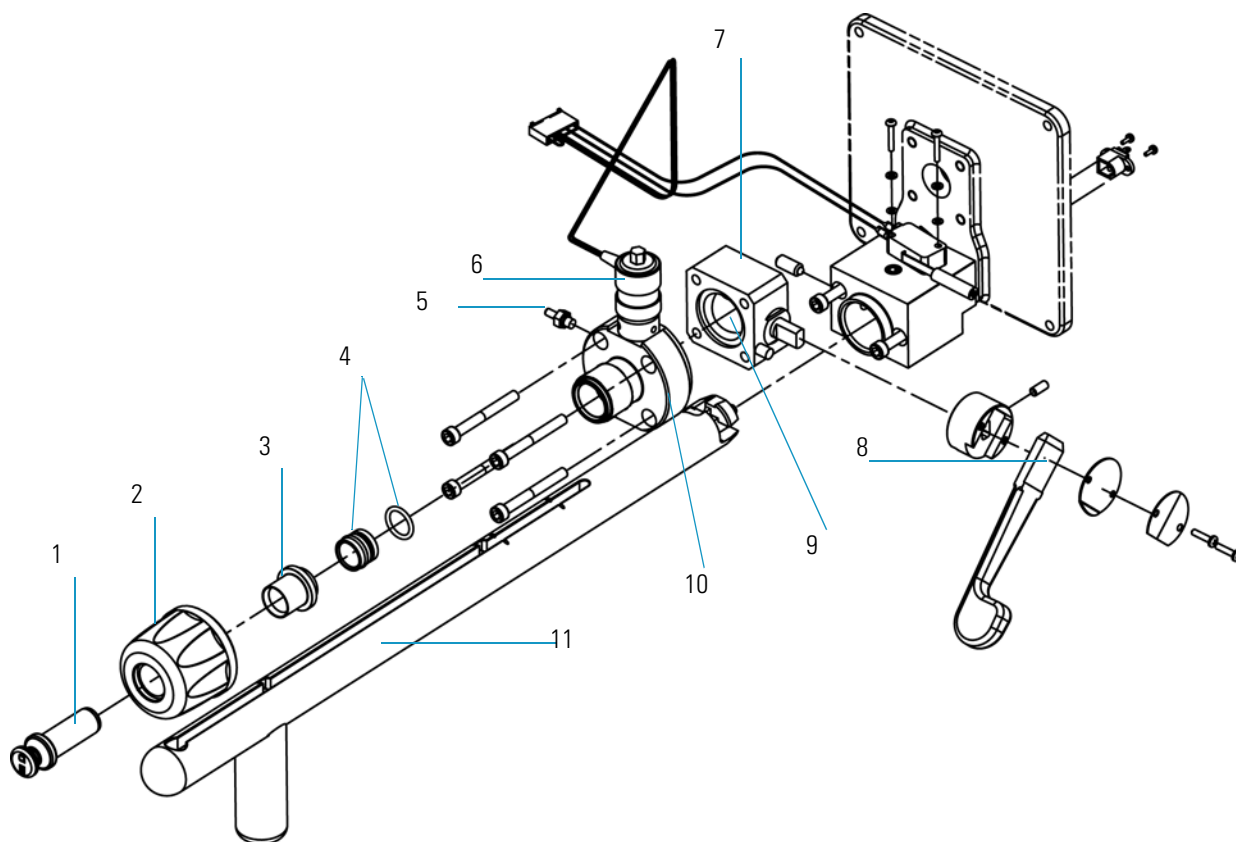
1	Ball Valve	6	Inlet Valve Plug
2	Inlet Valve Solenoid	7	Inlet Valve Block
3	Inlet Valve Chamber	8	Ball Valve Lever
4	Inlet Valve Seal	9	Guide Bar Housing
5	Inlet Valve Knob	10	Vacuum Manifold

Figure 106 illustrates an exploded view of the inlet valve components.

## 5 Ion Source Components and Inlet Valve

Inlet Valve (Upgrade Option)

**Figure 106.** Inlet Valve Components (Exploded View)



1	Plug	7	Ball Valve
2	Knob	8	Lever
3	Ferrule, Inlet Valve	9	Inlet Valve Seal
4	Ball Valve Seal	10	Inlet Valve Housing
5	Foreline hose connection	11	Guide Bar
6	Inlet Valve Solenoid		

### Description

The inlet valve mounts onto the front port of the vacuum manifold and is the vacuum interlock mechanism for the mass spectrometer. The inlet valve is a vacuum sealed valve through which you insert and remove the ion volume assembly using an I/R (insertion/removal) tool.



## Theory of Operations

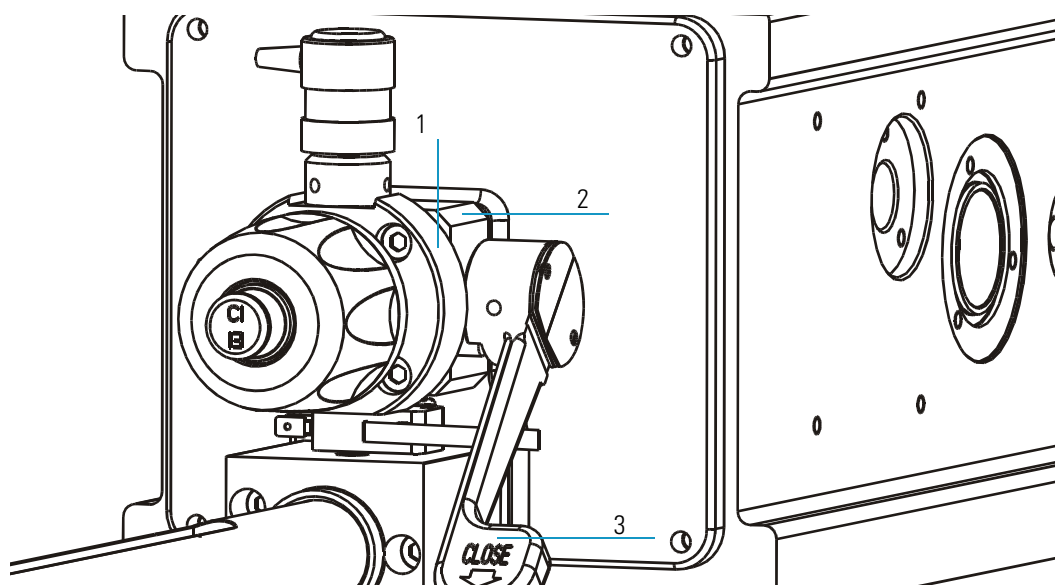
With the use of the I/R tool and guide bar, the inlet valve lets the ion volume be removed or installed in the ion source without having to vent the vacuum manifold to atmosphere. Once the inlet valve is evacuated, it can be opened, which allows the I/R tool to be inserted into the vacuum manifold.

The inlet valve is evacuated through the foreline hose connection to either a secondary rotary-vane pump or the primary rotary-vane pump equipped with an expansion volume.

## Ball Valve

A ball valve, shown in [Figure 107](#), is a ball with a hole through it and is located inside the ball valve housing and is positioned between the vacuum manifold and the inlet valve block.

**Figure 107.** Ball Valve and Lever



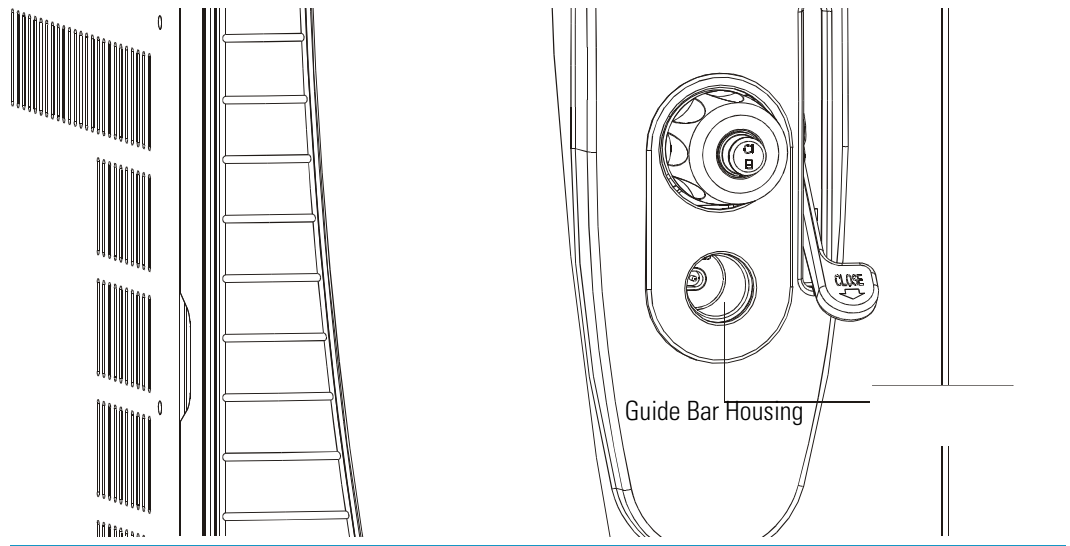
1	Inlet Valve Block	3	Ball Valve Lever
2	Ball Valve Housing		

When the ball valve is open, the I/R tool can enter the vacuum manifold. When the ball valve is closed, the vacuum manifold is sealed from atmospheric pressure.

## Guide Bar Housing

The guide bar housing, shown in [Figure 108](#), is an aluminum chamber mounted on the vacuum manifold. The guide bar housing has an opening for the guide bar.

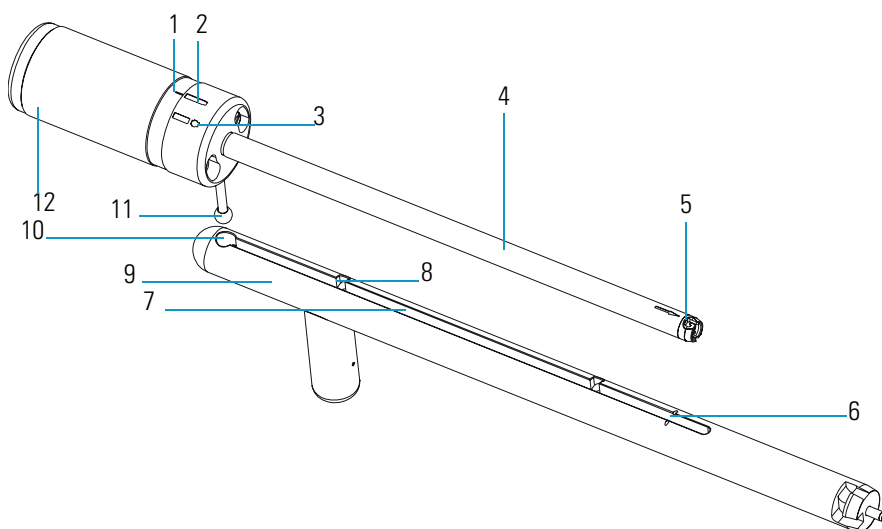
**Figure 108.** Guide Bar Housing



## I/R Tool and Guide Bar

The I/R tool, shown in (Figure 109), is used to insert and remove ion volumes. The tool consists of a shaft, handle, and guide ball.

**Figure 109.** I/R Tool and Guide Bar



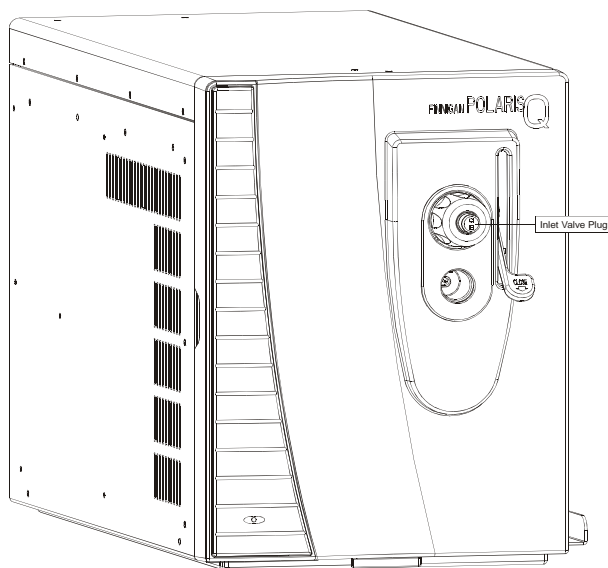
1	Alignment Line	7	Guide Bar Track
2	Lock Position	8	Guide Bar First Stop
3	Unlock Position	9	Guide Bar
4	I/R Tool	10	Guide Ball Hole
5	Bayonet Lock	11	Guide Ball
6	Guide Bar Second Stop	12	Handle

The I/R tool is designed to be used with the guide bar. The guide ball located on the I/R tool fits inside a hole located on the guide bar, then slides forward along the guide ball track and inserts into the entry housing. The guide bar is designed to accurately stop the I/R tool the correct distance within the inlet valve in order to evacuate atmospheric pressure before opening the ball valve. Once the ball valve is opened, the I/R tool is slid along the guide bar track all the way into the vacuum manifold.

## Inlet Valve Plug

The inlet valve plug, shown in [Figure 110](#), seals the opening of the inlet valve when it is not in use. The plug is etched with “EI” on one side and “CI” on the other to help you remember what kind of ion volume is installed.

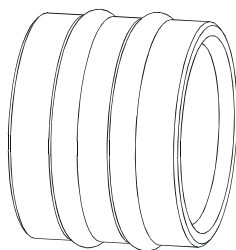
**Figure 110.** Inlet Valve Plug



## Inlet Valve Seal

The inlet valve seal, shown in [Figure 111](#), forms a seal over the shaft of the I/R tool when it is inserted into the inlet valve. The inlet valve knob allows you to tighten the seal against the I/R tool to form a vacuum-tight seal. Alternatively, you can loosen it to allow the I/R tool to be inserted and removed more easily. You should replace the inlet valve seals periodically. Replacement instructions are in [“To replace the ball valve seal and O-ring, you will need:”](#) on [page 48](#).

**Figure 111.** Inlet Valve Seal



## **5 Ion Source Components and Inlet Valve**

Inlet Valve Seal

# Ion Trap System

This chapter discusses the ion trap, also called a mass analyzer.

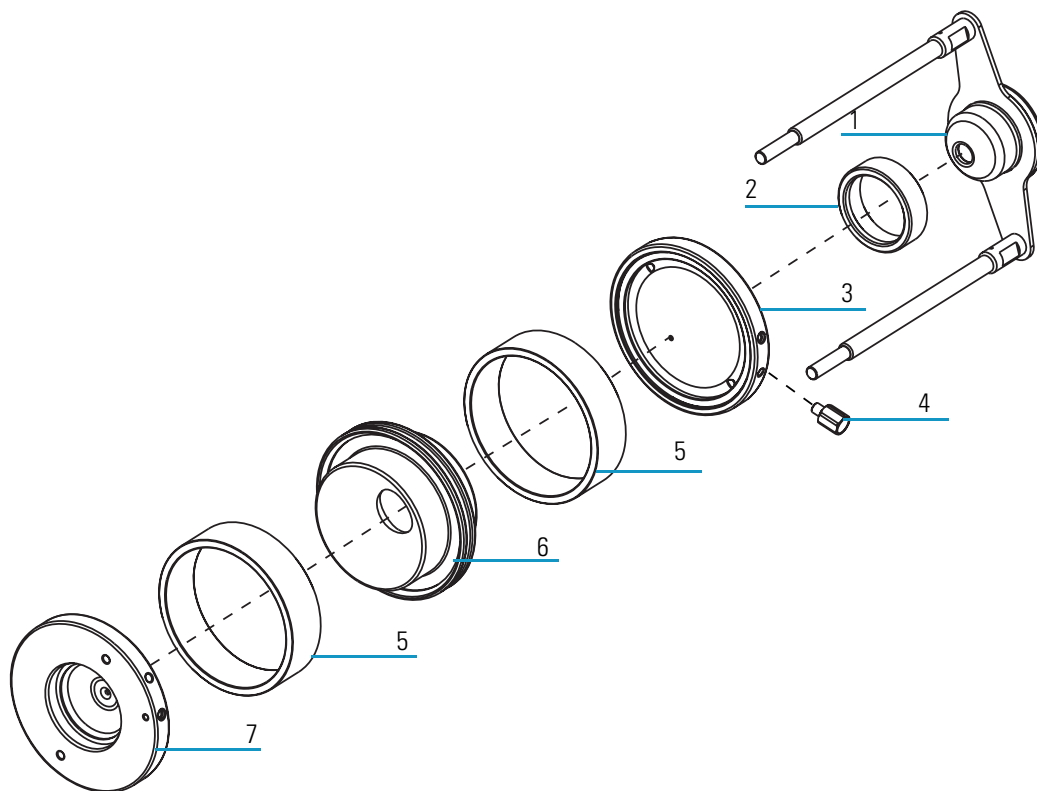
## Contents

- “Components” on page 184
- “Description” on page 184
- “Theory of Operations” on page 185

## Components

An ion trap stores and manipulates ions and performs mass analyses.

**Figure 112.** Ion Trap (Top View)



1	Exit Lens	5	Spacers
2	Exit Lens Spacer	6	Ring Electrode
3	Exit Endcap	7	Entrance Endcap
4	Helium Inlet		

## Description

The ion trap is located within the vacuum manifold between the ion source and ion detector system. It functions to separate ions according to their mass-to-charge ratios. The ion trap contains three electrodes (entrance, ring, and exit) which collectively form a cavity for ion storage and mass analysis. Both entrance endcap and exit endcap electrodes have a small hole in their centers to permit the passage of ions into and out of the ion trap.

The ring electrode is separated from the endcaps by two spacer rings. These spacers are used to electrically isolate and precisely separate the endcaps from the ring electrode. The exit lens shields the ion trap from the electric fields created by the ion detector system.



## Theory of Operations

A dc offset voltage is applied to the ion trap to draw ions from the ion source. Typically, the magnitude voltage is -10 V for positive ions and +10 V for negative ions. Damping gas is introduced into the ion trap to increase the analytical performance as well as provide a background for CID, if your system is equipped with the optional MSn upgrade. An ion trap stores and analyzes ions. If your system has the optional MSn upgrade, then the trap will also isolate an ion of a particular  $m/z$ , fragment it through CID, and analyze the product ions.

Sample ions formed in the ion source are trapped in the ion trap only if the ions have mass-to-charge ratios greater than the minimum storage mass and the ions are not rejected by the injection waveform voltage.

## **6 Ion Trap System**

Components

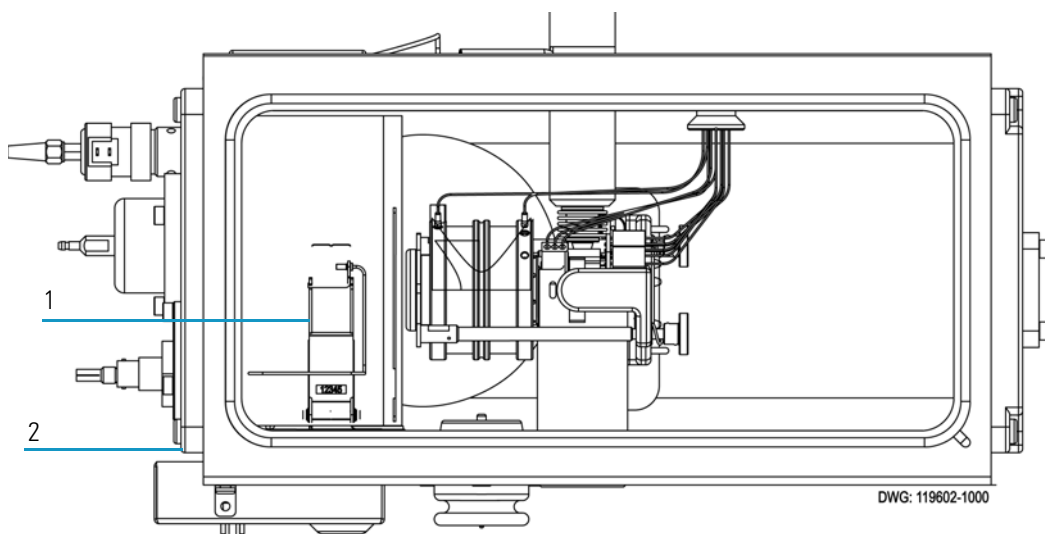
# Ion Detector Systems

The mass spectrometer has an electron multiplier.

## Contents

- “Description” on page 188
- “Theory of Operations” on page 189

**Figure 113.** Ion Detector Systems



1	Electron multiplier
2	Vacuum Manifold

## Electron Multiplier

An electron multiplier increases the instrument's linear working range. When the multiplier needs to be replaced, no tools are needed once you are in the vacuum manifold.

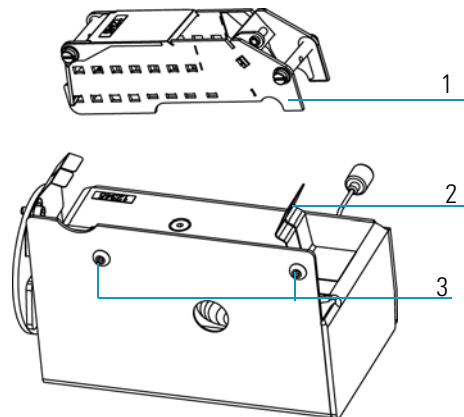
Briefly, this detector provides:

- Better overall sensitivity; the conversion dynode and ion optics have been designed for maximum detection efficiency.
- Much higher dynamic range capability
- Lower overall background noise, which improves signal-to-noise.

## Description

The electron multiplier snaps into an assembly, as show in [Figure 114](#).

**Figure 114.** Electron Multiplier Assembly



1	Electron Multiplier	3	Button-head screws
2	Spring clip		

The electron multiplier is used to detect the ions that are ejected from the ion trap. The multiplier generates a pulse of electrons for each ion. The gain of the multiplier determines how many electrons are generated per ion. Typically, the gain is set to  $3 \times 10^5$  electrons per ion. This high level of amplification allows for the detection of single ions. The electron multiplier system consists of the multiplier which contains a conversion dynode, and a mount in the vacuum manifold that provides both mechanical support and electrical connections. The electron multiplier uses a series of individual dynodes. This approach allows for higher electron currents to be generated, which increases the dynamic range of the system. The discrete dynode approach also reduces the amount of noise generated by the multiplier.

The multiplier is designed to snap into the vacuum manifold mount without the need for additional tools. The electron multiplier system is located towards the back of the vacuum manifold.

## Theory of Operations

The electron multiplier is designed to accelerate an ion into a conversion dynode. The impact of the ion generates a group of electrons. These electrons are accelerated into a series of dynodes within the multiplier. At each dynode, the impact of the group of electrons generates a larger group of electrons. After going through the entire multiplier, there will be about  $3 \times 10^5$  electrons generated per initial ion, depending on the gain of the system. This pulse of electrons is then sent to the electrometer by way of the anode feedthrough.



## Replaceable Parts

This appendix contains mass spectrometer drawings and part numbers for replaceable parts and consumables. To ensure proper results in servicing the mass spectrometer system, order only the parts listed or their equivalent. Contact Thermo Fisher Scientific and have your mass spectrometer serial number ready.

### Contents

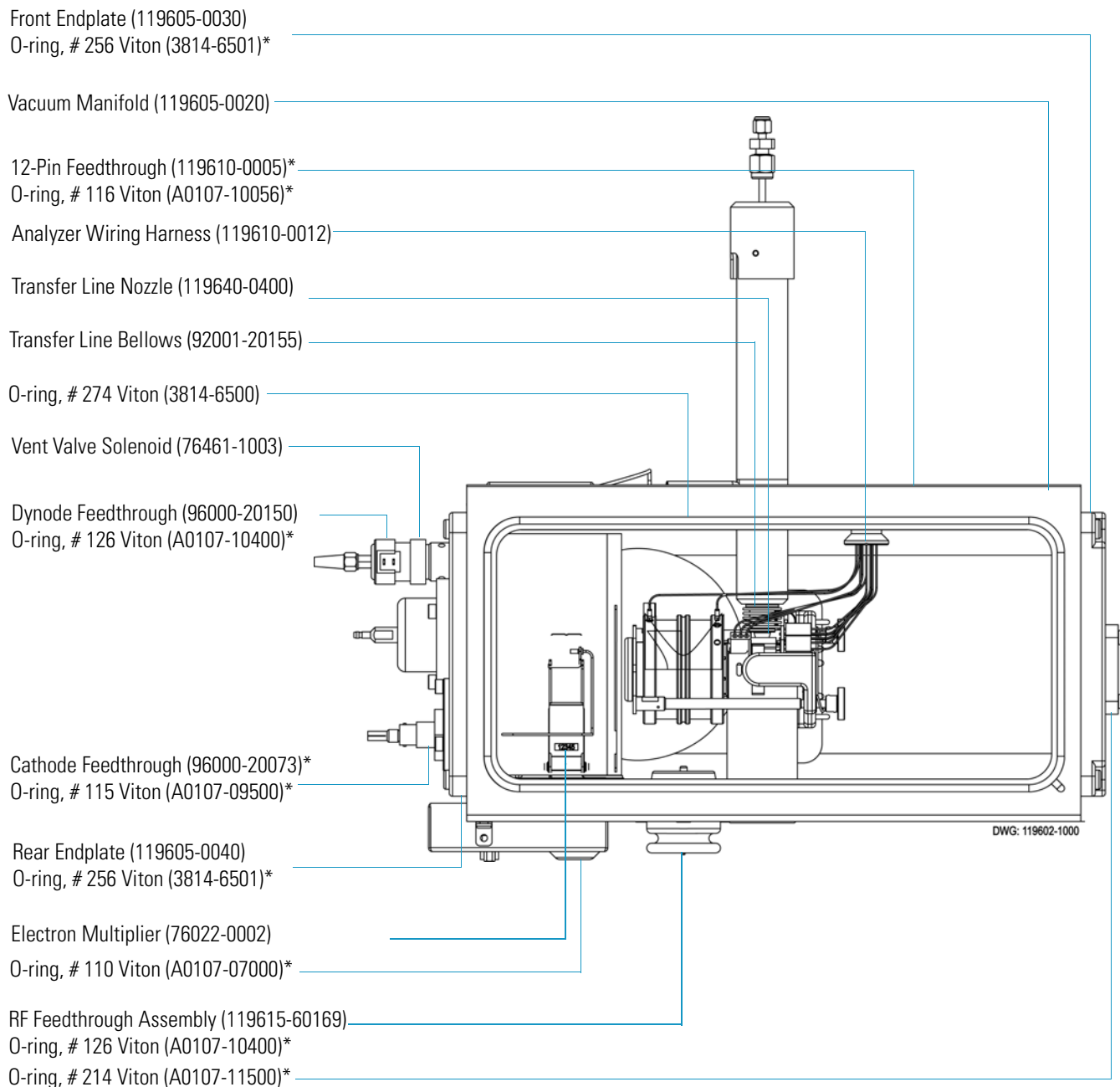
- “Vacuum Manifold” on page 192
- “Analyzer Assembly” on page 194
- “Ion Source” on page 196
- “Ion Source Lenses” on page 198
- “Ion Trap” on page 200
- “Gas Inlets and Gauges” on page 202
- “PCBs and Cables” on page 206
- “Turbomolecular Pump” on page 214
- “Inlet Valve (Upgrade Option)” on page 216
- “Installation Kit” on page 218
- “Miscellaneous Items” on page 219

## Vacuum Manifold

**Table 9.** Vacuum Manifold Parts List

<b>Description</b>	<b>Part Number</b>
12-Pin Feedthrough	119610-0005
Analyzer Wiring Harness	119610-0012
Cathode Feedthrough	96000-20073
Dynode Feedthrough	96000-20150
Electron Multiplier	76022-0002
Front Endplate	119605-0030
O-ring, # 110 Viton	A0107-07000
O-ring, # 115 Viton	A0107-09500
O-ring, # 116 Viton	A0107-10056
O-ring, # 126 Viton	A0107-10400
O-ring, # 214 Viton	A0107-11500
O-ring, # 256 Viton	3814-6501
O-ring, # 274 Viton	3814-6500
Rear Endplate	119605-0040
RF Feedthrough Assembly	119615-60169
Screws, Electron Multiplier Assembly	A0452-20000
Transfer Line Bellows	92001-20155
Transfer Line Nozzle	119640-0400
Vacuum Manifold	119605-0020
Vent Valve Solenoid	76461-1003



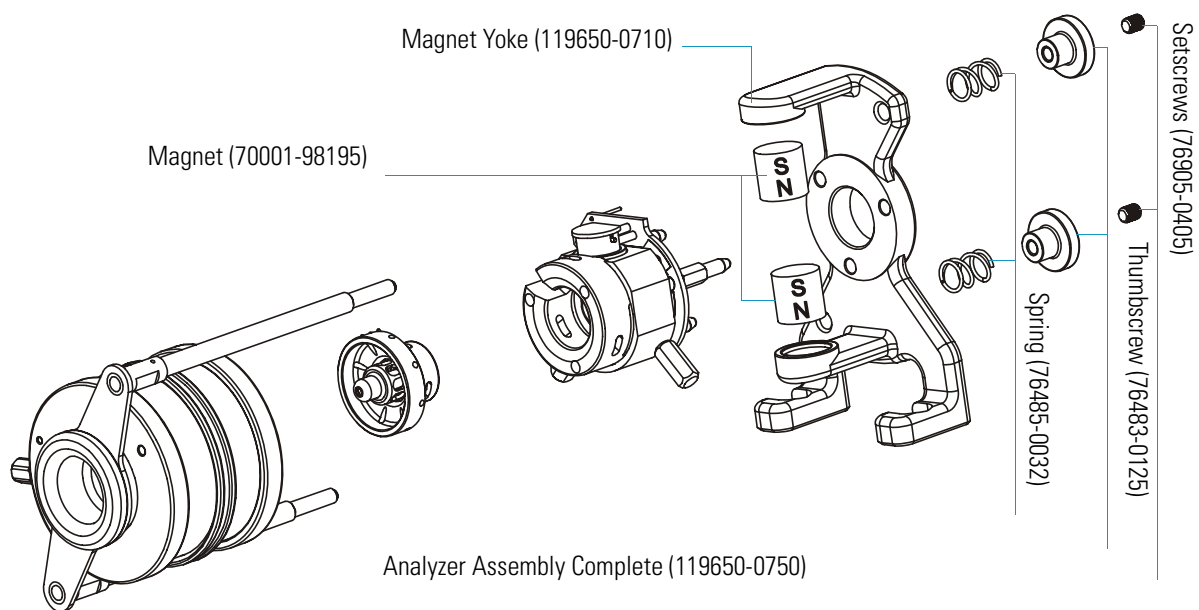


\* - Not Shown

## Analyzer Assembly

**Table 10.** Analyzer Assembly

<b>Description</b>	<b>Part Number</b>
Analyzer Assembly (Complete)	119650-0750
Magnet	70001-98195
Magnet Yoke	119650-0710
Setscrew	76905-0405
Spring	76485-0032
Thumbscrew	76483-0125



## Ion Source

**Table 11.** Ion Source Parts List

<b>Description</b>	<b>Part Number</b>
Base Stud	119650-0215
Ball Plunger	119572-0001
CI Ion Volume	119650-0230
Closed Exit Ion Volume (CEI)	119650-0221-T
EI Ion Volume	119650-0220
EI/CI Combo Ion Volume	119650-0240
Filament	119701-60287
Filament Spacer	119650-0235
Heater Ring	119650-0422
Ion Source PCB	96000-60087
Ion Source Block (does not include ball plunger or setscrew)	119650-0205
Ion Volume Key Thumbscrew	119650-0206
Ion Volume Holder	70001-20532
Setscrew	119573-0001
Spring	96000-20176
Spring Thumbscrew	119650-0208

Base Stud (119650-0215)

Ion Source PCB (96000-60087)

Ion Volume Holder (70001-20532)

El Ion Volume (119650-0220)

Filament (119701-60287)

Filament Spacer (119650-0235)

Setscrew (119573-0001)

Heater Ring (119650-0422)

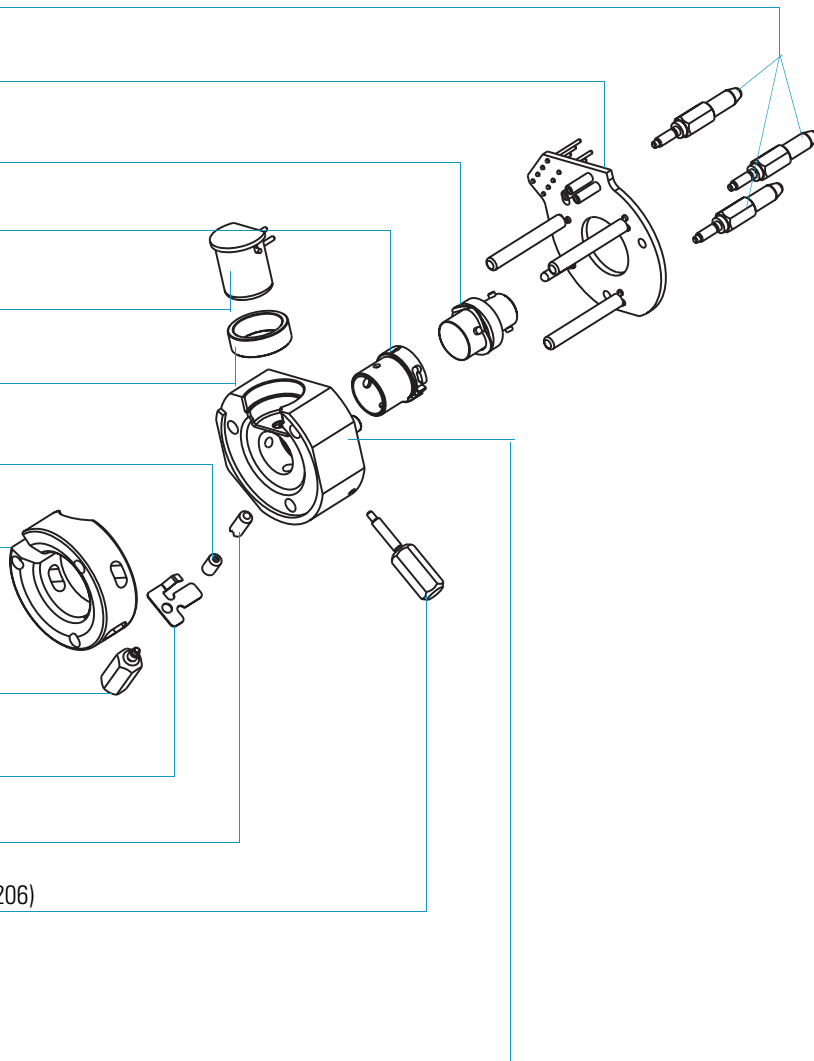
Spring Thumbscrew (119650-0208)

Spring (96000-20176)

Ball Plunger (119572-0001)

Ion Volume Key Thumbscrew (119650-0206)

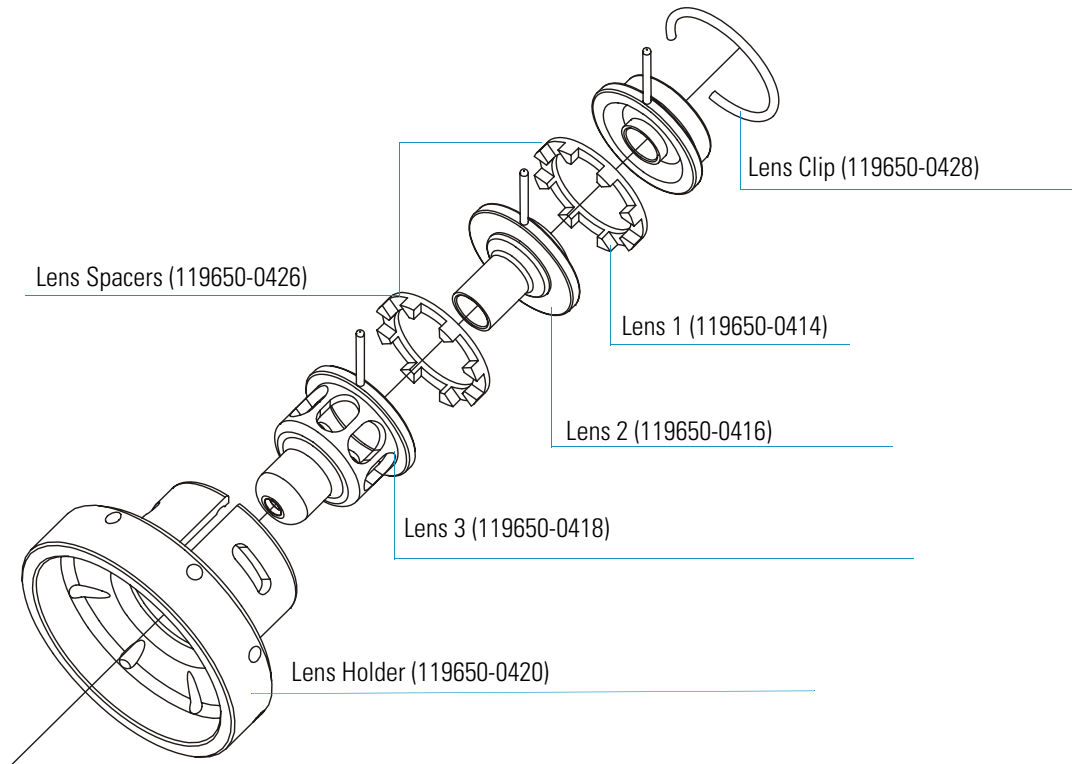
Ion Source Block 119650-0205



## Ion Source Lenses

**Table 12.** Ion Source Lenses Parts List

<b>Description</b>	<b>Part Number</b>
Lens 1	119650-0414
Lens 2	119650-0416
Lens 3	119650-0418
Lens Clip	119650-0428
Lens Holder	119650-0420
Lens Spacer	119650-0426



## Ion Trap

**Table 13.** Ion Trap Parts List

<b>Description</b>	<b>Part Number</b>
Endcap Electrode	119650-0520
Exit Lens	119650-0530
Exit Lens Spacer	119650-0515
Helium Inlet	119650-0532
Ring Electrode	119650-0525
Spacer	119650-0540



Exit Lens (119650-0530)

Exit Lens Spacer (119650-0515)

Helium Inlet (119650-0532)

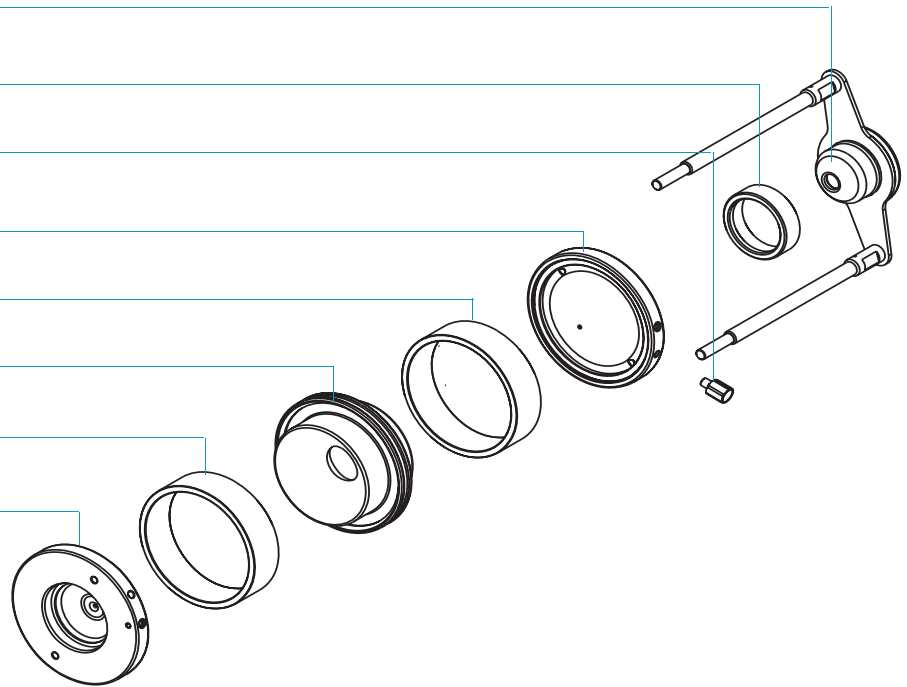
Endcap Electrode (119650-0520)

Spacer (119650-0540)

Ring Electrode (119650-0525)

Spacer (119650-0540)

Endcap Electrode (119650-0520)



## Gas Inlets and Gauges

**Table 14.** Gas Inlets and Gauges Parts List (left cover)

<b>Description</b>	<b>Part Number</b>
Cable, CI Flow Module to Analog PCB	119378-0014
Cable, Vacuum Control PCB to Calibration Gas and Vent Valves	119378-0019
Calibration Gas Flow Module	119246-0001
Calibration Gas Vial	96000-40013
Variable Damping Gas Regulator (Upgrade Option)	23331-0100
CI Reagent Gas Flow Module (Upgrade Option)	23331-0091
Ferrule, Glass Filled Teflon	95001-20310
Ion Gauge	A0105-06003
O-ring, # 116 Viton	A0107-10056
Union, Elbow, 1/8-in., SS (Without CI)	4030-0602
Union, Tee, 1/8-in., SS (With CI)	4032-0182

CI Reagent Gas Flow Module (23331-0091)

Variable Damping Gas Regulator (23331-0100)\*

With CI: Union, Tee, 1/8-in., SS (4032-0182)

Without CI: Union, Elbow, 1/8-in., SS (4030-0602)\*

Cable, CI Flow Module to Analog PCB  
(119378-0014)\*

Calibration Gas Flow Module (119246-0001)

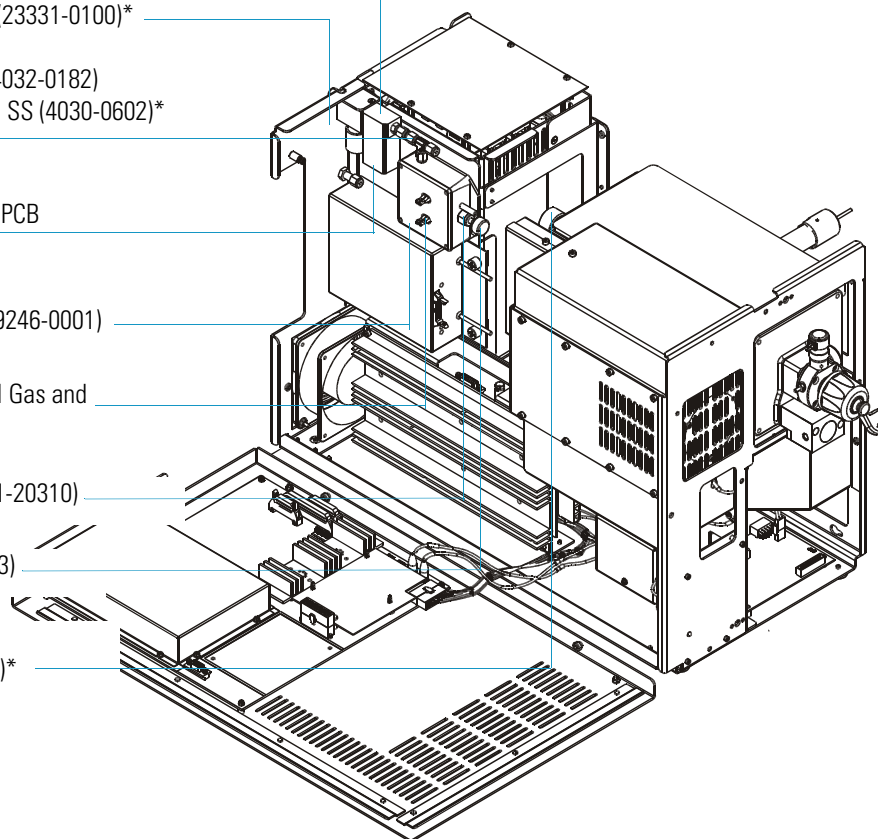
Cable, Vacuum Control PCB to Cal Gas and  
Vent Valves (119378-0019)\*

Ferrule, Glass Filled Teflon (95001-20310)

Calibration Gas Vial (96000-40013)

Ion Gauge (A0105-06003)

O-ring, # 116 Viton (A0107-10056)\*



\* - Not Shown

**Table 15.** Gas Inlets and Gauges Parts List (right cover)

<b>Description</b>	<b>Part Number</b>
Cable, Vacuum Control PCB to Calibration Gas and Vent Valves	119378-0019
Ferrule, 1/8-1/16-in., Graphite/Vespel	76458-0009
Damping Gas Flow Module, Adjustable (Upgrade Option)	119247-0002
Damping Gas Flow Module, Standard	119247-0001
Ferrule, 1/8 in., Graphite/Vespel	76458-2014
Helium Inlet Ferrule	76458-5001
Helium Inlet Fitting	76480-0014
Helium Inlet Sleeve	76480-0015
O-ring, # 012 Viton	3814-6012
O-ring, # 124 Viton	A0107-10404
Union, Bulkhead, 1/8-in., SS, 10 µm Frit	4035-0721
Transfer Line Assembly (Complete)	119640-1050
• Ferrule, 1/8-in., Graphite/Vespel	76458-2014
• Ferrule, 1/8-in., No hole, Graphite/Vespel	76458-2009
• Reducing Union, 1/8-1/16-in., SS	A0101-03151
• Transfer Line	119640-1005
• Transfer Line Bellows	92001-20155
• Transfer Line Nozzle	119640-0400
Vent Valve Solenoid	76461-1003
Helium Inlet Adapter	119605-0011
Union, 1/8-in., SS	4035-0702

Union, Bulkhead, 1/8-in., SS, 10  $\mu$ m Frit (4035-0721)  
Ferrule, 1/8-1/16-in., Graphite/Vespel (76458-0009)\*

Vent Valve Solenoid (76461-1003)  
Cable, Vacuum Control PCB to Cal Gas and  
Vent Valves (119378-0019)\*

Damping Gas Flow Module, Standard (119247-0001)  
Damping Gas Flow Module, Adjustable (119247-0002)\*

Helium Inlet Adapter (119605-0011)  
O-ring, # 012 Viton (3814-6012)\*

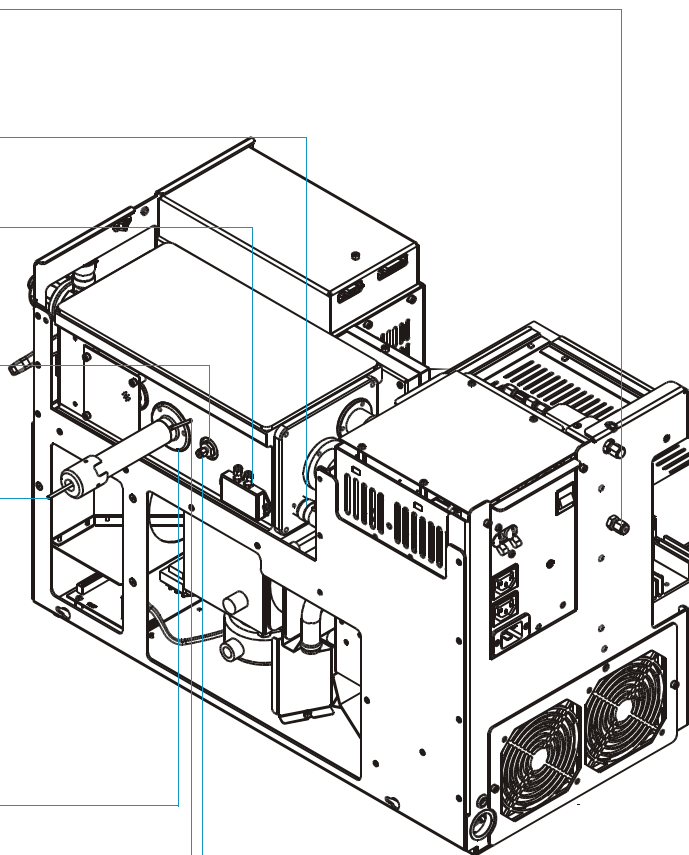
Transfer Line Assembly (119640-1050)  
Includes:

Transfer Line (119640-1005)  
Transfer Line Bellows (92001-20155)\*  
Transfer line Nozzle (119640-0400) \*  
Ferrule, 1/8-in. Graphite/Vespel (76458-2014)\*  
Ferrule, 1/8-in., No hole, Graphite/Vespel  
(76458-2009)\*  
Reducing Union, 1/8-1/16-in. SS (A0101-03151)\*

O-ring, # 124 Viton (A0107-10404)\*

Union, 1/8-in., SS (4035-0702)\*

Helium Inlet Fitting (76480-0014)  
Helium Inlet Sleeve (76480-0015)  
Helium Inlet Ferrule (76458-5001)



\* - Not Shown

## PCBs and Cables

**Table 16.** PCBs and Cables Parts List (left cover)

<b>Description</b>	<b>Part Number</b>
Analog PCB	119590-0021
Cable, Analog to Balun PCB	119378-0003
Cable, Analog to Balun PCB	119378-0011
Cable, Ground Strap	119378-0030
Cable, Low Pass Filter to Balun PCB	119378-0012
Cable, Main System Power	119378-0001
Cable, Ribbon, Analog PCB to Multiplier/Dynode Power Supply	119378-0009
Digital PCB	119590-0010
Multiplier/Dynode Power Supply	119377-0001
Multiplier/Dynode Power Supply (PPINICI) Upgrade option.	119377-0002
RF Generator PCB	119590-0060
Spacer, Analog PCB	76350-0056
Spacer, Digital to Analog PCB	119567-0001

Cable, Low Pass Filter to  
Balun PCB (119378-0012)

Cable, Ground Strap (119378-0030)

Cable, Ribbon, Analog PCB to Multiplier/Dynode  
Power Supply (119378-0009)\*

RF Generator PCB (119590-0060)

Multiplier/Dynode Power Supply (119377-0001)  
Multiplier/Dynode Power Supply (PPINICI) Upgrade option  
(119377-0002)

Analog PCB (119590-0021)

Spacer, Digital to Analog PCB (119567-0001)\*

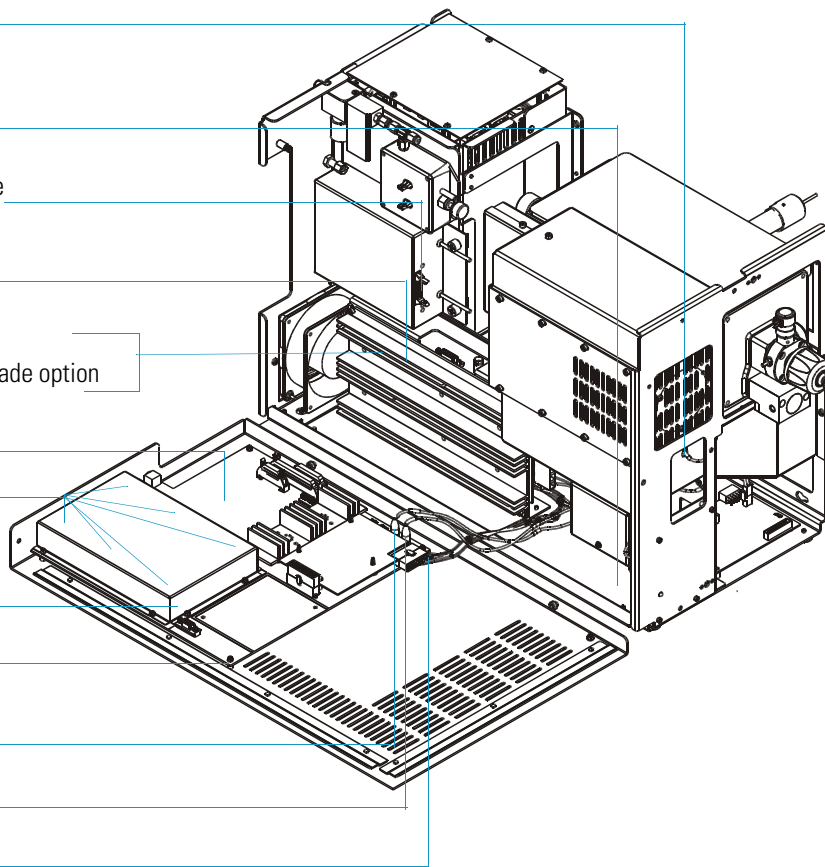
Digital PCB (119590-0010)\*

Spacer, Analog PCB (76350-0056)

Cable, Analog to Balun PCB (119378-0003)

Cable, Analog to Balun PCB (119378-0011)

Cable, Main System Power (119378-0001)



\* - Not Shown

**Table 17.** PCB's and Cables Parts List (left cover)

<b>Description</b>	<b>Part Number</b>
Balun PCB	119590-0090
Cable, Analog to RF Detector PCB	119378-0004
Cable, Coax, RF Generator to Low Pass Filter PCB	119378-0013
Cable, Electrometer to Digital PCB	119378-0008
Cable, RF Detector to RF Generator PCB	119378-0010
Cable, Ribbon, Analog to RF Generator PCB	119378-0002
Cable, Ribbon, Analog to Vacuum Control PCB	119378-0005
Cable, Vacuum Control PCB to Convectron Gauge	119378-0015
Electrometer PCB	119590-0101
Fan	119253-0001
Ion Gauge Control PCB (Upgrade option)	119590-0120
Ion Gauge Control PCB Standoff (Upgrade option)	76350-1007
Low Pass Filter PCB	119590-0080
Power Module 115 V	119655-1115
Power Module 230 V	119655-1230
RF Coil	119670-0001
Vacuum Control PCB	119590-0031



Cable, RF Detector to RF Generator PCB (119378-0010)\*

Cable, Analog to RF Detector PCB (119378-0004)

Electrometer PCB (119590-0101)

Cable, Coax, RF Generator to Low Pass Filter PCB (119378-0013)

Cable, Electrometer to Digital PCB (119378-0008)\*

Power Module 115 V (119655-1115)

Power Module 230 V (119655-1230)

Cable, Ribbon, Analog to Vacuum Control PCB (119378-0005)\*

Cable, Ribbon, Analog to RF Generator PCB (119378-0002)

Fan (119253-0001)

Balun PCB (119590-0090)

Low Pass Filter PCB (119590-0080)\*

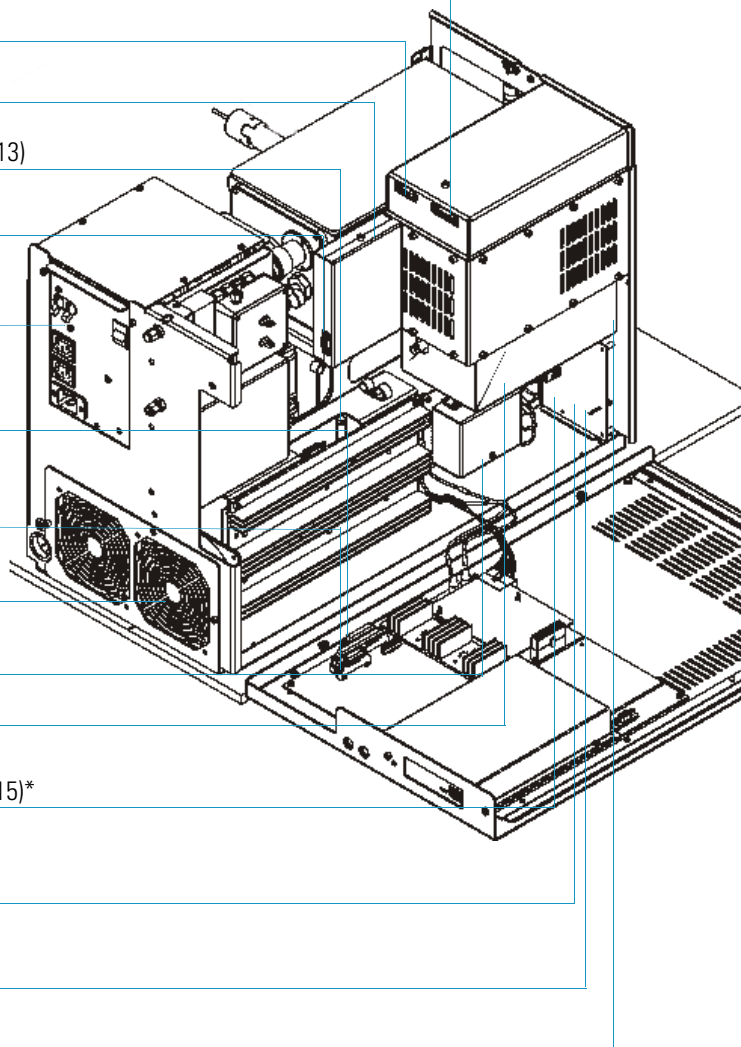
Cable, Vacuum Control PCB to Convectron Gauge (119378-0015)\*

Ion Gauge Control PCB (119590-0120)\*

Ion Gauge Control PCB Standoff (76350-1007)\*

Vacuum Control PCB (119590-0031)

RF Coil (119670-0001)

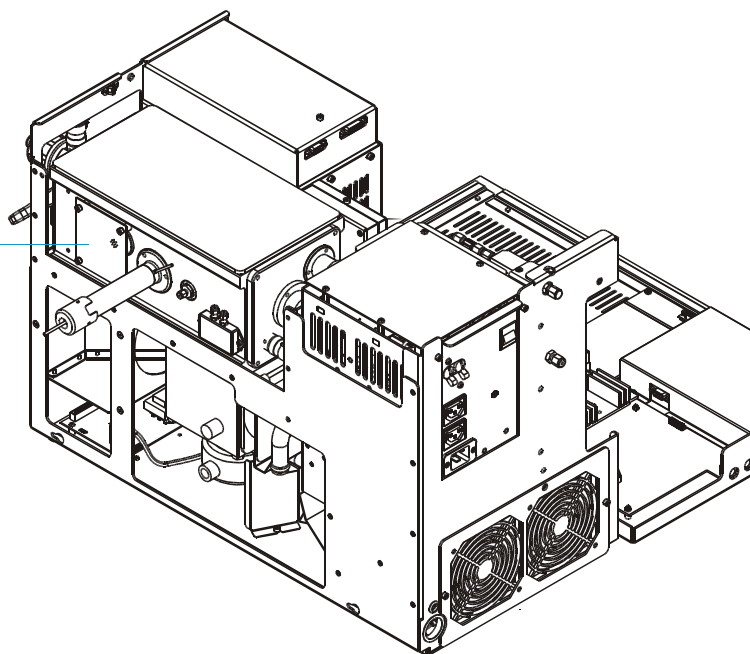


\* - Not Shown

**Table 18.** PCB's and Cables Parts List (right cover)

<b>Description</b>	<b>Part Number</b>
Lens Interface PCB	119590-0110

Lens Interface PCB (119590-0110)

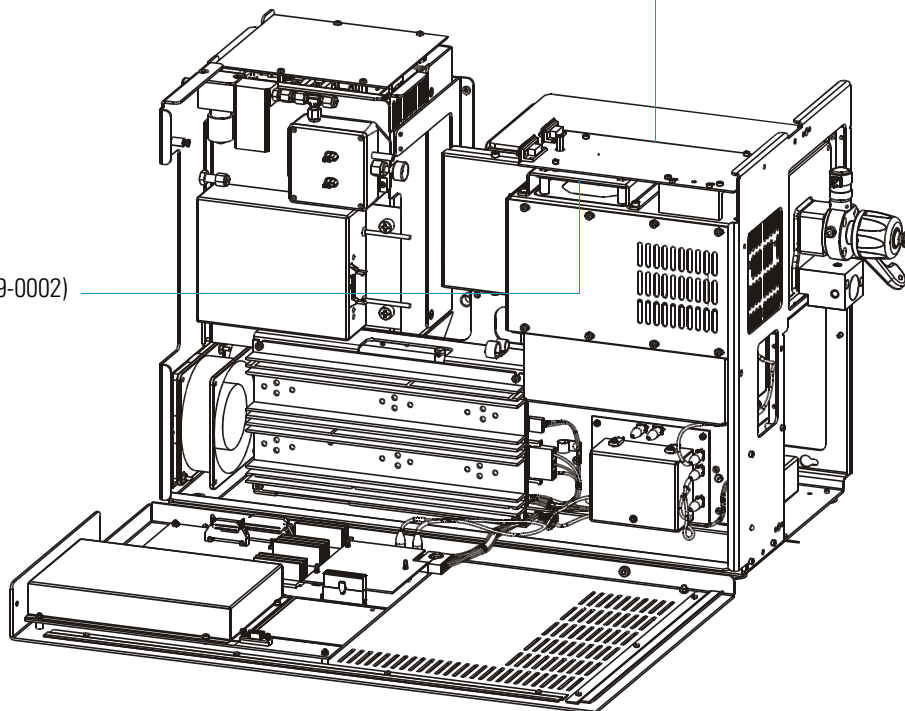


**Table 19.** PCBs Parts List (under the RF Detector PCB cover)

<b>Description</b>	<b>Part Number</b>
RF Detector PCB	119590-0070
RF Capacitor Assembly	119669-0002

RF Detector PCB (119590-0070)

RF Capacitor Assembly (119669-0002)



## Turbomolecular Pump

**Table 20.** Turbomolecular Pump Parts List

Description	Part Number
70 L/s Turbo Pump Foreline Adapter Assembly	119259-0003
Includes: Convectron Gauge	A0105-00501
250 L/s Turbo Pump Foreline Adapter Assembly	119259-0002
Includes: Convectron Gauge	A0105-00501
Cable, Turbo Pump Power Supply to Main Power	119378-0006
Cable, Turbo Pump Power Supply to Vacuum Control PCB	119378-0017
Clamp, 250 L/s Turbo Pump, NW25	76505-2002
Clamp, 70 L/s Turbo Pump, NW16	76505-1013
Foreline Hose	76505-0003
O-ring, 250 L/s Turbo Pump, w/centering ring, NW25	76505-2001
O-ring, 70 L/s Turbo Pump, w/centering ring, NW16	76505-0005
Oil, Rotary-Vane Pump, 1 L	A0301-15101
Rotary-Vane Pump	76505-3007
Turbomolecular Pump, 250 L/s	119268-0001
Turbomolecular Pump, 70 L/s	76505-3006
Turbomolecular Pump Controller	76505-3005
Turbomolecular Pump Power Supply	119254-1000

Turbomolecular Pump Controller (76505-3005)\*

250 L/s Turbomolecular Pump  
 Foreline Adapter Assembly (119259-0002)  
 Includes: Convectron Gauge (A0105-00501)  
 70 L/s Turbomolecular Pump  
 Foreline Adapter Assembly (119259-0003) Includes  
 Convectron Gauge (A0105-00501)

250 L/s Turbomolecular Pump  
 Clamp, NW25 (76505-2002)\*  
 O-ring, w/centering ring, NW25 (76505-2001)\*  
 70 L/s Turbomolecular Pump  
 Clamp, NW16 (76505-1013)\*  
 O-ring, w/centering ring, NW16 (76505-0005)\*

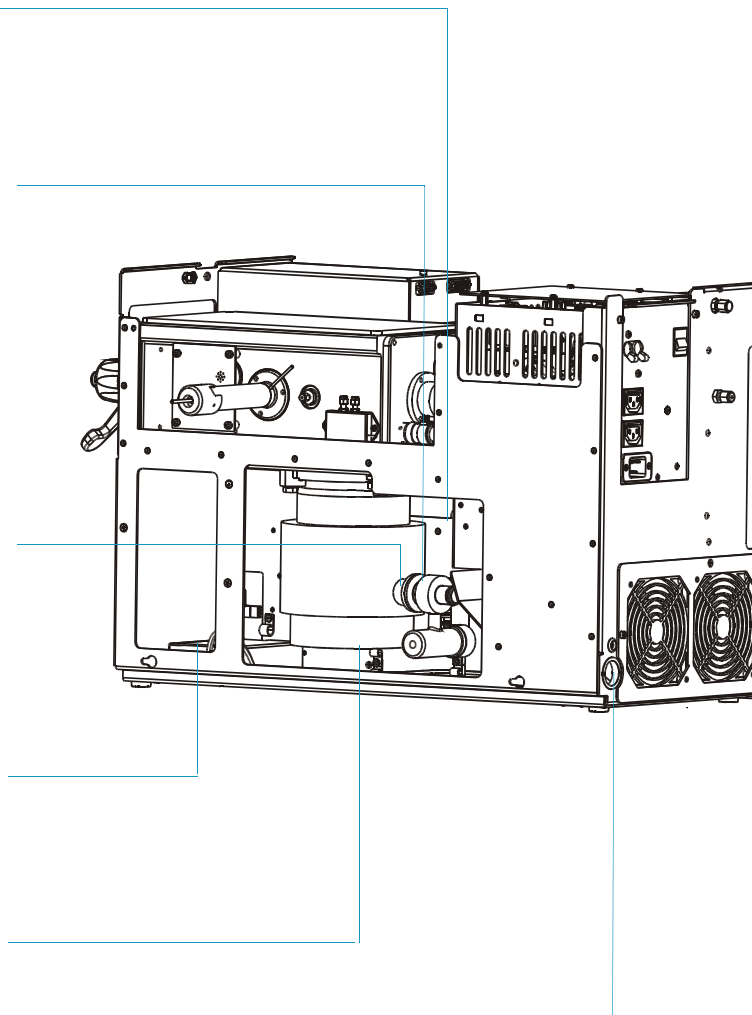
Turbo Pump Power Supply (119254-1000)  
 Cable, Turbo Pump Power Supply to  
 Main Power (119378-0006)\*

Cable, Turbo Pump Power Supply to Vacuum  
 Control PCB (119378-0017)\*

Turbomolecular Pump, 250 L/s (119268-0001)  
 Turbomolecular Pump, 70 L/s (76505-3006) \*

Foreline Hose (76505-0003)\*

\* Not Shown

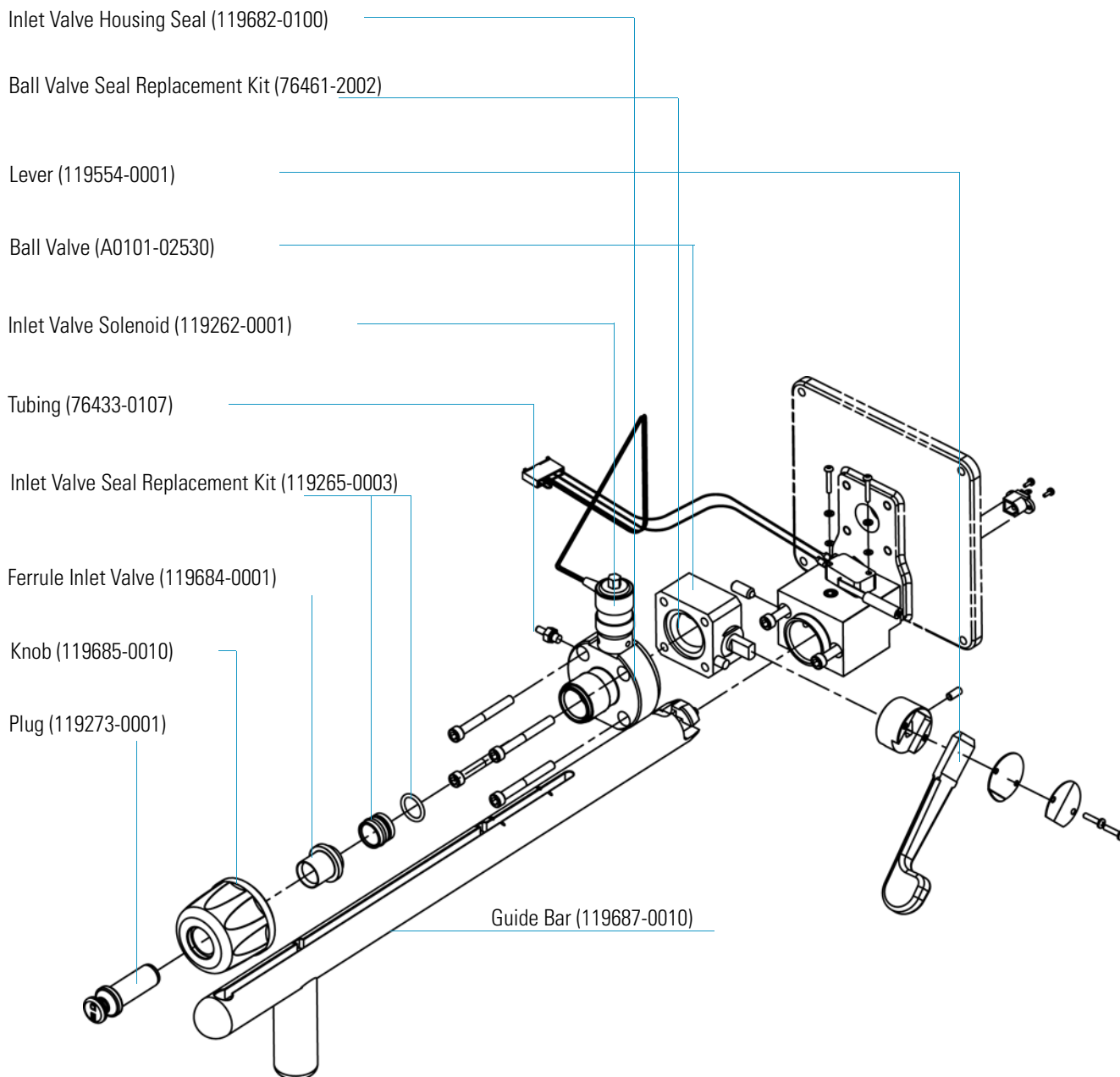


## Inlet Valve (Upgrade Option)

**Table 21.** Inlet Valve Parts List

<b>Description</b>	<b>Part Number</b>
Ball Valve	A0101-02530
Ball Valve Seal Replacement Kit	76461-2002
Ferrule, Inlet Valve	119684-0001
Guide Bar	119687-0010
I/R Tool	96000-60057
Inlet Valve Housing Seal	119682-0100
Inlet Valve Seal Replacement Kit	119265-0003
Inlet Valve Solenoid	119262-0001
Knob	119685-0010
Lever	119554-0001
Plug	119273-0001
Tubing	76433-0107





## Installation Kit

**Table 22.** Installation Kit Parts List

Description	Part Number
Complete Installation Kit	119255-0004
• Allen Wrench Kit, Metric	3812-0100
• Aluminum Oxide	32000-60340
• Back Ferrule, 1/8-in., Brass	A0101-02500
• Cable, PC to Instrument (15 ft Ethernet crossover)	76396-0052
• Calibration Compound	50010-30059
• Column Measuring Tool	119640-0550
• Copper Tubing, Precleaned, 25 ft	76381-0041
• Cotton Tipped Applicators (1 pack)	A0301-02000
• Gloves, Medium	23827-0008
• Gloves, Large	23827-0009
• Filament Assembly	120320-0030
• Front Ferrule, 1/8-in., Brass	A0101-08500
• Fuse, 2 A Microfuse	76339-0008
• Fuse, 0.315 A SB	A0006-04550
• Fuse, 0.8 A SB	A0006-06075
• Fuse, 0.5 A	A0006-07608
• Fuse, 1.0 A	A0006-07610
• Ion Trap Series User's Guide	120425-USER
• Ion Volume Tool	119270-0001
• Methods and Manuals CD	120150-CDMANS
• Nut, 1/8-in., Brass	A0101-15500
• Oxygen, Hydrocarbon, Moisture Trap (with Quick Change Base)	A0950-01600
• Oxygen, Hydrocarbon, Moisture Trap (Replacement for Use with Quick Change Base)	A0950-R1600
• Syringe, 10 $\mu$ L with a 70 mm Needle	36500103
• Tie down, 7"	A0007-90500
• Transfer Line Ferrule, 1/16-in. to 0.4 mm, Graphite/VespeI	A0101-18100
• Union, Tee, 1/8-in., Brass	4032-0082

## Miscellaneous Items

**Table 23.** Miscellaneous Items

Description	Part Number
Cable, GC to PC	23098000
Cable, GC to mass spectrometer Remote Start	76396-0050
Capillary Column, TR-5MS	A0012-08143
Injector Ferrule, for 0.25 mm i.d. Column	29013488
Transfer Line Ferrule, 1/16-in. to 0.4 mm, Graphite/Vespel for 0.25 mm i.d. Column	A0101-18100
Syringe, 10 $\mu$ L w/70 mm Needle	36500103

**A Replaceable Parts**  
Miscellaneous Items

## Functional Block Diagrams

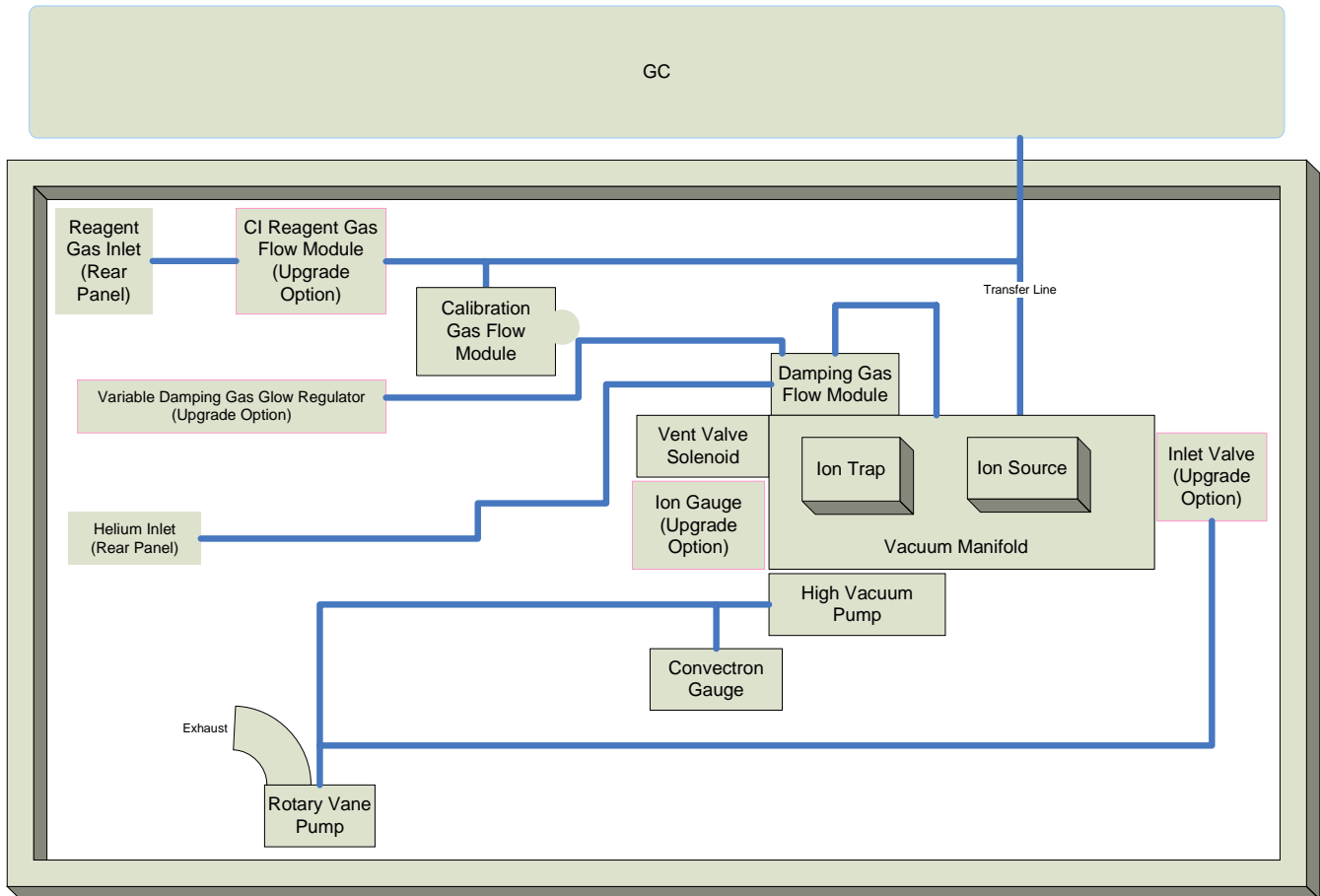
This appendix contains functional block diagrams for the mass spectrometer system and its subsystems.

### Contents

- “Vacuum System and Gas Inlets” on page 222
- “Electronic Assemblies” on page 223
- “Power Distribution” on page 224
- “Cable Connections” on page 225

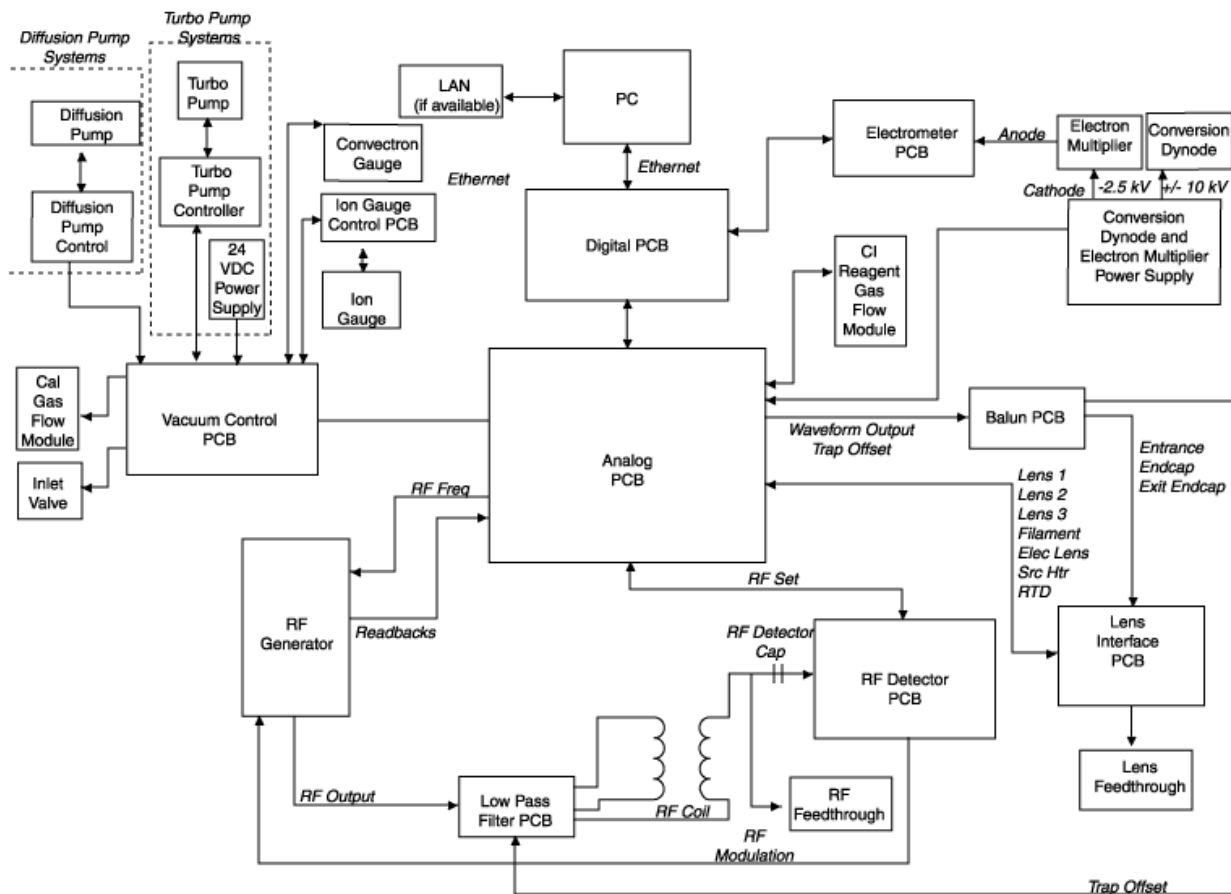
# Vacuum System and Gas Inlets

Figure 115. Vacuum System and Gas Inlets



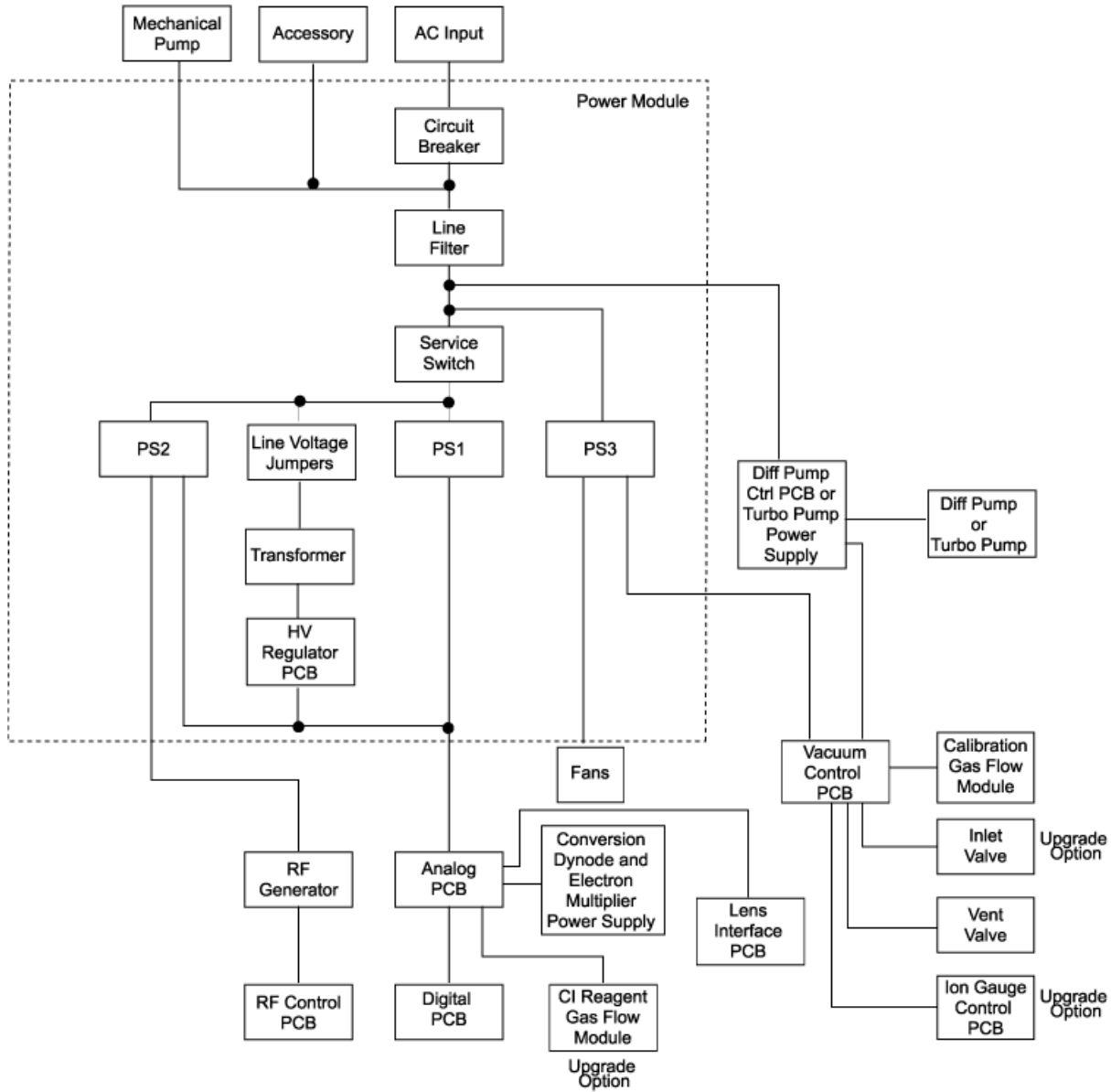
# Electronic Assemblies

**Figure 116.** Electronic Assemblies



# Power Distribution

Figure 117. Power Distribution

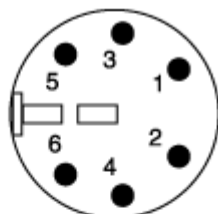




## Cable Connections

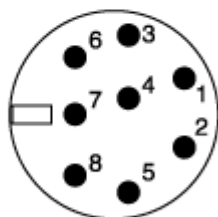
**Figure 118.** Remote Start Cable Connections (Back of mass spectrometer)

### Accessory Start



Trigger Bit 0 *	1
Trigger Bit 1 *	2
Trigger Bit 2 *	3
Trigger Bit GND **	4
Remote Start In ***	5
GND	6

### GC Start



N/C (Not Connected)	1
Inhibit Ready Out with High Signal	2
GND	3
Remote Start In ***	4
N/C	5
N/C	6
N/C	7
Inhibit Ready Out with Low Signal	8

\* For electromagnetic compatibility, use a shielded cable. Tie the shield to the connector's metal can.

\*\* Use only with trigger bits (pins 1-3).

\*\*\* Polarity set in instrument configuration. Default is start when signal is low.

The mass spectrometer offers two connections to start remote injections; Accessory Start and GC Start. Use these connections to determine which connection to plug the remote start cable into. Plug one end of the remote start cable into the back of the mass spectrometer and the other end into the device you intend to use to start injections.

## **B Functional Block Diagrams**

### Cable Connections

## Abbreviations

### Numerics

$\mu$  micro ( $10^{-6}$ )

$\Omega$  ohm

### A

**A** ampere

**ACE** automatic collision energy

**ac** alternating current

**amu** atomic mass unit

**ADC** analog-to-digital converter

**ASCII** american standard code for information interchange

### B

**baud rate** data transmission speed in events per second.

### C

**°C** degrees Celsius

**CD-ROM** compact disc read-only memory

**CE** (F. Conformité Européenne) European conformity. Mandatory european marking for certain product groups to indicate conformity with essential health and safety requirements set out in european directives.

**cfm** cubic feet per minute

**CI** chemical ionization

**CID** collision induced dissociation

**CIP** carriage and insurance paid to

**cm** centimeter

**cc or cm<sup>3</sup>** cubic centimeter

**CPU** central processing unit (in a computer)

### D

**Da** Dalton

**DAC** digital-to-analog converter

**dc** direct current

**DDS** data dependency scanning

**DEP™** direct exposure probe

**DIP** direct insertion probe

**DS** data system

**DSP** digital signal processor

### E

**EI** electron ionization

**ESD** electrostatic discharge

**eV** electron volt

**EN** european conformity

## F

**f** femto ( $10^{-15}$ )

**°F** degrees Fahrenheit

**FCC** federal communication commission

**FOB** free on board

**ft.** foot

**FSE** field service engineer

**FTP** file transfer protocol

## G

**g** gram

**G** giga ( $10^9$ )

**GB** gigabytes 1024 MB (billion)

**GC** gas chromatograph

**GC/MS** gas chromatograph / mass spectrometer

**GND** electrical ground

**GPB** general-purpose interface bus

**GUI** graphical user interface

## H

**HV** high voltage

**Hz** hertz (cycles per second)

## I

**ICIS™** interactive chemical information system

**IEC** international electrotechnical commission

**IEEE** institute of electrical and electronics engineers

**in.** inch

**I/O** input/output

## K

**k** kilo ( $10^3$ , 1000)

**K** Kelvin

**kb** kilobyte 1024 bytes (thousand)

**kg** kilogram

**kPa** kilopascal

**kVA** kilo volt amperes (1000 VA)

## L

**L** liter

**LAN** local area network

**lb** pound

**LED** light-emitting diode

## M

**m** meter; milli ( $10^{-3}$ )

**M** mega ( $10^6$ )

**MB** megabyte or 1,024 kb (million)

**M<sup>+</sup>** molecular ion

**min** minute

**mL** milliliter

**mm** millimeter

**MS** scan power: MS<sup>1</sup>, mass spectrometer

**m/z** mass-to-charge ratio

## N

**n** nano ( $10^{-9}$ )

## P

**p** pico ( $10^{-12}$ )

**Pa** Pascal

**PCB** printed circuit board

**PID** proportional / integral / differential

**PN** part number

**P/P** peak-to-peak voltage

**PPINICI** pulsed positive ion negative ion chemical ionization

**ppm** parts per million

**PQD** pulsed  $q$  dissociation

**psig** pounds per square inch, gauge

## Q

$q$  maximum excitation energy

## R

**RAM** random access memory

**RF** radio frequency

**RMS** root mean square

**ROM** read-only memory

**RS-232** industry standard for serial communications

## S

**s** second

**SCSI** small computer system interface

**SIM** selected ion monitoring

**SI** international system of units

**S/N** signal to noise ratio

## T

**TIC** total ion current

**TCP/IP** transmission control protocol / Internet protocol

**Torr** torr

## U

**URL** uniform resource locator

**USB** universal serial bus

## V

**V** volt

**V ac** volts alternating current

**V dc** volts direct current

**Abbreviation:**

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