Thermo Finnigan

PolarisQ™

Mass Spectrometer Hardware Manual

Xcalibur Data System, ver. 1.2

Revision B
PN 120010

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POLARIS Q

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PolarisQ Hardware Manual
Rev. B
PN 120010

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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

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POLARIS Q

Regulatory Compliance

Thermo Finnigan thoroughly tests and evaluates its products to ensure full regulatory compliance with applicable domestic and international regulations. Your system (instruments and software) is CE compliant and meets Electromagnetic Compatibility (EMC) and Safety standards.

CAUTION

Instrument Damage/Void in Warranty

Ensure compliance with EMC and Safety standards by ordering replacement parts only from Thermo Finnigan authorized representatives. If you make any changes to your system you may void compliance with one or more of these EMC or safety standards. Changes to your system include replacing a part.

CE Compliance

EMC	**Safety**
EN 55011 (1998) EN 50082-1 (1998) EN 61000-4-2 (1995) EN 61000-4-3 (1997) EN 61000-4-4 (1995) EN 61000-4-5 (1995) EN 61000-4-6 (1967) EN 61000-4-11 (1994)	EN 61010-1 1993 plus Amendment 2, 1995

FCC Compliance

FCC part 15, Class A

Thermo Finnigan Standard Warranties

Thermo Finnigan

This standard warranty covers all products manufactured by Thermo Finnigan, hereinafter referred to as the “Seller”.

WARRANTY AND LIMITATIONS. Seller warrants that the products to be delivered hereunder “products” are free from defects in material and workmanship and meet Seller’s field performance specifications as published by the Seller, provided, however, that

1. Seller’s liability under this warranty is, at the discretion of the Seller, limited to repairing or replacing or issuing a credit for any product delivered hereunder not conforming to this warranty. The alternative remedies provided for herein are Buyer’s sole and exclusive remedies.
2. Except as otherwise provided in this document, Buyer’s warranty on all products is limited to a period of ninety (90) days, commencing with the date of acceptance of any such product or sixty (60) days after shipment, whichever occurs first.
3. Minor deviations from specifications that do not affect performance of the products covered hereby are excluded from this warranty.
4. Warranty on repaired or replaced parts is extended only to the expiration date of an issued standard warranty, and only after receipt of written authorization from Seller.
5. Seller makes no warranty as to expendable items including but not limited to electron multipliers, filaments, O-rings, vacuum gauge tubes, fuses, septa, lamps, sources reaction tubes, and solvents. Moreover, after initial installation, any readjustment, recleaning or recalibration is expressly excluded from this warranty.
6. The warranty will be null and void and Seller will not be liable under this warranty upon the occurrence of the following events unless Seller’s prior written consent to the continuation of this warranty is granted:
    a. In the event Buyer installs products or physically moves products from their position of installation at time of acceptance by Buyer, or
    b. In the event Buyer transfers ownership of products to third parties other than Buyer.

7. Seller will not be liable under this warranty unless: (i) Seller is promptly notified in writing by Buyer upon discovery of the failure of any products to conform to this warranty, (ii) when possible, such, product is returned to Seller with Seller's written approval, transportation charges prepaid by Buyer, (iii) such product is received by Seller not more than ten (10) days after the last day of the applicable warranty period, (iv) Seller's examination of such product shall disclose to Seller's reasonable satisfaction that such defects or failures have not been caused by misuse, neglect, improper installation by Buyer, repair, alteration or accident, including but not limited to failure of electric power, excessive or erratic power, failure of environmental control equipment as defined in Seller's published specifications, failure of Buyer's self-maintenance program, or failure of Buyer to maintain product in accordance with Seller's manual or instructions.
8. All claims under warranty must be made promptly after occurrence of circumstances giving rise thereto and must be received within the applicable warranty period by Seller or its authorized representative. Such claims should include the product type and serial numbers and a full description of the circumstances giving rise to the claim. At it discretion, Seller may authorize the prepaid return to Seller's plant or designated repair center of products or parts that prove to be defective, or Seller may repair or replace at Buyer's premises. Before any products are returned for repair and / or adjustment, written authorization from Seller for the return and instructions as to how and where the product should be shipped must be obtained.
9. When any product is returned for examination and inspection or for any other reason, Buyer shall be responsible for all damage resulting from improper packing or handling and for loss in transit, notwithstanding any defect or nonconformity in the product. If it is found that the defective product returned to Seller has been caused by the fault of the Buyer, or has been returned without cause and is still serviceable, Seller shall notify Buyer and shall return such product to Buyer at Buyer's expense; in addition, a charge for testing and examination, may at Seller's discretion, be made on products so returned.
10. Seller will not authorize return or repair or replacement at Buyer's lab of defective products that have been used for the analysis of toxic, carcinogenic, mutagenic or corrosive / irritant chemicals until said products are certified to have been decontaminated by Buyer. Seller shall not warranty products that have not been decontaminated, and Seller shall have no obligation to repair or replace such products. Any products returned to Seller for examination shall be sent prepaid via the means of transportation indicated as acceptable to Seller.

11. Seller reserves the right to reject any warranty claim not made in accordance with the foregoing procedures or any warranty claim on any item that has been altered or has been shipped by nonacceptable means of transportation.
12. Except as above expressly provided, **no warranty is made as to the merchant ability of the goods to be delivered, nor is except as expressly provided above, no warranty is made as to the fitness of such goods for any particular purpose.**
13. Statements, expressed or implied, by any person, including employees or authorized representatives of Seller, that are inconsistent or in conflict with this warranty shall not be binding upon Seller unless said statement is in writing and signed by an officer of Seller.

Liability: **In no event shall Seller be liable to buyer or any other party for incidental, consequential, or special damages.**

Damages: **Seller's liability (whether by reason of breach of warranty, breach of contract, tort, or otherwise and irrespective of Seller's negligence) for damages shall in no event exceed the payment, if any, received by seller for the unit or productor service furnished or to be furnished, as the case may be, which is the subject of claim or dispute.**

August 1998
This warranty shall be governed by the laws of the State of California
P / N QSF-PR-0012 Rev A

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Index 1

Read This First

The **Polaris*Q* Mass Spectrometer (MS) Hardware Manual** contains instructions for operating, maintaining, and troubleshooting the MS.

This manual is written for readers found in the chemical science industry — technicians, analysts, and chemists. We assume you have experience in chemistry and established good laboratory practices (GLP). If you are curious about how the major components work, read chapters 4 through 7 containing theory of operations.

Chapter Summaries

Chapter 1: Routine Operations, discusses routine operations using the Polaris*Q* mass spectrometer.

Chapter 2: Maintenance, contains maintenance procedures for essential Polaris*Q* components.

Chapter 3: Troubleshooting, provides quick reference to identify symptoms, causes, and solutions for poor instrument performance or malfunction.

Chapter 4: Vacuum System and Gas Inlets, contains theory of operations for the Vacuum System and Gas Inlets.

Chapter 5: Ion Source Components and Inlet Valve, contains theory of operations for Ion Source components and the Inlet Valve.

Chapter 6: Ion Trap System, contains theory of operations for the Ion Trap System.

Chapter 7: Ion Detector System, contains theory of operations for the Ion Detector System.

Appendix A: Replaceable Parts, contains Polaris*Q* drawings and part numbers for replaceable parts and consumables.

Appendix B: Functional Block Diagrams, contains functional block diagrams for the Polaris*Q* system and its subsystems.

Appendix C: How to Find Xcalibur Help Topics, contains information on finding Help topics in the Xcalibur help files.

Index, provides an alphabetized, quick reference list of topics from the manual.

PolarisQ Features and Specifications

Your Thermo Finnigan Polaris*Q* is a powerful Y2K ion trap mass spectrometer (MS), with features benefitting people working in the chemical science industry—analysts, technicians, and chemists. A Polaris*Q* System includes the Polaris*Q* MS, the TRACE GC, and the Xcalibur ver. 1.2 software for gas chromatography detection and analysis (Fig. 1).

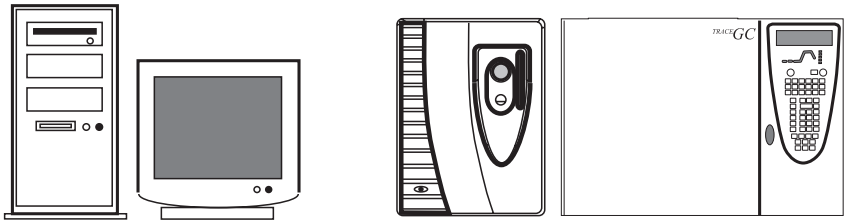


Figure 1. The PolarisQ MS System

Features

- *Calibration Gas Flow Module (CGFM)*
- *CPU, Monitor, Keyboard, and mouse*
- *Windows NT 4.0*
- *Diffusion Pump* (optional turbomolecular pump)
- *Ethernet connection*
- *Fast Electrometer*
- *EI ion source* (new design)
- *Full scan EI, SIM, Segment Scan* (includes simultaneous scan events) *(m/z 10-1000)*
- *Ion Detection System* (Conversion Dynode and Multiplier)
- *Ion Trap* (Mass Analyzer)
- *Rapid scan speed*
- *Fixed Transfer Line*
- *High Vacuum System*
- *Xcalibur ver. 1.2 Software*

Options

- *CI Ion Source* (external)
- *CI Reagent Gas Flow Module control (CI RGFM)*
- *Direct Sample Probe* (DIP or DEP)
- *Inlet valve*
- *Turbomolecular pump* (250 L/sec or 70 L/sec)
- *MS/MS* (MS^n, n=1 to 5)

PolarisQ Specifications

Specifications are subject to change without notice or obligation.

- *Certification: electromagnetic compatibility (EMC) and FCC Class A*
- *Dimensions: l 68 cm x w 33 cm x h 44 cm*
- *Gases: Damping—Helium. CI Reagent—Methane, Isobutane, and Ammonia*
- *Humidity: between 40-80%*
- *Power: 120 V ac (20 A) or 230 V ac (16 A), 50/60 Hz*
- *Space Requirements: 2 m (6 ft)*
- *Temperature: between 15-31 °C (59-88 °F)*
- *Weight: 98 lbs (45 kg)*

Xcalibur ver. 1.2 Data System Software

Xcalibur is the data system software used to configure instruments, calibrate the mass spectrometer, and setup instrument methods for data acquisition and data processing.

Instrument Control— Instrument Configuration configures instruments for use. Instrument setup contains method editors to control instruments and store method parameters for data acquisition. The MS Instrument Setup method editor has access to the Tune program. Use the Tune program to setup precise tuning parameters for Polaris*Q* instrument sensitivity and mass assignments.

Data Acquisition—store mass spectra peaks as they evolve and monitor the total ion chromatogram (TIC) or the intensity of a selected ion.

Data Processing—integrate chromatograms, view mass spectral data, compare spectra to reference libraries, quantify and qualify data, and use Merlin the Report writer to customize and automate reports.

Safety Information

- Read each instruction carefully before using the procedures.
- Look for safety alerts placed in this manual to protect you from injury and your instrument from damage.

CAUTION

Instrument Damage

This safety alert contains information to prevent instrument damage or alert against practices that could possibly void the manufacturer's warranty.

⚠ DANGER

Personal Injury

DANGER safety alerts indicate an imminent hazard exits that WILL result in death or serious personal injury.

⚠ WARNING	
	Personal Injury WARNING safety alerts indicate a potential hazard exits that COULD result in death or serious personal injury.

⚠ CAUTION	
	Personal Injury CAUTION safety alerts indicate a potential hazard exists that MAY result in minor or moderate personal injury. This safety alert also warns against *unsafe* practices.

- Look for safety alerts found on your instruments.

Safety Labels Found On Your Instrument

	Warning against Personal Injury Indicates imminent or potential hazard. Consult the instrument User's Manual.
	Warning against Personal Injury Indicates a hot surface. Make sure the instrument is room temperature before touching.
	Warning against Personal Injury Indicates risk of electrical shock. Make sure the instrument is OFF and unplugged.
	Warning and Caution against potential personal injury and instrument damage. Consult your documentation for instructions. Follow the instructions listed in the Polaris*Q Hardware Manual* before servicing.

- Follow all instructions marked on the product and in the manuals.
- Enroll in *Thermo Finnigan Instrument Training* to prevent accidents and to get maximum use of your instrument.

View and Download Manuals

Visit our website:
http://www.tmqaustin.com/Manuals/fr_manuals.htm

Abbreviations, Acronyms, and Symbols

These abbreviations, acronyms, and symbols are used in this manual and the online help.

A

A	ampere
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

ºC	degrees Celsius
cfm	cubic feet per minute
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.
CI	chemical ionization
CIP	Carriage and Insurance Paid To
cm	centimeter
cc or cm^3	cubic centimeter
CPU	central processing unit (in a computer)
CSE	Customer Service Engineer

D

Da	Dalton
DAC	digital-to-analog converter
dc	direct current

DDS	direct digital synthesizer
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
FTP	file transfer protocol

G

g	gram
G	giga (10^{9})
GC	gas chromatograph
GC/MS	gas chromatograph / mass spectrometer
GND	electrical ground
GPIB	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
I/R tool	Insert/Remove ion volumes tool

K

k	kilo (10^3, 1000)
K	kilo (2^{10}, 1024); Kelvin
kg	kilogram
kPa	kilopascal

L

L	liter
LAN	local area network
lb	pound
LED	light-emitting diode

M

m	meter; milli (10^{-3})
M	mega (10^6)
M+	molecular ion
µ	micro (10^{-6})
min	minute
mL	milliliter
mm	millimeter
MS	scan power: MS^1, Mass Spectrometer
MS/MS	scan power: MS^2

MS^n	scan power: MS^n, n = 1 through 5
m/z	mass-to-charge ratio

N

n	nano (10^{-9})

O

Ω	ohm

P

p	pico (10^{-12})
Pa	pascal
PCB	printed circuit board
PID	proportional / integral / differential
PN	part number
P/P	peak-to-peak voltage
ppm	parts per million
psig	pounds per square inch, gauge

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
SRM	selected reaction monitoring

T

TIC	total ion current
TCP/IP	transmission control protocol / Internet protocol
Torr	torr

U

URL	uniform resource locator

V

V	volt
V ac	volts alternating current
V dc	volts direct current
VGA	Video Graphics Array

W

W	Watt
WWW	World Wide Web

Typographical Conventions

Typographical conventions describe how we present information to our readers. In the **Polaris*Q* Document Set** (PN 120000) we established conventions for three groups:

- Text
- Notes
- Topic headings

Text

Text is specially formatted to help you quickly find information contained in the document.

We used the following conventions to help you quickly find information contained in the document.

- Prompts and messages displayed on the screen are represented by capitalizing the first letter of each word and italicizing each word.

  Example: *Login*.

- Information required by the reader, buttons, and cross-references are **boldface**.

  Example: Press **Enter**. See **Polaris*Q* Hardware Manual**.

- For brevity, we say “Select **File** | **Directories**” rather than “pull down the File menu and choose directories.”

  Example: Select **File | Directories**

- Function keys (F1-F12) and keyboard keys are enclosed in angle brackets to represent a single keystroke. For example, “press <**F1**>” means “press the key labeled **F1**.”

  Example: Press **<F1>**.

- Simultaneous key functions are shown with a hyphen connecting the keys. For example, “press <**Shift**>-<**F1**>” means “press and hold **Shift**, then press **F1**.”

  Example: Press **<Shift>-<F1>**.

Notes

Notes provide important or helpful information about the current subject. Look for Note boxes like this:

> **Note:** A ***Note*** contains important information that can improve the quality of operation. In addition, notes can contain troubleshooting information.

Topic headings

Topic headings vary to help you predict where and how to find information (Fig. 2).

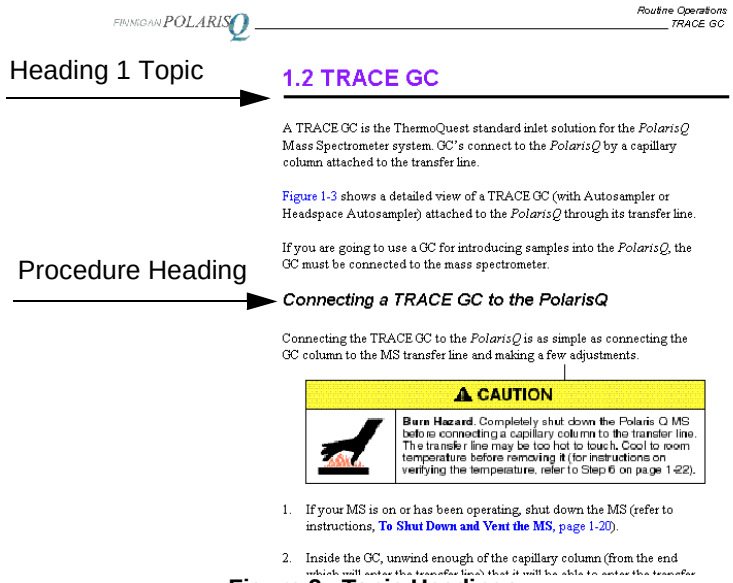


Figure 2. Topic Headings

Heading 1 Topics introduce a subtopic within the chapter. Procedure Headings provide instructions related to the Heading 1 topic.

How to Use the Polaris*Q* Document Set

The **Polaris*Q* Document Set** (PN 120000) serves as your library for information about the Polaris*Q* hardware and software. If one of these manuals is missing from your set, notify customer service for a replacement. Thermo Finnigan part numbers (*PN*) are provided for each book.

Polaris*Q* Preinstallation Guide (PN 120011)
While you are waiting for your instruments to arrive, you will need to prepare your site to facilitate a quick instrument installation. This guide helps you prepare your site for your Polaris*Q* instrument arrival.

Polaris*Q* Mass Spectrometer Hardware Manual (PN 120010)
Instructions for operating, maintaining, and troubleshooting the Polaris*Q* are in this manual. Including the theory of operations for each major component and ordering replacement parts.

Xcalibur-Getting Productive Merlin the Custom Report Writer (PN Xcali-97001)
Use this manual to generate Xcalibur custom reports with Microsoft Word.

Xcalibur-Getting Productive Quan Analysis (PN Xcali-97016)
Contains procedures to automate acquisitions and quantitative analyses, and to create and report calibration curves.

Xcalibur-Getting Productive Qual Analysis (PN Xcali-97017)
Contains procedures to automate acquisitions and qualitative analyses and to use interactive data processing operations, such as spectrum refinement and library building.

Xcalibur-Getting Productive Processing Setup (PN Xcali-97019)
Instructs how to create a Processing Method that analyses a sample data set and how to review and report the results.

Related Documentation

Finnigan Corporation. *Introduction to Mass Spectrometry and Glossary of Mass Spectrometry Terms;* San Jose, CA, 1989.

Price, Phil. Standard Definitions of Terms Relating to Mass Spectrometry, *J. Am. Soc. Mass Spectrom.* 1991, 2, 336-348.

Handbook of Chemistry and Physics, CRC Press Inc., Boca Raton, FL, 1995.
Dodd, Janet. *The ACS Style Guide*, 2d Ed., 1997, American Chemical Society.

Chapter 1
Routine Operations

This chapter discusses routine operations using the Polaris*Q* Mass Spectrometer mass spectrometer.

Performing routine operations increases laboratory productivity and helps you get the most out of your instrument. The Polaris*Q* MS uses ion trap technology to give analysts, technicians, and technical directors a powerful tool for mass spectrometry.

Topics are organized in essential usage order:

1.1 Polaris*Q* MS System, 1-2

1.2 TRACE GC, 1-4

1.3 Autosamplers, 1-12

1.4 Sample Probe (Upgrade Option), 1-14

1.5 PolarisQ MS, 1-16

1.1 Polaris*Q* MS System

A standard Polaris*Q* Mass Spectrometer (MS) system consists of a Polaris*Q* MS, a TRACE GC, and the Xcalibur Data System. Available options include a Liquid Autosampler, a Headspace Autosampler, and an Inlet Valve.

Figure 1-1 illustrates the standard Polaris*Q* Mass Spectrometer system (Data System, Polaris*Q*, and TRACE GC).

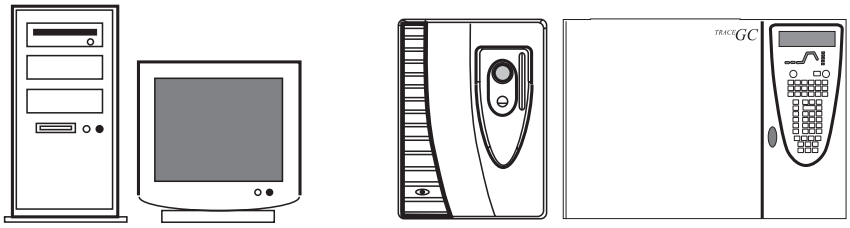


Figure 1-1. The Polaris*Q* MS System

Figure 1-2 illustrates the front of the Polaris*Q*.

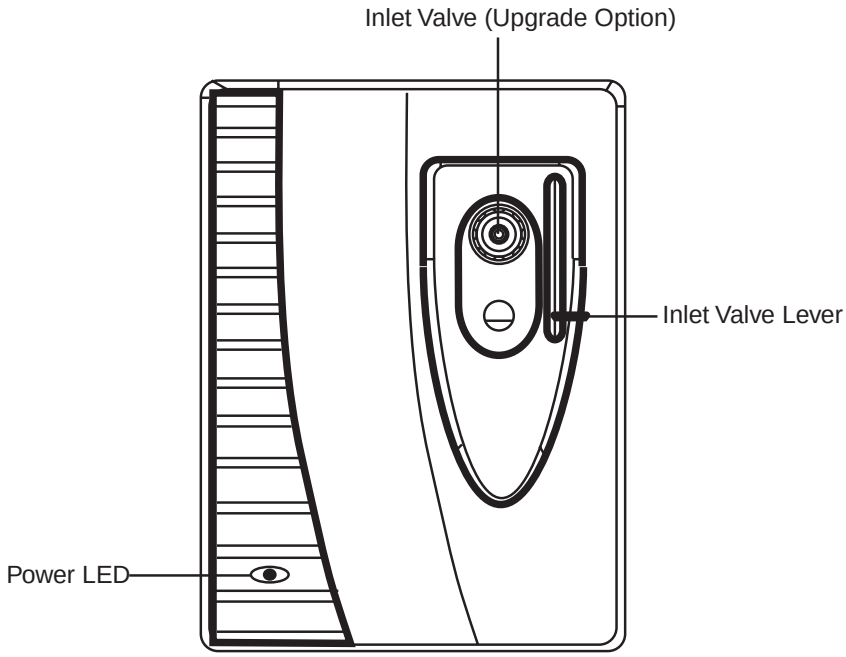


Figure 1-2. Polaris*Q* Key Features

Figure 1-2 illustrates the back of the Polaris*Q*.

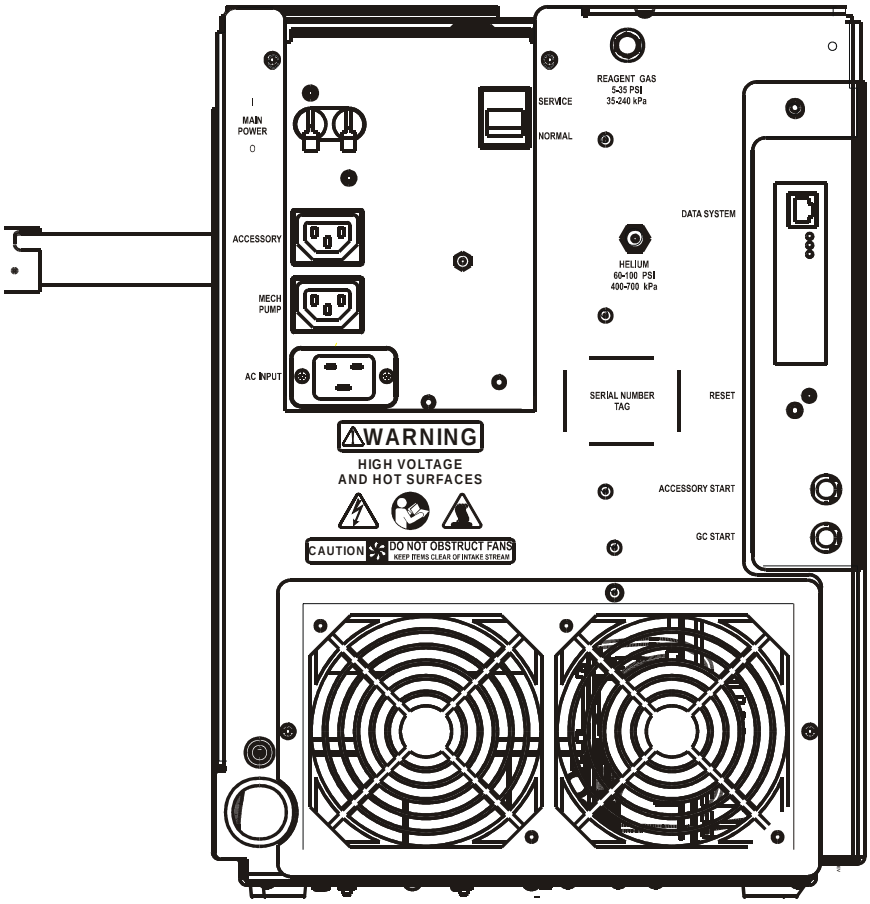


Figure 1-3. Polaris*Q* Main Features (Back)

1.2 TRACE GC

A TRACE GC is the standard inlet solution for the Polaris*Q* Mass Spectrometer system. GCs connect to the Polaris*Q* by a capillary column inserted in the transfer line.

This section contains these procedures:

- Connecting a TRACE GC to the PolarisQ Transfer Line, 1-5
- Configuring the TRACE GC for Operation, 1-8
- Disconnecting the TRACE GC from the PolarisQ, 1-11

Figure 1-4 illustrates the TRACE GC connected to the Polaris*Q* through the transfer line.

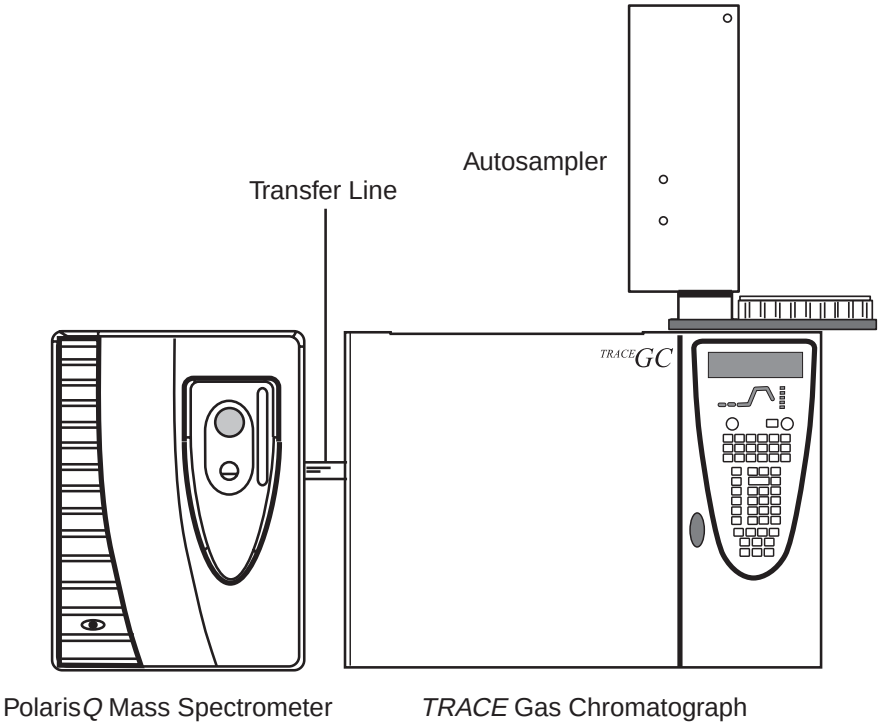


Figure 1-4. Polaris*Q* with TRACE GC and AS attached

Connecting a TRACE GC to the PolarisQ Transfer Line

Materials Needed:

- graphite/Vespel ferrule, i.d. 0.4 mm (PN A0101-18100)
- Kimwipes or other lint-free industrial tissue
- magnifying glass
- Methanol
- scribing tool
- septum (may be a used inlet septum)
- wrench, (open-end) 5/16-in.
- wrench, (open-end) 7/16-in. (2)

FYI: ***How to Find Xcalibur Help Topics****, Appendix C.*

***Frequency*:** As needed

⚠ CAUTION

Burn Hazard

Completely shut down the Polaris*Q* MS before connecting a capillary column to the transfer line. The transfer line may be too hot to touch (for instructions on verifying the temperature, refer to Step 4 on page 1-23).

Connecting the TRACE GC to the Polaris*Q* is as simple as connecting the Gas Chromatograph column to the Mass Spectrometer transfer line and making a few adjustments.

1. **Setup the Polaris*Q*.**

   a. Shut down the Polaris*Q* (details are on page 1-21).

2. **Install a column inside the TRACE GC.**

   a. Inside the GC, unwind enough of the capillary column (from the end which will enter the transfer line) that it will be able to enter the transfer line with some slack (approximately one coil) still in the oven.

   b. Slide a septum, and 1/16 in. Swagelok®-type transfer line nut, and a graphite/Vespel ferrule, flat side first, onto the column, approximately 250 mm from the end.

c. Wipe the column with a tissue soaked in methanol from the nut to the end.

d. Score the column with a scribing tool approximately 50 mm (2 in.) from the end of the column. Break the column at the score mark. Do this carefully to ensure a smooth, square cut.

e. Inspect the end of the column with a magnifying glass. Verify that the cut is square and smooth. Recut if necessary.

f. Slide the septum, nut, and ferrule so the back of the nut is exactly 270 mm (10.63-in.) from the end of the column (Figure 1-5).

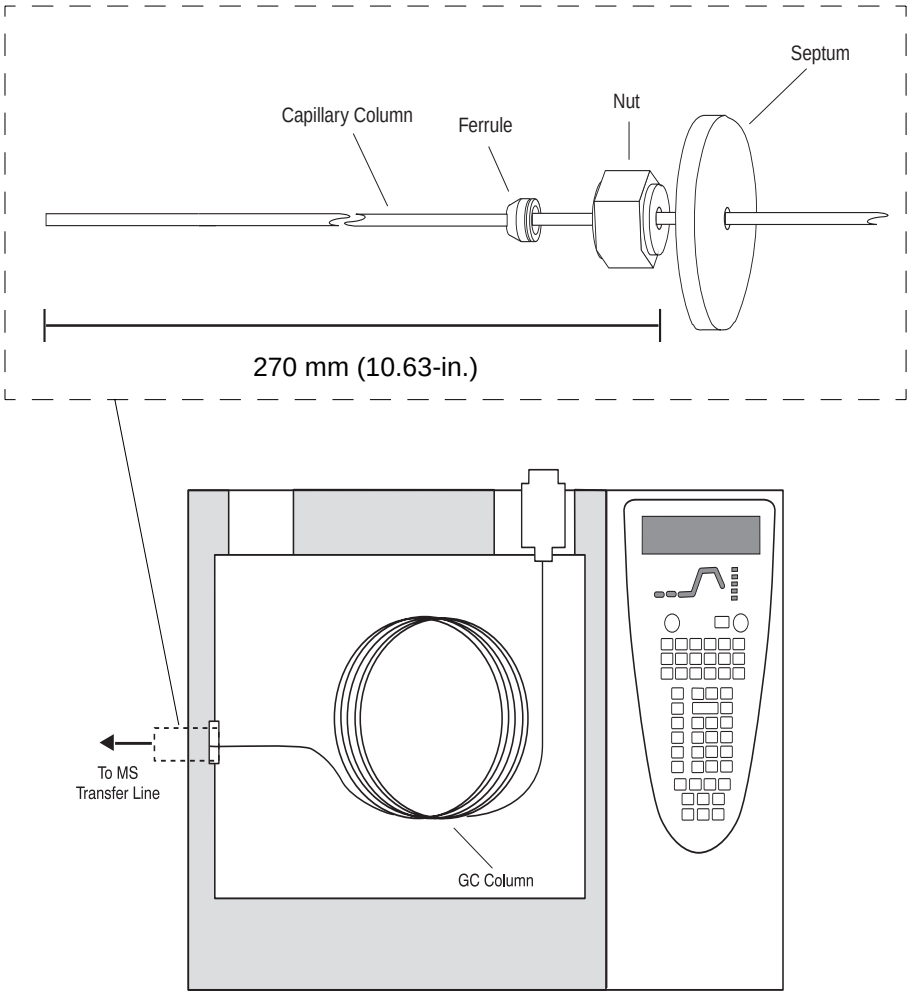


Figure 1-5. GC Ferrule, Nut, and Septum assembly and location

3. **Feed the column from the inside of the GC into the Polaris*Q* transfer line.**

   a. Tighten the nut by hand onto the end of the transfer line.

   b. Continue inserting the column until the septum is in contact with the nut.

4. **Secure the GC column to the Polaris*Q*.**

   a. Use 5/16-in. and 7/16-in. open-end wrenches to tighten the nut until the column is secure.

   b. Use two 7/16-in. open-end wrenches to tighten the 1/8-in. nut so the union is tight on the transfer line.

   c. Check the tightness again after one or two heat cycles in the GC oven.

> **Note:** The column should extend 1 mm beyond the end of the Transfer Line tip inside the Vacuum Manifold.

Configuring the TRACE GC for Operation

	Materials Needed: • TRACE GC • Xcalibur 1.2 or greater *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed

Configure the TRACE GC using the Xcalibur software and/or the TRACE GC Keypad**.**

1. **Turn on the Polaris*Q*.**

2. **Configure the GC for use with Xcalibur software.**

   a. Select **Xcalibur** | **Instrument Configuration** from the Start menu to display the Instrument Configuration screen.

   b. Configure Xcalibur to use the TRACE GC by clicking on its graphic and selecting **Add**.

   c. Configure the instrument for use. Exit Instrument Configuration.

   d. Select **Xcalibur** from the Start menu to display the Xcalibur Roadmap Home Page window.

3. **Setup the TRACE GC.**

   a. Ensure that a capillary column is installed in the GC column oven and the transfer line is properly installed to the Polaris*Q*.

   b. Turn on the GC using the **main power** on/off switch.

   c. Ensure that the helium tank head pressure is 400 to 700 kPa (60 to 100 psi). Set the carrier gas flow to a good beginning value, such as 40 cm/s or 1 mL/min. If you need more detailed instructions on controlling the GC, refer to the TRACE GC Operating Manual (PN 31709170), or the operating manual for the GC you are using.

4. **Setup a TRACE GC method.**

   a. From the Home Page, select **Instrument Setup** to display the Instrument Setup window (Figure 1-6). From here, select the **TRACE GC** instrument icon to display the GC Method Editor.

      In Figure 1-6 we demonstrate naming conventions in the Xcalibur Graphical User Interface (GUI).

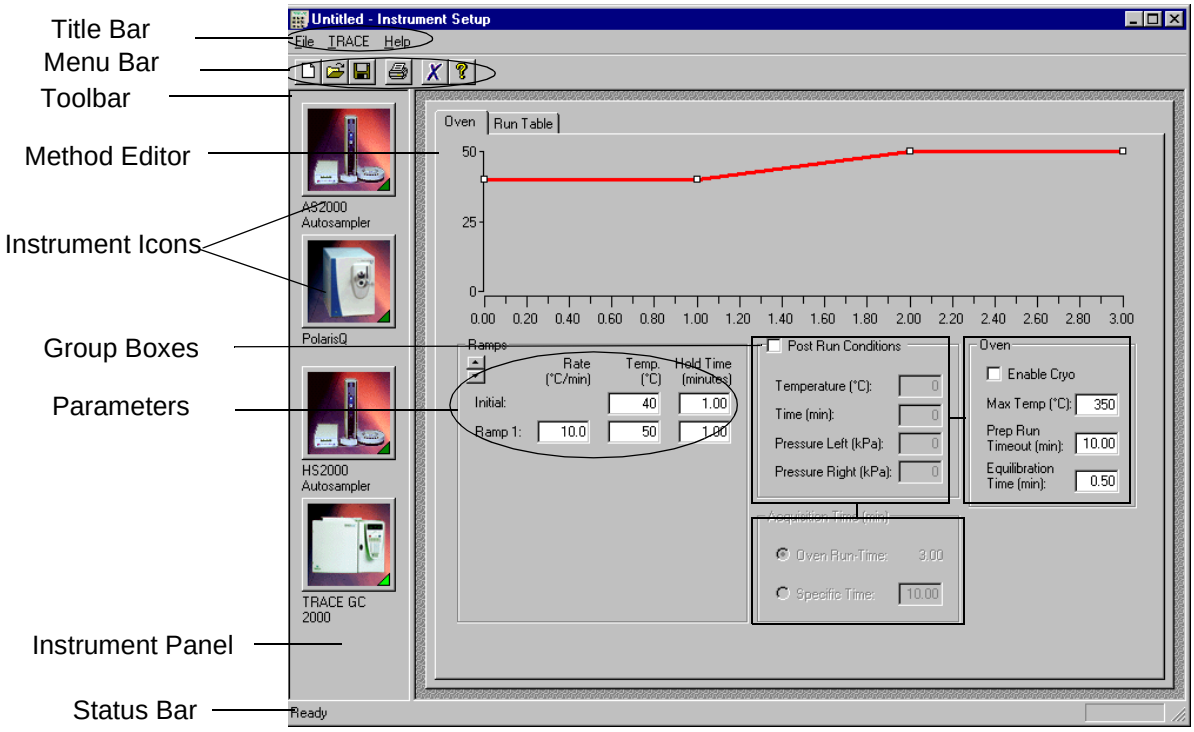


Figure 1-6. Instrument Setup Window and Method Editor Menu

b. Use the GC Method Editor to set up TRACE GC operating parameters, or use the TRACE keypad (Figure 1-7) to manually setup operating parameters.

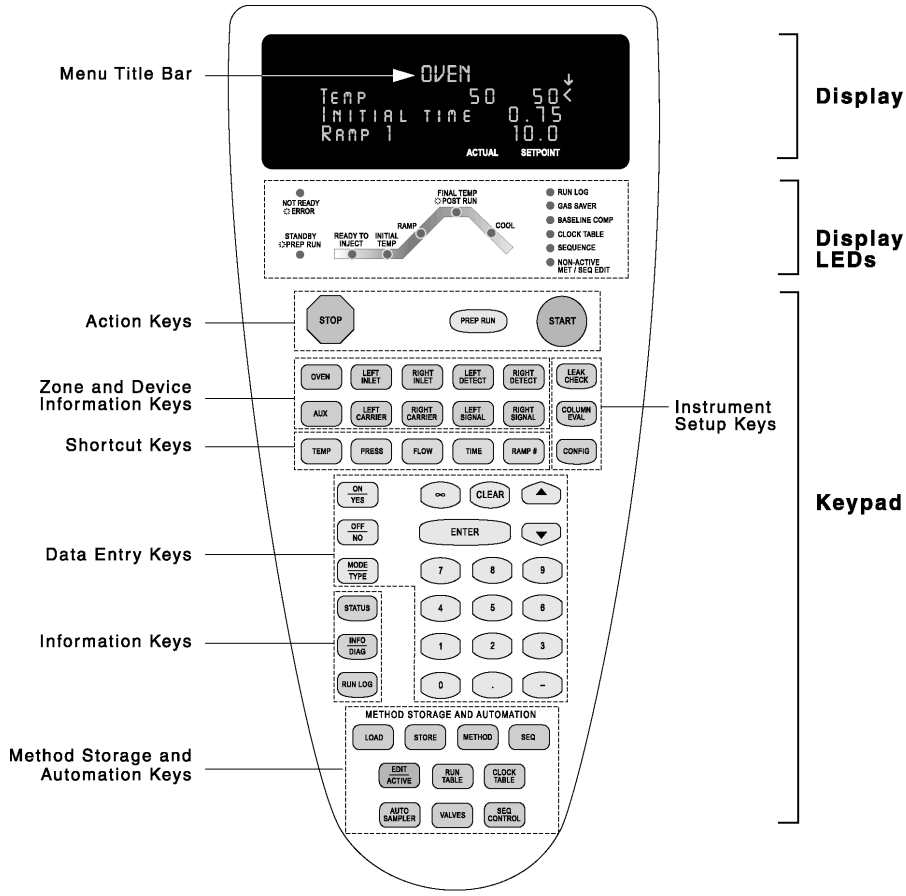


Figure 1-7. TRACE Keypad

Disconnecting the TRACE GC from the PolarisQ

	Materials Needed: • wrench, (open-end) 5/16-in. • wrench, (open-end) 7/16-in. *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed

⚠ WARNING

Burn, Electric Shock, or Other Personal Injury

The transfer line and ion source may be as hot as 350 ˚C. Do not open or work inside the Mass Spectrometer before making sure the system is off, unplugged, and cool to touch. This may take as long as one hour after Xcalibur prompts you to turn the MS off.

Disconnect the TRACE GC from the Polaris*Q* for maintenance and cleaning procedures.

1. **Setup the Polaris*Q*.**

   a. Shut down and vent the Polaris*Q* MS (see Shutting Down and Venting the PolarisQ, 1-21).

2. **Remove the GC capillary column from the Polaris*Q*.**

   a. From inside the GC, loosen the 1/16-in. Swagelok type transfer line nut using 5/16-in. and 7/16-in. open ended wrenches.

   b. Carefully pull the capillary column until it is free of the transfer line.

Note: If the nut was not previously overtightened, the ferrule can be reused.

1.3 Autosamplers

	Materials Needed: • AS2000 Operating Manual (PN 31709250) • HS2000 Operating Manual (PN 31709260) *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed

Thermo Finnigan autosamplers (AS2000, HS2000) automate sample injections into the TRACE GC.

1. **Setup the Autosampler.**

   a. Make sure the AS is properly connected to the TRACE GC (the electrical cables are firmly connected, the support and brackets are solidly attached to the chassis and fit easily in their slots).

   This is typically done when the Customer Service Engineer sets up your instrument. For operating information, see the *AS2000 Operating Manual* (PN 31709250) or the *HS2000 Operating Manual* (PN 31709260).

   b. Make sure each instrument (Polaris*Q* and GC) is connected and turned on.

   c. Flip the AS main power switch to the **ON** position.

2. **Configure the Autosampler for use with Xcalibur software.**

   a. Select **Xcalibur** | **Instrument Configuration** from the Start menu to display the Instrument Configuration screen.

   b. Select your autosampler from the list of icons on the left and click **Add**.

   c. Configure the autosampler for use. Exit Instrument Configuration.

3. **Use Xcalibur to setup instrument parameters.**

   a. Select **Xcalibur** from the Start menu to display the Xcalibur Roadmap Home Page.

   b. Use the software to set up method parameters.

For details on placing sample vials, preparing solvent and waste bottles, and installing syringes, refer to the manual that came with the autosampler.

1.4 Sample Probe (Upgrade Option)

	Materials Needed: • DPC and Sample Probe (DIP or DEP) • DPC and Sample Probes Manual (PN 119327) • I/R tool and Guide Bar • Xcalibur 1.2 or greater *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed to introduce samples to the Polaris*Q*

A Direct Sample Probe is an inlet device for introducing solid and liquid samples directly into the ion source. This is useful for compounds that are thermally labile, highly active, or have physical characteristics that would prohibit or limit their ability to be analyzed using gas chromatography.

Refer to the *DPC and Sample Probes User Manual* (PN 119327) for detailed procedures in using a Sample Probe with the Polaris*Q*.

In Xcalibur 1.2, use the Insert/Remove Probe button located on the Home Page or Tune program (Figure 1-8) to operate the Probe in the Polaris*Q*.

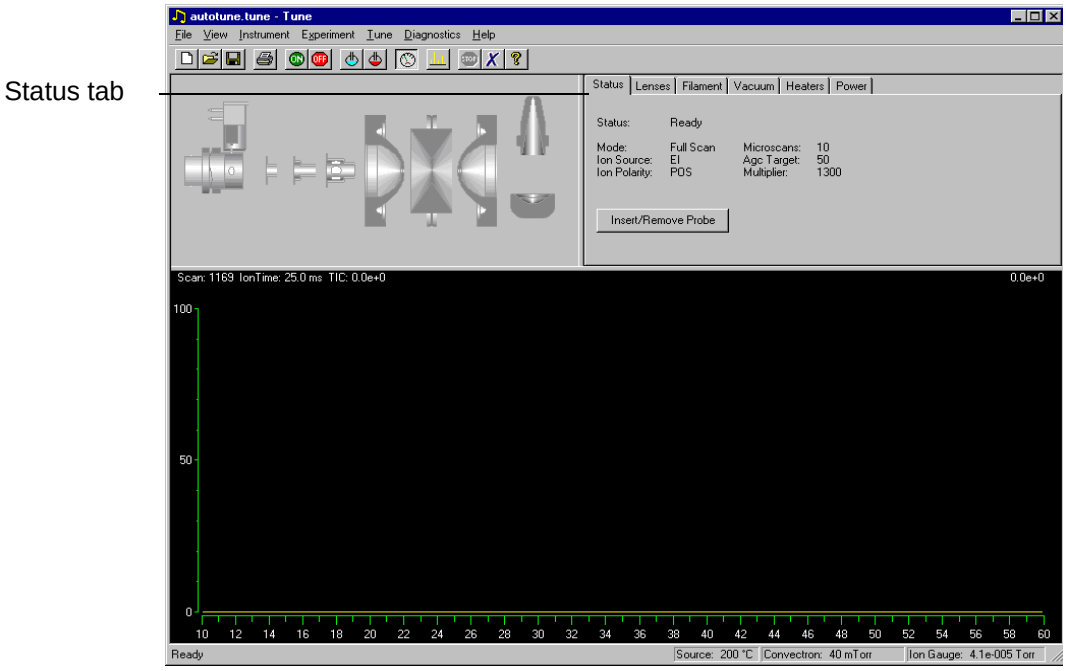


Figure 1-8. Insert/Remove Probe Option in Tune

1.5 Polaris*Q* MS

The Polaris*Q* Mass Spectrometer is completely controlled by the Xcalibur Data System. Run Xcalibur by selecting **Programs** | **Xcalibur** from the Start menu.

Procedures for this section include:

- Starting and Stopping the PolarisQ MS, 1-17
- Putting in Standby, 1-20
- Shutting Down and Venting the PolarisQ, 1-21
- Shutting Down the PolarisQ in an Emergency, 1-24
- Setting Up Basic Mass Spectrometer Operating Conditions, 1-25

Starting and Stopping the PolarisQ MS

	Materials Needed: • PolarisQ MS • Xcalibur 1.2 or greater *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** First time use

Starting and stopping the Polaris*Q* is a routine operation that becomes necessary during first time use, performing maintenance, or anytime you find it necessary to stop and restart the instrument.

1. Setup the Polaris*Q*.

a. Verify that the Main Circuit Breaker (located on the back of the Polaris*Q*) is in the **off** position (down)

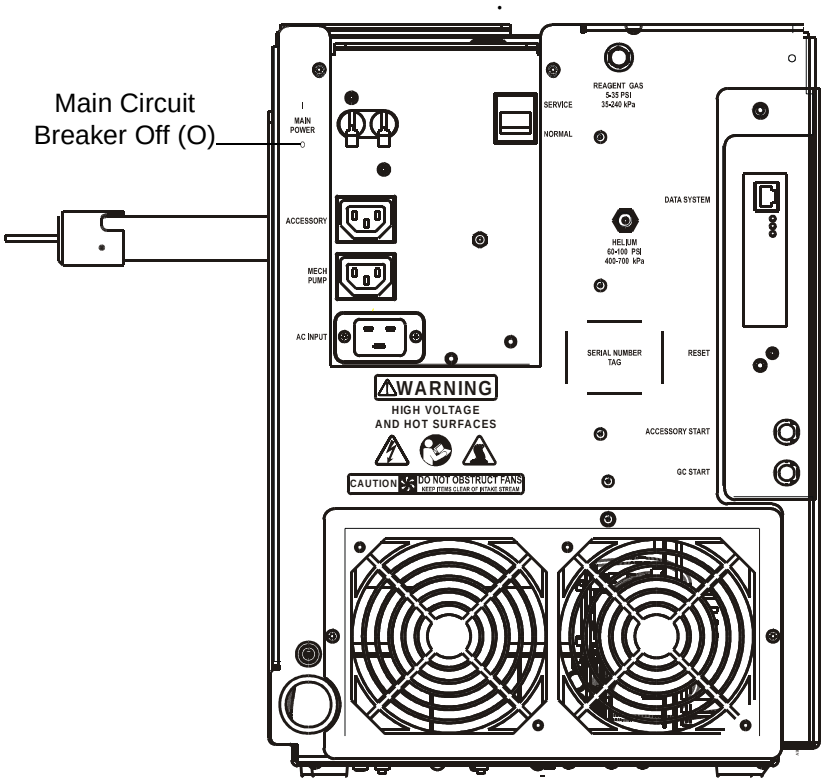


Figure 1-9. Polaris*Q* Back View

b. Verify the capillary column from the GC is properly inserted into the Transfer Line.

c. Verify the GC is on and there is carrier gas flowing through the Capillary Column into the Polaris*Q*.

CAUTION

Potential instrument damage. Turning on the MS without capillary flow will force air to be drawn through the column and cause damage.

d. Plug in the power cord for the Polaris*Q*.

2. **Flip the main circuit breaker up to power on the system. When you do, this occurs:**

   - Rotary-Vane Pump turns on.
   - Foreline pressure reaches the proper operating pressure, and the Diffusion Pump (or optional Turbomolecular Pump) turns on.
   - The Ion Source, Mass Analyzer, and Ion Detector system remain off.
   - The vacuum system is operational in 30 minutes or less, and the Data System displays a Vacuum Ready message.

3. **Configure the Polaris*Q* for use with Xcalibur software.**

   a. Select **Xcalibur** | **Instrument Configuration** from the Start menu to display the Instrument Configuration screen.

   b. Select **Polaris*Q*** from the list of icons on the left and click **Add**.

   c. Configure the Polaris*Q* for use. Exit Instrument Configuration.

4. **Start Xcalibur.**

   a. Select **Xcalibur** from the Start menu to display the Xcalibur Roadmap Home Page.

   b. If the Data System fails to display a Vacuum Ready message, check the system for leaks. Steps for leak-checking can be found in **Chapter 3: Troubleshooting**.

c. Once the data system is ready, setup Polaris*Q* operating conditions or stop the instrument.

To Stop the PolarisQ:

- ...if you will not be using the Polaris*Q* for less than two weeks, Putting in Standby, 1-20 for instructions
- ...if you need to shut down the system for more than two weeks or perform maintenance, see Shutting Down and Venting the PolarisQ, 1-21 for instructions
- ...in case of an emergency, see Shutting Down the PolarisQ in an Emergency, 1-24 for instructions

Putting in Standby

	Materials Needed: • PolarisQ MS • Xcalibur 1.2 or greater *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** If you will be away from the instrument for less than 2 weeks.

The standby mode is useful if the instrument is not used for short periods of time (less than two weeks). Placing the system in standby puts less stress on the components than a complete shutdown.

1. **Turn off the gases.**

   a. Wait until the data acquisition, if any, is complete.

   b. Open the Tune window (For more details, see Xcalibur Tune Help topic: Tuning and Calibrating the Instrument).

   c. Verify that the CI Reagent and Calibration gases are off. Use the toolbar button to toggle gas on or off.

2. **Put the system in standby.**

   a. Choose **Instrument | System Off** to turn off voltages to the EI/CI ion source, mass analyzer, and ion detector system.

   b. Leave the GC carrier gas flow and the septum purge on, and turn off the split vent (found in either the Carrier or Inlet menus depending on your configuration).

   c. Set the GC column oven temperature to 50 °C, or to the column manufacturer's specifications.

> **Note:** You can set the GC column oven temperatures through Xcalibur by selecting (or creating) and downloading a GC method to the GC. For more details, see Xcalibur Help topic: GC Instrument Setup. You can also set the GC column oven temperature from the GC front panel keypad. For instructions on how to operate the GC from the front panel, refer to the manual that came with the GC.

   d. Leave the Transfer Line and Ion Source temperatures at the standard operating values.

   e. Leave the PolarisQ, GC, autosampler, and data system on.

Shutting Down and Venting the PolarisQ

	Materials Needed: • Polaris*Q* MS • Xcalibur 1.2 or greater *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	***Frequency*:** Only to shut down the Polaris*Q* for more than 2 weeks, or perform a maintenance procedure

Shutting down the system cuts power from internal components and vents the vacuum manifold. If the system will be used again in less than 2 weeks, it is better to put the system in Standby than shut it down. Venting the Polaris*Q* produces contaminants that take time to bake and pump away.

Note: If you are shutting down the system to install a CI ion volume (that is, you are changing from an EI operation to CI operation), first tune the Polaris*Q* for EI operation. The Automatic Tune is designed so that an EI tune must be performed before a CI tune. Instructions for tuning an EI operation are listed in the Xcalibur Online Help.

1. **Cool the TRACE GC.**

   a. If you plan to turn off the GC, download a GC method to cool the GC oven and injector to room temperature.

      For more details, see Xcalibur Instrument Setup Help topic: Setting Up Method Parameters, or use the controls on the GC front panel. For detailed information on using the GC front panel, refer to the TRACE GC Operating Manual (PN 31709170), or the operating manual for the GC you are using.

   b. Turn off the Transfer Line heater (AUX1 Zone on the TRACE GC).

2. **Shut down and vent the Polaris*Q*.**

   a. From the Instrument Setup window, click the **Tune** icon to display the Xcalibur Tune window.

   b. Choose **Instrument | Shutdown** to start the automatic shutdown procedure. When you choose **Shutdown**, the following actions occur:

      • Xcalibur Shut Down screen displays.

      • Calibration Gas Flow and CI Reagent Gas Flow Modules are turned off.

- Voltages are turned off to the Ion Source, Ion Trap, and Ion Detector System.
- Ion Source heater is turned off.
- Diffusion Pump or Turbomolecular Pump turns off.
- Xcalibur counts down twenty minutes for the diffusion pump to cool (or ten minutes for the optional turbomolecular pump to spin down). The amount of time left in the shutdown procedure is displayed in the Xcalibur Shut Down screen. The system also waits for the Ion Source to cool to < 175 °C. This will prevent oxidation of the hot parts when they are exposed to air. Be sure to wait for the Transfer Line to cool to < 175 °C as well.

Note: To terminate the automatic shutdown procedure, click on **Restart** in the Shut Down dialog box. Then, choose **Startup** from the Instrument menu

3. **Turn the Polaris*Q* off.**

   a. Look for a screen to display that it is OK to turn off the main power to the Polaris*Q*.

   b. Click **OK**.

   c. Switch the Polaris*Q* main circuit breaker to **OFF** (0).

      This 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 4 minutes.

   d. Unplug the Polaris*Q* power cord.

4. **Wait for the GC injector, column oven, and transfer line to cool to room temperature.**

   a. Verify the GC injector temperature. Select the **Left** or **Right Inlet** key (depending on your configuration) on the TRACE GC keypad. The Inlet information menu displays. Read the injector temperature from the menu.

   b. Verify the column oven temperature. Select the **Oven** key from the TRACE GC keypad. The Oven information menu displays. Read the oven temperature from the menu.

   c. Verify the transfer line temperature. Select **AUX** from the TRACE GC keypad. The AUX information menu displays. Select **Temp** and **Enter**. Read the Transfer Line temperature from the menu.

⚠ CAUTION	
	Burn Hazard The GC oven, injector, transfer line, EI/CI ion source, and diffusion pump may be very hot and can cause severe burns if they are touched before they are cool. Allow heated components to cool before servicing them.

Note: If you are planning to perform system maintenance on the Polaris*Q* only (for example, to clean the EI/CI ion source or mass analyzer), you do not need to turn off the GC, data system, and autosampler. In this case, the shutdown procedure is complete after step 4. However, if you do not plan to operate your system for an extended period of time, we recommend that you turn off the GC, data system, and autosampler as described in step 5.

5. **Turn off:**
   - GC carrier gas (for instructions, see the manual that came with your GC)
   - Helium supply at the tank
   - GC using the GC main power on/off switch
   - Autosampler (optional) by using the main power on/off switch

Shutting Down the PolarisQ in an Emergency

	Materials Needed: None *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency: In an emergency, such as fire or an impending emergency

Shutting down the Polaris*Q* in an emergency (such as a fire or an impending emergency) is a simple operation requiring only two steps.

1. Turn off the system power switches.

a. Turn the Main Circuit Breaker located on the back of the Polaris*Q* to **OFF** (O) (Figure 1-10).

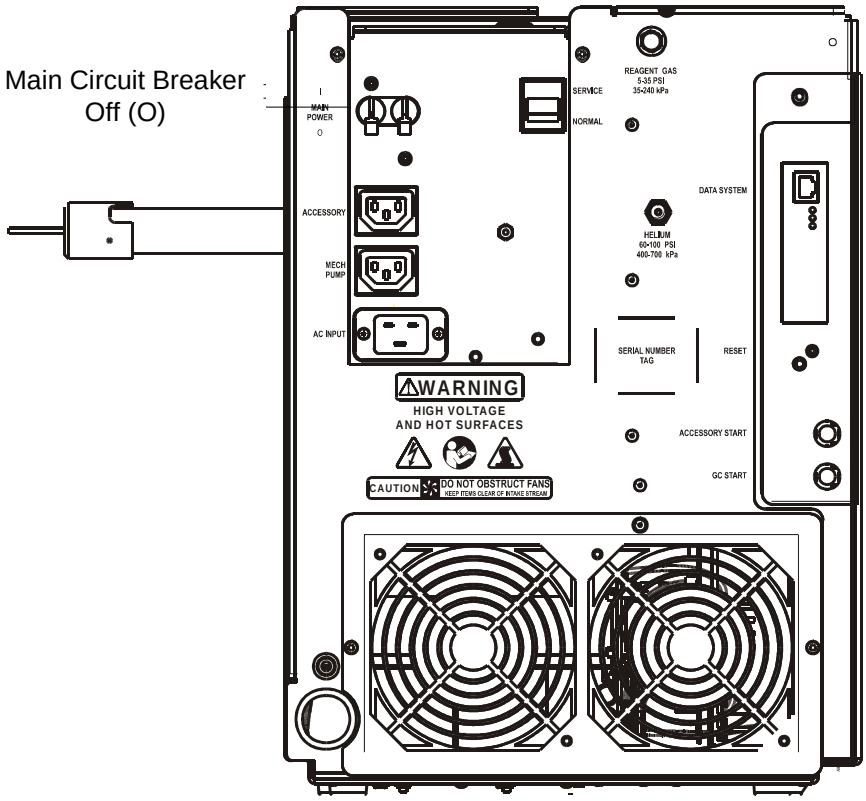


Figure 1-10. Polaris*Q* Back View

b. Turn power switches on the GC, autosampler, and computer off.

Setting Up Basic Mass Spectrometer Operating Conditions

	Materials Needed: • Polaris*Q* MS • Xcalibur 1.2 or greater *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	***Frequency*:** After a complete shutdown, where the MS has been powered down

Setup Operating Conditions so that you can be certain your system is ready for basic operations.

1. Pump down the Polaris*Q*.

a. Allow the system to pump down for at least one hour after you start the system to remove any air and water vapor from the vacuum manifold.

b. Verify that vacuum manifold pressure is low enough for proper operation:

- If you have an ion gauge, check the pressure in the vacuum manifold (For more details, see Xcalibur Polaris*Q* Help topic: The Vacuum System Test**)**. If the pressure is above 1.0 x 10^{-4} Torr, do not turn on the filament or electron multiplier. If necessary, allow additional pumping time. Check the air/water spectrum (For more details, see Xcalibur Tune Help topic: Beginning Your Day, steps 6 and 7).

- If you do not have an ion gauge, check the air/water spectrum to determine the amount of air and water in the manifold as described in the online help (For more details, see Xcalibur Tune Help topic: Beginning Your Day, steps 6 and 7). Turn off the filament and electron multiplier, if the air/water spectrum indicates large amounts of air and water. If necessary, recheck the air/water spectrum after additional pumping time.

2. **Verify that the GC injector, column oven, transfer line, and ion source have come to thermal equilibrium.**

   Table 1-1 shows the typical install operating temperatures for various instruments.

Table 1-1. Operating Temperatures

Instrument	Typical	Maximum
GC Injector (SSL)	250 °C	400 °C
GC Column Oven	40 °C	450 °C
Transfer Line	300 °C	350 °C
EI/CI Ion Source	225 °C	300 °C

   a. Check the GC injector and column oven temperatures from the GC front panel display.

      You can set the GC injector, column oven, and Transfer Line temperatures from the Status View located in the Xcalibur Home Page or from the GC front panel keypad.

   b. Check the Ion Source temperature from the Status view located in the Xcalibur Home Page window.

      For more detailed information on controlling your TRACE GC, see the *TRACE GC Getting Started Manual* (PN 31709230).

⚠ CAUTION

Burn Hazard

Upper end temperatures of the components listed in Table 1-1 are enough to cause severe burns. Use caution when working around or with them.

3. **Use Xcalibur software to configure the basic Polaris*Q* operating conditions.**

   a. Tune the Polaris*Q* for EI or CI operation (for more details, see Xcalibur Polaris*Q* Help topic: Tuning and Calibrating the Instrument).

   b. Check the disk space, helium supply, and cooling fan.

c. Print out a copy of the Status report (from Tune, select **File|Print**, then specify **Status Report**).

d. Analyze a standard test sample (whose analysis results are already known).

e. Verify that the column is installed properly, the instrument parameters are set correctly, and the instrument is functioning properly.

Note: Test samples for stand alone GC's are different than GC/MS systems.

Chapter 2
Maintenance

This chapter contains maintenance procedures for essential Polaris*Q* components.

Topics are organized in essential usage order:

2.1 Recommended Maintenance Schedule, 2-3

2.2 Polaris*Q* Covers, 2-6

2.3 Vacuum Manifold, 2-12

2.4 Cleaning Parts, 2-17

2.5 Ion Source, 2-25

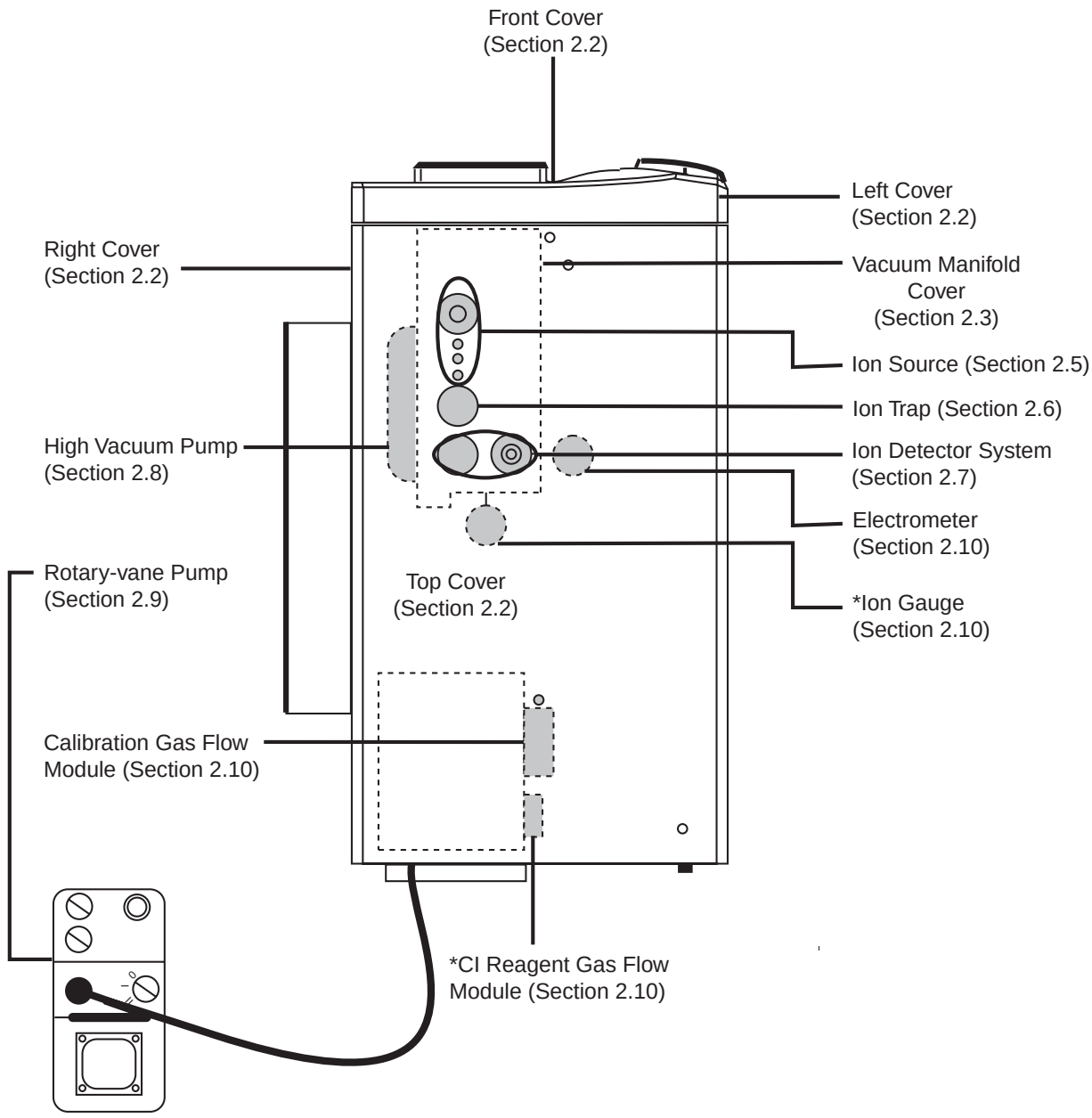
2.6 Ion Trap, 2-53

2.7 Ion Detector System, 2-59

2.8 High Vacuum Pumps, 2-69

2.9 Rotary-Vane Pump, 2-79

2.10 Replaceable Parts, 2-87



*Upgrade Option

Figure 2-1. Polaris*Q* Maintenance Components (Top View)

2.1 Recommended Maintenance Schedule

Tools Needed[1]**:**

- Clean, dry gas
- Gloves, cotton, lint free (PN A0301-09710)
- Gloves, latex, impermeable
- Lint free cloth or paper
- Nut driver, 5.5 mm
- Protective eye wear
- 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 end) 1/4-in., 5/16-in., 7/16-in. (2), 1/2-in., 9/16-in.
- Wrench; (socket) 1/2-in.

FYI: ***How to Find Xcalibur Help Topics****, Appendix C.*

Frequency**:** Depends on the types and amounts of sample and solvents used. Refer to Table 2-1, Routine Recommended Maintenance Schedule, on page 2-4.

1: List of all the tools required for the entire chapter.

You can perform much of the Polaris*Q* maintenance yourself. For your safety, be sure to read each instruction carefully before using any procedure.

Table 2-1 on page 2-4 lists a routine recommended maintenance schedule. Topics are based on running multiple samples in an 8-hour day. Adapt the schedules to how clean samples are and how many analyses per day.

Look at Table 2-3 listed on 2-88 for a non-routine maintenance schedule. Keep a record of system maintenance and performance to identify variations from normal operation and to take corrective action.

Table 2-1. Routine Recommended Maintenance Schedule

Routine Tasks	1 Month	4 Months	6 Months	Yearly	2 Years	2.5 Years	*As needed
Ion Source Components (details in Section 2.5)							
Clean the Ion Volume, 2-26							✔
Replace the Inlet Valve components, 2-36							✔
Clean the Ion Source Lenses, 2-43							✔
Clean the Ion Source, 2-46							✔
Replace the Ion Source Filament, 2-50							✔
Ion Trap Components (details in Section 2.6)							
Clean the Ion Trap components, 2-53							✔
Ion Detector System Components (details in Section 2.7)							
Clean the Ion Detector system, 2-60							✔
Clean or Replace the Electron Multiplier Anode, 2-61							✔
Replace the Electron Multiplier Cathode, 2-65							✔
Diffusion Pump (details in Section 2.8)							
Check Diffusion Pump Oil; add oil when needed, 2-70		✔					
Replace the Diffusion Pump Oil, 2-70						✔	
Rotary Vane Pump (details in Section 2.9)							
Check Rotary-Vane Pump Oil; add when needed, 2-82	✔						
Change the Rotary-Vane Pump Oil, 2-84		✔**					
Miscellaneous							
Add calibration compound, 2-101				✔			
Clean rear cooling fans, 2-145		✔					

*: *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.

**: Every month if you use ammonia as a chemical ionization reagent gas.

Figure 2-2 illustrates the sequence in which to perform routine maintenance on the Polaris*Q*:

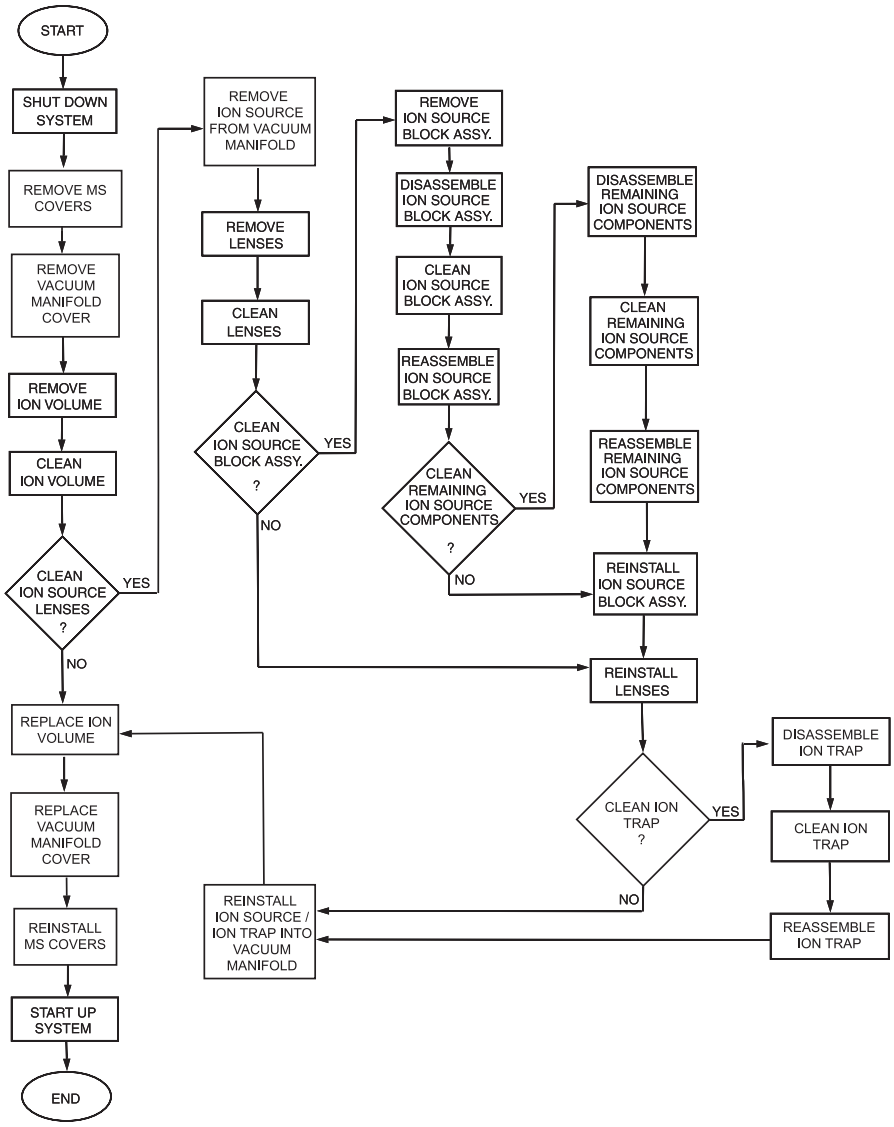


Figure 2-2. Sequence of Routine Maintenance

2.2 PolarisQ Covers

In order to get to the components inside the MS, you first must remove the necessary covers from the PolarisQ. Before you remove any of the PolarisQ covers, shut down and vent the system (details are on page 1-21).

Because the covers overlap each other they must be removed in this order:

- Front cover, 2-7
- Top cover, 2-8
- Right, 2-9

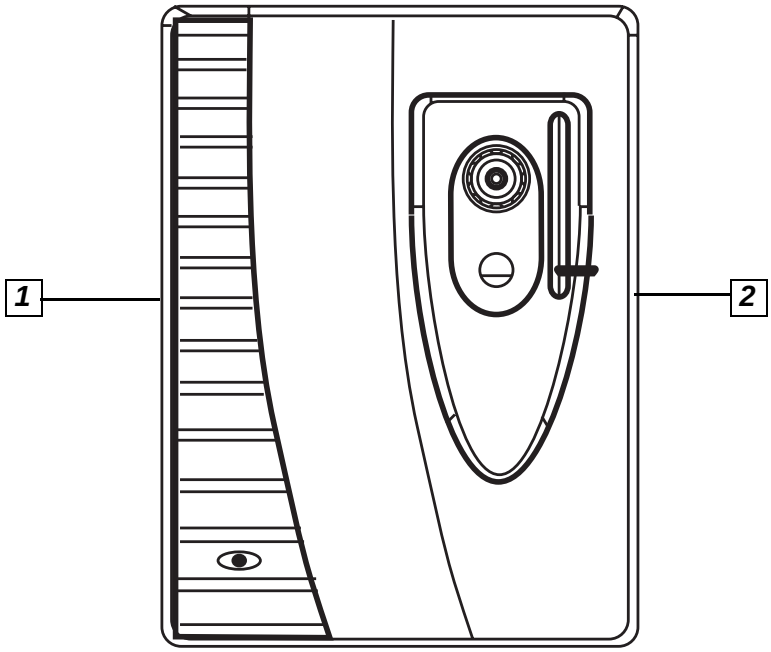
  and/or...

- Left cover, 2-10

Removing the PolarisQ Front Cover

	Materials Needed: None *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed to get inside the MS

1. **Shut down and vent the system (details are on page 1-21).**
2. **Remove the Inlet Valve Lever by pulling it free if your system is equipped with an Inlet Valve.**
3. **Grasp the cover by the two hand slots on the left and right (Figure 2-3). Pull the cover toward you. It will snap out of connectors located on the top and bottom of the Polaris*Q*.**



1	Left Side Handslot	2	Right Side Handslot

Figure 2-3. Removing the Front Cover

Reverse these steps to reinstall the Polaris*Q* front cover.

Removing the PolarisQ Top Cover

	Materials Needed: Phillips screwdriver, #2 *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed to access the MS interior

1. **Shut down and vent the system (details are on page 1-21).**
2. **Remove the front cover.**
3. **Loosen the fastener located on the front of the Polaris*Q* that attaches the top cover to the chassis (Figure 2-4).**

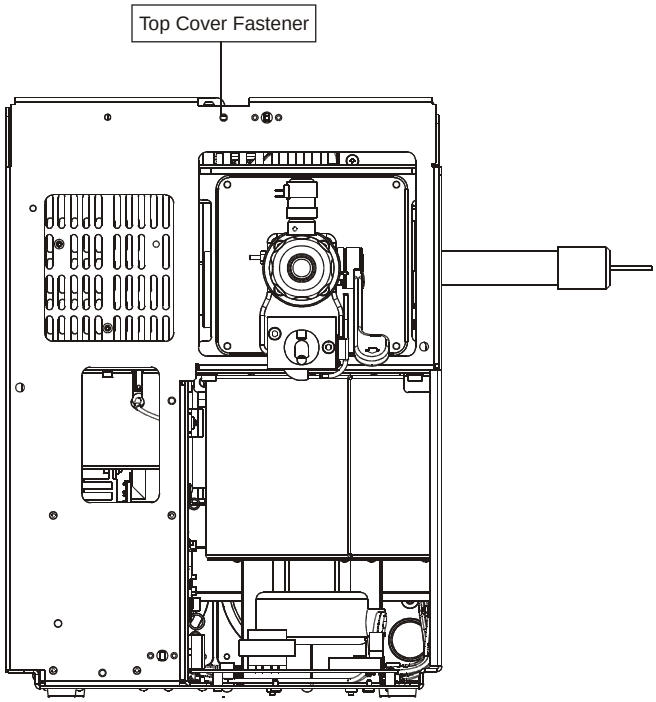


Figure 2-4. Removing the Polaris*Q* Top Cover

4. **Slide the top cover forward about 2.5 cm (1-in.).**
5. **Lift the top cover up and away from the Polaris*Q*.**

Reverse these steps to reinstall the Polaris*Q* top cover.

Removing the PolarisQ Right Cover

	Materials Needed: Wrench, (Allen) 2.5 mm *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed to access the MS interior

1. **Shut down and vent the system (details are on page 1-21).**
2. **Remove the front and top covers.**
3. **Remove the Capillary Column (details are on page 1-11).**
4. **Remove the two screws located at the top of the cover (Figure 2-5).**

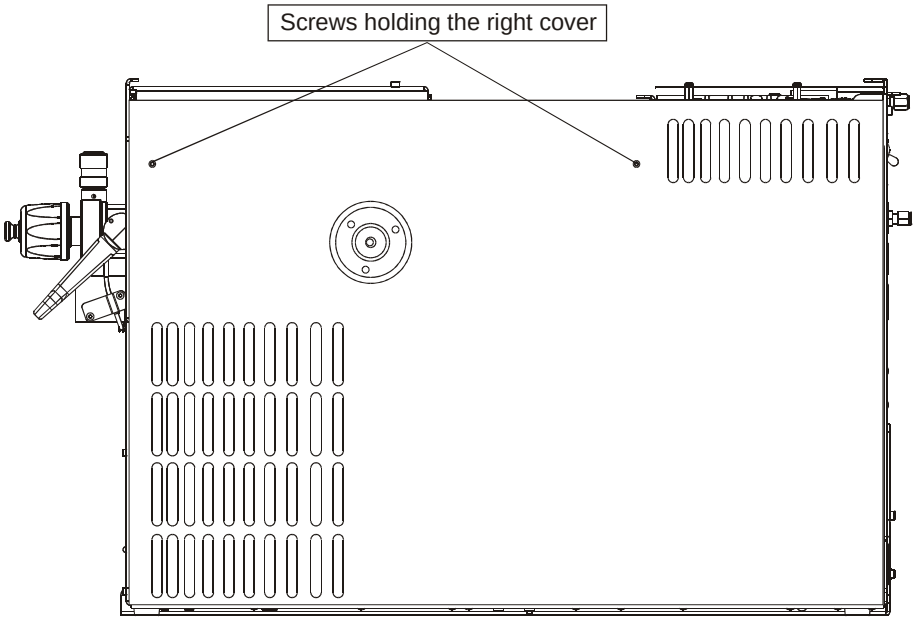


Figure 2-5. Removing the PolarisQ Right Cover

5. **Slide the cover towards the back of the instrument. Pull the cover away from the PolarisQ.**

Reverse these steps to reinstall the PolarisQ right cover.

Removing the PolarisQ Left Cover

	Materials Needed: Phillips screwdriver, #2 *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed to access the MS interior

1. **Shut down and vent the system (details are on page 1-21).**
2. **Remove the front and top covers.**
3. **Remove the single screw located at the rear of the instrument which holds the cover against the chassis (Figure 2-6).**

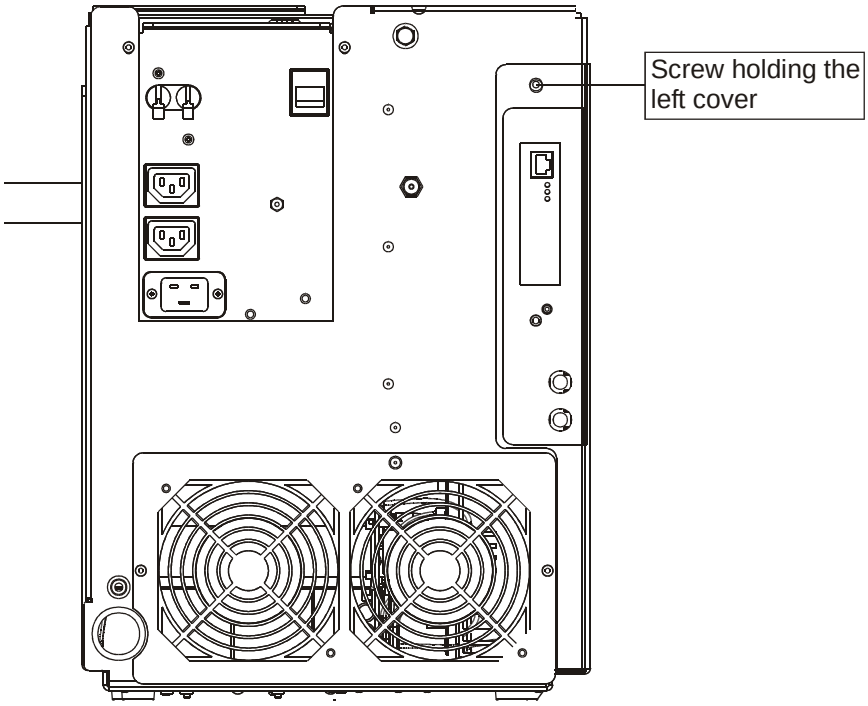


Figure 2-6. Removing the Polaris*Q* Left Cover

4. **Slide the cover toward the rear of the instrument until the tabs come to the end of the grooved slots. Pull the cover away from the instrument.**

CAUTION

Potential Instrument Damage

Behind the left cover is the Analog PCB and Digital PCB. As a result, it is significantly heavier than the right cover. Also, be aware that several cables protrude from both PCB's to other parts of the instrument. Do not pull the cover too far away from the instrument or you will stretch the cables.

Reverse these steps to reinstall the Polaris*Q* left cover.

2.3 Vacuum Manifold

After removing the Polaris*Q* covers, you must remove the Vacuum Manifold cover to get inside the Vacuum Manifold. The Vacuum Manifold contains the heart of the Mass Spectrometer: the Ion Source, Ion Trap, and Ion Detector System. Operational theory chapters devoted to these components are in this manual.

To perform maintenance inside the vacuum manifold, you must remove the following:

- Vacuum manifold cover, 2-7
- Ion source and ion trap assembly, 2-8

Removing the Vacuum Manifold Cover

	Materials Needed: • Clean, dry gas • Gloves, cotton, lint free (PN A0301-09710) • Lint free cloth *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed to access the MS interior

CAUTION

Potential Data Corruption

Always replace the Vacuum Manifold cover 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 can cause excessive noise in mass spectra.

1. Remove the Vacuum Manifold cover.

a. Shut down and vent the system (details are on page 1-21).

⚠ WARNING

Electrical Shock Hazard

Unplug the Polaris*Q* before proceeding.

b. Remove the front and top covers (details are on page 2-8).

c. Lift off the Vacuum Manifold cover.

Note: Cover will be difficult to remove if the vacuum manifold has not been completely vented to atmospheric pressure. The Vacuum Manifold takes approximately four minutes to reach atmospheric pressure. When the Vacuum Manifold is vented to atmosphere, then the cover is easily removed.

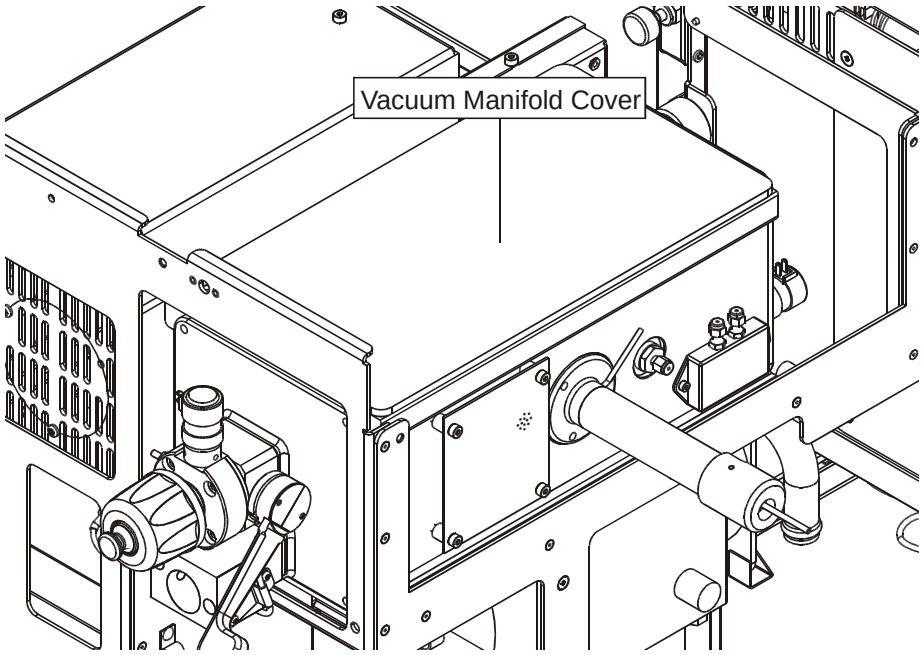


Figure 2-7. Vacuum Manifold Cover

2. **Replace the Vacuum Manifold cover.**

   a. Check the O-ring (PN 3814-6500) for signs of wear. Replace if necessary.

   b. Check that there are no particles on the O-ring. Wipe off with a lint free cloth if necessary.

   c. Clean the Electron Multiplier, Conversion Dynode and Ion Trap with clean, dry gas. Do not use liquids to clean the Ion Detector System.

> **Note:** Even the smallest amount of dust or lint on the electron multiplier, conversion dynode or ion trap can cause spectral noise.

   d. Replace the Vacuum Manifold cover.

   e. Replace the top and front covers.

   f. Restart your system.

Removing the Ion Source and Ion Trap Assembly

	Materials Needed: • Clean, dry gas • Gloves, cotton, lint free (PN A0301-09710) • Lint free cloth *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed to perform maintenance inside the vacuum manifold

1. **Remove the Ion Source and Ion Trap Assembly.**

   a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING	
	Electrical Shock Hazard Unplug the Polaris*Q* before proceeding.

   b. Remove the Polaris*Q* front and top covers (details are on page 2-7).

   c. Remove the Vacuum Manifold Cover (details are on page 2-13).

   d. Disconnect the 12-pin Connector from the right inside wall of the Vacuum Manifold. Be careful not to pull the connector by the wires.

> **Note:** Wear clean, lint free, cotton gloves when you handle parts inside the vacuum manifold.

   e. With your left hand, apply pressure to the base of the Magnet Yoke and slide it towards the left of the instrument. With your right hand, grasp the Exit Lens Mounting Bracket and moving it left and right as you slide the Magnet Yoke to the left.

2. **Replace the Ion Source and Ion Trap Assembly.**

   a. Loosen the 2 thumbscrews that hold the assembly 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 (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 instrument.

e. Be sure to align the Helium Supply with the Helium Inlet on the Exit Endcap and the Transfer Line with the Ion Source.

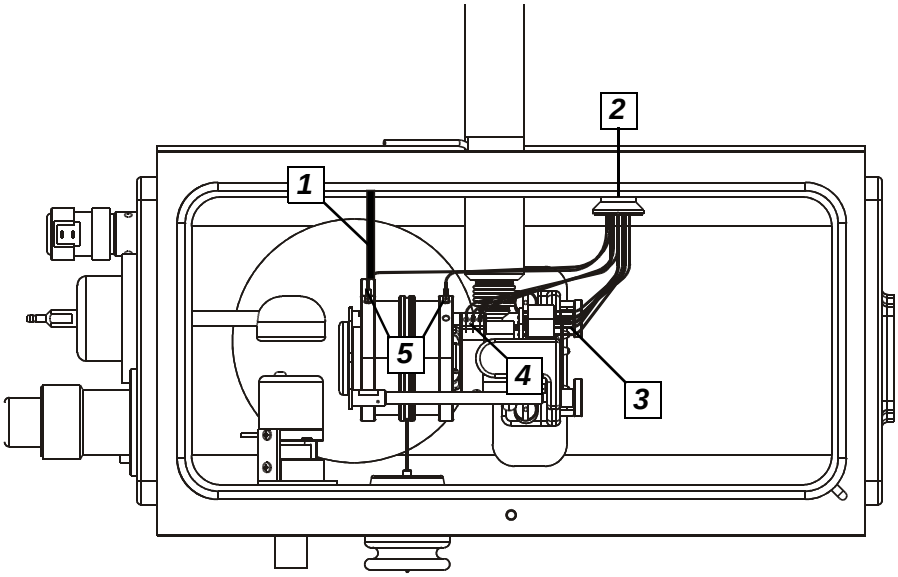
f. Tighten the 2 thumbscrews just enough so that the endcaps cannot be easily rotated.

g. With the notch at the top, plug in the 12-pin Connector.

CAUTION

Potential 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.



1	Helium Supply Line	4	3-Pin Lens Cable
2	12-Pin Connector	5	Electrical Leads to the Endcap Electrodes
3	8-Pin Source Cable		

Figure 2-8. Ion Source and Ion Trap Assembly

2.4 Cleaning Parts

A large part of maintaining your Polaris*Q* is making sure that components are clean. Use the cleaning procedures listed in this section to clean these parts. However, use caution when doing so, as some components can be damaged by exposure to liquids.

This section contains these maintenance procedures:

- Cleaning Stainless Steel Parts, page 2-18
- Cleaning Ceramic, Aluminum or Gold-Plated Parts, page 2-22

When your instrument is clean and in good working order, perform benchmark tests and record the results. A good benchmark test is a mixture of decafluorobenzophenone, benzophenone, and methyl stearate, which is included with the instrument. 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 Polaris*Q* depends on the types and amounts of samples and solvents you introduce into the instrument. 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.

Tip: If you just want to change or clean the ion volumes and the instrument 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 items listed in ***Materials Needed*** before using the procedure. Purchase items without part numbers at the hardware store.

Note: This section is not meant to relate strictly to the parts and components listed in this chapter. These cleaning procedures can be used to clean other stainless steel, ceramic, aluminum, and gold-plated parts within the MS. However, use caution when doing so, as some components can be damaged by exposure to liquids.

Cleaning Stainless Steel Parts

Materials Needed:

- 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)
- Gloves, cotton, lint free (PN A0301-09710)
- Gloves, latex, impermeable
- Glycerol, reagent grade
- Kimwipes or other lint free industrial tissue
- Methanol, reagent grade
- Protective eye wear
- Tap water
- Ultrasonic cleaner

FYI: ***How to Find Xcalibur Help Topics****, Appendix C.*

***Frequency*:** As needed (depends on the types and amounts of sample and solvents used)

Use this procedure to clean *only* stainless steel parts, such as the:

- Ion Volume and Ion Volume Holder
- Ion Source Block and Lenses
- Exit Lens

CAUTION

Potential Instrument Damage

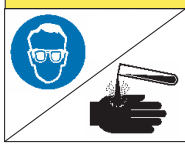
Do not use this procedure to clean ceramic, aluminum, or gold-plated parts. Instead, use the procedure for **Cleaning Ceramic, Alminum, and Gold-Plated Parts** on page 2-19.

CAUTION

Potential Instrument Damage

Do not use this procedure to clean the inside surfaces of the endcap electrodes or ring electrode. Follow the procedure **To Clean the Ion Trap Components** on page 2-47 to clean the Ion Trap.

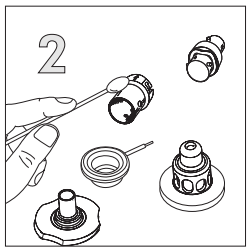
⚠ CAUTION



Risk of Eye Injury and Chemical Burn

Always wear impermeable laboratory gloves and eye protection when performing cleaning procedures.

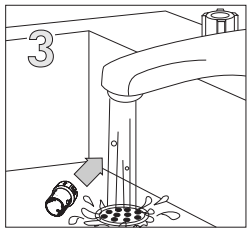
1. **Gather the necessary supplies listed in** *Materials Needed* **for this procedure.**



2. **Remove contamination from all the surfaces you are cleaning.**

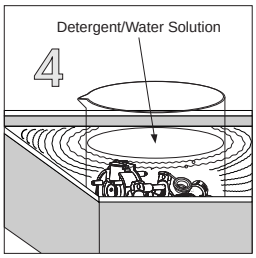
   a. Use a slurry of number 600 aluminum oxide in glycerol and a cleaning brush or cotton-tipped applicator. Contamination appears as dark or discolored areas, but often is not visible. The heaviest contamination is usually found around the apertures - for example, the electron entrance hole on an ion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

   b. Use a Dremel tool with the polishing swab at its lowest speed to increase cleaning efficiency, as well as decrease the time required to clean the items. Use care when using the Dremel tool as it is an electrical appliance. To prevent personal injury, be sure to keep the tool away from possible hazards such as standing water or flammable solvents.



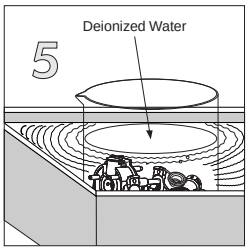
3. **Rinse each item under running water.**

   Use a clean applicator to remove the aluminum oxide slurry. Do not let the slurry dry on the metal; dried aluminum oxide is difficult to remove.



4. Place the parts in a beaker containing a detergent solution in warm water.

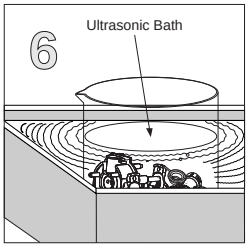
Place the beaker and its contents in an ultrasonic bath for 5 minutes, then rinse the parts with tap water to remove the detergent.



5. Sonicate the parts.

a. Using clean tools, place the parts in a beaker containing deionized water, and then place the beaker and contents in an ultrasonic bath for 5 minutes.

b. 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 5 minutes. Repeat until the water is clear.

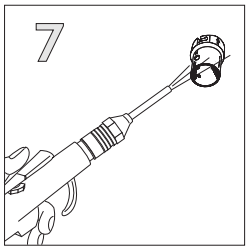


6. Use methanol to clean the parts:

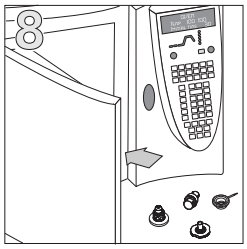
a. Rinse the parts with methanol.

b. Place the parts in a beaker containing fresh methanol.

c. Place the beaker and its contents in an ultrasonic bath for 5 minutes.



7. Remove the parts from the beaker. Blow off the methanol from the parts with a clean, dry gas



8. **Dry the parts in an oven, set at 100 °C, for 30 minutes. Allow the parts to cool before putting them back together.**

Cleaning Ceramic, Aluminum or Gold-Plated Parts

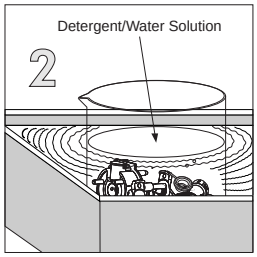
	Materials Needed: • Acetone, reagent grade • Beaker, 450 mL • Clean, dry gas • De-ionized water • Detergent (Alconox, Micro, or equivalent) • Gloves, cotton, lint free (PN A0301-09710) • Gloves, latex, impermeable • Kimwipes or other lint free industrial tissue • Methanol, reagent grade • Protective eye wear • Soft toothbrush • Tap water • Ultrasonic cleaner *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed (depends on the types and amounts of sample and solvents used)

Use this procedure to clean *only* ceramic, aluminum, or gold-plated parts found inside the Polaris*Q*, such as:

- Lens Holder
- Filament Spacer
- Heater Ring

⚠ CAUTION

Risk of Eye Injury and Chemical Burn
Always wear impermeable laboratory gloves and eye protection when performing cleaning procedures.



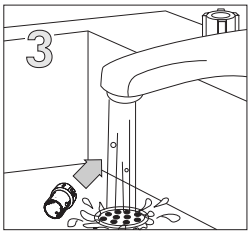
1. **Place the parts in a beaker so that no two parts are touching and cover the parts with a solution of detergent in warm water.**
2. **Place the beaker and its contents in an ultrasonic bath for 1 minute.**

   Remove any remaining deposits with a soft toothbrush and a solution of detergent in warm water

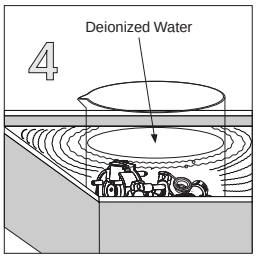
CAUTION

Potential instrument damage

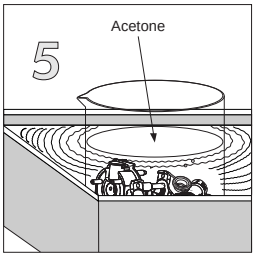
Do not leave aluminum parts in detergent for long periods of time. Basic solutions such as detergent will discolor aluminum.



3. Rinse the parts with fresh water.



4. Place the parts in a beaker containing Deionized water. Then place the beaker in an ultrasonic bath for 5 minutes.

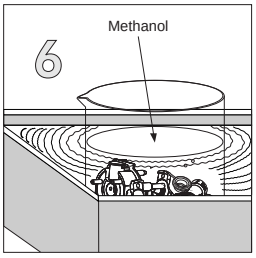


5. Use Acetone to clean the parts.

a. Rinse the parts with acetone.

b. Place the parts in a beaker containing fresh Acetone.

c. Place the beaker and its contents in an ultrasonic bath for 5 to 10 minutes.

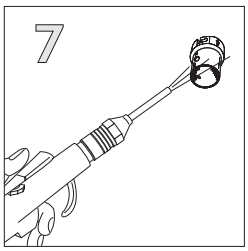


6. Use Methanol to clean the parts.

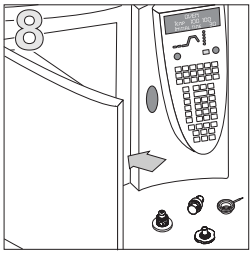
a. Rinse the parts with Methanol.

b. Place the parts in a beaker containing fresh Methanol.

c. Place the beaker and its contents in an ultrasonic bath for 5 to 10 minutes, then remove the parts from the beaker.

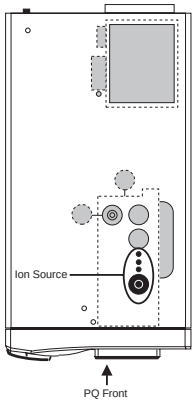


7. Blow off the methanol from the parts with a clean, dry gas.



8. Dry the parts in an oven set at 100 °C for 30 minutes. Allow the parts to cool before you reassemble them.

2.5 Ion Source



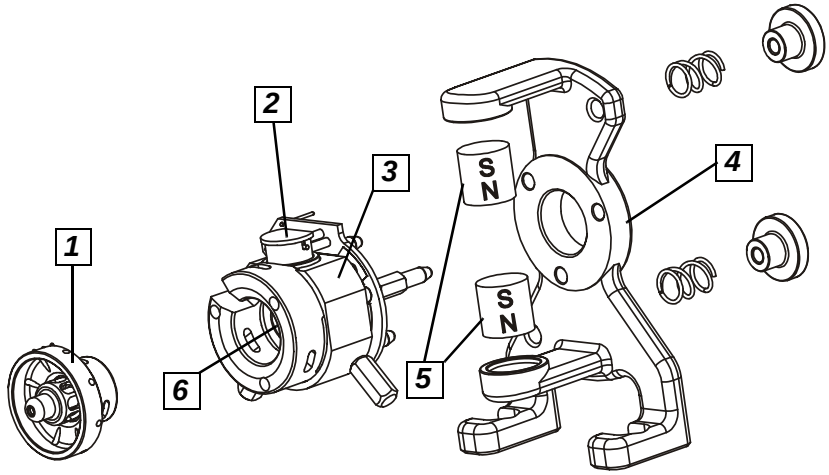
The Ion Source assembly has an Ion Volume, Filament, and Ion Source Lenses. Because the Ion Volume is exposed directly to samples introduced into the Polaris*Q*, it requires the most frequent cleaning. You can access the Ion Volume Assembly with or without an Inlet Valve.

To restore system performance, always clean the Ion Volume first, then the ion source lenses. If cleaning either of these components does not restore system performance try cleaning the entire Ion Source.

This section contains these maintenance procedures:

- Cleaning the Ion Volume with an Inlet Valve, page 2-26
- Replacing Inlet Valve Components, page 2-36
- Cleaning the Ion Volume without an Inlet Valve, page 2-39
- Cleaning the Ion Source Lenses, page 2-43
- Cleaning the Ion Source, page 2-46
- Replacing the Ion Source Filament, page 2-50

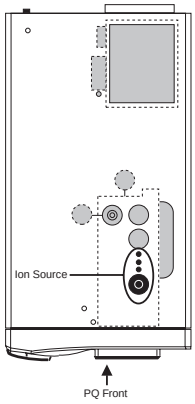
Figure 2-9 illustrates the Ion Source, Ion Trap and their components.



1	Ion Source Lenses	4	Magnet Support
2	Filament Assembly	5	Magnets
3	Ion Source Block	6	Ion Volume (inside Ion Source Block)

Figure 2-9 Ion Source Components (left view)

Cleaning the Ion Volume with an Inlet Valve



	Materials Needed: • Cleaning supplies for stainless steel parts • Gloves, cotton, lint free (PN A0301-09710) • Insert Removal Tool and Guide Bar • Lint free cloth *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed to clean or replace the ion volume

The Ion Volume is the site where molecules interact with energetic electrons to form ions. Because the Ion Volume is exposed directly to samples introduced into the Polaris*Q*, 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 breaking pressure.

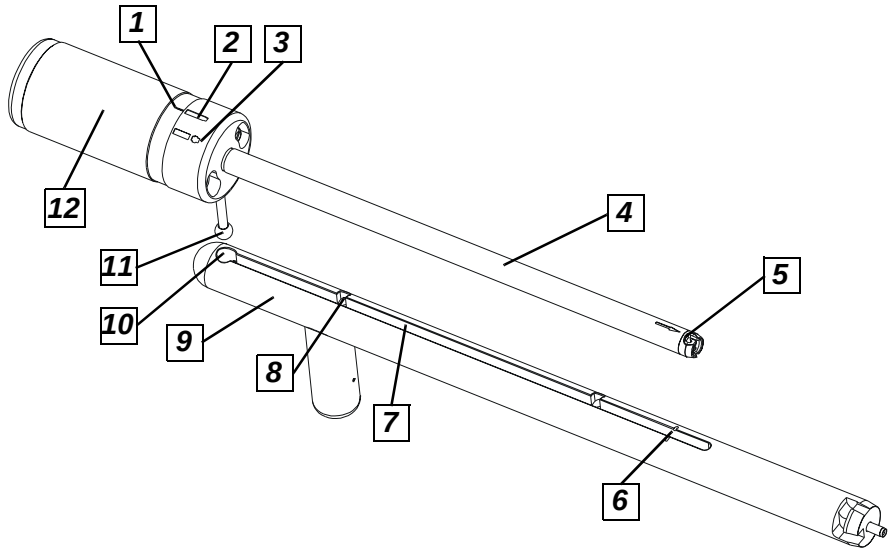
1. **Open the Insert/Remove Probe Screen.**

   a. From the Xcalibur Home Page, click on Polaris*Q* in the **Status** tab.

   b. Click on **Insert/Remove Probe** in the Polaris*Q* **Status** tab.

2. Insert the Guide Bar into the Guide Bar Opening.

With the Guide Ball Track facing left, insert the Guide Bar (Figure 2-10) into the Entry Housing (Figure 2-11). Push the Guide Bar in as far as it will go, then rotate it 90° clockwise to lock it in the opening.

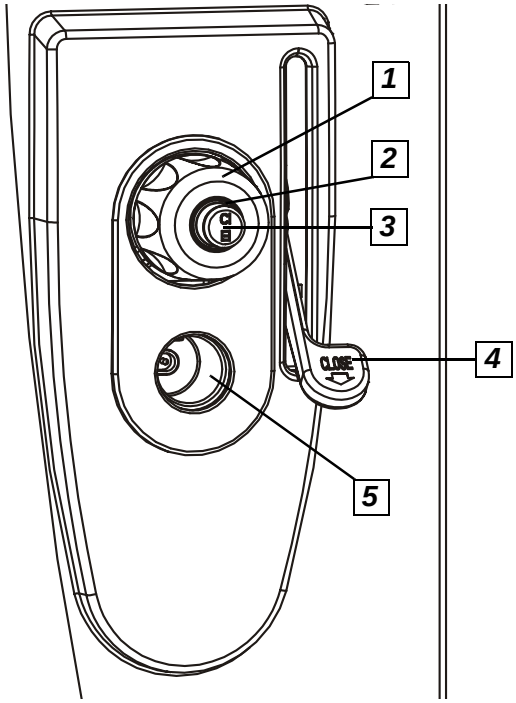


1	Alignment Line	7	Guide Bar Track
2	Hold Position	8	Guide Bar First Stop
3	Release Position	9	Guide Bar
4	I/R Tool	10	Guide Ball Hole
5	Bayonet Lock	11	Guide Ball
6	Guide Bar Second Stop	12	Handle

Figure 2-10 I/R Tool and Guide Bar

3. Prepare Inlet Valve and I/R Tool for insertion.

a. Make sure the Inlet Valve is closed (Inlet Valve Lever is down). Remove the Inlet Valve Plug (Figure 2-11). The Inlet Valve Plug prevents air from entering the Vacuum Manifold if the Inlet Valve is inadvertently opened.



1	Inlet Valve Knob	4	Inlet Valve Lever (down is closed, up is open)
2	Inlet Valve Seal	5	Entry Housing
3	Inlet Valve and Inlet Valve Plug		

Figure 2-11. Inlet Valve

b. Turn the I/R Tool to the Release Position . The release position indicates the I/R Tool is in position to accept the Ion Volume.

4. Insert I/R Tool and Evacuate the Inlet Valve.

a. Insert the I/R Tool Guide Ball into the Guide Ball Hole in the Guide Bar. Slide the I/R Tool forward in the Guide Bar Track until the Guide Ball is at the Guide Bar First Stop (Figure 2-13).

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 insure a leak tight seal.

d. From the Insert/Remove Probe screen, select **Evacuate Inlet Valve**.

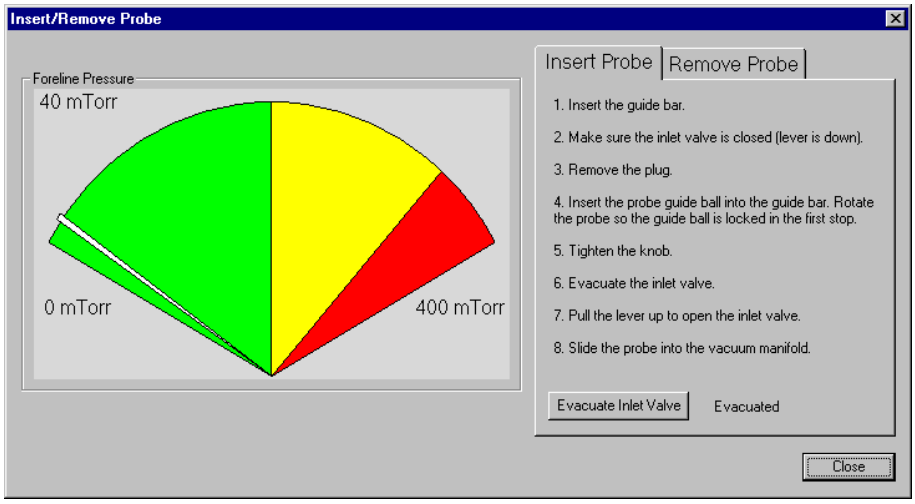
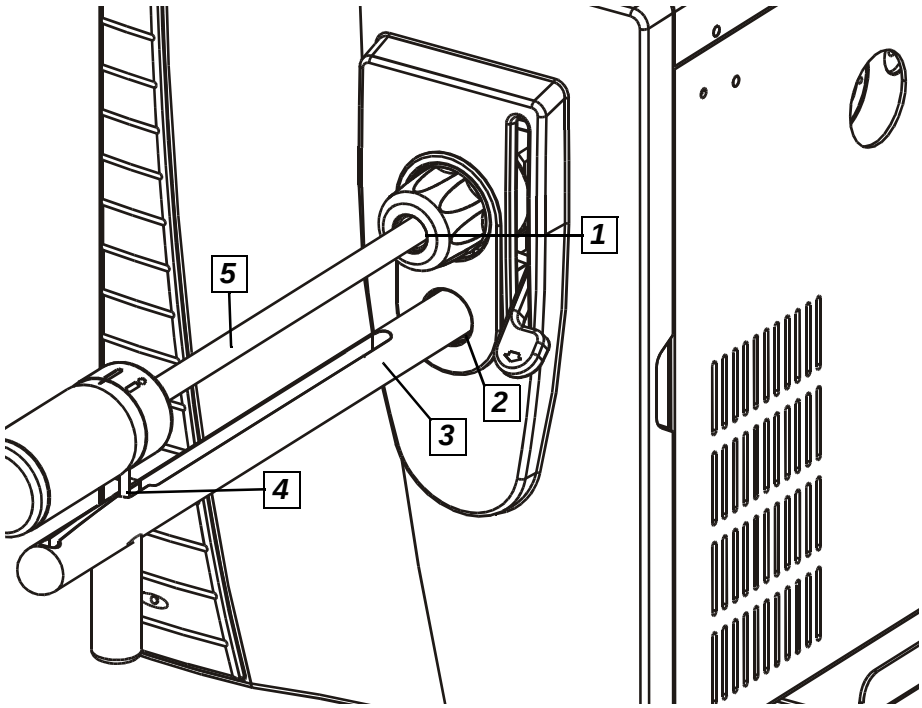


Figure 2-12. Insert Probe Screen

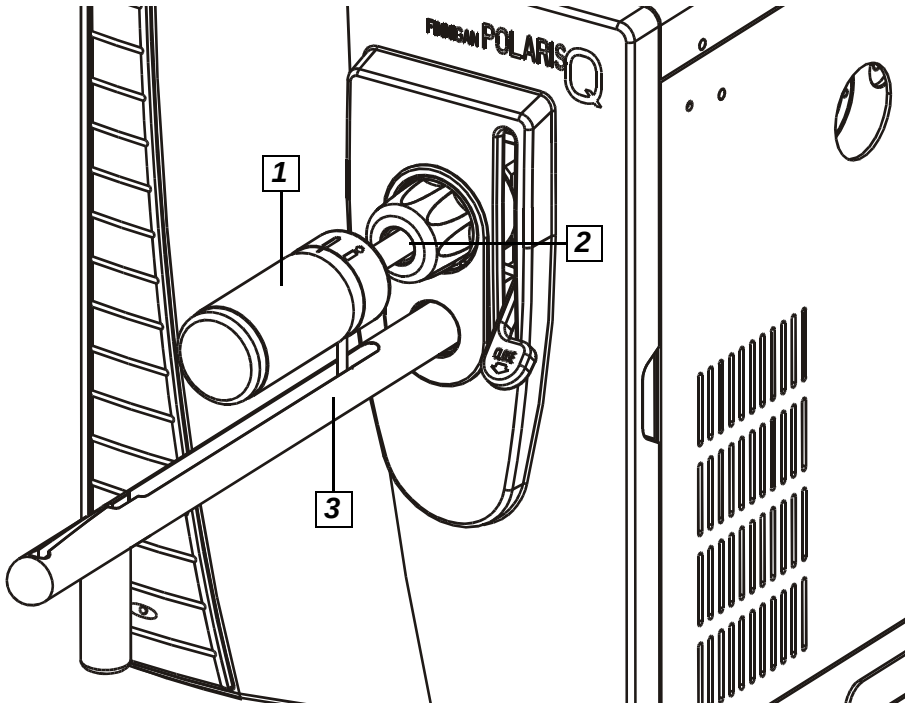


1	Inlet Valve Opening	4	Guide Bar First Stop
2	Entry Housing	5	I/R Tool
3	Guide Bar		

Figure 2-13. I/R Tool at Guide Bar First Stop

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 (details are on page 2-36).

f. Once evacuation is complete, pull the Inlet Valve Lever up to open the Inlet Valve.



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

Figure 2-14. I/R Tool Inserted into 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 (Figure 2-14). The Guide Ball will be slightly beyond the Second Stop on the Guide Bar.

b. Turn the I/R Tool handle counterclockwise to put the I/R Tool into Hold Position . Listen for a “click” indicating the handle is fully engaged in the Hold 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 (Figure 2-13).

d. Close the Inlet Valve (Pull the Inlet Valve Lever down).

CAUTION

Potential Instrument Damage

Do not withdraw the I/R Tool beyond the point where the Guide Ball reaches the First Stop in the Guide Bar. Close the Inlet Valve first. Otherwise, the system vents to the atmosphere, and cleaning may be required if the instrument has a Diffusion Pump.

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.

⚠ CAUTION

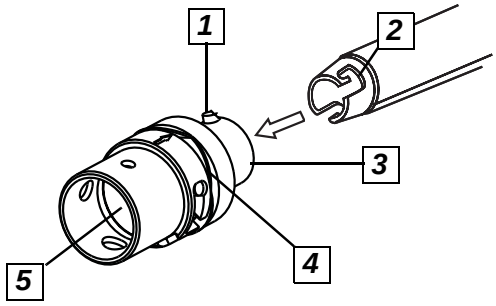
Burn Hazard
The Ion Volume may be too hot to touch. Let it cool to room temperature before handling it.

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

b. Clean the Ion Volume Assembly by using the instructions for **Cleaning Stainless Steel Parts** on 2-18.



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

Figure 2-15. Ion Volume Assembly

7. Place Clean Ion Volume on 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 on the I/R Tool are facing each other (Figure 2-16).

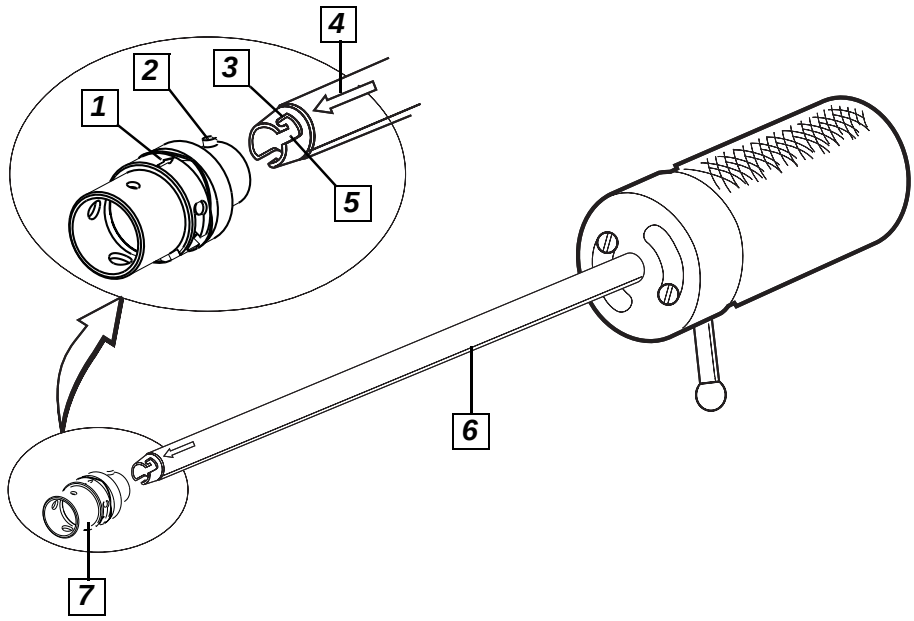
Note: Wear clean, lint free, cotton gloves when you handle parts inside the vacuum manifold.

b. Turn the I/R Tool Handle to the Hold Position .

CAUTION

Potential instrument damage

The arrows on the I/R tool and Ion Volume assembly must be aligned to avoid damage to the source assembly.



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

Figure 2-16. Placing the Ion Volume on the I/R Tool

8. Insert I/R Tool and Evacuate the Inlet Valve.

a. Insert the I/R Tool Guide Ball into the Guide Ball Hole in the Guide Bar. Slide the I/R Tool forward in the Guide Bar Track until the Guide Ball is at the Guide Bar First Stop (Figure 2-13).

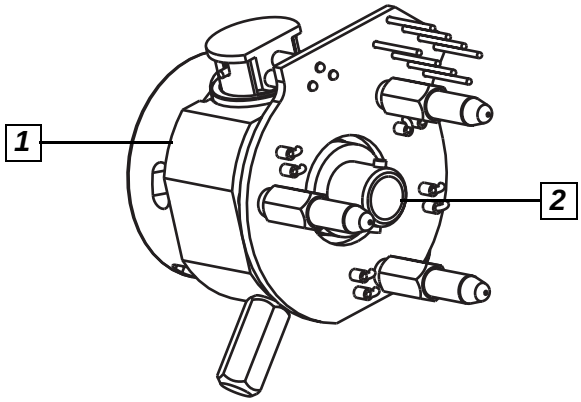
b. Turn the I/R Tool so the Guide Ball is in the groove at the First Stop. This prevents the probe from being pulled forward when the Inlet Valve is evacuated.

c. Tighten the Inlet Valve Knob to insure a leak tight seal.

d. From the Insert/Remove Probe screen, select **Evacuate Inlet Valve**.

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 (details are on page 2-36).

f. Once evacuation is complete, pull the Inlet Valve Lever up to open the Inlet Valve.



1	Ion Source Block	2	Ion Volume

Figure 2-17. Ion Volume connected to the Ion Source Block

9. Reinsert the Ion Volume.

a. Slide the I/R Tool into the Vacuum Manifold (Figure 2-14). Listen for a “click” indicating the Ion Volume has connected with the Ion Source Block (Figure 2-17). The Guide Ball will be slightly beyond the Second Stop on the Guide Bar.

b. Turn the I/R Tool Handle to the Release Position .

c. Verify that the Ion Volume Assembly is fully seated into the Ion Source Block:

- Withdraw the I/R Tool away from the Ion Volume and turn the I/R Tool Handle to the Hold Position.
- Slide the I/R Tool back into the Vacuum Manifold until the end

of the I/R Tool just touches the Ion Volume Assembly.

- If the I/R Tool does not go into the Inlet Valve completely, the Ion Volume Assembly is seated properly.

d. Withdraw the I/R Tool (the Ion Volume is attached) until the Guide Ball reaches the First Stop (Figure 2-13).

e. Close the Inlet Valve (Pull the Inlet Valve Lever down).

CAUTION

Potential Instrument Damage

Do not withdraw the I/R Tool beyond the point where the Guide Ball reaches the First Stop in the Guide Bar. Close the Inlet Valve first. Otherwise, the system vents to the atmosphere, and cleaning may be required if the instrument has a Diffusion Pump.

f. Loosen the Inlet Valve Knob.

g. 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° counter-clockwise and sliding it out of the Entry Housing.

b. Replace the Inlet Valve Plug.

c. From the Insert/Remove Probe screen, select **Close**.

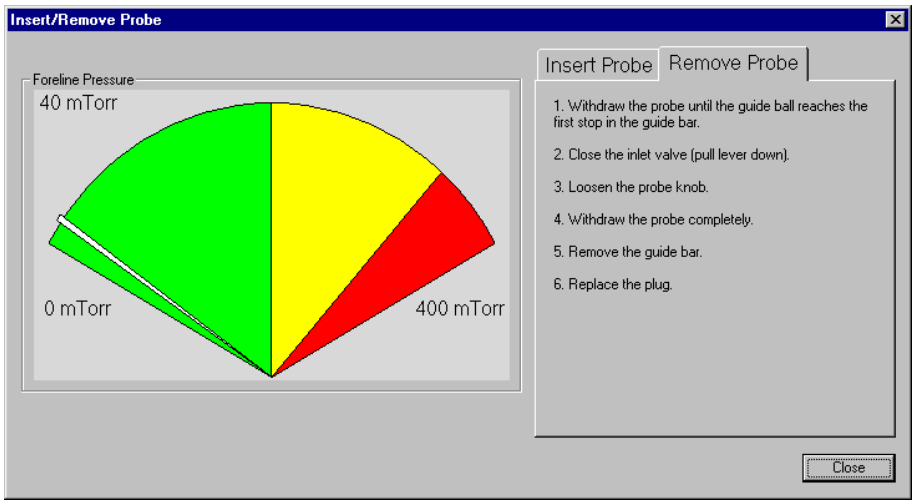
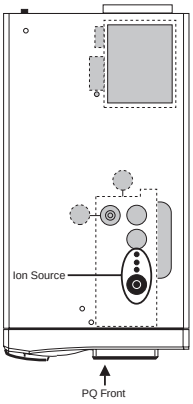


Figure 2-18. Remove Probe Screen

Replacing Inlet Valve Components

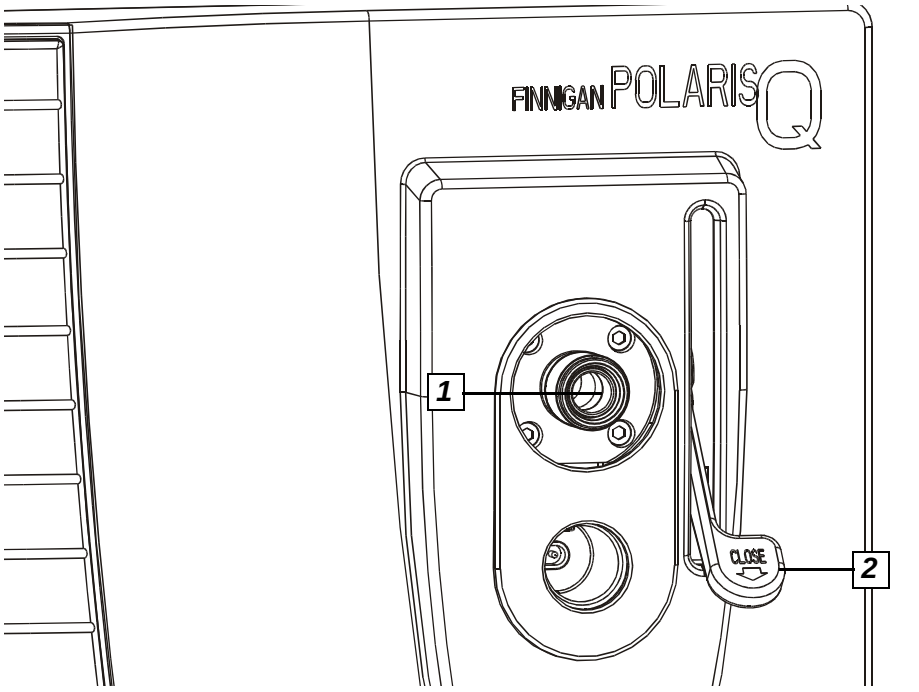


	Materials Needed: • Ball valve, complete (PN A0101-02530) • Inlet valve seal kit (PN 119265-0003) • Lint free cloth • Replacement ball valve o-ring and seal kit (PN 76461-2002) • Wrench, (open-ended) 5/16-in. • Wrench, (Allen) 4 mm *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** for replacing the Inlet Valve Seal and/or the Inlet Valve

This contains procedures for replacing the Inlet Valve Seal and Inlet Valve.

To replace the Inlet Valve Seal:

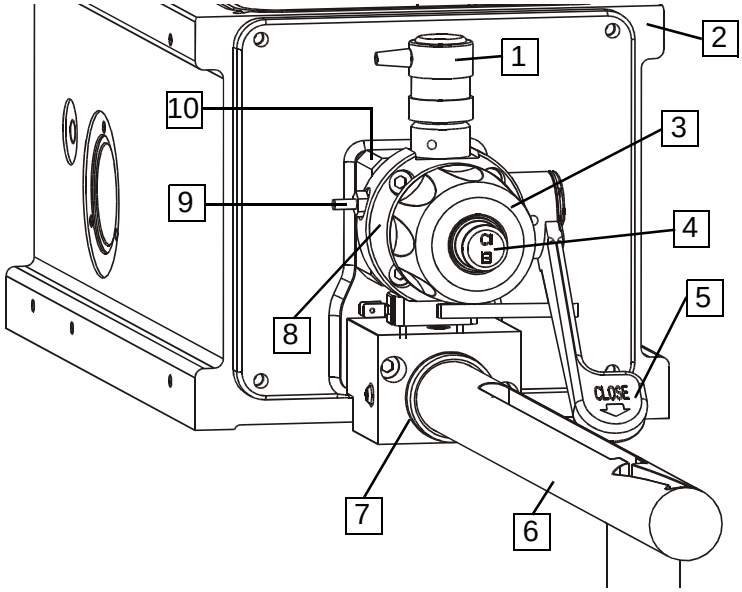
1. Close the Inlet Valve (pull Inlet Valve Lever down).



1	Inlet Valve Seal	2	Inlet Valve Lever

Figure 2-19. Inlet Valve Seal

2. Remove the Inlet Valve Plug, Knob, and Ferrule (Figure 2-20).



1	Inlet Valve Solenoid	6	Guide Bar
2	Vacuum Manifold	7	Entry 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 2-20 Inlet Valve Components (I/R tool not shown)

3. Remove the existing Inlet Valve Seal.

a. Insert the supplied tool (PN 119283-0001) into the Inlet Valve.

b. Press the button on the tool to engage the seal.

c. Pull out the seal and discard it.

Note: Do not scratch the sealing surface. Use the supplied tool only.

4. Replace the Inlet Valve Seal with a new Inlet Valve Seal.

5. Put the ferrule, knob and plug back into the Inlet Valve Opening.

To replace the Inlet Valve:

1. **Prepare the Polaris*Q* for maintenance.**

   a. Prepare a clean work area by covering the area with lint free cloth.

   b. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING	
	Electrical Shock Hazard Unplug the Polaris*Q* before proceeding.

   c. Remove the Polaris*Q* front and top covers (details are on page 2-7).

2. **Remove the Inlet Valve**

   a. Remove the Inlet Valve Plug, Knob, and Ferrule (Figure 2-20).

   b. Disconnect the Foreline Hose Connection to the Inlet Valve.

   c. Unplug 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. Place the Inlet Valve on a clean surface.

3. **Replace the Inlet Valve.**

   a. Insert the new Inlet Valve into the Front Port of the vacuum manifold.

   b. Ensure that the Entry Housing, Ball Valve, and O-ring are intact. Check the O-ring for wear. If it is worn, replace the O-ring.

   c. Replace the four hex-socket screws that hold the Entry Housing to the Vacuum Manifold.

   d. Reconnect the Foreline Hose Connection to the Inlet Valve.

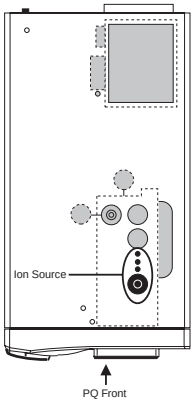
   e. Plug the Inlet Valve Solenoid into the Vacuum Control PCB.

4. **Restore the Polaris*Q* for operation.**

   a. Replace the top and front covers to the Polaris*Q*.

   b. Restart the system.

Cleaning the Ion Volume without an Inlet Valve



	Materials Needed: • Cleaning supplies for stainless steel parts • Gloves, cotton, lint free (PN A0301-09710) • Ion Volume Tool (PN 119270-0001) • Lint free cloth *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed to clean or replace the ion volume

The Ion Volume is the site where molecules interact with energetic electrons to form ions. Because the Ion Volume is exposed directly to samples introduced into the Polaris*Q*, 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.

If you don't have an Inlet Valve you can still access and remove the Ion Volume for cleaning using an Ion Volume Tool.

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front and top covers (details are on page 2-7).

c. Remove the Vacuum Manifold Cover (details are on page 2-12).

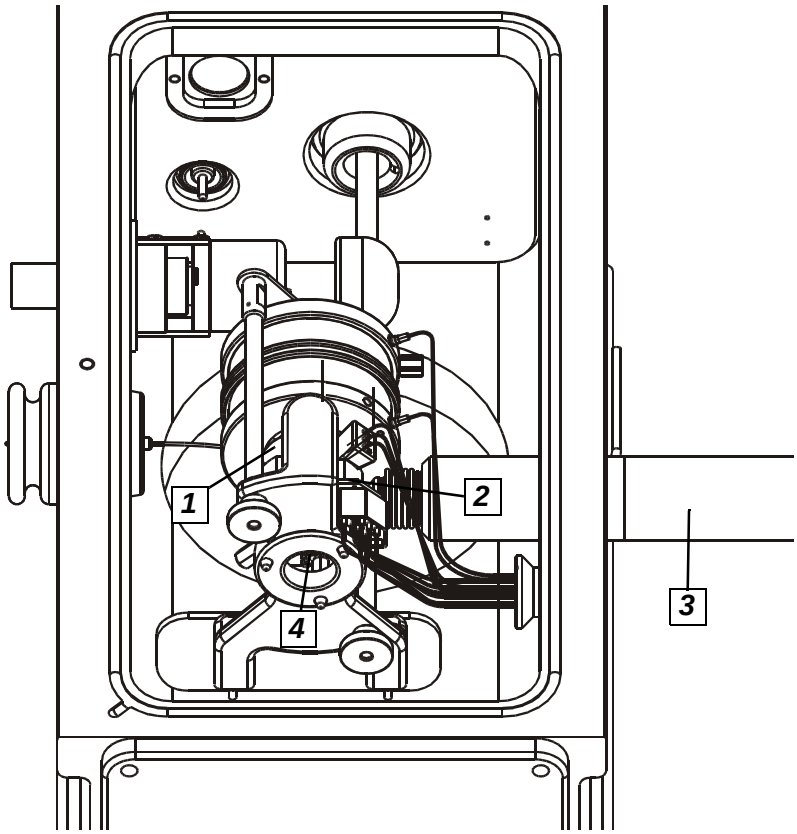
Note: Wear clean, lint free, cotton gloves when you handle parts inside the vacuum manifold.

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 2-21).

b. Turn the Ion Volume Tool Handle counter-clockwise 30° 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.



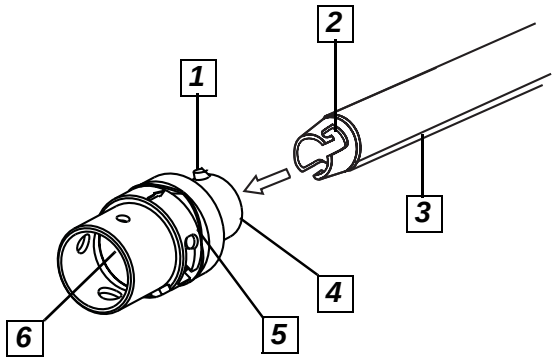
1	Ion Source Lenses	3	Transfer Line
2	Ion Source PCB	4	Ion Volume Holder (not shown)

Figure 2-21. Removing the Ion Volume (Top View)

3. Clean the Ion Volume.

a. Remove the Ion Volume from the Ion Volume Tool.

Using clean gloves press the Ion Volume forward into the tip of the Ion Volume Tool and rotate it to disconnect the Bayonet Pins from the Pin Guides. Pull the Ion Volume out of the Ion Volume Tool.



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

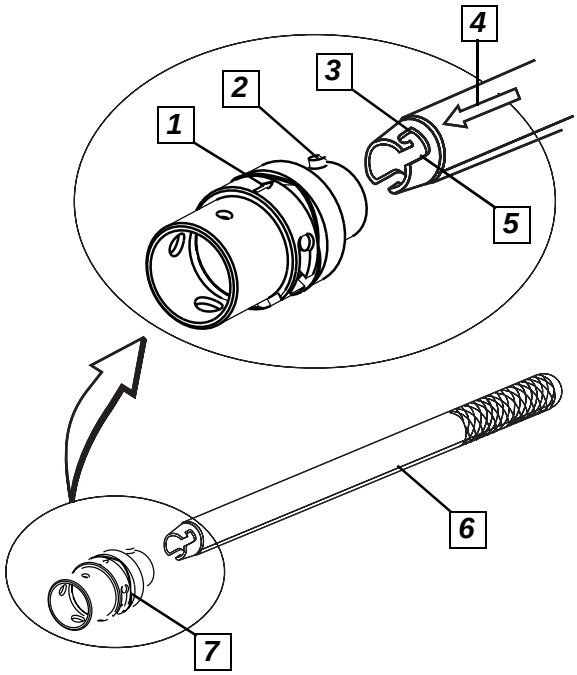
Figure 2-22. Ion Volume Assembly

b. Clean the Ion Volume using the instructions for **Cleaning Stainless Steel Parts** on 2-17.

4. Replace the Ion Volume.

a. Insert the Ion Volume Holder onto the end of the Ion Volume Tool (Figure 2-23).

Note: Wear clean, lint free, cotton gloves when you handle parts inside the vacuum manifold.



1	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		

Figure 2-23. Inserting the Ion volume On the Ion Volume Tool

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 clockwise 30º to disengage the Ion Volume.

c. Be sure the Ion Volume is oriented with the arrow up and the Ion Volume goes all the way into the Ion Source Block and snaps into place.

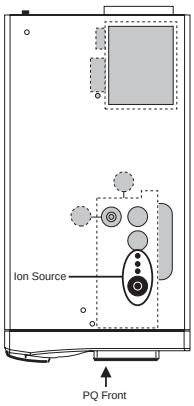
5. Restore the Polaris*Q* for operations.

a. Replace the Vacuum Manifold Cover.

b. Replace the Polaris*Q* front and top covers.

c. Restart the system.

Cleaning the Ion Source Lenses



	Materials Needed: • Cleaning supplies for stainless steel parts • Gloves, cotton, lint free (PN A0301-09710) • Lint free cloth *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** every six months, or if cleaning the ion volume does not restore the instrument to its normal operating parameters

If cleaning the Ion Volume did not restore system performance, try cleaning the Ion Source Lenses. The Ion Source Lenses (especially L1) come in direct contact with samples introduced into the Polaris*Q* and need to be cleaned periodically (though not as often as the Ion Volume).

1. **Prepare the Polaris*Q* for maintenance.**

   a. Prepare a clean work area by covering the area with lint free cloth.

   b. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING	
	Electrical Shock Hazard Unplug the Polaris*Q* before proceeding.

   c. Remove the Polaris*Q* front and top covers (details are on page 2-7).

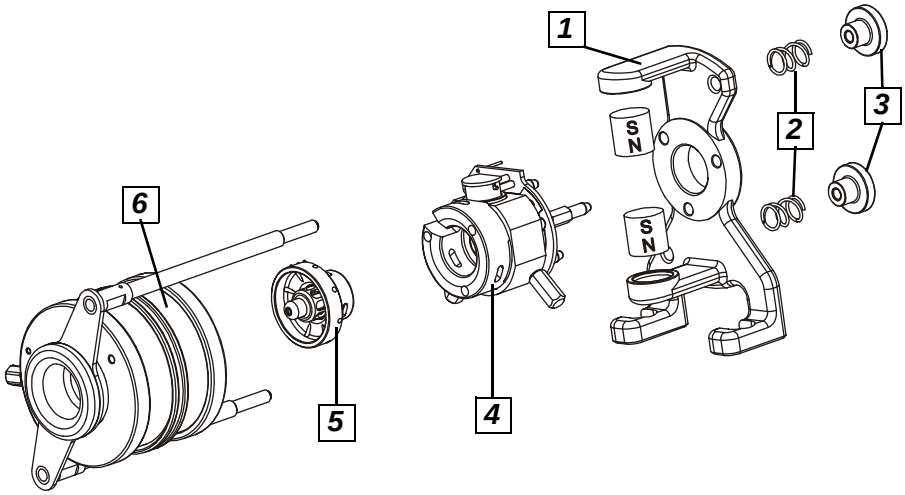
   d. Remove the Vacuum Manifold Cover (details are on page 2-12).

Note: Wear clean, lint free, cotton gloves when you handle parts inside the vacuum manifold.

2. **Remove the Ion Source.**

   a. Remove the Ion Source and Ion Trap Assembly (details are on page 2-15).

b. Remove the 2 Thumbscrews holding the Ion Trap and Ion Source together (Figure 2-24).



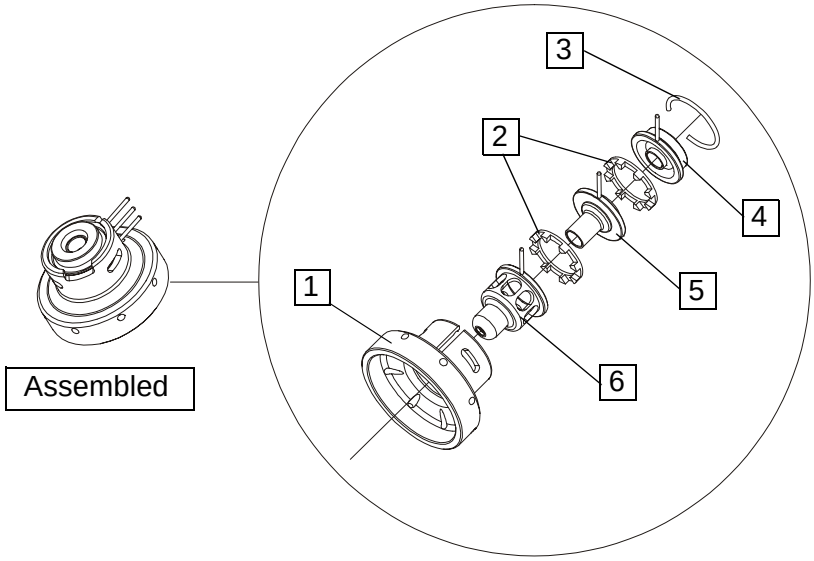
1	Magnet Yoke	4	Ion Source Assembly
2	Springs	5	Ion Source Lenses
3	Thumbscrews	6	Ion Trap

Figure 2-24. Removing the Ion Source and Ion Trap

c. Remove the Magnet Yoke and Ion Source assembly (Figure 2-24).

d. Remove the Ion Source Lens assembly (Figure 2-24).

e. Remove the Lens Clip by pinching the ends with your fingers or a pair of tweezers. Remove the lenses from the ceramic Lens Holder (Figure 2-25).



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

Figure 2-25. Ion Source Lens Assembly

3. Clean the Ion Source Lenses.

Use the instructions on 2-18 for **Cleaning Stainless Steel Parts**. Pay particular attention to the areas inside the tube and around the hole in each lens.

4. Replace the Ion Source.

a. Place the Lenses and Lens Spacers into the ceramic Lens Holder. Install the Lens Clip by pinching the ends with your fingers or a pair of tweezers (Figure 2-25).

b. Place the Lens Assembly into the heater ring.

c. Reassemble the Ion Source and Ion Trap Assembly.

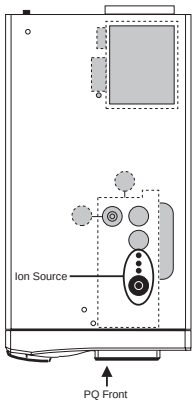
d. Reinstall the Ion Source and Ion Trap assembly into the Vacuum Manifold (details are on page 2-15).

5. Restore the Polaris*Q* for operations.

a. Replace the Vacuum Manifold Cover.

b. Replace the Polaris*Q* top and front covers, and restart the system.

Cleaning the Ion Source



	Materials Needed: • Cleaning supplies • Gloves, cotton, lint free (PN A0301-09710) • Lint free cloth *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** No more than once every six months

If cleaning the Ion Volume and the Ion Source Lenses does not restore system performance, you may need to clean the Ion Source.

1. Prepare the Polaris*Q* for maintenance.

a. Prepare a clean work area by covering the area with lint free cloth.

b. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING

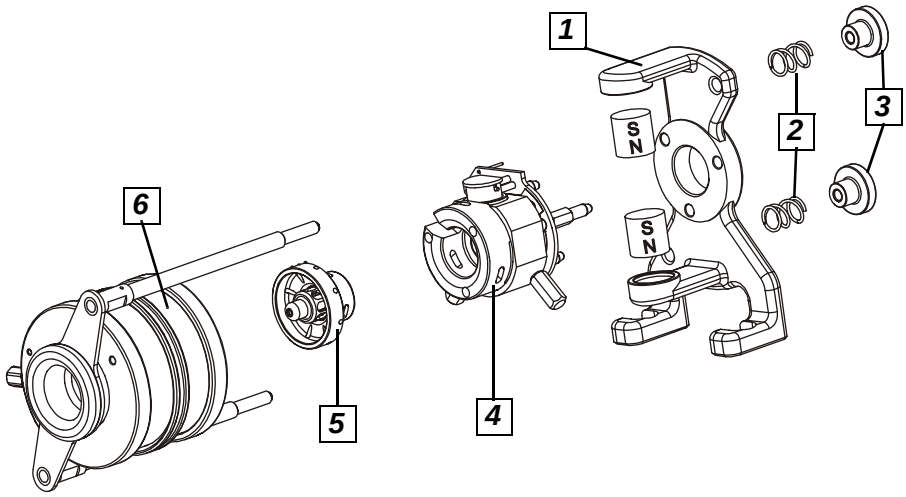
Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

c. Remove the Polaris*Q* front and top covers (details are on page 2-7).

d. Remove the Vacuum Manifold Cover (details are on page 2-12).

e. Remove the Ion Source and Ion Trap Assembly (details are on page 2-15).

Note: Wear clean, lint free, cotton gloves when you handle parts inside the vacuum manifold.



1	Magnet Yoke	4	Ion Source Assembly
2	Springs	5	Ion Source Lenses
3	Thumbscrews	6	Ion Trap

Figure 2-26. Removing the Ion Source and Ion Trap

2. Disassemble the Ion Source.

a. Remove the 2 Thumbscrews holding the Ion Trap and Ion Source together (Figure 2-26).

b. Remove the Magnet Yoke and the Ion Source assembly.

c. Remove the Ion Source Lens assembly.

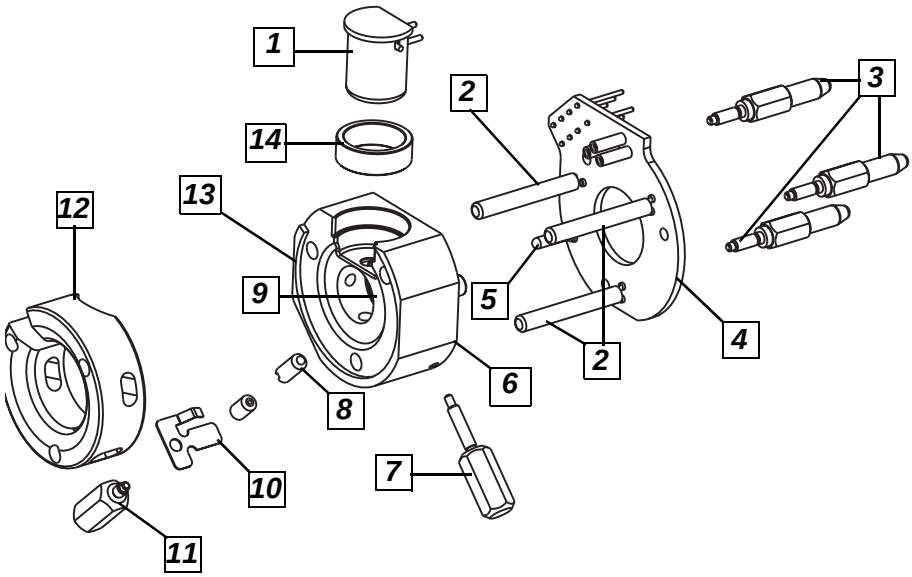
d. Remove the Spring Thumbscrew from the Ion Source Block.

e. Remove the three Base-Studs. Be careful not to damage the leads on the Ion Source PCB.

f. Gently pull 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 assembly straight away from the three filament connectors on the Ion Source Block PCB.

Do not bend or twist the Cartridge Heaters or the Temperature Sensor.

g. Remove the filament and ceramic spacer from the Ion Source Block.



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

Figure 2-27. Ion Source Block Assembly

h. Remove the Ion Volume Key Thumbscrew.

Note: It is not necessary to remove the Ion Volume Pin. If it is removed, it should be reinserted just far enough so the ball will keep an ion volume from falling out. If the ball extends too far, ion volumes will be difficult to remove.

3. **Clean and replace the Ion Source.**

   a. Clean each component by following the instructions for **Cleaning Stainless Steel Parts** on 2-18 and **Cleaning Ceramic, Aluminum or Gold-Plated Parts** on 2-22.

   b. Reassemble the Ion Source (reverse steps **h**. through **a**. from **step 2**).

   c. Reinstall the Ion Source and Ion Trap assembly into the Vacuum Manifold (details are on page 2-15).

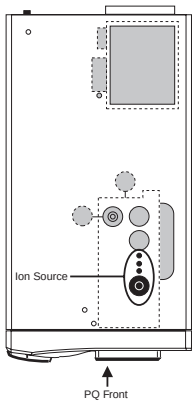
4. **Restore the Polaris*Q* for operation.**

   a. Replace the Vacuum Manifold cover.

   b. Replace the Polaris*Q* front and top covers.

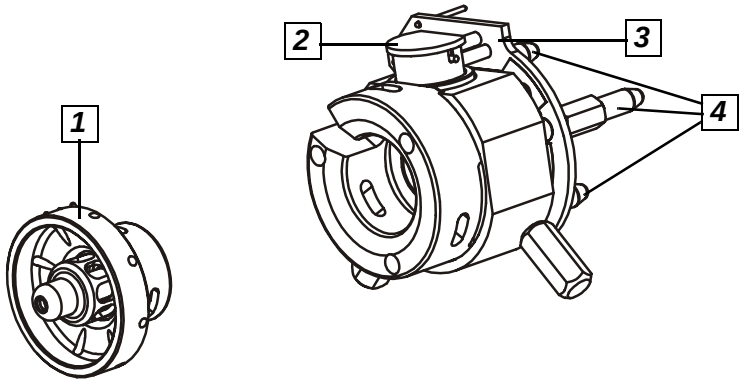
   c. Restart the system.

Replacing the Ion Source Filament



	Materials Needed: • Filament (PN 119701-60287) • Gloves, cotton, lint free (PN A0301-09710) • Lint free cloth *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed

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, then this might indicate 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.



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

Figure 2-28. Ion Source Filament

1. **Prepare the Polaris*Q* for maintenance.**
   a. Prepare a clean work area by covering the area with lint free cloth.
   b. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

c. Remove the Polaris*Q* front and top covers (details are on page 2-7).

d. Remove the Vacuum Manifold Cover (details are on page 2-12).

e. Remove the Ion Source and Ion Trap Assembly (details are on page 2-15).

Note: Wear clean, lint free, cotton gloves when you handle parts inside the vacuum manifold.

2. Disassemble the Ion Source and Ion Trap.

a. Remove the Ion Source Lenses (details are on page 2-43).

b. Remove the 3 Base-Studs.

c. Pull the Filament Assembly and Ion Source Block straight away from the 3 Filament Assembly Connectors and Heater Cartridges on the Ion Source PCB.

d. Remove the Filament assembly.

Tip: Now is a good time to clean the Ion Volume and Ion Source Lenses.

3. Inspect and install a new Filament.

a. Verify that the Filament Wire is centered in the Electron Lens Hole. See Figure 2-29 for a view of a centered wire. Insert the filament into the spacer in the Ion Source Block.

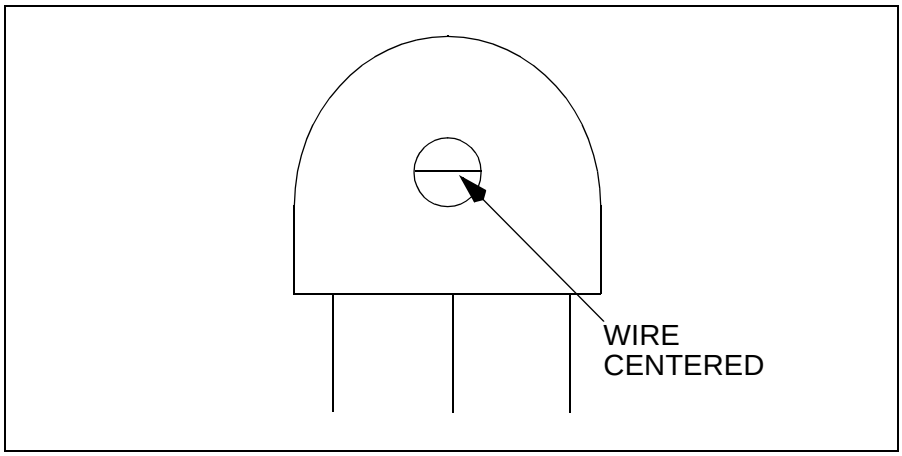


Figure 2-29. Ion Source Filament (picture enlarged to show detail)

b. Align the Electrical Leads on the Filament with the 3 connectors located on the Ion Source PCB and then gently press the Filament Leads into the connectors. Reinstall the three alignment studs.

4. Reassemble and reinstall the Ion Source and Ion Trap.

a. Reassemble the Ion Source (reverse steps **d**. through **a**. from **step 2**).

b. Reinstall the Ion Source and Ion Trap assembly into the Vacuum Manifold (details are on page 2-15).

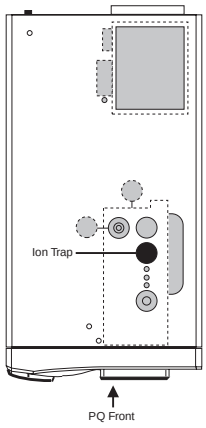
5. Restore the Polaris*Q* for operation.

a. Replace the Vacuum Manifold cover.

b. Replace the Polaris*Q* front and top covers.

c. Restart the system.

2.6 Ion Trap

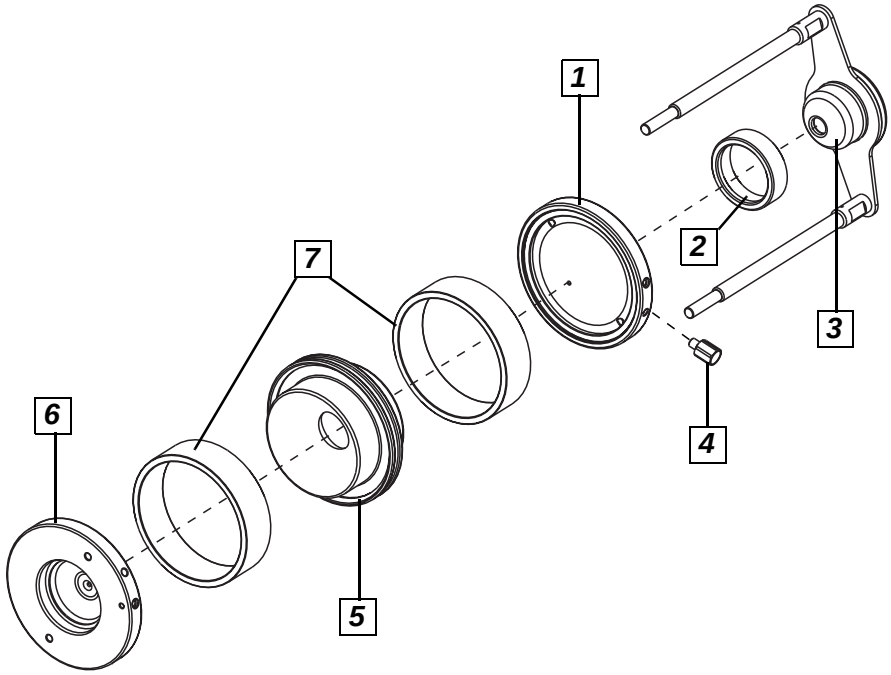


An Ion Trap (also known as the Mass Analyzer) is an assembly composed of an entrance endcap electrode central ring electrode, and exit endcap electrode. The ions that enter the Ion Trap are created in an external ionization source and are transferred into the Ion Trap through three lenses, and are separated according to mass-to-charge ratios.

This section contains these maintenance procedures:

- Cleaning the Ion Trap, page 2-54

Figure 2-30 shows a detailed view of the Ion Trap:



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

Figure 2-30. Ion Trap (Top View)

Cleaning the Ion Trap

	Materials Needed: • Beaker, 450 mL • Clean, dry gas • Gloves, cotton, lint free (PN A0301-09710) • Gloves, latex, impermeable • Lint free cloth • Methanol, reagent grade • Protective eye wear • Ultrasonic cleaner *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed

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. Under normal use the Ion Trap does not require cleaning more than once every two years.

1. Prepare the Polaris*Q* for maintenance.

a. Prepare a clean work area by covering the area with lint free cloth.

b. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING	
	Electrical Shock Hazard Unplug the Polaris*Q* before proceeding.

c. Remove the Polaris*Q* front and top covers (details are on page 2-7).

d. Remove the Vacuum Manifold Cover (details are on page 2-12).

e. Remove the Ion Source and Ion Trap Assembly (details are on page 2-15).

Note: Wear clean, lint free, cotton gloves when you handle parts inside the vacuum manifold.

2. Disassemble the Ion Source and Ion Trap.

a. Disconnect the electrical leads to the Exit Endcap Electrode and Entrance Endcap Electrode.

b. Remove the 3-pin Lens Cable. Be careful not to damage the ceramic lens insulators.

c. Remove the 8-pin Source Cable.

d. Remove the 2 Thumbscrews holding the Ion Trap and Ion Source together.

e. Remove the Magnet Yoke, Ion Source Assembly and Ion Source Lenses.

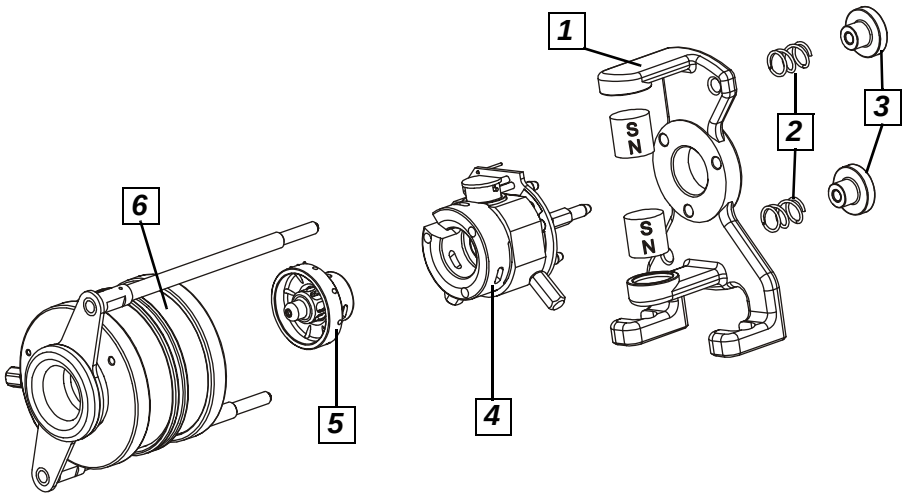
3. Disassemble the Ion Trap.

a. Place each part on the lint free cloth as you remove it.

b. Remove the Entrance Endcap Electrode.

c. Remove the 2 Spacer Rings and the Ring Electrode.

d. Remove the Exit Endcap Electrode.

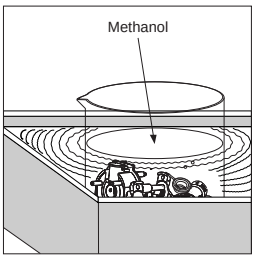


1	Magnet Yoke	4	Ion Source Assembly
2	Springs	5	Ion Source Lenses
3	Thumbscrews	6	Ion Trap

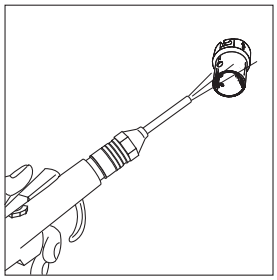
Figure 2-31. Removing the Ion Source and Ion Trap

4. Clean the Ion Trap components.

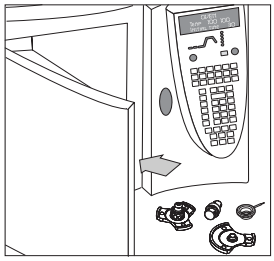
> **Note:** Do not clean the inside surfaces of the Ion Trap with aluminum oxide. This could damage the inside surfaces. However if a black ion burn forms around the Ion Entrance Hole in the Entrance Endcap Electrode, remove using the procedure for **Cleaning Stainless Steel Parts** on 2-18.



a. Place the parts in the beaker and cover the parts with methanol. Place the beaker in an ultrasonic bath for about 10 minutes. Pour the methanol out of the beaker. Rinse the parts with fresh methanol.



b. Remove the parts from the beaker. Blow the methanol off of the parts with clean, dry gas.



c. Dry the parts in an oven set at 100 °C for 30 minutes. Allow the parts to cool before reassembling.

5. Reassemble the Ion Source and Ion Trap Assembly.

a. Reinstall the Exit Lens Spacer so that it lays flat against the Exit Lens.

b. Reinstall the Endcap Electrodes, Ring Electrode, and Spacers. The Damping Gas Nipple should be oriented to the right.

CAUTION

Potential Instrument Damage

Handle the spacer rings carefully. Do not scrape the spacer rings against any metal surfaces. Metal deposits may be removed by cleaning the spacers in acid.

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. Replace the Ion Source Lenses and Ion Source Assembly.

d. Replace the Magnet Yoke and secure it with the 2 Thumbscrews.

6. **Reinstall the Ion Source and Ion Trap assembly into the Vacuum Manifold (details are on page 2-15).**

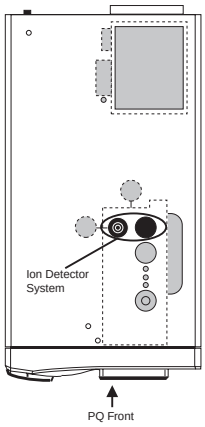
7. **Restore the Polaris*Q* for operation.**

   a. Replace the Vacuum Manifold cover.

   b. Replace the Polaris*Q* front and top covers.

   c. Restart the system.

2.7 Ion Detector System



The Ion Detector System consists of a Conversion Dynode and Electron Multiplier, and must be kept clean and free of dust. Even the smallest amount of lint on either the Electron Multiplier or the Conversion Dynode can cause spectral noise.

Remember:

- Clean the Conversion Dynode and Electron Multiplier each time you remove the Vacuum Manifold cover with clean dry gas, never liquids.
- If you temporarily step away, cover the Vacuum Manifold with the Vacuum Manifold Cover.

Note: We do not recommend cleaning the conversion dynode with aluminum oxide. This may damage the surface. An ion burn on the surface of the conversion dynode is normal and will not adversely affect performance.

This section contains these maintenance procedures:

- Cleaning the Ion Detector System, page 2-60
- Cleaning or Replacing the Anode, page 2-61
- Replacing an Electron Multiplier Cathode, page 2-65

Cleaning the Ion Detector System

	Materials Needed: • Clean, dry gas • Gloves, cotton, lint free (PN A0301-09710) *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed (when the Ion Detection System becomes dusty, or whenever you remove the Vacuum Manifold cover)

If you are receiving significant amounts of spectral noise, try spray cleaning the Ion Detector System with clean, dry gas. Use this procedure if the Ion Detector System becomes dusty and whenever you remove the Vacuum Manifold cover.

1. **Prepare the Polaris*Q* for maintenance.**

   a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

   b. Remove the Polaris*Q* front and top covers (details are on page 2-7).

   c. Remove the Vacuum Manifold Cover (details are on page 2-12).

Note: Wear clean, lint free, cotton gloves when you handle parts inside the vacuum manifold.

2. **Clean the Ion Detector System.**

   Clean the Conversion Dynode and Electron Multiplier using clean, dry gas only (no liquids).

3. **Restore the Polaris*Q* for operation.**

   a. Replace the Vacuum Manifold cover.

   b. Replace the Polaris*Q* front and top covers.

   c. Restart the system.

Cleaning or Replacing the Anode

	Materials Needed: • Anode (PN 96000-20076) • Gloves, cotton, lint free (PN A0301-09710) • Lint free cloth • Screwdriver, Phillips #2 • Wrench, (Allen) 5/64-in. *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed

If, after spray cleaning the Ion Detector System, you are still receiving noise, try cleaning or replacing the Anode, which is between the Electron Multiplier and the wall of the Vacuum Manifold.

1. Prepare the Polaris*Q* for maintenance.

a. Prepare a clean work area by covering the area with lint free cloth.

b. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING	
	Electrical Shock Hazard Unplug the Polaris*Q* before proceeding.

c. Remove the Polaris*Q* front and top covers (details are on page 2-7).

d. Remove the vacuum manifold cover (details are on page 2-12).

e. Remove the Ion Source and Ion Trap Assembly (details are on page 2-15).

Note: Wear clean, lint free, cotton gloves when you handle parts inside the vacuum manifold.

CAUTION

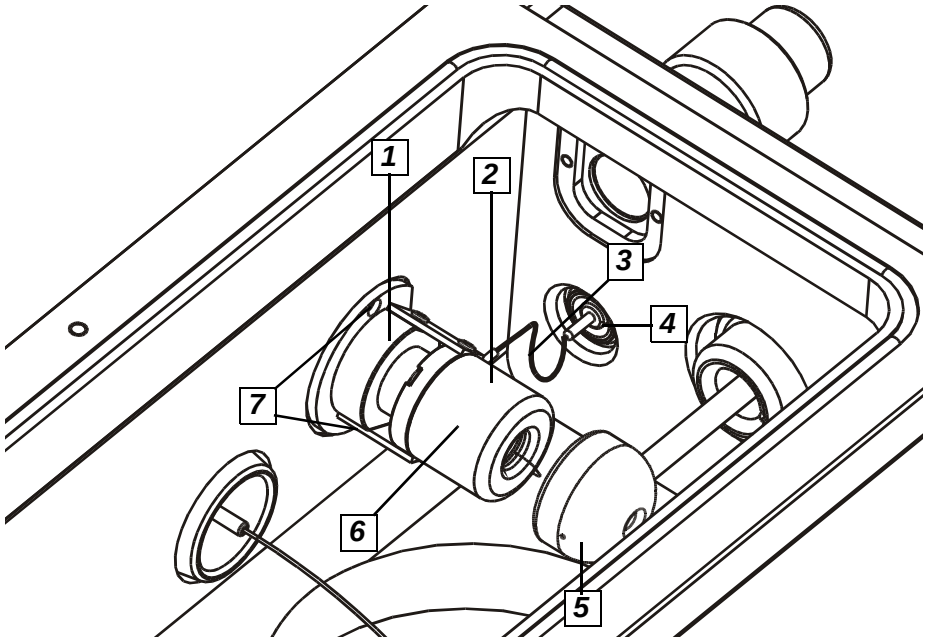
Potential Instrument Damage

Be careful not to damage the surface of the electron multiplier shield. The electron multiplier shield has been electropolished to prevent field emission.

2. Remove the Electron Multiplier.

a. Remove the 2 Socket-Head screws that hold the Electron Multiplier to the Vacuum Manifold (Figure 2-32).

Note: If you have a diffusion pump, place a lint free cloth or piece of aluminum foil under the electron multiplier to catch the screws before they fall in the pump.



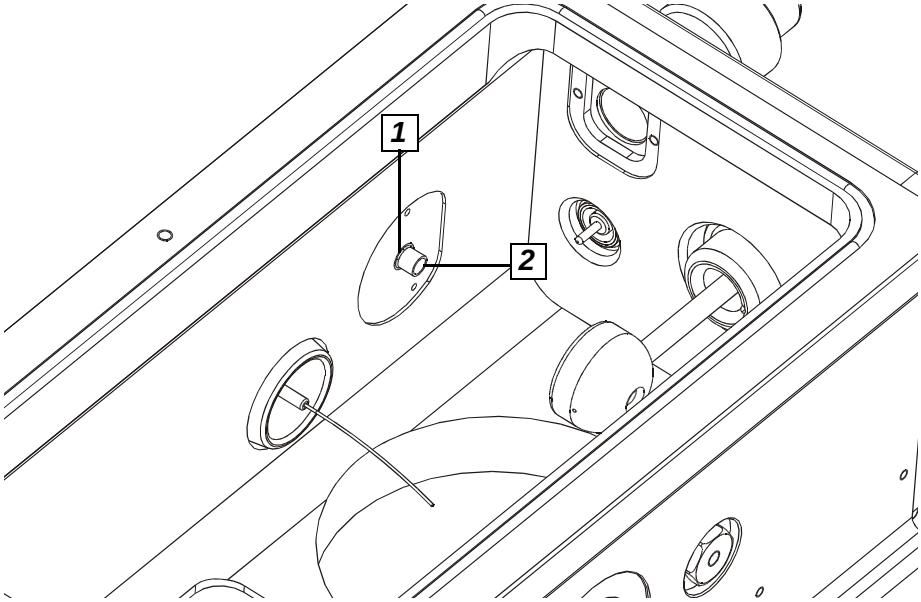
1	Anode (not shown)	5	Conversion Dynode
2	Electron Multiplier	6	Cathode (not shown)
3	Cathode Wire	7	Two Screws Holding the Electron Multiplier Support to the Vacuum Manifold (not shown)
4	Cathode Feedthrough		

Figure 2-32. Ion Detector System (Top Right View)

b. Detach the Cathode Wire from the Cathode Feedthrough located on the rear of the Vacuum Manifold (Figure 2-32).

3. Remove and clean the Anode.

a. Remove the Anode from the Anode Feedthrough by unscrewing it (turn it counterclockwise) by hand. Place it on a clean surface (Figure 2-33).



1	Anode Feedthrough	2	Anode

Figure 2-33. Anode

b. Clean the Anode by following the instructions for **Cleaning Stainless Steel Parts** (details are on page 2-18), or replace it with a new one.

c. Reinstall the Anode in the Anode Feedthrough in by screwing it (turn it clockwise) by hand.

Note: Make sure that the Anode is centered in the cavity.

4. Reinstall the Electron Multiplier into the Vacuum Manifold.

a. Ensure that the Cathode Wire is inserted in the Cathode Feedthrough.

b. Reinstall the 2 Socket-Head Setscrews that secure the Electron Multiplier Support to the Vacuum Manifold.

5. Reinstall the Ion Source and Ion Trap assembly into the Vacuum Manifold (details are on page 2-15).

6. Restore the Polaris*Q* for operation.

a. Replace the Vacuum Manifold cover.

b. Replace the Polaris*Q* front and top covers.

c. Restart the system.

Replacing an Electron Multiplier Cathode

	Materials Needed: • Cathode (PN A0022-02400) • Gloves, cotton, lint free (PN A0301-09710) • Lint free cloth • Screwdriver, Phillips #2 *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed

If, after cleaning or replacing the Anode, you still are receiving significant amounts of spectral noise, try replacing the Electron Multiplier Cathode. The Cathode is located inside the Electron Multiplier.

1. **Prepare the Polaris*Q* for maintenance.**

   a. Prepare a clean work area by covering the area with lint free cloth.

   b. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING	
	Electrical Shock Hazard Unplug the Polaris*Q* before proceeding.

   c. Remove the Polaris*Q* front and top covers (details are on page 2-7).

   d. Remove the Vacuum Manifold cover (details are on page 2-12).

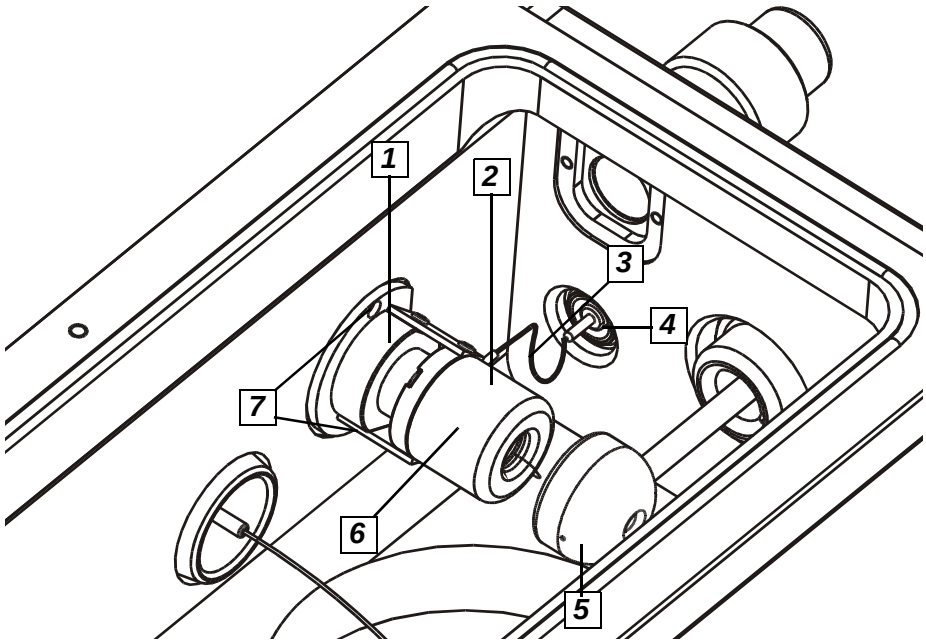
   e. Remove the Ion Source and Ion Trap Assembly (details are on page 2-15).

Note: Wear clean, lint free, cotton gloves when you handle parts inside the vacuum manifold.

2. Remove the Electron Multiplier.

a. Remove the 2 Socket-Head screws that hold the Electron Multiplier to the Vacuum Manifold (Figure 2-32).

> **Note:** If you have a diffusion pump, place a lint free cloth or piece of aluminum foil under the electron multiplier to catch the screws before they fall in the pump.



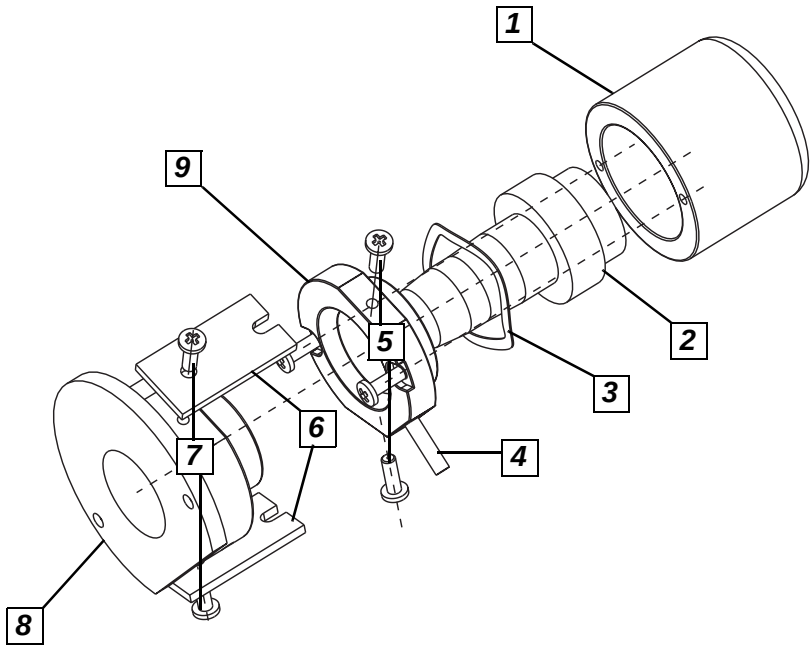
1	Anode (not shown)	5	Conversion Dynode
2	Electron Multiplier	6	Cathode (not shown)
3	Cathode Wire	7	Two Screws Holding the Electron Multiplier Support to the Vacuum Manifold (not shown)
4	Cathode Feedthrough		

Figure 2-34. Ion Detector System (Top Right View)

b. Detach the Cathode Wire from the Cathode Feedthrough located on the rear of the Vacuum Manifold (Figure 2-32).

3. Disassemble the Electron Multiplier.

a. Loosen (but do not remove) the two screws that secure the support plates to the High Voltage Ring (Figure 2-35).



1	Electron Multiplier Shield	6	Support Plates
2	Cathode	7	Two Screws holding the support plates to the electron multiplier support
3	Spring Washer	8	Electron Multiplier Support
4	Cathode Wire (not shown)	9	High Voltage Ring
5	Two Screws holding the electron multiplier shield to the high voltage ring		

Figure 2-35. Electron Multiplier (Exploded View)

b. Remove the 2 screws securing the Electron Multiplier Shield to the High Voltage Ring (Figure 2-32).

c. When the Electron Multiplier Shield is detached from the High Voltage Ring, the Cathode can be freely removed from the assembly.

4. Replace the Cathode.

Insert the narrow end of the new Cathode through the Spring Washer and then through the High Voltage Ring.

5. **Reassemble the Electron Multiplier.**

   a. Place the Electron Multiplier Shield over the wide end of the Cathode so that the screw holes in the Electron Multiplier shield are aligned with the screw holes in the High Voltage Ring (Figure 2-35).

   b. Hold the High Voltage Ring and Electron Multiplier Shield together to compress the Spring Washer. Secure the High Voltage Ring to the Electron Multiplier Shield by using 2 Phillips-head screws.

      The Cathode should be held in place between the High Voltage Ring and the Electron Multiplier Shield.

      The Spring Washer should apply a force to the Cathode to keep it in contact with the Electron Multiplier Shield.

   c. Reattach the High Voltage Ring to the Support Plates by inserting the two screws in the sides of the High Voltage Ring into the notches in the two Support Plates. Tighten the two Phillips-head screws that secure the High Voltage Ring to the two Support Plates.

6. **Reinstall the Electron Multiplier into the Vacuum Manifold.**

   a. Ensure that the Cathode Wire is inserted in the Cathode Feedthrough.

   b. Reinstall the 2 Socket-Head Setscrews that secure the Electron Multiplier Support to the Vacuum Manifold.

7. **Reinstall the Ion Source and Ion Trap assembly into the Vacuum Manifold (details are on page 2-15).**

8. **Restore the Polaris*Q* for operation.**

   c. Replace the Vacuum Manifold cover.

   d. Replace the Polaris*Q* front and top covers.

   e. Restart the system.

2.8 High Vacuum Pumps

A variety of high vacuum pumps, are available for the Polaris*Q*: a Diffusion Pump or an upgrade option 250 L/s or 70 L/s Turbomolecular Pump.

The high vacuum pump is located directly under the Vacuum Manifold. A high vacuum pump provides the high vacuum necessary for ion production.

This section contains these maintenance procedures:

- Maintaining the Diffusion Pump, page 2-70
- Maintaining the Turbomolecular Pumps, page 2-77

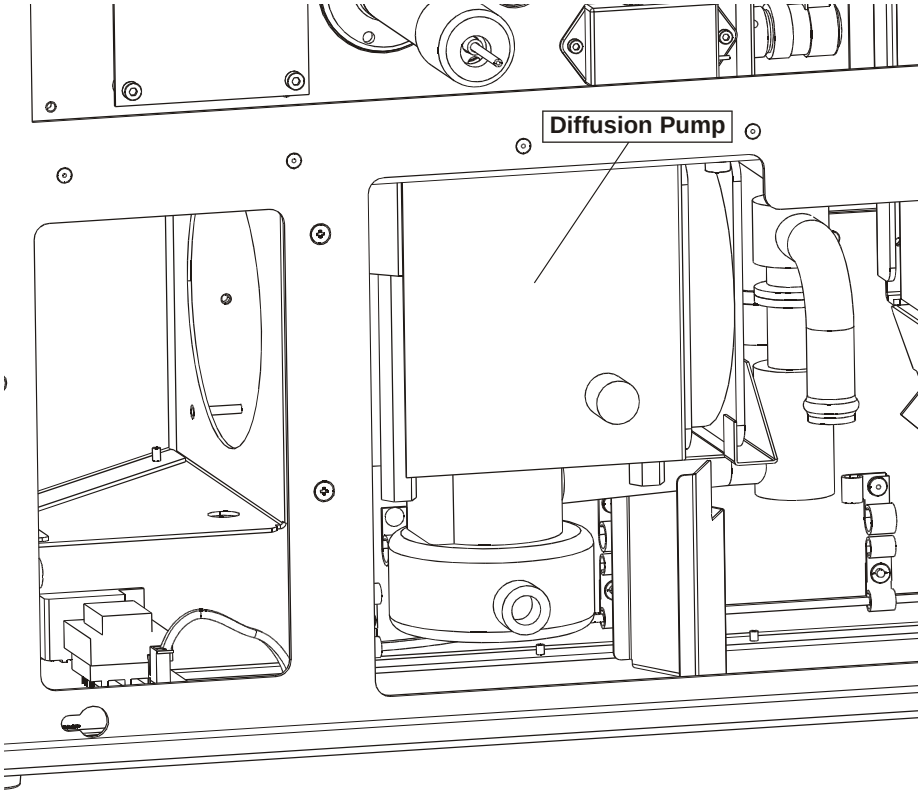
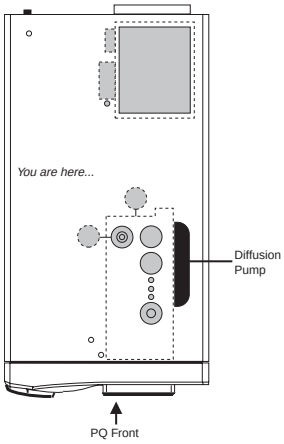


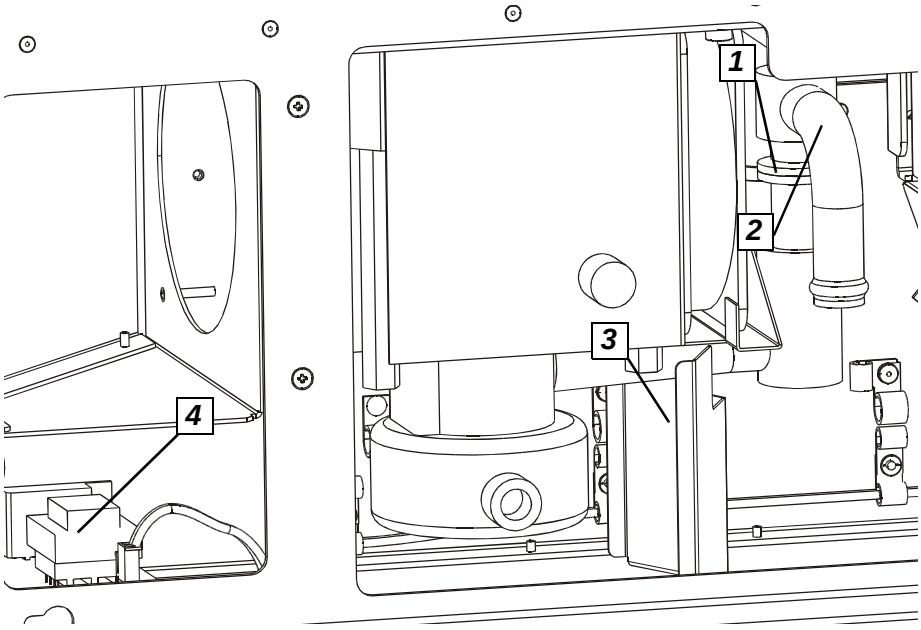
Figure 2-36. Diffusion Pump Polaris*Q* (Right Side)

Maintaining the Diffusion Pump



	Materials Needed: • Container suitable for spent oil • Diffusion Pump Oil (PN A0301-14100) • Screwdriver, flat blade • Gloves, cotton, lint free (PN A0301-09710) • Lint free cloth • Screwdriver, Phillips #2 • Wrench, (Allen) 5/32-in. • Wrench, (socket or open ended) 1/2-in. *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** Every two years and a half years

The diffusion pump is located under the Vacuum Manifold. Replace the diffusion pump oil every two and a half years.



1	Clamp holding the Foreline Adapter to the Backing Flange	3	Diffusion Pump Guard
2	Foreline Adapter	4	Diffusion Pump PCB

Figure 2-37. Diffusion Pump

⚠ CAUTION	
	Burn Hazard The GC oven, injector, transfer line, ion source, and diffusion pump can be very hot and can cause severe burns if touched. Allow heated parts to cool before servicing them

1. Prepare the Polaris*Q* for maintenance.

a. Prepare a clean work area by covering the area with lint free cloth.

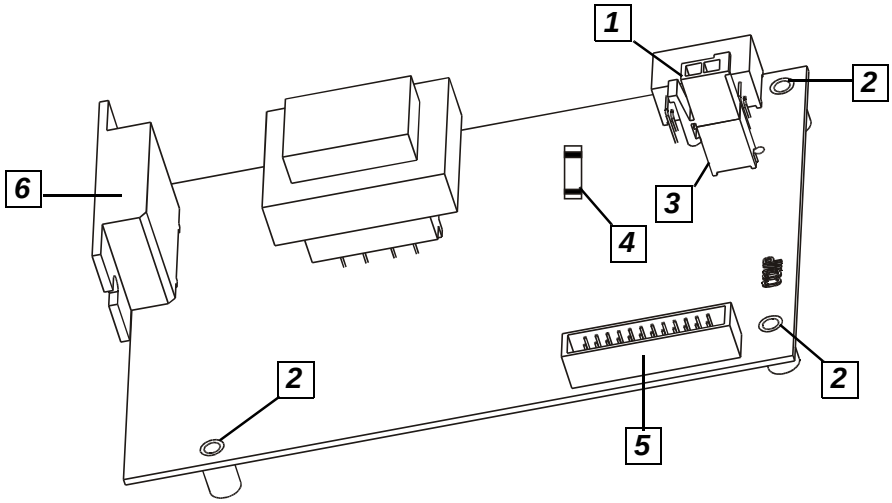
b. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING	
	Electrical Shock Hazard Unplug the Polaris*Q* before proceeding.

c. Remove the Polaris*Q* front, top, and side covers (details are on page 2-7).

2. Remove the Diffusion Pump.

a. Disconnect the 3 cables (P1 - P3) from the Diffusion Pump Control PCB (Figure 2-37).



1	P1	4	Fuse
2	Three Screws holding the PCB to the chassis	5	P3
3	P2	6	Two Screws holding the PCB to the inner wall

Figure 2-38. Diffusion Pump PCB

b. Loosen the 2 screws that hold the Diffusion Pump Guard. Remove the guard.

c. Loosen the clamp that holds the Foreline Adapter to the Backing Flange of the Diffusion Pump (Figure 2-37). Disconnect the Convectron Gauge Cable from the Convectron Gauge. Remove the Foreline Adapter from the pump.

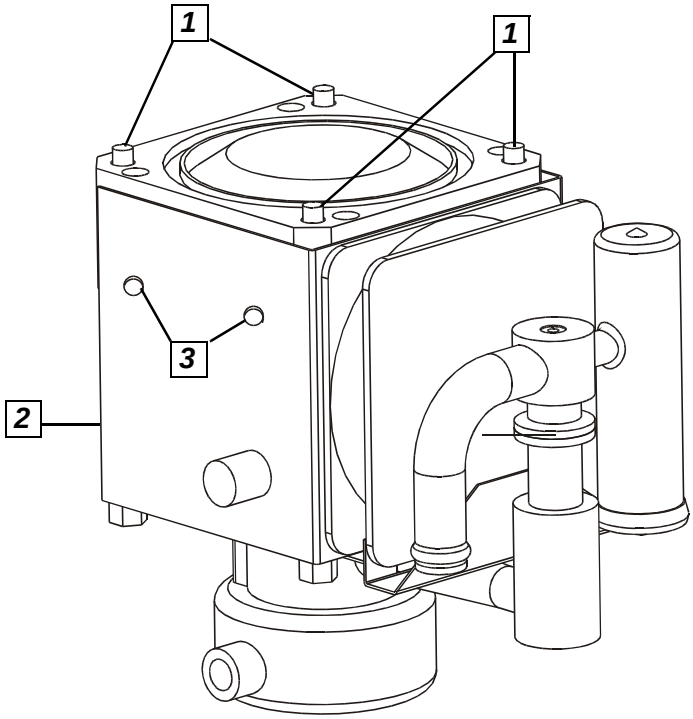
d. Support the Diffusion Pump with one hand or with a suitably sized object. Then, use a 1/2-in. socket wrench (or open-end wrench) to loosen the four screws that hold the Diffusion Pump to the Vacuum Manifold (Figure 2-39).

e. Carefully lower the Diffusion Pump and remove it through the right side of the Polaris*Q*.

⚠ CAUTION

Toxic Substances Hazard

Toxic residues from mass spectrometer samples are likely to be concentrated in the pump oil. Dispose of spent pump oil according to local and federal regulations.

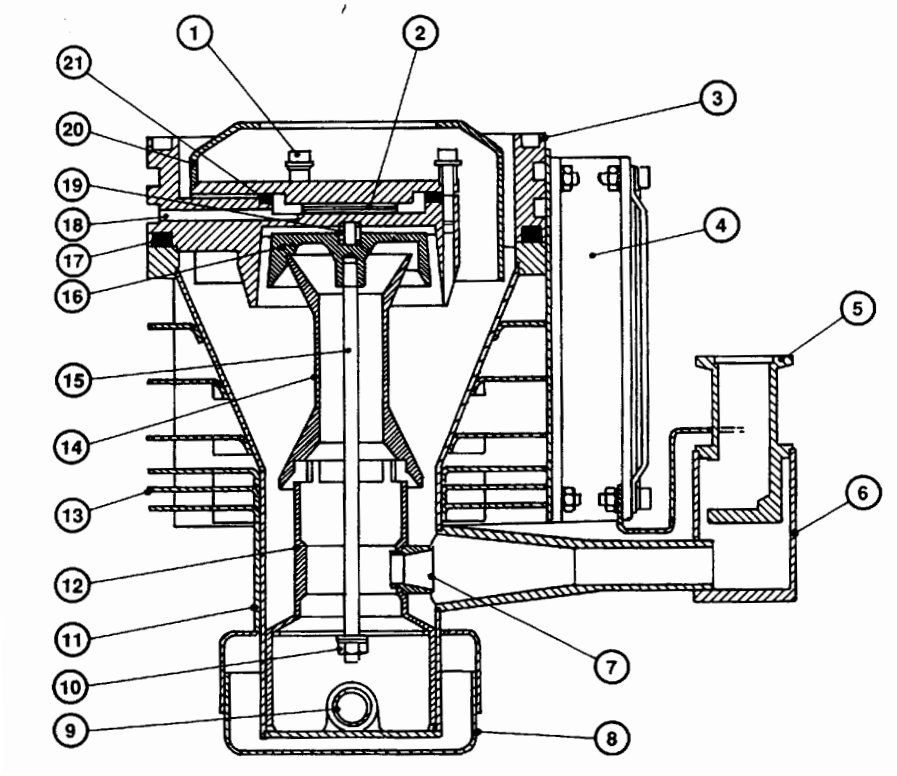


1	Four Screws holding the Diffusion Pump to the bottom of the Vacuum Manifold	3	Four Screws holding the Fan Cowl to the Diffusion Pump (identical locations on either side)
2	Fan Cowl		

Figure 2-39. Diffusion Pump (Removed)

3. Disassemble the Diffusion Pump.

a. With a flat head screwdriver, loosen (but do not remove) the four screws securing the Fan Cowl (Figure 2-39).



1	Screws, 3	12	Lower Jet-Stage
2	Thermoelectric device	13	Cooling-Fins
3	Inlet Flange	14	Upper Jet-Stage
4	Cooling Fan	15	Tie-Rod
5	Backing Flange	16	Top-Jet Cap
6	Backing Condenser	17	Pump Body O-Ring
7	Ejector Stage	18	Thermoelectric Device Cable Lead-through
8	Radiation Shield	19	Transit Spring
9	Heater	20	Inlet-Baffle Assembly
10	Nut and Washer	21	Inlet-Baffle O-Ring
11	Pump Body		

Figure 2-40. Diffusion Pump (Cross Section)

b. Wear gloves to withdraw the Inlet Baffle Assembly (**20**) by removing the 4 Fixing Screws on the Inlet Flange (**3**).

c. Place the Inlet Baffle Assembly on a clean, lint free surface. Do not disassemble the Inlet Baffle Assembly. Use care when handling the Inlet Baffle Assembly to avoid damage to the Peltier (Thermoelectric device) wires (**2**). Figure 2-40 shows the location of these components.

d. Remove the Transit Spring (**19**) and Upper (**14**) and Lower (**12**) Jet Assembly, while remembering the orientation. Place each part on a clean, lint free surface.

4. Change the Diffusion Pump Oil.

a. Warm the Diffusion Pump and replacement oil by placing them in the GC oven at 50 °C for 30 minutes.

b. Invert the pump and carefully pour out the pump oil through the top of the pump into a suitable container. Remove any oil that remains with a clean, lint free tissue. Dispose of the spent pump oil in accordance with your environmental regulations.

c. With the pump upright, pour the entire contents of one bottle of Diffusion Pump Oil into the bottom of the pump through the Pump Inlet Flange (**3**).

5. Reassemble the Diffusion Pump.

a. Reinstall the Upper (**14**) and Lower (**12**) Jet Assembly and Transit Spring (**19**).

b. Reinstall the Inlet Baffle Assembly (**20**). Secure the Inlet Baffle Assembly to the Diffusion Pump with four screws. If you loosened the four screws that secure the Fan Cowl in step 1, tighten the four screws.

c. Inspect the O-Ring on the top of the Diffusion Pump (**21**) for damage, dust, or debris.

6. Reinstall the Diffusion Pump.

a. Position the Diffusion Pump under the Vacuum Manifold. Place a suitably sized object under the Diffusion Pump (or support it with one hand) to hold it in contact (or near contact) with the Vacuum Manifold, and install the four screws that hold it in place.

CAUTION

Potential instrument damage

Be careful not to cross thread the screws, as damage to both the screws and the screw threads in the Vacuum Manifold will result.

b. Reconnect the Diffusion Pump to the Foreline Adapter with the Foreline Adapter Clamp. Tighten the clamp by hand.

c. Reconnect the Convectron Gauge Wire to the Convectron Gauge.

d. Reconnect the three Diffusion Pump Electrical Leads to the Diffusion Pump Control PCB.

7. Restore the Polaris*Q* for operation.

a. Replace the Diffusion Pump Guard.

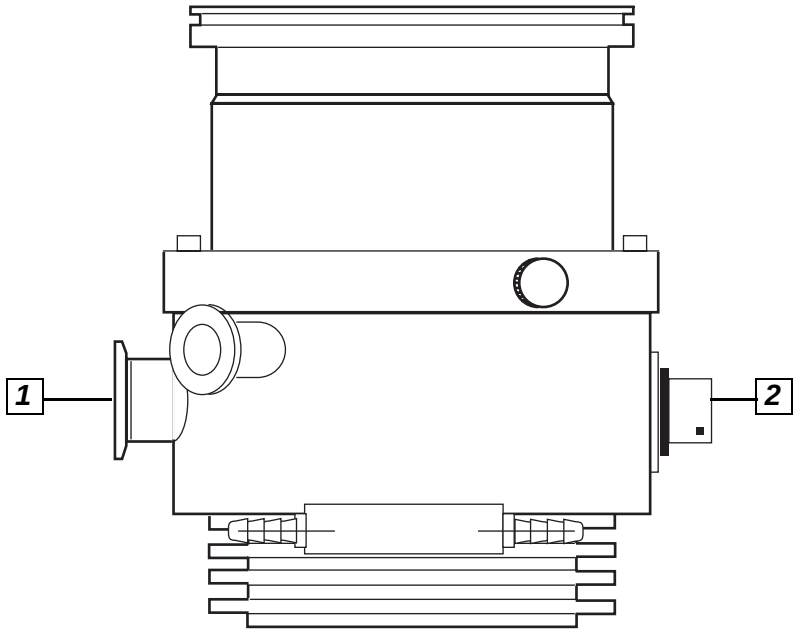
b. Replace the Polaris*Q* side, top, and front covers.

c. Restart the system.

Maintaining the Turbomolecular Pumps

As an upgrade option, your Polaris*Q* can be equipped with either a maintenance free 250 L/s Turbomolecular Pump or a 70 L/s Turbomolecular Pump. They contain sufficient lubricant to supply the bearings for life.

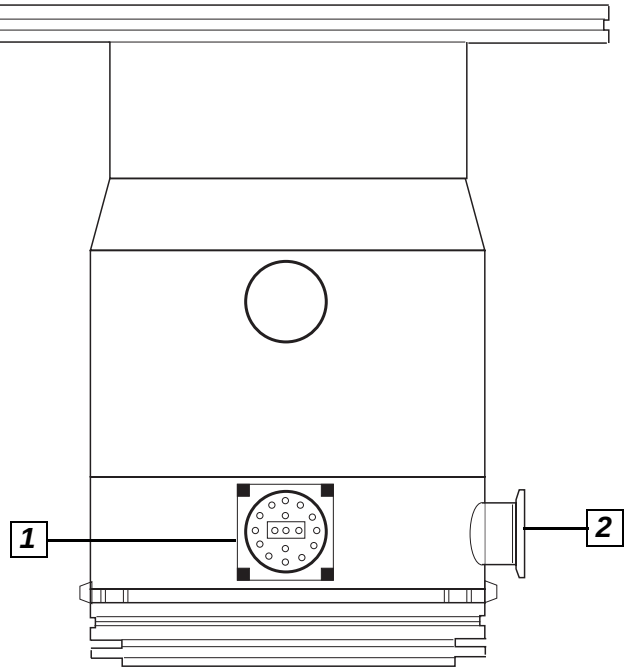
Figure 2-41 illustrates a 250 L/s Turbomolecular Pump.



1	Backing Port (Outlet Flange)	2	Electrical Supply Connector

Figure 2-41. 250 L/s Turbomolecular Pump (Left Side View)

Figure 2-42 illustrates a 70 L/s Turbomolecular Pump.



1	Electric Supply Connector	2	Backing Port (Outlet Flange)

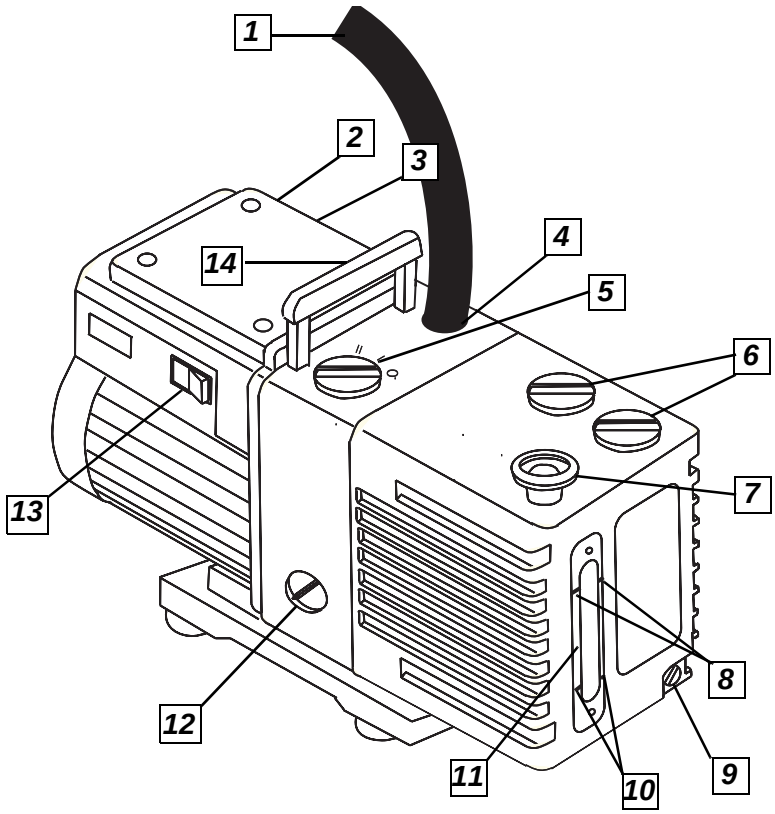
Figure 2-42. 70 L/s Turbomolecular Pump

2.9 Rotary-Vane Pump

The Rotary-Vane Pump is located under the work table where the Polaris*Q* is placed. All you have to do to maintain the rotary-vane pump is add, purge, and change the oil. Inspect the Rotary-Vane Pump oil through the oil-level Sight Glass (Figure 2-43).

This section contains these maintenance procedures:

- Adding Oil to the Rotary-Vane Pump, page 2-82
- Purging the Rotary-Vane Pump Oil, page 2-83
- Changing the Rotary-Vane Pump Oil, page 2-84



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

Figure 2-43. Rotary-Vane Pump

Rotary-vane pump oil (PN A0301-15101) is both light amber in color and clear. During normal operation, oil must always be visible in the oil-level sight glass between the MIN and MAX marks. Check the oil level often. If the oil level is below the MIN mark, add oil. If the oil 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 3000 hours (about 4 months) of operation.

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

Adding Oil to the Rotary-Vane Pump

	Materials Needed: • Rotary-vane pump oil (PN A0301-15101) *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed (if 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.

Use this procedure if the oil level is low. You can check the oil level by looking at the Oil Level Sight Glass (Figure 2-43).

1. **Shut down and vent the Polaris*Q* system (details are on page 1-21).**

⚠ WARNING

Electrical Shock Hazard

You must shut down and unplug the Polaris*Q* MS and the Rotary-Vane Pump before you can add oil to the Rotary-Vane Pump.

2. **Remove one of the Oil Filler Plugs from the Rotary-Vane Pump (Figure 2-43).**

CAUTION

Potential Instrument Damage

To avoid a decrease in performance and damage to the instrument, use only factory-approved Rotary-Vane Pump oil.

3. **Add fresh oil into 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. **Refit the Oil Filler Plug.**

5. **Plug in both the Rotary-Vane Pump and the Polaris*Q*, and Restart the system.**

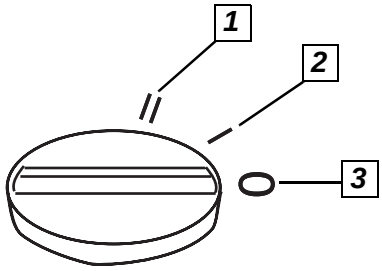
Purging the Rotary-Vane Pump Oil

	Materials Needed: None *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** As needed if oil is discolored or cloudy

Purging (or decontaminating) the oil in the Rotary-Vane Pump removes dissolved gases and low-boiling-point liquids from the pump oil. Purge the pump oil if it is cloudy or discolored. You can purge the pump oil without interrupting system operation. However, do not purge the pump during an acquisition, or while the Electron Multiplier or Filament are on.

1. **Set the Gas-Ballast Control to Position I, Low Flow (Figure 2-44).**
2. **To purge the oil, 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 Position 0, Closed (Figure 2-44).**



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

Figure 2-44. Gas-Ballast Control Positions

Changing the Rotary-Vane Pump Oil

You should change the rotary vane pump oil every four months (about 3000 hours of operation). If you use ammonia as a chemical ionization reagent gas you should change the oil every month. Ammonia is highly basic and quickly damages seals in the rotary-vane pump. Purging the oil with the gas ballast also helps remove dissolved ammonia from the oil.

	Materials Needed: • Rotary-vane pump oil (PN A0301-15101) • Suitable container for removing spent or excess oil *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** 4 months (or 3,000 hours)

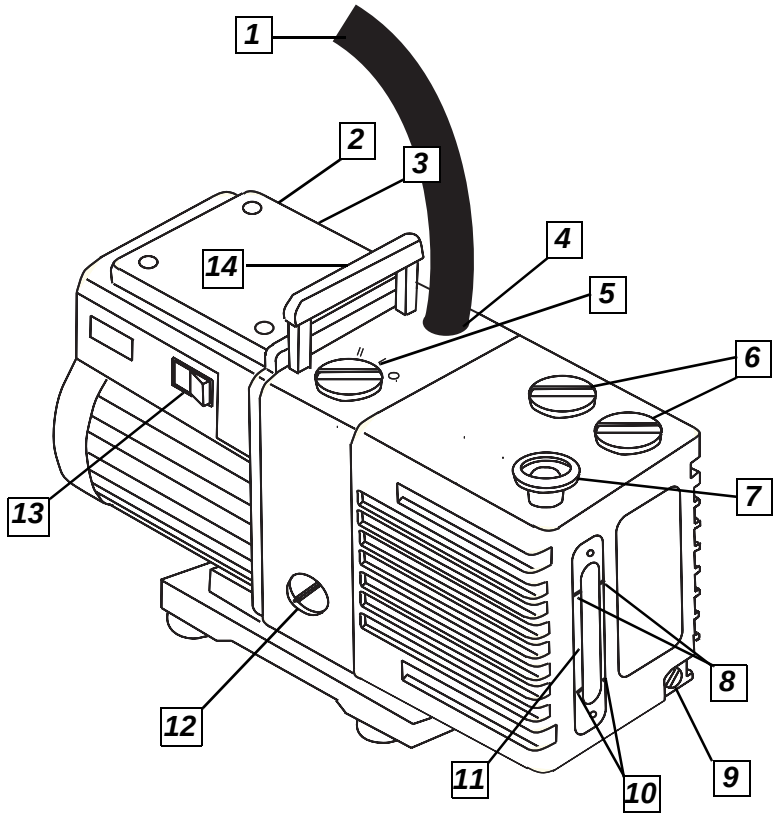
Tip: For best results, change the oil while the rotary-vane pump is still warm from operation. Be careful as the oil can be very hot if the pump was recently operated.

1. **Shut down and vent the Polaris*Q* system (details are on page 1-21).**

⚠ WARNING	
	Electrical Shock Hazard You must shut down and unplug the Polaris*Q* MS and the Rotary-Vane Pump before you can add oil to the Rotary-Vane Pump.

2. Disassemble the Rotary-Vane Pump.

a. Disconnect the Foreline Vacuum Hose.



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

Figure 2-45. Rotary-Vane Pump

a. Place the Rotary-Vane Pump on a bench.

⚠ CAUTION

Possible Lifting Injury

Use proper lifting technique to lift the Rotary-Vane Pump. It weighs approximately 50 pounds.

3. **Drain spent oil.**

   a. Remove one of the Oil Filler Plugs.

   b. Remove the Drain Plug, and allow the oil to drain into a suitable container.

   c. Dispose of the spent oil according to local environmental regulations.

   d. Replace the Oil Drain Plug.

4. **Add fresh oil.**

   a. Add oil into Oil Filler Reservoir 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.

5. **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 both the Rotary-Vane Pump and the Polaris*Q*, and Restart the system.

2.10 Replaceable Parts

This section provides instructions for removing and replacing fuses, PCB's, and other assemblies found outside the Vacuum Manifold.

Note: Retain the packing materials since some defective parts must be returned to Thermo Finnigan in Austin.

Fuses protect circuits by opening the circuits whenever an over-current occurs. Component and current ratings are listed in Table 2-2.

CAUTION

Potential Instrument Damage

Use only the fuses specified in Table 2-2. Never replace a fuse with a fuse of a different type, voltage, or current rating.

Table 2-2. Component and Current Ratings

Component	Fuse	Circuit	Type/Voltage/Current Rating	PN
Analog PCB	F1	Ion Source Heater	2A, very fast microfuse, 125 V	76339-0008
Diffusion Pump Control PCB	F1	Diffusion pump	3.15 A, SB, 5 x 20 mm, 250 V	A0006-10510
HV Regulator PCB	F1, F2	Transformer Secondary	0.315A, 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 Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer.

CAUTION

Potential instrument damage

To prevent damage to the PCB's due to electrostatic discharge, attach an electrostatic discharge (ESD) strap to your wrist before replacing fuses.

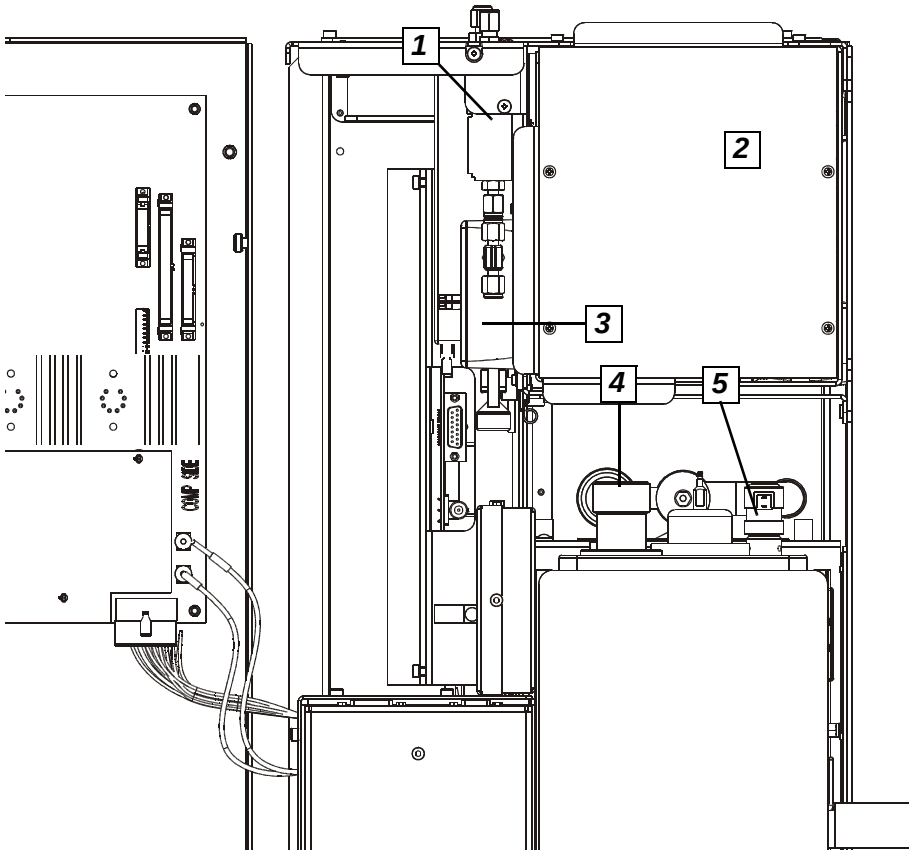
Table 2-3 lists all procedures listed in this section. Each replaceable part is listed alphabetically.

Table 2-3. Non-Routine Recommended Maintenance Schedule

Replaceable Parts	As needed *
Analog PCB, page 2-95	✔
Balun PCB, page 2-99	✔
Calibration Gas Flow Module, page 2-101	✔
CI Reagent Gas Flow Module, page 2-106	✔
Conversion Dynode and Electron Multiplier Power Supply, page 2-110	✔
Convectron Gauge and Foreline Adapter, page 2-113	✔
Diffusion Pump Control PCB, page 2-116	✔
Diffusion Pump Fan, page 2-120	✔
Digital PCB, page 2-124	✔
Electrometer PCB, page 2-127	✔
Helium Gas Flow Module, page 2-130	✔
Ion Gauge, page 2-143	✔
Lens Interface PCB, page 2-136	✔
Low Pass Filter PCB, page 2-138	✔
Power Module, page 2-143	✔
Rear Cooling Fans, page 2-145	✔
RF Detector PCB, page 2-148	✔
RF Generator PCB, page 2-151	✔
Transfer Line, page 2-156	✔
Turbomolecular Pump Power Supply, page 2-159	✔
Vacuum Control PCB, page 2-162	✔
Vent Valve Solenoid, page 2-165	✔

*: As needed implies ONLY when indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer.

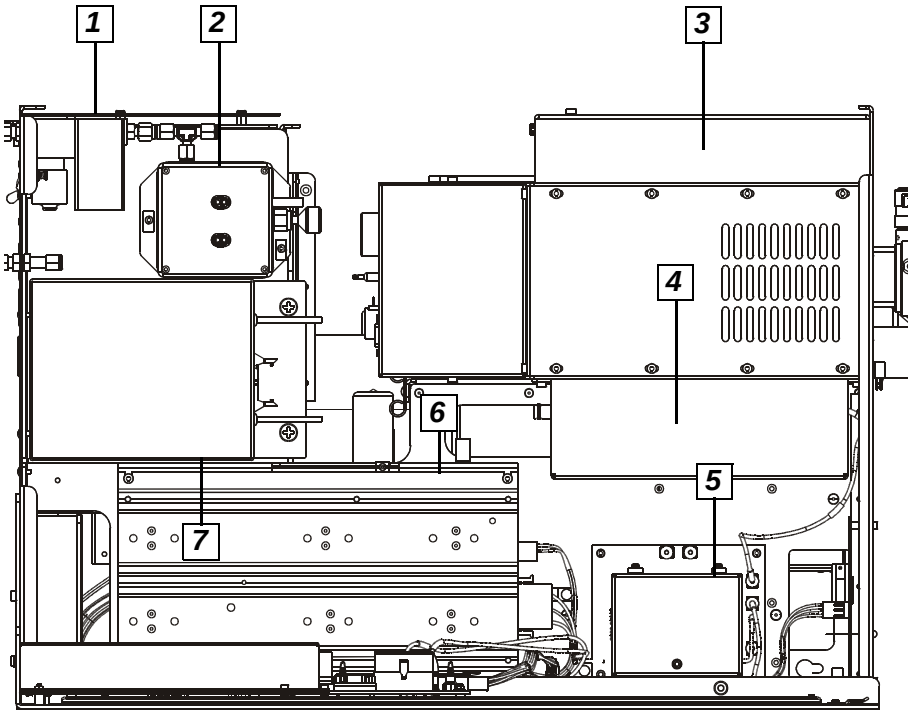
Figure 2-46 details replaceable parts located under the Polaris*Q* top cover.



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

Figure 2-46. Replaceable parts (top)

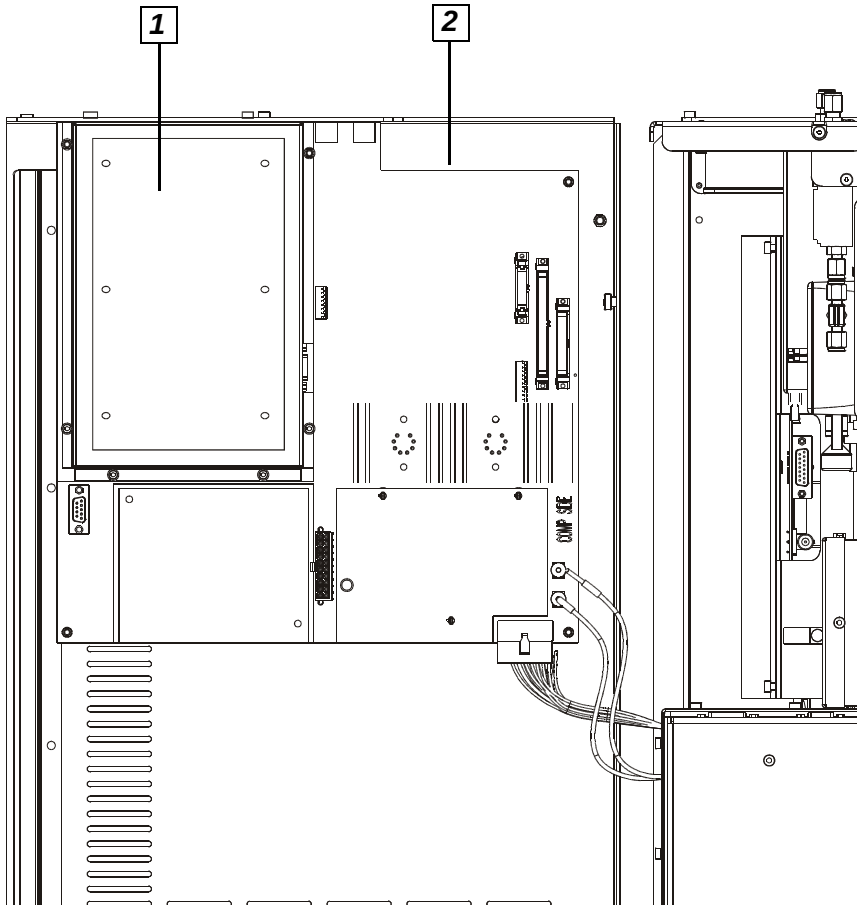
Figure 2-47 details replaceable parts located behind the Polaris*Q* left cover.



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 2-47. Replaceable parts (left side)

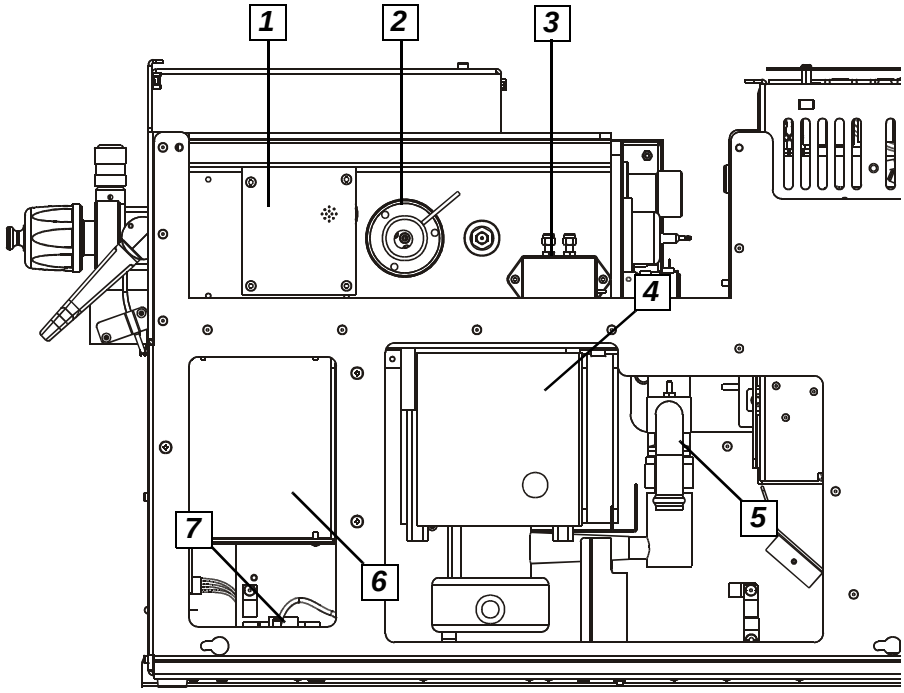
Figure 2-48 details replaceable parts located on the Polaris*Q* Left Cover.



1	Digital PCB	2	Analog PCB

Figure 2-48. Replaceable parts (left cover)

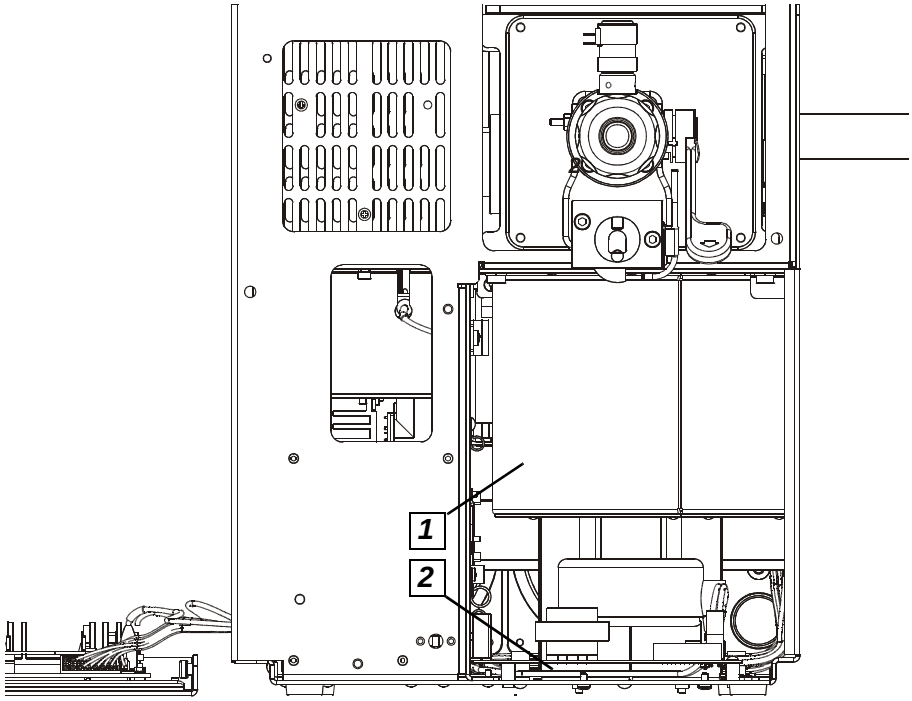
Figure 2-49 details replaceable parts located behind the Polaris*Q* right cover.



1	Lens Interface PCB	5	Convectron Gauge and Foreline Adapter
2	Transfer Line	6	Diffusion Pump Fan
3	Helium Gas Flow Module	7	Turbo Pump Power Supply ***or*** Diffusion Pump PCB
4	High Vacuum Pump		

Figure 2-49. Replaceable parts (right side)

Figure 2-50 details replaceable parts located behind the Polaris*Q* front cover.



1	Diffusion Pump Fan	2	Diffusion Pump Control PCB ***or*** Turbomolecular Pump Power Supply

Figure 2-50. Replaceable parts (front)

Figure 2-51 details replaceable parts located on the rear of the Polaris*Q*.

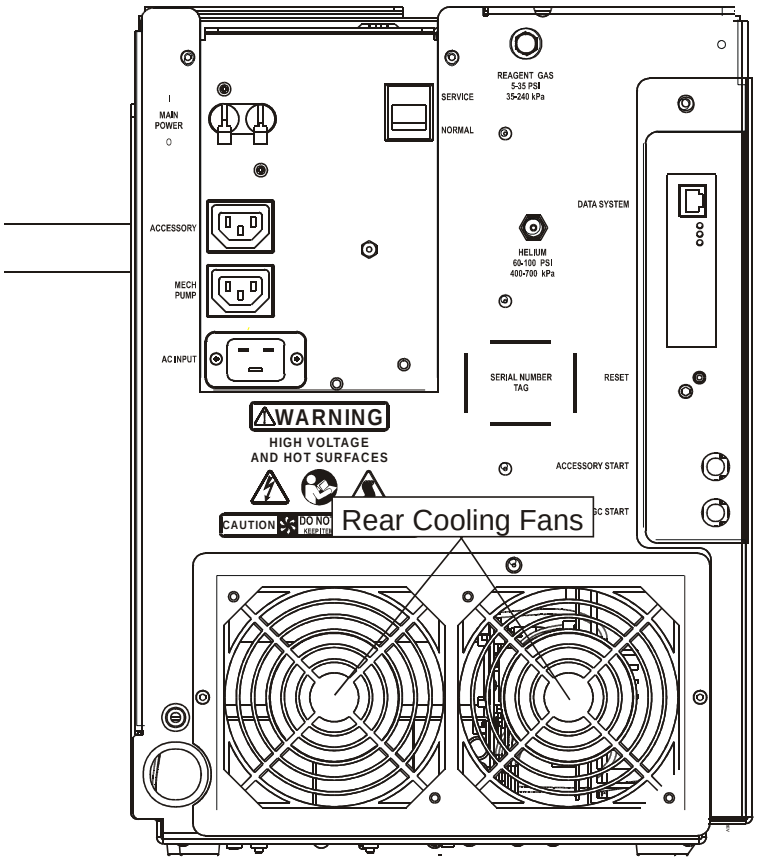
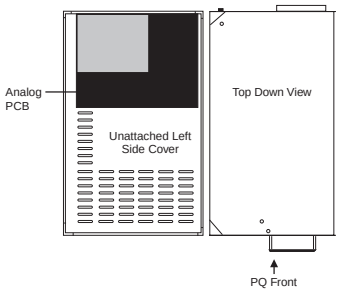


Figure 2-51. Replaceable parts (back)

Analog PCB



	Materials Needed: • Analog PCB (PN 119590-0020) • Nut driver, 5.5 mm *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

To replace the Analog PCB:

1. **Prepare the Polaris*Q* for maintenance.**

   a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING
Electrical Shock Hazard Unplug the Polaris*Q* before proceeding.

   b. Remove the Polaris*Q* front, top and left side covers (details are on page 2-7).

2. **Remove the Analog PCB.**

   a. Remove the Digital PCB (details are on page 2-124).

b. Disconnect the following cables from the Analog PCB:

RF Control PCB cable	J1
BALUN PCB cables	J3 and J4
GC Start Cable	J5
Lens interface PCB cable	P2
CI flow module cable	P6
Multiplier/dynode power supply cable	P7
RF Generator cable	P8
Power module cable	P9
Vacuum Control PCB cable	P10

c. Remove the six nuts which hold the Analog PCB to the left side cover (Figure 2-52).

d. Lift the Analog PCB from the cover.

3. Replace the Analog PCB.

a. Position the new PCB so that the 6 screws fit through the PCB.

b. Attach the PCB with 4 of the 6 nuts. The last 2 go on after the cover for the Digital PCB.

c. Replace the Digital PCB.

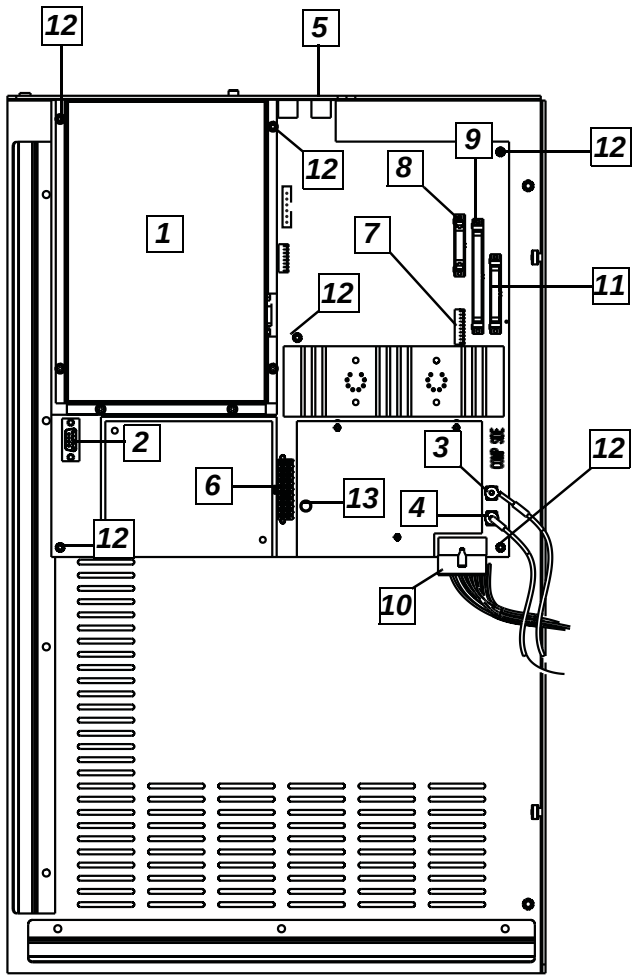
d. Reconnect all cables.

4. Restore the Polaris*Q* for operation.

a. Replace the top, left side, and front covers of the Polaris*Q*.

b. Restart the system.

c. Run Diagnostics to verify that your system is operational.



1	Digital PCB	8	P7
2	J1	9	P8
3	J4	10	P9
4	J3	11	P10
5	J5	12	Nuts holding the PCB to the panel
6	P2	13	Fuse
7	P6		

Figure 2-52. Analog PCB (Left Side Panel, Top Down View)

To replace a fuse on the Analog PCB:

1. **Prepare the Polaris*Q* for maintenance.**

   a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING

Electrical Shock Hazard

Unplug the Polaris*Q* before proceeding.

   b. Remove the Polaris*Q* front, top, and left side covers (details are on page 2-7).

2. **Locate and remove the defective fuse on the Analog PCB with a fuse of the same type, voltage, and current rating.**

   For a list of proper fuses, see Table 2-4.

Table 2-4. Component and Current Ratings

Component	Fuse	Circuit	Type/Voltage/Current Rating	PN
Analog PCB	F1	Ion Source Heater	2A, very fast microfuse, 125 V	76339-0008
Diffusion Pump Control PCB	F1	Diffusion pump	3.15 A, SB, 5 x 20 mm, 250 V	A0006-10510
HV Regulator PCB	F1, F2	Transformer Secondary	0.315A, 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

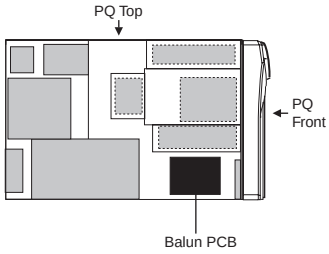
3. **Restore the Polaris*Q* for operations.**

   a. Reinstall the left, top, and front covers of the Polaris*Q*.

   b. Restart the system.

   c. Run Diagnostics to verify that your system is operational.

Balun PCB



	Materials Needed: • Balun PCB (PN 119590-0090) • Wrench, (Allen) 2.5 mm *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

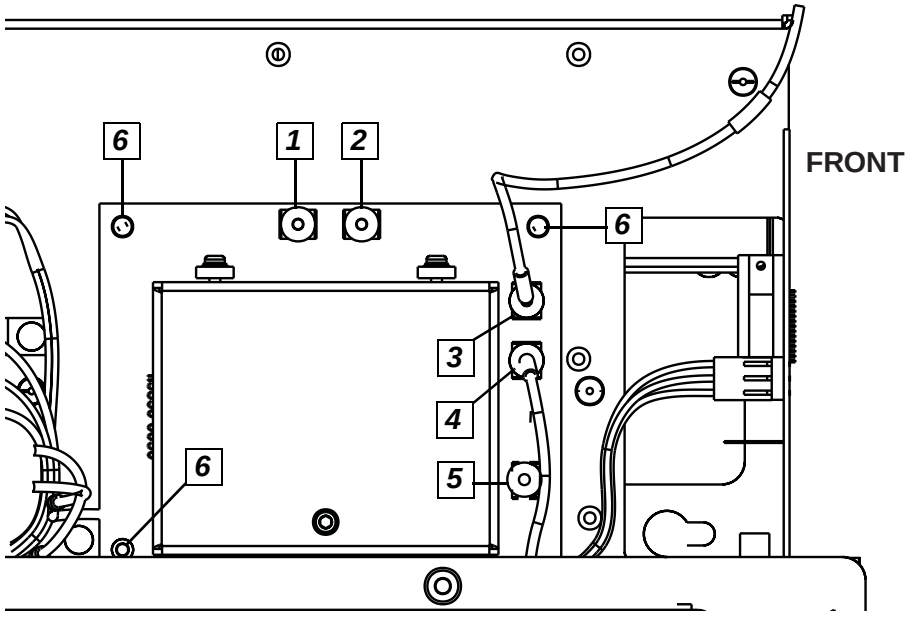
⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front, top, and left side covers (details are on page 2-7).

2. Remove the Balun PCB.

a. Disconnect the electrical cables at P1, P2, P3, P4, and P5.



1	P1	4	P4
2	P2	5	P5
3	P3	6	Screws holding the PCB to the chassis

Figure 2-53. Balun PCB (Side View)

b. With a 2.5 mm Allen wrench, remove the three screws which hold the PCB to the chassis. Pull the Balun PCB free of the chassis.

3. Replace the Balun PCB.

a. Attach the new Balun PCB to the chassis with the three screws, being sure the P1 and P2 connectors are aligned towards the top.

b. Reconnect the cables to P1, P2, P3, P4, and P5.

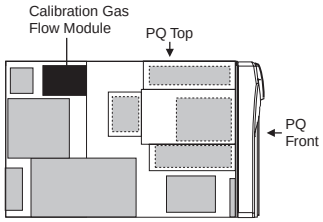
4. Restore the Polaris*Q* for operation.

a. Reinstall the left side, top, and front covers of the Polaris*Q*.

b. Restart the system.

c. Run Diagnostics to verify that your system is operational.

Calibration Gas Flow Module (CGFM)



	Materials Needed: • Calibration Gas Flow Module (PN 119246-0001) • FC-43 calibration compound (PN 50010-30059) • Lint free paper • Syringe • Wrench, (Allen) 3 mm • Wrench, (open ended) 7/16-in. • Wrench, (open ended) 9/16-in. *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

To replace the Calibration Gas Flow Module:

1. **Prepare the Polaris*Q* for maintenance.**

   a. Shut down and vent the Polaris*Q* (details are on page 1-21).

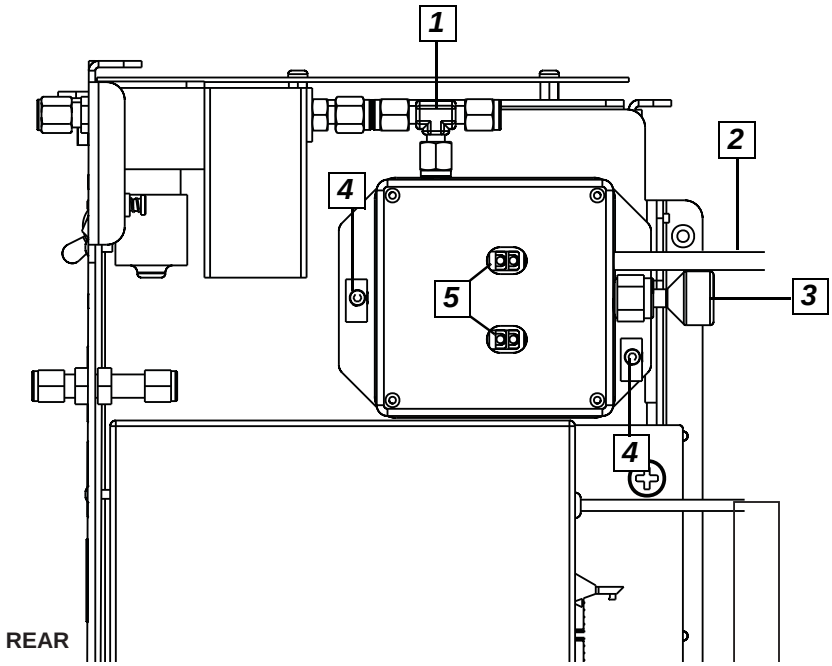
⚠ WARNING
Electrical Shock Hazard Unplug the Polaris*Q* before proceeding.

   b. Remove the Polaris*Q* front, top, and left side covers (details are on page 2-7).

   c. Turn off the CI Reagent Gas Supply (if present).

2. Remove the Calibration Gas Flow Module.

a. Disconnect the Gas Fittings from the top of the module (Figure 2-54).



1	Gas Fittings	4	Screws holding the module to the chassis
2	Foreline Adapter Tubing	5	Electrical Plugs
3	Calibration Compound Vial		

Figure 2-54. Calibration Gas Flow Module (Side View)

b. Disconnect the end of the clear Tubing from the Foreline Adapter.

c. Disconnect the four electrical plugs.

d. Remove the two screws.

e. Remove the Calibration Gas Flow Module (CGFM) from the chassis.

3. Replace the Calibration Gas Flow Module.

a. Position the module so that the gas line fitting will be on top and the Tubing and Electrical Cable are towards the front of the Polaris*Q*. Tighten the gas fittings with a 7/16-in open ended wrench. Attach the module to the chassis with the 2 screws.

b. Reconnect the four electrical cables, and the end of the tubing.

c. Turn on the CI Reagent Gas Supply (if present).

d. Add calibration compound to the vial (see below).

4. Restore the Polaris*Q* for operation.

a. Reinstall the front, top, and left side covers.

b. Restart the system.

To add Calibration Compound:

Calibration compound is a liquid whose mass spectrum of ions is used to tune and calibrate the MS. The Polaris*Q* uses FC-43 as its calibration compound.

You cannot tell by sight whether calibration compound needs to be added. However, during Xcalibur Automatic Tune an error message displays "the intensity of calibration gas ions is *too low.*" There are many factors that can cause a shortage of calibration gas ions besides a decrease in calibration compound. As a rule, the MS should never require adding calibration compound more than once a year.

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

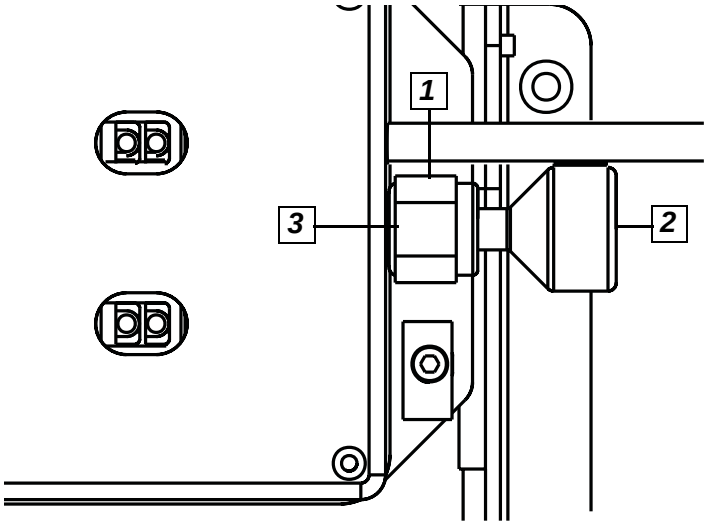
b. Remove the Polaris*Q* front, top, and left side covers (details are on page 2-7).

2. Disassemble the Calibration Compound Vial from the CGFM.

a. With a 9/16-in. wrench, remove the nut for the Calibration Compound Vial.

b. Slide the Vial away from the Calibration Compound Valve Fitting with the Ferrule and Nut attached.

c. Remove the Ferrule and Nut.



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

Figure 2-55. Calibration Compound Vial (Side View)

3. Add calibration compound.

a. Without injecting, insert a syringe in the Calibration Compound Vial until you touch the white frit at the bottom of the vial.

b. Inject no more than 0.1 mL of Calibration Compound into the Calibration Compound Vial.

The frit absorbs the Calibration Compound. If you see the Calibration Compound pooled (liquid on top of the frit), then you have too much. Immediately pour out the excess liquid according to local environmental regulations.

c. Remove the syringe from the Calibration Compound Vial.

CAUTION

Potential Instrument Damage

Adding more than 0.1 mL of the calibration compound can result in damage to the Calibration Gas Module. Be sure not only that you are adding the correct amount of calibrant to the chamber, but that the instrument truly needs the additional calibrant in the first place.

4. **Reinstall the Calibration Compound Vial into the CGFM.**

   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 (Figure 2-55).

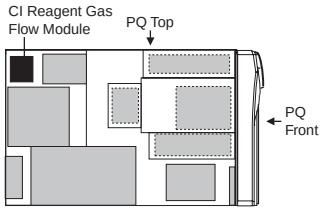
   c. Connect the vial to the Calibration Compound Valve Fitting with the Nut and Ferrule.

5. **Restore the Polaris*Q* for operation.**

   a. Replace the front and top covers of the Polaris*Q*.

   b. Restart the system.

CI Reagent Gas Flow Module (Upgrade Option)



	Materials Needed: • CI Reagent Gas Flow Module (PN 23331-0090) • Electronic Leak Detector (GL Sciences, Inc., model LD-228, or equivalent) • Phillips screwdriver, #2 • Wrench, (open ended) 7/16-in. (2) *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING

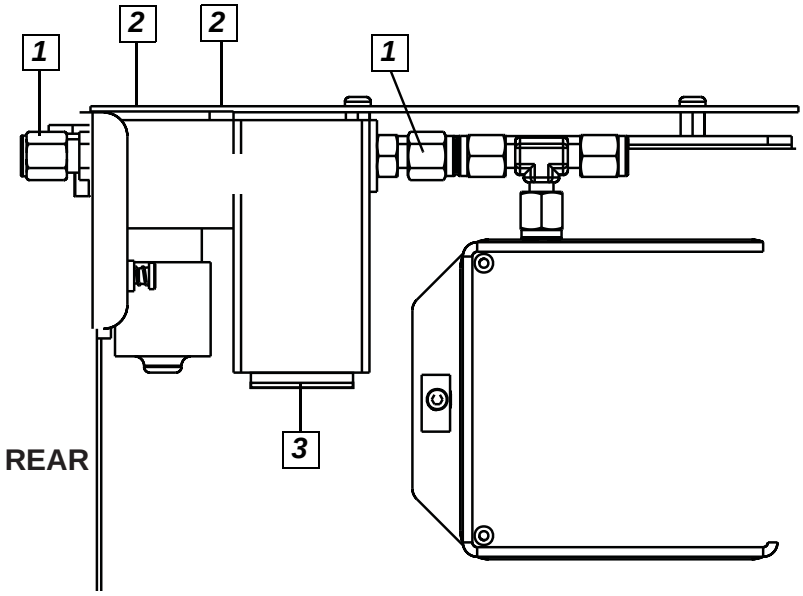
Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front, top, and left side covers (details are on page 2-7).

c. Turn off the CI Reagent Gas Supply.

2. Remove the CI Reagent Gas Flow Module.

a. Unplug the Analog PCB Electrical Cable.



1	Gas Line Fittings	3	Analog PCB Electrical Cable Connector
2	Screws holding the module to the chassis		

Figure 2-56. CI Reagent Gas Flow Module

b. Disconnect the two gas line fittings to the CI Reagent Gas Flow Module.

c. Remove the two screws that hold the CI Reagent Gas Flow Module to the Polaris*Q* chassis. Remove the CI Reagent Gas Flow Module.

3. Replace the CI Reagent Gas Flow Module.

a. Attach the new CI Reagent Gas Flow Module to the chassis with the two screws.

b. Reconnect the Analog PCB Electrical Cable to the CI Reagent Gas Flow Module.

⚠ WARNING

Burn or Explosive Hazard

Ensure that your work area is free from spark or flame. The reagent gas is either flammable or corrosive. You must vent the gas to a fume hood or other suitable exhaust. Leaks in reagent gas supplies can present a fire or explosion hazard.

c. Reconnect the Gas Line Fittings between the CI Reagent Gas Flow Module and the MS.

4. Purge the gas lines.

a. Turn on the reagent gas and set to 200 kPa (30 psi).

b. Allow the line to purge briefly, but no longer than 15 seconds. Be sure to vent the reagent gas to a suitable exhaust.

c. After the line is purged, connect the reagent gas supply to the CI Reagent Gas Flow Module.

d. Reset the regulator to a pressure between 35 and 240 kPa (5 and 35 psi). The nominal pressure is 70 kPa (10 psi).

5. Test the gas line fittings for leaks.

a. Use a hand-held electron leak detector (GL Sciences, Inc., model LD-228, or equivalent) to check each fitting for leaks. If a hand-held leak detector is not available, drop a small amount of methanol onto each fitting and watch for bubbles (which indicates a leak).

⚠ WARNING

Potential Burn or Explosive Hazard

Never use the liquid detector technique on or around electronic circuits. The recommended solvents are flammable and may ignite.

CAUTION

Potential Instrument Damage

Do not use liquid soap leak detectors (such as Snoop) to check for leaks. Liquid soap leak detectors may contaminate your system.

b. Correct leaks by tightening or replacing the connections. Continue to check and correct leaks until all connections are leak-free.

6. Restore the Polaris*Q* for maintenance.

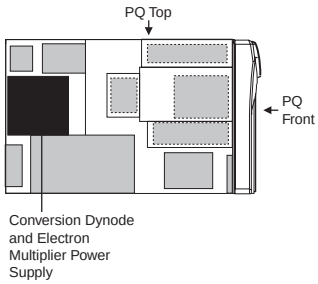
a. Replace the left side, top, and front covers of the Polaris*Q*.

b. Restart the system.

c. Once the MS has pumped down and is operational, check the Air/Water Spectrum for vacuum leaks (See Xcalibur Tune Online Help topic: Testing the Air/Water).

Note: Compressed electronic dusting spray containing an HFC can be used for manifold leak detection if the MS is running, pumped down, stabilized, and mass calibrated. For example, using MicroCare® Micro-Blast™ which contains tetrafluoroethane, scan in full-scan EI mode between 60 and 90 amu, looking for masses 69 and 83.

Conversion Dynode and Electron Multiplier Power Supply



	Materials Needed: • Conversion Dynode and Electron Multiplier Power Supply (PN 119377-0001) • Screwdriver, Phillips #2 *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

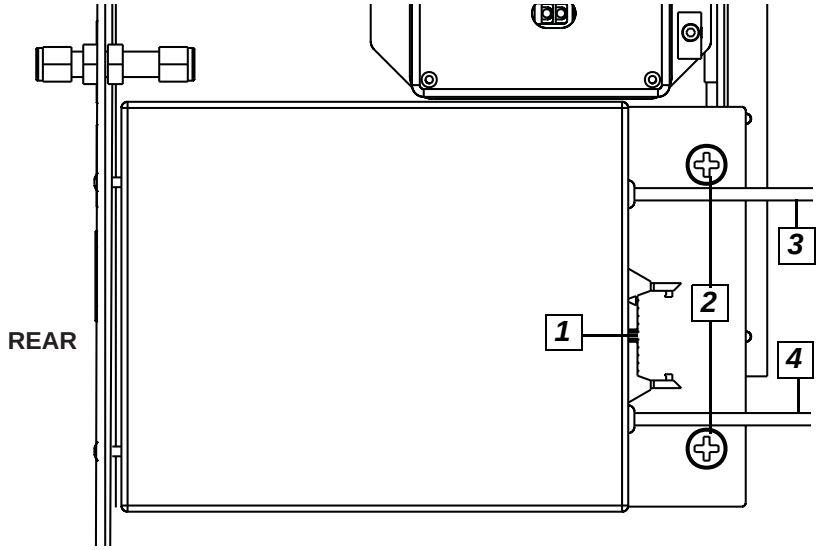
⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front, top, and left side covers. (details are on page 2-7).

2. Remove the Conversion Dynode and Electron Multiplier Power Supply.

a. Disconnect the Ribbon Cable from the Power Supply.



1	Ribbon Cable	3	Electron Multiplier High Voltage Cable
2	Two Screws holding the power supply to the chassis	4	Conversion Dynode High Voltage Cable

Figure 2-57. Conversion Dynode and Electron Multiplier Power Supply

b. Disconnect the Conversion Dynode High Voltage Cable from the Vacuum Manifold.

c. Disconnect the Electron Multiplier High Voltage Cable from the Vacuum Manifold.

d. Remove the Polaris*Q* the two large screws holding the power supply to the chassis.

3. Replace the Conversion Dynode and Electron Multiplier Power Supply.

a. Install the new Electron Multiplier and Conversion Dynode Power Supply.

b. Reconnect the Ribbon Cable, Dynode Cable, and Electron Multiplier Cable.

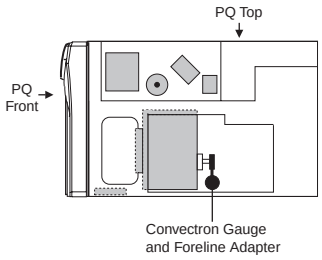
4. **Restore the Polaris*Q* for operation.**

   a. Replace the left side, top, and front covers of the Polaris*Q*.

   b. Restart the system.

   c. Run Diagnostics to verify that your system is operational.

Convectron Gauge and Foreline Adapter



	Materials Needed: • Wrench, adjustable • Convectron gauge and foreline adapter - Diffusion Pump system (PN 119259-0001) • Convectron gauge and foreline adapter - 250 L/s Turbopump system (PN 119259-0002) • Convectron gauge and foreline adapter - 70 L/s Turbopump system (PN 119259-0003) • Lint free paper • Screwdriver, flat blade *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

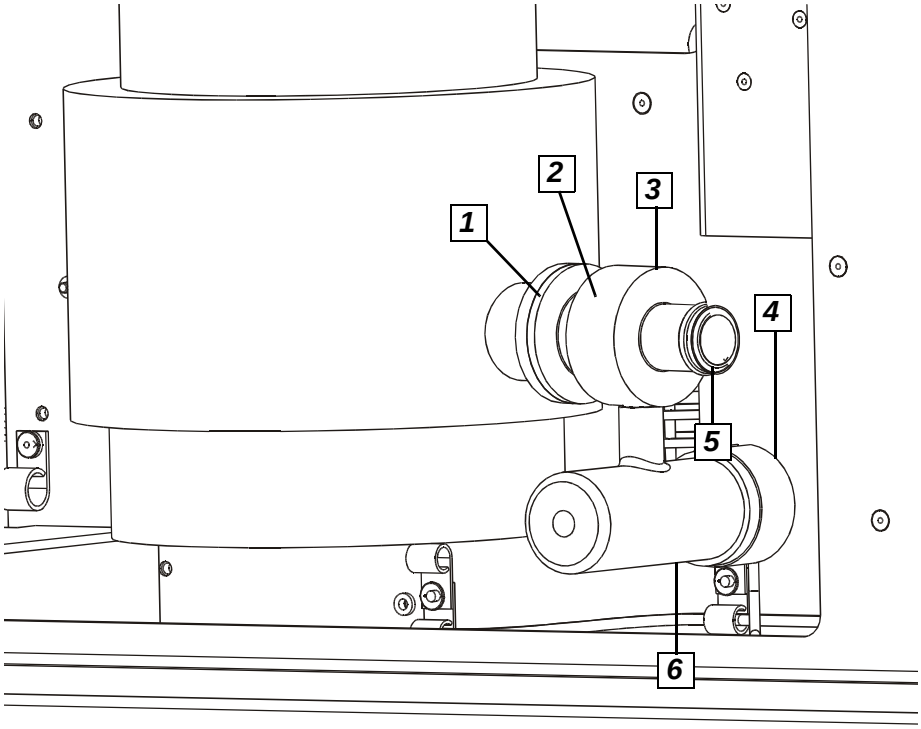
⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front, top, and right side covers (details are on page 2-7).

2. Remove the Convectron Gauge and Foreline Adapter.

a. Disconnect the Convectron Gauge Cable from the Foreline Adapter.



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

Figure 2-58. Convectron Gauge and Foreline Adapter

b. Disconnect both pieces of Tubing from the Gold Fitting on the Foreline Adapter.

c. Undo the Clamp holding the Foreline Adapter to the Pump.

d. Remove the clamp that holds the foreline hose to the Foreline Adapter.

e. Pull the Convectron Gauge and Foreline Adapter (together) out from the chassis.

3. **Replace the convectron gauge and foreline adapter.**

   a. Attach the Foreline Hose to the new Foreline Adapter with the clamp.

   b. Attach the Foreline Adapter Clamp to the Pump.

   c. Reconnect the thin Tubing and the Convectron Gauge Cable.

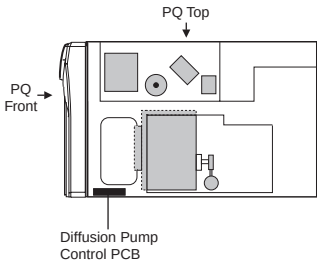
4. **Restore the Polaris*Q* for operation.**

   a. Replace the right side, top, and front covers of the Polaris*Q*.

   b. Restart the system.

   c. Run Diagnostics to verify that your system is operational.

Diffusion Pump Control PCB



	Materials Needed: • Diffusion pump control PCB (PN 119590-0040) • Wrench, (Allen) 2.5 mm *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

To replace the Diffusion Pump Control PCB:

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING

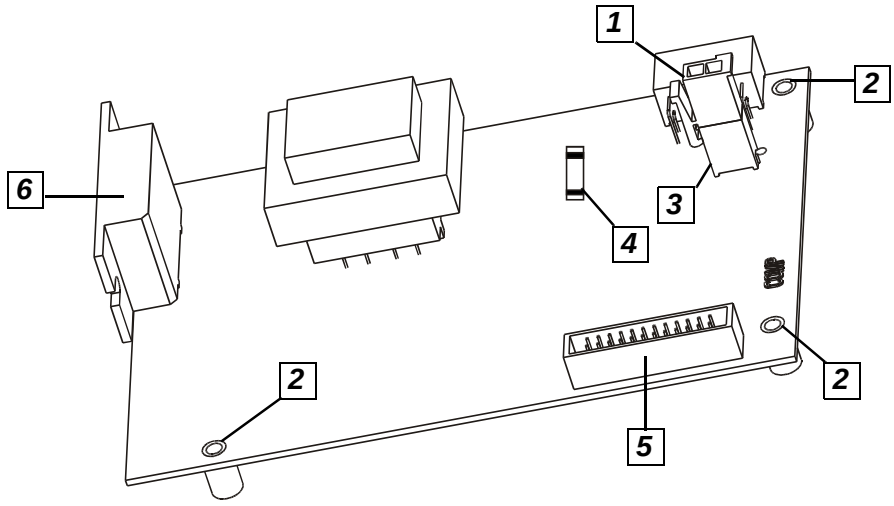
Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front cover (details are on page 2-7).

c. Remove the 2 screws from the Metal Safety Cover on the front of the Polaris*Q* and remove it.

2. Remove the Diffusion Pump Control PCB.

a. Disconnect the Electrical Cables at connectors P1, P2, and P3.



1	P1	4	Fuse
2	Three Screws holding the PCB to the chassis	5	P3
3	P2	6	Two Screws holding the PCB to the inner wall

Figure 2-59. Diffusion Pump PCB

b. Remove the 3 Screws on the base of the PCB, and the two screws which hold it against the inner wall (Figure 2-59).

c. Remove the Diffusion Pump Control PCB from the Polaris*Q* chassis.

3. Replace the Diffusion Pump Control PCB.

a. Install the new Diffusion Pump Control PCB with the 5 screws.

b. Reconnect the Electrical Cables.

4. Restore the Polaris*Q* for operation.

a. Replace the Metal Safety Cover.

b. Replace the front cover of the Polaris*Q*.

c. Restart the system.

d. Run Diagnostics to verify that your system is operational.

To replace a fuse on the Diffusion Pump Control PCB:

1. **Prepare the Polaris*Q* for maintenance.**

   a. Shut down and vent the Polaris*Q* (details are on page 1-21).

> **⚠ WARNING**
>
>
>
> **Electrical Shock Hazard**
> Unplug the Polaris*Q* before proceeding.

   b. Remove the Polaris*Q* front cover (details are on page 2-7).

   c. Remove the two screws from the Metal Safety Cover and remove it.

2. **Replace the defective fuse on the Diffusion Pump Control PCB with a fuse of the same type, voltage, and current rating.**

   Refer to Table 2-5 for a list of replacement fuses.

Table 2-5. Component and Current Ratings

Component	Fuse	Circuit	Type/Voltage/Current Rating	PN
Analog PCB	F1	Ion Source Heater	2A, very fast microfuse, 125 V	76339-0008
Diffusion Pump Control PCB	F1	Diffusion pump	3.15 A, SB, 5 x 20 mm, 250 V	A0006-10510
HV Regulator PCB	F1, F2	Transformer Secondary	0.315A, 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

3. **Restore the Polaris*Q* for operation.**

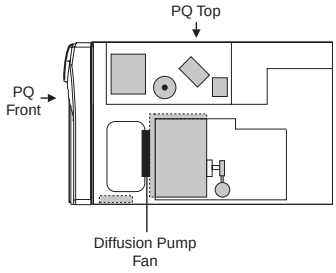
   a. Replace the Metal Safety Cover.

   b. Replace the Polaris*Q* front cover.

   c. Restart the system.

   d. Run Diagnostics to verify that your system is operational.

Diffusion Pump Fan



	Materials Needed: • Diffusion Pump Fan (PN 119253-0001) • Screwdriver, Phillips #2 • Wrench, (open ended) 1/4-in. *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING

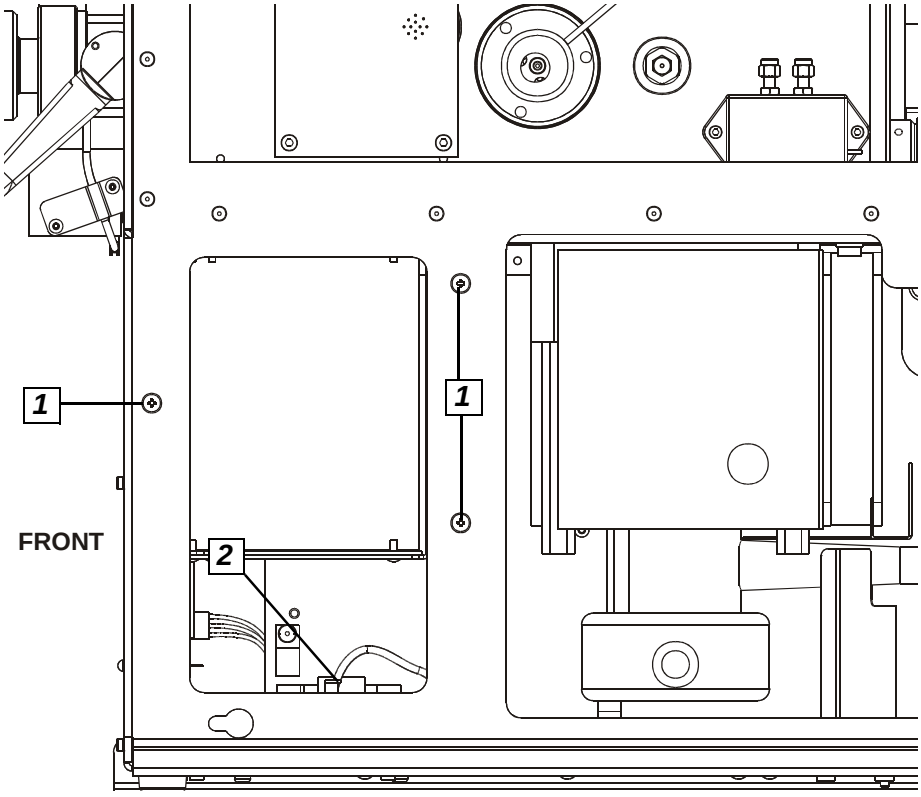
Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front, top, and right side covers (details are on page 2-7).

2. Remove the Diffusion Pump Fan.

a. Remove the Three Screws which hold the Diffusion Pump Fan to the chassis.

b. Pull the fan from the chassis through the front of the Polaris*Q*.

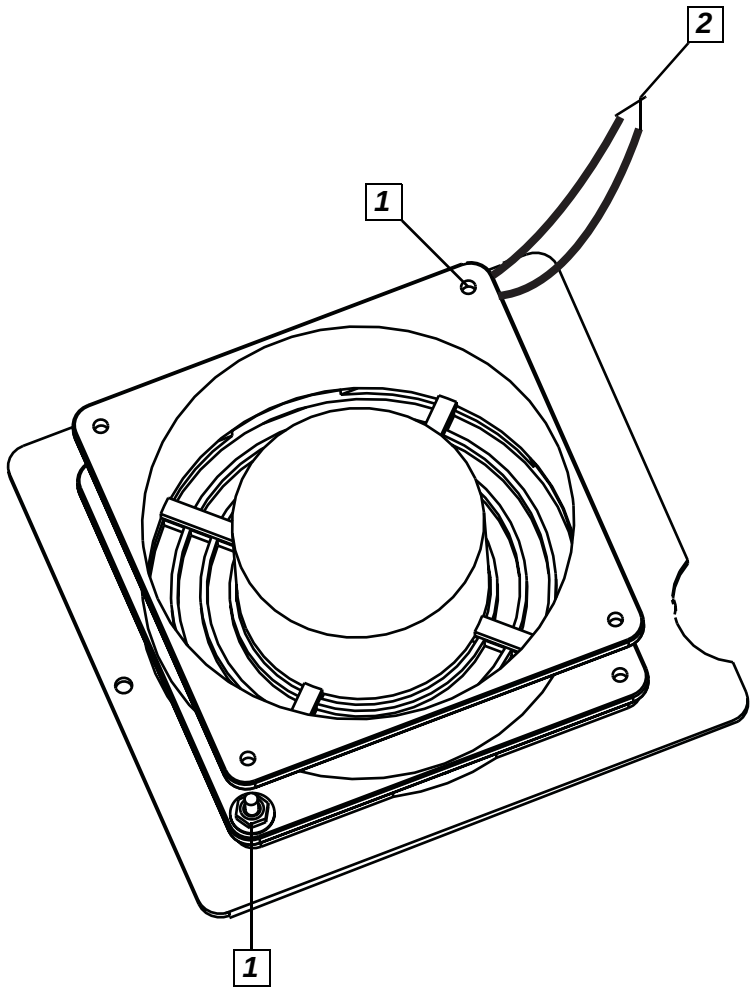


1	Three Screws holding the Diffusion Pump Fan to the chassis	2	Diffusion Pump PCB

Figure 2-60. Diffusion Pump Fan (Right View)

c. Disconnect the cables and its connector from the fan to the Diffusion Pump PCB.

d. With a 1/4-in open ended wrench, remove the 2 nuts which hold the Diffusion Pump Fan to the Fan Casing (Figure 2-61), remove the fan.



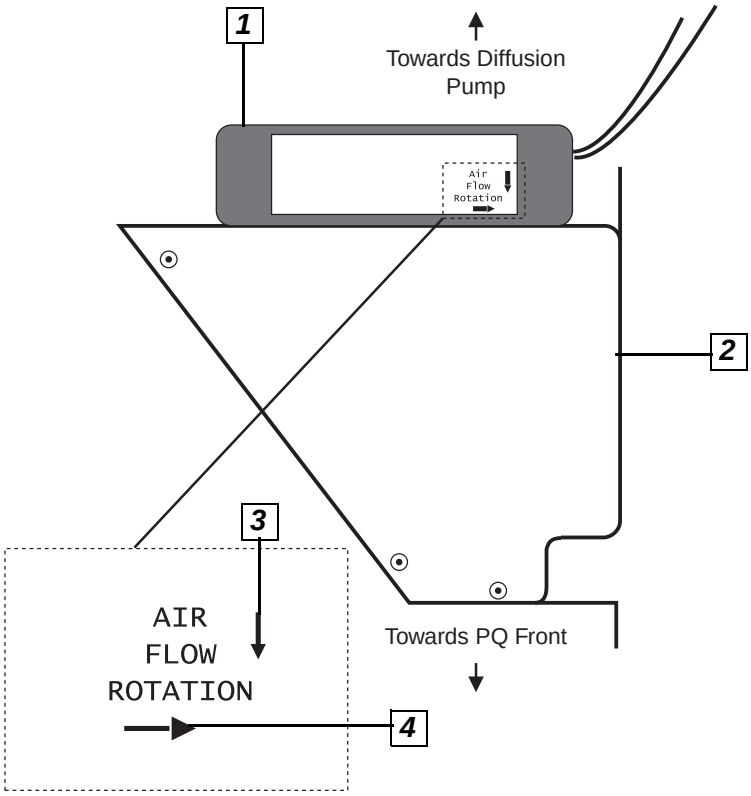
1	Two Nuts holding the fan to the casing	2	Cables to the Diffusion Pump PCB

Figure 2-61. Diffusion Pump Fan Assembly

3. Replace the Diffusion Pump Fan.

a. Position the new Fan in the Fan Casing, making sure the Air Flow Indicator Arrow points into the Vent, the Fan Rotation Arrow points to the right, and that the cables hang down from the Fan (Figure 2-62).

b. Attach the Fan to the Fan Casing with the 2 Nuts.



1	Diffusion Pump Fan	3	Air Flow Indicator Arrow
2	Fan Casing	4	Fan Rotation Arrow

Figure 2-62. Alignment for the Diffusion Pump Fan (Top Down View)

c. Reinstall the fan assembly in the chassis with the 3 screws.

d. Reattach the Fan's cables to the Diffusion Pump PCB.

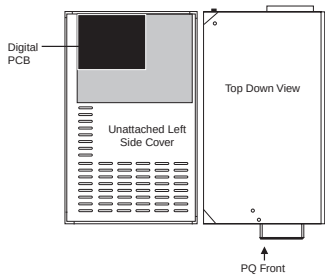
4. Restore the Polaris*Q* for operation.

a. Replace the Metal Safety Cover.

b. Replace the right side, top, and front covers of the Polaris*Q*.

c. Restart the system.

Digital PCB



	Materials Needed: • Digital PCB (PN 119590-0010) • Nut driver, 5.5 mm • Wrench, (Allen) 2.5 mm • Wrench, (Allen) 3 mm *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

1. Prepare the Polaris*Q* for maintenance.

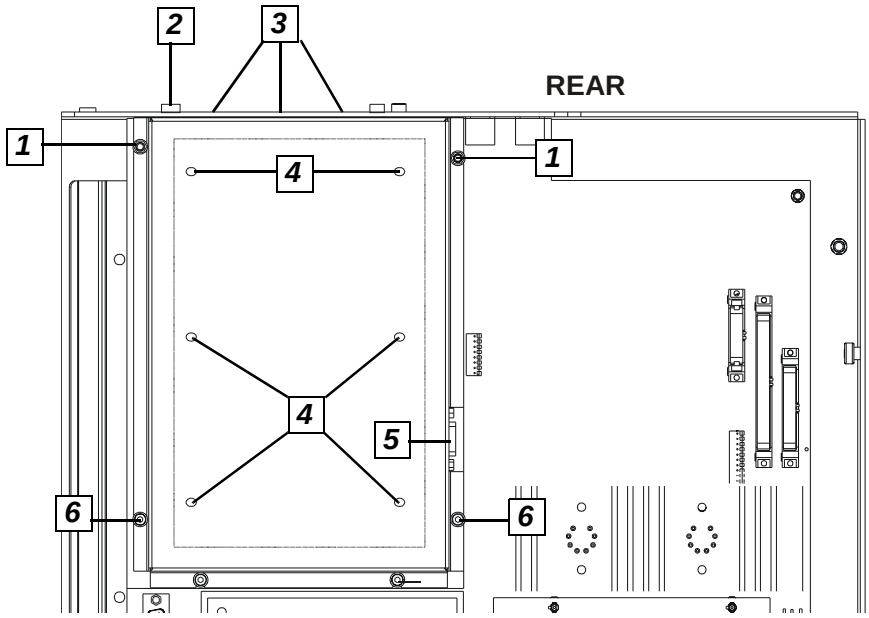
a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING	
	Electrical Shock Hazard Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front, top, and left side covers (details are on page 2-7).

2. Disassemble the Digital PCB from the Analog PCB.

a. Unplug the Electrometer Cable at J3.



1	Two 5.5 mm Nuts holding the Digital PCB Cover	4	Six Nuts holding the Digital PCB to the Analog PCB
2	Ethernet Cable	5	J3
3	Three Allen screws holding the cover to the left side panel	6	Two screws holding the Digital PCB to the Analog PCB

Figure 2-63. Digital PCB (Top Down View)

b. Remove the Ethernet Cable from the rear of the PCB.

c. Remove 3 screws located at the back of the Digital PCB Cover.

d. Remove 4 screws which hold the cover to the Analog PCB.

e. Remove 2 nuts that hold the cover to the Analog PCB.

f. Remove the cover.

g. Remove the 6 nuts that hold the Digital PCB to the Analog PCB.

3. **Remove the Digital PCB.**

   a. Lift the Digital PCB out away from the connections and the Analog PCB.

4. **Reassemble the Digital PCB to the Analog PCB.**

   a. Attach the new Digital PCB J5-plug (located under the board) to the Analog PCB P1-plug.

   b. Replace the 6 nuts that hold the Digital PCB to the Analog PCB.

   c. Replace the Digital PCB cover with the 2 nuts and 4 screws.

   d. Replace the 3 Allen screws located on the back of the Analog PCB left side panel.

   e. Reconnect the Electrical Cables.

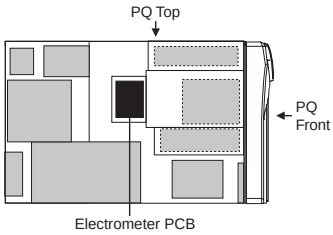
5. **Restore the Polaris*Q* for operation.**

   a. Replace the left side, top, and front covers of the Polaris*Q*.

   b. Restart the system.

   c. Run Diagnostics to verify that your system is operational.

Electrometer PCB



	Materials Needed: • Electrometer PCB (PN 119590-0100) • Wrench, (Allen) 2.5 mm • Wrench, (Allen) 3 mm *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

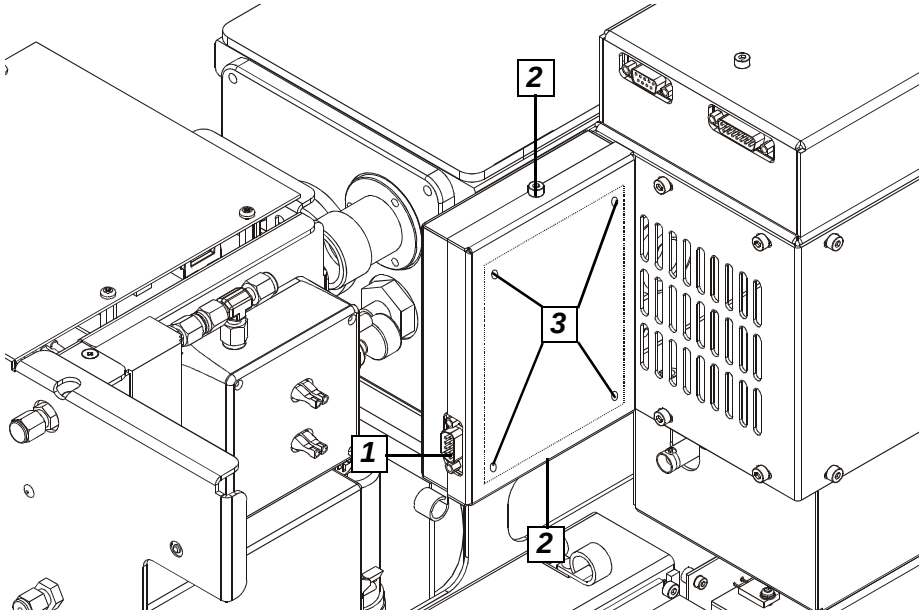
⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front, top, and left side covers (details are on page 2-7).

2. Remove the Electrometer PCB.

a. Disconnect the Electrometer PCB Cable at P1.



1	Electrometer PCB Cable	3	Four screws holding the Electrometer PCB to the chassis
2	Two Screws holding the Electrometer PCB Cover to the chassis		

Figure 2-64. Electrometer PCB (Left Side View)

b. Remove 2 screws holding the Electrometer PCB cover in place and remove the cover.

c. Remove 4 screws holding the Electrometer PCB to the chassis and pull the PCB free, and out of the chassis.

3. Replace the Electrometer PCB.

a. Position the new Electrometer PCB inside the Chamber. The spring goes around the anode feedthrough and is necessary to insure a good ground connection.

b. Attach the Electrometer PCB to the chassis with its four screws.

c. Reconnect the cable to P1.

d. Use the 2 screws to replace the Electrometer PCB cover.

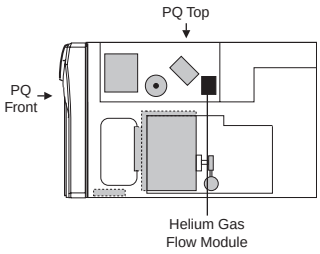
4. **Restore the Polaris*Q* for operation.**

   a. Reinstall the left side, top, and front covers of the Polaris*Q*.

   b. Restart the system.

   c. Run Diagnostics to verify that your system is operational.

Helium Gas Flow Module (HGFM)



	Materials Needed: • Helium Gas Flow Module (PN 119247-0001) • Wrench, (allen) 2.5 mm • Wrench, (open ended) 5/16-in. *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

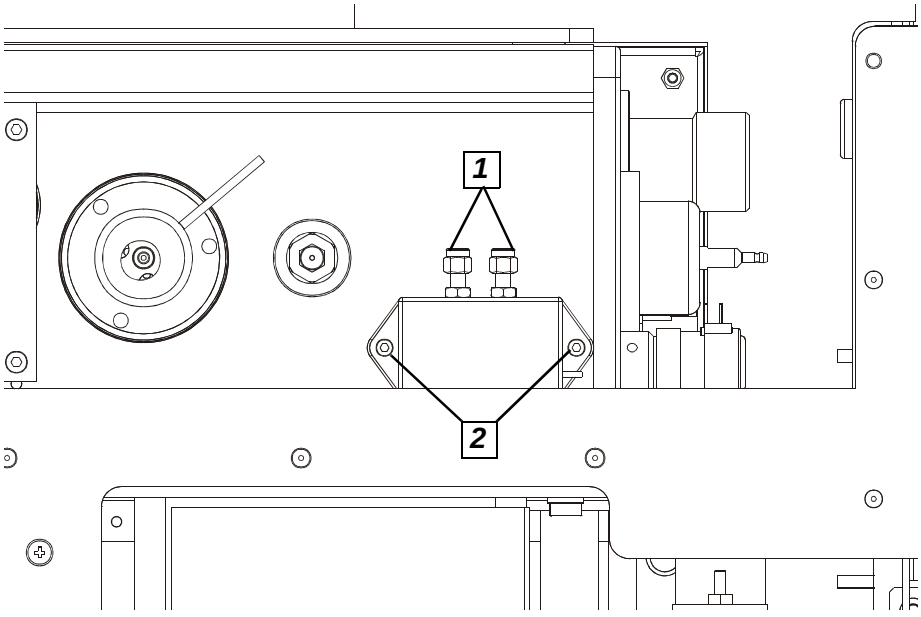
b. Remove the Polaris*Q* front, top, and right side covers (details are on page 2-7).

c. Turn off the Helium Gas Supply.

Note: If the Polaris*Q* and GC share a single helium gas line, you must turn off the GC as well.

2. Remove the Helium Gas Flow Module.

a. Disconnect the Gas Line Fittings to the Helium Gas Flow Module with a 5/16-in open ended wrench (Figure 2-65).



1	Two Gas Line Fittings	2	Two Screws holding the HGFM to the chassis

Figure 2-65. Helium Gas Flow Module (Right Side View)

b. Loosen 2 screws holding the Helium Gas Flow Module to the chassis (Figure 2-65).

c. Remove the HGFM.

3. Replace the Helium Gas Flow Module.

a. Install the new Helium Gas Flow Module and tighten the screws that hold the HGFM to the chassis.

b. Reconnect the 2 Gas Line Fittings to the Helium Gas Flow Module.

4. Purge the gas lines.

a. Turn on the helium gas and set to 200 kPa (30 psi).

b. Allow the line to purge briefly, but no longer than 15 seconds.

c. After the line is purged, connect the helium gas supply to the Helium Gas Flow Module.

d. Reset the regulator to a pressure between 400 and 700 kPa (60 and 100 psi). The nominal pressure is 550 kPa (80 psi).

5. Test the gas line fittings for leaks.

a. Use a hand-held electron leak detector (GL Sciences, Inc., model LD-228, or equivalent) to check each fitting for leaks. If a hand-held leak detector is not available, drop a small amount of methanol onto each fitting and watch for bubbles (which indicates a leak).

⚠ WARNING

Potential Burn or Explosive Hazard

Never use the liquid detector technique on or around electronic circuits. The recommended solvents are flammable and may ignite.

CAUTION

Potential Instrument Damage

Do not use liquid soap leak detectors (such as Snoop) to check for leaks. Liquid soap leak detectors may contaminate your system.

Note: It is normal for helium to flow out the vent on the side of the Helium Gas Flow Module.

b. Correct leaks by tightening or replacing the connections. Continue to check and correct leaks until all connections are leak-free.

6. Restore the Polaris*Q* for operation.

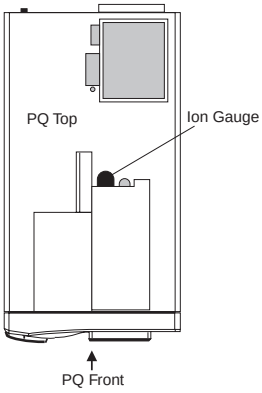
a. Replace the right side, top, and front covers of the Polaris*Q*.

b. Restart the system.

c. Once the MS has pumped down and is operational, check the Air/Water Spectrum for vacuum leaks (See Xcalibur Tune Online Help topic: Testing the Air/Water).

Note: Compressed electronic dusting spray containing an HFC can be used for manifold leak detection if the MS is running, pumped down, stabilized, and mass calibrated. For example, using MicroCare® Micro-Blast™ which contains tetrafluoroethane, scan in full-scan EI mode between 60 and 90 amu, looking for masses 69 and 83.

Ion Gauge (Upgrade Option)



	Materials Needed: • Gloves, cotton, lint free • Ion gauge (PN A0105-06003) • Wrench, (Allen) 3 mm *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

1. Prepare the Polaris*Q* for maintenance.

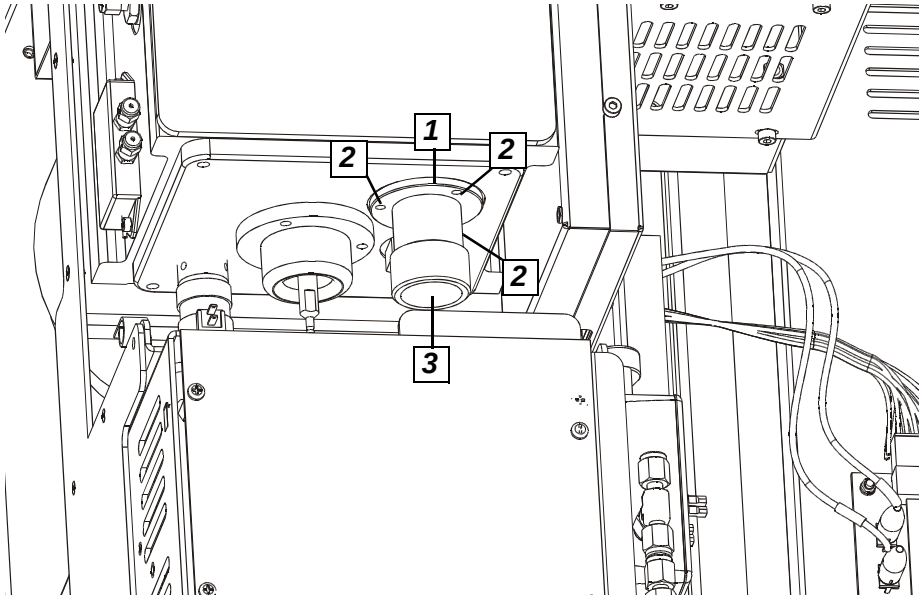
a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING	
	Electrical Shock Hazard Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front and top covers (details are on page 2-7).

2. Remove the Ion Gauge.

a. Disconnect the Electrical Cable on the Ion Gauge that comes from the Ion Gauge Control PCB (Figure 2-66).



1	Flange Collar	3	Electrical Cable from the Ion Gauge Control PCB (not shown)
2	Three screws holding the Ion Gauge Collar to the Vacuum Manifold		

Figure 2-66. Ion Gauge (Top Down View)

b. Remove the 3 screws holding the Ion Gauge Collar to the Vacuum Manifold (Figure 2-66). While holding the Ion Gauge, remove the Flange Collar.

c. Tilt the Ion Gauge outward and remove it, taking care that the O-ring does not fall down into the instrument chassis.

d. Wearing clean, lint free gloves, remove the O-ring from the Ion Gauge and slide the Ion Gauge out of the Flange Collar.

3. Replace the Ion Gauge.

a. Insert the new Ion Gauge into the Flange Collar 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 will hang straight down.

c. Reinstall the 3 screws that hold the Ion Gauge to the Vacuum Manifold.

d. Reconnect the Electrical Cable that comes from the Ion Gauge Control PCB to the Ion Gauge.

4. Restore the Polaris*Q* for operation.

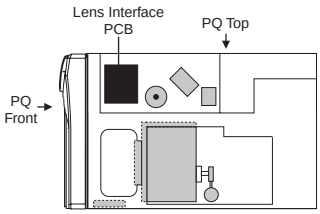
a. Replace the top and front covers of the Polaris*Q*.

b. Restart your system.

c. Run Diagnostics to verify that your system is operational.

Note: Compressed electronic dusting spray containing an HFC can be used for manifold leak detection if the MS is running, pumped down, stabilized, and mass calibrated. For example, using MicroCare® Micro-Blast™ which contains tetrafluoroethane, scan in full-scan EI mode between 60 and 90 amu, looking for masses 69 and 83.

Lens Interface PCB



	Materials Needed: • Lens Interface PCB (PN 119590-0110) • Wrench, (Allen) 3 mm *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front, top, right side, and left side covers (details are on page 2-7).

2. Remove the Lens Interface PCB.

a. Disconnect the Electrical Cable to the Analog and Balun PCBs.

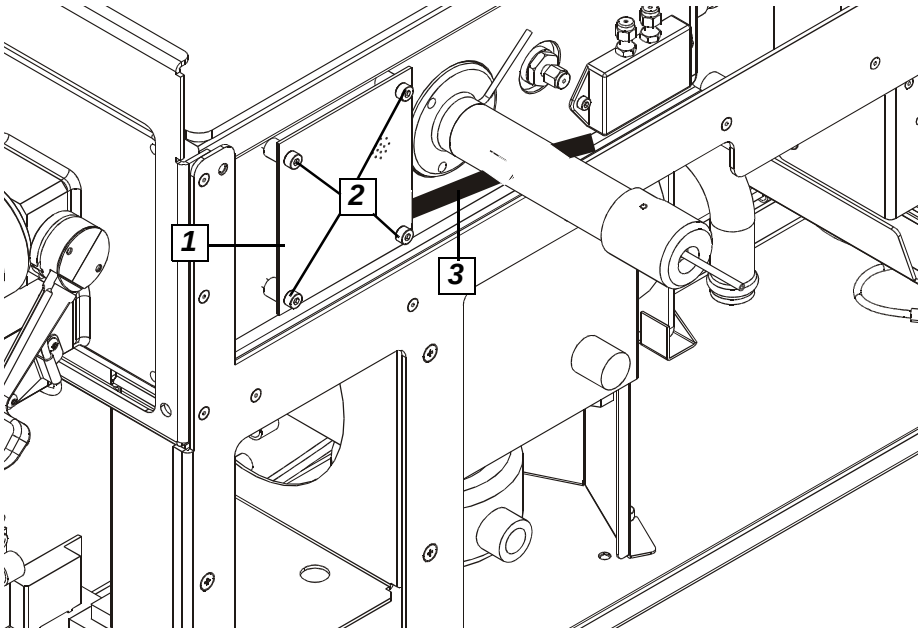
b. Remove 4 screws holding the Lens Interface PCB to the Vacuum Manifold (Figure 2-67).

c. Remove the Lens Interface PCB.

3. Replace the Lens Interface PCB.

a. Position the new Lens Interface PCB so that it plugs into the Lens Interface, and attach it to the chassis with the 4 screws.

b. Reconnect the Electrical Cable to the Analog and Balun PCBs.



1	Lens Interface PCB	3	Electrical Cable to the Analog and Balun PCBs
2	Four Screws holding the Lens Interface PCB to the chassis		

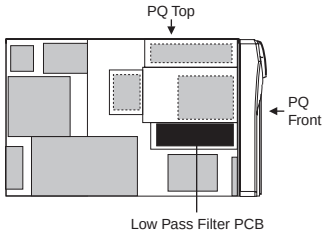
Figure 2-67. Lens Interface PCB (Right Side View)

4. **Restore the Polaris*Q* for operation.**

   a. Replace the top, left side, and right side covers of the Polaris*Q*.

   b. Restart the system.

Low Pass Filter PCB



	Materials Needed: • Wrench, (Allen) 2.5 mm • Wrench, (Allen) 3 mm • Low Pass Filter PCB (PN 119590-0080) • Screwdriver, Phillips #2 *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

Note: The RF Detector, RF Coil, and Low Pass Filter are each individually covered and connected together in a module referred to as the RF Module. Figure 2-68 illustrates the RF Module as it sits in the chassis.

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

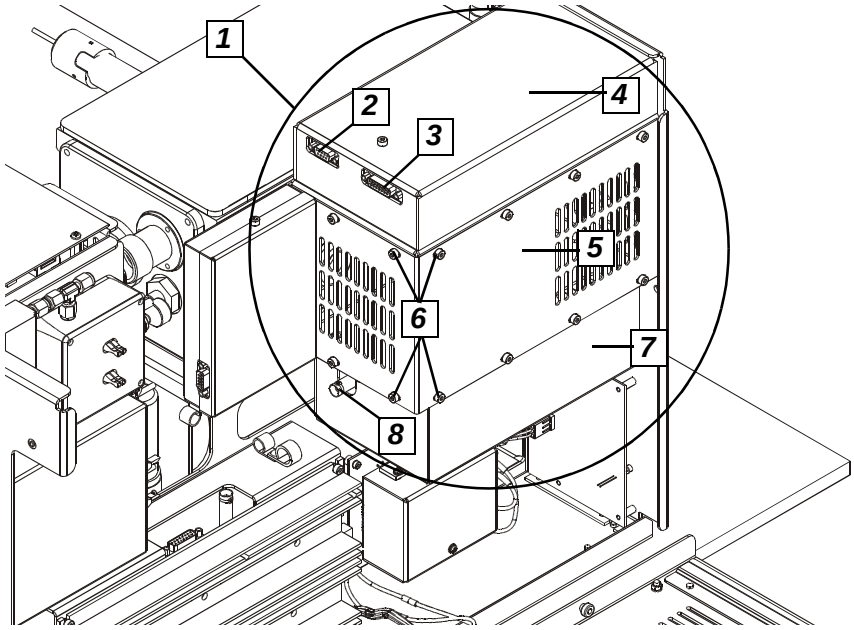
⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front, top, and left side covers (details are on page 2-7).

2. Disconnect the RF Module.

a. Remove the cables at P3 and P2 from the RF Control PCB.



1	RF Module	5	RF Coil Cover
2	P2	6	Screws holding the RF Coil Cover to the RF Module
3	P3	7	Low Pass Filter Cover
4	RF Detector PCB Cover	8	P1

Figure 2-68. RF Module (Left Side View)

b. Remove the Low Pass Filter PCB Cable at P1.

3. Remove the RF Coil Cover.

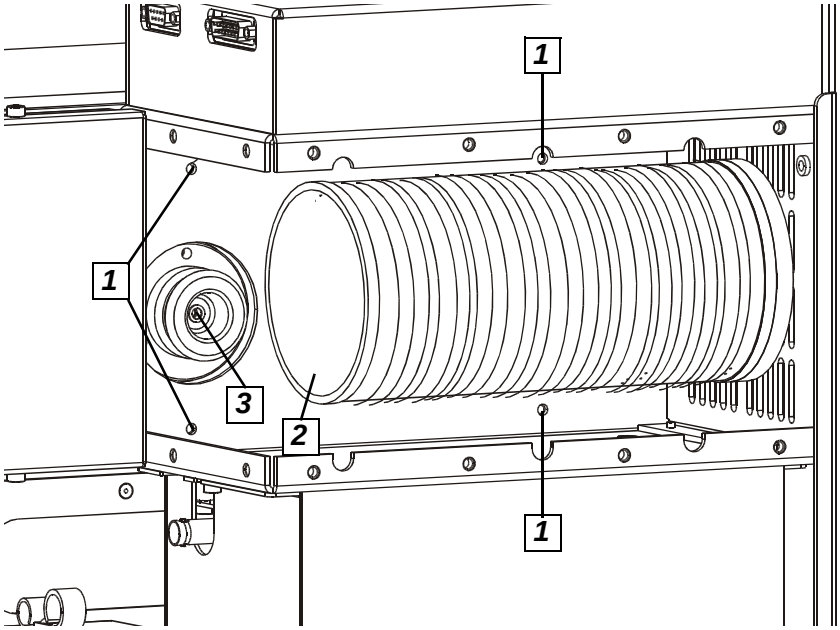
a. Remove 12 screws holding the RF Coil Cover to the RF Module.

b. Remove the cover.

4. Remove the RF Module from the Vacuum Manifold.

a. Disconnect the RF Feedthrough Connection.

b. Remove the bottom 2 screws that hold the RF Module to the Vacuum Manifold, and loosen the top 2.



1	4 Screws holding the RF Module to the Vacuum Manifold	3	RF Feedthrough Connection
2	RF Coil		

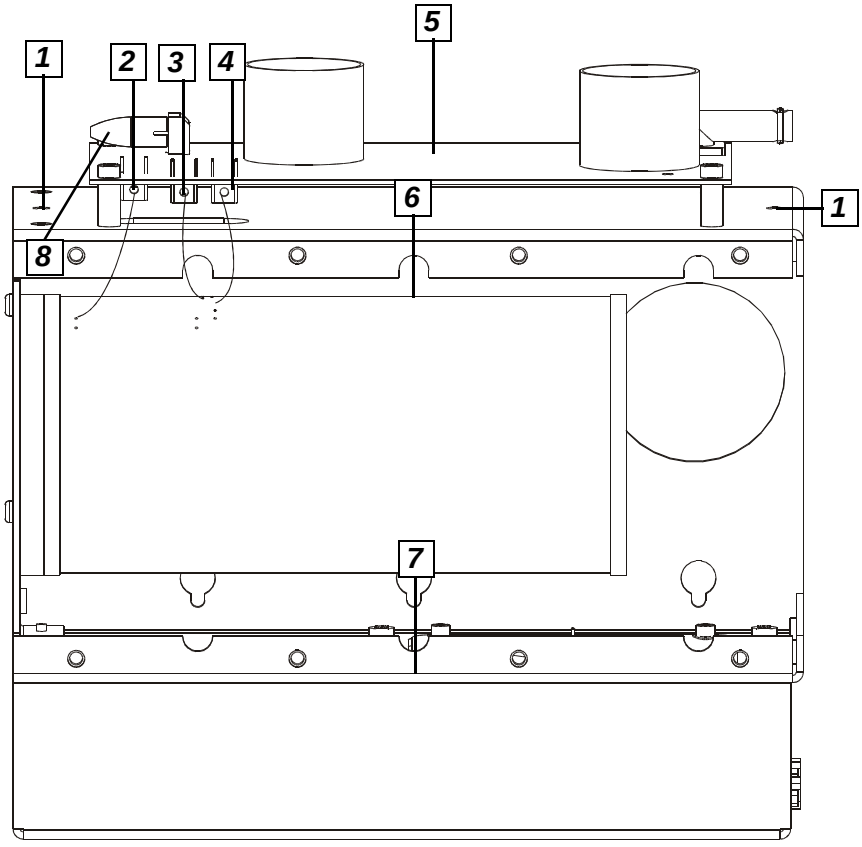
Figure 2-69. Screws behind the RF Coil (Left Side View)

c. Remove the 2 screws that hold the RF Module to the front of the chassis.

d. Lift the RF Module up and out of its slots.

5. Remove the Low Pass Filter PCB Cover.

a. Turn the RF Module over (setting it down on its top), and remove 2 screws on the bottom holding the cover in place.



1	Screws holding the Low Pass Filter Cover to the RF Module	5	Low Pass Filter PCB
2	J1	6	RF Coil
3	J2	7	RF Detector PCB Cover
4	J3	8	Cable to Balun PCB

Figure 2-70. RF Module with Low Pass Filter Uncovered (Upside Down)

b. Remove the cover.

6. **Remove the Low Pass Filter PCB.**

   a. Unscrew connectors J1 - J3 from the RF Coil.

   b. Disconnect the Cable to the Balun PCB.

   c. Remove four screws holding the Low Pass Filter PCB to the RF Module and remove it.

7. **Replace the Low Pass Filter PCB.**

   a. Insert the new Low Pass Filter PCB, reconnecting the wires to J1, J2, and J3.

   b. Reconnect the Cable to the Balun PCB.

   c. Attach the PCB to the module with the four screws.

8. **Replace the Low Pass Filter PCB Cover with the 2 screws.**

9. **Replace the RF Module.**

   a. Install the RF Module in its slots on the Vacuum Manifold.

   b. Tighten the 4 screws located behind the RF Coil.

   c. Install the 2 screws on the front of the chassis.

   d. Reconnect the RF Feedthrough Connection.

10. **Replace the RF Coil Cover with the 12 screws.**

11. **Reconnect the RF Module.**

    Reattach the cables at P3, P2, and P1.

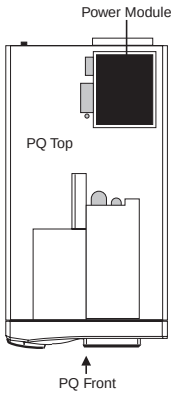
12. **Restore the Polaris*Q* for operation.**

    a. Replace the left side, front, and top covers of the Polaris*Q*.

    b. Restart the system.

    c. Run Diagnostics to verify that your system is operational.

Power Module



	Materials Needed: • Either the 115 V Power Module (PN 119655-0115) or the 230 V Power Module (PN 119655-0230) • Wrench, (Allen) 3 mm *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

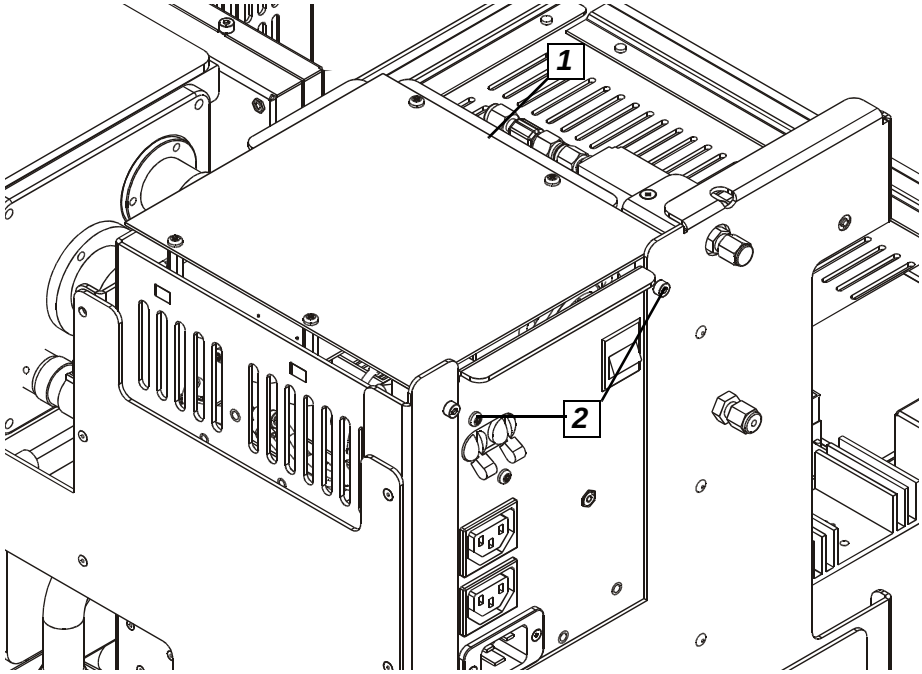
⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front and top covers (details are on page 2-7).

2. Remove the Power Module.

a. Remove the 2 screws which hold the Power Module to the chassis.



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

Figure 2-71. Power Module (Back View)

b. Lift the Power Module out of the chassis by its handles.

3. Replace the Power Module.

a. Place the new Power Module in the Power Module Slot, being sure to align the connector on the bottom of the module with the plug at the bottom of the slot.

b. Attach the Power Module to the chassis with the two screws.

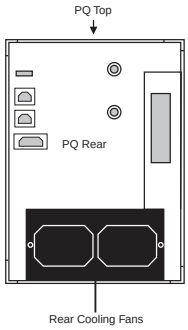
4. Restore the Polaris*Q* for operation.

a. Replace the top and front covers of the Polaris*Q*.

b. Restart the system.

c. Run Diagnostics to verify that your system is operational.

Rear Cooling Fans



	Materials Needed: • Rear cooling fan (PN 119253-0001) • Wrench, (Allen) 3 mm • Wrench, (open ended) 1/4-in. *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

The rear cooling fans provide the necessary airflow to keep the Polaris*Q* cool. The fans should be cleaned every 4 months by wiping them with a damp cloth. This helps prevent dust from accumulating inside the instrument.

1. **Prepare the Polaris*Q* for maintenance.**

   Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING
Electrical Shock Hazard Unplug the Polaris*Q* before proceeding.

2. **Remove the Fan Bracket.**

   a. Remove the 2 screws which hold the Fan Bracket to the chassis (Figure 2-72).

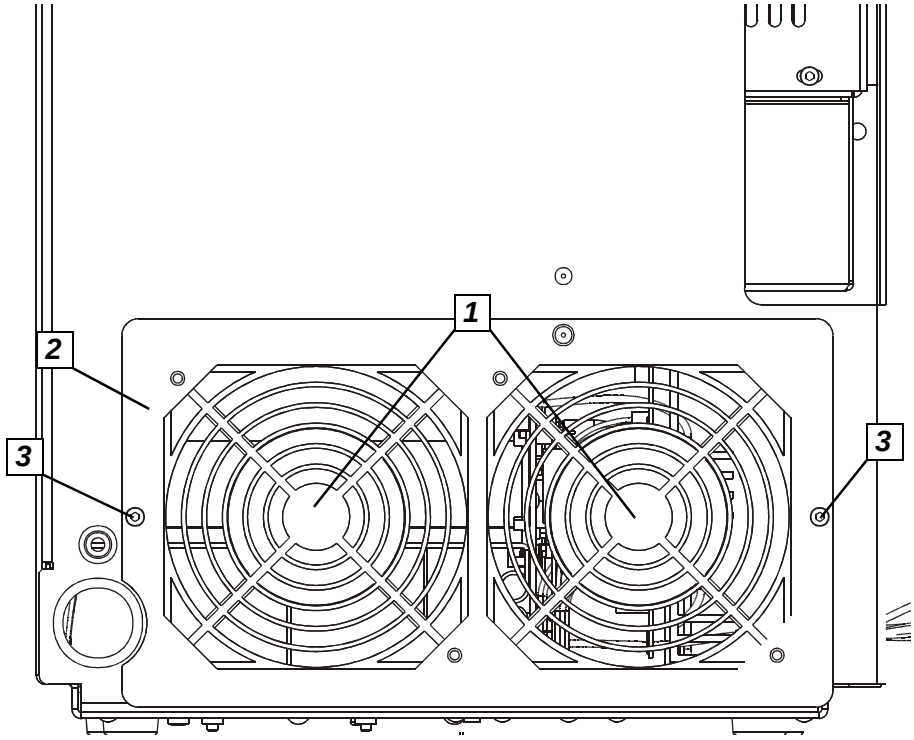
   b. Remove the assembly.

3. **Remove the Rear Cooling Fans from the Fan Bracket.**

   a. Disconnect the 2 Fan Cables.

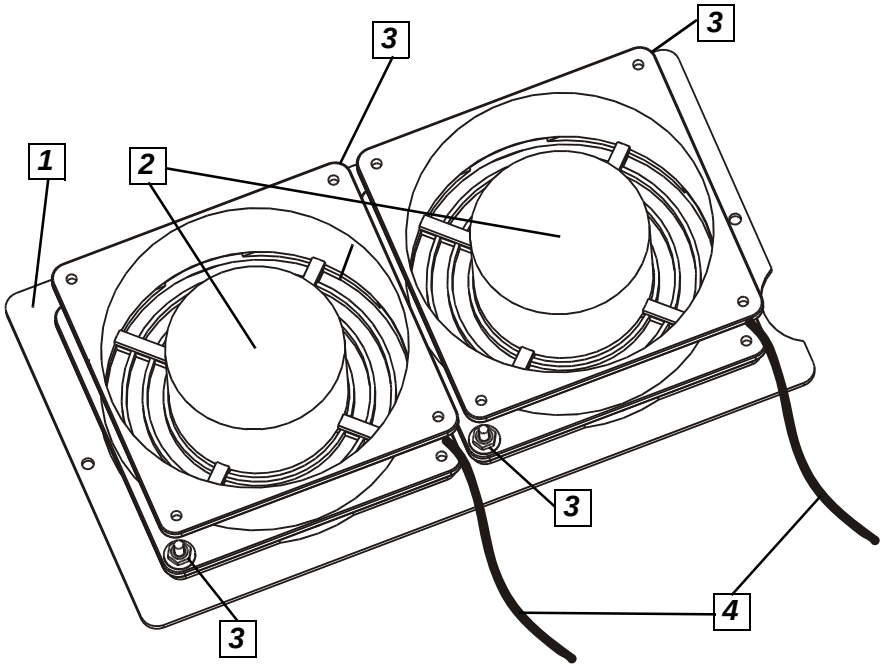
   b. Remove the four nuts which hold the 2 fans to the Fan Bracket.

   c. Remove the fans.



1	Rear Cooling Fans	3	Two Screws holding the Fan Bracket to the chassis
2	Fan Bracket		

Figure 2-72. Rear Cooling Fans (Back View)



1	Fan Bracket	3	4 Nuts holding the Rear Cooling Fans to the Fan Bracket
2	Rear Cooling Fans	4	Fan Cables

Figure 2-73. Rear Cooling Fans (Removed, Top Down)

4. Replace the Rear Cooling Fans.

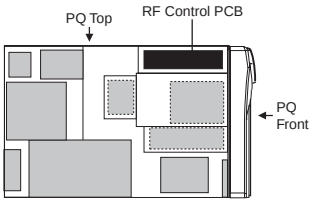
a. Attach the new fans to the Fan Bracket with the 4 nuts. Make sure the Airflow Indicator Arrow points into the Polaris*Q* chassis and the wires are facing down.

b. Connect the Diffusion Pump Control PCB Cables, making sure that they face down.

c. Position the Fan Assembly (the 2 fans and the Fan Bracket) into the chassis, and secure it with the 2 screws.

5. Restart the system.

RF Detector PCB



	Materials Needed: • RF Detector PCB (PN 119590-0070) • Wrench, (Allen) 2.5 mm • Wrench, (Allen) 3 mm *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

Note: The RF Detector, RF Coil, and Low Pass Filter are each individually covered and connected together in a module referred to as the RF Module. Figure 2-74 illustrates the RF Module as it sits in the chassis.

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

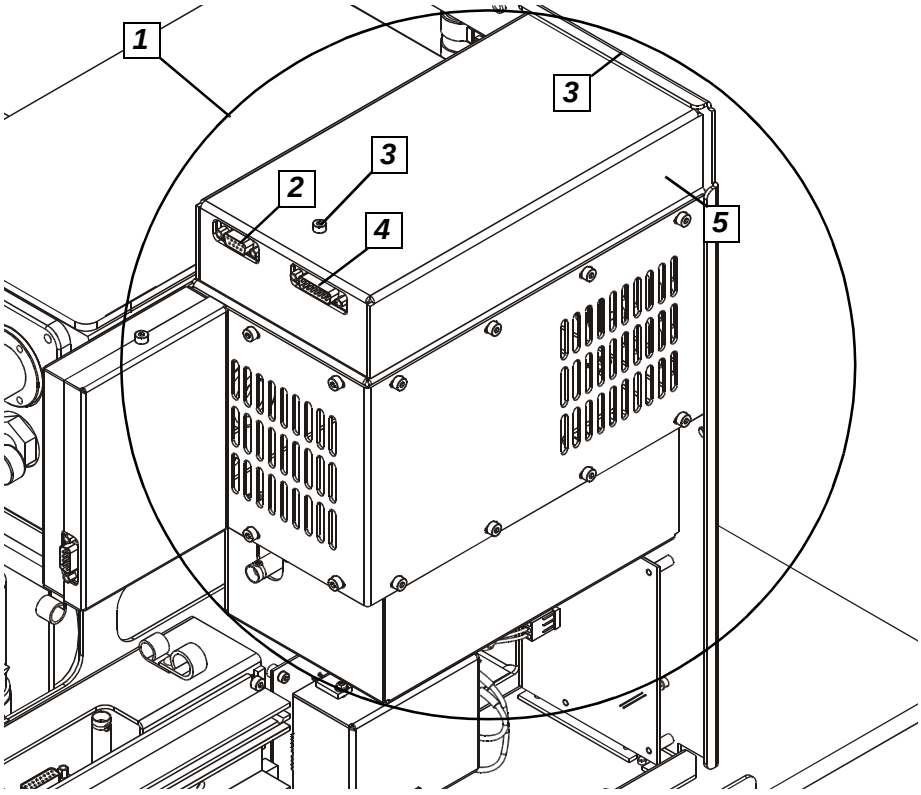
⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front, top, and left side covers (details are on page 2-7).

2. Remove the RF Detector PCB Cover.

a. Disconnect the cables at P2 and P3 on the RF Detector PCB.



1	RF Module	4	P2
2	P3	5	RF Detector PCB Cover
3	Two Screws holding the RF Detector PCB Cover to the RF Module		

Figure 2-74. RF Module (Left Side View)

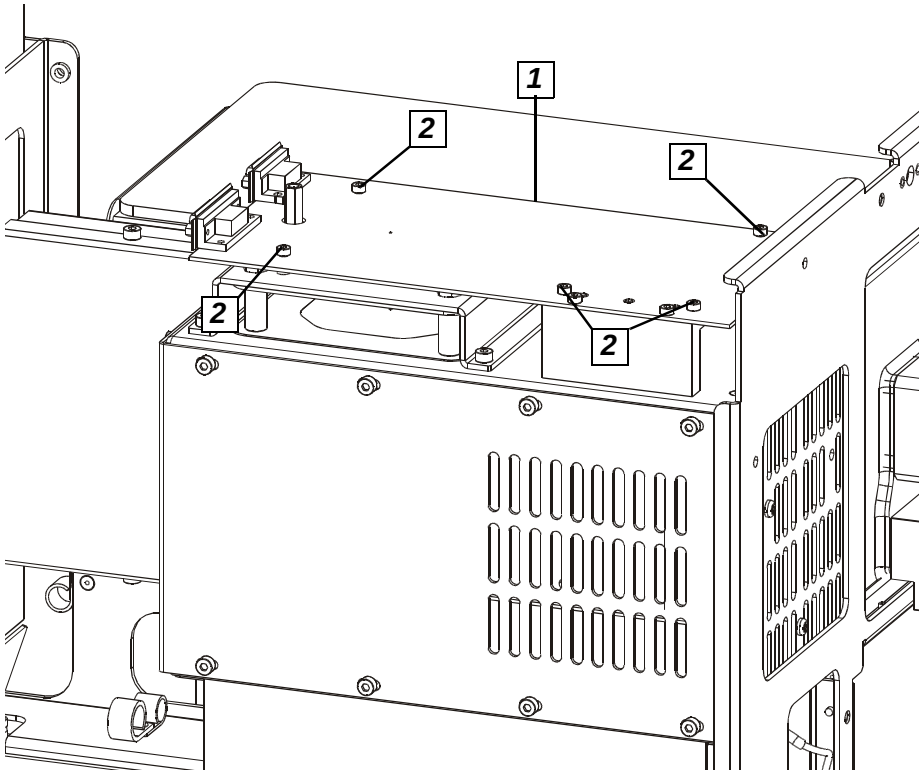
b. Remove 2 screws holding the RF Detector PCB Cover to the RF Module.

c. Remove the cover.

3. Remove the RF Detector PCB.

a. Remove 5 screws holding the RF Detector PCB to the RF Module.

b. Remove the RF Detector PCB.



1	RF Detector PCB	2	5 Screws holding the RF Detector PCB to the RF Module

Figure 2-75. RF Detector PCB Uncovered (Left Side View)

4. Replace the RF Detector PCB.

a. Position the new RF Detector PCB in the RF Module, being sure to keep the same alignment as the old PCB.

b. Reinstall the 5 screws.

5. Replace the RF Detector PCB Cover.

a. Replace the RF Detector PCB Cover over the PCB and secure it with the 2 screws.

b. Reconnect the cables to P2 and P3.

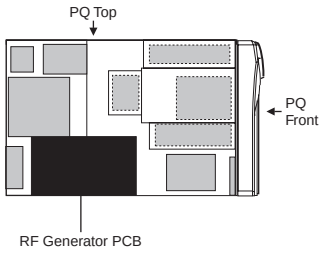
6. Restore the Polaris*Q* for operation.

a. Reinstall the front and top covers of the Polaris*Q*.

b. Restart your system.

c. Run Diagnostics to verify your system is operational.

RF Generator PCB



	Materials Needed: • RF Generator PCB (PN 119590-0060) • Wrench, (Allen) 3 mm *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

To replace the RF Generator PCB:

1. Prepare the Polaris*Q* for maintenance.

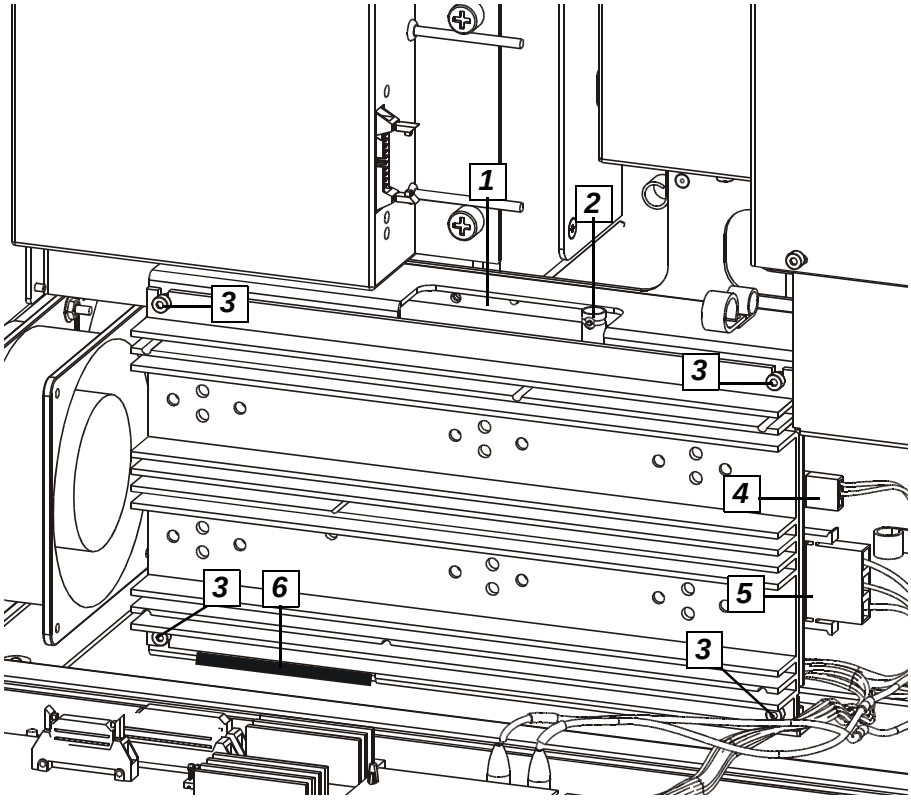
a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING	
	Electrical Shock Hazard Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front, top and left side covers (details are on page 2-7).

2. Remove the RF Generator PCB.

a. Disconnect the electrical cables at P1 and J1 - J3.



1	P1 (not shown)	4	J2
2	J1	5	J3
3	Four Screws holding the RF Generator PCB to the chassis	6	P2

Figure 2-76. RF Generator PCB (Left Side View)

b. Remove the top 2 and loosen the bottom 2 screws attaching the RF Generator PCB to the chassis.

c. Disconnect electrical cable P2.

d. Remove the RF Generator PCB from the instrument.

3. **Replace the RF Generator PCB:**

   a. Reconnect the cable at P2.

   b. Reattach the RF Generator PCB to the chassis in the same alignment as the old PCB with the 4 screws.

   c. Reconnect the electrical cables.

4. **Restore the Polaris*Q* for operation.**

   a. Replace the left side, top, and front covers of the Polaris*Q*.

   b. Restart the system.

   c. Run Diagnostics to verify that your system is operational.

   d. If the RF Gain Calibration fails, contact Thermo Finnigan Technical Support.

To replace a fuse on the RF Generator PCB:

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the front, top, and left side covers of the Polaris*Q* (details are on page 2-7).

2. Remove the RF Generator PCB:

a. Disconnect the electrical cables at P1 and J1 - J3.

b. Remove the top 2 and loosen the bottom 2 screws attaching the RF Generator PCB to the chassis.

c. Disconnect electrical cable P2.

d. Remove the RF Generator PCB from the instrument.

3. Locate and replace the defective fuse on the RF Generator PCB with a fuse of the same type, voltage, and current rating.

See Table 2-6 for a list of replacement fuses.

Table 2-6. Component and Current Ratings

Component	Fuse	Circuit	Type/Voltage/Current Rating	PN
Analog PCB	F1	Ion Source Heater	2A, very fast microfuse, 125 V	76339-0008
Diffusion Pump Control PCB	F1	Diffusion pump	3.15 A, SB, 5 x 20 mm, 250 V	A0006-10510
HV Regulator PCB	F1, F2	Transformer Secondary	0.315A, 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

4. **Replace the RF Generator PCB:**

   a. Reconnect the cable at P2.

   b. Reattach the RF Generator PCB to the chassis in the same alignment as the old PCB with the 4 screws.

   c. Reconnect the electrical cables.

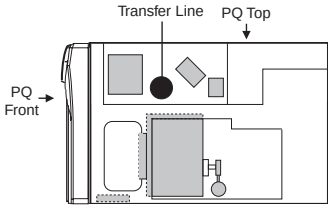
5. **Restore the Polaris*Q* for operation.**

   a. Reinstall the Polaris*Q* left side, top, and front covers.

   b. Restart the system.

   c. Run Diagnostics to verify that your system is operational.

Transfer Line



	Materials Needed: • Gloves, cotton, lint free • Transfer line (PN 119640-1005) • Wrench, (Allen) 3 mm • Wrench, (open ended) 5/16-in. • Wrench, (open ended) 7/16-in. (2) *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

⚠ WARNING

Burn, Electric Shock, or Other Personal Injury

The transfer line and ion source may be as hot as 350 ˚C. Do not open or work inside the Mass Spectrometer before making sure the system is off, unplugged, and cool to touch. This may take as long as one hour after Xcalibur prompts you to turn the MS off.

1. Prepare the Polaris*Q* and TRACE GC for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

b. Shut down the TRACE GC.

⚠ WARNING

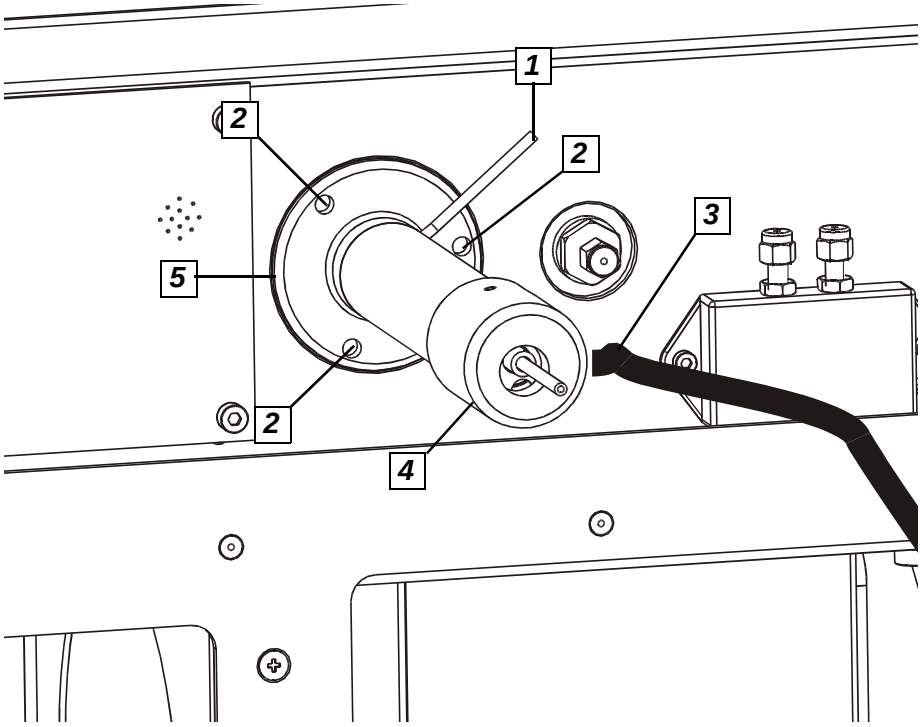
Electrical Shock Hazard

Unplug the Polaris*Q* before proceeding.

c. Remove the Polaris*Q* front, top, and right side covers (details are on page 2-7).

2. Remove the Transfer Line from the Vacuum Manifold.

a. Turn off the GC and disconnect the Transfer Line Heater/Sensor Cable.



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		

Figure 2-77. Transfer Line (Right Side View)

b. Loosen the Transfer Line Gas Fitting.

c. Remove the 3 screws which attach the Transfer Line to the Vacuum Manifold.

d. Withdraw the Transfer Line from the Vacuum Manifold.

3. **Replace the Transfer Line.**

   a. Check the O-ring for damage. Replace if necessary.

   b. Insert the new Transfer Line into the Vacuum Manifold. Attach the three screws.

   c. Reconnect the Transfer Line gas fittings.

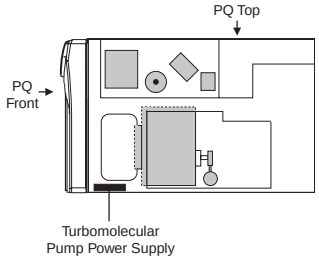
   d. Reconnect the Transfer Line Heater/Sensor Cable.

4. **Restore the Polaris*Q* and TRACE GC for operation.**

   a. Replace the right side, top, and front covers of the Polaris*Q*.

   b. Restart the system.

Turbomolecular Pump Power Supply (Upgrade Option)



	Materials Needed: • Screwdriver, Phillips #2 • Turbomolecular Pump Power Supply (PN 76330-0100) *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING

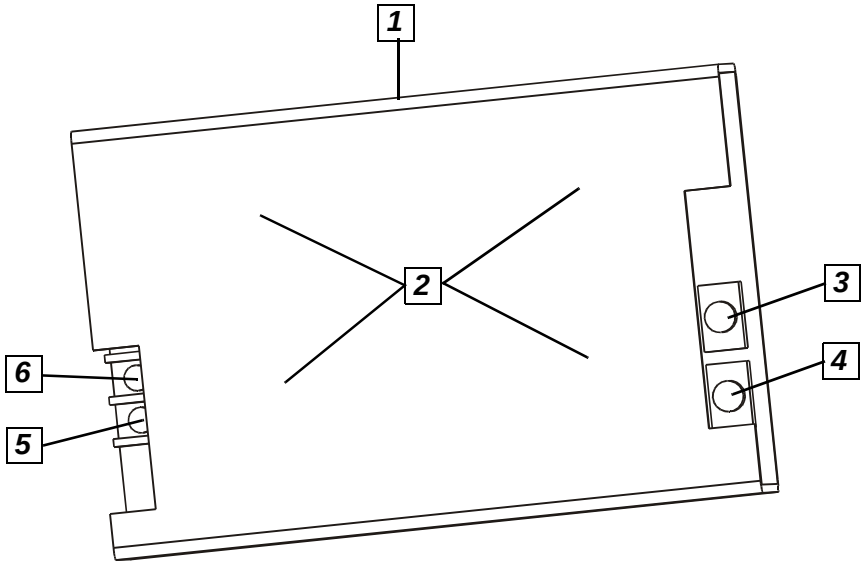
Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front cover (details are on page 2-7).

c. Remove two screws from the metal safety cover behind the front cover and remove it.

2. Remove the Turbo Pump Power Supply.

a. Disconnect connectors P2-1 (-), P2-2 (+), P1-2N and P1-2L.



1	Turbo Pump Power Supply	4	Connector P2-2 (+), red wire
2	4 Screws holding the Turbo Pump Power Supply to the chassis	5	Connector P1-2L, brown wire
3	Connector P2-1 (-), black wire	6	Connector P1-2N, blue wire

Figure 2-78. Turbomolecular Pump Power Supply (Top Down View)

b. From the bottom of the instrument, remove four screws holding the power supply to the assembly.

CAUTION

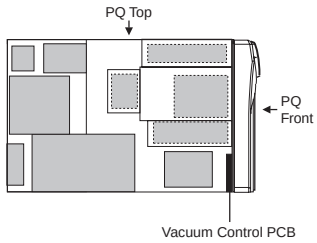
Potential instrument damage

If you find it necessary to slide the instrument forward, off your work area, to reach the screws, take care not to break the capillary column which runs between the GC and the MS.

c. Remove the Turbo Pump Power Supply from the chassis.

3. **Replace the Turbo Pump Power Supply.**
   a. Insert the new Turbo Pump Power Supply and replace the 4 screws.
   b. Reconnect the electrical cables.
4. **Restore the Polaris*Q* for operation.**
   a. Replace the metal safety cover.
   b. Replace the front cover of the Polaris*Q*.
   c. Restart the system.
   d. Run Diagnostics to verify that your system is operational.

Vacuum Control PCB



	Materials Needed: • Vacuum Control PCB (PN 119590-0030) • Wrench, (Allen) 2.5 mm *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

1. Prepare the Polaris*Q* for maintenance.

a. Shut down and vent the Polaris*Q* (details are on page 1-21).

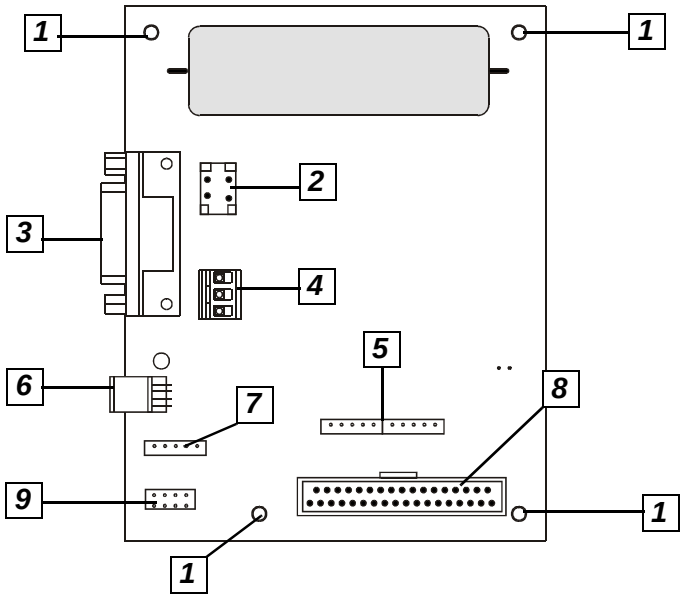
⚠ WARNING

Electrical Shock Hazard
Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front, top, and left side covers (details are on page 2-7).

2. Remove the Vacuum Control PCB.

a. Disconnect all of the cables shown in Figure 2-79.



1	4 Screws holding the Vacuum Control PCB to the chassis	6	J3
2	J1	7	P2
3	J2	8	P4
4	P1	9	P5
5	P3		

Figure 2-79. Vacuum Control PCB (Top Down View)

b. From the front of the instrument, remove 4 screws holding the Vacuum Control PCB to the chassis (Figure 2-79).

c. Remove the Vacuum Control PCB from the chassis.

3. **Replace the Vacuum Control PCB.**

   a. Position the new Vacuum Control PCB in the chassis, making sure P4 is positioned towards the bottom.

   b. Attach the PCB to the assembly with the four screws.

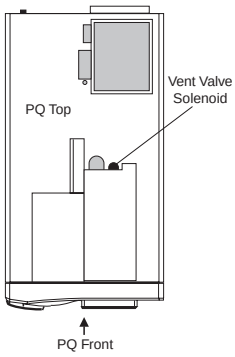
   c. Reconnect all of the cables.

4. **Restore the Polaris*Q* for operation.**

   a. Replace the left side, top, and front covers of the Polaris*Q*.

   b. Restart the system.

Vent Valve Solenoid



	Materials Needed: • Adjustable wrench • Lint free paper • Vent valve solenoid (76461-1003) *FYI:* ***How to Find Xcalibur Help Topics****, Appendix C.*
	Frequency**:** When indicated by Xcalibur Diagnostics, by Thermo Finnigan Technical Support, or by a Thermo Finnigan Customer Service Engineer

1. Prepare the Polaris*Q* for maintenance.

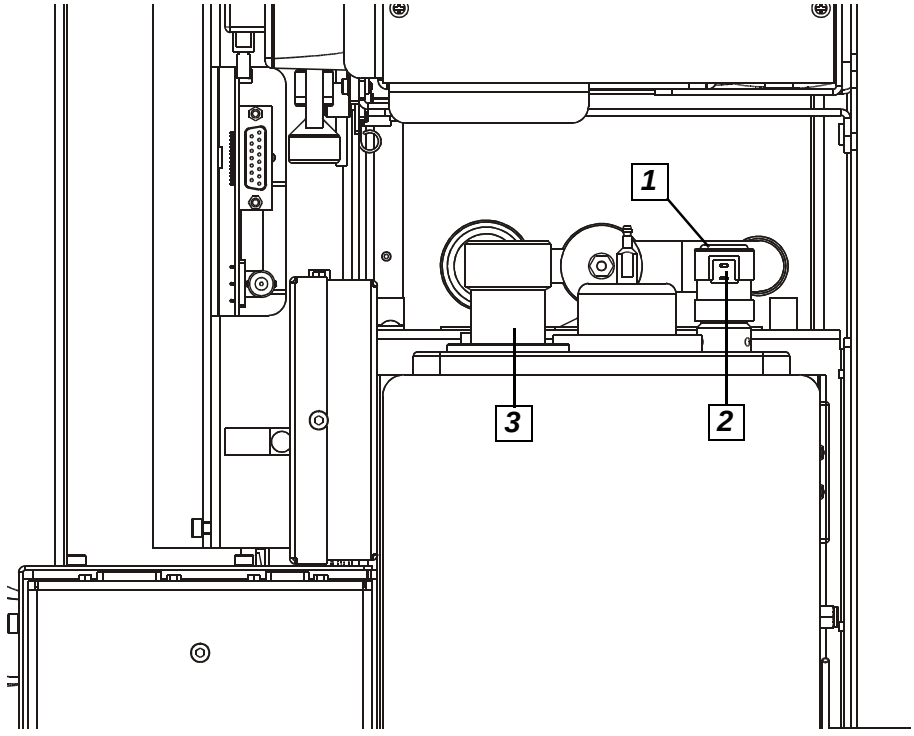
a. Shut down and vent the Polaris*Q* (details are on page 1-21).

⚠ WARNING	
	Electrical Shock Hazard Unplug the Polaris*Q* before proceeding.

b. Remove the Polaris*Q* front and top covers (details are on page 2-7).

2. Remove the Vent Valve Solenoid.

a. Disconnect the Vent Valve Cable.



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

Figure 2-80. Vent Valve Solenoid (Top Down View)

b. Unscrew the Vent Valve Solenoid and remove it.

3. Replace the Vent Valve Solenoid.

a. Insert the new Vent Valve Solenoid.

b. Reconnect the electrical cables.

4. Restore the Polaris*Q* for operation.

a. Reinstall the Polaris*Q* front and top covers.

b. Restart the system.

Chapter 3
Troubleshooting

This chapter provides quick reference to identify symptoms, causes, and solutions for poor instrument performance or malfunction.

Typically, Xcalibur Diagnostics will display a failure readback 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 Finnigan Technical support.

This section contains these topics:

3.1 Diagnostics, 3-2

3.2 Communication Symptoms, 3-4

3.3 Contamination Symptoms, 3-10

3.4 Filament and Lens Control Symptoms, 3-14

3.5 Heated Zone Symptoms, 3-17

3.6 High Vacuum Symptoms, 3-20

3.7 Linearity Symptoms, 3-25

3.8 Power Supply Symptoms, 3-27

3.9 RF Control Symptoms, 3-30

3.10 Sensitivity Symptoms, 3-33

3.11 Stability Symptoms, 3-37

3.12 Tuning Symptoms, 3-39

3.1 Diagnostics

If your instrument is running poorly or suspiciously, Xcalibur Diagnostics will most likely 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.

Before running the Diagnostics, refer to the flowchart in Figure 3-1 to determine solutions outside of Xcalibur Diagnostics.

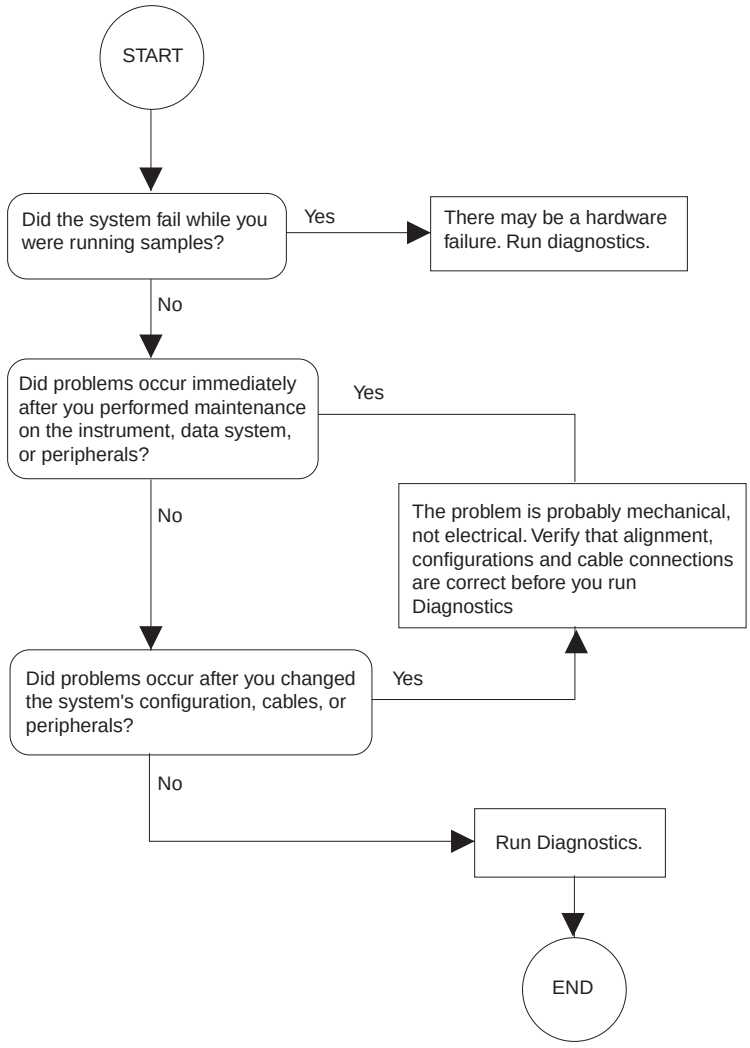


Figure 3-1. Diagnostics Flowchart

To run Xcalibur Diagnostics:

1. **Navigate to the Diagnostics screen.**

   a. From the Xcalibur Homepage select **Instrument Setup**.

   b. Open the Polaris*Q* Method Editor then click the **Tune** button.

   c. From Tune, select **Diagnostics** | **Run Tests** to display the Diagnostics screen.

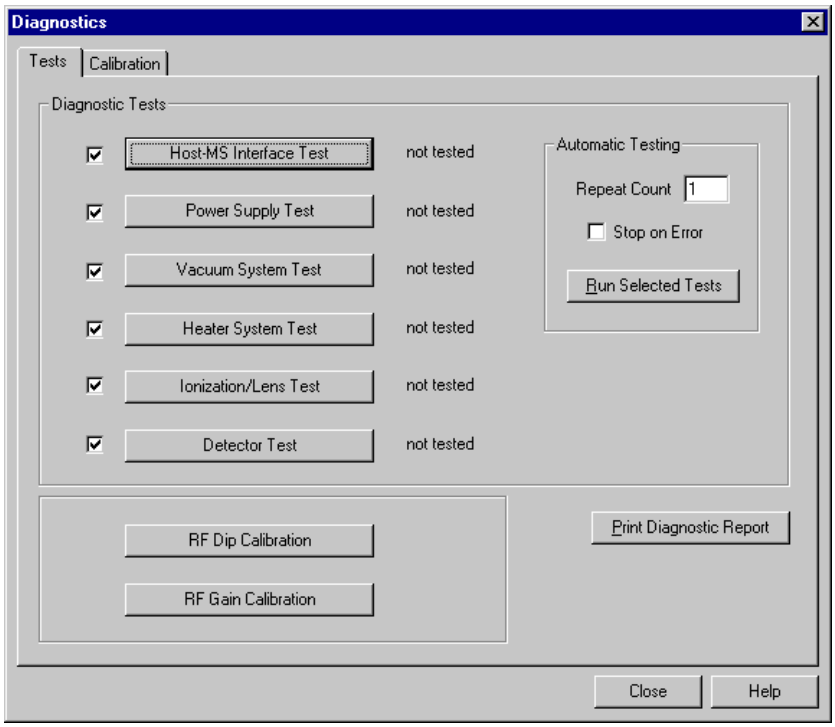


Figure 3-2. Diagnostics Screen

2. **Access the Tune help system for instructions.**

   a. Click the **Tune Help** button to display Tune help on the Diagnostics screen.

   b. Select the **Index** tab and type ‘perform diagnostics’ in the text box.

   c. Click **Display** to view or print the instructions for performing Diagnostics.

3.2 Communication Symptoms

Communication symptoms likely involve links between the data system and the mass spectrometer, the gas chromatograph, and the autosampler. This section does not address communication issues with other devices.

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 Polaris*Q* system is bi-directional; the data system downloads analytical methods to the instrument and activates functions to start, stop, shutdown, startup, and initialize. The Polaris*Q* 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 Polaris*Q* 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.

Problem:
Data system cannot initialize communication with Polaris*Q*

Diagnosis/Solution: The software is not configured correctly.

Select the PolarisQ from the Instrument Configuration window.

Diagnosis/Solution: The ethernet cable is unplugged.

Verify that the ethernet cable is connected to the data system port on the PolarisQ.

Diagnosis/Solution: The communication circuits on the Digital PCB are faulty.

Check connections to Digital PCB. Replace if necessary.

Diagnosis/Solution: The ethernet card in the PC is not configured or is faulty.

Check configuration, replace if necessary.

Diagnosis/Solution: The system is in service mode.

Check if green power LED on front cover is flashing; return service switch to normal position if necessary.

Diagnosis/Solution: 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.

Problem:
Computer loses communication with Polaris*Q* intermittently

Diagnosis/Solution: The ethernet cable is loose or damaged.

Inspect cable and replace if necessary.

Diagnosis/Solution: The communication circuits on the Digital PCB are faulty.

Check connections to Digital PCB. Replace if necessary.

Problem:
Cannot Download Methods to Polaris*Q*

Diagnosis/Solution: The software is not properly configured.

Verify correct settings in Instrument Configuration.

Problem:
Acquisition does not begin as expected

Diagnosis/Solution: The Polaris*Q* start mode is not properly configured.

Verify that instrument is configured properly. Refer to Xcalibur online help.

Diagnosis/Solution: The Polaris*Q* Instrument Setup file has incorrect settings.

Check start time in PolarisQ Instrument Setup file.

Diagnosis/Solution: 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 3-20.

Diagnosis/Solution: The remote start cable to the GC is disconnected.

Connect remote start cable.

Diagnosis/Solution: The GC did not start.

Verify GC methods and configuration.Verify connection between autosampler and GC.

Diagnosis/Solution: The autosampler did not start.

Verify autosampler methods and configuration. Verify that the sample is present.

Diagnosis/Solution: The Heated Zone setpoint is not attained.

Refer to section on Heated Zone Symptoms.

Problem:
Unstable instrument readback

Diagnosis/Solution: There is a faulty cable connection.

Check connections to the Analog PCB.

Diagnosis/Solution: The Digital PCB is faulty.

Reseat connector between Analog and Digital PCB; replace if necessary.

Diagnosis/Solution: The Analog PCB is faulty.

Check connections to the Analog PCB; replace if necessary.

Problem:
Acquisition terminates unexpectedly

Diagnosis/Solution: The End Run time in the Polaris*Q* Instrument Setup file is incorrect.

Check the Instrument Setup files for the GC and the MS.

Diagnosis/Solution: The data system is out of disk space.

Check disk space; back up and remove files.

Problem:
Cannot initialize GC

Diagnosis/Solution: The GC is not turned on.

Turn on the GC.

Diagnosis/Solution: The GC is not configured properly in Xcalibur software.

Check Instrument Configuration.

Diagnosis/Solution: The cable between COM1 and GC is disconnected.

Verify connection.

Diagnosis/Solution: COM1 is not configured properly.

Verify COM port configuration.

Diagnosis/Solution: GC communications malfunction.

Contact Thermo Finnigan Technical Support.

Problem:
Cannot download methods to GC

Diagnosis/Solution: There is a discrepancy between method and configuration.

Verify consistency between method and instrument configuration.

Diagnosis/Solution: COM1 is not configured properly.

Verify COM port configuration

Diagnosis/Solution: GC communications malfunction.

Contact Thermo Finnigan Technical Support.

Problem:
Cannot initialize Autosampler

Diagnosis/Solution: Autosampler not turned on.

Turn on Autosampler.

Diagnosis/Solution: Autosampler not configured properly in Xcalibur software.

Check Instrument Configuration

Diagnosis/Solution: Disconnected cable between GC and autosampler.

Verify connection.

Diagnosis/Solution: Autosampler Instrument Configuration not set for "Connected through TRACE"

Verify configuration.

Diagnosis/Solution: Autosampler communications malfunction.

Contact Thermo Finnigan Technical Support.

Problem:
Cannot download methods to Autosampler

Diagnosis/Solution: Discrepancy between method and configuration.

Verify consistency between method and instrument configuration.

Diagnosis/Solution: Autosampler communications malfunction.

Contact Thermo Finnigan Technical Support.

3.3 Contamination Symptoms

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

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 Siloxane 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, diffusion pump oil, or instrument cleaning solvents.

Always wear lint-free, cotton 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.

Problem:
There is excessive chemical background due to column bleed (m/z 429, 355, 281)

Diagnosis/Solution: Capillary column has not been properly conditioned.

Condition the capillary column.

Diagnosis/Solution: 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.

Problem:
There is excessive injection port septum bleed (Typical m/z 207, 429, 355, 281)

Diagnosis/Solution: The septum is worn out or damaged.

Replace the septum.

Diagnosis/Solution: Small pieces of septum are in the injection port liner.

Replace the injection port liner, condition the capillary column.

Problem:
There is phthalate background manifest in chromatograms (m/z 149, 167, 279)

Diagnosis/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.

Problem:
There is excessive hydrocarbon contamination manifest in chromatograms (Typical ions are m/z 43, 57, 71, 85, 99...)

Diagnosis/Solution: Carrier gas tubing is contaminated.

- *Isolate source of hydrocarbon contamination and remedy.*
- *Replace carrier gas tubing. Change carrier gas filters.*

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

Diagnosis/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 3-20.

Problem:
Spectra are observed due to solvents:

- Methanol (m/z 31)
- Acetone (m/z 43, 58, 59)
- Methylene chloride (m/z 84/83)
- Hexane (m/z 41, 43, 56, 57, 58, 85, 86)
- Toluene (m/z 91, 92)
- Xylene (m/z 105, 106)
- Trichloroethane (m/z 151, 153)

Diagnosis/Solution: There is residual solvent from a cleaning procedure or laboratory background contamination.

When you finish performing a cleaning procedure, allow cleaned components to dry thoroughly. Warm parts in the GC oven to drive off residual solvent.

Diagnosis/Solution: 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.

Problem:
Excessive diffusion pump oil in spectrum (m/z 446)

Diagnosis/Solution: The vacuum interlock valve has recently been used.

Allow vacuum system to stabilize.

Diagnosis/Solution: The system has been idle for a long period of time, resulting in condensation of diffusion pump oil on filament assembly.

Turn on filament and analyzer; allow system to stabilize until contamination vaporizes.

Diagnosis/Solution: There is an air leak in the manifold or the foreline, resulting in diffusion pump oil backstreaming.

Check for air leaks and remedy. See High Vacuum Symptoms on page 3-20.

Problem:
There is excessive diffusion pump oil breakdown products manifest in spectrum (m/z 262, 170, 141, 121)

Diagnosis/Solution: Diffusion pump oil has been subjected to oxidation due to an air leak.

Check for air leaks and remedy. See High Vacuum Symptoms on page 3-20.

Diagnosis/Solution: Diffusion pump oil needs to be replaced.

Change diffusion pump oil.

3.4 Filament and Lens Control Symptoms

The lifetime of a filament depends on its exposure to oxygen and solvent vapors. The filament assembly protects the filament and increases its lifetime for many months.

Xcalibur Diagnostics tests the filament for continuity and current regulation. Testing the filament for continuity before each acquisition ensures that an open filament condition will stop an autosampler sequence and generate an error message.

Diagnostics tests the lenses of the Polaris*Q*. A flat line, which represents voltage readback versus the predicted voltage ramp, indicates a lens or other control fault. Contamination causes lens performance to deteriorate over time; the amount of time depends on what type of sample and ionization mode you are using.

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.

Problem:
Diagnostics indicate filament is open

Diagnosis/Solution: The filament is open.

Vent the system and remove the filament. Normal resistance @ 1.0 Ω Replace if open.

Problem:
Inspection shows filament is good, but diagnostics still indicate filament is open

Diagnosis/Solution: There is a fault in the Source Heater PCB.

Replace the source heater PCB.

Diagnosis/Solution: The connection between the Analog and Lens Interface PCB is defective.

Check the connection.

Diagnosis/Solution: There is a problem with the Analog PCB.

Replace if necessary.

Problem:
Emission current is unstable

Diagnosis/Solution: The filament is near the end of its life span.

Replace the filament.

Diagnosis/Solution: There is a fault in the Source Heater PCB.

Replace the Source Heater PCB.

Diagnosis/Solution: There is a problem with the Analog PCB.

Replace if necessary.

Problem:
Short filament lifetime

Diagnosis/Solution: There is an air leak contributing to short filament lifetime.

Check for leaks; repair if any are found. See High Vacuum Symptoms on page 3-20.

Diagnosis/Solution: The filament is on during solvent peak.

Increase acquisition delay time until solvent peak has passed.

Diagnosis/Solution: High emission current is being used.

Use lower emission current to extend lifetime.

Problem:
Diagnostics indicate flat lens response

Diagnosis/Solution: The power supply to the lens has a fault.

Check HV Regulator PCB; replace if necessary.

Diagnosis/Solution: There is a fault with the lens drivers.

Replace the Analog PCB.

Problem:
Diagnostics indicate a problem with trap offset

Diagnosis/Solution: Cables J3 and J4 on the Analog PCB are reversed.

Check the cables and correct if necessary.

3.5 Heated Zone Symptoms

The Ion Source and Transfer Line are heated zones related to the Polaris*Q*. The ion source heater is controlled by the Polaris*Q* 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 Polaris*Q* 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.

Problem:
Excessive chromatographic peak tailing

Diagnosis/Solution: 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. Then, try increasing the ion source temperature.

Diagnosis/Solution: Sample analyte is adsorbing in the GC injector.

Clean and deactivate the injection liner. You can also try liners made of different materials.

Diagnosis/Solution: GC oven is not ramped to high enough temperature.

Extend upper oven temperature.

Diagnosis/Solution: GC column needs to be replaced or does not have the appropriate stationary phase for your application.

Change GC column.

Diagnosis/Solution: GC column does not extend 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. If the end of the column is inside the tip, an excessive amount of GC effluent will contact the inside wall of the tip.

Problem:
Source Heater will not heat

Diagnosis/Solution: The ion source heater cartridge is not connected.

Check connections between the Analog and Lens Interface PCBs and Lens Interface PCB and Ion Source PCB.

Diagnosis/Solution: Ion Source Heater fuse (F1) is blown on the Analog PCB.

Replace the Ion Source Heater fuse on the Analog PCB.

Diagnosis/Solution: The 24 V DC power supply is not operable.

Replace Power Module if necessary.

Diagnosis/Solution: 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 ≅ 24 Ω Replace the source heater PCB if necessary.

Diagnosis/Solution: The source temperature sensor (RTD) is defective.

Vent the system and check the resistance of the RTD (108 Ω at 20°C, 176 Ω at 200°C). Replace the source heater PCB if necessary.

Diagnosis/Solution: There is a problem with the Analog PCB.

Contact Thermo Finnigan Technical Support.

Problem:
Source Heater overheats

Diagnosis/Solution: The source temperature sensor (RTD) is defective.

Vent the system and check the resistance of the RTD (108 Ω at 20°C, 176 Ω at 200°C). Replace the source heater PCB if necessary.

Diagnosis/Solution: There is a problem with the Analog PCB.

Replace if necessary.

Problem:
Transfer Line will not heat

Diagnosis/Solution: Aux1 zone of GC is not configured for MS Transfer Line.

Configure Aux1 zone of GC and set Transfer Line temperature in GC Method Editor.

Diagnosis/Solution: Transfer line heater elements are defective.

Turn off the GC. Unplug the transfer line connector. Measure the heater resistance between the following pins:

- *2-3 ≅ 360 Ω*
- *2-4 ≅ 180 Ω*
- *3-4 ≅ 180 Ω*

Replace the transfer line if resistance is incorrect.

Diagnosis/Solution: The transfer line temperature sensor (RTD) is defective.

Measure resistance of RTD across pins 5-6 (108 Ω at 20°C, 204 Ω at 275°C). Replace transfer line if necessary.

Problem:
Transfer Line overheats

Diagnosis/Solution: The transfer line temperature sensor is defective.

Turn off the GC. Unplug the Transfer Line connector. Measure resistance of RTD across pins 5-6 (108 Ω at 20°C, 204 Ω at 275°C). Replace transfer line if necessary.

Diagnosis/Solution: There is a problem with the Aux1 zone of the GC.

Contact Thermo Finnigan Technical Support.

3.6 High Vacuum Symptoms

High Vacuum problems can manifest themselves in two ways. First, an intermittent vacuum condition (the vacuum pressure in the vacuum manifold fluxuates intermittently) can cause chromatographic signals to drop out, or, if the pressures exceed the maximum allowed pressures by Xcalibur, then the MS can automatically shut down. Second, if the vacuum is consistent enough to where it does not exceed the maximum allowed pressure and avoids the Xcalibur automatic shutdown, 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 x 10^{-5} Torr. For CI mode, forepressure is usually 60-90 mTorr, with manifold pressures no greater than 9 x 10^{-4} Torr.

The most reliable way to find vacuum leaks is to spray a gas around the vacuum manifold and looking for the characteristics 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 produce ions at m/z 69 and 83.

Problem:
Rotary-Vane Pump will not turn on

Diagnosis/Solution: The Rotary-Vane Pump is off.

Check the Rotary-Vane Pump switch.

Diagnosis/Solution: The Rotary-Vane Pump power cable from the *PolarisQ* is not connected.

Connect the power cable.

Diagnosis/Solution: The Rotary-Vane Pump is configured for incorrect line voltage.

Configure the Rotary-Vane Pump for proper line voltage.

Diagnosis/Solution: The Rotary-Vane Pump is faulty.

Replace the Rotary-Vane Pump.

Problem:
Rotary-Vane Pump turns on but will not pump down

Diagnosis/Solution: The oil level in the Rotary-Vane Pump is insufficient.

Check oil level; add if necessary.

Diagnosis/Solution: The foreline is leaking.

Check the clamps and connectors. Replace the foreline hose if a hole is found.

Diagnosis/Solution: The vacuum manifold top cover is leaking.

Press down on the top cover to make sure it is seated properly.

Diagnosis/Solution: The Rotary-Vane Pump is faulty.

Replace the forepump.

Diagnosis/Solution: The cable from the Convectron Gauge to the Vacuum Control PCB is faulty.

Check the cable from the Convectron Gauge to the Vacuum Control PCB.

Problem:
Diffusion Pump or Turbo Pump will not turn on

Diagnosis/Solution: The forepressure is not low enough.

Check the forepump and foreline plumbing for leaks and proper operation.

Diagnosis/Solution: Ready is not transmitted by the Vacuum Control PCB.

Check cable connections between Vacuum Control PCB and diffusion / turbo pump controller; replace if necessary.

Diagnosis/Solution: The laboratory environment is too hot.

Bring laboratory environment to within PolarisQ specifications.

Diagnosis/Solution: The thermal snap switch on diffusion pump inhibits ready.

Replace the thermal snap switch.

Diagnosis/Solution: Line voltage is out of tolerance.

Check line voltage; correct as necessary.

Diagnosis/Solution: The Diffusion Pump Control PCB is faulty.

Replace the PCB.

Diagnosis/Solution: The Diffusion pump is overheated.

- *Check cooling fans for proper operation.*
- *Verify correct air circulation around PolarisQ.*

Problem:
Diffusion pump turns on but will not create an acceptable high vacuum

Diagnosis/Solution: Gross leaks are present in the manifold.

Check transfer line, inlet valve, and top cover assembly for gross leaks.

Diagnosis/Solution: The diffusion pump oil level is insufficient.

Clean and recharge diffusion pump.

Diagnosis/Solution: The diffusion pump heater is not heating.

Replace diffusion pump.

Problem:
Diffusion pump shuts off during operation

Diagnosis/Solution: The laboratory is too hot.

Bring laboratory environment within PolarisQ specifications.

Diagnosis/Solution: The Diffusion Pump oil level is insufficient.

Clean and recharge the Diffusion Pump.

Diagnosis/Solution: The foreline pressure is too high.

Check for leaks in the foreline.

Problem:
Turbo Pump shuts off during operation

Diagnosis/Solution: The foreline pressure is too high.

Check for leaks in the foreline.

Diagnosis/Solution: The cable connection between the Turbomolecular Pump and Vacuum Control PCB is faulty.

Check connections.

Diagnosis/Solution: The Turbomolecular pump controller is faulty.

Replace or repair as necessary.

Diagnosis/Solution: The Turbomolecular pump power supply is faulty.

Replace or repair as necessary.

Diagnosis/Solution: The Turbo pump is faulty.

Replace the Turbo pump.

Problem:
Diffusion Pump overheats

Diagnosis/Solution: The pump ventilation is inadequate.

Check fans and air circulation.

Diagnosis/Solution: The Diffusion Pump oil level is insufficient.

Clean and recharge the pump.

Problem:
Unexpected full ventilation occurs

Diagnosis/Solution: A gross leak is present.

Check for leaks.

Diagnosis/Solution: The system was vented through the inlet valve, there was a GC column break at the transfer line, the foreline was cut.

Shut off the PolarisQ main circuit breaker. Allow system to vent and cool to room temperature.

Problem:
Vacuum Fault

Diagnosis/Solution: A gross leak is present.

Check for leaks.

Diagnosis/Solution: The ion gauge must be on (if you have one) and the pressure below $1x10^{-3}$ Torr.

Turn on ion gauge from Tune.

3.7 Linearity Symptoms

Linearity symptoms are when a plot of intensity versus concentration of a known compound are not uniform throughout the curve, or vary from their expected peaks. 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 concentration for most compounds. Like any instrument, however, the Polaris*Q* has a saturation point.

Perform routine injector and column maintenance to minimize linearity problems. Usually, a hardware fault that affects linearity will show different symptoms than those which might be attributed to linearity.

Problem:
Calibration plots not sufficiently linear

Diagnosis/Solution: High-end standards are too concentrated for the ion trap.

Use split injection technique to decrease amount of sample or lower emission current to reduce MS sensitivity.

Diagnosis/Solution: Ion Volume and lenses are dirty.

Clean Ion Volume and lenses.

Diagnosis/Solution: Multiplier Setting is incorrect.

Run Automatic Tune.

Diagnosis/Solution: Injection port liner or capillary column is dirty.

Change the injection port liner and trim the Capillary Column.

Diagnosis/Solution: Capillary column stationary phase is too thin for high concentration samples.

- *Use a higher capacity capillary column with a thicker stationary phase.*
- *Use split injection technique.*

Diagnosis/Solution: The capillary column is bad.

Replace Capillary Column.

3.8 Power Supply Symptoms

Xcalibur 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 the Polaris*Q* off 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 Polaris*Q* before removing the covers to avoid the risk of high electrical current.

Problem:
Polaris*Q* Will Not Turn On

Diagnosis/Solution: Disconnected Power Cord.

Verify that the Power Cord is plugged in.

Diagnosis/Solution: Voltage not coming from the electrical outlet.

Verify that the electrical outlet is operational.

Diagnosis/Solution: Improper Voltage at the electrical outlet.

Verify that the outlet is using the correct voltage for your system.

Diagnosis/Solution: Faulty Power Module.

Replace Power Module.

Problem:
PolarisQ turns on, but circuit breaker trips

Diagnosis/Solution: Faulty Power Module.

Replace Power Module.

Diagnosis/Solution: Rotary-Vane Pump causes circuit breaker to trip.

Check Rotary-Vane Pump; replace if necessary.

Problem:
PolarisQ Turns on, but there are no voltages available

Diagnosis/Solution: No +5, +/- 15, +24 Volt power.

Check Power Module. In-line fuse F1 may be blown or power supply 1 may be faulty. Replace if necessary.

Diagnosis/Solution: No +28 V power.

Check fuse on RF Generator; replace if necessary. If fuse blows again after replacement, replace RF Generator.

Diagnosis/Solution: No +/- 150 Volt power

Check HV Regulator PCB; replace if necessary.

Diagnosis/Solution: No 28 volt current.

Check connections to RF Generator, RF Control PCB, coil, and RF Feedthrough.

Diagnosis/Solution: No + 28 V current, -28 V, or +36 V (system is off).

Turn system on.

Problem:
28 Volt current is below acceptable range

Diagnosis/Solution: There is a bad connection in the RF circuit.

Check connection sequences between RF Generator, Low Pass Filter, RF coil, RF Control, RF Feedthrough, and ion trap ring electrode.

Problem:
28 Volt current is higher than acceptable range

Diagnosis/Solution: The RF frequency is not calibrated.

Calibrate the RF Frequency using Automatic Tune.

Diagnosis/Solution: The RF Generator overheated.

- *Check fans on back of PolarisQ; clean or replace as necessary.*
- *Verify adequate ventilation around PolarisQ.*
- *Verify that lab temperature is within operating limits of PolarisQ.*
- *Verify that the RF Frequency is calibrated using Automatic Tune.*

Diagnosis/Solution: The RF Generator is faulty.

Replace the RF Generator PCB.

Diagnosis/Solution: The RF Control assembly is faulty.

Check capacitor plate for high-voltage arcing; replace if necessary.

Diagnosis/Solution: There is a short circuit to ground in RF Feedthrough.

Replace RF Feedthrough.

Diagnosis/Solution: There is a short circuit in the RF coil.

Replace the RF coil.

3.9 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 Xcalibur 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. Figure 3-1, Diagnostics Flowchart, on page 3-2, is an excellent resource to begin troubleshooting RF control problems.

If the symptom is observed after performing work on the instrument, it points to mechanical issues; if the symptom arises suddenly during operation of the instrument, it indicates a fault condition.

Problem:
RF Dip Calibration shows random noise instead of a smooth RF Dip

Diagnosis/Solution: There is a loose cable.

Check these cables:

- *Analog to RF Detector PCB (PN 119378-0004)*
- *RF Generator to RF Detector PCB (PN 119378-0010)*
- *Lens Interface to Balun PCB*
- *Low Pass Filter to Balun PCB (PN 119378-0012)*
- *Cable from RF Generator to Low Pass Filter (PN 119378-0013)*
- *Cable from RF Coil to RF Detector capacitor or RF feedthrough*
- *Analog to RF Generator PCB (PN 119378-0002)*

Diagnosis/Solution: Ring electrode is not contacting RF feedthrough pin.

Vent the system and check the pin for correct contact.

Problem:
RF Dip Calibration shows random noise instead of a smooth RF Dip

Diagnosis/Solution: The RF feedthrough is arcing.

Replace RF feedthrough.

Diagnosis/Solution: There is a fault with RF Generator power supply (28 V power supply).

Check the fuse on the RF Generator PCB; replace if necessary.

Diagnosis/Solution: The RF Generator is faulty.

Replace the RF Generator PCB.

Problem:
RF Dip is present, but outside acceptable range

Diagnosis/Solution: There is a fault with the RF coil or the RF Detector PCB.

Contact Thermo Finnigan Technical Support for assistance.

Diagnosis/Solution: 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 if necessary. Replace the components if problems persist.

Problem:
The Det RF line (RF Gain Calibration screen) is not a smooth, straight line out to m/z 1000

Diagnosis/Solution: The RF Generator gain is not adjusted.

Contact Thermo Finnigan Technical Support for assistance.

Diagnosis/Solution: High voltage arcing is present.

Check RF coil, RF capacitor plate, RF feedthrough, and ion trap mass analyzer for evidence of high voltage arcing (discoloration or burn marks). Replace affected parts as necessary.

Problem:
The Det RF and RF Mod lines are erratic

Diagnosis/Solution: There is a loose cable.

Check the following cables:

- *Analog to RF Detector PCB (PN 119378-0004)*
- *RF Generator to RF Detector PCB (PN 119378-0010)*
- *Lens Interface to Balun PCB*
- *Low Pass Filter to Balun PCB (PN 119378-0012)*
- *Cable from RF Generator to Low Pass Filter (PN 119378-0013)*
- *Cable from RF Coil to RF Detector capacitor or RF feedthrough*
- *Analog to RF Generator PCB (PN 119378-0002)*

Diagnosis/Solution: There is a problem with the RF control PCB, low pass filter PCB, the RF Generator, or the RF Coil.

Contact Thermo Finnigan Technical Support.

Diagnosis/Solution: High voltage arcing is present.

Check RF Coil, RF capacitor plate, RF feedthrough, and ion trap mass analyzer for evidence of high voltage arcing (discoloration or burn marks). Replace affected parts as necessary.

3.10 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 too low sample level in the sample vial can give the appearance of instrument failure.

Gradual drops in sensitivity are usually the result of source or lens contamination, and are easily 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 your TRACE GC Maintenance Manual for more information on establishing a maintenance program.

Problem:
Low total ion current signal in chromatogram

Diagnosis/Solution: GC temperature ramp does not continue to a high enough temperature to elute high boiling point compounds. Multiple injections cause these compounds to accumulate in column, reducing sensitivity.

Extend upper temperature or time at upper temperature in GC oven ramp.

Diagnosis/Solution: The instrument is out of tune, or tune file is incorrect.

Select correct tune file for the method or run Automatic Tune.

Diagnosis/Solution: The Ion Volume is contaminated.

Clean the Ion Volume.

Diagnosis/Solution: The Ion Volume is incorrectly positioned.

Position the Ion Volume properly.

Diagnosis/Solution: 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.

Diagnosis/Solution: Dust has collected in the Electron Multiplier or on the Conversion Dynode.

Dust the Electron Multiplier and Conversion Dynode with dry gas.

Diagnosis/Solution: Emission current is set too low.

Check the setting listed for the emission current. See Tune | Manual and select the Controls tab.

Diagnosis/Solution: Cables J3 and J4 on the Analog PCB are reversed.

Check the cables and correct if necessary.

Diagnosis/Solution: 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.

Diagnosis/Solution: There is a problem with filament or lens control.

See Filament and Lens Control Symptoms on page 3-14.

Diagnosis/Solution: The source heater PCB is faulty, allowing emission current to leak to ground.

Replace the source heater PCB.

Diagnosis/Solution: Reagent gas is leaking into the analyzer, suppressing EI signal.

Check for presence of CI Reagent ions in spectrum. Replace CI Gas Flow Module if necessary.

Problem:
Poor compound sensitivity

Diagnosis/Solution: Incorrectly matched syringe, injection port liner, and column depth in injector.

See TRACE GC Operators Manual for correct combination.

Diagnosis/Solution: Insufficient sample delivery due to plugged syringe needle.

Clean or replace syringe.

Diagnosis/Solution: The injection port liner is contaminated.

Clean or replace injection port liner.

Diagnosis/Solution: Graphite or septa particles contaminate the injection port.

Clean the injection port.

Diagnosis/Solution: The injector or septum is leaking.

Replace septum and perform leak check on GC.

Diagnosis/Solution: The capillary column is at the end of its life span.

Replace capillary column.

Diagnosis/Solution: Method development problems are present.

Contact Thermo Finnigan Technical Support.

Problem:
Sensitivity is unstable or shows decrease with repeated injections

Diagnosis/Solution: The Ion Volume or lenses are contaminated.

Clean the Ion Volume and lenses.

Diagnosis/Solution: The Ion Source temperature is too low and cause it to contaminate too quickly.

Clean Ion Volume and lenses and then raise Ion Source temperature.

Diagnosis/Solution: There is a problem with the filament emission current control.

See Filament and Lens Control Symptoms on page 3-14.

Diagnosis/Solution: The multiplier is faulty.

See Multiplier Gain Calibration fails, page 3-40.

Diagnosis/Solution: The injection port liner or capillary column are contaminated.

Replace the injection port liner and trim the capillary column.

3.11 Stability Symptoms

Stability problem symptoms are concerned with consistent instrument precision and the reproducibility of accurate results. Good operating conditions for the mass spectrometer, gas chromatograph, and autosampler contribute to instrument stability.

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

Problem:
Mass Assignment is unstable

Diagnosis/Solution: There is a problem with ion trap control.

See RF Control Symptoms on page 3-30.

Problem:
Signal response is unstable or shows unexpected drop-out

Diagnosis/Solution: There is a problem with filament or lens control.

See Filament and Lens Control Symptoms on page 3-14.

Diagnosis/Solution: There is an air leak.

Check for leaks. *See High Vacuum Symptoms on page 3-20.*

Diagnosis/Solution: There is a high vacuum problem.

See High Vacuum Symptoms on page 3-20.

Diagnosis/Solution: There is a communication problem.

See Communication Symptoms on page 3-4.

Diagnosis/Solution: Dust has collected in the Electron Multiplier or on the Conversion Dynode.

Dust the Electron Multiplier and Conversion Dynode with dry gas.

3.12 Tuning Symptoms

Symptoms when tuning the ion trap and lens may be the result of a misadjusted manual control parameter.

Suspect a tuning problem when Xcalibur Autotune fails. Autotune performs several functions, and symptoms or error messages indicate different problems.

A tuning symptom can usually be found in Diagnostics.

Problem:
Error Message: Cannot find Calibration Gas

Diagnosis/Solution: 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.*

Diagnosis/Solution: There is a problem with Ion Trap control.

See RF Control Symptoms on page 3-30.

Diagnosis/Solution: Tune File settings are out of usable range.

Restore default Tune settings and Calibration settings. Run Automatic Tune.

Diagnosis/Solution: The calibration gas vial is empty.

Add 100 µL (max) to calibration gas vial.

Problem:
Multiplier Gain Calibration Fails

Diagnosis/Solution: The Electron Multiplier has not been given sufficient time to outgas since venting.

Allow more time to pump out.

Diagnosis/Solution: The GC column flow is too high.

Lower it to1 mL/min.

Diagnosis/Solution: Dust on dynode or multiplier.

Remove dust with dry gas.

Diagnosis/Solution: The multiplier anode is contaminated or loose.

Inspect and tighten anode. Clean the anode.

Diagnosis/Solution: 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.

Diagnosis/Solution: The multiplier power supply is faulty.

Replace multiplier power supply.

Diagnosis/Solution: The filament is the source of too much background noise.

See Filament and Lens Control Symptoms on page 3-14.

Diagnosis/Solution: Chemical background in the manifold is elevated.

Remedy leaks or sources of water contamination in carrier gas. See High Vacuum Symptoms on page 3-20.

Diagnosis/Solution: The difference between the Electron Energy and the setpoint is greater than 5 V.

Contact Thermo Finnigan Technical Support for assistance.

Problem:
Poor high mass resolution or resonant ejection calibration lines are always flat

Diagnosis/Solution: No helium buffer gas.

Replace helium tank and remove air from the gas lines.

Diagnosis/Solution: No resonant ejection signal on endcap electrodes.

Check all cables between Analog PCB, Balun PCB, and Lens Interface PCB. Replace Analog PCB because DDS or PA19 waveform amplifier may be defective.

Problem:
Error Message: Cannot perform waveform calibration

Diagnosis/Solution: There is poor high mass response.

The waveform calibration may be too far off to be calibrated. Try restoring the default calibration and re-running the Automatic Tune. If this does not work, run mass calibration and use the Estimate Waveform Calibration function in the Diagnostics. Then, re-run the Automatic Tune. Refer to the next topic, Poor High Mass Response.

Diagnosis/Solution: The cable connecting the Analog PCB to the Balun PCB is disconnected.

Check cable connections.

Diagnosis/Solution: The Analog PCB is faulty.

Replace the Analog PCB.

Problem:
Poor High Mass Response

Figure 3-3 shows a typical calibration gas spectrum. Table 3-1 lists the typical ion ratios observed. Since calibration gas is very sensitive to many instrument parameters, the instrument must be run with the operating parameters listed in Table 3-2.

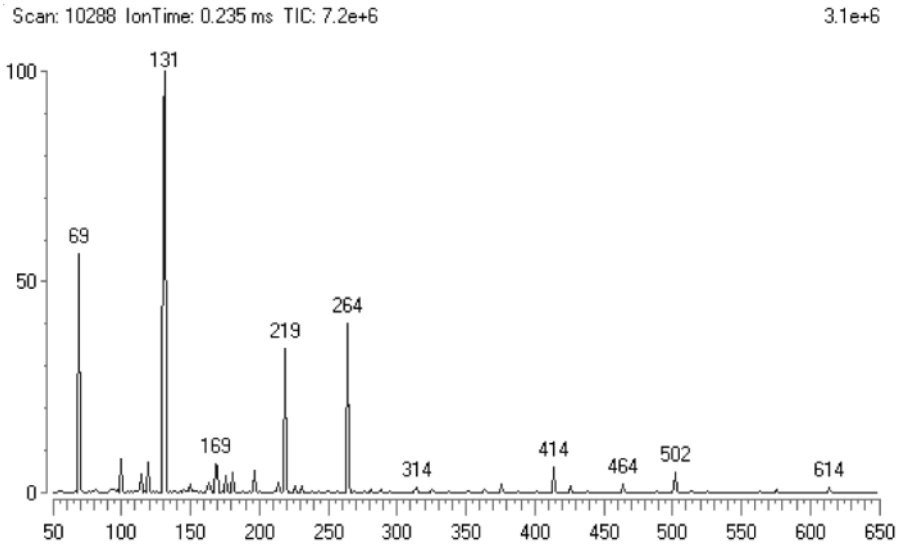


Figure 3-3. Typical calibration gas spectrum

Table 3-1. Typical calibration gas ion ratios

m/z 69	54% ± 20%
m/z 131	100%
m/z 264	45% ± 20%
m/z 414	8% ± 5%
m/z 502	6% ± 4%
m/z 614	0.7% ± 0.5%

Table 3-2. Operating parameters for spectrum shown in Figure 3-3

Filament	70 eV, 250 µA
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 3-2.**
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).**
3. **Allow the instrument to pump overnight.**
4. **Run Diagnostics and make sure no problems are reported.**
5. **Turn on EI/NICI calibration gas and allow it to stabilize for several minutes.**
6. **Run the Automatic Tune selecting all available options. It is very important to run all the Automatic Tune procedures including Multiplier Gain calibration.**
7. **Turn off calibration gas. Check for vacuum leaks with tetrafluoroethane (Falcon® Dust-Off® or MicroCare® MicroBlast™). Scan from m/z 60 - 90 and look for m/z 69 and 83 as you spray around the vacuum manifold.**

8. **If leaks are found, select Restore Default Calibration and return to step 5.**

Diagnosis/Solution: No high m/z ion intensity because the RF is not tuned correctly.

See RF Control Symptoms on page 3-30.

Diagnosis/Solution: No high m/z ion intensity because the DC trap offset is disconnected from the ring electrode.

Check cable from P3 of the balun PCB to the low pass filter PCB.

Diagnosis/Solution: Poor high m/z ion ratios because the ion source temperature is too high.

Reduce the ion source temeprature to reduce the amount of thermal decomposition and fragmentation of your analyte.

Diagnosis/Solution: Poor high m/z ion intensity because lens 1 is too positive.

High m/z ion ratios will increase as lens 1 is made more negative. Set to -25 V for most applications. Using Automatic Injection RF Mode will reduce this effect.

Diagnosis/Solution: Poor high m/z ion intensity because the trap offset is too negative. Using Automatic Injection RF Mode will reduce this effect.

High m/z ion ratios will increase as the trap offset is made more positive. Set to -10 V for most applications.

Diagnosis/Solution: Helium pressure in the ion source is too high or low.

Ion ratios are affected by the GC helium flow rate because helium can react with analyte molecules in the ion source. Set flow to 1.0 mL/min for most applications.

Diagnosis/Solution: 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 3-20.

Diagnosis/Solution: An excess amount of low m/z ions, such as hydrocarbons or column bleed.

These low m/z ions reduce the trapping efficiency of high m/z ions. Remedy the source of these low m/z ions. Or, if the ions are outside the scan range, use injection waveforms. If the ions are inside the scan range, use segmented scans.

Diagnosis/Solution: The ion volume or lenses are contaminated.

Clean the ion volume or lenses.

Diagnosis/Solution: m/z 131 is not base peak because AGC target is too high.

Resolution of low m/z ions will be poor at high AGC target values. This causes the peaks to be broad and therefore not as tall. Use an AGC target of 50.

Diagnosis/Solution: m/z 131 is not base peak because multiplier gain is too low.

If the gain of the multiplier is too low, AGC will store too many ions degrading the resolution of low m/z ions. This causes the peaks to be broad and therefore not as tall. High m/z ion ratios will look too high. The Multiplier Gain calibration may set the multiplier voltage too low for a noisy multiplier. Multipliers >2-3 years old are often noisy. See page 3-40, Multiplier Gain Calibration Fails.

Diagnosis/Solution: Poor high m/z intensity and poor resolution of low m/z ions because the conversion dynode is faulty.

Replace dynode and dynode power supply.

Diagnosis/Solution: The injection RF is not calibrated.

Run a complete Automatic Tune.

Diagnosis/Solution: There is a problem with filament or lens control.

See Filament and Lens Control Symptoms on page 3-14.

Diagnosis/Solution: The ion trap electrodes and/or spacers are

contaminated.

Clean the Ion Trap components.

Diagnosis/Solution: Reagent gas is leaking into the analyzer, suppressing EI signal.

Check for presence of CI Reagent ions in spectrum. Replace CI Reagent Gas Flow Module if necessary.

Problem:
Weak Signal

Diagnosis/Solution: The Ion Volume, Ion Source Lenses, or Ion Trap is dirty.

Clean the contaminated component(s).

Diagnosis/Solution: The multiplier is set too low.

Run Multiplier Gain Calibration in Automatic Tune. A multiplier >2-3 years old may be too noisy for the Multiplier Gain Calibration to accurately set the voltage. The multiplier may need to be replaced.

Diagnosis/Solution: The wrong type of ion volume is installed.

EI and CI require different ion volumes. They may not be used interchangeably.

Diagnosis/Solution: The ion volume is absent or incorrectly positioned.

Verify that the ion volume is positioned correctly.

Diagnosis/Solution: There is a filament or lens control problem.

See Filament and Lens Control Symptoms on page 3-14.

Diagnosis/Solution: The multiplier is faulty.

See multiplier gain calibration fails, page 3-40.

Chapter 4
Vacuum System and Gas Inlets

This chapter contains theory of operations for the vacuum system and gas inlets.

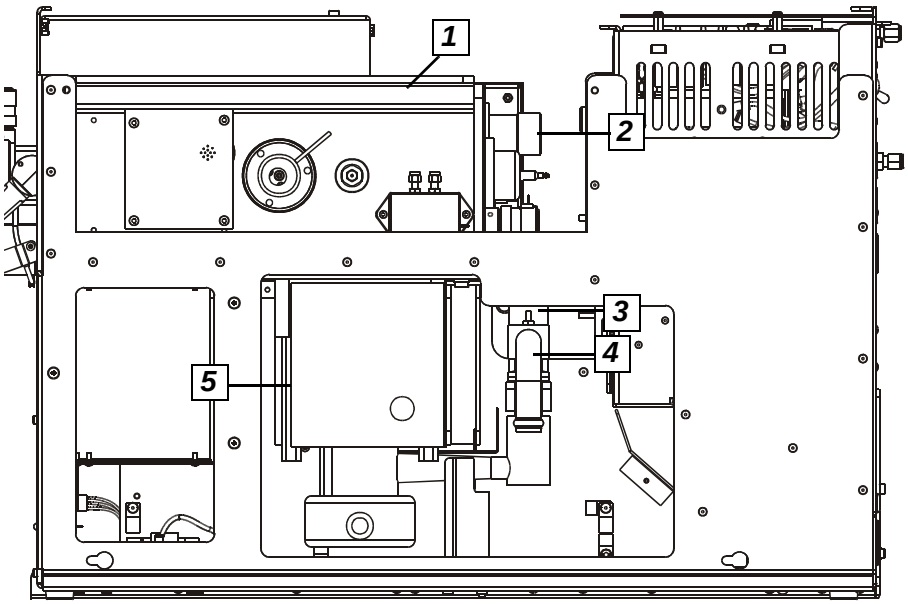
4.1 Vacuum System Components, 4-2

4.2 Gas Inlets, 4-13

4.1 Vacuum System Components

The vacuum system includes the following components:

- Convectron Gauge
- High Vacuum Pump (Diffusion or Turbomolecular)
- Ion Gauge (Upgrade Option)
- Rotary-Vane Pump (and Expansion Volume)
- Vacuum Manifold



1	Vacuum Manifold	4	Foreline Adapter (connects with the Foreline Hose to the Rotary-Vane Pump
2	Ion Gauge	5	High Vacuum Pump (Diffusion or Turbomolecular)
3	Convectron Gauge		

Figure 4-1. Vacuum System Components (right side view)

Description

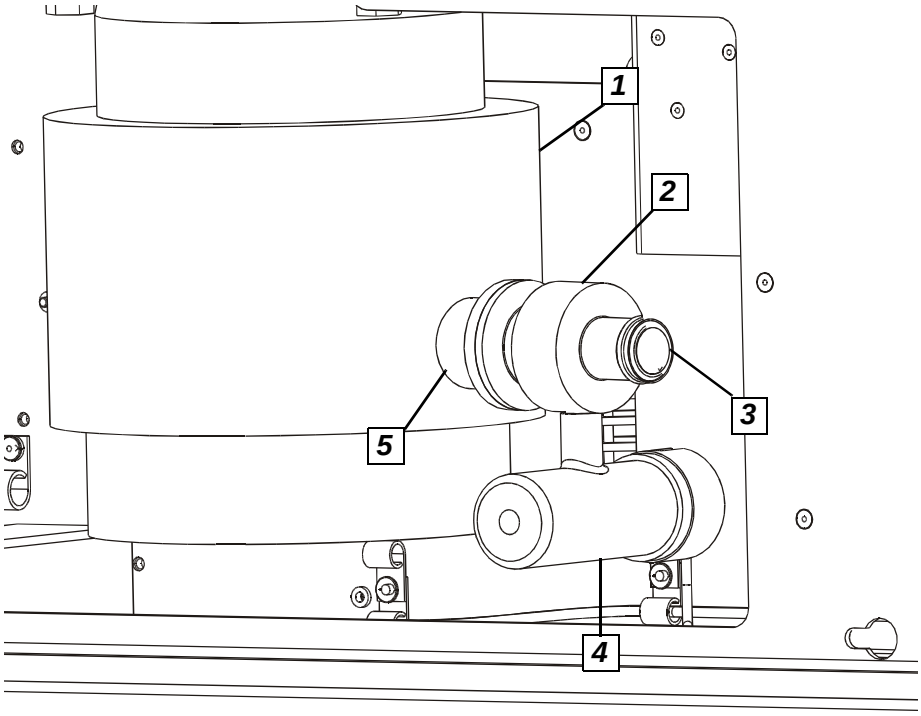
Vacuum system components lower the pressure within the Polaris*Q*. The principal components include: the convectron gauge, high vacuum pump, ion gauge, rotary-vane pump (and expansion volume), and the vacuum manifold. This also includes valves, gauges, and associated electronic and other control devices. 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.

Convectron Gauge and Foreline Adapter

The convectron gauge and foreline adapter connect between the foreline hose and high vacuum pump.



1	High Vacuum Pump	4	Convectron Gauge
2	Foreline Adapter	5	High Vacuum Pump Outlet
3	Foreline Hose Outlet		

Figure 4-2. Convectron Gauge (right side view)

The convectron gauge measures the pressure in the foreline connecting the high vacuum pump and the rotary-vane pump. If the pressure inside become too high, the vacuum control PCB removes power to the high vacuum pump.

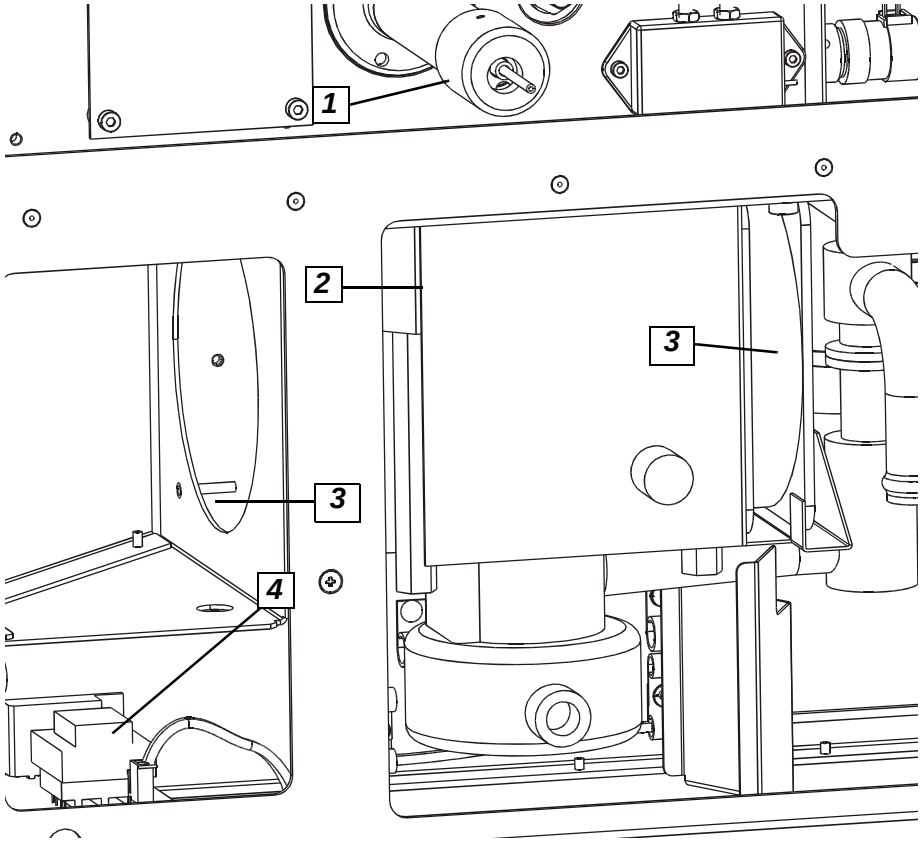
The foreline adapter connects the foreline hose from the rotary-vane pump at the foreline hose outlet to the high vacuum pump outlet.

High Vacuum Pump

The Polaris*Q* can be equipped with one of three types of high vacuum Pumps: a diffusion pump or the upgrade option 250 L/s or 70 L/s turbomolecular pump.

Diffusion Pump

A diffusion pump provides high vacuum for the Polaris*Q* to ionize sample molecules in the ion source and separate by mass in the ion trap. It mounts under the vacuum manifold.



1	Vacuum Manifold	3	Diffusion Pump Fans
2	Diffusion Pump	4	Diffusion Pump Control PCB

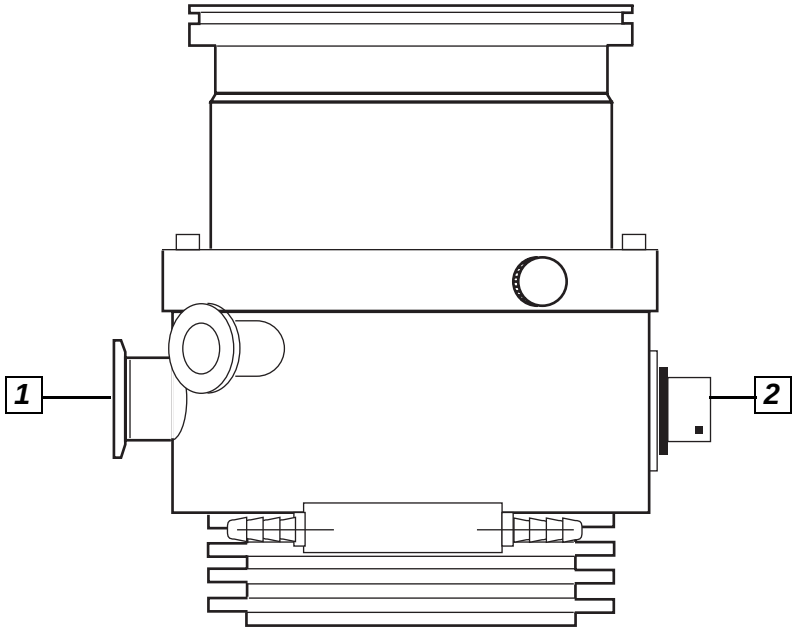
Figure 4-3. Diffusion Pump (right side view)

The pump is rated at 100 L/s (helium) and pump-down time is about 20 to 30 minutes. Under normal operating conditions the pump provides a vacuum of approximately 10^{-3} Pa (10^{-5} Torr). Two fans air-cool the pump.

Power to regulate the diffusion pump is provided by the diffusion pump control PCB. Power for the diffusion pump is turned on and off by the main circuit breaker and not by the service switch.

Turbomolecular Pumps (Upgrade Option)
Two turbomolecular pump types are available for the Polaris*Q* as upgrade options: 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.

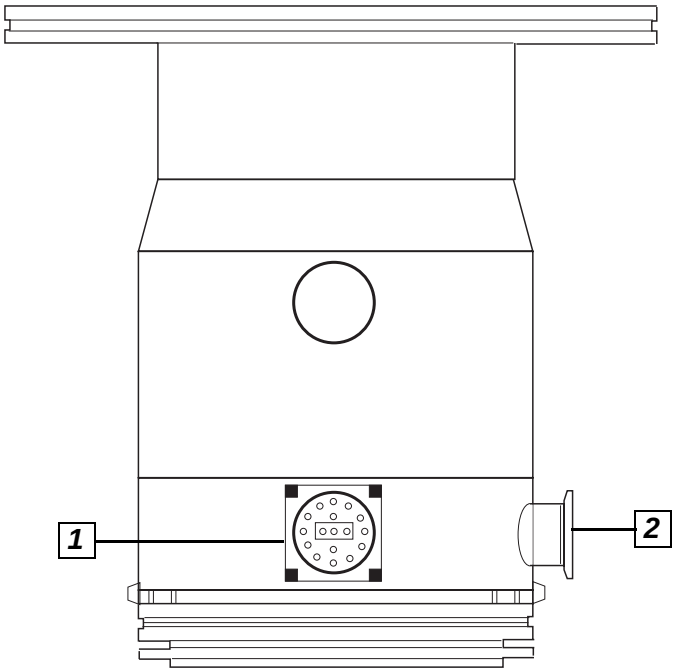
The 250 L/s turbomolecular pump is a multi-stage axial-flow turbine in which high speed rotating blades provide compression by increasing the probability of gas molecules moving in the pumping direction. The 250 L/s turbomolecular pump is optimized for molecular flow conditions and requires the use of a rotary-vane pump to exhaust to atmosphere.



1	Backing Port (Outlet Flange)	2	Electrical Supply Connector

Figure 4-4. 250 L/s Turbomolecular Pump (left side view)

The 70 L/s turbomolecular pump combines bladed turbomolecular stages with molecular drag stages on the same rotor. This design allows for high critical foreline pressures (typically >10 mbar).



1	Electric Supply Connector	2	Backing Port (Outlet Flange)

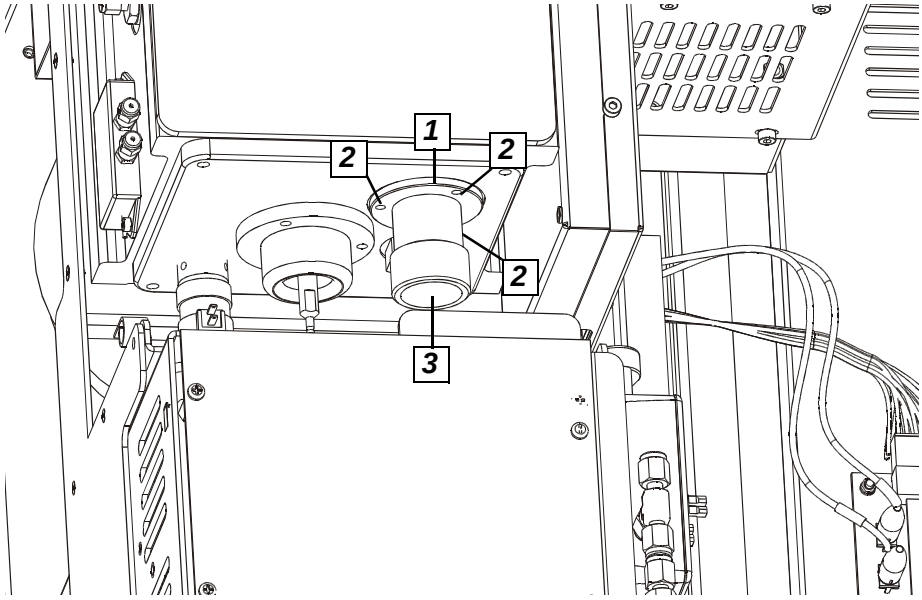
Figure 4-5. 70 L/s Turbomolecular Pump (left side view)

Turbomolecular Pumps have four advantages over the diffusion pump:

- Get to high vacuum faster
- No background contribution from pumping fluid
- No fluid levels to check
- Vent to atmosphere faster
- No maintenance

Ion Gauge (Upgrade Option)

The ion gauge mounts outside and to the back of the vacuum manifold.



1	Flange Collar	3	Electrical Cable from the Ion Gauge Control PCB (not shown)
2	Three screws holding the Ion Gauge Collar to the Vacuum Manifold		

Figure 4-6. Ion Gauge (top down view)

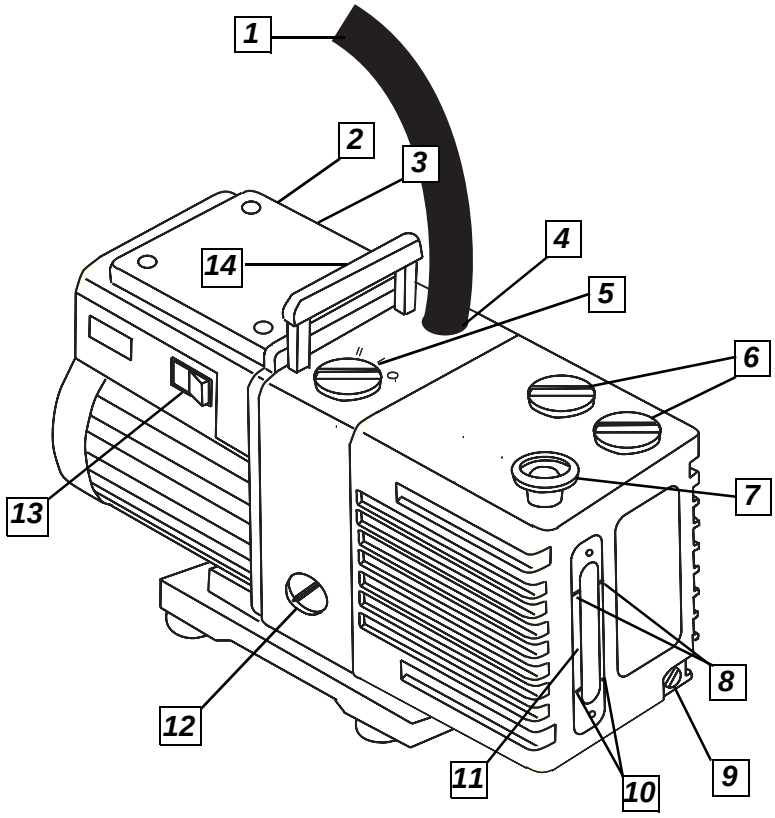
An ion gauge measures the pressure inside the vacuum manifold, and produces energetic electrons to ionize molecules. Positive ions formed in the ion gauge are attracted to a collector. The collector current is related to the pressure in the vacuum manifold.

If you have an ion gauge, it must be on and the pressure below $1x10^{-3}$ Torr to turn on the filament, electron multiplier, or conversion dynode.

Rotary-Vane Pump

The rotary-vane pump is typically located on the floor behind the Polaris*Q*.

It is a two-stage forepump that connects to the outside of the Polaris*Q*. It establishes the vacuum necessary for properly operating the diffusion pump or turbomolecular pump.



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 Sightglass
5	Gas-Ballast Control	12	Mode Selector
6	Oil Filler Plugs	13	On/Off Switch
7	Outlet Port	14	Lifting Handle

Figure 4-7. Rotary-Vane Pump (right, back side view)

The rotary-vane pump connects to a high-vacuum pump (diffusion or turbomolecular) by a piece of 0.75 in. ID tubing. The power cord plugs into the rear of the MS Detector 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.

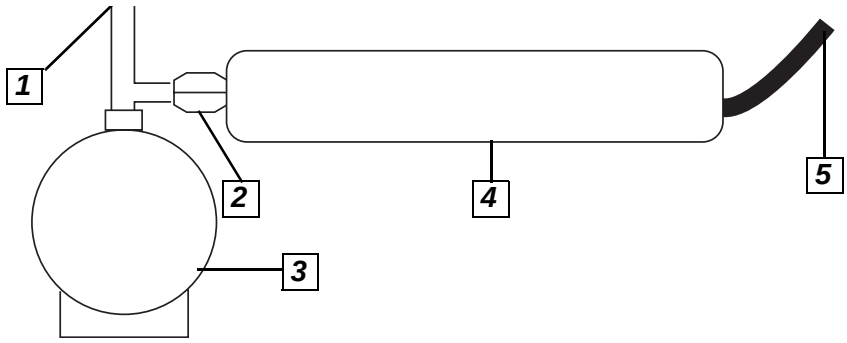
CAUTION

Potential Instrument Damage.

Always plug the rotary-vane pump power cord into the outlet on the rear of the Polaris*Q* and never into a wall outlet. If the pump is not plugged into the Polaris*Q* rear it will not shut down when the MS is powered off. As a result, the pump will continue to run and the MS will not be able to vent to atmosphere.

Expansion Volume (Upgrade Option)

As an upgrade option, the rotary-vane pump can include an expansion volume.



1	To Mass Spectrometer	4	Expansion Volume
2	Restrictor	5	To Inlet Valve
3	Rotary-Vane Pump		

Figure 4-8. Expansion Volume (right side view)

The expansion volume connects to the inlet port of the rotary-vane pump (Figure 4-7), and is a device which attenuates foreline pressure surges on an inlet valve equipped Polaris*Q*.

Inlet valve mechanisms typically contain several mL's of void volume which must be pre-evacuated before probe insertion into the Polaris*Q*. This is particularly the case for small diffusion pumped systems with relatively low critical foreline pressures. Traditionally, the job of inlet valve evacuation has been left to an accessory rotary-vane pump.

This device eliminates the need for a second rotary-vane pump by limiting the amplitude of the foreline pressure surge. The void volume expands to fill the expansion volume. Provided the expansion volume is large enough, the inlet valve pressure will drop to an acceptable level. Then, the expansion volume is slowly pumped out through the restrictor.

By pumping the void volume slowly through the restrictor, the maximum pressure at the rotary-vane pump is reduced. This prevents the high vacuum pump from receiving a high foreline surge. The expansion volume reduces cost by eliminating the need for a second rotary-vane pump.

Vacuum Manifold

The Vacuum Manifold is located on the top right of the Polaris*Q*, directly above the high vacuum pump.

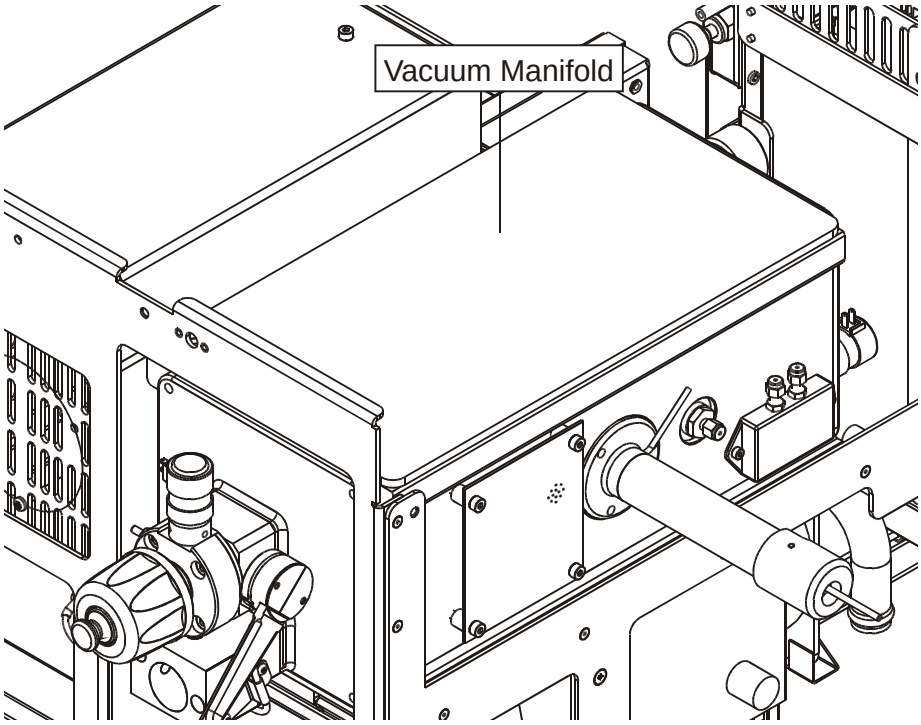


Figure 4-9. Vacuum Manifold (top, right view)

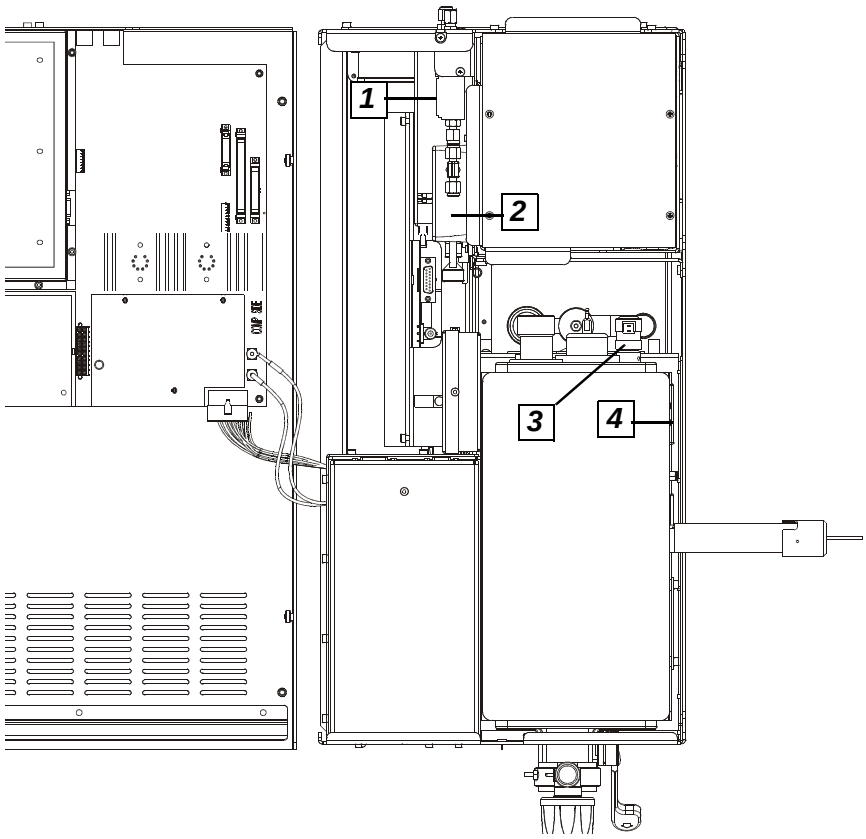
The vacuum manifold is a thick walled, aluminum chamber which encases the heart of the Polaris*Q* (the ion source, the ion trap, and the ion detector system). The vacuum manifold has a removable cover, machined flanges on the front and rear, and various electrical feedthroughs and gas inlets.

Ordering Information

Part Number	Description
119259-0001	Convectron Gauge w/ Foreline Adapter (Diffusion Pump)
119259-0002	Convectron Gauge w/ Foreline Adapter (250 L/s Turbo Pump)
119259-0003	Convectron Gauge w/ Foreline Adapter (70 L/s Turbo Pump)
76505-2115	Diffusion Pump, 115V
76505-2100	Diffusion Pump, 230V
76505-1016	Expansion Volume
A0105-06003	Ion Gauge
119269-0001	Rotary-Vane Pump, Diffusion Pump Systems
76505-3007	Rotary-Vane Pump, Turbo Pump Systems
119268-0001	Turbomolecular Pump 250 L/s
76505-3006	Turbomolecular Pump 70 L/s

4.2 Gas Inlets

Gas inlets control flow to the vacuum manifold.



1	CI Reagent Gas Flow Module	3	Vent Valve Solenoid
2	Calibration Gas Flow Module	4	Helium Gas Flow Module

Figure 4-10. Gas Inlets (top down view)

Description

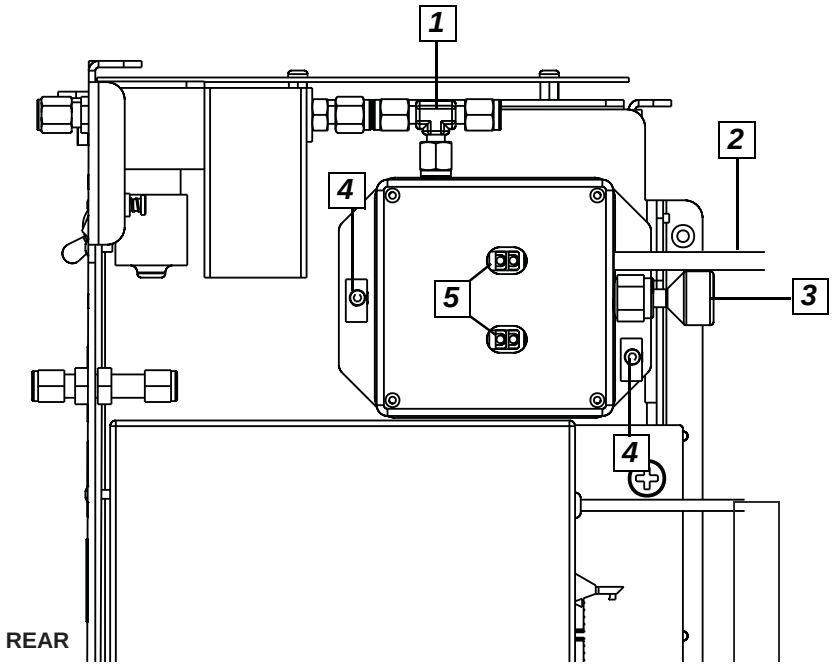
There are four gas inlets to the vacuum manifold. A calibration gas flow module for calibration compound control, a CI reagent gas flow module which regulates the flow of CI reagent gas into the ion source, the helium gas flow module which regulates helium flow into the ion trap, and a vent valve solenoid for venting the vacuum manifold to atmosphere.

Theory of Operations

Gas inlets control the input of various gases into the vacuum manifold.

Calibration Gas Flow Module

The calibration gas flow module controls the flow of calibration compound into the ion source and is mounted on the left rear of the Polaris*Q*.



1	Gas Fittings	4	Screws holding the module to the chassis
2	Foreline Adapter Tubing	5	Electrical Plugs
3	Calibration Compound Vial		

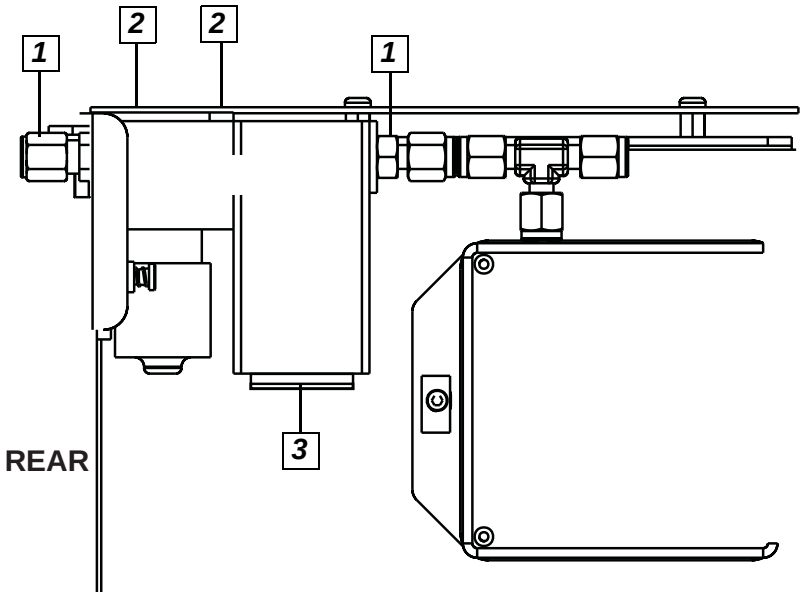
Figure 4-11. Calibration Gas Flow Module (left side view)

The module can deliver two different flows of calibration compound. One is a low flow for EI and NICI. The other is a higher flow used for PICI. The module permits calibration compound to enter the ion source through 1/8 in. OD tubing.

The module is factory charged with 0.1 mL of perfluorotributylamine, which is adequate for approximately 1 year of operation.

CI Reagent Gas Flow Module (Upgrade Option)

The CI reagent gas flow module controls the flow of CI reagent gas into the ion source and is located towards the left and back of the Polaris*Q*.



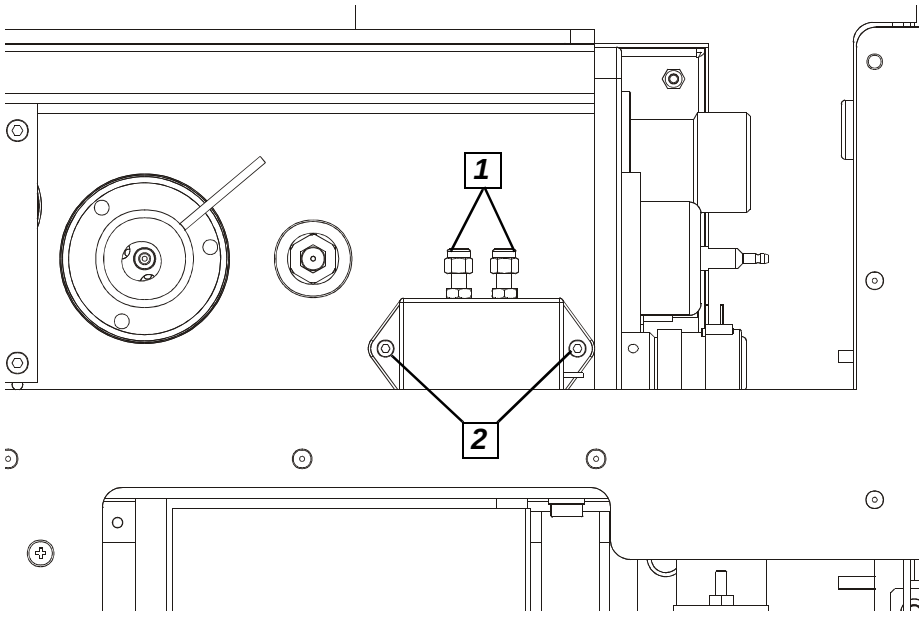
1	Gas Line Fittings	3	Analog PCB Electrical Cable Connector
2	Screws holding the module to the chassis		

Figure 4-12. CI Reagent Gas Flow Module (left side view)

The module uses electronic pressure control to precisely set the flow of reagent gas. The flow is programmed using Xcalibur, which allows you to reproduce accurate flows.

Helium Gas Flow Module

The helium gas flow module controls the flow of helium into the ion trap cavity and is located on the right side of the vacuum manifold.



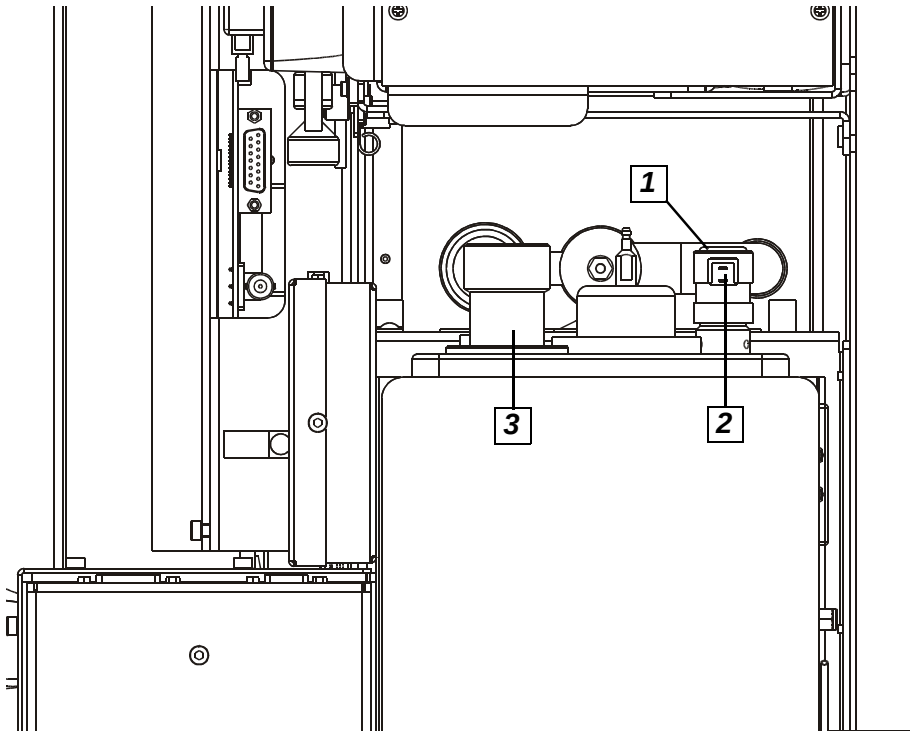
1	Two Gas Line Fittings	2	Two Screws holding the HGFM to the chassis

Figure 4-13. Helium Gas Flow Module (right side view)

Helium enters through the rear of the Polaris*Q* through a bulkhead fitting. The helium gas flow module regulates helium flow into the vacuum manifold through a nipple on the exit end cap. A small vent port on the helium gas flow module continuously vents approximately 5-10 mL/min of helium. This keeps the gas line purged and improves flow stability into the ion trap. Helium in the ion trap cavity dampens ionic motion and improves Polaris*Q* performance.

Vent Valve Solenoid

The vent valve solenoid 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.



1	Vent Valve Solenoid	3	Ion Gauge
2	Vacuum Control PCB Cable (not shown)		

Figure 4-14. Vent Valve Solenoid (top down view)

When the main circuit breaker is on, the vacuum control PCB supplies power to the vent valve solenoid to keep it closed. Approximately two to three seconds after power is removed from the system, the vent valve solenoid opens and the vacuum manifold is vented to atmospheric pressure. This process takes about four minutes.

Ordering Information

Part Number	Description
119246-0001	Calibration Gas Flow Module
23331-0090	CI Reagent Gas Flow Module
119247-0001	Helium Gas Flow Module
76461-1003	Vent Valve Solenoid

Chapter 5
Ion Source Components and Inlet Valve

This chapter contains theory of operations for ion source components and the inlet valve.

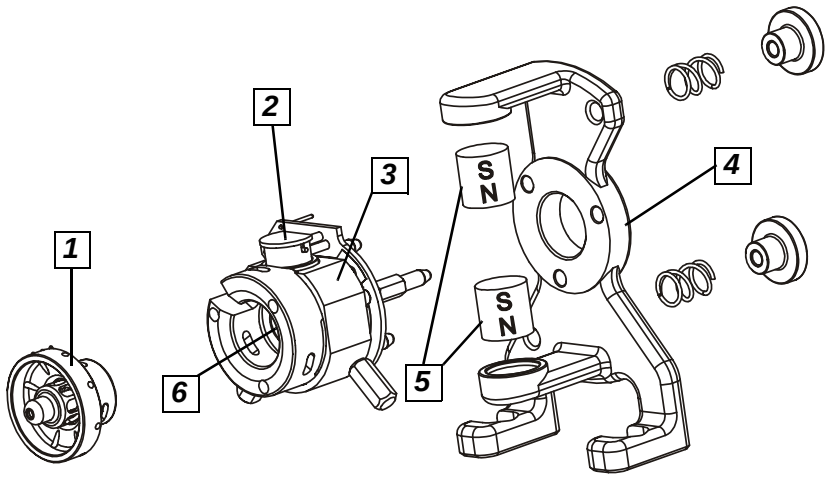
5.1 Ion Source Components, 5-2

5.2 Inlet Valve (Upgrade Option), 5-11

5.1 Ion Source Components

An ion source (EI or CI) has 6 main components:

- Filament Assembly
- Ion Source Block Assembly
- Ion Volume Assembly
- Ion Source Lenses
- Magnet Support
- Magnets



1	Ion Source Lenses	4	Magnet Support
2	Filament Assembly	5	Magnets
3	Ion Source Block	6	Ion Volume (inside Ion Source Block)

Figure 5-1 Ion Source Components

Description

The ion source is the part of the mass spectrometer where ions are formed (molecular ions and fragment ions, or in an MSn experiment, precursor ions). It is located inside and to the front of the vacuum manifold.

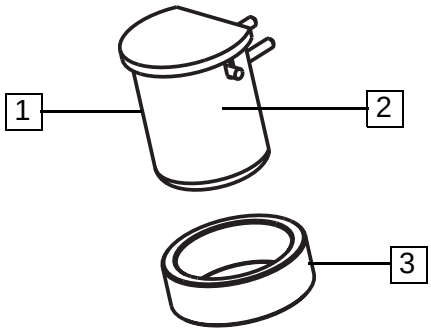
An ion source uses an interchangeable ion volume so that two different ionization modes can be used (EI or CI). The ion volume sits inside the ion source block, which is heated by three cartridge heaters. Three lenses at the exit of the ion volume draw out either positive or negative ions from the ion volume and pass 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 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. It is positioned on top of the ion source block and plugs into three sockets on the ion source block PCB.



1	Electron Lens	3	Filament Spacer
2	Filament and Reflector (inside Electron Lens)		

Figure 5-2 Filament Assembly (exploded view)

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 flux of electrons that enter the ion volume.

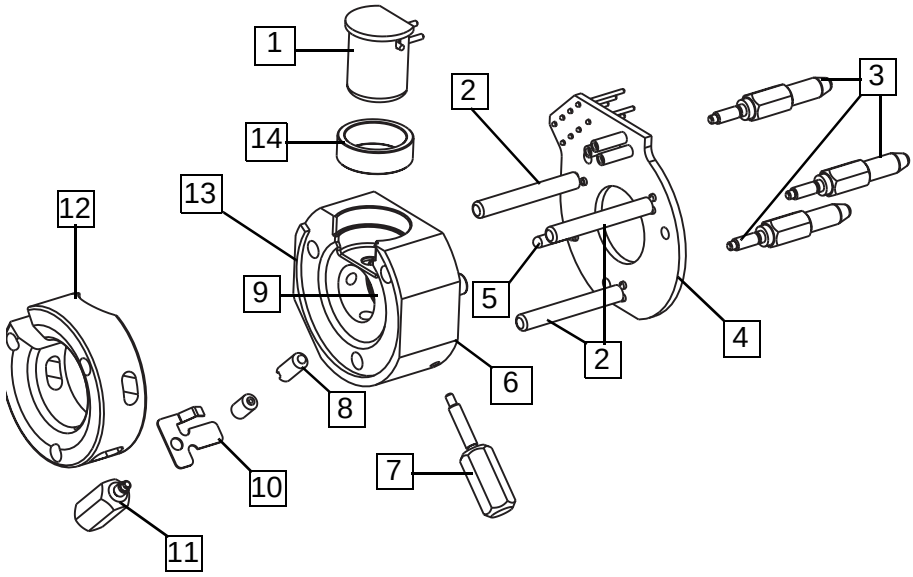
A **filament** is a rhenium wire inside the electron lens that is electrically heated to produce electrons by thermionic emission.

The **reflector** is located inside the electron lens, and repels electrons emitted by the filament toward the ion volume. Filaments and reflectors are maintained at negative potential relative to the ion volume, usually -70 V. The electrons emitted by the filament are accelerated into the ion volume.

The **filament spacer** is a ceramic ring that aligns the filament with the electron entrance hole in the ion source block and ion volume.

Ion Source Block Assembly

An ion source block assembly consists of an ion source block, ion source block PCB, three base studs, three cartridge heaters, and a temperature sensor.



1	Filament Assembly	8	Ball Plunger
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

Figure 5-3. Ion Source Block Assembly

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.

The ion source block PCB supplies voltages to the filament, electron lens, and cartridge heaters, as it passes signals from the temperature sensor.

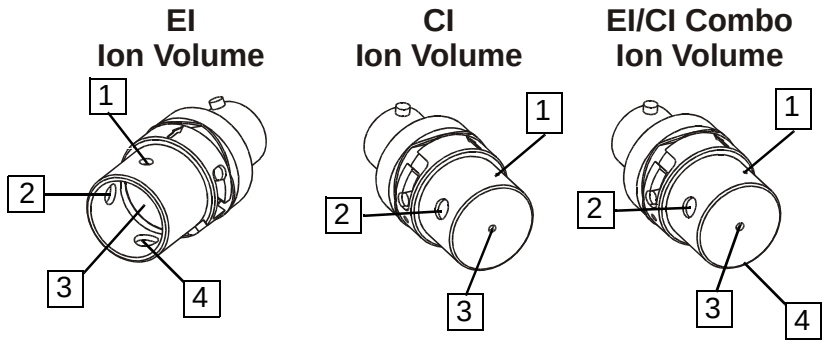
Three base studs hold the ion source block PCB to the ion source block. These studs slip into the magnet support and position the ion source block between two permanent magnets.

Three cartridge heaters and a temperature sensor are mounted on the ion source block PCB. Cartridge heaters pass through and heat the ion source block, as well as heat, align, and support the three ion source lenses. The temperature sensor monitors the temperature of the ion source block.

The heater ring slips over the cartridge heaters and transfers heat to the lenses.

Ion Volume Assembly

The ion volume assembly consists of the ion volume holder and the ion volume located inside the ion volume holder. The ion volume assembly is located in the center of the ion source.



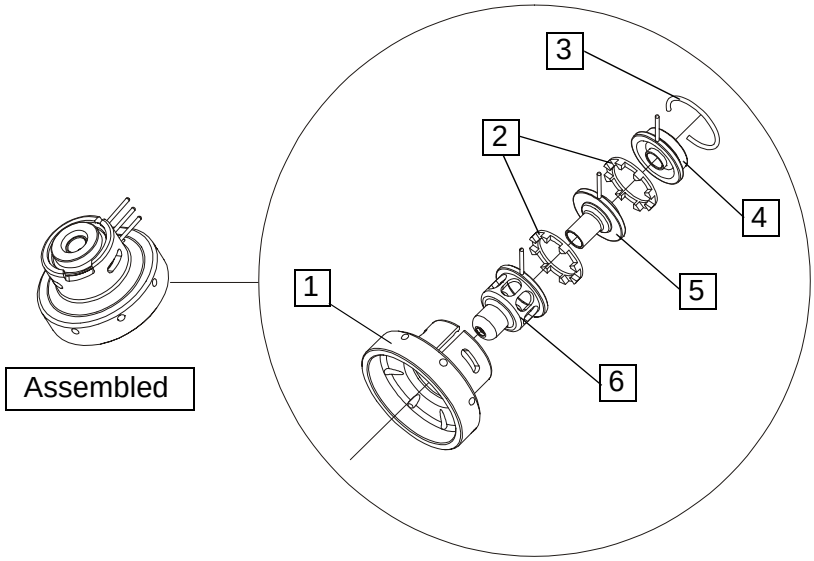
1	Electron Entrance Hole	3	Ion Exit Hole
2	GC Effluent, Calibration Gas, CI Reagent Gas Entrance Hole	4	Electron Exit Hole

Figure 5-4 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. Different ion volumes are needed for EI and CI operation modes. These optimized geometries maximize sensitivity for each ionization mode. An EI/CI combination ion volume is available that offers a compromise in sensitivity for both EI and CI. It allows you to switch ionization modes from one run to the next. This is especially useful for qualitative analysis.

Ion Source Lenses

Ion source lenses are connected to the front of the ion source block.



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

Figure 5-5. Ion Source Lenses

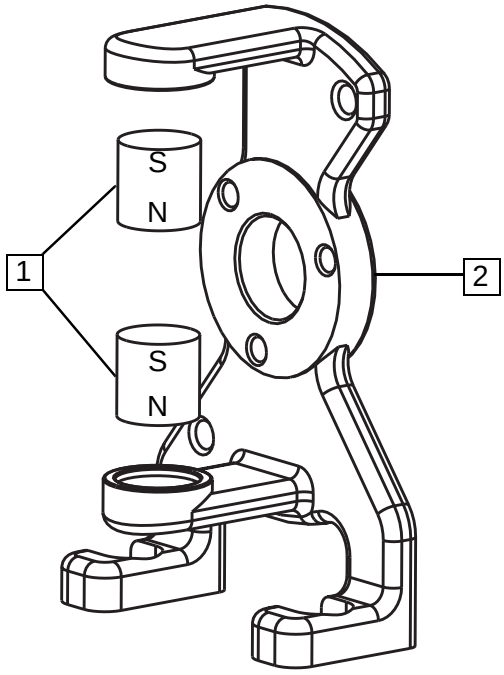
Ion source lenses transmit the ions formed in the ion volume to the ion trap. The lenses are stainless steel plates and tubes to which voltages are applied. The three ion source lenses are designated L1, L2, and L3, with L1 being nearest to the ion volume.

A lens' electrical connection is made through a stainless steel pin protruding from the edge of the lens. A small three-pin connector attaches to these pins and carries the voltage from the electrical feedthrough to the lens.

Magnets and Magnet Support

Two magnets focus emitted electrons into a beam that spirals through the ion volume. The spiraling of the beam ensure optimum ionization of the sample. The magnet support holds the two magnets in the proper position above and below the ion source block.

Position both magnets so the south pole is on top otherwise sensitivity will be poor. Electrons are not focused into the ion volume if one magnet is upside down.



1	Magnets	2	Magnet Support

Figure 5-6 Magnets and Magnet Support

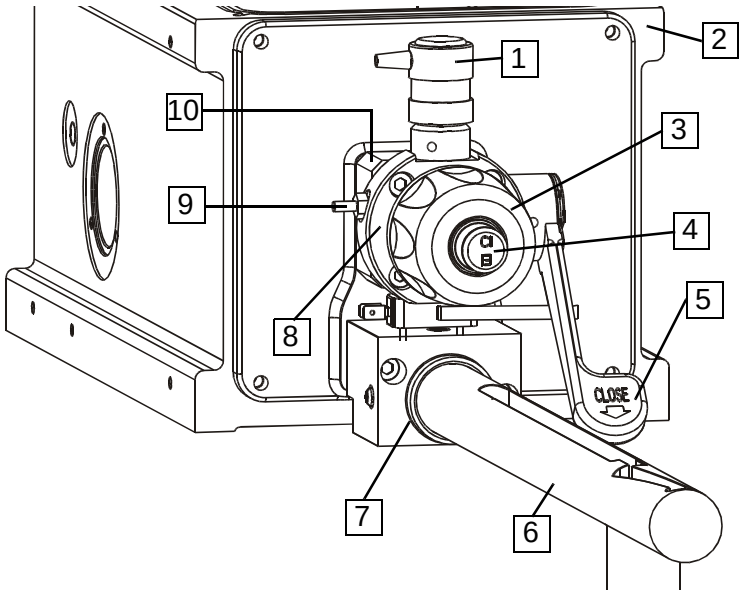
Ordering Information

Part Number	Description
119701-60287	Filament Assembly
119650-0205	Ion Source Block
119650-0220	EI Ion Volume
119650-0230	CI Ion Volume
119650-0240	EI/CI Combo Ion Volume
119650-0428	Lens Clip
119650-0414	Lens L1
119650-0416	Lens L2
119650-0418	Lens L3
119650-0420	Lens Holder
119650-0426	Lens Spacer
70001-98195	Magnet
119650-0710	Magnet Support

5.2 Inlet Valve (Upgrade Option)

Primary inlet valve components:

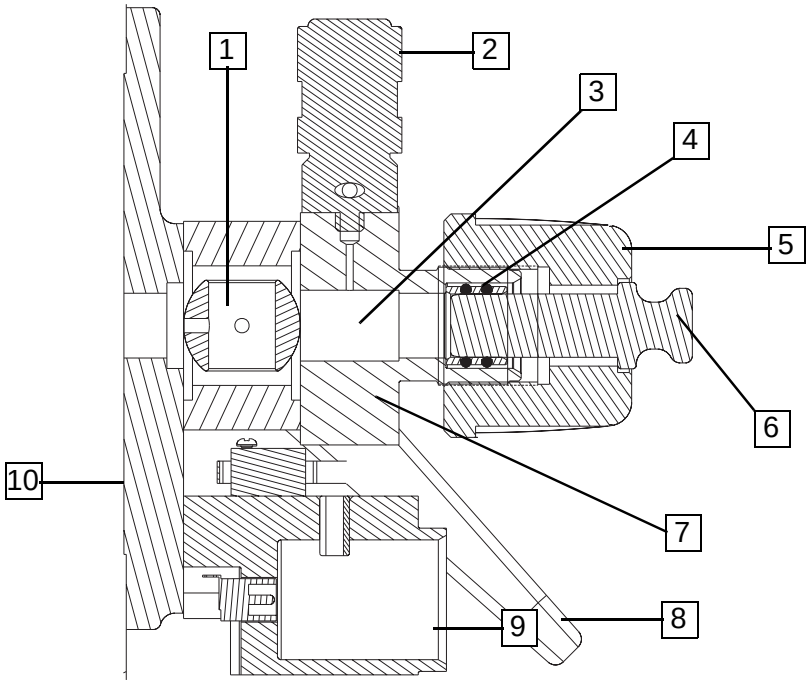
- Ball Valve
- Ball Valve Lever
- Entry Housing
- Guide Bar
- I/R Tool
- Inlet Valve Plug
- Inlet Valve Seal



1	Inlet Valve Solenoid	6	Guide Bar
2	Vacuum Manifold	7	Entry 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 5-7 Inlet Valve Components (I/R tool not shown)

Figure 5-8 illustrates a cross section of internal and external inlet valve components.



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	Entry Housing
5	Inlet Valve Knob	10	Vacuum Manifold

Figure 5-8 Inlet Valve Components (left view)

Description

The inlet valve mounts onto the front port of the vacuum manifold and is the vacuum interlock mechanism for the Polaris*Q*. 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.

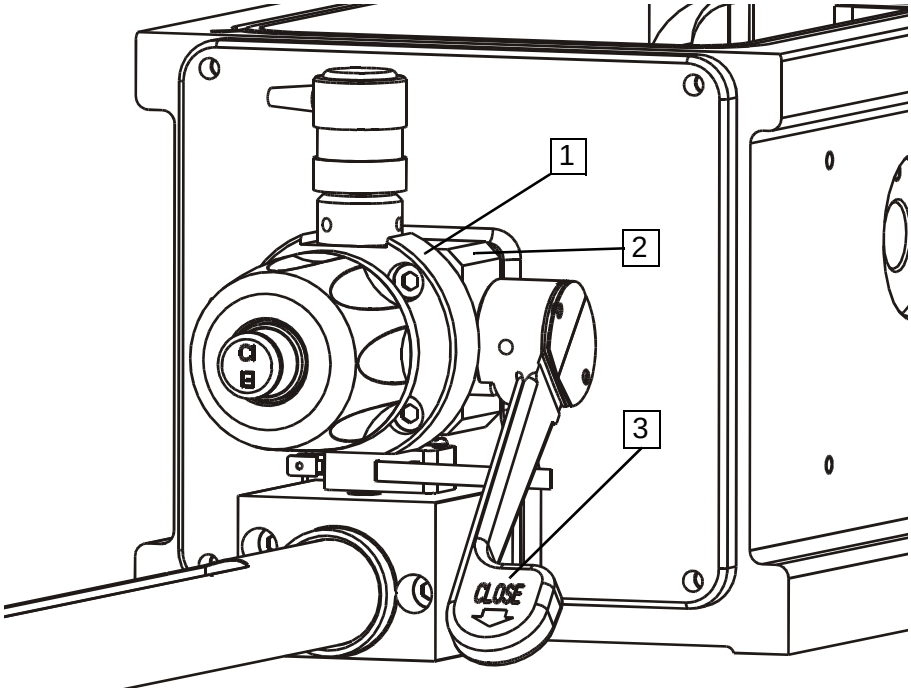
Theory of Operations

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 excess pressure is removed, the inlet valve can be opened which allows the I/R tool to be inserted into the vacuum manifold.

Excess pressure introduced into the inlet valve when inserting the I/R tool is removed through the foreline hose connection back to either a secondary rotary-vane pump or the primary rotary-vane pump equipped with an expansion volume.

Ball Valve

A ball valve 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.



1	Inlet Valve Block	3	Ball Valve Lever
2	Ball Valve Housing		

Figure 5-9 Ball Valve and Lever

The ball valve is open when the hole in the ball is aligned with the opening between the vacuum manifold and the inlet valve. When the ball valve is closed, it prevents the vacuum manifold from venting to atmosphere.

Ball Valve Lever

The ball valve lever opens and closes the ball valve. Open and close the ball valve with the ball valve lever. When the lever is up, the ball valve is open. The ball valve is closed when the lever is in the down position. The lever turns the ball valve to allow a probe device (sample probe or I/R tool) to enter the vacuum manifold.

Entry Housing

The entry housing is an aluminum chamber mounted on the vacuum manifold. The entry housing has an opening for the guide bar.

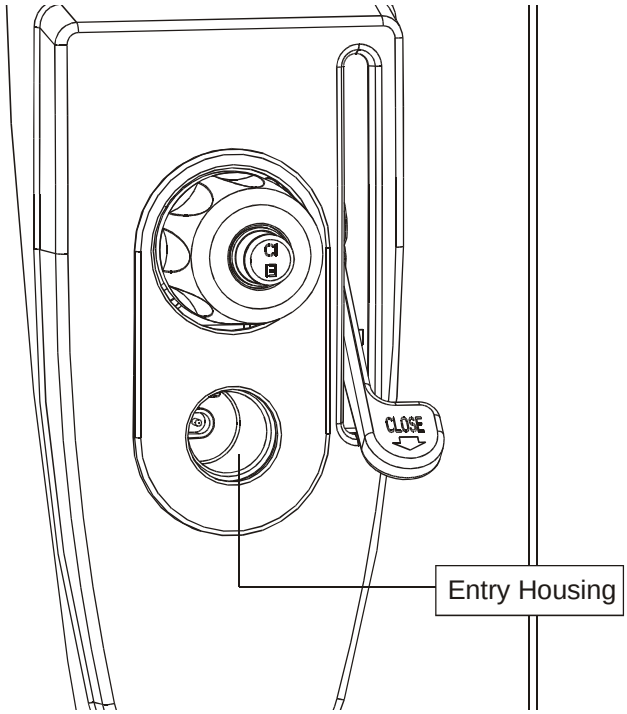
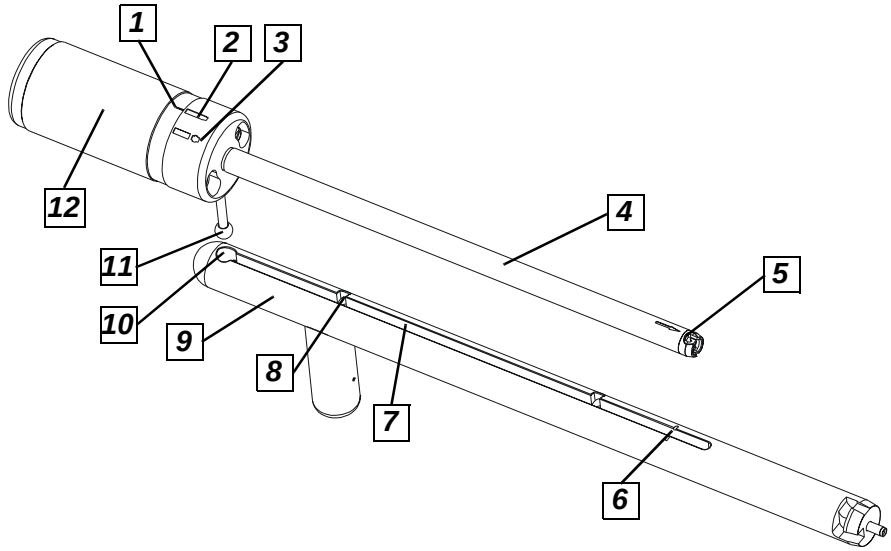


Figure 5-10 Entry Housing

I/R Tool and Guide Bar

The I/R tool is used to insert and remove ion volumes, and consists of a shaft, handle, and guide ball.



1	Alignment Line	7	Guide Bar Track
2	Hold Position	8	Guide Bar First Stop
3	Release 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

Figure 5-11 I/R Tool and Guide Bar

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, which closes access into the vacuum manifold. 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

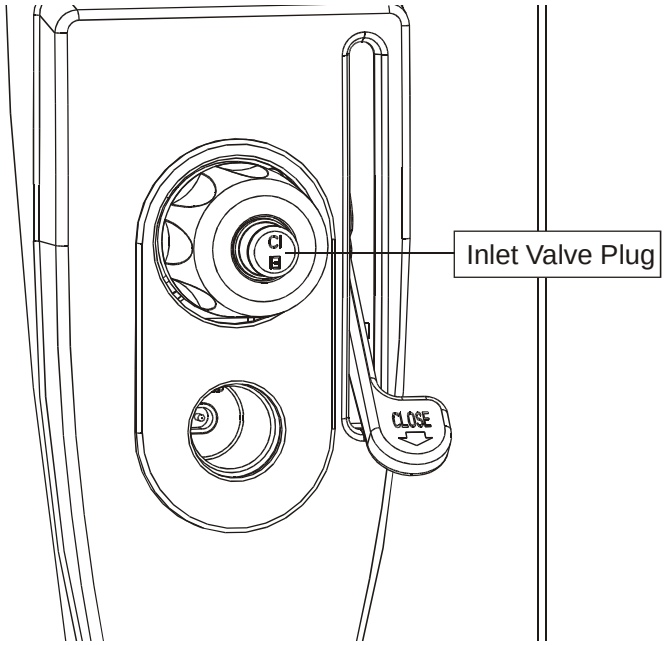


Figure 5-12 Inlet Valve Plug

The inlet valve plug 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 remind you whether an EI or CI ion volume is installed.

Inlet Valve Seal

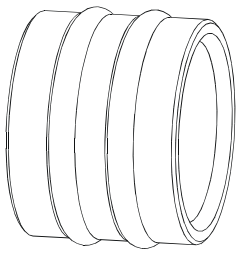


Figure 5-13 Inlet Valve Seal

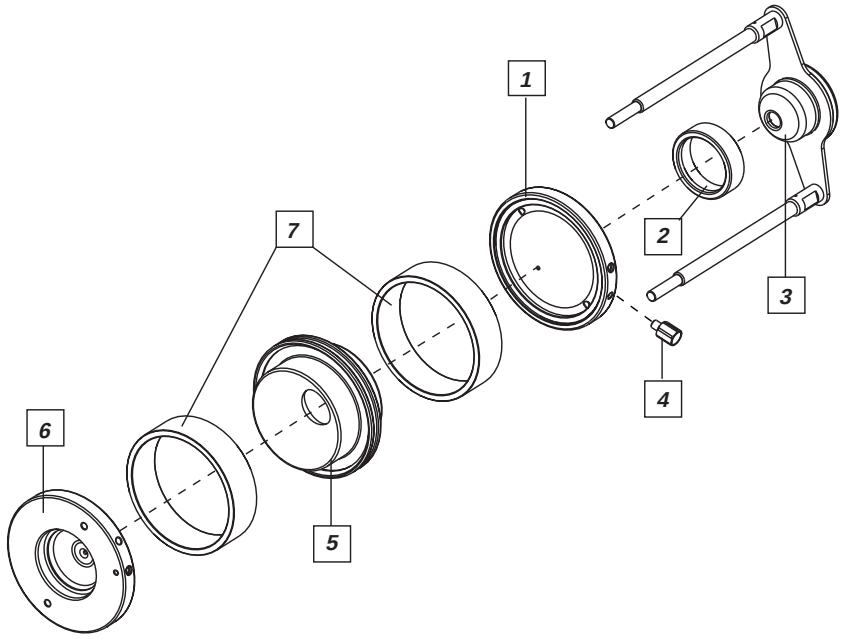
An inlet valve seal forms a vacuum-tight seal over the shaft of the I/R tool when it is inserted into the inlet valve. The inlet valve knob allows you to tighten the seal against the I/R tool to form a vacuum-tight seal. Or, you can loosen it to allow the I/R tool to be inserted and removed. You should replace the inlet valve seals periodically. Replacement instructions are in **Chapter 2: Maintenance**.

Ordering Information

Part Number	Description
119265-0003	Inlet Valve Seal
76461-2002	Replacement Ball Valve Seals
119554-0001	Ball Valve Lever
119273-0001	Inlet Valve Plug
119687-0010	Guide Bar
96000-60057	I/R Tool

Chapter 6
Ion Trap System

An ion trap, also called the mass analyzer, is the site of ion storage and mass analysis in the mass spectrometer.



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

Figure 6-1. Ion Trap (Top View)

Description

The ion trap, located within the vacuum manifold between the ion source and ion detector system, separates ionic species according to their mass-to-charge ratios of the ions. The Polaris*Q* uses a quadrupole ion trap mass analyzer.

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 Cavity.

Entrance endcap, exit endcap, and ring electrodes are separated by two spacer rings, which position them at the proper separation and also serve as electrical insulators.

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 electrodes to draw ions in from the Ion Source. Typically, the magnitude voltage is -10 V for positive ion polarity mode and +10 V for negative ion polarity mode. Ions enter the ion trap through the entrance endcap electrode, and helium damping gas enters through an inlet in the exit endcap electrode.

Ions entering the ion trap fulfill four functions:

- store ions
- isolate ions (SIM, MS/MS)
- collision induced dissociation (MS/MS)
- mass analysis

Sample ions formed in the ion source are trapped in the ion trap if the ions have mass-to-charge ratios greater than the minimum storage mass, and the ions are not rejected by the ionization waveform voltage.

Store Ions

After an optimum number of ions are trapped, the ionization waveform voltage turns off. The main RF storage voltage remains on.

Isolate Ions

For SIM and MS/MS analyses, the isolation waveform voltage is applied to the endcap electrodes. All ions eject, except the selected mass or narrow range of masses.

Collision Induced Dissociation

For MS/MS analyses, the resonance excitation RF voltage applied to the endcap electrodes causes collision induced dissociation. Product ions with masses greater than the minimum storage mass are stored.

Mass Analysis

Sample ions or product ions are separated by mass. The RF voltage applied to the ring electrode ramps from low to high voltage, and the resonance ejection RF voltage applied to the endcap electrodes facilitates ion ejection. As the main RF voltage increases, ions of greater mass-to-charge ratios become unstable and eject. The exit lens focuses the ions towards the ion detector.

Ordering Information

Part Number	Description
119650-0520	End Cap (Entrance or Exit)
119650-0525	Ring Electrode
119650-0532	Helium Inlet
119650-0540	Spacer
119650-0530	Exit Lens
119650-0515	Exit Lens Spacer

Chapter 7
Ion Detector System

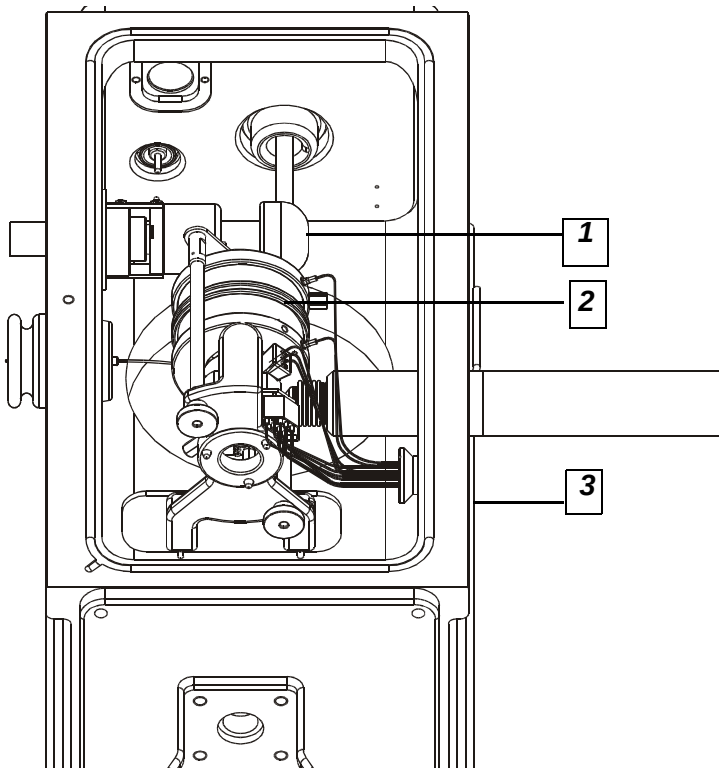
This chapter contains theory of operations for ion detector system components.

7.1 Conversion Dynode, 7-2

7.2 Electron Multiplier, 7-4

7.1 Conversion Dynode

The conversion dynode mounts inside the vacuum manifold, directly behind the ion trap.



1	Conversion Dynode	3	Vacuum Manifold
2	Ion Trap		

Figure 7-1. Ion Detector System (top view)

Description

A conversion dynode is a concave metal surface located at a right angle to the ion beam. A potential of +10 kV for negative ion detection or -10 kV for positive ion detection is applied to the conversion dynode.

The ion detector system increases signal and decreases noise. High voltage applied to the conversion dynode results in a high conversion efficiency and increased signal. That is, for each ion striking the conversion dynode, many secondary particles are produced. The increase in conversion efficiency is more pronounced for more massive ions than for less massive ions. This mass dependent gain factor minimizes detector noise due to the ionization of air and water, because these ions are of low mass.

Theory of Operations

When an ion strikes the surface of the conversion dynode, one or more secondary particles are produced. These secondary particles can include positive ions, negative ions, protons, electrons, and neutrals. When positive ions strike a negatively charged conversion dynode, the secondary particles are negative ions and electrons. When negative ions strike a positively charged conversion dynode, the secondary particles are positive ions and protons. These secondary particles are focused by the curved surface of the conversion dynode and accelerated by a voltage gradient into the electron multiplier.

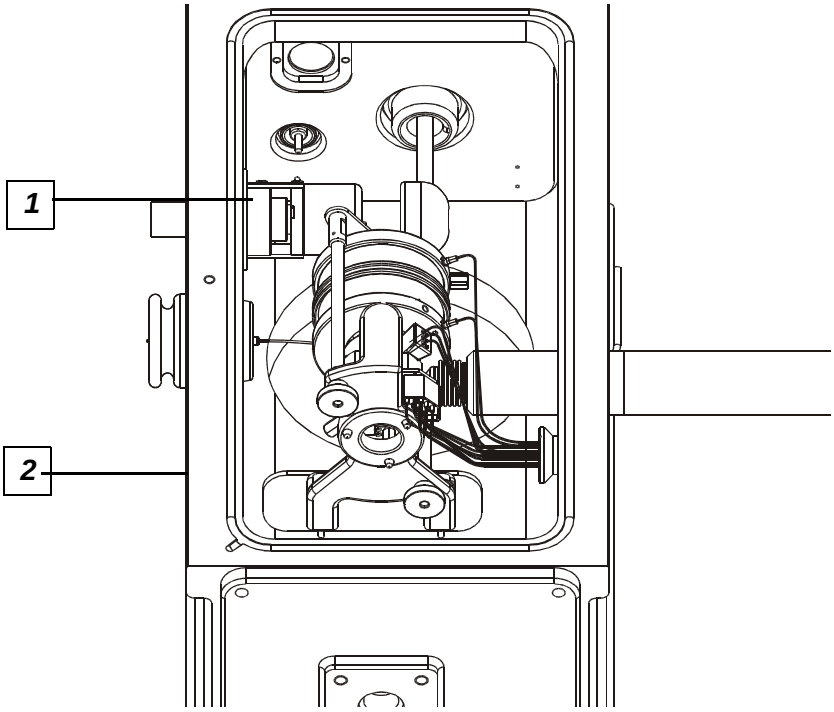
Because of the off-axis orientation of the ion detector system relative to the ion trap, neutral molecules from the mass analyzer tend not to strike the conversion dynode or electron multiplier. Thus, neutral noise reduces.

Ordering Information

Part Number	Description
96000-20150	Conversion Dynode, Assy

7.2 Electron Multiplier

The electron multiplier mounts inside the vacuum manifold on the left side.



1	Electron Multiplier	2	Vacuum Manifold

Figure 7-2. Electron Multiplier

Description

An electron multiplier is a device that amplifies a current by generating an electron cascade from an oxide-coated surface of an electrode. The two primary components of an electron multiplier are the cathode and anode.

Cathodes serve as the electrode the electron multiplier uses to generate the electron cascade. It is a lead oxide funnel-like resistor, which receives a potential of up to -3 kV from the high voltage ring. The exit end of the cathode is near ground potential, and is held in place by the high voltage ring, two support plates, the electron multiplier support, and the electron multiplier shield. A wave washer applies a force to the cathode to hold it in contact with the electron multiplier shield. The electron multiplier support is attached to the vacuum manifold by two screws.

The electron multiplier anode collects electrons produced by the cathode. It is a cup located at the exit end of the cathode and screws into the anode feedthrough on the left side of the vacuum manifold.

Theory of Operations

Secondary particles from the conversion dynode strike near the inner walls of the electron multiplier cathode with sufficient energy to eject electrons. The ejected electrons are accelerated farther into the cathode, drawn by the increasingly positive potential gradient. Due to the funnel shape of the cathode, the ejected electrons do not travel far before they again strike its inner surface, causing the emission of more electrons. Thus, a cascade of electrons is created that finally results in a measurable current at the end of the cathode where the electrons are collected by the electron multiplier anode. The current collected by the anode is proportional to the number of secondary particles striking the cathode.

Typically, the electron multiplier has a gain of about 10^5. If the current of ions and electrons entering the electron multiplier from the conversion dynode is 10^{-12} A, and the gain of the electron multiplier is 10^5, then a current of 10^{-7} A leaves the electron multiplier through the anode. This current is converted to a voltage by the electrometer circuit and recorded by the data system.

Ordering Information

Part Number	Description
96000-60036	Electron Multiplier
119619-20072	Anode Feedthru
96000-20076	Anode

Appendix A
Replaceable Parts

This appendix contains Polaris*Q* drawings and part numbers for replaceable parts and consumables.

To ensure proper results in servicing the Polaris*Q* system, order only the parts listed or their equivalent. Contact Thermo Finnigan Austin at (512) 251-1494. Please have your Polaris*Q* serial number ready when calling.

A.1 Vacuum Manifold, A-2

A.2 Analyzer Assembly, A-4

A.3 Ion Source, A-6

A.4 Ion Source Lenses, A-8

A.5 Ion Trap, A-10

A.6 Gas Inlets and Gauges, A-12

A.7 PCBs and Cables, A-16

A.8 Diffusion Pump, A-24

A.9 Turbomolecular Pump, A-26

A.10 Inlet Valve (Upgrade Option), A-28

A.11 Power Module, A-30

A.12 Installation Kit, A-31

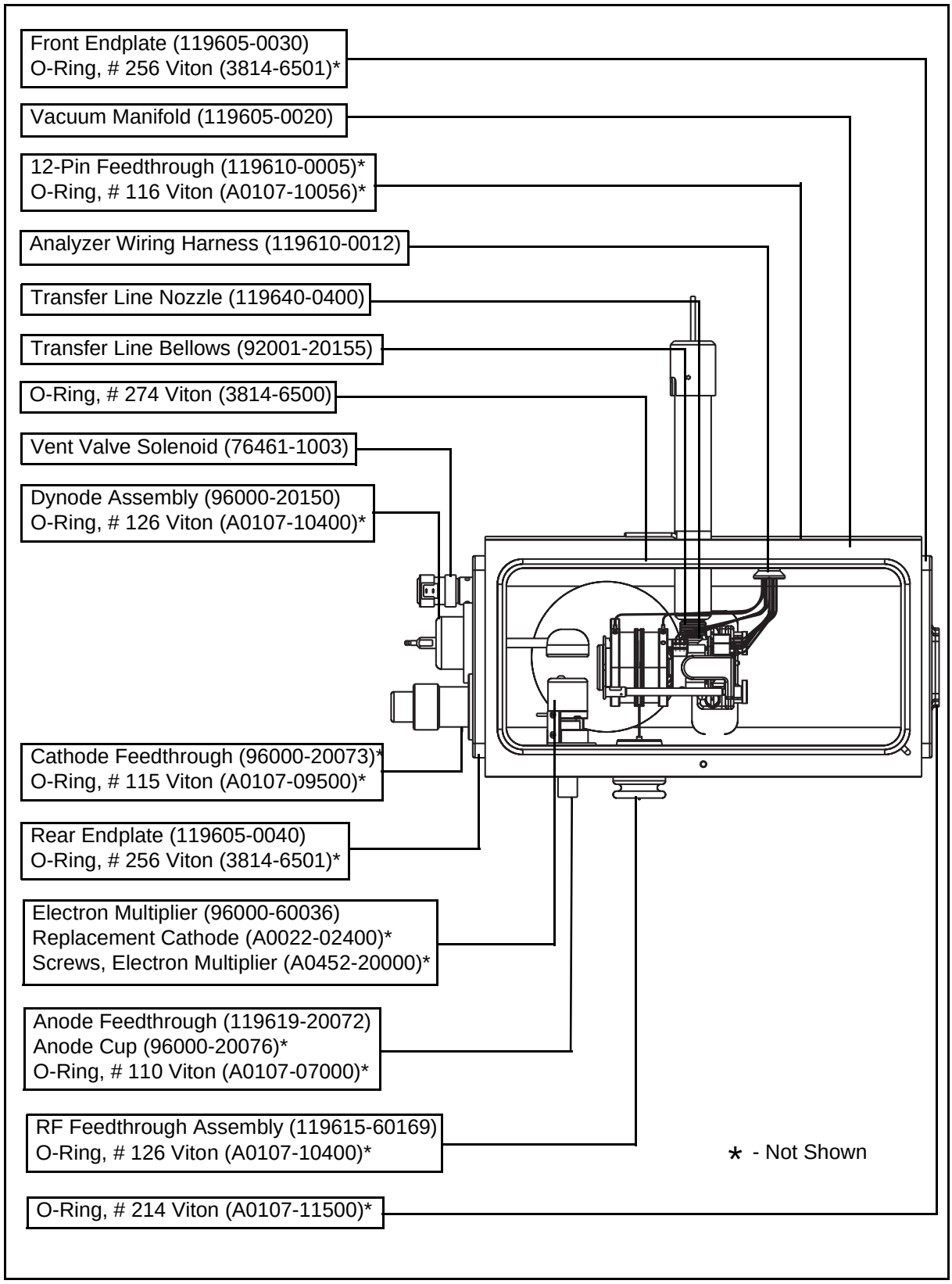
A.13 Document Set, A-32

A.14 Miscellaneous Items, A-33

A.1 Vacuum Manifold

Table A-1. Vacuum Manifold Parts List

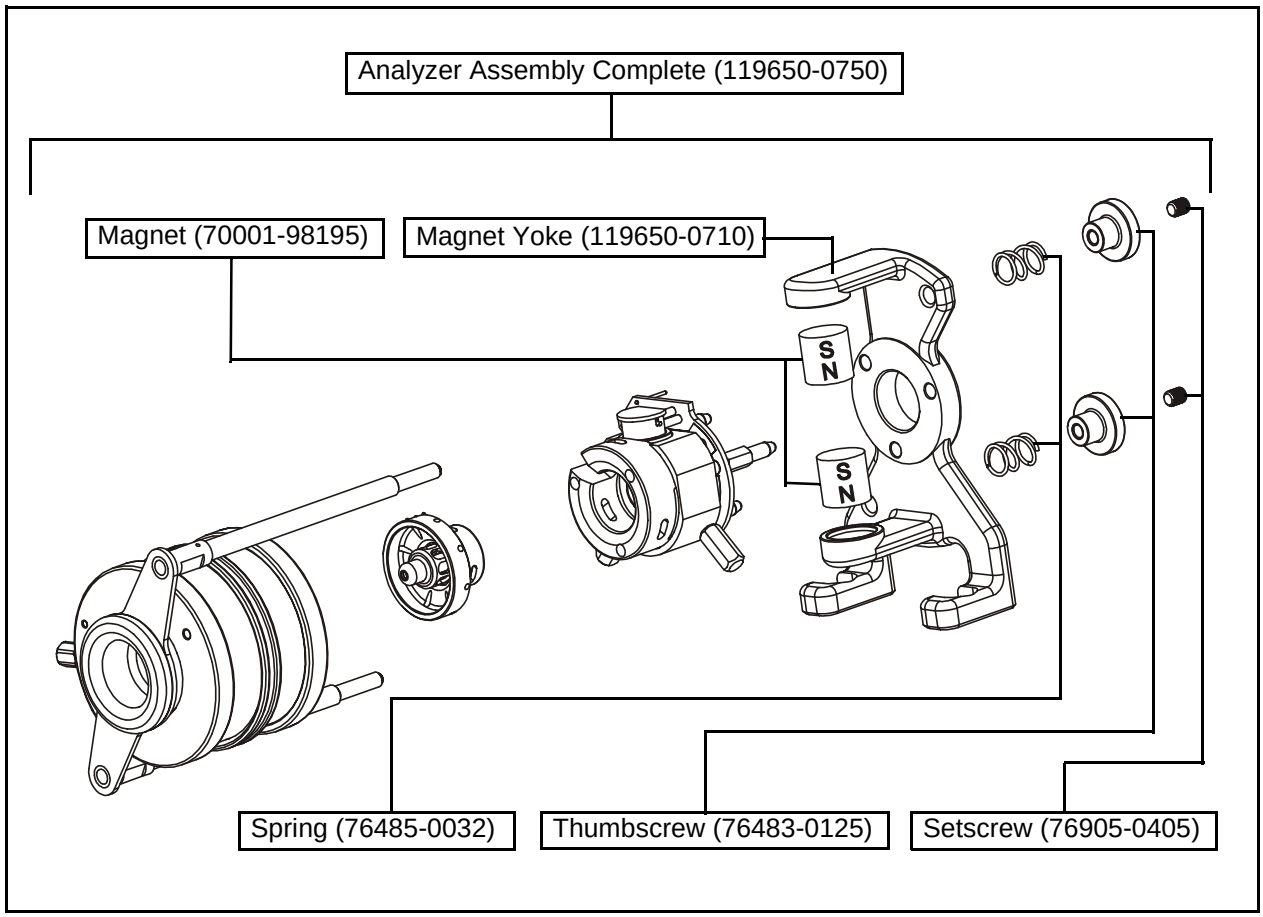
Description	Part Number
12-Pin Feedthrough	119610-0005
Analyzer Wiring Harness	119610-0012
Anode Cup	96000-20076
Anode Feedthrough	119619-20072
Cathode Feedthrough	96000-20073
Dynode Assembly	96000-20150
Electron Multiplier	96000-60036
Front Endplate	119605-0030
O-Ring, # 110 Viton	A0107-07000
O-Ring, # 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	A0452-20000
Transfer Line Bellows	92001-20155
Transfer Line Nozzle	119640-0400
Vacuum Manifold	119605-0020
Vent Valve Solenoid	76461-1003


Front Endplate (119605-0030)
O-Ring, # 256 Viton (3814-6501)*
Vacuum Manifold (119605-0020)
12-Pin Feedthrough (119610-0005)*
O-Ring, # 116 Viton (A0107-10056)*
Analyzer Wiring Harness (119610-0012)
Transfer Line Nozzle (119640-0400)
Transfer Line Bellows (92001-20155)
O-Ring, # 274 Viton (3814-6500)
Vent Valve Solenoid (76461-1003)
Dynode Assembly (96000-20150)
O-Ring, # 126 Viton (A0107-10400)*
Cathode Feedthrough (96000-20073)*
O-Ring, # 115 Viton (A0107-09500)*
Rear Endplate (119605-0040)
O-Ring, # 256 Viton (3814-6501)*
Electron Multiplier (96000-60036)
Replacement Cathode (A0022-02400)*
Screws, Electron Multiplier (A0452-20000)*
Anode Feedthrough (119619-20072)
Anode Cup (96000-20076)*
O-Ring, # 110 Viton (A0107-07000)*
RF Feedthrough Assembly (119615-60169)
O-Ring, # 126 Viton (A0107-10400)*
* - Not Shown
O-Ring, # 214 Viton (A0107-11500)*

A.2 Analyzer Assembly

Table A-2. Analyzer Assembly (complete)

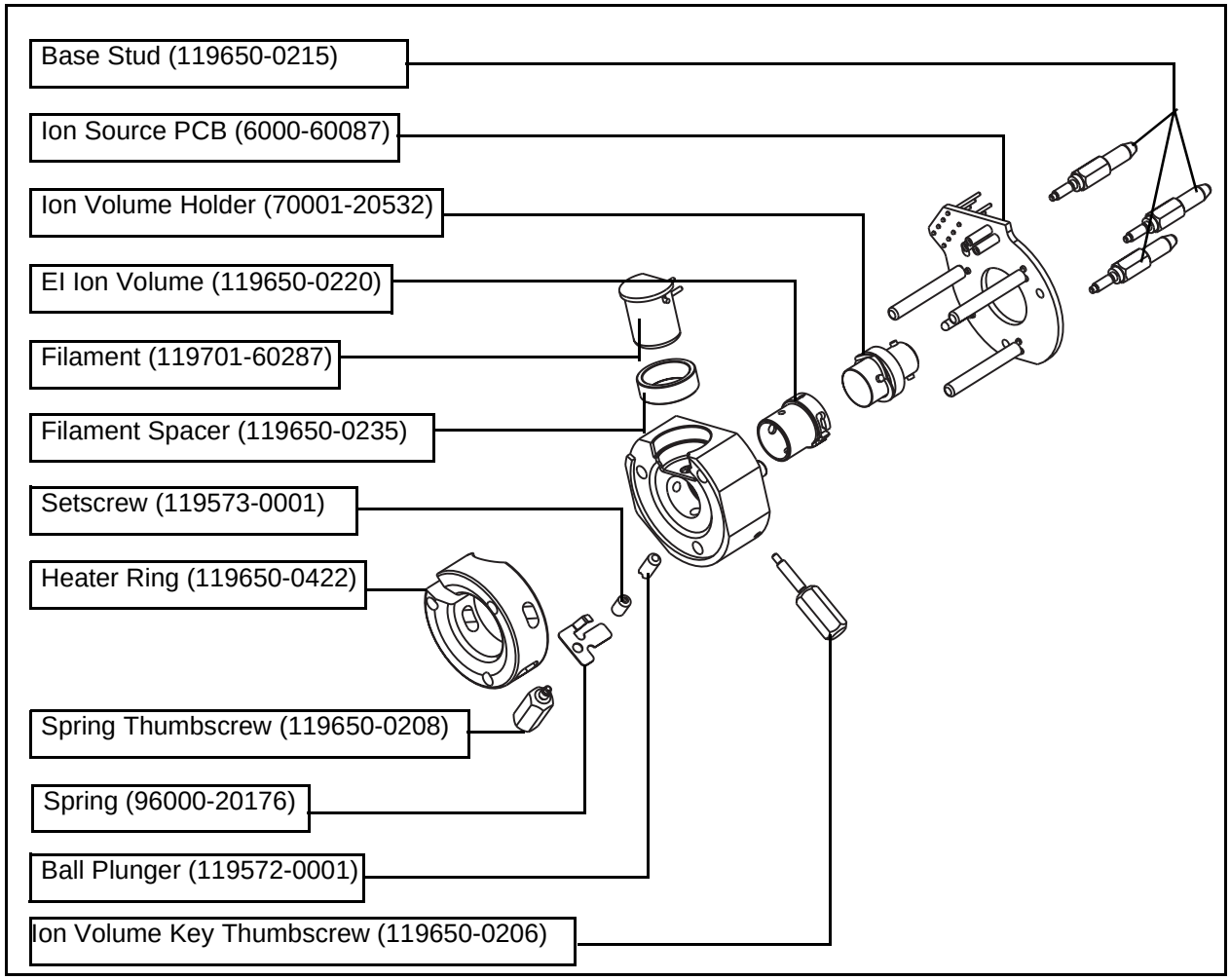
Description	Part Number
Analyzer Assembly	**119650-0750**
Includes:	
Magnet	70001-98195
Magnet Yoke	119650-0710
Setscrew	76905-0405
Spring	76485-0032
Thumbscrew	76483-0125


Analyzer Assembly Complete (119650-0750)
Magnet (70001-98195)
Magnet Yoke (119650-0710)
S
N
S
N
Spring (76485-0032)
Thumbscrew (76483-0125)
Setscrew (76905-0405)

A.3 Ion Source

Table A-3. Ion Source Parts List

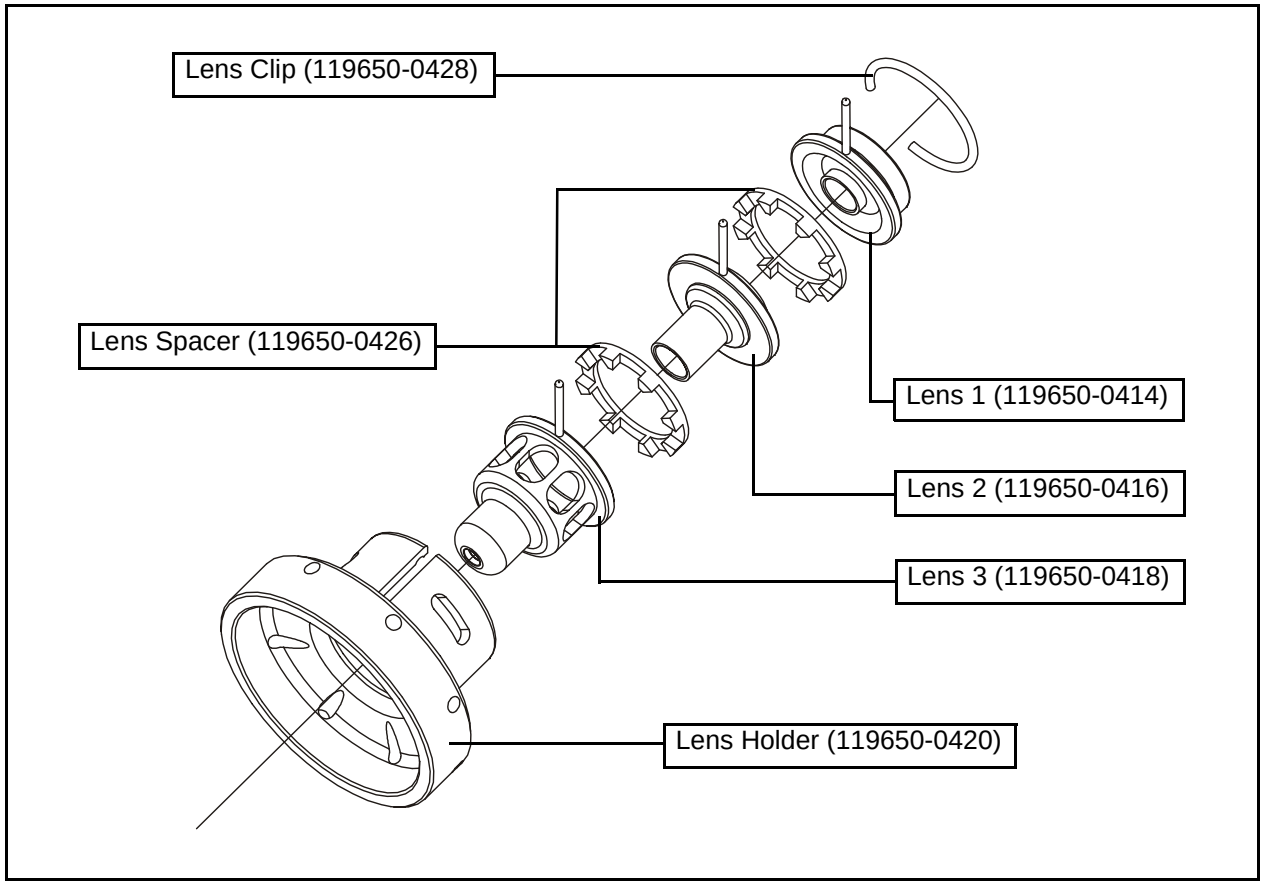
Description	Part Number
Ball Stud	119650-0215
Ball Plunger	119572-0001
CI Ion Volume	119650-0230
EI Ion Volume	119650-0220
EI/CI Combo Ion Volume	119650-0240
Filament	119701-60287
Filament Spacer	119650-0235
Heater Ring	119650-0422
Ion Source PCB	96000-60087
Ion Volume Key Thumbscrew	119650-0206
Ion Volume Holder	70001-20532
Setscrew	119573-0001
Spring	96000-20176
Spring Thumbscrew	119650-0208


Base Stud (119650-0215)
Ion Source PCB (6000-60087)
Ion Volume Holder (70001-20532)
EI 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)

A.4 Ion Source Lenses

Table A-4. Ion Source Lenses Parts List

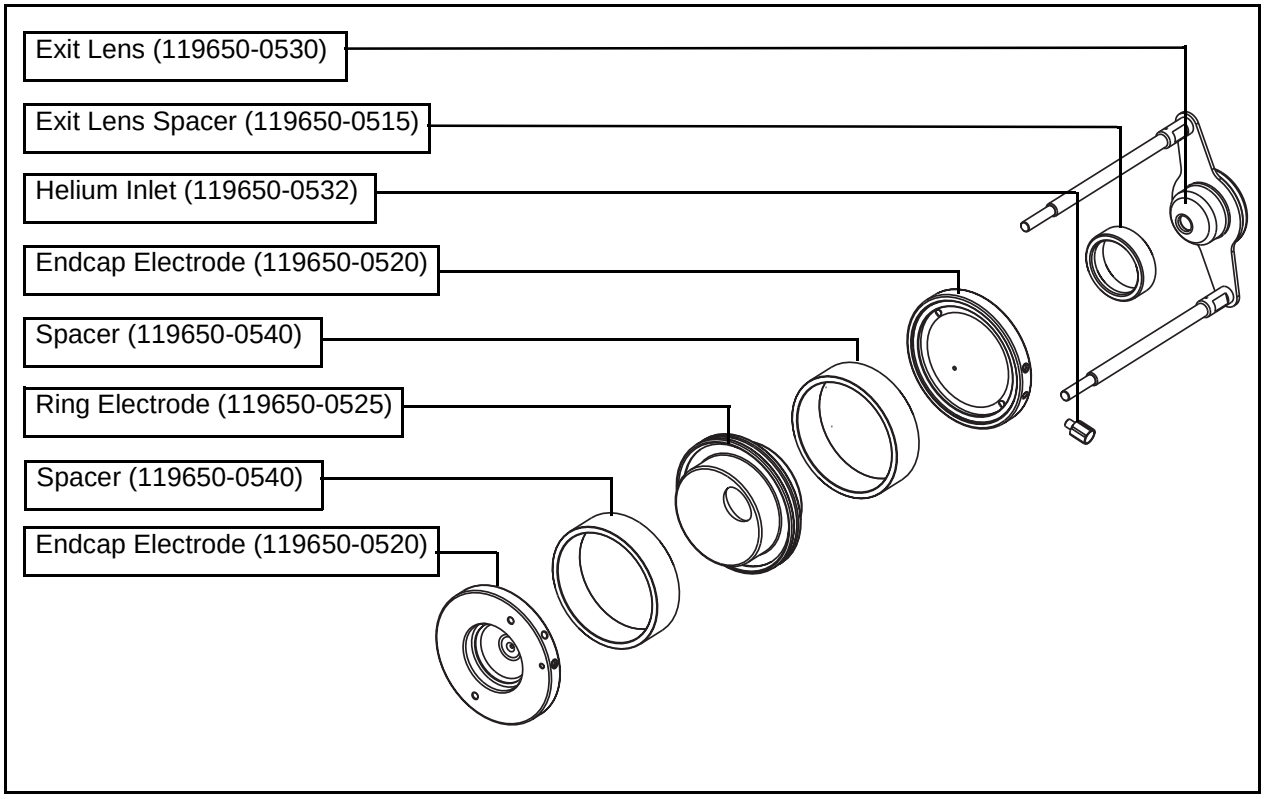
Description	Part Number
Lens 1	119650-0414
Lens 2	119650-0416
Lens 3	119650-0418
Lens Clip	119650-0428
Lens Holder	119650-0420
Lens Spacer	119650-0426


Lens Clip (119650-0428)
Lens Spacer (119650-0426)
Lens 1 (119650-0414)
Lens 2 (119650-0416)
Lens 3 (119650-0418)
Lens Holder (119650-0420)

A.5 Ion Trap

Table A-5. Ion Trap Parts List

Description	Part Number
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)

A.6 Gas Inlets and Gauges

Table A-6. Gas Inlets and Gauges Parts List (left cover)

Description	Part Number
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
CI Reagent Gas Flow Module	23331-0090
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

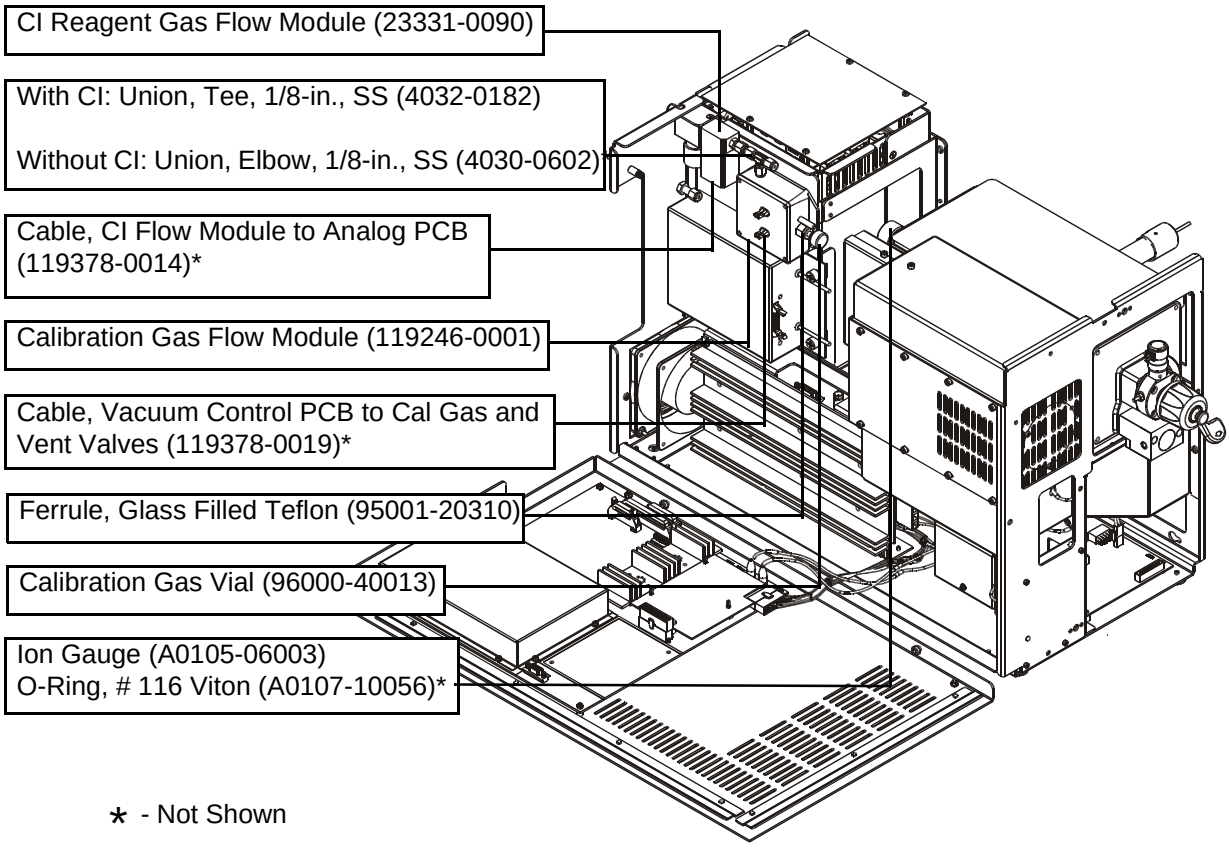
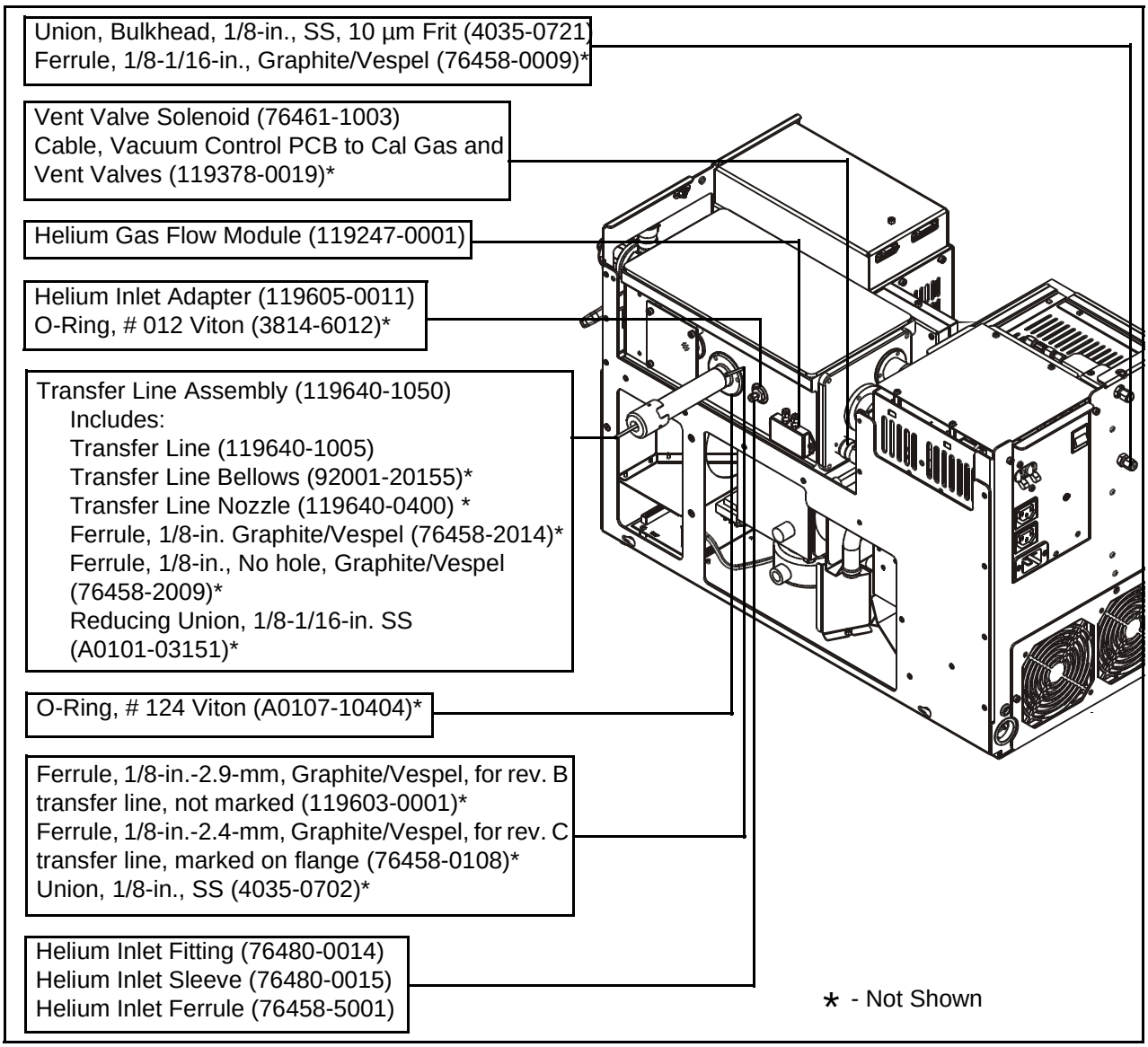

CI Reagent Gas Flow Module (23331-0090)
With CI: Union, Tee, 1/8-in., SS (4032-0182)
Without CI: Union, Elbow, 1/8-in., SS (4030-0602)
Cable, CI Flow Module to Analog PCB (119378-0014)*
Calibration Gas Flow Module (119246-0001)
Cable, Vacuum Control PCB to Cal Gas and Vent Valves (119378-0019)*
Ferrule, Glass Filled Teflon (95001-20310)
Calibration Gas Vial (96000-40013)
Ion Gauge (A0105-06003)
O-Ring, # 116 Viton (A0107-10056)*
* - Not Shown

Table A-7. Gas Inlets and Gauges Parts List (right cover)

Description	Part Number
Cable, Vacuum Control PCB to Calibration Gas and Vent Valves	119378-0019
Ferrule, 1/8-in.-2.9-mm, Graphite/Vespel (for rev. B transfer line, not marked)	119603-0001
Ferrule, 1/8-in.-2.4-mm, Graphite/Vespel (for rev. C transfer line, marked on flange)	76458-0108
Ferrule, 1/8-1/16-in., Graphite/Vespel	76458-0009
Helium Gas Flow Module	119247-0001
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	**119640-1050**
Includes:	
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 µm 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)*
Helium Gas Flow Module (119247-0001)
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)*
Ferrule, 1/8-in.-2.9-mm, Graphite/Vespel, for rev. B transfer line, not marked (119603-0001)*
Ferrule, 1/8-in.-2.4-mm, Graphite/Vespel, for rev. C transfer line, marked on flange (76458-0108)*
Union, 1/8-in., SS (4035-0702)*
Helium Inlet Fitting (76480-0014)
Helium Inlet Sleeve (76480-0015)
Helium Inlet Ferrule (76458-5001)
* - Not Shown

A.7 PCBs and Cables

Table A-8. PCBs and Cables Parts List (left cover)

Description	Part Number
Analog PCB	119590-0020
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
RF Generator PCB	119590-0060
Spacer, Analog PCB	76350-0056
Spacer, Digital to Analog PCB	119567-0001

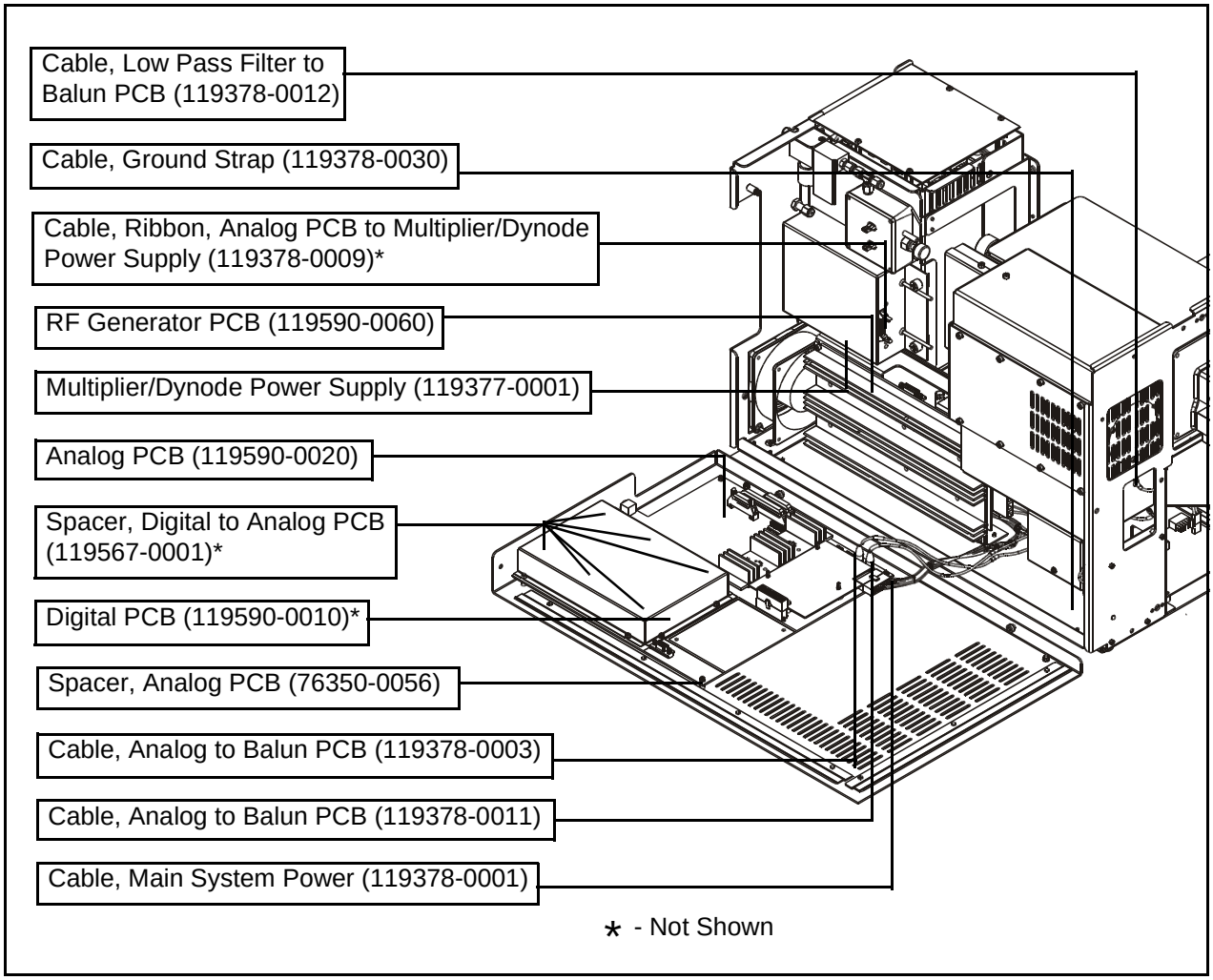

Cable, Low Pass Filter to Balun PCB (119378-0012)
Cable, Ground Strap (119378-0030)
Cable, Ribbon, Analog PCB to Multiplier/Dynode Power Supply (119378-0009)*
RF Generator PCB (119590-0060)
Multiplier/Dynode Power Supply (119377-0001)
Analog PCB (119590-0020)
Spacer, Digital to Analog PCB (119567-0001)*
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 A-9. PCB's and Cables Parts List (left cover)

Description	Part Number
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	119590-0100
Fan	119253-0001
Ion Gauge Control PCB	119590-0120
Ion Gauge Control PCB Standoff	76350-1007
Low Pass Filter PCB	119590-0080
Power Module 115 V	119655-0115
Power Module 230 V	119655-0230
RF Coil	119670-0001
Vacuum Control PCB	119590-0030

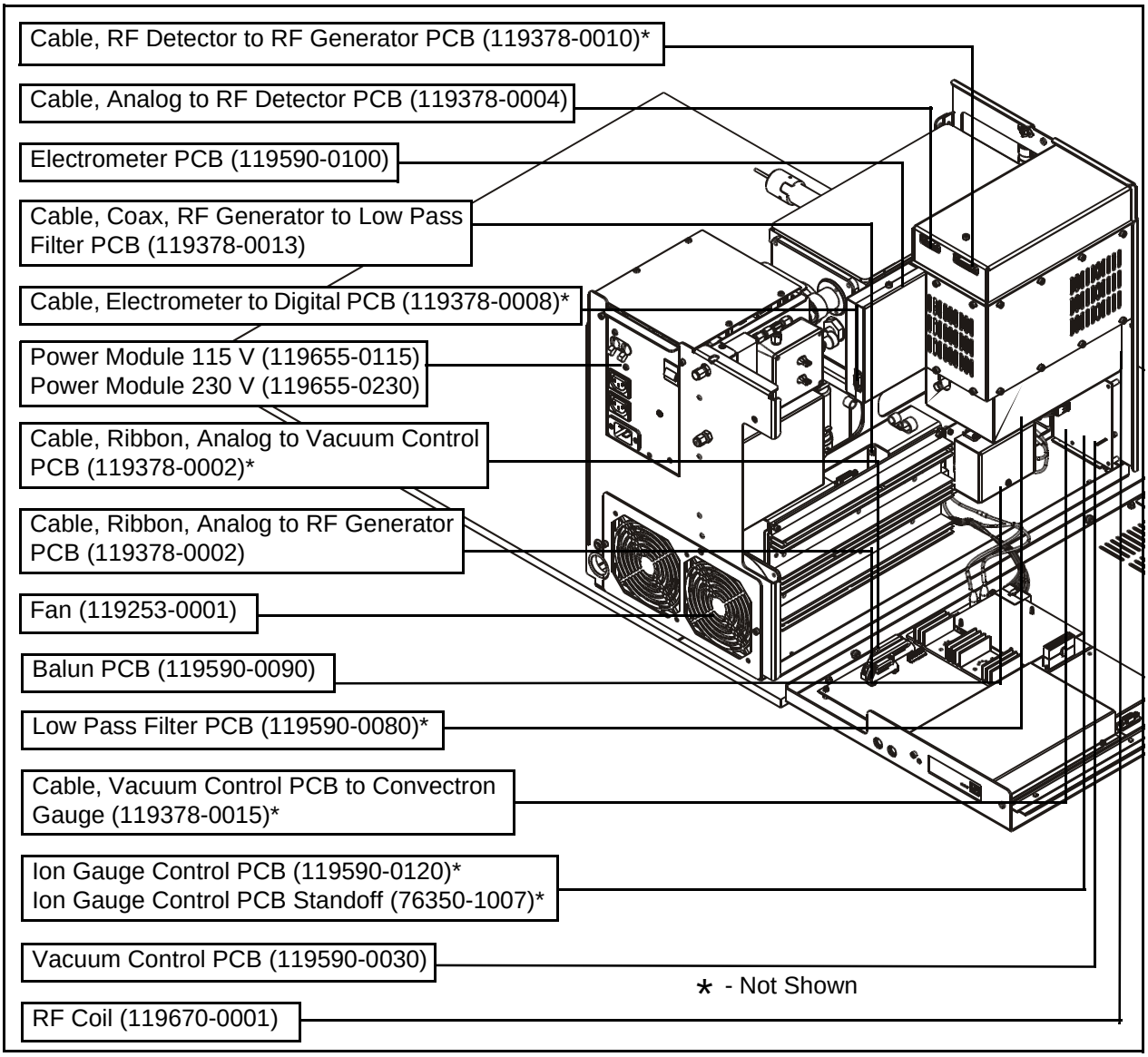

Cable, RF Detector to RF Generator PCB (119378-0010)*
Cable, Analog to RF Detector PCB (119378-0004)
Electrometer PCB (119590-0100)
Cable, Coax, RF Generator to Low Pass Filter PCB (119378-0013)
Cable, Electrometer to Digital PCB (119378-0008)*
Power Module 115 V (119655-0115)
Power Module 230 V (119655-0230)
Cable, Ribbon, Analog to Vacuum Control PCB (119378-0002)*
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 (119590-0030)
* - Not Shown
RF Coil (119670-0001)

Table A-10. PCB's and Cables Parts List (right cover)

Description	Part Number
Lens Interface PCB	119590-0110
Diffusion Pump Control PCB	119590-0040
Cable, Vacuum Control to Diffusion Pump Control PCB	119378-0016

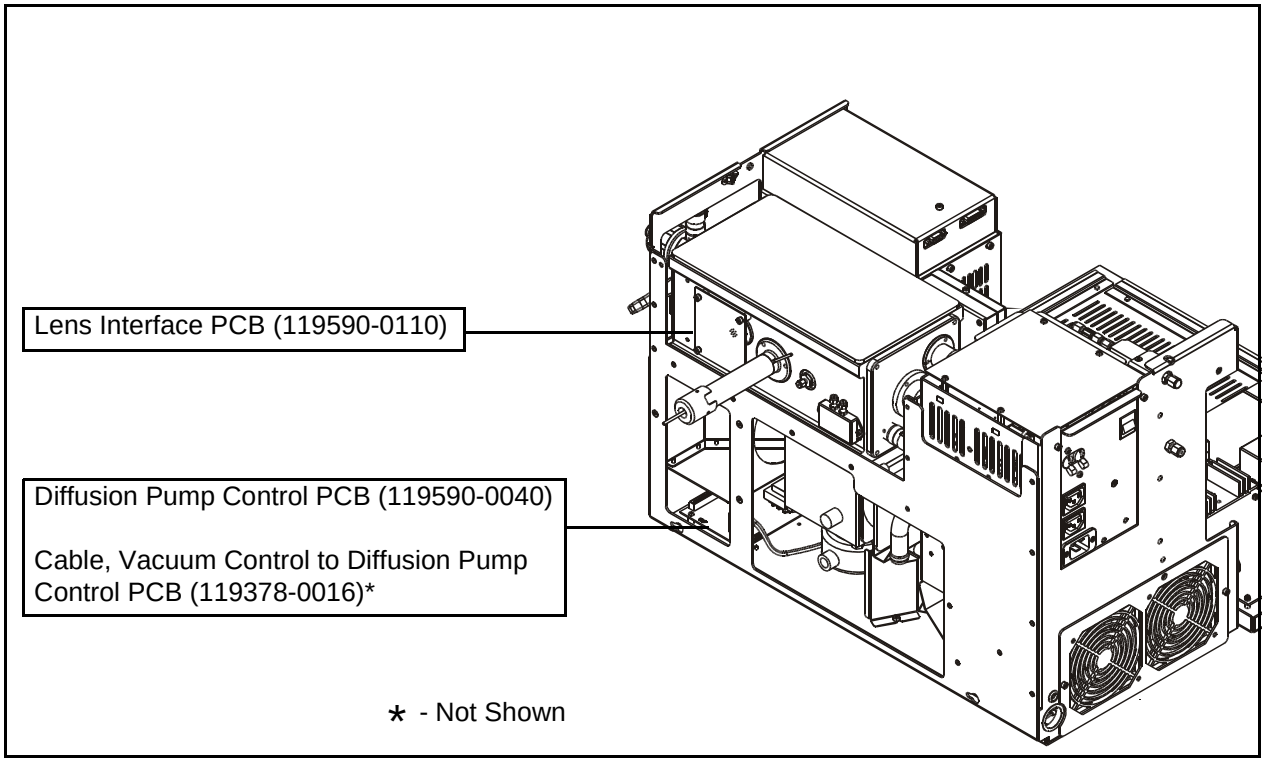
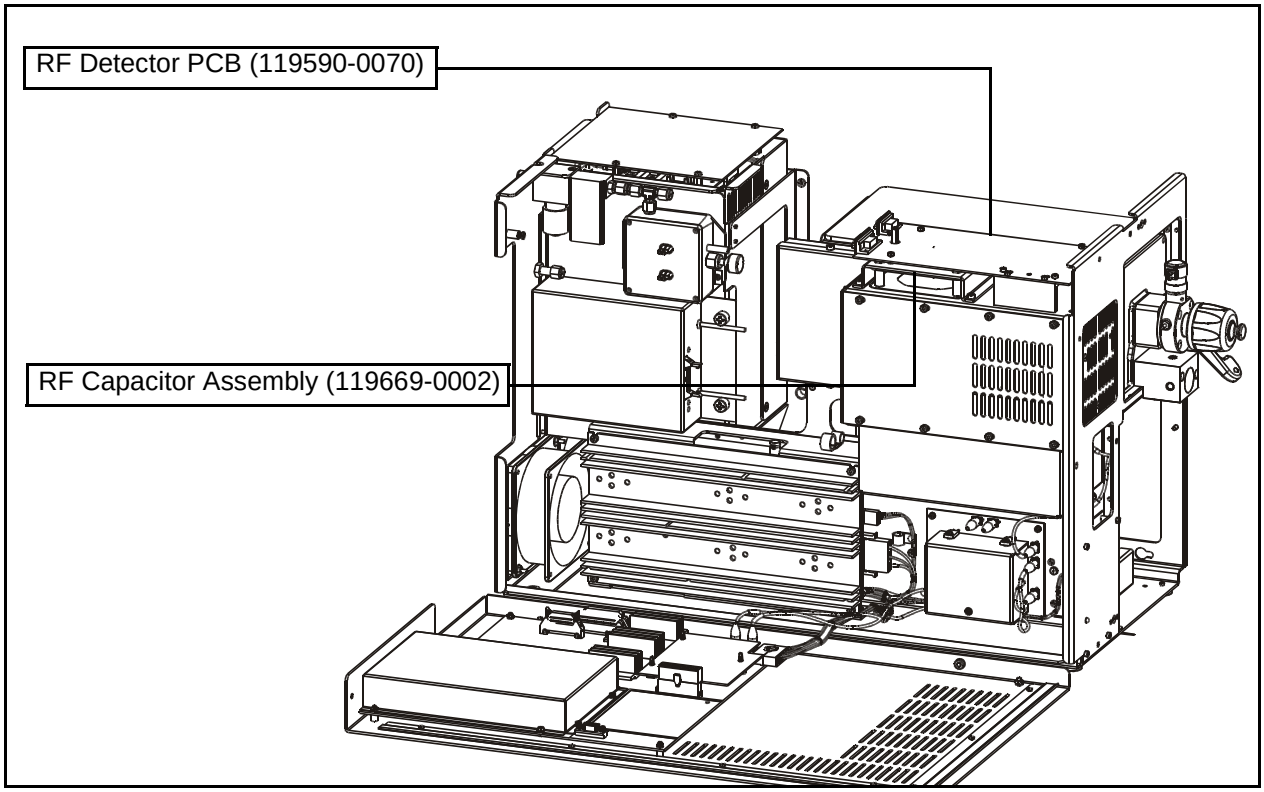

Lens Interface PCB (119590-0110)
Diffusion Pump Control PCB (119590-0040)
Cable, Vacuum Control to Diffusion Pump Control PCB (119378-0016)*
* - Not Shown

Table A-11. PCBs Parts List (under the RF Detector PCB cover)

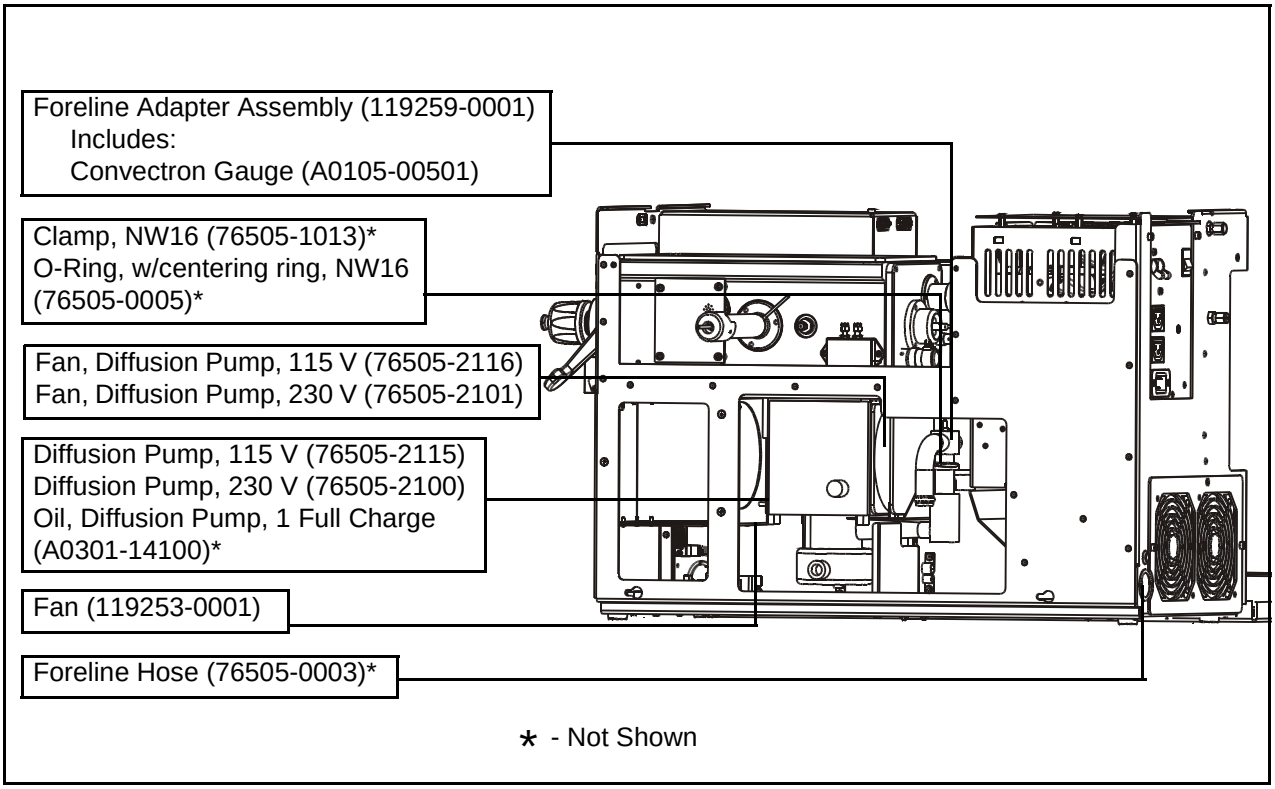
Description	Part Number
RF Detector PCB	119590-0070
RF Capacitor Assembly	119669-0002


RF Detector PCB (119590-0070)
RF Capacitor Assembly (119669-0002)

A.8 Diffusion Pump

Table A-12. Diffusion Pump Parts List

Description	Part Number
Clamp Nut, NW16	76505-1013
Diffusion Pump, 115 V	76505-2115
Diffusion Pump, 230 V	76505-2100
Fan	119253-0001
Fan, Diffusion Pump, 115 V	76505-2116
Fan, Diffusion Pump, 230 V	76505-2101
Foreline Adapter Assembly **Includes:** Convectron Gauge	**119259-0001** A0105-00501
Foreline Hose	76505-0003
Oil, Diffusion Pump, 1 Full Charge	A0301-14100
Oil, Rotary-Vane Pump, 1 L	A0301-15101
O-Ring, w/centering ring, NW16	76505-0005
Rotary-Vane Pump	119269-0001


Foreline Adapter Assembly (119259-0001)
Includes:
Convectron Gauge (A0105-00501)
Clamp, NW16 (76505-1013)*
O-Ring, w/centering ring, NW16 (76505-0005)*
Fan, Diffusion Pump, 115 V (76505-2116)
Fan, Diffusion Pump, 230 V (76505-2101)
Diffusion Pump, 115 V (76505-2115)
Diffusion Pump, 230 V (76505-2100)
Oil, Diffusion Pump, 1 Full Charge (A0301-14100)*
Fan (119253-0001)
Foreline Hose (76505-0003)*
* - Not Shown

A.9 Turbomolecular Pump

Table A-13. 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	76330-0100

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 (119259-0002)
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)*

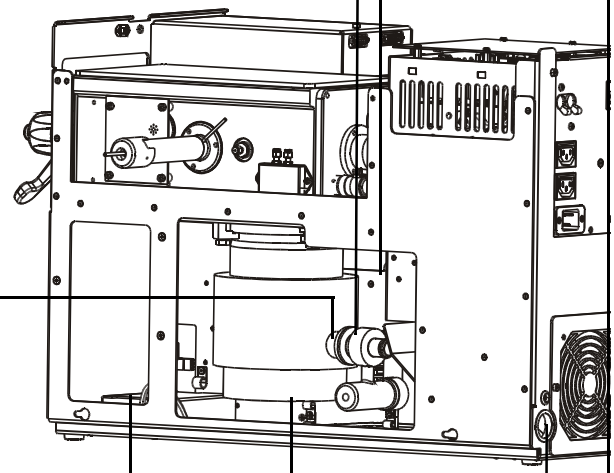
Turbo Pump Power Supply (76330-0100)

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)*

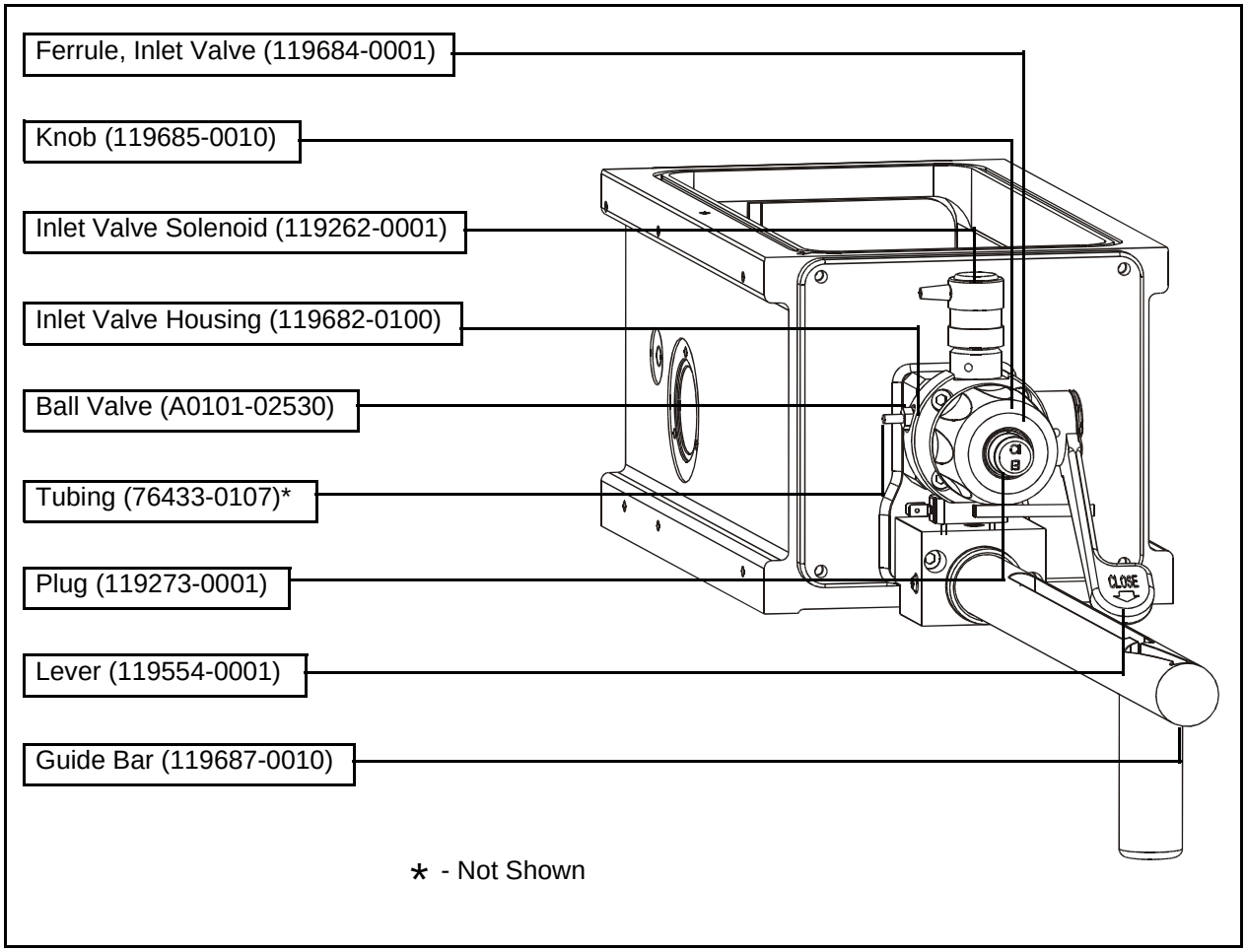


* - Not Shown

A.10 Inlet Valve (Upgrade Option)

Table A-14. Inlet Valve Parts List

Description	Part Number
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	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


Ferrule, Inlet Valve (119684-0001)
Knob (119685-0010)
Inlet Valve Solenoid (119262-0001)
Inlet Valve Housing (119682-0100)
Ball Valve (A0101-02530)
Tubing (76433-0107)*
Plug (119273-0001)
Lever (119554-0001)
Guide Bar (119687-0010)
* - Not Shown

A.11 Power Module

Table A-15. Power Module Components

Description	Part Number
Power Module	
115 V:	**119655-0115**
230 V:	**119655-0230**
Circuit Breaker, 15 A, 115 V	A0019-00520
Circuit Breaker, 10 A, 230 V	A0019-00505
Fuse, 3.15 A SB, 5x20 mm, 250 V (F1, F2)	A0006-10510
HV Regulator PCB	119590-0050
Line Filter	A0007-18349
Power Cord, 115 V (NEMA 5-20P plug)	96000-98034
Power Cord, 230 V (no plug)	96000-98036
Power Supply 1 (+5, ±15, +24 V)	76330-0225
Power Supply 2 (+36, -28 V)	A0012-24223
Power Supply 3 (+5, ±12 V)	76330-0080
Transformer	119376-0002

A.12 Installation Kit

Table A-16. Installation Kit Parts List

Description	Part Number
Kit, Installation, Polaris*Q*	**119255-0001**
Includes:	
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
Copper Tubing, Precleaned, 25 ft	76381-0041
Cotton Gloves, Medium	A0301-09710
Cotton Tipped Applicators (1 pack)	A0301-0200
Filament	119701-60287
Front Ferrule, 1/8-in., Brass	A0101-08500
Fuse, 2A 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 Volume Tool	119270-0001
Nut, 1/8-in., Brass	A0101-15500
Oxygen, Hydrocarbon, Moisture Trap	A0950-01500
Preinstallation Manual	120011
Test Mix, 100 ng/µL decafluorobenzophenone, benzophenone, methyl stearate	A0301-23057
Test mix, 100 pg/µL, 10 pg/µL, & 1 pg/µL decafluorobenzophenone	96000-98044
Union, Tee, 1/8-in., Brass	4032-0082

A.13 Document Set

Table A-17. PolarisQ Document Set Parts List

Description	Part Number
PolarisQ Mass Spectrometer Hardware Manual	120010
PolarisQ Preinstallation Guide	120011
Xcalibur-Getting Productive: Merlin the Custom Report Writer	Xcali-97001
Xcalibur-Getting Productive: Processing Setup	Xcali-97019
Xcalibur-Getting Productive: Qual Analysis	Xcali-97017
Xcalibur-Getting Productive: Quan Analysis	Xcali-97016

A.14 Miscellaneous Items

Table A-18. Miscellaneous Items

Description	Part Number
Cable, TRACE GC to PC	23098000
Cable, TRACE GC to Polaris*Q* Remote Start	76396-0050
Capillary Column, DB-5MS	A0012-08143
Ferrule, 1/16-in. to 0.4 mm, Graphite/Vespel	A0101-18100
Syringe, 10 µL w/70 mm Needle	36500103

Appendix B
Functional Block Diagrams

This appendix contains functional block diagrams for the Polaris*Q* system and its subsystems.

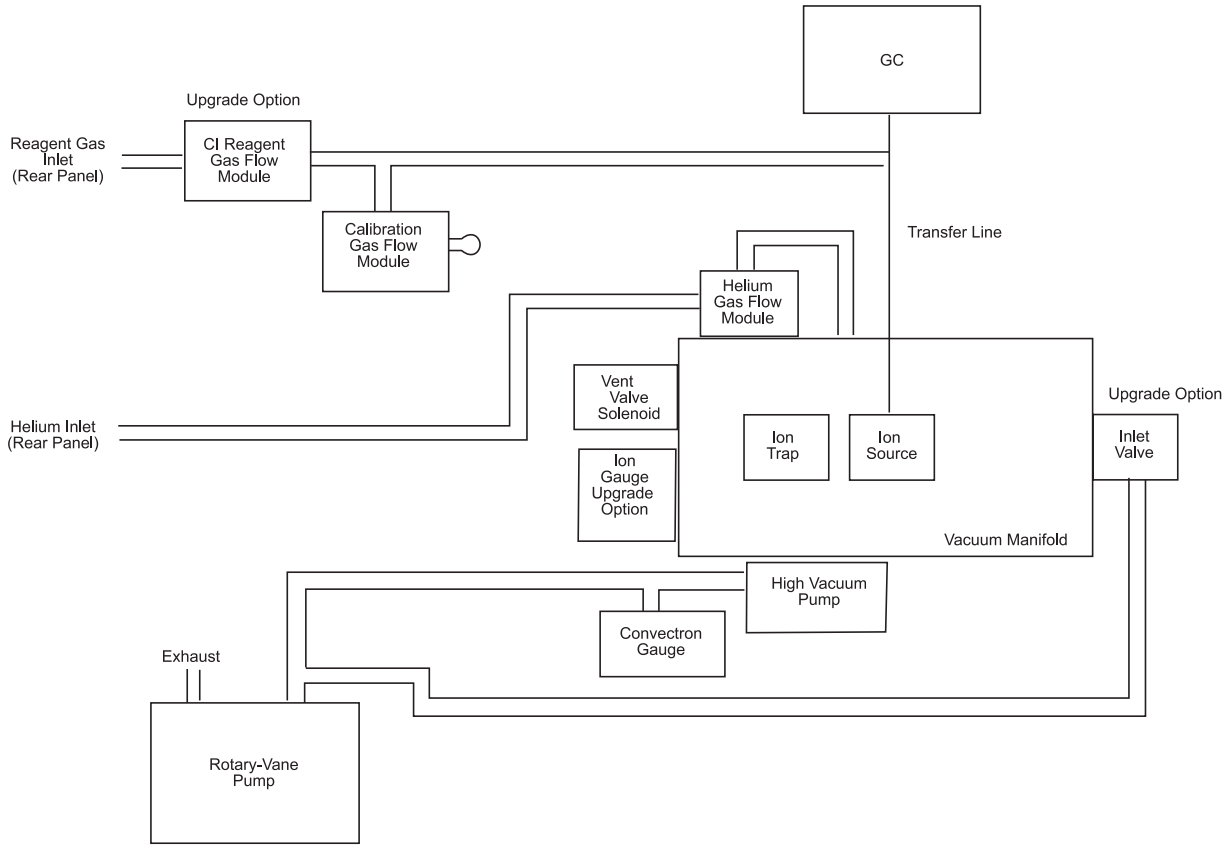


Figure B-1. Vacuum System and Gas Inlets

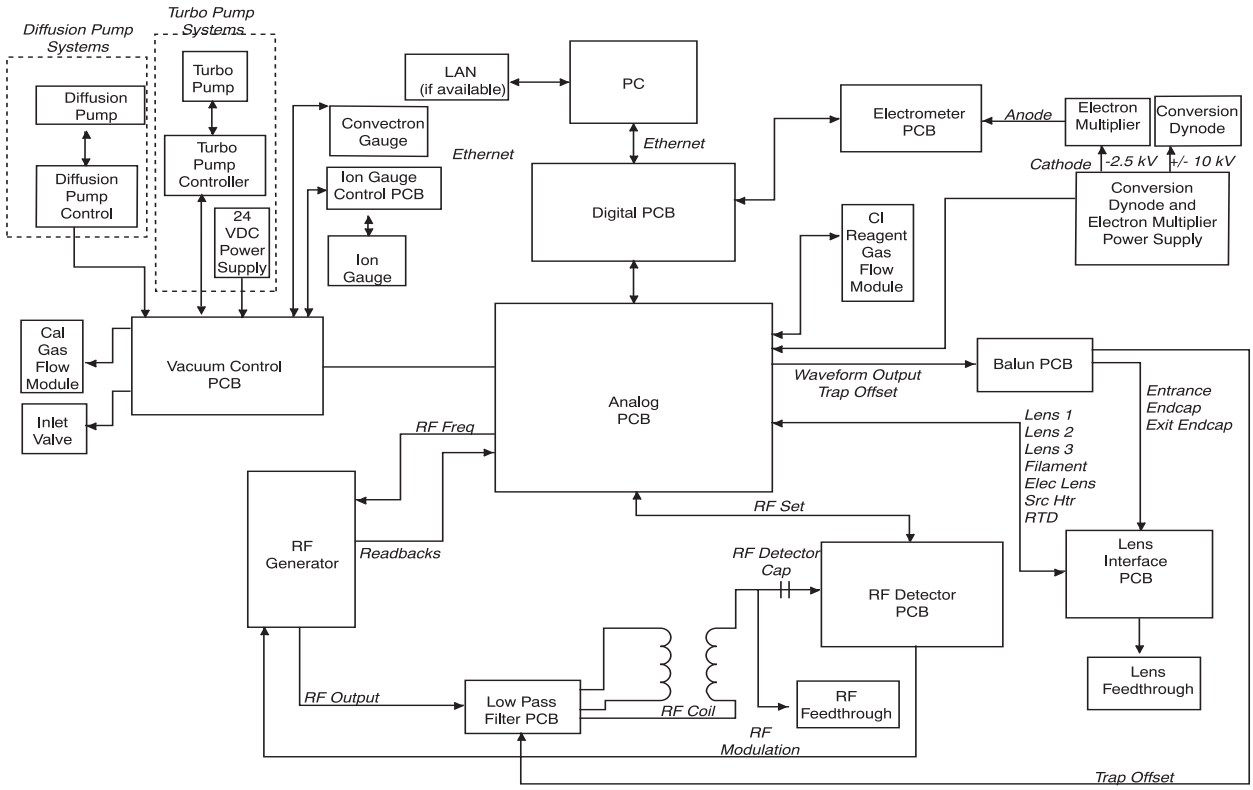


Figure B-2. Electronic Assemblies

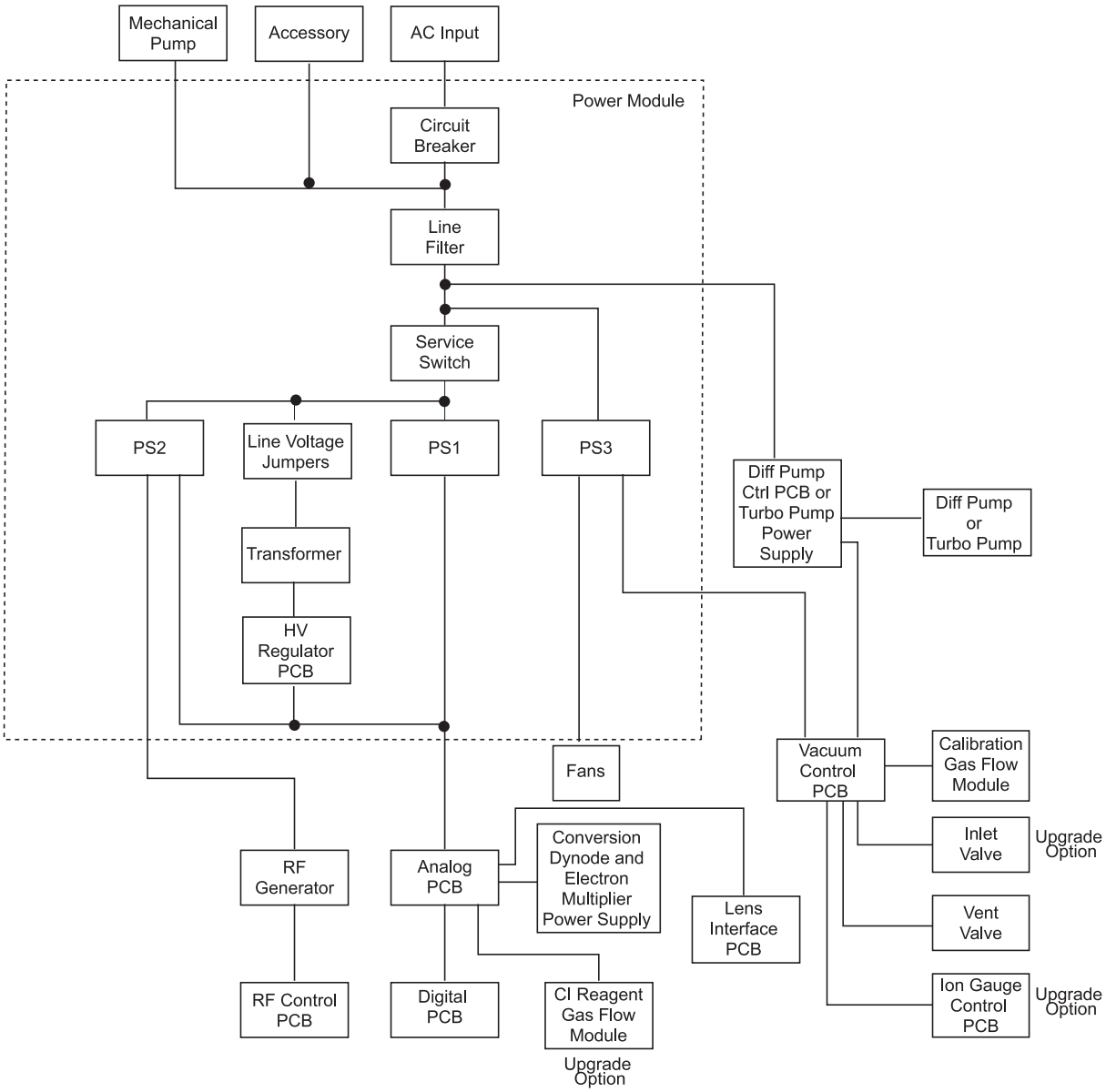
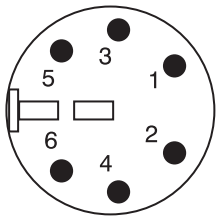


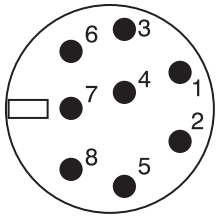
Figure B-3. Power Distribution

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
Inihibit Ready Out with Low Signal	8

Figure B-4. Remote Start Cable Connections (Back of Polaris*Q*)

The Polaris*Q* 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 Polaris*Q* and the other end into the device you intend to use to start injections.

* For electromagnetic compatibility, use a shielded cable. Tie the shield to the metal can of the connector.

** Use only with trigger bits (pins 1-3)

*** Polarity set in instrument configuration. Default is start when signal is low.

Appendix C
How to Find Xcalibur Help Topics

This appendix contains information on finding Help topics in the Xcalibur help files:

C.1 Xcalibur Home Page Help, page C-2

C.2 Xcalibur Instrument Setup Help, page C-3

C.3 Xcalibur Autosampler Help, page C-4

C.4 Xcalibur TRACE GC Help, page C-5

C.5 Xcalibur PolarisQ Help, page C-6

C.6 Xcalibur Tune Help, page C-7

C.1 Xcalibur Home Page Help

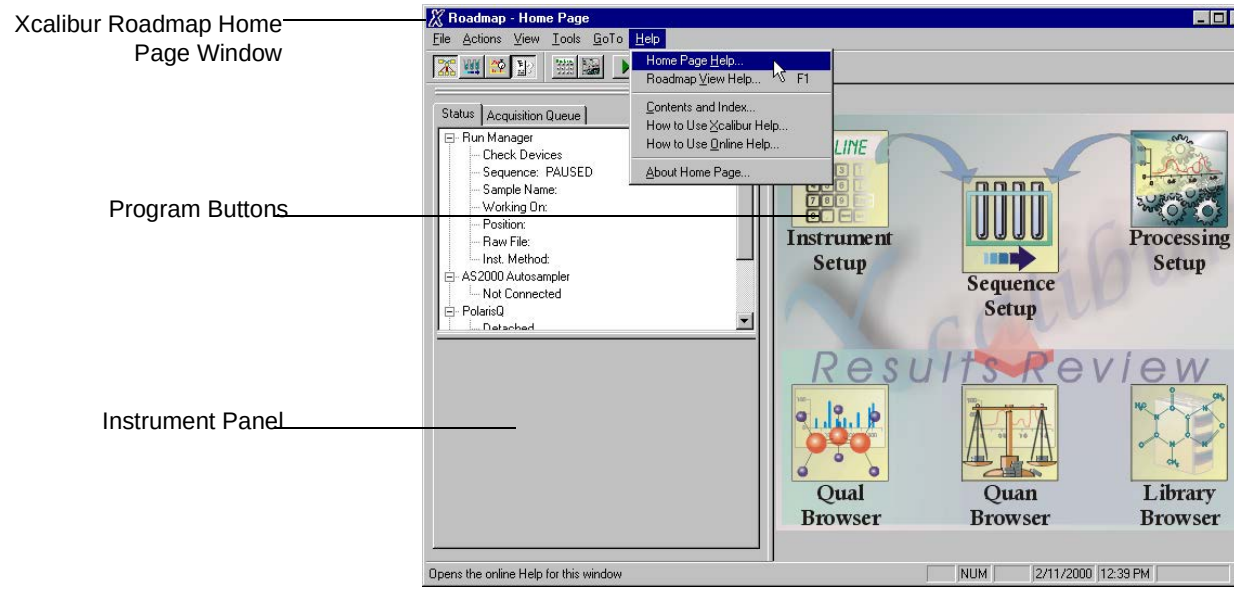


Figure C-1. Xcalibur Roadmap-Home Page

1. From the desktop, select the **Xcalibur** icon to display the Xcalibur Roadmap-Home Page.

2. Select **Help**|**Home Page Help** to display the **Home Page** help topic. This help system contains information common to all Xcalibur users.

3. From the **Home Page** help, select **Contents** to display a menu of the main help topics, **Index** to display an alphabetized list of help topics, or **Find** to initiate a dialogue to search the Help system for passages containing specific words.

C.2 Xcalibur Instrument Setup Help

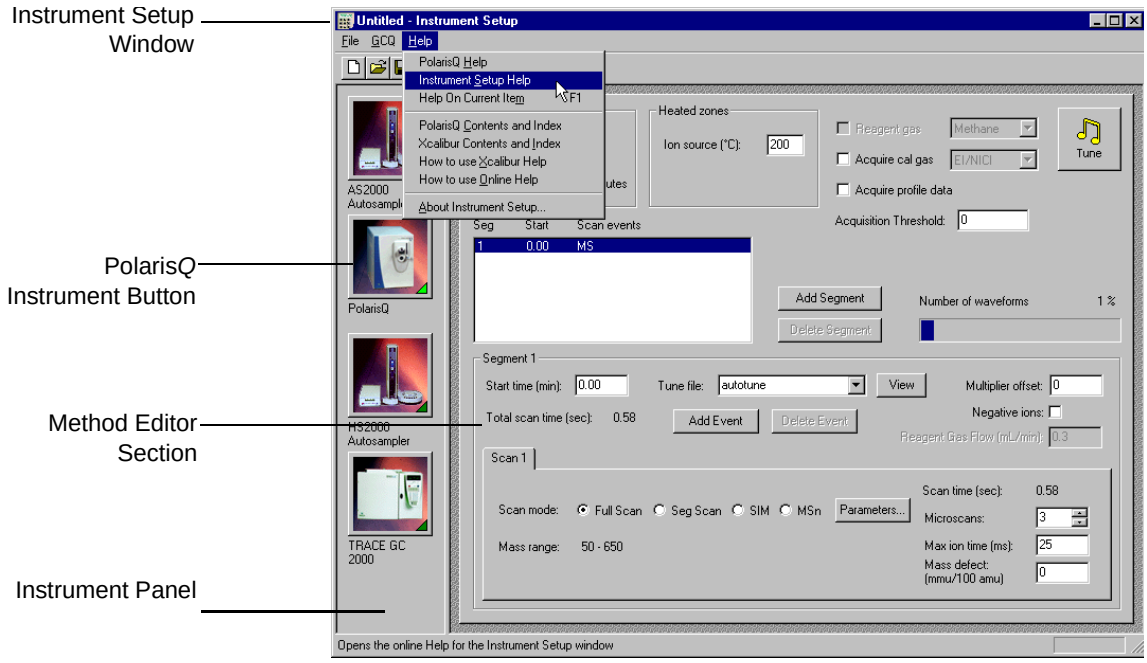


Figure C-2. Instrument Setup Window

1. From the desktop, select the **Xcalibur** icon to display the Xcalibur Roadmap Home Page.

2. Click the **Instrument Setup** button to display the Instrument Setup window.

3. Select **Help**|**Instrument Setup Help** to display **Instrument Setup** help. This help system contains information common to all Xcalibur users.

4. From the **Instrument Setup** help, select **Contents** to display a menu of the main help topics, **Index** to display an alphabetized list of help topics, or **Find** to initiate a dialogue to search the Help system for passages containing specific words.

C.3 Xcalibur Autosampler Help

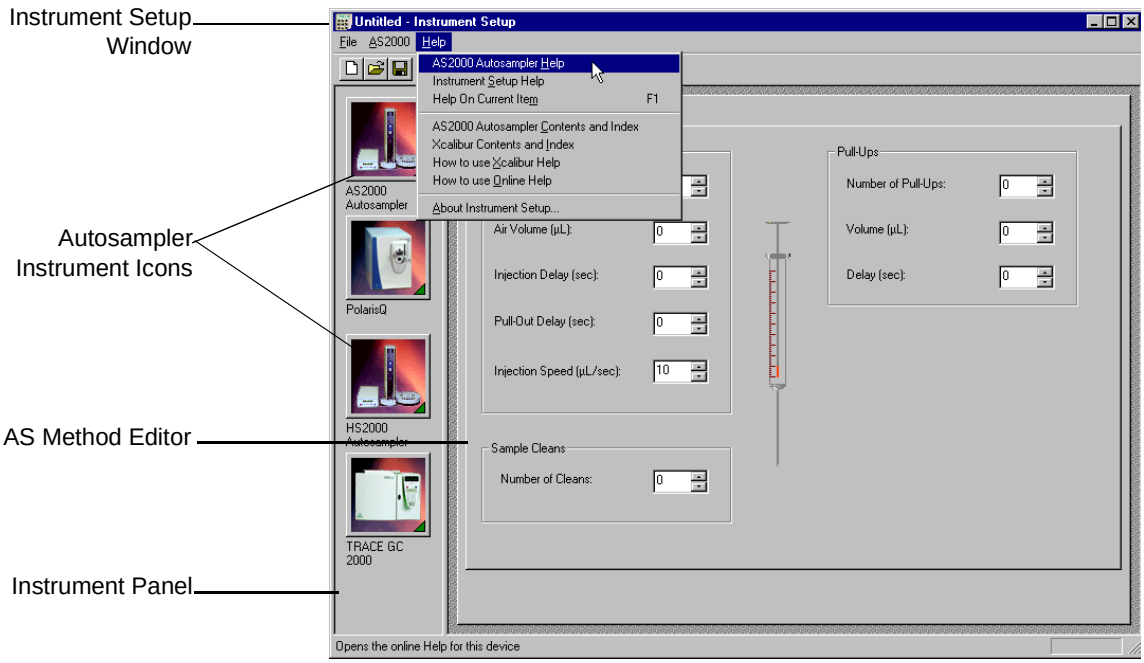


Figure C-3. AS2000 Autosampler Method Editor

1. From the desktop, select the **Xcalibur** icon to display the Xcalibur Roadmap Home Page.
2. Click the **Instrument Setup** button to display the Instrument Setup window.
3. Click on the **Autosampler** instrument button located in the Instrument Panel.
4. Select **Help**|**AS2000 Autosampler Help** to display **AS2000 Autosampler** online help. AS2000 Autosampler help contains information for AS2000 users only.

   Or...

   Select **Help**|**HS2000 Autosampler Help** to display the **HS2000 Autosampler** online help. HS2000 Autosampler help contains information for HS2000 users only.
5. From **Autosampler** help, select **Contents** to display a menu of the main help topics, **Index** to display an alphabetized list of help topics, or **Find** to initiate a dialogue to search the Help system for passages containing specific words.

C.4 Xcalibur TRACE GC Help

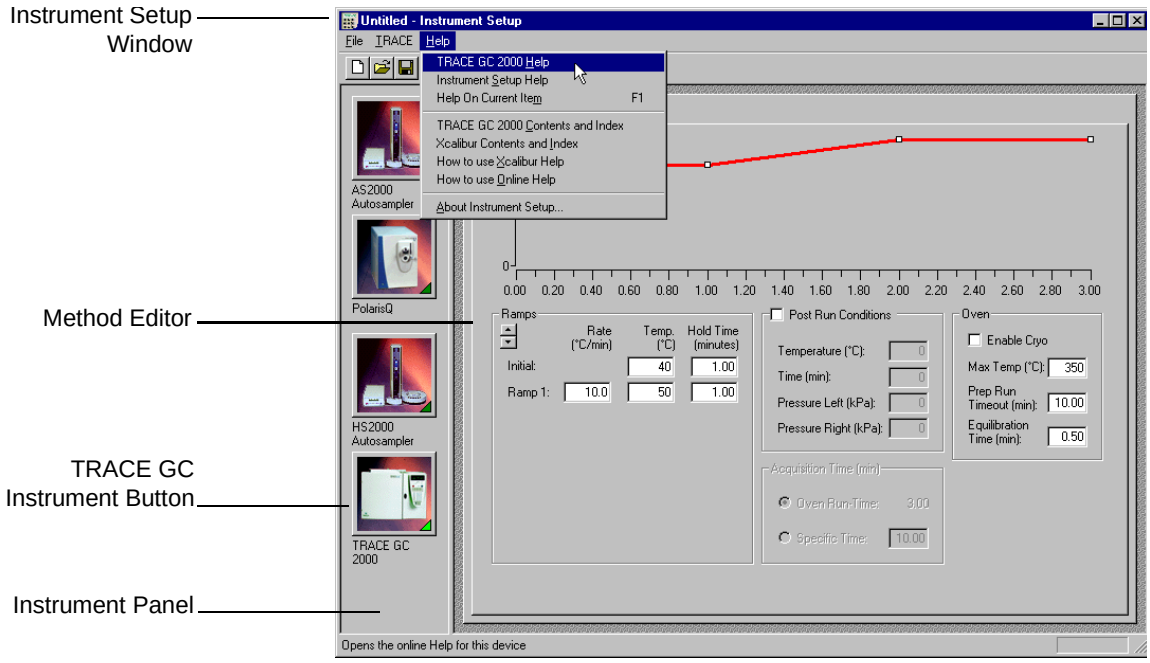


Figure C-4. TRACE GC 2000 Method Editor

1. From the desktop, select the **Xcalibur** icon to display the Xcalibur Roadmap Home Page.
2. Click the **Instrument Setup** button to display the Instrument Setup window.
3. Click on the **TRACE GC** button located in the Instrument Panel.
4. Select **Help**|**TRACE GC Help** to display **TRACE GC** online help. TRACE GC help contains information for TRACE GC instrument users only.
5. From **TRACE GC** help, select **Contents** to display a menu of the main help topics, **Index** to display an alphabetized list of help topics, or **Find** to initiate a dialogue to search the Help system for passages containing specific words.

C.5 Xcalibur PolarisQ Help

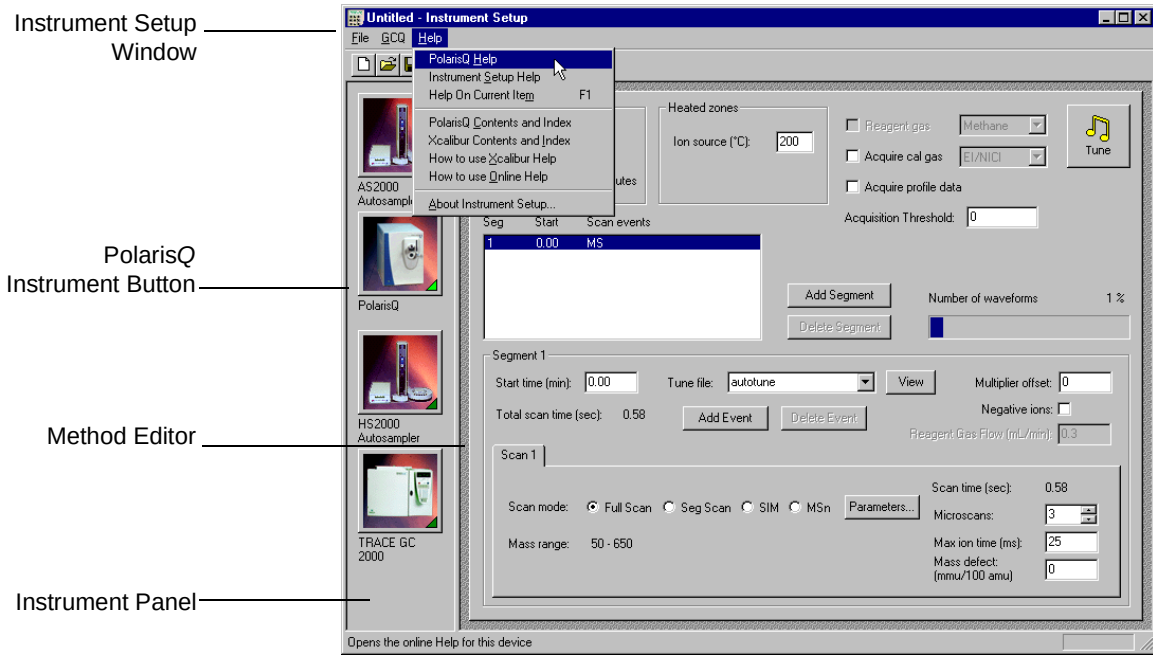


Figure C-5. Xcalibur PolarisQ Method Editor

1. From the desktop, select the **Xcalibur** icon to display the Xcalibur Roadmap Home Page.
2. Click the **Instrument Setup** button to display the Instrument Setup window.
3. Click on the **PolarisQ** button located in the Instrument Panel.
4. Select **Help**|**PolarisQ Help** to display **PolarisQ** Online Help. PolarisQ Help contains information for PolarisQ instrument users only.
5. From **PolarisQ** Help, select **Contents** to display a menu of the main help topics, **Index** to display an alphabetized list of help topics, or **Find** to initiate a dialogue to search the Help system for passages containing specific words.

C.6 Xcalibur Tune Help

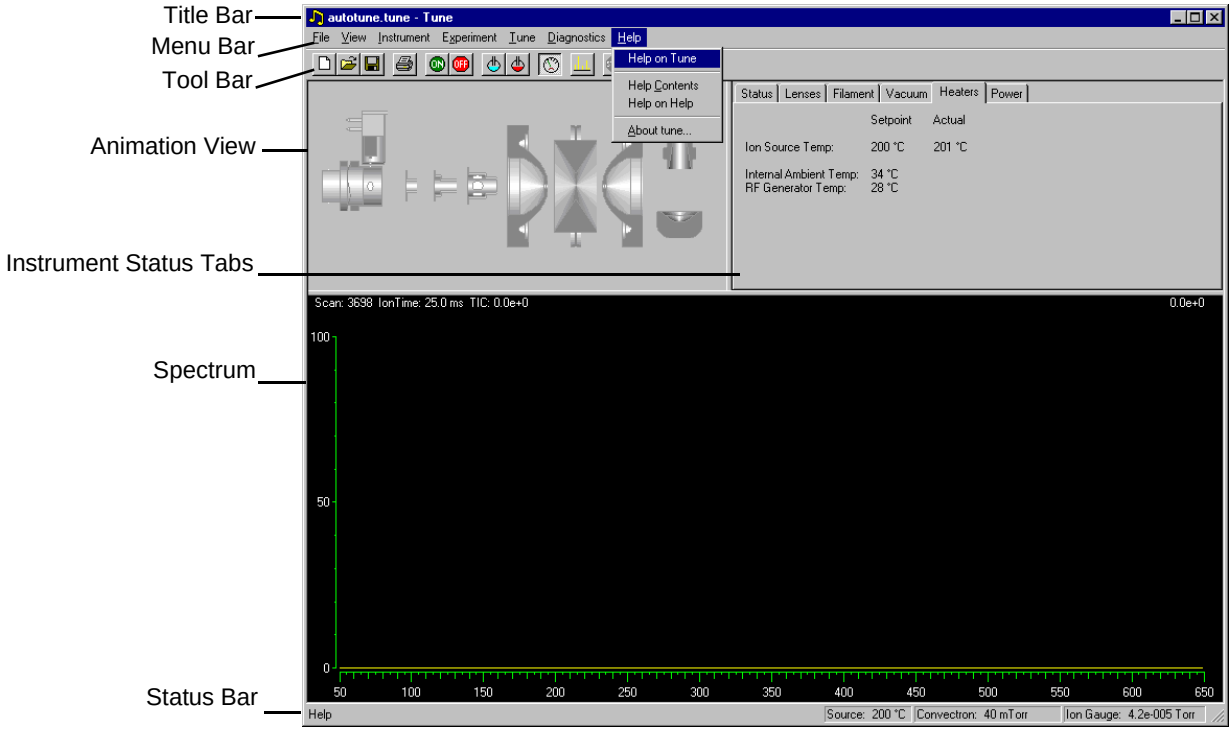


Figure C-6. Tune Window

1. From the desktop, select the **Xcalibur** icon to display the Xcalibur Roadmap Home Page.

2. Click the **Instrument Setup** button to display the Instrument Setup window.

3. Click the **Polaris*Q*** instrument button located on the Instrument Panel.

4. Click the **Tune** button from the Polaris*Q* Method Editor to display the Tune program.

5. Select **Help**|**Help on Tune** to display the **Tune** online help. Information in this help system is instrument specific.

6. From **Tune** help, select **Contents** to display a menu of the main help topics, **Index** to display an alphabetized list of help topics, or **Find** to initiate a dialogue to search the help system for passages containing specific words.

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